

Nižná Unit of the Pieniny Klippen Belt – new view on its stratigraphy and paleogeographic position.

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Introduction

Nižná Unit was distinguished by SCHEIBNER (1967) as a particular development of the Kysuca Unit that is different by its relatively shallow-water development of the Barenian-Aptian sequence. The Jurassic/Lower Cretaceous development of both units is approximately the same, consisting of Callovian-Oxfordian radiolrites (Czajakowa Formation), Kimmeridgian red nodular to pseudonodular limestones (Czorsztyn Limestone Formation) and Tithonian-Lower Cretaceous white Calpionella limestones with cherts (Pieniny Limestone Formation). Higher up, instead of dark grey to black foraminiferal marls of Koňhora Formation which are typical for the Kysuca Unit, organodetritic limestones are present in the Nižná Unit, that were named Nižná Limestone SCHEIBNER (1967). These Urgonian-like limestones were originally mapped as Middle Jurassic crinoidal limestones (ANDRUSOV, 1931). The limestone is mostly of allodapic origin, with detritus coming from a shallow-water platform. The further lithostratigraphic concept presented by SCHEIBNER (1967) supposed that the Nižná Limestone is directly overlain by exotic flysch that, as he supposed, was of Albian-Cenomanian age, later followed by higher Cenomanian-Senonian marly sedimentation.

Examined sites

Klippen of the Nižná Unit are located in a stripe between Tvrdosín (local part Medvedzie) and Dlhá nad Oravou. All the relevant profiles of the Nižná Unit were re-examined. They include the profiles mentioned by SCHEIBNER (1967) – Medvedzie (N 49°19'50.6", E 19°32'24.0"), Krásna Hôrka (N 49°19'40.8", E 19°32'11.9"), Zemianska Dedina (2 profiles: N 49°19'31.0", E 19°31'56.7" and N 49°19'31.6", E 19°31'59.8"), Ostražica (N 49°18'57.4", E 19°31'20.4"), then profile found by MIŠÍK (1990) – Ostrý vrch (N 49°16.521', E 19°26.455') and Vysoký Grúň (N 49°17'17.9", E 19°27'41.4"), known before from unpublished reports. One new profile, but of key importance, was found near Dlhá nad Oravou (N 49°16'10.6", E 19°26'12.3"). It is so far the southernmost profile of the Nižná Unit in Orava territory.

Results

Contact between the Nižná Limestone and underlying beds.

All the profiles show strong reduction of the Upper Jurassic-Lower Cretaceous strata, underlying the Nižná Limestone. Where preserved (Medvedzie, Krásna Hôrka, Zemianska Dedina, Vysoký Grúň), the white Calpionella Limestone is relatively thin (not more than 5 m). Calpionellid zones in the uppermost beds of this limestone never showed age younger than Berriasian. At other sites, the Nižná Limestone is in direct contact with radiolarites of the Czajakowa Formation. At first sight, this contact seemed to be tectonic but in most outcrops the strata of both formations lay conformably on each other. There was still a possibility that the radiolarites are of Cretaceous age, i.e. younger than the Nižná Limestone (see below). However, this was excluded by Oxfordian radiolarian fauna extracted from the radiolarites. The new outcrop found near Dlhá nad Oravou shed more light on this problem. The locality represents a klippe in an overturned position. It shows about 15 m profile of a breccia resting directly on Jurassic radiolarites. The breccia consists of chaotically arranged clasts and larger blocks (up to 40 cm in diameter) of radiolarite, red limestones, white Calpionella limestones and their black cherts. The cherts are always free; no clast of the limestone with chert inside was found. The clasts are mostly angular to subangular; rounded pebbles are rare. Matrix of the breccia is the same as the Nižná Limestone (organic detritus of bivalves, coralline algae, bentic and rarely planktonic foraminifers, rare rudists). After more thorough examination of the previous sections, such breccia was also revealed at Krásna Hôrka and at both profiles near Zemianska Dedina. Apart from Dlhá nad Oravou, where the breccia is thickest (about 10 m), in other profiles it does not reach more than 5 m. Where present, it always forms the base of the Nižná Limestone. In the literature, such breccia was only mentioned by SCHEIBNER (1967) from the second of the profiles near the Zemianska Dedina. However, the thickness of the breccia estimated by him was restricted only to 1 m on the base, where nice resedimented cherts are concentrated. In fact, the breccia is about 4 m thick there, but the clasts in higher strata are formed by less pronounced Calpionella Limestone and, therefore, remained unrecognized. We have met the same problem during our first field season, when much of the breccia sections remained unrecognized. Other example from literature may be found in MIŠÍK (1990, p. 40-42) who described very similar breccia but outside of the Orava territory – near Krivoklát in middle part of the Váh Valley. It is highly probable that this occurrence also belongs to the Nižná Unit. Although distant, such phenomena, typical for Orava sector of the Pieniny Klippen Belt, are locally found in the Váh Valley (SCHLÖGL, 1998, SCHLÖGL et al., 2000). For the newly discovered breccia, we propose the name Tvrdošín Breccia Member as a member of the Nižná Limestone Formation.

