DIATOMS FROM THE ARCHEOLOGICAL SITE, “LE GRAND MARAIS”, CHAMPAGNE-SUR-OISE, FRANCE

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ARCHEOLOGY
DIATOMS
PALEOECOLOGY
OISE
FRANCE
NEOLITHIC
MIDDLE AGE

ABSTRACT – A secondary channel associated with the archeological site «Le Grand Marais» was studied for its different stratigraphic layers and their diatom content. A reconstruction of the depositional environment of the third erosional phase was made :
– Layer 11 : The river Oise continued to flow in the secondary channel during this phase of deposition. Human influence on the quality of the water is shown by the presence of saprophilous and saprobiontic species.
– Layer 4 : A decrease in the current of the river is noted by an increase in the epiphytic species population.
– Layer 5 : A continuation of the environmental condition noted in layer 4 but with an increase in the amount of saproxene and saprophilous species.
– Layer 6, 7, and part of 8 : There is a marked decrease in the epiphyte population with an increase in the species which live in brooks and small streams. An increase in the statospores of chrysophytes indicate clearer and cleaner water conditions.
– Layer 8 : The reappearance of planktonic species in the sediments might be explained by their sedimentation during periods of flooding.

ARCHÉOLOGIE
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MOYEN ÂGE

RÉSUMÉ – Un ancien chenal de l'Oise coupe le site archéologique «Le Grand Marais». Les dépôts trouvés dans cet ancien lit ont été étudiés, ainsi que leur contenu en Diatomées. Les informations tirées de cette étude ont permis de reconstituer l'environnement contemporain de la troisième phase d'érosion :
– couche 11 : Le courant de l'Oise a continué de s'écouler dans ce bras. Une influence anthropologique sur la qualité des eaux est montrée par la présence d'espèces saprophiles et saprobiontes.
– couche 4 : La diminution de l'influence du courant est marquée par la présence d'espèces épiphytiques.
– couche 5 : Le régime hydrologique relevé dans la couche 4 se poursuit. On note une plus forte influence des espèces saproxènes et saprophiles dans cette couche.
– couche 6, 7 et plusieurs échantillons de la couche 8 : une nette diminution des espèces épiphytiques et par ailleurs une augmentation des espèces vivant dans des ruisseaux ainsi qu'une augmentation des statospores de chrysophytes font penser à un abaissement du niveau trophique de l'eau, ainsi qu'à une augmentation de sa transparence.
– couche 8 : Le retour des espèces planctoniques peut être expliqué par une sédimentation déterminée principalement par les périodes de grandes crues.

INTRODUCTION

A series of stratigraphic cross-sections were taken as part of a rescue of an archeological site due to the construction of the A16 tollway linking Paris with Beauvais. The site is located along the Oise river near the village of Champagne sur Oise (Val d'Oise) where the flood plain increases to about 1 km in width. The Oise along with the Yonne and the Marne are the three most important tributaries of the Seine. The 302 km long river starts in Belgium and ends at Conflans-St-Honorine where it enters the Seine. This is about 30 km below the site. This makes the river an important means of transporting goods, and harbors along the Oise are known from the Gaulo-roman time. The site is situated on the Ronquerolles anticline where the river has exposed Campagnian Chalks from the Mesozoic Era.

