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Bathymetry and seismic stratigraphy in St. Jonsfjorden, Spitsbergen

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St. Jonsfjorden is an approx. 21 km long and maximum ∼5 km wide fjord on west Spitsbergen where modern sediment supply is glacifluvial and from tidewater glaciers. Its large-scale bathymetry is characterised by shoals and ridges as shallow as <30 m, as well as an outer and inner basin with up to 160 and 110 m water depths, respectively. Several large N-S oriented 'steps' of up to 50 m and slopes exceeding 30 degrees are most probably related to vertical movements along tectonic lineaments within the West Spitsbergen Fold-and-Thrust Belt.
More detailed bathymetry reveals fjord-parallel linear features, most probably drumlinoid landforms providing evidence of fast ice flow through the fjord during the last glacial. Transverse, discontinuous, sinuous ridges are interpreted to be moraines deposited during temporal halts and/or re-advances of the ice front during the last deglaciation.
A landform assemblage typical for most inner fjords on Svalbard has formed close to the fjord head. This includes large transverse ridges (terminal moraines) that were most probably deposited during relatively recent advances of one or several tidewater glaciers at the fjord head. Multiple sediment lobes, the largest being more than 4.5 km long and up to >20 m thick, were deposited beyond the outermost terminal moraine. Fjord parallel linear features overlain by multiple small transverse ridges characterise the seafloor between the innermost terminal moraine and the present glacier fronts. Whereas the linear features are interpreted to be glacial lineations providing evidence of one or several relatively rapid glacier advances, the small ridges are suggested to be 'annual retreat moraines' that were formed during halts and/or small re-advances during the retreat of the ice front(s) after its/their maximum extent(s). The heights of these ridges exceed rarely 2 meters and the distances between their crests indicate that the annual retreat rate of the ice front(s) was mainly in the order of 30-40 m.
Apart from local variations, the general seismo-stratigraphy of the sub-seafloor in St. Jonsfjorden is similar to stratigraphies observed in other Spitsbergen fjords. It includes 1) a lowermost acoustically transparent to semi-transparent unit of glacigenic landforms and deposits above bedrock/acoustic basement, 2) acoustically stratified deposits reflecting frequently changing physical conditions in a glacier-proximal glacimarine environment during the last deglaciation, 3) an acoustically more transparent sequence with rare and discontinuous reflections that was deposited in a glacimarine environment with more stable physical conditions due to reduced glacial activity, and 4) an uppermost interval with strong and continuous reflections deposited during a time of increased glacial activity during the late Holocene.
Crater-like features (pockmarks) of maximum 5 m depth and 110 m diameter occur. Whereas these features are almost absent in the inner fjord, they are relatively abundant close to the fjord mouth. This may reflect localised fluid flow along tectonic lineaments as observed in other Spitsbergen fjords.