LITHOFACIAL EVOLUTIONS WITHIN THE MOLDAVIAN PLATFORM DURING SARMATIAN AND THEIR INFLUENCES ON MACROFAUNA ASSOCIATIONS

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Abstract. The appearance and evolution of the lithofacial areas during Sarmatian on Moldavian Platform extent are understood in terms of the dynamic relation between Carpathic orogene and Foreland. The shaping of the typical depozones (wedge-top depozone, fore-deep depozone, fore bulge and back bulge depozones) concerned a great part of the Sarmatian, and they evolved as orogene translated over the platform, from west to east. The Upper Basarabian is another important moment; afterwards the depozones evolution is out of the influence of orogene sector from the western part of the Platform, in comparison with the sector from the Carpathic curvature. The carbonate platforms, which appeared during Volhynian and Lower Basarabian, slowly migrated towards east, while during Upper Basarabian they slide towards south. These lithofacial areas of the platform extent created specific paleoemeral conditions that had remarkable influences on macrofauna associations: adjusting in shell thickness, adequate external adornment, size, frequency of genres and individuals’ number, or the appearance and evolution of some taxa.

Key words: Sarmatian, Lithofacies, Macrofauna associations, Moldavian Platform, Romania

INTRODUCTION

The sedimentary basin that functioned within the Moldavian Platform (Figure 1) extent was highly influenced by the tectonically relation between Carpathic orogene and foreland. The reason was that the Miocene tectogenesis determined the increasing of foreland sub-overthrust, followed by the uprising of the flysch nappe towards east. The overloading, as the flysch nappe pushed over, created within the platform extent a new situation. The Paratethys waters, withdrawn during the Badenian, had returned and it had been recorded the existence of some depozones, whose particularities modified during the Sarmatian. Thus the researches made by Bica Ionesi (1968), L. Ionesi, B. Ionesi, D. Bordei (1987), L. Ionesi et al. (1996), M. Brânzilă (1999) proved the development of some lithofacies, specific to the wedge top and fore deep depozones, containing rudits and arenits in the west part, and also the existence of carbonate platforms specific to the fore bulge depozone, or pelitic lithofacies within the back bulge depozone.

DISCUSSION

The superficial part of the Moldavian Platform is almost exclusively made from Sarmatian deposits. The exception is the northern part, from the Prut shore, where Badenian and even Cretaceous deposits are exposed.

Considering the Sarmatian stratigraphical interval of the Moldavian Platform, one may notice the presence of the deposits accumulated between Kossovian (Upper Badenian) and Meotian, as considered by Barbot de Marny (Sarmatian s.l.). They are separated into four biostratigraphical units, known as "subdivisions": Buglovian, Volhynian, Basarabian and Chersonian. It is noticeable that within the Moldavian Platform there is no sedimentation continuity between Badenian and Sarmatian, documented by a discrepancy between the superior and inferior Badenian deposits and fauna associations. As the sedimentary processes restarted (Upper Buglovian), the source areas for detritic material

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did not have very important relief energy, resulting in a low transported quantity of material, especially consisting in pellets. Regarding the Moldavian Platform there had been established a series of particularities. In the north part of the platform L. Ionesi, B. Ionesi (1982) considered a series of lithological units that made up a specific pelit predominant lithofacial area. There were separated: the Bajura-Cuzlău clays, Darabani-Mitoc clays, the sands and conglomerates from Ivancăuti, the bioherms with Serpula, Eșanca limestone. Some of these units have a local development, being synchronically within the Darabani-Mitoc clays.

Between Siret Valley and Moldova Valley, B. Ionesi, L. Ionesi (1968), B. Ionesi (1968) establish a considerably thickness of the Buglovian deposits (approx. 900 m), with a predominantly pelitic structure, only on top a few arenits being found.

In the northeastern part of the Moldavian Platform, between Jijia Valley and Prut Valley, Brânzilă (1999) points out along the Prut River a calcareous-recifal lithofacial, containing some marls and biochemical limestones, which became towards west an arenito-pelitic lithofacial, mainly consisting in sands and gravels. The thickness of the Buglovian deposits varies from 30 to 45 m.

