In-situ iron isotope analysis of pyrite and carbon/nitrogen isotope ratios from the Middle Proterozoic sediments, McArthur Basin, Northern Australia

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Oxygenation of Earth's surface is deeply linked to evolution of life. Many of independent evidences suggested that the Earth’s atmospheric oxidation state is increased in two-steps: (1) from 2,400 to 2,300 million years ago, and (2) around 600 million years ago [1]. On the other hand, ocean was mostly reducing condition during the Archean eon, whereas the Phanerozoic oceans were oxygenated as modern. It is generally assumed that the middle Proterozoic ocean was globally oxic at the surface and sulfidic (euxinic) at depth. Nitrogen limitation caused by trace metal scarcity has been proposed as an explanation for the delayed of eukaryotes radiation [2] [3].

Here we show iron isotope analysis of individual sedimentary pyrite of the middle Proterozoic sediments and whole rock nitrogen/carbon isotope ratio from four drillcore samples (MY 2, MR 2, Urapunga 4 and 5) in McArthur Basin, Northern Australia. Based on microscopic observation, we obtained a large variation of iron isotope data from 178 points of pyrite grains. Pyrites from the Wollogorang Formation of the Tawallah Group show the wide variation of δ^{56}Fe values from -2 to +2 ‰. The highly positive δ^{56}Fe values of pyrites suggest the occurrence of partial oxidation. $\delta^{15}N_{TN}$ values of the black shale in the Wollogorang and Barney Creek formations are from +4 to +7‰, relatively high values, which suggest the occurrence of partial denitrification in the water-column [4]. Our results suggested that middle proterozoic sulfidic condition did not persist for long periods.

[1] Holland (2006) *Proc. R. Soc.* **361**, 903–915. [2] Canfield (1998) *Nature* **396**, 450–453.[3] Anbar & Knoll (2002) *Science* **297**, 1137–1142. [4] Garvin et al. (2009) *Science* **323**, 1045–1048.