Mineralia Slovaca, 30 (1998), 157—166

Middle Jurassic crinoidal shoal complex at Hatné - Hrádok locality (Czorsztyn Unit, Pieniny Klippen Belt, western Slovakia)

ROMAN AUBRECHT and MILAN SÝKORA

Department of Geology and Paleontology, Comenius University, Mlynská dolina - G, 842 15 Bratislava

(Doručené 28. 11. 1997)

Abstract

Middle Jurassic crinoidal limestones (Krupianka Fm.) at Hrádok locality near Hatné village display many sedimentary features which are not common in this formation. They reflect a very shallow-water depositional environment. Cross-bedding, good sorting, winnowing of micrite, abrasion of crinoidal ossicles and rip-up bottom-derived clasts document sedimentation above the wave-base. Presence of the euhedral authigenic quartz overgrowths on detrital grains may represent part of a silcrete sequence developed during temporary emergence of the shoal complex.

Key words: Middle Jurassic, Western Carpathians, Pieniny Klippen Belt, crinoidal limestones, silcretes

Introduction

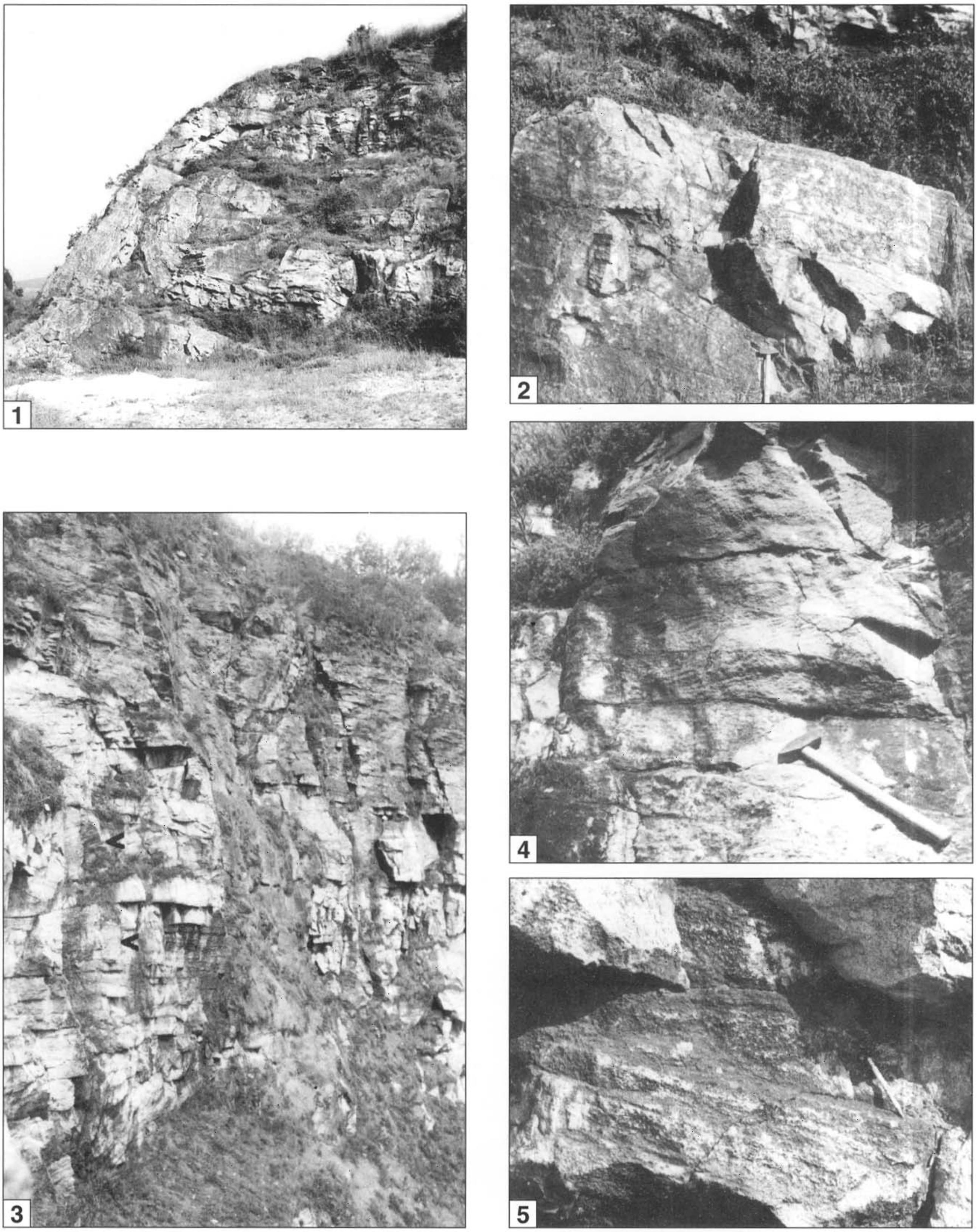
The locality Hrádok at Hatné village belongs most likely to the Czorsztyn Unit of the Pieniny Klippen Belt (with only one formation preserved). It represents the klippe of red crinoidal limestones of the Bathonian age (Krupianka Formation) transiting, in the uppermost preserved part, to the red nodular limestone (Czorsztyn Limestone). It is cut by Marikovský potok creek into two parts. The examined part of the klippe is a quarry (Pl. I, Fig. 1) occurring directly at the road connecting Udiča and Horná Mariková villages, near the cemetery of the Hatné village (Fig. 1). The locality has been mentioned by Pevný (1969) who treated in detail its brachiopod fauna. He introduced the list of following Bathonian brachiopods from this locality: *Loboidothyris perovalis* (SOW.), *Gnathorhynchia trigona* (QUENST.), *"Rhynchonella" balinensis* (SUESS) and *Aulacothyris concava* (PARONA). Later this locality was mentioned by Salaj (1994) as an occurrence of the thickest preserved red crinoidal limestone formation in his examined area.

The crinoidal limestones forming the klippe display sedimentary features which are not typical for the sediments known from the Czorsztyn Unit. Their sedimentary area appear to be shallower and more dynamic than at the other localities of this formation. That was the reason we were attracted by this locality.

Microfacial and sedimentological description of the profile

Crinoidal limestones (Smolegowa and Krupianka Formations) occupy the main portion of the quarry (Fig. 2). They are thick bedded, with frequent cross-beddings, a feature which is present in this formation very rarely. Cross-bedding in the lower part of the profile tends from left to right side of the quarry (Pl. I, Figs. 2 and 5), while in the upper parts an opposite direction appears (Pl. I, Figs. 3 and 4), with some beds containing both directions. Exact orientation measurements were not carried out in this stage of research for the preservation of cross-bedding is poor and the results would be useless without paleomagnetics (all the klippes in the Pieniny Klippen Belt were rotated along various axes). The individual beds are not always continuous; some of them wedge out as observed in the quarry wall (Pl. II, Fig. 1).

