11. SITE 562[1]

Shipboard Scientific Party[2]

HOLE 562

Date occupied: 21 October 1981

Date departed: 24 October 1981

Time on hole: 80 hr.

Position (latitude; longitude): 33°08.49′N, 41°40.76′W

Water depth (sea level; corrected m, echo-sounding): 3172

Water depth (rig floor; corrected m, echo-sounding): 3182

Bottom felt (m, drill pipe): 3182

Penetration (m): 331

Number of cores: 11

Total length of cored section (m): 90

Total core recovered (m): 44.9

Core recovery (%): 50

Oldest sediment cored:
Depth sub-bottom (m): 268
Nature: Limestone-interpillow breccia
Age: middle Miocene

Basement:
Depth sub-bottom (m): 240
Nature: Basalt

Principal results: Hole 562 was drilled on the west flank of the Mid-Atlantic Ridge south of the Hayes Fracture Zone on Magnetic Anomaly 5D (Fig. 1). The sediments were washed down to the basement, which was felt at 240 m sub-bottom depth.

The basement, cored for 90 m, consisted of sparsely plagioclase phyric pillow basalts. Two chemical groups have been recognized on the basis of major and trace elements. Fresh glasses at the margins of pillows are very common. Despite some altered parts, the bulk of the crystalline basalts is fairly fresh. The magmaphile elements show a typically depleted distribution with the following average figures: Nb = 3 ppm, Zr = 95 ppm, Ti = 9300 ppm, Y = 41 ppm, V = 325 ppm, and $(Nb/Zr)_{ch} \sim 0.3$. This result is consistent with the precruise hypothesis of a depleted mantle source south of the Hayes Fracture Zone.

No samples were taken for pore-water chemistry analysis, and no downhole measurements were taken at this site.

OPERATIONS

Approach to Site

It was decided to drill Site 562 (MAR-10) near Anomaly 5D and south of the Hayes Fracture Zone. The available geophysical data in the area, including a recent SEABEAM survey by Centre National pour l'Exploitation des Océans (now IFREMER) of the area near Anomaly 5 (MAR-9), indicated that there were several small fracture zones that had to be avoided. A tentative site was located midway between two small fracture zones about 50 and 75 miles respectively, south of the Hayes Fracture Zone. From Site 561, the track of the *Challenger* headed southwest and intersected a flow line passing through the proposed site about 40 miles east of the site. The track then followed the flow line in a northwesterly direction, crossing Anomalies 5B to 6 (Fig. 2). The identification of Anomaly 5B is not clear, and this anomaly could also be either Anomaly 5A or even Anomaly 5. Between 2330Z, 20 October and 0030Z, 21 October (Fig. 3), a low ridge was crossed with several potential drill sites. After steaming for two hours past this feature, no better sites were observed and we decided to drill on the site crossed at 0030Z. The course of the *Challenger* was reversed and the beacon was dropped on the site at 0412Z. The seismic profiler record indicated approximately 0.3 s of sediments above a strong basement reflector. The site is probably on Magnetic Anomaly 5D.

On-Site Operations

Hole 562 was spudded at 1053Z, 21 October and washed to basement. No mudline core was taken. Hard rock was hit at 240 m sub-bottom depth. Between 1400Z, 21 October and 2200Z, 23 October, 11 cores were cut penetrating 90 m of basement with 50% recovery without major incident (Table 1). Drilling was halted for time considerations; also, the diameter of the final cores was diminishing, indicating that bit failure was near. The drill string was pulled and the *Challenger* was under way to Site 563 at 1018Z, 24 October.

SEDIMENT LITHOLOGY

The sedimentary section drilled at Site 562 consists of 241 m of calcareous pelagic deposits, represented by one wash core (Core H1), in which 3.1 m of siliceous foraminiferal-nannofossil ooze and foraminiferal-nannofos-

[1] Bougalt, H., Cande, S. C., et al., *Init. Repts. DSDP*, 82: Washington (U.S. Govt. Printing Office).

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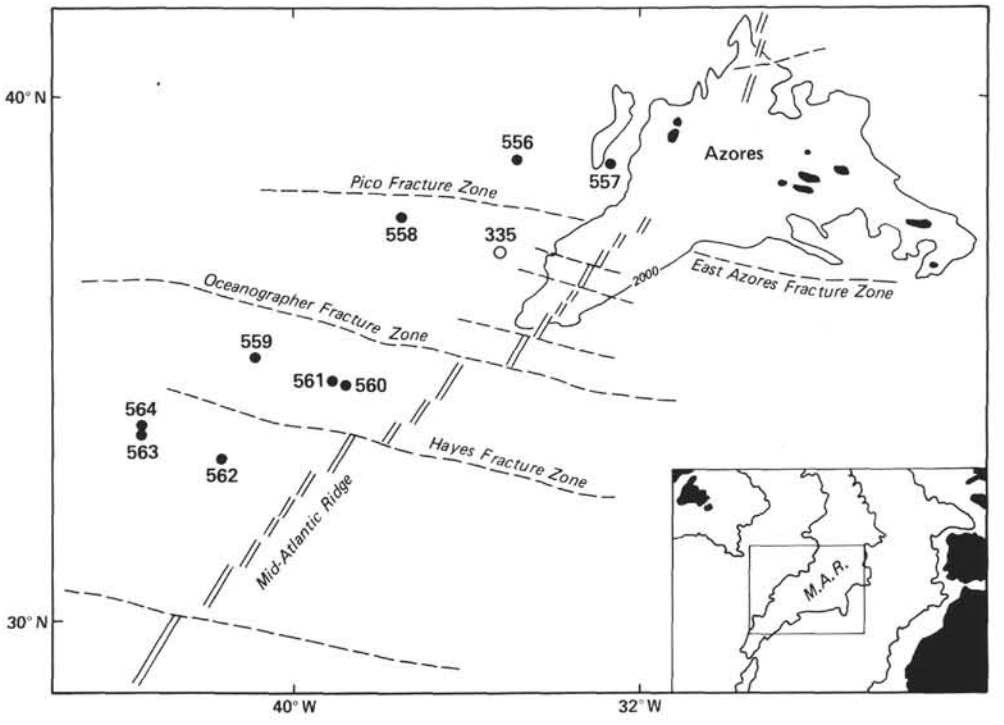


Figure 1. Site location map, Leg 82.

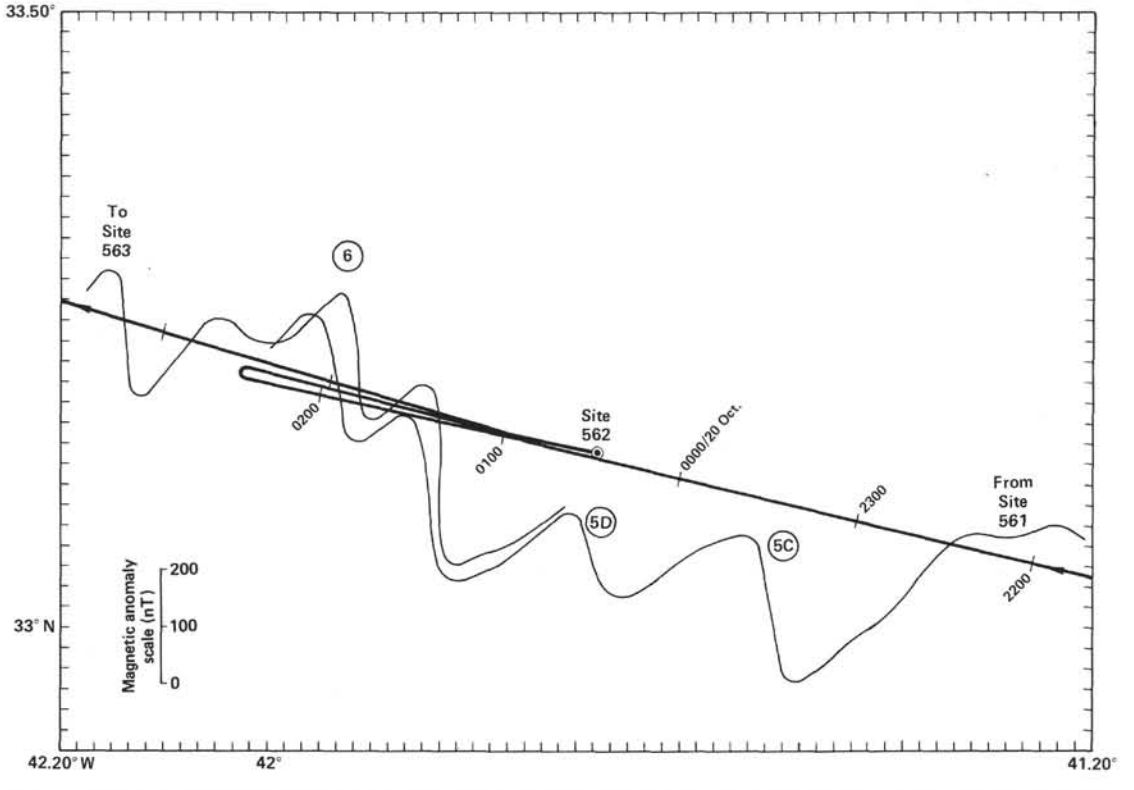


Figure 2. Approach and site survey track for Site 562. Heavy line is the ship's track with hours marked in GMT. Thin line is magnetic anomaly projected perpendicularly from the ship's track. Circled numbers are magnetic anomalies based on work at Lamont-Doherty Geological Observatory.

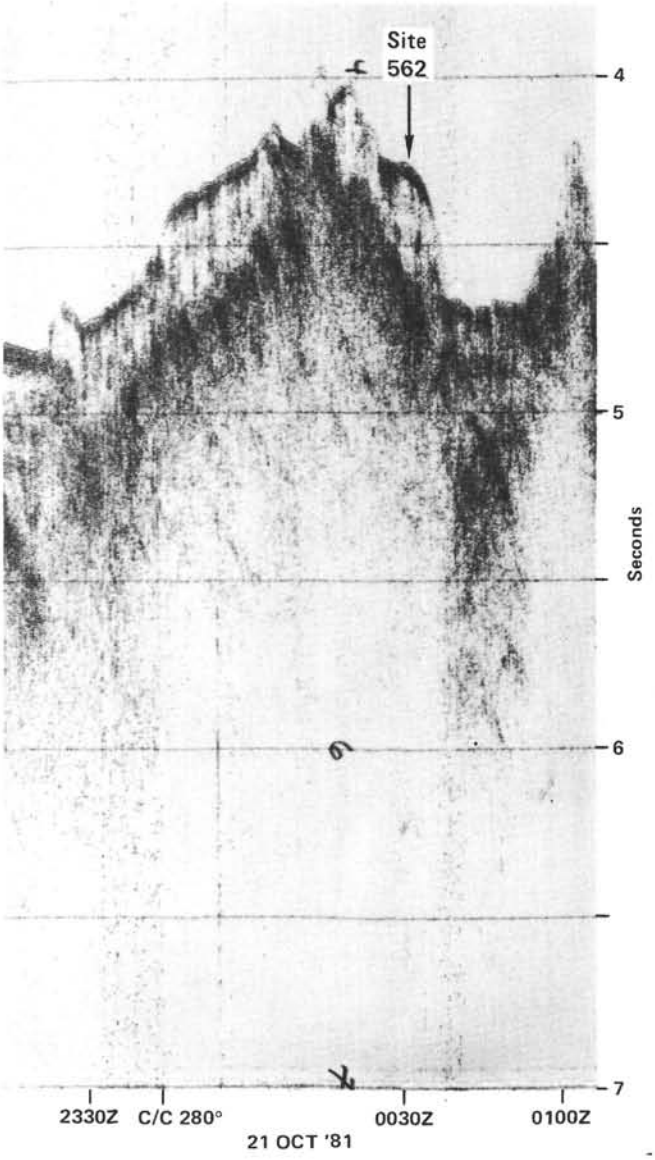


Figure 3. *Glomar Challenger* seismic profile over Site 562. For location of profile, see Figure 2. C/C = course change.

Table 1. Coring summary, Hole 562.

Core	Date (Oct. 1981)	Time (Z)	Depth from drill floor (m)	Depth below seafloor (m)	Length cored (m)	Length recovered (m)	Percent recovered
H1	21	1402	3182.0–3423.0	0.0–241.0	0.0	0.00	0
1	21	1930	3423.0–3432.0	241.0–250.0	9.0	3.60	40
2	22	0240	3432.0–3441.0	250.0–259.0	9.0	5.68	63
3	22	0745	3441.0–3450.0	259.0–268.0	9.0	5.27	59
4	22	1155	3450.0–3459.0	268.0–277.0	9.0	5.61	62
5	22	1700	3459.0–3468.0	277.0–286.0	9.0	6.90	77
6	22	2053	3468.0–3477.0	286.0–295.0	9.0	4.82	54
7	23	0130	3477.0–3482.0	295.0–300.0	5.0	3.30	66
8	23	0510	3482.0–3486.0	300.0–304.0	4.0	2.13	53
9	23	1040	3486.0–3495.0	304.0–313.0	9.0	3.23	36
10	23	1630	3495.0–3504.0	313.0–322.0	9.0	3.08	34
11	23	2200	3504.0–3513.0	322.0–331.0	9.0	1.31	15
					90.0	44.93	50

sil ooze were recovered. Below the top of basalt at 241 m, intrapillow limestone breccias and limestones are present at several intervals in Cores 1 and 2. A foraminiferal-nannofossil limestone, from 562-1-3, 112–120 cm between two pillows, is dated at 15 to 17 Ma, which agrees with the basement age at this site.

The siliceous foraminiferal-nannofossil ooze is very pale brown (10YR 7/3) with rare mottling. The core is highly disturbed, so no sedimentary structures are evident. The bedding is massive. A smear-slide estimate indicates that this lithology contains about 15% clay and 13% siliceous fossils in addition to the principal calcareous components. The age range represented by the 2 m of this sediment lithology is late Pliocene to Pleistocene.

The foraminiferal-nannofossil ooze (represented by 1 m of sediment) is white (2.5Y 8/2 to 2.5YN 8), with possible faint massive bedding. We observed no mottling or bioturbation in this highly disturbed core. The principal component of this lithology is calcareous nannofossils. The oldest fauna in the core is from the early middle Miocene or late early Miocene.

The intrapillow limestone is white to pale grayish tan micrite. At 562-1-3, 112–120 cm (245 m sub-bottom) the limestone is cross laminated and contains abundant foraminifers. A slightly lower occurrence appears to be bioturbated. A similar limestone at 562-2-3, 80–88 cm (254 m sub-bottom), which fills a space between pillow margins, appears to have graded bedding (geopetal texture?).

The intrapillow limestone breccias are pinkish white to white, with either rounded or angular clasts of black basalt and/or glass.

BIOSTRATIGRAPHY

Hole 562 was washed down to 241 m. Lower Pleistocene to lower middle-upper lower Miocene sediments were retrieved. At this site both the calcareous nannofossils and the foraminifers agree on this age for basement.

Calcareous Nannofossils

On the basis of *Discoaster quinqueramus, Amaurolithus primus, S. amplificus, A. delicatus,* and *Triquetrorhabdulus rugosus*, 562-H1,CC is assigned to the upper Miocene *D. quinqueramus* Zone (NN11). Sediment contained within the first piece of basalt indicates a middle Miocene basement at this site. The included sediment contains *Sphenolithus heteromorphus*, which indicates either the *S. heteromorphus* Zone CN4 (NN5) or the *Helicosphaera ampliaperta* Zone CN3 (NN3–NN4). Because of poor nannofossil preservation, a more refined zonation of this interval was not possible.

Foraminifers

The core catcher of Core H1 is a white nannofossil-foraminiferal ooze with well-preserved, diverse foraminifers. Although Pliocene elements are present in the section, the oldest fauna in the core is Miocene. The sample is assigned to lower middle or possibly upper lower Miocene.

Sample 562-H1-2, 31–33 cm contains a lower Pleistocene fauna and 562-H1-3, 2–4 cm is upper(?) Miocene. A piece of bedded limestone found between two basalt flows in Section 562-1-3 (241–250 m) has abundant planktonic foraminifers that indicate a lower-middle or possibly upper-lower Miocene assignment.

SEDIMENT ACCUMULATION RATES

Although we cannot calculate detailed sedimentation rates at this site, an overall average sediment accumulation rate of 15 m/Ma (241 m in 16 Ma) seems consistent with those calculated for calcareous pelagic sedimentation during similar time periods at other sites.

IGNEOUS PETROLOGY AND GEOCHEMISTRY

Hole 562 reached basement at 241 m sub-bottom and penetrated 90 m into a sequence of plagioclase phyric pillow basalts interrupted by two massive flows of very similar lithology (Fig. 4). Two chemical groups have been recognized within this sequence.

Lithology (Fig. 4)

Basalts of Site 562 are for the most part sparsely to moderately plagioclase phyric with fine-grained groundmass. They range from fresh to moderately altered. Pillow diameters vary from a few tens of centimeters to about 1.5 m. Most pillows have fresh glass rinds less than 15 mm thick separated from fine-grained pillow cores by variolitic zones only a few millimeters thick. Varioles range from about 0.5 to 1 mm in diameter. Thicker glass rinds, up to 5 cm thick, are also present in several places, but generally detached from pillows (by drilling?). Glass clasts are also common in interpillow breccias, usually cemented with a fine-grained limestone matrix.

