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SUPPLEMENTS TO THE PROPOSED STRATOTYPE ALBIAN-CENOMANIAN BOUNDARY (Dj. FGUIRA SALAH, TUNISIA)

(1 Fig., 2 Pls.)

Abstract: Documentation of rich finds of the species *Neostlingoceras carcitanense* (MATHERON) from the Cenomanian base at the localities Dj. Fguira Salah and Dj. Ech Chama in the area between the towns El Fahs and Zaghouan. These occurrences fully justify to situate the proposed stratotype locality of the Albian–Cenomanian boundary at the Cenomanian hypostratotype base defined at the first from the localities mentioned (El Fahs, 50 km SSW of Tunis). Paleogeographically both localities belong to the eastern part of the Tunisian trough.

Резюме: В статье приводится документация богатых находок вида *Neostlingoceras carcitanense* (MATHERON) из базы сеномана на местонахождениях Дж. Фрига Салах и Дж. Эх Хама в области между городами Эл Фахс и Загуан. Эти находки позволяют отнести предлагаемое местонахождение стратотипа границы альб-сеноман к сеноманской базе гипостратотипа определенной в первый раз на изучаемых местонахождениях (Эл Фахс, 50 км ЮЮЗ Туниса). Палеогеографически обе местонахождения принадлежат к восточной части Тунисского трога.

Introduction

The profiles most suitable to establishing of the stratotype Albian–Cenomanian boundary are in Algeria and Tunisia (Birkelund et al., 1984, p. 10) where at the Cenomanian base *Hypoturrilites schneegansi* Zone was established by Dubordieu (1956). From several of these profiles from the viewpoint of foraminifer microbiostratigraphy they were studied first by Sigal (1948, 1952). Regarding to that, as pointed out (Hancock 1984, p. 125) *Hypoturrilites schneegansi* DUBORDIEU is a synonym of the species *Neostlingoceras carcitanense* (MATHERON), the index species of the basal Cenomanian zone of Northern Europe of equal name. The finds of this species were proved by Hancock (1984, p. 126) at the N slope of Djebel Hameïa (Mts. Mellègue, 50 km SW of El Kef) and at the same time by Salaj (1984) at the locality Dj. Fguira Salah where the hypostratotype or neostratotype of the Cenomanian for the Tethys zone was proposed by Salaj (1973, 1974). At this locality not only the reference profiles of the Albian–Turonian investigated in detail by Salaj – Bellier (1978), but also of the Coniacian, Santonian and Campanian are also situated (Salaj, 1980).

One of the profiles is concerned, extraordinarily rich in Upper Albian and Cenomanian ammonite fauna, studied in detail first by Pervinquière (1903, 1907) and also mentioned by Castany (1951), Jauzein (1967). Regarding to the fact that the species *Neostlingoceras carcitanense* (MATHERON) found by the author in the year 1981 at the locality Dj. Fguira Salah, later in the year 1983 also together with Masters (determined by R. W. Scott) was not figured and as Hancock (1984, p. 126) recommends further investigation in this area, the find of this species is also stressed by its figuring in this work (Pl. 1, Fig. 2).

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Stratigraphy

a) *Profile Djebel Fguira Salah (El Fahs, Tunisia)*

The Cenomanian base at the profile Dj. Fguira Salah is formed by marls, in which are two layers of laminated thin-fissile aleuritic limestones. The opinion of G. Thomel (in Salaj – Bellier, 1978) that the finds of the species *Sciponoceras baculoides* (MANTELL), *Mantelliceras* aff. *coulomi* (D'ORBIGNY) and *Mantelliceras saxbyi* (SHARPE) come from the Cenomanian base is correct as also confirmed by the find of the species *Neostlingoceras carcitanense* (MATHERON) (Pl. 1, Fig. 2). Nearer data about the microfauna from the basal Cenomanian of this locality are mentioned in the work by Salaj – Bellier (1978) and in works by the author from the years 1980 and 1987.

b) *Profile Dj. Ech Chama (Zaghouan, Tunisia)*

For the purpose of solving of the question of the Albian–Cenomanian boundary a further well preserved profile was studied at the locality Dj. Ech Chama, known owing to the works by Pervinquière (1903, 1907); Castany (1951); Bajaník – Biely – Menčík – Salaj – Stránik (1977) and Salaj (1980, p. 70, p. 94).

