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MICROFACIES OF THE TRIASSIC LIMESTONES IN THE PIATRA ŞOIMULUI KLIPPE (TRANSYLVANIAN NAPPES, RARĂU SYNCLINE, EASTERN CARPATHIANS, ROMANIA)

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ABSTRACT. The Piatra Şoimului klippe belongs to the allochtonous sedimentary succession of the Transylvanian Nappes in the Rarău Syncline. It is situated on the western flank of the syncline over the Callovian – Oxfordian jaspers.

The identified micropaleotologic association consists of dasycladales, foraminifera, sphynctozoa, echinoderms, etc. which indicate Pelsonian–Norian age. The microfacies of these limestones demonstrate the origin of Piatra Şoimului klippe from a previously carbonate platform situated to the west of the Bucovinian sedimentary domain. The correlation between the allochemic and ortochemic components described in the numerous microfacies types proves that the Triassic sedimentation took place in an internal platform domain.

Keywords: Microfacies, paleoecology, Triassic, Piatra Şoimului klippe, Transylvanian Nappes.

INTRODUCTION

The Transylvanian Nappes constitute the upper part of the Central East-Carpathian Nappe System (the Median Dacides) which is part of the Crystalline Mesozoic Area of the Eastern Carpathians. This position favored their fragmentation in the process of obduction and slow gravitational decollement. Under these circumstances it is difficult to establish the exclusively Mesozoic sedimentary series belonging to the Transylvanian Nappes, especially because the majority of the lithostratigraphic members appear only as isolated olistoliths in the Hauterivian-Aptian wildflysh of the Bucovinian Nappe.

The olistolith blocks appear on approximately 100 – 150 km from the Rarău Syncline, in the north, to the Comana locality, in the south (the south-western part of the Perşani Mountains). The fossiliferous content of the olistoliths permitted to reconstruct a sedimentary series of Triassic-Early Cretaceous age, with an important gape corresponding to the Callovian–Oxfordian (Mutihac, 1990). The klippe's dimensions vary from meter-scale blocks to real mountain massifs, such as the limestones in the Rarău Syncline: Piatra Zimbrului, Piatra Şoimului, Pietrele Albe, Popii Rarăului, etc.

The Piatra Şoimului klippe, made up only of Triassic carbonate rocks, is situated on the western flank of the Rarău Syncline. It is the only klippe from this syncline disposed on the Callovian-Oxfordian jaspers of the Bucovinian Nappe (Fig. 1). This situation generated different opinions regarding their age and tectonic position. Most of the geologists uphold their allochton position as klippe incorporated

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in the newest deposits of the Bucovinian Nappe (Kräutner, 1929; Patrulius, 1966, 1967; Patrulius et al., 1971; Mutihac et al., 1969; Mutihac, 1966ab, 1968, 1990; Mirăuță & Gheorghian, 1978; Grasu et al., 1995; Turculeț, 2004). Other authors, such as Popescu & Patrulius (1964), Mutihac & Mirăuță (1964) and Turculeț (1971) considered that the limestones outcropping behind the Rarău chalet, called Piatra Şoimului, belong to the normal succession of the Triassic in the Bucovinian unit. The arguments of the last author in favor of the *in situ* character of these deposits are of lithological nature. He underlined their petrographic and paleontologic similarities with limestones disposed on the massive dolomites from the northern area of the Rarău Syncline.

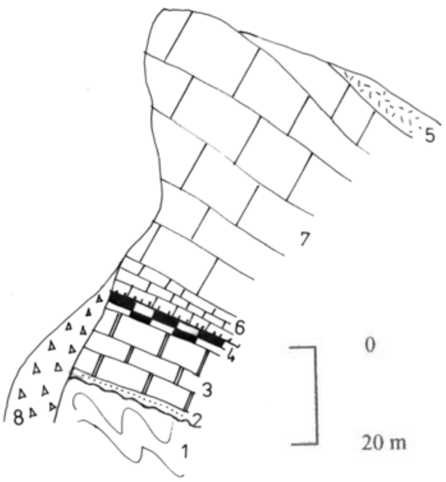

Fig. 1. *Geological sketch of the carbonate Triassic rocks from the Piatra Şoimului klippe (under the "tourists' balcony", NW slope). Bucovinian Nappe: 1-crystalline basement; 2-sandstones, Seisian; 3-dolomites, Lower Anisian; 4-jaspers, Callovian-Oxfordian; 5-wildflysh, Hauterivian-Albian. Transylvanian Nappes: 6-bedded limestones, Pelsonian-Illyrian; 7-massive limestones, Ladinian - Norian; 8-limestone rubble.*

LITHOLOGIC AND STRATIGRAPHIC ASPECTS

The limestones from the Piatra Şoimului klippe stratigraphically cover the Middle Anisian-Norian interval.

The Middle Anisian deposits consist of grey-white limestones with various yellow hues on altered surfaces. They outcrop at the bottom of the north-western slope of the Piatra Şoimului klippe (under the "tourists' balcony"). The limestones are very hard and they are disposed in thin beds of 2-10 cm thickness. They are mostly covered by limestone rubble, and outcrop on a thickness of approximately 6-7 m (Fig. 1).

The limestones which represent the most part of the Piatra Şoimului klippe belong to the **Ladinian–Carnian**. This stratigraphic assignement is sustained by the different micropaleontologic associations identified in the two extremities of the klippe.

The north-western slope of the Piatra Şoimului klippe is characterized by lithological uniformity, being made up only of grey, hard, massive limestones, developed on approximately 50 – 53 m, and disposed on a thin bedded level of Pelsonian-Illyrian limestones with *Oligoporella pilosa* PIA (Fig. 3). The uniform macroscopic aspect of the limestones makes it impossible a lithological differentiation of Ladinian deposits from the Carnian ones. Nevertheless, the presence of the two stages is argued by paleontological assemblages reach in algae (predominantely dasyclads), segmented calcisponges (sphinctozoa) and, in certain cases, foraminifera.

