

Hauterivian turbidites in the Kysuca Unit (Pieniny Klippen Belt, West Carpathians)

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Abstract

Hauterivian turbiditic sequence was found within the Pieniny Limestone Formation in a small klippe near Istebné (Orava). Slumping structures, grade bedded coarse-grained turbidites, matrix supported pebble-mudstones and olistoliths were recognized. The clasts in the turbidites are of local origin; they are composed of Oxfordian radiolarites (Czajakowa Formation), Lower Tithonian white nodular limestone (new formation - Revišné Limestone) and Tithonian - Valanginian calpionellid limestones of biancone facies. The resedimentation was probably induced by the local fault tectonic.

Key words: Lower Cretaceous, Hauterivian, turbidites, Pieniny Klippen Belt

Introduction

So far unknown development of the Kysuca Unit was found 200 m E of the cemetery of Istebné village in Orava territory (Fig. 1). It is represented by a small klippe in tectonically overturned position, largely disturbed by the exploitation (Pl. I, Fig. 1).

Following succession can be observed in the klippe: 1. block of greenish radiolarites - Oxfordian, 2. remnants of white nodular limestone with the greenish clay intercalations - proposed new term Revišné Limestone - Lower Tithonian, 3. white calpionellid limestones preserved only as the clasts in turbiditic layers - Tithonian to Valanginian, 4. turbidites and slumping structures - Hauterivian, 5. Grey marlstones - Uppermost Hauterivian to Barremian. First two mentioned formations were preserved only as the remnants after exploitation and their position in the profile is unclear. As they lack mutual stratigraphical transitions, and their smaller clasts occur also in the Hauterivian turbidites, they probably themselves represent the olistoliths in the above mentioned turbidite sequence.

Detailed description of the sequence

Greenish to white radiolarites (Podmajerz Member) - occur as a small block in the top of the quarry - probably olistolith, (Pl. I, Fig. 2) and as the small clasts (up to 3 cm) in the Hauterivian turbidites (Pl. I, Fig. 3). They rarely contain veinlets filled by the red radiolarite mud and frequent calcitic veinlets. On the bed surface some peculiar tumors of unknown origin occur. They may be related to the activity of the worms, since their traces were preserved on some of them (Pl. I, Fig. 5 -

arrow). However they can represent also the product of silicification (the chert-forming process) since also the matrix is affected by silicification in these parts. In the rest of the rock only the radiolarians are filled by chalcedony. The preservation of the radiolarians observable in the thin-sections is variable, depending on the intensity of calcification. In some parts they are filled by chalcedony exhibiting no influence of the calcite veinlets crossing nearby. In other parts they are completely calcified. Following radiolarian fauna has been extracted by dissolving in the hydrofluoric acid: *Emiluvia sedecimporata* (Wisniowski), *Podobursa spinosa* (Ožvoldová), *Triactoma jonesi* (Pessagno), *Mirifusus* aff. *dianae* (Karrer), *Tritrabs* sp., *Emiluvia pessagno* Foreman and *Emiluvia oreia* Baumgartner (determined by Ožvoldová). The last species indicates UA 7-8 zone of Oxfordian.

Saccocoma limestones (Kimmeridgian) - preserved only as the small clasts in the Hauterivian turbidites.

White to light grey nodular limestone (Revišné Limestone - new name) - occurs as an isolated block, the remnant after excavation, and also as the clasts in the Hauterivian turbidites. The limestone has biancone-like appearance but with nodular bedding surface intercalated by very thin (several mm) greenish unlitified clay layers. Indeterminable dissolved casts of ammonoids together with aptychi are frequent in this limestone. Biomicrite-wackestone containing "Cadosina" microfacies with *Parastomiosphaera malmica* (Borza), *Colomisphaera pulula* (Borza), *Colomisphaera minutissima* (Colom), *Cadosina parvula* Nagy and seldom saccocomas, indicating Lower Tithonian age (Borza, 1984), are typical for this limestone (Pl. I, Fig. 4). Less frequent aptychi, detritus from bivalvian shells and radiolarian ghosts are ob-

