

MAIN FEATURES OF THE PRE-GOSAU PALEOKARST IN THE BREZOVSKÉ KARPATY MTS. (WESTERN CARPATHIANS, SLOVAKIA)

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Abstract: The considerable areal extent and great thickness of Middle/Upper Triassic carbonate sequences favourably influenced the development of paleokarst during the Palealpine karst period in the Brezovské Karpaty Mts. Carbonate formations provide data concerning the first-pre-Gosau-phase of the Palealpine karst period. Freshwater limestones, bauxites, reddish ferruginous silty clays, Valchov Conglomerate, shallow doline-like depressions and deeper canyon-like forms represent the most important pre-Gosau karst sediments and forms.

Key words: Cretaceous, pre-Gosau paleokarst, doline- and canyon-like depressions, red clays, bauxites.

Introduction

The fundamental features of the nappe structure in the Central Western Carpathians originated during the Cretaceous (Plašienka 1997). The Palealpine (Uppermost Albian/Cenomanian-Senonian; Roth 1970) and Mesoalpine (Trümpy 1960) or Epipalealpine development (Činčura 1990) caused subaerial development of extensive parts of the Western Carpathians (Činčura 1990; Michalík & Činčura 1992; Činčura & Köhler 1995). Contributions which also deal with older karst periods of the Alpine epoch started to appear only during the last decade. Systematic research on karst phenomena older than Nealpine features (Miocene, Pliocene) was initiated. The Palealpine karst period (karst period and karst phase are used here in the sense of Bosák et al. 1989) was defined as the longest and most important paleokarst period in the Western Carpathians (Činčura 1990; Činčura & Köhler 1995).

Relics of forms and sediments belonging to Palealpine karst can be found in practically all Slovak mountains in which Middle/Upper Triassic limestones and dolomites occur.

The karst of the Brezovské Karpaty Mts. (Fig. 1) has been studied for more than five decades. The Pannonian (Uppermost Miocene) and younger karstification was thought to be the oldest karst phenomena until a short time ago. A summary

of previous contributions describing Pannonian and younger karst forms was collected by Stankoviansky (1982).

A brief outline of geology with regard to paleokarst

The region of the Brezovské Karpaty Mts. is mostly composed of Mesozoic units belonging to two individual cycles: 1. pre-Gosau (Triassic to Lower Cretaceous), and 2. Gosau (Upper Cretaceous). The marginal parts and embayments into the mountain consist of Neogene sediments.

Pre-Gosau paleokarst developed on Middle/Upper Triassic carbonate complexes of the Nédzov Nappe. Wetterstein Dolomite (Ladinian to Kordevolian, 300 to 500 m thick) and Hauptdolomite (Carnian to Norian, 400 to 600 m thick) dominate in the structure of the mountain. Owing to the thickness and large extent of both dolomitic units in subsurface and nearsurface of the mountains, a large number of karst forms developed in them.

The Valchov conglomerates (Coniacian) as a basal unit of the Brezová Group (Senonian; Samuel et al. 1980; Salaj et al. 1987) represent the most important factor to distinguish the pre-Gosau karst from other karst forms. The conglomerates transgressively overlay karstified Upper Triassic limestones and dolomites.

Pre-Gosau paleokarst

Sediments belonging to the Gosau cycle unconformably overlay the Hauptdolomite, Wetterstein Dolomite and other Middle Triassic limestones. Therefore, it can be expected, that Jurassic and Lower Cretaceous carbonate sequences destroyed by the pre-Gosau karst solution before the Senonian in numerous places were only several metres to several tens of metres thick (Fig. 2). This idea is supported, for example, by the occurrence of spicules of sponges and radiolarians in red clayey or silty matrix of

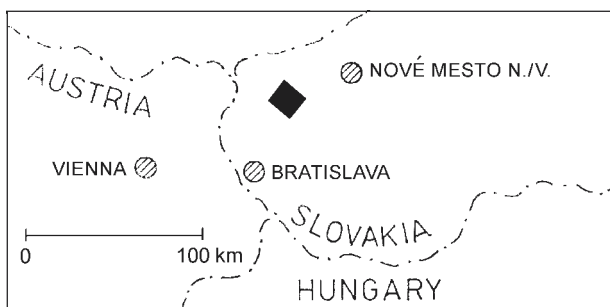


Fig. 1. Orientation map.

