

Constraints on metal mobilization in Archean and early Proterozoic marine sediments from uranium isotopes

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Uranium (U) is a redox-sensitive trace metal whose redox changes induce characteristic isotope fractionations. [1] These isotopic signatures may be preserved in the rock record and U isotopes may thus contribute to the reconstruction of the redox evolution of early Earth's atmosphere and oceans. We aim to apply this paleoredox proxy on Archean and early Proterozoic marine sedimentary archives. Samples comprise black shales, banded iron formations and carbonates from the Transvaal, Pongola and Barberton Supergroups in South Africa spanning an age range from 2.2 to 3.5 Ga. First analyses of U isotopes in sediments from the Transvaal Supergroup (Kaatvaal craton, Duitschland and Timeball Hill formations, 2.220 - 2.486 Ga, [2]), which were deposited immediately before and after Earth's surface redox-transition of the Great Oxidation Event (GOE), show significant authigenic U enrichment up to 9 times average continental crust. All investigated samples were taken from drill cores and most of them preserved $\delta^{234/238}\text{U}$ values around the secular equilibrium ($\delta^{234/238}\text{U} = 0 \pm 1 \text{ ‰}$), indicating negligible U mobilisation during sub-recent processes. Those samples with significant U enrichment ($U_{\text{EF}} > 2$, relative to average continental crust) show $\delta^{238/235}\text{U}$ ranging between -0.81 ‰ to -0.06 ‰ (against CRM-112A), i.e. both isotopically heavier and lighter than average continental crust ($\approx -0.3 \text{ ‰}$). These initial results confirm (consistent with [3]) that oxygen levels in the atmosphere and/or uppermost ocean water column were already high enough, some 100 Ma before the GOE, to generate significant isotope fractionation during weathering-induced U mobilization and subsequent deposition.

[1] Weyer et al., *Geochimica et Cosmochimica Acta* 72 (2008) 345–359.

[2] Bekker et al., *American Journal of Science*, Vol. 301 (2001) 261–285.

[3] Kendall et al., *Chemical Geology* 362 (2013) 105-114.