12th International Workshop on Modeling of Mantle Convection
and Lithospheric Dynamics

August 20th to 25th 2011, Döllnsee Germany

Understanding the effects of compression on the geoid and dynamic topography.

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We apply the Arrhenius law with strongly temperature and pressure dependent viscosity to a series of 2D-axisymmetric, spherical shell convection models to investigate the influence of compression on the geoid and dynamic topographic anomalies on mantle convection.
We compare compressible convection with constant and depth dependent thermal expansion and thermal conductivity to the commonly used extended Boussinesq approximation with constant properties. To account for compressibility effects, we employ an anelastic liquid approximation.
In the case of constant viscosity, we show that both dynamic topographies and geoid anomalies are reduced by adding depth dependent density, and it further decreases by including the depth dependent thermal expansion and thermal conductivity. However, by increasing the Rayleigh number, geoid and topographic anomalies become less dependent of these effects. Moreover, we prove that amplitude of the geoid anomalies would not decrease by the increase Rayleigh number for all range of convection vigor. Instead it increases for certain range of Rayleigh numbers, and then it starts to drop with increasing Ra.
In the variable viscosity case, depending on the viscosity profiles in the mantle, distinctive behaviors of geoid and topography are obtained. Changing in the amplitude of the geoid for temperature dependent and temperature – pressure dependent viscosity is different from cases with pressure dependent viscosity alone. All these points as well as effects of convection vigor will be discussed in details.