Geophysical Research Abstracts, Vol. 9, 03587, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03587

New perspectives on mantle heterogeneity

P. Armienti, D. Gasperini

Dipartimento di Scienze della Terra, Università di Pisa (armienti@dst.unipi.it/ Fax: +39 050-2215800)

The chemical structure of the mantle can be constrained by the contemporaneous evaluation of trace element and isotopic compositions of MORB and OIB. Multi-dimensional projections allow a broad view of large-scale mantle heterogeneities, revealing that each ocean island shows its own local geochemical end-members. Mantle heterogeneity results from a range of processes that cause incompatible element enrichment (e.g., recycling of lithosphere with a distinctive age and Pb isotope signature) and depletion (e.g., different degrees of partial melting of peridotite), where time plays a major role. The multi-dimensional evaluation of OIB/MORB mantle sources allows to move away from a perspective based on physically distinct mantle reservoirs to a model based on a marble-cake structure for the mantle. We assess that the depleted and enriched compositions are not physically distinct, and OIB/MORB geochemical variability is relatively independent of source depth. The highest degrees of partial melting of the mantle source of each ocean island can only reveal the distinctive local depleted source composition, precluding the existence of a mantle-wide, shallow and uniform DMM reservoir. Isotopic space series along oceanic ridges, believed to sample the DMM reservoir, show that the shallow mantle is characterized by a fractal distribution of geochemical heterogeneities. We assess that the distribution of mantle variability through vertical mantle columns, e.g., sampled at any ocean island, may reveal self-similarity, supporting the hypothesis of a widespread chaotic marble-cake mantle.