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Petrology and stratigraphy of the Meliaticum near the Meliata and Jaklovce Villages, Slovakia

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Abstract. Problematics of the Meliaticum, Meliata Ocean and the other questions that are closely connected with them have a prominent place not only in the Carpathian, but in the Alpine geology as well.

The present paper brings new contributions to this body of knowledge. It deals with the investigation of Meliaticum in the vicinity of the Meliata village (SW of Gemericum) and in the wider surroundings of the Jaklovce village (NE margin) (Fig.1).

The vicinity of the Meliata village represents tectonic half-window (Meliata tectonic window) whose rocks contain geological structure complicated by younger thrust tectonics. The Meliata Unit crops out as repeated discontinuous tectonic slices in this window. It is chiefly composed of the Jurassic deep-water shales. In this matrix various large blocks of older Triassic rocks occur. The shale slices were most likely accumulated in an accretionary wedge.

The shales contain sparse thin intercalations of breccias and sandstones, as well as of thin-bedded radiolarites, which also form olistoliths in shales.

The breccias contain mainly clasts of limestones, among which shallow-water limestones prevail. Other carbonate rocks are represented by metamorphosed limestones. Their metamorphism preceeded the formation of the breccia. Also found as clasts in the breccias are cherts and radiolarites. Volcanic rocks of various textures and chemical composition are also important clasts. Claystone lithoclasts in the breccias were derived from the underlying beds.

Radiolarian microfauna from radiolarites represent the stratigraphic range of Middle Bathonian - Early Callovian (Unitary Association Zone: U.A.Z. 6 - U.A.Z. 7 according to the latest biozonation of Baumgartner et al., 1995). The youngest assemblage of the Meliata village area was found in the uppermost part of the Meliata Unit type locality (Kozur & Mock, 1985) and was assigned to Late Callovian-Early Oxfordian (Kozur et al., 1996).

The Meliaticum at the Jaklovce village area is also represented by Jurassic melange. Claystones, siliceous shales, argillites and sandstones form its matrix. Coarse-grained sandstones to microbreccias and conglomerates are a less common part of the matrix. The Jurassic age of the matrix rocks is shown to be Middle Jurassic (Kozur & Mock, 1995) by fragments of belemnite rostra and by radiolarians from a layer of radiolarites in the matrix shales.

Pale, shallow-water, metamorphosed Honce limestones, pelagic cherty limestones, dolomites, basalts, radiolarites, serpentinites and perhaps clastic sediments of Early Triassic age represent the most common melange olistoliths. Olistoliths of Jurassic radiolarites have not yet been found in this area, but serpentinites and basic volcanic rocks are frequent in comparison with the Meliata area. Metabasalts are geochemically most similar to N-Morb (enriched mid-oceanic ridge basalts) types (according to minor element distribution) and indicate their origin to have been in marginal or back-arc basin.

Eight samples generally from Meliata area were analysed for heavy mineral contents. The results are complemented by samples from Florianikogel, Austria (Eastern Alps) and Margecany (northern occurrences of Meliaticum). The data are grouped into two different assemblages. Assemblage No.1, found in the siltstones of Middle Jurassic age from Meliata and in the sandstones from Florianikogel locality, is dominated by garnet and apatite, as well as by presumably authigenous barite. In these samples, some lesser amount of chromium spinels was also found. The apparent similarity between the Meliata and Florianikogel samples is noteworthy. Assemblage No.2, found in the sandstones and quarzites from the Meliata and Margecany areas, contain only the most stable minerals, e.g. tourmaline, zircon and rutile (without chromium spinels). These samples, however, are of uncertain age and position within the meliatic rock complex.

Key words: Western Carpathians, Meliaticum, Triassic, Jurassic, sedimentology, basalts, radiolarians, heavy minerals.

A. Introduction

The problems of the Meliaticum, Meliatic Ocean, the question of its eastward and westward prolongations, the problems of Cimmerian collision and suture zone, the temporal and spatial relationships with other mobile zones, e.g. the Penninic Ocean and/or its individual troughs (South and North Penninic), Pieniny Klippen Belt, Vardar Zone or Southern Tethys are all questions actively being debated around the Alpine Europe.

The Meliatic topic also has a prominent place in understanding of the Carpathian geology. During the last two decades, considerable progress has been achieved. However, there are still many unresolved problems and unanswered questions. Therefore, in the early nineties our team decided to contribute to the knowledge of the Meliaticum within the project "Geodynamic evolution and deep structure of the Western Carpathians". Key areas, in which also our investigation was concentrated, are near Meliata village and the wider surrounds of Jaklovce village. The first site lies southwest of the Gemeric Superunit, whereas the second occurs at its NE margin. The positions of these localities provide contributions to the solution of one of the key questions in the Western Carpathians: do the "northern" Meliatic occurrences represent an independent suture zone north of the Gemeric Superunit or are they just remnants of an obducted Meliatic nappe? This question was already treated by Kozur & Mock (1995, 1996, 1997) and Kozur et al. (1996), by which also some preliminary results of our investigation were mentioned. This paper presents the detailed petrological, sedimentological and paleontological data, obtained during the works on the aforementioned project.

B. Meliata unit in its type locality and vicinity

1. Geologic and tectonic setting

The area of Meliata village is the most important occurence of the Meliatic Unit; although it also has good outcrops, most of them, however, were not studied in detail until the early ninetees. The attention of numerous geologists was focused mainly on this area; several exploration bore-

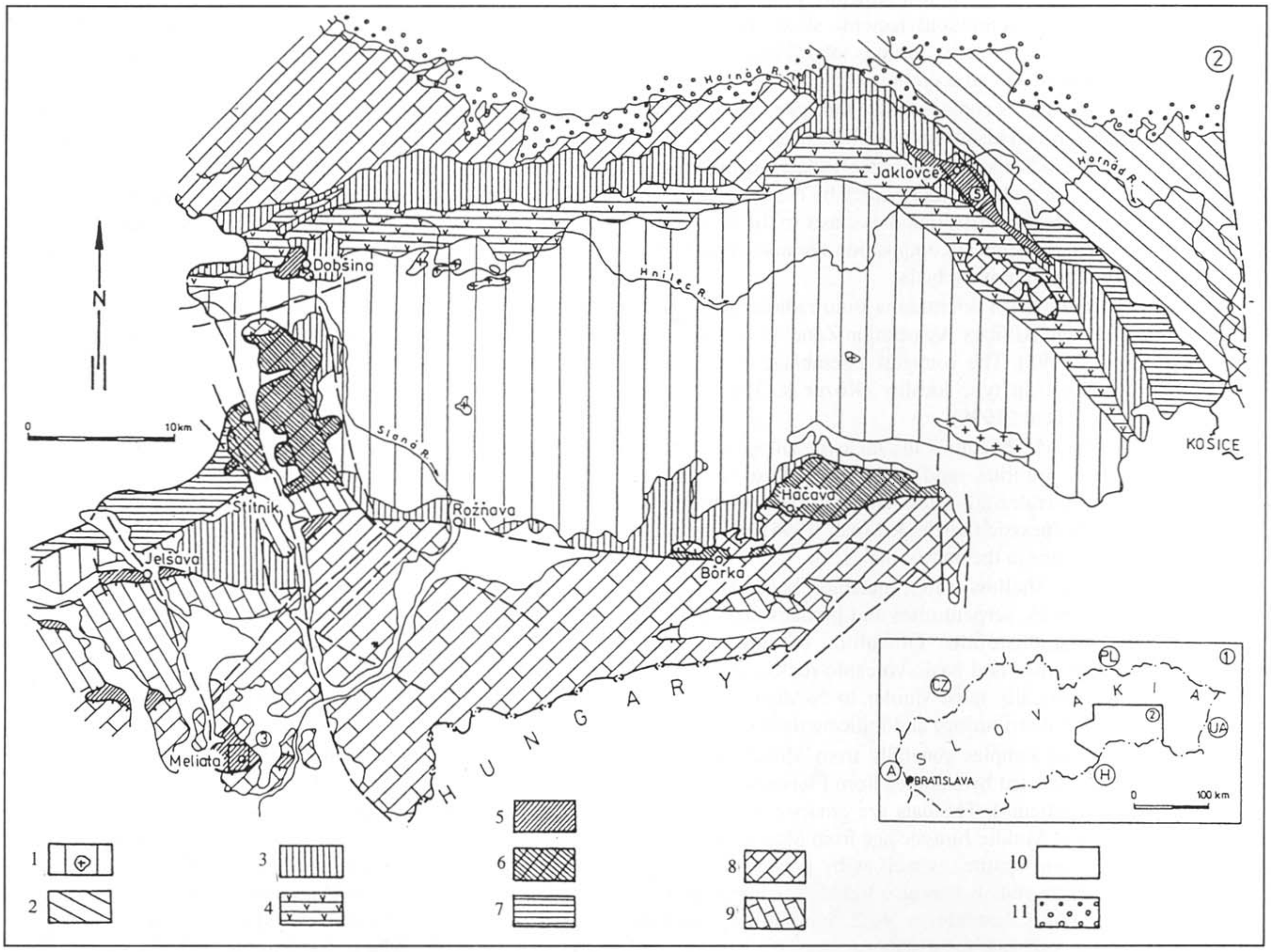


Fig.1 Position of the studied areas (see Fig.2).
Fig.2 Simplified scheme of tectono-stratigraphic units in the SE part of the Western Carpathians.
1 – Gemericum Gelnica Group, 2 – Veporicum, 3 – Gemericum Late Paleozoic, 4 – Gemericum Rakovec group, 5 – Meliaticum, 6 – Bôrka nappe, 7 – Ochtiná and Črmel unit, 8 – Silica, Stratená nappe, 9 – Turňa and Slovenská skala nappe, 10 – Quaternary, 11 – Central Carpathian Paleogene

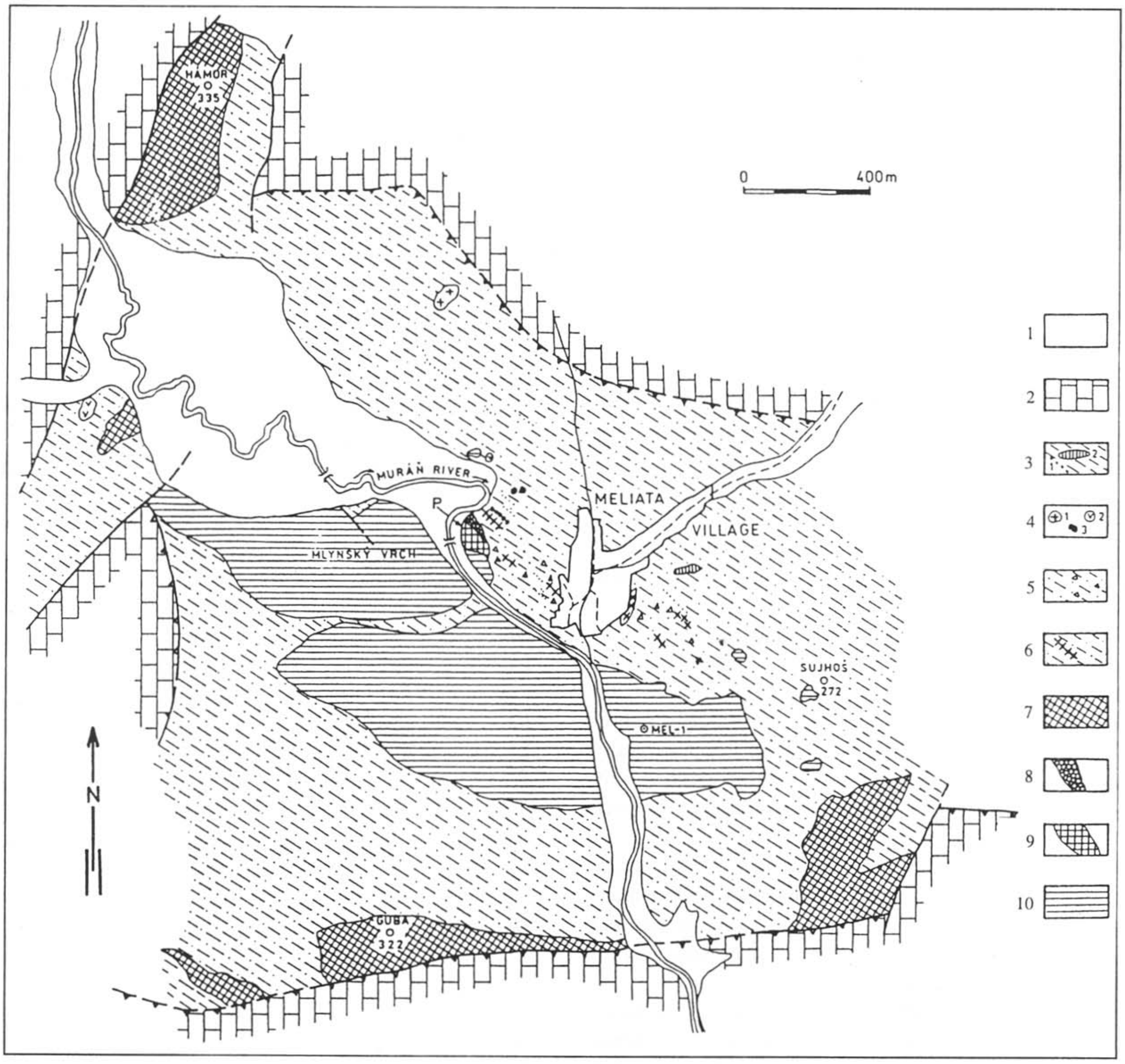


Fig. 3 Geological scheme of the Meliata village area (modified from Mello & al., 1996).
1 – Quaternary, 2 – Silicicum, 3 – 1-debris flow deposits, 2 - block of limestone (? Early Triassic), 4 –1- block of rhyolite, 2-blocks of basalts, 3 – block of arkose, 5 – dark gray and green shales, siltstones, sandstones with lithoclasts of radiolarites, 6 – thin layers of dark gray radiolarites (Calovian - Early Oxfordian) 7 – gray-green and reddish radiolarites (Bathonian-Calovian), 8 – Olistostroma with lithoclasts of Carnian and Norian Limestones (?Liassic), 9 – red radiolarites, shales and limestones (Ladinian-Early Carnian), 10 – light massive crystalline limestones (Pelsonian), P – studied profile see Fig. 4, ⊙ – borehole

holes and one deep structural borehole (Mel-1) were drilled here. The Meliata Unit of this area represents a tectonic half-window (the Meliata tectonic window), which has a complex geological structure, as is evident from the map of Mello et al. (1996) and from the material coming from the deep borehole (Straka et al., 1984; Straka, 1986). The borehole was, however, interpreted incorrectly. Fejdiová & Ondrejičková (1992) proved that the dark shales in the 1718 - 1900 m interval, originally considered to be the Early Triassic of the Silica Nappe (e.g. Straka, 1986), represent in fact the Jurassic deposits of the Meliata Unit. From the siliceous shales at 1750-1900 m they obtained well preserved Jurassic radiolarians.

The Meliata Unit in the Meliata tectonic window crops out discontinuously over an area of about 5 km^2. To the south it is present at Guba hill (lined by the Hraničná dolina valley) and on the north it forms Hámor hill (Fig. 3).

The field exploration showed that the Meliata Unit all around the window is chiefly composed of Jurassic deep-water shales, the slices of which are repeated several times. They comprise also of various large blocks of older, Triassic rocks. Whether they form olistoliths or tectonic lenses, is in some places indeterminable. The shale slices were most likely accumulated in an accretionary wedge (imbricated thrust sheets).

Jurassic rocks, representing the melange matrix in the Meliata area, underlie a large area south and southwest of the village, toward Sujhoš hill (272 m). They are well exposed directly at Meliata village, at a small gipsy settlement near the protestant church (at the turning of a field road from the village center to the Meliata mill). They are represented mainly by dark-grey to greenish-grey clayey shales, siliceous and laminated shales, grey and greenish sandstones and argillites, and rarely also by fine-grained polymictic conglomerates and breccias. The lamination in the shales is frequently formed by admixture of silty quartz, muscovite and rarely by biotite (Pl. I, Fig. 1). The latter is commonly chloritized. At the northern margin of the village, in the clayey shales also poorly preserved radiolarians have been found (Pl. VIII, Fig. 6). Autochthonous radiolarites, forming thin intercalations or even clasts in the shales, are also widespread. They are of the Middle Bathonian - Early Oxfordian age (see chapter B.5). The radiolarites are commonly tectonically disrupted (Pl. I, Fig. 4). They contain rare detrital quartz grains, and silt-sized mica flakes. The presence of rhombohedra of epigenetic Fe-carbonates is conspicuous. Where the radiolarites contain an increased portion of clayey matrix, they should rather be called radiolarian shales.

The Jurassic radiolarites occur also as megaolistoliths as at the hills Hámor (335 m) that is also partly formed probably by Triassic radiolarites, and Guba (322 m). Jurassic radiolarites possess greyish-green, reddish, ochre-yellow and greyish-blue colour. The reddish ones usually contain a detrital quartz admixture. They contain poorly preserved radiolarian assemblages of Middle Jurassic age (Kozur et al., 1996) (chapter B.5).

Some slump structures and boudinage of the deep-water sediments occur locally. Important sedimentary components are also Mn and Fe rich shales, lenses and nodules. The presence of olistoliths, either singly or in olistostromes, is characteristic for this area.

Pale, crystalline Lower Anisian Honce limestone, forming a large outcrop in a steep slope along the Muráň river 500 m south of Meliata, evidently represents a big block (olistolith) in the Jurassic rocks (the deep borehole Mel-1 penetrated through this block). Individual blocks of

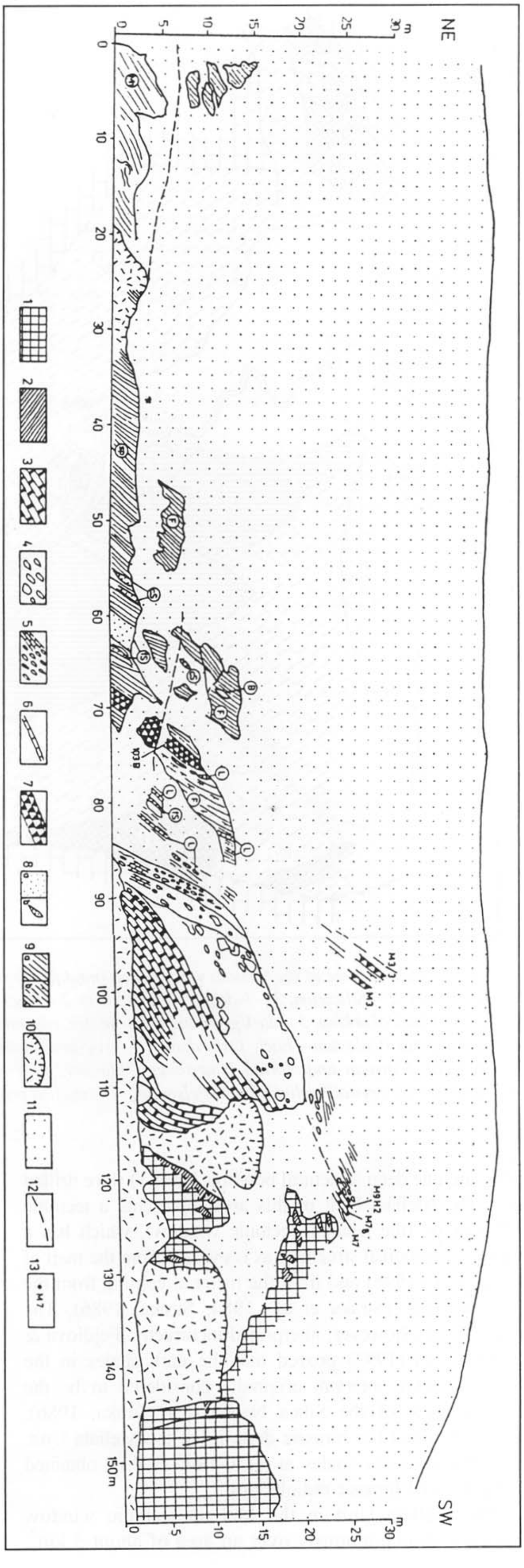


Fig.4 Sketch of the outcrop section on the left bank of the Muráň river near the Meliata village (the Meliata Unit type profile).
1 – light coloured metamorphosed Honce Limestone (Early Anisian), 2 – reddish Žarnov limestone - often as fissure filling in the underlying limestones (Pelsonian), 3 – red and partly green ribbon radiolarites and silicified limestones with intercalations of shales (Ladinian), 4 – unsorted and nearly matrix free breccia (olistostrome) composed of predominantly Late Triassic limestone clasts, 5 – breccia (olistostrome) composed of boudinaged clasts of grey grained limestone of Late Norian age, 6 – olistolites of grey (Early Jurassic?) limestones (L), 7 – intercalations and/or olistolites of grey radiolarites (Late Callovian - Early Oxfordian), 8 – a. fine-grained sandstones (fS), b. lens-shaped layers of coarse-grained sandstones (cS) or breccias (B), 9 – greenish-grey shales (a), calcareous shales (b), in some places spotty (sp), fucoid (F) silty and sandy shales. Occurrence of manganese admixture and concretions (Mn), 10 – slope debris, 11 – superficial deposits, 12 – footpath, 13 – some studied samples

this limestone were formerly considered to form one continuous layer with a thickness of several hundreds meters. Also, the white crystalline limestone at the base of the Meliata Unit type locality has been considered to belong to this layer. On the basis of the field study we believe that the limestones on the opposite bank of the river are independent Triassic blocks in the shaly Jurassic rocks. The largest block forms Mlynský vrch hill (287 m). The limestones are light grey, metamorphosed, foliated and with ductily deformed calcite grains. In the Mel-1 borehole, Early Anisian conodonts were found in the Honce Limestone (Straka, 1986; Kozur, 1991).

