The signature of recycled mafic crust in oceanic basalts

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Mafic oceanic crust is currently subducted at a rate of about 21km^3/a. Integrated through geological time this represents a significant geochemical reservoir, for incompatible elements in particular. Despite knowing that such material has been recycled into the mantle, clearly identifying it in mantle derived materials returned to the surface remains problematic. Most of the work in this field has focused on long-lived radiogenic isotopic systems. For example, arrays of ocean island basalts in Pb isotope space provided some of the earliest evidence for the role of recycled crust. Although appealing, several other processes can be invoked to fractionate U from Pb and so potentially generate such signatures. New tracers have been sought to track down more unequivocally recycled crust, and to some extent this quest has been aided by the advent of multi-collector inductively coupled plasma mass-spectrometers. Here we report on our work using three diverse techniques that range from a novel stable isotope system (^{7}Li/^{6}Li), short-lived nuclides (^{238}U-^{230}Th, ^{235}U-^{231}Pa) to the abundance of a major element (TiO_2). Perhaps ironically, it is the major element abundance that appears to provide the most definitive answer, although the other constraints serve to demonstrate why signatures of recycled crust are apparently so elusive.

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