Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.17473

Decoupled radiogenic Nd and Hf isotopes of clays reveal South Asian Monsoon control of silicate weathering intensity

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The weathering of silicate rocks removes CO_2 from the atmosphere-ocean system on geological timescales but the time required for weathering intensity to respond to changes in climate is poorly constrained. The radiogenic isotopes of hafnium and neodymium are decoupled during silicate weathering with the isotopic composition of river clays being offset from bulk rocks [1]. Here we examine the decoupled Nd-Hf isotopes of clays deposited in marine sediments from the northern Bay of Bengal near the mouth of the Ganga-Brahmaputra rivers. The sediment core (SO188 17286-1) covers the last 130 kyrs and has been used to study the past intensity of the South Asian Monsoon (SAM) [2, 3]. The deviation of the Hf isotope compositions from the array defined by global river clays (ΔεHf clay), has a pattern of variability similar to the record of SAM intensity inferred from the reconstructed $d^{18}O$ of seawater and dD of leaf waxes [2, 3]. These variations in silicate weathering intensity occur on timescales near 20 kyrs and appear to be paced by orbital precession. This suggests a strong, and rapid (on geological timescales), link between SAM hydroclimate and silicate weathering in this region. In contrast, changes in the source provenance of the clays as recorded by their Nd isotope signatures follow a glacial-interglacial pattern indicating either a sea level or global climate influence on changes in sediment transport to the shelf. This contrast demonstrates the great utility of ΔεHf clay to record changes in weathering intensity while directly accounting for shifts in sediment source provenance. The global river ΔεHf clay signal covaries with temperature and precipitation, and the Chemical Index of Alternation [1] and the range of 2 - 5 epsilon units in ΔεHf clay observed is indicative of variations of strong tropical weathering. Further refinement of this proxy by measurements of river and marine sediments may allow past changes in the CO_2 consumption by silicate weathering to be estimated.

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