Smaller blocks of pale Triassic dolomitic limestones, 150 m north of the Meliata type profile (text Fig. 3), are, apart from the previous ones, only anchimetamorphosed. Their original structure was more obliterated by dolomitization than by metamorphism. In several samples original structures were preserved; they were intrasparites (Pl. VIII, Fig. 1) to pelsparites. Rarely also poorly preserved foraminifers *Meandrospira iulia* (PREMOLI SILVA) and algal remnants are visible. Authigenic plagioclases (also some roc-turné compound crystals) occur frequently close to stylolites. The foraminifers indicate a Pelsonian age.

Besides the white Lower Anisian limestones, the most frequent blocks (olistoliths) are the red radiolarites. They make up for instance, part of Hámor hill (335 m). In much-covered terrain these resistant rocks form a conspicuous relief. The presence of the Jurassic shales among these harder blocks was verified at several places by digging. This association is observable also in the borehole material, e.g. in the Držkovce borehole (SW of Držkovce village, situated NW from Meliata) there were thin intercalations of Jurassic shaly matrix embedded between the Triassic clasts (e.g. at the 767 m depth).

The melange also contains rare smaller blocks of dark grey limestones. They were found just SE of Meliata village. These are laminated, in part folded, recrystallized limestones with barely identifiable biodetritus represented by calcified radiolarians and filaments. In some more detrital laminae, ostracods (Pl. VIII, Fig. 5), calciclasts, detrital quartz and authigenous plagioclases were identified. The presumed age of these rocks is Early Jurassic.

Just at SE margin of the village (Fig. 3), a block of thin-bedded dark grey to black limestone was found. The limestone is recrystallized; its original texture is preserved just in relics. It contains also detrital quartz (less than 1%) and epigenetic minerals (mainly pyrite, Fe-carbonates and authigenic feldspars). From the biodetrital components, some ostracods and echinoderm ossicles were identified in thin sections. Additionally, pelloid grains and some foraminifers *Cornuspira* sp. and *Hoyanella* sp. were also found (Pl. VIII, Fig. 2). The foraminifers indicate an Early Triassic age of the rock, i.e. it represents still a pre-rift component of the Meliatic Unit.

NW of Meliata behind the type profile of the Meliatic Unit, a block of grey arkosic arenite was found (Fig. 3). It comprises mainly of quartz and feldspar (predominantly plagioclases) grains; rarely also muscovite, accessoric minerals (zircon, tourmaline), clasts of low-grade metamorphosed rocks and rhombohedra of epigenetic carbonates are present. The cement is calcitic. The abundance of the individual components are: 66% quartz, 32% feldspars, 2% lithoclasts. The grains are not sorted, their average size is about 0.3 mm and their maximum is 5 mm.

Approximately 800 m N of the Meliata type profile (Fig. 3) is a block of light grey paleorhyolite measuring several tens of meters. Macroscopically, it is hardly distinguishable from radiolarites and other silicites. Also, the weathering colour is ochre-grey, just like that of the silicites. It contains grains of magmatically corroded quartz, K-feldspars and devitrified volcanic glass (Pl. I, Fig. 2). The quartz grains are slightly undulatory and faintly cracked. The feldspars are sericitized along the cleavage plains. A presumed age of the rock is Paleozoic, similar to the arkosic arenite described above.

2. Detailed sedimentological description

The section in the Meliata Unit type locality ("Meliata Series", named by Čekalová, 1954) is situated north of the Meliata mill, on the left bank of the Muráň river. The section is about 220 m long and locally up to 25 m high natural outcrop.

The type section is mentioned in many publications. It is interesting that in the first papers of Homola (1951), Čekalová (1954) and Bystrický (1959) the presumed Carboniferous (now Anisian) white crystalline limestone was not considered to be a part of the section with shales, grey limestones and red radiolarites, later recognized at the Meliata Unit. Also, based on field exploration and shallow boreholes drilled for the intended construction of a dam in the Muráň narrows, it was found that at the uppermost portions of the white crystalline limestone there are more and more red shales, rip-up clasts and red limestones (now Pelsonian) that are part of an overlying stratigraphic member. They were also assigned to the Meliata Unit, and their age was inferred to be Upper Permian and/or Lower Triassic (Nemčok, 1957; Bystrický, 1959, 1964).

Since the first conodonts were found at this locality (Kozur & Mock, 1973 a,b) and the Middle to Upper Triassic age of some members has been proven, the locality was mentioned in several supportative publications. They did not, however, substantially change the view from 1973 (Mock in Mello, 1975; Mock, 1980; Bystrický, 1981; Mello et al., 1983; Kozur & Mock, 1985).

In 1992, the type profile was re-examined at a 1:100 of scale. At key sites, the covering vegetation and soil were removed. About 200 samples were examined for microfossil contents, microfacies, heavy minerals, sedimentology and geochemistry. Based on these examinations, a new view on the structure of the profile was constructed (Fig. 4):

a.) The base of the section (the base of the unit, as was presumed until 1992) begins with thick white crystalline Honce Limestone (most probably metamorphosed Steinalm Limestone) of the Lower Anisian. In the upper part, the red shaly intercalations of the Žarnov Fm. are present. Their quantity increases upward, where a red limestone appears, filling neptunian dykes in the Honce Limestone.

Locally, the Žarnov Limestone contains angular clasts of the white crystalline limestone, documenting a disintegration of the former shallow-water carbonate platform. The red limestones are also recrystallized but less extensively than the underlying pale marbles (due to their different composition). The original structure was preserved in only rare cases. They represented biomicritic wackestones with filaments and calcified radiolarians (Pl.VIII, Fig. 3). Despite the metamorphism, they yielded a rich Pelsonian conodont fauna. The Pelsonian age was determined also for several layers of red micritic limestone in the uppermost part of the white crystalline limestone block (its Lower Anisian age was shown by the Pelsonian neptunian dykes and by conodonts obtained from similar limestone types in the Mel-1 borehole (Gaál in Straka et al., 1984). In the upper part of the outcrop, the Pelsonian limestone is distinctly laminated. The lamination indicates how were the fractures oriented during deposition. Some of them were parallel to the bedding of the underlying pale limestone.

b.) Above the white crystalline and red Anisian limestones, radiolarites of various colours (predominantly red) follow in the section (Ladinian). Their contact with the underlying limestone is, however, covered by debris and soil (at 125 m in the sketch of Fig. 4). Since 1973, a conformable continuation was assumed, though with a small gap. The main reason of this opinion was the similar dipping of both parts of the section. Under the debris cover between these outcrops, however, greenish Jurassic shales were uncovered (samples M-7, M-9), which indicate that the Anisian limestones and following Ladinian siliceous limestones and radiolarites are just blocks (maybe olistoliths) in the Jurassic matrix and the formerly presumed continuity of the profile was unwarranted. The misleading similar dips of the blocks most probably resulted from their natural orientation in the olistostrome along their longer axes determined by the bedding planes. It is possible that the upper part of the white crystalline limestones also consists of several blocks separated by thin Jurassic shale interlayers. However, some tectonic disturbance by younger tectonic movements is not excluded.

In the variegated radiolarites, pink and red colours predominate. Among them, silicified deep-water limestones also occur, frequently with big red chert nodules or layers. In the lowermost part a very short exploration gallery was dug, since this portion consists of dark grey radiolarites with Fe oxide coatings. According to radiolarian fauna (Kozur et al., 1996) the radiolarites are Ladinian.

c.) Between the variegated radiolarites and the overlying units, a sharp contact occurs in the form of a thin intercalation of greenish claystone (0-7 cm). It is followed by an olistostrome layer (6 m in the upper part of the outcrop, above 130 m in the sketch of Fig. 4) composed of lithoclasts of grey, grained and cherty Carnian limestones (10-30 cm size), also an angular block of the red radiolarite (chert, 20x10 cm in size) was found. The olistostrome is locally strongly squeezed with a minimum content of matrix, resembling a coarse nodular limestone (Pl.VII, Fig. 3). As a rule, the limestone clasts are subangular, whereas the radiolarite clasts are angular. In the nodular-like portion, the clasts were probably tectonically rounded. Numerous grey limestone samples yielded Carnian conodont fauna, hence a normal stratigraphic succession over the Ladinian radiolarites was inferred.

This relatively thin layer with olistoliths thickens downwards, reaching over 3 m at the foot of the profile. We infer that the aforementioned variegated radiolarite block is also a component of this olistostrome.

d.) Higher above the carbonate olistostrome, the content of dark calcareous shales increases (10 m) with decrasing quantity of the limestone olistoliths. In some of them, Carnian and Norian conodonts were found (Kozur & Mock, 1973; Mock in Mello, 1975). The shales are, however, of Jurassic age, not Upper Triassic (Kozur & Mock, 1973) or Ladinian (Planderová in Mello et al., 1983) as was proposed in the past. They are dark and calcareous, even with discontinuous layers (not olistoliths) of grey and bluish-grey limestones, free of conodonts or any stratigraphically valuable fossils. These rocks, together with the shales, are inferred to belong already to the Jurassic.

e.) Deposition of the grey calcareous shales in the upper part of the section gives way to a huge complex of non-calcareous claystones, in places with thin layers of grey and greenish-grey radiolarites. They contain radiolarian assemblages of Middle Jurassic-Early Oxfordian age (see chapter B.5). The lower part of this formation is extensively bioturbated. A spotty appearance of the rocks resemble the Lower Jurassic "Fleckenmergel" facies (Pl. VII, Fig. 2). In the claystones, a 130 cm thick layer (not olistolith) of thin-bedded grey radiolarite occurs. From this upper part of this sequence Modrová (1980) obtained radiolarians, that were introduced by Kozur & Mock (1985) as the first paleontological proof of the Jurassic in the Meliata Unit. The Late Callovian-Early Oxfordian radiolarian fauna is excellently preserved (Kozur & Mock, 1985; Kozur et al., 1996).

These radiolarites in the type profile are overlain by greyish-green to grey, often distinctly laminated shales with thin layers of sandstones to microconglomerates of similar colour. The latter probably represent shallow channel fillings (Pl. II, Fig. 2). This formation can be traced a further 70 m. In the claystones, some Fe-chlorite laminae were found (Pl. VII, Fig. 4; Tab. 1), likely related to synchronous volcanic activity (probably slightly metamorphosed tuffitic intercalations). Some trace fossils (*Helmintoides*) and a problematic fossil outprint (probably of a poorly preserved ammonoid) were also found in the shales. Graded-bedding in the sandstones and microconglomerates indicate that the formation lies in a normal position. These parts were also examined for heavy minerals (see chapter F). The whole formation is nearly free of $CaCO_3$ and has signs of deep-water sedimentation below CCD. In the uppermost portions of the profile shale layers with higher Mn concentrations (Mn-oxides forming nodules and interlayers) occur in several horizons.

The Jurassic shale complex, covered with Quaternary sediments, continues behind and above the type profile northward as far as Hámor hill .

Tab. 1 Chlorite analyses from the Meliata type profile

	metatuffite lamina in the shales			isolated grains from the shales		
sample	mel16-1	mel16-2	mel16-3	mel4	mel5	mel6
SiO_2	25.5	25.15	25.03	24.96	29.3	25.63
TiO_2	0.01	0.05	0.04	0.02	0.19	0
$Al2O_3$	19.64	18.61	19.24	21.33	21.92	22.9
FeO	29.94	30.98	31.88	25.08	22.55	24.74
MnO	1.33	1.33	1.31	0.23	0.35	0.15
MgO	10.21	8.96	8.63	11.96	8.57	13.16
CaO	0.03	0.02	0.03	0.01	0.2	0.04
Na_2O	0	0	0.02	0.01	0.02	0.04
K_2O	0	0	0	0.01	0.82	0.1
H_2O	11.08	10.98	10.96	11.34	11.23	11.42
total	97.74	96.08	97.14	94.95	95.15	98.18
structural formules						
Si IV	2.83	2.87	2.83	2.8	3.31	2.75
Al IV	1.17	1.13	1.17	1.2	0.69	1.25
T site	4	4	4	4	4	4
Al VI	1.4	1.38	1.39	1.62	2.23	1.64
Ti	0	0	0	0	0.02	0
Fe +2	2.78	2.96	3.01	2.35	2.13	2.22
Mn +2	0.13	0.13	0.13	0.02	0.03	0.01
Mg	1.69	1.53	1.45	2	1.44	2.1
Ca	0	0	0	0	0.02	0
Na	0	0	0	0	0	0.01
K	0	0	0	0	0.12	0.01
O site	6	6	6	6	6	6
O	10	10	10	10	10	10
OH	8	8	8	8	8	8
Charge	0.23	0.26	0.23	0.42	1.45	0.36

Element proportion recalculated on basis of 10 cations (after A. M. Afifi & E. J. Essene, 1988).
* $FeO + Fe_2O_3$ formally as FeO

3. Petrologic analysis of the detrital components in the microconglomerates and fine-grained breccias (except basalts).

Samples of two detrital horizons were analysed petrologically in thin sections:

a.) Samples of a coarse-grained sandstone to carbonatic breccia (see Fig. 4, cS). Carbonates represent the dominant component of the breccia. They can be divided into two groups.

The larger group comprise metamorphosed limestones (Pl. VI, Fig. 3, 4) that are partially replaced by authigenic feldspars (mainly albite). The degree of replacement as well as size of the feldspar grains is variable. In some instances, the authigenic feldspars are concentrated at the surface of the detrital grains.

The second group of the limestone lithoclasts is free of the authigenic feldspars. Though their matrix, as a rule, is partly recrystallized (probably also dolomitized), their original character is still discernible. They are oomicrites, oosparites (Pl. III, Fig. 6), pelsparites (Pl. III, Fig.7, 8), micrites (some with pseudomorphs after evaporites - Pl. VI, Fig. 1) and micrites without allochems. Also, some echinoderm ossicles (Pl. III, Fig. 4) and rare isolated ooids (Pl. III, Fig. 1) and oncoids (Pl. III, Fig. 5) occur among the clasts. Some of the crinoidal ossicles are also albitized.

Very rarely also, some detrital grains of intermediate volcanic rocks were found, with ophitic intersertal texture. Some grains, formed exclusively by feldspars, possess spheroidal shapes. Some individual grains of monocrystalline to polycrystalline detrital quartz were also found. Rip-up clasts of underlying claystones, with a variable content of silty admixture, are a current component of the psephite (Pl. III, Fig. 3). Pyrite is a usual authigenic mineral; it replaces the grains but occurs also in the matrix.

The content of carbonates in the analysed breccias ranges between 60 and 80%; the feldspar-free limestones occur in a 6-23 % range. The lithoclasts of claystones and clayey shales (the rip-up clasts) make up about 10% of the rock volume and the matrix 10-27%.

b.) Sample of a fine-grained polymictic breccia (see Fig. 4, fS), (Pl. II, Fig. 3). Its dominant components are clasts of volcanic rocks (see the next chapter) and some radiolarites (also Triassic - Pl. VI, Fig. 2). Limestones are also frequent in the breccia. They are mostly metamorphosed; in rare cases, some relics of their original texture were preserved. However, some pressure-deformed and slightly recrystallized oosparites, but free of strong metamorphic overprint, were also found. In some grains of a siliceous limestone, recrystallized radiolarians and thin-shelled bivalves were observed. Also, sparse grains of sandy to silty limestones were found but their original structure was also obliterated by the metamorphism. The metamorphosed limestones are frequently albitized (albite verified by microprobe), with albite grains concentrated, in some instances, at the surface of the lithoclasts or inside them. This invokes a theory that some grains of the feldspathic rocks might represent completely albitized limestones. Keratophyres are part of feldspathic rocks. They contain feldspathic spheroids (Pl. VII, Fig. 1) with brownish flaky minerals (probably biotite, according to some hexagonal cross-sections). Some quartz-feldspatic rocks, which may also represent some altered sediments, were also found.

Some grain margins are rimmed by fibrous calcite or chlorite (less common) that grow into the voids originated due to grain deformation. In this calcite the authigenic albite grains originated later.

The rip-up clasts of the underlying clayey shales and siltstones frequently occur in the breccia. It indicates an erosional character of the current that transported the detritus. The newly formed chlorite flakes that occur in the underlying and overlying claystone beds were not found in these rip-up clasts.

4. Detrital basaltic material analysis

Close to the type profile at Meliata, a small (about 2x1.5 m) outcrop of breccia was found, that also contains also some clasts of basaltic rocks. It probably represents a "diabase body" already mentioned by Kantor (1955) that occurrs approximately 200 m north from the type profile on a vegetation-covered slope above the left bank of the Muráň river.

The basaltic material is chiefly represented by fine-grained varieties (mainly more or less recrystallized volcanic glass); some more ophitic types are sparsely preserved. The devitrification of volcanic glass is shown by of fan-like aggregates of acicular plagioclase (up to 80%). In one instance, a clast incorporated to the breccia appeared to represent originally a volcanic breccia. Basalts with intersertal structure are also widespread. The clasts are largely spilitized, which is shown by newly formed chlorite and carbonates in veinlets, fine-grained aggregates and as independent xenomorphic grains. The ophitic texture was observed in just two clasts. In one of them, the plagioclases are replaced by epidote pseudomorphs, with a preservation of the original magmatic texture. The basaltic material in the breccia originated probably as a marginal part of a lava flow.

Other basaltic clasts are frequently found in detrital layers directly in the greenish Jurassic shales in the Meliata type profile (chapter B.3).

Although it does not represent a homogenous magmatic rock but clasts in detrital layers, miscellaneous magmatic rocks can be distinguished (Pls.IV, V):

a.) **Non-recrystallized volcanic glass** with amigdales (Pl. IV, Fig.1, 2) is a relatively frequent component. It is a dark-green to black glass with widespread (also non-crystalline) opaque pigment. The amigdales are tiny and possess regular circular shapes. As a rule, they are filled with chlorite and calcite, less quartz.

b.) **Recrystallized volcanic glass** (Pl. IV, Fig. 3, 4, Pl. V, Fig. 1) with signs of formation of intersertal, less arborescent structure, i.e. the rock is composed of microcrystalline plagioclase needles (most likely albite). The rest comprise a xenomorphic aggregate of chlorite and amorphous ore pigment. The amigdales (filled with chlorite and calcite) are frequent; elongated to massive plagioclase phenocrysts can be found also.

c.) **Fine- to coarse-grained intersertal basalts** (Pl.V, Fig. 2) form the majority of the basaltic clasts. The main portion of the rock texture consists of usually subhedral elongated plagioclase crystals; the intergranular spaces are again filled by chlorite. The opaque minerals are present in form of amorphous pigment and, to a lesser extent, as crystals (commonly acicular). Similar to rocks of groups a. and b., the plagioclase phenocrysts and amigdales are present in places.

d.) **Ophitic basalt** (Pl. V, Fig. 3) is a relatively rare component, consisting of big massive plagioclase crystals in various stages of saussuritization. As a rule, they are strongly altered; mineral grains of the epidote-zoisite group appear as a product of this alteration. Pyroxenes were not observed; however, their former presence is indicated by chlorite between the plagioclase crystals. Opaque minerals are again represented by brown pigment or as tiny crystals.

e.) **Dolerite** (?) clasts (Pl. V, Fig. 4) were found in very small amounts. They are strongly saussuritized forming large plagioclase crystals, that were in many cases further albitized. From other minerals, grains of quartz, chlorite, epidote and cubic-shaped mineral (likely pyrite) are present also.

These types were divided to facilitate their description; in fact, continuous transitions appear among them. Based on their petrographic characteristics, they represent different parts of a submarine lava flow: vitreous margins, fine- to coarse-grained intersertal types to coarse-grained ophitic and doleritic (?) varieties forming inner parts of the flow. Although, due to small size and high degree of spilitization, these clasts are inadequate for geochemical analysis, they probably represent an equivalent of the ophiolitic formation of the Meliata Unit defined as Švablica Formation (Hovorka & Spišiak, 1988) or as Bódva Ophiolite Formation (Réti, 1985).

