Paleogene-Early Miocene Igneous Rocks and Geodynamics of the Alpine-Carpathian-Pannonian-Dinaric Region: an Integrated Approach

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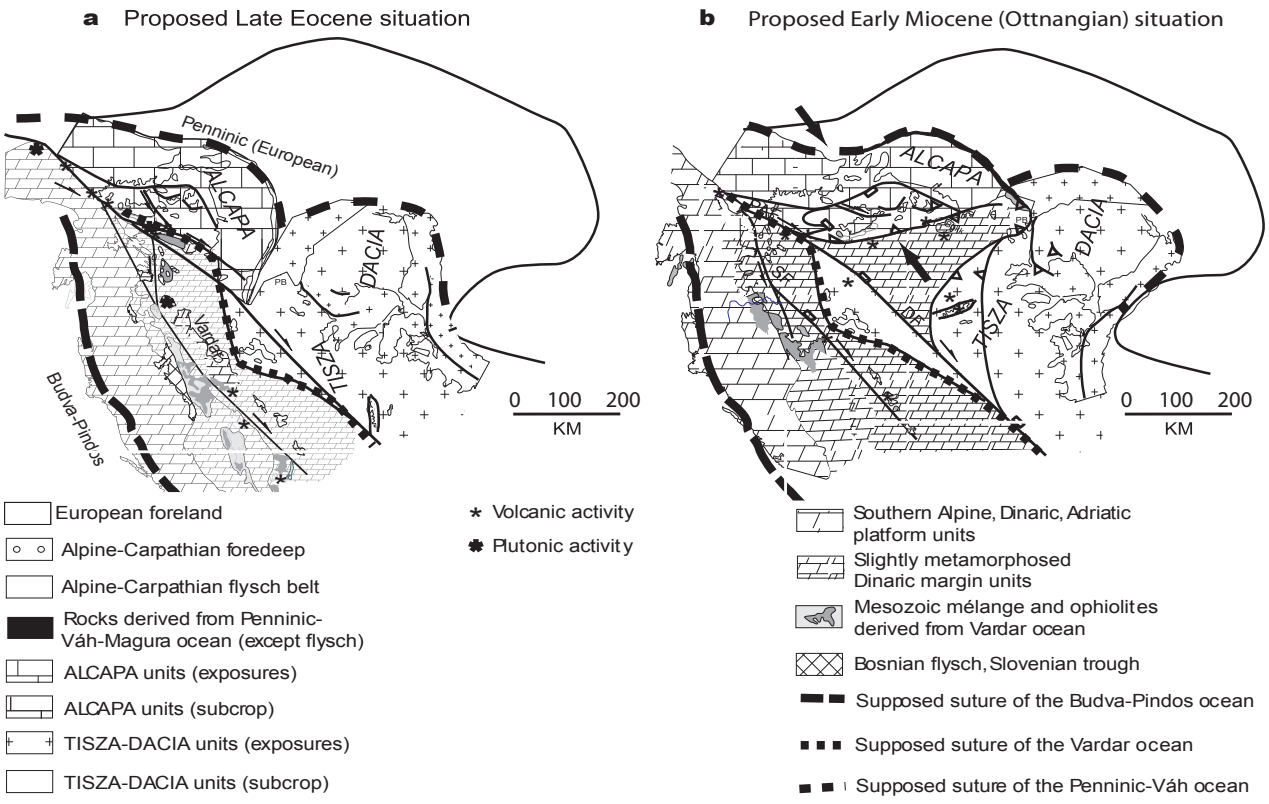
We attempt to reveal the geodynamic link between Paleogene-Early Miocene igneous rocks of the Mid-Hungarian zone and those of the Alps and Dinarides. Our summary suggests that the Paleogene-Early Miocene igneous suite in all studied igneous provinces of the Alps, Carpathians, Pannonian Basin and Dinarides was formed in the same time interval, with three peak episodes of magmatic activity in the Eocene, Late-Eocene-Early Oligocene and Late Oligocene-Early Miocene. The studied igneous rocks have similar geochemistry and petrology, which shows a subduction-related character. The magmatic belt along the Periadriatic zone can be followed along the Balaton fault, on the northern margin of the Mid-Hungarian zone to the Bükk Mts. (N Hungary). This continuity is supported by well-correlated Mesozoic and Paleogene-Early Miocene sedimentary sequence assemblages, forming the basement of these magmatic bodies (Fig. 1). On the other hand, these North Hungarian country rocks have their counterparts in the internal zone of the Dinarides, along the Sava-Vardar Zone, that also host similar magmatic rocks. We, therefore, suggest that all the Paleogene-Early Miocene magmatic rocks of the studied region are closely related and have a common, subduction-related origin (Fig. 1).

