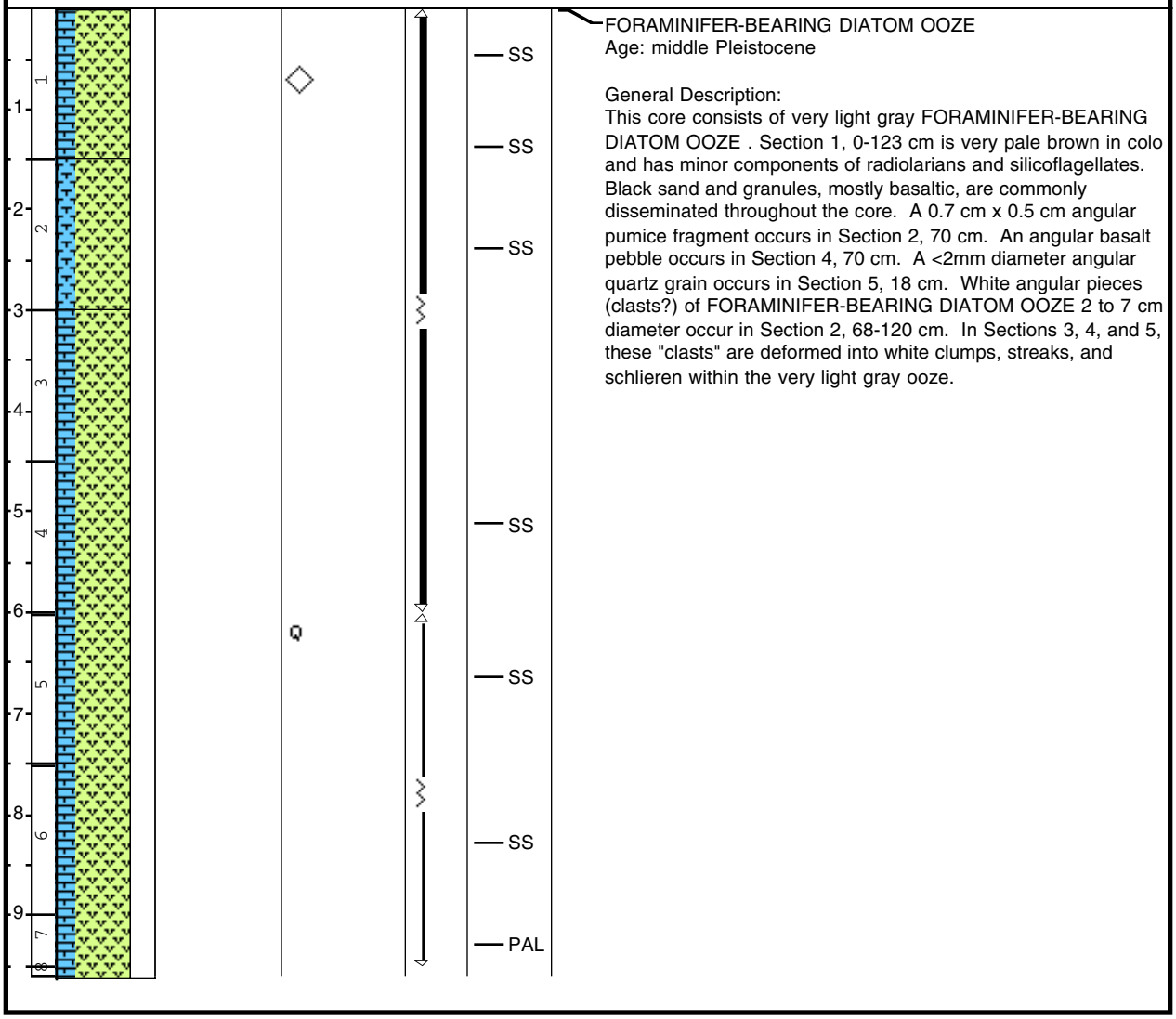
Core Photo

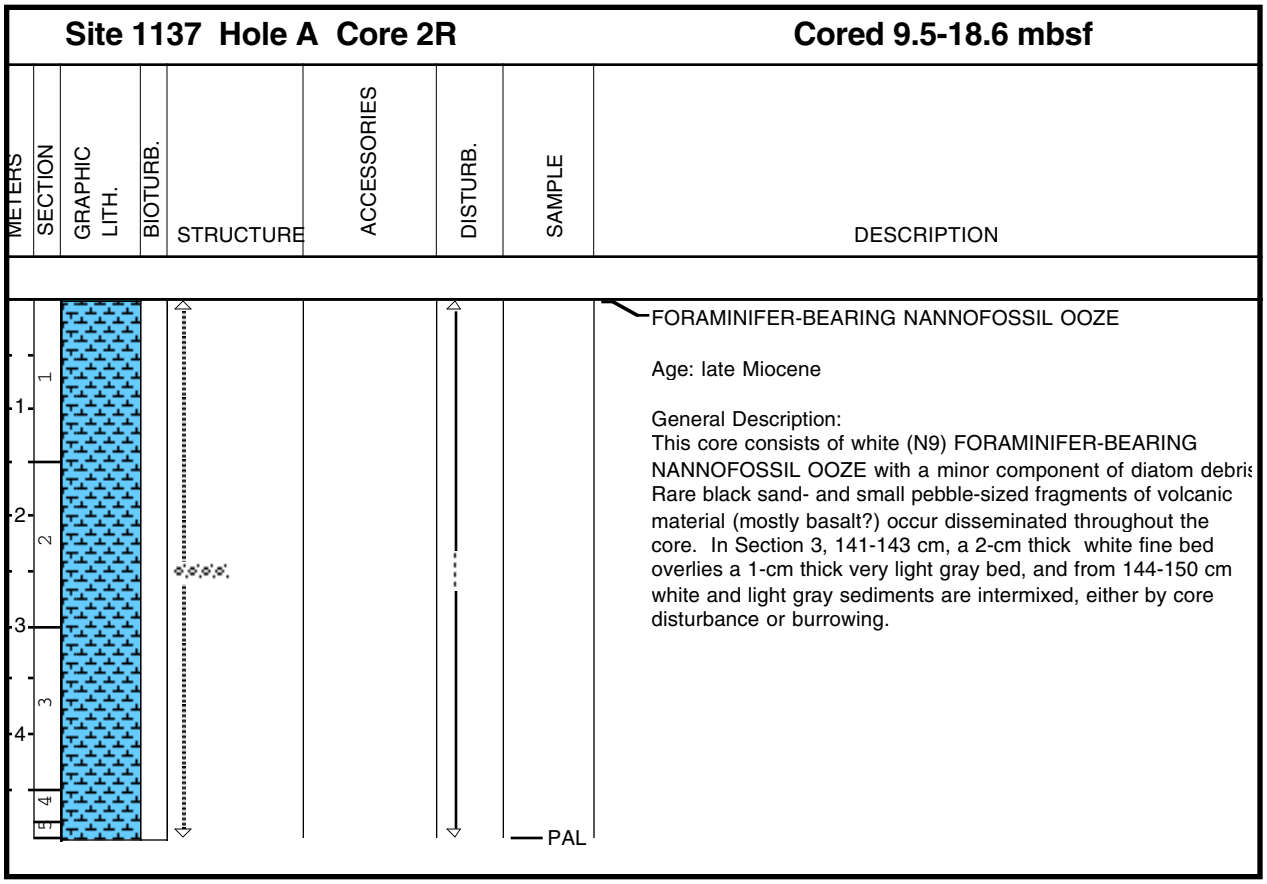
Site 1137 Hole A Core 1R **Cored 0-9.5 mbsf**



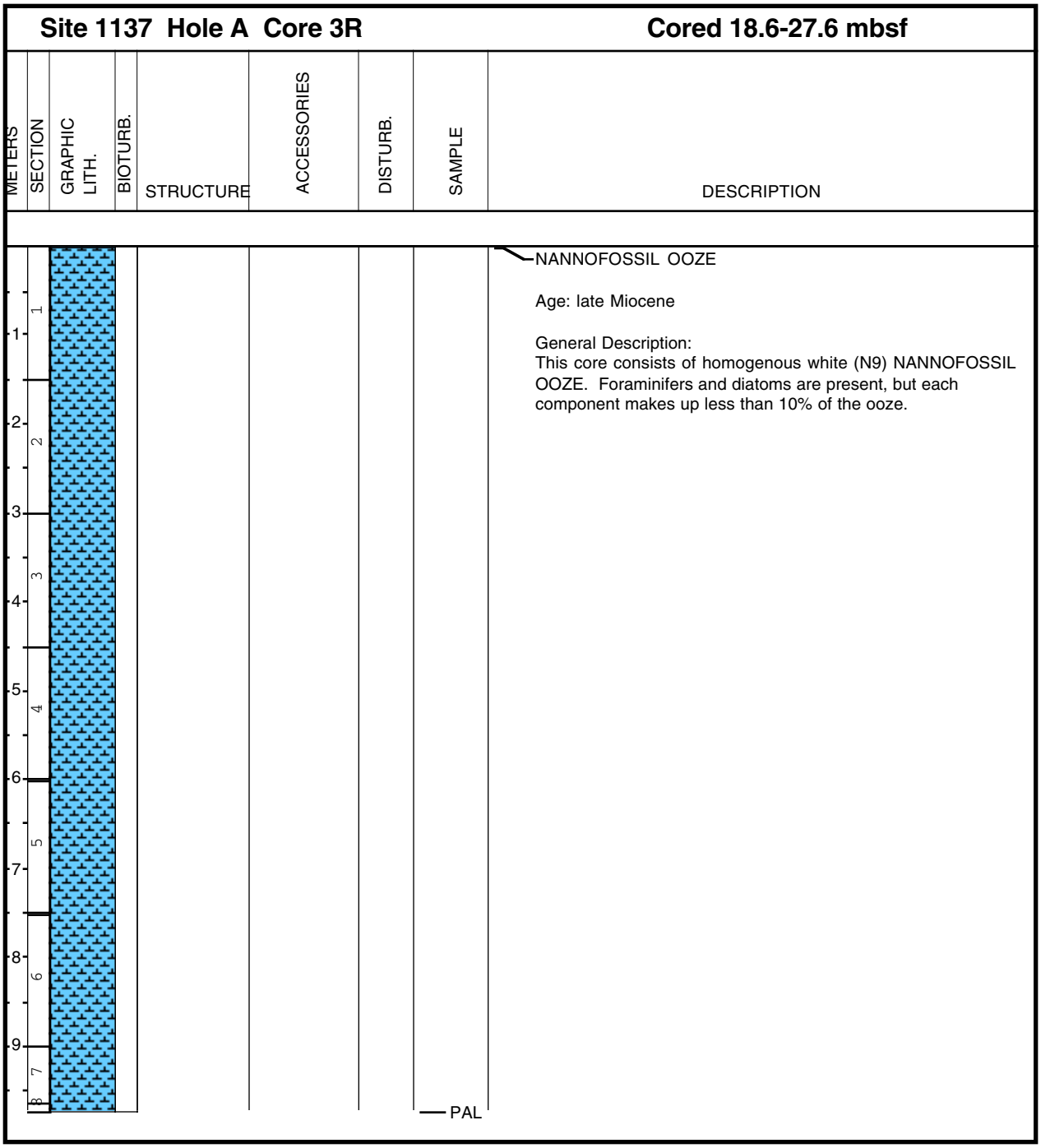
FORAMINIFER-BEARING DIATOM OOZE
Age: middle Pleistocene

General Description:
This core consists of very light gray FORAMINIFER-BEARING DIATOM OOZE . Section 1, 0-123 cm is very pale brown in colo and has minor components of radiolarians and silicoflagellates. Black sand and granules, mostly basaltic, are commonly disseminated throughout the core. A 0.7 cm x 0.5 cm angular pumice fragment occurs in Section 2, 70 cm. An angular basalt pebble occurs in Section 4, 70 cm. A <2mm diameter angular quartz grain occurs in Section 5, 18 cm. White angular pieces (clasts?) of FORAMINIFER-BEARING DIATOM OOZE 2 to 7 cm diameter occur in Section 2, 68-120 cm. In Sections 3, 4, and 5, these "clasts" are deformed into white clumps, streaks, and schlieren within the very light gray ooze.

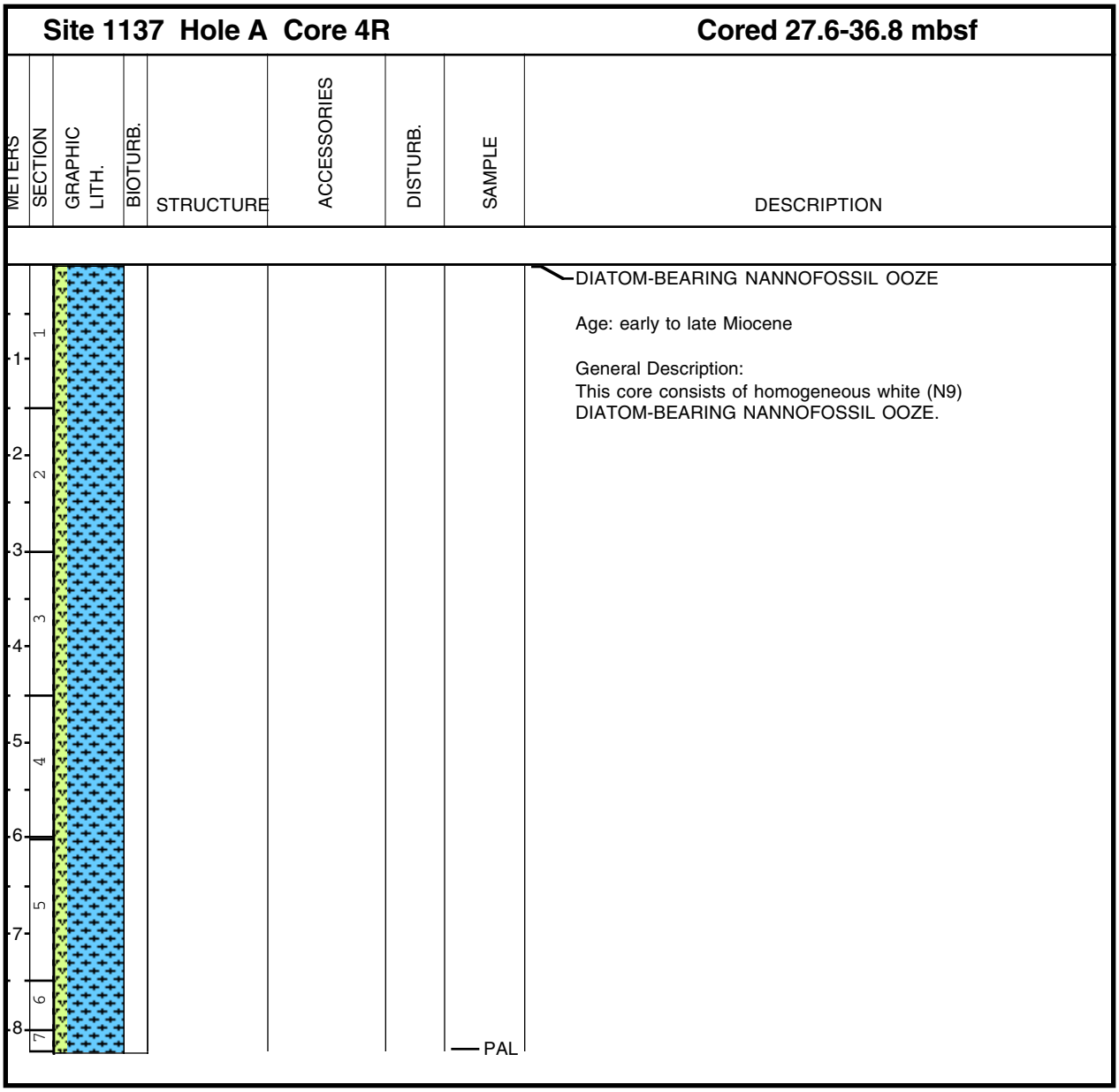
Core Photo


Site 1137 Hole A Core 2R
Cored 9.5-18.6 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
PAL
FORAMINIFER-BEARING NANNOFOSSIL OOZE
Age: late Miocene
General Description:
This core consists of white (N9) FORAMINIFER-BEARING NANNOFOSSIL OOZE with a minor component of diatom debris
Rare black sand- and small pebble-sized fragments of volcanic material (mostly basalt?) occur disseminated throughout the core. In Section 3, 141-143 cm, a 2-cm thick white fine bed overlies a 1-cm thick very light gray bed, and from 144-150 cm white and light gray sediments are intermixed, either by core disturbance or burrowing.

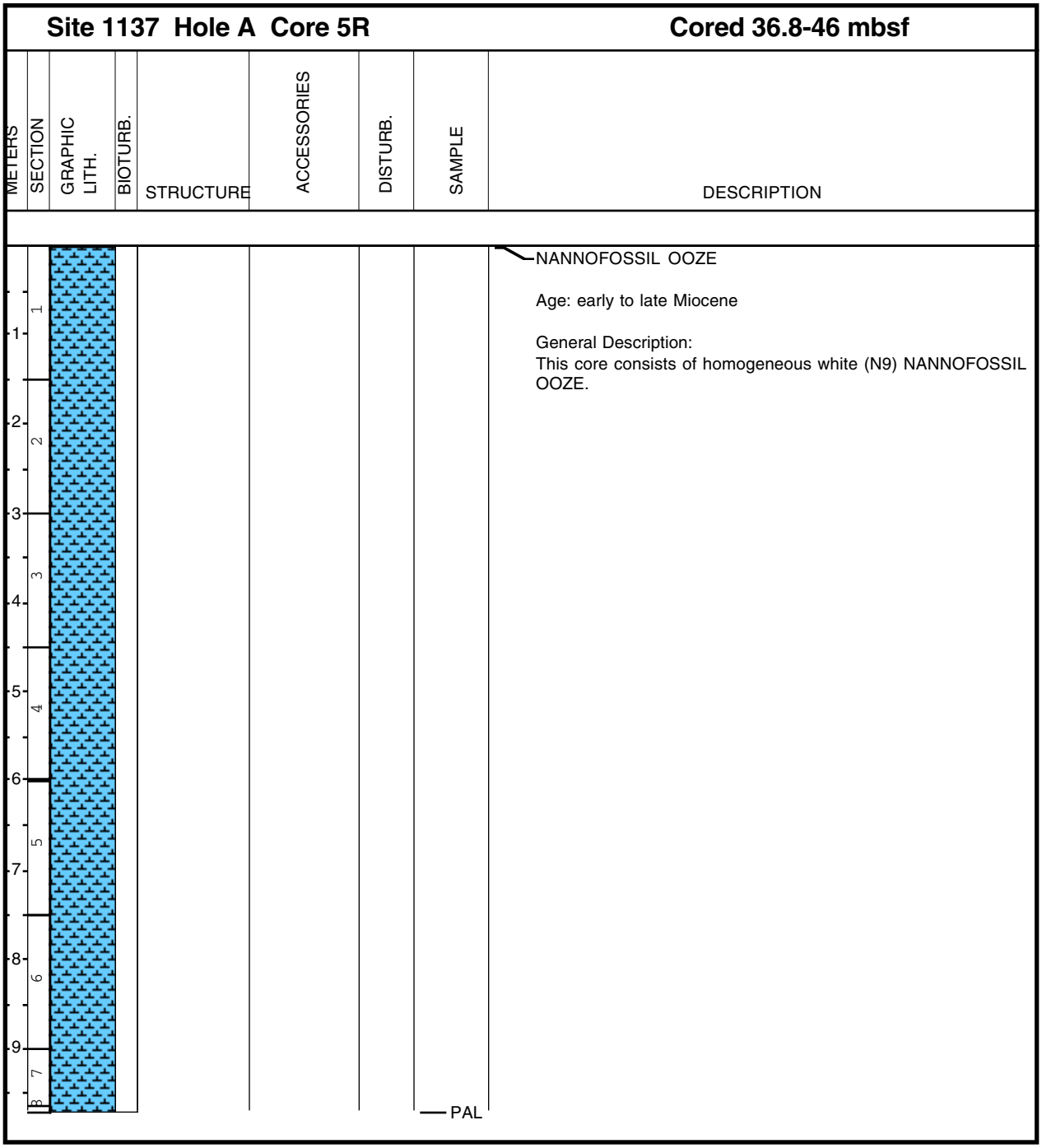
Core Photo


Site 1137 Hole A Core 3R
Cored 18.6-27.6 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
NANNOFOSSIL OOZE
Age: late Miocene
General Description:
This core consists of homogenous white (N9) NANNOFOSSIL OOZE. Foraminifers and diatoms are present, but each component makes up less than 10% of the ooze.
PAL

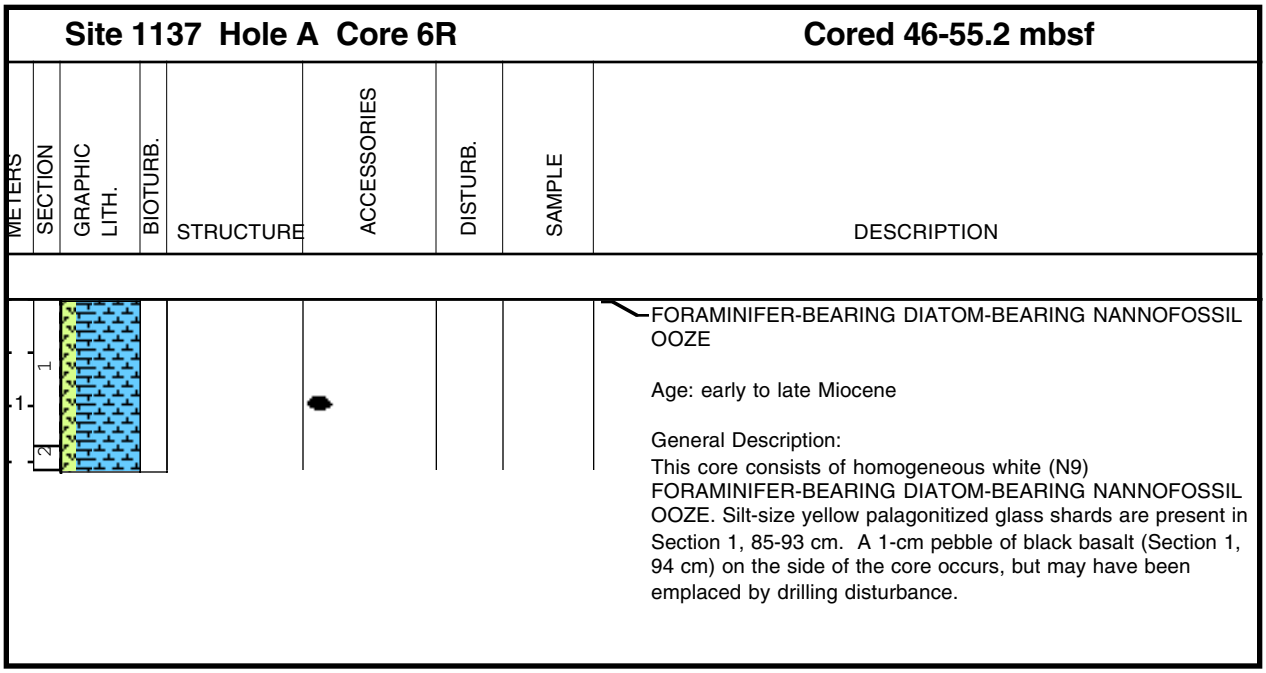
Core Photo


Site 1137 Hole A Core 4R
Cored 27.6-36.8 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
DIATOM-BEARING NANNOFOSSIL OOZE
Age: early to late Miocene
General Description:
This core consists of homogeneous white (N9) DIATOM-BEARING NANNOFOSSIL OOZE.
PAL