5. Evaluation of radiolarian assemblages

The first radiolarian research of radiolarites in the locality Meliata was described in the paper of Kozur & Mock (1985). On the basis of revaluation of radiolarians from the uppermost part of the type section along the bend of Muráň river (Modrová, 1980) with the large stratigraphical interval of evaluated radiolarians - Triassic - Jurassic) Kozur (l.c.) demonstrated the occurrence of Jurassic in the Meliata Unit (Late Callovian-Early Oxfordian).

The 1992 samples from this section provided radiolarian assemblages, which all showed signs of sorting (size and shape uniformity). The conical, oval and flask-like shapes of small size highly prevailed here. Spumellarians occurred rarely, mainly as fragments. The species *Tricolocapsa conexa* Matsuoka was dominant in all assemblages.

They represented the stratigraphic range of the Bathonian to the upper half of the Callovian (Kozur et al., 1996) and, according to the assemblage described in the paper of Kozur & Mock (1985) the uppermost radiolarite layers were assigned to the Late Callovian-Early Oxfordian (Kozur et al., 1996).

According to the latest biozonation of Baumgartner et al. (1995) the assemblages from the samples of 1992 are of the stratigraphic interval Middle Bathonian to Early Callovian (Unitary Association Zone: U.A.Z.6 - U.A.Z.7).

Sample M-7 (Pl.IX) - U.A.Z. 6 - U.A.Z. 7 - Middle Bathonian - early Callovian (the co-occurrence of *Stylocapsa oblongula* Kocher, with *Stichocapsa robusta* MATSUOKA and *Dictyomitrella* (?) *kamoensis* MIZUTANI et KIDO.)

Sample M-3, M-3/3 (Pl.X) - U.A.Z. 6 - U.A.Z. 7 - Middle Bathonian-early Callovian (the co-occurrence of *Stylocapsa oblongula* MATSUOKA with *Stichocapsa robusta* MATSUOKA).

But, both of these associations lacked the species *Cinguloturris carpatica* Dumitrica or *Eucyrtidiellum ptyctum* Riedel et Sanfilippo, which occurred in the next assemblages from the superposed sample M-103B. Therefore they probably represent the lower part of this range.

Sample M-**103B** (Pl. XI) - U.A.Z 7 - late Bathonian-early Callovian (the co-occurrence of *Cinguloturris carpatica* DUMITRICA with *Stichocapsa robusta* MATSUOKA).

Tab.2 Distribution of radiolarians in the samples studied from the Meliata Unit type locality

Samples Radiolarian fauna	M-7	M-3	M-3/3	M-103B	G - 6
Acanthocircus suboblongus s.l. Yao					*
Angulobracchia sp.					*
Archaeodictyomitra exigua Blome	*				
Archaeodictyomitra primigena Pessagno et Whalen	*				
Archaeodictyomitra rigida Pessagno				*	*
Archaeodictyomitra sp.		*			
Archaeospongoprunum imlayi Pessagno				*	
Cingulotturris carpatica Dumitrica				*	
Dictyomitrella (?) kamoensis Mizutani et Kido	*		*		
Eucyrtidiellum ptyctum Riedel et Sanfilippo				*	*
Eucyrtidiellum semifactum Nagai et Mizutani	*				*
Eucyrtidiellum unumaense unumaense (Yao)	*			*	*
Eucyrtidiellum unumaense pustulatum Baumgartner			*		
Obesacapsula morroensis Pessagno			*		
Parahsuum sp.				*	
Parvicingula dhimenaensis s.l. Baumgartner	*		*		
Parvicingula dhimenaensis ssp. A sensu Baumg.et al.1995				*	*
Podobursa sp.				*	
Protunuma (?) lanosus Ožvoldová					*
Protunuma (?) ochiensis Matsuoka					*
Ristola altissima major Baumgartner et De Wever				*	
Semihsuum sourdoughense Pessagno, Blome et Hull				*	
Spongocapsula palmerae Pessagno					*
Stichocapsa convexa Yao	*	*	*	*	*
Stichocapsa robusta Matsuoka	*	*	*	*	
Stichocapsa sp. E sensu Baumgartner et al. 1995					*
Stylocapsa oblongula Kocher	*	*	*	*	
Theocapsomma cordis Kocher		*		*	
Theocapsomma cf. *cordis* Kocher		*			
Transhsuum brevicostatum (Ožvoldová)		*	*	*	
Transhsumm cf. *brevicostatum* (Ožvoldová)			*		
Transhsuum maxwelli gr. (Pessagno)	*	*	*		*
Tricolocapsa conexa Matsuoka	*	*	*	*	*
Tricolocapsa plicarum Yao		*			
Tricolocapsa cf. *plicarum* Yao			*		
Unuma latusicostatus (Aita)					*
Unuma sp. A sensu Baumgartner et al. 1995	*				*
Williriedellum sp. A sensu Matsuoka, 1983		*			
Williriedellum sp.	*				
Zhamoidellum sp.	*				

But the species *Eucyrtidiellum ptyctum* Riedel et Sanfilippo also occurred there. Baumgartner et al. (1995) established its appearance in U.A.Z. 5 (latest Bajocian - early Bathonian), but according to our research, as well as that of other authors (e.g. Yamamoto et al., 1985; Goričan, 1994), this species appears in Callovian.

Therefore this assemblage probably represents the uppermost part of the range of U.A.Z. 7.

The species *Eucyrtidiellum ptyctum* also occurred in the assemblage from the radiolarite in the locality Guba (**sample G-6**) (Pl. XII), NW of the studied section. This assemblage also represents the same stratigraphic interval as the sample M-103B.

The youngest assemblage from radiolarites in the type profile (late Callovian-Early Oxfordian) (Kozur & Mock, 1985) (Kozur et al., 1996) were not found from the samples of 1992.

The assemblages from Jurassic radiolarites in the locality Hamor were relatively poorly preserved. Their species composition showed mostly the large stratigraphical interval of Middle Jurassic age (Kozur et al., 1996).

C. Meliata Unit in the Jaklovce area

1. Previous investigations

The rocks near Jaklovce village (Fig. 5) have long attracted attention of geologists. Of interest to them were "diabases" and serpentinites, rocks that are not common in the Carpathian Mesozoic. They were thoroughly mapped and described by Kamenický (1957). His map remains the best information about the occurrences of these rocks in this complex area.

The basic and ultrabasic rocks were believed to be of Early Triasic age. The "Werfenian with diabases" of Jaklovce was a well-known term. Sediments surrounding the volcanites and serpentinites were also considered to be of Early Triassic age.

However, some controversial data in the descriptions of Kamenický (l.c.) and some of his successors attracted a new generation of investigators to this area. It was namely a problematic radiolarian fauna found in thin sections from the "Early Triassic" rocks, then the recrystallized pale limestones, quarried between Jaklovce and Margecany, that were strikingly similar to those in Meliata and in other known Meliatic localities. It is noteworthy that in the time when the marbles in Meliata were still considered to be of Carboniferous age, those from Jaklovce were, even without any known fossil remnants, attributed to the Middle Triassic (Steinalm Limestone). At the same time, however, the metamorphic difference between these marbles at Jaklovce and the unmetamorphosed limestones of Galmus Plateau (Silicicum s.l.) was explained through narrowing and squeezing of the "north-Gemeridic syncline" in this section and a weak metamorphism of the Triassic rocks.

In the late seventies, Mock (1980) found pink and red neptunian dykes in an abandoned quarry (with marbles and black aphanitic basalt in its upper parts). This material provided some Pelsonian conodonts. Similar dykes were already known from the Meliata Unit. The other rocks such as serpentinites, basalts, red claystones and silicitic shales, interbedded in basalts etc., however, were not known from this unit. Therefore, as with the Meliata Unit, this developement was considered to be an independent Jaklovce Group (Mock, 1980) and presumed to represent a Mesozoic cover of the northern Gemericum. Later, Gaál (1984) and Mahel' (1986) used the term Jaklovce Sequence.

Later, when all the typical Meliatic rocks had been reported from the Jaklovce area, the term Jaklovce Group became unnecessary; the whole sequence was attributed to the Meliata Unit s.s. sensu Kozur & Mock (1985). The red "Werfenian shales" with "diabase" bodies appeared to be red deep-water claystones, siliceous shales and radiolarites of the Middle Triassic age.

New biostratigraphic and geologic data came from an unpublished thesis of Nižňanský (1982), Ištvan (1984) and detailed mapping of Gaál (1984). A slightly simplified geological map of the latter author was also published by Mahel' (1986, p.138). The chaotic and complex geological structure of the area between Kurtova skala Hill and Margecany was divided by him into two sequences, the Jaklovce and Kurtova skala. The latter was considered to be the higher tectonic unit, a nappe remnant of the Middle Triassic limestones of the north Gemeric type (Stratená type - Silicicum s.l.); the lower, Jaklovce sequence, with frequent radiolarites and ophiolites, was considered to be a developement similar to the Meliata Unit. However, the Steinalm Limestones of Kurtova skala Hill are affected by the same (even a higher) degree of metamorphism as the pale Anisian marbles of the Jaklovce sequence of Gaál (l.c.).

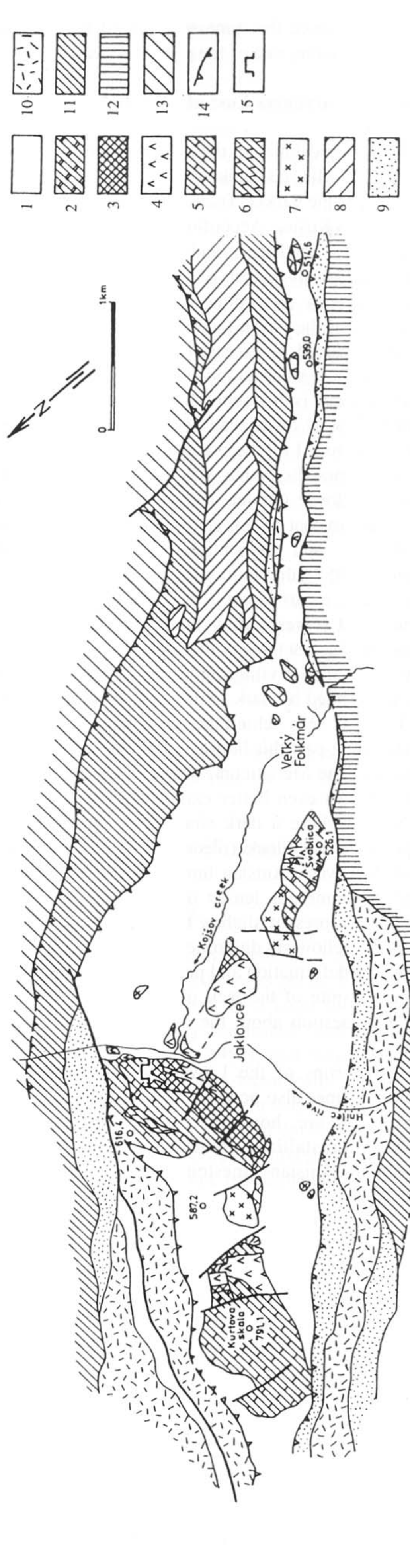
The Meliatic Unit in the Jaklovce area also commonly has numerous volcanic and magmatic rocks. They include a wide spectrum of volcanic and subvolcanic "diabases" (many altered) and various types of keratophyres and paleorhyolites. These basic volcanic rocks are dealt with in the separate chapter. The area is well-known mainly by its serpentinitic occurrences with chrysotile asbestos deposits. They form several isolated bodies (blocks) that were either thought to be ultrabasic protrusions or their tectonic emplacements. Most of the basic and ultrabasic rocks represent just the blocks, either olistoliths or tectonic lenses, in the Jurassic subduction melange.

2. New sedimentological and stratigraphical data

The Meliata Unit in the Jaklovce area represents a Jurassic sequence containing numerous detrital components of various size, from tiny clasts in breccias to megaolistoliths. Apart from it, they represent the same types of magmatic, volcanic and sedimentary rocks, predominantly of Triassic age.

The principal type of the Jurassic rocks (matrix of melange) is variegated claystones; they are most frequently grey, greyish-green, commonly laminated shales, but also include red, violetish to beige, noncalcareous to slightly calcareous shales. Siliceous shales with indeterminable radiolarians are widespread also. As a rule, the shales contain silty admixture mainly of macroscopically visible tiny mica flakes. Additionally, some argillites and sandstones are also present. Less frequent are coarse-grained sandstones to microconglomerates and breccias with miscellaneous detritic material. All these rocks were formerly considered to belong to the Lower Triassic. Actually, the Lower Triassic sediments in the Gemer area are similar to the Jurassic ones.

In the shale complex south of the 587.2 m elevation point, about 200 m W of the uppermost part of the large Margecany quarry our team found thin intercalations of greenish fine-grained breccias with polymictic composition that excludes the Lower Triassic age (Pl. XVI, Fig. 1). They comprise clasts of radiolarites and other silicites, various types of limestones and volcanics. Among the limestone clasts, shallow and deep-water types are present; the fact, that some of them are metamorphosed and some are not, is noteworthy. It indicates a pre-Jurassic or Jurassic metamorphism in this area. In some of them, crinoidal ossicles and foraminifers are observable. Clasts of albitized rocks are also frequent (Pl. XIII, Fig. 4).



The Jurassic age of the shales and breccias is indicated by the belemnite rostra (Pl. XV, Fig. 1-4). They were found in greenish shales and breccias (diamictites) with limestone clasts, occurring at the uppermost part of the rocks at Margecany quarry, among the Middle Triassic red radiolarites and basalts. Though indeterminable, some belemnites were also found in thin sections from the rocks of other sites. Besides the belemnite rostra, some other fauna is also visible in the thin sections. There are frequent crinoidal ossicles and fragments of bivalve shells (Pl.XIII, Fig.3); rarely also some juvenile ammonoid tests were observed. The breccia itself is mainly composed of lithoclasts of grey, rarely reddish limestones and numerous clasts of volcanics (mostly with intersertal textures). The basinal filamentous and filament-radiolarian microfacies are dominant in the limestones (Pl. XIV, Fig. 1, 3, 4). According to Ištvan (1984) such limestones are of Carnian age. Besides the deep-water facies, some shallow-water ones also occur (pelsparites - Pl.XIII, Fig. 2, Pl. XIV, Fig. 2); they probably belong to Middle Triassic. Rarely also some clasts of endostratic breccias (Pl.XIII, Fig. 1) and some mica schists with garnet (Pl. XV, Fig. 5) were also found in the breccias. The margins of the limestone lithoclasts are, generally, replaced by authigenic plagioclases. The matrix of the breccia is formed by calcareous claystone with some detrital quartz grains.

Another indication of the Jurassic age of the shales is provided by the occurrence of radiolarite with poorly preserved Jurassic radiolarians (Kozur & Mock, 1995) forming a thin (4-5 cm) layer in the laminated grey shales in the forested ground above the large Margecany quarry.

The next type of the Jurassic shales are black calcareous and non-calcareous claystones observable at Kurtova skala Hill (formerly interpreted as Reigraben Shales by Gaál, 1984) and at Mačací vrch Hill (448.5 m) S of Jaklovce. As a rule, they occur together with dark fine-grained sandstones. In an excavation at the railway viaduct near Jaklovce, grey to black rocks of lyditic character were uncovered. The surrounding well exposed rocks, formerly also regarded as Lower Triassic, are phyllite-like slates, sandy shales with detrital muscovite

←

Fig.5 Geological scheme of the area of Jaklovce and Veľký Folkmár villages (according to Kamenický, 1957, Gaál, 1984 and Polák et al., 1996 modified).

MELIATICUM: 1 – matrix of melange-calcareous shales, breccias with ?blocks of Early Triassic sediments, 2 – gray platy limestones with cherts (Carnian-Norian), 3 – siliceous shales, limestones and radiolarites (Illyr-Ladinian), 4 – basaltic rocks, volc. breccias (Middle Triassic, 5 – light massive crystalline Honce limestones (Pelson), 6 – gray and yellow dolomites (Anisian), 7 – serpentinites (?Triassic);

GEMERICUM: 8 – Črmel group - metabasalts, tuffs with shale intercalations (Early Carboniferous), 9 – Krompachy group, Knola formation - metaconglomerates (Early Permian), 10 – Krompachy group, Petrova hora formation - rhyolites, dacites, volcanoclastics (Early Permian), 11 – Dobšiná group, Hámor formation - clastic metasediments (Carboniferous), 12 – Rakovec group - phyllites metavolcanics (Devonian-Carboniferous);

VEPORICUM: 13 – crystalline rocks and sediments of Čierna hora Mts., 14 – thrust lines, 15 – Margecany quarry and lenses of pale limestones. The latter may represent tectonically deformed olistoliths. Along a path from the viaduct toward the local railway station in Jaklovce, a meter sized dolomite olistolith crops out. The dolomite olistoliths are conspicuous and interesting since they are not influenced by a pressure metamorphism. Such phenomana are observable at several sites.

The melange sequence includes clastic sediments of the Early Triassic age (identified by fossils). Kozur & Mock (1995) consider these rocks as blocks in the melange. As the area is poorly exposed (outcrops are very small and sparse) it is difficult to differentiate rocks of the Jurassic matrix from the lithologically similar Early Triassic clastics. Therefore they are not separated on the sketch (Fig.5).

Important components of the Jurassic sequence are olistoliths. The most widespread are pale recrystallized shallow-water Anisian Honce limestones and dolomites. These limestones form clasts of millimetre size to megaolistoliths. The largest Meliatic olistoliths are the blocks of shallow-water Anisian limestones at Kurtova skala Hill and at the 616.4 m elevation point north of Jaklovce. Another megaolistolith, represented by pelagic cherty limestones with Norian conodonts, occurs south of Jaklovce, between Švablica and the 525.1 m elevation point (the map of Gaál in Maheľ, 1986, p.138).

The limestone olistoliths, mainly of smaller size, are strongly deformed in the shales; in the past they were erroneously considered to be primary lenses or layers of the limestones in the shale formation. However, their olistolith character is recognizable only in a few places. Some egg-shaped to discoidal olistoliths encompassed in the greenish shales are commonly found, for instance, along the upper steps of the large Margecany quarry.

Other Meliatic rocks in the vicinity of Jaklovce are in most instances just olistoliths in the Jurassic shales. For instance, the basalts, red radiolarites, serpentinites and limestones at Švablica Hill are encompassed in shales, likely of the Jurassic age. A similar situation, with chaotically arranged blocks of various Anisian pale marbles (Honce limestones), Ladinian red radiolarites, Illyrian pelagic Žarnov limestones and basalts, is observable in the large Margecany quarry. In some places, the grey and greenish Jurassic shales form layers just several centimetres thick; in other places, the olistoliths are fully encompassed in the shales.

Bodies of basalts alternating with sediments are noteworthy. The largest such block is situated at the NE part of Jaklovce, at the road going towards Hnilec river. At an about 100 m-long outcrop, rocks of several basalt outflows separated by thin layers of red siliceous shales and radiolarites are observable (Jaklovce Formation sensu Kozur & Mock, 1985, p. 231). These deep-water sediments free of $CaCO_3$ contain an ubiquitous admixture of very fine detrital muscovite. Similar basalts and red deep-water sediments with submarine haematite (specularite) mineralization occur in the large Margecany quarry (Pl. XIV, Fig. 5, 6, Pl. XVI, Fig. 3).

The serpentinite blocks are difficult to rank stratigraphically. Their possible (Middle) Triassic age appear logical, since this time represented the period of the highest spreading rate of the meliatic oceanic floor.

D. Meliatic occurrences East of Jaklovce

In the Geological map of the eastern part of the Slovenské Rudohorie Mts. (Bajaník et al., 1984), a continuous narrow strip of the Lower Triassic is drawn, from Krompachy almost to Košice. According to the explanation, they are sandy shales, sandstones and limestones of the Lower Triassic, with locally preserved tiny remnants of Middle Triassic limestones. According to previous opinions, they represent part of the North Gemeric syncline, that is very narrow and reduced in its eastern segment. Permian and Triassic rocks, according to this opinion, lie directly on the Gemericum. There is no doubt that in this zone the Permian and Lower Triassic rocks really occur. The Early Triassic age was also proved by the presence of foraminifers from bedded limestones alternating with calcareous shales east of the village Jaklovce (Ištvan, 1984). However, for a long time it is known that in this narrow belt SE of Jaklovce, some diabase and serpentinite bodies are located (Kamenický, 1957), that do not fit into the Permian-Lower Triassic rock environment. We have studied some occurences that represent tiny but well exposed Meliatic remnants. Herein, just three of them will be mentioned.

In Veľký Folkmár village (Fig. 5), a serpentinite body occurs, surrounded by dark shales and fine-grained sandstones. It is best seen behind the house No.45 and along a field road going past this house. According to the present knowledge of the Meliaticum, the shales appear to be of Jurassic age. An even better example occurs behind the house No.41, where a dark shale complex outcrops. It encompasses a big block (olistolith) of pale laminated, likely shallow-water Anisian limestone. In other parts of the outcrop, numerous lenses of grey limestones occur that probably represent slightly tectonized olistoliths. An olistolith of yellowish dolomite was, however, not affected by any deformation and possess its original isometric shape. Despite of the lack of paleontological proves there is no question about the Jurassic age of the olistostrome.

