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The HOLOCENE environmental history of the Verkhoyansk Mountains region (NE SIBERIA, Russia) reconstructed from high-resolution Pollen data

S. Müller[1]*, P.E. Tarasov[1], A.A. Andreev[2], and B. Diekmann[2]

[1] Freie Universität Berlin, Geological Sciences, Palaeontology, Berlin, Germany

[2] Alfred-Wegener-Institute for Polar and Marine Research, Research Unit Potsdam, Germany

* Corresponding author: Stefanie Müller, stefm@zedat.fu-berlin.de

Introduction

The study presented here is part of the IPY project 106 "Lake Records of late Quaternary Climate Variability in northeastern Siberia" and the German Research Foundation project RI 809/17-1,2 "Late Quaternary environmental history of interstadial and interglacial periods in the Arctic reconstructed from bioindicators in permafrost sequences in NE Siberia". Both projects focus on generating high-resolution vegetation and climate proxy records mainly from lacustrine sediments along a north-south transect from Yakutia, Republic of Russia. This region is known for its climate extremes, with the Verkhoyansk Mountain Range being the coldest area in the Northern Hemisphere – "Pole of Cold" (**Fig. 1a**).

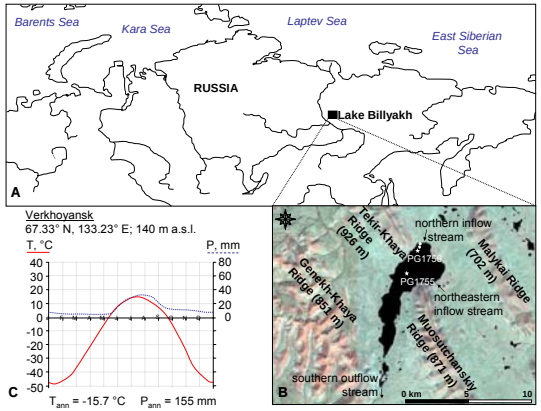

Fig. 1a. Map of Russia (**A**) and location of Lake Billyakh (**B**) as well as the climate diagram of Verkhoyansk (**C**) showing the extreme continental climate.

Fig. 1b. Photographs taken during the field campaign in April 2005.

Regional setting

Lake Billyakh (65°17' N, 126°47' E; altitude 340 m; LB) is situated in the central part of the Verkhoyansk Mountains (Fig. 1a). Modern climate is extremely continental with a mean temperature of −40°C in January and 15-19°C in July and annual precipitation of 300-400 mm (**Tarasov et al., 2007**). Cold deciduous forest with larch (*Larix dahurica*, *L. cajanderi*) dominance and abundant shrubs growing in the understorey occupies lower elevations; while tundra occurs above 700-1200 m. Together with larch, trees of Scots pine (*Pinus sylvestris*), birch (*Betula platyphylla*) and shrubs (*B. middendorfii*, *B. fruticosa*, *Duschekia fruticosa*) dominate the vegetation (**Fig. 1b**).

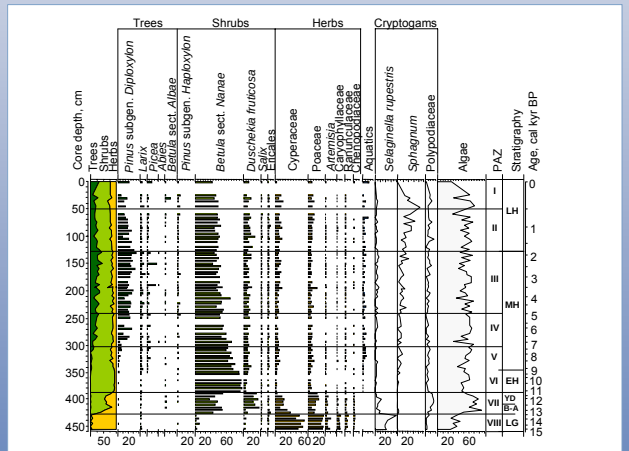

Fig. 2. Simplified pollen percentage diagram of LB sediment core PG1756; LG – Late Glacial, B-A – Bølling-Allerød, YD – Younger Dryas, EH – Early Holocene, MH – Middle Holocene, LH – Late Holocene.