The presence of breccia shows that the pre-Barremian strata in the Nižná Unit were eroded to relatively deep levels. As to the character of this erosion, a submarine erosion may be excluded. Only emergence may produce such a deep erosion and extract free cherts from the Pieniny Limestone. Although the clasts in the breccia are never bored by bivalves or other organisms, the

low degree of roundness shows that the clasts spent rather short time in agitated environment (probably the shoreline was narrow and steep).

Beds overlying the Nižná Limestone

SCHEIBNER (1967) presented his opinion that the Nižná Limestone is directly overlain by Albian-Cenomanian exotic flysch. In this sense, the Nižná Unit was the only Pienidic unit in which the deposition of exotics started as early as Albian (not taking into account a rare occurrence of Trawne Member in the Kysuca Unit – see BIRKENMAJER, 1987). Ostrý vrch and Vysoký Grúň are localities that contradict to this theory. They both show that the Nižná Limestone is overlain by at least 10 m thick uppermost Aptian to Cenomanian pelagites. Especially, combined natural and trenched profile at Vysoký Grúň revealed more or less continuous succession, where relatively thin Pieniny Limestone (5 m) is overlain by thin alloclastic layers of the Nižná Limestone (about 1 m) that is followed by alternating red pelagic limestones, marls and shales (about 3 m) of Upper Aptian- lowermost Albian age. Higher up, black radiolarites of presumably Cenomanian age (not yet proved biostratigraphically) occur. Their estimated thickness is about 3 m but it could not be verified by trenching. These lithostratigraphic units are similar to Tisá and Lalinok formations of the Kysuca Unit. Just after them, pale yellowish sandstones occur. They contain some exotic pebbles and rich coalified tiny plant detritus. These rocks may be considered as the aforementioned exotic flysch. Although no direct stratigraphic evidence was found there so far, the age of the flysch onset was surely younger than that proposed by SCHEIBNER (1967), despite stating that already in the uppermost parts of the Nižná Limestone, rare exotic pebbles were found (the fact that was not verified by us).

Discussion and conclusions

Deep erosion caused by emergence, together with onset of the exotic flysch later than originally supposed, shed more light on possible paleogeographic position of the Nižná Unit. On the example of the Czorsztyn Unit, AUBRECHT et al. (in press) showed that a large portion of the Pienidic domain (as far as the Niedzica/Pruské sedimentary area) might be emerged during Barremian-Aptian time. This emergence might even start as early as in Hauterivian. Although no detritic material coming from more shallow-water units was found in the Tvrdošín Breccia, we suppose that this event might be related to the same emergence. In the Nižná Unit, this emergence surely covered a time span from Barremian to Middle Aptian. According to the pelagic foraminiferal assemblages, the age of the Nižná Limestone is mostly the Late Aptian. This is the time of repeated submersion of the unit. Like in the Czorsztyn Unit, the processes that led to the emergence of the Nižná Unit have most likely started already in the Hauterivian, as evidenced by some occurrences of the Kysuca Unit with coarse-grained turbidites and mass-flow deposits in Hauterivian marls (AUBRECHT, 1994). Despite being older, the composition of these Hauterivian clastics is almost identical to the Tvrdošín Breccia.

All the above mentioned facts show that the Nižná Unit was situated at the margin of the sedimentary area of the Kysuca Unit. Apart from the previous opinions, on the basis of the new data, we place the Nižná unit on the opposite (northern ?) side of the Kysuca Trough, closer to the Czorsztyn Swell.

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