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Water column Zn and Cu Stable Isotopes in the Indian and Pacific Oceans

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Many transition metals are key micronutrients and their concentration profiles in the oceans often show nutrient-like patterns, with strong surface depletions and deep enrichments (1). In addition, their biological usage has been shown to induce isotopic fractionations (2) so that the precise and accurate analysis of their isotope systems in seawater has potential applications in tracing metal micronutrient usage in the past ocean. The analytical challenges involved in realising this goal are, however, considerable, given the low concentrations of transition metals in seawater and the requirement to extract small amounts from large samples at low blank and with no artificial isotopic fractionation. We have developed such a procedure and we here present the first depth profiles for Zn and Cu isotopic compositions of the oceans, specifically the SW Indian and NE Pacific.

Trace metals were concentrated from seawater using a Chelex-100 ion-exchange column (3) and further purified and separated from each other using a small anion column (4, 5). All isotopic analyses were performed on a ThermoFinnigan Neptune instrument at the University of Bristol. Zn isotopes and concentrations were measured using a double spike and Cu by standard-bracketing. Concentration profiles for Cu and Zn show typical patterns involving surface depletion and deep enrichment. The isotope systems of both elements show heavier compositions in the surface ocean. The coupled isotopic and concentration profiles suggest that the removal of these metals from the surface ocean is associated with a process that preferentially removes the lighter isotope. This observation is completely consistent with a biological origin for the elemental depletions. In the Indian Ocean profile, both Cu and Zn show broad excursions

towards isotopically heavier values, which may be a water mass signal. The bottom-most part of the Cu profiles show significantly higher concentrations, together with lighter isotopic compositions, which could potentially be linked to Cu being released from a benthic source.

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