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Rhaetian / Hettangian passage beds in the carbonate development in the Krížna Nappe (central Western Carpathians, Slovakia)

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Abstract. A record of Rhaetian-Hettangian gradual passage unusual of central Western Carpathians, is developed in a carbonate succession in the Jakub quarry near Banská Bystrica. Lower part of the section formed by ?Rhaetian Svätý Jakub Formation, is represented by thick bedded light-grey peloidal limestones with pellet microfacies, deposited in a restricted lagoonal environment. Hettangian Nový Svet Formation (new name) is formed by a rhythmic succesion of well-bedded dark-grey biopelmicrites alternating with thin yellowish less calcareous interbeds slightly enriched in clay and quartz silt. The scarcity of clastic terrigenous admixture is characteristic. Spicule-pseudopeloid-ostracod, brachiopod-bivalve-spicule, oyster-spicule and condensed microfacies were recognized. Fossil benthic assemblages dominated by brachiopods and bivalves in the upper part of this formation represented deeper subtidal environment with good oxygenation and normal salinity.

Key words: Rhaetian/Hettangian passage beds, Western Carpathians, microfacies, palaeogeography, brachiopod assemblages.

Introduction

At the beginning of Jurassic, fossiliferous Fatra Fm was replaced by clastic deposits of the Kopienec Fm in the West Carpathian Fatric Domain. Carbonate succession with gradual Triassic/Jurassic passage beds without any significant terrigenous influence was studied in the vicinity of both the Jakub and the Nový Svet villages by Banská Bystrica (Fig.1). Horák (1960) described *Coprolithus salevensis* Paréjas, 1948 (cylinder shaped coprolites of probably crustacean origin), with diameter of about 5 mm and with regular gutter structure from light grey massive „pseudoolithic„ limestones from the Jakub quarry near Banská Bystrica. Recently, they were determined by Gaździcki et al. (in press) as *Parafavreina thoronetensis* Bronn, Caron et Zaninetti. Čepek (1970) designated the mentioned rocks occurring in two parallel stripes north and south from Banská Bystrica as the Svätý Jakub Limestones. He characterised them as fossiliferous pelmicrites with intraclasts, which are usually heavy bedded to massive, due to absence or very small amount of bitumen light grey to white, formed mainly by „pseudooids„ (coprolites and peloids with no internal structure) and with irregularly recrystallized micrital matrix. According to him, these limestones „are strikingly closely spatially connected with the Liassic coarse-grained crinoid limestone development.„ In view of new facts (see below), this opinion is doubtfull.

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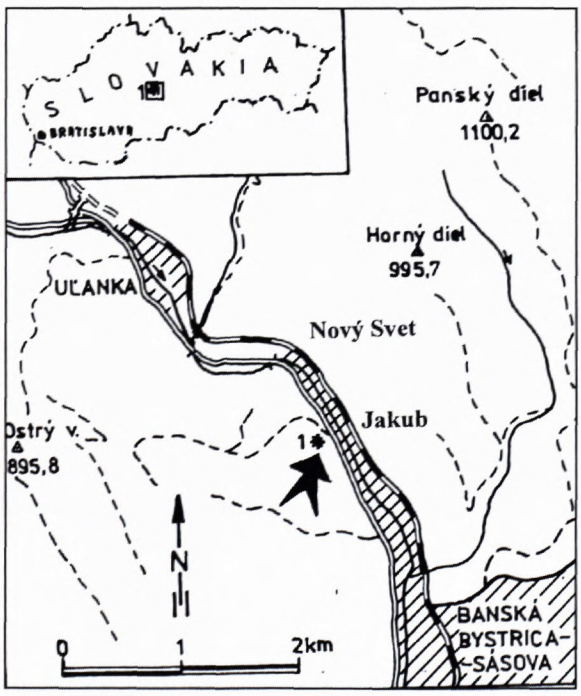

Fig. 1 The geographic position of the Jakub quarry near Banská Bystrica.

We thank also to Dr. M. Rakús for kind ammonite determination. The photographs have been made by L. Osvald. The paper contributes to the VEGA research projects No. 6169 and 7215.

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Lithology and biostratigraphy:
The Svätý Jakub Formation

The lower massive part is followed by heavy bedded light-grey compact peloid limestones (Fig. 2) with pale weathered surface. Two blocks in the quarry wall, separated by normal faults contain both limestone types consisting of pelsparite (grainstones), rarely pelmicrosparite and pelmicrite (packstones). They were assigned to the MF 1 (pellet) microfacies, characterised by abundant pellets, less common intraclasts, ooids and redeposited and poorly preserved organic remnants and matrix with locally unwinnowed micrite. The bitumen is present in very small amount, macrofossils are absent. Gradual sedimentary change is indicated by onset of rather microlithoclatic-bioclastic packstone microfacies with pseudopeloids prevailing in the uppermost beds. At present, the Rhaetian age of the Svätý Jakub Fm is only indirectly indicated by occurence of *Parafavreina thoronetensis,* and by Rhaetian foraminifers which has been determined from similar limestones in the Lučatín Unit (Soták & Plašienka, 1996). The Liassic age of the Svätý Jakub Fm was misinterpreted due to incorrect sampling and determination of Liassic brachiopods and bivalves in the Jakub quarry (Maheľ et al., 1964).

