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Mollusc based Biostratigraphy of the Clay Pit Mataschen in the Styrian Basin (Pannonian)

Mollusken-Biostratigrafie der Tongrube Mataschen im Steirischen Becken (Pannonium)

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Abstract: The mollusc fauna from the Lower Pannonian of Mataschen (Styria, Austria) is described. A correlation of the low diversity fauna with the *Mytilopsis ornithopsis* Zone (~Pannonian "Zone B" sensu PAPP 1951a) can be based on the rare occurrence of the index fossil *Mytilopsis ornithopsis* (BRUSINA, 1892). Thus, the correlation of the pelites with the Eisengraben Member and the Sieglegg Member of the Feldbach Formation as proposed by GROSS (2004) is confirmed.

Zusammenfassung: Die Molluskenfauna des Unter-Pannonium von Mataschen bei Kapfenstein in der Steiermark wird vorgestellt. Trotz der geringen Diversität kann aufgrund des Vorkommens von *Mytilopsis ornithopsis* (BRUSINA, 1892) eine Einstufung in die *Mytilopsis ornithopsis*-Zone (~Pannonium „Zone B" sensu PAPP 1951a) erfolgen. Damit wird die von GROSS (2004) vorgeschlagene Korrelation der Pelite mit der Eisengraben-Subformation und der Sieglegg-Subformation der Feldbach-Formation erhärtet.

Key Words: Styrian Basin; Pannonian; Feldbach Formation; Sieglegg Member; Eisengraben Member; *Mytilopsis ornithopsis* Zone.

Schlüsselwörter: Steirisches Becken; Pannonium; Feldbach-Formation; Sieglegg-Subformation; Eisengraben-Subformation; *Mytilopsis ornithopsis*-Zone.

Contents

1. Introduction

The clay pit Mataschen was intensively studied during the last years in the course of public excavation campaigns of the Landesmuseum Joanneum in Graz under the leadership of Dr. Ingomar FRITZ. The pit, owned by the Lias Österreich GmbH (formerly Österreichische Leca GmbH), is situated near Haselbach in Styria (Austria) close to Fehring and Kapfenstein in the Gnas Basin, a small subbasin of the Eastern Styrian Basin (46°54'16"N, 15°57'18"E). Currently an about 30 m thick section of thin bedded, gray-green silt, silty clay and marly clay is exposed. The base is formed by yellow sand. A distinct coarsening upward trend is reflected by the increasing number of silty and sandy intercalations towards the top. A detailed log is presented in GROSS (2004) and MELLER & HOFMANN (2004).

Various plant remains, rare vertebrates such as amphibians, fishes or reptiles and scattered molluscs comprise the majority of the fossil content. First reports on the flora and fauna of the clay pit Mataschen were presented by DRAXLER et al. (1994), Gross (1994), HOFMANN (2001), and MELLER (2001). According to these authors, the section is roughly separated into a brackish lower part which is characterised by the occurrence of Dinoflagellata cysts of *Spiniferites* and a limnic upper part, in which the content of pollens and spores increases. A nearshore, marshy depositional environment is indicated by remains of in situ tree trunks. Generally, a rather diverse flora with *Glyptostrobus*, *Trapa*, *Myrica*, *Taxodium*, and *Potamogeton* amongst others is already documented, which allowed a differentiation of various biotopes ranging from open limnic areas to nearshore marshes. Detailed taxonomic studies are now presented by CORIC & GROSS (2004), DAXNER-HÖCK (2004), GROSS (2004), KOVAR-EDER (2004), MELLER & HOFMANN (2004), SCHULTZ (2004) and TEMPFER (2004).

2. Stratigraphy

An exact dating of the deposits was missing until now. LOBITZER et al. (1988) and DRAXLER et. al. (1994) discussed a dating to the Middle Pannonian "zones D/E" based on the ostracod and mollusc fauna. In contrast, GROSS (1994) cites two deviating datings in unpublished reports of the Österreichische Leca GmbH to the "zone C" and to

"zone B". According to the geological map of KOLLMANN (1965) the outcrop lies within the extension of the younger Pannonian "zone C", whereas the Pannonian "zone B" with *Mytilopsis ornithopsis* (BRUSINA, 1892) appears about 600 m in the west separated by the topographic elevation of the Karlhöhe.

