Climate Change impacts on microbial communities: insights from paleo data and field experiments

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Introduction – Because of their proximity to freezing, climate change is affecting Polar regions stronger than lower latitude regions. Microbial organisms dominate these regions and are involved in important ecosystem services, including the uptake and emission of greenhouse gasses, and are closely linked to environmental and climatic conditions. However, it is not well known how their biodiversity and functioning will respond to climate change. Here, we present two projects studying climate change effects on microbial communities in Arctic and Antarctic lakes and soils.

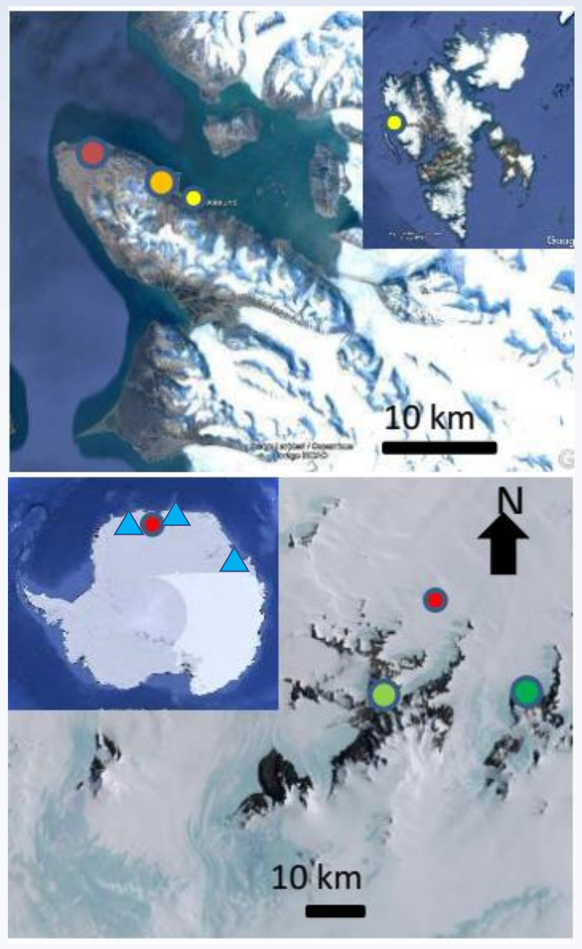

Fig. 1: Locations of experiments. Triangles show sediment core sites

HabitAnt (BRAIN-be, BelSPO) *Past and future habitability in Antarctic lakes: succession, colonization, extinction, and survival in glacial refugia lake sediment cores*

HabitAnt aims at studying past, present and future habitability of lakes and their catchments in coastal East Antarctica. This is based on the elucidation of key processes that contributed to their present-day community structure, including long-term persistence of biota in glacial refugia, and extinction, colonization, diversification and biological succession in response to environmental changes during the past 130,000 years. More specifically, we aim to (1) identify the presence of local glacial refugia including those situated below present-day sea level, (2) infer the recent evolutionary history of selected key lacustrine and terrestrial Antarctic biota in different functional and taxonomic groups, (3) assess species assembly and biological succession in newly formed lakes after deglaciation and their response to climate warming, and (4) use this paleoecological information, in combination with existing inventories of recent distribution data to predict the response of these communities to future climate changes.