The Nový Svet Formation (new name)

Type locality: A quarry situated in the slope above the Banská Bystrica – Donovaly road, between Jakub and Nový Svet villages (Fig. 1).

Thickness: More than 20 m in the type section.

Lithology: Rhythmic succession of regularly alternating dark grey- brown well-bedded (5 to 25 cm) fine-grained biopelmicritic and pelbiomicritic (wackestones and packstones, floatstones) limestones (MF 2, 3 and 4) and thin (0.5 to 1 cm) yellowish and yellow-grey interbeds (MF 5) containing sligth admixture of quartz silt grains and clay (Figs. 2). Black oval cherts form stratiform lenses in several beds. Sedimentary texture is bioturbated and peloidized. Upwards thinning cycles were observed in the lower part of the formation, while the bed thickness in upper parts is more or less uniform. Amalgamation of some limestone beds (probably owing to bioturbation) was recorded. Irregular waving of some bedding planes was probably caused by postsedimentary diagenetic compaction. Sponge spicules, ostracods and pseudopeloids are abundant in some beds, rarely fecal pellets or bacterially induced precipitations occur. Fecal pellets are smaller in size than in underlying formation. Biopelmicritic and pelbiomicritic packstones and wackestones in the lower part of sequence belong to the MF 2 (spicules-pseudopeloid-ostracod microfacies). In addition to frequent sponge spicules and ostracods, echinoderm, juvenile gastropod, bivalve and brachiopod shell fragments, foraminiferal tests sometimes occur. A condensed reddish ferrolitic crust occurs in thin bed no. 59. Brachiopod and bivalve coquinal biopelmicritic and biomicritic floatstones in the upper part of the section contain scarce regular echinoids. Brachiopod-, or brachiopod- and bivalve rich (MF 3: brachiopod-bivalve-spicule microfacies) limestone beds alternate with oyster beds (MF 4: oyster-spicule microfacies) and also with barren beds with well sorted biodetritic and pseudopeloid (microintraclastic) material.

Boundaries: The lower boundary with the Svätý Jakub Fm is transitional, being indicated by gradual thinning of limestone beds and by gradual microfacies change from the MF 1 to the MF 2a above the bed no. 36 (Fig. 2, Pl. 1, fig. 2). This biopelmicritic and biopelmicrosparitic packstone bed with dominant pseudopeloids and intraclasts contains poor benthic assemblage of ostracods and foraminifers (*Earlandia*). Fecal pellets characteristic of the MF 1 disappear, but spicules are scarce. The upper boundary is not known due to lack of exposure.

Age: The first representatives of *Chlamys (Chlamys) textoria* (Schlotheim) (bed no. 62) are known from the early Hettangian Planorbis Zone (Johnson, 1984). Dr. Rakús determined *Kammerkarites haploptychum* (Wähner) from the upper part of the formation (bed no 168), the index ammonite of the Middle Hettangian Megastoma Zone (Fig. 3).

Distribution: The formation is hitherto known from the vicinity of the Nový Svet village only.

Macrofauna: While macrofossils are rather poor in the Svätý Jakub Fm, pectinid bivalves (*Chlamys (Ch.) textoria* (Schlotheim)) and oysters (*Gryphaea* sp.) occur in thin yellowish and brownish interbeds (LMF 5) in the whole Nový Svet Fm. Although regular echinoids are rare, other benthics are very abundant in several limestone beds and interbeds in the upper part of the formation. In the Bed no.141, benthic assemblages with brachiopods firstly appear. Together with oysters, they often form a dominant group. From taphonomic view, limestone beds yielded primary biogenic shell concentrations (sensu Fürsich & Oschmann, 1993), representing "within-habitat time-averaged" autochthonous fossil assemblages (sensu Kidwell & Bosence, 1991). The character of the interbed assemblages was similar, but time-averaging was discontinuous and more significant due to an extremely very reduced sedimentation rate (slight winnowing and long exposure on sea floor). Therefore, skeletal accumulations in the interbeds belong to the condensed or hiatal shell concentrations (sensu Kidwell, 1991). Relative zeilleriid-, lobothyrid- and rhynchonellid abundance varied in time. Three basic benthic assemblages (lobothyrid-, zeilleriid/rhynchonellid/oyster and oyster dominated) were recognized. Other groups of organisms, namely regular echinoids, gastropods and ammonites occur rarely. Noteworthy, benthic macrofauna is quite missing in the bed no. 168, where the only ammonite specimen has been found.