Good outcrops of the Lower Triassic clastics and bedded limestones also occur at various places in Veľký Folkmár. They are, however, overlain by rauhwackes and pale recrystallized limestones macroscopically identical with Anisian limestones for example at Kurtova skala Hill.

Another occurrence of the Meliatic Unit is situated north of the road between Veľký Folkmár and Košice, near the 539 m elevation point. It is a small hill formed by black aphanitic basalts, belonging to one of the main Meliatic components. Some xenoliths of crystalline limestones indicate that the basalts had flowed to the limestone environment (Pl. XVI, Fig. 2). Other rocks, present only in debris, are greenish non-calcareous shales, greenish and light grey sandy shales, various types of sandstones and greywackes. All these rocks have a fine detrital muscovitic admixture. Also in this case, the Jurassic age of the rocks cannot be excluded.

The third Meliatic occurrence in this area is one of the most instructive outcrops of the Western Carpathians. It is a small abandoned quarry above the road between Veľký Folkmár and Košice, about 2 km west of Košické Hámre, below the 514.6 elevation point.

In the quarry wall, there is an olistostrome formation of undoubted Jurassic age. The matrix rock is greenish shales, comprising various rock components of different size and age. The whole complex is intensively deformed, even into very thin lenses. The parts consisting of numerous limestone olistoliths of similar size resemble metamorphosed nodular limestone. There are also larger blocks of pale wax-like shallow-marine limestones (originally Steinalm Limestone), various types of cherty and red limestones, containing extremely deformed and indeterminable conodonts, that indicate, however, their Triassic age. Furthermore, there are olistoliths of red radiolarites (likely of Ladinian age) and conspicuous undeformed dolomite clasts. Much of the quarry exposes greyish to black basalts overlying the sediments. They may also be a big olistolith body. The surrounding country is, however, mostly covered, further details are not observable.

The linear arrangement of the newly discovered Meliatic occurrences, as well as their intensive ductile deformation, suggest that they represent a tectonic line, along which the Meliatic components were uplifted and incorporated into the surrounding Permian and Lower Triassic rocks. This zone deserves a special structural-geological investigation.

Some Meliatic occurrences were also reported west and north of Kurtova skala Hill; they were, however, not studied by us.

E. Basic volcanic rocks of a wider surrounding of Jaklovce

1. Previous investigations

In vicinity of the Jaklovce village, numerous small bodies of basic and ultrabasic rocks occur. Field observations (e.g. in the upper part of a large quarry between Margecany and Jaklovce) confirmed, apart from older opinions (e.g. Kamenický, 1957), that they do not form continuous bodies but blocks tectonically involved into Jurassic shaly melange. No pattern was discerned in their spatial distribution, stratigraphy and thickness.

The fundamental petrological investigation of these basic rocks was carried out by Kamenický (1957) and later by Hovorka & Spišiak (1988). New views on the problematics of the studied area and new possibilities of geochemical interpretations, however, require a new treatment or at least a revision of the observations known so far. The basic rocks were affected by an oceanic floor metamorphism (chiefly spilitization in this case) and are strongly fractured and weathered which makes the geochemical and detail petrological sampling difficult.

2. Localities

In the wider surroundings of Jaklovce basic rocks occur in three areas. In some instances it is not clear whether they represent separated or continuous bodies. Taking into account this fact, the samples can be attributed (approximately) to the following larger bodies (from N):

a/. Near Kurtova skala hill and the large Margecany quarry.

b/. Near Švablica and the local manor-house.

c/. Between the Veľký Folkmár and Košické Hámre villages.

a/. Two bodies of basic rocks are situated on the SE slope of the Kurtova skala and around the Gottestal Valley; one body is in the higher parts of a small quarry in the Gottestal Valley, close to (SW of) the railway station, at the railway cut to the lime factory and on the slope above it and with some exposures also in the higher parts of the large quarry, which is probably an independent body.

b/. Another outcrop is in the village, roughly SE of the railway viaduct. On a flat hill locally called Švablica, W of the road to Folkmár, just one large body was found. The second body was mapped by Gaál (1984) as basalt but later it was seen to be a serpentinite body.

c/. The third cluster of outcrops lies along the road to Veľký Folkmár and further to Košické Hámre. Several bodies of basic rocks occur here, Veršek, Harbky, Dubov Harbek (Kamenický, 1957), but only two of them were verified by us. These are on the NE slope of the 539.0 m elevation point and close to it, in a small abandoned quarry above the road.

The literature on such occurences is difficult to work with in past because of inadequate location data and in part because local names changed.

3. Petrology of the basites

The basic rocks of the Jaklovce area represent a petrologicaly relatively homogenous group, with predominance of fine-grained types, ranging from hyaline - arborescent - intersertal - ophitic, to doleritic basalts. All of them are more or less spilitized, resulting mainly in the formation of albite, chlorite, epidote and leucoxenized Ti-minerals, at the expense of original magmatic paragenesis: basic plagioclase, volcanic glass, clinopyroxene, ilmenite and magnetite. The degree of the alteration is, of course, related also to the rock texture. The finer-grained the rock is, the more it is inclined to be altered. Hence in the coarser-grained rocks numerous relics of clinopyroxenes, important for genetic interpretation, are preserved. Therefore, the "classification" of the basalts based on the structural types is the most convenient. Such division appeared follows Kamenický (l.c.); herein, his findings will be adopted and augmented with some new data. Geochemical investigations substantiate that this approach was correct.

a.) **Medium to fine-grained metabasalts with ophitic to intersertal texture** represent the most widespread group. They occur at the Švablica Hill, in the railway cut, in the higher parts of the large quarry and also in the old quarry at Košické Hámre. Macroscopically, they are dark grey to greenish. At present they comprise an association of acicular to prismatic plagioclase of An_{32-38} (andesine) composition (approximately andesine), epidote, chlorite, clinozoisite and brownish cloudy product (probably leucoxene) after ilmenite. Other secondary minerals are calcite, limonite and pyrite. Intergranular spaces among the plagioclase needles are filled (in more fresh ophitic types) with relic clinopyroxene, compositionally close to the diopsidic augite. In finer-grained types, the vitreous mass altered into chlorite and epidote aggregates is present. Magnetite represents also a widespread accesoric component. This type is characteristic for the doleritic, ophitic and intersertal metabasalts.

b.) **Diabase porphyries with porphyric texture** have been described from two presently lost sites Dubov Harbek and Harbky at the Veľký Folkmár village Kamenický (l.c.). The samples from the railway cut in Jaklovce also belonged to this type. A difference with respect to the previous type is in the rare presence of the plagioclase phenocrysts (also with an An_{32-38} composition). They form subhedral, frequently twinned plates. Phenocrysts can occur in the texture in several varieties - intersertal, microdiabase, spilitic and blastoophitic texture.

c.) **Fine-grained basalts with arborescent textures** described Kamenický (l.c.) namely from the aforementioned "lost" localities of Harbky and Dubov Harbek. According to his original description, the rocks were formed of fan-like aggregates of thin, tiny needles of plagioclase, uralitized pyroxene and a vitreous mass in their intergranular spaces, with abundant chlorite (penninite) and lesser amount of titanite and epidote-zoisite minerals.

d.) **Aphanitic basalts** were described by Kamenický (l.c.) from another "lost" occurrence, Veršek at Veľký Folkmár. From our samples, some components of the volcanic breccias from a little quarry in the Trnkový potok valley near Košické Hámre can be assigned to this type. Macroscopically they are massive dark green rocks with hyaline and/or arborescent texture. About 60-70% of the rock consists of volcanic glass, that may be changed into fine-grained aggregates of chlorite. Clinopyroxene relics are rare and altered to chlorite-epidote aggregates. The plagioclases form irregularly dispersed tiny needles of the oligoclase-andesinic composition. Generally, the rocks are penetrated by a dense network of veinlets filled by albitic plagioclase, calcite and in places by actinolite.

e.) **Massive hyalodiabases with hyaline texture** are known again from the localities of Veršek, Harbky and Dubov Harbek (Kamenický, l.c.). Some components of the volcanic breccias are attributed to this type. These rocks are composed almost exclusively of volcanic glass (80-95%). Some tiny plagioclase needles are dispersed in this mass. Further primary components of the basites are fine pigment of the dispersed ilmenite and magnetite grains. The dense veinlet network is filled by epidote, chlorite and calcite.

f.) **Plagioclasites with intersertal structure** were not present in our samples. Kamenický (l.c.) mentioned them from the localities of Harbky and Dubov Harbek. He distinguished them by their higher percentage of plagioclases (up to 80%) with respect to the previous types. The plagioclase of these rocks is fine prismatic and tabular; the rest of the rock consists of volcanic glass and the products of its alteration (rarely also tiny clinopyroxene crystals) to chlorite-epidote aggregates.

Two other types can be added to the classical division of Kamenický (l.c.):

g.) **Coarse-grained metabasalt ("plagioclasite") with ophitic structure** was found in one sample from the abandoned quarry near Košické Hámre. It differs from the other ophitic basalts by its high content of massive plagioclase crystals (up to 80%); from the type f it differs only structurally. Clinopyroxene remnants are rare; the clinopyroxene crystals usually are altered to chlorite. Actinolite needles in xenomorphic chlorite grains, are a peculiarity.

h.) **Volcanic breccia** was found on the SE ridge of the 539.0 m elevation point between Košické Hámre and Veľký Folkmár and at the small abandoned quarry near Košické Hámre. The rock structure is brecciated, with matrix composed of volcanic glass, in places with relatively coarse-grained epidote aggregates. Irregularly dispersed basitic clasts of various grain-size are present, dominated by the fine-grained, hyaline, arborescent or intersertal types. The matrix and the clasts are pervasively spilitized; they represent a mixture of chlorite, brownish (likely titanium) pigment and calcite. The individual components, unfortunately, were not sufficient for geochemical sampling.

The named types represent various members of one volcanic series. A possible spatial shortening among the different basalt types results apparently from the tectonic reworking of the melange. The localities at Košické Hámre, Veľký Folkmár (and at the "lost" localities Veršek, Harbky and Dubov Harbek) are dominated by the vitreous and breccious types, whereas the Švablica and Jaklovce localities (at various places - in the large quarry and in the vicinity of Kurtova skala Hill) are characterized by a predominance of the intersertal and ophitic types. Note, that the lower oceanic crust, i.e. the major part of the ophiolite sequence (gabbros, cumulate complex etc.), is missing. The serpentinites in this area are evidently tectonically introduced into the melange structure, without genetic connection to the basalts.

The basaltic rocks from the Jaklovce area are considered to be the products of submarine volcanism with a dominant lava character. Although the pillow-lava structures have not been found, some parts of former lava flows can be determined. The vitreous rocks and volcanic breccias are the flow margins, the grain-size coarsens towards the center of the flow and changes through the arborescent and intersertal types to the ophitic types. The doleritic types indicate an origin of increased depths or in the center of the lava flow; some of them might even have come from a feeder dyke complex.

4. Mineralogy and geochemistry

Several methods have been used for deciphering the genetic relationship of the Jaklovce metabasalts, including microprobe analyses of the relic clinopyroxenes, silicate analyses and rare element analyses (detailed geochemical characteristics are being prepared).

Major element distribution and rare elements indicate association of the metabasalts to the oceanic tholeiites, in some cases with slight alkaline trend, that reflect ocean-floor alteration processes.

Based on the minor element distributions, the basalts are most similar to N-MORB (normal mid- ocean ridge basalts) with tendency to CAB (calc-alkaline basalts), which is characteristic for back-arc basin (Fig. 6).

The chondrite normalized patterns of REE show two groups: differentiated and non-differentiated types (Fig. 7)

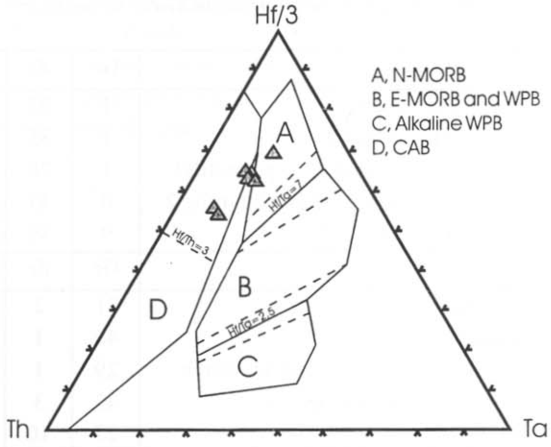


Fig. 6 Hf/3-Th-Ta discrimination diagram of the Jaklovce metabasalts (after Wood, 1980)

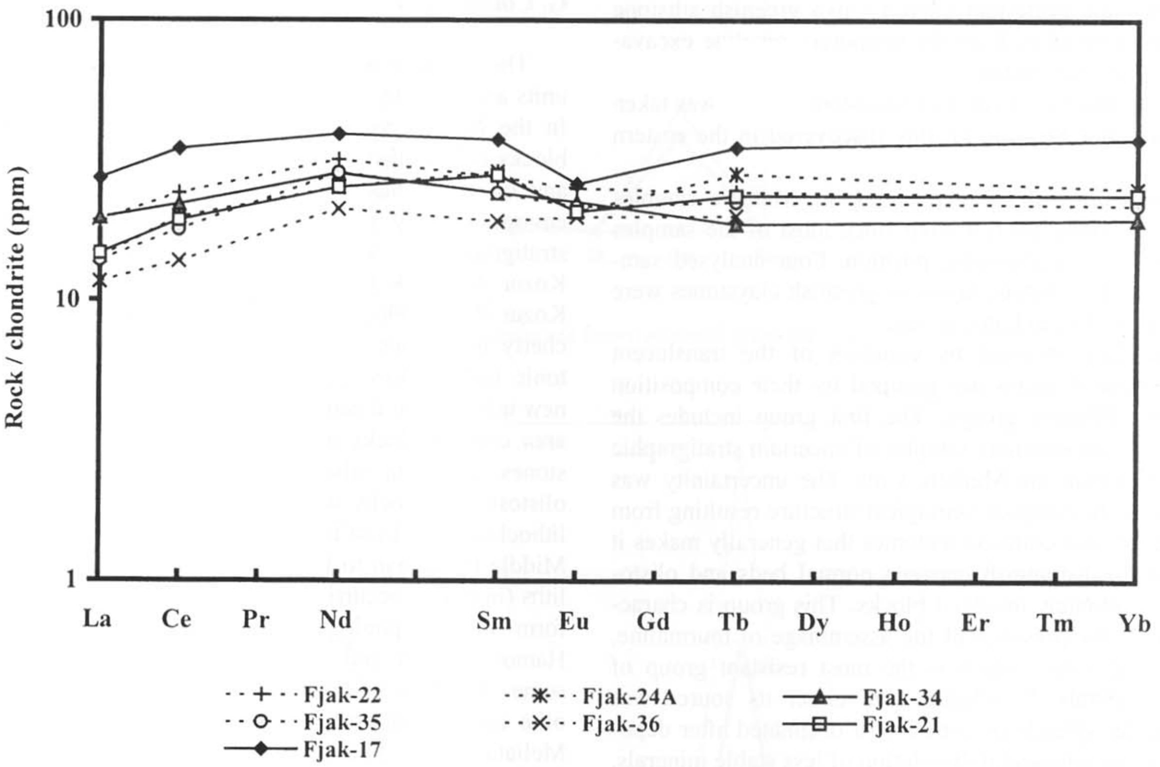


Fig. 7 Chondrite normalized patterns of REE for the Jaklovce metabasalts (normalization after Evensen & al., 1978).

F. Heavy mineral analysis of the Meliatic sediments from the Meliata and Jaklovce areas

Ten positive samples (containing enough sandy admixture) were analyzed from the Meliatic siliciclastic rocks (Tab. 3, Fig. 5, 6). They come not only from the Meliata area but also from the large quarry near Margecany and from the Florianikogel, the first Meliatic locality discovered in Austria (Mandl & Ondrejičková, 1992).

The locations of the sample sites are as follows:

Margecany - large quarry - sample represents a sandstone of uncertain stratigraphic position, found in the area of the Meliatic occurrences between Jaklovce and Margecany.

Meliata - above the southern end of the type profile - two samples of sandstones were taken from the slope debris.

Meliata - quartzites N of the type profile - two samples were taken from the quartzite blocks, cropping out on the slope upstream, behind the river curve. The quartzites are of uncertain stratigraphic and tectonic position.

Meliata - house No.72 - two samples were taken from the green siltstones and silty claystones in the outcrop behind the stable at this house.

Tab. 3 Percentual ratios of the translucent heavy minerals from the Meliata Unit.

	Gr	Zr	Ru	Tu	Ap	Am	Ti	St	Bar	Sp	Di
Margecany - large quarry	1	23	11	52	12	0	0	0	0	0	0
Meliata-end of the profile 1	1	35	9	42	1	0	1	0	10	0	0
Meliata- quartzites behind the type profile1	1	26	3	64	6	0	0	0	0	0	0
Meliata- quartzites behind the type profile 2	0	43	10	24	4	4	1	0	13	0	0
Meliata-end of the profile 2	9	39	13	38	0	0	0	*	*	0	0
	Gr	Zr	Ru	Tu	Ap	Am	Ti	St	Bar	Sp	Di
Meliata-house n.72/2	31	2	1	1	10	4	0	0	40	10	0
Meliata-house n.72/1	46	1	0	0	9	1	0	0	42	1	0
Meliata-100m above the protestant church.	29	1	1	**	8	1	1	0	57	0	1
Meliata - at the protestant church	43	3	3	0	10	0	0	0	40	0	0
Florianikogel	27	10	5	6	28	2	0	0	22	0	0

Explanations: Gr - garnet, Zr - zircon, Ru - rutile, Tu - tourmaline, Am - amphibole, Ap - apatite, Ti - titanite, St - staurolite, Cr - chromium spinels, Ba - baryte, + - content less than 1%

Meliata - the protestant church - two greenish siltstone samples were taken from the temporary pipeline excavations around the church.

Florianikogel, Austria - a sandstone sample was taken from the first Meliatic locality discovered in the eastern Alps.

Possibilities of comparison of the Meliatic samples with other units are restricted since most of the samples lacks precise stratigraphic position. Four analysed samples from the siltstone layers in greenish claystones were dated as Middle to Late Jurassic.

The data obtained by counting of the translucent heavy mineral grains are grouped by their composition into two different groups. The first group includes the sandstone and quartzite samples of uncertain stratigraphic position within the Meliatic Unit. The uncertainity was caused by the complex geological structure resulting from subduction and collision tectonics that generally makes it difficult to distinguish between normal beds and olistoliths of tectonicly involved blocks. This group is characterized by the presence of the assemblage of tourmaline, zircon and rutile, which is the most resistant group of heavy minerals. It indicates that either its source was some older siliciclastic rocks, or it originated after deposition by an intrastratal dissolution of less stable minerals. Such an assemblage is typical for the Jurassic sediments all around the Central and Inner Western Carpathians. The second group is represented by the siltstone samples, coming from the greenish non-calcareous claystones and by the sandstone sample from Florianikogel locality. This group contains mainly garnet and abundant apatite, baryte (likely authigenic), sparse chromium-spinel grains are also present. In the Jurassic of the Western Carpathians, the higher concentrations of detrital garnet are typical only for the Outer Carpathians (Pieniny Klippen Belt, Flysch Belt) and foreland units (autochthonous Jurassic sediments covering the slopes of the Bohemian Massif). However, a comparison of these units with the Meliata Unit only on the basis of heavy minerals remains premature.

G. Conclusions

The melange of the two studied areas of the Meliata units are mutually similar, yet in some details they differ. In the Meliata village area, the Meliata Unit contains blocks (olistoliths) of limestones, radiolarites, volcanics and clastics. These were transported to the deep-water environment by turbidity currents. The olistoliths are stratigraphically variable; in the published papers of Kozur & Mock (1980), Straka (1986), Kozur (1991), Kozur et al. (1996) there is a lot of age data of limestones, cherty limestones and radiolarites from the Meliata tectonic half-window. From these data augmented by our new information it can be stressed that the breccias at this area contain blocks of Lower to Middle Triassic limestones, Ladinian siliceous limestones and radiolarites, olistostrome blocks with Carnian and Norian limestone lithoclasts, blocks of likely Lower Jurassic limestones and Middle Bathonian to Lower Oxfordian radiolarite olistoliths (in places occurring as continuous layers). The latter form the morphologically conspicuous elevations of Hámor (335m) and Guba (322m) hills. Additionally, some olistoliths of basic volcanics, blocks of paleorhyolite and arkosic sandstone are sparsely present at the Meliata village. The latter two blocks are presumably of Paleozoic age.

