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Beenchime Salaatinsky Crater in Northern Yakutia
- origin and Late Quaternary records of the 8-km circular structure -

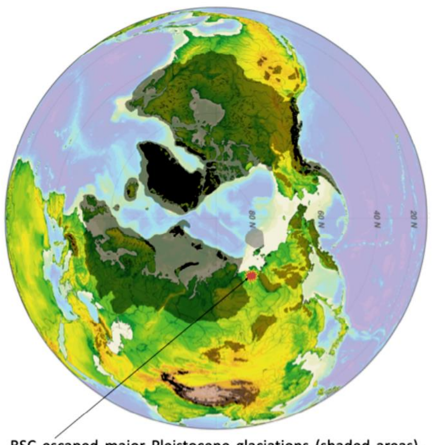
A reconnaissance study at Beenchime Salaatinsky Crater (BSC) in Northern Yakutia had the following short-term scientific goals:

(i) analysing the bedrock geology for evidencing a kimberlite or impactite explosion, and (ii) reconstruction of the late Quaternary environmental history in the basin.

Long-term scientific goals are (i) identifying, if the site is a suitable target for deep drilling efforts for studying the depth and depositional history of the presumably million years old basin fill and (ii) aiding the reconstruction of the crater origin.

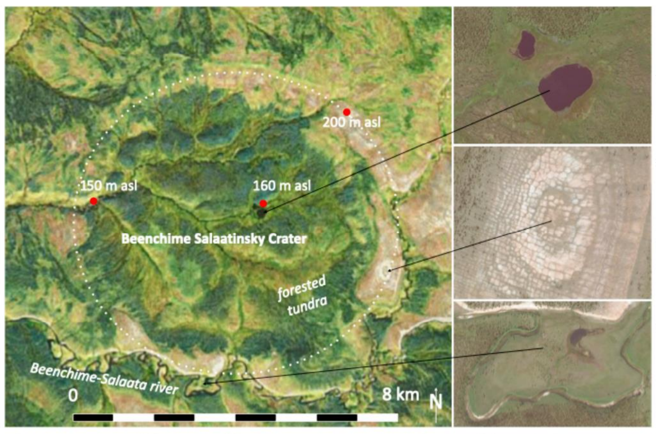
We sampled several landforms; i.e. ancient river terraces, modern river sediments, a central lake depression, and Paleozoic bedrock. GPR surveys helped to image bathymetry and permafrost features (patterned ground).

Setting I



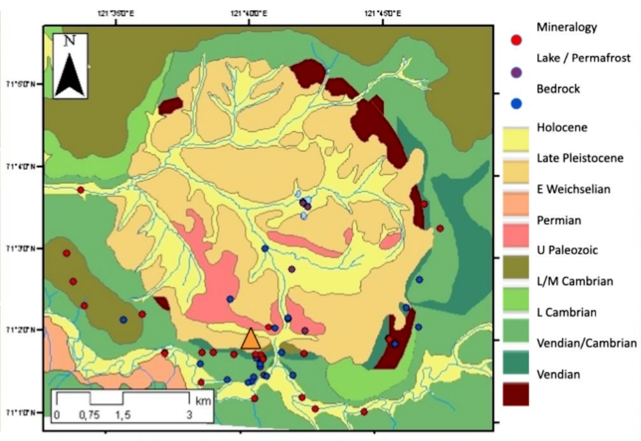
BSC escaped major Pleistocene glaciations (shaded areas). The ring structure is exposed on the northeastern flank of the Siberian craton. [H. Grobe 2008 redrawn from Ehlers and Gibbard 2007, Niessen et al. 2013]

Setting II

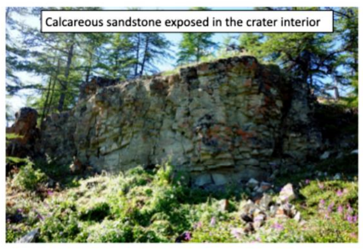


The crater is named for its neighbouring river. Drainage in the overall low relief terrain exits to the west. Periglacial weathering takes place in the crater rim dolostones. The basin centre holds a group of small lakes. [WorldView-2 imagery 2013]

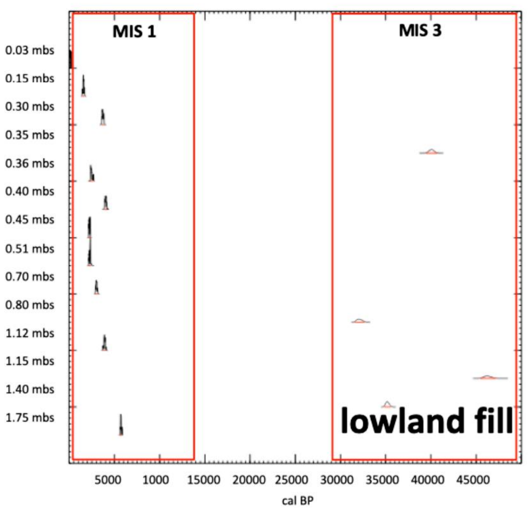
Setting III and sampling



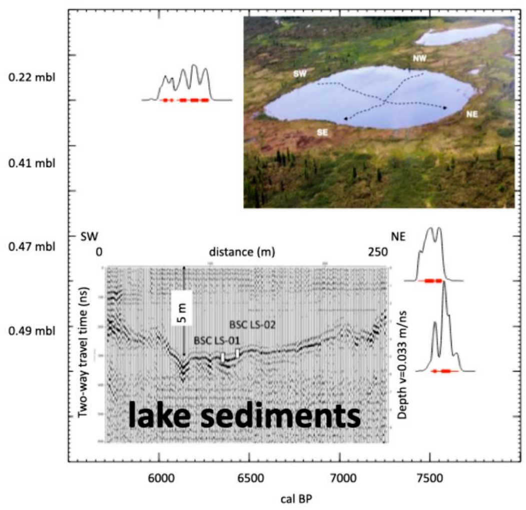
Paleozoic rock from platform sediments form the crater wall, the crater inside and outside. [based on Mikhailov 1978, Masaitis 1999, modified]