Microfacies (MF)
A restricted lagoonal environment (above wave base):
MF 1 - pellet microfacies

Description of microfacies. Pelsparitic, pelmicrosparitic and pelmicritic grainstones and packstones (Pl. 1, fig. 1) with unhomogenous (sometimes secondarily recry-

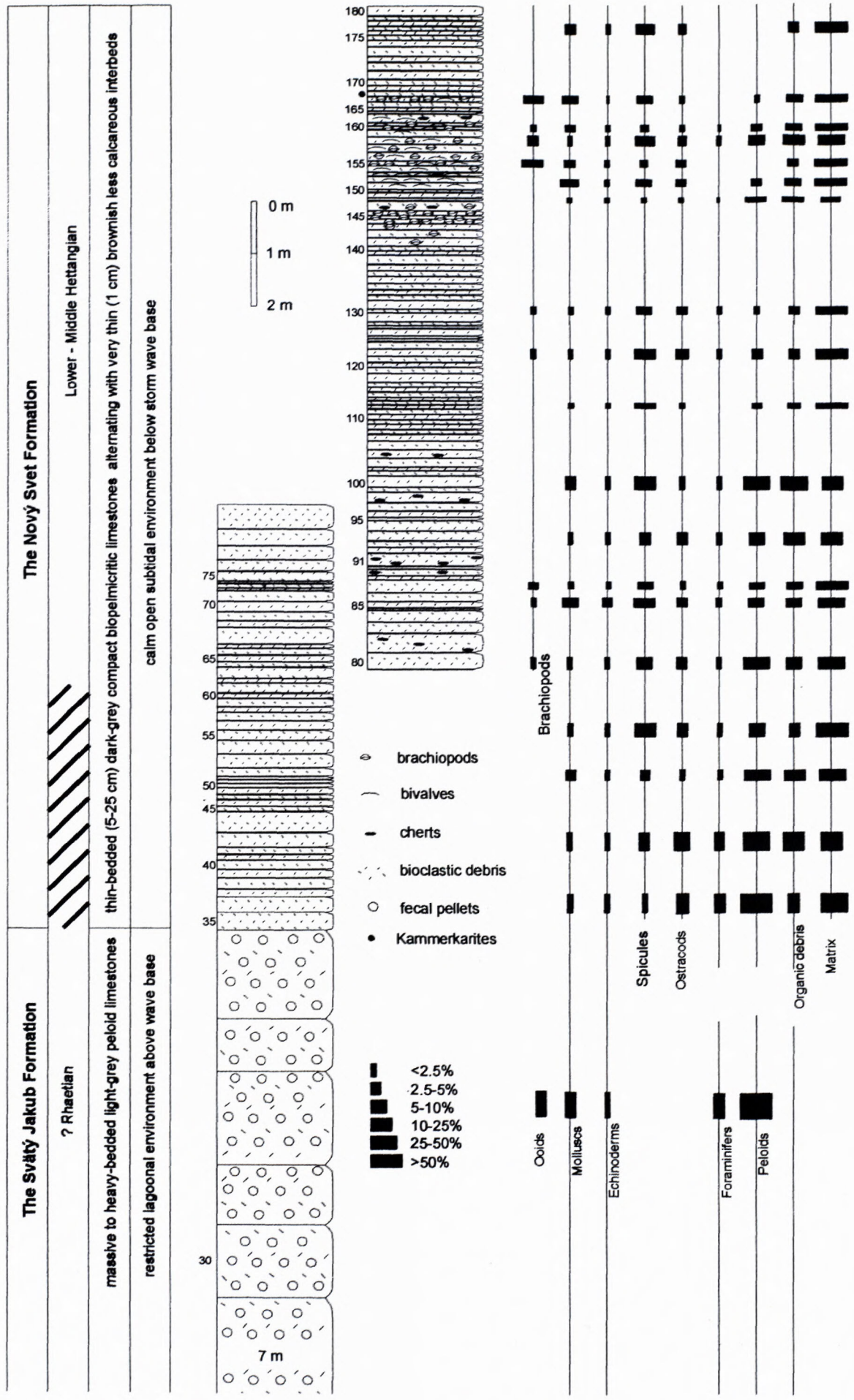

Fig. 2 The lithological section in left part of the Jakub quarry near Banská Bystrica

