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Central Arctic Ocean ice cover, iceberg drift and circum-Arctic glaciation 0-60 ka

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The history of environmental conditions in the central Arctic Ocean during the last 60,000 years remains elusive despite intensified research efforts in the last decades. The major obstacle is extremely low sedimentation rates after a massive deglacial event at the end of the extensive continental glaciation in northern Eurasia in marine isotope stage (MIS) 4 and early MIS 3 (ca. 70-50 ka). Sediments from the last glacial maximum (MIS 2) are apparently missing due to non-deposition or were so thin that they are undetectable after bioturbational mixing with older (MIS 3) and younger (MIS 1) deposits. In most cores, the last 40-50 ky are represented by only 5-15 cm of sediments.

To investigate differences between MIS4/3 and younger glaciations, we have collected data sets of eight sediment cores from locations spread over the entire central Arctic Ocean, i.e. the area north of 85°N. Radiocarbon datings are available but hardly allow to established detailed age models. However, it seems possible to distinguish between the rapidly deposited coarse-grained layers from the MIS4/3 glaciation and the overlying younger sediments. Of particular interest are data on the content and lithological composition of coarse ice-rafted debris (IRD, >0.5 mm) because some lithologies can be assigned to regionally well-defined source areas. The coarse-grained layers from the MIS4/3 glaciation and deglacial are characterized by a dominance of IRD grains consisting of quartz, feldspar and crystalline rock fragments (QFC, 60-80%). Smectite data available for two cores point to a provenance in northern Eurasia. Carbonate rock frament (incl. dolomite), which can be traced to North American sources, make up less than 20% (except in one core from the Alpha Ridge). This indicates that icebergs from northern Eurasia could penetrate deep into the Amerasian Basin and that the output of icebergs from North America was less important for IRD deposition, possibly because of a smaller or more static glaciation in this area than thereafter. On the other hand, carbonate IRD is significantly higher in percentage in the younger sediments (MIS 3-1) while the QFC component decreases. Even on the Gakkel Ridge in the central Eurasian Basin, carbonate IRD is dominant in some samples. We interpret this change in the IRD deposition pattern as indicative of a larger expansion of the North American ice sheet which released more icebergs than before, spreading within a mega-Beaufort Gyre. In contrast, in MIS 3 and 2 the Eurasian ice sheet was smaller in size and concentrated more in western Eurasia than in MIS 4. Accordingly, icebergs with typical Eurasian IRD probably left the Arctic Ocean through the Nansen Basin and did not reach the central Arctic Ocean. Foraminifer and isotope data as well as the very low sedimentation rates point to a thick and dense cover in MIS 3-2 and a rather weak influence of Atlantic Water in the uppermost water column.