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Geological overview of the Paleozoic of the Barrandian Unit

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The Lower Paleozoic of the Barrandian Unit

The only non-metamorphosed, weakly tectonized, and almost complete Lower Palaeozoic succession in the Bohemian Massif is preserved in the so-called Barrandian Unit that comprise the Prague Synform (Fig. 1) that is an asymmetric elliptical structural depression, an erosional relic of unmetamorphosed Lower Paleozoic volcanic-sedimentary successions (Melichar, 2004). The Prague Synform belongs to Teplá-Barrandian Unit (also known as Bohemicum) in terms of larger scale structural and regional geology (Fig. 1). The rocks of the inner parts of the Prague Synform are well exposed in the SW periphery of Prague and adjacent areas in this direction. The Barrandian Unit is composed of sedimentary and volcanic complexes representing a distinct tectonostratigraphic megacycles – Precambrian, Cambrian (with two separate basins) and Ordovician-Middle Devonian.
The first tectonic deformation was eo-Variscan, starting in the Givetian. This early deformation culminated in the Frasnian and was followed by the maximum structural burial in Famennian – Tournaisian (2.5 – ?5 km or more); with maximum burial temperatures 80 – 110 °C, at faults also ~ 150 °C. The old terrane segments of TBU show an apparent peri-Gondwanan affinity of precursors. However, these segments were incorporated into and amalgamated with other Bohemian Massif precursor structures successively, with continuation until the Viséan – Baskhirian metamorphic and magmatic events. In Moscovian, the surface of the PS was eroded and dissected to a degree that the first post-orogenic siliciclastics deposited. The post-orogenic sedimentary cover has a limited occurrence, particularly when overlying limestones. Besides the Pennsylvanian conglomerates and sandstones, only Cretaceous marlstones and Miocene and Quaternary sands occur. For more detailed information see Chlupáč et al. (1998) and Cháb et al. (2010).
The following chapters are adopted and modified after Štorch et al. (2012).

Precambrian megacycle

The oldest rocks of the Barrandian Unit were deposited during the Precambrian tectonostratigraphic megacycle and can be correlated with the upper Riphean and Vendian sequences in age. The correlation is based on occurrences of microphytoplankton. Both the beginning and the end of the megacycle are, however, poorly dated in the Barrandian area.
According to the recent investigations, the Precambrian sedimentation took place on the oceanic crust. A complex of greywackes, siltstones, claystones, conglomerates, and spilitic volcanics, several kilometres thick, was folded, slightly metamorphosed and uplifted during the Cadomian Orogeny. Rather complicated structural and lithological development of the Precambrian (Proterozoic) strata motivated specialists in proposing several, not yet unified, stratigraphical interpretations of the succession.

Cambrian megacycle

At present, the Cambrian rocks are preserved in two separated regions: in the Příbram-Jince and in the Skryje-Týřovice basins. Lower Cambrian rocks in the Příbram-Jince Basin were deposited on the Precambrian basement with a pronounced angular unconformity and so were the middle Cambrian rocks in the Skryje-Týřovice Basin. As opposed to the completely marine deposits of the Precambrian basement, the Ordovician – Devonian rocks of the Prague Synform and Skryje-Týřovice Basin, the sediments of the Příbram-Jince Basin are characterized by prevalence of terrestrial deposits. The sedimentation continued in the much more extensive Příbram-Jince Basin until late Cambrian. This

deposition was followed by effusions of rhyolite-andesite rocks, partly subaerial, pertaining to the Strašice Volcanic Complex. In the Skryje-Týřovice Basin, the sedimentation was restricted to the middle Cambrian, being succeeded by mostly subaerial rhyolite to andesite volcanics of the Křivoklát-Rokycany Volcanic Complex.

