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4.4. Rudists and Larger Foraminifera below the Cretaceous-Tertiary Boundary in the Dolenja Vas Section

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Summary

The Vreme beds are part of the Liburnian Formation. At Dolenja vas which is situated on the Trieste-Komen platform, the Upper Maastrichtian age has been proved with co-occurring rudistids and foraminifera.

Introduction

Carbonate series passing continuously from the Cretaceous into the Tertiary are observable only in a few places in the Dinarids. A presumably continuous section is this of Dolenja vas near Senožeče (Fig. 1). Here, the carbonates of the Trieste-Komen plateau which have been deposited from the Lower Cretaceous to the end of Cretaceous are overlayn by the Tertiary (Paleocene) carbonates of the Vipava synclinorium. Cuisian flysch is overlying the Paleocene carbonate rocks.

The Maastrichtian open marine platform sediments of the Trieste-Komen plateau are developed as grey limestones with rudists (rudistid limestones). In restricted environments (partly lagoons of the carbonate platform) dark grey, grey brown or black micritic limestones or limestone breccias have been deposited. Brackish or fresh water intercalations may occur in the marine sediments. This development is typical for the Trieste-Komen plateau. It extends from the Cretaceous into the Paleocene and was named Liburnian Formation by STACHE

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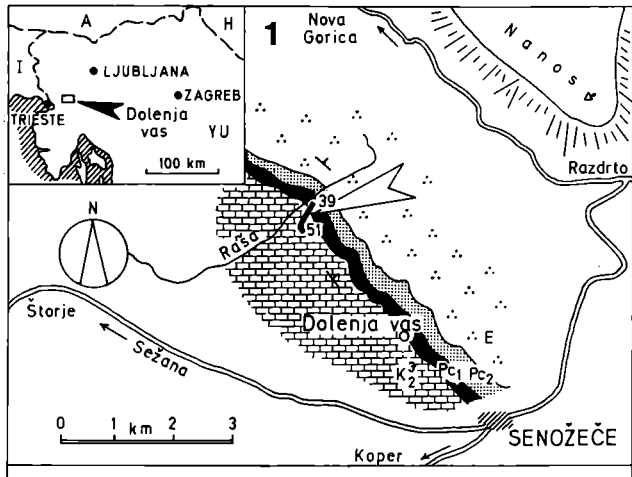
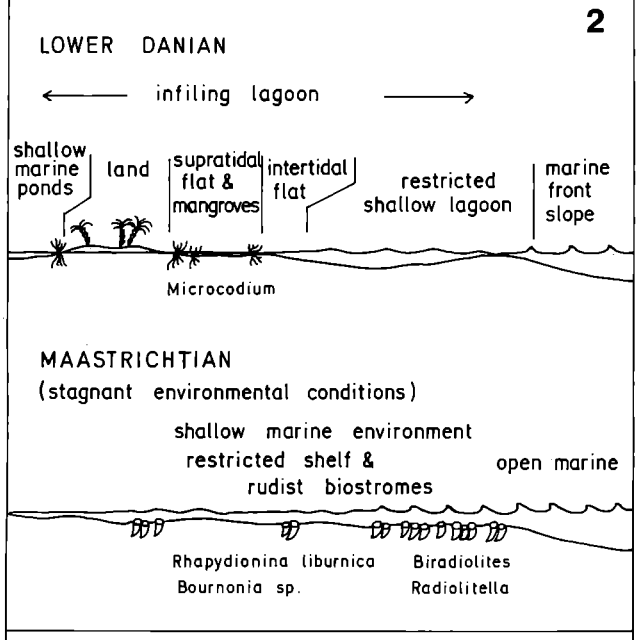
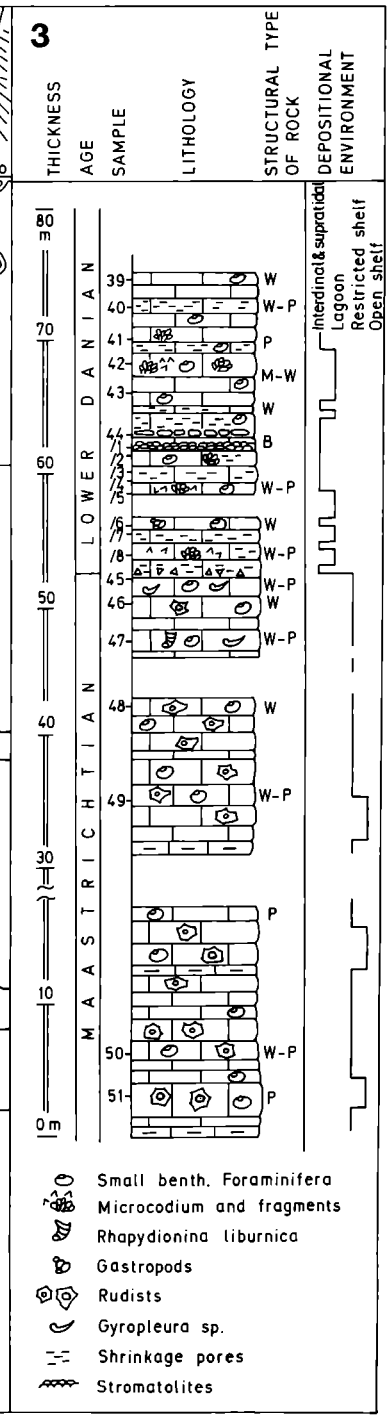