In the overlier of the Vraconian formed by dark thin-fissile bituminous shales with a rich ammonite fauna of the *Stoliczkaia dispar* Zone marls (28 m) with sporadical thin banks of biomicrite limestones, generally considered as Cenomanian, are found (Castany, 1951; Salaj, 1980).

In the lower part of marls (about 18 m) ammonites have not been found, but on the basis of microfauna we may consider them still as Upper Albian. From the samples taken (samples no Z-94/1987 and Z-95/1987) the following species were found in the association of foraminifers: *Thalmanninella ticinensis* (GANDOLFI), *Thalmanninella balernaensis* GANDOLFI, *Planomalina (Planomalina) buxtorfi* (GANDOLFI) and *Whiteinella gandolfii* GAŠPARIKOVÁ et SALAJ (Pl. 2, Figs. 9, 10).

From older samples equivalent to them (samples Z-269/1969 and Z-270/1969; Salaj, 1980, p. 94) also the species *Thalmanninella brotzeni* SIGAL is mentioned. After revision of this species mentioned from these samples the author quotes more precisely that the species *Thalmanninella balernaensis* GANDOLFI is concerned, in which the last chamber is moderately elongated and so resembles the species *Thalmanninella brotzeni* SIGAL. With this verification competence of this part of marls still to the uppermost Vraconian is fully confirmed, so as it is also at the profile Dj. Fguira Salah.

In the higher part of marls (10 m), in which are also the first layers of thin-fissile aleuritic limestones, a rich fauna of pyritized ammonites is found. From the rich list of macrofauna

Plate 1

Figs. 1–3 – *Neostlingoceras carcitanense* (MATHERON); x 3, 1. Figs. 4, 7 – *Thalmanninella gandolfii* (LUTERBACHER et PREMOLI SILVA); x 50. Figs. 5, 8 – *Thalmanninella balernaensis* GANDOLFI; x 60. Figs. 6, 9 – *Thalmanninella brotzeni* SIGAL: x 70, x 90. Figs. 2, 4–9 – Loc.: Dj Ech Chama (Zaghouan area, Tunisia), sample Z-270i. Base of the Cenomanian. Figs. 3 – Loc.: Dj. Fguira Salah (El Fahs area, Tunisia). Base of the hypostratotype of the Cenomanian.

Figs. 1–3 – photos made by author; Figs. 4–9 – the negatives of which were made by the operator Mr. K. Šebor, were prepared by aid of scanning microscope Stereoscan JSM-U_3 at the Dionýz Štúr Institute of Geology in Bratislava.

