Binns, R.A., Barriga, F.J.A.S., Miller, D.J., et al., 2002
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5. Site 1190[1]

Shipboard Scientific Party[2]

INTRODUCTION

Principal Results

We drilled Holes 1190A, 1190B, and 1190C (see Fig. **F1,** p. 67, in the "Site 1189" chapter) with the aim of intersecting volcanic rocks below an area devoid of evidence of recent hydrothermal activity. Drilling reached no farther than 17.2 meters below seafloor (mbsf) and produced only 110 cm of core. Almost all the rocks recovered are fresh, black, glassy, moderately vesicular, plagioclase-clinopyroxene ± magnetite phyric rhyodacite (70% SiO_2 on an anhydrous basis). Some samples are slightly altered, with evidence of incipient bleaching of the glassy volcanic groundmass. Most pieces exhibit rare, hairline siliceous (±clay) veinlets. The rocks recovered from Site 1190 are similar to those recovered at our other sites from the same depths. Thus, it is not possible to conclude whether or not intense alteration is present at shallow depths at Site 1190, as is the case in all of the other sites drilled, especially the nearby Roman Ruins high-temperature site.

Site Objectives

The original objectives for Site 1190 were to obtain information on the volcanic architecture of Pual Ridge and to collect fresh material for comparison with the rocks recovered at other sites. Additionally, results obtained earlier in Leg 193 suggested that hydrothermal alteration may be more intense and widespread than previously thought. Consequently, we also wanted to test the possibility that below a few tens of meters of fresh or incipiently altered rocks lie deeply altered counterparts even at this background site. However, because of the technical and logistics difficulties (see below), we were not able to fully address ei-

[1] **Examples of how to reference the whole or part of this volume.**
[2] **Shipboard Scientific Party addresses.**

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ther of these objectives, though the issue of volcanic architecture was effectively addressed by other holes drilled during Leg 193.

Operations Summary

Hole 1190A

Upon completion of operations at Hole 1189A, we assembled a new rotary core barrel (RCB) bottom-hole assembly (BHA), and the ship was offset ~200 m in dynamic positioning mode to our third primary target, Site 1190 (Table T1). A brief seafloor survey with the subsea camera system preceded a jet-in test that resulted in no penetration. Hole 1190A was then spudded at 0300 hr on 24 November 2000, at a seafloor depth measured by drill pipe length at 1714.0 meters below rig floor (mbrf). The vibration-isolated television (VIT) was recovered, and RCB coring commenced at 0345 hr.

T1. Coring summary, Site 1190, p. 10.

Core 193-1190A-1R was the only material recovered from this hole, cored to a depth of 9.1 mbsf. Recovery was a few small pieces (0.03 m). The drill string stuck while picking up off bottom at a depth of 6.0 mbsf. No rotation was possible; however, the pipe was pulled free with 200 klb of overpull. The bit cleared the seafloor at 0530 hr on 24 November 2000, ending Hole 1190A.

Hole 1190B

After deploying the subsea camera and conducting a brief survey, Hole 1190B was spudded at 0750 hr. The seafloor depth measured by drill pipe length was 1712.0 mbrf. Once again, the hole was limited to a single RCB core. Total penetration for the hole was 10.1 mbsf, of which the first 1.5 m was jetted in without rotation. The total cored interval for Core 193-1190B-1R was 8.6 m, and recovery totaled 0.24 m, or 2.8%. Tight hole conditions were encountered at a depth of 1720.0 mbrf, or 8.0 mbsf. The pipe was pulled free with 25 klb of overpull. The VIT was deployed, and we saw the bit pulling clear of the seafloor at 1105 hr on 24 November 2000, ending Hole 1190B.

