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REMARKS ON THE BIOSTRATIGRAPHY ON THE BUTKOV FORMATION IN THE MANÍN SEQUENCE

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Abstract: In the framework of a biostratigraphical study of the Albian - Cenomanian Butkov Formation attention is paid to the paleobathymetry of its basal part. The oldest planktonic foraminifers *Thalmanninella ticinensis subticinensis* (Gandolfi) appear in these beds. Usually, only the glauconitic moulds of the planktonic foraminifers are preserved; but in places there are also remnants of the original calcareous test. Their presence indicates sedimentation on a shallow-water raised bottom, surrounded by a deeper pelagic environment, precipitation of glauconite and the filling up of foraminifer tests with glauconite immediately after their death.

Key words: biostratigraphy, Albian - Cenomanian, foraminifers, marlstones, glauconite cores, sedimentary conditions.

Introduction

The Butkov marlstones contain abundant glauconite cores of planktonic foraminifers as well as abundant grains of glauconite in the basal part. Remnants of the original calcareous tests are sometimes preserved on the surface of the glauconite cores, mainly in sutures. Whole calcareous tests are preserved rarely.

According to Bé (1977) and Salaj (1985) the species present here are found in the first and partly in the second biological depth zones and require a water column 50 - 60 *m* high for their optimum life-cycle. The fact that immature individuals dominate, especially glauconite cores, whilst adult ones are only occasionally preserved, permits us to consider a shallow-water environment and deposition of planktonic foraminifers on a raised substratum.

The stratigraphic range of the Butkov Formation with detailed microbiostratigraphy was described by one of us (Boorová 1989) and by Began & Salaj (1978), also with evaluation of older data from literature.

Stratigraphical-ecological remarks

Began & Salaj (l.c.), Boorová (l.c.) proved the age of the Butkov Formation (upper part of the Middle Albian up to the lower part of the Middle Cenomanian), by the planktonic foraminifers belonging to the *Thalmanninella ticinensis* to *Th. appenninica* s.l. Salaj & Samuel (1984) Zones. Our investigation of the basal parts of this formation has not confirmed the presence of the Upper Cenomanian index form *Rotalipora cushmani cushmani* (Morrow) indicated by Samuel (in Rakús 1977) at this locality.

The presence of glauconite was established in the Butkov marlstones, and verified by X-ray curve (X-ray analysis was carried out by Mr. Gavenda). Glauconite is found in grains and the fillings of foraminifer tests, gradually decreasing and then disappearing completely towards the top. It is most abundant in close contact with the hard-ground or at the very base of the Butkov Formation, where essentially almost the whole association of planktonic foraminifers and benthic calcareous foraminifers is represented by glauconite cores (Pl. I, Figs. 1, 2 and 4 - 9; Pl. II, Figs. 1 - 3). The calcareous tests of foraminifers were mostly dissolved during diagenesis. The fact that at the base of this formation perfectly preserved glauconite cores of foraminifers with partly preserved remnants of calcareous test are found, where only occasional specimens have a completely preserved calcareous test (Pl. 1, Fig. 3; Pl. II, Figs. 4 - 7), permits us to draw the following conclusions.

The Butkov Formation is underlain by organodetrital cherty, in the uppermost part also by glauconitic, shallow-water limestones. Their age was proved by Borza (1980) as Lower Albian. They contain orbitolinas (*Paracoskinolina sunnilandensis* (Maync) determined by Gašparíková & Salaj (1984) and also planktonic foraminifers, especially of the species *Ticinella roberti* (Gandolfi). We conclude that before the onset of sedimentation of the Butkov marlstones there was a partial deepening of the sedimentary environment by collapse. However, this deepening probably did not reach more than 50 - 60 *m*. This also confirmed by the fact that apart from hedbergellas, immature individuals of the genus *Thalmanninella* Sigal dominate among the planktonic foraminifers. There are foraminifers of the first and second biological depth zones, which, as already mentioned in the introduction, had no suitable conditions for their optimum development. It is most probable that sedimentation set on raised bottom in an open pelagic environment, or in pelagic environment of the outer external platform, which was of shallow-water character. This is confirmed by the enourmous amount of glauconite as well as by the glauconite fillings of the tests of planktonic and calcareous benthic foraminifers. As a result of the formation of glauconite in this shallow-water environment and the presence of colloidal solutions, the tests of foraminifers were filled with glauconite, precipitating from the

