Geophysical Research Abstracts
Vol. 13, EGU2011-3652, 2011
EGU General Assembly 2011

What role have phase changes played in mantle evolution?

J. Huw Davies (1) and Martin Wolstencroft (2)

(1) School of Earth and Ocean Sciences, Cardiff University, Cardiff, Wales, United Kingdom, (2) Department of Earth Sciences, University of Ottawa, Ottawa, ON, Canada

Given a sufficiently negative Clapeyron slope for the phase change in olivine from ringwoodite to Mg-perovskite and Ferropericlase at 660 km depth, layerered mantle convection can occur. Models show a regime whereby this layering can break down periodically, resulting in phenomena known as 'avalanches'. A dynamic response to these avalanches can produce massive upwellings. It has been suggested that the layering influence can be seen in the stalled slabs observed in seismic tomography of East Asia. Additionally, other conceptual models propose that some large magmatic events over Earth history can be attributed to such phenomena.

We have undertaken a comprehensive study of the dynamic behaviours exhibited as a function of Rayleigh number (Ra) and Clapeyron slope of the phase change (Cl) for spherical convection models. Seismological estimates of Cl tend to be more negative than mineralogical estimates, the latter becoming more negative with high water content. Given this uncertainty in estimates of Cl and Ra it is possible that Earth has been at least partially layered in its past. For such partially layered mantle systems, we investigate the time interval between such pulsing events. In particular, we examine the importance of mantle parameters such as the radial viscosity profile. We hope this work will allow constraints to be placed on the viability of the layer breakdown mechanism over Earth's geological history.