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Barium uptake and isotope fractionation by a marine diatom

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Barium (Ba) is a nutrient-type element and an important tracer for reconstructing marine productivity, yet the mechanisms controlling its biological uptake and stable isotope fractionation remain poorly understood. In this study, we present culture experiments using the marine diatom *Thalassiosira weissflogii* to investigate how biological Ba uptake contributes to pelagic barite ($BaSO_4$) formation and its associated isotope effects.

Our experiments reveal that Ba cell quotas (Ba/P) are positively correlated with Ba concentrations in the culture medium, with the slope of this relationship influenced by diatom-specific growth rates. Trends in the uptake of Ba, Ca, and Sr suggest that Ba is likely taken up passively via Ca transporters, effectively entering cells as a leakage from seawater. We also report the first measurements of Ba/C ratios in *T. weissflogii*, which are significantly lower than those observed in marine field particles. This difference indicates that additional sources of Ba are necessary to sustain the particulate Ba flux associated with export production in the water column.

The Ba isotope compositions of the cultured diatoms show a preferential uptake of isotopically light Ba from seawater, and the isotope fractionation factors are independent of growth rates. These findings help explain the discrepancy between Ba isotope fractionation factors observed in field pelagic barite and those measured in laboratory-precipitated barite. Overall, this study provides the first constraint on Ba cell quotas and isotope fractionation in marine diatoms, highlighting their implications for pelagic barite formation and the marine Ba cycle.