The REE fractionation in differentiated I-type granitic rocks of the Western Carpathians

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Variscan I-type granodiorites and tonalites are known from both the Tatric and Veporic Superunit of the Western Carpathians. Regionally they are situated in the Slovak Ore Mts.: the Sihla type in the Veporic Superunit, Modra massif of the Malé Karpaty Mts., SE part of the Tribeč Mts., nothern slopes of the Nizke Tatry Mts. (Ďumbier and Prašiva type), central part of the High Tatra Mts., eastern part of the Veľká Fatra Mts. and in the Čierna Hora Mts, all in the Tatric Superunit. Based on existing geochronological data, two I-type granite suites may be recognized, the Lower Carboniferous and Upper Carboniferous.

Mineralogical composition in the both groups shows typical I-type granite characteristics: biotite (10–15 %) is Mg-dominant [Fe/(Fe+Mg) = 0.4–0.5] and oxidised [$Fe^{3+}/(Fe^{3+}+Fe^{2+})$ = 0.15], plagioclase ($An_{30–45}$). K-feldspar in primary and secondary form is more common in Lower Carboniferous granites (author's data), on the other hand, K-feldspar in the Upper Carboniferous granites is rare and occurs mostly as interstitial microcline. (Petrík – Kohút, 2001). The accessory assemblage consists of zircon (S_{12} subtypes), apatite, magnetite, titanite, allanite and epidote. The composition points to an oxidation during magmatic crystallization.

Geochemically, these rocks are characterized by moderate content of SiO_2 (60–74%), Na_2O/K_2O>1 and A/CNK is around 1 (Broska – Uher, 2001). Compatible trace elements Zr, Ba, Sr, LREE and Fe group elements have higher concentrations at lower SiO_2. The REE patterns are typicaly highly fractionated and with no Eu anomaly (Petrík – Kohút, 2001). The Harker type diagrams show two different groups within both I-type granite suites: 1) the group of granodiorites and tonalites with the SiO_2 contents below 70 %, and 2) group of the rocks with SiO_2 values higher than 70 %. The second group is typical by relatively higher abundance of TiO_2, Fe_{tot}, MnO, K_2O, P_2O_5, Rb, Zr, Ba, Pb and LREE. The trend resulted from chemical fractionation of the mentioned elements in the late, differentiated members. The trends in both groups have a negative character. While the rocks of the first group form main granite plutonic bodies, the second group is formed by differenciated aplites or small pegmatites veins, but some of them are also granite differentiates. The second group is a phosphorus – poor class, with the P_2O_5 content below 0.18 wt.%. On the other hand, the first group shows trends similar to trends of S-type granitic rocks.

The melts of I-type granitic rocks probably originated in the lower crust with addition of mantle material and their long-distance evolution from the zone of anatexis to emplacement is seen as a main reason of the strong fractionation of their late differentiated members.

References

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