Hole 1190C

With the camera still deployed, we conducted yet another seafloor survey to find another potential drilling location. Hole 1190C was spudded at 1215 hr at a seafloor depth of 1707.0 mbrf. Once the VIT was recovered, continuous RCB coring was initiated. Cores 193-1190C-1R through 3R were cut to a depth of 1724.2 mbrf (17.2 mbsf). Drilling in this hole was the hardest and slowest of all the holes spudded so far on this cruise. While cutting Core 193-1190C-3R, the driller noted an increase in drilling torque and pump pressure with a rapid increase in rate of penetration. We suspected that the drilling circulation was going into the formation rather than up the hole annulus and out at the seafloor. The subsea TV camera was deployed to verify if drill cuttings were getting back to the seafloor while the sandline was deployed to recover the last 4.0 m of RCB core. Seafloor observations confirmed that no returns were reaching the surface, and the VIT was recovered back to the ship. While retrieving Core 193-1190C-3R, the aft core line parted at ~577 m. Fortunately, the loose end hung up in the top drive, preventing a time-consuming fishing ordeal. T-bar clamps were used to remove the parted core line, and an additional 300 m of badly corroded line was removed. The drill string was pulled clear of the seafloor at 2400 hr and cleared the rig floor at 0520 hr on 25 November 2000, ending Hole 1190C.

Site Survey

Hole 1190A

The short survey (0240–0256 hr, 24 November 2000) was on target and did not extend far enough to sight the two markers laid at this site. No new beacon was deployed. Initially, the pipe tagged bottom on the lower side of a ledgelike lava outcrop with several rocks visible. A jet-in test here showed hard bottom. The pipe was then moved a few meters south, climbing onto the flat, lightly sediment-covered upper surface of the ledge, apparently a sheet flow as anticipated from the precruise site surveys. Hole 1190A was spudded on this spot.

Hole 1190B

After lowering the camera at Site 1190A without sighting a hole or the site markers, a short 20-m traverse (0720–0753 hr, 24 November 2001) to the southeast (along the presumed isobath) was conducted. This crossed moderately thick sediment cover on a gently sloping surface with occasional exposed rocks and hummocks over buried rocks. A jet-in test experienced hard bottom after blowing away a few centimeters of sediment, so the hole was spudded at this site.

Hole 1190C

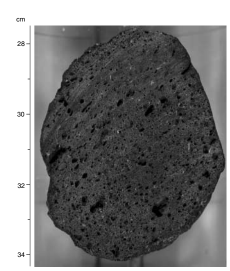
The VIT was lowered with the pipe still inserted at Hole 1190B. After extracting the pipe, we moved along three sides of a rectangle before spudding (1048–1225 hr, 24 November 2001). The track passed over scattered rocks on a sedimented surface, initially 50 m southeast, while climbing 7 m gradually, then 25 m northeast descending 6 m, then 20 m northwest climbing 5 m up a lava ledge. Hole 1190C was spudded in sediment between two small rocks after a jet-in test penetrated only 1 m.

IGNEOUS PETROLOGY

Site 1190 is an area without any indication of hydrothermal activity on the surface and was expected to provide a section through relatively unaltered volcanic rocks as a background reference. Only shallow penetrations were achieved. Holes 1190A and 1190B yielded one core each, with 6 and 45 cm of curated rock recovery, respectively. Samples from Hole 1190C come from three cores, for a total of 59 cm of curated core representing 13.4 m of drilled depth below seafloor.

Almost all of the rocks recovered are fresh, black, glassy, moderately vesicular dacite (Fig. F1). However, Pieces 2 and 4 from Section 193-1190B-2R-1 exhibit slight bleaching. Originally logged as aphyric (<1% phenocrysts), thin-section analysis indicates that the rocks are commonly sparsely to moderately porphyritic with as much as 3% plagioclase, clinopyroxene, and rare magnetite phenocrysts (commonly <1 mm in maximum dimension). The siliceous composition of the samples has been confirmed by measurements of the refractive index of the

F1. Fresh to slightly altered dacite, p. 7.



glass on Samples 193-1190A-1R-1 (Piece 1) and 193-1190B-2R-1 (Piece 1), which indicate a SiO_2 content of about 71–72 wt% SiO_2. In the absence of any substantial lithologic heterogeneity, all samples are assigned to Unit 1 of their respective holes (Table T2). There are no significant differences between the rocks from the three holes, suggesting that all three holes sampled the same lava flow at the surface of Site 1190.

T2. Lithology and alteration, p. 11.

Volcanic Features

Primary volcanic features recognized in the Site 1190 specimens include vesicles, phenocrysts, quenched glassy groundmass, and flow banding.

