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SEDIMENTOLOGY, LITHOFACIES AND DIAGENESIS OF THE SEDIMENTS OF THE REIFLING INTRAPLATFORM BASINS IN THE CENTRAL WESTERN CARPATHIANS

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Abstract: The article analyses a sedimentological, lithostratigraphical, microfacial and geochemical data from the sediments of the Ladinian tensional intraplatform basins in the Central Western Carpathians. It is also concerned with the questions of silicification and diagenetic dolomitization, as well as with the paleotectonic control of the origin and development of the Middle Triassic sedimentary areas in the Alpine-Carpathian shelf block.

Key words: pelagic carbonates, microfacies, geochemistry, tensional basins, Middle Triassic, Central Western Carpathians.

Introduction

Middle Triassic basinal facies (Zámostie-, Reifling-, Partnach- and Svarín Formations) were documented in fifteen detailed sections in the area of the Malé- (Rajtárka-, Červenica-, Mokrá- and Suchá Dolina Valleys), Brezovské and Čachtické Karpaty Mts. (Dobrá Voda, Dv-1 borehole, Vrátno, Jablonica, U Fajnorov), in the castle rocks of Beckov and Trenčín, in the Choč Nappe in the Nízke Tatry Mts. (Svarín, Zámostie), the Chočské Vrchy Mts. (Turík) and the Strážovské Vrchy Mts. (Húštik) (Figs. 1, 2). All the sections come from the southern zones of the Central Western Carpathians (from the Hronicum, represented by Choč Nappe and from the "higher" nappes, correlated with the Upper Eastern Alpine Göller Nappe (Masaryk 1987, 1990), exposed in the northern part of the Malé Karpaty Mts).

The thickness of the sequences formed by individual lithofacies and formations in the Reifling depression is also changeable in the framework of a limited region. The maximum thickness of 200 m was found in the Dobrá Voda 1 borehole (Brezovské Karpaty Mts.). In the Veterlín Nappe of the Malé Karpaty Mts., the Middle Triassic basin limestone complex reaches a thickness of 70 to 100 m and together with the Raming limestones up to 200 m. In the profiles from the Choč Nappe, the thickness varies from 40 to 110 m.

Lithostratigraphy

Zámostie Formation

The formation was defined at the southern foot of the Nízke Tatry Mts. in the Choč Nappe (Kochanová & Michalík 1986). Its age was limited by the Upper Pelsonian to Illyrian *Balatonites balatonicus* Zone (on the basis of ammonites, cf. Rakús 1986), or the Kockeli Zone (on the basis of conodonts, cf. Papšová & Pevný 1987). In a typical profile, Farkašovo Megabreccia (slope or collapse breccia in the Gutenstein Formation) underlies it. In the Malé Karpaty Mts. where the formation is known from the sequence of the Veterlín- (Michalík et al. 1989) and the Göller Nappe (Dobrá Voda 1 borehole: Michalík et al. 1992), organodetrital biomicritic limestone with dasycladacean algae and crinoids of the Steinalm type underlies it (Fig. 3). The formation is overlain by the Reifling Formation, mainly represented by Knollenkalk.

The Reifling Limestone Formation

The stratotype is found at Grossreifling near the Enns in Austria (Štúr 1871 in Andrusov & Samuel 1985). Gessner (1966) divided the type profile of Grossreifling into Lower Reifling Limestone ("Untere Reiflinger Kalk") with four members, and Upper Reifling Limestone ("Obere Reiflinger Kalk"). Bechstädt & Mostler (1974) considered the Reifling Limestone to be a member of the "Formation of Alpine Muschelkalk" and distinguished massive and coarsely bedded limestones (**Reiflinger Bankkalk**) and well bedded nodular limestones (**Reiflinger Knollenkalk**) in it. The term Reifling Limestone also includes thinly bedded siliceous limestones (known as **Göstlingkalk**) and shale with layers of limestone (Partnach Beds). Hohenegger & Lein (1977) described a peri-reefal facies, formed by atypical cherty limestones with allodapic layers, from the area of the Schneeberg Massif, under the term **Grafensteigkalk**. In the Western Carpathians, Reifling limestones were distinguished by Štúr (1868 in Andrusov & Samuel 1985). Later Andrusov (1936), Mock (1974), Bystrický (in Andrusov & Samuel 1985) and others were concerned with them.

The range of Reifling Limestone from the zone of *Paraceratites trinodosus* (Lower Illyrian) through Fassanian and Longobardian up to the Cordevolian substage, may be established by macrofauna (ammonites, brachiopods, bivalves) and microfauna (conodonts and foraminifers).

The formation is characteristic of the Middle Triassic sequence of the Hronicum, especially in the Choč (river Biely Váh)

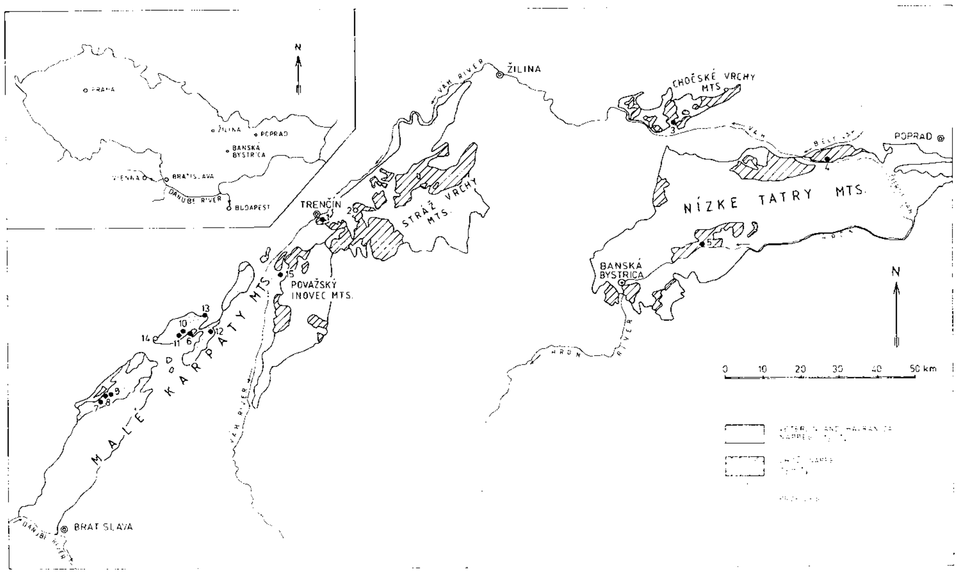

Fig. 1. Localization of the sections in the Veterlín and Choč Nappes.
Legend: 1 - Trenčín; 2 - Húštik; 3 - Turík; 4 - Svarín; 5 - Zámostie; 6 - Dobrá Voda borehole; 7 - Rajtárka; 8 - Suchá dolina Valley; 9 - Mokrá dolina Valley; 10 - Vrátno; 11 - castle Dobrá Voda; 12 - Kamenica; 13 - U Fajorov; 14 - Jablonica; 15 - Beckov.

Nappe, and is also present to a lesser extent in the Silica units (Strážov-, Silica-, Muráň-, Veterlín- and the Drienok Nappes). In the rocks underlying the Neogene filling of the Vienna Basin, the Reifling Formation is represented in the equivalent Lunz-, Göller- and Schneeberg Nappes, belonging to Austroalpine Unit of the Northern Calcareous Alps.

In the area of the Hronicum, it is underlain by the Zámostie Formation, or Ramsau Dolomite. In the Silica area, Steinalm-, or Schreyeralm- (Slovenský Kras, Drienok), or Zámostie Formation (Malé Karpaty Mts.) are found below it. In the Hronicum area, the Svarín, Lunz or Raming Formations overlie it, while in the Silica area the Raming and Wetterstein Formations form the overlying rocks.

The Partnach Formation

Štúr (1865 in Andrusov & Samuel 1985) made Gümbel's (1858) original term more exact, and limited its understanding only to the so-called Partnach shales and "Bröckelschiefer". This is how the Partnach Beds are understood up to now (Hirsch 1966; Miller 1971; Bechstädt & Mostler 1974). The term Partnach Beds is also used to mean the deposits of marly shales and marls in the Reifling Formation (Tollmann 1966, 1976). Bechstädt & Mostler (1974) do not consider the name Partnach Beds to be appropriate for the shale deposits in the Reifling limestones. In the Western Carpathians, dark shale intercalations in the Reifling Limestone are classified as Partnach Beds (Andrusov, 1935, 1936; Zawidzka 1972; Kotański 1973; Mock 1974), although some authors (Bystrický 1982) have identified reservations to this.

The stratigraphic range of the formation is variable (believed to be Early Ladinian to Lower Julian).

The Svarín Formation

The authors accept the age determined by Andrusová (in Bystrický 1973) for the formation, on the basis of macrofauna (ammonites, bivalves), microfauna (conodonts, foraminifers) and microflora, as Cordevolian to Lower Julian (*Trachyceras aonoides* Zone). The formation under the name dark "shale with *Ammonites aon*" was described from the Eastern Alps by Štúr (1863), and later by Hertle (1865) who renamed it "Aon Beds". The term Trachyceras Beds, which was introduced in an attempt to replace the inappropriately chosen term, was introduced to Carpathian literature by Bystrický (1982). He considered them provisionally as an informal lithostratigraphic unit of the category "formation", which had to include various litho- stratigraphic units of a lower order, as for example "Korytnica Limestone", "Svarín Beds" and the formally unnamed "Aon Beds" from Turík and other localities. Havrila et al. (1988) incline to the term "Trachyceras Beds" in evaluating the Turík section.

The Reifling Formation (Knollenkalk), or limestones with stratiform silicites (Göstlingkalk) underlie the Svarín Formation. Siliclastic sediments of the Lunz-Reingraben Formation form the overlying rocks. The formation is characteristic of the Choč Nappe (river Biely Váh), and of the Lunz- and Göller Nappes underlying the Vienna Basin.

Sedimentology

Shallow intraplatform basin facies

Zámostie Formation

Rapid vertical changes of facies in the basal part of the sequence are a reflection of sudden rapid subsidence. The formation reaches a maximum thickness of 20 m and records a facial transition from platform shallow water carbonates of the Steinalm- or Gutenstein Formations to sediments of a shallow intraplatform basin. With further subsidence, a system of intraplatform depression s acose from them later.

