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Sedimentary Architecture of a Pleistocene Tunnel-Valley Fill from 3D Seismic Data in the German North Sea

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The aim of this research project is to analyse the distribution, dimensions, and evolution of Pleistocene tunnel valleys and their infills in northern Germany and adjacent areas. The findings of this analysis will be used to assess potential future tunnel-valley formation with regard to the long-term safety (over the next 1 million years) of a radioactive waste repository. Furthermore, the study aims to analyse sedimentary facies in order to draw conclusions about the infilling process and repeated erosion phases. This analysis will enable us to compare the development to the onshore tunnel valleys.

To achieve this goal, we are relying on a 3D high-resolution seismic dataset. Previously, the mapping of tunnel valleys on land was primarily based on 2D seismic data and boreholes, which have a rather low resolution. Therefore, we have opted to utilise a marine seismic dataset. The 3D seismic dataset, designated as 'GeoBasis3D', was acquired by the BGR in 2021. The survey area covers a region within the German Exclusive Economic Zone (EEZ), the so-called 'Entenschnabel' area. In this region, two intersecting tunnel valleys are present, one of which is situated above the salt dome 'Belinda'.

The following processes are to be examined based on the seismic data: the formation of the tunnel valley base through erosive processes and the influence of crestal faults above the salt dome on the formation and infill of the tunnel valley. The infill of the tunnel valleys will be characterised in terms of seismic facies, thereby enabling the interpretation of various sedimentary processes. The deepest parts of the tunnel valleys are characterised by steep slopes and chaotic internal reflectors, which suggests that this part of the tunnel valley was subglacially filled. The valley widens upwards, with some slump scars and slump deposits identifiable along the slopes of the tunnel valley. The sedimentary succession is characterised by typical cut-and-fill structures and various internal erosional unconformities, which can be traced across the tunnel valley. The tunnel valley displays evidence of multiple phases of sedimentation, including both high- and low-energy depositional processes. This is indicated by the presence of parallel and homogeneous reflectors. The crestal faults above the salt dome 'Belinda' have displaced the tunnel-valley floor and some deeper parts of the sedimentary infill. This leads to the conclusion that the faults must have been active during the Pleistocene. Nevertheless, an increase in the depth of the tunnel valleys along the faults could not be observed.

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