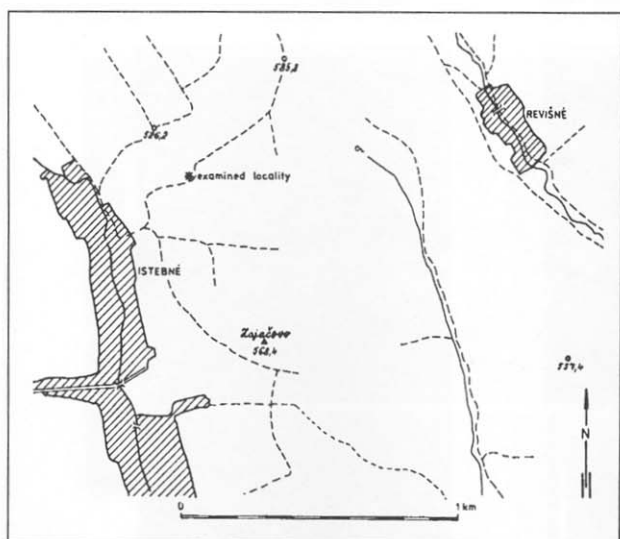


Fig. 1. The position of examined locality.

servable. No calpionellids have been found, which testifies its Lower Tithonian age. A foraminiferal fauna containing mainly *Ammodiscus* sp. and several other so far indetermined foraminifers together with rare *Saccocoma* particles have been extracted from the greenish clay intercalations. As this limestone was not described neither by Birkenmajer (1977) nor by later authors, it can be considered as the new limestone member. Unfortunately it was impossible to determine its original thickness in the examined locality due to the exploitation.

White calpionellid limestone - occur only as the clasts in the turbiditic breccia. They represent micrites with *Crassicollaria intermedia* (Durand Delga) and *Calpionella alpina* Lorenz, sometimes only with the latter species. They indicate Upper Tithonian and Beriasian age. One clast with *Chitinoidea* sp., indicating Middle Tithonian, has been found.

Turbiditic formation with slumping structures - forming the main part of the klippe.

In the upper part a matrix-supported breccia (pebble mudstone) occurs (Pl. I, Fig. 6). The clasts are subangular to rounded but no traces of boring organisms have been enregistered. The majority of the clasts are represented by radiolarites and rare calpionellid limestones with *Calpionella alpina* Lorenz. The matrix is formed by the marly micrite composed of *Nannoconus* sp., frequently disturbed by the bioturbation (Pl. I, Fig. 6). Aptychi (*Lamellaptychus* and *Laevaptychus*), thin-shelled ostracods and foraminifers (*Lenticulina* sp., agglutinated foraminifers and planispiral indetermined ones) are comprised in the matrix. The mass occurrence of *Nannoconus* sp. and the absence of the calpionellids indicates Hauterivian age (Borza, 1984).

The grade-bedded coarse-grained turbidites (Pl. II, Fig. 1) occur in the middle part of the klippe. The clasts are formed by the rocks of above mentioned formations i.e. the locally-derived material without any siliciclastic or exotic detritus. The clasts in the lower parts of the

graded layers are often packed without any matrix between (Pl. II, Fig. 6). An extensive silicification related with forming of dark-grey chert nodules took place during the early diagenesis. This process was coeval with the slump movements as indicated by the deformation of the elongated chert nodules (Pl. II, Fig. 4). Radiolarian fauna has been extracted from some of these cherts: *Alievium helenae* Schaff (Valanginian to Barremian), *Acanthocircus trizonalis* (Rust), *Acaeniotyle diaphorogona* Foreman and *A. umbilicata* (Rust). The clasts were also sometimes selectively affected by the silicification (Pl. II, Fig. 3). The clasts of micritic calpionellid limestones appear to be the most resistant ones with respect to the silicification.

The autochthonous thin marly parts (Pl. II, Fig. 1 - bottom) contain only *Nannoconus* sp. (Pl. II, Fig. 2) which indicates also Hauterivian age.

If compared with the work of Schlager and Schlager (1973), the combination of slumping structures, mud-flow-breccias and graded turbidites as well as the size of the detritus (up to 4 cm) indicates that the sediment was deposited most probably not more than 1 km from the source, on the slope with more than 10° dip angle.

Dark-grey shaly marlstones - occur in the bottom of the left part of the klippe. They represent stratigraphically the youngest member of the described sequence. *Nannoconus* sp. together with tiny *Hedbergella* sp. indicate the Uppermost Hauterivian - Lower Barremian age (Koňhora Formation sensu Andusov and Samuel, 1973). In this part no resedimentation features have been observed.