The olistoliths of Mesozoic rocks represent various stages of the Meliatic evolution. The dark-grey Lower Triassic, light-grey (predominantly intensively metamorphosed) Lower Anisian shallow-water Honce Limestone, paleorhyolite and arkosic sandstone document the pre-rift stage. The start of riftogenesis is characterized by basinal red Žarnov Limestone with radiolarians, filaments and conodonts. These cover the Lower Anisian limestones, frequently forming fissure fillings in fractured bottom. The sedimentation of pelagic limestones, radiolarites and cherty limestones continued during Ladinian and Late Triassic, also. According to Kozur (1991) and our own observations a change in the sedimentation character took place during the Late Triassic. At that time the sedimentation of allodapic limestones and limestone breccias began. During the Early Jurassic, clayey calcareous shales with limestone layers and lithoclasts became dominant. The Middle Jurassic period was characterized by the start of matrix supported breccias (olistostromes) as a result of continental margin tectonics. The process of olistostrome formation finished in the Early Oxfordian (or later), since the youngest known radiolarian assemblage from radiolarite (layer 103, Fig. 4) is of Late Callovian-Early Oxfordian age (Kozur et al., 1996). The melange matrix is

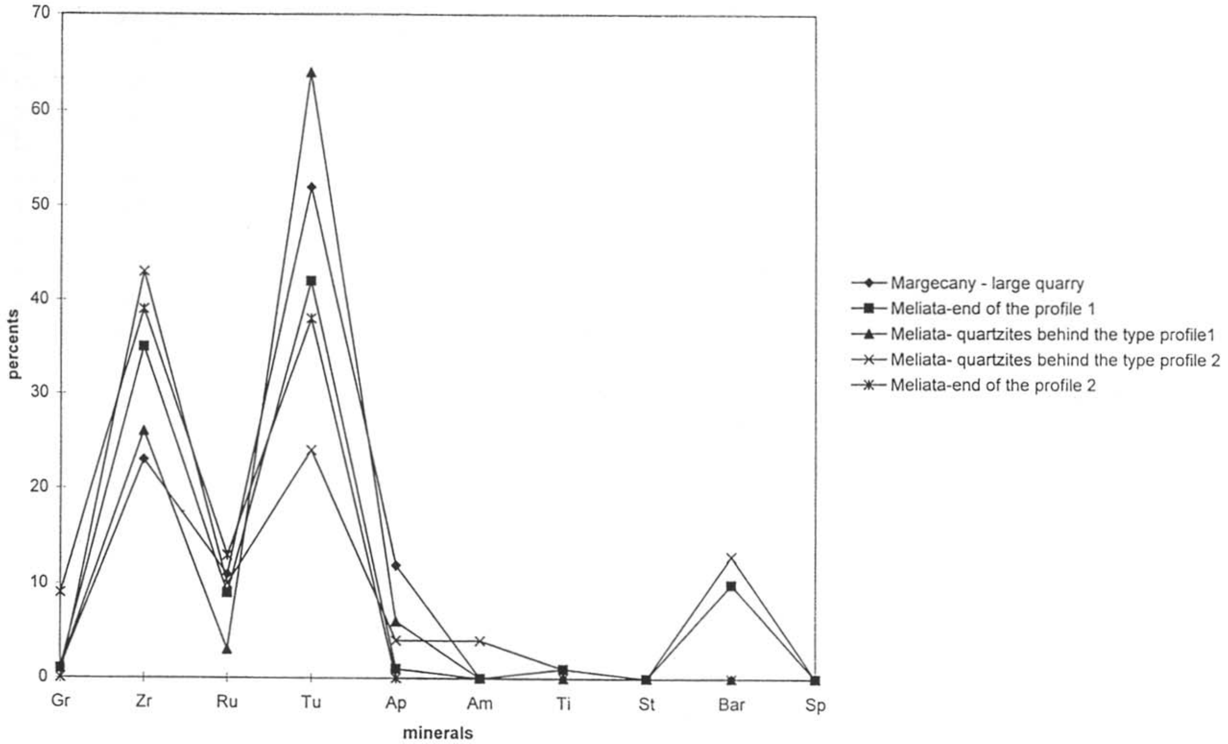


Fig. 8 Diagram displaying percentual contents of the translucent heavy minerals from the sandstones and quartzites of the Meliata Unit (group No.1).

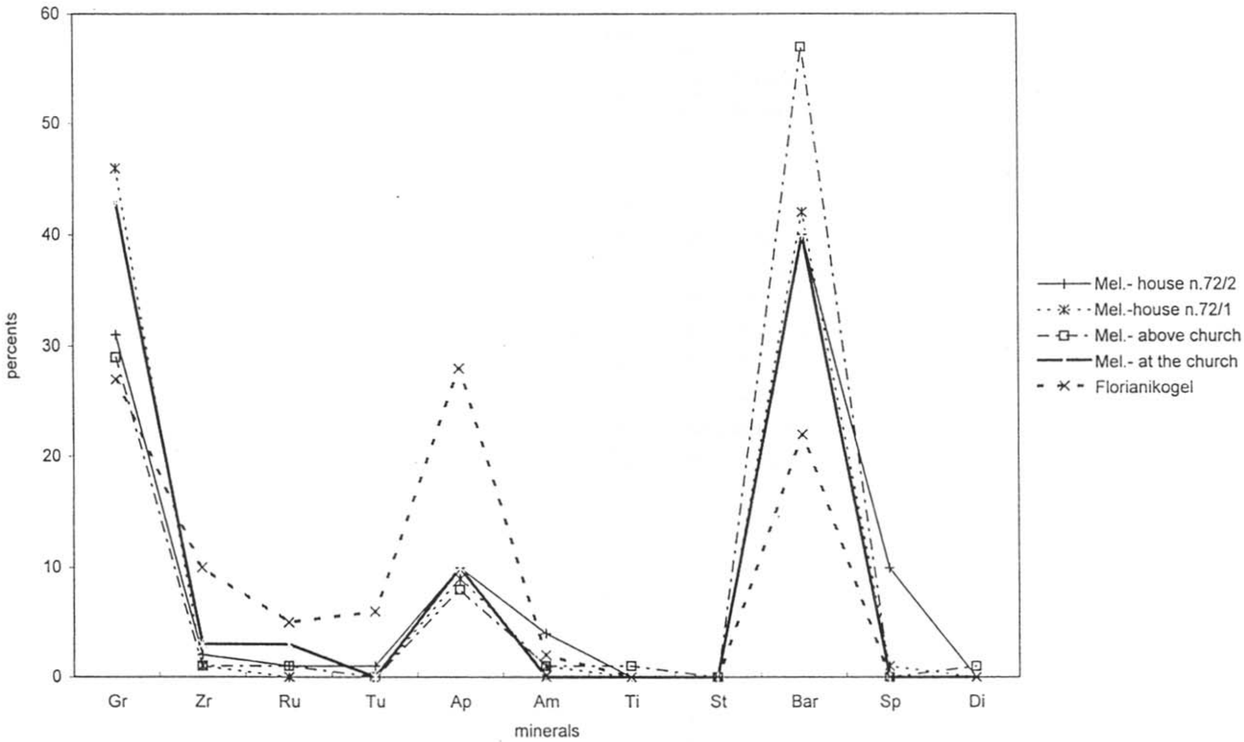


Fig. 9 Diagram displaying percentual contents of the translucent heavy minerals from the siltstone layers in the Middle Jurassic greenish claystones and the sandstone from the Florianikogel locality (group No.2).

represented by clastic development - clayey shales, siltstones, sandstones and rare breccias. On the left bank of Muráň river (Fig. 4) there is the grey radiolarite layer and laminae of presumably chloritized tuffites. According to Kozur (1991) the volcanic activity finished in the Early Cordevolian. The entire rock sequence was then anchimetamorphosed.

Microscopic analysis of the sandstones and breccias provided some information on the source of clastics. These psammites and psephites consist mainly of sedimentary rocks (predominantly limestones) and volcanic rocks. The limestone lithoclasts occur either as light-grey marbles or as pale non-metamorphosed shallow-water, most likely Triassic limestones. Similarly, the marbles and weakly metamorphosed limestones with the preserved original structures and microfossils also occur among carbonate olistoliths in the melange. A difference also is evident between the metamorphism of the Jurassic matrix and marbles. According to illite crystallinity (Šucha, pers. comm.), the Jurassic shales are just weakly anchimetamorphosed, whereas the conodonts from the marbles were strongly deformed and corroded (CAI 6). This indicates that the source area includes both, metamorphosed and unmetamorphosed limestone terranes, some even of the same age.

The lithoclasts of volcanics (basalts) represent predominantly fragments of submarine lava flows (glass to "doleritic" textures).

The melange in the Jaklovce area consists of lithologically, stratigraphically and dimensionally variable blocks. The pre-rift stage is also represented by Honce Limestone (its age was, however, not yet proven in this area), paleorhyolites and locally probably also by Lower Triassic clastics. The weakly metamorphosed Honce Limestone is overlain by reddish-grey to red Žarnov Limestone. According to Nižňanský (1982) and Ištvan (1984), it is of Pelsonian-Illyrian? age. As in the Meliata area, they commonly form fissure fillings related to the synrift stage of the Meliatic evolution.

NE of Veľký Folkmár village (Fig. 5) there is a megablock displaying a contact between weakly metamorphosed limestone (presumably Honce Limestone) with so called Jaklovce paleobasalts of the Švablica Formation. This indicates that before, or synchronously with, the sedimentation of the Žarnov Limestone, volcanic activity occurred locally within the newly formed rift structure.

The red limestones are overlain by a rock sequence referred to by Gaál (1984) as the diabase-shale-silicite complex. Its inferred age is Illyrian to Ladinian. In this complex, the deep-water siliceous shales with radiolarite layers are dominant. Their colour is chiefly greyish-red to red. Some irregular metabasalt bodies occur in the shales also. According to the minor element distribution, they are similar to marginal and back-arc basin basalts.

As in the Meliata area, carbonate sedimentation of conodont-bearing grey cherty limestones (now preserved as blocks) occurred in the Late Triassic (Cordevolian-Julian-?Norian). Unlike the Meliata area, no olistoliths of Jurassic sediments (radiolarites) were found in the Jaklovce area. This northern area of Meliatic Unit is typical by serpentinite olistolith occurrences, namely at Švablica hill. Blocks of paleorhyolites and keratophyres are scarce.

Unlike at Meliata, the matrix of the melange in this "Folkmar Suture Zone" (Kozur & Mock, 1995) is chiefly formed by grey to greyish-green calcareous claystones; siltstones and sandstones are less frequent. In the Jurassic sedimentary complex, breccias, dominated by lithoclasts of Triassic basinal to shallow-water limestones, occur rarely. Locally also belemnite rostra fragments are found in the breccias, directly indicating their Jurassic age. Kozur & Mock (1995) determined the Middle Jurassic (likely Bathonian) radiolarians in silicite intercalations in the turbiditic clastics NE of Jaklovce. The Lower Triassic sediments, locally determined by microfossils, are lithologically similar to the Jurassic clastics. Therefore, it is often difficult to discern them and to determine their mutual relationship, which is also frequently complicated by extensive Quaternary sedimentary cover. Kozur & Mock (l.c.) consider the Lower Triassic detritic sediments as blocks in the melange.

The sedimentation of the thick Jurassic shaly formation with the olistostrome bodies indicates an environment of a subduction trench. Recently, such sediments resembling an accretionary zone sequences that were studied by some of us in 1990 on the Chukotka Pacific coast. The deep-sea shales and radiolarites of the Meliatic Jurassic resemble the Chukotka sediments named by local geologists as "shukha". In the Meliaticum, however, only a few relics of an accretionary prism are preserved, which, moreover, are affected by several orogenic deformation events. Some young lateral movement along this suture, the location of which is still uncertain and disputed, surely played an important role.

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Explanations to the Plates I–XVI

Plate I

Fig. 1 Upper Jurassic claystone with irregularly developed laminae of quartz sand. Melange between the Muráň river and Hámor hill (NW of Meliata). Thin section No.22 107, magn.27x.

Fig. 2 Paleorhyolite - block in the melange NW of Meliata (see text fig.3). It contains magmatically corroded quartz, K-feldspars and devitrified glass. Thin section No.22 105, magn.8.5x.

Fig. 3 Middle Jurassic radiolarite from Hámor hill (megaolistolith). Thin section No.22 092, magn.45x.

Fig. 4 Cataclasis of a radiolarite lithoclast from the complex of Upper Jurassic clastics at the northern margin of the Meliata village. Thin section No.21 028, magn.27x.

Plate II

Detrital layers from the Meliata Unit type profile (scale=1cm).

Fig.1 Cross-section of polymictic breccia bed (one of the rare layers in the Middle Jurassic shales), representing a graded-bedded turbidite deposited from high-density turbidity current. It contains abundant rip-up clasts of the underlying clayey shales.

Fig.2 Cross-section of a laminated channel filling in the Middle Jurassic claystones. The visible grade-bedded laminae (deposit of traction carpet) are overlain by a psephitic layer. Sample of debris.

Fig.3 Polymictic breccia (grain flow deposit?) from the Middle Jurassic shale complex. The breccia comprises mainly of clasts of spilitized volcanics, limestones, pale marbles and albitized sedimentary rocks.

Fig.4 Two layers of coarse-grained sandstones to fine-grained breccias in the Middle Jurassic claystones. The lighter part of the shale between the sandstone layers was seismicly disturbed and slided along a newly formed plane, oblique to the bedding.

Plate III

Detrital material from the breccias and sandstones from the Meliata Unit type profile (see Pl. II).

Fig.1 Recrystallized calcite ooid, as a clast, in the sedimentary breccia. Thin section No.20 658, magn.46x.

Fig.2 Triassic (?) foraminifer in a biosparitic (grainstone) lithoclast from a polymictic breccia. Thin section No.20 660, magn.80x.

Fig.3 Cross-section of a bivalve shell represents one of the rare bioclasts in the breccia. The thin lithoclast is a claystone rip-up clast from the underlying bed. Thin section No.20 654, magn.46x.

Fig.4 Corroded and bored echinoderm ossicle, as a clast in the breccia. Thin section No.20 662, magn.30x.

Fig.5 Oncoid, as a clastic grain in the breccia. Thin section No.20 659, magn.40x.

Fig.6 Oosparite-grainstone of Triassic or Early Jurassic age, as a lithoclast in the breccia. Thin section No.20 654, magn.46x.

Fig.7 Pelsparite-grainstone, as a lithoclast in the breccia. Thin section No.20 662, magn.46x.

Fig.8 Pelmicrosparite with *Aeolisaccus* sp. - Triassic lithoclast in the breccia. Thin section No.20 659, magn.46x.

Plate IV

Detrital material from the breccias and sandstones from the Meliata Unit type profile (see Pl. II).

Fig.1 Lithoclast of non-recrystallized volcanic glass with amigdales. The glass contains opaque pigment; the amigdales are filled with calcite and chlorite. Plain light, thin section No.20 654, magn.27x.

Fig.2 Lithoclast of volcanic glass with deformed amigdales filled by calcite. Parallel polars, thin section No.20 654, magn.46x.

Fig.3 Lithoclast of recrystallized volcanic glass with pseudomorph of albite after a magmatic plagioclase. Crossed polars, thin section No.20 953, magn.46x.

Fig.4 Lithoclast of recrystallized volcanic glass with signs of an intersertal texture. The phenocrysts form thin laths of plagioclase. Crossed polars, thin section No.20 656, magn.30x.

Plate V

Clasts of basic volcanics in the detrital layers (see Pl. II)

Fig.1 Lithoclast of vitreous basalt with acicular crystals of plagioclase and opaque pigment. The amigdales are filled with chlorite. Crossed polars, thin section No.20 656, magn.27x.

Fig.2 Basaltic lithoclast with intersertal texture comprising the needle plagioclase crystals, glass and opaque pigment. Crossed polars, thin section No.20 657, magn.27x.

Fig.3 Lithoclast of basalt with ophitic texture, with plagioclase phenocrysts and partially also opaque pigment. Crossed polars, thin section No.20 654, magn.30x.

Fig.4 Coarse-grained basalt (dolerite?) as a lithoclast of the sedimentary breccia. Crossed polars, thin section No.20 654, magn.46x.

Plate VI

Detrital material from the breccias and sandstones from the Meliata Unit type profile (see Pl. II).

Fig.1 Lithoclast of micrite with calcitic pseudomorphs after gypsum crystals (probably Triassic) in the polymictic breccia. Thin section No.20 953, magn.30x.

Fig.2 Radiolarite lithoclast (Triassic?) in the breccia. Thin section No.20 955, magn.30x.

Fig.3 Metamorphosed limestone as a lithoclast in the breccia. Crossed polars, thin section No.20 657, magn.30x.

Fig.4 Lithoclasts of metamorphosed limestone and claystone (the rip-up clast) in the breccia. Thin section No.20 656, magn.95x.

Plate VII

Fig.1 Keratophyre as a lithoclast in the sedimentary breccia. The feldspar crystals are oval shaped with signs of spheroidal texture. The matrix among the grains is carbonate and albite (from the detrital layers as the previous plates). Thin section No.20 958, magn.95x.

Fig.2 Jurassic spotted bioturbated claystone with some quartz and chlorite grains. Outcrop at the left bank of the Muráň river (text fig. 4). Thin section No.20 524, magn.30x.

Fig.3 Pressure deformed carbonate breccia (probably Jurassic). The lithoclasts are the Carnian metamorphosed limestones. Locality - as for Fig. 2.

Fig.4 Middle Jurassic laminated clayey shale. The laminae formed by Fe-chlorite represent probably a chloritized tuffitic material related to synchronous volcanism. Locality - as for Fig. 2.

Plate VIII

Fig.1 Intrasparite - a block in the melange NW from Meliata. The foraminifers (outside the figure) indicate its Pelsonian age. Thin section No.23 101, magn.32x.

Fig.2 *Hoyanella* sp. (left) and *Cornuspira* sp. (right), from a block of Lower Triassic metamorphosed limestone. Locality - near the NE margin of Meliata (text fig.3). Thin section No.24 722, magn.62.5x.

Fig.3 Filaments and poorly preserved calcified radiolarians in a reddish-grey Pelsonian Žarnov Limestone (the age indicated by conodonts). Left bank of the Muráň river (text fig.4). Thin section No.20 793, magn.19x.

Fig.4 Lithoclast of biomicrite with filamentous microfacies (probably Carnian) in the Jurassic shales. Left side of the Muráň river valley, at the Meliata mill. Thin section No.21 050, magn.32x.

Fig.5 Lamina of detrital limestone with ostracod tests in a clayey limestone block (probably Lower Jurassic). Close to the NE margin of Meliata. Thin section No.21 060, magn.27x.

Fig.6 Resedimented radiolarians as a detritus in a Jurassic siltstone. Northern margin of the Meliata village. Thin section No.21 617, magn.86x.