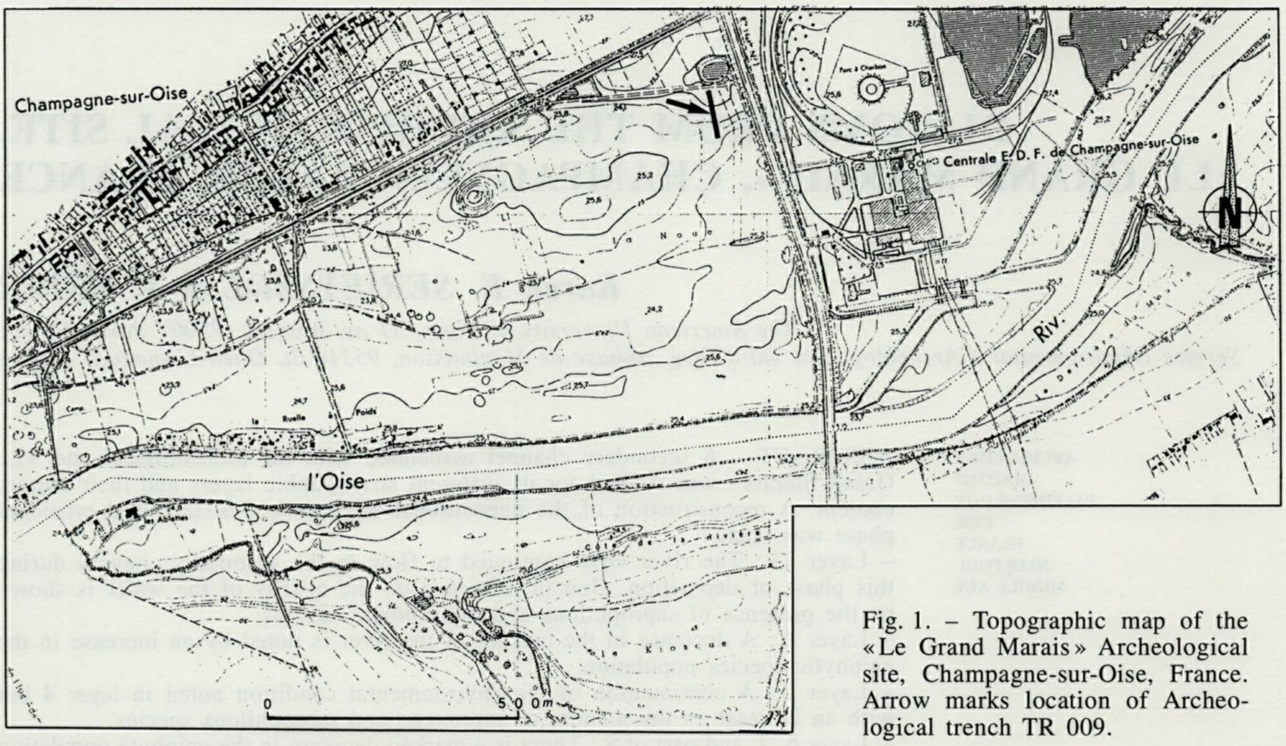

Fig. 1. – Topographic map of the «Le Grand Marais» Archeological site, Champagne-sur-Oise, France. Arrow marks location of Archeological trench TR 009.

A morphological study of the valley in this area shows that the main channel of the Oise flowed in approximately the same position as it does today while a secondary channel existed in the interior of the curve of the Oise river. This secondary channel divided into two branches passing on both sides of a hill composed of sand and gravel. The hill itself has been identified as a medieval feudal motte and is easily recognizable in the area (just west of the site which is marked by an arrow, Fig. 1). The stratigraphic cross-section TR 009 (marked by arrow, Fig. 1) cuts the northern branch of the secondary channel.

Northern Branch Stratigraphy : section TR 009

A 75 meter long trench through the northern branch of the secondary channel was surveyed (Fig. 2). The base of the trench exposes periglacial alluvium composed of green sands and sub-horizontal beds of gravel. This material makes up the mound that separates the secondary channel and it has been reworked creating a layer of reworked gravel mixed with sand. The first erosional phase (layer EP 1, Fig. 2) took place in two areas, one in the bottom of the secondary channel and the other along the northern side of the trench. The northern section was then filled in with a layer of sand, which at times can be slightly loamy, and contains cryoturbation structures indicating its origin in the Weichselian periglacial. These deposits are covered by a dark brown humus rich soil about 20 to 30 cm thick, that could be of Tardiglacial age. It is fossilized by a layer of white or blue plastic mud (layer 3, Fig. 2). This layer covers the total surface area of the first erosional phase.

The second erosional phase (layer EP 2, Fig. 2) cuts into the first erosional phase especially in the northern branch of the secondary channel. Its channel was then filled by an accumulation of organic remains (branches, leaves, grains) mixed with animal and flint archeological materials. This 30 cm thick layer changes laterally to the north and south sides of the channel into a dark brown loamy soil. The organic remains and soil make up the main archeological layer dated as lower or middle Neolithic and they are covered by a 1.5 m thick deposit composed of blue plastic mud or silt, silty sand and sandy silt.

The third erosional phase cuts through all of the preceding deposits in the axial part of the northern branch. This renewed erosional activity is followed by the deposition of oblique layers of sand and loam (layer 12, Fig. 2). A small renewal of erosional activity cuts this layered deposit. After this, the channel is filled again with a sand mixed with organic materials (layer 11, Fig. 2); fragments of wood, macro-vegetable remains, charcoal, and followed by a layer of plastic loam (layer 4, Fig. 2) very rich in branches of wood and archeological material (worked wood, ceramics, and animal remains) dated as Middle Age.

