Geophysical Research Abstracts
Vol. 15, EGU2013-8697, 2013
EGU General Assembly 2013

Crustal and basin evolution of the southwestern Barents Sea: from the Caledonian orogeny to continental breakup

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A new generation of aeromagnetic data documents the post-Caledonian tectonic evolution of the southwestern Barents Sea (SBS) up to the continent-ocean transition. Clear evidence of reactivation of Caledonian structures controlling both, Late Palaeozoic and Mesozoic basins can be observed at the edge of the Hammerfest and Nordkapp basins where reactivated low-angle detachments are observed on seismics. Our new aeromagnetic surveys confirm most of the previous structural elements, but new features appear and illustrate the complexity of the pre-Permian tectonic and the basement architecture in the SBS. We propose an updated tectonic scenario of the SBS where the Caledonian nappes and thrust sheets, well constrained onshore, swing anticlockwise from a NE-SW trend close to the Varanger Peninsula to NW-SE across the Nordkapp Basin and the Bjarmeland Platform. On the Bjarmeland Platform, the dominant magnetic grain is clearly NNW-SSE. We show that this pattern reflects a regional pre-Permian system involving several Caledonian thrust sheets that possibly collapsed and controlled the post-Caledonian late Palaeozoic rift development of the SBS. We also consider that this model can explain the later development of the SBS. One specific case is the Bjørnøya Basin, located between the Loppa and Stappen highs which are interpreted as a series of rigid and poorly thinned continental blocks (ribbons) flanked by the Hammerfest and Bjørnøya basins and the basins of the Vestbakken volcanic province. As part of this extensive complex system, the Bjørnøya Basin is interpreted as a extensively thinned and propagating system that aborted in Late Mesozoic time. This thick, Cretaceous sag basin is characterised by a deep high-density body, interpreted as a combination of exhumed lower crust and/or potential serpentinised mantle as suggested by potential field modelling. The abortion of this propagating basin may be partly explained by its trend, which is oblique to the inherited regional structural grain, as revealed by the new aeromagnetic compilation. This abortion coincides with a migration and complete reorganisation of the crustal extension towards the western volcanic sheared margin and proto-breakup axis.