Geophysical Research Abstracts
Vol. 13, EGU2011-3588-2, 2011
EGU General Assembly 2011

Deep structure of the Central European Basin System and adjacent areas based on integrated 3D gravity and 3D thermal analyses

Yuriy P. Maystrenko and Magdalena Scheck-Wenderoth

Helmholtz Centre, Potsdam GFZ German Research Centre For Geosciences, Potsdam, Germany (yuram@gfz-potsdam.de, leni@gfz-potsdam.de)

The Central European Basin System is a complex basin system as a result of a multi-stage evolution and structural differentiation at both shallow and deep levels. During the last decades, the deep structure of the Central European Basin System has extensively been investigated by deep reflection/refraction seismic lines, passive seismological experiments, gravity modeling, magnetic and magnetotelluric studies and other methods. These recently obtained results are an exceptional background for further evaluation of the deep structure beneath the Central European Basin System and adjacent areas. Based on new data, a well-constrained 3D structural model of the Central European Basin System has been constructed. This 3D model was validated by 3D gravity modelling and, finally, was used for 3D gravity stripping and 3D thermal modelling. These calculations were carried out with help of Interactive Gravity and Magnetic Application System (IGMAS) and by 3D thermal modelling.

One of the key results of this integrated study is related to the crust-free gravity anomalies which were calculated by removal of the gravity effect of sea water, sediments and crystalline crust from the observed gravity field. According to the results of the 3D gravity stripping, the crust-free gravity field shows negative anomalies over southern Norway, the Rhenish Massif, the British Isles and surrounding areas. On the other hand, positive residual gravity anomalies are observed over the East European Craton and western Poland. It is obvious that this kind of gravity pattern requires different upper mantle densities beneath the mentioned areas. Where gravity anomalies are negative, upper mantle densities have to be lower compared with areas where positive gravity anomalies are present on the map of the crust-free gravity field. However, what is the responsible mechanism for this lateral density variations? A comparison of the pattern found in the map of the crust-free gravity anomalies with the temperature distribution from 3D thermal modelling indicates that some negative anomalies correlates with areas where high temperatures are present within the upper mantle. This spatial correlation implies that local density reductions in the lithospheric mantle can partially be explained by the thermal expansivity of the constituting rocks due to nonuniform increase in temperature with depth beneath the study area.

The regional pattern of temperature within the lithospheric mantle is mostly controlled by the depth to the lithosphere-asthenosphere boundary which is located near the top of the convecting mantle. Its position strongly affects the conductive heat transport through the lower part of the Earth's lithosphere. However, the depth to the lithosphere-asthenosphere boundary is locally contradictory within the Central European Basin System, depending on the method used to determine the lithospheric thickness. On the other hand, results of seismic tomography, surface wave tomography, geothermics and electromagnetic methods (magnetotellurics) show that a regional trend of the lithosphere-asthenosphere boundary is independent of the method. The lithosphere is always thick beneath the East European Craton and is relatively thin beneath the western part of the Central European Basin System and adjacent areas.