

Transect through the Cenozoic magmatism in WSW Bulgaria and Macedonia from Pirin Mountain to Kozhuf: temporal and isotope geochemistry constraints

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Closing of Vardar Ocean at the Late Cretaceous to Early Cenozoic was followed by collision which caused thickening of the crust under the Morava-Rhodope zone (in Pirin region nowadays it is 49.5–48 km). We present new, preliminary Sr and Nd isotope data and U-Pb zircon ages for Cenozoic magmatic rocks along a NNE–SSW transect through WSW Bulgaria and SE Macedonia, characterized by highly variable crustal thickness. The study is based on U-Pb LA-ICP-MS zircon dating acquired in the Geological institute of BAS and zircon dating and whole-rock $^{87}\text{Sr}/^{86}\text{Sr}_{(i)}$ and $^{143}\text{Nd}/^{144}\text{Nd}_{(i)}$ ratios obtained in ETH–Zurich using Triton ID–TIMS.

The zircon ages support and contribute the idea for general rejuvenation of the Cenozoic magmatism from NNE to SSW. The oldest studied rocks (39.86 ± 0.44 Ma) are the rhyolites of Visoka Elha that crop out to the north-easternmost part of the transect. Further SSW, the volcanic and subvolcanic rocks between the villages of Padesh and Kresna and the granitoides of North Pirin pluton represent a volcano-plutonic system with older plutonic rocks (35.2–34 Ma) and somewhat younger volcanic activity (33.75–31.64 Ma). Further south, the volcanic and subvolcanic rocks near to the villages of Razdol, Krastiltsi and Karnalovo are dated between 31.83–30.80 Ma and to the WSW the subvolcanic bodies and dykes near to Ilovitsa village are in the interval of 30–28 Ma. The volcanic rocks in Kratovo-Zletovo and Buchim–Borov dol areas in Macedonia, located to the WSW, show ages between 31–24.8 Ma and 23.74–23.52 Ma, respectively. The youngest are the south-easternmost situated trachydacites of Kozhuf – 5.64 ± 0.025 Ma. The Kozhuf trachydacites, in Bulgarian territory, yielded age of 12.11 ± 0.57 Ma and represent separate Neogene episode of extensional magmatism.

The magmatic rocks in the transect show considerable isotopic and age variations. The volcanic and subvolcanic rocks near to the villages of Padesh and Kresna, and the granitoides of the North Pirin pluton, which are underlain by the thickest crust (49.5–48 km), exhibit the most radiogenic $^{87}\text{Sr}/^{86}\text{Sr}_{(i)}$ (0.71413–0.71558) and least radiogenic $^{143}\text{Nd}/^{144}\text{Nd}_{(i)}$ (0.51220–0.51227) isotopic ratios. Additionally, their zircon populations contain a great number of xeno-grains and inherited cores. Razdol and Karnalovo volcanic and subvolcanic rocks 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) have lower $^{87}\text{Sr}/^{86}\text{Sr}_{(i)}$ and higher $^{143}\text{Nd}/^{144}\text{Nd}_{(i)}$ ratios suggesting decreasing crustal input. The assimilation of crustal material decreases with the decreasing crustal thickness which reflects on the zircon populations that consist of propagating less number of inherited cores and xeno-grains. The clear correlation between Sr and Nd isotopes and crustal thickness, accompanied by changes in the acid/intermediate rock proportions and decreasing of inherited component suggests that they are most probably formed in post-collisional setting after the main crustal thickening in the area studied. The rhyolites of Visoka Elha have low $^{87}\text{Sr}/^{86}\text{Sr}_{(i)}$ (0.70557) ratio and large population of Cretaceous zircons, suggesting more primitive affinity and assimilation of Upper Cretaceous igneous rocks. The Miocene Kozhuf trachydacite also has low $^{87}\text{Sr}/^{86}\text{Sr}_{(i)}$ (0.70643) which is more likely due to fractionation of a mantle-derived magma with moderate crustal assimilation. The high $^{87}\text{Sr}/^{86}\text{Sr}_{(i)}$ (0.70904) in the trachydacite of Kozhuf volcano in respect to that of the volcanic rocks of Kratovo-Zletovo (0.70482–0.70835) and Bucim-Borov dol areas (0.7067–0.7073) is most probably related to the metasomatism of the melting substrate due to the magmatism in the Kratovo-Zletovo and Buchim-Borov dol areas.