ORIGIN, EVOLUTION AND GEOTECTONIC SETTING OF GRANITOID ROCKS OF CER MT. (WESTERN SERBIA)

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ABSTRACT

The central parts of the Balkan Peninsula in Serbia are characterized by intensive Tertiary magmatism occurring along the composite terranes of the Vardar Zone and the Serbo-Macedonian Massif (e.g. Karamata et al. 1999). The magmatism comprises volcanic rocks and numerous granitoids, and represents part of a regional Tertiary plutonic-volcanic belt stretching from the Periandria Line in the north and continuing through Serbia and further to the south-southeast in the north Greece.

Among the granitoid plutons, Cer Mt. pluton is found in western Serbia. Geotectonically, they occur at the junction of the northern Dinarides and southern Pannonian realm. Therefore, the understanding of their origin and evolution provides significant constraints on the geodynamic conditions which operated in this region during the Tertiary.

The Cer Mt. pluton is a laccolith-like composite intrusive body (~60 km²), which consists mainly of tonalite-monzodiorite (TMD) intruded by muscovite granite (MG). To the west it is accompanied by a smaller body (~7 km²), the Stražanica tonalite-granodiorite (TGDS). Available radiometric data (e.g. Peckskaj et al., 2001) suggest a ~30 Ma crystallization age for TMD and a ~20 Ma for both MG and TGDS. It is noteworthy that the MG and TGDS intrusives produced apparently wider contact-metamorphic aureoles in the adjacent Paleozoic meta-sandstones and meta-peilies than TMD.

TMD rocks consist of quartz, K-feldspar (Or~40), plagioclase (An13-15), biotite (Mg~0.5), tsermakite-magnesiosohornblende as main constituents, and titanite, allanite, epidote, zircon, apatite, rutile, magnetite and ilmenite as accessory minerals. Their SiO₂ contents ranges from 61 to 64 wt.% Cr, Y, Zr and Nb slightly decrease with differentiation, Rb, Pb and Th increase whereas Ni, La, Ce, Ba and Sr concentrations are scatter. (La/Lu)CN and YREE is 16-19 and 146-178, respectively. Eu/Eu* is constant ~0.75, Strontium isotopic initial ratios (⁶⁸Sr/⁶⁶Sr) range from 0.7080 to 0.7082 and εNd between ~3.8 and ~5.6.

MG is a muscovite-rich leucocratic rock-type. It is generally composed of quartz, K-feldspar (Or~50), plagioclase (An13-15) and muscovite (Cel~), as main minerals, with biotite, garnet, tourmaline, apatite and zircon as accessories. SiO₂ contents are mostly above 70 wt.%. Trace element variations are similar to those of TGDS, except for Ga, Nb and Ba, which form cross-cutting trends. MG rocks have (La/Lu)CN between 59 and 91 and the largest Eu anomaly (Eu/Eu*~0.48-0.65). (⁶⁸Sr/⁶⁶Sr) ratios for MG range 0.7197-0.7212 while εNd values are from ~3.3 to ~9.69.

TGDS is composed of quartz, plagioclase (An39-46), K-feldspar (Or~50) and biotite, as main minerals and zircon, allanite, apatite, muscovite, epidote and titanite as accessories. Its silica contents range from 67.5 to 70.5 wt.%. TGDS shows lower contents of most trace elements in comparison to TMD, (La/Lu)CN is 15-24, YREE contents range between 81 and 97 while Eu anomaly is apparently small (Eu/Eu*~0.81-0.97). (⁶⁸Sr/⁶⁶Sr) ratios and εNd values range 0.7068-0.7070 and ~3.89-~4.04, respectively.

Geochemical data coupled with geological evidence and radiometric ages suggest that TMD, TGDS and MG are not concomagmatic.
The evolution of TMD is dominated by AFC processes and that is inferred from major and trace element modelling, as well as from variations of isotopic composition. Major element geochemistry and isotopic ratios indicate that TMD could have originated within lower crust by melting of rocks of alkali-rich or aluminia-rich basaltic composition. These basalts may represent underplatings, i.e. mantle melts which mainly ponded near the crust-mantle boundary. Alternatively, TMD could have been evolved by modification of mantle-derived primary magmas. Although it would require a huge amount of fractionation, possibly at different pressure-conditions, the available data cannot exclude such a hypothesis.

The compositions of TGDS and MG are more akin to magmas generated by melting of amphibolite and gneiss, respectively, which, however, suggests a subsequent increasing of the role of higher crustal levels in their petrogenesis.

On discrimination diagrams based on trace element abundances and ratios TMD and TGDS mainly plot in the VAG-field, whereas MG occupy the field of syn-COLG. However, conventional discrimination diagrams are not enough informative in the case of post-collisional magmatism.

Although not enough constrained, the radiometric data suggests an age difference of around 10 Ma between TMD and TGDS, MG. The minimum crystallization pressure for rocks having hornblende was calculated, based on the Al-in-hornblende geobarometer, around 5 kb. This value and the fact that the adjacent schists were anchimetamorphosed imply that TMD started to consolidate considerably deep in the crust and emplaced at around 2-3 kb. This pressure is in accordance with its rather weak contact-metamorphic aureole. Much stronger contact-metamorphic effects were observed around TGDS and MG, which suggests shallower levels of emplacement of TGDS and MG with respect to TMD and in turn, requires a significant age difference necessary for uplift and erosion.

Assuming the differences in age and origin and evolution, discussed above, it may be concluded that TMD were related to different geodynamic conditions in comparison to TGDS and MG. TMD rocks of Cer Mt. bear similar age and compositional characteristics with other Serbian Oligocene-Early Miocene plutons occurring along the Varadar Zone. TMD originated either by melting of the lower crust or via multi-stage fractionation from basaltic magmas derived directly from upper mantle. In both cases this magmatism is likely related to post-collisional geodynamic conditions and orogen collapse. The same geotectonic setting has been recently proposed for the coeval basaltic magmatism in Serbia (Cvetković et al. in press). On the other hand, TGDS and MG derived from higher crustal levels suggesting a substantial stretching of the lithosphere. Such scenario, including the attenuation of the lithosphere, asthenospheric upwelling and extension, is generally accepted for the Early/Middle Miocene acid volcanism of the Pannonian basin (e.g. Póka et al., 1998).

In summary, the composite Cer Mt. pluton is an example where different granitoid rocks provide evidence of the change of tectonic styles along the present junction of the northern Dinarides and southern Pannonian basin. TMD originated during the collapse of the Dinaride orogen as other Oligocene/Early Miocene plutons in Serbia. TGDS and MG formed in response to the Pannonian collapse and they delineate the southern limit where this extension-related acid magmatism occurs.

REFERENCES