DOLENJA VAS SECTION

SLOVENIA

C-T BOUNDARY

Fig.1. Location sketch map of Dolenja vas section

Fig.2. Depositional environment during Maastrichtian & Lower Danian in the Dolenja vas area

Fig.3. Columnar lithostratigraphic section

(1889). R. PAVLOVEC (1963) has named the lower part of the Liburnian Formation, for which Maastrichtian age is now proved, Vreme beds (Fig. 1).

At Dolenja vas a sequence of the Liburnian Formation in which Vreme beds pass upwards into the Paleocene has been investigated (Fig. 3). While the rocks between field numbers 51 and 45 have been dated as Maastrichtian, those of point 44 belong already to the Paleocene. The Cretaceous carbonate series is developed in lagoonal facies. It has been deposited in the back of a biostrome reef and consists of limestones which are partly rhytmic and bioturbated. Of the rudists recorded in the limestones, *Biradiolites* and *Radiolitella* have probably lived on the reef under high energy conditions and have been re-deposited in the lagoon. *Bournonia* was supposedly living on the bottom of the lagoon, partly buried in mud.

Description of the section and rudistid fauna

At point 51, in the oldest (lowermost) part of the studied section, rudistid species characteristic for the Upper Senonian, partly for Maastrichtian, were found in grey micritic limestone. The autochthonous species are *Bournonia adriatica* PEJOVIĆ, *B. judaica* BLANCKENHORN, *B. quadripinnae* PEJOVIĆ. Rudistid specimens of reef origin buried here including *Kuehnia* aff. *serbica* MILOVANOVIĆ, *Radiolitella* aff. *maestrichtiana* PEJOVIĆ, *Fossulites undesaltus* ASTRE and *Pseudopolyconites* sp.

Higher up, at point 49, remains of the rudists *Sauvagesia* cf. *slovenica* PLENIČAR, *Durania martellii* PARONA and *Pseudopolyconites* sp. were found in a similar limestone. At various levels between points 51 and 49, fragments of valves belonging to the genus *Biradiolites* were found. Point 48 has yielded valves of the genera *Bournonia, Apricardia* and *Gyropleura*. A similar fauna was recorded at point 47; here, the rudistid fauna was accompanied by foraminifera of the species *Rhapydionina liburnica* (STACHE). At point 46, the remains of rudistid valves of the genera *Gyropleura* and *Apricardia* were found in several layers. They were partly crushed by wave action and transported into a less agitated depositional environment. Therefore, they are found accumulated in lenses and beds of grey micritic limestone. These beds also contain numerous foraminifera of the species *Rhapydionina liburnica* (STACHE) as well as miolids.