The highest part of the Krupianka Formation is represented by red bedded (with beds about 10-20 cm thick) crinoidal limestones with undulated bedding planes (Pl. II, Figs. 2 and 3). Colour of the limestones depends on their character, i.e. the cross-bedded strata are of light grey, white to yellowish colour, while the structureless or parallel-bedded ones are red. They contain rich siliciclastic and dolomitic admixture of sand to small pebble size (up to 1 cm, Pl. II, Fig. 4); some beds have intraclasts derived



Pl. I. 1 - View on the left part of the quarry near Hatné, 2 - Cross-bedding at the bottom of the quarry, oriented rightwards. Hammer for scale (centre bottom), 3 - View on the upper part of the quarry wall. Arrows indicate the beds with lefward dipping cross-bedding, 4 - Leftwards oriented cross-bedding in two beds from the upper part of the quarry, 5 - Rightwards dipping cross-bedding in the upper part of the quarry (pencil for scale).

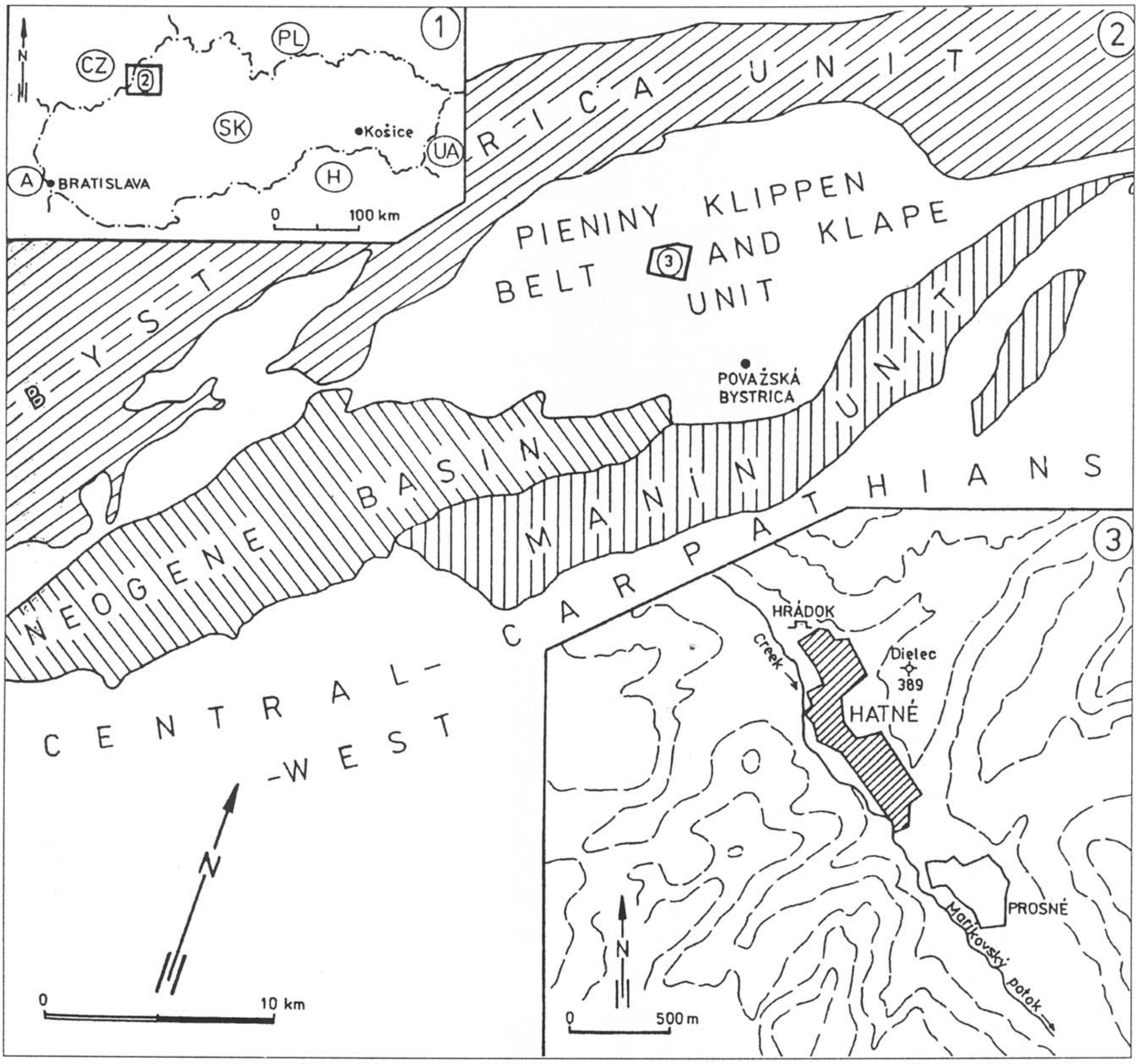


Fig.1. Position of the examined locality.

