Oxygen oases were persistent and widespread before the GOE

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It is becoming increasingly evident that O_2 was being produced in shallow marine oxygen oases before accumulating in the atmosphere during and after the Great Oxidation Event (GOE) [e.g. 1]. However, the spatial extent and longevity of oxygen oases are not known.

If oxygen oases were large enough to impinge on continental shelves, and if they existed over multi-year timescales, then these settings should have continuously buried manganese (Mn) as an insoluble oxide. Today, appreciable Mn oxide burial only occurs where oxygenated waters persistently penetrate deep into marine sediments [2].

Mn oxide burial on continental shelves before the GOE would have had a profound effect on both the thallium (Tl) and molybdenum (Mo) isotopic compositions of seawater. Specifically, adsorption of both elements to Mn oxides in the ocean would have resulted in opposing trends in their residual seawater isotope signatures [3].

We report opposing Tl and Mo isotope trends over tens of meters of deposition in the organic-rich 2.5 billion-year-old (Ga) Mt. McRae Shale from Western Austalia. These trends are interpreted to reflect changes in seawater Tl and Mo isotope signatures, and serve as strong evidence for the burial of Mn oxides on at least a basinal scale and over million-year timescales well before the GOE. Oxygen oases must have also been present on the same spatial and temporal scales to promote Mn oxide burial.

[1] Eichmann et al. (2018) Nature Geoscience 11, p. 133-138. [2] Calvert and Pedersen (1996) Economic Geology 91, p. 36-47. [3] Owens et al. (2017) GCA 213, p. 291-307.