As for Siret Valley, reconsidering Pătrău data (1990) it permitted to appreciate the buglovian deposits thickness to 500 m, made almost exclusively from pellets.

The previous situations suggest for the Upper Buglovian a relatively complex sedimentary basin, with predominantly, although in variable ratio, pellets accumulation. The considerably thickness of the deposits, nearby orogene, prove a continue subsidence process for the entire Buglovian interval. The arenits presence on top of the deposits column, seems to show a slightly growth of the relief energy in the carpathic area. The macrofauna associations from the Buglovian deposits contain little differences induced by the lithofacies they evolved in, probably due to the fact they still were in an adjustment process to the new marine-brackish environmental conditions. Considering the northern part of the platform, L. Ionesi, B. Ionesi (1981) noticed that the macrofauna is generally poor at the base of the Buglovian deposits (Bajura-Cuzlău clays). It had been remarked from the associations the absence of the stenohalin (Badenian type) taxa, although they have been found within the deposits of the Nistru shore. Considering the recifal-calcareous lithofacies, Brânzilă (1999) points out a remarkable growth in size of some taxa (Obsoletiforma lithodolica Dub., O. sarmatica Barbot, Abra alba scytica Wood, etc.), and for others a frequency growth of the individuals. Situated more to west then the previous, the arenitic-pelitcal lithofacies contains at the inferior part a great quantity of gastropodes: Mohrensternia inflata (Andrs.), M. sarmatica Friedeb., Terebralia andrzejowskii Friedeb., Potamides pictus (Defr.) etc. As the pellets became predominant, the macrofauna associations also modify, notably the abundance of Cardiids: Inaequicostata inopinata Grisch., L. pia Zhizh., Obsoletiforma sarmatica Barbot. The characteristic features of these individuals (which practically can be found in all platform buglovian deposits) are: small size, fragile shells. In addition, for the majority of the sectors, the presence of the relic forms (which vanish by the limit of Volynian) must be pointed out.

The Volynian deposits overlay the Buglovian ones, some of them being exposed on an important surface. The limit between is marked by the presence of Eșanca limestone (in the east) and of the (Pădureni) calcareous-sandstones with Serpula (in the west); afterwards, on a short interval it has been noticed a scarcity in fauna associations.

It is known and accepted that in the western part of the platform, right near orogene, the Volynian sedimentary process became more complex (on a thickness of approx. 500 m).

The pellets remain on a secondary place, the sands, sandstones and even oolithic lime becoming predominantly.

Between the Siret Valley and the Moldova Valley, B. Ionesi (1968) found eight intercalations of oolithic limestones and numerous sandstones and sand packages. This situation suggests the existence of a sedimentary basin, with relatively close detritic alimentation source – the carpathic land, with uprising relief energy. The subsidence started during the Buglovian and had a discontinuous character, as numerous fillings interested the basin. Because of the filling the waters depth continuously decreased and there were created conditions for a carbonate platform existence. In some higher sectors, even on land, there appeared lakes or coal-bearing swamp (Fălticeni-Boroaia zone) and deltaic deposits formed at the rivers mouth of the hydrographical network.

In the eastern part of the Moldavian Platform the accumulation of the Darabani-Mitoc clays (whose source areas was the Ukrainian land) continued. Never the less a small quantity of the detritic material came from the carpathic zone.

Even if the macrofauna associations of the previous lithofacies contain approximately the same taxa, they have different characteristics.
In the western part of the platform, including the Dealu Mare – Hârău area, the associations contain taxa with well developed, thick valves and obvious external adornment. The most representative taxa are those from the calcareous-gritty intercalations *Tapes gregarius* Parths., *T. vitalianus* d’Orb., *Mcatra eichwaldi* Lask., *M. vitaliana* d’Orb., *Plicatiforma plicata* Eichw., *P. plicatofittoni* Sinz., *Obsoletiforma vindobonense* Parths., *Potamides mitralis* Eichw., *P. pictus* Bast. The analysis of the existing data indicates for the Volhynian deposits stack, at the inferior part, a macrofauna association with a high frequency of the *Ervilia* and *Tapes* taxa. On top, one may notice the abundance of cerits and cardiids.