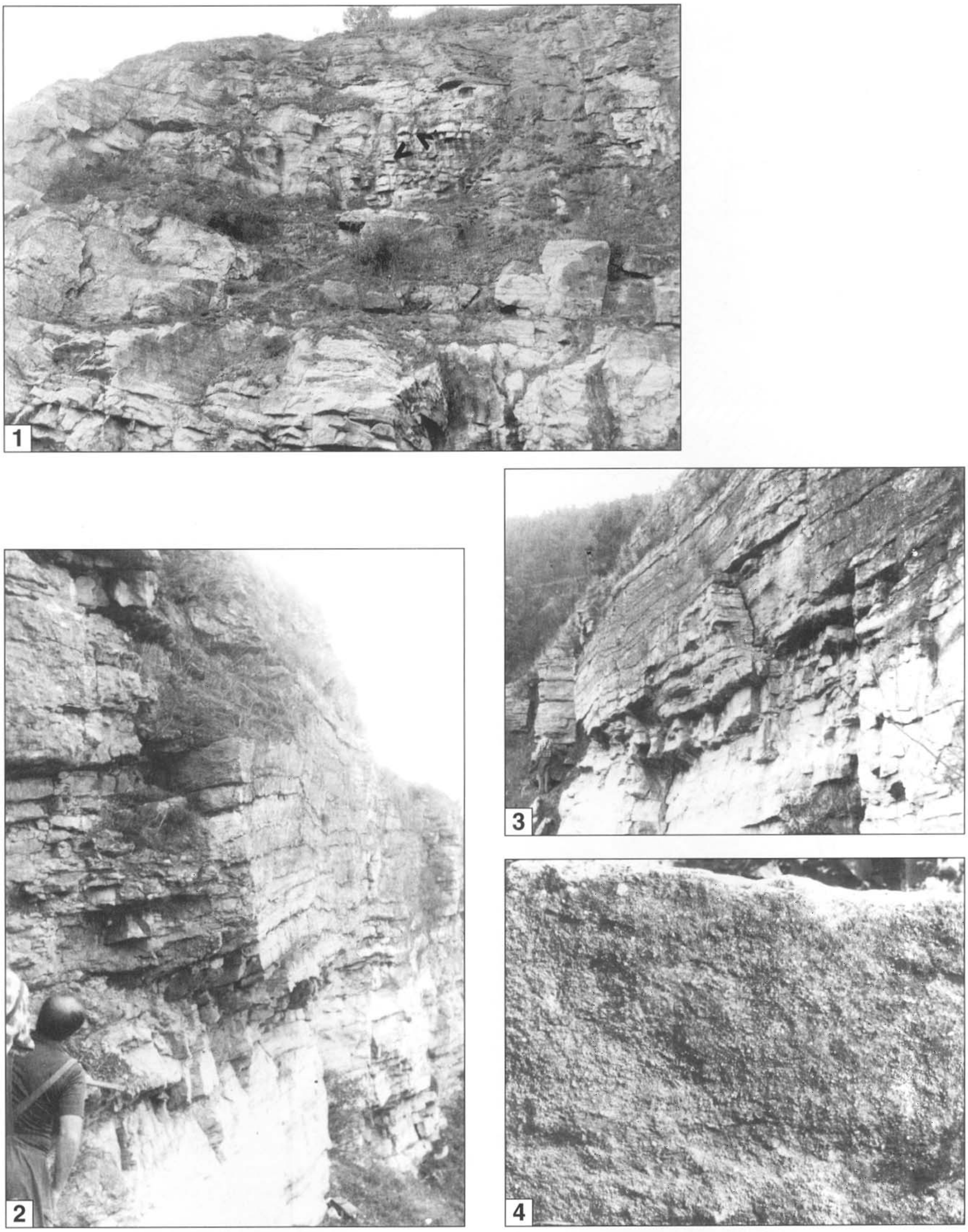
from the underlying layers, concentrated at the bottom.

In the upper left part of the quarry, a steep onlap of the white crinoidal limestone onto the red one, is observable (Pl. III, Fig. 3). The contact is stair-shaped which can be related to synsedimentary tectonics. The white crinoidal limestone contains also up to 5 cm clasts derived from the red crinoidal limestone, close to this contact.

These features reflect clearly a dynamic water environment; the sediments were most likely deposited above the wave base. The higher part of the formation displays gradual deepening of the sedimentary area and cessation of the wave activity.

Microfacial analysis displays also a large difference between the white (cross-bedded) and red (parallel-bedded) crinoidal limestones. The first one represents crinoidal biosparite (grainstone, Pl. III, Fig. 1) while the latter is biomicrite (Pl. III, Fig. 2) with more diversified skeletal composition. Already Folk (1962) and Dunham (1962) mentioned an indirect dependence between presence of micrite and dynamics of the sedimentary environment. This fact was also evident during study at the Mestečská skala locality (Aubrecht, 1992). However, the sparite formation took place not always due to micrite winnowing but also some instances of micrite replacement by syntaxial rims on crinoid ossicles were enregistered. In such cases, the micrite is enclosed in a very narrow space among the syntaxial rims which excludes later emplacement of micrite.

However, biota and clastic contents in both kinds of limestones are identical, though in somewhat different ratios (the red limestones have more diversified skeletal composition). The main portion of sediment consists of crinoid os-



Pl. II. 1 - View on the quarry wall exhibiting a wedging out of some beds (follow the convergent bedding planes indicated by arrows), 2 - Oblique view to the top part of the klippe (other side behind the quarry) formed by red bedded crinoidal limestones with undulated bedding planes, 3 - The same as Fig. 2. Opposite view (person for scale), 4 - Bedding plane of the crinoidal limestone, covered by small quartz pebbles (a grass leaf in lower left corner is about 15 cm long).

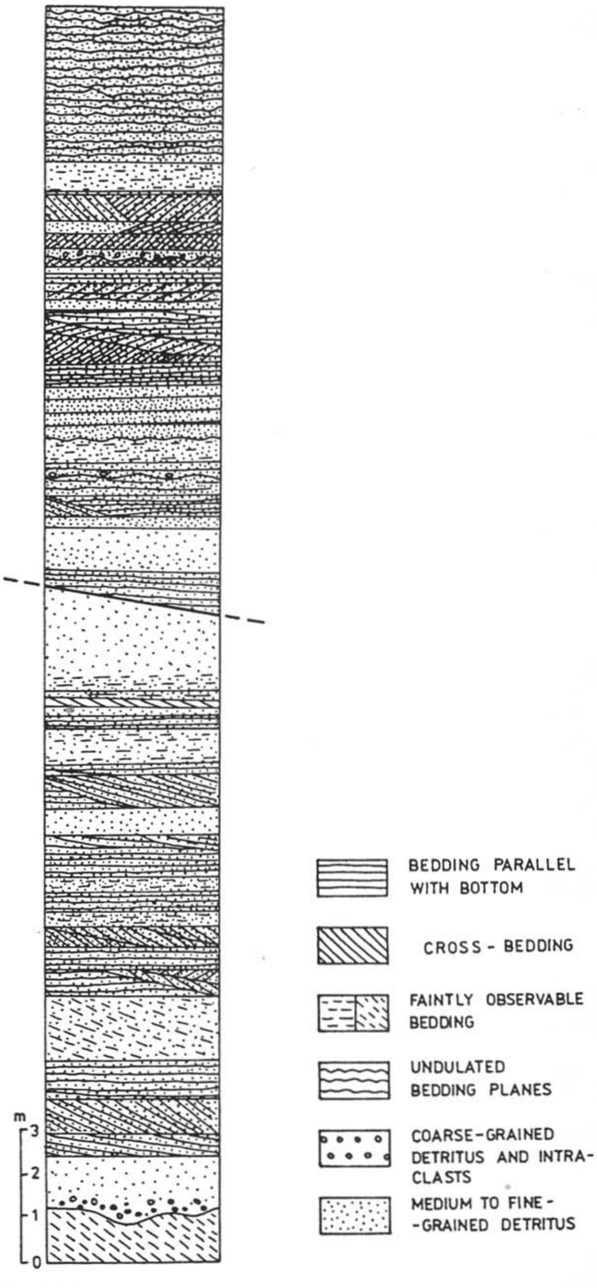


Fig. 2. Lithological and sedimentological profile through the middle part of the quarry wall.

sicles. Preservation of the crinoid skeletons is very poor; their stems were disintegrated completely (exceptionally some pluricolumnals even with attached cirri have been found), with individual ossicles frequently broken. This indicates Z4 zone of deposition of Gluchowski (1987) i.e. the near-shore shallow water environment which is consistent with other sedimentological observations. Crinoidal detritus is usually full of small inclusions (even of cloudy appearance), but the syntaxial rims are clear.

