Crystallization trends in potassic-alkaline quartz syenites from the Svidnya association

Последователности на кристализация при калиевоалкални кварцсиенити от Свидненската асоциация

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The interest in the potassic-alkaline rocks, outcropping in the area of the village of Svidnya, Sofia district, Western Balkan Mountains, is determined by their specific mineral and chemical composition, special geochemical features and wide range of differentiation. Dimitrov (1937) describes in details 3 groups of successively formed rocks: shonkinites, potassic-alkaline quartz syenites and potassic-alkaline quartz tinguaite porphyries (grorudite porphyries). The rocks build up several small hypabyssal and vein bodies, exposed in a small area (N 42°55–57'; E 23°16–18'). According to recent petrological nomenclature, quartz tinguaite porphyries must be considered as amphibole-aegirine syenite porphyries. Vladykin et al. (2001) present a new data about magmatic successions: clinopyroxene-biotite shonkinites (phase I), potassic-alkaline biotite-amphibole syenite porphyries (phase II), potassic-alkaline aegirine-amphibole quartz syenites (phase III), and potassic-alkaline amphibole-aegirine quartz syenite porphyries (phase IV). Recently, a new conception was proposed in the abstract thesis of Dyulgerov (2005) but the data are not published yet.

The aim of the present work is to draw some trends of crystallization in the magmatic rocks of phase III. The main part of the used data is taken from Dimitrov (1937) and Grozdanov et al. (2006). Rocks of the 3 intrusive bodies are included in the present work: (1) south-eastern body, exposed in the Haydushka Padina locality, (2) southern body, outcropping in the ridge of Rogo, and (3) a bigger intrusive body, around the hamlet of Padezh, and upwards and south, along the north slope of the Lilyako Peak.

The next successions of crystallization are established in this work:

• A break in pyroxene formation is established in the middle parts of the big intrusive body of the main crystallization trend (Dimitrov, 1937). This fact should be taken as a sign of peritectic reaction. Due to the faster cooling, typical for hypabyssal level, a corrosion of crystals is not detected. The cause of breaking in pyroxene formation most likely is a gradually increasing of water potential. In accordance with established heteromorphism in potassic-alkaline rocks, manifested by 3 categories of water saturation (Grozdanov et al., 2003), it should be accepted here a transition from low (with pyroxene and amphibole) to moderate (amphibole only) water saturation. The chemical composition of a non-pyroxene rock of the main trend of crystallization is: SiO_2 63.94; TiO_2 1.13; Al_2O_3 11.00; Fe_2O_3 6.17; FeO 1.26; MnO 0.14; MgO 2.25; CaO 1.80; BaO 0.21; Na_2O 4.20; K_2O 6.53; P_2O_5 0.66; CO_2 0.12; H_2O 0.35; total 99.76 (in wt. %); Ka 1.27; Mg# 37.06 (sample No 27). Amphibole is homogeneous, richterite type. In comparison with the rocks of the beginning of the main crystallization trend (sample No 2, Grozdanov et al., 2006), an increasing in SiO_2 ~ 5%, in Al_2O_3 ~ 2%, in Fe_2O_3 ~ 1.5% and in Na_2O ~ 1%, and decreasing in FeO ~ 4%, in MgO ~ 2% and in CaO ~ 1.5% are realized here.

• Pyroxene do not already take part in the interstitions of aegirine-amphibole quartz syenites of the south-eastern intrusive body, where this rock corresponds to the beginning of the main crystallization trend of the phase III (Grozdanov et al., 2006, sample No 2). This break in pyroxene formation by analogy with already considered break in pyroxene formation in the main trend of the big intrusive body (over the hamlet of Padezh), may be regarded as a suppressed peritectic reaction, provoked by the increasing water potential. The interstitions take up ~ 15% of rock volume where the K-feldspar is ~ 7%, amphibole ~ 3%, and quartz ~ 5%. Interstitional amphibole composition is very close to that of the most outer zone of the big amphibole crystals. On the base of this mineralogical composition the chemical composition of the interstitions is calculated as: SiO_2 72.89; TiO_2 0.57; Al_2O_3 8.23; Fe_2O_3 2.45; FeO 3.31; MnO 0.17; MgO 2.21; CaO 0.93; Na_2O 1.92; K_2O 6.95; P_2O_5 0.14; total 99.77 (in wt. %); Ka 1.30; Mg# 41.67. This composition is different from the bulk rock composition (Grozdanov et al., 2006, sample No 2). With its appreciable content of SiO_2 and the decreasing in mafic components, this composition probably presents the possible end product of the main crystallization trend, where the content of quartz increases, finally becoming a main mineral. There are not analyses for such type of rocks, due to intensive alteration processes (Dimitrov, 1937).

• The potassic-alkaline quartz syenites (phase III), exposed in the ridge of Rogo, refer to the peripheral orthophyric facies (Dimitrov 1937). The phenocryst generation consists of well individualized paragenesis of K-feldspar (30%), zonal amphibole (20%) and aegirine-augite (10%). In the interstitions there are some quartz. Chemical composition of the rocks is given by Grozdanov (2006, sample No 5). From all published analyses of this phase (Dimitrov, 1937; Vladykin at al., 2001; Grozdanov et al., 2006), sample No 5 of the last authors has relatively low content of SiO_2 (57.30 wt. %) and high Mg# (51.20). The well expressed three-mineral paragenesis, in correspondence with the two above mentioned special features of this sample, give reason for the investigated rock to be regarded as a product of evolved magma with cotectic-eutectic characteristics. The corroded brown-red biotite in the porphyritic facies (Mincheva-Stefanova, 1951, p. 46 and Fig. 5) is indicative of a longer magma evolution.

• The zonallity of the amphiboles composition (Grozdanov et al., 2006), is another argument for the crystallization trend. These amphiboles belong to the rocks of the beginning of the main crystallization trend in the south-eastern body and in the southern body of the ridge of Rogo. The mentioned zonal structure, in accordance with Zavaritskiy and Sobolev (1961, p. 65), should be a result of the faster cooling. The composition goes from richterite to Mg-arfvedsonite, with decreasing of the Ca and Mg (within the limits of Mg-arfvedsonite) and increasing of the Na and Fe contents. According to the Konovalov's rule (Dimitrov, 1953, p. 110), in the amphibole firstly enter components which raise the melting temperature: in our case the higher-energetic Ca and Mg.

• Some evaluation of the crystallization trend extent in the direction of peripheral facies can be given by the comparison of the rock chemistry of the south-eastern and southern bodies (Grozdanov et al., 2006, samples No 2 and 5). A visible increase in Fe_2O_3 (from 4.76 to 6.82), MgO (from 4.03 to 5.30), CaO (from 3.28 to 4.00), K_2O (from 6.46 to 7.08), Na_2O (from 3.42 to 4.23) and decrease in FeO (from 5.72 to 2.87), weakly decrease in SiO_2 (from 58.55 to 57.30) and significant increase in Mg# (from 41.80 to 51.18) are indicative. Alkali coefficient increases from 1.30 to 1.64.

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