THE SHELLY SARMATIAN-BEDS IN THE RÂMNICU SĂRAT BASIN (JITIA DE JOS, VRANCEA COUNTY)

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Abstract. The Sarmatian shell-beds of the Râmnicu Sarat river basin (Carpathian Foredeep) account for significant features that can help decipher the paleoenvironmental conditions in the sedimentation basin. The accummulation of the monotaxic – even monospecific – molluscs valves (*e.g.* extraordinary abundance of the *Mactra caspia*) seem to originate from prolonged conditions of high energy littoral events, like the storm induced currents. The sedimentary structures displayed by the shell beds indicate that the transport and sedimentation of the shelly material took place within a shallow water, littoral environment. The shells/sandy matrix ratio probably expresses the energy level of the transporting currents.

Key words: molluscs, shell-bed, taxonomic composition, sedimentary structures, sedimentation environment, Upper Sarmatian, Carpathian Foredeep

INTRODUCTION

The shell beds or the dense accumulations of fossils result from an interaction of mechanical and biological processes (Boyer *et al*., 2004).

The shell beds exemplify the complete scale of the ecologic changes. They also supply useful information regarding the changes in dominance and abundance of the bivalves over time.

According to their taxonomic composition, the shell beds fall into the following three basic categories:

- monospecific beds, with one single species [over 95%];
- monotaxic beds, with a taxonomic group [over 95%] but with more than one species;
- polytaxic beds, with two or more taxonomic groups (*e.g.* crinoids and gastropodes).

The shell concentrations are generally considered *event beds*, accumulated in the space between the fair weather waves and the base of the storm waves.

To describe the shell beds the following parametres are taken into consideration: condensation, internal lamination, crash, taxonomic composition and diversity.

PALEONTOLOGIC DATA OF THE RÂMNICU SĂRAT BASIN SHELL BEDS

According to the geologic map at the 1: 50 000 scale, the Dumitresti sheet (Andreescu & Ţicleanu, 1976), the Sarmatian deposits in the Râmnicu Sărat Basin, laying East of the Casin-Bisoca, belong to the Lower Volhynian – Basarabian (= the Şipoţelu Beds or the "pelitic complex") and to the Upper Basarabian – Chersonian (the Valea Ciomegii Beds = the "variegated compound" and the Râmnic Beds = the flyshoid series with organogenous limestone interbedding). The Râmnic Beds make up the base of the Milcov Formation which includes the Upper Sarmatian - Romanian – Lower Pleistocene deposits.

The paleontologic content of the Şipoţelu Beds consists of the following: *Mactra eichwaldi, Cryptomactra pseudotelina, Cardium obsoletum, Ervilia dissita, Cryptomactra pes-anseris, Congeria romanica* and *Dorsanum duplicatum*.

In the Upper Basarabian – Chersonian formations there are *Mactra fabreana, M. tapesoides, M. padolica, M. crassicolis, M. bulgarica bisocensis* and *M. bulgarica*.

The shell beds were studied in the argillous and shelly limestone blocks – most of them metric blocks – occuring along the Râmnicu Sărat talweg in the vicinity of the Jitia de Jos village.

On the bedding plane there are quite frequent *Mactra* specimens of varying lengths (Fig. 1) with the nacre layer comparatively well preserved (Plate 1a); others appear as casts. Specimens with undamaged valves, filled either with a rock-matrix (Plate 1c) or with a material distinct from it (Plate 1b).

On the other hand, the *Mactra* specimens disposed on the bedding plane display a positively asymmetric bimodal length distribution (Fig. 2), typical of the fossil populations (Boyer *et al*., 2004).

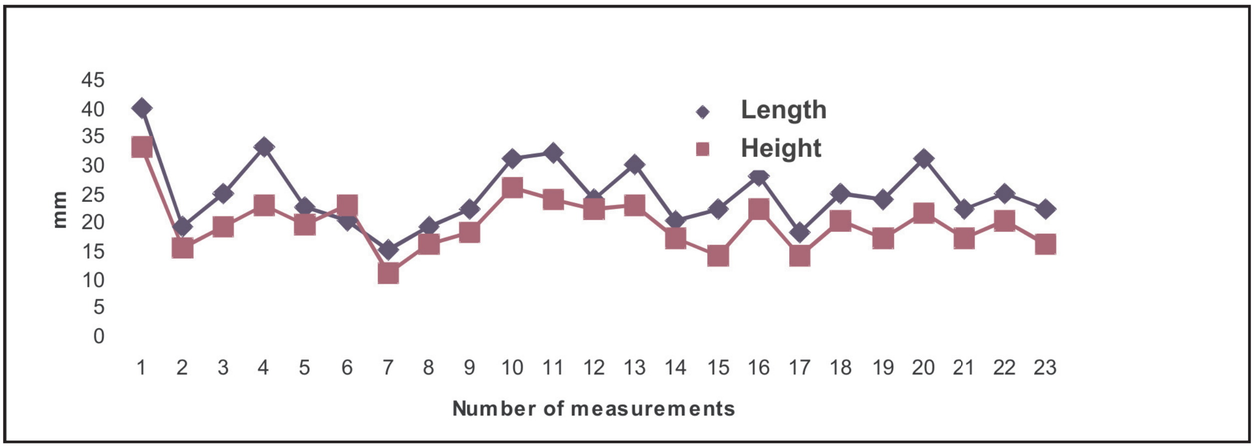


Fig. 1 The diagram of the ratio variation (length and height) for several *?Mactra caspia* (n= 23) specimens

