

Middle Jurassic stromatactis mud-mounds in the Pieniny Klippen Belt (Carpathians) – A possible clue to the origin of stromatactis

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ABSTRACT

Four occurrences of Jurassic stromatactis mud-mounds were found in the Czorsztyn Unit of the Pieniny Klippen Belt (Western Carpathians) – in western Slovakia (Slavnické Podhorie, Babiná), and in the Transcarpathian Ukraine (Priborzhavskoe and Veliky Kamenets). Their stratigraphic range is from Bajocian to Callovian. The mounds consist of micropeloidal mudstones, wackestones to packstones with a fauna including pelecypods, brachiopods, ammonites and crinoids. Spicules and skeletons of siliceous sponges are abundant in every section. All of the mounds contain networks of stromatactis cavities that are partially filled with radiaxial fibrous calcite (RFC) and locally by internal sediments. At Slavnické Podhorie, the sparry masses that fill stromatactis cavities are weathered out and show casts of sponges. Parallel study of the weathered casts and their cross-sections in slabs showed that they bear all the signs of stromatactis (relatively flat bottoms and digitate upper parts, RFC initial fillings and eventual blocky calcite later filling). Almost no original sponge structures were preserved. This strongly supports the possible sponge-related origin for stromatactis cavities.

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1. Introduction

Stromatactis mud-mounds are typical elements of the Paleozoic subtidal marine facies (Krause et al., 2004). Stromatactis was first described by Dupont (1881, 1882) and it is still an enigmatic phenomenon. It can be defined as the masses of spar (with partial substitution of internal sediment) which have smooth base, digitate roof, occur in swarms and have reticulate distribution (Bathurst, 1982). There is still no agreement in opinions concerning the origin of stromatactis. The suggested origins for stromatactis included internal erosion and reworking of small cavities (e.g. Kukal, 1971; Wallace, 1987; Bridges and Chapman, 1988; Matyszkiewicz, 1993, 1997), dewatering or escape of fluids (Heckel, 1972; Desbordes and Maurin, 1974; Bernet-Rollande et al., 1981), neomorphism or recrystallization of the calcareous mud (Black, 1952; Orme and Brown, 1963; Ross et al., 1975), dynamic metamorphism (Logan and Semeniuk, 1976), slumps (Schwarzacher, 1961) and fresh-water karstification (Dunham, 1969). Most recent ideas involve frozen clathrate hydrates in the calcareous mud, after which the stromatactis cavities remained (Krause, 2001) or the cavities are interpreted as a result of sedimentation of stirred

polydisperse sediment (Hladil, 2005; Hladil et al., 2006, 2007). Second, biogenic origins for stromatactis have also been suggested. The most widely invoked origin for stromatactis is that they are cavities which remained after decomposition of an unknown soft-bodied organism or by neomorphism of carbonate-secreting organism. The suggested organisms include stromatoporoids (Dupont, 1881, 1882; Lowenstam, 1950; Carozzi and Zadnik, 1959), bryozoans (Textoris and Carozzi, 1964), algae (Philcox, 1963; Textoris, 1966; Coron and Textoris, 1974), stromatolites (Cross and Klosterman, 1981), microbial colonies (Tsien, 1985), and burrowing activity of crustaceans (Shinn, 1968). The organisms which are most frequently mentioned in the stromatactis literature are sponges. The sponge theory was firstly suggested by Bourque and Gignac (1983), followed by Bourque and Boulvain (1993), Neuweiler et al. (2001), Neuweiler and Bernouilli (2005) and Delecat and Reitner (2005). Some authors suggested an opinion that a combination of several processes played role in the onset of stromatactis, such as microbial binding of the sediment and excavating of the unbound mud (Bathurst, 1982; Pratt, 1982) or a succession of sponges and microbial colonies (Flajs and Hüßner, 1993; Flajs et al., 1996).

Mesozoic stromatactis mud-mounds (including Jurassic) are not common. Neuweiler et al. (2001) ascribed this fact to taphonomy of Mesozoic sponge taxa which was different from those of Paleozoic. The Mesozoic taxa were prone to more rapid decay resulting in common cavity collapse and sediment filling. Neuweiler et al. (2001) introduced special terms used for incompletely developed

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stromatactis, such as aborted stromatactis, which is cavity filled entirely (or nearly entirely) with fine-grained internal sediment, and inhibited stromatactis which is initially filled with cement but the rest is filled by sediment.

This paper describes the Middle Jurassic (Bajocian to Callovian) stromatactis mud-mounds in the Slovak and Ukrainian Western Carpathians (Fig. 1). These mud-mounds may provide a clue to the long lasting problem of stromatactis origin.

