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Loss of SDHB Promotes Dysregulated Iron Homeostasis, Oxidative Stress, and Sensitivity to Ascorbate

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► To cite this version:

Judith Goncalves, Sophie Moog, Aurélie Morin, Géraldine Gentric, Sebastian Müller, et al.. Loss of SDHB Promotes Dysregulated Iron Homeostasis, Oxidative Stress, and Sensitivity to Ascorbate. Cancer Research, 2021, 10.1158/0008-5472.CAN-20-2936 . hal-03263468

HAL Id: hal-03263468

<https://hal.sorbonne-universite.fr/hal-03263468v1>

Submitted on 17 Jun 2021

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1 Loss of SDHB promotes dysregulated iron homeostasis, oxidative
2 stress and sensitivity to ascorbate.

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37 **Running title:** Consequences of SDHD and SDHB deficiency in cells and tumors

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40 **Keywords:** metastatic paraganglioma, *SDHB*, iron homeostasis, oxidative stress, ascorbate

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42 **Additional information:**

43 **Financial support:**

44 This work has received funding from The Plan Cancer, Epigénétique et Cancer (EPIG201303
45 METABEPIC), The Paradifference Foundation, la Ligue Contre le Cancer (Equipe Labellisée) and the

46 Cancer Research for Personalized Medicine - CARPEM project (Site de Recherche Intégré sur le Cancer
47 - SIRIC). The London Metallomics Facility is funded by the Wellcome trust (grant No 202902/Z/16/Z).
48 Sophie Moog is the recipient of a fellowship from la Fondation pour la Recherche Médicale. Judith
49 Goncalves is the recipient of a fellowship from la Ligue Nationale contre le Cancer. The R.R. research
50 group is funded by the European Research Council (ERC) under the European Union's Horizon 2020
51 research and innovation programme (grant agreement No [647973]), the Fondation Charles Defforey-
52 Institut de France and Ligue Contre le Cancer (Equipe Labellisée).

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65 **Conflict of interest disclosure statement:** the authors declare no potential conflicts of interest

66

67 **Word count:** 8555

68

69 **Number of figures:** 6

70

71

72 **Abstract**

73

74 Succinate dehydrogenase is a key enzyme in the tricarboxylic acid cycle and the electron transport
75 chain. All four subunits of succinate dehydrogenase are tumor suppressor genes predisposing to
76 paraganglioma, but only mutations in the SDHB subunit are associated with increased risk of
77 metastasis. Here we generated an *Sdhd* knockout chromaffin cell line and compared it to *Sdhb*-
78 deficient cells. Both cell types exhibited similar SDH loss of function, metabolic adaptation, and
79 succinate accumulation. In contrast, *Sdhb*^{-/-} cells showed hallmarks of mesenchymal transition
80 associated with increased DNA hypermethylation and a stronger pseudo-hypoxic phenotype
81 compared to *Sdhd*^{-/-} cells. Loss of SDHB specifically led to increased oxidative stress associated with
82 dysregulated iron and copper homeostasis in the absence of NRF2 activation. High-dose ascorbate
83 exacerbated the increase in mitochondrial reactive oxygen species, leading to cell death in *Sdhb*^{-/-}
84 cells. These data establish a mechanism linking oxidative stress to iron homeostasis that specifically
85 occurs in SDHB deficient cells and may promote metastasis. They also highlight high-dose ascorbate as
86 a promising therapeutic strategy for SDHB-related cancers.

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88

89 **Statement of significance**

90 Loss of different succinate dehydrogenase subunits can lead to different cell and tumor phenotypes,
91 linking stronger 2-OG-dependent-dioxygenases inhibition, iron overload, and ROS accumulation
92 following SDHB mutation.

93

94

95 Introduction

96 Succinate dehydrogenase (SDH) is a key enzyme localized in the inner mitochondrial
97 membrane where it participates both in the tricarboxylic acid (TCA) cycle and the electron transport
98 chain (ETC), as complex II. In the TCA cycle, SDH catalyzes the oxidation of succinate into fumarate
99 while in the ETC, it allows the transfer of electrons from succinate to the ubiquinone pool. SDH is
100 constituted of two anchoring subunits (SDHC, SDHD) and two catalytic subunits (SDHA, SDHB) encoded
101 by the four *SDHx* nuclear genes (*SDHA*, *SDHB*, *SDHC* and *SDHD*). SDHA is a flavoprotein to which the
102 substrate succinate binds in order to be oxidized to fumarate, while the resulting electrons are
103 channeled to ubiquinone, through the three Fe-S clusters of SDHB. Since the initial discovery of *SDHD*
104 mutations in 2000(1), all four *SDHx* genes have been demonstrated to act as tumor-suppressor genes
105 (2,3,4). Their mutations predispose to pheochromocytoma and paraganglioma (PPGL), rare
106 neuroendocrine tumors arising from chromaffin cells of the adrenal medulla and from the sympathetic
107 and parasympathetic nervous systems, respectively; as well as gastro-intestinal stromal tumors (GIST)
108 and rare forms of renal cell carcinomas. It is now estimated that mutations in *SDHx* genes stand for
109 almost 50% of inherited cases of PPGL. Interestingly, *SDHB* mutations have been shown to be the
110 highest risk factor of malignancy in patients with PPGL: approximately 50% of PPGL patients carrying
111 *SDHB* mutations will ultimately develop a metastatic form of the disease and a germline mutation in
112 *SDHB* is found in up to 36% of all metastatic PPGL cases (5). In contrast, metastatic forms of the disease
113 are found in only 5% of patients with an *SDHD* gene mutation. Moreover, *SDHB* mutated cancers are
114 more aggressive than non-mutated metastatic ones. The overall survival of patients with metastatic
115 *SDHB*-related PPGL was initially estimated at 42 months after diagnosis of the first metastasis versus
116 244 months for patients with a metastatic PPGL but without an *SDHB* gene mutation (6). Interestingly,
117 recent studies have revealed that increased follow-up of patients with genetically determined PPGL
118 has significantly improved their survival, demonstrating the beneficial impact of genetic testing in
119 these patients (7,8).

120 In all cases, germline *SDHx* mutations are associated with loss of heterozygosity, which causes the
121 complete loss of SDH function in the tumor (9) and a subsequent accumulation of its substrate,
122 succinate (10). Succinate (as other TCA cycle intermediates such as fumarate and 2-hydroxyglutarate)
123 is considered as an oncometabolite, driving aberrant activation of transcription factors and global
124 epigenetic reprogramming. Indeed, high steady-state levels of these metabolites are known to inhibit
125 2-oxoglutarate (2-OG) dependent dioxygenases, such as the hypoxia-inducible transcription factor
126 (HIF) prolyl-hydroxylases (PHDs) and Ten-eleven translocation (TET) DNA demethylases (11). These
127 enzymes belong to the large family of iron (Fe) and 2-OG-dependent dioxygenases, which activity is
128 based on the use of iron (12), oxygen (13) and ascorbate (14) as main co-factors. Inhibition of PHDs
129 promotes the abnormal stabilization, and thus activity of HIF1 and HIF2, while TET inhibition leads to
130 a lack of DNA demethylation, resulting in pseudo-hypoxic and hypermethylator phenotypes,
131 respectively. These observations were initially revealed in genomic studies performed on large PPGL
132 tumor collections, resulting in a better understanding of the mechanisms of SDH-related
133 tumorigenesis. In these studies, all *SDHx* and *FH* mutated tumors clustered together, showing a
134 transcriptome signature characterized by activation of the hypoxic response pathway (2, 15, 16) and a
135 DNA hypermethylator phenotype (17). Despite this apparent homogeneity, some differences have
136 emerged suggesting that *SDHB*-mutated tumors may display a particularly marked hypermethylator
137 phenotype associated with hallmarks of neuroendocrine-to-mesenchymal transition (NMT), which
138 were not observed in other types of *SDHx*-mutated cases (i.e *SDHA*, *SDHC* and *SDHD* mutated)(18). In
139 order to decipher these mechanisms at the cellular level, we have generated an immortalized mouse
140 chromaffin cell (imCC) line knocked-out for the *Sdhb* gene (17). In these cells, we showed that *Sdhb*-
141 deficiency does promote a marked hypermethylator phenotype mediated by TET1 and/or TET2
142 blockade, which acts in synergy with HIF2 activation to promote NMT and metastatic dissemination
143 (19, 20). *Sdhb*^{-/-} cells also undergo significant metabolic reprogramming becoming critically dependent
144 on aspartate synthesis as a major source of carbon for anabolic purposes, which supports their viability
145 and proliferation, maintained mainly through reductive carboxylation (21).

146 Despite these important advances in the understanding of the oncogenic consequences of
147 SDHB loss of function, the exact cause of the metastatic phenotype of *SDHB*-related tumors remain
148 mostly unexplained. *SDHA* and *SDHC* mutations are rare in PPGL patients, probably because of low
149 penetrance of the disease in mutation carriers. In contrast, *SDHB* and *SDHD* are the most frequently
150 described mutations in PPGL, with an incidence of 8-10 and 5-7% among all PPGL cases, respectively
151 (22). Genotype-phenotype correlation studies performed in patients with *SDHB* or *SDHD* mutations
152 have undoubtedly demonstrated their different clinical behavior in terms of invasiveness. To address
153 this crucial question in the field, we have generated *Sdhd* knocked-out cell lines in the imCC model. In
154 this new and unique model, we have investigated the different pathways previously identified in SDH-
155 related tumors in order to identify the specificities that may explain their different clinical behavior.

156

157 **Materials and Methods**

158 Detailed methods are provided in the Supplementary Information section.

159 ***Sdhd* KO, *Sdhd*-rescue cell generation and cellular analysis**

160 Complete knock-out of *Sdhd* gene was achieved in immortalized mouse Chromaffin Cells (imCC) by
161 transfecting Wild-Type imCC, previously generated by our lab (17), with *in silico* designed targeted
162 gRNA, using the PrecisionX Cas9 SmartNuclease RNA system kit (System Biosciences). *Sdhd*-rescue
163 clones were established by transfecting *Sdhd*^{-/-} imCC with an SDHD-expressing vector (ORIGENE,
164 NM003002). Screening of these clones was performed by SDH activity test, qRT-PCR and direct
165 sequencing of the *Sdhd* gene by Sanger method. Cells used for experiments were maintained in DMEM
166 high glucose Glutamax (Gibco) unless when grown for metabolic or respirometry experiments (see
167 Supplementary Information). Wound scratch assays, proliferation and adhesion tests were performed
168 to assess cellular phenotype. When stated, cells were treated with indicated doses of iron Chloride
169 (Sigma), MitoTEMPO (Sigma), L-Ascorbic acid (Sigma), Talazoparib (MedChemTronica) or N-acetyl-
170 cysteine (Sigma).

171

172 **RNA-seq and RRBS data analysis**

173 RNA sequencing was performed for 7 samples: 3 *Sdhb*^{-/-}, 2 *Sdhd*^{-/-} and 2 WT imCC. Enriched samples
174 were used to generate sequencing libraries with the Illumina 'TruSeq Stranded mRNA Sample Prep' kit
175 and associated protocol provided by the manufacturer. Libraries were sequenced by IntegraGen (Evry,
176 France) on an Illumina HiSeq 2000 as paired-end 75 bp reads. Reduced Representation Bisulfite
177 Sequencing (RRBS) was also performed by Integragen SA, as previously described (17). **Details of the**
178 **process leading to the evaluation of differential expression and methylation rates are provided in**
179 **the Supplementary Information.** The sequencing data reported in this paper have been deposited to
180 the EGA (European Genome-phenome Archive) database (European Genome-phenome
181 Archive) database (accession number EGAS00001005279).

182

183

184 **Metabolite analysis, high resolution respirometry, enzymatic activities and features of oxidative**
185 **stress assessment**

186 All cell types underwent metabolite extraction using Methanol:H₂O:Chloroform at ratio 1:1:1,
187 following ¹³C-glucose and ¹³C-glutamine labeling. The polar fractions were used for Gas
188 Chromatography – Mass Spectrometry (GC-MS) analysis allowing acquisition of the isotope data. High
189 resolution respirometry was performed by loading Intact or permeabilized cells in an Oxygraph-O2 k
190 (Oroboros instruments) chamber, using Mir05 respiratory media and digitonin for the latter. A pseudo
191 dual-wavelength Varian CARY50 spectrophotometer (Victoria, Australia) was used to assess
192 respiratory chain activities as previously described (23). For the assessment of oxidative stress
193 features, cells treated as stated, were incubated with either CellRox, MitoSox or Bodipy C11 Reagent
194 (Termofisher) and Flow cytometry data were acquired using an LSR FORTESSA analyzer (BD
195 biosciences).

196

197 **Cellular and tumoral iron and copper analysis**

198 For cellular iron and copper assessment, cells were incubated with the relevant metal-specific probe
199 prior to being analyzed by flow cytometry on a BD Accuri C6 (BD Biosciences). Laser ablation-
200 inductively coupled plasma-mass spectrometry (LA-ICP-MS) was performed on dewaxed and
201 rehydrated formalin-fixed paraffin-embedded tumor sections. **Details of LA-ICP-MS experiments are**
202 **provided in the Supplementary Information.** LA-ICP-MS images were acquired in a fixed dosage mode,
203 with a vertical and horizontal spatial resolution of 20 μm , a detailed list of sample settings is available
204 in Supplementary Table 1. Average ^{56}Fe and ^{63}Cu intensities were calculated from pixels containing a
205 positive elemental tissue marker (^{31}P) ensuring background regions did not influence these
206 calculations.

207

208 **qRT-PCR, Western-blot, immunofluorescence staining and immunohistochemical analyses**

209 For qRT-PCR, total mRNA was extracted from cell pellets using RNeasy plus mini-kit (Qiagen). Reverse
210 transcription was fulfilled using iScriptTM cDNA Synthesis Kit (BIO-RAD) and qRT-PCR was performed on
211 CFX96TM Real-Time System C1000 TouchTM Thermal Cycler (BIO-RAD) using SuperScript SybrGreen
212 (BioRad) to assess the expression of *Sdhb*, *Sdhd*, *Snai1*, *, *Epas1*, *MMP9* and *18S*. Western-blot
213 analysis were performed to assess SDHB, SDHA, HIF2 α and TUBULIN expression. RIPA lysis buffer was
214 used for extraction of total protein and concentrations were determined with Bradford colorimetric
215 method. Results were read with a LAS-4000 Mini (Fuji). Actin staining and γH2AX immunofluorescence
216 were performed on cells plated on glass slides, while γH2AX immunohistochemistry was performed on
217 6 μm sections from paraffin-embedded tumors. **Details of primers, primary and secondary antibodies,**
218 **immunostaining, and experimental conditions are provided in the Supplementary Information.***

219

220 **Data analysis**

221 Data are represented as mean (of at least 3 independent experiments) \pm SEM (standard error of the
222 mean). Data were analyzed by one-way or 2-way ANOVA. Statistics tests were carried out using the
223 GraphPad Prism software. All analyses considered a value of $P \leq 0.05$ to be statistically significant. For
224 enrichment analysis, we used an in-house adaptation of the GSEA method to identify gene sets from
225 the MSigDB database overrepresented among up/down-regulated and hyper/hypomethylated genes.

226

227 **Results**

228 ***Loss of SDHB or SDHD leads to similar metabolic dysfunction and respiratory profiles***

229 To investigate the mechanisms underlying the metastatic characteristics of *SDHB* mutated-
230 PPGL but not of *SDHD*-deficient tumors, we knocked-out the *Sdhd* gene using the CRISPR/Cas9
231 procedure in wild-type (WT) imCC (17). We obtained two independent *Sdhd*^{-/-} clones (CIA and CIB)
232 each containing a different homozygous point mutation on exon 3 of *Sdhd*, c.119delC and
233 c.120_121delCA, respectively, both leading to premature stop codons (Fig. 1A). These mutations were
234 predicted to lead to the translation of truncated proteins of 79 and 68 amino acids, respectively,
235 instead of the 159 amino acids of the entire WT SDHD protein. To attest for the absence of off-target
236 effects in *Sdhd*^{-/-} cells, we generated a third cell line, in which SDHD loss was rescued by stably
237 transfecting an *Sdhd*-expressing vector in the *Sdhd*^{-/-} CIA (clone *Sdhd-R*). *Sdhd*-mutated cells showed
238 a decrease in *Sdhd* RNA levels (Supplementary Fig. 1A) when compared with WT and *Sdhd-R* cells,
239 which may be suggestive of nonsense-mediated decay in the mutant clones, and particularly in clone
240 A.

241 SDHD protein expression could not be estimated due to the lack of efficient antibody in mouse.
242 It is worth noting that *Sdhd* mRNA levels were also reduced in *Sdhb*-deficient cells. In contrast, *Sdhb*
243 mRNA levels were absent in *Sdhb*^{-/-} cells, but not significantly reduced in *Sdhd*^{-/-} imCC (Supplementary

244 Fig. 1B). It has previously been reported that disassembly of the SDH complex in case of *SDHx*
245 mutations leads to the degradation of the SDHB subunit in all *SDHx* mutant cells (24). However, our
246 data show that *Sdhd*^{-/-} clones retain a small but significant level of SDHB protein (Fig. 1B). Similarly,
247 evaluation of SDHB protein by immunohistochemistry in SDH-related PPGL frequently leads to a weak
248 diffuse signal in SDHD deficient tumors, while it is totally negative in SDHB-mutated ones, suggesting
249 that some SDHB remains present in this type of mutants (25). Nevertheless, they exhibited a complete
250 loss of SDH enzymatic activity, similar to that observed in *Sdhb*-deficient cells (Fig. 1C), and in
251 accordance with observations in mutated human PPGL (9,26). Interestingly, it has previously been
252 suggested that succinate accumulation might be less important in SDHD-deficient tumors, which may
253 account for their different metastatic potential (27). Analysis of intracellular succinate levels revealed
254 a substantial accumulation of succinate in *Sdhd*^{-/-} cells that reached that observed in the *Sdhb*^{-/-} imCC
255 model (Fig. 1D). Similarly, levels of the related metabolites, fumarate and 2-oxoglutarate, were
256 strongly reduced in all SDH-deficient cells regardless of the subunit inactivated. *Sdhd*^{-R} cells showed a
257 profile similar to that of WT imCC (Fig. 1E-F and Supplementary Fig. 1C, D).

258

259 Next, we assessed the metabolic and respiratory phenotypes of both types of SDH-deficient
260 cells. ¹³C-glucose tracing experiments revealed that in accordance with previous work (21), cells
261 deficient in SDH-activity undergo a metabolic rewiring in the absence of a fully functional TCA cycle
262 (Fig. 2A). Like *Sdhb*^{-/-} cells, the synthesis of aspartate by *Sdhd*^{-/-} imCC cannot rely on oxidative TCA
263 cycle metabolism (Fig. 2B and C, m+2 isotopomer) and instead increase the aspartate produced
264 through pyruvate carboxylation (PC) (Fig. 2B and C, m+3 isotopomer) for anabolic purposes. Equally,
265 their synthesis of citrate from glucose, a central metabolite for cellular anabolism, was greatly reduced
266 (Fig. 2B). The metabolism of another key nutrient, glutamine was therefore examined. Although both
267 cell lines retain some oxidative metabolism of glutamine to produce succinate, *Sdhd*^{-/-} imCC appear
268 to significantly increase their synthesis of aspartate and citrate using reductive carboxylation (Fig. 2C
269 and D), which is not observed to the same degree in *Sdhb*^{-/-} imCC. We then measured oxygen

270 consumption of intact and permeabilized imCC (Fig.2E and F). In both cases, *Sdhb*^{-/-} imCC exhibited no
271 significant change in basal respiration, while *Sdhd*^{-/-} cells showed a decrease, suggesting that a more
272 significant defect in respiration exists in the *Sdhd*^{-/-} cells compared to *Sdhb*^{-/-}. Maximal respiratory
273 capacity (FCCP-mediated uncoupled respiration) was significantly reduced in both SDH-deficient imCC
274 models, in compliance to that previously reported in *Sdhb*^{-/-} cells(28). The relative decrease in
275 respiratory activity observed in *Sdhd*^{-/-} cells compared to those deficient in *Sdhb* was consistent with
276 the increased reliance on reductive carboxylation for the synthesis of aspartate and citrate (Fig. 2C),
277 an effect previously observed in hypoxia (29). Given the decreased oxygen consumption observed in
278 the *Sdhd*-deficient cells compared to those lacking *Sdhb*, we examined whether there was a
279 compensatory increase in pyruvate reduction to lactate to regenerate cytosolic NADH and maintain
280 glycolysis. We indeed saw that while *Sdhb*^{-/-} cells show a small increase in lactate production, this is
281 further increased in *Sdhd*-deficient cells (Fig. 2G).

282 Altogether, these results suggest that massive succinate accumulation and rewired metabolism do not
283 constitute relevant triggers for SDHB-related malignancy, although the extent of mitochondrial
284 respiratory deficit may vary between the two models.

285

286 ***Sdhb* knockout in mouse chromaffin cells promotes neuroendocrine-to-mesenchymal transition**
287 **(NMT), unlike *Sdhd* knockout**

288 We previously reported that *Sdhb*^{-/-} imCC exhibit a mesenchymal-like phenotype with
289 increased adhesion, migration and invasion capacities (19). Morphological observation following
290 phalloidin staining qualitatively revealed that *Sdhd*^{-/-} cells appear to be generally smaller than *Sdhb*^{-/-}
291 cells, and display a less extensive and rather peripheral actin mesh unlike *Sdhb*^{-/-} imCC (Fig. 3A),
292 suggesting that only *Sdhb*^{-/-} cells undergo mesenchymal transformation. Accordingly, markers of NMT
293 activation such as *Snai1*, *Mmp9*, *Fn1* (Fig. 3B) were overexpressed in *Sdhb*^{-/-} imCC but not in *Sdhd*^{-/-}
294 cells. In accordance with the loss of neuroendocrine features, *NCadh* was downregulated in *Sdhb*^{-/-}
295 imCC, while it was actually overexpressed in *Sdhd*^{-/-} cells (Supplementary Fig. 2A). *Sdhd*^{-/-} cells showed

296 moderate increase in adhesion (Fig. 3C), and no increase in migration, evaluated both in collective (Fig.
297 3D) and individual migration assays (Supplementary Fig. 2B). *Sdhd*^{-/-} imCC also exhibited a much
298 slower cell growth than *Sdhb*^{-/-} cells (Supplementary Fig. 2C). Hence, despite similar SDH loss-of-
299 function and succinate levels, *Sdhd*-deficient cells do not display the mesenchymal and migratory
300 phenotype of *Sdhb* KO cells, as observed in human paraganglioma(18).

301

302 ***Sdhb*-deficient cells show greater inhibition of 2OG-dependent dioxygenases**

303 We have previously established that *SDHB*-mutated PPGL and *Sdhb*^{-/-} imCC display
304 pseudohypoxic and hypermethylator phenotypes, caused by inhibition of PHD and TET enzymes and
305 involved in the mesenchymal-like hallmarks associated with *SDHB* deficiency (17,20). We next
306 performed reduced representation bisulfite sequencing (RRBS) to precisely quantify 5-methyl-
307 cytosine (5mC) modifications along the genome after enrichment for CpG rich regions in the different
308 cell lines. Compared to WT, both *Sdhb* and *Sdhd* KO cells displayed a DNA hypermethylator phenotype,
309 but this phenotype was less pronounced in *Sdhd*^{-/-} cells (Fig. 3E). In total, *Sdhb*^{-/-} cells displayed 6,847
310 significantly hypermethylated gene-based features (TSS +/- 500 bp and gene bodies) against only 2,564
311 for *Sdhd*^{-/-} cells (Fig. 3F and Supplementary Table 2). Hypermethylator phenotypes in *Sdhb*^{-/-} and
312 *Sdhd*^{-/-} cells displayed a significant overlap and correlation (Fig. 3G and H), with 1,084 common
313 hypermethylated features representing 42% and 16% of hypermethylated features in *Sdhd*^{-/-} and
314 *Sdhb*^{-/-} imCC, respectively.

315 Surprisingly, Western-blot analysis in our cell lines revealed stabilization and massive increase of HIF2 α
316 protein levels in *Sdhb*^{-/-} cells, which was not seen in either *Sdhd*^{-/-}, WT or *Sdhd*-R imCC (Fig. 3I). We
317 thus analyzed the transcriptome of all cell lines using RNA-sequencing. Hierarchical clustering of
318 expression profiles across the 1,000 most variant genes (based on standard deviation) showed that
319 *Sdhd*^{-/-} imCC remain closer to wild-type cells and display less gene expression changes than *Sdhb*^{-/-}
320 cells (Fig. 3J). To investigate more specifically the expression of hypoxia-inducible genes, we analyzed the
321 expression of a previously published list of 52 HIF targets (3), among which 47 were present in the
322 transcriptome of imCCs (Supplementary Table 3). Twenty-four (24) of them were overexpressed in *Sdhb*-

323 deficient cells compared to WT (mean value >120% of WT), while 17 were overexpressed in *Sdhd*-deficient
324 cells compared to WT (13 overlapping with those high in *Sdhb* KO cells) (Fig. 3K). Comparison of both KO
325 cells showed that 19 of the 28 overexpressed genes showed stronger expression in *Sdhb*^{-/-} cells (Fig. 3L).
326 These data therefore suggested that although HIF2 α was hardly detectable by western blot, *Sdhd*^{-/-} cells
327 did show a mild pseudohypoxic signature. In order to validate this observation, we further analyzed
328 previously-published transcriptome data generated in a collection of 188 human PPGL. In this study, 3
329 *SDHD*, 1 *SDHA* and 2 *SDHC*-mutated PPGL were evaluated together with 17 *SDHB*-mutated ones (3), which
330 all clustered together using the expression of the 52 HIF-target genes. We have reanalyzed these data,
331 limiting them to the 41 highly expressed ones, and we evaluated their mean expression in *SDHB* versus
332 *SDHD*-mutated tumors. We observed that most genes were overexpressed in *SDHB*-related tumors while
333 the subset of genes over-represented in *SDHD*-mutated tumors corresponded to genes expressed by
334 endothelial cells or associated with angiogenic processes (Supplementary Fig. 3A), therefore reflecting the
335 very high vascular density described in these tumors (15,30). Similar results were obtained on the TCGA
336 cohort of PPGL (Supplementary Fig. 3B)(31).

337 Altogether, these findings indicate that *Sdhd* inactivation induces less DNA methylation and gene
338 expression changes than *Sdhb* deletion. We next aimed at identifying the causes of the seemingly
339 greater inhibition of 2OG-dependent dioxygenases in *Sdhb*^{-/-} cells.

340

341 ***Iron and copper homeostasis are dysregulated in SDH-deficient cells, and especially in Sdhb KO cells***

342 2OG-dependent dioxygenases are iron-containing enzymes. Because *SDHB* is the iron-sulfur
343 subunit of complex II, we wondered whether its complete loss might lead to disturbances in iron
344 metabolism, which would in turn modulate the activity of 2OG-dependent dioxygenases. We thus used
345 specific fluorescent probes to detect cytosolic and mitochondrial iron in all cell types, as well as
346 assessed iron levels in tumor samples from patients with *SDHB* mutations. We also evaluated
347 mitochondrial copper in all cell types. Indeed, iron and copper are both essential metals with close
348 metabolic interactions that have been known for a long time (32).

349 We first used the commercial Calcein-AM probe that reveals both Iron(II) and Iron(III) levels, but also
350 other ions such as calcium. This experiment showed a decrease in global labile iron in SDH-deficient
351 cells compared to WT imCC (Fig. 4A). To validate this observation in human PPGL, we performed laser
352 ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) in 6 pheochromocytomas
353 carrying *NF1* (n=2), *RET* (n=2) or *SDHB* (n=2) mutations, as well as 4 paragangliomas with *SDHB* (n=2)
354 or *SDHD* (n=2) gene mutations. We observed that average ⁵⁶Fe counts were significantly decreased in
355 tumors with *SDHB* mutations compared with tumors with *NF1*, *RET* or *SDHD* mutations (Fig. 4B-F). This
356 decrease was greater in *SDHB*-mutated paragangliomas (Fig. 4D) than in *SDHB*-mutated
357 pheochromocytomas (Fig. 4C). These results obtained in tumors from patients consolidate the
358 hypothesis that loss of the SDHB subunit leads to an altered iron metabolism. Calcein-AM probe being
359 poorly specific, we next examined the subcellular localization of Iron(II) using specific probes of both
360 this ion, and specific cell compartments. Unexpectedly, evaluation of the labile pool of cytosolic Iron(II)
361 revealed a significant increase in *Sdhb*^{-/-} cells only (Fig. 4G). This suggests that the calcein-AM data
362 would actually be imputable to a strong decrease in cytosolic levels of Iron(III) in SDH-deficient cells.
363 In opposition, we observed a significant decrease in the mitochondrial pool of chelatable iron (Iron(II))
364 in both knockout models, decrease which was especially pronounced in *Sdhb*^{-/-} cells and rescued in
365 *Sdhd-R* imCC (Fig. 4H).

366

367 We next evaluated mitochondrial copper levels in all cell types. Concerning the pool of labile
368 mitochondrial Cu(II), no significant changes were observed in the SDH-deficient cells, while
369 mitochondrial Cu(I) was significantly increased in *Sdhb* KO cells only (Supplementary Fig. 4A and B). LA-
370 ICP-MS was also used to quantify the levels of ⁶³Cu in 10 PPGL tumors. This evaluation of global copper
371 was not able to confirm the difference in *SDHB* vs *RET* or *NF1* tumors. However, it suggested that SDHD-
372 deficient PGL had a decrease in copper counts compared with the other genotypes (Supplementary
373 Fig. 4C). Hence, there was a dysregulation in copper and especially in iron pools in cells and tumors
374 depending on their genotypes. In support of these observations, we evaluated the mRNA expression

375 of several iron and copper transporters as well as of chaperones or different actors of iron/copper
376 homeostasis, which revealed that these pathways were indeed strongly affected in *Sdhb* KO cells (Fig.
377 4I, J). In particular, these cells showed a differential expression of transporters implicated in the entry
378 of iron and copper in the cell and the mitochondria: high DMT1 (*Slc11a2*) and low Slc25a37 would
379 sustain the increased cytosolic distribution of Iron(II), while low CTR1 (*Slc31a1*) and high Slc25a3, the
380 high mitochondrial Cu(I) levels. Consistently with these observations, human PPGL transcriptome data
381 showed an increase in *DMT1* mRNA levels in SDH tumors as compared with other types of mutated
382 PPGL. SDH tumors also exhibited a slight increase in the expression of other actors involved in iron
383 binding and transport, such as the hypoxia-inducible genes *TF* and *TFRC*. *SLC31A1* was significantly
384 decreased in both SDH and VHL tumors compared to RET or NF1-mutated ones. No differences were
385 detected for *TFR2* nor *SLC25A3* expression (Supplementary Fig. 4D).

386

387 ***Sdhb*-deficient cells display increased ROS levels without activation of the NRF2 pathway.**

388 *Sdhb*-KO cells show increased mitochondrial copper(I) and cytosolic Iron(II) levels, which could
389 cause important oxidative stress in these cell compartments (33). An increase in reactive oxygen
390 species (ROS) might also participate to the sustained inhibition of 2OG-dependent dioxygenases
391 activity (34). Flow cytometry analyses of fluorescent probes revealed that *Sdhb*-deficient cells showed
392 increased ROS both in the cytosol (Fig. 5A) and especially in the mitochondria (Fig. 5B). They also
393 displayed a significant increase in lipid peroxidation levels (Fig. 5C) and in mitochondrial activity (Fig.
394 5D) but not in overall mitochondrial mass (Fig. 5E). Unexpectedly, none of the *Sdhb*-deficient clones
395 showed any changes in ROS levels as compared to the WT cells.

396 Because *Sdhb*^{-/-} cells display such a significant increase in ROS, we postulated that they would
397 probably show increased anti-oxidant responses, either through superoxide dismutase (SOD) or
398 through activation of the NRF2 pathway. However, the global superoxide dismutase activity did not
399 differ between the different cell types (Supplementary Fig. 5A). Moreover, RNA-seq analysis showed a

400 significant downregulation of mitochondrial SOD2, thus demonstrating that *Sdhb*-deficient cells do not
401 detoxify the excess in mitochondrial ROS (Fig. 5F).

402 We performed gene set enrichment analyses using RNA-seq data of 58 NRF2-target genes
403 (Supplementary Table 4) which showed no activation of the pathway in *Sdhb* nor in *Sdhd* KO cells,
404 compared to WT (Supplementary Fig. 5B). In addition, treating the cells with N-acetyl cysteine (NAC)
405 had no effect on the levels of mitochondrial ROS in any of the cell types studied (Fig. 5G), neither
406 affected their proliferation (Fig. 5H). In order to fully validate this observation in the human context,
407 this list of genes was also tested in the transcriptome data of the human PPGL COMETE collection (Fig.
408 5I). Mean values of NRF2 targets levels in the groups of sporadic non-mutated tumors (n=49), *RET*
409 (n=19), *NF1* (n=37), *VHL* (n=40), *SDHA, C, D-* (n=6) and *SDHB*-mutated tumors (n=17) were used to
410 perform unsupervised classification, which confirmed that the NRF2 pathway is not activated in *SDHB*-
411 deficient tumors.

412

413 It has previously been reported that *SDHB* loss is associated with increased DNA damage (35), and a
414 sensitivity to inhibitors of poly (ADP-ribose) polymerase (PARP) (35, 36, 37). In addition to the recently
415 demonstrated mechanism associated with oncometabolite-induced inhibition of the lysine
416 demethylase KDM4B, increased ROS levels may participate to such phenotype. We therefore
417 evaluated DNA damage after staining PPGL tumor tissues and imCCs with anti- γ H2AX antibody
418 (Supplementary Fig. 5C and D). Although it was not statistically significant, we observed a slight
419 increase in γ H2AX levels in *SDHB*-deficient tumors, which was not seen in *Sdhb*^{-/-} imCCs. Treating cells
420 with increasing doses of the PARP inhibitor Talazoparib reduced cell survival in all cell types, with an
421 actually higher efficacy in WT and *Sdhd*-R cells (Supplementary Fig. 5E). In this cell model, it seemed
422 that Talazoparib efficiency was not related to *SDH*-deficiency, but was rather related to cell
423 proliferation indexes of the treated cell types.

424

425 ***Modulating Iron(II) and ROS levels affects pseudohypoxia and survival in Sdhb-deficient cells***

426 Altogether, these data suggest that in *Sdhb* KO cells, a combination of succinate accumulation,
427 dysregulation of iron homeostasis and high ROS levels may account for the increased inhibition of TET
428 and PHD hydroxylases. To demonstrate this link, we treated cells with Iron(II) (50 μ M), which had no
429 effect on cytosolic ROS (Supplementary Fig. 6A) but reduced mitochondrial ROS, only in *Sdhb*^{-/-} cells
430 (Fig. 6A). This was associated with a decrease in HIF2 α protein levels in *Sdhb*^{-/-} cells as well (Fig. 6B).
431 Treating cells with increasing doses of ferrous iron revealed a specific sensitivity of *Sdhb*-deficient cells.
432 Indeed, after 48 h of treatment, 0.1 mM doses of Iron(II) led to a 60% decrease in *Sdhb*^{-/-} cells survival
433 while it only moderately affected WT, *Sdhb*-KO or *Sdhb*-R cell types (Fig. 6C).
434 In order to further demonstrate that increased mitochondrial ROS were indeed responsible for the
435 massive HIF2 α stabilization observed in *Sdhb*-deficient cells, we then treated them for 12h with
436 MitoTEMPO, a mitochondrially targeted antioxidant that acts as a specific scavenger of mitochondrial
437 superoxide. MitoTEMPO (MTT) at 2.5 μ M had no effect on cytosolic ROS (Fig. 6D), but significantly
438 decreased mitochondrial ROS in *Sdhb*^{-/-} imCC (Fig. 6E), which was associated with a substantial
439 reduction of HIF2 α levels (Fig. 6F). High doses of MTT are suspected to show a reverse effect,
440 promoting a pro-oxidant response. We therefore treated cells with 2.5 mM of the compound and
441 showed that such high dose increased cytosolic ROS in all cell types and especially in WT and *Sdhb*^{-/-}
442 CIA cells (Fig. 6G), as well as mitochondrial ROS in WT and *Sdhb*^{-/-} cells (Fig. 6H). Strikingly, such
443 treatment promoted a strong pseudohypoxic response in WT, *Sdhb*^{-/-} and *Sdhb*-R cells, thus
444 demonstrating that increasing ROS was sufficient to mediate HIF2 α stabilization. In contrast, this led
445 to the opposite effect in *Sdhb*^{-/-} cells (Fig. 6I) in which HIF2 α protein was almost lost. It actually
446 appeared that high dose MTT was highly toxic for *Sdhb*^{-/-} cells exclusively (Fig. 6J), with perinuclear
447 vacuoles emerging after 12h and leading to the death of all *Sdhb*^{-/-} imCC after 72h.
448 In an attempt to evaluate another pro-oxidant treatment that might be used in a clinical context, we
449 finally tested the vulnerability of imCC to high dose ascorbate. A dose response curve showed that
450 *Sdhb*^{-/-} cells were indeed much more vulnerable to ascorbate with significant increase in cell death
451 appearing from a 1 mM dose onward, a complete lethality being reached at a 2.5 mM ascorbate dose

452 (Fig. 6K). At the higher dose, 85% of *Sdhb*-deficient cell loss was achieved after 24h, while a similar
453 response was only apparent in *Sdhb* and WT cells after 72h (Fig. 6L). To evaluate the mechanism
454 associated with ascorbate-induced lethality, we measured cytosolic and mitochondrial ROS in cells
455 treated for 48 h with 1 mM ascorbate. At such a dose, there was already a significant lethality of *Sdhb*-
456 KO cells and enough cell material was still available to allow the analyses (Supplementary Fig. 6B).
457 Interestingly, we observed that cytosolic ROS were not modified by ascorbate in any of the cell models
458 (Supplementary Fig. 6C). In contrast, ascorbate led to a massive increase in mitochondrial ROS,
459 specifically in *Sdhb*^{-/-} cells (Fig. 6M).
460 These data suggest that in *Sdhb*-KO cells ascorbate interacts with the increased Iron(II) labile pool to
461 enhance oxidative stress, leading to rapid cell death.

462

463 **Discussion**

464 It is well-established that a mutation in the *SDHB* gene is a high risk factor for metastatic PPGL
465 (38) and poor prognosis (6), unlike mutations in other *SDHx* genes (*SDHA*, *SDHC* or *SDHD*) that rarely
466 cause metastatic forms of the disease. This question has been unresolved for 20 years. Many studies
467 have been performed in the past years, mainly using cell lines exhibiting a decrease or complete lack
468 in the expression of *Sdhb*. Thereby, previous work from our team has shown that metastatic *SDHB*
469 tumors exhibit a NMT phenotype (18,19), associated with increased DNA methylation in comparison
470 to other *SDHx* mutated tumors (20,39). Further, we have recently demonstrated that this
471 hypermethylated profile is due to TET silencing and that the NMT phenotype observed in *SDHB*
472 mutated tumors is the result of synergistic roles of TET repression and pseudohypoxia, through HIF2
473 activation (20). Although these data have shed light on some mechanisms undeniably involved in the
474 tumorigenesis of *SDHB* mutated tumors, they do not explain the different clinical outcomes observed
475 in patients carrying mutations in the different *SDHx* genes. In the present study, we were able to
476 characterize and compare two physiologically appropriate cellular models exhibiting a complete

477 knock-out in *Sdhb* or *Sdhd* genes, which strikingly recapitulate most of the phenotypic characteristics
478 of *SDHB* and *SDHD*-mutated tumors.

479 Succinate accumulation is probably the major consequence of SDH loss of activity and increased
480 succinate levels in tumor samples are used as a biomarker of SDH-deficiency in PPGL patients (27,40–
481 42). For a long time, it has therefore been considered to be the main trigger of PPGL tumorigenesis.
482 The role of succinate as an oncometabolite was initially demonstrated in 2005, with the demonstration
483 of its inhibiting role on 2OG-dependent PHD enzymes, leading to the subsequent stabilization of HIF α
484 subunits even under normoxia (43,44). Later, it was demonstrated that succinate is also a major
485 epigenetic modifier, inhibiting TET enzymes and promoting a genome wide hypermethylated profile
486 (17,39,45). It has been suggested that a stronger inhibition of 2OG-dependent dioxygenases observed
487 in *SDHB*-mutated tumors versus tumors with mutations in other *SDHx* genes, might be explained by a
488 fuller inactivation of SDH enzyme associated with higher succinate (27). Here, we firmly invalidate this
489 long-held assumption, both *Sdhb*^{-/-} and *Sdhd*^{-/-} imCC models showing the same loss of SDH activity
490 and similar levels of succinate and fumarate (Fig. 1). Indeed, many of the metabolic characteristics
491 investigated were highly similar between the two cell models suggesting that merely measuring overall
492 steady-state succinate and fumarate levels are inadequate for predicting phenotype, and smaller
493 changes in metabolic function may drive downstream. Surprisingly, HIF2 α protein was hardly
494 detectable in *Sdhd*-deficient cells while it was strongly activated in *Sdhb*^{-/-} imCC. This provides further
495 evidence that although aspects of the overall metabolic phenotype were similar between *Sdhb*^{-/-} and
496 *Sdhd*^{-/-} models, as yet unexplored metabolic factors may play a role in the inactivation of the PHD
497 enzymes to stabilize HIF2 α . This was unexpected as previous transcriptome analyses of human tumor
498 samples have classified all *SDHx* mutated tumors together with *VHL*-mutated ones in a
499 “pseudohypoxic” cluster (16,17). However, such classifications were based on global transcriptome
500 and obviously included many other pathways. To our knowledge, only three studies have classified
501 PPGL tumors based on the expression of hypoxia-induced genes. Hensen *et al* compared hypoxia-
502 inducible genes in sporadic head and neck PGL (HNPGL) to HNPGL carrying *PGL2* or *SDHD* gene

503 mutations (46). This study was not able to identify any differences in the hypoxic signature of these 3
504 types of tumors. Besides, Fliedner *et al* evaluated the expression of HIF target genes in a larger
505 collection of *SDHD* (n=14) and *SDHB* (n=15) related PPGL and also revealed some differences between
506 the two types of tumors, with some genes being less overexpressed in *SDHD*-mutated PGL (47). Based
507 on previously published transcriptome data (3), our present study shows that most HIF-target genes
508 were overexpressed in *SDHB*-related tumors while the subset of targets over-represented in *SDHD*-
509 mutated tumors corresponded to genes expressed by endothelial cells. Hence, although it is most
510 probable that, as previously suggested in other studies (15,48–50), *SDHD* tumors display some
511 induction of pseudo-hypoxia *in vivo*, the combination of our *in vitro* data and human PPGL studies does
512 suggest that this effect is at least much more limited in non-*SDHB* mutated cells and can therefore not
513 be imputable to succinate accumulation only.

514 Our data reveal that while *SDHB* expression is completely abolished in *Sdhb*^{-/-} cells, a small fraction of
515 *SDHB* protein remains detectable in *Sdhd*^{-/-} clones, consistently with IHC data on tumors that
516 frequently report a weak diffuse *SDHB* staining in *SDHD*-mutated PPGL (25,51). *SDHB* is the Fe-S
517 subunit of Complex II and contains two highly conserved L(I)YR motifs that are essential for acquisition
518 of Fe-S clusters by recruiting the Fe-S transfer machinery. We postulate that the loss in mitochondrial
519 Fe-S clusters present in the *SDHB* subunit, may be responsible for the significant imbalance in cytosolic
520 and mitochondrial iron distribution, that we observe in *Sdhb*^{-/-} cells. Interestingly, Saxena *et al*
521 reported that 37% of disease-causing missense mutations in *SDHB* were located in either the L(I)YR Fe-
522 S transfer motifs or in the 11 Fe-S cluster-ligating cysteines. Moreover, analyses of reported missense
523 mutations in patients with *SDH*-RCC or GIST revealed that 50% of these patients had *SDHB* mutations
524 in the L(I)YR motif amino acid residues (52). Altogether, these observations point to a central role of
525 Fe-S clusters loss in *SDHB*-related disease, which are further reinforced by our present observations.

526 This labile iron overload may in turn be responsible for or exacerbate the overproduction of ROS
527 observed in *Sdhb*^{-/-} cells, thereby indirectly activating pseudohypoxia and DNA methylation. Indeed,
528 it has been previously demonstrated in a number of studies that in the context of excessive ROS levels,

529 these oxidant molecules can act as signals able to trigger the stabilization of HIF α transcription factors
530 in normoxic conditions (53–55; 34). Besides, in the present study we show that the use of MitoTEMPO,
531 a mitochondrially targeted antioxidant at low concentrations led to a significant decrease in
532 mitochondrial ROS, resulting in turn in reduced HIF2 α levels. Conversely, high doses of MTT appear to
533 exert a pro-oxidant action leading to increased cytosolic ROS in all of the cell types, resulting in a strong
534 pseudohypoxic response. Altogether, these results demonstrate the direct link between ROS and
535 HIF2 α stabilization and suggest that the elevated ROS levels observed in *Sdhb*^{-/-} cells are probably
536 responsible for their stronger pseudohypoxic phenotype. The association between SDH-deficiency and
537 ROS production has been controversial, with some studies showing an increase in ROS levels (28,53)
538 and others not (56). Actually, these apparently contradictory data are in total accordance with our
539 observations. Indeed, Selak *et al* first reported the absence of oxidative stress following SDH
540 inactivation, but this was observed in an *SDHD* KD cell model (56). In contrast, Guzy et al. proposed
541 that the mechanism explaining PPGL tumorigenesis following SDH inhibition was an increase in ROS
542 production, acting as messengers able to activate pseudohypoxic responses and probably resulting in
543 oxidative damage to DNA, genomic instability, and tumorigenesis (53). In that study, an *Sdhb*-Knock
544 Down (KD) model was compared to a *Sdha*-KD one, and ROS increase was only observed in *Sdhb* KD
545 cells. At that time, it was suspected that *SDHA* gene mutations were not associated with PPGL, an
546 assumption that we demonstrated to be untrue several years later (3). Based on these observations,
547 their conclusions were that loss of all but the *SDHA* subunits of SDH would produce such increase in
548 ROS production, explaining *SDHB/C/D*-mediated tumorigenesis. In view of the actual knowledge on
549 SDH genetics, the combination of these data with our current observations suggests that ROS
550 production is a specific feature of *SDHB*-mutated cells, and may be responsible, not for SDH-related
551 tumorigenesis in general, but for *SDHB*-related aggressive phenotype.

552 Our data suggest that the increased oxidative stress observed in *Sdhb*-deficient cells could be the
553 consequence of the dysregulated iron/copper homeostasis. Indeed, redox-active iron strongly
554 interacts with hydrogen peroxide through the Fenton/Haber-Weiss reaction. This usually slow reaction

555 is catalyzed by labile iron, yielding mainly the highly reactive and toxic hydroxyl radical ($\bullet\text{OH}$) from
556 hydrogen peroxide (H_2O_2) and superoxide ions ($\bullet\text{O}_2^-$): $\text{Iron(III)} + \bullet\text{O}_2^- \rightarrow \text{Iron(II)} + \text{O}_2$; $\text{Iron(II)} +$
557 $\text{H}_2\text{O}_2 \rightarrow \text{Iron(III)} + \text{OH}^- + \bullet\text{OH}$ (57). Oxidative damage arising from excessive levels of ROS are observed
558 in a variety of pathologies such as neurodegenerative diseases and cancer, and have been linked to
559 malignant transformation, together with an imbalance in iron homeostasis(58). Similar assumptions
560 can be made for copper (59). Our results are also consistent with a recent study demonstrating the
561 role of histone H3-H4 as a copper reductase enzyme that binds Cu(II) and catalyzes its reduction to
562 Cu(I). They showed that active H3-H4 is required for proper utilization of copper for mitochondrial
563 respiration and SOD function. Thereby, the excess of mitochondrial Cu(I) observed here predominantly
564 in *Sdhb*^{-/-} imCC suggests a greater inactivation of H3-H4 and thereby may explain the inhibition of *Sod2*
565 expression and the mitochondrial respiratory deficit observed following *Sdhb*-deficiency (60). In
566 addition, the lack of ROS changes observed in *Sdhd* KO cells might be associated with a residual activity
567 of Complex II in *Sdhb* KO cells. Indeed, while changes in SDH activity coupled to complexes I and III
568 have been shown in a number of different systems to generate ROS, SDH itself has also been suggested
569 to generate ROS when electron flow is compromised (61). It was recently suggested that cells lacking
570 SDHB maintain some form of SDH subunit-containing complex (62), which maintains some level of
571 activity. Although we have no data to validate this hypothesis, one could hypothesize that SDHB-
572 deficient cells can generate ROS due to the retention of an 'SDH-like' complex, while SDHD-deficient
573 cells avoid this through complete loss of SDH.

574 In this regard, our findings are consistent, although different, with those recently proposed by
575 Liu *et al* (63). Using an *Sdhb* KD cell model, these authors also describe ROS accumulation associated
576 with an increase in the intracellular labile iron pool. Surprisingly, these authors observed an increase
577 in iron pool using the calcein probe while in our model, and in human PPGL, this experiment actually
578 showed a decrease in *Sdhb* KO cells. A possible explanation stands in the fact that the model used in
579 the current study is, as the human PPGL studied, a true genetic KO with no SDHB expression, while the
580 model used by Liu *et al* is a KD in which 30% of SDHB protein expression remains. Hence, these different

581 models point to similar pathways, but with major differences in the adaptive responses of the cells.
582 Indeed, Liu *et al* propose that the iron overload would be due to increased expression of TF and TFR2,
583 while, as previously mentioned such overexpression was not observed in our model. We did observe
584 a slight increase in TF mRNA levels in SDH tumors as compared with other types of mutated PPGL, but
585 not in TFR2. However, in both cases, levels of expression were actually extremely low in all PPGLs and
586 therefore probably not biologically relevant (Supplementary Fig. 4). Furthermore, these authors
587 showed in the same model, that anti-oxidant responses were increased following *SDHB* KD, notably
588 through the upregulation of the nuclear factor erythroid 2-related factor 2 (NRF2). We did not observe
589 any activation of neither the NRF2 pathway nor superoxide dismutase (SOD) activity in any of our
590 different cell types and these data were further validated by our analysis of the transcriptome of
591 human PPGL. Besides, N-acetyl cysteine (NAC) treatment, an inhibitor of the NRF2 pathway, had no
592 effect on the production of mitochondrial ROS by *Sdhb*^{-/-} cells. Hence, it is quite interesting to notice
593 that although similar pathways seem to be affected in the *Sdhb* KO and KD cells (i.e. iron homeostasis,
594 oxidative stress), it seems that the mechanisms and the adaptive responses involved are not similar.

595 Collectively, these data demonstrate that cells carrying a complete abolition of *Sdhb* gene are
596 not able to neutralize the oxidative damage caused by the mitochondrial ROS excess, through the up-
597 regulation of any intrinsic anti-oxidant pathway. Since, ROS generation seems to be a critical hallmark
598 of SDHB loss, testing an antioxidant treatment that could be used for clinical purposes on our *Sdhb*^{-/-}
599 model appeared relevant. Ascorbate offers many assets, as it presents few side effects in healthy
600 tissues, even at pharmacological concentrations and is easy to access. However, although at
601 physiological concentration (micromolar), ascorbate acts as an antioxidant, able to decrease ROS levels
602 (64), it has been shown to have pro-oxidant actions when reaching high concentrations (65). In
603 addition to its strong oxidative role, ascorbate also affects iron homeostasis, as it reduces ferric iron
604 (Iron(III)) in a cycle of reactions leading to the fully oxidized form of ascorbate (DHA), ferrous iron
605 (Iron(II)) and eventually resulting in increased intracellular ROS levels (66,67). Therefore, in a context
606 of redox imbalance associated with an elevated pool of labile iron, ascorbate treatment could lead to

607 unbearably high ROS levels for the cells and thus aggravate an existing oxidative stress burden. Use of
608 ascorbic acid at pharmacologic concentrations was already suggested as a promising therapeutic
609 strategy on various types of tumor cells exhibiting increased ROS levels, increased labile iron and
610 metabolism impairments (58). All the more that, for the past few years many studies have
611 demonstrated the efficacy of ascorbate as an anticancer treatment, killing cancer cells *in vitro* (68,69)
612 and slowing tumor growth *in vivo* (70). In compliance with these reports, our data reveal that high-
613 dose ascorbate treatment led to a higher accumulation of ROS solely in the mitochondria of *Sdhb*^{-/-}
614 imCC, resulting promptly in cell death, thus validating the increased sensitivity of *Sdhb*^{-/-} cells for
615 ascorbate, mediated by ROS overload. Interestingly, Liu *et al* also recently reported that ascorbate
616 treatment increased apoptosis in *SDHB* KD cells *in vitro* and delayed the growth of tumors as well as
617 of hepatic lesions in xenografted mice models *in vivo* (70). Numerous clinical trials are currently
618 evaluating the efficacy of intravenous high-dose pharmacological ascorbate injection for treating
619 different cancer types (67,71). In that context, ascorbate intravenous injections at pharmacological
620 doses appear as a worthy and highly promising therapeutic strategy to treat SDHB-deficient
621 malignancies, which often exhibit a poor answer to current treatments strategies (radiotherapy,
622 chemotherapy, targeted therapy) and could also be tested in combination with other therapies.

623 Overall, the comprehensive comparison of the first relevant *Sdhb* and *Sdhd* knock-out cellular
624 models, reveals the common and distinctive pathways used by these cells to adapt to these
625 deficiencies, and highlight specific hallmarks associated with *Sdhb* mutations. Lifting the veil on a long-
626 lasting question, we show that *Sdhb*-deficient cells exhibit stronger PHD and TET inhibition than their
627 *Sdhd*-deficient counterparts, explaining their aggressive phenotype and mesenchymal morphology.
628 We demonstrate that *Sdhb*^{-/-} imCC manifest a significantly exacerbated imbalance in copper and iron
629 homeostasis resulting in an increased labile iron pool, associated with significant ROS accumulation.
630 High-dose ascorbate treatment of *Sdhb*^{-/-} imCC offers promising results, as it highly aggravated the
631 oxidative stress burden endured by *Sdhb*-deficient cells, thus rising as a potential original therapeutic
632 approach to treat malignant PPGL.

633 **Acknowledgements**

634 We thank all members of the Genetics Department, Biological Resources Center and Tumor Bank
635 Platform, Hôpital Européen Georges Pompidou (BB-0033-00063), the Metabolic Tracer Analysis Core
636 (MTAC) at the University of Birmingham for access to their technology platform, as well as the London
637 Metallomics Facility funded by the Wellcome Trust (grant reference 202902/Z/16/Z). We thank Dr Stijn
638 J.M. Van Malderen for assistance with shift correction.

639

640 **Author contributions**

641 J.F., E.L. and D.A.T conceived the study. J.G., A.M., G.G., S.M., C.L.A. designed and performed the
642 experiments, and analyzed the data. S.Mo., K.K., A.P.M., T.J.S., C.L-L., P.B. and A.T. performed the
643 experiments and analyzed the data. J.F., D.A.T., E.L., F.M-G. and R.R. designed the experiments and
644 analyzed the data. J.F. and A-P.G-R. supervised the study. J.F. and J.G. contributed to the management
645 of the project, wrote the manuscript and prepared the figures. E.L. and D.A.T. contributed to the
646 preparation of the manuscript. All the authors discussed the results and reviewed the manuscript.

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858 **Figure legends**

859

860 **Fig. 1 Generation of *Sdhd*-deficient immortalized mouse chromaffin cells.** **A**, Electrophoregrams of Sanger
861 sequencing of the exon 3 of *Sdhd* gene showing both homozygous point mutations c.119delC and
862 c.120_121delCA of CIA and CIB respectively compared to a control DNA (WT). **B**, Western-blot showing
863 SDHB protein expression in all cell types. **C**, Spectrophotometrical measurement of SDH activity. Steady-
864 state assessment of TCA cycle organic acids (**D**, succinate, **E**, fumarate and **F**, α -ketoglutarate). Results
865 shown are from at least three independent experiments, presented as mean \pm SEM. In **C-F**, One-way ANOVA
866 was used to assess statistical significance. ns, not significant, * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$.

867

868 **Fig. 2 Metabolic and respiratory profiles of *Sdhd*-deficient imCC and *Sdhb*^{-/-} cells.** **A**, Diagram describing
869 the incorporation of carbons from glucose through PDH (blue) or PCX (red) enzymes activity. Abbreviations
870 in metabolic diagram: PDH, pyruvate dehydrogenase; PCX, pyruvate carboxylase; AcCoA, acetyl coenzyme
871 A. **B**, Incorporation of ^{13}C into succinate, aspartate and citrate in stated cell lines. Isotopomers ^{13}C atoms
872 are shown as filled circles, whereas ^{12}C atoms are empty circles. **C**, Incorporation of $^{13}\text{C}_5$ -glutamine into
873 succinate, aspartate and citrate in indicated cell lines and **D**, the associated diagrammatic representation
874 of their oxidative (blue) and reductive (red) metabolism. **E**, Oxygen consumption (respiration) of intact and
875 **F**, permeabilized (CI + CII) cells. ETS refers to electron transfer system capacity and basal respiration to
876 oxygen consumption in non-permeabilised cells. **G**, Lactate production over time. Results shown are from
877 at least three independent experiments, presented as mean \pm SEM. Two-way ANOVA was performed; ns,
878 not significant, * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$ relative to WT and \$ $P \leq 0.05$, \$\$\$ $P \leq 0.001$ relative to *Sdhb*^{-/-}
879 imCC.

880

881 **Fig. 3 *Sdhb*, but not *Sdhd* knockout in mouse chromaffin cells initiates a mesenchymal phenotype**
882 **associated with stronger 2OG-dependent dioxygenases inhibition.** **A**, Actin staining in the indicated
883 cell lines. **B**, qRT-PCR analysis of known epithelial-to-mesenchymal markers (*Snai1*, *Mmp9*, *Fn1*). **C**,
884 Quantification of cell adhesion 1h after plating. **D**, Collective migration assessed after 10h in the stated
885 cell lines, represented as the closure percentage of the wound. **E**, Scatterplot representative of

886 methylation rates identified by RRBS in *Sdhb*^{-/-} versus WT cells and *Sdhd*^{-/-} versus WT cells,
887 respectively. **F**, number of differentially methylated features in *Sdhb*^{-/-} and *Sdhd*^{-/-} imCC (versus WT)
888 in TSS500 and gene body regions. **G**, Comparison of methylation changes generated by *Sdhd* and *Sdhb*
889 knockout in imCC. **H**, Number and overlap of differentially methylated features in *Sdhb*^{-/-} compared
890 with *Sdhd*^{-/-} imCCs. **I**, Western blot of HIF2 α in total cellular extracts of indicated cell lines. **J**, Heatmap
891 representation of transcriptome-based classification of imCCs according to their genotype resulting in
892 hierarchical clustering. **K**, Number and overlap of overexpressed hypoxia-inducible genes from a
893 selected list of 47 genes in *Sdhb*^{-/-} and *Sdhd*^{-/-} imCCs compared with WT cells. **L**, Relative expression
894 levels of overexpressed hypoxia-inducible genes in *Sdhb*^{-/-} and *Sdhd*^{-/-} imCCs compared with WT. In
895 **A, B, C, D** and **E** data shown are from at least three independent experiments, presented as mean \pm
896 SEM. **K** and **L** data are mean expression levels from RNAseq data generated in 3 *Sdhb*^{-/-}, 2 WT and 2
897 *Sdhd*^{-/-} clones. One-way ANOVA was used to assess statistical significance; ns, not significant,
898 **P \leq 0.01, ***P \leq 0.001 relative to WT and \$\$\$P \leq 0.001 relative to *Sdhb*^{-/-} imCC.

899

900 **Fig. 4 SDH-deficient cells exhibit significant alterations in iron homeostasis, notably marked in *Sdhb***
901 **KO cells. A**, Flow cytometry analysis of labile overall iron content in each cell line. **B**, Representative
902 ⁵⁶Fe images generated by LA-ICP-MS in one *NF1*-mutated human pheochromocytoma **C**, one *SDHB*-
903 mutated pheochromocytoma **D**, one *SDHB*-mutated paraganglioma and **E**, one *SDHD*-mutated
904 paraganglioma. Images are displayed using the same threshold to enable a direct visual comparison
905 between tumor sections. Average ⁵⁶Fe counts in 2 *NF1*, 2 *RET*, 4 *SDHB* and 2 *SDHD* tumors are shown
906 in **F**. **G**, Cytosolic Iron(II) content, **H**, mitochondrial Iron(II) content. **I**, Heatmap representation of the
907 expression profiles of several critical actors of iron/copper homeostasis in *Sdhb*^{-/-}, WT and *Sdhd*^{-/-}
908 cells, using mean level values to perform unsupervised classification. **J**, Diagram highlighting the role
909 played by some iron and copper transporters (*DMT1*, *Slc25a37*, *CTR1* and *Slc25a3*) explaining the major
910 alterations induced by *Sdhb* KO in their iron and copper cellular homeostasis. Data shown in **A, G** and

911 **H** are from three independent experiments, presented as mean \pm SEM. Non-parametric one-way
912 ANOVA was used to assess statistical significance; ns, not significant, * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$.

913

914 **Fig. 5 SDHB-deficient cells display increased ROS levels without activation of the NRF2 pathway.**

915 **A**, Specific MFI using CellROX probe in all imCC cell types. Similar assays were carried out using **B**,
916 Mitosox **C**, Bodipy C11 probe **D**, TMRM and **E**, Mitotracker probes. **F**, RNA-seq analysis showing the
917 mRNA levels of the different forms of superoxide dismutase (cytoplasmic SOD1, mitochondrial and
918 extracellular SOD3) and catalase. **G**, Specific MFI of MitoSOX probe in all imCC models following N-
919 acetyl-cysteine (NAC) treatment (3 mM) for 48h. **H**, Cell survival percentage of indicated cell lines after
920 treatment with 3 mM of NAC in comparison to vehicle-treated controls for 48h. **I**, Heatmap
921 representation of the expression of 58 NRF2-target genes through the transcriptome data of the
922 COMETE collection of human PPGL. Mean values of NRF2 targets levels in the groups of sporadic non-
923 mutated tumors (n=49), *RET*- (n=19), *NF1*- (n=37), *VHL*- (n=40), *SDHA*, *C*, *D*- (n=6) and *SDHB*-mutated
924 tumors (n=17) were used to perform unsupervised classification. Data shown in **A**, **B**, **C**, **D** and **E** each
925 dot is representative of an independent experiment (n=4), bar plots show means \pm SEM. One-way
926 ANOVA was used to assess statistical significance; ns, not significant, * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$
927 relative to WT and $\$P \leq 0.05$ relative to *Sdhb*^{-/-} imCC. In **G** and **H** results shown are from at least three
928 independent experiments and presented as means \pm SEM. To assess statistical significance in **F**, **G** and
929 **H**, Two-way ANOVA was used; ns, not significant, * $P \leq 0.05$, *** $P \leq 0.001$.

930

931 **Fig. 6 Modulation of Iron(II) and ROS levels affects HIF2 α stabilization and survival in Sdhb-deficient**

932 **cells. A**, Specific MFI of MitoSOX probe in all imCC models following treatment for 48h with either
933 Iron(II) 50 μ M or vehicle. **B**, Western blot of HIF2 α in total cellular extracts of *Sdhb*^{-/-} imCCs not-treated
934 (NT) or treated for 48h with Iron(II) (Fe²⁺). **C**, Dose-response curves showing cell survival of all cell types
935 following 48h of treatment with Iron(II). **D**, Specific MFI of CellROX probe in all imCC models following
936 treatment for 12 hours with MitoTEMPO (MTT) 2.5 μ M in comparison to NT cells. **E**, Same as **D**, using

937 MitoSOX probe. **F**, Western blot of HIF2 α in total cellular extracts NT or treated for 12h with 2.5 μ M
938 MTT. **G**, Same as **D**, after treatment with MTT 2.5 mM. **H**, Same as **G**, using MitoSOX probe. **I**, Same as
939 **F**, after treatment for 12h with 2.5 mM MTT. **J**, Cell morphology following treatment for 12h with MTT
940 2.5 mM. **K**, Same as **C** following Ascorbate treatment. **L**, Time-response curves showing cell survival of
941 all imCC models after treatment with 2.5 mM ascorbate. **M**, Specific MFI of MitoSOX probe in all imCC
942 models following treatment for 48h with either ascorbate 1mM or vehicle. Data for **C**, **K**, and **L** are all
943 relative to vehicle-treated controls and presented as means \pm SEM (n = 3 independent experiments,
944 with 3 technical replicates/experiment). Data from **A**, and **M** are mean of at least three independent
945 experiments and data from **D**, **E**, **G**, and **H** are mean of at least two independent experiments. Data are
946 presented as mean \pm SEM and two-way ANOVA was performed; ns, not significant, *P \leq 0.05,
947 ***P \leq 0.001.
948

Figure 1

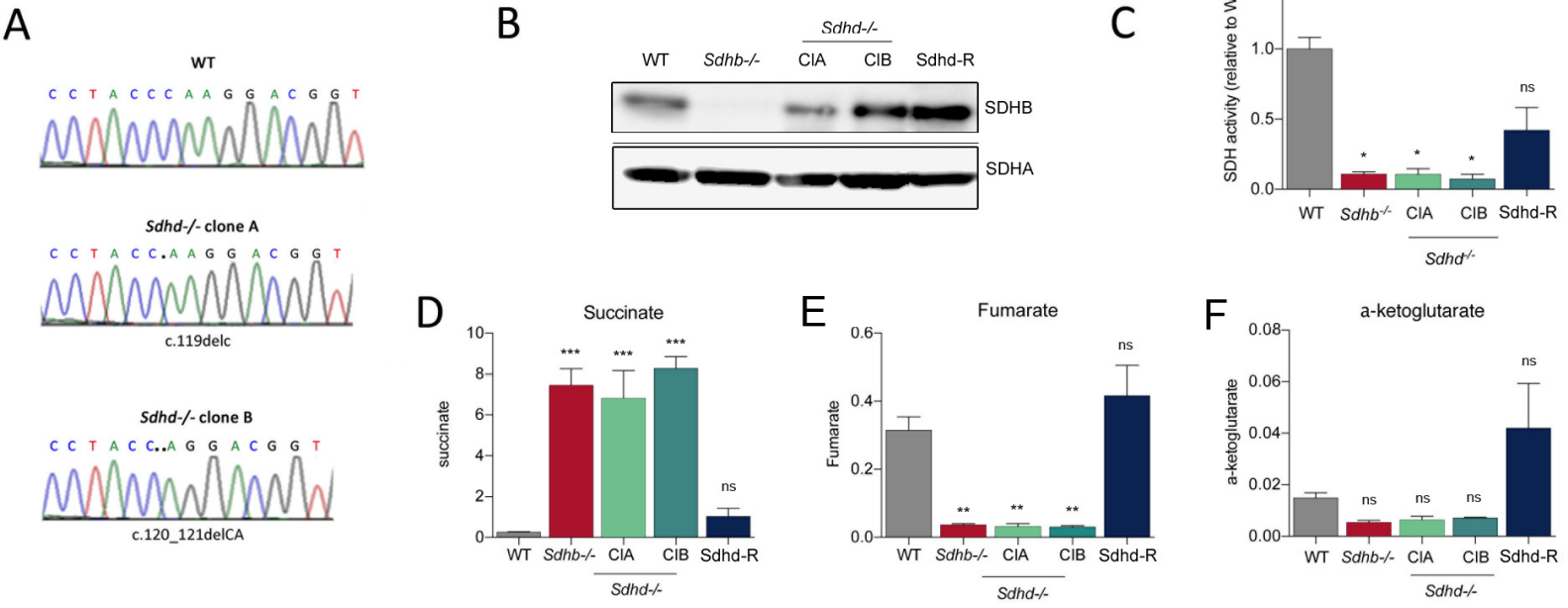


Figure 2

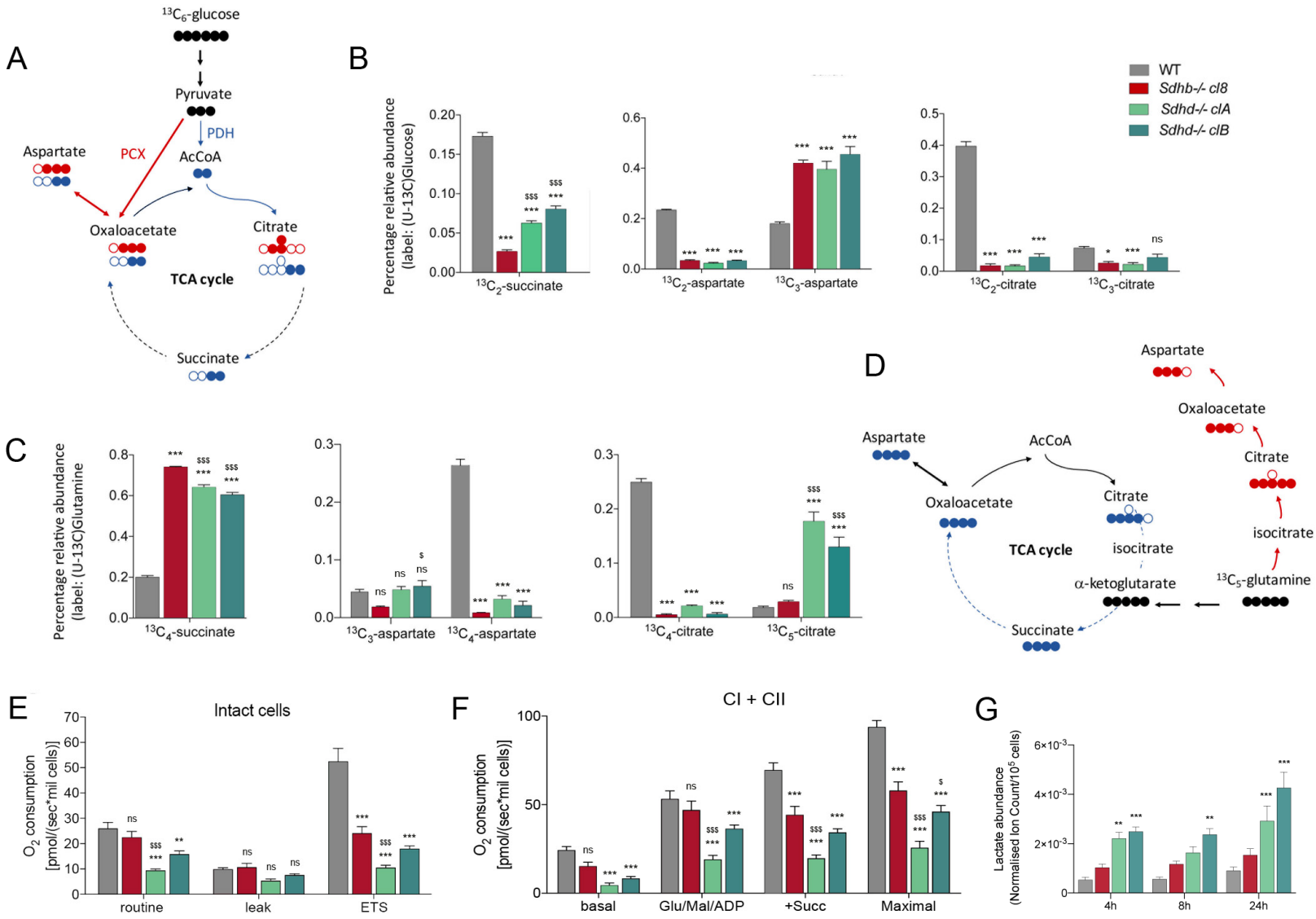


Figure 3

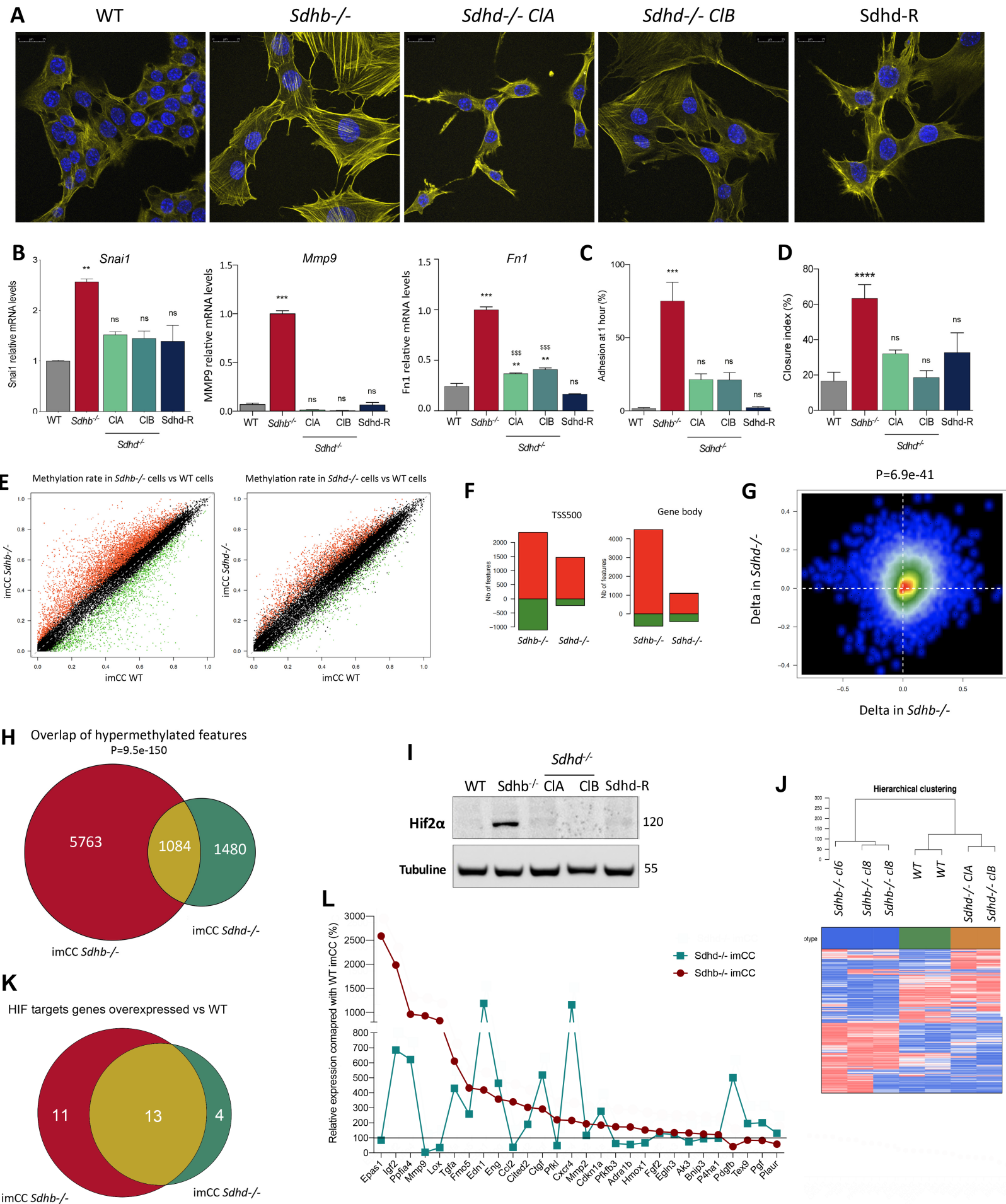


Figure 4

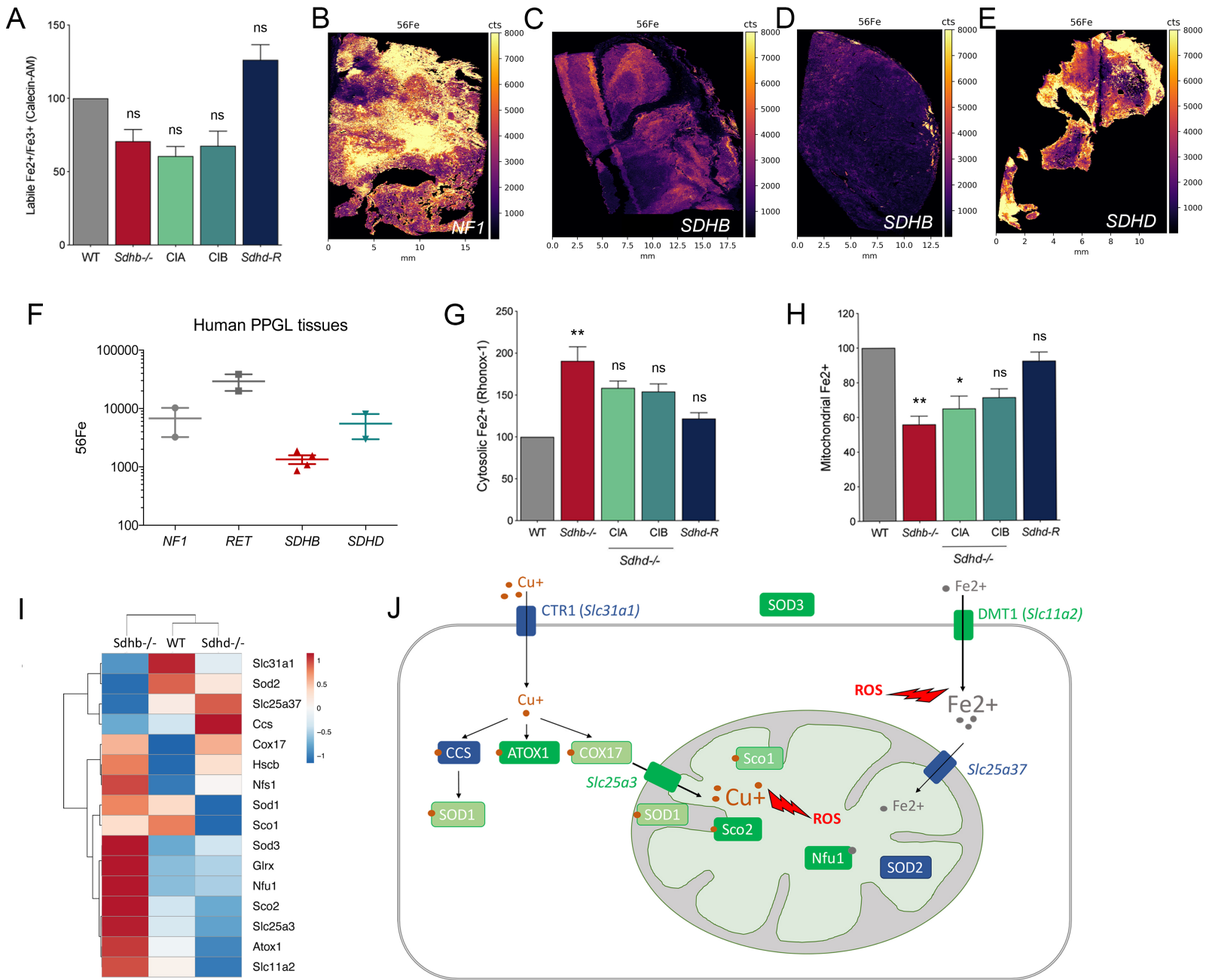


Figure 5

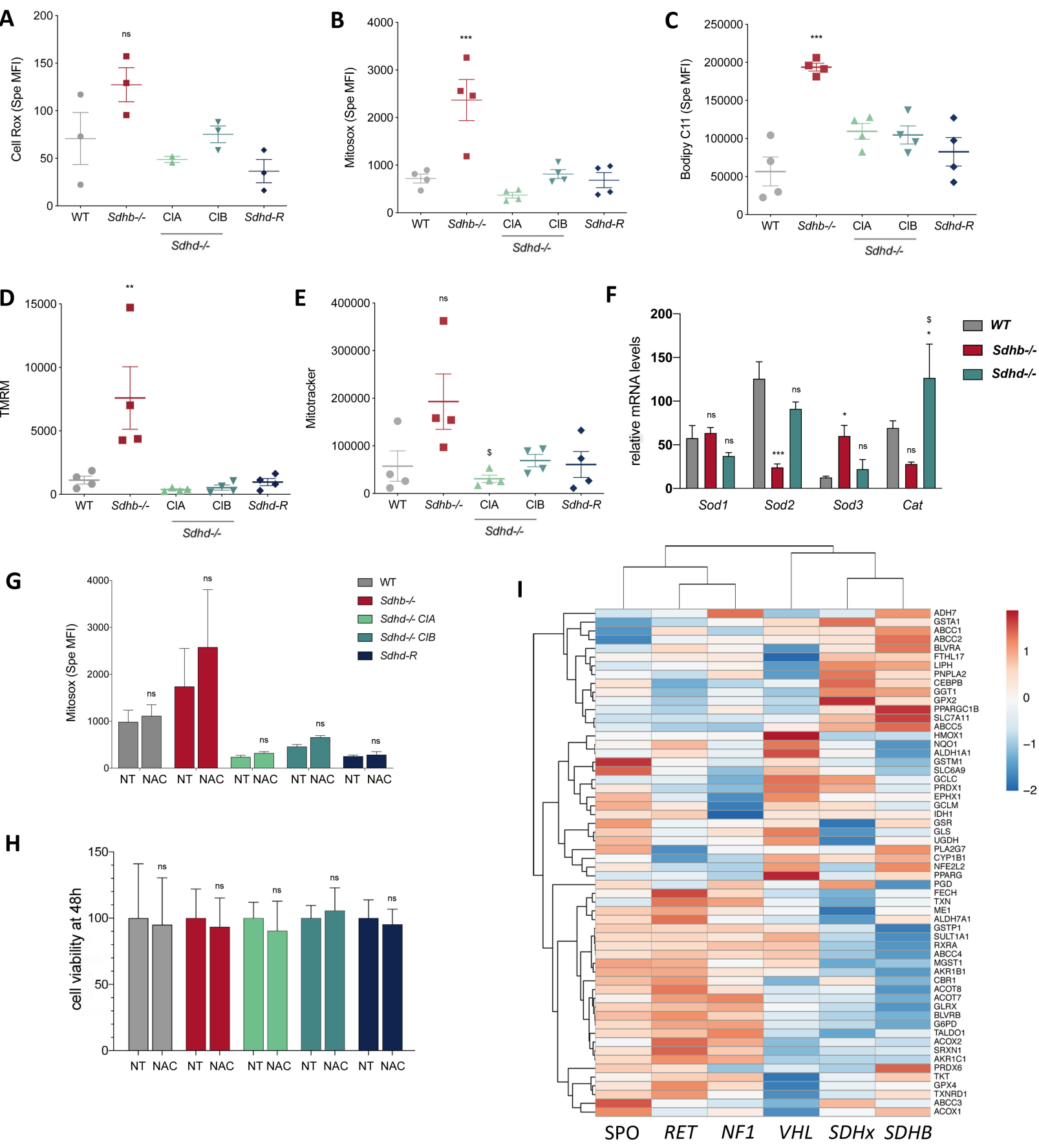
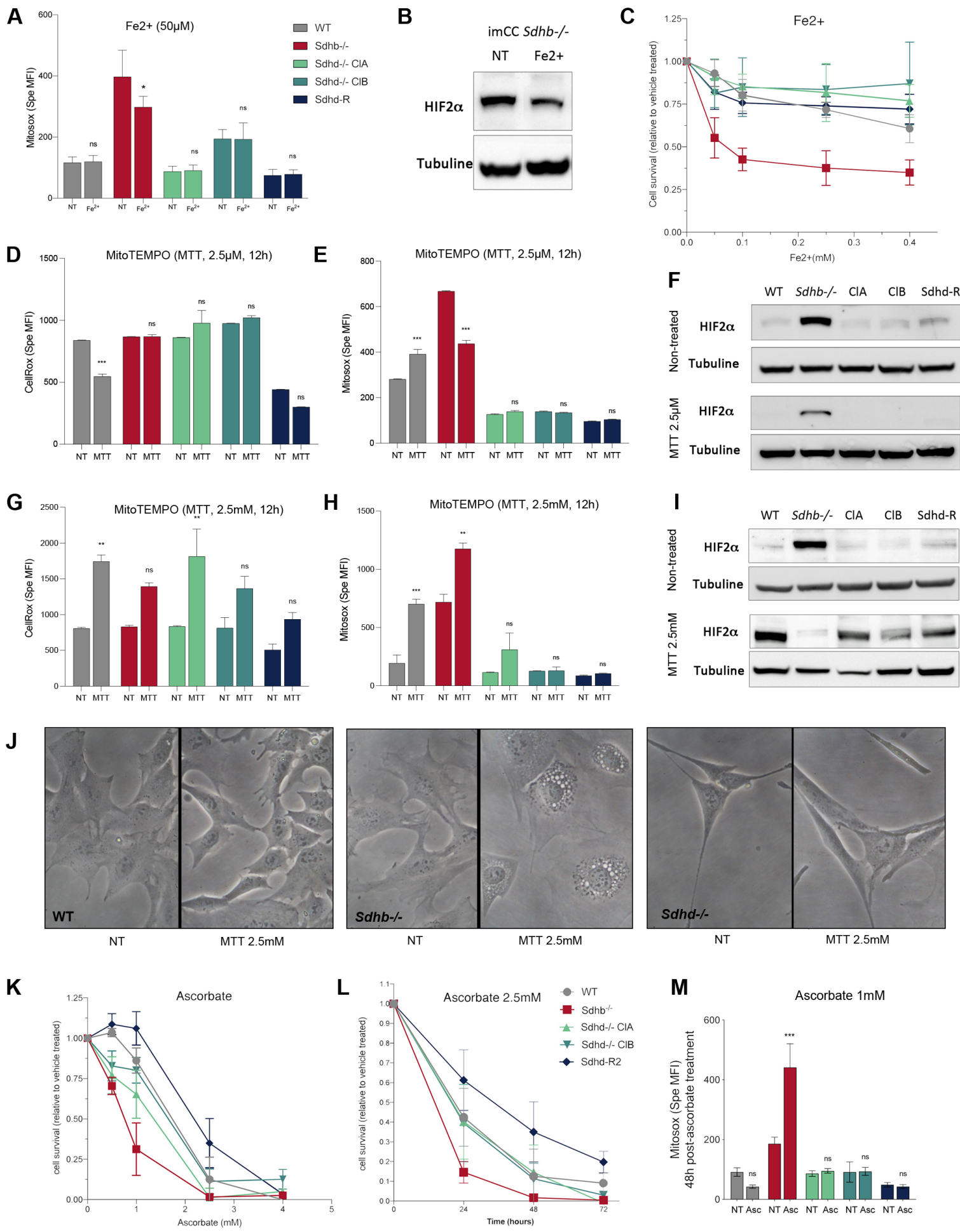


Figure 6



1 Loss of SDHB promotes dysregulated iron homeostasis, oxidative
2 stress and sensitivity to ascorbate.

3

4

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37 **Running title:** Consequences of SDHD and SDHB deficiency in cells and tumors

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40 **Keywords:** metastatic paraganglioma, *SDHB*, iron homeostasis, oxidative stress, ascorbate

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42 **Additional information:**

43 **Financial support:**

44 This work has received funding from The Plan Cancer, Epigénétique et Cancer (EPiG201303
45 METABEPIC), The Paradifference Foundation, la Ligue Contre le Cancer (Equipe Labellisée) and the

46 Cancer Research for Personalized Medicine - CARPEM project (Site de Recherche Intégré sur le
47 Cancer - SIRIC). The London Metallomics Facility is funded by the Wellcome trust (grant No
48 202902/Z/16/Z). Sophie Moog is the recipient of a fellowship from la Fondation pour la Recherche
49 Médicale. Judith Goncalves is the recipient of a fellowship from la Ligue Nationale contre le Cancer.
50 The R.R. research group is funded by the European Research Council (ERC) under the European
51 Union's Horizon 2020 research and innovation programme (grant agreement No [647973]), the
52 Fondation Charles Defforey-Institut de France and Ligue Contre le Cancer (Equipe Labellisée).

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65 **Conflict of interest disclosure statement:** the authors declare no potential conflicts of interest

66

67 **Word count:** 8555

68

69 **Number of figures:** 6

70

71

72 **Abstract**

73

74 Succinate dehydrogenase is a key enzyme in the tricarboxylic acid cycle and the electron transport
75 chain. All four subunits of succinate dehydrogenase are tumor suppressor genes predisposing to
76 paraganglioma, but only mutations in the SDHB subunit are associated with increased risk of
77 metastasis. Here we generated an *Sdhb* knockout chromaffin cell line and compared it to *Sdhb*-
78 deficient cells. Both cell types exhibited similar SDH loss of function, metabolic adaptation, and
79 succinate accumulation. In contrast, *Sdhb*^{-/-} cells showed hallmarks of mesenchymal transition
80 associated with increased DNA hypermethylation and a stronger pseudo-hypoxic phenotype
81 compared to *Sdhb*^{-/-} cells. Loss of SDHB specifically led to increased oxidative stress associated with
82 dysregulated iron and copper homeostasis in the absence of NRF2 activation. High-dose ascorbate
83 exacerbated the increase in mitochondrial reactive oxygen species, leading to cell death in *Sdhb*^{-/-}
84 cells. These data establish a mechanism linking oxidative stress to iron homeostasis that specifically
85 occurs in SDHB deficient cells and may promote metastasis. They also highlight high-dose ascorbate
86 as a promising therapeutic strategy for SDHB-related cancers.

87

88

89 **Statement of significance**

90 Loss of different succinate dehydrogenase subunits can lead to different cell and tumor phenotypes,
91 linking stronger 2-OG-dependent-dioxygenases inhibition, iron overload, and ROS accumulation
92 following SDHB mutation.

93

94

95 Introduction

96 Succinate dehydrogenase (SDH) is a key enzyme localized in the inner mitochondrial
97 membrane where it participates both in the tricarboxylic acid (TCA) cycle and the electron transport
98 chain (ETC), as complex II. In the TCA cycle, SDH catalyzes the oxidation of succinate into fumarate
99 while in the ETC, it allows the transfer of electrons from succinate to the ubiquinone pool. SDH is
100 constituted of two anchoring subunits (SDHC, SDHD) and two catalytic subunits (SDHA, SDHB)
101 encoded by the four *SDHx* nuclear genes (*SDHA*, *SDHB*, *SDHC* and *SDHD*). SDHA is a flavoprotein to
102 which the substrate succinate binds in order to be oxidized to fumarate, while the resulting electrons
103 are channeled to ubiquinone, through the three Fe-S clusters of SDHB. Since the initial discovery of
104 *SDHD* mutations in 2000(1), all four *SDHx* genes have been demonstrated to act as tumor-suppressor
105 genes (2,3,4). Their mutations predispose to pheochromocytoma and paraganglioma (PPGL), rare
106 neuroendocrine tumors arising from chromaffin cells of the adrenal medulla and from the
107 sympathetic and parasympathetic nervous systems, respectively; as well as gastro-intestinal stromal
108 tumors (GIST) and rare forms of renal cell carcinomas. It is now estimated that mutations in *SDHx*
109 genes stand for almost 50% of inherited cases of PPGL. Interestingly, *SDHB* mutations have been
110 shown to be the highest risk factor of malignancy in patients with PPGL: approximately 50% of PPGL
111 patients carrying *SDHB* mutations will ultimately develop a metastatic form of the disease and a
112 germline mutation in *SDHB* is found in up to 36% of all metastatic PPGL cases (5). In contrast,
113 metastatic forms of the disease are found in only 5% of patients with an *SDHD* gene mutation.
114 Moreover, *SDHB* mutated cancers are more aggressive than non-mutated metastatic ones. The
115 overall survival of patients with metastatic *SDHB*-related PPGL was initially estimated at 42 months
116 after diagnosis of the first metastasis versus 244 months for patients with a metastatic PPGL but
117 without an *SDHB* gene mutation (6). Interestingly, recent studies have revealed that increased
118 follow-up of patients with genetically determined PPGL has significantly improved their survival,
119 demonstrating the beneficial impact of genetic testing in these patients (7,8).

120 In all cases, germline *SDHx* mutations are associated with loss of heterozygosity, which causes the
121 complete loss of SDH function in the tumor (9) and a subsequent accumulation of its substrate,
122 succinate (10). Succinate (as other TCA cycle intermediates such as fumarate and 2-hydroxyglutarate)
123 is considered as an oncometabolite, driving aberrant activation of transcription factors and global
124 epigenetic reprogramming. Indeed, high steady-state levels of these metabolites are known to inhibit
125 2-oxoglutarate (2-OG) dependent dioxygenases, such as the hypoxia-inducible transcription factor
126 (HIF) prolyl-hydroxylases (PHDs) and Ten-eleven translocation (TET) DNA demethylases (11). These
127 enzymes belong to the large family of iron (Fe) and 2-OG-dependent dioxygenases, which activity is
128 based on the use of iron (12), oxygen (13) and ascorbate (14) as main co-factors. Inhibition of PHDs
129 promotes the abnormal stabilization, and thus activity of HIF1 and HIF2, while TET inhibition leads to
130 a lack of DNA demethylation, resulting in pseudo-hypoxic and hypermethylator phenotypes,
131 respectively. These observations were initially revealed in genomic studies performed on large PPGL
132 tumor collections, resulting in a better understanding of the mechanisms of SDH-related
133 tumorigenesis. In these studies, all *SDHx* and *FH* mutated tumors clustered together, showing a
134 transcriptome signature characterized by activation of the hypoxic response pathway (2, 15, 16) and
135 a DNA hypermethylator phenotype (17). Despite this apparent homogeneity, some differences have
136 emerged suggesting that *SDHB*-mutated tumors may display a particularly marked hypermethylator
137 phenotype associated with hallmarks of neuroendocrine-to-mesenchymal transition (NMT), which
138 were not observed in other types of *SDHx*-mutated cases (i.e *SDHA*, *SDHC* and *SDHD* mutated)(18). In
139 order to decipher these mechanisms at the cellular level, we have generated an immortalized mouse
140 chromaffin cell (imCC) line knocked-out for the *Sdhb* gene (17). In these cells, we showed that *Sdhb*-
141 deficiency does promote a marked hypermethylator phenotype mediated by TET1 and/or TET2
142 blockade, which acts in synergy with HIF2 activation to promote NMT and metastatic dissemination
143 (19, 20). *Sdhb*^{-/-} cells also undergo significant metabolic reprogramming becoming critically
144 dependent on aspartate synthesis as a major source of carbon for anabolic purposes, which supports
145 their viability and proliferation, maintained mainly through reductive carboxylation (21).

146 Despite these important advances in the understanding of the oncogenic consequences of
147 SDHB loss of function, the exact cause of the metastatic phenotype of *SDHB*-related tumors remain
148 mostly unexplained. *SDHA* and *SDHC* mutations are rare in PPGL patients, probably because of low
149 penetrance of the disease in mutation carriers. In contrast, *SDHB* and *SDHD* are the most frequently
150 described mutations in PPGL, with an incidence of 8-10 and 5-7% among all PPGL cases, respectively
151 (22). Genotype-phenotype correlation studies performed in patients with *SDHB* or *SDHD* mutations
152 have undoubtedly demonstrated their different clinical behavior in terms of invasiveness. To address
153 this crucial question in the field, we have generated *Sdhd* knocked-out cell lines in the imCC model.
154 In this new and unique model, we have investigated the different pathways previously identified in
155 SDH-related tumors in order to identify the specificities that may explain their different clinical
156 behavior.

157

158 **Materials and Methods**

159 Detailed methods are provided in the Supplementary Information section.

160 ***Sdhd* KO, *Sdhd*-rescue cell generation and cellular analysis**

161 Complete knock-out of *Sdhd* gene was achieved in immortalized mouse Chromaffin Cells (imCC) by
162 transfecting Wild-Type imCC, previously generated by our lab (17), with *in silico* designed targeted
163 gRNA, using the PrecisionX Cas9 SmartNuclease RNA system kit (System Biosciences). *Sdhd*-rescue
164 clones were established by transfecting *Sdhd*^{-/-} imCC with an SDHD-expressing vector (ORIGENE,
165 NM003002). Screening of these clones was performed by SDH activity test, qRT-PCR and direct
166 sequencing of the *Sdhd* gene by Sanger method. Cells used for experiments were maintained in
167 DMEM high glucose Glutamax (Gibco) unless when grown for metabolic or respirometry experiments
168 (see Supplementary Information). Wound scratch assays, proliferation and adhesion tests were
169 performed to assess cellular phenotype. When stated, cells were treated with indicated doses of iron

170 Chloride (Sigma), MitoTEMPO (Sigma), L-Ascorbic acid (Sigma), Talazoparib (MedChemTronica) or N-
171 acetyl-cysteine (Sigma).

172

173 **RNA-seq and RRBS data analysis**

174 RNA sequencing was performed for 7 samples: 3 *Sdhd*^{-/-}, 2 *Sdhb*^{-/-} and 2 WT imCC. Enriched samples
175 were used to generate sequencing libraries with the Illumina 'TruSeq Stranded mRNA Sample Prep'
176 kit and associated protocol provided by the manufacturer. Libraries were sequenced by IntegraGen
177 (Evry, France) on an Illumina HiSeq 2000 as paired-end 75 bp reads. Reduced Representation Bisulfite
178 Sequencing (RRBS) was also performed by Integragen SA, as previously described (17). **Details of the**
179 **process leading to the evaluation of differential expression and methylation rates are provided in**
180 **the Supplementary Information.** The sequencing data reported in this paper have been deposited to
181 the EGA (European Genome-phenome Archive) database (European Genome-phenome
182 Archive) database (accession number EGAS00001005279).

183

184

185 **Metabolite analysis, high resolution respirometry, enzymatic activities and features of oxidative** 186 **stress assessment**

187 All cell types underwent metabolite extraction using Methanol:H₂O:Chloroform at ratio 1:1:1,
188 following ¹³C-glucose and ¹³C-glutamine labeling. The polar fractions were used for Gas
189 Chromatography – Mass Spectrometry (GC-MS) analysis allowing acquisition of the isotope data.
190 High resolution respirometry was performed by loading Intact or permeabilized cells in an Oxygraph-
191 O2 k (Oroboros instruments) chamber, using Mir05 respiratory media and digitonin for the latter. A
192 pseudo dual-wavelength Varian CARY50 spectrophotometer (Victoria, Australia) was used to assess
193 respiratory chain activities as previously described (23). For the assessment of oxidative stress

194 features, cells treated as stated, were incubated with either CellRox, MitoSox or Bodipy C11 Reagent
195 (Termofisher) and Flow cytometry data were acquired using an LSR FORTRESSA analyzer (BD
196 biosciences).

197

198 **Cellular and tumoral iron and copper analysis**

199 For cellular iron and copper assessment, cells were incubated with the relevant metal-specific probe
200 prior to being analyzed by flow cytometry on a BD Accuri C6 (BD Biosciences). Laser ablation-
201 inductively coupled plasma-mass spectrometry (LA-ICP-MS) was performed on dewaxed and
202 rehydrated formalin-fixed paraffin-embedded tumor sections. **Details of LA-ICP-MS experiments are**
203 **provided in the Supplementary Information.** LA-ICP-MS images were acquired in a fixed dosage
204 mode, with a vertical and horizontal spatial resolution of 20 μm , a detailed list of sample settings is
205 available in Supplementary Table 1. Average ^{56}Fe and ^{63}Cu intensities were calculated from pixels
206 containing a positive elemental tissue marker (^{31}P) ensuring background regions did not influence
207 these calculations.

208

209 **qRT-PCR, Western-blot, immunofluorescence staining and immunohistochemical analyses**

210 For qRT-PCR, total mRNA was extracted from cell pellets using RNeasy plus mini-kit (Qiagen). Reverse
211 transcription was fulfilled using iScriptTM cDNA Synthesis Kit (BIO-RAD) and qRT-PCR was performed
212 on CFX96TM Real-Time System C1000 TouchTM Thermal Cycler (BIO-RAD) using SuperScript SybrGreen
213 (BioRad) to assess the expression of *Sdhb*, *Sdhd*, *Snai1*, *Fn1*, *Epas1*, *MMP9* and *18S*. Western-blot
214 analysis were performed to assess SDHB, SDHA, HIF2 α and TUBULIN expression. RIPA lysis buffer was
215 used for extraction of total protein and concentrations were determined with Bradford colorimetric
216 method. Results were read with a LAS-4000 Mini (Fuji). Actin staining and γH2AX

217 immunofluorescence were performed on cells plated on glass slides, while γ H2AX
218 immunohistochemistry was performed on 6 μ m sections from paraffin-embedded tumors. **Details of**
219 **primers, primary and secondary antibodies, immunostaining, and experimental conditions are**
220 **provided in the Supplementary Information.**

221

222 **Data analysis**

223 Data are represented as mean (of at least 3 independent experiments) \pm SEM (standard error of the
224 mean). Data were analyzed by one-way or 2-way ANOVA. Statistics tests were carried out using the
225 GraphPad Prism software. All analyses considered a value of $P \leq 0.05$ to be statistically significant. For
226 enrichment analysis, we used an in-house adaptation of the GSEA method to identify gene sets from
227 the MSigDB database overrepresented among up/down-regulated and hyper/hypomethylated
228 genes.

229

230 **Results**

231 ***Loss of SDHB or SDHD leads to similar metabolic dysfunction and respiratory profiles***

232 To investigate the mechanisms underlying the metastatic characteristics of *SDHB* mutated-
233 PPGL but not of *SDHD*-deficient tumors, we knocked-out the *Sdhd* gene using the CRISPR/Cas9
234 procedure in wild-type (WT) imCC (17). We obtained two independent *Sdhd*^{-/-} clones (CIA and CIB)
235 each containing a different homozygous point mutation on exon 3 of *Sdhd*, c.119delC and
236 c.120_121delCA, respectively, both leading to premature stop codons (Fig. 1A). These mutations
237 were predicted to lead to the translation of truncated proteins of 79 and 68 amino acids,
238 respectively, instead of the 159 amino acids of the entire WT SDHD protein. To attest for the absence
239 of off-target effects in *Sdhd*^{-/-} cells, we generated a third cell line, in which SDHD loss was rescued by
240 stably transfecting an *Sdhd*-expressing vector in the *Sdhd*^{-/-} CIA (clone *Sdhd-R*). *Sdhd*-mutated cells

241 showed a decrease in *Sdhd* RNA levels (Supplementary Fig. 1A) when compared with WT and *Sdhd-R*
242 cells, which may be suggestive of nonsense-mediated decay in the mutant clones, and particularly in
243 clone A.

244 SDHD protein expression could not be estimated due to the lack of efficient antibody in
245 mouse. It is worth noting that *Sdhd* mRNA levels were also reduced in *Sdhb*-deficient cells. In
246 contrast, *Sdhb* mRNA levels were absent in *Sdhb*^{-/-} cells, but not significantly reduced in *Sdhd*^{-/-}
247 imCC (Supplementary Fig. 1B). It has previously been reported that disassembly of the SDH complex
248 in case of *SDHx* mutations leads to the degradation of the SDHB subunit in all *SDHx* mutant cells (24).
249 However, our data show that *Sdhd*^{-/-} clones retain a small but significant level of SDHB protein (Fig.
250 1B). Similarly, evaluation of SDHB protein by immunohistochemistry in SDH-related PPGL frequently
251 leads to a weak diffuse signal in SDHD deficient tumors, while it is totally negative in SDHB-mutated
252 ones, suggesting that some SDHB remains present in this type of mutants (25). Nevertheless, they
253 exhibited a complete loss of SDH enzymatic activity, similar to that observed in *Sdhb*-deficient cells
254 (Fig. 1C), and in accordance with observations in mutated human PPGL (9,26). Interestingly, it has
255 previously been suggested that succinate accumulation might be less important in SDHD-deficient
256 tumors, which may account for their different metastatic potential (27). Analysis of intracellular
257 succinate levels revealed a substantial accumulation of succinate in *Sdhd*^{-/-} cells that reached that
258 observed in the *Sdhb*^{-/-} imCC model (Fig. 1D). Similarly, levels of the related metabolites, fumarate
259 and 2-oxoglutarate, were strongly reduced in all SDH-deficient cells regardless of the subunit
260 inactivated. *Sdhd-R* cells showed a profile similar to that of WT imCC (Fig. 1E-F and Supplementary
261 Fig. 1C, D).

262

263 Next, we assessed the metabolic and respiratory phenotypes of both types of SDH-deficient
264 cells. ¹³C-glucose tracing experiments revealed that in accordance with previous work (21), cells
265 deficient in SDH-activity undergo a metabolic rewiring in the absence of a fully functional TCA cycle
266 (Fig. 2A). Like *Sdhb*^{-/-} cells, the synthesis of aspartate by *Sdhd*^{-/-} imCC cannot rely on oxidative TCA

267 cycle metabolism (Fig. 2B and C, m+2 isotopomer) and instead increase the aspartate produced
268 through pyruvate carboxylation (PC) (Fig. 2B and C, m+3 isotopomer) for anabolic purposes. Equally,
269 their synthesis of citrate from glucose, a central metabolite for cellular anabolism, was greatly
270 reduced (Fig. 2B). The metabolism of another key nutrient, glutamine was therefore examined.
271 Although both cell lines retain some oxidative metabolism of glutamine to produce succinate, *Sdhd*^{-/-}
272 imCC appear to significantly increase their synthesis of aspartate and citrate using reductive
273 carboxylation (Fig. 2C and D), which is not observed to the same degree in *Sdhb*^{-/-} imCC. We then
274 measured oxygen consumption of intact and permeabilized imCC (Fig. 2E and F). In both cases, *Sdhb*^{-/-}
275 imCC exhibited no significant change in basal respiration, while *Sdhd*^{-/-} cells showed a decrease,
276 suggesting that a more significant defect in respiration exists in the *Sdhd*^{-/-} cells compared to *Sdhb*^{-/-}
277 . Maximal respiratory capacity (FCCP-mediated uncoupled respiration) was significantly reduced in
278 both SDH-deficient imCC models, in compliance to that previously reported in *Sdhb*^{-/-} cells(28). The
279 relative decrease in respiratory activity observed in *Sdhd*^{-/-} cells compared to those deficient in *Sdhb*
280 was consistent with the increased reliance on reductive carboxylation for the synthesis of aspartate
281 and citrate (Fig. 2C), an effect previously observed in hypoxia (29). Given the decreased oxygen
282 consumption observed in the *Sdhd*-deficient cells compared to those lacking *Sdhb*, we examined
283 whether there was a compensatory increase in pyruvate reduction to lactate to regenerate cytosolic
284 NADH and maintain glycolysis. We indeed saw that while *Sdhb*^{-/-} cells show a small increase in
285 lactate production, this is further increased in *Sdhd*-deficient cells (Fig. 2G).

286 Altogether, these results suggest that massive succinate accumulation and rewired metabolism do
287 not constitute relevant triggers for SDHB-related malignancy, although the extent of mitochondrial
288 respiratory deficit may vary between the two models.

289

290 ***Sdhb* knockout in mouse chromaffin cells promotes neuroendocrine-to-mesenchymal transition** 291 **(NMT), unlike *Sdhd* knockout**

292 We previously reported that *Sdhb*^{-/-} imCC exhibit a mesenchymal-like phenotype with

293 increased adhesion, migration and invasion capacities (19). Morphological observation following
294 phalloidin staining qualitatively revealed that *Sdhd*^{-/-} cells appear to be generally smaller than *Sdhb*^{-/-}
295 ^{-/-} cells, and display a less extensive and rather peripheral actin mesh unlike *Sdhb*^{-/-} imCC (Fig. 3A),
296 suggesting that only *Sdhb*^{-/-} cells undergo mesenchymal transformation. Accordingly, markers of
297 NMT activation such as *Snai1*, *Mmp9*, *Fn1* (Fig. 3B) were overexpressed in *Sdhb*^{-/-} imCC but not in
298 *Sdhd*^{-/-} cells. In accordance with the loss of neuroendocrine features, *NCadh* was downregulated in
299 *Sdhb*^{-/-} imCC, while it was actually overexpressed in *Sdhd*^{-/-} cells (Supplementary Fig. 2A). *Sdhd*^{-/-}
300 cells showed moderate increase in adhesion (Fig. 3C), and no increase in migration, evaluated both in
301 collective (Fig. 3D) and individual migration assays (Supplementary Fig. 2B). *Sdhd*^{-/-} imCC also
302 exhibited a much slower cell growth than *Sdhb*^{-/-} cells (Supplementary Fig. 2C). Hence, despite
303 similar SDH loss-of-function and succinate levels, *Sdhd*-deficient cells do not display the
304 mesenchymal and migratory phenotype of *Sdhb* KO cells, as observed in human paraganglioma(18).

305

306 ***Sdhb*-deficient cells show greater inhibition of 2OG-dependent dioxygenases**

307 We have previously established that *SDHB*-mutated PPGL and *Sdhb*^{-/-} imCC display
308 pseudohypoxic and hypermethylator phenotypes, caused by inhibition of PHD and TET enzymes and
309 involved in the mesenchymal-like hallmarks associated with *SDHB* deficiency (17,20). We next
310 performed reduced representation bisulfite sequencing (RRBS) to precisely quantify 5-methyl-
311 cytosine (5mC) modifications along the genome after enrichment for CpG rich regions in the
312 different cell lines. Compared to WT, both *Sdhb* and *Sdhd* KO cells displayed a DNA hypermethylator
313 phenotype, but this phenotype was less pronounced in *Sdhd*^{-/-} cells (Fig. 3E). In total, *Sdhb*^{-/-} cells
314 displayed 6,847 significantly hypermethylated gene-based features (TSS +/- 500 bp and gene bodies)
315 against only 2,564 for *Sdhd*^{-/-} cells (Fig. 3F and Supplementary Table 2). Hypermethylator
316 phenotypes in *Sdhb*^{-/-} and *Sdhd*^{-/-} cells displayed a significant overlap and correlation (Fig. 3G and
317 H), with 1,084 common hypermethylated features representing 42% and 16% of hypermethylated
318 features in *Sdhd*^{-/-} and *Sdhb*^{-/-} imCC, respectively.

319 Surprisingly, Western-blot analysis in our cell lines revealed stabilization and massive increase of

320 HIF2 α protein levels in *Sdhb*^{-/-} cells, which was not seen in either *Sdhd*^{-/-}, WT or *Sdhd*-R imCC (Fig.
321 3I). We thus analyzed the transcriptome of all cell lines using RNA-sequencing. Hierarchical clustering
322 of expression profiles across the 1,000 most variant genes (based on standard deviation) showed
323 that *Sdhd*^{-/-} imCC remain closer to wild-type cells and display less gene expression changes than
324 *Sdhb*^{-/-} cells (Fig. 3J). To investigate more specifically the expression of hypoxia-inducible genes, we
325 analyzed the expression of a previously published list of 52 HIF targets (3), among which 47 were present
326 in the transcriptome of imCCs (Supplementary Table 3). Twenty-four (24) of them were overexpressed in
327 *Sdhb*-deficient cells compared to WT (mean value >120% of WT), while 17 were overexpressed in *Sdhd*-
328 deficient cells compared to WT (13 overlapping with those high in *Sdhb* KO cells) (Fig. 3K). Comparison of
329 both KO cells showed that 19 of the 28 overexpressed genes showed stronger expression in *Sdhb*^{-/-} cells
330 (Fig. 3L). These data therefore suggested that although HIF2 α was hardly detectable by western blot,
331 *Sdhd*^{-/-} cells did show a mild pseudohypoxic signature. In order to validate this observation, we further
332 analyzed previously-published transcriptome data generated in a collection of 188 human PPGL. In this
333 study, 3 *SDHD*, 1 *SDHA* and 2 *SDHC*-mutated PPGL were evaluated together with 17 *SDHB*-mutated ones
334 (3), which all clustered together using the expression of the 52 HIF-target genes. We have reanalyzed
335 these data, limiting them to the 41 highly expressed ones, and we evaluated their mean expression in
336 *SDHB* versus *SDHD*-mutated tumors. We observed that most genes were overexpressed in *SDHB*-related
337 tumors while the subset of genes over-represented in *SDHD*-mutated tumors corresponded to genes
338 expressed by endothelial cells or associated with angiogenic processes (Supplementary Fig. 3A), therefore
339 reflecting the very high vascular density described in these tumors (15,30). Similar results were obtained
340 on the TCGA cohort of PPGL (Supplementary Fig. 3B)(31).

341 Altogether, these findings indicate that *Sdhd* inactivation induces less DNA methylation and gene
342 expression changes than *Sdhb* deletion. We next aimed at identifying the causes of the seemingly
343 greater inhibition of 2OG-dependent dioxygenases in *Sdhb*^{-/-} cells.

344

345 ***Iron and copper homeostasis are dysregulated in SDH-deficient cells, and especially in Sdhb KO cells***

346 2OG-dependent dioxygenases are iron-containing enzymes. Because SDHB is the iron-sulfur
347 subunit of complex II, we wondered whether its complete loss might lead to disturbances in iron
348 metabolism, which would in turn modulate the activity of 2OG-dependent dioxygenases. We thus
349 used specific fluorescent probes to detect cytosolic and mitochondrial iron in all cell types, as well as
350 assessed iron levels in tumor samples from patients with *SDHB* mutations. We also evaluated
351 mitochondrial copper in all cell types. Indeed, iron and copper are both essential metals with close
352 metabolic interactions that have been known for a long time (32).

353 We first used the commercial Calcein-AM probe that reveals both Iron(II) and Iron(III) levels, but also
354 other ions such as calcium. This experiment showed a decrease in global labile iron in SDH-deficient
355 cells compared to WT imCC (Fig. 4A). To validate this observation in human PPGL, we performed
356 laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) in 6 pheochromocytomas
357 carrying *NF1* (n=2), *RET* (n=2) or *SDHB* (n=2) mutations, as well as 4 paragangliomas with *SDHB* (n=2)
358 or *SDHD* (n=2) gene mutations. We observed that average ⁵⁶Fe counts were significantly decreased in
359 tumors with *SDHB* mutations compared with tumors with *NF1*, *RET* or *SDHD* mutations (Fig. 4B-F).
360 This decrease was greater in *SDHB*-mutated paragangliomas (Fig. 4D) than in *SDHB*-mutated
361 pheochromocytomas (Fig. 4C). These results obtained in tumors from patients consolidate the
362 hypothesis that loss of the SDHB subunit leads to an altered iron metabolism. Calcein-AM probe
363 being poorly specific, we next examined the subcellular localization of Iron(II) using specific probes of
364 both this ion, and specific cell compartments. Unexpectedly, evaluation of the labile pool of cytosolic
365 Iron(II) revealed a significant increase in *Sdhb*^{-/-} cells only (Fig. 4G). This suggests that the calcein-AM
366 data would actually be imputable to a strong decrease in cytosolic levels of Iron(III) in SDH-deficient
367 cells. In opposition, we observed a significant decrease in the mitochondrial pool of chelatable iron
368 (Iron(II)) in both knockout models, decrease which was especially pronounced in *Sdhb*^{-/-} cells and
369 rescued in *Sdhd-R* imCC (Fig. 4H).

370

371 We next evaluated mitochondrial copper levels in all cell types. Concerning the pool of labile
372 mitochondrial Cu(II), no significant changes were observed in the SDH-deficient cells, while
373 mitochondrial Cu(I) was significantly increased in *Sdhb* KO cells only (Supplementary Fig. 4A and B).
374 LA-ICP-MS was also used to quantify the levels of ⁶³Cu in 10 PPGL tumors. This evaluation of global
375 copper was not able to confirm the difference in *SDHB* vs *RET* or *NF1* tumors. However, it suggested
376 that SDHD-deficient PGL had a decrease in copper counts compared with the other genotypes
377 (Supplementary Fig. 4C). Hence, there was a dysregulation in copper and especially in iron pools in
378 cells and tumors depending on their genotypes. In support of these observations, we evaluated the
379 mRNA expression of several iron and copper transporters as well as of chaperones or different actors
380 of iron/copper homeostasis, which revealed that these pathways were indeed strongly affected in
381 *Sdhb* KO cells (Fig. 4I, J). In particular, these cells showed a differential expression of transporters
382 implicated in the entry of iron and copper in the cell and the mitochondria: high DMT1 (*Slc11a2*) and
383 low Slc25a37 would sustain the increased cytosolic distribution of Iron(II), while low CTR1 (*Slc31a1*)
384 and high Slc25a3, the high mitochondrial Cu(I) levels. Consistently with these observations, human
385 PPGL transcriptome data showed an increase in *DMT1* mRNA levels in SDH tumors as compared with
386 other types of mutated PPGL. SDH tumors also exhibited a slight increase in the expression of other
387 actors involved in iron binding and transport, such as the hypoxia-inducible genes *TF* and *TFRC*.
388 *SLC31A1* was significantly decreased in both SDH and VHL tumors compared to RET or NF1-mutated
389 ones. No differences were detected for *TFR2* nor *SLC25A3* expression (Supplementary Fig. 4D).

390

391 ***Sdhb*-deficient cells display increased ROS levels without activation of the NRF2 pathway.**

392 *Sdhb*-KO cells show increased mitochondrial copper(I) and cytosolic Iron(II) levels, which
393 could cause important oxidative stress in these cell compartments (33). An increase in reactive
394 oxygen species (ROS) might also participate to the sustained inhibition of 2OG-dependent
395 dioxygenases activity (34). Flow cytometry analyses of fluorescent probes revealed that *Sdhb*-
396 deficient cells showed increased ROS both in the cytosol (Fig. 5A) and especially in the mitochondria

397 (Fig. 5B). They also displayed a significant increase in lipid peroxidation levels (Fig. 5C) and in
398 mitochondrial activity (Fig. 5D) but not in overall mitochondrial mass (Fig. 5E). Unexpectedly, none of
399 the *Sdhd*-deficient clones showed any changes in ROS levels as compared to the WT cells.

400 Because *Sdhb*^{-/-} cells display such a significant increase in ROS, we postulated that they would
401 probably show increased anti-oxidant responses, either through superoxide dismutase (SOD) or
402 through activation of the NRF2 pathway. However, the global superoxide dismutase activity did not
403 differ between the different cell types (Supplementary Fig. 5A). Moreover, RNA-seq analysis showed
404 a significant downregulation of mitochondrial SOD2, thus demonstrating that *Sdhb*-deficient cells do
405 not detoxify the excess in mitochondrial ROS (Fig. 5F).

406 We performed gene set enrichment analyses using RNA-seq data of 58 NRF2-target genes
407 (Supplementary Table 4) which showed no activation of the pathway in *Sdhb* nor in *Sdhd* KO cells,
408 compared to WT (Supplementary Fig. 5B). In addition, treating the cells with N-acetyl cysteine (NAC)
409 had no effect on the levels of mitochondrial ROS in any of the cell types studied (Fig. 5G), neither
410 affected their proliferation (Fig. 5H). In order to fully validate this observation in the human context,
411 this list of genes was also tested in the transcriptome data of the human PPGL COMETE collection
412 (Fig. 5I). Mean values of NRF2 targets levels in the groups of sporadic non-mutated tumors (n=49),
413 *RET* (n=19), *NF1* (n=37), *VHL* (n=40), *SDHA*, *C*, *D*- (n=6) and *SDHB*-mutated tumors (n=17) were used
414 to perform unsupervised classification, which confirmed that the NRF2 pathway is not activated in
415 *SDHB*-deficient tumors.

416

417 It has previously been reported that *SDHB* loss is associated with increased DNA damage (35), and a
418 sensitivity to inhibitors of poly (ADP-ribose) polymerase (PARP) (35, 36, 37). In addition to the
419 recently demonstrated mechanism associated with oncometabolite-induced inhibition of the lysine
420 demethylase KDM4B, increased ROS levels may participate to such phenotype. We therefore
421 evaluated DNA damage after staining PPGL tumor tissues and imCCs with anti- γ H2AX antibody
422 (Supplementary Fig. 5C and D). Although it was not statistically significant, we observed a slight

423 increase in γ H2AX levels in SDHB-deficient tumors, which was not seen in *Sdhb*^{-/-} imCCs. Treating
424 cells with increasing doses of the PARP inhibitor Talazoparib reduced cell survival in all cell types,
425 with an actually higher efficacy in WT and *Sdhd*-R cells (Supplementary Fig. 5E). In this cell model, it
426 seemed that Talazoparib efficiency was not related to SDH-deficiency, but was rather related to cell
427 proliferation indexes of the treated cell types.

428

429 ***Modulating Iron(II) and ROS levels affects pseudohypoxia and survival in Sdhb-deficient cells***

430 Altogether, these data suggest that in *Sdhb* KO cells, a combination of succinate
431 accumulation, dysregulation of iron homeostasis and high ROS levels may account for the increased
432 inhibition of TET and PHD hydroxylases. To demonstrate this link, we treated cells with Iron(II) (50
433 μ M), which had no effect on cytosolic ROS (Supplementary Fig. 6A) but reduced mitochondrial ROS,
434 only in *Sdhb*^{-/-} cells (Fig. 6A). This was associated with a decrease in HIF2 α protein levels in *Sdhb*^{-/-}
435 cells as well (Fig. 6B). Treating cells with increasing doses of ferrous iron revealed a specific sensitivity
436 of *Sdhb*-deficient cells. Indeed, after 48 h of treatment, 0.1 mM doses of Iron(II) led to a 60%
437 decrease in *Sdhb*^{-/-} cells survival while it only moderately affected WT, *Sdhd*-KO or *Sdhd*-R cell types
438 (Fig. 6C).

439 In order to further demonstrate that increased mitochondrial ROS were indeed responsible for the
440 massive HIF2 α stabilization observed in *Sdhb*-deficient cells, we then treated them for 12h with
441 MitoTEMPO, a mitochondrially targeted antioxidant that acts as a specific scavenger of mitochondrial
442 superoxide. MitoTEMPO (MTT) at 2.5 μ M had no effect on cytosolic ROS (Fig. 6D), but significantly
443 decreased mitochondrial ROS in *Sdhb*^{-/-} imCC (Fig. 6E), which was associated with a substantial
444 reduction of HIF2 α levels (Fig. 6F). High doses of MTT are suspected to show a reverse effect,
445 promoting a pro-oxidant response. We therefore treated cells with 2.5 mM of the compound and
446 showed that such high dose increased cytosolic ROS in all cell types and especially in WT and *Sdhd*^{-/-}
447 CIA cells (Fig. 6G), as well as mitochondrial ROS in WT and *Sdhb*^{-/-} cells (Fig. 6H). Strikingly, such
448 treatment promoted a strong pseudohypoxic response in WT, *Sdhd*^{-/-} and *Sdhd*-R cells, thus

449 demonstrating that increasing ROS was sufficient to mediate HIF2 α stabilization. In contrast, this led
450 to the opposite effect in *Sdhb*^{-/-} cells (Fig. 6I) in which HIF2 α protein was almost lost. It actually
451 appeared that high dose MTT was highly toxic for *Sdhb*^{-/-} cells exclusively (Fig. 6J), with perinuclear
452 vacuoles emerging after 12h and leading to the death of all *Sdhb*^{-/-} imCC after 72h.
453 In an attempt to evaluate another pro-oxidant treatment that might be used in a clinical context, we
454 finally tested the vulnerability of imCC to high dose ascorbate. A dose response curve showed that
455 *Sdhb*^{-/-} cells were indeed much more vulnerable to ascorbate with significant increase in cell death
456 appearing from a 1 mM dose onward, a complete lethality being reached at a 2.5 mM ascorbate dose
457 (Fig. 6K). At the higher dose, 85% of *Sdhb*-deficient cell loss was achieved after 24h, while a similar
458 response was only apparent in *Sdhb* and WT cells after 72h (Fig. 6L). To evaluate the mechanism
459 associated with ascorbate-induced lethality, we measured cytosolic and mitochondrial ROS in cells
460 treated for 48 h with 1 mM ascorbate. At such a dose, there was already a significant lethality of
461 *Sdhb*-KO cells and enough cell material was still available to allow the analyses (Supplementary Fig.
462 6B). Interestingly, we observed that cytosolic ROS were not modified by ascorbate in any of the cell
463 models (Supplementary Fig. 6C). In contrast, ascorbate led to a massive increase in mitochondrial
464 ROS, specifically in *Sdhb*^{-/-} cells (Fig. 6M).
465 These data suggest that in *Sdhb*-KO cells ascorbate interacts with the increased Iron(II) labile pool to
466 enhance oxidative stress, leading to rapid cell death.

467

468 **Discussion**

469 It is well-established that a mutation in the *SDHB* gene is a high risk factor for metastatic
470 PPGL (38) and poor prognosis (6), unlike mutations in other *SDHx* genes (*SDHA*, *SDHC* or *SDHD*) that
471 rarely cause metastatic forms of the disease. This question has been unresolved for 20 years. Many
472 studies have been performed in the past years, mainly using cell lines exhibiting a decrease or
473 complete lack in the expression of *Sdhb*. Thereby, previous work from our team has shown that

474 metastatic *SDHB* tumors exhibit a NMT phenotype (18,19), associated with increased DNA
475 methylation in comparison to other *SDHx* mutated tumors (20,39). Further, we have recently
476 demonstrated that this hypermethylated profile is due to TET silencing and that the NMT phenotype
477 observed in *SDHB* mutated tumors is the result of synergistic roles of TET repression and
478 pseudohypoxia, through HIF2 activation (20). Although these data have shed light on some
479 mechanisms undeniably involved in the tumorigenesis of *SDHB* mutated tumors, they do not explain
480 the different clinical outcomes observed in patients carrying mutations in the different *SDHx* genes.
481 In the present study, we were able to characterize and compare two physiologically appropriate
482 cellular models exhibiting a complete knock-out in *Sdhb* or *Sdhd* genes, which strikingly recapitulate
483 most of the phenotypic characteristics of *SDHB* and *SDHD*-mutated tumors.

