Ocean redox conditions between the Snowballs – geochemical constraints from Arena Formation, East Greenland

EVA L. SCHELLER[1,2], ALEXANDER J. DICKSON[3,4], DONALD E. CANFIELD[4], CHRISTOPH KORTE[3], KASPER K. KRISTIANSEN[1], **TAIS W. DAHL**[1*]

[1] University of Copenhagen, DK-1350 Copenhagen K, Denmark, tais.dahl@snm.ku.dk
[2] California Institute of Technology, CA 91125, USA, eschelle@caltech.edu
[3] University of Oxford, OX1 3AN, United Kingdom
[4] University of Southern Denmark, DK-5230 Odense M, Denmark

The emergence of animal ecosystems is largely believed to have occurred in increasingly oxygenated oceans after the termination of the Sturtian and Marinoan glaciations. This transition has led to several hypotheses for the mechanism driving ocean oxygenation and animal evolution. One hypothesis is that enhanced weathering increased oceanic nutrient levels, primary productivity and organic carbon burial, and ultimately oxygenated the atmosphere and oceans. Another hypothesis suggests that an animal-driven reorganization of the marine biogeochemical cycles might have oxygenated the oceans.

Through molybdenum enrichments, iron speciation data and Mo isotopic analyses of the Arena shale Formation, East Greenland, we constrain both oceanic redox conditions after the Sturtian deglaciation and before the major radiation of animals. The lower part of the Arena Fm consists of black shales deposited under locally euxinic conditions as evidenced by high proportions of highly reactive iron and pyrite. These black shales display muted Mo enrichments, low Mo/TOC compared to overlying shales and Phanerozoic euxinic sediments. The δ^{98}Mo values are consistent with other Cryogenic euxinic basins and well below that of the modern oceans. The combination of low [Mo] and δ^{98}Mo suggests that anoxic water masses were widespread in the oceans at this time. These results are consistent with most other studies from this time suggesting that ocean were not permanently oxygenated in the aftermath of Snowball Earth deglaciation, but was delayed until animals effectively entered the scene.