A radical model for the North Atlantic and the Greenland-Iceland-Faroes Ridge

Christian Schiffer¹, Kenni Petersen², Gillian Foulger², and Laurent Geoffroy³

¹Department of Earth Sciences, Univ. of Uppsala, Sweden
²Durham University, UK
³UBO, IUEM, CNRS, France

Analysis of teleseismic data from a seismological experiment in the East Greenland Caledonides reveals an east-dipping sub-crustal high velocity structure. The observations are consistent with a dipping eclogite layer underlying hydrated serpentinitised mantle. The structure is therefore interpreted as a fossil subduction complex and may have radical implications for our understanding of the North Atlantic.

Comparison with the very similar and well-known “Flannan reflector” in northern Scotland suggests that these two structures were once connected and now separated by the North Atlantic Ocean. Spatial correlation with geodynamic and magmatic events as well as structural peculiarities in the North Atlantic suggests an important control of this pre-existing structure on the plate tectonic evolution. For example, the Greenland-Faroe-Iceland Ridge formed where the North Atlantic rift crossed the proposed structure. The Jan Mayen Microplate formed exactly to the north of this intersection[CS1].

We propose a new model for the formation of the North Atlantic that involves mainly plate tectonic processes and structural inheritance. The model involves delamination of dense orogenic crustal root and lithosphere triggering lower mantle upwelling and formation of a Large Igneous Province (LIP). Crustal flow and/or exhumation of the initially very thick (e.g. Tibet-like) continental lower-crust beneath extrusives could explain part of the anomalous thickness of the Greenland-Iceland-Faroes Ridge.

Our model explains several features of the North Atlantic, including microplate formation, enhanced magmatism and LIP formation, the formation of magma-rich and magma-poor continental margins, high-velocity lower crustal bodies, rift migration and formation of the Greenland-Faroe-Iceland Ridge.