TERTIARY POST–COLLISION GRANITOID OF Mt. KOPAONIK (SERBIA) – PETROGENETIC CONSTRAINTS BASED ON NEW GEOCHEMICAL DATA

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Abstract: First microprobe and XRF data on granitoids of the main mass of Mt. Kopaonik and from the mass of Drenje are presented and discussed. In the Mt. Kopaonik pluton three types and in the Drenje mass one type of mafic enclaves are distinguished. Within the all litologies there is a similar trend of variations of TiO_2, FeO^t, MgO, CaO and Co and V (all compatible) with some differences in K_2O, Rb, Ba and Sr (incompatible) and Zr and La (scattered). This data set is suggestive for a co-magmatic evolution of Mt. Kopaonik and Drenje masses, which is conflicting with available radiometric ages.

Key words: Granitoid, Geochemistry, Post-collision, Dinarides, Balkan Peninsula

INTRODUCTION

Tertiary granitoid rocks of Mt. Kopaonik belong to the Dinaride granitoid suite of the Late Paleogene/Early Neogene calc-alkaline igneous formation of the Serbian part of the Balkan Peninsula (Cvetković et al., 2000, 2001) which continues in southern Bulgaria (e.g. Boncev, 1980; Cvetković et al., 1995) and northern Greece (e.g. Eleftheriadis, 1995; Christofides et al., 1998). Based mainly on evidence from other intrusives, for instance the massive of Boranja or Oligocene granitoids of Mt. Cer and Mt. Bukulja (Steiger et al., 1989; Karamata et al., 1992; Knežević et al., 1994; Cvetković et al., this volume), it is generally believed that this magmatism occurred in a post-collision geotectonic setting, which followed eastward convergent processes. This plutonic activity was contemporaneous to dextral transcurrent movements, wrench tectonics and formation of lacustrine basins along the central axis of the Balkan Peninsula (Marović et al., 2000).

Earlier investigations of Mt. Kopaonik granitoids dealt mainly with rock petrography (Dimitrijević & Dragić, 1957; Stefanović & Pavlović, 1960; Mićić, 1980) and age determinations (Karamata et al., 1992). Here we present the first data on mineral chemistry and XRF analyses on major and trace element of rock samples from the main mass of the Mt. Kopaonik pluton as well as of the adjacent mass of Drenje.

GEOLOGY, AGE AND PETROGRAPHY OF GRANITOID ROCKS OF Mt. KOPAONIK

Geotectonically, the Mt. Kopaonik intrusives belong to a sub-unit of the Vardar Zone. It is distinguished as the Kopaonik block/terrane (Dimitrijević, 1995; Karamata, 1995 and references therein) and characterized by specific Paleozoic/Mesozoic evolution. In the wide area of Mt. Kopaonik occur the main granitoid mass, which is accompanied by comparatively smaller mass of Kremići in the west and several tiny bodies near Brzeće in the east. Karamata et al. (1992) reported Oligocene age (K/Ar ages range 29-35 Ma) for all of them and considered all the adjacent occurrences as satellite bodies of the main intrusion of Mt. Kopaonik. However, to the north of Mt. Kopaonik occurs the granitoid of Drenje, which is believed to be Miocene in age (18-22 Ma – Delaloye et al., 1989). The spatial distribution of granitoid rocks at Mt. Kopaonik is given in Fig. 1.

