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Pleistocene tunnel valleys in the German North Sea - geometry, morphology and origin

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The distribution of tunnel valleys in the German North Sea is mapped from more than 25 000 km of 2-D and 3 000 km2 of 3-D seismic data. The number of identified tunnel valleys is much higher than previously known from former studies. Areas which could not be mapped so far because of a lack of data are now studied. The new map reveals that tunnel valleys are common features in the German North Sea but areas remain where they are absent.
At least three different generations of valley formation can be differentiated in the 3-D seismic data sets. The mapped valleys have widths of up to 8 km and lengths of up to 66 km, thus forming impressive geomorphological features. They are incised down to 400 m into the Neogene sediments and cut-and-fill structures within the tunnel valleys are imaged by high-fold 2-D seismic data indicating a re-use of existing tunnel valleys during subsequent ice advances and retreats. The valley fill of large tunnel valleys shows a typical pattern with a chaotic seismic facies at the bottom overlain by a high amplitude reflector and sub-horizontal to inclined low amplitude reflectors. This pattern correlates with results from on- and off-shore studies of tunnel valley infill and suggests coarse-grained sediments at the base overlain by fine-grained glaciomarine and/or glaciolacustrine sediments. The tunnel valleys in the eastern and central German North Sea are probably of Elsterian age, because the surrounding Dutch, Danish and onshore German tunnel valleys are of inferred or proven Elsterian age.
The interpretation of 3-D seismic data also reveals subtle morphological features like iceberg scours. They occur at depth of 300-800 ms in the study area indicating iceberg movement in the southern North Sea before the onset of the main glaciations. The orientation of iceberg scours was mapped along four horizons and shows a mainly N-S orientation.