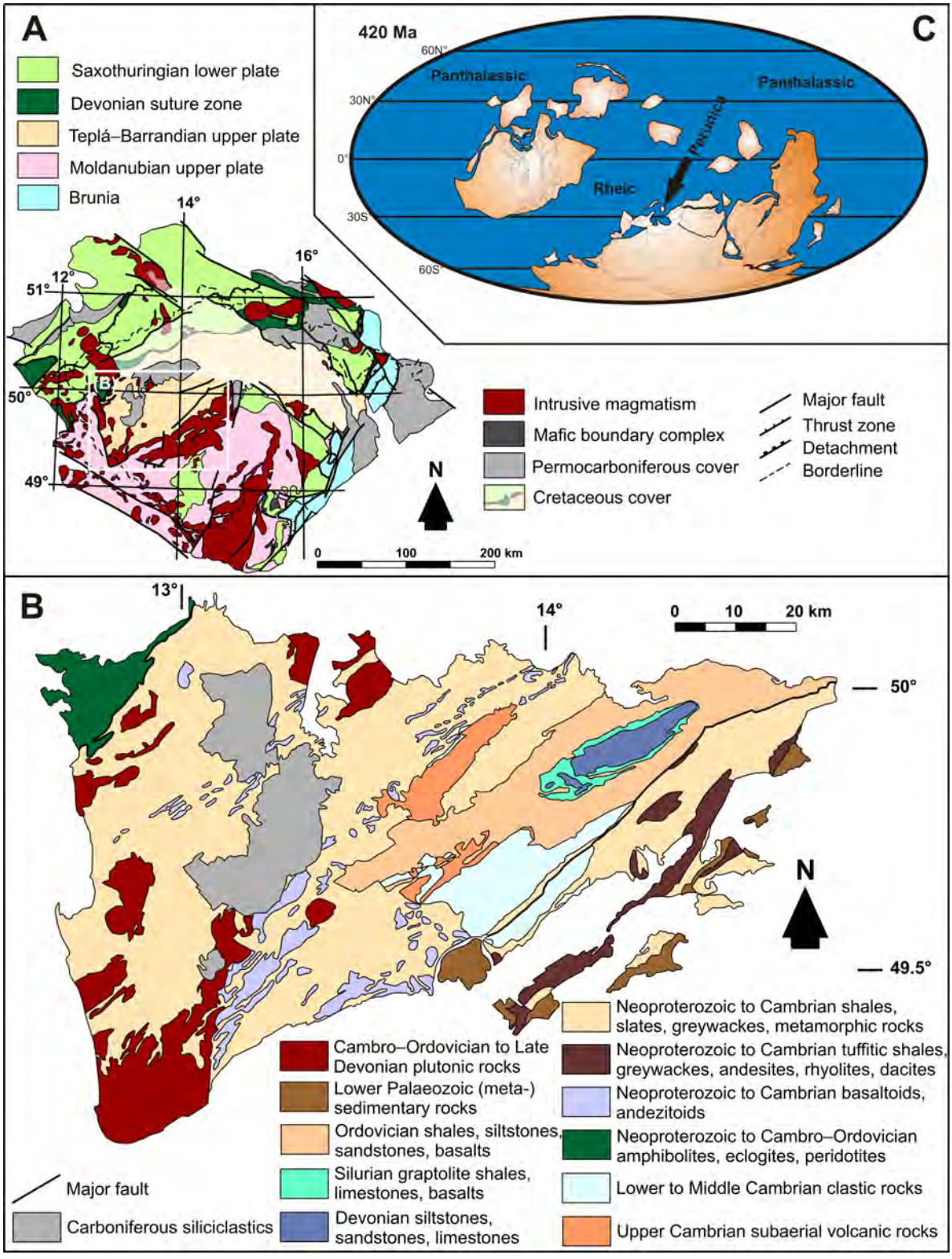

Figure 1. A. Simplified geological map of the Bohemian massif. **B.** Geological map of the Teplá-Barrandian Unit. **C.** Paleogeographical position of the microcontinent Perunica during late Silurian (after Torsvik & Cocks, 2013).

Ordovician – Middle Devonian megacycle

In Tremadocian, a new marine transgression reached the Barrandian Unit. The newly originated sedimentary basins later resulted in formation of the Prague Synform that was later tectonically shorted and now represents a narrow depression with longitudinal axis striking SW–NE, and striked at about 20° to the former Příbram-Jince Basin of Cambrian age.

The sedimentation persisted until the Middle Devonian without any prominent breaks. Ordovician strata are characterized by siliciclastic deposits, replaced by limestone facies from about the middle of the Silurian (Ludlow). The limestone-dominated Devonian sedimentation was terminated by a siliciclastic flysch deposition in the Givetian.

Repeated, tectonically predisposed submarine volcanism produced large but local accumulations of alkali basalt lavas, hyaloclastites (granulates) and tuffs.

