Compositional patterns in basalts and mantle sources

ANDREAS STRACKE[1]

[1]Insitut für Mineralogie, Westfälische Wilhelms-Universität, Münster, stracke.andreas@uni-muenster.de

Spatial patterns in the isotopic composition of erupted basalts are often related in a one-to-one fashion to how heterogeneous components are distributed in their mantle sources. Such an inference requires the simplistic assumption that melts from different source components rise vertically and erupt directly over the location where they are produced at depth. However, melt generation, in both ocean island and ridge settings, occurs in a several 100 km wide melting region, whereas melts erupt in localized volcanoes or at the ridge axis. Hence, lateral focussing of melts occurs over several 100 km distances, which makes it unavoidable that melts from the entire melting region mix during melt focussing. Any spatial compositional pattern observed in erupted melts is thus unlikely to represent the same compositional pattern in the underlying mantle source.

Some level of correspondance may be expected in certain special cases: (1) if spacing between eruptive centers is larger than the distance over which melt funneling occurs or, (2) if the size of heterogeneity is *larger* than the scale of melt focusing, or if (3) indeed only vertical transport of melts occurs, or any comibation of (1)–(3). It is vital, therefore, to acknowledge that we need to develop a better understanding about the plumbing systems at ocean islands and ridges and about the size of isotopic heterogeneities.

Only then will it become clear how the observed features in the geochemical and isotopic data of erupted melts relate to variations in their mantle sources. However, postulating compositional variations that transcend beyond the depth of the immediate melting region from observations in erupted melts, perhaps down to ca. 3000 km depth at the core-mantle boundary (CMB), is unwarranted. For mantle ascent rates of several cm, material now at the CMB takes several 100 Ma to rise to the shallow mantle, and thus to become available for sampling through partial melting in the future. Hence, we cannot use the present compositional variability in erupted melts to augur what composition mantle sources at several 1000 km depth in the mantle might have.