

Titanium isotope fractionation in synthetic TiO₂-rich lunar melts

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Equilibria between Ti-rich oxides (e.g. ilmenite and rutile) and silicate melt during basalt petrogenesis are known to lead to Ti isotope fractionation in both lunar and terrestrial samples [1,2]. Oxides are typically isotopically light and coexisting silicate melt is isotopically heavy. However, at fO_2 relevant to lunar magmatism ($\sim IW-1$) 10% of the overall Ti is Ti^{3+} [3], which might influence Ti stable isotope fractionation to an unknown extent. In order to determine the effect of Ti-oxides and fO_2 on Ti stable isotope fractionation, experiments with a TiO₂-rich composition were carried out at different fO_2 in gas mixing furnaces. Samples were mixed with a Ti double-spike, and then processed in a highly modified HFSE chemistry to separate Ti from matrix, to determine its Ti isotope composition.

Our results show that from oxidised to reduced conditions (air to $IW-1$), armalcolite displays light Ti isotope compositions (-0.056‰ to -0.003‰ relative to OL-Ti [4]), whereas silicate melt ($+0.035\text{‰}$ to $+0.197\text{‰}$) and orthopyroxene ($+0.033\text{‰}$ to $+0.247\text{‰}$) show intermediate to high $\delta^{49}Ti$. Our results show that Ti isotope fractionation during mare basalt petrogenesis is likely to be redox dependent and pre-existing mineral-melt fractionation factors may not be directly applied in the case of lunar basalt petrogenesis.

[1] Millet *et al.* (2016) *EPSL* **449**, 197-205. [2] Deng *et al.* (2019) *PNAS* **116** (4), 1132-1135. [3] Leitzke *et al.* (2018) *Contrib. to Mineral. Petrol.* **173**, 103. [4] Millet and Dauphas (2014) *JAAS* **29**, 1444.