Plate 1

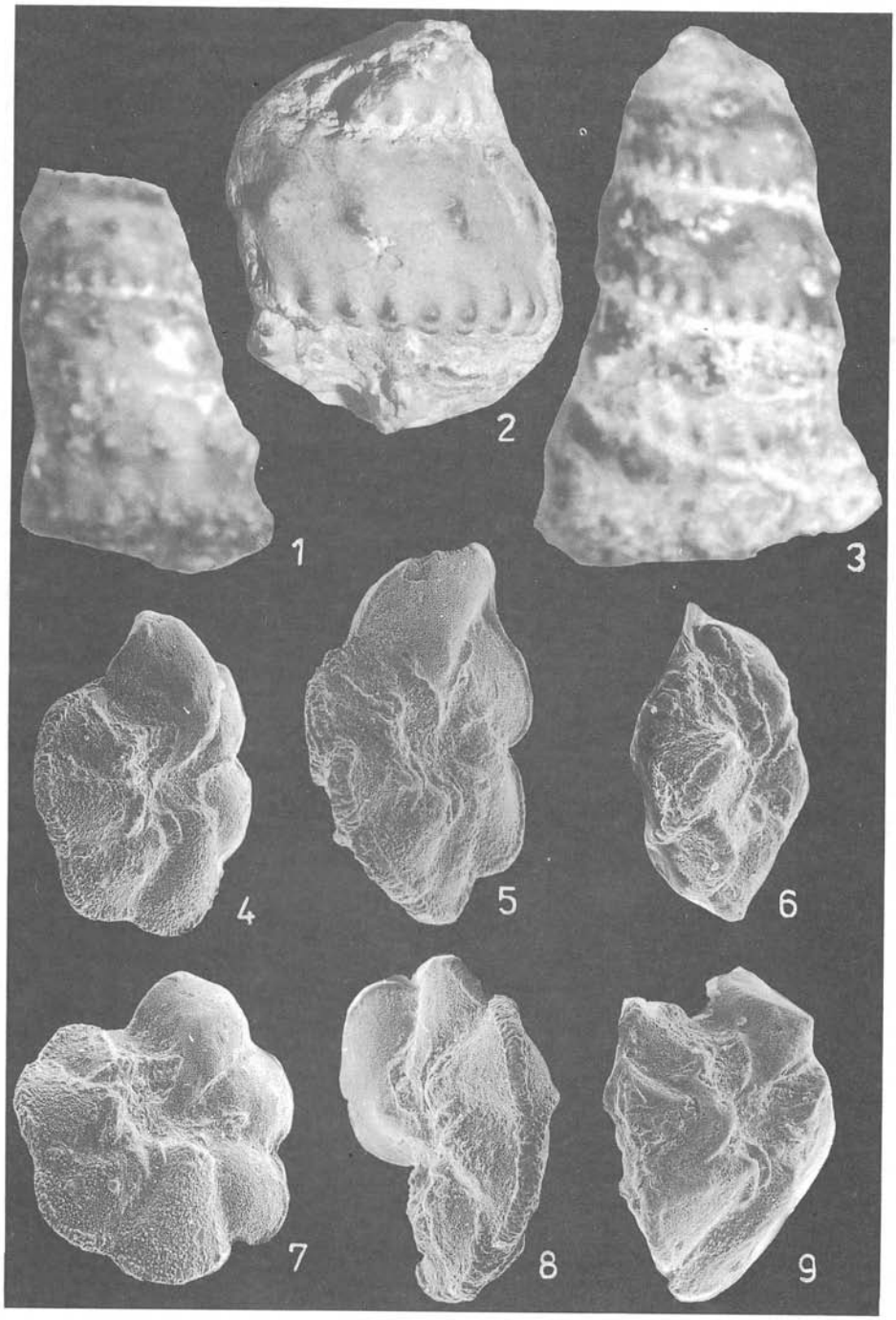
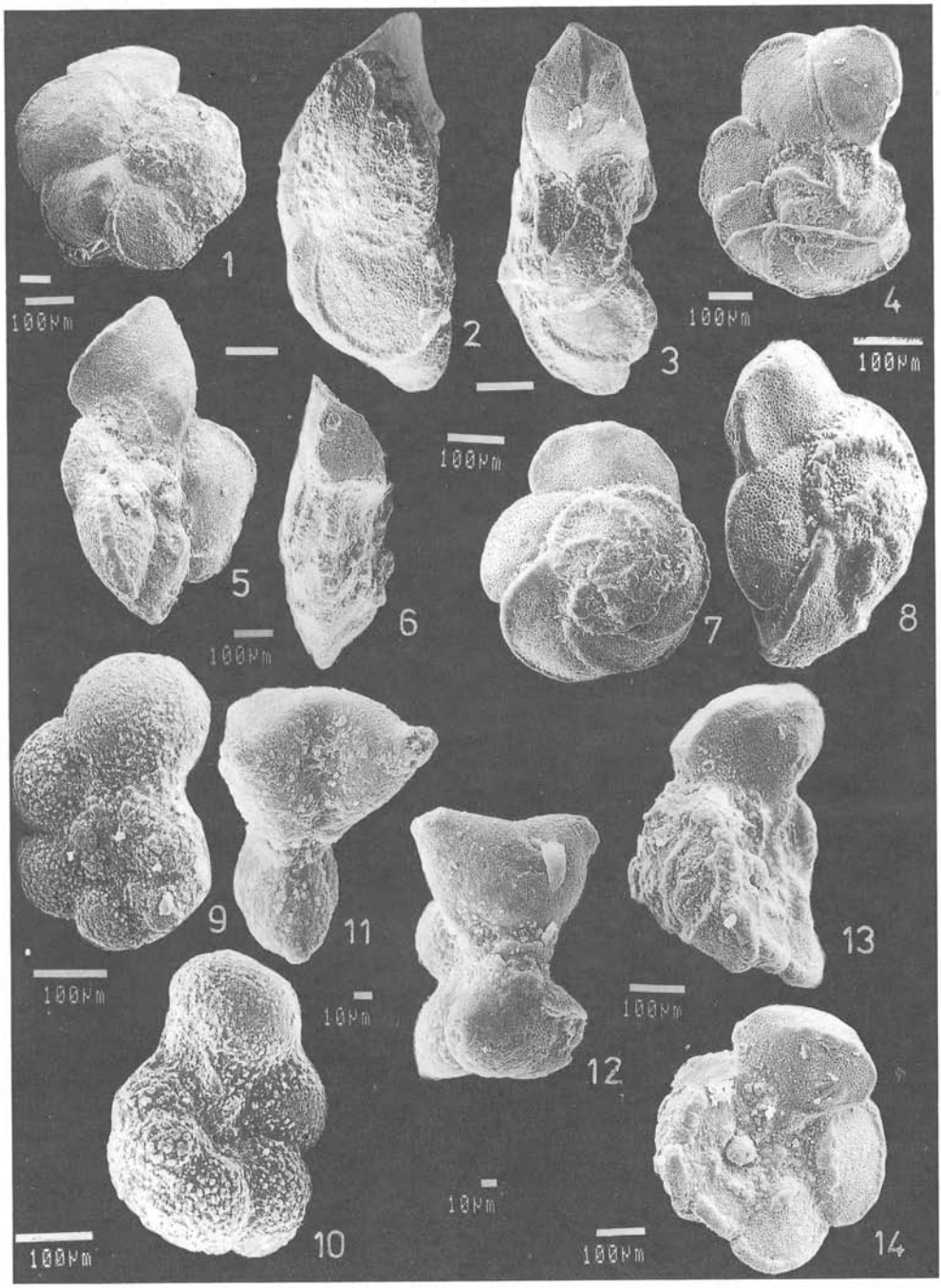