The latest Cretaceous beds (point 45) are synsedimentary breccias formed in a lagoonal environment as well as dark grey to dark brown, almost black micritic limestone. These beds have the character of rhythmites and bioturbidites. They have yielded numerous rudistids of the genera *Bournonia, Biradiolites* and *Radiolitella*. The autochthonous species of the genus *Bournonia* found in the cement of breccias were identified as *Bournonia adriatica* PEJOVIĆ, *B. parva* PEJOVIĆ, *B. problematica* PLENIČAR & ZUCCHI-STOLFA, *B.* aff. *retrolata* (ASTRE), *B.* aff. *wiontzeki* PEJOVIĆ and *B. triangulata* PLENIČAR & ZUCCHI-STOLFA (Pl. 1, fig. 1–5). Fragments of *Biradiolites baylei* TOUCAS and *Radiolitella* aff. *maestrichtiana* PEJOVIĆ were also found in this breccia. Several species

are characteristic for the Maastrichtian, e. g., *Bournonia adriatica, B. wiontzeki, Biradiolites baylei* and *Radiolitella maestrichtiana,* while others are typical for the Senonian in general (PLENIČAR & ZUCCHI-STOLFA, in DROBNE et al., 1988). At point 44, no more traces of rudistids could be found (Fig. 2).

Foraminifera

In the Maastrichtian, especially in its upper part, Larger foraminifera are very rare on the shallow carbonate platform. In the studied section, foraminifera were studied from sample 47 upwards. The boundary between the Cretaceous and the Tertiary lies between samples 45 and 44/8. According to determinations of algae, foraminifera and corals, the beds above the boundary are of Danian age (Fig. 3, Pl. 2, fig. 1–3. DROBNE at al., 1988, 1989).

Between beds 47 and 45 *Rhapydionina liburnica* (Stache) is most characteristic. The frequency of tests is extremely variable in particular beds. They are quite numerous in micritic limestones and rare in beds with rudistids and *Gyropleura.* A peculiarity in the *Rh. liburnica* population is the occurrence of solely conical tests belonging to the megalospheric generation. The number of chambers and their diameters vary greatly (Pl. 2, fig. 2). Fan-like forms of the microspheric generation or fragments of their tests were not found. This might be an indicatior of rapid changes of depositional conditions in this area, which prevented the development of the entire reproductive cycle. Tests of both generations occur in a western extension of these beds at Vrabče (DROBNE, 1981). *Rh. liburnica* was also associated with *Dicyclina schlumbergeri* MUNIER-CHALMAS and *Moncharmontia* sp. 1.

Among the porcelaneous foraminifera, large miliolids with irregularily arranged chambers are worth mentioning. They have been preliminarily indentified as *"Dargenioella"* (DE CASTRO, 1988).

The appearance of *Rhapydionina liburnica* indicates an Upper Maastrichtian age of the beds. This is supported by the biostratigraphic range of *Bournonia adriatica* and *B. wiontzeki.* Thus, two different fossil groups known as endemic can be used for interpreting the age and for the correlation with similar beds of the Adriatic carbonate platform. On the island of Brač, beds with similar fossil associations were lately attributed to the Maastrichtian (PEJOVIĆ & RADOIČIĆ, 1985/86; GUŠIĆ et al., 1988). Based on ecological adaptation and geographic extension of large foraminifera of the groups Meandropsinidae and Rhapydioninae, E. CAUS and L. HOTTINGER (1986) deduced several bioprovinces in the otherwise uniform western Tethys during the Upper Cretaceous. Differentiation was most probably due rather to oceanic current directions than to barriers in the marine regions. According to these authors, Meandropsinidae are characteristic for the Pyrenean bioprovince, Rhapydioninae for the Mediterranean bioprovince in the central part of the western Tethys. A similar delimitation of bioprovinces on the Adriatic-Apulian platform was proposed by G. BIGNOT (1987). However, paleobioecological data from the Dolenja vas profile

show, that this region belonged during the Upper Cretaceous, i. e. at the Cretaceous-Tertiary transition, to the area with Rhapydioninae on the NW part of the Adriatic carbonate platform.

