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Non-traditional stable isotopes in global basalts through time and the evolution of mantle mineralogical heterogeneity

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Recent studies of non-traditional stable isotope systems (e.g., Fe, Ni, Zn, Ti, Ca, Cr, V) have exploited variations in mineral- and redox-specific equilibrium fractionation effects to link observed variations to source mineralogy and processes, such as partial melting, magmatic differentiation, and the tectonic recycling of surface material [e.g., 1-4]. In this presentation, we will review some examples of how novel stable isotope systems, such as Fe, can be used to place constraints on the mineralogy and chemistry of the mantle source regions of ocean island basalts (OIB), Archean metabasalts and komatiites, and what the implications of these findings are for the mineralogical evolution of the Earth's upper and lower mantles. We will also discuss recent studies exploiting quantitative combined phase equilibria and equilibrium melt isotope fractionation models [5-6] and the extent that these can be used to predict equilibrium stable isotope partitioning during upper mantle melting of enriched and depleted lithologies. Finally we will review new novel isotope constraints on OIB mantle source region mineralogical heteorogenity with implications for the nature of large low-shear velocity provinces and the preservation of geochemical heterogeneities within the mantle.

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