

TOURMALINES FROM THE CRYSTALLINE BASEMENT OF THE WESTERN TATRA MOUNTAINS (POLAND) – INDICATORS OF PARTIAL MELTING PROCESSES

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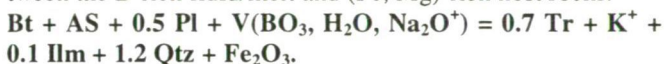
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Tourmaline is the most important mafic mineral in the pegmatites and leucogranites present in the crystalline basement of the Western Tatra Mts. Tourmalines are very irregularly distributed, spatially bound to the leucogranites (alaskites) and their pegmatites (GAWĘDA, 1993). They are usual component of leucogranite pegmatites – as idiomorphic and/or xenomorphic crystals, ranging from 0.3 cm to 8 cm in length. Tourmaline-rich lenses at the contact between leucogranite and mica schists can be also found. Tourmalines are rarely present as small (up to 3 mm) dispersed crystals in folded mica schists, defining L₂ lineation. Both leucogranites and associated tourmaline occurrences are located in the shear zones, cutting the metamorphic complex of the Western Tatra Mts. which acted as a migration path both for the escaped melt and fluids.

All tourmalines, found in the Western Tatra Mts., belong to the schorl-dravite solid solution. They are saturated with respect to Al (Al in Y sites = 0.182–0.631 a.p.f.u.), poor in Li (0.001–0.003 wt.%), with X-sites occupied mainly by Na (0.564–0.801 a.p.f.u.), relatively poor in F (0.18–0.19 a.p.f.u.). The crystal zoning, typical of tourmaline group, is very poor. Some crystals are nearly homogeneous. But the chemistry and Fe³⁺/Fe_{total} ratio differ in different localities.

Fm parameter, defined as Fe_T/(Fe_T + Mg), of the investigated tourmalines varies in the range 0.362–0.652. The lowest values are typical of the internal zone of tourmaline-rich lenses, while tourmalines from the outer part of the same lens are characterized by the **Fm** values in the range of 0.427 to 0.508. The highest **Fm** values (0.513–0.652) are reported from tourmaline-bearing pegmatites.

The origin of tourmalines is interpreted, in general, as crystallization of B-rich portions of fluid, separated from the anatectic leucogranite magma, formed by partial melting (dehydration-melting of muscovite) of metasediments (GAWĘDA, 2001). The main factor was the reaction between the B-rich fluid/melt and (Fe, Mg)-rich host rocks:



The speculations about the source of boron resulted in two conclusions:

1. the source of boron can be the decomposition of primary B-bearing minerals (i.e. muscovite),
2. introduction of B-rich fluid could have occurred along the shear zone.

The temperature of crystallization, calculated according to tourmaline-biotite geothermometer (COLOPIETRO & FREIBERG, 1987) ranged from 490 to 515 °C. The Fe³⁺/Fe_{total} ratio varies in all investigated samples. The possible explanation for the different Fe-oxidation states can be presented in two ways:

1. Oxygen fugacity differed from place to place in the source rocks due to their inhomogeneity and presence or lack of graphite. Because separate magma batches had no contact with each other, and there was no equilibrium in the metamorphic complex the original differences in oxygen fugacity could have been preserved.
2. The magmatic/post-magmatic fluid interacted with the host rocks, forming a chemical gradient. Such gradient produced the internal zoning in the tourmaline nest and the differences in the Fe³⁺/Fe_{total} ratio in the tourmalines.

Both possibilities are applicable for different localities.

The irregular distribution of tourmalines is interpreted as a result of limited boron and water availability in the melted metasedimentary rocks and restricted mobilization of mafic (Fe, Mg) components. The escape of (B, H₂O)-rich fluid phase along a zone of shearing was an additional factor, controlling the occurrences of tourmaline-bearing rocks.

References

- COLOPIETRO, M. R. & FREIBERG, L. M. (1987). Geol. Soc. Amer. Abstr. Progr. 19: 264.
GAWĘDA, A. (1993). Arch. Miner. XLIX/2: 113-144.
GAWĘDA, A. (2001). Monographs of the University of Silesia, No. 1997, Katowice.