484 Succinate accumulation is probably the major consequence of SDH loss of activity and increased
485 succinate levels in tumor samples are used as a biomarker of SDH-deficiency in PPGL patients (27,40–
486 42). For a long time, it has therefore been considered to be the main trigger of PPGL tumorigenesis.
487 The role of succinate as an oncometabolite was initially demonstrated in 2005, with the
488 demonstration of its inhibiting role on 2OG-dependent PHD enzymes, leading to the subsequent
489 stabilization of HIF α subunits even under normoxia (43,44). Later, it was demonstrated that succinate
490 is also a major epigenetic modifier, inhibiting TET enzymes and promoting a genome wide
491 hypermethylated profile (17,39,45). It has been suggested that a stronger inhibition of 2OG-
492 dependent dioxygenases observed in *SDHB*-mutated tumors versus tumors with mutations in other
493 *SDHx* genes, might be explained by a fuller inactivation of SDH enzyme associated with higher
494 succinate (27). Here, we firmly invalidate this long-held assumption, both *Sdhb*^{-/-} and *Sdhd*^{-/-} imCC
495 models showing the same loss of SDH activity and similar levels of succinate and fumarate (Fig. 1).
496 Indeed, many of the metabolic characteristics investigated were highly similar between the two cell
497 models suggesting that merely measuring overall steady-state succinate and fumarate levels are
498 inadequate for predicting phenotype, and smaller changes in metabolic function may drive
499 downstream. Surprisingly, HIF2 α protein was hardly detectable in *Sdhd*-deficient cells while it was

500 strongly activated in *Sdhb*^{-/-} imCC. This provides further evidence that although aspects of the
501 overall metabolic phenotype were similar between *Sdhb*^{-/-} and *Sdhd*^{-/-} models, as yet unexplored
502 metabolic factors may play a role in the inactivation of the PHD enzymes to stabilize HIF2 α . This was
503 unexpected as previous transcriptome analyses of human tumor samples have classified all *SDHx*
504 mutated tumors together with *VHL*-mutated ones in a “pseudohypoxic” cluster (16,17). However,
505 such classifications were based on global transcriptome and obviously included many other
506 pathways. To our knowledge, only three studies have classified PPGL tumors based on the expression
507 of hypoxia-induced genes. Hensen *et al* compared hypoxia-inducible genes in sporadic head and neck
508 PGL (HNPG) to HNPG carrying *PGL2* or *SDHD* gene mutations (46). This study was not able to
509 identify any differences in the hypoxic signature of these 3 types of tumors. Besides, Flidner *et al*
510 evaluated the expression of HIF target genes in a larger collection of *SDHD* (n=14) and *SDHB* (n=15)
511 related PPGL and also revealed some differences between the two types of tumors, with some genes
512 being less overexpressed in *SDHD*-mutated PGL (47). Based on previously published transcriptome
513 data (3), our present study shows that most HIF-target genes were overexpressed in *SDHB*-related
514 tumors while the subset of targets over-represented in *SDHD*-mutated tumors corresponded to
515 genes expressed by endothelial cells. Hence, although it is most probable that, as previously
516 suggested in other studies (15,48–50), *SDHD* tumors display some induction of pseudo-hypoxia *in*
517 *vivo*, the combination of our *in vitro* data and human PPGL studies does suggest that this effect is at
518 least much more limited in non-*SDHB* mutated cells and can therefore not be imputable to succinate
519 accumulation only.

520 Our data reveal that while *SDHB* expression is completely abolished in *Sdhb*^{-/-} cells, a small fraction
521 of *SDHB* protein remains detectable in *Sdhd*^{-/-} clones, consistently with IHC data on tumors that
522 frequently report a weak diffuse *SDHB* staining in *SDHD*-mutated PPGL (25,51). *SDHB* is the Fe-S
523 subunit of Complex II and contains two highly conserved L(I)YR motifs that are essential for
524 acquisition of Fe-S clusters by recruiting the Fe-S transfer machinery. We postulate that the loss in
525 mitochondrial Fe-S clusters present in the *SDHB* subunit, may be responsible for the significant

526 imbalance in cytosolic and mitochondrial iron distribution, that we observe in *Sdhb*^{-/-} cells.
527 Interestingly, Saxena et al reported that 37% of disease-causing missense mutations in SDHB were
528 located in either the L(I)YR Fe-S transfer motifs or in the 11 Fe-S cluster-ligating cysteines. Moreover,
529 analyses of reported missense mutations in patients with SDH-RCC or GIST revealed that 50% of
530 these patients had *SDHB* mutations in the L(I)YR motif amino acid residues (52). Altogether, these
531 observations point to a central role of Fe-S clusters loss in SDHB-related disease, which are further
532 reinforced by our present observations.

533 This labile iron overload may in turn be responsible for or exacerbate the overproduction of ROS
534 observed in *Sdhb*^{-/-} cells, thereby indirectly activating pseudohypoxia and DNA methylation. Indeed,
535 it has been previously demonstrated in a number of studies that in the context of excessive ROS
536 levels, these oxidant molecules can act as signals able to trigger the stabilization of HIF α transcription
537 factors in normoxic conditions (53–55; 34). Besides, in the present study we show that the use of
538 MitoTEMPO, a mitochondrially targeted antioxidant at low concentrations led to a significant
539 decrease in mitochondrial ROS, resulting in turn in reduced HIF2 α levels. Conversely, high doses of
540 MTT appear to exert a pro-oxidant action leading to increased cytosolic ROS in all of the cell types,
541 resulting in a strong pseudohypoxic response. Altogether, these results demonstrate the direct link
542 between ROS and HIF2 α stabilization and suggest that the elevated ROS levels observed in *Sdhb*^{-/-}
543 cells are probably responsible for their stronger pseudohypoxic phenotype. The association between
544 SDH-deficiency and ROS production has been controversial, with some studies showing an increase in
545 ROS levels (28,53) and others not (56). Actually, these apparently contradictory data are in total
546 accordance with our observations. Indeed, Selak *et al* first reported the absence of oxidative stress
547 following SDH inactivation, but this was observed in an *SDHD* KD cell model (56). In contrast, Guzy et
548 al. proposed that the mechanism explaining PPGL tumorigenesis following SDH inhibition was an
549 increase in ROS production, acting as messengers able to activate pseudohypoxic responses and
550 probably resulting in oxidative damage to DNA, genomic instability, and tumorigenesis (53). In that
551 study, an *Sdhb*-Knock Down (KD) model was compared to a *Sdha*-KD one, and ROS increase was only

552 observed in *Sdhb* KD cells. At that time, it was suspected that *SDHA* gene mutations were not
553 associated with PPGL, an assumption that we demonstrated to be untrue several years later (3).
554 Based on these observations, their conclusions were that loss of all but the SDHA subunits of SDH
555 would produce such increase in ROS production, explaining SDHB/C/D-mediated tumorigenesis. In
556 view of the actual knowledge on SDH genetics, the combination of these data with our current
557 observations suggests that ROS production is a specific feature of *SDHB*-mutated cells, and may be
558 responsible, not for SDH-related tumorigenesis in general, but for SDHB-related aggressive
559 phenotype.

560 Our data suggest that the increased oxidative stress observed in *Sdhb*-deficient cells could be the
561 consequence of the dysregulated iron/copper homeostasis. Indeed, redox-active iron strongly
562 interacts with hydrogen peroxide through the Fenton/Haber-Weiss reaction. This usually slow
563 reaction is catalyzed by labile iron, yielding mainly the highly reactive and toxic hydroxyl radical
564 ($\bullet\text{OH}$) from hydrogen peroxide (H_2O_2) and superoxide ions ($\bullet\text{O}_2^-$): $\text{Iron(III)} + \bullet\text{O}_2^- \rightarrow \text{Iron(II)} + \text{O}_2$;
565 $\text{Iron(II)} + \text{H}_2\text{O}_2 \rightarrow \text{Iron(III)} + \text{OH}^- + \bullet\text{OH}$ (57). Oxidative damage arising from excessive levels of ROS are
566 observed in a variety of pathologies such as neurodegenerative diseases and cancer, and have been
567 linked to malignant transformation, together with an imbalance in iron homeostasis(58). Similar
568 assumptions can be made for copper (59). Our results are also consistent with a recent study
569 demonstrating the role of histone H3-H4 as a copper reductase enzyme that binds Cu(II) and
570 catalyzes its reduction to Cu(I). They showed that active H3-H4 is required for proper utilization of
571 copper for mitochondrial respiration and SOD function. Thereby, the excess of mitochondrial Cu(I)
572 observed here predominantly in *Sdhb*^{-/-} imCC suggests a greater inactivation of H3-H4 and thereby
573 may explain the inhibition of *Sod2* expression and the mitochondrial respiratory deficit observed
574 following *Sdhb*-deficiency (60). In addition, the lack of ROS changes observed in *Sdhb* KO cells might
575 be associated with a residual activity of Complex II in *Sdhb* KO cells. Indeed, while changes in SDH
576 activity coupled to complexes I and III have been shown in a number of different systems to generate
577 ROS, SDH itself has also been suggested to generate ROS when electron flow is compromised (61). It

578 was recently suggested that cells lacking SDHB maintain some form of SDH subunit-containing
579 complex (62), which maintains some level of activity. Although we have no data to validate this
580 hypothesis, one could hypothesize that SDHB-deficient cells can generate ROS due to the retention
581 of an 'SDH-like' complex, while SDHD-deficient cells avoid this through complete loss of SDH.

582 In this regard, our findings are consistent, although different, with those recently proposed
583 by Liu *et al* (63). Using an *Sdhb* KD cell model, these authors also describe ROS accumulation
584 associated with an increase in the intracellular labile iron pool. Surprisingly, these authors observed
585 an increase in iron pool using the calcein probe while in our model, and in human PPGL, this
586 experiment actually showed a decrease in *Sdhb* KO cells. A possible explanation stands in the fact
587 that the model used in the current study is, as the human PPGL studied, a true genetic KO with no
588 SDHB expression, while the model used by Liu *et al* is a KD in which 30% of SDHB protein expression
589 remains. Hence, these different models point to similar pathways, but with major differences in the
590 adaptive responses of the cells. Indeed, Liu *et al* propose that the iron overload would be due to
591 increased expression of TF and TFR2, while, as previously mentioned such overexpression was not
592 observed in our model. We did observe a slight increase in TF mRNA levels in SDH tumors as
593 compared with other types of mutated PPGL, but not in TFR2. However, in both cases, levels of
594 expression were actually extremely low in all PPGLs and therefore probably not biologically relevant
595 (Supplementary Fig. 4). Furthermore, these authors showed in the same model, that anti-oxidant
596 responses were increased following *SDHB* KD, notably through the upregulation of the nuclear factor
597 erythroid 2-related factor 2 (NRF2). We did not observe any activation of neither the NRF2 pathway
598 nor superoxide dismutase (SOD) activity in any of our different cell types and these data were further
599 validated by our analysis of the transcriptome of human PPGL. Besides, N-acetyl cysteine (NAC)
600 treatment, an inhibitor of the NRF2 pathway, had no effect on the production of mitochondrial ROS
601 by *Sdhb*^{-/-} cells. Hence, it is quite interesting to notice that although similar pathways seem to be
602 affected in the *Sdhb* KO and KD cells (i.e. iron homeostasis, oxidative stress), it seems that the
603 mechanisms and the adaptive responses involved are not similar.

604 Collectively, these data demonstrate that cells carrying a complete abolition of *Sdhb* gene are
605 not able to neutralize the oxidative damage caused by the mitochondrial ROS excess, through the up-
606 regulation of any intrinsic anti-oxidant pathway. Since, ROS generation seems to be a critical
607 hallmark of SDHB loss, testing an antioxidant treatment that could be used for clinical purposes on
608 our *Sdhb*^{-/-} model appeared relevant. Ascorbate offers many assets, as it presents few side effects in
609 healthy tissues, even at pharmacological concentrations and is easy to access. However, although at
610 physiological concentration (micromolar), ascorbate acts as an antioxidant, able to decrease ROS
611 levels (64), it has been shown to have pro-oxidant actions when reaching high concentrations (65).
612 In addition to its strong oxidative role, ascorbate also affects iron homeostasis, as it reduces ferric
613 iron (Iron(III)) in a cycle of reactions leading to the fully oxidized form of ascorbate (DHA), ferrous
614 iron (Iron(II)) and eventually resulting in increased intracellular ROS levels (66,67). Therefore, in a
615 context of redox imbalance associated with an elevated pool of labile iron, ascorbate treatment
616 could lead to unbearably high ROS levels for the cells and thus aggravate an existing oxidative stress
617 burden. Use of ascorbic acid at pharmacologic concentrations was already suggested as a promising
618 therapeutic strategy on various types of tumor cells exhibiting increased ROS levels, increased labile
619 iron and metabolism impairments (58). All the more that, for the past few years many studies have
620 demonstrated the efficacy of ascorbate as an anticancer treatment, killing cancer cells *in vitro* (68,69)
621 and slowing tumor growth *in vivo* (70). In compliance with these reports, our data reveal that high-
622 dose ascorbate treatment led to a higher accumulation of ROS solely in the mitochondria of *Sdhb*^{-/-}
623 imCC, resulting promptly in cell death, thus validating the increased sensitivity of *Sdhb*^{-/-} cells for
624 ascorbate, mediated by ROS overload. Interestingly, Liu *et al* also recently reported that ascorbate
625 treatment increased apoptosis in *SDHB* KD cells *in vitro* and delayed the growth of tumors as well as
626 of hepatic lesions in xenografted mice models *in vivo* (70). Numerous clinical trials are currently
627 evaluating the efficacy of intravenous high-dose pharmacological ascorbate injection for treating
628 different cancer types (67,71). In that context, ascorbate intravenous injections at pharmacological
629 doses appear as a worthy and highly promising therapeutic strategy to treat SDHB-deficient

630 malignancies, which often exhibit a poor answer to current treatments strategies (radiotherapy,
631 chemotherapy, targeted therapy) and could also be tested in combination with other therapies.

632 Overall, the comprehensive comparison of the first relevant *Sdhb* and *Sdhd* knock-out cellular
633 models, reveals the common and distinctive pathways used by these cells to adapt to these
634 deficiencies, and highlight specific hallmarks associated with *Sdhb* mutations. Lifting the veil on a
635 long-lasting question, we show that *Sdhb*-deficient cells exhibit stronger PHD and TET inhibition than
636 their *Sdhd*-deficient counterparts, explaining their aggressive phenotype and mesenchymal
637 morphology. We demonstrate that *Sdhb*^{-/-} imCC manifest a significantly exacerbated imbalance in
638 copper and iron homeostasis resulting in an increased labile iron pool, associated with significant
639 ROS accumulation. High-dose ascorbate treatment of *Sdhb*^{-/-} imCC offers promising results, as it
640 highly aggravated the oxidative stress burden endured by *Sdhb*-deficient cells, thus rising as a
641 potential original therapeutic approach to treat malignant PPGL.

642 **Acknowledgements**

643 We thank all members of the Genetics Department, Biological Resources Center and Tumor Bank
644 Platform, Hôpital Européen Georges Pompidou (BB-0033-00063), the Metabolic Tracer Analysis Core
645 (MTAC) at the University of Birmingham for access to their technology platform, as well as the
646 London Metallomics Facility funded by the Wellcome Trust (grant reference 202902/Z/16/Z). We
647 thank Dr Stijn J.M. Van Malderen for assistance with shift correction.

648

649 **Author contributions**

650 J.F., E.L. and D.A.T conceived the study. J.G., A.M., G.G., S.M., C.L.A. designed and performed the
651 experiments, and analyzed the data. S.Mo., K.K., A.P.M., T.J.S., C.L-L., P.B. and A.T. performed the
652 experiments and analyzed the data. J.F., D.A.T., E.L., F.M-G. and R.R. designed the experiments and
653 analyzed the data. J.F. and A-P.G-R. supervised the study. J.F. and J.G. contributed to the
654 management of the project, wrote the manuscript and prepared the figures. E.L. and D.A.T.

655 contributed to the preparation of the manuscript. All the authors discussed the results and reviewed
656 the manuscript.

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868 **Figure legends**

869

870 **Fig. 1 Generation of *Sdhd*-deficient immortalized mouse chromaffin cells.** **A**, Electrophoregrams of
871 Sanger sequencing of the exon 3 of *Sdhd* gene showing both homozygous point mutations c.119delC and
872 c.120_121delCA of CIA and ClB respectively compared to a control DNA (WT). **B**, Western-blot showing
873 SDHB protein expression in all cell types. **C**, Spectrophotometrical measurement of SDH activity. Steady-
874 state assessment of TCA cycle organic acids (**D**, succinate, **E**, fumarate and **F**, α -ketoglutarate). Results
875 shown are from at least three independent experiments, presented as mean \pm SEM. In **C-F**, One-way
876 ANOVA was used to assess statistical significance. ns, not significant, * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$.

877

878 **Fig. 2 Metabolic and respiratory profiles of *Sdhd*-deficient imCC and *Sdhb*^{-/-} cells.** **A**, Diagram describing
879 the incorporation of carbons from glucose through PDH (blue) or PCX (red) enzymes activity.
880 Abbreviations in metabolic diagram: PDH, pyruvate dehydrogenase; PCX, pyruvate carboxylase; AcCoA,
881 acetyl coenzyme A. **B**, Incorporation of ¹³C into succinate, aspartate and citrate in stated cell lines.
882 Isotopomers ¹³C atoms are shown as filled circles, whereas ¹²C atoms are empty circles. **C**, Incorporation
883 of ¹³C₅-glutamine into succinate, aspartate and citrate in indicated cell lines and **D**, the associated
884 diagrammatic representation of their oxidative (blue) and reductive (red) metabolism. **E**, Oxygen
885 consumption (respiration) of intact and **F**, permeabilized (CI + CII) cells. ETS refers to electron transfer
886 system capacity and basal respiration to oxygen consumption in non-permeabilised cells. **G**, Lactate
887 production over time. Results shown are from at least three independent experiments, presented as
888 mean \pm SEM. Two-way ANOVA was performed; ns, not significant, * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$ relative
889 to WT and \$ $P \leq 0.05$, \$\$\$ $P \leq 0.001$ relative to *Sdhb*^{-/-} imCC.

890

891 **Fig. 3 *Sdhb*, but not *Sdhd* knockout in mouse chromaffin cells initiates a mesenchymal phenotype**
892 **associated with stronger 2OG-dependent dioxygenases inhibition.** **A**, Actin staining in the indicated
893 cell lines. **B**, qRT-PCR analysis of known epithelial-to-mesenchymal markers (*Snai1*, *Mmp9*, *Fn1*). **C**,
894 Quantification of cell adhesion 1h after plating. **D**, Collective migration assessed after 10h in the
895 stated cell lines, represented as the closure percentage of the wound. **E**, Scatterplot representative

896 of methylation rates identified by RRBS in *Sdhb*^{-/-} versus WT cells and *Sdhd*^{-/-} versus WT cells,
897 respectively. **F**, number of differentially methylated features in *Sdhb*^{-/-} and *Sdhd*^{-/-} imCC (versus WT)
898 in TSS500 and gene body regions. **G**, Comparison of methylation changes generated by *Sdhd* and
899 *Sdhb* knockout in imCC. **H**, Number and overlap of differentially methylated features in *Sdhb*^{-/-}
900 compared with *Sdhd*^{-/-} imCCs. **I**, Western blot of HIF2 α in total cellular extracts of indicated cell lines.
901 **J**, Heatmap representation of transcriptome-based classification of imCCs according to their
902 genotype resulting in hierarchical clustering. **K**, Number and overlap of overexpressed hypoxia-
903 inducible genes from a selected list of 47 genes in *Sdhb*^{-/-} and *Sdhd*^{-/-} imCCs compared with WT
904 cells. **L**, Relative expression levels of overexpressed hypoxia-inducible genes in *Sdhb*^{-/-} and *Sdhd*^{-/-}
905 imCCs compared with WT. In **A**, **B**, **C**, **D** and **E** data shown are from at least three independent
906 experiments, presented as mean \pm SEM. **K** and **L** data are mean expression levels from RNAseq data
907 generated in 3 *Sdhb*^{-/-}, 2 WT and 2 *Sdhd*^{-/-} clones. One-way ANOVA was used to assess statistical
908 significance; ns, not significant, **P \leq 0.01, ***P \leq 0.001 relative to WT and \$\$\$P \leq 0.001 relative to
909 *Sdhb*^{-/-} imCC.

910

911 **Fig. 4 SDH-deficient cells exhibit significant alterations in iron homeostasis, notably marked in *Sdhb***

912 **KO cells. A**, Flow cytometry analysis of labile overall iron content in each cell line. **B**, Representative

913 ⁵⁶Fe images generated by LA-ICP-MS in one *NF1*-mutated human pheochromocytoma **C**, one *SDHB*-

914 mutated pheochromocytoma **D**, one *SDHB*-mutated paraganglioma and **E**, one *SDHD*-mutated

915 paraganglioma. Images are displayed using the same threshold to enable a direct visual comparison

916 between tumor sections. Average ⁵⁶Fe counts in 2 *NF1*, 2 *RET*, 4 *SDHB* and 2 *SDHD* tumors are shown

917 in **F**. **G**, Cytosolic Iron(II) content, **H**, mitochondrial Iron(II) content. **I**, Heatmap representation of the

918 expression profiles of several critical actors of iron/copper homeostasis in *Sdhb*^{-/-}, WT and *Sdhd*^{-/-}

919 cells, using mean level values to perform unsupervised classification. **J**, Diagram highlighting the role

920 played by some iron and copper transporters (*DMT1*, *Slc25a37*, *CTR1* and *Slc25a3*) explaining the

921 major alterations induced by *Sdhb* KO in their iron and copper cellular homeostasis. Data shown in **A**,

922 **G** and **H** are from three independent experiments, presented as mean \pm SEM. Non-parametric one-
923 way ANOVA was used to assess statistical significance; ns, not significant, * $P \leq 0.05$, ** $P \leq 0.01$,
924 *** $P \leq 0.001$.

925

926 **Fig. 5 SDHB-deficient cells display increased ROS levels without activation of the NRF2 pathway.**

927 **A**, Specific MFI using CellROX probe in all imCC cell types. Similar assays were carried out using **B**,
928 Mitosox **C**, Bodipy C11 probe **D**, TMRM and **E**, Mitotracker probes. **F**, RNA-seq analysis showing the
929 mRNA levels of the different forms of superoxide dismutase (cytoplasmic SOD1, mitochondrial and
930 extracellular SOD3) and catalase. **G**, Specific MFI of MitoSOX probe in all imCC models following N-
931 acetyl-cysteine (NAC) treatment (3 mM) for 48h. **H**, Cell survival percentage of indicated cell lines
932 after treatment with 3 mM of NAC in comparison to vehicle-treated controls for 48h. **I**, Heatmap
933 representation of the expression of 58 NRF2-target genes through the transcriptome data of the
934 COMETE collection of human PPGL. Mean values of NRF2 targets levels in the groups of sporadic
935 non-mutated tumors (n=49), *RET*- (n=19), *NF1*- (n=37), *VHL*- (n=40), *SDHA*, *C*, *D*- (n=6) and *SDHB*-
936 mutated tumors (n=17) were used to perform unsupervised classification. Data shown in **A**, **B**, **C**, **D**
937 and **E** each dot is representative of an independent experiment (n=4), bar plots show means \pm SEM.
938 One-way ANOVA was used to assess statistical significance; ns, not significant, * $P \leq 0.05$, ** $P \leq 0.01$,
939 *** $P \leq 0.001$ relative to WT and $\$P \leq 0.05$ relative to *Sdhb*^{-/-} imCC. In **G** and **H** results shown are from
940 at least three independent experiments and presented as means \pm SEM. To assess statistical
941 significance in **F**, **G** and **H**, Two-way ANOVA was used; ns, not significant, * $P \leq 0.05$, *** $P \leq 0.001$.

942

943 **Fig. 6 Modulation of Iron(II) and ROS levels affects HIF2 α stabilization and survival in Sdhb-**

944 **deficient cells. A**, Specific MFI of MitoSOX probe in all imCC models following treatment for 48h with
945 either Iron(II) 50 μ M or vehicle. **B**, Western blot of HIF2 α in total cellular extracts of *Sdhb*^{-/-} imCCs
946 not-treated (NT) or treated for 48h with Iron(II) (Fe²⁺). **C**, Dose-response curves showing cell survival
947 of all cell types following 48h of treatment with Iron(II). **D**, Specific MFI of CellROX probe in all imCC

948 models following treatment for 12 hours with MitoTEMPO (MTT) 2.5 μ M in comparison to NT cells. **E**,
949 Same as **D**, using MitoSOX probe. **F**, Western blot of HIF2 α in total cellular extracts NT or treated for
950 12h with 2.5 μ M MTT. **G**, Same as **D**, after treatment with MTT 2.5 mM. **H**, Same as **G**, using MitoSOX
951 probe. **I**, Same as **F**, after treatment for 12h with 2.5 mM MTT. **J**, Cell morphology following
952 treatment for 12h with MTT 2.5 mM. **K**, Same as **C** following Ascorbate treatment. **L**, Time-response
953 curves showing cell survival of all imCC models after treatment with 2.5 mM ascorbate. **M**, Specific
954 MFI of MitoSOX probe in all imCC models following treatment for 48h with either ascorbate 1mM or
955 vehicle. Data for **C**, **K**, and **L** are all relative to vehicle-treated controls and presented as means \pm SEM
956 (n = 3 independent experiments, with 3 technical replicates/experiment). Data from **A**, and **M** are
957 mean of at least three independent experiments and data from **D**, **E**, **G**, and **H** are mean of at least
958 two independent experiments. Data are presented as mean \pm SEM and two-way ANOVA was
959 performed; ns, not significant, *P \leq 0.05, ***P \leq 0.001.

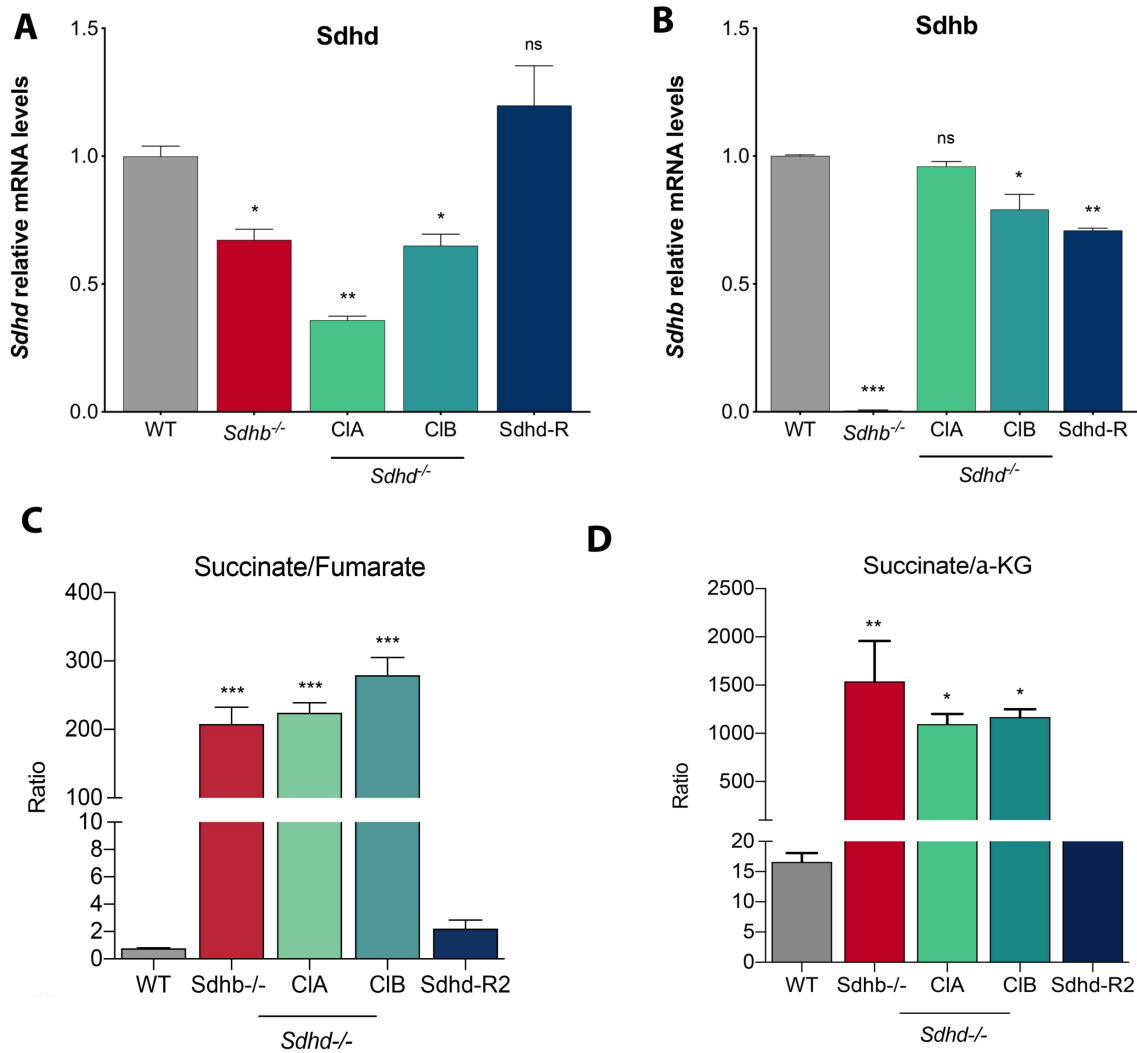
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1 **Supplementary data**

2 **Loss of SDHB, but not SDHD, promotes dysregulated iron homeostasis, oxidative stress and** 3 **vulnerability to ascorbate.**

4
5 Judith Goncalves, Sophie Moog, Aurélie Morin, Géraldine Gentric, Sebastian Müller, Alexander P. Morrell, Katarína Klůčková,
6 Theodora J. Stewart⁷, Cynthia L. Andoniadou, Charlotte Lussey-Lepoutre, Paule Bénit, Alpesh Thakker, Lisa Vettore, Jennie
7 Roberts, Raphaël Rodriguez, Fatima Mechta-Grigoriou, Anne-Paule Gimenez-Roqueplo, Eric Letouzé, Daniel A. Tennant and
8 Judith Favier

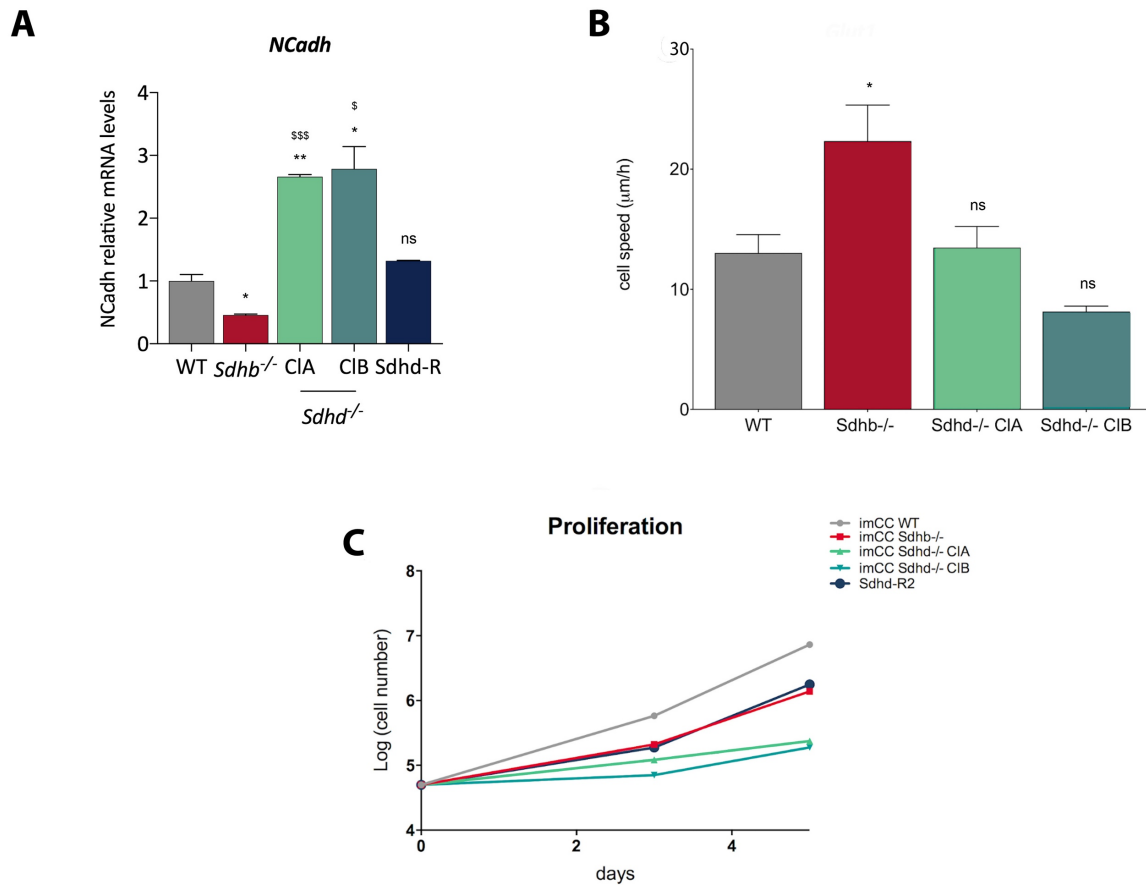
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13 - Supplementary Figure 1
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22 - Supplementary Table 4
23 - Supplementary Methods
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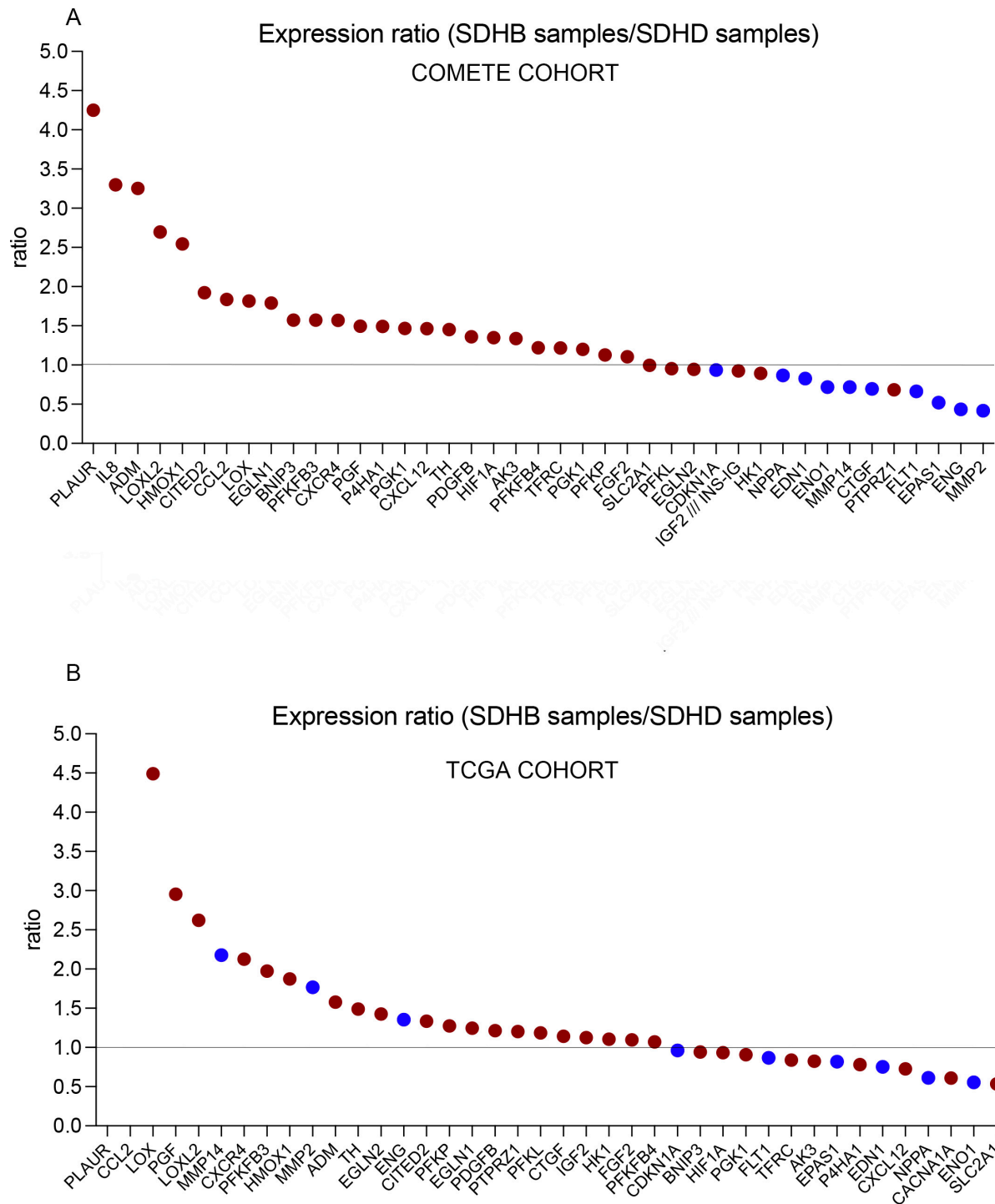
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27 **Supplementary Fig. 1 Related to Figure 1. Validation of new *Sdhd* knock-out cell models.** **A**, qRT-PCR
 28 analysis of *Sdhd* gene in the indicated cell lines. **B**, qRT-PCR analysis of *Sdhb* gene in the indicated cell
 29 lines. For **A and B** data shown are from at least six independent experiments, presented as mean \pm
 30 SEM. **C**, Succinate to Fumarate ratio and **D**, Succinate to α -ketoglutarate (α -KG) assessed in all the
 31 indicated cell lines, using steady-state levels of the former organic acids measured by GS-MS (n=3).
 32 Data are shown as mean \pm SEM. Student's test was performed to assess statistical significance; ns, not
 33 significant, * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$.

34

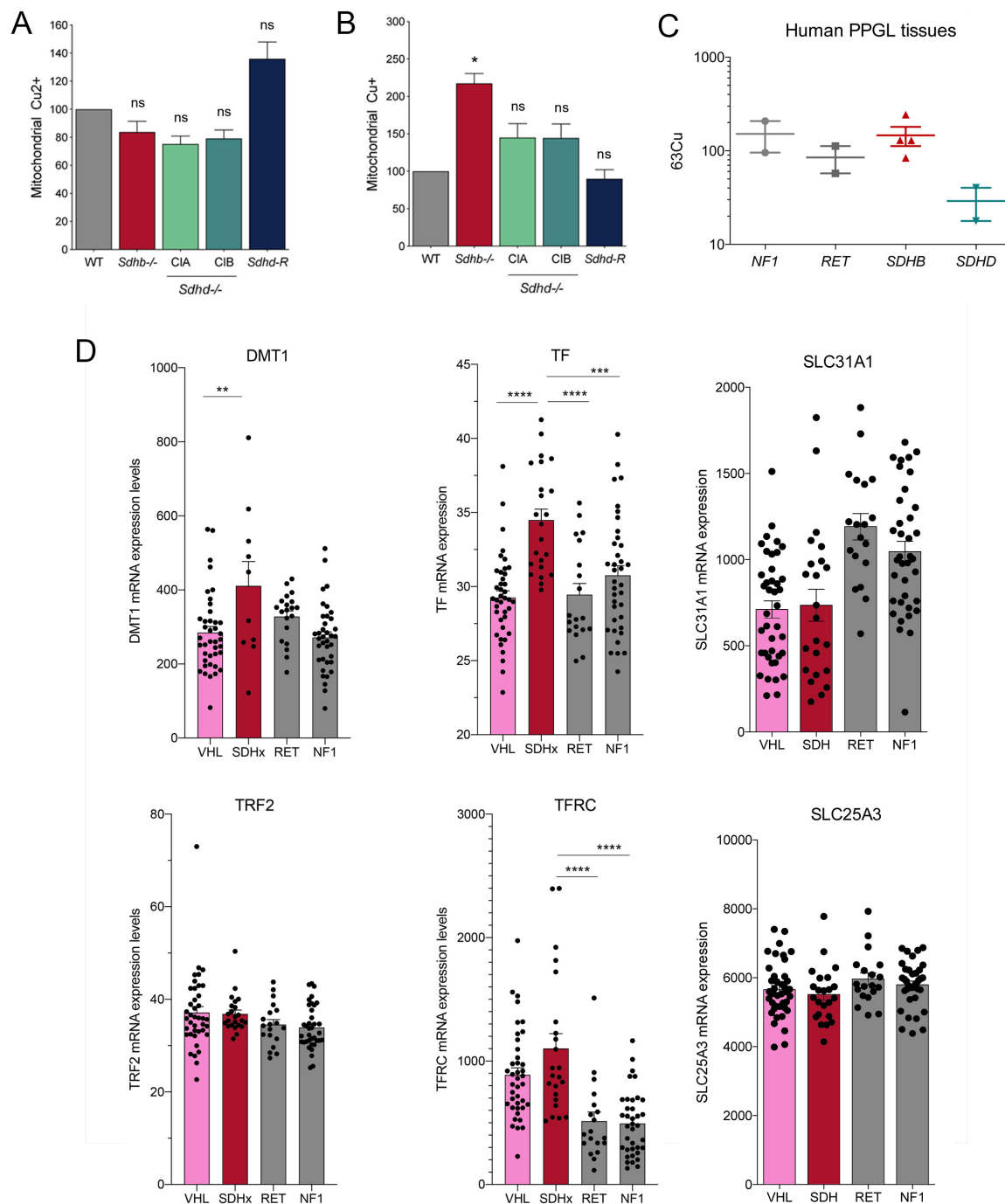


35
 36 **Supplementary Fig. 2 Related to Figure 3. *Sdhb* KO, but not *Sdhd* KO cells exhibit a mesenchymal**
 37 **metastatic phenotype. A**, qRT-PCR analysis of *NCadh* gene in the indicated cell lines. Data shown are
 38 from at least three independent experiments, presented as mean ± SEM. **B**, Individual cell speed was
 39 estimated (in μm/hour) by tracking cell nucleus during 12 hours (n=3). **C**, Growth curves of all the
 40 indicated cell lines were established by counting cells after three, five and seven days. The experiment
 41 was performed three times, in duplicates. Data are shown as mean ± SEM. Student's test was
 42 performed to assess statistical significance; ns, not significant, *P≤0.05, **P≤0.01, ***P≤0.001 relative
 43 to WT and \$P≤0.05, \$\$\$P≤0.001 relative to *Sdhb*^{-/-} imCC.
 44



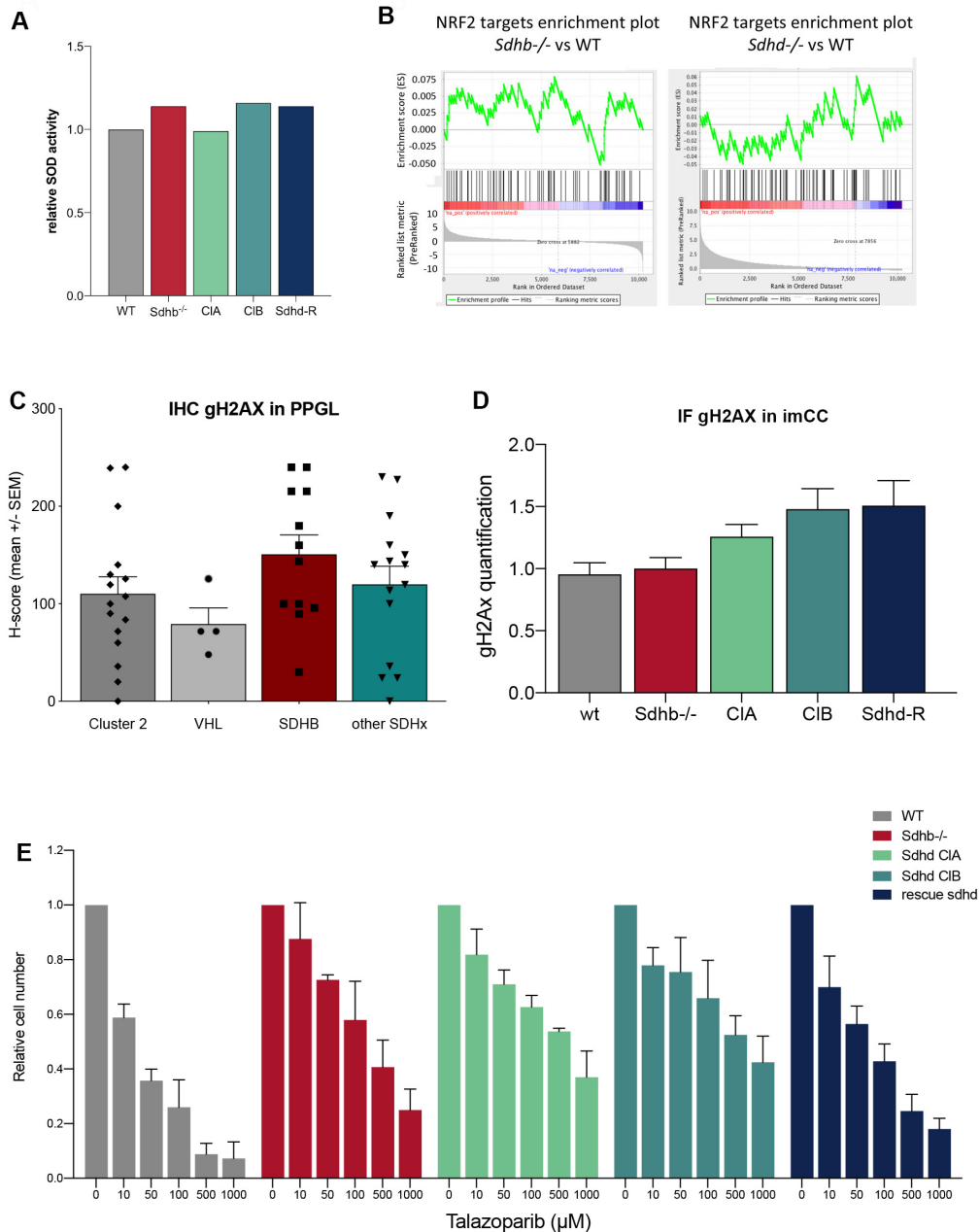
45
 46 **Supplementary Fig. 3 Related to Figure 3. Overexpression of HIF-target genes in *SDHB*-mutated**
 47 **tumors versus *SDHD*-mutated tumors.** Ratio between mean expressions of 41 highly expressed HIF-
 48 target genes in *SDHB* versus *SDHD*-mutated tumors. Data from A, the CIT COMETE collection and B,
 49 the TCGA collection. Both analyses include and compare transcriptomic data from 3 *SDHD* and 17
 50 *SDHB*- mutated tumors. Blue dots indicate genes specifically expressed in endothelial cells.

51



52
 53 **Supplementary Fig. 4 Related to Figure 4. SDH-deficient cells and tumors display alterations in**
 54 **copper homeostasis and *SDHx*-mutated tumors exhibit slight changes in transferrin (TF) mRNA**
 55 **expression levels in comparison to other types of mutated PPGL. A, mitochondrial Cu(II) content using**
 56 **turn-off Cu(II) probe (1) and B, mitochondrial Cu(I) content using turn-on Cu(I) probe (2) C, Average**
 57 **⁶³Cu counts in 2 NF1, 2 RET, 4 SDHB and 2 SDHD tumors. A and B are from three independent**
 58 **experiments, presented as mean ± SEM. D, Microarray-based expression analysis of several critical**

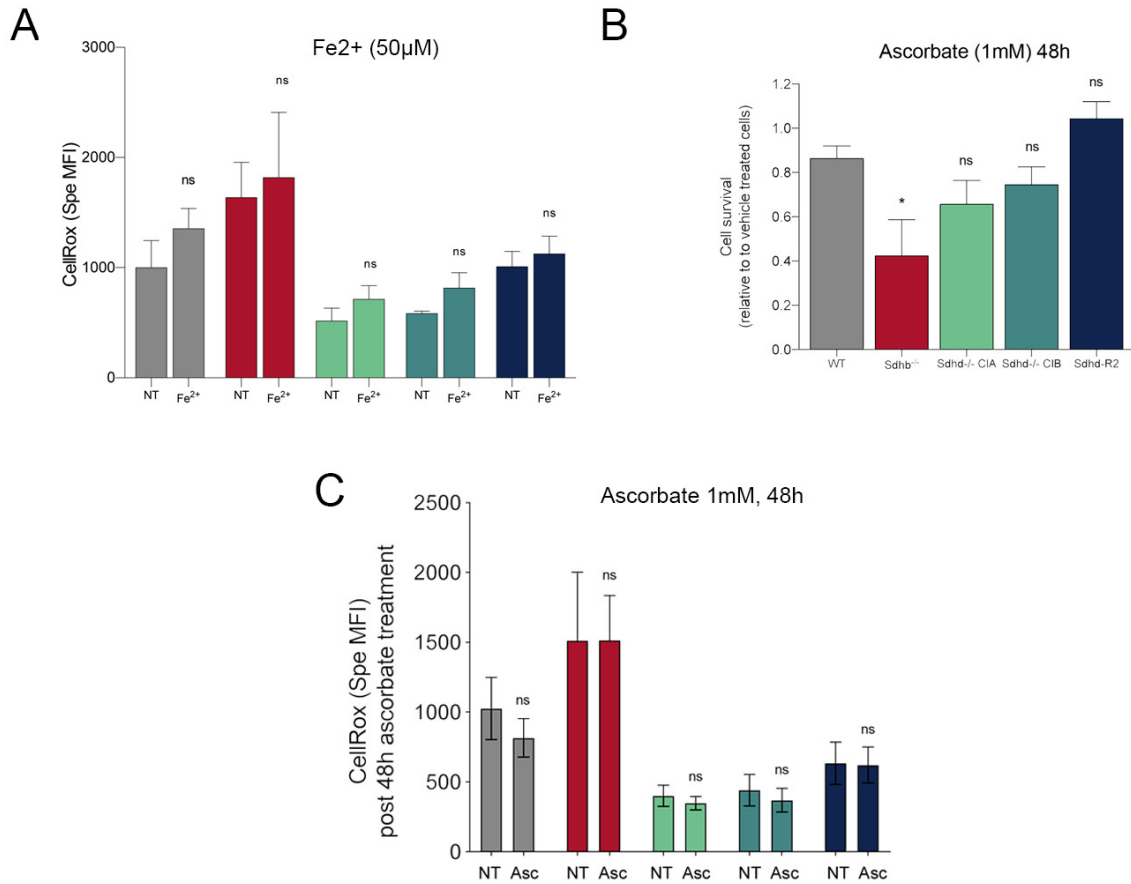
59 actors of cellular iron homeostasis *DMT1*, *TF*, *TFR2*, *TFRC*, *SLC31A1* and *SLC25A3* in a cohort of human
 60 PPGL, including 40 *VHL*-mutated, 19 *RET*-mutated, 37 *NF1*-mutated and 23 *SDHx*-mutated tumors.
 61 Expression clusters have been described in Burnichon et al., 2010. Data are presented as means \pm SEM.
 62 Non-parametric one-way ANOVA was used to assess statistical significance; ns, not significant,
 63 * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$.



64

65 **Supplementary Fig. 5 Related to Figure 5. *SDHB*-mutated PGL exhibit significant decrease in ⁵⁶Fe and**
 66 ***Sdhb*-deficient cells do not detoxify the excess in mitochondrial ROS. A,** Global superoxide dismutase
 67 (SOD) activity measured by spectrophotometry in all the indicated cell lines. **B,** Gene set enrichment
 68 analyses using RNA-seq data of 58 NRF2-target genes in *Sdhb* and *Sdhd* KO cells versus WT cells. **C,** H-
 69 score (ranging from 0 to 300) representative of the γ H2AX staining intensity in 16 tumors belonging to

70 cluster 2, 4 VHL, 12 SDHB and 15 other *SDHx* tumors. **D**, Quantification of nucleus foci γ H2AX staining
 71 intensity following immunofluorescence in all imCC models. Data are presented as means \pm SEM. **E**,
 72 Relative cell number of all imCC models treated for 72 hours with Talazoparib (10 μ M, 50 μ M, 100 μ M,
 73 500 μ M, 1000 μ M) relative to vehicle-treated controls (0 μ M). Data shown are from 3 independent
 74 experiments and presented as means \pm SEM.



75

76 **Supplementary Fig. 6 Related to Figure 6. Iron(II) and ascorbate treatment do not affect cytosolic**
 77 **ROS levels in SDH-deficient cells.** **A**, Specific MFI of CellROX probe in all imCC models following
 78 treatment for 48 hours with either Iron(II) 50 μ M or vehicle (PBS 1X). **B**, Same as **A** following ascorbate
 79 1mM treatment. Data from **A** and **B** are mean of at least three independent experiments, presented
 80 as mean \pm SEM and two-way ANOVA was performed; ns, not significant, * $P \leq 0.05$, *** $P \leq 0.001$.

81

82

83 **Supplementary Table 1 Related to Figure 3 Methods. Experimental parameters and data**
 84 **acquisition parameters used for LA-ICP-MS imaging.**
 85

| | Tumors | NIST 612 Scans |
|---|---|---|
| Teledyne Photon Machines Analyte Excite | | |
| Energy density (J cm ⁻²) | 0.5 | 2.02 |
| Repetition rate (Hz) | 125 | 125 |
| Scan speed (μm s ⁻¹) | 500 | 500 |
| Beam waist diameter (μm) | 20 (Circle) | 40 (Circle) |
| Scanning Mode | Fixed Dosage | Fixed Dosage |
| Scanning Direction | Uni-directional | Uni-directional |
| Effective Dosage (shots per position) | 5 | 5 |
| He Carrier gas flow rate (L min ⁻¹) | 0.5 | 0.5 |
| Thermo Fisher Scientific iCAP TQ ICP-MS | | |
| RF power (W) | 1550 | 1550 |
| Ar plasma gas flow rate (L min ⁻¹) | 14 | 14 |
| Ar auxiliary gas flow rate (L min ⁻¹) | 0.8 | 0.8 |
| Nebuliser gas flow rate (L min ⁻¹) | 1.03 | 1.03 |
| He gas flow rate (L min ⁻¹) | 3.25 | 3.25 |
| Acquired m/z ratios (amu) | ³¹ P, ⁵⁶ Fe, ⁶³ Cu | ³¹ P, ⁵⁶ Fe, ⁶³ Cu |
| Respective dwell times (ms) | 2.0, 5.8, 29.6 | 2.0, 5.8, 29.6 |
| Total scan cycle time (ms) | 40 | 40 |
| | | |

86
87

88

89 **Supplementary Table 2 Related to Figure 2. Differentially methylated gene-based features in *Sdhd*-**

90 ***/-* versus *Sdhd**/-* imCCs**

91 *See excel file.*

92

93 **Supplementary Table 3 Related to Figure 4. List of 52 HIF-target genes used for transcriptomic**
 94 **analyses**

| | |
|---------|---|
| Adm | adrenomedullin |
| Adra1b | adrenergic receptor, alpha 1b |
| Ak3 | adenylate kinase 3 |
| Bnip3 | BCL2/adenovirus E1B interacting protein 3 |
| Cacna1a | calcium channel, voltage-dependent, P/Q type, alpha 1A subunit |
| Car9 | carbonic anhydrase 9 |
| Ccl2 | chemokine (C-C motif) ligand 2 |
| Cdkn1a | cyclin-dependent kinase inhibitor 1A (P21) |
| Cited2 | Cbp/p300-interacting transactivator, with Glu/Asp-rich carboxy-terminal domain, 2 |
| Cp | ceruloplasmin |
| Ctgf | connective tissue growth factor |
| Cxcl12 | chemokine (C-X-C motif) ligand 12 |
| Cxcl8 | Interleukin 8 |
| Cxcr4 | chemokine (C-X-C motif) receptor 4 |
| Edn1 | endothelin 1 |
| Egln1 | egl-9 family hypoxia-inducible factor 1 |
| Egln2 | egl-9 family hypoxia-inducible factor 2 |
| Egln3 | egl-9 family hypoxia-inducible factor 3 |
| Eng | endoglin |
| Eno1 | enolase 1, alpha non-neuron |
| Epas1 | endothelial PAS domain protein 1 |
| Fgf2 | fibroblast growth factor 2 |
| Flt1 | FMS-like tyrosine kinase 1 |
| Fmo5 | flavin containing monooxygenase 5 |
| Hgf | hepatocyte growth factor |
| Hif1a | hypoxia inducible factor 1, alpha subunit |
| Hk1 | hexokinase 1 |
| Hmox1 | heme oxygenase 1 |
| Igf2 | insulin-like growth factor 2 |
| Lct | lactase |
| Lep | leptin |
| Lox | lysyl oxidase |
| Loxl2 | lysyl oxidase-like 2 |
| Mmp13 | matrix metalloproteinase 13 |
| Mmp14 | matrix metalloproteinase 14 (membrane-inserted) |
| Mmp2 | matrix metalloproteinase 2 |
| Nppa | natriuretic peptide type A |
| P4ha1 | procollagen-proline, 2-oxoglutarate 4-dioxygenase (proline 4-hydroxylase), alpha 1 polypeptide |
| Pdgfb | platelet derived growth factor, B polypeptide |
| Pfkfb3 | 6-phosphofructo-2-kinase/fructose-2,6-biphosphatase 3 |
| Pfkfb4 | 6-phosphofructo-2-kinase/fructose-2,6-biphosphatase 4 |
| Pfkl | phosphofructokinase, liver, B-type |
| Pfkp | phosphofructokinase, platelet |
| Pgf | placental growth factor |
| Pgk1 | phosphoglycerate kinase 1 |
| Plaur | plasminogen activator, urokinase receptor |
| Ppfia4 | protein tyrosine phosphatase, receptor type, f polypeptide (PTPRF), interacting protein (liprin), alpha 4 |
| Ptprz1 | protein tyrosine phosphatase, receptor type Z, polypeptide 1 |
| Slc2a1 | solute carrier family 2 (facilitated glucose transporter), member 1 |
| Tfrc | transferrin receptor |
| Th | tyrosine hydroxylase |
| Trf | transferrin |

95

96

97 **Supplementary Table 4 Related to Figure 4. List of 58 NRF2-target genes used for transcriptomic**
 98 **analyses**

| | |
|----------|--|
| Abcc1 | ATP-binding cassette, sub-family C (CFTR/MRP), member 1 |
| Abcc2 | ATP-binding cassette, sub-family C (CFTR/MRP), member 2 |
| Abcc3 | ATP-binding cassette, sub-family C (CFTR/MRP), member 3 |
| Abcc4 | ATP-binding cassette, sub-family C (CFTR/MRP), member 4 |
| Abcc5 | ATP-binding cassette, sub-family C (CFTR/MRP), member 5 |
| Acot7 | acyl-CoA thioesterase 7 |
| Acot8 | acyl-CoA thioesterase 8 |
| Acox1 | acyl-Coenzyme A oxidase 1, palmitoyl |
| Acox2 | acyl-Coenzyme A oxidase 2, branched chain |
| Adh7 | alcohol dehydrogenase 7 (class IV), mu or sigma polypeptide |
| Akr1b1 | aldo-keto reductase family 1, member B1 (aldose reductase) |
| Akr1c1 | aldo-keto reductase family 1, member C1 |
| Aldh1a1 | aldehyde dehydrogenase family 1, subfamily A1 |
| Aldh7a1 | aldehyde dehydrogenase family 7, member A1 |
| Blvra | biliverdin reductase A |
| Blvrb | biliverdin reductase B (flavin reductase (NADPH)) |
| Cbr1 | carbonyl reductase 1 |
| Cebpb | CCAAT/enhancer binding protein (C/EBP), beta |
| Cyp1b1 | cytochrome P450, family 1, subfamily b, polypeptide 1 |
| Ephx1 | epoxide hydrolase 1, microsomal |
| Fech | ferrochelatase |
| Fthl17 | ferritin, heavy polypeptide-like 17 |
| G6pd | glucose-6-phosphate dehydrogenase |
| Gclc | glutamate-cysteine ligase, catalytic subunit |
| Gclm | glutamate-cysteine ligase, modifier subunit |
| Ggt1 | gamma-glutamyltransferase 1 |
| Glrx | glutaredoxin |
| Gls | glutaminase |
| Gpx2 | glutathione peroxidase 2 |
| Gpx4 | glutathione peroxidase 4 |
| Gsr | glutathione reductase |
| Gsta1 | glutathione S-transferase, alpha 1 (Ya) |
| Gstm1 | glutathione S-transferase, mu 1 |
| Gstp1 | glutathione S-transferase, pi 1 |
| Hmox1 | heme oxygenase 1 |
| Idh1 | isocitrate dehydrogenase 1 (NADP+), soluble |
| Liph | lipase, member H |
| Me1 | malic enzyme 1, NADP(+)-dependent, cytosolic |
| Mgst1 | microsomal glutathione S-transferase 1 |
| Nfe2l2 | nuclear factor, erythroid derived 2, like 2 |
| Nqo1 | NAD(P)H dehydrogenase, quinone 1 |
| Pgd | phosphogluconate dehydrogenase |
| Pla2g7 | phospholipase A2, group VII (platelet-activating factor acetylhydrolase, plasma) |
| Pnpla2 | patatin-like phospholipase domain containing 2 |
| Pparg | peroxisome proliferator activated receptor gamma |
| Ppargc1b | peroxisome proliferative activated receptor, gamma, coactivator 1 beta |
| Prdx1 | peroxiredoxin 1 |
| Prdx6 | peroxiredoxin 6 |
| Rxra | retinoid X receptor alpha |
| Slc6a9 | solute carrier family 6 (neurotransmitter transporter, glycine), member 9 |
| Slc7a11 | solute carrier family 7 (cationic amino acid transporter, y+ system), member 11 |
| Srxn1 | sulfiredoxin 1 homolog (<i>S. cerevisiae</i>) |
| Sult1a1 | sulfotransferase family 1A, phenol-preferring, member 1 |
| Taldo1 | transaldolase 1 |
| Tkt | Transketolase |
| Txn | thioredoxin |
| Txnrd1 | thioredoxin reductase 1 |
| Ugdh | UDP-glucose dehydrogenase |

99 **Supplementary methods**

100 **Generation of *Sdhd*^{-/-} Immortalized Mouse Chromaffin Cells by CRISPR-Cas9 method**

101 Targeted gRNA was designed *in silico* by using <http://crispr.genome-engineering.org/> as previously
102 described (3). gRNA was transcribed *in vitro* using the kit PrecisionX Cas9 SmartNuclease RNA system
103 (System Biosciences CAS510A-KIT). Briefly, targeted oligonucleotides were annealed to form double
104 strands, and then cloned into SmartNuclease Linearized T7 gRNA Vector. The resulting recombinant
105 vector was linearized by EcoRI digestion. The generated template was used to produce gRNA by *in vitro*
106 transcription. gRNA was then purified (miRNeasy minikit, Qiagen) and its purity was assessed using the
107 Experion RNA StdSens Analysis Kit (BioRad).

108 Wild-type immortalized mouse chromaffin cells (WT imCC), previously generated by our lab(4), were
109 transfected with 0.6 µg of gRNA (RNA i-MAX (Life Technologies)) and 2µg of Cas9 (System Biosciences
110 CAS940A-1) and 2µg of YFP plasmids (Lipofectamine 2000 (Life Technologies)). Fluorescent cells were
111 cloned by FACS sorting. Clones were screened by direct sequencing of the targeted sequence of murine
112 *Sdhd* gene. Two consecutive transfections were performed: the first generated three heterozygous
113 clones out of 70, and the second performed on heterozygous clones generated 2 homozygous clones
114 out of 288. Mycoplasma contamination was ruled out using the PCR Mycoplasma Test kit I/C
115 (PromKine, PK-CA91-1048).

116

117 ***Sdhd*^{-/-} clones transfection by SDHD expressing plasmid**

118 *Sdhd*^{-/-} clone A was transfected with 2 µg of SDHD-expressing vector (ORIGENE, NM003002) using
119 Lipofectamine 2000 (Life Technologies). Forty-eight hours later, selection was performed with
120 Geneticin (Sigma, G418, 1200 µg/ml) and selected cells were cloned by FACS sorting. Clones were then
121 screened by SDH activity test and by qRT-PCR in order to assess *Sdhd* expression.

122

123 **Direct sequencing of *Sdhd* gene**

124 Direct sequencing of the four exons and exon-intron boundaries of the *Sdhd* gene was performed by
125 Sanger method. Specific primers (available upon request) were designed to amplify small amplicons
126 for *Sdhd* gene sequencing. The sequencing reactions were performed using the BigDye Terminator v3.1
127 kit (Life Technologies), in an ABI Prism3730XL DNA Analyzer (Perkin Elmer Applied Biosystems, Foster
128 City, CA).

129

130 **Cell culture**

131 imCC were cultured in DMEM high glucose Glutamax (Dulbecco Modified Eagle Medium, Gibco) with
132 10% FBS (Fetal bovine serum, Gibco) and 1% antibiotics (penicillin/streptomycin, Gibco) unless when
133 grown for metabolic or respirometry experiments, in which case they were supplemented with
134 pyruvate (1 mM) and no antibiotics. Cells were grown at 37°C, in 5% CO₂. When stated, cells were
135 treated with indicated doses of iron Chloride (Sigma, 372870), MitoTEMPO (Sigma, SML0737), L-
136 Ascorbic acid (Sigma, A5960), Talazoparib (MedChemTronica, HY-1606) or 3 mM of N-acetyl-cysteine
137 (Sigma, A9165) for 12 h to 72 h.

138

139 **¹³C-glucose and ¹³C-glutamine labeling**

140 Cells (3 x 10⁵) were seeded onto five wells of a six-well plate and cultured in standard medium for 24
141 h, the remaining well was used as a control containing only medium. Cells were washed in PBS and the
142 medium was then replaced by either fresh DMEM (no glucose, no phenol red) with 10 mM ¹³C₆-D-
143 glucose (Sigma) or DMEM (high glucose, no glutamine) supplemented with 2 mM ¹³C₅-L-glutamine
144 (Sigma) for 72 h.

145

146

147 **Metabolite extraction**

148 For spent media analysis, 200 µl of cleared media was first extracted. Culture media were then
149 aspirated and cells were washed cold with 0.9% NaCl saline solution before being scraped off the
150 precooled plates into Methanol/water mixture. In all cases, glutaric acid supplied in water was used as
151 internal standard and polar metabolites were extracted using Methanol:H₂O:Chloroform at ratio
152 1:1:1. Briefly, samples were vortexed vigorously, left to shake with all the solvents for 15 min at 4 °C
153 and then centrifuged at 15 000g for 15 min at 4 °C which led to separation into polar and nonpolar
154 fractions. The polar fractions were transferred to new tubes, evaporated to dryness by SpeedVac
155 concentrator and used for Gas Chromatography – Mass Spectrometry (GC-MS) analysis.

156

157 **GC-MS analysis**

158 The dried extract was first incubated at 95 °C in open tubes and then solubilized in 40 µl of 2%
159 methoxyamine HCl in pyridine followed by 60 minutes incubation at 60°C and subsequently 60 µl N-
160 tertbutyldimethylsilyl-N-methyltrifluoroacetamide with 1% (w/v) tertbutyldimethyl-chlorosilane
161 derivatisation reagent was added. The suspension was incubated for an hour at 60 °C in a well-sealed
162 tube to prevent evaporation. Finally, the samples were centrifuged at 16000 g for 5 minutes and the
163 clear supernatant was transferred to a chromatography vial with a glass insert (Thermo Fisher
164 Scientific) and proceeded immediately to GC-MS analysis.

165 For analysis of the derivatised samples an Agilent 7890B Series GC/MSD gas chromatograph with a
166 polydimethylsiloxane GC column coupled, with a mass spectrometer (GC-MS) (Agilent Technologies
167 UK Limited, Stockport, UK) was used. Prior to sample analysis the GC-MS was tuned to a full width at
168 half maximum (FWHM) peak width of 0.60 a.m.u. in the mass range of 50 to 650 mass to charge ratio
169 (m/z) using PFTBA tuning solution. 1 µl of sample was injected into the GC-MS in splitless mode with
170 helium carrier gas at a rate of 1.0 ml min⁻¹. The inlet liner containing glass wool was set to a
171 temperature of 270 °C. Oven temperature was set at 100 °C for 1 minute before ramping to 280 °C at

172 a rate of 5 °C min⁻¹. Temperature was further ramped to 320 °C at a rate of 10 °C min⁻¹ held at 320 °C
173 for 5 minutes. Compound detection was carried out in full scan mode in the mass range 50 to 650 m/z,
174 with 2-4 scans sec⁻¹, a source temperature of 250 °C, a transfer line temperature of 280 °C and a solvent
175 delay time of 6.5 minutes. The injector needle was cleaned with acetonitrile three times before
176 measurement commencement and three times following every measurement thereafter. The raw GC-
177 MS data was converted to common data format (CDF) using the acquisition software and further
178 processing of the isotope data including isotope correction and mass isotopomer analysis /batch
179 quantification was performed on metabolite detector software. The raw peak area for each analyte of
180 interest was calculated using the metabolite detector software followed by normalizing the response
181 to the internal standard peak area.

182

183 **High resolution respirometry**

184 For the measurement in intact state, trypsinised cells were resuspended in cell culture media (4.5g/L
185 glucose + 1 mM pyruvate) and loaded in Oxygraph-O2 k (Oroboros instruments) chamber. After closing
186 the chambers and recording routine respiration, oligomycin (2.5 µM) was added to inhibit ATP
187 synthase. Measurements of the non-phosphorylating electron transfer system (ETS) capacity were
188 obtained through stepwise (0.5 µM) titration of the uncoupler, Carbonyl cyanide 4-
189 (trifluoromethoxy)phenylhydrazone (FCCP). Respiration was inhibited by addition of rotenone (0.5
190 µM) and antimycin A (2.5 µM) at the end of the experiment. For the measurement in permeabilised
191 state, trypsinised and washed cells were resuspended in respiratory media Mir05 (110 mM sucrose,
192 60 mM K⁺-lactobionate, 0.5 mM EGTA, 3 mM MgCl₂, 20 mM taurine, 10 mM KH₂PO₄, 20 mM HEPES,
193 1g/L BSA essentially fatty acid free, pH 7.1). After closing the chambers and recording respiration on
194 endogenous substrates, digitonin was added to permeabilise the cells. Substrate combinations were
195 used as indicated in the graphs. The concentrations used were 2 mM malate (M), 10 mM glutamate
196 (G) and 20 mM succinate (SUC). In all experiments on permeabilised cells 3 mM ADP was used and

197 maximum respiratory capacity was reached by stepwise titration of FCCP. Respiration was inhibited by
198 addition of 0.5 μ M rotenone and antimycin A (2.5 μ M) at the end of the experiment. Values after
199 antimycin A addition were subtracted from all recorded values.

200

201 **Assessment of enzymatic activities**

202 Respiratory chain activities in subconfluent chromaffin cells were assayed as previously described (5).
203 Malonate-sensitive succinate dehydrogenase (RC complex II; E.C. 1.3.5.1), glycerol 3 phosphate
204 dehydrogenase (EC 1.1.5.3), cyanide-sensitive cytochrome *c* oxidase (RC complex IV; EC 1.9.3.1),
205 malonate-sensitive succinate cytochrome *c* reductase (RC complex II+III; EC 1.3.99.1), and glycerol
206 cytochrome *c* reductase (glycerol 3-phosphate dehydrogenase + RC complex III) were assayed
207 spectrophotometrically at 37°C using a pseudo dual- wavelength Varian CARY50 spectrophotometer
208 (Victoria, Australia) as described previously (6). Protein concentrations were determined by the
209 Bradford method. All chemicals were analytical reagent grade from Sigma Chemical Company.

210

211 **Quantitative Real-Time PCR**

212 Total RNAs were extracted from cell pellets using RNeasy plus mini-kit (Qiagen) as described by the
213 manufacturer. Reverse transcription was fulfilled using iScript™ cDNA Synthesis Kit (BIO-RAD) during
214 30 min at 42°C. qRT-PCR was then performed on CFX96™ Real-Time System C1000 Touch™ Thermal
215 Cycler (BIO-RAD) using SuperScript SybrGreen (BioRad). Normalization was performed with 18S
216 amplifications, and comparisons were calculated using the $\Delta\Delta$ Ct method. Primers' sequences were as
217 follows:

218 18S: F 5'-CGCGGTTCTATTTTGTGGT-3'; R 5'-AACCATAAACGATGCCGAC-3';

219 Sdhd: F 5'-GGACCAGTGAGAGGGTTGTC-3'; R 5'-AAGCTGAGAGTGCCAAGAGG-3'

220 Sdhb : F 5'-GCAGCTCCAGAATCAAAA-3' ; R 5'-CCAGAGTATTGCCTCCGTTG-3'

221 Snai1: F 5'-TGGAAAGGCCTTCTCTAGGC-3'; R 5'-AAAAGCACGGTTGCAGTGG-3'

222 Fn1: F 5'- GAAATCTGCAGCCTGGGTCT-3'; R 5'- ACACCCAGCTTGAAGCCAAT-3'

223 Epas1: F 5'-AGGGCCACAGCAAAGAGAG-3'; R 5'-CATCACGGGATTTCTCCTTC-3'

224 Mmp9: F 5'-CGGCACGCTGGAATGATC-3'; R 5'- TCGAACTTCGACACTGACAAGAA -3

225

226 **Western blot**

227 Total proteins were extracted in RIPA lysis buffer, containing protease and phosphatase inhibitors
228 cocktail (Thermo Fisher, #88669). Protein concentrations were determined with Bradford colorimetric
229 method. Equal quantities of proteins were resolved on NuPAGE® Novex 4–12 % Bis-Tris gradient gel
230 (Invitrogen) and transferred on nitrocellulose membrane. After blocking in PBS-milk solution (5%),
231 membranes were incubated overnight with specific primary antibodies, followed by washing in PBS,
232 0.05% tween-20 and incubation with corresponding HRP-conjugated (anti-rabbit or anti-mouse)
233 secondary antibodies (Bio-FX). The bound antibodies were revealed by chemiluminescence using ECL
234 (Pierce) and the results read with a LAS-4000 Mini (Fuji). The antibodies used were: anti-tubulin
235 (1/2500, Sigma-Aldrich, T9026), anti-HIF2 α (1/500, abcam, ab8365), anti-SDHB (1/500, Sigma,
236 HPA002868), anti-SDHA (1/500, abcam, ab14715). The experiment was performed independently
237 three times and representative results are shown.

238

239 **Fluorescent staining**

240 All Fluorescent staining were performed on cells plated on glass slides until 80% confluence. After a
241 wash in PBS 1X, cells were fixed for 10 min in ice-cold 4% paraformaldehyde. For actin staining, a
242 permeabilization step was performed with proper buffer (0.5% triton X-100, 20 mM Tris-HCl (pH=8),
243 50 mM NaCl, 3 mM MgCl₂, 300 mM sucrose) for 10 min at room temperature. Phalloidin-TRITC toxin

244 (Sigma #P1951) diluted 1/1000 in PBS 1X was incubated for 1h at room temperature and washed
245 before mounting the coverslip in vectashield with Dapi.

246 For γ H2AX immunofluorescence, after blocking of aspecific sites for 30 min with PBS 1% BSA 0,1%
247 triton, the slides were incubated, overnight at 4°C, anti- γ H2AX (phospho S139) (1/100, Abcam
248 ab81299) diluted in blocking buffer. Primary antibody was washed and the slides were incubated with
249 the secondary antibody, conjugated with Alexa Fluor 488 (1/2000, Invitrogen) for 1 h at room
250 temperature in the dark and then washed with PBS. Finally, the slides were mounted in Vectashield,
251 containing DAPI, for a blue nuclear staining. Image acquisition was performed using a Confocal SP8
252 Leica microscope and 12 z-stacks of 0.5 μ m were merged. Nucleus foci staining intensity was measured
253 using ImageJ software, and results were shown as the mean +/- SEM staining intensity per cell type
254 normalized to the mean staining of *Sdhb*^{-/-} cells.

255

256 **Immunohistochemical analyses**

257 Immunohistochemistry was performed on 6 μ m sections from paraffin-embedded tumors with anti-
258 γ H2AX antibody (phospho S139) (1/100, ab26350, Abcam). Antigen retrieval was performed by boiling
259 slides in citrate buffer for 20 min. Revelation was performed using DAB (Dako, Australia). Images were
260 acquired with a Leica DM400B microscope with Leica Application Suite software V.2.8.1 and a Leica
261 DFC420C camera. H-score (ranging from 0 to 300) taking into consideration the staining intensity in
262 conjunction with the percentage of positively stained cells was used as a semi-quantitative measure.

263

264 **Cell proliferation assay**

265 50.000 cells were plated on 6-well plates. Growth curves were established by counting cells after three,
266 five and seven days. The experiment was performed three times, in duplicates.

267

268 **Cell migration assay**

269 Wound scratch assays were performed during 10 hours as previously described (7) and analyzed using
270 ImageJ software. The experiment was performed four times.

271

272 **Cell adhesion assay**

273 After complete detachment from their plates by trypsin EDTA 0.05 % (Gibco), cells were plated in 6-
274 wells plates. Cell adhesion was evaluated by taking pictures 1 h post-seeding. Adherent and non-
275 adherent cells were identified on the basis of their morphology and the percentage of adhesive cells
276 was calculated. The experiment was performed three times.

277

278 **RNA-seq analysis**

279 RNA sequencing was performed for 7 samples: 3 *Sdhb*^{-/-}, 2 *Sdhd*^{-/-} and 2 wild-type imCC. RNA samples
280 were enriched for polyadenylated RNA from 5 µg of total RNA, and the enriched samples were used to
281 generate sequencing libraries with the Illumina 'TruSeq Stranded mRNA Sample Prep' kit and
282 associated protocol as provided by the manufacturer. Libraries were sequenced by IntegraGen (Evry,
283 France) on an Illumina HiSeq 2000 as paired-end 75 bp reads. Quality of reads was assessed for each
284 sample using FastQC (<http://www.bioinformatics.babraham.ac.uk/projects/fastqc/>). Fastq files were
285 aligned to the reference Human genome hg19/GRCh37 or to the reference Mouse genome mm10 with
286 tophat2 (-p 16 -r 150 -g 2 --library-type fr-firststrand). We removed reads mapping to multiple
287 locations. We used HTSeq to obtain the number of reads associated to each gene in the Gencode vM9
288 (Mouse) database, restricting to protein-coding genes, antisense and lncRNAs. We used the
289 Bioconductor DESeq package to import raw HTSeq counts for each sample into R statistical software
290 and extract the count matrix. After normalizing for library size, we normalized the count matrix by the
291 coding length of genes to compute FPKM scores (number of fragments per kilobase of exon model and
292 millions of mapped reads). We used the Bioconductor DESeq package to obtain size factors and

293 dispersion estimates, and perform differential expression analysis. Hierarchical clustering (Euclidean
294 distance, Ward method) was used to classify samples according to their expression profiles across the
295 1,000 most variant genes (based on standard deviation).

296

297 **Reduced Representation Bisulfite Sequencing (RRBS) Analyses**

298 RRBS was performed by Integragen SA (Evry, France), as previously described (4)..In short, 4 µg of
299 mouse genomic DNA plus CeGX Sequencing Control (3% W/W) were digested with MspI (NEB). After
300 end-repair, A-tailing, and ligation to methylated Illumina adapters, the library fragments of 40–220 bp
301 were gel isolated, subjected to a double bisulfite conversion using the TrueMethyl 24 kit (Cambridge
302 Epigenetix) for each sample according to the manufacturer’s instructions, PCR amplified, and
303 sequenced on an Illumina HiSeq2000 sequencer as paired-end 75 bp reads.

304 We generated approximately 30 million uniquely aligned reads for each sample, which covered ≈ 1.5
305 million CpG sites. We used BS-Seeker2 (8) to map RRBS data to the Mouse genome mm10 and retrieve
306 the number of methylated and unmethylated cytosines at each covered CpG site. Methylation rates
307 were then integrated across CpG island (CGI)-based and gene-based features. CGI-based features were
308 defined as follows: CpG islands (from UCSC database Mouse mm10), shores (2 kb on each side of the
309 island) and shelves (2 kb on each side of the shores). DNA methylation outside CpG islands was
310 analyzed by grouping CpG sites not located in CGI-based features every 100kb window. Gene-based
311 features were defined based on Ensembl mus musculus GRCm38.78 assembly. We calculated for each
312 gene the methylation rate across the promoter region (TSS +/- 500bp) and the gene body. We
313 compared methylation rates across all CGI-based and gene-based features. *q* values were computed
314 by comparing the number of methylated and unmethylated reads in each condition using a logistic
315 regression and the SLIM method for p-value adjustment, as implemented in the methylKit package (9).
316 We also calculated the methylation rate difference (delta) between each pair of test and reference
317 sample. We considered as differentially methylated every region with a *q*-value <0.05 and a

318 methylation delta >0.05 or <-0.05 in at least 80% of test-reference pairs.

319

320 **Features of Oxidative Stress**

321 Cells were seeded onto six-well plates and grown up to 70% confluency for 2 days. After what they
322 were directly incubated with fluorescent probes for basal conditions. Cells were washed with PBS,
323 trypsinized and resuspended in PBS solution containing 10% FBS for flow cytometric analysis. Flow
324 cytometry data were acquired using an LSR FORTRESSA analyzer (BD biosciences). For ROS
325 quantification upon treatment, cells were treated for 12 or 48 hours with 3 mM of N-acetyl-cysteine
326 (Sigma, A9165), 50 μ M iron chloride (Sigma, 372870), 2.5 μ M or 2.5 mM MitoTEMPO (Sigma, SML0737)
327 or 2.5 mM of L-Ascorbic acid (Sigma, A5960) and then processed, as described above.

328

329 **Cellular and mitochondrial ROS**

330 Cells were incubated with either 5 μ M CellRox Reagent (Thermofisher, #10422) or 5 μ M MitoSox
331 (Thermofisher, #M36008) for 30 min at 37°C in the dark.

332

333 **Lipid Peroxide Product**

334 Cells were incubated with 2 μ M Bodipy C11 Reagent (Termofisher, #D3861) for 30 min at 37°C in the
335 dark.

336

337 **Mitochondrial mass and membrane potential assessment using MitoTracker Probe**

338 Cells were seeded onto six-well plates and grown up to 70% confluency. Mitochondrial content per
339 cell line was estimated using MitoTracker Deep Red FM (Thermofisher #M22426). For assessment of
340 mitochondrial membrane potential, cells were stained with tetramethylrhodamine-methyl-ester

341 (TMRM, Thermofisher #T668). Cells were stained with 250 nM MitoTracker Deep Red FM or 100 μ M
342 TMRM for 30 min at 37C. Cells were then washed with PBS solution, trypsinized, and resuspended in
343 PBS solution containing 10% FBS for flow cytometric analysis. Flow cytometry data were acquired using
344 an LSR FORTESSA analyzer (BD biosciences).

345

346 **Cellular levels of iron and copper**

347 Metal-specific probes were synthesized as previously described. For mitochondrial copper and iron
348 probes, cells were incubated at 37°C in the dark with the relevant probe prior to being analyzed by
349 flow cytometry using the following probes and conditions: 1 μ M turn-off Iron(II) probe (10) (1h) for
350 mitochondrial Iron(II) content; 5 μ M Rhonox-1 (turn-on Iron(II)) probe (11) (1h) for cytosolic Iron(II)
351 content ; 1 μ M Calcein-AM probe (Thermofisher, #C1430) (1h) for labile overall iron content ; 10 μ M
352 turn-off Cu(II) probe (1) (1h) for mitochondrial Cu(II) content ; 1 μ M turn-on Cu(I) probe (2) (30min) for
353 mitochondrial Cu(I) content. Cells were trypsinized (TrypLE Express Enzyme, Life Technologies,
354 12605010) and washed twice with ice cold PBS. Data were recorded on a BD Accuri C6 (BD Biosciences)
355 and processed using Cell Quest (BD Biosciences) and FlowJo (FLOWJO, LLC) software.

356

357 **Laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS)**

358 For the LA-ICP-MS experiments, an Analyte Excite 193 nm ArF*excimer-based LA system (Teledyne
359 Photon Machines, Bozeman, MT, USA) was used, equipped with the HeEx II two-volume ablation cell.
360 The LA system was coupled to a Thermo Fisher Scientific iCAP TQ ICP-mass spectrometer (Thermo
361 Fisher Scientific, Waltham, MA, USA) via the Aerosol Rapid Introduction System (ARIS). Tuning of the
362 instrument settings was performed using a NIST SRM 612 glass certified reference material (National
363 Institute for Standards and Technology, Gaithersburg, MD, USA), optimizing for low laser-induced
364 elemental fractionation through monitoring of $^{238}\text{U}+^{232}\text{Th}+$ ratios, low oxide formation (<1%)
365 monitoring $^{232}\text{Th}^{16}\text{O}+^{232}\text{Th}+$ ratios, and high sensitivity for $^{59}\text{Co}+$, $^{115}\text{In}+$ and $^{238}\text{U}+$. LA-ICP-MS images

366 were acquired in a fixed dosage mode, with a vertical and horizontal spatial resolution of 20 μm , a
367 detailed list of sample settings is available in Supplementary Table 1. Formalin-fixed paraffin-
368 embedded tumor tissue sections were dewaxed in xylene immediately prior to imaging, and
369 rehydrated through a descending ethanol series. Two experimental repeats were conducted, each of
370 which consisted of imaging sections from one *NF1* mutant and two *SDHB* mutant tumors (n=6 total
371 tumors interrogated using LA-ICP-MS). Samples were mounted inside a bespoke three slide sample
372 holder of the HelEx II two-volume ablation cell (Teledyne Photon Machines). To correct for
373 instrumental drift, a series of NIST 612 standard ablation scans were performed before and after each
374 tumor image. ICP-MS and positional data were reconstructed using the HDF-based Image Processing
375 software (HDIP, Teledyne Photon Machines Inc., Bozeman, MT, USA). A bespoke pipeline written in
376 Python (version 2.7), was used to generate elemental images from reconstructed data. Negative
377 values, attributed to instrumental noise, were replaced with zeros. All LA-ICP-MS images are displayed
378 using the same threshold to enable a direct visual comparison between tumor sections. Average ^{56}Fe
379 and ^{63}Cu intensities were calculated from pixels containing a positive elemental tissue marker (^{31}P)
380 ensuring background regions did not influence these calculations. Statistical significance between
381 elemental intensities was assessed by Student's t-test.

382

383 **Statistical analysis**

384 Data are represented as mean (of at least 3 independent experiments) \pm SEM (standard error of the
385 mean). Data were analyzed by one-way or 2-way ANOVA. The results were considered to be significant
386 if $p \leq 0.05$. Statistics tests were carried out using the Graph-Pad software.

387

388 **Enrichment analysis**

389 We used an in-house adaptation of the GSEA method to identify gene sets from the MSigDB database
390 overrepresented among up/down-regulated and hyper/hypomethylated genes.

391

392 **Data access**

393 The sequencing data reported in this paper have been deposited to the EGA (European Genome-
394 phenome Archive) database (European Genome-phenome Archive) database (accession
395 number EGAS00001005279).

396

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- 427

Gene-based features showing significantly different methylation in *Sdhb*

| chr | start | end | gene name | gene feature |
|------|----------|----------|---------------|--------------|
| chr1 | 3670998 | 3671998 | Xkr4 | TSS500 |
| chr1 | 3205901 | 3670998 | Xkr4 | body |
| chr1 | 3905739 | 3985715 | RP23-333I7.1 | body |
| chr1 | 4290846 | 4408741 | Rp1 | body |
| chr1 | 4490931 | 4496854 | Sox17 | body |
| chr1 | 4808288 | 4848410 | Lypla1 | body |
| chr1 | 5588966 | 5606131 | Oprk1 | body |
| chr1 | 5913707 | 5916898 | Npbwr1 | body |
| chr1 | 6358718 | 6359718 | Fam150a | TSS500 |
| chr1 | 6487731 | 6860940 | St18 | body |
| chr1 | 7089420 | 7173628 | Pcmt1 | body |
| chr1 | 7349406 | 7397369 | Gm26901 | body |
| chr1 | 7498468 | 7518149 | RP24-181G14.2 | body |
| chr1 | 9299378 | 9300378 | Sntg1 | TSS500 |
| chr1 | 8361475 | 9299378 | Sntg1 | body |
| chr1 | 9545908 | 9547455 | Rrs1 | body |
| chr1 | 9600699 | 9601699 | 3110035E14Rik | TSS500 |
| chr1 | 9601699 | 9627143 | 3110035E14Rik | body |
| chr1 | 9797607 | 9798607 | Sgk3 | TSS500 |
| chr1 | 9908138 | 9909138 | Mcm2 | TSS500 |
| chr1 | 9909138 | 9942085 | Mcm2 | body |
| chr1 | 9967432 | 9968432 | Tcf24 | TSS500 |
| chr1 | 10008636 | 10009636 | Ppp1r42 | TSS500 |
| chr1 | 10324720 | 10719445 | Cpa6 | body |
| chr1 | 10992965 | 10993965 | Prex2 | TSS500 |
| chr1 | 10993965 | 11303681 | Prex2 | body |
| chr1 | 11413605 | 11414605 | A830018L16Rik | TSS500 |
| chr1 | 11414605 | 11975901 | A830018L16Rik | body |
| chr1 | 12668063 | 12673090 | Gm17644 | body |
| chr1 | 12992150 | 12993150 | Slco5a1 | TSS500 |
| chr1 | 12866549 | 12992150 | Slco5a1 | body |
| chr1 | 13126663 | 13127663 | Prdm14 | TSS500 |
| chr1 | 13113457 | 13126663 | Prdm14 | body |
| chr1 | 13139105 | 13373583 | Ncoa2 | body |
| chr1 | 13564698 | 13589410 | Tram1 | body |
| chr1 | 13623330 | 13660046 | Lactb2 | body |
| chr1 | 13669271 | 13701723 | Xkr9 | body |
| chr1 | 14309735 | 14310735 | Eya1 | TSS500 |
| chr1 | 14168954 | 14309735 | Eya1 | body |

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|------|----------|----------|---------------|--------|
| chr1 | 14753437 | 14776931 | Gm9947 | body |
| chr1 | 14755492 | 14756492 | Msc | TSS500 |
| chr1 | 14753346 | 14755492 | Msc | body |
| chr1 | 15286754 | 15287754 | Kcnb2 | TSS500 |
| chr1 | 15287754 | 15723750 | Kcnb2 | body |
| chr1 | 15806146 | 15844052 | Terf1 | body |
| chr1 | 15892222 | 15893222 | Sbson | TSS500 |
| chr1 | 16519612 | 16520612 | Stau2 | TSS500 |
| chr1 | 16540790 | 16618989 | Ube2w | body |
| chr1 | 16898685 | 17091631 | Gm28376 | body |
| chr1 | 17097389 | 17098389 | Jph1 | TSS500 |
| chr1 | 17124247 | 17125247 | Gm28783 | TSS500 |
| chr1 | 17144862 | 17145862 | Gdap1 | TSS500 |
| chr1 | 17727146 | 17728146 | Gm16070 | TSS500 |
| chr1 | 17676027 | 17727146 | Gm16070 | body |
| chr1 | 17727545 | 17766344 | Crispld1 | body |
| chr1 | 19063300 | 19104340 | Gm15825 | body |
| chr1 | 19102522 | 19103522 | Tfap2d | TSS500 |
| chr1 | 19209414 | 19238576 | Tfap2b | body |
| chr1 | 20057779 | 20617564 | Pkhd1 | body |
| chr1 | 20356952 | 20392300 | 4930486I03Rik | body |
| chr1 | 20890106 | 20891106 | Paqr8 | TSS500 |
| chr1 | 20952126 | 20990841 | Efhc1 | body |
| chr1 | 21218075 | 21219075 | Tmem14a | TSS500 |
| chr1 | 21250359 | 21271093 | Gm28836 | body |
| chr1 | 21961442 | 21962442 | Kcnq5 | TSS500 |
| chr1 | 21960342 | 21962530 | Gm26580 | body |
| chr1 | 22805224 | 22806224 | Rims1 | TSS500 |
| chr1 | 22286251 | 22805224 | Rims1 | body |
| chr1 | 23762253 | 23849158 | B3gat2 | body |
| chr1 | 24178110 | 24252684 | Col9a1 | body |
| chr1 | 24586972 | 24587972 | Col19a1 | TSS500 |
| chr1 | 24261890 | 24586972 | Col19a1 | body |
| chr1 | 24963209 | 24964658 | Gm28237 | body |
| chr1 | 25829207 | 25830207 | Bai3 | TSS500 |
| chr1 | 25067476 | 25829207 | Bai3 | body |
| chr1 | 32172214 | 32173214 | Khdrbs2 | TSS500 |
| chr1 | 32173214 | 32658568 | Khdrbs2 | body |
| chr1 | 33852052 | 33907316 | Bend6 | body |
| chr1 | 34460262 | 34475733 | Ptpn18 | body |
| chr1 | 34560443 | 34561443 | Prss40 | TSS500 |
| chr1 | 34543968 | 34560443 | Prss40 | body |
| chr1 | 34579211 | 34580211 | 1700101I19Rik | TSS500 |
| chr1 | 34579157 | 34580157 | Amer3 | TSS500 |

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|------|----------|----------|---------------|--------|
| chr1 | 34580157 | 34590944 | Amer3 | body |
| chr1 | 34677688 | 34678688 | Arhgef4 | TSS500 |
| chr1 | 36067900 | 36068900 | Hs6st1 | TSS500 |
| chr1 | 36068900 | 36106446 | Hs6st1 | body |
| chr1 | 36264597 | 36274179 | Neurl3 | body |
| chr1 | 36368681 | 36369681 | Kansl3 | TSS500 |
| chr1 | 36471120 | 36472120 | Cnm4 | TSS500 |
| chr1 | 36538929 | 36539929 | ANKRD23 | TSS500 |
| chr1 | 36537507 | 36546945 | Ankrd39 | body |
| chr1 | 36761298 | 36762298 | Zap70 | TSS500 |
| chr1 | 37027096 | 37187613 | Vwa3b | body |
| chr1 | 37132273 | 37132764 | RP23-259P18.1 | body |
| chr1 | 37214934 | 37263384 | Cnga3 | body |
| chr1 | 37300365 | 37410736 | Inpp4a | body |
| chr1 | 37540516 | 37541516 | Mgat4a | TSS500 |
| chr1 | 37439340 | 37540516 | Mgat4a | body |
| chr1 | 37719585 | 37720585 | 2010300C02Rik | TSS500 |
| chr1 | 37754776 | 37865929 | Tsga10 | body |
| chr1 | 37874801 | 37889911 | Mitd1 | body |
| chr1 | 37946736 | 37957259 | Lyg1 | body |
| chr1 | 38132583 | 38159892 | RP23-195A24.5 | body |
| chr1 | 38177326 | 38664455 | Aff3 | body |
| chr1 | 38384449 | 38385449 | Gm16152 | TSS500 |
| chr1 | 38897661 | 38898661 | Chst10 | TSS500 |
| chr1 | 38863867 | 38897661 | Chst10 | body |
| chr1 | 38885254 | 38888072 | RP23-101P2.3 | body |
| chr1 | 39048648 | 39057137 | RP24-226L19.1 | body |
| chr1 | 39193231 | 39194231 | Npas2 | TSS500 |
| chr1 | 39478255 | 39479255 | Tbc1d8 | TSS500 |
| chr1 | 39371492 | 39478255 | Tbc1d8 | body |
| chr1 | 39618406 | 39650974 | Creg2 | body |
| chr1 | 39649676 | 39650676 | D930019O06Rik | TSS500 |
| chr1 | 40074579 | 40125231 | Il1r2 | body |
| chr1 | 40085351 | 40086351 | Gm16894 | TSS500 |
| chr1 | 40325110 | 40367562 | Il1rl2 | body |
| chr1 | 40430070 | 40465415 | Il1rl1 | body |
| chr1 | 40580581 | 40630725 | Slc9a4 | body |
| chr1 | 40680074 | 40681074 | Slc9a2 | TSS500 |
| chr1 | 40790187 | 40791187 | Mfsd9 | TSS500 |
| chr1 | 41782308 | 41939560 | Gm29260 | body |
| chr1 | 42590782 | 42694342 | Pantr1 | body |
| chr1 | 42695268 | 42696268 | Pou3f3 | TSS500 |
| chr1 | 42696268 | 42703176 | Pou3f3 | body |
| chr1 | 42851733 | 42905682 | Mrps9 | body |

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| chr1 | 42952372 | 42953372 | Gpr45 | TSS500 |
| chr1 | 43047200 | 43098137 | Tgfbrap1 | body |
| chr1 | 43092088 | 43093088 | 8430432A02Rik | TSS500 |
| chr1 | 43123074 | 43196484 | Fhl2 | body |
| chr1 | 43934147 | 44003000 | Tpp2 | body |
| chr1 | 44086613 | 44101941 | Tex30 | body |
| chr1 | 45312038 | 45349706 | Col3a1 | body |
| chr1 | 46066815 | 46373546 | Dnah7b | body |
| chr1 | 46426092 | 46807476 | Dnah7c | body |
| chr1 | 46807544 | 46892352 | Slc39a10 | body |
| chr1 | 49245116 | 49340443 | C230029F24Rik | body |
| chr1 | 50901147 | 51187270 | Tmeff2 | body |
| chr1 | 51333279 | 51334279 | 9330175M20Rik | TSS500 |
| chr1 | 51507086 | 51596218 | Gm17767 | body |
| chr1 | 51915571 | 51916571 | Myo1b | TSS500 |
| chr1 | 51749765 | 51915571 | Myo1b | body |
| chr1 | 51987648 | 52107189 | Stat4 | body |
| chr1 | 52119940 | 52161865 | Stat1 | body |
| chr1 | 52656286 | 52726962 | Mfsd6 | body |
| chr1 | 52844429 | 52845429 | Hibch | TSS500 |
| chr1 | 52845429 | 52920986 | Hibch | body |
| chr1 | 52922324 | 53019679 | 1700019D03Rik | body |
| chr1 | 53189187 | 53296518 | Pms1 | body |
| chr1 | 53397006 | 53706284 | Dnah7a | body |
| chr1 | 53755506 | 53784724 | Stk17b | body |
| chr1 | 54194668 | 54195668 | Hecw2 | TSS500 |
| chr1 | 53806876 | 54194668 | Hecw2 | body |
| chr1 | 55053270 | 55072702 | Coq10b | body |
| chr1 | 55300069 | 55340089 | BOLL | body |
| chr1 | 55405421 | 55406421 | Plcl1 | TSS500 |
| chr1 | 55931741 | 55972328 | 9130227L01Rik | body |
| chr1 | 56978150 | 56979150 | Satb2 | TSS500 |
| chr1 | 57200645 | 57214493 | BC055402 | body |
| chr1 | 57773662 | 57774662 | Spats2l | TSS500 |
| chr1 | 57774662 | 57948394 | Spats2l | body |
| chr1 | 57955101 | 58018456 | Kctd18 | body |
| chr1 | 58113630 | 58200698 | Aox3 | body |
| chr1 | 58210897 | 58268597 | Aox4 | body |
| chr1 | 58646903 | 58695489 | Als2cr12 | body |
| chr1 | 59257406 | 59352993 | Cdk15 | body |
| chr1 | 59379430 | 59392299 | Gm29016 | body |
| chr1 | 59482924 | 59486955 | Fzd7 | body |
| chr1 | 60042684 | 60043684 | Ica1l | TSS500 |
| chr1 | 60069785 | 60098145 | Wdr12 | body |

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| chr1 | 60098747 | 60153953 | Carf | body |
| chr1 | 60410119 | 60481158 | Abi2 | body |
| chr1 | 61378932 | 61395904 | 9530026F06Rik | body |
| chr1 | 61639324 | 62642284 | Pard3b | body |
| chr1 | 62456725 | 62498761 | Pard3bos3 | body |
| chr1 | 62714723 | 62717573 | Gm29083 | body |
| chr1 | 63112578 | 63113578 | Ino80dos | TSS500 |
| chr1 | 63272863 | 63273863 | Gm24513 | TSS500 |
| chr1 | 63272765 | 63273765 | Zdbf2 | TSS500 |
| chr1 | 63445391 | 63446391 | Adam23 | TSS500 |
| chr1 | 63965227 | 63968999 | Gm13749 | body |
| chr1 | 64302543 | 64303543 | Gm28981 | TSS500 |
| chr1 | 64533145 | 64604548 | Creb1 | body |
| chr1 | 64606473 | 64616742 | Mettl21a | body |
| chr1 | 65061872 | 65062952 | Crygd | body |
| chr1 | 66175773 | 66442583 | Map2 | body |
| chr1 | 66467867 | 66468867 | Unc80 | TSS500 |
| chr1 | 66701331 | 66719805 | Rpe | body |
| chr1 | 66944904 | 66945904 | Myl1 | TSS500 |
| chr1 | 66924295 | 66944904 | Myl1 | body |
| chr1 | 67123526 | 67231259 | Cps1 | body |
| chr1 | 67249700 | 67323609 | Gm15668 | body |
| chr1 | 69107559 | 69108559 | ErbB4 | TSS500 |
| chr1 | 68032186 | 69107559 | ErbB4 | body |
| chr1 | 69826470 | 69827470 | Spag16 | TSS500 |
| chr1 | 69827470 | 70725132 | Spag16 | body |
| chr1 | 71894068 | 71916625 | Gm28818 | body |
| chr1 | 71958998 | 72004695 | 4933417E11Rik | body |
| chr1 | 71983681 | 72038231 | 4930556G22Rik | body |
| chr1 | 72107155 | 72121501 | Gm4319 | body |
| chr1 | 72235965 | 72236965 | D230017M19Rik | TSS500 |
| chr1 | 72283814 | 72284814 | Pecr | TSS500 |
| chr1 | 72283869 | 72284869 | Tmem169 | TSS500 |
| chr1 | 72711760 | 72713809 | Rpl37a | body |
| chr1 | 72824003 | 72825003 | Igfbp2 | TSS500 |
| chr1 | 72825003 | 72852474 | Igfbp2 | body |
| chr1 | 72857932 | 72874384 | Igfbp5 | body |
| chr1 | 72985344 | 73025507 | 1700027A15Rik | body |
| chr1 | 73269564 | 73306360 | Gm29185 | body |
| chr1 | 74123949 | 74124949 | Tns1 | TSS500 |
| chr1 | 73910231 | 74123949 | Tns1 | body |
| chr1 | 74125041 | 74126041 | Rufy4 | TSS500 |
| chr1 | 74126041 | 74148223 | Rufy4 | body |
| chr1 | 74206120 | 74207120 | Mir1928 | TSS500 |

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|------|----------|----------|---------------|--------|
| chr1 | 74279840 | 74284238 | Aamp | body |
| chr1 | 74392009 | 74397285 | Ctdsp1 | body |
| chr1 | 74409876 | 74435559 | Vil1 | body |
| chr1 | 74714074 | 74737892 | Cyp27a1 | body |
| chr1 | 74738922 | 74748721 | Prkag3 | body |
| chr1 | 74772392 | 74785322 | Wnt6 | body |
| chr1 | 74774943 | 74776905 | Gm29539 | body |
| chr1 | 74792016 | 74804179 | Wnt10a | body |
| chr1 | 74854434 | 74855434 | Cdk5r2 | TSS500 |
| chr1 | 74855434 | 74857732 | Cdk5r2 | body |
| chr1 | 74884919 | 74885919 | Fev | TSS500 |
| chr1 | 74881509 | 74884919 | Fev | body |
| chr1 | 74892643 | 74893643 | Cryba2 | TSS500 |
| chr1 | 74900226 | 74901226 | Mir375 | TSS500 |
| chr1 | 74935099 | 74936099 | Ccdc108 | TSS500 |
| chr1 | 74951172 | 74952172 | Ihh | TSS500 |
| chr1 | 75171717 | 75179892 | Abcb6 | body |
| chr1 | 75209231 | 75210231 | Gm27943 | TSS500 |
| chr1 | 75264002 | 75265002 | Ptprn | TSS500 |
| chr1 | 75247027 | 75264002 | Ptprn | body |
| chr1 | 75359829 | 75360829 | Des | TSS500 |
| chr1 | 75360829 | 75368579 | Des | body |
| chr1 | 75374512 | 75375512 | Gm15179 | TSS500 |
| chr1 | 75368212 | 75374512 | Gm15179 | body |
| chr1 | 75374797 | 75375797 | Speg | TSS500 |
| chr1 | 75375797 | 75432320 | Speg | body |
| chr1 | 75450936 | 75474343 | Asic4 | body |
| chr1 | 75479310 | 75505952 | Obsl1 | body |
| chr1 | 75480032 | 75485705 | Tmem198 | body |
| chr1 | 75545766 | 75546766 | Slc4a3 | TSS500 |
| chr1 | 76421192 | 76528422 | Gm29069 | body |
| chr1 | 77514588 | 77515588 | Epha4 | TSS500 |
| chr1 | 77514780 | 77515780 | Gm28386 | TSS500 |
| chr1 | 77515780 | 77517128 | Gm28386 | body |
| chr1 | 78309845 | 78310845 | Sgpp2 | TSS500 |
| chr1 | 78511658 | 78512658 | BC035947 | TSS500 |
| chr1 | 78614967 | 78615967 | Gm29611 | TSS500 |
| chr1 | 78816258 | 78817258 | Kcne4 | TSS500 |
| chr1 | 79434669 | 79439620 | Scg2 | body |
| chr1 | 79606876 | 79671472 | Ap1s3 | body |
| chr1 | 79794197 | 79860680 | Serpine2 | body |
| chr1 | 80198706 | 80217973 | Fam124b | body |
| chr1 | 80264923 | 80339980 | Cul3 | body |
| chr1 | 80445432 | 80446432 | 1700016L21Rik | TSS500 |

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|------|----------|----------|---------------|--------|
| chr1 | 80446432 | 80479867 | 1700016L21Rik | body |
| chr1 | 80758027 | 80759027 | Dock10 | TSS500 |
| chr1 | 82233101 | 82290916 | Irs1 | body |
| chr1 | 82586349 | 82587349 | Col4a4 | TSS500 |
| chr1 | 82586421 | 82587421 | Col4a3 | TSS500 |
| chr1 | 82725390 | 82752394 | Mff | body |
| chr1 | 82838946 | 82839946 | Gm22396 | TSS500 |
| chr1 | 82838983 | 82839983 | Agfg1 | TSS500 |
| chr1 | 83012523 | 83037948 | Slc19a3 | body |
| chr1 | 83254139 | 83407700 | Sphkap | body |
| chr1 | 84036296 | 84363680 | Pid1 | body |
| chr1 | 84721189 | 84840016 | Trip12 | body |
| chr1 | 84992690 | 85270066 | C130026I21Rik | body |
| chr1 | 85011867 | 85012867 | Gm27907 | TSS500 |
| chr1 | 85083069 | 85109353 | A530032D15Rik | body |
| chr1 | 85106446 | 85114035 | A530040E14Rik | body |
| chr1 | 85600878 | 85645037 | Sp140 | body |
| chr1 | 85604085 | 85611396 | Gm10552 | body |
| chr1 | 85650488 | 85709998 | Sp100 | body |
| chr1 | 85933247 | 85936832 | Gm28884 | body |
| chr1 | 85972365 | 85986417 | Gm28100 | body |
| chr1 | 86017316 | 86029958 | Spata3 | body |
| chr1 | 86045363 | 86046363 | 2810459M11Rik | TSS500 |
| chr1 | 86046363 | 86055456 | 2810459M11Rik | body |
| chr1 | 86063887 | 86064887 | Psmc1 | TSS500 |
| chr1 | 86303332 | 86307305 | B3gnt7 | body |
| chr1 | 86303559 | 86304559 | Gm28626 | TSS500 |
| chr1 | 86303195 | 86303559 | Gm28626 | body |
| chr1 | 86583404 | 86609375 | Cops7b | body |
| chr1 | 86666291 | 86670071 | Nppc | body |
| chr1 | 87079671 | 87080671 | Gm29371 | TSS500 |
| chr1 | 87098002 | 87101106 | Alpi | body |
| chr1 | 87147655 | 87156021 | Ecel1 | body |
| chr1 | 87183813 | 87188405 | Prss56 | body |
| chr1 | 87191107 | 87200070 | Chrnd | body |
| chr1 | 87205157 | 87212694 | Chrng | body |
| chr1 | 87263863 | 87264863 | Efhd1 | TSS500 |
| chr1 | 87264863 | 87310839 | Efhd1 | body |
| chr1 | 87264674 | 87265674 | Efhd1os | TSS500 |
| chr1 | 87327498 | 87450796 | Gigyf2 | body |
| chr1 | 87394229 | 87395229 | Kcnj13 | TSS500 |
| chr1 | 87509389 | 87510389 | Neu2 | TSS500 |
| chr1 | 87620812 | 87720507 | Inpp5d | body |
| chr1 | 87852787 | 87853787 | Dgkd | TSS500 |

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|------|----------|----------|---------------|--------|
| chr1 | 88055888 | 88219004 | Ugt1a10 | body |
| chr1 | 88071300 | 88218997 | Ugt1a9 | body |
| chr1 | 88088313 | 88219004 | Ugt1a8 | body |
| chr1 | 88095562 | 88220002 | Ugt1a7c | body |
| chr1 | 88103752 | 88219003 | Ugt1a6b | body |
| chr1 | 88135309 | 88218997 | Ugt1a6a | body |
| chr1 | 88166512 | 88218997 | Ugt1a5 | body |
| chr1 | 88201101 | 88218997 | Ugt1a2 | body |
| chr1 | 88212459 | 88218997 | Ugt1a1 | body |
| chr1 | 88227486 | 88262289 | Mroh2a | body |
| chr1 | 88673125 | 88701721 | Arl4c | body |
| chr1 | 89360342 | 89405633 | C030007H22Rik | body |
| chr1 | 89950220 | 90014166 | Asb18 | body |
| chr1 | 90152901 | 90153901 | lqca | TSS500 |
| chr1 | 90042132 | 90152901 | lqca | body |
| chr1 | 90153128 | 90154128 | 4930434B07Rik | TSS500 |
| chr1 | 90154128 | 90159462 | 4930434B07Rik | body |
| chr1 | 90914585 | 90915585 | Mlph | TSS500 |
| chr1 | 90915585 | 90951142 | Mlph | body |
| chr1 | 90958133 | 90969161 | Rab17 | body |
| chr1 | 90999237 | 91128944 | Lrrfip1 | body |
| chr1 | 91179322 | 91180322 | Ramp1 | TSS500 |
| chr1 | 91180322 | 91225196 | Ramp1 | body |
| chr1 | 91305092 | 91320601 | Gm17090 | body |
| chr1 | 91322575 | 91348306 | Espnl | body |
| chr1 | 91365930 | 91366930 | Fam132b | TSS500 |
| chr1 | 91411483 | 91413538 | Hes6 | body |
| chr1 | 91458824 | 91459824 | Per2 | TSS500 |
| chr1 | 91483524 | 91484774 | Gm28382 | body |
| chr1 | 91610906 | 91611906 | Gm28380 | TSS500 |
| chr1 | 91611906 | 91624500 | Gm28380 | body |
| chr1 | 91802437 | 91803437 | Gm29100 | TSS500 |
| chr1 | 92479681 | 92480119 | Olfr1416 | body |
| chr1 | 92511048 | 92518015 | Olfr1414 | body |
| chr1 | 92641485 | 92642485 | Myeov2 | TSS500 |
| chr1 | 92849878 | 92850878 | Mir149 | TSS500 |
| chr1 | 92907481 | 92908435 | Dusp28 | body |
| chr1 | 93101451 | 93102451 | Kif1a | TSS500 |
| chr1 | 93015464 | 93101451 | Kif1a | body |
| chr1 | 93123603 | 93124603 | Gm28086 | TSS500 |
| chr1 | 93134740 | 93135740 | Agxt | TSS500 |
| chr1 | 93135740 | 93145421 | Agxt | body |
| chr1 | 93169225 | 93231072 | E030010N08Rik | body |
| chr1 | 93235341 | 93236341 | Sned1 | TSS500 |

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| chr1 | 93374430 | 93404303 | Ano7 | body |
| chr1 | 93512579 | 93621976 | Farp2 | body |
| chr1 | 93861806 | 93876494 | Gal3st2 | body |
| chr1 | 93991009 | 94017147 | Gm6086 | body |
| chr1 | 95667071 | 95668071 | St8sia4 | TSS500 |
| chr1 | 95587682 | 95667071 | St8sia4 | body |
| chr1 | 95990659 | 96021258 | 1700063A18Rik | body |
| chr1 | 96612057 | 96662073 | 4930533P14Rik | body |
| chr1 | 96871671 | 96872671 | Slco4c1 | TSS500 |
| chr1 | 96871626 | 96881234 | Panct2 | body |
| chr1 | 97770672 | 97793709 | Gin1 | body |
| chr1 | 98421624 | 98516991 | Slco6d1 | body |
| chr1 | 98589017 | 98590017 | Gm7967 | TSS500 |
| chr1 | 98590017 | 98607384 | Gm7967 | body |
| chr1 | 99773265 | 100485942 | Cntnap5b | body |
| chr1 | 105356210 | 105357210 | Rnf152 | TSS500 |
| chr1 | 105276914 | 105356210 | Rnf152 | body |
| chr1 | 105355507 | 105356507 | Gm17634 | TSS500 |
| chr1 | 105356507 | 105361737 | Gm17634 | body |
| chr1 | 105664361 | 105755191 | 2310035C23Rik | body |
| chr1 | 105990906 | 106034074 | Zcchc2 | body |
| chr1 | 106538178 | 106713774 | Bcl2 | body |
| chr1 | 106861673 | 106883348 | Serpinb5 | body |
| chr1 | 107153940 | 107277861 | Serpinb3b | body |
| chr1 | 107400155 | 107452689 | Serpinb7 | body |
| chr1 | 107917759 | 108028337 | D830032E09Rik | body |
| chr1 | 109982931 | 110140157 | Cdh7 | body |
| chr1 | 110888326 | 110977084 | Cdh19 | body |
| chr1 | 115685256 | 116587323 | Cntnap5a | body |
| chr1 | 116393913 | 116394913 | Gm23393 | TSS500 |
| chr1 | 117830581 | 117854496 | Gm28360 | body |
| chr1 | 118389558 | 118612678 | Clasp1 | body |
| chr1 | 118628445 | 118685168 | Tfcp2l1 | body |
| chr1 | 119305346 | 119326333 | Gm29456 | body |
| chr1 | 119328700 | 119329700 | Gm29455 | TSS500 |
| chr1 | 119421748 | 119422748 | Inhbb | TSS500 |
| chr1 | 119415465 | 119421748 | Inhbb | body |
| chr1 | 119520090 | 119525859 | Gm27184 | body |
| chr1 | 119529480 | 119535665 | 3830432H09Rik | body |
| chr1 | 119545037 | 119648500 | Epb4.1l5 | body |
| chr1 | 119912708 | 119913708 | Tmem177 | TSS500 |
| chr1 | 119996734 | 119997734 | Cfap221 | TSS500 |
| chr1 | 120006394 | 120007394 | Sctr | TSS500 |
| chr1 | 120073574 | 120074574 | Tmem37 | TSS500 |

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|------|-----------|-----------|---------------|--------|
| chr1 | 120113280 | 120120578 | Dbi | body |
| chr1 | 120190757 | 120272205 | Steap3 | body |
| chr1 | 120340082 | 120341082 | C1ql2 | TSS500 |
| chr1 | 120341082 | 120343174 | C1ql2 | body |
| chr1 | 120601918 | 120602918 | En1 | TSS500 |
| chr1 | 120602918 | 120607992 | En1 | body |
| chr1 | 120622240 | 120690403 | 2610027F03Rik | body |
| chr1 | 121087905 | 121178441 | Celrr | body |
| chr1 | 123321471 | 124045059 | Dpp10 | body |
| chr1 | 125561095 | 125595820 | Slc35f5 | body |
| chr1 | 125676495 | 125677495 | Gpr39 | TSS500 |
| chr1 | 125912601 | 125913601 | Lypd1 | TSS500 |
| chr1 | 125867622 | 125912601 | Lypd1 | body |
| chr1 | 126830299 | 126831299 | Nckap5 | TSS500 |
| chr1 | 125913620 | 126830299 | Nckap5 | body |
| chr1 | 127486546 | 127679048 | Tmem163 | body |
| chr1 | 127753616 | 127773592 | 2900009J06Rik | body |
| chr1 | 127868273 | 127869273 | Rab3gap1 | TSS500 |
| chr1 | 128588199 | 128591793 | Cxcr4 | body |
| chr1 | 128770599 | 128773921 | Gm26686 | body |
| chr1 | 129272802 | 129273802 | Thsd7b | TSS500 |
| chr1 | 129273802 | 130219278 | Thsd7b | body |
| chr1 | 130423324 | 130437914 | Gm15674 | body |
| chr1 | 130462244 | 130463244 | Cd55 | TSS500 |
| chr1 | 130462076 | 130463076 | Gm16083 | TSS500 |
| chr1 | 130463076 | 130557075 | Gm16083 | body |
| chr1 | 130717827 | 130724358 | Yod1 | body |
| chr1 | 130732476 | 130744622 | AA986860 | body |
| chr1 | 130866169 | 130880791 | Faim3 | body |
| chr1 | 130932656 | 130939615 | Il19 | body |
| chr1 | 131244758 | 131245758 | Rassf5 | TSS500 |
| chr1 | 131599739 | 131612000 | Avpr1b | body |
| chr1 | 131743522 | 131744522 | Slc26a9 | TSS500 |
| chr1 | 131744522 | 131771504 | Slc26a9 | body |
| chr1 | 131797881 | 131821473 | Pm20d1 | body |
| chr1 | 131826993 | 131827993 | Slc41a1 | TSS500 |
| chr1 | 131827993 | 131848865 | Slc41a1 | body |
| chr1 | 131866724 | 131867724 | Rab29 | TSS500 |
| chr1 | 131911034 | 131936321 | Nucks1 | body |
| chr1 | 131963467 | 131982969 | Slc45a3 | body |
| chr1 | 132067562 | 132068562 | Mfsd4 | TSS500 |
| chr1 | 132022806 | 132067562 | Mfsd4 | body |
| chr1 | 132037305 | 132067945 | Gm26892 | body |
| chr1 | 132112237 | 132139184 | Cdk18 | body |

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|------|-----------|-----------|---------------|--------|
| chr1 | 132190931 | 132191931 | Lemd1 | TSS500 |
| chr1 | 132203303 | 132204303 | 1700037F24Rik | TSS500 |
| chr1 | 132417055 | 132418055 | Dstyk | TSS500 |
| chr1 | 132564690 | 132741297 | Nfasc | body |
| chr1 | 132879773 | 132880773 | Lrrn2 | TSS500 |
| chr1 | 133045167 | 133046167 | Pik3c2b | TSS500 |
| chr1 | 133180821 | 133181821 | Plekha6 | TSS500 |
| chr1 | 133250398 | 133269308 | Gm19461 | body |
| chr1 | 133310300 | 133323026 | Golt1a | body |
| chr1 | 133310327 | 133329722 | Kiss1 | body |
| chr1 | 133310327 | 133329901 | Gm28040 | body |
| chr1 | 133351010 | 133360325 | Ren1 | body |
| chr1 | 133363072 | 133364072 | Etnk2 | TSS500 |
| chr1 | 133382303 | 133423877 | Sox13 | body |
| chr1 | 133699457 | 133800541 | Atp2b4 | body |
| chr1 | 133910304 | 133920914 | Prelp | body |
| chr1 | 134111742 | 134151540 | Chit1 | body |
| chr1 | 134182676 | 134190181 | Chil1 | body |
| chr1 | 134193948 | 134201232 | Mybph | body |
| chr1 | 134234931 | 134235931 | Adora1 | TSS500 |
| chr1 | 134199223 | 134234931 | Adora1 | body |
| chr1 | 134290489 | 134292548 | Myog | body |
| chr1 | 134296783 | 134332428 | Ppfia4 | body |
| chr1 | 134386440 | 134390981 | 4933406M09Rik | body |
| chr1 | 134406059 | 134411740 | Cyb5r1 | body |
| chr1 | 134455031 | 134456031 | Klhl12 | TSS500 |
| chr1 | 134559671 | 134560671 | Kdm5b | TSS500 |
| chr1 | 134560671 | 134635285 | Kdm5b | body |
| chr1 | 134642254 | 134646020 | Gm26783 | body |
| chr1 | 134962065 | 134963065 | Ube2t | TSS500 |
| chr1 | 135147324 | 135156269 | Arl8a | body |
| chr1 | 135160234 | 135167181 | Gpr37l1 | body |
| chr1 | 135249061 | 135266443 | Gm26642 | body |
| chr1 | 135262712 | 135283584 | Rnpep | body |
| chr1 | 135585273 | 135599948 | Gm4793 | body |
| chr1 | 135719561 | 135720561 | Csrp1 | TSS500 |
| chr1 | 135720561 | 135752232 | Csrp1 | body |
| chr1 | 135779934 | 135810989 | Tnni1 | body |
| chr1 | 135818098 | 135819098 | Lad1 | TSS500 |
| chr1 | 135819098 | 135833342 | Lad1 | body |
| chr1 | 135836854 | 135852260 | Tnnt2 | body |
| chr1 | 135918707 | 135919707 | Pkp1 | TSS500 |
| chr1 | 135953578 | 136005842 | Igfn1 | body |
| chr1 | 136007650 | 136008650 | Tmem9 | TSS500 |

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|------|-----------|-----------|---------------|--------|
| chr1 | 136050304 | 136051304 | Ascl5 | TSS500 |
| chr1 | 136258907 | 136259907 | Gm26781 | TSS500 |
| chr1 | 136259907 | 136274406 | Gm26781 | body |
| chr1 | 136260373 | 136261373 | Gpr25 | TSS500 |
| chr1 | 136259797 | 136260373 | Gpr25 | body |
| chr1 | 136578977 | 136579977 | RP24-68C1.4 | TSS500 |
| chr1 | 136842571 | 136959948 | Nr5a2 | body |
| chr1 | 138848077 | 138849077 | Lhx9 | TSS500 |
| chr1 | 138825186 | 138848077 | Lhx9 | body |
| chr1 | 139455273 | 139494088 | Aspm | body |
| chr1 | 139697623 | 139780743 | Gm4788 | body |
| chr1 | 140245658 | 140246658 | Kcnt2 | TSS500 |
| chr1 | 140246658 | 140612067 | Kcnt2 | body |
| chr1 | 143716838 | 143749676 | Glrx2 | body |
| chr1 | 143777772 | 143807466 | Uchl5 | body |
| chr1 | 144138654 | 144176872 | Rgs13 | body |
| chr1 | 146419436 | 146494560 | Gm29514 | body |
| chr1 | 146495260 | 146902472 | Brinp3 | body |
| chr1 | 146809831 | 146841196 | Gm15584 | body |
| chr1 | 150992935 | 150993935 | Hmcn1 | TSS500 |
| chr1 | 150562524 | 150992935 | Hmcn1 | body |
| chr1 | 150625766 | 150783499 | Gm20631 | body |
| chr1 | 152399330 | 152400330 | Colgalt2 | TSS500 |
| chr1 | 152751051 | 152757544 | Apobec4 | body |
| chr1 | 152836995 | 152902146 | Smg7 | body |
| chr1 | 152954493 | 152955493 | Nmnat2 | TSS500 |
| chr1 | 153185947 | 153186947 | Lamc2 | TSS500 |
| chr1 | 153122756 | 153185947 | Lamc2 | body |
| chr1 | 153424662 | 153425662 | Shcbp1l | TSS500 |
| chr1 | 153549545 | 153550545 | Npl | TSS500 |
| chr1 | 153503015 | 153549545 | Npl | body |
| chr1 | 153652525 | 153653525 | Rgs8 | TSS500 |
| chr1 | 153653525 | 153700323 | Rgs8 | body |
| chr1 | 153739849 | 153740849 | Rgs16 | TSS500 |
| chr1 | 153749926 | 153764221 | Rnasel | body |
| chr1 | 154117451 | 154118451 | A830008E24Rik | TSS500 |
| chr1 | 154200687 | 154201687 | Zfp648 | TSS500 |
| chr1 | 154201687 | 154205689 | Zfp648 | body |
| chr1 | 154256189 | 154270416 | 4930532M18Rik | body |
| chr1 | 154390731 | 154884001 | Cacna1e | body |
| chr1 | 155099136 | 155100136 | ler5 | TSS500 |
| chr1 | 155275701 | 155416915 | Xpr1 | body |
| chr1 | 155526643 | 155527643 | Gm5532 | TSS500 |
| chr1 | 155698031 | 155751184 | Lhx4 | body |

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| chr1 | 156075966 | 156204526 | Fam163a | body |
| chr1 | 156303164 | 156304164 | Tdrd5 | TSS500 |
| chr1 | 156310227 | 156311227 | Nphs2 | TSS500 |
| chr1 | 156311227 | 156328035 | Nphs2 | body |
| chr1 | 156559286 | 156649568 | Abl2 | body |
| chr1 | 156678532 | 156718586 | Fam20b | body |
| chr1 | 157099139 | 157108180 | Tex35 | body |
| chr1 | 157458077 | 157459077 | BC026585 | TSS500 |
| chr1 | 157459077 | 157492638 | BC026585 | body |
| chr1 | 158355826 | 158356826 | Brinp2 | TSS500 |
| chr1 | 158245269 | 158355826 | Brinp2 | body |
| chr1 | 158361773 | 158362773 | Astn1 | TSS500 |
| chr1 | 159134772 | 159166387 | RP23-375F6.1 | body |
| chr1 | 159524269 | 159931729 | Tnr | body |
| chr1 | 160041701 | 160043831 | RP23-71J17.3 | body |
| chr1 | 161142191 | 161143191 | Ankrd45 | TSS500 |
| chr1 | 161143191 | 161170498 | Ankrd45 | body |
| chr1 | 161394909 | 161395909 | Tnfsf4 | TSS500 |
| chr1 | 161395909 | 161418410 | Tnfsf4 | body |
| chr1 | 161968686 | 161969686 | Pigc | TSS500 |
| chr1 | 161968700 | 161969700 | RP24-499I2.1 | TSS500 |
| chr1 | 162670725 | 162740056 | Prrc2c | body |
| chr1 | 162793188 | 162813472 | Fmo4 | body |
| chr1 | 162829561 | 162866110 | Fmo1 | body |
| chr1 | 162953800 | 162984028 | Fmo3 | body |
| chr1 | 163024302 | 163085170 | Mroh9 | body |
| chr1 | 163245119 | 163313210 | Prrx1 | body |
| chr1 | 164249546 | 164265385 | Slc19a2 | body |
| chr1 | 164457855 | 164458855 | Atp1b1 | TSS500 |
| chr1 | 164461942 | 164462942 | RP24-272N10.3 | TSS500 |
| chr1 | 164682482 | 164712771 | RP23-260J11.3 | body |
| chr1 | 164899091 | 164900091 | RP23-152I6.2 | TSS500 |
| chr1 | 165137855 | 165160273 | Tbx19 | body |
| chr1 | 165646516 | 165709257 | Rcsd1 | body |
| chr1 | 165764246 | 165775308 | Creg1 | body |
| chr1 | 165789181 | 165877277 | Cd247 | body |
| chr1 | 166309085 | 166310085 | 5330438I03Rik | TSS500 |
| chr1 | 166379597 | 166393621 | Tada1 | body |
| chr1 | 166974023 | 166999228 | RP24-192L21.1 | body |
| chr1 | 167000341 | 167001341 | Gm16701 | TSS500 |
| chr1 | 167000917 | 167001917 | Fam78b | TSS500 |
| chr1 | 167001917 | 167091302 | Fam78b | body |
| chr1 | 167284820 | 167285820 | Uck2 | TSS500 |
| chr1 | 167445669 | 167466280 | Lrrc52 | body |

