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# A Modeling Experiment on the Grounding of an Ice Shelf in the Central Arctic Ocean During MIS 6

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TI: A modeling experiment on the grounding of an ice shelf in the central Arctic Ocean during MIS 6
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AB: High-resolution chirp sonar subbottom profiles from the Lomonosov Ridge in the central Arctic Ocean, acquired from the Swedish icebreaker Oden in 1996, revealed large-scale erosion of the ridge crest down to depths of 1000 m below present sea level [Jakobsson, 1999]. Subsequent acoustic mapping during the SCICEX nuclear submarine expedition in 1999 showed glacial fluting at the deepest eroded areas and subparallel ice scours from 950 m water depth to the shallowest parts of the ridge crest [Polyak et al., 2001]. The directions of the mapped glaciogenic bed-forms and the redeposition of eroded material on the Amerasian side of the ridge indicate ice flow from the Barents-Kara Sea area. Core studies revealed that sediment drape the eroded areas from Marine Isotope Stage (MIS) 5.5 and, thus, it was proposed that the major erosional event took place during Marine Isotope Stage (MIS) 6 [Jakobsson et al., 2001]. Glacial geological evidence suggests strongly that the Late Saalian (MIS 6) ice sheet margin reached the shelf break of the Barents-Kara Sea [Svendsen et al. in press] and this gives us two possible ways to explain the ice erosional features on the Lomonosov Ridge. One is the grounding of a floating ice shelf and the other is the scouring from large deep tabular iceberg. Here we apply numerical ice sheet modeling to test the hypothesis that an ice shelf emanating from the Barents/Kara seas grounded across part of the Lomonsov Ridge and caused the extensive erosion down to a depth of around 1000 m below present sea level. A series of model experiments was undertaken in which the ice shelf mass balance (surface accumulation and basal melting) and ice shelf strain rates were adjusted. Grounding of the Lomonosov Ridge was not achieved when the ice shelf strain rate was 0.005 yr-1 (i.e. a free flowing ice shelf). However this model produced two interesting findings. First, with basal melt rates of up to 50 cm yr-1 an ice shelf grew from the St. Anna Trough ice stream across the section of the ridge where there is evidence for grounding. Second, even with ultra low rates of basal melting, the ice shelf thickness was always less than 200 m over the ridge. We conclude that grounding of the Lomonosov Ridge by a free-flowing ice shelf is not possible. When the strain rate was reduced to zero, however, the shelf thickness increased substantially. Such conditions are likely only to have occurred during periods of large-scale glaciation across the Eurasian Arctic such as in the Saalian, and if a substantial stagnant thickened sea ice was present in the ocean, buttressing the shelf flowing from the Barents Sea. Our results are interpreted using new techniques for dynamic 3D-visualization. Jakobsson, M., Lovlie, R., Arnold, E. M., Backman, J., Polyak, L., Knutsen, JO., and Musatov, E.,, Pleistocene stratigraphy and paleoenvironmental variation from Lomonosov Ridge sediments, central Arctic Ocean, Global and Planetary Change, 31(1-4), 1-21, 2001. Jakobsson, M., First high-resolution chirp sonar profiles from the central Arctic Ocean reveal erosion of Lomonosov Ridge sediments, Marine Geology, 158, 111-123, 1999. Polyak, L., Edwards, M. H., Coakley, B. J. and Jakobsson, M., Ice shelves in the Pleistocene Artic Ocean inferred from glaciogenic deep-sea bedforms, Nature, 410, 453-457, 2001. Svendsen, J.I. et al, Late Quaternary ice sheet history of Nortern Eurasia, submitted to Quaternay Science Reviews, in press.
DE: 1620 Climate dynamics (3309)
DE: 1863 Snow and ice (1827)
DE: 3022 Marine sediments--processes and transport
DE: 4267 Paleoceanography

DE: 9604 Cenozoic
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