Astronomical tuning of the Aptian Stage

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We present a new astronomical tuning for the Aptian stage, based on the combined record of the Piobbico Core (Umbria-Marche Basin, central Italy - this study) and the Cismon Core (Belluno Basin, northwestern Italy - Malinverno et al., 2010). Integrated bio-chemostratigraphy is available for both cores, granting their chronostratigraphic characterization and highest correlability.

A continuous high-resolution greyscale log of the Piobbico Core, obtained after full reprocessing of core photos, was used as input for the cyclostratigraphic analysis. Evolutionary spectral analysis reveals unstable frequencies throughout the record, indicative of uneven sedimentation rates ranging from about 2 to about 9 m/My. Reconstructed sedimentation rate model is based on the optimal fit of the long-eccentricity ~405-kyr-cycle. Changes in accumulation rate were further validated by applying the evolutionary coefficient analysis of the stratigraphic series, with the main components of the La2010a astronomical solution used as targets. Estimated variations in sedimentation rate well reflect the major lithofacies variations, from marlstone-dominated to marly limestone-dominated intervals, and the relative changes in biogenic components along the succession.

Results of the cyclostratigraphic analysis indicate that orbital forcing controlled the depositional patterns. Visual variations in the greyscale log, further supported by spectral analysis, highlight an evident cyclicity related to long- and short-eccentricity orbital periodicities. The combined short- and long-eccentricity amplitude envelope of the tuned record shows significant long-term modulations in the short eccentricity bands. Frequencies related to precession index fit as well with the La2010a astronomical model. The calibration with the theoretical astronomical solution allowed to define a consistent age model for the studied succession.

The tuned greyscale log of the Piobbico Core (this study) was merged with the tuned FMI resistivity log of the Cismon Core (Malinverno et al., 2010) in order to obtain a composite record covering the entire Aptian time interval and determine the duration of the Aptian time interval. In addition, by anchoring the results of the cyclostratigraphy to the U-Pb absolute age of 113.1 ± 0.3 Ma for the Aptian/Albian boundary, we provide a new estimate for the age of the Barremian/Aptian boundary, currently placed at the base of the M0r polarity Chron. The ~405 ky-tuned Piobbico and
Cismon merged record indicates a duration of 9.77 My for the Aptian, and an age of 122.87 ± 0.3 Ma for the Barremian/Aptian boundary.