TIMING AND MAGMA SOURCES OF IGRALISHTE PLUTON (SW BULGARIA): PRELIMINARY ISOTOPE-GEOCHRONOLOGICAL AND GEOCHEMICAL DATA

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The Igralishte granite pluton crops out over a territory of 32 km^2 in the Ograzhden mountain between the villages Igralishte and Krustiltsi, SW Bulgaria. In the geological literature it is first described by Boyadjiev et al. (1966) in connection with the mappings M 1:100000 (Boyadjiev et al., unpublished) and 1:25000 (Zidarov et al., unpublished). The structural peculiarities of the granite are studied in detail by Ignatovski (1969a,b, 1970). The contacts of the pluton to the host metamorphic rocks (gneisses, gneiss-schists and amphibolites) are intrusive and steep. Close to the village of Krustiltsi in the contact area a stock-like subvolcanic delenite body is intruded aged at 32.63 ± 1.34 Ma (Pecskay et al., 2001).

The prevailing part of the pluton is built up by porphyritic after plagioclase middle- to coarse-grained, two-mica to biotite granite. In the outer northern, eastern and western parts of the body a narrow band of leucocratic muscovite-bearing granite occurs. The transition between the two granite varieties is gradual, whilst the muscovite content increases respectively the biotite ones decrease. In the periphery zones of the pluton amphibolite resorbed xenoliths are observed. Pegmatitic, aplitic and quartz veins cross cut the granite as well as the host metamorphites.

Ignatovski (1969a) described primary and secondary structures within the pluton. The primary magmatic structures are flow layers, platy flow structures and lineation of the feldspar porphyries. The postmagmatic deformations are different kinds of faults as well as shistosity, the latter developed parallel to the platy flow structures. According to the same author (Ignatovski, 1969a) "the internal structure of the pluton as a whole is harmonious with the foliation of the mantle".

The main rock-forming minerals are plagioclase, K-feldspar, quartz, biotite and muscovite. The accessories are represented by sphene, ilmenite, magnetite, monazite, xenotime, zircon and garnet. Secondary products of the plagoclases and micas are sericite, chlorite, epidote-group minerals.

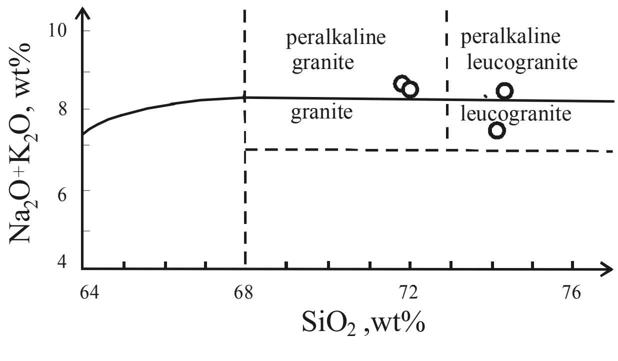

Fig. 1. SiO_2 vs. (K_2O+Na_2O) plot (Магматические породы..., 1983) for igneous rocks of the Igralishte pluton.

Using the TAS-classification the rocks of the Igralishte pluton belong to the subalkaline granites and the normal to subalkaline leucogranites (Fig. 1), whereas the SiO_2 content change in the range 71.80 to 74.31 wt. % and the (Na_2O+K_2O) one – in the range 7.49-8.48 wt. %. According to the K_2O content of

3.25-4.48 wt. % the granites belong to the high-K calc-alkaline magmatic series (Peccerillo and Taylor, 1976). The average ASI coefficient of 1.05 determines the rocks as peraluminous S-type granites.

