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Subsolidus Replacement of Primary Columbite-tantalite by Microlite and Fersmite associated with Alpine Type Epidote at Maršíkov-Schinderhübel I Pegmatite; Implications to Redistribution and Mobility of Ta, Nb and Ti

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Pegmatite Maršíkov-Schinderhübel I (LCT-family, beryl-columbite subtype) forms a symmetrically zoned dike, up to 1 m thick, cutting amphibole gneiss of the Sobotín Massif. Accessory minerals include spessartine, beryl, gahnite, zircon and crystals of columbite-tantalite, up to 1 cm large, occurring chiefly in albite unit. Pegmatite underwent dynamic metamorphism producing rare chrysoberyl and sillimanite, it is cut by several thin epidote-dominant Alpine veins, which are very abundant in this region. Two distinct textural-paragenetic assemblages involving primary columbite-tantalite replaced by secondary microlite, fersmite and rare betafite and tantalite were distinguished. Proximal *replacement assemblage* is developed within fissure epidote ($\pm$ chlorite, titanite, albite). Pseudomorphs after primary columbite-tantalite are formed mostly by fersmite $>$ microlite; microlite, betafite and tantalite form overgrowths. Distal *fissure-filling assemblage* distributed randomly within the pegmatite is represented by microlite and fersmite developed on open microscopic fissures within primary columbite-tantalite. Primary oscillatory zoned columbite-tantalite and secondary tantalite exhibit Ta/(Ta+Nb) = 0.33-0.66 (0.82-0.85), Mn/(Mn+Fe) = 0.63-0.86 (0.52-0.57) and Ti $<$ 0.19 (0.02) apfu; highly heterogeneous microlite is characterized by Ta/(Ta+Nb) = 0.46-0.96, Ti = 0-0.58 apfu, high Ca ($\sim$1.4 apfu), low Na ($<$0.23 apfu) and vacancy in the A-site ($\sim$0.4 pfu), highly variable F contents (0-0.63 apfu), rare betafite shows Ti = 0.69-0.85 apfu, Ta = 0.63-0.74 apfu and Nb = 0.50-0.56 apfu; slightly heterogeneous fersmite has Ta/(Ta+Nb) = 0.12-0.50 and Ti $<$ 0.13 apfu. Both

assemblages have minerals with similar chemical composition; they differ by presence/absence of epidote, textures (replacement *versus* fissure-filling) and more abundant Ti-rich minerals in the replacement assemblage. Chlorite thermometry (using several methods) T = 250-300 ˚C agrees with the data from hydrothermal systems with the assemblage epidote-chlorite (e.g., 230-280˚C - Nouraliee 2000; 220-300˚C - Tomita et al. 2002).

Alteration of primary columbite-tantalite at both assemblages redistributed Nb, Ta and Ti in a small scale; Nb is concentrated in fersmite, Ta in microlite and tantalite, and Ti in betafite (+Ti-rich microlite, titanite). Abundance of fersmite is unusual and indicates that at given PTX conditions the assemblage fersmite+microlite is more stable than pyrochlore-microlite with Ta/(Ta+Nb) matching primary columbite-tantalite precursor. Fersmite seems more abundant in such assemblages but it may be overlooked due to similar composition of fersmite $CaNb_2O_6$ and pyrochlore with the empirical formula close to ?$CaNb_2O_6$?. Dominance of fersmite and microlite in both assemblages manifests high activity of Ca, presence of tantalite, betafite and titanite suggests higher activity of Ti and Fe in the proximal replacement assemblage. Apparently higher proportion of fersmite over microlite in pseudomorphs after columbite-tantalite, microlite ($\pm$betafite) overgrowths on these pseudomorphs and isolated grains of microlite distributed randomly within epidote (or chlorite) suggest higher mobility of Ta relative to Nb in the conditions of lower greenschist metamorphic conditions. Dominant epidote, minor chlorite, titanite and albite on Alpine veins, and textural relations in associated Nb,Ta-oxides suggest that Ca, Al, most of Ti and perhaps Fe (Mg) were received from host amphibole gneiss. The relative mobility Ca $>$ Ti $>$ Ta $>$ Nb is implied for these assemblages.