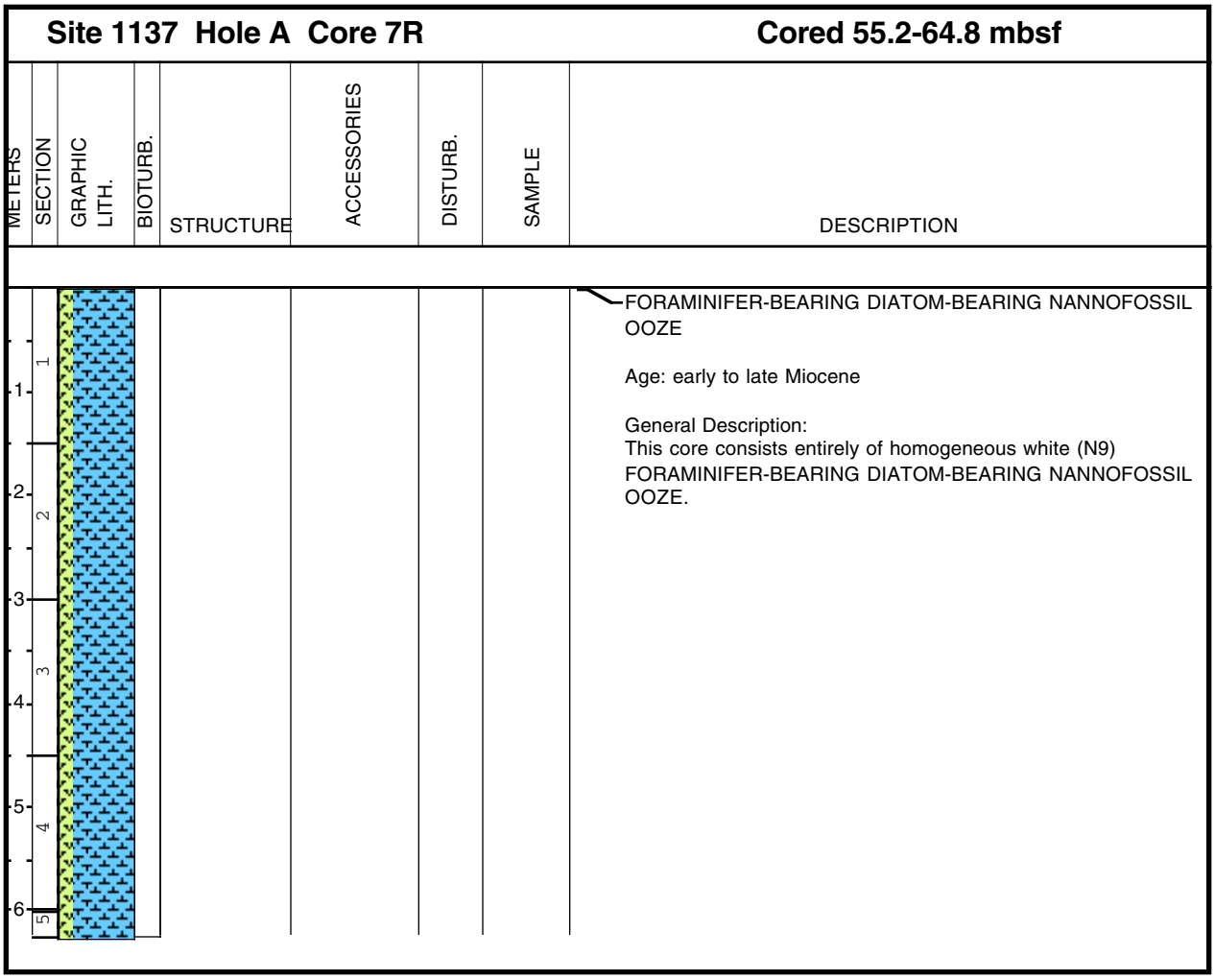
Core Photo


Site 1137 Hole A Core 5R
Cored 36.8-46 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
NANNOFOSSIL OOZE
Age: early to late Miocene
General Description:
This core consists of homogeneous white (N9) NANNOFOSSIL OOZE.
PAL

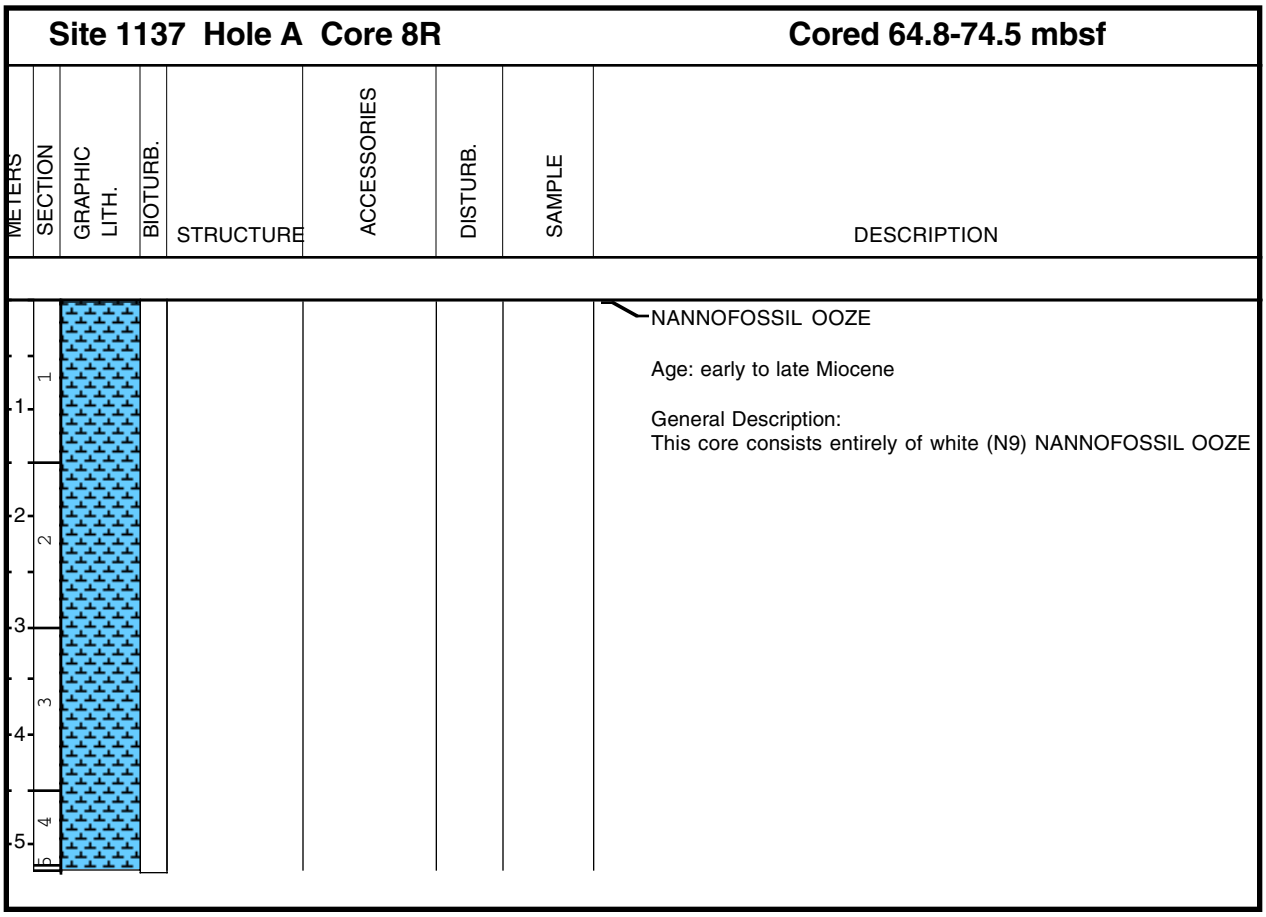
Core Photo


Site 1137 Hole A Core 6R
Cored 46-55.2 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
1
2
FORAMINIFER-BEARING DIATOM-BEARING NANNOFOSSIL OOZE
Age: early to late Miocene
General Description:
This core consists of homogeneous white (N9) FORAMINIFER-BEARING DIATOM-BEARING NANNOFOSSIL OOZE. Silt-size yellow palagonitized glass shards are present in Section 1, 85-93 cm. A 1-cm pebble of black basalt (Section 1, 94 cm) on the side of the core occurs, but may have been emplaced by drilling disturbance.

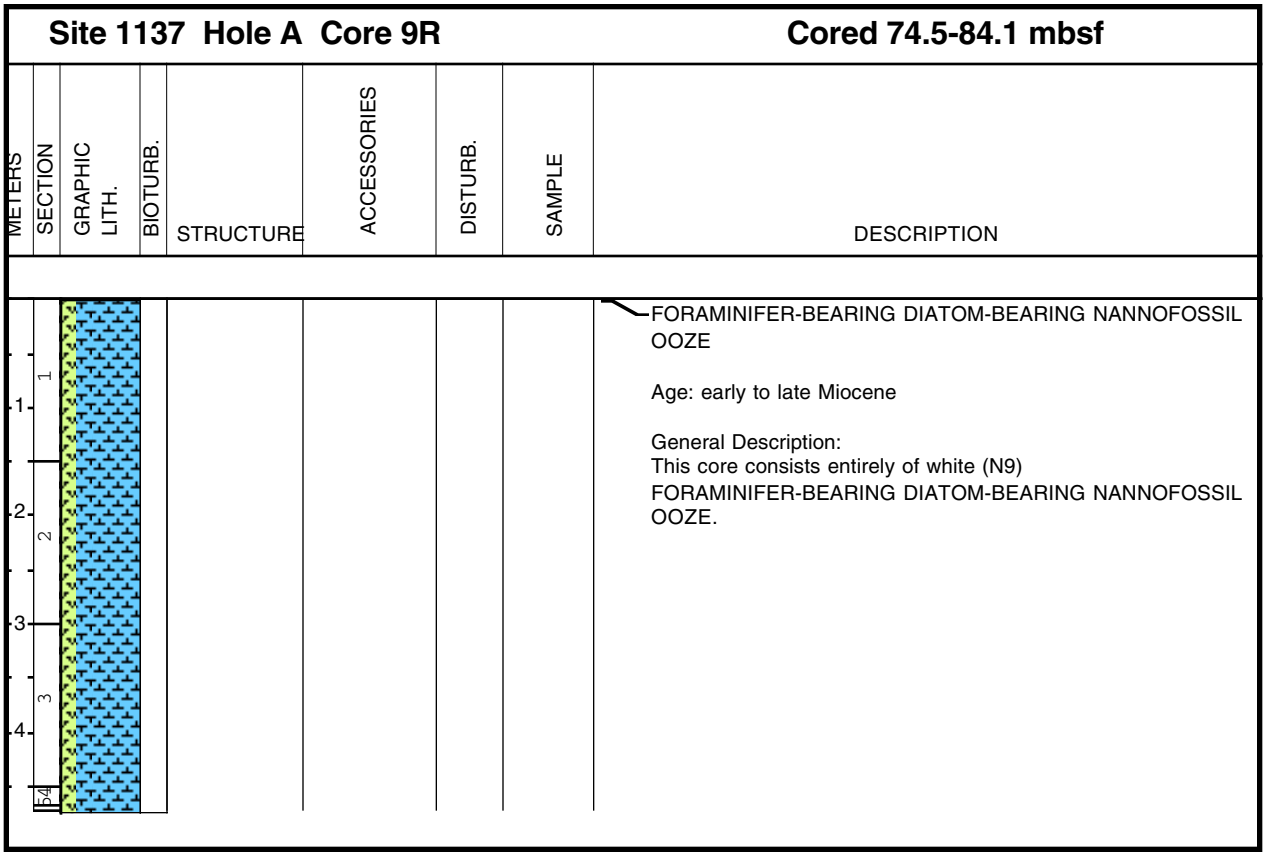
Core Photo


Site 1137 Hole A Core 7R
Cored 55.2-64.8 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
3
4
5
6
FORAMINIFER-BEARING DIATOM-BEARING NANNOFOSSIL OOZE
Age: early to late Miocene
General Description:
This core consists entirely of homogeneous white (N9) FORAMINIFER-BEARING DIATOM-BEARING NANNOFOSSIL OOZE.

Core Photo


Site 1137 Hole A Core 8R
Cored 64.8-74.5 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
NANNOFOSSIL OOZE
Age: early to late Miocene
General Description:
This core consists entirely of white (N9) NANNOFOSSIL OOZE

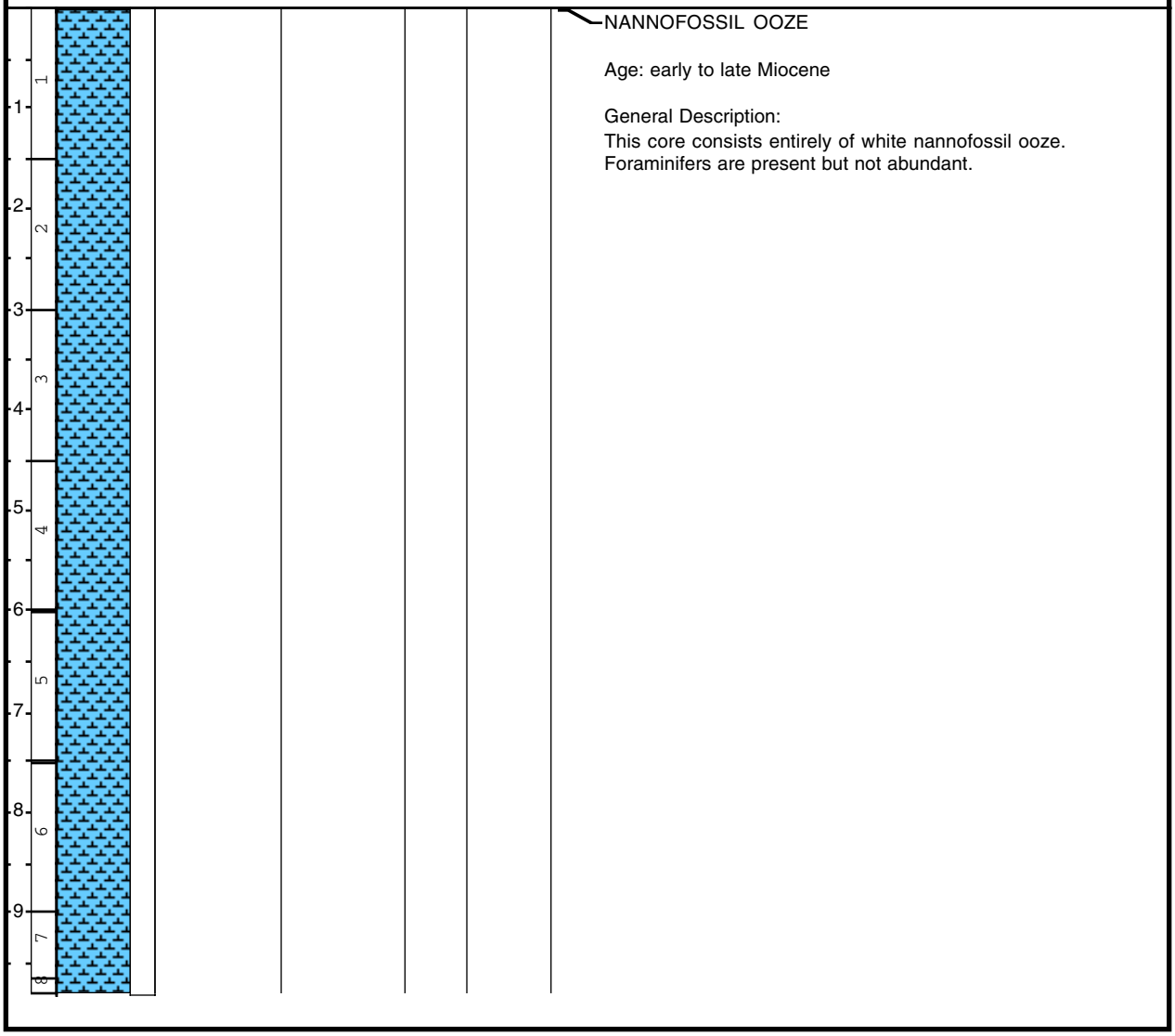
Core Photo



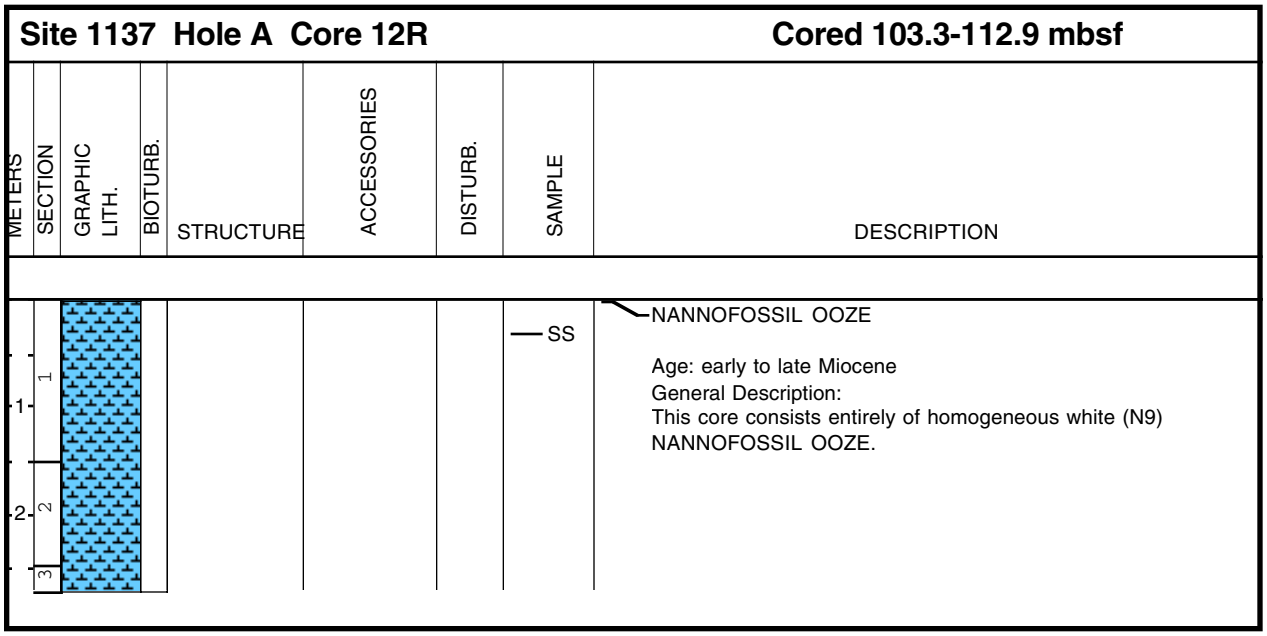
1137A-10R NO RECOVERY

Core Photo

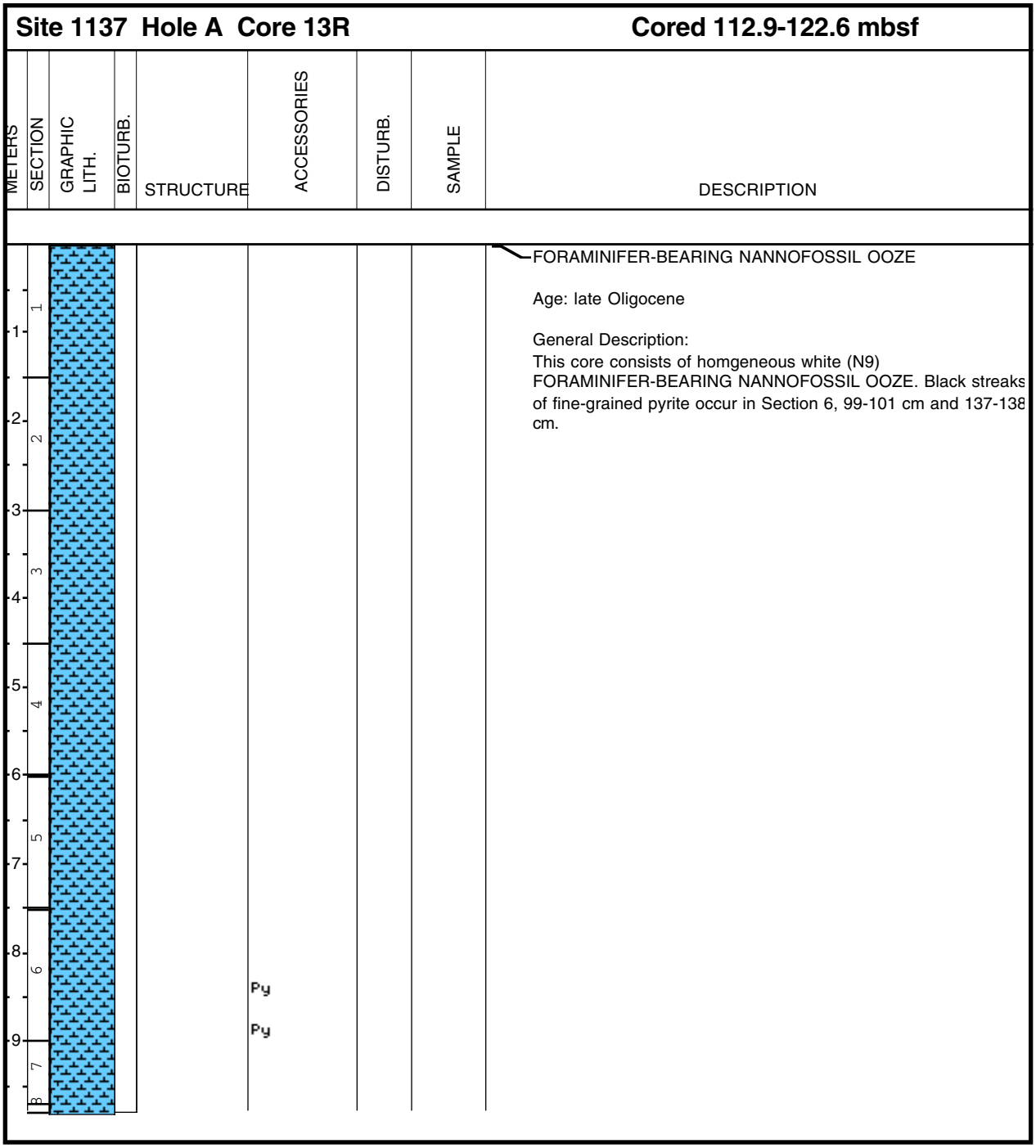
Site 1137 Hole A Core 11R **Cored 93.7-103.3 mbsf**



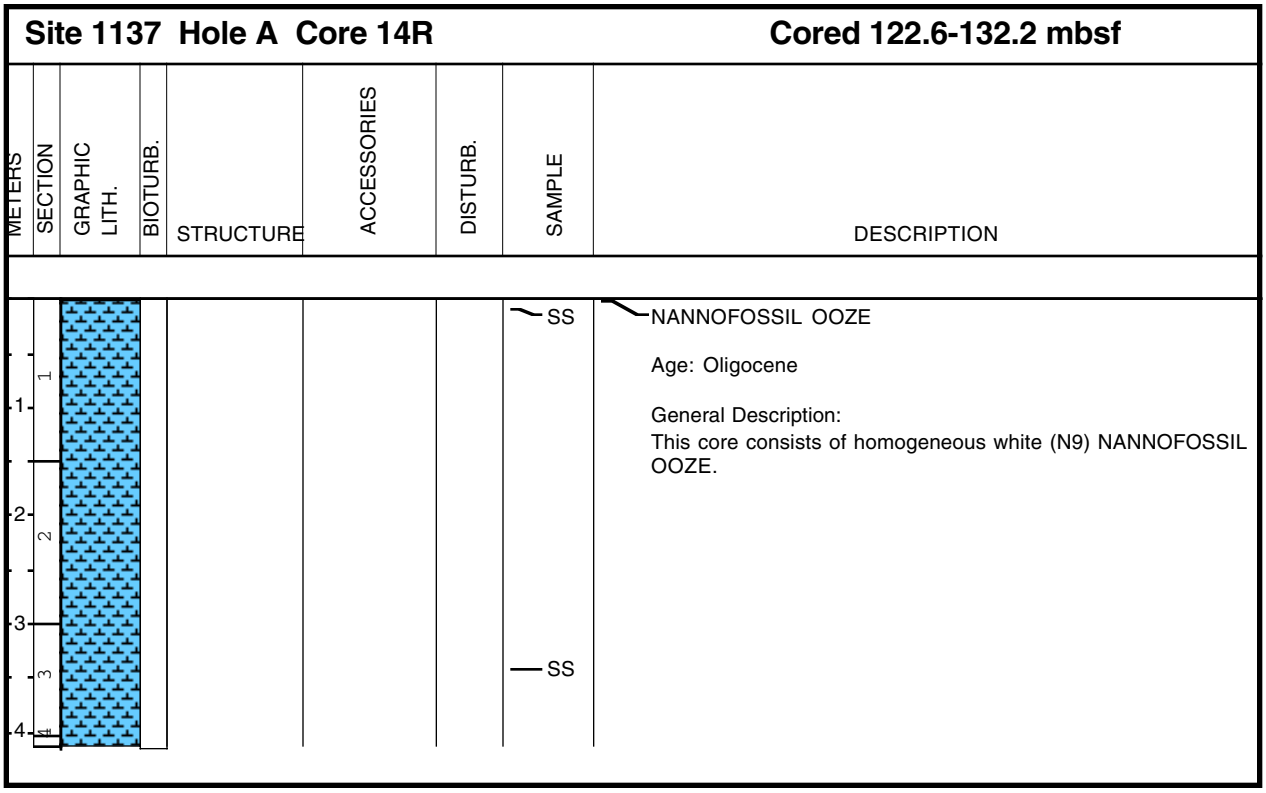
Core Photo


Site 1137 Hole A Core 12R
Cored 103.3-112.9 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
3
SS
NANNOFOSSIL OOZE
Age: early to late Miocene
General Description:
This core consists entirely of homogeneous white (N9) NANNOFOSSIL OOZE.

