

Crust-Mantle and Core-Mantle recycling

W. F. McDONOUGH AND R. D. AREVALO

Department of Geology, Univ. of Maryland, College Park,
MD, 20742, USA; mcdonoug@umd.edu

The formation, evolution and composition of the Depleted Mantle, the OIB source region and other mantle domains (present-day and ancient) are evaluated and constrained by using a variety of “constant” element ratios (e.g., Ce/Pb, Nb/U). Such element ratios typically involve pairs that have similar bulk partition coefficients during mantle melting, but have contrasting behavior during crust formation and/or during core separation, the two most significant differentiation events in the Earth. It is also highly advantageous to consider element ratio pairs across a spectrum of incompatibility (highly to moderately incompatible to compatible). Examples of these ratios include: Ba/W, Ba/Cs, Th/W, Mo/Ce, P/Nd, Re/Yb, Fe/Mn, Ge/Si, Mg/Ni. Moreover, in harmony with the insights discussed in Sun and McDonough (1989), it is necessary to link these chemical variations with radiogenic isotopic compositional variations that are consistent with the sense recorded in parent-daughter fractionation. By quantifying the variations in both the concentrations of the elements and the absolute values of the ratios we can more narrowly define the limits on the composition of the mantle and its domains, as well as the composition of the Earth’s core. These data are, in turn, used to constrain crust to mantle recycling as well as core-mantle exchange.

We have recently acquired data (laser ablation ICP-MS) for such element ratios on glassy basalt chips from various tectonic settings in the oceanic environment with our target precision on the element ratios being $<\pm 5\%$. We find limited evidence for crustal contributions to OIB source regions, with an upper limit of $<2\%$. In addition, these data reveal that contributions from the core to plume magmatism, which may be ascending from core-mantle boundary depth, are limited to $<0.5\%$.

This abstract is dedicated to the memory of Shen-su Sun, a great mentor, colleague and friend.