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Late Holocene climate information from stable water isotopes of ice wedges on the Dmitrii Laptev Strait, Northeast Siberian Arctic

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Ice wedges are the most abundant type of ground ice in the ice-rich permafrost deposits of the Northeast Siberian Arctic and are formed by the periodic repetition of frost cracking and subsequent crack filling mostly by melt water of winter snow. Therefore, ice wedges can be used for the reconstruction of past winter temperatures and moisture generation and transport patterns. In the framework of the International Polar Year Project 15 "Past Permafrost" extensive ice-wedge investigations were carried out on the Dmitrii Laptev Strait (72.7˚N, 143.5˚E) in August 2007.

Here we present data on the stable isotope composition (δ^{18}O, δD, d excess) of ice wedges and recent ice veins located in a vast thermokarst depression formed due to permafrost degradation during the Late Glacial to Early Holocene warming. Three 2.5 to 3.5 m wide ice wedges were sampled in high resolution (100 to 200 samples each). AMS ^{14}C ages of organic matter enclosed in the ice document the Late Holocene age of the studied horizontal ice wedge profiles and indicate syngenetic growth associated with sediment accumulation over the last about 3 000 years. The ice wedges co-isotopic relationships close to the Global Meteoric Water Line point to a good suitability for paleoclimate studies and only minor influence of secondary isotopic fractionation. All three profiles show similar isotopic features: The lowest δ^{18}O values of about -26‰ are found in the outer ice wedge parts, the highest values from -23‰ to -21‰ in the youngest ice wedge parts and in the recent ice veins. This reflects a general Late Holocene winter warming trend with a marked variability and several briefer maxima and minima. This trend is accompanied by a shift in the d excess values from 8‰ - 11‰ to 5‰ - 8‰ probably caused by varying proportions of different moisture sources for precipitation, e.g. the North Atlantic Ocean, the North Pacific Ocean and polynyas of the Laptev- and East Siberian Seas. The highest winter temperatures and an increased influence of regional moisture in recent decades reflect ongoing Arctic warming.