The thickness of the indistinct beds of nodular, dark brown to black limestones with isolated cherts rapidly diminishes towards the overlying rocks (at the base, the average thickness is 50 cm), and the highest part is thinly laminated (20 cm). Deposits of clayey limestones with weak silty admixture, pyrite concretions and clayey intercalations are rarer (in borehole DV-1). Irregular diagenetic dolomitization of the basic material and alochems

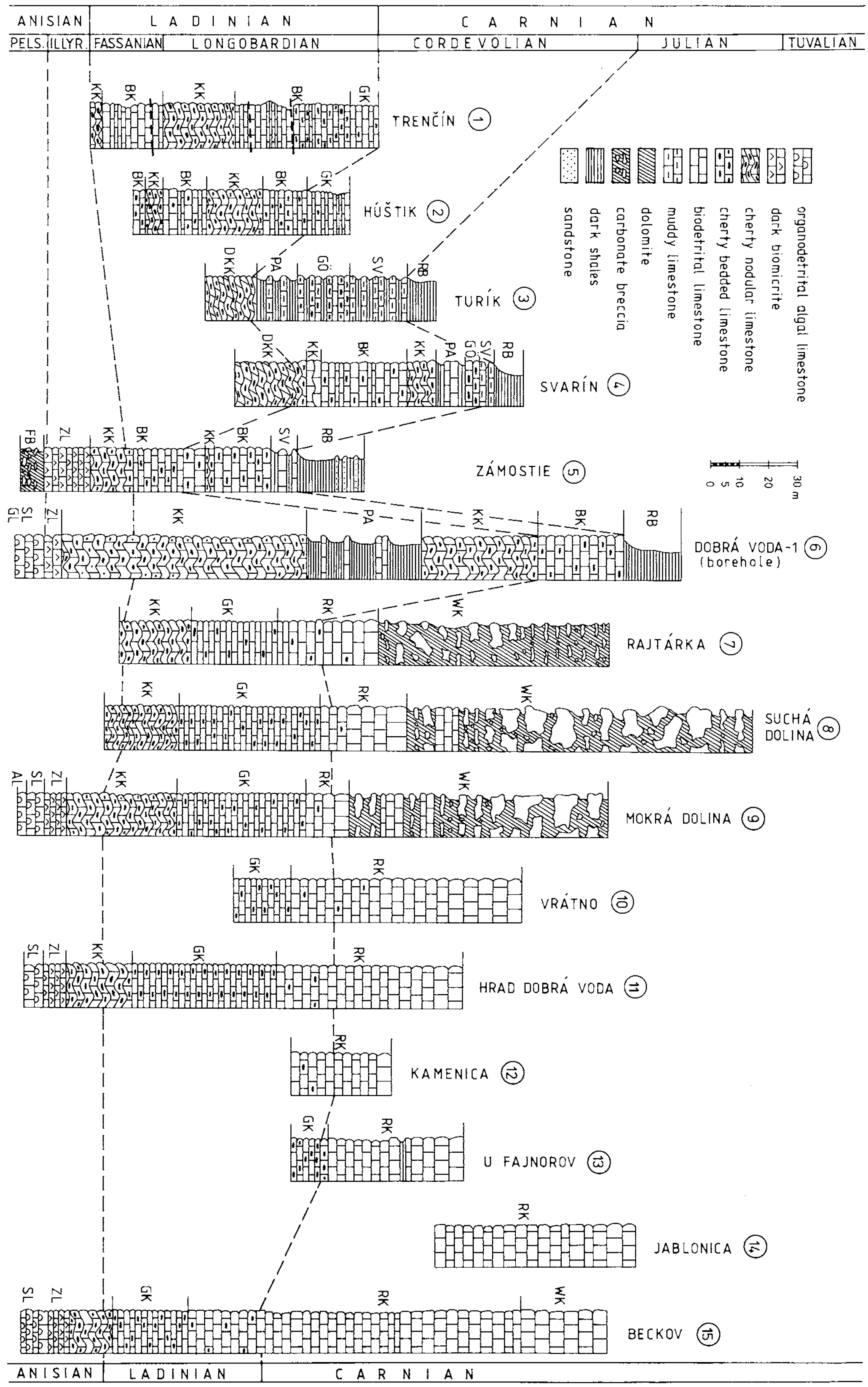

Fig. 2. Stratigraphic and sedimentologic correlation of the lithofacies in the sections studied.
GL - Gutenstein Limestone; AL - Annaberg Limestone; FB - Farkašovo breccia; SL - Steinalm Limestone; ZL - Zámostie Limestone; KK - Reifling Limestone - Knollenkalk; DKK - dolomitized Knollenkalk; BK - Reifling Limestone- Bankkalk; GK - Reifling Limestone - Grafensteigkalk; RK - Raming Limestone; GÖ - Reifling Limestone - Göstlingkalk; PA - Partnach shales; SV - Svarín Formation; RB - Reingraben shales; WK - Wetterstein Limestone.

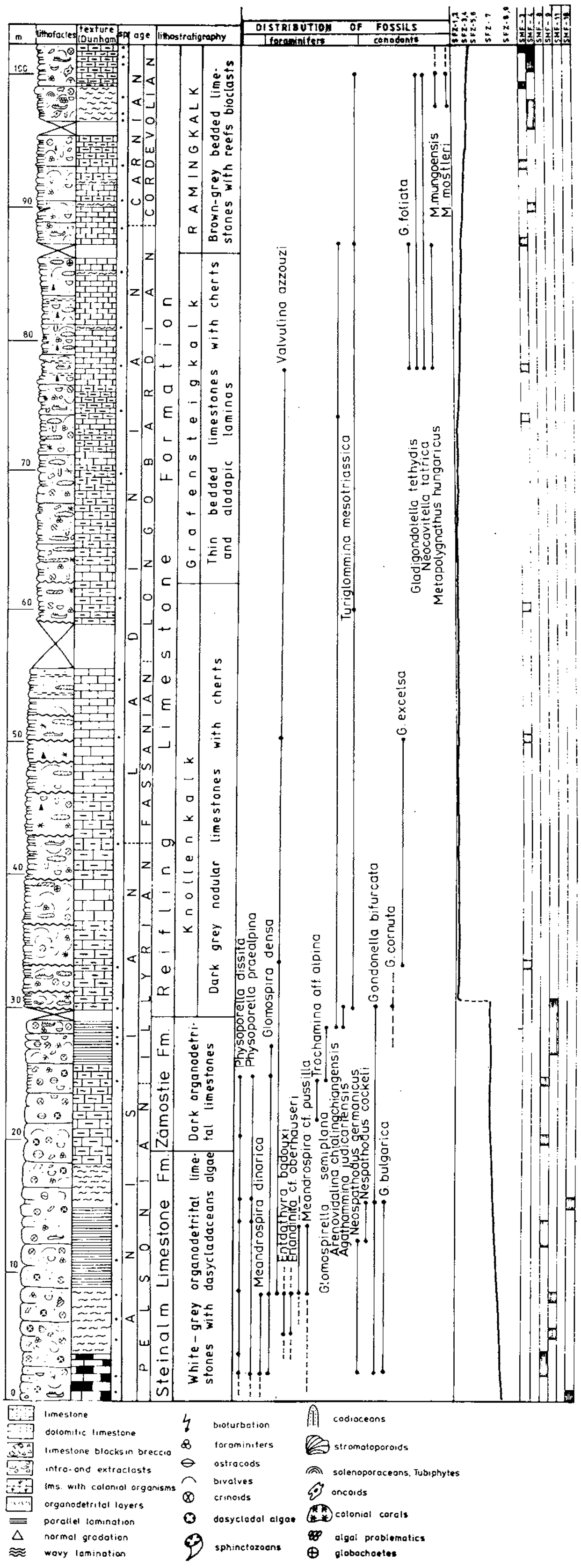

Fig. 3. Section 9 - Mokrá dolina Valley, with detailed sedimentology, biostratigraphy and lithostratigraphy.

concerns above all weakly clayey micrites with a low content of allochems. The content of organic detritus is relatively high (on average 25 - 30 %) compared to the Reifling Formation. It varies from a few percent in the dark biomicrites (mudstone-wackestone) to 80 - 90 % (packstone in the detritic, often laminated and gradationally bedded deposits (Pl. 1: F). Its composition also reflects the composition of the community of benthonic fauna (gastropods, brachiopods, bivalves, scaphopods, sponges, ostracods, foraminifers, echinoderms spines and ophiuroids and associations of pelagic organisms (juvenile bivalves and radiolarians cf. Pl. 1: A, C, D, E). In material redeposited from shallow water zones of the carbonate platform, occur especially crinoids and also occasional dasycladacean algae (Pl. 1: B, F). Redeposited bio- and lithoclasts are partly worked by transport and wave action, and micritized to peletoids, probably by the activity of boring algae. Some packing biomicrites are notable for relatively intensive neomorphic recrystallization with oriented growth of calcite on bio- and lithoclasts. Original orthosparitic structures, which could indicate origin in a shallow water dynamic environment were not found.

In the basal part of the sequence, a crinoidal and crinoid - foraminiferal microfacies prevails. In an upward direction, there is a gradual increase of planktonic organisms, which is a result of a deepening depression. Crinoid-filament and crinoid spicule microfacies with occasional radiolarians are characteristic of the upper part of the sequence. In all sections, nodular cherty limestone (Knollenkalk), which contains often varied (red-yellow) marly insertions, which indicate a probable decrease of sedimentary rate, are present in the overlying rocks.

The dark colour of the limestones and abundant secondary pyrite are at first sight in conflict with the rich association of benthic epifauna (Kochanová & Michalík 1986). The anoxic conditions were probably not far below the surface of the sediment and did not allow the development of infauna, or reducing conditions were early diagenetic in nature. The sedimentary environment had a depth of only a few tens of metres, probably below the base of the waves.

Basin plain facies

Nodular cherty limestone - Knollenkalk

This member of the Reifling Formation is developed in all the sections. However, its thickness is greatest in facies, not overlain by slope-, or platform margin facies (Grafensteigkalk, Ramingkalk), but by basin sediments of the Svarín or Lunz-Reingraben Formations. It reaches its maximum thickness of 115 m in borehole DV-1 in the Göller Nappe, where it forms almost 70 % of the Reifling Formation sequence (Fig. 2). In the Reifling Formation sections in the Choč Nappe (Svarín, Turík, Húštik, Trenčín and Zámostie), it is also the most frequent lithofacies, but its thicknesses are smaller (from 15 to 40 m), apparently due to intensive diagenetic dolomitization, which affected a significant part of the sequence of the Reifling Formation. In the Veterlín Nappe of the Malé- and Brezovské Karpaty Mts. (Mokrá and Suchá dolina Valleys, Rajtárka Valley, the castles of Dobrá Voda and Beckov), where basin facies is overlain by slope and platform margin facies, its thickness is low (10 - 25 m), and slope facies dominates in the Reifling Formation.

