Figure F1. Expedition 352 sites at the IBM fore arc. Red circle = Site U1440, yellow circles = other Expedition 352 sites. White lines = multichannel seismic lines (S. Kodaira, pers. comm., 2013).

Figure F2. Location of Site U1440 along multichannel seismic Line IBr11n (S. Kodaira, pers. comm., 2013). Green bar shows the depth of Hole U1440A, blue bar shows the depth of Hole U1440B. CDP = common depth point.

Figure F3. Reentry system.

Figure F4. Lithostratigraphic summary of sediment cores. Very closely spaced ash layers may not always appear individually in the tephra column.

Figure F5. Selected major element oxides analyzed by ICP-AES, Hole U1440A (see **Sediment and rock geochemistry**).

Figure F6. (A) Weakly bioturbated, brownish to beige mud with (B) thin, graded tephra interbeds, Hole U1440A.

Figure F7. Thick ash layer composed of inferred primary fall-out ash (at least ~39 cm thick), followed by 44 cm of reworked ashy material showing planar and laminar bedding, plus some darker, more mineral rich horizons, as seen in smear slides. The original distinction between primary and reworked ash is likely to have been obscured by drilling disturbance because the entire ash horizon is soupy. In addition, there is a 25 cm thick horizon of ashy material (dispersed ash) admixed with background sediment.

Figure F8. Greenish gray hemipelagic mud with foraminifers, together with minor sand layers. Hole U1440A.

Figure F9. Typical background sediment of dark greenish gray to greenish brown silty mud, Hole U1440A. This subunit is more heterogeneous than Subunits IA and IB, as shown by the presence of (A, B) interlayers of ash and (C) tuffaceous sand and mud.

Figure F10. Sediment layers, Hole U1440A. A. Greenish gray and brown volcaniclastic-rich, variably bioturbated silty mud and an intercalated light grayish tephra, together with several dark tuffaceous sand layers. B. Lower part of the subunit with brown coarser grained sediment within bioturbated silty mud. The matrix-supported clast-rich layers include several clasts (centimeter sized) made up of poorly consolidated pink noncalcareous siltstone and highly altered basalt.

Figure F11. Core disturbance, Hole U1440A. A. Flow-in structure in the upper part of the subunit, as revealed by the mixing of dark tephra with greenish gray background muddy sediment. B. The lower part of the subunit is also heavily disturbed by flow-in, resulting in irregular mixtures of greenish gray sandy mud and clast-rich brown silty mud.

Figure F12. Color alternation and banding, Hole U1440A. A. Alternating beige to brown silty, noncalcareous mud with scattered clasts ranging up to granule or pebble size. B. Vague subhorizontal color banding from beige to brownish and light brown to dark brown together with (C) rare very dark metal oxide (manganese?) segregations.

Figure F13. A. Brown to dark brown mud-supported granule-grade breccia/conglomerate alternating with grayish-brownish to pinkish calcareous ooze. The rounded basalt, tuff, and pumice clasts are strongly altered and range from millimeters to several centimeters in size. B. Thin (several centimeter-thick) beds of homogeneous, noncalcareous dark brown mud are intercalated with thin, distorted layers of silty volcaniclastic sand. C. Several thin (decimeter thick) layers of silty nannofossil ooze alternate with dark layers (<15 cm thick) that appear to be enriched in iron and/or manganese oxide.

Figure F14. Age-depth plot with approximate ages from productive intervals, Holes U1440A and U1440B.

Figure F15. Stratigraphic column of sedimentary units with calcareous nannofossil biozonation indicating approximate ages of each unit.

Figure F16. Methane concentrations in headspace gas and interstitial water ammonium and phosphate concentrations, Hole U1440A.

Figure F17. Interstitial water, sulfate, sodium, and bromide concentrations, Hole U1440A. Blue arrows = seawater values.

Figure F18. Interstitial water alkalinity, potassium, calcium, and magnesium concentrations, Hole U1440A. Blue arrows = seawater values.

Figure F19. Stratigraphic summary of basement cores. Lithologies are based on thin section and pXRF chemical data; interpretations are based on macroscopic characteristics. The volcanic/extrusive zone comprises volcanic rocks only, whereas the transition zone includes both volcanic rocks and dikes. The dike complex is entirely intrusive.

