Across-arc geochemical variations of Late-Cretaceous magmatism in the Eastern Srednogorie, Bulgaria

The Late-Cretaceous magmatic evolution in Bulgaria has led to the formation of the Srednogorie volcano-intrusive zone (SVIZ) interpreted as mature ensialic island arc with an incipient back-arc rift (Boccaletti et al., 1974; Stanisheva-Vassileva, 1980, 1989). Three volcano-intrusive areas are distinguished in SVIZ: western (WSVIA), central (CSVIA) and eastern (ESVIA). Our study concerns ESVIA where the most intensive, basic and high-K magmatism occurs, and is based on over 1200 major composition analysis; 300 trace elements anal. of Rb, Ba, Sr, Ni, Co, Cr, V, Cu, Pb, Zn, Sc, Th, U, Zr, Hf, Ta and 94 REE anal.—La, Ce, Nd, Sm, Eu, Tb, Yb, Lu, Y. The modified Peccerillo & Taylor K$_2$O-SiO$_2$ diagram is used for classification of the ESVIA magmatic rocks.

From the south to the north, three magmatic regions are distinguished in ESVIA: Strandija volcano-intrusive (SVIR), Yambol-Burgas volcano-intrusive (YBVIR) and North Burgas volcanic (NBVR). They reflect the temporal and chemical evolution of a subduction-related magmatism in ESVIA: 1. Magmatism poor in K in the volcanic fore-arc (SVIR) where there are an early, weakly differentiated tholeiitic (TH) series, a later calc-alkaline (CA) and the latest, stronger differentiated high-K calc-alkaline (HKCA) series. Plagio-clase fractionation dominates the multi-stage crystallization history of this region; 2. Magmatism steadily rich in K from the initial to the final stages of its evolution — in YBVIR (axial and back parts of the volcanic arc). Two main series are distinguished, shoshonitic(SH) and high-K transitional (HKTR). The predominating, strongly differentiated HKTR series is characterized by pyroxene fractionation and rapid ascent of magmas; 3. Magmatism extremely rich in K in NBVR (back-arc rift) with series of the SH and HKTR types, dominated, however, by the hyper-K transitional (bulgarianic, BG) series.

The absolute abundances, distribution and ratios of trace elements support the petrochemical zonality mentioned above. From SVIR to YBVIR, the following main regularities of trace element behaviour are observed: 1. The absolute concentrations of K, Mg, Rh, Ba, Sr, Ni, Cr, Sc, Th, U, Zr, Hf, Ta increase as do K/Ti, Zr/Hf, Ba/La. This trend is even more expressed for REE (especially LREE — La/Yb from 6.4 to 10.7); 2. Geochemical abundance patterns of incompatible elements show the striking feature of subduction-related magmas — a consistent enrichment of LILE and HFSE. These variations are characteristic of the differentiation both in the volcano-intrusive regions and of the series within them, and are interpreted as indicating different depths of the source and fluid transfer.

The incipient back-arc rift (NBVR) is involved in the across-arc zonality only with its extreme K-enrichment, up to 11—13% K$_2$O-SiO$_2$ 57—60% . This zonality is discontinued with respect to the absolute concentrations, distribution of trace elements and their ratios, since there is a clear decrease in comparison with YBVIR. This phenomenon could result from the specific magma genesis involving a trachytic residuum of highly evolved, K-rich, primary magmas, and respectively higher level of formation. Pifiting and the consequent rapid magma ascent probably have also influenced the differences of trace element behaviour.

We accept the suggestion of Manetti et al. (1979) for the main role of evolved mantle partial melting in the origin of magmas in ESVIA, pointing out, however, the difference between magmatism levels (deeper for YBVIR than SVIR) as particularly important.

References


G. Stanisheva-Vassileva, L. Daieva
Geological Institute
Bulgarian Academy of Sciences,
1113 Sofia