Characteristics and the distribution of source materials for OIB at the West African passive margin

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Among the several types of Ocean Island Basalts (OIB), those located along passive continental margins are most widely distributed off the West African continent (West Africa passive margin OIB or WAPM-OIB: Madeira, Selvagen, Canary, Cape Verde, and Cameroon volcanic line [CVL]). Despite their extended eruptive activity in each archipelago (25-70 My), magma production rates for WAPM-OIB were relatively small with no clear age progression of the hot-spot tracks. Thus it has previously been difficult to explain the origin of the magmas by a model involving a simple long-lived upwelling mantle plume. The observed heterogeneous isotopic compositions of the WAPM-OIB are in general explained by mixing of proposed mantle components (DM, HIMU, EM1, and EM2). However, their source characteristics and spatial distribution have not yet been clearly explained. High-precision Sr-Nd-Hf-Pb isotopic data for oceanic sector volcanoes in CVL [1] reveals varying degrees of involvement of lower continental crust (LCC) in these lavas. The involvement of LCC is also observed for the Canary and Cape Verde magmas, but less so for Madeira. This geographical distribution is consistent with the presence of a continental root in WAPM [2], and the LCC identified could be crustal materials detached during the breakup of the African and South American continents. In addition to the LCC, three distinct mantle components were identified for the CVL. All isotopic variation for the other WAPM-OIB can also be explained by mixing of these commonly invoked components possibly derived from depleted asthenospheric mantle and detached SCLM. This result indicates that the melt production to produce the WAPM-OIB was controlled by tectonically-controlled mantle convection along the oceanic-continental boundary.

[1] Belay, I. G. et al. (2015) Goldschmidt abstract, 246; [2] O'Reilly et al. (2009) Lithos, 211S, 1043-1054.