Facies

The Maastrichtian limestone was deposited on a broad and shallow shelf area (Fig. 2). The more open parts were occupied by rudistid biostromes with numerous rudistids (biomicritic and biointramicritic rudistid limestones, "packstone" after DUNHAM's classification). In wave-protected, more restricted parts of the shelf, numerous foraminifera, especially miliolids, as well as tiny snails (the "wackestone" type is prevailing) occur together with rudists and gyropleuras (Pl. 2, fig. 2, 3). The rudistid valves show marks of intensive endolithization (Pl. 2, fig. 3).

At the end of the Cretaceous period, at the boundary to the Lower Danian, the water depth above the carbonate shelf decreased. Local emersion phases and intertidal belts occurred between prevailing lagoons. The supratidal and intertidal depositional environments are characterized by numerous shrinkage pores, thin stromatolithic laminae, nests of fine emersion breccia and numerous Microcodium structures which were formed along contours of roots. Bioturbation structures are also frequent. Limestone, biomicrites ("wackestone" and "packstone"), indicate an environment of very low energy. Pyritic pigment and organic matter which give the rocks a dark to black coloration, indicate local reducing conditions within the sediment (Pl. 2, fig. 1). Characteristic for the passage between the Cretaceous and Tertiary are thin accumulations of the phosphate mineral collophane. These beds show structures of an intra- and supratidal sedimentation.

Conclusions

The Vreme beds of the Liburnian Formation which have been studied in a section at Dolenja vas have been deposited in a highly saline, partly brackish environment. The water was warm and relatively calm. The chemical and biochemical deposition was intensive. At the time of deposition the carbonate platform of the northwest Dinarides was uplifted and desintegrated. The sea retreated temporarily from small resticted areas. As in Vremski Britof, intercalations of fresh water sediments characterized by snails and coal lenses have been recorded in a small number of other localities.

Rudists of the genus *Bournonia* show long, narrow cylindrical lower valves up to 1 cm in diameter. They are reinforced by strong longitudinal ribs (pl. 1, fig. 1–5, pl. 2, fig. 3). The texture of the walls is lamellar-prismatic; transversal barriers are developed between the lamellae. Therefore, the texture of the wall is very dense.

Among the Larger Foraminifera occurring together with the rudists, *Rhapydionia liburnica* is abundant. Like the species of *Bournonia* it proves latest Maastrichtian for the sediments. The strata of the Dolenje vas section have been deposited exclusively on a shallow water carbonate platform. There are no severe changes in sedimentation at the Cretaceous-Tertiary boundary.

References

BIGNOT, G. (1987): Evolution comparée de deux bassins épicontinentaux dans le nord de la plaque Adriatique au Crétacé supérieur. – Mém. Géol. Univ. Dijon, **11:** 183–193. Dijon.

CAUS, E., & HOTTINGER, L. (1986): Particularides de la fauna (macroforaminiferos) del Cretacio superior pirenaico. – Paleontologia i evolucio, **20:** 115–123. Barcelona.

DE CASTRO, P. (1989): On some Foraminifera and Algae in Apennine Upper Cretaceous and Paleocene. – Mem. Soc. Geol. Ital., **40:** 109–124. Roma.

DROBNE, K. (1981): Značilne foraminifere in njih združbe v podlagi danijskih plasti. (Characteristical foraminifers and their associations in the base of Danian beds.) – Simpozij o problemih danija v Jugoslaviji, Zbornik referatov 85–103. Ljubljana.

DROBNE, K., OGORELEC, B., PAVLOVEC, R., PAVŠIČ, J. (1987): Section Golez. In: Danian-Cuisian Sympos. "Evolution of the karstic carbonate platform, Excursion guide III: 17–22. Trieste.

