PALAEOGEOGRAPHY AND STRATIGRAPHY OF THE BOHEMIAN CRETACEOUS BASIN (CZECH REPUBLIC) – AN OVERVIEW

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Abstract
Palaeogeographically, the area of the present day Bohemian Cretaceous Basin (BCB) formed a narrow Seaway between the North Sea Basin and the Tethys Ocean during the Late Cretaceous. The BCB together with adjacent Brannau-Regensburg Basin (Danubian Cretaceous Group) in Bavaria were a part of the peri-Tethyan shelf zone and contain a record of recurrent warm-temperate faunal assemblages with several incursions of Boreal fauna. The distribution of the coarse siliciclastic sediments demonstrate a significant control of stratigraphic architecture by tectonic activity and spatially variable sediment supply during the lifetime of the Bohemian Cretaceous Basin. Intra-basinal correlations of the BCB are based on application of both, non-biostratigraphic and biostratigraphic or eventostratigraphic methods. Nevertheless, some difficulties still appear with intra- and interbasinal correlation of the BCB (e. g., continental/marine, nearshore-offshore, entry of biomarkers or Boreal/Tethys correlations).

Late Cretaceous palaeogeography and tectonosedimentary history

The Bohemian Cretaceous Basin (BCB), the largest of the intracontinental basins within the Bohemian Massif, extends across Saxony, Bohemia, Moravia and Silesia. During the late Cretaceous the area of present day Bohemian Cretaceou Basin formed a narrow Seaway connecting the North Sea Basin and the Tethys Ocean (fig. 1).

According to general palaeogeographic context, the BCB was surrounded by an archipelago of emerged paleo-highs (Central European Island, West and East Sudetic Islands) (fig. 1) from which the nearshore siliciclastic sediments were derived. The quartzose to subarcosic sandstone (Quadersansteine) lithofacies is unique and most dominant for BCB in contrast with chalk facies developed in the most part of the North Sea Basin in the Central and Western Europe. A diverse recurrent assemblages of warm-water fauna (e. g. rudists, colonial hexacorals, nerineid and actaeonellid gastropods, thick-shelled bivalves, rock-boring and cemented bivalves) were associated with paleo-highs while temperate benthic fauna inhabited their shoreface and offshore zones (Kollmann et al. 1998, Žítt – Nekvasilová 1996). Palaeobotanical data (Knobloch 1991) reveal a subtropical/tropical climate conditions which prevailed over long periods of the whole lifetime of the BCB. Thus the Bohemian Cretaceous Basin and the adjacent Brannau-Regensburg Basin (Danubian Cretaceous Group) in Bavaria formed a peri-Tethyan shelf zone during the Late Cretaceous.