Thinly laminated to thin bedded grey, grey-brown, noticeably nodular limestones with numerous cherts of varying form contain frequent marly intercalations, crooked clayey laminae and dark bituminous deposits with secondary pyrite. The limestones are biomicritic (mudstone - wackestone) weakly recrystallized (microsparitic) with a low proportion of allochems (3 - 45 %; Pl. 2: B, C, F), only in the detritic laminated and often normally graded deposits (packstone) is the content higher (up to 80 %; Pl. 2: A). In the organic detritus, mainly filaments and radiolarians (filament-radiolarian microfacies) are represented, while sponge spicules, conodonts, fish teeth, scales and globochaetes are less frequent. The sediment was affected by bioturbation, and sometimes by weak dolomitization. In the rare detritic graded and parallel laminated beds and laminae (up to 5 cm thick), which may be considered as distal turbidites, mainly peletoids, small intraclasts, crinoids, ostracods, foraminifers and echinoderms spines are present. The frequence and thickness of turbidite deposits increases in an upward direction, which indicates progradation of platform margins.

The nodular cherty limestones represent a facies separated from the platform margin, which was a primary source of calcareous ooze and to a lesser extent also of organic detritus. The bottom of the basin was well aerated, as the bioturbated parts document. Dark bituminous deposits with sulphides are most probably characteristic of reducing diagenetic conditions, and not of episodes of anoxic conditions on the bottom during sedimentation. Rare nodular texture probably originated by combination of primary sedimentary texture and early diagenesis. In comparison with the slope facies, the sedimentary rate was lower (10 - 15 mm /kyr), but in comparison with basin pelagic facies was relatively high.

Laminated silicified limestones - Göstlingkalk

In the Turík and Svarín sections (Figs. 2, 3) dark grey and black thin bedded limestones with bedded thick laminated silicites are present. In the Turík section they reach a thickness of 16 m, at Svarín 3.5 m. A similar facies is unknown from other localities of the Central Western Carpathians, and probably represents the deepest water of the Middle Triassic carbonate facies. Some parts already have the character of radiolarian limestones with laminae of grey radiolarites. Thin (1 - 5 cm) fine parallel laminated and normally graded organodetritic deposits among micrite limestones are probably a product of distal turbidites (Pl. 3: A, B, C). However the prevailing part does not contain shallow water detritus, and so may be almost contourites.

Grey-black, or occasionally grey-brown thin bedded laminated limestones with bedded, thick laminated silicites contain characteristic intercalations of dark marlstones, bituminous deposits with secondary pyrite and gradation. The limestones are biomicritic with a low proportion of organic detritus (mudstone-wackestone, in the proportions of 5 - 10 %; Pl. 3: B, C) with occasional deposits of packed bio- and biopelmicrites (packstone). In the organic detritus, planktonic forms prevail - radiolarians, filaments, sponge spicules, indicating a radiolarian and radiolarian - filament microfacies. Ostracods, foraminifers and crinoids are present in smaller quantities. There are small peletoids and intraclasts in the detritic laminae. The clayey admixture is relatively low - up to 10 %.

Dark marly and clayey limestones - Partnach Formation

In the Turík and Svarín sections, the lithofacies forms a few thin intervals (maximum up to 4 m) (Figs. 2, 3). The total thickness in these profiles is 5 - 7 m. In the borehole DV-1, the lithofacies was found at two intervals, and its total thickness reached 40 m. The prevailing lithotypes are grey-black crumbly clayey-calcareous shale with deposits of varied clayey limestones. The basic material is cryptocrystallic clayey-carbonate, with a significant proportion of limonite pigment and authigenous pyrite. The shales contain hardly any organic detritus, relicts resembling radiolarians and filaments are found only occasionally. Dolomitization in the form of extensively dispersed small rhomboheders (15 - 20 μm) which often includes up to 30 % of the bulk of the rock, is a characteristic feature. The limestones contain a changeable quantity of clayey component (2 - 10 %), and the content of organic detritus is low (on average 3 - 5 %). Only a few deposits form organodetritic limestones of the wackestone type (Pl. 3: D, E, F). Filaments, radiolarians, sponge spicules and ostracods are present in the detritus, while crinoids, foraminifers, pellets and algal problematics occur occasionally.

According to the interpretation of Bechstädt & Mostler (1974, 1976), the Partnach Formation represents the relatively deepest water sedimentation in the axial parts of the Reifling depression, which were most distant from the margin of the carbonate platform (Michalík et al. 1992).

Grey-black clayey limestones with Halobia - Svarín Formation

The lithofacies was studied in the Turík and Svarín sections (the type locality). Grey-black and grey clayey limestones with intercalations of marlstones make up the formation. At the Turík locality, it reaches a thickness of 21 m, in the Svarín section only 5 m (Fig. 2). The thin bedded shaly, crumbling limestones contain characteristic bituminous clayey admixture (on average 15 %, increasing in an upward direction) and secondary pyrite. Silicification is relatively rare (macroscopically almost unobservable), affecting mainly the foraminifers. The limestones are biomicritic, with much fine organic detritus, often current laminated and immaturely graded. In the microfauna, planktonic forms prevail (Pl. 3: G, H, I, J). The filaments, globochaets, and benthic organisms are represented less (echinoid spines, sponge spicules, ostracods, gastropods and ophiuroids), as is shallow water detritus from the neighbouring carbonate platform (crinoid, bivalves and pelletoids). The content of organic detritus and pelletoids is on average low (up to 10 % of the mudstone and wackestone), only in detritic (turbiditic) laminae does it reach up to 50 % (packstone). From the microfacial types, the filament microfacies dominates, while the filament - radiolarian, filament-spiculite, and spiculite microfacies are less frequent.

The formation represents a transition between basin carbonate sedimentation of the Reifling Formation and basin siliclastic sedimentation of the Lunz- and Reingraben Formations. The irregular thickness of the formation, from a few dm to 20 m is directly dependent on the depth regime, and indirectly dependent on distance from the margin of the carbonate platform. The maximum thickness indicates axial and probably also the deepest part of the intraplatform depression.

Basin margin - lower slope facies

Massive, coarse heavy bedded cherty limestones - Bankkalk

The lithofacies is characteristic for the development of the Reifling Formation only in sections, where the overlying rocks include terrigenous basin facies of the Svarín- and Lunz Formations (DV-1, Svarín, Žámostie, Trenčín; Fig. 2). Representation

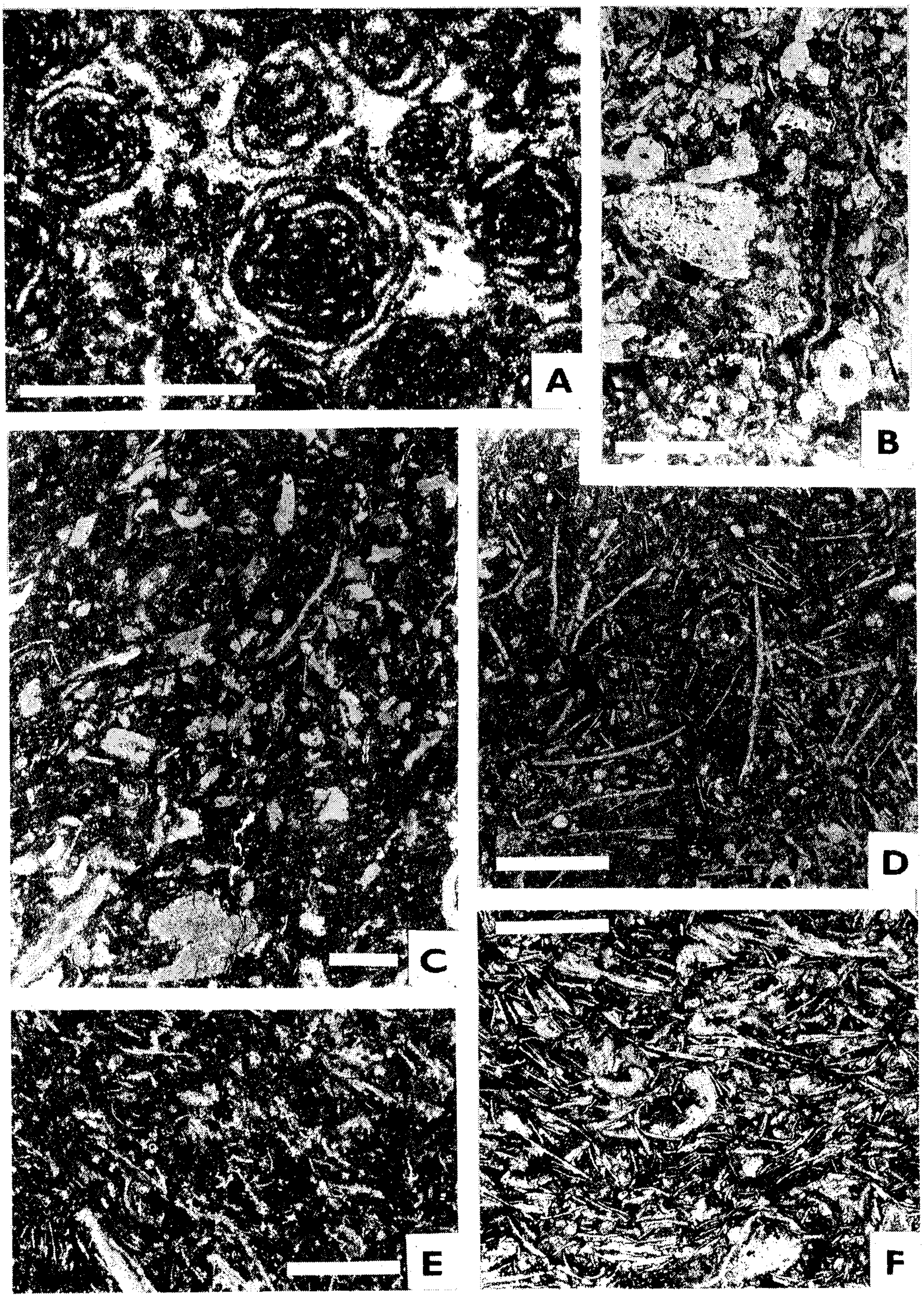

Plate 1: Shallow intraplatform basin facies (Zámostie).
A - partly recrystallized foraminiferal biomicritic limestone (packstone) with monoassociation of the *Glomospira densa.* Zámostie section, no. 9. B - crinoidal biomicritic limestone (wackestone - packstone). As well as pieces of crinoid, nodosariid foraminifers, ophiuroids, ostracods and algal problematics are present. Borehole Dobrá Voda 1, depth 823.5 m. C - dark biomicritic limestone (wackestone) with selectively silicified shell fragments of brachiopods and gastropods. Fine detritus, in which crinoids, filaments, ophiuroids, foraminifers, sponge spicules, echinoderms spines and pelletoids are present. Suchá dolina section S/84, no. 3. D - biomicritic limestone (wackestone) with filaments, and calcified radiolarians. Foraminifers, crinoids, ostracods and pelletoids are represented less. Borehole Dobrá Voda 1, depth 821.7 m. E - biomicritic limestone (wackestone) with fragments of bivalves and gastropods. There are relicts of filaments, ostracods and pelletoids in the fine detritus. Zámostie section, no. 25. F - biomicritic limestone (packstone) with filaments and spicules. Reworked relicts of crinoids are occasionally present. Zámostie section, no. 24. Scale bar = 0.1 mm.