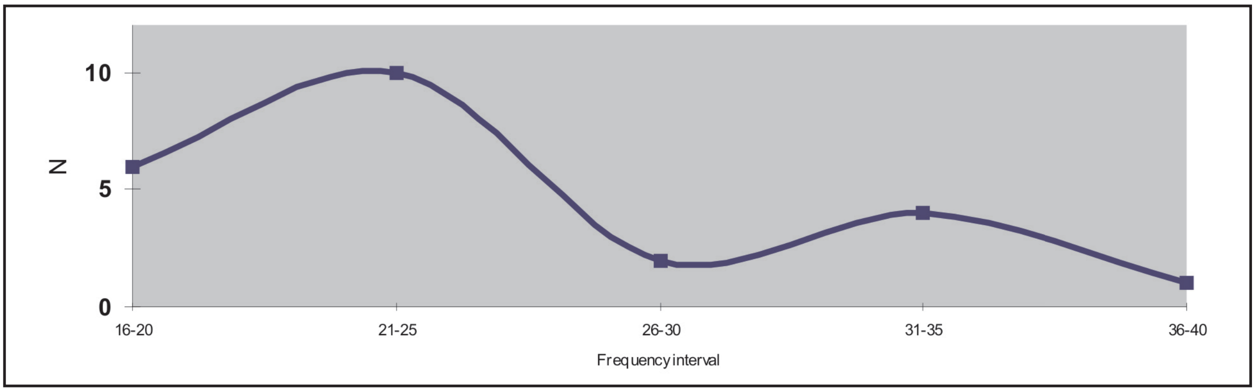


Fig. 2 The positively asymmetric bimodal distribution of the *Mactra* (n= 23) specimens length

The height/length ratio leads to the conclusion that most of the specimens belong to the *Mactra caspia* species; there might also be specimens of the *Mactra bulgarica bisocensis* and, probably, of the *Mactra buzoensis* (Fig. 3).

Although the *Mactra caspia* is dominant, the presence of the other two species turns the shelly beds into a monotaxic bed, with either a lesser condensation degree (Plate 2a, Plate 3a) or a strong or even cemented condensation degree (Plate 2b). The valves are, in most cases, laying concave upwards (Plate 2a, 2c).

The crash degree of the shells is also diverse. Most of the beds contain unarticulated valves with the concavity upwards (Plate 2a, Plate 4b). There are also valves with the concavity downwards, for example, a 14 cm thick shell bed in which the concave-convex- articulated valves ratio is 25%, 71% and 4%, respectively (Fig. 4). For a bed three times thicker than the exemplified one (45 cm; Plate 2a), the concave-convex-articulated valves ratio reaches 13%, 86% and 1%, respectively.

Generally speaking, the crash of the shells differ both from one shell bed to another (Table 2a) and in the same shell bed (Table 2c; Table 3b). Sometimes, the shell detritus form thin sequences which are interbedded between two shelly beds (Table 5b). In some beds, the isolated valves as well as the whole shells of *Mactra* display an isometric fragmentation in a microfissure system generated either by the compaction of the bed or by the tectonic stress. The extreme crash of the shells favoured their dissolution while the remobilization of the solutions lead to the diagenesis of some of the shell beds. Eventually, they turned into real – compact – limestones.

The analysis of a bed which is over 2m thick (2.14 cm, Plate 5a) shows, *grosso modo*, a sequence of no less than 10 shell beds. The first 5 beds at the bottom employ an obvious parallel lamination while the next 5 beds show a convolute lamination. Apart from the more or less evident joints, the first 5 shell beds are made of disarticulate valves,

