Geophysical Research Abstracts
Vol. 18, EGU2016-13365-1, 2016
EGU General Assembly 2016

New stratigraphic and isotopic record of the Toarcian Oceanic Anoxic Event from Hungary

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In the Early Toarcian (∼183 Ma) major global environmental changes took place in the ocean-atmosphere system, including the widely discussed Toarcian Oceanic Anoxic Event (T-OAE). This phenomenon is characterized by strong perturbation of the carbon-cycle and other geochemical systems. A peculiar negative carbon-isotope excursion (CIE) is a hallmark of the event, reflecting the injection of large amount of isotopically light carbon into the ocean-atmosphere system, possible due to dissociation of gas-hydrate from shelf areas. This observed negative CIE and a subsequent broad positive anomaly could be also key signals for chemostratigraphical correlation. In our study we obtained new, high-resolution organic carbon isotope data from the Réka Valley section of the Mecsek Mts. in southern Hungary. The Mecsek Basin was located at the European margin where a thick Lower Jurassic succession of siliciclastic hemipelagic sediments is interrupted by 13 m of organic-rich black shales in the Lower Toarcian. The $\delta^{13}C_{org}$ data from the Réka Valley section is characterized by very negative values (averaging -32 ‰), with apparently cyclic fluctuation. The shape of the $\delta^{13}C_{org}$ shows that a continuous and complete record can be found in the Réka Valley and also suggests mixed features between the carbon isotope record of the NW European and Tethyan regions. We have also carried out high resolution handheld XRF analyzes to study cyclostratigraphic signals in the section. The distribution of four elements Ti, Ca, Si and Al were used in our studies beside the $\delta^{13}C_{org}$ data. The duration for the negative shift at Réka Valley, calculated from XRF signals, is either 550–750 kyr, 200–275 kyr or 116–158 kyr, based on 100 kyr short eccentricity, 36.6 kyr obliquity or 21.1 kyr precession signals, respectively. Several previous studies concluded that the most probable astronomical forcing factor during the CIE of the Toarcian OAE is obliquity. Therefore, we assume a duration around 200–275 kyr for the CIE at the Réka Valley based on obliquity controlled astronomical forcing. The section was previously biostratigraphically poorly constrained, our new data on calcareous nannoplankton help improve the dating. Biozones NJ5b, NJ6 and NJ7 are spanning the negative CIE, NJ6 covers the interval where $\delta^{13}C_{org}$ values are the most negative. The new high resolution isotope data allow reliable chemostratigraphic correlation of the Réka Valley with other European Toarcian successions (e.g. Peniche, Yorkshire, Dotternhausen and Valdorbia).