MICROFACIES, SEDIMENTARY ENVIRONMENTS AND EVOLUTION OF CARBONATE DEPOSITS OF MIRDITA, ALBANIA - PRELIMINARY NOTE

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Abstract. A detailed microfaciesal and paleoenvironmental analysis of Triassic-Jurassic carbonate platform series from eastern and western parts of the Mirdita ophiolitic basin will help to better understand the full registration of sedimentary carbonate deposits. Carbonate sediments are particularly sensitive to environmental changes. The benthic foraminifera and "microproblematica" are the main components of Late Triassic reefs and carbonate platforms and have proved to be extremely helpful in the zonation of platform carbonates. In this paper we will present two sections belonging to Mirdita carbonate platform: Lura section in pelagic deep water to reefal and shallow subtidal environment and Staveci section in shallow subtidal-lagoonal, peritidal (inter/supratidal) environment.

Keywords: microfacies, paleoenvironment, Triassic, Jurassic, Mirdita, carbonate platform, subtidal, lagoonal.

Rezumat. Microfaciesurile, mediile sedimentare şi evoluţia depozitelor de carbonaţi de la Mirdita, Albania – date preliminare. O analiză microfaciesală şi de paleomediu detaliată a depozitelor carbonatice de platformă situate la est şi la vest de bazinul ofiolitic Mirdita va ajuta la o mai bună înţelegere a înregistrării depunerii depozitelor sedimentare carbonatice din această zonă. Sedimentele carbonatice sunt deosebit de sensibile la schimbările de paleomediu şi pot fi utilizate cu mare succes în definirea arhitecturii unei platforme carbonatice. Foraminiferele bentice şi organismele de tip „microproblematica", spre exemplu, sunt componenţi importanţi ai mediilor tipice de recif şi platformă care au caracterizat o mare parte a depozitelor Triasicului superior. În această lucrare vom prezenta două secţiuni aparţinând depozitelor carbonatice de vârstă Triasic superior-Jurasic inferior din zona Mirdita şi anume: secţiunea Lura cu faciesuri caracteristice pelagice, recifale şi intertidale de platformă şi secţiunea Staveci, cu microfaciesuri subtidal-lagunare, peritidale (inter/supratidale) ambele acoperite microfaciesurile condensate pelagice aparţinând Jurasicului inferior.

Cuvinte cheie: microfacies, paleomediu, Triasic, Jurasic, Mirdita, platformă carbonatică, subtidal, lagunar.

INTRODUCTION

Most of the carbonate deposits have biogenic origin. The organisms that produce carbonates represent an essential factor in the evolution of a carbonate platform. These organisms are able to migrate vertically and horizontally in order to maintain their balance with the available space for their sedimentation. Any brutal changes in the regional environment will affect the productivity of these organisms and in this case, the development of the carbonate platform will be also affected in its turn.

The sedimentary evolution of a carbonate platform is that of transition from subtidal to intertidal, supratidal and then a total emersion (ZEEH, 1994). If this gradual and normal progression is perturbed by an exceptional event, a tectonic pulsation for example, the evolution of the platform is affected.

In this paper we will present two sections belonging to Mirdita carbonate platform: Lura section in pelagic deep water to reefal and shallow subtidal platform environments and Staveci section in shallow subtidal-lagoonal, peritidal (inter/supratidal) environments. By some authors, these two sections are considered to be the equivalents of two carbonate platforms, Gjalica (Lura) and Hajmeli (Staveci) or by the other, of a single carbonate platform affected in Jurassic by the obduction of the ophiolites. Our aim is to try to find similarities between the carbonate environments from Gjalica and Hajmeli units by analysing and correlating complementary sections and to see if they belong to different carbonate platforms or to one single carbonate platform.

Geological setting

The Albanides show a complex structural evolution. To the west and north, the tectonic units belonging to the Apulian plate-margin were progressively emplaced in a subductional geodynamic environment and characterize an in-sequence thrust system (External Albanides; Fig 1). This thrusting was active during the Eocene time in the internal part of the structure and affected the more external zones during the Pliocene time. Eastern and Central Albania (Internal Albanides; Fig. 1) shows oceanic units (Ophiolitic Mirdita nappe) and their tectonic substratum.

Within the ophiolites and napes of Krasta Zone (External Albanides) there is a very deformed tectonic complex interpreted and named in different ways: as peripheral complex according to ROBERTSON & SHALLO (2000) or Hajmeli, Qerret-Miliska and Gjalica according to KODRA *et al*. (1993), MECO & ALIAJ (2000). This tectonic complex can be divided into three main structures. The lower structure is characterized by a thick carbonate platform sequence and according to KODRA *et al*. (1993) it was named Hajmeli in the western part of Mirdita and Gjalica in the eastern part.

The second structure settled on the carbonate platform is represented by a volcanic, volcano-detric and pelagic (limestones and cherts) sequence confirmed and dated in different countries by microfauna, radiolareans and conodontes (KODRA *et al*., 1993; MEÇO & ALIAJ, 2000). The name of this complex is Rubiku nape.

The third complex consists of ophiolites of Mirdita Zone and is divided in two belts: the ophiolitic belt of Western Mirdita (OMP) and the ophiolitic belt of Eastern Mirdita (OML) (SHALLO *et al*., 1987; BECCALUVA *et al*., 1994; TASHKO 1996). Mirdita ophiolitic nape has been overthrusted or obducted during Middle Jurassic (DIMO, 1997; DIMO-LAHITTE *et al*., 2001), shortly after their magmatic setting. After this process of tectonic setting, the ophiolites have been subject to erosion.

The post-obduction sediments consist of a chaotic association coming from the internal structures and ophiolites. However, the ophiolitic elements are quite rare, undoubtedly as a result of climatic conditions in which it is developed and carried the erosion of OML. The chaotic sequence is covered by turbidites from Tithonian-Lower Cretaceous (SHGJSH-SHERBIMI GJEOLOGJIK SHQIPTAR, 2003), and then by thin carbonate formations of Hauterivian – Barremian and Upper Cretaceous turbidites (SHGJSH-SHERBIMI GJEOLOGJIK SHQIPTAR, 2003; PEZA, 1985; SHALLO, 1990).

