

A new oxybarometer for rutile

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Vanadium (V) is a multivalent element that transitions from V^{3+} to V^{4+} to V^{5+} at fO_2 near the quartz-fayalite-magnetite (QFM) oxygen buffer [1], making it an excellent redox sensor for rocks from both the mantle and the continental crust. Rutile (TiO_2) will incorporate V^{4+} on the Ti^{4+} site and is an attractive candidate for the development of a new V-oxybarometer. To examine V solubility in rutile as a function of oxidation state, we executed a series of partitioning experiments in a gas-mixing furnace at 1300 °C under varying oxygen fugacity. Three different melt compositions were saturated in rutile to examine how melt composition, in addition to valence state, affects V partitioning between rutile and silicate liquids. For all melt compositions, vanadium is most compatible in rutile at fO_2 s where V^{4+} dominates and rutile/melt partition coefficients show dynamic range over $\log fO_2=QFM-2$ to $QFM+4$. However, V solubility in rutile is strongly influenced by melt composition and increases significantly as the melt becomes more polymerized. Our results indicate the amount of V incorporated in natural rutile grains should be diagnostic of system redox state, as well as melt composition if rutile precipitated in equilibrium with a silicate liquid.

[1] Sutton SR, Karner J, Papike J, Delaney JS, Shearer C, Newville M, Eng P, Rivers M, Dyar MD (2005) *Geochim Cosmochim Acta* 69, 2333-2348.