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Testate amoebae record from the Laptev Sea coast and its implication for the reconstruction of Late Pleistocene and Holocene environments in the Arctic Siberia

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ABSTRACT

Our study aims to look for testate amobae (TA) in the surface and fossil sediments from the Cape Mamontov Klyk (73°60′–73°63′ N, 116°88′–117°18′ E), southern coast of the Laptev Sea, ca 150 km west of the Lena Delta and to discuss the potential of TA analysis for Glacial/Interglacial environmental reconstructions in Arctic Siberia. The radiocarbon age determination suggests that the studied sediments accumulated between ca 45,000 ^{14}C yr BP and present. A total of 98 TA taxa were identified in the 10 recent surface and 59 fossil samples. Results of taxonomical identification and ecological analysis of TA in the modern and fossil samples suggest that major changes in the soil moisture conditions took place. Our results show that soil-living taxa dominated the TA assemblages at the study sites during the past 45,000 years. The environmental conditions of the study area were most favourable (relatively warm and humid) during the Kargin Interstadial (ca 45,000–25,000 ^{14}C yr BP). An opposite situation is reconstructed for the Sartan Stadial (ca. 25,000–15,000 ^{14}C yr BP). During the Kargin Interstadial, optimum conditions occurred between ca 44,000 and 40,000 ^{14}C yr BP characterised by highest TA abundances and taxa diversity. This initial optimal phase was followed by the interval with drier and colder conditions about 40,000–30,000 ^{14}C yr BP. The sediments dated between ca. 24,000 and 18,000 ^{14}C yr BP show low TA abundances and diversity, in agreement with the much colder and drier environments during the maximum phase of the Last Glacial. The onset of the Holocene is indicated by a broad representation of obligate hydrophilic taxa, especially from genus *Difflugia*, suggesting wet and relatively warm conditions. By comparison with other environmental proxies used in the studied sections as well as from the neighbouring arctic regions our results suggest that TA analysis can provide valuable information, contributing to the better understanding of the Late Quaternary climate and environments in Arctic Siberia.

1. Introduction

The Arctic is more sensitive to climate change than most other parts of our planet (ACIA, 2004). Here effects of the current warming can obviously be seen from the present destruction of terrestrial and sub-sea permafrost surfaces as well as the reduction of the sea-ice cover. There are also many indications of various palaeoenvironmental changes in lowland regions of Northeast Siberia during the Late Quaternary that are available from multi proxy studies of permafrost records (e.g. Andreev et al., 2002b; Schirrmeister et al., 2002a). Northern Eurasia has long been known as an important region for understanding the magnitude of climatic and environmental changes during the Late Quaternary and their consequences for other high-latitude regions (e.g. Velichko, 1984; Khotinskiy, 1984; Hubberten et al., 2004; Lozhkin et al., 2007; Kienast et al., 2008). This area has been lagged behind other regions in terms of high-resolution palaeoclimatic studies. Therefore comprehensive multidisciplinary and high-resolution palaeoecological studies are necessary in order to understand the complex environmental changes that took place in the Arctic periglacial environments in the past.

Permafrost sequences exposed around the Laptev Sea coast have proven to represent informative archives of Late Quaternary environmental and climate dynamics. One of the best preserved sequences on the Laptev Sea coastal region has been studied using a multi proxy approach at Bykovsky Peninsula (e.g. Schirrmeister et al., 2002a,b; Meyer et al., 2002; Andreev et al., 2002b; Bobrov et al., 2004; Kienast et al., 2005; Sher et al., 2005). Environmental changes from the Middle to the Late Weichselian and into the Holocene have been reconstructed through multidisciplinary studies. The two clearest results of these studies are (i) the continuous existence of a treeless grass/herb-dominated vegetation