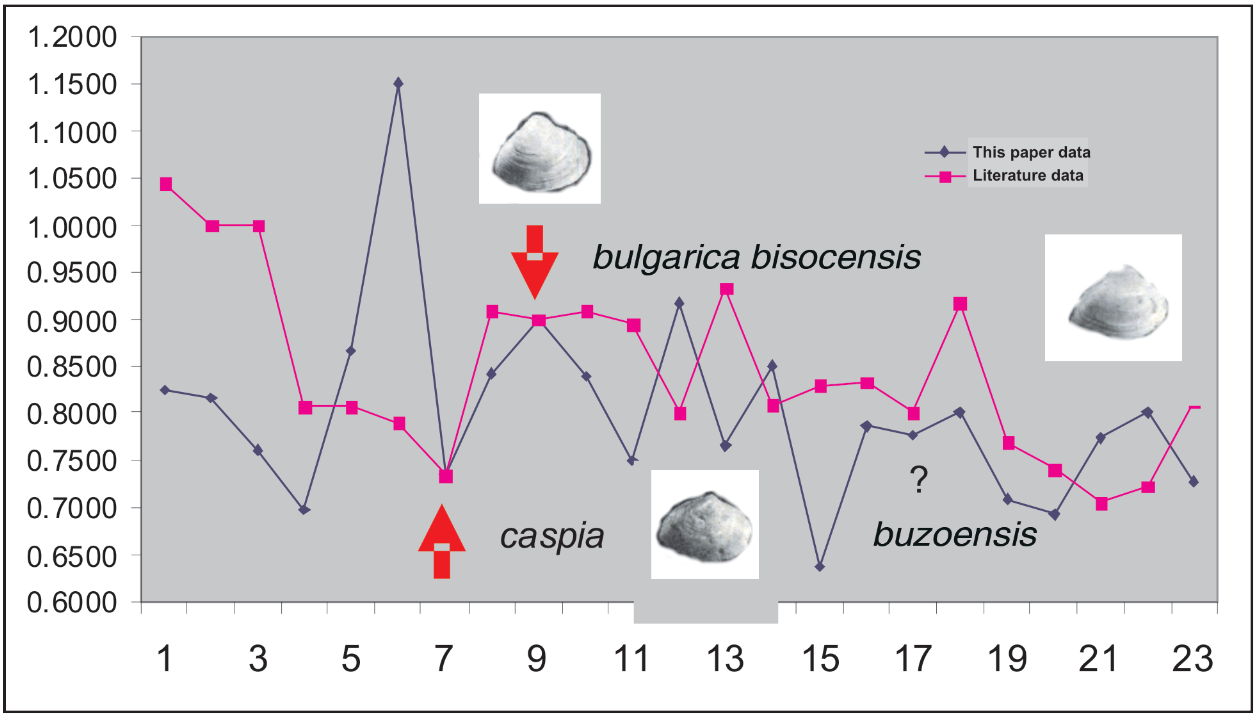


Fig. 3 The diagram of the height/length (h/L) ratio for the *Mactra* specimens at Jitia de Jos village compared to the literature data (Simionescu & Barbu, 1940; Macarovici & Turculeţ, 1973)

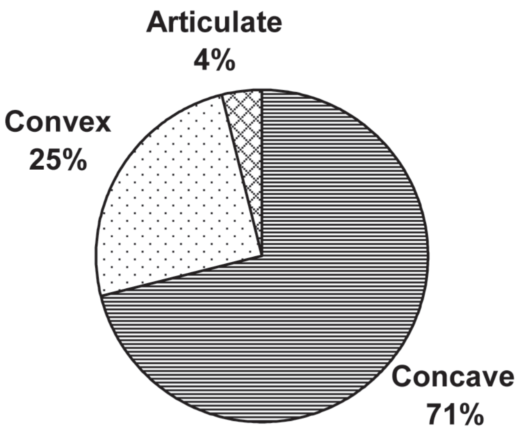


Fig. 4 The relative percent distribution of the valves orientation in a shell bed (*cf.* Table 2c)

most of them with an upward concavity and highly triturated valves.

The upper beds include comparatively numerous articulated valves (Table 5b), along with shell fragments, some of them of very small sizes typical of the convolute lamination. Particularly, the filling of the articulated shells is fine grained material; one of these substances has an obvious gradded bedding (Plate 5b, center down).

SEDIMENTOGENETIC DATA OF THE RÂMNICU SĂRAT BASIN SHELL BEDS

The Late Sarmatian (*s.l.)* shell beds cropping out on the Râmnicu Sărat Valley show sedimentary features which point out their genetic significance.

The medium scale cross lamination displayed by the shell bed in figure 5 underline the current transportation of the shelly material.