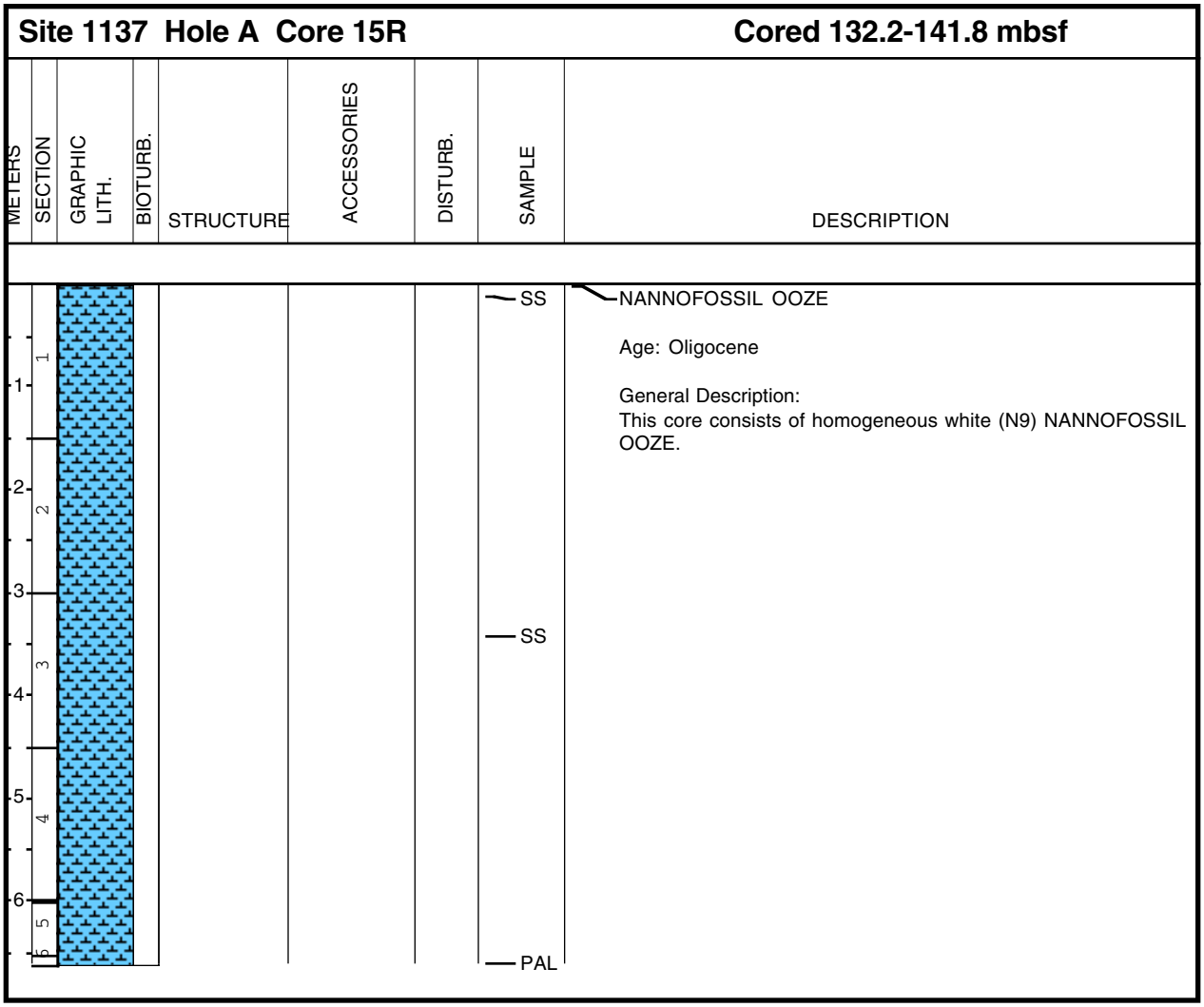
Core Photo


Site 1137 Hole A Core 13R
Cored 112.9-122.6 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
FORAMINIFER-BEARING NANNOFOSSIL OOZE
Age: late Oligocene
General Description:
This core consists of homgeneous white (N9) FORAMINIFER-BEARING NANNOFOSSIL OOZE. Black streaks of fine-grained pyrite occur in Section 6, 99-101 cm and 137-138 cm.
Py
Py

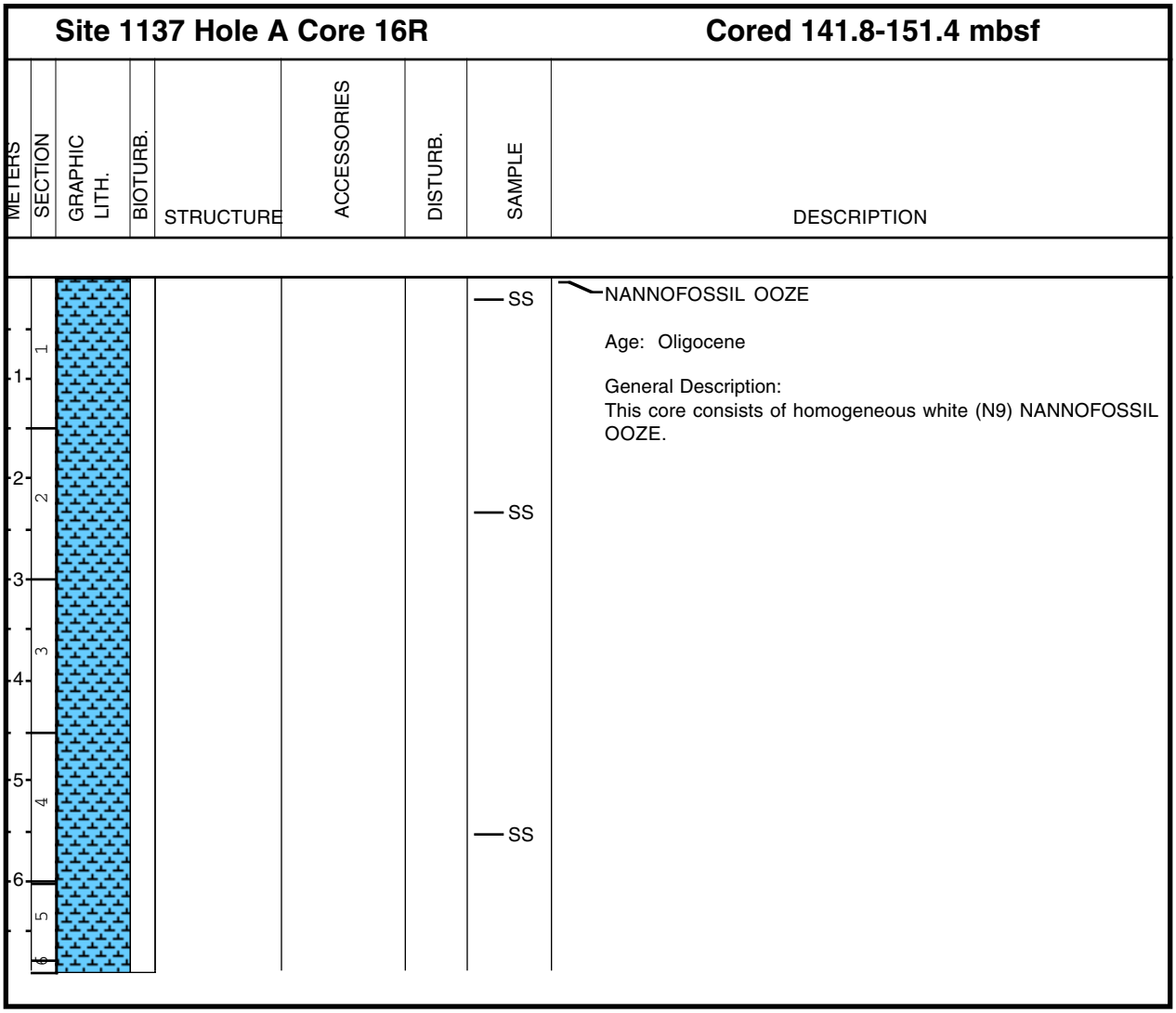
Core Photo


Site 1137 Hole A Core 14R
Cored 122.6-132.2 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
SS
SS
NANNOFOSSIL OOZE
Age: Oligocene
General Description:
This core consists of homogeneous white (N9) NANNOFOSSIL OOZE.

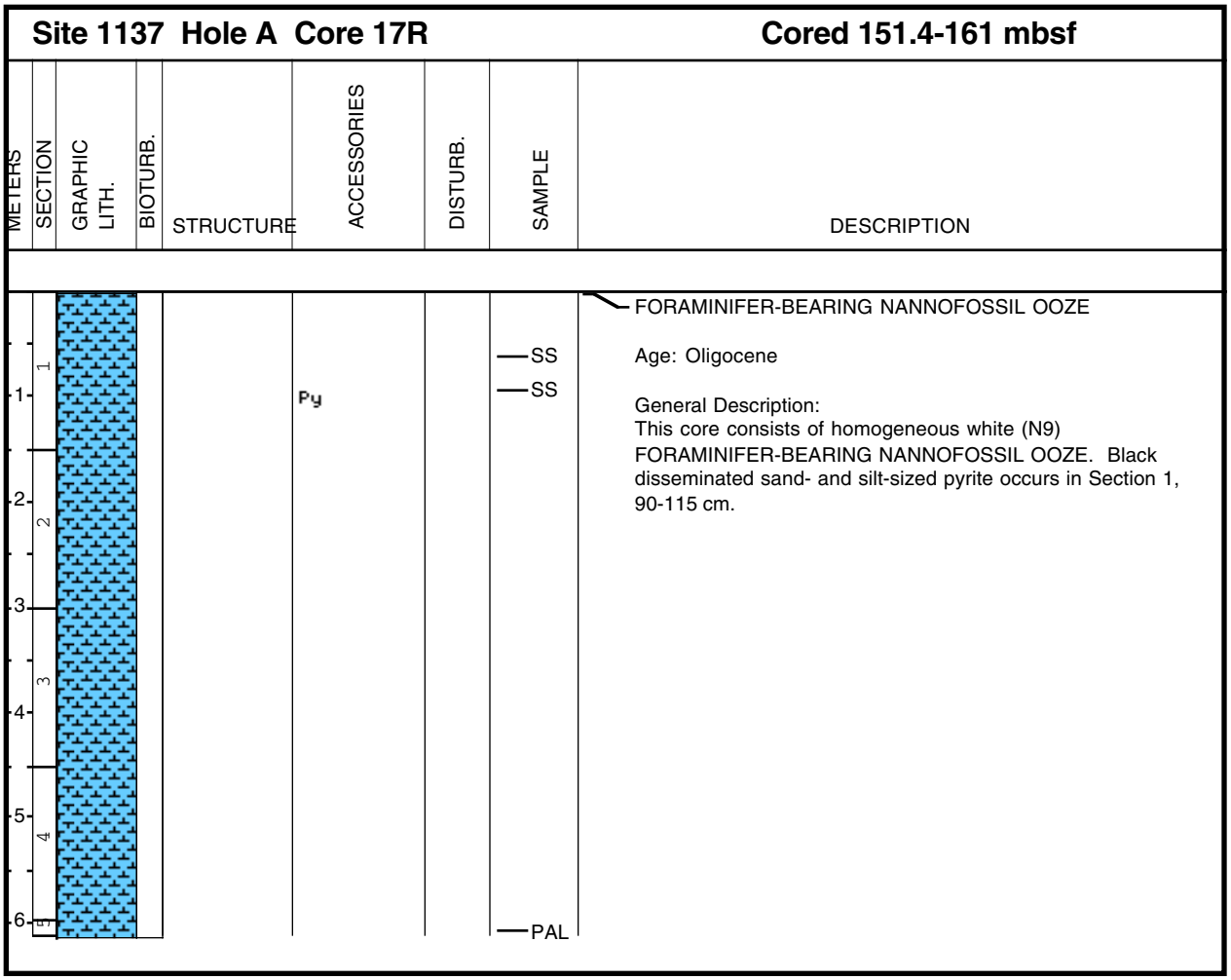
Core Photo


Site 1137 Hole A Core 15R
Cored 132.2-141.8 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
SS
SS
PAL
NANNOFOSSIL OOZE
Age: Oligocene
General Description:
This core consists of homogeneous white (N9) NANNOFOSSIL OOZE.

Core Photo


Site 1137 Hole A Core 16R
Cored 141.8-151.4 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
SS
SS
SS
NANNOFOSSIL OOZE
Age: Oligocene
General Description:
This core consists of homogeneous white (N9) NANNOFOSSIL OOZE.

Core Photo

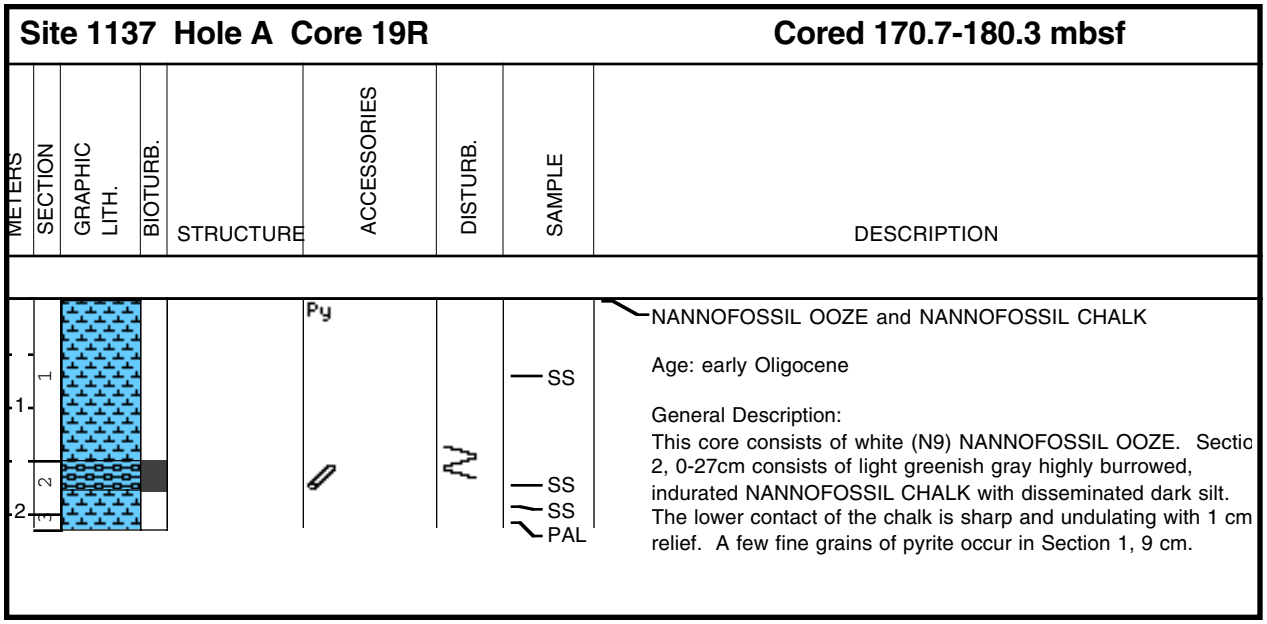

Site 1137 Hole A Core 17R
Cored 151.4-161 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
Py
SS
SS
PAL
FORAMINIFER-BEARING NANNOFOSSIL OOZE
Age: Oligocene
General Description:
This core consists of homogeneous white (N9) FORAMINIFER-BEARING NANNOFOSSIL OOZE. Black disseminated sand- and silt-sized pyrite occurs in Section 1, 90-115 cm.

Core Photo

Site 1137 Hole A Core 18R **Cored 161-170.7 mbsf**

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
1	1						SS	NANNOFOSSIL OOZE Age: Oligocene General Description: This core consists of white (N9) NANNOFOSSIL OOZE.
	2						PAL	

Core Photo


Site 1137 Hole A Core 19R
Cored 170.7-180.3 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
Py
SS
SS
SS
PAL
NANNOFOSSIL OOZE and NANNOFOSSIL CHALK
Age: early Oligocene
General Description:
This core consists of white (N9) NANNOFOSSIL OOZE. Sectio
2, 0-27cm consists of light greenish gray highly burrowed,
indurated NANNOFOSSIL CHALK with disseminated dark silt.
The lower contact of the chalk is sharp and undulating with 1 cm
relief. A few fine grains of pyrite occur in Section 1, 9 cm.

Core Photo

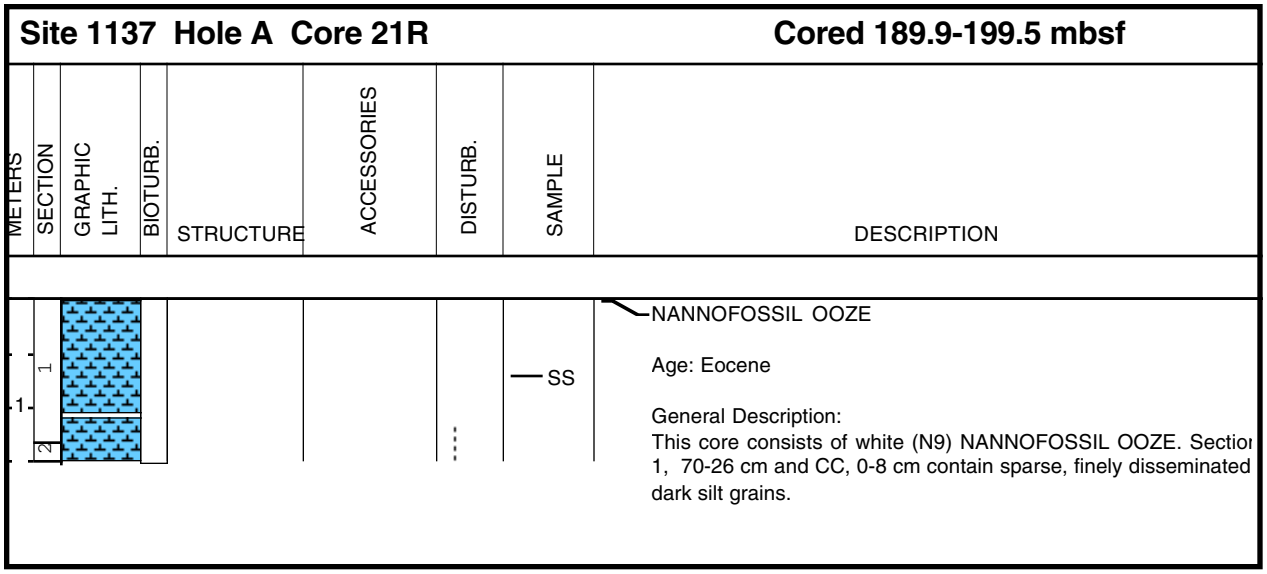
Site 1137 Hole A Core 20R **Cored 180.3-189.9 mbsf**

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
	1						SS	FORAMINIFER-BEARING NANNOFOSSIL OOZE

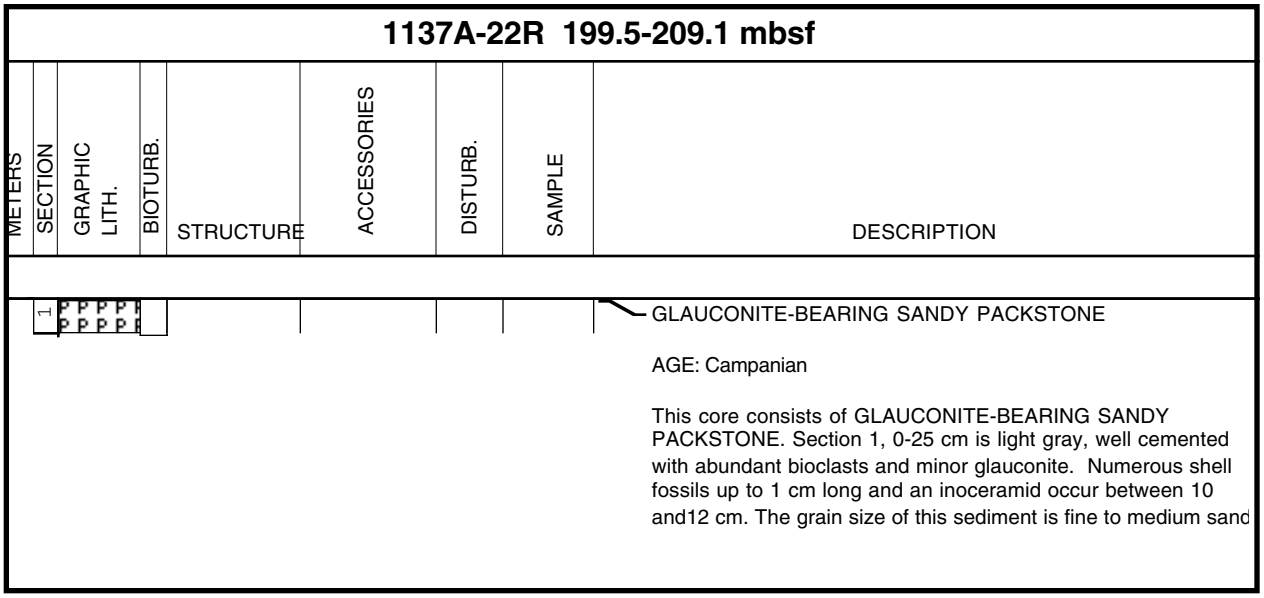
Age: Eocene

General Description:
This core consists of white (N9) FORAMINIFER-BEARING NANNOFOSSIL OOZE.

Core Photo


Site 1137 Hole A Core 21R
Cored 189.9-199.5 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
1
2
SS
NANNOFOSSIL OOZE
Age: Eocene
General Description:
This core consists of white (N9) NANNOFOSSIL OOZE. Sectio
1, 70-26 cm and CC, 0-8 cm contain sparse, finely disseminated
dark silt grains.

