Changes in tourmaline trace element geochemistry during magmatic differentiation and hydrothermal ore deposition

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The Cu-Sn-W ore deposits of Cornwall (SW England) are related to Variscan magmatism and accompanying hydrothermal activity. To understand the formation of these deposits, the distribution of Cu, Sn and W between various phases during melt differentiation, fluid exsolution and precipitation are of key importance. Tourmaline is a perfect recorder of these processes as it is the only mineral present during all these stages in abundant quantities and it is stable over a wide range of p-T conditions. Incorporating trace elements like Cu, Sn and W into its structure, tourmaline will shed light on the formation of these ore deposits.

The variety of different geological occurrences, textures and zoning patterns of tourmaline was analyzed by EMPA and reveals a compositional range between different end-members like dravite and schorl, feruvite, uvite, foitite, and Mg-foitite, with each end-member occuring as oxy, hydroxyl and fluor phase as well.

Trace elements in tourmaline were analyzed by LA-ICP-MS. Some economically important elements like Sn show clear systematics. Sn content in tourmaline increase from 2-65 μg/g during magmatic stages and up to 6000 μg/g during hydrothermal stages. Other elements such as Cu and W show a more complex behavior. We therefore plan a detailed fluid inclusion study to obtain further insight. The precipitation of cassiterite (SnO_2) takes place only after a certain Fe^{2+}/Fe^{3+} ratio has been reached (about $Fe^{3+}/\Sigma Fe = 0.3$), which we assume reflects the redox state of the system. With the precipitation of SnO_2, other elements in tourmaline like Sr, Ca, Mg, Cr and in some cases Co increase, which could be related to the influence of an externally-derrived fluid or reaction with the host rocks and may therfore indicate the opening of the granitic system.