Vesicles

The vesicularity of samples was estimated in hand specimen to be ~5% for Unit 1 of Hole 1190A, between 5% and 15% for Unit 1 of Hole 1190B, and between 5% and 20% for Unit 1 of Hole 1190C. These figures are supported by vesicularity estimates of representative thin sections, determined by point counting, of between 7% and 15% (Table T3).

T3. Results of point counts on volcanic rock thin sections, p. 12.

Most vesicles are generally millimeter scale in their cross-sectional dimension; however, elongate tubes and flattened shapes are very common. Minimum vesicle sizes are just a fraction of a millimeter, whereas maximum sizes reach several centimeters along the longest axis, and there appears to be a broad unimodal vesicle size distribution.

Phenocrysts

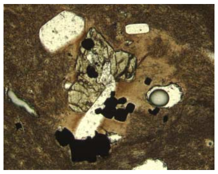
Three phenocryst types are present at Site 1190. Plagioclase is the most common phenocryst (1–2 vol%), forming euhedral to subhedral, blocky and elongate lath-shaped crystals. They vary from 0.1 to 2.0 mm in long dimension, averaging ~0.8–1.0 mm long. The plagioclase, which is not significantly zoned, commonly contains melt inclusions and partly or wholly encloses magnetite grains.

Elongate prisms of euhedral to subhedral clinopyroxene are less abundant as phenocrysts than plagioclase (<1 vol%). Reaching a maximum dimension of 1.4 mm in Hole 1190A, they are more commonly 0.1 to 0.8 mm long, with an average of 0.5 mm. Some clinopyroxene crystals enclose magnetite.

Minor magnetite phenocrysts (<0.2 vol%) are euhedral to anhedral, ranging in size from ~0.04 to 0.3 mm, and averaging 0.1 mm across. Although very small, these grains nonetheless exceed the typical groundmass microlite opaque grains, which are typically 0.001–0.010 mm across.

Clusters of several phenocrysts, including two or all three phenocryst phases, are common. Notably, the glassy groundmass that occupies interstitial and concave spaces in and around these clusters is usually free or nearly free of microlites, in contrast to the microlite-rich glassy mesostasis elsewhere in the rocks (Fig. F2). Apparently, microlites are difficult to nucleate in these areas, perhaps because the melt is locally enriched in the chemical components rejected by the growing phenocrysts. High-viscosity and low-diffusion coefficients, characteristic of cool felsic magmas, could explain why these areas might be chemically distinct from the bulk groundmass.

F2. Glomerophyric cluster of phenocrysts in Unit 1, p. 8.



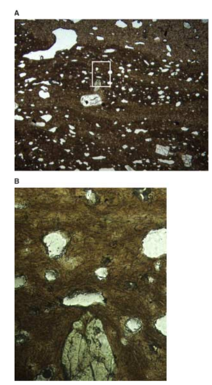
Groundmass

The groundmass visible in thin sections is typically comprised of tan glass packed with felted, clear, acicular microcrysts (probably plagioclase, possibly also pyroxene) measuring ~0.025 mm long and 0.001–0.002 mm wide and disseminated 0.001–0.010 mm granular opaque minerals (magnetite). Locally, the groundmass grades to microlite-free tan glass in and around clustered phenocrysts, as described previously.

Flow Banding

Faint flow banding defined by subtle changes in groundmass color can be observed locally in hand specimen. In thin section, bands of dark brown groundmass domains have a lensoidal to wavy geometry with diffuse margins against a more common light brown groundmass (Fig. F3A). In detail, the dark bands are enriched in plagioclase microlite needles, whereas light groundmass contains about equal proportions of volcanic glass and microlites (Fig. F3A). Microvesicles (<0.1 mm in diameter) are abundant in dark bands suggesting that phase separation and the formation of gas bubbles in the melt was favored in the microlite-rich domains.

F3. Flow banding defined by light- and dark-colored groundmass from Unit 1, p. 9.



HYDROTHERMAL ALTERATION

Site 1190 is located on a portion of Pual Ridge where no surficial evidence of hydrothermal activity has been observed. The intention of drilling this site was to recover a "background" sequence of less-altered volcanic rocks to investigate the volcanic architecture of Pual Ridge. Recovery was poor, and it was necessary to abandon all three holes drilled at the site at shallow depths (Hole 1190A: 6.0 mbsf; Hole 1190B: 8.6 mbsf; Hole 1190C: 17.2 mbsf).