Core Photo

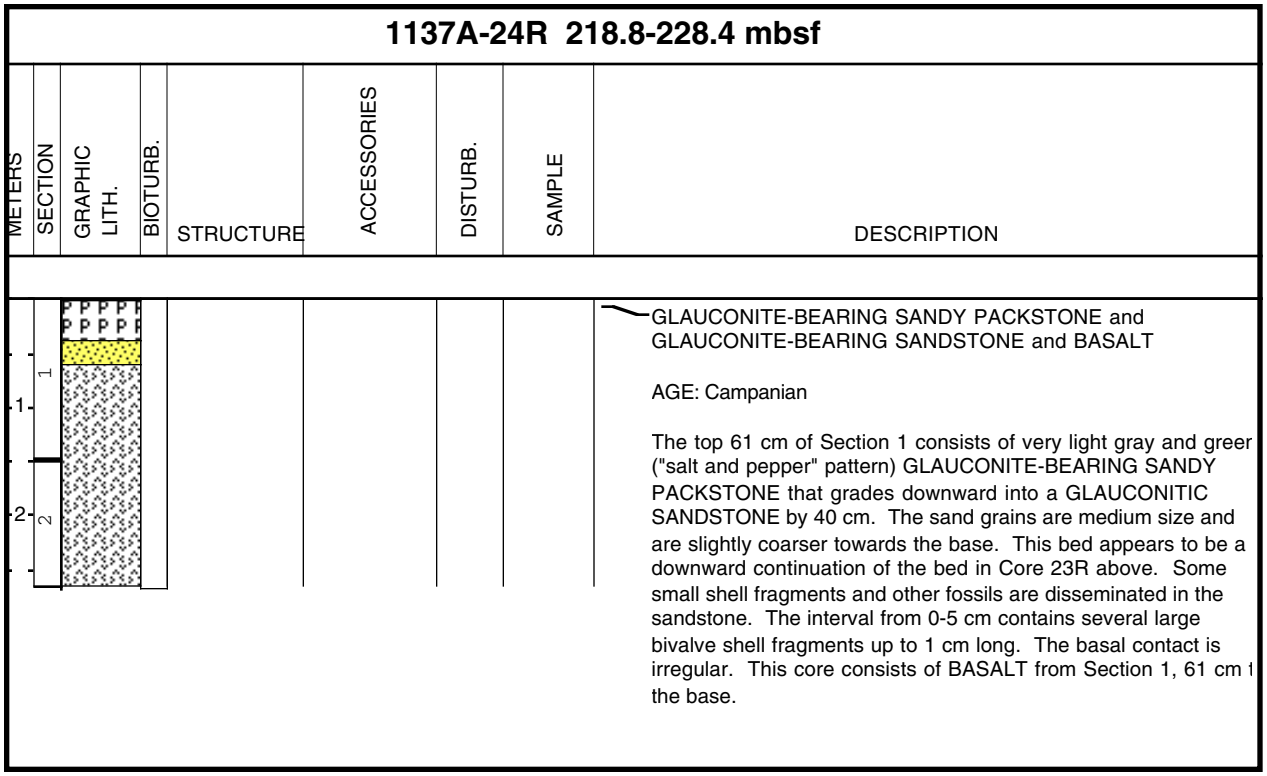

1137A-22R 199.5-209.1 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
GLAUCONITE-BEARING SANDY PACKSTONE
AGE: Campanian
This core consists of GLAUCONITE-BEARING SANDY PACKSTONE. Section 1, 0-25 cm is light gray, well cemented with abundant bioclasts and minor glauconite. Numerous shell fossils up to 1 cm long and an inoceramid occur between 10 and12 cm. The grain size of this sediment is fine to medium sand

Core Photo

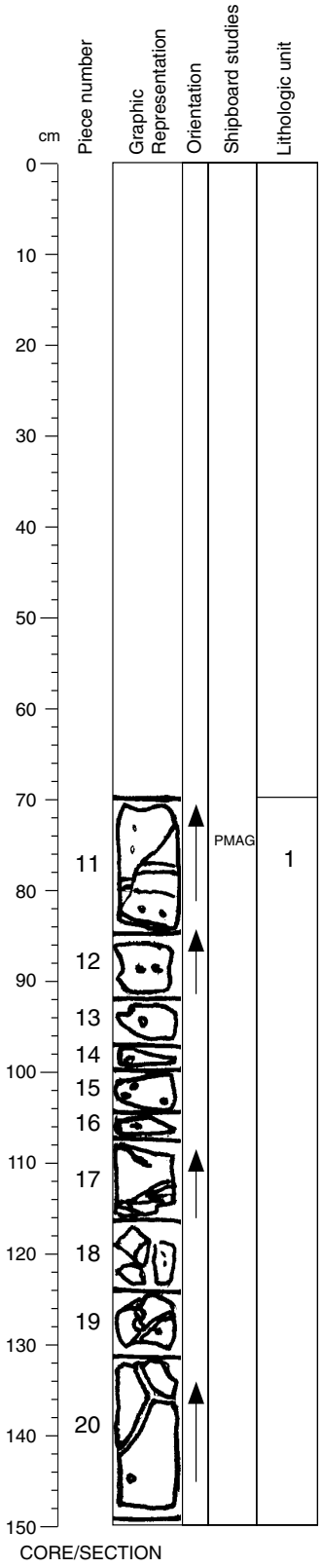
1137A-23R 209.1-218.8 mbsf

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
1	1 2							GLAUCONITE-BEARING SANDY PACKSTONE AGE: Campanian This core consists of very light gray GLAUCONITE-BEARING SANDY PACKSTONE, which coarsens downward from fine- to mediium-sand size. Small shell fragments and other fossils are common. Slight burrowing is present in some intervals.

Core Photo


1137A-24R 218.8-228.4 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
GLAUCONITE-BEARING SANDY PACKSTONE and GLAUCONITE-BEARING SANDSTONE and BASALT
AGE: Campanian
The top 61 cm of Section 1 consists of very light gray and greer ("salt and pepper" pattern) GLAUCONITE-BEARING SANDY PACKSTONE that grades downward into a GLAUCONITIC SANDSTONE by 40 cm. The sand grains are medium size and are slightly coarser towards the base. This bed appears to be a downward continuation of the bed in Core 23R above. Some small shell fragments and other fossils are disseminated in the sandstone. The interval from 0-5 cm contains several large bivalve shell fragments up to 1 cm long. The basal contact is irregular. This core consists of BASALT from Section 1, 61 cm t the base.

Core Photo



183-1137A-24R-1 **Section top: 218.80 (mbsf)**

UNIT 1: SPARSELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 11-20 (For description of Pieces 1-10, see Comments below.)

CONTACTS: Not recovered; inferred to be above Piece 11.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	1	6	0.5	2	Euhedral laths; subhedral glomerocrysts with clinopyroxene
Clinopyroxene:	<1	1	0.5	0.5	Euhedral to embayed; subhedral with plagioclase in glomerocrysts

GROUNDMASS: Fine grained.

VESICLES: Sparse, 1-6 mm, rimmed with blue-green clay, centers filled with zeolite. The larger vesicles are rounded, the smaller ones more irregular.

COLOR: Medium gray.

STRUCTURE: Massive.

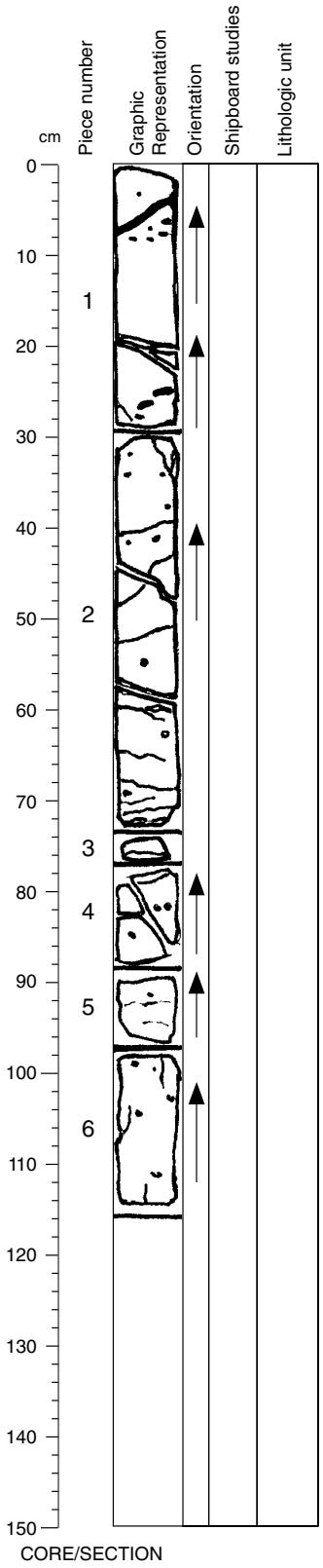
ALTERATION: Slight.

VEINS/FRACTURES: Sparsely veined with calcite-filled veins.

COMMENTS: Pieces 1-9 (0-61 cm) are calcareous glauconitic sandstone (very light gray to dark green), consisting mostly of medium sand-size grains and coarsening slightly toward the base. From 0-5 cm, the sandstone contains large bivalve shell fragments up to 3 cm long.

Piece 10 is a subrounded cobble of gray to light olive-green, aphyric (probably originally glassy), highly to very highly altered volcaniclastic breccia. Individual clasts within the breccia are nonvesicular to sparsely vesicular and set in a matrix of glauconitic clay and calcite.This piece is now silicified. It is not clear if this piece is a flow-top breccia to Unit 1 and thus essentially in place, or a cobble at the bottom of the sandstone unit.

Core Photo



183-1137A-24R-2 **Section top: 220.29 (mbsf)**

UNIT 1: SPARSELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-6

CONTACTS: None

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	≤1	5	1	1	Laths; also very rare glomerocrysts (up to 5 mm)
Olivine:	<<1	1	0.25		Euhedral; outlined by black clay and completely replaced by deep green clay similar to that in vesicles
Clinopyroxene:	<1	1	0.5		Subhedral, replaced by dark clays

GROUNDMASS: Fine grained.

VESICLES: Three kinds: (1) sparse, round, 1-4 mm; (2) very sparse elongate, 2-20 mm; (3) sparse irregular, 0.2-0.4 mm. All three types are lined with a narrow black rim, inside of which is green clay. The large vesicles have inner, concentric yellow and colorless zeolites; their innermost filling is layered horizontally.

COLOR: Medium gray.

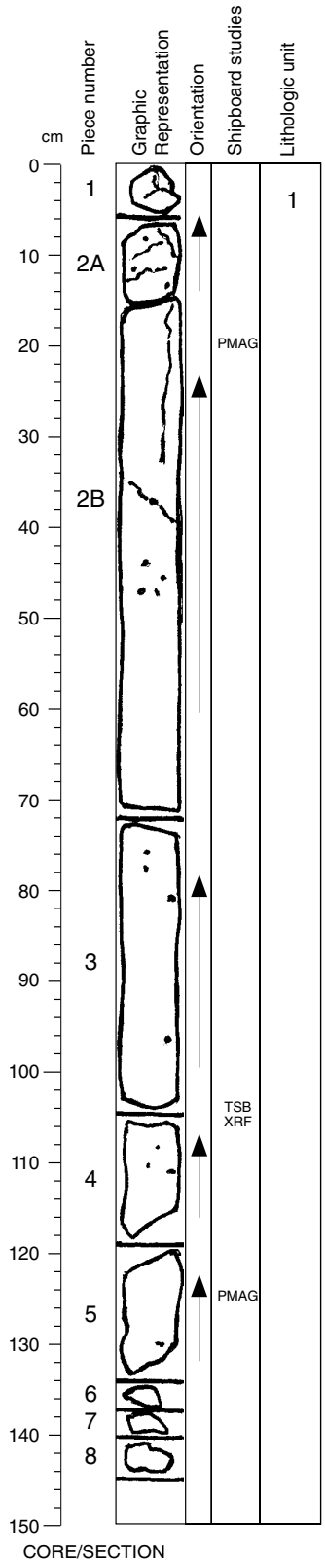
STRUCTURE: Massive.

ALTERATION: Slight to moderate. Abundant altered mesostasis.

VEINS/FRACTURES: Three types: (1) Pieces 1 and 2 have <1-mm-wide, calcite-filled veins in variable orientations; (2) at the base of Piece 2 and top of Piece 4 are subhorizontal veins, 4-8 mm wide, filled with calcite; (3) Pieces 5 and 6 have ≤1-mm-wide subhorizontal to subvertical veinlets, some of which are filled with dark green clay.

COMMENTS:

Core Photo



183-1137A-25R-1 **Section top: 228.40 (mbsf)**

UNIT 1: SPARSELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-8

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	5	1	1	Laths; also very rare glomerocrysts (≤5 mm)
Olivine:	<<1	1	0.25		Euhedral; completely replaced by green clays
Clinopyroxene:	<1	1	0.5		Subhedral; replaced by dark clays

GROUNDMASS: Fine grained, with both coarser and finer patches, especially in Piece 5.

VESICLES: The irregular small vesicles seen in Section 24R-2 are much rarer here. At the top of this section, the abundance of the irregular vesicles is similar to that in Section 24R-2, but decreases greatly by Piece 2B. A vesicle trail is present in Piece 2B from 35-40 cm, associated with a 1-2 mm wide, finer-grained zone of dark groundmass.

COLOR: Gray.

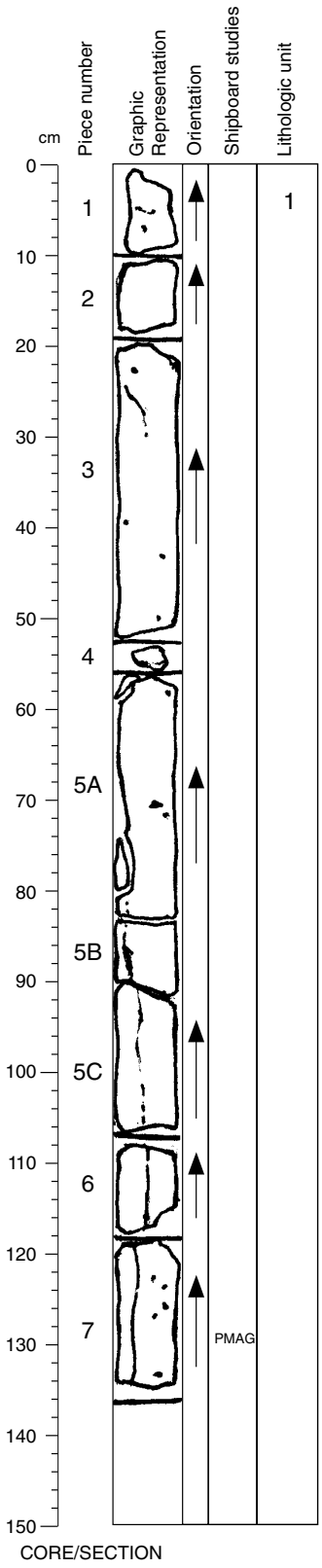
STRUCTURE: Massive.

ALTERATION: Slight. In the top ~40 cm of the section, bright orange rims outline veins and small, irregular groundmass vesicles. This alteration spreads into groundmass as patches of dark and light brown clay.

VEINS/FRACTURES: Irregular hairline cracks filled with dark green clay (Pieces 2A, 3, 4); zeolite fillings at top grade downward through section to blue-green clay. In the bottom half of Piece 2B (48-50 cm), the vein wall is intermittently lined with pyrite.

COMMENTS:

Core Photo



183-1137A-25R-2 **Section top: 229.84 (mbsf)**

UNIT 1: SPARSELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-7

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	1	2	0.5	1	Euhedral laths; subhedral with clinopyroxene in glomerocrysts
Olivine:	<<1	1	0.5		Subhedral; replaced by dark clays
Clinopyroxene:	<<1	2	1	0.5	Euhedral to embayed; subhedral with plagioclase in glomerocrysts

GROUNDMASS: Fine grained.

VESICLES: Nonvesicular to sparsely vesicular; vesicles are 1-4 mm, round, and concentrically filled with black clay, blue-green clay, and white zeolite.

COLOR: Gray.

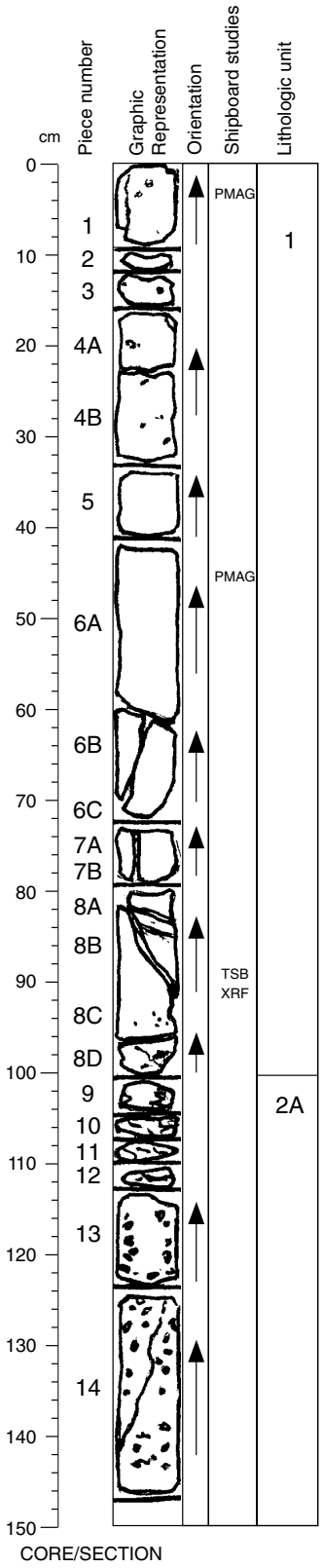
STRUCTURE: Massive.

ALTERATION: Slight.

VEINS/FRACTURES: Much less common and thinner than in the upper part of Unit 1 (see Section 25R-1 description). A <1-mm-wide, subvertical fracture filled with blue-green clay and zeolite is present between 69 and 135 cm.

COMMENTS:

Core Photo



183-1137A-25R-3 **Section top: 231.22 (mbsf)**

UNIT 1: SPARSELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-8

CONTACTS: Not recovered; contact between Units 1 and 2 is inferred to be between Pieces 8 and 9.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	1	2.5	0.4	1	Laths, tabular, and stubby
Olivine:	<1	2	0.5	0.75	Euhedral, altered to black or green clay
Clinopyroxene:	<<1	1.5	0.5	0.75	Subhedral to anhedral

GROUNDMASS: Fine grained, with some very fine-grained streaks (e.g., in Piece 8B). Groundmass is aphanitic in Piece 8D, which appears to be near chilled base of flow.

VESICLES: Very sparse in Pieces 1-4; absent in Pieces 5-7, sparse to moderate in Piece 8 (96-100 cm). Irregular groundmass vesicles similar to those in Section 24R-2 are present throughout this section. Some vesicles in Piece 8D are interconnected in irregular orange trails; the same coloration is seen in patches of groundmass near the vesicle trails, commonly enclosing relatively fresh olivine or clinopyroxene.

COLOR: Gray.

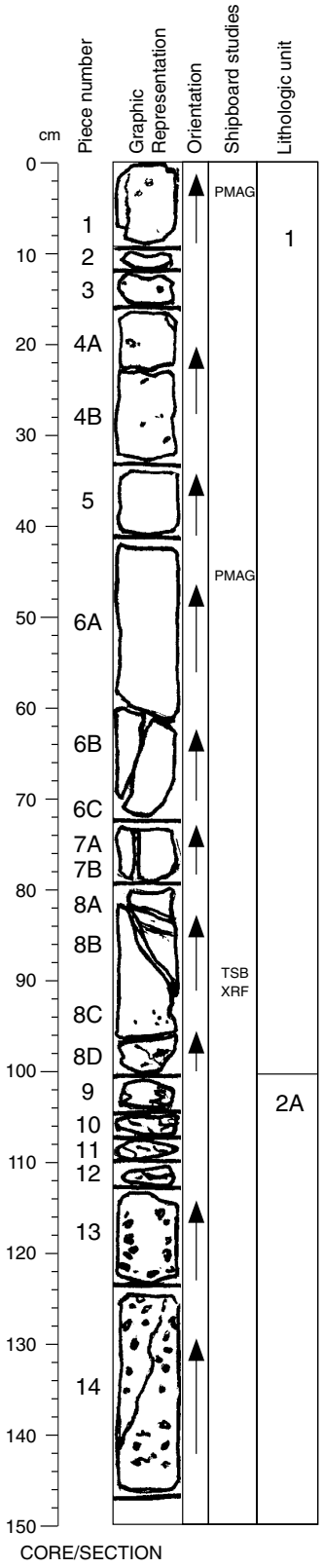
STRUCTURE: Massive.

ALTERATION: Fresh to slightly altered.

VEINS/FRACTURES: None in Pieces 1-7; Piece 5 has two subhorizontal carbonate-filled veins, ≤2 mm wide.

COMMENTS: Bottom 10 cm interpreted as rapidly cooled base of Unit 1.

Core Photo



183-1137A-25R-3 **Section top: 231.22 (mbsf)**

UNIT 2A: SPARSELY PLAGIOCLASE-PHYRIC BASALTIC BRECCIA

Pieces: 9-14

CONTACTS: Not recovered; contact between Units 1 and 2 is inferred to between Pieces 8 and 9.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	2	1	0.1	0.3	Laths and other euhedral forms
Olivine:	<<1?0.2		<0.1		Euhedral; one 0.2 mm skeletal olivine seen

GROUNDMASS: Very fine grained; may be devitrified glass.

VESICLES: Very sparsely to highly vesicular. Pieces 9-12: vesicles are stretched and filled, 1-8 mm long; Pieces 13 and 14: vesicles are abundant, subrounded, 2-8 mm; most are partly filled. Vesicle fillings include green clay and zeolite.

COLOR: Reddish brown.

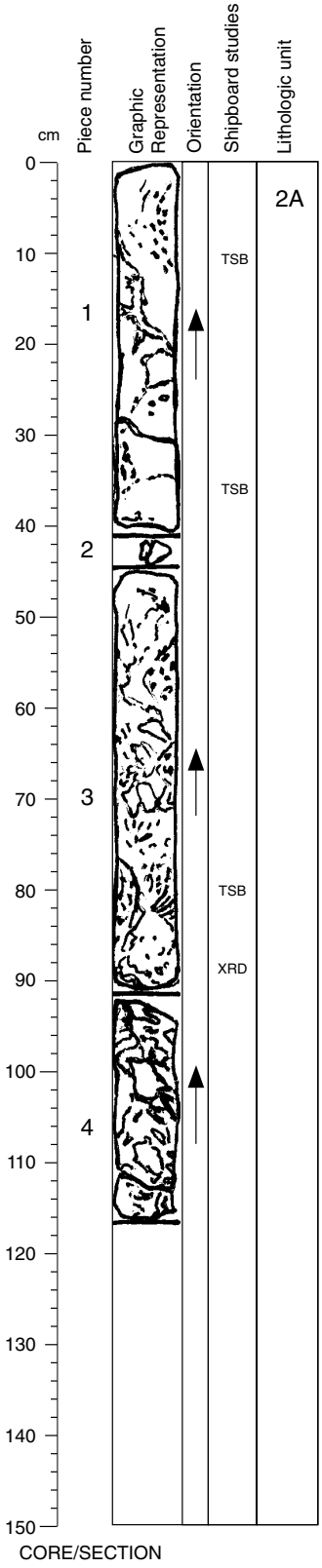
STRUCTURE: Pieces 9-12 are brecciated, probably a fragmented flow top, cemented by vein-fill material; Pieces 13 and 14 are massive.

ALTERATION: Slight to moderate. Phenocrysts appear fresh to slightly altered.

VEINS/FRACTURES: Numerous veins, 0.1-1 mm, are filled with calcite, zeolite, and green clays.

COMMENTS: Interpreted to be a flow top with large lobes penetrating earlier-formed, variably oxidized breccia. Plagioclase phenocryst content increases to 3% in Pieces 13 and 14, and the groundmass coarsens slightly. Identification of mafic phenocrysts is uncertain because of small grain size.

Core Photo



183-1137A-25R-4 **Section top: 232.69 (mbsf)**

UNIT 2A: MODERATELY PLAGIOCLASE-PHYRIC BASALTIC BRECCIA

Pieces: 1-4

CONTACTS: Many irregular *internal* contacts within Subunit 2A.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	2-3	1.5	0.1	0.2	Laths
Olivine:	<1	0.2	0.1		Subhedral
Clinopyroxene:	1	0.2	0.1		Subhedral

GROUNDMASS: Most clasts are aphanitic. Many have a <1 cm chill zone (devitrified glass).

VESICLES: Moderately vesicular; vesicle fill is mostly white carbonate and some zeolite in Pieces 3 and 4. Vesicles in Piece 1 have an intense green fill (Mg-saponite-celadonite?). Vesicle walls are marked by bright orange-red color (Fe oxides and oxyhydroxides, and clay minerals).

COLOR: Variable, depending on clasts. Smaller clasts and fragments are gray; other (older?) fragments are dark reddish brown to brick red, and granulated margins are brick red.

