

## Modern and Fossil Diatom Assemblages from Bol'shoy Lyakhovsky Island (New Siberian Archipelago, Arctic Siberia)

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**Abstract**—This article discusses the results of a taxonomic and ecological investigation of diatoms from polygonal ponds and Quaternary permafrost deposits of Bol'shoy Lyakhovsky Island (New Siberian Archipelago) and the reconstruction of climatic changes on the Island during late Pleistocene/Holocene transition using fossil diatom assemblages from the permafrost deposits. The taxonomic list of diatoms includes 159 diatom species. The main ecological factors that determine the distribution of diatoms in the investigated data set are mean July air temperature, pH, electrical conductivity, water depth, and concentrations of Si<sup>4+</sup> and Al<sup>3+</sup>. An increase in water depth and stable lacustrine conditions in the Lateglacial–Holocene in the ancient thermokarst lake relate to Lateglacial warming before 11860 ± 160 years BP and during the early Holocene between 11210 ± 160 and 7095 ± 60 years BP.

**Keywords:** high Arctic, Bol'shoy Lyakhovsky Island, diatoms, ecological factors, Pleistocene, Holocene

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### INTRODUCTION

The territory of the high Arctic zone (71° N and higher), which includes the New Siberian Islands, has extreme climatic conditions (long winters, constant low temperatures, and short growing seasons). Therefore, this zone remains almost unaffected by anthropogenic impact and consequently has an exceptional potential to be used for the reconstruction of historical environment (Cremer and Wagner, 2003; Palagushkina et al., 2014, Frolova, 2016). Palaeoarchives of such arctic conditions are benthic sediments in both modern aquatic ecosystems and permafrost sequences formed on the place of existing lakes after drainage (Wetterich et al., 2009a). Diatoms are widely used as palaeoindicators but remain relatively poorly studied in the palaeoarchives of the high Arctic zone of Siberia. Some literature data on the Quaternary deposits of diatoms was collected on both islands of the New Siberian Archipelago, namely, Bol'shoy Lyakhovsky Island (Romanovsky, 1958; Rapoport and Romanovsky, 1959; Pirumova, 1968; Archangelov et al., 1996; Kunitsky, 1998; Grigor'ev and Kunitsky 2000; Andreev et al., 2004, 2009, 2011) and Zhokhov Island (Anisimov et al., 2009a, 2009b). The investigation of species composition and ecological parameters of dia-

toms in the high Arctic will provide additional data for regional databases and will help to increase the accuracy of palaeoecological reconstructions.

The purpose of this work is to study the taxonomic composition and ecological features of diatoms in the palaeoarchives of Bol'shoy Lyakhovsky Island and identify the main ecological factors that determine the diatom communities nowadays and during the last transition between glacial and interglacial conditions.

### MATERIALS AND METHODS

The complex investigation of the Russian and German expedition team was performed on the Bol'shoy Lyakhovsky Island in July 2007 (Fig. 1). According to climatic zoning, the study area belongs to the arctic zone and is characterized by great differences in the amount of sunlight in winter and summer, 9-month-long cold period, and a frostless period of 30–45 days. The mean temperature in January varies from –35 to –32°C; the mean temperature in July varies from +6 to +8°C. The mean annual precipitation rate is less than 150 mm; the summer season accounts for more than 60% of it (Gavrilova, 1973). Thermokarst lakes are rather rare in the modern relief of the island, but thermoerosional valleys and polygonal ponds are