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|------|-----------|-----------|---------------|--------|
| chr1 | 167597884 | 167598884 | Rxrg | TSS500 |
| chr1 | 167598884 | 167639623 | Rxrg | body |
| chr1 | 167688737 | 167689737 | Lmx1a | TSS500 |
| chr1 | 169747142 | 169748142 | Rgs4 | TSS500 |
| chr1 | 169929148 | 169934653 | 1700084C01Rik | body |
| chr1 | 170298199 | 170305832 | Gm7694 | body |
| chr1 | 170589361 | 170590361 | Nos1ap | TSS500 |
| chr1 | 170302668 | 170589361 | Nos1ap | body |
| chr1 | 170308303 | 170309303 | 1700015E13Rik | TSS500 |
| chr1 | 170907273 | 170912441 | Fcrlb | body |
| chr1 | 170917576 | 170927083 | Fcrla | body |
| chr1 | 171150103 | 171151103 | Sdhc | TSS500 |
| chr1 | 171150211 | 171151211 | Mpz | TSS500 |
| chr1 | 171250888 | 171251888 | Ndufs2 | TSS500 |
| chr1 | 171234853 | 171250888 | Ndufs2 | body |
| chr1 | 171275990 | 171280686 | Ppox | body |
| chr1 | 171329645 | 171342331 | Dedd | body |
| chr1 | 171389454 | 171410298 | Arhgap30 | body |
| chr1 | 171436818 | 171437818 | Gm26641 | TSS500 |
| chr1 | 171423185 | 171436818 | Gm26641 | body |
| chr1 | 171437035 | 171438035 | F11r | TSS500 |
| chr1 | 171500568 | 171503611 | B930036N10Rik | body |
| chr1 | 171518122 | 171534794 | Itln1 | body |
| chr1 | 171559693 | 171609746 | Cd244 | body |
| chr1 | 171632403 | 171652535 | Slamf7 | body |
| chr1 | 171682509 | 171705258 | Cd48 | body |
| chr1 | 172052292 | 172057073 | Nhlh1 | body |
| chr1 | 172127255 | 172136493 | Pex19 | body |
| chr1 | 172196728 | 172206304 | Pea15a | body |
| chr1 | 172262141 | 172319841 | Igsf8 | body |
| chr1 | 172271709 | 172297564 | Atp1a2 | body |
| chr1 | 172340710 | 172341710 | Kcnj10 | TSS500 |
| chr1 | 172520301 | 172521301 | Cfap45 | TSS500 |
| chr1 | 172556438 | 172563717 | Vsig8 | body |
| chr1 | 173331886 | 173333250 | Ackr1 | body |
| chr1 | 173367195 | 173368195 | Cadm3 | TSS500 |
| chr1 | 173351379 | 173466040 | Aim2 | body |
| chr1 | 174501325 | 174502325 | Fmn2 | TSS500 |
| chr1 | 174502325 | 174822729 | Fmn2 | body |
| chr1 | 175492000 | 175493000 | Rgs7 | TSS500 |
| chr1 | 175059087 | 175492000 | Rgs7 | body |
| chr1 | 175620881 | 175662116 | Kmo | body |
| chr1 | 175692276 | 175693276 | Opn3 | TSS500 |
| chr1 | 175699093 | 175815734 | Wdr64 | body |

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|------|-----------|-----------|---------------|--------|
| chr1 | 175880081 | 175881081 | Exo1 | TSS500 |
| chr1 | 176274812 | 176275812 | Pld5 | TSS500 |
| chr1 | 175962306 | 176274812 | Pld5 | body |
| chr1 | 177589021 | 177594022 | RP23-326H11.2 | body |
| chr1 | 177982923 | 177983923 | Gm16432 | TSS500 |
| chr1 | 177983923 | 178172704 | Gm16432 | body |
| chr1 | 178406585 | 178484513 | Efcab2 | body |
| chr1 | 178528625 | 178529625 | Kif26b | TSS500 |
| chr1 | 178529625 | 178939200 | Kif26b | body |
| chr1 | 178898582 | 178917114 | Gm16564 | body |
| chr1 | 179517541 | 179518541 | Smyd3 | TSS500 |
| chr1 | 179668710 | 179687189 | Sccpdh | body |
| chr1 | 179744894 | 179803180 | Ahctf1 | body |
| chr1 | 180329985 | 180330985 | Itpkb | TSS500 |
| chr1 | 180519227 | 180520227 | RP23-453G13.2 | TSS500 |
| chr1 | 180696534 | 180697534 | Mixl1 | TSS500 |
| chr1 | 180726543 | 180754204 | Acbd3 | body |
| chr1 | 180768156 | 180769156 | RP23-201I6.6 | TSS500 |
| chr1 | 180893608 | 180899103 | Lefty2 | body |
| chr1 | 180976210 | 181020404 | Ephx1 | body |
| chr1 | 181145193 | 181168994 | Cnih4 | body |
| chr1 | 181353128 | 181460641 | Cnih3 | body |
| chr1 | 181739488 | 181769674 | Dnah14 | body |
| chr1 | 181852689 | 181853689 | Gm5533 | TSS500 |
| chr1 | 182124237 | 182125237 | Srp9 | TSS500 |
| chr1 | 182483679 | 182484679 | RP23-67I3.4 | TSS500 |
| chr1 | 182565507 | 182632352 | Capn8 | body |
| chr1 | 182764360 | 182896591 | Susd4 | body |
| chr1 | 183221022 | 183222022 | Disp1 | TSS500 |
| chr1 | 183086266 | 183221022 | Disp1 | body |
| chr1 | 183749477 | 183809746 | RP23-352D14.1 | body |
| chr1 | 184610280 | 184628973 | RP24-286C21.1 | body |
| chr1 | 184712997 | 184718989 | 4930488B22Rik | body |
| chr1 | 184786767 | 184810813 | Marc1 | body |
| chr1 | 184813068 | 184845951 | Marc2 | body |
| chr1 | 184882718 | 184883718 | C130074G19Rik | TSS500 |
| chr1 | 184923636 | 184942500 | RP24-190B16.4 | body |
| chr1 | 185092491 | 185099547 | RP23-450D2.3 | body |
| chr1 | 185312687 | 185313803 | RP24-150H14.2 | body |
| chr1 | 185312819 | 185313819 | Mir194-1 | TSS500 |
| chr1 | 185313081 | 185314081 | Mir215 | TSS500 |
| chr1 | 185447116 | 185455068 | Gm2061 | body |
| chr1 | 185455348 | 185468762 | Slc30a10 | body |
| chr1 | 185744303 | 185745303 | RP24-71M17.1 | TSS500 |

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|------|-----------|-----------|---------------|--------|
| chr1 | 186087731 | 186116810 | Lyplal1 | body |
| chr1 | 186511838 | 186558181 | RP23-28F18.1 | body |
| chr1 | 186705489 | 186706489 | Tgfb2 | TSS500 |
| chr1 | 186705195 | 186706195 | Gm29491 | TSS500 |
| chr1 | 187448377 | 187462664 | RP23-349L18.1 | body |
| chr1 | 187651324 | 187652324 | RP24-240J15.1 | TSS500 |
| chr1 | 188262523 | 188965041 | Ush2a | body |
| chr1 | 188971095 | 189007341 | Kctd3 | body |
| chr1 | 189880435 | 189884652 | RP24-288J3.2 | body |
| chr1 | 190170214 | 190171214 | Prox1 | TSS500 |
| chr1 | 190168170 | 190169170 | Gm28172 | TSS500 |
| chr1 | 190169170 | 190169633 | Gm28172 | body |
| chr1 | 190169796 | 190170796 | Prox1os | TSS500 |
| chr1 | 190170796 | 190217276 | Prox1os | body |
| chr1 | 190403145 | 190404145 | RP24-240P15.1 | TSS500 |
| chr1 | 190594826 | 190604548 | RP24-511E9.1 | body |
| chr1 | 191025850 | 191029781 | A230020J21Rik | body |
| chr1 | 191062512 | 191063512 | Nsl1 | TSS500 |
| chr1 | 191097347 | 191098347 | Batf3 | TSS500 |
| chr1 | 191098347 | 191108945 | Batf3 | body |
| chr1 | 191133157 | 191134014 | RP23-399N18.9 | body |
| chr1 | 191217539 | 191218539 | Atf3 | TSS500 |
| chr1 | 191170296 | 191217539 | Atf3 | body |
| chr1 | 191326412 | 191350914 | Tmem206 | body |
| chr1 | 191351975 | 191402772 | Ppp2r5a | body |
| chr1 | 191436340 | 191464548 | RP23-103B18.8 | body |
| chr1 | 191821944 | 191833050 | Nek2 | body |
| chr1 | 191977870 | 191988283 | Rd3 | body |
| chr1 | 192190274 | 192191274 | Kcni1 | TSS500 |
| chr1 | 192191274 | 192510159 | Kcni1 | body |
| chr1 | 192770723 | 192771723 | Hhat | TSS500 |
| chr1 | 193035275 | 193036275 | Syt14 | TSS500 |
| chr1 | 192891233 | 193035275 | Syt14 | body |
| chr1 | 193091104 | 193129772 | Diexf | body |
| chr1 | 193152611 | 193153611 | Irf6 | TSS500 |
| chr1 | 193168546 | 193177832 | A130010J15Rik | body |
| chr1 | 193208199 | 193343878 | Lamb3 | body |
| chr1 | 193272717 | 193273717 | G0s2 | TSS500 |
| chr1 | 193509674 | 193510674 | 4631405K08Rik | TSS500 |
| chr1 | 193507238 | 193509674 | 4631405K08Rik | body |
| chr1 | 194938319 | 194939319 | Cd34 | TSS500 |
| chr2 | 3114724 | 3227806 | Fam171a1 | body |
| chr2 | 3341982 | 3396710 | Olah | body |
| chr2 | 3423631 | 3424631 | Dclre1c | TSS500 |

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|------|----------|----------|---------------|--------|
| chr2 | 3512530 | 3513530 | Cdnf | TSS500 |
| chr2 | 3855530 | 3877575 | Gm13180 | body |
| chr2 | 4017217 | 4018217 | Frmd4a | TSS500 |
| chr2 | 4132063 | 4140641 | 1700080N15Rik | body |
| chr2 | 4717331 | 4718331 | Bend7 | TSS500 |
| chr2 | 4919519 | 4938730 | Phyh | body |
| chr2 | 4976622 | 4985748 | Ucma | body |
| chr2 | 5137749 | 5230364 | Gm26776 | body |
| chr2 | 5137276 | 5138276 | Ccdc3 | TSS500 |
| chr2 | 5138276 | 5230878 | Ccdc3 | body |
| chr2 | 5714015 | 5715015 | Camk1d | TSS500 |
| chr2 | 5896115 | 5942292 | Dhtkd1 | body |
| chr2 | 6129711 | 6130711 | Proser2 | TSS500 |
| chr2 | 6097607 | 6129711 | Proser2 | body |
| chr2 | 6132369 | 6133369 | RP23-413M3.5 | TSS500 |
| chr2 | 6188465 | 6212533 | Echdc3 | body |
| chr2 | 6193751 | 6321611 | A230108P19Rik | body |
| chr2 | 6322167 | 6323167 | Usp6nl | TSS500 |
| chr2 | 6471500 | 6472500 | Gm13391 | TSS500 |
| chr2 | 7077765 | 7081313 | Gm26565 | body |
| chr2 | 7716151 | 7780908 | Gm13211 | body |
| chr2 | 9889534 | 9890534 | Gata3 | TSS500 |
| chr2 | 9876756 | 9877756 | Gm13256 | TSS500 |
| chr2 | 9881752 | 9883921 | 4930412O13Rik | body |
| chr2 | 9889040 | 9890040 | 9230102O04Rik | TSS500 |
| chr2 | 9883041 | 9889040 | 9230102O04Rik | body |
| chr2 | 10370010 | 10371010 | Sfmbt2 | TSS500 |
| chr2 | 10371010 | 10595253 | Sfmbt2 | body |
| chr2 | 11037373 | 11060129 | Gm13264 | body |
| chr2 | 11171608 | 11172608 | Prkcq | TSS500 |
| chr2 | 11471433 | 11553577 | Pfkfb3 | body |
| chr2 | 11585437 | 11603653 | Rbm17 | body |
| chr2 | 11705790 | 11734317 | Il15ra | body |
| chr2 | 12301422 | 12302422 | Itga8 | TSS500 |
| chr2 | 12106632 | 12301422 | Itga8 | body |
| chr2 | 12300446 | 12301446 | E030013I19Rik | TSS500 |
| chr2 | 12301446 | 12312315 | E030013I19Rik | body |
| chr2 | 12923541 | 12924541 | Pter | TSS500 |
| chr2 | 13544168 | 13545168 | Trdmt1 | TSS500 |
| chr2 | 13574427 | 13582826 | Vim | body |
| chr2 | 13793564 | 13794564 | St8sia6 | TSS500 |
| chr2 | 14229892 | 14332057 | Mrc1 | body |
| chr2 | 14388816 | 14494977 | Slc39a12 | body |
| chr2 | 14603588 | 14987908 | Cacnb2 | body |

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|------|----------|----------|----------------|--------|
| chr2 | 14706834 | 14739222 | RP23-446D4.9 | body |
| chr2 | 15526979 | 16255555 | Malrd1 | body |
| chr2 | 16355804 | 16356804 | Plxdc2 | TSS500 |
| chr2 | 16959518 | 16960518 | Gm24933 | TSS500 |
| chr2 | 17343909 | 17730964 | Nebi | body |
| chr2 | 18037237 | 18038237 | A930004D18Rik | TSS500 |
| chr2 | 18025193 | 18037237 | A930004D18Rik | body |
| chr2 | 18033033 | 18039633 | Gm13330 | body |
| chr2 | 18677518 | 18686629 | Bmi1 | body |
| chr2 | 18694532 | 18699037 | Gm13334 | body |
| chr2 | 18698523 | 18699523 | BC061194 | TSS500 |
| chr2 | 19198802 | 19199802 | Armc3 | TSS500 |
| chr2 | 19199802 | 19310241 | Armc3 | body |
| chr2 | 19370940 | 19371940 | Msrb2 | TSS500 |
| chr2 | 19431483 | 19432483 | Gm13344 | TSS500 |
| chr2 | 19429104 | 19431483 | Gm13344 | body |
| chr2 | 19446174 | 19447174 | Ptf1aos | TSS500 |
| chr2 | 19445163 | 19446163 | Ptf1a | TSS500 |
| chr2 | 19446163 | 19447501 | Ptf1a | body |
| chr2 | 19658252 | 19660583 | Otud1 | body |
| chr2 | 19910280 | 20810713 | Etl4 | body |
| chr2 | 21341925 | 21368611 | Gm13327 | body |
| chr2 | 21368042 | 21830547 | Gpr158 | body |
| chr2 | 22228003 | 22618252 | Myo3a | body |
| chr2 | 22940073 | 23039741 | Abi1 | body |
| chr2 | 23321746 | 23401973 | Nxph2 | body |
| chr2 | 24002910 | 24048894 | Hnmt | body |
| chr2 | 24277454 | 24283426 | Il1f5 | body |
| chr2 | 24367080 | 24368080 | Psd4 | TSS500 |
| chr2 | 24368080 | 24414954 | Psd4 | body |
| chr2 | 24420560 | 24475099 | Pax8 | body |
| chr2 | 24762652 | 24763652 | Cacna1b | TSS500 |
| chr2 | 24603887 | 24762652 | Cacna1b | body |
| chr2 | 25054675 | 25055675 | Gm24328 | TSS500 |
| chr2 | 25080804 | 25085716 | Entpd8 | body |
| chr2 | 25094649 | 25095649 | Noxa1 | TSS500 |
| chr2 | 25144896 | 25145896 | Gm13387 | TSS500 |
| chr2 | 25122603 | 25144896 | Gm13387 | body |
| chr2 | 25180258 | 25181258 | Nrarp | TSS500 |
| chr2 | 25181258 | 25183339 | Nrarp | body |
| chr2 | 25180781 | 25182839 | RP23-132N23.22 | body |
| chr2 | 25236287 | 25237287 | Rnf224 | TSS500 |
| chr2 | 25241952 | 25242952 | Cysrt1 | TSS500 |
| chr2 | 25238818 | 25241952 | Cysrt1 | body |

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|------|----------|----------|---------------|--------|
| chr2 | 25241755 | 25242755 | Rnf208 | TSS500 |
| chr2 | 25255939 | 25256292 | Tmem203 | body |
| chr2 | 25272978 | 25285915 | Anapc2 | body |
| chr2 | 25289415 | 25290415 | Lrrc26 | TSS500 |
| chr2 | 25290415 | 25291180 | Lrrc26 | body |
| chr2 | 25291181 | 25318687 | Grin1 | body |
| chr2 | 25395374 | 25396374 | Entpd2 | TSS500 |
| chr2 | 25396374 | 25401321 | Entpd2 | body |
| chr2 | 25398851 | 25399851 | Npdc1 | TSS500 |
| chr2 | 25469546 | 25470546 | Ptgds | TSS500 |
| chr2 | 25490845 | 25493411 | Lcn12 | body |
| chr2 | 25517982 | 25546440 | Traf2 | body |
| chr2 | 25573430 | 25574724 | Phpt1 | body |
| chr2 | 25608635 | 25617178 | Ccdc183 | body |
| chr2 | 25621505 | 25622505 | Tmem141 | TSS500 |
| chr2 | 25624666 | 25627530 | Fcna | body |
| chr2 | 25683226 | 25686081 | Lcn10 | body |
| chr2 | 25705850 | 25709216 | A230005M16Rik | body |
| chr2 | 25707239 | 25707721 | Bmyc | body |
| chr2 | 25822653 | 25823653 | Lcn9 | TSS500 |
| chr2 | 25846748 | 25847748 | Sohlh1 | TSS500 |
| chr2 | 26122720 | 26123720 | Nacc2 | TSS500 |
| chr2 | 26139046 | 26139543 | 1810012K08Rik | body |
| chr2 | 26191178 | 26192178 | Gm13553 | TSS500 |
| chr2 | 26200212 | 26207789 | Lhx3 | body |
| chr2 | 26206202 | 26207202 | Gm27196 | TSS500 |
| chr2 | 26208637 | 26237025 | Qsox2 | body |
| chr2 | 26271646 | 26294057 | 4932418E24Rik | body |
| chr2 | 26352176 | 26360418 | Card9 | body |
| chr2 | 26409431 | 26444716 | Sec16a | body |
| chr2 | 26586139 | 26587139 | Gm20532 | TSS500 |
| chr2 | 26603917 | 26604917 | Agpat2 | TSS500 |
| chr2 | 26933428 | 26934428 | Surf4 | TSS500 |
| chr2 | 26933547 | 26934547 | Stkld1 | TSS500 |
| chr2 | 26934547 | 26953496 | Stkld1 | body |
| chr2 | 27021363 | 27027498 | Slc2a6 | body |
| chr2 | 27079879 | 27108981 | Adamtsl2 | body |
| chr2 | 27141991 | 27142991 | Fam163b | TSS500 |
| chr2 | 27144898 | 27162203 | Dbhos | body |
| chr2 | 27515657 | 27536535 | Wdr5 | body |
| chr2 | 27675940 | 27676940 | Rxra | TSS500 |
| chr2 | 28095977 | 28127731 | F730016J06Rik | body |
| chr2 | 28192492 | 28193492 | Olfm1 | TSS500 |
| chr2 | 28446300 | 28447300 | Ppp1r26 | TSS500 |

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|------|----------|----------|---------------|--------|
| chr2 | 28447300 | 28455508 | Ppp1r26 | body |
| chr2 | 28465832 | 28466832 | 1700007K13Rik | TSS500 |
| chr2 | 28566311 | 28583251 | Gtf3c5 | body |
| chr2 | 28609450 | 28621482 | Gfi1b | body |
| chr2 | 28692080 | 28699227 | 1700026L06Rik | body |
| chr2 | 28916168 | 28917168 | Barhl1 | TSS500 |
| chr2 | 29194541 | 29252505 | Ntng2 | body |
| chr2 | 29819575 | 29820575 | Urm1 | TSS500 |
| chr2 | 29888721 | 29889721 | Odf2 | TSS500 |
| chr2 | 29889721 | 29931746 | Odf2 | body |
| chr2 | 30078184 | 30091022 | Pkn3 | body |
| chr2 | 30097283 | 30124085 | Zer1 | body |
| chr2 | 30185124 | 30205347 | Ccbl1 | body |
| chr2 | 30240067 | 30241067 | Gm28035 | TSS500 |
| chr2 | 30284231 | 30285834 | Dolk | body |
| chr2 | 30358837 | 30359837 | Sh3glb2 | TSS500 |
| chr2 | 30344809 | 30358837 | Sh3glb2 | body |
| chr2 | 30594540 | 30595540 | Cstad | TSS500 |
| chr2 | 30595540 | 30608943 | Cstad | body |
| chr2 | 30794769 | 30803161 | 1700001O22Rik | body |
| chr2 | 30804293 | 30807429 | 4930527E20Rik | body |
| chr2 | 30889471 | 30929363 | Ptges | body |
| chr2 | 30960627 | 30967433 | Tor1a | body |
| chr2 | 31469707 | 31470707 | Ass1 | TSS500 |
| chr2 | 31470707 | 31520672 | Ass1 | body |
| chr2 | 31573151 | 31617526 | Fubp3 | body |
| chr2 | 31640089 | 31641089 | Gm13425 | TSS500 |
| chr2 | 31633453 | 31640089 | Gm13425 | body |
| chr2 | 31639537 | 31640537 | Prdm12 | TSS500 |
| chr2 | 31640537 | 31655795 | Prdm12 | body |
| chr2 | 31887791 | 31946539 | Lamc3 | body |
| chr2 | 31950639 | 31973442 | Aif1l | body |
| chr2 | 31962047 | 31963047 | Gm13442 | TSS500 |
| chr2 | 32084357 | 32085357 | Fam78a | TSS500 |
| chr2 | 32259659 | 32260659 | Uck1 | TSS500 |
| chr2 | 32308471 | 32352829 | Dnm1 | body |
| chr2 | 32317749 | 32318749 | Gm23363 | TSS500 |
| chr2 | 32317960 | 32318960 | Mir199b | TSS500 |
| chr2 | 32396396 | 32405772 | Ptges2 | body |
| chr2 | 32525531 | 32527990 | Gm13412 | body |
| chr2 | 32575184 | 32576184 | 9430097D07Rik | TSS500 |
| chr2 | 32600209 | 32620806 | St6galnac6 | body |
| chr2 | 32622258 | 32635058 | Ak1 | body |
| chr2 | 32646095 | 32647095 | Eng | TSS500 |

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|------|----------|----------|---------------|--------|
| chr2 | 32705784 | 32712576 | Cdk9 | body |
| chr2 | 32732620 | 32740516 | 6330409D20Rik | body |
| chr2 | 32873755 | 32875501 | Gm13523 | body |
| chr2 | 33640693 | 33641693 | C130021I20Rik | TSS500 |
| chr2 | 33641693 | 33646354 | C130021I20Rik | body |
| chr2 | 33887446 | 33888446 | Mvb12b | TSS500 |
| chr2 | 33941645 | 33942645 | Gm13403 | TSS500 |
| chr2 | 34107235 | 34108235 | C230014O12Rik | TSS500 |
| chr2 | 34018289 | 34107235 | C230014O12Rik | body |
| chr2 | 34372642 | 34373642 | Pbx3 | TSS500 |
| chr2 | 34825811 | 34826811 | Fbxw2 | TSS500 |
| chr2 | 34873896 | 34874896 | Cutal | TSS500 |
| chr2 | 34961272 | 34962272 | Traf1 | TSS500 |
| chr2 | 35060938 | 35061938 | Hc | TSS500 |
| chr2 | 35084046 | 35101043 | Al182371 | body |
| chr2 | 35108992 | 35109992 | Cntrl | TSS500 |
| chr2 | 35180205 | 35200620 | Rab14 | body |
| chr2 | 35280163 | 35307892 | Gsn | body |
| chr2 | 35400179 | 35462731 | Ggta1 | body |
| chr2 | 35557766 | 35558766 | Dab2ip | TSS500 |
| chr2 | 35751241 | 35979413 | Ttll11 | body |
| chr2 | 36036326 | 36048906 | Ndufa8 | body |
| chr2 | 36081953 | 36104908 | Lhx6 | body |
| chr2 | 37442671 | 37443671 | Zbtb6 | TSS500 |
| chr2 | 37442621 | 37443621 | Zbtb26 | TSS500 |
| chr2 | 37442779 | 37443779 | Rabgap1 | TSS500 |
| chr2 | 37703359 | 37704359 | Strbp | TSS500 |
| chr2 | 37775749 | 37776749 | Crb2 | TSS500 |
| chr2 | 38338781 | 38339781 | Lhx2 | TSS500 |
| chr2 | 38339781 | 38369733 | Lhx2 | body |
| chr2 | 38347816 | 38348816 | Gm27197 | TSS500 |
| chr2 | 38347357 | 38347816 | Gm27197 | body |
| chr2 | 38643587 | 38644587 | Psmb7 | TSS500 |
| chr2 | 38692656 | 38714042 | Nr5a1 | body |
| chr2 | 38997758 | 38998758 | Gm13496 | TSS500 |
| chr2 | 38996976 | 38997976 | Wdr38 | TSS500 |
| chr2 | 39066214 | 39190230 | Scai | body |
| chr2 | 48062548 | 48456745 | Gm13481 | body |
| chr2 | 48902824 | 48949777 | Orc4 | body |
| chr2 | 49787188 | 49788188 | Lypd6b | TSS500 |
| chr2 | 50065929 | 50066929 | Lypd6 | TSS500 |
| chr2 | 51242331 | 51295945 | Gm13497 | body |
| chr2 | 51363572 | 51364999 | Gm13499 | body |
| chr2 | 51656966 | 51731509 | Gm13490 | body |

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|------|----------|----------|----------|--------|
| chr2 | 51934663 | 51935663 | Rbm43 | TSS500 |
| chr2 | 51924448 | 51934663 | Rbm43 | body |
| chr2 | 52338298 | 52339298 | Neb | TSS500 |
| chr2 | 52385416 | 52386416 | Gm13522 | TSS500 |
| chr2 | 52397951 | 52424401 | Arl5a | body |
| chr2 | 52676331 | 52677331 | Cacnb4 | TSS500 |
| chr2 | 52428320 | 52676331 | Cacnb4 | body |
| chr2 | 54085052 | 54086052 | Rprm | TSS500 |
| chr2 | 54435817 | 54436817 | Galnt13 | TSS500 |
| chr2 | 54436817 | 55118309 | Galnt13 | body |
| chr2 | 55437360 | 55438360 | Gm26794 | TSS500 |
| chr2 | 55433514 | 55437360 | Gm26794 | body |
| chr2 | 55435470 | 55436470 | Kcnj3 | TSS500 |
| chr2 | 55436470 | 55598145 | Kcnj3 | body |
| chr2 | 58129137 | 58195032 | Cytip | body |
| chr2 | 58267453 | 58357395 | Acvr1c | body |
| chr2 | 59611542 | 59612542 | Tanc1 | TSS500 |
| chr2 | 59882091 | 59883091 | Wdsub1 | TSS500 |
| chr2 | 60283988 | 60284988 | Cd302 | TSS500 |
| chr2 | 60382803 | 60383803 | Ly75 | TSS500 |
| chr2 | 60552808 | 60553808 | Pla2r1 | TSS500 |
| chr2 | 60417543 | 60552808 | Pla2r1 | body |
| chr2 | 60551257 | 60553923 | Gm13583 | body |
| chr2 | 60598292 | 60722143 | Itgb6 | body |
| chr2 | 62045962 | 62046962 | Slc4a10 | TSS500 |
| chr2 | 62357571 | 62470913 | Gm13561 | body |
| chr2 | 62645755 | 62646755 | Ifih1 | TSS500 |
| chr2 | 62663785 | 62664785 | Gca | TSS500 |
| chr2 | 64912476 | 65024487 | Grb14 | body |
| chr2 | 65316430 | 65363534 | Slc38a11 | body |
| chr2 | 65363900 | 65364900 | Mir6337 | TSS500 |
| chr2 | 65457118 | 65567127 | Scn3a | body |
| chr2 | 65621357 | 65767447 | Scn2a1 | body |
| chr2 | 65846267 | 66031546 | Csrnp3 | body |
| chr2 | 66124494 | 66125494 | Galnt3 | TSS500 |
| chr2 | 66082766 | 66124494 | Galnt3 | body |
| chr2 | 66124817 | 66125817 | Gm28638 | TSS500 |
| chr2 | 66270781 | 66440340 | Scn1a | body |
| chr2 | 66480080 | 66634462 | Scn9a | body |
| chr2 | 66673425 | 66784414 | Scn7a | body |
| chr2 | 67414225 | 67433086 | Gm21830 | body |
| chr2 | 67446502 | 67526614 | Xirp2 | body |
| chr2 | 67565371 | 67566371 | B3galt1 | TSS500 |
| chr2 | 68860941 | 68861941 | Cers6 | TSS500 |

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| chr2 | 69248807 | 69272491 | Gm13613 | body |
| chr2 | 69380945 | 69404533 | Dhrs9 | body |
| chr2 | 69646671 | 69647671 | Bbs5 | TSS500 |
| chr2 | 69647671 | 69667571 | Bbs5 | body |
| chr2 | 69723045 | 69754012 | Ppig | body |
| chr2 | 69821444 | 69822444 | Klhl23 | TSS500 |
| chr2 | 69885115 | 69886115 | Mettl5 | TSS500 |
| chr2 | 69885228 | 69886228 | Mettl5os | TSS500 |
| chr2 | 70039626 | 70429198 | Myo3b | body |
| chr2 | 70474423 | 70475423 | Sp5 | TSS500 |
| chr2 | 70475423 | 70477729 | Sp5 | body |
| chr2 | 70562857 | 70563857 | Gad1os | TSS500 |
| chr2 | 70489940 | 70562857 | Gad1os | body |
| chr2 | 70508699 | 70509699 | Erich2os | TSS500 |
| chr2 | 70508319 | 70509319 | Erich2 | TSS500 |
| chr2 | 70509319 | 70540884 | Erich2 | body |
| chr2 | 70553572 | 70602014 | Gad1 | body |
| chr2 | 70661608 | 70662608 | Gm26558 | TSS500 |
| chr2 | 70661076 | 70662076 | Gorasp2 | TSS500 |
| chr2 | 71117423 | 71118423 | Cybrd1 | TSS500 |
| chr2 | 71527613 | 71528613 | Dlx1 | TSS500 |
| chr2 | 71718917 | 71719917 | Gm1631 | TSS500 |
| chr2 | 71873724 | 71903858 | Pdk1 | body |
| chr2 | 71980740 | 71981740 | Rapgef4 | TSS500 |
| chr2 | 72224688 | 72231802 | Rapgef4os2 | body |
| chr2 | 72745846 | 72813217 | 6430710C18Rik | body |
| chr2 | 73218424 | 73219424 | Ola1 | TSS500 |
| chr2 | 73357768 | 73364333 | Gm13703 | body |
| chr2 | 73596026 | 73597026 | Chn1os3 | TSS500 |
| chr2 | 73774846 | 73775846 | Chn1 | TSS500 |
| chr2 | 74135257 | 74136257 | Gm13667 | TSS500 |
| chr2 | 74136257 | 74150834 | Gm13667 | body |
| chr2 | 74652991 | 74659057 | Evx2 | body |
| chr2 | 74667810 | 74668810 | Hoxd13 | TSS500 |
| chr2 | 74668810 | 74671599 | Hoxd13 | body |
| chr2 | 74675513 | 74677705 | Hoxd12 | body |
| chr2 | 74680057 | 74687016 | Hoxd11 | body |
| chr2 | 74691424 | 74692424 | Hoxd10 | TSS500 |
| chr2 | 74692424 | 74695105 | Hoxd10 | body |
| chr2 | 74696020 | 74697365 | Gm14396 | body |
| chr2 | 74698227 | 74700208 | Hoxd9 | body |
| chr2 | 74703248 | 74715630 | Hoxd3os1 | body |
| chr2 | 74712429 | 74729160 | Hoxd4 | body |
| chr2 | 74726228 | 74727228 | Gm28230 | TSS500 |

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| chr2 | 74748422 | 74762396 | Hagl | body |
| chr2 | 74752184 | 74753184 | Gm14424 | TSS500 |
| chr2 | 74753184 | 74753744 | Gm14424 | body |
| chr2 | 74762480 | 74763480 | Hoxd1 | TSS500 |
| chr2 | 75137298 | 75138298 | Gm13652 | TSS500 |
| chr2 | 75139342 | 75322897 | 2600014E21Rik | body |
| chr2 | 75675513 | 75704141 | Nfe2l2 | body |
| chr2 | 75938085 | 75939085 | Ttc30b | TSS500 |
| chr2 | 76338274 | 76339274 | Pde11a | TSS500 |
| chr2 | 75989141 | 76338274 | Pde11a | body |
| chr2 | 76359950 | 76360950 | Cyct | TSS500 |
| chr2 | 76369484 | 76370484 | Rbm45 | TSS500 |
| chr2 | 76703980 | 76982047 | Ttn | body |
| chr2 | 77462169 | 77463169 | Gm13944 | TSS500 |
| chr2 | 78051677 | 78194430 | 4930440I19Rik | body |
| chr2 | 78238047 | 78302230 | Gm14461 | body |
| chr2 | 79254926 | 79255926 | Itga4 | TSS500 |
| chr2 | 79456285 | 79457285 | Cerkl | TSS500 |
| chr2 | 79456251 | 79457251 | Neurod1 | TSS500 |
| chr2 | 79452521 | 79456251 | Neurod1 | body |
| chr2 | 79453485 | 79454485 | Gm26755 | TSS500 |
| chr2 | 79454485 | 79461107 | Gm26755 | body |
| chr2 | 80292972 | 80295356 | Prdx6b | body |
| chr2 | 80411970 | 80447125 | Frzb | body |
| chr2 | 82052722 | 82053722 | Zfp804a | TSS500 |
| chr2 | 82053722 | 82259879 | Zfp804a | body |
| chr2 | 83915079 | 83940728 | Zswim2 | body |
| chr2 | 84424911 | 84425911 | Calcrl | TSS500 |
| chr2 | 84330626 | 84424911 | Calcrl | body |
| chr2 | 84765387 | 84774944 | Serping1 | body |
| chr2 | 84838350 | 84839350 | Slc43a1 | TSS500 |
| chr2 | 84839350 | 84863594 | Slc43a1 | body |
| chr2 | 84886210 | 84887210 | Rtn4rl2 | TSS500 |
| chr2 | 84871924 | 84886210 | Rtn4rl2 | body |
| chr2 | 84937079 | 84958509 | Slc43a3 | body |
| chr2 | 85196199 | 85197199 | Lrrc55 | TSS500 |
| chr2 | 85197432 | 85198675 | Gm13716 | body |
| chr2 | 85483594 | 85518524 | 4833423E24Rik | body |
| chr2 | 90051414 | 90063094 | Olfr140 | body |
| chr2 | 90429754 | 90580147 | Ptprj | body |
| chr2 | 90677715 | 90736328 | Nup160 | body |
| chr2 | 90782227 | 90783227 | Agbl2 | TSS500 |
| chr2 | 90885360 | 90886360 | C1qtnf4 | TSS500 |
| chr2 | 90894634 | 90904327 | Ndufs3 | body |

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| chr2 | 90940882 | 91019497 | Celf1 | body |
| chr2 | 91061791 | 91069917 | Slc39a13 | body |
| chr2 | 91082890 | 91115756 | Spi1 | body |
| chr2 | 91256454 | 91264679 | Pacsin3 | body |
| chr2 | 91527262 | 91620664 | Ckap5 | body |
| chr2 | 91931797 | 91932797 | Mdk | TSS500 |
| chr2 | 91929805 | 91931797 | Mdk | body |
| chr2 | 91975364 | 91976364 | Dgkz | TSS500 |
| chr2 | 91944430 | 91945430 | Mir6999 | TSS500 |
| chr2 | 91982328 | 92024002 | Creb3l1 | body |
| chr2 | 92054989 | 92058869 | 2900072N19Rik | body |
| chr2 | 92365046 | 92374369 | Gylt1b | body |
| chr2 | 92375176 | 92381217 | Pex16 | body |
| chr2 | 92403646 | 92433543 | Cry2 | body |
| chr2 | 92484426 | 92529809 | Gm13814 | body |
| chr2 | 92741730 | 92742730 | Gm13816 | TSS500 |
| chr2 | 92914598 | 92915598 | Syt13 | TSS500 |
| chr2 | 93188048 | 93201759 | Trp53i11 | body |
| chr2 | 93334005 | 93335005 | Tspan18 | TSS500 |
| chr2 | 93201760 | 93334005 | Tspan18 | body |
| chr2 | 93462640 | 93463640 | Cd82 | TSS500 |
| chr2 | 93453319 | 93469871 | Gm10804 | body |
| chr2 | 93642884 | 93681339 | Alx4 | body |
| chr2 | 93855361 | 93868657 | Accsl | body |
| chr2 | 93956701 | 93957701 | Gm13889 | TSS500 |
| chr2 | 93955810 | 93956701 | Gm13889 | body |
| chr2 | 93956817 | 93995854 | Gm27027 | body |
| chr2 | 94240953 | 94241953 | Mir129-2 | TSS500 |
| chr2 | 94251879 | 94264258 | E530001K10Rik | body |
| chr2 | 96317669 | 96318669 | Lrrc4c | TSS500 |
| chr2 | 101649032 | 101650032 | B230118H07Rik | TSS500 |
| chr2 | 101649001 | 101650001 | Rag1 | TSS500 |
| chr2 | 101714285 | 101882527 | Prr5l | body |
| chr2 | 102300119 | 102407328 | Trim44 | body |
| chr2 | 102451999 | 102452999 | Fjx1 | TSS500 |
| chr2 | 102449366 | 102451999 | Fjx1 | body |
| chr2 | 102549512 | 102550512 | Pamr1 | TSS500 |
| chr2 | 102658159 | 102659159 | Slc1a2 | TSS500 |
| chr2 | 102659159 | 102790784 | Slc1a2 | body |
| chr2 | 103021075 | 103073013 | Pdhx | body |
| chr2 | 103302778 | 103303778 | Ehf | TSS500 |
| chr2 | 103721256 | 103760770 | Nat10 | body |
| chr2 | 103912524 | 103918960 | Gm13881 | body |
| chr2 | 103957486 | 103958486 | Lmo2 | TSS500 |

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| chr2 | 104069349 | 104070349 | Cd59b | TSS500 |
| chr2 | 104096301 | 104115354 | Cd59a | body |
| chr2 | 104122269 | 104123269 | A930018P22Rik | TSS500 |
| chr2 | 104143073 | 104409834 | D430041D05Rik | body |
| chr2 | 104256172 | 104257172 | Gm13883 | TSS500 |
| chr2 | 104257172 | 104275757 | Gm13883 | body |
| chr2 | 104591023 | 104665429 | Cstf3 | body |
| chr2 | 104742378 | 104743378 | Depdc7 | TSS500 |
| chr2 | 104868305 | 105017904 | Ccdc73 | body |
| chr2 | 105076538 | 105126010 | Wt1os | body |
| chr2 | 105223820 | 105224820 | Them7 | TSS500 |
| chr2 | 105386291 | 105398819 | Rcn1 | body |
| chr2 | 105669830 | 105670830 | Pax6os1 | TSS500 |
| chr2 | 105536080 | 105669830 | Pax6os1 | body |
| chr2 | 105660192 | 105661192 | RP23-431C3.3 | TSS500 |
| chr2 | 105657862 | 105660192 | RP23-431C3.3 | body |
| chr2 | 105668400 | 105669400 | Pax6 | TSS500 |
| chr2 | 105669400 | 105697364 | Pax6 | body |
| chr2 | 106003049 | 106004049 | Dnajc24 | TSS500 |
| chr2 | 107291139 | 107298502 | Kcna4 | body |
| chr2 | 109675200 | 109727007 | Bdnf | body |
| chr2 | 109891353 | 109901003 | Lin7c | body |
| chr2 | 110031250 | 110049979 | Ccdc34os | body |
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| chr2 | 110597798 | 110647779 | Slc5a12 | body |
| chr2 | 110655201 | 110950423 | Ano3 | body |
| chr2 | 110721840 | 110739527 | Muc15 | body |
| chr2 | 111162061 | 111229102 | 4930430A15Rik | body |
| chr2 | 111246131 | 111255663 | Gm13962 | body |
| chr2 | 112266325 | 112363163 | Slc12a6 | body |
| chr2 | 112363011 | 112367527 | Emc4 | body |
| chr2 | 112479171 | 112480269 | Chrm5 | body |
| chr2 | 112631355 | 113216596 | Ryr3 | body |
| chr2 | 113327236 | 113328236 | Fmn1 | TSS500 |
| chr2 | 113440594 | 113441594 | Gm13963 | TSS500 |
| chr2 | 113440681 | 113441804 | Gm13966 | body |
| chr2 | 113440789 | 113441789 | FMN1 | TSS500 |
| chr2 | 113758146 | 113759146 | Grem1 | TSS500 |
| chr2 | 114853593 | 114854593 | Gm13974 | TSS500 |
| chr2 | 115344885 | 115346968 | Gm13976 | body |
| chr2 | 116067725 | 116085911 | G630016G05Rik | body |
| chr2 | 116879191 | 116892494 | Tmco5 | body |
| chr2 | 116972575 | 116975928 | Gm29340 | body |
| chr2 | 118256466 | 118257466 | Fsip1 | TSS500 |

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| chr2 | 118270233 | 118275669 | A930104D05Rik | body |
| chr2 | 118528757 | 118549187 | Bmf | body |
| chr2 | 118662803 | 118663803 | Pak6 | TSS500 |
| chr2 | 118663803 | 118698020 | Pak6 | body |
| chr2 | 118703463 | 118704463 | Ankrd63 | TSS500 |
| chr2 | 118699103 | 118703463 | Ankrd63 | body |
| chr2 | 118727938 | 118728938 | Plcb2 | TSS500 |
| chr2 | 118814503 | 118853957 | Knstrn | body |
| chr2 | 118899877 | 118900877 | Bahd1 | TSS500 |
| chr2 | 119156534 | 119157534 | Rmdn3 | TSS500 |
| chr2 | 119137001 | 119156534 | Rmdn3 | body |
| chr2 | 119270772 | 119271772 | Rhov | TSS500 |
| chr2 | 119269201 | 119270772 | Rhov | body |
| chr2 | 119618798 | 119651244 | Nusap1 | body |
| chr2 | 119662327 | 119663327 | Ndufaf1 | TSS500 |
| chr2 | 119741837 | 119742837 | Itpka | TSS500 |
| chr2 | 119751320 | 119759931 | Ltk | body |
| chr2 | 119896728 | 119897728 | Mga | TSS500 |
| chr2 | 120244835 | 120245835 | Pla2g4e | TSS500 |
| chr2 | 120166412 | 120244835 | Pla2g4e | body |
| chr2 | 120265595 | 120288697 | Pla2g4d | body |
| chr2 | 120456519 | 120504913 | Capn3 | body |
| chr2 | 120732816 | 120850104 | Ttbk2 | body |
| chr2 | 121140153 | 121141153 | Lcmt2 | TSS500 |
| chr2 | 121128307 | 121140153 | Lcmt2 | body |
| chr2 | 121139928 | 121140928 | Adal | TSS500 |
| chr2 | 121171154 | 121198770 | Tubgcp4 | body |
| chr2 | 121193281 | 121270907 | Trp53bp1 | body |
| chr2 | 121358214 | 121363737 | Ckmt1 | body |
| chr2 | 121363728 | 121386668 | Strc | body |
| chr2 | 121392631 | 121413292 | Catsper2 | body |
| chr2 | 121439010 | 121443778 | Ell3 | body |
| chr2 | 121439059 | 121456281 | Serinc4 | body |
| chr2 | 121506165 | 121507165 | Mfap1a | TSS500 |
| chr2 | 121491911 | 121506165 | Mfap1a | body |
| chr2 | 121506223 | 121507223 | Wdr76 | TSS500 |
| chr2 | 121545529 | 121806587 | Frmd5 | body |
| chr2 | 121866217 | 121867217 | Gm14019 | TSS500 |
| chr2 | 121866470 | 121867470 | Casc4 | TSS500 |
| chr2 | 121867470 | 121936220 | Casc4 | body |
| chr2 | 122120108 | 122185689 | Patl2 | body |
| chr2 | 122186772 | 122206397 | 4933406J08Rik | body |
| chr2 | 122297665 | 122298665 | Duox2 | TSS500 |
| chr2 | 122299400 | 122302885 | Duoxa2 | body |

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|------|-----------|-----------|---------------|--------|
| chr2 | 122313230 | 122314230 | Duoxa1 | TSS500 |
| chr2 | 122302191 | 122313230 | Duoxa1 | body |
| chr2 | 122368662 | 122369662 | Shf | TSS500 |
| chr2 | 122610803 | 122611803 | Gatm | TSS500 |
| chr2 | 122594467 | 122610803 | Gatm | body |
| chr2 | 122637486 | 122641191 | AA467197 | body |
| chr2 | 124089469 | 124090469 | Sema6d | TSS500 |
| chr2 | 125123161 | 125124161 | Myef2 | TSS500 |
| chr2 | 125300594 | 125507493 | Fbn1 | body |
| chr2 | 125504589 | 125505589 | Gm9913 | TSS500 |
| chr2 | 125505589 | 125507881 | Gm9913 | body |
| chr2 | 125563088 | 125624613 | Cep152 | body |
| chr2 | 125723648 | 125724648 | Shc4 | TSS500 |
| chr2 | 125627447 | 125723648 | Shc4 | body |
| chr2 | 125859609 | 125984299 | Galk2 | body |
| chr2 | 125983483 | 126151504 | Fam227b | body |
| chr2 | 126035158 | 126091185 | Fgf7 | body |
| chr2 | 126320973 | 126500174 | Atp8b4 | body |
| chr2 | 126553162 | 126554162 | Gm26697 | TSS500 |
| chr2 | 126552907 | 126588243 | Slc27a2 | body |
| chr2 | 126627442 | 126675837 | Gabpb1 | body |
| chr2 | 127142942 | 127143942 | Itpr1 | TSS500 |
| chr2 | 127336659 | 127338376 | Dusp2 | body |
| chr2 | 127362708 | 127363708 | Adra2b | TSS500 |
| chr2 | 127424699 | 127425699 | Gpat2 | TSS500 |
| chr2 | 127425699 | 127436092 | Gpat2 | body |
| chr2 | 127521594 | 127522594 | Kcnip3 | TSS500 |
| chr2 | 127540967 | 127541967 | Prom2 | TSS500 |
| chr2 | 127656195 | 127657195 | Mal | TSS500 |
| chr2 | 127633226 | 127656195 | Mal | body |
| chr2 | 127729432 | 127730432 | Mall | TSS500 |
| chr2 | 127740732 | 127788397 | Nphp1 | body |
| chr2 | 127831365 | 127832365 | Bub1 | TSS500 |
| chr2 | 128190487 | 128204634 | Gm14009 | body |
| chr2 | 128698456 | 128699456 | Mertk | TSS500 |
| chr2 | 128699456 | 128802894 | Mertk | body |
| chr2 | 128967902 | 129018563 | Zc3h6 | body |
| chr2 | 129183447 | 129184447 | Gm14029 | TSS500 |
| chr2 | 129246876 | 129268526 | Gm14024 | body |
| chr2 | 129458359 | 129536102 | F830045P16Rik | body |
| chr2 | 129565568 | 129566568 | Gm14041 | TSS500 |
| chr2 | 129699344 | 129700344 | Pdyn | TSS500 |
| chr2 | 129800017 | 129801017 | Stk35 | TSS500 |
| chr2 | 130112916 | 130154232 | Tgm6 | body |

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|------|-----------|-----------|---------------|--------|
| chr2 | 130295669 | 130370481 | Ebf4 | body |
| chr2 | 130397074 | 130398074 | Cpxm1 | TSS500 |
| chr2 | 130424839 | 130444269 | Vps16 | body |
| chr2 | 130576673 | 130577054 | Oxt | body |
| chr2 | 130590002 | 130629538 | Ubox5 | body |
| chr2 | 130613840 | 130629527 | Fastkd5 | body |
| chr2 | 130684113 | 130697019 | Slc4a11 | body |
| chr2 | 131063314 | 131064314 | Adam33 | TSS500 |
| chr2 | 131050591 | 131063314 | Adam33 | body |
| chr2 | 131160037 | 131171342 | Gm14232 | body |
| chr2 | 131170261 | 131186782 | Spef1 | body |
| chr2 | 131179567 | 131180567 | Cenpb | TSS500 |
| chr2 | 131175182 | 131179567 | Cenpb | body |
| chr2 | 131233563 | 131234563 | Mavs | TSS500 |
| chr2 | 131234563 | 131248025 | Mavs | body |
| chr2 | 131298064 | 131352392 | Rnf24 | body |
| chr2 | 131491996 | 131525922 | Smox | body |
| chr2 | 131950361 | 131951361 | Prnd | TSS500 |
| chr2 | 131989415 | 132029758 | Rassf2 | body |
| chr2 | 132144033 | 132145033 | Gm14051 | TSS500 |
| chr2 | 132384947 | 132385947 | Prokr2 | TSS500 |
| chr2 | 132337733 | 132384947 | Prokr2 | body |
| chr2 | 132425241 | 132452499 | 4921508D12Rik | body |
| chr2 | 132780778 | 132781778 | Chgb | TSS500 |
| chr2 | 132781778 | 132795079 | Chgb | body |
| chr2 | 132847166 | 132866785 | Crls1 | body |
| chr2 | 132868305 | 132880391 | Lrrn4 | body |
| chr2 | 133432595 | 133453362 | A430048G15Rik | body |
| chr2 | 133551659 | 133552659 | Bmp2 | TSS500 |
| chr2 | 133552659 | 133562885 | Bmp2 | body |
| chr2 | 134785659 | 134786659 | Plcb1 | TSS500 |
| chr2 | 134786659 | 135475258 | Plcb1 | body |
| chr2 | 135169573 | 135215116 | 4930545L23Rik | body |
| chr2 | 135658511 | 135659511 | Plcb4 | TSS500 |
| chr2 | 136051739 | 136052739 | Lamp5 | TSS500 |
| chr2 | 136052739 | 136069917 | Lamp5 | body |
| chr2 | 136387467 | 136388467 | Pak7 | TSS500 |
| chr2 | 136502410 | 136562091 | Ankef1 | body |
| chr2 | 137081456 | 137116144 | Jag1 | body |
| chr2 | 139494413 | 139637674 | Sptlc3 | body |
| chr2 | 139677678 | 139678678 | lsm1 | TSS500 |
| chr2 | 139678678 | 139758581 | lsm1 | body |
| chr2 | 140229855 | 140389206 | Sel1l2 | body |
| chr2 | 143546656 | 143816285 | Pcsk2 | body |

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|------|-----------|-----------|---------------|--------|
| chr2 | 143747583 | 143795465 | Pcsk2os2 | body |
| chr2 | 144059138 | 144068306 | Banf2os | body |
| chr2 | 144173150 | 144188790 | Gm5535 | body |
| chr2 | 144250123 | 144270406 | Snx5 | body |
| chr2 | 144331646 | 144332646 | Ovol2 | TSS500 |
| chr2 | 144330959 | 144331959 | 1700108N11Rik | TSS500 |
| chr2 | 144331959 | 144332639 | 1700108N11Rik | body |
| chr2 | 144593554 | 144594554 | Gm561 | TSS500 |
| chr2 | 144600397 | 144768758 | Dtd1 | body |
| chr2 | 144824156 | 144824415 | Scp2d1 | body |
| chr2 | 145167254 | 145168254 | Slc24a3 | TSS500 |
| chr2 | 146221421 | 146222421 | Insm1 | TSS500 |
| chr2 | 146222421 | 146225020 | Insm1 | body |
| chr2 | 146839232 | 146840232 | Gm14114 | TSS500 |
| chr2 | 146828327 | 146839232 | Gm14114 | body |
| chr2 | 146856364 | 146970097 | Kiz | body |
| chr2 | 147084945 | 147085945 | Nkx2-4 | TSS500 |
| chr2 | 147083316 | 147084945 | Nkx2-4 | body |
| chr2 | 147193743 | 147194743 | Nkx2-2 | TSS500 |
| chr2 | 147183583 | 147184583 | Nkx2-2os | TSS500 |
| chr2 | 147184583 | 147331681 | Nkx2-2os | body |
| chr2 | 147186924 | 147187924 | 6430503K07Rik | TSS500 |
| chr2 | 147187924 | 147188407 | 6430503K07Rik | body |
| chr2 | 147361425 | 147362425 | Pax1 | TSS500 |
| chr2 | 147362425 | 147393295 | Pax1 | body |
| chr2 | 147711193 | 147717632 | A530006G24Rik | body |
| chr2 | 148039703 | 148040703 | 9030622O22Rik | TSS500 |
| chr2 | 147944740 | 148039703 | 9030622O22Rik | body |
| chr2 | 148046469 | 148047469 | Foxa2 | TSS500 |
| chr2 | 148042877 | 148046469 | Foxa2 | body |
| chr2 | 148394844 | 148395844 | Sstr4 | TSS500 |
| chr2 | 148407688 | 148408688 | Thbd | TSS500 |
| chr2 | 148673101 | 148676027 | Nxt1 | body |
| chr2 | 148681523 | 148692949 | Gzf1 | body |
| chr2 | 148846711 | 148864538 | 9230104L09Rik | body |
| chr2 | 149743927 | 149798243 | Gm14133 | body |
| chr2 | 149829711 | 150004392 | Syndig1 | body |
| chr2 | 149830713 | 149831713 | C530025M09Rik | TSS500 |
| chr2 | 149830524 | 149830713 | C530025M09Rik | body |
| chr2 | 150181255 | 150182255 | Gm14139 | TSS500 |
| chr2 | 150217573 | 150218573 | Zfp937 | TSS500 |
| chr2 | 150362265 | 150363265 | 3300002I08Rik | TSS500 |
| chr2 | 150324202 | 150363071 | Gm10130 | body |
| chr2 | 150484591 | 150485591 | Zfp345 | TSS500 |

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| chr2 | 150668000 | 150669000 | Acss1 | TSS500 |
| chr2 | 150618105 | 150668000 | Acss1 | body |
| chr2 | 150688860 | 150689860 | Vsx1 | TSS500 |
| chr2 | 150680702 | 150688860 | Vsx1 | body |
| chr2 | 150787235 | 150831758 | Pygb | body |
| chr2 | 151205695 | 151231614 | Gm14149 | body |
| chr2 | 151380650 | 151431902 | Gm14152 | body |
| chr2 | 151573122 | 151590005 | Sdcbp2 | body |
| chr2 | 151679361 | 151685839 | Tmem74bos | body |
| chr2 | 151701508 | 151702508 | Tmem74b | TSS500 |
| chr2 | 151715812 | 151743686 | Psmf1 | body |
| chr2 | 151842427 | 151843427 | Rspo4 | TSS500 |
| chr2 | 151843427 | 151874668 | Rspo4 | body |
| chr2 | 151996011 | 151997011 | Slc52a3 | TSS500 |
| chr2 | 152081029 | 152082029 | Scrt2 | TSS500 |
| chr2 | 152376138 | 152377138 | Nrsn2 | TSS500 |
| chr2 | 152411955 | 152414527 | Zcchc3 | body |
| chr2 | 152477563 | 152479934 | Defb20 | body |
| chr2 | 152538714 | 152539598 | Defb29 | body |
| chr2 | 152622356 | 152622553 | Defb25 | body |
| chr2 | 152626451 | 152627451 | Rem1 | TSS500 |
| chr2 | 152686535 | 152687535 | Mcts2 | TSS500 |
| chr2 | 152753673 | 152754673 | Cox4i2 | TSS500 |
| chr2 | 152754673 | 152765037 | Cox4i2 | body |
| chr2 | 152780668 | 152831228 | Bcl2l1 | body |
| chr2 | 152910852 | 152911852 | Mylk2 | TSS500 |
| chr2 | 152951198 | 152952198 | Dusp15 | TSS500 |
| chr2 | 152962985 | 153008482 | Ttll9 | body |
| chr2 | 153031352 | 153032352 | Xkr7 | TSS500 |
| chr2 | 153066455 | 153081735 | Ccm2l | body |
| chr2 | 153107968 | 153108968 | Hck | TSS500 |
| chr2 | 153108968 | 153151441 | Hck | body |
| chr2 | 153407462 | 153529471 | Nol4l | body |
| chr2 | 153616933 | 153632281 | Commd7 | body |
| chr2 | 153875545 | 153895270 | Bpifb2 | body |
| chr2 | 154335380 | 154372510 | Cdk5rap1 | body |
| chr2 | 154407599 | 154408599 | Snta1 | TSS500 |
| chr2 | 154376313 | 154407599 | Snta1 | body |
| chr2 | 154558390 | 154559390 | Necab3 | TSS500 |
| chr2 | 154544399 | 154558390 | Necab3 | body |
| chr2 | 154547585 | 154550003 | 1700003F12Rik | body |
| chr2 | 154559407 | 154569392 | E2f1 | body |
| chr2 | 155018766 | 155027104 | Gm14226 | body |
| chr2 | 155099581 | 155100581 | 2310005A03Rik | TSS500 |

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| chr2 | 155097789 | 155099581 | 2310005A03Rik | body |
| chr2 | 155275797 | 155276797 | Map1lc3a | TSS500 |
| chr2 | 155276797 | 155278073 | Map1lc3a | body |
| chr2 | 155356317 | 155357317 | Mir695 | TSS500 |
| chr2 | 155774842 | 155775842 | Mmp24 | TSS500 |
| chr2 | 155846894 | 155929810 | Uqcc1 | body |
| chr2 | 155955958 | 155956958 | Cep250 | TSS500 |
| chr2 | 156052447 | 156053447 | Fer1l4 | TSS500 |
| chr2 | 156144539 | 156145797 | Romo1 | body |
| chr2 | 156196966 | 156309952 | Phf20 | body |
| chr2 | 156311847 | 156312204 | Scand1 | body |
| chr2 | 156840507 | 156855570 | Tgif2 | body |
| chr2 | 156863628 | 156873563 | 1110008F13Rik | body |
| chr2 | 157078754 | 157079754 | Soga1 | TSS500 |
| chr2 | 157015799 | 157078754 | Soga1 | body |
| chr2 | 157087555 | 157096482 | Tldc2 | body |
| chr2 | 157208550 | 157279049 | Mroh8 | body |
| chr2 | 157347006 | 157348006 | Ghrh | TSS500 |
| chr2 | 157329497 | 157347006 | Ghrh | body |
| chr2 | 157417944 | 157418944 | Src | TSS500 |
| chr2 | 157559578 | 157560578 | Nnat | TSS500 |
| chr2 | 157560578 | 157562522 | Nnat | body |
| chr2 | 157915153 | 157944719 | Vstm2l | body |
| chr2 | 158182533 | 158228722 | D630003M21Rik | body |
| chr2 | 158258594 | 158284531 | Bpi | body |
| chr2 | 158359428 | 158360428 | RP23-132A3.5 | TSS500 |
| chr2 | 158375138 | 158376138 | Snhg11 | TSS500 |
| chr2 | 158513296 | 158550762 | Arhgap40 | body |
| chr2 | 158611267 | 158615748 | Slc32a1 | body |
| chr2 | 158625388 | 158639211 | Actr5 | body |
| chr2 | 159946876 | 159947876 | Gm14223 | TSS500 |
| chr2 | 160311393 | 160333662 | Gm826 | body |
| chr2 | 160366565 | 160367565 | Mafb | TSS500 |
| chr2 | 160363703 | 160366565 | Mafb | body |
| chr2 | 160926148 | 160927148 | Gm14228 | TSS500 |
| chr2 | 160925541 | 160926148 | Gm14228 | body |
| chr2 | 162660647 | 162661647 | Ptprt | TSS500 |
| chr2 | 162867079 | 162867694 | Gm14255 | body |
| chr2 | 162987830 | 163014127 | Sgk2 | body |
| chr2 | 163017854 | 163046141 | Ift52 | body |
| chr2 | 163123106 | 163143959 | Gm11454 | body |
| chr2 | 163202625 | 163203625 | Tox2 | TSS500 |
| chr2 | 163203625 | 163324170 | Tox2 | body |
| chr2 | 163438976 | 163455324 | Gdap1l1 | body |

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| chr2 | 163506308 | 163507308 | Hnf4a | TSS500 |
| chr2 | 163821361 | 163833146 | Wisp2 | body |
| chr2 | 163854151 | 163859746 | Kcnk15 | body |
| chr2 | 164053540 | 164070669 | Tomm34 | body |
| chr2 | 164170613 | 164171613 | Kcns1 | TSS500 |
| chr2 | 164182242 | 164183242 | Wfdc5 | TSS500 |
| chr2 | 164176327 | 164182242 | Wfdc5 | body |
| chr2 | 164178084 | 164196564 | A730032A03Rik | body |
| chr2 | 164198863 | 164199630 | Wfdc15a | body |
| chr2 | 164214454 | 164221160 | Wfdc15b | body |
| chr2 | 164235929 | 164237966 | Svs2 | body |
| chr2 | 164388595 | 164389595 | Slpi | TSS500 |
| chr2 | 164389393 | 164404660 | Matn4 | body |
| chr2 | 164461467 | 164490760 | Gm20458 | body |
| chr2 | 164473224 | 164474224 | Trp53tg5 | TSS500 |
| chr2 | 164485606 | 164486606 | Dbndd2 | TSS500 |
| chr2 | 164486606 | 164493319 | Dbndd2 | body |
| chr2 | 164551030 | 164559730 | Gm14317 | body |
| chr2 | 164569695 | 164572959 | Spint3 | body |
| chr2 | 164579519 | 164584947 | Wfdc6a | body |
| chr2 | 164596458 | 164613126 | Wfdc8 | body |
| chr2 | 164634707 | 164638296 | Wfdc16 | body |
| chr2 | 164649631 | 164656083 | Wfdc9 | body |
| chr2 | 164662894 | 164673587 | Wfdc11 | body |
| chr2 | 164826389 | 164828037 | Spata25 | body |
| chr2 | 164832956 | 164833956 | Neurl2 | TSS500 |
| chr2 | 164830732 | 164832956 | Neurl2 | body |
| chr2 | 164832373 | 164833373 | Ctsa | TSS500 |
| chr2 | 164833373 | 164841032 | Ctsa | body |
| chr2 | 164839518 | 164857211 | Pltp | body |
| chr2 | 164891882 | 164911257 | Zfp335 | body |
| chr2 | 164961316 | 164999727 | Slc12a5 | body |
| chr2 | 165234353 | 165235353 | Cdh22 | TSS500 |
| chr2 | 165111507 | 165234353 | Cdh22 | body |
| chr2 | 165472730 | 165473730 | Slc13a3 | TSS500 |
| chr2 | 165405028 | 165472730 | Slc13a3 | body |
| chr2 | 165594532 | 165595532 | Eya2 | TSS500 |
| chr2 | 165601287 | 165602287 | Gm28163 | TSS500 |
| chr2 | 165880525 | 165882056 | Gm11465 | body |
| chr2 | 165976757 | 165985424 | Gm11463 | body |
| chr2 | 165980726 | 165992017 | Gm11464 | body |
| chr2 | 166155163 | 166156163 | Sulf2 | TSS500 |
| chr2 | 166073089 | 166155163 | Sulf2 | body |
| chr2 | 166190362 | 166191362 | Gm11466 | TSS500 |

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| chr2 | 166274408 | 166294831 | Gm11468 | body |
| chr2 | 166380828 | 166397687 | Gm14268 | body |
| chr2 | 166713332 | 166714332 | Prex1 | TSS500 |
| chr2 | 166566342 | 166713332 | Prex1 | body |
| chr2 | 167101326 | 167102326 | Gm14290 | TSS500 |
| chr2 | 167240104 | 167241104 | Ptgis | TSS500 |
| chr2 | 167191805 | 167240104 | Ptgis | body |
| chr2 | 167201076 | 167202076 | Gm14291 | TSS500 |
| chr2 | 167493145 | 167516173 | Rnf114 | body |
| chr2 | 167643959 | 167644959 | Gm22355 | TSS500 |
| chr2 | 168010118 | 168011118 | Fam65c | TSS500 |
| chr2 | 168010029 | 168011029 | Gm14236 | TSS500 |
| chr2 | 168281236 | 168282236 | Kcng1 | TSS500 |
| chr2 | 168601157 | 168602157 | Nfatc2 | TSS500 |
| chr2 | 168476410 | 168601157 | Nfatc2 | body |
| chr2 | 168741909 | 168742909 | Atp9a | TSS500 |
| chr2 | 168634438 | 168741909 | Atp9a | body |
| chr2 | 169632513 | 169633513 | Tshz2 | TSS500 |
| chr2 | 169633513 | 170071816 | Tshz2 | body |
| chr2 | 169633646 | 169888003 | Gm26883 | body |
| chr2 | 170108643 | 170147603 | Zfp217 | body |
| chr2 | 170346991 | 170427345 | Bcas1 | body |
| chr2 | 170356861 | 170380435 | Bcas1os2 | body |
| chr2 | 170482708 | 170496645 | Cyp24a1 | body |
| chr2 | 170495928 | 170496928 | Pfdn4 | TSS500 |
| chr2 | 170579418 | 170601517 | 4930470P17Rik | body |
| chr2 | 170731307 | 170732307 | Dok5 | TSS500 |
| chr2 | 171193769 | 171271350 | Gm14266 | body |
| chr2 | 172003495 | 172004495 | Gm14641 | TSS500 |
| chr2 | 172247992 | 172248992 | Mc3r | TSS500 |
| chr2 | 172324834 | 172338663 | Gm14273 | body |
| chr2 | 172450313 | 172458096 | Gcnt7 | body |
| chr2 | 172549093 | 172550093 | Tfap2c | TSS500 |
| chr2 | 172550093 | 172558622 | Tfap2c | body |
| chr2 | 172939821 | 172940821 | Bmp7 | TSS500 |
| chr2 | 172868012 | 172939821 | Bmp7 | body |
| chr2 | 172977200 | 172978200 | Spo11 | TSS500 |
| chr2 | 173020998 | 173034734 | Rbm38 | body |
| chr2 | 173093609 | 173119025 | Ctcf1 | body |
| chr2 | 173111318 | 173133204 | Ctcf1os | body |
| chr2 | 173152548 | 173153548 | Pck1 | TSS500 |
| chr2 | 173218423 | 173219423 | Zbp1 | TSS500 |
| chr2 | 173224458 | 173276033 | Pmepa1 | body |
| chr2 | 173523086 | 173528501 | 1700021F07Rik | body |

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| chr2 | 173568666 | 173577865 | Ankrd60 | body |
| chr2 | 174076808 | 174099771 | Stx16 | body |
| chr2 | 174109849 | 174110849 | Npepl1 | TSS500 |
| chr2 | 174281237 | 174294936 | Nespas | body |
| chr2 | 174283820 | 174284820 | Gnas | TSS500 |
| chr2 | 174451195 | 174457882 | Tubb1 | body |
| chr2 | 174463605 | 174464605 | Atp5e | TSS500 |
| chr2 | 174465067 | 174472581 | Slmo2 | body |
| chr2 | 174644034 | 174710832 | Zfp831 | body |
| chr2 | 174761119 | 174784042 | Edn3 | body |
| chr2 | 175141512 | 175142512 | Gm14399 | TSS500 |
| chr2 | 175175371 | 175176371 | Gm14443 | TSS500 |
| chr2 | 177464233 | 177465233 | Gm14420 | TSS500 |
| chr2 | 177896596 | 177897596 | Gm14327 | TSS500 |
| chr2 | 177897596 | 177905784 | Gm14327 | body |
| chr2 | 178413972 | 178414972 | Ppp1r3d | TSS500 |
| chr2 | 178414024 | 178415024 | Fam217b | TSS500 |
| chr2 | 178415024 | 178424428 | Fam217b | body |
| chr2 | 178431031 | 178487366 | Cdh26 | body |
| chr2 | 180043009 | 180070201 | Ss18l1 | body |
| chr2 | 180119806 | 180162680 | Osbpl2 | body |
| chr2 | 180258540 | 180272996 | Cables2 | body |
| chr2 | 180289379 | 180290379 | Rbbp8nl | TSS500 |
| chr2 | 180277646 | 180289379 | Rbbp8nl | body |
| chr2 | 180334199 | 180335199 | Gata5 | TSS500 |
| chr2 | 180325133 | 180334199 | Gata5 | body |
| chr2 | 180333357 | 180340732 | Gata5os | body |
| chr2 | 180385385 | 180386385 | B230312C02Rik | TSS500 |
| chr2 | 180370491 | 180385385 | B230312C02Rik | body |
| chr2 | 180455745 | 180456745 | Slco4a1 | TSS500 |
| chr2 | 180456745 | 180474867 | Slco4a1 | body |
| chr2 | 180499476 | 180500476 | Ntsr1 | TSS500 |
| chr2 | 180500476 | 180544980 | Ntsr1 | body |
| chr2 | 180581804 | 180586304 | Mrgbp | body |
| chr2 | 180589745 | 180595836 | Ogfr | body |
| chr2 | 180597290 | 180598290 | Col9a3 | TSS500 |
| chr2 | 180725763 | 180742280 | Slc17a9 | body |
| chr2 | 180774381 | 180776400 | Bhlhe23 | body |
| chr2 | 180829490 | 180889160 | Gm14342 | body |
| chr2 | 180836981 | 180848914 | Gm14344 | body |
| chr2 | 180893531 | 180894531 | Mir124a-3 | TSS500 |
| chr2 | 180893605 | 180894605 | Gm27032 | TSS500 |
| chr2 | 180954199 | 180955199 | Nkain4 | TSS500 |
| chr2 | 180934772 | 180954199 | Nkain4 | body |

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|------|-----------|-----------|-----------|--------|
| chr2 | 180953964 | 180954964 | Gm14341 | TSS500 |
| chr2 | 180954964 | 180966812 | Gm14341 | body |
| chr2 | 180987035 | 181017540 | Col20a1 | body |
| chr2 | 181018380 | 181043046 | Chrna4 | body |
| chr2 | 181134791 | 181135791 | Kcnq2 | TSS500 |
| chr2 | 181156514 | 181157514 | Eef1a2 | TSS500 |
| chr2 | 181202289 | 181203289 | Ptk6 | TSS500 |
| chr2 | 181212685 | 181213685 | Srms | TSS500 |
| chr2 | 181205562 | 181212685 | Srms | body |
| chr2 | 181219513 | 181220513 | BC051628 | TSS500 |
| chr2 | 181227615 | 181241527 | Helz2 | body |
| chr2 | 181357690 | 181364904 | Arfrp1 | body |
| chr2 | 181492706 | 181493706 | Abhd16b | TSS500 |
| chr2 | 181493706 | 181494980 | Abhd16b | body |
| chr2 | 181587468 | 181588468 | Mir7006 | TSS500 |
| chr2 | 181592368 | 181655660 | Prpf6 | body |
| chr2 | 181598712 | 181599712 | Samd10 | TSS500 |
| chr2 | 181671140 | 181672140 | Sox18 | TSS500 |
| chr2 | 181669836 | 181671140 | Sox18 | body |
| chr2 | 181696793 | 181697942 | Lkaear1 | body |
| chr2 | 181715516 | 181720985 | Opr1 | body |
| chr2 | 181763832 | 181827797 | Myt1 | body |
| chr2 | 181991726 | 182001766 | Gm14496 | body |
| chrX | 5466898 | 5468765 | Mycs | body |
| chrX | 6070978 | 6071978 | Gm27360 | TSS500 |
| chrX | 6081219 | 6082919 | AU022751 | body |
| chrX | 6172515 | 6173515 | Nudt10 | TSS500 |
| chrX | 6779806 | 6948363 | Dgkk | body |
| chrX | 6979652 | 7041119 | Ccnb3 | body |
| chrX | 7068019 | 7078609 | Akap4 | body |
| chrX | 7557296 | 7573783 | Ppp1r3f | body |
| chrX | 7574100 | 7581015 | Ppp1r3fos | body |
| chrX | 7605017 | 7606017 | Ccdc22 | TSS500 |
| chrX | 7607583 | 7635196 | Cacna1f | body |
| chrX | 7638971 | 7653256 | Syp | body |
| chrX | 7651106 | 7656758 | Gm14703 | body |
| chrX | 7667941 | 7670890 | Plp2 | body |
| chrX | 7673164 | 7680751 | Magix | body |
| chrX | 7696631 | 7697631 | Gpkow | TSS500 |
| chrX | 7721473 | 7722473 | Wdr45 | TSS500 |
| chrX | 7762060 | 7763060 | Tfe3 | TSS500 |
| chrX | 7790265 | 7820567 | Gripap1 | body |
| chrX | 7883541 | 7884541 | Slc35a2 | TSS500 |
| chrX | 7898769 | 7899769 | Pqbp1 | TSS500 |

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|------|----------|----------|---------------|--------|
| chrX | 7898857 | 7899857 | Timm17b | TSS500 |
| chrX | 7899857 | 7908351 | Timm17b | body |
| chrX | 7919322 | 7920322 | Pcsk1n | TSS500 |
| chrX | 7947389 | 7948389 | Hdac6 | TSS500 |
| chrX | 7930120 | 7947389 | Hdac6 | body |
| chrX | 7977571 | 7978571 | Gata1 | TSS500 |
| chrX | 7959260 | 7977571 | Gata1 | body |
| chrX | 8004200 | 8017992 | Glod5 | body |
| chrX | 8081453 | 8089998 | Was | body |
| chrX | 8175681 | 8176681 | Tbc1d25 | TSS500 |
| chrX | 8206025 | 8207025 | Porcn | TSS500 |
| chrX | 8193848 | 8206025 | Porcn | body |
| chrX | 8238668 | 8251906 | Ftsj1 | body |
| chrX | 8413805 | 8422157 | Ssxb1 | body |
| chrX | 8454345 | 8461226 | Ssxb2 | body |
| chrX | 8684887 | 8690344 | Ssxb8 | body |
| chrX | 8874753 | 8880750 | Gm5751 | body |
| chrX | 8892882 | 8894964 | B630019K06Rik | body |
| chrX | 9435252 | 9487271 | Cybb | body |
| chrX | 9886122 | 9994543 | Syt15 | body |
| chrX | 10117209 | 10118209 | Srpx | TSS500 |
| chrX | 10037977 | 10117209 | Srpx | body |
| chrX | 10216420 | 10217420 | Rpgr | TSS500 |
| chrX | 10252805 | 10321024 | Otc | body |
| chrX | 10716742 | 10717742 | Gm10489 | TSS500 |
| chrX | 10715513 | 10719690 | Mid1ip1 | body |
| chrX | 10718210 | 10719210 | Gm14493 | TSS500 |
| chrX | 12159855 | 12160855 | Bcor | TSS500 |
| chrX | 12339782 | 12354496 | Gm14635 | body |
| chrX | 12587301 | 12588301 | Atp6ap2 | TSS500 |
| chrX | 12673168 | 12674168 | 1810030O07Rik | TSS500 |
| chrX | 12761573 | 12762573 | Med14 | TSS500 |
| chrX | 12675369 | 12761573 | Med14 | body |
| chrX | 13071998 | 13173328 | Usp9x | body |
| chrX | 13234641 | 13247236 | 2010308F09Rik | body |
| chrX | 13517080 | 13850867 | Cask | body |
| chrX | 16709282 | 16816866 | Maob | body |
| chrX | 16885521 | 16911274 | Ndp | body |
| chrX | 17556564 | 17571825 | Fundc1 | body |
| chrX | 18163075 | 18279936 | Kdm6a | body |
| chrX | 19237356 | 19238356 | Gm26652 | TSS500 |
| chrX | 19224789 | 19237356 | Gm26652 | body |
| chrX | 20291307 | 20292307 | Slc9a7 | TSS500 |
| chrX | 20105755 | 20291307 | Slc9a7 | body |

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| chrX | 20364981 | 20405653 | Rp2h | body |
| chrX | 20615326 | 20617119 | Ndufb11 | body |
| chrX | 20618003 | 20650901 | Rbm10 | body |
| chrX | 20657826 | 20658826 | Uba1 | TSS500 |
| chrX | 20658826 | 20683179 | Uba1 | body |
| chrX | 20920504 | 20921504 | Syn1 | TSS500 |
| chrX | 20860511 | 20920504 | Syn1 | body |
| chrX | 21028939 | 21061816 | Zfp182 | body |
| chrX | 21360865 | 21364122 | Gm26593 | body |
| chrX | 23364582 | 23365582 | Klhl13 | TSS500 |
| chrX | 23219271 | 23364582 | Klhl13 | body |
| chrX | 23693551 | 23806025 | Wdr44 | body |
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| chrX | 24616617 | 24617617 | Gm27910 | TSS500 |
| chrX | 26672777 | 26702138 | Gm14525 | body |
| chrX | 29013494 | 29046381 | Gm2200 | body |
| chrX | 30587056 | 30620775 | Gm14974 | body |
| chrX | 36327853 | 36328853 | Lonrf3 | TSS500 |
| chrX | 36743159 | 36744159 | Slc25a43 | TSS500 |
| chrX | 36744159 | 36777202 | Slc25a43 | body |
| chrX | 36873611 | 36874611 | C330007P06Rik | TSS500 |
| chrX | 36873858 | 36874858 | Ube2a | TSS500 |
| chrX | 36902399 | 36903399 | Nkrf | TSS500 |
| chrX | 37049345 | 37050418 | Sowahd | body |
| chrX | 37084902 | 37085902 | Rpl39 | TSS500 |
| chrX | 37091678 | 37109822 | Upf3b | body |
| chrX | 37126295 | 37127295 | Nkap | TSS500 |
| chrX | 37190663 | 37191663 | Ndufa1 | TSS500 |
| chrX | 37213804 | 37221758 | Rhox1 | body |
| chrX | 37250419 | 37258983 | Rhox3a | body |
| chrX | 37411567 | 37412567 | Rhox2b | TSS500 |
| chrX | 37412567 | 37424764 | Rhox2b | body |
| chrX | 37454180 | 37469861 | Rhox2c | body |
| chrX | 37459085 | 37473964 | Rhox3c | body |
| chrX | 37492928 | 37493928 | Rhox2d | TSS500 |
| chrX | 37493928 | 37497623 | Rhox2d | body |
| chrX | 37581492 | 37585496 | Rhox3f | body |
| chrX | 37642970 | 37643970 | Rhox2g | TSS500 |
| chrX | 37826410 | 37827410 | Rhox6 | TSS500 |
| chrX | 38104077 | 38110407 | Rhox12 | body |
| chrX | 38455954 | 38456954 | Lamp2 | TSS500 |
| chrX | 38575696 | 38576696 | Cul4b | TSS500 |
| chrX | 38600078 | 38601078 | Mcts1 | TSS500 |
| chrX | 38630785 | 38634587 | C1galt1c1 | body |

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| chrX | 38773171 | 38962686 | 6030498E09Rik | body |
| chrX | 41400354 | 41401354 | Gria3 | TSS500 |
| chrX | 41794991 | 41920174 | Thoc2 | body |
| chrX | 42148817 | 42149817 | Stag2 | TSS500 |
| chrX | 42149817 | 42277185 | Stag2 | body |
| chrX | 42502953 | 42529330 | Sh2d1a | body |
| chrX | 42527866 | 43428626 | Tenm1 | body |
| chrX | 44365458 | 44367842 | Dcaf12l2 | body |
| chrX | 46473585 | 46773599 | Gm29242 | body |
| chrX | 47809368 | 47892474 | Smarca1 | body |
| chrX | 48034353 | 48035353 | Apln | TSS500 |
| chrX | 48025146 | 48034353 | Apln | body |
| chrX | 48146936 | 48161565 | Sash3 | body |
| chrX | 48284926 | 48285926 | 9530027J09Rik | TSS500 |
| chrX | 48276792 | 48284926 | 9530027J09Rik | body |
| chrX | 48340858 | 48341858 | Bcorl1 | TSS500 |
| chrX | 48411046 | 48462632 | Elf4 | body |
| chrX | 48474944 | 48513063 | Aifm1 | body |
| chrX | 48519785 | 48530232 | Rab33a | body |
| chrX | 48541625 | 48594004 | Zfp280c | body |
| chrX | 48622913 | 48623913 | Slc25a14 | TSS500 |
| chrX | 48623913 | 48662294 | Slc25a14 | body |
| chrX | 48694504 | 48695504 | Rbmx2 | TSS500 |
| chrX | 49797249 | 49798249 | Igsf1 | TSS500 |
| chrX | 49782536 | 49797249 | Igsf1 | body |
| chrX | 50840547 | 50841547 | Stk26 | TSS500 |
| chrX | 50942210 | 50943210 | Frmd7 | TSS500 |
| chrX | 51017518 | 51018518 | Rap2c | TSS500 |
| chrX | 51206032 | 51207032 | Mbnl3 | TSS500 |
| chrX | 51800733 | 51801733 | Usp26 | TSS500 |
| chrX | 51753959 | 51800733 | Usp26 | body |
| chrX | 51972272 | 51973272 | 1700080016Rik | TSS500 |
| chrX | 52164752 | 52165752 | Gpc4 | TSS500 |
| chrX | 52613450 | 52614450 | Gpc3 | TSS500 |
| chrX | 52272426 | 52613450 | Gpc3 | body |
| chrX | 52576343 | 52619047 | A630012P03Rik | body |
| chrX | 52790700 | 52791700 | Ccdc160 | TSS500 |
| chrX | 52911766 | 52912766 | Phf6 | TSS500 |
| chrX | 53243415 | 53269305 | Fam122b | body |
| chrX | 53370002 | 53371002 | Mospd1 | TSS500 |
| chrX | 53344598 | 53370002 | Mospd1 | body |
| chrX | 53643182 | 53644182 | Cxx1a | TSS500 |
| chrX | 53669908 | 53670908 | Cxx1b | TSS500 |
| chrX | 53724326 | 53725326 | 4930502E18Rik | TSS500 |

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| chrX | 53797206 | 53798206 | Xlr | TSS500 |
| chrX | 56136072 | 56137072 | 3830403N18Rik | TSS500 |
| chrX | 56189827 | 56212381 | Gm773 | body |
| chrX | 56455357 | 56507843 | Ddx26b | body |
| chrX | 56585512 | 56597569 | Mmgt1 | body |
| chrX | 56821826 | 56822826 | Mtap7d3 | TSS500 |
| chrX | 57042574 | 57043574 | Brs3 | TSS500 |
| chrX | 57088606 | 57106540 | Vgll1 | body |
| chrX | 57212643 | 57224042 | Cd40lg | body |
| chrX | 57392536 | 57393536 | Rbmx | TSS500 |
| chrX | 57383530 | 57392536 | Rbmx | body |
| chrX | 57409654 | 57488767 | Gm364 | body |
| chrX | 57503257 | 57504257 | Gpr101 | TSS500 |
| chrX | 59999964 | 60030759 | F9 | body |
| chrX | 60178589 | 60179589 | Mcf2 | TSS500 |
| chrX | 60055956 | 60178589 | Mcf2 | body |
| chrX | 60592198 | 60593198 | Atp11c | TSS500 |
| chrX | 60894153 | 60898067 | Gm14662 | body |
| chrX | 61709997 | 61710955 | Ldoc1 | body |
| chrX | 64174048 | 64178778 | 3830417A13Rik | body |
| chrX | 64276496 | 64277496 | Sliitrk4 | TSS500 |
| chrX | 68677899 | 68678899 | Gm10474 | TSS500 |
| chrX | 68667514 | 68677899 | Gm10474 | body |
| chrX | 68678041 | 68679041 | Fmr1 | TSS500 |
| chrX | 68679041 | 68717963 | Fmr1 | body |
| chrX | 68762339 | 68804567 | Fmr1nb | body |
| chrX | 69356596 | 69360769 | Gm14705 | body |
| chrX | 69359794 | 69360794 | Aff2 | TSS500 |
| chrX | 69360794 | 69868037 | Aff2 | body |
| chrX | 69929259 | 70143088 | 1700111N16Rik | body |
| chrX | 70364584 | 70365584 | Ids | TSS500 |
| chrX | 70343069 | 70364584 | Ids | body |
| chrX | 70385377 | 70386377 | 1110012L19Rik | TSS500 |
| chrX | 71211267 | 71315691 | Mtm1 | body |
| chrX | 71420060 | 71492349 | Cd99l2 | body |
| chrX | 71816424 | 71839757 | Vma21 | body |
| chrX | 71928316 | 71929316 | Gm1141 | TSS500 |
| chrX | 71963124 | 71972722 | Prrg3 | body |
| chrX | 72274303 | 72275303 | Gabre | TSS500 |
| chrX | 72255999 | 72274303 | Gabre | body |
| chrX | 72432681 | 72656348 | Gabra3 | body |
| chrX | 73081978 | 73082978 | Xlr4a | TSS500 |
| chrX | 73096595 | 73097595 | Xlr3a | TSS500 |
| chrX | 73086293 | 73096595 | Xlr3a | body |

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| chrX | 73107635 | 73292476 | Xlr5a | body |
| chrX | 73213833 | 73214833 | Xlr4b | TSS500 |
| chrX | 73227791 | 73228791 | F8a | TSS500 |
| chrX | 73242630 | 73243630 | Xlr4c | TSS500 |
| chrX | 73264890 | 73265890 | Xlr3c | TSS500 |
| chrX | 73342121 | 73343121 | Zfp275 | TSS500 |
| chrX | 73483102 | 73484102 | Bgn | TSS500 |
| chrX | 73484102 | 73495933 | Bgn | body |
| chrX | 73503586 | 73571005 | Atp2b3 | body |
| chrX | 73672650 | 73673650 | Slc6a8 | TSS500 |
| chrX | 73716097 | 73717097 | Abcd1 | TSS500 |
| chrX | 73757590 | 73772514 | Plxnb3 | body |
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| chrX | 73922121 | 73930350 | Renbp | body |
| chrX | 73942792 | 73965857 | Hcfc1 | body |
| chrX | 74023418 | 74024418 | Irak1 | TSS500 |
| chrX | 74023098 | 74024098 | Mir5132 | TSS500 |
| chrX | 74023436 | 74024436 | Mir718 | TSS500 |
| chrX | 74223461 | 74249320 | Flna | body |
| chrX | 74270312 | 74271312 | Rpl10 | TSS500 |
| chrX | 74296597 | 74297597 | Atp6ap1 | TSS500 |
| chrX | 74353118 | 74354118 | Lage3 | TSS500 |
| chrX | 74365718 | 74372718 | Ubl4 | body |
| chrX | 74392772 | 74393772 | Fam3a | TSS500 |
| chrX | 74392790 | 74393790 | lkbkg | TSS500 |
| chrX | 75109733 | 75130516 | Mpp1 | body |
| chrX | 75172715 | 75382115 | F8 | body |
| chrX | 75513799 | 75514799 | Vbp1 | TSS500 |
| chrX | 75514799 | 75534942 | Vbp1 | body |
| chrX | 75550617 | 75551617 | Gm15384 | TSS500 |
| chrX | 75577731 | 75578731 | Rab39b | TSS500 |
| chrX | 76260892 | 76261892 | Gm14717 | TSS500 |
| chrX | 77510513 | 77511513 | Tbl1x | TSS500 |
| chrX | 79266559 | 79294781 | Gm16462 | body |
| chrX | 79482568 | 79516785 | Gm7173 | body |
| chrX | 79623231 | 79670935 | Mageb16 | body |
| chrX | 81070694 | 81072602 | Gm26775 | body |
| chrX | 81070198 | 81071198 | Tmem47 | TSS500 |
| chrX | 81071198 | 81097872 | Tmem47 | body |
| chrX | 81419575 | 81457621 | 4930595M18Rik | body |
| chrX | 82949370 | 85206141 | Dmd | body |
| chrX | 85573522 | 85574522 | Tab3 | TSS500 |
| chrX | 86250254 | 86304593 | Mageb4 | body |

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| chrX | 86740870 | 88115145 | Il1rapl1 | body |
| chrX | 89409189 | 89410189 | Pet2 | TSS500 |
| chrX | 90891642 | 90892642 | Gm44 | TSS500 |
| chrX | 90892642 | 90893134 | Gm44 | body |
| chrX | 92118879 | 92599072 | Mageb18 | body |
| chrX | 93286945 | 93298357 | Arx | body |
| chrX | 93631655 | 93632655 | Pola1 | TSS500 |
| chrX | 93655363 | 93749951 | Pcyt1b | body |
| chrX | 93968159 | 93969159 | AU015836 | TSS500 |
| chrX | 94366617 | 94367617 | Apoo | TSS500 |
| chrX | 94541643 | 94542643 | Maged1 | TSS500 |
| chrX | 94793603 | 94798237 | Gm26617 | body |
| chrX | 95196321 | 95197321 | Arhgef9 | TSS500 |
| chrX | 95420318 | 95444372 | Amer1 | body |
| chrX | 95711178 | 95712178 | Zc3h12b | TSS500 |
| chrX | 96247203 | 96292938 | Vsig4 | body |
| chrX | 96306178 | 96455794 | Hsf3 | body |
| chrX | 96455859 | 96574485 | Heph | body |
| chrX | 97333840 | 97376716 | Eda2r | body |
| chrX | 99003748 | 99074728 | Stard8 | body |
| chrX | 99135630 | 99136630 | Efnb1 | TSS500 |
| chrX | 99443297 | 99444297 | Gm14812 | TSS500 |
| chrX | 99409571 | 99418395 | Gm14809 | body |
| chrX | 99465734 | 99470773 | Pja1 | body |
| chrX | 99820521 | 99821521 | Tmem28 | TSS500 |
| chrX | 99821521 | 99848790 | Tmem28 | body |
| chrX | 99975106 | 99976106 | Eda | TSS500 |
| chrX | 99976106 | 100400762 | Eda | body |
| chrX | 100402221 | 100442217 | Awat2 | body |
| chrX | 100494791 | 100516125 | Igfbp1 | body |
| chrX | 100594369 | 100595369 | P2ry4 | TSS500 |
| chrX | 100590154 | 100594369 | P2ry4 | body |
| chrX | 100730373 | 100738895 | Gdpd2 | body |
| chrX | 100838648 | 101059167 | Tex11 | body |
| chrX | 101222063 | 101223063 | Snx12 | TSS500 |
| chrX | 101097786 | 101222063 | Snx12 | body |
| chrX | 101254028 | 101255028 | Foxo4 | TSS500 |
| chrX | 101255028 | 101260873 | Foxo4 | body |
| chrX | 101261376 | 101263492 | Gm614 | body |
| chrX | 101261405 | 101268523 | Gm20489 | body |
| chrX | 101273530 | 101274530 | Med12 | TSS500 |
| chrX | 101298668 | 101299668 | Nlgn3 | TSS500 |
| chrX | 101376878 | 101385629 | Gjb1 | body |
| chrX | 101428818 | 101429818 | Nono | TSS500 |

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| chrX | 101639560 | 101640560 | Ogt | TSS500 |
| chrX | 101640560 | 101684351 | Ogt | body |
| chrX | 101731535 | 101733769 | Cxcr3 | body |
| chrX | 102156591 | 102157591 | Ercc6l | TSS500 |
| chrX | 102188894 | 102189894 | Rps4x | TSS500 |
| chrX | 102504859 | 102505859 | Hdac8 | TSS500 |
| chrX | 102284639 | 102504859 | Hdac8 | body |
| chrX | 102643746 | 102644746 | Phka1 | TSS500 |
| chrX | 103184176 | 103186140 | Nap1l2 | body |
| chrX | 103355976 | 103356976 | Chic1 | TSS500 |
| chrX | 103623254 | 103624254 | Ftx | TSS500 |
| chrX | 103697414 | 103821465 | Slc16a2 | body |
| chrX | 103980784 | 103981784 | Rlim | TSS500 |
| chrX | 104200685 | 104201685 | C77370 | TSS500 |
| chrX | 104077434 | 104200685 | C77370 | body |
| chrX | 104482318 | 104483318 | Uprt | TSS500 |
| chrX | 104483318 | 104507490 | Uprt | body |
| chrX | 104536969 | 104670564 | Zdhhc15 | body |
| chrX | 105079256 | 105080256 | Pbdc1 | TSS500 |
| chrX | 105119878 | 105120878 | Magee1 | TSS500 |
| chrX | 105120878 | 105123927 | Magee1 | body |
| chrX | 105348282 | 105391276 | 5330434G04Rik | body |
| chrX | 105763779 | 105764779 | Fgf16 | TSS500 |
| chrX | 105797615 | 105928897 | Atrx | body |
| chrX | 106026776 | 106027776 | Atp7a | TSS500 |
| chrX | 106027776 | 106124926 | Atp7a | body |
| chrX | 106143704 | 106160493 | Tlr13 | body |
| chrX | 106186600 | 106187600 | Pgk1 | TSS500 |
| chrX | 106484901 | 106485901 | Fndc3c1 | TSS500 |
| chrX | 106420041 | 106484901 | Fndc3c1 | body |
| chrX | 106837082 | 106840144 | Zcchc5 | body |
| chrX | 107256378 | 107296769 | Gpr174 | body |
| chrX | 107815834 | 107816834 | 2610002M06Rik | TSS500 |
| chrX | 107793090 | 107872909 | Fam46d | body |
| chrX | 108833872 | 108834872 | Brwd3 | TSS500 |
| chrX | 109012904 | 109013904 | Hmgn5 | TSS500 |
| chrX | 109094865 | 109095865 | Sh3bgrl | TSS500 |
| chrX | 112011507 | 112127326 | Tex16 | body |
| chrX | 112311834 | 112372755 | Apool | body |
| chrX | 112384303 | 112406279 | Satl1 | body |
| chrX | 113040593 | 113185017 | Chm | body |
| chrX | 113298010 | 113836386 | Dach2 | body |
| chrX | 114473833 | 114474833 | Klhl4 | TSS500 |
| chrX | 114474833 | 114560829 | Klhl4 | body |

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| chrX | 120290759 | 120910619 | Pcdh11x | body |
| chrX | 120312595 | 120313595 | H2afb3 | TSS500 |
| chrX | 122396901 | 122397901 | Nap1l3 | TSS500 |
| chrX | 123102995 | 123103995 | 3110007F17Rik | TSS500 |
| chrX | 123103995 | 123188795 | 3110007F17Rik | body |
| chrX | 123704291 | 123705291 | Gm17467 | TSS500 |
| chrX | 124629393 | 124630393 | Gm17469 | TSS500 |
| chrX | 126017057 | 126018057 | Gm17267 | TSS500 |
| chrX | 129749242 | 129750242 | Diap2 | TSS500 |
| chrX | 133687280 | 133688280 | Gm26851 | TSS500 |
| chrX | 133907926 | 133908926 | Srpx2 | TSS500 |
| chrX | 134058687 | 134059687 | Cstf2 | TSS500 |
| chrX | 134188001 | 134208028 | Arl13a | body |
| chrX | 134295725 | 134305969 | Tmem35 | body |
| chrX | 134308584 | 134362639 | Cenpi | body |
| chrX | 134404051 | 134405051 | Drp2 | TSS500 |
| chrX | 134585154 | 134586154 | Rpl36a | TSS500 |
| chrX | 134601679 | 134607060 | Hnrnph2 | body |
| chrX | 134686019 | 134687019 | Armcx4 | TSS500 |
| chrX | 134717463 | 134718463 | Armcx1 | TSS500 |
| chrX | 134756095 | 134757095 | Armcx3 | TSS500 |
| chrX | 134757095 | 134761455 | Armcx3 | body |
| chrX | 134757131 | 134758131 | Mir7093 | TSS500 |
| chrX | 134804145 | 134808721 | Armcx2 | body |
| chrX | 135210187 | 135211187 | Tceal6 | TSS500 |
| chrX | 135302807 | 135312652 | Pramel3 | body |
| chrX | 135654698 | 135693290 | 1700008I05Rik | body |
| chrX | 135743233 | 135803474 | Gprasp1 | body |
| chrX | 135885351 | 135886351 | Bhlhb9 | TSS500 |
| chrX | 135886351 | 135891081 | Bhlhb9 | body |
| chrX | 135993324 | 135994324 | Arxes2 | TSS500 |
| chrX | 136072099 | 136084755 | Nxf3 | body |
| chrX | 136139496 | 136140443 | Bex4 | body |
| chrX | 136215013 | 136216013 | Bex1 | TSS500 |
| chrX | 136213972 | 136215013 | Bex1 | body |
| chrX | 136214279 | 136215279 | Tceal7 | TSS500 |
| chrX | 136245579 | 136247139 | Wbp5 | body |
| chrX | 136448107 | 136543556 | Kir3dl2 | body |
| chrX | 136518499 | 136534309 | Kir3dl1 | body |
| chrX | 136591342 | 136668378 | Tceal3 | body |
| chrX | 136707482 | 136708482 | Tceal1 | TSS500 |
| chrX | 136976369 | 136977369 | Tmsb15l | TSS500 |
| chrX | 136954988 | 136976369 | Tmsb15l | body |
| chrX | 136976374 | 136977374 | Tmsb15b1 | TSS500 |

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| chrX | 136981116 | 137037802 | Slc25a53 | body |
| chrX | 136993655 | 136998472 | Zcchc18 | body |
| chrX | 137050094 | 137082503 | Fam199x | body |
| chrX | 137121583 | 137122583 | Esx1 | TSS500 |
| chrX | 137570108 | 137571108 | Il1rapl2 | TSS500 |
| chrX | 137571108 | 138846946 | Il1rapl2 | body |
| chrX | 138914930 | 139010532 | Nrk | body |
| chrX | 139209542 | 139210542 | Mum1l1 | TSS500 |
| chrX | 139334183 | 139338169 | Trap1a | body |
| chrX | 139479867 | 139480867 | D330045A20Rik | TSS500 |
| chrX | 139563816 | 139673145 | Rnf128 | body |
| chrX | 139684496 | 139685496 | Tbc1d8b | TSS500 |
| chrX | 139889511 | 139998095 | Rbm41 | body |
| chrX | 140006805 | 140062212 | Nup62cl | body |
| chrX | 140063379 | 140106797 | E230019M04Rik | body |
| chrX | 140277362 | 140278362 | Gm15046 | TSS500 |
| chrX | 140178698 | 140277362 | Gm15046 | body |
| chrX | 140539528 | 140600159 | Tsc22d3 | body |
| chrX | 140812933 | 140813933 | Tex13 | TSS500 |
| chrX | 140808307 | 140812933 | Tex13 | body |
| chrX | 140908108 | 140939472 | Vsig1 | body |
| chrX | 140956228 | 140957228 | Psm10 | TSS500 |
| chrX | 140956407 | 140957407 | Atg4a | TSS500 |
| chrX | 141473576 | 141474576 | Col4a6 | TSS500 |
| chrX | 141474885 | 141475885 | Col4a5 | TSS500 |
| chrX | 141475885 | 141689234 | Col4a5 | body |
| chrX | 142081160 | 142196431 | Gucy2f | body |
| chrX | 142317993 | 142390035 | Acsl4 | body |
| chrX | 142680906 | 142681906 | Tmem164 | TSS500 |
| chrX | 142681906 | 142843494 | Tmem164 | body |
| chrX | 142966228 | 142967228 | Ammecr1 | TSS500 |
| chrX | 142851146 | 142966228 | Ammecr1 | body |
| chrX | 143393762 | 143394762 | Chrdl1 | TSS500 |
| chrX | 143285674 | 143393762 | Chrdl1 | body |
| chrX | 143518091 | 143519091 | Pak3 | TSS500 |
| chrX | 143519091 | 143797796 | Pak3 | body |
| chrX | 143855842 | 143932811 | Dcx | body |
| chrX | 144317312 | 144318312 | Alg13 | TSS500 |
| chrX | 144318312 | 144374450 | Alg13 | body |
| chrX | 144457081 | 144477066 | Trpc5os | body |
| chrX | 144689407 | 145122411 | Zcchc16 | body |
| chrX | 146962013 | 146963013 | Htr2c | TSS500 |
| chrX | 146963013 | 147197277 | Htr2c | body |
| chrX | 147383476 | 147428692 | Il13ra2 | body |

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|------|-----------|-----------|---------------|--------|
| chrX | 147766491 | 147833456 | Gm15128 | body |
| chrX | 148181224 | 148224710 | Gm15107 | body |
| chrX | 148858140 | 148924139 | Luzp4 | body |
| chrX | 149595070 | 149636764 | Gm10439 | body |
| chrX | 150312601 | 150332565 | Gm15104 | body |
| chrX | 150458654 | 150459654 | Tmem29 | TSS500 |
| chrX | 150397773 | 150458654 | Tmem29 | body |
| chrX | 150588729 | 150643878 | Pfkfb1 | body |
| chrX | 150657083 | 150658083 | Tro | TSS500 |
| chrX | 150645304 | 150657083 | Tro | body |
| chrX | 151046650 | 151089521 | Fgd1 | body |
| chrX | 151169200 | 151170200 | Gm15138 | TSS500 |
| chrX | 151198578 | 151320152 | Wnk3 | body |
| chrX | 151520172 | 151521172 | Phf8 | TSS500 |
| chrX | 151859062 | 151860062 | Mir3113 | TSS500 |
| chrX | 152001345 | 152002345 | Hsd17b10 | TSS500 |
| chrX | 152015795 | 152016795 | Ribc1 | TSS500 |
| chrX | 152015928 | 152016928 | Smc1a | TSS500 |
| chrX | 152143768 | 152144768 | Iqsec2 | TSS500 |
| chrX | 152368204 | 152369204 | Gpr173 | TSS500 |
| chrX | 152609509 | 152768965 | Shroom2 | body |
| chrX | 153006969 | 153009416 | Usp51 | body |
| chrX | 153037075 | 153038075 | Mageh1 | TSS500 |
| chrX | 153237966 | 153396132 | Klf8 | body |
| chrX | 153497727 | 153498727 | Ubqln2 | TSS500 |
| chrX | 154109633 | 154120185 | Gm15140 | body |
| chrX | 154995350 | 154996350 | Magea8 | TSS500 |
| chrX | 155215949 | 155216949 | Sat1 | TSS500 |
| chrX | 155323918 | 155340254 | Prdx4 | body |
| chrX | 155623314 | 155624314 | Ptchd1 | TSS500 |
| chrX | 155573455 | 155623314 | Ptchd1 | body |
| chrX | 155622289 | 155623289 | Gm15156 | TSS500 |
| chrX | 155623289 | 155623361 | Gm15156 | body |
| chrX | 157598215 | 157599215 | Mbtps2 | TSS500 |
| chrX | 157568485 | 157569485 | Yy2 | TSS500 |
| chrX | 157797519 | 157798519 | Gm15169 | TSS500 |
| chrX | 159209807 | 159210807 | Rps6ka3 | TSS500 |
| chrX | 159371678 | 159372678 | Eif1ax | TSS500 |
| chrX | 159527188 | 159593081 | A830080D01Rik | body |
| chrX | 159626772 | 159627772 | Sh3kbp1 | TSS500 |
| chrX | 159988933 | 160123351 | Map3k15 | body |
| chrX | 160390190 | 160391190 | Gpr64 | TSS500 |
| chrX | 160488549 | 160499370 | Gm15241 | body |
| chrX | 160501666 | 160502666 | Phka2 | TSS500 |

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|------|-----------|-----------|---------------|--------|
| chrX | 160994202 | 160995202 | Cdkl5 | TSS500 |
| chrX | 160784308 | 160994202 | Cdkl5 | body |
| chrX | 161717569 | 161779496 | Rai2 | body |
| chrX | 161831612 | 161832612 | Gm15205 | TSS500 |
| chrX | 162159230 | 162160230 | Nhs | TSS500 |
| chrX | 161907723 | 161908723 | Gm15202 | TSS500 |
| chrX | 162643149 | 162644149 | Reps2 | TSS500 |
| chrX | 162411954 | 162643149 | Reps2 | body |
| chrX | 162778919 | 162828954 | Txlng | body |
| chrX | 163760829 | 163761829 | Rnf138rt1 | TSS500 |
| chrX | 163908517 | 163909517 | Ap1s2 | TSS500 |
| chrX | 163909517 | 163933666 | Ap1s2 | body |
| chrX | 163958161 | 163959161 | Zrsr2 | TSS500 |
| chrX | 163976822 | 164027497 | Car5b | body |
| chrX | 164089330 | 164118860 | Tmem27 | body |
| chrX | 164139832 | 164188420 | Ace2 | body |
| chrX | 164192842 | 164257693 | Bmx | body |
| chrX | 164268871 | 164269871 | Pir | TSS500 |
| chrX | 164437494 | 164459170 | Asb11 | body |
| chrX | 165129017 | 165326893 | Glra2 | body |
| chrX | 166238411 | 166239411 | Gpm6b | TSS500 |
| chrX | 166239411 | 166388988 | Gpm6b | body |
| chrX | 166440204 | 166441204 | Ofd1 | TSS500 |
| chrX | 166440074 | 166441074 | Trappc2 | TSS500 |
| chrX | 166585220 | 166586220 | Egfl6 | TSS500 |
| chrX | 166523007 | 166585220 | Egfl6 | body |
| chrX | 166618102 | 166621042 | Gm15226 | body |
| chrX | 167028497 | 167029497 | Gm22368 | TSS500 |
| chrX | 167208815 | 167209815 | Tmsb4x | TSS500 |
| chrX | 167346322 | 167382249 | Prps2 | body |
| chrX | 167471309 | 168576731 | Frmpd4 | body |
| chrX | 168654117 | 168673398 | Msl3 | body |
| chrX | 168794599 | 168795599 | Arhgap6 | TSS500 |
| chrX | 169037674 | 169106036 | Gm15261 | body |
| chrX | 169319872 | 169320872 | Hccs | TSS500 |
| chrX | 169684699 | 169685699 | Mid1 | TSS500 |
| chrX | 169685699 | 170005736 | Mid1 | body |
| chr3 | 3508530 | 3658052 | Hnf4g | body |
| chr3 | 4797058 | 4798058 | 1110015O18Rik | TSS500 |
| chr3 | 7613260 | 7614260 | Il7 | TSS500 |
| chr3 | 8925593 | 9004223 | Tpd52 | body |
| chr3 | 9427020 | 9609585 | Zfp704 | body |
| chr3 | 10012048 | 10013048 | Fabp5 | TSS500 |
| chr3 | 10204088 | 10208076 | Fabp4 | body |

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|------|----------|----------|---------------|--------|
| chr3 | 10244209 | 10300683 | Fabp12 | body |
| chr3 | 10339953 | 10350817 | Zfand1 | body |
| chr3 | 10366407 | 10367407 | Chmp4c | TSS500 |
| chr3 | 13471329 | 13472329 | RP23-333L19.2 | TSS500 |
| chr3 | 13471155 | 13472155 | RP23-333L19.1 | TSS500 |
| chr3 | 13472155 | 13474596 | RP23-333L19.1 | body |
| chr3 | 13471906 | 13474096 | Gm2464 | body |
| chr3 | 14641227 | 14642227 | Car13 | TSS500 |
| chr3 | 14863012 | 14864012 | Car3 | TSS500 |
| chr3 | 14885773 | 14886773 | Car2 | TSS500 |
| chr3 | 15153065 | 15170942 | RP24-150C17.1 | body |
| chr3 | 17790421 | 17808970 | Mir124-2hg | body |
| chr3 | 18053674 | 18054674 | Bhlhe22 | TSS500 |
| chr3 | 18054674 | 18057517 | Bhlhe22 | body |
| chr3 | 18242838 | 18243838 | Cyp7b1 | TSS500 |
| chr3 | 18071950 | 18242838 | Cyp7b1 | body |
| chr3 | 18341667 | 18460754 | RP23-77D22.1 | body |
| chr3 | 18468287 | 18479977 | RP24-86E1.1 | body |
| chr3 | 19693401 | 19694896 | Crh | body |
| chr3 | 20034815 | 20035815 | Hps3 | TSS500 |
| chr3 | 20275233 | 20276233 | Cpb1 | TSS500 |
| chr3 | 20366677 | 20367677 | Agtr1b | TSS500 |
| chr3 | 20314473 | 20366677 | Agtr1b | body |
| chr3 | 25426215 | 26331960 | Nlgn1 | body |
| chr3 | 26331650 | 26333377 | A830092H15Rik | body |
| chr3 | 26638120 | 26983212 | Spata16 | body |
| chr3 | 27183465 | 27284608 | Nceh1 | body |
| chr3 | 27316528 | 27317528 | Tnfsf10 | TSS500 |
| chr3 | 27370851 | 27371851 | Ghsr | TSS500 |
| chr3 | 27371851 | 27378010 | Ghsr | body |
| chr3 | 28262714 | 28263714 | Tnik | TSS500 |
| chr3 | 28263714 | 28675858 | Tnik | body |
| chr3 | 28698403 | 28728363 | Slc2a2 | body |
| chr3 | 28702667 | 28780608 | 1700112D23Rik | body |
| chr3 | 29081523 | 29082523 | Egfem1 | TSS500 |
| chr3 | 29773466 | 29892677 | RP23-212H4.3 | body |
| chr3 | 29891514 | 29924191 | Mannr | body |
| chr3 | 30547508 | 30548508 | Mecom | TSS500 |
| chr3 | 29951296 | 30547508 | Mecom | body |
| chr3 | 30645007 | 30672431 | Lrriq4 | body |
| chr3 | 30699343 | 30700343 | Lrrc31 | TSS500 |
| chr3 | 30855450 | 30856450 | Gpr160 | TSS500 |
| chr3 | 31038466 | 31039466 | Mir7008 | TSS500 |
| chr3 | 31149420 | 31150420 | Cldn11 | TSS500 |

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|------|----------|----------|---------------|--------|
| chr3 | 31150420 | 31164324 | Cldn11 | body |
| chr3 | 31309878 | 31310878 | Slc7a14 | TSS500 |
| chr3 | 31202858 | 31309878 | Slc7a14 | body |
| chr3 | 31286087 | 31316891 | Gm15496 | body |
| chr3 | 31902007 | 31903007 | Kcnmb2 | TSS500 |
| chr3 | 31903007 | 32200180 | Kcnmb2 | body |
| chr3 | 32334792 | 32365514 | Zmat3 | body |
| chr3 | 32725397 | 32737105 | Mrpl47 | body |
| chr3 | 32817046 | 32818046 | Usp13 | TSS500 |
| chr3 | 32818046 | 32938071 | Usp13 | body |
| chr3 | 32949408 | 33142747 | Pex5l | body |
| chr3 | 33025277 | 33088607 | 4930419G24Rik | body |
| chr3 | 33812361 | 33843810 | Ccdc39 | body |
| chr3 | 34005011 | 34006011 | Gm9791 | TSS500 |
| chr3 | 34020579 | 34069342 | Fxr1 | body |
| chr3 | 34481707 | 34482707 | Gm29135 | TSS500 |
| chr3 | 35932545 | 35933545 | Gm15952 | TSS500 |
| chr3 | 36221775 | 36222775 | Qrfpr | TSS500 |
| chr3 | 37222759 | 37232118 | Il21 | body |
| chr3 | 37613413 | 37614413 | 4930594O21Rik | TSS500 |
| chr3 | 37639447 | 37640447 | Spry1 | TSS500 |
| chr3 | 38557714 | 38558714 | Gm24462 | TSS500 |
| chr3 | 38886440 | 38887440 | Fat4 | TSS500 |
| chr3 | 38887440 | 39011985 | Fat4 | body |
| chr3 | 39358628 | 39359628 | Gm9845 | TSS500 |
| chr3 | 40531786 | 40704774 | Intu | body |
| chr3 | 40743995 | 40744995 | Hspa4l | TSS500 |
| chr3 | 40893623 | 40894623 | 6430590A07Rik | TSS500 |
| chr3 | 41066326 | 41082546 | Pgrmc2 | body |
| chr3 | 45160195 | 45161195 | Gm27989 | TSS500 |
| chr3 | 45377760 | 45378760 | 2610316D01Rik | TSS500 |
| chr3 | 45280437 | 45377760 | 2610316D01Rik | body |
| chr3 | 45377898 | 45378898 | Pcdh10 | TSS500 |
| chr3 | 46447719 | 46448719 | Pabpc4l | TSS500 |
| chr3 | 46442197 | 46447719 | Pabpc4l | body |
| chr3 | 48608602 | 48609602 | 1700018B24Rik | TSS500 |
| chr3 | 49326180 | 49367359 | RP23-290N20.3 | body |
| chr3 | 50443114 | 50444114 | Slc7a11 | TSS500 |
| chr3 | 49892526 | 50443114 | Slc7a11 | body |
| chr3 | 51058910 | 51074356 | Gm29230 | body |
| chr3 | 51224947 | 51251644 | Ccrn4l | body |
| chr3 | 51377524 | 51378524 | RP23-403H2.2 | TSS500 |
| chr3 | 51396238 | 51397238 | Mgarp | TSS500 |
| chr3 | 51515319 | 51560379 | Setd7 | body |

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|------|----------|----------|---------------|--------|
| chr3 | 51685907 | 52104576 | Maml3 | body |
| chr3 | 52134047 | 52221497 | RP24-568B16.4 | body |
| chr3 | 52268435 | 52268935 | Gm20402 | body |
| chr3 | 52740216 | 52776656 | RP24-92E18.1 | body |
| chr3 | 52906756 | 52927166 | RP24-297E7.1 | body |
| chr3 | 53448588 | 53462823 | Nhlrc3 | body |
| chr3 | 53656855 | 53657855 | Frem2 | TSS500 |
| chr3 | 53513939 | 53656855 | Frem2 | body |
| chr3 | 54155557 | 54156557 | Trpc4 | TSS500 |
| chr3 | 54156557 | 54318470 | Trpc4 | body |
| chr3 | 54631939 | 54634627 | Gm26678 | body |
| chr3 | 54915387 | 54916387 | Sertm1 | TSS500 |
| chr3 | 55054555 | 55055555 | Ccna1 | TSS500 |
| chr3 | 55137839 | 55172935 | Ccdc169 | body |
| chr3 | 55182528 | 55209957 | Sohlh2 | body |
| chr3 | 55243026 | 55539064 | Dclk1 | body |
| chr3 | 57642904 | 57651215 | Commd2 | body |
| chr3 | 57666485 | 57692037 | Ankub1 | body |
| chr3 | 58141707 | 58163307 | 1700007F19Rik | body |
| chr3 | 59006478 | 59007478 | Med12l | TSS500 |
| chr3 | 59007478 | 59318410 | Med12l | body |
| chr3 | 59343894 | 59344894 | Igsf10 | TSS500 |
| chr3 | 59343771 | 59344771 | RP23-314I1.1 | TSS500 |
| chr3 | 60473330 | 60629750 | Mbnl1 | body |
| chr3 | 61003286 | 61004286 | RP24-159H19.2 | TSS500 |
| chr3 | 61003295 | 61008982 | P2ry1 | body |
| chr3 | 61365451 | 61366451 | B430305J03Rik | TSS500 |
| chr3 | 62340032 | 62341032 | RP23-83N21.1 | TSS500 |
| chr3 | 62337524 | 62340032 | RP23-83N21.1 | body |
| chr3 | 62337844 | 62338844 | Arhgef26 | TSS500 |
| chr3 | 62338844 | 62462221 | Arhgef26 | body |
| chr3 | 62529077 | 62604640 | Gpr149 | body |
| chr3 | 63242037 | 63386030 | Mme | body |
| chr3 | 64258961 | 64286995 | Vmn2r3 | body |
| chr3 | 64388621 | 64414796 | Vmn2r4 | body |
| chr3 | 64537561 | 64564798 | Vmn2r6 | body |
| chr3 | 64690660 | 64844265 | Vmn2r7 | body |
| chr3 | 65108884 | 65109884 | Kcnab1 | TSS500 |
| chr3 | 65658788 | 65659788 | Mir8120 | TSS500 |
| chr3 | 65665728 | 65666728 | Lekr1 | TSS500 |
| chr3 | 65829116 | 65871781 | RP23-251B16.2 | body |
| chr3 | 66053558 | 66296337 | Veph1 | body |
| chr3 | 66220410 | 66225805 | Ptx3 | body |
| chr3 | 66971727 | 66981271 | Shox2 | body |

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|------|----------|----------|---------------|--------|
| chr3 | 66980890 | 66981890 | Rsrc1 | TSS500 |
| chr3 | 67515023 | 67516023 | Rarres1 | TSS500 |
| chr3 | 67478972 | 67515023 | Rarres1 | body |
| chr3 | 67891720 | 67892720 | lqcj | TSS500 |
| chr3 | 67892720 | 68056593 | lqcj | body |
| chr3 | 67891732 | 67892732 | SCHIP1 | TSS500 |
| chr3 | 67892732 | 68626466 | SCHIP1 | body |
| chr3 | 68065302 | 68626481 | Schip1 | body |
| chr3 | 68869766 | 68870766 | Gm17641 | TSS500 |
| chr3 | 68867917 | 68869766 | Gm17641 | body |
| chr3 | 68869086 | 68870086 | 1110032F04Rik | TSS500 |
| chr3 | 68870086 | 68872163 | 1110032F04Rik | body |
| chr3 | 69067149 | 69126613 | Kpna4 | body |
| chr3 | 69131733 | 69157177 | Gm1647 | body |
| chr3 | 69221919 | 69222919 | Arl14 | TSS500 |
| chr3 | 69574158 | 69598460 | B3galnt1 | body |
| chr3 | 70008113 | 70028708 | Otol1 | body |
| chr3 | 72888557 | 72967363 | Sis | body |
| chr3 | 73057303 | 73058303 | Slitrk3 | TSS500 |
| chr3 | 73047265 | 73057303 | Slitrk3 | body |
| chr3 | 73066816 | 73594830 | RP23-275B16.1 | body |
| chr3 | 73329934 | 73470014 | RP24-74B11.1 | body |
| chr3 | 73351206 | 73481151 | RP24-369K4.1 | body |
| chr3 | 73707915 | 73708915 | Bche | TSS500 |
| chr3 | 75037907 | 75164534 | Zbbx | body |
| chr3 | 75875084 | 75956449 | Golim4 | body |
| chr3 | 76074770 | 76710019 | Fstl5 | body |
| chr3 | 79287673 | 79289848 | RP24-253I2.1 | body |
| chr3 | 79337161 | 79464129 | Gm17359 | body |
| chr3 | 80055392 | 80213085 | RP23-121N19.3 | body |
| chr3 | 80802335 | 80803335 | Gria2 | TSS500 |
| chr3 | 80681450 | 80802335 | Gria2 | body |
| chr3 | 81035916 | 81036916 | Pdgfc | TSS500 |
| chr3 | 82032004 | 82074211 | Gucy1b3 | body |
| chr3 | 82092427 | 82145289 | Gucy1a3 | body |
| chr3 | 82538383 | 82547584 | Npy2r | body |
| chr3 | 82926665 | 83007988 | RP24-180K20.1 | body |
| chr3 | 83008224 | 83015049 | Fgg | body |
| chr3 | 83049363 | 83050363 | Fgb | TSS500 |
| chr3 | 83128746 | 83129746 | Gm10710 | TSS500 |
| chr3 | 83128448 | 83357209 | Dchs2 | body |
| chr3 | 83555363 | 83573622 | 1700028M03Rik | body |
| chr3 | 83765821 | 83766821 | Sfrp2 | TSS500 |
| chr3 | 83766821 | 83774316 | Sfrp2 | body |

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|------|----------|----------|---------------|--------|
| chr3 | 83789456 | 83790456 | Gm26771 | TSS500 |
| chr3 | 83841267 | 83842267 | Tlr2 | TSS500 |
| chr3 | 84155286 | 84156286 | Mnd1 | TSS500 |
| chr3 | 84160439 | 84304946 | Trim2 | body |
| chr3 | 84479929 | 84480929 | Fhdc1 | TSS500 |
| chr3 | 84582125 | 84583125 | Arfip1 | TSS500 |
| chr3 | 84496426 | 85887016 | RP24-559D1.1 | body |
| chr3 | 84665692 | 84666692 | Tmem154 | TSS500 |
| chr3 | 85660061 | 85887018 | Fam160a1 | body |
| chr3 | 86768071 | 86778153 | RP23-438M14.4 | body |
| chr3 | 86786151 | 86920352 | Dclk2 | body |
| chr3 | 87250758 | 87263238 | Fcrls | body |
| chr3 | 87376887 | 87402934 | Fcrl1 | body |
| chr3 | 87436273 | 87500678 | Fcrl5 | body |
| chr3 | 87616899 | 87617899 | Gm24109 | TSS500 |
| chr3 | 87617059 | 87618059 | Arhgef11 | TSS500 |
| chr3 | 87736923 | 87748125 | Lrrc71 | body |
| chr3 | 87747890 | 87823806 | Pear1 | body |
| chr3 | 87794662 | 87795662 | Ntrk1 | TSS500 |
| chr3 | 87778244 | 87794662 | Ntrk1 | body |
| chr3 | 87797451 | 87816101 | Insrr | body |
| chr3 | 87948166 | 87949166 | Crabp2 | TSS500 |
| chr3 | 87949166 | 87953376 | Crabp2 | body |
| chr3 | 87970578 | 87971578 | Nes | TSS500 |
| chr3 | 87971578 | 87980451 | Nes | body |
| chr3 | 88142872 | 88172086 | Mef2d | body |
| chr3 | 88199102 | 88204095 | AI849053 | body |
| chr3 | 88207313 | 88229959 | Gm3764 | body |
| chr3 | 88214671 | 88215671 | Mir3093 | TSS500 |
| chr3 | 88254209 | 88255209 | Rhbg | TSS500 |
| chr3 | 88282757 | 88296499 | Tsacc | body |
| chr3 | 88364084 | 88365084 | Paqr6 | TSS500 |
| chr3 | 88372243 | 88373243 | Bglap3 | TSS500 |
| chr3 | 88377736 | 88378199 | Bglap2 | body |
| chr3 | 88607954 | 88648052 | Arhgef2 | body |
| chr3 | 88834731 | 88835731 | Gon4l | TSS500 |
| chr3 | 89092863 | 89093863 | Rusc1 | TSS500 |
| chr3 | 89135642 | 89136642 | Pklr | TSS500 |
| chr3 | 89159696 | 89160696 | Hcn3 | TSS500 |
| chr3 | 89182643 | 89183643 | Fam189b | TSS500 |
| chr3 | 89226588 | 89227588 | Mtx1 | TSS500 |
| chr3 | 89226698 | 89227698 | Mir92b | TSS500 |
| chr3 | 89271733 | 89280642 | Efna1 | body |
| chr3 | 89350219 | 89364753 | Dcst1 | body |

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|------|----------|----------|---------------|--------|
| chr3 | 89377644 | 89394276 | Zbtb7b | body |
| chr3 | 89430714 | 89435128 | Pygo2 | body |
| chr3 | 89519664 | 89520664 | Kcnn3 | TSS500 |
| chr3 | 89764132 | 89765132 | Chrn2 | TSS500 |
| chr3 | 89753448 | 89764132 | Chrn2 | body |
| chr3 | 89774109 | 89783997 | Ube2q1 | body |
| chr3 | 89830870 | 89831870 | She | TSS500 |
| chr3 | 89999589 | 90051975 | Ubap2l | body |
| chr3 | 90243012 | 90244012 | Creb3l4 | TSS500 |
| chr3 | 90253663 | 90254663 | Crtc2 | TSS500 |
| chr3 | 90389438 | 90390438 | Slc27a3 | TSS500 |
| chr3 | 90385239 | 90389438 | Slc27a3 | body |
| chr3 | 90465366 | 90466366 | Npr1 | TSS500 |
| chr3 | 90498956 | 90508998 | Chtop | body |
| chr3 | 90600715 | 90602702 | S100a3 | body |
| chr3 | 90727406 | 90741517 | Pglyrp4 | body |
| chr3 | 92080271 | 92082642 | Lor | body |
| chr3 | 92428032 | 92428923 | Gm9774 | body |
| chr3 | 93015187 | 93016187 | Crc1 | TSS500 |
| chr3 | 93281825 | 93282092 | AC158361.1 | body |
| chr3 | 93306468 | 93464859 | RP23-227A12.5 | body |
| chr3 | 93394199 | 93399442 | Rptn | body |
| chr3 | 93442830 | 93449077 | Tchh | body |
| chr3 | 93469254 | 93471980 | Tchh1 | body |
| chr3 | 94362944 | 94364567 | C2cd4d | body |
| chr3 | 94399719 | 94404501 | Lingo4 | body |
| chr3 | 94412796 | 94413796 | Tdrkh | TSS500 |
| chr3 | 94464983 | 94479841 | Riad1 | body |
| chr3 | 94478331 | 94479331 | Celf3 | TSS500 |
| chr3 | 94694056 | 94704413 | Selenbp2 | body |
| chr3 | 94785992 | 94786992 | Cgn | TSS500 |
| chr3 | 94760069 | 94785992 | Cgn | body |
| chr3 | 95139521 | 95141860 | Tnfaip8l2 | body |
| chr3 | 95253674 | 95281576 | Prune | body |
| chr3 | 95527286 | 95556403 | Ctss | body |
| chr3 | 95625480 | 95632102 | Ensa | body |
| chr3 | 95881751 | 95882751 | Ciart | TSS500 |
| chr3 | 95878503 | 95881751 | Ciart | body |
| chr3 | 95893469 | 95894469 | Aph1a | TSS500 |
| chr3 | 96180651 | 96181651 | Sv2a | TSS500 |
| chr3 | 96220619 | 96221619 | Hist2h2be | TSS500 |
| chr3 | 96261682 | 96262811 | Hist2h4 | body |
| chr3 | 96401514 | 96402514 | 4930477E14Rik | TSS500 |
| chr3 | 96401881 | 96402881 | Gm26654 | TSS500 |

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| chr3 | 96577872 | 96593681 | Polr3gl | body |
| chr3 | 96597136 | 96599775 | Ankrd34a | body |
| chr3 | 96601633 | 96625352 | Lix1l | body |
| chr3 | 96696884 | 96706070 | Pias3 | body |
| chr3 | 96708060 | 96709060 | Nudt17 | TSS500 |
| chr3 | 96711490 | 96727128 | Polr3c | body |
| chr3 | 96904846 | 96905846 | Gpr89 | TSS500 |
| chr3 | 96918863 | 96925520 | Gja8 | body |
| chr3 | 97658693 | 97673812 | Prkab2 | body |
| chr3 | 97888207 | 97889207 | Pde4dip | TSS500 |
| chr3 | 97689824 | 97888207 | Pde4dip | body |
| chr3 | 97930673 | 97967018 | Gm5544 | body |
| chr3 | 98222656 | 98236748 | Reg4 | body |
| chr3 | 98618636 | 98629809 | Hsd3b5 | body |
| chr3 | 98709255 | 98724076 | Hsd3b2 | body |
| chr3 | 98940756 | 98941756 | 5730437C11Rik | TSS500 |
| chr3 | 98935644 | 98940756 | 5730437C11Rik | body |
| chr3 | 99884906 | 99885906 | Spag17 | TSS500 |
| chr3 | 99885906 | 100143322 | Spag17 | body |
| chr3 | 100425905 | 100426905 | 4930406D18Rik | TSS500 |
| chr3 | 100426905 | 100437754 | 4930406D18Rik | body |
| chr3 | 100562208 | 100685003 | Man1a2 | body |
| chr3 | 100825959 | 100895679 | Vtcn1 | body |
| chr3 | 101275899 | 101287439 | Cd2 | body |
| chr3 | 101306579 | 101307579 | Gm10355 | TSS500 |
| chr3 | 102010645 | 102015492 | Nhlh2 | body |
| chr3 | 102469428 | 102470428 | Ngf | TSS500 |
| chr3 | 102734917 | 102735917 | Tspan2os | TSS500 |
| chr3 | 102720231 | 102734917 | Tspan2os | body |
| chr3 | 102734029 | 102735029 | Tspan2 | TSS500 |
| chr3 | 102735029 | 102772292 | Tspan2 | body |
| chr3 | 103574731 | 103575731 | Syt6 | TSS500 |
| chr3 | 103575731 | 103645569 | Syt6 | body |
| chr3 | 103800605 | 103808944 | Dclre1b | body |
| chr3 | 103833101 | 103854618 | Bcl2l15 | body |
| chr3 | 104781340 | 104782340 | Fam19a3 | TSS500 |
| chr3 | 104767406 | 104781340 | Fam19a3 | body |
| chr3 | 104780556 | 104781556 | Ppm1j | TSS500 |
| chr3 | 104781556 | 104786018 | Ppm1j | body |
| chr3 | 104789511 | 104794459 | Rhoc | body |
| chr3 | 104961209 | 104962209 | Wnt2b | TSS500 |
| chr3 | 105452455 | 105453455 | Kcnd3os | TSS500 |
| chr3 | 105441595 | 105452455 | Kcnd3os | body |
| chr3 | 105451830 | 105452830 | Kcnd3 | TSS500 |

