Geophysical Research Abstracts
Vol. 15, EGU2013-5870, 2013
EGU General Assembly 2013

Evolution of the compositionally dense layer at the bottom of the mantle

Márton Pál Farkas, Attila Galsa, Mátyás Herein, and László Lenkey
Department of Geophysics and Space Sciences, Eötvös University, Budapest, Hungary (maartonpal@gmail.com)

Two-dimensional numerical models have been carried out in order to investigate how the evolution of the compositionally dense D" layer influences the time series of the heat flux, velocity, temperature and concentration of dense material. The initial density difference between D" and the overlaying mantle, β was the single studied parameter which was varied between 0.1–2%.

Based on the time series six stages of the D" evolution were separated from the surface deformation of the dense layer to the totally homogenized mantle. In all studied cases the final state got over the homogenization, even for β=2% when the traditional buoyancy ratio was larger than 1. In order to investigate the evolution of the compositionally dense layer a time-dependent buoyancy ratio, B was defined by the ratio of the chemical and thermal density difference between D" and the overlaying mantle. The decrease in B was deduced from three reasons: (1) the increase in temperature difference between the layers due to the inhibited heat advection as well as the decrease in concentration difference owing to (2) the pollution of the upper layer by surface erosion of the D" and (3) the dilution of the dense layer with light material intermixed from the upper layer facilitated by convection within D". As the value of B approaches to 1, the mixing of the dense material becomes more effective, it is the most vigorous phase of the thermo-chemical convection. For B=0 the mantle is mixed, the homogenization continues protractedly.

It was established that larger initial density difference, β has longer/stronger effect on the monitored parameters. An exponential relation was found between the occurrences of different stages characterizing the evolution of D" layer and β. The reduction in B during the erosion/dilution phase ((2) and (3)) and the effective mixing of the dense layer ($0\leq B \leq 1$) can be approximated by a linear function, thus the occurrences of single stages are anticipated. The slope of the linear segments shows an exponential dependence on β, as well.

This research has been supported by the Hungarian Scientific Research Fund (OTKA K-72665).