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Lithosphere-Asthenosphere Boundar below East European Craton and properties of lower lithosphere

Leszek Czechowski
University of Warsaw, Institute of Geophysics, Faculty of Physics, Warsaw, Poland (lczech@op.pl)

Lithosphere-Asthenosphere Boundary (LAB) is a lower boundary of the lithosphere. We use numerical program LABWA2015 to determine some properties of the lithosphere below East European Craton (EEC) along part of Profile 42N 0E-53N 60E [1, 2].

The idea of isostasy is based on the assumption that upper layers of Earth could be treated as series of rigid columns that float on a liquid layer [3, 4, 5]. The total mass above some level (compensation level) is the same for each column. According to plate tectonics, compensation level should be placed inside the asthenosphere.

In isostasy, elevation E is a function of density and thickness of lithospheric layers and density of asthenosphere. Consider a simple two layer model with densities of sea water ρ_w, crust ρ_c [kg m^{-3}], lithospheric mantle ρ_m and asthenosphere ρ_a. Moreover z$_c$and z$_L$ are depths of Moho and LAB, respectively. L_o is the position of the hypothetical column composed of the matter with the density of asthenosphere. For such model we have [1, 4, 5, 6]:

E= (z$_c$(ρ_m - ρ_c)- z$_L$(ρ_m- ρ_a) - $\rho_a L_o$)/($\rho_c - \rho_w$). (1)

The geoid anomaly N could be expressed as an integral of the density contrast $\Delta\rho(z)$ – see e.g. [1, 4]. E and N give two equations for each column of lithosphere in isostasy.

The profile 42N 0E-53N 60E extends from West Europe to Ural. Tectonic structure of its part over EEC enables us to write several independent pairs of equations for E and N, for each column (see [1]). This system of equations is used determine a few parameters of lithosphere. Note that density is a function of temperature and composition. LABWA2015 uses full equation of heat flow to calculate temperature T :

c ρ $\partial T/\partial t$=div($k(T,p)$ grad $T) + Q(t)$ (2)

We found a few different models of the lithosphere below the profile. Our preliminary calculations indicate rather low (average) heat production and relatively constant thermal conduction along the profile. Note however that higher heat production could be compensated by lower heat flow from the asthenosphere (we use also surface heat data as additional constrains). Similarly higher temperature could be compensated by lower coefficient of thermal expansion. We plan to use additional constrains to reach full agreement of different data: seismic [7], petrologic, gravimetric, etc.

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