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| chr3 | 105800830 | 105801830 | Rap1a | TSS500 |
| chr3 | 105871358 | 105908928 | Adora3 | body |
| chr3 | 105996957 | 106014146 | Pifo | body |
| chr3 | 106481905 | 106482905 | Dennd2d | TSS500 |
| chr3 | 106684487 | 106685487 | Lrif1 | TSS500 |
| chr3 | 106934382 | 107093394 | Gm27008 | body |
| chr3 | 107035662 | 107036662 | Kcna3 | TSS500 |
| chr3 | 107101067 | 107102067 | Kcna2 | TSS500 |
| chr3 | 107102067 | 107106879 | Kcna2 | body |
| chr3 | 107183556 | 107195721 | Kcna10 | body |
| chr3 | 107326110 | 107332789 | Rbm15 | body |
| chr3 | 107517518 | 107518518 | Slc6a17 | TSS500 |
| chr3 | 107467543 | 107517518 | Slc6a17 | body |
| chr3 | 107594531 | 107595531 | Alx3 | TSS500 |
| chr3 | 107595531 | 107605776 | Alx3 | body |
| chr3 | 107926334 | 107931317 | Gstm7 | body |
| chr3 | 108017473 | 108018473 | Gstm1 | TSS500 |
| chr3 | 108018294 | 108024749 | Gm12498 | body |
| chr3 | 108044394 | 108045394 | Gstm4 | TSS500 |
| chr3 | 108186835 | 108192286 | Amigo1 | body |
| chr3 | 108226148 | 108227148 | Sypl2 | TSS500 |
| chr3 | 108211472 | 108226148 | Sypl2 | body |
| chr3 | 108284343 | 108285343 | Gm12523 | TSS500 |
| chr3 | 108283591 | 108284591 | Sort1 | TSS500 |
| chr3 | 108284591 | 108361511 | Sort1 | body |
| chr3 | 108415052 | 108416052 | Celsr2 | TSS500 |
| chr3 | 108455694 | 108536036 | 5330417C22Rik | body |
| chr3 | 108740158 | 108782296 | Aknad1 | body |
| chr3 | 108853678 | 108889508 | Fndc7 | body |
| chr3 | 109079969 | 109080969 | Slc25a54 | TSS500 |
| chr3 | 109780040 | 110143511 | Ntng1 | body |
| chr3 | 110246109 | 110250498 | Prmt6 | body |
| chr3 | 114031040 | 114220718 | Col11a1 | body |
| chr3 | 114904578 | 115125722 | Olfm3 | body |
| chr3 | 116488963 | 116507708 | Rtca | body |
| chr3 | 116512570 | 116513570 | Dbt | TSS500 |
| chr3 | 116918256 | 116968487 | Palmd | body |
| chr3 | 116968767 | 116984406 | 4930455H04Rik | body |
| chr3 | 117060517 | 117077265 | 1700061I17Rik | body |
| chr3 | 117319145 | 117360376 | Lppr4 | body |
| chr3 | 117322441 | 117323441 | Gm22408 | TSS500 |
| chr3 | 117574727 | 117575727 | Lppr5 | TSS500 |
| chr3 | 117781497 | 117868436 | Snx7 | body |
| chr3 | 118429824 | 118430824 | Gm26871 | TSS500 |

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| chr3 | 118430824 | 118530022 | Gm26871 | body |
| chr3 | 118434221 | 118435221 | Gm24155 | TSS500 |
| chr3 | 118561629 | 118562629 | Dpyd | TSS500 |
| chr3 | 118562629 | 119432918 | Dpyd | body |
| chr3 | 120604109 | 120886233 | 6530403H02Rik | body |
| chr3 | 121171195 | 121172195 | Rwdd3 | TSS500 |
| chr3 | 121531844 | 121532844 | Slc44a3 | TSS500 |
| chr3 | 121531111 | 121532111 | A530020G20Rik | TSS500 |
| chr3 | 121532111 | 121535438 | A530020G20Rik | body |
| chr3 | 121952826 | 121953826 | Arhgap29 | TSS500 |
| chr3 | 122044943 | 122180061 | Abca4 | body |
| chr3 | 122728658 | 122729658 | Pde5a | TSS500 |
| chr3 | 122729658 | 122859374 | Pde5a | body |
| chr3 | 123235649 | 123236649 | Synpo2 | TSS500 |
| chr3 | 123446413 | 123447413 | Prss12 | TSS500 |
| chr3 | 123447413 | 123506602 | Prss12 | body |
| chr3 | 123690352 | 123691352 | Ndst3 | TSS500 |
| chr3 | 124320537 | 124321537 | Tram1l1 | TSS500 |
| chr3 | 125403594 | 125404594 | Ndst4 | TSS500 |
| chr3 | 125404594 | 125724986 | Ndst4 | body |
| chr3 | 125938050 | 125939050 | Ugt8a | TSS500 |
| chr3 | 125865359 | 125938050 | Ugt8a | body |
| chr3 | 127498759 | 127499759 | Ank2 | TSS500 |
| chr3 | 127161805 | 127168288 | Gm16958 | body |
| chr3 | 127632636 | 127633636 | Neurog2 | TSS500 |
| chr3 | 127790372 | 127832135 | Tifa | body |
| chr3 | 129067805 | 129070044 | Gm28543 | body |
| chr3 | 129199378 | 129200378 | Pitx2 | TSS500 |
| chr3 | 129200378 | 129219591 | Pitx2 | body |
| chr3 | 129332220 | 129333220 | Enpep | TSS500 |
| chr3 | 129269175 | 129332220 | Enpep | body |
| chr3 | 129754822 | 129755822 | Egf | TSS500 |
| chr3 | 129803530 | 129804530 | Lrit3 | TSS500 |
| chr3 | 129804408 | 129822005 | Rrh | body |
| chr3 | 129837239 | 129875328 | Cfi | body |
| chr3 | 130181391 | 130599877 | Col25a1 | body |
| chr3 | 130616948 | 130617948 | Etnppl | TSS500 |
| chr3 | 130617948 | 130635750 | Etnppl | body |
| chr3 | 131109971 | 131110971 | Lef1 | TSS500 |
| chr3 | 131110971 | 131224356 | Lef1 | body |
| chr3 | 131290491 | 131302727 | Cyp2u1 | body |
| chr3 | 131302143 | 131303143 | 4930534D22Rik | TSS500 |
| chr3 | 131303143 | 131316661 | 4930534D22Rik | body |
| chr3 | 132084792 | 132085792 | Dkk2 | TSS500 |

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|------|-----------|-----------|---------------|--------|
| chr3 | 132660498 | 132683379 | Aimp1 | body |
| chr3 | 132949791 | 132950791 | Npnt | TSS500 |
| chr3 | 133112278 | 133234449 | Arhgef38 | body |
| chr3 | 133309610 | 133310610 | Ppa2 | TSS500 |
| chr3 | 133310610 | 133378235 | Ppa2 | body |
| chr3 | 134240036 | 134241036 | Gm26691 | TSS500 |
| chr3 | 133955473 | 134240036 | Gm26691 | body |
| chr3 | 134235991 | 134236991 | Cxxc4 | TSS500 |
| chr3 | 134236991 | 134262090 | Cxxc4 | body |
| chr3 | 134240083 | 134241083 | Mir1895 | TSS500 |
| chr3 | 134340285 | 134630265 | Gm26820 | body |
| chr3 | 134828507 | 134829507 | Tacr3 | TSS500 |
| chr3 | 135281721 | 135304426 | Bdh2 | body |
| chr3 | 135308200 | 135342767 | Slc9b2 | body |
| chr3 | 135348529 | 135397827 | Slc9b1 | body |
| chr3 | 135824779 | 135825779 | Slc39a8 | TSS500 |
| chr3 | 136670624 | 136937727 | Ppp3ca | body |
| chr3 | 137621112 | 137622112 | Ddit4l | TSS500 |
| chr3 | 138048761 | 138066888 | Gm5105 | body |
| chr3 | 138064552 | 138065552 | 1110002E22Rik | TSS500 |
| chr3 | 138261491 | 138290698 | Adh1 | body |
| chr3 | 138313786 | 138331134 | Adh6a | body |
| chr3 | 138374621 | 138388291 | Adh6-ps1 | body |
| chr3 | 139206194 | 139710299 | Stpg2 | body |
| chr3 | 141210004 | 141211855 | Pdha2 | body |
| chr3 | 141465064 | 141466064 | Unc5c | TSS500 |
| chr3 | 141466064 | 141834924 | Unc5c | body |
| chr3 | 142168925 | 142169925 | Bmpr1b | TSS500 |
| chr3 | 142560552 | 142573209 | Gbp3 | body |
| chr3 | 144188530 | 144204720 | Lmo4 | body |
| chr3 | 144688844 | 144719823 | Sh3glb1 | body |
| chr3 | 144822623 | 144848857 | Clca4 | body |
| chr3 | 144879322 | 144895511 | Gm6289 | body |
| chr3 | 145070265 | 145098604 | Clca5 | body |
| chr3 | 145292972 | 145552011 | Col24a1 | body |
| chr3 | 145650812 | 145652093 | Gm17501 | body |
| chr3 | 146150333 | 146195513 | Mcoln2 | body |
| chr3 | 146220461 | 146221461 | Lpar3 | TSS500 |
| chr3 | 146221461 | 146286214 | Lpar3 | body |
| chr3 | 146580985 | 146596112 | Dnase2b | body |
| chr3 | 146645193 | 146650817 | 4930503B20Rik | body |
| chr3 | 146685092 | 146686092 | Samd13 | TSS500 |
| chr3 | 147096684 | 147128749 | RP24-539A2.1 | body |
| chr3 | 149225245 | 149226245 | Gm10287 | TSS500 |

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| chr3 | 151837130 | 151838130 | Ptgr | TSS500 |
| chr3 | 151798918 | 151837130 | Ptgr | body |
| chr3 | 152165730 | 152166730 | Gipc2 | TSS500 |
| chr3 | 152093533 | 152165730 | Gipc2 | body |
| chr3 | 152164874 | 152165874 | D630002J18Rik | TSS500 |
| chr3 | 152165874 | 152166488 | D630002J18Rik | body |
| chr3 | 152178511 | 152209779 | Dnajb4 | body |
| chr3 | 152210958 | 152236830 | Fubp1 | body |
| chr3 | 152339907 | 152340907 | Fam73a | TSS500 |
| chr3 | 152981746 | 152982746 | St6galnac5 | TSS500 |
| chr3 | 152817081 | 152981746 | St6galnac5 | body |
| chr3 | 153724562 | 153725562 | St6galnac3 | TSS500 |
| chr3 | 153205405 | 153724562 | St6galnac3 | body |
| chr3 | 153843709 | 153844709 | Asb17 | TSS500 |
| chr3 | 153912466 | 153913466 | Rabggtb | TSS500 |
| chr3 | 153973936 | 154271722 | Slc44a5 | body |
| chr3 | 154306294 | 154330061 | Lhx8 | body |
| chr3 | 154597211 | 154623182 | Cryz | body |
| chr3 | 154663359 | 154664359 | BC007180 | TSS500 |
| chr3 | 154664359 | 154767790 | BC007180 | body |
| chr3 | 154786291 | 155054907 | Tnni3k | body |
| chr3 | 155093934 | 155194280 | Lrriq3 | body |
| chr3 | 156561294 | 156562294 | Negr1 | TSS500 |
| chr3 | 156562294 | 157316445 | Negr1 | body |
| chr3 | 157566392 | 157567392 | Ptger3 | TSS500 |
| chr3 | 157567392 | 157644758 | Ptger3 | body |
| chr3 | 159599733 | 159624799 | Rpe65 | body |
| chr4 | 3242555 | 3258092 | Al838599 | body |
| chr4 | 3677615 | 3678615 | Lyn | TSS500 |
| chr4 | 3678117 | 3689048 | Gm26857 | body |
| chr4 | 3870657 | 3871605 | Mos | body |
| chr4 | 4019163 | 4020163 | Sdr16c5 | TSS500 |
| chr4 | 3995936 | 4019163 | Sdr16c5 | body |
| chr4 | 4055929 | 4077022 | Sdr16c6 | body |
| chr4 | 4138319 | 4139319 | Penk | TSS500 |
| chr4 | 4133531 | 4138319 | Penk | body |
| chr4 | 6265612 | 6275133 | Cyp7a1 | body |
| chr4 | 6686353 | 6991057 | Tox | body |
| chr4 | 7759170 | 7760170 | Gm11795 | TSS500 |
| chr4 | 8536144 | 8607778 | Rab2a | body |
| chr4 | 10479962 | 10797311 | 1700123O12Rik | body |
| chr4 | 11199158 | 11253758 | Ints8 | body |
| chr4 | 11261315 | 11321637 | Dpy19l4 | body |
| chr4 | 11386283 | 11387283 | Esrp1 | TSS500 |

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| chr4 | 11331933 | 11386283 | Esrp1 | body |
| chr4 | 11703957 | 11704957 | Gem | TSS500 |
| chr4 | 11758647 | 11817895 | Cdh17 | body |
| chr4 | 12171515 | 12172515 | Fam92a | TSS500 |
| chr4 | 13743936 | 13893649 | Runx1t1 | body |
| chr4 | 14809498 | 14826087 | Otud6b | body |
| chr4 | 14929408 | 14930408 | Gm11837 | TSS500 |
| chr4 | 14930408 | 14953030 | Gm11837 | body |
| chr4 | 15149294 | 15150294 | Necab1 | TSS500 |
| chr4 | 14952245 | 15149294 | Necab1 | body |
| chr4 | 17657463 | 17658463 | Gm11851 | TSS500 |
| chr4 | 17852393 | 17853393 | Mmp16 | TSS500 |
| chr4 | 18860454 | 19122026 | Cnbd1 | body |
| chr4 | 19281350 | 19510623 | Cngb3 | body |
| chr4 | 19575662 | 19606932 | Rmdn1 | body |
| chr4 | 19876841 | 19922105 | Atp6v0d2 | body |
| chr4 | 20007438 | 20008438 | Ttpa | TSS500 |
| chr4 | 20041064 | 20042064 | 4930598A11Rik | TSS500 |
| chr4 | 20778366 | 20779366 | Nkain3 | TSS500 |
| chr4 | 20118874 | 20778366 | Nkain3 | body |
| chr4 | 21685463 | 21686463 | Prdm13 | TSS500 |
| chr4 | 21677480 | 21685463 | Prdm13 | body |
| chr4 | 21930829 | 21931829 | Faxc | TSS500 |
| chr4 | 22487866 | 22488866 | Pou3f2 | TSS500 |
| chr4 | 22482780 | 22487866 | Pou3f2 | body |
| chr4 | 23261284 | 23392503 | Gm11884 | body |
| chr4 | 24850624 | 24851624 | Klhl32 | TSS500 |
| chr4 | 24792180 | 24793180 | Gm11899 | TSS500 |
| chr4 | 25799744 | 25800744 | Fut9 | TSS500 |
| chr4 | 25609332 | 25799744 | Fut9 | body |
| chr4 | 26346391 | 26347391 | Manea | TSS500 |
| chr4 | 28812631 | 28813631 | Epha7 | TSS500 |
| chr4 | 28813631 | 28967499 | Epha7 | body |
| chr4 | 28814576 | 28815576 | Gm11915 | TSS500 |
| chr4 | 28814297 | 28814576 | Gm11915 | body |
| chr4 | 30432612 | 30523783 | Gm11924 | body |
| chr4 | 30665096 | 30796663 | 4930556G01Rik | body |
| chr4 | 31964597 | 32023467 | Map3k7 | body |
| chr4 | 32238304 | 32239304 | Bach2 | TSS500 |
| chr4 | 32982537 | 32983537 | Rragd | TSS500 |
| chr4 | 32983537 | 33022180 | Rragd | body |
| chr4 | 33063499 | 33095865 | Gabrr2 | body |
| chr4 | 33133021 | 33163588 | Gabrr1 | body |
| chr4 | 33174230 | 33189237 | Pm20d2 | body |

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|------|----------|----------|---------------|--------|
| chr4 | 33208491 | 33209491 | Srsf12 | TSS500 |
| chr4 | 33209491 | 33233340 | Srsf12 | body |
| chr4 | 33245423 | 33289663 | Pnrc1 | body |
| chr4 | 33924093 | 33925093 | Cnr1 | TSS500 |
| chr4 | 33925093 | 33948831 | Cnr1 | body |
| chr4 | 34024874 | 34049691 | Spaca1 | body |
| chr4 | 34729706 | 34730706 | 1700003M02Rik | TSS500 |
| chr4 | 34688559 | 34729706 | 1700003M02Rik | body |
| chr4 | 34962720 | 34966965 | Gm12364 | body |
| chr4 | 36951247 | 36952247 | Lingo2 | TSS500 |
| chr4 | 35706647 | 36951247 | Lingo2 | body |
| chr4 | 37249903 | 37332515 | Gm12374 | body |
| chr4 | 38571667 | 38854983 | Gm12381 | body |
| chr4 | 39398045 | 39449749 | Gm17094 | body |
| chr4 | 40472680 | 40477168 | Tmem215 | body |
| chr4 | 40849638 | 40850638 | Mir5123 | TSS500 |
| chr4 | 40849726 | 40850726 | Gm24112 | TSS500 |
| chr4 | 40849902 | 40850902 | Gm25931 | TSS500 |
| chr4 | 40948907 | 40965303 | Chmp5 | body |
| chr4 | 41097683 | 41098683 | Aqp3 | TSS500 |
| chr4 | 41505009 | 41516833 | 1110017D15Rik | body |
| chr4 | 41569038 | 41570038 | Fam219a | TSS500 |
| chr4 | 41569275 | 41570275 | Dnaic1 | TSS500 |
| chr4 | 41657498 | 41696589 | Cntfr | body |
| chr4 | 41730642 | 41731642 | Arid3c | TSS500 |
| chr4 | 41738493 | 41755657 | Sigmar1 | body |
| chr4 | 41755728 | 41758695 | Galt | body |
| chr4 | 41773747 | 41774747 | Ccl27a | TSS500 |
| chr4 | 42735045 | 42736045 | 4930578G10Rik | TSS500 |
| chr4 | 42736045 | 42846248 | 4930578G10Rik | body |
| chr4 | 42781928 | 42856271 | Gm12394 | body |
| chr4 | 42916160 | 42917160 | N28178 | TSS500 |
| chr4 | 42970104 | 42983640 | 1700022I11Rik | body |
| chr4 | 43002343 | 43010006 | Fancg | body |
| chr4 | 43058453 | 43059453 | Unc13b | TSS500 |
| chr4 | 43427019 | 43428634 | Fam166b | body |
| chr4 | 43492400 | 43493400 | Ccdc107 | TSS500 |
| chr4 | 43508247 | 43509247 | Gm12454 | TSS500 |
| chr4 | 43507466 | 43513729 | Car9 | body |
| chr4 | 43583994 | 43584994 | Msmg | TSS500 |
| chr4 | 43588572 | 43608755 | Gm12472 | body |
| chr4 | 43651335 | 43653094 | Spag8 | body |
| chr4 | 43655966 | 43656966 | Hint2 | TSS500 |
| chr4 | 43654227 | 43655966 | Hint2 | body |

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| chr4 | 43659622 | 43668645 | Fam221b | body |
| chr4 | 43705628 | 43709731 | Olfr71 | body |
| chr4 | 43956901 | 43957901 | Glipr2 | TSS500 |
| chr4 | 44083677 | 44084677 | Gne | TSS500 |
| chr4 | 44528659 | 44529659 | Gm19980 | TSS500 |
| chr4 | 44531145 | 44709987 | Pax5 | body |
| chr4 | 44663915 | 44664915 | Gm12462 | TSS500 |
| chr4 | 44664915 | 44685347 | Gm12462 | body |
| chr4 | 44967269 | 44968269 | Gm12493 | TSS500 |
| chr4 | 44981895 | 44990734 | Grhpr | body |
| chr4 | 45105208 | 45107614 | Tomm5 | body |
| chr4 | 45243490 | 45244490 | Frmpd1os | TSS500 |
| chr4 | 45408266 | 45409266 | Slc25a51 | TSS500 |
| chr4 | 45639436 | 45640436 | Gm12408 | TSS500 |
| chr4 | 45684089 | 45723338 | Gm829 | body |
| chr4 | 45798522 | 45799522 | Aldh1b1 | TSS500 |
| chr4 | 45826423 | 45827423 | Igfbpl1 | TSS500 |
| chr4 | 45965834 | 46034761 | Tdrd7 | body |
| chr4 | 46343109 | 46344109 | Foxe1 | TSS500 |
| chr4 | 46601702 | 46602702 | Coro2a | TSS500 |
| chr4 | 46991373 | 46992373 | Gabbr2 | TSS500 |
| chr4 | 47010281 | 47011281 | Gm568 | TSS500 |
| chr4 | 47056806 | 47057806 | Anks6 | TSS500 |
| chr4 | 47091409 | 47092409 | Galnt12 | TSS500 |
| chr4 | 48045653 | 48086447 | Nr4a3 | body |
| chr4 | 48124415 | 48125415 | Stx17 | TSS500 |
| chr4 | 48663014 | 48664014 | Murc | TSS500 |
| chr4 | 48899093 | 48963237 | Gm12436 | body |
| chr4 | 49059773 | 49340259 | Lppr1 | body |
| chr4 | 49379840 | 49407651 | Acnat2 | body |
| chr4 | 49521676 | 49531517 | Zfp189 | body |
| chr4 | 49597376 | 49598376 | Tmem246 | TSS500 |
| chr4 | 49845244 | 49846244 | Grin3a | TSS500 |
| chr4 | 49661611 | 49845244 | Grin3a | body |
| chr4 | 51217178 | 51230272 | Cylc2 | body |
| chr4 | 52910833 | 52918672 | Olfr272 | body |
| chr4 | 52988772 | 52989772 | Nipsnap3a | TSS500 |
| chr4 | 53012380 | 53022060 | Nipsnap3b | body |
| chr4 | 53159395 | 53160395 | Abca1 | TSS500 |
| chr4 | 53261356 | 53269732 | AI427809 | body |
| chr4 | 53714498 | 53765785 | Fktn | body |
| chr4 | 53779205 | 53780205 | Tal2 | TSS500 |
| chr4 | 53780205 | 53788712 | Tal2 | body |
| chr4 | 54944548 | 54945548 | Zfp462 | TSS500 |

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| chr4 | 55563765 | 55599296 | Gm12511 | body |
| chr4 | 56864688 | 56865688 | Ctnnal1 | TSS500 |
| chr4 | 56989891 | 56990891 | Frrs1l | TSS500 |
| chr4 | 56991972 | 57142937 | Epb4.1l4b | body |
| chr4 | 57360868 | 57363792 | 1700042G15Rik | body |
| chr4 | 57433747 | 57434747 | Palm2 | TSS500 |
| chr4 | 57567679 | 57568679 | Palm2Akap2 | TSS500 |
| chr4 | 57568679 | 57896982 | Palm2Akap2 | body |
| chr4 | 57718157 | 57896984 | Akap2 | body |
| chr4 | 58206359 | 58207359 | Svep1 | TSS500 |
| chr4 | 58178747 | 58206635 | Gm26889 | body |
| chr4 | 58286460 | 58374303 | Musk | body |
| chr4 | 58435255 | 58553398 | Lpar1 | body |
| chr4 | 58943128 | 58944128 | Zkscan16 | TSS500 |
| chr4 | 59003710 | 59041888 | Gm20503 | body |
| chr4 | 59034588 | 59035588 | Gng10 | TSS500 |
| chr4 | 59035588 | 59041903 | Gng10 | body |
| chr4 | 59438133 | 59439133 | Susd1 | TSS500 |
| chr4 | 59314683 | 59438133 | Susd1 | body |
| chr4 | 59581063 | 59582063 | Hsdl2 | TSS500 |
| chr4 | 59769637 | 59801089 | Inip | body |
| chr4 | 59894424 | 59895424 | Gm12542 | TSS500 |
| chr4 | 59905126 | 59914556 | Slc46a2 | body |
| chr4 | 62088788 | 62090524 | Gm12909 | body |
| chr4 | 62189540 | 62207946 | Zfp37 | body |
| chr4 | 62470396 | 62471396 | Wdr31 | TSS500 |
| chr4 | 62448653 | 62470396 | Wdr31 | body |
| chr4 | 62499008 | 62502967 | Hdhd3 | body |
| chr4 | 62560347 | 62704001 | Rgs3 | body |
| chr4 | 62627677 | 62633212 | Gm11209 | body |
| chr4 | 62965073 | 62966073 | Zfp618 | TSS500 |
| chr4 | 62966073 | 63139708 | Zfp618 | body |
| chr4 | 63143275 | 63154299 | Ambp | body |
| chr4 | 63165634 | 63171631 | Kif12 | body |
| chr4 | 63345060 | 63348163 | Orm1 | body |
| chr4 | 63362949 | 63365878 | Orm2 | body |
| chr4 | 63402854 | 63403854 | Akna | TSS500 |
| chr4 | 63381858 | 63394018 | Aknaos | body |
| chr4 | 63545272 | 63550750 | Atp6v1g1 | body |
| chr4 | 63558281 | 63559281 | 6330416G13Rik | TSS500 |
| chr4 | 63596902 | 63604761 | Gm11213 | body |
| chr4 | 63607089 | 63621928 | 1700018C11Rik | body |
| chr4 | 63727084 | 63744613 | Tnfsf15 | body |
| chr4 | 63831308 | 63860847 | Tnfsf8 | body |

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| chr4 | 65124674 | 65357509 | Pappa | body |
| chr4 | 66404111 | 66405111 | Astn2 | TSS500 |
| chr4 | 65380803 | 66404111 | Astn2 | body |
| chr4 | 68023531 | 68137113 | Gm11751 | body |
| chr4 | 68953897 | 68954897 | Brinp1 | TSS500 |
| chr4 | 72852134 | 72853134 | Aldoart1 | TSS500 |
| chr4 | 73790209 | 73791209 | Rasef | TSS500 |
| chr4 | 73714579 | 73790209 | Rasef | body |
| chr4 | 74012942 | 74013942 | Frmd3 | TSS500 |
| chr4 | 78211461 | 78212461 | Ptprd | TSS500 |
| chr4 | 75941238 | 78211461 | Ptprd | body |
| chr4 | 78661088 | 78662088 | Gm11261 | TSS500 |
| chr4 | 78659858 | 78661088 | Gm11261 | body |
| chr4 | 82290173 | 82705250 | Nfib | body |
| chr4 | 82507516 | 82508516 | Gm11266 | TSS500 |
| chr4 | 82508516 | 82547292 | Gm11266 | body |
| chr4 | 82692305 | 82693305 | Gm11269 | TSS500 |
| chr4 | 82897920 | 83051839 | Frem1 | body |
| chr4 | 84883809 | 84884809 | Cntln | TSS500 |
| chr4 | 86054415 | 86428385 | Adamtsl1 | body |
| chr4 | 86558946 | 86559804 | Fam154aos | body |
| chr4 | 86611555 | 86612555 | Haus6 | TSS500 |
| chr4 | 86578855 | 86611555 | Haus6 | body |
| chr4 | 86873896 | 86874896 | Acer2 | TSS500 |
| chr4 | 87229977 | 87230977 | Slc24a2 | TSS500 |
| chr4 | 86983124 | 87229977 | Slc24a2 | body |
| chr4 | 87769925 | 88032864 | Mllt3 | body |
| chr4 | 88759619 | 88760619 | Gm13283 | TSS500 |
| chr4 | 88793891 | 88794891 | Gm26525 | TSS500 |
| chr4 | 88784455 | 88793891 | Gm26525 | body |
| chr4 | 88793987 | 88794987 | Gm13275 | TSS500 |
| chr4 | 88805031 | 88806031 | Gm13288 | TSS500 |
| chr4 | 89137622 | 89181081 | Mtap | body |
| chr4 | 89679936 | 89694772 | Dmrta1 | body |
| chr4 | 93335011 | 93336011 | Tusc1 | TSS500 |
| chr4 | 93334138 | 93335011 | Tusc1 | body |
| chr4 | 94500081 | 94556296 | Caap1 | body |
| chr4 | 94556046 | 94557046 | Gm10306 | TSS500 |
| chr4 | 94739789 | 94874976 | Tek | body |
| chr4 | 95558007 | 95926939 | Fggy | body |
| chr4 | 95966740 | 95967740 | Hook1 | TSS500 |
| chr4 | 96628773 | 96663654 | Cyp2j5 | body |
| chr4 | 96723647 | 96784686 | Gm12695 | body |
| chr4 | 97777578 | 97778578 | E130114P18Rik | TSS500 |

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|------|-----------|-----------|---------------|--------|
| chr4 | 97773234 | 98118874 | Nfia | body |
| chr4 | 98727234 | 98738480 | L1td1 | body |
| chr4 | 98817037 | 98818037 | Kank4 | TSS500 |
| chr4 | 98754898 | 98817037 | Kank4 | body |
| chr4 | 98794268 | 98798900 | Kank4os | body |
| chr4 | 98818475 | 98823340 | I0C0044D17Rik | body |
| chr4 | 99115914 | 99116914 | Gm12705 | TSS500 |
| chr4 | 99653607 | 99654483 | Gm12688 | body |
| chr4 | 99655799 | 99656799 | Foxd3 | TSS500 |
| chr4 | 99656799 | 99658622 | Foxd3 | body |
| chr4 | 99657242 | 99658242 | Gm23366 | TSS500 |
| chr4 | 99765402 | 99929313 | Itgb3bp | body |
| chr4 | 100095291 | 100096291 | Ror1 | TSS500 |
| chr4 | 100096291 | 100444765 | Ror1 | body |
| chr4 | 101068483 | 101069483 | Raver2 | TSS500 |
| chr4 | 101292414 | 101321245 | Gm12796 | body |
| chr4 | 101346531 | 101356235 | E130102H24Rik | body |
| chr4 | 101418777 | 101419777 | Ak4 | TSS500 |
| chr4 | 101496148 | 101497148 | Dnajc6 | TSS500 |
| chr4 | 102087043 | 102088043 | Pde4b | TSS500 |
| chr4 | 102967266 | 102989255 | Gm12709 | body |
| chr4 | 103017872 | 103026342 | InsI5 | body |
| chr4 | 103038065 | 103114055 | Wdr78 | body |
| chr4 | 103114890 | 103165754 | Mier1 | body |
| chr4 | 103230445 | 103290363 | 4921539E11Rik | body |
| chr4 | 103618859 | 103619859 | Dab1 | TSS500 |
| chr4 | 103619859 | 104744844 | Dab1 | body |
| chr4 | 104912956 | 104913956 | 1700024P16Rik | TSS500 |
| chr4 | 105157847 | 105232764 | Ppap2b | body |
| chr4 | 106088714 | 106104568 | Gm12729 | body |
| chr4 | 106316713 | 106441322 | Usp24 | body |
| chr4 | 106463829 | 106464829 | Pcsk9 | TSS500 |
| chr4 | 106483456 | 106491783 | Bsnd | body |
| chr4 | 106505835 | 106506835 | Tmem61 | TSS500 |
| chr4 | 106804498 | 106805498 | Acot11 | TSS500 |
| chr4 | 106744555 | 106804498 | Acot11 | body |
| chr4 | 106847420 | 106848420 | Gm12746 | TSS500 |
| chr4 | 106841761 | 106847420 | Gm12746 | body |
| chr4 | 106911201 | 107049694 | Ssbp3 | body |
| chr4 | 107126113 | 107127113 | Gm12802 | TSS500 |
| chr4 | 107209680 | 107218060 | Ldlrad1 | body |
| chr4 | 107313863 | 107314863 | Yipf1 | TSS500 |
| chr4 | 107434072 | 107435072 | Gm24804 | TSS500 |
| chr4 | 107434091 | 107435091 | Glis1 | TSS500 |

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| chr4 | 107435091 | 107635061 | Glis1 | body |
| chr4 | 107690201 | 107758985 | 1700047F07Rik | body |
| chr4 | 107765580 | 107770601 | Gm12907 | body |
| chr4 | 107827896 | 107830344 | Lrp8os1 | body |
| chr4 | 108014791 | 108095945 | Podn | body |
| chr4 | 108043839 | 108144498 | Scp2 | body |
| chr4 | 108164937 | 108165937 | Echdc2 | TSS500 |
| chr4 | 108217422 | 108218422 | Zyg11a | TSS500 |
| chr4 | 108367777 | 108382849 | Fam159a | body |
| chr4 | 108400390 | 108406461 | Gpx7 | body |
| chr4 | 108563172 | 108578836 | Prpf38a | body |
| chr4 | 108835101 | 108862127 | Txndc12 | body |
| chr4 | 108848119 | 108849119 | A730015C16Rik | TSS500 |
| chr4 | 108848285 | 108849413 | Kti12 | body |
| chr4 | 108878563 | 108879563 | Rab3b | TSS500 |
| chr4 | 109061145 | 109201772 | Osbpl9 | body |
| chr4 | 109977313 | 109978313 | Dmrta2os | TSS500 |
| chr4 | 109976738 | 109977313 | Dmrta2os | body |
| chr4 | 109977553 | 109978553 | Dmrta2 | TSS500 |
| chr4 | 109978553 | 109983687 | Dmrta2 | body |
| chr4 | 110397161 | 110398161 | Agbl4 | TSS500 |
| chr4 | 110398161 | 111664324 | Agbl4 | body |
| chr4 | 111414506 | 111415506 | Bend5 | TSS500 |
| chr4 | 111719484 | 111720484 | Spata6 | TSS500 |
| chr4 | 111919892 | 111950358 | Skint8 | body |
| chr4 | 114163884 | 114245028 | Skint11 | body |
| chr4 | 114406224 | 114407224 | Trabd2b | TSS500 |
| chr4 | 114407224 | 114615098 | Trabd2b | body |
| chr4 | 114681304 | 114687595 | Gm12829 | body |
| chr4 | 114817161 | 114902359 | 9130410C08Rik | body |
| chr4 | 114821222 | 114822222 | Gm12830 | TSS500 |
| chr4 | 114822222 | 114856166 | Gm12830 | body |
| chr4 | 114925513 | 114926513 | Foxe3 | TSS500 |
| chr4 | 114925147 | 114925513 | Foxe3 | body |
| chr4 | 115055926 | 115056926 | Tal1 | TSS500 |
| chr4 | 115242584 | 115254557 | Cyp4a29 | body |
| chr4 | 115299546 | 115332815 | Cyp4a12a | body |
| chr4 | 115412124 | 115439034 | Cyp4a12b | body |
| chr4 | 115601469 | 115621602 | Cyp4a32 | body |
| chr4 | 115624725 | 115647223 | Cyp4b1 | body |
| chr4 | 115890165 | 115891165 | 6430628N08Rik | TSS500 |
| chr4 | 115939426 | 115940426 | Dmbx1 | TSS500 |
| chr4 | 116017426 | 116018426 | Faah | TSS500 |
| chr4 | 115967145 | 116017426 | Faah | body |

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| chr4 | 116176746 | 116177732 | Gm12951 | body |
| chr4 | 116508049 | 116538243 | lpp | body |
| chr4 | 116558158 | 116593882 | Gpbp1l1 | body |
| chr4 | 116597154 | 116600266 | Ccdc17 | body |
| chr4 | 116819904 | 116821207 | Hpdl | body |
| chr4 | 116824403 | 116825403 | Gm12996 | TSS500 |
| chr4 | 116877876 | 116989264 | Zswim5 | body |
| chr4 | 117095575 | 117096575 | Ptch2 | TSS500 |
| chr4 | 117128655 | 117133463 | Plk3 | body |
| chr4 | 117159639 | 117182139 | Kif2c | body |
| chr4 | 117213333 | 117251625 | Gm1661 | body |
| chr4 | 117252451 | 117268582 | Tmem53 | body |
| chr4 | 117496552 | 117497552 | Rnf220 | TSS500 |
| chr4 | 117271463 | 117496552 | Rnf220 | body |
| chr4 | 117296317 | 117297725 | Gm12843 | body |
| chr4 | 117757836 | 117765148 | Klf17 | body |
| chr4 | 117884326 | 117886833 | Atp6v0b | body |
| chr4 | 117894486 | 117914499 | lpo13 | body |
| chr4 | 117929263 | 117930263 | Artn | TSS500 |
| chr4 | 118526499 | 118527499 | 2610528J11Rik | TSS500 |
| chr4 | 118527499 | 118530228 | 2610528J11Rik | body |
| chr4 | 118543544 | 118544544 | Tmem125 | TSS500 |
| chr4 | 118554551 | 118620277 | Cfap57 | body |
| chr4 | 118689476 | 118689950 | Olfr1342 | body |
| chr4 | 118954419 | 118955419 | Gm12863 | TSS500 |
| chr4 | 118984058 | 118996698 | Gm12865 | body |
| chr4 | 119232212 | 119233212 | AU022252 | TSS500 |
| chr4 | 119203570 | 119232212 | AU022252 | body |
| chr4 | 119205107 | 119217717 | 4930538K18Rik | body |
| chr4 | 119300010 | 119320046 | Ppih | body |
| chr4 | 119422314 | 119423314 | Zmynd12 | TSS500 |
| chr4 | 119423314 | 119467444 | Zmynd12 | body |
| chr4 | 119492128 | 119493128 | Rimkla | TSS500 |
| chr4 | 119465283 | 119492128 | Rimkla | body |
| chr4 | 119734284 | 120138045 | Hivep3 | body |
| chr4 | 120286849 | 120287849 | Foxo6 | TSS500 |
| chr4 | 120539868 | 120569776 | Ctps | body |
| chr4 | 120854316 | 120855316 | Rims3 | TSS500 |
| chr4 | 120968317 | 121016747 | Smap2 | body |
| chr4 | 121038885 | 121039885 | Col9a2 | TSS500 |
| chr4 | 121039885 | 121055322 | Col9a2 | body |
| chr4 | 121316316 | 121324417 | Gm12888 | body |
| chr4 | 122946850 | 122960688 | Mfsd2a | body |
| chr4 | 123104665 | 123105665 | Bmp8b | TSS500 |

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| chr4 | 123115766 | 123116766 | Oxct2b | TSS500 |
| chr4 | 123127115 | 123139451 | Ppie | body |
| chr4 | 123201004 | 123202004 | Nt5c1a | TSS500 |
| chr4 | 123234056 | 123249875 | Heyl | body |
| chr4 | 123312645 | 123342752 | Bmp8a | body |
| chr4 | 123323134 | 123324134 | Oxct2a | TSS500 |
| chr4 | 123321875 | 123323134 | Oxct2a | body |
| chr4 | 123734559 | 123749845 | Akirin1 | body |
| chr4 | 124293693 | 124299348 | Gm12916 | body |
| chr4 | 124302837 | 124310961 | 1700021L23Rik | body |
| chr4 | 124414416 | 124485459 | 1700057H15Rik | body |
| chr4 | 124656669 | 124657669 | Gm27247 | TSS500 |
| chr4 | 124528924 | 124656669 | Gm27247 | body |
| chr4 | 124568690 | 124569690 | 4933407E24Rik | TSS500 |
| chr4 | 124656307 | 124657307 | Pou3f1 | TSS500 |
| chr4 | 124657307 | 124660655 | Pou3f1 | body |
| chr4 | 124743281 | 124744281 | Mir698 | TSS500 |
| chr4 | 124861671 | 124862671 | Maneal | TSS500 |
| chr4 | 124881399 | 124917800 | Epha10 | body |
| chr4 | 124894282 | 124895282 | 1700125G02Rik | TSS500 |
| chr4 | 124986509 | 124987509 | Gm12930 | TSS500 |
| chr4 | 124957647 | 124986509 | Gm12930 | body |
| chr4 | 124985930 | 124986930 | Rspo1 | TSS500 |
| chr4 | 124986930 | 125009099 | Rspo1 | body |
| chr4 | 125065203 | 125066203 | Dnali1 | TSS500 |
| chr4 | 125055338 | 125065203 | Dnali1 | body |
| chr4 | 125229097 | 125242052 | 1700041M05Rik | body |
| chr4 | 125490200 | 125491200 | Grik3 | TSS500 |
| chr4 | 125491200 | 125714173 | Grik3 | body |
| chr4 | 126103457 | 126104457 | Stk40 | TSS500 |
| chr4 | 126147244 | 126148244 | Eva1b | TSS500 |
| chr4 | 126148244 | 126149875 | Eva1b | body |
| chr4 | 126162991 | 126163991 | Sh3d21 | TSS500 |
| chr4 | 126262825 | 126275883 | Trappc3 | body |
| chr4 | 126286293 | 126287293 | Col8a2 | TSS500 |
| chr4 | 126287293 | 126314330 | Col8a2 | body |
| chr4 | 126489541 | 126532972 | Ago4 | body |
| chr4 | 126609318 | 126610318 | 5730409E04Rik | TSS500 |
| chr4 | 126610318 | 126614371 | 5730409E04Rik | body |
| chr4 | 126735740 | 126736740 | Tfap2e | TSS500 |
| chr4 | 126716006 | 126735740 | Tfap2e | body |
| chr4 | 127077883 | 127124372 | Zmym6 | body |
| chr4 | 127124191 | 127129644 | Gm12942 | body |
| chr4 | 127168704 | 127169704 | Dlgap3 | TSS500 |

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|------|-----------|-----------|---------------|--------|
| chr4 | 127313539 | 127314539 | Gja4 | TSS500 |
| chr4 | 127531122 | 127532122 | 1700080G11Rik | TSS500 |
| chr4 | 127544601 | 127545601 | A630031M04Rik | TSS500 |
| chr4 | 127970451 | 127971451 | CK137956 | TSS500 |
| chr4 | 127987357 | 127988357 | Csmd2 | TSS500 |
| chr4 | 127988357 | 128567656 | Csmd2 | body |
| chr4 | 128618119 | 128619119 | Tlr12 | TSS500 |
| chr4 | 128615443 | 128618119 | Tlr12 | body |
| chr4 | 128654202 | 128655202 | Phc2 | TSS500 |
| chr4 | 128755864 | 128769298 | A3galt2 | body |
| chr4 | 128846697 | 128873698 | Gm12968 | body |
| chr4 | 128883080 | 128884080 | Trim62 | TSS500 |
| chr4 | 128884080 | 128911328 | Trim62 | body |
| chr4 | 128930233 | 128961942 | Azin2 | body |
| chr4 | 128936505 | 128940195 | Gm15904 | body |
| chr4 | 128991458 | 128992458 | Ak2 | TSS500 |
| chr4 | 128992458 | 129011529 | Ak2 | body |
| chr4 | 129105048 | 129106048 | Tmem54 | TSS500 |
| chr4 | 129106048 | 129111626 | Tmem54 | body |
| chr4 | 129121536 | 129122536 | Hpca | TSS500 |
| chr4 | 129111570 | 129121536 | Hpca | body |
| chr4 | 129136499 | 129137499 | Fndc5 | TSS500 |
| chr4 | 129148005 | 129189227 | S100pbp | body |
| chr4 | 129219578 | 129260904 | C77080 | body |
| chr4 | 129262465 | 129265010 | Gm12976 | body |
| chr4 | 129309581 | 129318443 | Gm26722 | body |
| chr4 | 129440353 | 129441353 | Zbtb8b | TSS500 |
| chr4 | 129425765 | 129440353 | Zbtb8b | body |
| chr4 | 129490522 | 129491522 | Tssk3 | TSS500 |
| chr4 | 129491690 | 129491956 | Fam229a | body |
| chr4 | 129491969 | 129509246 | Gm12979 | body |
| chr4 | 129513081 | 129514081 | Marcks1 | TSS500 |
| chr4 | 129576815 | 129578049 | Fam167b | body |
| chr4 | 129601168 | 129624059 | Tmem234 | body |
| chr4 | 129618599 | 129619599 | Iqcc | TSS500 |
| chr4 | 129615126 | 129618599 | Iqcc | body |
| chr4 | 129672267 | 129673267 | Kpna6 | TSS500 |
| chr4 | 129643980 | 129672267 | Kpna6 | body |
| chr4 | 129810719 | 129811719 | Ptp4a2 | TSS500 |
| chr4 | 129959874 | 129960874 | 1700003M07Rik | TSS500 |
| chr4 | 129984370 | 129985370 | Bai2 | TSS500 |
| chr4 | 130024256 | 130047274 | Gm12963 | body |
| chr4 | 130138859 | 130139859 | Hcrtr1 | TSS500 |
| chr4 | 130174622 | 130175622 | Tinagl1 | TSS500 |

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| chr4 | 130209109 | 130221901 | Gm853 | body |
| chr4 | 130253495 | 130278705 | Serinc2 | body |
| chr4 | 130309095 | 130315463 | Fabp3 | body |
| chr4 | 130792037 | 130793037 | Sdc3 | TSS500 |
| chr4 | 130793037 | 130826319 | Sdc3 | body |
| chr4 | 130944885 | 130955475 | Matn1 | body |
| chr4 | 130974290 | 130975290 | Gm12973 | TSS500 |
| chr4 | 130975290 | 131001339 | Gm12973 | body |
| chr4 | 131009974 | 131010974 | A930031H19Rik | TSS500 |
| chr4 | 131000832 | 131009974 | A930031H19Rik | body |
| chr4 | 131487697 | 131505527 | Gm831 | body |
| chr4 | 131677345 | 131678345 | Gm12962 | TSS500 |
| chr4 | 131710008 | 131711008 | Gm16080 | TSS500 |
| chr4 | 131694607 | 131710008 | Gm16080 | body |
| chr4 | 131768457 | 131837788 | Ptpru | body |
| chr4 | 131921271 | 131922271 | Tmem200b | TSS500 |
| chr4 | 132075197 | 132076992 | Gm10300 | body |
| chr4 | 132221025 | 132261102 | Gmeb1 | body |
| chr4 | 132302885 | 132303885 | Rab42 | TSS500 |
| chr4 | 132492032 | 132510001 | Sesn2 | body |
| chr4 | 132530555 | 132533159 | Atpif1 | body |
| chr4 | 132532187 | 132533187 | Gm12999 | TSS500 |
| chr4 | 132563567 | 132564567 | Ptafr | TSS500 |
| chr4 | 132732046 | 132733046 | Xkr8 | TSS500 |
| chr4 | 132795887 | 132796887 | Themis2 | TSS500 |
| chr4 | 132781843 | 132795887 | Themis2 | body |
| chr4 | 132826929 | 132842669 | Ppp1r8 | body |
| chr4 | 132899213 | 132922058 | Fam76a | body |
| chr4 | 132974595 | 133001910 | Fgr | body |
| chr4 | 133011760 | 133078110 | Ahdc1 | body |
| chr4 | 133084974 | 133085974 | Gm26615 | TSS500 |
| chr4 | 133212036 | 133213036 | Gpr3 | TSS500 |
| chr4 | 133209340 | 133212036 | Gpr3 | body |
| chr4 | 133211631 | 133212631 | Cd164l2 | TSS500 |
| chr4 | 133253090 | 133262613 | Syt1l | body |
| chr4 | 133266045 | 133277292 | Tmem222 | body |
| chr4 | 133352981 | 133353981 | Wdtdc1 | TSS500 |
| chr4 | 133491100 | 133498050 | Trnp1 | body |
| chr4 | 133518463 | 133519463 | Kdf1 | TSS500 |
| chr4 | 133600556 | 133601668 | Sfn | body |
| chr4 | 133649654 | 133650654 | Zdhhc18 | TSS500 |
| chr4 | 133605299 | 133649654 | Zdhhc18 | body |
| chr4 | 134065412 | 134066412 | Aim1l | TSS500 |
| chr4 | 134129858 | 134186612 | Cep85 | body |

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| chr4 | 134190804 | 134202504 | Gm7534 | body |
| chr4 | 134237899 | 134238899 | Cnksr1 | TSS500 |
| chr4 | 134314620 | 134315620 | Trim63 | TSS500 |
| chr4 | 134342681 | 134343681 | Slc30a2 | TSS500 |
| chr4 | 134343681 | 134354484 | Slc30a2 | body |
| chr4 | 134356372 | 134383350 | Extl1 | body |
| chr4 | 134396820 | 134427413 | Pafah2 | body |
| chr4 | 134448766 | 134449671 | 1700021N21Rik | body |
| chr4 | 134496197 | 134497197 | Paqr7 | TSS500 |
| chr4 | 134511499 | 134523927 | Aunip | body |
| chr4 | 134551666 | 134552666 | Sepn1 | TSS500 |
| chr4 | 134852845 | 134853845 | Tmem57 | TSS500 |
| chr4 | 134897849 | 134914524 | Tmem50a | body |
| chr4 | 135118221 | 135119947 | Gm16225 | body |
| chr4 | 135121152 | 135177990 | Runx3 | body |
| chr4 | 135213969 | 135272314 | Clic4 | body |
| chr4 | 135320484 | 135352821 | Srrm1 | body |
| chr4 | 135445420 | 135494538 | Nipal3 | body |
| chr4 | 135495290 | 135537803 | Stpg1 | body |
| chr4 | 135573130 | 135574130 | Grhl3 | TSS500 |
| chr4 | 135541888 | 135573130 | Grhl3 | body |
| chr4 | 135685787 | 135686787 | Ifnlr1 | TSS500 |
| chr4 | 135686787 | 135708181 | Ifnlr1 | body |
| chr4 | 135727672 | 135728672 | Il22ra1 | TSS500 |
| chr4 | 135728672 | 135752140 | Il22ra1 | body |
| chr4 | 135760215 | 135815564 | Myom3 | body |
| chr4 | 135895894 | 135920207 | Cnr2 | body |
| chr4 | 135972126 | 135973126 | Lypla2 | TSS500 |
| chr4 | 136028265 | 136052928 | Rpl11 | body |
| chr4 | 136172894 | 136196057 | E2f2 | body |
| chr4 | 136205865 | 136206865 | Asap3 | TSS500 |
| chr4 | 136248229 | 136274898 | Tcea3 | body |
| chr4 | 136423024 | 136424024 | Htr1d | TSS500 |
| chr4 | 136462750 | 136463977 | 6030445D17Rik | body |
| chr4 | 136610937 | 136613226 | 4930549C01Rik | body |
| chr4 | 136623121 | 136639110 | Lactbl1 | body |
| chr4 | 136885687 | 136886687 | C1qb | TSS500 |
| chr4 | 136889804 | 136892565 | C1qc | body |
| chr4 | 136895917 | 136898303 | C1qa | body |
| chr4 | 137401554 | 137409291 | Cela3a | body |
| chr4 | 137574069 | 137575069 | Ldlrad2 | TSS500 |
| chr4 | 137664226 | 137665226 | Rap1gap | TSS500 |
| chr4 | 137665226 | 137729861 | Rap1gap | body |
| chr4 | 137696979 | 137706106 | Rap1gapos | body |

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| chr4 | 137795884 | 137796884 | Alpl | TSS500 |
| chr4 | 137741733 | 137795884 | Alpl | body |
| chr4 | 137883437 | 137884437 | Gm13012 | TSS500 |
| chr4 | 137992522 | 137993522 | Eif4g3 | TSS500 |
| chr4 | 138249903 | 138250903 | Sh2d5 | TSS500 |
| chr4 | 138249935 | 138250935 | Kif17 | TSS500 |
| chr4 | 138394092 | 138396028 | Fam43b | body |
| chr4 | 138394698 | 138395698 | AB041806 | TSS500 |
| chr4 | 138395698 | 138397714 | AB041806 | body |
| chr4 | 138709837 | 138736667 | Ubxn10 | body |
| chr4 | 138724292 | 138725292 | Pla2g2c | TSS500 |
| chr4 | 138878442 | 138882817 | Pla2g2e | body |
| chr4 | 138967612 | 138968360 | Rnf186 | body |
| chr4 | 139092493 | 139093493 | Nbl1 | TSS500 |
| chr4 | 139310208 | 139311208 | Pqlc2 | TSS500 |
| chr4 | 139310244 | 139311244 | Akr7a5 | TSS500 |
| chr4 | 139337706 | 139338706 | Gm25732 | TSS500 |
| chr4 | 139337804 | 139338804 | Gm24245 | TSS500 |
| chr4 | 139347435 | 139352076 | Mrto4 | body |
| chr4 | 139353087 | 139378730 | Emc1 | body |
| chr4 | 139376549 | 139379879 | 2700016F22Rik | body |
| chr4 | 139531048 | 139620382 | Iffo2 | body |
| chr4 | 139654038 | 139670280 | Tas1r2 | body |
| chr4 | 139737062 | 139833028 | Pax7 | body |
| chr4 | 139909988 | 139910988 | Gm1667 | TSS500 |
| chr4 | 139967120 | 139968120 | Mir2139 | TSS500 |
| chr4 | 140026846 | 140246284 | Igsf21 | body |
| chr4 | 140425144 | 140431931 | Gm13021 | body |
| chr4 | 140745865 | 140773736 | Padi4 | body |
| chr4 | 140905844 | 140906844 | Padi2 | TSS500 |
| chr4 | 141010918 | 141015984 | Mfap2 | body |
| chr4 | 141060050 | 141061050 | Crocc | TSS500 |
| chr4 | 141066512 | 141077857 | Necap2 | body |
| chr4 | 141147413 | 141148413 | Fbxo42 | TSS500 |
| chr4 | 141239999 | 141257564 | Arhgef19 | body |
| chr4 | 141367720 | 141368720 | Fam131c | TSS500 |
| chr4 | 141384610 | 141398224 | Clcnka | body |
| chr4 | 141538097 | 141539097 | Spen | TSS500 |
| chr4 | 141664399 | 141665399 | Plekhn2 | TSS500 |
| chr4 | 141625734 | 141664399 | Plekhn2 | body |
| chr4 | 141683851 | 141685099 | Rsc1a1 | body |
| chr4 | 141746172 | 141747172 | Agmat | TSS500 |
| chr4 | 141760189 | 141790431 | Dnajc16 | body |
| chr4 | 141814962 | 141825660 | Cela2a | body |

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| chr4 | 141886154 | 141897282 | Fhad1os2 | body |
| chr4 | 142014582 | 142015582 | Fhad1 | TSS500 |
| chr4 | 141983492 | 141986797 | Fhad1os1 | body |
| chr4 | 142018398 | 142028996 | 4930455G09Rik | body |
| chr4 | 142083804 | 142084804 | Tmem51 | TSS500 |
| chr4 | 142030992 | 142083804 | Tmem51 | body |
| chr4 | 142238901 | 142239901 | Kazn | TSS500 |
| chr4 | 142102390 | 142238901 | Kazn | body |
| chr4 | 143212495 | 143213495 | Prdm2 | TSS500 |
| chr4 | 143267431 | 143299064 | Pdpm | body |
| chr4 | 143349257 | 143350257 | Lrrc38 | TSS500 |
| chr4 | 144407964 | 144408964 | Pramef12 | TSS500 |
| chr4 | 144453771 | 144463256 | Aadacl3 | body |
| chr4 | 145314664 | 145315664 | Tnfrsf8 | TSS500 |
| chr4 | 145869294 | 145899975 | Gm13235 | body |
| chr4 | 146448523 | 146449523 | Gm13251 | TSS500 |
| chr4 | 146502527 | 146539395 | Gm13247 | body |
| chr4 | 146519039 | 146546373 | 1700095A21Rik | body |
| chr4 | 146610461 | 146611461 | Gm13248 | TSS500 |
| chr4 | 147869479 | 147870358 | Fv1 | body |
| chr4 | 147909753 | 147936267 | Plod1 | body |
| chr4 | 148001091 | 148003514 | Gm13054 | body |
| chr4 | 148074920 | 148075920 | Gm13201 | TSS500 |
| chr4 | 148098437 | 148130198 | Draxin | body |
| chr4 | 148129884 | 148130884 | Mad2l2 | TSS500 |
| chr4 | 148130884 | 148145699 | Mad2l2 | body |
| chr4 | 148152800 | 148159982 | Fbxo44 | body |
| chr4 | 148161121 | 148166424 | Fbxo2 | body |
| chr4 | 148287465 | 148288465 | Ptchd2 | TSS500 |
| chr4 | 148240264 | 148287465 | Ptchd2 | body |
| chr4 | 148306353 | 148307353 | Gm13206 | TSS500 |
| chr4 | 148307353 | 148316569 | Gm13206 | body |
| chr4 | 148643817 | 148671572 | Gm572 | body |
| chr4 | 148803929 | 148804929 | Casz1 | TSS500 |
| chr4 | 149479166 | 149483531 | Gm13097 | body |
| chr4 | 149585968 | 149586968 | Clstn1 | TSS500 |
| chr4 | 149702071 | 149703071 | Pik3cd | TSS500 |
| chr4 | 150086865 | 150087865 | Gpr157 | TSS500 |
| chr4 | 150113879 | 150118763 | Gm13093 | body |
| chr4 | 150651674 | 150652674 | Slc45a1 | TSS500 |
| chr4 | 150915062 | 150946102 | Tnfrsf9 | body |
| chr4 | 150917322 | 151861376 | Camta1 | body |
| chr4 | 151089070 | 151090070 | Gm13090 | TSS500 |
| chr4 | 152009303 | 152017680 | Klhl21 | body |

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| chr4 | 152019774 | 152027171 | Zbtb48 | body |
| chr4 | 152027914 | 152038068 | Tas1r1 | body |
| chr4 | 152151871 | 152152871 | Espn | TSS500 |
| chr4 | 152120331 | 152151871 | Espn | body |
| chr4 | 152158367 | 152159367 | Hes2 | TSS500 |
| chr4 | 152159367 | 152162469 | Hes2 | body |
| chr4 | 152291162 | 152292162 | Hes3 | TSS500 |
| chr4 | 152285972 | 152291162 | Hes3 | body |
| chr4 | 152318493 | 152319493 | Rnf207 | TSS500 |
| chr4 | 152307019 | 152318493 | Rnf207 | body |
| chr4 | 152338151 | 152339151 | Chd5 | TSS500 |
| chr4 | 152339151 | 152390194 | Chd5 | body |
| chr4 | 152476206 | 152477206 | Nphp4 | TSS500 |
| chr4 | 152697040 | 152698040 | Gm833 | TSS500 |
| chr4 | 152698040 | 152700515 | Gm833 | body |
| chr4 | 153482311 | 153483311 | Ajap1 | TSS500 |
| chr4 | 154025730 | 154026730 | Smim1 | TSS500 |
| chr4 | 154042177 | 154043177 | Ccdc27 | TSS500 |
| chr4 | 154026639 | 154042177 | Ccdc27 | body |
| chr4 | 154139708 | 154140708 | Trp73 | TSS500 |
| chr4 | 154301176 | 154302176 | Arhgef16 | TSS500 |
| chr4 | 154278486 | 154301176 | Arhgef16 | body |
| chr4 | 154549782 | 154550782 | Gm13133 | TSS500 |
| chr4 | 154550782 | 154557645 | Gm13133 | body |
| chr4 | 154638076 | 154644724 | Gm13111 | body |
| chr4 | 154855700 | 154856700 | Ttc34 | TSS500 |
| chr4 | 154871503 | 154872503 | Gm13112 | TSS500 |
| chr4 | 154898635 | 154899635 | Fam213b | TSS500 |
| chr4 | 154960423 | 154961423 | Hes5 | TSS500 |
| chr4 | 154961423 | 154962371 | Hes5 | body |
| chr4 | 154983115 | 155056284 | Plch2 | body |
| chr4 | 155042546 | 155045422 | Gm10564 | body |
| chr4 | 155074110 | 155085882 | Rer1 | body |
| chr4 | 155260129 | 155360861 | Prkcz | body |
| chr4 | 155490861 | 155491861 | Gnb1 | TSS500 |
| chr4 | 155625354 | 155649938 | Cdk11b | body |
| chr4 | 155652884 | 155653884 | Mmp23 | TSS500 |
| chr4 | 155694842 | 155696481 | B930041F14Rik | body |
| chr4 | 155735300 | 155740564 | Tmem240 | body |
| chr4 | 155761678 | 155769264 | Atad3aos | body |
| chr4 | 155774198 | 155775198 | Vwa1 | TSS500 |
| chr4 | 155769469 | 155770469 | Gm26840 | TSS500 |
| chr4 | 155847902 | 155859303 | Dvl1 | body |
| chr4 | 155887879 | 155891281 | Pusl1 | body |

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| chr4 | 155993372 | 156013610 | Sdf4 | body |
| chr4 | 156022008 | 156031143 | Gm16008 | body |
| chr4 | 156034840 | 156058914 | Ttll10 | body |
| chr4 | 156165290 | 156196988 | Agrn | body |
| chr5 | 3596085 | 3597085 | Rbm48 | TSS500 |
| chr5 | 4753873 | 4757535 | Fzd1 | body |
| chr5 | 5505015 | 5514458 | Cldn12 | body |
| chr5 | 5663739 | 5664739 | Cfap69 | TSS500 |
| chr5 | 6769030 | 6876023 | Zfp804b | body |
| chr5 | 7959972 | 7960972 | Steap4 | TSS500 |
| chr5 | 8037294 | 8052207 | Gm15731 | body |
| chr5 | 8046578 | 8069379 | Sri | body |
| chr5 | 8072352 | 8367660 | Adam22 | body |
| chr5 | 8622452 | 8623452 | Rundc3b | TSS500 |
| chr5 | 8490334 | 8622452 | Rundc3b | body |
| chr5 | 8659577 | 8660577 | Abcb1a | TSS500 |
| chr5 | 9118801 | 9161276 | Dmtf1 | body |
| chr5 | 9265618 | 9266618 | 9330182L06Rik | TSS500 |
| chr5 | 10188366 | 10237890 | Gm10482 | body |
| chr5 | 12382666 | 12383666 | Sema3d | TSS500 |
| chr5 | 12383666 | 12588943 | Sema3d | body |
| chr5 | 14024776 | 14025776 | Sema3e | TSS500 |
| chr5 | 14514418 | 14515418 | Pclo | TSS500 |
| chr5 | 14515418 | 14860184 | Pclo | body |
| chr5 | 14539352 | 14540352 | Gm26918 | TSS500 |
| chr5 | 16553050 | 16554050 | Hgf | TSS500 |
| chr5 | 16554050 | 16619439 | Hgf | body |
| chr5 | 17574781 | 17730268 | Sema3c | body |
| chr5 | 18359913 | 18360913 | Gnai1 | TSS500 |
| chr5 | 18265135 | 18359913 | Gnai1 | body |
| chr5 | 19227546 | 20704798 | Magi2 | body |
| chr5 | 20986645 | 21055411 | Ptpn12 | body |
| chr5 | 21373142 | 21378374 | Fgl2 | body |
| chr5 | 21646313 | 21662694 | Armc10 | body |
| chr5 | 21662901 | 21700896 | Napepld | body |
| chr5 | 21757267 | 21784751 | Dnajc2 | body |
| chr5 | 21865104 | 21866104 | Slc26a5 | TSS500 |
| chr5 | 21810655 | 21865104 | Slc26a5 | body |
| chr5 | 21910431 | 21911431 | Gm10475 | TSS500 |
| chr5 | 21911431 | 21954014 | Gm10475 | body |
| chr5 | 22550937 | 22807850 | 6030443J06Rik | body |
| chr5 | 24351104 | 24352104 | Kcnh2 | TSS500 |
| chr5 | 24319589 | 24351104 | Kcnh2 | body |
| chr5 | 24364310 | 24365310 | Nos3 | TSS500 |

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| chr5 | 24383114 | 24384114 | Gm15587 | TSS500 |
| chr5 | 24384181 | 24391643 | Atg9b | body |
| chr5 | 24413951 | 24417834 | Asic3 | body |
| chr5 | 24438440 | 24444787 | Fastk | body |
| chr5 | 24526702 | 24527702 | Gbx1 | TSS500 |
| chr5 | 24711738 | 24730227 | Wdr86 | body |
| chr5 | 24757508 | 24758508 | Crygn | TSS500 |
| chr5 | 24751003 | 24757508 | Crygn | body |
| chr5 | 24986342 | 24998168 | 1500035N22Rik | body |
| chr5 | 25181960 | 25220297 | Galnt15 | body |
| chr5 | 25516567 | 25518021 | Cct8l1 | body |
| chr5 | 25759497 | 25760497 | Actr3b | TSS500 |
| chr5 | 25760497 | 25850342 | Actr3b | body |
| chr5 | 25949797 | 25953844 | Gm21671 | body |
| chr5 | 26816703 | 26817703 | Dpp6 | TSS500 |
| chr5 | 27841447 | 27842447 | Htr5a | TSS500 |
| chr5 | 28019465 | 28070605 | Gm26608 | body |
| chr5 | 28071863 | 28078662 | Insig1 | body |
| chr5 | 28165194 | 28166194 | En2 | TSS500 |
| chr5 | 28166194 | 28172166 | En2 | body |
| chr5 | 28200819 | 28245292 | Cnpy1 | body |
| chr5 | 28466601 | 28467601 | Shh | TSS500 |
| chr5 | 28466874 | 28480973 | Gm26894 | body |
| chr5 | 29229814 | 29377890 | Lmbr1 | body |
| chr5 | 29336346 | 29337346 | Gm23801 | TSS500 |
| chr5 | 29473034 | 29477970 | Mnx1 | body |
| chr5 | 29736188 | 29786478 | Dnajb6 | body |
| chr5 | 30104859 | 30105859 | 3110082J24Rik | TSS500 |
| chr5 | 30104661 | 30105661 | Gareml | TSS500 |
| chr5 | 30105661 | 30118378 | Gareml | body |
| chr5 | 30155748 | 30184593 | Hadhb | body |
| chr5 | 30232081 | 30233081 | Ept1 | TSS500 |
| chr5 | 30281888 | 30366708 | Drc1 | body |
| chr5 | 30461432 | 30462432 | Otof | TSS500 |
| chr5 | 30647433 | 30648433 | Slc35f6 | TSS500 |
| chr5 | 30647436 | 30648436 | Mir5625 | TSS500 |
| chr5 | 30667277 | 30674827 | Cenpa | body |
| chr5 | 30921056 | 30922056 | Khk | TSS500 |
| chr5 | 30950853 | 30959830 | Preb | body |
| chr5 | 31048812 | 31054633 | Atraid | body |
| chr5 | 31054280 | 31055280 | Cad | TSS500 |
| chr5 | 31107737 | 31108737 | Slc30a3 | TSS500 |
| chr5 | 31086106 | 31107737 | Slc30a3 | body |
| chr5 | 31106785 | 31112526 | Dnajc5g | body |

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|------|----------|----------|---------------|--------|
| chr5 | 31116212 | 31117212 | Trim54 | TSS500 |
| chr5 | 31136844 | 31137844 | Gm15469 | TSS500 |
| chr5 | 31138329 | 31139329 | Ucn | TSS500 |
| chr5 | 31290614 | 31291614 | Ift172 | TSS500 |
| chr5 | 31295377 | 31296377 | Fndc4 | TSS500 |
| chr5 | 31452936 | 31481749 | Zfp512 | body |
| chr5 | 31527495 | 31554042 | Slc4a1ap | body |
| chr5 | 31596435 | 31597435 | Mrpl33 | TSS500 |
| chr5 | 31597435 | 31701972 | Mrpl33 | body |
| chr5 | 32233208 | 32366520 | Plb1 | body |
| chr5 | 32459474 | 32517433 | Ppp1cb | body |
| chr5 | 33019316 | 33027966 | Ywhah | body |
| chr5 | 33103719 | 33104719 | Slc5a1 | TSS500 |
| chr5 | 33104719 | 33162872 | Slc5a1 | body |
| chr5 | 33213518 | 33217738 | Spon2 | body |
| chr5 | 33336072 | 33373294 | Maea | body |
| chr5 | 33433476 | 33434476 | Nkx1-1 | TSS500 |
| chr5 | 33721224 | 33722224 | Fgfr3 | TSS500 |
| chr5 | 33821225 | 33897975 | Whsc1 | body |
| chr5 | 33982937 | 33983937 | Gm1673 | TSS500 |
| chr5 | 33995484 | 33996484 | Nat8l | TSS500 |
| chr5 | 33996484 | 34005916 | Nat8l | body |
| chr5 | 34287949 | 34288949 | Zfyve28 | TSS500 |
| chr5 | 34513497 | 34514497 | Tnip2 | TSS500 |
| chr5 | 34526338 | 34563638 | Sh3bp2 | body |
| chr5 | 34638532 | 34659648 | Nop14 | body |
| chr5 | 34761240 | 34762240 | Htt | TSS500 |
| chr5 | 34916415 | 34923839 | Msantd1 | body |
| chr5 | 35278066 | 35279066 | Adra2c | TSS500 |
| chr5 | 35279066 | 35281761 | Adra2c | body |
| chr5 | 35387976 | 35388976 | E130018O15Rik | TSS500 |
| chr5 | 35388608 | 35389608 | Hmx1 | TSS500 |
| chr5 | 35525198 | 35526198 | Cpz | TSS500 |
| chr5 | 35502215 | 35525198 | Cpz | body |
| chr5 | 35679282 | 35680282 | Htra3 | TSS500 |
| chr5 | 35697180 | 35728776 | Sh3tc1 | body |
| chr5 | 35757380 | 35758380 | Ablim2 | TSS500 |
| chr5 | 36017180 | 36397639 | Sorcs2 | body |
| chr5 | 36473670 | 36483785 | Tada2b | body |
| chr5 | 36485088 | 36488172 | Ccdc96 | body |
| chr5 | 36868013 | 36869013 | Ppp2r2c | TSS500 |
| chr5 | 37027835 | 37028835 | Jakmip1 | TSS500 |
| chr5 | 37241580 | 37242580 | Crmp1 | TSS500 |
| chr5 | 37242580 | 37292132 | Crmp1 | body |

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|------|----------|----------|---------------|--------|
| chr5 | 37336394 | 37337394 | Evc | TSS500 |
| chr5 | 37338999 | 37425055 | Evc2 | body |
| chr5 | 37716653 | 37717653 | Stk32b | TSS500 |
| chr5 | 37736019 | 37739820 | Cyt11 | body |
| chr5 | 38039242 | 38137765 | Stx18 | body |
| chr5 | 38320394 | 38321394 | Gm26560 | TSS500 |
| chr5 | 38320009 | 38322310 | Drd5 | body |
| chr5 | 38526814 | 38561166 | Wdr1 | body |
| chr5 | 38684326 | 38685326 | Zfp518b | TSS500 |
| chr5 | 38668484 | 38684326 | Zfp518b | body |
| chr5 | 38706462 | 38876312 | Clnc | body |
| chr5 | 41761483 | 41764001 | Nkx3-2 | body |
| chr5 | 43516069 | 43618817 | C1qtnf7 | body |
| chr5 | 43601230 | 43602230 | Gm15866 | TSS500 |
| chr5 | 43869309 | 43912375 | Cd38 | body |
| chr5 | 43909385 | 43910385 | Gm16015 | TSS500 |
| chr5 | 43909215 | 43909385 | Gm16015 | body |
| chr5 | 43993625 | 44101532 | Prom1 | body |
| chr5 | 44099942 | 44100942 | Gm16401 | TSS500 |
| chr5 | 44472133 | 44799207 | Ldb2 | body |
| chr5 | 45434032 | 45449735 | Qdpr | body |
| chr5 | 45493874 | 45512674 | Lap3 | body |
| chr5 | 45520721 | 45529276 | Med28 | body |
| chr5 | 45529706 | 45639001 | Fam184b | body |
| chr5 | 49524404 | 49525404 | Kcnip4 | TSS500 |
| chr5 | 48389502 | 49524404 | Kcnip4 | body |
| chr5 | 52150209 | 52190019 | Dhx15 | body |
| chr5 | 52363446 | 52364446 | Sod3 | TSS500 |
| chr5 | 52471043 | 52472043 | Ccdc149 | TSS500 |
| chr5 | 52374651 | 52471043 | Ccdc149 | body |
| chr5 | 52565803 | 52566803 | Lgi2 | TSS500 |
| chr5 | 52618511 | 52619511 | 8030423F21Rik | TSS500 |
| chr5 | 52774909 | 52775909 | Zcchc4 | TSS500 |
| chr5 | 52834515 | 52867797 | Anapc4 | body |
| chr5 | 53037582 | 53038582 | Slc34a2 | TSS500 |
| chr5 | 53107084 | 53212952 | Sel1l3 | body |
| chr5 | 61808384 | 61809384 | G6pd2 | TSS500 |
| chr5 | 62765698 | 62766698 | Arap2 | TSS500 |
| chr5 | 62602445 | 62765698 | Arap2 | body |
| chr5 | 62814323 | 62888308 | Dthd1 | body |
| chr5 | 63649764 | 63650764 | Gm9954 | TSS500 |
| chr5 | 63811995 | 63812995 | 0610040J01Rik | TSS500 |
| chr5 | 64158951 | 64159951 | Tbc1d1 | TSS500 |
| chr5 | 64647249 | 64648249 | Gm25306 | TSS500 |

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| chr5 | 65347886 | 65348886 | Klb | TSS500 |
| chr5 | 65864069 | 65896700 | Rhoh | body |
| chr5 | 65935421 | 65977326 | Chrna9 | body |
| chr5 | 66150713 | 66151713 | Gm26725 | TSS500 |
| chr5 | 66259412 | 66260412 | Nsun7 | TSS500 |
| chr5 | 66675997 | 66676997 | Uchl1os | TSS500 |
| chr5 | 66626495 | 66675997 | Uchl1os | body |
| chr5 | 66675598 | 66676598 | Uchl1 | TSS500 |
| chr5 | 66745335 | 66746335 | Limch1 | TSS500 |
| chr5 | 66746335 | 67057159 | Limch1 | body |
| chr5 | 67094405 | 67098801 | Phox2b | body |
| chr5 | 67427299 | 67428299 | Bend4 | TSS500 |
| chr5 | 67392147 | 67427299 | Bend4 | body |
| chr5 | 67427180 | 67428180 | Gm26756 | TSS500 |
| chr5 | 67607383 | 67608383 | Shisa3 | TSS500 |
| chr5 | 67608383 | 67623552 | Shisa3 | body |
| chr5 | 67618140 | 67846932 | Atp8a1 | body |
| chr5 | 67642901 | 67646776 | Gm15478 | body |
| chr5 | 68032335 | 68166398 | Grxcr1 | body |
| chr5 | 69341209 | 69342209 | Kctd8 | TSS500 |
| chr5 | 69109285 | 69341209 | Kctd8 | body |
| chr5 | 69340283 | 69341283 | Gm24368 | TSS500 |
| chr5 | 69516675 | 69542147 | Yipf7 | body |
| chr5 | 69573108 | 69591837 | Gnpda2 | body |
| chr5 | 71095349 | 71096349 | Gabra2 | TSS500 |
| chr5 | 70961057 | 71095349 | Gabra2 | body |
| chr5 | 71657808 | 71658808 | Gabra4 | TSS500 |
| chr5 | 71569734 | 71657808 | Gabra4 | body |
| chr5 | 71700432 | 72138389 | Gabrb1 | body |
| chr5 | 72580584 | 72581584 | Zar1 | TSS500 |
| chr5 | 72587050 | 72588050 | Gm5868 | TSS500 |
| chr5 | 72867983 | 72868983 | Tec | TSS500 |
| chr5 | 73006404 | 73007404 | Slc10a4 | TSS500 |
| chr5 | 73322199 | 73338447 | Ociad2 | body |
| chr5 | 73405576 | 73406576 | Cwh43 | TSS500 |
| chr5 | 73406576 | 73453435 | Cwh43 | body |
| chr5 | 73606643 | 73632005 | Lrrc66 | body |
| chr5 | 73650880 | 73651880 | Spata18 | TSS500 |
| chr5 | 74592446 | 74702411 | Lnx1 | body |
| chr5 | 74948694 | 74949694 | Gm6116 | TSS500 |
| chr5 | 74949694 | 74966368 | Gm6116 | body |
| chr5 | 75044274 | 75045274 | Chic2 | TSS500 |
| chr5 | 75001026 | 75044274 | Chic2 | body |
| chr5 | 75074964 | 75075964 | Gsx2 | TSS500 |

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| chr5 | 75075964 | 75077893 | Gsx2 | body |
| chr5 | 75977958 | 75978958 | Kdr | TSS500 |
| chr5 | 75932827 | 75977958 | Kdr | body |
| chr5 | 76183380 | 76184380 | Tmem165 | TSS500 |
| chr5 | 76363288 | 76364288 | Nmu | TSS500 |
| chr5 | 76657012 | 76873554 | C530008M17Rik | body |
| chr5 | 76928868 | 76947758 | 2310040G07Rik | body |
| chr5 | 77006449 | 77018363 | 1700112J05Rik | body |
| chr5 | 77015523 | 77016523 | 1700023E05Rik | TSS500 |
| chr5 | 77016523 | 77061529 | 1700023E05Rik | body |
| chr5 | 77114621 | 77115621 | Hopx | TSS500 |
| chr5 | 77095032 | 77102303 | Hopxos | body |
| chr5 | 77205107 | 77210971 | Spink2 | body |
| chr5 | 77265991 | 77286432 | Rest | body |
| chr5 | 77294182 | 77309584 | Noa1 | body |
| chr5 | 77407545 | 77408545 | Igfbp7 | TSS500 |
| chr5 | 84416882 | 84417882 | Epha5 | TSS500 |
| chr5 | 84057791 | 84416882 | Epha5 | body |
| chr5 | 86072246 | 86103993 | Stap1 | body |
| chr5 | 86180754 | 86197401 | Gnrhr | body |
| chr5 | 86231481 | 86288808 | Tmprss11c | body |
| chr5 | 86302217 | 86372920 | Tmprss11d | body |
| chr5 | 86485876 | 86518100 | Tmprss11g | body |
| chr5 | 86521898 | 86631924 | Tmprss11f | body |
| chr5 | 86705186 | 86745315 | Tmprss11e | body |
| chr5 | 86804721 | 86836659 | Ythdc1 | body |
| chr5 | 87826186 | 87846386 | Prr27 | body |
| chr5 | 88886318 | 88887318 | Slc4a4 | TSS500 |
| chr5 | 89527929 | 89583740 | Npffr2 | body |
| chr5 | 89882834 | 89883834 | Adamts3 | TSS500 |
| chr5 | 90491214 | 90508907 | Afp | body |
| chr5 | 90758799 | 90759799 | Cxcl5 | TSS500 |
| chr5 | 90785603 | 90786603 | Cxcl3 | TSS500 |
| chr5 | 90903399 | 90904399 | Cxcl2 | TSS500 |
| chr5 | 91139115 | 91140115 | Areg | TSS500 |
| chr5 | 91518115 | 91626894 | Parm1 | body |
| chr5 | 91767414 | 91768414 | Gm28271 | TSS500 |
| chr5 | 92043564 | 92055960 | Gm26582 | body |
| chr5 | 92226974 | 92252659 | Ppef2 | body |
| chr5 | 92257659 | 92277670 | Naaa | body |
| chr5 | 92332327 | 92414628 | Art3 | body |
| chr5 | 92348389 | 92349389 | Cxcl10 | TSS500 |
| chr5 | 92554569 | 92555569 | Fam47e | TSS500 |
| chr5 | 92607954 | 92674771 | Ccdc158 | body |

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| chr5 | 92682935 | 92683935 | Shroom3 | TSS500 |
| chr5 | 92808988 | 92809988 | 4932430I15Rik | TSS500 |
| chr5 | 93044522 | 93045522 | Sowahb | TSS500 |
| chr5 | 93041123 | 93044522 | Sowahb | body |
| chr5 | 93044220 | 93045220 | 9330159N05Rik | TSS500 |
| chr5 | 93045220 | 93048430 | 9330159N05Rik | body |
| chr5 | 93634993 | 93671051 | C87414 | body |
| chr5 | 95306315 | 95343917 | Gm3259 | body |
| chr5 | 96374455 | 96784728 | Fras1 | body |
| chr5 | 97111096 | 97112096 | Paqr3 | TSS500 |
| chr5 | 97456508 | 97457508 | Gk2 | TSS500 |
| chr5 | 97455161 | 97456508 | Gk2 | body |
| chr5 | 98253684 | 98254684 | Fgf5 | TSS500 |
| chr5 | 98329854 | 98801910 | 1700007G11Rik | body |
| chr5 | 98853939 | 98854939 | Bmp3 | TSS500 |
| chr5 | 98854939 | 98880960 | Bmp3 | body |
| chr5 | 99036851 | 99037851 | Prkg2 | TSS500 |
| chr5 | 99252427 | 99253427 | Rasgef1b | TSS500 |
| chr5 | 99728565 | 99729565 | A930011G23Rik | TSS500 |
| chr5 | 99297244 | 99728565 | A930011G23Rik | body |
| chr5 | 100159308 | 100160308 | Tmem150c | TSS500 |
| chr5 | 100077872 | 100159308 | Tmem150c | body |
| chr5 | 100518809 | 100547803 | Cops4 | body |
| chr5 | 100654723 | 100674640 | Coq2 | body |
| chr5 | 100671359 | 100678105 | Gm15777 | body |
| chr5 | 101664496 | 101665496 | Nkx6-1 | TSS500 |
| chr5 | 101659177 | 101664496 | Nkx6-1 | body |
| chr5 | 101764630 | 101765630 | Cds1 | TSS500 |
| chr5 | 103210834 | 103211834 | Mapk10 | TSS500 |
| chr5 | 103655510 | 103656510 | 1700016H13Rik | TSS500 |
| chr5 | 103648039 | 103655510 | 1700016H13Rik | body |
| chr5 | 104021419 | 104022419 | Hsd17b11 | TSS500 |
| chr5 | 104045806 | 104046806 | Nudt9 | TSS500 |
| chr5 | 104113588 | 104114588 | Sparcl1 | TSS500 |
| chr5 | 104079111 | 104113588 | Sparcl1 | body |
| chr5 | 104108717 | 104109717 | Gm26703 | TSS500 |
| chr5 | 104299671 | 104311469 | lbsp | body |
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| chr5 | 105215699 | 105293199 | Gbp6 | body |
| chr5 | 105400745 | 105401745 | Gm26519 | TSS500 |
| chr5 | 106457666 | 106458666 | Barhl2 | TSS500 |
| chr5 | 106452523 | 106457666 | Barhl2 | body |
| chr5 | 106470507 | 106471507 | Gm26872 | TSS500 |

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| chr5 | 106574218 | 106575218 | Gm28050 | TSS500 |
| chr5 | 106574375 | 106575375 | Gm29464 | TSS500 |
| chr5 | 106616739 | 106696787 | Zfp644 | body |
| chr5 | 106963822 | 106964822 | Cdc7 | TSS500 |
| chr5 | 107432049 | 107435039 | Lpcat2b | body |
| chr5 | 107509444 | 107551549 | 1700028K03Rik | body |
| chr5 | 107687515 | 107688515 | Gm26692 | TSS500 |
| chr5 | 107725536 | 107726536 | Gfi1 | TSS500 |
| chr5 | 107716657 | 107725536 | Gfi1 | body |
| chr5 | 108461732 | 108506976 | Pcgf3 | body |
| chr5 | 108549524 | 108550524 | Cplx1 | TSS500 |
| chr5 | 108518554 | 108549524 | Cplx1 | body |
| chr5 | 109156068 | 109191607 | Vmn2r13 | body |
| chr5 | 109558493 | 109559493 | Crlf2 | TSS500 |
| chr5 | 109674545 | 109690541 | 5430403G16Rik | body |
| chr5 | 109923900 | 109943936 | Gm15446 | body |
| chr5 | 110100469 | 110105953 | Plxcd1 | body |
| chr5 | 110109592 | 110110592 | Zfp605 | TSS500 |
| chr5 | 110259130 | 110269413 | Pgam5 | body |
| chr5 | 110361754 | 110448003 | Fbrsl1 | body |
| chr5 | 110386335 | 110388073 | Gm26711 | body |
| chr5 | 110664373 | 110770217 | Ep400 | body |
| chr5 | 111416862 | 111417862 | Mn1 | TSS500 |
| chr5 | 111417862 | 111457033 | Mn1 | body |
| chr5 | 111580922 | 111581922 | C130026L21Rik | TSS500 |
| chr5 | 111742349 | 111743349 | Gm16019 | TSS500 |
| chr5 | 112213228 | 112228895 | Miat | body |
| chr5 | 112216560 | 112217560 | Gm26953 | TSS500 |
| chr5 | 112255315 | 112256315 | Crybb1 | TSS500 |
| chr5 | 112343583 | 112378414 | Hps4 | body |
| chr5 | 112576698 | 112577698 | Sez6l | TSS500 |
| chr5 | 112419151 | 112576698 | Sez6l | body |
| chr5 | 112688876 | 112895862 | Myo18b | body |
| chr5 | 113015014 | 113016014 | Adrbk2 | TSS500 |
| chr5 | 112910478 | 113015014 | Adrbk2 | body |
| chr5 | 113227409 | 113239263 | Tmem211 | body |
| chr5 | 113356794 | 113357794 | Aym1 | TSS500 |
| chr5 | 113489833 | 113490833 | Wscd2 | TSS500 |
| chr5 | 113490833 | 113589725 | Wscd2 | body |
| chr5 | 113649926 | 113650926 | Cmklr1 | TSS500 |
| chr5 | 113612354 | 113649926 | Cmklr1 | body |
| chr5 | 113644463 | 113645463 | Gm15736 | TSS500 |
| chr5 | 113692422 | 113724272 | 1700069L16Rik | body |
| chr5 | 113773248 | 113778288 | Iscu | body |

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| chr5 | 113937094 | 113993394 | Ssh1 | body |
| chr5 | 114004203 | 114025449 | Dao | body |
| chr5 | 114099833 | 114100833 | Usp30 | TSS500 |
| chr5 | 114123926 | 114127718 | Alkbh2 | body |
| chr5 | 114130886 | 114139323 | Ung | body |
| chr5 | 114146035 | 114147035 | Acacb | TSS500 |
| chr5 | 114273307 | 114274307 | Foxn4 | TSS500 |
| chr5 | 114254164 | 114273307 | Foxn4 | body |
| chr5 | 114363567 | 114380015 | Kctd10 | body |
| chr5 | 114551789 | 114554016 | Gm13790 | body |
| chr5 | 114567516 | 114568516 | Fam222a | TSS500 |
| chr5 | 114657921 | 114658921 | Trpv4 | TSS500 |
| chr5 | 114622152 | 114657921 | Trpv4 | body |
| chr5 | 114775017 | 114776017 | Git2 | TSS500 |
| chr5 | 114813476 | 114814476 | 1500011B03Rik | TSS500 |
| chr5 | 114822960 | 114823960 | Gm20499 | TSS500 |
| chr5 | 114822968 | 114823968 | 2610524H06Rik | TSS500 |
| chr5 | 114917318 | 114922777 | Gm13822 | body |
| chr5 | 114969323 | 114971400 | Hnf1aos2 | body |
| chr5 | 115122550 | 115134475 | Unc119b | body |
| chr5 | 115193881 | 115194881 | Cabp1 | TSS500 |
| chr5 | 115341725 | 115343569 | Triap1 | body |
| chr5 | 115429099 | 115430099 | Msi1 | TSS500 |
| chr5 | 115430099 | 115455698 | Msi1 | body |
| chr5 | 115466762 | 115474722 | Pla2g1b | body |
| chr5 | 115507176 | 115555987 | Pxn | body |
| chr5 | 115632429 | 115647736 | Rab35 | body |
| chr5 | 115731121 | 115732121 | Ccdc64 | TSS500 |
| chr5 | 116008816 | 116009816 | Gm14508 | TSS500 |
| chr5 | 116024008 | 116025008 | Prkab1 | TSS500 |
| chr5 | 116013586 | 116024008 | Prkab1 | body |
| chr5 | 116082744 | 116083744 | Tmem233 | TSS500 |
| chr5 | 116038755 | 116082744 | Tmem233 | body |
| chr5 | 116305682 | 116308860 | Gm13838 | body |
| chr5 | 116311860 | 116312860 | B230112J18Rik | TSS500 |
| chr5 | 116312860 | 116318281 | B230112J18Rik | body |
| chr5 | 116408491 | 116422364 | Hspb8 | body |
| chr5 | 116439220 | 116465487 | Srrm4os | body |
| chr5 | 116439272 | 116591317 | Srrm4 | body |
| chr5 | 116820954 | 116821954 | 4930569F06Rik | TSS500 |
| chr5 | 117119629 | 117120629 | Taok3 | TSS500 |
| chr5 | 117282651 | 117287125 | Pebp1 | body |
| chr5 | 117781532 | 117958840 | Nos1 | body |
| chr5 | 117977270 | 118010191 | Fbxo21 | body |

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| chr5 | 118165148 | 118189478 | Hrk | body |
| chr5 | 118331806 | 118332806 | Gm28563 | TSS500 |
| chr5 | 119626442 | 119634464 | Gm16063 | body |
| chr5 | 119835163 | 119885218 | Tbx5 | body |
| chr5 | 120121103 | 120138763 | Gm10390 | body |
| chr5 | 120287226 | 120288226 | Gm26474 | TSS500 |
| chr5 | 120431241 | 120432241 | Gm27199 | TSS500 |
| chr5 | 120431270 | 120432270 | Lhx5 | TSS500 |
| chr5 | 120432270 | 120441223 | Lhx5 | body |
| chr5 | 120472310 | 120473310 | Sdsl | TSS500 |
| chr5 | 120458186 | 120472310 | Sdsl | body |
| chr5 | 120476031 | 120477031 | Sds | TSS500 |
| chr5 | 120510668 | 120511668 | Slc8b1 | TSS500 |
| chr5 | 120628335 | 120633735 | Ccdc42b | body |
| chr5 | 120648540 | 120648749 | Gm15749 | body |
| chr5 | 120711427 | 120712427 | Dtx1 | TSS500 |
| chr5 | 120847867 | 120857986 | Oas1f | body |
| chr5 | 120896256 | 120907021 | Oas1a | body |
| chr5 | 121009018 | 121010018 | Rph3a | TSS500 |
| chr5 | 121204981 | 121209241 | Rpl6 | body |
| chr5 | 121452393 | 121524183 | Tmem116 | body |
| chr5 | 121518613 | 121545405 | Mapkapk5 | body |
| chr5 | 121593324 | 121594324 | Aldh2 | TSS500 |
| chr5 | 121598284 | 121618438 | Acad12 | body |
| chr5 | 121661063 | 121687248 | Brap | body |
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| chr5 | 122048882 | 122055654 | Gm15637 | body |
| chr5 | 122101451 | 122113472 | Myl2 | body |
| chr5 | 122870668 | 123014580 | Kdm2b | body |
| chr5 | 123068915 | 123117749 | Tmem120b | body |
| chr5 | 123132192 | 123133192 | Rhof | TSS500 |
| chr5 | 123251602 | 123252602 | Wdr66 | TSS500 |
| chr5 | 123343334 | 123344334 | Bcl7a | TSS500 |
| chr5 | 123523676 | 123524676 | Diablo | TSS500 |
| chr5 | 123684118 | 123685118 | Clip1 | TSS500 |
| chr5 | 123748914 | 123749914 | Rsrc2 | TSS500 |
| chr5 | 123749226 | 123750226 | Kntc1 | TSS500 |
| chr5 | 123879520 | 123880520 | Hcar1 | TSS500 |
| chr5 | 123906675 | 123907675 | Denr | TSS500 |
| chr5 | 123907675 | 123928832 | Denr | body |
| chr5 | 124004641 | 124031760 | Vps37b | body |
| chr5 | 124440430 | 124462308 | Setd8 | body |
| chr5 | 124724585 | 124725585 | Dnah10 | TSS500 |
| chr5 | 125003947 | 125012547 | Fam101a | body |

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| chr5 | 125017153 | 125178719 | Ncor2 | body |
| chr5 | 125531274 | 125532274 | Tmem132b | TSS500 |
| chr5 | 125532274 | 125792583 | Tmem132b | body |
| chr5 | 127632397 | 127633397 | Slc15a4 | TSS500 |
| chr5 | 127631762 | 127632762 | Glt1d1 | TSS500 |
| chr5 | 127632762 | 127708754 | Glt1d1 | body |
| chr5 | 128600344 | 128601344 | Fzd10 | TSS500 |
| chr5 | 129669599 | 129670599 | Zfp11 | TSS500 |
| chr5 | 129683391 | 129708011 | sept-14 | body |
| chr5 | 129787939 | 129845820 | Cct6a | body |
| chr5 | 129881156 | 129886970 | Chchd2 | body |
| chr5 | 129895223 | 129896223 | Zbed5 | TSS500 |
| chr5 | 129908040 | 129909040 | Nupr1l | TSS500 |
| chr5 | 130073826 | 130135729 | Tpst1 | body |
| chr5 | 130144361 | 130145361 | Kctd7 | TSS500 |
| chr5 | 130245731 | 130255030 | Sbds | body |
| chr5 | 130369976 | 130840645 | Caln1 | body |
| chr5 | 131307578 | 131308578 | Wbscr17 | TSS500 |
| chr5 | 130872082 | 131307578 | Wbscr17 | body |
| chr5 | 132542844 | 132543844 | Auts2 | TSS500 |
| chr5 | 132543935 | 132544935 | Gm28616 | TSS500 |
| chr5 | 134184519 | 134224355 | Gtf2ird2 | body |
| chr5 | 134220053 | 134229125 | Ncf1 | body |
| chr5 | 134456216 | 134457216 | Gtf2ird1 | TSS500 |
| chr5 | 134489386 | 134551934 | Clip2 | body |
| chr5 | 134600268 | 134614523 | Lat2 | body |
| chr5 | 134656039 | 134688090 | Limk1 | body |
| chr5 | 134703781 | 134746741 | Eln | body |
| chr5 | 134931868 | 134932868 | Wbscr27 | TSS500 |
| chr5 | 134932868 | 134942637 | Wbscr27 | body |
| chr5 | 134946434 | 134947434 | Cldn4 | TSS500 |
| chr5 | 134985714 | 134986714 | Cldn3 | TSS500 |
| chr5 | 134986714 | 134987472 | Cldn3 | body |
| chr5 | 135022982 | 135023982 | Stx1a | TSS500 |
| chr5 | 135107391 | 135138382 | Mlxipl | body |
| chr5 | 135250730 | 135251730 | Fzd9 | TSS500 |
| chr5 | 135248938 | 135250730 | Fzd9 | body |
| chr5 | 135349491 | 135350491 | Fkbp6 | TSS500 |
| chr5 | 135352795 | 135353795 | Trim50 | TSS500 |
| chr5 | 135353795 | 135368005 | Trim50 | body |
| chr5 | 135394046 | 135395046 | Pom121 | TSS500 |
| chr5 | 135376141 | 135394046 | Pom121 | body |
| chr5 | 135633118 | 135646448 | Rhbdd2 | body |
| chr5 | 135807390 | 135874772 | Srrm3 | body |

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| chr5 | 135887419 | 135888419 | Hspb1 | TSS500 |
| chr5 | 135888419 | 135889563 | Hspb1 | body |
| chr5 | 136218149 | 136244403 | Sh2b2 | body |
| chr5 | 136693646 | 136701094 | Myl10 | body |
| chr5 | 136741759 | 136882709 | Col26a1 | body |
| chr5 | 136966116 | 136967116 | Cldn15 | TSS500 |
| chr5 | 136967116 | 136975858 | Cldn15 | body |
| chr5 | 137026892 | 137033351 | Vgf | body |
| chr5 | 137287019 | 137288019 | Ache | TSS500 |
| chr5 | 137288019 | 137294466 | Ache | body |
| chr5 | 137378637 | 137476564 | Zan | body |
| chr5 | 137553017 | 137554017 | Actl6b | TSS500 |
| chr5 | 137612503 | 137628502 | Fbxo24 | body |
| chr5 | 137645214 | 137646214 | Irs3 | TSS500 |
| chr5 | 137730883 | 137741107 | Nyap1 | body |
| chr5 | 137788298 | 137822621 | Zcwpw1 | body |
| chr5 | 138021776 | 138034665 | Smok3a | body |
| chr5 | 138021929 | 138050636 | Smok3b | body |
| chr5 | 138164583 | 138171922 | Mcm7 | body |
| chr5 | 138164904 | 138165904 | Mir25 | TSS500 |
| chr5 | 138165110 | 138166110 | Mir93 | TSS500 |
| chr5 | 138165318 | 138166318 | Mir106b | TSS500 |
| chr5 | 138172502 | 138178708 | Ap4m1 | body |
| chr5 | 138203609 | 138206808 | Gm454 | body |
| chr5 | 138226398 | 138253363 | Nxpe5 | body |
| chr5 | 138272340 | 138273340 | Gal3st4 | TSS500 |
| chr5 | 138264952 | 138279505 | Gpc2 | body |
| chr5 | 138280740 | 138312393 | Stag3 | body |
| chr5 | 138363219 | 138364219 | Gm10874 | TSS500 |
| chr5 | 138819580 | 138820580 | Gm5294 | TSS500 |
| chr5 | 138820580 | 138821619 | Gm5294 | body |
| chr5 | 138996870 | 138997870 | Pdgfa | TSS500 |
| chr5 | 138995556 | 139000577 | 6330403L08Rik | body |
| chr5 | 139017306 | 139149501 | Prkar1b | body |
| chr5 | 139352117 | 139353117 | Cyp2w1 | TSS500 |
| chr5 | 139405780 | 139415623 | C130050O18Rik | body |
| chr5 | 139542994 | 139543994 | Uncx | TSS500 |
| chr5 | 139579956 | 139580956 | Gm29102 | TSS500 |
| chr5 | 139802485 | 139819417 | Tmem184a | body |
| chr5 | 139907443 | 139908443 | Elfn1 | TSS500 |
| chr5 | 140073605 | 140074605 | Gm16122 | TSS500 |
| chr5 | 140207885 | 140210751 | Gm16120 | body |
| chr5 | 140661827 | 140701878 | Iqce | body |
| chr5 | 140724627 | 140761439 | Amz1 | body |

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| chr5 | 140758408 | 140829931 | Gna12 | body |
| chr5 | 141240990 | 141241990 | Sdk1 | TSS500 |
| chr5 | 142464431 | 142478715 | Ap5z1 | body |
| chr5 | 142562365 | 142608300 | Mmd2 | body |
| chr5 | 142701601 | 142702601 | Slc29a4 | TSS500 |
| chr5 | 142959843 | 142960843 | Fscn1 | TSS500 |
| chr5 | 142990893 | 143112520 | Rnf216 | body |
| chr5 | 143216316 | 143226390 | Spdyb | body |
| chr5 | 143228218 | 143234748 | 4930448H16Rik | body |
| chr5 | 143287755 | 143291856 | Zfp853 | body |
| chr5 | 143390730 | 143403248 | Gm20635 | body |
| chr5 | 143549206 | 143564531 | Fam220a | body |
| chr5 | 143757825 | 143758825 | D130017N08Rik | TSS500 |
| chr5 | 143897185 | 143898185 | Ankrd61 | TSS500 |
| chr5 | 144761149 | 144762149 | Tmem130 | TSS500 |
| chr5 | 144735915 | 144761149 | Tmem130 | body |
| chr5 | 145113715 | 145114715 | Arpc1b | TSS500 |
| chr5 | 145128769 | 145139738 | Pdap1 | body |
| chr5 | 145436309 | 145469223 | Cyp3a16 | body |
| chr5 | 145773983 | 145805374 | Cyp3a44 | body |
| chr5 | 145854426 | 145879464 | Cyp3a11 | body |
| chr5 | 146231730 | 146302874 | Cdk8 | body |
| chr5 | 146384485 | 146385485 | Wasf3 | TSS500 |
| chr5 | 146385485 | 146472411 | Wasf3 | body |
| chr5 | 146514651 | 146516724 | Gm3402 | body |
| chr5 | 146584739 | 146585739 | Gpr12 | TSS500 |
| chr5 | 146845571 | 146847726 | Rasl11a | body |
| chr5 | 147077550 | 147111361 | Polr1d | body |
| chr5 | 147188196 | 147189196 | Gsx1 | TSS500 |
| chr5 | 147189196 | 147190947 | Gsx1 | body |
| chr5 | 147271021 | 147272021 | 2210019I11Rik | TSS500 |
| chr5 | 147270459 | 147278008 | Pdx1 | body |
| chr5 | 147300805 | 147306770 | Cdx2 | body |
| chr5 | 147399989 | 147400989 | Flt3 | TSS500 |
| chr5 | 147330741 | 147399989 | Flt3 | body |
| chr5 | 147400054 | 147401917 | Gm26597 | body |
| chr5 | 147725511 | 147726511 | Flt1 | TSS500 |
| chr5 | 147894315 | 147895315 | Slc46a3 | TSS500 |
| chr5 | 147878437 | 147894315 | Slc46a3 | body |
| chr5 | 147956820 | 147957820 | Mtus2 | TSS500 |
| chr5 | 147957820 | 148316065 | Mtus2 | body |
| chr5 | 148741340 | 148742340 | 2210417A02Rik | TSS500 |
| chr5 | 148777463 | 148778463 | 4930505K14Rik | TSS500 |
| chr5 | 148820267 | 148821267 | Gm15407 | TSS500 |

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|------|-----------|-----------|---------------|--------|
| chr5 | 148958778 | 148959778 | Gm15409 | TSS500 |
| chr5 | 149015313 | 149016313 | Gm15411 | TSS500 |
| chr5 | 149234816 | 149247182 | Gm29264 | body |
| chr5 | 149265558 | 149288045 | Alox5ap | body |
| chr5 | 149411249 | 149412249 | Medag | TSS500 |
| chr5 | 149529179 | 149611894 | Wdr95 | body |
| chr5 | 149677730 | 149678730 | B3glct | TSS500 |
| chr5 | 150018175 | 150019175 | Rxfp2 | TSS500 |
| chr5 | 150019175 | 150082184 | Rxfp2 | body |
| chr5 | 150259430 | 150260430 | Fry | TSS500 |
| chr5 | 150260430 | 150497752 | Fry | body |
| chr5 | 150517664 | 150518664 | Zar1l | TSS500 |
| chr5 | 150594025 | 150595025 | N4bp2l1 | TSS500 |
| chr5 | 150608007 | 150665112 | N4bp2l2 | body |
| chr5 | 150952107 | 150953107 | Kl | TSS500 |
| chr5 | 151233336 | 151234336 | Stard13 | TSS500 |
| chr5 | 151367720 | 151427710 | D730045B01Rik | body |
| chr5 | 151561661 | 151586424 | Vmn2r18 | body |
| chr6 | 3764213 | 3765213 | Calcr | TSS500 |
| chr6 | 4600340 | 4601340 | Casd1 | TSS500 |
| chr6 | 4746704 | 4747704 | Sgce | TSS500 |
| chr6 | 4746806 | 4747806 | Peg10 | TSS500 |
| chr6 | 5220852 | 5255786 | Pon3 | body |
| chr6 | 5382886 | 5383886 | Asb4 | TSS500 |
| chr6 | 5383886 | 5433022 | Asb4 | body |
| chr6 | 5725139 | 5726139 | Dync1i1 | TSS500 |
| chr6 | 5726139 | 6028039 | Dync1i1 | body |
| chr6 | 6249159 | 6378675 | Gm20619 | body |
| chr6 | 6456189 | 6483987 | Gm20617 | body |
| chr6 | 6603712 | 6691021 | Gm20618 | body |
| chr6 | 6820189 | 6869031 | Dlx6os1 | body |
| chr6 | 6862834 | 6863834 | Dlx6 | TSS500 |
| chr6 | 6863834 | 6868568 | Dlx6 | body |
| chr6 | 6863797 | 6864650 | Dlx6os2 | body |
| chr6 | 6877805 | 6881585 | Dlx5 | body |
| chr6 | 7555379 | 7565834 | Tac1 | body |
| chr6 | 7982930 | 7983930 | Gm9825 | TSS500 |
| chr6 | 8510100 | 8597548 | Glcci1 | body |
| chr6 | 8947931 | 8948931 | Nxph1 | TSS500 |
| chr6 | 8948931 | 9249032 | Nxph1 | body |
| chr6 | 12099518 | 12109083 | Gm6578 | body |
| chr6 | 13070259 | 13089269 | Tmem106b | body |
| chr6 | 13185613 | 13224465 | Vwde | body |
| chr6 | 14754774 | 14755774 | Ppp1r3a | TSS500 |

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| chr6 | 14901849 | 15441977 | Foxp2 | body |
| chr6 | 16833381 | 16897941 | Tfec | body |
| chr6 | 17198251 | 17210152 | D830026I12Rik | body |
| chr6 | 17206823 | 17385104 | Gm15581 | body |
| chr6 | 18030085 | 18031085 | Wnt2 | TSS500 |
| chr6 | 18514369 | 18515369 | Cttnbp2 | TSS500 |
| chr6 | 18366478 | 18514369 | Cttnbp2 | body |
| chr6 | 18865818 | 18866818 | Ankrd7 | TSS500 |
| chr6 | 21216003 | 21729805 | Kcnd2 | body |
| chr6 | 21771395 | 21852015 | Tspan12 | body |
| chr6 | 22355743 | 22356743 | Fam3c | TSS500 |
| chr6 | 22875002 | 22876002 | Ptprz1 | TSS500 |
| chr6 | 22876002 | 23052916 | Ptprz1 | body |
| chr6 | 23072173 | 23132486 | Aass | body |
| chr6 | 23245047 | 23247764 | Fezf1 | body |
| chr6 | 23838921 | 23839921 | Cadps2 | TSS500 |
| chr6 | 23262773 | 23838921 | Cadps2 | body |
| chr6 | 24088283 | 24167592 | Slc13a1 | body |
| chr6 | 24444865 | 24514567 | Iqub | body |
| chr6 | 24733745 | 24745452 | Hyal6 | body |
| chr6 | 24876409 | 24891805 | Hyal5 | body |
| chr6 | 24955797 | 24956797 | Tmem229a | TSS500 |
| chr6 | 24951141 | 24955797 | Tmem229a | body |
| chr6 | 25668607 | 25690229 | Gpr37 | body |
| chr6 | 28134678 | 28135678 | Grm8 | TSS500 |
| chr6 | 27275121 | 28134678 | Grm8 | body |
| chr6 | 28215055 | 28216055 | 6530409C15Rik | TSS500 |
| chr6 | 28216055 | 28260862 | 6530409C15Rik | body |
| chr6 | 28239931 | 28397505 | Zfp800 | body |
| chr6 | 28416091 | 28427890 | Gcc1 | body |
| chr6 | 28475639 | 28935162 | Snd1 | body |
| chr6 | 28981134 | 28982134 | Gm3294 | TSS500 |
| chr6 | 28982134 | 29022165 | Gm3294 | body |
| chr6 | 29200434 | 29215864 | Impdh1 | body |
| chr6 | 29348569 | 29377110 | Calu | body |
| chr6 | 29396809 | 29426994 | Ccdc136 | body |
| chr6 | 29396117 | 29397117 | Gm26220 | TSS500 |
| chr6 | 29467218 | 29468218 | Atp6v1f | TSS500 |
| chr6 | 29468218 | 29470512 | Atp6v1f | body |
| chr6 | 29507452 | 29508452 | Kcp | TSS500 |
| chr6 | 29473162 | 29507452 | Kcp | body |
| chr6 | 29507225 | 29508225 | Gm26627 | TSS500 |
| chr6 | 29526125 | 29527125 | Irf5 | TSS500 |
| chr6 | 29527125 | 29541869 | Irf5 | body |

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|------|----------|----------|---------------|--------|
| chr6 | 29917513 | 29959681 | Strip2 | body |
| chr6 | 29984829 | 29985829 | 1700023L04Rik | TSS500 |
| chr6 | 30459628 | 30460628 | 1700012C14Rik | TSS500 |
| chr6 | 30541082 | 30542082 | Cpa2 | TSS500 |
| chr6 | 30542082 | 30564476 | Cpa2 | body |
| chr6 | 30568869 | 30592418 | Cpa4 | body |
| chr6 | 30611510 | 30631745 | Cpa5 | body |
| chr6 | 30653457 | 30693249 | Cep41 | body |
| chr6 | 30724047 | 30748455 | Mest | body |
| chr6 | 30956023 | 30958578 | Klf14 | body |
| chr6 | 31357243 | 31372369 | Gm14532 | body |
| chr6 | 31563481 | 31564481 | Podxl | TSS500 |
| chr6 | 31519488 | 31563481 | Podxl | body |
| chr6 | 31605711 | 31743316 | Gm13847 | body |
| chr6 | 31665631 | 31666631 | Gm13848 | TSS500 |
| chr6 | 31787175 | 31922270 | Gm13849 | body |
| chr6 | 32587692 | 32588692 | Plxna4 | TSS500 |
| chr6 | 34179732 | 34186392 | Gm13855 | body |
| chr6 | 34734889 | 34735889 | Gm14547 | TSS500 |
| chr6 | 34780932 | 34859459 | Agbl3 | body |
| chr6 | 35508906 | 35539388 | Mtpn | body |
| chr6 | 36387584 | 36388584 | Chrm2 | TSS500 |
| chr6 | 36388584 | 36528414 | Chrm2 | body |
| chr6 | 37299684 | 37300684 | Dgki | TSS500 |
| chr6 | 36846022 | 37299684 | Dgki | body |
| chr6 | 36937548 | 36985784 | 1700111E14Rik | body |
| chr6 | 38287396 | 38298759 | Zc3hav1l | body |
| chr6 | 38534002 | 38539449 | 1110001J03Rik | body |
| chr6 | 38551834 | 38609470 | Luc7l2 | body |
| chr6 | 38626660 | 38636739 | Klrg2 | body |
| chr6 | 38662569 | 38663569 | Clec2l | TSS500 |
| chr6 | 39380675 | 39381675 | Rab19 | TSS500 |
| chr6 | 39381675 | 39390380 | Rab19 | body |
| chr6 | 39873771 | 40255150 | Tmem178b | body |
| chr6 | 40203298 | 40208759 | Gm26807 | body |
| chr6 | 40401375 | 40435635 | E330009J07Rik | body |
| chr6 | 40920437 | 40940057 | 1700074P13Rik | body |
| chr6 | 41604982 | 41605982 | Ephb6 | TSS500 |
| chr6 | 41605982 | 41620509 | Ephb6 | body |
| chr6 | 41635905 | 41636905 | Trpv6 | TSS500 |
| chr6 | 41686330 | 41703839 | Kel | body |
| chr6 | 41771258 | 41771866 | Olfr459 | body |
| chr6 | 42245435 | 42246435 | Gstk1 | TSS500 |
| chr6 | 42315312 | 42324143 | Fam131b | body |

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| chr6 | 42350328 | 42360146 | Zyx | body |
| chr6 | 42372768 | 42373768 | Epha1 | TSS500 |
| chr6 | 42371171 | 42381215 | 2010310C07Rik | body |
| chr6 | 42668002 | 42709572 | Fam115a | body |
| chr6 | 43265082 | 43266082 | Arhgef5 | TSS500 |
| chr6 | 43345001 | 43665778 | Tpk1 | body |
| chr6 | 45060561 | 47301369 | Cntnap2 | body |
| chr6 | 47530274 | 47594841 | Ezh2 | body |
| chr6 | 48062395 | 48086093 | Zfp746 | body |
| chr6 | 48447729 | 48448729 | Sspo | TSS500 |
| chr6 | 48448729 | 48501250 | Sspo | body |
| chr6 | 48572170 | 48573170 | Rarres2 | TSS500 |
| chr6 | 48627264 | 48633689 | AI854703 | body |
| chr6 | 48701582 | 48707725 | Gimap6 | body |
| chr6 | 48719107 | 48752600 | Gm28053 | body |
| chr6 | 48738346 | 48740121 | Gimap1os | body |
| chr6 | 48738554 | 48739554 | Gimap1 | TSS500 |
| chr6 | 48739554 | 48743790 | Gimap1 | body |
| chr6 | 48859856 | 48860856 | Gm7932 | TSS500 |
| chr6 | 48895754 | 48909188 | Aoc1 | body |
| chr6 | 48987361 | 48991725 | Svs1 | body |
| chr6 | 49074295 | 49086751 | Malsu1 | body |
| chr6 | 49396104 | 49469501 | Stk31 | body |
| chr6 | 49823210 | 49829507 | Npy | body |
| chr6 | 50573302 | 50596132 | 4921507P07Rik | body |
| chr6 | 50877579 | 50878579 | G930045G22Rik | TSS500 |
| chr6 | 50846524 | 50877579 | G930045G22Rik | body |
| chr6 | 51379710 | 51392277 | Gm26677 | body |
| chr6 | 51432170 | 51433170 | Nfe2l3 | TSS500 |
| chr6 | 52164331 | 52165331 | Hoxa2 | TSS500 |
| chr6 | 52162511 | 52164331 | Hoxa2 | body |
| chr6 | 52163359 | 52212839 | Gm28308 | body |
| chr6 | 52169062 | 52212836 | Hoxa3 | body |
| chr6 | 52174717 | 52175717 | Hoxaas3 | TSS500 |
| chr6 | 52175717 | 52215076 | Hoxaas3 | body |
| chr6 | 52183610 | 52189925 | Gm29430 | body |
| chr6 | 52204087 | 52205087 | Hoxa5 | TSS500 |
| chr6 | 52201754 | 52204087 | Hoxa5 | body |
| chr6 | 52208222 | 52209222 | Hoxa6 | TSS500 |
| chr6 | 52214491 | 52221354 | Hoxa7 | body |
| chr6 | 52230589 | 52231589 | Hoxa9 | TSS500 |
| chr6 | 52223100 | 52230589 | Hoxa9 | body |
| chr6 | 52229665 | 52230665 | Mir196b | TSS500 |
| chr6 | 52240354 | 52241354 | Hoxa10 | TSS500 |

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|------|----------|----------|---------------|--------|
| chr6 | 52231197 | 52240354 | Hoxa10 | body |
| chr6 | 52245310 | 52246310 | Hoxa11 | TSS500 |
| chr6 | 52242106 | 52245310 | Hoxa11 | body |
| chr6 | 52260380 | 52261380 | Hoxa13 | TSS500 |
| chr6 | 52263275 | 52267603 | Hottip | body |
| chr6 | 52308389 | 52314332 | 5730457N03Rik | body |
| chr6 | 52312998 | 52313998 | Evx1 | TSS500 |
| chr6 | 53068131 | 53069131 | Jazf1 | TSS500 |
| chr6 | 52768797 | 53068131 | Jazf1 | body |
| chr6 | 53573884 | 53696007 | Creb5 | body |
| chr6 | 53820330 | 53821330 | Tril | TSS500 |
| chr6 | 53819475 | 53820475 | Gm16499 | TSS500 |
| chr6 | 53873379 | 53978162 | Cpvl | body |
| chr6 | 54039054 | 54040054 | Chn2 | TSS500 |
| chr6 | 54040054 | 54301810 | Chn2 | body |
| chr6 | 54245742 | 54278576 | Gm15527 | body |
| chr6 | 54429721 | 54430721 | 9130019P16Rik | TSS500 |
| chr6 | 54269681 | 54429721 | 9130019P16Rik | body |
| chr6 | 54326512 | 54327512 | Prr15 | TSS500 |
| chr6 | 54429103 | 54430103 | Wipf3 | TSS500 |
| chr6 | 54430103 | 54503768 | Wipf3 | body |
| chr6 | 54565989 | 54566989 | Scrn1 | TSS500 |
| chr6 | 54505890 | 54565989 | Scrn1 | body |
| chr6 | 54817416 | 54893500 | Znrf2 | body |
| chr6 | 55090049 | 55132516 | Crhr2 | body |
| chr6 | 55336932 | 55348555 | Aqp1 | body |
| chr6 | 55376795 | 55388530 | Ghrhr | body |
| chr6 | 55451478 | 55452478 | Adcyap1r1 | TSS500 |
| chr6 | 55677818 | 55680763 | Neurod6 | body |
| chr6 | 55837395 | 55978735 | Ccdc129 | body |
| chr6 | 56017015 | 56018015 | Ppp1r17 | TSS500 |
| chr6 | 56069821 | 56369134 | Pde1c | body |
| chr6 | 56882400 | 56923432 | Nt5c3 | body |
| chr6 | 57035413 | 57036413 | Vmn1r8 | TSS500 |
| chr6 | 57691578 | 57692578 | Pyurf | TSS500 |
| chr6 | 57703101 | 57739438 | Lancl2 | body |
| chr6 | 59208370 | 59209370 | Tigd2 | TSS500 |
| chr6 | 59425790 | 59426790 | Gprin3 | TSS500 |
| chr6 | 60032467 | 60150045 | Gm5570 | body |
| chr6 | 60731573 | 60829355 | Snca | body |
| chr6 | 61180310 | 61181310 | A730020E08Rik | TSS500 |
| chr6 | 61180824 | 62382865 | Ccser1 | body |
| chr6 | 63255376 | 63256376 | Grid2 | TSS500 |
| chr6 | 63256376 | 64668282 | Grid2 | body |

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|------|----------|----------|---------------|--------|
| chr6 | 64728646 | 64729646 | Atoh1 | TSS500 |
| chr6 | 64729646 | 64731233 | Atoh1 | body |
| chr6 | 65380605 | 65381605 | C130060K24Rik | TSS500 |
| chr6 | 65381605 | 65458150 | C130060K24Rik | body |
| chr6 | 65590898 | 65634040 | Tnip3 | body |
| chr6 | 65671090 | 65672090 | Ndnf | TSS500 |
| chr6 | 67035096 | 67036957 | Gadd45a | body |
| chr6 | 67375688 | 67376688 | Il12rb2 | TSS500 |
| chr6 | 67422932 | 67491355 | Il23r | body |
| chr6 | 67535322 | 67536322 | Tacstd2 | TSS500 |
| chr6 | 67534059 | 67535322 | Tacstd2 | body |
| chr6 | 71143846 | 71144846 | Thnsl2 | TSS500 |
| chr6 | 71707061 | 71708061 | Reep1 | TSS500 |
| chr6 | 72235077 | 72236077 | Atoh8 | TSS500 |
| chr6 | 72565922 | 72597913 | Elmod3 | body |
| chr6 | 73221151 | 73222151 | Dnah6 | TSS500 |
| chr6 | 73017606 | 73221151 | Dnah6 | body |
| chr6 | 77979199 | 77980199 | Ctnna2 | TSS500 |
| chr6 | 76881637 | 77979199 | Ctnna2 | body |
| chr6 | 77242189 | 77243189 | Lrrtm1 | TSS500 |
| chr6 | 77243189 | 77257791 | Lrrtm1 | body |
| chr6 | 81900464 | 81910300 | 1700009C05Rik | body |
| chr6 | 82401975 | 82402975 | Tacr1 | TSS500 |
| chr6 | 82402975 | 82560103 | Tacr1 | body |
| chr6 | 83034673 | 83052562 | Loxl3 | body |
| chr6 | 83068324 | 83069725 | Tlx2 | body |
| chr6 | 83078369 | 83080855 | Pcgf1 | body |
| chr6 | 83085867 | 83086867 | Lbx2 | TSS500 |
| chr6 | 83086867 | 83088243 | Lbx2 | body |
| chr6 | 83134963 | 83135963 | Rtkn | TSS500 |
| chr6 | 83135963 | 83152579 | Rtkn | body |
| chr6 | 83512905 | 83535765 | Actg2 | body |
| chr6 | 83671207 | 83677357 | Cd207 | body |
| chr6 | 83711701 | 83712701 | Vax2os | TSS500 |
| chr6 | 83692806 | 83711701 | Vax2os | body |
| chr6 | 83743517 | 83758809 | Atp6v1b1 | body |
| chr6 | 83762365 | 83763365 | 1700124L16Rik | TSS500 |
| chr6 | 83763144 | 83768326 | Ankrd53 | body |
| chr6 | 83795482 | 83803420 | Nagk | body |
| chr6 | 84571414 | 84593408 | Cyp26b1 | body |
| chr6 | 85125625 | 85126625 | Gm5878 | TSS500 |
| chr6 | 85332922 | 85333922 | Sfxn5 | TSS500 |
| chr6 | 85502494 | 85503494 | Fbxo41 | TSS500 |
| chr6 | 85513089 | 85514089 | Egr4 | TSS500 |

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| chr6 | 85511131 | 85513089 | Egr4 | body |
| chr6 | 85808024 | 85820454 | Gm11128 | body |
| chr6 | 85942268 | 85961167 | Dusp11 | body |
| chr6 | 86016691 | 86017691 | Figla | TSS500 |
| chr6 | 86194751 | 86195751 | Tgfa | TSS500 |
| chr6 | 86195751 | 86275639 | Tgfa | body |
| chr6 | 86438874 | 86473500 | C87436 | body |
| chr6 | 86495149 | 86497804 | Gm28720 | body |
| chr6 | 86526771 | 86564442 | 1600020E01Rik | body |
| chr6 | 86684022 | 86685022 | Snrnp27 | TSS500 |
| chr6 | 86691768 | 86732878 | Gmcl1 | body |
| chr6 | 87335275 | 87336275 | Antxr1 | TSS500 |
| chr6 | 87133854 | 87335275 | Antxr1 | body |
| chr6 | 87383268 | 87388435 | Gkn3 | body |
| chr6 | 87590201 | 87591201 | Prokr1 | TSS500 |
| chr6 | 87730369 | 87731369 | Efcc1 | TSS500 |
| chr6 | 87731369 | 87755908 | Efcc1 | body |
| chr6 | 87811664 | 87812664 | Rab43 | TSS500 |
| chr6 | 87914435 | 87936629 | Hmces | body |
| chr6 | 87981383 | 88005471 | Gm5577 | body |
| chr6 | 88193391 | 88194391 | Gata2 | TSS500 |
| chr6 | 88221768 | 88222768 | Dnajib8 | TSS500 |
| chr6 | 88222768 | 88223257 | Dnajib8 | body |
| chr6 | 88547340 | 88637450 | Kbtbd12 | body |
| chr6 | 88724001 | 88725001 | Gm26588 | TSS500 |
| chr6 | 88723912 | 88724912 | Mgll | TSS500 |
| chr6 | 88724912 | 88828360 | Mgll | body |
| chr6 | 88874544 | 88875544 | Podxl2 | TSS500 |
| chr6 | 88842558 | 88874544 | Podxl2 | body |
| chr6 | 89595152 | 89596152 | Chchd6 | TSS500 |
| chr6 | 89644488 | 89675529 | Txnrd3 | body |
| chr6 | 90324685 | 90325685 | Chst13 | TSS500 |
| chr6 | 90428297 | 90429297 | Ccdc37 | TSS500 |
| chr6 | 90403736 | 90428297 | Ccdc37 | body |
| chr6 | 90462076 | 90463076 | Klf15 | TSS500 |
| chr6 | 90463076 | 90475238 | Klf15 | body |
| chr6 | 90485927 | 90486927 | Aldh11 | TSS500 |
| chr6 | 90604225 | 90605225 | Slc41a3 | TSS500 |
| chr6 | 91877553 | 91878553 | Ccdc174 | TSS500 |
| chr6 | 91878553 | 91899843 | Ccdc174 | body |
| chr6 | 91915259 | 91950640 | 4930590J08Rik | body |
| chr6 | 91978378 | 91979378 | Fgd5 | TSS500 |
| chr6 | 91979378 | 92076004 | Fgd5 | body |
| chr6 | 92183533 | 92184533 | Mrps25 | TSS500 |

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| chr6 | 92242061 | 92244150 | Trh | body |
| chr6 | 92705645 | 92706645 | Prickle2 | TSS500 |
| chr6 | 92942992 | 92943992 | Adamts9 | TSS500 |
| chr6 | 92940869 | 93272889 | 9530026P05Rik | body |
| chr6 | 95116740 | 95117740 | Kbtbd8 | TSS500 |
| chr6 | 95255726 | 95333493 | AY512915 | body |
| chr6 | 96831209 | 97059911 | Fam19a4 | body |
| chr6 | 97211189 | 97233315 | Arl6ip5 | body |
| chr6 | 97238528 | 97252280 | Lmod3 | body |
| chr6 | 97617041 | 97618041 | Frmd4b | TSS500 |
| chr6 | 97807558 | 98021349 | Mitf | body |
| chr6 | 98238014 | 98342254 | Gm765 | body |
| chr6 | 99625135 | 99666271 | Eif4e3 | body |
| chr6 | 99692179 | 99693179 | Gpr27 | TSS500 |
| chr6 | 99693179 | 99693818 | Gpr27 | body |
| chr6 | 99725892 | 99726892 | Prok2 | TSS500 |
| chr6 | 99711299 | 99725892 | Prok2 | body |
| chr6 | 99725271 | 99726271 | Gm26748 | TSS500 |
| chr6 | 99726271 | 99732553 | Gm26748 | body |
| chr6 | 100228566 | 100286941 | Rybp | body |
| chr6 | 100526900 | 100527900 | 1700049E22Rik | TSS500 |
| chr6 | 100704234 | 100705234 | Gxylt2 | TSS500 |
| chr6 | 101198069 | 101199069 | Gm26911 | TSS500 |
| chr6 | 102163306 | 102464167 | Cntn3 | body |
| chr6 | 103510376 | 103511376 | Chl1 | TSS500 |
| chr6 | 104493290 | 104863406 | Cntn6 | body |
| chr6 | 105677160 | 105678160 | Cntn4 | TSS500 |
| chr6 | 107529226 | 107530226 | Lrrn1 | TSS500 |
| chr6 | 107530226 | 107570228 | Lrrn1 | body |
| chr6 | 108577039 | 108660434 | 0610040F04Rik | body |
| chr6 | 108783559 | 108823723 | Arl8b | body |
| chr6 | 110645081 | 110646081 | Grm7 | TSS500 |
| chr6 | 112274258 | 112330425 | Lmcd1 | body |
| chr6 | 112359324 | 112387523 | Ssu2 | body |
| chr6 | 112459001 | 112460001 | Cav3 | TSS500 |
| chr6 | 112619850 | 112696186 | Rad18 | body |
| chr6 | 112717971 | 112946766 | Srgap3 | body |
| chr6 | 113045725 | 113046725 | Thumpd3 | TSS500 |
| chr6 | 113194884 | 113195884 | Lhfpl4 | TSS500 |
| chr6 | 113281807 | 113282807 | Cpne9 | TSS500 |
| chr6 | 113282807 | 113305627 | Cpne9 | body |
| chr6 | 113418848 | 113419848 | Rpusd3 | TSS500 |
| chr6 | 113458984 | 113470751 | Il17re | body |
| chr6 | 113482797 | 113483797 | CrelD1 | TSS500 |