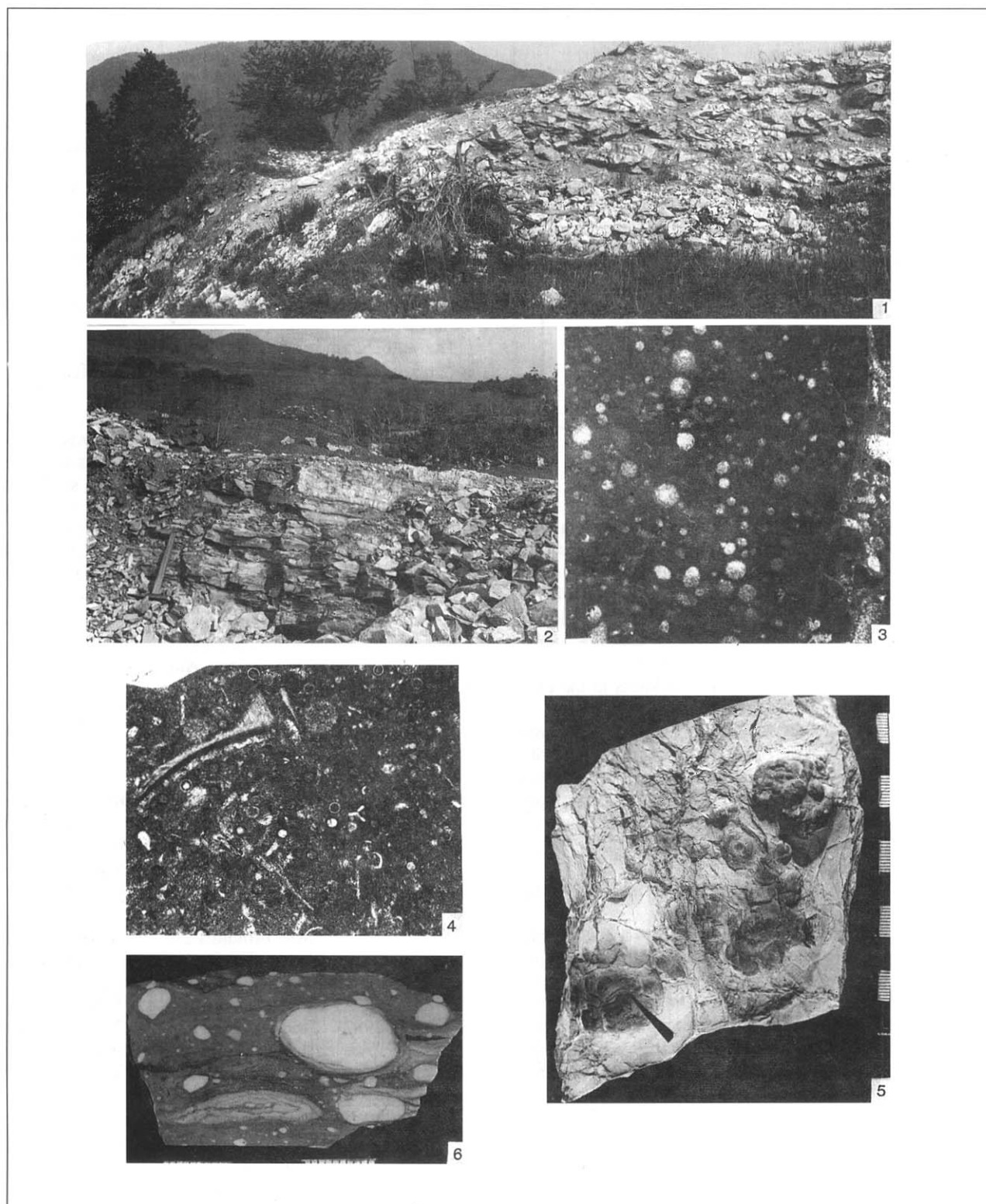
Discussion and conclusions

The described sequence belongs most probably to the Kysuca Unit (Branisko Unit sensu Birkenmajer, 1953). However the signs of resedimentation of the Hauterivian age are exceptional; Pieniny Limestone Formation (white micritic bedded limestone with cherts) is typical for this stratigraphical level (Birkenmajer, 1977).