Biostratigraphy: The herein documented occurrence of *M. ornithopsis* in the lower part of the section (Eisengraben Member and basal Sieglegg Member according to GROSS 2004) allows now a clear dating into the Lower Pannonian *M. ornithopsis* Zone sensu RÖGL et al. (1993) and MAGYAR et al. (1999). The biozone corresponds fully to the frequently used Pannonian "zone B" of the Vienna Basin as defined by PAPP (1951a). A correlation with absolute ages points to an approximate age ranging about 11.3 my according to the chart in RÖGL & DAXNER-HÖCK (1996) or 11.8 my according to the chart in MAGYAR et al. (1999).

Lithostratigraphy: Sediments of the *M. ornithopsis* Zone are widespread in the Gnas Basin. They occur along the so-called Sarmatian spur in the Gleichenberg region. KOLLMANN (1965) describes an arch of outcrops which reaches from Kittenbach, St. Stefan/Rosental, Perlsdorf, Paldau, Saaz, Gniebing, Raabau in the west via Feldbach to St. Anna/Aigen and Jamm at the South Burgenland Swell in the East. KOLLMANN (1965) characterizes this zone in the Gnas Basin as a twofold succession, starting with a few metre thick sandy layer with *Melanopsis impressa* KRAUSS, 1853, followed by a thick unit of green to blue-grey clay and marly clay with *M. ornithopsis*, *M. impressa* and numerous ostracods as the lower unit. The overlaying top unit comprises marly clay with sandy intercalations and points to a general coarsening upward trend. In the area of Perlsdorf, scattered gravel layers and thin lignite beds are intercalated within the top unit (KOLLMANN 1965). GROSS (2000) introduced the lithostratigraphic terms Eisengraben Member and Sieglegg Member for the lower and the upper part of the succession which he unites in the Feldbach Formation. Thus, aside from the biostratigraphic feedback, the general lithological development at the section Mataschen as described by FRITZ & GROSS (2002) can be correlated with the top unit of the "zone B" or the *M. ornithopsis* Zone respectively and represents the Eisengraben Member and the Sieglegg Member of the Feldbach Formation (see also GROSS 2000, 2004).

Sequence stratigraphy: In terms of sequence stratigraphy the pelitic Eisengraben Member is interpreted as a high order transgressive systems tract which is followed by a coarsening and shallowing upward trend of the high stand systems tract represented by the Sieglegg Member (KOSI et al. 2003).

3. Material

Molluscs occur frequently in the pelitic part of the section Mataschen. Diversity, however, is low and only few species dominate the assemblage. Most taxa represent bivalves whereas gastropods are extremely rare. Despite the similar aragonitic composition of the shell only the bivalves are preserved as shells, whilst gastropods are nearly exclusively documented by steinkerns. All material is deposited in the paleontological collection of the Landesmuseum Joanneum in Graz (Styria, Austria).

Class Bivalvia Linne, 1758
Subclass Palaeoheterodonta Newell, 1965
Superfamily Unionoidea Rafinesque, 1820
Family Unionidae Rafinesque, 1820
Genus ?*Unio* Philippson, 1788

Remarks: At least two species of unionid bivalves are documented. A small keeled specimen of 38 mm length (Inv.No. 201071) is reminiscent of "*Unio vasarhelyii*" which was described by Lörenthey (1902) from Tinnye in Hungary. A clear identification, however, is impossible due to the preservation.

The second unidentifiable unionid species is represented by a single steinkern of a large, elongated shell of 72 mm length (Inv.No. 201106). This species is probably unknown from the Pannonian of the Austrian basins. It differs in its wide and angulated posterior margin from typical Pannonian species, such as *Unio atavus* Hörnes, 1865 and *Unio stegersbachensis* (Sauerzopf, 1952).

Subclass Heterodonta Neumayr, 1884
Superfamily Dreissenoidea Gray in Turton, 1840
Family Dreissenidae Gray in Turton, 1840
Genus *Mytilopsis* Conrad, 1858

***Mytilopsis ornithopsis* (Brusina, 1892)**
Pl. 1, Fig. 1

1892 *Congeria ornithopsis* Brusina n. sp. – Brusina: 495.
1985 *Congeria ornithopsis* Brusina – Papp: 295, Pl. 37, Figs. 1-3. [cum syn.]

Remarks: The identification of the shells is based on the comparison with the conspecific specimens illustrated by Papp (1953, 1985) from Leobersdorf (Lower Austria) and with shells from Kyjov, Czech Republic (former Gaya) which were used by Brusina (1892) for the definition of his *C. ornithopsis*. Especially among the shells from Leobersdorf several specimens correspond exactly in shape and size and develop an equally

sharp keel. Based on the holotype and the specimens illustrated by PAPP (1953, 1985) the slightly younger but closely related *Mytilopsis hoernesi* (BRUSINA, 1892) differs in its larger size and the more expanded anal-shield (sensu PAPP, 1985).

