



1 Orogenic structures in the North Sea evidenced by integrated geophysical modelling

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The spatial distribution of large-scale crustal domains and their boundaries in the North Sea may be investigated using a combination of potential field data and available reflection and refraction seismic data. The North Sea tectonic setting comprises three main terranes: Baltica, Laurentia and Avalonia. The tectonic history of these three continents has previously been described, but the details regarding the continental collision style and location of the continental sutures, as well as the influence of pre-existing Caledonian crustal structures on the later Mesozoic rifting are still controversial.

By applying different filters and transformations to potential field data (e.g. calculation of fractional derivatives and integrals, pseudogravity transformation, calculation of the horizontal gradient as well as upward continuation and spectral analysis) constrained by well-data seismic data, we find that much of the crystalline crust in areas previously believed to be of Laurentia affinity may instead be of Baltica affinity, at least in the deep crust.

Our modelling indicates that pre-existing crustal thrust planes and shear zones of Caledonian origin and possibly older, have had a significant control on the subsequent Mesozoic rifting. We tentatively suggest, that the north-south trending Mesozoic Viking Graben and Central Graben developed by extensional reactivation of Caledonian collision sutures, and that the location of these important hydrocarbon producing

rifts is defined by the rim of Baltica upper and middle crust. However, for the lower crust the picture is somewhat different: The integration of potential field data with deep reflection/wide-angle refraction seismic data reveals fundamental differences between the lithosphere of Avalonia and Baltica. We believe that a significant lineament across the entire North Sea from Scotland to North Germany, revealed in the potential field transformations, corresponds to the lower crustal edge of Baltica which apparently extend across most of the North Sea. This lineament could as such represent the lower crustal and upper mantle suture between lithosphere of Avalonia origin versus lithosphere of Baltica origin in the lower crust and upper mantle. It may be the missing link for the reconstruction of the triple plate collision.