Geophysical Research Abstracts
Vol. 12, EGU2010-12575, 2010
EGU General Assembly 2010

Mantle convection, topography and geoid

Olivia Golle (1), Caroline Dumoulin (1), Gaël Choblet (1), and Ondrej Cadek (2)

(1) Planetary and geodynamic Laboratory, Nantes, France (olivia.golle@univ-nantes.fr), (2) Department of Geophysics, Prague, CZECH REPUBLIC

The internal evolution of planetary bodies often include solid-state convection. This phenomenon may have a large impact on the various interfaces of these bodies (dynamic topography occurs). It also affects their gravity field (and the geoid). Since both geoid and topography can be measured by a spacecraft, and are therefore available for several planetary bodies (while seismological measurements are still lacking for all of them but the Moon and the Earth), these are of the first interest for the study of internal structures and processes.
While a classical approach now is to combine gravity and altimetry measurements to infer the internal structure of a planet [1], we propose to complement it by the reverse problem, i.e., producing synthetic geoid and dynamic topography from numerical models of convection as proposed by recent studies (e.g. for the CMB topography of the Earth,[2]).

This procedure first include a simple evaluation of the surface topography and geoid from the viscous flow obtained by the 3D numerical tool OEDIPUS [3] modeling convection in a spherical shell.
An elastic layer will then be considered and coupled to the viscous model – one question being whether the elastic shell shall be included 'on top' of the convective domain or within it, in the cold 'lithospheric' outer region. What we will present here corresponds to the first steps of this work: the comparison between the response functions of the topography and the geoid obtained from the 3D convection program to the results evaluated by a spectral method handling radial variations of viscosity [4]. We consider the effect of the elastic layer whether included in the convective domain or not. The scale setting in the context of a full thermal convection model overlaid by an elastic shell will be discussed (thickness of the shell, temperature at its base...).

References

[1] A.M. Wieczorek, (2007), The gravity and topography of the terrestrial planets, Treatise on Geophysics, 10, 165-206.

[2] T.M. Lassak, A.K. McNamara, E.J Garnero, S. Zhong, (2010), Core-mantle boundary topography as a possible constraint on lower mantle chemistry and dynamics, Earth and Planetary Science Letters, 289, 232-241

[3] G. Choblet, O. Čadek, F. Couturier, C. Dumoulin, (2007), OEDIPUS : a new tool to study the dynamics of planetary interiors, Geophysical Journal International, 170, 9-30.

[4] M. Pauer, K.Flemming, O. Čadek, (2006), Modeling the dynamic component of the geoid and topography of Venus, Journal of Geophysical Research, 111, E11012.