Regional Deep Seismic Crustal Study Northwest Europe — Transecting the North Sea Rift, the Norwegian Sea Passive Margin and the Barents Sea Platform

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Abstract

This paper presents a new, deep, regional seismic and crustal transect study of the Northwest European Continental shelf and its margins. The study integrates newly acquired, deep-tow, long offset seismic data, crossing the Norwegian, UK and Faroe Islands margins. It commences in the Danish sector, continues along the prolific grabens of the North and Norwegian Seas, then to the southwestern area of the Norwegian Barents Sea, extending to the Fedynsky High and terminating at the Russian border. Seismic lines are between 350 and 750 km in length, with tie-lines as long as 1,500 km, providing a super-regional cross-border perspective of the entire basin(s) and sub-basin architecture. The key driver behind the study is to provide, for the first time, a deep crustal basinal understanding of the whole region. The seismic data was acquired using a source of large volume and slanted deep-tow streamer, with long offsets, to image the crust and upper mantle down to ~80 km depth. The data was processed and imaged with state-of-the-art broadband technologies, including advanced demultiple sequences. The processing included extensive local velocity model building and tomography updates, as well as basement velocity scans. The number of transects and their locations in the area made it possible to further enhance the regional geological and tectonic interpretations, by utilizing joint reflection/refraction 3D seismic tomography. Gravity and magnetic data was acquired simultaneously to complement the seismic data, with a view to recovering the properties of the upper mantle and identify

different crustal domains. Results In the far East corner of the Norwegian Barents Sea, the seismic data provided a new and unique view of the deep crustal and upper mantle structures, related to major tectonic events. Across the Finnmark Platform and into the Hammerfest and Tromsø Basins, a clear imprint of the ultra-deep structures was identified, providing an insight on how they affect the prolific fault systems that serve as today's exploration targets. Within the Norwegian and North Seas, the long cross border transects assist in improving our understanding of large-scale tectonic events and basin geometry. Seismic data is directly tied to wells released into the public domain. These deep transects can provide a new framework that links the regional geological understanding across whole basins, sub-basins, political borders (countries) and major tectonic events.