The species is usually known as *C. ornithopsis* in the literature (e. g. PAPP 1953). Later, MARINESCU (1973) introduced the new genus *Triangularia* MARINESCU, 1973 with *C. ornithopsis* as type species. Finally, NUTTALL (1990) supposed *Triangularia* to be a synonym of *Mytilopsis* and thus *C. ornithopsis* turned out to belong to *Mytilopsis*. This view is adopted herein, although NUTTALL's decision is not generally accepted.

Taphonomy and paleoecology: Only two individuals were found during the excavations. These are both more or less articulated; one fully articulated specimen seems to be still in life position (unfortunately the orientation of the slab was not marked during excavation and thus the unlikely possibility that the specimen is in an upside down position cannot be excluded). The second specimen lies perpendicularly to the bedding plane with slightly dislocated, gaping valves (Inv.No. 200514). Both occurrences document little disturbance and point to very low water agitation during deposition.

Mytilopsis neumayri (ANDRUSOV, 1897)

Pl. 1, Fig. 2

1985 *Congeria neumayri* ANDRUSOV – PAPP: 292, Pl. 35, Figs. 1-5. [cum syn.]

Remarks: This species, too, has to be affiliated with *Mytilopsis* CONRAD, 1858, if the revision of NUTTALL (1990) is executed consequently.

M. neumayri is by far the most abundant, identifiable mollusc at the section Mataschen. It displays a high morphologic plasticity ranging from small sized, elongated trigonal shapes to strongly elongated, slender shells which are reminiscent of small *Mytilopsis spathulata* (PARTSCH, 1836) at the first glance. The latter morphology might be the cause for the alleged co-occurrences of the strictly Middle Pannonian species with *M. ornithopsis* in the older literature (e. g. STINY 1918). In contrast, *M. neumayri* has an extraordinary long stratigraphic range and is mentioned by PAPP (1953) from the Karpatian to the Pannonian in the Austrian basins.

Taphonomy and paleoecology: *M. neumayri* occurs usually disarticulated; only very rare specimens display articulated valves. Isolated shells floating in the sediment are typical; sometimes small clusters of several individuals can be found as well. Additionally, the thin coquina lenses of the section Mataschen consist mainly of shell hash of *M. neumayri*. Its mode of life was similar to that of the extant *Dreissena* BENEDEN, 1835, which lives byssally attached to pebbles or wood. The absence of gravel and the scarceness of mollusc shells which could have acted as secondary hardground points out that driftwood or submerged plants have been the potential holdfast. This interpretation is also supported by the observation of PAPP (1953) that *M. neumayri* is fre-

quently associated with lignites in the Vienna Basin. During the *M. neumayri* Zone (corresponds to the "zone F" of PAPP 1951a) it obviously settled swift riverine environments and was adapted to pure freshwater (HARZHAUSER & TEMPFER 2004).

Genus *Dreissenomya* FUCHS, 1870

***Dreissenomya* ? cf. *primiformis* PAPP, 1951**
Pl. 1, Fig. 3

Remarks: Only a single shell is available (Inv.No. 200550); this is very fragile and only the exterior surface is visible. Therefore no interior shell features can be examined and any identification stays doubtful. Aside from the smaller size, the shell outline corresponds largely to that of flattened "*Dreissenomya*" *primiformis* PAPP, 1951 from the Pannonian of Hennersdorf and Vösendorf in the Vienna Basin (PAPP 1951b). The generic identification of the taxa usually assigned to *Dreissena* and *Dreissenomya* from the Early and Middle Pannonian of Austria is in need of revision and thus the author refrains from assigning the discussed shell definitely to *Dreissenomya* as redefined by NUTTALL (1990).

Superfamily Cardioidea LAMARCK, 1809
Family Lymnocardiidae STOLICZKA, 1871
Genus *Lymnocardium* STOLICZKA, 1871

Remarks: At least 3 different species are represented in the samples. The preservation is generally poor; usually only fragments occur, which do not allow any reliable identification. Some fragments display ribs with tiny spines and are thus reminiscent of *Lymnocardium spinosum* (LÖRENTHEY, 1902). Other fragments are characterised by a great number of narrow spaced ribs and might represent *Lymnocardium promultistriatum* (JEKELIUS, 1944).