The timing of the Igralishte granite was especially important as it is not metamorphosed and is weakly deformed, hence postdates the high-grade metamorphism in Ograzhden mountains. We used U-Pb analyses on single zircons and monazites and ID-TIMS techniques for this purpose. Long prismatic beige zircon grains of sample A7 (two mica granite) were separated to avoid inherited cores, which are common in peraluminous granitic rocks. Some of the grains are additionally abraded to remove the outer parts as they are usually enriched in uranium and the structure in these parts could be damaged by its radioactive decay, hence these parts could loose easier the the radiogenic lead. Six zircons yield a discordia line (Fig. 2) with an upper intercept age of 240 +13/-9 Ma (MSWD 0.36), interpreted to reflect the time of the granite intrusion. The three abraded grains are almost concordant, one of them – concordant at 244 Ma. The non abraded zircons show lead loss, which we interpret as due, from one hand, to the active Alpine tectonics and the possible higher thermal gradient related to the Late Alpine volcanites in the region and on the other hand as provoked by the high U-concentration of the zircons (1200-1500 ppm). The analyzed monazites are discordant also and the grade of discordance may be related to the high Th and U concentrations as well. The monazites give evidence for crystallization almost contemporary with the zircons.

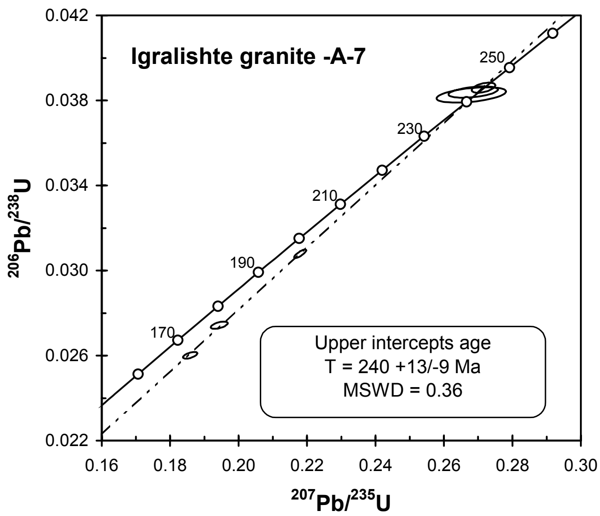

Fig. 2. U-Pb Concordia diagram for zircons of the Igralishte granite, sample A7.

Cathode luminescent (CL, zircons) and BSE images (zircon and monazites) of both accessory minerals reveal magmatic oscillatory zoning (Fig.3). The REE patterns of the zircons (LA-ICP-MS measurements) are typical for magmatic rocks, but without or with weak positive Ce-anomaly and with weak Eu-negative anomaly. The latter is most probably due to the chemical peculiarities of the magma (fractionation of plagioclase), than to its oxidation characteristics. Recrystallized areas of the zircon grains loosed the light and middle REE or all REE - the concentration decreased one or two orders within these parts. One possible explanation is leaching by hydrothermal solutions as low-temperature diffusion is not strong enough to explain the considerable drop of the trace element concentration in these zircon parts.