The presence of the cerits, with rich ornamented shells, especially within the sandy intercalations, proves the substratum they lived on and the relatively small depth of the water.

The macrofauna associations of the Volhynian deposits between Siret and Prut, except those from Dealu Mare-Hârău area, had been influenced by the specific paleo medial conditions. The taxa present thin shell, sometimes translucid, with poor external adornment, with small intercostals spaces, scales and thorns. The reduced number of individuals within the rocks and some morphological aspects proves the lack of optimal food conditions. The most frequent taxa are *Ervilia podolica* Eichw., *E. dissita* Eichw., *Mcatra eichwaldi* Lask., *Tapes vitalianus* d’Orb., *T. aksajicus* Bogd., *Innaeucostata gleichenbergense* Papp., *I. pia* Zhizh., *Obsoletiforma ringieseni* Jek., *O. bajanunasi* Kol., *Plicatiforma plicata* Eichw. (Plate I).

The accumulation of the Basarabian deposits in a special sedimentary context.

During the first part of the Basarabian on the platform extent, with specific depozones there are known two important lithofacial areas. The western one, of an arenitic character with rudit accumulation, is on the border with the oogene. The other area that developed east to Flămâni-Tg. Frumos line is of a pelitic character and contains the *Cryptomactra* clays.

Within the Dealu Mare-Hârău area, Ștefan (1989) observed during the Lower Basarabian the existence of some carbonate platforms that are situated more to east, south-east than the others from Volhynian, west to Siret. Into this area there have been separated three lime and oolitic sandstones intercalations, of up to 5 m thickness: the Hărmănești oolites, Hârău oolit and the Criveghi oolitic sandstones. The fauna association is rich and diverse, proving favorable conditions of substratum and food. The predominant taxa are: *Mactra pallasi* Baily, *Tapes gregarius ponderosus* d’Orb., *Obsoletiforma nefanda* Kol., *Plicatiforma plicatofittoni* d’Orb., *Tapes gregarius gregarius* Parths., *Potamides pictus* (Defr.), *Dorsanum duplicatum* (Sow) etc. with strongly evolved, thick shells of a well shaped adornment.

B. Ionesi (1986), L. Ionesi, B. Ionesi, D. Bordei (1987) have described similar associations within the Basarabian deposits, consisting both in arenits and rudits (Boiștea, Corni), situated west to Siret Valley.

During the Lower Basarabian as well as during the first part of the Upper Basarabian, in the conditions of the "*Cryptomactra* clays" lithofacies, a macrofauna of special characteristics evolved east to Flămâni-Tg. Frumos line. The macrofauna associations are characterised by a relatively small number of genres, as it it also the number of individuals spread within the rock, except a few concentration at different levels (probably when the food conditions permitted a certain development). Noteworthy the presence of some taxa from the neighbouring lithofacial zones arrived by migration or transported. The most frequent is *Cryptomactra pesanseni* May, among others also in a great number *Mactra vitaliana* d’Orb., *M. podolica* Eichw., *Tapes gregarius* Parths., *T. vitalianus* (d’Orb.), *Obsoletiforma barboti* Hoern., *O. michaiowi* Toul, *O. nefanda* Kol., *Innaeucostata suessi* Barbot, *Musculus sarmaticus* Gats (Plate II). These taxa are strongly influenced by the environmenty conditions. The individuals have reduced size, with a fragile, poor in adornment valves. Among the taxa transported or migrated in the "clays with *Cryptomactra*" lithofacies one may notice the presence of *Plicatiforma fittoni* d’Orb., *P. plicatofittoni* Sinz., *Solen subfragilis* Eichw., *Gibbula beaumonti* (d’Orb) which have the shell size and features specific to the rectical lithofacies. After the accumulation of the *Cryptomactra* clays, the northern part of the Moldavian Platform was subaery exposed. On the new shaped land, the incipient hydrographical network spread, almost homogeneously, over the basin (that was evolving towards south) the detritic material and also a great quantity of fresh water. Thus, low brackish biofacial conditions appeared on a quiet large zone from the shore towards the sea. Specific macrofauna with small sized macltras and conglomer shaped. Among these, one may notice the fresh water fauna intercalations (*Anodonta, Unio, Hydrobia*), and even mammals remains (*HippParion*) that came from the land nearby.

