# (Re)defining the Structure of the Great Oxidation Event

IZON, G.[1], ONO, S.[1], BEUKES, N.[2], SUMMONS, R.[1]

[1]*Department of Earth, Atmospheric and Planetary Sciences, MIT, Cambridge, MA 02139, USA.*
[2]DST-NRF CIMERA, *Department of Geology, University of Johannesburg, P.O. Box 524, Auckland Park 2006, South Africa.*

The narrative of Earth's oxygenation history is implicitly coupled to the chemical 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), whilst simultaneously serving as a chemostratigraphic marker of the Great Oxidation Event (GOE).

Unfortunately, our temporal understanding of the GOE has been retarded by the lack of suitably pristine outcrop and a detailed chronostratigraphic framework. Recent work, exploiting three closely-spaced drillcores from the Transvaal Supergroup (South Africa), has helped to close this knowledge gap, placing the GOE within the Rooihoogte Formation of the Pretoria Group in the Carltonville area of the Transvaal basin. These records suggest that the shift in atmospheric composition was rapid (1–10 Myr) and unidirectional, terminating in an oxygenated atmosphere by 2.33 Ga. Interestingly, similar S-MIF trends have also been documented 300 km to the NW from the coeval Duitschland Formation but feature a data-gap owing to lack of outcrop.

In this contribution, we seek to test these hypotheses, and *(re)define the GOE across the wider Transvaal basin*. Here we report $SF_6$-derived quadruple S-isotope data from four regionally spaced cores, drilled with funding from the Agouron Institute, 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 bulk-$SF_6$ records with spatially resolved SIMS analyses to decipher the relative contribution of photochemical and weathering-derived processes on the S-isotope records that define the GOE.