The biogeochemistry of Arctic lake sediments: paleoclimate signal or post-depositional cycling?

TOR EINAR MØLLER[1,2], STEFFEN LETH JØRGENSEN[1,2], DESIREE ROERDINK[1,2]* AND WILLEM VAN DER BILT[1]

[1] Department of Earth Science, University of Bergen, Norway
[2] K.G. Jebsen Centre for Deep Sea Research, Bergen, Norway
(* corresponding author, desiree.roerdink@uib.no)

Sediment records of glacier-fed lakes represent prime paleoenvironmental archives that help constrain Holocene climate variability [1]. Traditional proxies use physical and chemical properties of the sediments to reconstruct past glacier activity and the input of glacially-sourced material, and include organic matter contents (loss-on-ignition), environmental magnetism (magnetic susceptibility), grain size and sediment geochemistry (XRF, XRD). However, lake sediments are subject to ongoing geochemical and microbial processes that may either reflect or alter these sediment-based paleoclimate signals.

Here, we explore this issue using a multi-discplinary approach on two sediment cores from Ymer Lake on Ammassalik Island, South-East Greenland [2]. We combine downcore sedimentological proxies with data on pore fluid geochemistry and microbial community structures to address whether: (1) biogeochemical profiles in Arctic lake sediments reflect the paleoclimate signatures derived from more traditional proxies, and (2) active microbial and geochemical processes may have altered the sediment-based paleorecord.

Principal component analyses (PCA) show that downcore variability in the microbial community structure changes between the four stratigraphic units that were identified from sedimentological proxies, and interpreted to reflect different paleoclimate conditions [2]. This zonation is less pronounced in the pore fluid geochemistry of species relevant for microbial processes (pH, alkalinity, Fe^{2+}, Mn^{2+}, NO_3^-, NH_4^+, PO_4^{3-} and SO_4^{2-}), possibly due to the lack of a steady state in the system. Strong fluctuations in concentrations with depth suggest that microbially-induced dissolution-precipitation reactions are active in the lake sediments. In addition, distinct trace metal pore water profiles (Co, Ni) between the two cores hint at adsorption reactions with organic matter or clay minerals. These active biogeochemical processes potentially alter the geochemistry of the sediments and could blur the original sedimentological fingerprints of past climate.

[1] Van der Bilt et al (2006) *Geol. Today*, 32:213-218; [2] Van der Bilt et al (2018) *Glob. Planet. Change*, in press.