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Decadal- to centennial-scale climate cycles in Upper Miocene lacustrine deposits of Lake Pannon

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Astronomical tuning fostered time resolution in geological records down to Milankovitch cycles (104–106 yr). Few studies exist with a higher resolution in pre-Quaternary records, what would be crucial for deeper understanding Earth's climate system in the past and for serious predictions. Here, we will present first high-resolution studies of sub-Milankovitch climate cycles in lacustrine deposits of the Late Miocene of Central Europe. These are based on two up to 600-cm-long sediment cores in total with sample distances of 1 cm representing roughly one decade in time each. The data sets comprise geophysical, geochemical, palynological and ostracod data. These records allow a correlation between bottom water conditions, surface water productivity and coastal vegetation. Further, information on high-frequency modulations of seasonality, precipitation and air temperature can be obtained.
Sample resolution is adequate to spot even decadal cycles which might be related to solar cycles. These are tested by best-fit models based on calculated sedimentation rates and suggest that most of the Holocene solar cycles appear also in Miocene records. A much trickier problem is to explain why single parameters, such as natural gamma radiation and magnetic susceptibility, react differently to the various cycles.
In contrast to the Holocene, these "millennia-records" are floating erratically in Miocene time and represent spotty and regional signals due to a total lack of comparable records. The value of such detailed studies will be evident only in the context of numerous other records which have to be gathered in the future. Nevertheless, the recognition of some typical but poorly understood Pleistocene-Holocene cycles in Late Miocene records is of major importance to uncouple these cycles from ice-sheet dynamic models.

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