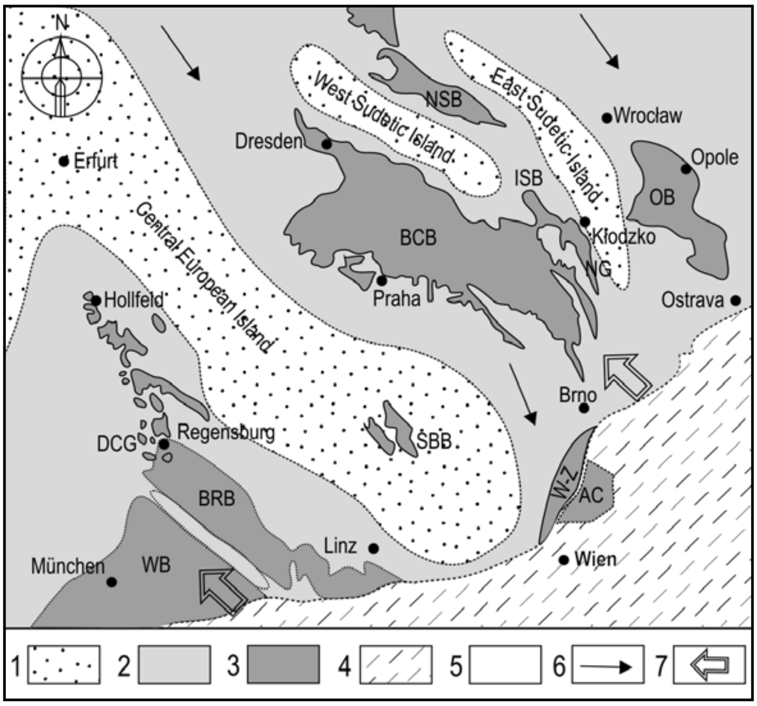

Fig. 1: Simplified paleogeographic situation of the Bohemian Massif and adjacent areas during the Cretaceous. Explanation: 1 – emerged paleo-highs; 2 – epicontinental seas; 3 – preseved Cretaceous basins: BCB, Bohemian Cretaceous Basin; NSB, North Sudetic Basin; ISB, Intrasudetic Basin; NG, Nysa Graben; OB, Opole Basin; SBB, South Bohemian Basins; DCG, Danubian Cretaceous; BRB, Brannau-Regensburg Basin; WB, Wasserburg Basin; W–Z, Waschberg–Ždánice Zone; AC, Autochtonous Cretaceous recognized in the deep cores beneath the foreland basin deposits and Flysch Belt of the West Carpathians; 4 – deep marine basins; 5 – outer margin of Alpine and Carpathian nappes; 6 – cool bottom currents; 7 – warm surface currents (adapted from Valečka – Skoček 1991).

