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U-series disequilibria in historical lavas from Izu-arc, Japan, reflect the role of slab fluid during magma genesis

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Historical lavas from three Izu-islands, Oshima, Miyakejima and Torishima, have been analyzed for U-series nuclide activities together with a basalt from the Sumisu Rift behind the arc. The three volcanoes display variable disequilibrium ratios with (231Pa) > (235U) and (226Ra) > (238U) > (230Th) unrelated to Th concentrations. (231Pa/235U) and (238U/230Th) correlate positively, and both ratios increase with Ba/Th. Regular decrease of Th-isotope ratios from south to north along the volcanic front is observed, whereas individual islands show relatively constant (230Th/232Th). 226Ra-excesses diminish systematically with increasing magma differentiation in a given volcano. Positive correlation between 10Be/9Be and (238U/230Th) in Kermadec arc and between lavas from the only two Izu-islands already analyzed suggests, as in the Southern Volcanic Zone of Chile, that U-excess are due to addition of a slab component and flux-melting of the depleted mantle wedge. Basalts and boninites so generated will rise rapidly to surface in order to preserve large 226Ra-excesses and correlation between (226Ra/230Th) and (238U/230Th) as observed in the Holocene products of Miyakejima (Yokoyama et al., 2006). Absence of correlation between (230Th/232Th) and (238U/232Th) in Izu-volcanoes would require either heterogeneous slab components (SC) between islands or a homogeneous slab component added to a variably depleted mantle protolith.

Increasing mantle wedge depletion will result in higher (238U/232Th) as observed in Torishima to the south, where back-arc spreading is better developped than in the north. This is also reflected in variable (230Th/232Th). Relatively modest 238U-

excesses over 230Th in the Izu arc lavas suggest that the slab component is not Th-free. The association of high Ba/Th, Th/La, (238U/230Th) and (231Pa/235U) suggests that Pa also can be carried in the slab component. Indeed, the systematics between 231Pa-excesses and 238U-excesses are readily explained by a slab-derived fluid that is a mixture of fluid from the basaltic and sedimentary portion of the slab. Elsewhere, silicic melts of subducted sediments play much stronger role than at Izu. Taken together, the U-series results in arc basalts can be readily explained by variable slab inputs.