Figure F1. Bathymetric map of the Kermadec arc, trench, and major tectonic elements. Brothers volcano is located on the active volcanic front in the southern half of the arc. From de Ronde et al. (2012).

Figure F2. Detailed bathymetry of Brothers volcano and surrounding area. Dashed lines = structural ridges. NF = North fault, SF = South fault, NRZ = North rift zone, UC = Upper Cone, LC = Lower Cone, UCald = Upper Caldera, NWC = NW Caldera, WC = W Caldera, SEC = SE Caldera, RTR = regional tectonic ridge. A–B (coincident with Seismic Line Bro-3) and C–D are endpoints for the bathymetric cross sections shown in the top panels. Contour interval = 200 m. Modified from Embley et al. (2012).

Figure F3. A. AUV tracks from the 2007 *ABE* dives (colored tracks) and the 2011 *Sentry* dive (white tracks). Figure from Baker et al. (2012). B. Results of the high-resolution (~2 m) mapping of the caldera walls and cones from the *ABE* survey overlain on EM300 bathymetric survey (~25 m resolution) data for the caldera floor, Upper Caldera walls in the northwest, and the outside flanks of the volcano. From Merle et al. (2007) and reproduced with some modification in Embley et al. (2012).

Figure F4. Distribution of plume tracers in (A–D) 2007 using the *ABE* survey and in (E, F) 2011 using the *Sentry* survey overlain on bathymetry from Figure F3B. Light blue shaded area in some panels marks area of Dive 205 survey (see Figure F3A) where no Δ nephelometric turbidity units (ΔNTU) or dE/dt data were recorded. A. Δθ (°C) anomalies. B. ΔNTU anomalies. C. dE/dt (mV/s) anomalies. D. Fluid discharge types inferred from ΔNTU/Δθ values. E. ΔNTU anomalies. F. dE/dt (mV/s) anomalies. Plots from Baker et al. (2012).

Figure F5. Apparent magnetization map of Brothers volcano showing reduced crustal magnetization over four areas that include five hydrothermal vent sites. A = Upper Caldera and NW Caldera, B = Upper Cone, C = SE Caldera, D = W Caldera. Outlined areas have either very low (<2.5 A/m; Zones A and D) or moderate (<3.5 A/m; Zones B and C) magnetization, which is in general agreement with the location of the various vent fields. The Lower Cone hydrothermal vent site is situated immediately northeast of Zone B and does not have an associated reduced crustal magnetization signature. Zone C is largely an extinct vent site. Structural lineaments (white lines) and ring faults (white lines with hash marks) are shown for reference. Figure from Caratori Tontini et al. (2012a).

Figure F6. Detailed bathymetry (contour interval is 200 m) of Brothers volcano and surrounding area showing the location of sites drilled during Expedition 376: U1527, U1528, U1529, U1530, and U1531 (modified from Embley et al., 2012).

Figure F7. Lithostratigraphic summary of Holes U1527A and U1527C on the rim of the caldera at the NW Caldera hydrothermal field. CSF-A = core depth below seafloor, Method A.

Figure F8. Distribution of alteration types and abundance of key minerals, Site U1527.

Figure F9. Representative intervals of alteration types, Hole U1527C. Type Ia: unaltered to slightly altered clast of dacite (376-U1527C-6R-1, 94–101 cm). Type Ib: dark unaltered clasts of dacite with well-defined boundaries surrounded by altered yellow-brown matrix (11R-1, 0–6 cm). Type IIa: pervasively altered clasts surrounded by chlorite-altered matrix (14R-2, 120–138 cm). Type IIb: overprint of IIb onto IIa (14R-2, 4–20 cm). Type III: pervasively altered clasts with resorbed, gradational boundaries (18R-1, 30–39 cm).

Figure F10. Variations of major element oxides compared with macroscopic estimate of degree of alteration, Holes U1527A and U1527C. Vertical lines = average values of shallower unaltered Igneous Unit 1 in Hole U1527A. Dashed lines = 1σ from average values. The two shallowest samples correspond to relatively unaltered volcanic material recovered from the BHA in Hole U1527C.

Figure F11. Lithostratigraphic summary of Holes U1528A, U1528B, and U1528D in the pit crater of the Upper Cone.