Plagioclase phenocrysts (2–5%) are mostly scattered uniformly throughout the rock, but in some places—mainly in the lower drilled portion—abundances may locally increase to as much as 15% or decrease to zero. Plagioclase phenocrysts range in size from about 1 to 10 mm and in shape from subhedral to rounded, possibly as a result of resorption. Glomerophyric clusters of plagioclase (about 15 mm in diameter) occur throughout the section.

Olivine microphenocrysts are sometimes observable, generally replaced by brown clay materials.

Vesicles are rare to absent (less than 1%), and commonly rounded, although some irregular ones do occur; they range from less than 1 mm to 2 mm in diameter. In the more altered parts of the basalt, vesicles are mainly clay filled, but calcite filling is also common. In fresh material close to pillow margins, most vesicles remain unfilled.

Massive lava flows were encountered at 268 m (3.7 m thick) and at 279 m (5.1 m thick). They are lithologically, petrographycally and chemically very similar to the pillow basalts, although slightly coarser grained. The upper flow is almost nonvesicular. It has an aphyric upper margin about 50 cm thick becoming sparsely phyric to moderately phyric downhole. Plagioclase phenocrysts increase in abundance from 0 to 10% and in size from 2 to 10 mm. An aphyric basalt margin about 25 cm thick with a narrow glass selvage marks the base of this flow. The lower flow has a narrow glass rim underlain by a narrow variolitic zone at its upper margin. It is sparsely to moderately plagioclase phyric (2–5%) throughout with no apparent systematic variation in phenocryst size or abundance. The lower boundary is not clearly defined and may not have been recovered. Vesicles are abundant

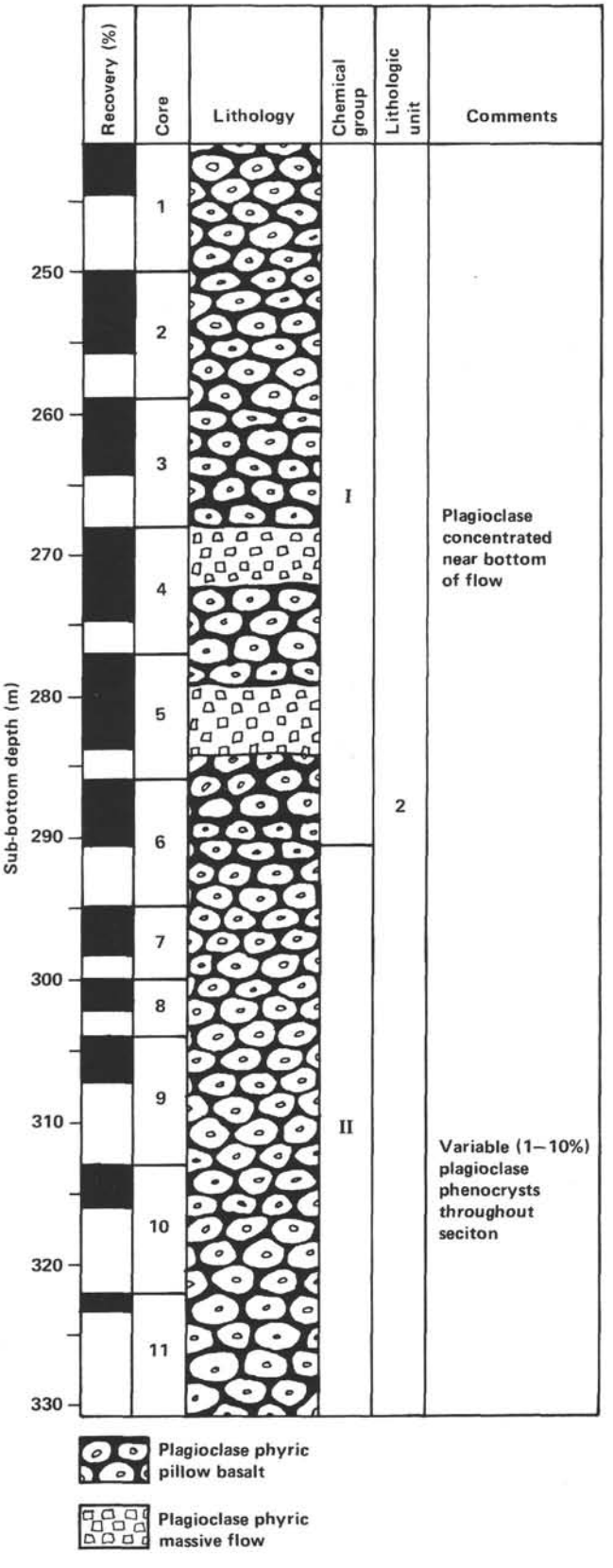


Figure 4. Basement lithology column, Hole 562.

(up to 5%) in the uppermost 20 cm of this lower flow, but are rare downwards.

Calcite-filled and/or limestone-filled veins and fractures occur throughput the drilled section. Minor basalt breccias and basalt-glass breccias with limestone matrix and sparry calcite are also present.

Petrography

The two chemical groups of Site 562 cannot be distinguished petrographically—all pillow basalts are very similar, with only minor variations in texture and grain size. The two massive flows differ from flows in other sections only in their slightly larger grain size and their almost complete lack of interstitial glass.

Site 562 basalts are characterized by the presence of three distinct generations of plagioclase. They also differ from basalts of previous sites in the rounded, possibly resorbed appearance of olivine. In their mineralogy, Site 562 basalts are remarkably uniform throughout the hole, with approximately 45% plagioclase, 35% clinopyroxene, 2–3% olivine, 5–10% magnetite, and 10–15% mesostasis. Plagioclase occurs in three distinct generations which are, in order of crystallization, as follows.

1. Large prismatic phenocryst are generally 2–3 mm, rarely up to 10 mm. They are typically subhedral (resorbed) and complex in internal structure, frequently with corroded cores. Small glass inclusions are also common. Few grains suitable for optical determination were observed; most yielded compositions close to AN_{60} with a few higher, but this figure may not be reliable.[3]

2. Elongate, hollow laths, generally about 1 mm long, but ranging up to 3 mm, form radiating clusters, generally centered on olivine, or parallel growths from the ends of prismatic, Type 1 phenocrysts. Compositions of laths and overgrowths appear to be 5–10 wt.% lower in An content than Type 1. Type 2 generally makes up 10 to 20% of all plagioclase.

3. Plagioclase in the form of fine laths less than 0.2 mm long and of anhedral intergrowths with fine, prismatic clinopyroxene makes up about 50% of the groundmass of most samples.

Clinopyroxene occurs mainly as small (less than 0.5 mm, generally less than 0.2 mm) prismatic or granular grains intergrown with Type 3 plagioclase and interstitial to Type 2 plagioclase. In samples close to pillow margins, this intergrowth has the appearance of devitrified glass, giving rise to a hyalophitic or hyalophilitic texture when viewed at low magnification. Such samples are, however, almost holocyrstalline, with only about 10% of interstitial glass remaining. Fine granular magnetite (about 0.05 mm) is associated with clinopyroxene and glass.

Olivine, as small (0.1–0.6 mm), rounded, anhedral microphenocrysts, forms 2–3% of these basalts. In one sample (562-3-3, 103–106 cm) from close to a pillow margin, quench chains of olivine are present along with sheaves of skeletal plagioclase (Type 2). Individual olivine crystallites in the chains appear corroded, suggesting resorption of olivine by liquid or during subsequent, plagioclase-dominated crystallization. The rounded shapes of olivine phenocrysts at this site contrast with the euhedral, prism-shaped, diamond-shaped, and lantern-shaped microphenocrysts of previous sites. These, too, may suggest that olivine is unstable relative to the liquids that formed these rocks.

In these rocks, plagioclase has begun to crystallize earlier in the cooling history, and has persisted longer throughout that history than at any previous Leg 82 site. Type 1 plagioclase phenocrysts clearly formed before eruption and were subsequently corroded. Olivine appears to be later that Type 1 plagioclase, but is earlier than Type 2, and may have been resorbed during crystallization of Type 2.

Finally, with the entry of clinopyroxene as a crystallizing phase, crystallization became more rapid. Type 3 plagioclase precipitated together with clinopyroxene, whereas magnetite crystallized at grain boundaries and within the small remaining amounts of interstitial liquid (glass).

Geochemistry

Twenty-six basalts samples were analyzed for major and trace elements at Site 562. Two distinct chemical groups can be recognized (Fig. 5), although the lithology and petrology are relatively homogeneous. On an extended Coryell-Masuda plot (Fig. 6), all samples analyzed display a depleted magmaphile element signature. Within Chemical Group II, a small subgroup occurs as a consequence of sampling within an aphyric region of the otherwise slightly to moderately plagioclase phyric pillow sequence.

Chemical Group I is represented by 19 samples from Sections 562-1-1 through 562-6-3 (Table 2). Samples from Sections 562-4-1 and 562-4-3 are the only visibly altered samples analyzed, but an examination of Sr and K_2O abundances suggests that the majority of samples have undergone some degree of alteration. Figure 7 shows the very scattered relationship of Sr values to CaO content. In an attempt to further assess the effects of alteration, we can assume that in a suite of fresh samples Sr and CaO should show a reasonably coherent, positive correlation and that seawater addition increases Sr content with little effect of CaO. The lower bound of the field of values in Figure 7 is a straight line passing through samples from Sections 562-2-1, 562-2-2, 562-2-3, 562-2-4, and 562-5-2. The slope of this line is the same as that derived in the same way for samples from Site 559. It seems reasonable to assume that these five samples are unaltered and that all other samples have undergone some Sr addition. When these samples are plotted on Figure 8 (K_2O versus Sr) they occupy a separate field at low K_2O and Sr values (along with other samples lying close to the Sr versus CaO line). Those samples that appear to have had Sr added have also had K_2O added.

In order to assess the effects of alteration on other elements, we take the average composition of the five unaltered samples (562-2-1 to 562-2-4 and 562-5-2), express it in mole %, and compare it to the compositions of vis-

[3] Preliminary shore-based microprobe studies suggests a plagioclase phenocryst core composition close to about An_{90}, zoned to a marginal composition of about An_{75}. Type 2 plagioclase compositions are An_{70}.

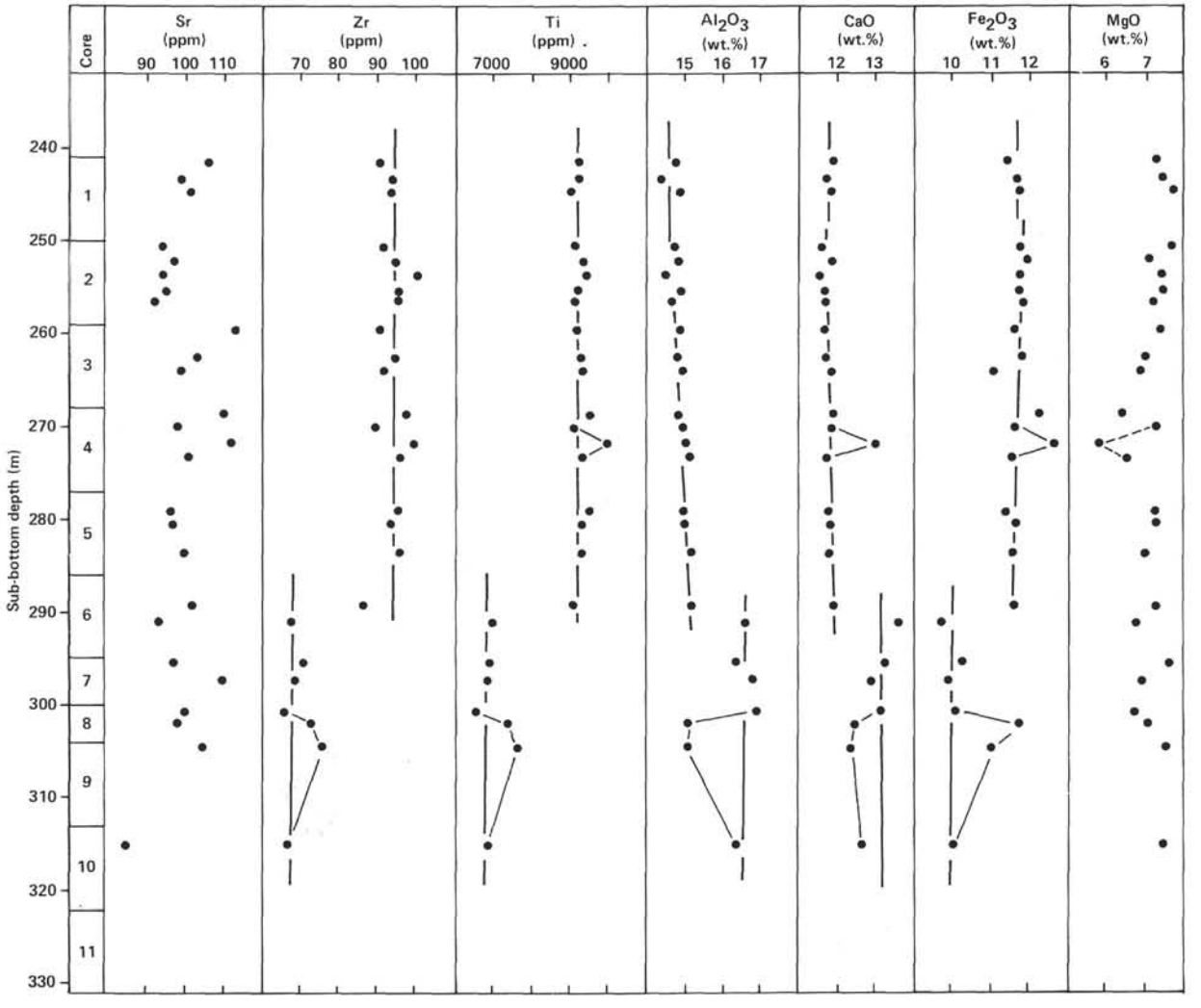


Figure 5. Downhole variations in chemical abundances, Hole 562.

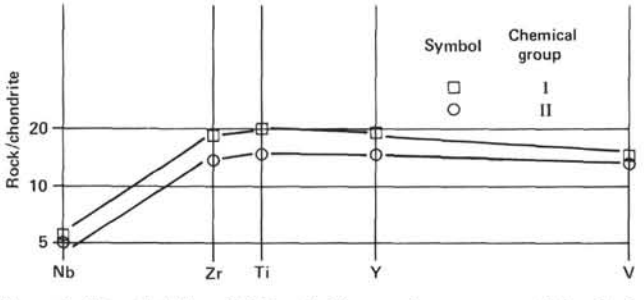


Figure 6. Extended Coryell-Masuda diagram for averages of chemical Groups I and II Hole 562 basalts.

ibly altered Samples 562-4-1, 9–12 cm and 562-4-3, 83–85 cm normalized to the unaltered TiO_2 value (Table 3). Relative to TiO_2, alteration has produced significant decreases in SiO_2 (Section 562-4-3 only) and MgO, with increases in K_2O and Sr. Apparent increases in V (562-4-3) and decreases in Nb (both samples) require further evaluation, preferably on single pillows. Nb variations, however, are within X-ray fluorescence analytical precision.