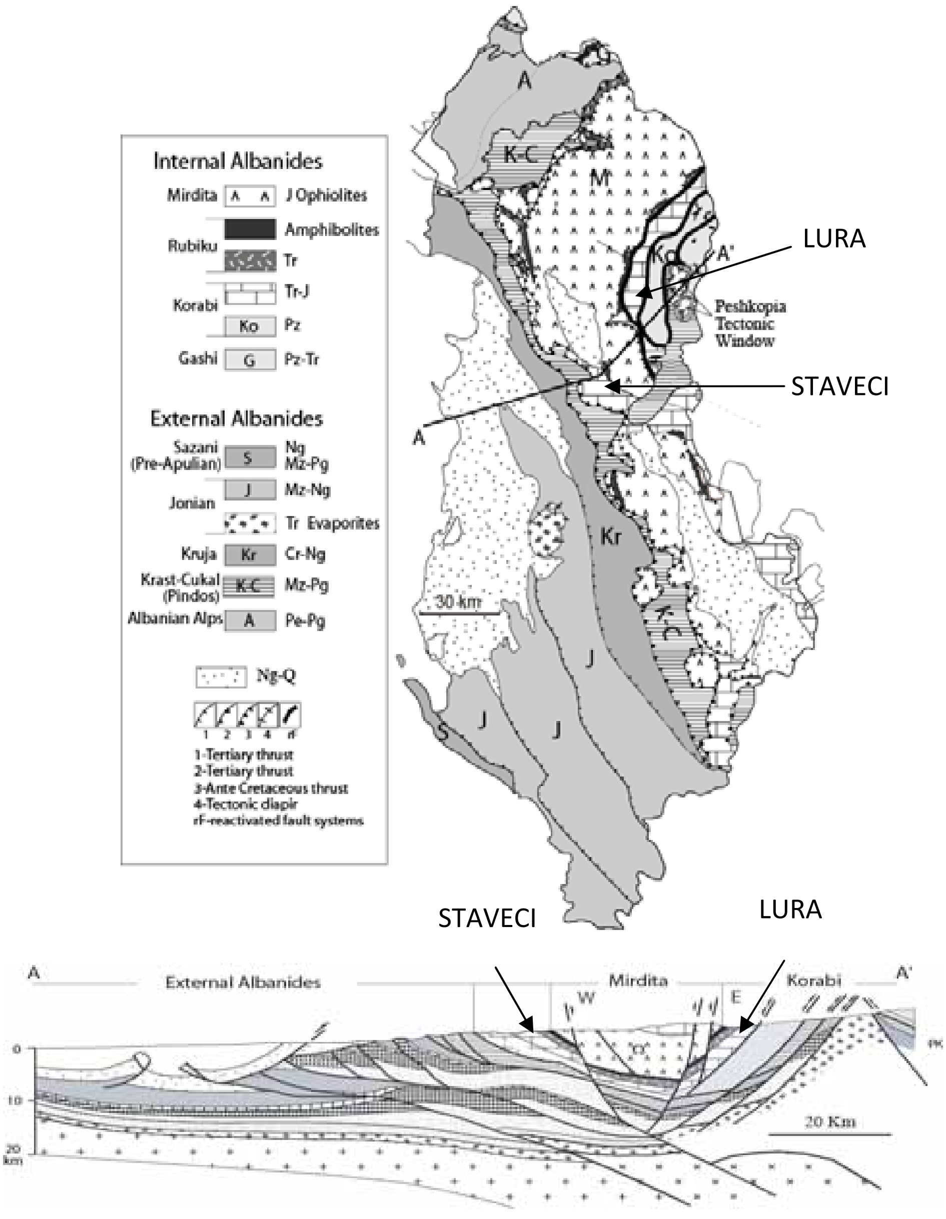

Figure 1. Schematic geological map and cross-section of the Albanides (in MUCEKU *et al*., 2008).
Figura 1. Harta geologică schematică şi secţiunea transversală a Albanidelor (in MUCEKU *et al*., 2008).

Stratigraphy

The stratigraphy of Lura and Staveci deposits, equivalents of Gjalica and Hajmeli, is well known (GJATA K *et al*., 1980; SHALLO *et al*., 1986; GJATA TH. *et al*., 1985, 1987; GODROLI, 1992) and will be briefly described here below.

Stratigraphy of Lura

The Triassic-Jurassic sedimentary and volcano-sedimentary deposits of Lura are present in the eastern and southern part of Lura massif, while the Cretaceous deposits are found in its western part.

Ladinian

The Ladinian deposits are the oldest sediments in the region and consist of gray limestone layers with *Earlandia gracilis* ELLIOT, *Ophtalmidium* sp., *Tubiphytes* sp., ostracods, etc., confirming the Ladinian age. The thickness of these deposits is ranging from 300 m to several hundred meters.

Upper Triassic

The Upper Triassic deposits are gradually following those of Ladinian and are widespread in the eastern and southern parts of Lura ultrabasic massif. They consist of thick massive limestones with varying shades of gray colour. Characteristic for these deposits are overlapping layers of algal stromatolitic limestones that are widespread in Upper Triassic of the Alps. Their thickness varies from some tens of meters up to 300 meters. Microfauna determined in these deposits is represented by *Involutina cf. sinuosa* WEYNSCHENK, *I. gaschei*, *Trochammina alpina* KRISTAN-TOLLMANN, *T. jaunensis, Trochamina* sp., *Agathamina austroalpina* KRISTAN-TOLLMANN & TOLLMANN, *Glomospira friedli* KRISTAN-TOLLMANN, *Endothyra austrotriassica, Thaumatoporella parvovesiculifera* RAINERI, *Ophtalmidium* sp. and dasycladacean alga confirming the Upper Triassic age.

Lower Liassic

These deposits are normally following the Upper Triassic limestones and consist of biomicritic limestones layers of grey colour containing *Thaumatoporella parvovesiculifera* RAINERI and ostracodes. In the field it is difficult to distinguish them from the Upper Triassic limestones. Their thickness is 3-4 m.

Middle and Upper Liassic

The Middle and Upper Triassic deposits include a horizon of stratified reddish marly limestone with siliceous concretions of reddish to yellowish colour. Within these limestones there were identified two micro faunistic levels: a first level with *Involutina liassica* JONES, *Vidalina cf. martana* FARINACCI, *Lenticulina* sp, *Globochaete* sp., *Frondicularia* sp., *Trocholina* sp., *Turispirilina* sp., confirming the Middle Liassic age and a second level represented by microfacies containing embryonic ammonites, abundant pelagic bivalves and radiolarians, which is thought to be Upper Liassic. The thickness of these deposits is 5-7 m.

Dogger-Lower Malm

These deposits represent the upper part of the reddish limestones with siliceous concretions and containing abundant pelagic bivalves, *Globigerina* ("*Protoglobigerina") jurassica* HOFMAN, *Lenticulina* sp, radiolarians and ostracods. Elsewhere in the region these deposits are not signalled.

Malm

The Dogger-Lower Malm reddish deposits with siliceous concretions are covered by radiolaritic-hematitic package with manganese matter content. Their thickness in the region ranges from a few meters up to 50 m.

Stratigraphy of Staveci section

In Staveci area the geological formations are divided in three groups: 1) the Upper Triassic-Liassic neritic limestones and the limestones in condensed facies overlaid by the radiolarites (cherts), 2) the detritic and volcanic-sedimentary formations and 3) the ophiolitic massif.

The Upper Triassic-Liassic succession of about 800 m in thickness is disposed in metric beds and it is probably one of the most representative carbonate sections of Hajmeli sub-zone and looks like a typical "layer cake" formed by intercalations of limestones with Megalodonts, rare oolitic limestones and stromatolitic limestones.

From bottom to top in this succession we can distinguish four distinct lithological levels:

Norian-Rhetian

A first level represented by limestones in stromatolitic facies with fenestra. The presence of *Turrispirillina minima* Pantic confirms the Norien-Rhetian age for these deposits (dated by A. Pirdeni, Martini and Zaninetti).This level also contains a black spotted limestone representing a mudstone with voids filled with a peloidal packestone-grainstone and containing recrystallized Involutinidae and crinoids.

Middle Liassic

The second level is represented by limestones of pale colour with some evidences of nodularisations in peloidal and ooidal packestone-grainstone microfacies, rich in benthic foraminifera, crinoids and gastropods. The presence in this level of *Involutina liassica* JONES and *Vidalina martana* FARINACCI confirm their Middle Liassic (dated by A. Pirdeni). A breccia level of pink colour is overlaying in some sectors the stromatolitic limestones can be considered as equivalent of this second level.

Dogger

The third level is represented by the limestones in condensed facies. This level contains Fe-Mn nodules with different sizes and is very rich in fauna: embryonic ammonites, proboglobigerines, pelagic bivalves, crinoids, radiolarians. The age of this level is Dogger (dated by Poisson, Martini and Zaninetti).

The fourth level is represented by radiolarites (cherts) containing intercalations of turbiditic limestones of several centimetres in thickness with peloidal grainstones, debris of foraminifera, alga, crinoides and ostracods. Due to their position above the limestones in condensed facies, their age can be considered also Dogger.

