Geophysical Research Abstracts
Vol. 16, EGU2014-10686, 2014
EGU General Assembly 2014

Ice wedges as climate archives – opportunities and limitations

Thomas Opel (1), Hanno Meyer (1), Alexander Dereviagin (2), Sebastian Wetterich (1), and Lutz Schirrmeister (1)

(1) Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Department of Periglacial Research, Potsdam, Germany (thomas.opel@awi.de), (2) Moscow State University, Faculty of Geology, Moscow, Russia

Permafrost regions are assumed to play a major role for Global Climate Change as they are susceptible to recent warming in particular with regard to the potential release of stored fossil carbon. Permafrost serves as archive of past environmental and climate conditions (such as sedimentation processes, temperature and precipitation regimes as well as landscape and ecosystem development) over tens of thousands of years that can be traced by the study of the frozen deposits, paleontological content and ground ice. Ground ice comprises all types of ice contained in frozen ground, including pore ice, segregation ice and ice wedges.

Here, we focus on ice wedges as the most promising climate archive that can be studied by stable water isotope methods analogously to glacier ice. They may be identified by their vertically oriented foliations. Ice wedges form by the repeated filling of wintertime thermal contraction cracks by snow melt water in spring. As the melt water quickly refreezes at negative ground temperature no isotopic fractionation takes place. Hence, the isotopic composition (δ18O, δD, d excess) of wedge ice is assumed to be representative of annual cold period climate conditions, i.e. winter and spring.

Ice wedges are widely distributed in non-glaciated high northern latitudes, are diagnostic of permafrost and, in general, indicative of cold and stable climate conditions. They are found in continuous and discontinuous permafrost zones and may also have formed during and survived interglacials. They may provide unique paleo information that is not captured by other climate archives. Usually, ice wedges are dated by radiocarbon dating of organic material incorporated in the ice, but also 36Cl/Cl ratios have been successfully used to date ice wedges. Nevertheless reliable age determination is challenging when studying ice wedges.

Here we tackle the potential of ice wedges from the Siberian and American Arctic to trace past climate changes from stable isotope variations from the differentiation of Late Quaternary stratigraphic units to detailed centennial scale climate records of the Late Glacial and Holocene. Based on several examples we discuss the opportunities and difficulties of ice-wedge based paleoclimate studies.