Characterizing Crustal Structure on the Norwegian Atlantic Margin, Using 3-D-Gravity-Inversion and 3-D-Backstripping to Assist Petroleum-Systems Modeling

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ABSTRACT

We have investigated the deep-crustal structure of the Norwegian Atlantic margin as part of a broader study which aims to assess the remaining petroleum potential of this area. We have looked at the crustal structure on two scales: i) The whole NE Atlantic, including the Greenland conjugate margin, ii) An area focussed on the Møre & Vøring Basins, which is the AOI for the petroleum-systems study. The NE Atlantic has been investigated via a series of 3D-gravity-inversion models, which use as input a new compilation of sediment-thickness derived from multiple public and proprietary sources. The results of the gravity-inversion have been used to predict the magnitude of stretching/thinning, Moho-depth and crustal structure along the conjugate Norway-UK and Greenland Atlantic margins, and also within the ocean basin between. Predictions of stretching-factor have been used to condition a new deformable-plates model for the NE Atlantic. The Møre-Vøring focus area has been investigated via both 3D-gravity-inversion and 3D-backstripping, two independent techniques which can be used together to produce internally-consistent estimates of stretching/thinning and crustal structure. While the Base Cretaceous can be mapped from seismic interpretation, one of the biggest geological uncertainties in any analysis of the deep geology of the Møre-Vøring area is identifying top-basement/base-sediment with any degree of certainty. In order to compensate for this a number of scenarios have been tested, based on the possible depth of top basement relative to the Base Cretaceous. Our preferred model produces consistent results between gravity and backstripping analyses and is also consistent with other prior geological knowledge of the area. The results suggest that, in the deep Møre & Vøring Basins, top basement lies regionally at less than 2km depth below the Base Cretaceous and also that Mesozoic extension occurred in a magma-poor extensional setting. This model produces high stretching-factors ($\beta \sim 5$) in the deep Vøring Basin, but crucially stretching/thinning does not rise to oceanic values. Consequently we believe the whole Møre-Vøring area to be underlain by highly-thinned continental crust, with no oceanic crust of any age inboard of the known early Tertiary Atlantic margin. Our analysis also makes it unlikely that the deep “T-reflector” is a seismic image of top basement. We believe it most likely to be a reflection from within the basement.