

Two Types of Granitic Rocks in Boulders from Cretaceous to Paleogene Flysch, the Pieniny Klippen Belt, Western and Eastern Carpathians.

Pavel UHER

Geological Institute, Slovak Academy of Sciences, Dúbravská cesta 9, 842 26 Bratislava, Slovakia

Boulders of magmatic, metamorphic and sedimentary rocks, which occur in numerous localities of Albian to Eocene flysch conglomerates of the Klape and Kysuca-Pieniny Units, the Pieniny Klippen Belt (PKB) have been the focus of attention of several generations of geologists mainly due to the presence of many exotic rocks unknown in the Carpathians. Well-rounded granitic boulders, up to 1.5 m in size, belong to the widespread lithologic types in the conglomerates through at least 500 km long part of the PKB (e.g. Wieser 1958, Krivý 1969, Šímová 1985, Marschalko 1986). Since the first studies (Zoubek 1931), two principal groups of granitic boulders can be distinguished (Uher and Marschalko 1993; Uher et al. 1994):

- (1) The Upohlav type boulders (the exotic type of Zoubek 1931) comprise leucocratic biotite granites to granite porphyries of alkali feldspar granite to monzogranite according to mesonormative classification. The granites s.s. show hypidiomorphic-granular texture, commonly with albite + K-feldspar exsolutions in single phenocrysts, the granite porphyries have granophyric or microgranitic texture. These textures indicate a hypersolvus to transsolvus nature of the rocks. Biotite is anhedral to subhedral and interstitial, very rich in Fe, it is annite with $Fe/(Fe+Mg) = 0.78 - 0.94$. Biotite is often replaced by acicular stilpnomelane, chlorite and rarely by epidote - (clino)zoisite. Zircon typology reveals high-T and alkaline subtypes (mainly P_{4,5} and D; Uher and Marschalko 1993). Allanite-(Ce), apatite, magnetite, pyrite and locally ilmenite and garnet belong to the other characteristic accessory minerals. The Upohlav type granites show typical features of post-orogenic peraluminous A-type suite (Uher et al. 1994), U-Pb zircon dating indicate Early Permian age: 274 ± 13 Ma (Uher and Pushkarev 1994).
- (2) The Krivá type boulders (Tatra type of Zoubek 1931) include muscovite-biotite leucotonalites, granodiorites to monzogranites, locally granitic pegmatites. The rocks have equigranular hypidiomorphic texture with both feldspars (subsolvus granite). Biotite is subhedral, $Fe/(Fe+Mg) = 0.53 - 0.55$. Zircon typology indicates Al-rich and low-T magma environment (mainly S_{1,2} subtypes; Uher and Marschalko 1993). Apatite, monazite-(Ce) and garnet are the most widespread accessory minerals. The Krivá type granites show features of peraluminous calc-alkaline orogenic S-type granite suite. The monazite microprobe U-Th-Pb dating reveals

Early Carboniferous age of the Krivá granites: 341 ± 26 Ma (Uher and Finger, unpubl. data).

The Krivá type granites are analogous to common Tatric and Veporic Hercynian collisional granites, whereas the "exotic" Upohlav suite is well similar to the small intrusions of post-orogenic Permian granites in the Western Carpathians (Turčok, Velenca and Hrončok granite; Uher and Broska 1996).

References

- KRIVÝ M. 1969. Exotické valúny magmatických hornín západnej časti bradlového pásma. *Acta Geologica et Geographica Universitatis Comenianae, Geologica*, 18, 165-197.
- MARSCHALCO R. 1986. Vývoj a geotektonický význam kriedového flyšu bradlového pásma. *Veda*, 140 pp. Bratislava.
- ŠÍMOVÁ M. 1985. Magmatogénne horniny kriedových zlepenčov západnej časti bradlového a manínskeho pásma. *Západné Karpaty, Séria Mineralógia, Petrografia, Geochemia, Metalogenéza*, 10, 9-110.
- UHER P. and BROSKA I. 1996. Post-orogenic Permian granitic rocks in the Western Carpathian-Pannonian area: Geochemistry, mineralogy and evolution. *Geologica Carpathica*, 47, 311-321.
- UHER P. and MARSCHALCO R. 1993. Typology, zoning and chemistry of zircon from main types of granitic and rhyolitic pebbles in conglomerates of the Pieniny Klippen Belt Cretaceous flysch (Western Slovak Segment, Western Carpathians). *Geologica Carpathica*, 44, 113-121.
- UHER P. and PUSHKAREV Y. D. 1994. Granitic pebbles of the Cretaceous flysch of the Pieniny Klippen Belt, Western Carpathians: U/Pb zircon ages. *Geologica Carpathica*, 45, 375-378.
- UHER P., MARSCHALCO R., MARTINY E., PUŠKELOVÁ L., STREŠKO V., TOMAN B. and WALZEL E. 1994. Geochemical characterization of granitic rock pebbles from Cretaceous to Paleogene flysch of the Pieniny Klippen Belt. *Geologica Carpathica*, 45, 171-183.
- WIESER T. 1958. Magmatic and metamorphic exotic rocks from the Cretaceous and Palaeogene of the Pieniny Klippen Belt (Carpathians). *Instytut Geologiczny Biuletyn*, 135, 1-35.
- ZOUBEK V. 1931. Caractéristique de quelques roches Cristallophilliens et eruptives des galets exotiques des conglomerats sénéoniens et paleogenes de Carpathes occidentales. *Knihovna Státniho Geologického Ústavu*, 13, 353-358.