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Glacial erosion and seascape evolution: new evidence from three-dimensional seismic data from the Barents Sea.

Karin Andreassen

Department of Geology, University of Tromso, 9037 Tromso, Norway
(karin.andreassen@ig.uit.no / Phone: +47 77644420 / Fax: +47 77645600)

Former ice sheets and their associated ice streams have during glacial periods expanded across the shelves, where an imprint of their activity is preserved in the form of wide bathymetric troughs containing streamlined sub-glacial landforms. Large volumes of sediments were eroded, brought to the shelf edge and remobilized down-slope by mass-movement processes, resulting in development of fan-shaped sediment accumulations, 'trough mouth fans' (TMFs). The Bear Island Trough Mouth Fan, the largest of the Polar North Atlantic TMFs contains up to 3-4 km of glacigenic sediments. It extends from the shelf break, where the average water depth is 500 m, to the abyssal plain, and is in area extent comparable with the Amazon and Mississippi Fans, although the drainage areas of the two latter fans are 5-10 times greater that that of the Bear Island TMF.

We here present results from studies of semi-regional industry three-dimensional seismic data from the south-western Barents Sea. This data provide a unique archive of ice- stream activity of the former Eurasian ice sheet. Regional two-dimensional seismic data are used for correlation between 3D-seismic datasets. The 3D-seismic data provide a new type of information about the Plio-Pleistocene glacigenic sediments. The vertical resolution is, with a dominant frequency of $\sim$40 Hz, not very good, $\sim$12 m. The horizontal resolution is, however, very good due to a high spatial sample rate (12.5 m) and the 3D migration. The data therefore provide detailed plan view images, showing the morphology of interpreted horizons and related 3D-attribute maps, giving detailed information about sedimentary facies.

The integration of sea-floor geomorphology at various scales with vertical seismic

profiles documents that today's sea-floor in the area is dominated by erosion and deposition of ice-streams operating during the last glaciation. Glacial activity through pre-Weichselian glaciations have been studied using a 3D-data set at the south-western Barents Sea margin. Former ice-stream activity is evidenced by mega-scale streamlined lineations on at least seven seismic reflectors that can be correlated regionally. The flow pattern of mega-scale glacial lineations extending over long distances has often been regarded to represent a snapshot view of the bed from one single flow event rather than being generated time-transgressively. The preservation of several hundred meters thick sedimentary units between glaciated horizons provides in this area the opportunity to study ice-stream related processes covering longer time spans. The combined use of volumetric attribute maps and vertical seismic sections reveals the existence of the longest chains ($>$ 50 km) of megablocks and rafts ever described, buried in sediments between glacially eroded. We examine their significance for glaciology and provide constrains on their formation and timing. We also discuss their implications with respect to ice-stream dynamics and subglacial processes.

The results indicate that glaciotectonic erosion and transport of ice streams may account for high sediment fluxes from the Barents Sea to the shelf edge and the BIT Mouth Fan during the Late Plio-Pleistocene. Whereas earlier discussions on sub-ice-stream processes have focused on ductile deformation of weak sediments and moulding of subglacial landforms, this work demonstrates the importance of brittle deformation in these settings, adding to the understanding of ice streams as agents of erosion, transport and sedimentation. Consequences for climate changes and hydrocarbon exploration will be discussed.