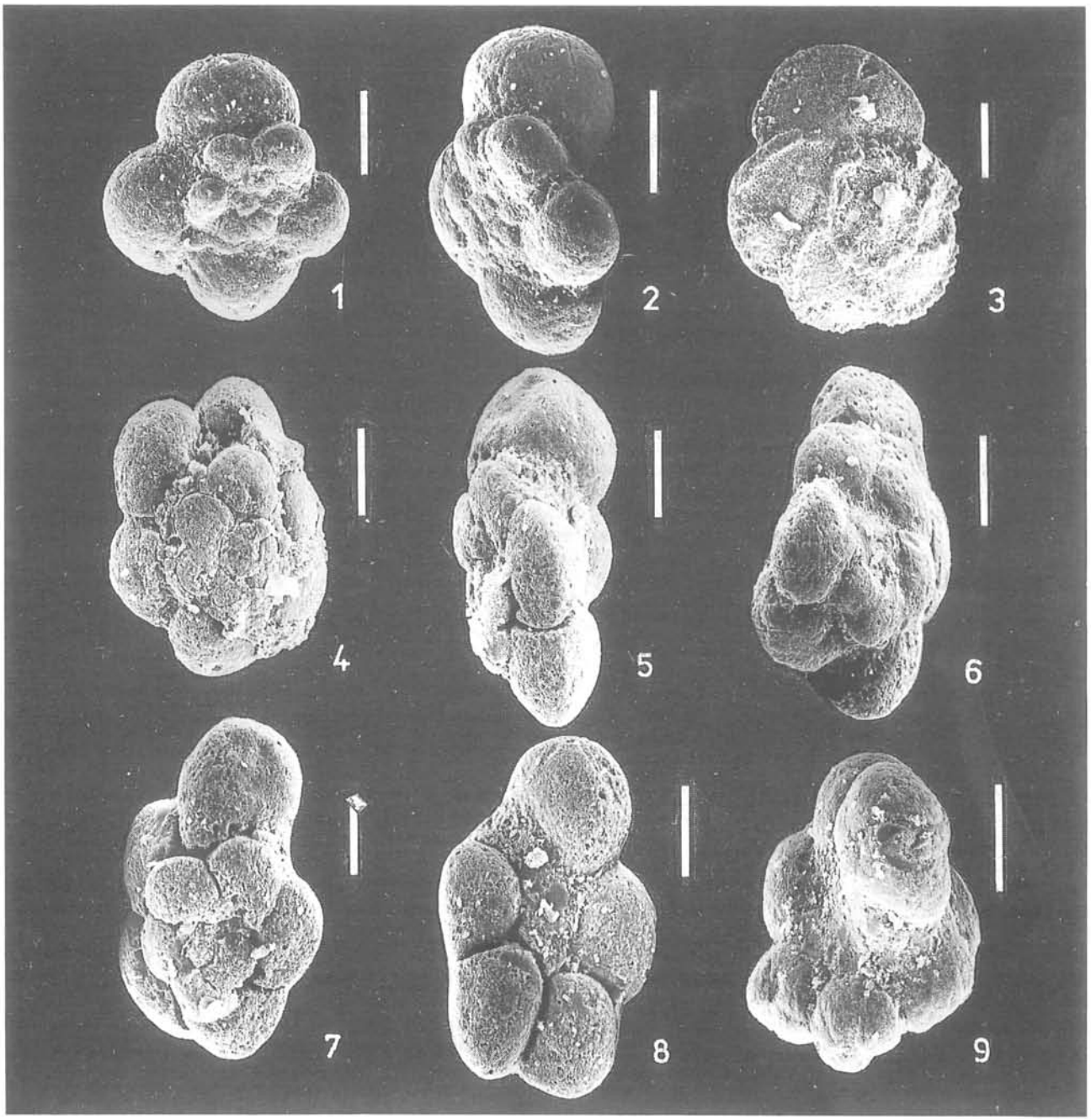

Plate I: Figs. 1, 2 - *Hedbergella delrioensis* (Carsey) 1-110x; 2-135x. Sample No. 17, Ladce - quarry. *Thalmanninella ticinensis subticinensis* Zone. Glauconite cores. Upper part of the Middle Albian. Fig. 3 - *Thalmanninella ticinensis ticinensis* (Gandolfi) 95x. Sample No. 17, Ladce - quarry. Upper part of the Middle Albian. Figs. 4-9 - *Thalmanninella ticinensis subticinensis* (Gandolfi); Figs. 4-8 - 115x; Fig. 9 - 135x. Sample No. 17, Ladce - quarry. Glauconite cores with remnants of calcareous test. Upper part of the Middle Albian. Scale lines = 100 μm.

colloidal solutions, immediately after they died and sank to the bottom.