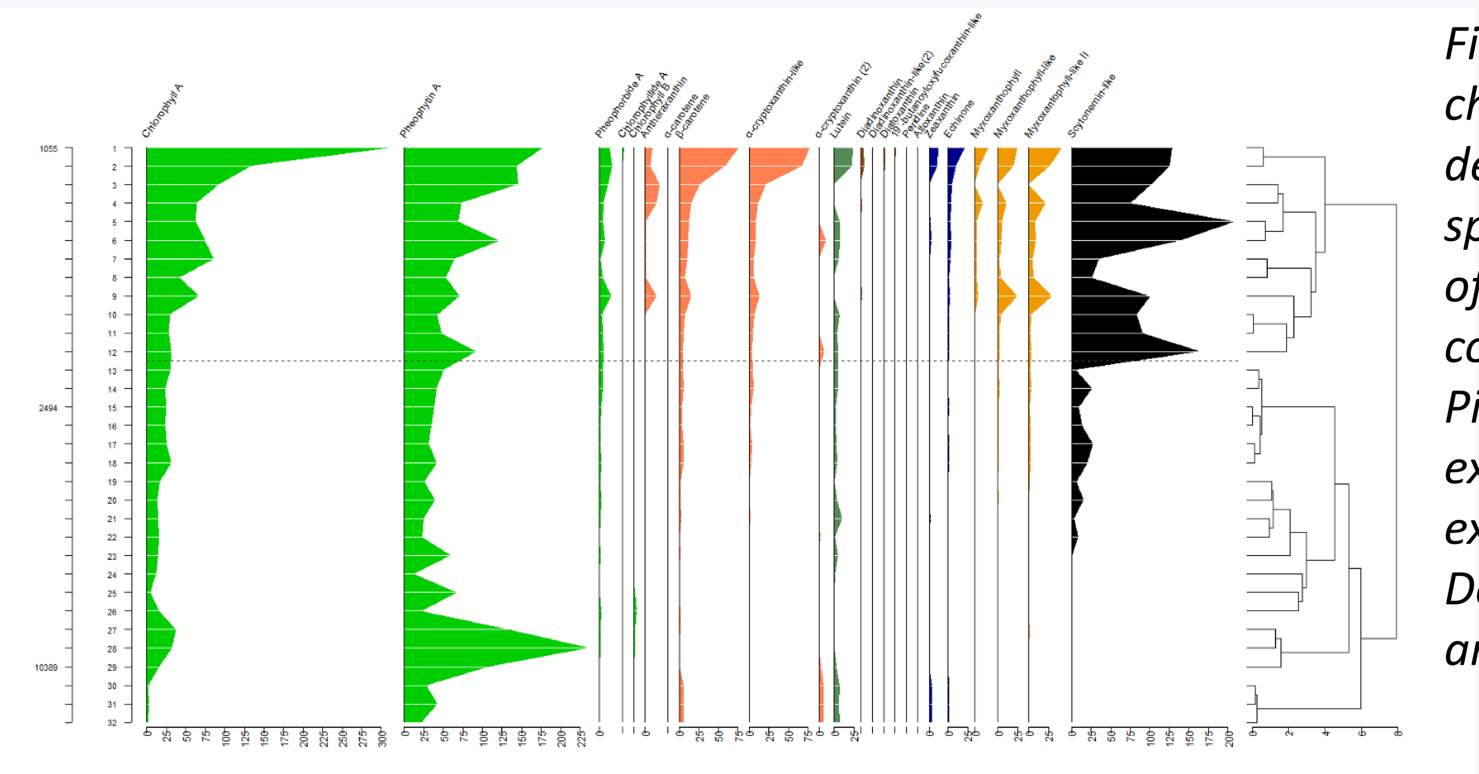

Fig. 2: Pigment stratigraphy of chlorophylls and their derivatives (green), and specific carotenoids (orange) of the upper 30 cm of Zub Lake core (Schirmacher Oasis). Pigment concentration is expressed in µg/g dry weight, except for scytonemin-like. Depths and calibrated ages are showed on the y-axis.

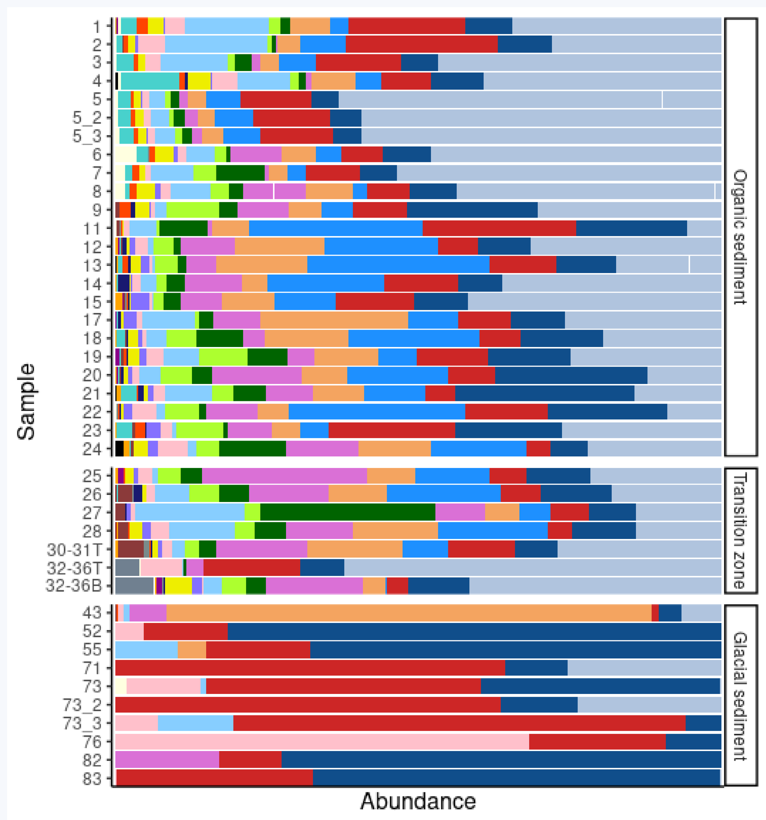

Fig. 3: Ancient DNA 18S rRNA community composition (relative abundances) of the Zub Lake core. Samples were grouped according to major sediment type zone. Sample depth in cm (y-axis).

ExPoSoils (Impuls, BelSPO) *Climate Change experiments in Arctic and Antarctic polar desert soils*

ExPoSoils is aimed at studying the effects of increased temperature and snow cover on the biodiversity and genetic functional potential of microbial communities in polar desert and tundra soils in Svalbard and Antarctica (Sør Rondane Mountains). Long-term experiments using Open Top Chambers and snowfences were initiated 5-10 years ago with baseline samples taken. High-Throughput Sequencing (HTS) will be used to compare baseline data and data from resampling efforts. This can be used to identify changes and responses to future climate change.
In addition, a long term monitoring effort was started in the ASPA in the Sør Rondane Mountains.

Fig. 4: Open Top Chambers (OTCs) in Svalbard, installed in 2014 by Dr. K. Newsham (BAS). Soil and air temperature is increased inside an OTC. Amplicon and metatranscriptomics HTS will be used to track responses to warming in the taxonomic composition and functioning of tundra microbial communities, incl. bacteria, protists and fungi.

Fig. 5: Snowfence in the Sør Rondane Mountains (East Antarctica). Identical set-ups are installed in Svalbard. Increased snow accumulation will reduce growing season and promote heterotrophic activity, and increased water availability and protection from cold winds.

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