Plate 2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quoted by Castany (1951) from this locality the author found and determined besides the uncommonly abundant species *Neostlingoceras carcitanense* (MATHERON) (Pl. 1, Figs. 1, 3): *Puzosia (Puzosia) octosulcata* (SHARPE), *Mantelliceras saxbii* (SHARPE), *Mantelliceras mantelli* (SOWERBY), *Hyphohoplites falcatus falcatus* (MANTELL), *Idiohamites collignoni* SPATH, *Idiohamites ellipticus* (MANTELL) *radiatus* SPATH, *Mantelliceras ventnorense* DIENER, *Ostlingoceras? gallienii* (BOULE, LEMOINE et THÉVENIN), *Hibolites minimus* LISTER, *Hibolites ultimus* D'ORBIGNY, *Phylloceras tanit* PERVINQUIÈRE, *Lytoceras* div. sp. and *Hemiaster fourneli* DESH.

In the uppermost layer of marls already the species *Mantelliceras dixoni* SPATH, the index species of the IInd zone of the Lower Cenomanian, is present. In the overlier of the described Lower Cenomanian marls is an alternation of grey micrite limestones and marls with layers of thin-fissile aleuritic limestones, which in their lower part still belong to the Lower Cenomanian, as it is confirmed in the area of Dj. Fguira Salah by the find of the species *Ostlingoceras rorayensis* (COLLIGNON) (Salaj, 1987).