Except crinoidal ossicles, also bryozoan fragments, echinoid spines, bivalvian and brachiopod shells are ubiquitous; gastropod shells and serpulid tubes are rare. In one instance, a poorly preserved fragment of coral or calcareous sponge was found. An absence of foraminifers in the sediment is striking. The sediment was strongly affected by compaction, as indicated by frequent pressure-solution features among the skeletal detritus up to the formation of frequent stylolites. They represent the latest diagenetic stage as they cut fully developed syntaxial rims on the echinoderm particles (Pl. III, Fig. 1).

Yellowish dolomitic and/or dedolomitized clasts are frequent in the sediment. They are either micritic of crystalline. In case of dedolomitization the crystals are often oriented inward the clast, indicating the dedolomitization after redeposition. They sometimes possess Liesegang's stripes indicating their weathering on land. Around the dolomitic clasts, thin limonitic films developed frequently, related to iron expulsion during dedolomitization. The only rare faunal relics in dolomitic clasts were thin ostracod shells.

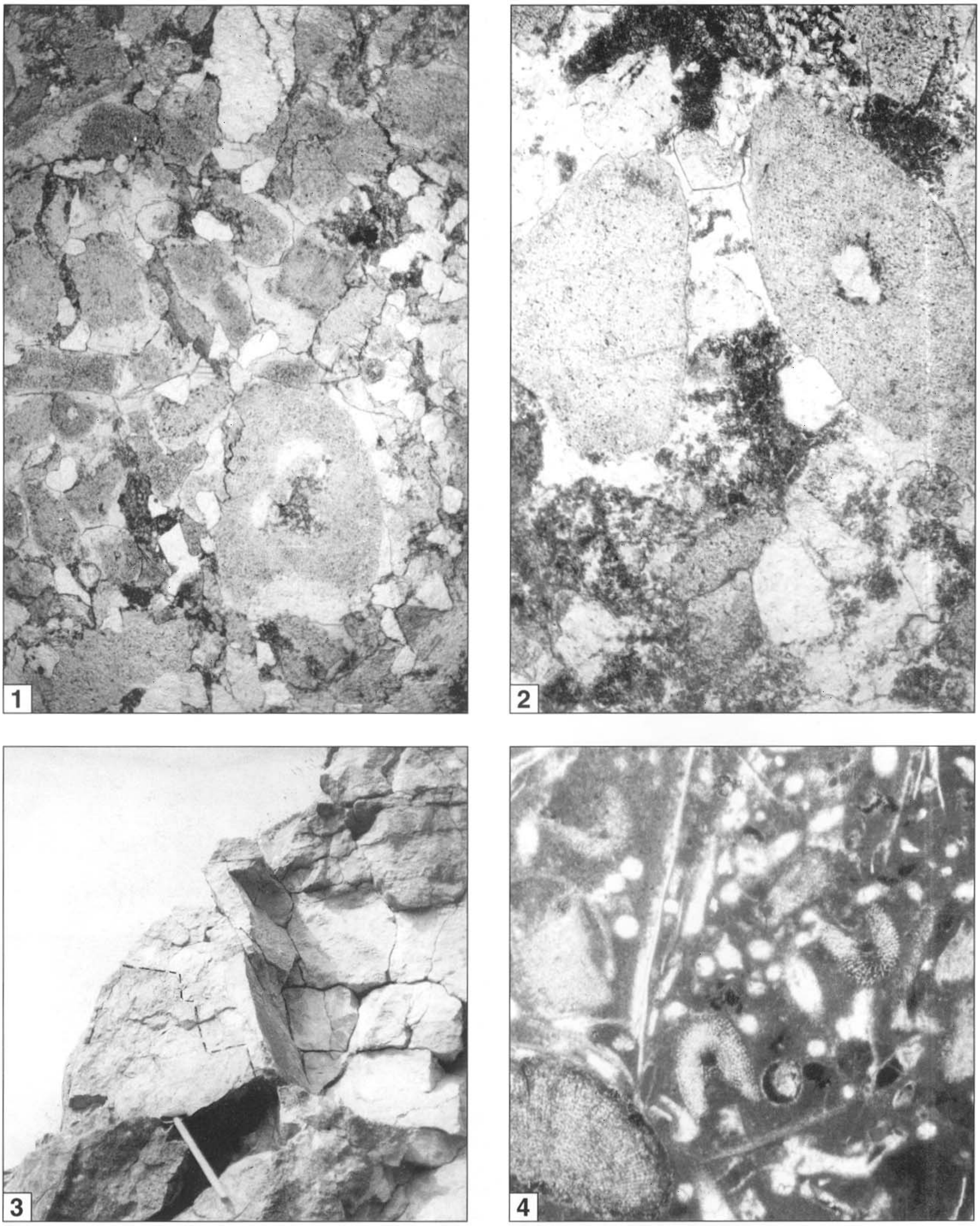
Many interesting data have been obtained about the siliciclastic admixture, hence we dedicate it a separate chapter.

Red partly nodular limestone (base of the Czorsztyn Formation) is preserved only at top of the right part of the quarry, which is relatively thrown down along a small normal fault. It is represented by wackestone to packstone (locally grainstone), with calcified sponge spicules and crinoidal ossicles being the dominant skeletal components (Pl. III, Fig. 4). Bivalve and brachiopod shells, together with gastropods, juvenile ammonoids, echinoid spines and bryozoan fragments form smaller portion of the skeletal detritus. However, the diversity of skeletal components is remarkably higher than in the underlying crinoidal shoal complex. The dominance of micrite, together with absence of the siliciclastic admixture indicate deepening of the sedimentary area and flooding of land areas of the Czorsztyn Swell. The sediment itself is penetrated by veinlets filled by clear blocky calcite. These veinlets are, however, cut by numerous stylolites, which then appear to be the latest diagenetical phenomenon in the limestone.

Siliciclastic admixture in the crinoidal limestones

Sandy admixture and small pebbles are ubiquitous at the Hatné locality. Most of sand consists of quartz grains, with rare feldspars, zircons and rutile grains recorded in thin sections (for detail analysis of heavy minerals see Aubrecht, 1993).

