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P-Cable 3D high-resolution seismic data as a powerful tool to characterize subglacial landforms and their genesis: A case study from the SW Barents Sea

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High-resolution 3D seismic data have significantly increased our knowledge about petroleum reservoirs and submarine geohazards. However, little effort has been undertaken to evaluate the potential of such data for mapping subglacial landforms. The Barents Sea has been subjected to repeated Pleistocene glaciations, which intensively eroded the region, resulting in a generally thin (<100 m) Quaternary sediment cover. Here we use the uppermost 200 ms of a P-Cable 3D seismic cube in the SW Barents Sea to study subglacial expressions and the correlation with the sub-bottom geology. The seismic data cover an area of ∼200 km2 in water depths of 380-470 m with a recorded in-line spacing of <7 m. Three seismic horizons, highly affected by glacial processes, have been interpreted in great detail. Combining different seismic volume attributes allowed to improve the visualization and characterization of subglacial features. Grids of the most prominent intra-glacial reflection reveal an up to 50 m-thick ridge-shaped feature, which cannot be identified in conventional seismic data. Internal inclined negative-amplitude reflections characterize the ridge-shaped feature. The outermost inclined reflection is laterally extending to a NE-SW topographic step on the Upper Regional Unconformity. Therefore we suggest the ridge-shaped feature to represent a shear margin moraine generated during one of the episodes of the Bjørnøyrenna Ice Stream readvances. We interpret fast-streaming ice in the west and slowly-flowing ice sheet to the east of the shear margin moraine. This past glacial configuration is further suggested to affect the current morphology of the sea bed. The zone correlating with ice-streaming is overlain by a thick package of homogenous to semi-parallel negative amplitude reflections, dominated by megascale glacial lineations. The shear margin moraine is overlain by a thin glacial package and its sea bed dominated by iceberg ploughmarks. The third zone, affected by the paleo ice-sheet, is characterized by a flat sea bed and few pockmarks. We conclude that the mapped seabed morphologies are strongly dependent on the sub-bottom geology. Therefore high-resolution seismic data is beneficial in identifying and analyzing small-scale glacial structures and their expression in the underlying strata in great detail, contributing to the understanding of processes involved in paleo-ice stream dynamics.