Chemical Group II is composed of the remaining samples from Site 562. Relative to Chemical Group I, Group II is lower in TiO_2, Fe_2O_3 (total iron), P_2O_5, V, Y, and Zr and higher in Al_2O_3 and CaO. Samples from Sections 562-8-2 and 562-9-1 form a separate subgroup; higher in TiO_2, Fe_2O_3 (total iron), V, Y, and Zr and lower in Al_2O_3 and CaO relative to the remainder of Chemical Group II. However, the two samples of this subgroup are aphyric whereas the remainder of Group II samples are sparsely to moderately plagioclase phyric. The geochemical differences between the subgroups are readily explained by this difference in plagioclase phenocryst content. Calculations presented in Table 4 are for a mixture of one part liquid having a chemical composition equal to the average of samples from Sections 562-8-2 and 562-9-1 with 8% added plagioclase phenocryst. Two plagioclase compositions were used, An_{60} and An_{75} (Deer et al., 1976). The composition resulting from An_{60} addition is remarkably similar to that of Section 562-7-2; the addition of An_{75} to the average liquid results in a composition almost exactly that of Sections 562-7-2 and 562-8-1. This calculated composition also approximates Sections 562-

Table 2. Analyses of major elements (in wt.%) and trace elements (in ppm) of Hole 562 basalts.[a]

Core-Section (interval in cm) (piece number)	Sub-bottom depth (m)	Chemical group	SiO_2	TiO_2	Al_2O_3	Fe_2O_3[b]	MnO	MgO	CaO	K_2O	P_2O_5	Total	Mg'[c]	Ti	V	Sr	Y	Zr	Nb
1-1, 104-107 (6D)	242.1		50.06	1.54	14.79	11.42	0.18	7.20	11.87	0.17	0.14	97.37	59	9240	321	106	40.8	91	2.9
1-2, 34-37 (2C)	242.9		49.99	1.54	14.38	11.67	0.18	7.33	11.69	0.07	0.15	97.00	59	9240	311	99	41.3	94	2.3
1-3, 92-95 (3C)	244.9		49.47	1.51	14.87	11.73	0.18	7.65	11.81	0.20	0.14	97.56	59	9060	328	103	41.3	94	2.1
2-1, 55-59 (3B)	250.6		49.72	1.52	14.75	11.73	0.18	7.63	11.57	0.09	0.14	97.33	59	9120	319	94	40.5	92	2.2
2-2, 54-59 (8A)	252.1		49.19	1.56	14.86	11.93	0.18	7.01	11.87	0.33	0.14	97.07	57	9360	328	97	43.2	95	3.0
2-3, 61-65 (4C)	253.6		50.40	1.57	14.54	11.75	0.18	7.38	11.53	0.17	0.14	97.66	59	9420	326	94	41.6	101	3.1
2-4, 33-38 (2C)	254.9		50.37	1.54	14.92	11.73	0.18	7.41	11.67	0.04	0.14	98.00	59	9240	322	95	40.5	96	3.5
2-5, 73-76 (4B)	256.6		50.35	1.53	14.67	11.83	0.18	7.20	11.70	0.00	0.15	97.61	58	9180	317	92	41.3	96	2.9
3-1, 85-88 (3B)	259.9		50.39	1.54	14.91	11.62	0.18	7.35	11.68	0.11	0.16	97.94	59	9240	330	113	41.6	91	2.6
3-3, 103-106 (6D)	263.1	I	49.33	1.55	14.85	11.81	0.18	6.95	11.68	0.31	0.14	96.80	57	9300	327	103	41.9	95	3.7
3-4, 120-123 (7)	264.7		50.08	1.56	14.98	11.05	0.17	6.83	11.85	0.02	0.14	96.68	58	9360	322	99	40.6	92	2.2
4-1, 9-12 (1B)	268.1		49.40	1.59	14.83	12.28	0.18	6.34	11.89	0.22	0.15	96.88	58	9540	330	110	42.4	98	2.5
4-2, 0-3 (1A)	269.3		49.74	1.53	14.98	11.66	0.18	7.26	11.84	0.05	0.14	97.38	58	9180	316	98	40.3	90	3.4
4-3, 83-85 (2H)	271.7		48.23	1.67	15.06	12.64	0.21	5.80	13.02	0.24	0.18	97.05	51	10020	368	112	46.7	100	2.0
4-4, 100-103 (7B)	273.4		49.54	1.56	15.13	11.54	0.17	6.46	11.71	0.32	0.15	96.58	56	9360	316	101	43.0	96	4.1
5-2, 76-79 (4B)	279.3		50.16	1.59	15.00	11.37	0.17	7.20	11.75	0.13	0.15	97.52	59	9540	342	96	41.6	96	3.3
5-3, 104-107 (1G)	281.0		49.89	1.56	15.07	11.62	0.18	7.22	11.79	0.10	0.15	97.58	53	9360	319	97	40.5	94	2.2
5-5, 75-79 (3D)	283.6		49.79	1.56	15.21	11.56	0.18	6.93	11.77	0.27	0.15	97.42	57	9360	320	100	41.2	96	4.1
6-3, 74-77 (3A)	289.8		49.77	1.52	15.23	11.57	0.18	7.23	11.90	0.33	0.14	97.87	58	9120	334	102	40.2	87	2.9
6-4, 74-78 (2F)	291.3		48.94	1.17	16.63	9.78	0.15	6.74	13.61	0.16	0.12	97.30	61	7020	302	93	31.5	68	3.7
7-1, 29-33 (4B)	295.3		49.10	1.16	16.41	10.28	0.16	7.57	13.29	0.15	0.13	98.25	62	6960	299	97	31.5	71	2.3
7-2, 44-47 (2C)	297.0		50.00	1.15	16.82	9.95	0.14	6.86	12.92	0.14	0.12	98.10	61	6900	287	110	32.2	69	2.6
8-1, 95-98 (7A)	301.0	II	49.60	1.10	16.90	10.13	0.17	6.70	13.14	0.24	0.11	98.09	60	6600	277	100	31.1	66	2.2
8-2, 26-29 (4A)	301.8		49.59	1.24	15.12	11.71	0.18	7.03	12.48	0.39	0.13	97.87	57	7440	316	98	33.0	73	2.4
9-1, 140-142 (7)	305.4		50.36	1.28	15.13	11.01	0.17	7.48	12.40	0.38	0.16	98.37	60	7680	359	105	36.6	76	4.2
10-2, 125-128	315.8		49.89	1.16	16.40	10.07	0.14	7.43	12.66	0.04	0.10	97.89	62	6960	290	85	29.9	67	1.8

[a] On-board measurements were made on ignited samples. Onshore analyses of loss on ignition are less than 1% in most cases. Compiled data tables at the end of this volume (Appendix) include volatile components.
[b] Total Fe as Fe_2O_3.
[c] Mg' is the atomic ratio of 100 × (Mg/[Mg + Fe^{2+}]), calculated using an assumed Fe_2O_3/FeO ratio of 0.15.

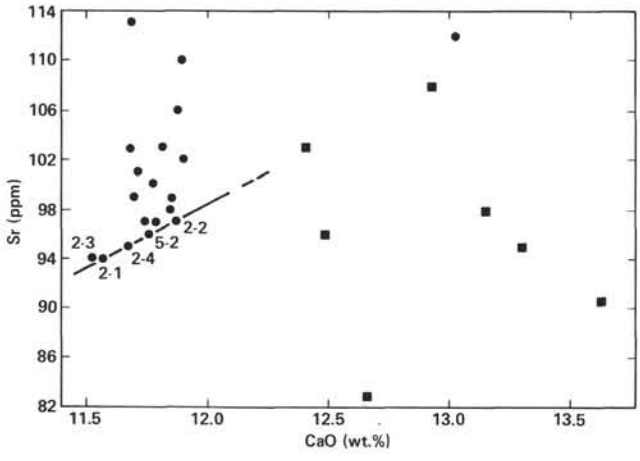


Figure 7. Chemical alteration effects: Sr versus CaO, Chemical Groups I (circles) and II (squares). Numbers indicate core and section for certain samples.

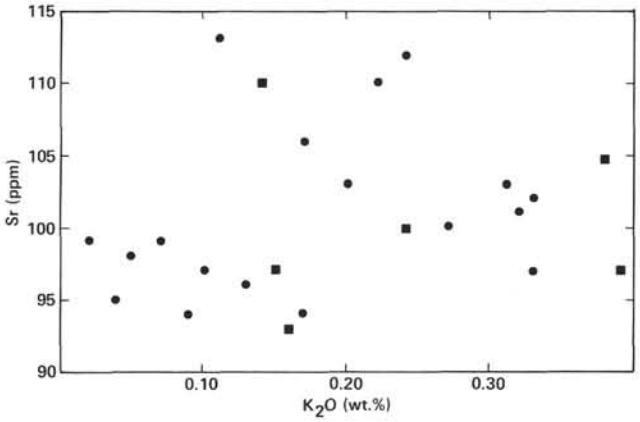


Figure 8. Chemical alteration effects: Sr versus K_2O, Chemical Groups I (circles) and II (squares).

6-4, 562-7-1, and 562-10-2, except that CaO and/or MgO concentrations are higher than calculated. Hence, this chemical subgroup is an artifact of sampling in a non-uniform sequence and not of petrogenetic significance.

K_2O and Sr abundances of Group II rocks also show a wide scatter indicating widespread alteration with this group (Figs. 7 and 8).

MAGNETICS

Basalt Paleomagnetism

At this site, 90 m of basalt were cored and 33 oriented minicores were taken for on-board study of paleomagnetic properties. The normal remanent magnetization (NRM) and susceptability were routinely measured, and then each sample was subjected to alternating field (AF) demagnetization at various steps until the remanent magnetization value was 50% of the NRM intensity. The NRM, susceptibility, median demagnetizing field (MDF), and the results of AF demagnetization are given in Table 5. The typical results of demagnetization (Figs. 9, 10) separated two types of basalt.

Type A basalt has high susceptibility (more than 200 × 10^{-6} emu/cm^3, and mostly around 600 × 10^{-6} emu/cm^3) and low MDF (less than 200 Oe, and mostly less than 100 Oe). This suggests that the magnetic mineral in the basalt is of low coercivity, which might be the result of the larger grain size of titanomagnetite or the presence of magnetite.

Type B basalt has low susceptibility (less than 200 × 10^{-6} emu/cm^3, and mostly less than 100 × 10^{-6} emu/

Table 3. Effects of alteration on chemical composition Group I, Hole 562.

Element	Average	562-4-1, 9–12 cm Measured	T	Change (%)	562-4-3, 83–85 cm Measured	T	Change (%)
Major elements (mole %)							
SiO_2	56.51	57.20	55.10	−2	56.00	51.00	−10
TiO_2	1.33	1.38	1.33	0	1.46	1.33	0
Al_2O_3	9.97	10.10	9.73	−2	10.30	9.38	−6
Fe_2O_3	5.05	5.35	5.16	+2	5.52	5.03	0
MnO	0.17	0.17	0.16	−5	0.21	0.19	+12
MgO	12.50	10.90	10.5	−16	10.00	9.11	−27
CaO	14.30	14.70	14.2	−1	16.20	14.80	+1
Na_2O	—	—	—	—	—	—	—
K_2O	0.11	0.16	0.15	+36	0.18	0.16	+45
P_2O_5	0.07	0.07	0.07	0	0.09	0.08	+14
	100.01	100.03	96.40		96.26	91.08	
Trace elements (ppm)							
Ti	9336	9540		+2	10020		+7
V	327	330		+1	368		+13
Sr	95	110		+16	112		+18
Y	14.5	42.40		+2	46.7		+13
Zr	96	98		+2	100		+4
Nb	3.0	2.50		−7	2.0		−33

Note: Average is average composition of the five least altered basalts from Group I; T is normalized composition with respect to TiO_2 = 1.33 wt.%; change (%) is change relative to average basalt composition. Total Fe as Fe_2O_3. Mg′ is the atomic ratio of 100 × (Mg/[Mg + Fe^{2+}]); calculated using an assumed Fe_2O_3 ratio of 0.15.

cm^3) and high MDF (more than 200 Oe; mostly more than 400 Oe). This suggests that these basalts have titanomagnetite of single-domain grain size of coercivity higher than those of Type A basalts.

The plot of susceptibility and MDF versus depth (Fig. 11) clearly indicates the two different types of basalts, and the two different units of basalts. Unit 1 is the upper unit of basalt from 240 m to a depth of about 286 m, and is identified by the presence of both Type A basalt and Type B basalt. Unit 2 is the lower unit of basalt from 286 m to last cored depth of 331 m, and is identified by the presence of only Type B basalt.

At this time, the reason for these two different types of basalts is not known, but they may be the results of two different magma sources or just different cooling histories.

The inclination values are much smaller than the expected dipole inclination for the latitude of this site, which may be due to a tectonic rotation of crust since the basalts were erupted.

PHYSICAL PROPERTIES

The hole was washed to basement with no recovery of undeformed sediment. Velocity and density measurements were made on basalt cores as shown in Table 6.

The results are remarkable only for densities and velocities that are generally higher than for average basalts from this leg. The specimen from Core 3 with a velocity of 5.98 km/s and density of 2.91 Mg/m^3 is the highest of these, and well above a mean value for ocean basalts at laboratory temperature and pressure. The basalts recovered are from a massive flow unit, in contrast to the predominance of pillow basalts in the previous holes of this leg. The variation in properties downhole does not reveal any systematic pattern.

SUMMARY AND CONCLUSIONS

Hole 562 was drilled on Anomaly 5D about 60 miles south of the Hayes Fracture Zone, the first site on the southernmost flow line. The sediments were washed down and the bottom felt at 240 m.

The basement, cored for 90 m, consisted of sparsely plagioclase phyric pillow basalts. Fresh glasses at the margins of the pillows are very common. Despite some altered parts, the bulk of the crystalline basalts are fairly fresh. The macro-description and micro-description of recovered samples show one petrographic unit, but both major and trace element data show two different chemical groups. The first chemical group in the basement is fairly homogeneous even though a downhole gradient is observed for Al_2O_3 (from 14.6 at the top to 15.2 in the lower region). The second chemical group is less homogeneous, because of variable plagioclase phenocryst distribution. The two chemical groups show a depleted character for magmaphile elements, with $(Nb/Zr)_{ch}$ of ~ 0.3.

It would have been ideal to drill a second hole in the area to obtain a more extensive sampling of basalt material, but we decided to save time for the last hole at Anomaly 13, where logging and piston coring were planned.

REFERENCE

Deer, W. A., Howie, R. A., and Zussmann, J., 1976. *An Introduction to the Rock Forming Minerals*: London (Longmans).

Table 4. Effect of plagioclase phenocryst addition on chemical composition, Group II, Hole 562.

Element	Liquid (average composition of samples from Sections 562-8-2 and 562-9-1)	Composition of plagioclase An_{60}	1 part liquid + 0.08 plagioclase	Composition of plagioclase An_{75}	1 part liquid + 0.08 plagioclase
SiO_2	49.98	52.96	50.20	49.06	49.91
TiO_2	1.26		1.17		1.17
Al_2O_3	15.13	29.72	16.21	32.14	16.39
Fe_2O_3	11.36	0.84	10.58	0.27	10.54
MnO	0.18		0.17		0.17
MgO	7.26		6.72	0.20	6.74
CaO	12.44	12.28	12.43	15.38	12.66
K_2O	0.38	0.13	0.36	0.17	0.36
P_2O_5	0.16		0.15		0.15

Note: Plagioclase An_{60} and An_{75} compositions from Deer et al., 1976.

Table 5. Paleomagnetics properties of Site 562 basalts.

Core-Section (interval in cm)	J_{NRM} ($\times 10^{-3}$ emu/cm^3)	NRM inc. (°)	Stable inc. (°)	χ ($\times 10^{-6}$ emu/cm^3 Oe)	MDF (Oe)
1-2, 28-30	16.77	-27.4	-34.3	410	90
2-1, 64-71	3.71	-12.7	-30.8	490	65
2-2, 142-144	1.95	-27.7	-29.4	110	370
2-3, 41-43	2.53	-39.3	-40.0	60	490
2-4, 7-9	3.95	-18.8	-39.1	600	85
2-5, 9-11	3.46	-25.9	-35.0	250	75
3-1, 46-48	1.66	-21.8	-38.0	145	360
3-2, 141-143	4.39	-13.1	-24.8	216	150
3-3, 86-88	0.77	-29.2	-45.6	108	365
3-4, 110-112	4.02	27.0	31.6	290	77
4-1, 75-77	4.01	-21.5	-28.0	746	200
4-2, 46-48	4.26	-27.6	-34.4	224	185
4-3, 26-28	4.31	-17.1	-38.7	682	75
4-4, 117-119	3.28	-38.1	-40.2	138	355
5-1, 64-66	2.34	-31.2	-40.9	82	325
5-2, 89-91	1.81	-11.1	-32.8	540	115
5-3, 40-42	3.59	-2.2	-19.1	652	170
5-3, 79-81	2.90	-6.9	-31.9	820	157
5-4, 29-31	3.41	-14.6	-27.3	610	75
5-4, 122-124	2.39	-10.5	-27.4	804	75
5-5, 47-49	2.21	-10.3	-24.6	135	280
6-3, 85-87	1.43	-41.5	-42.1	85	450
6-4, 94-96	2.85	-43.9	-49.8	85	465
7-1, 26-28	2.33	-21.8	-23.9	85	567
7-2, 56-58	3.02	-25.7	-28.1	105	375
7-1, 126-128	1.89	-33.5	-35.3	98	475
7-3, 64-66	1.42	-28.4	-29.7	80	625
8-1, 144-146	3.94	-30.0	-31.8	112	470
8-2, 7-9	4.01	-36.5	-36.2	132	410
9-1, 82-84	3.02	-29.7	-31.2	95	400
9-2, 23-25	2.18	-30.4	-33.3	92	450
9-2, 81-83	3.20	-35.6	-36.4	93	450
11-1, 115-117	1.48	-33.5	-33.9	94	550

Note: J_{NRM} = intensity of natural remanent magnetization (NRM); inc. = inclination; χ = susceptibility; MDF = median demagnetizing field.

