The studied metabasites show high contents of transitional elements (Cr, Ni and Co) and low concentrations of LILE (such Rb and Sr), HFSE (Ti, Zr etc.) and REE. Many samples of mafic metavolcanic rocks are also depleted in Nb and Ta.

The Sedlčany–Krásná Hora Islet metabasites generally display typical tholeiitic patterns of chondrite-normalized trace element distributions (Fig. 1). The REE contents in metabasites are very low and the REE chondrite-normalized patterns are relatively flat – the $(Ce/Yb)_N$ ratios are 3.1–6.7 (Fig. 2). The rocks correspond to tholeiitic low-Ti basalts and basaltic andesites. The major and trace element composition of the rocks was locally modified by mobile element concentration changes during the Variscan tectonism.

Two samples of the metabasites – distinguished by the presence of pyroxene phenocrysts of up to 1 cm in diameter – correspond to geochemically primitive Mg-rich boninitic to picritic rocks of the depleted mantle derivation. They show characteristic features of the high-Ca boninitic lavas identical to those of the Upper Pillow Lavas of the Troodos Ophiolite Complex in Cyprus (Crawford et al. 1989; Rogers et al. 1989). These features are: SiO_2 content generally above 49 wt.%, high Mg# (Mg/[Mg+Fe_{TOT}]) values (0.65–0.75), TiO_2 content below 2 wt.%, values of CaO/Al_2O_3 above 0.75 and sum of alkalis below 2 %.

References

ANDERS E. and GREVESSE N., 1989. Abundances of the elements: Meteoritic and solar. *Geochimica and Cosmochimica Acta*, 53: 197-214.

CRAWFORD A.J., FALLOON T. J. and GREEN D. H., 1989. Classification, petrogenesis and tectonic setting of boninites. In: A.J. CRAWFORD (Editor), Boninites. Unwin Hyman, London, pp. 1-49.

DEER W.A., HOWIE R.A. and ZUSSMAN J., 1966. Porodoobrazuyushchiye mineraly (tom 4). Izdatelstvo Mir, Moskva.

CHLUPÁČ I., 1989. Stratigraphy of the Sedlčany–Krásná Hora metamorphic „islet“ in Bohemia (Proterozoic? to Devonian). *Časopis pro mineralogii a geologii*, 34: 1-16.

LEAKE B.E., 1978. Nomenclature of amphiboles. *American Mineralogist*, 63: 1023-1052.

LeMAITRE R.W. (Editor), 1989. A classification of igneous rocks and glossary of terms. Blackwell Scientific Publications, Oxford etc.

ROGERS N.W., MACLEOD C.J. and MURTON B.J., 1989. Petrogenesis of boninitic lavas from the Limassol Forest Complex, Cyprus. In: A.J. CRAWFORD (Editor), Boninites. Unwin Hyman, London, pp. 288-313.

SVOBODA J., 1933. Metamorfovaný ostrov sedlčansko-krásnohorský. *Archiv pro přírodovědecký výzkum čech*, 18: 1-66.

THOMPSON R.N., MORRISON M.A, HENDRY G.L. and PARRY S.J., 1984. An assessment of the relative roles of a crust and mantle in magma genesis: an elemental approach. *Phil. Trans. R. Soc. Lond.* A310: 549-590.

Tourmalines of Povondraite – "Oxy-dravite" Series from Alto Chapare, Cochabamba, Bolivia

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Tourmalines including povondraite occur with many additional minerals in a highly unusual rock called the Locotal Breccia, which represents brecciated metamorphosed Precambrian evaporite cap rock (Žáček et al. 1998). Locotal Breccia outcrops sporadically within a roughly 50 km² area of rain-forest topography in the Alto Chapare region, Cochabamba Department, Bolivia, in the steep eastern foothills of the Andes.

