Oxic and ?anoxic deposits of the Pannonian E (Late Miocene) from the Vienna Basin (sedimentological and micropaleontological description of sediments with *Congeria subglobosa* horizon)

Dušan Starek[1], Radovan Pipík[2]

[1]*Geological Institute, Slovak Academy of Sciences, Dúbravská cesta 9, SK-840 05, Bratislava, Slovak Republic.*

[2]*Geological Institute, Slovak Academy of Sciences, Severná 5, SK-974 01 Banská Bystrica, Slovak Republic.*

Key words: Vienna Basin, Pannonian, sedimentology, paleontology, molluscs, ostracods

Introduction

The Late Miocene depositional systems of the Lake Pannon are very heterogeneous, represented by alluvial and fluvial facies, ephemeral lake, swamp, subaquatic delta plain deposits passing continually to offshore pelitic facies (Kováč et al., 2005). This latest one is typical for a period of maximal flooding surface (9.5 Ma) and well recognized by bivalve *Congeria subglobosa*. Harzhauser and Mandic (2004) suppose this large and heavily calcified bivalve to be adapted to muddy, low energetic hypolimnion environment, poor on oxygen with supersaturated sulfidic interstitial waters. It should be a significant biotope, which could play an important role in evolution of the endemic Lake Pannon fauna.

Congeria subglobosa horizon is well known from many sites in the Vienna Basin, but nowadays only outcrop in Gbely (Figure 1) is accessible for the sedimentological and paleontological study. The horizon is not exposed on the other localities (Hennersdorf, Hodonín) or the *Congeria subglobosa* valves are disarticulated and in allochthonous position (Pezinok).

An autochthonous position of *C. subglobosa* at locality Gbely (Slovakia) is approved by a presence of the closed shells (Figure 2d). The outcrop (Figure 2a) was investigated by sedimentological and paleontological methods to attest a hypoxic origin of *Congeria subglobosa* horizon. It offers sedimentologically and paleontologically contrast paleobiotopes, rich on meiofauna (Figure 3).

The studied lithofacies originated in subaqueous conditions below wave base and they are formed by clay, silt and rarely fine sand. Lower part of the profile (0.0-10.0 m), including *Congeria subglobosa* horizon, represents shelf-mud environment with prevalence of clayey sedimentation which sharply passes to rhythmic prodeltaic sedimentation of clay, silt and fine-grained sand (10.0-?23.0 m).

Sedimentological and paleontological data

The clay deposits of the offshore region, where fine-grained material is deposited at a slow rate predominate in lower part of the profile (0.0-10.0 m). A stratification within the clay is mainly a result of the difference in color, and rarely due a presence or absence of shell fragments.

Sand, silt and calcareous light clay (0.0-1.0 m) with microfauna (brackish *Cyprideis heterostigma*) passes to weakly calcareous gray-brown and non-calcareous grayish blue homogenous clay (1.7-2.4 m) barren of macrofossils and bioturbation and it could represent a horizon with low oxygen level or lacking of oxygen.

This sequence is overlaid by calcareous, silty, and laminated body (2.4-4.8 m) with a sharp lower contact (Figure 2b). The base of this sedimentary body is formed by thin sandy horizon with disarticulated *Unio* shells, *Melanopsis*, brackish ostracods *Cyprideis*, *Amplocypris*, and Paratethyan Candoninae, and carbonised macroflora detritus. A parallel or subparallel lamination is irregular and cross-stratified interval is developed in a middle thickness of the sedimentary body. A silty sediment contains a small rounded clay intraclasts. All mentioned sedi-

