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An anchored astronomical time-scale for the Turonian reference sections in the Umbria-Marche Basin, Italy

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In the Umbria-Marche basin, the aftermath of Ocean Anoxic Event 2 (OAE2, Bonarelli Level) is represented by the Turonian part of the Scaglia Rossa Formation. The Scaglia Rossa pelagic limestones were studied in the classic Contessa and Bottaccione sections near Gubbio, in the Umbria-Marche region of the northeastern Apennines of Italy. Oscillations between radiolarian cherts interbedded with foram-coccolith pelagic limestones are interpreted to follow the rhythm of precession and show hierarchical bundles, which are suggestive of eccentricity-related grouping. Eccentricity-bundles are correlated amongst the two studied sections. Moreover, the magnetic susceptibility signal of the Bottaccione section and the δ18O and δ13C record of both sections clearly demonstrate the imprint of precession and eccentricity. Eccentricity minima are associated with relatively warm periods (δ18O minima), characterized by an increased magnetic susceptibility signal and radiolarian blooms, which are expressed by frequent chert beds. Radiolarian blooms seem to hamper primary productivity, given that they correlate with δ13C minima.

The delineated astronomical cycles constitute an eccentricity-based cyclostratigraphy for the Turonian part of the Scaglia Rossa. Moreover, the constructed cyclostratigraphy is anchored to numerical time by calibration with the astronomical solution La2010 (Laskar et al., 2011) and with recent radioisotopic ages from the Cenomanian-Turonian boundary interval near the GSSP in Colorado, USA (Meyers et al., 2012). The numerical age (93.9 $\pm$ 0.15 Ma; Meyers et al., 2012) of the Cenomanian-Turonian boundary (0.75 m above the top of the Bonarelli Level in the Contessa section; Tsikos et al., 2004; Kennedy et al., 2005) is used as the pinpoint to which our astronomical time-scale is anchored. Using the anchored astronomical time-scale for the Turonian of the Umbria-Marche basin, the top of the Bonarelli Level is placed at 93.97 $\pm$ 0.25 Ma, and the boundary between the Whiteinella archaeocretacea and Helvetoglobotruncana helvetica planktonic foraminiferal zones is put at 93.48 $\pm$ 0.25 Ma. These ages are consistent with the numerical ages obtained from radioisotopic dating of the near-GSSP USGS #1 Portland core (Meyers et al., 2012).

High-resolution XRF geochemical analysis through the 82 cm thick Bonarelli Level in the Bottaccione section at Gubbio, reveals four strong $\sim$21 cm thick cycles. Spectral analyses on the SiO_2 and $Al2O_3$ concentration and in the Si/Al ratio suggest an eccentricity and precession signature if one assumes an average sedimentation rate of 2.0 m/Myr during the OAE2 in this pelagic basin. These results indicate a duration of $\sim$410 kyr for the Bonarelli Level and place the bottom of this anoxic interval at 94.38 $\pm$ 0.25 Ma. In the near future, the latter marker-bed could be used to connect the astronomical time-scale presented in this abstract to the Cenomanian astronomical time-scale based on the nearby Furlo section (Batenburg et al., this session), in order to obtain a considerably long (> 5 Myr) astronomically calibrated time-scale across a an intriguing time interval in Earth history, with unprecedented precision and accuracy.

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