Do chromium isotope compositions record signs of oxygenation in the Campbellrand-Malmani Platform (2.56 to 2.52 Ga, South Africa)?

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The oxygenation history of Earth's surface remains a highly investigated topic, with an increasing number of studies indicating a dynamic change from anoxic to oxic conditions in the Precambrian. The Campbellrand-Malmani platform (Transvaal Supergroup, South Africa) was deposited in a shallow marine environment between 2.56 and 2.52 Ga (Sumner and Grotzinger 2004), just before the Great Oxidation Event. The sedimentary rocks hold a large variety of stromatolites, which can produce oxygen through photosynthetic cyanobacteria. While some studies find indications of oxygen production (e.g., Czaja et al. 2012), post-depositional alteration can challenge interpretations of data from non-traditional isotope systems.

We present Cr isotope compositions ($\delta^{53}Cr$) and concentration data (trace metals) in sedimentary rocks from the Campbellrand-Malmani platform to better constrain the robustness of the Cr isotope system to post-depositional changes. Preliminary results show that even though the detrital contribution is low, most dolostone and chert samples show $\delta^{53}Cr$ values of around -0.12 ± 0.10 ‰ (2SD, n = 14) and are thus similar to the detrital $\delta^{53}Cr$ value. Only two samples fall off the detrital value, with one dolostones sample showing a positive $\delta^{53}Cr$ value of 0.26 ± 0.05 ‰ (2SE).

Our preliminary results indicate that many of the $\delta^{53}Cr$ values in the studied dolostones and cherts were overprinted by post-depositional processes. With the aid of additional isotope (S, N isotope compositions) and auxiliary data (trace metals), we seek to characterise the drivers of the observed $\delta^{53}Cr$ values.

Czaja A, Johnson M, Roden E, Beard B, Voegelin A, Nägler T, Beukes N, Wille M (2012): Evidence from free oxygen in the Neoarchean ocean based on coupled iron-molybdenum isotope fractionation. – Geochim Cosmochim Acta 86, 118-137

Sumner D, Grotzinger J (2004): Implications for Neoarchean ocean chemistry from primary carbonate mineralogy of the Campbellrand-Malmani Platform, South Africa. – Sedimentology 51, 1273-1299