Stop 16 – Štramberk, Kotouč quarry, Silesian Unit, Baška development, Hradiště Formation and Baška Formation (Upper Jurassic to Upper Cretaceous)

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Sedimentation in the Baška Development (subunit), which was defined by Matějka & Roth (1949, 1955), is delimited in extent to a relatively small area of Palkovice Hills between Frýdek and Nový Jičín. Initial sedimentation is connected with the carbonate platform that was situated on the Baška Cordillera (elevation). The Štramberk Limestone, defined by Hohenegger (1849) was deposited there. Nevertheless, he did not state any type locality.

The limestones are white-grey, diversified in components, and rich in fossils, which were studied since XIX century. They contain the most diversified latest Jurassic–lowest Cretaceous coral assemblage in the world (Eliášová, 2008 and references therein). Ammonites were also extensively studied there (e.g., Houša, 1961; Vašíček & Skupien, 2016).

The Štramberk Limestone is mostly known as reefal limestones, but they were deposited in different settings of the carbonate platform, from lagoon with restricted circulation to forereef (Eliáš & Eliášová, 1984, 1986). According to these authors coral reefs occurred in a low-energy inner platform, as well as in deeper parts of the reef front. Hoffmann *et al.* (2021) based on exotics of the Štramberk-type

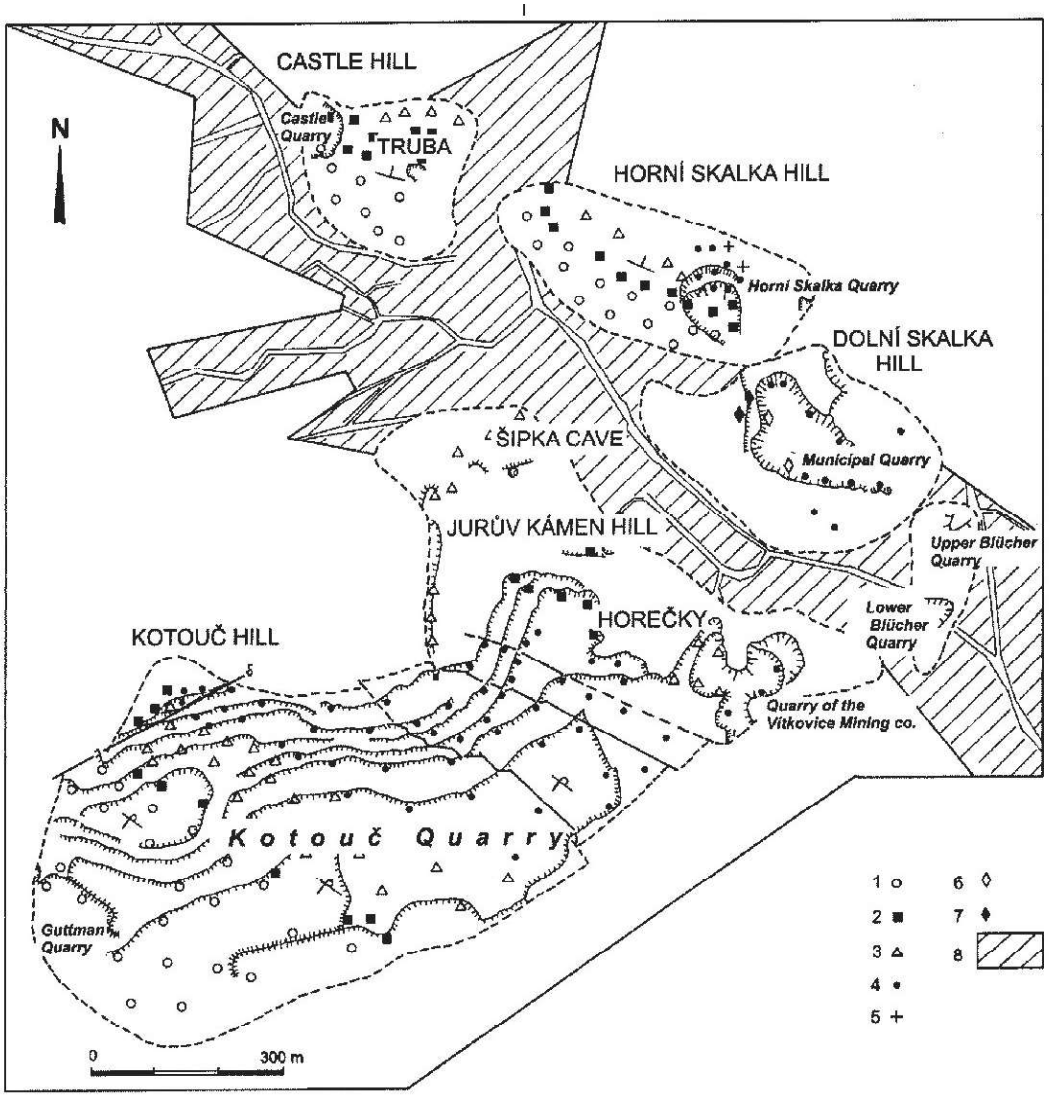