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| chr6 | 113501318 | 113502318 | Prrt3 | TSS500 |
| chr6 | 113605272 | 113616948 | Brk1 | body |
| chr6 | 113697550 | 113711069 | Tatdn2 | body |
| chr6 | 113740243 | 113741243 | Sec13 | TSS500 |
| chr6 | 113745669 | 114042113 | Atp2b2 | body |
| chr6 | 114005289 | 114052108 | Gm15083 | body |
| chr6 | 114130741 | 114131741 | Slc6a11 | TSS500 |
| chr6 | 114131741 | 114249886 | Slc6a11 | body |
| chr6 | 114397436 | 114398436 | Hrh1 | TSS500 |
| chr6 | 114643597 | 114860614 | Atg7 | body |
| chr6 | 115135402 | 115282626 | Syn2 | body |
| chr6 | 115227843 | 115259294 | Gm17482 | body |
| chr6 | 115245616 | 115251349 | Timp4 | body |
| chr6 | 115360721 | 115361721 | Pparg | TSS500 |
| chr6 | 115361721 | 115490401 | Pparg | body |
| chr6 | 115545164 | 115578350 | Tsen2 | body |
| chr6 | 115805505 | 115808247 | Rpl32 | body |
| chr6 | 115837912 | 115838912 | Efcab12 | TSS500 |
| chr6 | 115852871 | 115853871 | Mbd4 | TSS500 |
| chr6 | 115840697 | 115852871 | Mbd4 | body |
| chr6 | 115931427 | 115932427 | Rho | TSS500 |
| chr6 | 116582531 | 116583531 | Olfr215 | TSS500 |
| chr6 | 116628499 | 116629499 | Zfp422 | TSS500 |
| chr6 | 116624016 | 116628499 | Zfp422 | body |
| chr6 | 116673336 | 116674336 | Rassf4 | TSS500 |
| chr6 | 116650184 | 116651184 | 8430408G22Rik | TSS500 |
| chr6 | 116651184 | 116652847 | 8430408G22Rik | body |
| chr6 | 116716413 | 116717413 | Tmem72 | TSS500 |
| chr6 | 117169035 | 117181367 | Cxcl12 | body |
| chr6 | 117936835 | 117937835 | Fxyd4 | TSS500 |
| chr6 | 118065885 | 118066885 | Rasgef1a | TSS500 |
| chr6 | 118428670 | 118429670 | Gm25953 | TSS500 |
| chr6 | 118561726 | 118562726 | Ankrd26 | TSS500 |
| chr6 | 118587240 | 119195918 | Cacna1c | body |
| chr6 | 119330266 | 119331266 | Lrtm2 | TSS500 |
| chr6 | 119315133 | 119330266 | Lrtm2 | body |
| chr6 | 119432531 | 119543847 | Wnt5b | body |
| chr6 | 120463697 | 120483727 | Il17ra | body |
| chr6 | 120488939 | 120493307 | Cecr6 | body |
| chr6 | 121064964 | 121069954 | Gm4651 | body |
| chr6 | 121210234 | 121211234 | Tuba8 | TSS500 |
| chr6 | 121211234 | 121226854 | Tuba8 | body |
| chr6 | 121223692 | 121225653 | Gm15856 | body |
| chr6 | 121325176 | 121326176 | Gm24855 | TSS500 |

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| chr6 | 121343576 | 121365775 | Slc6a12 | body |
| chr6 | 121372933 | 121473178 | lqsec3 | body |
| chr6 | 121636673 | 121679237 | A2m | body |
| chr6 | 122007298 | 122085967 | Mug2 | body |
| chr6 | 122270596 | 122282382 | Klrg1 | body |
| chr6 | 122390879 | 122391879 | 1700063H04Rik | TSS500 |
| chr6 | 122485813 | 122486813 | Rimklb | TSS500 |
| chr6 | 122506345 | 122529290 | Mfap5 | body |
| chr6 | 122554301 | 122564180 | Aicda | body |
| chr6 | 122577792 | 122601944 | Apobec1 | body |
| chr6 | 122625910 | 122626910 | Dppa3 | TSS500 |
| chr6 | 122801140 | 122802140 | Slc2a3 | TSS500 |
| chr6 | 122727809 | 122801140 | Slc2a3 | body |
| chr6 | 122820114 | 122821114 | Gm26826 | TSS500 |
| chr6 | 122990867 | 123024105 | Clec4a4 | body |
| chr6 | 123050462 | 123071555 | Clec4b1 | body |
| chr6 | 123106928 | 123143999 | Clec4a2 | body |
| chr6 | 123173393 | 123204671 | Clec4b2 | body |
| chr6 | 123703321 | 123742291 | Vmn2r23 | body |
| chr6 | 124430759 | 124464294 | Clstn3 | body |
| chr6 | 124513132 | 124523440 | C1ra | body |
| chr6 | 124769173 | 124770173 | Eno2 | TSS500 |
| chr6 | 124760053 | 124769173 | Eno2 | body |
| chr6 | 124830047 | 124833701 | Cdca3 | body |
| chr6 | 124834240 | 124839775 | Gnb3 | body |
| chr6 | 124863417 | 124864417 | Gpr162 | TSS500 |
| chr6 | 124864692 | 124887721 | Cd4 | body |
| chr6 | 124904361 | 124911205 | Lag3 | body |
| chr6 | 124913681 | 124917446 | Ptms | body |
| chr6 | 124931888 | 124936138 | Mlf2 | body |
| chr6 | 124997194 | 125003096 | Pianp | body |
| chr6 | 125216051 | 125244543 | Vamp1 | body |
| chr6 | 125278274 | 125285542 | Tuba3a | body |
| chr6 | 125321159 | 125344943 | Scnn1a | body |
| chr6 | 125494930 | 125499668 | Gm26728 | body |
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| chr6 | 126532553 | 126697692 | Kcna5 | body |
| chr6 | 126645301 | 126646301 | Kcna1 | TSS500 |
| chr6 | 126740174 | 126741174 | Kcna6 | TSS500 |
| chr6 | 126708329 | 126740174 | Kcna6 | body |
| chr6 | 126719184 | 126741601 | Gm26673 | body |
| chr6 | 126853598 | 126874307 | Akap3 | body |

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|------|-----------|-----------|---------------|--------|
| chr6 | 126921339 | 126922339 | Dyrk4 | TSS500 |
| chr6 | 126876020 | 126921339 | Dyrk4 | body |
| chr6 | 126923050 | 126939087 | Rad51ap1 | body |
| chr6 | 127015042 | 127016042 | Fgf6 | TSS500 |
| chr6 | 127072402 | 127073402 | Fgf23 | TSS500 |
| chr6 | 127073402 | 127081408 | Fgf23 | body |
| chr6 | 127149889 | 127212411 | 9330179D12Rik | body |
| chr6 | 127578475 | 127629938 | Cracr2a | body |
| chr6 | 127768972 | 127769972 | Prmt8 | TSS500 |
| chr6 | 127887089 | 127888089 | Tspan11 | TSS500 |
| chr6 | 127888089 | 127953031 | Tspan11 | body |
| chr6 | 127934689 | 127944339 | Gm15870 | body |
| chr6 | 128399240 | 128400240 | Gm15862 | TSS500 |
| chr6 | 128662885 | 128677374 | Clec2h | body |
| chr6 | 128848044 | 128890626 | BC035044 | body |
| chr6 | 128951204 | 128974529 | Gm15987 | body |
| chr6 | 129237482 | 129238482 | 2310001H17Rik | TSS500 |
| chr6 | 129426684 | 129451500 | Clec1a | body |
| chr6 | 130013033 | 130026454 | Klra6 | body |
| chr6 | 130129398 | 130130398 | Klra8 | TSS500 |
| chr6 | 130675247 | 130698516 | Gm26919 | body |
| chr6 | 131219223 | 131246862 | Klra2 | body |
| chr6 | 131292744 | 131293744 | Magohb | TSS500 |
| chr6 | 133292716 | 133295790 | 5530400C23Rik | body |
| chr6 | 133529689 | 133532762 | Gm5885 | body |
| chr6 | 134396818 | 134438736 | Bcl2l14 | body |
| chr6 | 134631988 | 134632988 | Mansc1 | TSS500 |
| chr6 | 134640127 | 134711184 | Loh12cr1 | body |
| chr6 | 134869093 | 134897425 | Gpr19 | body |
| chr6 | 134981501 | 134982501 | Apold1 | TSS500 |
| chr6 | 135065151 | 135066151 | Gprc5a | TSS500 |
| chr6 | 135066151 | 135084709 | Gprc5a | body |
| chr6 | 135167715 | 135168715 | Hebp1 | TSS500 |
| chr6 | 135237329 | 135253851 | Gsg1 | body |
| chr6 | 136173011 | 136174011 | Grin2b | TSS500 |
| chr6 | 135713232 | 136173011 | Grin2b | body |
| chr6 | 135733370 | 135744311 | Gm14329 | body |
| chr6 | 136172561 | 136173561 | Gm26653 | TSS500 |
| chr6 | 136329043 | 136329778 | Gm8994 | body |
| chr6 | 136518302 | 136519302 | Atf7ip | TSS500 |
| chr6 | 136519302 | 136611038 | Atf7ip | body |
| chr6 | 136781265 | 136782265 | Gucy2c | TSS500 |
| chr6 | 136827733 | 136828733 | Wbp11 | TSS500 |
| chr6 | 137252799 | 137464629 | Ptpro | body |

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|------|-----------|-----------|---------------|--------|
| chr6 | 137754042 | 137755042 | Dera | TSS500 |
| chr6 | 137755042 | 137837891 | Dera | body |
| chr6 | 137983586 | 138079416 | Slc15a5 | body |
| chr6 | 138362918 | 138581468 | Lmo3 | body |
| chr6 | 138422605 | 138423605 | A830011K09Rik | TSS500 |
| chr6 | 139586721 | 139587721 | Pik3c2g | TSS500 |
| chr6 | 139587721 | 139969284 | Pik3c2g | body |
| chr6 | 139989676 | 140040957 | Plcz1 | body |
| chr6 | 141238278 | 141250061 | Gm28524 | body |
| chr6 | 141249509 | 141250509 | Gm28523 | TSS500 |
| chr6 | 141246920 | 141249509 | Gm28523 | body |
| chr6 | 141248769 | 141249769 | Pde3a | TSS500 |
| chr6 | 141708118 | 141773310 | Gm5724 | body |
| chr6 | 141907282 | 141946462 | Slco1a1 | body |
| chr6 | 142507457 | 142508457 | Ldhb | TSS500 |
| chr6 | 142570856 | 142571856 | Kcnj8 | TSS500 |
| chr6 | 142701774 | 142702774 | Abcc9 | TSS500 |
| chr6 | 142587862 | 142701774 | Abcc9 | body |
| chr6 | 142615095 | 142626462 | RP23-330I2.1 | body |
| chr6 | 142963952 | 142964952 | St8sia1 | TSS500 |
| chr6 | 142821545 | 142963952 | St8sia1 | body |
| chr6 | 143167730 | 143208542 | Etnk1 | body |
| chr6 | 143535008 | 143536008 | 4930579D09Rik | TSS500 |
| chr6 | 144721411 | 144759883 | Sox5os4 | body |
| chr6 | 145048059 | 145050430 | Gm26666 | body |
| chr6 | 145442256 | 145444028 | Gm15499 | body |
| chr6 | 145858243 | 145865058 | Bhlhe41 | body |
| chr6 | 146501723 | 146502723 | Itpr2 | TSS500 |
| chr6 | 146602352 | 146642324 | Tm7sf3 | body |
| chr6 | 146796555 | 146833529 | Arntl2 | body |
| chr6 | 147180744 | 147208285 | E330012B07Rik | body |
| chr6 | 147263667 | 147264667 | Pthlh | TSS500 |
| chr6 | 147252101 | 147263667 | Pthlh | body |
| chr6 | 147442802 | 147475546 | Gm6288 | body |
| chr6 | 148046839 | 148047839 | Far2os2 | TSS500 |
| chr6 | 148046759 | 148047759 | Far2 | TSS500 |
| chr6 | 148047759 | 148182758 | Far2 | body |
| chr6 | 148443889 | 148444889 | Tmtc1 | TSS500 |
| chr6 | 148232430 | 148443889 | Tmtc1 | body |
| chr6 | 148354156 | 148355156 | Rps4l | TSS500 |
| chr6 | 149408484 | 149409484 | Bicd1 | TSS500 |
| chr7 | 3111450 | 3112450 | Gm7353 | TSS500 |
| chr7 | 3108535 | 3111450 | Gm7353 | body |
| chr7 | 3154664 | 3168703 | AU018091 | body |

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|------|----------|----------|---------------|--------|
| chr7 | 3218419 | 3219419 | Mir291a | TSS500 |
| chr7 | 3218689 | 3219689 | Mir292 | TSS500 |
| chr7 | 3218982 | 3219982 | Mir291b | TSS500 |
| chr7 | 3332455 | 3333455 | Cacng7 | TSS500 |
| chr7 | 3391183 | 3415648 | Cacng8 | body |
| chr7 | 3414566 | 3415566 | Gm23450 | TSS500 |
| chr7 | 3423695 | 3424695 | Cacng6 | TSS500 |
| chr7 | 3424695 | 3435667 | Cacng6 | body |
| chr7 | 3645790 | 3661108 | Cnot3 | body |
| chr7 | 3660098 | 3665340 | Leng1 | body |
| chr7 | 3816781 | 3825187 | Gm15448 | body |
| chr7 | 4147915 | 4149874 | Leng9 | body |
| chr7 | 4164360 | 4165360 | Cdc42ep5 | TSS500 |
| chr7 | 4151260 | 4164360 | Cdc42ep5 | body |
| chr7 | 4461174 | 4479404 | Eps8l1 | body |
| chr7 | 4481520 | 4501180 | Ppp1r12c | body |
| chr7 | 4523729 | 4524729 | Tnni3 | TSS500 |
| chr7 | 4518305 | 4523729 | Tnni3 | body |
| chr7 | 4631501 | 4658450 | Ppp6r1 | body |
| chr7 | 4690104 | 4691104 | Brsk1 | TSS500 |
| chr7 | 4752594 | 4753594 | Cox6b2 | TSS500 |
| chr7 | 4808155 | 4811851 | Ube2s | body |
| chr7 | 4844196 | 4845196 | Shisa7 | TSS500 |
| chr7 | 4825552 | 4844196 | Shisa7 | body |
| chr7 | 4844959 | 4865693 | Isoc2b | body |
| chr7 | 4876553 | 4877553 | Isoc2a | TSS500 |
| chr7 | 4922751 | 4925006 | Nat14 | body |
| chr7 | 4956134 | 4963890 | Sbk2 | body |
| chr7 | 5056652 | 5060785 | Ccdc106 | body |
| chr7 | 6010510 | 6011510 | Vmn1r65 | TSS500 |
| chr7 | 6222778 | 6239423 | Zscan5b | body |
| chr7 | 6330785 | 6331785 | Zfp583 | TSS500 |
| chr7 | 6399215 | 6432093 | Smim17 | body |
| chr7 | 6410777 | 6441691 | Gm20715 | body |
| chr7 | 6695950 | 6696950 | Zim1 | TSS500 |
| chr7 | 6729921 | 6730921 | Peg3 | TSS500 |
| chr7 | 6961660 | 6963769 | Usp29 | body |
| chr7 | 6994943 | 6995943 | Aurkc | TSS500 |
| chr7 | 7209498 | 7210498 | Zfp772 | TSS500 |
| chr7 | 7282316 | 7299011 | Clcn4-2 | body |
| chr7 | 7311723 | 7337031 | Vmn2r30 | body |
| chr7 | 7786151 | 7819367 | Vmn2r35 | body |
| chr7 | 10494894 | 10495894 | Zik1 | TSS500 |
| chr7 | 12513017 | 12556323 | 2900092C05Rik | body |

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|------|----------|----------|---------------|--------|
| chr7 | 12693998 | 12732605 | Vmn2r56 | body |
| chr7 | 12834261 | 12835261 | Zfp110 | TSS500 |
| chr7 | 12927916 | 12931072 | 2310014L17Rik | body |
| chr7 | 12988346 | 12997692 | Slc27a5 | body |
| chr7 | 13042303 | 13054264 | Mzf1 | body |
| chr7 | 13624467 | 13670807 | Sult2a5 | body |
| chr7 | 13734005 | 13779636 | Sult2a2 | body |
| chr7 | 14067452 | 14122544 | Sult2a3 | body |
| chr7 | 14222403 | 14254370 | Sult2a6 | body |
| chr7 | 15389448 | 15556866 | Obox1 | body |
| chr7 | 15839178 | 15840178 | Obox6 | TSS500 |
| chr7 | 15833241 | 15839178 | Obox6 | body |
| chr7 | 15865947 | 15879468 | Crx | body |
| chr7 | 16129800 | 16130800 | Slc8a2 | TSS500 |
| chr7 | 16130800 | 16160509 | Slc8a2 | body |
| chr7 | 16310116 | 16318205 | Bbc3 | body |
| chr7 | 16453279 | 16455489 | Tmem160 | body |
| chr7 | 16455721 | 16476280 | Npas1 | body |
| chr7 | 16493719 | 16614493 | Arhgap35 | body |
| chr7 | 16618627 | 16619332 | Gm29442 | body |
| chr7 | 16738910 | 16749294 | Ap2s1 | body |
| chr7 | 16815389 | 16816389 | Strn4 | TSS500 |
| chr7 | 16945182 | 16948828 | Pnmal2 | body |
| chr7 | 16960295 | 16962319 | Pnmal1 | body |
| chr7 | 17031507 | 17061927 | Hif3a | body |
| chr7 | 17150782 | 17164253 | Ceacam3 | body |
| chr7 | 17713752 | 17761121 | Ceacam5 | body |
| chr7 | 18066429 | 18077986 | Ceacam12 | body |
| chr7 | 18674107 | 18685685 | Psg20 | body |
| chr7 | 18718590 | 18727248 | Psg22 | body |
| chr7 | 18813937 | 18821107 | Psg17 | body |
| chr7 | 18840466 | 18858654 | Mill2 | body |
| chr7 | 18925388 | 18926388 | Nova2 | TSS500 |
| chr7 | 18926388 | 18965319 | Nova2 | body |
| chr7 | 18962415 | 18964673 | Gm26821 | body |
| chr7 | 18989554 | 18992274 | Gm10676 | body |
| chr7 | 19086328 | 19087328 | Mir3100 | TSS500 |
| chr7 | 19157125 | 19165627 | Gipr | body |
| chr7 | 19175921 | 19176921 | Eml2 | TSS500 |
| chr7 | 19180965 | 19181965 | Mir330 | TSS500 |
| chr7 | 19212038 | 19213038 | Gpr4 | TSS500 |
| chr7 | 19213038 | 19224176 | Gpr4 | body |
| chr7 | 19279549 | 19280549 | Ppm1n | TSS500 |
| chr7 | 19276807 | 19279549 | Ppm1n | body |

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| chr7 | 19300270 | 19301270 | Gm26802 | TSS500 |
| chr7 | 19356849 | 19358983 | Cd3eap | body |
| chr7 | 19359249 | 19360249 | Ppp1r13l | TSS500 |
| chr7 | 19420917 | 19421917 | A930016O22Rik | TSS500 |
| chr7 | 19457994 | 19458994 | Mark4 | TSS500 |
| chr7 | 19505814 | 19507831 | Bloc1s3 | body |
| chr7 | 19573323 | 19574323 | Gemin7 | TSS500 |
| chr7 | 19564946 | 19573323 | Gemin7 | body |
| chr7 | 19576787 | 19577787 | Zfp296 | TSS500 |
| chr7 | 19577787 | 19580656 | Zfp296 | body |
| chr7 | 19671579 | 19680923 | Apoc2 | body |
| chr7 | 19698666 | 19699666 | Apoe | TSS500 |
| chr7 | 19696109 | 19698666 | Apoe | body |
| chr7 | 19756131 | 19770516 | Bcam | body |
| chr7 | 19796309 | 19797309 | Cblc | TSS500 |
| chr7 | 19860799 | 19861799 | Ceacam16 | TSS500 |
| chr7 | 19965912 | 19991113 | Ceacam20 | body |
| chr7 | 23385389 | 23386389 | Nlrp5 | TSS500 |
| chr7 | 24111814 | 24112814 | Zfp112 | TSS500 |
| chr7 | 24112814 | 24127952 | Zfp112 | body |
| chr7 | 24300732 | 24301732 | Zfp61 | TSS500 |
| chr7 | 24333465 | 24334465 | Tescl | TSS500 |
| chr7 | 24333080 | 24333465 | Tescl | body |
| chr7 | 24369763 | 24370763 | Kcnn4 | TSS500 |
| chr7 | 24431922 | 24435034 | Irgc1 | body |
| chr7 | 24481523 | 24482523 | Cadm4 | TSS500 |
| chr7 | 24541699 | 24545571 | Pinlyp | body |
| chr7 | 24587141 | 24588141 | Zfp575 | TSS500 |
| chr7 | 24588043 | 24608925 | Ethe1 | body |
| chr7 | 24610828 | 24611828 | Phldb3 | TSS500 |
| chr7 | 24631145 | 24637416 | Gm26550 | body |
| chr7 | 24636070 | 24637070 | Lypd3 | TSS500 |
| chr7 | 24708759 | 24709759 | BC049730 | TSS500 |
| chr7 | 24709759 | 24714533 | BC049730 | body |
| chr7 | 24743985 | 24759811 | Cd177 | body |
| chr7 | 24861713 | 24862713 | Gm9844 | TSS500 |
| chr7 | 24864620 | 24869441 | Lypd4 | body |
| chr7 | 24897881 | 24902197 | Cd79a | body |
| chr7 | 24969750 | 24972228 | Rabac1 | body |
| chr7 | 25005457 | 25006457 | Atp1a3 | TSS500 |
| chr7 | 25159422 | 25160422 | Pou2f2 | TSS500 |
| chr7 | 25219359 | 25220359 | Dedd2 | TSS500 |
| chr7 | 25268204 | 25294159 | Cic | body |
| chr7 | 25297486 | 25298486 | Pafah1b3 | TSS500 |

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|------|----------|----------|-----------|--------|
| chr7 | 25379527 | 25398210 | Lipe | body |
| chr7 | 25461702 | 25477125 | Ceacam1 | body |
| chr7 | 25615392 | 25616392 | Erich4 | TSS500 |
| chr7 | 25614621 | 25615392 | Erich4 | body |
| chr7 | 25618914 | 25619914 | Atp5sl | TSS500 |
| chr7 | 25674666 | 25675666 | Tmem91 | TSS500 |
| chr7 | 25711106 | 25718588 | Ccdc97 | body |
| chr7 | 25816154 | 25817154 | Gm26707 | TSS500 |
| chr7 | 26061995 | 26096196 | Cyp2b13 | body |
| chr7 | 26322473 | 26403200 | Nlrp9c | body |
| chr7 | 27187005 | 27195771 | Snrpa | body |
| chr7 | 27196281 | 27205386 | BC024978 | body |
| chr7 | 27337192 | 27338192 | Ltbp4 | TSS500 |
| chr7 | 27305136 | 27337192 | Ltbp4 | body |
| chr7 | 27356919 | 27357919 | Gm20479 | TSS500 |
| chr7 | 27352649 | 27356919 | Gm20479 | body |
| chr7 | 27487410 | 27490316 | Sertad1 | body |
| chr7 | 27592052 | 27640826 | Akt2 | body |
| chr7 | 27653415 | 27654415 | Ttc9b | TSS500 |
| chr7 | 27863057 | 27879567 | Zfp607 | body |
| chr7 | 28070736 | 28071736 | Fcgbp | TSS500 |
| chr7 | 28099660 | 28101987 | Gm10935 | body |
| chr7 | 28179969 | 28187294 | Dyrk1b | body |
| chr7 | 28267381 | 28268381 | Eid2 | TSS500 |
| chr7 | 28277206 | 28278206 | Eid2b | TSS500 |
| chr7 | 28290686 | 28291686 | BC089491 | TSS500 |
| chr7 | 28301738 | 28302738 | Dll3 | TSS500 |
| chr7 | 28293553 | 28301738 | Dll3 | body |
| chr7 | 28393451 | 28399388 | Paf1 | body |
| chr7 | 28543596 | 28546754 | Nccrp1 | body |
| chr7 | 28630832 | 28631832 | Pap1 | TSS500 |
| chr7 | 28607634 | 28630832 | Pap1 | body |
| chr7 | 28693349 | 28699338 | Fbxo27 | body |
| chr7 | 28788469 | 28789469 | Rin1 | TSS500 |
| chr7 | 28864353 | 28866284 | Lgals7 | body |
| chr7 | 28983354 | 29003279 | Map4k1 | body |
| chr7 | 29124651 | 29125651 | Ryr1 | TSS500 |
| chr7 | 29134354 | 29135354 | Rasgrp4 | TSS500 |
| chr7 | 29232022 | 29233022 | Kcnk6 | TSS500 |
| chr7 | 29281477 | 29282477 | Spint2 | TSS500 |
| chr7 | 29256331 | 29281477 | Spint2 | body |
| chr7 | 29304451 | 29317588 | Dpf1 | body |
| chr7 | 29562315 | 29563315 | Gm29326 | TSS500 |
| chr7 | 29697219 | 29726515 | Catsperg2 | body |

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|------|----------|----------|---------------|--------|
| chr7 | 29816572 | 29832042 | Zfp790 | body |
| chr7 | 29860479 | 29877292 | Zfp420 | body |
| chr7 | 30072400 | 30073400 | Zfp82 | TSS500 |
| chr7 | 30054489 | 30072400 | Zfp82 | body |
| chr7 | 30199130 | 30200889 | Gm26810 | body |
| chr7 | 30233439 | 30235225 | Ovol3 | body |
| chr7 | 30315307 | 30319046 | Syne4 | body |
| chr7 | 30362272 | 30363272 | Lrfn3 | TSS500 |
| chr7 | 30355514 | 30362272 | Lrfn3 | body |
| chr7 | 30421232 | 30422232 | Nfkbid | TSS500 |
| chr7 | 30422232 | 30428746 | Nfkbid | body |
| chr7 | 30445082 | 30446082 | Aplp1 | TSS500 |
| chr7 | 30457190 | 30458190 | Kirrel2 | TSS500 |
| chr7 | 30447534 | 30457190 | Kirrel2 | body |
| chr7 | 30457815 | 30458815 | Nphs1 | TSS500 |
| chr7 | 30458815 | 30487223 | Nphs1 | body |
| chr7 | 30465091 | 30466091 | Nphs1os | TSS500 |
| chr7 | 30514622 | 30515622 | Arhgap33os | TSS500 |
| chr7 | 30533680 | 30534680 | Arhgap33 | TSS500 |
| chr7 | 30564737 | 30564856 | Gm17104 | body |
| chr7 | 30603092 | 30612234 | Upk1a | body |
| chr7 | 30616974 | 30625651 | Cox6b1 | body |
| chr7 | 30633616 | 30635352 | Etv2 | body |
| chr7 | 30738153 | 30748437 | Gm26935 | body |
| chr7 | 30763256 | 30764256 | Dmkn | TSS500 |
| chr7 | 30787396 | 30788396 | Krtdap | TSS500 |
| chr7 | 30854330 | 30855678 | Ffar3 | body |
| chr7 | 30861064 | 30862064 | Ffar1 | TSS500 |
| chr7 | 30860473 | 30861064 | Ffar1 | body |
| chr7 | 30865402 | 30879842 | Cd22 | body |
| chr7 | 30873233 | 30873333 | Gm29439 | body |
| chr7 | 30914373 | 30915373 | Mag | TSS500 |
| chr7 | 31059842 | 31070935 | Lgi4 | body |
| chr7 | 31068172 | 31076204 | Fxyd3 | body |
| chr7 | 31114790 | 31115790 | Hpn | TSS500 |
| chr7 | 31098725 | 31114790 | Hpn | body |
| chr7 | 31116524 | 31126445 | Scn1b | body |
| chr7 | 33653940 | 33659268 | Gm12763 | body |
| chr7 | 34230420 | 34233575 | Gm12762 | body |
| chr7 | 34236707 | 34313051 | 4931406P16Rik | body |
| chr7 | 34438637 | 34520885 | Gm12766 | body |
| chr7 | 34652684 | 34653684 | Gm12781 | TSS500 |
| chr7 | 34665413 | 34673499 | Gm12756 | body |
| chr7 | 34674468 | 34812211 | Chst8 | body |

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|------|----------|----------|---------------|--------|
| chr7 | 35046422 | 35056003 | Cebpg | body |
| chr7 | 35118793 | 35119793 | Cebpa | TSS500 |
| chr7 | 35119793 | 35121926 | Cebpa | body |
| chr7 | 35185885 | 35186885 | Slc7a10 | TSS500 |
| chr7 | 35214870 | 35215870 | Lrp3 | TSS500 |
| chr7 | 35449537 | 35466036 | Slc7a9 | body |
| chr7 | 35578993 | 35585082 | Rgs9bp | body |
| chr7 | 35803092 | 35838074 | E130304I02Rik | body |
| chr7 | 37773141 | 37774141 | Zfp536 | TSS500 |
| chr7 | 39431007 | 39432007 | Gm27437 | TSS500 |
| chr7 | 39588518 | 39591179 | Gm26526 | body |
| chr7 | 40373302 | 40468740 | Gm28807 | body |
| chr7 | 40818476 | 40900437 | A230077H06Rik | body |
| chr7 | 40898715 | 40899715 | Vstm2b | TSS500 |
| chr7 | 40899715 | 40930594 | Vstm2b | body |
| chr7 | 41545674 | 41573162 | Gm6871 | body |
| chr7 | 42505226 | 42506226 | Zfp141 | TSS500 |
| chr7 | 42660105 | 42692218 | Gm5595 | body |
| chr7 | 42816829 | 42866734 | Gm2381 | body |
| chr7 | 42903251 | 42933289 | Vmn2r63 | body |
| chr7 | 43350841 | 43351841 | Siglecf | TSS500 |
| chr7 | 43441282 | 43443328 | Cldnd2 | body |
| chr7 | 43463651 | 43471913 | Vsig10l | body |
| chr7 | 43489575 | 43490575 | Iglon5 | TSS500 |
| chr7 | 43492044 | 43505440 | 4931406B18Rik | body |
| chr7 | 43659661 | 43660661 | Siglece | TSS500 |
| chr7 | 43797445 | 43798445 | 2310002F09Rik | TSS500 |
| chr7 | 43695209 | 43797445 | 2310002F09Rik | body |
| chr7 | 43781554 | 43785410 | Klk10 | body |
| chr7 | 43797077 | 43798077 | Klk8 | TSS500 |
| chr7 | 43798077 | 43803822 | Klk8 | body |
| chr7 | 43842769 | 43851181 | Klk5 | body |
| chr7 | 44207935 | 44211754 | Klk1b4 | body |
| chr7 | 44360043 | 44385320 | 1700008O03Rik | body |
| chr7 | 44384602 | 44400187 | Syt3 | body |
| chr7 | 44428518 | 44429518 | Lrrc4b | TSS500 |
| chr7 | 44489937 | 44496029 | Emc10 | body |
| chr7 | 44590164 | 44591164 | Kcnc3 | TSS500 |
| chr7 | 44670343 | 44671343 | Myh14 | TSS500 |
| chr7 | 44709243 | 44719842 | Izumo2 | body |
| chr7 | 44731481 | 44750550 | Zfp473 | body |
| chr7 | 44747913 | 44748913 | Vrk3 | TSS500 |
| chr7 | 44840901 | 44848579 | Tbc1d17 | body |
| chr7 | 44849491 | 44855421 | Akt1s1 | body |

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|------|----------|----------|---------------|--------|
| chr7 | 44895579 | 44896579 | Fuz | TSS500 |
| chr7 | 44900373 | 44928996 | Ap2a1 | body |
| chr7 | 44942722 | 44943722 | Tsk | TSS500 |
| chr7 | 44959373 | 44974351 | Cpt1c | body |
| chr7 | 44975989 | 44985992 | Prmt1 | body |
| chr7 | 45018478 | 45021646 | Ras | body |
| chr7 | 45053613 | 45062177 | Prrg2 | body |
| chr7 | 45125558 | 45135731 | Rpl13a | body |
| chr7 | 45131188 | 45135932 | Flt3l | body |
| chr7 | 45154084 | 45155084 | Aldh16a1 | TSS500 |
| chr7 | 45154803 | 45160069 | Pih1d1 | body |
| chr7 | 45164421 | 45176138 | Slc17a7 | body |
| chr7 | 45176349 | 45179097 | Gfy | body |
| chr7 | 45204392 | 45205392 | Ccdc155 | TSS500 |
| chr7 | 45211383 | 45212383 | Dkk1 | TSS500 |
| chr7 | 45238615 | 45239615 | Cd37 | TSS500 |
| chr7 | 45233632 | 45238615 | Cd37 | body |
| chr7 | 45240585 | 45241585 | Slc6a16 | TSS500 |
| chr7 | 45278013 | 45288998 | 1700039E15Rik | body |
| chr7 | 45334790 | 45335790 | Hrc | TSS500 |
| chr7 | 45370083 | 45371083 | Lin7b | TSS500 |
| chr7 | 45367891 | 45370083 | Lin7b | body |
| chr7 | 45405460 | 45406460 | Kcna7 | TSS500 |
| chr7 | 45413195 | 45414195 | Ntf5 | TSS500 |
| chr7 | 45466398 | 45467398 | Bax | TSS500 |
| chr7 | 45522916 | 45525768 | Ppp1r15a | body |
| chr7 | 45555393 | 45567752 | Hsd17b14 | body |
| chr7 | 45617106 | 45618106 | Fut1 | TSS500 |
| chr7 | 45630664 | 45632577 | Gm16047 | body |
| chr7 | 45640477 | 45646521 | Mamstr | body |
| chr7 | 45665808 | 45666808 | Fut2 | TSS500 |
| chr7 | 45759112 | 45760112 | Sult2b1 | TSS500 |
| chr7 | 45729983 | 45759112 | Sult2b1 | body |
| chr7 | 45783238 | 45784238 | Lmtk3 | TSS500 |
| chr7 | 45806637 | 45814081 | Cyth2 | body |
| chr7 | 45870428 | 45871428 | Grin2d | TSS500 |
| chr7 | 45831883 | 45870428 | Grin2d | body |
| chr7 | 45885222 | 45896214 | Syngn4 | body |
| chr7 | 46195350 | 46238003 | Ush1c | body |
| chr7 | 46375974 | 46376974 | Myod1 | TSS500 |
| chr7 | 46395997 | 46396997 | Kcnc1 | TSS500 |
| chr7 | 46396997 | 46438375 | Kcnc1 | body |
| chr7 | 46647130 | 46672037 | Tph1 | body |
| chr7 | 46742480 | 46743480 | Saa1 | TSS500 |

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|------|----------|----------|---------------|--------|
| chr7 | 46751333 | 46752333 | Saa2 | TSS500 |
| chr7 | 46796603 | 46823800 | Gtf2h1 | body |
| chr7 | 47077798 | 47133184 | Ptpn5 | body |
| chr7 | 47185707 | 47204420 | Mrgpra6 | body |
| chr7 | 47234861 | 47252348 | Mrgpra9 | body |
| chr7 | 47334875 | 47353740 | Mrgpra1 | body |
| chr7 | 47426328 | 47451639 | Mrgpra2a | body |
| chr7 | 47463806 | 47528362 | Mrgpra2b | body |
| chr7 | 48020971 | 48027097 | Mrgprx1 | body |
| chr7 | 48478619 | 48498821 | Mrgprx2 | body |
| chr7 | 49636349 | 49637349 | Dbx1 | TSS500 |
| chr7 | 49631499 | 49636349 | Dbx1 | body |
| chr7 | 49758606 | 49759606 | Htatip2 | TSS500 |
| chr7 | 49759606 | 49773999 | Htatip2 | body |
| chr7 | 49910646 | 49963856 | Slc6a5 | body |
| chr7 | 49974364 | 49975364 | Nell1 | TSS500 |
| chr7 | 49975364 | 50865255 | Nell1 | body |
| chr7 | 51510529 | 51511529 | Ano5 | TSS500 |
| chr7 | 51511529 | 51598709 | Ano5 | body |
| chr7 | 51621330 | 51622330 | Slc17a6 | TSS500 |
| chr7 | 51622330 | 51671125 | Slc17a6 | body |
| chr7 | 52005518 | 52006518 | Svip | TSS500 |
| chr7 | 51997165 | 52005518 | Svip | body |
| chr7 | 54835459 | 54836459 | Luzp2 | TSS500 |
| chr7 | 55768678 | 55778925 | Siglech | body |
| chr7 | 55793648 | 55794648 | Tubgcp5 | TSS500 |
| chr7 | 55842245 | 55930700 | Cyfip1 | body |
| chr7 | 55977567 | 56019454 | Nipa1 | body |
| chr7 | 56240260 | 56536517 | Oca2 | body |
| chr7 | 57386688 | 57387688 | Gabrg3 | TSS500 |
| chr7 | 56716465 | 57386688 | Gabrg3 | body |
| chr7 | 57386772 | 57387772 | Gm9962 | TSS500 |
| chr7 | 57509509 | 57510509 | Gabra5 | TSS500 |
| chr7 | 57407690 | 57509509 | Gabra5 | body |
| chr7 | 57590018 | 57591018 | Gabrb3 | TSS500 |
| chr7 | 57591018 | 57828802 | Gabrb3 | body |
| chr7 | 61127996 | 61311221 | A230006K03Rik | body |
| chr7 | 62376479 | 62377479 | Magel2 | TSS500 |
| chr7 | 62377479 | 62381640 | Magel2 | body |
| chr7 | 62419639 | 62420639 | Mkrn3 | TSS500 |
| chr7 | 63212026 | 63213026 | Chrna7 | TSS500 |
| chr7 | 63098692 | 63212026 | Chrna7 | body |
| chr7 | 63444029 | 63445029 | 4930554H23Rik | TSS500 |
| chr7 | 63444251 | 63445251 | Otud7a | TSS500 |

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|------|----------|----------|---------------|--------|
| chr7 | 65156070 | 65157070 | Fam189a1 | TSS500 |
| chr7 | 64756113 | 65156070 | Fam189a1 | body |
| chr7 | 64867052 | 64872497 | Ndn12 | body |
| chr7 | 65296165 | 65370739 | Tjp1 | body |
| chr7 | 65579998 | 65635413 | Gm7546 | body |
| chr7 | 65691669 | 65701913 | Tm2d3 | body |
| chr7 | 65862234 | 66050340 | Pcsk6 | body |
| chr7 | 66109515 | 66172621 | Gm26827 | body |
| chr7 | 66110015 | 66173789 | Chsy1 | body |
| chr7 | 66427017 | 66428017 | Aldh1a3 | TSS500 |
| chr7 | 66390892 | 66427017 | Aldh1a3 | body |
| chr7 | 66744004 | 66823692 | Cers3 | body |
| chr7 | 66840235 | 67152625 | Adamts17 | body |
| chr7 | 67204082 | 67221958 | 1700112J16Rik | body |
| chr7 | 67223044 | 67228468 | Lysmd4 | body |
| chr7 | 67759242 | 67760242 | Synm | TSS500 |
| chr7 | 67802996 | 67803996 | 4833412C05Rik | TSS500 |
| chr7 | 67784725 | 67802996 | 4833412C05Rik | body |
| chr7 | 68276094 | 68277094 | Gm16157 | TSS500 |
| chr7 | 68274339 | 68363089 | Fam169b | body |
| chr7 | 68338668 | 68352701 | Gm16158 | body |
| chr7 | 71350985 | 71351985 | Gm10295 | TSS500 |
| chr7 | 71348961 | 71350985 | Gm10295 | body |
| chr7 | 71350951 | 71351951 | Gm29295 | TSS500 |
| chr7 | 71351951 | 71391272 | Gm29295 | body |
| chr7 | 72306095 | 72307095 | Mctp2 | TSS500 |
| chr7 | 72077830 | 72306095 | Mctp2 | body |
| chr7 | 73375239 | 73376239 | A730056A06Rik | TSS500 |
| chr7 | 73375020 | 73376020 | Rgma | TSS500 |
| chr7 | 73376020 | 73419899 | Rgma | body |
| chr7 | 73740417 | 73741417 | A830073O21Rik | TSS500 |
| chr7 | 73738893 | 73740417 | A830073O21Rik | body |
| chr7 | 73739807 | 73740807 | Fam174b | TSS500 |
| chr7 | 73740807 | 73776919 | Fam174b | body |
| chr7 | 73781429 | 73816003 | Gm10619 | body |
| chr7 | 74013190 | 74014190 | St8sia2 | TSS500 |
| chr7 | 74235058 | 74236058 | Gm27459 | TSS500 |
| chr7 | 74554280 | 74555280 | Slco3a1 | TSS500 |
| chr7 | 75114897 | 75308762 | Sv2b | body |
| chr7 | 76318572 | 76766608 | Agbl1 | body |
| chr7 | 78577908 | 78578908 | Ntrk3 | TSS500 |
| chr7 | 78192362 | 78577908 | Ntrk3 | body |
| chr7 | 78578330 | 78579330 | Gm9885 | TSS500 |
| chr7 | 79053983 | 79115099 | Acan | body |

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|------|----------|----------|---------------|--------|
| chr7 | 79499526 | 79500526 | AI854517 | TSS500 |
| chr7 | 79500526 | 79534403 | AI854517 | body |
| chr7 | 79504764 | 79505764 | Mir9-3 | TSS500 |
| chr7 | 79660696 | 79698134 | Ticrr | body |
| chr7 | 79721164 | 79732276 | Plin1 | body |
| chr7 | 79735957 | 79742631 | Pex11a | body |
| chr7 | 79793288 | 79794288 | Mesp1 | TSS500 |
| chr7 | 79792241 | 79793288 | Mesp1 | body |
| chr7 | 79847710 | 79848710 | Anpep | TSS500 |
| chr7 | 80246876 | 80260821 | Ttll13 | body |
| chr7 | 80534619 | 80535619 | Blm | TSS500 |
| chr7 | 80636517 | 80644384 | Gm15880 | body |
| chr7 | 80900769 | 80901769 | Wdr73 | TSS500 |
| chr7 | 80890723 | 80900769 | Wdr73 | body |
| chr7 | 80904576 | 80905576 | Nmb | TSS500 |
| chr7 | 81058100 | 81105612 | Alpk3 | body |
| chr7 | 81213096 | 81214096 | Pde8a | TSS500 |
| chr7 | 81493425 | 81494425 | Ap3b2 | TSS500 |
| chr7 | 81533308 | 81566444 | Fsd2 | body |
| chr7 | 81571792 | 81596836 | Whamm | body |
| chr7 | 81706425 | 81707425 | Homer2 | TSS500 |
| chr7 | 81782182 | 81788978 | 3110040N11Rik | body |
| chr7 | 81859501 | 81884434 | Tm6sf1 | body |
| chr7 | 81933973 | 81934973 | Hdgfrp3 | TSS500 |
| chr7 | 81881251 | 81933973 | Hdgfrp3 | body |
| chr7 | 81991799 | 81992799 | Bnc1 | TSS500 |
| chr7 | 81966672 | 81991799 | Bnc1 | body |
| chr7 | 82173340 | 82174340 | Sh3gl3 | TSS500 |
| chr7 | 82174340 | 82307419 | Sh3gl3 | body |
| chr7 | 82335194 | 82336194 | Adamtsl3 | TSS500 |
| chr7 | 82867833 | 82871563 | Mex3b | body |
| chr7 | 83745226 | 83746226 | Il16 | TSS500 |
| chr7 | 84409459 | 84410459 | Arnt2 | TSS500 |
| chr7 | 84940169 | 84963509 | Vmn2r65 | body |
| chr7 | 86148042 | 86171224 | Vmn2r75 | body |
| chr7 | 86775364 | 86776364 | Folh1 | TSS500 |
| chr7 | 86795641 | 86812032 | Vmn2r77 | body |
| chr7 | 86915800 | 86955177 | Vmn2r78 | body |
| chr7 | 87245596 | 87246596 | Nox4 | TSS500 |
| chr7 | 87246596 | 87398710 | Nox4 | body |
| chr7 | 87427405 | 87492911 | Tyr | body |
| chr7 | 87603044 | 88134907 | Grm5 | body |
| chr7 | 88429773 | 88430773 | Rab38 | TSS500 |
| chr7 | 89940699 | 89941699 | I7Rn6 | TSS500 |

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|------|-----------|-----------|----------|--------|
| chr7 | 90130732 | 90209447 | Picalm | body |
| chr7 | 90264932 | 90265932 | Ccdc83 | TSS500 |
| chr7 | 91090206 | 91091206 | Dlg2 | TSS500 |
| chr7 | 92581723 | 92636642 | Ankrd42 | body |
| chr7 | 93007482 | 93104789 | Gm26862 | body |
| chr7 | 93080527 | 93081527 | Gm9934 | TSS500 |
| chr7 | 93052081 | 93080527 | Gm9934 | body |
| chr7 | 96170744 | 96171744 | Tenm4 | TSS500 |
| chr7 | 96596423 | 96628569 | Gm15414 | body |
| chr7 | 97331520 | 97332520 | Usp35 | TSS500 |
| chr7 | 97331827 | 97332827 | Kctd21 | TSS500 |
| chr7 | 97399503 | 97400503 | Ndufc2 | TSS500 |
| chr7 | 97451834 | 97459553 | Kctd14 | body |
| chr7 | 97737747 | 97738747 | Aqp11 | TSS500 |
| chr7 | 97842435 | 97843435 | Pak1 | TSS500 |
| chr7 | 97843435 | 97912381 | Pak1 | body |
| chr7 | 97920455 | 98049663 | Gdpd4 | body |
| chr7 | 98192420 | 98198981 | B3gnt6 | body |
| chr7 | 98494722 | 98501831 | Lrrc32 | body |
| chr7 | 98834612 | 98835612 | Wnt11 | TSS500 |
| chr7 | 98835612 | 98855195 | Wnt11 | body |
| chr7 | 99153663 | 99182213 | Dgat2 | body |
| chr7 | 99219084 | 99238119 | Mogat2 | body |
| chr7 | 99266718 | 99267718 | Gm26705 | TSS500 |
| chr7 | 99266947 | 99267947 | Map6 | TSS500 |
| chr7 | 99352730 | 99353730 | Serpinh1 | TSS500 |
| chr7 | 99381049 | 99382049 | Gdpd5 | TSS500 |
| chr7 | 99626603 | 99627603 | Gm4980 | TSS500 |
| chr7 | 99624082 | 99626603 | Gm4980 | body |
| chr7 | 99625436 | 99626436 | Gm10605 | TSS500 |
| chr7 | 99626436 | 99631711 | Gm10605 | body |
| chr7 | 99657804 | 99710840 | Slco2b1 | body |
| chr7 | 99859718 | 99917824 | Xrra1 | body |
| chr7 | 100177170 | 100184869 | Kcne3 | body |
| chr7 | 100473490 | 100486432 | Ucp3 | body |
| chr7 | 100492837 | 100493837 | Ucp2 | TSS500 |
| chr7 | 100503018 | 100514460 | Dnajb13 | body |
| chr7 | 100642892 | 100661914 | Plekhb1 | body |
| chr7 | 100862946 | 100863946 | Relt | TSS500 |
| chr7 | 100963891 | 100964891 | P2ry6 | TSS500 |
| chr7 | 101011491 | 101012491 | P2ry2 | TSS500 |
| chr7 | 101578860 | 101580661 | Art2b | body |
| chr7 | 101664133 | 101790168 | Clpb | body |
| chr7 | 101818813 | 101822726 | Phox2a | body |

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| chr7 | 101858331 | 101870288 | Folr1 | body |
| chr7 | 102066213 | 102096864 | Trpc2 | body |
| chr7 | 102083616 | 102096396 | TRPC2 | body |
| chr7 | 102096879 | 102102345 | Art5 | body |
| chr7 | 102239123 | 102249623 | Rhog | body |
| chr7 | 102442195 | 102469771 | Rrm1 | body |
| chr7 | 102557922 | 102564969 | Trim21 | body |
| chr7 | 102578969 | 102579506 | Olfr550 | body |
| chr7 | 102588319 | 102589319 | Olfr551 | TSS500 |
| chr7 | 102640748 | 102641201 | Olfr554 | body |
| chr7 | 102740721 | 102758971 | Olfr78 | body |
| chr7 | 103998800 | 104136905 | 4930516K23Rik | body |
| chr7 | 104129326 | 104130326 | 4931431F19Rik | TSS500 |
| chr7 | 104127912 | 104129326 | 4931431F19Rik | body |
| chr7 | 104142779 | 104143779 | Ubqln3 | TSS500 |
| chr7 | 104140623 | 104142779 | Ubqln3 | body |
| chr7 | 104179456 | 104179906 | Olfr648 | body |
| chr7 | 104244957 | 104340693 | Trim34a | body |
| chr7 | 104263386 | 104287594 | Trim5 | body |
| chr7 | 104314966 | 104315966 | Trim12a | TSS500 |
| chr7 | 104300730 | 104336909 | Trim34b | body |
| chr7 | 104470014 | 104507349 | Trim30d | body |
| chr7 | 104618157 | 104618647 | Olfr656 | body |
| chr7 | 104646805 | 104647805 | Olfr658 | TSS500 |
| chr7 | 105069969 | 105070410 | Olfr678 | body |
| chr7 | 105425317 | 105426317 | Cckbr | TSS500 |
| chr7 | 105480607 | 105481697 | Prkcdbp | body |
| chr7 | 105581153 | 105582153 | Apbb1 | TSS500 |
| chr7 | 105633071 | 105634071 | Trim3 | TSS500 |
| chr7 | 105634203 | 105639916 | Arfip2 | body |
| chr7 | 105737092 | 105742925 | Ilk | body |
| chr7 | 105787154 | 105788154 | Dchs1 | TSS500 |
| chr7 | 107097967 | 107098414 | Olfr17 | body |
| chr7 | 107370228 | 107371228 | Syt9 | TSS500 |
| chr7 | 107371228 | 107548656 | Syt9 | body |
| chr7 | 107566946 | 107567946 | Olfml1 | TSS500 |
| chr7 | 107567946 | 107591094 | Olfml1 | body |
| chr7 | 107594551 | 107595551 | Ppfibp2 | TSS500 |
| chr7 | 107595551 | 107748582 | Ppfibp2 | body |
| chr7 | 107757532 | 107758532 | Cyb5r2 | TSS500 |
| chr7 | 108921860 | 108929658 | Nlrp10 | body |
| chr7 | 109010325 | 109011325 | Tub | TSS500 |
| chr7 | 109011325 | 109034460 | Tub | body |
| chr7 | 109082831 | 109083831 | Ric3 | TSS500 |

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| chr7 | 109034312 | 109082831 | Ric3 | body |
| chr7 | 109169808 | 109170808 | Lmo1 | TSS500 |
| chr7 | 109138572 | 109169808 | Lmo1 | body |
| chr7 | 109438581 | 109439581 | Stk33 | TSS500 |
| chr7 | 109279223 | 109438581 | Stk33 | body |
| chr7 | 109507634 | 109508634 | Trim66 | TSS500 |
| chr7 | 109523911 | 109616647 | St5 | body |
| chr7 | 109781525 | 109782525 | Nrip3 | TSS500 |
| chr7 | 109758055 | 109781525 | Nrip3 | body |
| chr7 | 109865179 | 109866179 | Scube2 | TSS500 |
| chr7 | 109972187 | 109986429 | Tmem41b | body |
| chr7 | 110018925 | 110055114 | Ipo7 | body |
| chr7 | 110062202 | 110095392 | Zfp143 | body |
| chr7 | 110626281 | 110638858 | Gm28863 | body |
| chr7 | 110627161 | 110628161 | Adm | TSS500 |
| chr7 | 110628161 | 110629820 | Adm | body |
| chr7 | 110767706 | 110768706 | Ampd3 | TSS500 |
| chr7 | 110868266 | 110981961 | Mrvi1 | body |
| chr7 | 112428005 | 112591692 | Parva | body |
| chr7 | 112535183 | 112536183 | Parvaos | TSS500 |
| chr7 | 112953462 | 112954462 | Rassf10 | TSS500 |
| chr7 | 112954462 | 112957457 | Rassf10 | body |
| chr7 | 113514334 | 113571511 | Far1 | body |
| chr7 | 113730154 | 113752166 | Gm29507 | body |
| chr7 | 114414661 | 114415661 | 4933406118Rik | TSS500 |
| chr7 | 114414781 | 114415781 | Pde3b | TSS500 |
| chr7 | 114415781 | 114539251 | Pde3b | body |
| chr7 | 114744194 | 114850380 | Insc | body |
| chr7 | 115171773 | 115172773 | Gm27684 | TSS500 |
| chr7 | 115471344 | 116038244 | Sox6 | body |
| chr7 | 116031479 | 116032479 | Sox6os | TSS500 |
| chr7 | 116082863 | 116084135 | Gm4353 | body |
| chr7 | 116123493 | 116307876 | Plekha7 | body |
| chr7 | 116333690 | 116334690 | Rps13 | TSS500 |
| chr7 | 117380479 | 117381479 | Xylt1 | TSS500 |
| chr7 | 117381479 | 117667751 | Xylt1 | body |
| chr7 | 118115686 | 118116686 | Rps15a | TSS500 |
| chr7 | 118485114 | 118491475 | Itpripl2 | body |
| chr7 | 118535843 | 118584236 | Tmc7 | body |
| chr7 | 119183874 | 119184874 | Gpr139 | TSS500 |
| chr7 | 119144323 | 119183874 | Gpr139 | body |
| chr7 | 119462866 | 119478755 | Umod | body |
| chr7 | 119486587 | 119522982 | Pdilt | body |
| chr7 | 119525804 | 119526804 | Acsm5 | TSS500 |

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| chr7 | 119554969 | 119600694 | Acsm2 | body |
| chr7 | 119607526 | 119662515 | Acsm1 | body |
| chr7 | 119690526 | 119714567 | Acsm4 | body |
| chr7 | 119760423 | 119761423 | Acsm3 | TSS500 |
| chr7 | 119794506 | 119848943 | 2610020H08Rik | body |
| chr7 | 119922717 | 120094677 | Dnah3 | body |
| chr7 | 120329184 | 120407687 | Abca15 | body |
| chr7 | 120410147 | 120544813 | Abca16 | body |
| chr7 | 120843331 | 120907219 | Eef2k | body |
| chr7 | 121733979 | 121734979 | Scnn1g | TSS500 |
| chr7 | 121864611 | 121865611 | Scnn1b | TSS500 |
| chr7 | 122020722 | 122021722 | Gga2 | TSS500 |
| chr7 | 122066763 | 122067763 | Ears2 | TSS500 |
| chr7 | 122066675 | 122067675 | Ubfd1 | TSS500 |
| chr7 | 122219996 | 122222824 | Chp2 | body |
| chr7 | 122289251 | 122634402 | Prkcb | body |
| chr7 | 122669992 | 122670992 | Cacng3 | TSS500 |
| chr7 | 123369415 | 123370415 | Arhgap17 | TSS500 |
| chr7 | 123499949 | 123500949 | Zkscan2 | TSS500 |
| chr7 | 123982954 | 123983954 | Gm27040 | TSS500 |
| chr7 | 123971046 | 123982954 | Gm27040 | body |
| chr7 | 123982369 | 123983369 | Hs3st4 | TSS500 |
| chr7 | 123983369 | 124398989 | Hs3st4 | body |
| chr7 | 125329643 | 125349272 | 4933440M02Rik | body |
| chr7 | 125369361 | 125371013 | 4930571K23Rik | body |
| chr7 | 125552782 | 125579472 | Il4ra | body |
| chr7 | 125708415 | 125874793 | D430042O09Rik | body |
| chr7 | 126414370 | 126415370 | Cd19 | TSS500 |
| chr7 | 126579032 | 126580032 | Mir7059 | TSS500 |
| chr7 | 126585442 | 126589112 | Apobr | body |
| chr7 | 126623249 | 126630361 | Nupr1 | body |
| chr7 | 126689468 | 126695284 | Slx1b | body |
| chr7 | 126780983 | 126781983 | Tbx6 | TSS500 |
| chr7 | 126781983 | 126785560 | Tbx6 | body |
| chr7 | 126817385 | 126830219 | Fam57b | body |
| chr7 | 126830996 | 126831996 | 4930451I11Rik | TSS500 |
| chr7 | 126922417 | 126923417 | Tmem219 | TSS500 |
| chr7 | 127020711 | 127021711 | Prrt2 | TSS500 |
| chr7 | 127191660 | 127195500 | Cd2bp2 | body |
| chr7 | 127212108 | 127214298 | Mylpf | body |
| chr7 | 127245026 | 127254803 | Zfp771 | body |
| chr7 | 127386666 | 127387666 | 9130019O22Rik | TSS500 |
| chr7 | 127406322 | 127407322 | Zfp764 | TSS500 |
| chr7 | 127403668 | 127406322 | Zfp764 | body |

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| chr7 | 127512369 | 127513369 | 1700008J07Rik | TSS500 |
| chr7 | 127712236 | 127713236 | Ctf1 | TSS500 |
| chr7 | 127713236 | 127718185 | Ctf1 | body |
| chr7 | 127776170 | 127777170 | Setd1a | TSS500 |
| chr7 | 127803900 | 127824049 | Stx1b | body |
| chr7 | 127823794 | 127824794 | Stx4a | TSS500 |
| chr7 | 127912017 | 127913017 | Kat8 | TSS500 |
| chr7 | 127967957 | 127982368 | Fus | body |
| chr7 | 128002849 | 128004690 | Gm15533 | body |
| chr7 | 128063140 | 128128160 | Itgam | body |
| chr7 | 128130047 | 128150656 | Itgax | body |
| chr7 | 128153876 | 128154876 | Itgad | TSS500 |
| chr7 | 128154876 | 128223816 | Itgad | body |
| chr7 | 128205866 | 128206866 | Cox6a2 | TSS500 |
| chr7 | 128247312 | 128253712 | Tgfb1i1 | body |
| chr7 | 128696441 | 128739995 | Mcmbp | body |
| chr7 | 129256594 | 129257594 | Ppapdc1a | TSS500 |
| chr7 | 130577984 | 130764784 | Tacc2 | body |
| chr7 | 130935611 | 130936611 | Htra1 | TSS500 |
| chr7 | 131308554 | 131321792 | Cuzd1 | body |
| chr7 | 131542367 | 131543367 | Hmx3 | TSS500 |
| chr7 | 131543367 | 131544925 | Hmx3 | body |
| chr7 | 131549273 | 131556589 | Hmx2 | body |
| chr7 | 131560891 | 131571898 | Bub3 | body |
| chr7 | 131965960 | 131966960 | Gpr26 | TSS500 |
| chr7 | 132042816 | 132154239 | Cpxm2 | body |
| chr7 | 132153671 | 132154671 | Gm15677 | TSS500 |
| chr7 | 132316728 | 132317728 | Chst15 | TSS500 |
| chr7 | 132235780 | 132316728 | Chst15 | body |
| chr7 | 132575898 | 132576898 | Oat | TSS500 |
| chr7 | 132557475 | 132575898 | Oat | body |
| chr7 | 132594878 | 132599137 | Nkx1-2 | body |
| chr7 | 132596887 | 132597887 | Gm16764 | TSS500 |
| chr7 | 132611138 | 132706420 | Lhpp | body |
| chr7 | 132852173 | 132853173 | Mettl10 | TSS500 |
| chr7 | 133777361 | 133881532 | Fank1 | body |
| chr7 | 133883199 | 134231646 | Adam12 | body |
| chr7 | 134266262 | 134385161 | D7Ertd443e | body |
| chr7 | 134937930 | 134938930 | Fam196a | TSS500 |
| chr7 | 135410867 | 135413615 | Foxi2 | body |
| chr7 | 135511466 | 135528154 | Clrn3 | body |
| chr7 | 135537324 | 135538324 | Ptpre | TSS500 |
| chr7 | 135651814 | 135652814 | 5830432E09Rik | TSS500 |
| chr7 | 135689788 | 135715879 | Mki67 | body |

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| chr7 | 136894111 | 136895111 | Mgmt | TSS500 |
| chr7 | 136895111 | 137128187 | Mgmt | body |
| chr7 | 137313945 | 137314945 | Ebf3 | TSS500 |
| chr7 | 137438148 | 137468594 | Glrx3 | body |
| chr7 | 138397230 | 138398230 | Tcerg1l | TSS500 |
| chr7 | 138940230 | 138941230 | Jakmip3 | TSS500 |
| chr7 | 138941230 | 139083976 | Jakmip3 | body |
| chr7 | 139085501 | 139086501 | Dpysl4 | TSS500 |
| chr7 | 139086501 | 139102704 | Dpysl4 | body |
| chr7 | 139103638 | 139212807 | Stk32c | body |
| chr7 | 139213488 | 139242979 | Lrrc27 | body |
| chr7 | 139582297 | 139583297 | Nkx6-2 | TSS500 |
| chr7 | 139894196 | 139895196 | Kndc1 | TSS500 |
| chr7 | 139943289 | 139944289 | Utf1 | TSS500 |
| chr7 | 139944289 | 139945112 | Utf1 | body |
| chr7 | 139978255 | 139979255 | 6430531B16Rik | TSS500 |
| chr7 | 140048589 | 140049589 | Msx3 | TSS500 |
| chr7 | 140093895 | 140097200 | Prap1 | body |
| chr7 | 140101941 | 140102941 | Fuom | TSS500 |
| chr7 | 140154377 | 140155377 | Sprn | TSS500 |
| chr7 | 140150628 | 140154377 | Sprn | body |
| chr7 | 140162514 | 140163514 | Olfr522 | TSS500 |
| chr7 | 140247801 | 140299791 | 5830411N06Rik | body |
| chr7 | 140807449 | 140821678 | Zfp941 | body |
| chr7 | 140845189 | 140846189 | C330022C24Rik | TSS500 |
| chr7 | 140837221 | 140845189 | C330022C24Rik | body |
| chr7 | 140921402 | 140929192 | Nlrp6 | body |
| chr7 | 140949739 | 140950739 | Ifitm5 | TSS500 |
| chr7 | 141060774 | 141061774 | B4galnt4 | TSS500 |
| chr7 | 141078718 | 141090510 | Pkp3 | body |
| chr7 | 141100046 | 141101046 | Sigirr | TSS500 |
| chr7 | 141122882 | 141157021 | Ptdss2 | body |
| chr7 | 141194657 | 141210055 | Lrrc56 | body |
| chr7 | 141216360 | 141218658 | Rassf7 | body |
| chr7 | 141265981 | 141266981 | Irf7 | TSS500 |
| chr7 | 141278633 | 141279633 | Sct | TSS500 |
| chr7 | 141292506 | 141294999 | Drd4 | body |
| chr7 | 141328239 | 141337156 | Tmem80 | body |
| chr7 | 141339380 | 141363020 | Eps8l2 | body |
| chr7 | 141392699 | 141402968 | Taldo1 | body |
| chr7 | 141428991 | 141429991 | Cend1 | TSS500 |
| chr7 | 141443525 | 141444525 | Pidd1 | TSS500 |
| chr7 | 141454698 | 141455698 | Pnpla2 | TSS500 |
| chr7 | 141461594 | 141466613 | Cracr2b | body |

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| chr7 | 141475740 | 141493427 | Tspan4 | body |
| chr7 | 141610066 | 141613247 | Gm16982 | body |
| chr7 | 142325837 | 142373253 | lfitm10 | body |
| chr7 | 142371148 | 142387538 | Ctsd | body |
| chr7 | 142575529 | 142577643 | H19 | body |
| chr7 | 142650766 | 142666316 | Igf2 | body |
| chr7 | 142659193 | 142660193 | Igf2os | TSS500 |
| chr7 | 142660193 | 142670356 | Igf2os | body |
| chr7 | 142831727 | 142852266 | Gm6471 | body |
| chr7 | 142892752 | 142930628 | Th | body |
| chr7 | 142966822 | 142968764 | Ascl2 | body |
| chr7 | 143069749 | 143071093 | Tssc4 | body |
| chr7 | 143106862 | 143427042 | Kcnq1 | body |
| chr7 | 143322775 | 143330150 | 4933417O13Rik | body |
| chr7 | 143458350 | 143460550 | Cdkn1c | body |
| chr7 | 143474221 | 143499334 | Slc22a18 | body |
| chr7 | 143513579 | 143548590 | Nap1l4 | body |
| chr7 | 143607685 | 143627345 | Tnfrsf26 | body |
| chr7 | 143649161 | 143650161 | Tnfrsf22 | TSS500 |
| chr7 | 143665809 | 143685372 | Tnfrsf23 | body |
| chr7 | 143756485 | 143757485 | Osbpl5 | TSS500 |
| chr7 | 143688762 | 143756485 | Osbpl5 | body |
| chr7 | 144002428 | 144424494 | Shank2 | body |
| chr7 | 144368048 | 144406433 | Gm14372 | body |
| chr7 | 144577318 | 144581963 | Fadd | body |
| chr7 | 144588549 | 144751474 | Ano1 | body |
| chr7 | 144837583 | 144838583 | Fgf3 | TSS500 |
| chr7 | 144861886 | 144865243 | Fgf4 | body |
| chr7 | 144896961 | 144897961 | Gm26793 | TSS500 |
| chr7 | 144894560 | 144896961 | Gm26793 | body |
| chr7 | 144896032 | 144897032 | Fgf15 | TSS500 |
| chr7 | 144897032 | 144900953 | Fgf15 | body |
| chr7 | 145315335 | 145324059 | Mrgprd | body |
| chr10 | 3267271 | 3268271 | H60c | TSS500 |
| chr10 | 3366635 | 3367635 | Gm26752 | TSS500 |
| chr10 | 3364073 | 3366635 | Gm26752 | body |
| chr10 | 3365650 | 3366650 | Ppp1r14c | TSS500 |
| chr10 | 3366650 | 3464975 | Ppp1r14c | body |
| chr10 | 3739864 | 3740864 | Plekhg1 | TSS500 |
| chr10 | 3740864 | 3967303 | Plekhg1 | body |
| chr10 | 4265829 | 4266829 | Akap12 | TSS500 |
| chr10 | 4432967 | 4455141 | 1700052N19Rik | body |
| chr10 | 4482002 | 4483002 | Ccdc170 | TSS500 |
| chr10 | 4612093 | 5005614 | Esr1 | body |

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| chr10 | 5550192 | 5551192 | Syne1 | TSS500 |
| chr10 | 5639718 | 5647614 | Vip | body |
| chr10 | 5811887 | 5823410 | Mtrf1l | body |
| chr10 | 6759006 | 7038198 | Oprm1 | body |
| chr10 | 6885796 | 7051978 | lpcef1 | body |
| chr10 | 7589300 | 7590300 | Lrp11 | TSS500 |
| chr10 | 7629373 | 7680636 | Pcmt1 | body |
| chr10 | 7681709 | 7716458 | Lats1 | body |
| chr10 | 7832970 | 7870397 | Zc3h12d | body |
| chr10 | 7905653 | 7955730 | Tab2 | body |
| chr10 | 8518325 | 8519325 | Ust | TSS500 |
| chr10 | 8204753 | 8518325 | Ust | body |
| chr10 | 9627259 | 9674708 | Samd5 | body |
| chr10 | 9977127 | 10151476 | Gm28905 | body |
| chr10 | 10335703 | 10471826 | Adgb | body |
| chr10 | 10686059 | 11081856 | Grm1 | body |
| chr10 | 13473896 | 13474896 | Phactr2 | TSS500 |
| chr10 | 13207717 | 13473896 | Phactr2 | body |
| chr10 | 13868480 | 13869480 | Aig1 | TSS500 |
| chr10 | 13967024 | 14006905 | Gm26835 | body |
| chr10 | 14544536 | 14545536 | Gpr126 | TSS500 |
| chr10 | 17900466 | 17947567 | Heca | body |
| chr10 | 18210390 | 18211390 | Ect2l | TSS500 |
| chr10 | 18129022 | 18210390 | Ect2l | body |
| chr10 | 18213676 | 18234498 | Ccdc28a | body |
| chr10 | 18234553 | 18235553 | Gm10827 | TSS500 |
| chr10 | 18588011 | 18743258 | D10Bwg1379e | body |
| chr10 | 18844571 | 18845571 | Perp | TSS500 |
| chr10 | 19357060 | 19358606 | Olig3 | body |
| chr10 | 19645250 | 19660801 | 9230106D20Rik | body |
| chr10 | 19712087 | 19713087 | Il20ra | TSS500 |
| chr10 | 19850959 | 19851959 | Slc35d3 | TSS500 |
| chr10 | 19933972 | 19934972 | Map3k5 | TSS500 |
| chr10 | 19934972 | 20142753 | Map3k5 | body |
| chr10 | 20147971 | 20148971 | Map7 | TSS500 |
| chr10 | 20148971 | 20281589 | Map7 | body |
| chr10 | 20398004 | 20724578 | Pde7b | body |
| chr10 | 21686911 | 21707440 | Gm5420 | body |
| chr10 | 21881684 | 21882684 | Sgk1 | TSS500 |
| chr10 | 22113050 | 22148770 | E030030I06Rik | body |
| chr10 | 22819628 | 22820628 | Tcf21 | TSS500 |
| chr10 | 23796486 | 23797486 | Slc18b1 | TSS500 |
| chr10 | 23851962 | 23869843 | Vnn3 | body |
| chr10 | 23970206 | 23971206 | Taar5 | TSS500 |

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| chr10 | 24149817 | 24188959 | Stx7 | body |
| chr10 | 24223017 | 24224017 | Moxd1 | TSS500 |
| chr10 | 24224017 | 24302790 | Moxd1 | body |
| chr10 | 24711659 | 24712659 | Enpp1 | TSS500 |
| chr10 | 24637914 | 24711659 | Enpp1 | body |
| chr10 | 25169090 | 25307370 | Akap7 | body |
| chr10 | 26078552 | 26079552 | Tmem200a | TSS500 |
| chr10 | 25991186 | 26078552 | Tmem200a | body |
| chr10 | 26077755 | 26078755 | Gm9767 | TSS500 |
| chr10 | 26078755 | 26079447 | Gm9767 | body |
| chr10 | 28668860 | 28883818 | Themis | body |
| chr10 | 29143694 | 29144694 | Gm9996 | TSS500 |
| chr10 | 29143282 | 29143694 | Gm9996 | body |
| chr10 | 29143496 | 29144496 | Soga3 | TSS500 |
| chr10 | 29144496 | 29199630 | Soga3 | body |
| chr10 | 29212143 | 29230779 | 9330159F19Rik | body |
| chr10 | 29535367 | 29536367 | Rspo3 | TSS500 |
| chr10 | 29453109 | 29535367 | Rspo3 | body |
| chr10 | 30200040 | 30201040 | Cenpw | TSS500 |
| chr10 | 31312882 | 31313882 | Hddc2 | TSS500 |
| chr10 | 31445421 | 31446421 | Tpd5211 | TSS500 |
| chr10 | 31493193 | 31608684 | Rnf217 | body |
| chr10 | 32889962 | 32890962 | Nkain2 | TSS500 |
| chr10 | 33512286 | 33624269 | Clvs2 | body |
| chr10 | 34282690 | 34285275 | Tspyl1 | body |
| chr10 | 34295912 | 34298407 | Gm26564 | body |
| chr10 | 34296942 | 34297942 | Tspyl4 | TSS500 |
| chr10 | 34483900 | 34611226 | Frk | body |
| chr10 | 36506314 | 36507314 | Hs3st5 | TSS500 |
| chr10 | 36975044 | 37001889 | Hdac2 | body |
| chr10 | 37336986 | 37337986 | Gm26535 | TSS500 |
| chr10 | 38966015 | 39110188 | Lama4 | body |
| chr10 | 39898738 | 39899738 | AA474331 | TSS500 |
| chr10 | 39898829 | 39899829 | 4930547M16Rik | TSS500 |
| chr10 | 39959653 | 39960653 | G630090E17Rik | TSS500 |
| chr10 | 39986146 | 39987146 | BC021785 | TSS500 |
| chr10 | 39958061 | 39986146 | BC021785 | body |
| chr10 | 40024768 | 40025768 | AI317395 | TSS500 |
| chr10 | 40141754 | 40142754 | Slc16a10 | TSS500 |
| chr10 | 40349603 | 40350603 | Cdk19os | TSS500 |
| chr10 | 40569836 | 40570836 | Slc22a16 | TSS500 |
| chr10 | 40630511 | 40649931 | Ddo | body |
| chr10 | 40682782 | 40683782 | Mettl24 | TSS500 |
| chr10 | 41071785 | 41072785 | Gpr6 | TSS500 |

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| chr10 | 41475814 | 41476814 | Mical1 | TSS500 |
| chr10 | 41810074 | 41811074 | Sesn1 | TSS500 |
| chr10 | 42017942 | 42018942 | Armc2 | TSS500 |
| chr10 | 41914990 | 42017942 | Armc2 | body |
| chr10 | 43172763 | 43173763 | Gm29246 | TSS500 |
| chr10 | 43578669 | 43579669 | Cd24a | TSS500 |
| chr10 | 43579669 | 43584262 | Cd24a | body |
| chr10 | 43950307 | 44004346 | Aim1 | body |
| chr10 | 44528001 | 44529001 | Prdm1 | TSS500 |
| chr10 | 45178598 | 45318452 | Popdc3 | body |
| chr10 | 45288924 | 45289924 | Gm15934 | TSS500 |
| chr10 | 45335262 | 45336262 | Bves | TSS500 |
| chr10 | 45469701 | 45470701 | Lin28b | TSS500 |
| chr10 | 45376620 | 45469701 | Lin28b | body |
| chr10 | 45536744 | 45537744 | Gm27731 | TSS500 |
| chr10 | 49099460 | 49788266 | Grik2 | body |
| chr10 | 50895151 | 50896151 | Sim1 | TSS500 |
| chr10 | 50896151 | 50989152 | Sim1 | body |
| chr10 | 51614823 | 51630958 | Gprc6a | body |
| chr10 | 51677256 | 51678256 | Rfx6 | TSS500 |
| chr10 | 52022002 | 52023002 | Vgll2 | TSS500 |
| chr10 | 52023002 | 52028471 | Vgll2 | body |
| chr10 | 52690033 | 52691033 | Slc35f1 | TSS500 |
| chr10 | 52691033 | 53111622 | Slc35f1 | body |
| chr10 | 53750409 | 53751409 | Fam184a | TSS500 |
| chr10 | 53633145 | 53750409 | Fam184a | body |
| chr10 | 56014298 | 56228189 | Tbc1d32 | body |
| chr10 | 56107417 | 56116880 | Msl3l2 | body |
| chr10 | 56377800 | 56390419 | Gja1 | body |
| chr10 | 57478381 | 57485853 | 4930467K11Rik | body |
| chr10 | 57632481 | 57741112 | Pkib | body |
| chr10 | 57785381 | 57788450 | Fabp7 | body |
| chr10 | 57793835 | 57794835 | Smpdl3a | TSS500 |
| chr10 | 57794835 | 57811830 | Smpdl3a | body |
| chr10 | 58600789 | 58675154 | Edar | body |
| chr10 | 58812859 | 58813859 | Sh3rf3 | TSS500 |
| chr10 | 58813859 | 59138916 | Sh3rf3 | body |
| chr10 | 59222453 | 59226434 | Sowahc | body |
| chr10 | 59322796 | 59323796 | P4ha1 | TSS500 |
| chr10 | 59403160 | 59404160 | Pla2g12b | TSS500 |
| chr10 | 59879056 | 59880056 | Dnajb12 | TSS500 |
| chr10 | 60105719 | 60106719 | Spock2 | TSS500 |
| chr10 | 60181532 | 60218760 | Chst3 | body |
| chr10 | 60302748 | 60695990 | Cdh23 | body |

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| chr10 | 60762610 | 60831081 | Unc5b | body |
| chr10 | 61038229 | 61042311 | Gm20625 | body |
| chr10 | 61046422 | 61051400 | Gm20610 | body |
| chr10 | 61298336 | 61304263 | Prf1 | body |
| chr10 | 61418472 | 61425338 | Nodal | body |
| chr10 | 61432497 | 61452169 | Eif4ebp2 | body |
| chr10 | 61476437 | 61477437 | D830039M14Rik | TSS500 |
| chr10 | 61476333 | 61582226 | Lrrc20 | body |
| chr10 | 61595992 | 61626385 | Npffr1 | body |
| chr10 | 61714763 | 61715763 | Aifm2 | TSS500 |
| chr10 | 61783647 | 61784647 | H2afy2 | TSS500 |
| chr10 | 61738665 | 61783647 | H2afy2 | body |
| chr10 | 61978608 | 61979608 | Col13a1 | TSS500 |
| chr10 | 61838236 | 61978608 | Col13a1 | body |
| chr10 | 62071515 | 62072609 | Gm5424 | body |
| chr10 | 62107655 | 62143420 | 2010107G23Rik | body |
| chr10 | 62132590 | 62133590 | Neurog3 | TSS500 |
| chr10 | 62133590 | 62134763 | Neurog3 | body |
| chr10 | 62193727 | 62194727 | Mir7662 | TSS500 |
| chr10 | 62252938 | 62265990 | Tacr2 | body |
| chr10 | 62449238 | 62450238 | Supv3l1 | TSS500 |
| chr10 | 62493833 | 62526951 | Srgn | body |
| chr10 | 62659043 | 62725628 | Stox1 | body |
| chr10 | 62743928 | 62791868 | Ccar1 | body |
| chr10 | 62804570 | 62898618 | Tet1 | body |
| chr10 | 63115795 | 63203452 | Mypn | body |
| chr10 | 63381204 | 63382204 | Sirt1 | TSS500 |
| chr10 | 63319005 | 63381204 | Sirt1 | body |
| chr10 | 63382943 | 63408840 | Dnajc12 | body |
| chr10 | 63430598 | 65003667 | Ctnna3 | body |
| chr10 | 64089777 | 64090777 | Lrrtm3 | TSS500 |
| chr10 | 63928472 | 64089777 | Lrrtm3 | body |
| chr10 | 66120605 | 66253723 | 1700023F02Rik | body |
| chr10 | 66641418 | 66641862 | Gm28139 | body |
| chr10 | 66912489 | 66919758 | 1110002J07Rik | body |
| chr10 | 66921402 | 66923599 | Gm26576 | body |
| chr10 | 67096625 | 67256326 | Jmjd1c | body |
| chr10 | 68025450 | 68026126 | Gm16212 | body |
| chr10 | 68723246 | 68724246 | Tmem26 | TSS500 |
| chr10 | 68724246 | 68782654 | Tmem26 | body |
| chr10 | 69151934 | 69291791 | Rhobtb1 | body |
| chr10 | 70440168 | 70441168 | Fam13c | TSS500 |
| chr10 | 70441168 | 70558731 | Fam13c | body |
| chr10 | 70557682 | 70655465 | Phyhipl | body |

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| chr10 | 70869169 | 70934324 | 4930533K18Rik | body |
| chr10 | 71159200 | 71160200 | Bicc1 | TSS500 |
| chr10 | 70922832 | 71159200 | Bicc1 | body |
| chr10 | 73098842 | 73099842 | Pcdh15 | TSS500 |
| chr10 | 73201399 | 73326527 | Gm15398 | body |
| chr10 | 74957477 | 75032086 | Rsph14 | body |
| chr10 | 74967677 | 75016907 | Gnaz | body |
| chr10 | 75036558 | 75037558 | Rab36 | TSS500 |
| chr10 | 75774115 | 75780914 | Gstt3 | body |
| chr10 | 75798084 | 75799084 | Gstt1 | TSS500 |
| chr10 | 75892898 | 75893898 | Derl3 | TSS500 |
| chr10 | 75935073 | 75936073 | Chchd10 | TSS500 |
| chr10 | 75936073 | 75937725 | Chchd10 | body |
| chr10 | 75943557 | 75949657 | Vpreb3 | body |
| chr10 | 75954014 | 75955014 | Gm5134 | TSS500 |
| chr10 | 75992691 | 75993492 | Gm16220 | body |
| chr10 | 76449581 | 76461110 | 2610028H24Rik | body |
| chr10 | 76468614 | 76469614 | Ybey | TSS500 |
| chr10 | 76468471 | 76469471 | Mcm3ap | TSS500 |
| chr10 | 76564765 | 76570032 | Gm15343 | body |
| chr10 | 77012495 | 77022214 | Gm10787 | body |
| chr10 | 77031741 | 77032741 | Slc19a1 | TSS500 |
| chr10 | 77166048 | 77167048 | Col18a1 | TSS500 |
| chr10 | 77605597 | 77606597 | Sumo3 | TSS500 |
| chr10 | 77690257 | 77691257 | Gm19402 | TSS500 |
| chr10 | 77798633 | 77799633 | Gm19668 | TSS500 |
| chr10 | 77829967 | 77887021 | Tspear | body |
| chr10 | 77978024 | 77979024 | 1810043G02Rik | TSS500 |
| chr10 | 77979024 | 77986905 | 1810043G02Rik | body |
| chr10 | 78043110 | 78044110 | Aire | TSS500 |
| chr10 | 78042447 | 78063622 | Dnmt3l | body |
| chr10 | 78069860 | 78079525 | Icosl | body |
| chr10 | 78400362 | 78412543 | Rrp1 | body |
| chr10 | 78425170 | 78426170 | Cstb | TSS500 |
| chr10 | 78487342 | 78488342 | Gm9978 | TSS500 |
| chr10 | 78484570 | 78487342 | Gm9978 | body |
| chr10 | 78575000 | 78584498 | Ilvbl | body |
| chr10 | 78746924 | 78752567 | Ccdc105 | body |
| chr10 | 78779996 | 78780996 | Slc1a6 | TSS500 |
| chr10 | 78780996 | 78814825 | Slc1a6 | body |
| chr10 | 79149297 | 79195012 | Vmn2r80 | body |
| chr10 | 79248277 | 79294535 | Vmn2r81 | body |
| chr10 | 79469443 | 79492154 | Vmn2r83 | body |
| chr10 | 79606857 | 79613525 | C2cd4c | body |

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| chr10 | 79637418 | 79638418 | Shc2 | TSS500 |
| chr10 | 79617940 | 79637418 | Shc2 | body |
| chr10 | 79665074 | 79668536 | Madcam1 | body |
| chr10 | 79669910 | 79676126 | Tpgs1 | body |
| chr10 | 79688520 | 79689520 | Gzmm | TSS500 |
| chr10 | 79754619 | 79755619 | Fgf22 | TSS500 |
| chr10 | 79776772 | 79777772 | Fstl3 | TSS500 |
| chr10 | 79821521 | 79830452 | Misp | body |
| chr10 | 79874976 | 79883174 | Prtn3 | body |
| chr10 | 79885812 | 79886812 | Elane | TSS500 |
| chr10 | 79917471 | 79922273 | Kiss1r | body |
| chr10 | 79927543 | 79955018 | Arid3a | body |
| chr10 | 79970215 | 79971215 | Grin3b | TSS500 |
| chr10 | 80017153 | 80031472 | Hmha1 | body |
| chr10 | 80047666 | 80056439 | Gpx4 | body |
| chr10 | 80172444 | 80173444 | 1600002K03Rik | TSS500 |
| chr10 | 80178982 | 80179982 | Efna2 | TSS500 |
| chr10 | 80292953 | 80294114 | Rps15 | body |
| chr10 | 80318254 | 80320037 | 2310011J03Rik | body |
| chr10 | 80329453 | 80330453 | Reep6 | TSS500 |
| chr10 | 80355959 | 80356959 | Plk5 | TSS500 |
| chr10 | 80494335 | 80495335 | Onecut3 | TSS500 |
| chr10 | 80495335 | 80517276 | Onecut3 | body |
| chr10 | 80538624 | 80539624 | Atp8b3 | TSS500 |
| chr10 | 80578147 | 80579147 | Gm26710 | TSS500 |
| chr10 | 80681338 | 80682338 | Gm26541 | TSS500 |
| chr10 | 80703193 | 80705382 | Izumo4 | body |
| chr10 | 80805748 | 80807648 | Amh | body |
| chr10 | 80808496 | 80812998 | Jsrp1 | body |
| chr10 | 80827156 | 80829290 | Oaz1 | body |
| chr10 | 80828297 | 80829297 | Mir1982 | TSS500 |
| chr10 | 80930591 | 80932204 | Gadd45b | body |
| chr10 | 81028538 | 81036926 | Slc39a3 | body |
| chr10 | 81177131 | 81182507 | Eef2 | body |
| chr10 | 81195109 | 81210877 | Atcayos | body |
| chr10 | 81198170 | 81201537 | Nmrk2 | body |
| chr10 | 81204508 | 81230333 | Atcay | body |
| chr10 | 81233655 | 81252123 | Zfr2 | body |
| chr10 | 81252435 | 81253435 | Matk | TSS500 |
| chr10 | 81301701 | 81302417 | Gm16315 | body |
| chr10 | 81329232 | 81335171 | Tbxa2r | body |
| chr10 | 81342766 | 81343766 | Gipc3 | TSS500 |
| chr10 | 81337762 | 81342766 | Gipc3 | body |
| chr10 | 81430505 | 81431505 | Nfic | TSS500 |

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| chr10 | 81396186 | 81430505 | Nfic | body |
| chr10 | 81523725 | 81524725 | Gna15 | TSS500 |
| chr10 | 81559994 | 81566362 | Aes | body |
| chr10 | 81575440 | 81576440 | Gm15917 | TSS500 |
| chr10 | 81572612 | 81575440 | Gm15917 | body |
| chr10 | 81627297 | 81628297 | Sirt6 | TSS500 |
| chr10 | 81629040 | 81647610 | Ankrd24 | body |
| chr10 | 82177735 | 82178735 | Gm15608 | TSS500 |
| chr10 | 82178735 | 82198385 | Gm15608 | body |
| chr10 | 82240780 | 82241780 | Zfp938 | TSS500 |
| chr10 | 82619851 | 82622728 | 1190007I07Rik | body |
| chr10 | 82811623 | 82812623 | 1700028I16Rik | TSS500 |
| chr10 | 82812623 | 82824242 | 1700028I16Rik | body |
| chr10 | 83487450 | 83533640 | Aldh1l2 | body |
| chr10 | 83722365 | 83723365 | 1500009L16Rik | TSS500 |
| chr10 | 83723365 | 83762761 | 1500009L16Rik | body |
| chr10 | 84526305 | 84533536 | Ckap4 | body |
| chr10 | 84547417 | 84552838 | C330046G13Rik | body |
| chr10 | 84577126 | 84614359 | Tcp11l2 | body |
| chr10 | 84619332 | 84622078 | Gm17249 | body |
| chr10 | 84756562 | 84906538 | Rfx4 | body |
| chr10 | 85387314 | 85660292 | Btbd11 | body |
| chr10 | 86095385 | 86096385 | 4930486F22Rik | TSS500 |
| chr10 | 86299872 | 86300872 | Timp3 | TSS500 |
| chr10 | 86656439 | 86657381 | Gm5174 | body |
| chr10 | 86779505 | 86838389 | Nt5dc3 | body |
| chr10 | 87493160 | 87494160 | Ascl1 | TSS500 |
| chr10 | 87490819 | 87493160 | Ascl1 | body |
| chr10 | 87522295 | 87584136 | Pah | body |
| chr10 | 87858765 | 87937042 | Igf1 | body |
| chr10 | 88518279 | 88604652 | Mybpc1 | body |
| chr10 | 88885492 | 88886492 | Slc5a8 | TSS500 |
| chr10 | 89344262 | 89345262 | Ano4 | TSS500 |
| chr10 | 89408823 | 89443467 | Gas2l3 | body |
| chr10 | 89620753 | 89621753 | Slc17a8 | TSS500 |
| chr10 | 89874009 | 90973300 | Anks1b | body |
| chr10 | 90989311 | 91082270 | Apaf1 | body |
| chr10 | 91083440 | 91102607 | Ikbip | body |
| chr10 | 92071037 | 92164670 | Rmst | body |
| chr10 | 92162603 | 92164690 | Gm26700 | body |
| chr10 | 92171301 | 92374873 | Gm20757 | body |
| chr10 | 93081118 | 93082118 | Cfap54 | TSS500 |
| chr10 | 93161376 | 93241342 | Cdk17 | body |
| chr10 | 93310635 | 93311635 | Elk3 | TSS500 |

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| chr10 | 93539533 | 93540533 | Amdhd1 | TSS500 |
| chr10 | 93583029 | 93589206 | Snrpf | body |
| chr10 | 93674218 | 93682822 | Gm15915 | body |
| chr10 | 93832055 | 93848524 | Usp44 | body |
| chr10 | 94311449 | 94312449 | Tmcc3 | TSS500 |
| chr10 | 94944078 | 94945078 | Plxnc1 | TSS500 |
| chr10 | 95174746 | 95323597 | Cradd | body |
| chr10 | 95385362 | 95416680 | Socs2 | body |
| chr10 | 95416875 | 95417875 | 5730420D15Rik | TSS500 |
| chr10 | 95417875 | 95428640 | 5730420D15Rik | body |
| chr10 | 95558821 | 95559821 | Mir3058 | TSS500 |
| chr10 | 95941163 | 96045518 | Eea1 | body |
| chr10 | 99107659 | 99108659 | Galnt4 | TSS500 |
| chr10 | 99757705 | 99759158 | Csl | body |
| chr10 | 101681987 | 102391469 | Mgat4c | body |
| chr10 | 103029844 | 103030844 | Gm17028 | TSS500 |
| chr10 | 105573951 | 105574951 | Tmtc2 | TSS500 |
| chr10 | 106466939 | 106470268 | C230021G24Rik | body |
| chr10 | 106469810 | 106470810 | Ppfia2 | TSS500 |
| chr10 | 107123168 | 107124168 | Acss3 | TSS500 |
| chr10 | 106936164 | 107123168 | Acss3 | body |
| chr10 | 107271343 | 107272343 | Lin7a | TSS500 |
| chr10 | 107485634 | 107486634 | Myf5 | TSS500 |
| chr10 | 107482908 | 107485634 | Myf5 | body |
| chr10 | 107911634 | 107912634 | Otogl | TSS500 |
| chr10 | 107762223 | 107911634 | Otogl | body |
| chr10 | 108331689 | 108332689 | Pawr | TSS500 |
| chr10 | 109010482 | 109011482 | Syt1 | TSS500 |
| chr10 | 108497650 | 109010482 | Syt1 | body |
| chr10 | 110455704 | 110456704 | Nav3 | TSS500 |
| chr10 | 109682660 | 110455704 | Nav3 | body |
| chr10 | 114801807 | 114802807 | Trhde | TSS500 |
| chr10 | 114801226 | 114802226 | Gm15723 | TSS500 |
| chr10 | 115078641 | 115184522 | Tph2 | body |
| chr10 | 115289863 | 115315091 | Rab21 | body |
| chr10 | 115587280 | 115588280 | Lgr5 | TSS500 |
| chr10 | 115450311 | 115587280 | Lgr5 | body |
| chr10 | 115817784 | 115849893 | Tspan8 | body |
| chr10 | 116018713 | 116274932 | Ptpr | body |
| chr10 | 116300874 | 116301874 | Ptprb | TSS500 |
| chr10 | 116301874 | 116389538 | Ptprb | body |
| chr10 | 116473378 | 116474378 | Kcnmb4 | TSS500 |
| chr10 | 116417861 | 116473378 | Kcnmb4 | body |
| chr10 | 116417552 | 116418552 | Kcnmb4os1 | TSS500 |

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| chr10 | 116473663 | 116475319 | Kcnmb4os2 | body |
| chr10 | 116485161 | 116581011 | Cnot2 | body |
| chr10 | 116723067 | 116728677 | 1700030O20Rik | body |
| chr10 | 116985814 | 116986814 | Best3 | TSS500 |
| chr10 | 116986814 | 117025040 | Best3 | body |
| chr10 | 117629000 | 117630000 | Cpm | TSS500 |
| chr10 | 119093405 | 119103107 | 1700064J06Rik | body |
| chr10 | 119199255 | 119239555 | Cand1 | body |
| chr10 | 119429367 | 119454879 | Grip1os3 | body |
| chr10 | 119453534 | 119454534 | Grip1 | TSS500 |
| chr10 | 119746063 | 119761199 | Grip1os2 | body |
| chr10 | 119825204 | 119851890 | Grip1os1 | body |
| chr10 | 120141648 | 120201630 | Irak3 | body |
| chr10 | 120201090 | 120202090 | Tmbim4 | TSS500 |
| chr10 | 120202090 | 120224917 | Tmbim4 | body |
| chr10 | 120361275 | 120475969 | Hmga2 | body |
| chr10 | 121034460 | 121100650 | Wif1 | body |
| chr10 | 121310689 | 121311689 | Tbc1d30 | TSS500 |
| chr10 | 121263824 | 121310689 | Tbc1d30 | body |
| chr10 | 121641088 | 121642088 | D930020B18Rik | TSS500 |
| chr10 | 122046815 | 122047815 | Srgap1 | TSS500 |
| chr10 | 121780991 | 122046815 | Srgap1 | body |
| chr10 | 122078114 | 122096871 | Tmem5 | body |
| chr10 | 122447999 | 122448999 | Avpr1a | TSS500 |
| chr10 | 122448999 | 122453453 | Avpr1a | body |
| chr10 | 122678262 | 122679262 | Ppm1h | TSS500 |
| chr10 | 122678815 | 122679815 | Mir8104 | TSS500 |
| chr10 | 125328463 | 125329463 | Slc16a7 | TSS500 |
| chr10 | 126979217 | 126999975 | Ctdsp2 | body |
| chr10 | 126995030 | 126996030 | Mir26a-2 | TSS500 |
| chr10 | 127031004 | 127041013 | Mettl21b | body |
| chr10 | 127048750 | 127053006 | Cyp27b1 | body |
| chr10 | 127079407 | 127093169 | Agap2 | body |
| chr10 | 127164656 | 127165656 | B4galnt1 | TSS500 |
| chr10 | 127180145 | 127181145 | Slc26a10 | TSS500 |
| chr10 | 127189554 | 127190554 | Arhgef25 | TSS500 |
| chr10 | 127190378 | 127195228 | Dtx3 | body |
| chr10 | 127266762 | 127281959 | Dctn2 | body |
| chr10 | 127291274 | 127296288 | Ddit3 | body |
| chr10 | 127324227 | 127329943 | Arhgap9 | body |
| chr10 | 127341089 | 127342089 | Gli1 | TSS500 |
| chr10 | 127351272 | 127352272 | Inhbe | TSS500 |
| chr10 | 127380827 | 127499384 | R3hdm2 | body |
| chr10 | 127534059 | 127535059 | Nxph4 | TSS500 |

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| chr10 | 127525473 | 127534059 | Nxph4 | body |
| chr10 | 127660918 | 127668068 | Nab2 | body |
| chr10 | 127663339 | 127664339 | Gm16229 | TSS500 |
| chr10 | 127664339 | 127665484 | Gm16229 | body |
| chr10 | 127801652 | 127846565 | Rdh16 | body |
| chr10 | 127866974 | 127877317 | BC089597 | body |
| chr10 | 127990941 | 128000178 | Hsd17b6 | body |
| chr10 | 128129470 | 128179797 | Rbms2 | body |
| chr10 | 128209908 | 128211294 | Spryd4 | body |
| chr10 | 128296140 | 128297584 | Il23a | body |
| chr10 | 128322959 | 128327187 | Cnpy2 | body |
| chr10 | 128395934 | 128400724 | Slc39a5 | body |
| chr10 | 128548805 | 128549805 | Rpl41 | TSS500 |
| chr10 | 128645491 | 128646491 | Ikzf4 | TSS500 |
| chr10 | 128645384 | 128646384 | Gm26876 | TSS500 |
| chr10 | 128720141 | 128743556 | Dgka | body |
| chr10 | 128806176 | 128819446 | Dnajc14 | body |
| chr10 | 128913593 | 128922388 | Rdh5 | body |
| chr10 | 128933313 | 128934313 | Itga7 | TSS500 |
| chr10 | 129607547 | 129607979 | Olfr796 | body |
| chr8 | 3353915 | 3390295 | A430078G23Rik | body |
| chr8 | 3493638 | 3497208 | Zfp358 | body |
| chr8 | 3568490 | 3584939 | C330021F23Rik | body |
| chr8 | 3630455 | 3631455 | Stxbp2 | TSS500 |
| chr8 | 4239240 | 4251423 | Map2k7 | body |
| chr8 | 4253602 | 4256219 | Snapc2 | body |
| chr8 | 4257648 | 4258774 | Ctxn1 | body |
| chr8 | 4678962 | 4688494 | Gm6410 | body |
| chr8 | 8666577 | 8690037 | Arglu1 | body |
| chr8 | 9770518 | 9771518 | Fam155a | TSS500 |
| chr8 | 9206001 | 9770518 | Fam155a | body |
| chr8 | 10006343 | 10007343 | Tnfsf13b | TSS500 |
| chr8 | 10927957 | 10928957 | 3930402G23Rik | TSS500 |
| chr8 | 10924427 | 10927957 | 3930402G23Rik | body |
| chr8 | 11188255 | 11204503 | Gm15418 | body |
| chr8 | 11198423 | 11312326 | Col4a1 | body |
| chr8 | 11453392 | 11478138 | Rab20 | body |
| chr8 | 11478429 | 11480241 | E230013L22Rik | body |
| chr8 | 11611583 | 11635254 | Ankrd10 | body |
| chr8 | 11654924 | 11700563 | 1700016D06Rik | body |
| chr8 | 11727605 | 11728605 | Arhgef7 | TSS500 |
| chr8 | 11728605 | 11835219 | Arhgef7 | body |
| chr8 | 12395795 | 12400126 | Sox1 | body |
| chr8 | 12706944 | 12718627 | Gm15348 | body |

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|------|----------|----------|---------------|--------|
| chr8 | 12756514 | 12757514 | Atp11a | TSS500 |
| chr8 | 12874306 | 13020905 | Mcf2l | body |
| chr8 | 12879878 | 12883226 | Gm15353 | body |
| chr8 | 12915258 | 12916258 | Gm15351 | TSS500 |
| chr8 | 13077189 | 13104959 | Pcid2 | body |
| chr8 | 13106121 | 13147940 | Cul4a | body |
| chr8 | 13200124 | 13201124 | Grtp1 | TSS500 |
| chr8 | 13200220 | 13201220 | 2810030D12Rik | TSS500 |
| chr8 | 13339174 | 13340174 | Tfdp1 | TSS500 |
| chr8 | 13435959 | 13461452 | Tmem255b | body |
| chr8 | 13465374 | 13494035 | Gas6 | body |
| chr8 | 13550733 | 13561961 | 1700029H14Rik | body |
| chr8 | 13705389 | 13706389 | 4932443I19Rik | TSS500 |
| chr8 | 13758176 | 13781938 | Cdc16 | body |
| chr8 | 14096365 | 14847680 | Dlgap2 | body |
| chr8 | 14881835 | 14901720 | Cln8 | body |
| chr8 | 15010525 | 15011525 | Kbtbd11 | TSS500 |
| chr8 | 15011525 | 15033333 | Kbtbd11 | body |
| chr8 | 15041444 | 15045578 | BB014433 | body |
| chr8 | 17535086 | 17536086 | Csmd1 | TSS500 |
| chr8 | 15892537 | 17535086 | Csmd1 | body |
| chr8 | 18690263 | 18741062 | Angpt2 | body |
| chr8 | 18846777 | 18891361 | Agpat5 | body |
| chr8 | 18950475 | 18951475 | Xkr5 | TSS500 |
| chr8 | 19158386 | 19159578 | Spag11a | body |
| chr8 | 19730246 | 19752236 | 4930467E23Rik | body |
| chr8 | 19790298 | 19798548 | Gm26853 | body |
| chr8 | 20943693 | 20944248 | AY761185 | body |
| chr8 | 21938852 | 21940878 | Defb35 | body |
| chr8 | 22282941 | 22283941 | Tpte | TSS500 |
| chr8 | 22375554 | 22398121 | Slc25a15 | body |
| chr8 | 22462615 | 22476379 | Smim19 | body |
| chr8 | 22480791 | 22483330 | Gm17491 | body |
| chr8 | 22757244 | 22758244 | Plat | TSS500 |
| chr8 | 22806266 | 22809537 | 1700041G16Rik | body |
| chr8 | 22974344 | 22975344 | Ank1 | TSS500 |
| chr8 | 22975344 | 23150497 | Ank1 | body |
| chr8 | 23149085 | 23150085 | Gm15816 | TSS500 |
| chr8 | 23138794 | 23149085 | Gm15816 | body |
| chr8 | 23153769 | 23158948 | Nkx6-3 | body |
| chr8 | 23237168 | 23238168 | Gins4 | TSS500 |
| chr8 | 23412002 | 23449632 | Sfrp1 | body |
| chr8 | 23636519 | 24156585 | Zmat4 | body |
| chr8 | 24531894 | 24575833 | Ido2 | body |

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|------|----------|----------|---------------|--------|
| chr8 | 24584136 | 24596509 | Ido1 | body |
| chr8 | 24727093 | 24823869 | Adam5 | body |
| chr8 | 25016711 | 25017711 | Tm2d2 | TSS500 |
| chr8 | 25038462 | 25039462 | Htra4 | TSS500 |
| chr8 | 25025451 | 25038462 | Htra4 | body |
| chr8 | 25101694 | 25102694 | Plekha2 | TSS500 |
| chr8 | 25601101 | 25602101 | Whsc1l1 | TSS500 |
| chr8 | 25602101 | 25719667 | Whsc1l1 | body |
| chr8 | 25816191 | 25847194 | Ash2l | body |
| chr8 | 26021421 | 26118724 | Hook3 | body |
| chr8 | 27023299 | 27024299 | Erlin2 | TSS500 |
| chr8 | 27123832 | 27128132 | Brf2 | body |
| chr8 | 27142410 | 27143410 | 4933416M07Rik | TSS500 |
| chr8 | 27197460 | 27202047 | Got1l1 | body |
| chr8 | 27225776 | 27229088 | Adrb3 | body |
| chr8 | 27259827 | 27260827 | Eif4ebp1 | TSS500 |
| chr8 | 27413444 | 27414444 | Chrna6 | TSS500 |
| chr8 | 27604851 | 27620452 | Gm1698 | body |
| chr8 | 29218838 | 29219838 | Unc5d | TSS500 |
| chr8 | 31088971 | 31089971 | Dusp26 | TSS500 |
| chr8 | 31089971 | 31097047 | Dusp26 | body |
| chr8 | 31150816 | 31164702 | Tti2 | body |
| chr8 | 32949526 | 32950526 | Gm3985 | TSS500 |
| chr8 | 32888505 | 32949526 | Gm3985 | body |
| chr8 | 33385825 | 33386825 | Purg | TSS500 |
| chr8 | 33517238 | 33585582 | Tex15 | body |
| chr8 | 33653023 | 33698163 | Gsr | body |
| chr8 | 33929363 | 33930363 | Rbpms | TSS500 |
| chr8 | 33782643 | 33929363 | Rbpms | body |
| chr8 | 33812703 | 33813703 | Gm26632 | TSS500 |
| chr8 | 33813703 | 33833094 | Gm26632 | body |
| chr8 | 34049762 | 34057046 | Gm9951 | body |
| chr8 | 34115530 | 34125185 | Mboat4 | body |
| chr8 | 34146533 | 34147533 | Leprotl1 | TSS500 |
| chr8 | 35375241 | 35376241 | Ppp1r3b | TSS500 |
| chr8 | 35826059 | 35827059 | Cldn23 | TSS500 |
| chr8 | 35824709 | 35826059 | Cldn23 | body |
| chr8 | 36094328 | 36095328 | D8Ertd82e | TSS500 |
| chr8 | 36216064 | 36249016 | Lonrf1 | body |
| chr8 | 36457048 | 36458048 | 6430573F11Rik | TSS500 |
| chr8 | 39006367 | 39165112 | Tusc3 | body |
| chr8 | 40307958 | 40386308 | Micu3 | body |
| chr8 | 40634297 | 40635297 | Mtmr7 | TSS500 |
| chr8 | 40551095 | 40634297 | Mtmr7 | body |

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|------|----------|----------|---------------|--------|
| chr8 | 40675594 | 40682199 | Adam24 | body |
| chr8 | 40862395 | 40865147 | Gm26584 | body |
| chr8 | 40861896 | 40862896 | Slc7a2 | TSS500 |
| chr8 | 40862896 | 40922308 | Slc7a2 | body |
| chr8 | 40926712 | 40990785 | Pdgfrl | body |
| chr8 | 41040256 | 41042053 | Gm16192 | body |
| chr8 | 41827767 | 42046202 | 2810404M03Rik | body |
| chr8 | 43183619 | 43193881 | Triml2 | body |
| chr8 | 43306509 | 43307509 | Zfp42 | TSS500 |
| chr8 | 43650435 | 43698987 | Adam34 | body |
| chr8 | 45294359 | 45295359 | Klkb1 | TSS500 |
| chr8 | 45269671 | 45332716 | Cyp4v3 | body |
| chr8 | 45395665 | 45410108 | Tlr3 | body |
| chr8 | 45885985 | 45919546 | Pdlim3 | body |
| chr8 | 45934119 | 45935119 | Ccdc110 | TSS500 |
| chr8 | 45974752 | 45975752 | 1700029J07Rik | TSS500 |
| chr8 | 45975028 | 45976028 | Ufsp2 | TSS500 |
| chr8 | 46294171 | 46295171 | Helt | TSS500 |
| chr8 | 46470541 | 46471541 | Acsl1 | TSS500 |
| chr8 | 46987425 | 47094895 | Enpp6 | body |
| chr8 | 47026805 | 47037677 | 4930579M01Rik | body |
| chr8 | 47351848 | 47352848 | Stox2 | TSS500 |
| chr8 | 47180048 | 47351848 | Stox2 | body |
| chr8 | 47294272 | 47445862 | 4930448N21Rik | body |
| chr8 | 47412629 | 47413629 | Gm10083 | TSS500 |
| chr8 | 47413629 | 47415359 | Gm10083 | body |
| chr8 | 48843526 | 48844526 | Tenm3 | TSS500 |
| chr8 | 54955228 | 55060877 | Gpm6a | body |
| chr8 | 55940960 | 56125429 | Gira3 | body |
| chr8 | 56294052 | 56295052 | Hpgd | TSS500 |
| chr8 | 57331618 | 57332618 | 5033428I22Rik | TSS500 |
| chr8 | 57332618 | 57340682 | 5033428I22Rik | body |
| chr8 | 57523828 | 57652532 | Galnt7 | body |
| chr8 | 57962064 | 57963064 | Galntl6 | TSS500 |
| chr8 | 57776225 | 57962064 | Galntl6 | body |
| chr8 | 58171935 | 58298866 | Gm26905 | body |
| chr8 | 58912255 | 58914298 | BC030500 | body |
| chr8 | 60430024 | 60502698 | Gm10283 | body |
| chr8 | 60506624 | 60545677 | Aadat | body |
| chr8 | 60632327 | 60633327 | Mfap3l | TSS500 |
| chr8 | 60633327 | 60676729 | Mfap3l | body |
| chr8 | 60890918 | 60907580 | 2700029M09Rik | body |
| chr8 | 60910389 | 60982800 | Clcn3 | body |
| chr8 | 61288372 | 61289372 | 1700001D01Rik | TSS500 |

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|------|----------|----------|---------------|--------|
| chr8 | 61487234 | 61488234 | Cbr4 | TSS500 |
| chr8 | 62950509 | 62951509 | Spock3 | TSS500 |
| chr8 | 65129063 | 65130063 | BC030870 | TSS500 |
| chr8 | 65617400 | 65618400 | March1 | TSS500 |
| chr8 | 65618400 | 66471637 | March1 | body |
| chr8 | 66511256 | 66512256 | Tktl2 | TSS500 |
| chr8 | 66687594 | 66688594 | Npy5r | TSS500 |
| chr8 | 67352104 | 67364504 | Gm10660 | body |
| chr8 | 67494367 | 67495367 | Nat2 | TSS500 |
| chr8 | 68061786 | 68062786 | Psd3 | TSS500 |
| chr8 | 67957270 | 67978051 | Gm15991 | body |
| chr8 | 68276067 | 68277067 | Sh2d4a | TSS500 |
| chr8 | 68277067 | 68347694 | Sh2d4a | body |
| chr8 | 68734646 | 68735646 | Csgalnact1 | TSS500 |
| chr8 | 68367934 | 68368934 | 1700125H03Rik | TSS500 |
| chr8 | 68879991 | 68880991 | Lpl | TSS500 |
| chr8 | 69761326 | 69790678 | Zfp866 | body |
| chr8 | 69821929 | 69822929 | Lpar2 | TSS500 |
| chr8 | 69822929 | 69831102 | Lpar2 | body |
| chr8 | 69887187 | 69888187 | Cilp2 | TSS500 |
| chr8 | 69880369 | 69887187 | Cilp2 | body |
| chr8 | 69902212 | 69903212 | Yjefn3 | TSS500 |
| chr8 | 69902058 | 69903058 | Ndufa13 | TSS500 |
| chr8 | 69902684 | 69903518 | Tssk6 | body |
| chr8 | 69907069 | 69995879 | Gatad2a | body |
| chr8 | 70016123 | 70042234 | Mau2 | body |
| chr8 | 70084029 | 70090862 | Hapln4 | body |
| chr8 | 70120373 | 70121373 | Ncan | TSS500 |
| chr8 | 70139999 | 70167488 | 2310045N01Rik | body |
| chr8 | 70220172 | 70233966 | Armc6 | body |
| chr8 | 70292866 | 70301989 | Ddx49 | body |
| chr8 | 70373048 | 70374048 | Comp | TSS500 |
| chr8 | 70374048 | 70382065 | Comp | body |
| chr8 | 70486858 | 70487858 | Tmem59l | TSS500 |
| chr8 | 70493658 | 70504081 | Crlf1 | body |
| chr8 | 70510301 | 70511301 | Uba52 | TSS500 |
| chr8 | 70617344 | 70620850 | Lrrc25 | body |
| chr8 | 70718043 | 70719043 | Gm3336 | TSS500 |
| chr8 | 70724220 | 70751186 | Pde4c | body |
| chr8 | 70797635 | 70798635 | Mir7240 | TSS500 |
| chr8 | 70808949 | 70821424 | Il12rb1 | body |
| chr8 | 70835155 | 70839220 | Arrdc2 | body |
| chr8 | 70842049 | 70856508 | Kcnn1 | body |
| chr8 | 70862627 | 70863627 | A230052G05Rik | TSS500 |

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| chr8 | 70863627 | 70865428 | A230052G05Rik | body |
| chr8 | 70868227 | 70872990 | Ccdc124 | body |
| chr8 | 71118842 | 71119842 | Gm27628 | TSS500 |
| chr8 | 71405510 | 71406510 | Ankle1 | TSS500 |
| chr8 | 71465426 | 71465752 | Mrpl34 | body |
| chr8 | 71488603 | 71499583 | Gtpbp3 | body |
| chr8 | 71497754 | 71511269 | Plvap | body |
| chr8 | 71536937 | 71537937 | Bst2 | TSS500 |
| chr8 | 71543430 | 71548024 | Mvb12a | body |
| chr8 | 71598148 | 71607936 | Fam129c | body |
| chr8 | 71610524 | 71611524 | Colgalt1 | TSS500 |
| chr8 | 71624417 | 71671257 | Unc13a | body |
| chr8 | 71675796 | 71676796 | Jak3 | TSS500 |
| chr8 | 71676796 | 71690575 | Jak3 | body |
| chr8 | 71688714 | 71689714 | Insl3 | TSS500 |
| chr8 | 71701300 | 71702300 | B3gnt3 | TSS500 |
| chr8 | 71691719 | 71701300 | B3gnt3 | body |
| chr8 | 71725216 | 71726216 | Fcho1 | TSS500 |
| chr8 | 71882568 | 71892565 | Zfp709 | body |
| chr8 | 71908108 | 71909108 | Zfp882 | TSS500 |
| chr8 | 71908135 | 71909135 | Zfp617 | TSS500 |
| chr8 | 72189168 | 72190168 | Hsh2d | TSS500 |
| chr8 | 72240518 | 72257385 | Ap1m1 | body |
| chr8 | 72480641 | 72492114 | Slc35e1 | body |
| chr8 | 72572603 | 72587282 | Tmem38a | body |
| chr8 | 74992856 | 74993856 | Hmgxb4 | TSS500 |
| chr8 | 75034186 | 75070121 | Tom1 | body |
| chr8 | 75214444 | 75224113 | Rasd2 | body |
| chr8 | 75449194 | 75984503 | 1700007B14Rik | body |
| chr8 | 76899942 | 77245012 | Nr3c2 | body |
| chr8 | 78213797 | 78394326 | Ttc29 | body |
| chr8 | 78436145 | 78437145 | Pou4f2 | TSS500 |
| chr8 | 78433010 | 78436145 | Pou4f2 | body |
| chr8 | 80057506 | 80058506 | Hhip | TSS500 |
| chr8 | 79966115 | 80057506 | Hhip | body |
| chr8 | 80511842 | 80513973 | 4930505O20Rik | body |
| chr8 | 80610580 | 80611580 | Frem3 | TSS500 |
| chr8 | 80738997 | 80739997 | Smarca5 | TSS500 |
| chr8 | 81013076 | 81014076 | Gm9725 | TSS500 |
| chr8 | 81342056 | 81343056 | Inpp4b | TSS500 |
| chr8 | 81343056 | 82125036 | Inpp4b | body |
| chr8 | 82402722 | 82403722 | Il15 | TSS500 |
| chr8 | 82862856 | 82863856 | Rnf150 | TSS500 |
| chr8 | 83289848 | 83290848 | Ucp1 | TSS500 |

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| chr8 | 83348971 | 83382320 | Mgat4d | body |
| chr8 | 83389367 | 83390367 | Clgn | TSS500 |
| chr8 | 83608675 | 83611902 | Dnajb1 | body |
| chr8 | 83653178 | 83664788 | Gipc1 | body |
| chr8 | 83998172 | 84000386 | Samd1 | body |
| chr8 | 84011671 | 84012671 | 2210011C24Rik | TSS500 |
| chr8 | 84011133 | 84012133 | Mir1199 | TSS500 |
| chr8 | 84021971 | 84030295 | Palm3 | body |
| chr8 | 84063561 | 84064637 | Gm10643 | body |
| chr8 | 84126489 | 84132527 | Podnl1 | body |
| chr8 | 84148525 | 84172590 | 4930432K21Rik | body |
| chr8 | 84178287 | 84179287 | Mir181d | TSS500 |
| chr8 | 84178468 | 84179468 | Mir181c | TSS500 |
| chr8 | 84197167 | 84198167 | Gm26887 | TSS500 |
| chr8 | 84192774 | 84197167 | Gm26887 | body |
| chr8 | 84249906 | 84256826 | Mri1 | body |
| chr8 | 84670483 | 84687362 | Nacc1 | body |
| chr8 | 84685807 | 84686807 | Trmt1 | TSS500 |
| chr8 | 84701957 | 84704715 | Lyl1 | body |
| chr8 | 84722507 | 84723507 | G430095P16Rik | TSS500 |
| chr8 | 84815405 | 84822323 | Dand5 | body |
| chr8 | 84831022 | 84832022 | Gadd45gip1 | TSS500 |
| chr8 | 84871611 | 84872611 | Syce2 | TSS500 |
| chr8 | 84936859 | 84937859 | Mast1 | TSS500 |
| chr8 | 84946491 | 84947491 | Rtbdn | TSS500 |
| chr8 | 84978248 | 84979248 | Junb | TSS500 |
| chr8 | 85007202 | 85013908 | Best2 | body |
| chr8 | 85080806 | 85081806 | Wdr83 | TSS500 |
| chr8 | 85081240 | 85082339 | Wdr83os | body |
| chr8 | 85119137 | 85120137 | Zfp791 | TSS500 |
| chr8 | 85171822 | 85173622 | Cks1brt | body |
| chr8 | 85300132 | 85308278 | Orc6 | body |
| chr8 | 86624543 | 86723873 | Lonp2 | body |
| chr8 | 86902953 | 86919422 | Gm27167 | body |
| chr8 | 87199350 | 87200350 | Gm10637 | TSS500 |
| chr8 | 87203526 | 87293504 | Gm27169 | body |
| chr8 | 87472092 | 87473092 | Cbln1 | TSS500 |
| chr8 | 87472312 | 87473312 | Gm2694 | TSS500 |
| chr8 | 87476055 | 87494962 | Gm27016 | body |
| chr8 | 87959095 | 87960095 | Zfp423 | TSS500 |
| chr8 | 87661810 | 87959095 | Zfp423 | body |
| chr8 | 88138355 | 88172027 | Heatr3 | body |
| chr8 | 88521844 | 88594887 | Nkd1 | body |
| chr8 | 88626828 | 88635628 | Snx20 | body |

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|------|-----------|-----------|---------------|--------|
| chr8 | 89043662 | 89044662 | Sall1 | TSS500 |
| chr8 | 89027248 | 89043662 | Sall1 | body |
| chr8 | 89146747 | 89147747 | Gm6625 | TSS500 |
| chr8 | 90347843 | 90348843 | Tox3 | TSS500 |
| chr8 | 91798525 | 91801416 | Irx3 | body |
| chr8 | 91866371 | 91872995 | Gm28511 | body |
| chr8 | 92024942 | 92038438 | Gm28516 | body |
| chr8 | 92365121 | 92366121 | Gm29177 | TSS500 |
| chr8 | 92673788 | 92674788 | Irx6 | TSS500 |
| chr8 | 92854850 | 92855850 | Lpcat2 | TSS500 |
| chr8 | 92960579 | 93001667 | Slc6a2 | body |
| chr8 | 93020214 | 93047692 | Ces1a | body |
| chr8 | 93099015 | 93130783 | Ces1c | body |
| chr8 | 93201218 | 93229119 | Ces1e | body |
| chr8 | 93302369 | 93336808 | Ces1g | body |
| chr8 | 93499213 | 93535207 | Ces5a | body |
| chr8 | 93750147 | 93809792 | Gm26843 | body |
| chr8 | 93810466 | 93969388 | Gnao1 | body |
| chr8 | 94037698 | 94067921 | Ogfod1 | body |
| chr8 | 94172118 | 94173118 | Mt2 | TSS500 |
| chr8 | 94378421 | 94379622 | Gm15889 | body |
| chr8 | 94574943 | 94601226 | Fam192a | body |
| chr8 | 94695742 | 94696742 | Plip | TSS500 |
| chr8 | 94745090 | 94746090 | Ccl22 | TSS500 |
| chr8 | 94771509 | 94772509 | Cx3cl1 | TSS500 |
| chr8 | 94863828 | 94875812 | Dok4 | body |
| chr8 | 94924194 | 94943290 | Gpr114 | body |
| chr8 | 94976609 | 94977609 | Gpr56 | TSS500 |
| chr8 | 94977609 | 95014208 | Gpr56 | body |
| chr8 | 95311066 | 95326323 | Tepp | body |
| chr8 | 95332792 | 95347507 | Usb1 | body |
| chr8 | 95351768 | 95352768 | Mmp15 | TSS500 |
| chr8 | 95420252 | 95434369 | Cfap20 | body |
| chr8 | 95634059 | 95645059 | Gins3 | body |
| chr8 | 99415971 | 99416971 | Cdh8 | TSS500 |
| chr8 | 99024471 | 99415971 | Cdh8 | body |
| chr8 | 99416142 | 99417142 | A330008L17Rik | TSS500 |
| chr8 | 99417142 | 99733438 | A330008L17Rik | body |
| chr8 | 102784611 | 102785611 | Cdh11 | TSS500 |
| chr8 | 104102125 | 104144502 | Cdh5 | body |
| chr8 | 104170013 | 104171013 | Bean1 | TSS500 |
| chr8 | 104171013 | 104219092 | Bean1 | body |
| chr8 | 104226691 | 104248058 | Tk2 | body |
| chr8 | 104251403 | 104264936 | Cklf | body |

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| chr8 | 104281347 | 104309645 | Cmtm1 | body |
| chr8 | 104395307 | 104396307 | Cmtm4 | TSS500 |
| chr8 | 104417674 | 104442547 | Dync1li2 | body |
| chr8 | 104509410 | 104510410 | Ccdc79 | TSS500 |
| chr8 | 104446719 | 104509410 | Ccdc79 | body |
| chr8 | 104535200 | 104550343 | Car7 | body |
| chr8 | 104590968 | 104591968 | Pdp2 | TSS500 |
| chr8 | 104947856 | 104955962 | Ces2f | body |
| chr8 | 105258286 | 105264109 | Tradd | body |
| chr8 | 105265148 | 105269326 | Fbxl8 | body |
| chr8 | 105269301 | 105270301 | Hsf4 | TSS500 |
| chr8 | 105276947 | 105281939 | Nol3 | body |
| chr8 | 105289924 | 105295598 | Exoc3l | body |
| chr8 | 105298163 | 105305369 | E2f4 | body |
| chr8 | 105306101 | 105310623 | Elmo3 | body |
| chr8 | 105307400 | 105308400 | Gm27320 | TSS500 |
| chr8 | 105307960 | 105308960 | Mir328 | TSS500 |
| chr8 | 105518246 | 105519246 | Hsd11b2 | TSS500 |
| chr8 | 105519246 | 105523984 | Hsd11b2 | body |
| chr8 | 105565547 | 105566547 | Atp6v0d1 | TSS500 |
| chr8 | 105524465 | 105565547 | Atp6v0d1 | body |
| chr8 | 105565824 | 105566824 | RP23-410B24.2 | TSS500 |
| chr8 | 105566824 | 105578109 | RP23-410B24.2 | body |
| chr8 | 105604729 | 105605729 | Fam65a | TSS500 |
| chr8 | 105614966 | 105615966 | Mir1966 | TSS500 |
| chr8 | 105698159 | 105700595 | Acd | body |
| chr8 | 105701654 | 105703493 | Pard6a | body |
| chr8 | 105935728 | 105937892 | Psmb10 | body |
| chr8 | 106136474 | 106137474 | Esrp2 | TSS500 |
| chr8 | 106252548 | 106337488 | Smpd3 | body |
| chr8 | 106510413 | 106511413 | Cdh3 | TSS500 |
| chr8 | 106602851 | 106603851 | Cdh1 | TSS500 |
| chr8 | 106893101 | 106894101 | Chtf8 | TSS500 |
| chr8 | 106893140 | 106894140 | Cirh1a | TSS500 |
| chr8 | 106936250 | 107014192 | Sntb2 | body |
| chr8 | 107031722 | 107045755 | Vps4a | body |
| chr8 | 107048114 | 107049114 | Pdf | TSS500 |
| chr8 | 107046289 | 107056189 | Cog8 | body |
| chr8 | 107095606 | 107096606 | Mir7075 | TSS500 |
| chr8 | 107293970 | 107379517 | Nfat5 | body |
| chr8 | 107388225 | 107402706 | Nqo1 | body |
| chr8 | 107436898 | 107558594 | Wwp2 | body |
| chr8 | 107580381 | 107587982 | Psmc7 | body |
| chr8 | 109074722 | 109075722 | D030068K23Rik | TSS500 |

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| chr8 | 109494527 | 109542642 | Pmfbp1 | body |
| chr8 | 109548017 | 109565101 | Dhx38 | body |
| chr8 | 109614017 | 109615017 | Pkd1l3 | TSS500 |
| chr8 | 109615017 | 109672592 | Pkd1l3 | body |
| chr8 | 109706049 | 109724932 | Zfp821 | body |
| chr8 | 109737239 | 109738239 | Atxn1l | TSS500 |
| chr8 | 109869042 | 109944671 | Phlpp2 | body |
| chr8 | 109961703 | 109962703 | Marveld3 | TSS500 |
| chr8 | 110167706 | 110168706 | Calb2 | TSS500 |
| chr8 | 110142539 | 110167706 | Calb2 | body |
| chr8 | 110267477 | 110610253 | Hydin | body |
| chr8 | 110805424 | 110806424 | Il34 | TSS500 |
| chr8 | 110805138 | 110806138 | Gm15895 | TSS500 |
| chr8 | 111003188 | 111031251 | Ddx19b | body |
| chr8 | 111032644 | 111033644 | Aars | TSS500 |
| chr8 | 111154421 | 111258716 | Glg1 | body |
| chr8 | 111393324 | 111394324 | Fa2h | TSS500 |
| chr8 | 111345135 | 111393324 | Fa2h | body |
| chr8 | 111449700 | 111450700 | Mir1957b | TSS500 |
| chr8 | 111535597 | 111536597 | Znrf1 | TSS500 |
| chr8 | 111629874 | 111630874 | Ldhd | TSS500 |
| chr8 | 111909699 | 111910699 | Chst5 | TSS500 |
| chr8 | 111933291 | 111934291 | Tmem231 | TSS500 |
| chr8 | 111941203 | 111953612 | Gabarapl2 | body |
| chr8 | 112569075 | 112570075 | Gm26994 | TSS500 |
| chr8 | 112570543 | 112882717 | Cntnap4 | body |
| chr8 | 113635086 | 113636086 | Mon1b | TSS500 |
| chr8 | 113636086 | 113645178 | Mon1b | body |
| chr8 | 113697126 | 113848115 | Adamts18 | body |
| chr8 | 114205112 | 114206112 | Vat1l | TSS500 |
| chr8 | 116504515 | 116505515 | Dynlrb2 | TSS500 |
| chr8 | 116732491 | 116733491 | Cdyl2 | TSS500 |
| chr8 | 116568724 | 116732491 | Cdyl2 | body |
| chr8 | 116981810 | 116993037 | Gcsh | body |
| chr8 | 117096354 | 117133720 | Bco1 | body |
| chr8 | 117498791 | 117635140 | Plcg2 | body |
| chr8 | 117673189 | 117674189 | Sdr42e1 | TSS500 |
| chr8 | 117661399 | 117673189 | Sdr42e1 | body |
| chr8 | 117702446 | 117759029 | Hsd17b2 | body |
| chr8 | 119344038 | 119345038 | Hsbp1 | TSS500 |
| chr8 | 119395378 | 119411102 | Mlycd | body |
| chr8 | 119446219 | 119447219 | Necab2 | TSS500 |
| chr8 | 119447219 | 119472640 | Necab2 | body |
| chr8 | 119479602 | 119501198 | Slc38a8 | body |

