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AN INTEGRATED STRATIGRAPHY OF THE PANNONIAN (LATE MIOCENE) IN THE VIENNA BASIN

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The Upper Miocene Pannonian stage is represented in the Vienna Basin by an up to 1200 m thick siliciclastic succession comprising lacustrine and terrestrial deposits. The Pannonian is a crucial time in the development of the Vienna Basin as it is characterised by the retreat of Lake Pannon from the Vienna Basin giving place to terrestrial-fluvial settings. For the first time, we integrate the maze of Pannonian lithostratigraphic terms and zones used by palaeontologists, oil companies and field geologists into a rigid lithostratigraphic scheme. This concept allows a clear correlation of surface outcrops with the basin-fill. The letter-zones of Papp (1951) are refined and applied to representative well-logs. This and the integration of biostratigraphic and magnetostratigraphic data, allow a strongly improved estimation of the chronostratigraphic content of each zone.

The Sarmatian/Pannonian boundary is still not defined by a stratotype. A radiometric determined age of approximately 11.5 Ma was proposed by many authors. This age does not correspond to the former Serravallian/Tortonian boundary that was placed at 11.20 Ma by Berggren et al. (1995). New astronomically based data on the age of the Serravallian/Tortonian boundary, however, point to an absolute age of either 11.539 Ma (Lirer et al., 2002) or 11.608 Ma (Hilgen et al., 2000), and even suggest that it corresponds to the glacio-eustatic sea-level lowstand of TB3.1. Hence, we suggest that this major and global sea-level fluctuation is also reflected in the Pannonian basins area, which ultimately resulted in the withdrawal of the Paratethys at the end of the Sarmatian. A 3rd order cycle, which marks the Tortonian transgression in the Mediterranean area, coincides with a rise in water table of Lake Pannon. Comparisons with geophysical logs from the Styrian Basin document that lake level oscillations during the TST of this 3rd order cycle are well reflected in both basins. Correspondingly, the maximum extension of Lake Pannon in the Middle Pannonian is documented in all Pannonian basins. Hence, the sedimentary record of the Vienna Basin reflects the “history” of Lake Pannon during the early Late Miocene rather than being exclusively an expression of local tectonics.

Furthermore, the cyclicity in the sedimentary successions – most obvious in geophysical logs – suggests a trigger, such as astronomical forcing, which is independent of geodynamics and pure autocyclic processes. According to this preliminary approach, the 2.35-myr eccentricity cycle might have influenced the development of Lake Pannon. Geophysical logs clearly document a well-developed periodicity of funnel-shaped curves from the Lower to the Middle Pannonian. These curves are most regular in the upper Lower and the Middle Pannonian, and seem to coincide with the maximum of the 2.35-myr component. Hence, the transgression and maximum extension during the maximum of the 2.35-myr cycle applies for the entire Lake Pannon and is not restricted to the Vienna Basin. Finally, the desiccation of the Vienna Basin resulted in a considerable gap in sedimentation which could be related to the following 2.35-myr eccentricity minimum. Outside the Vienna Basin, this phase corresponds to a general shrinkage of the lake. For example, the Sarmatian/Pannonian boundary and the major reduction of Lake Pannon in the Late Pannonian correlate well with two minima of that cycle, whereas the maximum extension took place during a 2.35-myr maximum. The dramatic shift in the composition of fossil mammal assemblages from the Early/Middle Pannonian to the Late Pannonian, which reflects an increase in seasonality and in aridity, supports this

interpretation. The small mammal faunas of the Early Vallesian (MN9) indicate extended wetlands with rather humid, forested environments accompanied by dense vegetation during the heyday of Lake Pannon. The mammal fauna of the late Vallesian (MN10) comprises a high diversity of semi-aquatic, arboreal and gliding rodents. Nevertheless, the number of ground dwellers increases which might point to the successive spreading of open woodlands and to a trend towards advanced seasonality. The subsequent sedimentary gap between the Čáry Formation and the Gbely Formation seems to coincide with the 2.35-myr eccentricity cycle minimum, which occurs roughly between 9.3 and 9.6 Ma. This hiatus also coincides with a major faunal turn-over within the mammal assemblages of the Vienna Basin.
The Lower Turolian (MN11) mammal fauna, represented by the large mammals from the Mannersdorf, Wolkersdorf and Prottes sections and by the small mammals from the Eichkogel section, are characterized by murid-cricetid-dominated associations and by a dramatic increase of carnivores (Hyaenidae) and ruminants (Bovidae and Giraffidae). The dominance of ground-dwelling rodents, the diversity of ruminants and the occurrence of the porcupine *Hystrix* hint at more dry conditions, a seasonal climate and relatively open woodland-environments. Similarly, as summarized by van Dam (1997), various climate-related records of the NE Atlantic-Mediterranean region document strong shifts within that interval. In the Vienna Basin, this phase, which is also characterised by repeated interruptions in Upper Pannonian sedimentation, might best be interpreted as a period of dry climate conditions which was strongly accentuated by a change of the geodynamic system from pull-apart kinematics towards basin inversion.