Fig. 3 Kammerkarites haploptychum (Wähner), scale: 1 cm

stallized) fabric formed by orthosparite and locally also uncompletely winnowed microsparite and micrite contain high proportion of allochems (about 60%). Intensive bioturbation probably destroyed any former sedimentary textures. In the Wilson´s (1975) microfacies classification, this type belongs to the SMF 16. Peloids are dominating (50%), ooids (5%) and bioclasts (5 %) are less abundant. They are moderately size-sorted peloids (150 to 720 μm) are of variable shapes. Regular oval fecal pellets, sometimes with internal structure prevail, while strongly micritized bioclasts and ooids (pelletoids), micritic intraclasts, mostly irregular (pseudopeloids) are frequent. *Parafavreina thoronetensis* coprolites were derived just from this microfacies type. Abraded and micritized bivalve and echinoderm fragments are rarely represented in bioclastic debris. Nodosariid foraminifers, spicules and echinoid spines are very rare. Agglutinated foraminifers (*Trochammina alpina* Kristan-Tollmann, *Endothyra* sp.) represent the only autochthonous body fossils. Size of bioclasts reaches 400 μm to 2 mm. Ellipse-shaped ooids are well size sorted (190 to 530 μm). Superficial ooid types with one cryptocrystallic, originally probably radial layer (thickness 10 to 15 μm) prevail. The layer mentioned is sometimes coated by one regular micrite layer of the same thickness. The nucleus is formed mainly by peloid, less often by bivalve fragment, gastropod, crinoid ossicle or unidentifiable recrystallized bioclast. Broken and compound ooids are rarely present. Clastic quartz silt admixture is very rare.

The sedimentary environment: Poor and low diversified benthic assemblage represents a mixed indigenous-exotic type (sensu Kidwell & Bosence, 1991) consisting mainly from redeposited fragments. Complete absence of autochtonous benthic and planktonic body fossils (with the exception of agglutinated foraminifers), but the presence of fecal pellets producing crustaceans indicate a special composition of biocoenosis. The absence of autochthonous stenohaline organisms suggests a deviated water salinity. Higher energy of environment is indicated by prevailing sparite structure and by reworking of bioclasts. Micritisation of bioclasts indicate their long exposure on the bottom connected with slow sedimentation rate. Incompletely winnowed micrite can be explained by temporarily increased water energy due to wave action. The Svätý Jakub Fm was deposited in warm subtidal restricted lagoonal environment with unstable hydrodynamic regime including salinity and temperature fluctuations. The bottom was probably situated above the normal wave base, the substrate being flat, soft and muddy. Similar lithofacies occur on the recent Great Bahama Bank margin sheltered from trade winds and strong tidal activity (Bathurst, 1971). The proportion of polychaete fecal pellets of *Armandia maculata* reaches 17 to 38%. Fauna is rare, both in density and diversity, due to high-stress hypersaline environment. The environment of peloidal wackestone to packstone (e.g. *Favreina*-type coprolites) from the Hauptdolomit and the Dachstein Fm from the Transdanubian Central Range posessed similar features (the subtidal C member of Lofer cycles in Haas & Balog, 1995). Modern and ancient restricted subtidal environment are characterised by a small number of alochem types: carbonate or terrigenous mud, fecal pellets, peloids, grapestones, intraclasts and limited share of skeletal components (Enos, 1983). On the basis of Wilson´s (1975) classification, the environment belongs to the 8th facies zone: the shelf with restricted circulation.

Calm open deeper subtidal environment (below storm wave base)

Four microfacies characterize this environment - MF 2 (spicule-peloid-ostracod microfacies), MF 3 (brachiopod-bivalve-spicule microfacies), MF 4 (oyster-spicule microfacies) and MF 5 (condensed microfacies). The Nový Svet Fm consists of well bedded fine-grained biopelmicrites (MF 2, 3 and 4) regularly alternating with thin less calcareous interbeds slightly enriched in clay and silt quartz grains with MF 5.

MF 2 - Spicule-pseudopeloid-ostracod microfacies

Description of microfacies: Biopelmicritic and pelbiomicritic wackestones and packstones contain variable content (35 to 65 %) of allochems (Pl. 1, Figs. 3-6, Pl. 2, Fig. 1, 3). The matrix is unhomogenous, commonly bioturbated, with pseudopeloids and fine well-sorted calcisiltic bioclastic debris. As the content of often poorly distinguishable (clotted structure) pseudopeloids and spicules is very variable and often contrasting, two subtypes were recognized: the MF 2a with pseudopeloids dominating and the MF 2b one with spicules prevailing. These two subtypes alternate in the section in several cycles. The first microfacies is more abundant in the lower part of the section (until the bed no. 100), while the second one is more frequent higher up. Calcified, mainly monaxone and triaxone sponge spicules, sometimes parallell oriented (proportion varies from 5 to 25%), disarticulated valves and recrystallized ostracod shells (2 to 4.5%) are represented in fossil assemblages. In some beds, juvenile gastropod shells (Pl. 1, fig. 3), involutinid foraminifers

(Pl. 1, fig. 6), *Earlandia dunningtoni* (Elliot), and *E. incostans* (Radoičic) are frequent (Pl. 2, figs. 5-9). Oyster and pectenid shell fragments are less common. Locally, poorly preserved calcareous and aglutinaceous, glomospirellid and nodosariid foraminifers, or *Involutina liassica* (Jones) are present in the bioclastic debris. Echinoid spines, fragments of holothurian sclerites (*Theelia* sp.), recrystallized *Globochaete alpina* Lombard, calcisphaeres *Didemnoides moreti* (Durand Delga) and halicoryne algae fragments are rare. Abraded, sometimes also micritized and bored bivalve valves and relicts of corroded echinoderm ossicle fragments form scarce redeposited bioclasts. Proportion of variable shaped pseudopeloids is between 15 and 60%, their sorting is always good (average size 20 -100 μm). Larger irregular moderately sorted micritic intraclasts are rare, angular quartz silt grains and authigenous quartz crystals are very scarce. The sediment contains low admixture of organic matter. Carbonized floral remnants are also present.The pyrite forms globular aggregates and it impregnates small bioclasts. Larger bioclasts are partly affected by selective silicification.