Taphonomy and paleoecology: The lymnocardiids at the section Mataschen are often disarticulated and fragmented. Gaping but more or less articulated individuals are also frequently detected. In situ preservation, however, seems to be completely absent. Lymnocardiids were shallow burrower, which lived close to the sediment surface due to their short siphones.

Class Gastropoda CUVIER, 1797
Subclass Caenogastropoda COX, 1959
Order Littorinimorpha GOLIKOV & STAROBOGATOV, 1975
Superfamily Littorinoidea CHILDREN, 1834
Family Pomatiidae NEWTON, 1891
Genus *Pomatias* STUDER, 1789

Pomatias cf. *conicus* (Klein, 1853)

2002 *Pomatias conicus* (Klein) – Harzhauser & Kowalke: 70, Pl. 10, Figs. 6-8. [cum syn.]

Remarks: Rarely circular opercula occur in washing residue. These correspond fully to those of *P. conicus* as illustrated by Lueger (1981) and Harzhauser & Kowalke (2002). The species is frequently found throughout the Sarmatian and Pannonian in the Austrian basins. It is the only terrestrial gastropod from Mataschen; shells, however, are missing and thus the identification is arguable.

Taphonomy and paleoecology: The modern relative *Pomatias elegans* (Müller, 1774) prefers woodland habitats, pebbles and unconsolidated bottoms but may also thrive in more open environments (Kerney et al. 1979). During the Sarmatian and Pannonian *P. conicus* is one of the most typical elements in marshy deposits and thus might have lived in the closeby woodland bordering the swamps and lakes. Some sorting by transport, however, can be deduced by the sole occurrence of opercula, whilst the shells might already have been destroyed.

Order Cerithiimorpha Golikov & Starobogatov, 1975
Superfamily Cerithioidea Ferussac, 1819
Family Melanopsidae H. & A. Adams, 1854
Genus *Melanopsis* Ferussac, 1807

Melanopsis bouei Ferussac, 1823

2002 *Melanopsis bouei* Ferussac – Harzhauser et al.: 96, Pl. 5, Figs. 6-8.

Remarks: This species was mentioned by Fritz & Gross (2002) from the section, but is not represented in the herein studied material. As recently discussed by Bandel (2000) and Harzhauser et al. (2002) the separation of biological subspecies based on the various morphologies developed by *M. bouei* should be rejected. *M. bouei* appears during the Sarmatian and holds on to the Upper Pannonian.

Paleoecology: *M. bouei* seems to be a rather rare species at the section Mataschen. It is interpreted by Geary et al. (1989) as a freshwater dweller that might have also tolerated slightly higher salinities. The species probably preferred moderately agitated nearshore environments and might have avoided the calm bottom habitats of Lake Pannon. If it occurs in "offshore" deposits such as at Hennersdorf in the Vienna Basin, it is usually confined to sandy lenses which were transported by storms and water energy from the coast to the deeper depositional environment.

Family Pachychilidae Troschel, 1857
Subfamily Melanatriinae Thiele, 1929
Genus *Tinnyea* Hantken, 1887

***Tinnyea escheri* (Brongniart, 1822)**

1953 *Brotia* (*Tinnyea*) *escheri escheri* (Brongniart) – Papp: 128, Pl. 3, Fig. 29. [cum syn.]

Remarks: Several specimens are found in pelitic sediment. These represent exclusively fragmented steinkerns which lack the aragonitic shell. The casts, however, display remnants of the characteristic sculpture of the species and thus a reliable identification is warranted.

The species was intensively discussed by Harzhauser et al. (2002). According to Harzhauser et al. (2002) the different protoconch morphology justifies the separation of *T. escheri* from the Indo-West Pacific *Brotia* Adams, 1866, which is often cited in the Paratethys literature.

Taphonomy and paleoecology: The dissolution of the shells is very typical for *Tinnyea* at the locality Mataschen, but rarely also bivalves may display a similar preservation. This untypical preservation and the strong fragmentation which occurred before deposition, reveal the specimens as allochthonous elements. A characteristic groove-ridge sculpture of some steinkerns might be a hint to strong bioerosion of the shells by cyanobacteria before their final deposition.

