Low-temperature, fluid-driven resetting of titanite following ultrahigh-temperature metamorphism in Madagascar

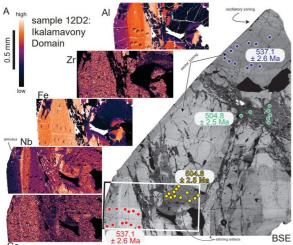
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LA-ICP-MS U-Pb dates and EPMA trace-element maps of titanite were collected from granulite-facies calc-silicate gneisses of southern Madagascar (peak T: 750-950°C) to evaluate how titanite responds to high-temperature metamorphism, cooling, and retrogression. Fluid-mediated replacement of precursor titanite by titanite of different composition (interface-coupled dissolution-precipitation, ICDR)-not diffusion-was the primary mechanism by which titanite was reset following highgrade metamorphism. Comparison of titanite U-Pb dates (530-490 Ma) with independent petrology and thermochronology indicates that the alteration occurred at temperatures as low as 300-500 °C. Apparent Zr temperatures (temperatures calculated assuming titanite-quartz-zircon equilibrium) in altered titanite are less than or equal to the metamorphic peak, but higher than the inferred alteration temperature, implying that Zr was removed, but that titanite-quartz-zircon equilibrium was not achieved during alteration. Although evidence for ICDR was observed over a region of ~100 km, differences in U-Pb dates among samples, and even among titanite grains in the same thin section suggest that alteration was highly localized at any given time.



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