Almost all pieces of core recovered from holes drilled at Site 1190 were fresh volcanic rock (<2% altered). Two pieces (intervals 193-1190B-2R-1, 12–16 cm, and 2R-1, 19–28 cm) were classified as slightly altered and showed evidence of incipient bleaching of the glassy volcanic groundmass. The remaining core pieces exhibited no evidence of pervasive alteration. Most showed rare white hairline siliceous veinlets, poorly developed patchy blue-gray silica ± clay films, and very rare orange iron oxide films and spotting on vesicle walls and fracture surfaces. Fine-grained short prismatic zeolite (heulandite?) crystals were observed to line vesicles in one sample (interval 193-1190B-2R-1, 19–28 cm). A rare, well-developed, pale yellowish alteration crust on another piece (interval 193-1190B-2R-1, 34–38 cm) exhibited very fine rod-shaped white crystals, dark red-brown oxide spots, and rare white botryoids. The crust fizzed gently in HCl, suggesting the presence of calcium carbonate.

Four thin sections were cut from Holes 1190A, 1190B, and 1190C. All sections showed no evidence of alteration. A single X-ray diffraction analysis (Table T4) detected igneous plagioclase, augite, and possible traces of smectitic clay.

T4. Minerals identified by X-ray diffraction analysis, p. 13.

The alteration exhibited by material recovered from Site 1190 is similar to that observed for fresh near-surface volcanic rocks from Sites 1188 and 1189 and is consistent with an absence of hydrothermal activity at Site 1190. However, because of the shallow penetration at Site 1190, it is not possible to preclude the presence of hydrothermally altered rocks at depth. A detailed description of the limited alteration in individual core pieces is presented in the in the alteration tables (see the **"Site 1190 Alteration Log,"** p. 13).

GEOCHEMISTRY

From Site 1190, only one fresh igneous rock (Sample 193-1190C-2R-1, 3–5 cm; 3.53 mbsf) was analyzed. This sample is representative of the material in the core obtained from the site. The sample was analyzed by nitrogen, carbon, sulfur (NCS) elemental analyzer for elemental concentrations of total hydrogen and sulfur. Major element oxides and trace elements (Zr, Sr, Cu, Zn, Ba, and Y) were determined by inductively coupled plasma–atomic emission spectroscopy (ICP-AES) using the igneous method described in **"Geochemistry,"** p. 15, in the "Explanatory Notes" chapter.

Results

The analytical results for the ignited powder Sample 193-1190C-2R-1, 3–5 cm, are given in Table **T5,** together with rock composition and total sulfur and water values as obtained by elemental analysis. In terms of CIPW norm mineralogy and total alkali vs. silica classification for igneous rocks, the composition of the sample can be described as a dacite. The chemical character of the fresh sample from Hole 1190C is comparable to the fresh rocks in Holes 1188A and 1191A but is slightly enriched in SiO_2 with respect to the fresh rock analyzed from Hole 1189A (Section 193-1189A-1R-1).

T5. Results of geochemical analyses, Site 1190, p. 14.

PHYSICAL PROPERTIES

Physical properties measurements taken on core recovered from Site 1190 consist of thermal conductivity and standard index properties measurements. Recovery from Holes 1190A, 1190B, and 1190C was low and did not allow for many physical properties measurements. Because the short fragmented core pieces were not suitable for automated multisensor track measurements, no magnetic susceptibility or natural gamma radiation measurements were taken. Likewise, compressional wave velocity could not be measured. One thermal conductivity measurement was possible on core from Hole 1190B; Section 193-1190B-2R (Piece 7, 39–45 cm) had a value of 1.07 W/(m·K). This value is similar to those obtained for unaltered rock at Sites 1188 and 1189. Index properties measurements were taken on one minicore from Hole 1190B, and the data are shown in Table **T6.** Grain density for a powder sample prepared for ICP-AES from interval 193-1190B-2R-1, 3–5 cm (3.53 mbsf), is 2.60 g/cm^3. The grain density for the minicore is slightly lower than the measurement on the ICP-AES powder, but the samples were taken from different intervals, so a direct comparison cannot be made. The grain density values are lower than those of unaltered rocks from Sites 1188 and 1189, but the porosity value is higher.