Most of the quartz grains possess undulatory extinction; they are frequently polycrystalline with sutured margins of the individual crystals. This led us to detail evaluation of the quartz types according to Young (1976). He distinguished 6 types of quartz deformation with approximate interpretation of the deformation conditions. They are as follows: 1. nonundulose monocrystalline quartz, 2. undulose quartz, 3. polygonized quartz, 4. elongated original quartz crystals with sutured margins, 5. polycrystalline quartz with various content of newly formed grains, 6. polygonal crystals with nonsutured boundaries. These types form a continuous deformation and recrystallization cycle with each type representing one deformation stage; the transition between the types 6 and 1 represents melting and for-



Pl. III. 1 - Sandy crinoidal biosparite with perfectly washed-out lime mud. Sample comes from a cross-bedded layer. Macroscopically it represents a white crinoidal limestone. Note the microstylolites cutting also the syntaxial rims on the crinoidal ossicles. Magn. 33x, thin-section No. 21 358, 2 - Thin section of the crinoidal limestone with imperfectly washed-out lime mud. Sample comes from a structureless to parallel-bedded layer, macroscopically representing red crinoidal limestone. Magn. 45x, thin-section No. 21 357, 3 - Steep onlap of the white crinoidal limestone onto the red crinoidal limestone in upper left part of the quarry. A stair-shaped contact indicates synsedimentary tectonic activity, 4 - Wackestone to packstone with crinoidal ossicles and calcified sponge spicules and radiolarians. Transition to the Czorsztyn Nodular Limestone. Magn. 30x, thin section No. 24 244.

ming of a new magmatic rock (Fig. 3). Similar observations have been achieved already by Blatt (1967) who distinguished detrital quartz types coming from magmatic and metamorphic rocks, according to their structure.

The ratios of individual quartz types, complemented with results from other localities of the Czorsztyn and Pruské units (Milpoš, Vršatec, Beňatina, Horné Sŕnie - - Samášky and Bolešovská dolina), were plotted to special diagrams for comparison (Fig. 4). These samples are representative for detrital quartz coming from the Czorsztyn Ridge. From six examined samples, four localities have unimodal ratio of the types, the Vršatec locality has bi-

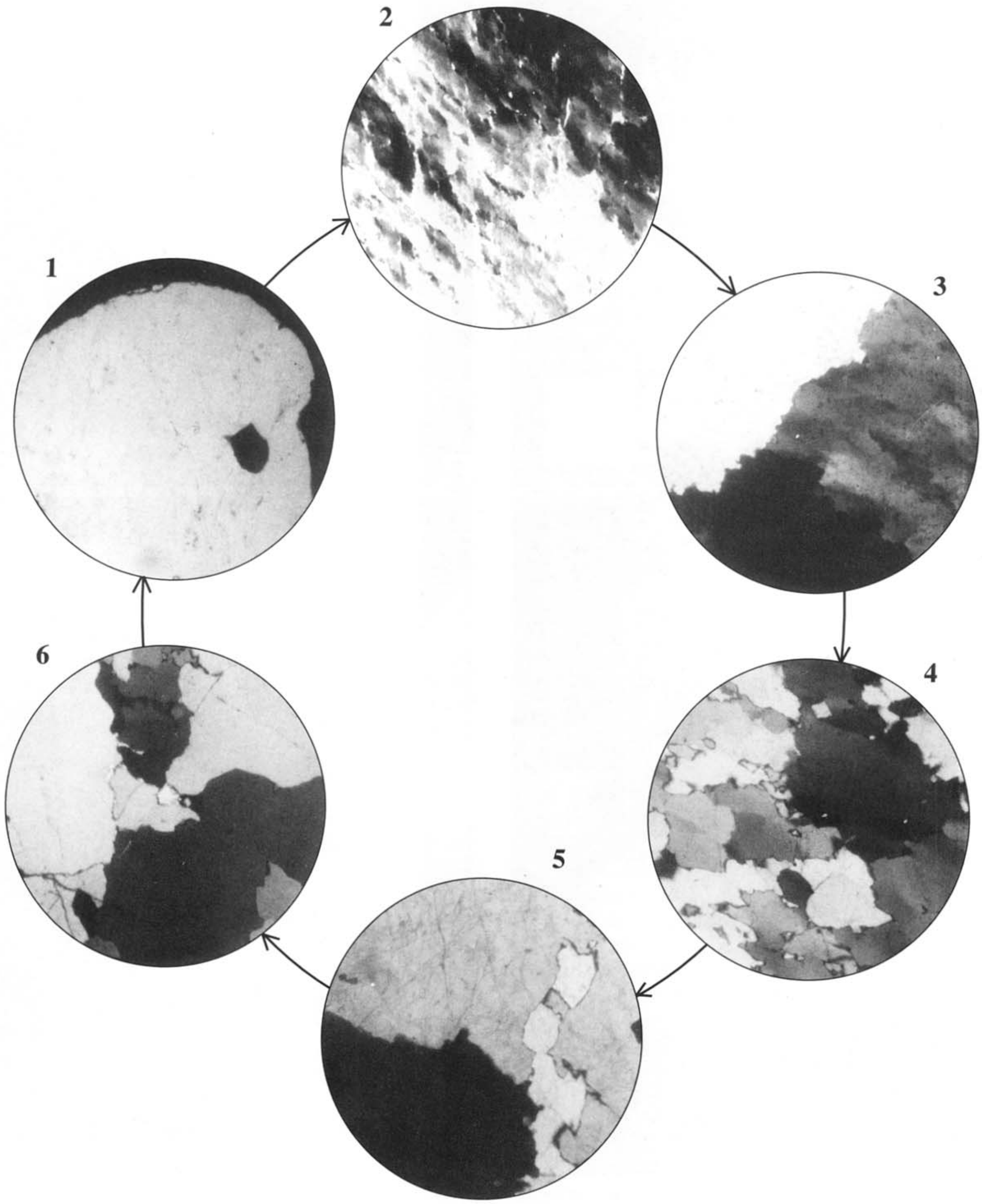
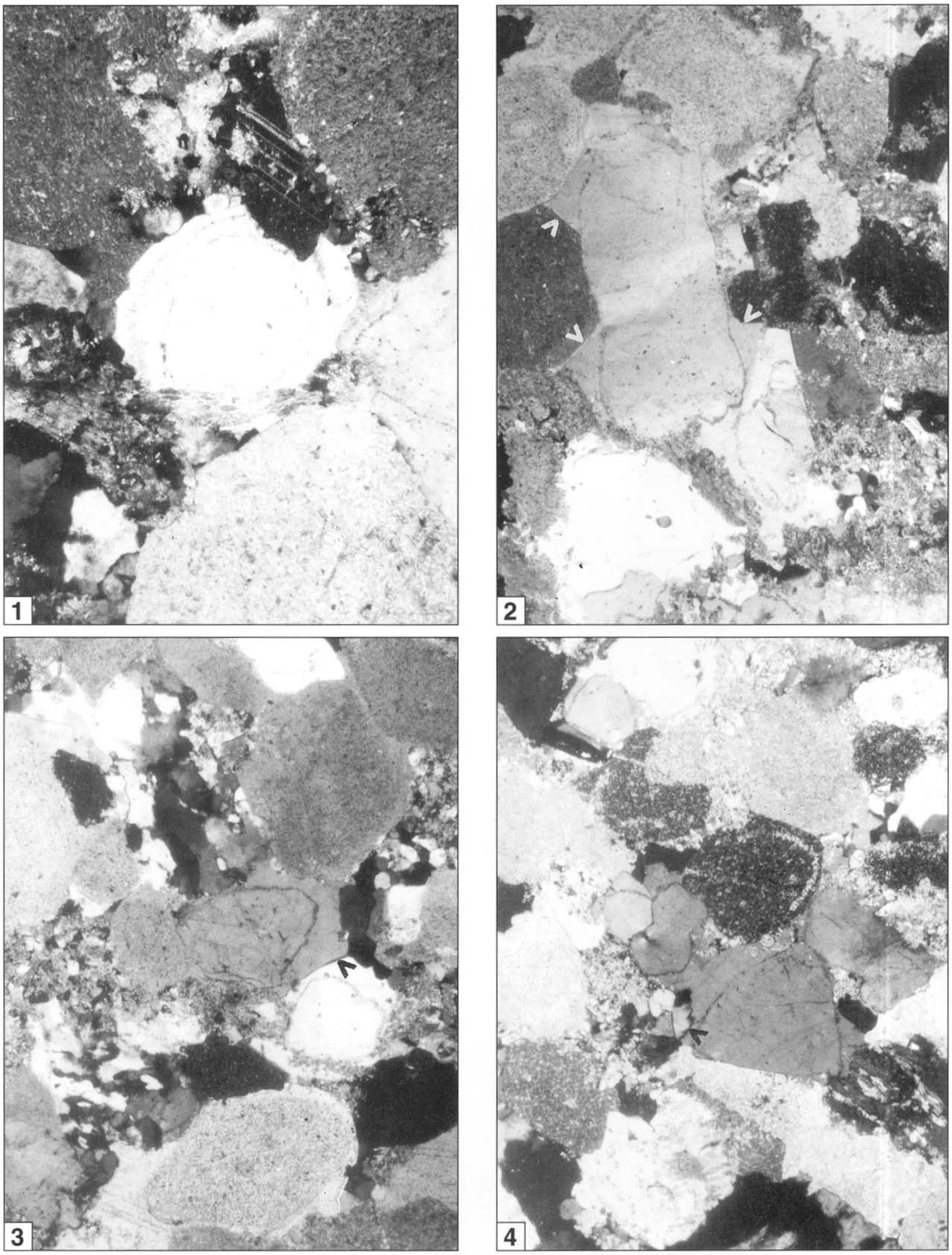