DROBNE, K., OGORELEC, B., PLENIČAR, M., † ZUCCHI-STOLFA, M. L., TURNŠEK, D. (1988): Maastrichtian, Danian and Thanetian beds in Dolenja vas (NW Dinarides, Yugoslavia). Microfacies, Foraminifers, Rudists and Corals. – Razprave SAZU 4. razr., 29, 147–224, Pl. 1–35, Ljubljana.

DROBNE, K., OGORELEC, B., PLENIČAR, M., BARATTOLO, F., TURNŠEK, D., † ZUCCHI-STOLFA, M. L. (1989): The Dolenja vas section, a transition from Cretaceous to Paleocene. NW Dinarides, Yugoslavia. – Mem. Soc. Geol. Ital., **40:** 73–83. Roma.

DUNHAM, R. J. (1962): Classification of carbonate rocks according to depositional texture. – In: W. E. HAM (ed), Classification of Carbonate Rocks. – Am. Assoc. Petrol. Geol., Mem., **1:** 108–121. Tulsa.

KLAPPA, C. F. (1980): Rhizoliths in terrestrial carbonates; classification, recognition, genesis and significance. – Sedimentology, **27:** 613–629. London.

KOCH, R. (1978/79): Fazies und Diagenese eines Biostrom-Komplexes (Oberkreide, Jugoslawien). – Zeitschrift Erdöl – Kohle, Erdgas, Petrochemie. Compendium, 78/79: 41–64. Leinfelden-Echterdingen.

PEJOVIĆ, D. (1988): New Bournonias from the Senonian of Brač. – Bull. Acad. Serbe des Sci, Class sc. nat., **28:** 41–45. Beograd.

PEJOVIĆ, D., & RADOIČIČ, R. (1985/86): Prilog stratigrafiji gornje krede ostrva Brača. – Jadranska karbonatna platforma. (Contribution to the study of Upper Cretaceous stratigraphy of Brač.) – Geologija **28/2:** 121–150. Ljubljana.

PLENIČAR, M. (1970): Tolmač za list Postojna, osnovna geološka karta SFRJ. Zvezni geoloski zavod, 1–62. Beograd.

REIJERS, T. J. A., & HSÜ, K. J. (1986): Manual of carbonate sedimentology: A lexicographical approach. Academic Press, 302 p. London.

SCHNEIDER, J. F. (1975): Recent tidal deposits of Abu Dhabi, UAE, Arabian Gulf. In: Ginsburg, R. N. (ed.), Tidal Deposits. Springer Verlag, p. 209–214. Berlin.

Plate 1

Fig. 1: *Bournonia triangulata* Pleničar & Zucchi-Stolfa 1988;
transversal section through the lower valve; thin section; Dolenja vas near Senožeče; Maastrichtian.

Fig. 2: *Bournonia* cf. *wiontzeki* Pejović 1968;
transversal section through the lower valve; thin section; Dolenja vas near Senožeče; Maastrichtian.

Fig. 3: *Bournonia problematica* Pleničar & Zucchi-Stolfa 1988;
transversal section through the lower valve; thin section; Dolenja vas near Senožeče; Maastrichtian.

Fig. 4: *Bournonia parva* Pejović 1988;
transversal section through the lower valve; thin section; Dolenja vas near Senožeče; Maastrichtian.

Fig. 5: *Bournonia* aff. *retrolata* (Astre) 1929;
transversal section through the lower valve; thin section; Dolenja vas near Senožeče; Maastrichtian.