Ordovician

The Tremadocian sea penetrated into a narrow, newly originated depression of the Prague Synform. Beginning with the late Tremadocian/early Arenigian (= Tremadocian – early Floian), the synsedimentary tectonic differentiation of the area gave rise to several segments parallel to the longitudinal axis of the synform. Further synsedimentary differentiation, perpendicular to the longitudinal axis, produced another two segments: a less rapidly subsiding southwestern segment, and a more rapidly subsiding northeastern segment, characterized by higher thicknesses of sediments. The basin extended outside the central depression from about the Llanvirnian (= Darriwilian).

The Ordovician succession of the Prague Synform is typical by the alternation of shale and sand facies. Time to time, the distal parts of shallow-water sandstone facies reached even the central depression of the basin. In general, however, the central depression of the Prague Synform was characterized by the deposition of black clayey shales from the beginning of the Llanvirnian to the late Berounian (Darriwilian to Sandbian). Several iron ore horizons are present, usually used as basal markers of the lithostratigraphic units.

The shallow sea that flooded the Barrandian Unit (Perunica in paleogeographic sense; Havlíček et al., 1994; Fatka & Mergl, 2009, see Figure 1C) was situated on the northern periphery of Gondwana in the Ordovician. It was populated by the „Mediterranean Province“ fauna, reflecting cold or cool temperate climatic conditions. The fauna was very close to that of other peri-Gondwanan regions (Spain, France, Sardinia and Italian-Austrian Carnic Alps). Also the topmost Ordovician glacial event accompanied by a prominent glacio-eustatic regression is well recorded in the topmost Ordovician Kosov Formation (Hirnantian) in the Prague Synform.

Extensive Ordovician basaltic volcanism was concentrated mostly to the Komárov Volcanic Complex. It commenced in the late Tremadocian, increased strongly in the Arenigian (Floian) and persisted till the latest Berounian (= Sandbian). The peak volcanic activity is documented from the upper Arenigian/lower Lanvirnian (Floian/Darriwilian) and upper Berounian strata. The maximum thickness reaches nearly 1000 m. The Ordovician deposits are max. 2500 m thick, including the volcanic rocks.

The Ordovician of the Prague Synform is subdivided into 7 regional stages (or series according to some authors) with 12 formations.

Silurian

The complete, non-metamorphosed Silurian succession with richly diversified benthic and pelagic faunas is confined, together with the Devonian deposits, to the central part of the present Prague Synform. Silurian rocks are preserved only in the central part of the Prague Synform between Prague and Zdice.

During the Silurian, gradual synsedimentary deformation of the basin was accompanied by strong submarine volcanism that culminated in the late Wenlock and early Ludlow. Then, volcanoclastic accumulations gave rise to submarine elevations and even an emergent island surrounded by shallowwater bioclastic limestones.

The maximum thickness of the Silurian succession is more than 450 m in the volcanic-rich area near Svatý Jan pod Skalou. Black graptolitic shales prevail in the Lower Silurian, but towards the top of the Silurian they are gradually replaced by limestones. The sedimentation of limestones continued from the Late Silurian to the Early Devonian with no interruption, except for a local gap at the top of the former volcanic island near Svatý Jan. For the basic lithostratigraphy of the Silurian, see Figure 2.
Absolute prevalence of biodetritic types is a typical feature of the Silurian limestones in the Prague Synform. The Silurian deposits as a whole originated in a shallower, warm-water environment, in about the subtropical climatic zone (Fig. 1-C).