PLATE 1

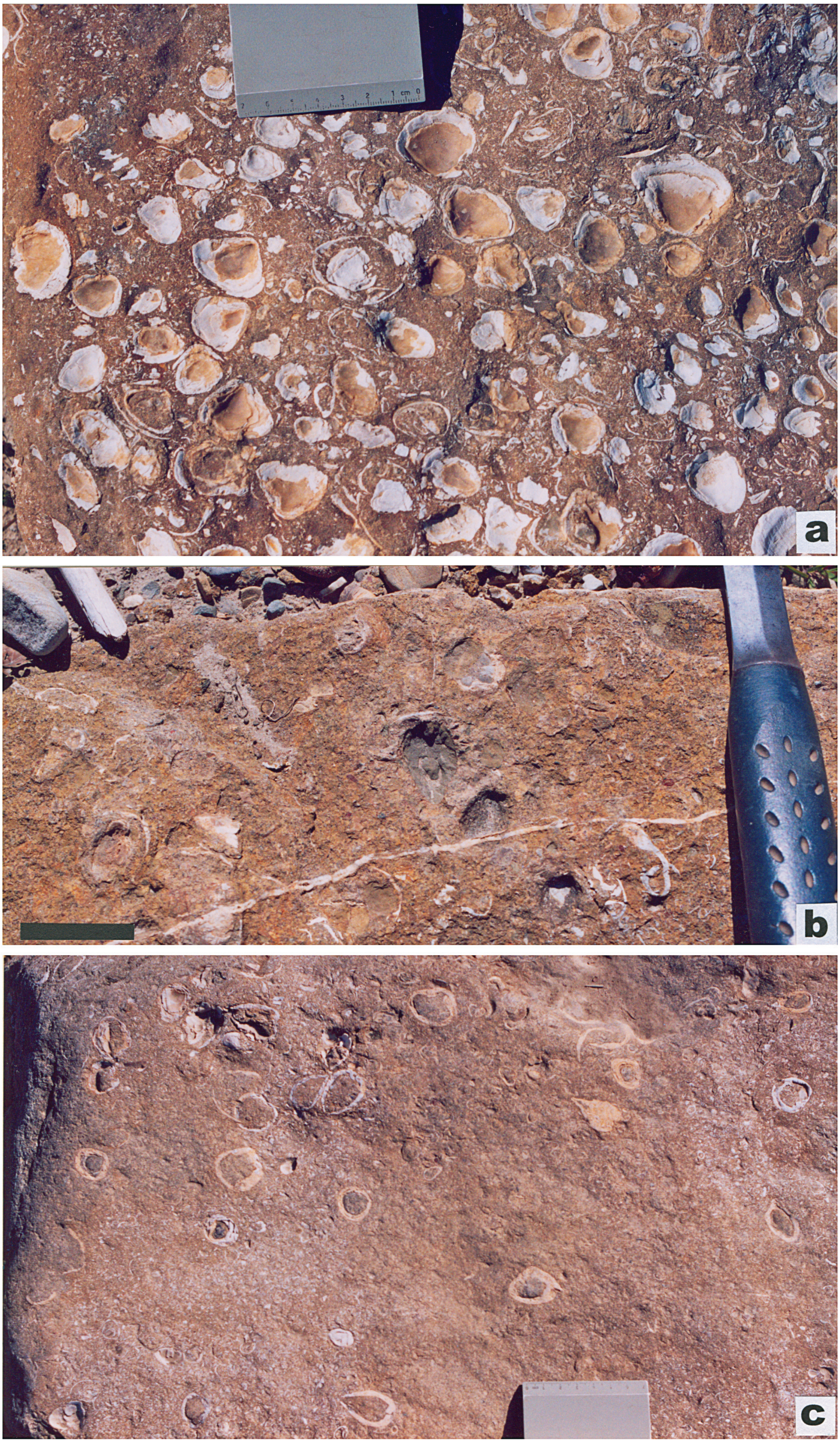


PLATE 2

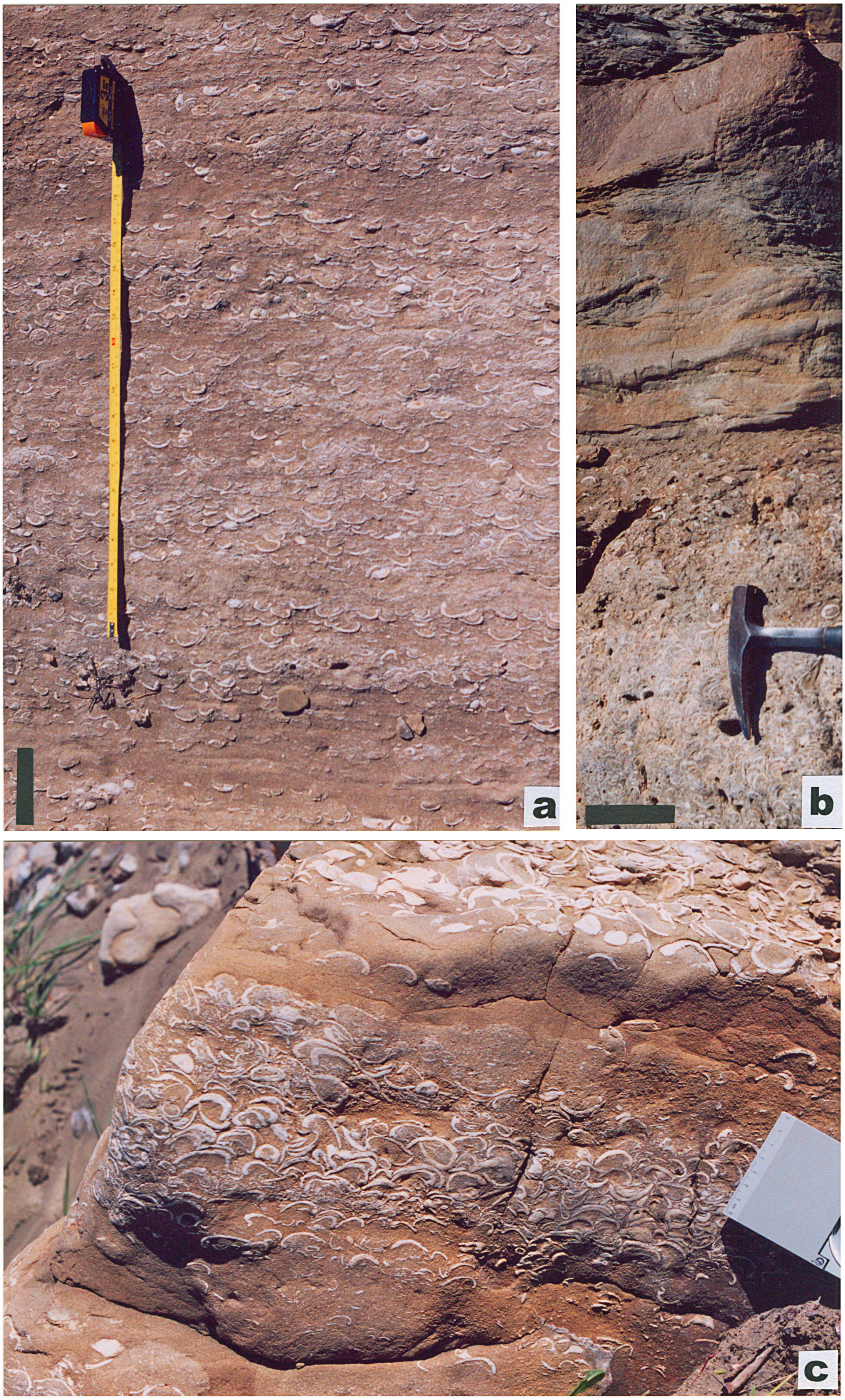


