Composition of Biotites from Čierna Hora Granitoids (Western Carpathians) as an Indicator of the Granite Tectonic Setting

Katarína BÓNOVÁ[1], Igor BROSKA[2], Jozef LIPKA[3] and Ignác TÓTH[4]

[1] Institute of Geography, Faculty of Sciences, Pavol Jozef Šafárik University, Jesenná 5, 040 01 Košice, Slovak Republic
[2] Geological Institute of the Slovak Academy of Sciences, Dúbravská cesta 9, 842 26 Bratislava, Slovak Republic
[3] Department of Nuclear Physics and Technics, Slovak university of Technology, Ilkovičova 3, 812 19 Bratislava, Slovak Repblic
[4] Department of Nuclear Physics and Technics, Slovak university of Technology, Ilkovičova 3, 812 19 Bratislava, Slovak Republic

Biotite – the dominant ferromagnesian mineral – has been analysed from Variscan granitoid rocks of the Čierna Hora Mts. (Western Carpathians) by an electron microprobe for completing of the existing data of their major elements and by Mössbauer spectroscopy for estimation of their Fe^{3+} vs. Fe^{2+} ratio. The direct relation between chemical composition of biotite and parental rock along with the presence of numerous minute inclusions of primary accessories trapped during biotite growth suggests the magmatic origin of biotite.

The analysed biotites exhibit a fairly wide range of X_{Fe} values and total Al content atoms per formula unit (apfu). Biotite from Ťahanovce area is characterised by high mean Al contents ~ 3.2 apfu and Fe/(Fe+Mg) values in the range 0.5 to 0.63. The positive correlation between Fe/(Fe+Mg) and Al_{tot} indicates the participation of sedimentary material on the granitoid petrogenesis. The trend of assimilation of aluminous crustal material to the magma is more significant in granites from Miklušovce complex because of higher mean Fe/(Fe+Mg) value (0.77) with more pronounced trend of increasing total Al (~ 0.8 apfu). On the other hand, biotites from Sokoľ and Sopotnica area show lower mean values of Al (approximately 2.97 apfu) and Fe/(Fe+Mg) ratio varies within 0.49 to 0.53 what indicate the I-type character of host rock. Concerning to the Fe valency, higher content Fe^{3+} (up to 20 wt. %) is characteristic for biotites from Sokoľ and Sopotnica granitoid bodies, whereas biotites from Ťahanovce granitoid massif show decrease Fe^{3+} content (around 5 wt. %). Such relation indicates the typical I-type oxidizing conditions due to the presence of higher water content during Sokoľ and Sopotnica granitoid evolution. Biotites from Ťahanovce area imply more reducing conditions with lower water content, and this is characteristic for the S-type granites.

According to the biotite chemistry we assume the affinity of granitoids from Sokoľ and Sopotnica massifs to the I-type granitoid suite which has been formed from slightly differentiated magma with mantle contribution. Contrary to it, Ťahanovce granitoid body and granitoids from Miklušovce complex show affinity to the S-type granitoid suite due to the precipitation of Fe-biotites from multiply contaminated melt by crustal material.

Granitic Rocks from Branisko Mts. (Western Carpathians): Geochemistry, Mineralogy and Tectonic Implications

Katarína BÓNOVÁ[1] and Igor BROSKA[2]

[1] Institute of Geography, Faculty of Sciences, Pavol Jozef Šafárik University, Jesenná 5, 040 01 Košice, Slovak Republic
[2] Geological Institute of the Slovak Academy of Sciences, Dúbravská cesta 9, 842 26 Bratislava, Slovak Republic

On the basis of textures, mineral composition and geochemical characteristics, the granitoid rocks of Branisko crystalline basement form two separate main groups: 1) syn-collision peraluminous leucocratic granites and granodiorites widely distributed in the S and W part of Branisko crystalline basement; 2) post-collision granodiorites inhabited mainly in the NE part of mention crystalline basement. Available mineralogical and geochemical data reveal that these two groups can be characterised by different magmatic evolution or protolith history.

