GEOLOGICA BALCANICA, 32.2-4, Sofia, Decemb. 2002, p. 93-96

Differentiation tendencies in Svidnya potassic-alkaline magmatites

Lyudmil Grozdanov[1], Nikolay Vladykin[2], Konstantin Uzunov[1], Andrey Andreev[1]

[1]*Geological Institute, Bulgarian Academy of Sciences, 1113 Sofia*
[2]*Institute of Geochemistry, Siberian branch of the Russian Academy of Sciences, P.O.B. 4019, 664033 Irkutsk*

The interest in Svidnya potassic-alkaline magmatic association is determined by the specific mineral and chemical composition of the rocks, their genesis and geodynamic position as well as by the possibilities to use some of them as a complex mineral raw material. The present study is focused on the differentiation tendencies of the four phases, which produced the rocks of Svidnya association. This allows drawing some conclusions about the entire differentiation process.

The discussed rocks form small intrusive and vein bodies with a total exposed area of about 2,5 km^2. They are located in the three quarters of Svidnya Village, Western Stara Planina Mountain, about 30 km north of Sofia and 5 km west of the town of Svoge. The Svidnya potassic-alkaline magmatic association belongs to the Stara Planina complex of the alkaline gabbro-syenite formation. The discussed rocks were reported in the very beginning of the 20-th century by Lazar Vankov but were described for the first time in the literature by Бончев (1908) in his monograph "The Eruptive Rocks of Bulgaria". The first petrographic descriptions, including the contact-metamorphic rocks, were published by Андреев (1910). The basic, still valid detailed petrographic characterization of the Svidnya magmatites was made by Димитров (1937). They were further described also in some later works of this author. From the middle of the last century, the discussed rocks have been subject of a number of other studies (see Vladykin et al., 2001).

Phase I (Димитров, 1937) of the association includes potassic shonkinites that form mainly small intrusive bodies. The larger part of these rocks were denoted as aegyrine-augite-biotite shonkinites. Fourteen samples were selected — 8 published by Stefanova (1966, No 23, 28, 33, 37, 46, 45, 47 and 48) which are referred to by Stefanova et al. (1974) as typical magmatites; 1 sample of Grozdanov (1979) and 5 samples of Vladykin et al. (2001, No 16, 18, 26, 28 and 53). Vladykin et al. (2001) proposed the updated name Cpx-Bi shonkinites for these rocks. Samples from the internal parts of the larger intrusive bodies of augite-biotite-katophorite shonkinites and their transitions from augite-katophorite shonkinites with biotite as described by Димитров (1937) were not studied since, according to Стефанова et al. (1974), these rocks were altered by postmagmatic processes. Typical of this unaffected by such processes part of the Cpx-Bi- shonkinites are albite lamellae in K-feldspar, long-prismatic apatite as well as lack of large poikilitic biotite crystals.

The rocks of phase II are potassic alkaline biotite-amphibole syenite porphyries. They form only thin veins that cut the Cpx-Bi shonkinites. Pieces of them were found in the rocks of phase III (Грозданов, 1965). So far, significant postmagmatic alterations of these rocks were not established. Seven samples have been selected — 1 from Грозданов (1965), 1 from Грозданов et al. (1980, No 34), 1 from Vladykin et al. (2001, No 17) and 4 unpublished analyses — samples No 29, 33, 45 and 69.

Phase III (phase II after Димитров, 1937) is represented by potassic-alkaline aegyrine-amphibole quartz syenites. They form small intrusive bodies and dykes (Димитров, 1937). The samples have been selected taking into account the proportional distribution of the variations in