T6. Index properties, p. 15.

Figure F1. This representative close-up photograph of fresh to slightly altered dacite recovered from Site 1190 shows a black, moderately vesicular, and superficially aphyric volcanic rock. However, careful observation and thin-section petrography show that the glassy to microcrystalline groundmass contains as much as 3 vol% of plagioclase, clinopyroxene, and minor magnetite phenocrysts (interval 193-1190B-2R-1, 28–34 cm).

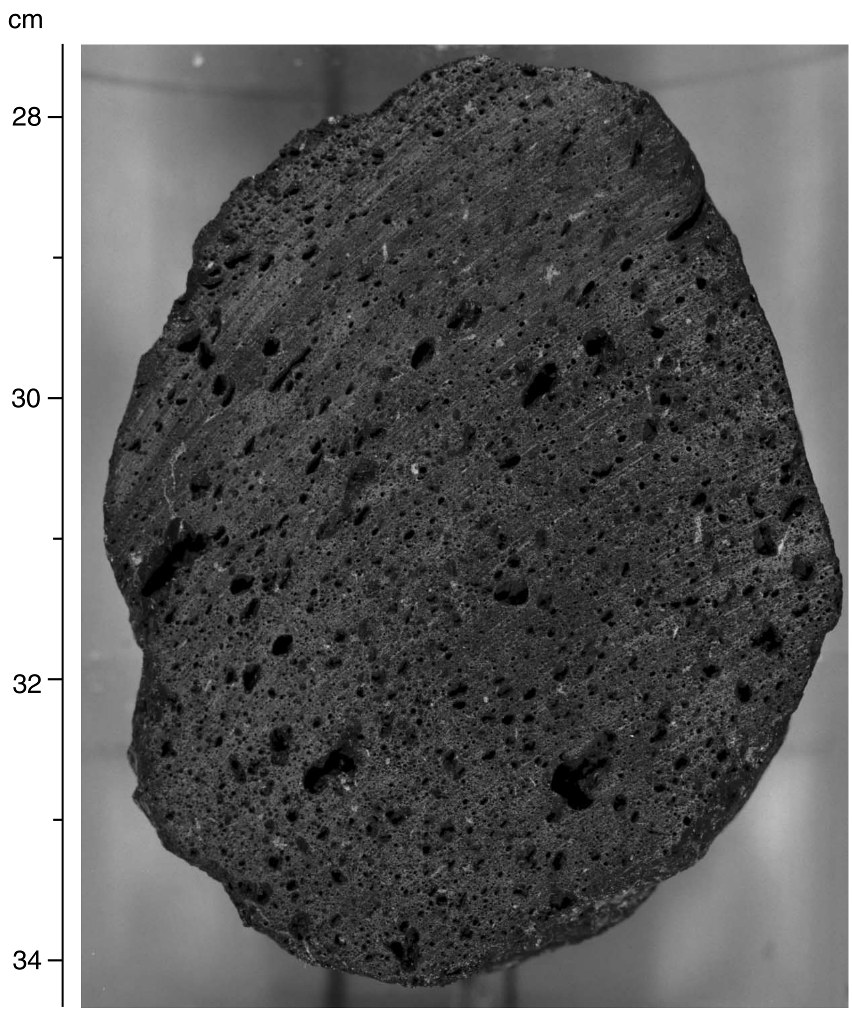


Figure F2. Photomicrograph of a glomerophyric cluster of phenocrysts (plagioclase, clinopyroxene, and magnetite) and a nearby microvesicle, which are common features of Unit 1. Interstitial spaces around these aggregates typically consist of microlite-free volcanic glass (Sample 193-1190B-2R-1 [Piece 7, 40–43 cm]; width of view = 1.38 mm. Photomicrograph ID# 1190B_1; **thin section 44**).

