Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16706

Origin and scale of mantle heterogeneities: snapshots from field-based studies and experimental works

GIULIO BORGHINI[1], PATRIZIA FUMAGALLI[1] AND ELISABETTA RAMPONE[2]

[1]Dipartimento di Scienze della Terra, University of Milano
[2]Università di Genova

Presenting Author: giulio.borghini@unimi.it

Upper mantle is the main source of magmatism on the Earth. Several lines of evidence, including field, geochemical and geophysical observations, indicate that mantle sources are chemically and lithologically heterogeneous at various length-scales [1]. The high variability of chemical and isotopic composition of oceanic basalts (MORB and OIB) is the main proof that mantle source include both enriched and depleted components, although in many cases melts aggregation and extraction processes smooth the extent of mantle heterogeneity [2]. While depleted components are poorly sampled by basalts' composition, enriched components are expected to greatly contribute to magma production. They are thought to consist of very fertile lithologies such as pyroxenites, often invoked to explain enriched isotopic signals reflecting ancient recycled crustal materials. However, if subduction may introduce lithological heterogeneities in the mantle, they are expected to encounter size reduction and stretching by mantle convection and variable extent of partial melting and melt-rock reaction able to significantly modify their mineral assemblage and composition. Therefore, if chemical/isotopic composition of oceanic basalts strongly supports the evidence of significant mantle heterogeneity at variable scales, the nature of enriched mantle sources is rather enigmatic and hotly debated, because direct observations are completely lacking. Here we want to provide some insights on the evolution of mantle sources combining results from field-based petrological studies and experimental works. Along with partial melting, a wide range of melt-rock reactions may potentially introduce significant chemical and mineralogical modifications in the upper mantle, depending on pressure and temperature, as well as on the composition and amount of reacting melt. Experimental data can be used to constrain the information extrapolated by studying natural mantle sequences, which are among the best proxies of the unknown asthenospheric mantle.

1. Stracke, A. Earth's heterogeneous mantle: a product of convection-driven interaction between crust and mantle. Chemical Geology 330-331, 274-299 (2012)

2. Mallik, A., Lambart, S., Chin, E.J. Tracking the evolution of magmas from heterogeneous mantle source to eruption. In: Konter, J., Ballmer, M., Cottaar, S., Marquardt, H. (Eds.), Mantle Convection and Surface Expressions. Geophysical Monograph, 263, pp. 153–176.