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Hydrogen zoning in zinc-bearing staurolite from a high-*P*, low-*T* diasporite (Samos, Greece): A combined EMP-SIMS-FIB-FTIR study

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Abstract

Li-rich zincostaurolite occurs as millimeter-long crystals at the marble footwall of a meta-karst-bauxite on eastern Samos. The Samos rocks have been metamorphosed during an early Alpine high-*P*, low-*T* metamorphism (M1) followed by a late Alpine greenschist-grade overprint (M2). Textures and mineral chemistry indicate that staurolite formed from gahnite, cookeite, and pyrophyllite during the early M1 stage. Staurolite crystals show growth zoning with cores enriched in Zn. Concentrations of Fe, Mg, Co, and, to a minor extent, Li increase toward the rims.

Hydrogen concentrations were analyzed by SIMS. They are significantly higher in cores (up to 5.97 atoms H per 48 O) compared to rims (3.9 to 4.5 atoms H) and clearly negatively correlated with Al. Synchroton-light polarized FTIR spectra on oriented FIB-prepared foils show the same zonation effect, the absolute hydrogen concentrations being systematically lower by about 25%. The discrepancy is caused by sub-micrometer scale hydrogen loss at the crystal surface during FIB-thinning. This staurolite is unique as from the three available hydrogen sites the H3 site has the highest occupation ever observed, whereas the H2 site is not occupied. This is probably due to the high Li content.

The zonation in hydrogen is interpreted as reflecting the two-stage growth. M1-staurolite that formed a low *T* of about 400–450 °C and high *P* of >1.5 GPa incorporated nearly the maximum amount of hydrogen allowed by the staurolite structure (6 H pfu) and was subsequently overgrown and marginally replaced during the M2 stage by less hydrous, Fe-Co richer staurolite. Hydrogen zoning in staurolite is facilitated by the sensitivity of its structure to changing *P*-*T* conditions. Water in staurolite is maximized at high *P* and low *T*. Cores of staurolite from Samos represent the most hydrous staurolite compositions reported to date.

Keywords: Staurolite, hydrogen zoning, SIMS, FTIR, Metabauxite