Figure F20. pXRF chemostratigraphy data, Hole U1440B. Dashed horizontal lines indicate unit boundaries. Horizontal lines within Unit 15 mark boundaries between Subunits 15a (top) through 15e (bottom).

Figure F21. Notable macroscopic features of igneous units, Hole U1440B. A. Onion-skin weathering, Unit 2 (4R-2A, 5–13 cm). B. Segregation vesicles, Unit 2 (5R-1A, 8–17 cm). C. Pillow lava radial fractures and vesicles, Unit 5 (17R-1A, 36–52 cm). D. Andesite vitrophyre, Unit 6 (19R-1A, 7–18 cm). E. Segregation-pipe vesicles, Unit 13 (31R-1A, 26–33 cm).

Figure F22. Microscopic features of igneous units, Hole U1440B. A. Aphyric intersertal to intergranular plagioclase and augite in basalt, Unit 2 (10R-1W, 109–111 cm; TS23; cross-polarized light [XPL]). B. Large phenocrysts of plagioclase in microcrystalline intersertal groundmass, Unit 5 (17R-2W, 24–27 cm; TS36; XPL). C. Fresh clear glass with localized devitrified spherulites, from a glass-chilled rim, Unit 6 (19R-1W, 74–77 cm; TS39; plane-polarized light [PPL]). D. Plagioclase phenocrysts in a spherulitic devitrified glass matrix (22R-1W, 58–60 cm; TS44; XPL). E. Quenched textured basalt, defined by fibrous splays of devitrification (22R-1W, 58–60 cm; TS44; PPL). F. Subophitic large augite phenocrysts in an intergranular plagioclase-rich matrix (36R-1W, 115–118 cm; TS76; XPL). G. Ophimottled augite enclosing plagioclase (36R-1W, 115–118 cm; TS76; XPL). H. Small euhedral interstitial quartz crystals between plagioclase in dolerite (36R-1W, 115–118 cm; TS76; PPL).

Figure F23. Transformation of groundmass to a mixture of zeolites, clays, and oxidized iron oxides, Hole U1440B. A. SEM image of lava groundmass showing fresh primary phases (light gray; plagioclase and pyroxene) with interstitial zeolite and clay (dark gray). B. Plagioclase phenocryst transformed into zeolite next to calcite- and zeolite-filled vesicles (12R-1; TS27). C. Vesicle filled with zeolites (21R-1; TS41). D. Brownish alteration zone parallel to calcite veins in Section 35R-1 corresponding to microcracks filled with a mixture of clays and sulfides (36R-1; TS73).

Figure F24. Hole U1440B thin sections. A. Vein filled with zeolite and a calcite margin cutting the phenocrysts as well as the groundmass (24R-1; TS48; XPL). B. Vein filled with zeolite and a calcite margin cutting devitrified groundmass (24R-1; TS48; XPL). C. Composite vein with zeolite and calcite filling; green clay replaced lately the zeolite and calcite primary assemblage (32R-1; TS65; XPL). D. Calcite vein containing clasts of the host rock and sulfides (35R-1; TS72; SEM).

Figure F25. CO_2 (solid symbols = total carbon, open symbols = inorganic carbon), Sr, and some major element oxide concentrations in sediment, Holes U1440A (blue) and U1440B (green). Gray shaded areas = composition of clay- and volcaniclastic-dominated silty mud.

Figure F26. SiO_2, Mg#, LOI, Cr, Zr, and Ti/V ratios for igneous rocks. Blue = volcanic units, pale violet = mixed volcanic and doleritic units, purple = lower dolerites.

Figure F27. H_2O and CO_2 concentrations vs. LOI values (see **Alteration**), Site U1440.

Figure F28. Total alkali content vs. SiO_2 volcanic rock classification diagram (Le Bas et al., 1986), Site U1440. All mafic rocks drilled at Site U1440 are tholeiitic and lie in the basalt and basaltic andesite fields, with a single differentiated sample from Unit 6 in the andesite field.

Figure F29. SiO_2 and CaO/Al_2O_3 ratios vs. MgO, Site U1440. Compositions are compared to a compilation of published compositions of MORB (Jenner and O'Neill, 2012) together with IAT (GEOROC database; August 2014), and FAB (Reagan et al., 2010) from the IBM subduction system.

