Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.9632

Titanium transport and isotopic fractionation in the critical zone

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The Ti isotope compositions of 93 surface samples from a broad geographical area and a range of climate regimes including loess, sedimentary rocks, river sediment, and two separate weathering profiles record the degree to which Ti isotopes are fractionated in the Critical Zone. Small Ti isotope fractionations exist in samples subjected to extreme chemical weathering processes. For example, the δ^{49}Ti isotopic composition of bauxite samples developed on Columbia River basalt vary by up to 0.1‰, becoming isotopically heavier with increasing weathering intensity. Titanium isotope variations in loess do not correlate with chemical weathering intensity or size sorting, but may instead be related to the provenance of the sediment. Some Amazon River sediment samples show a correlation with clay content, with an increasing δ^{49}Ti isotope composition relative to Al/Zr ratio. The results here have implications for studies that utilize the Ti elemental concentration to calculate relative enrichment or depletion during chemical and physical weathering processes in the Critical Zone, and for studies using Ti isotopes in terrigenous sediments to infer source compositions.