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| chr8 | 119561979 | 119574700 | Hsd11 | body |
| chr8 | 119575735 | 119598454 | Dnaaf1 | body |
| chr8 | 119612247 | 119613247 | Adad2 | TSS500 |
| chr8 | 119613247 | 119616926 | Adad2 | body |
| chr8 | 119635180 | 119636180 | Kcng4 | TSS500 |
| chr8 | 119666023 | 119667023 | Wfdc1 | TSS500 |
| chr8 | 119700509 | 119757718 | Atp2c2 | body |
| chr8 | 119840079 | 119841079 | Cot11 | TSS500 |
| chr8 | 119991938 | 119992938 | Crispld2 | TSS500 |
| chr8 | 120044787 | 120045787 | Gm15684 | TSS500 |
| chr8 | 120166397 | 120176966 | Fam92b | body |
| chr8 | 120230036 | 120231036 | Gse1 | TSS500 |
| chr8 | 120231036 | 120581390 | Gse1 | body |
| chr8 | 120588804 | 120589804 | Gins2 | TSS500 |
| chr8 | 120599052 | 120599277 | Gm26739 | body |
| chr8 | 120644450 | 120653687 | Gm26537 | body |
| chr8 | 120736858 | 120756694 | Irf8 | body |
| chr8 | 120880706 | 120882481 | Gm26878 | body |
| chr8 | 121082610 | 121083610 | Fendrr | TSS500 |
| chr8 | 121054882 | 121082610 | Fendrr | body |
| chr8 | 121084886 | 121088144 | Foxf1 | body |
| chr8 | 121095012 | 121107892 | Mthfsd | body |
| chr8 | 121115671 | 121116671 | Foxc2 | TSS500 |
| chr8 | 121116671 | 121118895 | Foxc2 | body |
| chr8 | 121127440 | 121128440 | Foxl1 | TSS500 |
| chr8 | 121128440 | 121130644 | Foxl1 | body |
| chr8 | 121256747 | 121356336 | Gm26815 | body |
| chr8 | 121542622 | 121543481 | Gm27045 | body |
| chr8 | 121881150 | 121907194 | Slc7a5 | body |
| chr8 | 121908333 | 121918428 | BC048644 | body |
| chr8 | 121916126 | 121944404 | Car5a | body |
| chr8 | 121950145 | 121951145 | Gm27011 | TSS500 |
| chr8 | 122270069 | 122272650 | Gm22 | body |
| chr8 | 122432440 | 122433440 | Cyba | TSS500 |
| chr8 | 122424772 | 122432440 | Cyba | body |
| chr8 | 122460192 | 122461192 | Snai3 | TSS500 |
| chr8 | 122619471 | 122622239 | Pabpn1l | body |
| chr8 | 122621875 | 122622875 | Mir6396 | TSS500 |
| chr8 | 122628739 | 122698609 | Cbfa2t3 | body |
| chr8 | 123101850 | 123102850 | Rpl13 | TSS500 |
| chr8 | 123102850 | 123105244 | Rpl13 | body |
| chr8 | 123116874 | 123117874 | Cpne7 | TSS500 |
| chr8 | 123410924 | 123411924 | Tubb3 | TSS500 |
| chr8 | 123477403 | 123478403 | Afg3l1 | TSS500 |

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| chr8 | 123514963 | 123515963 | Dbnidd1 | TSS500 |
| chr8 | 123805485 | 123806485 | Rab4a | TSS500 |
| chr8 | 123840831 | 123859709 | Ccsap | body |
| chr8 | 123894236 | 123895236 | Acta1 | TSS500 |
| chr8 | 124520267 | 124521267 | Cog2 | TSS500 |
| chr8 | 124575611 | 124576611 | Capn9 | TSS500 |
| chr8 | 124635766 | 124662869 | 2310022B05Rik | body |
| chr8 | 124751309 | 124752309 | Fam89a | TSS500 |
| chr8 | 124740257 | 124751309 | Fam89a | body |
| chr8 | 124792519 | 124793519 | Trim67 | TSS500 |
| chr8 | 124793519 | 124834713 | Trim67 | body |
| chr8 | 124890300 | 124897205 | Exoc8 | body |
| chr8 | 125053695 | 125054695 | Disc1 | TSS500 |
| chr8 | 125224400 | 125226823 | Gm16237 | body |
| chr8 | 125897817 | 125898817 | Pcnxl2 | TSS500 |
| chr8 | 125751508 | 125897817 | Pcnxl2 | body |
| chr8 | 125897414 | 125898414 | A730098A19Rik | TSS500 |
| chr8 | 125909950 | 125910950 | BC021891 | TSS500 |
| chr8 | 125910950 | 125947439 | BC021891 | body |
| chr8 | 125994602 | 125995602 | Kcnk1 | TSS500 |
| chr8 | 125995602 | 126030683 | Kcnk1 | body |
| chr8 | 126298058 | 126299058 | Slc35f3 | TSS500 |
| chr8 | 126299058 | 126395482 | Slc35f3 | body |
| chr8 | 126426652 | 126474565 | Gm17296 | body |
| chr8 | 126567470 | 126590988 | Gm26759 | body |
| chr8 | 126945421 | 126946421 | Tomm20 | TSS500 |
| chr8 | 126970579 | 126971579 | Rbm34 | TSS500 |
| chr8 | 128980019 | 129065017 | Ccdc7 | body |
| chr14 | 3262840 | 3305832 | 1700110I01Rik | body |
| chr14 | 3332127 | 3333127 | Gm2956 | TSS500 |
| chr14 | 3428603 | 3594220 | Gm3005 | body |
| chr14 | 3810574 | 3966518 | Gm3002 | body |
| chr14 | 3884672 | 3921640 | Gm2916 | body |
| chr14 | 4084620 | 4099306 | Gm3115 | body |
| chr14 | 4110026 | 4111026 | Gm8108 | TSS500 |
| chr14 | 4182076 | 4183076 | Gm2974 | TSS500 |
| chr14 | 4334263 | 4335263 | 2610042L04Rik | TSS500 |
| chr14 | 4398026 | 4406347 | Gm3159 | body |
| chr14 | 4414948 | 4415948 | Gm3164 | TSS500 |
| chr14 | 4855076 | 4856076 | Gm3264 | TSS500 |
| chr14 | 5070540 | 5071540 | Gm8281 | TSS500 |
| chr14 | 5501174 | 5502174 | Gm3488 | TSS500 |
| chr14 | 5879882 | 5880882 | Gm8237 | TSS500 |
| chr14 | 5857918 | 5879882 | Gm8237 | body |

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| chr14 | 5961245 | 5962245 | Gm3248 | TSS500 |
| chr14 | 5939225 | 5961245 | Gm3248 | body |
| chr14 | 5970744 | 5978637 | Gm3453 | body |
| chr14 | 6016759 | 6037709 | Gm8206 | body |
| chr14 | 6108165 | 6109165 | Gm3468 | TSS500 |
| chr14 | 6105321 | 6125307 | Gm3476 | body |
| chr14 | 6314876 | 6343178 | Gm3618 | body |
| chr14 | 6435796 | 6444111 | Gm3594 | body |
| chr14 | 7026949 | 7027949 | Gm10406 | TSS500 |
| chr14 | 7568066 | 7569066 | Gm3558 | TSS500 |
| chr14 | 8080867 | 8091834 | Rpp14 | body |
| chr14 | 8317523 | 8318523 | Fam107a | TSS500 |
| chr14 | 8296274 | 8317523 | Fam107a | body |
| chr14 | 8665740 | 8666740 | 4930452B06Rik | TSS500 |
| chr14 | 8431192 | 8665740 | 4930452B06Rik | body |
| chr14 | 9550092 | 11161535 | Fhit | body |
| chr14 | 11227052 | 11228052 | Rpl21-ps4 | TSS500 |
| chr14 | 12345365 | 12346365 | Fezf2 | TSS500 |
| chr14 | 12341892 | 12345365 | Fezf2 | body |
| chr14 | 12822579 | 12823579 | Cadps | TSS500 |
| chr14 | 12372563 | 12822579 | Cadps | body |
| chr14 | 13284138 | 13285138 | Gm5087 | TSS500 |
| chr14 | 13157388 | 13284138 | Gm5087 | body |
| chr14 | 13284280 | 13285280 | Synpr | TSS500 |
| chr14 | 13285280 | 13615459 | Synpr | body |
| chr14 | 13777651 | 13778651 | Gm27506 | TSS500 |
| chr14 | 14012991 | 14107296 | Atxn7 | body |
| chr14 | 14345995 | 14346995 | Il3ra | TSS500 |
| chr14 | 15438487 | 15439487 | Lrrc3b | TSS500 |
| chr14 | 15437123 | 15438123 | B230110C06Rik | TSS500 |
| chr14 | 16574972 | 16575972 | Rarb | TSS500 |
| chr14 | 16430842 | 16574972 | Rarb | body |
| chr14 | 17660460 | 17661460 | Thrb | TSS500 |
| chr14 | 17661460 | 18038088 | Thrb | body |
| chr14 | 18282722 | 18331359 | Ube2e1 | body |
| chr14 | 19584635 | 19585635 | Gm2237 | TSS500 |
| chr14 | 19977127 | 19978127 | Gng2 | TSS500 |
| chr14 | 20262756 | 20268662 | Kcnk16 | body |
| chr14 | 20294190 | 20295190 | Nudt13 | TSS500 |
| chr14 | 20384638 | 20388410 | Dnajc9 | body |
| chr14 | 20455261 | 20479633 | Anxa7 | body |
| chr14 | 20656040 | 20657040 | Myoz1 | TSS500 |
| chr14 | 20649102 | 20656040 | Myoz1 | body |
| chr14 | 20667854 | 20668854 | Synpo2l | TSS500 |

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| chr14 | 20674821 | 20694850 | Sec24c | body |
| chr14 | 20708052 | 20723618 | Zswim8 | body |
| chr14 | 20836162 | 20837162 | Plau | TSS500 |
| chr14 | 21481934 | 21672478 | Kat6b | body |
| chr14 | 21845861 | 21848477 | Comtd1 | body |
| chr14 | 21989101 | 21990101 | Zfp503 | TSS500 |
| chr14 | 21983962 | 21989101 | Zfp503 | body |
| chr14 | 22019212 | 22020212 | 1700112E06Rik | TSS500 |
| chr14 | 22020212 | 23056085 | 1700112E06Rik | body |
| chr14 | 24004359 | 24005359 | Kcnma1 | TSS500 |
| chr14 | 23289431 | 24004359 | Kcnma1 | body |
| chr14 | 24133953 | 24245420 | Dlg5 | body |
| chr14 | 24606704 | 24616811 | 4930542C16Rik | body |
| chr14 | 24618068 | 24621693 | 4931403M11Rik | body |
| chr14 | 25459685 | 25666743 | Zmiz1 | body |
| chr14 | 25548390 | 25553869 | Gm26772 | body |
| chr14 | 25694654 | 25700468 | Ppif | body |
| chr14 | 25711642 | 25768539 | Zcchc24 | body |
| chr14 | 25856777 | 25869766 | Gm9872 | body |
| chr14 | 25979077 | 25990088 | Duxbl1 | body |
| chr14 | 26413168 | 26534431 | Slmap | body |
| chr14 | 26659958 | 26669383 | Pde12 | body |
| chr14 | 26692774 | 26693774 | Dnah12 | TSS500 |
| chr14 | 26693774 | 26891703 | Dnah12 | body |
| chr14 | 26999862 | 27000862 | Hesx1 | TSS500 |
| chr14 | 27039501 | 27107286 | Il17rd | body |
| chr14 | 28504250 | 28505250 | Wnt5a | TSS500 |
| chr14 | 28505250 | 28527447 | Wnt5a | body |
| chr14 | 28510892 | 28511892 | Gm2670 | TSS500 |
| chr14 | 28508074 | 28510892 | Gm2670 | body |
| chr14 | 29721364 | 29722364 | Cacna2d3 | TSS500 |
| chr14 | 28904943 | 29721364 | Cacna2d3 | body |
| chr14 | 29967808 | 29968808 | Selk | TSS500 |
| chr14 | 30008396 | 30009396 | Il17rb | TSS500 |
| chr14 | 30008523 | 30009523 | Chdh | TSS500 |
| chr14 | 30009523 | 30040466 | Chdh | body |
| chr14 | 30039949 | 30490656 | Cacna1d | body |
| chr14 | 30548859 | 30574722 | Tkt | body |
| chr14 | 30908573 | 30923260 | Itih3 | body |
| chr14 | 30950986 | 30951986 | Nek4 | TSS500 |
| chr14 | 31001893 | 31012441 | Glt8d1 | body |
| chr14 | 31139013 | 31168141 | Stab1 | body |
| chr14 | 31251950 | 31259944 | Bap1 | body |
| chr14 | 31337138 | 31371986 | Capn7 | body |

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| chr14 | 31359880 | 31435578 | Sh3bp5 | body |
| chr14 | 31523082 | 31590843 | Colq | body |
| chr14 | 31829915 | 31830915 | Ankrd28 | TSS500 |
| chr14 | 32028489 | 32029489 | Galnt15 | TSS500 |
| chr14 | 32080566 | 32085192 | Dph3 | body |
| chr14 | 32085874 | 32103202 | Oxnad1 | body |
| chr14 | 32142526 | 32158370 | Msemb | body |
| chr14 | 32160365 | 32179855 | Ncoa4 | body |
| chr14 | 32321519 | 32322519 | Ogdhl | TSS500 |
| chr14 | 32387873 | 32388873 | 1700024G13Rik | TSS500 |
| chr14 | 32376502 | 32387873 | 1700024G13Rik | body |
| chr14 | 32465409 | 32466409 | Chat | TSS500 |
| chr14 | 32408203 | 32465409 | Chat | body |
| chr14 | 32462438 | 32464350 | Slc18a3 | body |
| chr14 | 32464542 | 32465542 | Gm2990 | TSS500 |
| chr14 | 32465542 | 32483539 | Gm2990 | body |
| chr14 | 32659119 | 32684772 | 3425401B19Rik | body |
| chr14 | 32686148 | 32687516 | Gm28651 | body |
| chr14 | 32834462 | 32836789 | Fam170b | body |
| chr14 | 32856256 | 32857256 | Vstm4 | TSS500 |
| chr14 | 32959547 | 33185008 | Wdfy4 | body |
| chr14 | 33214526 | 33369934 | Arhgap22 | body |
| chr14 | 33923087 | 33924087 | Gdf10 | TSS500 |
| chr14 | 33924087 | 33935280 | Gdf10 | body |
| chr14 | 33954522 | 33964216 | Rbp3 | body |
| chr14 | 33967070 | 33978264 | Zfp488 | body |
| chr14 | 34051132 | 34102254 | A630023A22Rik | body |
| chr14 | 34201133 | 34202133 | Gprin2 | TSS500 |
| chr14 | 34311227 | 34345144 | Glud1 | body |
| chr14 | 34526699 | 34588181 | Ldb3 | body |
| chr14 | 34590618 | 34599642 | Opn4 | body |
| chr14 | 34819325 | 34820325 | Grid1 | TSS500 |
| chr14 | 37055330 | 37064946 | Lrit1 | body |
| chr14 | 37097811 | 37098811 | Cdhr1 | TSS500 |
| chr14 | 39472588 | 39473588 | Nrg3 | TSS500 |
| chr14 | 38368952 | 39472588 | Nrg3 | body |
| chr14 | 38898802 | 38958794 | Nrg3os | body |
| chr14 | 39656163 | 39685293 | 1700109I08Rik | body |
| chr14 | 41049209 | 41068574 | Dydc2 | body |
| chr14 | 41150956 | 41151956 | Mbl1 | TSS500 |
| chr14 | 41172212 | 41184698 | Sftpd | body |
| chr14 | 41944495 | 42003821 | 1700024B05Rik | body |
| chr14 | 43818765 | 43875017 | Ear1 | body |
| chr14 | 44972268 | 45006400 | Gm17173 | body |

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| chr14 | 44988695 | 45003820 | Ptger2 | body |
| chr14 | 45220219 | 45281230 | Gpr137c | body |
| chr14 | 45329324 | 45330324 | Psmc6 | TSS500 |
| chr14 | 46378914 | 46379914 | Gm15217 | TSS500 |
| chr14 | 46383520 | 46390169 | Bmp4 | body |
| chr14 | 46388019 | 46389282 | Gm15222 | body |
| chr14 | 47153895 | 47188913 | Gch1 | body |
| chr14 | 47368251 | 47386160 | Lgals3 | body |
| chr14 | 48669788 | 48793348 | Otx2os1 | body |
| chr14 | 49171726 | 49172726 | Naa30 | TSS500 |
| chr14 | 49298519 | 49525546 | Slc35f4 | body |
| chr14 | 49782883 | 49783883 | 3632451O06Rik | TSS500 |
| chr14 | 50238383 | 50239383 | Olfr731 | TSS500 |
| chr14 | 50319836 | 50320368 | Olfr734 | body |
| chr14 | 50944802 | 50965237 | Pnp | body |
| chr14 | 50955492 | 50956492 | Pnp2 | TSS500 |
| chr14 | 51070942 | 51071942 | Olfr750 | TSS500 |
| chr14 | 51114065 | 51115065 | Eddm3b | TSS500 |
| chr14 | 51195423 | 51196423 | Ang2 | TSS500 |
| chr14 | 51255266 | 51255612 | Rnase2a | body |
| chr14 | 51553290 | 51662953 | Gm5622 | body |
| chr14 | 51763878 | 51773090 | Ang4 | body |
| chr14 | 51800546 | 51826359 | AY358078 | body |
| chr14 | 51836651 | 51837651 | Gm27375 | TSS500 |
| chr14 | 51885342 | 51893039 | Mettl17 | body |
| chr14 | 51918925 | 51920699 | Tppp2 | body |
| chr14 | 51922273 | 51923273 | Rnase13 | TSS500 |
| chr14 | 51984219 | 51985219 | Arhgef40 | TSS500 |
| chr14 | 52006077 | 52020233 | Zfp219 | body |
| chr14 | 52017365 | 52019787 | Tmem253 | body |
| chr14 | 52261759 | 52279045 | Rab2b | body |
| chr14 | 52311172 | 52328262 | Sall2 | body |
| chr14 | 54361341 | 54369669 | Oxa1l | body |
| chr14 | 54625810 | 54629556 | Psmb11 | body |
| chr14 | 54711674 | 54712674 | Cebpe | TSS500 |
| chr14 | 54781386 | 54782386 | Slc7a8 | TSS500 |
| chr14 | 54722216 | 54781386 | Slc7a8 | body |
| chr14 | 54906727 | 54912632 | Slc22a17 | body |
| chr14 | 54926288 | 54927288 | Efs | TSS500 |
| chr14 | 54935970 | 54936970 | Cmtm5 | TSS500 |
| chr14 | 54941921 | 54966427 | Myh6 | body |
| chr14 | 55054369 | 55072397 | RP23-171A13.12 | body |
| chr14 | 55491593 | 55508246 | Lrrc16b | body |
| chr14 | 55518978 | 55524481 | Nrl | body |

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| chr14 | 55587441 | 55590613 | Psme2 | body |
| chr14 | 55603071 | 55604071 | Irf9 | TSS500 |
| chr14 | 55604071 | 55610030 | Irf9 | body |
| chr14 | 55635965 | 55643306 | Tm9sf1 | body |
| chr14 | 55657879 | 55660008 | Mdp1 | body |
| chr14 | 55672735 | 55678750 | Gmpr2 | body |
| chr14 | 55739020 | 55745190 | Dhrs1 | body |
| chr14 | 55766462 | 55768494 | Ltb4r1 | body |
| chr14 | 55788357 | 55789357 | Ripk3 | TSS500 |
| chr14 | 55824295 | 55825295 | Nfatc4 | TSS500 |
| chr14 | 55853536 | 55854536 | Nynrin | TSS500 |
| chr14 | 55899732 | 55900732 | Sdr39u1 | TSS500 |
| chr14 | 56174096 | 56175096 | Gzmn | TSS500 |
| chr14 | 56364568 | 56365568 | Atp12a | TSS500 |
| chr14 | 56365568 | 56388551 | Atp12a | body |
| chr14 | 56526761 | 56571346 | Cenpj | body |
| chr14 | 56722441 | 56777816 | Pspc1 | body |
| chr14 | 57057530 | 57058530 | Gja3 | TSS500 |
| chr14 | 57104202 | 57105202 | Gjb2 | TSS500 |
| chr14 | 57115383 | 57116383 | Gm4491 | TSS500 |
| chr14 | 57112506 | 57115383 | Gm4491 | body |
| chr14 | 57123303 | 57133111 | Gjb6 | body |
| chr14 | 57397983 | 57398983 | Cryl1 | TSS500 |
| chr14 | 57524329 | 57525329 | Il17d | TSS500 |
| chr14 | 58071047 | 58112337 | Fgf9 | body |
| chr14 | 60377786 | 60378786 | Amer2 | TSS500 |
| chr14 | 60378786 | 60381003 | Amer2 | body |
| chr14 | 60485708 | 60599031 | Gm29266 | body |
| chr14 | 60634501 | 60764556 | Spata13 | body |
| chr14 | 60768634 | 60780869 | C1qtnf9 | body |
| chr14 | 60776329 | 60784081 | Mipepos | body |
| chr14 | 61046355 | 61047355 | Tnfrsf19 | TSS500 |
| chr14 | 60963834 | 61046355 | Tnfrsf19 | body |
| chr14 | 61137957 | 61138957 | Sacs | TSS500 |
| chr14 | 61138957 | 61240695 | Sacs | body |
| chr14 | 61257990 | 61258990 | Sgcg | TSS500 |
| chr14 | 61292980 | 61317646 | 1700109G14Rik | body |
| chr14 | 61339763 | 61359945 | Ebpl | body |
| chr14 | 62292479 | 62293479 | Dleu7 | TSS500 |
| chr14 | 62276231 | 62292479 | Dleu7 | body |
| chr14 | 62292089 | 62293089 | Rnaseh2b | TSS500 |
| chr14 | 62293089 | 62372992 | Rnaseh2b | body |
| chr14 | 62555237 | 62556237 | Fam124a | TSS500 |
| chr14 | 62664167 | 62692243 | Serpine3 | body |

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| chr14 | 62761001 | 62830126 | 4931440J10Rik | body |
| chr14 | 63145153 | 63177293 | Fdft1 | body |
| chr14 | 63193041 | 63194041 | Neil2 | TSS500 |
| chr14 | 63182443 | 63193041 | Neil2 | body |
| chr14 | 63198922 | 63271192 | Gata4 | body |
| chr14 | 63435894 | 63436894 | Fam167a | TSS500 |
| chr14 | 63508592 | 63509592 | Tdh | TSS500 |
| chr14 | 63492347 | 63508592 | Tdh | body |
| chr14 | 63606872 | 63607872 | Gm15918 | TSS500 |
| chr14 | 63943174 | 63944174 | Sox7 | TSS500 |
| chr14 | 63944174 | 63950732 | Sox7 | body |
| chr14 | 63971122 | 63987280 | 4930578I06Rik | body |
| chr14 | 64086734 | 64097670 | Prss51 | body |
| chr14 | 64587831 | 64593961 | A930011O12Rik | body |
| chr14 | 64652031 | 64653031 | Kif13b | TSS500 |
| chr14 | 64653031 | 64806296 | Kif13b | body |
| chr14 | 65599046 | 65648531 | Nuggc | body |
| chr14 | 65666903 | 65764826 | Scara5 | body |
| chr14 | 65953244 | 65954244 | Scara3 | TSS500 |
| chr14 | 65967983 | 65968983 | Clu | TSS500 |
| chr14 | 65968983 | 65981548 | Clu | body |
| chr14 | 66008710 | 66009710 | Gulo | TSS500 |
| chr14 | 65986787 | 66008710 | Gulo | body |
| chr14 | 66077233 | 66078233 | Adam2 | TSS500 |
| chr14 | 66027329 | 66077233 | Adam2 | body |
| chr14 | 66124000 | 66125000 | Ephx2 | TSS500 |
| chr14 | 66084377 | 66124000 | Ephx2 | body |
| chr14 | 66280552 | 66281552 | Ptk2b | TSS500 |
| chr14 | 66343796 | 66344796 | Stmn4 | TSS500 |
| chr14 | 66634751 | 66635751 | Adra1a | TSS500 |
| chr14 | 66635751 | 66733462 | Adra1a | body |
| chr14 | 66785029 | 66793758 | Gm10032 | body |
| chr14 | 66910670 | 66911670 | Pnma2 | TSS500 |
| chr14 | 66911670 | 66920054 | Pnma2 | body |
| chr14 | 67071971 | 67072971 | Ppp2r2a | TSS500 |
| chr14 | 67232792 | 67233792 | Ebf2 | TSS500 |
| chr14 | 67745729 | 67749435 | Gnrh1 | body |
| chr14 | 68124346 | 68125346 | Nefm | TSS500 |
| chr14 | 68083363 | 68084363 | Nefl | TSS500 |
| chr14 | 69028789 | 69029789 | Stc1 | TSS500 |
| chr14 | 69164797 | 69171357 | 1700092C10Rik | body |
| chr14 | 69172302 | 69175518 | Nkx2-6 | body |
| chr14 | 69190138 | 69191138 | Nkx3-1 | TSS500 |
| chr14 | 69582164 | 69682786 | Gm27177 | body |

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| chr14 | 69609568 | 69695834 | Loxl2 | body |
| chr14 | 69840920 | 70059886 | Pebp4 | body |
| chr14 | 70076945 | 70077945 | Egr3 | TSS500 |
| chr14 | 70159002 | 70160002 | 9930012K11Rik | TSS500 |
| chr14 | 70180468 | 70207137 | Sorbs3 | body |
| chr14 | 70530321 | 70531321 | Lgi3 | TSS500 |
| chr14 | 70552712 | 70573548 | Hr | body |
| chr14 | 70602184 | 70635548 | Dmtn | body |
| chr14 | 70652584 | 70653584 | Npm2 | TSS500 |
| chr14 | 70654246 | 70766128 | Xpo7 | body |
| chr14 | 70889630 | 70890630 | Gfra2 | TSS500 |
| chr14 | 73525819 | 73596142 | Sucla2 | body |
| chr14 | 74641340 | 74706859 | Htr2a | body |
| chr14 | 75131601 | 75230842 | Lcp1 | body |
| chr14 | 75455482 | 75456482 | Siah3 | TSS500 |
| chr14 | 76556187 | 76557187 | Serp2 | TSS500 |
| chr14 | 77156263 | 77157263 | Enox1 | TSS500 |
| chr14 | 77903739 | 77904739 | Epsti1 | TSS500 |
| chr14 | 78307543 | 78308543 | Tnfsf11 | TSS500 |
| chr14 | 78277445 | 78307543 | Tnfsf11 | body |
| chr14 | 78724589 | 78725589 | Dgkh | TSS500 |
| chr14 | 79301145 | 79302145 | Rgcc | TSS500 |
| chr14 | 79288756 | 79301145 | Rgcc | body |
| chr14 | 79397272 | 79398272 | Mtrf1 | TSS500 |
| chr14 | 79426011 | 79427011 | Kbtbd7 | TSS500 |
| chr14 | 79661670 | 79662670 | Lect1 | TSS500 |
| chr14 | 79766775 | 79770812 | Pcdh8 | body |
| chr14 | 79769408 | 79770408 | RP24-317P2.2 | TSS500 |
| chr14 | 79999802 | 80000802 | Olfm4 | TSS500 |
| chr14 | 84443063 | 84444063 | Pcdh17 | TSS500 |
| chr14 | 84444063 | 84537060 | Pcdh17 | body |
| chr14 | 88470896 | 88471896 | Pcdh20 | TSS500 |
| chr14 | 88464743 | 88470896 | Pcdh20 | body |
| chr14 | 93890179 | 93891179 | Pcdh9 | TSS500 |
| chr14 | 93013410 | 93890179 | Pcdh9 | body |
| chr14 | 96105259 | 96518602 | Klhl1 | body |
| chr14 | 98169265 | 98170265 | Dach1 | TSS500 |
| chr14 | 97786853 | 98169265 | Dach1 | body |
| chr14 | 101199830 | 101200830 | Prr30 | TSS500 |
| chr14 | 101197690 | 101199830 | Prr30 | body |
| chr14 | 101654467 | 101696124 | Uchl3 | body |
| chr14 | 102982137 | 102983137 | Kctd12 | TSS500 |
| chr14 | 102976581 | 102982137 | Kctd12 | body |
| chr14 | 102978720 | 102982528 | Gm26778 | body |

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| chr14 | 102982132 | 102983132 | Mir5130 | TSS500 |
| chr14 | 103047477 | 103056573 | Irg1 | body |
| chr14 | 103069716 | 103070716 | Cln5 | TSS500 |
| chr14 | 103080239 | 103099066 | Fbxl3 | body |
| chr14 | 103513841 | 103613346 | Scel | body |
| chr14 | 103649728 | 103650728 | Slain1 | TSS500 |
| chr14 | 103650728 | 103704907 | Slain1 | body |
| chr14 | 103650057 | 103651057 | Gm22877 | TSS500 |
| chr14 | 103843673 | 103844673 | Ednrb | TSS500 |
| chr14 | 103814625 | 103843673 | Ednrb | body |
| chr14 | 104467499 | 104468499 | Pou4f1 | TSS500 |
| chr14 | 104461676 | 104467499 | Pou4f1 | body |
| chr14 | 106105698 | 106106698 | Trim52 | TSS500 |
| chr14 | 108909991 | 108913739 | Slitrk1 | body |
| chr14 | 111674615 | 111675615 | Slitrk5 | TSS500 |
| chr14 | 111675615 | 111683134 | Slitrk5 | body |
| chr14 | 115091715 | 115092715 | Gpc5 | TSS500 |
| chr14 | 115092715 | 116525179 | Gpc5 | body |
| chr14 | 118236530 | 118237530 | Sox21 | TSS500 |
| chr14 | 119137915 | 119138915 | Hs6st3 | TSS500 |
| chr14 | 119138915 | 119869594 | Hs6st3 | body |
| chr14 | 120019585 | 120041935 | Oxgr1 | body |
| chr14 | 120478961 | 120507194 | Rap2a | body |
| chr14 | 120749685 | 120750062 | Gm17613 | body |
| chr14 | 121034700 | 121035700 | Farp1 | TSS500 |
| chr14 | 121504754 | 121505754 | Slc15a1 | TSS500 |
| chr14 | 122182194 | 122402232 | Clybl | body |
| chr14 | 122229905 | 122233154 | 1700108J01Rik | body |
| chr14 | 122450615 | 122451615 | Gm5089 | TSS500 |
| chr14 | 122434854 | 122450615 | Gm5089 | body |
| chr14 | 122465177 | 122466177 | Zic5 | TSS500 |
| chr14 | 122456795 | 122465177 | Zic5 | body |
| chr14 | 122474935 | 122475935 | Zic2 | TSS500 |
| chr14 | 122490086 | 122491086 | Gm10837 | TSS500 |
| chr14 | 124676627 | 124677627 | Fgf14 | TSS500 |
| chr9 | 3404585 | 3479236 | Cwf19l2 | body |
| chr9 | 4795734 | 4796734 | Gria4 | TSS500 |
| chr9 | 4417899 | 4795734 | Gria4 | body |
| chr9 | 6168112 | 6169112 | Pdgfd | TSS500 |
| chr9 | 7558929 | 7568486 | Mmp8 | body |
| chr9 | 7571896 | 7581885 | Mmp27 | body |
| chr9 | 7571958 | 7581393 | AC115689.1 | body |
| chr9 | 7628731 | 7674968 | Mmp20 | body |
| chr9 | 7872686 | 7873686 | Birc3 | TSS500 |

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| chr9 | 8133794 | 8134794 | AK129341 | TSS500 |
| chr9 | 8543696 | 8544696 | Trpc6 | TSS500 |
| chr9 | 8544696 | 8680565 | Trpc6 | body |
| chr9 | 8899333 | 8900333 | Pgr | TSS500 |
| chr9 | 8900333 | 8968611 | Pgr | body |
| chr9 | 9235788 | 9236788 | Gm16833 | TSS500 |
| chr9 | 9660891 | 10904275 | Cntn5 | body |
| chr9 | 13807792 | 13826607 | Cep57 | body |
| chr9 | 14276801 | 14326138 | Sesn3 | body |
| chr9 | 14353990 | 14380742 | Endod1 | body |
| chr9 | 14541966 | 14614983 | Amotl1 | body |
| chr9 | 14705142 | 14719058 | Gm10706 | body |
| chr9 | 14748459 | 14751622 | Fut4 | body |
| chr9 | 14770530 | 14771530 | 1700012B09Rik | TSS500 |
| chr9 | 15505987 | 15545260 | Smco4 | body |
| chr9 | 15627433 | 15628433 | Ccdc67 | TSS500 |
| chr9 | 15910205 | 16377731 | Fat3 | body |
| chr9 | 18455575 | 18477768 | Zfp558 | body |
| chr9 | 18495455 | 18512385 | Muc16 | body |
| chr9 | 20237662 | 20260913 | Olfr872 | body |
| chr9 | 20652630 | 20666584 | Pin1 | body |
| chr9 | 20727719 | 20728719 | Olfm2 | TSS500 |
| chr9 | 20814567 | 20815567 | Col5a3 | TSS500 |
| chr9 | 20868142 | 20869142 | A230050P20Rik | TSS500 |
| chr9 | 20879227 | 20880227 | Angptl6 | TSS500 |
| chr9 | 20873809 | 20879227 | Angptl6 | body |
| chr9 | 20887675 | 20888675 | Ppan | TSS500 |
| chr9 | 20976293 | 20977293 | S1pr2 | TSS500 |
| chr9 | 21003237 | 21008835 | Mrpl4 | body |
| chr9 | 21015460 | 21016460 | Icam1 | TSS500 |
| chr9 | 21016460 | 21028797 | Icam1 | body |
| chr9 | 21028307 | 21031857 | Gm20603 | body |
| chr9 | 21028873 | 21029873 | Icam4 | TSS500 |
| chr9 | 21029873 | 21030531 | Icam4 | body |
| chr9 | 21031538 | 21032538 | Icam5 | TSS500 |
| chr9 | 21032538 | 21039036 | Icam5 | body |
| chr9 | 21037282 | 21038282 | Gm26592 | TSS500 |
| chr9 | 21091488 | 21092488 | Raver1 | TSS500 |
| chr9 | 21074168 | 21091488 | Raver1 | body |
| chr9 | 21091255 | 21092255 | 1700084C06Rik | TSS500 |
| chr9 | 21247943 | 21248943 | S1pr5 | TSS500 |
| chr9 | 21288463 | 21290709 | Cdkn2d | body |
| chr9 | 21311833 | 21312833 | Ap1m2 | TSS500 |
| chr9 | 21411220 | 21412220 | Gm16853 | TSS500 |

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| chr9 | 21411337 | 21412337 | Qtrt1 | TSS500 |
| chr9 | 21412337 | 21420277 | Qtrt1 | body |
| chr9 | 21547394 | 21589487 | Carm1 | body |
| chr9 | 21835010 | 21836010 | Gm6484 | TSS500 |
| chr9 | 21917692 | 21918692 | Rab3d | TSS500 |
| chr9 | 21921010 | 21927035 | Tmem205 | body |
| chr9 | 21958899 | 21963076 | Epor | body |
| chr9 | 22051523 | 22052523 | Elavl3 | TSS500 |
| chr9 | 22015005 | 22051523 | Elavl3 | body |
| chr9 | 22126731 | 22135246 | Acp5 | body |
| chr9 | 22187668 | 22188668 | Zfp872 | TSS500 |
| chr9 | 22188668 | 22202123 | Zfp872 | body |
| chr9 | 22259395 | 22260395 | Zfp599 | TSS500 |
| chr9 | 22307138 | 22308138 | Zfp810 | TSS500 |
| chr9 | 22475215 | 22476215 | Bbs9 | TSS500 |
| chr9 | 24720812 | 24773803 | Tbx20 | body |
| chr9 | 25108130 | 25151281 | Herpud2 | body |
| chr9 | 25482047 | 25604110 | Eepd1 | body |
| chr9 | 26733228 | 26734228 | B3gat1 | TSS500 |
| chr9 | 26734228 | 26763101 | B3gat1 | body |
| chr9 | 26763044 | 26805968 | Glb1l2 | body |
| chr9 | 26817953 | 26860323 | Glb1l3 | body |
| chr9 | 26879567 | 26922581 | Gm1110 | body |
| chr9 | 28994750 | 29962641 | Ntm | body |
| chr9 | 29060299 | 29070199 | Gm15520 | body |
| chr9 | 30426829 | 30427829 | Snx19 | TSS500 |
| chr9 | 30921952 | 30922952 | Adamts15 | TSS500 |
| chr9 | 31081975 | 31082975 | Gm17508 | TSS500 |
| chr9 | 31131353 | 31132353 | St14 | TSS500 |
| chr9 | 31149557 | 31211315 | Aplp2 | body |
| chr9 | 31463738 | 31464738 | Tmem45b | TSS500 |
| chr9 | 31912962 | 31913962 | Barx2 | TSS500 |
| chr9 | 32542361 | 32543361 | Fli1 | TSS500 |
| chr9 | 32508913 | 32516958 | Gm27201 | body |
| chr9 | 32635721 | 32636721 | Ets1 | TSS500 |
| chr9 | 33942810 | 34007173 | Gm27164 | body |
| chr9 | 34485394 | 34486394 | Kirrel3 | TSS500 |
| chr9 | 35200675 | 35247973 | Srpr | body |
| chr9 | 35516321 | 35517769 | Gm1113 | body |
| chr9 | 35558028 | 35559028 | Ddx25 | TSS500 |
| chr9 | 35541847 | 35558028 | Ddx25 | body |
| chr9 | 35558095 | 35559095 | Pus3 | TSS500 |
| chr9 | 35559095 | 35567401 | Pus3 | body |
| chr9 | 35570784 | 35690318 | Pate2 | body |

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| chr9 | 36119934 | 36128279 | Gm5916 | body |
| chr9 | 36729344 | 36767179 | Stt3a | body |
| chr9 | 36821439 | 36822439 | Fez1 | TSS500 |
| chr9 | 36890982 | 37146822 | Pknx2 | body |
| chr9 | 37366868 | 37367868 | Hepacam | TSS500 |
| chr9 | 37367868 | 37386572 | Hepacam | body |
| chr9 | 37432663 | 37433663 | Robo3 | TSS500 |
| chr9 | 37415669 | 37432663 | Robo3 | body |
| chr9 | 37528578 | 37538319 | Esam | body |
| chr9 | 37538755 | 37539755 | Vsig2 | TSS500 |
| chr9 | 37539755 | 37544205 | Vsig2 | body |
| chr9 | 37659902 | 37668722 | Panx3 | body |
| chr9 | 39128667 | 39145072 | Olfr27 | body |
| chr9 | 40685462 | 40686462 | Clmp | TSS500 |
| chr9 | 40686462 | 40785319 | Clmp | body |
| chr9 | 40874627 | 40877972 | Bsx | body |
| chr9 | 40963618 | 40964618 | 4931429I11Rik | TSS500 |
| chr9 | 40894849 | 40963618 | 4931429I11Rik | body |
| chr9 | 41206637 | 41217627 | 1700063D05Rik | body |
| chr9 | 42123797 | 42124797 | Sorl1 | TSS500 |
| chr9 | 42023115 | 42034113 | Gm16214 | body |
| chr9 | 42518135 | 42943993 | Grik4 | body |
| chr9 | 42861629 | 42862629 | Gm27509 | TSS500 |
| chr9 | 43116070 | 43117070 | Tmem136 | TSS500 |
| chr9 | 43108653 | 43116070 | Tmem136 | body |
| chr9 | 43221278 | 43239316 | Oaf | body |
| chr9 | 43260379 | 43280075 | D630033O11Rik | body |
| chr9 | 43311263 | 43336125 | Trim29 | body |
| chr9 | 43829463 | 43830463 | Gm3898 | TSS500 |
| chr9 | 44043884 | 44048579 | Thy1 | body |
| chr9 | 44067521 | 44095627 | Usp2 | body |
| chr9 | 44106745 | 44107745 | C1qtnf5 | TSS500 |
| chr9 | 44123768 | 44133985 | Gm10687 | body |
| chr9 | 44268099 | 44269099 | Nlr1 | TSS500 |
| chr9 | 44288115 | 44289115 | Abcg4 | TSS500 |
| chr9 | 44273188 | 44288115 | Abcg4 | body |
| chr9 | 44336350 | 44343728 | Hmbs | body |
| chr9 | 44408214 | 44410405 | Rps25 | body |
| chr9 | 44499636 | 44510388 | Bcl9l | body |
| chr9 | 44673733 | 44686305 | Treh | body |
| chr9 | 44741564 | 44767345 | Arcn1 | body |
| chr9 | 44768408 | 44792714 | Ift46 | body |
| chr9 | 44798807 | 44799807 | Tmem25 | TSS500 |
| chr9 | 44793776 | 44798807 | Tmem25 | body |

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| chr9 | 44799400 | 44802451 | Ttc36 | body |
| chr9 | 45055686 | 45077436 | Mpzl3 | body |
| chr9 | 45172726 | 45203592 | Tmprss4 | body |
| chr9 | 45182507 | 45250020 | BC049352 | body |
| chr9 | 45268649 | 45269649 | Il10ra | TSS500 |
| chr9 | 45253837 | 45268649 | Il10ra | body |
| chr9 | 45369685 | 45370685 | Fxyd6 | TSS500 |
| chr9 | 45370685 | 45396158 | Fxyd6 | body |
| chr9 | 45430732 | 45431732 | 4833428L15Rik | TSS500 |
| chr9 | 45416626 | 45430732 | 4833428L15Rik | body |
| chr9 | 45429793 | 45430793 | Dscaml1 | TSS500 |
| chr9 | 45430793 | 45753164 | Dscaml1 | body |
| chr9 | 45907069 | 45929692 | Pcsk7 | body |
| chr9 | 45965311 | 45984371 | Pafah1b2 | body |
| chr9 | 46240196 | 46241196 | Apoa4 | TSS500 |
| chr9 | 46243029 | 46244029 | Gm10680 | TSS500 |
| chr9 | 46303361 | 46319486 | 4931429L15Rik | body |
| chr9 | 46326391 | 46328913 | 4930448E22Rik | body |
| chr9 | 46913993 | 46927366 | 2900052N01Rik | body |
| chr9 | 48494830 | 48495830 | Rbm7 | TSS500 |
| chr9 | 48494845 | 48495845 | Gm5617 | TSS500 |
| chr9 | 48591877 | 48604653 | Nnmt | body |
| chr9 | 48835445 | 48836445 | Zbtb16 | TSS500 |
| chr9 | 48654311 | 48835445 | Zbtb16 | body |
| chr9 | 48935008 | 48964490 | Htr3b | body |
| chr9 | 49340162 | 49341162 | Drd2 | TSS500 |
| chr9 | 50662752 | 50739017 | Dixdc1 | body |
| chr9 | 50845801 | 50894229 | Ppp2r1b | body |
| chr9 | 51101578 | 51102578 | 4833427G06Rik | TSS500 |
| chr9 | 51103145 | 51104145 | Mir34b | TSS500 |
| chr9 | 51278054 | 51279054 | Gm684 | TSS500 |
| chr9 | 51278013 | 51279013 | 2010007H06Rik | TSS500 |
| chr9 | 51279013 | 51284210 | 2010007H06Rik | body |
| chr9 | 51289686 | 51328417 | 1810046K07Rik | body |
| chr9 | 51765837 | 51853856 | Arhgap20 | body |
| chr9 | 51832814 | 51875386 | Arhgap20os | body |
| chr9 | 53384523 | 53401867 | Kdelc2 | body |
| chr9 | 53405786 | 53432803 | 4930550C14Rik | body |
| chr9 | 53684110 | 53705732 | Rab39 | body |
| chr9 | 53771035 | 53772035 | Slc35f2 | TSS500 |
| chr9 | 53974801 | 53975801 | Elmod1 | TSS500 |
| chr9 | 54067911 | 54068911 | Tnfaip8l3 | TSS500 |
| chr9 | 54025606 | 54067911 | Tnfaip8l3 | body |
| chr9 | 54268578 | 54301070 | Gldnos | body |

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| chr9 | 54285986 | 54286986 | Gldn | TSS500 |
| chr9 | 54286986 | 54341786 | Gldn | body |
| chr9 | 54501260 | 54502260 | Dmxi2 | TSS500 |
| chr9 | 54559718 | 54560718 | Cib2 | TSS500 |
| chr9 | 54764248 | 54765248 | Crabp1 | TSS500 |
| chr9 | 54864255 | 54912534 | Ireb2 | body |
| chr9 | 54916783 | 54917783 | Hykk | TSS500 |
| chr9 | 54981380 | 55007779 | Chrna5 | body |
| chr9 | 55048044 | 55049044 | Chrn4 | TSS500 |
| chr9 | 55028156 | 55048044 | Chrn4 | body |
| chr9 | 55326344 | 55327344 | Nrg4 | TSS500 |
| chr9 | 55326413 | 55327413 | AI118078 | TSS500 |
| chr9 | 55327413 | 55438345 | AI118078 | body |
| chr9 | 55540388 | 55541388 | Gm17226 | TSS500 |
| chr9 | 55539549 | 55540388 | Gm17226 | body |
| chr9 | 55962589 | 55980414 | Rfpl3s | body |
| chr9 | 56135885 | 56160570 | Tspan3 | body |
| chr9 | 56851463 | 56852463 | Odf3l1 | TSS500 |
| chr9 | 56848659 | 56851463 | Odf3l1 | body |
| chr9 | 56864604 | 56865604 | Cspg4 | TSS500 |
| chr9 | 56865604 | 56899870 | Cspg4 | body |
| chr9 | 56927871 | 56928871 | Snx33 | TSS500 |
| chr9 | 57147805 | 57148805 | Neil1 | TSS500 |
| chr9 | 57155041 | 57157799 | Commd4 | body |
| chr9 | 57175775 | 57186108 | 1700041C23Rik | body |
| chr9 | 57439614 | 57440614 | Ppcdc | TSS500 |
| chr9 | 57467524 | 57468524 | Scamp5 | TSS500 |
| chr9 | 57531287 | 57537129 | Gm26631 | body |
| chr9 | 57588952 | 57589952 | Ulk3 | TSS500 |
| chr9 | 57626647 | 57645153 | Csk | body |
| chr9 | 57750711 | 57765360 | Clk3 | body |
| chr9 | 57939613 | 57940613 | Sema7a | TSS500 |
| chr9 | 57997541 | 57998541 | Gm17322 | TSS500 |
| chr9 | 58028677 | 58118323 | Ccdc33 | body |
| chr9 | 58032774 | 58048997 | Gm16130 | body |
| chr9 | 58196298 | 58203819 | Islr2 | body |
| chr9 | 58218076 | 58249286 | Pml | body |
| chr9 | 58287723 | 58312712 | Loxl1 | body |
| chr9 | 58359804 | 58369869 | Tbc1d21 | body |
| chr9 | 58524300 | 58554632 | Cd276 | body |
| chr9 | 58582740 | 58657955 | Nptn | body |
| chr9 | 58823012 | 58824012 | Hcn4 | TSS500 |
| chr9 | 58874679 | 59035941 | Neo1 | body |
| chr9 | 59291072 | 59292072 | Adpgk | TSS500 |

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| chr9 | 59578417 | 59607292 | Celf6 | body |
| chr9 | 59656868 | 59679375 | Pkm | body |
| chr9 | 59679644 | 59680644 | Gramd2 | TSS500 |
| chr9 | 59680644 | 59718874 | Gramd2 | body |
| chr9 | 59750149 | 59751149 | Senp8 | TSS500 |
| chr9 | 59750396 | 59751396 | Myo9a | TSS500 |
| chr9 | 59960159 | 59961159 | Nr2e3 | TSS500 |
| chr9 | 59942771 | 59960159 | Nr2e3 | body |
| chr9 | 60521546 | 60522546 | Thsd4 | TSS500 |
| chr9 | 59966931 | 60521546 | Thsd4 | body |
| chr9 | 60568859 | 60687658 | Lrrc49 | body |
| chr9 | 60712489 | 60713489 | Larp6 | TSS500 |
| chr9 | 60743620 | 60770276 | 1700036A12Rik | body |
| chr9 | 61953481 | 62026356 | Paqr5 | body |
| chr9 | 62536544 | 62537544 | Coro2b | TSS500 |
| chr9 | 62419492 | 62536544 | Coro2b | body |
| chr9 | 62857604 | 62858604 | Calml4 | TSS500 |
| chr9 | 63148461 | 63149461 | Skor1 | TSS500 |
| chr9 | 63138170 | 63148461 | Skor1 | body |
| chr9 | 64049329 | 64050329 | 1110036E04Rik | TSS500 |
| chr9 | 64281107 | 64282107 | Tipin | TSS500 |
| chr9 | 64340788 | 64341788 | Dis3l | TSS500 |
| chr9 | 64951107 | 64952107 | Slc24a1 | TSS500 |
| chr9 | 64960332 | 64961332 | Vwa9 | TSS500 |
| chr9 | 65021217 | 65022217 | Ptplad1 | TSS500 |
| chr9 | 64986985 | 65021217 | Ptplad1 | body |
| chr9 | 65101986 | 65137940 | Igdcc4 | body |
| chr9 | 65214190 | 65215190 | Parp16 | TSS500 |
| chr9 | 65391152 | 65392152 | Kbtbd13 | TSS500 |
| chr9 | 65388684 | 65391152 | Kbtbd13 | body |
| chr9 | 65398988 | 65414853 | Rasl12 | body |
| chr9 | 65422273 | 65423273 | Slc51b | TSS500 |
| chr9 | 65554386 | 65579540 | Plekho2 | body |
| chr9 | 65909474 | 66045009 | Csnk1g1 | body |
| chr9 | 66069231 | 66070231 | Snx22 | TSS500 |
| chr9 | 66157723 | 66158723 | Dapk2 | TSS500 |
| chr9 | 66798678 | 66803859 | BC050972 | body |
| chr9 | 66834226 | 66835226 | Aph1c | TSS500 |
| chr9 | 66814994 | 66834226 | Aph1c | body |
| chr9 | 66834199 | 66835199 | Gm17098 | TSS500 |
| chr9 | 67759730 | 67760730 | M5C1000I18Rik | TSS500 |
| chr9 | 67758937 | 67759937 | C2cd4b | TSS500 |
| chr9 | 67759937 | 67760930 | C2cd4b | body |
| chr9 | 67831830 | 67832830 | C2cd4a | TSS500 |

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|------|----------|----------|---------------|--------|
| chr9 | 67830532 | 67831830 | C2cd4a | body |
| chr9 | 68653286 | 68654286 | Rora | TSS500 |
| chr9 | 68654286 | 69388246 | Rora | body |
| chr9 | 69348889 | 69363747 | Gm15511 | body |
| chr9 | 69670852 | 69671852 | Gm27537 | TSS500 |
| chr9 | 69760440 | 69761440 | Foxb1 | TSS500 |
| chr9 | 69757710 | 69760440 | Foxb1 | body |
| chr9 | 69759240 | 69830845 | B230323A14Rik | body |
| chr9 | 71215289 | 71216289 | Aldh1a2 | TSS500 |
| chr9 | 71216289 | 71296243 | Aldh1a2 | body |
| chr9 | 72274356 | 72275356 | Gm27253 | TSS500 |
| chr9 | 72274360 | 72275360 | Zfp280d | TSS500 |
| chr9 | 72532740 | 72622937 | Rfx7 | body |
| chr9 | 72662846 | 72749852 | Nedd4 | body |
| chr9 | 72925145 | 72926145 | Pygo1 | TSS500 |
| chr9 | 72926145 | 72952181 | Pygo1 | body |
| chr9 | 72958285 | 72959285 | Dyx1c1 | TSS500 |
| chr9 | 72958352 | 72959352 | Dyx1c1Ccp1 | TSS500 |
| chr9 | 72979722 | 72984882 | Ccp1os | body |
| chr9 | 73045354 | 73097629 | Rab27a | body |
| chr9 | 73102336 | 73104438 | Khdc3 | body |
| chr9 | 73479422 | 73968466 | Unc13c | body |
| chr9 | 74109856 | 74110856 | Wdr72 | TSS500 |
| chr9 | 74110856 | 74283308 | Wdr72 | body |
| chr9 | 74848963 | 74891476 | Gm20649 | body |
| chr9 | 74854885 | 74855885 | Gm28182 | TSS500 |
| chr9 | 74861421 | 74862421 | Onecut1 | TSS500 |
| chr9 | 75071515 | 75223688 | Myo5a | body |
| chr9 | 75231514 | 75232514 | Myo5c | TSS500 |
| chr9 | 75442024 | 75466432 | Leo1 | body |
| chr9 | 75565621 | 75610825 | Tmod2 | body |
| chr9 | 75775864 | 75900310 | Bmp5 | body |
| chr9 | 75897843 | 76014692 | Gm26903 | body |
| chr9 | 76225880 | 76323356 | Hcrtr2 | body |
| chr9 | 76490054 | 76566616 | Fam83b | body |
| chr9 | 76951693 | 77045294 | Tinag | body |
| chr9 | 77102081 | 77352469 | Mlip | body |
| chr9 | 77637000 | 77660127 | Klhl31 | body |
| chr9 | 77755035 | 77794485 | Gclc | body |
| chr9 | 78109692 | 78172107 | Ick | body |
| chr9 | 78328089 | 78329620 | Omt2b | body |
| chr9 | 78395658 | 78396658 | 4930542C12Rik | TSS500 |
| chr9 | 78395277 | 78396277 | Ddx43 | TSS500 |
| chr9 | 78442737 | 78443737 | Mb21d1 | TSS500 |

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| chr9 | 78430526 | 78442737 | Mb21d1 | body |
| chr9 | 78488651 | 78489651 | Eef1a1 | TSS500 |
| chr9 | 78616046 | 78716253 | Cd109 | body |
| chr9 | 79718331 | 79719331 | Col12a1 | TSS500 |
| chr9 | 79768943 | 79793007 | Tmem30a | body |
| chr9 | 79977304 | 79978304 | Filip1 | TSS500 |
| chr9 | 80165531 | 80311729 | Myo6 | body |
| chr9 | 80313330 | 80464981 | Impg1 | body |
| chr9 | 80803151 | 80864861 | Gm27224 | body |
| chr9 | 81175957 | 81203591 | Gm26713 | body |
| chr9 | 81628291 | 81633328 | Htr1b | body |
| chr9 | 81631051 | 81632051 | D430036J16Rik | TSS500 |
| chr9 | 81632051 | 81645156 | D430036J16Rik | body |
| chr9 | 81776695 | 81858391 | Gm26907 | body |
| chr9 | 81863170 | 81864170 | Mei4 | TSS500 |
| chr9 | 81864170 | 82206007 | Mei4 | body |
| chr9 | 83547827 | 83548827 | Sh3bgrl2 | TSS500 |
| chr9 | 83690975 | 83691975 | Gm2109 | TSS500 |
| chr9 | 85841880 | 85842880 | Tpbg | TSS500 |
| chr9 | 85842880 | 85847040 | Tpbg | body |
| chr9 | 86307306 | 86464450 | Ube2cbp | body |
| chr9 | 86571491 | 86572491 | Rwdd2a | TSS500 |
| chr9 | 86695960 | 86701253 | A330041J22Rik | body |
| chr9 | 86743149 | 86744149 | Prss35 | TSS500 |
| chr9 | 86880154 | 86881154 | Snap91 | TSS500 |
| chr9 | 86765923 | 86880154 | Snap91 | body |
| chr9 | 87015037 | 87016037 | Ripply2 | TSS500 |
| chr9 | 87143806 | 87144806 | Mrap2 | TSS500 |
| chr9 | 87144806 | 87184045 | Mrap2 | body |
| chr9 | 87702800 | 87730760 | Tbx18 | body |
| chr9 | 88326697 | 88327697 | Nt5e | TSS500 |
| chr9 | 88327697 | 88372092 | Nt5e | body |
| chr9 | 88599016 | 88600016 | 9430037G07Rik | TSS500 |
| chr9 | 88599156 | 88600156 | Gm26567 | TSS500 |
| chr9 | 88839664 | 88848190 | Trim43c | body |
| chr9 | 88859511 | 88883554 | Gm26611 | body |
| chr9 | 89113111 | 89177387 | 4930579C12Rik | body |
| chr9 | 89211176 | 89377713 | Mthfs | body |
| chr9 | 89622625 | 89623625 | AF529169 | TSS500 |
| chr9 | 89803370 | 89806055 | 1700017I07Rik | body |
| chr9 | 89909408 | 89910408 | Rasgrf1 | TSS500 |
| chr9 | 89910408 | 90026977 | Rasgrf1 | body |
| chr9 | 90053652 | 90054652 | Ctsh | TSS500 |
| chr9 | 90054652 | 90076089 | Ctsh | body |

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| chr9 | 90163569 | 90208071 | Adamts7 | body |
| chr9 | 91365310 | 91366310 | Zic1 | TSS500 |
| chr9 | 91358058 | 91365310 | Zic1 | body |
| chr9 | 91361913 | 91362913 | Zic4 | TSS500 |
| chr9 | 91362913 | 91389348 | Zic4 | body |
| chr9 | 91404974 | 91562818 | Gm29478 | body |
| chr9 | 94669409 | 94670409 | Slc9a9 | TSS500 |
| chr9 | 94670409 | 95230445 | Slc9a9 | body |
| chr9 | 94695704 | 94701819 | Gm16262 | body |
| chr9 | 95406222 | 95407222 | Chst2 | TSS500 |
| chr9 | 95399292 | 95406222 | Chst2 | body |
| chr9 | 95456898 | 95511496 | U2surp | body |
| chr9 | 95559157 | 95560157 | Paqr9 | TSS500 |
| chr9 | 95560157 | 95568023 | Paqr9 | body |
| chr9 | 96119862 | 96184608 | Gk5 | body |
| chr9 | 96682770 | 96752331 | Zbtb38 | body |
| chr9 | 96705328 | 96706328 | A930006L05Rik | TSS500 |
| chr9 | 98032681 | 98033681 | Clstn2 | TSS500 |
| chr9 | 97444395 | 98032681 | Clstn2 | body |
| chr9 | 98748599 | 98819587 | E330023G01Rik | body |
| chr9 | 98855994 | 98856994 | Gm6406 | TSS500 |
| chr9 | 98864267 | 98865267 | 2410012M07Rik | TSS500 |
| chr9 | 98865267 | 98866583 | 2410012M07Rik | body |
| chr9 | 98955107 | 98956107 | Foxl2 | TSS500 |
| chr9 | 98956107 | 98956847 | Foxl2 | body |
| chr9 | 99358057 | 99359057 | Esyt3 | TSS500 |
| chr9 | 99436881 | 99437881 | Mras | TSS500 |
| chr9 | 99478372 | 99568399 | Armc8 | body |
| chr9 | 99875670 | 99876670 | Sox14 | TSS500 |
| chr9 | 99874106 | 99875670 | Sox14 | body |
| chr9 | 100552188 | 100570590 | Slc35g2 | body |
| chr9 | 100598298 | 100959375 | Stag1 | body |
| chr9 | 101341694 | 101342694 | Gm28979 | TSS500 |
| chr9 | 102354193 | 102355193 | Ephb1 | TSS500 |
| chr9 | 102505250 | 102506250 | Ky | TSS500 |
| chr9 | 102584598 | 102626034 | Cep63 | body |
| chr9 | 102626796 | 102634425 | Anapc13 | body |
| chr9 | 103111287 | 103112287 | Rab6b | TSS500 |
| chr9 | 103229807 | 103230807 | Gm20425 | TSS500 |
| chr9 | 103229944 | 103230944 | Trf | TSS500 |
| chr9 | 103305715 | 103350428 | Topbp1 | body |
| chr9 | 103353094 | 103365340 | Cdv3 | body |
| chr9 | 103424920 | 103479920 | Bfsp2 | body |
| chr9 | 103471584 | 103472584 | Gm16252 | TSS500 |

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| chr9 | 103472584 | 103492930 | Gm16252 | body |
| chr9 | 103482947 | 103761337 | Tmem108 | body |
| chr9 | 103557590 | 103565891 | 4932413F04Rik | body |
| chr9 | 103919289 | 103959635 | Gm29154 | body |
| chr9 | 104361332 | 104362332 | Gm28548 | TSS500 |
| chr9 | 104362332 | 104385031 | Gm28548 | body |
| chr9 | 105052739 | 105053739 | Mrpl3 | TSS500 |
| chr9 | 105208696 | 105211863 | Gm20643 | body |
| chr9 | 105687809 | 105827660 | Col6a6 | body |
| chr9 | 105960143 | 105961143 | Col6a5 | TSS500 |
| chr9 | 105989454 | 106096283 | Col6a4 | body |
| chr9 | 106126560 | 106127560 | Gm29208 | TSS500 |
| chr9 | 106148187 | 106149187 | D030055H07Rik | TSS500 |
| chr9 | 106149187 | 106160201 | D030055H07Rik | body |
| chr9 | 106157638 | 106158638 | Glyctk | TSS500 |
| chr9 | 106203608 | 106215389 | Twf2 | body |
| chr9 | 106223098 | 106226883 | Tlr9 | body |
| chr9 | 106281561 | 106350521 | Poc1a | body |
| chr9 | 106309944 | 106335333 | Gm29123 | body |
| chr9 | 106448288 | 106452922 | Abhd14b | body |
| chr9 | 106453791 | 106464012 | Pcbp4 | body |
| chr9 | 106470322 | 106476449 | Parp3 | body |
| chr9 | 106475463 | 106476463 | Rrp9 | TSS500 |
| chr9 | 106561131 | 106562131 | lqcf3 | TSS500 |
| chr9 | 106514073 | 106515073 | lqcf5 | TSS500 |
| chr9 | 106644537 | 106655609 | Grm2 | body |
| chr9 | 106688082 | 106788694 | Rad54l2 | body |
| chr9 | 107254927 | 107289377 | Mapkapk3 | body |
| chr9 | 107399112 | 107400112 | Cacna2d2 | TSS500 |
| chr9 | 107423857 | 107430067 | Gm17141 | body |
| chr9 | 107547798 | 107551319 | Zmynd10 | body |
| chr9 | 107550268 | 107551268 | RP23-456B9.21 | TSS500 |
| chr9 | 107562755 | 107563755 | Tusc2 | TSS500 |
| chr9 | 107568445 | 107572779 | Hyal2 | body |
| chr9 | 107576427 | 107577427 | Hyal1 | TSS500 |
| chr9 | 107588142 | 107593385 | lfrd2 | body |
| chr9 | 107596575 | 107597575 | RP23-456B9.23 | TSS500 |
| chr9 | 107597674 | 107608729 | Sema3b | body |
| chr9 | 107614125 | 107634867 | Gnai2 | body |
| chr9 | 107679212 | 107680212 | Gnat1 | TSS500 |
| chr9 | 107681500 | 107709975 | Sema3f | body |
| chr9 | 107976005 | 107984060 | Uba7 | body |
| chr9 | 107983558 | 107995007 | Gm20661 | body |
| chr9 | 107991684 | 107995156 | 4921523L03Rik | body |

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|------|-----------|-----------|---------------|--------|
| chr9 | 107991997 | 107992997 | Cdhr4 | TSS500 |
| chr9 | 107998116 | 108001904 | 4930535L15Rik | body |
| chr9 | 108051534 | 108082846 | Rnf123 | body |
| chr9 | 108080936 | 108085003 | Mst1 | body |
| chr9 | 108189884 | 108190884 | Bsn | TSS500 |
| chr9 | 108296353 | 108297353 | Amt | TSS500 |
| chr9 | 108337773 | 108338773 | RP23-448A11.8 | TSS500 |
| chr9 | 108392305 | 108393305 | 1700102P08Rik | TSS500 |
| chr9 | 108403611 | 108427984 | Ccdc36 | body |
| chr9 | 108570386 | 108572774 | Dalrd3 | body |
| chr9 | 108572311 | 108578239 | Wdr6 | body |
| chr9 | 108597167 | 108598167 | P4htm | TSS500 |
| chr9 | 108825820 | 108826820 | Celsr3 | TSS500 |
| chr9 | 108936133 | 108937133 | Uqcrc1 | TSS500 |
| chr9 | 108937133 | 108949623 | Uqcrc1 | body |
| chr9 | 108969422 | 108970422 | Mir711 | TSS500 |
| chr9 | 108991070 | 108992070 | RP24-212K17.5 | TSS500 |
| chr9 | 108991402 | 108992402 | Pfkfb4 | TSS500 |
| chr9 | 109074568 | 109082087 | Tma7 | body |
| chr9 | 109093844 | 109097296 | Gm7628 | body |
| chr9 | 109094936 | 109095936 | Plxnb1 | TSS500 |
| chr9 | 109179227 | 109195475 | Fbxw13 | body |
| chr9 | 109432319 | 109448640 | Fbxw16 | body |
| chr9 | 109601117 | 109625559 | Fbxw24 | body |
| chr9 | 109717566 | 109745589 | Fbxw26 | body |
| chr9 | 109931958 | 110083946 | Map4 | body |
| chr9 | 110132524 | 110240177 | Smarcc1 | body |
| chr9 | 110244283 | 110262575 | Cspg5 | body |
| chr9 | 110477458 | 110525174 | Kif9 | body |
| chr9 | 110827190 | 110831502 | Prss43 | body |
| chr9 | 110835088 | 110841313 | Prss45 | body |
| chr9 | 110857467 | 110858467 | Prss50 | TSS500 |
| chr9 | 110858467 | 110864628 | Prss50 | body |
| chr9 | 110879613 | 110880613 | Tmie | TSS500 |
| chr9 | 110865711 | 110879613 | Tmie | body |
| chr9 | 110879370 | 110880370 | Als2cl | TSS500 |
| chr9 | 110914739 | 110916361 | Gm590 | body |
| chr9 | 110952045 | 110984066 | Lrrc2 | body |
| chr9 | 111271108 | 111272108 | Mlh1 | TSS500 |
| chr9 | 111438581 | 111439581 | Dclk3 | TSS500 |
| chr9 | 112065091 | 112235438 | Arpp21 | body |
| chr9 | 112118215 | 112119215 | Mir128-2 | TSS500 |
| chr9 | 114056854 | 114057854 | Susd5 | TSS500 |
| chr9 | 114515197 | 114516197 | C130032M10Rik | TSS500 |

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| chr9 | 114689290 | 114724302 | Dync1li1 | body |
| chr9 | 114979069 | 115232225 | Osopl10 | body |
| chr9 | 115909955 | 116076176 | Gadl1 | body |
| chr9 | 115990956 | 116001288 | Gm16142 | body |
| chr9 | 117872644 | 117873644 | Gm26614 | TSS500 |
| chr9 | 118149696 | 118150696 | Cmc1 | TSS500 |
| chr9 | 118149731 | 118150731 | Gm17399 | TSS500 |
| chr9 | 118404097 | 118405599 | Gm26975 | body |
| chr9 | 118477712 | 118478712 | Eomes | TSS500 |
| chr9 | 118478712 | 118486132 | Eomes | body |
| chr9 | 118606190 | 118607190 | ltga9 | TSS500 |
| chr9 | 118607190 | 118901003 | ltga9 | body |
| chr9 | 119031296 | 119032296 | Mir26a-1 | TSS500 |
| chr9 | 119052278 | 119053278 | Vill | TSS500 |
| chr9 | 119156593 | 119157593 | Acaa1b | TSS500 |
| chr9 | 119148023 | 119156593 | Acaa1b | body |
| chr9 | 119193002 | 119208605 | Slc22a13 | body |
| chr9 | 119357881 | 119393797 | Xylb | body |
| chr9 | 119578516 | 119579516 | Scn5a | TSS500 |
| chr9 | 120023098 | 120024098 | Xirp1 | TSS500 |
| chr9 | 120013755 | 120023098 | Xirp1 | body |
| chr9 | 120150242 | 120181484 | Mobp | body |
| chr9 | 120303436 | 120304436 | Myrip | TSS500 |
| chr9 | 120539318 | 120540318 | Entpd3 | TSS500 |
| chr9 | 120576846 | 120577846 | 5830454E08Rik | TSS500 |
| chr9 | 120924455 | 120930302 | 4930593C16Rik | body |
| chr9 | 120929716 | 120960507 | Ctnnb1 | body |
| chr9 | 121641596 | 121642596 | Lyzl4 | TSS500 |
| chr9 | 121642216 | 121643216 | Vipr1 | TSS500 |
| chr9 | 121704990 | 121705990 | Sec22c | TSS500 |
| chr9 | 121709889 | 121710889 | Deb1 | TSS500 |
| chr9 | 122571997 | 122572997 | 9530059O14Rik | TSS500 |
| chr9 | 122747846 | 122802074 | Topaz1 | body |
| chr9 | 123035239 | 123067561 | Tgm4 | body |
| chr9 | 123259058 | 123260289 | Tmem158 | body |
| chr9 | 123678385 | 123679385 | Slc6a20a | TSS500 |
| chr9 | 123678939 | 123783457 | Ccr9 | body |
| chr9 | 124291804 | 124312196 | 2010315B03Rik | body |
| chr11 | 3131850 | 3192963 | Sfi1 | body |
| chr11 | 3193516 | 3193763 | Gm12735 | body |
| chr11 | 3288374 | 3289374 | Patz1 | TSS500 |
| chr11 | 3289374 | 3309083 | Patz1 | body |
| chr11 | 3415982 | 3451863 | Rnf185 | body |
| chr11 | 3487784 | 3488784 | Pla2g3 | TSS500 |

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|-------|---------|---------|---------------|--------|
| chr11 | 3504321 | 3505321 | Inpp5j | TSS500 |
| chr11 | 3494375 | 3504321 | Inpp5j | body |
| chr11 | 3863403 | 3864403 | Osbp2 | TSS500 |
| chr11 | 3894598 | 3895598 | 4921536K21Rik | TSS500 |
| chr11 | 3886088 | 3894598 | 4921536K21Rik | body |
| chr11 | 3894740 | 3895740 | Dusp18 | TSS500 |
| chr11 | 3937541 | 3976278 | 4930556J24Rik | body |
| chr11 | 3983136 | 3984136 | Gal3st1 | TSS500 |
| chr11 | 3984136 | 3999326 | Gal3st1 | body |
| chr11 | 4065341 | 4077736 | Sec14l3 | body |
| chr11 | 4274589 | 4281931 | Gm11959 | body |
| chr11 | 4629511 | 4630511 | Gm11961 | TSS500 |
| chr11 | 4746278 | 4747278 | Cabp7 | TSS500 |
| chr11 | 4736892 | 4746278 | Cabp7 | body |
| chr11 | 4947564 | 4948564 | Nefh | TSS500 |
| chr11 | 4938754 | 4947564 | Nefh | body |
| chr11 | 5057628 | 5058628 | Rasl10a | TSS500 |
| chr11 | 5151757 | 5152757 | Emid1 | TSS500 |
| chr11 | 5106265 | 5151757 | Emid1 | body |
| chr11 | 5528887 | 5541687 | Ccdc117 | body |
| chr11 | 5570184 | 5689337 | Ankrd36 | body |
| chr11 | 5703983 | 5715180 | Mrps24 | body |
| chr11 | 5801640 | 5803233 | Pgam2 | body |
| chr11 | 5900820 | 5949581 | Gck | body |
| chr11 | 5956193 | 5967780 | Ykt6 | body |
| chr11 | 6229643 | 6230643 | Npc1l1 | TSS500 |
| chr11 | 6270369 | 6274370 | Tmed4 | body |
| chr11 | 6292133 | 6356642 | Ogdh | body |
| chr11 | 6389574 | 6406158 | Zmiz2 | body |
| chr11 | 6467599 | 6475417 | Purb | body |
| chr11 | 6638137 | 6639137 | Wap | TSS500 |
| chr11 | 6635482 | 6638137 | Wap | body |
| chr11 | 6658021 | 6659021 | Ramp3 | TSS500 |
| chr11 | 7062989 | 7063989 | Adcy1 | TSS500 |
| chr11 | 7063989 | 7178506 | Adcy1 | body |
| chr11 | 7213423 | 7214423 | Igfbp3 | TSS500 |
| chr11 | 7206086 | 7213423 | Igfbp3 | body |
| chr11 | 8431652 | 8664035 | Tns3 | body |
| chr11 | 8972766 | 8973766 | Pkd1l1 | TSS500 |
| chr11 | 8993137 | 9010691 | Hus1 | body |
| chr11 | 9016054 | 9048491 | Sun3 | body |
| chr11 | 9049094 | 9069356 | Gm11992 | body |
| chr11 | 9191442 | 9192442 | Abca13 | TSS500 |
| chr11 | 9192442 | 9684259 | Abca13 | body |

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|-------|----------|----------|---------------|--------|
| chr11 | 11113723 | 11114723 | Vwc2 | TSS500 |
| chr11 | 11461908 | 11462908 | Zpbp | TSS500 |
| chr11 | 11461594 | 11462594 | 4930415F15Rik | TSS500 |
| chr11 | 11462594 | 11515192 | 4930415F15Rik | body |
| chr11 | 11556921 | 11557921 | Gm11998 | TSS500 |
| chr11 | 11557921 | 11579460 | Gm11998 | body |
| chr11 | 11589223 | 11627335 | 4930512M02Rik | body |
| chr11 | 11684503 | 11685503 | Ikzf1 | TSS500 |
| chr11 | 11685503 | 11772926 | Ikzf1 | body |
| chr11 | 11814101 | 11897644 | Ddc | body |
| chr11 | 11867623 | 11868623 | 1700042O10Rik | TSS500 |
| chr11 | 11868623 | 11885321 | 1700042O10Rik | body |
| chr11 | 12038183 | 12039183 | Grb10 | TSS500 |
| chr11 | 12464460 | 12465460 | Cobl | TSS500 |
| chr11 | 12236608 | 12464460 | Cobl | body |
| chr11 | 12315014 | 12351028 | Gm12002 | body |
| chr11 | 14072103 | 14178541 | 4930554G24Rik | body |
| chr11 | 16257224 | 16258224 | Vstm2a | TSS500 |
| chr11 | 16500530 | 16507984 | Sec61g | body |
| chr11 | 17051086 | 17052086 | Cnrip1 | TSS500 |
| chr11 | 17954470 | 17959578 | Etaa1os | body |
| chr11 | 18595248 | 18709722 | Gm12023 | body |
| chr11 | 19009628 | 19011183 | Gm16140 | body |
| chr11 | 21572735 | 21898989 | Wdpcp | body |
| chr11 | 22002397 | 22003397 | Otx1 | TSS500 |
| chr11 | 21994764 | 22002397 | Otx1 | body |
| chr11 | 22484108 | 22491363 | Gm12051 | body |
| chr11 | 22860461 | 22861461 | B3gnt2 | TSS500 |
| chr11 | 22896136 | 22981882 | Commd1 | body |
| chr11 | 22972715 | 22973715 | Zrsr1 | TSS500 |
| chr11 | 23152640 | 23166375 | 1700061J23Rik | body |
| chr11 | 23487882 | 23497530 | Ahsa2 | body |
| chr11 | 23862646 | 23894753 | Papolg | body |
| chr11 | 23894060 | 23895060 | Gm12061 | TSS500 |
| chr11 | 24048955 | 24074554 | A830031A19Rik | body |
| chr11 | 24076059 | 24077059 | Gm12063 | TSS500 |
| chr11 | 24077556 | 24078556 | Bcl11a | TSS500 |
| chr11 | 24078556 | 24174123 | Bcl11a | body |
| chr11 | 24099688 | 24114905 | Gm12064 | body |
| chr11 | 24160528 | 24172324 | 4930538E20Rik | body |
| chr11 | 24201918 | 24217601 | Gm12066 | body |
| chr11 | 24426746 | 24722646 | Gm12068 | body |
| chr11 | 25233126 | 25367137 | 4933427E13Rik | body |
| chr11 | 26210263 | 26211263 | 5730522E02Rik | TSS500 |

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|-------|----------|----------|---------------|--------|
| chr11 | 25602763 | 26210263 | 5730522E02Rik | body |
| chr11 | 28339104 | 28339367 | Gm6685 | body |
| chr11 | 28583824 | 28584824 | Ccdc85a | TSS500 |
| chr11 | 28385685 | 28583824 | Ccdc85a | body |
| chr11 | 28752133 | 28815767 | Gm12082 | body |
| chr11 | 28852704 | 28853704 | Efemp1 | TSS500 |
| chr11 | 29525908 | 29526908 | Mtif2 | TSS500 |
| chr11 | 29743048 | 30025533 | Eml6 | body |
| chr11 | 30267675 | 30268675 | Sptbn1 | TSS500 |
| chr11 | 30426006 | 30471327 | 4930505A04Rik | body |
| chr11 | 30884858 | 30885858 | Gpr75 | TSS500 |
| chr11 | 31357307 | 31369574 | Stc2 | body |
| chr11 | 31871711 | 31872711 | Cpeb4 | TSS500 |
| chr11 | 31872711 | 31935634 | Cpeb4 | body |
| chr11 | 32205915 | 32208984 | Snrnp25 | body |
| chr11 | 32226005 | 32227005 | Mpg | TSS500 |
| chr11 | 32276900 | 32278116 | Hba-x | body |
| chr11 | 32531581 | 32532581 | Efcab9 | TSS500 |
| chr11 | 32925660 | 32926660 | Gm12111 | TSS500 |
| chr11 | 32903137 | 32925660 | Gm12111 | body |
| chr11 | 33069051 | 33080521 | Gm12114 | body |
| chr11 | 33146900 | 33147900 | Fgf18 | TSS500 |
| chr11 | 33117430 | 33146900 | Fgf18 | body |
| chr11 | 33203089 | 33204089 | Tlx3 | TSS500 |
| chr11 | 33200752 | 33203089 | Tlx3 | body |
| chr11 | 33203555 | 33204555 | Gm12116 | TSS500 |
| chr11 | 33513246 | 33514246 | Ranbp17 | TSS500 |
| chr11 | 33550781 | 33578459 | Gabrp | body |
| chr11 | 33599802 | 33625618 | D130052B06Rik | body |
| chr11 | 33992652 | 33993652 | Kcnip1 | TSS500 |
| chr11 | 33962513 | 33963513 | Kcnmb1 | TSS500 |
| chr11 | 34047420 | 34092295 | Lcp2 | body |
| chr11 | 34207589 | 34208589 | Foxi1 | TSS500 |
| chr11 | 34783392 | 34784392 | Dock2 | TSS500 |
| chr11 | 34226815 | 34783392 | Dock2 | body |
| chr11 | 34315322 | 34422640 | Fam196b | body |
| chr11 | 34809190 | 34833141 | Spdl1 | body |
| chr11 | 35120724 | 35121724 | Slit3 | TSS500 |
| chr11 | 35121724 | 35708507 | Slit3 | body |
| chr11 | 35798384 | 35799384 | Fbll1 | TSS500 |
| chr11 | 36006656 | 37235464 | Tenm2 | body |
| chr11 | 36277541 | 36278541 | Gm12127 | TSS500 |
| chr11 | 40008694 | 40337831 | Gm12132 | body |
| chr11 | 40694703 | 40695703 | Mat2b | TSS500 |

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|-------|----------|----------|----------|--------|
| chr11 | 40734167 | 40740046 | Nudcd2 | body |
| chr11 | 42182430 | 42183430 | Gabra1 | TSS500 |
| chr11 | 42130939 | 42182430 | Gabra1 | body |
| chr11 | 42420257 | 42629028 | Gabrb2 | body |
| chr11 | 43150377 | 43262285 | Atp10b | body |
| chr11 | 43197424 | 43259284 | Gm12146 | body |
| chr11 | 43473776 | 43474776 | C1qtnf2 | TSS500 |
| chr11 | 43528284 | 43529284 | Ccnjl | TSS500 |
| chr11 | 43529284 | 43586997 | Ccnjl | body |
| chr11 | 43729512 | 43747508 | Ttc1 | body |
| chr11 | 43774606 | 43900710 | Adra1b | body |
| chr11 | 43959589 | 44134987 | Gm12153 | body |
| chr11 | 44616817 | 44617817 | Ebf1 | TSS500 |
| chr11 | 44617817 | 45008091 | Ebf1 | body |
| chr11 | 45409042 | 45468004 | Gm12162 | body |
| chr11 | 46166008 | 46167008 | Nipal4 | TSS500 |
| chr11 | 46325150 | 46389015 | Itk | body |
| chr11 | 46397059 | 46407982 | Fam71b | body |
| chr11 | 46668960 | 46706561 | Timd2 | body |
| chr11 | 46811300 | 46844332 | Timd4 | body |
| chr11 | 48826640 | 48852209 | Trim7 | body |
| chr11 | 48904656 | 48991726 | Gm12185 | body |
| chr11 | 48945690 | 48946690 | Psme2b | TSS500 |
| chr11 | 49076087 | 49077087 | lfi47 | TSS500 |
| chr11 | 49077087 | 49096974 | lfi47 | body |
| chr11 | 49148759 | 49149212 | Olfr1395 | body |
| chr11 | 49609763 | 49652739 | Flt4 | body |
| chr11 | 49794678 | 49838613 | Gfpt2 | body |
| chr11 | 49846251 | 49847251 | Mapk9 | TSS500 |
| chr11 | 49847251 | 49886421 | Mapk9 | body |
| chr11 | 49901335 | 49902335 | Rasgef1c | TSS500 |
| chr11 | 49902335 | 49980994 | Rasgef1c | body |
| chr11 | 50024846 | 50025846 | Rnf130 | TSS500 |
| chr11 | 50025846 | 50104758 | Rnf130 | body |
| chr11 | 50199366 | 50210327 | Sqstm1 | body |
| chr11 | 50354962 | 50359699 | Cby3 | body |
| chr11 | 50601584 | 50602584 | Adamts2 | TSS500 |
| chr11 | 50851185 | 50866208 | Grm6 | body |
| chr11 | 50851332 | 50852082 | Gm12660 | body |
| chr11 | 50872720 | 50887151 | Zfp454 | body |
| chr11 | 51027504 | 51027945 | Olfr54 | body |
| chr11 | 51290420 | 51583918 | Col23a1 | body |
| chr11 | 51600100 | 51606347 | Hnrnpab | body |
| chr11 | 52269014 | 52270014 | Gm26551 | TSS500 |

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|-------|----------|----------|---------------|--------|
| chr11 | 52252371 | 52282514 | Tcf7 | body |
| chr11 | 52276555 | 52286179 | A630014C17Rik | body |
| chr11 | 52765134 | 53188538 | Fstl4 | body |
| chr11 | 53119556 | 53120556 | Gm11186 | TSS500 |
| chr11 | 53111451 | 53119556 | Gm11186 | body |
| chr11 | 53431523 | 53437904 | Gdf9 | body |
| chr11 | 53456610 | 53457610 | Gm10447 | TSS500 |
| chr11 | 53456705 | 53457705 | Shroom1 | TSS500 |
| chr11 | 53457705 | 53467766 | Shroom1 | body |
| chr11 | 53518757 | 53519757 | sept-08 | TSS500 |
| chr11 | 53566879 | 53567879 | Kif3a | TSS500 |
| chr11 | 53602982 | 53618169 | Il4 | body |
| chr11 | 53979832 | 53980832 | Slc22a21 | TSS500 |
| chr11 | 53949965 | 53979832 | Slc22a21 | body |
| chr11 | 54027590 | 54028590 | Slc22a4 | TSS500 |
| chr11 | 54249167 | 54250167 | Csf2 | TSS500 |
| chr11 | 54248100 | 54254495 | Gm12223 | body |
| chr11 | 54303298 | 54304298 | Acsl6 | TSS500 |
| chr11 | 54371152 | 54426790 | 4930404A10Rik | body |
| chr11 | 54717456 | 54787175 | Cdc42se2 | body |
| chr11 | 54826866 | 54860416 | Lym7 | body |
| chr11 | 54902953 | 54910377 | Gpx3 | body |
| chr11 | 55158470 | 55184577 | Slc36a2 | body |
| chr11 | 55191719 | 55197364 | Slc36a1os | body |
| chr11 | 55336064 | 55337064 | Fat2 | TSS500 |
| chr11 | 55607698 | 55608698 | Glra1 | TSS500 |
| chr11 | 55514238 | 55607698 | Glra1 | body |
| chr11 | 55772588 | 56070848 | Gm12239 | body |
| chr11 | 57010887 | 57011887 | Gria1 | TSS500 |
| chr11 | 57011887 | 57330244 | Gria1 | body |
| chr11 | 57623698 | 57648994 | 4933424L21Rik | body |
| chr11 | 57802137 | 57810217 | Sap30l | body |
| chr11 | 57832318 | 57833318 | Hand1 | TSS500 |
| chr11 | 57828705 | 57832318 | Hand1 | body |
| chr11 | 57972634 | 57973634 | Gm12249 | TSS500 |
| chr11 | 58199056 | 58200056 | Igtp | TSS500 |
| chr11 | 58200056 | 58207591 | Igtp | body |
| chr11 | 58199118 | 58200118 | Irgm2 | TSS500 |
| chr11 | 58379543 | 58390728 | Lypd8 | body |
| chr11 | 58446149 | 58452423 | 4930504O13Rik | body |
| chr11 | 58455000 | 58455447 | Olfr30 | body |
| chr11 | 58625073 | 58625544 | Olfr323 | body |
| chr11 | 58639965 | 58640965 | Trim58 | TSS500 |
| chr11 | 58640965 | 58652404 | Trim58 | body |

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|-------|----------|----------|---------------|--------|
| chr11 | 58778629 | 58779058 | Olfr315 | body |
| chr11 | 58785736 | 58786736 | Olfr314 | TSS500 |
| chr11 | 58918408 | 58927158 | Btnl10 | body |
| chr11 | 58954185 | 58955185 | Trim17 | TSS500 |
| chr11 | 58954185 | 58955185 | Hist3h2a | TSS500 |
| chr11 | 59155369 | 59163239 | Iba57 | body |
| chr11 | 59207821 | 59208821 | 2310033P09Rik | TSS500 |
| chr11 | 59290252 | 59291252 | Wnt3a | TSS500 |
| chr11 | 59661805 | 59780860 | Mprip | body |
| chr11 | 59964444 | 59965444 | Rasd1 | TSS500 |
| chr11 | 59963181 | 59964444 | Rasd1 | body |
| chr11 | 59970614 | 60045989 | Pemt | body |
| chr11 | 60222081 | 60223081 | Srebf1 | TSS500 |
| chr11 | 60226714 | 60352405 | Tom1l2 | body |
| chr11 | 60535881 | 60536881 | Alkbh5 | TSS500 |
| chr11 | 60714123 | 60726763 | Flii | body |
| chr11 | 60902246 | 60914250 | Natd1 | body |
| chr11 | 61022064 | 61023064 | Kcnj12 | TSS500 |
| chr11 | 61023064 | 61071131 | Kcnj12 | body |
| chr11 | 61127255 | 61149372 | Tnfrsf13b | body |
| chr11 | 61208037 | 61218421 | Aldh3a1 | body |
| chr11 | 61342360 | 61343360 | Slc47a2 | TSS500 |
| chr11 | 61377845 | 61378845 | Slc47a1 | TSS500 |
| chr11 | 61453631 | 61454631 | Rnf112 | TSS500 |
| chr11 | 61448442 | 61453631 | Rnf112 | body |
| chr11 | 61957279 | 62223013 | Specc1 | body |
| chr11 | 62248484 | 62249484 | Adora2b | TSS500 |
| chr11 | 62249484 | 62266453 | Adora2b | body |
| chr11 | 62550047 | 62550541 | Gm12279 | body |
| chr11 | 62604884 | 62648023 | Lrrc75a | body |
| chr11 | 62753377 | 62788962 | Zfp286 | body |
| chr11 | 62760736 | 62761736 | Zfp286os | TSS500 |
| chr11 | 62919079 | 62921092 | Tvp23bos | body |
| chr11 | 63921790 | 63922790 | Hs3st3b1 | TSS500 |
| chr11 | 63963726 | 63964726 | 9630013K17Rik | TSS500 |
| chr11 | 64435156 | 64436153 | F930015N05Rik | body |
| chr11 | 64434832 | 64435832 | Hs3st3a1 | TSS500 |
| chr11 | 65162461 | 65163461 | Arhgap44 | TSS500 |
| chr11 | 65269489 | 65270489 | Myocd | TSS500 |
| chr11 | 65277654 | 65365298 | Gm12295 | body |
| chr11 | 66168051 | 66169051 | Dnah9 | TSS500 |
| chr11 | 65831282 | 66168051 | Dnah9 | body |
| chr11 | 66211725 | 66525464 | Shisa6 | body |
| chr11 | 66905721 | 66946586 | Gm12298 | body |

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|-------|----------|----------|----------------|--------|
| chr11 | 66911481 | 66912481 | Pirt | TSS500 |
| chr11 | 67078800 | 67102291 | Myh3 | body |
| chr11 | 67099304 | 67100304 | Mir6923 | TSS500 |
| chr11 | 67171527 | 67197517 | Myh2 | body |
| chr11 | 67200552 | 67224575 | Myh1 | body |
| chr11 | 67237073 | 67238073 | Gm12300 | TSS500 |
| chr11 | 67454937 | 67455937 | Gas7 | TSS500 |
| chr11 | 67661502 | 67770653 | Glp2r | body |
| chr11 | 67798687 | 67816005 | Dhrs7c | body |
| chr11 | 67921653 | 67922653 | Usp43 | TSS500 |
| chr11 | 67924806 | 67965151 | Cfap52 | body |
| chr11 | 67966693 | 68207148 | Stx8 | body |
| chr11 | 68209364 | 68400323 | Ntn1 | body |
| chr11 | 68431621 | 68432621 | Pik3r5 | TSS500 |
| chr11 | 68555686 | 68556686 | Mfsd6l | TSS500 |
| chr11 | 68586457 | 68587457 | Ccdc42os | TSS500 |
| chr11 | 68586521 | 68587521 | Ccdc42 | TSS500 |
| chr11 | 68943155 | 68956980 | Arhgef15 | body |
| chr11 | 68990178 | 68991178 | Mir3062 | TSS500 |
| chr11 | 69120054 | 69122089 | 9130213A22Rik | body |
| chr11 | 69119904 | 69120904 | Hes7 | TSS500 |
| chr11 | 69156489 | 69157489 | Alox12b | TSS500 |
| chr11 | 69157489 | 69169792 | Alox12b | body |
| chr11 | 69183932 | 69197343 | Alox8 | body |
| chr11 | 69218117 | 69236536 | Gucy2e | body |
| chr11 | 69326758 | 69333042 | Kcnab3 | body |
| chr11 | 69331622 | 69332622 | Kcnab3os | TSS500 |
| chr11 | 69329825 | 69331622 | Kcnab3os | body |
| chr11 | 69396519 | 69397734 | Tmem88 | body |
| chr11 | 69605442 | 69606442 | Atp1b2 | TSS500 |
| chr11 | 69622524 | 69623870 | Sat2 | body |
| chr11 | 69654814 | 69655814 | Sox15 | TSS500 |
| chr11 | 69682638 | 69691141 | Tnfsf13os | body |
| chr11 | 69682577 | 69695598 | Tnfsf12Tnfsf13 | body |
| chr11 | 69686250 | 69695349 | Tnfsf12 | body |
| chr11 | 69765412 | 69766412 | Zbtb4 | TSS500 |
| chr11 | 69796068 | 69801357 | Fgf11 | body |
| chr11 | 69803603 | 69805124 | Tmem102 | body |
| chr11 | 69820876 | 69821680 | Spem1 | body |
| chr11 | 69851005 | 69858230 | Tnk1 | body |
| chr11 | 69935296 | 69936296 | Ybx2 | TSS500 |
| chr11 | 69936296 | 69941605 | Ybx2 | body |
| chr11 | 69947688 | 69948688 | Slc2a4 | TSS500 |
| chr11 | 69942539 | 69947688 | Slc2a4 | body |

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|-------|----------|----------|---------------|--------|
| chr11 | 69965279 | 69967885 | Cldn7 | body |
| chr11 | 69981656 | 69990601 | Ctdnep1 | body |
| chr11 | 70093144 | 70106187 | Asgr2 | body |
| chr11 | 70229298 | 70230298 | Bcl6b | TSS500 |
| chr11 | 70224128 | 70229298 | Bcl6b | body |
| chr11 | 70235206 | 70239330 | Gm21988 | body |
| chr11 | 70254853 | 70255853 | Alox12 | TSS500 |
| chr11 | 70322128 | 70323128 | Alox12e | TSS500 |
| chr11 | 70315610 | 70322128 | Alox12e | body |
| chr11 | 70344152 | 70351531 | Alox15 | body |
| chr11 | 70458933 | 70459933 | Zmynd15 | TSS500 |
| chr11 | 70459933 | 70466202 | Zmynd15 | body |
| chr11 | 70514116 | 70515116 | Vmo1 | TSS500 |
| chr11 | 70540564 | 70558110 | Pld2 | body |
| chr11 | 70614883 | 70618716 | Chrne | body |
| chr11 | 70615348 | 70616348 | 4930544D05Rik | TSS500 |
| chr11 | 70623027 | 70625061 | Gm12315 | body |
| chr11 | 70657702 | 70662513 | Eno3 | body |
| chr11 | 70669463 | 70687605 | Camta2 | body |
| chr11 | 70763709 | 70764709 | Zfp3 | TSS500 |
| chr11 | 70812086 | 70813086 | Scimp | TSS500 |
| chr11 | 70845278 | 70943105 | Rabep1 | body |
| chr11 | 70969713 | 70970713 | Rpain | TSS500 |
| chr11 | 70977836 | 70982526 | C1qbp | body |
| chr11 | 71007164 | 71019341 | Derl2 | body |
| chr11 | 71092236 | 71144204 | Nlrp1a | body |
| chr11 | 71153102 | 71230233 | Nlrp1b | body |
| chr11 | 71739966 | 71740966 | Gm12326 | TSS500 |
| chr11 | 71750420 | 71789647 | Wscd1 | body |
| chr11 | 71928471 | 71939622 | 4930401O10Rik | body |
| chr11 | 72027963 | 72037009 | Aipl1 | body |
| chr11 | 72047528 | 72135278 | Pitpnm3 | body |
| chr11 | 72153929 | 72206959 | 4933427D14Rik | body |
| chr11 | 72313944 | 72314944 | Fbxo39 | TSS500 |
| chr11 | 72361942 | 72362942 | Tekt1 | TSS500 |
| chr11 | 72344722 | 72361942 | Tekt1 | body |
| chr11 | 72489404 | 72490404 | Spns2 | TSS500 |
| chr11 | 72451638 | 72489404 | Spns2 | body |
| chr11 | 72607783 | 72686481 | Ube2g1 | body |
| chr11 | 72961669 | 72993044 | Atp2a3 | body |
| chr11 | 73135485 | 73137794 | Gsg2 | body |
| chr11 | 73159921 | 73160921 | P2rx5 | TSS500 |
| chr11 | 73234792 | 73261242 | Trpv1 | body |
| chr11 | 73304992 | 73329096 | Aspa | body |

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| chr11 | 73689278 | 73713798 | Zfp735 | body |
| chr11 | 74070455 | 74087292 | Zfp616 | body |
| chr11 | 74589686 | 74590686 | Rap1gap2 | TSS500 |
| chr11 | 74383356 | 74589686 | Rap1gap2 | body |
| chr11 | 74620105 | 74641516 | E130309D14Rik | body |
| chr11 | 74867694 | 74868694 | Mir6926 | TSS500 |
| chr11 | 74898571 | 74909342 | Tsr1 | body |
| chr11 | 75038848 | 75039848 | Gm12333 | TSS500 |
| chr11 | 75169019 | 75170019 | Hic1 | TSS500 |
| chr11 | 75194283 | 75267769 | Rtn4rl1 | body |
| chr11 | 75409769 | 75422201 | Serpinf1 | body |
| chr11 | 75510594 | 75513168 | Rilp | body |
| chr11 | 75532194 | 75577575 | Slc43a2 | body |
| chr11 | 75679759 | 75706908 | Crk | body |
| chr11 | 75795549 | 75796549 | Doc2b | TSS500 |
| chr11 | 75768966 | 75795549 | Doc2b | body |
| chr11 | 75999412 | 76000412 | 1700016K19Rik | TSS500 |
| chr11 | 76120987 | 76243225 | Glod4 | body |
| chr11 | 76621814 | 76622814 | Abr | TSS500 |
| chr11 | 76416734 | 76621814 | Abr | body |
| chr11 | 76671970 | 76672970 | Bhlha9 | TSS500 |
| chr11 | 76680308 | 76698664 | Tusc5 | body |
| chr11 | 76778424 | 76846518 | Cpd | body |
| chr11 | 77009373 | 77010373 | Gm12343 | TSS500 |
| chr11 | 77077935 | 77078935 | Ccdc55 | TSS500 |
| chr11 | 77077672 | 77078672 | Mir423 | TSS500 |
| chr11 | 77515480 | 77516480 | Trp53i13 | TSS500 |
| chr11 | 77515621 | 77538607 | Abhd15 | body |
| chr11 | 77686655 | 77741921 | Nufip2 | body |
| chr11 | 77785453 | 77787247 | Gm10277 | body |
| chr11 | 77880615 | 77893596 | Pipox | body |
| chr11 | 77930300 | 77931300 | Sez6 | TSS500 |
| chr11 | 77931300 | 77979048 | Sez6 | body |
| chr11 | 78095160 | 78156700 | Fam222b | body |
| chr11 | 78188930 | 78192193 | Rab34 | body |
| chr11 | 78342982 | 78343982 | Unc119 | TSS500 |
| chr11 | 78343982 | 78349164 | Unc119 | body |
| chr11 | 78357577 | 78386058 | Foxn1 | body |
| chr11 | 78465197 | 78466197 | Slc46a1 | TSS500 |
| chr11 | 78512693 | 78522736 | Poldip2 | body |
| chr11 | 78826084 | 78827084 | Lym9 | TSS500 |
| chr11 | 78827084 | 78846870 | Lym9 | body |
| chr11 | 78921287 | 78960254 | Nos2 | body |
| chr11 | 78962974 | 78984446 | Lgals9 | body |

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|-------|----------|----------|---------------|--------|
| chr11 | 79590712 | 79591712 | Rab11fip4 | TSS500 |
| chr11 | 79591712 | 79698023 | Rab11fip4 | body |
| chr11 | 79670372 | 79674628 | Rab11fip4os2 | body |
| chr11 | 79704130 | 79705130 | Gm11205 | TSS500 |
| chr11 | 79705130 | 79705420 | Gm11205 | body |
| chr11 | 79993606 | 80034123 | Suz12 | body |
| chr11 | 80089900 | 80135794 | Atad5 | body |
| chr11 | 80153605 | 80154605 | Adap2 | TSS500 |
| chr11 | 80154605 | 80178958 | Adap2 | body |
| chr11 | 80184351 | 80199757 | Rnf135 | body |
| chr11 | 80377534 | 80378534 | 5730455P16Rik | TSS500 |
| chr11 | 80360492 | 80377534 | 5730455P16Rik | body |
| chr11 | 80809675 | 80810675 | Tmem98 | TSS500 |
| chr11 | 80810675 | 80822033 | Tmem98 | body |
| chr11 | 80858865 | 80867814 | Spaca3 | body |
| chr11 | 81967957 | 81968957 | Asic2 | TSS500 |
| chr11 | 80880169 | 81967957 | Asic2 | body |
| chr11 | 82176657 | 82305190 | Ccl1 | body |
| chr11 | 82388400 | 82389400 | Tmem132e | TSS500 |
| chr11 | 82719250 | 82763821 | Cct6b | body |
| chr11 | 82890114 | 82891114 | Rad51d | TSS500 |
| chr11 | 82876434 | 82890114 | Rad51d | body |
| chr11 | 82911050 | 82943403 | Unc45b | body |
| chr11 | 82991330 | 82992330 | Slfn9 | TSS500 |
| chr11 | 83002158 | 83020310 | Slfn8 | body |
| chr11 | 83440768 | 83462571 | Mmp28 | body |
| chr11 | 83473586 | 83506743 | Taf15 | body |
| chr11 | 83647844 | 83648855 | Ccl3 | body |
| chr11 | 83849563 | 83850563 | Hnf1b | TSS500 |
| chr11 | 83850563 | 83905819 | Hnf1b | body |
| chr11 | 84525035 | 84526035 | Lhx1 | TSS500 |
| chr11 | 84525160 | 84526160 | Lhx1os | TSS500 |
| chr11 | 84763855 | 84777329 | Gm11431 | body |
| chr11 | 84957286 | 84958286 | Car4 | TSS500 |
| chr11 | 85169904 | 85170904 | 1700125H20Rik | TSS500 |
| chr11 | 85187262 | 85234630 | Appbp2 | body |
| chr11 | 85353667 | 85826058 | Bcas3 | body |
| chr11 | 85766831 | 85775180 | Bcas3os2 | body |
| chr11 | 85832051 | 85833051 | Tbx2 | TSS500 |
| chr11 | 85833051 | 85841948 | Tbx2 | body |
| chr11 | 85846790 | 85849833 | Gm11444 | body |
| chr11 | 85886922 | 85916097 | Tbx4 | body |
| chr11 | 86201870 | 86304443 | Brip1os | body |
| chr11 | 86257075 | 86258075 | Ints2 | TSS500 |

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| chr11 | 86267033 | 86357102 | Med13 | body |
| chr11 | 86583865 | 86683336 | Vmp1 | body |
| chr11 | 86807246 | 86808246 | Dhx40 | TSS500 |
| chr11 | 86936425 | 86993207 | Ypel2 | body |
| chr11 | 87109734 | 87124635 | Ska2 | body |
| chr11 | 87121567 | 87126458 | Gm11491 | body |
| chr11 | 87358523 | 87359523 | Ppm1e | TSS500 |
| chr11 | 87405565 | 87555823 | Tex14 | body |
| chr11 | 87569403 | 87590539 | sept-04 | body |
| chr11 | 87616664 | 87617664 | Hsf5 | TSS500 |
| chr11 | 87617664 | 87659542 | Hsf5 | body |
| chr11 | 87663222 | 87735539 | Rnf43 | body |
| chr11 | 87761041 | 87785928 | Bzrap1 | body |
| chr11 | 87794081 | 87804413 | Mpo | body |
| chr11 | 87795784 | 87800644 | Gm11505 | body |
| chr11 | 87827789 | 87828789 | Lpo | TSS500 |
| chr11 | 87806428 | 87827789 | Lpo | body |
| chr11 | 87864000 | 87875036 | Epx | body |
| chr11 | 88068779 | 88084729 | Vezf1 | body |
| chr11 | 88098558 | 88194140 | Cuedc1 | body |
| chr11 | 88905428 | 88906428 | Scpep1os | TSS500 |
| chr11 | 89065229 | 89069098 | Dgkeos | body |
| chr11 | 89301832 | 89302832 | Nog | TSS500 |
| chr11 | 89300638 | 89301832 | Nog | body |
| chr11 | 89302223 | 89303223 | Gm2018 | TSS500 |
| chr11 | 89390223 | 89418448 | 4932411E22Rik | body |
| chr11 | 89420987 | 89639131 | Ankfn1 | body |
| chr11 | 90002394 | 90003394 | Pctp | TSS500 |
| chr11 | 89982665 | 90002394 | Pctp | body |
| chr11 | 90029848 | 90030848 | Tmem100 | TSS500 |
| chr11 | 90030848 | 90036508 | Tmem100 | body |
| chr11 | 90187184 | 90188184 | Mmd | TSS500 |
| chr11 | 90336536 | 90390395 | Hlf | body |
| chr11 | 90637584 | 90638584 | Stxbp4 | TSS500 |
| chr11 | 90638673 | 90644931 | Cox11 | body |
| chr11 | 90687866 | 90688866 | Tom11 | TSS500 |
| chr11 | 91577058 | 91578058 | Kif2b | TSS500 |
| chr11 | 91575315 | 91577058 | Kif2b | body |
| chr11 | 93097528 | 93098528 | Car10 | TSS500 |
| chr11 | 93859243 | 93885266 | Utp18 | body |
| chr11 | 93886352 | 93946985 | Mbtd1 | body |
| chr11 | 93996591 | 94126085 | Spag9 | body |
| chr11 | 94211954 | 94215495 | Tob1 | body |
| chr11 | 94235956 | 94245505 | Wfikkn2 | body |

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|-------|----------|----------|---------------|--------|
| chr11 | 94343295 | 94392497 | Abcc3 | body |
| chr11 | 94408391 | 94473698 | Cacna1g | body |
| chr11 | 94499474 | 94500474 | Epn3 | TSS500 |
| chr11 | 94489599 | 94499474 | Epn3 | body |
| chr11 | 94521242 | 94522242 | Mycbpap | TSS500 |
| chr11 | 94501347 | 94521242 | Mycbpap | body |
| chr11 | 94557102 | 94601371 | Acsf2 | body |
| chr11 | 94565547 | 94569127 | Chad | body |
| chr11 | 94663851 | 94677015 | Xylt2 | body |
| chr11 | 94936724 | 94953042 | Col1a1 | body |
| chr11 | 95033259 | 95038283 | Gm11513 | body |
| chr11 | 95145763 | 95146763 | Dlx4 | TSS500 |
| chr11 | 95140447 | 95145763 | Dlx4 | body |
| chr11 | 95144552 | 95145552 | A730090H04Rik | TSS500 |
| chr11 | 95145552 | 95159047 | A730090H04Rik | body |
| chr11 | 95223290 | 95225132 | Gm11515 | body |
| chr11 | 95336908 | 95337908 | Gm11521 | TSS500 |
| chr11 | 95336518 | 95337518 | Fam117a | TSS500 |
| chr11 | 95413580 | 95414580 | Spop | TSS500 |
| chr11 | 95509845 | 95514070 | Nxph3 | body |
| chr11 | 95568818 | 95587235 | Ngfr | body |
| chr11 | 95622160 | 95623160 | Gm11528 | TSS500 |
| chr11 | 95667457 | 95680773 | Phb | body |
| chr11 | 95824999 | 95832140 | Phospho1 | body |
| chr11 | 95841976 | 95842976 | Abi3 | TSS500 |
| chr11 | 95830074 | 95841976 | Abi3 | body |
| chr11 | 95837716 | 95845734 | Gngt2 | body |
| chr11 | 95914391 | 95915391 | B4galnt2 | TSS500 |
| chr11 | 96005440 | 96006440 | Igf2bp1 | TSS500 |
| chr11 | 95957163 | 96005440 | Igf2bp1 | body |
| chr11 | 96005389 | 96006389 | Gm29202 | TSS500 |
| chr11 | 96006389 | 96008055 | Gm29202 | body |
| chr11 | 96111464 | 96112464 | Calcoco2 | TSS500 |
| chr11 | 96099326 | 96111464 | Calcoco2 | body |
| chr11 | 96194816 | 96197447 | Hoxb13 | body |
| chr11 | 96251605 | 96264868 | Gm53 | body |
| chr11 | 96271957 | 96276595 | Hoxb9 | body |
| chr11 | 96303836 | 96306121 | Hoxb5 | body |
| chr11 | 96323826 | 96347930 | Hoxb3 | body |
| chr11 | 96343072 | 96354191 | Hoxb3os | body |
| chr11 | 96365252 | 96366252 | Hoxb1 | TSS500 |
| chr11 | 96817414 | 96829468 | Nfe2l1 | body |
| chr11 | 96849893 | 96850893 | Mir152 | TSS500 |
| chr11 | 96928604 | 96937830 | Prr15l | body |

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|-------|-----------|-----------|---------------|--------|
| chr11 | 96943486 | 96944486 | Pnp0 | TSS500 |
| chr11 | 97013894 | 97024734 | Sp6 | body |
| chr11 | 97051128 | 97068904 | Osbpl7 | body |
| chr11 | 97098071 | 97114831 | Tbx21 | body |
| chr11 | 97136171 | 97150995 | Tbkbp1 | body |
| chr11 | 97280628 | 97282897 | Gm11592 | body |
| chr11 | 97332109 | 97351577 | Gpr179 | body |
| chr11 | 97363051 | 97398542 | Socs7 | body |
| chr11 | 97629202 | 97630202 | E130012A19Rik | TSS500 |
| chr11 | 97781937 | 97782937 | Rpl23 | TSS500 |
| chr11 | 97799500 | 97838764 | Lasp1 | body |
| chr11 | 97841280 | 97844099 | B230217C12Rik | body |
| chr11 | 97883654 | 97884654 | Fbxo47 | TSS500 |
| chr11 | 97985944 | 97986944 | Plxdc1 | TSS500 |
| chr11 | 97995681 | 97996681 | Arl5c | TSS500 |
| chr11 | 97989578 | 97995681 | Arl5c | body |
| chr11 | 98203559 | 98278504 | Cdk12 | body |
| chr11 | 98329148 | 98330148 | Neurod2 | TSS500 |
| chr11 | 98325415 | 98329148 | Neurod2 | body |
| chr11 | 98385950 | 98386950 | Pnmt | TSS500 |
| chr11 | 98446894 | 98455373 | Grb7 | body |
| chr11 | 98545531 | 98546531 | Ikzf3 | TSS500 |
| chr11 | 98551597 | 98558665 | Zbp2 | body |
| chr11 | 98581256 | 98586868 | Ormdl3 | body |
| chr11 | 98598791 | 98599073 | Gm12 | body |
| chr11 | 98625161 | 98626161 | Gm12355 | TSS500 |
| chr11 | 98928318 | 98974942 | Rara | body |
| chr11 | 98982516 | 98983516 | Gjd3 | TSS500 |
| chr11 | 98982180 | 98982516 | Gjd3 | body |
| chr11 | 99243585 | 99244585 | Krt222 | TSS500 |
| chr11 | 99279959 | 99284762 | Krt24 | body |
| chr11 | 99328550 | 99337466 | Krt26 | body |
| chr11 | 99350604 | 99351604 | Krt27 | TSS500 |
| chr11 | 99421759 | 99422759 | Krt12 | TSS500 |
| chr11 | 99417456 | 99425497 | A830036E02Rik | body |
| chr11 | 99492637 | 99493637 | Krt23 | TSS500 |
| chr11 | 100095741 | 100096741 | Krt35 | TSS500 |
| chr11 | 100092193 | 100095741 | Krt35 | body |
| chr11 | 100105771 | 100111606 | Gm12347 | body |
| chr11 | 100140810 | 100148165 | Krt19 | body |
| chr11 | 100186781 | 100192746 | Krt9 | body |
| chr11 | 100256217 | 100260529 | Krt17 | body |
| chr11 | 100269371 | 100270371 | Krt42 | TSS500 |
| chr11 | 100262882 | 100269371 | Krt42 | body |

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|-------|-----------|-----------|---------------|--------|
| chr11 | 100397263 | 100398263 | Jup | TSS500 |
| chr11 | 100368958 | 100397263 | Jup | body |
| chr11 | 100414336 | 100415336 | Leprel4 | TSS500 |
| chr11 | 100415197 | 100416197 | Fkbp10 | TSS500 |
| chr11 | 100476353 | 100527500 | Acly | body |
| chr11 | 100691955 | 100692955 | Zfp385c | TSS500 |
| chr11 | 100759442 | 100760442 | Kcnh4 | TSS500 |
| chr11 | 100761069 | 100762431 | Hcrt | body |
| chr11 | 100770457 | 100771457 | Ghdc | TSS500 |
| chr11 | 100766032 | 100770457 | Ghdc | body |
| chr11 | 101155407 | 101156407 | Tubg2 | TSS500 |
| chr11 | 101171023 | 101190724 | Cntnap1 | body |
| chr11 | 101172997 | 101174943 | Ccr10 | body |
| chr11 | 101245528 | 101246528 | Ramp2 | TSS500 |
| chr11 | 101260067 | 101261067 | Wnk4 | TSS500 |
| chr11 | 101285952 | 101301786 | Becn1 | body |
| chr11 | 101331105 | 101341938 | Aoc3 | body |
| chr11 | 101352937 | 101353937 | Gm25593 | TSS500 |
| chr11 | 101368061 | 101377903 | G6pc | body |
| chr11 | 101406664 | 101424296 | Gm27029 | body |
| chr11 | 101464499 | 101465499 | Rnd2 | TSS500 |
| chr11 | 101593743 | 101598756 | Gm11634 | body |
| chr11 | 101611114 | 101615956 | Gm11635 | body |
| chr11 | 101877510 | 101893874 | Meox1 | body |
| chr11 | 101886737 | 101891206 | Gm11551 | body |
| chr11 | 101962458 | 101966515 | Sost | body |
| chr11 | 101971143 | 101986513 | Dusp3 | body |
| chr11 | 102042009 | 102055620 | Cd300lg | body |
| chr11 | 102057015 | 102088015 | Mpp2 | body |
| chr11 | 102106676 | 102107332 | Pyy | body |
| chr11 | 102145013 | 102146013 | Nags | TSS500 |
| chr11 | 102146013 | 102149477 | Nags | body |
| chr11 | 102145746 | 102146746 | Gm11586 | TSS500 |
| chr11 | 102155904 | 102156904 | Tmem101 | TSS500 |
| chr11 | 102248382 | 102249382 | BC030867 | TSS500 |
| chr11 | 102289300 | 102296131 | Atxn7l3 | body |
| chr11 | 102376520 | 102377520 | Bloodlinc | TSS500 |
| chr11 | 102430815 | 102437048 | Grn | body |
| chr11 | 102447182 | 102448182 | Fam171a2 | TSS500 |
| chr11 | 102578961 | 102579961 | Gm11627 | TSS500 |
| chr11 | 102576398 | 102578961 | Gm11627 | body |
| chr11 | 102623916 | 102624916 | 2810433D01Rik | TSS500 |
| chr11 | 102760939 | 102761939 | Adam11 | TSS500 |
| chr11 | 102799579 | 102819200 | Gjc1 | body |

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|-------|-----------|-----------|---------------|--------|
| chr11 | 102836349 | 102838040 | Higd1b | body |
| chr11 | 102863837 | 103075903 | Gm26668 | body |
| chr11 | 102994047 | 103027833 | Dcakd | body |
| chr11 | 103101158 | 103102158 | Plcd3 | TSS500 |
| chr11 | 103101182 | 103102182 | Acbd4 | TSS500 |
| chr11 | 103102182 | 103112200 | Acbd4 | body |
| chr11 | 103116731 | 103119725 | Hexim1 | body |
| chr11 | 103132929 | 103139876 | Hexim2 | body |
| chr11 | 103170607 | 103171607 | Fmnl1 | TSS500 |
| chr11 | 103192396 | 103193396 | Gm20511 | TSS500 |
| chr11 | 103208058 | 103209058 | 1700023F06Rik | TSS500 |
| chr11 | 103198944 | 103208058 | 1700023F06Rik | body |
| chr11 | 103217932 | 103218932 | Spata32 | TSS500 |
| chr11 | 103345253 | 103350124 | Arhgap27os3 | body |
| chr11 | 103355201 | 103356201 | Arhgap27os2 | TSS500 |
| chr11 | 103362713 | 103363713 | Arhgap27os1 | TSS500 |
| chr11 | 103451955 | 103504097 | Lrrc37a | body |
| chr11 | 103638390 | 103639390 | Lyzl6 | TSS500 |
| chr11 | 103631070 | 103638390 | Lyzl6 | body |
| chr11 | 103649070 | 103650070 | Rprml | TSS500 |
| chr11 | 103749321 | 103750321 | Wnt9b | TSS500 |
| chr11 | 103773650 | 103774650 | Wnt3 | TSS500 |
| chr11 | 103774650 | 103817957 | Wnt3 | body |
| chr11 | 104132355 | 104133355 | Crhr1 | TSS500 |
| chr11 | 104133355 | 104175523 | Crhr1 | body |
| chr11 | 104231890 | 104332090 | Mapt | body |
| chr11 | 104333229 | 104468361 | Kansl1 | body |
| chr11 | 104686207 | 104753962 | Gm11639 | body |
| chr11 | 105126925 | 105140394 | Mettl2 | body |
| chr11 | 105177726 | 105180933 | 1700052K11Rik | body |
| chr11 | 105292143 | 105293143 | Mrc2 | TSS500 |
| chr11 | 105456235 | 105457235 | March10 | TSS500 |
| chr11 | 105933702 | 105952836 | Cyb561 | body |
| chr11 | 105968445 | 105989964 | Ace | body |
| chr11 | 106272472 | 106273472 | Smarcd2 | TSS500 |
| chr11 | 106277172 | 106288745 | Tcam1 | body |
| chr11 | 106318592 | 106352788 | Scn4a | body |
| chr11 | 106364972 | 106365972 | 2310007L24Rik | TSS500 |
| chr11 | 106654217 | 106750128 | Pecam1 | body |
| chr11 | 106789752 | 106819930 | Cep95 | body |
| chr11 | 106972058 | 106972590 | Gm11707 | body |
| chr11 | 106999041 | 107000041 | Kpna2 | TSS500 |
| chr11 | 107025181 | 107026181 | Gm11705 | TSS500 |
| chr11 | 107207892 | 107470199 | Pitpnc1 | body |

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|-------|-----------|-----------|---------------|--------|
| chr11 | 107337550 | 107338550 | Gm11716 | TSS500 |
| chr11 | 107338550 | 107344804 | Gm11716 | body |
| chr11 | 107410890 | 107413549 | Gm11713 | body |
| chr11 | 107794057 | 107795057 | Cacng4 | TSS500 |
| chr11 | 108920849 | 108950783 | Axin2 | body |
| chr11 | 109363331 | 109401369 | Gna13 | body |
| chr11 | 109426446 | 109452813 | Amz2 | body |
| chr11 | 109450855 | 109473098 | Slc16a6 | body |
| chr11 | 109473874 | 109573330 | Arsg | body |
| chr11 | 109573331 | 109611467 | Wipi1 | body |
| chr11 | 109649905 | 109669656 | Prkar1a | body |
| chr11 | 109932190 | 109995345 | Abca8b | body |
| chr11 | 110167696 | 110168696 | Abca9 | TSS500 |
| chr11 | 110100749 | 110167696 | Abca9 | body |
| chr11 | 110251276 | 110252276 | Abca6 | TSS500 |
| chr11 | 110176820 | 110251276 | Abca6 | body |
| chr11 | 110968533 | 111027968 | Kcnj16 | body |
| chr11 | 111065664 | 111066664 | Kcnj2 | TSS500 |
| chr11 | 111066664 | 111076821 | Kcnj2 | body |
| chr11 | 112107938 | 112132196 | Gm11680 | body |
| chr11 | 112825654 | 112832469 | 4933434M16Rik | body |
| chr11 | 113209169 | 113210169 | 4732490B19Rik | TSS500 |
| chr11 | 113619842 | 113626028 | Sstr2 | body |
| chr11 | 113726850 | 113751381 | Cdc42ep4 | body |
| chr11 | 113776374 | 114066546 | Sdk2 | body |
| chr11 | 114219239 | 114238002 | Gm11690 | body |
| chr11 | 114252343 | 114253127 | Gm11691 | body |
| chr11 | 114726908 | 114727908 | Dnaic2 | TSS500 |
| chr11 | 114727908 | 114757889 | Dnaic2 | body |
| chr11 | 114764888 | 114765888 | Kif19a | TSS500 |
| chr11 | 114850652 | 114851652 | Gprc5c | TSS500 |
| chr11 | 114851652 | 114872617 | Gprc5c | body |
| chr11 | 114922781 | 114933886 | Cd300lb | body |
| chr11 | 114982274 | 114989422 | Cd300ld | body |
| chr11 | 115090931 | 115091931 | Rab37 | TSS500 |
| chr11 | 115116214 | 115133492 | Cd300lf | body |
| chr11 | 115163841 | 115181181 | Slc9a3r1 | body |
| chr11 | 115249169 | 115266743 | Grin2c | body |
| chr11 | 115297163 | 115298163 | Fads6 | TSS500 |
| chr11 | 115307663 | 115332303 | Otop2 | body |
| chr11 | 115321541 | 115322541 | Ush1g | TSS500 |
| chr11 | 115315192 | 115321541 | Ush1g | body |
| chr11 | 115415689 | 115419462 | Atp5h | body |
| chr11 | 115497353 | 115513887 | Hn1 | body |

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| chr11 | 115523102 | 115535776 | Sumo2 | body |
| chr11 | 115604425 | 115608036 | Mrps7 | body |
| chr11 | 115627795 | 115628795 | Slc25a19 | TSS500 |
| chr11 | 115614962 | 115615962 | Gm26613 | TSS500 |
| chr11 | 115815224 | 115823094 | Tsen54 | body |
| chr11 | 115824549 | 115855780 | Llgl2 | body |
| chr11 | 115892595 | 115932977 | Recql5 | body |
| chr11 | 115899466 | 115900466 | Smim5 | TSS500 |
| chr11 | 115946450 | 115951605 | Sap30bpos | body |
| chr11 | 115975209 | 116008412 | Itgb4 | body |
| chr11 | 115993215 | 115994215 | B230344G16Rik | TSS500 |
| chr11 | 116027462 | 116028462 | H3f3b | TSS500 |
| chr11 | 116078573 | 116086495 | Wbp2 | body |
| chr11 | 116199355 | 116215318 | Ten1 | body |
| chr11 | 116280439 | 116281439 | Galr2 | TSS500 |
| chr11 | 116281439 | 116283938 | Galr2 | body |
| chr11 | 116330704 | 116334899 | Foxj1 | body |
| chr11 | 116434594 | 116439077 | Ubal2 | body |
| chr11 | 116465819 | 116466819 | Gm11739 | TSS500 |
| chr11 | 116493702 | 116494702 | Prpsap1 | TSS500 |
| chr11 | 116529215 | 116532577 | Gm29292 | body |
| chr11 | 116530425 | 116531425 | Sphk1 | TSS500 |
| chr11 | 116531425 | 116536674 | Sphk1 | body |
| chr11 | 116653813 | 116654813 | Cygb | TSS500 |
| chr11 | 116653034 | 116654034 | Gm11744 | TSS500 |
| chr11 | 116654034 | 116668389 | Gm11744 | body |
| chr11 | 116671160 | 116672160 | 1810032O08Rik | TSS500 |
| chr11 | 116694368 | 116695368 | St6galnac2 | TSS500 |
| chr11 | 116675303 | 116694368 | St6galnac2 | body |
| chr11 | 116803062 | 116827546 | Mxra7 | body |
| chr11 | 116918363 | 116919363 | Mgat5b | TSS500 |
| chr11 | 117199161 | 117200161 | sept-09 | TSS500 |
| chr11 | 117200161 | 117362325 | sept-09 | body |
| chr11 | 117414889 | 117415368 | Gm11729 | body |
| chr11 | 117483868 | 117484868 | Gm11733 | TSS500 |
| chr11 | 117484868 | 117489014 | Gm11733 | body |
| chr11 | 117523103 | 117524103 | Gm11734 | TSS500 |
| chr11 | 117790813 | 117791813 | Gm11724 | TSS500 |
| chr11 | 117810168 | 117839904 | Gm20708 | body |
| chr11 | 117810168 | 117814283 | Syng2 | body |
| chr11 | 117826424 | 117839908 | Afmid | body |
| chr11 | 117872981 | 117873981 | Tha1 | TSS500 |
| chr11 | 117867952 | 117872981 | Tha1 | body |
| chr11 | 118392751 | 118401592 | Lgals3bp | body |

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| chr11 | 118427703 | 118428703 | C1qtnf1 | TSS500 |
| chr11 | 118428703 | 118449963 | C1qtnf1 | body |
| chr11 | 118477329 | 118489209 | Engase | body |
| chr11 | 118489762 | 118911097 | Rbfox3 | body |
| chr11 | 118791872 | 118793828 | Gm11750 | body |
| chr11 | 118987688 | 118988688 | Enpp7 | TSS500 |
| chr11 | 119036305 | 119040469 | Cbx8 | body |
| chr11 | 119110925 | 119111925 | Gm11754 | TSS500 |
| chr11 | 119123011 | 119137921 | Gm11755 | body |
| chr11 | 119227999 | 119228999 | Tbc1d16 | TSS500 |
| chr11 | 119219660 | 119220660 | Gm11752 | TSS500 |
| chr11 | 119267387 | 119268387 | Gaa | TSS500 |
| chr11 | 119547253 | 119548253 | Nptx1 | TSS500 |
| chr11 | 119538719 | 119547253 | Nptx1 | body |
| chr11 | 119912941 | 119913941 | Chmp6 | TSS500 |
| chr11 | 119913941 | 119919548 | Chmp6 | body |
| chr11 | 119935803 | 119942198 | Gm11767 | body |
| chr11 | 120046667 | 120047667 | Aatk | TSS500 |
| chr11 | 120067738 | 120068738 | Gm25948 | TSS500 |
| chr11 | 120150846 | 120151846 | Slc38a10 | TSS500 |
| chr11 | 120361034 | 120362034 | Fscn2 | TSS500 |
| chr11 | 120380370 | 120437208 | Nploc4 | body |
| chr11 | 120526855 | 120531284 | Gm11789 | body |
| chr11 | 120530199 | 120531199 | Gcgr | TSS500 |
| chr11 | 120549979 | 120550632 | Ppp1r27 | body |
| chr11 | 120560298 | 120572753 | P4hb | body |
| chr11 | 120578104 | 120581124 | Arhgdia | body |
| chr11 | 120617436 | 120618436 | Pcyt2 | TSS500 |
| chr11 | 120647658 | 120648658 | Myadml2 | TSS500 |
| chr11 | 120648170 | 120657061 | Myadml2os | body |
| chr11 | 120660675 | 120661675 | Notum | TSS500 |
| chr11 | 120653788 | 120660675 | Notum | body |
| chr11 | 120659657 | 120661815 | Notumos | body |
| chr11 | 120673473 | 120709447 | Aspscr1 | body |
| chr11 | 120689146 | 120708947 | Gm17178 | body |
| chr11 | 120720970 | 120721970 | Rac3 | TSS500 |
| chr11 | 120763294 | 120764419 | Hmga1-rs1 | body |
| chr11 | 120948980 | 120960868 | Slc16a3 | body |
| chr11 | 120961749 | 120990830 | Csnk1d | body |
| chr11 | 120963344 | 120964344 | Gm28192 | TSS500 |
| chr11 | 121053458 | 121063069 | Sectm1b | body |
| chr11 | 121145643 | 121146643 | Tex19.1 | TSS500 |
| chr11 | 121237753 | 121255856 | Narf | body |
| chr11 | 121434413 | 121435413 | Fn3k | TSS500 |

