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Reprint of: Benthic and planktic community changes at the North Siberian margin in response to Atlantic water mass variability since last deglacial times ☆

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ABSTRACT

The eastward penetration of Atlantic-derived water (ADW) into the Eurasian Basin of the Arctic Ocean was investigated at the western Laptev Sea continental margin for the time since c. 17.6 ka. Using a high-resolution investigation of the lithology, geochemistry, planktic and benthic foraminifers, and ostracods on a sediment core from 270 m water depth major steps in the environmental evolution of the region are recognized. In general, ADW was continuously present in the study area. Between 17.6 and 15.4 ka ADW manifested itself through open-water polynyas and associated upwelling events. Comparison between the Laptev Sea and northern Svalbard shelf using *Cassidulina neoteretis* allows assuming an unmodified subsurface inflow of ADW within its northern branch between 15.4 and 13.2, which was strongest after 14.7-ka and in line with the overall climate amelioration. A local freshwater event at 13 ka followed by shelf flooding and the establishment of a freshened shelf water mass resulted in an off-shelf displacement of ADW from the studied site as suggested by the disappearance of *C. neoteretis* between 12 and 7 ka. As evidenced by an abundance peak in *Nonion labradoricum*, the sea-ice marginal zone was located at the site around 12–11 ka but then shifted northward during the early Holocene warming. Enhanced ADW inflow since 7 ka correlated with climate cooling and southward retreat of the seasonal drift-ice margin. The inflow of ADW during mid–late Holocene differed from deglacial times because of the combined influence of northern and eastern ADW branches.

1. Introduction

The recently observed changes in the Arctic which are commonly related to global warming are expressed not only by considerable shrinking of the summer sea-ice cover extent (Serreze et al., 2007; Comiso et al., 2008; Polyak et al., 2010), but also by intensification of Atlantic-derived water inflow together with the increasing temperature of Atlantic water layer (Schauer et al., 2004; Polyakov et al., 2005). Besides instrumental measurements the latter is also evidenced by unprecedented changes in the composition of planktic foraminifers from Fram Strait during the early 21st century compared to the previous 2 thousand years (Spielhagen et al., 2011). Knowledge about the extent and timing of past inflows of Atlantic-derived waters carrying heat and salt to the Arctic Ocean is crucial for reconstructing short and long-term climate changes. During interglacial epochs, inflows of Atlantic-derived waters resulted in generally milder climate conditions in the Arctic and reduced sea-ice cover with more open-water leads (Knies et al., 2000; Spielhagen et al., 2004; Polyak et al., 2010). There is evidence that the subsurface inflows of these waters along Eurasian continental margin could be quite intense during both deglacial and glacial times (Knies et al., 1999; Bauch et al., 2001a; Nørgaard-Pedersen et al., 2003; Kristoffersen et al., 2004; Wollenburg et al., 2004; Rasmussen et al., 2007). Different patterns of Atlantic water inflows to subarctic Nordic seas and adjacent Eurasian Arctic periphery in relation to the extent and disintegration of the Barents-Kara ice sheet and water mass changes during lateglacial to Holocene times are fairly well reconstructed (Polyak and Mikhailov, 1996; Polyak et al., 1997; Hald et al., 1999; Bauch et al., 2001a; Duplessy et al., 2001; Hald et al., 2001; Lubinski et al., 2001; Ivanova et al., 2002; Koç et al., 2002; Hald et al., 2003, 2004; Duplessy et al., 2005; Ślubowska et al., 2005; Ebbesen et al., 2007; Hald et al., 2007; Rasmussen et al., 2007; Ślubowska-Woldengen et al., 2007, 2008; Aagard-Sørensen et al., 2010; Chistyakova et al., 2010; Risebrobakken

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et al., 2010). Contrary to this, sediment records from Siberian Arctic margins further eastward are considerably less studied primarily due to the lack of cores with reliable chronologies.

