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Tertiary development of the Faroes-Shetland Basin: Intracontinental rifting or failed continental breakup?

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The Faroes-Shetland Basin, an apparent intracontinental rift basin located to the north of the UK, is co-axial with the Moere rifted margin (NE Atlantic) to the north-east which formed by sea-floor spreading initiation on the Aegir ridge at ˜ 54 Ma. While the Faroes-Shetland Basin lithosphere experienced Late Jurassic and Early Cretaceous intracontinental rifting, the basin also exhibits anomalously high rates of Palaeocene to Recent subsidence. Flexural backstripping and reverse thermal subsidence modelling of three regional stratigraphic cross-sections across the Faroes-Shetland Basin have been carried out. Successful restoration of the top Palaeocene stratigraphic marker to sea-level, constrained by palaeo-bathymetric observations of top Balder formation coals and other subaerial features at ˜54Ma, requires a lithospheric beta factor of three or more to account for post-Palaeocene subsidence if a depth uniform intracontinental type lithosphere stretching model is used. However the upper crust of the Faroes-Shetland Basin shows very little evidence of significant stretching or faulting at Palaeocene and Late Cretaceous times, substantially less than that indicated by post-Palaeocene thermal subsidence. The accelerated Tertiary tectonic subsidence of the Faeroe-Shetland Basin can be accounted for by thinning of the lithospheric mantle and lower crust beneath the Faeroe-Shetland Basin, contemporaneous with continental breakup and formation of the Moere rifted margin to the north. The Faeroe-Shetland Basin lay at the southern propagating tip of the Aegir ocean ridge but continental breakup was not successful. Post-Palaeocene subsidence has been successfully modelled using a new model of continental lithosphere breakup and sea-floor spreading initiation in which thinning and rupture of continental lithosphere occurs due to an upwelling divergent flow field within continental lithosphere and asthenosphere. The

model predicts that an ascending flow field, propagating upwards from the base of the lithosphere, may first have thinned the lithospheric mantle under the Faroes-Shetland Basin causing uplift before thinning the lower crust, leading to rapid basin subsidence. While to the north the ascending flow field reached the surface and successfully ruptured the lithosphere resulting in continental breakup and sea-floor spreading initiation, under the Faroes-Shetland Basin the ascending flow field appears to have 'died out' before reaching the surface. Late Palaeocene basin collapse was followed by lithosphere thermal re-equilibration and thermal subsidence, which continues to the present day. This work forms part of the NERC Margins iSIMM project. iSIMM investigators are from Liverpool and Cambridge Universities, Badley Geoscience & Schlumberger Cambridge Research supported by the NERC, the DTI, Agip UK, BP, Amerada Hess Ltd, Anadarko, Conoco-Phillips, Shell, Statoil and WesternGeco. The iSIMM team comprises NJ Kusznir, RS White, AM Roberts, PAF Christie, A Chappell, J Eccles, R Fletcher, D Healy, N Hurst, ZC Lunnon, CJ Parkin, AW Roberts, LK Smith, V Tymms & R Spitzer.