

Atmospheric oxygen concentrations from Mesoproterozoic shale geochemistry and modelling

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The gross sequence of steps in Earth's biological evolution is relatively well established, while there is much greater uncertainty about the accompanying ocean and atmosphere redox-geochemical evolution. Understanding the latter is fundamental for our understanding of the former and how co-evolution might have shaped the oxidation and eventual greening of our planet. Recent observations from Mesoproterozoic successions either indicate extremely low or high relative oxygen levels depending on the methods used and the formations studied. We shortly review some of our recent geochemical observations from the 1.4 Ga Xiamaling Formation and the simplest qualitative interpretation [1]; namely a three layer water column with an oxygenated photic zone, intermediate anoxic waters and slightly oxygenated waters below. Next, we present the oceanographic modelling background and uncertainties. While our modelling takes its inspiration from present-day upwelling systems, it need not be limited to such system as long as a three layer system is permitted. In particular, we will focus on uncertainties in water residence times, productivity, particle aggregation, settling rates and remineralization rates and how these impact our calculations of atmospheric oxygen levels at the time of Xiamaling Formation deposition.

[1] Zhang, Wang, Wang, Bjerrum, Hammarlund, Costa, Connelly, Zhang, Su, & Canfield (2016) *PNAS*, **113**, 1731-1736.