Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.5176

Hydrodynamic sorting of Fe-Ti oxides: implications for $\delta^{49/47}$Ti of detrital sediments

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Detrital sediments hold valuable clues about the average composition of the erodible crust through time. Recently, the isotopic composition of titanium ($\delta^{49/47}$Ti) in detrital sediments has been proposed as a robust tracer of the average SiO_2 content of their source(s), thus allowing reconstruction of the proportion of felsic crust from the Archaean to the present-day [1,2]. This approach relies on the key premise that Ti isotopes are not fractionated relative to their source(s) during weathering and sedimentary processing.

The main hosts of Ti in igneous and metamorphic rocks are Fe-Ti oxides. Due to their durability and similar density to zircon, Fe-Ti-oxides are a common component of heavy mineral assemblages and can therefore be concentrated in coarse sediments. Hydrodynamic sorting of isotopically light Fe-Ti oxides [3] thus has the potential to bias $\delta^{49/47}$Ti of the shale record. We use a suite of well-characterised sediments from the Eastern Mediterranean Sea (EMS) to test this hypothesis. These sediments contain variable contributions of young Nile-derived clastic sediment and older Saharan dust.

The EMS sediments display limited inter-sample covariation between Al_2O_3/TiO_2 and $\delta^{49/47}$Ti resulting from hydrodynamic sorting of Fe-Ti oxides. From their well-constrained provenance framework, it is, however, evident that the Nile-derived component in the EMS sediments is strongly depleted in Fe-Ti oxides as it has significantly lower TiO_2/Nd and higher $\delta^{49/47}$Ti than its protolith. Whereas Ti is carried essentially unmodified from the source to the delta of the Nile [4], considerable loss of isotopically light Fe-Ti oxides in the Nile littoral cell depletes the finer sediment fractions in Ti and increases their $\delta^{49/47}$Ti by ~0.15 ‰. The isotopic effect of hydrodynamic sorting of oxides can lead to a gross overestimation of the proportion of felsic crust, or at least account for the scatter in $\delta^{49/47}$Ti in the shale record. Such a bias makes $\delta^{49/47}$Ti in detrital sediments a potentially unreliable proxy of crustal composition.

[1] Greber *et al.* (2017) *Science* **357** 1271-1274; [2] Saji *et al.* (2019) *Goldschmidt abstract* **2929**; [3] Hoare *et al.* (2020) *GCA* **282** 38-54; [4] Garzanti *et al.* (2015) *QSR* **130** 9-56.