Continental weathering and climate conditions in southern high latitudes during the Albian-Santonian interval (U1512 and U1513 sites, Exp IODP 369, SW Australia)

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The Albian-Santonian interval (113-83 Ma) is considered as a transitional period between the Early Cretaceous times, marked by a succession of short climatic variations associated with volcanism episodes and the Late Cretaceous times, marked by a progressive decrease of temperatures. This 30 Myr-longed interval is characterized by a gradual increase of temperature in oceanic domain, which culminates during the Cretaceous thermal Maximum, at the end of the Turonian (~ 90 Ma). Although the evolutions of continental weathering and climatic conditions are well documented in oceanic domain of low to middle latitudes, especially in Atlantic and Tethyan oceans, their record are less well known in high latitudes, especially in the proto-Indian Ocean. Thanks to the Exp IODP 369, two new boreholes, U1512 and U1513, drilled respectively in the Bight Basin (Southern Australia) and in the Mentelle Basin (Southwestern Australia), provide the opportunity to study the Albian to Santonian deposits at high latitudes (~60°S). Cores of the site U1513 recovered a sedimentary sequence from Albian to Santonian whereas the site U1512 record a continuous sequence from Turonian to Santonian. An integrated study, coupling mineralogical determination (XRD analyse and SEM observation) and isotopic analyses of neodymium on clay fraction was done on both sites in order to determine climatic and weathering conditions in these southern high latitude zone.

Our study reveals that the clay fraction are dominated by smectites (>85% in average) with lower proportions of kaolinites (< 25%) and traces of illites (<5%) associated with opal-CT and clinoptilolites. SEM observations have demonstrated a negligible impact of both burial diagenesis and authigenesis on clay assemblage. They are thus interpreted as the products of the alteration of rocks and pedogenic blankets from adjacent landmasses. At Site U1513, the Albian clay fraction contains noticeable proportions of kaolinites (5 to 25%), which progressively decrease during the Cenomanian and disappear at the Cenomanian-Turonian boundary (~94 Ma). Turonian to Coniacian deposits are almost exclusively composed of smectites. The decrease in kaolinite proportions is coeval with a decrease in ε_{Nd} values, which indicates a probable diminution in the erosion of Australian Archean rocks. At Site U1512, clay mineral assemblages, show slight variations along the borehole, which reflects stable weathering conditions during the 10 Myr of the Turonian-Santonian interval.

The dominance of smectites and to a lesser extent of kaolinites seem to indicate a warm/temperate and humid climate for high latitude zone during the Albian-Santonian interval. The decrease in kaolinite proportions from Albian to early Turonian in U1513 reflect probably a decrease of hydrolysis conditions associated with increasing temperatures and sea-level rise in southwestern Australian margins. The absence of noticeable variations from the Turonian to the Santonian in both sites would be the result of a stable continental climate for several million years after the Cretaceous thermal maximum (~ 90 Ma). The persistent presence of kaolinites in U1512 (southern Australia) could be due to the proximity of the Bight Basin with Australian Western Highlands.