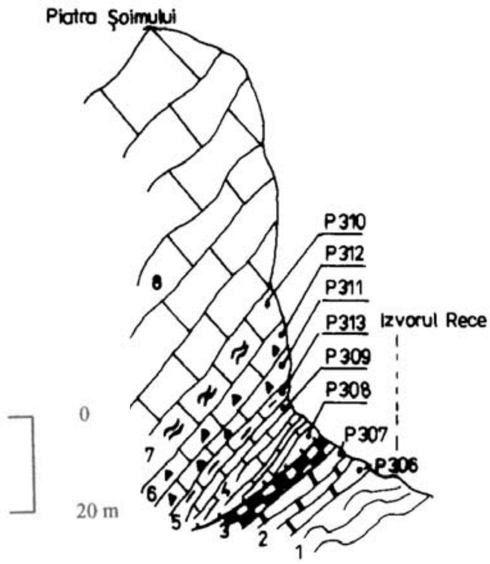

Fig. 2. *Geological sketch of the Transylvanian carbonate Triassic from the Piatra Şoimului klippe (south-eastern slope). Bucovinian Nappe: 1-crystalline basement; 2-dolomites, Lower Anisian; 3-jaspers, Callovian-Oxfordian. Transylvanian Nappes: 4-grey thin bedded limestones; 5-white limestones; 6-red calcareous breccia; 7-stromatolitic pink limestones; 8-white massive limestones, Norian; 4-7 Ladinian-Carnian.*

On the south-eastern slope, behind the Rarău chalet, the Ladinian-Carnian succession starts with a carbonate bedded level of 6 – 7 m thickness, covered mostly by the limestone rubble (Fig. 2). It is made up of thin-bedded (0.5-7 cm) grey limestones, with different hues on fresh surfaces, and yellow on altered areas. They are followed by white, poorly silicious limestones. The overlying deposit is a breccia (3 m) with a pink-reddish matrix and angular grey limestones elements. At its upper part it contains a white, massive, stromatolitic level, with very thin pink-reddish parallel lamellae (Fig. 4). The limestone from the south-eastern extremity of the Piatra Şoimului klippe is reach in cyanobacterial nodules, some algae and foraminifera.

The Norian deposits consist of massive, grey-white limestones that appear at the upper part of the Piatra Şoimului klippe.

MICROFACIES

The microscopic study of the limestones of the Piatra Şoimului klippe allowed the differentiation of several microfacies types whose micropaleontological content covers the Middle Anisian–Norian time interval.

The Anisian microfacies (1) are: pelmicrites and biomicrosparites. They appear only at the bottom of the north-western slope of the klippe as a thin (7 m) bedded level (Fig. 3).

The Ladinian-Carnian microfacies (2), according to their frequency, are: algal biopelmicrites, algal biopelsparites, pelintramicrites, pelmicrosparites, microsparites, sparites, biosparites and biomicrites. They make up the massive limestones outcropping in both slopes.

The Norian microfacies (3), (micrites and intramicrites), have been identified in the massive, grey limestones, situated at the upper part of the north-western slope, immediately under the "tourists' balcony".

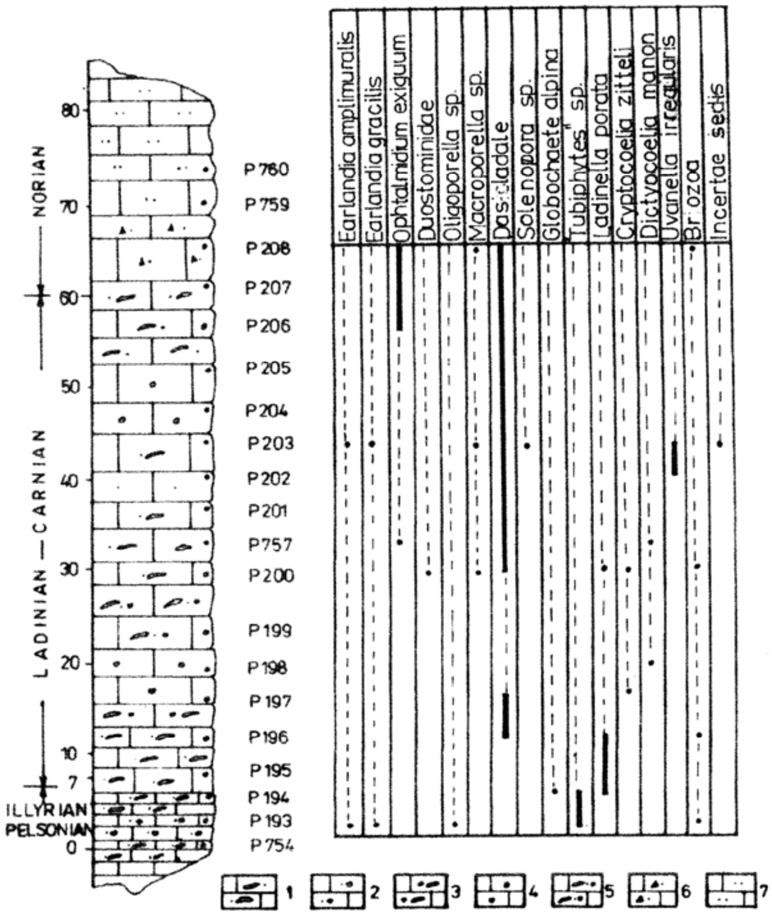

Fig. 3. *Succession of the Triassic carbonate deposits from the Piatra Şoimului klippe, north-western slope (under the "tourists' balcony"): 1-pelmicrites; 2-microsparites; 3-pelsparites; 4-sparites; 5-pelmicrosparites; 6-intramicrites; 7-micrites.*

1. Anisian Microfacies

The pelmicrites (samples 754, 194, 195) present cryptocrystalline cement with numerous micritic ovoidal-spheroid pellets. The small size pellets are predominant. Additionally, sparry calcite clasts with micritic edges are present. The sample 754 taken from the basis of the thin bedded level presents binary sequences of pelmicrit-microsparit type which make the transition to the following microfacies type illustrated by the biomicrosparites (sample 193) above them. Sample 754 typically contains spheroid oncoids with internal concentric lamination disposed around a nucleus of microsparitic or sparitic calcite or of detritic quartz. Sometimes, such oncoids are joined to some sparitic intraclasts. Two cement generations are present in this level: radial fibrous and granular.

