Geophysical Research Abstracts
Vol. 17, EGU2015-5255, 2015
EGU General Assembly 2015

Heterogeneity of the North Atlantic oceanic lithosphere based on integrated analysis of GOCE satellite gravity and geological data

Olga Barantseva, Irina Artemieva , Hans Thybo, and Matija Herceg

Copenhagen, Department of Geosciences and Natural Resource Management, Geology Section, Copenhagen K, Denmark (barantseva.o@yandex.ru)

We present the results from modelling the gravity and density structure of the upper mantle for the off-shore area of the North Atlantic region. The crust and upper mantle of the region is expected to be anomalous: Part of the region affected by the Icelandic plume has an anomalously shallow bathymetry, whereas the northern part of the region is characterized by ultraslow spreading. In order to understand the links between deep geodynamical processes that control the spreading rate, on one hand, and their manifestations such as oceanic floor bathymetry and heat flow, on the other hand, we model the gravity and density structure of the upper mantle from satellite gravity data.

The calculations are based on interpretation of GOCE gravity satellite data for the North Atlantics. To separate the gravity signal responsible for density anomalies within the crust and upper mantle, we subtract the lower harmonics caused by deep density structure of the Earth (the core and the lower mantle). The gravity effect of the upper mantle is calculated by subtracting the gravity effect of the crust for two crustal models. We use a recent regional seismic model for the crustal structure (Artemieva and Thybo, 2013) based om seismic data together with borehole data for sediments. For comparison, similar results are presented for the global CRUST 1.0 model as well (Laske, 2013).

The conversion of seismic velocity data for the crustal structure to crustal density structure is crucial for the final results. We use a combination of Vp-to-density conversion based on published laboratory measurements for the crystalline basement (Ludwig, Nafe, Drake, 1970; Christensen and Mooney, 1995) and for oceanic sediments and oceanic crust based on laboratory measurements for serpentinites and gabbros from the Mid-Atlantic Ridge (Kelemen et al., 2004). Also, to overcome the high degree of uncertainty in Vp-to-density conversion, we account for regional tectonic variations in the Northern Atlantics as constrained by numerous published seismic profiles and potential-field models across the Norwegian off-shore crust (e.g. Breivik et al., 2005, 2007).

The results demonstrate the presence of strong gravity and density heterogeneity of the upper mantle in the North Atlantic region. In particular, there is a sharp contrast at the continent-ocean transition, which also allows for recognising mantle gravity anomalies associated with continental fragments and with anomalous oceanic lithosphere.