

## **Uranium isotope fractionation factors in ferruginous settings**

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Uranium isotopes are now widely used as a marine redox proxy through much of Earth's history. However, the current understanding of fractionation factors during the reduction and burial of U in different marine environments remains poor. Foremost, there are minimal constraints on the fractionation of U isotopes under ferruginous conditions, which are thought to be relatively widespread through most of Earth's history. Here we present more than 320 new U isotope data points from modern sediments including the Peru Margin and two ferruginous lakes, along with additional data from Paleozoic and Precambrian ferruginous settings. We find that; 1) there are a large range of values in both temporally equivalent strata and within individual formations, 2) modern sediments in ferruginous and oxic settings are isotopically indistinguishable, 3) average fractionations in ferruginous settings have likely been overestimated in global isotope mass balance models. In sum, we suggest that U isotope values provide non-unique solutions for the structure of the marine redox landscape. A given mean seawater U isotope value could be consistent with a large solution space ranging from largely oxygenated to largely anoxic global seafloor redox landscapes. In this framework, large swings in seawater U isotope values are likely to primarily track swings in the extent of organic matter loading in marine sediments or the extent of anoxic and sulfidic (euxinic) conditions.