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Magma fertility and porphyry-epithermal mineralization: Insights from the northern part of the Central Srednogorie segment of the Late Cretaceous Apuseni-Banat-Timok-Srednogorie Magmatic and Metallogenic Belt

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The Late Cretaceous magmatism in the Apuseni–Banat–Timok–Srednogorie Magmatic and Metallogenic Belt is considered as a product of a continental margin magmatic arc. It results from the northward oblique subduction of the Vardar-Izmir Ocean beneath the Serbo-Macedonian and Rhodope massifs with southward shifting of the magmatic activity from 94 to 67 Ma, related to retreating of the subducted plate and slab roll-back. The present study is focused on the fertile magmatism in the northern part of the Central Srednogorie segment of the belt and the associated porphyry copper and epithermal Cu-Au systems – the Elatsite porphyry-copper deposit and several occurrences located to the north (Etropole, Gorna Kamenitsa and Praveshka Lakavitsa). The subvolcanic rocks are intermediate, high-K calc-alkaline in composition. On primitive-mantle normalized diagrams they show patters typical patterns for orogenic arc magmas. The rocks exhibit adakite-like characteristics related to amphibole fractionation with suppression of plagioclase crystallization. Lower crustal cognates (hornblendite, gabbro, gabbro-pegmatite) have been found in the Praveshka Lakavits area. They testify for the presence of a large lower crustal (27-30 km) juvenile water-saturated magma chamber, beneath the magmatic plumbing system. Amphibole geobarometry of the subvolcanic rocks infer crystallisation at middle (22-15 km) to upper (10-5 km) crustal levels. Numerous mafic enclaves indicate mingling, while reverse zonation and sieve textures in amphiboles, clinopyroxenes and plagioclaseds are indicative of magma mixing and cyclic magma chamber recharge processes. The presence of primary sulfide inclusions (pyrrhotite, chalcopyrite) in amphibole, clinopyroxene and plagioclase argue for sulfide saturation and sequestration during the early stages of magmatic evolution. LA-ICP-MS zircon dating, $^{87}Sr/^{86}Sr(i)$ and $\varepsilon Nd_{(i)}$ values of the subvolcanic rocks show slight rejuvenation and decrease of primitive affinity from north (Praveshka Lakavitsa subvolcanics: 93.11±0.38 Ma; 0.70435–0.70419; -0.78/0.38; cumulate cognates: 0.70350; +3.90) to south (Elatsite deposit 92.1±0.3 to 91.34±0.39; 0.70474 to 0.70450; -1.12/-0.95). CA-ID-TIMS dating of different porphyritic rocks bracket the porphyry copper mineralization at Elatsite between 92.329 ± 0.021 Ma and 92.050 ± 0.019 Ma, thus constraining the entire lifespan for ore-forming magmatism and high-temperature hydrothermal activity over a maximum duration of 0.31 Ma.

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