Geophysical Research Abstracts
Vol. 12, EGU2010-6753, 2010
EGU General Assembly 2010

The effect of continental lids on the long-term efficiency of mantle convective stirring

Henri Samuel (1) and Bhaskar Deo (2)

(1) Bayreuth University, Bayerishes Geoinstitut, Bayreuth, Germany (henri.samuel@uni-bayreuth.de, +49 921 55-376), (2) Indian Institute of Technology, Kharagpur

Interpreting surface geochemical data requires the understanding of the dynamic mechanisms that can preserve or erase chemical heterogeneities over geological times. Among these, the presence of continental lids is known to have a first order impact on mantle convective dynamics and heat transfer. On Earth oceanic plates are recycled into the mantle and are characterized by a relatively strong heat flux, while continents are more insulating, lighter and therefore not subductable.

Numerical and laboratory experiments have demonstrated that the dichotomy between continents and oceans can have a first order influence on mantle motions. One should therefore expect that this influence also reflects on the efficiency of convective stirring over billions of years. However, this effect has not been considered in previous studies that investigated mantle convective stirring efficiency.

We have therefore investigated the influence of continental lids on convective stirring efficiency using numerical experiments at infinite Prandtl number, in rectangular domain. Differences between oceanic and continental plates are accounted for by imposing heterogeneous surface boundary conditions for temperature and velocities: oceanic plates are described by Dirichlet boundary conditions while continents are modeled as highly viscous, floating lids of variable extent, locally imposing a prescribed surface heat flux. We use passively advected tracers to quantify the stirring efficiency with various diagnostics such as mixing time and Lyapunov exponent distribution. This numerical set up allows us to quantify systematically the influence of several governing parameters on the convective stirring efficiency: the Rayleigh number Ra, the horizontal extent of continental lids, as well as the magnitude of their insulating character.