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Role of recycled oceanic basalt and sediment in generating the long-lived isotopic mantle array

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The isotopic heterogeneity of all present-day oceanic basalts - Mid-Oceanic Ridge Basalts (MORB) and Oceanic Island Basalts (OIB) - is now well characterized for several isotopic systems such as Sr, Nd and Hf. These variations can be quantified and expressed in terms of relative abundance distributions. Using Monte Carlo simulations, we can simulate and test different mixtures of various components. Following the Hofmann & White (1982) model of recycling of oceanic crust in the source of intraplate volcanism, we simulate the Nd and Hf compositions measured for Mid-Oceanic Ridge Basalts and Oceanic Island Basalts. The model mixes three components: ancient recycled oceanic crust of varying ages, overlying subducted sediments and a typical depleted mantle. The results of this direct Monte Carlo approach were recently published (Chauvel, 2008, Nature Geosci.) and we showed that the presence of sediments with high 176Hf/177Hf ratios is required in the recycled component to account for the range and the distribution of Hf and Nd isotopic values found in MORB and OIB. Here, we built on the previous Monte Carlo simulation to optimize the fit to the oceanic basalt data. We constrain some of the key parameters that control the distribution and average value of the data for both OIB and MORB. This is a kind of inversion procedure. Extension of the model to the Sr isotopic system and its correlation with Nd and Hf constrains the characteristic Sr compositions of the major mantle sources.

A.W. Hofmann & W.M.White : Mantle plumes from ancient oceanic crust. Earth Planet. Sci. Lett., 1982, vol.57, pp.421-436. C. Chauvel, É. Lewin, M. Carpentier, N.T. Arndt and J.-C. Marini : Role of recycled oceanic sediments in generating the Hf-Nd mantle array. Nature Geoscience, jan.2008, vol.1 iss.1, pp.64-67.