Volcanic glasses from Exp. 352 cores

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Early subduction dynamics were explored by analyzing fresh glasses from an intact volcanic reference section drilled during IODP Expedition 352 to the Bonin fore-arc. The oldest lavas are “fore-arc basalts” (FAB), with compositions reminiscent of MORB, but with several peculiarities consistent with a different geodynamic origin. Major element compositions are consistent with extensive melting at high T, and final mantle equilibration at low-P. FAB from Sites U1440 and U1441 have exceedingly depleted incompatible trace element compositions compared to MORB, including relatively fugitive elements such as Cs, Rb, and U. Nevertheless, water and Cl concentrations are relatively high compared with depleted MORB, indicating that magma genesis might have involved subducted fluids. The youngest lavas atop Sites U1439 and U1442 are “high-Si boninites” (HSB), with extraordinarily depleted Ti and middle REE concentrations, high water (1.6 to 2.3 wt %) and extreme ratios between fluid soluble trace elements (e.g. Rb) and Ti. Lavas underlying HSB at these two sites have compositions that are transitional between FAB and HSB. The transition is progressive but non-linear with decreasing depth. FAB appear largely to have been generated by decompression melting during near-trench sea-floor spreading, perhaps with an assist from unusually solute-poor fluids from the nascent subducting slab. Melting to generate boninites involved a transition to shallower flux melting involving fluids and perhaps melts derived over a broad range of pressures from the subducting slab.