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Investigating marine nitrogen cycling dynamics before, during, and after global glaciations: insights from Neoproterozoic sediments of the southwestern United States

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The availability and cycling of nitrogen (N) in marine environments influences biogeochemical and potentially evolutionary processes [1]. We can use marine sedimentary $\delta^{15}N$ values, combined with redox proxies, to reconstruct nutrient availability in ancient seawater. The $\delta^{15}N$ record is sparse during the Neoproterozoic, an era containing dynamic redox transitions, global glaciations, and key biologic developments. To address this knowledge gap, we present $\delta^{15}N$ values, redox proxies, and trace element compositions for Tonian, Cryogenian, and Ediacaran sediments from the southwestern U.S.. Siliclastic sediments were collected from Neoproterozoic marine successions near Death Valley, CA and the Wasatch Mountains, UT. Initial results for Tonian and Cryogenian sediments include sixty-one samples from the Horse Thief Springs and Kingston Peak formations, CA. The Wasatch Mountain sediments include thirty-one samples from the Big Cottonwood and the Cryogenian Mineral Fork formations. Tonian sediments of the Horse Thief Springs and Big Cottonwood formations have average $\delta^{15}N$ values of 6.7 $\pm$ 0.9‰ and 4.4 $\pm$ 2.5‰, respectively. Cryogenian sediments of the Kingston Peak and Mineral Fork formations have average $\delta^{15}N$ values of 5.6 $\pm$ 1.1‰ and 7.0 $\pm$ 3.6‰, respectively. Petrographic observations and element concentration plots of N vs. C, Al, & K indicate N-hosts are primarily organic matter and authigenic silicates. Non-seawater N signals from detrital inputs and metamorphic overprinting are observed as well.

Observed positive $\delta^{15}N$ values likely reflect aerobic N cycling occurring in partially oxygenated waters prior to and during glaciation in their respective basins. These findings support hypotheses of synglacial deposition occurring proximal to ice-free water and /or near oxygenated meltwater at the ice-grounding line [2]. Our $\delta^{15}N$ values also indicate a steady supply of nitrate, considered a limiting nutrient for eukaryotic evolution [1]. Future work includes analysis of collected Ediacaran samples, as well as further bulk and *in situ* methods to identify degrees of detrital contamination, diagenesis, and metamorphism. These results will provide additional insight into nitrogen cycling dynamics of paleoenvironments throughout the Neoproterozoic.

[1] Kang et al., 2023, Science Advances, 9647. [2] Lechte et al., 2019, PNAS, 310