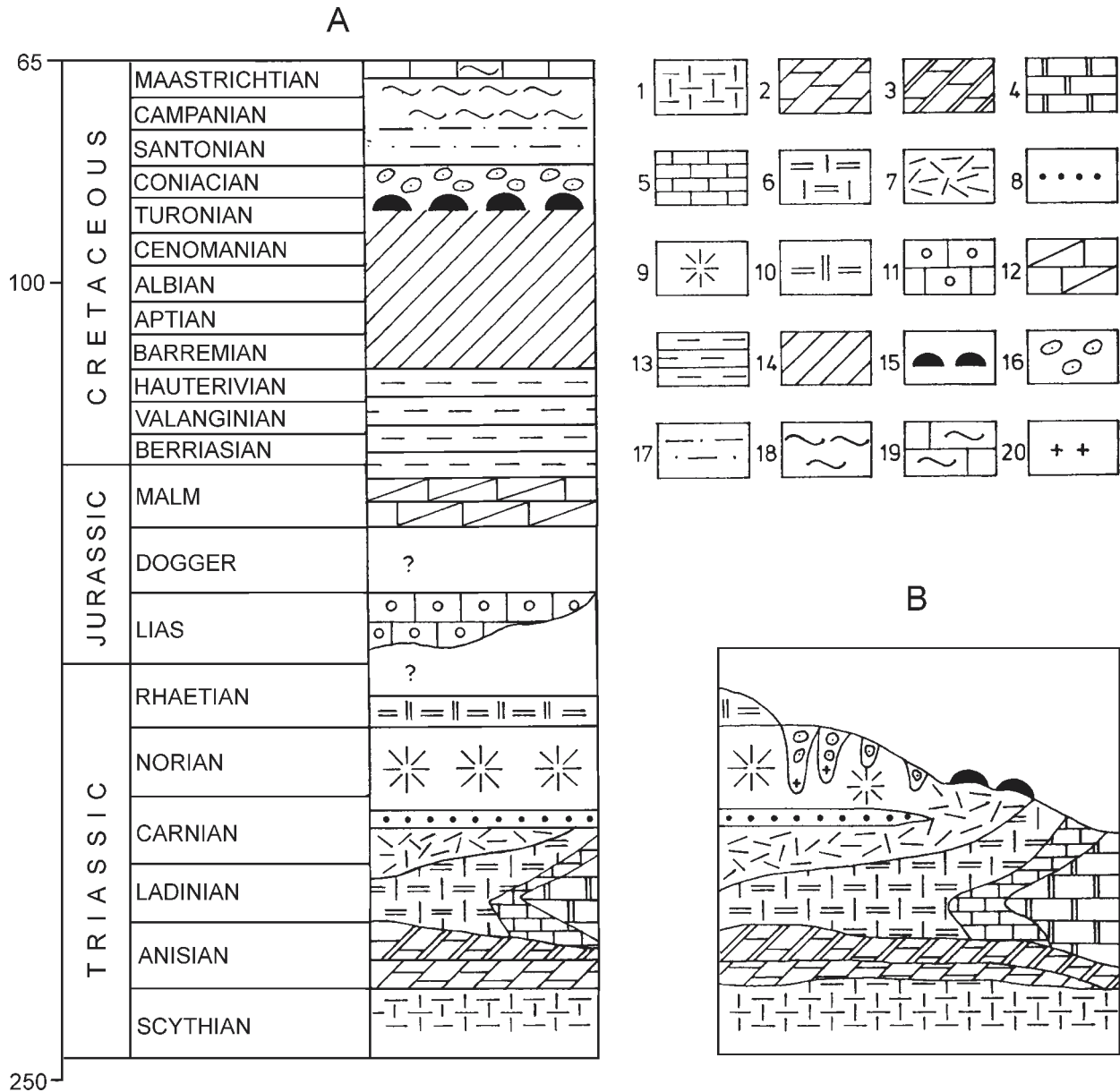


Fig. 2. Lithostratigraphic section of the Nedzov Nappe and the Senonian Gosau facies, **A** — modified after Salaj et al. (1987), and **B** — present interpretation: 1—sandy shale, sandstones (Scythian), 2—Gutenstein Limestone (Anisian), 3—Steinalm Limestone (Anisian), 4—Reifling Limestone (Ladinian), 5—Ramin Limestone (Ladinian), 6—Wetterstein Limestone (Anisian to Ladinian), 7—Wetterstein Dolomite (Carnian), 8—Lunz Formation (Carnian), 9—Hauptolomite (Norian), 10—Dachtein Limestone (Rhaetian), 11—crinoidal limestones (Liassic), 12—Oberalm and Barmstein Limestones (Malmian), 13—marls and clayey limestones (Lower Cretaceous), 14—gap (Barremian to Turonian, about 20 Ma), 15—freshwater limestones (?Turonian), 16—Valchov Conglomerate (Coniacian), 17—marls and sandstones (Santonian), 18—marls and sandstones (Campanian), 19—limestones and conglomerates (Maastrichtian), 20—boehmite-kaolinite bauxite (Lower to ?middle Cretaceous).

the Valchov conglomerates. Such occurrences can be interpreted as insoluble residua of Jurassic radiolarian limestones and spongolites (Borza 1962; Činčura 1997a). The first phases of the Palealpine karst period are recorded by this way in carbonate formations of the Brezovské Karpaty Mts.