Typical microfacies from Lura

The sedimentary succession starts with argillaceous schists interbedded with black marls (Plate I, Fig. 2) and biocalcarenitic (Plate I, Fig. 1) limestones followed by red radiolarites with hematitic matrix, rare radiolaritic marls (Plate I, Fig. 4) and microbreciated turbiditic limestones (Plate 1, Fig. 3).

The predominant microfacies presents in Lura section will be briefly described here bellow:

Radiolarean wackestone-packestones

The matrix with a fine texture is stylolitized and in some cases contains dispersed chlorite, feromagnezian matter and authigenic quartz. Stylolites parallel to bedding are often associated with abundant fractures sets filled with predominantly fibrous calcite crystals and oriented in several directions. This close coexistence between stylolites and fractures suggests that they were formed synchronously and can be used as paleostress indicators. The micropaleontological content is represented by thin-shelly pelagic bivalves *Halobia* and *Daonella* oriented parallel to stratification, *Bacanella floriformis* PANTIC, radiolarians filled with sparitic calcite, pelagic crinoids and rare small lagenids (Plate I, Figs. 5-6, Plate II, Fig.1).

The age of these limestones is Ladinian.

Algal crinoidal wackestones

The matrix is by crossed by calcite veins, often recrystallized or in few cases recrystallized-dolomitized (dolosparit) and contains different allochems and bioclasts. The predominantly allochems are represented by pelloids showing irregular forms and different sizes and probably of algal origin (FLUGEL, 1982). Occasionally we can meet oncoides. The crinoid debris is represented by abundant plates with reticulate structure and most of them are broken along the calcite cleavage planes. The microfauna is represented by the problematical organism *Ladinella porata* OTT typical for the Ladinian reefs, *Earlandia (Aeolisacus) aplimuralis* PANTIC and recrystallized unidentified alga.

Ladinella porata OTT and *Earlandia (Aeolisacus) aplimuralis* PANTIC are typical for Ladinian deposits.

Coralgal wackestones-packstone to biosparudites

The originally aragonitic coral skeletons are replaced by blocky calcite with mosaic fabric. The corals are surrounded by thin micritic crusts and in some cases the alveolar-septa are filled by blocky and/or drusy cement. The allochems are represented by oncolites and peloides probably of algal origin. The microfauna contains microproblematica *Ladinella porata* OTT, *Galleanela panticae* ZANINETTI & BRONNIMANN, *Bacanella floriformis* PANTIC, *Tubiphytes* sp., the sphinctozoans *Cryptocoelia zitelli* STEINMANN and *Colospongia catenulata* OTT, the benthic foraminifera *Earlandia (Aeolisacus) amplimuralis* PANTIC and *Ophtalmidium* sp., codiacean and recrystallized dasycladacean alga, different rare benthic foraminifera, crinoids and worm tubes. Brachiopods with characteristic foliated lamellar structure and thin-shelled bivalves also occur. Ostracods are very rare. (Plate II, Figs. 2-5)

Peloidal and oncoidal wackestone-packestones

The matrix is cut by calcite veins and contains abundant unidentified skeletal grains The identified bioclasts are represented by *Thaumatoporella* sp., *Ophtalmidum* sp., *Duostomina* sp., small lagenids, recrystallized corals, debris of dasycladacean alga, crinoids and small gastropods. Oncoids have various sizes, are relatively poorly sorted and often ellipsoidal (Plate 3, Fig. 6).

Algal packestone-grainstones

They have drusy (blocky) cement which in few cases is locally dolomitized. The bioclasts are represented by *Thaumatoporella* sp., *Cryptocoellia zitteli* STEINMANN, benthic foraminifera, dasycladacean alga, gastropods, crinoids (Plate 3, Figs. 4-5)

Bioclastic mudstones

They are often crossed by calcite veins and microstylolites with iron oxide. Bioclastes are represented by abundant *Thaumathoporella*, *Triassina hantkeni* MAJZON, *Trochammina alpina* KRISTAN-TOLLMANN, recrystallized involutinids, lagenids, ostracodes, charophytes.

Mudstones with Charophytes and Ostracodes

The matrix is crossed by calcite veins and locally show voids filled with drusy (blocky) cement. This facies is characteristic for lagoonal environments.

Oncoidal and peloidal mudstones

The matrix is crossed by calcite veins and occasionally by stylolites. The oncolithes are formed around a nucleus consisting of a planktonic crinoid or lagenid. The bioclasts are represented by *Vidalina martana* FARINACCI, rare lagenids, ostracodes and small gastropods.

Wackestone-packestones in condensed facies

The fine-grained matrix is occasionally crossed by calcite veins accompanied by stylolites with iron hydroxide matter and contains Fe-Mn nodules. The microorganisms are represented by abundant embryonic ammonites, abundant planktonic crinoids, pelagic bivalves, *Involutina liassica* JONES, *Vidalina martana* FARINACCI. The crinoid debris is represented by abundant plates with reticulate structure and most of them are broken along the calcite cleavage planes. The age of this level is Dogger.

Paleoenvironmental remarks

Taking into consideration the microfacies and microorganisms described in the carbonate deposits belonging to Lura sector, we can identify a depositional framework extending from pelagic deep water to reefal and shallow-subtidal carbonate platform environments.

The bivalves *Halobia* sp. and *Daonela* sp. associated to radiolarians in the radiolarian wackestone-packstones were widely distributed throughout the Late Triassic (Carnian-Norian) Tethys and were typical for pelagic environments. Globochaete alpina? Lombard is abundant in open-marine pelagic carbonates but it also occurs in shallow-marine environments (SCHAFER & SENOWBARI-DARYAN, 1980; BACHMAN, 1987).

Bacanella floriformis Pantic is common in the shallow-water reef facies and is a constituent of cryptic cavities in the central parts of Middle and Late Triassic reefs. *Galeanella panticae* ZANINETTI & BRONNIMANN associated to micritic clasts is located in marge platform reefs and *Cryptocoelia zitteli* STEINMANN is among the most common sponges presents in the Ladinian and Carnian reefs builders.

Ophtalmidium sp. is common in protected areas between reefbuilders and in mud-rich reefs formed at the upper slope, while the typical platform environment is characterized by the presence of *Triasina hantkeni* MAJZON, which is known between the most widespread foraminifers in the open environment carbonate platforms of Late Triassic. The Duostominidae foraminifera here associated with Involutinidae and green algae are usually concentrated in carbonate sands.

Even if in Lura section the micropaleontological content is not very rich, the presence of different microorganisms signalled above associated to small gastropods, bivalves, ostracods, brachiopods, etc., as well as of some allochems (pellets, oncoids, intraclasts) allows us to affirm that the limestones of the Lura section were formed in an depositional framework extending from pelagic deep water to reefal and from shallow-subtidal carbonate platform environments. The radiolaritic facies were formed in relatively deep conditions, where turbiditic currents were responsible for the turbiditic microbreciated limestone. The algal crinoidal wackestones, the coralgal wackestone-packestones and biosparudites were formed in reefal environments while the algal wackestone-grainstones, mudstones with Charophytes and Ostracods or the oncolitic and peloidal mudstones with algal stromatolites were formed in tidal-intertidal conditions.

Starting with the Liassic the carbonate platform is fragmented and affected by a progressive deepening of the basin when the pelagic limestones in condensed facies were formed.

Typical microfacies from Staveci section

The microfacies from Staveci section are characteristics from restricted environments. A brief description of these microfacies is presented here below.