After the deposition of the basal part of the Butkov Formation a more distinct deepening took place. Mature individuals are present and there is a decrease in the glauconite cores of foraminifers.

The second alternative possibility is that planktonic foraminifers were carried by upwelling currents from deeper open pelagic environment to shallow raised bottom. At that time, however, planktonic foraminifers were found together from nepionic stages to their greatest dimensions, testifying to forms of various depth zones, concentrated in a shallow-water environment. Even in the case of Ladce it is not unambiguously excluded that a part of this assemblage could be transported here by upwelling currents. However, the planktonic foraminifers present are mainly of small dimensions. They are represented by the species (Pl. I, Figs. 1-9; Pl. II, Figs. 1-3,5,6): *Thalmanninella ticinensis subticinensis* (Gandolfi), which has the dominant position in the lowermost horizon of the Butkov Formation, *Th. ticinensis ticinensis* (Gandolfi), *Planomalina (Planomalina)*

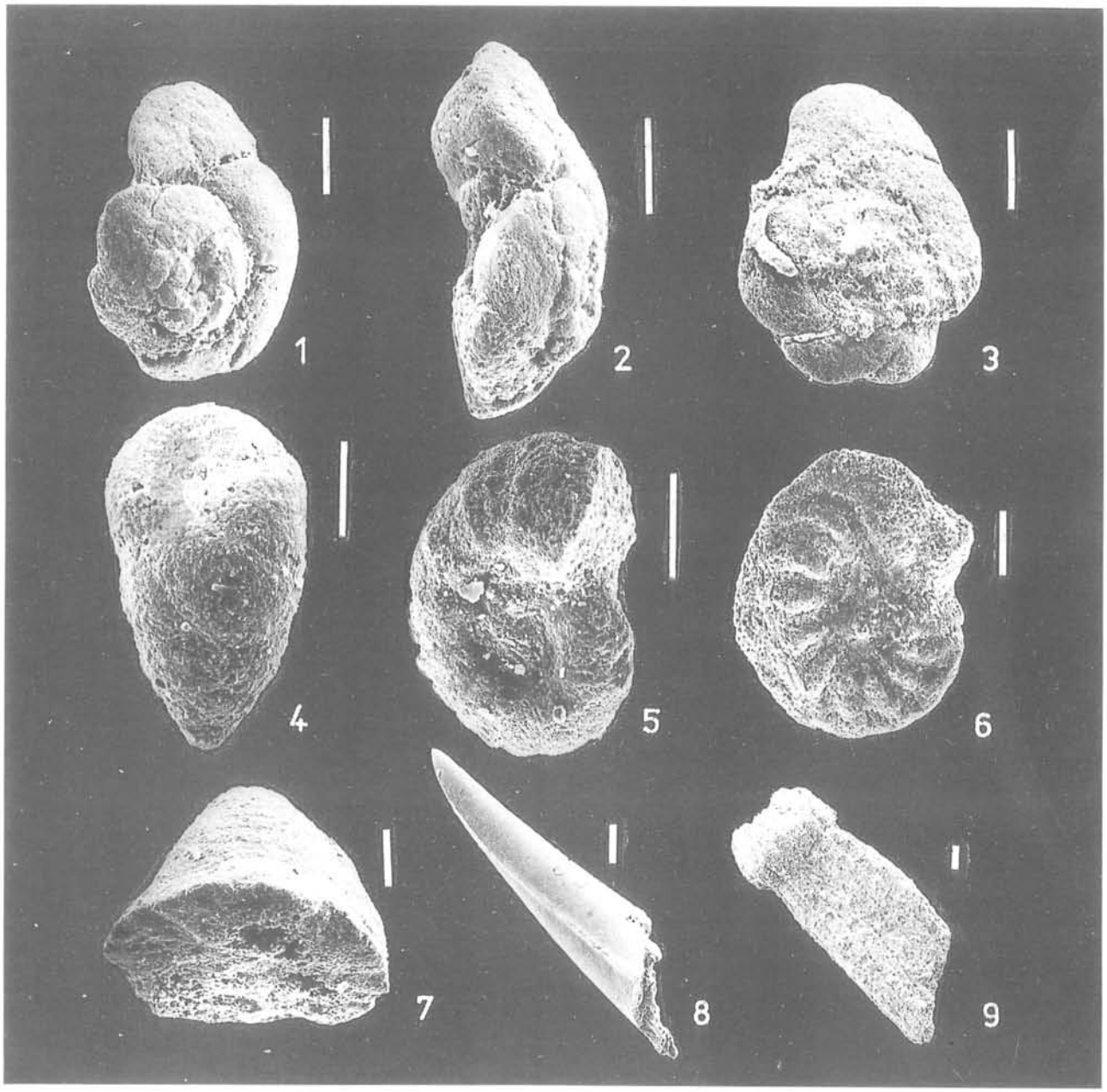

Plate II: Figs. 1-3 - *Thalmanninella ticinensis ticinensis* (Gandolfi) 1-3 - 100x; 2 - 125x. Sample No.17 , Ladce - quarry. *Thalmanninella ticinensis subticinensis* Zone. Glauconite cores with remnants of calcareous test. Upper part of the Middle Albian. Fig. 4 - *Dorothia oxycona* (Reuss) 125x. Sample No. 17, Ladce - quarry. Upper part of the Middle Albian. Fig. 5 - *Anomalina (Gavelinella) complanata* Reuss 125x. Sample No. 17, Ladce - quarry. Upper part of the Middle Albian. Fig. 6 - *Planomalina (Planomalina) buxtorfi* (Gandolfi) 85x. Sample No. 17 , Ladce - quarry. Upper part of the Middle Albian. Fig. 7 - *Dorothia trochus* (d'Orbigny) 75x. Sample No. 17, Ladce - quarry. Upper part of the Middle Albian. Fig. 8 - fish tooth 50x. Sample No. 17, Ladce - quarry. Fig. 9 - echinoid spine 50 x. Sample No. 17, Ladce - quarry. Scale lines = 100 *m*.