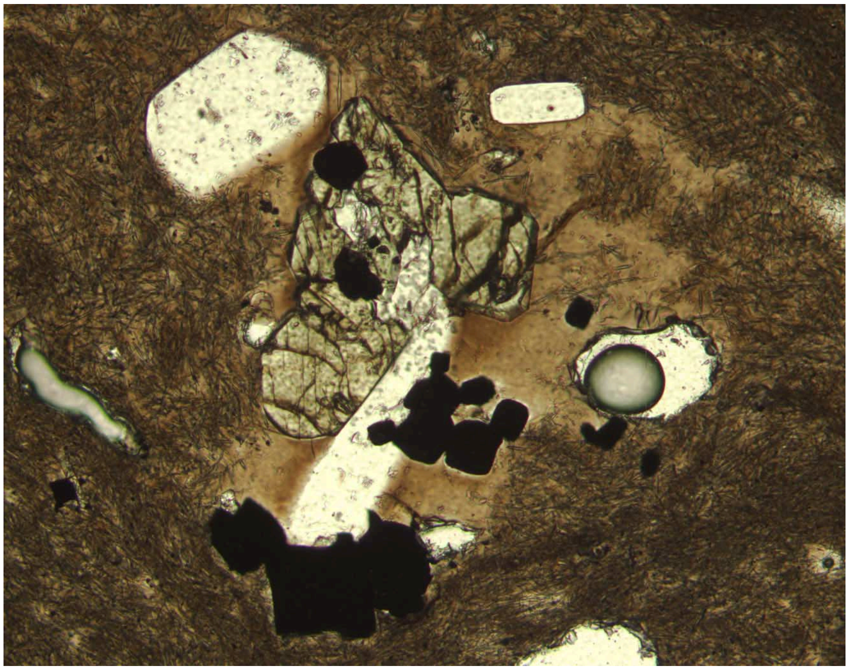
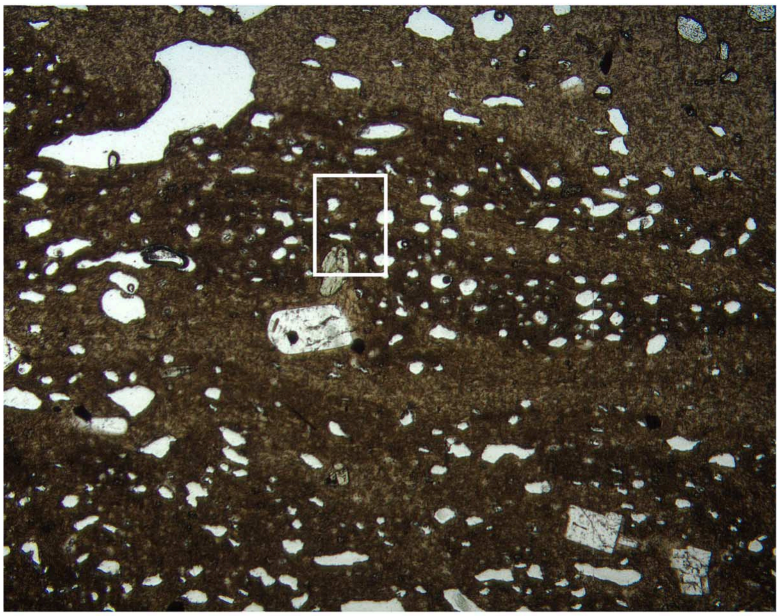


Figure F3. Flow banding defined by light- and dark-colored groundmass can be observed in Unit 1 (Sample 193-1190C-3R-1 [Piece 3, 7–9 cm]. Photomicrograph ID# 1190C_1; **thin section 46**). **A.** In thin section, dark brown groundmass domains form lensoidal to wavy bands and are enriched in microvesicles. Width of view = 5.5 mm. **B.** Enlargement of white square shown in (A). Width of view = 0.7 mm × 0.55 mm. In detail, dark brown groundmass domains are enriched in plagioclase microcrysts, whereas light brown groundmass contains about equal proportions of volcanic glass and microcrysts. The contact between these groundmass domains is gradational (Photomicrograph ID# 1190C_2; **thin section 46**).

