

Deep ice-rich permafrost: Final report of the Yedoma Action Group

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Permafrost landscapes are threatened by climate warming and degrade in different ways. This includes near surface processes such as active layer deepening, as well as extensive processes like thermal erosion, and development of thermokarst features. In the Siberian and North American late Pleistocene ice-rich yedoma, permafrost thaw processes cause surface subsidence of several tens of metres due to loss of ground ice. With thawing, currently freeze-locked organic matter can be mobilized and contribute to the carbon-climate feedback, which is a process of global significance if formerly inactive, fossil carbon is re-introduced into the active carbon cycle.

But where is this deep and ice-rich permafrost? Focusing on the impressive yedoma sediments, the main objective of this Action Group was to get international experts together for compiling a map of the circum-Arctic distribution and thickness of yedoma deposits. This product is of importance for assessing infrastructure vulnerability, assessing permafrost carbon stocks, and to improve the modelling of future landscape change trajectories within this part of the (sub)Arctic.

The Yedoma Action Group started its activities in early 2015. With data on thickness extracted from drilling records and outcrop observations reported in the scientific literature, we aimed to derive the yedoma coverage based on the digitization of surface geological and Quaternary geological maps. A key milestone was reached by conducting a hands-on workshop organized prior to the 11th International Conference on Permafrost in Potsdam,

involving 24 scientists from 5 countries. The Action Group's progress and results were disseminated at numerous international conferences and meetings in Russia, Switzerland, Germany, and the United States. An appropriate finish was a plenary talk at the 2nd Asian Conference on Permafrost in Japan.

Deliverables and further products like a yedoma photo database and the first version of the yedoma map are published online and available on the Arctic Permafrost Geospatial Centre (APGC, <http://apgc.awi.de/tl/group/about/ipa-action-group-the-yedoma-region-a-synthesis-of-circum-arctic-distribution-and-thickness>) and the Pangaea database (<http://dx.doi.org/10.1594/PANGAEA.861733>). In addition, an open-access article "Deep Yedoma permafrost: A synthesis of depositional characteristics and carbon vulnerability" (Earth-Science Reviews, <http://dx.doi.org/10.1016/j.earsci-rev.2017.07.007>) was published. This Action Group effort identified that the yedoma domain, including drained thermokarst basins, contains ~398 gigatons thaw-susceptible organic carbon. This is more than 25% of the frozen carbon of the

permafrost area, while the Yedoma domain is covering only 7% of the permafrost region. Our results underline the need to account for the yedoma domain and its destabilization mechanisms in next generation Earth System Models for a more complete representation of the permafrost-carbon feedback.

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Degrading yedoma on Sobo Sise Island, Lena Delta, Siberia, with a person for scale. More geotagged pictures of the impressive yedoma cliffs are available at our picture database: <http://apgc.awi.de/tl/dataset/iryp/resource/660a0aa2-9763-4385-b054-b6bd6dd1d3dd>.