Temporal evolution of the Cenozoic magmatism in WSW Bulgaria and SE Macedonia; crustal thickness control on zircon populations and whole-rock $^{87}\text{Sr}/^{86}\text{Sr} - ^{143}\text{Nd}/^{144}\text{Nd}$ ratios

Temпорална еволюция на кайнозойския магматизъм в ЗЮЗ България и ЮИ Македония; контрол на дебелината на кората върху цирконовите популяции и $^{87}\text{Sr}/^{86}\text{Sr} - ^{143}\text{Nd}/^{144}\text{Nd}$ отношения

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We present new, preliminary Sr and Nd isotope data and U-Pb zircon ages for Cenozoic magmatic rocks along a NNE–SSW transect trough WSW Bulgaria and SE Macedonia, characterized by highly variable crustal thickness (Boykova et al., 1999). Seventeen rock samples for zircon age dating and 25 samples for isotopic studies were collected (Fig. 1). U-Pb LA-ICP-MS ages were acquired in the Geological institute of BAS and whole-rock $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ ratios were obtained in ETH–Zurich using Triton ID–TIMS.

The LA-ICP-MS zircon ages supports and contributes the idea for general younging of the magmatism from NNE to SSW, a regularity noticed by Boev and Yanev (2001 and references there in). The oldest studied rocks are the rhyolites of Visoka Elha volcano dated at 39.86±0.44 Ma. Further SSW, the volcanic and subvolcanic rocks between the villages of Padesh, Kresna, and Gorna Breznitsa, and Dautovo granites (Pirin Mountain), which are underlain by the thickest crust (49.5–48 km) exhibit the most radiogenic $^{87}\text{Sr}/^{86}\text{Sr}$ (0.71413–0.71558) and least radiogenic $^{143}\text{Nd}/^{144}\text{Nd}$ (0.51220–0.51227) isotopic ratios. Additionally, their zircon populations contain a number of xeno-grains and inherited cores. Kresna, Razdol and Karnalovo volcanics in Bulgaria and, particularly, Ilovitsa, Buchim–Borov Dol and Kratovo–Zletovo volcanic areas in Macedonia, located on progressively thinner continental crust (39–34.5 km) contain rocks with lower $^{87}\text{Sr}/^{86}\text{Sr}$ and higher $^{143}\text{Nd}/^{144}\text{Nd}$ ratios suggesting decreasing crustal input. The zircon populations consist of less number of inherited cores and xeno-grains. The rhyolites of Visoka Elha have lower $^{87}\text{Sr}/^{86}\text{Sr}$ (0.70557) ratio and large population of Cretaceous zircons, suggesting assimilation of Upper Cretaceous igneous rocks. The Miocene Kozhuh trachydacite also has lower $^{87}\text{Sr}/^{86}\text{Sr}$ (0.70643) which is more likely due to fractionation of a mantle-derived magma with moderate crustal assimilation.

The magmatic rocks in the transect show considerable isotopic and age variations. Paleogene rocks, except Visoka Elha, show a clear correlation between Sr and Nd isotopes and crustal thickness, accompanied by changes in the acid/intermediate rock proportions. The volcanic rocks near to the villages Padesh, Kresna, and Gorna Breznitsa, and Dautovo granites (Pirin Mountain), which are underlain by the thickest crust (49.5–48 km) exhibit the most radiogenic $^{87}\text{Sr}/^{86}\text{Sr}$ (0.71413–0.71558) and least radiogenic $^{143}\text{Nd}/^{144}\text{Nd}$ (0.51220–0.51227) isotopic ratios. Additionally, their zircon populations contain a number of xeno-grains and inherited cores. Kresna, Razdol and Karnalovo volcanics in Bulgaria and, particularly, Ilovitsa, Buchim–Borov Dol and Kratovo-Zletovo volcanic areas in Macedonia, located on progressively thinner continental crust (39–34.5 km) contain rocks with lower $^{87}\text{Sr}/^{86}\text{Sr}$ and higher $^{143}\text{Nd}/^{144}\text{Nd}$ ratios suggesting decreasing crustal input. The zircon populations consist of less number of inherited cores and xeno-grains. The rhyolites of Visoka Elha have lower $^{87}\text{Sr}/^{86}\text{Sr}$ (0.70557) ratio and large population of Cretaceous zircons, suggesting assimilation of Upper Cretaceous igneous rocks. The Miocene Kozhuh trachydacite also has lower $^{87}\text{Sr}/^{86}\text{Sr}$ (0.70643) which is more likely due to fractionation of a mantle-derived magma with moderate crustal assimilation.

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References


Fig. 1. A, Sketch of the Cenozoic magmatic rocks in WSW Bulgaria and SE Macedonia; B, Relationship between $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ ratios and Moho discontinuity; C, Diagram of zircon populations; D, Temporal diagram for the Cenozoic magmatic rocks studied. The contours of Moho discontinuity are after Boykova (1999).