Holocene paleoenvironmental reconstruction of the Buor Khaya Peninsula using a multiproxy approach

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Fig. 1: Location of the study site

Introduction

The study site Buor Khaya peninsula (71°23'N, 132°12'E) is located in the northeastern part of Yakutia, Russia (**Fig. 1**) and is margined by the Laptev Sea. This investigation is part of the Russian-German Cooperation SYSTEM LAPTEV SEA Buor Khaya Peninsula 2010. The objectives of this study is a paleoenvironmental reconstruction of Buor Khaya during the Holocene using a multiproxy approach.

Methods

Basis for the multiproxy approach were two shore sediments profiles taken from yedoma (ice-rich permafrost accumulation plain remnant, **Fig.2**, **A**) and alas (thermokarst depression, **Fig.2**, **B**) deposits. In this context, degradation of organic matter fixed in the permafrost was of particular interest. In order to recieve detailed information on the paleoenvironmental development, the following different proxies were analyzed on the archieves:

sediments

geochronology (AMS) | grain size parameters | density fractionation | magnetic suceptibility | TOC, TN, TC, $\delta^{13}C$ | bioindicators

ground ice

$\delta^{18}O$, ^{2}H | gravimetric ice content

Results and Discussion

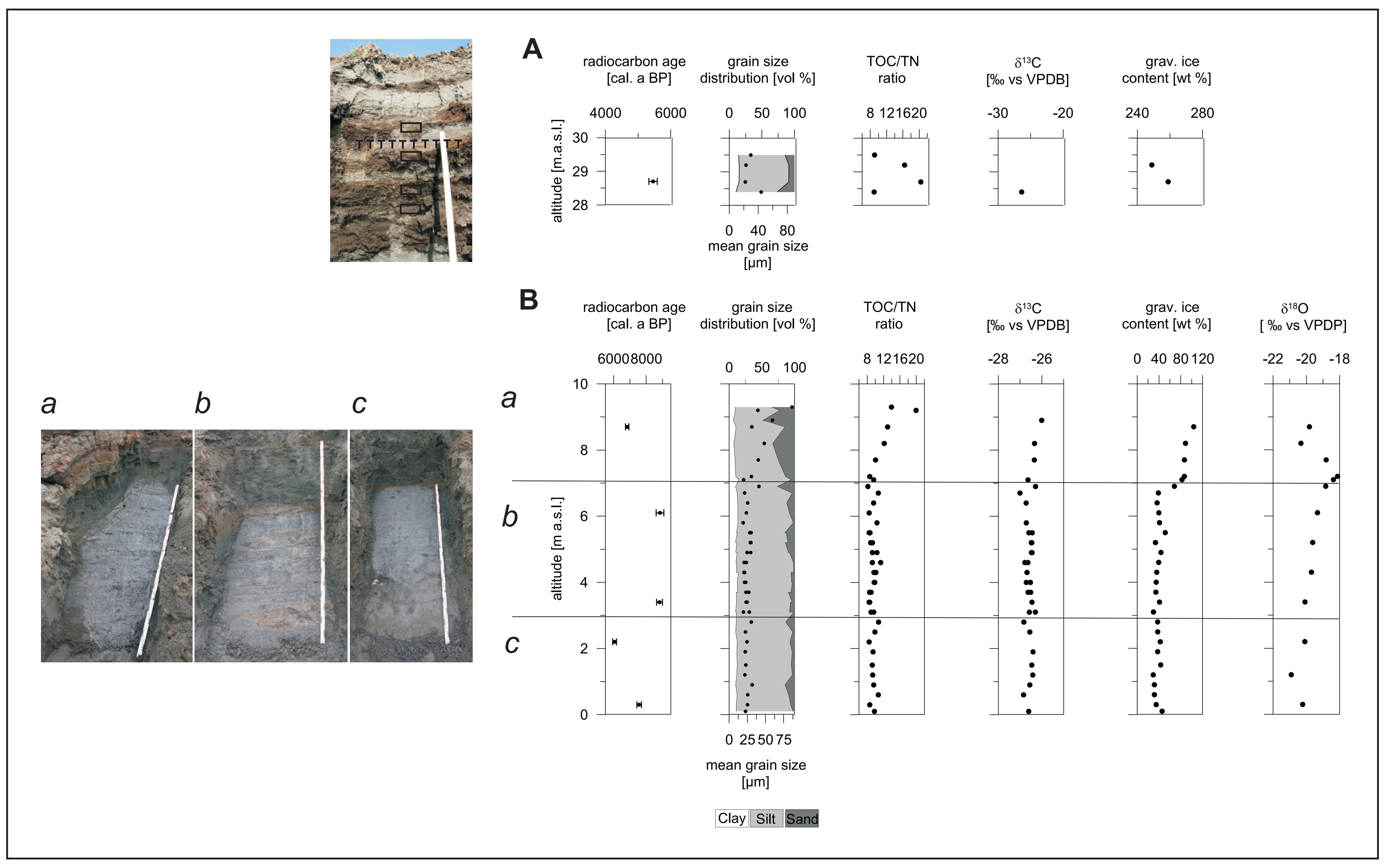

Fig. 2: Extracts from the results of the sediment profiles (**A**) BUO-03 and (**B**) BUO-05.

