THE SIGNIFICANCE OF SOME SARMATIAN FAUNAS FROM THE SOUTHWESTERN PART OF THE PADUREA CRAILUI MOUNTAINS (ROMANIA)

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Abstract. The recently identified Sarmatian deposits from the south-western part of the Padurea Craiului Mountains contain some very interesting and diverse micro- and macrofossil assemblages. The good preservation and typical patterns of the taxa enable interpretation of their biostratigraphy, paleoenvironment, and their paleogeographic affinity. The Early Sarmatian age of the deposits was established on the basis of the fossil foraminifera, gastropods and ostracods. The fossil assemblages are typical for a marginal shallow water paleoenvironment, with particular values of high salinity, probably extended over large areas on the border of the rising Apuseni Mountains.

Keywords: foraminifera, ostracods, gastropods, Sarmatian, Padurea Craiului Mountains, paleoecology, paleogeography

INTRODUCTION

In the southwestern part of the Padurea Craiului Mountains (Fig. 1), the Vida Valley crosses over a territory with Lower Cretaceous and Jurassic deposits. Some patches of Quaternary deposits occur on the right side of the valley, (Bordea, 1986).

Exploratory drilling carried out recently on the Quaternary deposits, intercepted an unexpected sequence consisting of fine and coarse Sarmatian deposits unconformably laid over the Lower Cretaceous limestones.

A rich micro- and macrofauna was preserved in the fine grained deposits. The particular aspects of the faunas are important mainly from a stratigraphic, paleoecologic and paleogeographic point of view.

Some preliminary findings on the mentioned faunas were published by Popa et al. (1999). Similar assemblages were previously referred to by Rado (1972), Nicorici & Istoescu (1970) and Nicolici (1971) from the Beiș and Borod basins.

Figure 1 - Location of the studied area

MATERIAL AND METHODS

The fossil material, provided by Dr. I. Cociuba, was collected from the well Site no. 20 (Transgex S.A. Cluj). The core samples were processed by standard methods, by immersion in water and sieving the disaggregated sediment on a 63-μm mesh. The fossil fauna was picked from the entire >63-μm residue and the specimens were photographed using a SEM microscope (microfauna) and a stereo microscope (macrofauna) at Babeș-Bolyai University.

BIOSTRATIGRAPHY

The foraminifera are very typical for the Sarmatian deposits. The prevailing specimens are the miliolids, *Ephidium* and *Ammonia*.

Based on the composition of the foraminiferal assemblage and the presence of *Varidentella* spp., *Ephidium aculeatum* and *Ephidium reginum*, we confidently assigned on Early Sarmatian age (Middle to Late Volhynian) to the upper sequence (from 2 to 29 m) recovered in the hole. The reference stratigraphic scale is presented in Fig. 2.

Few taxa have a wider stratigraphic range. This could be a clue for a possible reworking or unexpected values of salinity (Plate I, II).

By analyzing the stratigraphic distribution of the gastropod species, we determined that most of them are mentioned only in the Lower Sarmatian deposits ("Mohrensternia beds" of Papp, 1954) of the Central Paratethys. Only very few taxa, such as *Acteocina lajonkaireana lajonkaireana* (BASTEROT), *Hadraniaca coelata* (DUJARDIN), *Hydrobia frauenfeldi* HÖRNE and *Theodoxus pictus pictus* (FERRUSAC) were also mentioned from the Badenian deposits of the Central Paratethys.

The stratigraphic significance of the ostracod assemblages is also very clear, the species (especially *Aurilia*) representing the Lower Sarmatian biozone B of Jiřiček (1972).

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PALEOECOLOGY


The above mentioned assemblage can be associated with a morphogroup living in a marginal marine environment. It is well known that the forms with imperforate porcelaneous wall, hosting chlorophycean symbionts, have higher nutritional requirements and need higher light levels. The dominance of such forms in our assemblages suggest shallow environment conditions, probably between 0-15 m or slightly more.