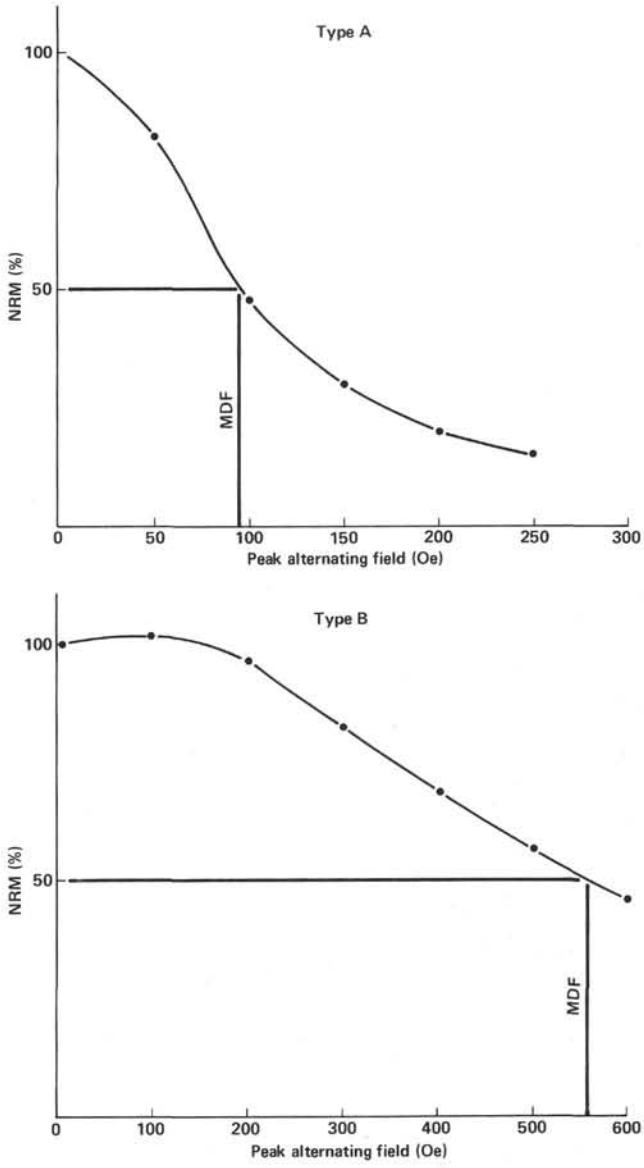


Figure 9. Percent natural remanent magnetization (NRM) versus peak alternating field curves for Type A basalt (562-5-4, 29–31 cm) and Type B basalt (562-7-1, 26–28 cm). MDF = median demagnetizing field.

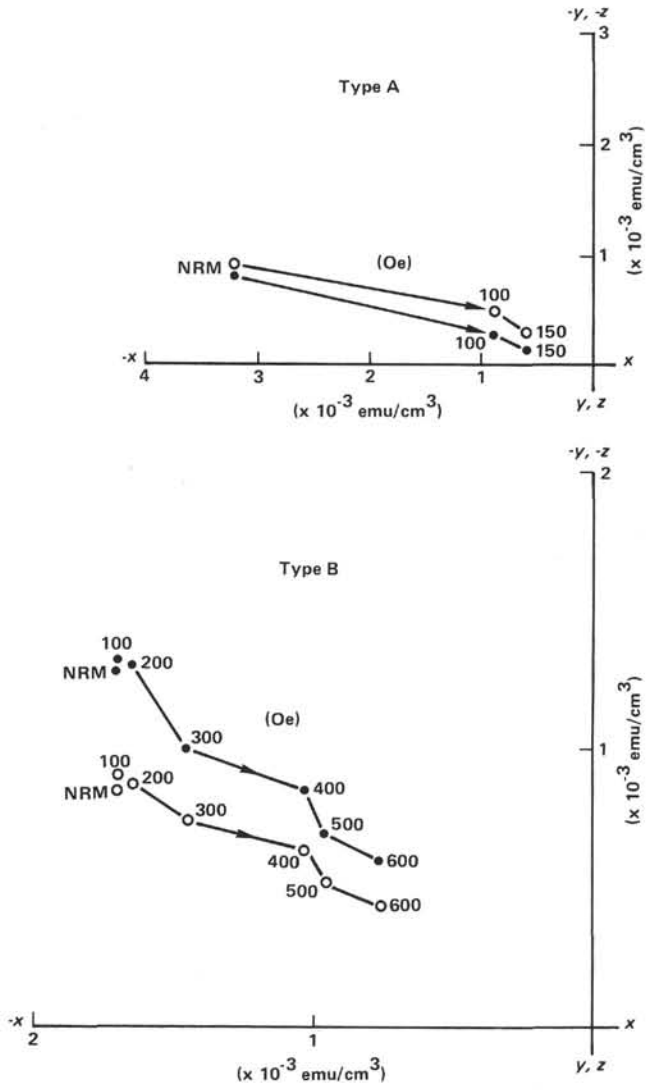


Figure 10. Vector diagrams showing the change of NRM after alternating field demagnetization for Type A basalt (562-5-4, 29–31 cm) and Type B basalt (562-7-1, 26–28 cm). Solid circles are plotted on the horizontal plane and open circles are plotted on the vertical plane. NRM = natural remanent magnetization.

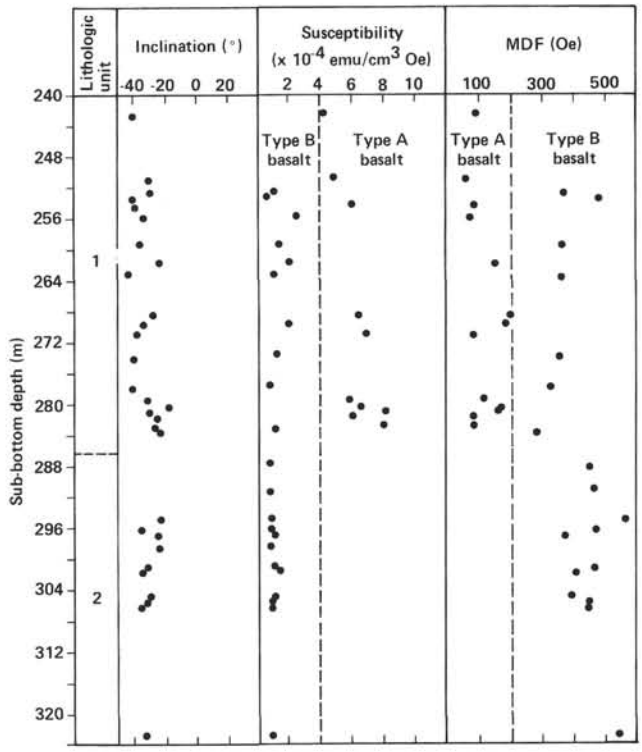


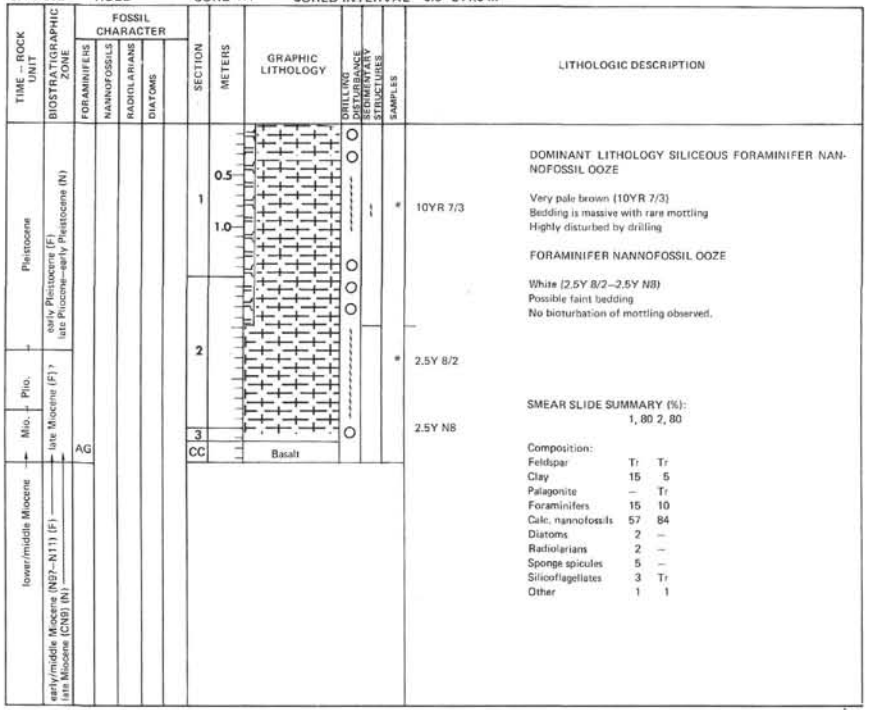
Figure 11. Downhole plot of magnetic properties with Type A and B basalts indicated. MDF = median demagnetizing field.

Table 6. Physical properties, Hole 562.

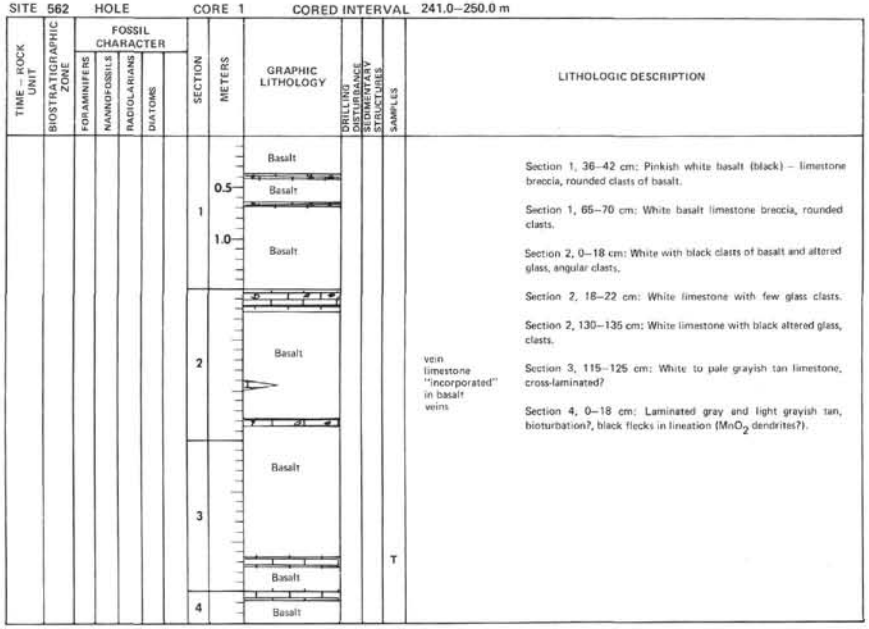
Core-Section (interval in cm)	Sub-bottom depth (m)	Sonic velocity (km/s) (horizontal)	Temperature (°C)	GRAPE density (g/cm3) (horizontal)	Gravimetric density			Lithology or remarks
					Wet-bulk density (g/cm3)	Water content (%)	ϕ (%)	
1-1, 94–104	242.0	5.70	22.0	2.88	2.86	1	3	Plag. phyric basalt
2-3, 113–117	254.2	5.63	22.0	2.80	2.87	1	4	Basalt
3-1, 31–36	259.3	5.98	22.0	2.91	2.91	1	3	Basalt
4-1, 52–57	268.5	5.42	22.0	2.83	2.85	2	6	Plag. phyric basalt
5-1, 20–25	277.2	5.15	22.0	2.77	2.82	3	8	Vesicular basalt
5-5, 54–59	283.6	5.82	22.0	2.88	2.90	1	3	Plag. phyric basalt
6-2, 100–112	287.0	5.44	22.0	2.78	2.84	2	7	Basalt
7-2, 134–138	297.2	5.32	22.0	2.76	2.82	2	7	Basalt

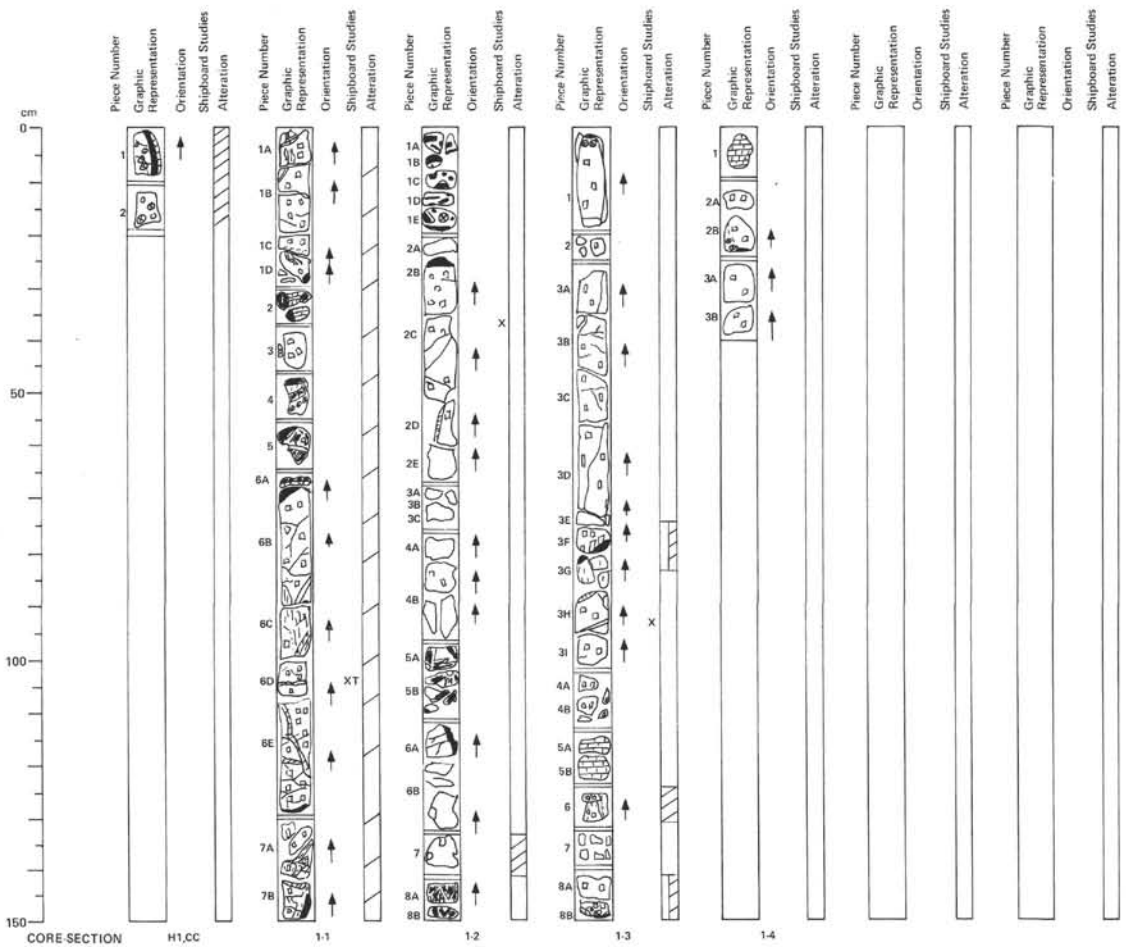
Note: Water content is corrected; ϕ = porosity; Plag. = plagioclase. All values measured at laboratory temperature and pressure. For details of techniques, see Explanatory Notes chapter (this volume).

SITE 562 HOLE CORE H1 CORED INTERVAL 0.0–241.0 m



SITE 562 HOLE CORE 1 CORED INTERVAL 241.0–250.0 m





SITE 562, CORE H1 Depth 0.0–241.0 m

CORE-CATCHER

VARIOLITIC BASALT

0–19 cm: Aphyric variolitic basalt with <1% scattered plagioclase phenocrysts and relic olivine microphenocrysts, dark gray (7.5YR N4/0), fine grained, plagioclase, <1%, anhedral, 2–10 mm, olivine (relic), subhedral, <1 mm, moderately altered, variolites are brown (10YR 5/3). Vesicle percentage 10% in unchilled areas only.

0–10 cm, Piece 1: There is a rind (2 cm width) of fresh black basalt glass which grades into a variolitic zone. There is a crust of sediment on the glass rind which contains 1–2 mm devitrified glass shards.

SITE 562, CORE 1 Depth 241.0–250.0 m

SECTION 1

PLAGIOCLASE PHYRIC PILLOW BASALT

0–30, 38–42, and 65–150 cm: Plagioclase moderately phyric basalt, dark gray (2.5Y N4) in fresh parts and grayish brown (2.5Y 5/2) in altered parts fine grained. Plagioclase phenocrysts (2–3%), 3 mm–1 cm moderately altered to gray brown (2.5Y 5/2). <1% rounded and irregular vesicles (<1 mm) filled with light green (clay?). Veins filled with calcite or limestone.

30–38 and 45–65 cm: Glass clasts (black) in limestone matrix, mostly fresh with alteration to dark brown (7.5YR 4/4) clay(?) around edges of clasts.

SECTION 2

PLAGIOCLASE PHYRIC PILLOW BASALT

22–95 and 113–135 cm: Plagioclase moderately phyric pillow basalt gray (2.5Y N6), fresh to slightly altered. <1% rounded and irregular vesicles filled with dark to light green clay(?). 1–2% plagioclase phenocrysts (2–5 mm). Looks like less phyric than in Section 1.

0–22 and 97–110 cm: Glass clasts (black) in limestone matrix, mostly fresh with alteration as in Section 1.

135–140 cm: Limestone with heavily altered glass clasts (3–7 cm).

SECTION 3

PLAGIOCLASE PHYRIC PILLOW BASALT

0–113 and 125–150 cm: Moderately plagioclase phyric basalt, dark gray (7.5YR N4/0), fine to medium grained, plagioclase phenocrysts, 2–3%, anhedral (resorbed), 1–10 mm.

Fresh interiors to moderately altered along fractures and variolitic zones, brown (10YR 5/3). 1% vesicles, <1 mm, white, talc, and green chlorite.

0–1, 76–77, and 150 cm: Fresh black glass.

113–121 cm: Graded fossiliferous limestone, white (5YR 8/1) graded undisturbed foram beds, sedimentary clasts (consolidated limestone), dendritic MnO.

