Two previous models are based on the prescribed thickness of the crust (given by CRUST2) and model topography does not match exactly the observed topography of TAP. In model 3 we assume that the CRUST2 model is inaccurate. We stretched the thickness of the model crust so that after isostatical adjustment observed and model topography match exactly. Varying ΔT within model 3 we found that the optimal value for constant ΔT within TAP and improve significantly the match between model results and observation.

The density of mantle within models 1—3 depends only on thermal state of mantle, which in turn depends on the age and crustal thickness. The observations, however, point out existence of significant compositional (and thus, density) variations of the mantle beneath TAP. In model 4 we assume that part of mismatch between CRUST2 — based topography and observed topography is associated mantle density variations. That was emulated by variations of effective thermal situation, simply by assuming ΔT varies laterally.

In addition to the stresses directly resulted from GPE, we considered several additional complications of the model. In series B we considered basal drag caused by sub-mantle flow derived from mantle convection model. We couple this flow filed to models 3 and and vary parameters of coupling. Whereas the model B3 shows little improvement compared to model 3, the basal drag with reasonable parameters of coupling improves significantly model with variable density of the lithospheric mantle (model 4 vs, model B4).

All the models considered above are based on uniform rheological properties of TAP. This is very strong simplifying assumption. In model series C we considered simplest variations of rheological properties, assigning weakening along mid-oceanic ridges. The results improve (model C4) when weakening related to young age of the ocean floor is by up to two orders of magnitude.

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Kola Super-deep — evidence of fluids in the Crust

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The program of deep continental drilling became qualitatively a new stage in progressing of knowledge of the Earth crust. The major point of this new knowledge became the evidence of deep-seated fracturing of the crust. Geothermal investigations in Kola hole (SD-3) have been combined with a wide range of the adjoining studies which are carried on in this hole — hydrogeology, petrology, geochemistry of RAE, rock mechanics, numerous geophysical observations. It has given the chance to study thermal conditions of the Earth crust more deeply. The report includes some important results of geothermal in SD-3 [Ljubimova et al., 1985; Kremenetsky et al., 1986; Arshavskaya et al., 1987; Borevsky et al., 1985; 1997; 1998; Milanovsky, 1998]. Along with measuring, they included interpreting of a modification of a heat flux and its components with depth. It is necessary to name as the most essential result detection of link of a thermal field with hydro physical zonality of the crust and its fracturing. By geothermal study in SD-3 it was established, that heat flow density is enlarged with depth from 30 mWm^{-2} to 49.5 mWm^{-2}, locally to 68 mWm^{-2} [Borevsky et al., 1997; 1998; Milanovsky, 1998]. These values practically have a little varied after conducting of the subsequent mass measuring of a thermal conductivity of cores from SD-3 [Popov et al., 1999]. It was found, that by the most essential reason of growth of heat flow with depth, along with paleoclimatic effect which is limited with depth the downward filtering of meteoric waters is [Ljubimova et al., 1985; Borevsky et al., 1985]. On geothermal data Darcy velocity of a downward filtering in Proterozoic metamorphic rocks — 0.4 cm per year has been estimated. The evaluation of rate of this filtering has appeared is close to rate of modern uplift of blocks of a surface on Baltic Shield. The refraction of a vertical component of a temperature gradient on sloping interfaces of stratums of contrasting thermal conductivity is found. It is demonstrated, that geothermal parameters respond the physical-mechanical boundary lines [Milanovsky, 1998, Abdrakhimov et al., 1999] determined by complex analyses of SD-3 section [Borevsky et al., 1987; 1998; Milanovskiy, Borevsky, 2000]: Detailed level-by-level allocation of RAE (U, Th and K) of SD-3 cross-section [Kremenetsky et al., 1986] was studied. Average heat generation of the rocks in Protrusion complex is $0.41 \cdot 10^{-6}$ Wm^{-3}, in Achaean complex — $1.47 \cdot 10^{-6}$ Wm^{-3}. The contribution of Low Proterozoic complex in an integral heat flux is 2.8 mWm^{-2}, and of Achaean complex is 6.86 mWm^{-2}. Link of metamorphic processes with non-uniformly scaled redistribution of U and Th in the rocks on depths up to 10 km was found. Comparison of heat flux value in Kola super-deep with heat generation model allows to conclude:

1) in Pechenga (Proterozoic) complex the heat flux depends from radiogenic heat sources a little; the controlling factors instituting fluctuations of heat flow value are hydro-geological, structural and thermal;

2) in Archean part heat generation growth result in decreasing of heat flux with depth on the average ~5 mWm^{-2}. Along with deep studies, in Kola region field work on temperature gradient analysis 36 prospecting holes on the Ni-ore field "Verchnee" have been made. Salinity of fluid in a number of holes was measured, and also a thermal conductivity of 1375 samples of rock cores from 21 holes was mesured [Christoph et al., 1996; Schellerschmidt et al., 2003a; 2003b]. The heat flow in 19 boreholes on “Verhnee” varied between 31—45 mWm^{-2} with a mean 38 mWм$^{-2}$ [Mottaghy et al., 2005]. In the majority of boreholes the heat flux tests the considerable modifications with depth that correspond to the analogous variations of a heat flow observed in the upper part of SD-3. The carried out analysis [Mottaghy et al., 2005] allows drawing a conclusion, that this regularity is not a consequence of production operations, and reflecting a natural appearance. The reason of this effect — combination of advective filtration in fractured rocks, structure factor and paleoclimat. The preliminary analysis of a heat flux has demonstrated that filtration (fracturing) plays a defining role at the subordinate effect of varying surface temperature and the insignificant contribution of structural heterogeneity of rocks. Near surface geothermal studies have allowed to detect the space in homogeneity of a thermal field in the upper crust. Analysis of hydro-geothermal field has shown its link with stress field, fault tectonics and accordingly with inhomogeneous lateral permeability of the upper crust. The obtained data have been used for 2D thermal modeling of Pechenga Synclinorium and for calculation of deep temperatures in the crust. From a stand dilatancy model [Nikolaevskiy, 1996] analysis geothermal, seismic, geoelectric, density and petrologic models of old crust [Milanovsky, 1984; Milanovsky, Nikolaevskiy, 1989; 2000] was carried out. Comparison of *PT*-conditions on Conrad and Moho boundaries their correspondence to boundary lines of stick-slip and dislocation plasticity accordingly was established. The range of a bright dilatation for geomaterials coincides with the position of low velocity zone in SD-3 section.

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