Wackestone-packestones

The fine matrix is characterized by cavities filled with a peloidal packstone-grainstone. The bioclasts are represented by recrystallized involutinidae and crinoids. The peloidal packstone-grainstone present in this type of cavities can represent digenetic cavities fillings (Plate 4, Fig. 1).

Peloidal wackestone-packestone

The pelmicritic matrix often contains voids lined with scalenohedral dogtooth cement, geopetal and birds eyes structures. Peloids are rounded to well rounded, well sorted, and less than 1 mm in diameter. Dogtooth cement and its filling record the influx of meteoric water from exposed parts of the nearby platform (FLÜGEL and KOCH 1995). The identified bioclasts are represented by *Thaumatoporella parvovesiculifera* RAINERI, *Involutina gaschei* KOEHN-ZANINETTI and BRONNIMANN, *Trochammina alpina* KRISTAN-TOLLMANN, *Ophtalmidium* sp., *Earlandia* sp., associated to dasycladacean alga, ostracods, brachiopods and gastropods. (Plate 4, Figs. 2, 6; Plate 5, Fig. 6).

Flat laminated algal stromatolites

This microfacies is characterized by a well-developed lamination, desiccation cracks and bird's eyes containing internal vadose sediment at the base and spar filling in the residual space (geopetal structures). Thrombolitic structures composed of dark, clotted micrite with peloids are common. The biological association is dominated by gastropods and ostracods. This microfacies can represent the member B of a loferitic cycle. (Plate 4, Fig. 3).

Bioclastic mudstones

Usually they are grey or black fenestral mudstones with sparite filling fractures, calcite filled-voids, geopetal and birds eyes structures or dessication cracks. The microfauna is represented by *Rivularia*–type cyanobacteria, ostracods, brachipods and gastropods (Plate 4, Figs. 4-5; Plate 5, Fig. 5).

Floatstone with Megalodonts and gastropods

This microfacies contains small Megalodonts, gastropods and foraminifers and can be the member C of a loferitic-cycle (Plate 5, Fig. 3). The flat laminated algal stromatolites and the floatstone with Megalodonts and gastropods represent a typical Alpine Dachstein Lofer cycles. FISCHER (1964) provided a detailed description of loferitic facies as it follows: a disconformity at the base; member A – a basal argillaceous member (red or green) representing reworked residue of altered material; member B – intertidal member of loferites with algal stromatolitic mats, geopetal structures and desiccation features; member C – subtidal megalodont limestone. The identified cyclothem in Staveci section is incomplete and shows members B and C from a typical lofer cycle described by FISCHER (1964): the intertidal member with algal mats and abundant geopetal structures corresponds to member B while the subtital carbonate facies with Megalodontes correspond to Member C of the typical Dachstein Lofer Cycle.

Subordonated microfacies are brecciated limestone (Plate 5, Figs. 1, 2) and oncolitic packstones (Plate 5, Fig. 4).

Wackestone-packstones in condensed facies

The fine-grained matrix is occasionally crossed by calcite veins accompanied by stylolites with iron hydroxide matter and contains Fe-Mn nodules. The microorganisms are represented by abundant embryonic ammonites, abundant planktonic crinoids, pelagic bivalves, *Involutina liassica* JONES, *Vidalina martana* FARINACCI. The crinoid debris is represented by abundant plates with reticulate structure and most of them are broken along the calcite cleavage planes. The age of this level is Dogger (Plate 6, Figs. 1-6).

Paleoenvironmental remarks

The peloidal wackestone-packstones and packstones/grainstones with the small benthic foraminifera, dasycladacean alga, *Thaumatoporella parvovesiculifera* RAINERI, Megalodonts, small gastropods and small intraclasts can be interpreted as shallow subtidal/back-reef lagoon deposits.

The flat laminated algal stromatolitic facies with "fenestra" and rich in gastropods and ostracodes can be interpreted as a subtital deposits.

The laminated and of laminated and fenestral mudstones characterized by well-developed laminations, probably of microbial origin, small fenestrae with geopetal filling and a variety of desiccation structures can be interpreted as inter-supratidal facies.

The facies from Staveci section are typical for shallow subtidal-lagoonal and inter-supratidal depositional environment corresponding to an inner restricted platform–tidal flat system, the platform being affected by several subaerial exposure-related by the presence of geopetal fillings of pores.

The microfauna of Upper Triassic limestones from Staveci are characteristic for a tropical lagoon with low water energy. The deposits show similarities with the Alpine Dachstein Lofer cycles and show a general regressive upward-shallowing tendency with its top preserving subaerial exposure evidences. The identified cyclothem in Staveci is incomplete in the studied section, members B and C from a typical lofer cycle described by FISCHER (1964). The subtital carbonate facies with Megalodontes correspond to Member C of the typical Dachstein Lofer Cycle and the intertidal member with algal mats and abundant desiccations corresponds to member B.

CONCLUSIONS

The recognized microfacies of both selected outcrops allows us to distinguish two categories of carbonate platform facies: open-marine shallow subtidal facies in Lura section, extending from pelagic deep water to reefal and shallow-subtidal carbonate platform environments while in Staveci section, we have identified restricted facies typical for shallow subtidal-lagoonal and inter-supratidal depositional environment corresponding to an inner restricted platform–tidal flat system. Both sections are overlayed by the condensed facies comprise nodular limestones and specific faunal assemblage formed in pelagic conditions.

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PLATE I - Lura / PLANŞA I - Lura

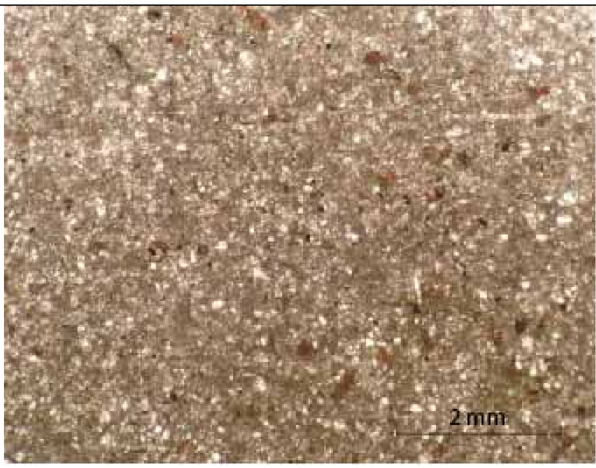


Figure 1. Microcalcarenite limestone with authigenic quartz, sample 1579. / Figura 1. Calcar microcalcarenitic cu cuarţ autigen, proba 1579 (original).

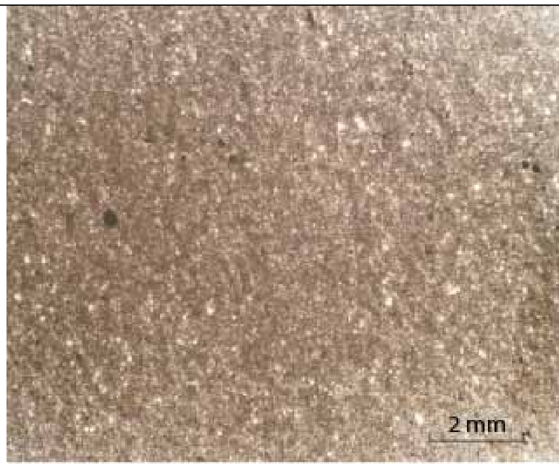


Figure 2. Black marl with dispersed pyrite crystals, sample 1579a. / Figura 2. Marnă neagră cu cristale de pirită, proba 1579a (original).

Figure 3. Microbreciated turbiditic limestone, sample 1581a. / Figura 3. Calcar turbiditic microbreciat, proba 1581a (original).