MF 3 - Brachiopod-bivalve-spicule microfacies

Description of microfacies: Biomicritic and biopelmicritic floatstones with abundant silt-sized bioclasts (derived mainly from spicules) and also with larger brachiopod and bivalve shells (several cm, Pl. 2, fig. 2). The matrix is homogenous, containing approximately 35 to 50% of allochems. The sediment is slightly bioturbated. Fragments of well-preserved punctate and impunctate brachiopod valves and recrystallized calcified siliceous monaxone, triaxone and tetraxone sponge spicules (10 to 15%) occur in bioclastic debris. Locally, fragments and complete valves of pectenid and ostreid bivalves dominate over ostracod valves (1.5 to 3.5%), juvenile gastropod fragments and crinoid ossicles. Calcisphaeres, globochaetes and ophiuroid fragments are scarce. Pseudopeloids (30 to 100 μm) are of variable shapes, their proportion is mostly low. Fecal pellets are scattered, slightly recrystallized, forming clotted structure. As in the MF 2, clastic quartz grains of silt size are very scarce. Badly preserved and redeposited fragments of bivalves are affected by micritization, boring traces were observed rarely. The proportion of bioclasts varies from 25 to 30%. They are mostly autochthonous. Brachiopod and oyster valves are partly selectively silicified (chalcedony spherulites).

MF 4 - Oyster-spicule microfacies

Description of microfacies: Biopelmicritic floatstones of the SMF 8 (Wilson, 1975), sometimes recrystallized to biopelmicrosparites. The matrix is homogenous, sligthly bioturbated (relict parallel orientation of some monaxones preserved locally), with scattered silt-sized bioclastic debris (10 to 60 μm) and indistinctly bounded peloids (clotted structure), allochem content reaches 65%. In a benthic assemblage, well preserved non-abraded fragments and complete valves of oysters with foliated structure (25%), calcified monaxone sponge spicules (20%) and recrystallized ostracodshells and valves are abundant. In other features, this microfacies is similar to MF 3.

MF 5 - Condensed microfacies

Description of microfacies: It occurs in thin less calcareous interbeds (0,5 to 1 cm), slightly enriched in clastic silt quartz grains and clay admixture (5%). The calcareous constituent consists of bioclasts and pseudopeloids only, the proportion of micrite is low. In the fossiliferous part of the Nový Svet Fm, this microfacies also contains condensed or hiatal shell concentrations with bivalves, brachiopods, and crinoid ossicles. Shells are frequently corroded, disarticulated or fragmented and encrustation is sometimes present on oysters. The valves are mostly oriented concordantly with bedding planes. Locally, red ferrigenous crusts occur on the bedding planes of interbeds. Sedimentary rate was extremely reduced.

Sedimentary environments: Open shelf (middle shelf of Wilson & Jordan, 1983), normal salinity and good oxygenation zone, with depths about 30 to 100 m is inferred. Locally, parallelly oriented sponge spicules indicate weak current regime. In some periods, micritic pseudopeloid material was redeposited. Alternation of biomicrite (MF 2, 3 and 4) with thin less calcareous aleuritic interbeds (MF 5) indicates regularly alternating conditions related to changes in rate of sedimentation. The sedimentary rate was relatively higher during deposition of MF 2, 3 and 4 than this of MF 5. The absence of autochthonous ooids, oncoids, cortoids and aggregate grains and the presence of siliceous sponges points to deeper subtidal conditions. Moreover, this assumption can be supported by the scarcity of photosynthetic organisms and boring and encrusting organisms. The bottom was soft and muddy. This environment should belong to the FZ 2 - open shelf zone (Wilson, 1975).

Discussion

During the Triassic, central Western Carpathians were situated at the NW margin of the North European shelf (Michalík, 1994). The opening of the Penninic Ocean and the simultaneous closure of the Paleotethys as well, influenced climatic, eustatic and tectonic processes in this region during the Triassic/Jurassic boundary.

Tatricum: uppermost Triassic sediments are often missing due to emersion, with the only exception of the continental Tomanová Fm (Michalík et al., 1976, 1988) an the rest of marine beds in the Strážovské vrchy Mts (Štrbkovci locality, Michalík, 1980).

