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16th Emile Argand Conference
Alpine Workshop
16-18 September 2024 - Siena, Italy

alpshop2024-38, updated on 20 Aug 2024
16th Emile Argand Conference on Alpine Geological Studies

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The complex geodynamic evolution of the northernmost Neotethys is the subject of ongoing controversy. Key issues revolve around the waning stages of the Tethyan ocean(s) in the Balkans and the timing of the Europe-Adria collision. Some researchers propose that this collision occurred in the Late Jurassic, while others argue it happened at the end of the Cretaceous along the Sava Zone. The latter hypothesis suggests that the Cretaceous Sava Ocean is a remnant of the youngest Tethyan oceanic realm, left behind after a major convergence in the Jurassic.

In this study, we present recent findings from magmatic, sedimentary, and basement formations within the Sava Zone. Our goal is to constrain the timing, origin, geodynamic environment, and lifespan of the purported Cretaceous Sava Ocean. The central scientific question we address is whether the Sava Zone represents: (i) a relic of the Neo-Tethyan Ocean that closed in the late Cretaceous, or (ii) a diffuse tectonic boundary between earlier collided Gondwana-related blocks and Europe, characterized by a system of pull-apart basins and transtensional tectonics.

Cretaceous igneous formations are found on both sides of the Sava-Vardar suture Zone, in the Dinarides (Gondwana) and Serbian-Macedonian Mass (Europe). These formations predominantly consist of basalts, with subordinate occurrences of lamprophyres, trachybasalts, and andesites, none of which exhibit ophiolitic geochemical characteristics. They show heterogeneous geochemical affinities, primarily derived from (metasomatized) continental lithospheric mantle. Notably, there are clear geochemical differences between the lavas in the Dinarides (depleted) and those in Europe (enriched due to metasomatism).

Our recent zircon provenance data from Cretaceous sediments in the Sava Zone offer new insights into the closure of the Tethys in the Balkans. We first analysed numerous zircon grains from various basement units. Our results indicate that zircons from both the Dinarides and Europe contain ubiquitous Neoproterozoic (Cadomian) and well-defined Silurian-Ordovician (±Devonian) populations. Carboniferous (Hercynian) zircons (>300 Ma) are predominant on the European side, whereas they are somewhat younger (~300 Ma) in the Dinarides. Permotriassic zircons constitute the strongest geochronological signal in all examined Dinarides samples (Africa) likely representing a ubiquitous signal in all Gondwana-affinity units in the Balkans, but are absent on the European side.

Our zircon provenance data from Cretaceous formations in the Sava-Vardar suture Zone show the ubiquitous presence of Permotriassic zircons, constituting the strongest geochronological signal in all samples. If our findings are correct, the basin on the European margin was partially filled from the Adriatic side during the Lower Cretaceous, which suggests the non-existence of a vast (>350 km) Sava (Tethys) Ocean.

Acknowledgement: This research was financed by the Science Fund of the Republic of Serbia through project RECON TETHYS (7744807).