The majority of the specimens were epifaunal and mainly epiphytic, the abundance of the vegetal material being also noticed in the washed residue. The porcelaneous taxa were mainly herbivore, free or clinging on vegetation. The keeled forms of *Elphidium* were, herbivore, epifaunal, free or clinging on vegetation, while the non-keeled forms were free, mainly infaunal, detritivore or herbivore. All the specimens lived on a muddy sand substrate, in temperate – warm conditions.

Traditionally, the Sarmatian environments were considered brackish, but, taking into consideration our faunas, we believe that, during Early Sarmatian, not always the salinity values were situated below normal parameters (32-37‰). The assemblages from the recent brackish marginal environments have no (or a very low) porcelaneous component, except near-marine, and also a high agglutinated content. The presence of euryhaline *Ammonia, Elphidium* and miliolids specimens provide evidence for abnormal values of salinity. The high porcelaneous content and the absence of the agglutinated taxa in our samples could argue for normal to hypersaline environment. Some similarities with certain recent faunas from the hypersaline environments living in the Gulf of Mexico, Carribean lagoons and other regions can be drawn (see Murray, 1991). There are some similar examples even in the fossil record, such as the Paleogene hypersaline marginal environments (Paris Basin, Transylvania, etc.) with miliolids associated with cerithid gastropods.

An evolution of euryhaline Badenian genera can be observed within the ostracod fauna. Beside the occurrence of these genera, which are exclusively marine, the absence of freshwater forms is noteworthy, as these are usually very common in brackish environments. All the taxa in our assemblages are related to shallow waters, rich in aquatic vegetation. Among the identified taxa, *Cytheridea hungarica* (ZALÁNYI) is the last representative of the genus in the Central Paratethyan area. It dissapeared in the Zone B - also equivalent to *Elphidium regium* Zone - Kollmann, 1960; Jirićek, 1974). The other common forms - *Aurila mehesi* (ZALÁNYI), *Aurila merita* (ZALÁNYI), Callistocythere maculata PIETRZENIUK, Graptocythere loorentheyi sarmatica (JIRÍČEK) and Loxoconcha cf. dobrotic STANCHEVA - are the representatives of the genera that resisted environmental changes. These forms generated successful, well-adapted assemblages for the rest of Sarmatian and, subsequently, for
Pannonian and Pontian (the genus Hemicytheria arose at the beginning of Pannonian from the genus Aurlia).

The mollusk assemblage is dominated by more than twenty gastropod taxa. Only very few juvenile cardinals occur in the lower part of the sequence. The genus Mohrensternia prevails: M. angulata (EICHWALD), M. graeensis HILBER, M. hydrobioides HILBER, M. inflata JEKELIUS, M. multicosata (SENEŠ), M. pseudo-samaha FRIEDBERG, M. samaha FRIEDBERG, M. cf. styrlica HILBER. It is quantitatively followed by Pirellina picta picta (DERFRANCE) and other species of Acteocina, Calliostoma, Caspia, Hadriana, Hydrobia, Pseudannicola, Theodoxus and Valvata (Popa et al., 1998). The assemblage was euryhaline, well adapted to a wide range of salinity, living on the same type of muddy sand substrate (Caspia, Pseudannicola, Theodoxus, Valvata) or adhering to the vegetation (Mohrensternia, Pseudannicola, Valvata).

The composition of the fossil assemblages suggests that, following the brackish environments represented by the lower part of Volhynian, normal marine to hypersaline conditions were reinstated during the Late Volhynian. Boda (1974) had already found that although the new brackish foraminifera and mollusk faunas widely spread over the Paratethyan realm at the beginning of Sarmatian, they became extinct later in Sarmatian. Other interesting conclusions were presented by Jambor (1976), based on certain lithological and geochemical aspects. He assumed that, after the significant decrease of salinity at the Badenian / Sarmatian boundary, which produced the extinction of marine Badenian faunas, an important increase of salinity occurred (even to hypersaline conditions). This change could not be clearly reflected in the fossil record because the geographical isolation made impossible the large scale repopulation of the Paratethyan basins by the typical open marine taxa. The same author considered that the next essential decrease of salinity occurred only during Pannonian.