Fatricum and northern Veporicum: Rhaetian sediments are represented by the Fatra Fm: shallow-water limestone beds with marl and dolomite intercalations with repeating shallowing upward cycles deposited in a partially isolated basin, inhabited by rich but little diversified benthic communities (Michalík & Jendrejáková, 1978). Soták and Plašienka (1996) described massive biomicritic

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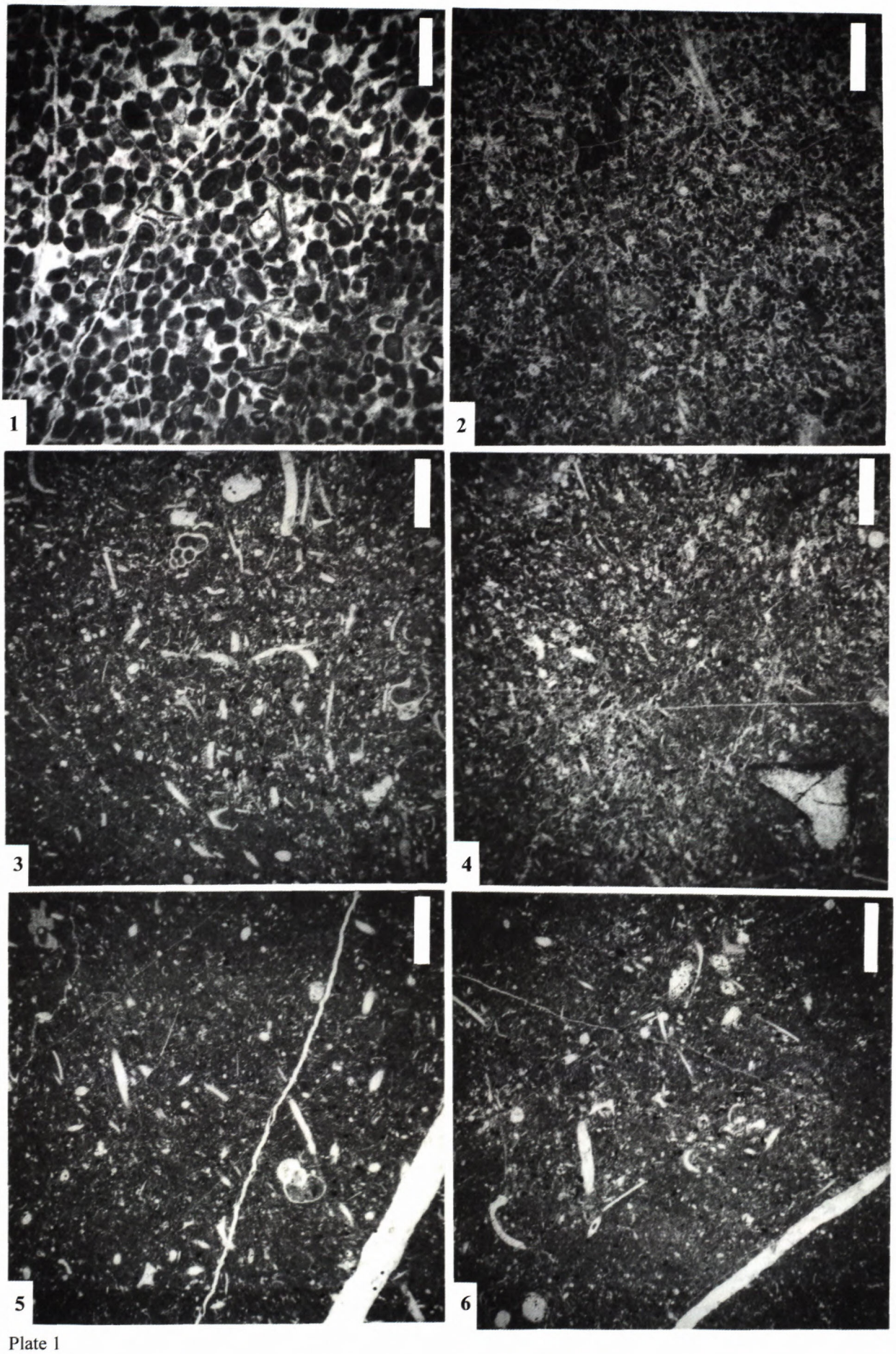