It is necessary to mention the also the significant regionally extended horizon of 30 cm thick ochreous limestone with *Kingena wacoensis* (ROEMER), about 10 m from the base of this sequence, is also present in this area.

In the association of foraminifers from samples taken from the basal Cenomanian horizon (samples No. Z-97/1987 and Z-98/1987) with *Neostlingoceras carcitanense* (MATHERON) the following species are found (Pls. 1, 2): *Thalmanninella brotzeni* SIGAL, *Thalmanninella balernaensis* GANDOLFI, *Thalmanninella gandolfii* LUTERBACHER et PREMOLI SILVA, *Thalmanninella appeninica* (RENZ) sensu MARIE (1948) or sensu ROBASZYNSKI et CARON (1979, Pl. 5, Fig. 1a–c only), *Thalmanninella globotruncanoides* SIGAL, *Whiteinella gandolfii* GAŠPARIKOVÁ et SALAJ, *Ticinella multiloculata* (MORROW), *Praeglobotruncana delrioensis* (PLUMMER), *Schackoina cenomana* (SCHACKO), *Schackoina bicornis* REICHEL and *Anomalina (Gavelinella) cenomanica* BROTZEN. Extraordinarily abundant are representatives of the genus *Hebergella* BROENNIMANN et BROWN 1958.

Onset of a rich ammonite fauna and planktonic foraminifer microfauna with distinct diversification of species is connected with obvious deepening in the Tunisian trough and with distinct transgression to the south. A distinct deepening of the sea is testified by relatively large species of the genus *Thalmanninella*. The stage is also arrived that many of them have besides indication to formation of inflated chambers (I. depth zone – bound to surface water distinctly overheated) also indication to formation of conical forms with flat ventral side. They are developed from the individual above mentioned species of the genus *Thalmanninella* and corresponding to the *Thalmanninella* n. sp. These varieties were bound to deeper water, corresponding to the IV. depth zone. It is interesting that another species from the same depth

Plate 2

Figs. 1, 5 – *Thalmanninella brotzeni* SIGAL – conical forms, x 40, x 60. Figs. 2, 6 – *Thalmanninella gandolfii* (LUTERBACHER et PREMOLI SILVA) – conical forms, x 65, x 50. Figs. 3, 4 – *Thalmanninella balernaensis* (GANDOLFI); x 70, x 55. Figs. 7, 8 – *Thalmanninella brotzeni* SIGAL; x 70, x 85. Figs. 9, 10 – *Whiteinella gandolfii* GAŠPARIKOVÁ et SALAJ; x 90, x 95. Fig. 11 – *Schackoina cenomana cenomana* (SCHACKO); x 250. Fig. 12 – *Schackoina cenomana bicornis* (REICHEL); x 200. Figs. 13, 14 – *Thalmanninella ticinensis* (GANDOLFI) n. subsp. – conical form; x 70, x 60.
Figs. 1–14 – Loc.: Dj. Ech Chama, sample No. Z-98/1987, basal Cenomanian marls with *Neostlingoceras carcitanense* (MATHERON), Tunisia.

zone *Thalmanninella deeckei* (FRANKE) with distinctly elongated chambers on the ventral side – appears first in the uppermost layers of the Lower Cenomanian marls only.

