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Pleistocene glaciation history of the Northern North Sea and Norwegian Channel documented by basin-scale 3D seismic analysis

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A regionally merged (c. 30,000 km2) 'megasurvey' 3D seismic dataset and an extensive set of 2D lines, tied to the Troll (89-03) core and wireline logs, was used to investigate the glacial and inter-glacial evolution of the northernmost North Sea through the Plio-Pleistocene.

An extensive regional unconformity (URU) exists throughout the study area truncating the Naust Formation, a Plio-Pleistocene glacially-influenced progradational delta system, and older strata. This major erosion surface forms the base of the Norwegian Channel, a large (800 km long) cross-shelf trough located along the southern Norwegian coast. The evolution and exact erosion mechanism of this enigmatic feature is still debated. The stratigraphic succession above the URU consists of relatively flat-lying, alternating glacial and glacio-marine units of mid Pleistocene-Holocene age. This study is the first to present fully 3D seismic-constrained maps of the URU, the Naust clinoforms and all major glacial erosion surfaces within the Norwegian Channel infill. Furthermore it documents the geometries and sedimentary facies characteristics of the till and marine units preserved within the Norwegian Channel and the Norwegian sector of the Northern North Sea.

Mapped erosional surfaces reveal a diverse assemblage of glacial morpologies interpreted as mega-scale glacial lineations, tunnel valleys, glaciotectonic thrust complexes, terminal moraines and meltwater conduits demarcating the terminus of successive grounded palaeo-ice sheets. Ice berg ploughing was common along the margin between 2.6 and 1.1 Ma with ice streaming commencing prior to 1.1 Ma. Repeated occupation of the NC by fast flowing ice streams, during the Elsterian, Saalian, and Weichselian (MIS 12, 10, 8, 6, 2), led to a progressively westward erosion of the channel margin, migrating approximately 60 km between 1.1 Ma and the LGM.

Although well imaged by seismic data, the prolific record of glaciations and interglacials in the Northern North Sea require better age constraints to further fine tune the record of Pleistocene environmental changes. Whilst a large number of wells exist in the North Sea, giving basic lithological information, only very few have sufficiently detailed stratigraphic data in the Pleistocene section. Further research should thus include coring tied to high-resolution seismic data that can be linked to the basin-scale 3D seismic observations presented herein.

As this study provides a unique insight into the spatial and temporal dynamics of shelf-edge glaciation in the northern North Sea and its Atlantic margin throughout the late Cenozoic, the plethora of features documented within the Northern North Sea may serve as a template for interpreting other less well imaged glaciated margins.