Plate IX

Radiolarians from the sample M-7 (Meliata)

Fig.1 *Stylocapsa oblongula* KOCHER - 0535, magn.500x
Fig.2 *Dictyomitrella(?) kamoensis* MIZUTANI et KIDO - 0537, magn.350x
Fig.3 *Parvicingula dhimenaensis* s.l. BAUMGARTNER - 0551, magn.300x
Fig.4 *Tricolocapsa conexa* MATSUOKA - 0548, magn.380x
Fig.5 *Unuma* sp.A sensu BAUMG. et al.,1995 - 0557, magn.400x
Fig.6 *Stichocapsa robusta* Matsuoka - 0536, magn.280x
Fig.7 *Archaeodictyomitra exigua* Blome - 0555, magn.500x
Fig.8 *Transhsuum maxwelli* gr. (PESSAGNO) - 0547, magn.300x
Fig.9 *Zhamoidellum* sp. - 0549, magn.390x
Fig.10 *Stichocapsa convexa* Yao - 0530, magn.310x
Fig.11 *Williriedellum* sp. - 0532, magn.350x
Fig.12 *Eucyrtidiellum semifactum* Nagai et Mizutani - 0526, magn.550x
Fig.13 *Archaeodictyomitra primigena* Pessagno et Whalen - 0554, magn.600x

Plate X

Radiolarians from the samples M-3, M-3/3 (Meliata)

Fig.1 *Stichocapsa robusta* Matsuoka - 3,3995, magn.300x
Fig.2 *Dictyomitrella*(?) *kamoensis* Mizutani et Kido-3/3,2788, magn.300x
Fig.3 *Parvicingula dhimenaensis* s.l. Baumgartner - 3/3, 2796, magn.300x
Fig.4 *Tricolocapsa conexa* Matsuoka - 3/3, 2799, magn.400x
Fig.5 *Transhsuum maxwelli* gr.(Pessagno) - 3/3, 2810, magn.300x
Fig.6 *Transhsuum* cf. *brevicostatum* (Ožvoldová) - 3/3, 2797, magn.300x
Fig.7 *Tricolocapsa* cf.*plicarum* Yao - 3, 4047, magn.380x
Fig.8 *Stichocapsa convexa* Yao - 3/3, 2798, magn.400x
Fig.9 *Stylocapsa oblongula* Kocher - 3, 4036, magn.600x
Fig.10 *Williriedellum* sp.A sensu Matsuoka,l983 - 3, 4046, magn.450x
Fig.11 *Obesacapsula morroensis* Pessagno - 3/3, 2805, magn.175x
Fig.12 *Archaeodictyomitra* sp.- 3, 4037, magn.550x
Fig.13 *Theocapsomma* cf.*cordis* Kocher - 3, 4049, magn.500x

Plate XI

Radiolarians from the sample M-103B (Meliata)

Fig.1 *Cinguloturris carpatica* Dumitrica - 0183, magn.28Ox
Fig.2 *Eucyrtidiellum ptyctum* Riedel et Sanfilippo - 0185, magn.420x
Fig.3 *Stichocapsa robusta* Matsuoka - 0215, magn.330x
Fig.4 *Ristola altissima major* Baumgartner et De Wever - 103B, 0219, magn.175x
Fig.5 *Tricolocapsa conexa* Matsuoka - 0233, magn.390x
Fig.6 *Theocapsomma cordis* Kocher - 0225, magn.500x
Fig.7 *Stylocapsa oblongula* Kocher - 0240, magn.500x
Fig.8 *Stichocapsa convexa* Yao - 0215, magn.300x
Fig.9 *Archaeodictyomitra rigida* Pessagno - 0179, magn.350x
Fig.10 *Transhsuum brevicostatum* (Ožvoldová) - 0218, magn.300x
Fig.11 *Archaeospongoprunum imlayi* Pessagno - 0190, magn.240x
Fig.12 *Semihsuum sourdoughense* Pessagno,Blome et Hull - 0214, magn.330x
Fig.13 *Parahsuum*? sp. - 0180, magn.420x
Fig.14 *Podobursa* sp. - 0181, magn.225x

Plate XII

Radiolarians from the sample G-6 (Guba)

Fig.1 *Eucyrtidiellum ptyctum* Riedel et Sanfilippo - 2041, magn.400x
Fig.2 *Eucyrtidiellum semifactum* Nagai et Mizutani - 2700, magn.520x
Fig.3 *Parvicingula dhimenaensis* ssp.A sensu Baumgartner et al. 1995 - 2687, magn.390x
Fig.4 *Spongocapsula palmerae* Pessagno - 2688, magn.290x

Fig.5 *Unuma* sp.A sensu Baumgartner et al.1995 - 2683, magn.390x
Fig.6 *Tricolocapsa conexa* Matsuoka - 2047, magn.410x
Fig.7 *Acanthocircus suboblongus* s.l. Yao - 2684, magn.300x
Fig.8 *Unuma latusicostatus* (Aita) - 2686, magn.400x
Fig.9 *Stichocapsa* sp. E sensu Baumgartner et al.1995 - 2689, magn.320x
Fig.1O *Acanthocircus* sp.- 2039, magn.300x
Fig.11 *Eucyrtidiellum unumaense unumaense* (Yao) - 2671, magn.500x
Fig.12 *Protunuma*? *lanosus* Ožvoldová - 2667, magn.450x
Fig.13 *Stichocapsa convexa* Yao - 2049, magn.390x
Fig.14 *Angulobracchia* sp. - 2677, magn.150x

Plate XIII
Components of breccias from the area between the Margecany quarry and Kurtova skala hill.
Fig.1 Lithoclast of an older limestone breccia in the Jurassic sedimentary breccia. Thin section No.21 826, magn.30x.
Fig.2 Pressure deformed lithoclast of pelsparite-grainstone (Triassic?) in the Jurassic sedimentary breccia. Thin section No.21 825, magn.30x.
Fig.3 Lithoclast of volcanite (devitrified glass) and bivalve shell fragment in the Jurassic breccia. Thin section No.21 826, magn.30x.
Fig.4 Micrite clast with authigenic feldspar grains (left) and bioclasts in the Jurassic breccia. Thin section No.21 826, magn.30x.

Plate XIV
Components of breccias and shales from the top part of the Margecany quarry.
Fig.1 Lithoclast with filamentous microfacies (probably Upper Triassic) from carbonate breccia in the Jurassic shales. Thin section No.23 524, magn.19x.
Fig.2 Pelbiosparite lithoclast with filaments and peloids (probably Upper Triassic). Thin section No.23 533, magn.19x.
Fig.3 Biomicrite lithoclast with calcified radiolarians and rare filaments (probably Upper Triassic). Thin section No.23 525, magn.19x.
Fig.4 Biomicrite lithoclast with calcified radiolarians, filaments and a juvenile ammonoid test. Thin section No.23 524, magn.19x.
Fig.5 Radiolarite with stylolites and pressure deformed radiolarian tests. Detrital quartz grains (silt to fine-grained sand) visible on the left side of the picture. From the red shale formation at the top part of the quarry. Thin section No.21 829, magn.48x.
Fig.6 Haematite-siliceous lamina in radiolarite (for the rock see Pl.XVI, Fig.3. Thin section No.21 829, magn.48x.

Plate XV
Fig.1,2 Fragments of belemnite rostra in the Jurassic carbonate breccia. Locality - top part of the Margecany quarry (scale = 1cm).
Fig.3,4 Transverse (3) and longitudinal (4) cross-section through a deformed belemnite rostrum from the Jurassic carbonate breccia. Locality - as for Figs.1 and 2. Magn. 8x.
Fig.5 Pressure deformed lithoclast of a garnet mica-schists and an echinoderm ossicle replaced by pale grey silicate in the Jurassic carbonate breccia. Locality - the area between the Margecany quarry and Kurtova skala hill. Magn. 30x.

Plate XVI
Fig.1 Carbonate breccia from the Jurassic shale formation. Locality - the area between Margecany and Kurtova skala hill. All scales = 1cm.
Fig.2 Breccia composed of metamorphosed limestone and tuffitic material. Locality - abandoned quarry at the road brtween Košické Hámre and Veľký Folkmár.
Fig.3 Radiolarite with lensoid laminae of haematite-siliceous rock (see also Pl.XIV, Fig.6) from the Jurassic red shale formation. Locality - top part of the Margecany quarry.
Fig.4 Breccia comprising grey fine-grained silicite clasts and red siliceous matrix from the Jurassic red shale formation. Locality - top part of the Margecany quarry.

Plate I

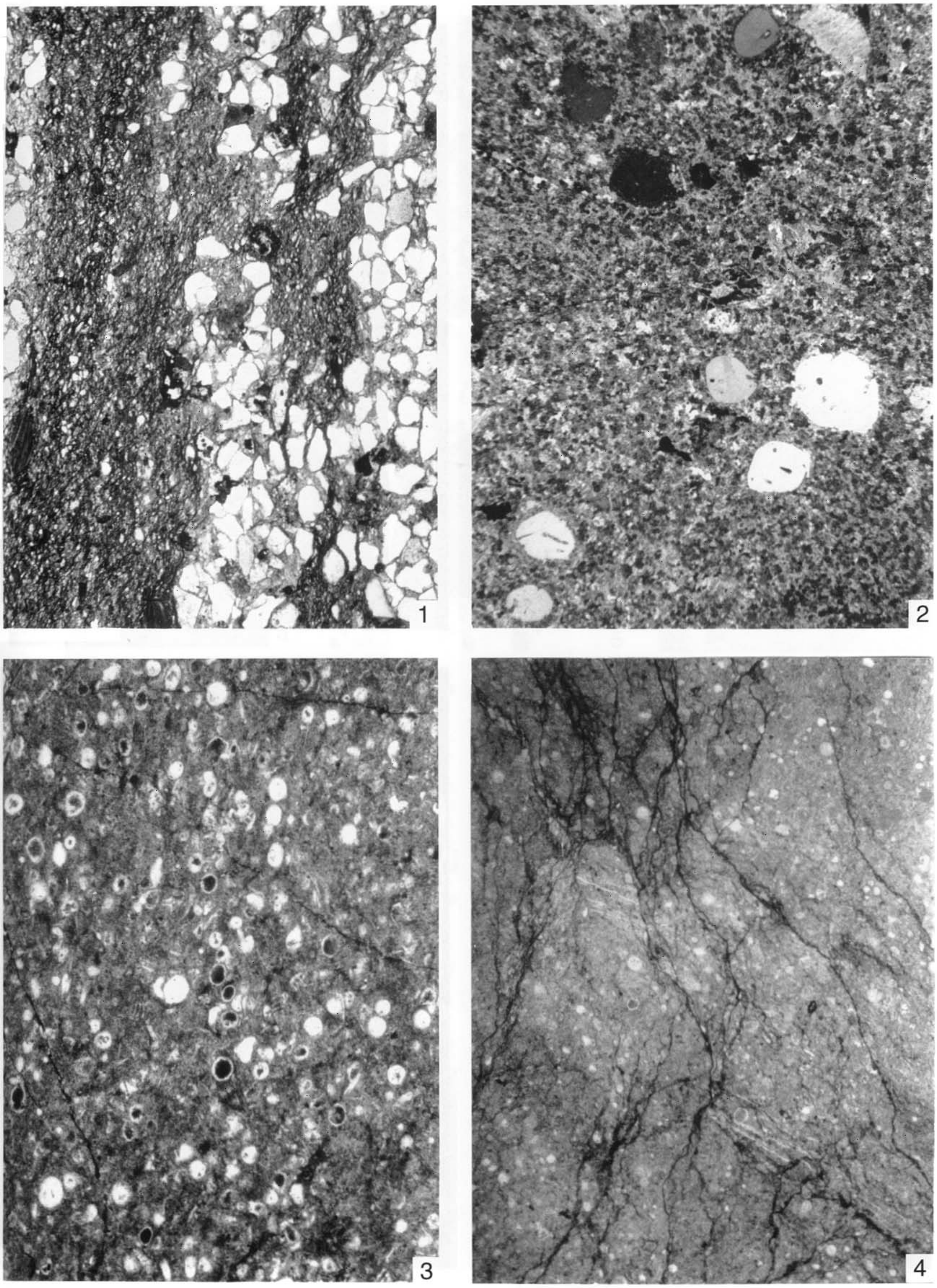
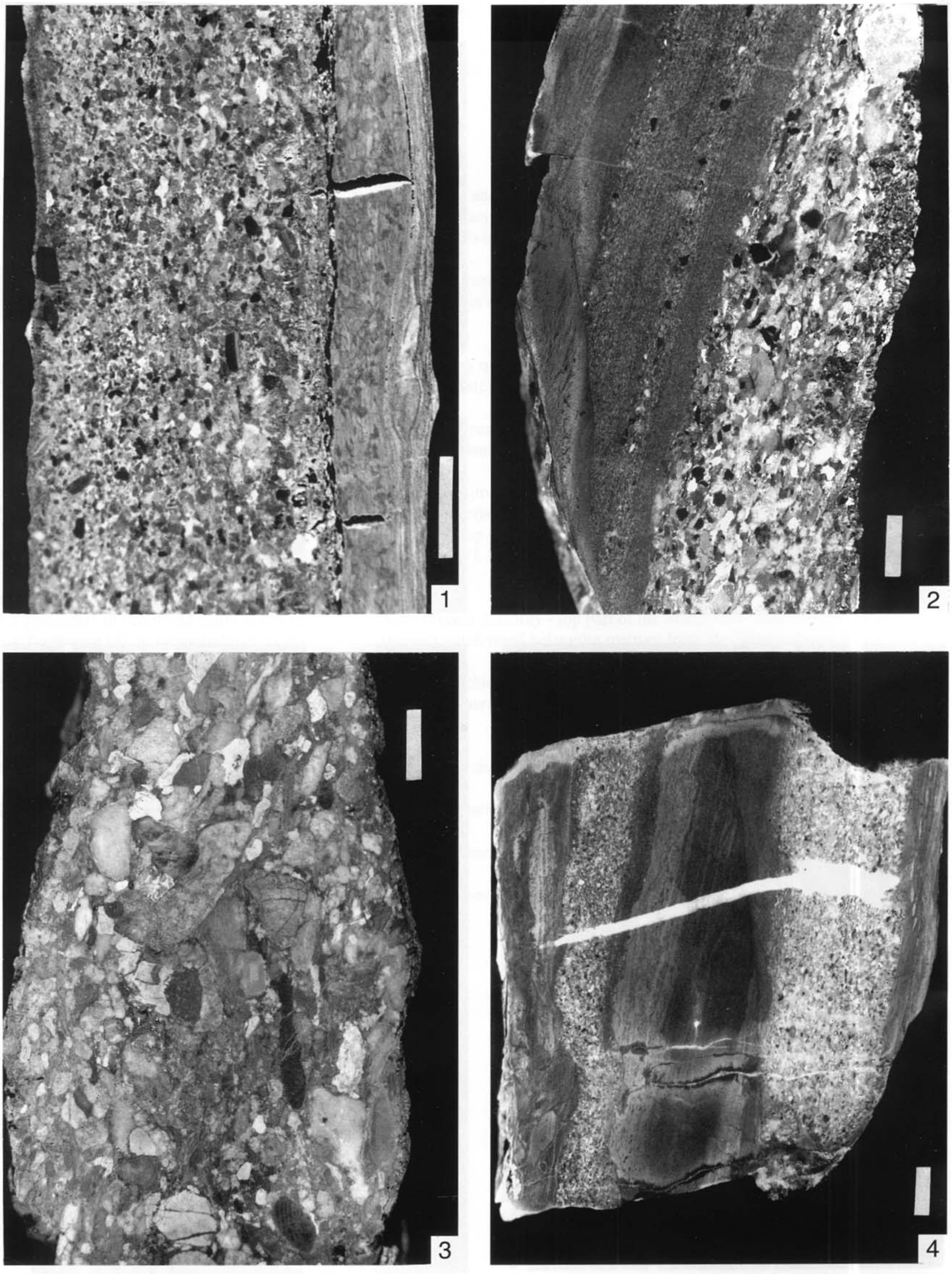


Plate II



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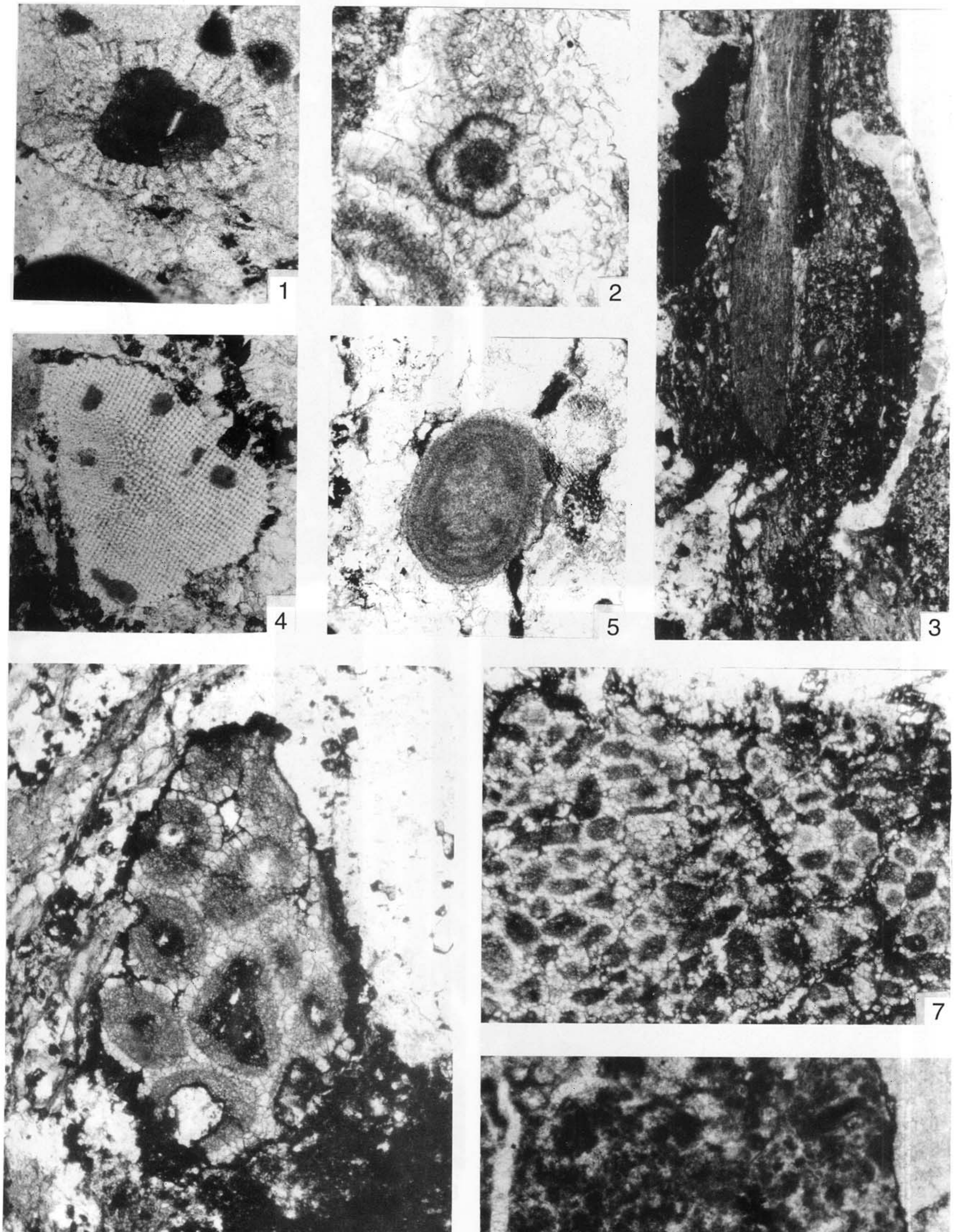

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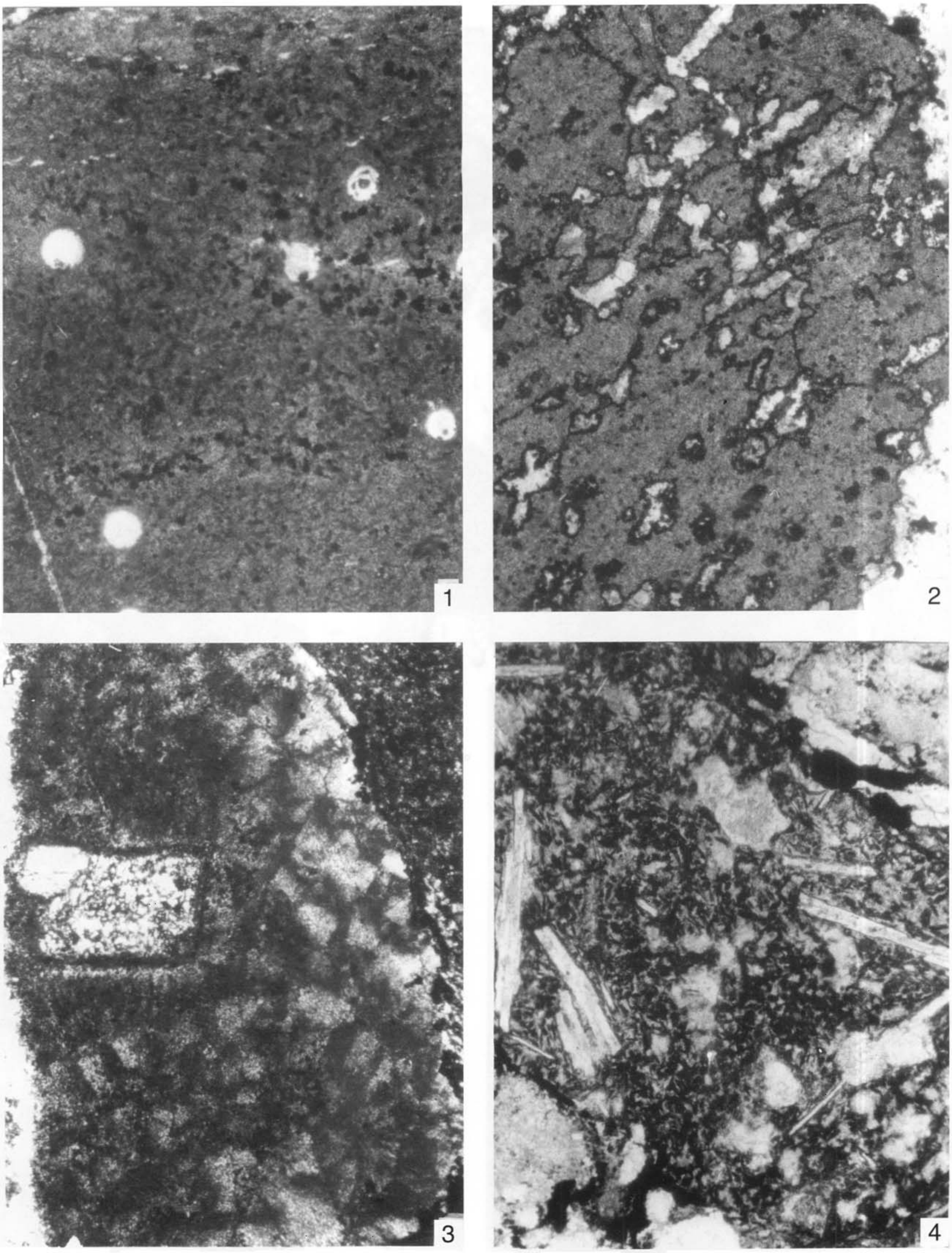

