

HYDROTHERMAL ALTERATION OF TOURMALINE FROM TOURMALINITES IN THE KRKONOŠE CRYSTALLINE UNIT, BOHEMIAN MASSIF, CZECH REPUBLIC

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Tourmaline is the most common borosilicate occurring in a variety of rock types with variable composition and geological setting. Tourmaline shows a wide stability field from diagenetic zone to granulite-facies metamorphism. It is usually considered to be resistant to weathering and low-temperature hydrothermal alteration. Only some studies report tourmaline breakdown during hydrothermal alteration in pegmatites (AHN & BUSECK, 1998) or in ore deposits (SLACK, 1996).

This abstract deals with the hydrothermal alteration of the tourmaline from tourmalinites in the Krkonoše Crystalline Unit, Bohemian Massif investigated by electron microprobe. Tourmalinites composed of major tourmaline and quartz and minor muscovite and chlorite form stratiform layers in surrounding metasediments (mica schists). Accessory minerals include monazite, apatite, rutile and zircon. The host mica schists are composed of quartz, muscovite, garnet, chlorite ± tourmaline ± biotite. Based on petrographic and electron microprobe data, three generations of tourmaline were distinguished. The early (i) Mg-rich tourmaline [Al-rich dravite with Mg/(Mg + Fe) = 0.81–0.99 and 6.19–7.12 *apfu* Al] reflects growth from Mg-rich hydrothermal fluids in the submarine hydrothermal system. This Mg-rich tourmaline is overgrown by (ii) schorl-dravite [avg. Mg/(Mg + Fe) = 0.61; avg. 6 *apfu* Al; low X-site vacancy avg. 0.09 *pfu*; enriched in F avg. 0.25 *apfu* F]. The third generation of tourmaline, (iii) schorl-dravite [avg. Mg/(Mg + Fe) = 0.56; with varying Al 5.79–6.68 *apfu* and X-site vacancy 0.05–0.36 *pfu*; poor in F avg. 0.17 *apfu* F] replaced early tourmaline. It was developed in relation to the Variscan regional metamorphic overprint and associated K-rich metasomatism. The calculated P-T conditions for this metamorphic event from mica schist (Qtz + Ms + Bt + Chl + Grt) hosted tourmalinite layer yielded T = 553 ± 30°C and P = 13 ± 2.5 kbar (calculated by THERMOCALC in average PT mode; HOLLAND & POWELL, 1998).

Tourmaline from tourmalinite layers has undergone metasomatic replacement reactions in some cases. They include: a) replacement of early tourmaline by newly formed schorl-dravite (type iii) + muscovite + quartz; b) replacement of schorl-dravite (type ii and iii) by chlorite ± muscovite. The type of replacement reaction seems to be dependent on the tourmaline chemistry. The replacement reaction (a) was observed preferentially in

Mg-rich tourmaline cores (i). Chloritization of tourmaline (b) was observed exclusively in tourmaline of schorl-dravite composition (ii).

Muscovite replacing tourmaline contains higher Si, Mg, F and lower Al and Na contents compared with the matrix muscovite. The sum of oxides and cation occupancy in T+A sites (~ 6 *apfu*) in muscovite formed after tourmaline indicate that this muscovite does not contain significant B content. Chlorites correspond to Al-rich chamosite [2.69–2.86 *apfu* Al; Mg/(Mg + Fe) = 0.23–0.47], although the Mg/(Mg + Fe) ratio varies significantly from sample to sample. Chemical composition of chlorite replacing tourmaline differs from chlorite in tourmalinite matrix and is quite similar to fan-like chlorite from quartz-chlorite veins. Chlorite replacing tourmaline and chlorite from quartz-chlorite veins contain higher Si and lower Fe compared to chlorite from the matrix and the contents of Ca and Na were usually detectable by electron microprobe.

Positive correlation between degree of alteration of tourmaline to muscovite [replacement reaction (a)] and amount of muscovite in tourmalinite matrix and presence of muscovite-rich layers suggest that this alteration was caused by K-rich fluids. Intensive K-rich metasomatism and replacement reaction (a) relates probably to the Variscan metamorphic event. Our observations indicate that chloritization of tourmaline [replacement reaction (b)] occurred in relation to younger hydrothermal fluid flux together with quartz-chlorite vein formation. The empirical chlorite thermometer (JOWETT, 1991) indicates T = 246–260°C for formation quartz-chlorite veins.

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