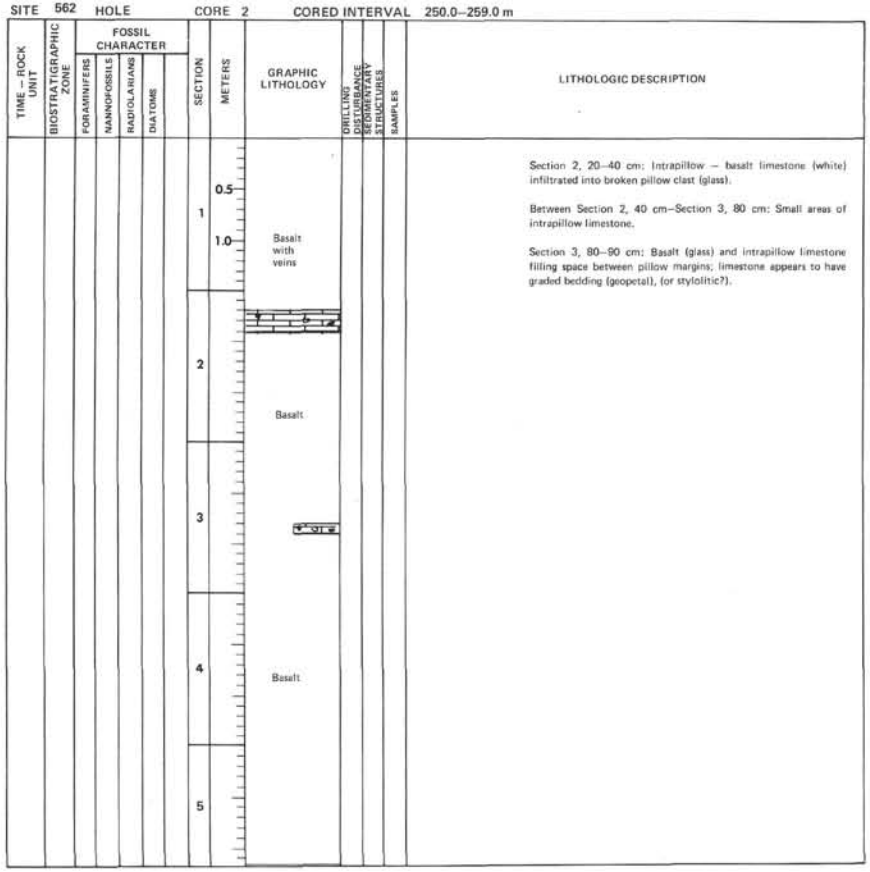
SECTION 4

PLAGIOCLASE PHYRIC PILLOW BASALT

0–10 cm: Limestone white (5YR 8/1). Dendritic MnO.

10–40 cm: Same as Section 1 basalt description.

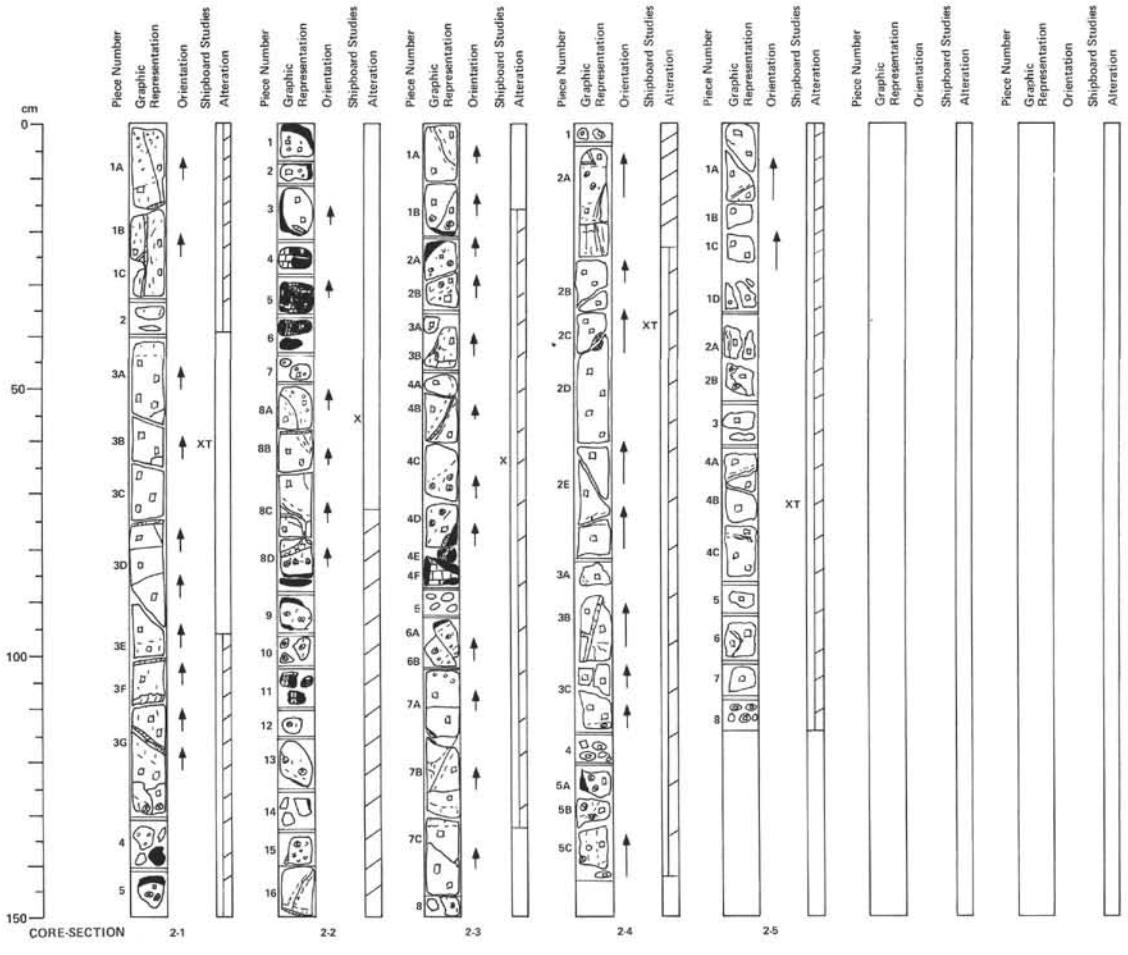
SITE 562 HOLE CORE 2 CORED INTERVAL 250.0–259.0 m



Section 2, 20–40 cm: Intrapillow – basalt limestone (white) infiltrated into broken pillow clast (glass).

Between Section 2, 40 cm–Section 3, 80 cm: Small areas of intrapillow limestone.

Section 3, 80–90 cm: Basalt (glass) and intrapillow limestone filling space between pillow margins; limestone appears to have graded bedding (geopetal), (or stylolitic?).



SITE 562, CORE 2 Depth 250.0–259.0 m

SECTION 1

PLAGIOCLASE PHYRIC PILLOW BASALT

0–129 cm: Sparsely to moderately plagioclase-phyric basalt. Plagioclase 1–5%, generally 2–3%. Prisms and rounded(?) glomerocrysts to 10 mm, generally 2–5 mm. Rare olivine to 2 mm, altered greenish clay. Matrix fine grained dark gray (7.5YR N4) with visible plagioclase laths to 1 mm weathered brown (7.5YR 5/4) close to fractures.

0–10 cm: Sparsely vesicular decreasing downhole. Vesicles round, generally <1 mm dark clay filled.

15–80 cm: Minor calcite veinlets as shown (diagonal hatched).

95–120 cm: Limestone veins as shown. Irregular margins light gray (5Y 7/1) (greenish tint).

126–146 cm: Pillow margins dark gray aphanitic and variolitic, aphyric sparsely vesicular. Fresh glass, highly fractured but only slightly altered to palagonite along cracks.

SECTION 2

SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALT

0–43 cm: Pillow margin material. Sparsely plagioclase phyric aphanitic basalt (very dark gray – 7.5YR N3) and fresh black glass. Plagioclase phenocrysts 2–3%, mainly 2–5 mm some to 10 mm rounded(?) glomerocrysts and prisms. Glass altered dark olive gray (5Y 3/2) along fractures.

43–140 cm: Sparsely phyric to aphyric (still with scattered phenocrysts) mainly aphanitic pillow basalt, dark gray (7.5YR N4). Variolitic where shown ( ). Altered brown (10YR 5/3) mottled gray along fractures. Sparse vesicles near tops of some pillows (~5 cm, 50 cm, and 135 cm). Vesicles round, <1 mm filled with dark clay, sometimes bluish green (no number).

22–40, 70–80, and 102–109 cm: Limestone veins and interpillow breccia matrix. Fine grained limestone white (5YR 8/1) to pink (5YR 7/3).

SECTION 3

SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALTS

0–15 and 105–145 cm: Sparsely phyric, fine grained basalt as in Section 1 – pillow interiors.

15–105 cm: Sparsely phyric, mainly aphanitic basalt and glass of pillow margins as in Section 2. Variolitic zones somewhat thicker (~5 cm) and more altered to light yellowish brown (10YR 6/4).

78–86 cm: Limestone. Pinkish gray (5YR 6/2) fine grained limestone with some laminae containing sand-sized, angular basalt grains.

22–35 and 95–103 cm: Sparsely vesicular near pillow tops. Small (<1 mm) round vesicles unfilled or filled by white expanding clay.

SECTION 4

SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALT

0–110 cm:

Sparsely plagioclase phyric pillow basalt (gray – 7.5YR N5/0).

Plagioclase phenocrysts, generally 2–4 mm long and needle-like aggregates visible with hand lens. Some 3–7 mm rounded prisms and/or glomerocrysts.

Altered along fractures within rock and adjacent to calcite veins. Tinged with yellowish brown hue (10YR 5/6). Zones few mm to few cm wide.

Variolitic where shown; gradation in gray, but no real color change in transition zone.

Vesicles sparsely scattered throughout; rounded <1 mm–1.5 mm in diameter filled with dark clay, bluish green (no color since it changes with hydration).

110–140 cm:

Sparsely plagioclase phyric pillow basalt gray (7.5YR N5/0) as above, exceptions as follows:

Variolitic zone as noted, grades from glass through aphanitic basalt (very dark gray – 7.5YR N3/0) through variolitic zone (brownish yellow – 10YR 6/6) to sparsely plagioclase phyric basalt (dark gray – 7.5YR N5/0).

114–120 cm, Piece 4: Rock pieces in Piece 4 show glass and variolitic transition, surfaces not cut.

Some glass, as indicated.

SECTION 5

SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALT

0–113 cm:

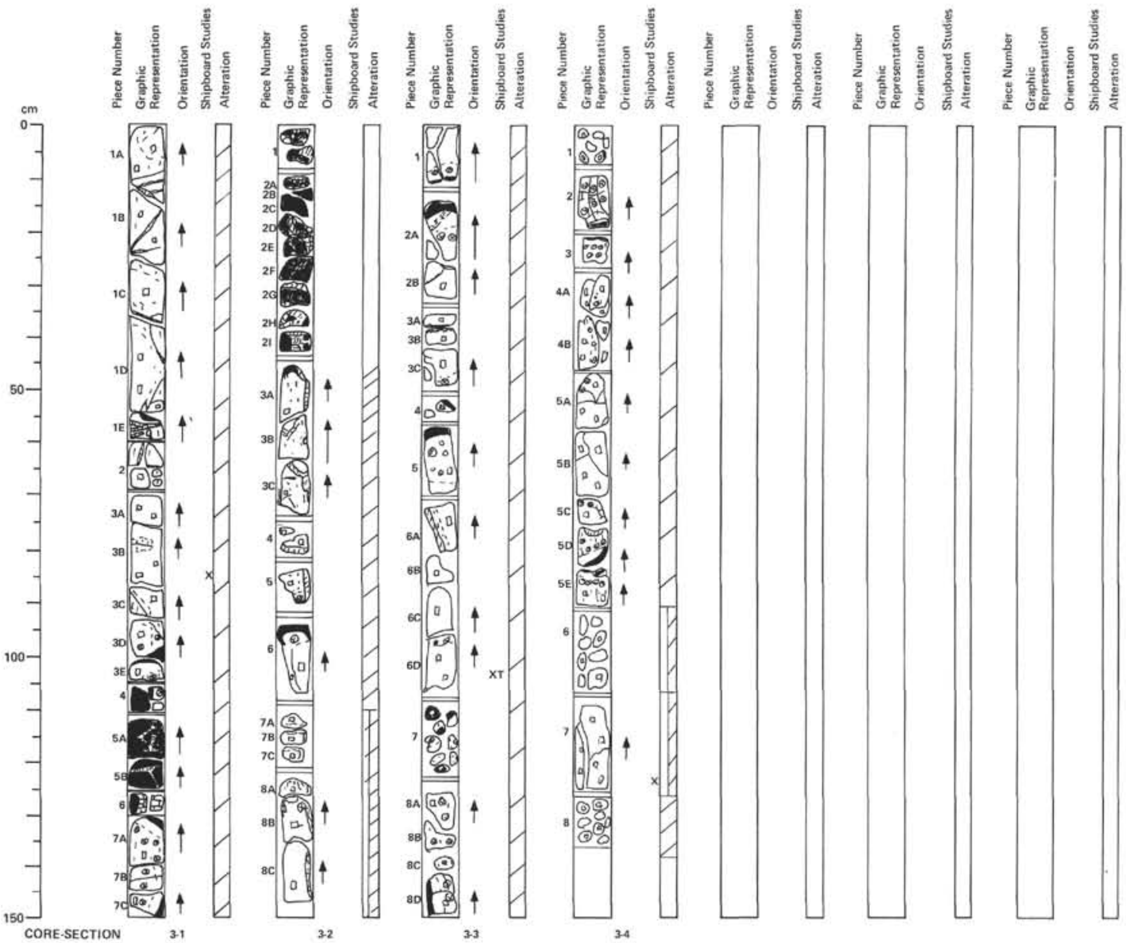
Sparsely plagioclase phyric pillow basalt gray (7.5YR N5/0).

Plagioclase phenocrysts, 2–4 mm long. Some 3–7 mm rounded prisms and/or glomerocrysts.

Alteration present along fractures and adjacent to calcite veinlets. Tinged with yellowish brown (10YR 5/6) hue. Zones narrow, only few mm wide.

Vesicles sparsely scattered throughout, rounded <1 mm–1.5 mm diameter, filled with dark clay; some bluish green (no color code) or yellowish brown (10YR 5/6) as in alteration.

Variolitic where shown: grades in color with brownish yellow (10YR 6/6) in variolite zone grading to gray slightly plagioclase phyric basalt gray (7.5YR N5/0).



SITE 562, CORE 3 Depth 259.0–268.0 m

SECTION 1

SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALT

0–40 and 70–85 cm: Sparsely phyric, fine grained basalt – pillow interiors as in Core 2, Section 1.

40–70 and 80–85 cm: Sparsely phyric aphanitic and variolitic basalt and glass – pillow margin material as in Core 2, Sections 2–5.

53–57 and 113–123 cm: Calcite veinlets, with cavities in lower interval.

125–128 cm: Limestone fine grained, light yellowish brown (10YR 6/4).

SECTION 2

GLASS AND SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALT

0–44 cm: Black (10YR 2/1) glass in a calcite cement. May be broadly classified as a breccia, but some pieces are entirely glass without calcite, while other pieces have calcite and limestone. Calcite is sparry in cavities, and limestone and calcite are slightly off-white. Rims of glass pieces (those within limestone) slightly altered to palagonite. Vesicles are present and rounded $\lesssim$1–2 mm in diameter.

47–147 cm:

Sparsely plagioclase phyric pillow basalt, gray (7.5YR N5/0).

Plagioclase phenocrysts, 3–5 mm long. Some 5–9 mm rounded prisms and/or glomerocrysts.

Alteration present along fractures within rock and adjacent to calcite rims. Color modified with yellowish brown (10YR 5/6) hue. Zones wide, few cm thick.

Variolitic sequence where shown. Glassy rim grades into black (10YR 2/1) aphanitic aphyric basalt, through variolitic zone (10YR 6/6) grading down to gray (7.5YR N5/0) slightly plagioclase phyric basalt.

Vesicles sparsely scattered; especially concentrated in altered basalt, aphanitic basalt and glass, and variolitic zone. May/may not be present in plagioclase phyric basalt adjacent to the variolite zone.

SECTION 3

SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALT

43–49 and 65–105 cm: Sparsely phyric, fine grained basalt – pillow interiors as in Core 2, Section 1 and Core 3, Section 1.

0–43, 50–65, and 124–150 cm: Sparsely phyric aphanitic and variolitic basalt and basalt glass – pillow margins as in Core 2, Section 2 and Core 3, Section 1.

101–121 cm: Fragments include all above rock types plus angular glass fragments in calcite matrix.

Scattered calcite veinlets where shown.

