Origin of 2.0 Ga phosphorites and associated carbon and sulphur isotope anomalies, Zaonega Formation, NW Russia

K. ÜPRAUS[1*], A. LEPLAND[12], A. ZERKLE[3], H. ODURO[3], N. K. PATEL[3], F. MCLEAN[3], T. KREITSMANN[4], K. KIRSIMÄE[4], B. A. WING[5], T. MARTMA[6], A. E. ROMASHKIN[7] AND D. RYCHANCHIK[7]

[1]Centre for Arctic Gas Hydrate, Environment, and Climate, University of Tromsø, Norway
(*correspondence: kart.upraus@ngu.no)
[2]Geological Survey of Norway, Trondheim, Norway,
[3]Department of Earth and Environmental Science, University of St Andrews, UK
[4]Department of Geology, University of Tartu, Estonia
[5]Department of Earth & Planetary Sciences, McGill University, Canada
[6]Institute of Geology, Tallinn University of Technology, Estonia
[7]Institute of Geology, Karelian Science Centre, Petrozavodsk, Russia

The Great Oxidation Event (GOE) between ~2.4 to 2.3 Ga changed the redox state of Earth's atmosphere-ocean system and triggered the oxidative weathering of landmasses, possibly leading to enhanced discharges of sulphate and phosphate into the oceans. Modern sulphur metabolizing microbial communities are known to mediate redox-dependent P-cycling inducing phosphorite formation. Changes in Paleoproterozoic ocean chemistry might have created suitable habitats for a complex microbial ecosystem that triggered Earth's first significant phosphogenic episode ~100-300 Ma after the GOE, particularly in settings with sharp redoxclines and abundant reactants and nutrients. It has been proposed that initial establishment of such microbial processes and corresponding habitats in the aftermath of the GOE caused the Paleoproterozoic phosphogenic episode.

The ~2.0 Ga Zaonega Fm in NW Russia contains some of the best preserved Paleoproterozoic rocks that record this phosphogenic episode. Recently obtained drill cores from the upper part of the Zaonega Fm contain several mm to cm scale P-rich layers. These rocks are also exceptionally organic-rich and formed in a vent- or seep-influenced depositional setting contemporaneous with voluminous mafic volcanism. Here we present new C and S isotope data in order to assess models of phosphorite formation, either linked to global changes (weathering, changing sulphate reservoir) or basinal processes (magmatic activity, hydrocarbon seepage).