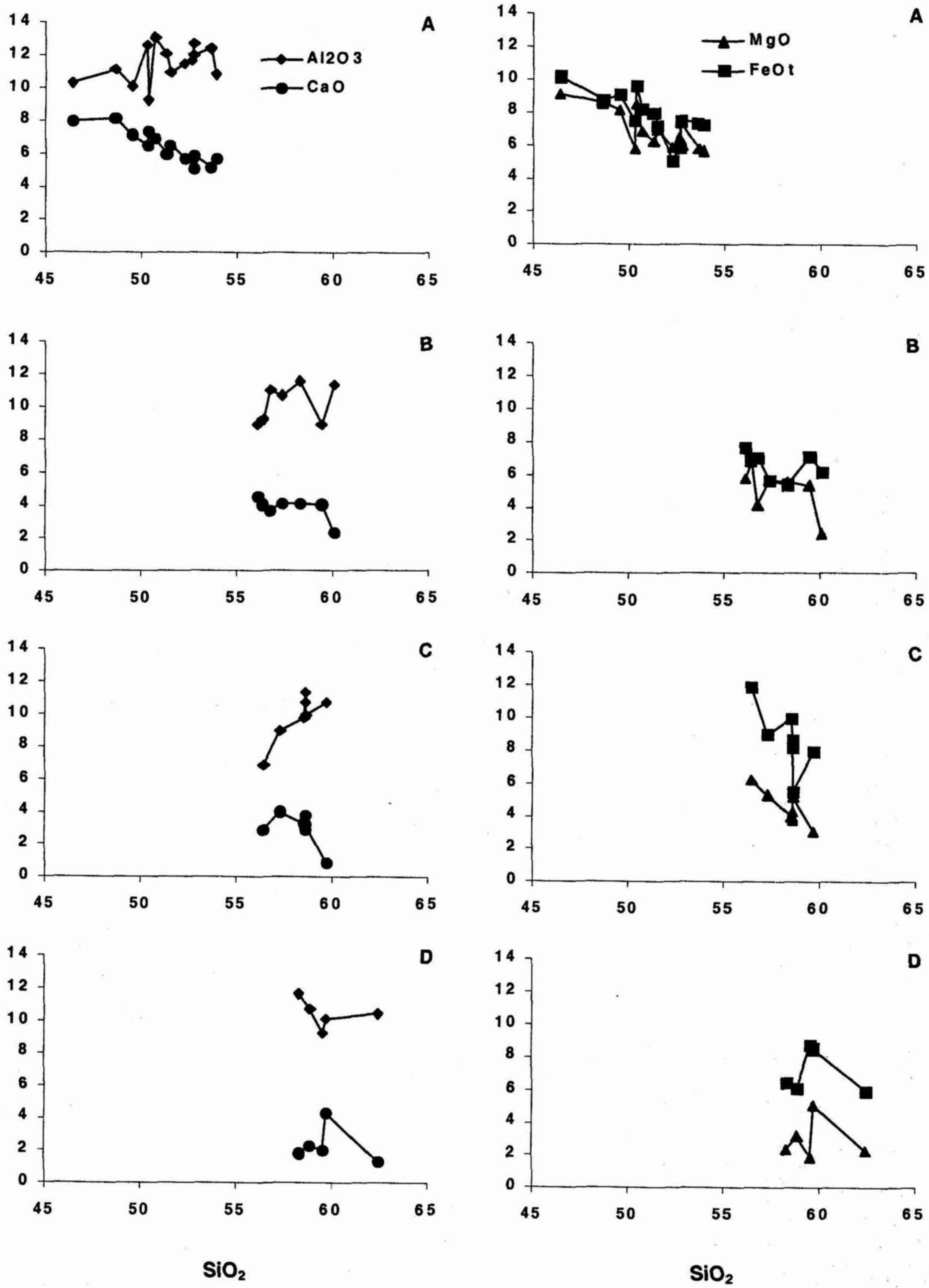

Fig. 1. Diagrams SiO_2 — Al_2O_3 and CaO , SiO_2 — MgO and FeO^t (in w. %)
A — I phase; B — II phase; C — III phase; D — IV phase

the mineral composition. Four samples of Vladykin et al. (2001, Nos 38, 42, 45, 47 and 48) and three unpublished analyses (samples Nos 2, 5 and 28) have been studied. Sectors with abundant development of fine, needle-like to fibrous aegyrine were not sampled. Such sectors are denoted by Димитров (1937) as tinguaite schlieren facies. According to Стефанова et al. (1974), these rocks are products of post-magmatic processes.

