

Uranium isotope fractionation across the GOE boundary: Insights from a new dataset and changepoint analyses

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The atmosphere first became oxidised during the “Great Oxidation Event” (GOE; ca. 2.4 – 2.3 Ga). Evidence for “whiffs of oxygen” has emerged from the study of redox sensitive elements in Archean rocks to suggest that the shelf regions of the ancient oceans were oxidised up to ca. 500 Ma before the early atmosphere. Uranium (U) isotope fractionation during biotic and abiotic reduction may be used to fingerprint the redox state of the early oceans. Here we utilise a new dataset (n = 92) of authigenic U isotope data from the periods before, during and after the GOE in the early Proterozoic (Brüske et al., in prep.). Following the approach of Wang et al. (2018), we conduct changepoint analyses to detect changes in the variance of the authigenic U data. Relative to crustal values, we found a gradual rise in U enrichment factors from the Mesoarchean to the early Proterozoic but no statistical changepoints were detected in the variance of U enrichment factor values. During the GOE from ca. 2.5 to 2.3 Ga, the distribution of $\delta^{238}\text{U}$ values slightly increased towards lower $\delta^{238}\text{U}$ values, consistent with the onset of U mobilisation by oxidative weathering. A statistical changepoint was found at 2.32 Ga, indicating a decrease in $\delta^{238}\text{U}$ variance following the GOE in the Timeball Hill Formation but further data are required to confirm whether this was restricted to a local phenomenon. These analyses provide evidence that the rise in the oceanic U inventory was gradual and may have begun as early as the Mesoarchean.

[1] Brüske et al., in prep.

[2] Wang, X. et al. (2018) GCA 238, 438–452.