Figure F30. Zr, Y, and V vs. Ti, Site U1440. Compositions are compared to a compilation of published compositions of MORB (Jenner and O'Neill, 2012) together with IAT (GEOROC database; August 2014), and FAB (Reagan et al., 2010) from the IBM subduction system.

Figure F31. TiO_2 vs. Mg#, Site U1440. Compositions are compared to a compilation of published compositions of MORB (Jenner and O'Neill, 2012) together with IAT (GEOROC database; August 2014), and FAB (Reagan et al., 2010) from the IBM subduction system.

Figure F32. Zr/Y ratio vs. Zr, Site U1440. Compositions are compared to a compilation of published compositions of MORB (Jenner and O'Neill, 2012) together with IAT (GEOROC database; August 2014), and FAB (Reagan et al., 2010) from the IBM subduction system.

Figure F33. Bedding dip angles as a function of depth. The subhorizontal attitude of bedding highlights the fact that the sedimentary units essentially remain in their original orientation.

Figure F34. Isotropic magmatic microfabric, Hole U1440B (2R-1W, 65–68 cm; TS43; XPL).

Figure F35. SPO of plagioclase defining a magmatic foliation at microscale, Hole U1440B (23R-1W, 29–32 cm; TS45; XPL).

Figure F36. Microstructural radial arrangement of plagioclase laths attesting to rapid cooling, Hole U1440B (21R-1W, 10–13 cm; TS41; XPL).

Figure F37. Macroscopic foliation formed by clusters of chlorite, Hole U1440B (35R-1W, 4–7 cm; TS71; XPL). Full thin section.

Figure F38. Foliation dip angles as a function of depth, Hole U1440B.

Figure F39. Fracture dip angles as a function of depth, Hole U1440B.

Figure F40. Frequency distribution of fracture dip angles, Hole U1440B.

Figure F41. Vein and tension gash dip angles, Hole U1440B.

Figure F42. Frequency distribution of vein and tension gash dip angles, Hole U1440B.

Figure F43. Frequency of vein and tension gash dip angles as a function of depth, Hole U1440B.

Figure F44. Hydraulic breccia, Hole U1440B. Host rock fragments are embedded within mainly sparitic carbonate cement (17R-1A, 113–118 cm).

Figure F45. Plastic fabric in a calcite crystal within a vein, Hole U1440B (12R-1W, 99–101 cm; TS27; XPL).

Figure F46. Macroscopic fabric of a foliated domain within dolerite, Hole U1440B (35R-1A, 29–46 cm).

Figure F47. Microstructure of cataclastically deformed rock, Hole U1440B. The isotropic magmatic fabric can still be discerned. The rock-forming minerals (prismatic plagioclase and clinopyroxene), however, are fragmented by multiple sets of microfractures. A. 36R-1W, 110–113 cm; TS75; PPL. B. 36R-1W, 110–113 cm; TS75; XPL.

Figure F48. WRMSL physical properties summary of sediment cores. Blue points = raw values, red lines = filtered data (mean values in 50 cm range).

Figure F49. SHMSL physical property data and discrete sample MAD measurements of sediment cores. L*, a* b*: blue points = raw values, red lines = filtered data (mean values in 50 cm range). MAD and porosity: solid circles = discrete values (blue = dry density, black = bulk density, purple = grain density, red = porosity). Black points in MAD are WRMSL GRA density data shown for comparison.

Figure F50. WRMSL physical property measurements of basement cores, Hole U1440B. Blue points = raw values, red points = filtered data (maximum values of rock pieces ≥10 cm in length), red lines = trend of maximum value in each core.

Figure F51. SHMSL and discrete sample physical property measurements of basement cores, Hole U1440B. Discrete samples were used for magnetic susceptibility (green diamonds), *P*-wave caliper (PWC), and MAD measurements. L*, a*, b*: blue points = raw values, red points = filtered data (maximum values of rock pieces ≥10 cm in length), red lines = trend of maximum value in each core.

