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Sequence Stratigraphy of the Late Badenian & Sarmatian (Serravallian) of the Eastern Part of the Vienna Basin – Deltaic to tidal flats environment

Bohuslava Sopková, Adriana Škulová, Jana Hlavatá & Michal Kováč

In Miocene sedimentary record of the Vienna Basin, similarly as in other basins of the Pannonian Basin System, frequent relative sea level changes of global as well as of local character are registered. These well recognizable sea level fluctuations can be detected in palaeo-depth of sedimentary environment as well as in the shift of shoreline.

Our study was focused on the Late Badenian and Sarmatian strata on the eastern margin of the Vienna Basin, in Slovakia. In terms of the Mediterranean time scale, Late Badenian and Sarmatian coincide with Middle Miocene Serravallian stage established for the whole Central Paratethys region. Serravallian designates the time interval of 13.65–11.61 Ma (Gradstein et al. 2004).

Both, Late Badenian as well as Sarmatian, represent two single 3rd order cycles, which could be more or less related to the Mid-Miocene shoreline shifts within the whole Mediterranean (Kováč et al. 2004).

Late Badenian cycle in the Vienna Basin represents a single 3rd order cycle of relative sea level change, that is comparable with TB 2.5 cycle sensu Haq et al. (1988) and the time span between the boundaries Ser-2 (13.65 Ma) and Ser-3 (12.7 Ma) determined by Hardenbol et al. (1998), as well. The Sarmatian refers to the time interval between 12.7 and 11.61 Ma. In Vienna Basin the Sarmatian cycle comprises a single 3rd order cycle, which is equivalent of the TB 2.6 cycle of relative sea level change according to Haq et al. (1988) and the Ser-3 (base) and Ser-4/Tor-1 (top) boundaries of Hardenbol et al. (1998).

The existence of the previously mentioned 3rd order cycles was proved in case study area. In addition, based on the electrosequence analysis of the well logs (SP, RAG), seismic profiles, biostratigraphy and sedimentology of obtained drill cores we attempted to identify cycles of the 4th or even lower order within the Mid-Miocene sedimentary record. Generally, we have traced four 4th order cycles. Two cycles comprise Late Badenian strata (lower Late Badenian 4th order cycle - LB1, upper Late Badenian 4th order cycle - LB2) and the other two cycles (Lower Sarmatian - Sa1, Upper Sarmatian - Sa2) are assigned to the Sarmatian stage. Above-mentioned 4th order Late Badenian cycles refer rather to local impulses, than to the global sea level fluctuation.

LB1 and LB2 were forced more likely by local delta lobes switching. Beside this, Sa1 and Sa2 can be well correlated with the development of the Sarmatian sedimentary record in the Austrian part of the Vienna Basin (Harzhauser & Piller 2004) and might be related to regional shifts of the Vienna Basin shoreline.

Another goal was to establish the development of depositional environment in area of interest. The lower Upper Badenian sedimentary architecture and lithofacies show a gradual transition from the basinal environment with low oxygen content to the environment of prograding proximal delta setting (prodelta). Toward the overlying strata the Upper Badenian depositional environment became more and more shallower. This shoaling was forced by eastward progradation of deltaic clinoform body influenced by increasing sediment supply (causing the onset of forced regression). This progradation is detectable on the well log profiles as well. Following development of the depositional environment in space and time within the Upper Badenian strata could be established: basin plain – prodelta – delta front with prograding mouth bars – lower delta plain with distributary and interdistributary areas displaying common distributary channel avulsion, development of crevasse splays.

Sarmatian sedimentary record reveals deposition in a shallow brackish environment. During Lower Sarmatian, the sedimentation in the studied area passes continually from the Upper Badenian, on the lower delta plain. Further upwards, the well log study and core analysis unambiguously point to the environment of tidal flats, indicated by clays and incised channels. Present silts and sands often comprise flaser and lenticular beddings, thus we suppose deposition mainly in the intertidal to subtidal zone with the tidal flats. At the end of the Lower Sarmatian increased input of material was detected, what triggered the facies shifting from the subtidal through intertidal towards the supratidal zone. This is documented by complex network of channels with sand bars yielding clastic material derived from NW–N, together with interdistributary areas represented by swamp and marsh systems. Character of tidally influenced marshes continued to the end of the Lower Sarmatian.

The onset of the Upper Sarmatian is detected by the network of flat incised channels on the tidal flat with synchronous sand ridges and reworked sandy bodies by coastal currents. Upwards, gradual flooding within regressive phase of the Late Sarmatian has been observed. We suggest sediment load carried by channels to be reworked by coastal currents mainly of tidal and long-shore character, forming some kind of barriers triggering the sedimentation in protected bays or lagoons with possible ebb-tidal deltas. At the end of the Upper Sarmatian, we suggest subaerial deposition, evidenced by occurrence of lignite layer.

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Authors address:
Bohuslava Sopková, Adriana Škulová, Jana Hlavatá & Michal Kováč
Comenius University
Faculty of Natural Sciences
Department of Geology and Paleontology
Mlynská dolina pav. G
SK-842 15 Bratislava
sopkova@fns.uniba.sk