Plate 1

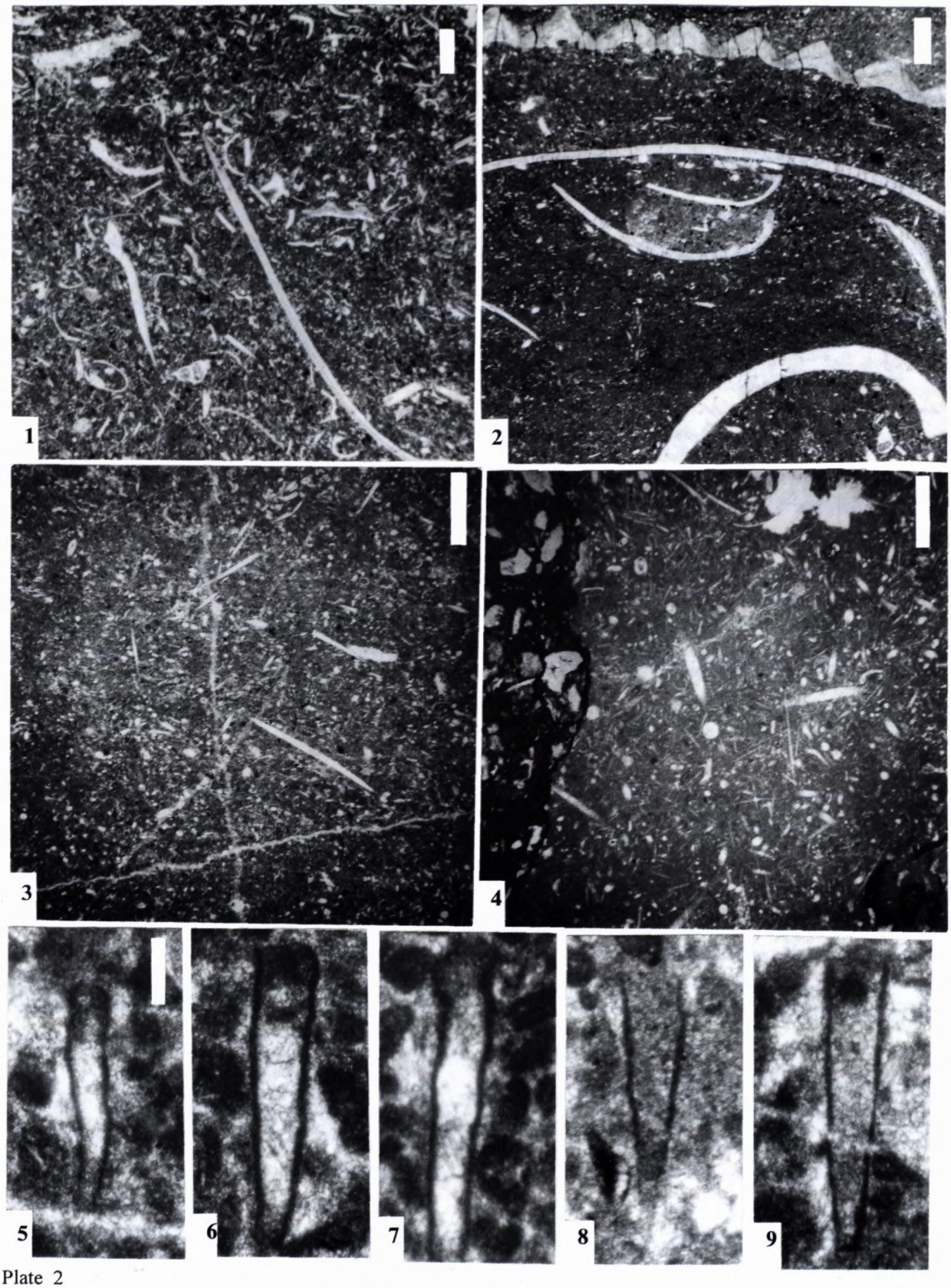

Plate 2

limestones with Rhaetian foraminifers and cavity fillings build of layered-fibrous calcite from the Farbište Subunit (the Lučatin Unit) of the Veporicum. They probably belonged to a biohermal complex along the northern side of the Veporic Unit. Hettangian terrigenous influx strongly influenced northern part of the Fatric Basin. Surprisingly, the Nový Svet Fm is characterised by the rareness of terrigenous clastics (very slightly increased content of clay and probably eolian silt quartz). Biomicrite with calcified spicules, ostracods, juvenile gastropods, thin-shelled bi-

valves and foraminifers, rare crinoidal debris and with only silt quartz grains were also found in intraclasts surrounded by coarse-grained sandy crinoidal matrix without spicules and ostracods in the Sinemurian - ?Lotharingian Trlenská Fm and in the overlying Liassic crinoidal limestones complex (the Vývrat and the Prístodolok Fms) in the Vysoká Unit (Pl. 2, fig. 4) (Koša,1998).

Hronicum: Rhaetian Norovica Fm formed by pale grey biodetritic, oolitic and oncolitic fossiliferous biomicrite, pelmicrite, pelsparite, oopelsparite and pelbiooosparite with *Parafavreina thoronetensis*, by sole beds of loferitic dolomites and marls was deposited in neritic environment, with intermittent influence of open sea (Gaździcki & Michalík, 1980, Gaździcki et al., in press). Light brown massive and heavy bedded oncosparitic limestones, with rests of foraminifers and *Parafavreina thoronetensis* coprolites were found in the Nedze Nappe of the Malé Karpaty Mts (Hanáček, 1987). The Hybe Fm is formed by rhythmic alternation of dark-grey marls with organodetrital limestone beds deposited in shallow sea, with abundant benthic assemblages (Michalík, 1973). This formation overlies pale grey oolitic limestones of the Dachstein type. Similarly as in the Norovica Fm and in all Silicic sequences, Liassic crinoidal limestones overlie the Hybe Fm with an erosional contact.

