Geophysical Research Abstracts
Vol. 16, EGU2014-2011, 2014
EGU General Assembly 2014

Carbon stable isotopes and ammonite biochronostratigraphy across the Sinemurian-Pliensbachian boundary in the Lusitanian Basin, Portugal

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Here, we present an integrated stratigraphical study across the Sinemurian-Pliensbachian interval cropping out into the Portuguese reference section of S. Pedro de Moel (Lusitanian Basin). Characterized by marl-limestone alternations belonging to the Água de Madeiros Formation (subdivided into Polvoeira and Praia da Pedra Lisa members), this unit is particularly dominated by organic-rich facies (black shales) and represented by a large diversity of benthic and nektonic macrofossils. Using this stratigraphic and sedimentary setting, we developed a high-resolution carbon isotopic study, involving new ammonite biochronostratigraphic precisions and other palaeontological data. The analysis of the collected ammonite specimens facilitated the characterization of Oxynotum and Raricostatum chronozones and the definition of Raricostatum, Macdonnelli and Aplanatum subchronozones to accurately identify the Sinemurian-Pliensbachian boundary in the western Iberian margin. The characterization of the carbon isotope evolution in bulk carbonate ($\delta^{13}C_{carb}$) was performed in 351 samples, representing the Oxynotum – earliest Jamesoni chronozone interval. In this interval, the carbon-isotope values exhibited a large range of results, varying between +2.85‰ (Oxynotum Subchronozone) to strong negative values observed in some limestone beds from the Raricostatum Subchronozone (lowest reaching -6.7 ‰), a variation clearly controlled through lithological and facies changes. Despite these strong anomalous isotopically light values (below -1‰), clearly associated with organic matter degradation and early diagenesis, the $\delta^{13}C_{carb}$ curve shows a long-term negative trend across the Oxynotum to the early Taylori subchronozone interval. This tendency is reversed around 5 meters above the Sinemurian-Pliensbachian boundary, and the $\delta^{13}C_{carb}$ value becomes positive with the absence of organic matter and argillaceous sediments in the series (in the limestones of Praia da Pedra Lisa Member). Rather than a global event, as recently recognized for the Late Sinemurian, the $\delta^{13}C$ curve recorded across the Sinemurian-Pliensbachian of the western Iberian margin is controlled through internal depositional conditions in the Lusitanian Basin.