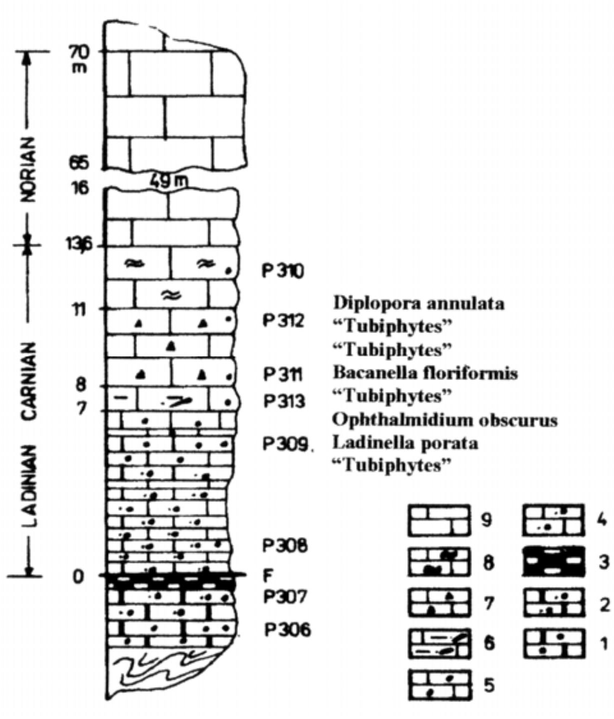

Fig. 4. *Succession of the Triassic carbonate deposits from the Piatra Şoimului klippe (SE slope, behind the Rarău chalet) Bucovinian Nappe: 1-dolosparites, 2- dolomicro-sparites, Lower Anisian; 3-jaspers, Callovian-Oxfordian. Transylvanian Nappes: 4-micro-sparites; 5-algal biosparites; 6-pelmicrites; 7-calcareous breccia; 8-stromatolitic limestones; 9-massive limestones; 4-9 Ladinian-Norian.*

The pelmicrites discontinuously develop algal-mats made up of flat laminae with peloidal structure. The algal mats incorporate calcareous grains. Algal laminae are also disposed around some calcareous sponges, and algal nodules with incorporated calcareous grains appear quite frequently.

The thin, curved filaments, as well as the bryozoan fragments and ostracods are rare. The fossil association consists of "*Tubiphytes*" sp. (Pl. IV, Fig. 4) *Globochaete alpina* LOMBARD and *Ladinella porata* OTT.

The biomicrosparites (sample 193). Neoformated calcite areas as subhedral crystals with brownish impurities betraying their diagenetic change through "aggradation" are developed in the microcrystalline calcite cement. Some peloidal grains of algal origin are visible as well (the spheroid pellets are predominant). The bioclasts are represented by bryozoans fragments, microproblematicae as "*Tubiphytes*", foraminifera belonging especially to the species *Earlandia amplimuralis* PANTIĆ and *Earlandia gracilis* ELLIOTT, and some rare dasycladales (*Oligoporella pilosa* PIA, *Oligoporella* sp.) (Pl. I, Fig. 1).

Biostratigraphic remarks

Oligoporella pilosa PIA is indicative of the Pelsonian–Illyrian interval. It is cited in specific associations to this stratigraphic interval in the limestones from Dunavăţu in North Dobrogea (Dragastan & Grădinaru, 1975), but especially in those in Pădurea Craiului (Bleahu et al., 1972; Popa & Dragastan, 1973; Dragastan, 1980). The general distribution of this species is Pelsonian-Lower Illyrian (Bucur, 1997).

Ladinella porata OTT is typical of the Ladinian from the External Dinarides (Pantić, 1971-1972, 1973-1974), being also found in the Upper Anisian from the lower part of the Wetterstein limestones in the Apuseni (Mantea, 1985; Dragastan et al., 1982); this species was found also in Lower Carnian (Baltreş et al., 1981; Istocescu & Dragastan, 1978; Săndulescu et al., 1976).

Earlandia amplimuralis PANTIĆ is described by Pantić (1971-1972) in the Ladinian dolomitic limestones from Crna Gora (External Dinarides). Săndulescu & Tomescu (1978) quote it together with a characteristic association for the Upper Anisian-Lower Ladinian interval in the limestones of the Botuş quarry (the Rarău Syncline).

The micropaleontological assemblage we identified in Piatra Şoimului proves, for the first time, the presence of the Pelsonian–Illyrian in the basal part of this calcareous klippe.

2. Ladinian–Carnian microfacies

The algal biopelmicrites (samples 195, 196, 200, 201, 203, 206, 207, 757) have the highest frequency on the northern slope of the Piatra Şoimului klippe. They have cryptocrystalline cement and contain varied allochems and bioclasts. The allochems with the highest frequency are the micritic pellets with irregular shapes and different sizes, relatively poorly sorted of a probably algal origin (Flügel, 1982). Sparitic clasts with micritic edges and oncoids with concentric lamination around a microsparitic or sparitic clast are also present. The oncoids have preponderantly ellipsoidal and, in some cases, spheroid shapes. Sometimes in the pelmicritic matrix of the limestones, sparitic areas are present (samples 207, 757) and even brecciated areas made up of large crystallysed calcitic clasts accompanied by smaller clasts of twinned dolomite (sample 201).

The most frequent bioclasts are those of cyanobacterial origin. The algal-microbial material is disposed in thin crusts around some bioclasts, some intraclasts, etc. In most of the cases, siltic quartz grains are also trapped among the cyanobacterial filaments. The cyanobacterial material is present also in clasts with spheroid aspects as well as nodular forms with irregular outline and internal skeleton preserved as tubular filaments (*Porostromata*).

The following algal assemblage was determinated: *Macroporella* sp*.*, *Ladinella porata* OTT (Pl. I, Fig. 5), *Globochaete alpina* LOMBARD. Beside algae (Pl. I, Fig. 3), rarely ostracods (Pl. III, Fig. 5; Pl. VI, Fig. 3), brachiopods, hydrozoans, bryozoans, small gasteropod fragments, worm tubes (Pl. III, Fig. 6) and *Incertae sedis* organisms also appear (Pl. V, Fig. 5).

The segmented calcisponges (*Sphinctozoa*) (Pl. II, Fig. 5) are represented by: *Cryptocoelia zitteli* OTT (Pl. I, Fig. 5), *Uvanella irregularis* OTT and *Dictyocoelia manon* MŰNSTER.

Foraminifera are represented by several exemplaries of *Duostominidae*. Some foraminifera have the interior of the test filled with small pellets, which outline their contour after a previous dissolution of the internal structure. Among these were determined: *Ophthalmidium* cf. *exiguum* KOEHN-ZANINETTI (Pl. III, Fig. 2), *Earlandia amplimuralis* PANTIĆ (Pl. III, Fig. 3) and *Earlandia gracilis* ELLIOTT. The last two species are trapped in the tissu of some algae of the *Solenopora* type (Pl. I, Fig. 4).

