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Thermo-chemical heterogeneity of the upper mantle in he North Atlantic region

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Cooling and contraction of the oceanic lithosphere with age globally is explained by the convective half-space cooling model (HSC) that accounts well for the variation in depth and heat flow with ocean floor's age for <70-80Ma (Stein&Stein, 1992). Residual mantle gravity anomalies, if caused only by the age-dependent temperature changes associated with the ocean plate cooling, should correlate with the square-root of the ocean floor's age. In case thermal or compositional anomalies are present beneath an ocean plate, it will affect mantle density and therefore cause a deviation of the residual mantle gravity anomalies (RMGA) from the HSC model's predictions. Such thermos-chemical heterogeneities in mantle structure reflect an interplay of deep and shallow geodynamical processes related to plate tectonics and recent mantle dynamics.

We present a model of the upper mantle residual gravity anomalies for the North Atlantic region (north of 45N), from which the gravitational effect of the crust was subtracted. The model based on the GOCE satellite gravity data and has spatial resolution ca. 150 km. We interpret our results by comparing them with the predictions for 'normal' ocean and speculate on thermos-chemical heterogeneity of the region. We map the anomalies in chemical composition in the upper mantle and we analyze them together with the regional geochemical models. This allows us to link geodynamic evolution of the region to mantle processes.