Two separated Lower Cretaceous basins in the Transdanubian Range, Hungary and their relation to the Eastern and Southern Alps

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The Transdanubian Range is the only tectonic unit where the original connection between the North- and the South-Alpine facies connection is preserved. The first signal for the stop of the more or less uniform development of the Transdanubian Range occured at the end of the Triassic. In the Bakony Mts continued the deposition of the platform carbonates in the Hettangian while the Gerecse (Eastern part of the Range) has been raised above the sea level at the end of the Triassic, the sedimentation started there in the Late Hettangian. Further on in the Jurassic the successions of the Bakony and the Gerecse Mts are similar. The basin is fragmented by submarine highs in the Early Jurassic. The sedimentation is more or less continuous in the basins while on the highs highly lacunose and condensed. Thanks to the rifting process of the Penninic ocean the tendency in both areas is the deepening till the end of the Middle Jurassic but the subsidence in the Bakony area was quicker than in the Gerecse. The result is that the first area became deep bathyal while the other one only shallow bathial.

Based on the Jurassic and Cretaceous formations in the axial (synclinal) part of the Transdanubian Range the Gerecse Basin is separated completely from the Bakony one in the Early Berriasian albeit the process started in the Late Tithonian already. In the South Bakony the pelagic Tithonian Szentiványhegy Limestone is replaced upward by the Maiolica or Biancone facies (Mogyorósdomb Limestone Fm) typical for the Southern Alps, while in the Gerecse the change is more complicated. In the Eastern Gerecse the Szentiványhegy Limestone is substituted by the Bersek Marl in the Early Berriasian while it lasted in the Western Gerecse until the Valanginian. As a consequence the formation of the Felsővadács Breccia as a product of an event at the boundary of the Berriasian/Valanginian it is found in the Bersek Marl in the Eastern Gerecse and in the Szentiványhegy Limestone in the Western Gerecse.

The result of the Eastward shallowing tendency is that the Berriasian-Hauterivian Mogyorósdomb Limestone is replaced by a crinoideal, ammonite and bivalve-bearing, highly condensed Borzavár Limestone restricted only for the Zirc Basin. The Biancone facies in the Southern Bakony turns into grey marl facies such as in the Karawanken.

The Lower Cretaceous in the Gerecse Mts is dominated by a coarsening upwards flysh type siliciclastic succession similar to the Rossfeld one and in part to the Inner Dinarides.

The two basins must have been united temporalily for the fist time in the Late Aptian when the crinoidal Tata Limestone covered the entire Bakony Mts and the Vértes Foreland and in part the Vértes Mts as well. This limestone is proved to be in the Tatabánya Basin and intercalated in the Lábatlan Sandstone as well.

The two basin separated again in the Early Albian (Austrian tectonic phase) when the whole Bakony Mts and is western continuation has been raised, strongly eroded, katsified and bauxite accumulated, as far as the sedimentation is continued in the Gerecse and in part of the Vértes Foreland. On the Western margin of the Gerecse and partly on the Vértes area restricted basinal facies developed which interfinger with the lower rudisted Urgonian limestone restricted for a few km broad zone only.

The large part of the Albian bauxite is covered by fluvial, lacustrine and later brackish-water – predominantly pelitic and marly sediments (Tés Clay Fm) in the Bakony Mts. The marine invasion came from the Gerecse the northern foreland of which platform carbonate existed since the Berriasian. The Tés Clay is overlain by the beds of the 2nd Urgonian limestone succession which was deepening step by step. In the Late Albian - Cenomanian time the entire Transdanubia Range but at least ist synclinal part has been flooded again thanks to the global sea level rise. After a long period when the fundamental differences

between the two part of the Transdanubian Range North-Alpine and the South-Alpine origin ceased.

Late Cretaceous bimodal igneous association of the northern Kozara Mts. revisited: New geochemical data serving for refined geodynamic interpretations

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The recent interpretations suggest that the Sava-Vardar (SVZ) is a relic of the youngest Tethyan realm in the present-day Balkan area, which left behind after Upper Jurassic closure of the West and East Vardar domains. The SVZ supposedly represents the last suture between the Tisza/Dacia and Dinarides acting as upper and lower plate, respectively. One of the best exposed SVZ segments is found on the Kozara Mts. (northern Bosnia and Herzegovina). We here report and discuss new geochemical data on igneous rocks of the northern Kozara Mts. in order to further constrain their geotectonic setting and with special emphasis on the petrogenetical link between the basic and acid rock suite.

The northern Kozara Mts. bimodal igneous association is thrust onto the West Vardar ophiolites of the southern Kozara Mts. and is unconformably overlain by Late Cretaceous-Paleogene fluvial siliciclastic sediments. It consists of isotropic to layered gabbro, diabase dykes and basaltic pillow lavas and hyaloclastites, as well as of relicts of rhyodacite-rhyolite lava flows and extrusions and subordinate small-scale granitoid intrusions representing basic (BS) and acid suite (AS), respectively. We analyzed 13 samples of the BS and 11 samples of the AS on major and trace element concentrations (including rare earth elements – REE) in the ACME Laboratories Ltd. Vancouver (Canada). A vast majority of the studied rocks show silica contents <53 wt % or >64 wt % SiO_2. The BS and AS rocks show different trends on Harker's diagrams with SiO_2 as index of differentiation. Thus, Al_2O_3, P_2O_5 and TiO_2 contents in the BS rocks mostly increase with increasing silica concentrations, while in the AS rocks the opposite trend is observed. On the chondrite- and primitive mantle-normalized diagrams for REE and incompatible trace elements, respectively, the BS rocks show relatively flat to moderately light-REE enriched patterns with no or weak negative Eu-anomaly. The AS rocks exhibit steeper patterns and have distinctively more pronounced Eu- and Sr- negative anomalies. Compared to the known intra-ophiolitic granitoids from the Eastern Vardar Zone, the AS rocks show geochemical similarities to oceanic plagiogranites.

These new geochemical data confirm earlier opinions that the BS rocks of the northern Kozara Mts. neither derived from pure mid-ocean ridge basalts (MORB) nor from volcanic arc basaltic magmas. This conclusion appears to be robust even taking into consideration that most BS rocks crystallized from evolved magmas. Moreover, it is suggested that the BS primary magmas probably correspond more to enriched MORB (or to MORB+EMORB) than to typical ocean island basalts. On the other hand, geochemical characteristics of the AS rocks indicate that their primary magmas most probably originated via partial melting of the altered gabbros from the lower oceanic crust. Main geodynamic implications of our study are, first, that it confirms the oceanic nature of the northern Kozara Mts. rock assemblage, and second, that it could have formed within an anomalous ridge setting similar to present-day Iceland. We therefore challenge previous interpretations that the northern Kozara Mts. ophiolites are relicts of an oceanic plateaux from a wide oceanic area.

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