The algal biopelsparites (samples 197, 313) contain about the same allochems and bioclasts as the previous type, except for the matrix which is microcrystalline. Beside the above presented bioclasts, in these limestones also appear: nodules of "*Tubiphytes"* type, filaments, echinoderm fragments with microbial crusts. Among the determined forms we mention *Ophthalmidium exiguum* KOEHN-ZANINETTI (Pl. III, Fig. 1) and *Cryptocoelia zitteli* OTT (Pl. II, Fig. 2).

In one sample (197) two cement generations appear, with different crystal morphology reflecting different mineralogical composition. The first generation consists of radial-fibrous calcite cement precipitated in marine environment. The former aragonitic cement of the rock was probably dissolved and replaced by calcite. The recrystallisation processes are proved by the isolated presence of the radial-fibrous structure (Pl. VI, Fig. 5). The second generation is made up of largely crystallised cement that was precipitated in reducing conditions during the meteoric-phreatic or burrial diagenesis (Adams & Mackenzie, 1998).

The pelintramicrites (samples 311, 312) correspond to the calcareous breccia from the south-eastern slope of the Piatra Şoimului klippe. The pelmicritic mass contains sparitic intraclasts, ellipsoidal oncomicrites (Pl. IV, Fig. 2) with concentric laminations and diagenised algae. The clorophycean algae are represented by *Diplopora annulata* SCHAFHÄUTL. The microbial structures of the *Baccanella floriformis* PANTIĆ type are frequent (Pl. V, Fig. 1). They are accom-panied by some samples of "*Tubiphytes"* (Pl. IV, Figs. 1, 3) and rare *Incertae sedis* microorganisms (Pl. V, Fig. 3). This microfacies is typical of the shallow subtidal and probably protected portions of the Triassic reefs.

The pelmicrosparites (sample 199) are characterized by micritic algal pellets. Slightly curved bivalve shells show micritic envelopes and are cemented by granular sparite. Algal material is rarely present.

The microsparites (sample 308) appear in the lower part of the thin bedded level at the base of the eastern slope of the klippe. It presents sparitic fenestrae and is devoid of bioclasts.

The sparites (samples 204, 205, 309) are made up of large euhedral and subhedral calcite crystals with impurities of probably clay minerals. The crystals are yellow-brown and present numerous striations caused by the pressure. The brown colour is typical of the carbonate minerals that underwent diagenetic processes. One of the thin sections (204) contains a micritic area in which the cyanophytic-algal material is abundant. It is made up of laminae disposed almost parallel on the surface of some dasycladales. The sparite was formed throught the gradual recrystallization of a micritic sediment with algae (Pl. V, Fig. 1). The only identified bioclasts are some nodules of the "*Tubiphytes"* type encrusted by *Ladinella porata* OTT (sample 309) (Pl. I, Fig. 6).

The biosparites (sample 198), as the **biomicrites** (sample 202), are characterised by the abundance in microbial material (Pl. V, Fig. 2) which covers some carbonate lithoclasts, ostracods and diagenesed dasycladales. Algal structures are also present. Among the determined forms we mention *Dictyocoelia manon* MÜNSTER (sample 198) and *Uvanella irregularis* OTT (Pl. II, Figs. 3, 4).

Biostratigrafic remarks

The Piatra Şoimului klippe offered some *Daonella* specimens (Mutihac, 1968) of which Turculeț (1972) describes only one species of *Daonella (Moussonella)* cf. *moussoni* MÉR typical for Ladinian. Turculeț (1971) quoted from the same klippe two species of sponges: *Colospongia dubia* MÜNSTER var. *pectusa* KLIP and *Colospongia dubia* MÜNSTER var. *pustulipora* TOULA. In the Northern Alps these species are described in the Ladinian-Carnian interval. All the algal species we identified have their maximum of evolution in Ladinian, being also quoted in Cordevolian.

The same stratigraphic interval, Ladinian–Cordevolian, is proved by the existence of the three species of sphinctozoa: *Dictyocoelia manon* MÜNSTER, *Cryptocoelia zitteli* OTT and *Uvanella irregularis* OTT (Dragastan & Grădinaru, 1975; Istocescu & Dragastan, 1978; Pantić, 1971-1972). *Uvanella irregularis* OTT and *Ophthalmidium exiguum* KOEHN–ZANINETTI show the presence of the Ladinian and of the entire Carnian from the Insula Popina (Baltreş et al., 1981). In the Western Carpathians, the last species has a stratigraphic range limited only to the Lower Carnian (Gazdzicki et al., 1978). Salaj et al. (1983) quoted the same species in the Ladinian-Carnian from the Calcareous Northern Alps, Italian Alps, the Bakony Mountains (Hungary), Helenides, Balcans and Caucasus; in the Slovak Karst this species was found in Carnian and Norian deposits.

As a conclusion, the micropaleontological association we identified in two thirds of the limestones of the Piatra Şoimului klippe is characteristic for the Ladinian-Lower Carnian. In the south-eastern slope, even if the species determined are not so diverse, we can assign the thin bedded limestones, the white siliceous limestones and the breccia level to the Ladinian and the Cordevolian. The following stromatolitic limestone and the overlying massive limestones could be assigned to the Julian-Tuvalian and to the Norian, respectively only based on stratigraphic criteria.

3. Norian Microfacies

Of the two types of Norian microfacies, **the micrites** (samples 759, 760) are the most frequent and completely lacking microfauna.

The intramicrites (sample 208) present large diagenetically modified calcite granoclasts with multiple twinnings and striations. Microsparitic intraclasts and diverse bioclasts (pseudopunctate brachiopods (Pl. VI, Fig. 4), sponges (Pl. II, Fig. 6), echinoids spines, bryozoans (Pl. III, Fig. 4), and numerous dasyclad fragments) and *Incertae sedis* (Pl. V, Fig. 6) are surrounded by the micritic matrix. Sometimes the recrystallisation of some dasyclad algae marks their determination impossible. We identified a single species of foraminifera: *Ophthalmidium exiguum* KOEHN–ZANINETTI (Pl. III).

Biostratigrafic remarks

The presence of the Norian in the Piatra Şoimului klippe was proved by Patrulius (1970) and Patrulius et al. (1971) through the determination of the algae *Gryphoporella curvata* GŰMBEL, *Gyroporella* aff. *vesiculifera* GŰMBEL and *Macroporella (Pianella)* aff. *sturi* BYSTRICKY (i.e. *Salpingoporella sturi*).