PLATE 3

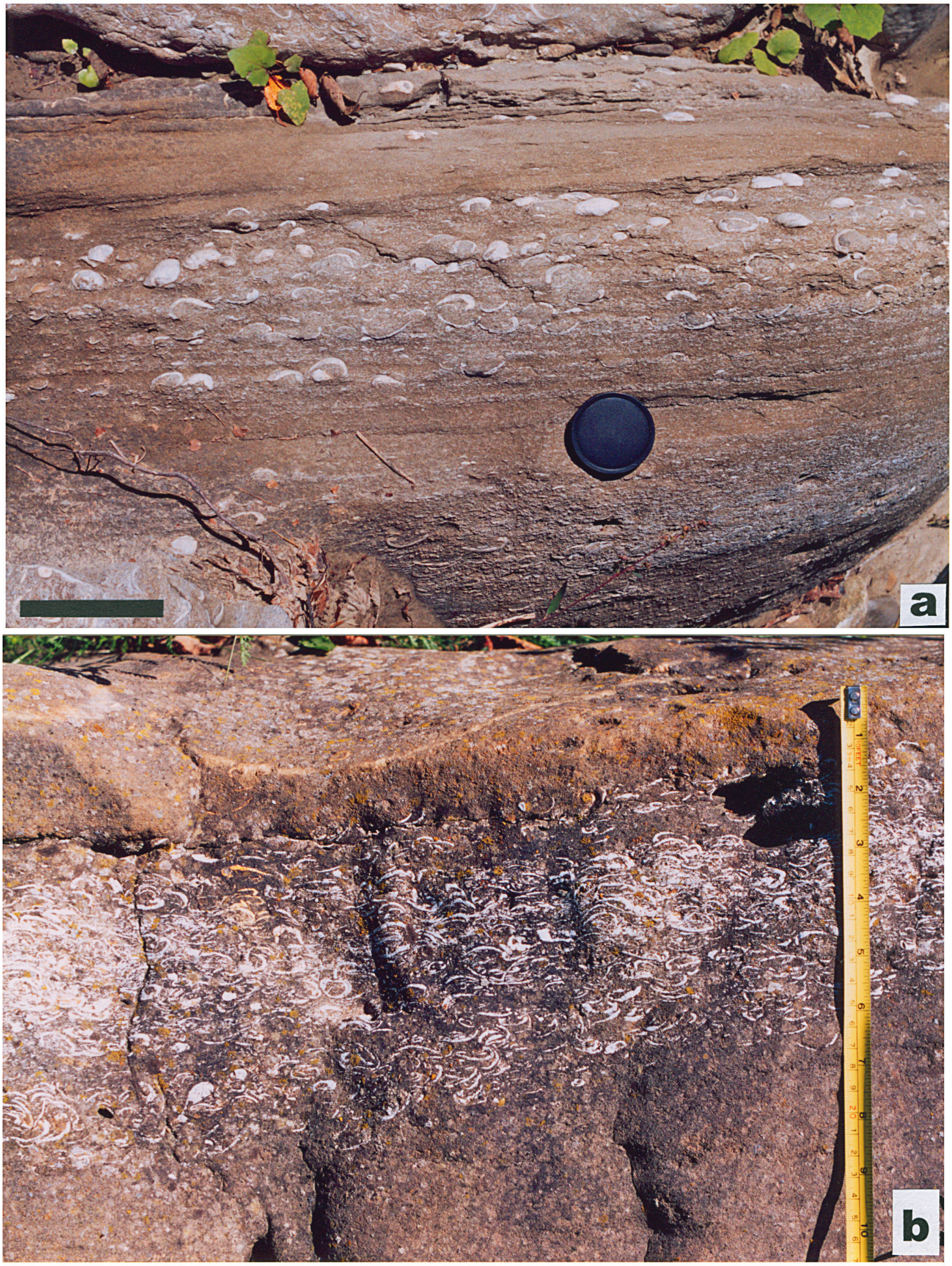


PLATE 4

