An Oxygenation Event or *The* Oxygenation Event? Prejuices, Perspectives and Possibilities.

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The narrative of Earth's oxygenation is implicitly coupled to the chemical, climatic and ecological evolution of our planet. Although an anoxic Archean atmosphere has long been envisaged, constraining the initial rise in atmospheric O_2 has proven problematic: hindered by the availability of only an indirect geochemical toolkit. The discovery of variable S-isotope fractionation preserved in the geological record—shifting from mass independent fractionation (MIF) to mass dependent fractionation (MDF)—has revolutionised our understanding of planetary oxygenation and is widely touted as the "Smoking Gun", constraining when pO_2 first exceeded 10^{-5} times the present atmospheric level (PAL).

Exploiting three closely-spaced drillcores (Carltonville, Transvaal basin, South Africa), the disappearance of S-MIF was pin-pointed within the Rooihoogte Formation of the Pretoria Group. Using the demise of S-MIF as a chemostratigraphic marker of the Great Oxidation Event (GOE), it was argued that atmospheric oxygenation was rapid (1–10 Myr) and unidirectional. Emerging data, however, has challenged these claims, suggesting that an oxygenated atmosphere was attained earlier, and the subsequent QSI record comprises crustal memory effects. Alternatively, others have argued that atmospheric oxygenation was episodic, proceeding via 3 steps associated with widespread volcanism and glaciation.

In this contribution, we seek to test these conflicting hypotheses, outlining the prejudices, perspectives and possibilities of the Transvaal-derived quadruple S-isotope (QSI) records. Here, we report SF_6-derived QSI data from four regionally spaced, Agouron funded, cores (ADL-1, AGP-1/2 and ANW-1), intersecting the Rooihoogte/Duitschland Formation. Interestingly, although the regional chemostratigraphic record is largely consistent with that from the Carltonville area, the $\Delta^{33}S$ and $\Delta^{36}S$ datasets show variability and reveal an interval of MIF-baring pyrites enveloped within MDF-containing sediments. We plan to combine these SF_6-derived records with SIMS analyses to decipher the relative contribution of photochemical- and weathering-derived processes on the S-isotope records that define *an*, if not *the*, oxygenation event preserved within the Transvaal Basin, South Africa.