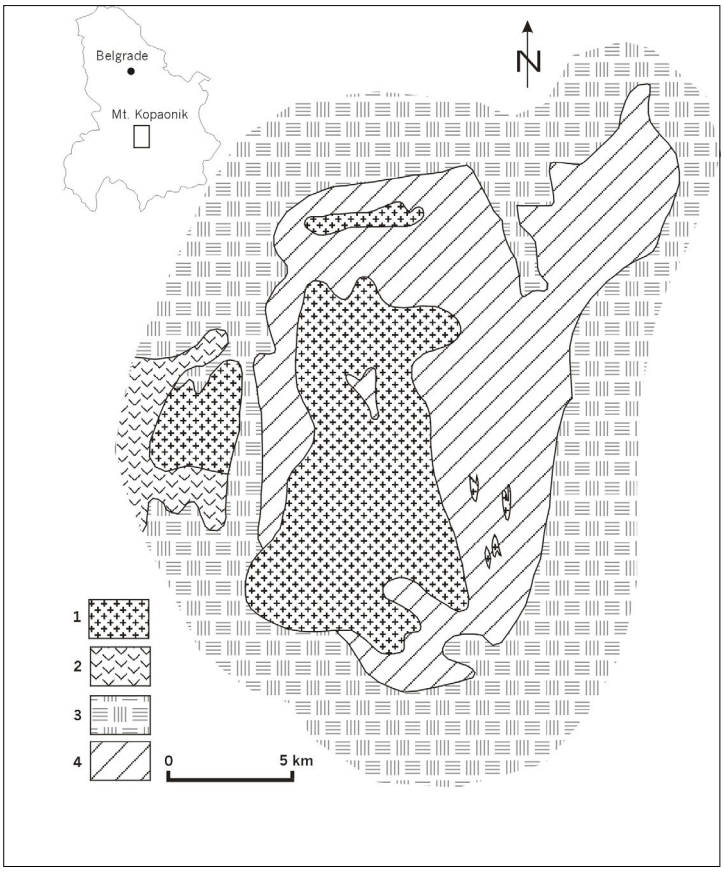

Fig. 1. Simplified geological sketch of the Mt. Kopaonik area; EXPLANATION: 1 – Paleozoic; 2 – Jurassic peridotites; 3 – Tertiary volcanics; 4 – Granitoid massive of Mt. Kopaonik

The main granitoid mass of Mt. Kopaonik is a N-S elongated pluton intruded into a northward dipping anticline made of Paleozoic series. This series is composed of deep-water Carboniferous clastic sediments and is overlain by Lower Triassic continental slope clastites and rare limestones and volcanics, which grade into Upper Triassic limestones and dolomites. In the SE the main granitoid mass of Mt. Kopaonik contact-metamorphosed pelitic and calcareous sediments under conditions of P≈1-2 kb and T≈550°C (Knežević et al., 1995). The main Mt. Kopaonik intrusive displays a zonal distribution of rock types. The southernmost part of the pluton (i.e. the deepest parts) is represented by porphyritic granodiorite and quartzmonzonite, the middle part by mostly equigranular granodiorite and the northernmost part (the shallowest facies) by fine-grained granodiorite to quartzdiorite. All field relations among the facies appear to be transitional except in the northernmost area where irregular bodies and dykes of quartzdiorite and diorite composition often cut the granodiorite host. In general, granitoid rocks of the main mass of Mt. Kopaonik consist of quartz, andesine, K-feldspar ($Or_{>86}$), biotite (Mg# around 55) and magnesiohornblende as main and titanite, epidote, allanite, apatite, zircon and magnetite as accessory minerals. Porphyritic texture is developed through the appearance of large microperthitic K-feldspar grains often as large as 3x5 cm, sometimes containing circular arrays of tiny inclusions of opaque crystals. Transitions between more and less mafic facies are mostly gradual but at places evidence of the coexistence of two different magmas (crystal mushes?) is found (e.g. sharp but irregular contacts between compositionally different facies, large K-feldspar grains enclosed in a more mafic domain, etc.). Besides, different types of rounded to subrounded cm-dm sized enclaves are found. They range from micro granular to porphyritic and slightly more mafic than the host to equigranular mafic enclaves in which usuallz hornblende is more abundant than biotite.

The granodiorite mass of Drenje crops out as a rather small and E-W elongated body composed of hypidiomorphic equigranular rock with quartz, andesine, microclinized K-feldspar, hornblende and biotite as main minerals and titanite, epidote, magnetite and zircon as usual accessories. Rounded to sub-angular, dm-cm sized, enclaves of slightly more mafic composition than the host are frequent. With respect to mineral composition (higher modal contents of dark minerals and higher Mg# in biotite and magnesiohornblende (around 65 and 75, respectively) and rock chemistry (discussed below) these enclaves are akin to

quartzdiorite dykes and similar enclaves occurring in the northernmost area of the main mass of Mt. Kopaonik.

