Geophysical Research Abstracts
Vol. 21, EGU2019-9268, 2019
EGU General Assembly 2019

The Formation of the SE Greenland Rifted Margin by Distributed Magma Rich Plate Divergence

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The conjugate rifted margins of south-east Greenland and Hatton Bank in the North Atlantic, which formed synchronous with the North Atlantic Igneous Province, are classified as magma-rich rifted margins. Existing interpretations propose that the SE Greenland margin has a broad 150 km wide region of anomalously thick igneous crust and that it is asymmetric compared with that of the Hatton Bank margin. The margin asymmetry has been explained by asymmetric magma-rich sea-floor spreading. An alternative hypothesis is that the SE Greenland margin consists of a wide region of hyper-extended continental crust sandwiched between extrusive and intrusive magmatic material, which is absent on the conjugate Hatton Bank margin. Each hypothesis for the structure of the SE Greenland margin has implications for the location of the continent-ocean boundary, spreading rates and magmatic addition affecting the overall evolution of the SE Greenland and Hatton Bank margins.
Using data from the SIGMA seismic survey, we investigate the OCT structure on the SE Greenland margin to determine if continental or igneous crust is present. We integrate gravity inversion, residual depth anomaly analysis, velocity analysis and joint inversion of seismic and gravity Moho data, to determine crustal thickness, basement seismic velocity and basement density across the margin. Gravity inversion and RDA analysis both suggest thick crust ranging from 10-15 km. Velocity analysis and joint inversion of seismic and gravity data suggest combined SDR and basement seismic velocities and densities in excess of 6.4 km s-1 and 2900 kg m-3 respectively. Lateral changes in seismic velocity and basement density suggest a change in composition oceanwards to less dense material.
Overall, our results favour the presence of thick igneous crust on the SE Greenland margin rather than thinned hyper-extended continental crust sandwiched between extrusive and magmatic material. We interpret this crust, with up to 15 km thickness, as very thick oceanic crust. This interpretation of the SE Greenland margin pushes the location of the continent-ocean boundary inboard.
Rather than invoking asymmetric sea-floor spreading to explain the asymmetry of the SE Greenland and Hatton Bank margins, we suggest that the asymmetry results from a two stage process consisting of first distributed magma rich plate divergence and oceanic crustal accretion followed by plate boundary localization and more normal sea-floor spreading.