Fig. 49. A map of the main limestone bodies in the vicinity of Štramberk, with the positions of principal quarries and calpionellid zonation (from Houša, 1990, revised Houša & Vašíček, 2005). 1 – limestone without calpionellids; 2 – *Chitinoidella* Zone; 3 – *Crassicollaria* Zone; 4 – *Calpionella alpina* Subzone; 5 – *Remaniella ferasini* Subzone; 6 – *Calpionella elliptica* Subzone; 7 – *Calpionellopsis simplex* Subzone; 8 – town of Štramberk (after Skupien & Vašíček, 2008)

limestones dispersed in the flysch deposits of the Polish Outer Carpathians, paleoecology of corals, and some recently described facies of Štramberk Limestone (Hoffmann *et al.*, 2017) proposed a modified model of the latest Jurassic–earliest Cretaceous platforms, which were developed along the northern part of Western Tethys. According to this model coral-microbial patch-reefs grew in the inner carbonate platform, microencruster-microbial-cement buildups in the upper slope, and microbial as well as and microbial-sponge buildups in the deeper setting, while platform margin is represented by reef-derived detrital limestones and ooid limestones.

Opinions about time span occupied by the Štramberk Limestones differ in detail. Most frequently, the Tithonian is stated. According to Houša (1990) the sedimentation of these deposits began in the earliest Tithonian and ended in the lower Berriasian (calpionellid Remaniella Subzone of Calpionella Zone).

The Štramberk Limestone in a classical form occurs in several quarries (Fig. 49) in the immediate vicinity of the town of Štramberk in the shape of large carbonate blocks, smaller blocks, breccias and conglomerates. Opinions about the setting and position of the limestone in the Silesian Unit have been controversial up to now. Matějka & Roth (1955),

