Early diagenesis impact on Holocene sedimentary recording in the Bay of Biscay

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Early diagenesis processes in the Bay of Biscay have been studied in the mid-2000 on short multi-tube cores (cruises OXYBENT-FORAMPROX-PECH, Côtes de la Manche). In order to complete the data base and to characterize deep anoxic processes, 1 to 3 meters long piston cores were collected at 150, 550, 1000 and 2000m water depth on the continental slope of the southeastern part of the Bay of Biscay during the cruise CADIAC (Côtes de la Manche, 2009). The aim of this work was to determine how a recorded signal can be changed in the several thousand-year situation of the Holocene period. The sediment consists of a muddy facies deposited continuously during the Holocene.

Profiles of dissolved compounds directly produced from organic matter mineralization have been obtained from a continuum between short cores and Kullenberg cores at four sites of the Bay of Biscay. They indicate that biogeochemical processes of organic matter degradation occur deeply in the sediments, all along the Holocene sequence and beyond. Three major interfaces have been identified to influence the transformation of geochemical proxies. The first is the water-sediment interface, where more than half of settling particulate organic carbon is fast recycled by aerobic processes of respiration. The transition between oxic and anoxic sediment is also concerned, since a diagenetic enrichment in Mn and Fe oxides is observed. Moreover, quarter to half of buried C-org is mineralized below this front by sulphate-reduction processes. The third interface is the sulphate-methane transition zone, in which sulphate is completely consumed, causing a strong production of alkalinity. This process favours the precipitation of secondary calcium carbonates but also authigenic forms associated to sulphur and phosphorus. Fossilization of some geochemical proxies like C-org, carbonates, phosphorus or manganese, is a long-term process. Quantification of diagenetic reactions modifying these proxies is essential to distinguish environmental changes records from diagenetic signals.

This study shows an extensive data set on 20 redox parameters measured along four sediment cores. Such long and fastidious work cannot always be done on long core dedicated to paleo-oceanographic studies. Our results, however, suggest us to encourage the paleo-oceanographic community to follow these recommendations : bring a small bench top centrifuge during cruises to extract pore waters. In each deep-sea core collect about 20 ml of sediment at regular interval (e.g every 50 cm for a 10 m long core, or a better vertical resolution if possible), extract pore water and keep the water in a fridge. This will give enough pore water to obtain profiles of dissolved calcium, sulphate and ammonium. These three parameters will allow to locate the sulphate-methane transition zone and to quantify authigenic carbonate formation and deep sediment organic matter mineralization.