

## OCNAtm: A biogeochemical model of Archean Earth

JULIA HORNE AND COLIN GOLDBLATT

University of Victoria

Presenting Author: [juliahorne@uvic.ca](mailto:juliahorne@uvic.ca)

A new biogeochemical model for the early Earth with climate feedbacks illustrates the effects of increasing surface oxidation on the cycling of carbon and nitrogen species between atmosphere-ocean and geological reservoirs. This model is used to study the transition between the Neoproterozoic to Paleoproterozoic.

Previous biogeochemical models of the Proterozoic assumed a constant organic carbon burial fraction ( $f_{org}$ ), which is generally found to be 0.2 throughout the geologic record [1] [2]; maintaining  $f_{org}$  enabled these researchers to suggest other mechanisms for driving the GOE, such as changing oxidation state of outgassed mantle volatiles or irreversible hydrogen escape. In contrast, an evaluation of carbon isotope fractionation suggests that  $f_{org}$  may have propelled the GOE by increasing by a factor of 1.5 or 2 following the advent of photosynthetic metabolisms [3]. Our new model recreates the feedbacks between surface oxygenation and microbial remineralization to resolve this question of whether  $f_{org}$  drove or followed the GOE.

This new biogeochemical model is also used to investigate the long-term nitrogen cycle. Recent evidence has shown increasing nitrogen concentrations in continents with decreasing age [4]. Geologic nitrogen sequestration is mediated by biologic assimilation and remineralization; our model recreates the biosphere-driven transfer of volatile nitrogen into geologic reservoirs, and further allows us to identify the primary mechanisms controlling the magnitude of sequestration, especially as this changed under increasing environmental oxidation.

### References

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