Hofmann and White (1982) re-revisited

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Brandenburg et al. (2008) quantitatively explored the hypothesis from Hofmann and White (1982) that oceanic crust recycling contributes significantly to the trace element heterogeneity observed in MORBs and OIBs. They presented geodynamical models of mantle convection that satisfy the convective vigor of the present day Earth and investigated the roles of oceanic crust and continental crust formation on the U-Th-Pb, Rb-Sr, Re-Os, and Sm-Nd isotope systems. Reasonable agreement was found between model predictions and the spread of MORB and OIB data for DMM, HIMU, and EMI. The model results confirmed that the subduction and storage of dense oceanic crust in the deep mantle is key in developing the geochemical compositions that define these mantle endmembers. The formation and recycling of continental crust plays a lesser role, with the exception of the U-Th-Pb system. In that case increased enrichment of the continental crust after 2.5 Ga is required, which could be accounted for by the fluid-mobile nature of Pb and the onset of modern-style subduction.

Here, we extend this work to include Lu-Hf, U-Th-He, and K-Ar to provide further constraints on the geochemical mantle evolution, the nature of atmospheric ingassing at subduction zones, and the potential role of IDP in generating high-$^{3}He/^{4}He$ signatures.

We also significantly improve the finite element models to provide higher resolution compressible models that incorporate phase changes in the transition zone and the role of primordial heterogeneity that may have formed before and after the Moon-forming impact to investigate the role of initial heterogeneity and the counteracting roles of the formation and destruction of mantle heterogeneity by mantle convection and crust formation.