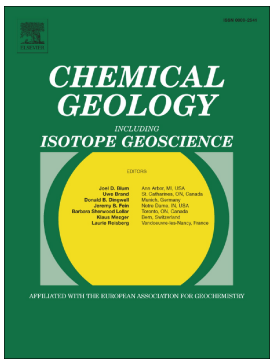

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Assessing the mechanisms of common Pb incorporation into titanite

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Abstract

Common Pb, the portion of non-radiogenic Pb within a uranium bearing mineral, needs to be accurately accounted for in order to subtract its effect on U-Pb isotopic ratios so that meaningful ages can be calculated. The propensity to accommodate common Pb during crystallization, or later, is different across the range of uranium bearing minerals used for geochronology. Titanite frequently accommodates significant amounts of common Pb. However, the most appropriate method to correct for this requires knowledge on the mechanism and timing of common Pb incorporation; information that is commonly difficult to extract. In this study, the spatial and compositional distribution of trace elements (including Pb) in metamorphic titanites from a Greenland amphibolite is investigated on the grain- to nano-scale. Titanites have an isotopically similar signature for both common and radiogenic-Pb in all grains but significantly different quantities of the non-radiogenic component. Microstructural and compositional examination of these grains reveals undeformed, but high common Pb (F207%) titanites have homogeneous element distributions on the atomic scale suggesting common Pb is incorporated into titanite during its growth and not during later processes. In contrast, deformed titanite comprising low-angle boundaries, formed by subgrain rotation recrystallization, comprise networks of dislocations that are enriched in Mg, Al, K and Fe. Smaller cations may migrate due to elastic strain in the vicinity of the dislocation network, yet the larger K cations more likely reflect the mobility of externally-derived K along the orientation interface. The absence of Pb enrichment along the boundary indicates that either Pb was too large to fit into migrating lattice dislocations or static low-angle boundaries and/or that there was no external Pb available to diffuse along the grain boundary. As the common Pb composition is distinctly different to regional Pb models, the metamorphic titanite grew in a homogeneous Pb reservoir dominated by