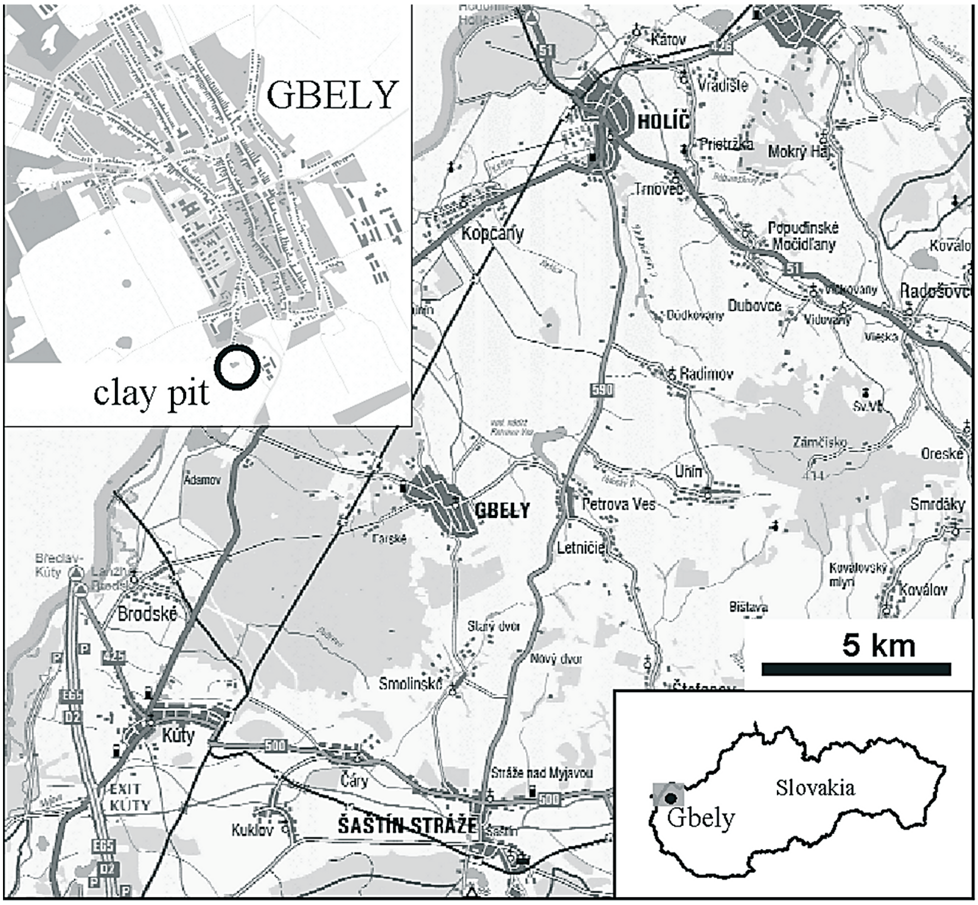

Figure 1. Geographical position of the clay pit Gbely.

mentary features - sharp bed base, graded interval with shell, lamination, cross-stratification, and rounded clay intraclasts – suggest a deposit of a past storm activity – tempestite.

An increase of preserved ostracod valves of *Cyprideis*, *Amplocypris,* and Paratethyan Candoninae and a high concentration of the preserved articulated and disarticulated *Limnocardium schedelianum* shells in concave and convex position (Figure 2c) is documented in clayey silt 4.8-6.3 m.

A homogeneous grey-blue and brown weakly-calcareous clay and silty clay of the offshore region (6.3-8.8 m) lack any bioturbations and rarely contain small *Limnocardium* fragments and *Amplocypris*. A contrast in abundance of meiofauna between this horizon and the horizons situated below (4.8-6.3 m) and above (8.8-10.0 m, see the next paragraph) can reflect a decrease of oxygen on hypoxic level and thus a change in oxic regime of the bottom.

This horizon continually passes to clay and silty clay with *Congeria subglobosa* (8.8-10.0 m, Figure 2d). The valves of this great bivalve are closed, frequent, and irregularly distributed in the deposit. An ostracod species richness rise and is the highest of all studied horizons at the outcrop in Gbely. The following brackish ostracods were determined – *Hemicytheria reniformis, H. folliculosa*, *Loxoconcha granifera*, *Cypria abbreviata*, *Cyprideis obesa*, *Euxinocythere lacunosa*. The numerous candonids - *Pontoniella* sp., *Typhlocypris* sp. juv., *Lineocypris* sp. juv. – are also preserved, but their valves are frequently damaged. Their significance for reconstruction of the oxic regime result that they are benthic animals, which avoid an ability to swim. An infauna settled this shelf-muddy environment, which of the traces are attributed to the „chemichnion" or agrichnion (*Chondrites*) (Figure 2e).