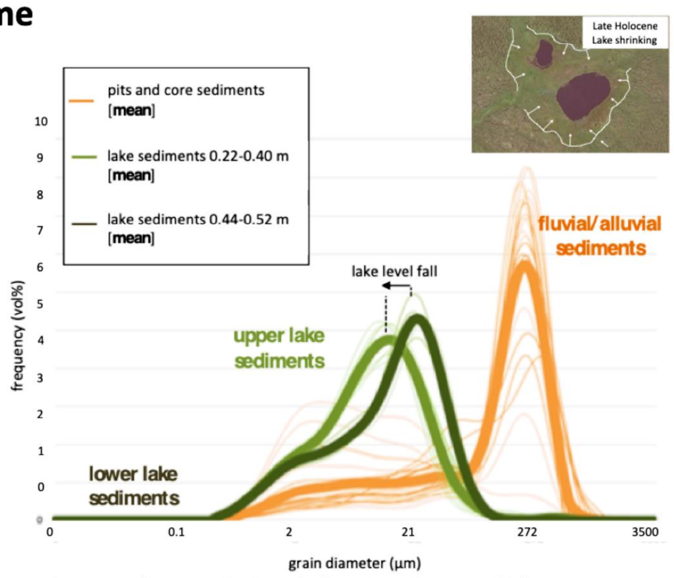
Results - Late Quaternary cover deposits - ages and transport regime



Posterior probability distribution of ^{14}C ages for all section samples (soil pits and short cores). (mbs = m below surface) [Calib 7.10]

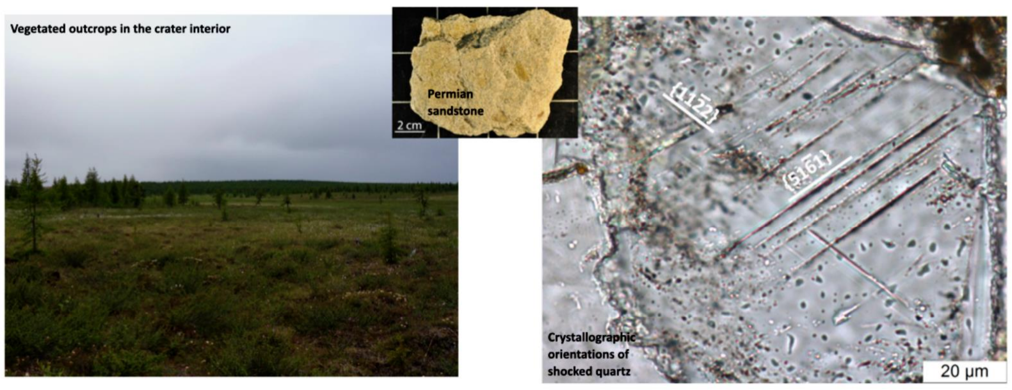


Probability distribution of ^{14}C ages for lake sediment samples. *Inset*: 50 MHz GPR line crossing the lake SW to NE, water depth 5 m at maximum. (mbl = m below lake floor) [Calib 7.10]

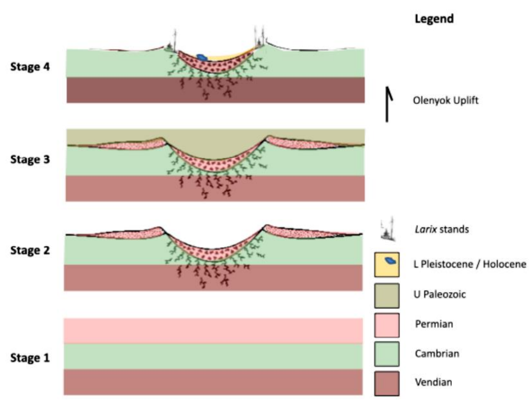


Frequency of mean grain sizes of all section sediments and lake sediments. Note: Lower lake sediments are coarser than upper lake sediments. Uppermost layer (0.00-0.22 m) is organic detritus only.

Results - Bedrock analysis - volcanic or meteoritic?



Vegetated outcrops in the crater interior. Thin section studies on various bedrock samples from outcrops are analyzed using polarized light microscopy. In fact, **shocked quartz** minerals with PDFs (planar deformation fractures) were found in a sample taken from a **Permian sandstone** outcrop in the crater interior. Crystallographic orientations are given based on U-stage microscope measurements.



Simplified scetch of **basinal history**. The impact event is of Permian (or younger) age. Late Pleistocene detritus results from erosional break-up of Permian sandstone.

Interpretation

- We propose a (Post-) Permian **impact event**, a Mesozoic overburdening and subsequent erosion in the course of the Mesozoic-Cenozoic Olenyok Uplift.
- We document late Quaternary landscape dynamics including **fluvial activity during MIS 3** and **mid to late MIS 1**.
- We interpret a **lake formation** linked to the **Holocene Thermal Maximum** in N Siberia (~7000 years ago).
- We suggest a **thermokarst** lake origin (thaw lake).
- We deduce a **lake shrinkage** based on a decreasing mean grain size composition from the lower to the upper core along with **decreasing sedimentation rates** from mid Holocene towards modern time.

Literature

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