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Muddy waters accompanied the initial warming during the Bølling west off Svalbard and the Yermak Plateau (Arctic Ocean)

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The Bølling interstadial was an exceptional warm and humid period at the end of the last glacial. It is coeval to the Meltwater Peak 1A (MWP-1A) that caused a dramatic sealevel rise of 40 mm/a between 14,650 and 14,310 years ago (Deschamps et al. 2012). We present various data of 15 sediment cores recovered from the western Svalbard margin and the western flank of the Yermak Plateau. All cores reveal an enigmatic fine-grained layer of up to 250 cm thickness that was deposited roughly within 300 years from the beginning of the Bølling interstadial. The core locations are under the direct influence of the West Spitsbergen Current and the Yermak Slope Current (YSC). The YSC advects Norwegian Sea Deep Water towards the Arctic Ocean. The speed of the YSC reflects the vigor of thermohaline overturn in the Nordic Seas. The studied interval is characterized by a sortable-silt mean grain size of 11 to 19 μm, which makes this zone the finest one in the studied cores. As yet the sediment layer was found in 32 sediment cores (mostly published data) from c. 72°N to 82°N at water depths ranging from c. 300 m (Kveithola, NW Barents Sea) to 1880 m (Yermak slope) south, west and north of Svalbard. Further, it shows the lowest magnetic susceptibility values measured in the respective cores, very low planktic foraminifer flux rates, strongly corroded foraminifer tests that appear to not allow reasonable AMS age determinations, exceptionally heavy stable oxygen isotope values (above 4.5, some even >5 permil), and IRD is almost absent. A distinct decrease in Ca-ratios and slightly increased Ti-ratios are further key characteristics of the investigated layer (XRF analyses of 4 cores). AMS age determinations of another 4 cores show a doubled to ten-fold sedimentation rate during the deposition of this layer. The greatest thickness of the fine-grained layer occurs between 1400 and 1500 m of water depth. The layer is significantly thinner in water depths >1600 m and <1100 m water depth (except for Kveithola), respectively. Thus, the fine-grained material was transported northwards in a relatively narrow flow of turbid muddy waters along the western Svalbard and Yermak slopes. A very conservative estimate is that the volume of the fine-grained sediment is about 32 km3.
The distribution and thickness of the investigated sediment layer can be linked to both, the rapid melting of the Svalbard and the Barents Sea ice sheets in response to the intense warming and the extraordinarily rapid sea level rise at the onset of the Bølling period. Since Kveithola trough is assumed to be fully deglaciated since 14.7 cal. ka BP a sediment source in the adjacent Barents Sea as well as in the local fjords of Spitsbergen is likely. The Bear Island trough mouth fan (TMF) probably served as a major drainage outlet for the meltwater deposits. The fine-grained layer has also been identified in a sediment core south of this massive TMF. A major shift in the clay mineral composition for the deposition of the fine-grained layer supports this assumption.
Ref.: Deschamps, P. et al. (2012): Ice-sheet collapse and sea-level rise at the Bølling warming 14,600 years ago.- Nature 483, 559-564.