Salpingoporella sturi is quoted in the entire Carnian from the Slovak Karst (Bystricky, 1967 a, b) and, respectively in the Lower and Middle Tuvalian from the Western Carpathians (Bystricky, 1979).

Gyroporella vesiculifera GŰMBEL covers the entire Upper Triassic. It was recorded in the Carnian of the Apuseni (Dragastan et al., 1982) and the External Dinarides (Pantić, 1973–1974) and the Rhaetian from the Muran Plateau (Bystricky, 1967 a). Herak et al. (1967) identified *Gryphoporella curvata* GŰMBEL and *Gyroporella vesiculifera* GŰMBEL in the Norian of the External Dinarides (Croatia). Consequently, the association quoted by Patrulius (1970) and Patrulius et al. (1971) indicates the presence of the Norian.

PALEOGEOGRAPHIC IMPLICATIONS

The sedimentary deposits of the Transylvanian unit are lithologically almost exclusively represented by carbonate pelagic deposits. Many authors (Săndulescu, 1968, 1969, 1972, 1973, 1974, 1975, 1976; Mutihac, 1966a, b, 1968, 1969, 1970, 1990; Ilie, 1957; Patrulius, 1966, 1967, etc.) remarked the presence of many facies types especially at the Triassic level, which is an evidence for variable morphology of the source area of the Transylvanian sedimentary deposits. The characteristic feature of these sedimentary deposits consists in their association with ophiolitic volcanic material. This is an evidence that the Transylvanian sedimentary deposit was formed in a labile expansion area with oceanic crust (Săndulescu, 1984; Mutihac, 1990; Grasu et al., 1995).

The sedimentation of the Bucovinian Triassic from the Rarău Syncline, and actually from the entire Crystalline Mesozoic Area of the Eastern Carpathians corresponds in part to the rifting stage with a breaching subsidence type (Grasu et al., 1995).

The presence of the limestones klippes over the sedimentary deposits of the Bucovinian Nappe or comprised in the Wildflysh Formation (Hauterivian–Albian) account for the existence of a carbonate platform. As a consequence, during the Triassic existed in the same time two different sedimentation domains: the Bucovinian domain and, the Transylvanian domain situated westward to the previous. In both domains the sedimentation took place on very large shallow water, predominantly carbonate platforms. The klippes resulted from the fragmentation of the Transylvanian Platform. Subsequently, the klippes were embedded through gravitational slidings in the deposits of the Bucovinian Nappe. Many of the klippes are included in the most recent formation of the Bucovinian Nappe, respectively the wildflysh. The Piatra Şoimului klippe is situated on the Callovian-Oxfordian jaspers, which are stratigraphically in a lower position in respect to the wildflysh. This suggests that the Piatra Şoimului klippe was probably put in place during the Upper Jurassic.

The detailed description of the various microfacies types allows the reconstitution of the environmental factors in which were formed the deposits of the Piatra Şoimului klippe.

The predominance of micrites and biomicrites indicates a low energy depositional environment, although very weak currents may lead to a slight reworking of the calcareous mud. With more intense currents, the grains remain poorly sorted, resulting in “unsorted biosparite”.

The lithofacies analyses must be coroborated with the study of the micropaleontological content. The presence of the different organic debris -dasycladales algae (*Oligoporella, Diplopora, Macroporella*) and solenoporacean algae (*Solenopora*), foraminifera (*Earlandinidae, Duostominidae, Ophthalmiidae*), sphynctozoa (*Uvanella irregularis, Cryptocoelia zitteli, Dictyocoelia manon*), small gasteropods, bivalves, ostracods, brachiopods etc., as well as of some allochems (pellets, oncoids, intraclasts) show that the limestones of the Piatra Şoimului klippe were formed in an internal shallow subtidal sector of a carbonate platform, in a tropical-subtropical climate. Many of the quoted fossil organisms are indices of the environmental factors. The algae, for example, indicate light and salinity, as they live in calm or little agitated, clear and shallow waters (under 10 m).

The stromatolitic level from the south-eastern slope of the klippe is also indicative of a very shallow sedimentation area. The level has plane morphology, each lamina being the result of the cyanobacterial action at the sediment-water interface.

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PLATES

Plate I

Fig. 1. – ?*Oligoporella pilosa* PIA, longitudinal section, in microsparry calcite cement. Sample 193e, Pelsonian-Illyrian, X24.

Fig. 2, 3. – Dasyclad thalli: 2-fragment in longitudinal section, in sparry calcite cement, sample 197d; 3-fragment in transverse section fragment, in micritic matrix, sample 206; Ladinian-Carnian, X24.

Fig. 4. – *Earlandia amplimuralis* PANTIĆ incorporated in an algal structure (?*Solenopora*). Sample 203, Ladinian-Carnian, X24.

Fig. 5. – *Ladinella porata* OTT and *Cryptocoelia zitteli* OTT in micritic matrix. Sample 200a, Ladinian-Carnian, X24.

Fig. 6. – Nodule of „*Tubiphytes*” type incrusted by *Ladinella porata* OTT. Sample 309c, Ladinian-Cordevolian, X24.

Plate II

Fig. 1, 2. – *Cryptocoelia zitteli* OTT. 1-in micritic matrix, sample 200b; 2-in algal biopelsparite, sample 197f; Ladinian-Carnian, X24.

Fig. 3. – *Dyctyocoelia manon* MŰNSTER in sparry calcite cement. Sample 198c, Ladinian-Carnian, X24.

Fig. 4. – *Uvanella irregularis* OTT with algal crusts in micritic matrix. Sample 202, Ladinian-Carnian, X24.

Fig. 5, 6. – Calcareous sponges with successive algal crusts. 5-sample 195a, Ladinian-Carnian; 6-sample 208b, Norian, X40.

Plate III

Fig. 1, 2. – *Ophthalmidium exiguum* KOEHN-ZANINETTI. 1-Sample 313g, X24; 2-sample 757e, X40; Ladinian-Carnian.

Fig. 3. – *Earlandia amplimuralis* PANTIĆ and few filaments in pelmicrite. Sample 203f, Ladinian-Carnian, X40.

Fig. 4. – Bryozoan fragment in micritic matrix. Sample 208a, Ladinian-Carnian, X24.

