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Pliensbachian (Early Jurassic) calcareous nannofossils from the Peniche section (Lusitanian Basin, Portugal): A clue for palaeoenvironmental reconstructions

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ABSTRACT

Quantitative analysis of Early Jurassic calcareous nannofossil assemblages from the Peniche section in Portugal have been performed in order to interpret palaeoenvironmental changes occurring in the Lusitanian Basin during the Late Pliensbachian Davoei, Margaritatus and Spinatum Ammonite Zones. Nannofossil data are compared to already published carbon and oxygen stable isotope data, organic matter content (wt.%Total Organic Carbon, TOC), and biomarker analysis. A significant change in calcareous nannofossil assemblages and species diversity at the transition between the Margaritatus and Spinatum Ammonite Zones matches with the pattern shown by geochemical data. This suggests that a profound change in environmental conditions occurred at that time. In the Davoei and Margaritatus Ammonite Zones, in a context of general sea-level rise, the Lusitanian Basin was characterized by water column stratification that favoured the sedimentation and preservation of organic matter. Biomarkers and oxygen isotope trends suggest that stratification of water masses occurred because of low salinity in surface waters. The shallowest part of the water column, characterized by oligotrophic conditions, was inhabited by the (probable) calcareous dinocyst *Schizosphaerella* spp., while the deep-dweller *Crepidolithus crassus* flourished in the lower photic-zone layers. In the Spinatum Ammonite Zone, a regressive trend occurred and a salinity increase is inferred on the basis of oxygen isotope values. Water masses were probably less stratified at that time. The upper photic-zone nannofossil assemblages were still dominated by *Schizosphaerella* spp. whilst, in the deep photic-zone, *Mitrolithus jansae* (a Mediterranean taxon) replaced *C. crassus* (a taxon with NW-European affinity). This pattern may indicate a change in palaeoceanographic conditions related to surface current circulation. The sea-level fall occurring during the Spinatum Ammonite Zone may have resulted in the partial isolation of the Lusitanian Basin from the NW-Europe basins because of the creation of a threshold. Alternatively, tectonic drowning of North African carbonate platforms in the Late Pliensbachian may have promoted better exchanges of nannoplankton between the Lusitanian Basin and the Mediterranean Tethys *via* the creation of new seaway connections.

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1. Introduction

Coccolithophores belonging to the Phylum Haptophyte represent a major group of marine unicellular phytoplankton living in the oceanic photic zone. They are considered to be responsible for about half of all modern precipitation of $CaCO_3$ in the Oceans, thus they play a primary role in the global carbon cycle (Milliman, 1993). Many recent studies on the dynamics and ecology of calcareous nannoplankton provide increased knowledge of the habitat preferences of living coccolithophores (Young, 1994; Baumann et al., 1999; Hagino et al., 2000; Kinkel et al., 2000; Takahashi and Okada, 2000; Boeckel and Baumann, 2004, 2008). The importance of coccolithophores in marine ecosystems and their widespread occurrence in the fossil record has led to the extensive use of nannofossil abundance and species diversity as proxies in palaeoenvironmental studies, particularly for reconstructions of palaeo-temperature and nutrient availability in surface waters (Beaufort et al., 1997; Street and Bown, 2000; Herrle, 2003; Dunkley-Jones and Bown, 2007). Some authors have used stratigraphic changes in nannofossil community to reconstruct water mass movements (Chinzei et al., 1987; Flores et al., 1997; Okada and Wells, 1997).

In this paper, we show a quantitative study of calcareous nannofossils from the Late Pliensbachian (Early Jurassic) of the

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