

# Mechanisms of isostatic adjustment in continental lithosphere at long timescales: an example of the Trans European Suture Zone in Poland

E. Kozlovskaya (1), M. Majdański (2), M. Świeczak (2)

(1) Sodankylä Geophysical Observatory/Oulu Unit, University of Oulu, Finland

(2) Institute of Geophysics, Polish Academy of Science, Warsaw, Poland

[elena.kozlovskaya@oulu.fi](mailto:elena.kozlovskaya@oulu.fi)

We present analysis of different mechanisms of isostatic adjustment in continental lithosphere at long timescales in the area of the Trans European Suture Zone (TESZ) separating the Precambrian East European Craton (EEC) from younger tectonic units of Palaeozoic Europe in Poland (PP). The major feature in the crust in our study area is the strong contrast in thickness of the crust and surface heat flow between the EEC and younger units to the west from the TESZ. In order to investigate the mechanisms of isostatic compensation, we compiled a detailed 3-D velocity model of the crust for the territory of Poland using high-resolution seismic models of the crust and upper mantle from recent controlled-source experiments. The model was converted to a density model assuming different equations connecting seismic velocities to densities for crustal rocks, sediments and the uppermost mantle. After that we calculated synthetic geoid undulations caused by 3-D density distribution within the crust and compared them to an existing gravimetric quasi-geoid solution. The modelling showed that the difference in crustal structure between the East European Platform and Palaeozoic Platform explains significant part of the observed geoid undulations in the study area. The remained residual could be related to density inhomogeneities in the upper mantle. To estimate them, we performed inversion of a residual between the observed geoid and undulations caused by the 3-D density distribution in the crust. Basing on the assumption of local isostatic compensation and Pratt–Hayford isostasy model, the density distribution in the upper mantle was parametrized as a 40-km-thick layer located above the assumed maximum compensation depth of 140 km and subdivided into irregular blocks. The boundaries of the blocks were defined according to boundaries of major tectonic units in the study area and position and shape of the most pronounced anomalies in the residual geoid. After that we analysed at what depth different loads and mass deficiencies in the lithosphere are isostatically compensated.

Our result showed that different loads and mass deficiencies are compensated at different levels of the lithosphere. Thus the loads due to topography in Sudetes, Bohemian Massif and Carpathians as well as thick sediments in the TESZ are compensated at a depth corresponding to the lower crust, which suggests that the lower crust is mechanically weak there. However, strong contrast in density and thickness of the crust between the EEC and younger units of Western Europe is not compensated at the Moho boundary. The total compensation of all loads in the lithosphere occurs in the upper mantle compensation of variations in crustal thickness and structure between EEC and PP requires the mechanically weak layer in the mantle also.