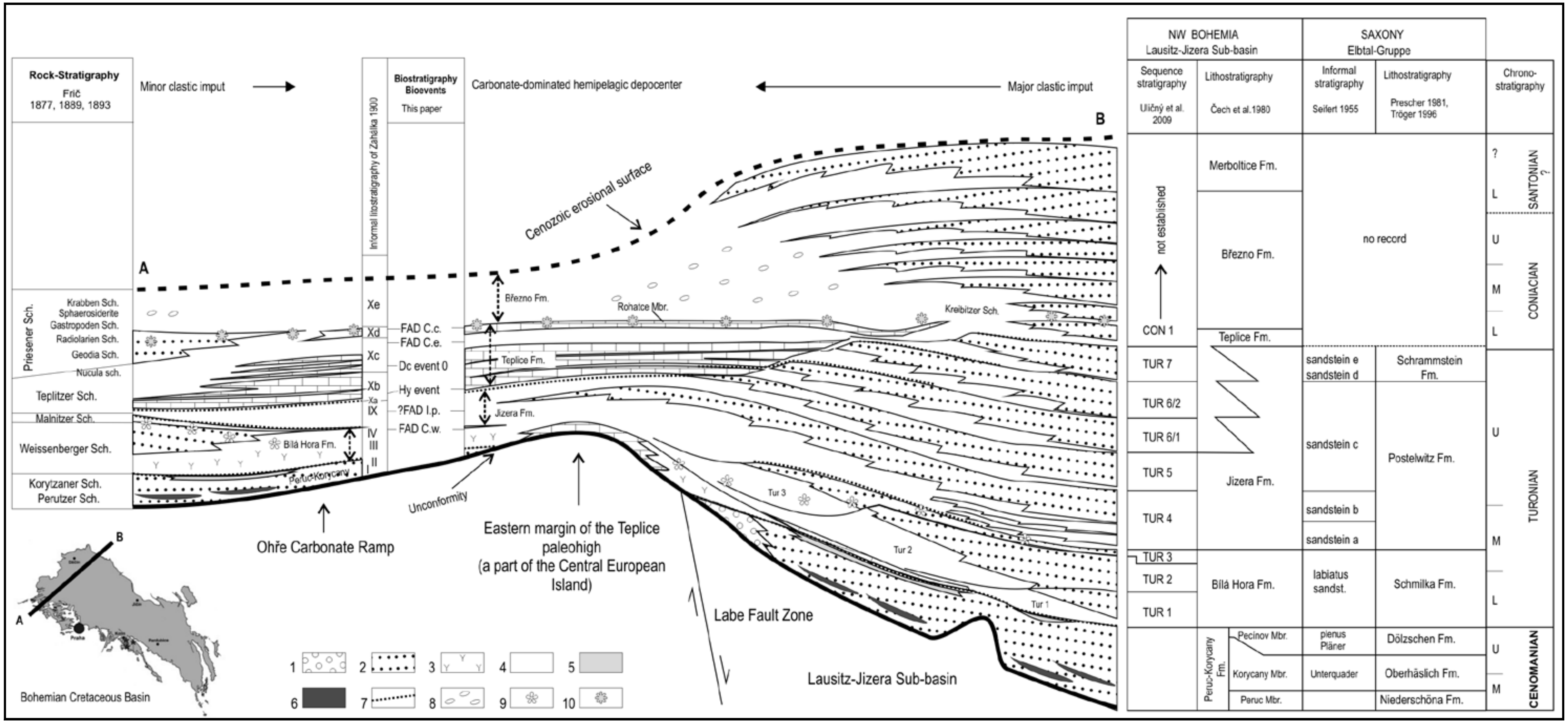

Fig. 2: Idealised regional cross-section of the NW part of the BCB showing principal lithofacies, regional stratigraphic units of the Late Cretaceous sediments in NW Bohemia and in Saxony, genetic stratigraphic units, informal lithostratigraphic units, biostratigraphic markers and some bioevents. Explanation: 1 – conglomerates; 2 – sandstones (Quadersandsteine); 3 – spiculitic sandstones to siltsones; 4 – marlstones to calcareous claystones; 5 – plenus Bed; 6 – coal; 7 – glauconitic beds; 8 – clay ironstone nodules; 9 – LAD *Mytiloides hercynicus*; 10 – *Cremnoceramus deformis crassus* Event.

However, several incursions of typical Boreal fauna are evidenced by the occurrences of belemnites in the BCB (Košťák et al. 2004).

The BCB was formed probably during the mid-Cretaceous reactivation of the main fault zones of the Variscan basement of the Bohemian Massif in combination with features of the global transgression (Cenomanian transgression). The Elbe Fault Zone and conjugate, NNE trending, Jizera System faults played a significant role in the tectono-sedimentary evolution of the BCB. The tectonosedimentary evolution of the BCB can be subdivided into three periods or phases (Uličný et al. 2009).

In the Cenomanian, the fluvial, estuarine and shallow shoreface facies association reflects a long-term sea-level rise (Phase I). During the late Cenomanian and the Turonian, coarse clastic sediments filled two main depocenters within the BCB (Phase II): the Lausitz-Jizera in the NW and the Orlice-Žďár in the SE. Significant changes in basin geometry, deposition of thick clastic wedges with extensive basinal muds and long-term sea-level fall took place in the Coniacian and the Santonian (Phase III). Maximum preserved thickness of Cenomanian to Santonian deposits is ca. 1 000 m in the Lausitz-Jizera sub-basin (fig. 2). The data on organic maturity analyses of the sediments of the BCB indicate that the deposition in the basin probably continued beyond the Santonian. However, these sediments have been eroded during the Cenozoic inversion and erosion (Uličný – Franců 1996).

Lithostratigraphy, genetic stratigraphy and chemostratigraphy

Stratigraphic subdivision of the BCB is based on the regional lithostratigraphic concept (Čech et al. 1980) (fig. 2) which follows the formerly established rock-stratigraphic concept of Frič. But some lithostratigraphic units are defined in terms of cyclostratigraphy (Bílá Hora Fm., Jizera Fm.) or allostratigraphy (bases of the Bílá Hora and Teplice Formations). More recently, sequence/or genetic stratigraphic concept was used by Uličný et al. (2009) (fig. 2) to correlate marginal marine and basinal Turonian sequences in NW Bohemia (fig. 1). Cyclostratigraphic and chemostratigraphic analyses are also used for the Cenomanian (Uličný et al. 1997) and Turonian (Štaffen 1999, Wiese et al. 2004) intra- and inter-basinal correlations as well as litho-events (Valečka – Skoček 1991).

Biostratigraphy and palaeontology

Macrofossils (inoceramids, ammonites, belemnites, echinoderms, sponges, brachiopods, vertebrates) and micro-or nannofossils (foraminifers, calcareous nanoplankton, palynomorphs) have been studied for biostratigraphic correlation.