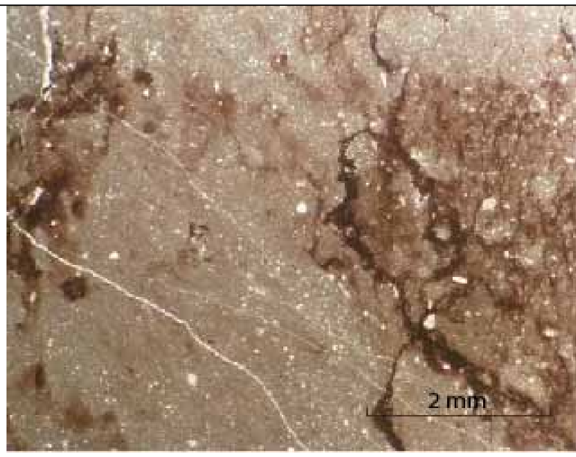


Figure 4. Marl, sample 1584. / Figura 4. Marnă, proba 1584 (original).

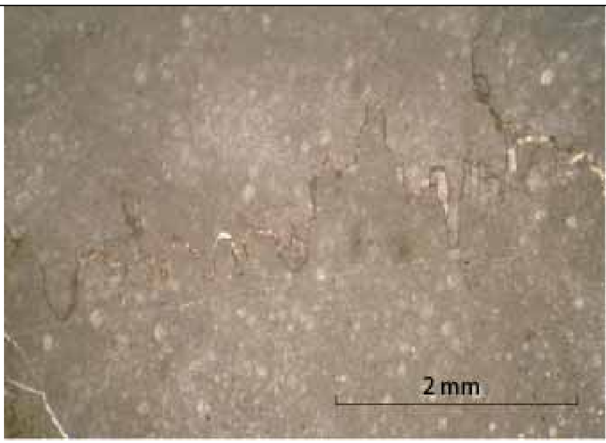


Figure 5. Radiolarian wackestone-packstone with stylolites, sample 1594. / Figura 5. Wacestone-packstone radiolaritic cu stilolite, proba 1594 (original).

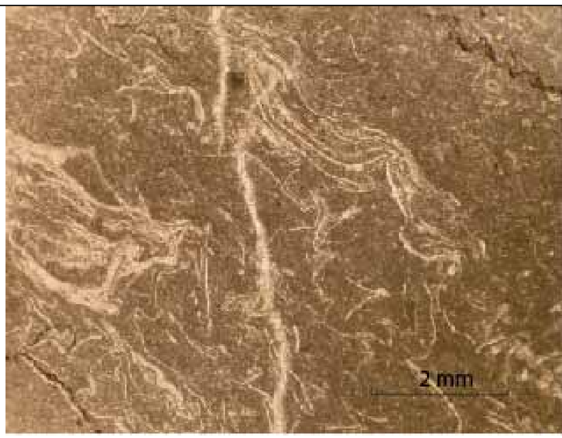


Figure 6. Radiolarian wackestone-packstone with *Halobia* sp., sample 1604. / Figura. 6. Wackestone-packestone radiolaritic cu *Halobia* sp., proba 1604 (original).

PLATE II – Lura / PLANŞA II – Lura

Figure 1. Radiolarian wackestone-packstone with *Bacanella floriformis*, sample 1620. / Figura 1. Wackestone-packestone radiolaritic cu *B. floriformis*, proba 1620 (original).

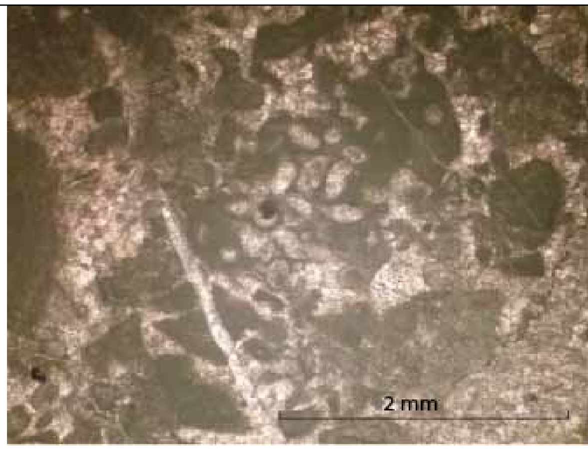


Figure 2. Coralgal wackestone-packstone with *Ladinella porata*, sample 1626. / Figura 2. Wackestone-packestone coralgal cu *L. porata*, proba 1626 (original).

Figure 3. Coralgal wackestone-packstone with *Tubipytes* sp., sample 1648. / Figura 3. Wackestone-packestone coralgal cu *Tubiphytes* sp., proba 1648 (original).

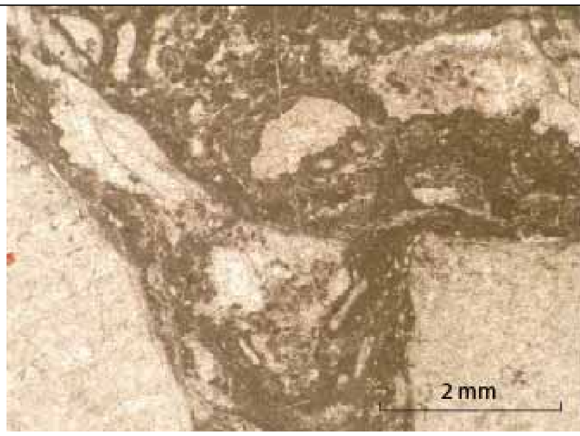


Figure 4. Recrystallized corals surounded by thin micritic crusts, sample 1654. / Figura 4. Corali recristalizați înconjurați de cruste micritice, proba 1654 (original).

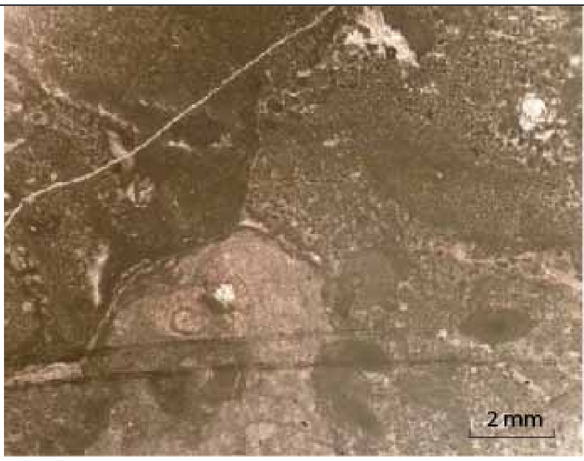


Figure 5. Coralgal wackestone-packstone - biosparudit, sample 1658. / Figura 5. Wackestone-packestone coralgal - biosparudit, proba 1658 (original).

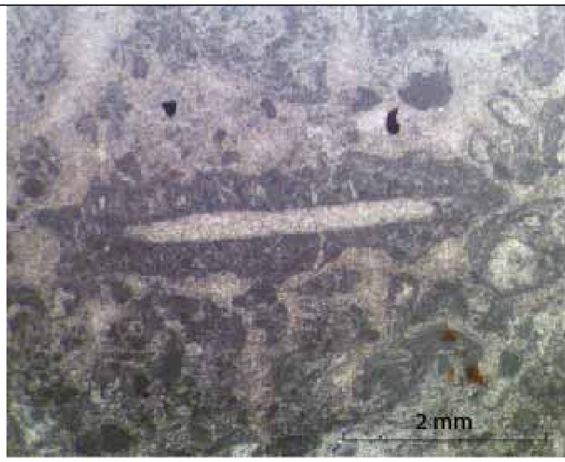


Figure 6. Dasycladacean alga (oblique section), sample 1672. / Figura 6. Alge dasycladacee (secțiune oblică), proba 1672 (original).