During the Upper Basarabian the sedimentary process on the Moldavian Platform continued only in the southern part and has an homogeneous character, the northern part
evolving as firm land. In Volynian and Lower Basarabian the evolution of some carbonate platforms was possible due to the overloading of the Moldavian Platform, as the flysch nappes slide over it. During Upper Basarabian the carbonate platforms appear towards the south of the platform extent. This phenomenon is explained by the evolution of the curvature zone of Orogene. Noteworthy the accumulation of the Repedea oolitic lime with numerous remains of the macrofauna associations. The predominant taxon is Mastra podolica Eichw., which sometimes realizes important lumarhelic associations. Plicatiforma fittoni d’Orb., P. plicatofittoni Sinz., Potamides disjunctus Sow., Gibbulla beaumonti (d’Orb), Mastra fabreana, M. vitaliana d’Orb, Barbotella intermedia Rad et Pavl., may also be found.

The superior part of the Repedea oolitic lime stands for sands and gritty intercalations (Şcheia sands and sandstones) which prove a uniform sedimentary process, sometimes connected with the beach. The composition of the macrofauna associations is not significantly modified. One may notice a high frequency of reduced size macras. Within the southern part of the Moldavian Platform, where the sedimentary process continued during the Upper Basarabian, there are not remarked distinct lithofacial areas.

The Chersonian sedimentation took place, as the platform land was moving towards south, even after a short stop (L. Ionesi, B. Ionesi 1984).

This situation allowed the development of some deltaic lithofacies, nearby the land, as well as of a marine-brackish one in the distal zones, towards south. The macrofauna associations are represented only by a small sized taxa: Mastra caspia Eichw., M. supermaculata Mac. of fragile, thin valves with non distinct features, which suggest an inauspicious environment.

CONCLUSIONS

The Miocene tectogenesis processes determined the Carpathian flysch partially uprising over the Moldavian Platform in the east. This phenomenon developed some specific depozones: wedge-top, fore deep, fore bulge and back bulge, during an important interval within the Sarmatian (Upper Buglovian-Upper Basarabian).

These depozones influenced throughout the paleomedial features the evolution of some macrofauna associations, similar in their taxa content, yet with some distinct morphological characteristic.

From Upper Basarabian the mentioned depozones ceased their evolution and the northern part of the Moldavian Platform became firm land. The waters of the sedimentary basin withdrawn towards south and the lithofacial differences are minor.

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PLATES

Plate I - The characteristic association of the pelitic facies from the Lower Sarmatian

Figure 1 – Inaequicostata inopinata Grisch (x2.5).
Figures 2, 3 – Abra reflexa (Eichw.) (x2).
Figure 4 – Obsoletiforma lithopolica Dub. (x2).
Figure 5 – Inaequicostata pia Zhizh. (x2).
Figure 6 – Obsoletiforma planicostata Atanasiu et Mac (x2).
Figure 7 – Obsoletiforma ringeiseni Jek. (x4).
Figure 8 – Obsoletiforma obsoleta Eichw. (x2.5).
Figures 9, 10, 11, 12 – Inaequicostata gleichenbergense Papp (x2.5).
Figure 13 – Ervilia podolica Eichw. (x3).
Figure 14, 15 – Mactra eichwaldi Lask. (x2.5).

Plate II - The characteristic association of the Cryptomactra lithofacies

Figures 1, 2, 3, 4 – Cryptomactra pesanseris (May) (x2).
Figure 5 – Mactra podolica podolica Eichw. (x2.5).
Figure 6 – Mactra podolica ovata Ionesi (x2).
Figure 7 – Mactra vitaliana d’Orb (x1).
Figure 8 – Tapes gregarius Partsch (x2).
Figure 9 – Solen subfragilis Eichw. (x1).
Figure 10 – Musculus sarmaticus (Gal) (x2).
Figure 11 – Obsoletiforma sarmatica Barbot (x2).
Figure 12 – Obsoletiforma kolesnikovi Davit (x2).
Figures 13, 14 – Obsoletiforma barboli (Hoern) (x2).
Figure 15 – Plicatiforma filtoni d’Orb (x2).