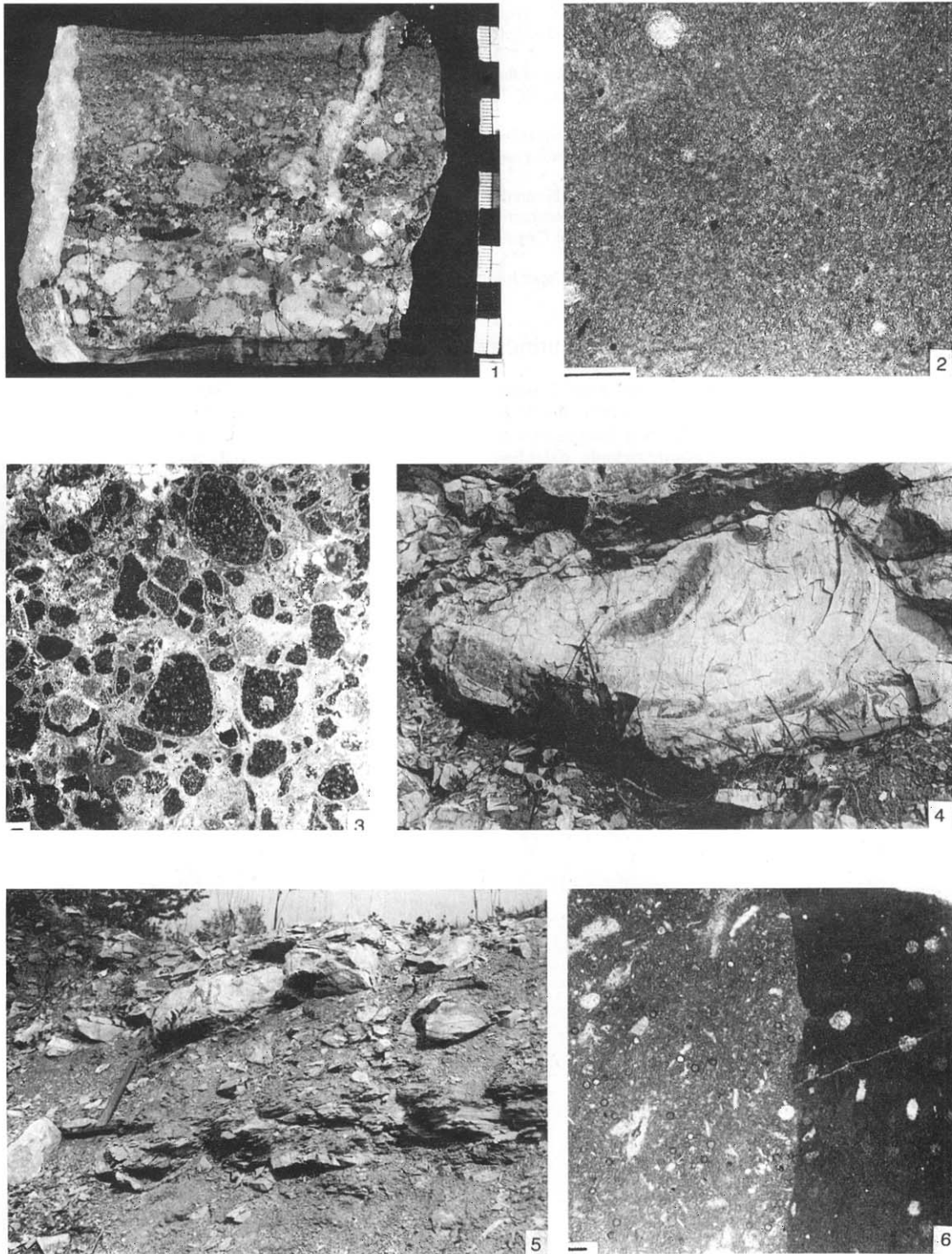
The upper mentioned turbidites are coeval with some resedimentation events known from the Alps or Central Western Carpathians - i.e. Rossfeld Formation (Faupl and Tollmann, 1979) and its equivalents (Lefeld, 1974; Jablonský, 1992), Strážovce Formation (Borza et al., 1980) etc. However the processes which initiated the resedimentation in these paleogeographically different formations were not identical.

The resedimentation in the examined locality was induced by the local restricted faulting which uncovered the underlying formations not deeper than Oxfordian. This process could be related with that one which caused the later Barremian - Aptian facial differentiation in the Kysuca sedimentary area and the originating of its special development - Nižná Subunit (Scheibner, 1967, p.139).