The first group shows rather evolved geochemical characteristics. Major and trace element geochemistry of (leuco)granites clearly indicates their crustal origin. The main rock-forming minerals are K-feldspar + quartz + albite (An_{0-5}) + muscovite; essential accessory mineral phases are apatite, zircon (S_{1-3}; L_{1-3} types), monazite, xenotime, garnet ± rutile whereas REE contents (La_N/Yb_N ~ 19) are particularly controlled mainly by monazite. EMPA dating of monazite yielded age 342 ± 15 Ma for leucocratic granites (Bónová et al. 2005). Granodiorites which are occurred in western part of Branisko crystalline basement show slightly different features in comparison with granodiorites–tonalites from NE side. Higher volume of K-feldspars and significantly lower content of biotite or other mafic minerals is their dominant feature. Biotite exhibits a high total Al contents, reaching up to ~ 3.25 apfu. The biotite samples from investigated granodiorites define a relatively narrow range of Fe/(Fe+Mg) values, from 0.51 to 0.54 apfu and higher contents of TiO_2 (around 3.8 wt.%). Accessory minerals are zircon, apatite, rutile and monazite.

The granites of S and W parts of Branisko crystalline complex generally display affinity to S-type granites. In particular, we suggest that leucocratic granites have been formed by crystal fractionation within main meso-Hercynian (350–330 Ma) period as a part of S-type granite suite of the Western Carpathian basement complexes or as a result of continental collision during Missisipian (Lower Carboniferous).

The second group show less evolved geochemical character, biotite tonalite with hornblende and granodiorite prevail. Typical is enrichment in Ti, Sr, Zr and incompatible elements; normalized REEs are plotted with steep pattern ($La_N/Yb_N \sim 29$; Kohút et al. 2003). The main rock-forming minerals of these granitoids are represented by plagioclase (An_{34}) + quartz + K-feldspar + biotite. Biotite is defined by low Fe/(Fe+Mg) ratio (0.47 apfu) and total Al content reaches maximal 2.79 apfu. Significant abundance of titanite in an investigated rocks is compensated by lower TiO_2 content in biotite (1.89 to 2.73 wt.%). Typical accessories are zircon ($S_{12,16,17}$ subtypes), allanite, titanite, apatite and magnetite. The accessory mineral assemblage indicates an oxidation conditions in magma and geochemical aspects of investigated granodiorites suggest their competence to I-type suite of granitic rocks. This magmatism, similarly as in the other core mountains of the Western Carpathians, is rooted in the low crust and emplaced rather high to the middle crustal level. I-type plutonism in Western Carpathians is interpreted as an independent pulse during extension or transtensional regime within meso-Variscan orogenesis (Broska and Gregor 1992, Broska and Uher 1991, 2001, Haunschmid et al. 1997, Petrík et al. 1994, Petrík and Kohút 1997, Petrík et al. 2001 and other). Consequently, we assume that granitoids in Branisko crystalline complex of S and I-type affinities are genetically joined with two separate tectonomagmatic events.

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Attempt to Dating of Accretion in the West Carpathian Flysch Belt: Apatite Fission Track Thermochronology of Tuff Layers

Dariusz BOTOR[1], István DUNKL[2], Marta RAUCH–WŁODARSKA[3] and Hilmar von EYNATTEN[2]

[1] AGH University of Science & Technology, al. Mickiewicza 30, Kraków PL-30-059, Poland
[2] University of Göttingen, Goldschmidtstrasse 3, D-37077 Göttingen, Germany
[3] Polish Academy of Sciences, Institute of Geological Sciences, Kraków Research Centre, Senacka 1, PL-31-002 Kraków, Poland

The Carpathians are a part of the European Alpine chain created by convergence and collision of the European and African plates (Golonka et al. 2000). The Outer Western Carpathians are a north-verging fold-and-thrust belt composed largely of Lower Cretaceous to Lower Miocene flysch sediments arranged into stacked complex of several nappes (from top to bottom: Magura, Dukla and Fore-Magura, Silesian, Sub-Silesian and Skole nappes. The tectonic evolution of the Outer Carpathians is subdivided into two successive shortening events: 1) NNW-(N) directed and 2) NE-(NNE) directed (Aleksandrowski 1989, Decker et al. 1997). During the first event the folding and thrusting started in the most inner, southern nappe (Magura nappe) and were