Statement of Interest

US GEOTRACES Pacific sections: Iron, zinc, cadmium, and copper stable isotopes

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My lab plans to measure dissolved stable isotope ratios of Fe, Zn, Cd, and Cu at every depth and station along the US GEOTRACES Pacific zonal and meridional sections. Particulate δ^{56}Fe will be measured where samples are available. New methods which are ideally suited to GEOTRACES have recently been developed at USC for the simultaneous extraction and purification of Fe, Zn, Cd, and Cu isotopes from seawater. This allows us to measure all four isotope ratios on a single seawater sample, making efficient use of limited sample volumes. Simultaneous extraction also decreases processing time, making it feasible to generate this data within the timeframe of GEOTRACES.

This effort supports core GEOTRACES objectives of identifying processes and fluxes which affect TEI distribution in the oceans, because stable isotopes of Fe, Zn, Cd, and Cu trace the marine biogeochemical cycling of these elements. For example, seawater δ^{56}Fe can be used to fingerprint different sources of Fe to the oceans, thereby constraining the relative impact of Fe fluxes from surface dust deposition, hydrothermal vents, and reducing continental-margin sediments. Additionally, δ^{56}Fe in surface waters may be used to study the biological cycling of Fe as a nutrient. Both δ^{66}Zn and ε^{114}Cd increase in surface waters due to biological uptake, suggesting the applicability of these isotopes as tracers of biological productivity and remineralization. Cu isotopes are relatively unexplored but, as with the other elements, GEOTRACES represents a unique opportunity to develop new isotopic tools which trace TEI biogeochemical cycling.

The Pacific sections include several regions of particular interest for us. δ^{56}Fe from dust, continental margins, and hydrothermal vents will be measured in Asian-dust impacted surface waters, the Peru OMZ, and the East Pacific Rise, respectively, so that we can quantify the relative importance of these Fe sources on a global scale. Productivity gradients from the Peru upwelling region to the extreme oligotrophy of the Central South Pacific provide an opportunity to observe the biologically-driven fractionation of metal isotopes under diverse conditions. Stations across the equatorial upwelling region will help to distinguish the relative impact of upwelling versus remineralization in controlling Fe, Zn, and Cd isotope and concentration profiles.

Sample requirements are ideally 4 L of filtered seawater at each depth for the ‘surface’ cast and 2 L for the ‘deep’ cast. Particulate sample requirements are ideally 1/8th of the filter material at each depth. We do not require berthing space.