

Reaction Between Hydrous, Sediment-derived Melts and Peridotite at the Base of the Mantle Transition Zone

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The generally accepted interpretation of the isotopic and trace-element systematics of enriched- or EM-type ocean island basalts (OIB) is that their plume source incorporates a recycled component derived from the continental crust or its deeply subducted sediments. Inclusions of hydrous ringwoodite in ultradeep diamonds [1] suggest that the mantle transition zone (MTZ) is variably “water-rich” with a bulk H₂O content of ~1 wt%. If “wet spots” in the MTZ are associated with subduction, then any deeply subducted sediments are likely to respond to localized hydrous fluids, whether internally- or externally-derived, by undergoing partial melting, since their solidus is dramatically reduced in the presence of water. This scenario has been investigated in a series of “layered” experiments in the multi-anvil apparatus at ~23 GPa, with a layer of primitive mantle (KLB-1) on top of a layer of water-bearing “continental” sediment. At temperatures above ~1400-1500°C, a hydrous, Fe- and alkali-rich, Si- and Al-poor partial melt forms in the sediment, in equilibrium with stishovite + NAL-phase (“new aluminous phase”). These melts are highly-enriched in incompatible elements (e.g., K, Ba, Sr, REE, U and Th), and can easily migrate into the overlying layer of peridotite, metasomatizing the initial assemblage of (Mg-Fe) perovskite + ferropericlasite to wustite-free Al-rich (Mg,Fe) perovskite.

[1] Pearson, D.G. *et al.* (2014) *Nature* **507**, 221-224.