Phase IV (phase III after Димитров, 1937) is represented only by dykes. The rocks are denoted by Димитров (1937) as potassic-alkaline quartz tinguaite porphyries (grorudite porphy-

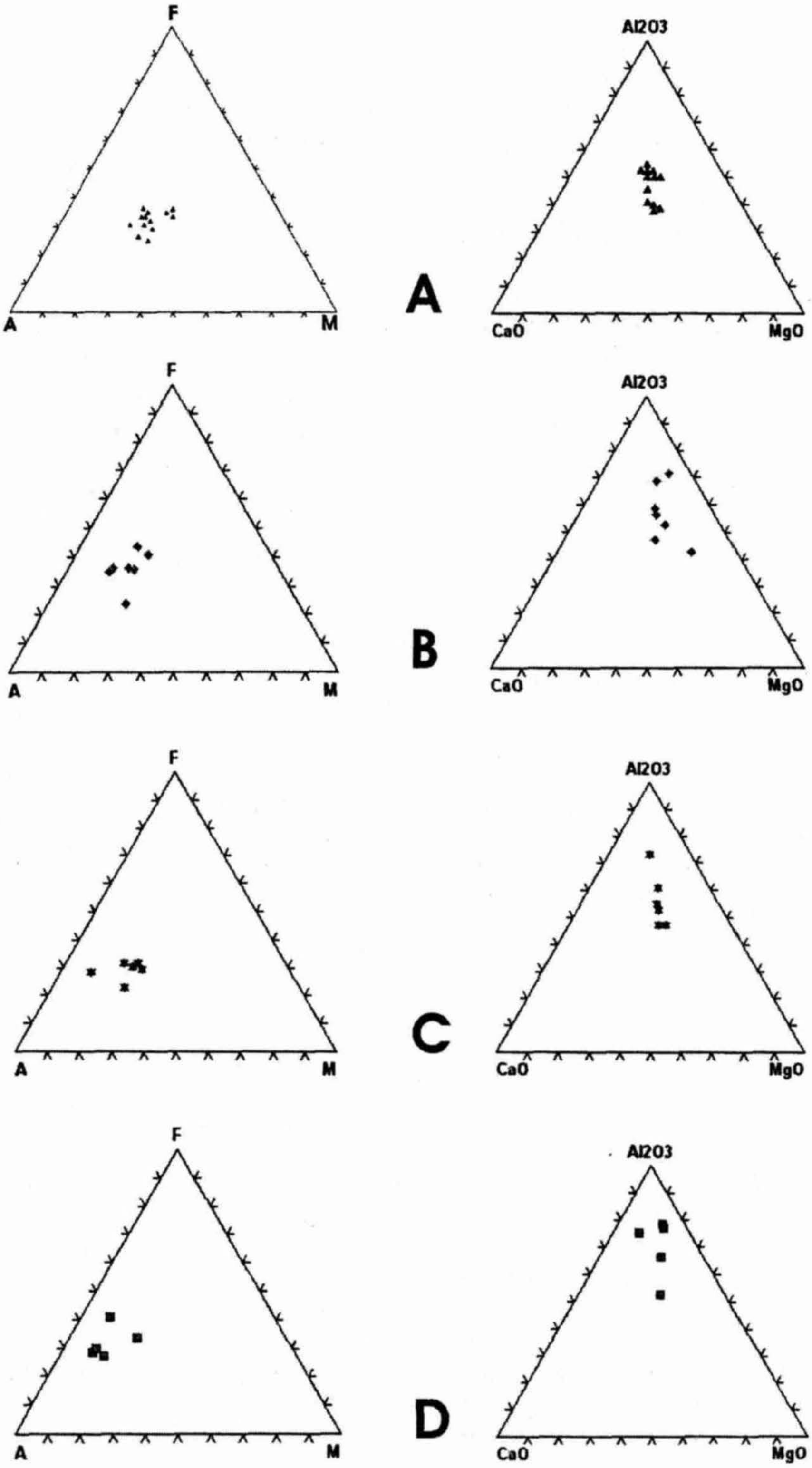

Fig. 2. Diagrams AFM and CaO — Al_2O_3 — MgO (in w. %)
A — I phase; B — II phase; C — III phase; D — IV phase