The final filling of the northern branch of the secondary channel consists of a series of layers, 1.5 m thick, listed in order of deposition : a green plastic sandy loam, a gray brown loam (layer 5, Fig. 2), a yellow loam (layer 6, Fig. 2) with a small hyromorphic horizon, a humus rich black loamy soil which is a few centimeters thick (layer 7, Fig. 2), a gray brown loam (layer 8, Fig. 2), a second small humus rich black loamy

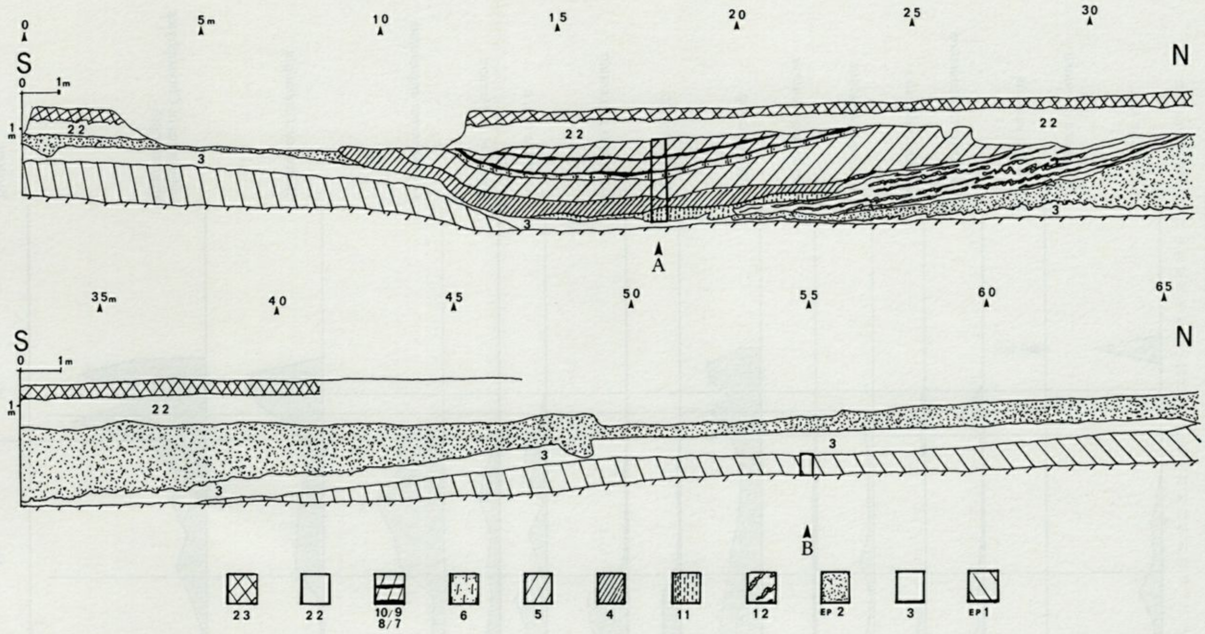

Fig. 2. – Stratigraphic section TR 009 of the northern branch of the secondary channel associated with the archeological site «Le Grand Marais». EP 1 – first erosional phase, final layer of which is of Tardigracial age; layer 3 – white or blue plastic mud; EP 2 – second erosional phase; layers 12, 11, 4, 5, 6, 7, 8, 9, & 10 – third erosional phase; layers 22 & 23 – surface cover. Explanation in text.

soil (layer 9, Fig. 3) and lastly a gray brown loam containing a horse shoe (layer 10, Fig. 3).

The whole surface area of the site is covered first by a brown loam and then by a humus rich loamy soil, related to agricultural activity in the region.

Diatom samples and their preparation

Due to the low diatoms content in the samples, it was decided to prepare a series of eight samples by using the standard hydrochoric acid (20 %) and hydrogen peroixide (30 %) technique and then comparing it with a series of the same samples mounted without any chemical treatment. It was found that the non-treated samples contained more diatoms and in better state of preservation than the treated samples. This may be due to the silts and clays present in the sediment. Following the recommendation of Battarbee (1988), «it is safer to make dilute preparations and increase the coverslip area counted.» Therefore, for each sample, a known amount of dry sediment was suspended in a known volume of water and directly mounted on a 8 x 8 mm cover slip without any chemical treatment. After drying over night, the cover slips were mounted with Naphrax. Wherever possible, 300 diatom valves were counted. As for broken diatoms, a choice was made to either count the central areas of a specific species as one valve or two extremities as one valve. The absolute number of diatoms per gram of sediment was calculated. Diatoms identification and ecological information came from R. Fabri (1984), R. Fabri and L. Leclercq (1984), H. Germain (1981), F. Gasse (1980), F. Hustedt (1930), F. Hustedt (1957), K. Krammer and H. Lange-Bertalot (1986-1991), R. Lowe (1974).