Figure F12. Distribution of alteration types and abundance of key minerals, Site U1528. MS = magnetic susceptibility, WRMSL = Whole-Round Multisensor Logger.

Figure F13. Representative intervals of alteration types, Site U1528. A. Type I (376-U1528A-1R-3, 25–38 cm). B. Type II (376-U1528D-22R-1, 91–103 cm). C. Type III (4R-2, 94–102 cm). D. Type IV. Top: Type IV crosscutting Type II (10R-1, 71–76 cm). Bottom: Type IV crosscutting Type III (18R-2, 71–77 cm).

Figure F14. Salinity (NaCl equivalent wt%) vs. homogenization temperature and corresponding enthalpy of NaCl-H_2O (Bischoff and Rosenbauer, 1985) for fluid inclusions from anhydrite, gypsum, and natroalunite recovered from Site U1528. NaCl saturation curve calculated from Driesner and Heinrich (2007), and NaCl vapor conjugate curve calculated from Bischoff (1991). Phase separation (boiling) curves calculated for seawater (bc1), seawater (sw) + 0.22 m CO_2 (bc2), 33 wt% NaCl equivalent hypersaline brine (bc3), and 33 wt% NaCl equivalent hypersaline brine + 0.22 m CO_2. Broken line with arrow = salinities caused by vapor condensation under subcritical conditions.

Figure F15. Variations in major element oxides, Site U1528. Horizontal dashed lines = depth intervals marked by major geochemical changes and alteration types. Vertical shaded area = compositional range (and 2σ from the average) for fresh dacites from Igneous Unit 1 in Hole U1527A and at Site U1529. Data are from ICP-AES analyses, except those with plus symbols, which are handheld portable X-ray fluorescence (pXRF)-generated data.

Figure F16. Representative macroscopic samples from the single igneous unit at Site U1529. A. Volcaniclastic xenocryst included in dacite lava. B, C. Dacite with fractures accentuated by white halite. D. Lapilli-sized fragments of dacite lava.

Figure F17. Lithostratigraphic summary of Hole U1530A on the caldera wall of the NW Caldera hydrothermal field.

Figure F18. Distribution of alteration types and abundance of key minerals, Hole U1530A. Abundance is based on the mineral assemblages determined by XRD and thin section observations.

Figure F19. Representative alteration types in hand specimens, Hole U1530A. A. Type I: blue-gray illite-rich clasts crosscut by a network of pyrite-anhydrite-silica veins with a mesh texture. B. Type II: sediment with fine-grained, subhorizontal laminations that are subsequently cut by a vuggy anhydrite vein. C. Subtype IIIa: subrounded to subangular light gray clasts in a gray silicified matrix. D. Subtype IIIb: variably silicified blue-gray clasts exhibiting extensive resorption in a matrix of pyrite intergrown with quartz, with the occasional vug infilled with anhydrite. E. Type IV: homogeneous gray matrix with poorly distinguishable clasts containing patchy pyrophyllite and abundant vugs infilled with quartz and anhydrite. F. Type V: mottled equigranular rock with a clear distinction between light gray quartz-dominated and dark gray diaspore-pyrophyllite–rich areas.

Figure F20. Salinity (NaCl equivalent wt%) vs. homogenization temperature and corresponding enthalpy of NaCl-H_2O (Bischoff and Rosenbauer, 1985) for fluid inclusions from anhydrite, Site U1530. The critical line divides the diagram into the supercritical and subcritical zones. NaCl saturation curve calculated from Driesner and Heinrich (2007); NaCl vapor conjugate curve calculated from Bischoff (1991). Phase separation (boiling) curves calculated for seawater and for 41 wt% NaCl equivalent hypersaline brine (bc1). Salinities measured near the seawater line may be due to condensation from a supercritical NaCl vapor. Hypersaline brine salinities above the NaCl saturation curve may be caused by boiling (bc1) or a NaCl brine with additional major cations such as K (line NK).

Figure F21. Variations in major element oxides in altered volcaniclastic rocks and lavas, Hole U1530A. Average values for fresh dacites recovered from Hole U1527A and at Site U1529 are shown with dashed vertical lines representing 2σ from average values.