Povondraite as a new member of tourmaline group has an interesting history. The first specimen was studied by Walenta and Dunn (1977) and they described it as a new tourmaline ferridravite. Crystallographical study of Grice et al. (1993) showed that it is a Fe^{3+} analogon of buergerite in fact, with the composition $Na\,Fe_3^{3+}Fe_6^{3+}\,Si_6O_{18}\,(BO_3)_3\,(O,OH)_4$. Therefore a new name povondraite was proposed after Czech mineralogist and well-known tourmaline specialist Dr. P. Povondra. New study of Hawthorne and Henry (1999), in accordance with survey of additional ferrian tourmalines, shows that the ideal endmember formula of povondraite is:

$Na\,Fe_3^{3+}Mg_2\,Fe_4^{3+}\,Si_6O_{18}\,(BO_3)_3\,(OH)_3\,O$ and that there is solid solution between povondraite and "oxy-dravite":

$NaMgAl_2\,MgAl_5\,Si_6O_{18}\,(BO_3)_3\,(OH)_3\,O$.

New compositional data of Chapare tourmalines are in accordance with povondraite and "oxy-dravite" formulae, proposed by Hawthorne and Henry (1999). The present study proved for the first time the existence of nearly complete compositional range between povondraite and "oxy-dravite" (Fig.

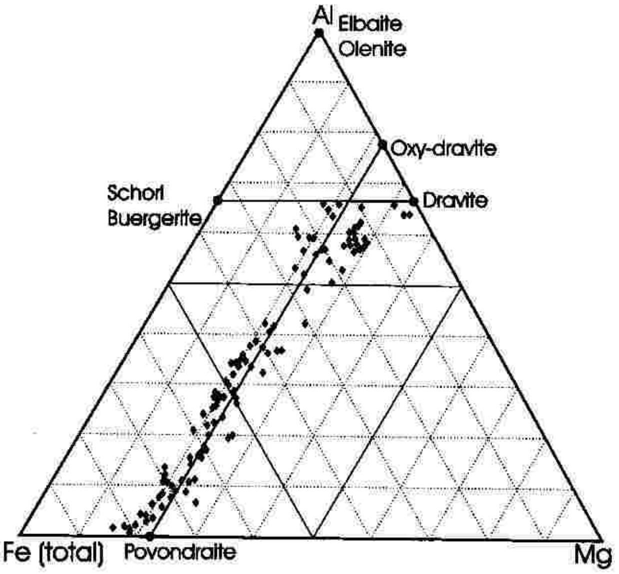

Fig. 1. Al – Fe^{tot} – Mg diagram for Chapare tourmalines.

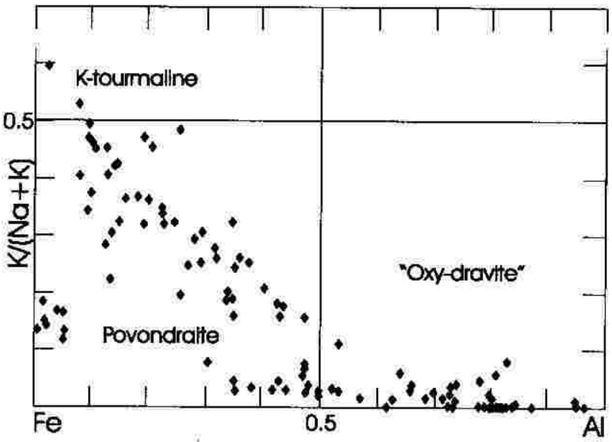

Fig. 2. $X_{Fe\text{-}Al}$ vs. X_K diagram for Chapare tourmalines.

1). The most prominent substitution is principally represented by exchange vector $Fe(Al)_{-1}$ being Fe^{3+} (0.28–7.03 apfu) for Al (0.03–5.75 apfu). The amount of Mg is 1.4–2.5 apfu, strongly variable Ti ranges from 0.0 to 0.5 Ti apfu. There is a significant negative correlation between the sum Ti+Mg and the sum $Al+Fe^{tot}$. These tourmalines are sodic, they have low Ca and a low X-site vacancy. The potassium X-site occupancy ranges from 0.0 to 58 %, and increases with growing Fe^{tot} amount but no portions of potential new species (K-dominant tourmaline) larger than several tens of micron were observed (Fig. 2).

The povondraite – "oxy-dravite" solid solutions tend to occur in additional meta-evaporite tourmalines from other localities but all these tourmalines are much more aluminous, ferrian "oxy-dravites" (Henry et al. 1999). The unique geochemistry (highly oxidic, Al-poor, K-, B-, Fe-rich environment) and probably also elevated P-T conditions explain the extremely wide compositional range of Chapare tourmalines. For details see paper by Žáček et al. (2000).

