Permafrost properties of the Yedoma key site at Duvanny Yar (Kolyma lowland, East Siberia)

I. BACKGROUND
Duvanny Yar is the well known stratigraphic key site for late Quaternary deposits in Beringia, the landmass non-glaciated during the late Pleistocene between the Taymyr Peninsula and Alaska [1]. The outcrop is dominated by Middle Weichselian ice-rich permafrost sequences, termed as "Ice Complex" or "Yedoma Suite" [2].

In course of the IPY project #15: Past Permafrost, the aim of this study was to obtain a comprehensive cryolithological characterization of Ice Complex deposits which represent a significant carbon reservoir under climate warming conditions due to permafrost degradation [3].

II. STRATIGRAPHY
Six permafrost profiles along the right bank of the Kolyma river were sampled in summer 2008 (Figures 1). They exposed Eemian lacustrine deposits (profiles DY-02, DY-03), long sequences of Middle Weichselian Ice Complex deposits (profiles DY-01, DY-05) and Holocene lacustrine and bog deposits in thermokarst depressions (profile DY-04) (Figure 2).

III. MULTIPROXY APPROACH
A multidisciplinary approach of cryolithological methods was applied to obtain data sets of stable isotope composition of ground ice ($\delta^{18}$O, $\delta^{2}H$), ice contents, grain size and biogeochemical parameters (TOC, TN, $\delta^{13}$C), mineral density, mass-specific magnetic susceptibility and radiocarbon ages of the sediments (Figures 3-6). Based on density, ice and TOC contents (in wt%), the organic carbon content (in kg TOC per m$^3$) was estimated for the Ice Complex to quantify the carbon pool stored therein.

IV. ICE COMPLEX CHARACTERISTICS

Ice
- Massive to lenticular and layered cryostructures; thus syngenetic freezing processes
- Mean gravimetric ice content: 55 to 60 wt%
- Huge syngenetic ice wedges:
  - up to 2.5 m wide and up to 7 m long

Grain size
- Uniform polymodal grain size distribution
- Poorly sorted clayey and sandy silt:
  - Trask sorting co-efficient 3-4
- Two major peaks in fine silt and coarse silt fractions, one minor peak in fine sand fraction
- Magnetic susceptibility mainly from 30 to 60 SI indicating a rather homogenous mineral composition; thus stable sediment source
- Regular transport and accumulation conditions during the whole period of Ice Complex formation

Organic carbon
- TOC (0.5 to 2 wt%), TOC/TN (5 to 15), $\delta^{13}$C (-27.4 to -24.6‰); thus organic source from fresh water and subaerial terrestrial environments
- Peaty paleosols with higher TOC (>2 wt%) and TOC/TN (>10)
- Estimated mean organic carbon amounts to 16±11 kg m$^{-3}$

References

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