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| chr11 | 121702044 | 121716306 | Metrn1 | body |
| chr11 | 121829603 | 121830603 | Gm15643 | TSS500 |
| chr11 | 121829747 | 121830747 | Ptchd3 | TSS500 |
| chr11 | 121883363 | 121884363 | Gm12590 | TSS500 |
| chr13 | 3360529 | 3361529 | Gm16505 | TSS500 |
| chr13 | 3538575 | 3566261 | Gdi2 | body |
| chr13 | 3633532 | 3634532 | Asb13 | TSS500 |
| chr13 | 3940688 | 3944849 | Ucn3 | body |
| chr13 | 4049511 | 4090422 | Akr1c14 | body |
| chr13 | 6648277 | 6649277 | Pfkp | TSS500 |
| chr13 | 8203366 | 8768747 | Adarb2 | body |
| chr13 | 9875486 | 10360344 | Chrm3 | body |
| chr13 | 10358979 | 10359979 | Gm26861 | TSS500 |
| chr13 | 11553103 | 12106445 | Ryr2 | body |
| chr13 | 12439415 | 12464444 | Lgals8 | body |
| chr13 | 12566383 | 12609526 | Ero1lb | body |
| chr13 | 12701862 | 12702862 | Gm2399 | TSS500 |
| chr13 | 13437102 | 13438102 | Nid1 | TSS500 |
| chr13 | 14063732 | 14199603 | Arid4b | body |
| chr13 | 14226438 | 14522726 | Hecw1 | body |
| chr13 | 14629745 | 14630745 | AW209491 | TSS500 |
| chr13 | 15463735 | 15730026 | Gli3 | body |
| chr13 | 17986640 | 17992851 | Yae1d1 | body |
| chr13 | 18121101 | 18381541 | Pou6f2 | body |
| chr13 | 18947871 | 18948871 | Amph | TSS500 |
| chr13 | 18948871 | 19150913 | Amph | body |
| chr13 | 19622675 | 19623675 | Sfrp4 | TSS500 |
| chr13 | 19697294 | 19698294 | Nme8 | TSS500 |
| chr13 | 21363327 | 21369824 | Zscan12 | body |
| chr13 | 21478407 | 21479407 | Zkscan4 | TSS500 |
| chr13 | 21478941 | 21479941 | Gm10065 | TSS500 |
| chr13 | 21611041 | 21611467 | Olfr1362 | body |
| chr13 | 21981694 | 21988734 | Pom121l2 | body |
| chr13 | 22002176 | 22009242 | Prss16 | body |
| chr13 | 22013968 | 22014968 | Gm11290 | TSS500 |
| chr13 | 22691799 | 22714987 | Gm11309 | body |
| chr13 | 23312900 | 23313900 | 4930557F10Rik | TSS500 |
| chr13 | 23276204 | 23312900 | 4930557F10Rik | body |
| chr13 | 23427975 | 23430522 | C230035l16Rik | body |
| chr13 | 23456992 | 23465401 | Btn1a1 | body |
| chr13 | 23477676 | 23488357 | Btn2a2 | body |
| chr13 | 23573696 | 23574696 | Hist1h2bf | TSS500 |
| chr13 | 23573970 | 23574970 | Hist1h2ad | TSS500 |
| chr13 | 23583742 | 23620624 | Hist1h2be | body |

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|-------|----------|----------|---------------|--------|
| chr13 | 23622002 | 23623002 | Hist1h1e | TSS500 |
| chr13 | 23710354 | 23711354 | Hfe | TSS500 |
| chr13 | 23760730 | 23761730 | Hist1h4a | TSS500 |
| chr13 | 23763217 | 23764217 | Hist1h1a | TSS500 |
| chr13 | 23933962 | 23934962 | Hist1h2aa | TSS500 |
| chr13 | 23990714 | 23991714 | Scgn | TSS500 |
| chr13 | 24327920 | 24477285 | Cmah | body |
| chr13 | 24631918 | 24638067 | C530050E15Rik | body |
| chr13 | 24844635 | 24845635 | D130043K22Rik | TSS500 |
| chr13 | 24943652 | 24990753 | Gpld1 | body |
| chr13 | 25056504 | 25210706 | Dcdc2a | body |
| chr13 | 26768173 | 26769619 | Hdgfl1 | body |
| chr13 | 28943548 | 28951671 | Gm26735 | body |
| chr13 | 29014899 | 29040336 | A330102I10Rik | body |
| chr13 | 30660499 | 30711231 | Dusp22 | body |
| chr13 | 30749726 | 30766927 | Irf4 | body |
| chr13 | 31328575 | 31330267 | Gm11374 | body |
| chr13 | 31371299 | 31408422 | Gm11375 | body |
| chr13 | 31558833 | 31559833 | A530084C06Rik | TSS500 |
| chr13 | 31556134 | 31558833 | A530084C06Rik | body |
| chr13 | 31557824 | 31558824 | Foxq1 | TSS500 |
| chr13 | 31558824 | 31560976 | Foxq1 | body |
| chr13 | 31565492 | 31582013 | 1700018A04Rik | body |
| chr13 | 31619668 | 31620369 | Gm11378 | body |
| chr13 | 31625316 | 31626316 | Foxf2 | TSS500 |
| chr13 | 31626316 | 31631403 | Foxf2 | body |
| chr13 | 31626043 | 31627043 | Gm27516 | TSS500 |
| chr13 | 31807191 | 31810643 | Foxc1 | body |
| chr13 | 32700827 | 32783454 | Mylk4 | body |
| chr13 | 32802538 | 32822609 | Wrnip1 | body |
| chr13 | 32802349 | 32803349 | D930007J09Rik | TSS500 |
| chr13 | 33149275 | 33159242 | Serpib9c | body |
| chr13 | 33965159 | 33988465 | Nqo2 | body |
| chr13 | 34077508 | 34078508 | Tubb2a | TSS500 |
| chr13 | 34129854 | 34130854 | Tubb2b | TSS500 |
| chr13 | 34344682 | 34345682 | Slc22a23 | TSS500 |
| chr13 | 34179158 | 34344682 | Slc22a23 | body |
| chr13 | 34652181 | 34653181 | Pxdc1 | TSS500 |
| chr13 | 34875994 | 34902877 | Prpf4b | body |
| chr13 | 34924909 | 34955875 | 4933417A18Rik | body |
| chr13 | 35893472 | 35905859 | Rpp40 | body |
| chr13 | 35959339 | 35970388 | Ppp1r3g | body |
| chr13 | 36725625 | 36733977 | Nrn1 | body |
| chr13 | 37345845 | 37419036 | Ly86 | body |

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| chr13 | 37421833 | 37434649 | Gm4035 | body |
| chr13 | 37777900 | 37778900 | Rreb1 | TSS500 |
| chr13 | 38345216 | 38346216 | Bmp6 | TSS500 |
| chr13 | 38961119 | 38966299 | 5033403F01Rik | body |
| chr13 | 40001882 | 40287511 | Ofcc1 | body |
| chr13 | 40704505 | 40707949 | Gm9979 | body |
| chr13 | 41025120 | 41079206 | Mak | body |
| chr13 | 41113807 | 41114807 | Sycp2l | TSS500 |
| chr13 | 41114807 | 41171684 | Sycp2l | body |
| chr13 | 41219905 | 41220905 | Elovl2 | TSS500 |
| chr13 | 41182495 | 41219905 | Elovl2 | body |
| chr13 | 41250360 | 41276574 | Smim13 | body |
| chr13 | 41606716 | 41641347 | Tmem170b | body |
| chr13 | 41763148 | 41847184 | Adtrp | body |
| chr13 | 42300770 | 42301770 | Edn1 | TSS500 |
| chr13 | 42787758 | 42788758 | Gm15810 | TSS500 |
| chr13 | 43171001 | 43172001 | Tbc1d7 | TSS500 |
| chr13 | 43402673 | 43480473 | Ranbp9 | body |
| chr13 | 43559691 | 43560691 | Mcur1 | TSS500 |
| chr13 | 43615210 | 43616210 | Rnf182 | TSS500 |
| chr13 | 43616210 | 43670945 | Rnf182 | body |
| chr13 | 43784607 | 43785607 | Cd83 | TSS500 |
| chr13 | 43785607 | 43803130 | Cd83 | body |
| chr13 | 44400436 | 44454803 | Gm27007 | body |
| chr13 | 44440212 | 44457569 | 1700029N11Rik | body |
| chr13 | 44728974 | 44729974 | Jarid2 | TSS500 |
| chr13 | 46175428 | 46190548 | Gm10113 | body |
| chr13 | 46417800 | 46418800 | Rbm24 | TSS500 |
| chr13 | 46418800 | 46431090 | Rbm24 | body |
| chr13 | 46501348 | 46502348 | Cap2 | TSS500 |
| chr13 | 47014350 | 47015350 | Nhlrc1 | TSS500 |
| chr13 | 47122220 | 47123220 | Rnf144b | TSS500 |
| chr13 | 47960330 | 48018108 | 4931429P17Rik | body |
| chr13 | 48262123 | 48263123 | A330033J07Rik | TSS500 |
| chr13 | 48044231 | 48262123 | A330033J07Rik | body |
| chr13 | 48260927 | 48261927 | Id4 | TSS500 |
| chr13 | 48261927 | 48264036 | Id4 | body |
| chr13 | 48662498 | 48663498 | Barx1 | TSS500 |
| chr13 | 48663498 | 48666507 | Barx1 | body |
| chr13 | 49147514 | 49148514 | Wnk2 | TSS500 |
| chr13 | 49036303 | 49147514 | Wnk2 | body |
| chr13 | 49583266 | 49592609 | Omd | body |
| chr13 | 51408118 | 51409118 | S1pr3 | TSS500 |
| chr13 | 51566584 | 51567584 | Shc3 | TSS500 |

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| chr13 | 51431041 | 51566584 | Shc3 | body |
| chr13 | 51972714 | 51973714 | Gm26651 | TSS500 |
| chr13 | 52582673 | 52583673 | Syk | TSS500 |
| chr13 | 53285624 | 53286624 | Ror2 | TSS500 |
| chr13 | 53472574 | 53473574 | Msx2 | TSS500 |
| chr13 | 54055158 | 54056158 | Drd1a | TSS500 |
| chr13 | 54051186 | 54055158 | Drd1a | body |
| chr13 | 54370849 | 54371849 | Cplx2 | TSS500 |
| chr13 | 54371849 | 54383917 | Cplx2 | body |
| chr13 | 54458837 | 54468349 | Thoc3 | body |
| chr13 | 54551218 | 54564935 | 4833439L19Rik | body |
| chr13 | 54592401 | 54610844 | Cltb | body |
| chr13 | 54749374 | 54750374 | Gprin1 | TSS500 |
| chr13 | 54736671 | 54749374 | Gprin1 | body |
| chr13 | 54766095 | 54767095 | Sncb | TSS500 |
| chr13 | 54758860 | 54766095 | Sncb | body |
| chr13 | 54789877 | 54796776 | Tspan17 | body |
| chr13 | 54948911 | 54949911 | Unc5a | TSS500 |
| chr13 | 54949911 | 55006018 | Unc5a | body |
| chr13 | 55099800 | 55100800 | Uimc1 | TSS500 |
| chr13 | 55105811 | 55134825 | Zfp346 | body |
| chr13 | 55319223 | 55321480 | Rab24 | body |
| chr13 | 55322555 | 55325271 | Preli1 | body |
| chr13 | 55329258 | 55330258 | Mxd3 | TSS500 |
| chr13 | 55325168 | 55329258 | Mxd3 | body |
| chr13 | 55370232 | 55384687 | Rgs14 | body |
| chr13 | 55400148 | 55414695 | Slc34a1 | body |
| chr13 | 55445834 | 55460925 | Grk6 | body |
| chr13 | 55463767 | 55464767 | Prr7 | TSS500 |
| chr13 | 55473429 | 55487611 | Dbn1 | body |
| chr13 | 55539319 | 55570620 | Fam193b | body |
| chr13 | 55775136 | 55784005 | 4930451E10Rik | body |
| chr13 | 55784068 | 55785068 | Catsper3 | TSS500 |
| chr13 | 55785068 | 55808998 | Catsper3 | body |
| chr13 | 55835692 | 55836692 | Pitx1 | TSS500 |
| chr13 | 55835595 | 55836595 | Gm28760 | TSS500 |
| chr13 | 55835360 | 55835595 | Gm28760 | body |
| chr13 | 56437855 | 56438855 | Slc25a48 | TSS500 |
| chr13 | 56703510 | 56742377 | Smad5 | body |
| chr13 | 57421195 | 57907814 | Spock1 | body |
| chr13 | 58113092 | 58114092 | Klhl3 | TSS500 |
| chr13 | 58004221 | 58113092 | Klhl3 | body |
| chr13 | 58022700 | 58023700 | Mir874 | TSS500 |
| chr13 | 58125879 | 58128056 | Hnrnpa0 | body |

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| chr13 | 58148277 | 58149277 | 1700066J03Rik | TSS500 |
| chr13 | 58157149 | 58158149 | Idnk | TSS500 |
| chr13 | 58806096 | 58807096 | Ntrk2 | TSS500 |
| chr13 | 58807096 | 59133970 | Ntrk2 | body |
| chr13 | 59449537 | 59584727 | Agtpbp1 | body |
| chr13 | 60601447 | 60602447 | Dapk1 | TSS500 |
| chr13 | 60602447 | 60763185 | Dapk1 | body |
| chr13 | 60842621 | 60863916 | 4930486L24Rik | body |
| chr13 | 61335955 | 61336955 | Gm27704 | TSS500 |
| chr13 | 61564631 | 61569627 | Cts3 | body |
| chr13 | 61803748 | 61804748 | Gm23739 | TSS500 |
| chr13 | 62130416 | 62173419 | Zfp808 | body |
| chr13 | 62382666 | 62383666 | Gm3604 | TSS500 |
| chr13 | 62382737 | 62383737 | Gm25933 | TSS500 |
| chr13 | 62857900 | 62858900 | Fbp2 | TSS500 |
| chr13 | 62836884 | 62857900 | Fbp2 | body |
| chr13 | 62864753 | 62887782 | Fbp1 | body |
| chr13 | 63573098 | 63574098 | Ptch1 | TSS500 |
| chr13 | 63508328 | 63573098 | Ptch1 | body |
| chr13 | 64058274 | 64088701 | Hsd17b3 | body |
| chr13 | 64128830 | 64129830 | Slc35d2 | TSS500 |
| chr13 | 64096310 | 64128830 | Slc35d2 | body |
| chr13 | 64248200 | 64249200 | 1810034E14Rik | TSS500 |
| chr13 | 64481246 | 64497292 | 1190003K10Rik | body |
| chr13 | 64737591 | 64903388 | Cntnap3 | body |
| chr13 | 65112482 | 65113482 | Hiatl1 | TSS500 |
| chr13 | 65279314 | 65304221 | Zfp369 | body |
| chr13 | 66244716 | 66264522 | Gm26754 | body |
| chr13 | 66519023 | 66520023 | Gm26806 | TSS500 |
| chr13 | 67424549 | 67451124 | Zfp874a | body |
| chr13 | 67491152 | 67525651 | Gm26965 | body |
| chr13 | 67552638 | 67553638 | Zfp748 | TSS500 |
| chr13 | 67538641 | 67552638 | Zfp748 | body |
| chr13 | 67553734 | 67564009 | 9430065F17Rik | body |
| chr13 | 67728619 | 67729619 | Zfp65 | TSS500 |
| chr13 | 67728762 | 67729762 | Zfp85os | TSS500 |
| chr13 | 67780254 | 67792512 | Zfp493 | body |
| chr13 | 67796594 | 67830485 | 4930525G20Rik | body |
| chr13 | 67833735 | 67843113 | Gm10037 | body |
| chr13 | 68999041 | 69000041 | Adcy2 | TSS500 |
| chr13 | 69497959 | 69533339 | Papd7 | body |
| chr13 | 69534246 | 69635780 | Nsun2 | body |
| chr13 | 69739397 | 69740397 | Ube2ql1 | TSS500 |
| chr13 | 69702835 | 69739397 | Ube2ql1 | body |

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|-------|----------|----------|---------------|--------|
| chr13 | 69809382 | 69810382 | Med10 | TSS500 |
| chr13 | 69809914 | 69815594 | Gm26819 | body |
| chr13 | 70727802 | 70841311 | Adamts16 | body |
| chr13 | 71963223 | 71964223 | lrx1 | TSS500 |
| chr13 | 71957921 | 71963223 | lrx1 | body |
| chr13 | 72628320 | 72629320 | lrx2 | TSS500 |
| chr13 | 72629320 | 72634198 | lrx2 | body |
| chr13 | 73259979 | 73260979 | lrx4 | TSS500 |
| chr13 | 73330509 | 73331509 | Mrpl36 | TSS500 |
| chr13 | 73467697 | 73516422 | Lpcat1 | body |
| chr13 | 73536247 | 73537247 | Slc6a3 | TSS500 |
| chr13 | 73626501 | 73627501 | Tert | TSS500 |
| chr13 | 73627501 | 73649041 | Tert | body |
| chr13 | 73679745 | 73704365 | Slc6a19 | body |
| chr13 | 73700326 | 73709850 | Slc6a19os | body |
| chr13 | 73847131 | 73848131 | Nkd2 | TSS500 |
| chr13 | 74122015 | 74166064 | Slc9a3 | body |
| chr13 | 74169805 | 74208200 | Exoc3 | body |
| chr13 | 74291831 | 74292831 | Ahrr | TSS500 |
| chr13 | 74211118 | 74291831 | Ahrr | body |
| chr13 | 74694286 | 74807421 | Cast | body |
| chr13 | 75089326 | 75090326 | Pcsk1 | TSS500 |
| chr13 | 75090326 | 75132498 | Pcsk1 | body |
| chr13 | 75968239 | 75998968 | Spata9 | body |
| chr13 | 79949506 | 80129968 | Gm28526 | body |
| chr13 | 80963230 | 80964230 | Gm4211 | TSS500 |
| chr13 | 80963388 | 81128864 | 9330111N05Rik | body |
| chr13 | 81064977 | 81065977 | Gm25241 | TSS500 |
| chr13 | 81095068 | 81632654 | Gpr98 | body |
| chr13 | 83891708 | 83928710 | 2810049E08Rik | body |
| chr13 | 85214780 | 85288529 | Rasa1 | body |
| chr13 | 88821972 | 89323223 | Edil3 | body |
| chr13 | 89541136 | 89611832 | Hapln1 | body |
| chr13 | 89742009 | 89743009 | Vcan | TSS500 |
| chr13 | 89655312 | 89742009 | Vcan | body |
| chr13 | 91742012 | 91786148 | Acot12 | body |
| chr13 | 92131156 | 92132156 | Rasgrf2 | TSS500 |
| chr13 | 92415017 | 92426724 | C030017D09Rik | body |
| chr13 | 92426396 | 92441658 | Ankrd34b | body |
| chr13 | 92483531 | 92484531 | Fam151b | TSS500 |
| chr13 | 92449622 | 92483531 | Fam151b | body |
| chr13 | 92794318 | 92795318 | Thbs4 | TSS500 |
| chr13 | 92751590 | 92794318 | Thbs4 | body |
| chr13 | 93040713 | 93144224 | Cmya5 | body |

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| chr13 | 93304257 | 93404129 | Homer1 | body |
| chr13 | 93616891 | 93637461 | Bhmt | body |
| chr13 | 93655720 | 93673802 | Bhmt2 | body |
| chr13 | 93673933 | 93674933 | Dmgdh | TSS500 |
| chr13 | 93706182 | 93718675 | AW495222 | body |
| chr13 | 94285357 | 94286357 | Scamp1 | TSS500 |
| chr13 | 94875102 | 94876102 | Otp | TSS500 |
| chr13 | 94876102 | 94885130 | Otp | body |
| chr13 | 95207612 | 95208612 | Gm16243 | TSS500 |
| chr13 | 95431371 | 95444331 | Crhbp | body |
| chr13 | 95524740 | 95525740 | F2r1 | TSS500 |
| chr13 | 95511732 | 95524740 | F2r1 | body |
| chr13 | 95891422 | 95892422 | lqgap2 | TSS500 |
| chr13 | 95627177 | 95891422 | lqgap2 | body |
| chr13 | 96132077 | 96133077 | Sv2c | TSS500 |
| chr13 | 95959443 | 96132077 | Sv2c | body |
| chr13 | 96132869 | 96133869 | Gm29543 | TSS500 |
| chr13 | 96416134 | 96470698 | Ankdd1b | body |
| chr13 | 96924189 | 96925189 | Gcnt4 | TSS500 |
| chr13 | 96925189 | 96950912 | Gcnt4 | body |
| chr13 | 97067787 | 97129521 | Fam169a | body |
| chr13 | 97098796 | 97099796 | Gm6169 | TSS500 |
| chr13 | 97291519 | 97292519 | Gm22007 | TSS500 |
| chr13 | 97434470 | 97435470 | Lincenc1 | TSS500 |
| chr13 | 97435470 | 97497007 | Lincenc1 | body |
| chr13 | 97733498 | 97746911 | 5330416C01Rik | body |
| chr13 | 98353742 | 98354742 | Foxd1 | TSS500 |
| chr13 | 98354742 | 98356703 | Foxd1 | body |
| chr13 | 98491501 | 98492501 | Gm10320 | TSS500 |
| chr13 | 98686235 | 98694334 | Tmem171 | body |
| chr13 | 98723407 | 98814949 | Fcho2 | body |
| chr13 | 99100206 | 99101206 | Gm807 | TSS500 |
| chr13 | 99900183 | 99901183 | Cartpt | TSS500 |
| chr13 | 99898484 | 99900183 | Cartpt | body |
| chr13 | 100144063 | 100201592 | Naip2 | body |
| chr13 | 100552218 | 100553218 | Ocln | TSS500 |
| chr13 | 100496507 | 100552218 | Ocln | body |
| chr13 | 100668981 | 100669981 | Ccdc125 | TSS500 |
| chr13 | 101398170 | 101464160 | 4932411K12Rik | body |
| chr13 | 101680563 | 101767717 | Pik3r1 | body |
| chr13 | 103818787 | 103920014 | Erbp2ip | body |
| chr13 | 104863393 | 104864393 | Fam159b | TSS500 |
| chr13 | 105054430 | 105055430 | Rgs7bp | TSS500 |
| chr13 | 105082622 | 105121782 | 4933425L06Rik | body |

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|-------|-----------|-----------|---------------|--------|
| chr13 | 105149352 | 105270539 | Rnf180 | body |
| chr13 | 105443193 | 105444193 | Htr1a | TSS500 |
| chr13 | 105444193 | 105448133 | Htr1a | body |
| chr13 | 107724618 | 107889564 | Zswim6 | body |
| chr13 | 108052590 | 108158125 | Ndufaf2 | body |
| chr13 | 110279706 | 110280706 | Rab3c | TSS500 |
| chr13 | 110054187 | 110279706 | Rab3c | body |
| chr13 | 111725017 | 111726017 | Gm15287 | TSS500 |
| chr13 | 111808493 | 111809493 | Map3k1 | TSS500 |
| chr13 | 111867436 | 111868436 | Gm15326 | TSS500 |
| chr13 | 111868436 | 111874730 | Gm15326 | body |
| chr13 | 112988302 | 112990778 | Ccno | body |
| chr13 | 112993368 | 112994368 | Mcidas | TSS500 |
| chr13 | 113100479 | 113101479 | Gzma | TSS500 |
| chr13 | 113663176 | 113664176 | Hspb3 | TSS500 |
| chr13 | 114931541 | 114932541 | Itga2 | TSS500 |
| chr13 | 115101464 | 115102464 | Itga1 | TSS500 |
| chr13 | 116309189 | 116310189 | Isl1 | TSS500 |
| chr13 | 116298281 | 116309189 | Isl1 | body |
| chr13 | 116854824 | 117025016 | Parp8 | body |
| chr13 | 117220575 | 117221575 | Gm17509 | TSS500 |
| chr13 | 118714896 | 118715896 | Gm16263 | TSS500 |
| chr13 | 118695292 | 118714896 | Gm16263 | body |
| chr13 | 119428101 | 119429101 | Paip1 | TSS500 |
| chr13 | 119463259 | 119486117 | 4833420G17Rik | body |
| chr13 | 119487261 | 119487883 | 3110070M22Rik | body |
| chr13 | 119624319 | 119654354 | Ccl28 | body |
| chr13 | 119689962 | 119690962 | Hmgcs1 | TSS500 |
| chr13 | 119836506 | 119846570 | D13Erttd608e | body |
| chr12 | 3235004 | 3236004 | Rab10os | TSS500 |
| chr12 | 3954451 | 3955451 | Pomc | TSS500 |
| chr12 | 3955451 | 3960618 | Pomc | body |
| chr12 | 4038415 | 4039415 | Efr3b | TSS500 |
| chr12 | 4132603 | 4133603 | Adcy3 | TSS500 |
| chr12 | 4713817 | 4737883 | Fam228a | body |
| chr12 | 4841095 | 4842095 | Fkbp1b | TSS500 |
| chr12 | 4833175 | 4841095 | Fkbp1b | body |
| chr12 | 4873859 | 4874859 | Mfsd2b | TSS500 |
| chr12 | 5375182 | 5376182 | Klhl29 | TSS500 |
| chr12 | 5077472 | 5375182 | Klhl29 | body |
| chr12 | 5375370 | 5376370 | 2810032G03Rik | TSS500 |
| chr12 | 5376370 | 5416631 | 2810032G03Rik | body |
| chr12 | 7978148 | 8016835 | Apob | body |
| chr12 | 8301454 | 8302454 | Gdf7 | TSS500 |

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| chr12 | 8297934 | 8301454 | Gdf7 | body |
| chr12 | 8598566 | 8599566 | Slc7a15 | TSS500 |
| chr12 | 8674634 | 8752581 | Pum2 | body |
| chr12 | 8922164 | 8938742 | Laptm4a | body |
| chr12 | 9574942 | 9581499 | Osr1 | body |
| chr12 | 11150342 | 11151342 | Kcns3 | TSS500 |
| chr12 | 11090202 | 11150342 | Kcns3 | body |
| chr12 | 11208448 | 11209448 | Msgn1 | TSS500 |
| chr12 | 11325247 | 11436149 | Vsnl1 | body |
| chr12 | 11455579 | 11456579 | Rad51ap2 | TSS500 |
| chr12 | 12261639 | 12262639 | Fam49a | TSS500 |
| chr12 | 12262639 | 12376359 | Fam49a | body |
| chr12 | 12787485 | 12788485 | Gm17337 | TSS500 |
| chr12 | 12903220 | 12907251 | 4930519A11Rik | body |
| chr12 | 12941414 | 12942414 | Mycn | TSS500 |
| chr12 | 14151538 | 14152538 | Fam84a | TSS500 |
| chr12 | 14147599 | 14151538 | Fam84a | body |
| chr12 | 15791727 | 15816377 | Trib2 | body |
| chr12 | 16652970 | 16653970 | Ntsr2 | TSS500 |
| chr12 | 16670615 | 16800386 | Greb1 | body |
| chr12 | 17176388 | 17177388 | Kcnf1 | TSS500 |
| chr12 | 17172100 | 17176388 | Kcnf1 | body |
| chr12 | 17267045 | 17284770 | Pdia6 | body |
| chr12 | 17284721 | 17328859 | Atp6v1c2 | body |
| chr12 | 18514238 | 18515238 | 5730507C01Rik | TSS500 |
| chr12 | 19387309 | 19388309 | Gm5784 | TSS500 |
| chr12 | 19388309 | 19390286 | Gm5784 | body |
| chr12 | 21112248 | 21270171 | Asap2 | body |
| chr12 | 23009784 | 23010784 | 2410018L13Rik | TSS500 |
| chr12 | 23968345 | 23969345 | Gm17330 | TSS500 |
| chr12 | 24044701 | 24096468 | 9030624G23Rik | body |
| chr12 | 24498081 | 24499081 | Taf1b | TSS500 |
| chr12 | 24681313 | 24682313 | Cys1 | TSS500 |
| chr12 | 24665838 | 24681313 | Cys1 | body |
| chr12 | 24832099 | 24960301 | Mboat2 | body |
| chr12 | 26414756 | 26415756 | Rnf144a | TSS500 |
| chr12 | 26306797 | 26414756 | Rnf144a | body |
| chr12 | 26414510 | 26415510 | Mir6538 | TSS500 |
| chr12 | 27160133 | 27161133 | Gm9866 | TSS500 |
| chr12 | 27140796 | 27160133 | Gm9866 | body |
| chr12 | 27342074 | 27343074 | Sox11 | TSS500 |
| chr12 | 27334264 | 27342074 | Sox11 | body |
| chr12 | 28437795 | 28551803 | Dcdc2c | body |
| chr12 | 28553755 | 28582023 | Allc | body |

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| chr12 | 28594173 | 28622790 | Colec11 | body |
| chr12 | 28635453 | 28636453 | Rps7 | TSS500 |
| chr12 | 28650102 | 28659591 | Rnaseh1 | body |
| chr12 | 28690629 | 28749953 | Trappc12 | body |
| chr12 | 29528884 | 29923209 | Myt1l | body |
| chr12 | 30054659 | 30132124 | Tpo | body |
| chr12 | 30174482 | 30372875 | Sntg2 | body |
| chr12 | 30884822 | 30893854 | Fam150b | body |
| chr12 | 31073468 | 31074468 | Fam110c | TSS500 |
| chr12 | 31184123 | 31185123 | 6030469F06Rik | TSS500 |
| chr12 | 31265734 | 31329644 | Lamb1 | body |
| chr12 | 31391371 | 31473917 | Slc26a3 | body |
| chr12 | 31559469 | 31560469 | Slc26a4 | TSS500 |
| chr12 | 31519827 | 31559469 | Slc26a4 | body |
| chr12 | 31926254 | 31950035 | Hbp1 | body |
| chr12 | 31958476 | 32060796 | Prkar2b | body |
| chr12 | 32820835 | 32853369 | Nampt | body |
| chr12 | 32954391 | 32979050 | Sypl | body |
| chr12 | 33395354 | 33401269 | Efcab10 | body |
| chr12 | 34290592 | 34291592 | Gm18025 | TSS500 |
| chr12 | 34874328 | 34875328 | 4921508M14Rik | TSS500 |
| chr12 | 34984261 | 34985261 | Prps1l1 | TSS500 |
| chr12 | 35926120 | 35949736 | Agr3 | body |
| chr12 | 36014557 | 36042000 | Tspan13 | body |
| chr12 | 36157624 | 36197291 | Ankmy2 | body |
| chr12 | 36314669 | 36318452 | Sostdc1 | body |
| chr12 | 36381681 | 36382681 | D630036H23Rik | TSS500 |
| chr12 | 36381242 | 36381681 | D630036H23Rik | body |
| chr12 | 36381019 | 36382019 | Ispd | TSS500 |
| chr12 | 36382019 | 36689444 | Ispd | body |
| chr12 | 37109040 | 37179534 | Meox2 | body |
| chr12 | 37242141 | 37582202 | Agmo | body |
| chr12 | 37880205 | 37881205 | Dgkb | TSS500 |
| chr12 | 37881205 | 38633410 | Dgkb | body |
| chr12 | 40223258 | 40229184 | Gm7008 | body |
| chr12 | 41485251 | 41486251 | Lrrn3 | TSS500 |
| chr12 | 44221870 | 44312343 | Pnpla8 | body |
| chr12 | 44328385 | 44329385 | Nrcam | TSS500 |
| chr12 | 51592841 | 51593841 | Coch | TSS500 |
| chr12 | 51593841 | 51605773 | Coch | body |
| chr12 | 51608541 | 51691414 | Strn3 | body |
| chr12 | 51743722 | 51829036 | Hectd1 | body |
| chr12 | 53249177 | 54072175 | Npas3 | body |
| chr12 | 55300077 | 55382533 | 1110008L16Rik | body |

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| chr12 | 55383722 | 55384722 | Psma6 | TSS500 |
| chr12 | 55489411 | 55492147 | Nfkbia | body |
| chr12 | 55598417 | 55599417 | Insm2 | TSS500 |
| chr12 | 55599417 | 55602018 | Insm2 | body |
| chr12 | 56536408 | 56537408 | Nkx2-1 | TSS500 |
| chr12 | 56531958 | 56536408 | Nkx2-1 | body |
| chr12 | 56535843 | 56607476 | Gm26973 | body |
| chr12 | 56611389 | 56612784 | Nkx2-9 | body |
| chr12 | 56689918 | 56692464 | Gm15524 | body |
| chr12 | 56691267 | 56692267 | Pax9 | TSS500 |
| chr12 | 57196972 | 57197972 | Slc25a21 | TSS500 |
| chr12 | 56712634 | 57196972 | Slc25a21 | body |
| chr12 | 57545621 | 57546621 | Foxa1 | TSS500 |
| chr12 | 57540631 | 57545621 | Foxa1 | body |
| chr12 | 57563613 | 57564613 | Ttc6 | TSS500 |
| chr12 | 57585975 | 57618102 | 4921518K17Rik | body |
| chr12 | 58268758 | 58269758 | Clec14a | TSS500 |
| chr12 | 58264720 | 58268758 | Clec14a | body |
| chr12 | 59080519 | 59081519 | Gm5786 | TSS500 |
| chr12 | 59096299 | 59109130 | Mia2 | body |
| chr12 | 61523650 | 61858342 | Lrfr5 | body |
| chr12 | 64918411 | 64924591 | Gm527 | body |
| chr12 | 65035833 | 65036833 | Prpf39 | TSS500 |
| chr12 | 65226017 | 65228454 | Wdr20rt | body |
| chr12 | 67222049 | 67223049 | Mdga2 | TSS500 |
| chr12 | 66469568 | 67222049 | Mdga2 | body |
| chr12 | 69158686 | 69159686 | Rps29 | TSS500 |
| chr12 | 69157722 | 69158686 | Rps29 | body |
| chr12 | 69197929 | 69198929 | Dnaaf2 | TSS500 |
| chr12 | 69197711 | 69199868 | 9330151L19Rik | body |
| chr12 | 69241676 | 69284632 | Klhdc1 | body |
| chr12 | 69311544 | 69356676 | Nemf | body |
| chr12 | 69790207 | 69791207 | Cdkl1 | TSS500 |
| chr12 | 69789788 | 69790788 | 4930512B01Rik | TSS500 |
| chr12 | 69790788 | 69840479 | 4930512B01Rik | body |
| chr12 | 70190811 | 70230988 | Pygl | body |
| chr12 | 70227341 | 70228341 | F730035M05Rik | TSS500 |
| chr12 | 70347114 | 70348114 | Trim9 | TSS500 |
| chr12 | 70244539 | 70347114 | Trim9 | body |
| chr12 | 71110928 | 71111928 | Tomm20l | TSS500 |
| chr12 | 71136175 | 71137175 | Timm9 | TSS500 |
| chr12 | 71136348 | 71137348 | 2700049A03Rik | TSS500 |
| chr12 | 72070491 | 72071491 | Gpr135 | TSS500 |
| chr12 | 72084939 | 72085939 | L3hypdh | TSS500 |

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| chr12 | 72073428 | 72084939 | L3hypdh | body |
| chr12 | 72408554 | 72409554 | Rtn1 | TSS500 |
| chr12 | 72211752 | 72408554 | Rtn1 | body |
| chr12 | 72442366 | 72514334 | Lrrc9 | body |
| chr12 | 72536857 | 72580213 | Pcnxl4 | body |
| chr12 | 72761711 | 72794940 | Ppm1a | body |
| chr12 | 72940274 | 72941274 | 4930447C04Rik | TSS500 |
| chr12 | 72881109 | 72940274 | 4930447C04Rik | body |
| chr12 | 72939392 | 72940392 | Six6 | TSS500 |
| chr12 | 73053387 | 73054387 | Six1 | TSS500 |
| chr12 | 73040015 | 73053387 | Six1 | body |
| chr12 | 73585297 | 73778185 | Prkch | body |
| chr12 | 73965030 | 73984820 | Snapc1 | body |
| chr12 | 73997261 | 73998261 | Syt16 | TSS500 |
| chr12 | 73998261 | 74267916 | Syt16 | body |
| chr12 | 74234640 | 74235640 | Gm29587 | TSS500 |
| chr12 | 74283781 | 74284781 | 1700086L19Rik | TSS500 |
| chr12 | 74284781 | 74295945 | 1700086L19Rik | body |
| chr12 | 75450883 | 75595700 | Ppp2r5e | body |
| chr12 | 76176759 | 76177759 | Esr2 | TSS500 |
| chr12 | 76198692 | 76246246 | Tex21 | body |
| chr12 | 76324391 | 76325391 | Akap5 | TSS500 |
| chr12 | 76404676 | 76406934 | Hspa2 | body |
| chr12 | 76417099 | 76418099 | Ppp1r36 | TSS500 |
| chr12 | 76710047 | 76711047 | Sptb | TSS500 |
| chr12 | 76580488 | 76710047 | Sptb | body |
| chr12 | 76766038 | 76783180 | Churc1 | body |
| chr12 | 77238604 | 77476338 | Fut8 | body |
| chr12 | 78862319 | 78887010 | Eif2s1 | body |
| chr12 | 79007127 | 79008127 | Tmem229b | TSS500 |
| chr12 | 79029663 | 79081648 | Plekhh1 | body |
| chr12 | 79130277 | 79131277 | Arg2 | TSS500 |
| chr12 | 79131277 | 79156301 | Arg2 | body |
| chr12 | 79156017 | 79172167 | Vti1b | body |
| chr12 | 79174337 | 79191793 | Rdh11 | body |
| chr12 | 80518416 | 80519416 | Gm26777 | TSS500 |
| chr12 | 80518490 | 80519490 | Galnt16 | TSS500 |
| chr12 | 80519490 | 80603896 | Galnt16 | body |
| chr12 | 80644715 | 80683341 | Slc39a9 | body |
| chr12 | 80691966 | 80692966 | Plekhd1os | TSS500 |
| chr12 | 80692091 | 80693091 | Plekhd1 | TSS500 |
| chr12 | 80760041 | 80761041 | Ccdc177 | TSS500 |
| chr12 | 80754046 | 80760041 | Ccdc177 | body |
| chr12 | 80757906 | 80758906 | Gm26796 | TSS500 |

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| chr12 | 80945004 | 80946004 | Srsf5 | TSS500 |
| chr12 | 81026308 | 81027308 | Smoc1 | TSS500 |
| chr12 | 81027308 | 81186414 | Smoc1 | body |
| chr12 | 81197915 | 81332680 | Slc8a3 | body |
| chr12 | 81484627 | 81485627 | Cox16 | TSS500 |
| chr12 | 81573557 | 81594508 | Med6 | body |
| chr12 | 81630869 | 81631869 | Ttc9 | TSS500 |
| chr12 | 81780670 | 81781670 | Map3k9 | TSS500 |
| chr12 | 82496037 | 82497037 | Gm5435 | TSS500 |
| chr12 | 82617425 | 83162056 | Rgs6 | body |
| chr12 | 82932520 | 82938655 | 1700085C21Rik | body |
| chr12 | 83063392 | 83098374 | Gm29530 | body |
| chr12 | 83519966 | 83520966 | Dcaf4 | TSS500 |
| chr12 | 83763134 | 83764134 | Papln | TSS500 |
| chr12 | 83764134 | 83792382 | Papln | body |
| chr12 | 83954499 | 83984352 | Gm17673 | body |
| chr12 | 84010002 | 84017670 | Acot1 | body |
| chr12 | 84037879 | 84038879 | Acot4 | TSS500 |
| chr12 | 84053307 | 84054307 | 4732463B04Rik | TSS500 |
| chr12 | 84069825 | 84076020 | Acot5 | body |
| chr12 | 84100154 | 84101154 | Acot6 | TSS500 |
| chr12 | 84101154 | 84111349 | Acot6 | body |
| chr12 | 84114866 | 84147498 | Dnal1 | body |
| chr12 | 84218381 | 84219381 | Elmsan1 | TSS500 |
| chr12 | 84149176 | 84218381 | Elmsan1 | body |
| chr12 | 84284732 | 84285732 | Ptgr2 | TSS500 |
| chr12 | 84409571 | 84433780 | Ccdc176 | body |
| chr12 | 84416696 | 84417696 | Rnf113a2 | TSS500 |
| chr12 | 84570262 | 84595457 | Vsx2 | body |
| chr12 | 84641519 | 84651455 | Vrtn | body |
| chr12 | 84677278 | 84698307 | Syndig1l | body |
| chr12 | 84876032 | 84877032 | Ltbp2 | TSS500 |
| chr12 | 84875269 | 84876269 | D030025P21Rik | TSS500 |
| chr12 | 84971397 | 84983303 | Fcf1 | body |
| chr12 | 85150764 | 85151764 | Rps6kl1 | TSS500 |
| chr12 | 85176796 | 85177796 | Pgf | TSS500 |
| chr12 | 85270091 | 85271091 | Mlh3 | TSS500 |
| chr12 | 85287938 | 85288938 | Acyp1 | TSS500 |
| chr12 | 85288091 | 85289091 | Zc2hc1c | TSS500 |
| chr12 | 85340614 | 85374217 | Tmed10 | body |
| chr12 | 85686169 | 85687169 | Batf | TSS500 |
| chr12 | 85687169 | 85709087 | Batf | body |
| chr12 | 85746039 | 85747039 | Mfsd7c | TSS500 |
| chr12 | 85747039 | 85813585 | Mfsd7c | body |

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| chr12 | 85962598 | 85978514 | Gm26531 | body |
| chr12 | 86169841 | 86195102 | Gm805 | body |
| chr12 | 86360617 | 86361617 | Esrrb | TSS500 |
| chr12 | 86361617 | 86521628 | Esrrb | body |
| chr12 | 86678200 | 86679200 | Vash1 | TSS500 |
| chr12 | 86679200 | 86692091 | Vash1 | body |
| chr12 | 86734883 | 86763795 | Lrrc74a | body |
| chr12 | 86988176 | 86989176 | Zdhhc22 | TSS500 |
| chr12 | 86983381 | 86988176 | Zdhhc22 | body |
| chr12 | 87102039 | 87103039 | Ngb | TSS500 |
| chr12 | 87200223 | 87213541 | Samd15 | body |
| chr12 | 88360054 | 88361054 | Adck1 | TSS500 |
| chr12 | 88722376 | 88723376 | Nrxn3 | TSS500 |
| chr12 | 88723376 | 90334935 | Nrxn3 | body |
| chr12 | 91400494 | 91401494 | Tshr | TSS500 |
| chr12 | 95691726 | 95692726 | Flrt2 | TSS500 |
| chr12 | 95692726 | 95785215 | Flrt2 | body |
| chr12 | 98900984 | 98901984 | Eml5 | TSS500 |
| chr12 | 99341654 | 99361827 | 3300002A11Rik | body |
| chr12 | 99885017 | 99955219 | Tdp1 | body |
| chr12 | 99964999 | 100062682 | Kcnk13 | body |
| chr12 | 100199935 | 100209806 | Calm1 | body |
| chr12 | 100209314 | 100210314 | Gm26723 | TSS500 |
| chr12 | 100520322 | 100521322 | Ttc7b | TSS500 |
| chr12 | 100907698 | 100908698 | Gpr68 | TSS500 |
| chr12 | 100876682 | 100907698 | Gpr68 | body |
| chr12 | 101028483 | 101029483 | Ccdc88c | TSS500 |
| chr12 | 101405173 | 101626009 | Catsperb | body |
| chr12 | 101718023 | 101719023 | Tc2n | TSS500 |
| chr12 | 101834043 | 101912767 | Trip11 | body |
| chr12 | 102129406 | 102130406 | Gm16339 | TSS500 |
| chr12 | 102283548 | 102390855 | Rin3 | body |
| chr12 | 102554469 | 102555469 | Chga | TSS500 |
| chr12 | 102719977 | 102726822 | RP23-377G8.1 | body |
| chr12 | 102948359 | 102949359 | Unc79 | TSS500 |
| chr12 | 102949359 | 103184065 | Unc79 | body |
| chr12 | 103241650 | 103242650 | Prima1 | TSS500 |
| chr12 | 103196908 | 103241650 | Prima1 | body |
| chr12 | 103311475 | 103317065 | Fam181a | body |
| chr12 | 103314269 | 103315269 | Gm29508 | TSS500 |
| chr12 | 103531783 | 103532783 | Ppp4r4 | TSS500 |
| chr12 | 103614786 | 103630944 | Serpina10 | body |
| chr12 | 103668808 | 103675639 | Gm46 | body |
| chr12 | 103728156 | 103829873 | Serpina1b | body |

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|-------|-----------|-----------|---------------|--------|
| chr12 | 103763594 | 103773092 | Serpina1d | body |
| chr12 | 103853589 | 103863062 | Serpina1a | body |
| chr12 | 103894926 | 103904387 | Serpina1c | body |
| chr12 | 103895397 | 103896397 | B430119L08Rik | TSS500 |
| chr12 | 103946931 | 103958475 | Serpina1e | body |
| chr12 | 103994743 | 104013255 | Serpina9 | body |
| chr12 | 104028769 | 104043943 | Serpina12 | body |
| chr12 | 104215044 | 104221129 | Serpina3f | body |
| chr12 | 104235745 | 104236745 | Serpina3g | TSS500 |
| chr12 | 104472830 | 104473830 | Gsc | TSS500 |
| chr12 | 104471209 | 104472830 | Gsc | body |
| chr12 | 104473988 | 104474988 | Gm10000 | TSS500 |
| chr12 | 104474988 | 104477489 | Gm10000 | body |
| chr12 | 104864576 | 104865576 | Clmn | TSS500 |
| chr12 | 104864830 | 104865830 | 4930408O17Rik | TSS500 |
| chr12 | 105222293 | 105223293 | Tcl1 | TSS500 |
| chr12 | 105216750 | 105222293 | Tcl1 | body |
| chr12 | 105337094 | 105383932 | Tunar | body |
| chr12 | 105453356 | 105454356 | D430019H16Rik | TSS500 |
| chr12 | 105563672 | 105593071 | Bdkrb2 | body |
| chr12 | 105785194 | 105838944 | Papola | body |
| chr12 | 106009763 | 106010763 | Vrk1 | TSS500 |
| chr12 | 106010763 | 106077410 | Vrk1 | body |
| chr12 | 106558250 | 106559250 | Gm17033 | TSS500 |
| chr12 | 106559250 | 106574924 | Gm17033 | body |
| chr12 | 106838482 | 106878841 | 1700013N06Rik | body |
| chr12 | 107079360 | 107099173 | Gm16086 | body |
| chr12 | 107159707 | 107160707 | Gm16084 | TSS500 |
| chr12 | 107147164 | 107159707 | Gm16084 | body |
| chr12 | 107744136 | 107783541 | Gm15208 | body |
| chr12 | 107910403 | 108003102 | Bcl11b | body |
| chr12 | 108274917 | 108275917 | Ccdc85c | TSS500 |
| chr12 | 108206345 | 108274917 | Ccdc85c | body |
| chr12 | 108305770 | 108306770 | Hhipl1 | TSS500 |
| chr12 | 108333877 | 108334877 | Cyp46a1 | TSS500 |
| chr12 | 108334877 | 108362231 | Cyp46a1 | body |
| chr12 | 108555114 | 108556114 | Gm16596 | TSS500 |
| chr12 | 108701806 | 108702806 | Degs2 | TSS500 |
| chr12 | 108686792 | 108701806 | Degs2 | body |
| chr12 | 108850629 | 108851629 | Slc25a47 | TSS500 |
| chr12 | 109067717 | 109068717 | Begain | TSS500 |
| chr12 | 109067667 | 109068667 | BEGAIN | TSS500 |
| chr12 | 109540501 | 109541501 | Meg3 | TSS500 |
| chr12 | 109541501 | 109571726 | Meg3 | body |

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|-------|-----------|-----------|---------------|--------|
| chr12 | 109585290 | 109586290 | Mir337 | TSS500 |
| chr12 | 109585571 | 109586571 | Mir540 | TSS500 |
| chr12 | 109585814 | 109586814 | Mir665 | TSS500 |
| chr12 | 109589194 | 109599830 | Rtl1 | body |
| chr12 | 109611000 | 109612000 | Mir341 | TSS500 |
| chr12 | 109727629 | 109728629 | Mir539 | TSS500 |
| chr12 | 109728321 | 109729321 | Gm27379 | TSS500 |
| chr12 | 110275384 | 110277568 | Dio3os | body |
| chr12 | 110278568 | 110279568 | Dio3 | TSS500 |
| chr12 | 111039851 | 111115901 | Rcor1 | body |
| chr12 | 111270611 | 111271611 | Amn | TSS500 |
| chr12 | 111407309 | 111412077 | A230065H16Rik | body |
| chr12 | 111417930 | 111431182 | Exoc3l4 | body |
| chr12 | 111441969 | 111442969 | Tnfaip2 | TSS500 |
| chr12 | 111442969 | 111455018 | Tnfaip2 | body |
| chr12 | 111485323 | 111486323 | Gm266 | TSS500 |
| chr12 | 111484611 | 111485323 | Gm266 | body |
| chr12 | 111671838 | 111672838 | Ckb | TSS500 |
| chr12 | 111678605 | 111683902 | Trmt61a | body |
| chr12 | 111758349 | 111759349 | Klc1 | TSS500 |
| chr12 | 111803192 | 111813373 | Xrcc3 | body |
| chr12 | 111907555 | 111908555 | Ppp1r13b | TSS500 |
| chr12 | 111828458 | 111907555 | Ppp1r13b | body |
| chr12 | 111972059 | 112068854 | Tdrd9 | body |
| chr12 | 112130380 | 112131380 | Mir203 | TSS500 |
| chr12 | 112145708 | 112146708 | Kif26a | TSS500 |
| chr12 | 112413915 | 112422712 | A730018C14Rik | body |
| chr12 | 112510660 | 112511660 | Tmem179 | TSS500 |
| chr12 | 112674384 | 112675384 | Akt1 | TSS500 |
| chr12 | 112653821 | 112674384 | Akt1 | body |
| chr12 | 112678328 | 112679328 | Zbtb42 | TSS500 |
| chr12 | 112679328 | 112682747 | Zbtb42 | body |
| chr12 | 112721674 | 112722674 | Cep170b | TSS500 |
| chr12 | 112809475 | 112816245 | BC022687 | body |
| chr12 | 112908590 | 112928995 | Jag2 | body |
| chr12 | 112920041 | 112921041 | Mir6941 | TSS500 |
| chr12 | 112941618 | 112942618 | Nudt14 | TSS500 |
| chr12 | 112946363 | 112950012 | Gm26583 | body |
| chr12 | 113140736 | 113145504 | Crip2 | body |
| chr12 | 113151512 | 113152512 | Crip1 | TSS500 |
| chr12 | 113156921 | 113165456 | 4930427A07Rik | body |
| chr12 | 113186403 | 113189520 | Tmem121 | body |
| chr12 | 115263184 | 115287908 | RP23-354D10.5 | body |
| chr12 | 116485220 | 116486220 | Ptprn2 | TSS500 |

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|-------|-----------|-----------|---------------|--------|
| chr12 | 116486220 | 117276849 | Ptprn2 | body |
| chr12 | 117516979 | 117756978 | Rapgef5 | body |
| chr12 | 117804789 | 117878706 | Cdca7l | body |
| chr12 | 117877982 | 118198543 | Dnah11 | body |
| chr12 | 119158022 | 119238302 | Itgb8 | body |
| chr12 | 119946457 | 120019211 | Tmem196 | body |
| chr15 | 3996539 | 4015858 | Gm2093 | body |
| chr15 | 4374991 | 4375991 | Plcx3 | TSS500 |
| chr15 | 4375991 | 4575553 | Plcx3 | body |
| chr15 | 4899237 | 4962203 | Mroh2b | body |
| chr15 | 6300288 | 6440712 | Dab2 | body |
| chr15 | 6653803 | 6654803 | Gm2245 | TSS500 |
| chr15 | 7129059 | 7130059 | Lifr | TSS500 |
| chr15 | 7130059 | 7197489 | Lifr | body |
| chr15 | 7397895 | 7398895 | Egflam | TSS500 |
| chr15 | 7206120 | 7397895 | Egflam | body |
| chr15 | 7811511 | 7837575 | Gdnf | body |
| chr15 | 8291225 | 8443963 | Nipbl | body |
| chr15 | 8710264 | 8711264 | Slc1a3 | TSS500 |
| chr15 | 8634124 | 8710264 | Slc1a3 | body |
| chr15 | 8968926 | 9066551 | Ranbp3l | body |
| chr15 | 9273819 | 9315032 | Ugt3a1 | body |
| chr15 | 9578193 | 9748368 | Spef2 | body |
| chr15 | 10176738 | 10177738 | Prlr | TSS500 |
| chr15 | 10359032 | 10410153 | Agxt2 | body |
| chr15 | 10715336 | 10790123 | 4930556M19Rik | body |
| chr15 | 10951832 | 10952832 | C1qtnf3 | TSS500 |
| chr15 | 11033717 | 11037491 | Rxfp3 | body |
| chr15 | 11905174 | 11906174 | Npr3 | TSS500 |
| chr15 | 11839896 | 11905174 | Npr3 | body |
| chr15 | 12118331 | 12185683 | Zfr | body |
| chr15 | 12739424 | 12740424 | Pdzd2 | TSS500 |
| chr15 | 12359711 | 12739424 | Pdzd2 | body |
| chr15 | 13034200 | 13173139 | Cdh6 | body |
| chr15 | 16778601 | 16857094 | Cdh9 | body |
| chr15 | 18078137 | 18165488 | 4921515E04Rik | body |
| chr15 | 18819447 | 19014236 | Cdh10 | body |
| chr15 | 20666250 | 20667250 | Acot10 | TSS500 |
| chr15 | 20919714 | 20920714 | Gm27397 | TSS500 |
| chr15 | 21111952 | 21589533 | Cdh12 | body |
| chr15 | 22273570 | 22274570 | Gm27525 | TSS500 |
| chr15 | 24981620 | 25026858 | Gm2824 | body |
| chr15 | 25413264 | 25414264 | Basp1 | TSS500 |
| chr15 | 26308548 | 26309548 | March11 | TSS500 |

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|-------|----------|----------|---------------|--------|
| chr15 | 26894549 | 26895549 | Fbxl7 | TSS500 |
| chr15 | 26543084 | 26894549 | Fbxl7 | body |
| chr15 | 28204252 | 28472045 | Dnah5 | body |
| chr15 | 30172093 | 30173093 | Ctnnd2 | TSS500 |
| chr15 | 30173093 | 31029311 | Ctnnd2 | body |
| chr15 | 31367259 | 31368259 | Ankrd33b | TSS500 |
| chr15 | 32921223 | 33034730 | Sdc2 | body |
| chr15 | 33687383 | 33688383 | Tspyl5 | TSS500 |
| chr15 | 33683876 | 33687383 | Tspyl5 | body |
| chr15 | 34355921 | 34356921 | 9430069I07Rik | TSS500 |
| chr15 | 34572799 | 34678206 | Nipal2 | body |
| chr15 | 35296598 | 35303304 | Osr2 | body |
| chr15 | 36139900 | 36140900 | Rgs22 | TSS500 |
| chr15 | 36164384 | 36165384 | Fbxo43 | TSS500 |
| chr15 | 36173510 | 36174510 | Polr2k | TSS500 |
| chr15 | 36179868 | 36235610 | Spag1 | body |
| chr15 | 36496291 | 36497291 | Ankrd46 | TSS500 |
| chr15 | 37008023 | 37044100 | Gm26766 | body |
| chr15 | 37232809 | 37233809 | Gm16136 | TSS500 |
| chr15 | 37231921 | 37232809 | Gm16136 | body |
| chr15 | 37232536 | 37233536 | Grhl2 | TSS500 |
| chr15 | 37233536 | 37363569 | Grhl2 | body |
| chr15 | 37366175 | 37792070 | Ncald | body |
| chr15 | 37426054 | 37440644 | 4930447A16Rik | body |
| chr15 | 39005685 | 39006685 | Gm26704 | TSS500 |
| chr15 | 39005780 | 39006780 | Fzd6 | TSS500 |
| chr15 | 39197832 | 39198832 | Rims2 | TSS500 |
| chr15 | 39198832 | 39681940 | Rims2 | body |
| chr15 | 39746432 | 39760934 | Dcstamp | body |
| chr15 | 39768485 | 39856970 | Dpys | body |
| chr15 | 41869220 | 41870220 | Abra | TSS500 |
| chr15 | 43170318 | 43171318 | Rspo2 | TSS500 |
| chr15 | 43020811 | 43170318 | Rspo2 | body |
| chr15 | 43477729 | 43527777 | Emc2 | body |
| chr15 | 44458053 | 44597143 | Pkhd11l | body |
| chr15 | 44787563 | 44788563 | Sybu | TSS500 |
| chr15 | 44787282 | 44788282 | 2310069G16Rik | TSS500 |
| chr15 | 44788282 | 44805827 | 2310069G16Rik | body |
| chr15 | 45114434 | 45115434 | Kcnv1 | TSS500 |
| chr15 | 45106284 | 45114434 | Kcnv1 | body |
| chr15 | 48791563 | 48792563 | Csmd3 | TSS500 |
| chr15 | 47580637 | 48791563 | Csmd3 | body |
| chr15 | 50889963 | 50890963 | Trps1 | TSS500 |
| chr15 | 50654752 | 50889963 | Trps1 | body |

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|-------|----------|----------|---------------|--------|
| chr15 | 50888614 | 50889614 | Mir1907 | TSS500 |
| chr15 | 51786558 | 51864981 | Eif3h | body |
| chr15 | 52039607 | 52040607 | Aard | TSS500 |
| chr15 | 52040607 | 52045722 | Aard | body |
| chr15 | 52712945 | 52730431 | Med30 | body |
| chr15 | 53902037 | 53903037 | Samd12 | TSS500 |
| chr15 | 53461621 | 53902037 | Samd12 | body |
| chr15 | 54250619 | 54277984 | Tnfrsf11b | body |
| chr15 | 54745202 | 54746202 | Nov | TSS500 |
| chr15 | 54746202 | 54754039 | Nov | body |
| chr15 | 54952448 | 54953448 | Gm26684 | TSS500 |
| chr15 | 54953448 | 54964642 | Gm26684 | body |
| chr15 | 55906449 | 55907449 | Sntb1 | TSS500 |
| chr15 | 55638843 | 55906449 | Sntb1 | body |
| chr15 | 56694039 | 56695039 | Has2 | TSS500 |
| chr15 | 56665627 | 56694039 | Has2 | body |
| chr15 | 57695165 | 57839832 | Zhx2 | body |
| chr15 | 58323669 | 58324669 | Klhl38 | TSS500 |
| chr15 | 58782269 | 58823030 | Tmem65 | body |
| chr15 | 58873149 | 58876781 | Trmt12 | body |
| chr15 | 58941244 | 59081526 | Mtss1 | body |
| chr15 | 60016118 | 60017118 | 4933412E24Rik | TSS500 |
| chr15 | 60853278 | 60854278 | Fam84b | TSS500 |
| chr15 | 60818994 | 60853278 | Fam84b | body |
| chr15 | 60917589 | 60920770 | A1bg | body |
| chr15 | 64921796 | 64922796 | Adcy8 | TSS500 |
| chr15 | 64818194 | 64937996 | Gm21798 | body |
| chr15 | 65787534 | 65873816 | Efr3a | body |
| chr15 | 65876053 | 65911897 | Oc90 | body |
| chr15 | 65976304 | 65977304 | Hhla1 | TSS500 |
| chr15 | 66285724 | 66286724 | Kcnq3 | TSS500 |
| chr15 | 66286417 | 66287417 | Gm27242 | TSS500 |
| chr15 | 66500410 | 66501410 | Lrrc6 | TSS500 |
| chr15 | 66890820 | 66891820 | Wisp1 | TSS500 |
| chr15 | 66929321 | 66969140 | Ndrp1 | body |
| chr15 | 68927920 | 68928920 | Khdrbs3 | TSS500 |
| chr15 | 68928920 | 69093512 | Khdrbs3 | body |
| chr15 | 71727338 | 71728338 | Fam135b | TSS500 |
| chr15 | 71445678 | 71727338 | Fam135b | body |
| chr15 | 71795795 | 72033727 | Col22a1 | body |
| chr15 | 72545779 | 72546779 | Kcnk9 | TSS500 |
| chr15 | 73095844 | 73184340 | Ago2 | body |
| chr15 | 73513060 | 73572242 | Dennd3 | body |
| chr15 | 73694604 | 73707005 | Gpr20 | body |

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|-------|----------|----------|---------------|--------|
| chr15 | 73839199 | 73840199 | Mroh5 | TSS500 |
| chr15 | 73835061 | 73839908 | Gm6569 | body |
| chr15 | 74515695 | 74516695 | Bai1 | TSS500 |
| chr15 | 74516695 | 74589465 | Bai1 | body |
| chr15 | 74672070 | 74673070 | Arc | TSS500 |
| chr15 | 74669083 | 74672070 | Arc | body |
| chr15 | 74720704 | 74721704 | Them6 | TSS500 |
| chr15 | 74746193 | 74747193 | 2300005B03Rik | TSS500 |
| chr15 | 74763120 | 74764120 | Ly6d | TSS500 |
| chr15 | 74818315 | 74819315 | Gml | TSS500 |
| chr15 | 74818571 | 74819571 | Hemt1 | TSS500 |
| chr15 | 74834125 | 74841143 | Cyp11b1 | body |
| chr15 | 74955551 | 74959905 | Ly6e | body |
| chr15 | 75007803 | 75024410 | Gm28068 | body |
| chr15 | 75566755 | 75567755 | Ly6h | TSS500 |
| chr15 | 75678300 | 75679300 | Top1mt | TSS500 |
| chr15 | 75747422 | 75748422 | Mafa | TSS500 |
| chr15 | 75746843 | 75747422 | Mafa | body |
| chr15 | 75861839 | 75862839 | Gsdmd | TSS500 |
| chr15 | 75894796 | 75909056 | Eef1d | body |
| chr15 | 75910235 | 75914535 | TIGD5 | body |
| chr15 | 75929230 | 75930230 | Tsta3 | TSS500 |
| chr15 | 75979872 | 75981955 | Ccdc166 | body |
| chr15 | 75993269 | 75994269 | Mapk15 | TSS500 |
| chr15 | 75994269 | 75999152 | Mapk15 | body |
| chr15 | 76001093 | 76013836 | Fam83h | body |
| chr15 | 76268589 | 76292572 | Spatc1 | body |
| chr15 | 76432714 | 76433714 | Mir6954 | TSS500 |
| chr15 | 76456938 | 76457938 | Scx | TSS500 |
| chr15 | 76516203 | 76521629 | Scrt1 | body |
| chr15 | 76612385 | 76616352 | Slc39a4 | body |
| chr15 | 76661141 | 76668196 | Kifc2 | body |
| chr15 | 76668284 | 76669448 | Foxh1 | body |
| chr15 | 76900410 | 76901305 | Commd5 | body |
| chr15 | 77015489 | 77050170 | Mb | body |
| chr15 | 77422210 | 77446992 | Apol7b | body |
| chr15 | 77633951 | 77642786 | Apol11b | body |
| chr15 | 77699389 | 77719288 | Apol7e | body |
| chr15 | 77729621 | 77736381 | Apol9b | body |
| chr15 | 77915047 | 77928506 | Txn2 | body |
| chr15 | 77956222 | 77957222 | Foxred2 | TSS500 |
| chr15 | 78119528 | 78120528 | Cacng2 | TSS500 |
| chr15 | 77991748 | 78119528 | Cacng2 | body |
| chr15 | 78159465 | 78173608 | lft27 | body |

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|-------|----------|----------|---------------|--------|
| chr15 | 78205900 | 78206900 | Pvalb | TSS500 |
| chr15 | 78245301 | 78262580 | Ncf4 | body |
| chr15 | 78282517 | 78305103 | Csf2rb2 | body |
| chr15 | 78326490 | 78351000 | Csf2rb | body |
| chr15 | 78348099 | 78349099 | Mir7676-2 | TSS500 |
| chr15 | 78405359 | 78406359 | Tst | TSS500 |
| chr15 | 78468134 | 78469134 | Tmprss6 | TSS500 |
| chr15 | 78480553 | 78494566 | Il2rb | body |
| chr15 | 78543845 | 78544845 | Sstr3 | TSS500 |
| chr15 | 78717613 | 78718613 | Elfn2 | TSS500 |
| chr15 | 78802542 | 78803542 | Card10 | TSS500 |
| chr15 | 78775138 | 78802542 | Card10 | body |
| chr15 | 79028712 | 79030498 | H1f0 | body |
| chr15 | 79053094 | 79062393 | Ankrd54 | body |
| chr15 | 79165541 | 79166541 | Gm10863 | TSS500 |
| chr15 | 79258195 | 79285037 | Baiap2l2 | body |
| chr15 | 79348041 | 79359072 | Maff | body |
| chr15 | 79417856 | 79443419 | Csnk1e | body |
| chr15 | 79504741 | 79505741 | Kcnj4 | TSS500 |
| chr15 | 79483718 | 79504741 | Kcnj4 | body |
| chr15 | 79777349 | 79778349 | Dnal4 | TSS500 |
| chr15 | 80014308 | 80015308 | Pdgfb | TSS500 |
| chr15 | 79995900 | 80014308 | Pdgfb | body |
| chr15 | 80091368 | 80092368 | Rpl3 | TSS500 |
| chr15 | 80077794 | 80091368 | Rpl3 | body |
| chr15 | 80090834 | 80091834 | Syng1 | TSS500 |
| chr15 | 80286738 | 80287738 | Cacna1i | TSS500 |
| chr15 | 80978265 | 81012289 | Sgsm3 | body |
| chr15 | 81234999 | 81235999 | Mchr1 | TSS500 |
| chr15 | 81678296 | 81696787 | Chadl | body |
| chr15 | 81872809 | 81915133 | Aco2 | body |
| chr15 | 81915030 | 81925713 | Polr3h | body |
| chr15 | 81937259 | 81950941 | Csdc2 | body |
| chr15 | 81980040 | 81981040 | 1700029P11Rik | TSS500 |
| chr15 | 82212315 | 82213315 | Shisa8 | TSS500 |
| chr15 | 82221744 | 82223839 | Tnfrsf13c | body |
| chr15 | 82251897 | 82252897 | 1500009C09Rik | TSS500 |
| chr15 | 82274435 | 82275435 | sept-03 | TSS500 |
| chr15 | 82275435 | 82294442 | sept-03 | body |
| chr15 | 82299484 | 82314558 | Wbp2nl | body |
| chr15 | 82389154 | 82393522 | Cyp2d11 | body |
| chr15 | 82407958 | 82408958 | Gm25990 | TSS500 |
| chr15 | 82612446 | 82613446 | Gm27742 | TSS500 |
| chr15 | 82615965 | 82620407 | Cyp2d34 | body |

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|-------|----------|----------|---------------|--------|
| chr15 | 82958796 | 82959796 | Mir3080 | TSS500 |
| chr15 | 82987330 | 82988330 | Gm29019 | TSS500 |
| chr15 | 82982725 | 82987330 | Gm29019 | body |
| chr15 | 82983370 | 82989134 | AW121686 | body |
| chr15 | 83032806 | 83033806 | Nfam1 | TSS500 |
| chr15 | 83089006 | 83090006 | Serhl | TSS500 |
| chr15 | 83125978 | 83148884 | Poldip3 | body |
| chr15 | 83251274 | 83252274 | A4galt | TSS500 |
| chr15 | 83226726 | 83251274 | A4galt | body |
| chr15 | 83527362 | 83544635 | Bik | body |
| chr15 | 83564073 | 83574201 | Tspo | body |
| chr15 | 83724521 | 83725521 | Scube1 | TSS500 |
| chr15 | 83779967 | 83858494 | Mpped1 | body |
| chr15 | 84064879 | 84065879 | Efcab6 | TSS500 |
| chr15 | 83866712 | 84064879 | Efcab6 | body |
| chr15 | 84105254 | 84106254 | Sult4a1 | TSS500 |
| chr15 | 84379203 | 84446597 | 1810041L15Rik | body |
| chr15 | 84557323 | 84558323 | Ldoc1l | TSS500 |
| chr15 | 84719552 | 84720552 | Arhgap8 | TSS500 |
| chr15 | 84720552 | 84772207 | Arhgap8 | body |
| chr15 | 84785381 | 84855549 | Phf21b | body |
| chr15 | 85016641 | 85017641 | Upk3a | TSS500 |
| chr15 | 85131457 | 85132457 | Smc1b | TSS500 |
| chr15 | 85131599 | 85132599 | Ribc2 | TSS500 |
| chr15 | 85205449 | 85206449 | Fbln1 | TSS500 |
| chr15 | 85535439 | 85581321 | Wnt7b | body |
| chr15 | 85580642 | 85581642 | AU022754 | TSS500 |
| chr15 | 85821233 | 85822233 | Pkdrej | TSS500 |
| chr15 | 85814676 | 85821233 | Pkdrej | body |
| chr15 | 85831806 | 85832806 | Ttc38 | TSS500 |
| chr15 | 85879812 | 85897394 | Trmu | body |
| chr15 | 86033277 | 86034277 | Celsr1 | TSS500 |
| chr15 | 86087640 | 86089560 | Gm15722 | body |
| chr15 | 87624730 | 87625730 | Fam19a5 | TSS500 |
| chr15 | 87625730 | 87759336 | Fam19a5 | body |
| chr15 | 88983409 | 89055152 | Mov10l1 | body |
| chr15 | 89059234 | 89060234 | Panx2 | TSS500 |
| chr15 | 89074624 | 89075624 | Trabd | TSS500 |
| chr15 | 89123307 | 89128200 | Hdac10 | body |
| chr15 | 89140203 | 89141203 | Mapk12 | TSS500 |
| chr15 | 89142486 | 89149106 | Mapk11 | body |
| chr15 | 89322472 | 89323472 | Adm2 | TSS500 |
| chr15 | 89378754 | 89379754 | Odf3b | TSS500 |
| chr15 | 89453413 | 89454413 | Mapk8ip2 | TSS500 |

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| chr15 | 89472476 | 89476925 | Arsa | body |
| chr15 | 89499123 | 89500123 | Shank3 | TSS500 |
| chr15 | 89582533 | 89591423 | Rabl2 | body |
| chr15 | 89841360 | 89842360 | Syt10 | TSS500 |
| chr15 | 91049448 | 91050448 | Kif21a | TSS500 |
| chr15 | 90933276 | 91049448 | Kif21a | body |
| chr15 | 91199994 | 91260894 | CN725425 | body |
| chr15 | 91572761 | 91573761 | Slc2a13 | TSS500 |
| chr15 | 91598083 | 91604676 | 4933438A12Rik | body |
| chr15 | 91838765 | 91861438 | Smgc | body |
| chr15 | 92050665 | 92051665 | Cntn1 | TSS500 |
| chr15 | 92051665 | 92341967 | Cntn1 | body |
| chr15 | 92396415 | 92397415 | Pdzrn4 | TSS500 |
| chr15 | 92397415 | 92771819 | Pdzrn4 | body |
| chr15 | 94464918 | 94465918 | Adamts20 | TSS500 |
| chr15 | 94628685 | 94629685 | Tmem117 | TSS500 |
| chr15 | 95528206 | 95529206 | Nell2 | TSS500 |
| chr15 | 95623563 | 95655460 | Dbx2 | body |
| chr15 | 95787856 | 95791142 | A130051J06Rik | body |
| chr15 | 95824459 | 95829572 | Gm17546 | body |
| chr15 | 96051616 | 96079053 | D030018L15Rik | body |
| chr15 | 96134819 | 96283995 | 2610037D02Rik | body |
| chr15 | 96642413 | 96643413 | Slc38a1 | TSS500 |
| chr15 | 96994823 | 97055456 | Slc38a4 | body |
| chr15 | 97705322 | 97706322 | Rpap3 | TSS500 |
| chr15 | 97767472 | 97768472 | Rapgef3 | TSS500 |
| chr15 | 97744770 | 97767472 | Rapgef3 | body |
| chr15 | 97760908 | 97766961 | Rapgef3os1 | body |
| chr15 | 97766049 | 97767049 | Rapgef3os2 | TSS500 |
| chr15 | 97767049 | 97768713 | Rapgef3os2 | body |
| chr15 | 98004195 | 98005195 | Col2a1 | TSS500 |
| chr15 | 97975602 | 98004195 | Col2a1 | body |
| chr15 | 98167306 | 98168306 | Ccdc184 | TSS500 |
| chr15 | 98168306 | 98170134 | Ccdc184 | body |
| chr15 | 98256807 | 98257807 | H1fnt | TSS500 |
| chr15 | 98255982 | 98256807 | H1fnt | body |
| chr15 | 98295630 | 98296630 | Zfp641 | TSS500 |
| chr15 | 98285588 | 98295630 | Zfp641 | body |
| chr15 | 98378096 | 98378697 | Olfr283 | body |
| chr15 | 98398919 | 98416268 | 1700031M16Rik | body |
| chr15 | 98455812 | 98456812 | Olfr281 | TSS500 |
| chr15 | 98456812 | 98457247 | Olfr281 | body |
| chr15 | 98497974 | 98498406 | Olfr279 | body |
| chr15 | 98645134 | 98662389 | Ddx23 | body |

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| chr15 | 98707707 | 98708707 | Ccdc65 | TSS500 |
| chr15 | 98777650 | 98778650 | Wnt10b | TSS500 |
| chr15 | 98771753 | 98777650 | Wnt10b | body |
| chr15 | 98898040 | 98899040 | Dhh | TSS500 |
| chr15 | 98985465 | 98986465 | 4930578M01Rik | TSS500 |
| chr15 | 99054674 | 99055674 | Prph | TSS500 |
| chr15 | 99055674 | 99058978 | Prph | body |
| chr15 | 99087317 | 99088317 | C1ql4 | TSS500 |
| chr15 | 99093670 | 99104737 | Dnajc22 | body |
| chr15 | 99271018 | 99286680 | Fam186b | body |
| chr15 | 99369982 | 99370982 | Fmnl3 | TSS500 |
| chr15 | 99601900 | 99605477 | Aqp6 | body |
| chr15 | 99702176 | 99704990 | Gm17349 | body |
| chr15 | 99702787 | 99713995 | Smarcd1 | body |
| chr15 | 99734881 | 99772385 | Cers5 | body |
| chr15 | 99918348 | 99966575 | Fam186a | body |
| chr15 | 99932211 | 99953044 | Gm21917 | body |
| chr15 | 100335429 | 100340341 | Mettl7a3 | body |
| chr15 | 100352649 | 100353649 | Mettl7a2Higd1c | TSS500 |
| chr15 | 100352700 | 100353700 | Mettl7a2 | TSS500 |
| chr15 | 100353700 | 100361840 | Mettl7a2 | body |
| chr15 | 100387898 | 100424572 | Slc11a2 | body |
| chr15 | 100422647 | 100428150 | Gm5475 | body |
| chr15 | 100551508 | 100552508 | Tfcp2 | TSS500 |
| chr15 | 100585596 | 100586596 | Gm20680 | TSS500 |
| chr15 | 100636365 | 100637365 | Smagp | TSS500 |
| chr15 | 100621342 | 100636365 | Smagp | body |
| chr15 | 100728876 | 100729876 | Galnt6 | TSS500 |
| chr15 | 100870183 | 100871183 | Scn8a | TSS500 |
| chr15 | 100871183 | 101045929 | Scn8a | body |
| chr15 | 101116255 | 101120022 | Ankrd33 | body |
| chr15 | 101131092 | 101132092 | Gm16031 | TSS500 |
| chr15 | 101223621 | 101224621 | A330009N23Rik | TSS500 |
| chr15 | 101221196 | 101223621 | A330009N23Rik | body |
| chr15 | 101369625 | 101370625 | Krt80 | TSS500 |
| chr15 | 101411543 | 101430313 | Krt7 | body |
| chr15 | 101438304 | 101439304 | Krt83 | TSS500 |
| chr15 | 101448245 | 101453909 | 1700011A15Rik | body |
| chr15 | 101459061 | 101463265 | Krt81 | body |
| chr15 | 101473978 | 101479983 | Krt86 | body |
| chr15 | 101491012 | 101492012 | 5430421N21Rik | TSS500 |
| chr15 | 101550159 | 101551159 | Krt82 | TSS500 |
| chr15 | 101541229 | 101550159 | Krt82 | body |
| chr15 | 101573404 | 101574404 | Krt75 | TSS500 |

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| chr15 | 101563345 | 101573404 | Krt75 | body |
| chr15 | 101676034 | 101679789 | Krt6b | body |
| chr15 | 101712391 | 101713391 | Krt5 | TSS500 |
| chr15 | 101707070 | 101712391 | Krt5 | body |
| chr15 | 101785958 | 101786958 | Krt72 | TSS500 |
| chr15 | 101801843 | 101802843 | Krt73 | TSS500 |
| chr15 | 101810689 | 101817669 | Krt2 | body |
| chr15 | 101845428 | 101850286 | Krt1 | body |
| chr15 | 101858732 | 101869205 | Krt77 | body |
| chr15 | 101996711 | 102003842 | Krt8 | body |
| chr15 | 102027716 | 102028716 | Krt18 | TSS500 |
| chr15 | 102143862 | 102144862 | Igfbp6 | TSS500 |
| chr15 | 102144862 | 102149511 | Igfbp6 | body |
| chr15 | 102215995 | 102231435 | Itgb7 | body |
| chr15 | 102325616 | 102326616 | Pfdn5 | TSS500 |
| chr15 | 102331209 | 102332209 | Myg1 | TSS500 |
| chr15 | 102332209 | 102338139 | Myg1 | body |
| chr15 | 102497649 | 102516564 | Map3k12 | body |
| chr15 | 102523843 | 102624567 | Gm28047 | body |
| chr15 | 102525946 | 102624964 | Atf7 | body |
| chr15 | 102671852 | 102672852 | Atp5g2 | TSS500 |
| chr15 | 102671366 | 102672366 | Mir688 | TSS500 |
| chr15 | 102921603 | 102928814 | Hoxc13 | body |
| chr15 | 102936257 | 102937257 | Hoxc12 | TSS500 |
| chr15 | 102953927 | 102954927 | Hoxc11 | TSS500 |
| chr15 | 102954927 | 102957708 | Hoxc11 | body |
| chr15 | 102967296 | 102971893 | Hoxc10 | body |
| chr15 | 102966943 | 102967943 | Hoxc5 | TSS500 |
| chr15 | 102967943 | 103017429 | Hoxc5 | body |
| chr15 | 102990107 | 102991107 | Hoxc8 | TSS500 |
| chr15 | 102998757 | 103011881 | Hoxc6 | body |
| chr15 | 103014410 | 103015410 | Mir615 | TSS500 |
| chr15 | 103019434 | 103036852 | Hoxc4 | body |
| chr15 | 103101611 | 103102611 | Gm28876 | TSS500 |
| chr15 | 103101737 | 103102737 | Gm10830 | TSS500 |
| chr15 | 103146328 | 103147328 | D930007P13Rik | TSS500 |
| chr15 | 103123070 | 103146328 | D930007P13Rik | body |
| chr15 | 103248212 | 103257903 | Nfe2 | body |
| chr15 | 103308236 | 103309938 | Gpr84 | body |
| chr15 | 103339586 | 103340586 | Zfp385a | TSS500 |
| chr15 | 103453325 | 103454325 | Nckap1l | TSS500 |
| chr15 | 103502798 | 103503798 | Pde1b | TSS500 |
| chr15 | 103503798 | 103530052 | Pde1b | body |
| chr15 | 103895859 | 103898812 | Spt1 | body |

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| chr16 | 3744593 | 3750790 | Zfp263 | body |
| chr16 | 3846768 | 3847768 | Zfp174 | TSS500 |
| chr16 | 3858321 | 3884061 | Zfp597 | body |
| chr16 | 3862884 | 3884505 | Gm26675 | body |
| chr16 | 3871875 | 3872875 | Naa60 | TSS500 |
| chr16 | 4595213 | 4624924 | Glis2 | body |
| chr16 | 4726861 | 4766742 | Hmox2 | body |
| chr16 | 5008730 | 5013017 | Rogdi | body |
| chr16 | 5013906 | 5049410 | Glyr1 | body |
| chr16 | 5146609 | 5147609 | Sec14I5 | TSS500 |
| chr16 | 6809722 | 7412479 | Rbfox1 | body |
| chr16 | 8424636 | 8425636 | Cldn26 | TSS500 |
| chr16 | 8471288 | 8490684 | Mettl22 | body |
| chr16 | 8633884 | 8637212 | Tmem186 | body |
| chr16 | 10169726 | 10170726 | Rpl39l | TSS500 |
| chr16 | 10193212 | 10243051 | Atf7ip2 | body |
| chr16 | 10281749 | 10313468 | Emp2 | body |
| chr16 | 10357948 | 10394990 | Tekt5 | body |
| chr16 | 10542554 | 10543554 | Dexi | TSS500 |
| chr16 | 10545839 | 10744878 | Clec16a | body |
| chr16 | 11066798 | 11074983 | Snn | body |
| chr16 | 11143625 | 11144625 | Gm23935 | TSS500 |
| chr16 | 11203883 | 11225796 | 2610020C07Rik | body |
| chr16 | 11314312 | 11320074 | Tnfrsf17 | body |
| chr16 | 11323408 | 11755472 | Snx29 | body |
| chr16 | 11901863 | 11930600 | Gm9961 | body |
| chr16 | 11984613 | 12270902 | Shisa9 | body |
| chr16 | 13667670 | 13668670 | Parn | TSS500 |
| chr16 | 13833148 | 13902631 | Pdxdc1 | body |
| chr16 | 13903661 | 13949619 | Mpv17l | body |
| chr16 | 13986104 | 13987104 | 2900011O08Rik | TSS500 |
| chr16 | 14109166 | 14158774 | Marf1 | body |
| chr16 | 14501600 | 14502600 | Gm1758 | TSS500 |
| chr16 | 14907137 | 14925879 | Efcab1 | body |
| chr16 | 16600049 | 16601049 | Fgd4 | TSS500 |
| chr16 | 16868402 | 16870343 | Vpreb1 | body |
| chr16 | 17113399 | 17124606 | 2610318N02Rik | body |
| chr16 | 17146729 | 17147729 | Ccdc116 | TSS500 |
| chr16 | 17144121 | 17145121 | Ydjc | TSS500 |
| chr16 | 17233072 | 17234072 | Hic2 | TSS500 |
| chr16 | 17489111 | 17490111 | Aifm3 | TSS500 |
| chr16 | 17509188 | 17526333 | Lztr1 | body |
| chr16 | 17560747 | 17561747 | Lrrc74b | TSS500 |
| chr16 | 17562385 | 17577800 | P2rx6 | body |

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| chr16 | 17572018 | 17576498 | Slc7a4 | body |
| chr16 | 17894723 | 17897922 | Tssk1 | body |
| chr16 | 17914559 | 17915559 | Gsc2 | TSS500 |
| chr16 | 17913107 | 17914559 | Gsc2 | body |
| chr16 | 17980065 | 17981065 | Vpreb2 | TSS500 |
| chr16 | 18052360 | 18053360 | Dgcr6 | TSS500 |
| chr16 | 18127142 | 18128142 | Rtn4r | TSS500 |
| chr16 | 18128142 | 18152408 | Rtn4r | body |
| chr16 | 18218670 | 18219313 | Gm7873 | body |
| chr16 | 18249179 | 18254772 | Trmt2a | body |
| chr16 | 18586469 | 18587469 | Tbx1 | TSS500 |
| chr16 | 18581713 | 18586469 | Tbx1 | body |
| chr16 | 18591492 | 18592492 | 4930588K23Rik | TSS500 |
| chr16 | 18592492 | 18609751 | 4930588K23Rik | body |
| chr16 | 18621811 | 18629438 | sept-05 | body |
| chr16 | 19760708 | 19772753 | B3gnt5 | body |
| chr16 | 19946499 | 19982537 | Klhl6 | body |
| chr16 | 20098054 | 20127744 | Klhl24 | body |
| chr16 | 20240858 | 20241858 | Map6d1 | TSS500 |
| chr16 | 20605451 | 20610268 | Alg3 | body |
| chr16 | 20692782 | 20693782 | Fam131a | TSS500 |
| chr16 | 20693782 | 20703048 | Fam131a | body |
| chr16 | 20734011 | 20735011 | Thpo | TSS500 |
| chr16 | 20733627 | 20742384 | Chrd | body |
| chr16 | 21247518 | 21296372 | Gm16863 | body |
| chr16 | 21694165 | 21695165 | 2510009E07Rik | TSS500 |
| chr16 | 21787344 | 21788344 | Ehhadh | TSS500 |
| chr16 | 21892469 | 21931877 | Map3k13 | body |
| chr16 | 21953826 | 21995042 | Liph | body |
| chr16 | 22381309 | 22439219 | Etv5 | body |
| chr16 | 22656721 | 22657721 | Dgkg | TSS500 |
| chr16 | 22468461 | 22656721 | Dgkg | body |
| chr16 | 22892542 | 22899438 | Ahsg | body |
| chr16 | 22951572 | 22961656 | Hrg | body |
| chr16 | 22985854 | 23028601 | Kng2 | body |
| chr16 | 23058365 | 23082068 | Kng1 | body |
| chr16 | 23225240 | 23360350 | St6gal1 | body |
| chr16 | 23451785 | 23520090 | Masp1 | body |
| chr16 | 23609419 | 23610419 | Rtp4 | TSS500 |
| chr16 | 26371341 | 26372341 | Cldn1 | TSS500 |
| chr16 | 26503793 | 26526271 | Tmem207 | body |
| chr16 | 26989474 | 26990474 | Gmnc | TSS500 |
| chr16 | 26957236 | 26989474 | Gmnc | body |
| chr16 | 27307989 | 27351212 | Ostn | body |

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| chr16 | 28444727 | 28445727 | Fgf12 | TSS500 |
| chr16 | 29811558 | 29837814 | Gm26834 | body |
| chr16 | 29946017 | 29947017 | Gm26569 | TSS500 |
| chr16 | 29907519 | 29946017 | Gm26569 | body |
| chr16 | 30205379 | 30206379 | Gm26562 | TSS500 |
| chr16 | 30256378 | 30267032 | Cpn2 | body |
| chr16 | 30282756 | 30283756 | Lrrc15 | TSS500 |
| chr16 | 30269302 | 30282756 | Lrrc15 | body |
| chr16 | 30388337 | 30389337 | Atp13a3 | TSS500 |
| chr16 | 31429276 | 31430276 | Gm15743 | TSS500 |
| chr16 | 31427876 | 31429276 | Gm15743 | body |
| chr16 | 31878310 | 31879310 | Mfi2 | TSS500 |
| chr16 | 31933351 | 31934351 | Pigz | TSS500 |
| chr16 | 31934351 | 31946046 | Pigz | body |
| chr16 | 31962506 | 32002787 | Senp5 | body |
| chr16 | 32400006 | 32401006 | Tm4sf19 | TSS500 |
| chr16 | 32777419 | 32796935 | Muc20 | body |
| chr16 | 32914600 | 33015647 | Lrch3 | body |
| chr16 | 33015385 | 33055718 | lqcg | body |
| chr16 | 33185571 | 33243311 | Osbp11 | body |
| chr16 | 33516828 | 33517828 | Slc12a8 | TSS500 |
| chr16 | 33794537 | 33819934 | Muc13 | body |
| chr16 | 34650421 | 34678618 | Ropn1 | body |
| chr16 | 34745710 | 35002420 | Mylk | body |
| chr16 | 35154377 | 35155377 | Adcy5 | TSS500 |
| chr16 | 35311131 | 35363418 | Sec22a | body |
| chr16 | 35540645 | 35541645 | Sema5b | TSS500 |
| chr16 | 35768856 | 35769856 | Dirc2 | TSS500 |
| chr16 | 35938970 | 35972605 | Parp9 | body |
| chr16 | 35966752 | 35982730 | Gm15564 | body |
| chr16 | 36221968 | 36257444 | 2010005H15Rik | body |
| chr16 | 36561641 | 36562641 | Casr | TSS500 |
| chr16 | 36603869 | 36665581 | Cd86 | body |
| chr16 | 36693478 | 36694478 | lldr1 | TSS500 |
| chr16 | 36935483 | 36963212 | Hcls1 | body |
| chr16 | 36989967 | 36990967 | Fbxo40 | TSS500 |
| chr16 | 37384462 | 37385462 | Stxbp5l | TSS500 |
| chr16 | 37915996 | 37916996 | Gpr156 | TSS500 |
| chr16 | 38297754 | 38341643 | Maats1 | body |
| chr16 | 38445399 | 38452189 | Adprh | body |
| chr16 | 38549758 | 38550758 | Poglut1 | TSS500 |
| chr16 | 38741764 | 38742764 | B4galt4 | TSS500 |
| chr16 | 38742764 | 38769049 | B4galt4 | body |
| chr16 | 39983861 | 39984861 | Lsamp | TSS500 |

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|-------|----------|----------|---------------|--------|
| chr16 | 39984861 | 42181679 | Lsamp | body |
| chr16 | 42340151 | 42341151 | Gap43 | TSS500 |
| chr16 | 43978593 | 43979593 | Zdhhc23 | TSS500 |
| chr16 | 44330497 | 44333050 | Gm26732 | body |
| chr16 | 44347621 | 44388497 | Spice1 | body |
| chr16 | 44395296 | 44482428 | Cfap44 | body |
| chr16 | 44485045 | 44558397 | Boc | body |
| chr16 | 44736768 | 44745863 | Gtpbp8 | body |
| chr16 | 44766236 | 44794978 | Cd200r1 | body |
| chr16 | 44812233 | 44839150 | Cd200r4 | body |
| chr16 | 45224815 | 45252895 | Btla | body |
| chr16 | 45411768 | 45492469 | Gm609 | body |
| chr16 | 45656315 | 45693158 | Tmprss7 | body |
| chr16 | 45746243 | 45953098 | Phldb2 | body |
| chr16 | 45946106 | 45971370 | Gm15638 | body |
| chr16 | 46498025 | 46499025 | Pvrl3 | TSS500 |
| chr16 | 48072944 | 48073944 | Gm7275 | TSS500 |
| chr16 | 48283235 | 48284235 | Dppa4 | TSS500 |
| chr16 | 48309977 | 48310977 | Dppa2 | TSS500 |
| chr16 | 48431737 | 48630905 | Morc1 | body |
| chr16 | 49057986 | 49199104 | Myh15 | body |
| chr16 | 49210641 | 49255272 | 1700026J12Rik | body |
| chr16 | 50526804 | 50559435 | G730013B05Rik | body |
| chr16 | 50719294 | 50732273 | 5330426P16Rik | body |
| chr16 | 50783909 | 50784091 | 1700116B05Rik | body |
| chr16 | 52032049 | 52208047 | Cblb | body |
| chr16 | 52453574 | 52454574 | Alcam | TSS500 |
| chr16 | 55225175 | 55297486 | Zpld1 | body |
| chr16 | 56007245 | 56029239 | Pcnp | body |
| chr16 | 56032609 | 56037319 | Trmt10c | body |
| chr16 | 56075909 | 56190011 | Senp7 | body |
| chr16 | 56478346 | 56690128 | Abi3bp | body |
| chr16 | 56690332 | 56716950 | Tfg | body |
| chr16 | 57166832 | 57167832 | Nit2 | TSS500 |
| chr16 | 57266139 | 57292365 | Tmem30c | body |
| chr16 | 58468125 | 58523743 | St3gal6 | body |
| chr16 | 58670708 | 58680391 | Cpox | body |
| chr16 | 58717435 | 58718224 | Gpr15 | body |
| chr16 | 59406832 | 59407832 | Gabrr3 | TSS500 |
| chr16 | 59407832 | 59461889 | Gabrr3 | body |
| chr16 | 59490775 | 59555252 | Crybg3 | body |
| chr16 | 59612949 | 59638891 | Arl6 | body |
| chr16 | 60605031 | 60606031 | Epha6 | TSS500 |
| chr16 | 60604266 | 60605266 | Gm9017 | TSS500 |

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| chr16 | 60605266 | 60611236 | Gm9017 | body |
| chr16 | 62854807 | 62929346 | Pros1 | body |
| chr16 | 63863658 | 63864658 | Epha3 | TSS500 |
| chr16 | 63543538 | 63863658 | Epha3 | body |
| chr16 | 64852496 | 64859507 | Cggbp1 | body |
| chr16 | 65105284 | 65106284 | Htr1f | TSS500 |
| chr16 | 64924729 | 65105284 | Htr1f | body |
| chr16 | 66655421 | 67620408 | Cadm2 | body |
| chr16 | 66893003 | 66910841 | 4933411O13Rik | body |
| chr16 | 72662649 | 72663649 | Robo1 | TSS500 |
| chr16 | 72663649 | 73046095 | Robo1 | body |
| chr16 | 74411325 | 74412325 | Robo2 | TSS500 |
| chr16 | 73892306 | 74411325 | Robo2 | body |
| chr16 | 75592344 | 75593344 | Rbm11 | TSS500 |
| chr16 | 78376692 | 78377692 | Btg3 | TSS500 |
| chr16 | 78576157 | 78577157 | D16Ertd472e | TSS500 |
| chr16 | 78931448 | 78951733 | Chodl | body |
| chr16 | 78953008 | 79090597 | Tmprss15 | body |
| chr16 | 81200197 | 81201197 | Ncam2 | TSS500 |
| chr16 | 81201197 | 81624285 | Ncam2 | body |
| chr16 | 84717576 | 84735242 | Mrpl39 | body |
| chr16 | 85552897 | 85553897 | Cyyr1 | TSS500 |
| chr16 | 85421533 | 85552897 | Cyyr1 | body |
| chr16 | 87896196 | 88055676 | Grik1 | body |
| chr16 | 88647296 | 88648296 | Krtap26-1 | TSS500 |
| chr16 | 88820715 | 88829844 | Krtap15 | body |
| chr16 | 90385897 | 90386897 | Hunk | TSS500 |
| chr16 | 90386897 | 90499553 | Hunk | body |
| chr16 | 90737824 | 90738824 | Mrap | TSS500 |
| chr16 | 90936092 | 91010808 | Synj1 | body |
| chr16 | 91168197 | 91170901 | Gm9881 | body |
| chr16 | 91226050 | 91228677 | Olig2 | body |
| chr16 | 91269272 | 91270272 | Olig1 | TSS500 |
| chr16 | 91270272 | 91271933 | Olig1 | body |
| chr16 | 91328495 | 91329495 | Gm15966 | TSS500 |
| chr16 | 91320452 | 91328495 | Gm15966 | body |
| chr16 | 91392221 | 91419451 | Gm21970 | body |
| chr16 | 91648006 | 91679221 | Son | body |
| chr16 | 92300786 | 92301786 | Smim11 | TSS500 |
| chr16 | 92358968 | 92359968 | Kcne1 | TSS500 |
| chr16 | 92391953 | 92465646 | Rcan1 | body |
| chr16 | 92486236 | 92541243 | Clic6 | body |
| chr16 | 93072255 | 93073255 | Gm28003 | TSS500 |
| chr16 | 93391677 | 93458372 | 1700029J03Rik | body |

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| chr16 | 93583457 | 93603563 | Setd4 | body |
| chr16 | 93607337 | 93608337 | Cbr1 | TSS500 |
| chr16 | 93682715 | 93683715 | Cbr3 | TSS500 |
| chr16 | 94008337 | 94009337 | Cldn14 | TSS500 |
| chr16 | 93919031 | 94008337 | Cldn14 | body |
| chr16 | 94084760 | 94085760 | Sim2 | TSS500 |
| chr16 | 94085760 | 94127032 | Sim2 | body |
| chr16 | 94129195 | 94313063 | Hlcs | body |
| chr16 | 94327920 | 94328920 | Ripply3 | TSS500 |
| chr16 | 94358763 | 94370515 | Pigp | body |
| chr16 | 94497783 | 94526330 | Dscr3 | body |
| chr16 | 94570510 | 94695517 | Dyrk1a | body |
| chr16 | 94997196 | 94998196 | Kcnj6 | TSS500 |
| chr16 | 94749266 | 94997196 | Kcnj6 | body |
| chr16 | 95258058 | 95300260 | Kcnj15 | body |
| chr16 | 95359169 | 95586093 | Erg | body |
| chr16 | 95928577 | 95929577 | 1600002D24Rik | TSS500 |
| chr16 | 95831123 | 95928577 | 1600002D24Rik | body |
| chr16 | 95992092 | 96082026 | Brwd1 | body |
| chr16 | 96191757 | 96192757 | Lca5l | TSS500 |
| chr16 | 96199970 | 96200970 | Sh3bgr | TSS500 |
| chr16 | 96200970 | 96228933 | Sh3bgr | body |
| chr16 | 96362168 | 96525580 | Igsf5 | body |
| chr16 | 96422288 | 96443119 | Itgb2l | body |
| chr16 | 97170252 | 97171252 | Dscam | TSS500 |
| chr16 | 96592079 | 97170252 | Dscam | body |
| chr16 | 97610695 | 97611695 | Tmprss2 | TSS500 |
| chr16 | 97564684 | 97610695 | Tmprss2 | body |
| chr16 | 97763237 | 97764237 | Ripk4 | TSS500 |
| chr16 | 97741933 | 97763237 | Ripk4 | body |
| chr16 | 97855210 | 97922133 | C2cd2 | body |
| chr17 | 3635240 | 3695761 | Nox3 | body |
| chr17 | 5492100 | 5493100 | Zdhhc14 | TSS500 |
| chr17 | 5493100 | 5753891 | Zdhhc14 | body |
| chr17 | 5798157 | 5799157 | 3300005D01Rik | TSS500 |
| chr17 | 6080286 | 6086517 | Gtf2h5 | body |
| chr17 | 6270975 | 6305783 | Tmem181a | body |
| chr17 | 6738041 | 6782284 | Ezr | body |
| chr17 | 7026337 | 7087467 | Gm1604b | body |
| chr17 | 7325146 | 7345974 | Tcp10a | body |
| chr17 | 7350904 | 7352196 | Ttll2 | body |
| chr17 | 7363712 | 7384805 | Gm9992 | body |
| chr17 | 7826802 | 7827802 | Fndc1 | TSS500 |
| chr17 | 7738569 | 7826802 | Fndc1 | body |

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|-------|----------|----------|---------------|--------|
| chr17 | 7925500 | 7926500 | Tagap | TSS500 |
| chr17 | 7926500 | 7934897 | Tagap | body |
| chr17 | 7946153 | 7979824 | Rsph3a | body |
| chr17 | 8339906 | 8340906 | Prr18 | TSS500 |
| chr17 | 8340906 | 8344112 | Prr18 | body |
| chr17 | 8388968 | 8389968 | Gm16702 | TSS500 |
| chr17 | 8379045 | 8388968 | Gm16702 | body |
| chr17 | 8433923 | 8434923 | T | TSS500 |
| chr17 | 8434923 | 8442496 | T | body |
| chr17 | 8525872 | 8986648 | Pde10a | body |
| chr17 | 8988833 | 9008319 | 1700010I14Rik | body |
| chr17 | 9147719 | 9167336 | 6530411M01Rik | body |
| chr17 | 9421560 | 9422560 | Gm17728 | TSS500 |
| chr17 | 9666497 | 9669204 | Pabpc6 | body |
| chr17 | 10403012 | 10839811 | Pacrg | body |
| chr17 | 10456716 | 10493055 | A230009B12Rik | body |
| chr17 | 10496946 | 10569396 | Gm16168 | body |
| chr17 | 10840884 | 12063361 | Park2 | body |
| chr17 | 11082250 | 11088968 | Gm28505 | body |
| chr17 | 12379109 | 12419384 | Plg | body |
| chr17 | 12507204 | 12508204 | Slc22a3 | TSS500 |
| chr17 | 12419972 | 12507204 | Slc22a3 | body |
| chr17 | 12648874 | 12675338 | Slc22a1 | body |
| chr17 | 12769164 | 12770164 | Igf2r | TSS500 |
| chr17 | 12682406 | 12769164 | Igf2r | body |
| chr17 | 12740811 | 12741811 | Airn | TSS500 |
| chr17 | 12911349 | 12915845 | Mrpl18 | body |
| chr17 | 13051321 | 13051780 | Gpr31b | body |
| chr17 | 13108617 | 13131291 | Unc93a | body |
| chr17 | 13354072 | 13355072 | Tcp10c | TSS500 |
| chr17 | 13355072 | 13377223 | Tcp10c | body |
| chr17 | 13761325 | 13762325 | Tcte2 | TSS500 |
| chr17 | 13759406 | 13759868 | Gm16049 | body |
| chr17 | 14203331 | 14204331 | Dact2 | TSS500 |
| chr17 | 14195231 | 14203331 | Dact2 | body |
| chr17 | 14279006 | 14280006 | Smoc2 | TSS500 |
| chr17 | 14280006 | 14404790 | Smoc2 | body |
| chr17 | 14934153 | 14935153 | Wdr27 | TSS500 |
| chr17 | 14829331 | 14934153 | Wdr27 | body |
| chr17 | 14943684 | 14959570 | 1600012H06Rik | body |
| chr17 | 15376372 | 15377372 | Dll1 | TSS500 |
| chr17 | 15367354 | 15376372 | Dll1 | body |
| chr17 | 15374500 | 15375500 | A930024N18Rik | TSS500 |
| chr17 | 15375500 | 15379475 | A930024N18Rik | body |

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|-------|----------|----------|---------------|--------|
| chr17 | 15475721 | 15497776 | Psemb1 | body |
| chr17 | 15563854 | 15564854 | Prdm9 | TSS500 |
| chr17 | 17704441 | 17734167 | Vmn2r90 | body |
| chr17 | 17888352 | 17971677 | Fpr3 | body |
| chr17 | 18085557 | 18136643 | Vmn2r91 | body |
| chr17 | 18152430 | 18185178 | Vmn2r92 | body |
| chr17 | 18424604 | 18452324 | Vmn2r95 | body |
| chr17 | 20540517 | 20564256 | Vmn2r109 | body |
| chr17 | 21383248 | 21384248 | Zfp677 | TSS500 |
| chr17 | 21535378 | 21536378 | 9330136K24Rik | TSS500 |
| chr17 | 21707241 | 21708241 | Zfp760 | TSS500 |
| chr17 | 21731295 | 21769342 | Zfp229 | body |
| chr17 | 21845259 | 21846259 | Zfp820 | TSS500 |
| chr17 | 21909426 | 21910426 | 2210404O09Rik | TSS500 |
| chr17 | 22165690 | 22166690 | Zfp947 | TSS500 |
| chr17 | 22360900 | 22361900 | Zfp944 | TSS500 |
| chr17 | 22360953 | 22361953 | Zfp758 | TSS500 |
| chr17 | 22547941 | 22572773 | Vmn2r111 | body |
| chr17 | 22689271 | 22690271 | Gm9805 | TSS500 |
| chr17 | 22817241 | 22818241 | Gm16386 | TSS500 |
| chr17 | 22784798 | 22817241 | Gm16386 | body |
| chr17 | 22866634 | 22867634 | Zfp945 | TSS500 |
| chr17 | 22846697 | 22866634 | Zfp945 | body |
| chr17 | 23644769 | 23645769 | Mmp25 | TSS500 |
| chr17 | 23745329 | 23746329 | Kremen2 | TSS500 |
| chr17 | 23742734 | 23743734 | 9530082P21Rik | TSS500 |
| chr17 | 23791162 | 23824741 | Srrm2 | body |
| chr17 | 23844355 | 23859776 | Prss32 | body |
| chr17 | 23942172 | 23945607 | Sbp | body |
| chr17 | 23954419 | 23955419 | Sbpl | TSS500 |
| chr17 | 23993535 | 23997600 | Prss22 | body |
| chr17 | 24205062 | 24206062 | Tbc1d24 | TSS500 |
| chr17 | 24208887 | 24209887 | Ntn3 | TSS500 |
| chr17 | 24203848 | 24208887 | Ntn3 | body |
| chr17 | 24414175 | 24415175 | Rnps1 | TSS500 |
| chr17 | 24649805 | 24650805 | Slc9a3r2 | TSS500 |
| chr17 | 24689455 | 24690455 | Syng3 | TSS500 |
| chr17 | 24685092 | 24689455 | Syng3 | body |
| chr17 | 24715839 | 24717557 | Rnf151 | body |
| chr17 | 24752503 | 24753503 | Hs3st6 | TSS500 |
| chr17 | 24803882 | 24804882 | Meiob | TSS500 |
| chr17 | 24848896 | 24849802 | Fahd1 | body |
| chr17 | 24896000 | 24897000 | Nme3 | TSS500 |
| chr17 | 25099570 | 25115467 | Telo2 | body |

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|-------|----------|----------|---------------|--------|
| chr17 | 25121260 | 25125268 | Ptx4 | body |
| chr17 | 25472090 | 25476594 | Tekt4 | body |
| chr17 | 25565892 | 25570186 | Sox8 | body |
| chr17 | 25716671 | 25717671 | Gng13 | TSS500 |
| chr17 | 25735540 | 25736540 | Mslnl | TSS500 |
| chr17 | 25748614 | 25753827 | Msln | body |
| chr17 | 25790508 | 25791784 | Fam173a | body |
| chr17 | 25794571 | 25796636 | Metrn | body |
| chr17 | 25794394 | 25795394 | Gm26694 | TSS500 |
| chr17 | 25808585 | 25809585 | Fbxl16 | TSS500 |
| chr17 | 25809585 | 25821244 | Fbxl16 | body |
| chr17 | 25823127 | 25824127 | Wdr24 | TSS500 |
| chr17 | 25828367 | 25829367 | Jmjd8 | TSS500 |
| chr17 | 25836795 | 25837795 | Rhbdl1 | TSS500 |
| chr17 | 25834465 | 25841263 | Gm20683 | body |
| chr17 | 25861001 | 25862001 | Wdr90 | TSS500 |
| chr17 | 25946387 | 25952065 | A930017K11Rik | body |
| chr17 | 25950972 | 25951972 | D630044L22Rik | TSS500 |
| chr17 | 25951972 | 25963610 | D630044L22Rik | body |
| chr17 | 26081211 | 26089829 | Decr2 | body |
| chr17 | 26095008 | 26096008 | Nme4 | TSS500 |
| chr17 | 26113816 | 26123254 | Tmem8 | body |
| chr17 | 26196226 | 26207286 | Arhgdig | body |
| chr17 | 26620358 | 26624600 | Gm17218 | body |
| chr17 | 26780579 | 26781579 | Bnip1 | TSS500 |
| chr17 | 26838664 | 26841065 | Nkx2-5 | body |
| chr17 | 26941884 | 26972434 | Syngap1 | body |
| chr17 | 27028509 | 27029509 | Bak1 | TSS500 |
| chr17 | 27143969 | 27167264 | Ip6k3 | body |
| chr17 | 27201532 | 27203071 | Gm26724 | body |
| chr17 | 27342960 | 27344825 | Gm10505 | body |
| chr17 | 27557120 | 27563674 | Hmga1 | body |
| chr17 | 27656009 | 27711106 | Pacsin1 | body |
| chr17 | 27714352 | 27728451 | Spdef | body |
| chr17 | 27909840 | 28062600 | Anks1 | body |
| chr17 | 28007932 | 28008932 | Gm15598 | TSS500 |
| chr17 | 27988028 | 28007932 | Gm15598 | body |
| chr17 | 28080139 | 28081139 | Tcp11 | TSS500 |
| chr17 | 28141816 | 28142816 | Scube3 | TSS500 |
| chr17 | 28142816 | 28174852 | Scube3 | body |
| chr17 | 28208278 | 28228608 | Def6 | body |
| chr17 | 28331671 | 28350305 | Tead3 | body |
| chr17 | 28351515 | 28364682 | Tulp1 | body |
| chr17 | 28522648 | 28523648 | Gm20109 | TSS500 |

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|-------|----------|----------|---------------|--------|
| chr17 | 28522757 | 28523757 | E230001N04Rik | TSS500 |
| chr17 | 28530360 | 28531360 | Armc12 | TSS500 |
| chr17 | 28548989 | 28549989 | Clpsl2 | TSS500 |
| chr17 | 28575218 | 28576218 | Lhfpl5 | TSS500 |
| chr17 | 28576218 | 28583593 | Lhfpl5 | body |
| chr17 | 28689487 | 28690487 | Slc26a8 | TSS500 |
| chr17 | 28768807 | 28769807 | Mapk13 | TSS500 |
| chr17 | 28859003 | 28860003 | Pnpla1os | TSS500 |
| chr17 | 28858911 | 28890308 | Pnpla1 | body |
| chr17 | 29237297 | 29238297 | Cpne5 | TSS500 |
| chr17 | 29156550 | 29237297 | Cpne5 | body |
| chr17 | 29319377 | 29329413 | Pi16 | body |
| chr17 | 29332072 | 29347404 | Mtch1 | body |
| chr17 | 29360414 | 29361414 | Fgd2 | TSS500 |
| chr17 | 29827956 | 29969587 | Mdga1 | body |
| chr17 | 30624854 | 30875264 | Dnah8 | body |
| chr17 | 30901367 | 30902367 | Glp1r | TSS500 |
| chr17 | 30902367 | 30936510 | Glp1r | body |
| chr17 | 30954179 | 30955179 | Umodl1 | TSS500 |
| chr17 | 30955179 | 31010708 | Umodl1 | body |
| chr17 | 31057198 | 31058198 | Abcg1 | TSS500 |
| chr17 | 31058198 | 31115777 | Abcg1 | body |
| chr17 | 31152252 | 31153252 | Gm15318 | TSS500 |
| chr17 | 31153252 | 31163052 | Gm15318 | body |
| chr17 | 31161396 | 31164553 | Tff1 | body |
| chr17 | 31198475 | 31199475 | Tmprss3 | TSS500 |
| chr17 | 31179272 | 31198475 | Tmprss3 | body |
| chr17 | 31208373 | 31242202 | Ubash3a | body |
| chr17 | 31255019 | 31276856 | Rsph1 | body |
| chr17 | 31294983 | 31295983 | Slc37a1 | TSS500 |
| chr17 | 31385734 | 31386734 | Pde9a | TSS500 |
| chr17 | 31557626 | 31559113 | 4833413E03Rik | body |
| chr17 | 31636699 | 31637699 | Cbs | TSS500 |
| chr17 | 31612623 | 31636699 | Cbs | body |
| chr17 | 32112929 | 32113929 | Gm17276 | TSS500 |
| chr17 | 32113929 | 32141839 | Gm17276 | body |
| chr17 | 32166380 | 32167380 | Notch3 | TSS500 |
| chr17 | 32120820 | 32166380 | Notch3 | body |
| chr17 | 32189049 | 32190049 | Ephx3 | TSS500 |
| chr17 | 32196274 | 32284222 | Brd4 | body |
| chr17 | 32285287 | 32298689 | Gm26549 | body |
| chr17 | 32369805 | 32378445 | Gm26858 | body |
| chr17 | 32403083 | 32404083 | Rasal3 | TSS500 |
| chr17 | 32390659 | 32403083 | Rasal3 | body |

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| chr17 | 32505962 | 32506962 | Cyp4f17 | TSS500 |
| chr17 | 32506962 | 32528894 | Cyp4f17 | body |
| chr17 | 32658910 | 32659910 | Cyp4f40 | TSS500 |
| chr17 | 32686127 | 32703352 | Cyp4f15 | body |
| chr17 | 33139183 | 33140183 | Morc2b | TSS500 |
| chr17 | 33358378 | 33359378 | Zfp81 | TSS500 |
| chr17 | 33556219 | 33607764 | Myo1f | body |
| chr17 | 33646233 | 33686360 | Hnrnpm | body |
| chr17 | 33742484 | 33760030 | Rab11b | body |
| chr17 | 33781075 | 33782075 | Angptl4 | TSS500 |
| chr17 | 33843591 | 33849774 | Cd320 | body |
| chr17 | 33951999 | 33955501 | Rps18 | body |
| chr17 | 33956312 | 33966984 | Vps52 | body |
| chr17 | 34028267 | 34031190 | Slc39a7 | body |
| chr17 | 34038937 | 34039937 | Col11a2 | TSS500 |
| chr17 | 34039937 | 34066685 | Col11a2 | body |
| chr17 | 34153572 | 34160230 | H2-DMb1 | body |
| chr17 | 34181988 | 34187264 | Psmb9 | body |
| chr17 | 34204949 | 34205949 | Gm20496 | TSS500 |
| chr17 | 34204027 | 34216321 | Tap2 | body |
| chr17 | 34239403 | 34245907 | H2-Ob | body |
| chr17 | 34262709 | 34263709 | H2-Ab1 | TSS500 |
| chr17 | 34263709 | 34269418 | H2-Ab1 | body |
| chr17 | 34293073 | 34305220 | Gm20513 | body |
| chr17 | 34325165 | 34326165 | H2-Eb2 | TSS500 |
| chr17 | 34377632 | 34385776 | Btnl1 | body |
| chr17 | 34399320 | 34460734 | BC051142 | body |
| chr17 | 34563768 | 34564768 | Notch4 | TSS500 |
| chr17 | 34589306 | 34590306 | Gpsm3 | TSS500 |
| chr17 | 34590306 | 34591754 | Gpsm3 | body |
| chr17 | 34590766 | 34591766 | Pbx2 | TSS500 |
| chr17 | 34601091 | 34603190 | Rnf5 | body |
| chr17 | 34628010 | 34629010 | Ppt2 | TSS500 |
| chr17 | 34629033 | 34630033 | Prrt1 | TSS500 |
| chr17 | 34644264 | 34645264 | Fkbpl | TSS500 |
| chr17 | 34671035 | 34719815 | Tnxb | body |
| chr17 | 34837519 | 34839233 | Dxo | body |
| chr17 | 34856374 | 34862018 | Cfb | body |
| chr17 | 34862604 | 34897765 | C2 | body |
| chr17 | 34878983 | 34879983 | Zbtb12 | TSS500 |
| chr17 | 34879983 | 34896867 | Zbtb12 | body |
| chr17 | 34971656 | 34972656 | Hspa1a | TSS500 |
| chr17 | 34972203 | 34973203 | Hspa1l | TSS500 |
| chr17 | 34982362 | 34985891 | Lsm2 | body |

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|-------|----------|----------|---------------|--------|
| chr17 | 35001487 | 35016322 | Vars | body |
| chr17 | 35016079 | 35017079 | Vwa7 | TSS500 |
| chr17 | 35058535 | 35059535 | Ddah2 | TSS500 |
| chr17 | 35065684 | 35066684 | G6b | TSS500 |
| chr17 | 35062693 | 35065684 | G6b | body |
| chr17 | 35064888 | 35065888 | Ly6g6c | TSS500 |
| chr17 | 35220334 | 35221334 | Gm16181 | TSS500 |
| chr17 | 35263230 | 35267499 | H2-D1 | body |
| chr17 | 35320905 | 35325099 | H2-Q1 | body |
| chr17 | 35341742 | 35342742 | H2-Q2 | TSS500 |
| chr17 | 35379792 | 35380792 | Gm11131 | TSS500 |
| chr17 | 35379117 | 35380117 | H2-Q4 | TSS500 |
| chr17 | 35424350 | 35425350 | H2-Q6 | TSS500 |
| chr17 | 35438655 | 35439655 | H2-Q7 | TSS500 |
| chr17 | 35439655 | 35443773 | H2-Q7 | body |
| chr17 | 35470589 | 35474563 | H2-Q10 | body |
| chr17 | 35505518 | 35506518 | Pou5f1 | TSS500 |
| chr17 | 35533701 | 35534647 | Psors1c2 | body |
| chr17 | 35551628 | 35552628 | Cdsn | TSS500 |
| chr17 | 35552628 | 35557180 | Cdsn | body |
| chr17 | 35652328 | 35660367 | Gm20483 | body |
| chr17 | 35704121 | 35705121 | Ddr1 | TSS500 |
| chr17 | 35681567 | 35704121 | Ddr1 | body |
| chr17 | 35703396 | 35704396 | Gm4577 | TSS500 |
| chr17 | 35704396 | 35708244 | Gm4577 | body |
| chr17 | 35739306 | 35740306 | Gm20443 | TSS500 |
| chr17 | 35833921 | 35837806 | Tubb5 | body |
| chr17 | 35860918 | 35866386 | Ppp1r18os | body |
| chr17 | 35861818 | 35865402 | Nrm | body |
| chr17 | 35897446 | 35912215 | Gm16279 | body |
| chr17 | 35897595 | 35909575 | Atat1 | body |
| chr17 | 35980351 | 35989462 | Gnl1 | body |
| chr17 | 35993953 | 35994953 | A930015D03Rik | TSS500 |
| chr17 | 35994953 | 36038435 | A930015D03Rik | body |
| chr17 | 36029773 | 36032355 | H2-T23 | body |
| chr17 | 36043461 | 36058645 | Gm6034 | body |
| chr17 | 36109719 | 36128925 | Gm7030 | body |
| chr17 | 36110926 | 36111926 | BC023719 | TSS500 |
| chr17 | 36145518 | 36163176 | 2410017I17Rik | body |
| chr17 | 36168037 | 36169037 | Gm8909 | TSS500 |
| chr17 | 36164443 | 36168037 | Gm8909 | body |
| chr17 | 36167482 | 36168482 | Gm20478 | TSS500 |
| chr17 | 36248321 | 36249321 | Gm20546 | TSS500 |
| chr17 | 36249321 | 36253679 | Gm20546 | body |

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|-------|----------|----------|---------------|--------|
| chr17 | 36257569 | 36258569 | Rpp21 | TSS500 |
| chr17 | 36258873 | 36271747 | Trim39 | body |
| chr17 | 36284227 | 36285990 | H2-M10.2 | body |
| chr17 | 36367917 | 36368917 | H2-M10.3 | TSS500 |
| chr17 | 36942418 | 36943418 | Rnf39 | TSS500 |
| chr17 | 36943418 | 36947986 | Rnf39 | body |
| chr17 | 36989037 | 36990037 | H2-M5 | TSS500 |
| chr17 | 36984061 | 36989037 | H2-M5 | body |
| chr17 | 37269720 | 37270720 | H2-M3 | TSS500 |
| chr17 | 40875482 | 40880058 | 9130008F23Rik | body |
| chr17 | 40935185 | 40961989 | Mut | body |
| chr17 | 42556783 | 42610813 | Opn5 | body |
| chr17 | 43016055 | 43017055 | Tnfrsf21 | TSS500 |
| chr17 | 43017055 | 43089188 | Tnfrsf21 | body |
| chr17 | 43270829 | 43324737 | Gpr110 | body |
| chr17 | 43534174 | 43543139 | Ankrd66 | body |
| chr17 | 43801351 | 43802351 | Rcan2 | TSS500 |
| chr17 | 44188072 | 44189072 | Clic5 | TSS500 |
| chr17 | 44189072 | 44280168 | Clic5 | body |
| chr17 | 45549177 | 45550177 | Tmem151b | TSS500 |
| chr17 | 45564464 | 45567669 | Slc35b2 | body |
| chr17 | 45599106 | 45600106 | Slc29a1 | TSS500 |
| chr17 | 45601602 | 45602602 | Gm7325 | TSS500 |
| chr17 | 45630204 | 45658825 | Capn11 | body |
| chr17 | 45733344 | 45734344 | 1600014C23Rik | TSS500 |
| chr17 | 45734006 | 45735006 | F630040K05Rik | TSS500 |
| chr17 | 45735006 | 45788594 | F630040K05Rik | body |
| chr17 | 46122035 | 46143716 | Rsph9 | body |
| chr17 | 46147390 | 46153053 | Mad2l1bp | body |
| chr17 | 46297921 | 46303271 | Dlk2 | body |
| chr17 | 46432185 | 46437977 | Slc22a7 | body |
| chr17 | 46487175 | 46488175 | Ttbk1 | TSS500 |
| chr17 | 46545888 | 46546888 | Cul9 | TSS500 |
| chr17 | 46564451 | 46629004 | Ptk7 | body |
| chr17 | 46644644 | 46645644 | Klc4 | TSS500 |
| chr17 | 46711963 | 46725541 | Pex6 | body |
| chr17 | 46728668 | 46729668 | Gnmt | TSS500 |
| chr17 | 46755663 | 46763212 | Ptcra | body |
| chr17 | 46782156 | 46783156 | Rpl7l1 | TSS500 |
| chr17 | 47369387 | 47381417 | Mrps10 | body |
| chr17 | 47394560 | 47400084 | Guca1a | body |
| chr17 | 47409863 | 47410863 | Gm5814 | TSS500 |
| chr17 | 47436115 | 47437115 | AI661453 | TSS500 |
| chr17 | 47488050 | 47501787 | Taf8 | body |

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| chr17 | 47505551 | 47599691 | Ccnd3 | body |
| chr17 | 47612089 | 47683861 | Gm20517 | body |
| chr17 | 47631190 | 47686738 | Usp49 | body |
| chr17 | 47688530 | 47689530 | Frs3 | TSS500 |
| chr17 | 47727342 | 47734482 | Pgc | body |
| chr17 | 47922878 | 47923429 | Gm15556 | body |
| chr17 | 48300538 | 48312534 | Trem12 | body |
| chr17 | 48316641 | 48327024 | B430306N03Rik | body |
| chr17 | 48419231 | 48432228 | Apobec2 | body |
| chr17 | 48455401 | 48539714 | Unc5cl | body |
| chr17 | 49563837 | 49564837 | Daam2 | TSS500 |
| chr17 | 49614636 | 49615636 | Kif6 | TSS500 |
| chr17 | 49615636 | 49909847 | Kif6 | body |
| chr17 | 49895467 | 49896467 | Gm16554 | TSS500 |
| chr17 | 50190174 | 50191174 | Rftn1 | TSS500 |
| chr17 | 49992257 | 50190174 | Rftn1 | body |
| chr17 | 50279394 | 50293099 | Dazl | body |
| chr17 | 50509047 | 50510047 | Plcl2 | TSS500 |
| chr17 | 50510047 | 50688493 | Plcl2 | body |
| chr17 | 50698025 | 50699025 | Gm7334 | TSS500 |
| chr17 | 51832790 | 51833790 | Satb1 | TSS500 |
| chr17 | 51736187 | 51832790 | Satb1 | body |
| chr17 | 52149789 | 52163048 | Gm19585 | body |
| chr17 | 52603209 | 52979194 | Kcnh8 | body |
| chr17 | 53567361 | 53672720 | Kat2b | body |
| chr17 | 53961615 | 53990174 | Sult1c1 | body |
| chr17 | 54298534 | 54299534 | Slc5a7 | TSS500 |
| chr17 | 54273594 | 54298534 | Slc5a7 | body |
| chr17 | 55444882 | 55445882 | St6gal2 | TSS500 |
| chr17 | 55592341 | 55624172 | Vmn2r118 | body |
| chr17 | 55959687 | 55967949 | Ccdc94 | body |
| chr17 | 56005070 | 56006070 | Stap2 | TSS500 |
| chr17 | 56005211 | 56006211 | Mpnd | TSS500 |
| chr17 | 56006211 | 56016790 | Mpnd | body |
| chr17 | 56117096 | 56118096 | Plin5 | TSS500 |
| chr17 | 56119680 | 56121446 | Lrg1 | body |
| chr17 | 56139843 | 56140843 | Sema6b | TSS500 |
| chr17 | 56269319 | 56276286 | Ticam1 | body |
| chr17 | 56609271 | 56610271 | 2410015M20Rik | TSS500 |
| chr17 | 56627643 | 56628643 | Catsperd | TSS500 |
| chr17 | 56830508 | 56831508 | Rfx2 | TSS500 |
| chr17 | 56775897 | 56830508 | Rfx2 | body |
| chr17 | 56843103 | 56873947 | Acsbg2 | body |
| chr17 | 56934888 | 56935888 | Mllt1 | TSS500 |

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| chr17 | 57041154 | 57042154 | Slc25a41 | TSS500 |
| chr17 | 57041275 | 57042275 | Gm17168 | TSS500 |
| chr17 | 57066056 | 57078010 | Dennd1c | body |
| chr17 | 57087282 | 57088282 | Tubb4a | TSS500 |
| chr17 | 57145997 | 57149277 | Cd70 | body |
| chr17 | 57193689 | 57194689 | Tnfsf14 | TSS500 |
| chr17 | 57203970 | 57227636 | C3 | body |
| chr17 | 57358186 | 57359186 | Emr1 | TSS500 |
| chr17 | 57770070 | 58410342 | Cntnap5c | body |
| chr17 | 64331416 | 64332416 | Pja2 | TSS500 |
| chr17 | 65256005 | 65540282 | Tmem232 | body |
| chr17 | 65923066 | 65950687 | Twsg1 | body |
| chr17 | 65967501 | 66076589 | Ankrd12 | body |
| chr17 | 66449250 | 66450250 | Mtcl1 | TSS500 |
| chr17 | 67697765 | 67822645 | Lama1 | body |
| chr17 | 68003620 | 68004620 | Arhgap28 | TSS500 |
| chr17 | 67842713 | 68003620 | Arhgap28 | body |
| chr17 | 68274297 | 68777961 | L3mbtl4 | body |
| chr17 | 68836636 | 68837636 | Tmem200c | TSS500 |
| chr17 | 68837636 | 68843138 | Tmem200c | body |
| chr17 | 69438804 | 69439804 | A930029G22Rik | TSS500 |
| chr17 | 69438826 | 69439826 | A330050F15Rik | TSS500 |
| chr17 | 69968573 | 69969573 | Dlgap1 | TSS500 |
| chr17 | 69969573 | 70821413 | Dlgap1 | body |
| chr17 | 70755082 | 70756082 | 5031415H12Rik | TSS500 |
| chr17 | 70745329 | 70755082 | 5031415H12Rik | body |
| chr17 | 70834164 | 70835164 | Gm20703 | TSS500 |
| chr17 | 70853267 | 70854267 | Gm9320 | TSS500 |
| chr17 | 70854267 | 70875965 | Gm9320 | body |
| chr17 | 70874349 | 70924496 | Gm26510 | body |
| chr17 | 70878578 | 71393284 | Gm26561 | body |
| chr17 | 70990287 | 70991287 | Myl12b | TSS500 |
| chr17 | 70973920 | 70990287 | Myl12b | body |
| chr17 | 71310465 | 71311465 | Emilin2 | TSS500 |
| chr17 | 71458327 | 71459895 | Gm4707 | body |
| chr17 | 71552561 | 71589533 | Spdya | body |
| chr17 | 71616715 | 71659031 | Wdr43 | body |
| chr17 | 71782447 | 71858351 | Clip4 | body |
| chr17 | 72603209 | 72604209 | Alk | TSS500 |
| chr17 | 71869442 | 72603209 | Alk | body |
| chr17 | 72837204 | 72851195 | Ypel5 | body |
| chr17 | 72918805 | 72941942 | Lbh | body |
| chr17 | 73306464 | 73398796 | Capn13 | body |
| chr17 | 73709953 | 73710953 | Galnt14 | TSS500 |