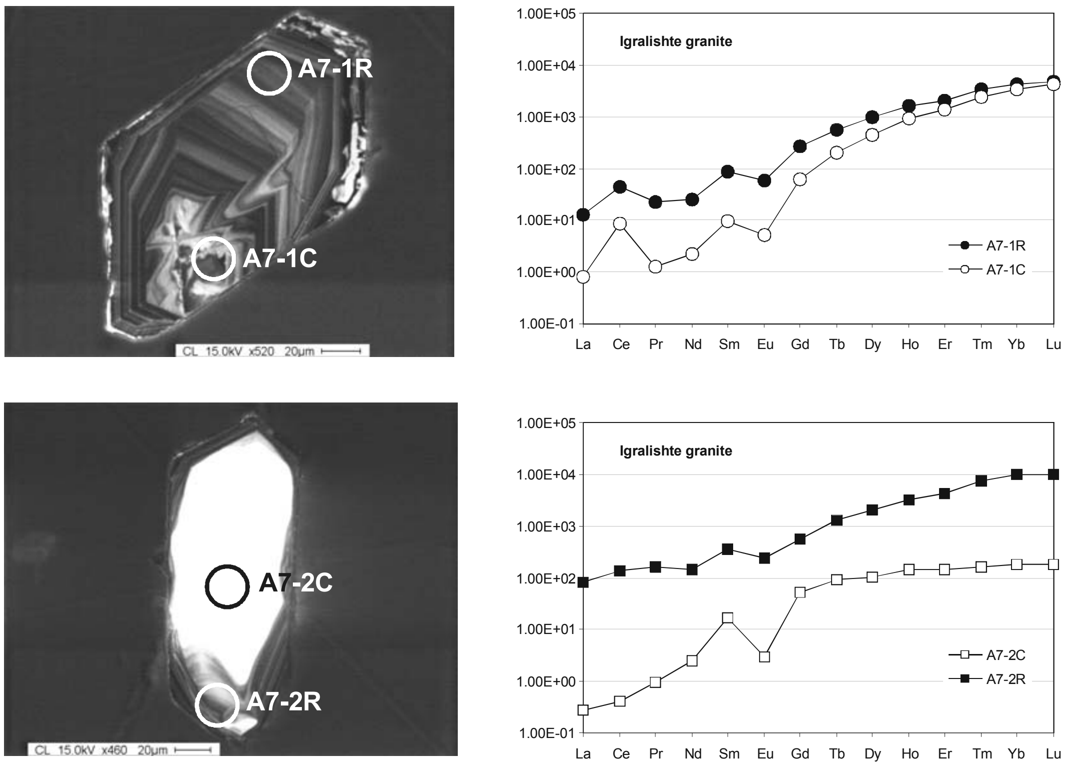

Fig. 3. Cathode luminescent (CL) pictures of zircons from sample A 7 of the Igralishte granite with the corresponding chondrite-normalized distribution of the REE. Circles on the pictures correspond to the laser ablation spot in the zircon crystals.

Preliminary Rb-Sr data give evidence for Late Alpine overprint of the Igralishte granite: the slope of the two-point reference line WR-biotite corresponds to an age of 36.36 ± 0.56 Ma (Fig. 4). As the closure temperature of the Rb-Sr biotite isotope system is ≥ 300°C, we need additional data for this thermal overprint; it is necessary to analyze other rock-forming minerals (muscovite, plagioclase), which are more resistant to thermal overprint.

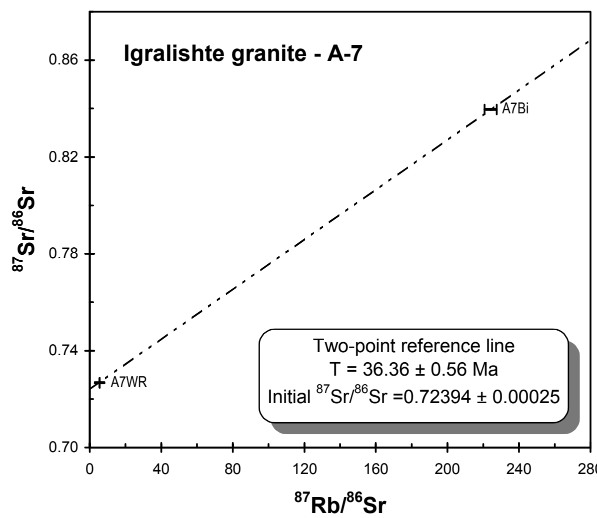

Fig. 4. $^{87}Rb/^{86}Sr$ vs. $^{87}Sr/^{86}Sr$ diagram for biotite (Bi) and whole rock (WR) fractions, sample A7, Igralishte granite.

The calculated initial strontium ratio $^{87}Sr/^{86}Sr_i$ (T 240) of 0.70804 for the whole-rock sample A7 argues for crustal dominated source of the granite magma of the Igralishte pluton.

The presented new isotope data about the Igralishte pluton give evidence for Pre-Alpine intrusion of the Igralishte granite about 245 Ma ago with Late Alpine overprint, probably related to the Alpine tectonic and hydrothermal activity in the region.

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