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Cyclostratigraphy in the Middle Miocene (Lower Badenian) of the southern Vienna Basin

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The scientific borehole Sooß penetrates a succession of Early Badenian (Langhian, Middle Miocene) sediments, starting from the subsurface at the type section of the Badenian, the old brickyard Sooß near Baden (Lower Austria). The whole 102 m have been drilled and cored for the application of multidisciplinary methods, including biostratigraphy, palaeoecology, palaeoichnology, sedimentology, geochemistry, magnetostratigraphy and magnetic climate proxies such as magnetic susceptibility (Kathun et al., 2005).

The sedimentary succession consists of more than 95% marly shales of the 'Badener Tegel' (Baden Formation). The main lithologies are bioturbated, medium to dark grey marls and shales with carbonate contents between 11% and 25% and organic carbon (Corg) percentages between 0.35 and 0.65 and increasing towards deeper part . Rare intercalations include up to 20 cm thick sand layers with some shell debris and a light-gray 5 cm thick tuff. A distinct m-thick interval around 84.5 m displays a fine mm-scale light-dark lamination interpreted as marine warves, without significant bioturbation. Grain size analysis of the marls indicates mainly silty clays. Mean grain size ranges from 2 to 4 μm. The sorting is rather poor. No distinct grain size trend has been recognized from top to bottom of the core.

Over the complete core, spectral analyses on magnetic susceptibility demonstrated four significant (p = 0.01) peaks with the periods of 40.3, 23.2, 11.1 and 8.3m and an additional peak at 1.6m. Since the first 40m of the core are tectonically slightly dis-

turbed by faults, further investigation about cyclicity concentrated on the deeper part of the core from 40m to 102m. The power spectrum of magnetic susceptibility shows results similar to the whole core, with significant peaks at 44.9, 20.6, 14.5, 11.2, and 7.6m. A second power spectrum based on the $CaCO_3$ content (in percentages) of the deeper part of the core gave similar results. Here, the significant peaks are at 44.9, 22.4, and 15.4m, almost identical to the magnetic susceptibility. This correspondence is manifested in the high significant negative correlation (r =-0.4297, p = 9.875E-16) between the two time series. The percentage content of organic carbon demonstrates in spectral analyses the significant peaks (p = 0,01) at 35.3, 22.4, and 11.2m, where the second peak is identical to the $CaCO_3$ content and the third to magnetic susceptibility. The significant positive correlation between the time series of organic Carbon and $CaCO_3$ (r = 0.4275, p = 3.356E-15) is a further indication of periodicity. Cross-correlations between the periods of magnetic susceptibility and $CaCO_3$ content on the one side with astronomical cycles on the other resulted in high concordance by equalizing the first period (49.9 core meters) with the tilting cycle of 41 ky and the following two significant periods with both precession cycles of 23 and 19 ky. This equalization enables the calculation of an average sedimentation rate of 1.14 mm y^{-1}, which corresponds perfectly with the sedimentation rate measured by the development of marine warves representing annual sedimentation changes. Here, the average sedimentation rate is 1.10 mm y^{-1}.

Since 3 cycles of similar periods are checked by different types of time series analysis as autocorrelation, wavelet transformation and spectral analysis, the whole core seems to span an interval of $\sim$ 100 ky fitting into the short time interval that is available for the upper part of the Early Badenian.

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