Feast then Famine: Exiting the GOE and setting the stage for a billion years of environmental stability

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While considerable attention has been placed on the transition into Earth's Great Oxidation Event (GOE), much less has been paid to its aftermath. The carbon isotope record within carbonates suggests the burial of large amounts of organic carbon and by consequence release of O_2 to the atmosphere, however, geochemical tools have struggled to apply an independent test to such a model or clearly dicipher possible underlying causes.

Here we present triple oxygen and multiple sulfur isotope results from sulfate minerals that span the syn-GOE and immediate post-GOE interval. This interval covers what has been termed the 'oxygen overshoot' and the period immediately afterward that begins the so called 'boring billion'. We interpret results through a previously published framework (Cao and Bao, 2013; Crockford et al., 2018; 2019) that links triple oxygen isotope values to pO_2, pCO_2 and primary productivity. Through this framework our results suggest that Earth's exit from the GOE happened, in conjunction with, or perhaps more likely as a consequence of, a dramatic drop in primary productivity of the biosphere from a high productivity syn-GOE state to one characterized by limited primary productivity that continued for over a billion years of Earth history. Linking these results to new radiometric ages on the Belcher Group, it is likely that this transition occurred over a few 10s of millions of years.

1. Cao, X. and Bao, H., 2013. Dynamic model constraints on oxygen-17 depletion in atmospheric O2 after a snowball Earth. *Proceedings of the National Academy of Sciences*, *110*(36), pp.14546-14550.
2. Crockford, P.W., et al., Triple oxygen isotope evidence for limited mid-Proterozoic primary productivity. *Nature*, *559*(7715), p.613.
3. Crockford, P.W., et al., Claypool continued: Extending the isotopic record of sedimentary sulfate. *Chemical Geology*.

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