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Diversified seabed substrate, sediment remobilisation and fluid migration features offshore NW Greenland – new insights from marine seismic data acquisition in the Northern Nares Strait during the RV Oden cruise 2015

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We present some preliminary observations from acquired seismic data from the Northern Nares Strait, NW Greenland. The studied area covers the Hall Basin in front of the Petermann Glacier and extends southward into the Kennedy Channel. It represents an area intensely affected by glacial related processes as well as deep tectonics. The data were acquired during the RV Oden cruise in late summer 2015, and thus represent valuable input to the understanding of the geological development of this scarcely accessed area of the Arctic.

The data were acquired in nearly ice-free conditions and consist of >700 km 2D seismic airgun data, supplemented by high-resolution subbottom profiler data and multibeam data. The different acoustic data acquired simultaneously enable us to correlate deeper geological observations (e.g. faults observed on airgun seismics) with shallow depositional architectures (observed on subbottom profiler) and finally correlate the relatively scattered 2D interpretation with the detailed 3D seafloor morphology obtained by the multibeam.

The seismic data reveal several provinces of varying seabed substrate geometry. The provinces include A: confined mini-basins; B: larger sedimentary basins; C: larger structural highs and D: “rough-and-faulted” terrain. The data also reveal a number of seismic anomalies, which indicate fluid flow and sediment remobilisation.

The mini-basins are 100-600 m wide, in contrast to the larger basins which typically extend over 6-12 km. The mini-basins are characterized by a flat, smooth and continuous seafloor reflection and have an infill dominated by parallel and sub-horizontal reflections onlapping the edges of the basins. The larger basins, where the internal reflection pattern appears more diverse and less parallel, have much greater relief at the seafloor. Vertical disturbance zones typically emerging above minor structures at the floor of the mini-basins are likely related to vertical fluid migration. The zones occasionally continue to the seafloor but more often terminate within the sediments. Scattered amplitude anomalies in conjunction with sag-like depressions are further potential indications of fluid migration within the mini-basins (palaeo-pockmarks?). Slumps and mounded features within the mini-basins and at the larger structural highs indicate syn-depositional sediment remobilisation. A BSR-like reflection, potentially representing the base of gas hydrates, is occasionally observed in the larger sedimentary basins (ca. 15-20 ms TWT b.s.fl.) and at the culmination of the larger structural highs (ca. 40-50 ms TWT b.s.fl.). Cone-shaped to elongated ridges 15-20 m high and 500 m across appear to be linked with deeper structures and might indicate remobilisation of the shallow subsurface sediments potentially linked to fluid escape. Alternatively, they might be of glacial origin.

Our preliminary results indicate that the basins are filled with subglacial and glaciofluvial sediments and that small-scale fluid migration and sediment remobilisation represent important processes in generating the depositional architecture in the Northern Nares Strait region. Further analyses are expected to constrain the interpretation of the observed features in detail, especially regarding the origin of the fluids.