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3D seismic imaging of buried valleys in the northern German North Sea - geometry, morphology and origin

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The North Sea is already a strongly used shelf sea at present and will also be in the future (pipelines, oil platforms, submarine cables, wind parks, exploration on oil and gas). Therefore, the knowledge about the morphology of the seabed and shallow subsurface is of great interest. In the Pleistocene the North Sea shelf and adjacent land masses were exposed to three phases of glaciation. As a result of the glacier retreat many deep and wide erosive structures were formed. They are interpreted as Quaternary tunnel-valleys. These valleys occur in the analyzed 3D-seismic data in the upper 500 ms TWT. The aim of this study was to investigate there geometric characteristics and to produce a map of regional pattern of the Quaternary valleys in the north-western German North Sea (tail end). Based on geometry, infill architecture and reflection characteristics the mapped valleys can be divided into two different categories: Type I valleys without preferential direction and type II valleys that trend NW-SE or NE-SW. Type I valleys show weak reflections, are relatively short (on average between 3-10 km), narrow (only 10-550 m wide) and reach down to a depth of approx. 220 m. The aspect ratios (depths : widths) are between 1:1 to 1:2. The valleys have a "U"-shaped cross section with steep flanks (40-50°) and the infill is seismically homogeneous. The origin of these smaller-sized valleys is probably due to fluvial or glaciofluvial processes. Another process is supposed for type II valleys. They developed beneath ice sheets as a result of erosion - primary by meltwater discharge and drainage at the base of a glacier and secondary by direct glacial erosion during the Quaternary glaciations. These valleys display clearer structures in the seismic profiles, are longer (6,5-40 km), substantially wider (up to 6 km) and deeper (360 m). The infill architecture is more complex and shows dipping reflectors. The aspect ratios are between 1:5 to 1:10. The valley flanks show a dip of 20-40°. The morphology of the type II

valley bases displays an irregular profile with swells and troughs. Partial overdeepening could have resulted from catastrophic meltwater discharge. Two generations of type II valleys were identified, which probably developed during two glaciations. One valley exhibits internal erosion surfaces pointing to a valley reactivation during one or two glaciations. We assume, that the occurrence of few large main valleys points to a relative stable drainage system. In the surroundings of two salt diapirs the influence of halokinetic structures on the valley orientation was determined. The valley direction does not have to be necessarily bound to salt structures and their accompanying fault systems. Generally, both valley types begin and/or end abruptly. However, in case of type II valleys this is due to the spatially limited data record. As a consequence, the actual length of type II valleys might be longer than determined here.