The following karst sediments and morphological forms belonging to pre-Gosau paleokarst can be distinguished: 1. Freshwater limestones, 2. Boehmite-kaolinite bauxite, 3. Red ferruginous silty clays, 4. Valchov Conglomerate, 5. Shal-

low doline-like depression, and 6. Deeper canyon-like depressions.

1. Occurrences of *freshwater limestones* have been known in the Brezovské Karpaty Mts. (Pustá Ves Formation, Michalík et al. 1993). Relatively extensive outcrops N of Kočín village represent the most important site (Peržel 1964), consisting of brown to chocolate brown thickly bedded to massive limestones with abundant organic remnants (especially of algae). They overlay the Wetterstein Dolomite and can be

dated, most probably, to middle, or basal Upper Cretaceous (?Turonian to Lower Coniacian; Salaj et al. 1987).

We regard them (together with bauxites) as the oldest known karst sediments of the pre-Gosau paleokarst deposited in lacustrine basins developed especially on the surface of karstified carbonate complexes (uvala-like depressions?), mostly on the Wetterstein Dolomite. Pebbles of such fresh-water limestones were found in the Valchov conglomerates in the nearby Myjavská pahorkatina Upland.

2. Red (probably lens-shaped?) boehmite-kaolinite *bauxite* is relatively rare. It represents a new find of bauxite in Slovakia. Minerals (boehmite, kaolinite, chlorite) were detected by X-ray analysis (Činčura 1997b; Šucha, pers. comm.). Bauxite occurs in the bottoms of deeper canyon-like depressions underlying the Valchov conglomerates, and represents the oldest Palealpine karst sediments.

3. Red *ferruginous silty clays* often fill different karst cavities; sometimes they also compose the matrix of the Valchov conglomerates. The clay fraction consists of chlorite, kaolinite, illite and illite/smectite (Šucha, pers. comm.), and it does not differ substantially from the materials known from adjacent areas (Činčura 1997a).

4. The coarse- and medium-grained *Valchov conglomerates* sometimes pass into breccias. The clasts are unsorted to poorly-sorted, angular to semi-ovate, composed of different limestones and dolomites of Triassic (60 to 75 %) and Jurassic age (25 to 30 %), and of some eruptive rocks (Salaj et al. 1987). The variable matrix is formed by red ferruginous clay and/or silty clay, or fine clasts of limestone, dolomite and quartz.

5. Shallow, only several metres deep and 2 to 3 m wide *doline-like depressions* are relatively common feature in the Brezovské Karpaty Mts. Such depressions and different kinds of fissures developed in dolomites and limestones are sometimes filled with red ferruginous clays. The Valchov conglomerates represent a more frequent fill (Fig. 3). Their matrix consists of red clay or other materials. It can be stated without any doubt that such shallow doline-like depressions are older than the basal conglomerates and they originated during the pre-Gosau paleokarst phase before the Senonian, i.e. within the first phase of the Palealpine karst period.

6. *Deeper depressions*, most probably of canyon-like shape, occur mostly in the NW part of the Brezovský Karst. They are more or less, linear, but not strictly straight-lined. They occur mostly on Hauptdolomites, less frequently on Dachstein limestones. Their width on the surface does not exceed a few tens of metres. The fill (bauxite, red ferruginous silty clays and Valchov conglomerates) indicates their pre-Gosau age.

Pre-Gosau paleogeography

Marine deposition in the region of the present Nedzov Nappe ended with a 20 to 30 m thick sequence of Lower Cretaceous marls and clayey limestones, about 120 Ma (Salaj et al. 1987).