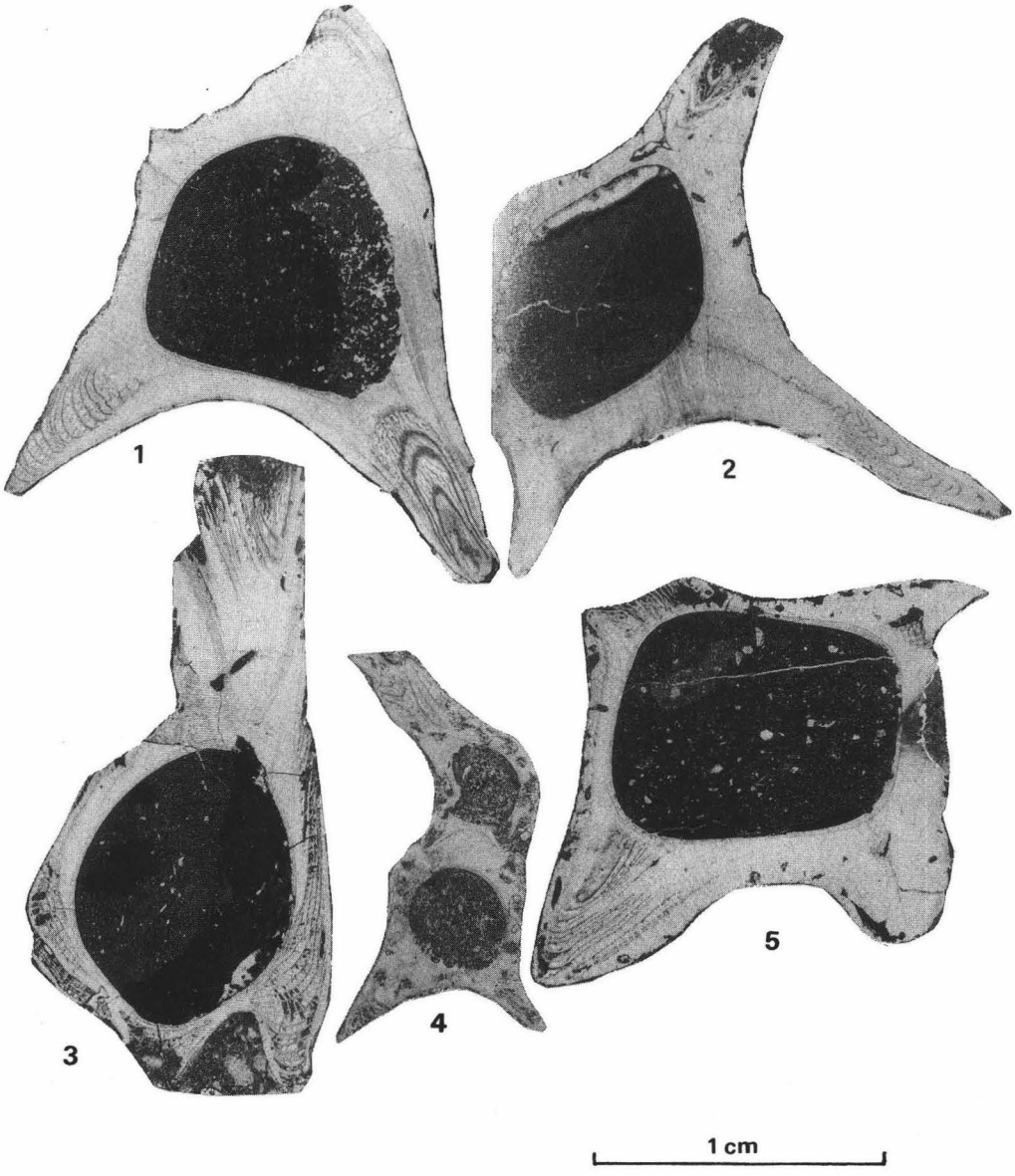

1
2
3
4
5
1 cm

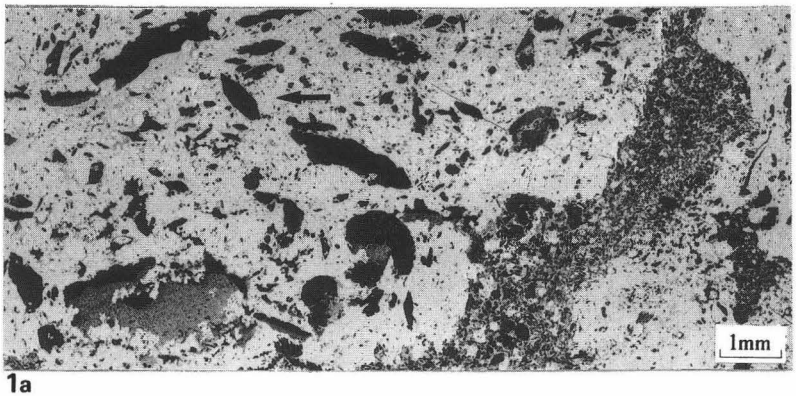
Plate 2

Fig. 1a: Micritic limestone with shrinkage pores integrated with synsedimentary intramicritic breccia. Intertidal sedimentary environment. Evaporite minerals (arrow) are replaced by sparry calcite. Dv 44/8 – 6556.

Fig. 1b: Microcodium structure from the same specimen. Dv 44/8 – 6556.

Fig. 2: Biomicritic limestone with numerous porcelaneous miliolids, *Rhapydionina liburnica* (arrow), Gyropleura