Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08927, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08927
EGU General Assembly 2008

Modeling convection-related observables and mantle flow with the new combined spectral-iterative method.

I. Rogozhina, M. K. Kaban and V. Trubitsyn

(1) GeoforschungsZentrum, Potsdam (valmont@gfz-potsdam.de), (2) Inst. Phys. of the Earth, Moscow

There has been developed a numerical method to model the convection-related observables such as dynamic geoid, dynamic topography and surface plate velocities induced by global mantle flow with the effect of strong lateral viscosity variations (LVV) in conjunction with the effects of self-gravitation and mantle compressibility. The employed technique comprises the combination of spherical harmonic method, direct method used for solving the Stokes and Poisson equations in spherical harmonics with arbitrary boundary conditions, functions of density and radial viscosity, and iterative method used for modeling the effect of LVV. The 3-D mantle viscosity model is based on the global seismic tomography model S20a converted to temperature variations. The maximum lateral viscosity contrast in the lithosphere-asthenosphere zone reaches four orders of magnitude. It is found that the influence of LVV on the dynamic geoid is extremely significant: the alteration of the geoid figure due to LVV exceeds 45% of the maximum geoid undulations. The detailed analysis has shown that the geoid is affected by LVV in the whole mantle, and opposite to a common opinion the effect of the lower mantle is also significant. According to this research the effects of the upper- and lower-mantle LVV on the geoid figure are nearly additive with respect to the whole-mantle LVV and partly compensate each other. There has been revealed an obvious similarity between the changes of geoid and dynamic topography due to LVV, although the disturbances of dynamic topography possess more small-scale details. The mantle flows are strongly affected by LVV as well, especially by the long-wavelength viscosity variations in the lower mantle: global upwellings tend to intensify due to LVV, while downwellings become weaker. The alteration of the

near-surface velocities reaches 30-40% of amplitude not only due to the LVV-induced toroidal flow but also due to change in the spheroidal velocity component. From the other side we study the principal behavior of mantle flows in the areas with small-scale LVV. If located in the very heart of the global flow with nearly constant velocity the small-scale LVV are found to influence very little the global motion. By contrast, if this viscosity contrast happens in the area with the abrupt velocity change, the surrounding flow keeps away of the small-scale LVV area turning round in advance.