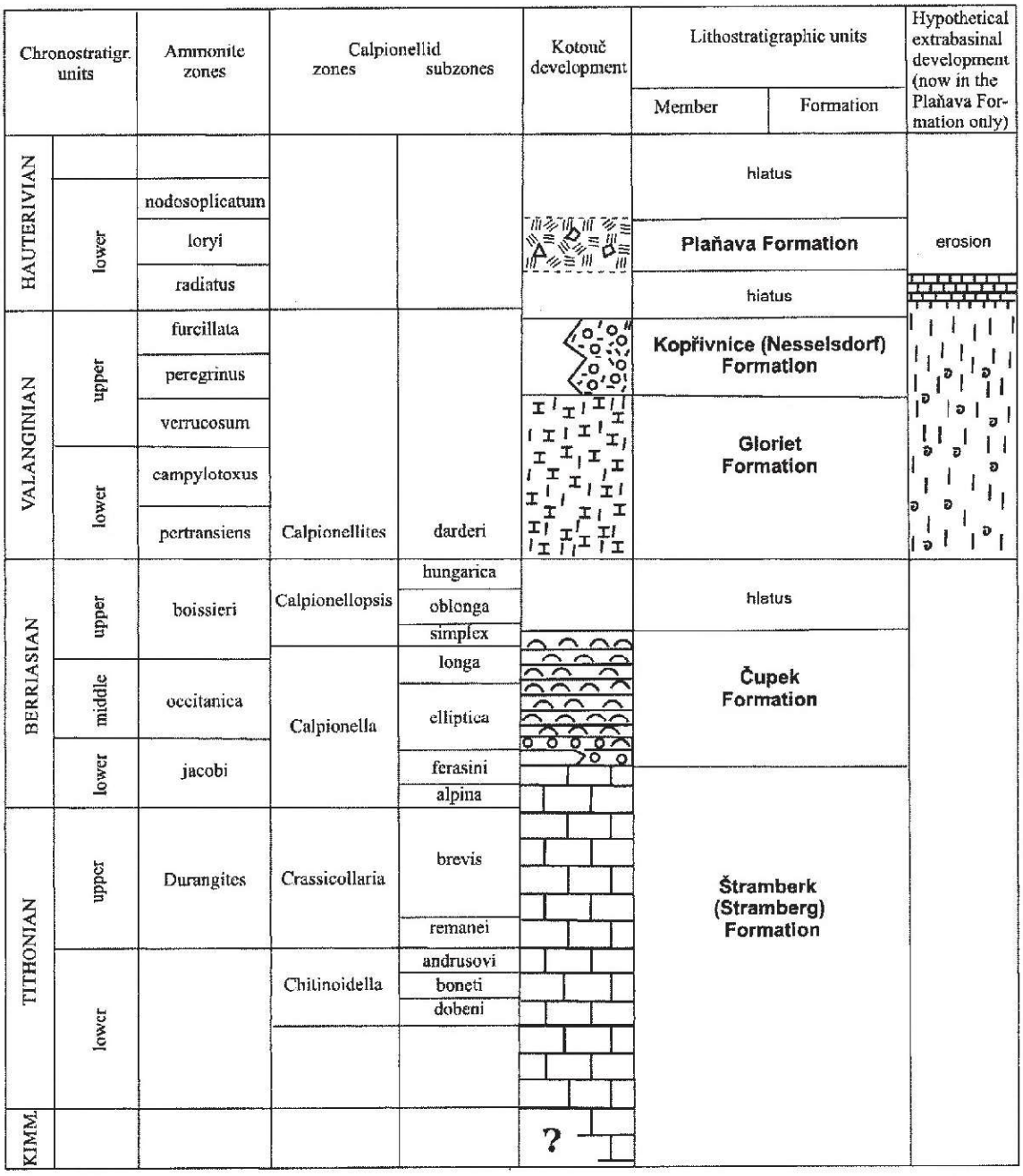

Fig. 50. Stratigraphic units in the region of Štramberk segment of the Baška elevation in the Tithonian and older part of the Early Cretaceous (after Houša & Vašíček, 2005; Skupien & Vašíček, 2008)

Frajová-Eliášová (1962), Houša (1976) and Menčík *et al.* (1983) interpret carbonate blocks as tectonic klippen separated from the carbonate platform in the course of Silesian Nappe overthrust. According to Eliáš & Stráník (1963), Eliáš (1979), Eliáš & Eliášová (1984, 1986), large and also smaller blocks were formed by the disintegration of the platform and redeposition of limestones into younger deposits at the foot of slope of the Baška ridge. None of the mentioned theories, however, explains completely the chaotic character of limestone-bearing deposits in the Štramberk area.

As stated by Picha *et al*. (2006) (in Picha & Golonka 2006), the truth lies somewhere in between both the opinions. The Štramberk carbonate platform rimmed by coral reefs was a source of clastics and debris. Gravitational slides and turbidite currents transported smaller and also larger blocks and fragments from the rim (edge) of platform as far as the foot of the adjacent basin. On the other hand, in the course of later tectonic transport, large tectonic pieces of carbonate platform were separated from softer, less competent rocks situated on the slopes of the platform. The result is a melange in which larger blocks from the carbonate platform have the characters of klippen. Smaller blocks and debris correspond to foot clastic sediments that developed especially in the Early Cretaceous and the early stage of Late Cretaceous.

