Geophysical Research Abstracts
Vol. 14, EGU2012-14444, 2012
EGU General Assembly 2012


# Mantle convection: concensus and queries (Augustus Love Medal Lecture)

Y. Ricard
CNRS, Université Lyon1, Ecole Normale de Lyon, Lyon France.

Thermal convection driven by surface cooling and internal heat production is the cause of endogenic activity of all planets, expressed as tectonic activity and volcanism for solid planets. The sluggish convection of the silicated mantle also controls the activity of the metallic core and the possibility of an active dynamo. A glimpse of the internal structure of Earth's mantle is provided by seismic tomography. However, both the limited resolution of seismic methods and the complexity of the relations between seismic velocities and the thermo-mechanical parameters (mostly temperature and density), leave to the geodynamicist a large degree of interpretation. At first order, a very simple model of mantle heterogeneities, only built from the paleogeographic positions of Cenozoic and Mesozoic slabs, explains the pattern and amplitude of Earth's plate motions and gravity field, while being in agreement with long wavelength tomography. This indicates that the mantle dynamics is mostly controlled by thermal anomalies and by the dynamics of the top boundary layer, the lithosphere. However, the presence of various complexities due to variations in elemental composition and to phase transitions is required by seismology, mineralogy and geochemistry. I will review how these complexities affect the dynamics of the transition zone and of the deep mantle and discuss the hypothesis on their origins, either primordial or as a consequence of plate tectonics. The rheologies that are used in global geodynamic models for the mantle and the lithosphere remain very simplistic. Some aspects of plate tectonics (e.g., the very existence of plates, their evolution, the dynamics of one-sided subductions...) are now reproduced by numerical simulations. However the rheologies implemented and their complexities remain only remotely related to that of solid minerals as observed in laboratories. The connections between the quantities measured at microscopic scale (e.g., mineralogy, grainsize, mechanisms of creeping, anisotropy, preferential shape orientations, water content...), their macroscopic averages, and the retroaction between them, are still unclear. The understanding of these relations would explain why Earth has plate tectonics while the other planets of the solar system, including her sister planet Venus, do not. As plate tectonics can be advocated to be a major ingredient for life to developp, we can speculate that a better understanding of the interaction between rheology and geodynamics would help us to estimate on what extrasolar planets including super earths, life might be expected.