

- FODOR, L., CSONTOS, L., BADA, G., GYÖRFI, I. & BENKOVICS, L. (1999): Tertiary tectonic evolution of the Pannonian basin system and neighbouring orogens: a new synthesis of paleostress data. In: DURAND, B., JOLIVET, L., HORVÁTH, F. & SÉRANNE, M. (eds.): *The Mediterranean Basins: Tertiary Extension Within the Alpine Orogen*. Blackwell Sciences Special Publications of the Geological Society of London, Oxford, 295–334.
- FODOR, L., BADA, G., CSILLAG, G., HORVÁTH, E., RUSZKICZAY-RÜDIGER, ZS., PALOTÁS, K., SÍKH-EGYI, F. & TIMÁR, G. (2005): An outline of neotectonic structures and morphotectonics of the western and central Pannonian Basin *Tectonophysics*, 410, 15–41.
- GRENERCZY, GY., KENYERES, A. & FEJES, I. (2000): Present crustal movement and strain distribution in central Europe inferred from GPS measurements. *Journal of Geophysical Research*, 105, 21835–21846.
- HORVÁTH, F. (1995): Phases of compression during the evolution of the Pannonian Basin and its bearing on hydrocarbon exploration. *Marine and Petroleum Geology*, 12, 837–844.
- HORVÁTH, F. & CLOETINGH, S. (1996): Stress-induced late-stage subsidence anomalies in the Pannonian Basin. *Tectonophysics*, 266, 287–300.
- MÁRTON, E., FODOR, L., JELEN, B., MÁRTON, P., RIFELJ, H. & KEVRIĆ, R. (2002): Miocene to Quaternary deformation in NE Slovenia: complex paleomagnetic and structural study. *Journal of Geodynamics*, 34, 627–651.
- SACCHI, M., HORVÁTH, F. & MAGYARI, O. (1999): Role of unconformity bounded units in the stratigraphy of the continental record: a case study from the Late Miocene of western Pannonian Basin, Hungary. In: DURAND, B., JOLIVET, L., HORVÁTH, F. & SÉRANNE, M. (eds.): *The Mediterranean Basins: Tertiary Extension within the Alpine Orogen*, Geological Society Special Publications, vol. 156, 357–390.
- TOMLJENVIĆ, B. & CSONTOS, L. (2001): Neogene–Quaternary structures in the border zone between Alps, Dinarides and Pannonian basin (Hrvatsko zagorje and Karlovac basin, Croatia). *International Journal of Earth Sciences*, 90, 560–578.

CERNIKIAN – A NEW PLIO-PLEISTOCENE REGIONAL STAGE OF THE SOUTHERN PANNONIAN BASIN

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The Pliocene to early Pleistocene *Viviparus* beds represent the topmost tectonostratigraphic megacycle of the southern Pannonian Basin. As demonstrated by seismic profiles from northern Croatia, they overlie transgressively the Lake Pannon brackish-water deposits and represent a fully independent sequence stratigraphic unit. Yet, their stratigraphic independence was not consequently approved by the regional chronostratigraphic classification. They were attributed either to uppermost Pannonian or to Dacian and Romanian stages of the Paratethys regional stratigraphic scheme. Yet, whereas the first stage is confined to the duration of the Lake Pannon, the latter two are constituents of the Dacian Basin chronostratigraphic classification, proved to be asynchronous with the *Viviparus* beds.



We recommend therefore the usage of a newly introduced regional stage Cernikian (MANDIC et al., 2015), constrained to the depositional cycle of the *Viviparus* beds. The latter reflects deposition of the freshwater Lake Slavonia and is bounded by discrete compressional events from the preceding Pannonian and the succeeding Pleistocene depositional intervals. The stage name derives from a type area located in NE Croatian municipality Cernik. The stage is three-fold; the substage correlation is facilitated by the strongly radiating *Viviparus* lineages, delivering backbone for a biostratigraphic zonation. Hence, the Lower Cernikian correlates to *V. neumayri* and *V. kochanskyae* zones; the Middle Cernikian to *V. bifarcinatus*, *V. stricturatus* and *V. nothus* zones; and the Upper Cernikian to *V. sturi*, *V. hoernesii*, *V. zelebori* and *V. vukotinovici* zones. The boundary stratotype, located NE of Cernik displays Pannonian sand with cardiid bivalves overlain by Cernikian clay bearing *Viviparus neumayri*. The most instructive section, showing a complete succession of the *Viviparus* beds, is represented by the Gojlo antiform E of Kutina (NE Croatia). There, the 900-m-thick Cernikian interval is composed largely by greenish clay and fine-sand bearing abundant viviparids. The 200-m-thick Lower Cernikian and the 600-m-thick Upper Cernikian interval contain 0.1 to 2-m-thick coal seams.

Although representing an isolated lake environment, at least temporary southward outflow from the Pannonian Basin existed, allowing some species to migrate to the Dacian Basin. The partial faunal overlap facilitates a rough calibration of the Cernikian biostratigraphy to the Dacian and Romanian stages based on shared *Viviparus* zonal markers. It further allows an indirect correlation to the Geological Time Scale using the current bio-magnetostratigraphic age model for the Dacian Basin. According to this correlation, the Cernikian spans the interval from 4.5 Ma to 2.0 Ma. The lower boundary of the Middle Cernikian is correlated to 4.2 Ma, the base of the Upper Cernikian corresponds to 3.3 Ma, approximately coinciding with the onset of the Pliocene Climate Optimum (PCO). The period between 4.3 and 2.7 Ma represents a generally warm phase, culminating between 3.3 and 2.9 Ma, when polar temperatures increased by up to 10°C. The increase of shell sculpture in lineages of the Lake Slavonia viviparids coincides with that warming trend. In contrast, the *V. vukotinovici* zone succeeding the PCO event shows retreat of weakly sculptured phenotypes.

MANDIC, O., KUREČIĆ, T., NEUBAUER, T.A. & HARZHAUSER, M. (2015): Stratigraphic and palaeogeographic significance of lacustrine molluscs from the Pliocene *Viviparus* beds in central Croatia. *Geologia Croatica*, 68/3, 179–207.

AMAZING BIODIVERSITY OF MIOCENE "REEFS"

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During the Middle Miocene a number of bioconstructions developed along the shelves of the Paratethys Sea (RIEGL & PILLER, 2000, HARZHAUSER & PILLER, 2007; SREMAC et al., 2016). Heterogeneity of carbonate-producing biota and architecture of boundstone bodies reflect the