2. Geological setting of the studied sections

The stromatactis mud-mounds reported here are located in the Pieniny Klippen Belt of the Western Carpathians. This belt represents the boundary between the internides and externides of the Carpathians, ranging from Slovakia, through Poland and Ukraine as far as Romania. Its very complex structure results from at least two deformation phases. Firstly, the Laramian nappe structure was created

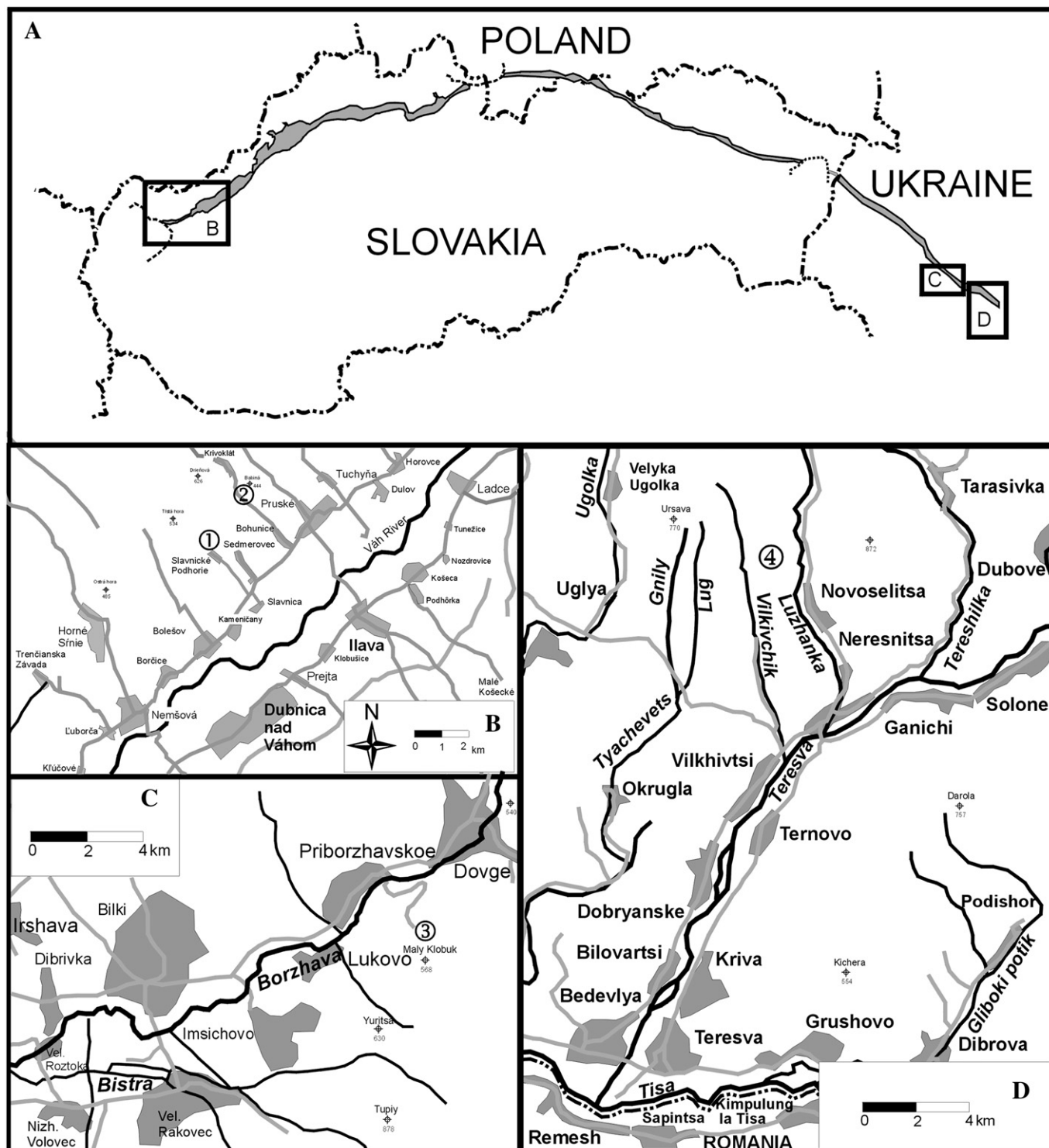


Fig. 1. Position of the examined sections. 1 – Slavnické Podhorie, 2 – Babiná, 3 – Priborzhavskoe, 4 – Veliky Kamenets.

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