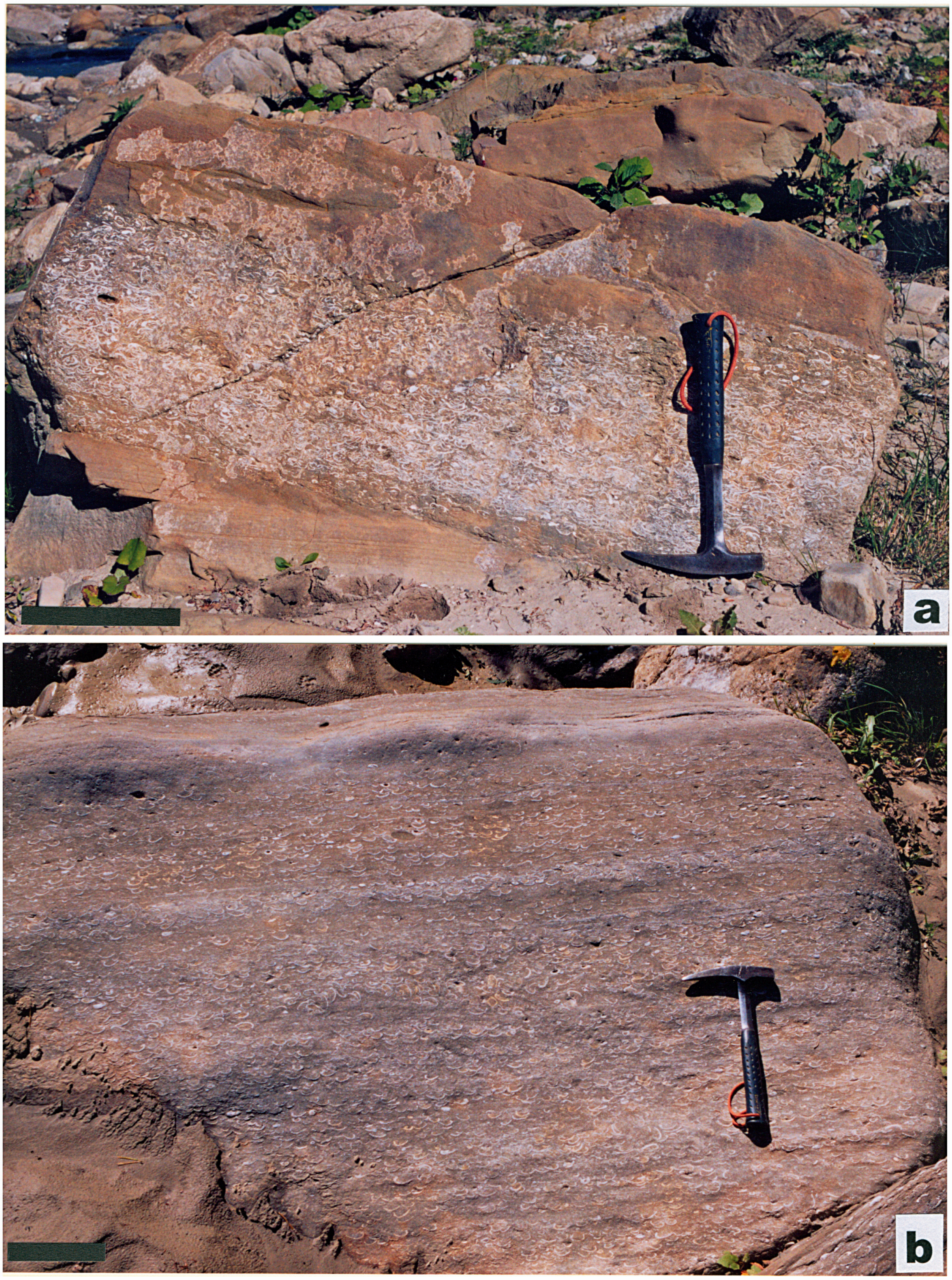
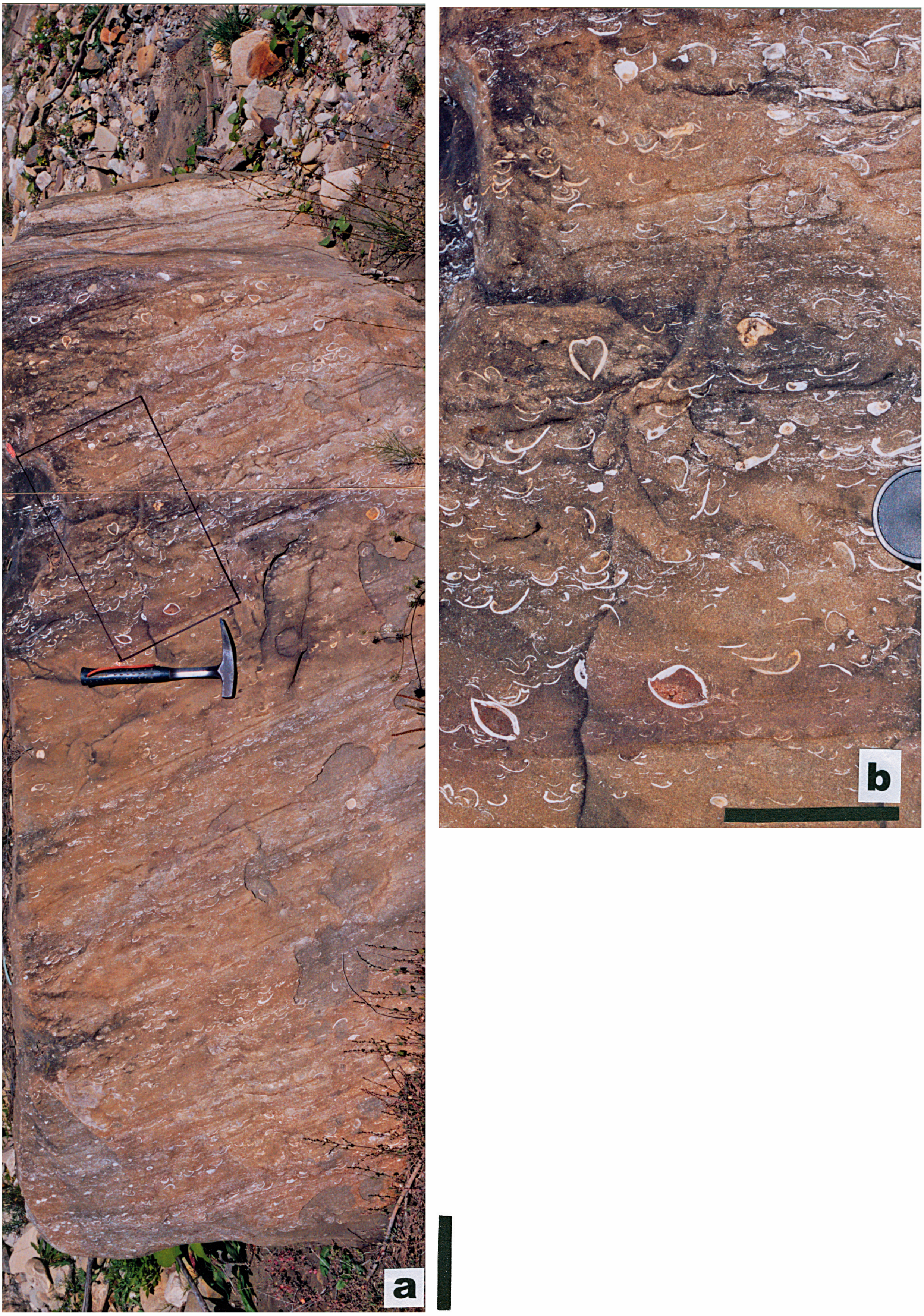