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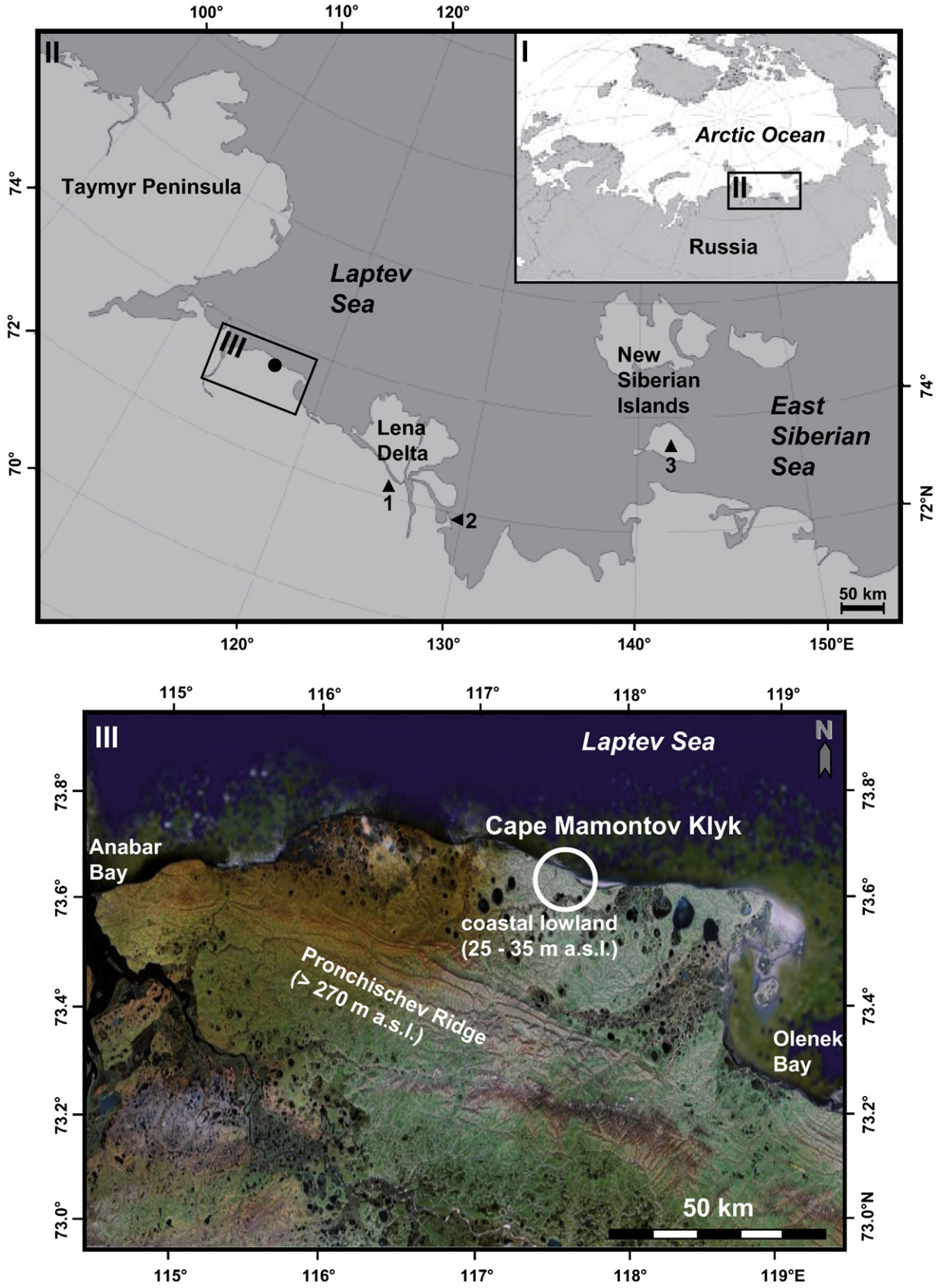

Fig. 1. Map of the Arctic (I) and Laptev Sea region (II) showing the location of the studied section at Cape Mamontov Klyk (III).; 1 — Olenek channel; 2 — Bykovsky Peninsula; 3 — Bol'shoi Lyakhovsky Island; source for III: GoogleEarth software.

(Andreev et al., 2002b), and (ii) very cold winters, attested by the continuous growth of thick ice wedges and by their stable-isotope composition (Meyer et al., 2002; Hubberten et al., 2004).

Recent studies in the Arctic regions show a complex response of the environmental system to major climatic fluctuations during the Late Pleistocene and Holocene. In such situations it is difficult, if at all