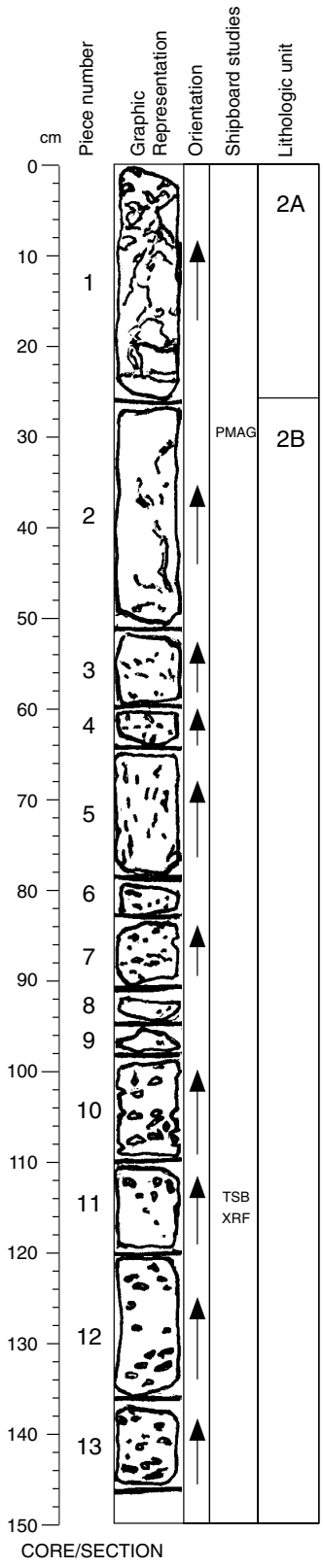
STRUCTURE: Brecciated, two types: smaller, more oxidized (earlier-formed?) clasts or lobes, and larger (later-formed?) lobes; originally void spaces are filled in by small breccia clasts.

ALTERATION: Highly to completely altered. Bright orange-red and yellow oxidation is present around irregular vesicles and in groundmass networks and patches. White zeolite followed by calcite fills large (originally) void spaces between clasts in the breccia.

VEINS/FRACTURES: Irregular cross-cutting vein networks are present, with some apparent hydraulic fracturing of basalt clasts. Massive late-stage zeolite followed by carbonate fills veins.

COMMENTS: This section is interpreted to be a flow-top breccia. The smaller, more oxidized clasts may be part of the primary flow-top breccia. Chilled margins are visible around altered basalt clasts in Piece 1 and Piece 3. The lava appears to have autobrecciated during emplacement and further brecciated during penetration of later lobes. Voids in the autobreccia were filled in, and hydraulic fracturing of autobreccia clasts occurred during alteration. Some centimeter-scale hydraulic brecciation occurred along margins of large veins.

Core Photo



183-1137A-25R-5 **Section top: 233.86 (mbsf)**

UNIT 2A: SPARSELY PLAGIOCLASE-PHYRIC BASALTIC BRECCIA

Pieces: 1

CONTACTS: Contact between upper breccia (Subunit 2A) and lower massive (Subunit 2B) parts of this unit is inferred between Pieces 1 and 2.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	1	2.5	0.5	0.7	Laths and some glomerocrysts
Clinopyroxene:	<<1	1	<0.1		One euhedral lath, others anhedral

GROUNDMASS: Aphanitic; pink to red.

VESICLES: Moderately vesicular; vesicles elongate, <5 mm, and generally filled with calcite.

COLOR: Brick red and gray.

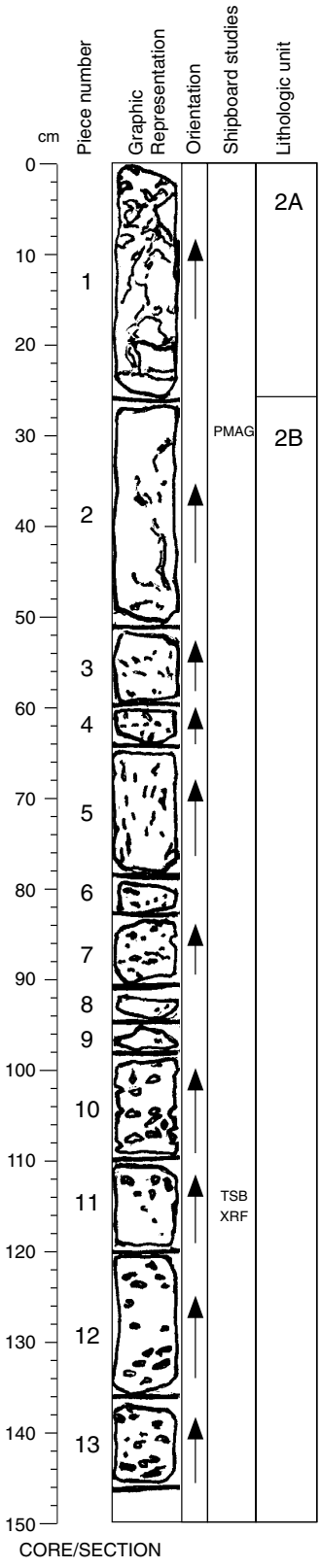
STRUCTURE: Brecciated.

ALTERATION: Moderate to high. Oxidation of groundmass, with strongest alteration near filled, irregular vesicles in the groundmass.

VEINS/FRACTURES: Networked by irregular veinlets of red clay or, less commonly, by gray clay.

COMMENTS: Interpreted as flow top breccia.

Core Photo



183-1137A-25R-5 **Section top: 233.86 (mbsf)**

UNIT 2B: SPARSELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 2-13

CONTACTS: Contact between upper breccia (Subunit 2A) and lower massive (Subunit 2B) parts of this unit is between Pieces 1 and 2.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	1	2.5	0.5	0.7	Laths and some glomerocrysts
Clinopyroxene:	<<1	1	<0.1		One euhedral lath, others anhedral

GROUNDMASS: Piece 2 has some aphanitic patches; from Piece 2 downward, groundmass is fine grained.

VESICLES: Moderately vesicular. Vesicles are highly variable in size, morphology, and distribution (see Vesicle Log). Pieces 2, 4, 6, and 7 have irregularly shaped, elongate, 1-8 mm vesicles. Within Piece 2, vesicle abundance increases downward from sparse to moderate. Vesicles in Piece 5 become less elongate downward in the piece. Piece 10 has large (≤10 mm) rounded vesicles. Vesicle fillings include zeolite and green clay.

COLOR: Reddish gray.

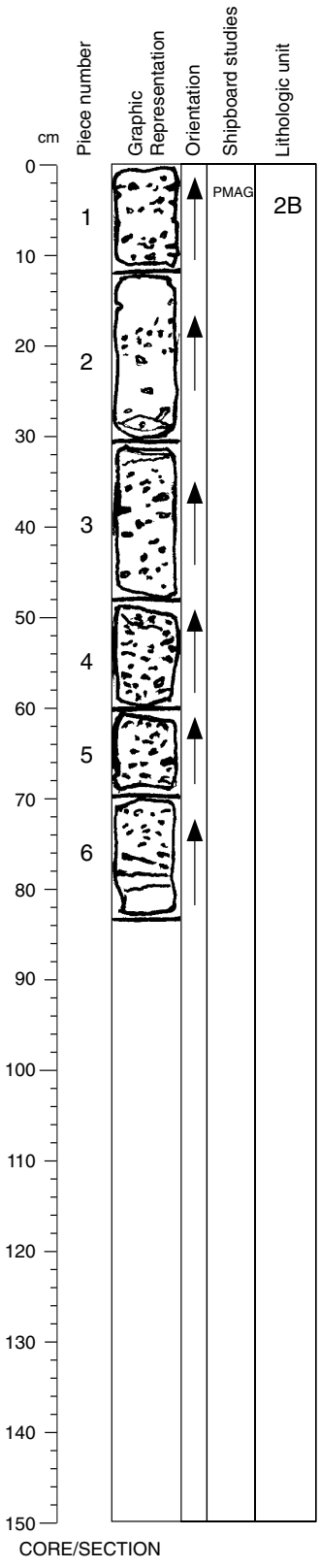
STRUCTURE: Massive, except top of Piece 2, which is transitional from breccia to massive.

ALTERATION: Moderate to high in upper part of section, decreasing downward to slight to moderate. Pink to red oxidation of groundmass decreases down section. In Piece 2, alteration is strongest around filled, irregular vesicles in the groundmass.

VEINS/FRACTURES: Piece 2 is networked by irregular veinlets, which are filled with red and green clay. Small patches of pyrite are associated with gray veins in Piece 2.

COMMENTS:

Core Photo



183-1137A-25R-6 **Section top: 235.33 (mbsf)**

UNIT 2B: APHYRIC BASALT

Pieces: 1-6

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	1.2	0.8		Subhedral

GROUNDMASS: Aphanitic to very fine grained. Plagioclase and possibly olivine observed.

VESICLES: Pieces 1-3 are moderately vesicular, with rounded to elongate, irregular vesicles (1 to 10 mm), wholly or partially filled with green clay, white zeolite, and carbonates. Piece 4 is highly vesicular, with rounded to irregular filled vesicles, as in Pieces 1-3, but the wholly filled vesicles are often interconnected, forming horizontal tracks. Pieces 5 and 6 are moderately vesicular and similar to Pieces 1-3, except that the bottom of Piece 6 contains a large (~1 x 6 cm), elongate, horizontal vesicle filled with zeolite and carbonates; zeolite forms a horizontal layer at the bottom of this vesicle. Below this vesicle, the basalt is nonvesicular. One vesicle In Piece 6 contains dark green framboidal clay.

COLOR: Slightly reddish gray.

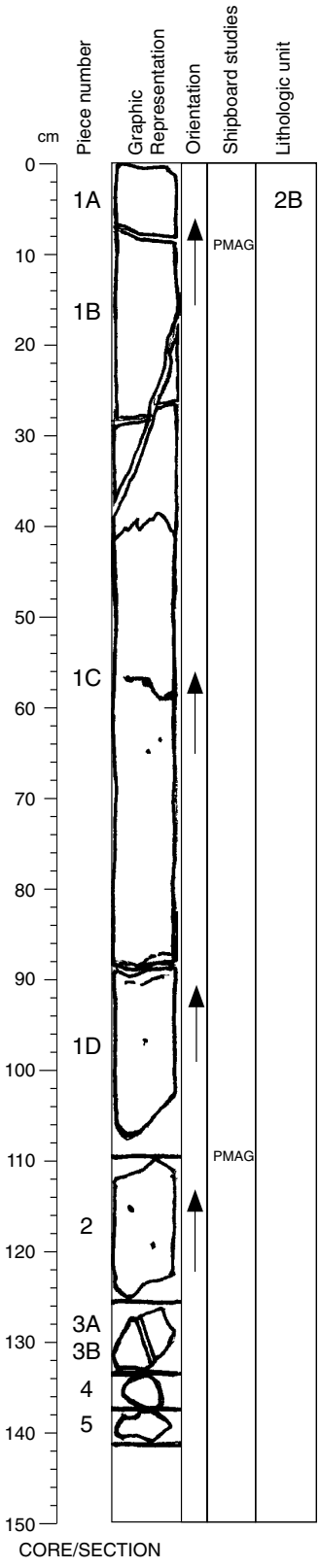
STRUCTURE: Massive.

ALTERATION: Slight to moderate. Red alteration layer is seen around the smallest vesicles.

VEINS/FRACTURES: A horizontal set of one 10-mm-thick vein and two 1-mm-thick veinlets separates Pieces 2 and 3. Veins are filled with a thin layer of yellow clay and carbonates.

COMMENTS:

Core Photo



183-1137A-25R-7 **Section top: 236.18 (mbsf)**

UNIT 2B: SPARSELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-5

CONTACTS: None.

PHENOCRYSTS:

	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	1	2		1	Euhedral; subhedral in glomerocrysts
Clinopyroxene:	<1	1	0.5	0.5	Eubhedral to subhedral

GROUNDMASS: Fine grained.

VESICLES: Nonvesicular to sparsely vesicular; vesicles are round to irregular, ≤1mm in size, and completely filled (commonly concentrically) with black to dark green to blue-green clay, commonly with clear zeolite at the core.

COLOR: Gray.

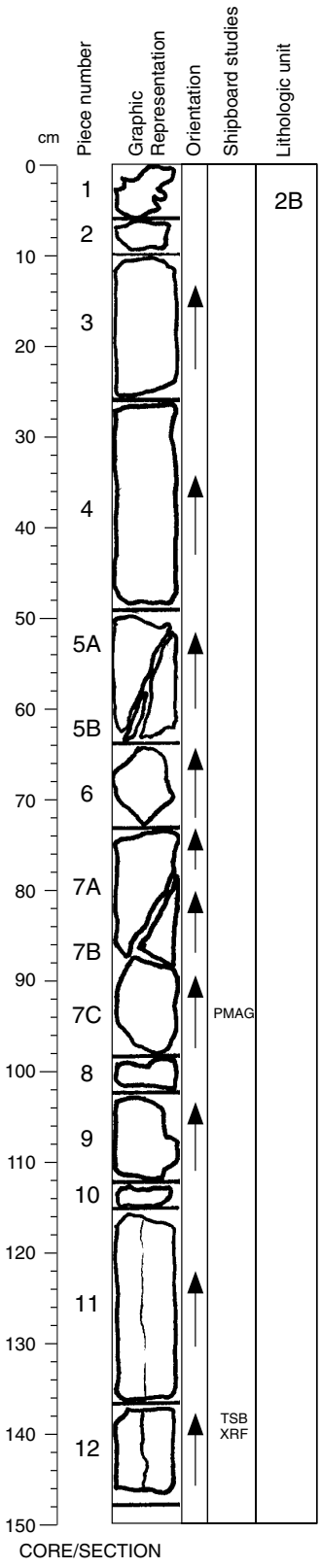
STRUCTURE: Massive.

ALTERATION: Slight to moderate; much of the groundmass is altered to dark green clay.

VEINS/FRACTURES: Sparse, <2 cm, filled with clay similar to that in vesicles; one 5-mm horizontal, calcite-and-clay-filled vein is at 91 cm.

COMMENTS:

Core Photo



183-1137A-26R-1 **Section top: 238.00 (mbsf)**

UNIT 2B: APHYRIC BASALT

Pieces: 3-12

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	4	1	1	Stubby laths
Clinopyroxene:	<1	0.5			Subhedral

GROUNDMASS: Fine grained, with coarser segregation in Piece 12 (~1 mm grain size). Layering is evident in top of Pieces 5A and 5B, where 5-mm-wide layers of clinopyroxene lie on either side of a vesicle layer 1.5 cm wide.

VESICLES: Very sparse; Pieces 3 to 7 are nonvesicular. Very sparse filled vesicles in other pieces are mostly <1 mm in size. Irregular vesicles have a black rim and are filled with blue-gray clay. In some areas, the fill is deep green, as in previous sections (e.g., the top of Piece 5). Macroscopic filled vesicles in Piece 9 show a sharply defined rim, narrow green clay lining, and zeolite filling.

COLOR: Gray.

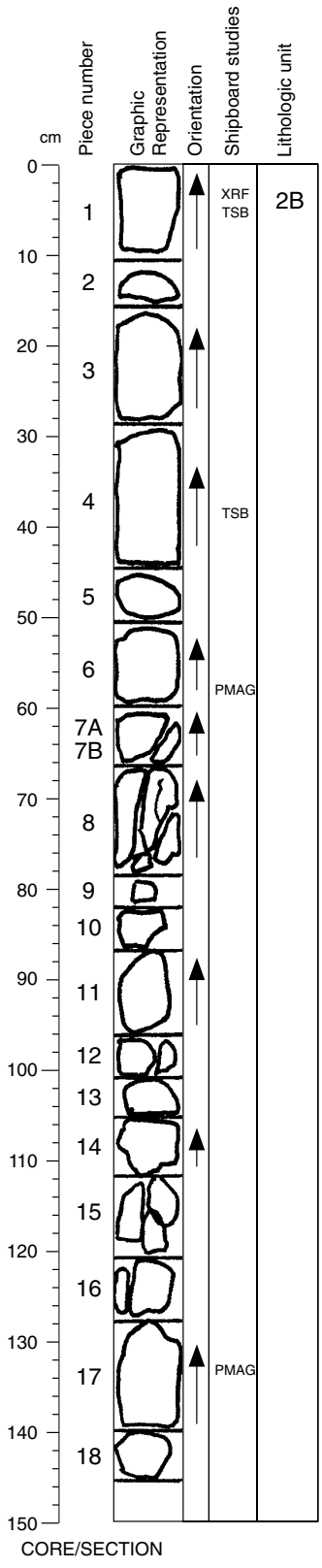
STRUCTURE: Massive.

ALTERATION: Slight to moderate, with narrow (1-3 cm) bands of more altered mesostasis.

VEINS/FRACTURES: Subvertical cracks filled with clay cut through Pieces 5, 7, 11, and 12.

COMMENTS: Pieces 1 and 2 are fossiliferous coarse sandstone interepreted as dropstones.

Core Photo



183-1137A-26R-2 **Section top: 239.48 (mbsf)**

UNIT 2B: APHYRIC BASALT

Pieces: 1-18

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	1	0.5		Euhedral
Clinopyroxene:	<1	1	0.5		Subhedral

GROUNDMASS: Fine grained.

VESICLES: Nonvesicular to moderately vesicular; vesicles are 0.5-1 mm in size, in several places forming horizontal sheets 2-5 cm wide.

COLOR: Gray to grayish green and grayish pink.

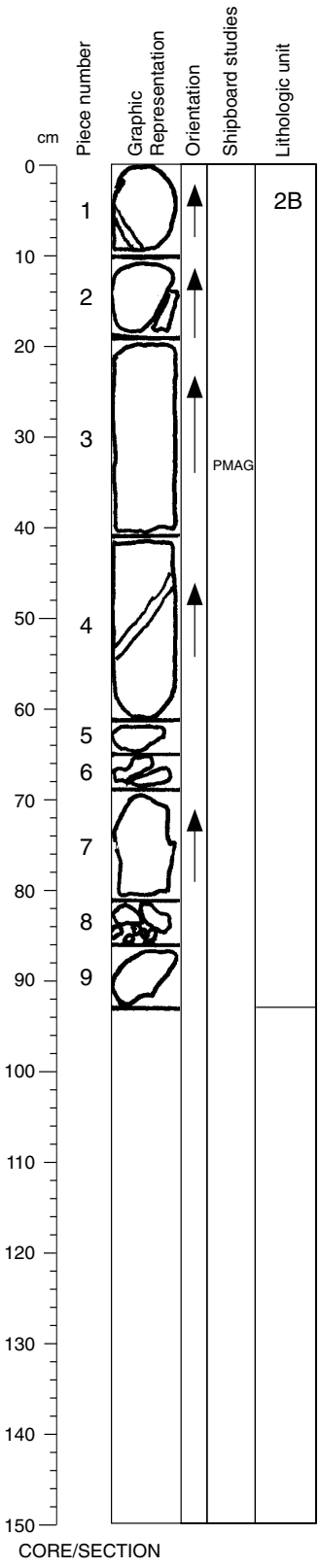
STRUCTURE: Massive.

ALTERATION: Slight to moderate; clay and zeolite fill vesicles and veins.

VEINS/FRACTURES: Rare, vertical, <0.5 mm.

COMMENTS: A 1-cm-long, late-stage magmatic pentlandite segregation is present in the groundmass of Piece 4.

Core Photo



183-1137A-26R-3 **Section top: 240.94 (mbsf)**

UNIT 2B: SPARSELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-9

CONTACTS: None recovered; contact between Units 2 and 3 is inferred to be below bottom of section.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	1-2	2	1		Euhedral to subhedral; rare glomerocrysts (Piece 3) of plagioclase and subordinate clinopyroxene
Clinopyroxene:	<1	2	1		Euhedral

GROUNDMASS: Fine grained.

VESICLES: Nonvesicular to sparsely vesicular; vesicles filled with dark green to bright green clay.

COLOR: Gray-green to gray-pink.

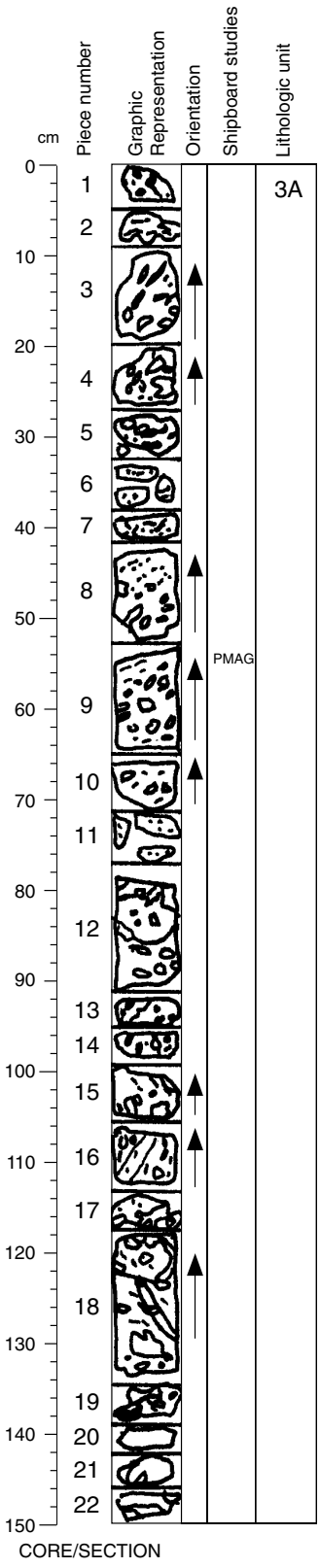
STRUCTURE: Massive.

ALTERATION: Slight to moderate; dark green and brown-green clay replaces clinopyroxene in the groundmass. A bright-orange to red zone of Fe-oxidation (with calcite) dips at ~30°, and subvertical hairline cracks are filled with dark green clays.

VEINS/FRACTURES: None

COMMENTS:

Core Photo



183-1137A-27R-1 **Section top: 247.60 (mbsf)**

UNIT 3A: APHYRIC BASALT

Pieces: 1-22

CONTACTS: None observed; contact between Units 2 and 3 is inferred to be above top of section.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	0.5	0.1		Euhedral laths

GROUNDMASS: Fine grained.

VESICLES: Highly vesicular. Vesicles are irregular, flattened or elliptical, 1-50 mm, and filled with calcite, dark green clay and, to a lesser extent, zeolite.

COLOR: Brick-red to mottled white and green.

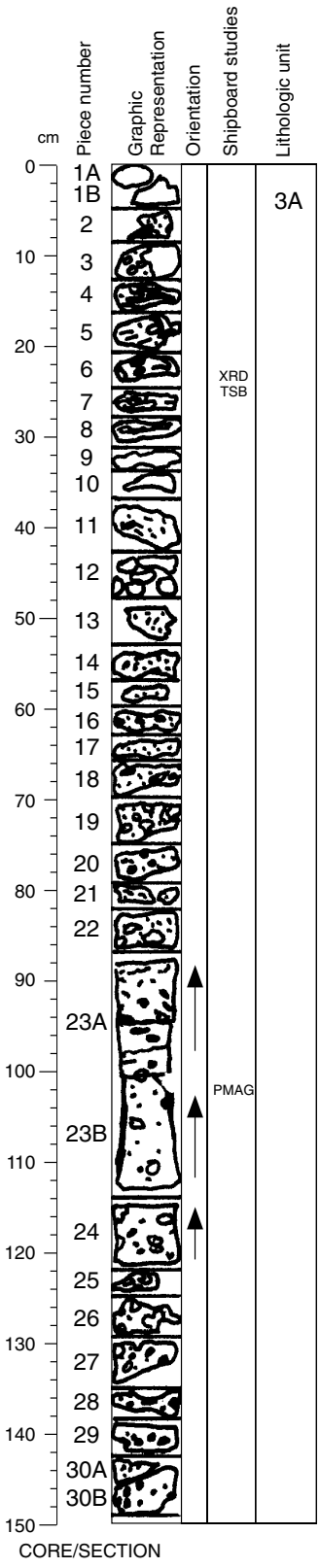
STRUCTURE: Original voids ≤4 cm across in Pieces 12, 20 and 22 are filled by blue-green, silty, fine-sand. Piece 21 is composed entirely of this silty fine-sand.

ALTERATION: Highly altered with pervasive dark red oxidation.

VEINS/FRACTURES: Inclined, hairline fractures filled with calcite and pale green clay.

COMMENTS: Interpreted to be the upper part of flow Unit 3 on the basis of high vesicularity. Silty fine-sand, laminated on a mm scale, fills voids in the basalt in Pieces 12 and 20-22; the sediment is indurated and may be silicified or baked; the mechanism for the infiltration of this sediment is not clear but is clearly post lava flow emplacement.