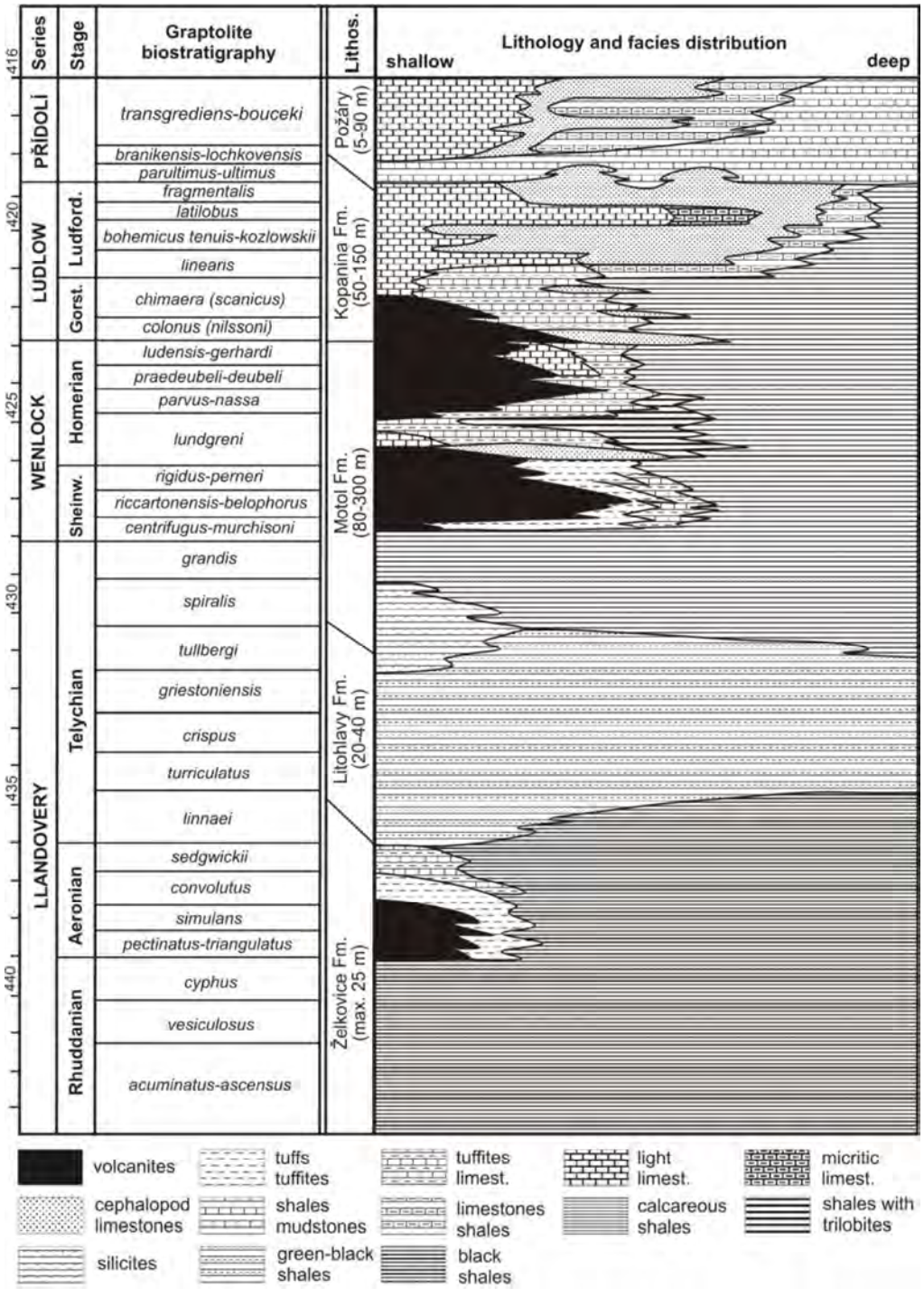

Figure 2. Silurian lithostratigraphy, graptolite biostratigraphy and facies development of the Prague Synform (after Kříž, 1992; 1999).

