Archean microfossils from the Farrel Quartzite (Pilbara craton, Australia, 3.0 Gyr) reveal contrasted $\delta^{15}N$ signatures.

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Oxygenation of oceans was proposed to start 3.0 Gyr ago leading to the great oxygenation event ca. 0.6 million year later. However, evidence for oxygenation was mainly found at 2.7-2.5 Gyr rocks and little is known about the earlier redox state.

Nitrogen (N) isotope composition is a promising tool to indirectly investigate the redox state of Archean oceans [1]. Thanks to microscopy observations, three types of carbonaceous microstructures (CM) were recognized in kerogens from the ca 3 Gyr Farrel Quartzite (Pilbara Craton, Australia). Elemental and N isotopic composition obtained by NanoSIMS *in situ* characterization of these CMs brought evidence for their biogenicity, especially lenticular and film-like ones. Thus, an exceptionally well-preserved lenticular CM exhibits contrasted relationship between N and phosphorus that was only reported in extant microorganisms. A wide range of N/C values was observed within the CMs suggesting a preservation gradient. Such unusual high N/C values entailed high N values which allowed *in situ* determination of their N isotopic composition by NanoSIMS.

Preliminary data gave unexpected results as $\delta^{15}N$ values ranges from 0 to +20‰ (± 2 ‰), with lenticular microfossils showing the highest values. Such a ^{15}N enrichment may result from ammonia oxidation, implying low oxygen concentration in 3.0 Gyr Archean oceans. However, although microstructures are syngenetic, we must ensure that $\delta^{15}N$ values differences do not reflect environmental variations to definitely argue for the low oxygenation of Archean oceans at 3.0 Gyr.

[1] Godfrey and Falkowski (2009) The cycling and redox state of nitrogen in the Archaean ocean. Nature Geoscience 2, 725–729.