Fig. 3. Deformation and recrystallization cycle observable in quartz grains (after Young, 1976). Explanations to the individual quartz types: 1 - nonundulose monocrystalline quartz, 2 - undulose quartz, 3 - polygonized quartz, 4 - elongated original quartz crystals with sutured margins, 5 - polycrystalline quartz with various content of newly formed grains, 6 - polygonal crystals with nonsutured boundaries.



Pl. IV. 1 - Detrital quartz grain (white) in crinoidal limestone, overgrown by early syntaxial authigenous rim. Individual zones are indicated by strings of inclusions. Crossed polars (whole plate). Magn. 86x, thin section No. 21 357 (whole plate), 2 - Authigenous rim on the detrital quartz core copying the surrounding clasts (arrows), which documents its early post-depositional origin. Magn. 45x, 3 - Two close detrital quartz grains with syntaxial rims forming a compromise boundary between them (arrow). Magn. 45x, 4 - Remnant of chalcedony (arrow) within an authigenous syntaxial overgrowth. It indicates its possible origin via formation of silcrete. Magn. 45x.

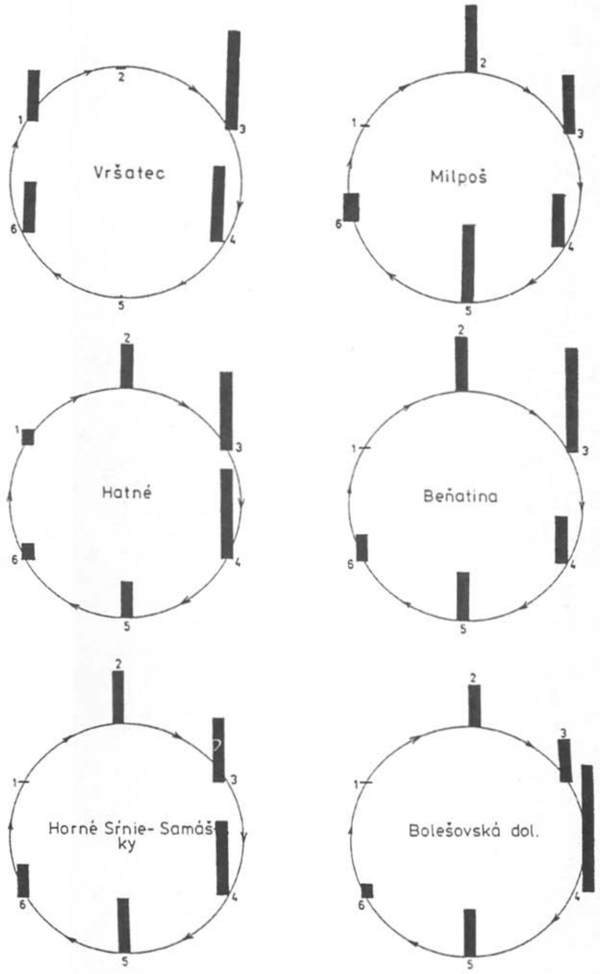


Fig. 4. Percentages (see size of the columns) of the individual types of detrital quartz (see numbers) estimated for selected localities of the Czorsztyn Unit.

modal ratio and the Milpoš locality relatively equal content of most of the types. The first four mentioned samples have their maxima at type No. 4; Beňatina locality is dominated by type No. 3. These types represent an assemblage of detritus of "unstable" quartz, strongly affected by deformation, but still without extensive formation of new crystals. It is typical for low-grade to moderately metamorphosed rocks (Young, 1976; Fig. 3). Vršatec locality also displays high content of No. 3 and 4 types of quartz and, on the other hand, a high content of No. 1 and 6 quartz types, coming most probably from nondeformed magmatic rocks.

