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Depositional Systems of the Northern Vienna Basin

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Vienna Basin, situated at the Alpine-Carpathian-Pannonian junction is one of the most explored sedimentary basins in Europe, with lots of borehole and seismic data, thus giving a good opportunity to serve as a natural laboratory for various geological studies. The sedimentary pattern of the Miocene fill is presented in lithostratigraphic scheme prefering the interrelation of individual lithotypes of rocks, each of them with conclusive genetic interpretation.

Depositional systems were defined as assemblage of process-related facies (Fisher and McGowen, 1967). The concept of a depositional system helps one to relate laterally adjacent, contemporaneous sedimentary environments and their resulting assemblages of laterally-intergradational and hence contemporaneous sedimentary facies. Thus a sedimentary facies represents a single depositional environment, and a depositional system represents a series of laterally adjacent depositional environments. Sedimentary rocks within a depositional system are related by a dispersal system (Swift and Thorne, 1991) defined as an assemblage of flow-linked depositional environments in a three-dimensional body comprising an amalgamated or averaged recording of countless individual sedimentation events. Marine depositional systems were divided into regressive and transgressive classes, thus reflecting the temporal relative sea-level changes (Swift, Phillips and Thorne, 1991).

The **Eggenburgian depositional systems** of the Northern Vienna Basin are represented mostly by shelf sand ridge depositional systems and show a distinct transgressive pattern. Initial stage of subsidence was manifested by deposition of alluvial variegated clay and sand of the Stráže Fm. in depressions. Transgressive - onshore deposits represent coarse debris aprons and marine conglomerates of Brezová, Chropov and Winterberg types (Baráth and Kováč, 1989). The offshore Eggenburgian Lužice Fm. gradually widened over the coastal sediments (Fig. 1). In the northeastern part of the basin the sedimentation started by upward fining shelf, shoreface, rocky-coast transgressive depositional system, passing upwards/landwards into a barrier-lagoon-estuary system. The southeasten part of the Štefanov depression and the northeastern part of the Vaďovce depression were marine bays with bay-head deltas, passing upward into estuarine deposits. The brackish environment of deposition in the area of Studienka and Lakšárska Nová Ves (Jiříček, 1983) can indicate a bay-head delta also in the Závod area. At the end of Eggenburgian a relative sea-level fall caused a rapid progradation of the Štefanov regressive deltaic mouth bar depositional system on the south.

During the Early **Ottnangian** the backstepping Štefanov deltaic sediments were flooded and covered by basinal Lužice clays (Fig. 1). Barrier-lagoon-estuary transgressive depositional system developed north of Štefanov, reaching a thickness 150 m (Biela, 1978). Similar transgressive system is recorded also in the Dobrá Voda depression, where the bay-head deltaic deposits are covered by dark clays within the Planinka Fm. (Kováč et al., 1991). Northern margin of the Vienna Basin show a dominance of shelf sands transgressive depositional systems, being later cut by regressive erosion. Below the Ottnangian/Karpatian boundary a progradation of fluvial-deltaic Bockfliess sandy mouth bars depositional system indicates a new regression. In the Dobrá Voda depression this regression is marked by coarsening upward pattern of the Late Ottnangian Planinka Fm. Clastics (Kováč et al., 1991).

The **Karpatian** stage comprises two major transgressive/regressive cycles. The first one starts by well pronounced transgressive depositional system of Týnec shelf sand ridges at the western margin of the basin and by the rapid flooding of Bockfliess deltaic body by open-marine Lakšáry Fm. on the south (Fig. 1). The later widespread regression caused the deposition of alluvial Gaensendorf clastics, passing northwards into deltaic Šaštín sands, reaching a thickness of 100-400 m (Jiříček and Seifert, 1990). This north-prograding regressive mouth bar depositional system reached almost the present northern margin of the basin. The second Karpatian cycle started by flooding and capping of the Šaštín sand body by offshore Závod Fm. and by the deposition of deltaic-lagoonal Aderklaa Fm., comparable with the Láb Ostracoda Mb. (Fig. 1). The presented succession is interpreted as a barrier-lagoon-estuary transgressive depositional system. At the end of Karpatian the lagoonal deposition was replaced by the north-prograding gravelly Aderklaa and Jablonica regressive mouth bars (Fig. 6). Large areas of the basin

