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Astronomical tuning of black cherts in the Cenomanian Scaglia Bianca as precursors of the Bonarelli level (OAE2) at Furlo, Italy

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Astronomical tuning of the Cenomanian Oceanic Anoxic Event (OAE2) critically depends on the phase relationship between eccentricity forcing and ocean-climate response. The mechanisms leading to oceanic anoxia are heavily debated, and both maxima and minima in eccentricity have been suggested to trigger the widespread deposition of organic-rich sediments. At the Furlo section in the north-eastern Apennines of Italy, the rhythmically bedded Scaglia Bianca formation forms a cyclic prologue to the Bonarelli level, the Tethyan sedimentary expression of OAE2. Regularly occurring black cherts are precursors of the extreme conditions leading to the oceanic anoxic event, and show the hierarchical stacking pattern of eccentricity modulated precession. Previous orbital tuning attempts have placed the occurrence of black cherts either in eccentricity maxima (Mitchell et al. 2008) or eccentricity minima (Lanci et al. 2010). These scenarios require distinctly different oceanographic regimes. Eccentricity maxima enhance the seasonal contrast, thereby intensifying monsoons, leading to an estuarine circulation in the Cretaceous North Atlantic with upwelling and increased productivity (Mitchell et al. 2008), potentially spurred by input of nutrients from volcanic activity (Trabucho Alexandre et al. 2010). Alternatively, it has been suggested that eccentricity minima could cause decreased seasonality, leading to stagnation and reduced ventilation of bottom waters (Lanci et al. 2010; Herbert and Fischer 1986), although eccentricity minima would not lower seasonality but rather avoid large seasonal extremes for a prolonged period of time. Lanci et al. (2010) attempted to establish this phase relation by measurements of $CaCO_3$ content in carbonates, but failed to incorporate the cherts, which reflect a much larger variability in carbonate content. New high-resolution lithological, geophysical and stable isotope data from the Furlo section unequivocally indicate that the timing of black chert deposition, as well as the onset of the oceanic anoxic event itself, is related to eccentricity maxima. The stable 405-kyr periodicity of eccentricity is readily discernible in the data records and can be used for tuning to the astronomical solution (Laskar et al. 2011). A total of five and a half 405-kyr cycles can be identified below the Bonarelli level, which itself comprises a 405-kyr cycle. This cyclostratigraphy can potentially be anchored to the absolute time scale by using the newly determined Cenomanian-Turonian boundary age of 93.9 ± 0.15 Ma, which is based on intercalibration of astrochronological and radioisotopic data for the Cenomanian-Turonian boundary interval near the GSSP in Colorado, USA (Meyers et al., 2012). Correlation to the orbitally tuned Turonian interval of the nearby Gubbio and Contessa sections in Italy (De Vleeschouwer et al., this session) allows the construction of an anchored astronomical time scale for the Cenomanian-Turonian interval of > 5 Ma.

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