Figure F1. Regional map of the Izu-Bonin-Mariana (IBM) system showing the location of sites from Expeditions 350, 351, and 352.

Figure F2. Compilation of $^{40}Ar/^{39}Ar$, K/Ar, and U-Pb zircon dating results for Eocene igneous rocks from the IBM fore arc, modified after Ishizuka et al. (2011). Expedition 352 focuses on the detailed stratigraphy of the 7–8 My period between subduction initiation and the start of "normal" arc volcanism. Data sources: Meijer et al. (1982), Cosca et al. (1998), Reagan et al. (2008, 2013), Kaneoka et al. (1970), Ishizuka et al. (2006, 2011). HMA = high-magnesium andesite.

Figure F3. Variations in REE patterns in the Bonin fore arc following subduction initiation. Note the recently discovered MORB-like patterns of the first volcanic products, the fore-arc basalt, and the contrast with the later U-shaped boninite patterns. Expedition 352 research will obtain complete information on gradations within and between these units. Plot taken from Ishizuka et al. (2006, 2011).

Figure F4. V-Ti systematics (Shervais, 1982) for the lavas erupted following subduction initiation. Note that the earliest lavas to erupt following subduction initiation are distinct from MORB and from later boninites. These are, however, isolated outcrops. Plot taken from Ishizuka et al. (2006, 2011).

Figure F5. Isotopic compositions highlight the complex variations in lava chemistry following subduction initiation. A complete stratigraphy will enable better interpretation of these data in terms of variations in mantle sources and subduction components following subduction initiation. Data from Ishizuka et al. (2006, 2011). KPR = Kyushu-Palau Ridge, NHRL = Northern Hemisphere reference line. Solid line = Quaternary Izu-Bonin front compositions, dashed line = Oligocene arc (KPR) compositions.

Figure F7. Basalt and boninite composition defined in terms of Ti8 and Si8. Yellow field = compositional field of boninite as defined by IUGS. Red line = Pearce and Robinson's (2010) definition of the compositional boundary between basalt and boninite. Basaltic vs. boninitic character is further defined in this figure as a function of the age of the lava following subduction initiation in the Bonin fore arc. FAB erupts first and at the end, but otherwise boninites dominate. Boninites are characteristic of subduction initiation, and the full stratigraphy would enable their tectonic significance to be explained better. Data are from Pearce et al. (1999), Reagan et al. (2010), and Ishizuka et al. (2011). IAB = island arc basalt, Chi = Chichijima.

Figure F6. Interpretation of tectonic evolution of the Bonin Ridge in Ishizuka (2006) based on the concept of Stern and Bloomer (1992). According to this model, subduction initiation is followed by sinking of the slab with slab-parallel subduction and hence normal arc volcanism only beginning later. Later discoveries of fore-arc basalt in the Mariana and Bonin fore arcs (Reagan et al., 2010; Ishizuka et al., 2011) have pushed back to 52–45 Ma the period addressed by this expedition in an attempt to test this model in detail. BRE = Bonin Ridge Escarpment.

Figure F8. Expedition 352 sites and locations of *Shinkai 6500* dives discussed in the text.

Figure F9. Rock types recovered from dredging and diving expeditions to the Bonin fore arc, showing its ophiolitic structure (after Ishizuka et al., 2011). Stars = Sites U1439–U1442, boxes = areas chosen for more detailed site survey dives.

Figure F10. Schematic cross-section (not to scale) for the Bonin fore-arc drill site area.

Figure F11. Lithostratigraphic sediment units and ages based on biostratigraphy.

Figure F12. Lithostratigraphic igneous units. Red hatched bars adjacent to lithology column represent fault zones. HSB = high-silica boninite, LSB = low-silica boninite.

Figure F13. Lithostratigraphic sediment units and ages based on biostratigraphy.

Figure F14. Lithostratigraphic igneous units.

Figure F15. Lithostratigraphic sediment units and ages based on biostratigraphy.

Figure F16. Lithostratigraphic igneous units.

Figure F17. Lithostratigraphic igneous units. Red hatched bars adjacent to lithology column represent fault zones. Opx = orthopyroxene, Ol = olivine, Cpx = clinopyroxene, Pl = plagioclase.

Figure F18. Lithostratigraphic sediment units and ages based on biostratigraphy.

Figure F19. Schematic igneous stratigraphic columns for Expedition 352 drill sites, from west to east. The western sites, U1439 and U1442, consist of boninite group lavas, including HSB, LSB, basaltic boninites, and evolved boninite-series lavas. Site U1442 includes a thick section of volcaniclastics and consists largely of hyaloclastite breccias with intercalated lava flows. In contrast, Site U1439 comprises lava flows with fewer hyaloclastite horizons. At both boninite sites, the most depleted primary boninites are found at the top of each section. The eastern sites, U1441 and U1440, consist of fore-arc basalts, including lavas, dikes or sills, and a transition zone of lavas and dikes. D-FAB, an ultradepleted variety of FAB with exceptionally low Ti concentrations, was found at Site U1441.

Figure F20. MgO vs. SiO_2 and TiO_2 vs. MgO diagrams used to classify the volcanic rocks and dikes sampled during Expedition 352. Boninites (sensu stricto) are defined by IUGS (Le Bas, 2000) as having MgO > 8 wt%, TiO_2 < 0.5 wt%, and SiO_2 > 52 wt% and so plot in the shaded rectangular fields on both diagrams. The dividing line between the boninite and the basalt-andesite-dacite-rhyolite (BADR) series is from Pearce and Robinson (2010) (Trans. = transitional). The upper boninite series field has been divided by us into basaltic, low-silica, and high-silica boninites for more precise naming of recovered rocks. Evolved boninite series rocks classify as HMA and plot in the fields shown.

Figure F21. (A) Zr vs. TiO_2, (B) Sr/Ti vs. Ti/Zr, and (C) V vs. TiO_2 for Sites U1439–U1442 and selected cores from DSDP Site 458. Diagonal lines in A illustrate Ti/Zr ratios, and those in C represent Ti/V ratios. The yellow fields illustrate Pacific and Atlantic MORB compositions using the glass analyses of Jenner and O'Neill (2012).

Figure F22. Concentrations of TiO_2 and Cr with depth, Hole U1440B.

Figure F23. Concentrations of TiO_2 and Cr with depth, Hole U1441A.

Figure F24. Cr concentrations and Ti/Zr ratios with depth. The central colored bars represent our stratigraphic correlation between these two holes (see text for further explanation). BB = basaltic boninite.

Figure F25. Summary of sedimentary sections. Eocene to Holocene sediment shows typical pelagic carbonates. They are variably influenced by local and regional volcanism, leading to the alternating sequences of volcaniclastic-rich and nannofossil-pure lithologic units.

Figure F26. Normalized ash abundance, Sites U1439–U1442. Note different amounts of felsic and mafic ash layers across the slope. Arrows mark the decrease and increase of felsic and mafic tephras, respectively.