A COMPREHENSIVE STUDY OF GDGT AND BHP INVENTORIES AND EXPORT PROXIES IN PERMAFROST DEPOSITS FROM THE SIBERIAN ARCTIC

S Kusch[1], S Höfle[1], J Martens[1], M Winterfeld[2], G Mollenhauer[2], J Rethemeyer[1]

[1] University of Cologne, Cologne, Germany
[2] Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

In the wake of anthropogenic climate change considerable effort has been devoted to tracing the export of permafrost-derived organic carbon (OC) into marine sediments in Arctic Siberia such as the Laptev and East Siberian Seas. Recent studies have highlighted the applicability of microbial biomarkers such as GDGTs and BHPs and their associated proxies, the BIT and R'_{soil} indices, to trace permafrost erosion into fluvial and marine sediments. However, the diversity of microbial biomarker inventories and BIT and R'_{soil} endmember values in typical, heterogeneous Siberian permafrost deposits are less well constrained.

Here, we present BHP and GDGT inventories and BIT and R'_{soil} values of 119 permafrost samples from different areas including Agra Island, Samoylov Island, and Kurungnakh Island in the Lena river delta as well as the Buor Khaya Peninsula and Great Lyakhovsky Island. This sample set represents typical Siberian permafrost deposits including polygonal tundra active layer soils, Holocene fluvial terrace sediments, Holocene thermokarst, and Pleistocene Yedoma/ice complex deposits.

Our data show large variability of both GDGT and BHP inventories as well as corresponding soil OC export proxy values. R'_{soil} ranges from 0.05 to 0.78 and BIT ranges from 0.47 to 1.00 in the investigated samples. Both proxies do not correlate with each other and only BIT indices show a trend in the distribution between the different deposits. BIT indices are highest in active layer soils and Holocene thermokarst samples (>0.90) whereas the lowest values are found in the Yedoma samples, particularly in those Yedoma sequences deposited during MIS 3 and MIS 5. R'_{soil} is much more variable and does not show systematic distribution patterns neither between the different deposits nor with BHP structural diversity. The BHP structural diversity is lower in active layer soils (4 to 16 BHPs) than in thermokarst and Yedoma deposits (10 to 23 BHPs) and active layer soils show higher average R'_{soil} values than thermokarst and Yedoma deposits, but the internal variability is high.

Overall, the different permafrost structures and deposits in Arctic Siberia are characterized by very heterogeneous GDGT and BHP pools. This complicates the definition of typical endmember values for the BIT and R'_{soil} indices particularly when used to obtain quantitative estimates of soil organic carbon export into marine sediments. In order to determine potential factors controlling the variability of GDGT and BHP inventories and the BIT and R'_{soil} indices, we will discuss the data in context with depositional and in situ environmental parameters such as pH, temperature, C and N content, aiming to provide better constraints on endmember values for qualitative estimates of permafrost OC export.