The horizon with *Congeria subglobosa* is overloaded by upward finning sandy, silty

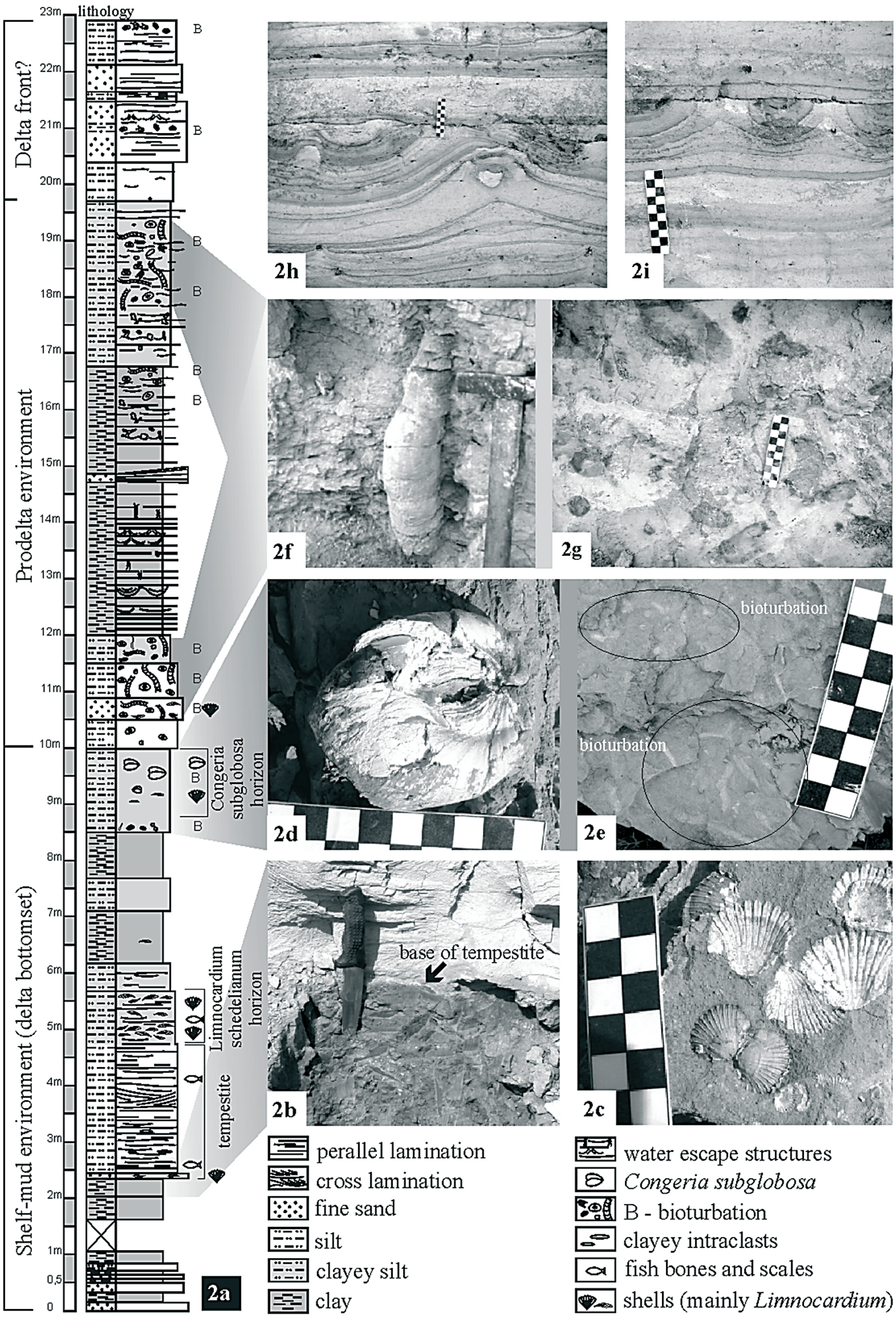

Figure 2. Lithological log (2a) of the outcrop Gbely and main sedimentary features: sharp contact between non-calcareous grayish blue clay and tempestite (2b), articulated and disarticulated shells of *Limnocardium schedelianum* (PARTSCH, 1837) in concave and convex position (2c), closed shells of *Congeria subglobosa* PARTSCH, 1835 (2d), *Chondrites* bioturbation in *Congeria subglobosa* horizon (2e), segmented burrow of *Thalasinoides* (2f, g), plastic deformations induced by water escaping (2h, 2i).