PLATE 5



The current lamination represents only one set, which develops within the whole shell bed. This shows that the shell bed material was carried during only one transport stage. Considering the almost 70 cm thickness of the shell bed (Fig. 5) one can conclude that only a very powerful current, triggered by a sudden energy impulse, could be able to displace the whole amount of sediments with large shells.

Small scale symmetrical, wave ripples occur within the sedimentary sequence with shell beds (Fig. 6). Consequently, the transport and sedimentation of the shelly material took place within a shallow water, littoral environment. The high energy bottom currents with instant motion appear to represent the kind of events initiated by storms into the Late Sarmatian shelly environment. This is also supported by the presence of a possible hummocky lamination structure at the upper part of the shell bed sequence.

The bivalve shells are imbedded within a variable amount of sandy matrix. The shells/sandy matrix ratio probably expresses the energy level of the transporting current. The powerful, highly competent currents carried large amount of shells. Through a grain size sorting process these currents retained a smaller volume of sand within the shelly material (Fig. 7). In this case, the shells have been constrained to stay in the concave down position, that is the stable orientation versus the hydrodynamic stress they were exposed to. Using the same rationale, the dominantly sandy beds with shells (Fig. 8) have been transported by lower energy currents. Under these conditions a significant number of shells were laying with their concavity upward, the current not having the ability to reorient them.