fragments, snail with internal sediment (geopetal texture, arrow). Wackestone to packstone type of rock. Dv 1/-5 – 4576.

Fig. 3: Organogenic biomicritic limestone with rare miliolids, *Bournonia* sp. and Gyropleura fragments. Bioturbation of sediment is evident. Packstone. Dv 46/ – 5077.
All enlarged 10 x in incident light.



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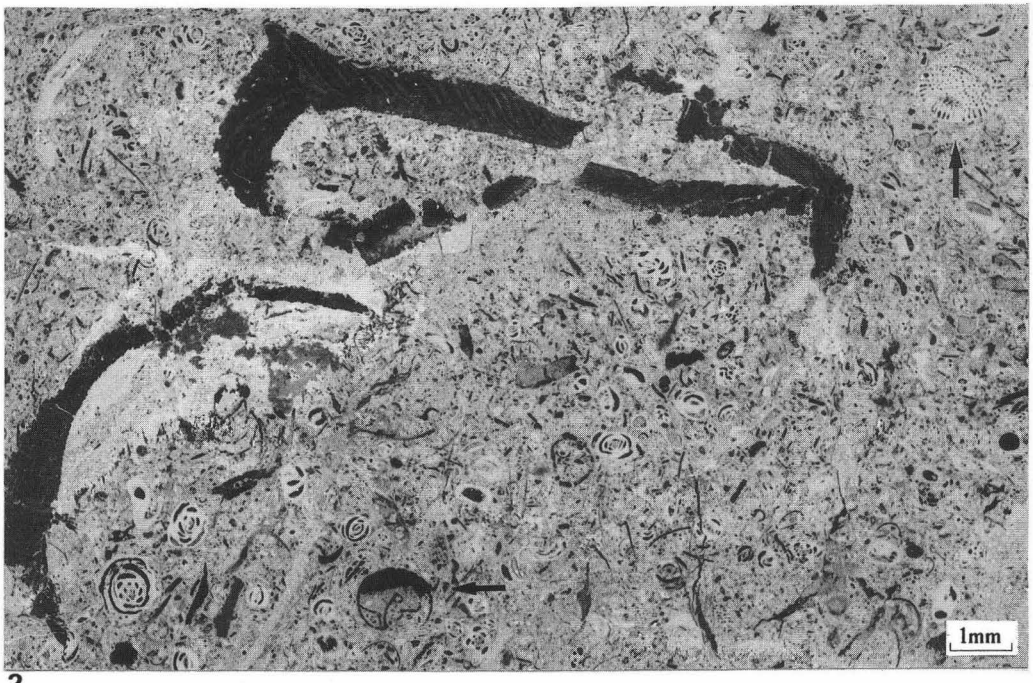

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