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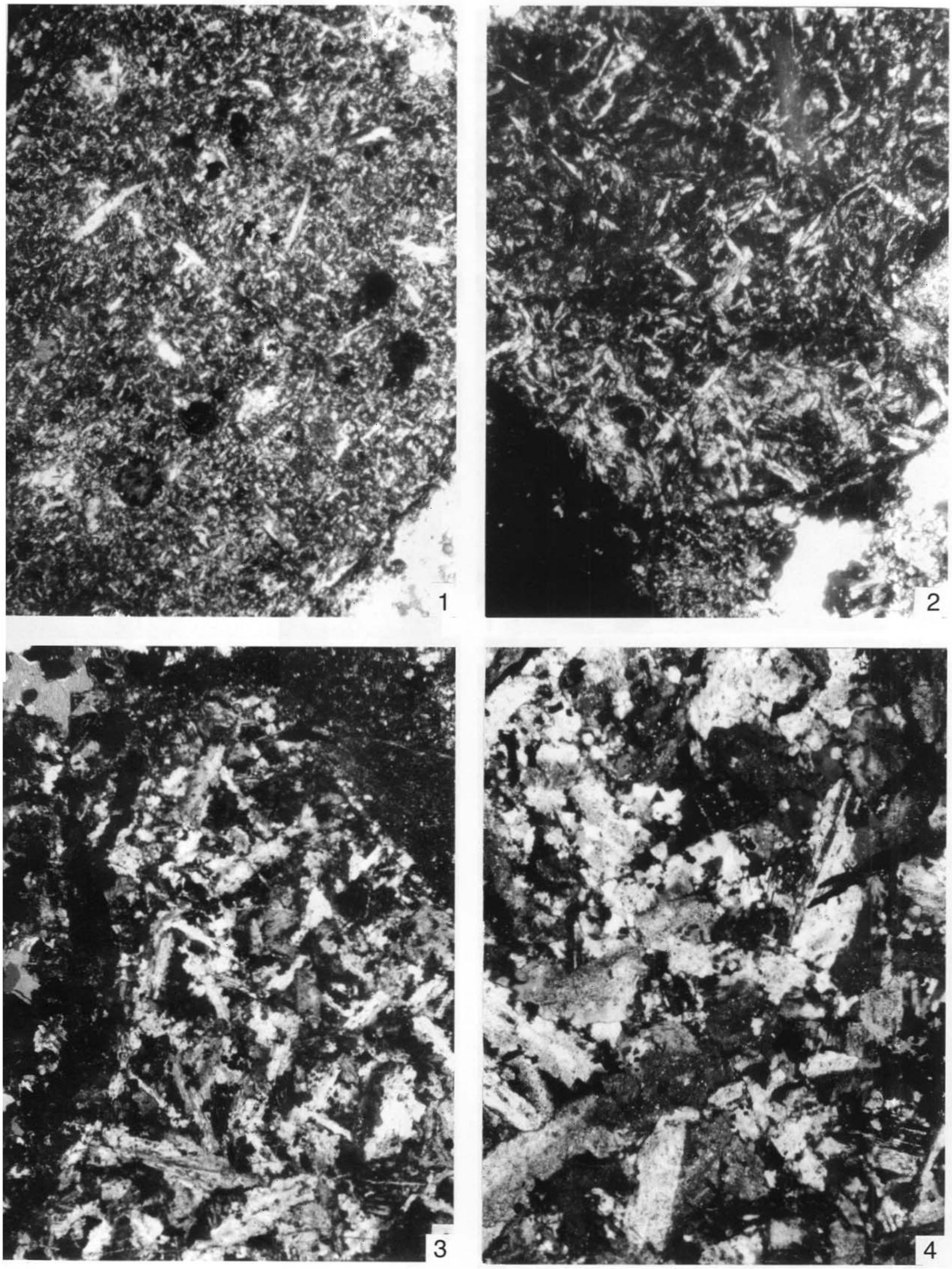

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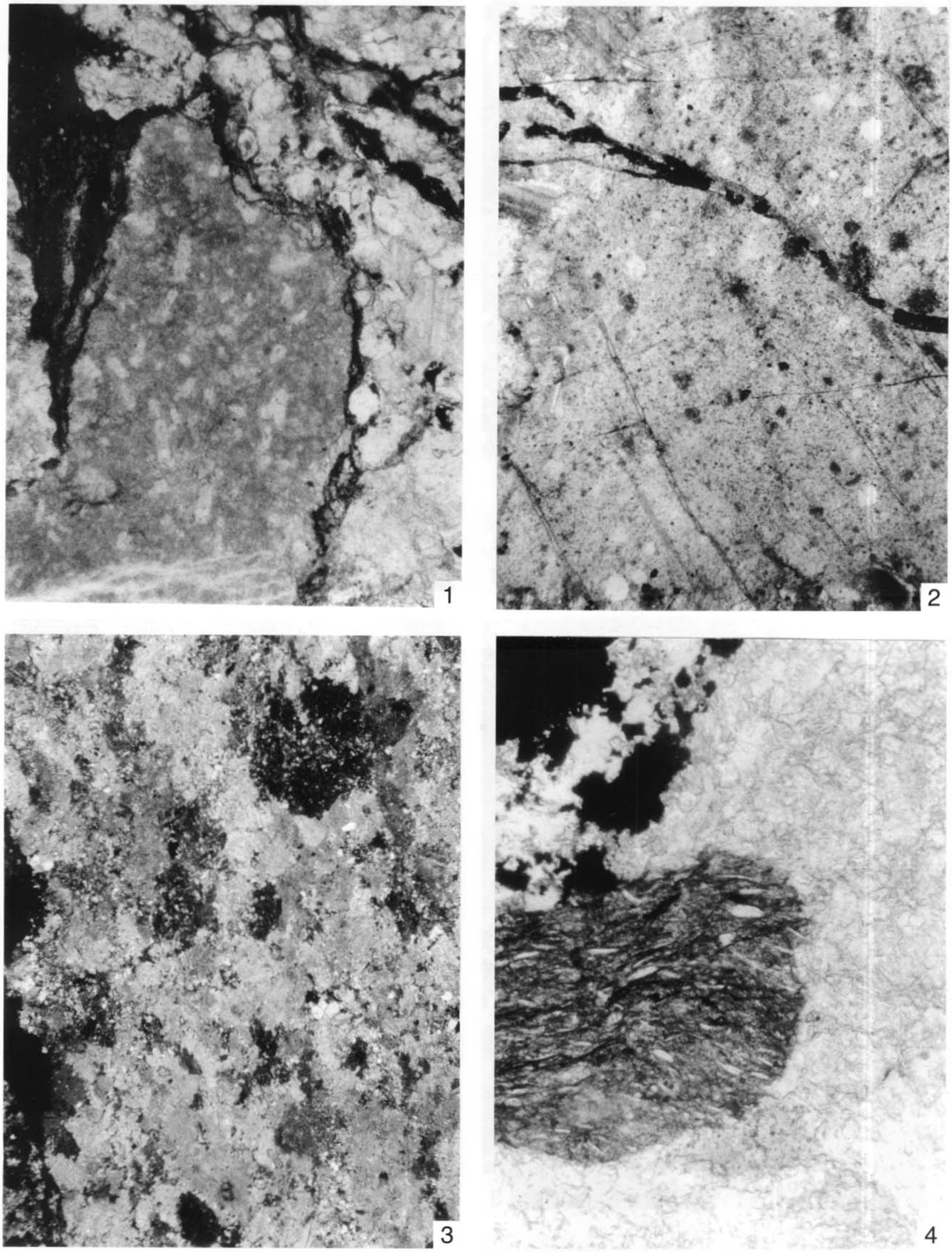

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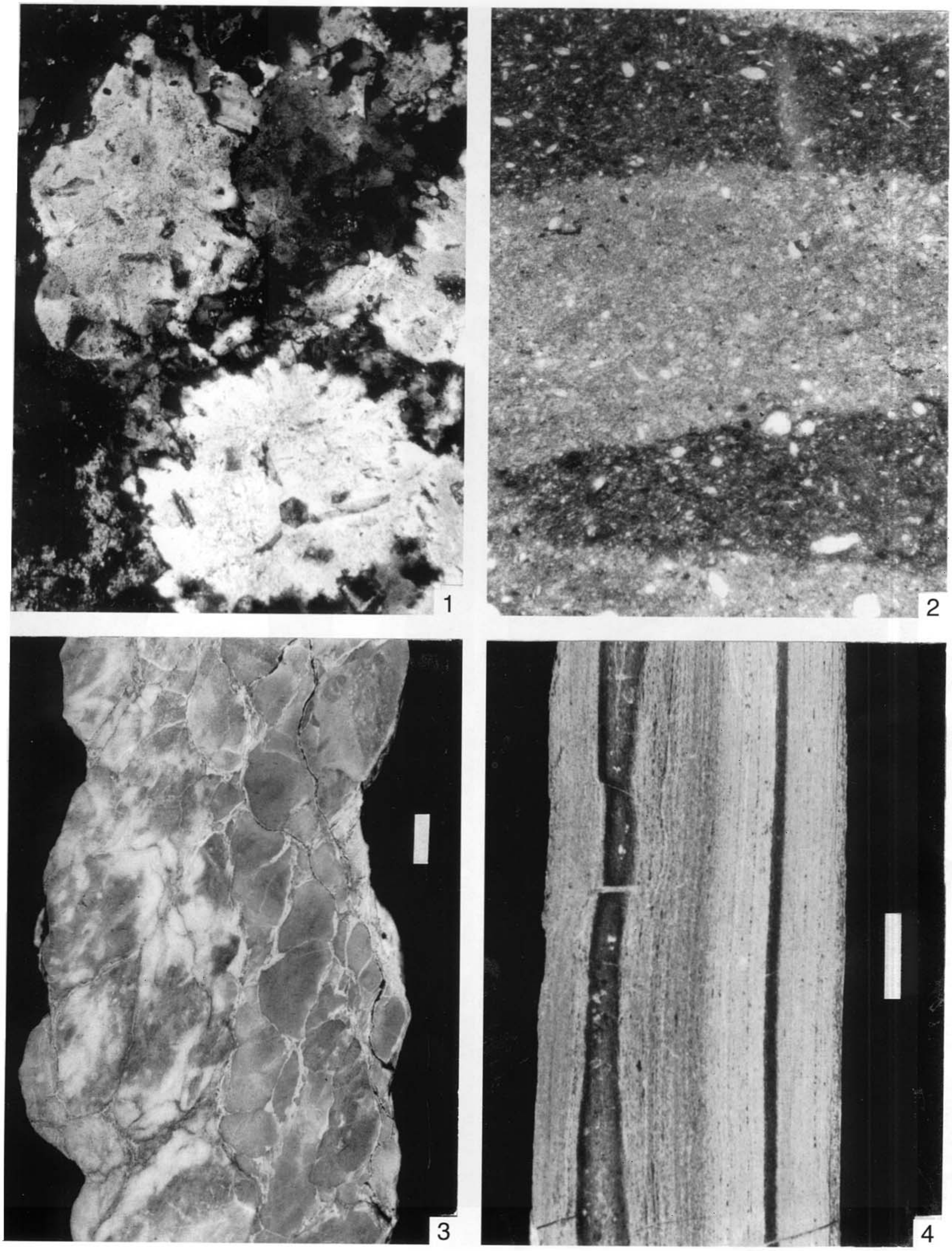

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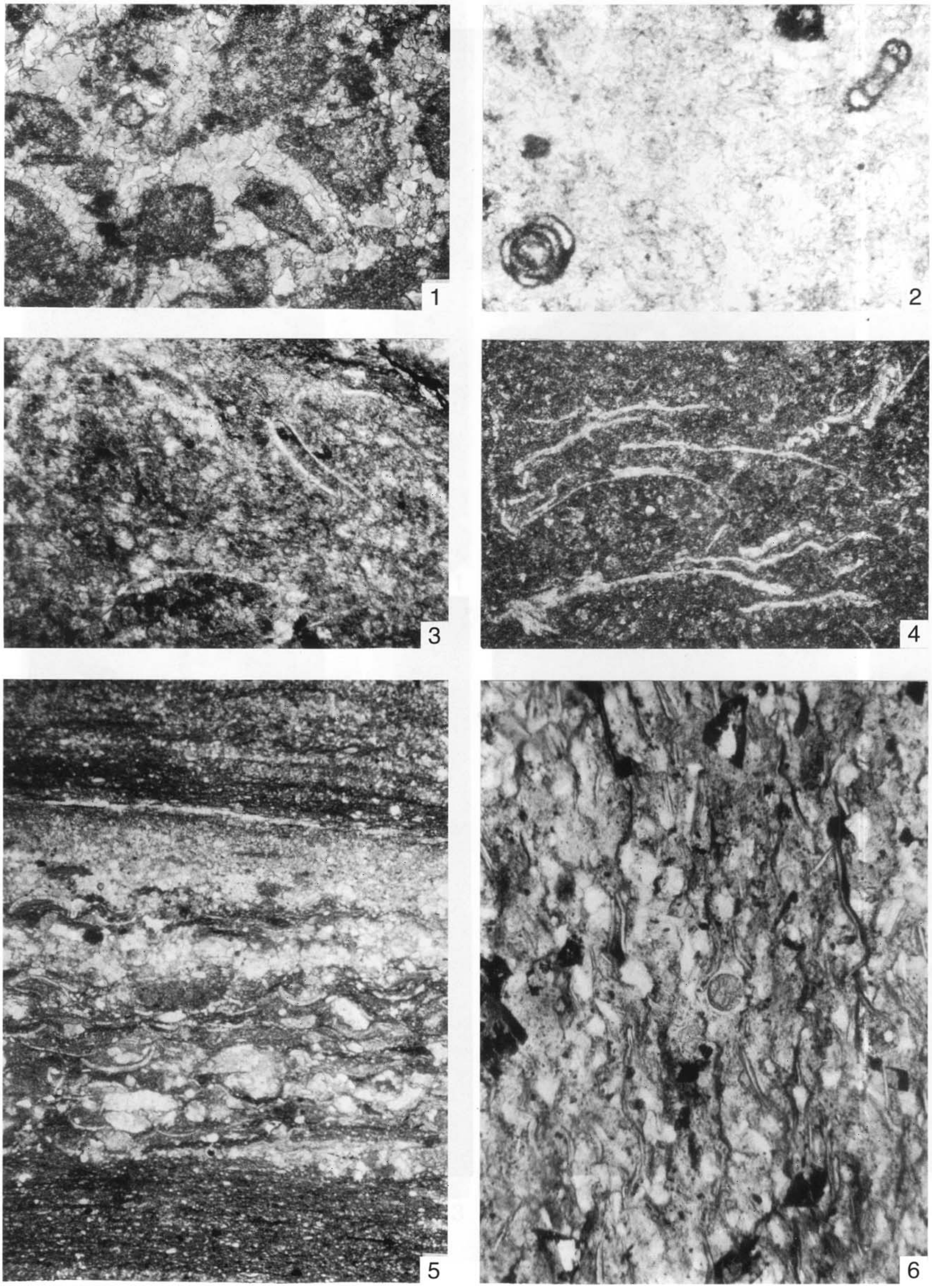

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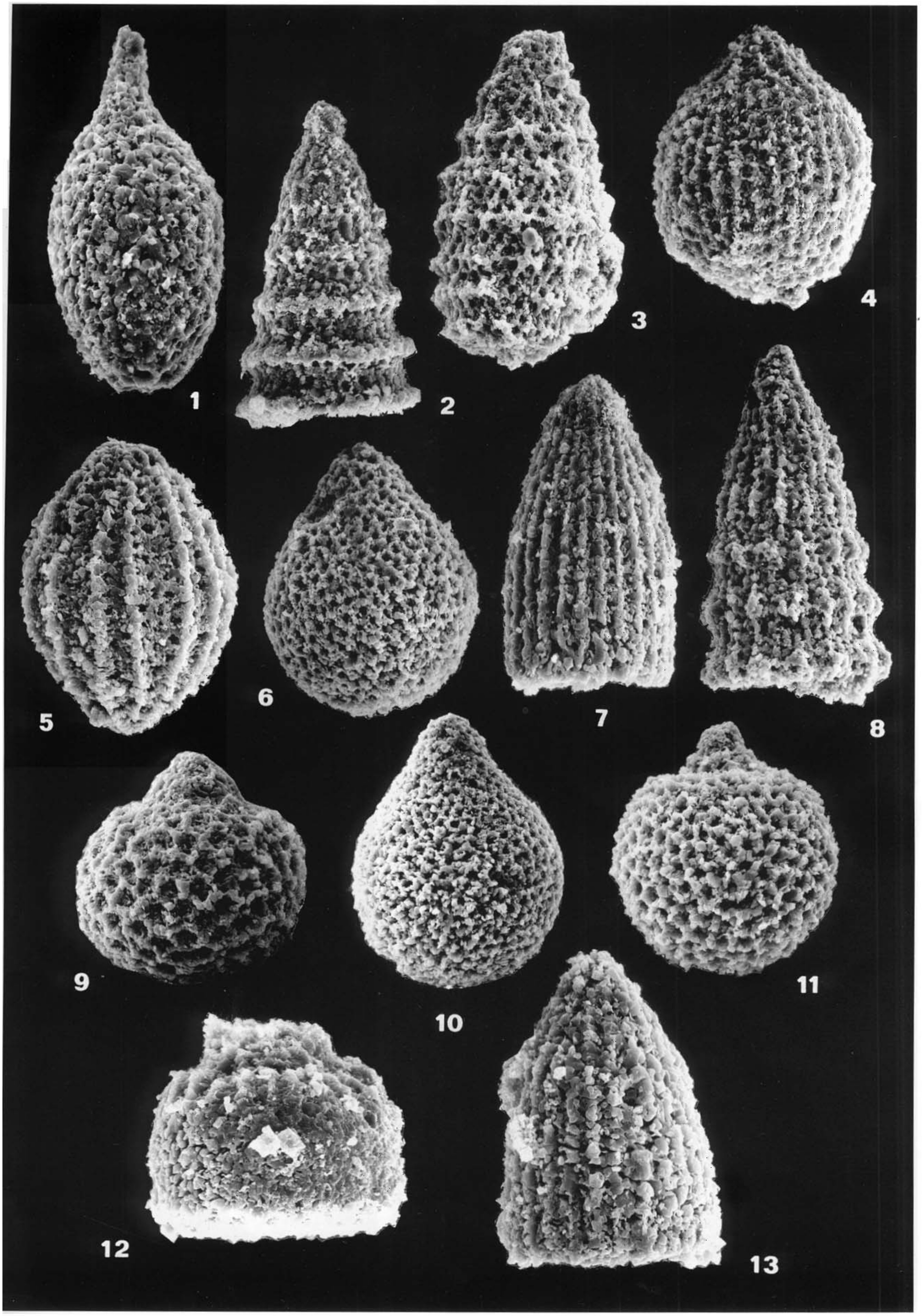