Figure F52. Thermal conductivity probe measurements and downhole temperature (DHT) measurements, Site U1440. TCON was measured on whole-round cores for the sediment interval (black points) and on discrete samples for basement rocks (blue points). Solid red line with error bars: mean and standard deviation for the Hole U1440A thermal conductivity measurements (blue circles), solid red line = least-squares fitted line to the four temperature measurements, solid black line = borehole temperature profile calculated with thermal conductivity data as a function of summed thermal resistance. Thermal conductivity is 0.87 ± 0.081 W/(m·K). Temperature gradient (T_{depth}) = 3.46 + 0.0224 × depth (m). Heat flow is 23.8 ± 2.2 mW/m^2. T_{bottom} = 8.1° ± 0.4°C.

Figure F53. Sediment core NRM intensity, Hole U1440A.

Figure F54. APC core magnetic stratigraphy, Hole U1440A. Paleomagnetic inclination measurements after 25 mT AF demagnetization. Horizontal gray zones = normal-polarity (positive inclination) sections. Core: NR = not recovered. Polarity and GPTS (Gradstein et al., 2012): hatched areas = uninterpretable, dashed lines = correlations. Chron terminology from Cande and Kent (1995). GAD = geocentric axial dipole.

Figure F55. Representative AF demagnetization results, Hole U1440B. A. Equal area stereonet showing the direction of the magnetization vector endpoint at different AF steps. B. Orthogonal vector (Zijderveld) plot showing the magnetization vector endpoints plotted on two orthogonal planes (one vertical and one horizontal). C. Normalized magnetization strength, *M*, at a given AF field demagnetization, normalized by the maximum magnetization strength, M_{max}.

Figure F56. AF demagnetization experiment that did not produce consistent results, Hole U1440B. The vector endpoint, as seen in B, never stops moving during the demagnetization. The orthogonal vector plot shows that the demagnetization path is curved so that there is no consistent direction. Plot conventions as in Figure **F55**.

Figure F58. Representative thermal demagnetization results, Hole U1440B. Between 200° and 350°C, the normalized magnetization increases and the vector endpoint moves away from the origin, indicating a partial self-reversal (Doubrovine and Tarduno, 2004, 2005). Plot conventions as in Figure **F55**.

Figure F59. pARM acquisition of eight representative samples used for AF demagnetization, Hole U1440B. Values measured with a sliding window of 10 mT in a direct-current field of 0.1 mT superimposed on an AF maximum field of 100 mT. The field indicated on the *x*-axis corresponds to the higher field in the interval. For example, the point at 20 mT is the pARM acquired on the 20–15 mT interval.

Figure F57. Thermal demagnetization results for coarse-grained sample, Hole U1440B. This sample was dunked in liquid nitrogen (N_2) to remove the effect of multidomain grains (Heider et al., 1992). The normalized magnetization plot shows that ~20% of the NRM was lost from this demagnetization technique, implying that the sample contains a fraction of multidomain magnetic grains. Plot conventions as in Figure **F55**.

Figure F60. IRM acquisition curves for five representative samples, Hole U1440B.

Figure F61. Inclination and lithology comparison, Hole U1440B. Inclinations derived from PCA calculations from AF and thermal demagnetization. TH = thermally demagnetized. Gray shaded bands = normal polarity. Stability column shows zones where virtually all archive core pieces produced inconsistent (unstable) demagnetization results.

Figure F62. Schematic of logging tool string deployments, Hole U1440B.

Figure F63. Summary of spectral gamma ray measurements, including corresponding data from recovered core material (gray circles; see **Physical properties** and **Sediment and rock geochemistry**).

Figure F64. Summary of triple combo-UBI tool string logs. R3 = medium resistivity reading, R5 = deepest HRLA resistivity reading, RT = true resistivity (modeled from all depths of investigation). Gray circles = core data. 43

Figure F65. Summary of FMS-sonic tool string logs. C1 = Caliper 1, C2 = Caliper 2. Gray circles = core data.

Figure F66. Comparison of main logs recorded during subsequent passes of the triple combo-UBI tool string.

Figure F67. Comparison of caliper (hole size) and gamma ray data acquired during subsequent tool string passes and tool string deployments (runs). 46

Figure F68. Statically processed FMS images, Hole U1440B. A. More conductive material higher in the hole, Unit 3. B. Very resistive material, Unit 4. C. Textural variations, Unit 5. D. Resistivity variations, Units 5 and 6.

Figure F69. Through-pipe gamma ray downhole logging data in Hole U1440B compared to NGR core data in Hole U1440A. Light gray lines = approximate position of pipe joints, dark gray line = bit depth.