Core Photo



183-1137A-27R-2 **Section top: 249.09 (mbsf)**

UNIT 3A: APHYRIC BASALT

Pieces: 1-30

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	0.5	0.5		Euhedral laths

GROUNDMASS: Fine grained. Plagioclase laths and small, rounded grains of olivine or clinopyroxene are visible.

VESICLES: Highly vesicular. Vesicles have irregular and varied shapes: elongated (0.2-25 mm) and usually parallel in Pieces 1-15; from Piece 11 downward, numerous small vesicles (0.1-0.5 mm), as well as larger ones (≤21 mm). Calcite, zeolites, and clay fill vesicles; vesicles in Pieces 26 and 29 are filled by a blocky zeolite (chabazite?).

COLOR: Brick-red, mottled white and green, and green. From Piece 22 downward, the color is more grayish green, whereas above this level it is redder.

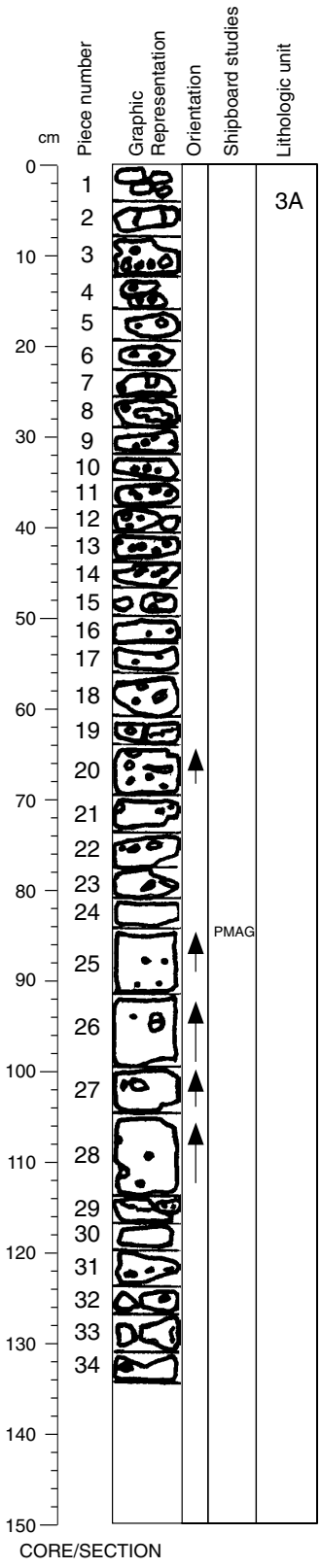
STRUCTURE: Highly vesicular.

ALTERATION: Highly altered with 50% dark red oxidation. Blue-green partially silicified clay-rich zones are present in Pieces 1-3 and 7-10.

VEINS/FRACTURES: Piece 23 has some hairline fractures filled with pale green-gray clay.

COMMENTS: Grouped with Subunit 3A on the basis of high vesicularity.

Core Photo



183-1137A-27R-3 **Section top: 250.58 (mbsf)**

UNIT 3A: APHYRIC BASALT

Pieces: 1-24

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	2.2	1.5	1.8	Subhedral

GROUNDMASS: Fine grained. Contains plagioclase laths, altered glass, clinopyroxene, and opaques.

VESICLES: Highly vesicular from Piece 1 to Piece 22; vesicles in this portion are irregular to rounded, 0.1 to 2.8 cm in size. From Piece 23 downward, moderately vesicular. Pale to dark green clay, amorphous silica, and zeolite fill vesicles. Geopetal structures of green clay and amorphous silica are present from Piece 22 to bottom of section.

COLOR: Grayish green.

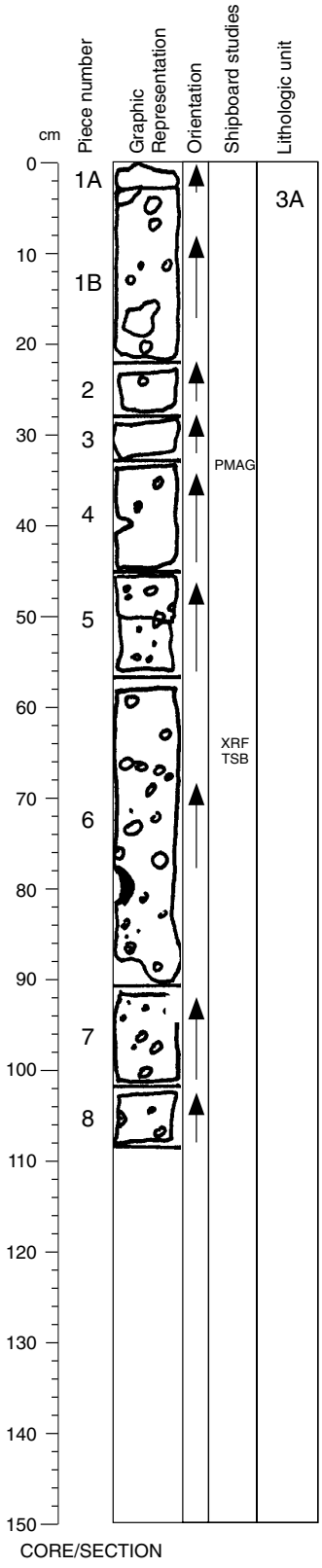
STRUCTURE: Vesicular to massive.

ALTERATION: Moderate.

VEINS/FRACTURES: None.

COMMENTS: This section is less altered and much less vesicular than Sections 27R-1 and 27R-2. Grouped with Subunit 3B on the basis of generally high vesicle content.

Core Photo



183-1137A-27R-4 **Section top: 251.92 (mbsf)**

UNIT 3A: APHYRIC BASALT

Pieces: 1-8

CONTACTS: None recovered; the division between Subunits 3A and 3B is placed between the bottom of Section 27R-4 and top of Section 28R-1.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	<1	2.2	1.5	1.8	Subhedral

GROUNDMASS: Fine grained. Contains tabular to elongate plagioclase laths, altered glass, tabular to elongate (almost acicular) clinopyroxene (some with an iridescent sheen from alteration), and opaques.

VESICLES: Moderately vesicular; large vesicles, averaging 2-5 mm (but ranging from <1 mm to 2.5 x 3 cm at 16 cm depth), generally rounded. Some of the largest are subangular. Generally, the vesicles are filled with pale greenish-gray clay, zeolite, or amorphous silica, which is commonly layered in the bottoms of the larger vesicles.

COLOR: Medium gray with green tinge from alteration.

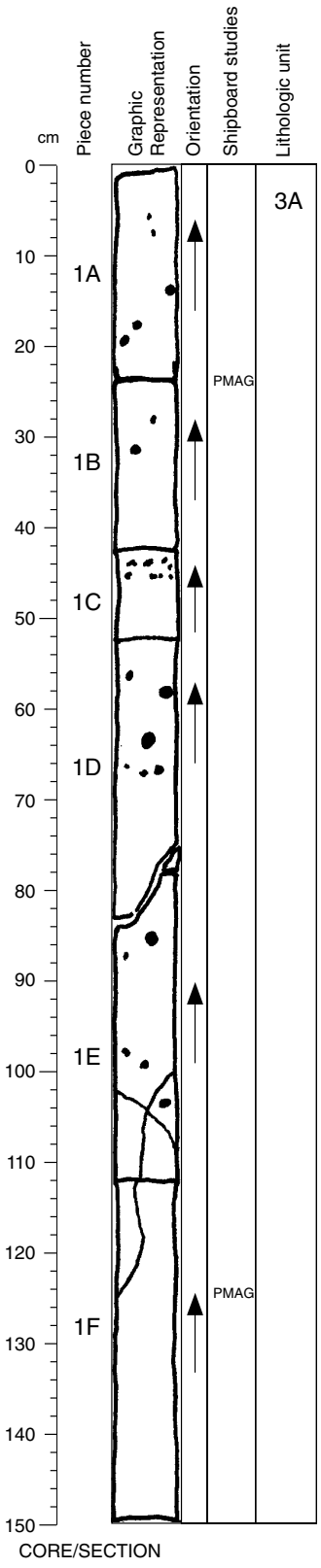
STRUCTURE: Massive, with large vesicles. Two vesicle sheets (four aligned vesicles in Piece 4 at 41 cm depth and one sheet at 61 cm). Evidence of flow alignment is displayed by acicular black crystals (titanomagnetite) aligned near vesicle sheets.

ALTERATION: Slight.

VEINS/FRACTURES: A few clay-zeolite and clay-amorphous silica veins, <1 mm thick, are present.

COMMENTS: Plagioclase and clinopyroxene are occasionally intergrown. This section is grouped with Subunit 3A because of its large vesicles.

Core Photo



183-1137A-28R-1 **Section top: 252.40 (mbsf)**

UNIT 3B: APHYRIC BASALT

Pieces: 1

CONTACTS: None recovered; the division between Subunits 3A and 3B is placed between the bottom of Section 27R-4 and the top of Section 28R-1.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	< 1	2	0.5		Euhedral to subhedral
Clinopyroxene:	< 1	1	0.5		Subhedral

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular; vesicles are round (1-10 mm) and filled with green clay, amorphous silica, and/or zeolites; horizontal, thin vesicle trains are present.

COLOR: Medium gray.

STRUCTURE: Massive.

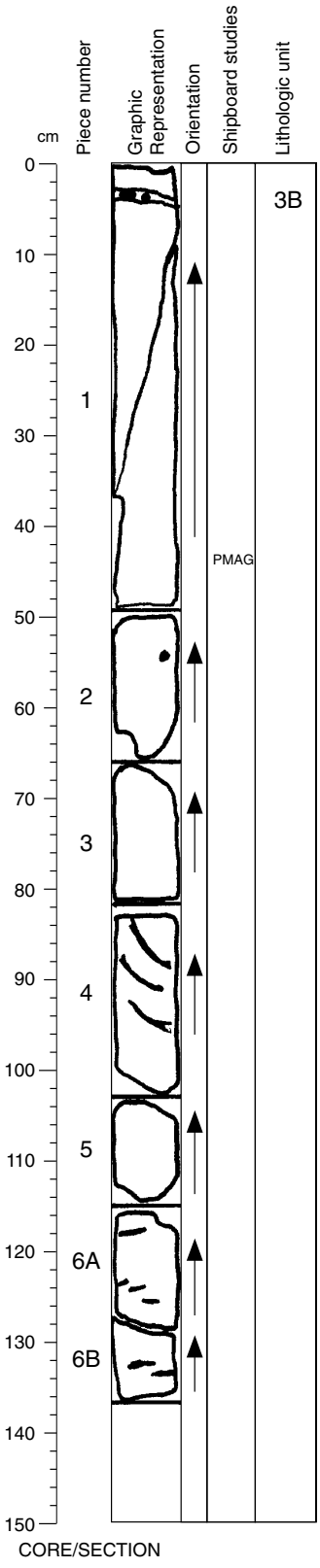
ALTERATION: Slightly altered; dark green clay partially replaces glassy mesostasis and groundmass clinopyroxene.

VEINS/FRACTURES: Horizontal fractures are clay-filled; sinuous thin veins (0.5 mm) are silica- or zeolite-filled.

COMMENTS: Subunit 3B is interpreted to be the massive interior of the lava flow on the basis of decreased vesicularity relative to Sections 27R-1 through 27R-4.

Horizontal, wispy, 1-cm-scale, originally glassy mesostasis (altered to dark green clay) forms horizontally banded structure.

Core Photo



183-1137A-28R-2 **Section top: 253.90 (mbsf)**

UNIT 3B: APHYRIC BASALT

Pieces: 1-6

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	< 1	2	0.5		Subhedral
Clinopyroxene:	< 1	1	0.5		Subhedral

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular. Vesicles are rounded (1-3 mm) and isolated or grouped into horizontal sheets (~5 mm wide); filled with dark green clay and zeolite.

COLOR: Medium gray.

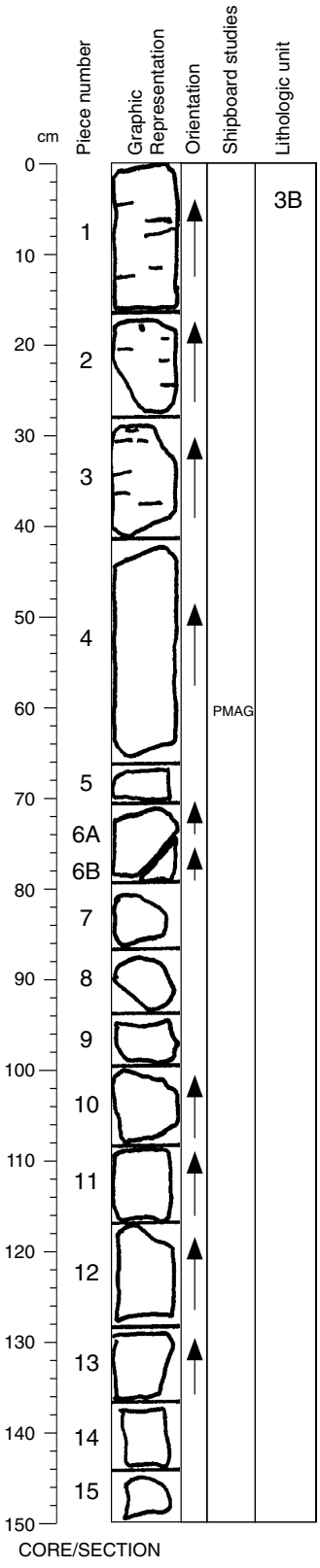
STRUCTURE: Massive, with horizontal to inclined (dip ≤45°), 1-cm-wide segregations of flow-banded wispy mesostasis.

ALTERATION: Slightly altered; mesostasis is altered to green clay.

VEINS/FRACTURES: Horizontal cooling fractures; sinuous veins dipping ~70°, clay- and zeolite-filled.

COMMENTS: In Piece 4A, clinopyroxene-opaque concentrations occur in cm-scale segregations, dipping ~45°.

Core Photo



183-1137A-28R-3 **Section top: 255.39 (mbsf)**

UNIT 3B: APHYRIC BASALT

Pieces: 1-15

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	trace	1.5	0.8		Subhedral to euhedral
Clinopyroxene:	trace	0.6	0.54		Euhedral

GROUNDMASS: Fine grained, with a uniform grain size. Plagioclase and clinopyroxene are 0.2-0.4 mm. Opaques, mesostasis, and glass are also visible.

VESICLES: Sparsely vesicular; vesicles are rounded, up to 4 mm in size, and filled with green clay and zeolite.

COLOR: Medium light gray. Glass segregations are altered to dark greenish gray.

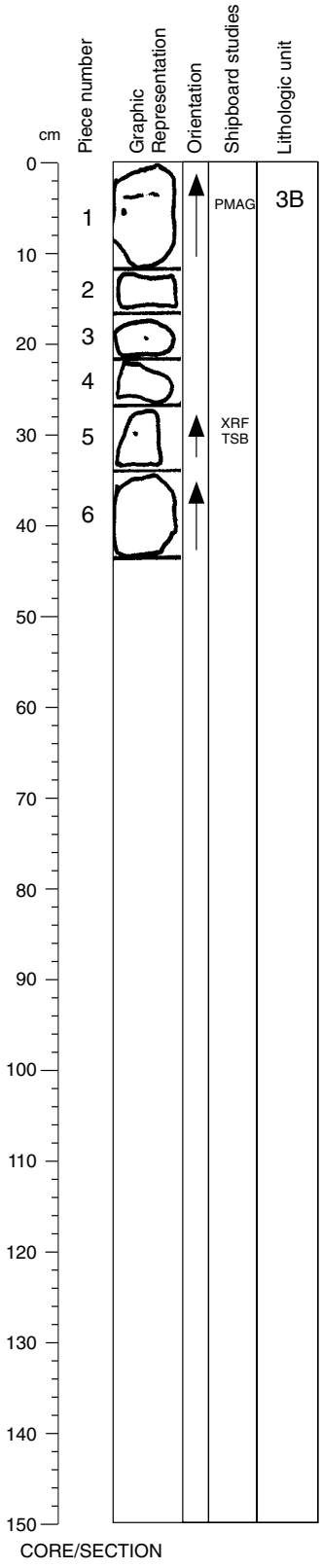
STRUCTURE: Discontinuous mesostasis segregations (altered, dark greenish gray) are seen in Pieces 1- 4; they are up to 3 cm long and 2-4 mm wide, and approximately horizontal.

ALTERATION: Slight to moderate. Mesostasis segregations are altered to dark green clay. Under the binocular microscope, plagioclase is remarkably fresh-looking, although clinopyroxene is moderately altered.

VEINS/FRACTURES: Numerous clay and zeolite-filled veins and fractures.

COMMENTS: Two glomerocrysts are present in Piece 13 (more of the large one is preserved in the working half of the core); size is 2 x 3 mm and 5 x 10 mm. Both have plagioclase and clinopyroxene (ratio ~ 70:30). One 3 x 6 mm glomerocryst of similar mineralogy is present in Piece 3.

Core Photo



183-1137A-28R-4 **Section top: 256.89 (mbsf)**

UNIT 3B: SPARSELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-6

CONTACTS: None.

PHENOCRYSTS:

	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	1	2	1		Euhedral to subhedral
Clinopyroxene:	< 1	1	0.5		Euhedral to subhedral

GROUNDMASS: Fine grained

VESICLES: Sparse, round (1-2 mm), with clay and zeolite fillings.

COLOR: Medium gray.

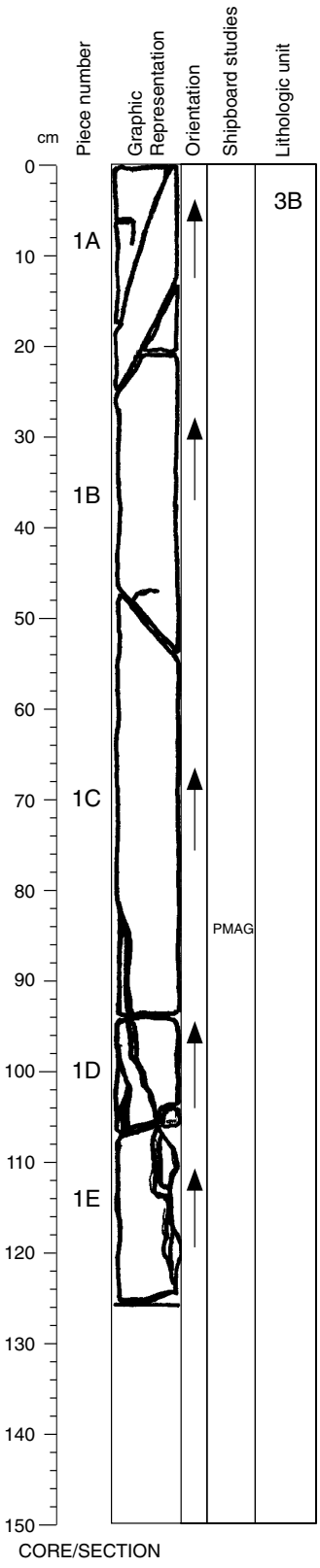
STRUCTURE: Massive.

ALTERATION: Slightly altered. Patchy replacement of clinopyroxene and glass with clay.

VEINS/FRACTURES: One 0.5 mm zeolite-filled vein is observed.

COMMENTS:

Core Photo



183-1137A-29R-1 **Section top: 257.20 (mbsf)**

UNIT 3B: APHYRIC BASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	4	2	2.2	Euhedral to subhedral
Clinopyroxene:	<1	0.6	0.3	0.4	Euhedral

GROUNDMASS: Fine grained. Plagioclase looks very fresh.

VESICLES: Sparse, round (1-2 mm diameter); filled with green clay and zeolite.

COLOR: Medium light gray.

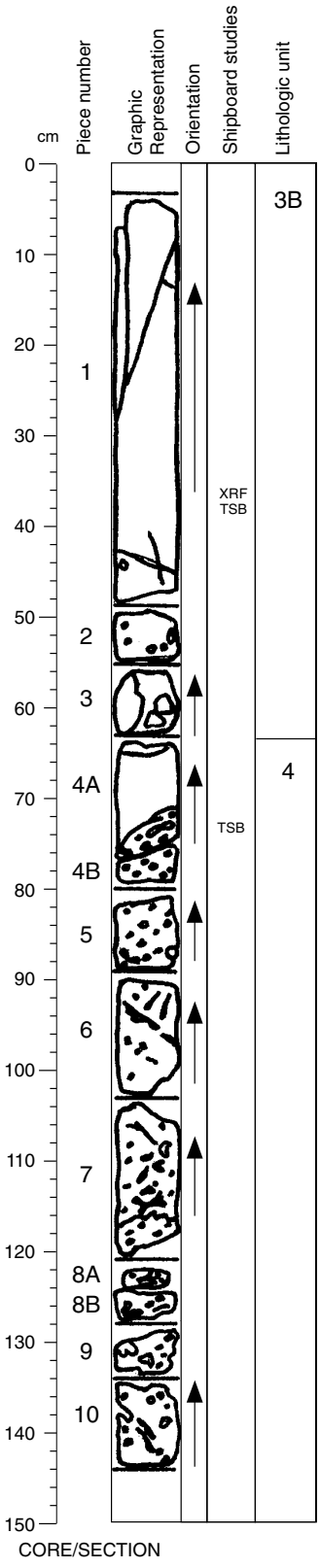
STRUCTURE: Massive.

ALTERATION: Slight. Green alteration halo noted around veins from 80-125 cm.

VEINS/FRACTURES: Zeolite- and green-clay-filled veins are common. A 5-mm-wide vein from 80-107 cm is filled with amorphous silica, zeolite, and clay.

COMMENTS: Clinopyroxene is only barely large enough to be called phenocrysts. Two glomerocrysts are seen (8 x 8 mm in Piece 1C; 3 x 5 mm in Piece 1B), consisting of plagioclase and clinopyroxene (ratio ~ 80:20).

Core Photo



183-1137A-29R-2 **Section top: 258.46 (mbsf)**

UNIT 3B: APHYRIC BASALT

Pieces: 1, 2 (For descripton of Piece 3 and top of Piece 4A, see Comments below.)

CONTACTS: The base of Unit 3 is interpreted to be at 64 cm in the section, within Piece 4A.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	4	2	2.2	Euhedral to subhedral
Clinopyroxene:	<1	0.6	0.3	0.4	Euhedral

GROUNDMASS: Fine grained.

VESICLES: Moderately vesicular, increasing markedly toward bottom of Piece 1. Piece 2 is highly vesicular, with round to ovoid vesicles reaching 1 cm in diameter. Vesicle fill is green clay and zeolite.

COLOR: Dark greenish gray.

STRUCTURE: Massive until Piece 2, where vesicles elongated subparallel to the base of the flow (particularly at the bottom of the piece) produce a banded structure.

ALTERATION: Moderate. Groundmass plagioclase is fresh, clinopyroxene moderately altered, and mesostasis altered. Cinopyroxene phenocrysts are moderately to highly altered.

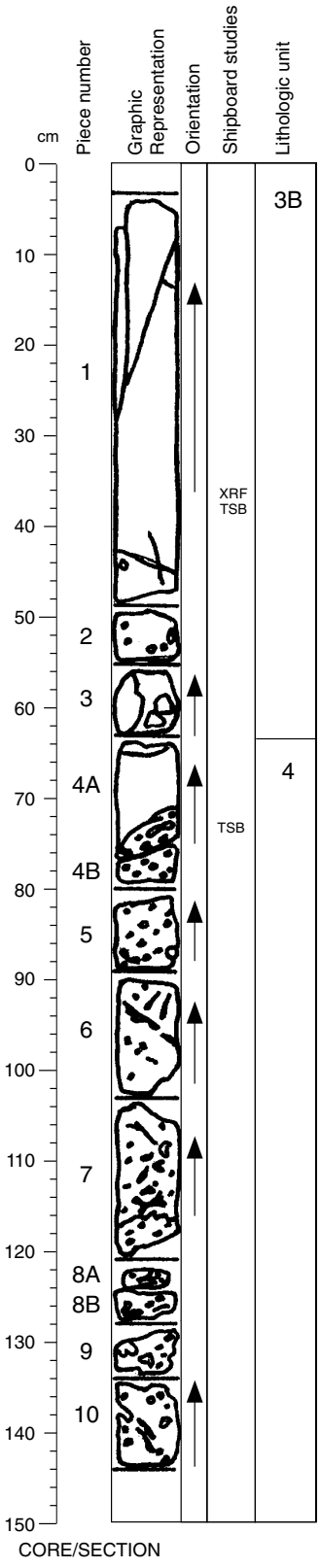
VEINS/FRACTURES: Three bifurcating, 1-3 mm wide, zeolite- and clay-filled veins in the top and middle of Piece 1; several 1-2 mm wide veins in the bottom 10 cm of Piece 1, running both parallel and transverse to the core.