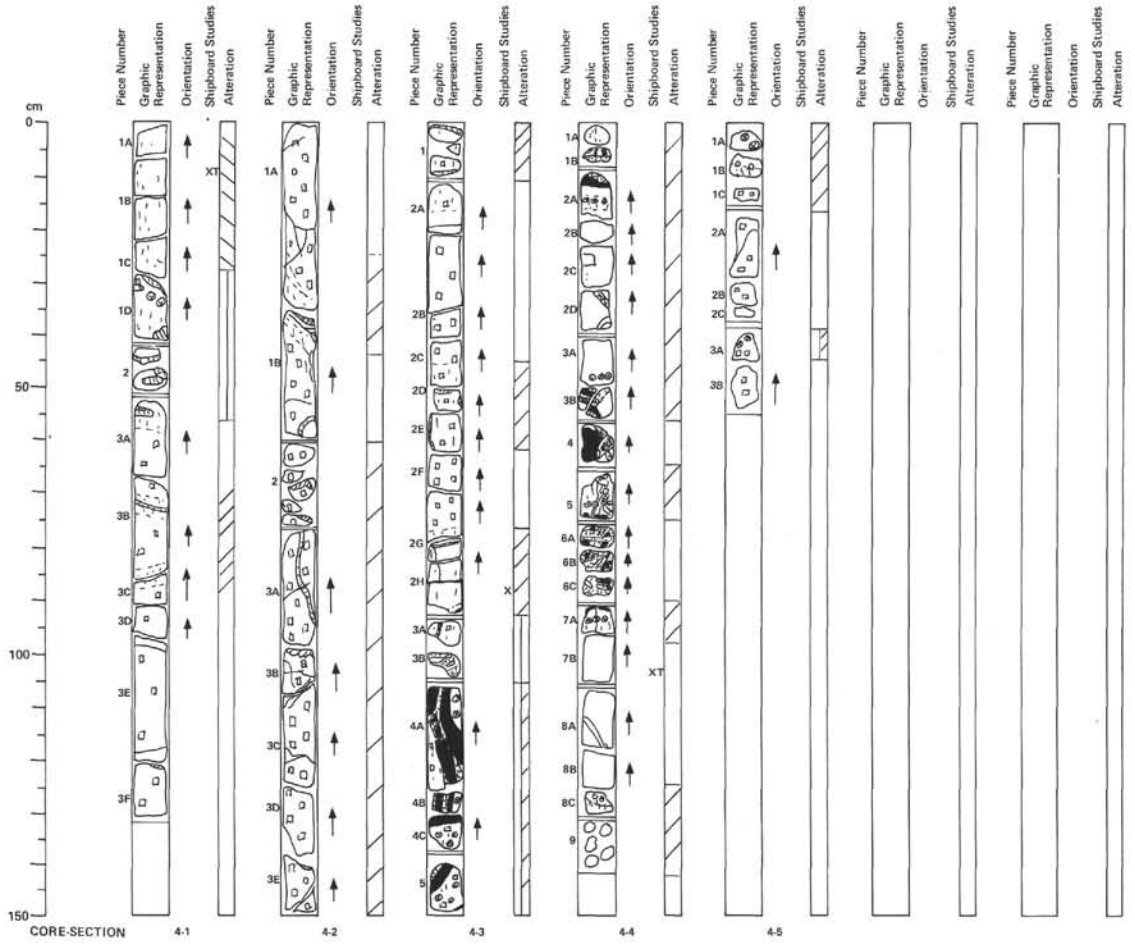
SECTION 4

SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALT

90–125 cm: Sparsely phyric, fine grained basalt – pillow interiors as in Core 2, Section 1 and Core 3, Section 1.

10–90 cm: Sparsely phyric aphanitic and variolitic pillow basalts as in Core 2, Section 2 and Core 3, Section 1. 1–2% rounded empty vesicles ($\lesssim$1 mm) in aphanitic and variolitic margins. 1–2% calcite-filled rounded and irregular vesicles (1–2 mm) in pillow interiors and variolitic zone. Little calcite veining. Not much glass here.

0–10 and 125–135 cm: Basalt chips.



SITE 562, CORE 4 — Depth 268.0–277.0 m

SECTION 1

APHYRIC TO SPARSELY PLAGIOCLASE PHYRIC BASALT (MASSIVE FLOW)

0–130 cm: Aphyric, fine grained basalt becoming sparsely plagioclase phyric downhole. Fine grained basalt gray (7.5YR N5) with abundant (30–40%?) unusually long plagioclase needles (to 3 mm) randomly oriented. Fine (< 0.5 mm) round, brown weathered? olivine (5–10%?) in weathered zones. Plagioclase phenocrysts, both prisms and rounded glomerocrysts(?) generally 2–5 mm, some to 10 mm. Abundance reaches 2–3% below 70 cm.

30–56 cm: Brick red, fine grained limestone as veins and irregular patches within basalt (yellowish red – 5YR 5/6) shown thus: ⋐⋑.

Calcite veins where shown ⋐⋑.

SECTION 2

SPARSELY TO MODERATELY PLAGIOCLASE PHYRIC BASALT (MASSIVE FLOW)

0–150 cm:

Fine grained, massive basalt becoming more plagioclase phyric downhole.

30–40% elongate (3–4 mm) plagioclase needles randomly oriented.

Fine, round, brown weathered olivine(?) (5–10%) in weathered zones.

Plagioclase phenocrysts, prisms and rounded glomerocrysts (2–5 mm up to 10 mm).

Some calcite filled veins, moderately altered.

SECTION 3

PLAGIOCLASE PHYRIC BASALT (MASSIVE FLOW)
PLAGIOCLASE PHYRIC PILLOW BASALT

0–77 cm:

Moderately plagioclase phyric basalt, gray (7.5YR N5), fine grained as in Section 1.

Plagioclase phenocrysts larger (to 10 mm) and more abundant (~5%, locally to 10%?).

Olivine phenocrysts to 2 mm, rare.

Apparently gravity accumulation near base of flow.

77–90 cm:

Aphyric basalt with only scattered, smaller (≤5 mm) plagioclase phenocrysts. Similar to above, but finer grained. Mostly weathered light gray (10YR 6/1) to light brownish gray (10YR 6/2).

Apparently the lower margin of flow. Note small glass rind at 91 cm.

93 cm: Base of flow.

94–150 cm:

Sparsely phyric aphanitic and variolitic basalt and basalt glass – pillow margins.

Variolitic zones altered light olive gray (5Y 6/2).

Veinlets of calcite and larger veins of limestone, fine grained, light reddish brown (5YR 6/3).

Glass only slightly palagonitized.

SECTION 4

SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALT AND GLASS CLASTS IN LIMESTONE – CALCITE MATRIX

10–56, 86–75, and 90–130 cm: Basalt pillows with variolitic zone grading into aphanitic black basalt with glass rims. As in Section 3, 94–150 cm. Fairly fresh to moderately altered. <1% rounded and irregular vesicles (<1 mm) calcite-filled at *pillow margins.*

0–10, 58–66, and 77–90 cm: Fresh to moderately altered (black) glass clasts in limestone (pinkish gray – 7.5YR 8/2) or calcite (white) or both together (82–89 cm).

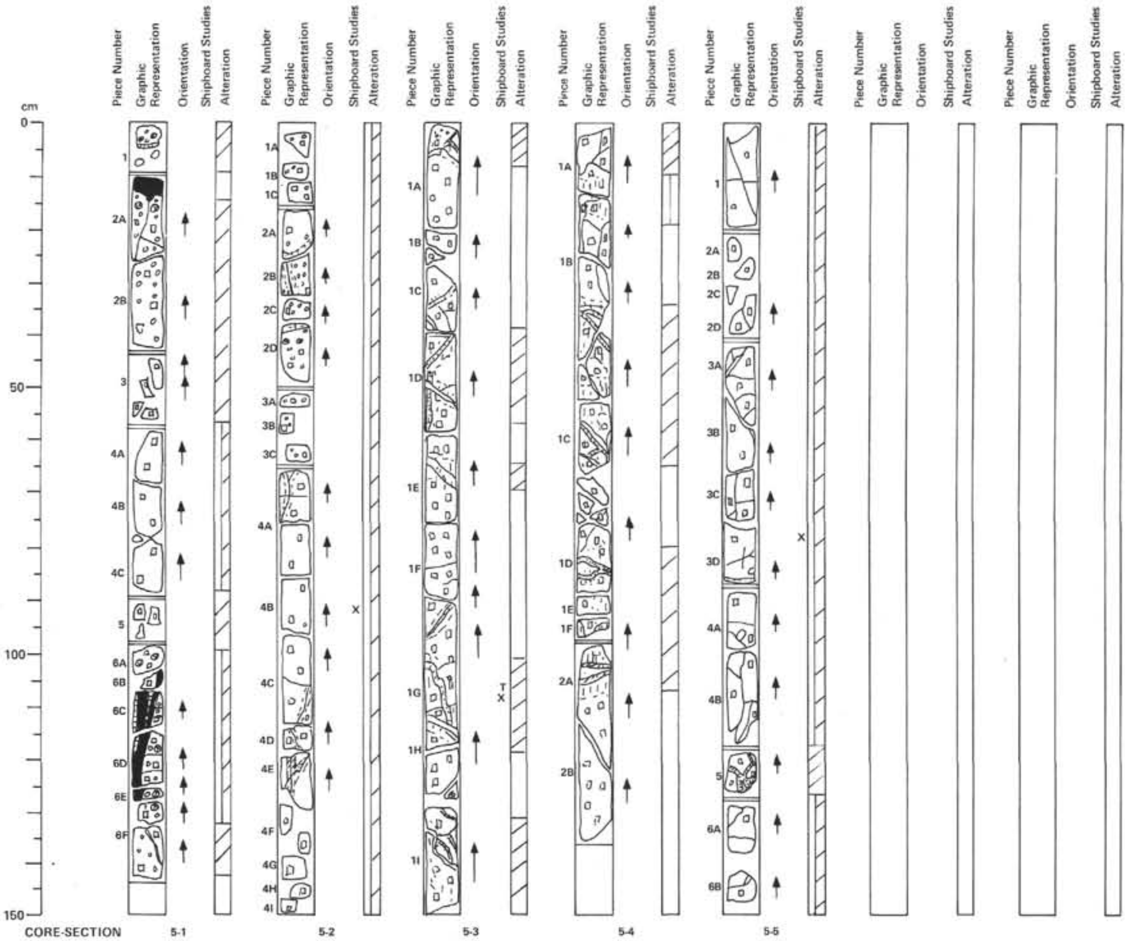
58–63 cm: Drusy calcite and glass clast with rounded, empty vesicles (1–2 mm).

SECTION 5

PLAGIOCLASE PHYRIC BASALT PILLOW

0–53 cm: Moderately plagioclase phyric basalt, dark gray (7.5YR N4/0), fine grained, plagioclase phenocrysts, 3–5%, anhedral (resorbed), 3–15 mm, fresh to moderately altered, <1% unfilled vesicles in variolitic zones, <1 mm.

0–3 and 40–42 cm: Variolitic zones.



SITE 562, CORE 5 — Depth 277.0–286.0 m

SECTION 1

PLAGIOCLASE-PHYRIC PILLOW BASALT

0–142 cm: Moderately plagioclase-phyric fine grained basalt, color dark gray (7.5YR N4/0). Subhedral to round, resorbed plagioclase (~2–5 vol. %), (size up to 1 cm). Rock is fresh to moderately altered. Vesicles are abundant in upper parts of pillows (10–40 and 107–142 cm), shape: round, size: <1.5 mm, filling: calcite or clay; some empty.

10–14 and 104–127 cm: Fresh black glass rinds of pillows, only weakly palagonitized along fractures. Variolitic zones occur close to glass and are moderately altered (color brown – 10YR 5/3). Few calcite-filled veins occur in Pieces 1, 6C and D.

SECTION 2

0–38 cm: PLAGIOCLASE-PHYRIC (PILLOW?) BASALT. Moderately plagioclase-phyric basalt, color dark gray (7.5YR 5/3); contains subhedral to rounded plagioclase phenocrysts (size: <1 cm, abundance: ~3 vol. %). Calcite-filled vesicles increase at bottom (Pieces 2B and C). Piece 2C shows also irregular vesicles (<1 cm), partly calcite coated.
grained; color dark gray (7.5YR N4/0). Subhedral to rounded, resorbed plagioclase phenocrysts (~2–5 vol. %), (size: <1 cm). Basalt is fairly fresh except a small zone parallel to fractures. Vesicles are common in the upper part (39 to 65 cm) and decrease to bottom. They are mostly empty or just coated with some clay mineral.

39–40 cm: At the top of Piece 2D occurs thin (1 cm) layer of pinkish-gray (7.5YR N6/2) limestone with angular palagonite fragments (size 1 to 6 mm). The basalt of Piece 2D shows variolitic transition from aphanitic to fine grained basalt downward. From 39 cm downward basalt looks more massive than above.

SECTION 3

MODERATELY PLAGIOCLASE PHYRIC MASSIVE BASALT

0–142 cm: Gray (7.5YR N5), fine grained plagioclase phyric basalt fairly fresh to moderately altered to grayish brown (2.5Y 5/2) along fractures. Some larger fractures are filled with pinkish gray (7.5YR 7/2) or light brown (7.5YR 6/4) limestone.

Some smaller fractures filled with calcite, particularly at 120–136 cm.

2–3% plagioclase phenocrysts (3–7 mm, up to 10 mm) prisms or equant in shape.

30–40% plagioclase needles (2–3 mm) randomly oriented.

<1% round and irregular vesicles (1–2 mm) filled with greenish clay(?).

SECTION 4

MODERATELY PLAGIOCLASE PHYRIC MASSIVE BASALT

Similar to Section 3. Generally more altered than Section 3, but otherwise similar.

78–81 cm: Veins filled with pinkish gray (5YR 7/2) limestone.

Minor calcite veinlets.

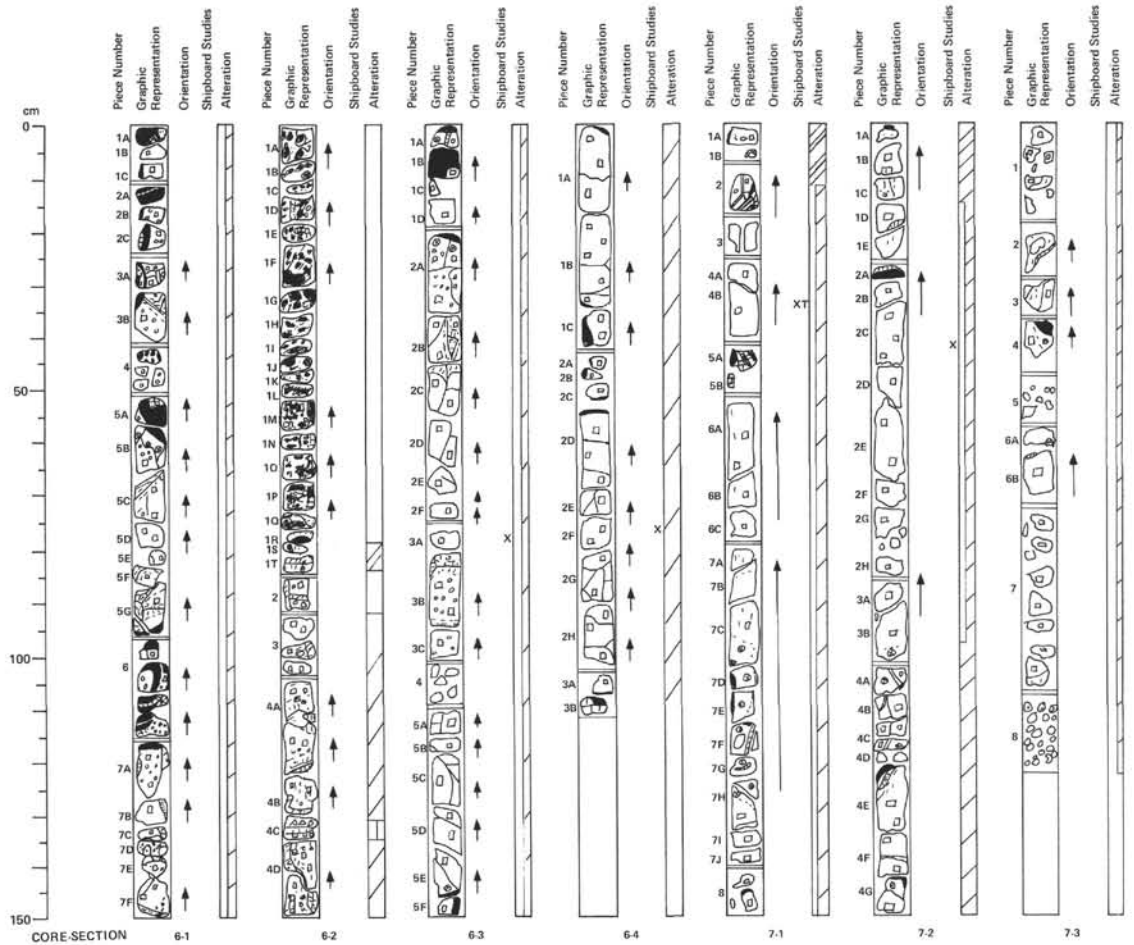
SECTION 5

0–117 cm: PLAGIOCLASE-PHYRIC BASALT. Moderately plagioclase-phyric fine grained basalt. Description as above. Few plagioclase phenocrysts coarser than 1 cm (<1.5 cm). No visible vesicles at 85 cm occurs pinkish gray limestone between sparry calcite and basalt.

At 117 cm: end of massive basalt.

118–125 cm: BASALT BRECCIA PIECE. Highly fractured and calcite cemented plagioclase-phyric basalt and palagonite. Variolites in basalt clasts <1 mm. Few vesicles occur: empty or calcite or clay filling.