PLATE III – Lura / PLANŞA III – Lura

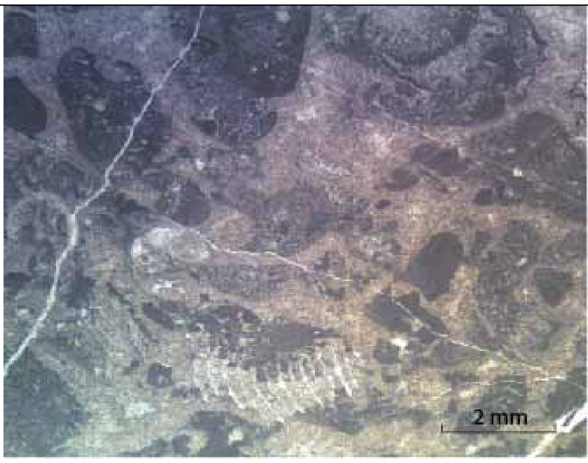


Figure 1. Coralgal wackestone-packstone, sample 1673. / Figura 1. Wackestone-packestone coralgal, proba 1673 (original).

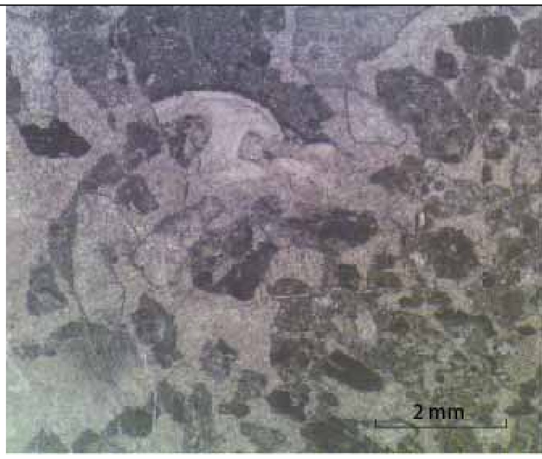


Figure 2. Coralgal wackestone-packestone with brachiopods and dasycladacean alga, sample 1675. / Figura 2. Wackestone-packestone coralgal cu brahiopode şi alge dasycladacee, proba 1675 (original).

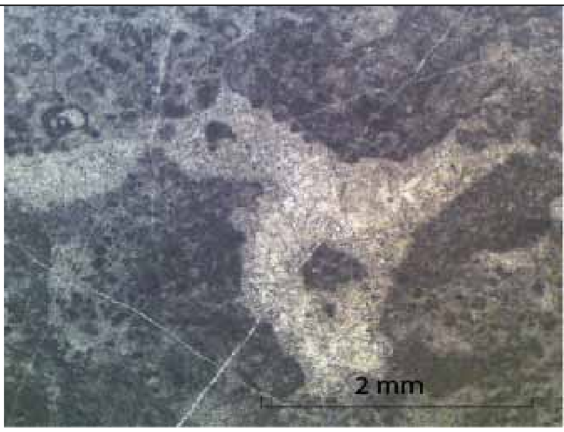


Figure 3. Drusy (blocky) cement in an algal packestone-grainstone, sample 1676. / Figura 3. Ciment druzic într-un packestone-grainstone algal, proba 1676 (original).

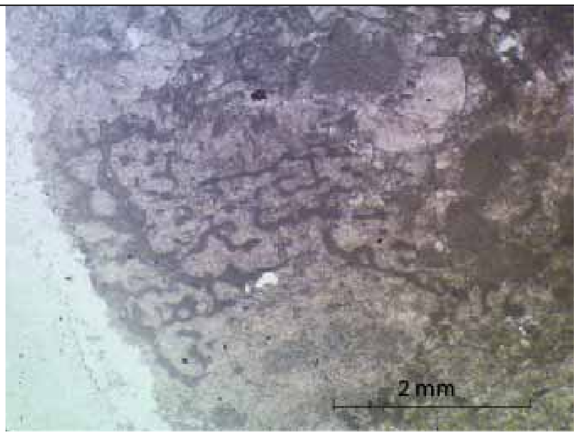


Figure 4. Algal packestone-grainstone *with Cryptocoelia zittelli*, sample 1681. / Figura 4. Packestone-grainstone algal cu *C. zittelli*, proba 1681 (original).

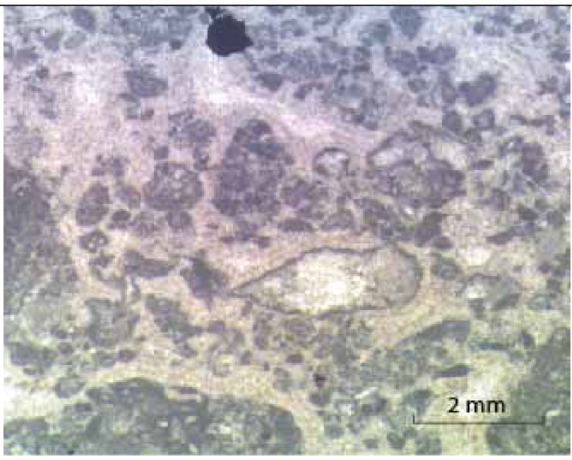


Figure 5. Algal packestone-grainstone biosparuditic, sample 1688. / Figura 5. Packestone-grainstone biosparuditic, proba 1688 (original).

Figure 6. Peloidal-oncoidal wackestone-packestone, sample 1689. / Figura 6. Wackestone-packestone peloidal-oncoidal, proba 1689 (original).

PLATE IV – Staveci / PLANŞA IV – Staveci

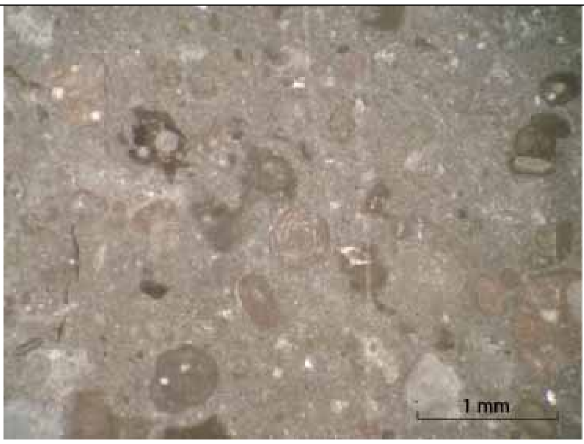
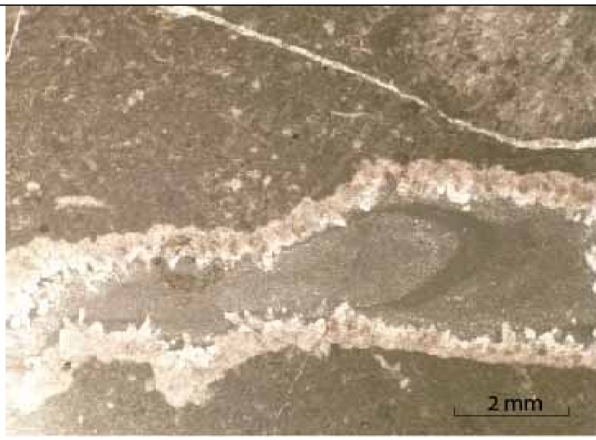
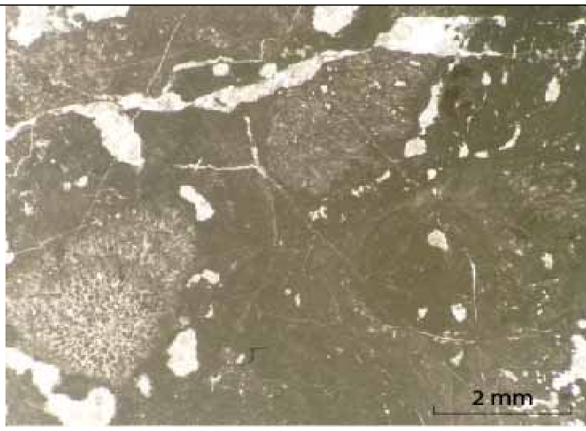
	

Figure 1. Peloidal packstone-grainstone, sample 3101. / Figura 1. Packstone-grainstone peloidal, proba 3101 (original).	Figure 2. Void filled with a fine peloids and lined with scalenohedral "dogtooth" cement, sample 3109. / Figura 2. Gol umplut cu peloide fine şi mărginit de ciment de tip "dinţi de câine", proba 3109 (original).
	
