Granitic rocks of the Branisko Mts. – partial melting products of the Patria amphibolite – gneissic (greenstone) complex

(2 figs)

M. KOHÚT[1] – U. POLLER[2] – P. NABELEK[3] – W. TODT[2] – A. S. GAAB[2]

[1] Dionýz Štúr Institute of Geology Bratislava, SK, milan@gssr.sk
[2] Max-Planck Institut für Chemie Mainz, D, poller (todt, gaab)@mpch-mainz.mpg.de
[3] University of Missouri, Columbia, Missouri, USA, nabelekp@missouri.edu

The Branisko Mts. are characterised by extraordinary structure, consisting of two principal units of the Central Western Carpathians (CWC). The northern part of the mountain range, Smrekovica massif, with typical fabric of core ountains belongs to the Tatric unit, whereas the southern part, Sľubica massif, represents the Veporic unit of the CWC. The Smrekovica massif is composed of a crystalline core, a Permian and Scythian sedimentary cover and the extensive Choč nappe with a very large dolomite complex that shows karst features. The crystalline core is built by the so called Patria complex consisting of magmatic rocks, including biotite granodiorite to tonalite and biotite (± muscovite-biotite) granite to granodiorite, amphibolites and migmatitic biotite and tonalitic gneisses. Various metapelitic gneisses, including garnet – biotite, garnet – biotite – sillimanite and/or garnet – biotite – kyanite gneisses with the typical assemblage Grt + Bt + Kfs + Pl ± Sil/Ky were described by Vozárová (1993). Amphibolitic rocks show a variegated association including biotite amphibolite, garnet amphibolite and garnet-free, hornblende-rich amphibolite. However, intimate relations between amphibolites and biotite amphibole (tonalitic) gneisses within the Patria complex generally resemble greenstones. This gneissic – amphibolitic complex shows an anatectic overprint (Fig. 1).

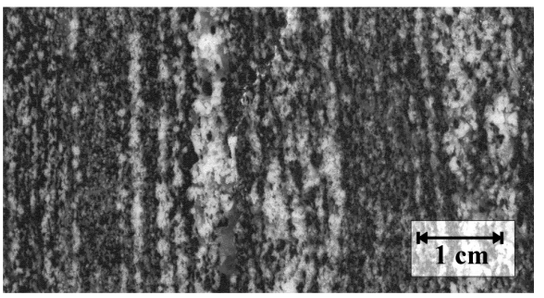

Fig. 1 Typical structure of tonalitic gneisses.

The tonalitic gneisses have "banded fabric" where the dark gneissic bands are composed of amphibole, plagioclase, biotite, quartz and the accessory mineral assemblage – zircon, apatite, ilmenite, epidote, titanite and/or ore minerals. The pale bands consist mostly of plagioclase and quartz. Plagioclase is dominant (up to 45 vol. %), generally is anhedral to subhedral with $An_{30–45}$ cores and $An_{8–20}$ rims. Hornblende (up to 35 vol. %) is euhedral to subhedral, with Si content ranging from 6.7 to 7.1 a./f.u. and X_{Mg} from 0.59 to 0.65. Biotite is abundant (10–15 vol. %), Mg-rich (Mg# 60–61) and has relatively low Ti concentrations (0.22–0.24). The pale bands represent typical trondhjemitic melt segregations. The bulk composition of the tonalitic gneisses is metaluminous (SiO_2 = 56–62 wt.%), A/CNK = 0.85–0.96 with CaO >5.0 wt. %, TiO_2 = 0.4–0.6 wt. %, and MgO >4.0 wt. %, low in Ba (270–320 ppm) and Sr (170–280 ppm). Generally moderate REE contents (with SREE ~ 150 ppm), moderate Eu anomaly and low to moderate La_N/Yb_N (8–10), but slightly enriched HREE indicate rather non-evolved rocks. Low Rb/Sr (0.2–0.3) ratios, with rather high $^{87}Sr/^{86}Sr_{(0)}$ ratio = 0.7130, and $\varepsilon Nd_{(0)}$ = –7.06, together with low values of $\delta^{18}O_{(SMOW)}$ = 7.8‰ and $\delta^{34}S_{(CDT)}$ = –0.11‰ call for a lower crustal origin. The lower crustal provenance of these rocks is also indicated by their Pb isotopic compositions with $^{206}Pb/^{204}Pb$ = 18.439–18.724 and $^{207}Pb/^{204}Pb$ = 15.676–15.679. Contrary to the tonalitic gneisses, the pale trondhjemitic bands display high silica contents (64–72 wt.%) and subaluminous character with A/CNK = 0.95–1.05 due to low Al_2O_3 (<16.5 wt.%) and rather high CaO (3.5–4.1 wt.%) along with moderate $Na_2O + K_2O$ (<5.6 wt.%). Similarly, Ba content is low at <300 ppm, Sr <270 ppm, Rb <60 ppm, and low to high ΣREE = 70–210 ppm with rather high La_N/Yb_N = 19–36. The Rb/Sr is identically low (0.13–0.25), $^{87}Sr/^{86}Sr_{(0)}$ is high (0.7142), $^{206}Pb/^{204}Pb$ is 18.392–19.647, $^{207}Pb/^{204}Pb$ is 15.633–15.744, $\delta^{18}O_{(SMOW)}$ is mod-