128–150 cm: PLAGIOCLASE PHYRIC BASALT. Moderately plagioclase-phyric basalt, fine grained, dark gray (7.5YR N5/0). ~5% plagioclase phenocrysts. They are subhedral to rounded, resorbed. No vesicles.



SITE 562, CORE 6 Depth 286.0–295.0 m

SECTION 1

PLAGIOCLASE PHYRIC PILLOW BASALT AND BASALT BRECCIA (+ HYALOCLASTITE?)

0–50 cm: Fragments of moderately plagioclase phyric basalt, fine grained. All pieces are from black aphanitic zone close to chilled glass rind and from glass rind. Vesicles are common, round <1.5 mm in diameter) and mostly empty. The glass shows some minor palagonitization along fractures.

Piece 3A: Shows basalt breccia with some altered glass clasts. Shape: rounded and angular; size: 15 mm to a few mm. Matrix is very pale brown (10YR 8/3) limestone and calcite.

52–95 cm: Separate pillow of moderately plagioclase-phyric, fine grained basalt, color: dark gray (2.5Y N4/0) to grayish brown (2.5YN 5/2) in altered zones close to calcite-filled fractures. Plagioclase (2–3 vol. %) subhedral to rounded, resorbed, size <3 mm. Vesicles are mostly empty.

97–150 cm: Pillow basalt fragments and interpillow breccia (hyaloclastite). Basalt is plagioclase-phyric (see above description). Breccia contains angular glass and some aphanitic basalt clasts (<1 cm). Some limestone matrix and finally calcite cement.

SECTION 2

SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALT AND GLASS CLASTS AND BRECCIA

0–13 and 22–73 cm: Black glass clasts and breccia in calcite cement (. . .) with limestone ( ) in some places (51–56 cm). Mostly fresh or altered to yellow (10YR 7/6) to reddish yellow (7.5YR 6/8) dark reddish brown (5YR 3/2) clays around edges or along fractures. 2–3% plagioclase glomerocrysts (2–5 mm) in the glass. 2–3% rounded empty vesicles (1–2 mm) in glass.

130–132 cm: Highly altered glass clasts in limestone matrix.

12–20 cm: Variolitic pillow edges with glass clast rims in calcite.

75–130 and 133–147 cm: Sparsely plagioclase phyric pillow basalts with brown (10YR 5/3) variolitic zones grading through black aphanitic basalt. Calcite and limestone in fractures. Plagioclase phenocrysts as in glass. Vesicles as in glass with some calcite filled in pillow interiors.

SECTION 3

PLAGIOCLASE PHYRIC PILLOW BASALT

0–19 cm: Fragments of moderately to sparsely plagioclase phyric basalt, Pieces 1C and D fine grained, gray (2.5Y N5/0), Pieces 1A and B aphanitic and chilled rind (glass). Plagioclase subhedral to rounded, resorbed (size: <5 mm). Minor palagonitization along fractures.

21–150 cm: Pillow basalt, moderately plagioclase phyric, color gray (2.5Y N5/0). Plagioclase up to 4 vol. %, size: <7 mm. Vesicles are abundant between 22–35 and 80–100 cm; filled with clay and calcite. Basalt is fairly fresh except narrow zones along fractures. Fresh glass at top and bottom.

SECTION 4

PLAGIOCLASE PHYRIC PILLOW BASALT

0–110 cm: Strongly plagioclase-phyric, fine grained basalt, color gray (2.5Y N5/0) to grayish brown in altered parts. Plagioclase phenocrysts are abundant (10–15 vol. %), size: <8 mm, shape: subhedral to rounded, resorbed. Vesicles are rare to absent. Some narrow veinlets are filled with calcite cement or limestone. Fresh glass at 0–2, 33–55, and 107–109 cm. Lowermost piece (3B) mainly consists of pinkish gray (7.5YR 7/2) limestone and shows fresh glass, too.

SITE 562, CORE 7 Depth 295.0–300.0 m

SECTION 1

MODERATE–STRONGLY PLAGIOCLASE PHYRIC PILLOW BASALT

0–150 cm:

Moderate to strongly plagioclase phyric pillow basalt gray (2.5Y N5/0) altered* to brownish yellow (10YR 6/6) in fractures, pillow edges near calcite veins and vesicular zones.

Plagioclase phenocrysts are abundant grading from moderately to strongly phyric down core (5–10%), 4–9 mm in diameter; glomerocrysts and/or rounded prisms.

*Alteration present as noted above.

Variolitic sequence where shown. Glassy rims grade into black (10YR 2/1) aphanitic plagioclase-phyric basalt through variolite zone (10YR 6/6) grading down to gray plagioclase-phyric basalt. Plagioclase phenorysts are observed in all phases cited except glass.

Vesicles sparsely scattered, rounded <1–2 mm in diameter. Filled with calcite predominantly, some clays noted. Few immediately adjacent to glass are empty.

Glass concentrated in Pieces 1A, 2, 5A, 7C–E and rim of a piece in 8.

SECTION 2

MODERATELY–STRONGLY PLAGIOCLASE PHYRIC PILLOW BASALT

0–150 cm: Same as for Section 1, exceptions as noted.

35–70 cm: Dark brownish green patches of material. Possibly alteration of olivine. May be remnants of olivine visible in thin section.

SECTION 3

MODERATELY PLAGIOCLASE PHYRIC PILLOW BASALT

0–121 cm:

Same as for Section 1, with exceptions as noted:

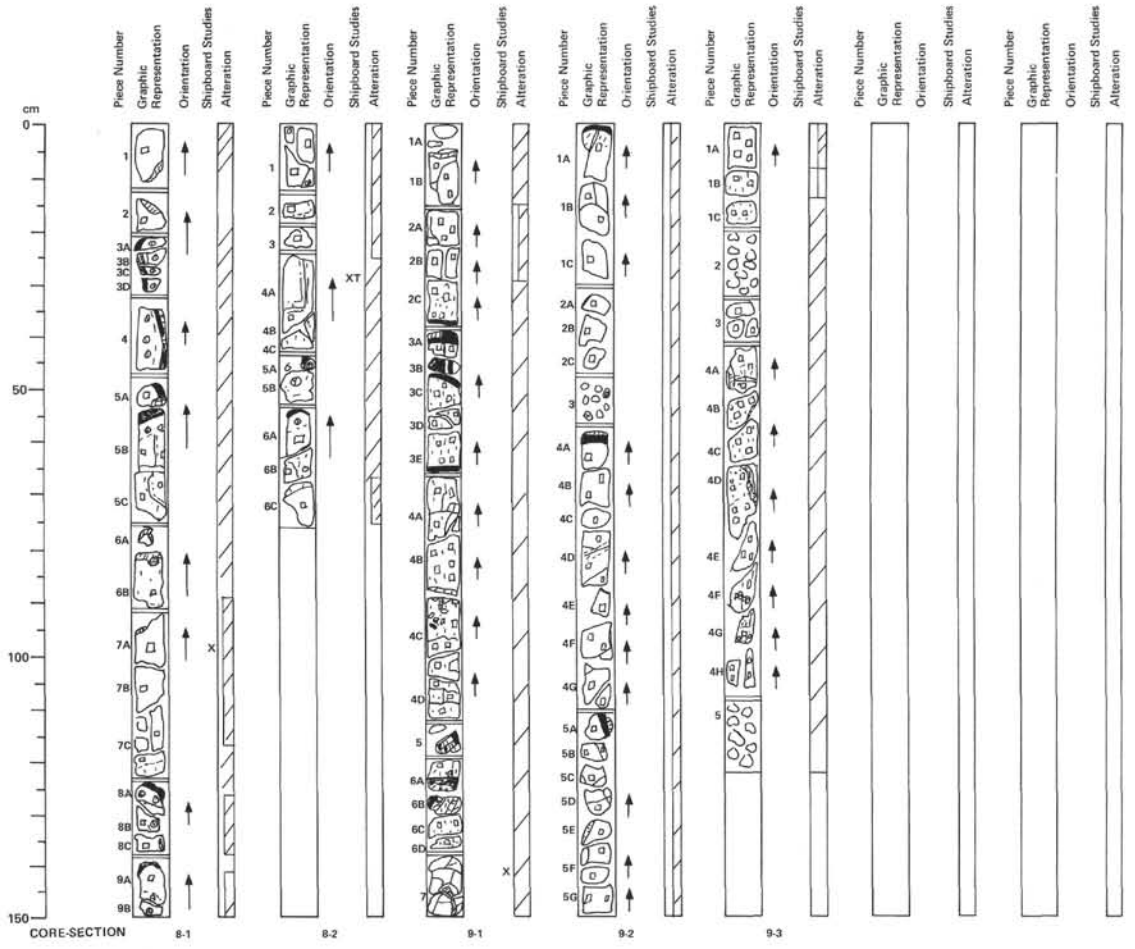
Plagioclase phenocrysts larger 4–8 mm in larger pieces of basalt. Smaller (2–4 mm) in smaller rock fragments.

Alteration of basalt from gray (2.5Y N5/0) to brownish yellow (10YR 6/6 + gray 2.5Y N5/0) hued basalt. Not as pronounced due to smaller size of rocks. Still present at fractures and pillow edges.

Variolitic sequence (outlined in Section 1) present as noted.

Vesicles sparsely scattered round, <1–2 mm in diameter. Calcite or clay lined, some empty.

Basalts are smaller pieces and clast fragments than previously cited in Sections 1 and 2. "Pieces" 1, 7, and 8 are good examples of this.



SITE 562, CORE 8 Depth 300.0–304.0 m

SECTION 1

SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALT SEQUENCE

0–150 cm:

Sparsely plagioclase phyric pillow basalt in sequence with glass – aphanitic plagioclase phyric – variolitic – plagioclase-phyric basalt. Generally gray (2.5YR N5/0); alteration present adjacent to fractures and pillow rims.

Plagioclase phenocrysts are present in various degrees of frequency, from nearly absent (Pieces 2, 8B and C, and 9A) to sparsely (Pieces 7A–C and 5B–C) to moderate (Pieces 1, 3, 4, and 5A). Overall, core is sparsely phyric: 2–9 mm diameter rounded prisms and/or glomerocrysts.

Alteration present as noted adjacent to calcite rinds, veins, and to rock fractures and pillow edges. Variolitic alteration as designated.

Variolitic sequence where shown. Interpillow glass – black aphanitic plagioclase-phyric basalt (10YR 2/1) – variolitic basalt, yellow brown hued 'gray' (10YR 6/6) – 2.5Y N5/0 zone – gray (2.5Y N5/0) plagioclase phyric basalt. Plagioclase phenocrysts noted in all phases up to intersecting glasses.

Vesicles sparsely scattered throughout rock, mainly concentrated near pillow margins (variolitic sequence). Vesicles rounded<1–2 mm in diameter. Filled with calcite, clays are empty.

Glass concentrated in Pieces 3, 4, 5A and B, 8A, and 9A. Centimeters and or volume.

SECTION 2

SPARSELY PLAGIOCLASE PHYRIC PILLOW BASALT

Sparsely plagioclase phyric pillow basalt sequence gray (2.5Y N5/0). Same as in Section 1. Exceptions noted.

Plagioclase phenocrysts 1–5 mm in diameter, nearly absent in Pieces 1, 2, and 6C and sections of others; all others are sparsely plagioclase phyric.

Alteration as in Section 1 to yellowish brown hued gray (10YR 6/6) plagioclase phyric.

Variolitic sequence as noted in Section 1 and indicated left.

Vesicles sparsely scattered, rounded <1–1 mm in diameter one half empty, one-half clay and/or calcite filled.

Glass as indicated (Pieces 5A and 6A strong glass rims).

SITE 562, CORE 9 Depth 304.0–313.0 m

SECTION 1

SPARSELY TO MODERATELY PLAGIOCLASE PHYRIC BASALT PILLOWS

0–113 cm:

Moderately plagioclase phyric pillow basalt gray (2.5Y N5), fine grained.

Glass margins almost right next to fine grained basalt with very narrow (1–2 mm) zones of black aphanitic basalt and/or very tiny K<1 mm) variolites (or no aphanitic basalt or variolities are visible at all).

3–5% plagioclase glomerocrysts (3–10 mm) in pillow interiors and glass rims.

Basalt fairly fresh gray (as above) to moderately altered (grayish brown – 2.5Y 5/2) especially along pillow edges next to glass rims or along fractures.

<1% rounded empty vesicles (<1 mm) scattered.

85–92 cm: <1% irregular calcite-filled vesicles (1–6 mm). Calcite and reddish brown (5YR 5/4) and light reddish brown (5YR 6/3) limestone in fractures.

120–150 cm: Aphyric pillow basalt, finer grained, colors as above. Calcite and limestone in fractures. < 1% irregular, calcite filled vesicles (2–5 mm), black.

115–118 cm: One piece of fresh to moderately altered (yellowish red [5YR 4/6] palagonite) glass clasts in pinkish gray (5YR 7/2) limestone matrix.

0–150 cm: Plagioclase-phyric pillow basalt, fine grained, color: gray (2.5Y N5/0). Plagioclase phenocrysts up to 8%; shape: subangular to round, resorbed; size: <8 mm. Vesicles are rare and mostly empty (a few filled with calcite).

0–2, 57–60, and 111–116 cm: Chilled glass rinds accompanied by very narrow variolitic zone (varioles < 0.5 mm).

Some pieces show calcite cemented veins (shown).

SECTION 3

MODERATELY PLAGIOCLASE PHYRIC PILLOW BASALT

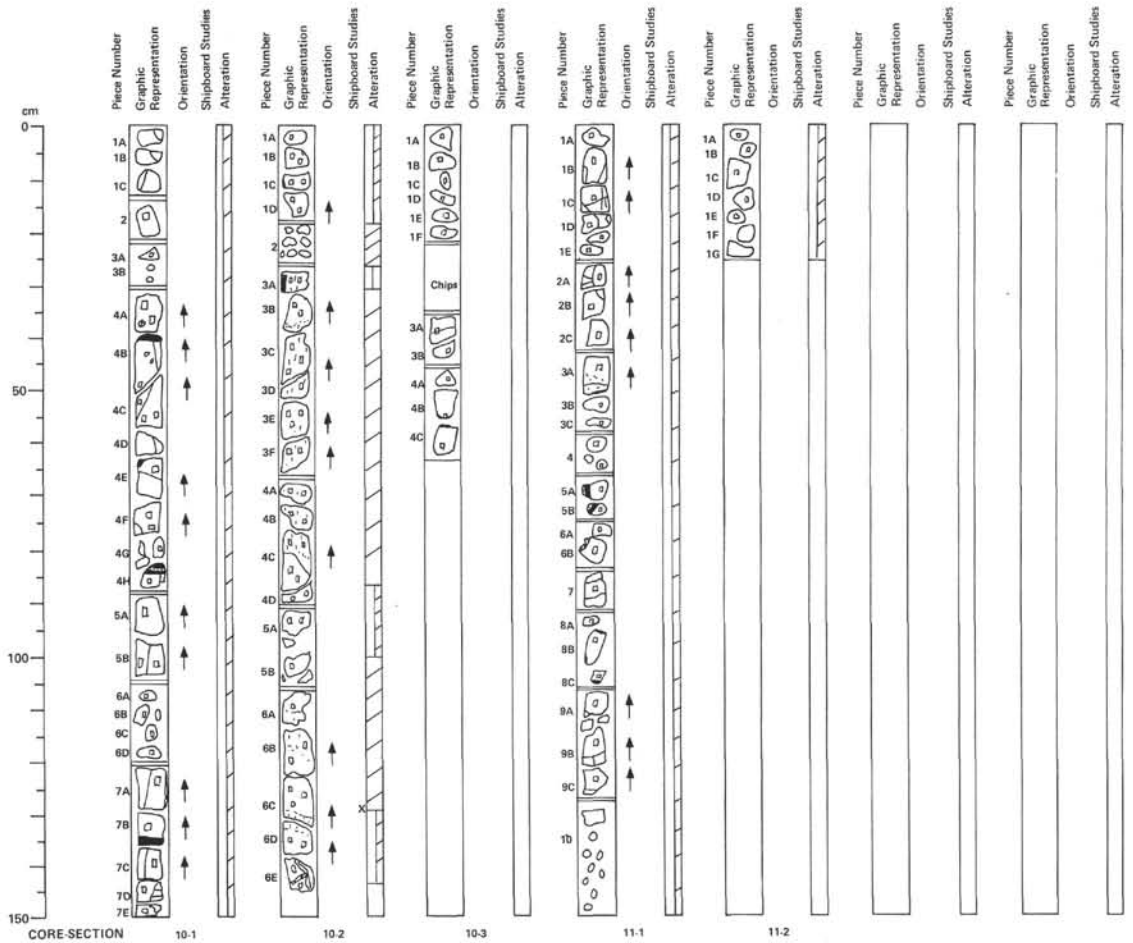
0–150 cm: Plagioclase phyric basalt gray (2.5Y N5), fine grained like Section 2.

3–5% plagioclase glomerocrysts (1–10 mm), fairly fresh (gray as above) to moderately altered (grayish brown – 5/2).

9–11 cm: One piece very strongly altered groundmass completely light grayish brown (2.5Y 6/2) in color with plagioclase phenocrysts.

<1% rounded, empty vesicles (1–2 mm) scattered.

<1% irregular and rounded vesicles (1–3 mm). Calcite and limestone in veins.



