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Experimental determination of tin partitioning between titanite, ilmenite and granitic melts using improved capsule designs.

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Investigating mineral/melt tin (Sn) partitioning at high temperatures and pressures is a difficult task as Sn is a multivalent element and alloys easily with sample capsule of noble metals. The alloying effect could result in severe Sn loss and inaccurate Sn partition coefficients. Titanite and ilmenite are two important accessory minerals in tin-granites. To obtain accurate Sn partition coefficients between titanite, ilmenite and hydrous granitic melts, we developed single capsule Pt or Au and double-capsule [PtRh (or Au)-Re] designs to avoid significant Sn loss at controlled fO_2. In the highly oxidizing experiments, we loaded silicate powder and fO_2 buffer together into a single capsule because Sn does not alloy with noble metals at the highly oxidizing condition. In the moderately oxidizing to reducing experiments, we, considering that Sn does not alloy significantly with Re, used the double-capsule design to avoid Sn loss. This design comprises of an inner Re sample capsule and a $Pt_{95}Rh_5$ (or Au) outer capsule with fO_2 buffers loaded inside or outside the Re capsule, depending on whether Sn reacts with the buffers.

The experiments were performed on a piston-cylinder apparatus at 0.5-1.0 GPa and 850-1000°C with fO_2 controlled by the solid buffers Ru-RuO_2, Re-ReO_2, Co-CoO, graphite and Fe-FeO (fO_2 = ~QFM+8 to ~>QFM-4). In the P–T–fO_2 conditions, mineral/melt Sn partition coefficients ($D_{Sn}^{min/melt}$) are 0.48-184.75 for titanite and 0.03-69.45 for ilmenite. The $D_{Sn}^{min/melt}$ values are crucially dependent on fO_2 although effects of melt composition and temperature are also observed. $D_{Sn}^{Ttn/melt}$ strongly decreases with decreasing fO_2, being ~46-185 at the most oxidizing Ru-RuO_2 buffer, ~2-16 at the moderately oxidizing to moderately reducing buffers (Re-ReO_2 to Co-CoO or graphite), and < 1.0 at the most reducing Fe-FeO buffer. $D_{Sn}^{Ilm/melt}$ exhibits a similar decrease with decreasing fO_2 but it is lower than that for titanite at a given fO_2. We used $D_{Sn}^{Ttn/melt}$ to estimate the Sn contents of the pre-mineralization granites at Qitianling, South China. The results show that the pre-mineralization Sn contents of the magma are ~488-929 ppm at ~NNO-1±0.5 (fO_2 of Qitianling granite), suggesting that relatively reducing magmas are favorable to Sn mineralization.