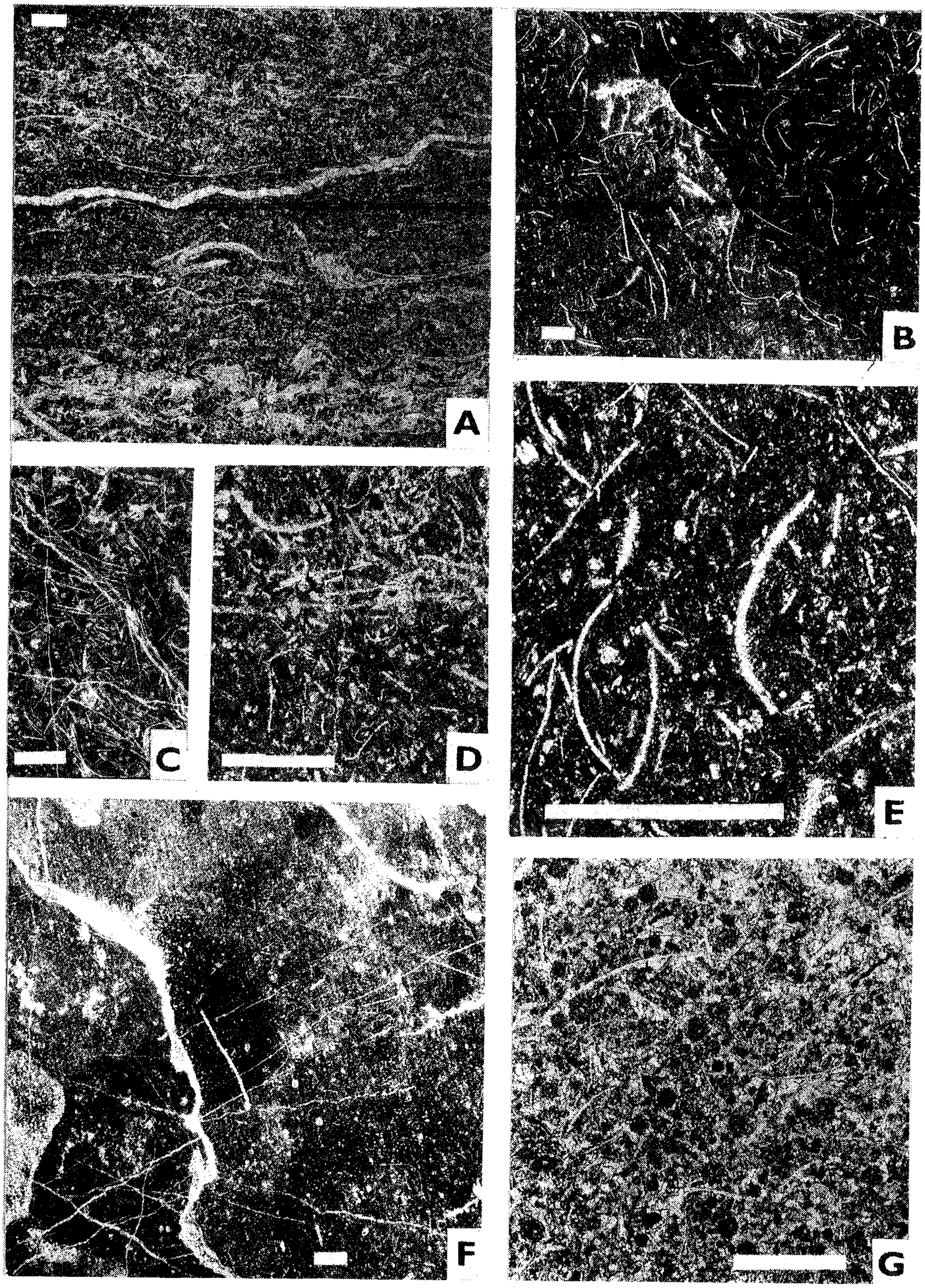

Plate 2: Lower slope and basin plain facies (Reifling Fm., Bankalk, D, E, G, and Knollenkalk, A, B, C, F).
A - filament-pellet biopellmicritic limestone (wackestone) with current directed and normal gradation of detritus. Borehole Dobrá Voda 1, depth 759 m. **B** - biomicritic limestone (wackestone) with filament-radiolarian microfacies. Typical pelagic facies without transport of detritus from the carbonate platform. Jablonica Quarry, no. 2. **C** - biomicritic limestone (wackestone) with pelagic association of organisms. Filaments, calcified radiolarians and occasional sponge spicules are present. Svarín section, no. 25. **D** - biomicritic limestone (wackestone) with filaments, radiolarians and globochaets. Sponge spicules, ostracods and pelletoids are present in smaller quantities. Zámostie section, no. 45. **E** - filaments-globochaete microfacies of biomicritic limestone (wackestone). Húštik section, no. 9/220. **F** - silicification front in filament-radiolarian biomicritic limestone. Incompletely silicified limestone is changed by significant neomorphic recrystallization of the basic material and allochems. Rajtárka section, no. 4. **G** - biomicritic limestone (packstone) with significant neomorphic recrystallization of the basic material. Newly formed microsparite, often oriented grew on filaments. The original siliceous tests of radiolarians are calcifified, and as a result granulated. Zámostie section, no. 49. Scale bar = 0.1 mm.

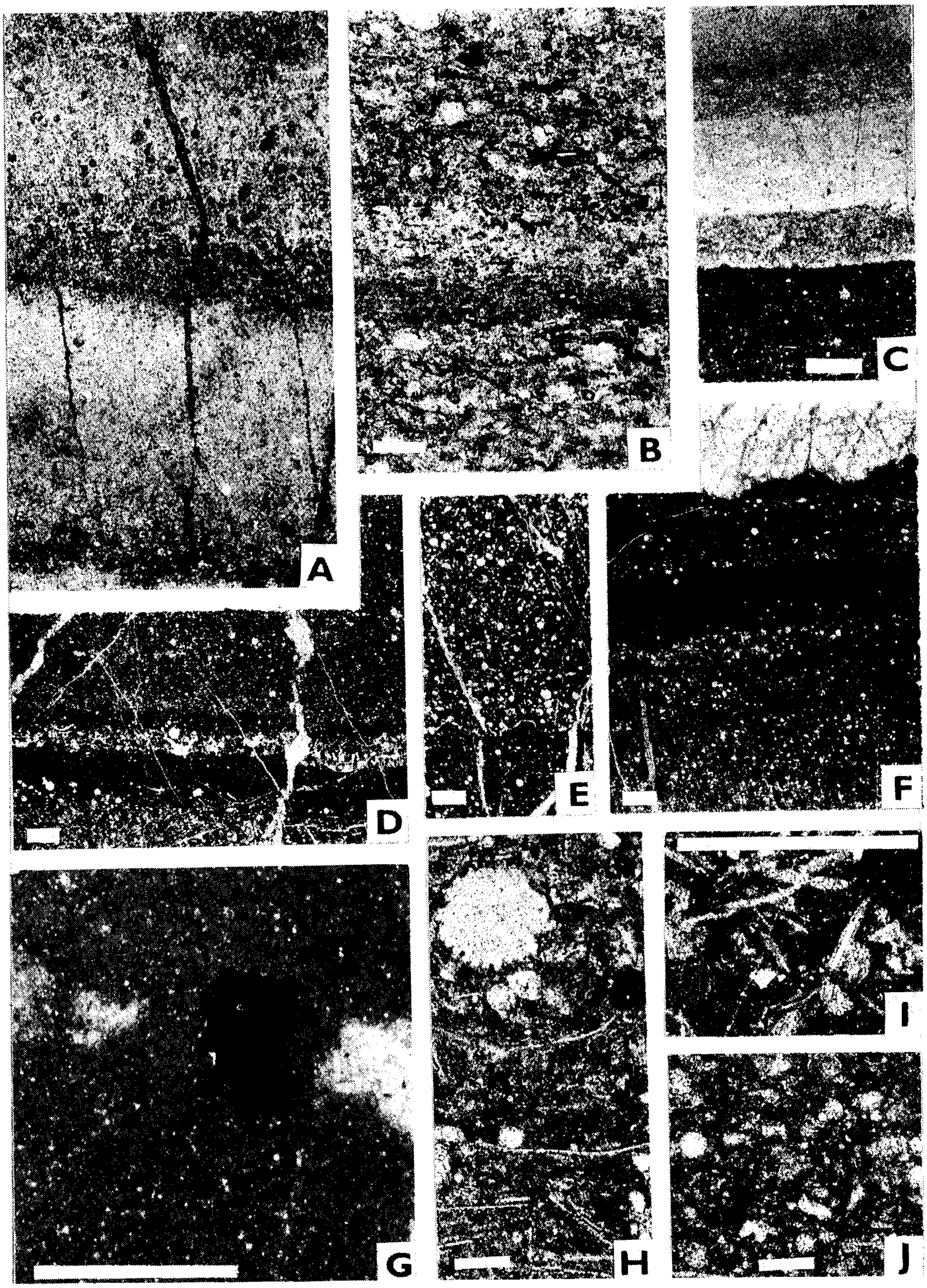

Plate 3: Basin plain facies (Reifling Fm., Göstlingkalk (A, B, C), Partnach Fm. (D, E, F), Svarín Fm., (G, H, I, J).
A - gradationally bedded silicified laminae with radiolarians in dark biomicritic weakly clayey limestone. Turík section, no. 33. **B** - detail of gradational silicified intervals with relicts of radiolarians. Turík section, no. 44. **C** - layer of stratiform laminated silicite in dark radiolarian biomicritic limestone. Turík section, no. 29. **D** - laminae with current directed and gradationally bedded organic detritus (contourites) in radiolarian - filament biomicritic limestone. Borehole DV-1, 687.7 m. **E** - dark radiolarian biomicritic limestone with insignificant gradation. Borehole DV-1, 693.8 m. **F** - gradationally bedded thin laminae with organic detritus with weakly clayey dark biomicritic limestone (contourite). Borehole DV-1, 698.5 m. **G** - idiomorphic secondary pyrite in clayey dark biomicritic limestone without allochems. Svarín section no.65. **H** - biomicritic limestone (wackestone) with clayey admixture. In the detritus are radiolarians, globochaets and filaments. Turík section no. 50. **I** - dark clayey biomicritic limestone with calcified sponge spicules. Turík section no. 71. **J** - biomicritic clayey limestone with relicts of calcified radiolarians. Turík section no. 58. Scale bar = 0.1 mm (A, C, D, E, F, G, I), and = 0.01 mm (B, H ,J).

