Fluid inclusion assemblages (FIA) display a wide range of liquid-vapor-solid phase ratios. Raman spectroscopy was used to identify solid phases within thirty different inclusions, and one representative polyphase inclusion was analyzed using a dual beam focused ion beam-scanning electron microscope (FIB-SEM). Inclusions ranging from 40 to 90 volume % solids contain quartz, pollucite, trilithionite, zabuyelite and an arsenic-antimony rich phase (predominantly native arsenic, senarmontite, paakonenite and/or arsenolite). Inclusions ranging from 5 to 40 volume % solids contain zabuyelite ± an arsenic-bearing phase and inclusions with less than 5 volume % solids typically contain an arsenic-rich solid phase. Rare stibnite, nahcolite, lithiophosphate and triphylite-lithiophilite are also present. The inclusion compositions indicate that tourmaline entrapped a Li-, Cs-, As-, Sb- and carbonate-enriched hydrous silicate liquid. This solute-rich fluid separated from the crystallizing pegmatite melt during crystallization and influenced the distribution of rare elements within the pegmatite and in the surrounding host rocks.

The origin and composition of polyphase inclusions in tourmaline from the Greenbushes pegmatite, Western Australia

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The (2.5 Ga) Greenbushes rare-element pegmatite in Western Australia is an important source of lithium, tin, and tantalum. The pegmatite, which was emplaced syngenetically into the Donnybrook-Bridgetown shear zone within the Yilgarn Craton, consists of five distinct petrologic zones. Zoned tourmaline crystals from the Ta-rich "mixed" zone are host to abundant primary and pseudosecondary polyphase inclusions. Petrographic analysis indicates that inclusions occur within a brown pleochroic growth zone that was subsequently overgrown by a blue growth zone devoid of inclusions.

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