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## New insights into North Sea tunnel valley infill and genesis from high-resolution 3D seismic data

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Tunnel valleys are large (kilometres wide, hundreds of metres deep) channels incised into bedrock and soft sediments by the action of pressurised subglacial meltwater. Discovered over a century ago, they are common across large swathes of North-West Europe and North America. However, many aspects of tunnel valley formation, and the processes by which they are infilled, remain poorly understood. Here, we use new high-resolution 3D seismic reflection data, collected by the geohazard assessment industry, to examine the infill lithology and architecture of buried tunnel valleys located in the central North Sea. The spatial resolution of our seismic data (3.125-6.25 m bin size) represents an order of magnitude improvement in the data resolution that has previously been used to study tunnel valleys in this region, allowing us to examine their infill in unprecedented detail. Inside the tunnel valleys, we identify a suite of buried subglacial landforms, some of which have rarely been reported inside tunnel valleys before. These landforms include a 14-km-long system of segmented eskers, crevasse-squeeze ridges, subsidiary meltwater channels and retreat moraines. Their presence suggests that, in some cases, tunnel valleys in the North Sea were reoccupied by ice following their initial formation, casting doubt on hypotheses which invoke catastrophic releases of water to explain tunnel valley creation.