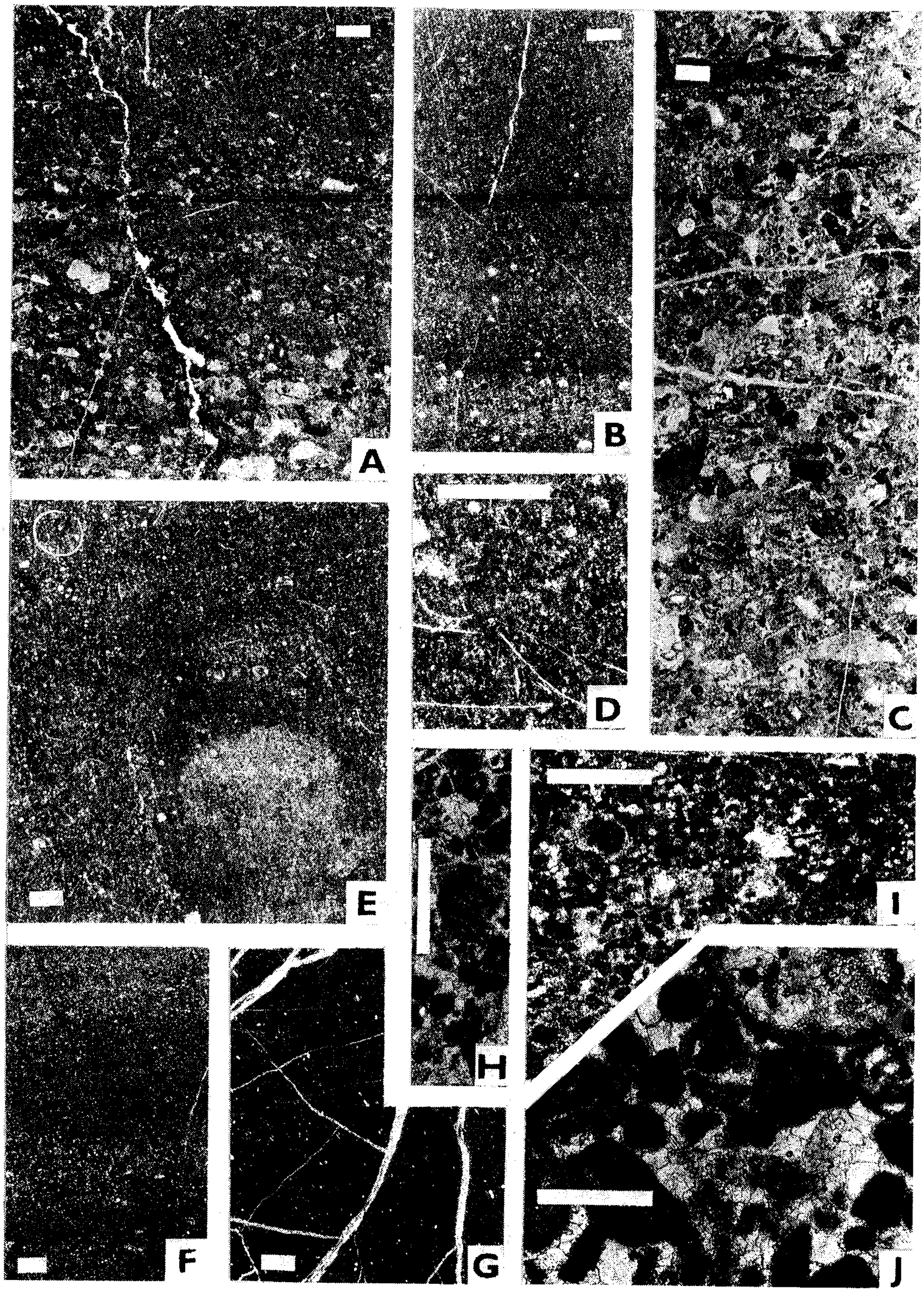

Plate 4: Slope and upper slope facies (Reifling Fm., Grafensteigkalk, Raming Fm.)
A - gradationally bedded allodapic laminae with worked and granulated bio- and lithoclasts. Mokrá dolina Valley section no. 29. **B** - pelletoidal fine laminated micritic limestone with occasional calcified radiolarians. Rajtárka section no. 5. **C** - coarse detritic intrabiomicritic limestone (floatstone). Bio- and lithoclasts are worked by transport and often secondarily micritized by the activity of boring algae. Mokrá dolina Valley section no. 34. **D** - biopelmicritic limestone with filaments and peletoids (granulated allochems). Vrátne section 5C. **E** - bio-disturbed biopellmicritic limestone (wackestone) with relicts of calcified radiolarians, filaments and pelets. Rajtárka section no. 6. **F** - alternation of detritic and micritic thin laminae. In the detritic laminae, pelletoids strongly prevail. Jablonica section no. 20A. **G** - dark micritic limestone with occasional very fine organic detritus (mudstone). Jablonica section no. 4B. **H** - detritic layer of intrabiosparitic limestone (grainstone). The greater part of the allochems is strongly micritized. U Fajnorov section no. 4C. **I** - fine calcarenite (grainstone). All bio- and lithoclasts are secondarily granulated into pelletoid. Jablonica section no. 4/2A. **J** - coarse detritic intrabiosparitic limestone (grainstone) with granulated clasts. Jablonica section no. 5/3. Scale bar = 0.1 mm.

in sections and thickness of the sequence is variable (thickness 30 - 70 m). It reaches its maximum thickness in the Trenčín section (70 m), but it is missing in the Turík section, representing the deepest facies. The limestones are thick bedded, locally even massive with evenly bedded areas and numerous cherts. The colour of the limestones is light grey, grey and grey-brown. Weakly recrystallized biomicritic limestones (mudstone-wackestone) with a low proportion of allochems (up to 20 %; Pl. 2: D, E, G) are dominant. Filaments, ostracods, crinoids, foraminifers, radiolarians, spicules, globochaets, bivalves and algal microproblematic are present in the organic detritus. Micritized bio- and lithoclasts peletoids form up to 50 % of the detritus. Intensive bioturbation probably destroyed any gradational and laminated textures. The most frequent microfacies are the pellet-filament and pellet microfacies (Pl. 2: E, G).

The ratio of "pelagic"to shallow water detritus, derived from the margin of the platform is approximately 1 : 1, but in an upward direction, it gradually changes to the disadvantage of the "pelagic component". In some sections (Svarín, Trenčín), the limestones are intensively diagenetically dolomitized, and their original texture is only occasionally preserved in the silicites. The dolomites and lime dolomites with cherts are mainly formed by polymodal dolosparite to microdolosparite with occasional relicts of bioclasts. The silicites, which originated in the early stages of lithification, probably by mobilization of the SiO_2 from the siliceous tests of radiolarians and spicules, are also strongly substituted by dolomite.

On the basis of the microfaunal character and its present texture and structure this is a facies, which is a transitional member between the typical basin facies (Knollenkalk and Göstlingkalk), and the slope detrital facies of the Grafensteinkalk and Ramingkalk. The sedimentary environment was close to the shelf slope, as the quantity of shallow water organisms and pellets in the sediments shows. The mechanisms of transport may be varied, in the strongly bioturbated sediment without primary sedimentary structure, it is difficult to distinguish them (turbidity, grain flow, talus streams ...).

Slope facies

Thin bedded laminated limestones - Grafensteigkalk

The lithofacies is characteristic for the facies of the Reifling Formation, which, in an upward direction, is followed by shallow water platform facies limestones and dolomites of the Wetterstein Formation s.l. (Figs. 2, 3). The thickness of the formation is relatively constant in different sections (30 - 50 m). The formation is present in the Veterník Nappe (Suchá-, Mokrá-, and Rajtárka dolina Valleys, Červenica, U Fajnorov, Dobrá Voda- and Beckov castles; Figs. 2, 3) but was found nowhere in the Choč Nappe.

Thin bedded grey-brown - grey limestones, with occasional silicites, often parallel laminated with normal gradation. The thickness of beds increases in an upward direction, while the modality and variety of organic detritus changes in a similar progressive way. A characteristic element is alternation of allodapic coarse detritic (often graded and laminated) layers with mudstone. The proportion of allodapic layers and "pelagites" significantly changes in an upward direction, and in the upper part of the formation pelagic limestones are almost completely absent. The mudstones are formed by weakly recrystallized bio- and biopellmicrites (mudstone-wackestone; Pl. 4: A, B, E, D) with a low proportion of detritus (up to 20 %). Pelletoids and filaments form the main component of the detritus, while radiolarians, spicules, globochaets, ostracods, foraminifers and crinoids are present in smaller quantities. In the residue, conodonts, fish teeth and scales are found. The prevailing microfacies is pelletal and filament-pelletal.

The detritic allodapic deposits contain mainly shallow water detritus (Pl. 4: C) derived from the platform margin, such as crinoids, pelletoids, foraminifers, ostracods and fragments of organogenic limestones with calcareous sponges (*Sphinctozoa*), tubiphytes, cyanophytic algae and corals. Ooids and algal oncoids are scarcely found. The content of detritus is high (50 - 80 %), intrabiomicrites and pellbiomicrites (packstone-floatstone) are the main types present, while sparite limestones (grainstones) are less abundant.

The lithofacies mentioned represents sediments of the middle and lower parts of the shelf slope. Apart from calcareous ooze, shallow water carbonate organic detritus was transported in the form of grain flows and talus streams, as well as (partly) by turbidity currents.

Upper slope - platform margin facies

Heavy bedded, massive limestones and breccias - Raming Formation

A characteristic feature of the formation, which is a facial transition between the deep water slope facies and the coarse clastic sediments of the platform margin, is its shallowing-upwards trend, and its lateral as well as vertical facial variability. In the area of the Malé Karpaty Mts. (Suchá-, Mokrá-, and Rajtárka dolina Valleys; Červenica sections; Figs. 2, 3), the thickness of the formation reaches 10 - 100 m. In the Brezovské Karpaty Mts. (Jablonica, U Fajnorov, Dobrá Voda Castle, Vrátno, Kamenica and Beckov it reaches 70 - 150 m. The formation is present only in sequences, where the Wetterstein organogenic limestones are present in the rocks overlying the Reifling Formation. This facies was therefore closely connected with the margin of the carbonate platform from which almost 90 % of the detritus and calcareous ooze originated.