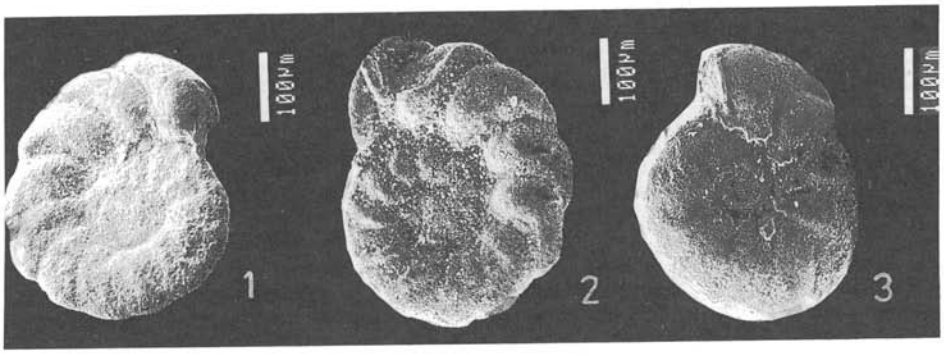

Fig. 1. *Anomalina (Gavelinella) cenomana* (BROTZEN). Magn. x 85, x 80, x 80. Loc.: Z-98, Dj. Ech Chama, Cenomanian marls.

Conclusion

It is necessary to remark that we have not recorded such a distinct diversification of species, connected with K-selection already in the lowemost Cenomanian, proved in the area of Zaghouan, in the area of Djebel Fguira Salah, neither in other areas of Tunisia, even nor in the West Carpathians. Obviously in future it will be necessary to pay attention to this problem.

In connection with biostratigraphical investigation in the West Carpathians it is necessary to say that the Albian–Cenomanian boundary was established only on the basis of planktonic foraminifers as no ammonite fauna has been found in the Lower Cenomanian of the West Carpathians so far. Its establishing on the basis of appearance of the species *Thalmaninnella brotzeni* SIGAL and *Schackoina cenomana* (SCHACKO) (Salaj – Samuel, 1984) is in agreement with the above mentioned knowledge from Tunisia.

Translated by J. Pevný

REFERENCES

BAJANÍK, Š. – BIELY, A. – MENČÍK, E. – SALAJ, J. – STRÁNÍK, Z., 1977: Carte géologique de la Tunisie à 1/50 000, feuille no 35, Dj. Zaghouan et notice explicative. *Ed. Serv. Géol. Tunisie* (Tunis), pp. 1–70.

BIRKELUND, T. – HANCOCK, J. ,. – HART, M. B. – RAWSON, P. F. – REMANE, J. – ROBASZYNSKI, F. – SCHMID, F. – SURLYK, F., 1984: Cretaceous stage boundaries – Proposals. *Bull. Geol. Soc. Denmark* (Copenhagen), 33 (1–2), pp. 3–20.

CASTANY, G., 1951: Etude géologique de l'Atlas tunisien oriental. *Ann. Mines et Géol.* (Tunis), 8, pp. 1–632.

DUBORDIEU, G., 1956: Étude géologique de la région de l'Ouenza (confins algéro-tunisiens). *Publ. Serv. géol. Algérie, N. S. Bùll.* (Alger), 10, pp. 1–659.

HANCOCK, J. M. 1984: Some possible boundary-stratotypes for the base of the Cenomanian and Turonian stages. *Bull. Geol. Soc. Denmark* (Copenhagen), 33 (1–2), pp. 123–128.

JAUZEIN, A., 1967: Contribution à l'étude Géologique des Confins de la Dorsale Tunisienne. *Ann. Mines et Géol.* (Tunis), 22, pp, 1–475.

KENNEDY, W. J., 1986: Ammonite biostratigraphy of the Albian to basal Santonian. In: Reyment,

A. R. – Bengston, P. (eds.) – Events of the Mid-Cretaceous. Final Reports on Results obtained by IGCP Project No.58, 1974–1985, *Pergamon Press* (Oxford), pp. 129–144.

PERVINQUIÈRE, L., 1903: Etude Géologique de la Tunisie centrale. *Dir. Trav. Publ. Carte géol. Tunisie* de Rudeval éd., Paris.

PERVINQUIÈRE, L., 1907: Etudes de Paléontologie tunisienne. I. Céphalopodes des Terrains secondaires. *Dir. Génér. Trav. Publ. Carte géol. de Tunisie,* Tunis.

ROBASZYNSKI, F. – CARON, M., 1979: Atlas de Foraminifères planctoniques du Crétacé moyen (mér Boreal et Téthys). *Cah. Micropal.* (Paris), 1, pp. 1–185.