Seldom, among the shelly material occur articulated pairs of shells (Fig. 7). From the sedimentogenetic viewpoint this feature indicate that the shelly material did not experience a long distance transport.

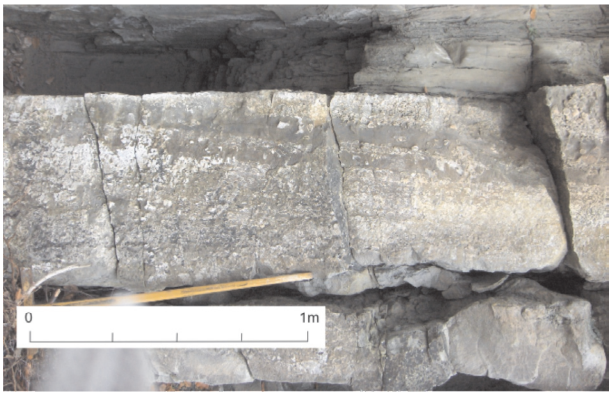


Fig. 5 Shell beds (Late Sarmatian s.l.) with cross lamination. Ramnicu Sarat River, upstream of Jitia de Sus village.

Fig. 6 Symmetrical, wave generated micro-ondulations occurring in the Late Sarmatian (s.l.) sedimentary sequence. Ramnicu Sarat River, upstream of Jitia de Sus village.

Fig. 7 Shell beds (Late Sarmatian s.l.) outcropping on the Ramnicu Sarat River, upstream of Jitia de Sus village. Note the reduced amount of sandy matrix and the exclusive concave down orientation of the shells. A: articulated shells.

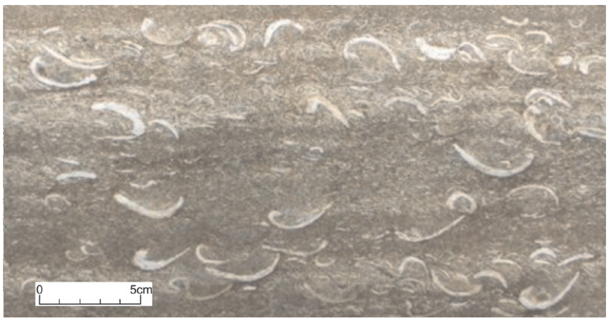


Fig. 8 Late Sarmatian (s.l.) sandstone with bivalve shells. Note the variable orientation (concave up and concave down) of the shells. Block on the Ramnicu Sarat River, Jitia de Sus village.

DISCUSSION AND CONCLUSIONS

The shell beds in the Sarmatian of the Sarmato-Pliocene zone (= the Carpathian Foredeep, *s.str*.) account for significant sedimentological events that can help decipher the paleoenvironmental conditions in the sedimentation basin.

Moreover, taphonomic clues from this kind of rocks can be used to interpret their formation through the accumulation of local or neighbouring bivalve communities of obvious paleoecological significance (Roger, 1974).

Thus, the persistence of the monotaxic - even monospecific –sedimentologic entities (*e.g.* the extraordinary abundance of the *Mactra caspia* specimens) seem to originate from prolonged conditions of stress, like storms, that carried along the coast a significant amount of bivalve shells.

It has been shown (Boucot, 1949 in Lehman, 1969), that the curve of the frequency of the individuals varying with size at the mollusc and brachiopod populations is typical of the way the fossil association takes shape. In this case (Fig. 2), the rate of the curve shows a bimodal distribution with a positive (left) skew. In spite of the small number of measurements it indicates the presence of a paleobiocenosis with *Mactra* carried along for a short distance and accumulated in the shallow shoreline water.

The transport of the *Mactra* shells by the marine currents and by the waves is consistent with the great number of desarticulated shells, most of them concave upwards. The desarticulate shells outnumber the articulate ones. In fact, Boucot (1958, in Lehman 1960) suggests to use this ratio to locate the source(s) of the lamellibranchiate and brachiopode shells.

According to Eagar (1960, in Lehman 1969) there are three kinds of ratios that help in the study of the freshwater lamellibranch: a/ the closure ratio, that is, the number of open shells to the number of closed shells; b/ the articulation ratio, namely the number of articulated to the number of disjoint shells; c/ the orientation ratio, *i.e*., the number of concave upward shells to the number of concave downward shells.

The transport and sedimentation of the shelly material took place within a shallow water, littoral environment. The high energy bottom currents with instant action acting into the Late Sarmatian shelly environment appear to represent the kind of events initiated by storms.

Ultimately, although the above considerations are mostly preliminary, the study of shell accumulations is significant. It can help descipher the paleoecologic and paleoenvironmental conditions that lead to the formation of the sediment deposits very rich in fossils. In that regard, the case of the Upper Sarmatian in the upper basin of Râmnicu Sărat is quite representative.

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