The limestones are thick bedded (the thickness of beds increases upwards, or in the direction of the platform margin). The average thickness of beds in the lower part of the sequence is 40 - 50 cm, and in the upper part 100 - 150 cm. Pale-brown, brown-grey and grey coloured limestones contain light-brown cherts and clayey intercalation. Gradation and parallel laminated detritus, isolated large fragments up to blocks of light organogenic limestones and slip deformation are characteristic.

The limestones contain debris of shallow water organisms (Pl. 4: D, G, H, I, J), such as crinoids, foraminifers, ostracods and fragments of organogenic limestones with calcareous sponges (*Sphinctozoa*), tubiphytes, cyanophytic algae, corals and pelletoids, derived from the platform margin. Ooids and algal oncoliths are rarely found. The content of detritus is high (50 - 80 %, and intra-biomicrites and pellbiomicrites (packstone-floatstone) are present. Intrasparitic and biopellsparitic limestones (grainstone, rudstone,) increase in an upward direction.

Chemical and isotope composition

Chemical composition of the rocks of the Middle Triassic intraplatform depressions and its connection with mineralogical com-

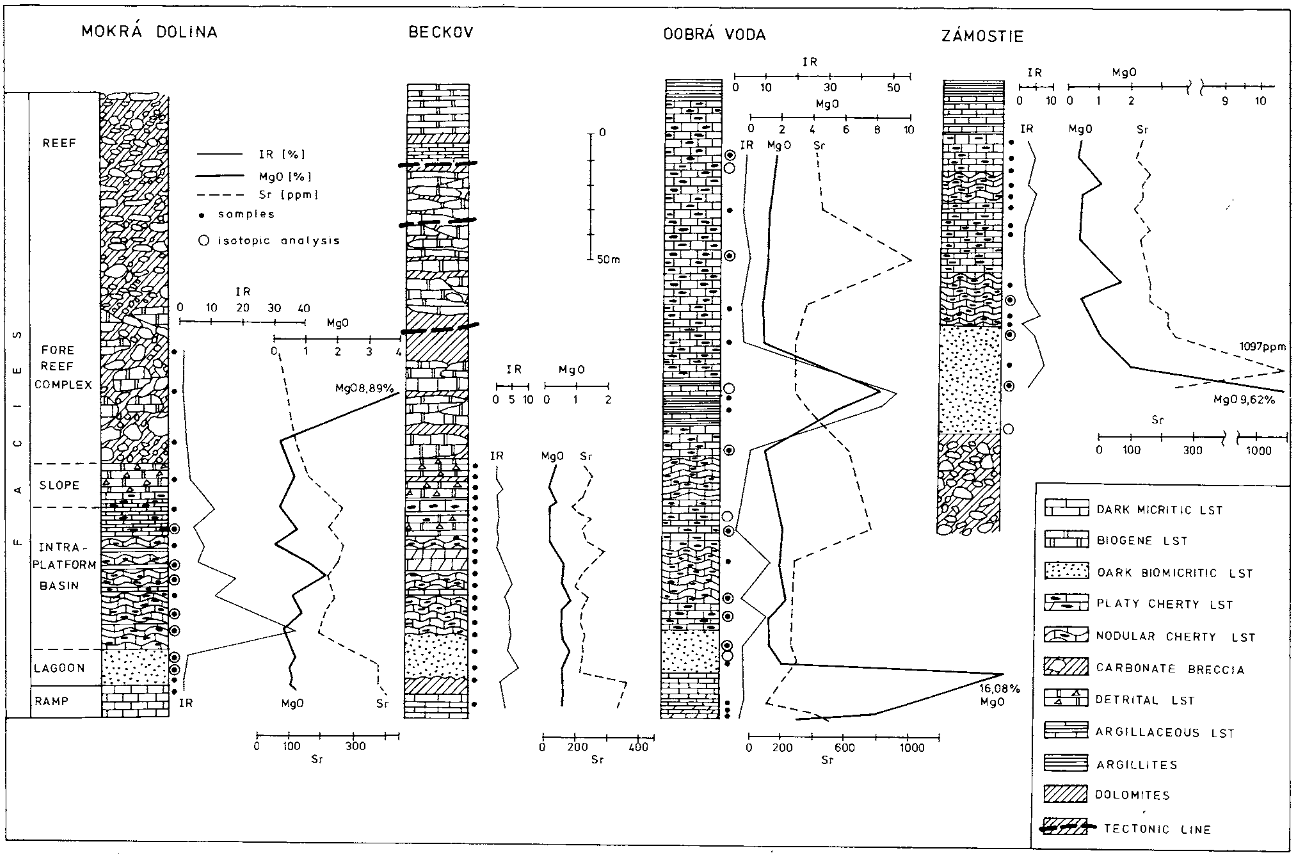

Fig. 4. The comparison of the geochemical results in selected sections. The localization of isotope analyses - open cyrcles.

position (insoluble residue - IR), the distribution of microelements and stable isotopes of C and O, according to division by lithofacial types and post-sedimentary (diagenetic) changes in the rocks have been established.

Interpretations of geochemical results from studies of Triassic platform carbonates from the Malé Karpaty Mts. have been done by Lintnerová et al. (1988, 1990), Lintnerová & Hladíková (1992); Michalík et al. (1992, 1992a). Geochemical results from the Reifling Limestone of the Choč Unit were published by Veizer & Demovič (1974), and Martinský (in Havrila et al. 1988).

The chemical analyses of rocks were carried out by X-ray fluorescence analysis, classical chemical analyses (IR, CaO, MgO of carbonates) and microelements were determined by the AAS method. X-ray diffraction and scanning electron microscopy (SEM) has been used for determination of the mineral composition (Laboratory of the Geological Institute, Slovak Academy of Sciences). The isotopic analyses of O and C were carried out in the Czech Geological Institute Laboratory in Prague, on the Finnigan MAT-2 equipment, after dissolution of microsamples of matrix of mainly biomicritic limestones in 100 % H_3PO_4, according to McCrea (1950). Results are reported in usual δ-notation relative to PDB.

Samples were analysed from 11 sections (Fig. 2; sections 5 - 15), a total of 186 samples. Orientational isotopic analysis of O and C from the Turík section was done to supplement older chemical analyses (Martinský in Havrila 1988). The overall chemical and mineralogical composition of the limestones did not essentially change in the pelagic basin facies, but we could follow a certain continual shift in composition in relation to the transitional facies, and in relation to the post-sedimentary development of the rock.

IR characteristics and the relation of IR to diagenetic change (silicification, dolomitization)

An essential part of the material, which was deposited in the basin, originates from the platform margin and slope environments. The transport or presence of a greater quantity of siliclastic material is associated with the deeper water basin facies (Partnach and Svarín Beds). Increased transport of siliclastic material completely interrupted the development of carbonate sedimentation in the rocks overlying the Svarín/Reifling limestones.

The IR in the limestones is formed by clay minerals, and by microcrystalline quartz in the form of typical cherts (silicification), less by clastic quartz. Authigenic pyrite is the most frequent mineral of the sulphur group. In the "heavy fraction" of IR of some samples from DV-1 were presented the grains of sphalerite and galenite also. The parallel orientation of mainly detritic clay minerals to the surfaces of pressure dissolution often emphasizes the nodular character of the rock, especially if large cherts are present. In IR we could identify by X-ray analysis, illites or light K-mica (clastic), chlorite and also kaolinite and mixed-layer IS minerals. Pressure from overlying rocks significantly increases dissolution of calcite (Maliva & Siever 1989), but phyllosilicates in carbonates behave entirely passively (Kreutzberger & Peacor 1988), which is in contrast to their behave in claystones and shales. However, the scanning electron microscopic study of samples showed the formation of diagenetic (authigenic) clay minerals (illite) in the carbonates. We consider that in the Partnach and Svarín Formations, where the content of clay minerals is essentially higher (IR frequently over 50 %, clays form a main part of IR), clay minerals were transformed by diagenetic processes, and could be the source of for example Mg^{2+} for dolomitization (McHargue & Price 1982; Sternbach & Friedman 1984; Lintnerová 1988), as well as of SiO_2 for silicification . The limestones in the surrounding carbonate shales in the DV-1 (lower IR - up to 15 %), are not massively dolomitized, although they contain rhombohedral dolomitized grains, dispersed in the rock. In the borehole DV-1, there was dolomitization in two of the samples studied from the Partnach Beds (Fig. 4), to an extent of 25 and 38 %. The clay minerals are formed by illite and mixed-layer IS minerals, with a content of S - layers of up to 15 % (Šucha & Zatkalíková in Michalík et al. 1992; Lintnerová 1988), with a smaller proportion of chlorite. From the petrographic and chemical results obtained, we can state that dolomitization went on through at least three stages of diagenetic development of the rocks : **1** - massive diagenetic dolomitization of limestones - Reifling dolomites; **2** - the form of dolomitized grain - rhomboheders in the recrystallized limestones, and **3** - dolomitization in the clayey limestones - Partnach Formation, associated with deeper burial. We have the least results, which could identify the dolomitization process, from the massive (late) diagenetic dolomites. Changes in the oxidation-reduction conditions in the buried sediments (anoxic diagenetic conditions - production of pyrite), and corresponding changes in the pH of solutions, could have contributed to their formation.

Siliceous tests of organisms (radiolarians, sponge spicules and others), which are found in calcified forms in the limestones, were the main source of SiO_2 for cherts in limestone. The question is, whether they gave a sufficient quantity of SiO_2 necessary for the formation of the large chert nodules abundantly represented in the limestones. At present, we are able to prove, that SiO_2 was precipitated in opal form (opal A - opal-CT: Williams et al. 1985; Maliva & Siever 1989), and as a result of the burial and aging of the rock, recrystallized as stable microcrystalline quartz. However, pseudomorphoses after opal-CT lepispheres in cherts from the limestones and dolomites preserve and document the maturing process of the SiO_2- phase in the limestones (Pl. 5: G to L) and partly also the conditions of postsedimentary development of the rock. In the cherts from the dolomites, we also directly observed the silicified remnants of filaments (Pl. 5: G to L), which are not preserved in surrounding dolomite, just as not preserved other sedimentary signs. Significant silicification was observed in the clayey rocks of the Turík section, which appear in laminae with abundant radiolarians.

The presence of diagenetic cherts or other form of silicification appears in the overall chemical composition, and in movement of the correlative relations of microelements and SiO_2. However, a positive correlation with Al_2O_3, or with K_2O preserve and characterize the connection of micro-elements with the content of clay minerals in the rocks. Differences in these dependences were not found. Weak sulphide as well as sulphate mineralization was observed in samples from the borehole DV-1 (Michalík et al. 1992). We consider it a result of migration and precipitation from solutions originating from the same sediments of intrabasinal origin, in conditions of burial.