ries), aegyrine-amphibole grorudite porphyries. According to mineral composition, they are analogous to the rocks of phase III but contain considerably larger amounts of aegyrine. For these rocks Vladykin et al. (2001) have proposed the more modern name potassic-alkaline amphibole-aegyrine syenite porphyries. During the sampling, sectors that are richer in fine, needle-like to fibrous aegyrine, were likewise avoided. Five samples were studied, 4 of Vladykin et al. (2001, No 21, 22, 23 and 52) and 1 unpublished analysis (No 44).

The well expressed tendency of increasing SiO_2 content in the process of differentiation of

Svidnya magmatites (Димитров, 1937; Vladykin et al., 2001) offers the possibility to reveal some relationships between other components of the individual intrusive phases. The following tendencies may be deduced from the diagrams in Figs. 1 and 2.

1) In Cpx-Bi shonkinites (phase I), the content of CaO, MgO and FeO^t gradually decreases with increasing SiO_2. On its turn, on the background of decreasing MgO and FeO^t, the sum of Na_2O+K_2O and Al_2O_3 increase parallel to the decreasing CaO and MgO content. As a whole, fractionation of SiO_2, Na_2O+K_2O and to a certain extent of Al_2O_3 may be deduced.

2) In biotite-amphibole syenite porphyries (phase II), at a noticeable increase of the SiO_2 content and lower amounts of CaO, MgO and FeO^t, in parts also of Al_2O_3, the above described tendencies in the Cpx-Bi shonkinites are repeated. Evidently, there is a tendency to a gradual transition of the differentiation process from phase I to phase II and a continuation of the fractionation of SiO_2, Na_2O+K_2O and in parts of Al_2O_3.

3) On its turn, the differentiation process in the aegyrine-amphibole quartz syenites (phase III) starts with the same quantities of SiO_2, Al_2O_3, CaO, MgO and FeO^t as in the biotite-amphibole syenite porphyries. This is indicative both for the continuation of the differentiation process from phase I and for the heteromorphism between phase II and III-— biotite vanishes and aegyrine appears. In the process of differentiation of the magma that produced the rocks of phase III, the tendency towards decreasing CaO, MgO and FeO^t is steeper, and a better expressed increase of Al_2O_3 is evident. The degree of enrichment in Na_2O+K_2O is almost the same as in phase II. It is worth noting that the interval, in which SiO_2 increases in phase III, is almost the same as in phase II.

4) A comparison between the diagrams in Fig. 1 for the amphibole-aegyrine syenite porphyries (phase IV) and those for the aegyrine-amphibole quartz syenites (phase III) shows that there is an overlapping and after that — a continuation of the differentiation process. However, there are some differences in the differentiation process of phase IV. With increasing SiO_2, the contents of Al_2O_3, CaO, MgO and FeO^t initially increase and later considerably decrease. The fractionation tendency of Na_2O+K_2O increases with respect to the decreasing content of MgO and FeO^t, while Al_2O_3 increases with respect to CaO and MgO.

The specific features in the variations of the chemical composition of zonal amphiboles from the rocks of phase III and IV support the concept for a gradual transition during the evolution of the magma that produced these rocks. In samples from phase III, from the central towards the peripheral parts of the amphibole crystals, the chemical composition changes from richterite to magnesio-arfvedsonite, while in the rocks of phase IV these changes occur only in the end members of the isomorphic series (Grozdanov, 1982).

If we assume that the character of the amphibole is a criterion to reveal the trends in the crystallization process of the discussed rocks, then the occurrence of homogenous magnesio-arfvedsonite in a vein of porphyroid alkaline syenite within Cpx-Bi- shonkinte (Грозданов, 1999) could be used as an indicator of its eutectic nature and respectively — of a terminal manifestation of the Svidnya magmatism.

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