Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.30144

Neritic Carbonates Resolve an Apparent Imbalance in Seawater Stable Strontium Isotopes

MATTHEW D NADEAU[1], JOHN A HIGGINS[1], LUCIEN NANA YOBO[2], CHRIS HOLMDEN[3] AND BLAIR SCHOENE[1]

[1]Princeton University
[2]Texas A&M University
[3]University of Saskatchewan

The stable strontium isotope composition of seawater ($\delta^{88/86}Sr_{sw}$) is a valuable tracer of global carbonate precipitation, yet its modern mass balance remains uncertain. Current estimates suggest an imbalance of ~0.1‰ between Sr inputs and outputs, interpreted as resulting from large fluctuations in Sr fluxes on glacial time scales. Alternatively, this discrepancy may stem from an incomplete understanding of the $\delta^{88/86}Sr$ signature of the neritic carbonate sink, which represents ~77% of Sr removal from seawater.

Here, we present the first large dataset (n=146) of $\delta^{88/86}Sr$ values in Neogene neritic carbonates. These data reveal substantial $\delta^{88/86}Sr$ variability (~0.10‰ to ~0.45‰), with systematically higher values in neritic carbonates than in pelagic carbonates. Paired geochemical and mineralogical analyses (e.g., $\delta^{44}Ca$, Sr/Ca, Mg/Ca) indicate that this variability is primarily controlled by carbonate mineralogy (aragonite vs. calcite) and biogenic precipitation kinetics. Early marine diagenesis further modifies carbonate $\delta^{88/86}Sr$ values, with dolomitized samples exhibiting the heaviest values (~0.36‰), aligning with expectations for slow recrystallization under near-equilibrium conditions from a pore fluid with a $\delta^{88/86}Sr$ signature of 0.40‰.

By integrating these results into a revised global Sr budget, we estimate a Sr burial flux-weighted carbonate sink $\delta^{88/86}Sr$ value which is significantly higher than previous estimates (0.15-0.21‰). This revision reconciles the marine Sr isotope mass balance and reduces the need for large, transient changes in Sr fluxes. Furthermore, the wide range observed in $\delta^{88/86}Sr$ values of modern neritic carbonates suggests that spatial heterogeneity must be considered when interpreting secular $\delta^{88/86}Sr$ trends in the rock record.

These findings highlight the first-order control of carbonate depositional environment and biogenic calcification on seawater $\delta^{88/86}Sr$, with implications for understanding the evolution of the global carbonate cycle.