DISCUSSION OF GEOCHEMICAL DATA AND CONCLUDING REMARKS

Localities and short a petrographic description of analyzed samples and the Q'-ANOR classification diagram are given in Table and in Fig. 2, respectively. Thirteen samples from the main mass of Mt. Kopaonik are represented by three types of enclaves, ranging in composition from diorite to quartzsyenite, their granitoid host (both porphyritic and equigranular, granodiorite in character), and diorite/quartzdiorite mafic dykes from the northernmost part of the pluton. In addition, five samples are taken from the outcrops in the Drenje Gorge, one is the host rock classified as quartzmonzodiorite and four are mafic enclaves corresponding to quartzdiorite (except one plotting in the monzodiorite/monzogabbro field).Most major and some trace elements on selected Harker's diagrams (Fig. 3) display a similar variation pattern. It is suggestive of a co-magmatic relationship among the all rock types discussed here implying that they derived from a common parental magma via evolutive processes. It is especially indicated by the mode of variations of TiO_2,

Table. Localities and petrography of analyzed granitoid samples from the main mass of Mt. Kopaonik and from the Drenje mass (* symbols used in Figs 2 and 3)

No	*	Locality	Petrography
K6/1	□	Kopaonik, southern part	Microgranular/porphyritic enclave of mineral composition similar to or slightly more mafic than the granodiorite host
K6/2			
K7/1 A	■		Hbl-Bt granodiorite, porphyritic, host rock
K7/1 B	◆		Hbl (±Bt) coarse grained, sometimes porphyritic mafic enclave; often irregular contacts with the host, sometimes enclosing large K-F crystals
K7/1 C			
K7/4			
K11/1	▲	Kopaonik, middle part	Bt-Hbl equigranular mafic enclave
K11/1D			
K11/2	△		Hbl-Bt granodiorite host, hypidiomorphic equigranular
K11/10			
K12	○	Kopaonik, northern part	Hbl-Bt granodiorite/quartzdiorite dykes
K17			
D1	+	Drenje, outcrops in the Drenje Gorge	Hbl-Bt granodiorite, equigranular, host rock
D4	×		Hbl-Bt mafic enclaves within granodioritic host granodioritic to quartzdioritic in composition
D5			
D6			
D7			

FeO^t, MgO, CaO as well as Co and V, all behaving as strongly compatible elements with differentiation. Furthermore, all types of enclaves and diorite/quartzdiorite dykes from the Mt. Kopaonik intrusive show similar variations and follow the pattern of

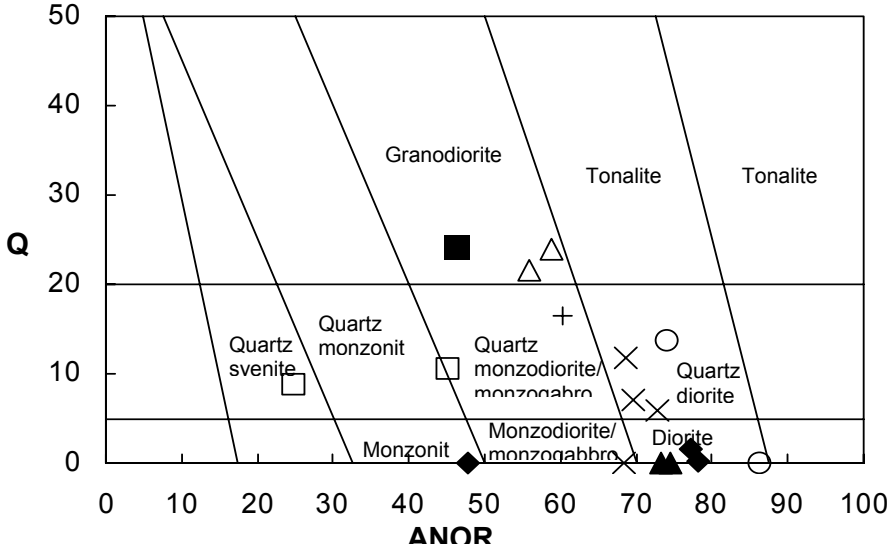

Fig. 2. Q'-ANOR chemical classification for plutonic rocks (Streckeisen & Le Maitre, 1979); symbols as in Table