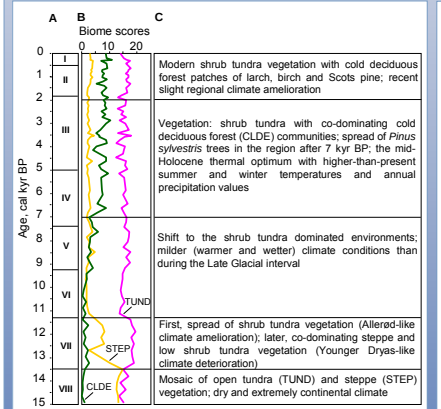

Fig. 3. Pollen assemblage zones (**A**), biomization results (**B**) and reconstructed vegetation characteristics (**C**) of sediment core PG1756.

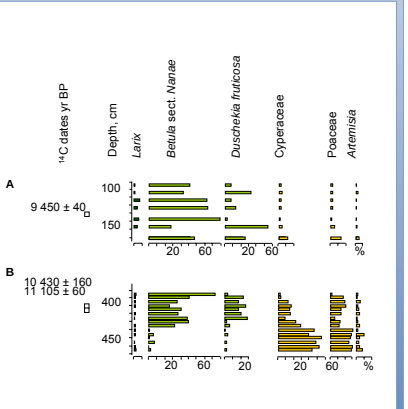

Fig. 4. Pollen record for selected taxa from LB sediment cores PG1756 (**A**) and PG1755 (**B**) for the Younger Dryas interval.

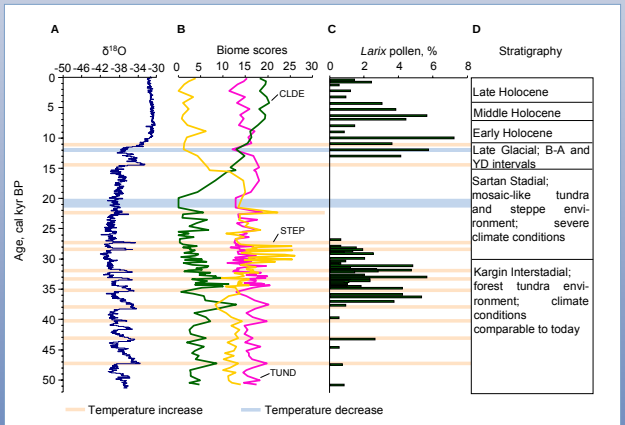

Fig. 5. Comparison of $\delta^{18}O$ values from Greenland (**A, North Greenland Ice Core Project members, 2004**) with LB sediment core PG1755 biome scores (**B**) and larch pollen percentages (**C**), (**D**) shows the stratigraphy (B-A – Bølling-Allerød, YD – Younger Dryas).

Results & Interpretation

The radiocarbon-dated pollen record and pollen-based biome reconstruction of the core PG 1756 from LB suggest that open cool steppe and grass and sedge tundra communities with Cyperaceae, Poaceae, *Artemisia*, Chenopodiaceae, Caryophyllaceae and *Selaginella rupestris* dominated the area from 15 to 13.5 kyr BP (**Fig. 2**, **3**). On the other hand, the constant presence of larch pollen in quantities comparable to today's values points to the constant presence of boreal deciduous conifer trees in the regional vegetation during the last glaciation (**Müller et al., 2009**).

Conclusion

The pollen data from PG1756 indicate that Younger Dryas climate was less severe than the climate during the earlier interval from 15 to 13.5 kyr BP (**Fig. 4**). The 9.36 m long PG1755 core from the central part of LB provides an even longer record, showing presence of larch pollen since about 50 kyr ago (**Fig. 5**). Present-day extension of larch in the Arctic is limited mainly by the 10-12°C mean July isotherm. It is very plausible that the western foreland of the Verkhoyansk Mountains with its numerous lake and river valleys provided enough moisture and warm microhabitats buffering larch trees against climatic extremes.

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