The microbial community structure in Arctic lake sediments reflects variation in Holocene climate conditions

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Reconstruction of past climatic variability using lake sedimentary records is a promising and widely used approach to help constrain trajectories for future climate development [1,2]. Many of the factors shaping microbial community structures (MCS) deposited in sediments are linked directly to prevailing climatic conditions through environmental factors like local temperature and precipitation. Indirect impact through water column depth and primary production has also been reported [3]. Hence, MCS may provide additional independent lines of paleoenvironmental evidence, complementing established approaches. However, this potential remains untapped in climatically sensitive regions like the Arctic.

We present data from two well-dated sediment cores, spanning the Holocene (past 11.7 ka BP), obtained from Ymer Lake, located in a particularly climate-sensitive region on South-East Greenland [2]. We combine established paleoenvironmental analyses like Loss On Ignition (LOI), Dry Bulk Density (DBD), grain size distribution and X-Ray Fluorescence (XRF) elemental mapping with pore fluid geochemistry and microbial 16S rRNA gene abundance and composition, using a suit of multivariate methods. We show that the MCS in Ymer Lake captures a previously inferred separation into lithological units, each deposited under distinct climatic conditions [2]. Despite the proximity of the two cores (200 metres apart), signal from e.g. LOI and DBD, and redox-sensitive XRF ratios (e.g. Mn/Ti) display differing trends during the Mid- to Late Holocene. These differences are captured by the MCS. This strengthens our hypothesis that Ymer Lake's two basins have been differentially impacted by their surrounding environment for a substantial part of the Holocene. We argue that this is due to effects of water column depth and stratification as well as primary production rates [2,4]. Our findings provide evidence of a tight coupling between the MCS and prevailing environmental conditions, with the potential to constrain past climate variability.

[1] Sundqvist et al. (2014) *Clim. Past*, **10**, pp. 1605-1631.
[2] van der Bilt et al. (2018) *Glo. Pla. Cha*. **164**, pp. 52-64.
[3] Vuillemin et al. (2018) *FEMS Mic. Ecol*. **94**(4), pp. 1-14.
[4] Briner et al. (2016) *Quart. Sci. Rev*. **147**, pp. 340-364.