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Petrogenetic Model of Formation of Orthoclase Gabbro of the Dzirula Crystalline Massif, the Caucasus

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Abstract : Orthoclase gabbro intrusive exposes in the Eastern part of the Dzirula crystalline massif of the Central Transcaucasian microcontinent. It is intruded in the Baikal quartz-diorite gneisses as a stock-like body. The intrusive is characterized by heterogeneity of rock composition: variability of mineral content and irregular distribution of rock-forming minerals. The rocks are represented by pyroxenites, gabbro-pyroxenites and gabbros of different composition – K-feldspar, pyroxene-hornblende and biotite bearing varieties. Scientific views on the genesis and age of the orthoclase gabbro intrusive are considerably different. Based on the long-term pertogeochemical and geochronological investigations of the intrusive with such an extraordinary composition the authors came to the following conclusions. According to geological and geophysical data, it is stated that in the Saurian orogeny horizontal tectonic layering of the Earth's crust of the Central Transcaucasian microcontinent took place. That is precisely this fact that explains the formation of the orthoclase gabbro intrusive. During the tectonic doubling of the Earth's crust of the mentioned microcontinent thick tectonic nappes of mafic and sialic layers overlap the sialic basement ('inversion' layer). The initial magma of the intrusive was of high-temperature basite-ultrabasite composition, crystallization products of which are pyroxenites and gabbro-pyroxenites. Petrochemical data of the magma attest to its formation in the Upper mantle and partially in the 'crustal astenolayer'. Then, a newly formed overheated dry magma with phenocrysts of clinopyrocxene and basic plagioclase intruded into the 'inversion' layer. From the new medium it was enriched by the volatile components causing the selective melting and as a result the formation of leucocratic quartz-feldspar material. At the same time in the basic magma intensive transformation of pyroxene to hornblende was going on. The basic magma partially mixed with the newly formed acid magma. These different magmas intruded first into the allochthonous basite layer without its significant transformation and then into the upper sialic layer and crystallized here at a depth of 7-10 km. By petrochemical data the newly formed leucocratic granite magma belongs to the S type granites, but the above mentioned mixed magma – to H (hybrid) type. During the final stage of magmatic processes the gabbroic rocks impregnated with high-temperature feldspar-bearing material forming anorthoclase or orthoclase. Thus, so called 'orthoclase gabbro' includes the rocks of various genetic groups: 1. protolith of gabbroic intrusive; 2. hybrid rock – K-feldspar gabbro and 3. leucocratic quartz-feldspar bearing rock. Petrochemical and geochemical data obtained from the hybrid gabbro and from the inrusive protolith differ from each other. For the identification of petrogenetic model of the orthoclase gabbro intrusive formation LA-ICP-MS- U-Pb zircon dating has been conducted in all three genetic types of gabbro. The zircon age of the protolith – mean 221.4±1.9 Ma and of hybrid K-feldspar gabbro – mean 221.9±2.2 Ma, records crystallization time of the intrusive, but the zircon age of quartz-feldspar bearing rocks – mean 323±2.9 Ma, as well as the inherited age (323±9, 329±8.3, 332±10 and 335±11 Ma) of hybrid K-feldspar gabbro corresponds to the formation age of Late Variscan granitoids widespread in the Dzirula crystalline massif.

Keywords : The Caucasus, isotope dating, orthoclase-bearing gabbro, petrogenetic model
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