COMMENTS: Several small glomerocrysts (2-3 mm) composed of plagioclase (with or without clinopyroxene; the clinopyroxene appears fresh) are present. Around vesicles, the grain size decreases to <0.1 mm; near the inferred flow contact in Piece 4A, the amount of mesostasis increases.

Piece 3 consists of a black, completely altered plagioclase-phyric basalt clast (covering most of the left side of the piece), which is draped with greenish gray silty sandstone. The sandstone exhibits four to five graded beds. Grain size ranges from coarse sand to clay. Sorting is poor, with coarser grains at the base of each graded bed. Also, within the sandstone is a 1.5 x 3 cm green clay pebble containing a band of red material. The sandstone is unbaked and interpreted to have been deposited in a reducing environment in a cavity at the base of Unit 3 (i.e., after Unit 3 was emplaced). The basaltic clast is interpreted to belong to Unit 3 and may be part of a flow-bottom breccia.

The top of Piece 4A contains the bottom part of the same basaltic clast, which is interpreted to mark the base of Unit 3.

Core Photo



183-1137A-29R-2 **Section top: 258.46 (mbsf)**

UNIT 4: VOLCANIC SILTSTONE

Piece: 4 (For description of top of Piece 4A, see previous sheet; for description of basaltic pahoehoe flow, see next sheet.)

CONTACTS: The top of Unit 4A is interpreted to be at 64 cm in the section, within Piece 4A. The topmost 8 cm is volcanic siltstone, which overlies the basaltic breccia of Unit 4A.

MATRIX: Indurated (silicified or baked) silt.

COLOR: Alternating red and pale gray laminations.

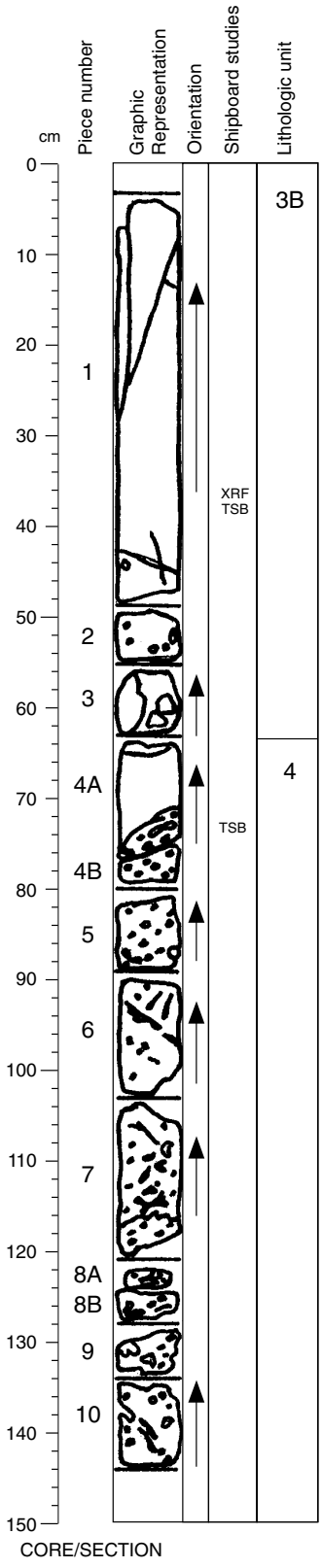
STRUCTURE: Laminated and brecciated.

ALTERATION: Possibly silicified; veining is associated with fracturing during brecciation.

VEINS/FRACTURES: Fine veinlets crosscut indurated, laminated silt, forming a breccia.

COMMENTS: The brecciated silt overlies a chilled basaltic breccia lobe, interpreted as the top of the lava flow of Subunit 4A. The reddish color of the silt and the underlying basaltic breccia (see next sheet) indicates subaerial emplacement. The laminated silt was indurated either by baking during emplacement of the overlying flow, or silicification during alteration; it was brecciated by multiple hairline fractures during alteration.

Core Photo



183-1137A-29R-2 **Section top: 258.46 (mbsf)**

UNIT 4: MODERATELY PLAGIOCLASE-CLINOPYROXENE-OLIVINE-PHYRIC BASALTIC BRECCIA

Pieces: 4-10

CONTACTS: Contact between top of basaltic breccia and silt is at ~72 cm, within Piece 4.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	3	1.5	0.2	0.9	Euhedral laths
Olivine:	1	1		0.3	Euhedral to subhedral
Clinopyroxene:	1-2	0.6		0.2	Euhedral to subhedral

GROUNDMASS: Aphanitic.

VESICLES: Highly vesicular. Vesicles are rounded to irregular, ≤20 mm (most are 2 to 5 mm), and filled with calcite, zeolite, and clay. Below 116 cm, the vesicles tend to have a flattened appearance.

COLOR: Weak red to dark brownish gray.

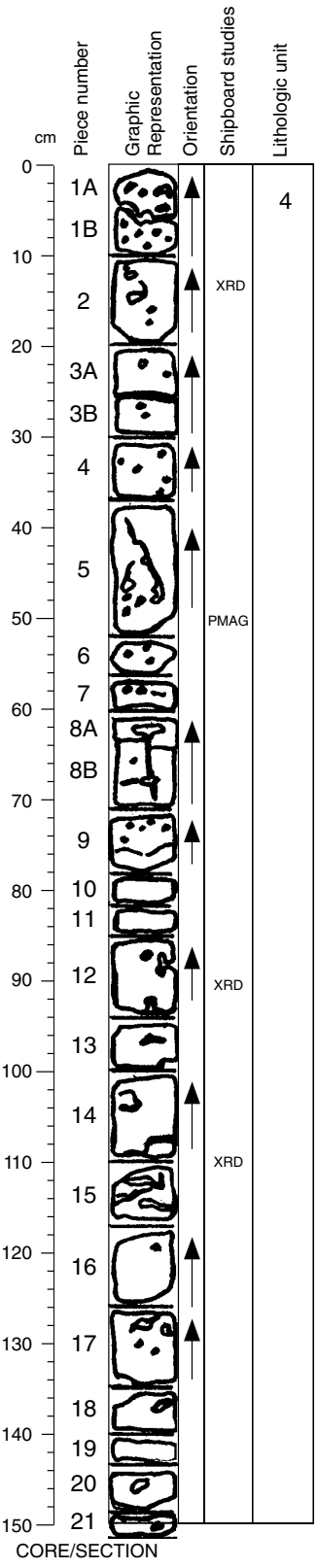
STRUCTURE: Scoriaceous to brecciated.

ALTERATION: High to complete.

VEINS/FRACTURES: None.

COMMENTS: Highly oxidized. The phenocrysts tend to be smaller in Piece 4B near the contact (i.e., the chilled margin) than in Pieces 5-10. Two lobes of the same flow type are evident: the first is from 72 cm to 116 cm, pahoehoe; the second extends downward from 116 cm and has a pahoehoe-like flow-top appearance.

Core Photo



183-1137A-29R-3 **Section top: 259.90 (mbsf)**

UNIT 4: HIGHLY PLAGIOCLASE-CLINOPYROXENE-OLIVINE-PHYRIC BASALT

Pieces: 1-21

CONTACTS: None.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	15	4	0.5	2.5	Subhedral to euhedral; some clusters
Olivine:	2-4	1.5	0.5	1	Discrete crystals and also associated with plagioclase in clusters
Clinopyroxene:	3-5	1.5	0.3	0.8	Euhedral to subhedral; discrete crystals and associated with plagioclase in clusters

GROUNDMASS: Very fine grained. A few 0.1-0.2 mm plagioclase laths and clinopyroxene prisms can be seen.

VESICLES: Highly vesicular. Vesicles are round to ovoid, 1-15 mm in diameter, and show some coalescence. Fill is partial to complete, consisting of green clay, blue-green clay, and white zeolite.

COLOR: Variable. From Piece 1 to bottom third of Piece 8B, dark reddish brown; from the bottom third of Piece 8B to the bottom third of Piece 11, medium-dark gray. The bottom third of Piece 11 is dark reddish brown; Pieces 12 to 15 are very dark red, and Pieces 6 to 21 are medium gray to dark gray.

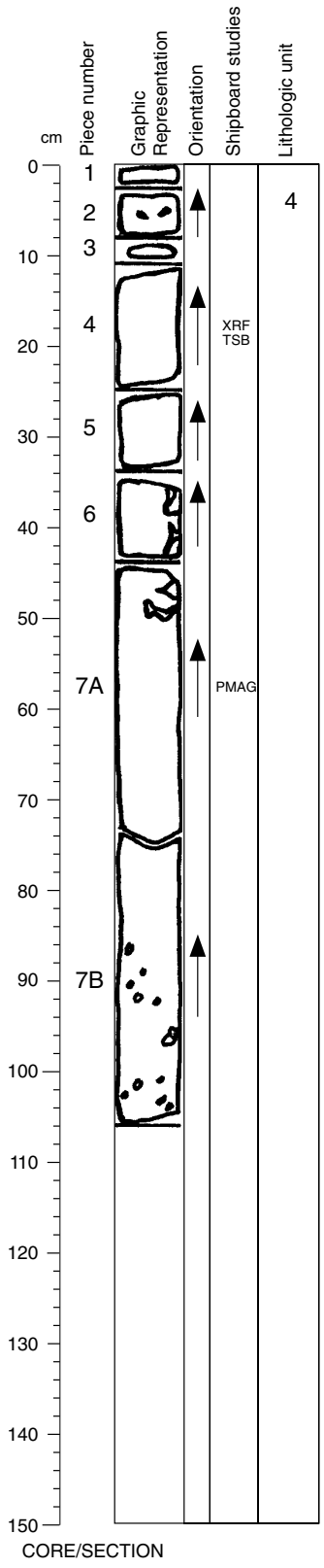
STRUCTURE: Massive.

ALTERATION: Highly altered in red portions; moderate elsewhere. Plagioclase phenocrysts are greenish in zones of oxidation.

VEINS/FRACTURES: Vein abundance is high in Pieces 3-5 and Pieces 12-15 (veins are randomly oriented in the latter pieces). Vein fill is white zeolite and dark green clay. Some veins appear to be coalesced vesicle trains.

COMMENTS:

Core Photo



183-1137A-29R-4 **Section top: 261.40 (mbsf)**

UNIT 4: HIGHLY PLAGIOCLASE-OLIVINE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1-7

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	15	8	0.5	3	Subhedral to euhedral; some clusters
Olivine:	5-8	0.8	0.3	0.5	Subhedral to anhedral; discrete crystals and in plagioclase clusters
Clinopyroxene:	3-5	1.5	0.3	0.8	Subhedral to euhedral; discrete crystals and in plagioclase clusters

GROUNDMASS: Very fine grained to aphanitic.

VESICLES: Highly vesicular (20-30%). Shapes are round to ovoid. Vesicle size in the upper portion is 0.5-5 mm, increasing at the bottom of Piece 7B to a maximum of 10-20 cm. Vesicles are partially to completely filled with light or dark green clay and white zeolite; many vesicles have a rim of light green clay.

COLOR: Very dark greenish gray.

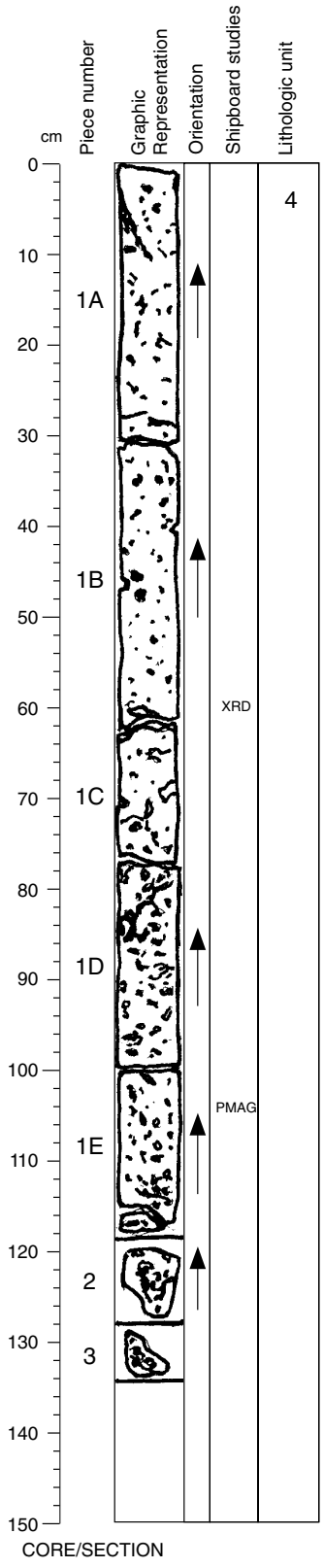
STRUCTURE: Massive.

ALTERATION: Moderate, because of vesicle fill; the groundmass and phenocrysts are slightly altered.

VEINS/FRACTURES: Vein width is 2-10 mm; veins are most abundant in Piece 6 and top of Piece 7A; could be coalesced vesicles. Filled with light to dark green clay and zeolite.

COMMENTS:

Core Photo



183-1137A-30R-1 **Section top: 261.90 (mbsf)**

UNIT 4: HIGHLY PLAGIOCLASE-CLINOPYROXENE-OLIVINE-PHYRIC BASALT

Pieces: 1-3

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	15	8	0.5	2-3	Euhedral laths to anhedral; some clusters with olivine and pyroxene
Olivine:	1-2	1	0.3	0.5	Subhedral to anhedral
Clinopyroxene:	2-3	1	0.3	0.5	Subhedral

GROUNDMASS: Very fine grained.

VESICLES: Moderately to highly vesicular; vesicles are ≤1 cm, and most are completely filled with light blue-green clay and zeolite, and have thin (<1 mm) rims of dark blue-green clay and white zeolite.

COLOR: Purplish gray groundmass with pale brown to white plagioclase phenocrysts and pale to grayish blue-green vesicle and vein filling.

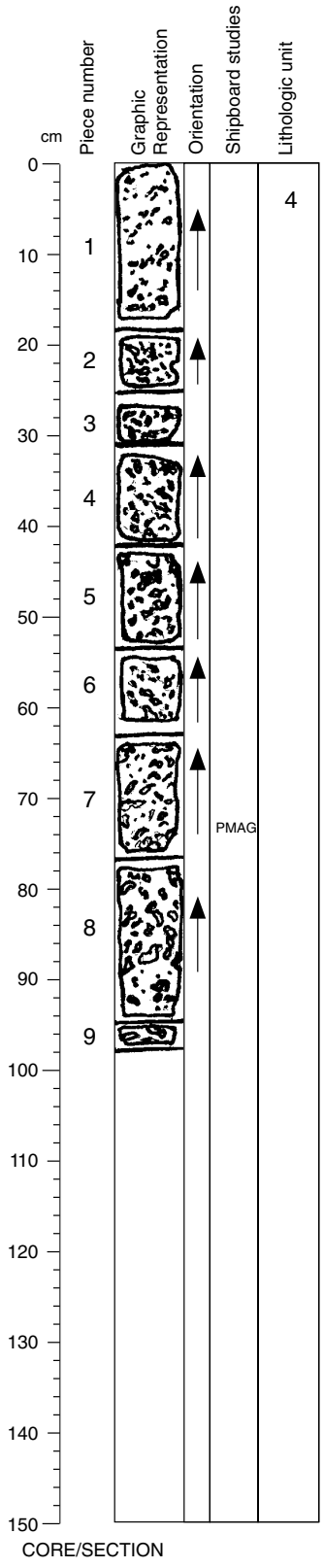
STRUCTURE: Massive.

ALTERATION: Moderate to high; most of the alteration is the vesicle filling; phenocrysts and groundmass are only slightly to moderately altered.

VEINS/FRACTURES: Rare, highly irregular veins are present at 2-10 cm (subvertical) and 62-63 cm (subhorizontal), and are filled with clay and zeolite.

COMMENTS:

Core Photo



183-1137A-30R-2 **Section top: 263.24 (mbsf)**

UNIT 4: HIGHLY PLAGIOCLASE-CLINOPYROXENE-OLIVINE-PHYRIC BASALT

Pieces: 1-9

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	15	8	0.5	2-3	Euhedral laths to anhedral; some clusters with olivine and pyroxene
Olivine:	1-2	1	0.3	0.5	Subhedral to anhedral
Clinopyroxene:	2-3	1	0.3	0.5	Subhedral

GROUNDMASS: Very fine grained.

VESICLES: Moderately to highly vesicular. Abundant large vesicles are ≤2 cm in diameter. Clay and zeolite fill vesicles; geopetal structures are also present.

COLOR: Purplish gray groundmass with pale brown to white plagioclase phenocrysts and pale to grayish blue-green vesicle and vein filling.

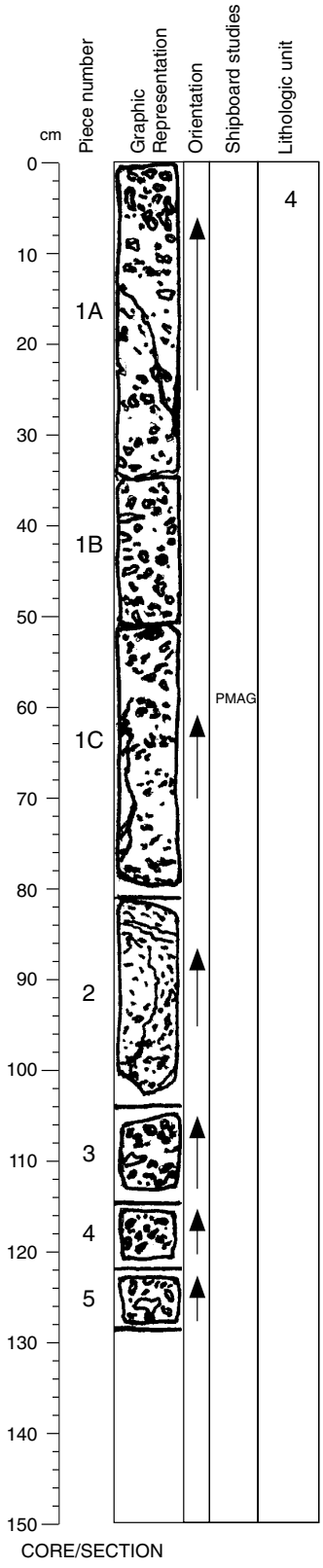
STRUCTURE: Massive.

ALTERATION: Moderate; most of the alteration is the vesicle filling; phenocyrsts and groundmass are only slightly to moderately altered.

VEINS/FRACTURES: Rare, thin (<1 mm) veins filled with clay.

COMMENTS:

Core Photo



183-1137A-30R-3 **Section top: 264.23 (mbsf)**

UNIT 4: HIGHLY PLAGIOCLASE-CLINOPYROXENE-OLIVINE-PHYRIC BASALT

Pieces: 1-5

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	15	8	0.5	2-3	Euhedral laths to anhedral; some clusters with olivine and pyroxene
Olivine:	1-2	1	0.3	0.5	Subhedral to anhedral
Clinopyroxene:	2-3	1	0.3	0.5	Subhedral

GROUNDMASS: Very fine grained.

VESICLES: Sparsely to moderately vesicular with vesicles up to 1 cm in diameter; most are completely filled with light blue-green clay and zeolite, with thin (<1 mm) rims of dark blue-green clay and white zeolite. A subhorizontal vesicle sheet 3-10 mm wide is present at 84-86 cm.

COLOR: Purplish gray groundmass with pale brown to white plagioclase phenocrysts and pale to grayish blue-green vesicle and vein filling.

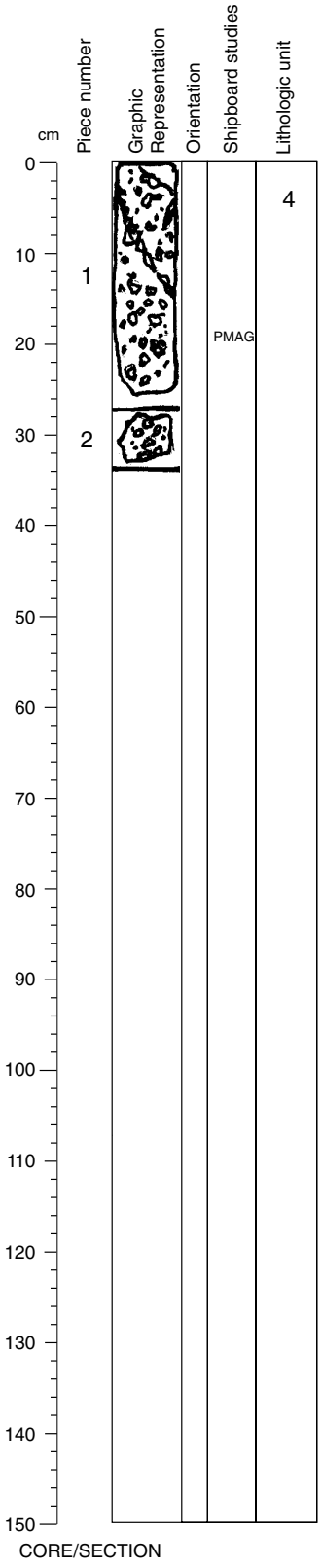
STRUCTURE: Massive.

ALTERATION: Moderate to high: most of the alteration is the vesicle filling; phenocrysts and groundmass are only slightly to moderately altered.

VEINS/FRACTURES: Long, subvertical fractures at 14-28 cm, 60-76 cm, and 87-103 cm; <1 mm to 5 mm wide, filled with material similar to that in vesicles.

COMMENTS:

Core Photo



183-1137A-30R-4 **Section top: 265.51 (mbsf)**

UNIT 4: HIGHLY PLAGIOCLASE-CLINOPYROXENE-OLIVINE-PHYRIC BASALT

Pieces: 1-2

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	15	8	0.5	2-3	Euhedral laths to anhedral; some clusters with olivine and pyroxene
Olivine:	1-2	1	0.3	0.5	Subhedral to anhedral
Clinopyroxene:	2-3	1	0.3	0.5	Subhedral

GROUNDMASS: Very fine grained.

VESICLES: Moderately to highly vesicular, with abundant ≤2-cm vesicles. Vesicles are filled with clay and zeolite. Geopetal structures are present.

COLOR: Purplish gray groundmass with pale brown to white plagioclase phenocrysts and pale to grayish blue-green vesicle and vein filling.

STRUCTURE: Massive.

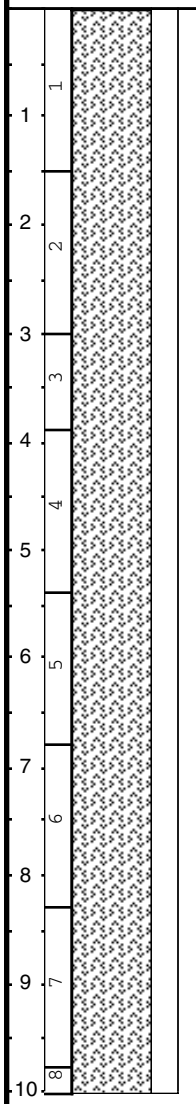
ALTERATION: Moderate to high; most of the alteration is the vesicle filling; phenocrysts and groundmass are only slightly to moderately altered.

VEINS/FRACTURES: Steeply dipping (60-70°) trail of vesicles merging into a 2-mm-wide irregular fracture at 4-14 cm. Minor clay- and zeolite-filled veins are present.

