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Geomorphological clues to ice sheet development and a major tsunami in East Greenland fjords

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High-resolution swath bathymetric data can provide clues to the geological history by revealing the seafloor geomorphology. Submarine glacial landforms, for example, can be used to reconstruct past ice sheet development and landslide debris may reveal areas of past tsunami formation. Here, a geomorphological investigation of swath bathymetric data acquired on five research expeditions of RV Polarstern in three glacier outlet systems of East Greenland (Kejser Franz Joseph Fjord, Kong Oscar Fjord, and Scoresby Sund) will be presented. The investigation refines the, so far, only poorly resolved reconstruction of East Greenland ice sheet development and, in addition, reveals a site of a large rock fall that most probably caused a major tsunami.

Combination of the marine geomorphological record with published geological data was used to infer the post-LGM ice dynamics and extent in the study area. The investigation suggests that most ice streams likely reached the shelf edge, via cross-shelf troughs, in all three glacier-outlet systems, probably during the LGM. Ice marginal landforms on the shelf and at the fjord entrances indicate a dynamic ice margin with still stands, retreat phases and subsequent readvances. A tentative chronology was developed based on the geomorphological constraints and the geological record. It suggests that in the Allerød-Bølling interstadial, ice retreated to the fjord entrances at Kejser Franz Joseph Fjord and Kong Oscar Fjord, and most probably into the fjord at Scoresby Sund. A subsequent readvance up to a mid-shelf position likely took place in the Younger Dryas. Thereafter, Holocene retreat on the shelf and in the outer fjord areas most likely was rapid, except for two phases of stabilization at the entrance of Kong Oscar Fjord.

Apart from glacial landforms, the swath bathymetry data revealed a large amount of landslide debris in the southern part of Scoresby Sund. The origin of this debris is an up to 1500 m high mountain cliff that likely collapsed sometime in the Holocene. On first approximation, the debris volume is a magnitude larger than the volumes of more recent rock falls, which resulted in devastating tsunamis. The size of the debris, as well as the height of its source, suggests that one or multiple tsunamis most probably once hit the coasts of Scoresby Sund.