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Late Glacial and Holocene paleoenvironments on the Bolshevik Island (Severnaya Zemlya), Russian High Arctic

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Late Quaternary history of the Severnaya Zemlya archipelago has been of interest for many paleoenvironmental studies since the 1970s. However, existing data records of the Holocene climate are fragmentary and sometimes contradictory. Here we present results of a multi-proxy study that included lithological, grain-size, pollen and geochemical analyses performed on a 2.46 m long sediment core from Lake Tvyordoe, located in the northwestern part of the Bolshevik Island. This study allowed to reconstruct the vegetation history, lake-level fluctuations, ice-cover conditions, and water and sediment inputs since the Last Glacial Maximum (LGM) to present time. Age model for the core is based on pollen stratigraphy and AMS radiocarbon dating. The age of the oldest deposits is estimated as ca. 24.2 ka cal BP. As revealed by our results, the Bolshevik Island was not covered by the Barents-Kara Ice Sheet during the LGM. The Mushketov Ice Cap, the closest glacier to Lake Tvyordoe, was located within or slightly beyond its present margins. During the late glacial time and the Pleistocene/Holocene transition, thin-laminated dense clays accumulated in the lake basin in permanent ice-cover conditions that prevented pollen deposition. The global warming at the termination of the Pleistocene occurred earlier than 12 ka cal BP, when warmer and wetter climate conditions than before resulted in higher sediment loads. During the early and middle Holocene (ca. 11.2–7.3 ka cal BP), most favourable environmental conditions on the Bolshevik Island existed, when low shrub tundra associations with dwarf birch, willow and alder dominated the vegetation. After 7.3 ka cal BP, a very abrupt climate cooling began. Similarity of the late glacial and late Holocene vegetation (sparse lichen–moss–grass cover) and relatively low total organic carbon (TOC) content suggests that cold and dry conditions were quite similar during the two periods.