SITE 562, CORE 10 — Depth: 313.0–322.0 m

SECTION 1

PLAGIOCLASE PHYRIC PILLOW BASALT

0–150 cm: Moderately plagioclase phyric to aphyric, fine grained basalt; color gray (7.5YR N5/0); plagioclase phenocrysts up to 1 cm, subhedral to rounded to resorbed.

The following intervals of this section are aphyric to sparsely plagioclase-phyric: 0–13, 40–50, and 57–62 cm. Vesicles only occur between 40–55 cm, rare, calcite-filled, and <1 mm.

Fresh glass at 38–39, 39–41, 63–65, 82–84, and 133–135 cm.

SECTION 2

MODERATELY PLAGIOCLASE PHYRIC PILLOW BASALT

0–150 cm: Fine grained, gray (2.5Y N5) moderately plagioclase phyric pillow basalt.

~ 5% plagioclase phenocrysts (2–10 mm), fairly fresh (gray as above) basalt to moderately altered (light olive brown – 2.5Y 5/5) along edges or fractures and some pillow interiors.

Calcite and pink (5YR 7/4) limestone in veins.

30–33 cm: Fresh black glass rims.

SECTION 3

PLAGIOCLASE PHYRIC BASALT

0–62 cm: Moderately to sparsely plagioclase-phyric basalt, fine grained, color: gray (7.5YR N5/0).

Plagioclase phenocrysts (3–5 vol. %) but rare to absent in Piece 4B.

Fresh glass at 55–58 cm.

SITE 562, CORE 11 — Depth 322.0–331.0 m

SECTION 1

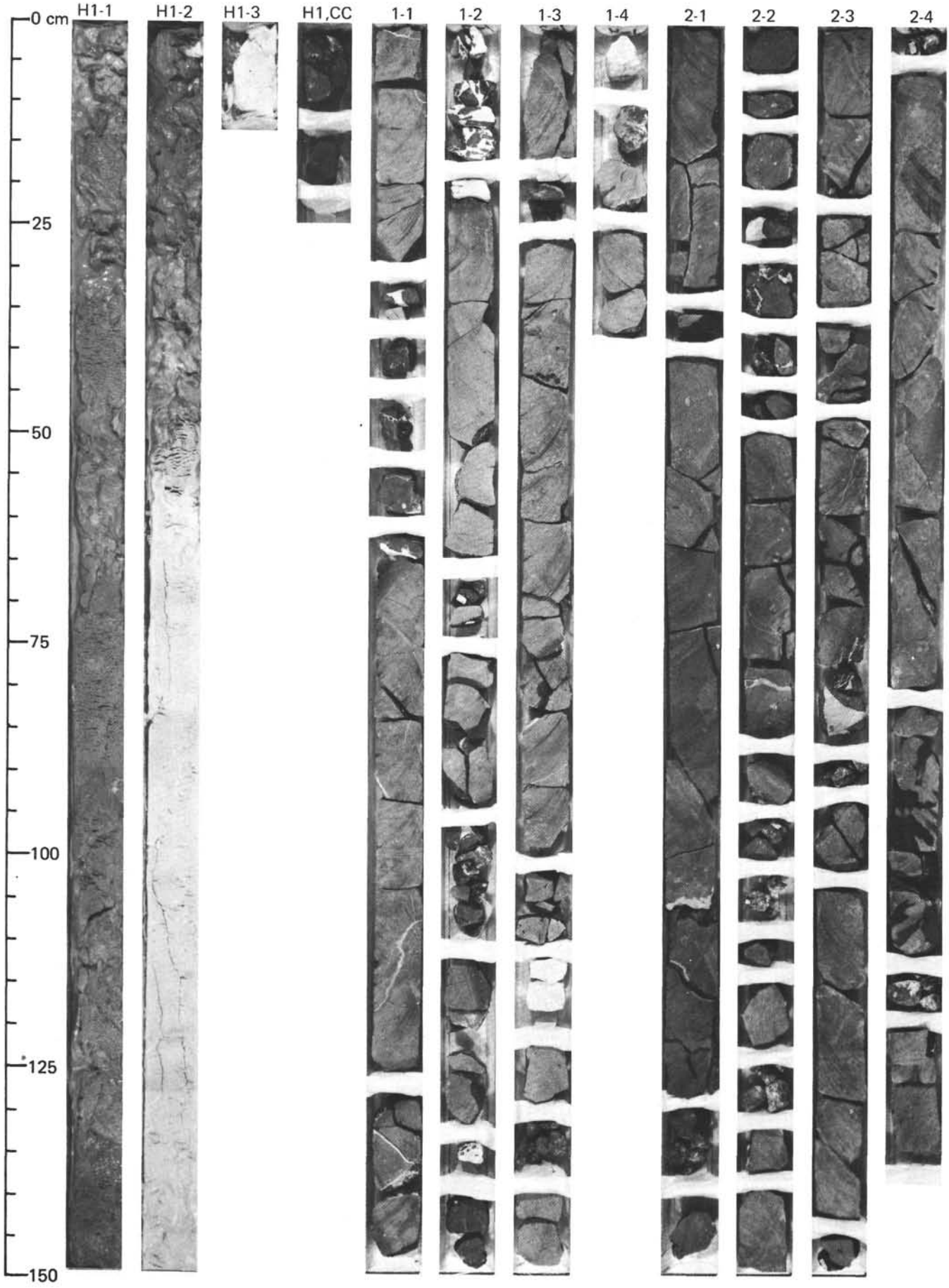
PLAGIOCLASE PHYRIC PILLOW BASALT

0–150 cm: Sparsely to moderately plagioclase phyric, fine grained basalt; color gray (7.5YR N5/0). Plagioclase phenocrysts (2–4%) up to 7 mm.

Fresh glass rinds at 50–51, 68–74, and 104–105 cm.

SECTION 2

0–25 cm: PLAGIOCLASE PHYRIC BASALT. See above descriptions.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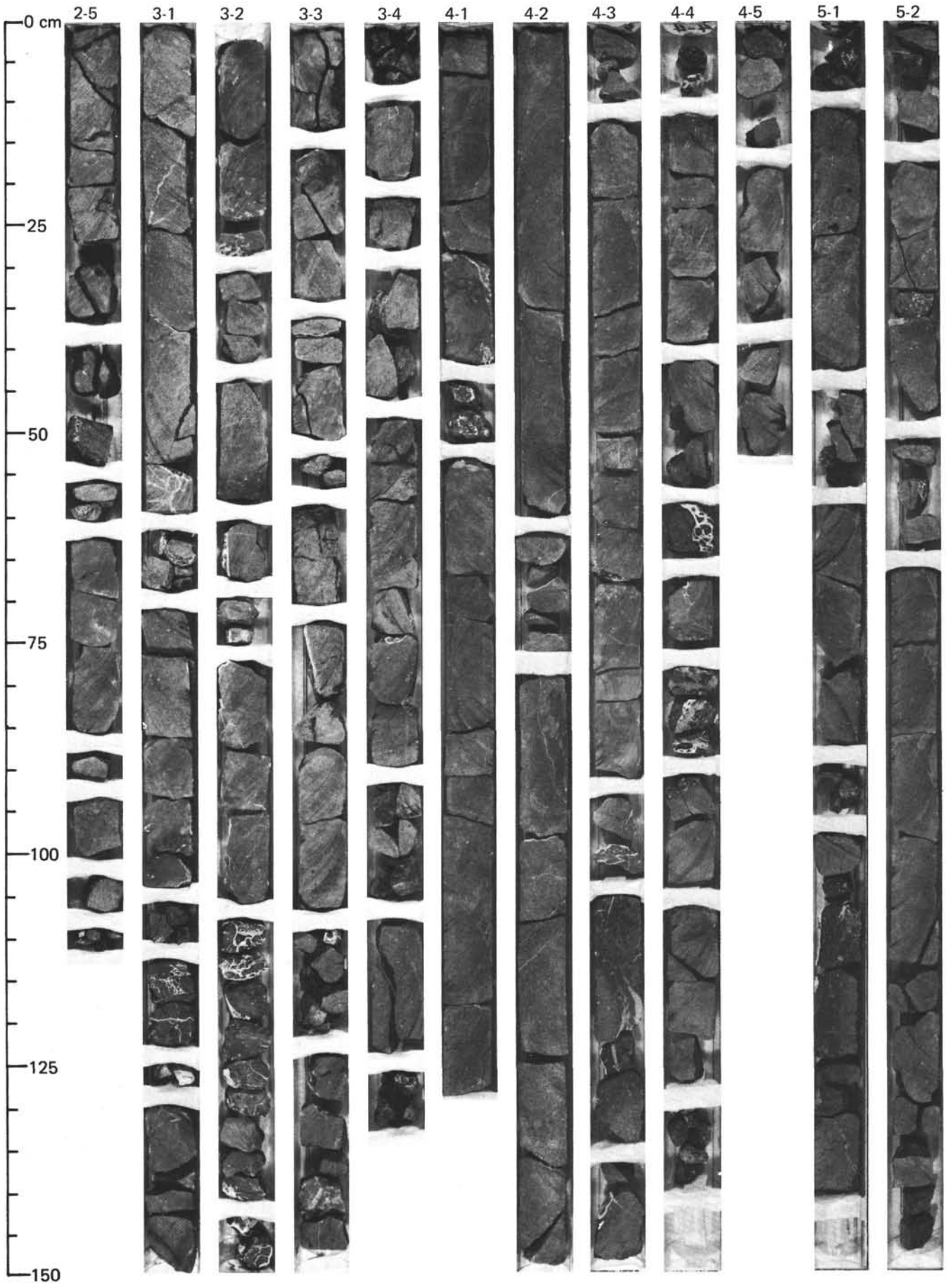
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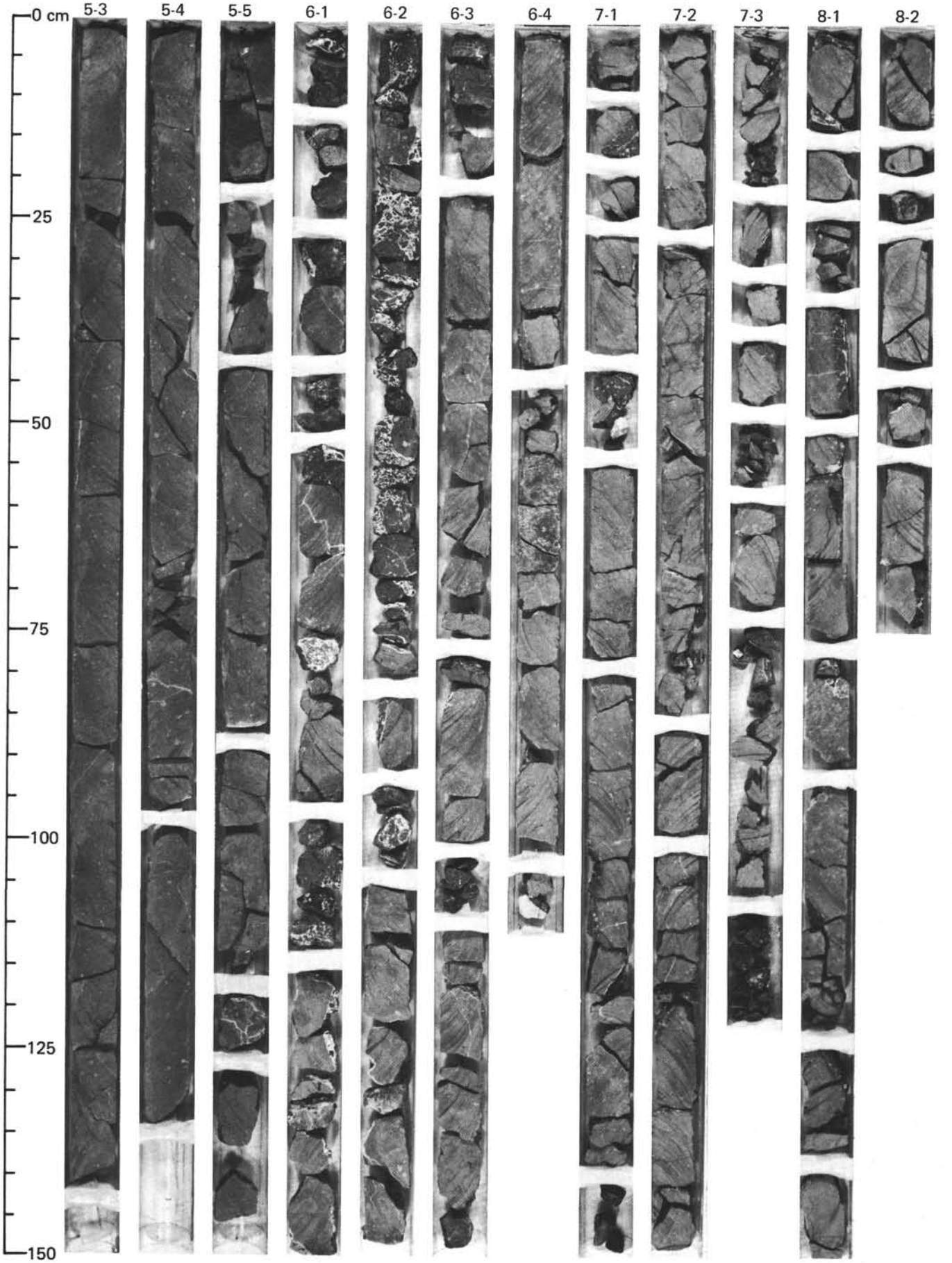
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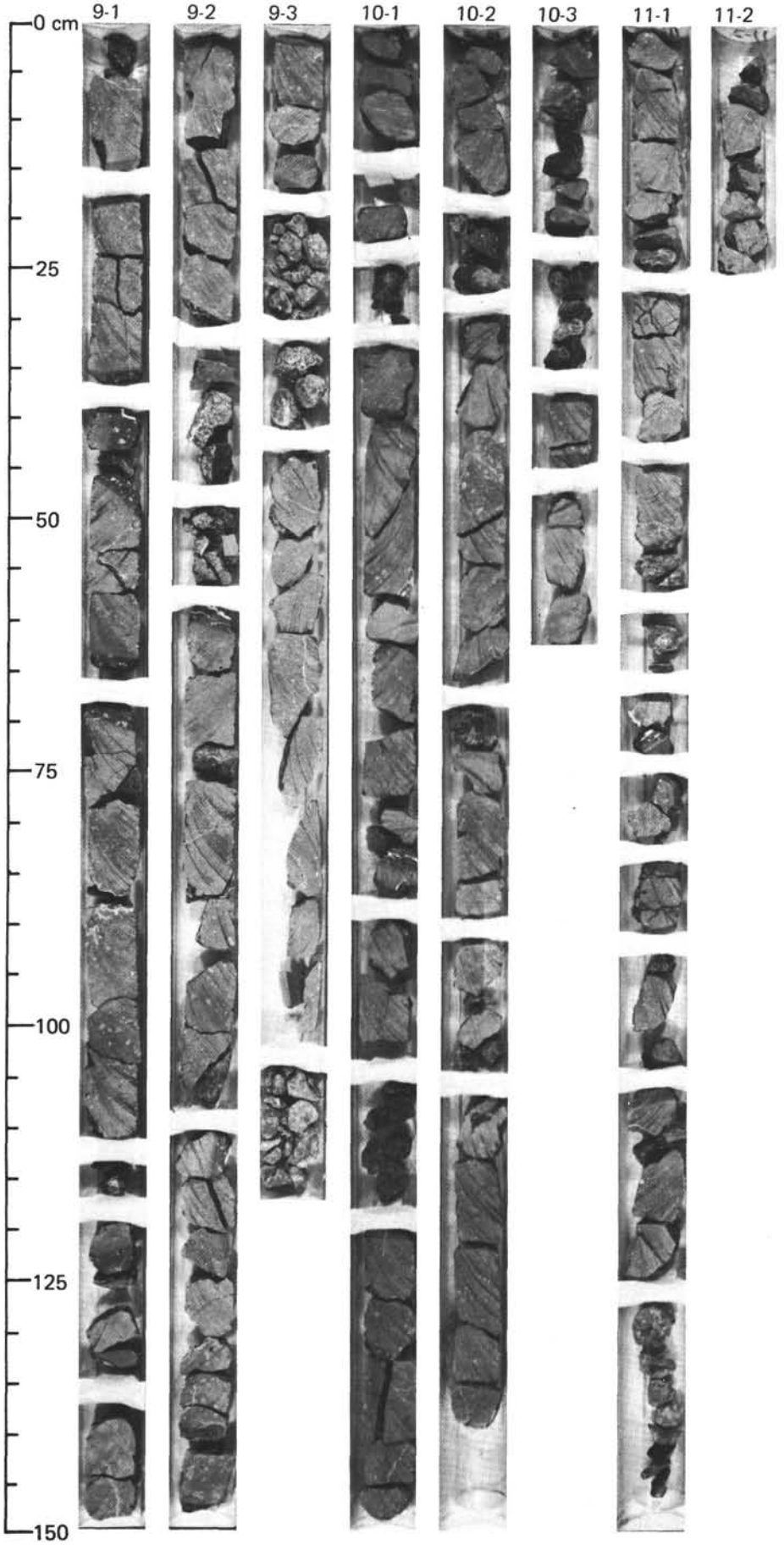
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