Plate X

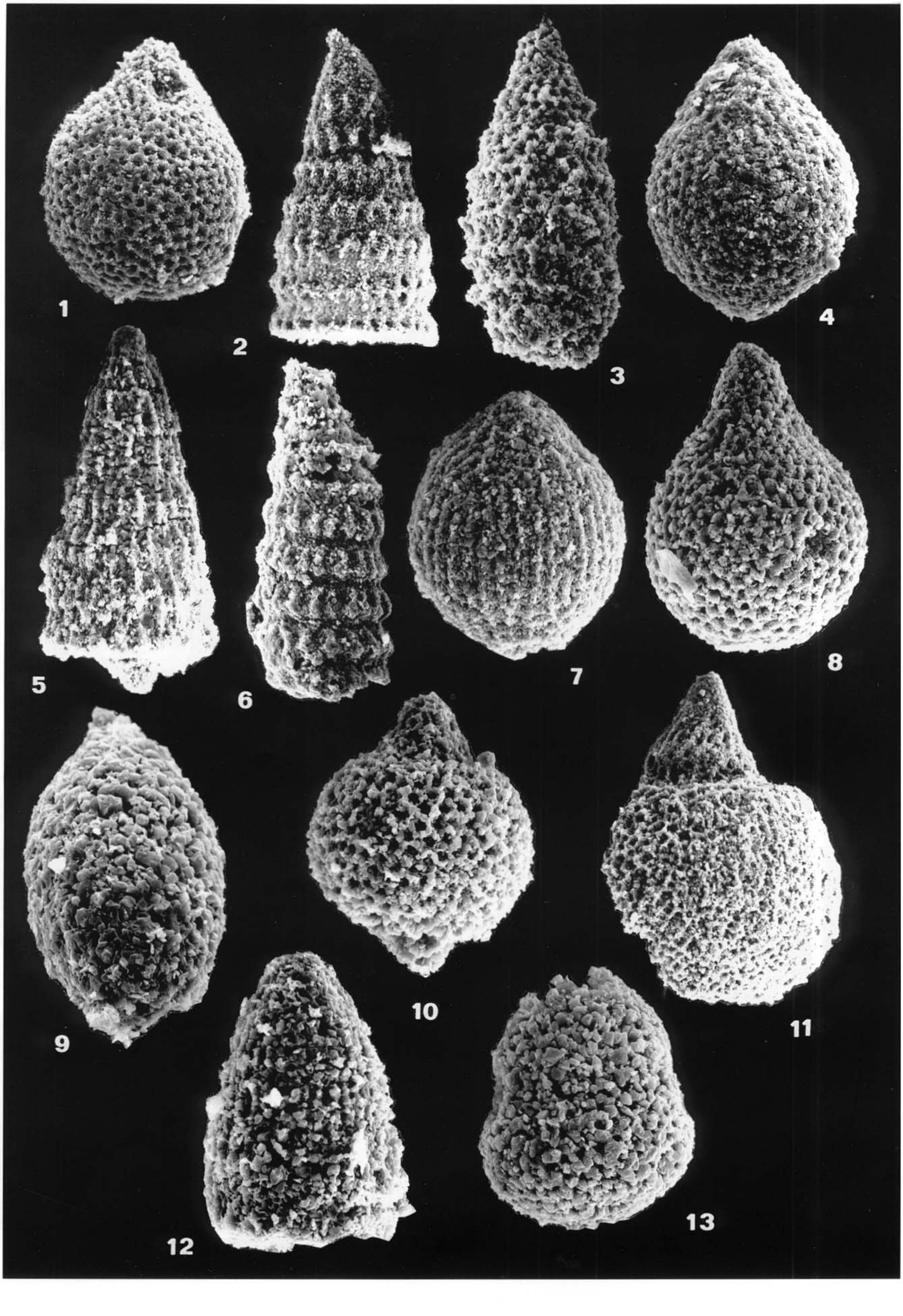
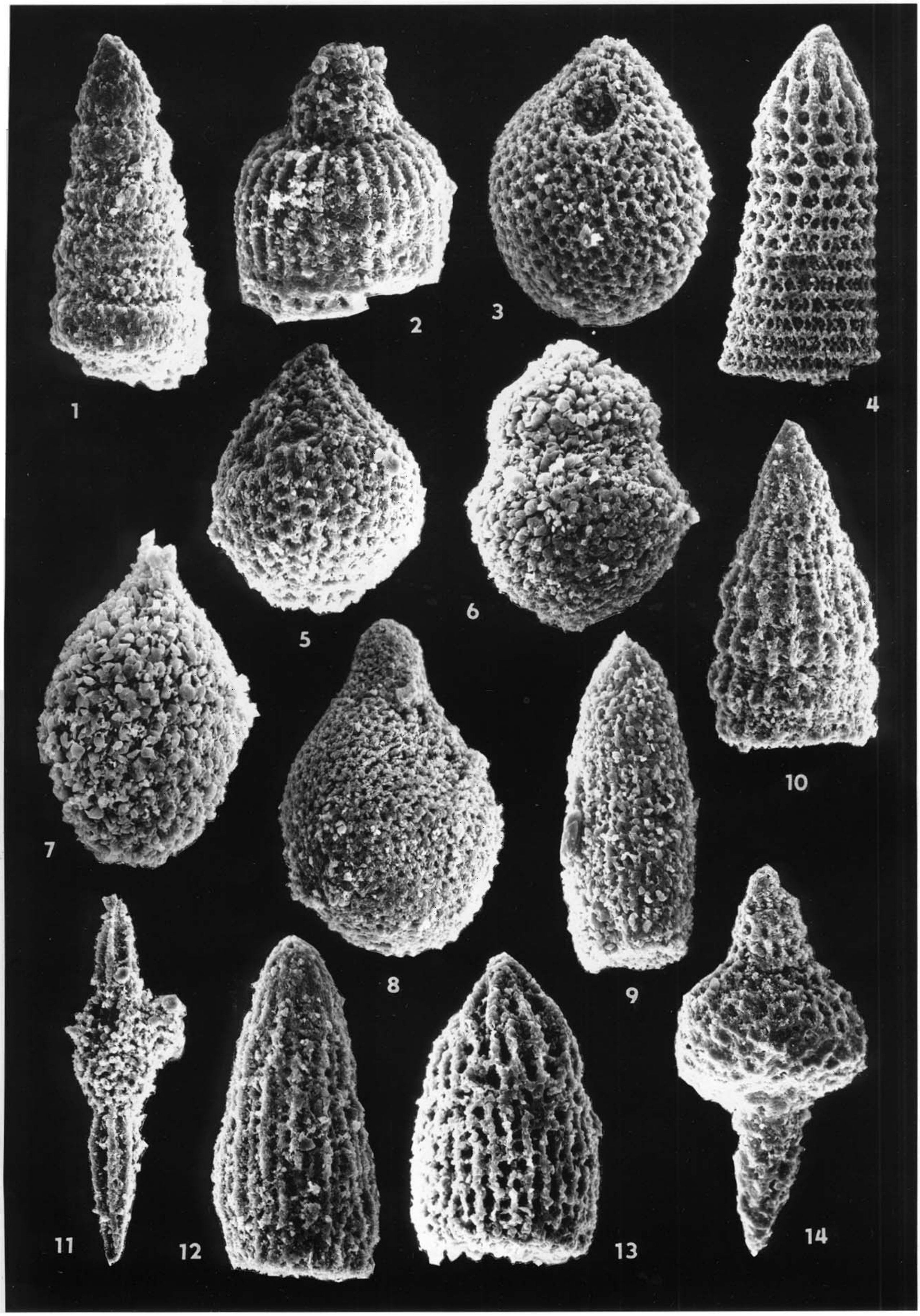


Plate XI



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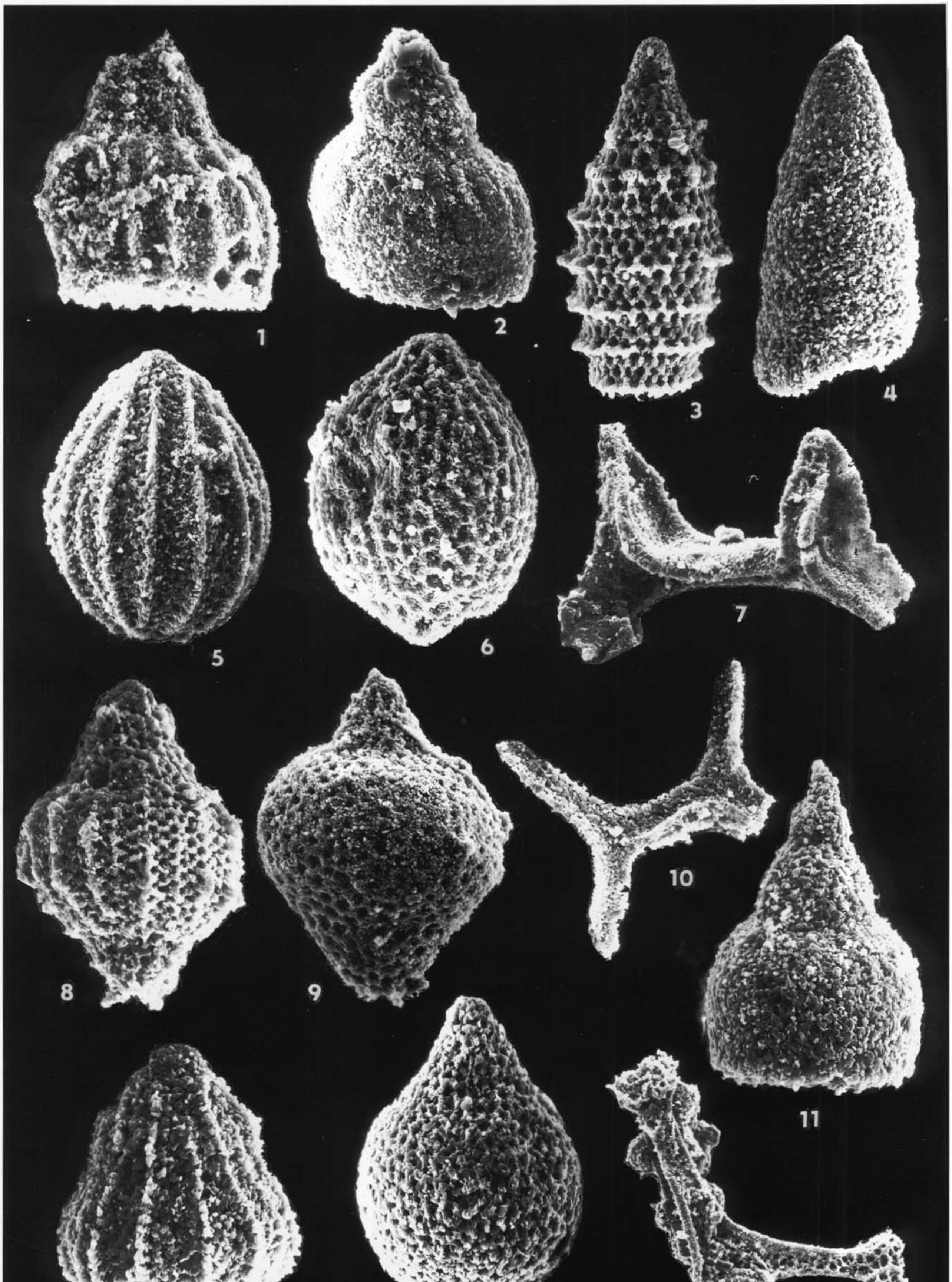

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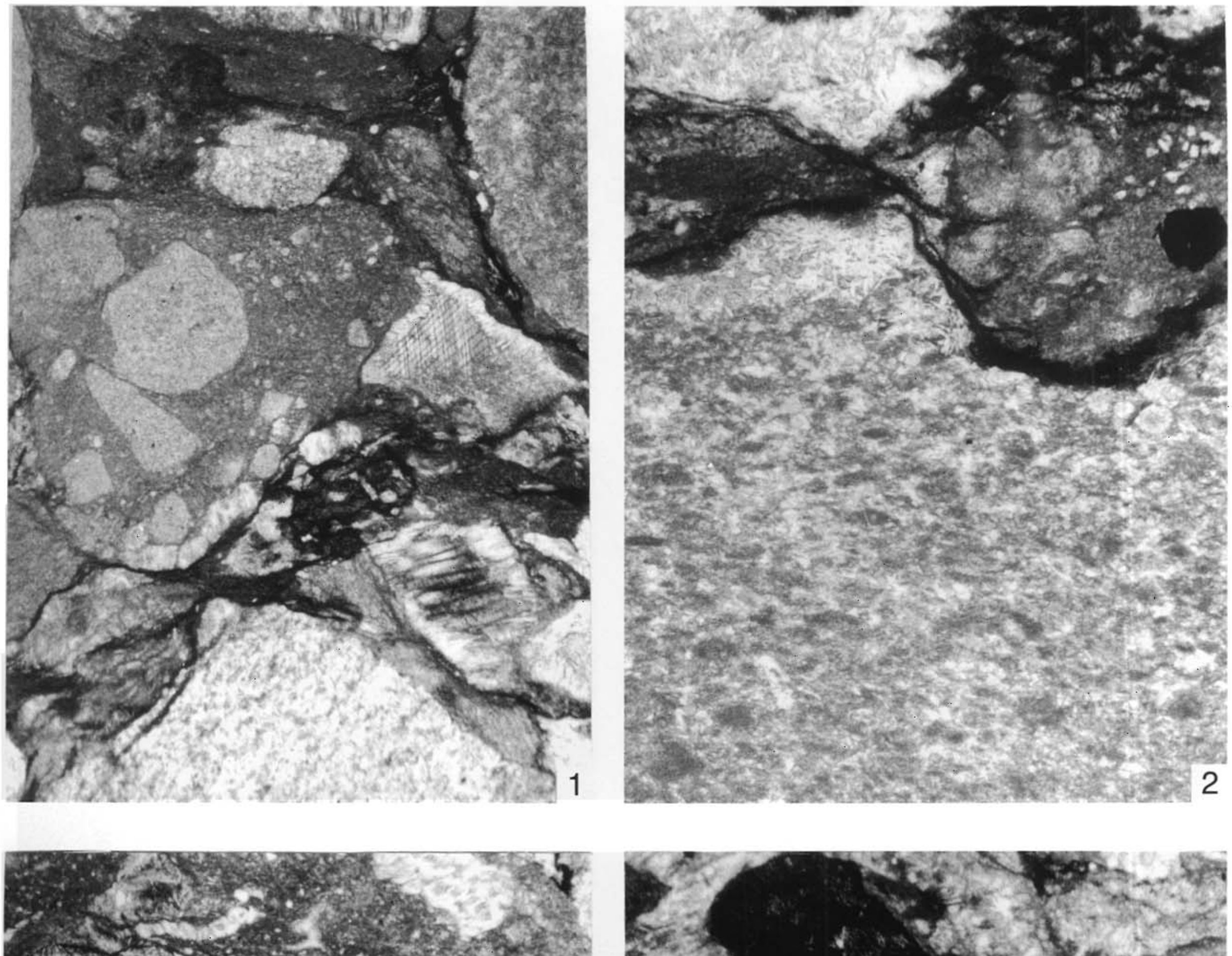

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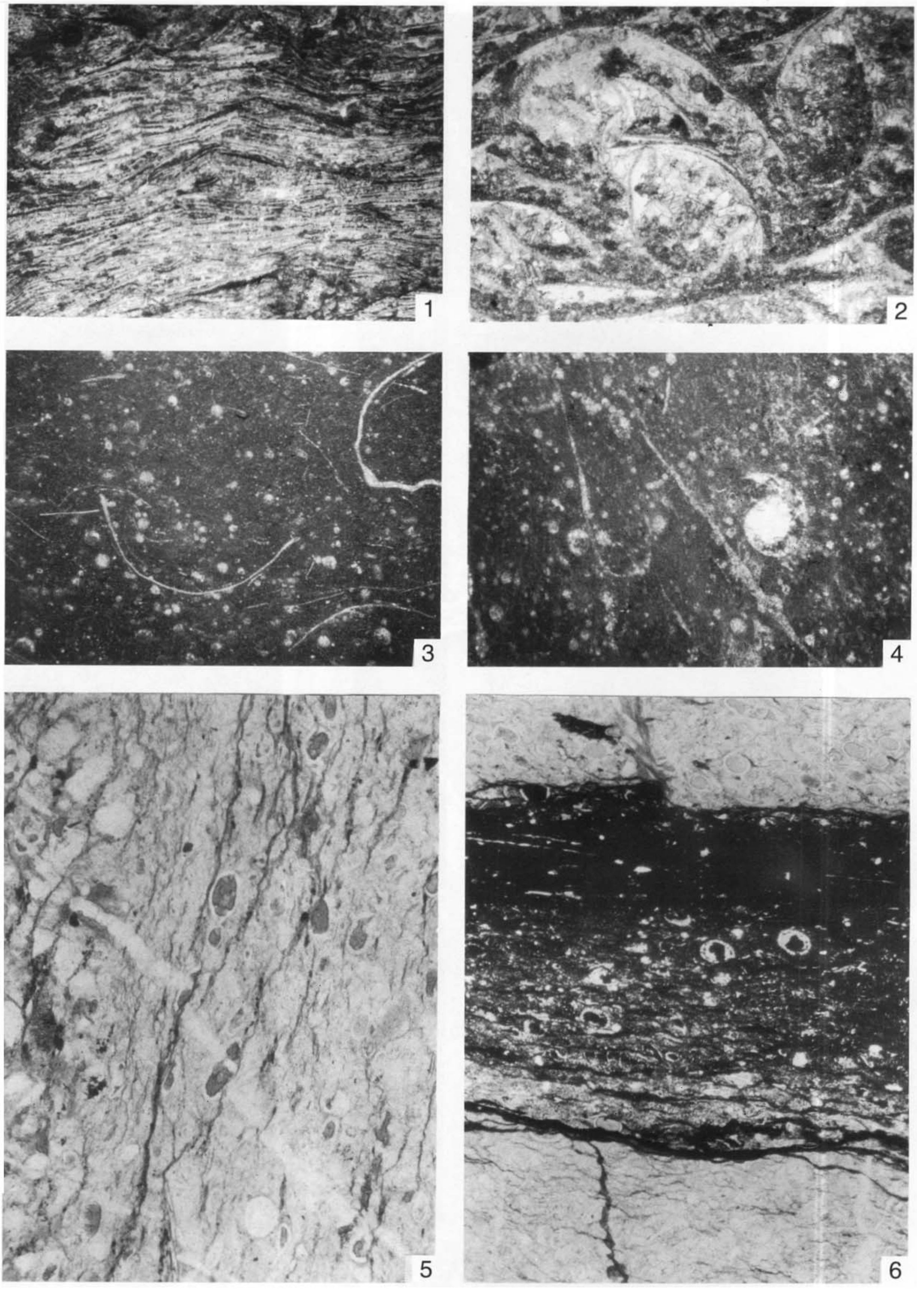

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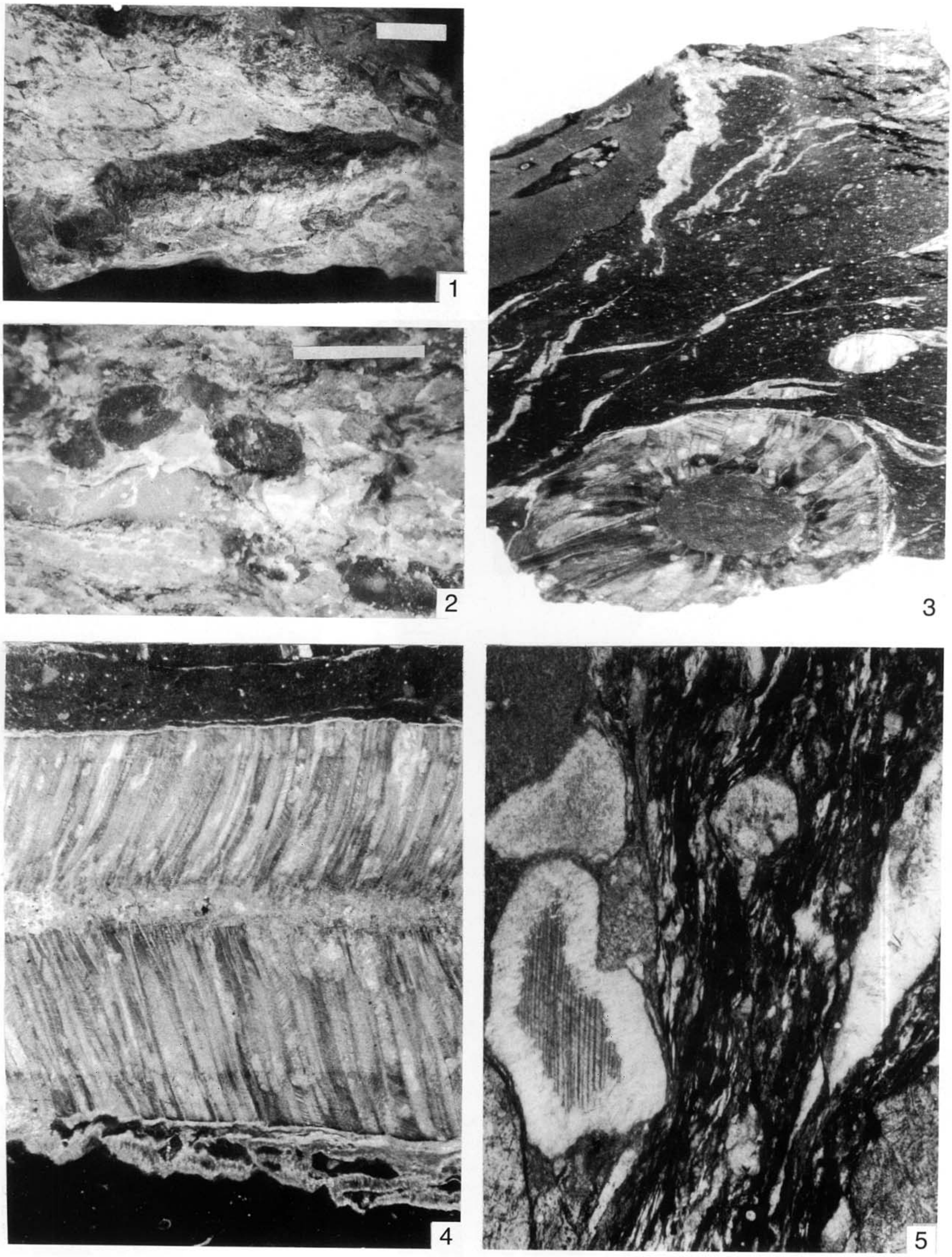

Plate XVI