CONCLUSIONS

The occurrence of lower Sarmatian deposits in this part of the Pádurea Craiului Massif suggests at least the existence of some gulfs extending further east over the rising mountains during Sarmatian. A likely scenario is that the Sarmatian sea covered significant areas in the western part of the Pádurea Craiului, joining the Borod and the Beiuș basins together and probably other areas towards east. This idea was affirmed by Nicolici (1988) who considered that the connection between the two basins existed in Vârcriogr area. It is also likely that some of the other quaternary patches scattered over broad areas in the Pádurea Craiului mountains hide older formations, and further studies could provide a clearer image on the paleogeographic evolution of the area.

Although some caution has to be taken when assemblages with different ages are compared, taking into account the existing and recent data, we believe that the salinity of the environment during Sarmatian was higher than stated before, at least at certain stratigraphic levels.

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REFERENCES

PLATES

Plate I - Foraminifera from Well no. 20 (scale bar 100μm)

1. Quinqueloculina aff. akneriana D'ORBIGNY; 11m
2-4. Varidentella reussi (BOGDANOWICZ); 14m
5. Varidentella pseudocostata (VENGLINSKI); 14m
6. Varidentella sarmatica (KARRER); 12.5m
7. Varidentella sp.; 12.5m
8. Pseudotriloculina consobrina (D'ORBIGNY); 12.5
9. Quinqueloculina buchiana D'ORBIGNY; 14m
10. Ammonia beccarii LINNÉ; 11m
11. Elphidium aculeatum D'ORBIGNY; 14m
12. Elphidium josephinum (D'ORBIGNY); 11m
13. Caucasina subulata (CUSHMAN & PARKER); 12.5m

Plate II - Foraminifera and ostracods from Well no. 20 (scale bar 100μm)

1. Elphidium flexuosum (D'ORBIGNY); 11m
2-5 Elphidium macellum (FICHTEL & MOLL); 2 - 14m; 3 - 12.5m; 4,5 - 11m
6. Elphidium regium (D'ORBIGNY); 12.5m
7. Elphidium incertum (WILLIAMSON); 11m
8. Elphidium puscharovskii SEROVA; 11m
9. Nonion bogdanowici VOLOSHINOVA; 14m
10. Aurila merita (ZALÁNYI); 12.5m
11. Aurila mehesi (ZALÁNYI); 12.5m
12. 13. Hemicytheria loerentheyi sarmatica Jiříček; 11m
14. Cellistocythere maculata PIETRZENIUK; 11m
15. 16. Cytheridea hungarica (ZALÁNYI); 12.5m
17. Loxoconcha cf. dobroticici STANCHEVA; 12.5m

Plate III - Gastropods from Well no. 20

1. Celliostoma angulatum spirocarinatum (PAPP); 11m, x11
2. Theodoxus pictus pictus (FERRUSAC); 11m, x6
3. Valvata moesiensis JEKELIUS; 14m, x28
4. Valvata soceni wiesenensis PAPP; 11m, x24
5. Hydobia frauenfeldi (HOERNES); 12.5m, x15
6. Hydobia cf. stagnalis (BASTEROT); 12.5m, x10
7. Hydobia saturata FUCHS; 12.5m, x12
8. Pseudamnicola inflata JEKELIUS; 12.5m, x20
9. Pseudamnicola sarmatica JEKELIUS; 12.5m, x14
10. Caspia graciliformis PAPP; 11m, x18
11. Mohrensternia angulata EICHWALD; 12.5m, x8
12. Mohrensternia graecensis HILBER; 14m, x8
13. Mohrensternia inflata ANDRUSOV; 12.5m, x10
14. Mohrensternia hydrobioides HILBER; 11m, x7
15. Mohrensternia multicostata SENEŠ; 12.5, x8
16. Mohrensternia cf. styriaca HILBER; 11m, x13
17. Mohrensternia pseudosarmatica FRIEDBERG; 11m, x18
18. Mohrensternia sarmatica FRIEDBERG; 11m, x14
19. Pirenella picta picta (DEFRANCE); 11m, x2.5
20. Hadriaea coelata (DUJARDIN); 14m, x6
21. Acteocina lajonkaireana lajonkaireana (BASTEROT); 12.5m, x24