Fig. 5. – Ostracod in pelmicrite. Sample 206a, Ladinian-Carnian, X24.

Fig. 6. – Worm tubes in pelmicrite. Sample 200, Ladinian-Carnian, X24.

Plate IV

Fig. 1, 3, 4. -„*Tubiphytes*" sp. (microproblematica). 1, 3-Sample 312a, Ladinian-Carnian, 1 x40, 3 X24; 4-sample 754, Pelsonian-Illyrian, X24.

Fig. 2. – Ellipsoidal oncoid with micritic–microsparitic nucleus in calcareous breccia. Sample 312b, Ladinian-Carnian, X24.

Fig. 5. – Oncoid fragment in sparry calcite cement. Sample 198, Ladinian-Carnian, X24.

Fig. 6. – Oncoid in pelmicrite with rare ostracods. Sample 200k, Ladinian-Carnian, X24.

Plate V

Fig.1, 2. - Microbial structures: 1 – *Baccanella floriformis* PANTIĆ in calcareous breccia, sample 311c, Ladinian-Carnian, X24; 2 – in micritic matrix, sample 202b; Ladinian-Carnian, X24.

Fig. 3 – 6. - Incertae sedis: 3,4-in calcareous breccia, sample 312, Ladinian-Carnian, X24; 5-in pelmicrite, sample 203d, Ladinian-Carnian, X24; 6-in intramicrite, sample 208d, Norian, X24.

Plate VI

Fig. 1. – Sparite. Sample 204d, Ladinian-Carnian, X24.

Fig. 2. – Pelsparite. Sample 313, Ladinian-Carnian, X24.

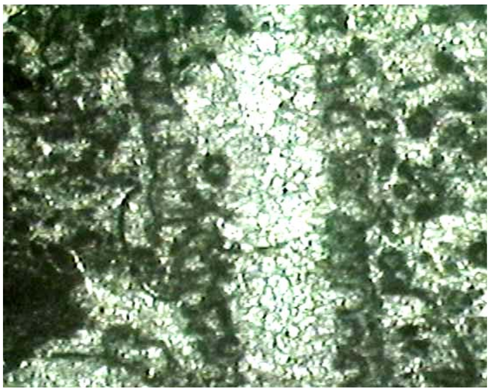
Fig. 3. – Pelmicrite with rare ostracods. Sample 754d, Pelsonian- Illyrian, X24.

Fig. 4. – Intramicrite with pseudopunctate brachiopods. Sample 208c, Norian, X24.

Fig. 5. – Two cement generations: radial-fibrous aragonite cement and sparry calcite cement. Sample 197e, Ladinian-Carnian, X24.

Fig. 6. – Stromatolitic structure. Sample 310b, Middle-Upper Carnian, X24

PLATE I



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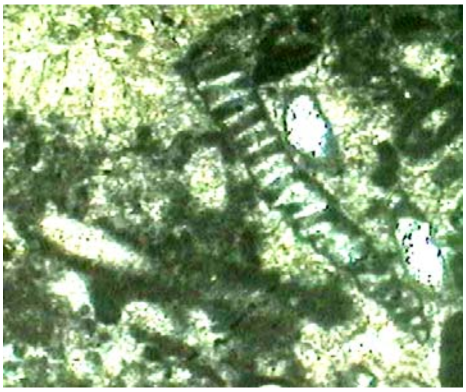

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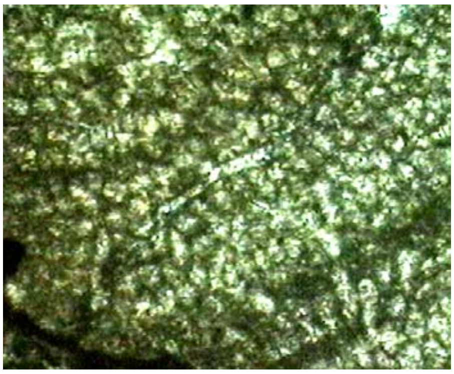

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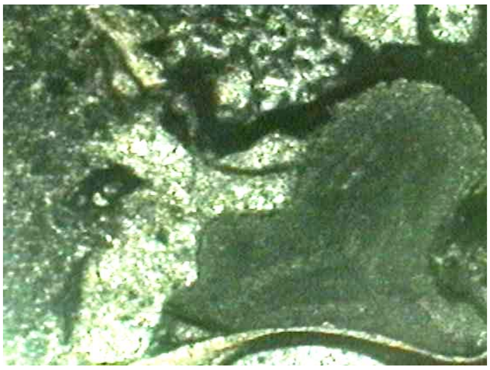

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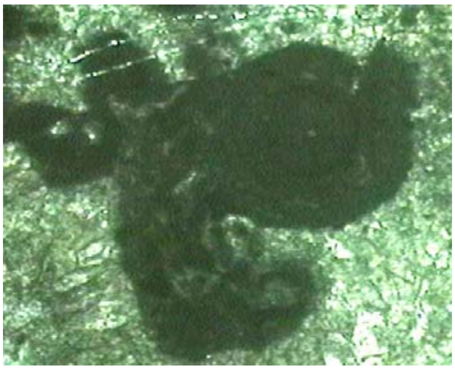

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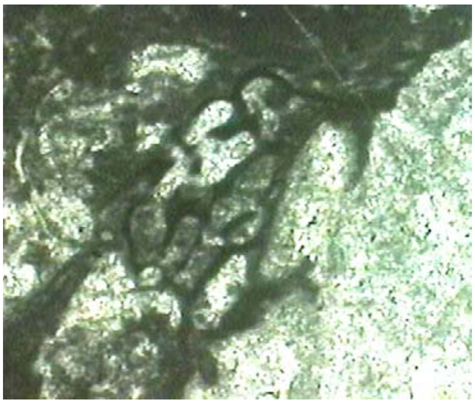

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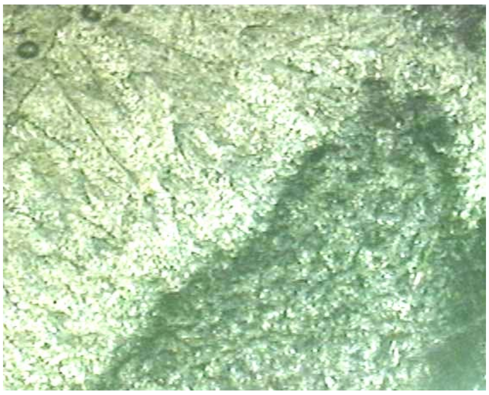