Figure 3. Flat laminated algal stromatolite facies, sample 3115. / Figura 3. Stromatolite algale laminate plane, proba 3115 (original).	Figure 4. Mudstone with Rivulariacean-type cyanobacteria, sample 3117. / Figura 4. Calcar nicritic cu cianobacterii rivulariacee, proba 3117 (original).

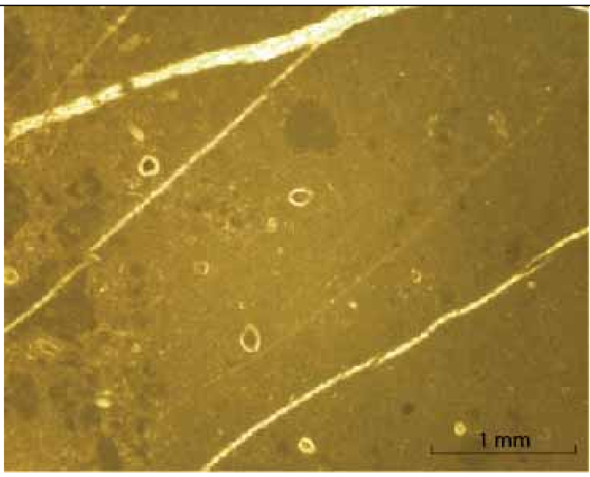
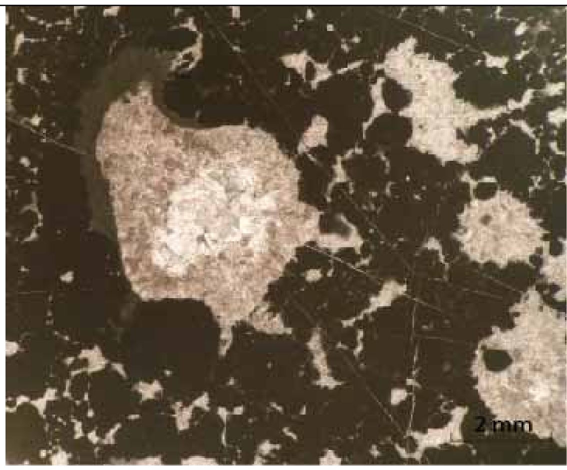

	

Figure 5. Mudstone with Ostracods, ample 3122. / Figura 5. Calcar nicritic cu ostracode, proba 3122 (original).	Figure 6. Voids filled with diagenetic cement in a peloidal wackestone, sample 3125. / Figura 6. Goluri umplute cu ciment diagenetic într-un wackestone peloidal, proba 3125 (original).

PLATE V- Staveci / PLANŞA V – Staveci

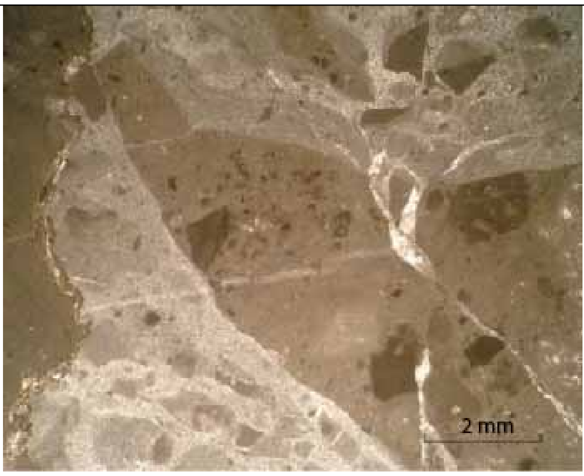


Figure 1. Brecciated limestone, sample 3133. / Figura 1. Calcar breciat, proba 3133 (original).

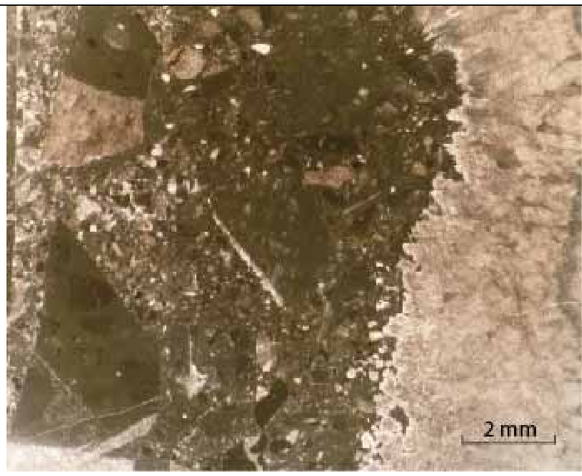


Figure 2. Brecciated limestone, sample 3136. / Figura 2. Calcar breciat, proba 3136 (original).

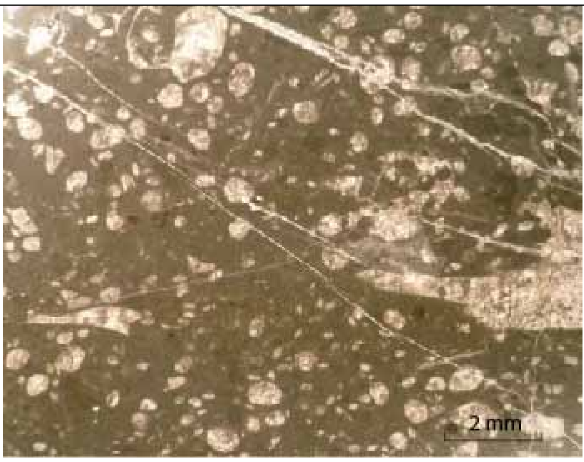


Figure 3. Typical facies with Megalodonts and Gastropods, sample 3139. / Figura 3. Facies tipic cu megalodonte şi gastropode, proba 3139 (original).

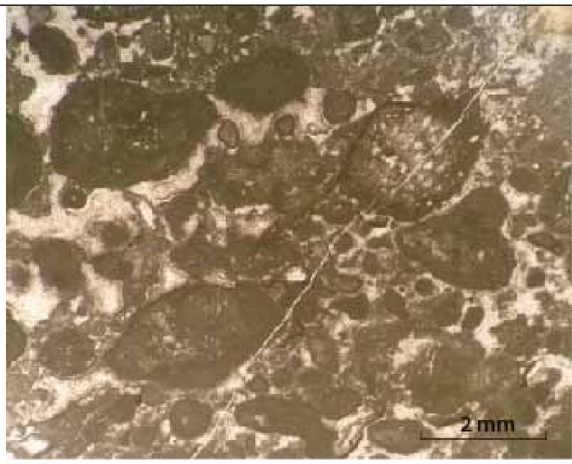


Figure 4. Oncolitic packstone, sample 3145. / Figura 4. Packstone oncolitic, proba 3145 (original).