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| chr17 | 73804341 | 73805341 | Ehd3 | TSS500 |
| chr17 | 73805341 | 73832093 | Ehd3 | body |
| chr17 | 73883908 | 73949682 | Xdh | body |
| chr17 | 74047416 | 74048416 | Srd5a2 | TSS500 |
| chr17 | 74017706 | 74047416 | Srd5a2 | body |
| chr17 | 74395108 | 74396108 | Slc30a6 | TSS500 |
| chr17 | 74426295 | 74458608 | Nlrc4 | body |
| chr17 | 74489993 | 74500277 | Yipf4 | body |
| chr17 | 75436405 | 75529043 | Rasgrp3 | body |
| chr17 | 75537086 | 75551446 | Fam98a | body |
| chr17 | 78492065 | 78493541 | Gm10093 | body |
| chr17 | 78508563 | 78627409 | Vit | body |
| chr17 | 78649913 | 78736696 | Strn | body |
| chr17 | 78882542 | 78892500 | Gm26637 | body |
| chr17 | 78916000 | 78917000 | Cebpzos | TSS500 |
| chr17 | 79355199 | 79358022 | Gm17315 | body |
| chr17 | 79614400 | 79615400 | Rmdn2 | TSS500 |
| chr17 | 79706953 | 79714541 | Cyp1b1 | body |
| chr17 | 80523550 | 80563334 | Cdkl4 | body |
| chr17 | 80944132 | 80945132 | Tmem178 | TSS500 |
| chr17 | 80945132 | 81001816 | Tmem178 | body |
| chr17 | 81388691 | 81649107 | Slc8a1 | body |
| chr17 | 83851675 | 83853893 | C430042M11Rik | body |
| chr17 | 84465696 | 84466696 | Thada | TSS500 |
| chr17 | 84511395 | 84512395 | Plekhh2 | TSS500 |
| chr17 | 84658234 | 84682511 | Abcg5 | body |
| chr17 | 84675802 | 84676802 | Abcg8 | TSS500 |
| chr17 | 85613108 | 85614108 | Six3 | TSS500 |
| chr17 | 85614108 | 85629302 | Six3 | body |
| chr17 | 85687774 | 85688774 | Six2 | TSS500 |
| chr17 | 85684277 | 85687774 | Six2 | body |
| chr17 | 85796218 | 85823544 | Gm29418 | body |
| chr17 | 86168285 | 86657919 | Prkce | body |
| chr17 | 86753407 | 86754407 | Epas1 | TSS500 |
| chr17 | 86754407 | 86833410 | Epas1 | body |
| chr17 | 87797494 | 87798494 | Kcnk12 | TSS500 |
| chr17 | 87745837 | 87797494 | Kcnk12 | body |
| chr17 | 88146084 | 88159261 | Gm26612 | body |
| chr17 | 88440211 | 88441211 | Foxn2 | TSS500 |
| chr17 | 88791476 | 88792476 | Lhcgr | TSS500 |
| chr17 | 88741549 | 88791476 | Lhcgr | body |
| chr17 | 88985170 | 89200112 | Fshr | body |
| chr17 | 91092305 | 91093305 | Nrxn1 | TSS500 |
| chr17 | 90033644 | 91092305 | Nrxn1 | body |

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| chr17 | 91557627 | 91591927 | Gm15404 | body |
| chr17 | 93199922 | 93205485 | Adcyap1 | body |
| chr17 | 94834299 | 94835299 | Gm1976 | TSS500 |
| chr17 | 94834406 | 94835406 | Gm26734 | TSS500 |
| chr18 | 3508457 | 3516404 | Bambi | body |
| chr18 | 4166332 | 4182232 | Lyzl1 | body |
| chr18 | 4331327 | 4352515 | Map3k8 | body |
| chr18 | 4373669 | 4379480 | Gm26865 | body |
| chr18 | 4375092 | 4376092 | Mtpap | TSS500 |
| chr18 | 5162880 | 5165231 | Gm26682 | body |
| chr18 | 5210031 | 5333939 | Zfp438 | body |
| chr18 | 5591360 | 5592360 | Zeb1 | TSS500 |
| chr18 | 6604133 | 6638966 | 4921524L21Rik | body |
| chr18 | 7004280 | 7005280 | Mkx | TSS500 |
| chr18 | 6910459 | 7004280 | Mkx | body |
| chr18 | 7088233 | 7297401 | Armc4 | body |
| chr18 | 7869332 | 7973547 | Wac | body |
| chr18 | 9213356 | 9216201 | Fzd8 | body |
| chr18 | 9995432 | 10044619 | Usp14 | body |
| chr18 | 10325677 | 10562934 | Greb1l | body |
| chr18 | 11052067 | 11053067 | 1010001N08Rik | TSS500 |
| chr18 | 11049087 | 11052067 | 1010001N08Rik | body |
| chr18 | 11052010 | 11053010 | Gata6 | TSS500 |
| chr18 | 11053010 | 11085635 | Gata6 | body |
| chr18 | 11838837 | 11839837 | Gm6277 | TSS500 |
| chr18 | 11838720 | 11839720 | Cables1 | TSS500 |
| chr18 | 11839720 | 11945627 | Cables1 | body |
| chr18 | 11839938 | 11840938 | Mir1901 | TSS500 |
| chr18 | 12194268 | 12198675 | Gm15956 | body |
| chr18 | 12305220 | 12306220 | Ankrd29 | TSS500 |
| chr18 | 12333319 | 12334319 | Lama3 | TSS500 |
| chr18 | 12740824 | 12741824 | Cabyr | TSS500 |
| chr18 | 13007490 | 13022882 | Hrh4 | body |
| chr18 | 13687013 | 13972233 | Zfp521 | body |
| chr18 | 14624198 | 14682414 | Ss18 | body |
| chr18 | 14706651 | 14762299 | Psma8 | body |
| chr18 | 14783745 | 14900359 | Taf4b | body |
| chr18 | 15150946 | 15151946 | Kctd1 | TSS500 |
| chr18 | 14968685 | 15150946 | Kctd1 | body |
| chr18 | 15389394 | 15403184 | Aqp4 | body |
| chr18 | 15451924 | 15759657 | Chst9 | body |
| chr18 | 16815907 | 16816907 | Gm15328 | TSS500 |
| chr18 | 17019551 | 17137559 | 1700001G01Rik | body |
| chr18 | 20001597 | 20002597 | Dsc3 | TSS500 |

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|-------|----------|----------|---------------|--------|
| chr18 | 20059054 | 20060054 | Dsc2 | TSS500 |
| chr18 | 20030633 | 20059054 | Dsc2 | body |
| chr18 | 20084703 | 20114273 | Dsc1 | body |
| chr18 | 20558574 | 20604521 | Dsg2 | body |
| chr18 | 21550377 | 21654218 | Klhl14 | body |
| chr18 | 21651948 | 21656105 | 4930426D05Rik | body |
| chr18 | 21810897 | 22170896 | Ccdc178 | body |
| chr18 | 22344383 | 22345383 | Asx13 | TSS500 |
| chr18 | 22345383 | 22530227 | Asx13 | body |
| chr18 | 23041153 | 23042153 | Nol4 | TSS500 |
| chr18 | 22693181 | 23041153 | Nol4 | body |
| chr18 | 23989132 | 23990132 | Zfp35 | TSS500 |
| chr18 | 24653191 | 24654191 | Mocos | TSS500 |
| chr18 | 24654191 | 24701556 | Mocos | body |
| chr18 | 24708848 | 24709848 | Gm9955 | TSS500 |
| chr18 | 24708945 | 24709945 | Fhod3 | TSS500 |
| chr18 | 24709945 | 25133500 | Fhod3 | body |
| chr18 | 25753483 | 25754483 | Celf4 | TSS500 |
| chr18 | 25477632 | 25753483 | Celf4 | body |
| chr18 | 30973489 | 31316790 | Rit2 | body |
| chr18 | 31932007 | 31958619 | Lims2 | body |
| chr18 | 31942997 | 31949136 | Gpr17 | body |
| chr18 | 31959234 | 32036461 | Myo7b | body |
| chr18 | 32022240 | 32026610 | Gm16344 | body |
| chr18 | 32067234 | 32068234 | lws1 | TSS500 |
| chr18 | 32359057 | 32377784 | A830052D11Rik | body |
| chr18 | 32559534 | 32560534 | Gypc | TSS500 |
| chr18 | 32815883 | 32819799 | Tslp | body |
| chr18 | 34372915 | 34373915 | Reep5 | TSS500 |
| chr18 | 34542813 | 34548273 | Wnt8a | body |
| chr18 | 34578615 | 34579615 | Nme5 | TSS500 |
| chr18 | 34625124 | 34633265 | Kif20a | body |
| chr18 | 34651235 | 34652235 | Cdc23 | TSS500 |
| chr18 | 34630951 | 34651235 | Cdc23 | body |
| chr18 | 34719887 | 34720887 | Gfra3 | TSS500 |
| chr18 | 34736859 | 34738014 | Gm3550 | body |
| chr18 | 34752309 | 34758685 | 2010110K18Rik | body |
| chr18 | 34759406 | 34773760 | Fam53c | body |
| chr18 | 34840089 | 34841089 | Reep2 | TSS500 |
| chr18 | 34860323 | 34864984 | Egr1 | body |
| chr18 | 35119388 | 35254773 | Ctnna1 | body |
| chr18 | 35214524 | 35215524 | Lrrtm2 | TSS500 |
| chr18 | 35562646 | 35593835 | Matr3 | body |
| chr18 | 35599117 | 35617186 | Paip2 | body |

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| chr18 | 35654740 | 35655740 | Prob1 | TSS500 |
| chr18 | 35661686 | 35662686 | Spata24 | TSS500 |
| chr18 | 35964330 | 35965330 | Psd2 | TSS500 |
| chr18 | 36196880 | 36197880 | Nrg2 | TSS500 |
| chr18 | 36281597 | 36301521 | Pura | body |
| chr18 | 36346119 | 36402980 | Cystm1 | body |
| chr18 | 36453995 | 36454995 | Pfdn1 | TSS500 |
| chr18 | 36504929 | 36515305 | Hbegf | body |
| chr18 | 36734568 | 36735568 | Tmco6 | TSS500 |
| chr18 | 36735568 | 36742391 | Tmco6 | body |
| chr18 | 36744156 | 36745156 | lk | TSS500 |
| chr18 | 36783508 | 36792562 | Hars2 | body |
| chr18 | 36929684 | 36930684 | PCDHA9 | TSS500 |
| chr18 | 36952148 | 36953148 | Pcdha4 | TSS500 |
| chr18 | 36952543 | 36953543 | RP23-193O23.3 | TSS500 |
| chr18 | 36952241 | 36953241 | PCDHA4 | TSS500 |
| chr18 | 36959940 | 36960940 | Pcdha5 | TSS500 |
| chr18 | 36991871 | 36992871 | Pcdha8 | TSS500 |
| chr18 | 36992871 | 37187657 | Pcdha8 | body |
| chr18 | 36998380 | 37187657 | Pcdha9 | body |
| chr18 | 37005703 | 37187657 | Pcdha10 | body |
| chr18 | 37159854 | 37178022 | Gm10544 | body |
| chr18 | 37265438 | 37267525 | Pcdhb1 | body |
| chr18 | 37300299 | 37301299 | Pcdhb3 | TSS500 |
| chr18 | 37320881 | 37323915 | Pcdhb5 | body |
| chr18 | 37412164 | 37414514 | Pcdhb10 | body |
| chr18 | 37448156 | 37456350 | Pcdhb14 | body |
| chr18 | 37485295 | 37489454 | Pcdhb17 | body |
| chr18 | 37489965 | 37494505 | Pcdhb18 | body |
| chr18 | 37518371 | 37524479 | Pcdhb22 | body |
| chr18 | 37661293 | 37662293 | Pcdhga1 | TSS500 |
| chr18 | 37662132 | 37663132 | RP23-56B11.7 | TSS500 |
| chr18 | 37668453 | 37669453 | Pcdhga2 | TSS500 |
| chr18 | 37673807 | 37674807 | PCDHGB6 | TSS500 |
| chr18 | 37689328 | 37690328 | Pcdhgb2 | TSS500 |
| chr18 | 37706539 | 37707539 | Pcdhga6 | TSS500 |
| chr18 | 37719869 | 37720869 | Pcdhgb4 | TSS500 |
| chr18 | 37730509 | 37731509 | Pcdhgb5 | TSS500 |
| chr18 | 37746493 | 37747493 | Pcdhga10 | TSS500 |
| chr18 | 37751100 | 37752100 | Pcdhgb7 | TSS500 |
| chr18 | 37814579 | 37815579 | Pcdhgc4 | TSS500 |
| chr18 | 37843601 | 37934976 | Diap1 | body |
| chr18 | 37954579 | 37955579 | Rell2 | TSS500 |
| chr18 | 37955579 | 37959179 | Rell2 | body |

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| chr18 | 37990445 | 37991445 | Mir6980 | TSS500 |
| chr18 | 38238405 | 38250065 | 17000860O06Rik | body |
| chr18 | 38419475 | 38464399 | Ndfip1 | body |
| chr18 | 38602034 | 39376284 | Arhgap26 | body |
| chr18 | 38928904 | 38929904 | Fgf1 | TSS500 |
| chr18 | 39246247 | 39302190 | Gm15336 | body |
| chr18 | 39367038 | 39388925 | Gm15337 | body |
| chr18 | 39773997 | 39776082 | Pabpc2 | body |
| chr18 | 41950694 | 41951694 | Preli2 | TSS500 |
| chr18 | 41875696 | 41950694 | Preli2 | body |
| chr18 | 42053167 | 42054167 | Sh3rf2 | TSS500 |
| chr18 | 42054167 | 42158960 | Sh3rf2 | body |
| chr18 | 42275853 | 42341542 | Rbm27 | body |
| chr18 | 42394039 | 42395039 | Pou4f3 | TSS500 |
| chr18 | 42395039 | 42397249 | Pou4f3 | body |
| chr18 | 42512010 | 42575551 | Tcerg1 | body |
| chr18 | 43207197 | 43208197 | Stk32a | TSS500 |
| chr18 | 43208197 | 43317481 | Stk32a | body |
| chr18 | 43477296 | 43478296 | Eif3j2 | TSS500 |
| chr18 | 43477277 | 43478277 | Gm27325 | TSS500 |
| chr18 | 43531408 | 43687273 | Jakmip2 | body |
| chr18 | 43777196 | 43792378 | Gm94 | body |
| chr18 | 44166358 | 44174573 | Spinkl | body |
| chr18 | 44334574 | 44355724 | Myot | body |
| chr18 | 44811682 | 44812682 | Mcc | TSS500 |
| chr18 | 44425061 | 44811682 | Mcc | body |
| chr18 | 45269360 | 45686024 | Kcnn2 | body |
| chr18 | 45683487 | 45896009 | A330093E20Rik | body |
| chr18 | 46212107 | 46213107 | Trim36 | TSS500 |
| chr18 | 46165302 | 46212107 | Trim36 | body |
| chr18 | 46727842 | 46728842 | Cdo1 | TSS500 |
| chr18 | 46732417 | 46741079 | Atg12 | body |
| chr18 | 46849539 | 46850539 | 4833403I15Rik | TSS500 |
| chr18 | 47235598 | 47368370 | Sema6a | body |
| chr18 | 48045835 | 48048378 | Eno1b | body |
| chr18 | 49832170 | 49833170 | Dmxl1 | TSS500 |
| chr18 | 51118398 | 51304641 | Prr16 | body |
| chr18 | 51865264 | 51865381 | Gm4950 | body |
| chr18 | 52331036 | 52332036 | Ftmt | TSS500 |
| chr18 | 52516069 | 52529367 | Lox | body |
| chr18 | 52768209 | 52915935 | Sncap | body |
| chr18 | 53464046 | 53465046 | Prdm6 | TSS500 |
| chr18 | 53465046 | 53575907 | Prdm6 | body |
| chr18 | 54990810 | 55079414 | Gm4221 | body |

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| chr18 | 56509687 | 56572451 | Aldh7a1 | body |
| chr18 | 56561943 | 56562943 | Phax | TSS500 |
| chr18 | 56562943 | 56587712 | Phax | body |
| chr18 | 56707313 | 56708313 | Lmnb1 | TSS500 |
| chr18 | 56974868 | 56975868 | C330018D20Rik | TSS500 |
| chr18 | 57468986 | 57478134 | Ctxn3 | body |
| chr18 | 57534280 | 57731065 | 1700011I03Rik | body |
| chr18 | 57879178 | 57946821 | Slc12a2 | body |
| chr18 | 58209426 | 58210426 | Fbn2 | TSS500 |
| chr18 | 58008623 | 58209426 | Fbn2 | body |
| chr18 | 58209752 | 58210752 | Gm26507 | TSS500 |
| chr18 | 58556757 | 58612773 | Slc27a6 | body |
| chr18 | 58658982 | 58659982 | Isoc1 | TSS500 |
| chr18 | 58836264 | 58837264 | Adamts19 | TSS500 |
| chr18 | 58837264 | 59053678 | Adamts19 | body |
| chr18 | 59061748 | 59062748 | A730017C20Rik | TSS500 |
| chr18 | 59174901 | 59175901 | Chsy3 | TSS500 |
| chr18 | 60212580 | 60247820 | Gm4951 | body |
| chr18 | 60526721 | 60558762 | Dctn4 | body |
| chr18 | 60591288 | 60592288 | Myoz3 | TSS500 |
| chr18 | 60593973 | 60659642 | Synpo | body |
| chr18 | 60911280 | 60912280 | Arsi | TSS500 |
| chr18 | 61013699 | 61014699 | Slc6a7 | TSS500 |
| chr18 | 60995381 | 61013699 | Slc6a7 | body |
| chr18 | 61035699 | 61036699 | Cdx1 | TSS500 |
| chr18 | 61536036 | 61537036 | Arhgef37 | TSS500 |
| chr18 | 61493794 | 61536036 | Arhgef37 | body |
| chr18 | 61647403 | 61648403 | Mir145a | TSS500 |
| chr18 | 61649625 | 61665037 | Mir143hg | body |
| chr18 | 61688435 | 61692537 | Il17b | body |
| chr18 | 61691884 | 61692884 | RP24-390G17.2 | TSS500 |
| chr18 | 61726890 | 61735917 | 1500015A07Rik | body |
| chr18 | 61786202 | 61787202 | Afap111 | TSS500 |
| chr18 | 62323704 | 62324704 | Htr4 | TSS500 |
| chr18 | 62324704 | 62467802 | Htr4 | body |
| chr18 | 62921827 | 62922827 | Apcdd1 | TSS500 |
| chr18 | 63386683 | 63387683 | Piezo2 | TSS500 |
| chr18 | 64339864 | 64340864 | Onecut2 | TSS500 |
| chr18 | 64660500 | 64661500 | Atp8b1 | TSS500 |
| chr18 | 64528979 | 64660500 | Atp8b1 | body |
| chr18 | 65431463 | 65478823 | Malt1 | body |
| chr18 | 65938589 | 65939589 | Rax | TSS500 |
| chr18 | 65934639 | 65938589 | Rax | body |
| chr18 | 65969678 | 65970678 | Cplx4 | TSS500 |

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| chr18 | 66022080 | 66023080 | Lman1 | TSS500 |
| chr18 | 65980754 | 66022080 | Lman1 | body |
| chr18 | 66458104 | 66459104 | Pmaip1 | TSS500 |
| chr18 | 66859972 | 66860972 | Mc4r | TSS500 |
| chr18 | 67288753 | 67289753 | Impa2 | TSS500 |
| chr18 | 67289753 | 67319146 | Impa2 | body |
| chr18 | 67343064 | 67344064 | Cidea | TSS500 |
| chr18 | 67404767 | 67448666 | Afg3l2 | body |
| chr18 | 67464349 | 67465349 | Slmo1 | TSS500 |
| chr18 | 67465349 | 67480581 | Slmo1 | body |
| chr18 | 67799607 | 67800607 | Cep192 | TSS500 |
| chr18 | 67800607 | 67885168 | Cep192 | body |
| chr18 | 68406907 | 68428751 | Mc2r | body |
| chr18 | 70471980 | 70472980 | 4930503L19Rik | TSS500 |
| chr18 | 70471954 | 70472954 | Stard6 | TSS500 |
| chr18 | 72350569 | 72351569 | Dcc | TSS500 |
| chr18 | 71258738 | 72350569 | Dcc | body |
| chr18 | 73735038 | 73753979 | Elac1 | body |
| chr18 | 74064859 | 74065859 | Mapk4 | TSS500 |
| chr18 | 74064602 | 74065602 | Gm9925 | TSS500 |
| chr18 | 74216631 | 74221491 | Cxxc1 | body |
| chr18 | 74268772 | 74282685 | Mbd1 | body |
| chr18 | 74441436 | 74771493 | Myo5b | body |
| chr18 | 74525140 | 74530624 | 1700120E14Rik | body |
| chr18 | 74960763 | 74961763 | Lipg | TSS500 |
| chr18 | 74939322 | 74960763 | Lipg | body |
| chr18 | 75514145 | 75515145 | Gm10532 | TSS500 |
| chr18 | 76855905 | 76856905 | Skor2 | TSS500 |
| chr18 | 76930517 | 76941605 | Ier3ip1 | body |
| chr18 | 76977148 | 77046808 | Katnal2 | body |
| chr18 | 77185757 | 77186757 | Gm7276 | TSS500 |
| chr18 | 77185006 | 77185757 | Gm7276 | body |
| chr18 | 77185353 | 77186353 | St8sia5 | TSS500 |
| chr18 | 77281458 | 77282458 | Loxhd1 | TSS500 |
| chr18 | 77282458 | 77442341 | Loxhd1 | body |
| chr18 | 77564647 | 77565647 | Rnf165 | TSS500 |
| chr18 | 77456110 | 77564647 | Rnf165 | body |
| chr18 | 77633281 | 77713510 | 8030462N17Rik | body |
| chr18 | 77732970 | 77733970 | A330094K24Rik | TSS500 |
| chr18 | 77773229 | 77774229 | Atp5a1 | TSS500 |
| chr18 | 77794045 | 77795045 | Pstpip2 | TSS500 |
| chr18 | 78043614 | 78056895 | Siglec15 | body |
| chr18 | 78141619 | 78142619 | Slc14a1 | TSS500 |
| chr18 | 78146940 | 78208594 | Slc14a2 | body |

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| chr18 | 80192265 | 80200158 | Rbfa | body |
| chr18 | 80229758 | 80246602 | Hsbp1l1 | body |
| chr18 | 80322835 | 80323835 | Gm26676 | TSS500 |
| chr18 | 80986078 | 80987078 | Sall3 | TSS500 |
| chr18 | 80986956 | 80987956 | Gm27239 | TSS500 |
| chr18 | 80987956 | 80988575 | Gm27239 | body |
| chr18 | 81235566 | 81236566 | 4930594M17Rik | TSS500 |
| chr18 | 82474646 | 82475646 | Mbp | TSS500 |
| chr18 | 82758541 | 82759541 | 2210420H20Rik | TSS500 |
| chr18 | 82754505 | 82758541 | 2210420H20Rik | body |
| chr18 | 82856394 | 82870604 | 4930445N18Rik | body |
| chr18 | 84719519 | 84720519 | Fam69c | TSS500 |
| chr18 | 84720519 | 84740436 | Fam69c | body |
| chr18 | 86394452 | 86395452 | Neto1 | TSS500 |
| chr18 | 86710610 | 86711610 | Cbln2 | TSS500 |
| chr18 | 89769028 | 89770028 | Dok6 | TSS500 |
| chr18 | 89301082 | 89769028 | Dok6 | body |
| chr19 | 3065711 | 3197214 | 1700030N03Rik | body |
| chr19 | 3388357 | 3389357 | Mtl5 | TSS500 |
| chr19 | 3935686 | 3949340 | Unc93b1 | body |
| chr19 | 4012306 | 4013306 | Ndufv1 | TSS500 |
| chr19 | 4007497 | 4012306 | Ndufv1 | body |
| chr19 | 4037421 | 4038421 | Gstp1 | TSS500 |
| chr19 | 4164324 | 4174979 | Carns1 | body |
| chr19 | 4170066 | 4174284 | Gm17552 | body |
| chr19 | 4268672 | 4269672 | Ssh3 | TSS500 |
| chr19 | 4261668 | 4268672 | Ssh3 | body |
| chr19 | 4282637 | 4283637 | Ankrd13d | TSS500 |
| chr19 | 4305722 | 4306722 | Adrbk1 | TSS500 |
| chr19 | 4397785 | 4398785 | Kdm2a | TSS500 |
| chr19 | 4425459 | 4438932 | Rhod | body |
| chr19 | 4476947 | 4477947 | Syt12 | TSS500 |
| chr19 | 4445908 | 4476947 | Syt12 | body |
| chr19 | 4510972 | 4621752 | Pcx | body |
| chr19 | 4625841 | 4698168 | Gm960 | body |
| chr19 | 4793401 | 4794401 | Rbm4 | TSS500 |
| chr19 | 4800569 | 4811134 | Rbm14 | body |
| chr19 | 4839866 | 4842528 | Ccdc87 | body |
| chr19 | 4877409 | 4878409 | Actn3 | TSS500 |
| chr19 | 4861223 | 4877409 | Actn3 | body |
| chr19 | 4886898 | 4906127 | Bbs1 | body |
| chr19 | 4930651 | 4942627 | Peli3 | body |
| chr19 | 4989471 | 4990471 | Npas4 | TSS500 |
| chr19 | 5067578 | 5068578 | Cd248 | TSS500 |

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|-------|---------|---------|---------------|--------|
| chr19 | 5068578 | 5070637 | Cd248 | body |
| chr19 | 5097918 | 5098918 | Cnih2 | TSS500 |
| chr19 | 5107746 | 5118060 | Klc2 | body |
| chr19 | 5133688 | 5272619 | Pacs1 | body |
| chr19 | 5297831 | 5298831 | Gal3st3 | TSS500 |
| chr19 | 5298831 | 5308738 | Gal3st3 | body |
| chr19 | 5349074 | 5350074 | Cst6 | TSS500 |
| chr19 | 5422805 | 5424479 | Drap1 | body |
| chr19 | 5448203 | 5455945 | Fosl1 | body |
| chr19 | 5560075 | 5561075 | Ovol1 | TSS500 |
| chr19 | 5568574 | 5571261 | Ap5b1 | body |
| chr19 | 5602373 | 5603439 | Rnaseh2c | body |
| chr19 | 5726706 | 5727706 | Gm16538 | TSS500 |
| chr19 | 5728088 | 5731232 | Sssca1 | body |
| chr19 | 5740404 | 5741404 | Ltbp3 | TSS500 |
| chr19 | 5802172 | 5803172 | Malat1 | TSS500 |
| chr19 | 5893607 | 5894607 | Tigd3 | TSS500 |
| chr19 | 5970234 | 5985643 | Slc22a20 | body |
| chr19 | 6053630 | 6057251 | Mrpl49 | body |
| chr19 | 6081756 | 6082756 | Gm28374 | TSS500 |
| chr19 | 6141483 | 6172476 | Batf2 | body |
| chr19 | 6277225 | 6300096 | Ehd1 | body |
| chr19 | 6305956 | 6306956 | Cdc42bpg | TSS500 |
| chr19 | 6341635 | 6355615 | Map4k2 | body |
| chr19 | 6398840 | 6399840 | Rasgrp2 | TSS500 |
| chr19 | 6399840 | 6415216 | Rasgrp2 | body |
| chr19 | 6419231 | 6544169 | Nrxn2 | body |
| chr19 | 6531511 | 6532511 | Gm14964 | TSS500 |
| chr19 | 6530711 | 6531511 | Gm14964 | body |
| chr19 | 6535845 | 6542519 | Slc22a12 | body |
| chr19 | 6906697 | 6909606 | Prdx5 | body |
| chr19 | 6934015 | 6935015 | Kcnk4 | TSS500 |
| chr19 | 6925710 | 6934015 | Kcnk4 | body |
| chr19 | 6938069 | 6941950 | Gpr137 | body |
| chr19 | 6975548 | 6977324 | Ppp1r14b | body |
| chr19 | 7266825 | 7267825 | Rcor2 | TSS500 |
| chr19 | 7275396 | 7341360 | Mark2 | body |
| chr19 | 7418125 | 7425904 | 2700081O15Rik | body |
| chr19 | 7422073 | 7423073 | Mir6991 | TSS500 |
| chr19 | 7425901 | 7482789 | Rtn3 | body |
| chr19 | 7493540 | 7494540 | Atl3 | TSS500 |
| chr19 | 7673061 | 7710810 | Slc22a19 | body |
| chr19 | 7864388 | 7965527 | Slc22a27 | body |
| chr19 | 8160165 | 8218400 | Slc22a29 | body |

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| chr19 | 8335371 | 8404611 | Slc22a30 | body |
| chr19 | 8590754 | 8591754 | Slc22a8 | TSS500 |
| chr19 | 8618496 | 8628299 | Slc22a6 | body |
| chr19 | 8740218 | 8741218 | 1700092M07Rik | TSS500 |
| chr19 | 8757573 | 8772475 | Nxf1 | body |
| chr19 | 8836929 | 8838746 | Gng3 | body |
| chr19 | 8836967 | 8837967 | Bscl2 | TSS500 |
| chr19 | 8837967 | 8848683 | Bscl2 | body |
| chr19 | 8889426 | 8897890 | Ints5 | body |
| chr19 | 8898590 | 8916663 | Ganab | body |
| chr19 | 8928856 | 8929856 | Rom1 | TSS500 |
| chr19 | 8942375 | 8952303 | Mta2 | body |
| chr19 | 8989784 | 9076919 | Ahnak | body |
| chr19 | 9135136 | 9136136 | Asrgl1 | TSS500 |
| chr19 | 9109868 | 9135136 | Asrgl1 | body |
| chr19 | 9985174 | 10001133 | Best1 | body |
| chr19 | 10002169 | 10038380 | Rab3il1 | body |
| chr19 | 10389590 | 10453181 | Syt7 | body |
| chr19 | 10456947 | 10457947 | Lrrc10b | TSS500 |
| chr19 | 10474257 | 10482397 | Ppp1r32 | body |
| chr19 | 10525744 | 10547735 | Cpsf7 | body |
| chr19 | 10577954 | 10588548 | Cyb561a3 | body |
| chr19 | 10603758 | 10604758 | Dak | TSS500 |
| chr19 | 10592200 | 10603758 | Dak | body |
| chr19 | 10633733 | 10634733 | Vwce | TSS500 |
| chr19 | 10668957 | 10677571 | Pga5 | body |
| chr19 | 10689315 | 10714419 | Vps37c | body |
| chr19 | 10829558 | 10830558 | Cd6 | TSS500 |
| chr19 | 10914287 | 10920132 | Zp1 | body |
| chr19 | 11047617 | 11050066 | AW112010 | body |
| chr19 | 11130376 | 11131376 | 1700017D01Rik | TSS500 |
| chr19 | 11197317 | 11299886 | 4930526L06Rik | body |
| chr19 | 11215010 | 11230040 | Ms4a12 | body |
| chr19 | 11249675 | 11265741 | Ms4a1 | body |
| chr19 | 11273238 | 11283373 | Ms4a5 | body |
| chr19 | 11321039 | 11335646 | Ms4a7 | body |
| chr19 | 11444053 | 11463549 | Ms4a4b | body |
| chr19 | 11586604 | 11604349 | Ms4a6d | body |
| chr19 | 11775119 | 11818903 | Stx3 | body |
| chr19 | 11896499 | 11897050 | Olfr1420 | body |
| chr19 | 12765132 | 12766132 | Cntf | TSS500 |
| chr19 | 12795626 | 12796626 | Zfp91 | TSS500 |
| chr19 | 13599268 | 13600268 | Gm22323 | TSS500 |
| chr19 | 16435167 | 16436167 | Gna14 | TSS500 |

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| chr19 | 16436167 | 16610818 | Gna14 | body |
| chr19 | 16873330 | 16874330 | Foxb2 | TSS500 |
| chr19 | 16872316 | 16873330 | Foxb2 | body |
| chr19 | 17356167 | 17357167 | Gcnt1 | TSS500 |
| chr19 | 17394543 | 17401349 | Rfk | body |
| chr19 | 17837132 | 17838132 | Pcsk5 | TSS500 |
| chr19 | 17432832 | 17837132 | Pcsk5 | body |
| chr19 | 18750483 | 18892510 | Trpm6 | body |
| chr19 | 20692953 | 20727062 | Aldh1a7 | body |
| chr19 | 20783458 | 20953702 | Tmc1 | body |
| chr19 | 22438520 | 22448365 | Gm27151 | body |
| chr19 | 23037390 | 23075353 | C330002G04Rik | body |
| chr19 | 23141726 | 23166911 | Klf9 | body |
| chr19 | 23447822 | 23448822 | Mamdc2 | TSS500 |
| chr19 | 23302609 | 23447822 | Mamdc2 | body |
| chr19 | 23558760 | 23652312 | 1700028P14Rik | body |
| chr19 | 23619242 | 23620242 | Gm9493 | TSS500 |
| chr19 | 23758376 | 23759376 | Apba1 | TSS500 |
| chr19 | 23759376 | 23949597 | Apba1 | body |
| chr19 | 24030519 | 24031519 | Fam189a2 | TSS500 |
| chr19 | 23972751 | 24030519 | Fam189a2 | body |
| chr19 | 24555372 | 24556372 | Pip5k1b | TSS500 |
| chr19 | 24294794 | 24555372 | Pip5k1b | body |
| chr19 | 24861355 | 24862355 | Pgm5 | TSS500 |
| chr19 | 24898965 | 24900809 | Foxd4 | body |
| chr19 | 24999029 | 25000029 | Dock8 | TSS500 |
| chr19 | 25000029 | 25202432 | Dock8 | body |
| chr19 | 25236475 | 25237475 | Kank1 | TSS500 |
| chr19 | 25237475 | 25434496 | Kank1 | body |
| chr19 | 25506118 | 25604329 | Dmrt1 | body |
| chr19 | 25610037 | 25611037 | Dmrt3 | TSS500 |
| chr19 | 25671753 | 25672753 | 2610016A17Rik | TSS500 |
| chr19 | 25671134 | 25671753 | 2610016A17Rik | body |
| chr19 | 25671920 | 25672920 | Dmrt2 | TSS500 |
| chr19 | 25672920 | 25679010 | Dmrt2 | body |
| chr19 | 26605615 | 26778321 | Smarca2 | body |
| chr19 | 28834549 | 28835549 | Slc1a1 | TSS500 |
| chr19 | 28835549 | 28913960 | Slc1a1 | body |
| chr19 | 28967300 | 28968300 | 4430402I18Rik | TSS500 |
| chr19 | 28893042 | 28967300 | 4430402I18Rik | body |
| chr19 | 29334170 | 29335170 | Rln1 | TSS500 |
| chr19 | 29366890 | 29367890 | Plgrkt | TSS500 |
| chr19 | 29348599 | 29366890 | Plgrkt | body |
| chr19 | 29366955 | 29367955 | Cd274 | TSS500 |

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| chr19 | 29411419 | 29471157 | Pdcd1lg2 | body |
| chr19 | 29486355 | 29522659 | A930007I19Rik | body |
| chr19 | 30004290 | 30006020 | Trpd52l3 | body |
| chr19 | 30030013 | 30031013 | Uhrf2 | TSS500 |
| chr19 | 30174918 | 30175918 | Gldc | TSS500 |
| chr19 | 30549165 | 30550165 | Dkk1 | TSS500 |
| chr19 | 30545863 | 30549165 | Dkk1 | body |
| chr19 | 31764533 | 31765533 | Prkg1 | TSS500 |
| chr19 | 30567551 | 31764533 | Prkg1 | body |
| chr19 | 31868261 | 31869261 | A1cf | TSS500 |
| chr19 | 32389214 | 32390214 | Sgms1 | TSS500 |
| chr19 | 32388716 | 32389716 | 2700046G09Rik | TSS500 |
| chr19 | 32389716 | 32391184 | 2700046G09Rik | body |
| chr19 | 33391795 | 33392795 | Rnls | TSS500 |
| chr19 | 33137747 | 33391795 | Rnls | body |
| chr19 | 33409131 | 33420142 | Gm7237 | body |
| chr19 | 33498037 | 33517280 | Lipo4 | body |
| chr19 | 33761451 | 33762451 | Lipo1 | TSS500 |
| chr19 | 33517740 | 33761451 | Lipo1 | body |
| chr19 | 33592213 | 33593213 | Gm27440 | TSS500 |
| chr19 | 33719670 | 33768642 | Lipo2 | body |
| chr19 | 33786962 | 33787962 | Gm5097 | TSS500 |
| chr19 | 33822408 | 33823408 | Gm5519 | TSS500 |
| chr19 | 34008754 | 34047903 | Lipk | body |
| chr19 | 34290159 | 34291159 | Fas | TSS500 |
| chr19 | 34474635 | 34475635 | Ch25h | TSS500 |
| chr19 | 34474308 | 34475308 | Gm26902 | TSS500 |
| chr19 | 34475308 | 34481546 | Gm26902 | body |
| chr19 | 34746789 | 34747789 | Slc16a12 | TSS500 |
| chr19 | 34668403 | 34746789 | Slc16a12 | body |
| chr19 | 34810894 | 34878955 | Pank1 | body |
| chr19 | 35835221 | 35924078 | A830019P07Rik | body |
| chr19 | 36057007 | 36058007 | Htr7 | TSS500 |
| chr19 | 35958734 | 36057007 | Htr7 | body |
| chr19 | 36379567 | 36456192 | Pcgf5 | body |
| chr19 | 36736153 | 36737153 | Ppp1r3c | TSS500 |
| chr19 | 37173343 | 37174343 | A330032B11Rik | TSS500 |
| chr19 | 37434310 | 37435310 | Hhex | TSS500 |
| chr19 | 37435310 | 37440731 | Hhex | body |
| chr19 | 37549918 | 37550918 | Exoc6 | TSS500 |
| chr19 | 37550918 | 37683245 | Exoc6 | body |
| chr19 | 37685081 | 37686081 | Cyp26c1 | TSS500 |
| chr19 | 37697308 | 37698308 | Cyp26a1 | TSS500 |
| chr19 | 37698308 | 37701528 | Cyp26a1 | body |

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| chr19 | 38096579 | 38097579 | Ffar4 | TSS500 |
| chr19 | 38116620 | 38124821 | Rbp4 | body |
| chr19 | 38132281 | 38133281 | Pde6c | TSS500 |
| chr19 | 38265282 | 38308939 | Lgi1 | body |
| chr19 | 38395480 | 38396480 | Slc35g1 | TSS500 |
| chr19 | 38480609 | 38481609 | Plce1 | TSS500 |
| chr19 | 38481609 | 38785030 | Plce1 | body |
| chr19 | 38931415 | 38971051 | Hells | body |
| chr19 | 39007519 | 39042693 | Cyp2c55 | body |
| chr19 | 39389556 | 39462575 | Cyp2c38 | body |
| chr19 | 39511362 | 39568529 | Cyp2c39 | body |
| chr19 | 39608842 | 39648551 | Cyp2c67 | body |
| chr19 | 39767071 | 39812314 | Cyp2c40 | body |
| chr19 | 39842660 | 39886269 | Cyp2c69 | body |
| chr19 | 40037941 | 40073311 | Cyp2c54 | body |
| chr19 | 40153353 | 40186833 | Cyp2c70 | body |
| chr19 | 40295049 | 40401767 | Sorbs1 | body |
| chr19 | 40868886 | 40874071 | E030044B06Rik | body |
| chr19 | 40894203 | 40895203 | Mir8092 | TSS500 |
| chr19 | 40894205 | 40895205 | Zfp518a | TSS500 |
| chr19 | 40928927 | 40994035 | Blnk | body |
| chr19 | 41062474 | 41076613 | Opalin | body |
| chr19 | 41206274 | 41207274 | Tll2 | TSS500 |
| chr19 | 41384570 | 41385570 | Pik3ap1 | TSS500 |
| chr19 | 41483145 | 41562246 | Lcor | body |
| chr19 | 41588151 | 41589151 | Mir8091 | TSS500 |
| chr19 | 41592863 | 41593863 | AI606181 | TSS500 |
| chr19 | 41743165 | 41744165 | Slit1 | TSS500 |
| chr19 | 41766588 | 41801584 | Arhgap19 | body |
| chr19 | 41982263 | 42034641 | Ubtcd1 | body |
| chr19 | 42085870 | 42086870 | Morn4 | TSS500 |
| chr19 | 42074939 | 42085870 | Morn4 | body |
| chr19 | 42163451 | 42164451 | Zfyve27 | TSS500 |
| chr19 | 42164451 | 42194590 | Zfyve27 | body |
| chr19 | 42201752 | 42202752 | Sfrp5 | TSS500 |
| chr19 | 42283037 | 42431283 | Crtac1 | body |
| chr19 | 42536850 | 42562608 | Gm16541 | body |
| chr19 | 42612313 | 42613313 | Loxl4 | TSS500 |
| chr19 | 42752275 | 42753275 | Pyroxd2 | TSS500 |
| chr19 | 43440936 | 43497212 | Cnm1 | body |
| chr19 | 43610125 | 43611125 | Gm20467 | TSS500 |
| chr19 | 43611825 | 43612825 | Nkx2-3 | TSS500 |
| chr19 | 43612825 | 43615892 | Nkx2-3 | body |
| chr19 | 43782692 | 43840740 | Abcc2 | body |

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| chr19 | 44005022 | 44028747 | Cyp2c44 | body |
| chr19 | 44135376 | 44136376 | Cwf19l1 | TSS500 |
| chr19 | 44145946 | 44146946 | Bloc1s2 | TSS500 |
| chr19 | 44493972 | 44514273 | Wnt8b | body |
| chr19 | 44545364 | 44546364 | Sec31b | TSS500 |
| chr19 | 44516957 | 44545364 | Sec31b | body |
| chr19 | 44543722 | 44552331 | Gm20538 | body |
| chr19 | 44692367 | 44694775 | Gm26644 | body |
| chr19 | 44755545 | 44756545 | Pax2 | TSS500 |
| chr19 | 44835438 | 44836438 | 1700039E22Rik | TSS500 |
| chr19 | 44988601 | 44989601 | Sema4g | TSS500 |
| chr19 | 45026906 | 45046114 | Pdzd7 | body |
| chr19 | 45150180 | 45151180 | Tlx1 | TSS500 |
| chr19 | 45151180 | 45156943 | Tlx1 | body |
| chr19 | 45158804 | 45159804 | Tlx1os | TSS500 |
| chr19 | 45232684 | 45235312 | Lbx1 | body |
| chr19 | 45300454 | 45310511 | Gm29595 | body |
| chr19 | 45329629 | 45337823 | Gm28578 | body |
| chr19 | 45742415 | 45743415 | Fgf8 | TSS500 |
| chr19 | 45747734 | 45749091 | Npm3 | body |
| chr19 | 45750261 | 45783020 | Mgea5 | body |
| chr19 | 45815561 | 45816561 | Kcnip2 | TSS500 |
| chr19 | 46003978 | 46006173 | Hps6 | body |
| chr19 | 46131397 | 46132397 | Elovl3 | TSS500 |
| chr19 | 46147826 | 46148826 | Pitx3 | TSS500 |
| chr19 | 46312087 | 46326656 | Psd | body |
| chr19 | 46335787 | 46338538 | Gm26792 | body |
| chr19 | 46341621 | 46375252 | Tmem180 | body |
| chr19 | 46667165 | 46672474 | Cyp17a1 | body |
| chr19 | 46762096 | 46878795 | Cnnm2 | body |
| chr19 | 47014653 | 47015653 | Nt5c2 | TSS500 |
| chr19 | 46886831 | 47014653 | Nt5c2 | body |
| chr19 | 47014198 | 47015198 | Ina | TSS500 |
| chr19 | 47015198 | 47025327 | Ina | body |
| chr19 | 47033619 | 47050345 | Pcgf6 | body |
| chr19 | 47157264 | 47158264 | Calhm3 | TSS500 |
| chr19 | 47179320 | 47259440 | Neurl1a | body |
| chr19 | 47273089 | 47274089 | Mir6995 | TSS500 |
| chr19 | 47537007 | 47538007 | Obfc1 | TSS500 |
| chr19 | 47866045 | 47886324 | Gsto2 | body |
| chr19 | 47938212 | 48035379 | Cfap58 | body |
| chr19 | 48205525 | 48206525 | Sorcs3 | TSS500 |
| chr19 | 48206525 | 48805505 | Sorcs3 | body |
| chr19 | 50678146 | 50679146 | Sorcs1 | TSS500 |

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|-------|----------|----------|---------------|--------|
| chr19 | 50677906 | 50778662 | Gm26629 | body |
| chr19 | 53076718 | 53084392 | 1700054A03Rik | body |
| chr19 | 53379214 | 53390073 | Smndc1 | body |
| chr19 | 53676806 | 53677806 | Rbm20 | TSS500 |
| chr19 | 53677806 | 53867080 | Rbm20 | body |
| chr19 | 53819354 | 53824628 | Gm16299 | body |
| chr19 | 53892731 | 53929861 | Pdcd4 | body |
| chr19 | 54044682 | 54045682 | Adra2a | TSS500 |
| chr19 | 55181233 | 55196313 | Tectb | body |
| chr19 | 55192178 | 55193178 | Mir6715 | TSS500 |
| chr19 | 55198297 | 55240736 | Gucy2g | body |
| chr19 | 55252869 | 55253869 | Acsl5 | TSS500 |
| chr19 | 56287637 | 56320822 | Habp2 | body |
| chr19 | 56320035 | 56389537 | Nrap | body |
| chr19 | 56461137 | 56462137 | Plekhs1 | TSS500 |
| chr19 | 56529167 | 56547722 | Dclre1a | body |
| chr19 | 56721872 | 56722872 | Adrb1 | TSS500 |
| chr19 | 56722872 | 56724862 | Adrb1 | body |
| chr19 | 56826709 | 56870012 | Tdrd1 | body |
| chr19 | 56873749 | 56874749 | Vwa2 | TSS500 |
| chr19 | 56912361 | 57007728 | Afap1l2 | body |
| chr19 | 57314419 | 57315419 | Ablim1 | TSS500 |
| chr19 | 57323385 | 57360275 | B230217O12Rik | body |
| chr19 | 58455409 | 58456409 | Gfra1 | TSS500 |
| chr19 | 58235604 | 58455409 | Gfra1 | body |
| chr19 | 58860484 | 58861484 | Hspa12a | TSS500 |
| chr19 | 58795751 | 58860484 | Hspa12a | body |
| chr19 | 58943925 | 58971419 | Eno4 | body |
| chr19 | 59075569 | 59076569 | 4930506M07Rik | TSS500 |
| chr19 | 58973358 | 59075569 | 4930506M07Rik | body |
| chr19 | 59169556 | 59170556 | Vax1 | TSS500 |
| chr19 | 59166187 | 59169556 | Vax1 | body |
| chr19 | 59220148 | 59237370 | Kcnk18 | body |
| chr19 | 59261378 | 59296012 | Slc18a2 | body |
| chr19 | 59296084 | 59345280 | Pdzd8 | body |
| chr19 | 59425104 | 59458135 | Emx2os | body |
| chr19 | 60144175 | 60145175 | E330013P04Rik | TSS500 |
| chr19 | 60226197 | 60227197 | Fam204a | TSS500 |
| chr19 | 60467804 | 60468804 | Prlhr | TSS500 |
| chr19 | 60761116 | 60790193 | Eif3a | body |
| chr19 | 60889249 | 60890249 | Grk5 | TSS500 |
| chr19 | 61175809 | 61176809 | Gm7102 | TSS500 |
| chr19 | 61227918 | 61228918 | Csf2ra | TSS500 |
| chr19 | 61224402 | 61227918 | Csf2ra | body |

-/- or *Sdhd* -/- as compared with wt imCC.

| methylation in wt imCC | methylation in <i>Sdhd</i> -/- imCC | methylation delta in <i>Sdhd</i> -/- imCC |
|-------------------------------|--|--|
| 0.509265832 | 0.41424196 | -0.095023872 |
| 0.39638233 | 0.530415891 | 0.134033561 |
| 0.40961911 | 0.320359281 | -0.089259829 |
| 0.218380282 | 0.363013699 | 0.144633417 |
| 0.583560345 | 0.526897214 | -0.05666313 |
| 0.707889499 | 0.801075269 | 0.09318577 |
| 0.407329809 | 0.657243816 | 0.249914007 |
| 0.566013015 | 0.713764813 | 0.147751798 |
| 0.326561176 | 0.109324759 | -0.217236417 |
| 0.473768075 | 0.583745195 | 0.10997712 |
| 0.579848971 | 0.63592233 | 0.05607336 |
| 0.409922295 | 0.474226804 | 0.064304509 |
| 0.292764511 | 0.485185185 | 0.192420674 |
| 0.657544937 | 0.534883721 | -0.122661216 |
| 0.530751278 | 0.625542535 | 0.094791257 |
| 0.170365707 | 0.080952381 | -0.089413326 |
| 0.66875 | 0.717213115 | 0.048463115 |
| 0.70540356 | 0.607352941 | -0.098050619 |
| 0.134341314 | 0.014218009 | -0.120123305 |
| 0.575786695 | 0.762295082 | 0.186508387 |
| 0.446760102 | 0.577586207 | 0.130826105 |
| 0.634047295 | 0.523229734 | -0.110817561 |
| 0.306053637 | 0.397297297 | 0.09124366 |
| 0.569049789 | 0.715419693 | 0.146369904 |
| 0.255688272 | 0.166666667 | -0.089021605 |
| 0.516469351 | 0.580495868 | 0.064026517 |
| 0.391919789 | 0.335311573 | -0.056608216 |
| 0.499216473 | 0.678710395 | 0.179493921 |
| 0.669521806 | 0.946428571 | 0.276906766 |
| 0.272258369 | 0.057416268 | -0.214842101 |
| 0.569099994 | 0.681835419 | 0.112735425 |
| 0.504216142 | 0.630071599 | 0.125855457 |
| 0.581201036 | 0.612238622 | 0.031037587 |
| 0.502926942 | 0.610811505 | 0.107884562 |
| 0.502081981 | 0.695839311 | 0.19375733 |
| 0.420413574 | 0.344943068 | -0.075470507 |
| 0.438813108 | 0.624472574 | 0.185659466 |
| 0.42038311 | 0.041420118 | -0.378962991 |
| 0.44209707 | 0.66892464 | 0.226827571 |

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| 0.630264279 | 0.419225634 | -0.211038645 |
| 0.599938753 | 0.362648221 | -0.237290531 |
| 0.70019664 | 0.537037037 | -0.163159603 |
| 0.602270337 | 0.638012618 | 0.035742281 |
| 0.506962257 | 0.61229611 | 0.105333854 |
| 0.298555171 | 0.415670651 | 0.11711548 |
| 0.552113307 | 0.678449259 | 0.126335951 |
| 0.307774652 | 0.056285178 | -0.251489474 |
| 0.224568949 | 0.390625 | 0.166056051 |
| 0.617243497 | 0.684752105 | 0.067508608 |
| 0.492500497 | 0.483785572 | -0.008714925 |
| 0.74618882 | 0.86993007 | 0.123741249 |
| 0.297379516 | 0.537313433 | 0.239933917 |
| 0.324949464 | 0.676595745 | 0.35164628 |
| 0.339020848 | 0.530726257 | 0.191705409 |
| 0.329403356 | 0.536908078 | 0.207504722 |
| 0.292481188 | 0.475609756 | 0.183128568 |
| 0.200568018 | 0.322632424 | 0.122064406 |
| 0.504703053 | 0.611560466 | 0.106857412 |
| 0.52505878 | 0.613497891 | 0.088439111 |
| 0.007936508 | 0.253731343 | 0.245794835 |
| 0.124885461 | 0.111714156 | -0.013171304 |
| 0.719938792 | 0.827586207 | 0.107647415 |
| 0.052392344 | 0.136268344 | 0.083875999 |
| 0.520719219 | 0.666666667 | 0.145947448 |
| 0.58666332 | 0.344805195 | -0.241858125 |
| 0.542399674 | 0.182628571 | -0.359771103 |
| 0.153183145 | 0.257952974 | 0.104769829 |
| 0.47140249 | 0.611140265 | 0.139737775 |
| 0.452313045 | 0.447352999 | -0.004960046 |
| 0.515020703 | 0.586797842 | 0.071777139 |
| 0.354656863 | 0.491048593 | 0.136391731 |
| 0.51842478 | 0.616034625 | 0.097609845 |
| 0.497654809 | 0.567099567 | 0.069444758 |
| 0.5669051 | 0.497761194 | -0.069143906 |
| 0.45272056 | 0.546742982 | 0.094022422 |
| 0.542345052 | 0.359375 | -0.182970052 |
| 0.435639853 | 0.595078834 | 0.159438981 |
| 0.719585323 | 0.742494715 | 0.022909391 |
| 0.569585662 | 0.680917623 | 0.11133196 |
| 0.585381914 | 0.6875 | 0.102118086 |
| 0.518416664 | 0.603773585 | 0.085356921 |
| 0.428698233 | 0.682953914 | 0.254255682 |
| 0.428698233 | 0.682953914 | 0.254255682 |

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| 0.701226796 | 0.669811321 | -0.031415475 |
| 0.492215753 | 0.391554702 | -0.100661051 |
| 0.110099191 | 0.018925057 | -0.091174134 |
| 0.448338472 | 0.579158317 | 0.130819845 |
| 0.5073074 | 0.639766484 | 0.132459084 |
| 0.126095898 | 0.057534247 | -0.068561651 |
| 0.029273504 | 0.104826546 | 0.075553042 |
| 0.222314719 | 0.489655172 | 0.267340453 |
| 0.624681859 | 0.637784725 | 0.013102866 |
| 0.473047551 | 0.652054795 | 0.179007244 |
| 0.548541204 | 0.702006336 | 0.153465132 |
| 0.553616292 | 0.66894198 | 0.115325687 |
| 0.569411453 | 0.651870119 | 0.082458666 |
| 0.673036149 | 0.612125163 | -0.060910986 |
| 0.247774881 | 0.048016701 | -0.199758179 |
| 0.607523367 | 0.723087339 | 0.115563972 |
| 0.362359315 | 0.270491803 | -0.091867511 |
| 0.151651946 | 0.233811172 | 0.082159225 |
| 0.737092992 | 0.678883072 | -0.05820992 |
| 0.304906899 | 0.548507463 | 0.243600564 |
| 0.472112871 | 0.596875 | 0.124762129 |
| 0.547443532 | 0.688045912 | 0.14060238 |
| 0.475107233 | 0.648648649 | 0.173541416 |
| 0.10487583 | 0.044534413 | -0.060341417 |
| 0.561931084 | 0.636911281 | 0.074980197 |
| 0.517468944 | 0.766233766 | 0.248764822 |
| 0.413173794 | 0.610441767 | 0.197267973 |
| 0.135298892 | 0.183098592 | 0.0477997 |
| 0.26290658 | 0.099260824 | -0.163645756 |
| 0.669681031 | 0.749559859 | 0.079878828 |
| 0.368121432 | 0.469041278 | 0.100919847 |
| 0.194656303 | 0.520938023 | 0.32628172 |
| 0.670307283 | 0.795152232 | 0.124844949 |
| 0.22872935 | 0.536398467 | 0.307669117 |
| 0.675231172 | 0.822695035 | 0.147463863 |
| 0.743311501 | 0.732072151 | -0.01123935 |
| 0.453123476 | 0.603361345 | 0.150237868 |
| 0.248875798 | 0.340375587 | 0.091499788 |
| 0.458368245 | 0.4140625 | -0.044305745 |
| 0.206090192 | 0.404709748 | 0.198619557 |
| 0.437485811 | 0.529210796 | 0.091724985 |
| 0.378521491 | 0.458037825 | 0.079516334 |
| 0.527754057 | 0.511635476 | -0.016118581 |
| 0.544477829 | 0.489696312 | -0.054781517 |

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| 0.29083026 | 0.055288462 | -0.235541798 |
| 0.468804217 | 0.563354267 | 0.094550049 |
| 0.041165097 | 0.113721805 | 0.072556707 |
| 0.387002453 | 0.269085412 | -0.117917041 |
| 0.786483552 | 0.827027027 | 0.040543475 |
| 0.194638086 | 0.330522766 | 0.135884679 |
| 0.531619805 | 0.629172714 | 0.097552909 |
| 0.364873875 | 0.462822014 | 0.097948139 |
| 0.516226435 | 0.5852194 | 0.068992965 |
| 0.376596192 | 0.452309985 | 0.075713793 |
| 0.585587495 | 0.659407666 | 0.07382017 |
| 0.327474919 | 0.430618581 | 0.103143662 |
| 0.195509978 | 0.341232227 | 0.14572225 |
| 0.536700125 | 0.63562753 | 0.098927405 |
| 0.198791237 | 0.041666667 | -0.15712457 |
| 0.606591217 | 0.673097535 | 0.066506317 |
| 0.381403519 | 0.471137988 | 0.089734469 |
| 0.411333591 | 0.524958403 | 0.113624812 |
| 0.416181454 | 0.532487091 | 0.116305638 |
| 0.002768499 | 0.056338028 | 0.053569529 |
| 0.593987837 | 0.495896835 | -0.098091002 |
| 0.547083522 | 0.689217134 | 0.142133613 |
| 0.616097233 | 0.671247357 | 0.055150125 |
| 0.47932129 | 0.59 | 0.11067871 |
| 0.025963194 | 0.117647059 | 0.091683865 |
| 0.728851886 | 0.003030303 | -0.725821583 |
| 0.525344348 | 0.422817331 | -0.102527017 |
| 0.21494578 | 0.325396825 | 0.110451045 |
| 0.44669397 | 0.553892216 | 0.107198245 |
| 0.084235879 | 0.018463811 | -0.065772068 |
| 0.391062995 | 0.64644714 | 0.255384145 |
| 0.475229266 | 0.134715026 | -0.34051424 |
| 0.692679964 | 0.75 | 0.057320036 |
| 0.397594975 | 0.215976331 | -0.181618644 |
| 0.52824088 | 0.594303875 | 0.066062995 |
| 0.178103224 | 0.282041729 | 0.103938505 |
| 0.542431484 | 0.621179815 | 0.078748332 |
| 0.545188037 | 0.644513827 | 0.09932579 |
| 0.582741521 | 0.567088608 | -0.015652913 |
| 0.693429016 | 0.743066884 | 0.049637868 |
| 0.674025656 | 0.786102063 | 0.112076407 |
| 0.272786495 | 0.18786924 | -0.084917255 |
| 0.228597061 | 0.129807692 | -0.098789369 |
| 0.724404002 | 0.488549618 | -0.235854383 |

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| 0.325467128 | 0.491651206 | 0.166184078 |
| 0.30737567 | 0.457436857 | 0.150061187 |
| 0.563616238 | 0.760797342 | 0.197181104 |
| 0.528370915 | 0.676732385 | 0.14836147 |
| 0.62473056 | 0.686838124 | 0.062107564 |
| 0.570929779 | 0.48255814 | -0.088371639 |
| 0.020113442 | 0.110344828 | 0.090231385 |
| 0.736436837 | 0.710804824 | -0.025632013 |
| 0.730935844 | 0.709536082 | -0.021399761 |
| 0.187149244 | 0.05416843 | -0.132980814 |
| 0.715510827 | 0.823459716 | 0.107948889 |
| 0.509057971 | 0.640564827 | 0.131506856 |
| 0.363675805 | 0.551348999 | 0.187673194 |
| 0.072531072 | 0.091127098 | 0.018596026 |
| 0.732945344 | 0.845454545 | 0.112509201 |
| 0.591168263 | 0.664348632 | 0.07318037 |
| 0.603397683 | 0.586538462 | -0.016859222 |
| 0.64718602 | 0.712418301 | 0.065232281 |
| 0.427694481 | 0.755319149 | 0.327624668 |
| 0.57353243 | 0.653916211 | 0.080383781 |
| 0.514217212 | 0.404270987 | -0.109946226 |
| 0.729579883 | 0.742738589 | 0.013158706 |
| 0.354483765 | 0.332286213 | -0.022197552 |
| 0.505888076 | 0.59821947 | 0.092331394 |
| 0.606175916 | 0.683932347 | 0.077756431 |
| 0.46625234 | 0.5631416 | 0.09688926 |
| 0.506806742 | 0.607508532 | 0.100701791 |
| 0.670263251 | 0.699731903 | 0.029468653 |
| 0.702103735 | 0.785272625 | 0.08316889 |
| 0.849279028 | 0.810730253 | -0.038548774 |
| 0.11517876 | 0.345757335 | 0.230578575 |
| 0.23998201 | 0.176470588 | -0.063511421 |
| 0.23998201 | 0.176470588 | -0.063511421 |
| 0.105555556 | 0.04040404 | -0.065151515 |
| 0.398981592 | 0.40552017 | 0.006538578 |
| 0.312924201 | 0.478173271 | 0.16524907 |
| 0.402549255 | 0.462003454 | 0.059454199 |
| 0.520037131 | 0.62558238 | 0.10554525 |
| 0.369639257 | 0.490959666 | 0.12132041 |
| 0.311395761 | 0.124385102 | -0.187010659 |
| 0.553267032 | 0.634597378 | 0.081330347 |
| 0.071006438 | 0.03196347 | -0.039042967 |
| 0.54931465 | 0.65339233 | 0.10407768 |
| 0.727682194 | 0.835082459 | 0.107400264 |

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| 0.638461538 | 0.714285714 | 0.075824176 |
| 0.44463883 | 0.41443539 | -0.03020344 |
| 0.47506571 | 0.581904199 | 0.106838489 |
| 0.628323118 | 0.680800942 | 0.052477824 |
| 0.618828541 | 0.692513369 | 0.073684828 |
| 0.539913559 | 0.661113369 | 0.12119981 |
| 0.480565678 | 0.622641509 | 0.142075832 |
| 0.335181296 | 0.501503965 | 0.166322669 |
| 0.150364742 | 0.285526316 | 0.135161573 |
| 0.419603249 | 0.511067388 | 0.091464139 |
| 0.213597553 | 0.320552147 | 0.106954594 |
| 0.297350778 | 0.440256046 | 0.142905267 |
| 0.242000661 | 0.401913876 | 0.159913215 |
| 0.152435378 | 0.307790549 | 0.155355171 |
| 0.263565163 | 0.326923077 | 0.063357914 |
| 0.383606329 | 0.254306809 | -0.129299521 |
| 0.668948161 | 0.728658537 | 0.059710375 |
| 0.143746037 | 0.201011378 | 0.057265341 |
| 0.073167263 | 0.221804511 | 0.148637248 |
| 0.30818098 | 0.393810032 | 0.085629052 |
| 0.684736582 | 0.814319973 | 0.129583391 |
| 0.685324621 | 0.848154657 | 0.162830036 |
| 0.584716527 | 0.728494624 | 0.143778097 |
| 0.314401623 | 0.554455446 | 0.240053823 |
| 0.558565682 | 0.789728682 | 0.231163 |
| 0.748069028 | 0.816772917 | 0.068703889 |
| 0.394790099 | 0.533998187 | 0.139208088 |
| 0.388893971 | 0.490160428 | 0.101266457 |
| 0.631746931 | 0.755673222 | 0.123926291 |
| 0.063383532 | 0.140350877 | 0.076967345 |
| 0.401397516 | 0.465738758 | 0.064341243 |
| 0.339766131 | 0.1239819 | -0.21578423 |
| 0.380372855 | 0.118357488 | -0.262015368 |
| 0.412892658 | 0.308729595 | -0.104163063 |
| 0.490760662 | 0.531733981 | 0.04097332 |
| 0.653836317 | 0.708571429 | 0.054735111 |
| 0.687514013 | 0.82063306 | 0.133119047 |
| 0.54161356 | 0.605433376 | 0.063819817 |
| 0.294427285 | 0.388489209 | 0.094061924 |
| 0.637406334 | 0.712391214 | 0.07498488 |
| 0.086405831 | 0.17654557 | 0.09013974 |
| 0.647979798 | 0.550632911 | -0.097346887 |
| 0.230421103 | 0.250933532 | 0.020512429 |
| 0.702032086 | 0.970238095 | 0.26820601 |

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| 0.400329723 | 0.440350877 | 0.040021154 |
| 0.224248702 | 0.087360595 | -0.136888108 |
| 0.358376367 | 0.463403263 | 0.105026896 |
| 0.292816414 | 0.397626113 | 0.104809699 |
| 0.292816414 | 0.397626113 | 0.104809699 |
| 0.286860928 | 0.47715736 | 0.190296433 |
| 0.051831124 | 0.144778481 | 0.092947357 |
| 0.053300127 | 0.147012579 | 0.093712451 |
| 0.325 | 0.551601423 | 0.226601423 |
| 0.40486065 | 0.502080969 | 0.097220318 |
| 0.550225841 | 0.659837513 | 0.109611672 |
| 0.301181731 | 0.474233983 | 0.173052252 |
| 0.523489193 | 0.588757176 | 0.065267983 |
| 0.638171567 | 0.787769784 | 0.149598217 |
| 0.343897933 | 0.443298969 | 0.099401036 |
| 0.479450827 | 0.585197935 | 0.105747107 |
| 0.3519418 | 0.444857497 | 0.092915697 |
| 0.335790777 | 0.4306894 | 0.094898623 |
| 0.336096897 | 0.351115422 | 0.015018525 |
| 0.548352475 | 0.472049689 | -0.076302786 |
| 0.546846151 | 0.604803493 | 0.057957343 |
| 0.407928001 | 0.51487524 | 0.106947239 |
| 0.654694267 | 0.665452653 | 0.010758386 |
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| 0.348067916 | 0.554778555 | 0.206710639 |
| 0.202893869 | 0.218064297 | 0.015170428 |
| 0.352459016 | 0.297213622 | -0.055245394 |
| 0.070286613 | 0.142857143 | 0.07257053 |
| 0.20066659 | 0.402150538 | 0.201483947 |
| 0.54775533 | 0.647009967 | 0.099254637 |
| 0.065248202 | 0.161616162 | 0.09636796 |
| 0.159305057 | 0.380772856 | 0.221467799 |
| 0.565780293 | 0.668229777 | 0.102449484 |
| 0.223861367 | 0.379650721 | 0.155789355 |
| 0.560766797 | 0.571336011 | 0.010569215 |
| 0.324403411 | 0.229460094 | -0.094943317 |
| 0.703698566 | 0.788990826 | 0.085292259 |
| 0.234496555 | 0.226169331 | -0.008327224 |
| 0.451310861 | 0.427331887 | -0.023978974 |
| 0.588642214 | 0.499263623 | -0.089378591 |
| 0.666417652 | 0.887057387 | 0.220639735 |
| 0.631236773 | 0.711256117 | 0.080019344 |
| 0.492394564 | 0.669625247 | 0.177230683 |
| 0.632883245 | 0.743333333 | 0.110450088 |
| 0.631455972 | 0.695812808 | 0.064356836 |
| 0.432291667 | 0.669902913 | 0.237611246 |
| 0.389673913 | 0.497797357 | 0.108123444 |
| 0.593983311 | 0.734870317 | 0.140887006 |
| 0.380312986 | 0.498827942 | 0.118514956 |
| 0.365562914 | 0.580536913 | 0.214973999 |
| 0.608844691 | 0.760579065 | 0.151734373 |
| 0.257331008 | 0.43910522 | 0.181774211 |
| 0.166203704 | 0.449541284 | 0.283337581 |
| 0.318621944 | 0.47979798 | 0.161176036 |
| 0.70577728 | 0.809471366 | 0.103694086 |
| 0.382717777 | 0.468538566 | 0.085820789 |
| 0.88001628 | 0.918215613 | 0.038199333 |
| 0.512888061 | 0.580645161 | 0.067757101 |
| 0.019748564 | 0.018452381 | -0.001296183 |
| 0.599580171 | 0.682775713 | 0.083195542 |
| 0.168189189 | 0.392677674 | 0.224488485 |

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| 0.617070294 | 0.748288404 | 0.13121811 |
| 0.319720803 | 0.536247335 | 0.216526531 |
| 0.295208105 | 0.453001133 | 0.157793028 |
| 0.131337573 | 0.272217774 | 0.140880202 |
| 0.309708494 | 0.284931507 | -0.024776987 |
| 0.488783604 | 0.573970928 | 0.085187324 |
| 0.476472498 | 0.621406206 | 0.144933708 |
| 0.527163064 | 0.594877765 | 0.067714701 |
| 0.425386905 | 0.484848485 | 0.05946158 |
| 0.452332948 | 0.610477398 | 0.15814445 |
| 0.401081065 | 0.38028169 | -0.020799375 |
| 0.558358308 | 0.749154453 | 0.190796145 |
| 0.415726272 | 0.488290614 | 0.072564342 |
| 0.206686833 | 0.141654979 | -0.065031854 |
| 0.473781061 | 0.722043144 | 0.248262083 |
| 0.6176057 | 0.697603966 | 0.079998266 |
| 0.739106543 | 0.822625698 | 0.083519156 |
| 0.13918548 | 0.070748299 | -0.068437181 |
| 0.667807514 | 0.749921973 | 0.082114459 |
| 0.217092038 | 0.341960784 | 0.124868747 |
| 0.724264565 | 0.792134831 | 0.067870266 |
| 0.050313476 | 0.04619226 | -0.004121216 |
| 0.459276193 | 0.53592044 | 0.076644246 |
| 0.399606483 | 0.525677603 | 0.12607112 |
| 0.367591189 | 0.422350041 | 0.054758852 |
| 0.279001985 | 0.163393559 | -0.115608427 |
| 0.616514939 | 0.758226791 | 0.141711852 |
| 0.4325778 | 0.452580195 | 0.020002396 |
| 0.607489614 | 0.71088488 | 0.103395266 |
| 0.53693901 | 0.635032652 | 0.098093642 |
| 0.392544328 | 0.458598726 | 0.066054398 |
| 0.322138529 | 0.204869857 | -0.117268672 |
| 0.351440356 | 0.553719008 | 0.202278652 |
| 0.32075359 | 0.204869857 | -0.115883733 |
| 0.511683325 | 0.572321801 | 0.060638476 |
| 0.514059019 | 0.639259904 | 0.125200885 |
| 0.317059778 | 0.54727475 | 0.230214972 |
| 0.523202199 | 0.718287186 | 0.195084987 |
| 0.577041428 | 0.808080808 | 0.23103938 |
| 0.340637452 | 0.506633499 | 0.165996047 |
| 0.408326731 | 0.604519774 | 0.196193043 |
| 0.194243782 | 0.304404145 | 0.110160363 |
| 0.377275361 | 0.404189294 | 0.026913933 |
| 0.194243782 | 0.304404145 | 0.110160363 |

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| 0.575232992 | 0.664148352 | 0.08891536 |
| 0.381993428 | 0.538113949 | 0.156120521 |
| 0.71153151 | 0.957236842 | 0.245705332 |
| 0.18768368 | 0.364086833 | 0.176403153 |
| 0.553404238 | 0.665498247 | 0.11209401 |
| 0.509891158 | 0.600961538 | 0.091070381 |
| 0.62101318 | 0.756666667 | 0.135653486 |
| 0.192090621 | 0.381900452 | 0.189809831 |
| 0.469730168 | 0.555115155 | 0.085384987 |
| 0.601321085 | 0.699521149 | 0.098200064 |
| 0.249359321 | 0.296567248 | 0.047207927 |
| 0.13203239 | 0.162283997 | 0.030251607 |
| 0.53119974 | 0.618577075 | 0.087377335 |
| 0.04001293 | 0.413360121 | 0.373347191 |
| 0.570925689 | 0.67877787 | 0.10785218 |
| 0.427605459 | 0.668997669 | 0.24139221 |
| 0.338276712 | 0.64 | 0.301723288 |
| 0.85534028 | 0.949468085 | 0.094127805 |
| 0.531159357 | 0.610189955 | 0.079030598 |
| 0.346923077 | 0.507494647 | 0.16057157 |
| 0.550079527 | 0.632138114 | 0.082058587 |
| 0.481666049 | 0.699186992 | 0.217520943 |
| 0.449790945 | 0.688981869 | 0.239190924 |
| 0.761922591 | 0.869627507 | 0.107704916 |
| 0.114022233 | 0.02293578 | -0.091086453 |
| 0.597546983 | 0.858020897 | 0.260473914 |
| 0.597546983 | 0.858020897 | 0.260473914 |
| 0.408170261 | 0.467889908 | 0.059719648 |
| 0.338621856 | 0.467595072 | 0.128973217 |
| 0.698415828 | 0.808303887 | 0.109888059 |
| 0.315844901 | 0.4 | 0.084155099 |
| 0.333450571 | 0.420547945 | 0.087097375 |
| 0.415992425 | 0.514117647 | 0.098125222 |
| 0.520278589 | 0.58816772 | 0.067889131 |
| 0.22550539 | 0.359615385 | 0.134109994 |
| 0.199273121 | 0.789317507 | 0.590044386 |
| 0.406392694 | 0.224156692 | -0.182236002 |
| 0.374609596 | 0.126070991 | -0.248538605 |
| 0.56980977 | 0.337965261 | -0.231844509 |
| 0.397822056 | 0.120941558 | -0.276880497 |
| 0.435646132 | 0.499354839 | 0.063708707 |
| 0.708457831 | 0.787610619 | 0.079152788 |
| 0.292179792 | 0.468948035 | 0.176768243 |
| 0.537080695 | 0.614613779 | 0.077533084 |

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| 0.201939954 | 0.295150502 | 0.093210548 |
| 0.599101476 | 0.691897045 | 0.092795569 |
| 0.677671885 | 0.723658052 | 0.045986167 |
| 0.591493163 | 0.666923472 | 0.075430309 |
| 0.147619457 | 0.098933075 | -0.048686383 |
| 0.223433323 | 0.122747748 | -0.100685576 |
| 0.612008759 | 0.713118843 | 0.101110084 |
| 0.380270985 | 0.306866953 | -0.073404032 |
| 0.484283849 | 0.571428571 | 0.087144723 |
| 0.64560049 | 0.733890215 | 0.088289725 |
| 0.551385907 | 0.643356643 | 0.091970737 |
| 0.568682111 | 0.673366834 | 0.104684723 |
| 0.493050304 | 0.503238665 | 0.010188361 |
| 0.579932801 | 0.660678643 | 0.080745842 |
| 0.432186235 | 0.481927711 | 0.049741476 |
| 0.412949017 | 0.742732558 | 0.329783541 |
| 0.691057191 | 0.755259541 | 0.064202351 |
| 0.721994932 | 0.753209427 | 0.031214495 |
| 0.480084814 | 0.363265306 | -0.116819508 |
| 0.466051156 | 0.364625072 | -0.101426084 |
| 0.61599266 | 0.688899828 | 0.072907168 |
| 0.421392783 | 0.489855072 | 0.06846229 |
| 0.241111507 | 0.144670051 | -0.096441456 |
| 0.352489964 | 0.497371613 | 0.144881649 |
| 0.398429493 | 0.403904253 | 0.00547476 |
| 0.81175553 | 0.764285714 | -0.047469816 |
| 0.596590909 | 0.725947522 | 0.129356613 |
| 0.337089947 | 0.493443044 | 0.156353097 |
| 0.758985275 | 0.8288854 | 0.069900126 |
| 0.321741628 | 0.433121019 | 0.111379391 |
| 0.164922469 | 0.044265594 | -0.120656875 |
| 0.353865433 | 0.433656958 | 0.079791525 |
| 0.459804067 | 0.66536965 | 0.205565583 |
| 0.376867768 | 0.454022989 | 0.07715522 |
| 0.362174036 | 0.526427061 | 0.164253025 |
| 0.510751339 | 0.586437485 | 0.075686146 |
| 0.559259259 | 0.63986014 | 0.080600881 |
| 0.185219168 | 0.055350554 | -0.129868614 |
| 0.270303391 | 0.421348315 | 0.151044923 |
| 0.515716188 | 0.615228289 | 0.0995121 |
| 0.585686795 | 0.534545455 | -0.051141341 |
| 0.560291455 | 0.586363636 | 0.026072181 |
| 0.418235289 | 0.43679665 | 0.018561361 |
| 0.674808994 | 0.736102719 | 0.061293725 |

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| 0.668621894 | 0.745173745 | 0.076551852 |
| 0.059268514 | 0.028481013 | -0.030787501 |
| 0.131594474 | 0.29119171 | 0.159597236 |
| 0.345911458 | 0.552403283 | 0.206491824 |
| 0.298781661 | 0.504533679 | 0.205752018 |
| 0.664685818 | 0.719523618 | 0.0548378 |
| 0.445181926 | 0.548970367 | 0.103788441 |
| 0.303493059 | 0.710280374 | 0.406787315 |
| 0.100435456 | 0.252428513 | 0.151993056 |
| 0.318381578 | 0.346325879 | 0.027944301 |
| 0.359797172 | 0.296717724 | -0.063079448 |
| 0.643560514 | 0.680215182 | 0.036654669 |
| 0.475480016 | 0.625118934 | 0.149638919 |
| 0.349879064 | 0.435948493 | 0.08606943 |
| 0.74451408 | 0.794828317 | 0.050314237 |
| 0.328916373 | 0.381051536 | 0.052135162 |
| 0.155471184 | 0.323955317 | 0.168484133 |
| 0.285196769 | 0.494584838 | 0.209388068 |
| 0.258909299 | 0.288808664 | 0.029899365 |
| 0.147148898 | 0.084337349 | -0.062811549 |
| 0.348767974 | 0.417845204 | 0.069077231 |
| 0.336993872 | 0.527518172 | 0.1905243 |
| 0.648626115 | 0.616355376 | -0.032270739 |
| 0.19627721 | 0.27696793 | 0.08069072 |
| 0.157866533 | 0.26225076 | 0.104384228 |
| 0.590091215 | 0.6496695 | 0.059578284 |
| 0.352615009 | 0.213286713 | -0.139328296 |
| 0.254737367 | 0.385375494 | 0.130638127 |
| 0.695052581 | 0.767819706 | 0.072767126 |
| 0.61201294 | 0.691720093 | 0.079707153 |
| 0.253565898 | 0.386904762 | 0.133338864 |
| 0.552510058 | 0.677649528 | 0.125139469 |
| 0.265339922 | 0.337828247 | 0.072488325 |
| 0.465525078 | 0.575025176 | 0.109500099 |
| 0.470078744 | 0.461919505 | -0.008159239 |
| 0.788361345 | 0.672413793 | -0.115947551 |
| 0.633627181 | 0.736038486 | 0.102411305 |
| 0.770342719 | 0.670250896 | -0.100091823 |
| 0.14174908 | 0.065121413 | -0.076627667 |
| 0.782508518 | 0.72183908 | -0.060669438 |
| 0.568643189 | 0.655496225 | 0.086853037 |
| 0.420113256 | 0.573129962 | 0.153016706 |
| 0.396655312 | 0.547580519 | 0.150925207 |
| 0.286808778 | 0.417525773 | 0.130716995 |

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| 0.354670159 | 0.490500261 | 0.135830103 |
| 0.715846209 | 0.823639775 | 0.107793566 |
| 0.068277486 | 0.042180402 | -0.026097084 |
| 0.186617401 | 0.119946985 | -0.066670416 |
| 0.610672367 | 0.714860335 | 0.104187968 |
| 0.581867291 | 0.703649635 | 0.121782344 |
| 0.205341522 | 0.347587719 | 0.142246197 |
| 0.176312948 | 0.383630048 | 0.2073171 |
| 0.550556282 | 0.65451664 | 0.103960358 |
| 0.54185712 | 0.692307692 | 0.150450573 |
| 0.632064447 | 0.733118971 | 0.101054524 |
| 0.26488727 | 0.19972067 | -0.065166599 |
| 0.562855912 | 0.692656929 | 0.129801016 |
| 0.611467596 | 0.732290831 | 0.120823235 |
| 0.745837548 | 0.745794393 | -4.32e-05 |
| 0.62621664 | 0.703761148 | 0.077544508 |
| 0.32426682 | 0.497326203 | 0.173059383 |
| 0.325851314 | 0.314165128 | -0.011686186 |
| 0.694728386 | 0.77064551 | 0.075917124 |
| 0.291852894 | 0.4552498 | 0.163396906 |
| 0.644254092 | 0.70051609 | 0.056261998 |
| 0.257902959 | 0.543847242 | 0.285944283 |
| 0.699650286 | 0.756529273 | 0.056878988 |
| 0.016503911 | 0.069439895 | 0.052935984 |
| 0.528912629 | 0.611437312 | 0.082524683 |
| 0.154032249 | 0.291459782 | 0.137427532 |
| 0.66916281 | 0.727740492 | 0.058577683 |
| 0.531678818 | 0.727052303 | 0.195373486 |
| 0.342300147 | 0.430833333 | 0.088533186 |
| 0.582099167 | 0.667947733 | 0.085848566 |
| 0.361478076 | 0.458085452 | 0.096607375 |
| 0.435000518 | 0.526888816 | 0.091888298 |
| 0.636777465 | 0.717607973 | 0.080830509 |
| 0.647200701 | 0.59030837 | -0.056892331 |
| 0.232785231 | 0.259666414 | 0.026881183 |
| 0.51697889 | 0.562588235 | 0.045609345 |
| 0.168780775 | 0.23225241 | 0.063471635 |
| 0.202599841 | 0.131714496 | -0.070885345 |
| 0.809891366 | 0.626923077 | -0.18296829 |
| 0.662838496 | 0.802405498 | 0.139567002 |
| 0.038184874 | 0.100153139 | 0.061968266 |
| 0.576220568 | 0.687220733 | 0.111000164 |
| 0.655169836 | 0.690322581 | 0.035152744 |
| 0.380276326 | 0.438296112 | 0.058019786 |

| q-value of methylation difference in Sdhb -/- imCC | methylation in Sdhb -/- imCC | methylation delta in Sdhb -/- imCC |
|---|---|---|
| 7.61e-10 | 0.683904632 | 0.1746388 |
| 1.02e-34 | 0.451618034 | 0.055235704 |
| 0.000120323 | 0.399159396 | -0.010459715 |
| 0.000362561 | 0.145098039 | -0.073282242 |
| 6.13e-09 | 0.684014846 | 0.100454501 |
| 0.000409511 | 0.753329118 | 0.045439619 |
| 1.93e-11 | 0.440131579 | 0.03280177 |
| 5.02e-16 | 0.620254346 | 0.054241332 |
| 6.29e-29 | 0.209420598 | -0.117140579 |
| 2.56e-26 | 0.509119161 | 0.035351085 |
| 0.003242297 | 0.616399844 | 0.036550873 |
| 0.026718201 | 0.181114329 | -0.228807966 |
| 1.76e-07 | 0.342926753 | 0.050162242 |
| 1.12e-16 | 0.771132559 | 0.113587623 |
| 1.42e-49 | 0.559763895 | 0.029012617 |
| 8.27e-14 | 0.141576937 | -0.02878877 |
| 0.175328411 | 0.825126263 | 0.156376263 |
| 4.81e-05 | 0.667517007 | -0.037886553 |
| 3.43e-31 | 0.168076661 | 0.033735347 |
| 2.31e-21 | 0.71654061 | 0.140753915 |
| 0.025587136 | 0.475566806 | 0.028806704 |
| 7.99e-25 | 0.779242507 | 0.145195212 |
| 0.00378684 | 0.436872977 | 0.13081934 |
| 3.04e-75 | 0.611301153 | 0.042251364 |
| 1.91e-13 | 0.282020562 | 0.026332291 |
| 1.05e-07 | 0.47248256 | -0.043986791 |
| 0.001642819 | 0.566766859 | 0.17484707 |
| 5.58e-98 | 0.545477637 | 0.046261164 |
| 1.89e-13 | 0.831119598 | 0.161597792 |
| 6.23e-58 | 0.511792774 | 0.239534406 |
| 3.09e-38 | 0.623119701 | 0.054019707 |
| 3.6e-09 | 0.498102824 | -0.006113318 |
| 0.002530606 | 0.692719389 | 0.111518353 |
| 5.14e-57 | 0.496027753 | -0.00689919 |
| 1.02e-16 | 0.509153972 | 0.007071991 |
| 4.82e-06 | 0.378890377 | -0.041523198 |
| 5.13e-14 | 0.459240976 | 0.020427867 |
| 1.58e-24 | 0.663549618 | 0.243166509 |
| 2.81e-31 | 0.430668414 | -0.011428655 |

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| 4.52e-43 | 0.722271361 | 0.092007082 |
| 7.69e-37 | 0.653068349 | 0.053129596 |
| 6.45e-10 | 0.86068182 | 0.160485181 |
| 0.001168828 | 0.701261684 | 0.098991346 |
| 9.98e-33 | 0.527362276 | 0.02040002 |
| 2.22e-08 | 0.320183511 | 0.02162834 |
| 4.27e-08 | 0.574559151 | 0.022445843 |
| 7.58e-39 | 0.404661922 | 0.096887269 |
| 7.24e-26 | 0.208197544 | -0.016371404 |
| 2.67e-07 | 0.618395889 | 0.001152391 |
| 0.298795292 | 0.765692311 | 0.273191813 |
| 4.21e-17 | 0.793528837 | 0.047340016 |
| 1.98e-09 | 0.61887626 | 0.321496745 |
| 2.18e-17 | 0.285206718 | -0.039742746 |
| 6.94e-11 | 0.292275906 | -0.046744942 |
| 1.57e-33 | 0.252016857 | -0.077386499 |
| 3.18e-37 | 0.540140469 | 0.247659281 |
| 5.4e-08 | 0.26420502 | 0.063637003 |
| 2.39e-34 | 0.589833934 | 0.08513088 |
| 2.23e-29 | 0.517653476 | -0.007405304 |
| 2.85e-09 | 0.028089888 | 0.02015338 |
| 0.070030046 | 0.229165086 | 0.104279625 |
| 1.37e-14 | 0.794862069 | 0.074923277 |
| 1.23e-06 | 0.048695781 | -0.003696564 |
| 0.008157915 | 0.510058024 | -0.010661195 |
| 3.1e-56 | 0.674086127 | 0.087422808 |
| 0 | 0.684888982 | 0.142489308 |
| 2.21e-15 | 0.196241409 | 0.043058264 |
| 3.59e-143 | 0.527576992 | 0.056174501 |
| 0.277385974 | 0.553600098 | 0.101287053 |
| 7.88e-10 | 0.502742185 | -0.012278518 |
| 1.28e-06 | 0.370784335 | 0.016127473 |
| 4.63e-49 | 0.561253045 | 0.042828265 |
| 0.045895156 | 0.616002215 | 0.118347406 |
| 8.77e-06 | 0.62722518 | 0.06032008 |
| 2.55e-63 | 0.489288705 | 0.036568145 |
| 2.07e-31 | 0.571928649 | 0.029583597 |
| 7.7e-66 | 0.476139615 | 0.040499763 |
| 0.024666642 | 0.818031849 | 0.098446525 |
| 4.23e-09 | 0.597598894 | 0.028013231 |
| 0.031986384 | 0.588697534 | 0.00331562 |
| 0.011140856 | 0.602013423 | 0.083596759 |
| 2.48e-74 | 0.415994516 | -0.012703716 |
| 2.48e-74 | 0.415994516 | -0.012703716 |

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| 1.08e-08 | 0.288780047 | 0.039904249 |
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| 6.93e-14 | 0.577801362 | -0.024011489 |
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| 2.3e-17 | 0.811658446 | 0.082485692 |
| 2.28e-15 | 0.448118735 | 0.018171154 |
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| 1.37e-50 | 0.636200107 | 0.074224578 |
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| 1.58e-05 | 0.80399556 | 0.244950047 |
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| 3.9e-278 | 0.595314583 | 0.05051911 |
| 2.46e-10 | 0.503752903 | 0.073892281 |
| 6.41e-42 | 0.457693503 | 0.022346003 |
| 2.55e-19 | 0.581814675 | 0.028497243 |
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| 3.26e-09 | 0.64043501 | 0.06029858 |
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| 3.52e-06 | 0.730921609 | 0.008392136 |
| 4.65e-06 | 0.695100763 | 0.113883123 |
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| 6.66e-14 | 0.50982423 | 0.146206531 |
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| 1.54e-14 | 0.275621118 | -0.265562879 |
| 1.31e-53 | 0.538658604 | -0.022037737 |
| 3.03e-99 | 0.331526567 | 0.006061079 |
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| 4.98e-16 | 0.625108097 | 0.039114867 |
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| 0.008497679 | 0.344275458 | 0.106775458 |
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| 6.75e-44 | 0.555758751 | 0.009323682 |
| 9.56e-54 | 0.479267809 | 0.053411107 |
| 6.83e-06 | 0.527590219 | 0.19098143 |
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| 0.036532547 | 0.463541667 | 0.078396469 |
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| 9.42e-19 | 0.467693563 | 0.090106643 |
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| 1.09e-09 | 0.629176639 | 0.078430082 |
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| 1.78e-06 | 0.222386601 | 0.097625868 |
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| 2.33e-20 | 0.229786888 | 0.053620475 |
| 6.04e-32 | 0.56342598 | 0.030095413 |
| 4.89e-53 | 0.03585744 | 0.000454091 |
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| 0.011564004 | 0.50682928 | 0.207901715 |
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| 5.52e-59 | 0.489122633 | 0.031957782 |
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| 1.2e-90 | 0.59675806 | 0.093764692 |
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| 2.81e-33 | 0.572157083 | 0.141344075 |
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| 1.94e-41 | 0.524900254 | -0.025694052 |
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| 2.33e-200 | 0.506067761 | 0.0141013 |
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| 8.67e-05 | 0.650717809 | 0.12554864 |
| 1.65e-109 | 0.2448124 | 0.012363723 |
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| 3.05e-19 | 0.613045167 | 0.022653711 |
| 1.75e-39 | 0.397225796 | 0.009353437 |
| 9.39e-24 | 0.232407516 | -0.051400165 |
| 2.37e-141 | 0.830418382 | 0.105988234 |
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| 4.47e-94 | 0.349560557 | 0.071576191 |
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| 2.68e-34 | 0.336925713 | 0.051599699 |
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| 2.97e-37 | 0.547496641 | 0.083597741 |
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| 1.38e-15 | 0.792031704 | 0.153850188 |
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| 2.21e-98 | 0.342140037 | 0.056274981 |
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| 1.47e-22 | 0.454043616 | 0.139503813 |
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| 1.15e-175 | 0.174176045 | -0.003743102 |
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| 1.08e-22 | 0.546488053 | 0.033621577 |
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| 1.62e-46 | 0.723502056 | 0.039769356 |
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| 0.154568727 | 0.62867964 | 0.222893211 |
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| 0.172215719 | 0.414049138 | 0.094447254 |
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| 1.2e-18 | 0.031372336 | 0.000481819 |
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| 2.1e-07 | 0.632460422 | 0.014711987 |
| 1.8e-70 | 0.365273086 | 0.156463291 |
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| 5.4e-16 | 0.447316821 | -0.043135881 |
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| 2.3e-23 | 0.727301337 | 0.066866406 |
| 2.69e-35 | 0.517146937 | 0.061477679 |
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| 1.27e-15 | 0.393972144 | 0.059884905 |
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| 2.58e-14 | 0.47690043 | 0.119184999 |
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| 6.67e-38 | 0.620387456 | 0.087839145 |
| 1.99e-12 | 0.624861178 | 0.040667199 |
| 4.1e-12 | 0.481957733 | 0.066950322 |
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| 3.81e-120 | 0.354692968 | 0.015435852 |
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| 9.38e-10 | 0.721426789 | 0.018786587 |
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| 1.36e-24 | 0.512984541 | 0.120429038 |
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| 3.73e-15 | 0.662643915 | 0.026563012 |
| 1.63e-23 | 0.603698906 | 0.043671979 |
| 4.8e-19 | 0.782993589 | 0.02634456 |
| 2.02e-25 | 0.627613342 | 0.054471693 |
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| 3.37e-05 | 0.519032815 | 0.073454075 |
| 6.02e-30 | 0.846288837 | 0.112893775 |
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| 2.05e-08 | 0.552804906 | 0.067288593 |
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| 1.42e-52 | 0.02632339 | 0.004602105 |
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| 1.16e-15 | 0.591058369 | 0.037452709 |
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| 5.18e-10 | 0.238910599 | 0.125516805 |
| 6.97e-15 | 0.49964142 | 0.082326158 |
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| 1.64e-06 | 0.30625 | 0.215774472 |
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| 9.34e-19 | 0.38503702 | 0.1000434 |
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| 2.4e-05 | 0.591378805 | 0.090744211 |
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| 6.74e-67 | 0.597534937 | 0.038895454 |
| 2.68e-38 | 0.49486352 | 0.077487392 |
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| 2.73e-10 | 0.615259853 | 0.012334549 |
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| 4.06e-33 | 0.685341615 | 0.008936988 |
| 1.74e-143 | 0.433105423 | 0.022749423 |
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| 2.53e-08 | 0.437606018 | -0.073385242 |
| 4.57e-34 | 0.43887258 | 0.121871011 |
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| 3.96e-47 | 0.599121963 | 0.042828177 |
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| 1.61e-05 | 0.797058824 | 0.006033183 |
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| 3.24e-89 | 0.430504823 | 0.017812873 |
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| 1.43e-45 | 0.7233031 | 0.023127248 |
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| 4.81e-66 | 0.538410285 | 0.092036692 |
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| 1.25e-13 | 0.644537815 | 0.055885333 |
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| 5.23e-12 | 0.384013392 | 0.181018556 |
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| 5.95e-48 | 0.278692943 | 0.075000598 |
| 3.15e-59 | 0.413849111 | 0.041946085 |
| 5.95e-95 | 0.272871657 | 0.119050353 |
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| 1.53e-05 | 0.634517324 | 0.050846471 |
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| 3.1e-28 | 0.608946609 | 0.30342757 |
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| 3.24e-11 | 0.444910645 | 0.076807504 |
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| 1.68e-05 | 0.67359681 | 0.088335899 |
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| 5.18e-24 | 0.28501157 | 0.147887229 |
| 7.18e-46 | 0.657289971 | 0.167138527 |
| 5.26e-55 | 0.650565642 | 0.164801425 |
| 2.28e-58 | 0.162680802 | 0.01321037 |
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| 2.83e-80 | 0.684548206 | 0.131933008 |
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| 7.68e-29 | 0.725310156 | 0.293010867 |
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| 1.01e-27 | 0.658628815 | 0.068620878 |
| 2.01e-37 | 0.429859895 | 0.073805269 |
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| 3.73e-08 | 0.423151535 | 0.071530118 |
| 2.5e-55 | 0.206935641 | 0.008058688 |
| 1.84e-107 | 0.550047435 | -0.000591865 |
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| 6.74e-48 | 0.427950863 | 0.005374105 |
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| 8.13e-125 | 0.63433872 | 0.134125718 |
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| 1.47e-111 | 0.649288982 | 0.028366565 |
| 1.9e-55 | 0.386047463 | 0.075494987 |
| 1.46e-110 | 0.641117031 | 0.00817451 |
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| 0.175826802 | 0.127909133 | 0.089615885 |
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| 3.93e-18 | 0.683248696 | 0.064968579 |
| 1.59e-29 | 0.256525068 | 0.037299004 |
| 9.7e-15 | 0.460068826 | 0.121440819 |
| 4.23e-05 | 0.800426895 | 0.006832641 |
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| 1.15e-98 | 0.56471867 | 0.04196408 |
| 2.05e-41 | 0.430034723 | 0.21957499 |
| 8.19e-24 | 0.777277896 | 0.089736764 |
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| 4.79e-47 | 0.602279906 | 0.007390673 |
| 1.03e-06 | 0.508250693 | 0.039763903 |
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| 1.03e-05 | 0.72372814 | 0.121997107 |
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| 3.1e-184 | 0.851377605 | 0.097152871 |
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| 1.68e-60 | 0.442972072 | 0.190230843 |
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| 2.55e-06 | 0.313269888 | 0.064710154 |
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| 1.07e-26 | 0.632418995 | 0.057186004 |
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| 5.73e-05 | 0.100178734 | -0.149180587 |
| 0.004125527 | 0.042399621 | -0.089632769 |
| 0.000550305 | 0.463186813 | -0.068012927 |
| 7.68e-222 | 0.002417795 | -0.037595135 |
| 2.86e-31 | 0.604788874 | 0.033863184 |
| 9.98e-25 | 0.544823232 | 0.117217773 |
| 4.94e-12 | 0.542311662 | 0.20403495 |
| 3.2e-06 | 0.839349254 | -0.015991027 |
| 1.57e-40 | 0.524572154 | -0.006587203 |
| 6.4e-08 | 0.358555714 | 0.011632638 |
| 8.51e-14 | 0.573792139 | 0.023712612 |
| 5.07e-32 | 0.508906883 | 0.027240834 |
| 2.02e-21 | 0.525101071 | 0.075310126 |
| 4.97e-08 | 0.893272543 | 0.131349952 |
| 1.02e-05 | 0.154651163 | 0.04062893 |
| 1.2e-67 | 0.782981891 | 0.185434908 |
| 1.2e-67 | 0.782981891 | 0.185434908 |
| 0.054773181 | 0.575493612 | 0.167323352 |
| 3.37e-22 | 0.438372093 | 0.099750238 |
| 2.98e-19 | 0.752296085 | 0.053880258 |
| 6.53e-23 | 0.306723958 | -0.009120943 |
| 1.37e-05 | 0.429068448 | 0.095617877 |
| 9.41e-26 | 0.61924721 | 0.203254785 |
| 2.56e-05 | 0.518524636 | -0.001753952 |
| 8.27e-42 | 0.137198113 | -0.088307277 |
| 3.78e-305 | 0.384837652 | 0.185564531 |
| 1.61e-22 | 0.497049671 | 0.090656977 |
| 9.8e-85 | 0.422892559 | 0.048282963 |
| 2.59e-66 | 0.544675155 | -0.025134615 |
| 6.86e-81 | 0.261481609 | -0.136340447 |
| 6.58e-16 | 0.474030268 | 0.038384136 |
| 3.95e-09 | 0.700624969 | -0.007832862 |
| 1.99e-68 | 0.440586622 | 0.14840683 |
| 4.49e-17 | 0.616751962 | 0.079671267 |

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|-------------|-------------|--------------|
| 1.65e-08 | 0.347659696 | 0.145719743 |
| 2.52e-26 | 0.62900379 | 0.029902314 |
| 0.008437907 | 0.767297585 | 0.089625701 |
| 6.72e-13 | 0.63591825 | 0.044425087 |
| 0.032495445 | 0.384025336 | 0.236405879 |
| 1.12e-24 | 0.316883929 | 0.093450606 |
| 9.38e-92 | 0.62190064 | 0.009891881 |
| 0.000311978 | 0.433650212 | 0.053379228 |
| 0.000593678 | 0.595728063 | 0.111444214 |
| 1.25e-12 | 0.633150762 | -0.012449728 |
| 2.63e-11 | 0.5962552 | 0.044869293 |
| 0.000740332 | 0.466953337 | -0.101728774 |
| 0.277595859 | 0.321804967 | -0.171245337 |
| 3.4e-05 | 0.690863254 | 0.110930453 |
| 0.109526826 | 0.266369955 | -0.16581628 |
| 1.55e-41 | 0.347010335 | -0.065938683 |
| 9.19e-50 | 0.681392194 | -0.009664997 |
| 0.000167184 | 0.792036167 | 0.070041235 |
| 3.81e-16 | 0.431452475 | -0.048632339 |
| 6.27e-13 | 0.428764322 | -0.037286834 |
| 4.5e-13 | 0.621789683 | 0.005797023 |
| 0.002334358 | 0.528103065 | 0.106710282 |
| 4.3e-20 | 0.474342158 | 0.233230652 |
| 9.24e-33 | 0.559794041 | 0.207304076 |
| 0.064406938 | 0.27363876 | -0.124790733 |
| 0.093116267 | 0.938575269 | 0.126819738 |
| 0.001170943 | 0.715467747 | 0.118876838 |
| 4.09e-58 | 0.39159776 | 0.054507813 |
| 0.005296485 | 0.787005534 | 0.02802026 |
| 4.65e-20 | 0.277154928 | -0.044586699 |
| 8.2e-13 | 0.243905536 | 0.078983067 |
| 0.015321345 | 0.692266336 | 0.338400903 |
| 3.64e-14 | 0.542234973 | 0.082430906 |
| 9.06e-19 | 0.369050141 | -0.007817628 |
| 1.16e-20 | 0.500018228 | 0.137844192 |
| 5.78e-68 | 0.51394845 | 0.00319711 |
| 0.036257408 | 0.647432908 | 0.088173649 |
| 2.96e-08 | 0.177139678 | -0.00807949 |
| 2.27e-07 | 0.278104994 | 0.007801602 |
| 5.6e-43 | 0.568093093 | 0.052376905 |
| 0.035144637 | 0.815387374 | 0.229700579 |
| 0.094308143 | 0.687720255 | 0.127428799 |
| 0.00267327 | 0.605316993 | 0.187081703 |
| 2.2e-18 | 0.677412794 | 0.0026038 |

| | | |
|-------------|-------------|--------------|
| 3.47e-06 | 0.706287808 | 0.037665914 |
| 3.77e-05 | 0.231080836 | 0.171812323 |
| 8.97e-24 | 0.046465802 | -0.085128672 |
| 7.44e-102 | 0.384890227 | 0.038978768 |
| 1.15e-39 | 0.465265725 | 0.166484064 |
| 3.2e-16 | 0.761217943 | 0.096532125 |
| 9.85e-28 | 0.529668269 | 0.084486343 |
| 7.3e-11 | 0.469308036 | 0.165814977 |
| 3.09e-172 | 0.109126147 | 0.00869069 |
| 2.79e-06 | 0.456415431 | 0.138033854 |
| 2.21e-07 | 0.52834499 | 0.168547818 |
| 0.000445545 | 0.728035744 | 0.08447523 |
| 9.13e-16 | 0.568443327 | 0.092963312 |
| 1.82e-32 | 0.412548182 | 0.062669118 |
| 1.24e-05 | 0.62285402 | -0.12166006 |
| 5.94e-17 | 0.45447826 | 0.125561887 |
| 6.52e-63 | 0.11816784 | -0.037303344 |
| 8.98e-11 | 0.404925174 | 0.119728404 |
| 0.029398972 | 0.475498655 | 0.216589356 |
| 4.73e-06 | 0.164567197 | 0.017418299 |
| 1.83e-14 | 0.417427999 | 0.068660026 |
| 3.81e-17 | 0.340340699 | 0.003346826 |
| 0.011386336 | 0.479030408 | -0.169595707 |
| 0.000201717 | 0.185217773 | -0.011059437 |
| 1.25e-30 | 0.275170257 | 0.117303724 |
| 1.23e-12 | 0.578183453 | -0.011907763 |
| 3.99e-06 | 0.311502118 | -0.041112891 |
| 3.25e-43 | 0.318984244 | 0.064246877 |
| 7.99e-08 | 0.755613941 | 0.060561361 |
| 3.03e-57 | 0.6460261 | 0.034013161 |
| 2.7e-14 | 0.5377609 | 0.284195002 |
| 4.89e-92 | 0.546393165 | -0.006116893 |
| 3.59e-06 | 0.523728866 | 0.258388944 |
| 1.47e-08 | 0.647834866 | 0.182309788 |
| 0.323480738 | 0.357676643 | -0.1124021 |
| 0.003857798 | 0.77120743 | -0.017153914 |
| 8.3e-128 | 0.690608483 | 0.056981302 |
| 1.68e-05 | 0.744956603 | -0.025386115 |
| 4.36e-06 | 0.029371635 | -0.112377445 |
| 4.81e-08 | 0.791562771 | 0.009054252 |
| 4.59e-49 | 0.606076088 | 0.0374329 |
| 1.91e-64 | 0.654037112 | 0.233923856 |
| 6.53e-229 | 0.449291576 | 0.052636264 |
| 2.36e-37 | 0.649882094 | 0.363073315 |

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|-------------|-------------|--------------|
| 1.49e-67 | 0.603342918 | 0.248672759 |
| 1.18e-06 | 0.638305847 | -0.077540362 |
| 0.000396744 | 0.162772278 | 0.094494791 |
| 6.63e-09 | 0.295397271 | 0.10877987 |
| 6.73e-136 | 0.605699659 | -0.004972709 |
| 5.87e-06 | 0.607002801 | 0.02513551 |
| 2.05e-45 | 0.191275607 | -0.014065916 |
| 2.4e-139 | 0.375717118 | 0.19940417 |
| 5.7e-11 | 0.608156268 | 0.057599986 |
| 1.69e-07 | 0.708552086 | 0.166694967 |
| 1,00E-19 | 0.637376978 | 0.00531253 |
| 0.00023551 | 0.438628901 | 0.173741631 |
| 9.1e-48 | 0.535490812 | -0.0273651 |
| 7.36e-131 | 0.578623687 | -0.032843909 |
| 0.390430028 | 0.865777146 | 0.119939598 |
| 3.91e-10 | 0.598203186 | -0.028013454 |
| 1.17e-26 | 0.344098905 | 0.019832085 |
| 0.080499108 | 0.447081076 | 0.121229762 |
| 2.53e-12 | 0.667579799 | -0.027148588 |
| 3.08e-56 | 0.354022488 | 0.062169594 |
| 8.56e-14 | 0.656437481 | 0.012183389 |
| 1.41e-62 | 0.453044111 | 0.195141152 |
| 1.02e-19 | 0.675033808 | -0.024616478 |
| 9.23e-33 | 0.041511723 | 0.025007812 |
| 1.33e-75 | 0.546285012 | 0.017372383 |
| 1.4e-30 | 0.339140271 | 0.185108022 |
| 7.84e-21 | 0.682510523 | 0.013347713 |
| 6.47e-65 | 0.5801718 | 0.048492982 |
| 1.02e-08 | 0.268357091 | -0.073943057 |
| 3.26e-28 | 0.647023055 | 0.064923889 |
| 9.24e-27 | 0.4369553 | 0.075477224 |
| 6.09e-31 | 0.531512473 | 0.096511955 |
| 0.000114233 | 0.638908882 | 0.002131417 |
| 0.000238676 | 0.651833017 | 0.004632316 |
| 0.007312532 | 0.102527223 | -0.130258008 |
| 4.18e-06 | 0.379817885 | -0.137161005 |
| 3.2e-05 | 0.173645366 | 0.004864591 |
| 9.25e-09 | 0.17076221 | -0.031837631 |
| 1.85e-07 | 0.823990683 | 0.014099317 |
| 4.11e-12 | 0.776587714 | 0.113749218 |
| 2.14e-31 | 0.019317112 | -0.018867762 |
| 2.38e-08 | 0.680848604 | 0.104628035 |
| 0.013197415 | 0.503245144 | -0.151924692 |
| 3.23e-26 | 0.36162982 | -0.018646506 |

**q-value of methylation
difference in Sdhd +/- imCC**

1.59e-47
1.17e-14
0.305609256
0.00267426
1.93e-40
0.053721157
0.081738
0.001597197
1.99e-16
2.29e-05
0.030770864
1.61e-14
0.062322137
2.17e-23
1.07e-07
0.02279795
0.001025182
0.083107886
6.37e-05
9.91e-16
0.294278047
2.23e-80
2.04e-05
2.36e-10
0.082079678
1.13e-05
2.61e-29
1.46e-09
2.16e-07
4.3e-48
7.12e-11
0.313324582
4.7e-45
0.33335956
0.337732247
0.001647622
0.24828876
9.78e-22
0.26851698

4.34e-17
0.000833629
1.59e-25
2.65e-27
0.001530752
0.130804619
0.333120561
2.02e-05
0.069847679
0.414326549
8.97e-152
0.006955885
2.26e-29
0.166727248
0.020759383
2.89e-08
2.98e-94
0.006174685
9.9e-39
0.123323223
0.0762955
2.14e-32
2.83e-15
0.315439527
0.101388111
9.54e-14
9.03e-92
8.08e-05
1.99e-34
2.43e-45
0.156958716
0.137724367
4.06e-11
0.000442687
4.11e-06
5.6e-18
0.001878246
4.99e-09
1.42e-28
0.047164173
0.274473488
0.008726194
0.03574062
0.03574062

4.28e-06
0.005081631
0.112468939
2.02e-90
0.042001292
1.6e-21
8.53e-26
3.41e-06
4.41e-23
0.117330217
1.39e-05
0.348852862
0.099213129
0.048341649
1.74e-183
0.000647084
1.09e-26
2.1e-06
0.20157107
0.143725271
0.016183316
6.55e-10
6.72e-11
1.58e-16
0.006378378
0.385850759
4.28e-07
1.14e-252
3.52e-80
0.072837719
1.85e-10
0.391808363
5.37e-07
2.94e-12
0.001017083
1.12e-10
0.002367102
0.005174725
1.34e-19
2.38e-25
0.348410543
1.2e-07
4.89e-45
6.93e-17

0.020989051
0.371816328
0.032389634
1.61e-43
3.98e-07
0.017459753
3.61e-11
7.81e-05
2.17e-09
0.057069397
3.57e-05
2.44e-05
0.007409184
0.155575499
1.32e-222
1.87e-05
0.000220044
0.001128377
4.88e-20
0.000539199
0.304769148
0.00563192
0.05483628
0.000206932
4.24e-05
1.08e-12
3.44e-06
0.009376337
0.363574718
1.39e-39
0.026287952
3.32e-05
0.235311569
0.000387883
5.08e-23
7.55e-06
0.000607293
0.13090216
4.1e-13
8.64e-18
0.027871621
0.009249592
7.81e-14
3.52e-05

0.291882515
0.041797007
0.02018001
7.06e-05
0.00044075
8.88e-06
2.27e-10
1.35e-53
1.34e-47
2.68e-103
4.86e-13
0.054308835
0.000214722
1.06e-07
0.351752432
1.03e-12
1.12e-39
6.35e-05
3.1e-08
2.88e-10
2.28e-58
0.000155825
4.79e-48
0.00439714
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0.003145697
0.004586439
0.00024266
0.013894332
8.46e-10
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0.054959037
1.24e-33
3.92e-23
0.372009575
0.263617794
5.47e-13
4.79e-20
1.68e-25
1.36e-15
0.000128502
0.238571723

0.269369969
3.38e-76
0.000127964
0.012526046
0.410766198
1.1e-10
0.071097601
3.21e-06
1.31e-11
2.32e-31
0.107220262
3.05e-85
0.211755406
0.005998617
4.58e-05
7.33e-08
0.1417786
7.59e-65
0.000117989
3.67e-30
0.017934223
1.66e-09
4.53e-05
0.130419102
6.05e-06
0.006252162
4.49e-07
2.52e-13
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0.000477021
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0.154085361
0.198415107
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7.12e-07
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1.33e-08
0.000675353
0.039561526
4.07e-07
0.364378216
2.85e-26
0.044661059

0.004067465
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0.001358222
8.9e-06
0.000138772
5.02e-05
6.33e-16
0.321225293
1.02e-12
5.98e-34
0.000334959
0.040772829
0.143272983
0.303904853
8.26e-06
1.73e-05
2.22e-05
0.239848594
0.014169627
1.5e-30
1.69e-44
8.15e-32
0.374966196
0.269677962
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2.01e-44
5.11e-16
0.163101384
0.000287913
3.13e-31
5.38e-05
5.02e-18
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1.02e-17
1.27e-11
0.000190355
7.54e-05
0.157056836
7.71e-72
2.04e-21
4.73e-28

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7.3e-10
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9.37e-28
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1.21e-14
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5.23e-08
4.9e-12
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Figure 1

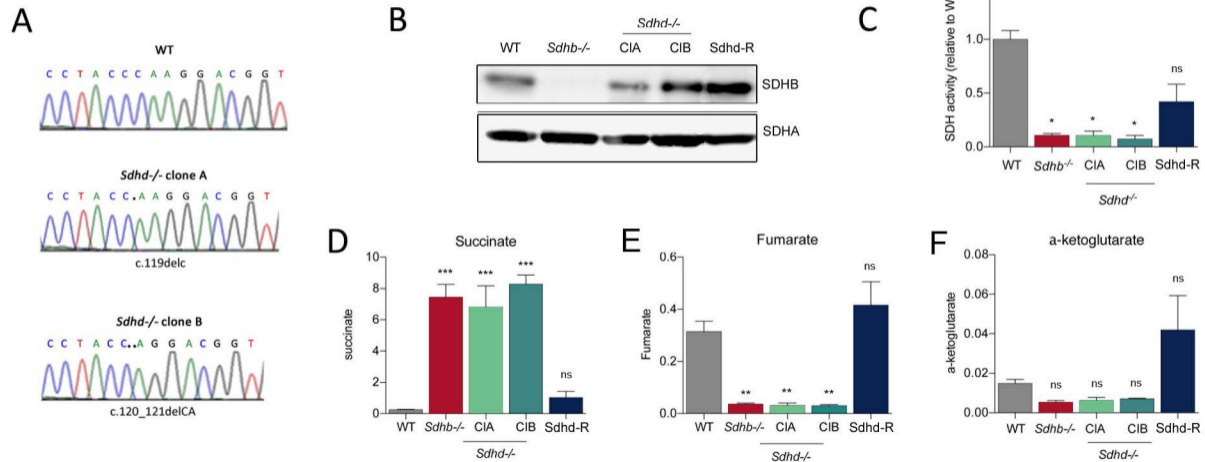


Figure 2

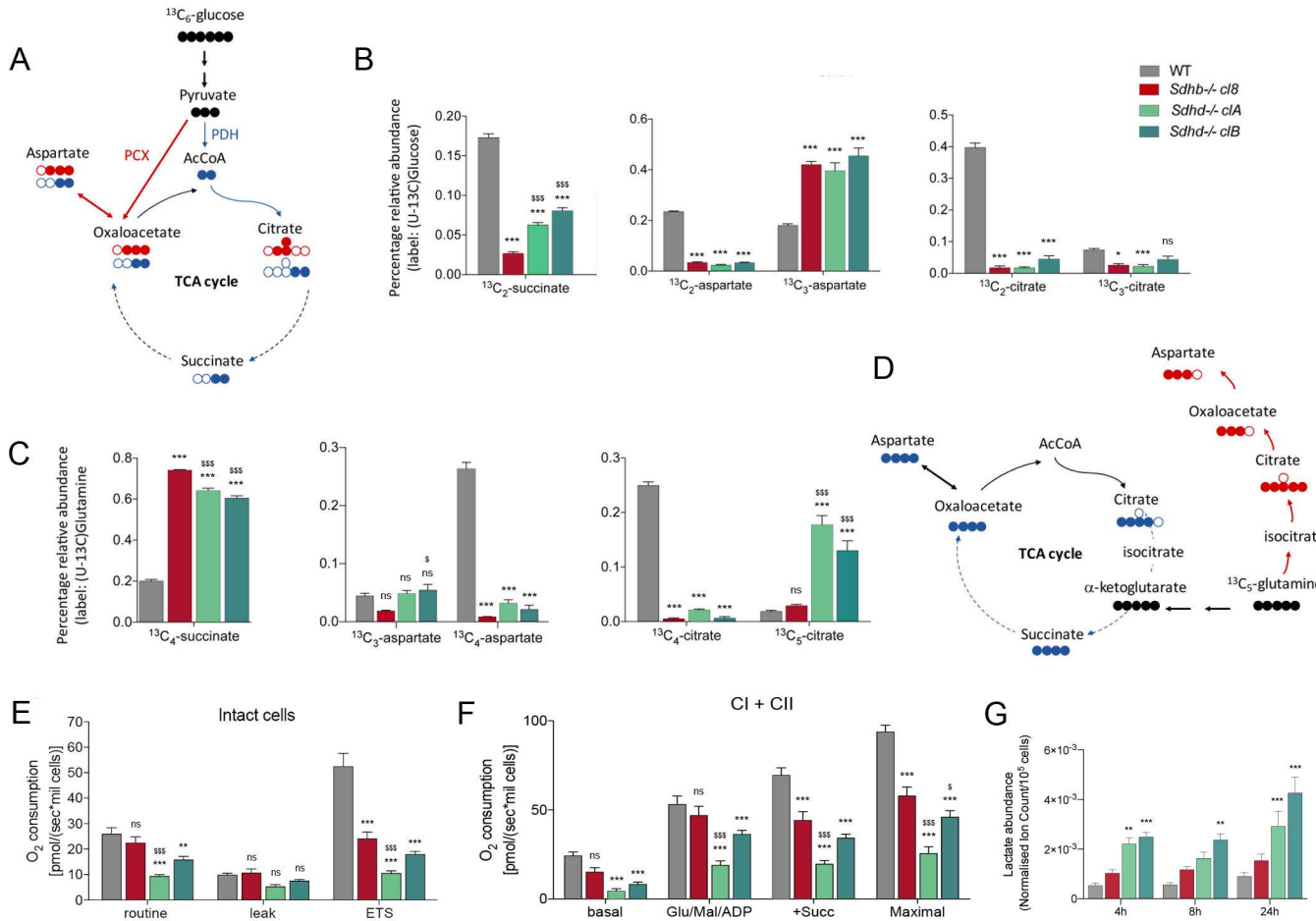


Figure 3

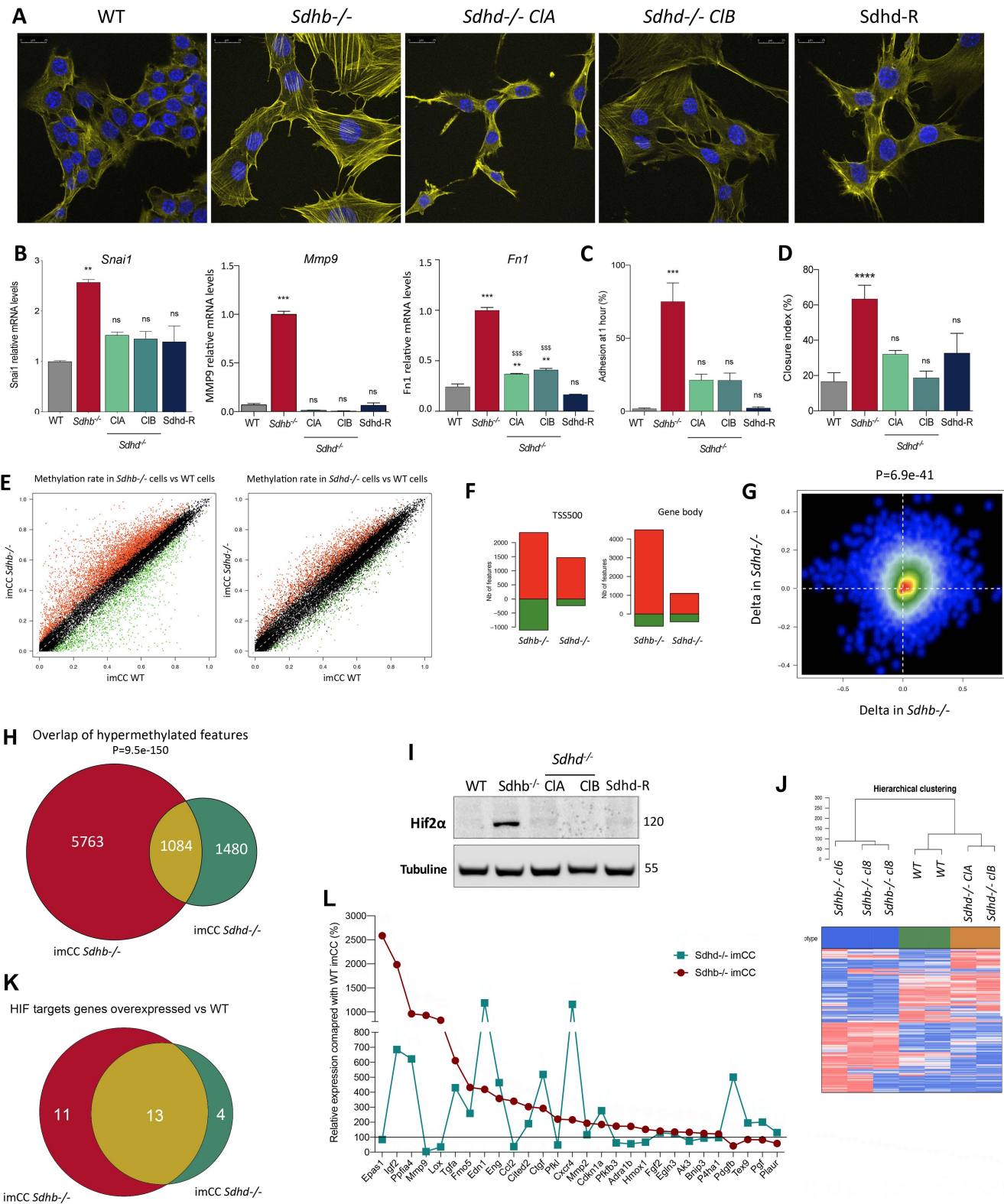


Figure 4

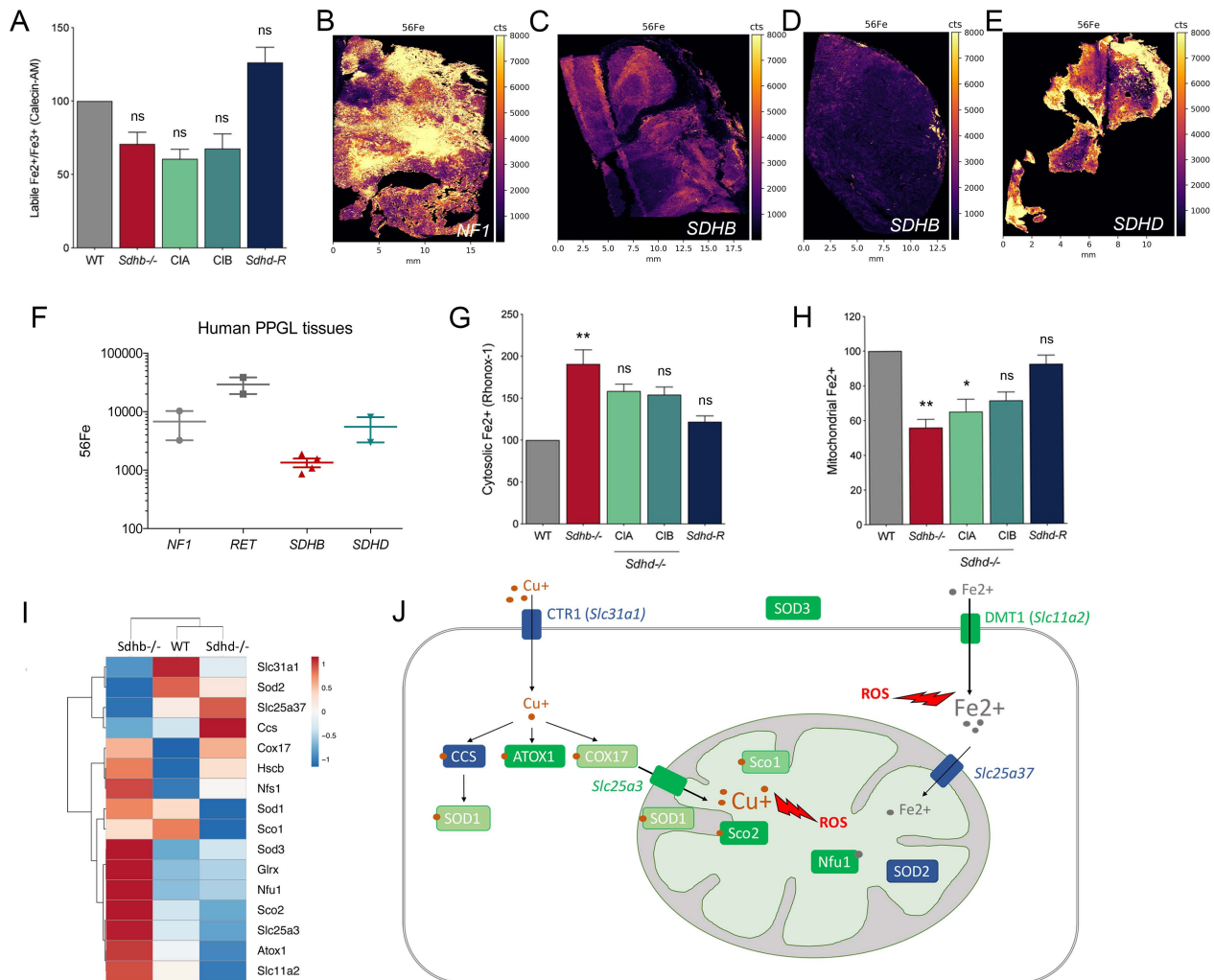


Figure 5

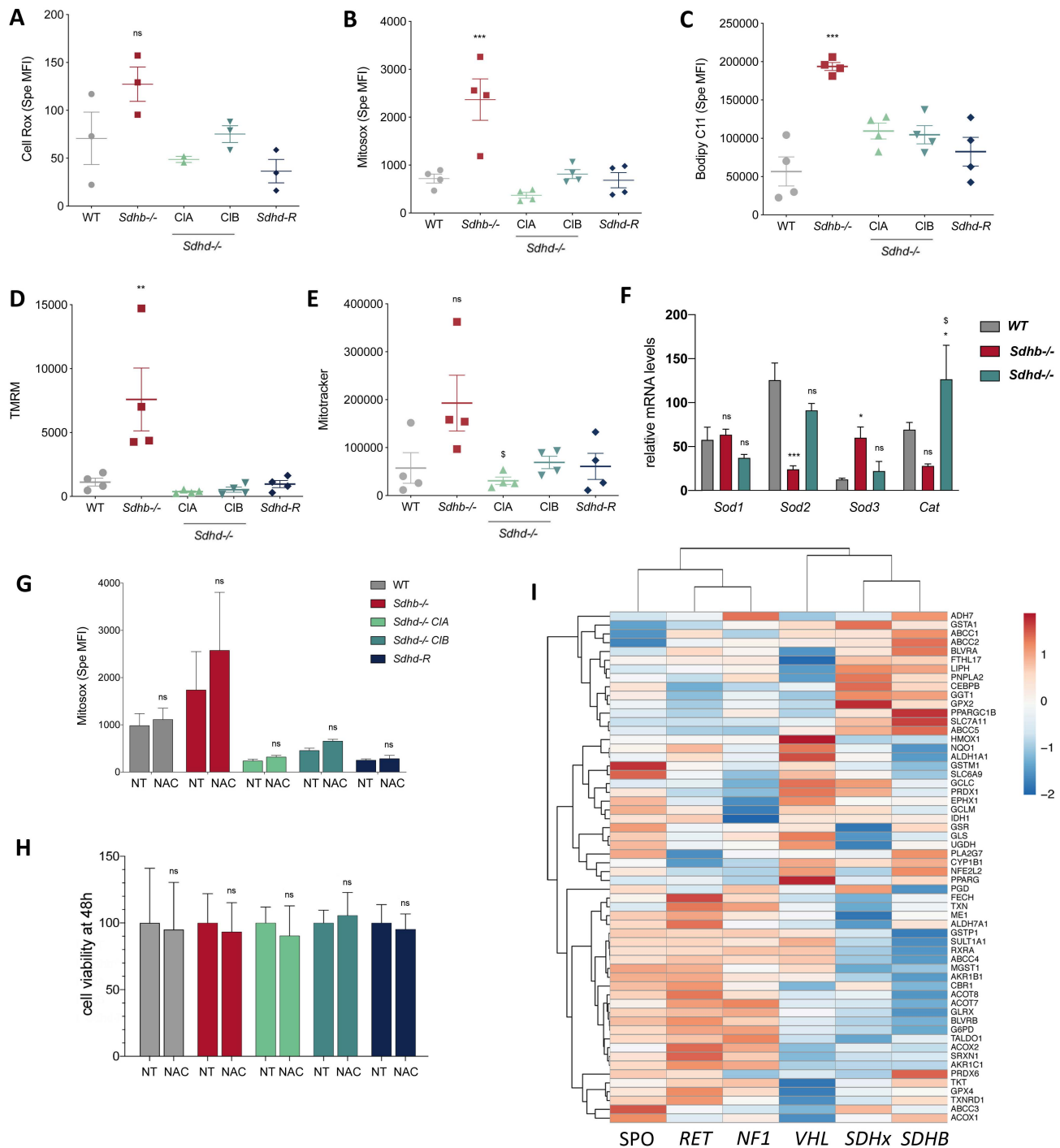


Figure 6