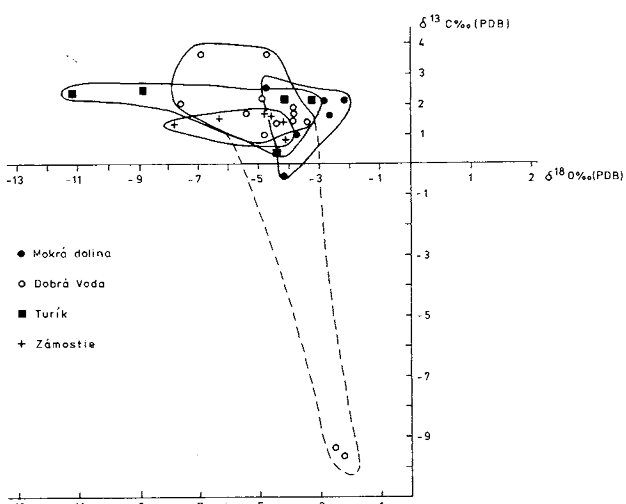

Fig. 5. Correlation diagram of the values $\delta^{13}C$ and $\delta^{18}O$ (PDB).

Micro-elements in basinal limestones

The transitional lagoonal member recorded in all geochemically studied sedimentary sequences still bears the marks of shallow water sedimentation but the cyclic transport of fossiliferous material indicates gradual or repeated deepening of the sedimentary area. These changes of conditions are partly reflected in changes of Sr content (Fig. 4). In comparison with the underlying muddy limestones of shallow ramp sedimentation (Annaberg Limestones) we noted gradual decline of the Sr values, as long as massive dolomitization was not found in the formation. Among the other studied elements (e.g. Mn, Na, Fe) connected with carbonate minerals, the insignificant differences found do not show a simple connection with changes in sedimentation conditions. They may reflect migration of solutions in diagenetic evolution of rocks. Some, for example the dolomitized samples, show a raised content of Na (over 200 ppm in comparison with 80 - 120 ppm in limestones), but also in some biodetritic limestones (limestones from the Zámostie Formation).

The Zámostie and Beckov sections (Figs.2, 4) document a continual evolution of lagoonal and basin sedimentation, with prevalence of biomicritic limestones (bankalk). However, here we follow the picture of relatively strong recrystallization (also partly dolomitization), especially in organodetritic deposits of Zámostie (Pl. 5: A to D). The content of Sr in the Zámostie section varies in a range from 114 to 240 ppm. We could not find more significant differencies according to microfacial types. Annaberg Limestone with a higher level of Sr (300 - 400 ppm) forms the base of the Beckov section. The content of Sr is moderately increased in comparison with Zámostie (197 - 292 ppm), but again without relation to microfacial type.

In sections of the Choč Unit, dolomitization effects a large part of the Reifling Limestone (Turík, Svarín sections; Figs. 2, 3) and the chemical characteristics follow this diagenetic change. Contents of Sr in the basinal limestones may vary in relatively wide intervals (180 - 1000 ppm), which we recorded in DV-1 (Fig. 4). The presence of celestine as an accessory mineral in these limestones is also a sign of the diagenatic mobilization of Sr.

Table 1: The results of isotope analyse of Reifling depression limestones from the sections Mokrá dolina Valley, Zámostie, Turík and from the borehole Dobrá Voda 1 (the localization of sample in sections - Fig. 4). The cavern calcite were analyzed in two samples.

Samples	$\delta^{13}C$ PDB [‰]	$\delta^{18}O$	Lithology	Samples	$\delta^{13}C$ PDB [‰]	$\delta^{18}O$	Lithology
				Dobrá Voda 1			
Mokrá dolina				561 m	+2.2	-4.9	biomicrite/wackstone
3	+2.0	-6.2	biomicrite/packstone	566 m	+3.6	-6.7	biomicrite/wackstone
4	+1.6	-5.2	biomicrite/packstone	585 m	+3.6	-4.7	biomicrite/wackstone
5	+1.6	-2.6	micrite/mudstone	639 m	-9.6	-2.6	micrite/mudstone
6	+1.2	-3.8	biomictite/mudstone	639 m	-9.4	-2.5	micrite/mudstone
6	+1.1	-3.7	biomicrite/calcite	673 m	+1.3	-3.3	biomicrite/mudstone
8	+2.2	-2.4	biomicrite/wackstone	673 m	+1.4	-3.9	biomicrite/calcite
9	+2.1	-2.2	biomicrite/wackstone	706 m	+1.4	-4.2	biomicrite/wackstone
11	-0.5	-4.3	intramicrite/wackstone	709 m	+1.8	-3.9	biomicrite/wackstone
				775 m	+1.7	-5.3	biomicrite/wackstone
				786 m	+1.6	-3.9	biomicrite/packstone
Zámostie				815 m	+1.0	-4.8	biomicrite/wackstone
0	+1.3	-7.8	biomicrite/packstone	828 m	+2.0	-7.6	biomicrite/wackstone
11	+1.7	-4.9	biomicrite/packstone	Turík			
20	+0.8	-4.1	biomicrite/wackstone	14	+2.2	-3.2	biomicrite/wackstone

The quantity of siliclastic material in sediment of the Turík section (Martinský in Havrila 1988), is relatively high; thin argillaceous layers more frequently alternate with carbonate deposits. The content of Sr in carbonates (Reifling and Trachyceras limestones, with the basal parts significantly dolomitized again), is significantly increased (200 - 1400 ppm). These higher contents of Sr are probably the result of the greater depth of sedimentation and relatively closed sedimentary and diagenetic environment. In the marly deposits, we again meet with dolomitization.

Gradual shallowing of the basin (increasing content of shallow water materials) up to the transition to slope and fore-reef facies is reflected in a decreasing in Sr content (more open diagenetic system), which was relatively well documented in the Malé Karpaty Mts. (Lintnerová et al. 1988, 1990). In the sections from the Brezovské Karpaty Mts. (Jablonica, U Fajnorov, Dobrá Voda castle, Vrátno; Fig. 2), the sediments of the middle and lower parts of the slope are recognizable. The contents of Sr are higher (170 - 350 ppm), but do not more than the average contents common in limestones.

The results of isotopic studies

The results of the preliminary comparative isotopic study of limestone matrix from the Reifling depressions are presented in Tab. 1 and in Fig. 5., where C/O isotopic excursion for the studied profiles are ploted. The $\delta^{18}O$ value fluctuates between -2.2 and -11.2 ‰ and are recognizable two basic trends in this range of relatively very different values.The high $\delta^{18}O$ values (from -2.2 to about -4.0 ‰) are common in the ancient pelagic limestones (Hudson 1977, Jankyns & Clayton 1986; Lini et al. 1992). The O-isotope values from Mokrá dolina Valley section in the plott (Fig. 5) fall to the field of pelagic limestones. The samples from the next three profiles follow more or less the diagenetic trend with the depleted $\delta^{18}O$ (from -4.0 to -11.2 ‰). The difference in $\delta^{18}O$ from two phases in the sample from Zámostie section (micritic matrix -4.6 ‰, white calcite in cavity -6.3 ‰) indicates isotopic differentiation in later diagenetic products and possibility to find a differerent diagenetic products in pelagic limestones (compare sample from Mokrá dolina Valley in Tab.1 - calcite has the same O and C-isotopic values).

In comparison with the shallow water platform limestones from Malé Karpaty Mts. (Lintnerová & Hladíková 1992; Michalík et al. 1993) the pelagic limestones from the Mokrá dolina Valley section have higher values of $\delta^{18}O$, which could indicate a relatively colder environment of sedimentation.

Low frequency fluctuations in the C-isotopic values in studied pelagic limestones are well observed in tree profiles, except DV-1. The $\delta^{13}C$ values are fluctuating between -0.5 to + 2.5 ‰, but prevaling number of the values have less wide range (Tab. 1). We noted a greater differentiation of C-isotope values in set from borehole DV-1. The $\delta^{13}C$ of the sample from the marl limestones (Partnach Formation) significantly dropped to -9.4 and -9.6 ‰. The O-isotopic values from this sample are relatively high: -2.6 and -2.5 ‰ resp.. We consider the jump in C-isotopic ratio in calcite in this sample to be result of dilution of marine carbonate C ($\delta^{13}C$ =0 ‰ , average in the studied set -1.9 ‰) by organogenic C ($\delta^{13}C$ = -24.5 ‰) originating by microbial fermentation of organic matter (McMahon et al. 1992). Marine carbon was diluted during diagenetic recrystallization in buried sediment. The content of organic (marine planktonic origin) C in these deposits reached level of 0.5% (Francû in Michalík et al. 1992). The content of organic matter in this dark marly lime sediment might had been originally substantially higher and during its transformation the organic C got into crystallization fluids . In connection with low-fluctuation of C-isotope ratio in pelagic limestones (Jurassic and Cretaceous, see review in Lini et al. 1992) the high C- isotopic value (+3.6 ‰) in upper part of pelagic limestones from borehole Dobrá Voda (Tab. 1) are also important.