Extensive areas of the Slovak Western Carpathians, as well as of the Austrian Northern Calcareous Alps and Hun-

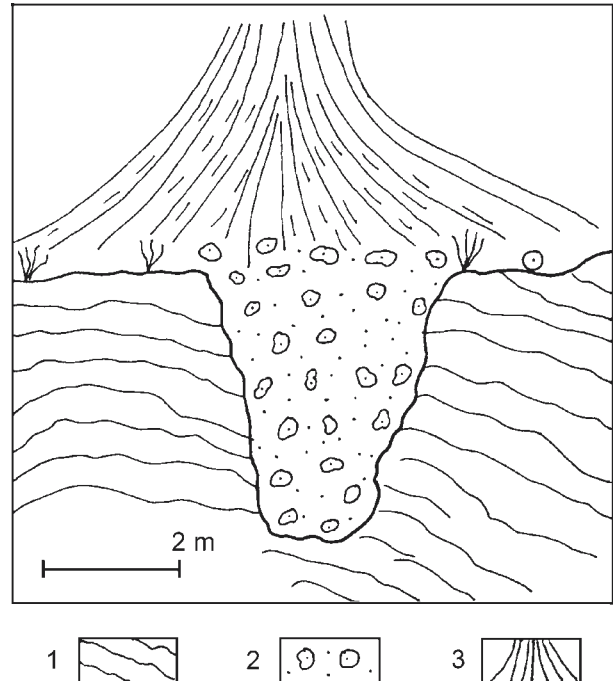


Fig. 3. Small doline-like depression W of Brezová pod Bradlom village: 1—Hauptdolomite, 2—Valchov Conglomerate, 3—debris.

garian Transdanubian Mid-Mountains were exposed to sub-aerial destruction during the Turonian to Coniacian before the transgression of the Gosau sea (Bárdossy & Kordos 1989; Leiss 1989; Činčura 1990).

Deeper, probably canyon-like depressions developed before the Gosau transgression during the middle Cretaceous indicating intensive entrenchment of karst streams. „Pre-bauxitic material“—ferruginous silty clay—successively accumulated on the bottom of depressions. The material was derived from weathering crusts on crystalline basements and transported by wind during the dry climatic season or by floods during the wet period. Deep karst depressions represented traps with the physico-chemical conditions necessary for the bauxitization of ferruginous silty clays and the origin of boehmite-kaolinite bauxites (cf. Činčura 1997b).

Karst solution in the pre-Gosau phase destroyed thicknesses of several metres to several tens of metres of limestones, especially of Jurassic age, in some places. Different shallow doline- or uvala-like depressions were later formed on Wetterstein dolomites. Their bottoms were flooded during heavy precipitation. Intermittent lakes originated with the growth of freshwater algae which contributed to the deposition of freshwater limestones.

The character of the pre-Gosau karstification reflected the position of the West-Carpathian realm encircled by tropical or subequatorial waters of the Tethys Ocean during the middle Cretaceous (Činčura 1987). The pre-Gosau karstification in the Brezovské Karpaty Mts. probably, represents the first manifestation of the Palealpine karst period; in other segments of the Western Carpathians it started later. The phase was interrupted by the transgression of the Gosau sea after about 20 Ma. The basal transgressive units (Valchov Con-

glomerate) unconformably covered and buried paleokarst morphology and sediments.

Post-Gosau karst evolution

Sediments of the gradually deepening and differentiating Gosau sea buried and conserved morphological forms and sediments of the pre-Gosau karst of the Brezovské Karpaty Mts. Paleokarst features were buried under a thick sequence of marine sediments at the end of Paleogene.

The fact that Upper Cretaceous sandstones also occur in Eggenburgian basal conglomerates indicates, that substantial parts of the pre-Gosau paleokarst were covered by Gosau sediments at the beginning of the Miocene. A significant karstification phase probably developed only during the Ottangian before the deposition of the Jablonica conglomerates (Karpatian). Some parts of the pre-Gosau karst were exhumed at this time and exposed to a new karstification. Nevertheless, clasts of Cretaceous sandstones are still present in the Jablonica Conglomerate (Kováč 1985). The Brezovské Karpaty Mts. have been a part of the West-Carpathian mainland since the Karpatian. The exhumation of pre-Gosau karst was probably completed and new forms and sediments belonging to the Neoalpine karst period developed.

Conclusions

1. Freshwater limestones (?Turonian to Coniacian), together with bauxites, are thought to be the oldest known karst sediments of the pre-Gosau paleokarst. They were deposited in lacustrine basins developed especially on the surface of carbonate complexes. Limestone fragments occur in the Coniacian Valchov conglomerates.

2. Shallow paleokarst depressions filled with the Valchov conglomerates, are older than their fill and originated during the Palealpine karst period.

3. Deep karst depressions with occurrences of boehmite-kaolinite bauxite represent the oldest morphological forms of the pre-Gosau age.

4. The Brezovské Karpaty Mts. have been a part of the West-Carpathian mainland since the Karpatian. The exhumation of pre-Gosau paleokarst practically finished at that time, and new karst forms and sediments of the Neoalpine karst periods started to develop.

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