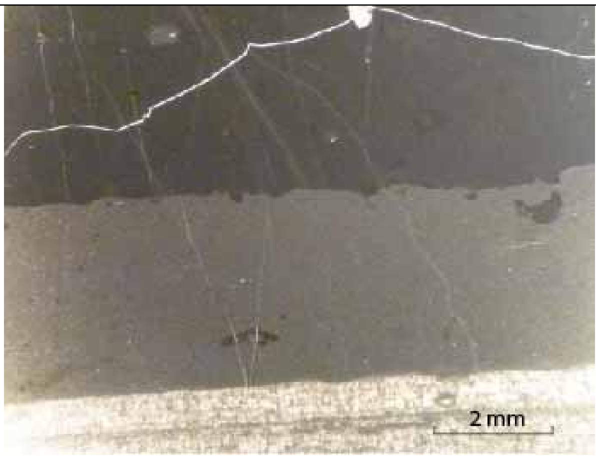


Figure 5. Small calcite filled-voids in a laminated dolomite mudstone, sample 3149. / Figura 5. Mici goluri umplute cu calcit într-un calcar nicritic dolomitic laminat, proba 3149 (original).

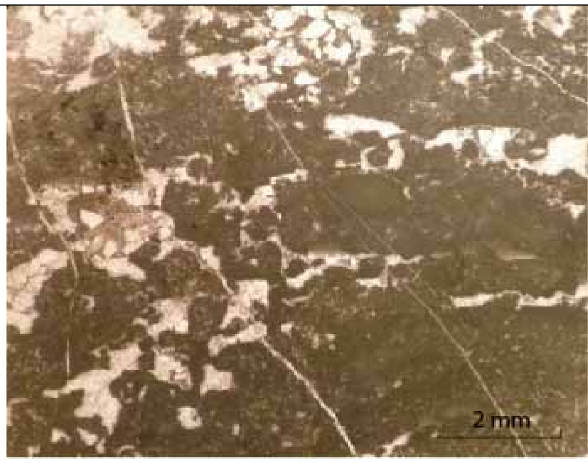


Figure 6. Voids with mechanically deposited calcite Crystals, sample 3166. / Figura 6. Goluri cu cristale de calcit, proba 3166 (original).

PLATE VI – Staveci / PLANŞA VI – Staveci

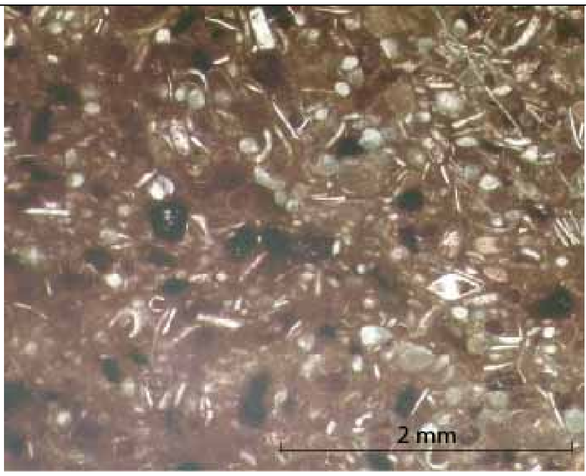


Figure 1. Typical condensed facies with embryonic ammonits, sample 3173. / Figura 1. Facies condensat tipic cu amoniţi embrionali, proba 3173 (original).

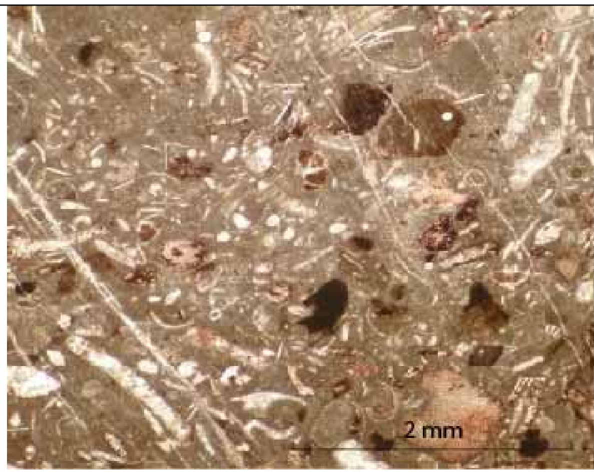


Figure 2. Typical condensed facies with crinoids, sample 3175. / Figura 2. Facies condensat tipic cu crinoide, proba 3175 (original).

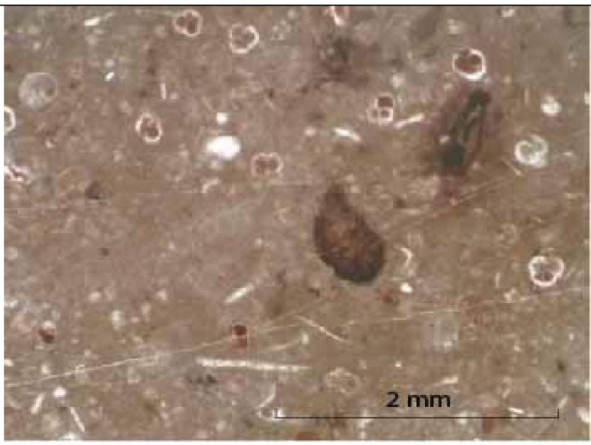


Figure 3. Typical condensed facies with Protoglobogerinids, sample 3176.
Figura 3. Facies condensat tipic cu protoglobigerine, proba 3176 (original).

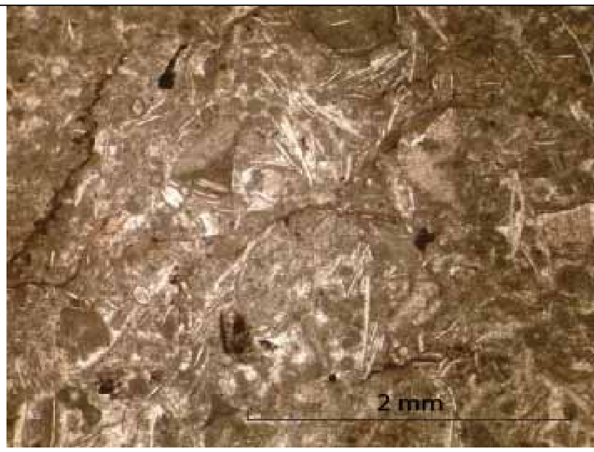


Figure 4. Typical condensed facies with pelagic bivalves, sample 3184.
Figura 4. Facies condensat tipic cu bivalve pelagice, proba 3184 (original).

Figure 5. Typical nodular amonitic limestone, sample 3188.
Figura 5. Facies amonitic nodular tipic, proba 3188 (original).

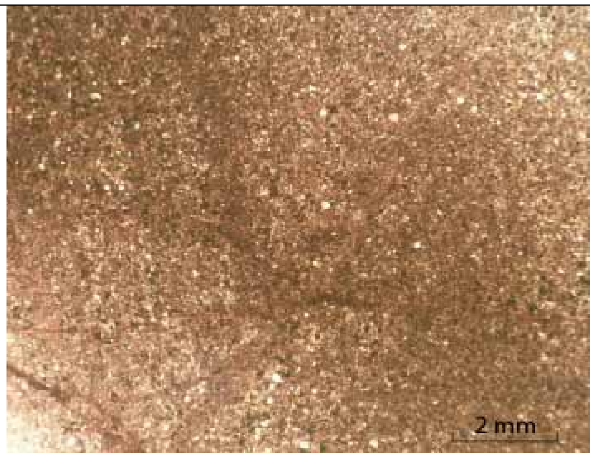


Figure 6. Radiolarit, sample 3189.
Figura 6. Radiolarit, proba 3189 (original).