Kinematics of lithosphere breakup deformation at the Goban Spur rifted continental margin

D. Healy and **N.J. Kusznir**

Department of Earth & Ocean Sciences, University of Liverpool, Liverpool UK
(dhealy@liverpool.ac.uk)

Deformation at a rifted continental margin during breakup and sea-floor spreading initiation can be described as the consequence of an upwelling divergent flow field within continental lithosphere and asthenosphere. A new model of lithosphere thinning leading to continental breakup and rifted margin formation (SfMargin) resulting from an upwelling divergent flow field has been developed. The new model successfully predicts lithosphere depth-dependent stretching at both magmatic and amagmatic margins, and mantle exhumation at amagmatic margins. The flow field is described by the horizontal divergence velocity Vx and the vertical upwelling velocity Vz. The kinematics of this flow field has important consequences for crustal thinning and lithosphere temperature evolution at rifted continental margins, and therefore for the predicted subsidence and heat flow history. We apply the SfMargin model to a profile through the Goban Spur on the eastern Atlantic continental margin to recover the flow velocities, Vx and Vz, of the upwelling divergent flow field, and the intial pre-breakup lithosphere stretching factor, Beta. Forward modelling of bathymetry and free air gravity anomalies yields values of Vx, Vz and Beta consistent with the known amagmatic history of this margin. We employ a grid search method to systematically explore model parameter space and to quantify the sensitivity of the SfMargin model to parameter values. The preferred forward model parameters coincide with low values of misfit with respect to observed present day bathymetry and free air gravity anomalies. Our results reveal the early kinematic history of the Goban Spur margin as characterised by initial ultraslow spreading and upwelling rates (0.5 cm per year) and only a modest amount of pre-breakup lithospheric stretching (Beta = 2). The model predictions match recent observations of depth dependent stretching and serpentinised mantle exhumation at this non-volcanic, sediment-starved rifted continental margin.

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, AR Chappell, J Eccles, RJ Fletcher, D Healy, NW Hurst, ZC Lunnon, CJ Parkin, AW Roberts, LK Smith, VJ Tymms & R Spitzer.