

MINERAL ASSEMBLAGES AND CRYSTALLIZATION OF THE KOSMAJ GRANITOIDS AND ITS ENCLAVES (SERBIA)

GAJIĆ, B.¹ & VASKOVIĆ, N.²

¹ Faculty of Forestry, University of Belgrade, Kneza Visislava 1, YU-11000 Belgrade, Yugoslavia.

E-mail: bgajic1@infosky.net

² Faculty of Mining and Geology, University of Belgrade, Djušina 7, YU-11000 Belgrade, Yugoslavia.

On the southwestern slopes of the Mt. Kosmaj (North Sumadija, Serbia) in an area of about 2.5 km² a few smaller or larger outcrops of granitic rocks are discovered. These occurrences expose a part of a granitoid pluton that intruded during Oligocene (29–30 Ma) into Upper Cretaceous flysch sediments. The pluton occurs in the Vardar Zone Composite Terrane (KARAMATA & KRSTIC, 1996). Its intrusion caused a 400–550 °C thermal contact aureole over an area of about 11 km² at a pressure of 0.5–1.5 kbar. Among the mentioned granitoid occurrences the most interesting one is outcropping in the Radovac creek and its tributaries and can be traced for about 1 km. It is characterized by a number of mafic igneous enclaves and fragments of contact metamorphosed flysch sediments.

The granitoid rocks are medium- to fine-grained with megacrysts of K-feldspar (1–6 cm in length). The main mineral constituents are K-feldspar (Or_{70.5-92.8}), rarely micropertite and mirmekite, plagioclase (An_{39.7-14.8}), quartz, amphiboles (magnesian-hornblende, edenite, actinolitic hornblende, actinolite, X_{Mg} = 0.63–0.75), biotite (X_{Mg} = 0.53–0.57), and accessories are zircon, apatite, titanite and magnetite. According to major element composition these rocks correspond to granodiorite (GRD) and tonalite (TON).

The mostly elliptic mafic igneous enclaves are irregularly distributed throughout the exposed mass. The enclaves usually have a size of 1–10 cm. Their structure is quite different from that of the incorporating granitoids: fine-grained or porphyritic. They are composed of plagioclase (An_{51.8-21.8}), K-feldspar (Or_{79.85}), quartz, amphibole (magnesian-hornblende, actinolitic hornblende; X_{Mg} = 0.65–0.76), biotite (X_{Mg} = 0.53–0.59); accessories are titanite, apatite and magnetite. Major element composition exhibits monzodioritic (MD) and dioritic (D) character.

Pressure of 0.5 to 1.5 kbar and temperatures from 668 to 529 °C were calculated for GRD and TON and 740–620 °C for the MD enclaves, using hornblende and co-existing hornblende and plagioclase compositions, respectively. The two feldspar geothermometer was calculated applying an average pressure of 0.5 to 1.5 kbar. The calculated temperatures range between 583 and 565 °C (± 50 °C) for GDR and 648–573 °C (± 50 °C) for MD enclaves. These temperatures are lower than those calculated for the equilibrium of the amphibole–plagioclase assemblage and

can be considered as the temperature at which GRD and MD magmas were completely crystallized or as a temperature of re-equilibration.

The thermo-sensitive cation content in amphiboles (Ti and Al^{IV}) projected on the empirical temperature scale of NABELEK & LINDSEY (1985) showed that temperatures are not significantly different from those calculated from the amphibole–plagioclase geothermometer.

In order to place thermal constraints on the late-magmatic crystallization at excess fluid composition CIPW normative of the Ab, Or, Qtz components of the Kosmaj granitoid rocks were projected via an into the ternary residual system for P_{H₂O} = 3 kbar (JOHANNES, 1985). MD and D enclaves plot above the binary Ab-Or minimum (765 °C) and close to M₂, indicating lower water pressure (1–2 kbar). However, plotting these data on to haplogranite diagram of P_{H₂O} = 2 kbar and a_{H₂O} = 1 (HOLTZ *et al.*, 1992) results in a little bit different temperatures, suggesting plagioclase fractionation joined by alkali-feldspar in the porphyritic types. Cotectic near minimum composition in rocks with An < 28% indicates water-excess crystallization which probably did not exceed 3 vol. % at temperatures between 720 and 680 °C.

The obtained results suggest that the main rock type (granodiorite) of the Kosmaj pluton crystallized in the temperature range of 640 ± 70 °C, and enclaves in the temperature range of 760 ± 20 °C, under the pressure range of 0.5 to 1.5 kbar, indicating shallow-level emplacement (cca. 1.5 to 3 km) and consolidation under H₂O-saturated conditions.

References

- HOLLAND, T. & BLUNDY, J. (1994). *Contrib. Mineral. Petrol.*, 116: 433-447.
HOLTZ *et al.* (1992). *Amer. Mineral.*, 72: 321-239.
JOHANNES, W. (1985): In "Migmatites" (Ed. Ashwort, J.R.), Blackie, 36-85.
KARAMATA, S. & KRSTIC, B. (1996): In "Terranes of Serbia and neighbouring areas" 25-40.
NABELEK, C. R. & LINDSEY, D. H. (1985). *Geol. Soc. Am. Prog. Abst.* 68384, 673.