A



B

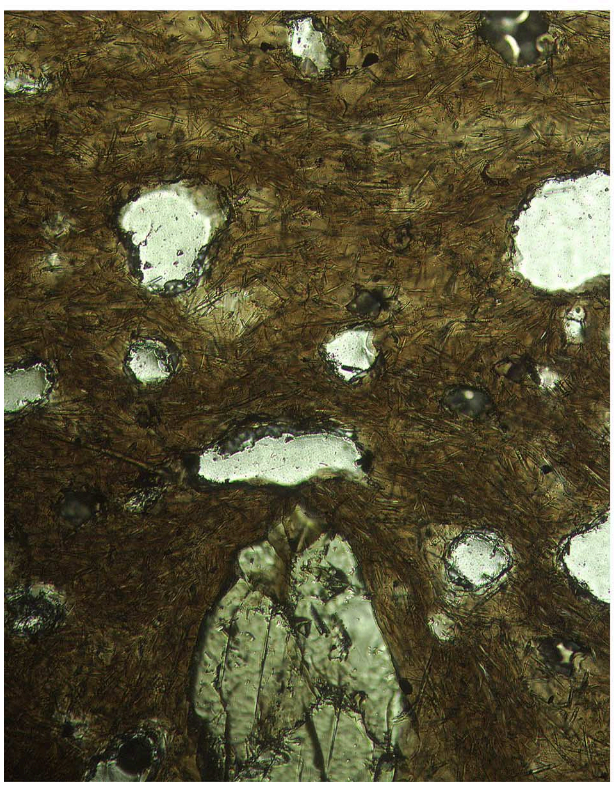


Table T1. Coring summary, Site 1190.

Hole 1190A
Latitude: 3°43.2920′S
Longitude: 151°40.5824′E
Time on site (hr, min): 32, 45 (2045 hr, 23 Nov 2000–0530 hr, 25 Nov 2000)
Time on hole (hr, min): 9, 30 (2045 hr, 23 Nov 2000–0615 hr, 24 Nov 2000)
Seafloor (drill pipe measurement from rig floor, mbrf): 1714.0
Distance between rig floor and sea level (m): 10.9
Water depth (drill pipe measurement from sea level, m): 1703.1
Total depth (from rig floor, mbrf): 1723.1
Total penetration (mbsf): 9.1
Total length of cored section (m): 9.1
Total core recovered (m): 0.03
Core recovery (%): 0.3
Total number of cores: 1

Hole 1190B
Latitude: 3°43.3142′S
Longitude: 151°40.6161′E
Time on hole (hr, min): 4, 45 (0615 hr, 24 Nov 2000–1100 hr, 24 Nov 2000)
Seafloor (drill pipe measurement from rig floor, mbrf): 1712.0
Distance between rig floor and sea level (m): 10.9
Water depth (drill pipe measurement from sea level, m): 1701.1
Total depth (from rig floor, mbrf): 1722.1
Total penetration (mbsf): 9.1
Total length of cored section (m): 8.6
Total core recovered (m): 0.25
Core recovery (%): 2.9
Total number of cores: 2 (1 wash core)

Hole 1190C
Latitude: 3°43.3036′S
Longitude: 151°40.6100′E
Time on hole (hr, min): 18, 30 (1100 hr, 24 Nov 2000–0530 hr, 25 Nov 2000)
Seafloor (drill pipe measurement from rig floor, mbrf): 1707.0
Distance between rig floor and sea level (m): 10.9
Water depth (drill pipe measurement from sea level, m): 1696.1
Total depth (from rig floor, mbrf): 1724.2
Total penetration (mbsf): 17.2
Total length of cored section (m): 17.2
Total core recovered (m): 0.40
Core recovery (%): 2.3
Total number of cores: 3

Core	Date (Nov 2000)	Time (local)	Top depth (mbsf)	Length (m)		Recovery (%)
				Cored	Recovered	
193-1190A-						
1R	24	0605	0.0	9.1	0.03	0.3
193-1190B-						
1W	24		0.0	0.0	0.00	NA
2R	24	1200	1.5	8.6	0.25	2.9
193-1190C-						
1R	24	1500	0.0	3.5	0.11	3.1
2R	24	1900	3.5	9.7	0.15	1.5
3R	25	0015	13.2	4.0	0.14	3.5

Note: NA = not applicable.

Table T2. Lithology and alteration, Site 1190.