buxtorfi (Gandolfi), *Anomalina (Gavelinella) complanata* Reuss, *Hedbergella delrioensis* (Carsey), *H. globigerinellinoides* (Subbotina). Adult individuals are rarely present here. However, they are more abundant higher up, when the environment deepened. This is indicated by the presence of all types of planktonic foraminifers, of various dimensions, corresponding to their living conditions and extension in various depth zones as well as by a gradual decrease in glauconite. In addition, the assemblage of planktonic foraminifers includes the calcareous benthic foraminifers *Dorothia oxycona* (Reuss) and *D. trochus* (d'Orbigny) as well echinoid spines and fish teeth (Pl. II, Figs. 4, 7-9).

Conclusion

The presence of planktonic (hedbergellas, immature specimens of the genus *Thalmanninella Sigal*) as well as benthic foraminifers, echinoid spines, fish teeth and abundant glauconite (usually forming the filling of foraminifer tests) testify to a shallow-water, but pelagic environment (raised bottom), of the basal part of the Butkov Formation, representing the first and partly the second biological depth zone.

Sedimentation of the Butkov marlstones set in shallow-water pelagic environment, the appearance of mature planktonic fo-

raminifers, together with a decline in benthic foraminifers and glauconite, indicate a subsequent gradual deepening of the sedimentary environment. The individuals, represented by larger or conical forms, appear only when depth conditions normal for life are renewed. For complete development of the normal life cycle of the Albian planktonic foraminifers described, from small to large forms, a normal living environment is necessary, associated with a depth of at least 100 to 1500 *m*.

The stratigraphic range of the Butkov Formation extends from the upper part of the Middle Albian to the lower part of the Middle Cenomanian. We stress that in the Butkov Formation no representatives of the subspecies *Rotalipora cushmani cushmani* (Morrow) have been found, which would admit a Late Cenomanian age of this formation.

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