Goldschmidt 2024 Abstract
https://doi.org/10.46427/gold2024.24707

Uranium isotope response to changing oxygen minimum zone dynamics in the Arabian Sea over the past 65 kyr

WILLOW A HASLEY-VELEZ[1], **GEOFFREY J GILLEAUDEAU**[1], TIAN GAN[2], GERT-JAN REICHART[3], RICK HENNEKAM[3], MARIANO N REMIREZ[4], ALAN J KAUFMAN[2] AND ARIEL D. ANBAR[5]

[1]George Mason University
[2]University of Maryland
[3]Royal Netherlands Institute for Sea Research (NIOZ)
[4]University of Copenhagen
[5]Arizona State University

Presenting Author: ggilleau@gmu.edu

Quantitative understanding of the $\delta^{238}U$ paleo-redox proxy requires constraints on $\delta^{238}U$ fractionation in a range of modern environments with different redox conditions. In particular, euxinic environments are known to exert a substantial lever on the global seawater $\delta^{238}U$ mass balance through preferential removal of ^{238}U. However, the degree of $\delta^{238}U$ fractionation under low-O_2, non-euxinic conditions is poorly understood. Here, we present $\delta^{238}U$ data for two cores from the Arabian Sea OMZ that span the past ~65 kyr—one core each from the Oman and Pakistan margins. Today, the Arabian Sea is characterized by suboxic, denitrifying, non-euxinic conditions, but the intensity of denitrification has varied over the past ~65 kyr in association with global climate cyclicity. $\Delta^{238}U$ values were calculated as the difference between sediment and modern seawater $\delta^{238}U$. We find that the median $\Delta^{238}U$ value for both cores over the past ~65 kyr is 0.15‰, indicating only a modest degree of fractionation. $\delta^{238}U$ varies cyclically in both cores, however. $\delta^{238}U$ maxima correspond to interstadials, with the two cores recording $\delta^{238}U$ maxima during different interstadials. The maximum $\Delta^{238}U$ value of 0.39‰ was recorded during Dansgaard-Oeschger Event 13 on the Oman Margin at 47.3 kyr. Trace metal proxies indicate that higher $\delta^{238}U$ values in the dataset may be associated with environments in which sulfide was present in pore waters, which we hypothesize resulted in greater fractionation than observed in other suboxic environments around the globe. We use a $\delta^{238}U$ mass balance model to explore the effect of "Arabian Sea-style" conditions on global seawater $\delta^{238}U$. We find that when a $\Delta^{238}U$ value of 0.15‰ is used for the "Arabian Sea-style" sink, even widespread expansion of this type of environment does not exert a substantial lever on the global $\delta^{238}U$ mass balance. When the maximum $\Delta^{238}U$ value (0.39‰) is used, however, expansion of "Arabian Sea-style" suboxia is capable of producing a seawater $\delta^{238}U$ value as low as −0.69‰, which matches the carbonate record of some anoxic events of the geologic past. This suggests that widespread ocean euxinia may not be required to explain some negative $\delta^{238}U$ excursions in the ancient carbonate record.