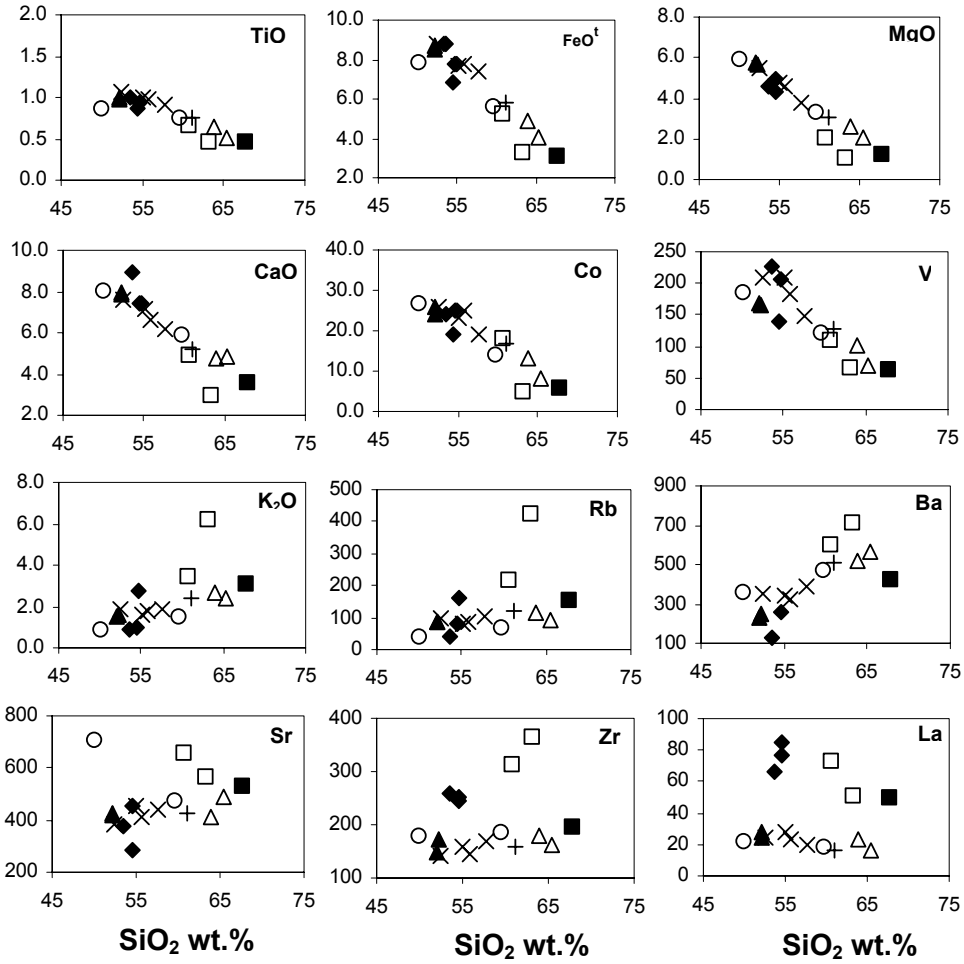

Fig. 3. Selected Harker's variation diagrams for granitoids of Mt. Kopaonik and Drenje Gorge; symbols are given in Table

Drenje samples. On the other hand, according to the mode of variation of K_2O, Rb, Ba and Sr, all behaving incompatible, and Zr and La, which display more flat and somewhat scattered trends, it may be concluded that microgranular/porphyritic and coarse-grained/porphyritic enclaves depart from the main trends indicating possible cumulitic origin. On the contrary, equigranular enclaves as well as diorite/quartzdiorite dykes (except one sample for Sr) always remain close to the variation trend of Drenje samples.

If Mt. Kopaonik intrusive and the mass of Drenje evolved from the same source then the samples of diorite/quartzdiorite dykes or equigranular mafic enclaves occurring in the northernmost part of Mt. Kopaonik and in the Drenje Gorge might approximate the composition of their parental magma. In this context, the mass of Drenje should be regarded as the northernmost marginal part of the Mt. Kopaonik pluton. However, this would be conflicting with radiometric ages reported by Delaloye et al. (1989) for Drenje or/and with those for Mt. Kopaonik intrusive, documented by Karamata et al. (1992). The data discussed here is the first step of a more detailed study of these rocks which will include additional radiometric age determinations, microprobe and XRF data but REE and isotope analyses as well. That will certainly provide better conditions for understanding the origin and evolution of granitoid rocks in this area.

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