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Evidence of an atmospheric oxygenation event in the "Boring Billion"period provided by trace element content of sedimentary pyrite in Proterozoic black shales

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The time period between 1800 to 800 Ma, also known as the "Boring Billion", is believed to represent a billion year of geological and biological stasis. Modelling of atmospheric oxygen levels [1] as well as application of various trace metal and isotope proxies [2], [3] suggest low levels of oxygen in the atmosphere in the Proterozoic. Suppressed tectonic activities along with lack of sufficient oxygen levels presumably caused a billion year of hiatus that delayed evolution of animals [4], [3]. Recently, Large et al, [5] introduced selenium content in sedimentary pyrite as a new proxy for atmospheric oxygenation. The present contribution attempts to apply the LA-ICP-MS technique introduced by Large et al, [5] to Proterozoic black shales to construct bio-essential nutrient trace element (TE) trends through the 1800-800 period.

Results so far suggest that trace element concentrations (Se, Mo, Ni, Co etc.) through the Boring Billion period have fluctuated over time, which is in contrast to general consensus. Redox sensitive trace elements show a decline at the start of the Boring Billion period (1800-1400 Ma) followed by a rise in the middle of the Boring Billion (~1360 Ma), suggesting an oxygenation event. The 1400 Ma event also marks an increase in ocean sulphate concentrations estimated by Kah et al, [6] and Luo et al, [7] and morphological complexity in eukaryotic organisms noted by Javaux et al, [8]. Recently, Zhang et al, [9]observed trace metal enrichments in the 1400 Ma Xiamaling Fm. in China, confirming the above possibility. The paper discusses the trace element availability and productivity in the oceans and redox state of the atmosphere in relation to evolution of eukaryotic organisms through the Boring Billion Period.

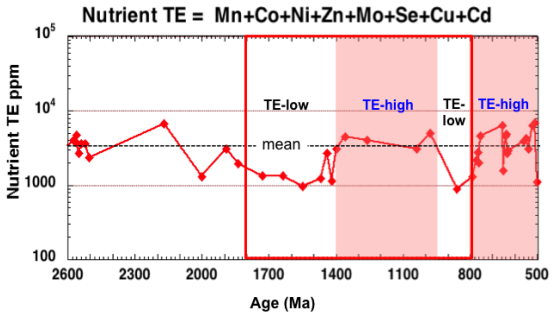

Fig 1 Nutrient Trace Element (TE) trend constructed using LA-ICP-MS analyses of sedimentary pyrite in black shales

References:

[1] Canfield D.E (2005) In: Annual Review of Earth and Planetary Sciences 33: 1–36
[2] Scott Cet al. (2008) Nature 452: 456–459
[3] Planavsky N.J et al. (2014) Science 346: 635-638
[4] Brasier M and Lindsay J.F (1998) Geology 26: 555-558
[5] Large R.R et al. (2014) Earth and Planetary Science Letters 389: 209-220
[6] Kah L et al. (2004) Nature 431: 834–838
[7] Luo G et al. (2015) Precambrian Research 258: 36-47
[8] Javaux E et al. (2004) Geobiology 2: 121–132

[9] Zhang S et al. (2016) PNAS early edition 1523449113: PubMed ID: 26729865