One of the better records with sufficient time resolution and radiocarbon chronology is a core from the upper slope of the western Laptev Sea continental margin (Fig. 1). The core dates back to c. 17.6 cal.ka and represents so far the longest radiocarbon-controlled record of postglacial and Holocene events in the region. As shown previously, the core holds evidence of iceberg-rafting events and meltwater inputs as well as the regional manifestations of Atlantic-derived water (ADW)

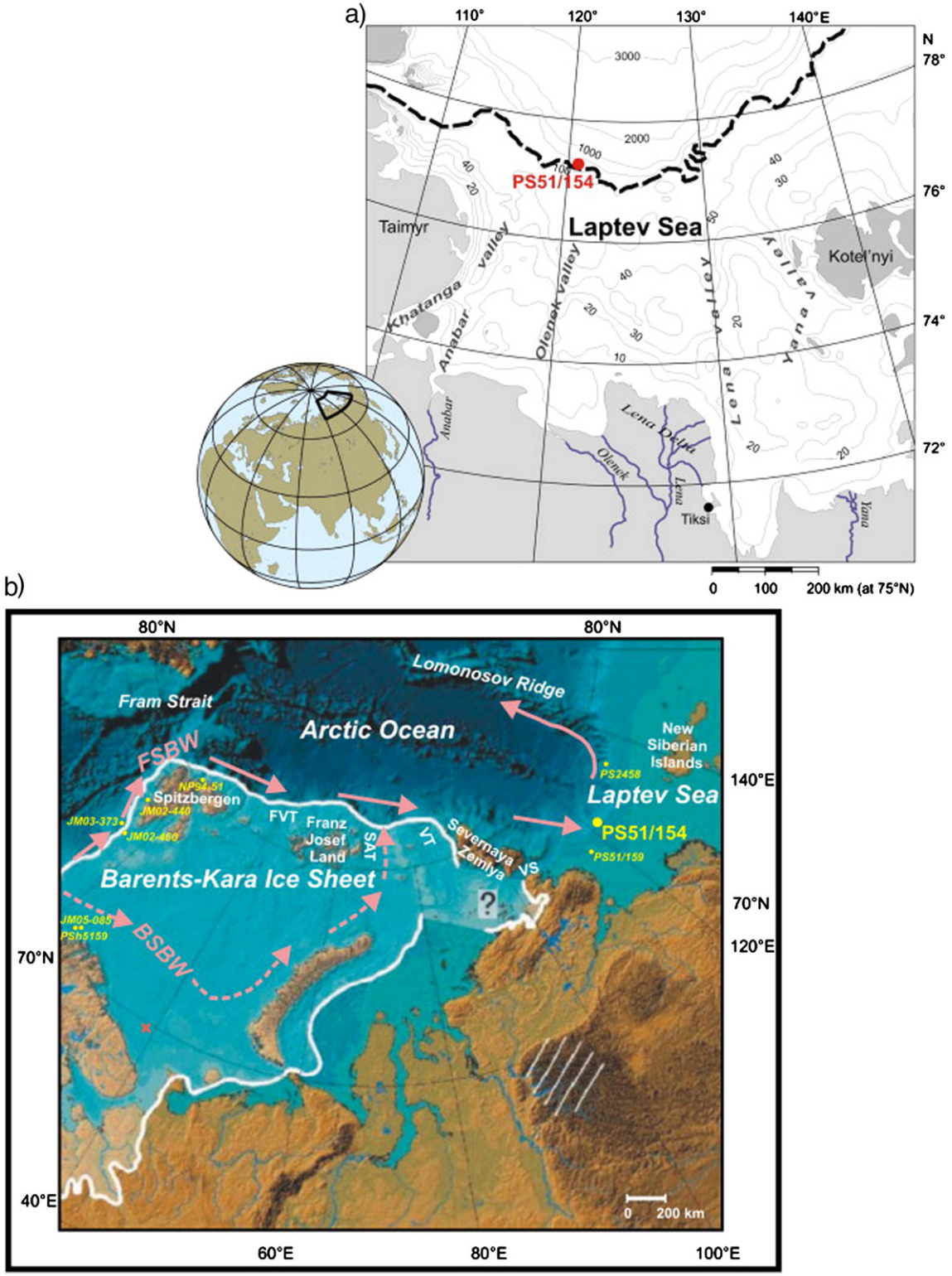

Fig. 1. a. Location of core PS51/154 in the Laptev Sea. Dashed line along the 100 m isobath shows the approximate position of the shoreline during the last glacial time. Major river paleovalleys are indicated. b. Extent of the Barents–Kara Ice Sheet during the LGM (after Svendsen et al., 2004). Arrows correspond to the main pathways of Atlantic-derived water masses in the Arctic; FSBW — Fram Strait Branch Water, BSBW — Barents Sea Branch Water. Other cores mentioned in the text are shown. FVT — Franz Victoria Trough, SAT — St. Anna Trough, VT — Voronin Trough, VS — Vilkitskii Strait.