Ground-ice stable-isotope paleoclimatology at the Batagay megaslump, East Siberia

Thomas Opel¹, Sebastian Wetterich¹, Hanno Meyer¹, and Julian Murton²
¹Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Potsdam, Germany (thomas.opel@awi.de)
²Permafrost Laboratory, Department of Geography, University of Sussex, Brighton, UK

In recent years, permafrost ground ice (i.e. ice wedges and pore ice) has been frequently utilized as a paleoclimate archive for the Late Pleistocene and Holocene, mainly using stable isotopes from water as proxies for local air temperatures. Due to their formation processes (frost cracking in winter and crack infilling mainly with snowmelt in spring), ice wedges have a unique winter seasonality, whereas pore ice integrates summer or annual precipitation.

The world's largest retrogressive thaw slump at Batagay in the Yana Upland, East Siberia (67.58 °N, 134.77 °E), provides unique access to Late and Middle Pleistocene permafrost formations usually deeply buried in the frozen ground. The Batagay megaslump exposes syngenetic ice wedges and composite wedges (ice–sand wedges) along with pore ice in four cryostratigraphic units: (1) the Lower Ice Complex, (2) the Lower Sand, (3) the Upper Ice Complex, and (4) the Upper Sand.

Here, we present ground-ice stable-isotope data from all four units. This dataset is accompanied by precipitation stable-isotope values from winter snowpack and summer rain as a first stable-isotope framework for this region.

The high continentality of the study region with – extremely low winter temperatures – is clearly reflected by the stable-isotope composition for ice wedges from the Upper Ice Complex (MIS 3) and nearby Holocene ice wedges. Both are much more depleted than for any other ice-wedge study site in East Siberia. The ice wedges from the Lower Ice Complex are likely the oldest ice wedges (>0.5 Ma) ever analyzed isotopically and also point to very cold winter climate during formation. Stable-isotope signatures of composite wedges and pore ice are less distinctive and require detailed studies of formation processes and seasonality.