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DYNAMICS OF JURASSIC RIFTING IN THE WESTERN CARPATHIANS

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The Jurassic period was the time of extensive rifting of the northern, European passive margin of Tethys, which brought about drowning of Triassic carbonate platforms and finally led to disintegration of the European shelf crust into numerous elevated and subsiding domains, some of them presumably floored by a newly-formed oceanic crust. Based on the character and distribution of syn- and post-rift sedimentary sequences, basically three principal rifting phases as climaxes of long-term extensional tectonic regime can be discerned within the Western Carpathian area: (1) the earliest Jurassic uniform "pure-shear" lithospheric stretching and wide-rifting of the epi-Variscan Triassic platform; (2) breakup of the South Penninic-Vahic ocean at the Lias/Dogger boundary; (3) breakup of the North Penninic-Magura ocean at the Jurassic/Cretaceous boundary.

Lithospheric stretching and crustal heating during the first rifting event at ca 200 Ma is documented by a radiometrically detected thermal event in the Tatric and North Veporic basement (MALUSKI et al., 1993; KRAL et al., 1997), but no volcanism occurred in that time. Broad intracontinental basins were formed (e.g. the Zliechov basin) flanked by uplifted rift shoulders providing terrigenous clastic material for syn-rift strata accumulated in marginal halfgrabens (e.g. the Borinka halfgraben). Comparatively thick hemipelagic marlstones and limy turbidites (Allgäu Fm.) deposited in axial zones of rapidly subsiding basins. For the next 100 Ma, pelagic basins within the Tatric area (Siprun basin) and the Fatric zone (Zliechov basin) of the Slovakocarpathian realm (analogous to the Austroalpine one) were subjected to slow thermal subsidence and calm pelagic sedimentation. Younger rifting and/or lowstand events are recorded by occasional incursions of turbidites (MICHALIK et al., 1996) and emersions on rift shoulders, but no substantial rebuilding of the basin architecture has been recognized. Widespread occurrences of small portions of submarine, mantle-derived, alkaline basaltic lava flows within Lower Cretaceous pelagic successions are interpreted as indications of persisting extensional tectonic regime within these basins (e.g. SPISIAK & HOVORKA, 1997), which were floored by a renewed, probably normal-thickness continental crust.

Zones along the northern edge of the Slovakocarpathian realm and areas north of it (Penninic realm) experienced a substantially different paleotectonic scenario. In addition to the first rift phase, the outermost Austroalpine and Slovakocarpathian units record a strong second rifting event approximately at the Lias/Dogger boundary (ca 180 Ma), which has been interpreted as a breakup phase of the South Penninic-Vahic oceanic zone (e.g. FROITZHEIM & MANATSCHAL, 1996; PLASIENKA, 1998). The north-facing Borinka halfgraben received thick scarp breccias during the Middle Jurassic, but no Upper Jurassic and Lower Cretaceous sediments are known there. This is tentatively ascribed to a thermal uplift of the upper plate due to asymmetric "simple-shear" rifting. The inner (southern) side of the uplifted area (North Tatric ridge) collapsed during the Middle Jurassic, giving rise to a zone with very rugged morphology at the northern flanks of the intra-Tatric Siprun basin. There, restricted basins represented by pelagic sedimentary successions rich in allodaps (often overlapping directly the pre-Alpine basement) alternated with small elevations marked by thin, incomplete and condensed Middle – Upper Jurassic successions (cf. PLASIENKA et al., 1991). It is inferred here, adopting the Alpine oceanic rifting models (e.g. LEMOINE et al., 1987, and many others), that the subcrustal lithospheric mantle was gradually exhumed within the lower plate, creating the floor of the South Penninic ocean, which was designated as the Vahic ocean in the Western Carpathians (see MAHEL, 1981; PLASIENKA, 1995). Although no ophiolites of this presumed oceanic zone participate at the present surface structure of the Western Carpathians, yet several indications of its existence do exist.

The third rifting event affected still more northern areas. Following the first rifting phase that produced system of halfgrabens filled with hemipelagic, often anoxic sediments, the second rifting phase individualized the elevated Oravic ribbon continent in a Middle Penninic position (Czorsztyn pelagic swell – MISIK, 1994). Approximately at the Jurassic/Cretaceous boundary, this swell was emerged and dissected, and subsided again some 50 Ma later in mid-Cretaceous times. The emergence of the Oravic swell is again ascribed to the thermal uplift of the upper plate of an asymmetric breakup zone of the North Penninic-Magura ocean.

The absence of rifting-related volcanism and a persistence of extensional tectonic regime for many tens of Ma indicate a passive rifting mode generated by tensile deviatoric stresses within the European lithosphere. In the Alps, the Jurassic rifting is traditionally interpreted as a consequence of eastward drift of Africa and Adria and opening of the Central Atlantic ocean. In the Eastern Alps and Western Carpathians, however, Adria was separated from Europe by the Triassic Meliata-Hallstatt oceanic trough until the Late Jurassic. This ocean was subducted beneath the distal Adriatic margin during the Jurassic, therefore tensional forces could not be effectively transmitted across the subduction zone towards the eastern sector of the European margin. Therefore it is alternatively presumed that tensile stresses were generated by the subduction slab pull force of the Meliata-Hallstatt oceanic lithosphere operating within the lower, European plate of the convergence system along the NE Adriatic margin.

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