

Paleoecological analysis of regressive, detrital Sarmatian deposits from Borzykowa region (Northern part of the Carpathian Foredeep, central Poland)

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The Carpathian Foredeep is a structure lies between Carpathians and Central-Polish Highlands. It was formed during Miocene when Carpathians finally folded (details in Oszczypko, 2006). This foredeep was flooded by water of Central Parathetys.

Sarmatian deposits cropping out near Chmielnik were deposited in northern part of the Carpathian Foredeep, on varying, older rocks (Radwański, 1973). Miocene rocks are represented here mostly by detrital limestones, sands, gravels, rarely by silts (Rutkowski, 1976). Litostratigraphically they belong to “detrital Sarmatian” (formerly Chmielnik Fm). These sediments were finally deposited during Early Sarmatian regression and contain mostly redeposited material come from Badenian (e.g. Czapowski & Studencka, 1990).

In the vicinity of Chmielnik, in many exposures, varied fossils of organisms from different marine habitats, though sometimes also terrestrial forms occur. In detrital deposits, marine fossils, typical for average salinity, were found, which are usually interpreted as redeposited fossils, however, euryhaline fossils, typical for water with lower or variable salinity were also recognised, which can be interpreted as in situ fossils. Locally there are a large amount of the terrestrial gastropods (Górka, 2008; Stworzewicz, 2013) and fragments of silicified wood, too.

Large scaled cross bedded quartz sands (clinoforms) in Borzykowa sand pit were analysed. Very fine- and fine-grained sands are dominated, but in some isolated horizons, medium- and coarse-grained sands and gravel occur. The angle of cross bedding measures approximately 15°. Within the cross-bedded sands, numerous, but rarely spaced fossils of small bivalves (usually up to 1 cm) *Maetra (Sarmatimaetra) eichwaldi* (Laskarew, 1914) occur. These specimens are usually observed within the deposit in their life position with articulated shells. Furthermore, probably redeposited (disarticulated) bivalves *Solen* sp. were also found there besides small, abraded gastropods and crushed algae. Such allochthonous assemblages mostly occur in horizons of coarse-grained sand and gravels.

Presence of bivalves with articulated shells in life position within the sediment suggest that they are in situ. The small size of bivalves provides that organisms live in unfavorable conditions. Mass occurrence in Miocene deposits such opportunistic forms, with no other organisms is traditionally considered as an evidence of lower

salinity of the Central Parathetys in the Sarmatian (e.g. Czapkowski & Studencka, 1990). However in nearest outcrops of detrital Sarmatian (Zwierzyniec, Zrecze Małe, Ślasków), molluscs are much more diverse and larger. Deposition structures in Borzykowa remind sand bars of Gilbert type delta (Gradziński *et al.*, 1986). Such delta could be evidence for the closeness of land and river mouth, what suggest also numerous gastropods and fragments of wood near Zwierzyniec. The Zwierzyniec succession exposes fine-grained, quartz sands with sandy muds. They are horizontally- or very low angle cross-bedded in large scale. Presence of both, euhaline organisms and organisms characteristics for mesohaline waters, suggest, that part of these fossils (euhaline) are redeposited (Stachacz *et al.*, 2013).

Significant lower angle of cross-bedding in Zwierzyniec, suggest lower rate of sediment accumulation than in Borzykowa, furthermore, the same bivalves has bigger sizes. These observations indicate, that the important factor which limit the growth and diversity of organisms from Borzykowa, was high rate of sediment accumulation, not only the lower salinity as previously thought. The lower salinity during Sarmatian is not questioned here, however, Piller & Harzhauser (2005) suggest otherwise possibility. Thus, it is necessary to continue further sedimentological and paleoecological studies on this area and revise the existing views.

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