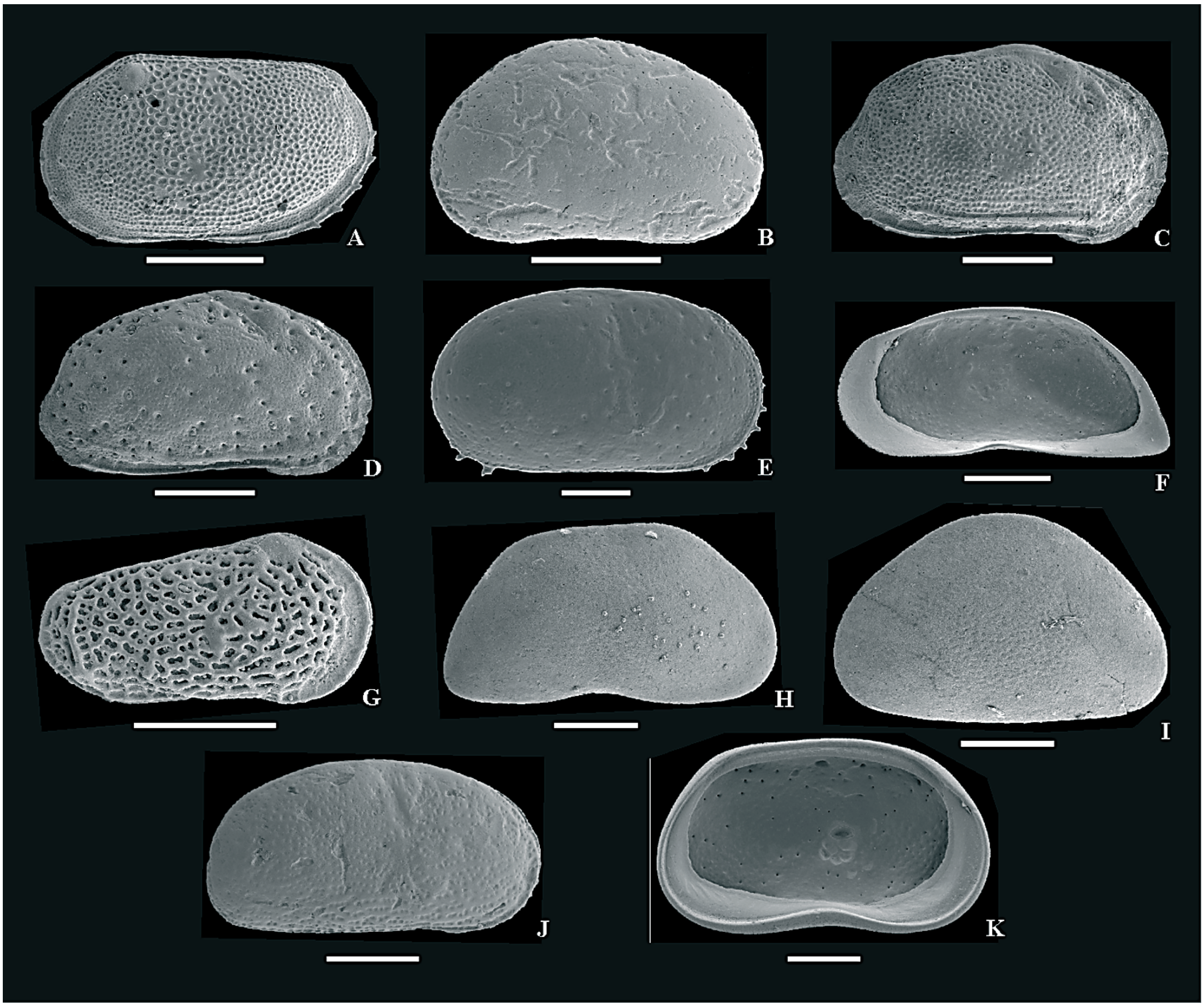

Figure 3. Ostracods of *Congeria subglobosa* horizon (A-I) and of the other horizons (J, K). Scale bar 0.2 mm
A *Loxoconcha granifera* (REUSS, 1850), LV, external lateral view,
B *Cypria abbreviata* (REUSS, 1850), RV, external lateral view,
C *Hemicytheria folliculosa* (REUSS, 1850), RV♀, external lateral view,
D *Hemicytheria reniformis* (REUSS, 1850), RV♀, external lateral view,
E *Cyprideis obesa* (REUSS, 1850), RV, external lateral view,
F *Pontoniella* sp., RV, internal lateral view,
G *Euxinocythere lacunosa* (REUSS, 1850), RV♂, external lateral view,
H *Lineocypris* sp. juv., RV, external lateral view,
I *Typhlocypris* sp. juv., LV, external lateral view,
J *Cyprideis heterostigma* (REUSS, 1850), RV♀, external lateral view,
K *Candona fahrioni* (TURNOVSKY, 1954), LV♀, internal lateral view.