The study also highlights orthopyroxene-rich websterite mantle xenoliths from Western Hungary (Bakony-Balaton Highland) and East Serbia that was formed in the vicinity of a subducted slab. These orthopyroxene-rich websterite mantle xenoliths have common petrographic and geochemical signatures.



■ **Fig. 1.** Tectonic reconstruction of the Alpine-Carpathian-Pannonian-Dinaric region.

These mantle rocks must have formed close to a subduction in a fore-arc setting. The closest subduction scar to both occurrences is that of the Vardar Ocean.

We discuss the location and polarity of all potential subduction zones of the area that may account for the igneous rocks and orthopyroxene-rich mantle rocks. Results of seismic tomography on subducted slabs beneath the studied area combined with geological data demonstrate that igneous rocks and mantle rocks may not be explained by the same subduction process. Instead, we propose that the western portion of igneous rocks in the Periadriatic zone is related to the Penninic subduction, whereas most of their Paleogene-Early Miocene counterparts in the Mid-Hungarian and Sava-Vardar zone could have originated from the Budva Pindos subduction. The most likely solution is that these oppositely dipping and synchronous subductions relayed each other and accommodated together the Europe-Africa convergence during the Paleogene.

The present diverging shape of the proposed arc has been achieved by considerable shear and rotations of major continental blocks. The Paleogene magmatic belt was strongly affected by lithospheric scale, arc-parallel, right lateral strike slip shear. This shear was initiated in the Late Eocene but maximum motion was achieved during Oligocene. The fault-induced pervasive fracturing could have localized magmatic activity, and vice versa, the heat impulse of the magmatic activity could have rheologically softened the country rocks and rendered them more easily deformable. This second case is strongly suggested for the Mid-Hungarian zone, which must have experienced highly intense deformations during the Early Miocene rotations (Fig. 1).

The occurrence of Late Oligocene-Early Miocene and also a part of the Middle Miocene-subrecent igneous rocks along the Mid-Hungarian zone in the Pannonian Basin match with those of the Late Eocene-Early Oligocene igneous rocks. We speculate that the genesis and ascent of Late Oligocene-Early Miocene magmas was initiated when the rotations took place. Thus, the rotated blocks could have also brought their earlier metasomatized lower lithosphere into the Carpathian embayment. The large volume of Early Miocene magmatic rocks associated with the Mid-Hungarian zone also suggests that the ascent of these magmas was controlled or facilitated by the most deformed part of this structural zone. Furthermore, a part of Middle Miocene igneous rocks close to the Paleogene-Early Miocene igneous rocks might have had the same subduction-related mantle source that had been transported to its present position from the former Paleogene arc. Consequently, it is proposed here that the same enriched mantle source could be reactivated several times during its geodynamic evolution providing different styles of volcanics depending on the process responsible for magma generation.

Reference

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Depositional Systems and Lithofacies of the Zlín Formation near the Contact between the Bystrica and Rača Units (Magura Nappe, Outer Carpathians, Eastern Slovakia)

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Magura basin has a complex tectono-sedimentary history with several phases of its evolution. Tectonic activity and sea-level changes controlled the sedimentary supply to the basin and induced formation of individual depositional elements and their migration in time and space.

Geological mapping (Žec et al. 2005) and detail sedimentological analysis on selected, relatively well exposed profiles revealed the significant differences between sedimentary character of Zlín Formation in Bystrica and Rača Units near their contact. Studied area is situated between Oľka and Laborec river valleys in the eastern Slovakia. Stratigraphic range of the Zlín Formation in the area is from the upper part of the Middle Eocene up to the Late Eocene. The formation is developed in overlayer of the Early to Middle Eocene Beloveža Formation which sedimentary conditions were affected by the subsidence and sea-level rise. During the uppermost Middle Eocene and Late Eocene, a significant uplift in the Magura basin was recorded (e.g. Oszczypko et al. 2003). This event influenced the sedimentary conditions in the area and triggered origin of depositional elements of the Zlín Formation.

The Zlín Formation of Bystrica Unit is characterized by higher sand/mud ratio (usually > 2) and the coarse-grained lithofacies resemble to those from Krynica unit (Strihovce Formation sandstones). Medium- to coarse-grained sandstones (lithofacies B1.1 sensu Pickering et al. 1986) are laterally continuous and often amalgamated. Grading is absent or poorly developed