The irregular fragmentation pattern differs completely from freshwater decapod predation scars as those described by Rust (1997) and excludes the influence by decapods. For the same reason a fragmentation by molluscivorous fishes is unlikely. Thus the shells seem to have experienced considerable transport. This interpretation fits well to the interpretation of *T. escheri* as a supposable fluvial species. In the Eisenstadt-Sopron Basin *Tinnyea* was recorded by Harzhauser et al. (2002) associated with *Unio atavus* in fluvial gravel lenses within fine sand deposits of the Pannonian "zone D". Correspondingly, it co-occurred with *U. atavus* in the Pannonian "zone C" in the northern Vienna Basin (Harzhauser et al. 2003).

Unidentified molluscs

Small-sized gastropod fragments of about 3 mm diameter are found on the surface of sediment slabs. These consist of 1–2 strongly convex whorls and derive from a stout turriculate gastropod. The poor preservation allows no identification of the fragments. Most of these shells are filled with pyritic sediment, which formation was probably triggered by the decaying snails in an oxygen deficient environment.

4. Conclusions

In total the fauna and its preservation reflect a quite inhomogeneous composition. Only *M. ornithopsis* is clearly an autochthonous but very rare element which appears more or less in life position with articulated valves. In addition, lymnocardiids are documented with gaping but nearly articulated valves which seems to contradict a considerable transport. According to PAPP (1985) and NUTTALL (1990), the species group of *M. ornithopsis* lived epifaunal byssate. Thus, *M. ornithopsis*, after an initial byssate phase, seems to have been adapted to a half-sunken life on the muddy bottom of Lake Pannon as adult animal, probably slightly similar to *Congeria subglobosa* PARTSCH, 1836 as reconstructed by HARZHAUSER & MANDIC (2004).

In contrast, all other bivalve species occur as disarticulated and often fragmented shells. Equally, the gastropod *T. escheri* is always strongly fragmented. The fragments of *T. escheri*, usually comprising 1–3, strongly leached whorls only, are often embedded in homogenous clay without additional fauna. Recently, HARZHAUSER et al. (2002) interpreted *T. escheri* as freshwater dweller which favoured riverine to estuarine conditions, corresponding to the requirements of its modern relatives. It is thus an indicator for repeated influx of fluvial elements into the less agitated lake environment. During such episodes also the robust opercula of *Pomatias* as sole remnants of terrestrial molluscs might have been transported into the lake. Only bivalves may form thin coquina lenses and shell hash which point to a transport from adjacent environments during higher energetic events. Aside from the rare lymnocardiids, these thin coquinas consist mainly of small sized, thin shelled, byssate *M. neumayri* which lived probably attached to submerged wood and axes. Therefore it is found more or less parautochthonous without having experienced a transport like the shells of *T. escheri*. Partly, however, *M. neumayri* might also derive from more agitated habitats, as the species is documented by RÖGL et al. (1993) and HARZHAUSER & TEMPFER (2004) from the section Götzendorf (Sandberg) in Lower Austria from an exclusively fluvial paleocommunity consisting of unionids and theodoxids.

Scattered pyrite in the clay of the lower part of the section indicates rather low oxygenation of the bottom and explains the nearly absent infauna and the scarceness of *M. ornithopsis*. The more frequent lymnocardiids seem to have been better adapted to these little aerated habitat. Correspondingly, the modern *Cerastoderma edule* (LINNE, 1758) is reported by WILLMANN (1989) to survive low oxygenation. Further, the absence of autochthonous herbivorous gastropods, such as valvatids, hydrobiids, bithyniids, lymnaeids, or planorbids reflect a limited resource of lush aquatic vegetation on the lake bottom.

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Explanation of the Plate

Coll. Geol. Paläont., Landesmus. Joanneum.

Plate 1
Fig. 1: *Mytilopsis ornithopsis* (Brusina, 1892), max. length: 43 mm (Inv.No. 200514)
Fig. 2: *Mytilopsis neumayri* (Andrusov, 1897), max. length: 22 mm (Inv.No. 200508)
Fig. 3: *Dreissenomya* ? cf. *primiformis* Papp, 1951, max. length: 9 mm, (Inv.No. 200550)

Tafelerläuterung

Coll. Geol. Paläont., Landesmus. Joanneum.

Tafel 1
Fig. 1: *Mytilopsis ornithopsis* (Brusina, 1892), max. Länge: 43 mm (Inv.Nr. 200514)
Fig. 2: *Mytilopsis neumayri* (Andrusov, 1897), max. Länge: 22 mm (Inv.Nr. 200508)
Fig. 3: *Dreissenomya* ? cf. *primiformis* Papp, 1951, max. Länge: 9 mm (Inv.Nr. 200550)

Plate 1