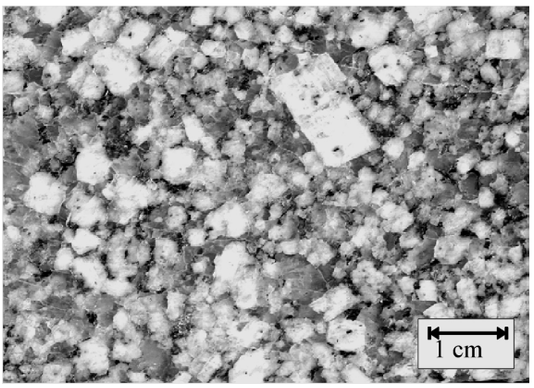

Fig. 2 Porphyritic structure of granite rocks.

erate (8.9‰). These data also suggest a crustal origin. The neighbouring common granites display more or less heterogeneous character. Indeed, there are closely related tonalites with sporadic amphibole and allanite on the one side, and leucogranites with garnet and monazite on the other side. The granitic rocks occur in several small bodies within Smrekovica massif, however any body may contain equigranular tonalitic and porphyric granitic varieties (Fig. 2).

The chemistry of granitic rocks is highly variable – SiO_2 = 57.5–75.3 wt.%, A/CNK = 1.07–1.25, whereas CaO scattered from 4.1 wt.% in tonalite to 0.28 wt.% in leucogranite. High sum of alkalies (5.1–8.8 wt.%) compensates theirs generally peraluminous character, albeit K_2O/Na_2O = 0.3–1.48. The considerable variability reflects their mixed tonalite/leucogranite character. Trace elements contents are similarly variable, e.g. Ba is 676 – 1300 ppm, Sr is 170–673 ppm, Rb is 50–110 ppm, and Zr is 55–253 ppm. REEs have moderate to slightly enriched values with a small negative Eu anomaly. Moderate ratios La_N/Yb_N = 16–29 indicate not very much fractionated patterns. Low Rb/Sr with 0.12–0.3 (tonalites) respectively moderate ratios 0.41–0.62 (granites), together with $^{87}Sr/^{86}Sr_{(0)}$ = 0.7097–0.7128 show the high heterogeneity of these granitic rocks. A crustally dominated source is indicated by $\varepsilon Nd_{(0)}$ values from –5.21 to –7.49, $\delta^{18}O_{(SMOW)}$ from 9.5 to 11.3‰, and lead isotopes with $^{206}Pb/^{204}Pb$ = 18.834–19.333 and $^{207}Pb/^{204}Pb$ = 15.713–15.738.

Field relations, petrography, and geochemistry demonstrate heterogeneity of the Branisko Mts. granitic rocks. We infer that primary source for these granitic rocks were most likely the surrounding tonalitic gneisses with minor contribution from amphibolites and common metapelitic gneisses, inasmuch the whole Patria greenstone complex displays intensive anatectic overprint that is obvious in a new 5 km long highway tunnel. The hybrid character of the granitic rocks is the consequence of mixing, assimilation and imperfect homogenisation (MASH) of magmas derived from variable source rocks.

References

Vozárová, A. (1993): Geologica Carpathica, 44, 4, 219–232.