SALAJ, J., 1973: Proposition pour les Néostratotypes du Crétacé supérieur (en vue de la zonation des régions de la Téthys). *Ann. Mines et Géol.* (Tunis), 26, pp. 219–222.

SALAJ, J., 1974: Microbiostratigraphie du Crétacé supérieur de la région de Pont du Fahs. Livret-guide des excursion – VI[e] Coll. Afr. Micropaléont. (Tunis), pp. 41–49.

SALAJ, J., 1980: Microbiostratigraphy du Crétacé et du Paléogène de la Tunisie septentrionale et orientale (Hypostratotypes tunisiens). *Geol. Ústav D. Štúra,* Bratislava, pp. 1–238.

SALAJ, J., 1984: Boundaries of Upper Cretaceous hypostratotypes at the profile Djebel Fguira Salah, Tunisia. *Bull. Geol. Soc. Denmark* (Copenhagen), 33 (1–2), pp. 199–201.

SALAJ, J., 1987: Integrated microbiostratihraphy of the Albian to Basal Santonian and its problems. *Geol. Zbor. Geol. carpath.* (Bratislava), 38, 3, pp. 357–370.

SALAJ, J. – BELLIER, J.-P., 1978: Une coupe de reférence pour la zonation de l'Albien, du Cénomanien et du Turonien de Tunisie septentionale. *Ann. Mus. Hist. Nat.* (Nice), 4, pp. XXI. 1–XXI. 10.

SALAJ, J. – SAMUEL, O., 1984: Microbiostratigraphical division of West Carpathian Mesozoic and Paleogene. *Západ. Karpaty, Sér. Paleont.* (Bratislava), 9, pp. 11–71.

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REVIEW

M. Maheľ, 1986: **Geologická stavba československých Karpát, Paleoalpínske jednotky, 1** (Regional geology of the Czechoslovak Carpathians, 1. – Paleoalpine units).
VEDA, Publ. House of the Slovak Academy of Sciences, Bratislava, 508 pp., 194 Figs. (In Slovak).

In the last decades, three synthetizing works, which evaluate the quickly accumulating knowledge on the West Carpathians, were published. Correlation with data obtained throughout the world, however, indicates that our geological science lacks information on some problems, slowly applies new theories and insufficiently generalizes its own theoretical knowledge.

The new work of academician Maheľ, which represents first part of the monography on the West Carpathian geology, is not only an innovation of the text-book issued two decades ago (Maheľ et al., 1967). The earlier text-book only registered numerous new data, whereas the submitted work attempts to summarize, look for relationships and synthetize. The work is intended for a wide spectrum of geologists engaged in basic and applied research as well as geological practice, and also for university students. In addition to this wide range of readers, the submitted book will surely attract attention of foreign experts working in the Eastern Alps, in Polish, Soviet, Hungarian as well as Rumanian parts of the Carpathians and also in other regions of Alpine Europe.

The work has 508 pages, comprises abundant tectonic schemes, maps as well as geological sections and is divided into three different chapters.

The first, geotectonic chapter characterizes the delineation and features of the West Carpathians, basic trends in their paleogeographic development, features of the structural plan as well as development of opinions on the geological structure of this mountain range. The chapter outlines a new, more dynamic concept of the development and structure which applies modern geotectonic data. Its up to date character is not reflected only by new denominations of the West Carpathian suprabelts (Polonides for the Outer Carpathians consisting of the Palavicum, Beskydicum, Oravicum and Vahicum, Slovakides for the Central Carpathians comprising the Tatricum, Veporicum and Gemericum, and finally Pannonides for the Inner Carpathians formed of the Meliaticum, Slanicum and Bükkicum). The work is original mainly in its attempt to choose a rational core from the classical geosynclinal theory and combine it with the principles of the new global tectonics of lithospheric plates. In some instances the results of these efforts