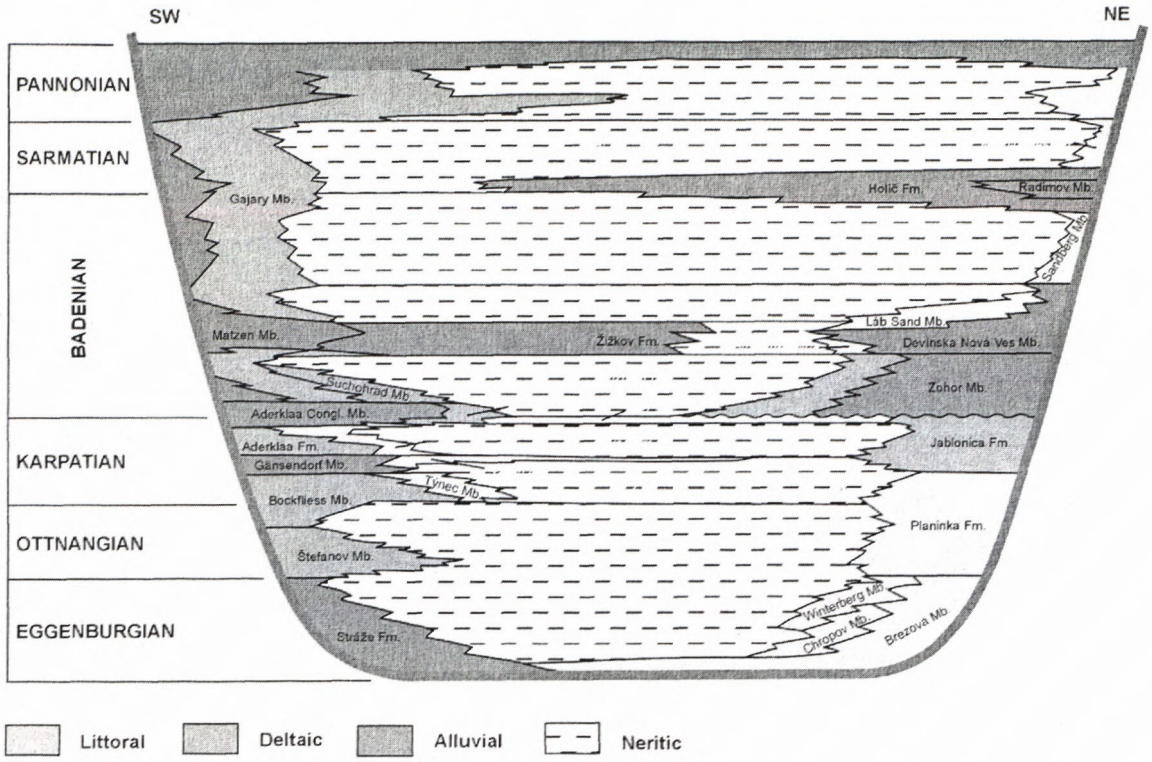

Fig. 1 Chart of the Northern Vienna Basin model of depositional facies, lithostratigraphy, and transgressive/regressive patterns.

have got hypersaline with the deposition of Kúty anhydrite Mb., followed by large-scale erosion in the northeastern part of the Vienna Basin.

The **Early Badenian** backstepping of the Suchohrad deltaic and Zohor alluvial-deltaic bodies and their gradual transition into shelf sand ridges mirror the new transgression to the southeast (Fig. 1). Similar depositional systems bound the northern margin of the basin, however the transgressive shelf ridges are without deltaic supply, and their clastic material came from the ravined underlying deposits. In this area the shoreface sand is covered by Lanžhot Fm. offshore clays.

At the Early/Middle Badenian boundary a major regression caused the origin of alluvial, deltaic and lagoonal Žižkov Fm., representing the strandplain-shelf and/or prograding mouthbar regressive depositional system. At its base, there occur also littoral Studienka sands, deposited probably in the early-regressive shelf plume system (Fig. 1). Another regressive mouth bar system is represented by Matzen sand in the Gajary and Suchohrad area (Jiříček, 1988, 1990). At the eastern margin of the basin the Láb sand sheet with algal bioherms, capped by offshore Jakubov Fm. clay document a new transgression in the late Middle Badenian time.

The **Late Badenian** sedimentation at both the eastern and northern margins of the basin started by minor regressive progradation of small mouth bars, which were rapidly replaced by transgressive Sandberg shelf sands depositional system with algal biostromes. The Upper Badenian transgression caused a widening of the open-marine Studienka clay Fm. depositional areas northwards (Fig. 1). At the end of Badenian time variegated facies started to prograde at the northern margin of the basin, thus marking the strandplain-shelf regressive depositional systems. In the same time the prograding Gajary mouth bar regressive depositional system originated on the south. These depositional systems document a new early regressive phase of the basin history.

During the early **Sarmatian** time a large-scale regression caused the retreat of brackish sea-shore southwards to the area of Malacky, Láb and Vysoká (Jiříček, 1988). The regressive alluvial plane-strandplain-shelf depositional system is represented by the rapidly prograding Holíč Fm. in the northern part of the basin (Fig. 1). The new Sarmatian transgression is represented by wide flooding of the northern basin margins by brackish-water Skalica Fm., comprising tidal sand bars and bryozoan-serpulid limestones transgressive system (Fig. 1). At the end of Sarmatian the prograding deltaic mouth bars of the paleo-Danube river mirror a regression in the southwestern part of the basin, continuing up to the early Pannonian time (Jiříček, 1985). Similar regressive mouth bar depositional system originated on the north (Elečko and Vass, 2001).

The next **Pannonian** brackish-water transgressive/-regressive cycle is represented by the Lower Pannonian Záhorie Fm. (Fig. 1). From the Upper Pannonian time, the sedimentary environments became to be coal-bearing limnic and alluvial in the whole Vienna Basin (Baráth and Kováč, 2000).

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