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Anomalous topography and lithosphere structure of the North Atlantic region

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It has long been known that the bathymetry of the North Atlantic ocean is among the most anomalous in oceans. The region includes complex geodynamic mosaics with the presence of paleo-spreading zones, continental fragments within the Jan Mayen block, still heavily debated Iceland mantle anomaly, the anomaly in crustal thickness across the North Atlantic ocean with its possible continuation across the Labrador Sea, and the transition to the ultra-slow spreading in the northern part of the region. The evolution of the continental margins of the North Atlantic ocean is also enigmatic, in particular the origin and the age of the high topography along the Norwegian and the Greenland margins. This anomalous off-shore and on-shore topography reflects an interplay of deep and shallow geodynamical processes related to plate tectonics and mantle convection.

We present an overview of the crustal and upper mantle structure of the North Atlantic region (north of 45N) both for the oceanic and the continental crust. For the latter, we present our new seismic interpretations for Norway and Greenland. We analyze regional patterns of crustal structural heterogeneity and link them to geodynamic evolution of the region.

We also present a model of thermo-chemical heterogeneities in the North Atlantic upper mantle based on the analysis of mantle residual gravity anomalies. To separate thermal and chemical heterogeneity of the upper mantle we compare the results with the predictions for “normal” oceans. We present the map of the calculated temperature anomaly in the upper mantle of the North Atlantic region and argue that it may not be easily resolved by seismic methods. We also map regions with strong chemical (compositional) anomalies in the upper mantle and speculate on their possible origin by comparing our results to published geochemical data.