Contrasting MORB-Boninite reaction trends in IBM forearc mantle

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Preliminary results from the petrographic and geochemical analysis of 50 lower crustal and upper mantle dunites, peridotites, troctolites and gabbros recovered by dredges D31 and D42 from the R/V Hakuho Maru KH07-02 dredging cruise of the inner trench slope of the Bonin Ridge (BR) have revealed 2 groups of samples which equilibrated with at least 2 distinct melt compositions. Group A consists of peridotites (Cpx-bearing harzburgite), plagioclase-dunites/olivine-troctolites, and gabbroic rocks which contain spinels with medium Cr# (100 x Cr / Cr + Al) ranging from 45 to 60 and high TiO2 and Al2O3 ranging from approximately 0.1 to 2.25 and 12 to 30 wt. % respectively. Group B consists of only dunites and peridotites (i.e. cpx-free harzburgite) which contain spinels with high Cr# ranging from 65 to 94 and low TiO2 and Al2O3 ranging from approximately 0 to 0.12 and 3 to 21 wt. % respectively. We interpret group A samples as having equilibrated with a MORB-like melt, whereas the group B samples equilibrated with a more depleted boninitic melt. Some evidence for this grouping has been observed in previous studies (i.e. Morishita et al., 2011) however the present data set is quite dramatic. Both boninites and MORB-like basalts, or fore-arc basalts (FAB), have been recovered in large amounts along the Bonin Ridge. Ishizuka et al. (2011) reported the FABs and the boninites as ranging in age from 50 to 52 and 44 to 48 Ma respectively, interpreting the gap in ages to represent the gradual change from decompression melting at subduction initiation to flux melting a boninitic volcanism over the span of 2 to 4 Ma. This means that the sub-solidus equilibration of the group B spinels with a boninitic melt had to be a more recent equilibration event than spinels belonging to group A. The group A and group B samples record the gradual change from MOR-like melts created by decompression melting at or soon after subduction initiation to arc-type flux melting and boninite volcanism. Further, the presence of lower-crustal melt-hybridized peridotites and gabbroic rocks with spinels belonging to group A and not group B suggests that a large portion of the lower crust along the BR might be made up of material related to the FABs. This would imply that a large portion of the lower crust in the fore-arc was formed during or shortly after subduction initiation and is similar in composition to MOR lower crust.

Morishita, T., et al., 2011, Diversity of melt conduits in the Izu-Bonin-Mariana forearc mantle: Implications for the earliest stage of arc magmatism: Geology, v. 39, p. 411-414, doi: 10.1130/G31706.1.
Ishizuka, O., et al., 2011, The timescales of subduction initiation and subsequent evolution of an oceanic island arc: Earth and Planetary Science Letters, v. 306, p. 229-240, doi: 10.1016/j.epsl.2011.04.006