BERYL IN GRANITIC PEGMATITES OF THE WESTERN CARPATHIANS (SLOVAKIA): COMPOSITIONAL VARIATIONS, MINERAL INCLUSIONS AND BREAKDOWN PRODUCTS

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Beryl is characteristic mineral of Hercynian (ca. 350 Ma) granitic pegmatites associated with S- and I-type granites-granodiorites of the Tatric Unit, Western Carpathians, Slovakia (UHER *et al.,* 2010; OZDÍN, 2010). The pegmatite dikes belong to LCT-suite and beryl-columbite subtype of the rare-element class (*sensu* ČERNÝ *&* ERCIT, 2005). The beryl-bearing pegmatites occur mainly in the Malé Karpaty (Bratislava Massif), Považský Inovec, and Nízke Tatry Mountains. Beryl represents the only essential rare-element phase in majority of the pegmatites, whereas accessory Nb-Ta-(Sn) oxide minerals occur in the most evolved ones (e.g., Moravany nad Váhom, Jezuitské Lesy, Sopotnica Valley). Beryl forms columnar pale green crystals (up to 15 cm across), usually on the boundary between blocky K-feldspar + muscovite zone and quartz core (beryl I), or locally in saccharoidal and cleavelandite albite unit (beryl II).

The EMPA, LA-ICP-MS and XRD data show mostly the presence of alkali-poor beryl. However, Na, Fe, and Mg-enriched domains are locally present (up to 2.7 wt% Na_2O, 5.1 wt% FeO, and 2.7 wt% MgO; Prašivá, Švábsky Hill, Sitina). Trace element compositions of the studied beryl show relatively wide variations. Concentrations of Li are typically 120 to 830 ppm, locally 1400 to 1800 ppm (Švábsky Hill and Kamzík II). The highest Li contents are in beryl from the Moravany nad Váhom pegmatite (up to 5600 ppm). On the other hand, the highest concentrations of Cs (5700 to 9800 ppm, 1 to 2 wt% Cs_2O in some zones) occur in beryl I from the Jezuitské Lesy pegmatite (BM), whereas other investigated samples contain only ~50 to 1400 ppm Cs. Locally beryl contains slightly elevated contents of K (1300 to 2300 ppm) and Zn (~900 to 1700 ppm; Jezuitské Lesy, BM). Rb and Mn concentrations are generally low (≤ 170 ppm Rb, ≤ 280 ppm Mn), contents of Sc, Ga and Ni are lower than 100 ppm. Distribution and mutual relationships between major elements (Al, Fe, Mg, Na, and Cs) show the dominant role of $Na(Fe^{2+},Mg)\square_{-1}Al_{-1}$ channel-octahedral substitution mechanism in beryl. However, elevated Li or Cs contents also indicate the presence of channel-tetrahedral substitutions in beryl from the most evolved pegmatites: $(Na,Cs)Li\square_{-1}Be_{-1}$ (Moravany nad Váhom) and $(Cs,Na)Al\square_{-1}Si_{-1}$ (Jezuitské Lesy).

A common patchy internal zoning of magmatic beryl I crystals indicates a late-magmatic to subsolidus, partial dissolution-reprecipitation processes. The primary evolution trend in beryl I shows increasing Cs and Cs/Na with decreasing Mg and Mg/Fe from less evolved to more fractionated pegmatites. However, a secondary evolution trend probably connected with post-magmatic partial dissolution-reprecipitation shows decreasing Cs and increasing Mg/Fe in the beryl I. Beryl II show almost homogeneous internal texture and lower content of Cs than beryl I.

The powder XRD data support the compositional results and substitution mechanisms. The *c/a* ratio (AURISICCHIO *et al.,* 1988) reflects the presence of tetrahedral type in the Na,Cs-enriched beryl I (*c/a* = 0.9997; Jezuitské Lesy) and octahedral type in Na,Fe,Mg-rich beryl I (*c/a* = 0.9916; Sitina), in contrast to normal beryl type with mixed octahedral-tetrahedral substitutions in the other samples (*c/a* = 0.9975 to 0.9985).

Numerous microscopic inclusions of cassiterite, “hydroxycalciomicrolite”, gahnite, pyrite, sphalerite, galena, and muscovite were detected in some beryl I crystals (Moravany nad Váhom, Švábsky Hill). Gahnite inclusions in beryl contain high iron concentrations (14 to 18 wt% FeO, 37 to 47 mol% of hercynite), which are unusual for pegmatite environment. Uranoan “hydroxycalciomicrolite” (7–9 wt% UO_2) forms zonal crystals in quartz-microcline veinlets in beryl.

Partial to almost complete breakdown of beryl I to secondary assemblage of phenakite ± bertrandite + quartz II + muscovite II ± K-feldspar II have been identified by CL, EMPA, XRD, and EBSD methods in almost all studied pegmatites. The beryl breakdown originated during subsolidus pegmatite alteration, probably by hydrothermal fluids.

References

AURISICCHIO, C., FIORAVANTI, G., GRUBESSI, O. & ZANAZZI, P.F. (1988): American Mineralogist, 73: 826–837.
ČERNÝ, P. & ERCIT, T.S. (2005): Canadian Mineralogist, 43: 2005–2026.
OZDÍN, D. (2010): Bulletin Mineralogicko-Petrologického Oddělení Národního Muzea (Praha), 18: 78–84.
UHER, P., CHUDÍK, P., BAČÍK, P., VACULOVIČ, T. & GALIOVÁ, M. (2010): Journal of Geosciences, 55: 69–80.