are controversial (unclear remains mainly the term "Hungarian Massif" incorporating numerous heterogeneous units which were independent, mainly in the Early Mesozoic). The speculation on Kimmerian disturbances in the Meliaticum, Silicicum and Bükkicum, partly also in the Oravicum and Beskydicum is inspiring. Some problems of the paleotectonic interpretation result from the premise that the Central and Inner Carpathians were subject exclusively to the Austrian folding phase, in contrast to later zones which were folded subsequently. Unlike the classical simplified schemes which assume that each "suprabelt", except in the effemere stage of its deformation, behaved as a rigid block, the author of the reviewed publication submits a speculation that numerous partial nappes in the Czechoslovak territory are, in fact, structures formed by younger orogenic movements. Remarkable is the idea of the polystage formation of the body of the Manín nappe: Jurassic–Lower Cretaceous megacycle was deposited in the vicinity of the Krížna unit. Middle Cretaceous sequence was formed at the front of the carried sedimentation area of the Central Carpathian nappes, whereas the Upper Cretaceous flysch was part of the near-klippen accretion zone closely related to the sedimentation area of the Klape unit.

In the second, regional-geological chapter, the author, in spite of the hazard that many of the raised questions will remain unresolved for the time being, adhered to the statement that "to form a system according to an old outdated concept means to hamper progress". He analysed the geological structure of the Inner and Central Carpathians (structure of the Outer Carpathians and post-tectonic cover will be presented in the second, prepared part of the publication) and emphasizes the role of the pre-Carboniferous complexes as an active element involved in the formation of the Mesozoic sedimentation areas. Unfortunately, despite attempts for correlation with the adjacent orogens, some reasons for paleotectonic changes are not always interpreted from the viewpoint of geotectonic changes in the development of the European Alpides (instead of this the author sometimes refers to closely undefined "regularities in geosynclinal development"). From the methodologic-terminological point of view, the book has been worked out on a level higher than that of average geological publications on the West Carpathians in which terms designating categories of time, space, material and movement are often mixed up and confused. In the Carpathian geology, the classical division into regionally defined "series" dies out, which in newer works are automatically without revision replaced by "groups". The author was aware of these and other numerous terminological pitfalls and avoided many of them. Despite this, some faults of this kind can be found in the text. Maybe, the terminological dictionary of geological sciences currently under preparation by the terminological commission of the Slovak Geological Society will help substantially to solve this problem because clean, unequivocal and correct scientific language is of prime importance by the formation of thinking of the new generation, for which this work is in great part dedicated.

The third chapter (undivided, nor marked by a heading) deals with the regional geology of the "core mountains". In its style and layout similar to the "Regional geology of the Czechoslovak Socialist Republic (1967)", it describes the geological structure of the geographically delineated territories. Although the author makes extensive use of comparisons and emphasizes differences in the structure of individual areas, he did not avoid repeated descriptions of successions of strata in this chapter. The summary of facts reveals still insufficiently worked out lithostratigraphic division of the West Carpathian sedimentary units which has made it inevitable to use numerous "pseudo-lithostratigraphic" terms (apart from the Lower and Upper Permian we find also "variegated", "basinal", "littoral", "north-Gemeric" or "Ľubietová" Permian etc.). The referred biostratigraphic indicators are not very reliable (numerous fossils are incorrectly cited, in incorrect assemblages or are assigned to wrong age). These imperfections as well as fairly complicated layout of the last part will probably make it difficult to understand for students of the Carpathian geology.

I think, however, that the submitted work truly reflects the state of knowledge on the structure of the Carpathian orogen. This book marks the culmination of the almost twenty-year-long stage of the geological research of the West Carpathians and will undoubtedly constitute a valuable basis for new, more detailed stage of familiarizing with the structure and development of our territory. Abundant data, inspiring speculations, ideas and challenging questions contained in the work will surely result in better knowledge, methodology of research, approaches as well as treatment of numerous problems and topics so far insufficiently explained – ultimately bringing the study of the West Carpathian geology to a qualitatively higher level.

Translated by Ľ. Bohmer

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