Most of quartz grains in the carbonate sediments display signs of corrosion which are typical for alkaline environment inside limestone. However, at the very top of a bed about 4 m above the bottom of the profile (parallel bedded red crinoidal limestone), the quartz grains possess syntaxial authigenic quartz overgrowths. They cut neither the surrounding crinoidal ossicles nor their syntaxial rims. Instead, they use to copy the original shape of surrounding grains and fill the pores (Pl. IV, Figs. 1 and 2), hence they represent a relatively early diagenetic phase. These overgrowths often exhibit undulatory extinction in continuation to the detrital core. The undulosity was either caused by effect of pressure in the sediment after formation of the authigenic overgrowths (see the late compactional features mentioned before) or it originated by strict copying of the detrital crystal structure during growth. In some instances of close opposite growing of the rims, straight compromise boundaries were formed between them (Pl. IV, Fig. 3). The first variant seems more probable. In some cases, the remnants of microquartz (chalcedony) was found, connected with authigenic rim (Pl. IV, Fig. 4). It is clear that the overgrowths were not formed in late diagenetic phases under burial conditions, as indicated by their occurrence only in one bed, filling of pores and pre-dating of all the diagenetic phases including syntaxial rim formation on crinoidal detritus. Our interpretation of this phenomenon is that the overgrowths represent part of the silcrete sequence, developed during emergence of the crinoidal sand shoal. Thiry and Millot (1987) and Thiry and Milnes (1991) described silcretes from Tertiary sediments of the Paris Basin and from the Stuart Creek opal field (Australia). In some instances they mentioned vertical sequences from opal at the bottom up to quartz at the top, including authigenic rims around pre-existing detrital quartz grains. They interprete such sequences as originated by descendant percolation of fresh water in conditions of alternating dry and wet climate. The only silcretes in the Czorsztyn Unit to date were mentioned by Mišík (1996) from Lower Cretaceous limestones. Their genesis is, however, unclear for they occur within the pelagic limestones, which are free of any signs of emergence. According to our opinion they may represent groundwater silcretes related to the later Barremian-Aptian emergence of the Czorsztyn Swell.

Discussion and conclusions

Deposition of the crinoidal limestones started in the Czorsztyn sedimentary area after the relative sea-level drop during Bajocian and lasted till the Late Bathonian, when the subsequent sea-level rise took place. At most localities the crinoidal limestones are structureless, massive to thin-bedded, but cross-bedding is a feature uncommon in this formation.

The standard lithostratigraphic scheme of the Czorsztyn Unit divides the crinoidal limestones into the lower, white to grey crinoidal limestone (Smolegowa Fm.) and upper, red crinoidal limestone (Krupianka Fm.). However, this division cannot be fully applied in the western part of the Pieniny Klippen Belt, which appear to be originally shallower than the recent eastern part (Aubrecht et al., 1997). Some localities in the western part show either an alternation of both colours of limestones in one section (Aubrecht, 1992) or even an overturned order of the limestones (Mišík et al., 1994). The Hrádok locality is also ranked among such localities, exhibiting the variable colour of the limestones as well as other shallow-water features. Presence of presumed silcrete indicates also a possibillity of temporal emergence. Some direct evidences of Bajocian-Bathonian emergence in the Czorsztyn Unit have already been described by Aubrecht (1997).

Although numerous localities with very shallow-water sediments were found so far in the western part of the Pieniny Klippen Belt, the shore itself with crystalline rocks was not found so far, and apparently will not be found in the near future. The only known crystalline rocks in the Pieniny Klippen Belt occur in the pebbles, particularly in the Cretaceous conglomerates of the Klape Unit. The amount of clastics in the Czorsztyn Unit and their size is often surprisingly large (size up to 10 cm), but their souce remains hidden to direct observation. Several pebble analyses were published to shed light on the composition of the emerged Czorsztyn Ridge (Birkenmajer et al., 1960; Krawczyk and Slomka, 1987; Mišík and Aubrecht, 1994). Our investigation complemented these data by determination of prevalent detrital quartz types. The dominance of "unstable" types indicates that main portion of the source area was composed of metamorphic rock complexes.

Acknowledgements. We appreciate many helpfull comments and advises of prof. Mišík; doc. Kováč, head of our department, is also acknowledged for his full support of our investigations. Financial support was provided by grant 1/3052/96 of VEGA agency, project "Geodynamic evolution of the Western Carpathians" managed by the Geological Survey of Slovak Republic and G06 project of the Comenius University.

References

Aubrecht, R., 1992: Mestečská skala klippe and its importance for stratigraphy of Czorsztyn Unit (Biele Karpaty Mts., Western Slovakia). *Acta geol. geogr. Univ. Comen., Geol., 48, 1, 55—64.*

Aubrecht, R., 1993: Clastic admixture in Dogger crinoidal limestones of Czorsztyn Unit. *Geol. Carpath., 44, 2, 105—111.*

Aubrecht, R., 1997: Indications of the Middle Jurassic emergence in the Czorsztyn Unit (Pieniny Klippen Belt, Western Carpathians). *Geol. Carpath., 48, 2, 71—84.*

Aubrecht, R., Mišík, M. & Sýkora, M., 1997: Jurassic synrift sedimentation on the Czorsztyn Swell of the Pieniny Klippen Belt in Western Slovakia. *ALEWECA symp. - Sept. 1997, Introduct. articles to the excursion, Bratislava, 53—64.*

Birkenmajer, K., Gasiorowski, S. M. & Wieser, T., 1960: Fragments of exotic rocks in the pelagic deposits of the Bathonian of the Niedzica Series (Pieniny Klippen Belt, Carpathians). *Rocz. Pol. Tow. geol. (Kaków), 30, 1, 29—57.*

Blatt, H., 1967: Original characteristics of clastic quartz grains. *J. Sed. Petrology (Tulsa), 37, 401—424.*

Dunham, R. J., 1962: Classification of carbonate rocks according to depositional texture. *In: Ham, W. E. (Ed.): Classification of Carbonate Rocks. Amer. Assoc. Petrol. Geologists, Bull., 43, 38.*

Folk, R. L., 1962: Spectral subdivision of limestone types. *In: Ham, W. E. (Ed.): Classification of Carbonate Rocks. Amer. Assoc. Petrol. Geologists, Mem., 1, 62—84.*

Gluchowski, E., 1987: Jurassic and Early Cretaceous Articulate Crinoidea from the Pieniny Klippen Belt and the Tatra Mts., Poland. *Stud. geol. pol. (Warszawa), 94, 102.*