References

GRICE J.D., ERCIT T.S. and HAWTHORNE F.C., 1993. Povondraite, a redefinition of the tourmaline ferridravite. *Am. Mineralogist*, 78: 433-436.

HAWTHORNE F.C. and HENRY D.J., 1999. Classification of the minerals of the tourmaline group. *Eur. J. Mineral.*, 11: 201-215.

HENRY D.J., KIRKLAND B.L. and KIRKLAND D.W., 1999. Sector-zoned tourmaline from the cap rock of a salt dome. *Eur. J. Mineral.*, 11: 263-280.

WALENTA K. and DUNN P.J., 1977. Ferridravite, a new mineral of the tourmaline group from Bolivia. *Am. Mineralogist*, 64: 945-948.

ŽÁČEK V., PETROV A. and HYRŠL J., 1998. Chemistry and origin of povondraite-bearing rocks from Alto Chapare, Cochabamba, Bolivia. *J. Czech Geol. Soc.*, 43/1-2: 59-67. Praha.

ŽÁČEK V., PETROV A., HYRŠL J. and ONDRUŠ P., 2000. Tourmalines of povondraite – "oxy-dravite" series from the cap rock of meta-evaporite in Alto Chapare, Cochabamba, Bolivia. *J. Czech Geol. Soc.*, Povondra Vol., (in print).

The CL Study of Feldspars from Durbachites – Genetic Implication

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Cathodoluminescence (CL) technique is commonly used in magmatic petrology to acquire detailed petrogenetic information about the evolution of the feldspar minerals (Stirling et al. 1999; Wenzel and Ramseyer 1992). This technique was used to characterize relations between K-feldspar and plagioclase from durbachite suite in the Jihlava Pluton (JP), Třebíč Pluton (TP) and in pebbles from the Carboniferous Luleč conglomerates.

The gabbro (G), monzogabbro (MG) and more evolved clinopyroxene–amphibole–biotite syenite (CABS) from JP were studied. Mafic minerals from gabbro exhibit systematically higher X_{Mg} relative to monzogabbro (Cpx – 0.75 vs. 0.57, Bt – 0.6 vs. 0.4). Intergranular, anhedral and mostly unzoned plagioclases (violet CL) from G, fill space between Cpx and Bt. Plgs from MG are usually anhedral, euhedral grains are rare. Some large grains display continuous zoning with An-rich core (An_{84}, yellow CL) and more acid rim (An_{47}, brown CL). Unzoned anhedral K-f (blue CL) locally overgrows Plg. Myrmekites (An_{35}, violet-brown CL) were observed at the contact between Plg and K-f.

CABS contain phenocrysts of K-f, and CL observations detected their complex structure. The central part consists of unzoned K-f (blue CL) with enclosed relics of zoned Plg (yellow to brown CL). A mosaic of subhedral, zoned K-f grains (blue CL) together with small graints of Plgs (violet CL) forms the outer zone of the phenocrysts. Both feldspars from the outer zone were identified in the matrix as well.

An inclusion of fine-grained amphibole-biotite syenite (ABS) with K-f phenocrysts, and coarse-grained porphyritic amphibole-biotite granite (PABG) from TP were studied. The feldspars from ABS (inclusions in TP) display the same fabric like CABS from JP.

PABS from TP are coarse-grained rocks with remarkable K-f phenocrysts. These K-fs exhibit commonly oscillatory zoning under CL, indicating polyphase crystal growth. A strongly altered Plgs were identified as inclusions in K-f. The shape of Plg inclusions is irregular, the borders are diffuse, Plgs from matrix are weakly zoned. The evolution from brown-violet CL in the centre to the brown luminescence on the rim documented this weak continuous zoning.

Two types of durbachites were found in the Carboniferous Luleč conglomerates. The first one can be compared with PABS from TP because of their similar mineralogy and mineral fabric. The second type, leucocratic, biotite-bearing porphyritic granite (LBG) has not been observed in the TP yet. Large phenocrysts of K-f (blue CL) show complex zonal fabric, combined continuous and discontinuous zoning. The K-fs from LBG