Li-rich zincoastaurolite and its decomposition-related breakdown products in a diasore-bearing metabauxite from East Samos (Greece): An EMP and SIMS study

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ABSTRACT

Li-H-rich zincoastaurolite locally formed at a metabauxite-marble contact along the eastern coast of Samos during early Alpine high-P, low-T metamorphism. The staurolite, which probably grew from gahnite, cookeite, kaolinite/pyrophyllite, diasore, and minor Fe-oxide, occurs as prismatic crystals (up to several mm long) in a calcite matrix. It has an unusual composition with 7.5–12.9 wt% ZnO, 1.0–4.9 wt% FeO, 0.66–0.82 wt% Li2O, up to 2.6 wt% NiO and 0.59 wt% CoO, and ≤ 0.32 wt% MgO. Calculated structural formulae point to high H2O contents (24.14 H atoms per 48 oxygen atoms). During late-Alpine uplift of the Samos rocks, the staurolite was, at greenschist-facies conditions, variably replaced by bluish cobaltoan gahnite (Xzn ≥ 0.82), white Na-Ca-Li mica, Ni-rich chlorite (Xzn = 0.42–0.59), zincohögbomite (Xzn = 0.68–0.80), diasore, and Fe-(hydr)oxide. Detailed EMP work and determination of Li in staurolite and mica by SIMS indicates systematic Zn-Fe-Mg-Ni-Co-Li partitioning between staurolite and its decomposition products, implying local-scale chemical equilibrium. Balanced reaction equations based on mineral-chemical data indicate that the breakdown of staurolite occurred largely isochemically with only introduction of water, Na, and Ca into the reacting system. The breakdown of high-P staurolite during uplift and decomposition is thought to be related to the sensitivity of its complex crystal chemistry to changes in physico-chemical conditions.

INTRODUCTION AND OCCURRANCES OF ZN-RICH STAUROLITE

Iron-rich staurolite is a key mineral for determining the metamorphic grade of Al-rich metasediments because its appearance defines the transition from greenschist to amphibolite facies. Although staurolite is typically rich in Fe and Mg, in certain environments it may incorporate considerable amounts of Zn and Li; these elements substitute preferentially into its structural formulae point to high H2O contents (24.14 H atoms per 48 oxygen atoms). During late-Alpine uplift of the Samos rocks, the staurolite was, at greenschist-facies conditions, variably replaced by bluish cobaltoan gahnite (Xzn ≥ 0.82), white Na-Ca-Li mica, Ni-rich chlorite (Xzn = 0.42–0.59), zincohögbomite (Xzn = 0.68–0.80), diasore, and Fe-(hydr)oxide. Detailed EMP work and determination of Li in staurolite and mica by SIMS indicates systematic Zn-Fe-Mg-Ni-Co-Li partitioning between staurolite and its decomposition products, implying local-scale chemical equilibrium. Balanced reaction equations based on mineral-chemical data indicate that the breakdown of staurolite occurred largely isochemically with only introduction of water, Na, and Ca into the reacting system. The breakdown of high-P staurolite during uplift and decomposition is thought to be related to the sensitivity of its complex crystal chemistry to changes in physico-chemical conditions.

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