Geophysical Research Abstracts
Vol. 20, EGU2018-7132-1, 2018
EGU General Assembly 2018

Linking sea level, climate, and palaeocirculation change during Mid-Cenomanian Event I (MCE I, 96 Ma): elemental and osmium isotope evidence from southern England

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Cenomanian times (100.5–93.9 Ma) represent perhaps the best documented episode of eustatic rise in sea level in Earth history and the beginning of the Late Mesozoic thermal maximum, driving global expansion of epicontinental seas and the onset of widespread pelagic and hemipelagic carbonate (chalk) deposition. Significant changes occurred in global δ13C-isotope records, including two prominent perturbations of the carbon cycle –Mid-Cenomanian Event I (MCEI; ~96.5–96.2 Ma) and Oceanic Anoxic Event 2 (OAE2; ~94.5–93.8 Ma).
MCEI is characterized by a prominent double-peak δ13Ccarb excursion of up to 1‰The excursion coincides with a major breakpoint on long-term carbon-isotope profiles, from relatively constant to very slowly rising δ13C values through the Lower Cenomanian, to a trend of generally increasing δ13C values through the Middle and Upper Cenomanian. This represents a significant long-term change in the global carbon cycle starting with MCEI. However, unlike OAE2, there is no evidence for the coeval deposition of black shales during MCEI in most areas. In NW Europe, MCEI is associated with a prominent sequence boundary, indicative of sea-level fall. The two carbon isotope peaks (MCE1a and Ib) are also coincident with the appearance of bivalve and belemnite pulse faunas of north Boreal affinity, suggesting the temporary influx of cool water masses into the northern European epicontinental sea.
Here, we present high-resolution major- and selected trace-element data and 187Os/188Os isotope results for MCEI from two English Chalk sections at Folkestone, east Kent and Culver Cliff, Isle of Wight. Our results are compared to published δ13Ccarb, δ18Ocarb, δ13Corg stable isotope and neodymium isotope εNd(t) data from the Folkestone section. Elemental proxies (Mn, Ti/Al, Zr/Al, Si/Al) define key sequence stratigraphic surfaces, refining the correlation between the two sections, and provide a basis for defining relative sea-level curves. Cyclical small-scale transgressive events within the mid-Cenomanian TST of depositional sequence Ce IV are accompanied by coupled increases in εNd(t) and decreases in 187Os/188Os ratios. Osi ratios of 0.8 – 0.9 prior to MCEI, peak at 1.2 in the lower peak of the isotope excursion, coincident an influx of boreal fauna and the lowest εNd(t) values in the section (<-10), and show a stepped fall thereafter. These geochemical data are interpreted to represent a pulse of continental weathering accompanying sea-level fall, together with cyclical changes in water mass sources and distribution in the Chalk sea, driven by a combination of sea-level and climate change.