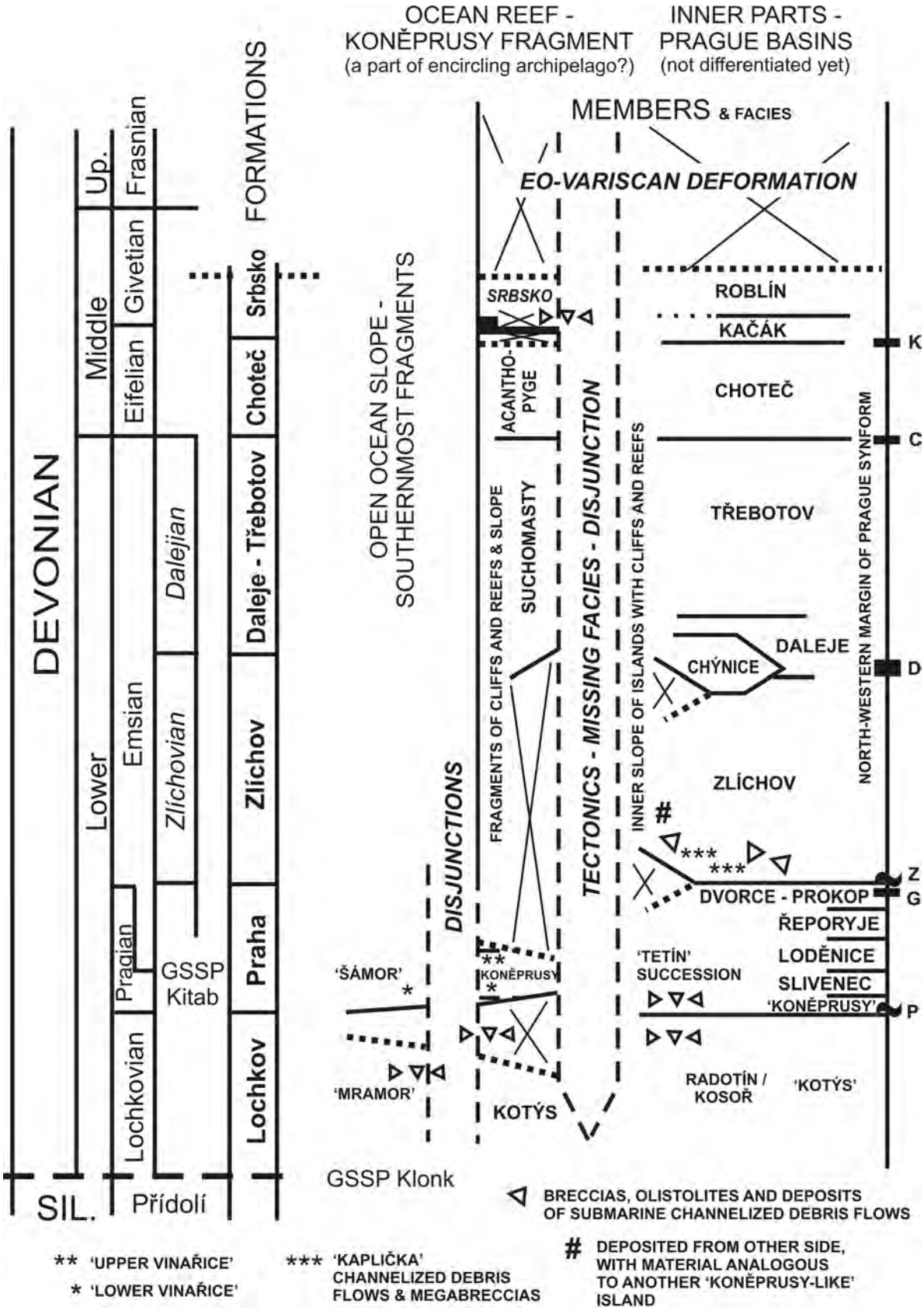

Figure 3. A simplified stratigraphic column of the Devonian units and facies in the Prague Synform. Letters on the right side: P – Basal Pragian Event, G – Bohemian Graptolite Event, Z – Basal Zlíchov Event, D – Daleje Event, C – Basal Choteč Event, K – Kačák Event. (After Hladil et al., 2016).

Devonian

The Devonian carbonate succession of the Prague Synform is characterized by two major lithofacies. The first one, represented by shallow-water biodetritic, mostly crinoidal limestones, also includes the local reef development of the Pragian age near Koněprusy. The second principal facies is more pelagic. It is represented mostly by calcisiltites. For the basic lithostratigraphy of the Devonian see Figure 3.

Several prominent fluctuations in sea level were recognized in the Devonian strata of the Prague Synform. Some of them are related to global eustatic events.

The sedimentation culminated by siliciclastic flysch-like Roblín Member (Srbsko Formation) of the Givetian age. Rapid sedimentation of the Roblín Member reflected the incoming Variscan tectonic movements that subsequently uplifted, folded and faulted the former sedimentation area. The average thickness of the Devonian is 500 m in the Prague Synform.

Both sediments (e.g. reef limestones, bahamites) and fauna (highly diverse, with many warm-water elements) account for well-oxygenated shallow sea in the subtropical-tropical climatic zone.

Outside the Barrandian Unit, large areas of the Devonian limestone form the Moravian Karst. Metamorphic rocks of Palaeozoic age are also embedded in peripheral mountains of the Bohemian Massif.

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