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Pl. I. 1 - View on the small klippe near Istebné (examined locality). Hammer at the left for the scale, 2 - Block of greenish radiolarite (Oxfordian) in the upper part of the klippe - the remnant after exploitation (probably olistolith in the Hauterivian turbidites), 3 - Radiolarian microfossils in the radiolarite clast from the Hauterivian breccia. The scale bar represents 100 μm , 4 - *Parastomiosphaera malmica* (Borza), *Colomisphaera pulla* (Borza), *Cadosina parvula* Nagy and particles of *Saccocoma* sp. in the Revišné Limestone (new name). The scale bar represents 100 μm , 5 - Tumors of unknown origin on the surface of radiolarite bed. Trace of worm activity is visible (arrow), 6 - Cross-section of the matrix-supported breccia with almost rounded clasts (upper left part of the klippe). The signs of bioturbation are evident. Most of the clasts are from radiolarites, the main component of the matrix is *Nannoconus* sp. (Hauterivian).



Pl. II. 1 - Cross-section of the grade-bedded coarse-grained turbiditic layer. The autochthonous thin pelagic layer is visible at the bottom (Hauterivian), 2 - *Nannoconus* sp. - the main component of the autochthonous pelagic layers between the turbidites (see Fig. 1). Scale bar represents 100 μ m, 3 - Selectively silicified clasts in the turbidite layer (crossed polars). Scale bar represents 100 μ m, 4 - Chert nodules deformed by the slumping (in the overturned position). About 10 cm long pocket-knife (right) as a scale, 5 - The contact of the Hauterivian turbiditic sequence with the Koňhora Formation - dark-grey shales (Uppermost Hauterivian - Barremian). All in overturned position, 6 - The direct contact between the clast containing *Cadosina parvula* Nagy with radiolarite clast in the coarse-grained turbidite layer. The scale-bar represents 100 μ m.

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Heterivské turbidity v kysuckej jednotke

Nedaleko obce Istebné (za miestnym cintorínom) bolo objavené malé bradlo s netypickým vývojom kysuckej jednotky. Bradlo je v prevrátenej pozícii a je značne rozrušené ťažbou. Jeho najstaršou zachovanou súčasťou sú zelenkasté radiolarity oxfordu, ďalej novovýčlenený revišniarsky vápenec - biely hľuznatý vápenec s vrstvičkami zelenkastého ílu obsahujúci kadosínovú mikrofaciu (spodný titón). Ďalšie členy, ako je sakokomový vápenec kimeridžu a kalpionelové vápence vrchného titónu až beriasu, sa zachovali len v podobe klastov v hrubozrnných heterivských turbiditoch, ktoré tvoria väčšiu časť bradla. Keďže sa z prvých dvoch spomenutých súvrství zachovali len zvyšky, ich pozícia svedčí o tom, že pravdepodobne ide o olistolity. Tento názor je podporený aj častým výskytom menších klastov týchto hornín v heterivských turbiditoch.

Stopy resedimentácie v heterive sú v pienidných jednotkách skôr výnimkou, najmä, keď ide najpravdepodobnejšie o kysuckú jednotku (resp. jej sedimentačnú oblasť). Resedimentácia sa pre-

javuje prítomnosťou brekcií až zlepcov s podpornou štruktúrou matrixu, ako aj gradačne zvrstvenými polohami turbiditov a sklzovými deformáciami pozorovateľnými na predĺžených rohových konkréciách. Autochtónne pelagické časti sedimentu obsahujú len nanokóny bez kalpionelíd alebo hedbergel, čo nám umožňuje začleniť súvrstvie do heterivu. Nad ním v stratigrafickej superpozícii sú sivé slienité bridlice bez alodapických vložiek obsahujúce drobné hedbergely, ktoré poukazujú na najvyšší heteriv až barém (koňhorské vrstvy).

Keďže uvedené súvrstvie turbiditov obsahuje lokálny materiál derivovaný len zo spomenutých súvrství, je pravdepodobné, že ide o resedimentáciu spätú s lokálnou zlomovou tektonikou. Jej pravdepodobným neskorším výsledkom mohla byť aj diferenciácia sedimentačného priestoru kysuckej jednotky počas barému - aptu a vznik jej osobitného vývoja - nižnanskej jednotky s plytkovodnou sedimentáciou.