Monzonites in the Stomanovo prospect: first finding of Paleogene intrusive rocks in the Bratsigovo–Dospat area

Монцонити в проучвателна площ Стоманово: първа находка на палеогенски интрузивни скали в район Брацигово–Доспат

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Introduction

Numerous Tertiary volcanic structures in the Rhodopes Massif are intruded by subvolcanic intrusive bodies, forming volcano-plutonic associations. Such plutons are known in all major volcanoes in the Eastern Rhodopess, e.g. Madzharovo, Zvezdel, Borovitsa. Much larger plutons, coeval with the volcanics, are known in the Mesta volcanic area (e.g. Teshovo and Central Pirin). So far, only in the Central Rhodopes Bratsigovo–Dospat volcanic area, such plutones have not been identified, although their existence under the hydrothermaly altered surface rocks was suggested by Harkovska and Velinov (2002).

During 2007 drilling campaign, 15 drill holes have been made in the hydrothermally altered rocks in the Stomanovo prospect, some of which discovered a monzonite pluton almost at the surface. In this paper, we report the first data about the whole rock and mineral composition of these rocks.

Geological setting

Bratsigovo–Dospat volcanic area consists of the largest felsic ignimbrite complex in the Central Rhodopes, covering ~700 km^2. The geology of the area is studied by Katskov (1987), who also reports for rare more mafic dykes.

The basement of the Tertiary rocks is composed by high-grade metamorphic rocks of the Rhodopes Massif. They are overlain by Priabonian–Lower Oligocene breccia-conglomerates, sandstones, aleurolites and lenses of limestones and felsic pyroclastics in the uppermost parts of the section. The age of the volcanic rocks is determined by K/Ar method at 32–30 Ma (Harkovska, Velinov, 2002 and references therein).

Alteration prospect Stomanovo occurs 2 km north of Devin town. It is located on the boundary between ignimbrites and underlying stratified sedimentary and volcanogenic rocks. Alteration products have been described by Velinov et al. (1972), Harkovska and Velinov (2002), Velinov et al. (2007) and referred as to advanced argillic type.

Sampling and analytical method

Plutonic rocks practically outcrop from the surface, covered only by a thin (10–12 m) layer of proluvial rocks. Because the near-surface core samples are strongly altered; we have selected 3samples from deeper fresh sections of the drill core. Samples have been taken from depth 62m (sample SV010-62), 85 m (sample SV010-85), and 129 m (sample SV010-129).

Mineral composition was determined using a JEOL 870 SUPERPROBE at the University of Florence. The abundances of the major and selected trace elements were determined on fused and pressed pellets, respectively, using a Philips PW2400 spectrometer at the University of Lausanne.

Petrography and whole rock composition

The Stomanovo pluton consists of macroscopically undeformed granitoid rock. Microscopically, the rock is holocrystalline, composed of zoned plagioclase, K-feldspar, orto- and clinopyroxene and biotite, with traces of apatite and opaques.

The samples span a narrow compositional range of SiO_2 from about 56.1 to 59.0 wt.%, showing slight increase of SiO_2 and K_2O, and decrease of CaO, MgO and FeO from deeper to shallow levels. They have high

Na_2O+K_2O total (~8.0 wt.%), with K_2O/Na_2O ratio 2.6–2.9, which determines their shoshonitic affinity. The rocks have also high contents of Rb (~450 ppm), Ba (2000–2600 ppm) and low Nb (~15 ppm).

Mineral chemistry

Orthopyroxene is totally replaced by Fe-Mg hydrosilicates of idingsite–bowlingite group.

Clinopyroxene is the major mafic phase among which several groups can be divided. One group shows a normal zonation with a core to rim variation from Mg#89.3 to 74. A second group is reversely zoned, with an Fe-rich core of Mg# around 71, sometimes strongly zoned to green low-Mg clinopyroxene (Mg# down to 55), surrounded by normally zoned rim (Mg#86.2–74), compositionally similar to the first group clinopyroxene. High-Mg clinopyroxenes show very low Na content (0.08–0.16 wt.%), while their outermost rims are more Na rich (Na_2O=0.32–0.46). The green outer rim of reversed zoned crystals has the highest Na content (Na_2O=0.57 wt.%).

Plagioclase occurs in 2 populations. The first one is normally zoned $An_{54–45}$, the second one with sieved outer rim and larger compositional variation ($An_{67–25}$).

K-felfspar is $Or_{77–69}$. BaO replaces K_2O reaching up to 1.5 wt.%.

Biotite is a common mafic mineral in all three samples of the monzonite. Mg# of the biotite ranges between 74–71, showing slight decrease from core to rim. Biotite is characterized by high TiO_2 (5.6–6.4 wt.%) and F (up to 3.3 wt.%).

Melt compositions and T of crystallization

Mineral composition of the Stomanovo pluton clearly show that it is a result of mixing between two differently evolved melts: (i) a very mafic, crystallizing clinopyroxenes of Mg#89–86, and (ii) a strongly evolved with very Fe- and Na-rich clinopyroxenes. Composition of the two magmas can be calculated by applying the Wood and Blundy (1997) clinopyroxene-melt equation. Clinopyroxenes with Mg#89–86 crystallized from melts with Mg#70–62, whereas clinopyroxene with Mg#55 corresponds to a melt with Mg#20.5.

Because of the obvious evidence for mixing, calculation of the crystallization temperature, using mineral-whole rock composition, is not correct and should be considered as an approximation. Using clinopyroxene–whole rock pairs of the clinopyroxene saturation equation of Putirka et al. (2008), for samples SV10-83 and SV010-129, we obtain 1100–1150 °C. Much lower temperatures (810–890 °C) have been obtained for these samples, using plagioclase–K-feldspar thermometer of Putirka et al. (2008). We interpret the higher temperature as the temperature of crystallization of the mafic magma. The lower temperature most probably is the temperature of late stage crystallization in subsurface conditions.

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