We could expect a similar dependence in the Turík section, where mixed clayey carbonate rocks are represented still more

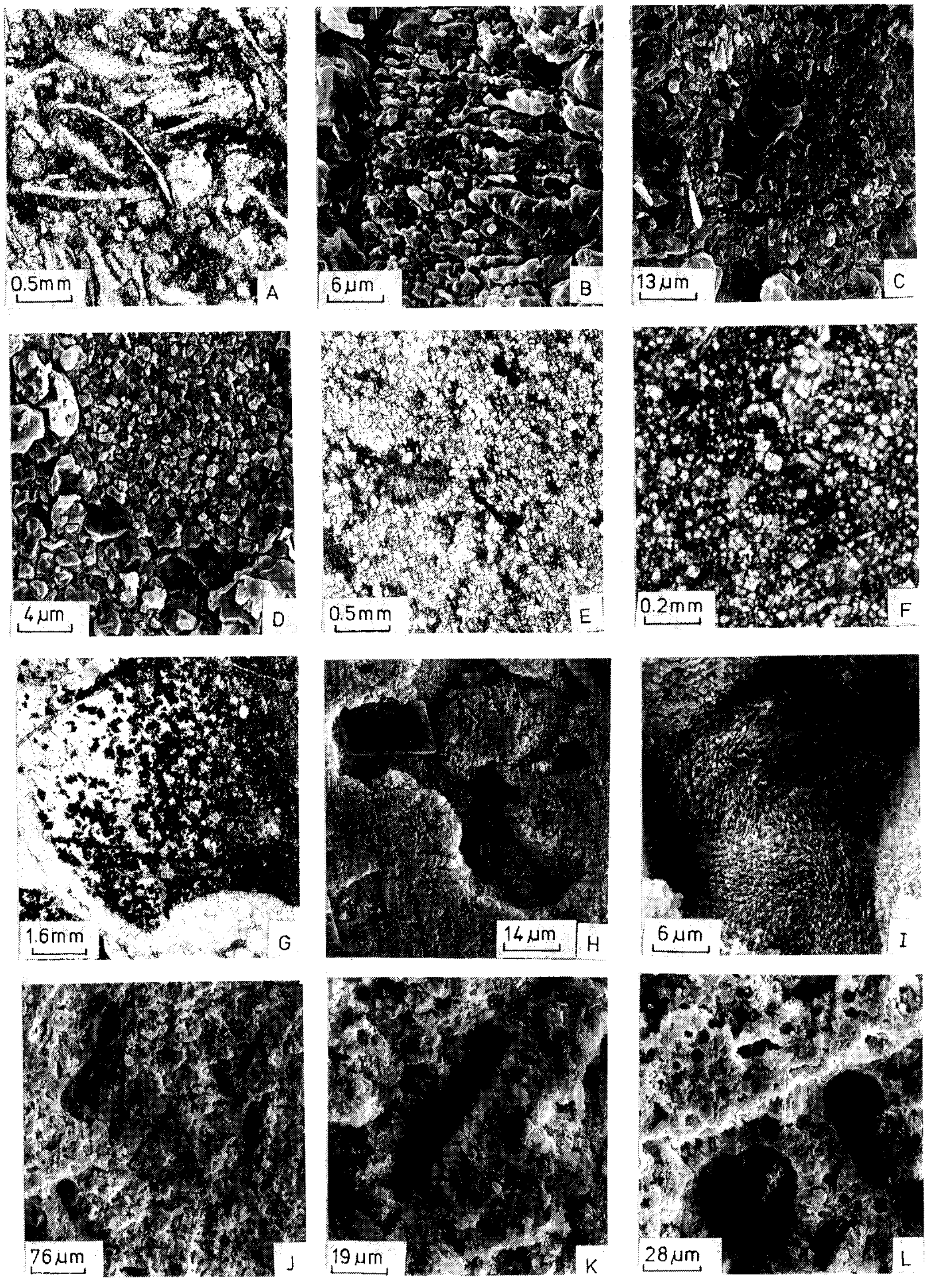

Plate 5: Diagenetic texture (dolomitization, silicification) in pelagic carbonate facies.
A - biomicritic (packstone) limestone from Zámostie (sample 23) marked by significant recrystallization of the matrix and clasts. Neomorphic pseudosparite orientationally grown on bioclasts (filaments). **B, C, D** - from studies (Zámostie) in SEM, we can follow the mode of preservation or recrystallization of clasts in packstones (Zámostie sample 22). On etched surface plates (10 s, 2 % HCl) we can follow the wall of a recrystallized filament (**B**), a cavity filled by coarse crystalline calcite (**C**) as well as preserved micritic material (**D**). **E** - diagenetic dolomitization wiped out the original sedimentary texture of the limestone (Jablonica no. 3B). **F** - dolomitization in clayey limestones appears, replacing the micritic matrix with rhomboheders of dolomite, remnants of thin walled tests of bivalves can be partly distinguished (Svarín no. 4). **G** - chert in Reifling limestone is changed into rhomboheders of carbonate (calcite) and veins filled by mosaic sparry calcite (Rajtárka no. 1). **H** - the basic material of chert is formed by micro-crystalline quartz, pseudomorphically replacing intermediary opal-CT. It forms characteristic lepispheres. They are easily distinguishable on the surface of the plate etched by HF. Grain calcite, but also traces of dissolved rhomboheder grains are easily visible in the cement with lepispheres (DV-1, 678.8 m). **I** - Morphological relicts of opal-CT (the precursor of microcrystalline quartz) are also preserved in the cherts from dolomites (Lopej, Reifling dolomite, Fig. I to K). **J, K, L** - remnants of the tests of organisms (filaments, radiolarians?) are also partly preserved in cherts. Later, the tests in limestone were dissolved and replaced by SiO_2 and were then enclosed in cherts.

significantly. However selection of isotopic analyses from 5 samples was directed towards pure limestone deposits. The values of $\delta^{13}C$ were comparable with the values in other sections (Fig. 5). We noted a greater differentiation in $\delta^{18}O$ values, in which an interval of -3 to -11 ‰ is found. This could reflect the relatively deeper conditions (temperature) of sedimentation and/or burial relative to the other sections. Indeed a more significant depletion of $\delta^{18}O$ is only in two samples. We did not observe a more substantial shift in the distribution of $\delta^{13}C$ even in samples with low $\delta^{18}O$.

We calculated the corresponding temperatures, according to Dixon & Coleman (1980), from the isotopic values of O. The differences in isotopic ratios of O correspond to a temperature range of approximately 35 °C. Therefore the temperature range is not large, in relation to the fact that the samples are from relatively distant sites, or at least two different tectonic units.

Summary

The chemical, mineralogical and isotopic characteristics prove the complete homogeneity of the material, and so also of the conditions of sedimentation, and partly also of diagenesis, in the Middle Triassic basins of the Western Carpathians. The presence of siliclastic material may have influenced the processes of diagenetic stabilization and recrystallization, which especially concerns the movement of solutions and also partly the sources of some elements. We did not observe more important differences in the composition (sources) of siliclastic material even in comparison with the Lunz Formation (Lintnerová 1988, Lintnerová in Michalík et al. 1992).

The isotopic ratios of O and C show that the diagenetic solutions were mainly of intrabasinal character, that is closed or saturated marine solutions. The isotopic ratio of O varied as a result of their partial differentiation and increasing temperature in the buried sediment. A significant decrease of $\delta^{13}C$ in clayed limestone represents in these conditions a dilution of marine C with organogenic C. The dolomites were not isotopically studied up to now, but such study may help in making a more exact assessment of the dolomitization process. In the latest studies, there are not sufficient additional results on the process of massive dolomitization, and we cannot explain it satisfactorily.

Paleodynamic remarks

A characteristic feature of the Ladinian development of the Middle Triassic carbonate platforms near the northern margin of the Mediterranean Tethys was the origin of tensional intraplatform depressions. Traces of increased mobility of the substrate of the paleo-European shelf are already preserved in the Upper Pelsonian formations of the Fatric (tsunamites in the Vysoká Limestone of the Malé Karpaty Mts., Michalík et al. 1992, sliding phenomena in the Gutenstein Formation of the Malá Fatra Mts.; Mišík 1968) and Hronic domain (Farkašovo megabreccia; Michalík 1978).

The seismic activity of this period may be connected with the creation of a left sided strike-slip zone (Roeder 1987) on the northern margin of the southern Alps, and with the movement of the Apulian block to the east. In areas with monotonous shallow water carbonate sedimentation, a reflection appeared in more pelagic sediments, sometimes accompanied by submarine volcanic products. Sedimentation in these rifted zones reached relatively high values (400 mm per millennium). The east-vergent movement of the Apulian caused the origin of tensional strains in the Alpine-Carpathian (Paleo-European) shelf. Intraplatformal basins with sedimentation of the Buchenstein, Livinallongo, Reifling, and partly also Hallstatt limestones, were formed in the system of carbonate platforms. The transition between platform carbonates and the superimposed basin filling was sharp, and sometimes accompanied by submarine volcanic products.

While the transgression in the extra-Tethys area continued, sedimentation on the Mediterranean shelf (except for the Hallstatt marginal zone) has an entirely regressive character. The Ladinian carbonate platforms bordered practically the whole Tethys shelf. The rate of sedimentation of the reefal carbonates reached 40 to 70 mm /kyr. However on the bottom of the intrashelf depressions, scarcely 4 to 14 mm of coarse bedded sediment accumulated in a millennium. In this way after continuing subsidence, the depth of the bottom of these basins increased by more than a thousand metres, up to the beginning of the Carnian. Various authors have supposed a direct connection between these depressions and the open sea, which allowed the origin of ascending currents, bringing psychrospheric ostracods, radiolarians and other deep sea microfauna.

The first sediments of the developing depressions in the Hronic and Silicic of the Central Western Carpathians, were locally coarse clastic Farkašovo megabreccias, after which the Zámostie Formation followed. After deepening, sedimentation of Reifling Limestone occurred. Sedimentation on the bottom of basins was slow, and fine grained carbonate sediments, to which grain flows and turbidity currents transported transported a quantity of material from the bordering barrier reef or shallow water mounds, are characteristic of them. The proportion of actual carbonate production and pelagic fallout in the production of sediment was relatively small in comparison with this transport of material. In the axial parts of the depressions, the Partnach beds were sedimented. At the boundary of the Middle and Upper Triassic, the Göstling and Svarín beds were deposited. During the Julian, these were covered by monotonous pelites of the Reingraben Formation.

Conclusions

1 - By means of sedimentological and microfacial evaluation of fifteen section of Middle Triassic basin sequences in the central Western Carpathians, we documented temporal and spatial changes in the sedimentary record of the Middle Triassic intra-platform depressions.

2 - Similar procedure has been used by description of shallow intraplatform basin facies (Zámostie Fm.), deeper basin facies (Knollenkalk, Göstlingkalk, Partnachmergel, Svarín Fms.), basin - lower slope facies (Bankkalk), slope facies (Grafensteinkalk) and upper slope facies (Ramingkalk).

3 - On the basis of geochemical research, questions of the chemical environment, conditions of diagenetic changes, silicification and dolomitization were discussed. More significant differences in the origin of siliclastic material were not found by comparing the mineralogical and chemical composition of IR.

4 - The isotopic ratios of O and C proved that diagenetic solutions were mainly of intrabasinal character, that is of marine origin.

$\delta^{18}O$ varied as a result of partial differentiation of solutions and raising of the temperature in the buried sediments. A significant decline of $\delta^{13}C$ in marly limestones, represents a dilution of marine C by organogenic C with low values for $\delta^{13}C$.

5 - The basins of the Reifling Formation originated from a tensional depressions on fragments accompanying a supposed left-side strike-slip zone within the northern Tethyan shelf. They were created by different rates of sedimentation, 40 - 70 mm /kyr on the reefogenic margins, but only 4 - 14 mm on the bottoms of the basins.

6 - Sedimentary and paleotectonic evolution of particular depressions differed in many details. Some of them were filled by products of prograding carbonate platforms and by sandstones of the Lunz Fm. at the end of the Middle and beginning of the Upper Triassic, the others by the terrigenous clastic Reingraben Formation during the Early Carnian.

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