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Compositional zoning and element partitioning in nickeloan tourmaline from a metamorphosed karstbauxite from Samos, Greece

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ABSTRACT

Blue-green nickeloan tourmaline from a micaceous enclave of a marble from Samos, Greece, contains unusually high concentrations of Ni (up to 3.5 wt% NiO), Co (up to 1.3 wt% CoO), and Zn (up to 0.8 wt% ZnO). The polymetamorphic karstbauxite sample has an uncommon assemblage of nickeloan tourmaline, calcite, zincian staurolite, gahnite, zincohögbomite, diaspore, muscovite, paragonite, and rutile. The complex geologic history is reflected in multi-staged tourmaline growth, with cores that represent detrital fragments surrounded by two-staged metamorphic overgrowths. Zone-1 metamorphic overgrowths, which nucleated next to detrital cores, are highly asymmetric and exhibit compositional polarity such that narrow overgrowths of brown schorl developed at the (–) c-pole are enriched in Mg, Ti, and F, and depleted in Al, Fe, and X-site vacancies ($^{X}\square$) relative to wider, gray-blue schorl-to-foitite overgrowths developed at the (+) c-pole. Volumetrically dominant Zone-2 overgrowths are strongly zoned nickeloan dravites with a continuous increase in Mg, Co, Ca, and F at the expense of Fe, Zn, Cr, and V from the Zone-1 interface to the outermost rim. Within Zone 2, Ni reaches a maximum of 0.5 apfu before decreasing in the outer 20–40 μm. Zone-2 overgrowths also exhibit compositional polarity such that, at the (–) c-pole, overgrowths are enriched in Mg, F, Na, Ca, and Cr relative to overgrowths at the (+) c-pole that are, in turn, enriched in Al, Fe, Ni, Co, and $^{X}\square$. Element partitioning involving tourmaline rims and coexisting minerals indicates that relative partitioning of Ni is tourmaline >> staurolite > gahnite; Co is tourmaline > staurolite > gahnite; and Zn is gahnite > staurolite >> tourmaline.