Spatially constrained nitrogen cycling on a Neoarchaean ocean margin

METTAM, C\textsuperscript{1}, ZERKLE, AL\textsuperscript{1}, CLAIRE, MW\textsuperscript{1}, POULTON, SW\textsuperscript{2}, JUNIUM, CK\textsuperscript{3}.

\textsuperscript{1}School of Earth and Environmental Sciences, University of St Andrews, Scotland, UK. cwm2@st-andrews.ac.uk
\textsuperscript{2}School of Earth and Environment, University of Leeds, UK.
\textsuperscript{3}Syracuse University, College of Arts and Sciences, Syracuse, NY, USA.

We present nitrogen isotope (\(\delta^{15}N\)) data from shallow-water sediments of the ~2.5Ga Campbellrand-Malmani carbonate platform, which reveal temporal and spatial heterogeneity in Late Neoarchaean N-cycling. Drillcore BH-1 Sacha records the development of this marginal marine setting from ramp to lagoonal environments. The lowermost part of the core contains sediments from a silici-clastic/carbonate ramp that was likely relatively open to oceanic influence. Here \(\delta^{15}N\) values are strongly negative, indicating non-quantitative assimilation of upwelling ammonium (\(\text{NH}_4^+\)) by marine organisms from a large, stable \(\text{NH}_4^+\) pool (e.g. \(J\)). In the upper part of the core \(\delta^{15}N\) values are ca. 0\% indicating the complete utilization of a smaller DIN-pool. Complete utilization reflects limited diazotrophy as progradation towards sub- to peri-tidal and/or lagoonal conditions isolated the depositional setting from upwelling of nutrients. Despite the suggestion of transient oxygen-oases prior to the Great Oxidation Event (\(2\)) and the presence of straomatolites in these shallow settings, these \(\delta^{15}N\) values provide no evidence for the presence of abundant nitrate (\(\text{NO}_3^-\)). We conclude that the N-cycle in these shallow waters was dominantly anaerobic, and/or that any (\(\text{NO}_3^-\)) that was generated was rapidly and quantitatively consumed during anaerobic respiration. We suggest that the partial uptake of \(^{15}N\)-depleted \(\text{NH}_4^+\) might have created an isotopically heavy residual DIN pool providing an alternative explanation for small positive \(\delta^{15}N\) values in more distal but temporally-equivalent sediments.