A total of 39 samples were taken at ~ 10 cm intervals from two columns. The first column B (Fig. 2; B), was taken from the first erosional phase. These samples contained a lot of sand indicating a high energy environment at the time of sedimentation. From each sample (samples 33 to 39) and using three slides, the entire surface of the covered slip was examined for diatoms but none were found leading to the conclusion that they were sterile. The same can be said for the sterile samples found in column A. The second column A came from the third erosional phase (samples 1 to 32) and certain of these samples contained diatoms.

RESULTS

Layer 11 and Middle Age Archeological layer

Sample 1 was sterile. This might be explained by the fact that the Oise could still have been flowing in this channel. This idea is supported by :

— the presence of sand in the samples indicating a higher energy environment (Straub, 1990);

— the lower numbers of diatom valves per gram of dry sediment found in samples 2 and 3 compared with layers 4 and 5 (Fig. 3);

— the highest percentage of *Cyclotella* (Fig. 3) were identified in this layer even through the two species, *Cyclotella meneghiniana* and *Cyclotella ocellata* are considered to be littoral species; they can live in the plankton;

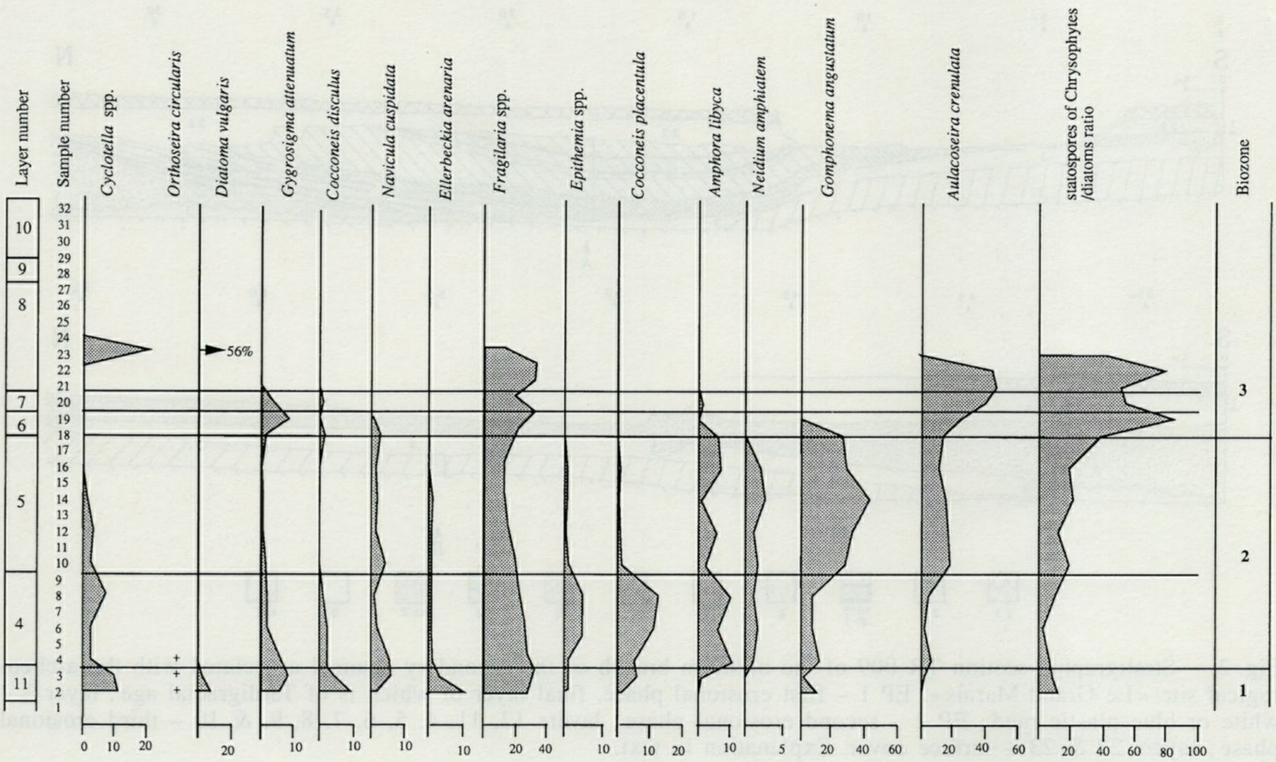

Fig. 3. – Diagram showing the position of the samples in the different sedimentary layers; the vertical variation of the most common diatoms in relative percentage; and the ratio of statospores of Chrysophytes/diatoms in percentage.

