Geophysical Research Abstracts
Vol. 13, EGU2011-345, 2011
EGU General Assembly 2011


# The response of the Apenninic Carbonate Platform (southern Italy) to the Early Toarcian oceanic anoxic event

Alberto Trecalli (1), Jorge Spangenberg (2), Thierry Adatte (3), Karl B. Föllmi (3), and Mariano Parente (1)

(1) Dipartimento di Scienze della Terra, Università di Napoli "Federico II", Napoli, Italy, (2) Institut de minéralogie et géochimie, Université de Lausanne, Lausanne, Switzerland, (3) Institut de géologie et paléontologie, Université de Lausanne, Lausanne, Switzerland

The early Toarcian (ca. 183 Ma) carbon isotopic excursion (CIE), documented in marine and continental sedimentary successions, witnessed a severe perturbation of the global carbon cycle which is thought to have been caused by the massive injection of isotopically light CO2 to the ocean-atmosphere system. Paleoenvironmental perturbations associated with this event go from severe global warming to acidification and de-oxygenation of the ocean and sudden shifts in the Earth hydrological cycle and in the patterns of nutrient distribution in coastal areas. Extinctions and increased species turnover and deposition of organic-rich sediments on a wide scale were among the most significant effects of these paleoenvironmental perturbations.

Most of what we know about the early Toarcian CIE and oceanic anoxic event (T-OAE) comes from relatively deep-water successions. Much less is known of the response of shallow-water carbonate platforms. This is a major bias because carbonate platforms were important players in the carbon cycle and represented a large share of total marine carbonate production in the Early Jurassic ocean, at a time when calcareous plankton and nannoplankton had not yet reached their Cretaceous dominance.

The Apenninic Carbonate Platform (ACP) grew during the Mesozoic at subtropical latitudes at the southern margin of the Tethys. Paleogeographic reconstructions show that since the Early Jurassic it was isolated from major continental blocks. The ACP was able to escape drowning and continued growing in shallow-water across the T-OAE: its geological record contains an important archive of the response of shallow-water carbonate platform ecosystems to global warming and ocean acidification.

We report the results of a high-resolution sedimentologic and geochemical study of two carbonate sequences cropping out in the southern Apennines (Italy). We performed a detailed facies analysis and produced a detailed record of the carbon-isotope ratio of carbonate and organic matter. Total phosphorus and clay-mineral content were also investigated to trace changes in nutrient input and availability.

Chemostratigraphic correlation with basinal reference $\delta$13C curves allows unprecedented high-resolution dating of our sections. This is of paramount importance because black shales are notably lacking in these shallow-water sections and biostratigraphy, based on larger foraminifers and calcareous algae, does not allow to pinpoint the interval corresponding to the T-OAE. This scope was optimally fulfilled by carbon-isotope stratigraphy which allowed also, as a precious by-product, the precise correlation of carbonate platform biostratigraphy to standard ammonite zones.

In the first part of the studied sequences, the most prolific carbonate producers are the large bivalves of the “Lithiotis” facies and the green alga Palaeodasycladus mediterraneus: both occur in rock-forming abundance, witnessing optimal environmental conditions. The onset of the Early Toarcian CIE coincides with the disappearance of these massive biocalcifiers. The extinction of the thick-shelled bivalves of the Lithiotis facies and of the calcareous alga Palaeodasycladus mediterraneus, both producing aragonitic skeletons, is therefore strictly coeval with the crisis of calcareous nannoplankton reported in deep-water sections. This suggests that the effects of the massive injection of CO2 in the ocean, witnessed by the prominent negative CIE, were severe also in the carbonate platforms of the tropics.

The rising branch of the Early Toarcian CIE corresponds to a massive accumulation of ooids. The occurrence of oolitic limestones, abruptly replacing biogenic facies dominated by large bivalves and calcareous algae, is a well known feature of all the Tethyan carbonate platforms that were not drowned during the T-OAE. More than a local facies signal, this widespread coeval occurrence of oolitic limestones could represent the recovery of ocean alkalinity, forced by enhanced continental weathering and/or dissolution of deep-water carbonates. The chemical precipitation in the form of oolites, assisted or not by microbial activity, would have been the only effective way to buffer the increased alkalinity of the shallow ocean in absence of the prolific biocalcifiers, wiped out by extinction. Under this scenario the early Toarcian oolitic limestones would represent an “overshoot” in the CaCO3 production after the biocalcification crisis induced by ocean acidification.