Geophysical Research Abstracts
Vol. 14, EGU2012-6184, 2012
EGU General Assembly 2012

The early Aptian OAE record in the Cau section (Prebetic Zone, Spain): High-resolution C-isotope stratigraphy, biomarker distributions, and elemental geochemistry

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The occurrence of time intervals of enhanced deposition of organic matter (OM) during the Cretaceous, defined as Oceanic Anoxic Events (OAE), reflect abrupt changes in global carbon cycling. These episodes raise questions about the causes for such perturbations, and their relation to fluctuations in ocean geochemistry, climate, and marine and continental biota. To investigate these questions, we have performed an integrated study comprising high-resolution C-isotope stratigraphy, biomarker distributions, and elemental geochemistry through the record of an expanded section of the OAE 1a (Cau section, Spain). This section belongs to the Prebetic Zone, which represents the platform domain of the Southern Iberian Paleomargin during the Mesozoic.

The high-resolution C-isotope curve records the characteristic first negative and subsequent positive excursions that are well known from a large number of sections around the world. Apparent in the section are all eight of the segments previously defined from the alpine domain by Menegatti et al (1998). Both carbonate and organic C-isotope curves are presented and compared, allowing qualitative consideration for changes in pCO_2.

Molecular analyses of sedimentary organic matter are powerful tools in assessing the origin of organic matter and constraining ancient environmental conditions, such as marine productivity, anoxia in bottom waters or the photic zone and sea surface temperatures as well as its thermal maturity. The biomarker association in the section comprises mainly four main groups of compounds: n-alkanes, isoprenoids, hopanes and steranes. Overall, all of the OM present in the studied samples is interpreted to derive from significant terrestrial inputs as well as marine and bacterial sources. It is also thermally immature, leading to a good preservation of the organic compounds. This study has revealed major variations in biomarker distributions through the section, including the distributions of n-alkanes (long-chain versus short-chain compounds), relative abundances of n-alkanes, hopanes and steranes, and other significant biomarkers. These changes are interpreted to be related to variations in the major sources of the organic matter (bacterial, terrestrial and marine plants, marine plankton), and in the environmental conditions (i.e. development of water column stratification, anoxia and productivity).

Elemental geochemical analyses have revealed major changes in redox-sensitive, productivity and provenance proxies through the section. The main contribution from these data is the observation of development of suboxic-anoxic conditions during the deposition of the OAE1a, with high frequency oscillations, especially during the onset of the event.

Integration of C-isotopes, biomarkers and elemental distributions represents a powerful tool in the interpretation of the environmental changes that occurred during deposition of the OAE1a. Data presented here suggest significant sedimentary and biological perturbations predating the OAE1a, and environmental instability during especially the first stages of the OAE.

Acknowledgements: This work is a contribution of the research project CGL2009-10329.