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Characterization of Glacigenic Debris Flows and Megaslides of the North Sea Fan from 3D Seismic Data

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High-latitude trough mouth fans are high-resolution paleoclimate and ice-sheet monitors dominated by stacked sequences of glacigenic debris flows (GDFs). The aim of this contribution is to characterize the sedimentary processes and deposits of the North Sea Fan and relate them to the glacial history of the Atlantic margins. The database consists of high-resolution processed 3D seismic data covering c. 16,000 km 2 of the North Sea Fan. The vertical and horizontal resolution is c. 8 m and c. 20 m, respectively. Twelve horizons have been picked with an in-line spacing of 150 m, followed by gridding, horizon attribute extraction, and seismic geomorphological interpretation. Six sediment packages containing stacked GDFs have been deposited at the upper slope of the North Sea Fan. The up to 400 m-thick uppermost package can be separated into six GDF sub-units. The structure maps of the top GDF horizons are characterized by sharp SE-NW-oriented gullies with well-developed levees, eroded islands of pre-existing GDFs, and densely-spaced pockmarks with diameters of c. 30 m. The GDF bases are dominated by negative, high-amplitude reflections. The GDF deposits have been removed from the upper slope by three megaslides, which are identified as deformed sequences bound by smooth lower and irregular upper surfaces. Negative-amplitude, continuous reflections at the base of the megaslides fade out uphill of the headwalls. The topography shaped by these megaslides is infilled by glacimarine deposits identified as low-amplitude, continuous reflections. Our results show that the Norwegian Channel Ice Stream reached the shelf edge during six marine isotope stages, and that the ice stream oscillated six times during the last glacial stage. Negative, high-amplitude reflections below the GDFs and megaslides indicate a gas-charged sandy base, and show a strong correlation between pre-conditioned glacimarine glide planes and megaslide occurrence. This study highlights the capacity of high-quality 3D seismic data for characterizing GDFs and megaslides on a ten-meter scale, and allows new conclusions about shelf-edge glaciations and fluid flow processes.