Houša (1975, 1990) and also Houša in Houša & Vašíček (2004) proved that after the ending of sedimentation of Štramberk Limestone in the Štramberk area, the sedimentation of Early Cretaceous carbonates still continued intermittently (Fig. 50). This is proved by calpionellids and ammonites. Of these Lower Cretaceous carbonates, the Kopřivnice Limestone is the most famous. Suess (1858) described it under the name Kalke von Nesseldorf (German name of Kopřivnice). The type locality is the upper Blücher quarry between Štramberk and Kopřivnice. The Kopřivnice Limestone contains, in addition to abundant brachiopods and echinoderms, Upper Valanginian ammonites (Houša & Vašíček, 2004). Limestones of the Kopřivnice type are brown-red and red micrites, clayey micrites, biomicrites, intrabiomicrites, intramicrites etc.

Picha *et al*. (2006) included all local Cretaceous deposits and local lithostratigraphic units in the area of Štramberk under the name Kotouč Facies. In the original version, the Kotouč development was however defined, namely by Eliáš & Stráník (1963), as dark grey to black-grey pelitic deposits of variable sand content with layers of tilloid conglomerates, and others. At present, the Kotouč Facies represents all the above-mentioned (carbonate, pelitic, conglomerate) specific Cretaceous deposits linked prevailingly to the area of Štramberk.

From paleogeographic viewpoint, the block accumulations form a part of the succession of the continental rise facies of the Baška development below the hypothetical Baška cordillera. They include slumps, slides, fallen blocks (olistholiths), rarely also turbidites (especially proximal), the material of which comes – along with the allodapic limestones of the Baška Formation – from both the carbonate platform (Malm to Coniacian) and the reef complex (Malm/Lower Cretaceous boundary) on the Baška cordillera and its slopes.

Stop 17 – Leszna Górna quarry – carbonate flysch (lowermost Cretaceous, Berriasian) (Figs 51–54)

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Within the active quarry in Leszna Górna village, formations of the Cieszyn Limestone Formation ("Lower and Upper Cieszyn limestones") are exposed, formed as medium- and coarse-rhythmic limestone flysch. At several exploitation levels of the quarry, both the lithofacies differentiation of these layers and the very visible phenomena of fold and fault tectonics can be observed. The total thickness of the deposits exposed here reaches about 120 meters. This flysch is mainly represented by calciturbidites and calcifluxoturbidites (cf. Malik, 1994), with a full range of sedimentary features typical of both the inner part of the fan (depositional lobes) and the outer fan of the model of submarine turbidite sedimentation (cf. Mutti & Ricci Lucchi, 1975; Stow, 1986; Mutti & Normark, 1987; Ghibaudo, 1992; Reading & Richards, 1994; Lowe, 1997; Shanmugam, 2000).

The main part of the formations exposed here is Berriasian in age, only the oldest parts of the lowest mining levels in the quarry may be of Upper Titonian. A striking feature of these formations is their facies formation corresponding to fine- and coarse-rhythmic calciturbidites, with stratigraphically higher beds characterized by a series of beds thickening upwards and thus corresponding to the facies ensemble of depositional lobes and their margins. The older, fine-rhythmic sequence would then correspond to the facies complex of the outer cone (Malik, 1994). In both complexes, many features of sedimentary sediments can be observed, indicating a very lively sys-sedimentary tectonics, expressed by a large number of reseded formations: landslides and undersea flows; large, large and small lithoclasts (especially clay-marly) in limestones; coarse biodetrital limestones with fractional graining, etc. Full Bouma sequences can be read in many calcareous beds, terminating in marly portions of intensely bioturbated sequences. A brief description of the most important features of the deposits exposed here was presented by Malik (1994), but it should be noted that due to the progress of exploitation over the last 15 years, at least a dozen to twenty meters of the older part of the formation have been exposed. By the way, this site is still waiting for detailed sedimentological profiling and, on this basis, a broader palaeoenvironmental and palaeogeographical interpretation (Waśkowska-Oliwa *et al*., 2008) is connected with destruction of shallow-sea carbonate platforms and the areas surrounding them and resedimented into the deeper parts of the basin.