

Geochemistry of Rutile: Applications for Geothermometry, Geochronology and Provenance Studies

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The mineral rutile (TiO₂) is not only a wide-spread accessory mineral in a range of metamorphic rocks and an ultrastable mineral in sedimentary environments, but has some interesting geochemical properties that have been largely neglected until recently. My research has shown that (1) the Zr concentration in rutile in equilibrium with zircon and quartz is very sensitive to temperature ; (2) Nb and Cr in rutile are a reliable indicator of the source rocks in which rutile crystallized (e.g., metapelites vs metabasites can be distinguished) and (3) rutiles are characterized by extremely low Th concentrations, so that measured ²⁰⁸Pb (also formed from ²³²Th decay) in rutile is almost entirely derived from the Pb incorporated during growth, which allows for a robust common Pb correction for U/Pb dating of rutile.

I will illustrate the potential of these discoveries with field examples from around the world. I have found applications for rutile geochemistry (1) by using rutiles with high Zr concentrations as an ultra-high temperature indicator in high grade terrains, (2) delineating complex cooling histories of lower crustal sections by measuring U/Pb ages of rutiles with different grain sizes and (3) exploiting all geochemical properties in concert for sedimentary sequences in provenance studies.

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