Geophysical Research Abstracts,
Vol. 11, EGU2009-1824, 2009
EGU General Assembly 2009

Transient Layering in Earth's Mantle

M. Wolstencroft and J. H. Davies
Cardiff University, School of Earth and Ocean Sciences, Cardiff, United Kingdom (wolstencroftm@cardiff.ac.uk)

Earth's mantle does not appear to be convecting in a layered manner at present. However, a number of geochemical indicators suggest the presence of more ancient material than the MORB source. The possibility of evolving layering of the mantle about the 660 km phase change provides a mechanism, which could introduce periodic layering as Earth cooled from its initial hotter state.

3-dimensional spherical geometry models at Earth-like Rayleigh numbers suggest that the transition from layered mantle convection to whole mantle convection is likely to result in an extended period of partial layering. During partial layering, the modelled mantle undergoes periodic avalanche and plume events, which result in significant peaks in global surface heat flux. Such processes have been suggested for a partially layered mantle using parameterized models (Davies 1995) and inferred from observational work (Condie 1998).

Should conditions within Earth's mantle be suitable for such processes to occur, the thermal history of Earth could show significant periodicity, a feature which would need to be considered when projecting mantle temperature back in time with parameterized models. It could also provide a mechanism to produce the phases of increased melting inferred by some geochemical studies (Parman 2007).

References

Condie, K. C. (1998) Episodic continental growth and supercontinents: a mantle avalanche connection? Earth and Planetary Science Letters, 163, 97-108. Davies, G. F., 1995, Punctuated tectonic evolution of the Earth: Earth Planet. Sci. Lett., v.136, p. 363-379. Parman, S. W., 2007, Helium isotopic evidence for episodic mantle melting and crustal growth: Nature, v. 446, p. 900-903.