and silty-clayey horizon (10.0-12.0 m) with very abundant bioturbation traces, variable in size, and recognized as *Thalasinoides* burrows (Figure 2f). Individual parts of the sediment are completely disturbed and suppose an environment saturated in oxygen. These coarser sandy and silty horizons and maybe also a horizon 20.0-23.0 m can be assigned to the flood-generated hyperpicnal floods which are capable to transport large quantities of even coarser sediment over a large distances into prodelta environment. Other possibility is, the coarser horizons represent a delta front sediments fingery extend to prodelta environment. These prodelta deposits (10.0-?23.0 m) are formed by fine-grained muddy facies, mainly by clay, silty clay, and silt with scattered pinching sandy layers. Sediments show layering due to differences in both a color and a grain size. Very thin rhythmites, 0.5 cm to 7.0 cm thick, of silt and clay are the most noticeable feature. Brackish *Amplocypris, Pontoniella,* and *Cyprideis* were found in the washed residue.

A bioturbation of the fine-grained facies in the lower part of this sequence (12.0-15.4 m) is very rare. Above, sediments (15.4-19.7 m) are more silty, probably represent an approximation of the delta front environment with a well-developed and abundant *Thalasinoides* burrows (Figure 2g), brackish ostracods *Loxoconcha granifera, Hemicytheria reniformis, Cypria abbreviata, Cyprideis obesa, Candona fahrioni*, *Camptocypria* sp., but a significant part of the ostracod taphocenosis has an abraded surface and thus signalizes a transportation and a current influence.

A distinction of the lamination and textural stratification is difficult due an intensive bioturbation. In the less bioturbated lower part (12.0-15.4 m), thin laminae of silt and very fine sand are disrupted by vertically escaping pore fluids. These deformations vary in intensity from gently deformed laminations, small water escape cusps to moderately strong concave-upward dish-and-pillar structures (Figure 2i). The soft-sediment intrusions and small-scale slump structures with folging of laminated bands are also visible. Two types of water escape structures can be recognized. The first, typically small-scale cusps (usually 1.0-2.0 cm high) and gently deformed laminae are irregularly distributed in entire prodelta sequence. They were formed probably as a result of spontaneous dewatering of sediment, deposited at high rate. The second type is represented by the plastic deformations of medium-scale (5.0-30.0 cm thick) (Figure 2h) induced by water escaping and including the dish-and-pillars, pipes, soft sediment intrusions, and slumps. These structures are also irregularly distributed and they are restricted to the narrow zones, surrounded by non-deformed laminated sets. These zones show a large lateral stability at a long distance. We suggest, that a stress was a triggering mechanism of this plastic deformation induced by a seismic activity.

Conclusion

Shelf-mud and prodelta environments were identified in the Pannonian E (Late Miocene) at the outcrop Gbely in the Vienna Basin. *Congeria subglobosa* horizon situated at the top of shelf-mud environment is rich on benthic brackish ostracods and the burrows similar to the „chemichnion“ or agrichnion (*Chondrites*). This offshore environment influenced by a storm activity was overlaid by prodeltaic clay and silt settled by meiofauna (abundant *Thalasinoides* burrows and brackish ostracods). All these sedimentological and paleobiological data provide a proof of well oxic environment. Only two clayey horizons (1.7-2.4 m and 6.3-8.8 m) of shelf-mud environment are barren of the macrofauna, ostracods, and bioturbation and they can be supposed as horizons with low oxygen level or lacking of oxygen.

Acknowledgements

This work was supported by the APVV agency (project APVT-51-045202) and VEGA agency (project No. 1/3053/06).

References

Harzhauser, M., Mandic, O. (2004): The muddy bottom of Lake Pannon – a challenge for dreissenids (Late Miocene; Bivalvia).

– Palaeogeogr., Palaeoclimatol., Palaeoecol. 204, 331-352.

Kováč, M., Fordinál, K., Halásová, E., Hudáčková, N., Joniak, P., Pipík, R., Sabol, M., Kováčová-Slamková, M., Sliva, Ľ. (2005): Western Carpathian fossil ecosystems and their relation to Neogene evolution of Euro-Asian continent. – Geol. Práce, Spr. 111, 61-121. [in Slovak].