

**Petrogenetic indicators in titanite:
Using the trace element signature to
constrain polygenetic titanite growth
and garnet growth**

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Titanite is a valuable chronometer as it occurs in a wide variety of geological settings, and frequently has clear textural relationships with the P-T history of the rock. However, titanite U/Pb data require careful assessment due to its resistance to age resetting during metamorphism. Characterising the crystallisation history of titanite relative to garnet may offer valuable thermal constraints for titanite U/Pb ages. We used LA-ICPMS to analyse trace element and U/Pb compositions of titanite in five amphibolite- to granulite-facies samples from the Albany-Fraser Orogen of Western Australia. Chondrite-normalised REE abundance patterns discriminate between populations of titanite. These populations correlate with distinct BSE microstructures and petrographic context. The Dy/Yb ratio can be used as a petrogenetic indicator to link titanite growth to garnet growth. Titanite that crystallised in equilibrium with garnet is HREE-depleted with Dy/Yb >2, whereas titanite that crystallised in the absence of garnet has flat HREE patterns with Dy/Yb <2.

Integration of trace element signatures with geochronology reveal titanite age components linked to magmatic crystallisation, metamorphic growth, garnet growth, and/or cooling through the closure temperature for Pb diffusion in titanite, and help to unravel the complex thermal histories of ancient orogens.