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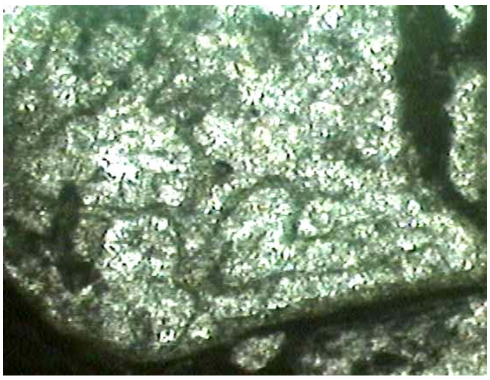

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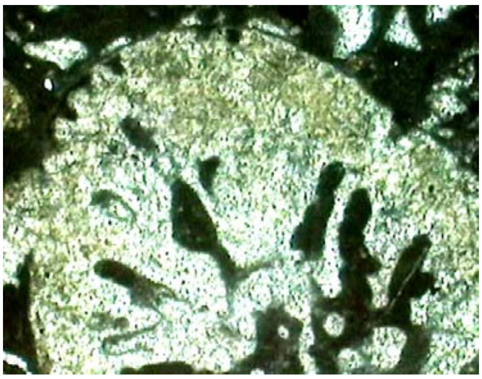

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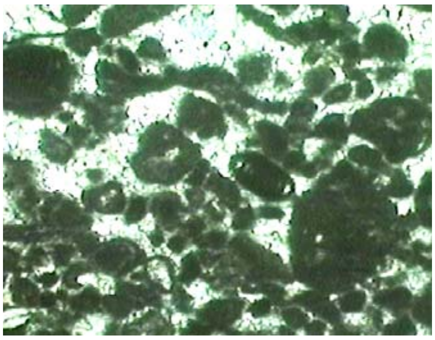
PLATE III



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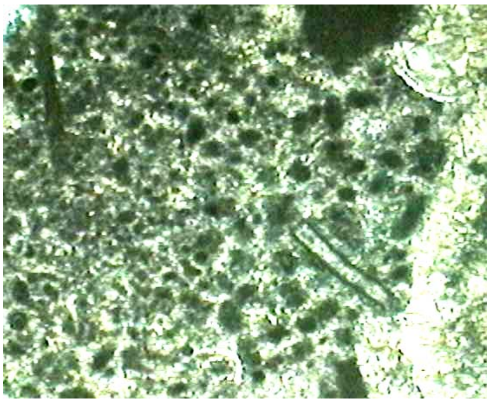

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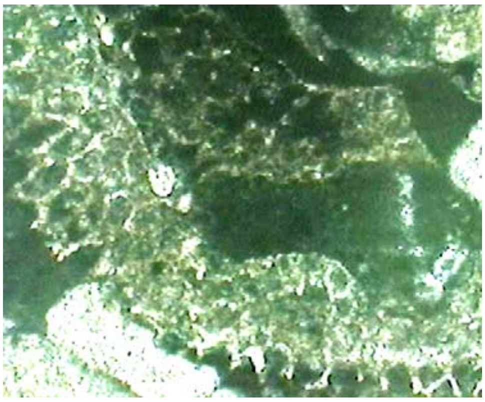

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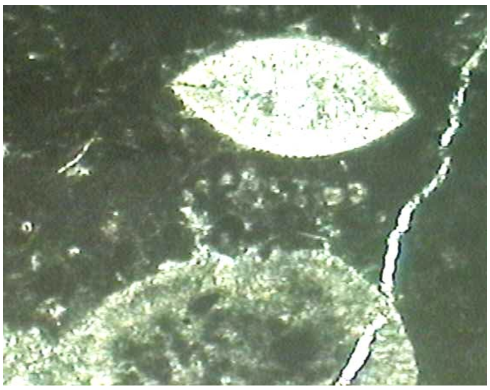

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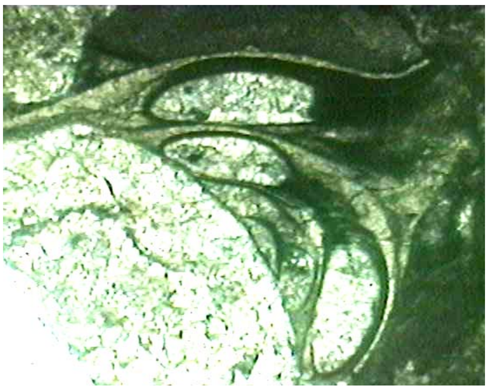

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PLATE IV

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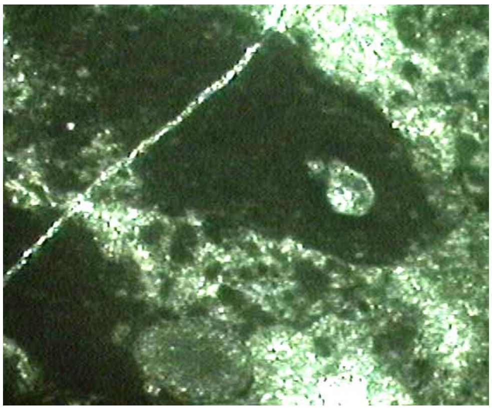

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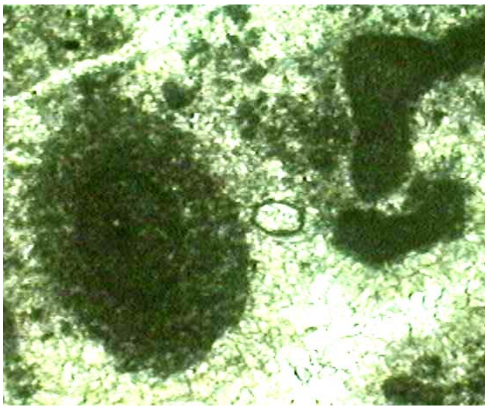

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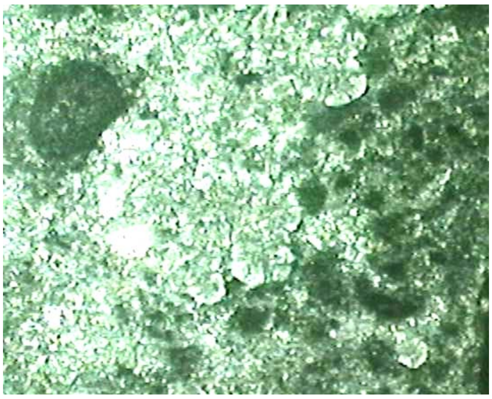
PLATE V



