RELATIONSHIPS BETWEEN DEPOSITIONAL CONDITIONS AND MICROTEXTURES IN THE ORGANIC-RICH LOWER OXFORD CLAY SEDIMENTS (U.K.)

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Six representative samples of the Lower Oxford Clay (LOC) and the Middle Oxford Clay (MOC) sediments have been assessed for total organic carbon (TOC from 1.2 to 14.2%), hydrogen indices (HI from 813 to 130), and carbon isotopic values ($\delta^{13}C$ from -23.1 to -27.7‰) (Kenig *et al.*, this symposium), and have been extensively studied using petrographic techniques. The use of the scanning electron microscope and particularly the backscattered electron mode was emphasized as it is the most suitable tool to study the relationships between organic matter and minerals at a micrometric scale.

The bulk mineralogy appears similar in all samples studied. The argillaceous matrix is predominantly composed of illite and kaolinite with detrital mineral grains of quartz, feldspar, mica (biotite and muscovite) and calcitic bioclasts (e.g. coccoliths). Diagenetic features consist mainly of dissolution of quartz grains, rim epigenization of quartz grains to kaolinite, and the presence of pyrite. The concentration of pyrite increases with the concentration of organic matter. Both framboidal and euhedral forms of pyrite are present. Euhedral pyrite crystals are more abundant in organic-rich samples, indicative of the more reducing conditions occurring in the organic-rich sediments. In organic-rich samples, coccoliths are concentrated in well preserved fecal pellets, suggesting a relatively high sedimentation rate. Preservation of coccospheres indicates a low energy environment of deposition and mild diagenesis. Unusually well-preserved biotite crystals may be indicative of the proximity of sediment sources and of the weakness of diagenetic processes.

In organic-rich samples, organic matter is encountered as elongated "patches" 20 to 50 µm in length and composed of several particles of marine phytoplanktonic origin; and as thin isolated particles closely associated with clays. These thin particles are both of marine phytoplanktonic and of terrestrial origin (woody debris, vegetal tissues and rare palynomorphs). In organic-poor samples, the frequency and the size (5 to 20 µm) of the patchy composite particles of phytoplanktonic organic matter decrease. Palynological studies indicated that 80% to 95% of the organic matter is amorphous and probably of marine origin. However, the proportion of structured organic matter, woody debris and vegetal tissues, increases from 5% to 20% as the TOC decreases.

None of the samples studied exhibited laminations at a sub-millimetric scale. However, the organic "patches" in the organic-rich samples lie parallel to the plane of stratification even if there is no obvious stratification of the mineral matrix. Clay minerals show a random and disorganized distribution that may be indicative of microbioturbation, even in the most organic-rich samples.

Organic and mineral microtextures are controlled by the environment of deposition and the diagenetic history of the sediments and are related to geochemical parameters as HI, $\delta^{13}C$ and TOC. Microbioturbation would indicate that the water column was never anoxic. In contrast, euhedral pyrites crystals suggest anoxia in the organic-rich sediments. The decrease in size of organic "patches" with decrease in TOC, as well as the variable distribution of coccoliths, may be indicative of changes in primary productivity and sedimentation rate.

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