— and the presence of *Diatoma vulgaris*, which prefers the littoral with a current (Hustedt (1930).

However, the water depth is probably relatively shallow because not a single species considered to be exclusively planktonic was identified from the layer. This interpretation is supported by the high percentage of *Gryosigma attenuatum* which are often found in small streams (Germain, 1981) and *Ellerbeckia arenaria* considered to be an aerophilous species which develops in large quantities on rocks situated in ooze and water falls (Krammer and Lange-Bertalot (1986-1991).

It is only in this layer that *Diatoma vulgaris* was identified. According to Fabri (1984), *Diatoms vulgaris* is considered to be a NH_4 and P – saprobiontic species. It was found in the richest and most polluted water of the Amblève and Our basins (Fabris and Leclerq, 1984). However, Hustedt (1957) considered it to be a saproxene species; Slàdeček (1973) and Lange-Bertalot (1979) classified it as a beta-mesosaprobic species while Germain (1981) found it not very sensitive to pollution. It seems that *Diatoma vulgaris* can tolerate a certain amount of organic pollution but can not live in very polluted waters. Its presence may be due to an anthropological influence on the water quality.

Layer 4 and Middle Age Archeological layer

The stream current decreases as observed by a change from the previous layer rich in sand to a plastic loam layer and by an increase in the number of valves per gram of sediment. An increase in the percentage of epiphytes (Fig. 4) seem to confirm this hypothesis. The presence of snail shells could explain the high percentage of *Cocconeis placentula* and the lower amounts of *Gomphonema angustatum* as *Cocconeis placentula* is more difficult to eat because it lives flat against the macrophytes while *Gomphonema angustatum* lives attached at one end with the other end extending into the water; thereby *Gomphonema angustatum* is easier to graze on (personal communication, Battarbee).

The pH was calculated using the formula presented by Renberg and Hellberg (1982). The highest pH levels are registered in this layer and the next one (Fig. 4). The increase in pH probably marks an augmentation in primary production, (supported by an increase in epiphytic species) with a corresponding increase in photosynthesis. This in turn would consume carbon dioxide, thereby, increasing the pH. The combination of increased pH and macrophytes can be taken as a sign of increased eutrophication of the water body (personal communication, Ector).

Layer 5

A very similar environment as in the previous layer is observed. The presence of epiphytes reaches its maximum, along with the percentage of saproxene species (species that generally live in a biotope poor in organic compounds) while the percentage of saprophilous species decreases. This change is probably more related to the increase in the number of epiphytes than a change in environmental conditions. Taking into consideration that the final layers of sedimentation of the secondary erosional phase are situated at an altitude about 1.5 meter higher than top of layers 4 and about 1 meter higher than layer 5, it seems feasible to estimate a maximum water depth of about 1 meter.

Layer 6

Layer 6 is marked by a net loss of the epiphyte species, a loss of the aerophilic species, and a net increase in the number of chrysophytes statospores (Fig. 4). The chrysophytes prefer oligotrophic water and were abundant in Canadian lakes before the arrival of man, but with increased anthropological activities their abundance has decreased (Smol, 1985). The number of valves per gram of sediment decreases indicating increase in energy in the environment along with an increase in the benthic and littoral living species, *Aulacoseira crenulata, Gryosigma attenuatum, Meridion circulare* and *Fragilaria*, that can live in small streams. A small brook may now flow in the channel or it has become a shallow pond.

Layer 7 and 8

The thin Layer 7 is marked by an increase in the number of valve per gram of sediment but this was short lived with a return to figures similar to that of layer 6 for layer 8. The dominant species in Layer 7 and the samples 21 and 22 of layer 8 are the same as those found in Layer 6, therefore, similar environmental conditions.