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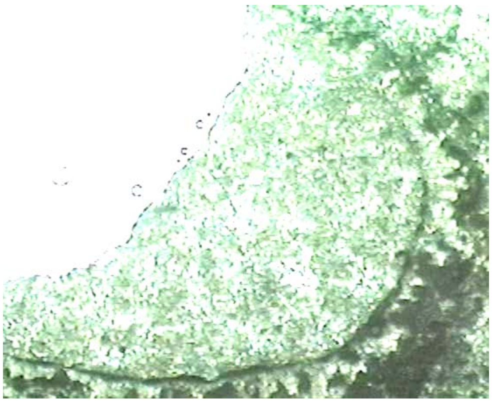

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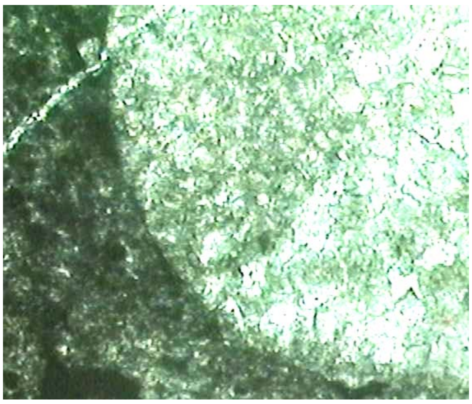

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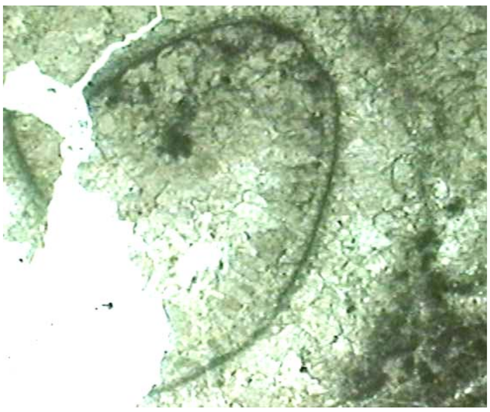

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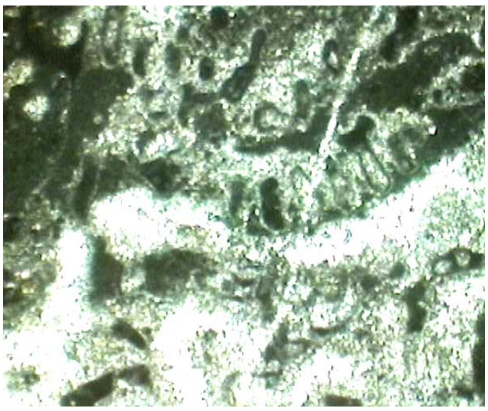

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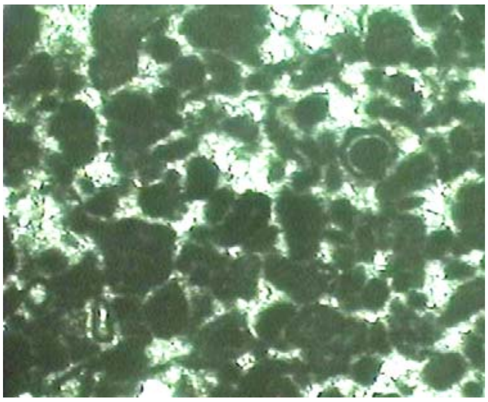

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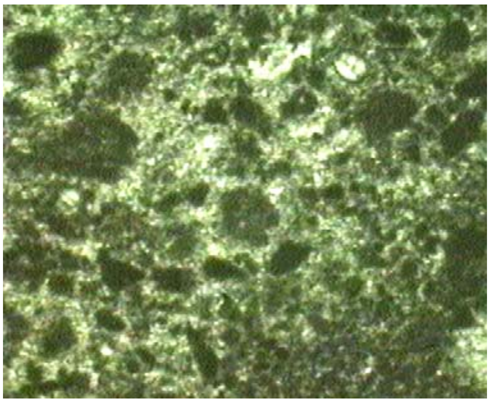

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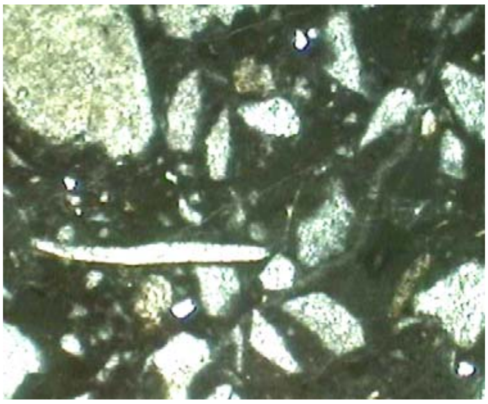

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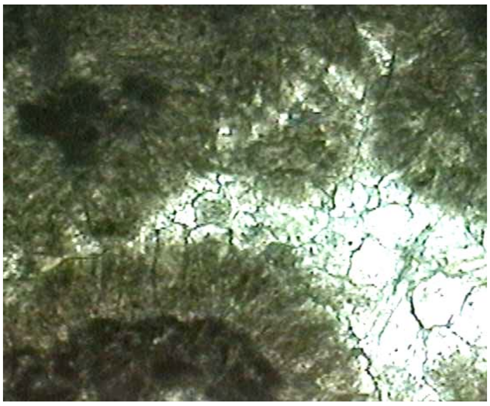

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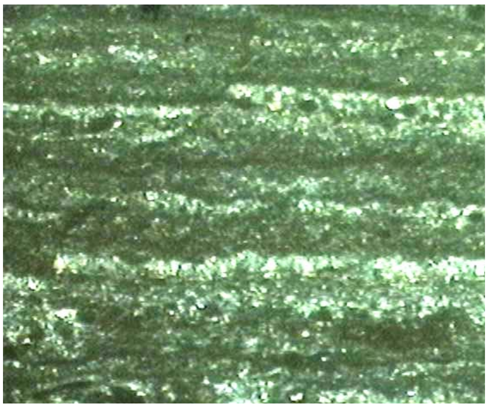

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