Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19930

Land plant radiation and its linkages to global marine anoxia during the Devonian

WILLIAM GILHOOLY III[1], BROOKE VANDER PAS[1], MATTHEW S SMART[1], GABRIEL FILIPPELLI[1], KAZUMI OZAKI[2], CHRISTOPHER T. REINHARD[3], JOHN E.A. MARSHALL[4] AND JESSICA WHITESIDE[4]

[1]Indiana University Purdue University Indianapolis

[2]Tokyo Institute of Technology

[3]Georgia Institute of Technology

[4]National Oceanography Centre Southampton, University of Southampton

Presenting Author: wgilhool@iupui.edu

The evolution of land plants and their expanded distribution in the Devonian triggered a profound change in the terrestrial biosphere that likely influenced marine paleo-productivity and biological crises. The inception of deeply rooted landscapes and the development of soils may have contributed to enhanced phosphorus delivery to the ancient ocean and marine anoxia that was a contributing factor to multiple marine mass extinctions. Our data from a lacustrine sequence from the Devonian Basin of East Greenland [1] exhibits two episodes of phosphorus mobilization that coincide with the Frasnian-Famennian extinction events. Based on these geochemical boundary conditions, an Earth system model of the coupled C-N-P-O_2-S biogeochemical cycles demonstrated linkages between globally scaled riverine phosphorus delivery and marine anoxia. To expand upon the scope of our observations in the paleo-tropics, we developed isotopic and geochemical records from a Middle to Late Devonian sequence from the western Falkland Islands and Bolivia. These near-polar paleolatitude sites exhibit pulses in phosphorus that coincide with proxies for enhanced chemical weathering. Phosphorus mobility within these subpolar sequences leading into the Frasnian suggests that, whether synchronous or asynchronous, the terrestrial biosphere in both high and low latitudes was primed for contributing to marine anoxia.

[1] Smart, Filippelli, Gilhooly, Marshall, & Whiteside (2022), GSA Bulletin, doi: https://doi.org/10.1130/B36384.1.