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First drilling subsea permafrost in the southeastern Laptev Sea, the East Siberian Arctic Shelf: results and challenges

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Most ancient organic carbon and methane hydrates are stored in continental shelf deposits, particularly in the arctic shelves, where they are sequirested beneath and within the sub-sea permafrost. The largest, shallowest, and thus most vulnerable fraction of methane deposits occurs on the East Siberian Arctic Shelf (ESAS). The ESAS sub-sea permafrost stability is key to whether sequestered ancient CH4 escapes through the seabed to the water column and further to the atmosphere. Caught between the warming effects of upward geothermal heat flux and downward heat flux from saline and river water and modern sediments, submarine permafrost is prone to significant destabilization and thawing. Currently, there are very few observational data on the ESAS subsea permafrost state and thermal regime. Thus our primary goal is to recover sediment cores up to 100m long from sites representing different stages in permafrost degradation, sediment variability, and rates of potential CH4 production. To do that we drilled in the seasonally ice-covered eastern part of the shallow shelf, east off the Lena Delta, where specific geochemical and geophysical surveys have been conducted in summer of 2010, 2009, 2008, and 2011. This report aims to represent initial thermal and biogeochemical results. From the numerical calculations, we suggest development of open taliks underneath submerged thaw lakes within a large area of the ESAS.

New challenges: 1)observed Arctic warming in early 21st century is stronger than predicted by several degrees, which may accelerate thaw release of methane from the upper seafloor layer by increasing bottom erosion and from deeper stratums (including hydrates) by sediment settlement and adjustment; 2) drastic sea ice shrinkage causes increase in storm activities and deepening of the wind-wave-mixing layer down to depth $\sim$50 m that enhance methane release from the water column to the atmosphere. These new challenges to be studied further in frame of the current International Siberian Shelf Studies (ISSS) by set of the biogeochemical and geophysical techniques -in summer, and drilling from the fast ice -in winter.