Krawczyk, A. J. & Slomka, T., 1987: Exotic rocks from the Szlachtowa Formation (Jurassic flysch) of the Pieniny Klippen Belt, Carpathians. *Stud. geol. pol. (Warszawa), 92, 7, 69—74.*

Mišík, M., 1996: Silica spherulites and fossil silcretes in carbonate rocks of the Western Carpathians. *Geol. Carpath., 47, 2, 91—105.*

Mišík, M. & Aubrecht, R., 1994: Source of rock fragments in the Jurassic crinoidal limestones of the Pieninicum (Klippen Belt, Western Carpathians). *Geol. Carpath., 45, 3, 159—170.*

Mišík, M., Siblík, M., Sýkora, M. & Aubrecht, R., 1994: Jurassic brachiopods and sedimentological study of the Babiná klippe near Bohunice (Czorsztyn Unit, Pieniny Klippen Belt). *Mineralia Slov., 26, 4, 255—266.*

Pevný, J., 1969: Middle Jurassic brachiopods in the Klippen Belt of the central Váh Valley. *Geol. Práce, Spr., 50, 133—160.*

Salaj, J., 1994: Geológia stredného Považia. Bradlové a pribradlové pásmo so súľovským paleogénom a mezozoikom severnej časti Strážovských vrchov. 1. časť. *Zem. Plyn Nafta, 39, 3, 195—291.*

Thiry, M. & Millot, G., 1987: Mineralogical forms of silica and their sequence of formation in silcretes. *J. Sed. Petrology, 57, 2, 343—352.*

Thiry, M. & Milnes, A., 1991: Pedogenic and groundwater silcretes at Stuart Creek opal field, South Australia. *J. Sed. Petrology, 61, 1, 111—127.*

Young, S., 1976: Petrographic textures of detrital polycrystalline quartz as an aid to interpreting crystalline source rocks. *J. Sed. Petrology, 46, 3, 595—603.*

Strednojurský príbrežný komplex krinoidových vápencov na lokalite Hatné - Hrádok (Czorsztynská jednotka, Pieninské bradlové pásmo, západné Slovensko)

Lokalita Hrádok pri obci Hatné (neďaleko miestneho cintorína) predstavuje lom v krinoidovom vápenci dogeru czorsztynskej jednotky (krupiansky vápenec), ktorý v stratigraficky najvyššej úrovni prechádza do czorsztynského hľuznatého vápenca.

Krinoidový vápenec má sedimentárne črty, ktoré sa v tomto súvrství vyskytujú len zriedka a poukazujú na extrémne plytkovodné prostredie sedimentácie v oblasti piesočných plytčín. Telesá vápenca sú lavicovité, často so šikmým a niekedy s krížovým zvrstvením. Ani jednotlivé vrstvy nie sú priebežné, ale vyznievajú laterálne. Až vrchnejšiu časť súvrstvia tvoria telesá doskovitého krinoidového vápenca so zvlnenými plochami vrstvovitosti, čo poukazuje na postupné prehlbovanie sedimentačnej oblasti. Farba vápenca závisí od jeho charakteru. Šikmo zvrstvené polohy majú svetlosivú až žltkastú farbu, kým bezštruktúrne alebo paralelne zrvstvený vápenec je červený. Súvisí to s vymytím červeného vápnitého kalu počas sedimentácie v dynamickom vodnom prostredí. Veľmi plytkovodné prostredie odráža aj zachovanie krinoidových článkov. Väčšinu článkov rozbilo vlnenie, čo podľa Gluchowského (1987) predstavuje sedimentačnú zónu Z4.

Telesá červeného hľuznatého vápenca (czorsztynského) sa zachovali len v pravej najvrchnejšej časti lomu, kde sú vrstvy poklesnuté pozdĺž malého zlomu, a telesá vápenca odrážajú prehlbovanie sedimentačnej oblasti. Prevláda v nich mikritická zložka, chýba piesčitá prímes a skeletové úlomky sa vyznačujú väčšou rôznorodosťou ako pri extrémne plytkovodnom podložnom krinoidovom vápenci.

Zvýšenú pozornosť sme venovali klastickej prímesi kremeňa, ktorá je v krinoidovom vápenci hojná v podobe piesku alebo drobných obliakov. Zhodnotili sme zastúpenie jednotlivých typov kremeňa, ako ich definoval Young (1976), ktorý rozlišuje šesť typov deformácie kremeňa. Podľa nich možno usúdiť, akým podmienkam bol kremeň vystavený, a potom približne určiť okruh, z ktorého zdrojová hornina pochádza. Sú to tieto typy: 1. neundulózny monokryštalický kremeň, 2. undulózny kremeň, 3. polygonizovaný kremeň, 4. predĺžené kremenné zrná so sutúrovými okrajmi, 5. polykryštalický kremeň s rozličným množstvom novotvoreného kremeňa, 6. Polygonálny kremeň tvorený mozaikou novotvorených kryštálov s nesutúrovými okrajmi. Tieto typy kremeňa tvoria jeden deformačný a rekryštalizačný cyklus, z ktorého každý typ predstavuje jedno štádium. Výsledky z lokality Hatné sme porovnali s niekoľkými inými lokalitami czorsztynskej a pruskej jednotky (Milpoš, Vršatec, Beňatina, Horné Srnie - Samášky a Bolešovská dolina). Z výsledkov vyplýva, že väčšina lokalít má unimodálne usporiadanie typov kremeňa s maximom na type 4 a 3. Tie predstavujú polykryštalický silne deformovaný kremeň pochádzajúci pravdepodobne z metamorfovaných hornín. Len lokalita Vršatec mala bimodálne usporiadanie s vyšším obsahom aj monokryštalického kremeňa pochádzajúceho z neporušených magmatických hornín. Na lokalite Milpoš boli všetky typy kremeňa zastúpené pomerne rovnomerne, čo odráža aj jej celkové pestré zloženie obliakov.

V jednej vrstve sme zaznamenali dorastanie autigénneho kremeňa na klastické jadrá. Keďže tieto novotvorené obruby „kopírujú" okolitý detritus a vypĺňajú dutiny, museli sa vytvoriť ešte počas skorej diagenézy. V ostatných vrstvách sme zaznamenali len koróziu klastických jadier, a preto autigénne obruby zrejme nevznikli, ako výsledok tepelného postihu pri hlbšej úrovni pochovania sedimentu. Tento fenomén interpretujeme ako časť silkrétového horizontu vytvoreného pri dočasnom vynorení sa plytčiny. Tento názor podporujú aj lokálne nájdené zvyšky chalcedónu až mikrokryštalického kremeňa späté s autigénnymi obrubami.