CENOMANIAN

According to palynomorph analyses (Svobodová 1999), fluvial deposits of the Peruc Member in the lowermost segment of the fill of the SE part of the BCB are of Early Cenomanian age. Rare occurrences of *Mytiloides atlanticus* in the Korycany sandstone indicate a Middle Cenomanian age. Ammonites of *Calycoceras guerangeri* and *Metoicoceras geslinianum* zones of the Upper Cenomanian are known from the Korycany and Pecínov members of the Peruc-Korycany Formation. Among inoceramids, *Inoceramus pictus* and its subspecies have been found in these zones. A prominent *plenus* Event is developed both in rocky-shore and basinal facies in the BCB within the *M. geslinianum* zone (Košťák et al. 2004, Svoboda 2006). *Mytiloides hattini* is also associated with this zone. Nevertheless, ammonites and inoceramids are usually missing at the Cenomanian/Turonian boundary. Only calcareous nannoplankton could identify a regional stratigraphic gap (including *N. juddi* and a part of *W. devonense* zones) at the Cenomanian/Turonian boundary in the boreholes in the south central part of the BCB (Švábenická in Čech et al. 2005).

TURONIAN

Near the base of the Bílá Hora Formation, Lower Turonian inoceramids of *Mytilodes kossmati* and *M. mytiloides* and ammonites of *Mammites nodosoides* are frequent. The last appearance datum (LAD) of *M. hercynicus* and *M. subhercynicus* is more prominent than their entry in the Bílá Hora Formation (fig. 2). In the basinal facies, the first appearance datum (FAD) of *Collignoniceras woolgari* is well recognized at the Lower/Middle Turonian boundary. The base of the Upper Turonian, usually defined as FAD of the inoceramid *I. perplexus*, has not been precisely established in the BCB yet. In the Úpohlavy Quarry, a significant *Hyphantoceras reussianum* Event (fig. 2) and a short-term incursion of *Preactinocamax bohemicus* in the Late Turonian was reported by Wiese et al. 2004 and by Košťák et al. (2004). A stratigraphic gap was recorded within the *H. reussianum* Event and discussed by (Čech 1989, Wiese et al. 2004, Vodrážka et al. 2009). The position of the Turonian/Coniacian stage boundary was studied (inoceramids, calcareous nannoplankton) at the type locality of the Březno Formation in the SW part of the BCB (Čech – Švábenická 1992). *Didymotis* events at this stage boundary (fig. 2) and the entry of calcareous nannoplankton species *Marthasterites furcatus* were discussed by Čech (1989, 2009) and by Švábenická (2010).

CONIACIAN

For Lower Coniacian, inoceramid *Cremnoceramus deformis crassus* is the most conspicuous in all facies in the BCB, while *C. erectus*, a biomarker for the base of the Coniacian, is scarce. The Lower/Middle Coniacian boundary is well marked in the BCB by the FADs of inoceramids *Volviceramus koeneni* and *Platyceramus mantelli* rather than by ammonites. The Upper Coniacian is characterized by the occurrence of inoceramid *Magadiceramus subquadratus* in the boreholes in NW Bohemia (Macák – Müller 1963). The Coniacian strata of the Březno Formation can be also well subdivided on the basis of benthic foraminifers (Hercogová 1974).

SANTONIAN

According to foraminifers and ostracods, Santonian species (*Gyroidinoides globosa*, *Gavelinella pertusa* and *Colcocythere costanodulosa*) appear within the Coniacian *M. subquadratus* Zone (for discussion see Čech et al. 1987). The uppermost fill of the BCB (Merboltice Formation) contains only long-range agglutinated foraminifers.

There are still several difficulties with stratigraphic subdivision and correlation of the Cretaceous deposits of the BCB. 1) determination of the age of the fluvial sediments and the correlation of non-marine and marine strata, 2) correlation of the different but coeval facies (rocky shore sediments – basinal muds – progradational clastic wedges, 3) time transgressive character of some lithological units in view of biostratigraphy and genetic stratigraphy, 4) the absence or scarce occurrence of some marker fossils (ammonites), 5) changes in the stratigraphic value of some taxa (e. g. *M. furcatus*), 6) different concepts of the stage/substage boundaries in several groups of fauna and flora, 7) correlation with adjacent intracontinental basins around the Bohemian Massif, 8) Boreal/Tethys correlation.

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