Generally, the sediment consists of bi- to multimodal grain sizes, few macro remains of plants and sporadic fossils like ostracods. The two profile diagrams (**Fig.2**,) show the sediment age, grain size, $\delta^{13}C$, the TOC/ TN ratio, $\delta^{18}O$ and the gravity ice content. In profile BUO-03 (**A**) organic-rich and silty layers appear alternately indicating boggier and drier periods. Under wet, anoxic conditions decomposition is retarded and organic matter accumulated. Dry conditions intensify eolian input. The occurence of ostracods display that the profile BUO-05 (**B**) contains lake sediments of a paleo thermokarst lake. Both profiles reveal different stages of thermokarst development (**Fig. 3**). Moreover, profile **A** has a remarkable high ice content. Profile **B** shows an inversion in age, which can be explained by relocation processes. In addition, increasing grain sizes from the bottom to the top can be explained with higher transportation energy. Furthermore, the mean $\delta^{18}O$ value of the analysis is -20. In contrast, recent ^{18}O- isotopes from precipitation and lake water have an average of -15.

Fig. 4: Photo of BUO-03 taken by P. Overduin

The relocation process concerning the age inversion is supported by similar grain size distribution curves comparing alas and yedoma deposits. That implicates the alas formation out of yedoma material. Moreover, the narrow range of the data suggests constant envionmental conditions. The comparison of $\delta^{18}O$ values indicate a colder climate during the alas formation. Continuing data interpretation will certainly reveal further results.

Conclusion

Referring to the stages of an alas relief development stated by Soloviev (1973) profile **A** presents the initial stage of the thermokarst process (**Fig. 3**,(**1**)). When the active layer increases in a yedoma, a boggy ambience is formed through the impermeable permafrost below. Further thawing can develop an alas with a thermokarst lake inside (**Fig.3**,(**2**)). Ostracods give evidence for the existence of freshwater ponds.

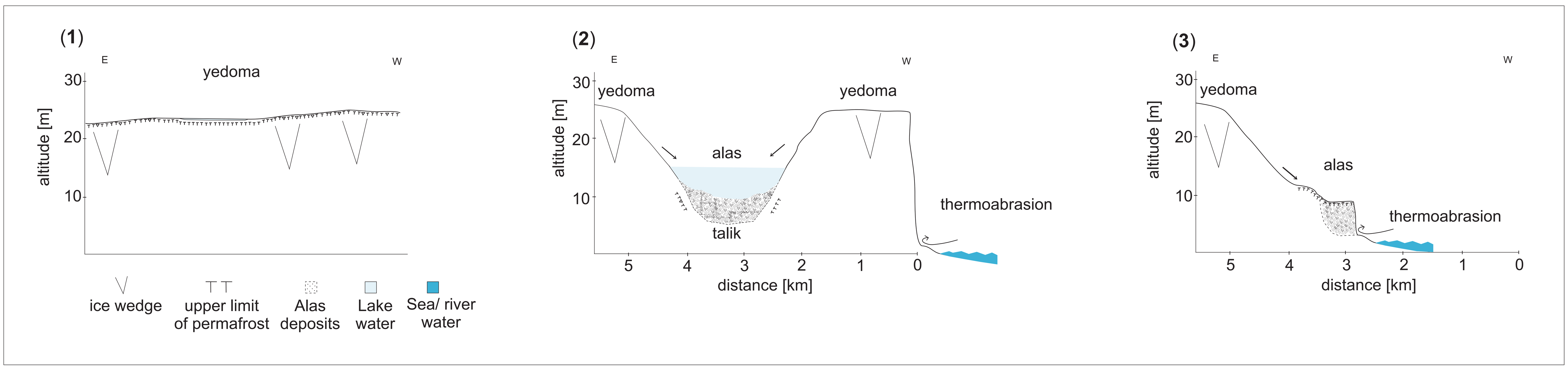

Fig. 3: Possible relief development: schema (**1**) thawing yedoma (profile **A**); schema (**2**) young alas including a thermokarst lake; schema (**3**) recent study site situation

References

Soloviev, P.A. 1973. Thermokarst phenomena and landforms due to frost heaving in Central Yakutia. Biuletyn Peryglacjalny, 23.

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