

Figure F1. Detailed bathymetry of Brothers volcano and surrounding area showing the location of sites drilled during Expedition 376. Contour interval = 200 m. Modified from Embley et al. (2012).

Figure F2. Lithostratigraphic summary, Holes U1531A–U1531C and U1531E.

Figure F3. Representative macroscopic images of Igneous Unit 1, Hole U1531B. A. Vesicular, glassy lava with visible plagioclase phenocrysts. B. Hybrid of effusive and clastic eruptive styles, with lava fragments (example of clast indicated by yellow dashed circle) enclosed in a glassy matrix.

Figure F4. Petrological features observed in thin sections of Igneous Unit 1, Holes U1531A–U1531C. A. Plagioclase (Plag)-clinopyroxene (Cpx) glomerocryst. Opx = orthopyroxene (cross-polarized light [XPL]). B. Plagioclase with oscillatory zoning (XPL). C. Melt inclusion (MI) and embayment in plagioclase (plane-polarized light [PPL]). D. Apatite and magnetite (Mgt) enclosed in plagioclase (PPL). E. Ortho- and clinopyroxenes intergrown with magnetite (XPL). F. Magnetite and sulfide (Sulf) inclusion (reflected light [Refl.]).

Figure F5. Representative microscopic images of textural features in thin sections of Igneous Unit 1, Holes U1531A and U1531B (PPL). A. Clast and lighter rim showing an exclusively microlitic groundmass. B. Dominant clast type with spherical, rounded vesicles and an irregular, probably quenched margin embedded in glassy matrix. Mgt = magnetite, Plag = plagioclase. C. Different clasts embedded in glassy matrix with flow texture. D. Second clast type with irregular vesicles embedded in glassy matrix.

Figure F6. Slightly altered volcanic rock, Hole U1531A. A. Native sulfur coats and fills voids together with a light gray clay mineral. B. Fe oxyhydroxide coating a vug with zeolite crystals. C. Fine-grained spherical pyrite grain aggregate with tabular-shaped (unidentified) zeolite crystals in a vug.

Figure F7. Volcanic fabrics, Holes U1531B and U1531C. A. Subvertical volcanic fabric defined by elongate vesicles. B. Moderately dipping volcanic fabric defined by foliation and lineation. Aspect ratio of vesicles is  $\leq 15$ . C. Moderate volcanic fabric defined by elongate vesicles, plagioclase microlites, and to a lesser extent plagioclase phenocrysts (PPL). Sample is unoriented.

D. Volcanic clasts with volcanic fabrics (white arrows) (PPL). Orientation of each fabric is distinct from fabrics in other clasts. Lower part of image is an isotropic to weak volcanic fabric. Sample is unoriented.

Figure F8. Total alkali ( $\text{Na}_2\text{O} + \text{K}_2\text{O}$ ) vs. silica ( $\text{SiO}_2$ ), Igneous Unit 1. Data are reported for fresh dacites from Hole U1527A and unaltered to slightly altered dacitic clasts and tephra from Sites U1531 and U1529. Major element oxide concentrations were recalculated to 100% on a volatile-free basis. Additional data for comparison include (1) dacitic to rhyolitic glasses and whole rock from Brothers volcano reported in previous studies (Haase et al., 2006; Wright and Gamble, 1999; Timm et al., 2012) and (2) subaerial lava recovered along the Kermadec arc ( $25^\circ$ – $37^\circ\text{S}$ ) (data compiled from the GEO-ROC geochemical database at <http://georoc.mpch-mainz.gwdg.de/georoc>; downloaded on 5 June 2018).

Figure F9. AF demagnetization experiment showing univectorial decay in Sample 376-U1531C-1R-1, 133–135 cm, with a large NRM before demagnetization (1.92 A/m). This sample shows high coercivity and stable primary magnetization for AF >10 mT.

Figure F10. TD experiment using Sample 376-U1531A-1R-1, 90–92 cm, with a large NRM before demagnetization (6.25 A/m). The drilling overprint in this experiment was removed at temperatures >200°C, leaving a stable primary component.

Figure F11. Physical properties, Hole U1531C (Lower Cone summit; top) and Holes U1531A, U1531B, and U1531E (Lower Cone flank; bottom). *P*-wave velocity values are the mean for each set of measurements. Lithology columns are aligned such that recovered core intervals correspond to the depths shown in the plots to reflect the Lower Cone summit vs. flank location and associated distinct water depths at the seafloor.

Figure F12. MAD *P*-wave velocity data for discrete samples, Holes U1531B, U1531C, and U1531E. Line shows best fit from linear regression.

Figure F13. Whole-round sample collected for microbiological analyses, Hole U1531C.