The domination of *Diatoma vulgaris* and *Cyclotella ocellata* in sample 23 along with the small number of valves per gram of sediment seems to indicate a return of the current. This could be explained by sedimentation during periods of flooding. Samples 24 to 32 contained no diatoms.

CONCLUSIONS

Diatom analysis of flood plain sediments can give us a better understanding of natural environment associated with an archeological sites. Anthropological eutrophication is observed in certain layers. A combination of diatom analysis and flood plain morphology can lead to estimations on water depth. In this study, the environment

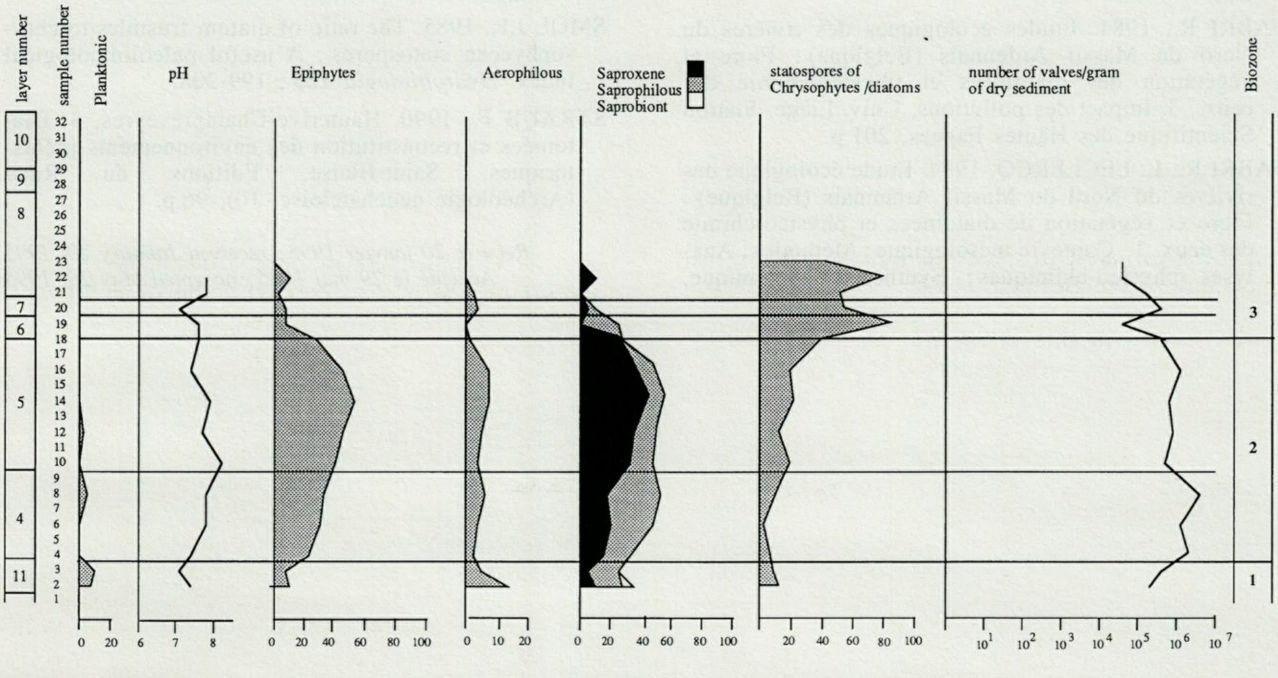

Fig. 4. – Diagram showing the position of the samples in the different sedimentary layers; the estimated pH; the vertical variation of the percentage of epiphytes, aerophile species, and species that are indicators of pollution; the ratio of statospores of Chrysophytes/diatoms in percentage; and the number of valves/gram of dry sediment.

changes as registered by the diatoms during the third erosional phase determined three biozones :

Biozone 1 (Layer 11) – the channel becomes cut off from the main river course.

Biozone 2 (Layers 4 and 5) – a period of major macrophyte development with some anthropological eutrophication. The secondary channel probably have had a maximum water depth of about 1 meter.

Biozone 3 (Layers 6, 7 and lower part of 8) – the final filling of the channel. Clear, higher energy water conditions with less nutrient waters are recorded. A small brook may have continued to flow in the channel. After this, sedimentation probably occurred only during periods of flooding. The land was probably used for agricultural purposes. No marsh or swamp conditions and their associated diatoms were identified. This may indicate that man deliberately drained the site to prevent these conditions from developing. The next sedimentary horizon (Layer 9) which was identified as a humus rich soil seem to confirm this hypothesis.

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