Core, section (Piece)	Unit	Curated depth (mbsf)		Curated length (m)	Lithology	Alteration
		Top	Base			
193-1190A-						
1R-1 (1)	1	0.00	0.06	0.06	Fresh, moderately vesicular, sparsely plagioclase-phyric dacite. Plagioclase, clinopyroxene, and rare magnetite phenocrysts (1–3 vol%) are generally <1 mm (maximum dimension).	Unaltered to slightly altered. Alteration includes: incipient groundmass bleaching, silica hairline veins, silica ± clay ± sulfate films, Fe oxide films, zeolite crystals in vesicles, and Fe oxide spots with calcium carbonate.
193-1190B-						
2R-1 (1-7)	1	1.50	1.95	0.45		
193-1190C-						
1R-1 (1-4)	1	0.00	0.21	0.21		
2R-1 (1-5)	1	3.50	3.68	0.18		
3R-1 (1-6)	1	13.20	13.40	0.20		

Table T3. Results of point counts on volcanic rock thin sections, Site 1190.

Core, section, interval (cm)	Unit	Rock type	Number of points	Groundmass (%)	Vesicles (%)	Phenocrysts (%)		
						Plagioclase	Clinopyroxene	Opaques
193-1190A-								
1R-1 (Piece 1, 0-2)	1	Dacite	500	85.6	11.4	2.2	0.6	0.2
193-1190B-								
2R-1 (Piece 7, 40-43)	1	Dacite	750	90.4	7.2	1.8	0.5	Tr
193-1190C-								
2R-1 (Piece 1, 3-5)	1	Dacite	750	88.2	9.7	1.4	0.2	0.2
3R-1 (Piece 3, 7-9)	1	Dacite	750	84.0	14.4	1.3	0.1	0.1

Notes: Tr = trace. Point counts were measured using a rectangular grid with a = 0.667 mm and b = 0.8 mm.

Table T4. Minerals identified by XRD, Site 1190.

Core, section, interval (cm)	Unit	Description	XRD identification: major (minor, "trace") minerals*
193-1190C-			
2R-1, 3-5	1	Fresh, aphyric, moderately vesicular rhyodacite with a small amount of pale blue alteration	Plagioclase (opaline silica, augite, corrensite?, "smectite")

Notes: XRD = X-ray diffraction. * = the terms major, minor, and trace are applied to XRD analyses as explained in "Hydrothermal Alteration," p. 8, in the "Explanatory Notes" chapter and do not imply quantitative abundances.

Table T5. Results of geochemical analyses, Hole 1190C.

Core, section: 193-1190C-:	2R-1
Interval (cm):	3-5
Curated depth (mbsf):	3.53
Rock type:	Dacite
Alteration style:	Fresh
Ignited rock powder composition:	
Major element oxide (wt%):	
SiO_2	69.37
TiO_2	0.46
Al_2O_3	14.14
Fe_2O_3	4.87
MnO	0.11
MgO	0.75
CaO	2.73
Na_2O	4.92
K_2O	1.85
P_2O_5	0.09
Total (wt%):	99.28
LOI (wt%):	1.25
Trace element (ppm):	
Zr	124
Y	32
Sr	250
Zn	65
Cu	55
Ba	424
Whole rock composition:	
Major element oxide (wt%):	
SiO_2	68.50
TiO_2	0.46
Al_2O_3	13.96
Fe_2O_3	4.81
MnO	0.11
MgO	0.74
CaO	2.70
Na_2O	4.86
K_2O	1.83
P_2O_5	0.09
Total S (wt%):	0.03
Total H_2O^+ (wt%):	1.34

Note: Major element oxides and selected trace element composition of ignited powder measured by inductively coupled plasma-atomic emission spectroscopy followed by loss on ignition and the whole rock composition, as well as the total sulfur and water, determined by NCS elemental analysis.

Table T6. Index properties, Hole 1190B.

Core, section, interval (cm)	Piece	Type	Depth (mbsf)	Bulk water content (%)	Density (g/cm^3)			Porosity (%)	Void ratio
					Bulk	Dry	Grain		
193-1190B-									
2R, 40-42	7	Minicore	1.9	0.2	2.272	2.267	2.278	0.5	0.005