Silicicum: Rhaetian sequence on the uppermost Triassic Dachstein and Furmanec carbonate platforms is represented by both fore-reef Bleskový prameň- and the Goštanová limestones, and the shallow lagoonal Skalka Limestone (Michalík, 1977). In the deeper parts of the basin, the Zlambach Fm was deposited, which passes upward into Liassic Allgäu Fm.

The Triassic/Jurassic boundary in *Southern Transdanubicum* (Vörös & Galácz, 1998) and in the *Csövár basin* east of the Danube (Haas et al., 1997): is characterised by a gradual passage of Dachstein Lst with Lofer cycles into Hettangian ooidal-oncoidal brachiopod-bearing Kardosrét Lst (Dulai, 1993), or their basinal equivalents. However, in NE Transdanubian Central Range, Middle Hettangian Pisznice Lst follows the Dachstein Lst with unconformity.

Northern Calcareous Alps: The microlithoclastic (pseudopeloid) packstone microfacies with abundant pseudopeloids (30%), fine biodetritus, crinoid, brachiopod and mollusc fragments, common ostracods and rare ooids of the Kendlbach Fm (Tiefenbach Mb) overlies the Rhaetian Kössen Fm (Böhm, 1992) sponge spicules are scarce, glauconite is very abundant and there is an expressive marl admixture. The upper, Breitenberg Mb of the Kendlbach Fm is almost identical with the upper part of the Nový Svet Fm (bioturbated bioclastic wackestones with lower marly admixture, with glauconite and abundant sponge spicules and brachiopods, Golebiowski, 1990). The microfacies of the Scheibelberg Limestone is similar to the LMF 2 of the Nový Svet Fm, too (packstone with spicule-fine biodetritus-ostracod microfacies: the MF 4b in Böhm, 1992).

Summary

1. Biostratigraphic and microfacies evaluation of the Jakub section near Banská Bystrica documented Rhaetian /Hettangian gradual passage in carbonate sedimentary sequence.

2. The Rhaetian (?) Svätý Jakub Fm represents a product of carbonate sedimentation in protected lagoonal environment with restricted and immature organism communities.

3. Newly defined Hettangian Nový Svet Fm was deposited in a deeper subtidal calm environment, below storm wave base. The sedimentation was temporarily influenced with input of microlithoclastic material. Later, during Middle Hettangian, marine bottom was locally stabilized and colonized by benthic brachiopod and bivalve assemblages.

4. The area studied was situated in southern part of the Fatric Basin, with affinity to the Veporicum. During Rhaetian, similar facies conditions existed also in the Hronicum. During Hettangian, sedimentary environment of the Nový Svet Fm indicates some resemblances to that of the Kendlbach Fm in the Northern Calcareous Alps.

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Explanations to the Plates

Plate I: The Svätý Jakub Fm. *MF 1 - pellet microfacies*: Fig. 1: pelsparitic grainstone (bed 32), locally with unwinnowed micrite. Scale: 1 mm. Fig. 2: transition between the Svätý Jakub Fm and the Nový Svet Fm: biopelsparitic and biopelmicrosparitic packstone (bed 36), with dominant pseudopeloids and scarce spicules, scale: 1 mm. The Nový Svet Fm. *MF 2: spicule-pseudopeloid-ostracod microfacies*: Fig. 3: biopelmicritic wackstone (bed 85), abundant juvenile gastropods, scale: 1 mm. Fig. 4: pelbiomicritic packstone (bed 100), scale: 1 mm. Fig. 5: pelbiomicritic wackestone (bed 122), scale: 1 mm. Fig. 6: pelbiomicritic wackestone (bed 130), with abundant *Involutina liassica* (Jones, 1853), scale: 1 mm.

Plate 2: The Nový Svet Fm. *MF 2: spicule-pseudopeloid-ostracod microfacies*: Fig. 1: biopelmicritic wackestone (bed 85), scale: 1 mm. *MF 3: brachiopod-bivalve-spicule microfacies*: Fig. 2: biomicritic floatstone (bed 167) with terebratulids and pectenids, scale: 1 mm. *MF 2: spicule-pseudopeloid-ostracod microfacies:* Fig. 3: biopelmicritic wackestone and packstone (bed 112), with abundant spicules, peloids and ostracods, scale: 1 mm. Fig. 4: biomicritic intraclast with abundant spicules and ostracods in the sandy-crinoidal Liassic limestone of the Vysoká Unit, similar to the spicule-pseudopeloid-ostracod microfacies, scale: 1 mm. Figs. 5-7: *Earlandia dunningtoni* (Elliot, 1958), 5: bed 43, 6,7: bed 36. Figs. 8-9: *Earlandia incostans* (Radoičic, 1967), 8: Bed 50III, 9: Bed 36. Scale for figs. 5-9: 10μm.