COMMENTS:

Core Photo

Hole 1137A Core 31R **266.6-276.1 mbsf**

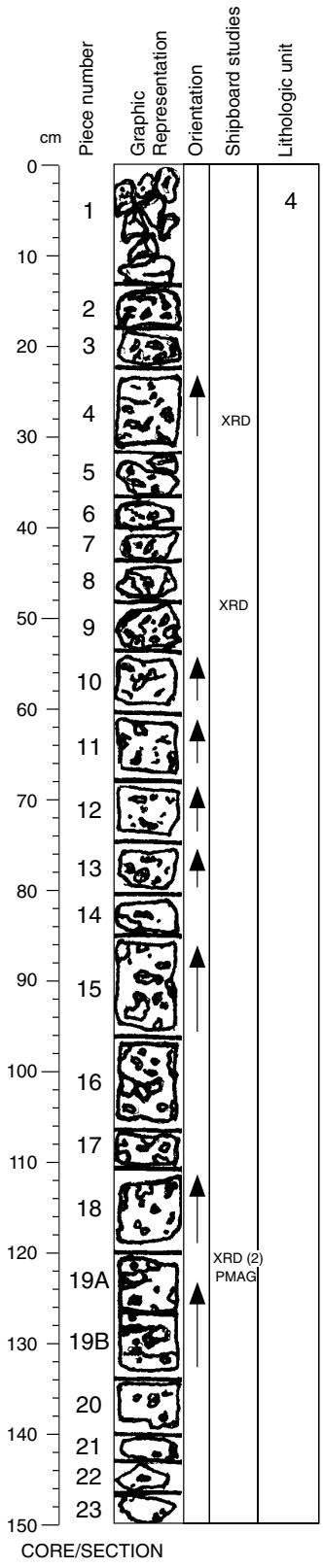


BASALT

Age: Cretaceous

General Description:
This core consists entirely of BASALT (from massive central part of flow in Unit 4).

Core Photo



183-1137A-31R-1 **Section top: 266.60 (mbsf)**

UNIT 4: HIGHLY PLAGIOCLASE-CLINOPYROXENE-OLIVINE-PHYRIC BASALT

Pieces: 1-23

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	15	7	0.5	1	Subhedral stubby tablets to laths; transparent to very pale brown to green
Olivine:	1	1	0.2	0.3	Equant, euhedral; altered
Clinopyroxene:	2	1	0.2		Subhedral

GROUNDMASS: Fine grained to aphanitic.

VESICLES: Moderately vesicular; subspherical to highly irregular “ameboid” shapes, <1 mm to 3 cm. Vesicles are filled with white, green, and orange clays, amorphous silica, and zeolites; multiple generations of zeolites are noted. Some large geopetal structures filled with clay and amorphous silica are present.

COLOR: Brownish gray to pinkish groundmass; white to medium grayish green or orange vesicle fillings. Groundmass pinkish.

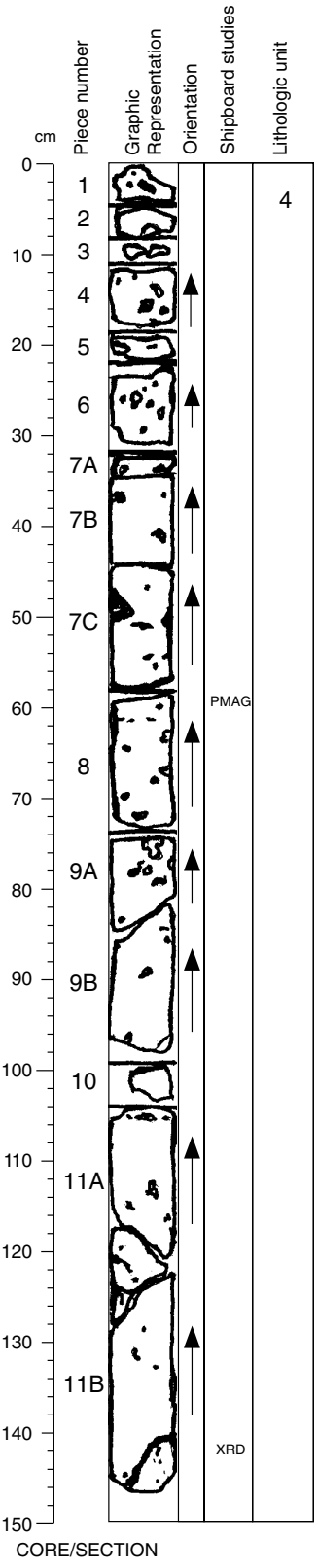
STRUCTURE: Massive.

ALTERATION: Moderate.

VEINS/FRACTURES: None.

COMMENTS: Three generations of plagioclase phenocrysts are present: (1) large (>3 mm) stubby prisms, (2) elongate laths of intermediate size, (3) small (~0.3 mm) nearly equant grains.

Core Photo



183-1137A-31R-2 **Section top: 268.10 (mbsf)**

UNIT 4: MODERATELY PLAGIOCLASE-CLINOPYROXENE-OLIVINE-PHYRIC BASALT

Pieces: 1-11

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	2-6	10	0.4	2	Stubby tablets to elongate laths; mostly fresh, some greenish areas
Olivine:	1-2	1	0.4	0.8	Equant, euhedral; altered
Clinopyroxene:	1-2	2	0.4	0.3	Subhedral prisms

GROUNDMASS: Fine grained to aphanitic; moderately altered.

VESICLES: Sparsely vesicular; vesicles are <1 mm to 7 mm with spherical to "ameboid" shapes; filled with green clay, amorphous silica, and zeolites. The large vesicle at 142-146 cm (covering ~3% of the section) is filled with quartz. A thin vesicle sheet is at 105 cm.

COLOR: Pale greenish gray; green to white vesicle fillings.

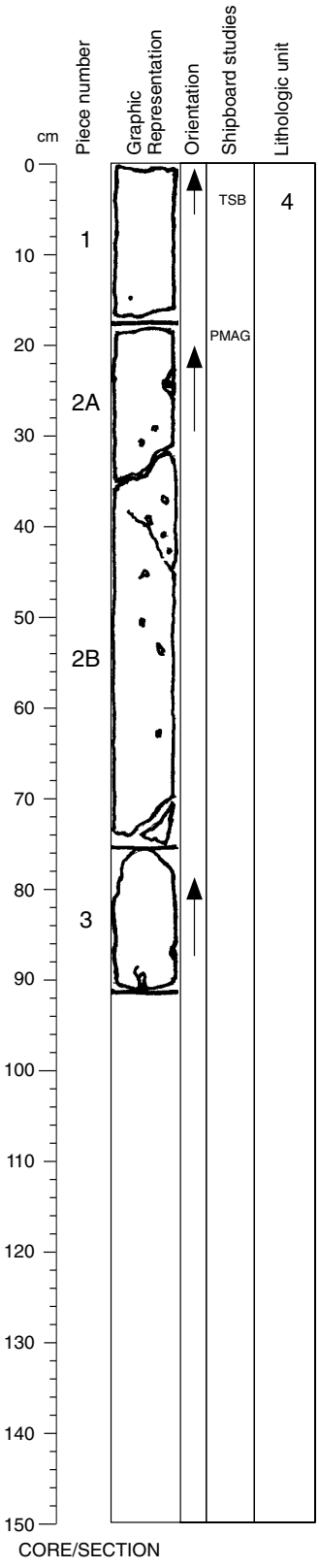
STRUCTURE: Massive.

ALTERATION: Moderate.

VEINS/FRACTURES: Several clay- and zeolite-filled veins are present.

COMMENTS:

Core Photo



183-1137A-31R-3 **Section top: 269.60 (mbsf)**

UNIT 4: MODERATELY TO HIGHLY PLAGIOCLASE-CLINOPYROXENE-OLIVINE-PHYRIC BASALT

Pieces: 1-3

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	2-15	10	0.4	1	Euhedral, stubby to elongate laths; looks fresh
Olivine:	1-2	1	0.2	0.8	Euhedral, equant to tabular; completely altered
Clinopyroxene:	2-3	1	0.2	0.3	Euhedral prisms

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular (<1%); vesicles are small (1-10 mm), subspherical, and filled with clay, zeolite, and amorphous silica.

COLOR: Medium gray.

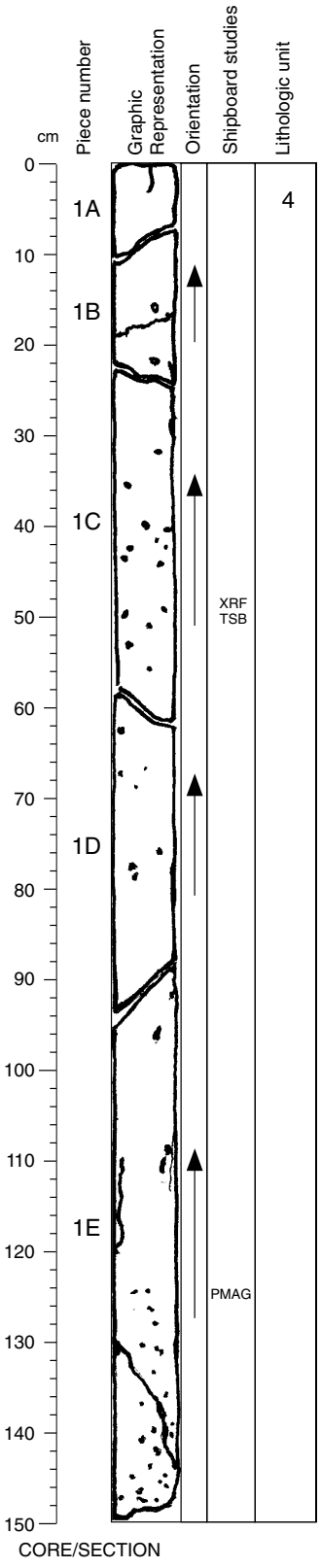
STRUCTURE: Massive.

ALTERATION: Slight.

VEINS/FRACTURES: Very fine (<<1 mm), filled with dark green clay.

COMMENTS:

Core Photo



183-1137A-31R-4 **Section top: 270.50 (mbsf)**

UNIT 4: MODERATELY TO HIGHLY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1-7

CONTACTS: None.

PHENOCRYSTS:

	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	5-15	10	0.4	2	Euhedral laths
Olivine:	0-1	0.7	0.3	0.5	Euhedral, equant
Clinopyroxene:	2	1.5	0.5		Subhedral

GROUNDMASS: Fine grained.

VESICLES: Sparsely to moderately vesicular (0-20%). Vesicles are 1-3 mm, sparse and filled with zeolite, except from 124 to 147 cm, where they are filled with green clay and moderately abundant.

COLOR: Pale, slightly greenish gray.

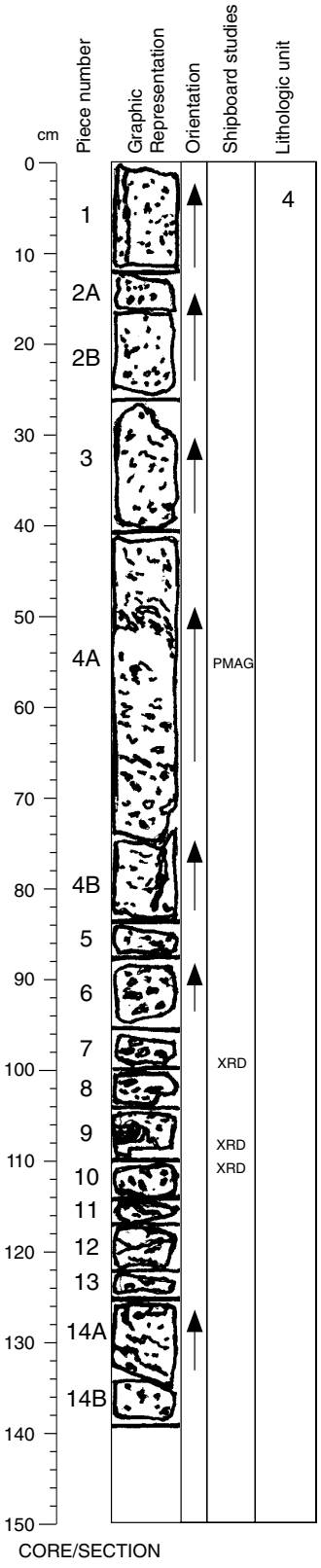
STRUCTURE: Massive.

ALTERATION: Slight. Olivine is completely altered, plagioclase appears unaltered.

VEINS/FRACTURES: Very fine (<<1 mm) fractures filled with green clay. Steeply dipping, 0.5-mm-wide veins are filled with zeolites.

COMMENTS:

Core Photo



183-1137A-31R-5 **Section top: 272.00 (mbsf)**

UNIT 4: HIGHLY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1-14

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	15	10	0.5		Largest grains subhedral with green or brown cores, clear rims ~0.5 mm thick; laths (1-4 mm); equant (~0.5 mm)
Clinopyroxene:	1	2	0.25	0.75	Large, anhedral, possibly aggregates
Olivine:	trace				Euhedral, totally altered

GROUNDMASS: Fine grained at top to aphanitic at bottom.

VESICLES: Moderately vesicular; shape and size vary down section. Pieces 1 and 2A have 1-4 mm round vesicles filled by dark green clay and rimmed by black or pale green clay. Vesicles are less abundant in Pieces 2B-9, and more irregular in shape (e.g., in Piece 4). Abundance of partly filled vesicles increases from Piece 2B through Piece 9; these range from 3-5 mm in Piece 3 to 5-15 mm in Piece 7, to >25 mm in Piece 9. These vesicles display multiple generations of zeolite fillings, and geopetal structures are also present.

COLOR: Dark reddish gray.

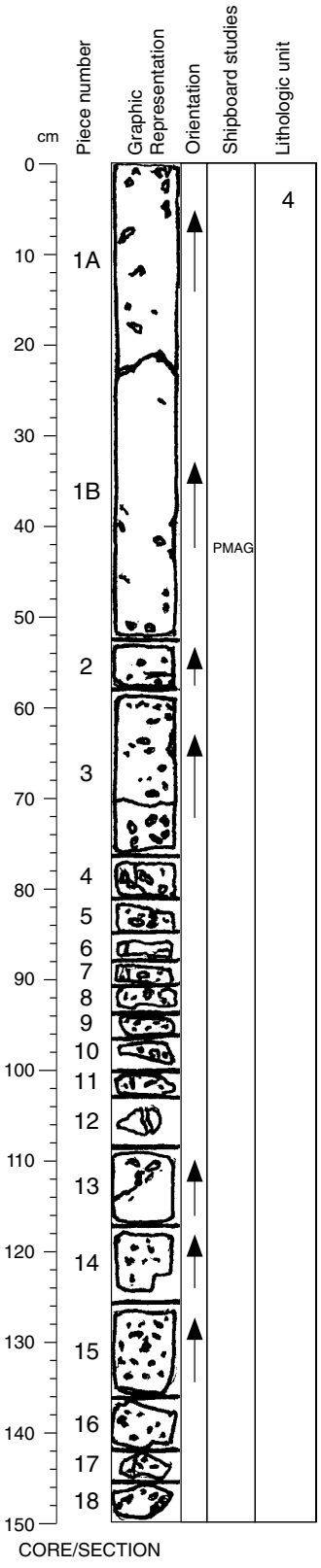
STRUCTURE: Massive.

ALTERATION: Moderate.

VEINS/FRACTURES: Numerous clay- and zeolite-filled veins and fractures ≤5 mm wide.

COMMENTS:

Core Photo



183-1137A-31R-6 **Section top: 273.39 (mbsf)**

UNIT 4: HIGHLY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1-18

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	15	10	0.5		Largest grains subhedral with green or brown cores, clear rims ~0.5 mm thick; laths (1-4 mm); equant (~0.5 mm)
Clinopyroxene:	1	2	0.25	0.75	Large anhedral (possibly aggregates)
Olivine:	trace				Euhedral, totally altered

GROUNDMASS: Top is fine grained; bottom is aphanitic (Pieces 15-18).

VESICLES: Sparsely vesicular, increasing to moderately vesicular down section. Pieces 1-4 have vesicles 2-10 mm across; larger ones are filled with amorphous silica and clay (geopetal structures). Vesicles in Pieces 5-18 have slightly more irregular shapes and larger ones have pale green laminated clay filling, or dark green framboidal clay walls. Small irregular vesicles are present in the groundmass throughout section, filled with green clay, zeolite, and amorphous silica.

COLOR: Gray.

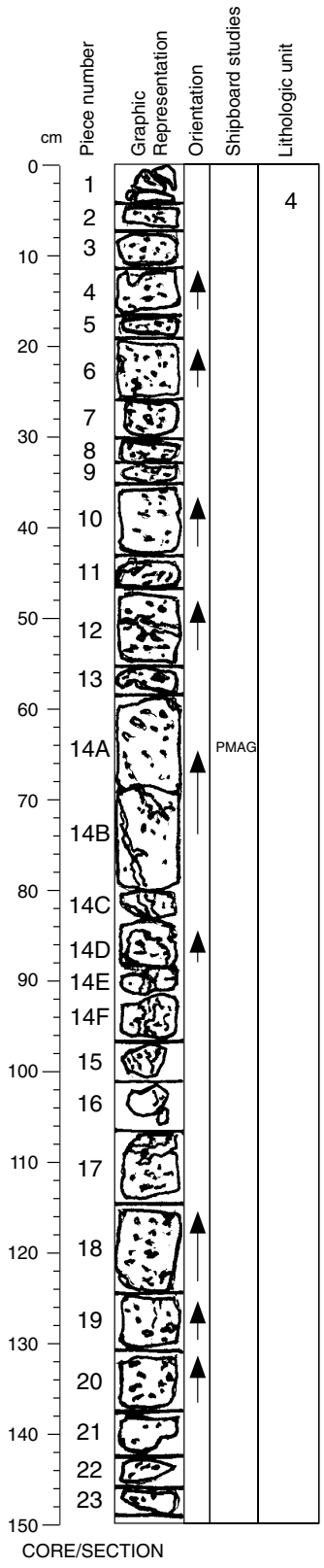
STRUCTURE: Massive.

ALTERATION: Slight to moderate. Red-brown alteration streaks and patches in groundmass.

VEINS/FRACTURES: Numerous thin (<1mm) veins and fractures filled with clay and zeolite.

COMMENTS: Phenocryst phases, morphology and abundance are generally similar to Section 31R-5, except for the following. (1) Large plagioclase phenocrysts are generally more strongly colored (dark green rims and pink cores, uncommonly with a clear outer rim). (2) Olivine is altered to black clay; the deep green alteration phase is either absent or only in small cores of crystals. (3) Piece 1 is less porphyritic (5-10%) and has a maximum plagioclase grain size of only 5 mm.

Core Photo



1831137A-31R-7 **Section top: 274.89 (mbsf)**

UNIT 4: HIGHLY PLAGIOCLASE-CLINOPYROXENE-OLIVINE-PHYRIC BASALT

Pieces: 1-23

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	10-15	5	0.4	2	Stubby to elongate laths
Olivine:	1-2	1	0.4	0.6	Euhedral equant
Clinopyroxene:	1-2	0.5	0.4	0.5	Subhedral

GROUNDMASS: Fine grained.

VESICLES: Moderately vesicular; vesicles are spherical to highly irregular, <1 mm to 2 cm in length. Clay, calcite, and zeolite fill the vesicles.

COLOR: Medium brownish green from 0-70 cm; pinkish with green vesicles below 70 cm.

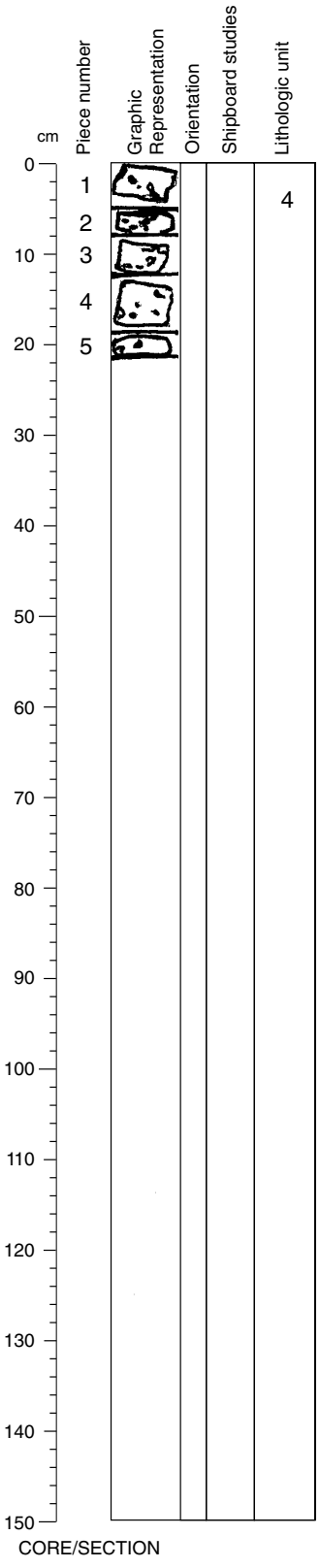
STRUCTURE: Massive.

ALTERATION: Slight to moderate. Oxidation zones are present below 70 cm. More highly altered shear (?) zone noted from 70-100 cm.

VEINS/FRACTURES: Vertical vein (2-15 mm wide) from 70-100 cm is filled with pale green clay.

COMMENTS: Vertical vein separates grayish rock in the upper part from reddish, more altered rock in lower part of section.

Core Photo



183-1137A-31R-8 **Section top: 276.38 (mbsf)**

UNIT 4: HIGHLY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1-5

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	10	4	0.5	2	Subhedral to euhedral laths
Clinopyroxene:	3-4	0.7	0.1	0.3	Euhedral equant
Olivine:	0-1	0.5	0.3		Subhedral

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular; vesicles are 1-10 mm in size, have subspherical to irregular shapes, and are filled with green clay, zeolite, and amorphous silica.

COLOR: Pale pink to greenish gray.

STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: None.

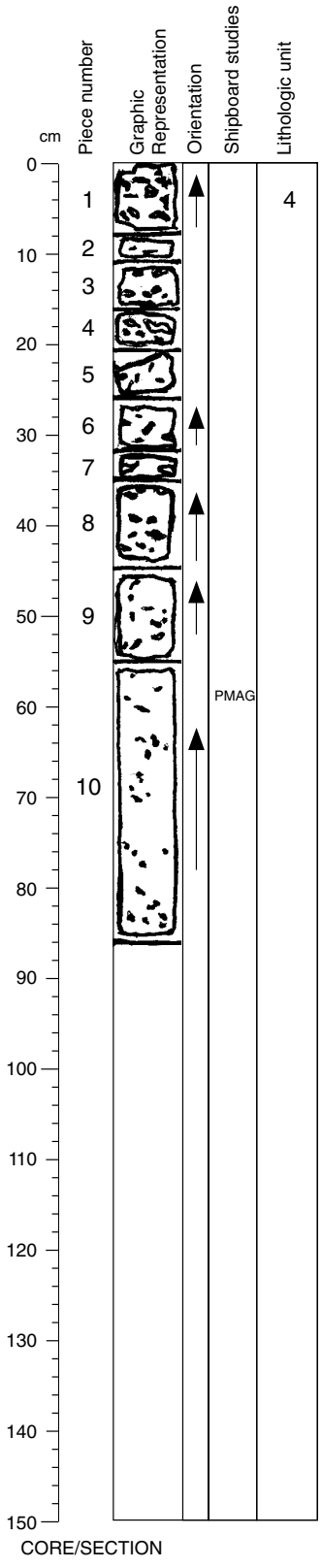
COMMENTS:

Core Photo

Hole 1137A Core 32R **276.1-285.5 mbsf**

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
0-8	1-7							BASALT Age: Cretaceous This core consists entirely of BASALT (massive bottom part of flow in Unit 4).

Core Photo



183-1137A-32R-1 **Section top: 276.10 (mbsf)**

UNIT 4: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1-10

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	8	10	0.5	2.5	Euhedral, large grains are elongate and glomerocrystic
Clinopyroxene:	2	1.2	0.2	0.8	Euhedral, altered
Olivine:	<1	0.2			Subhedral, altered

GROUNDMASS: Fine grained.

VESICLES: Upper part is highly vesicular and has large, elongate (0.5 to 1 cm) vesicles filled with horizontal succession of green and yellow clay, zeolite, and amorphous silica. Middle part is highly vesicular with rounded to irregular vesicles (0.2-3 cm) filled with light and dark green clay and zeolite. Lower part is moderately vesicular, with vesicle shapes and fillings similar to those in the middle part.

COLOR: Medium gray.

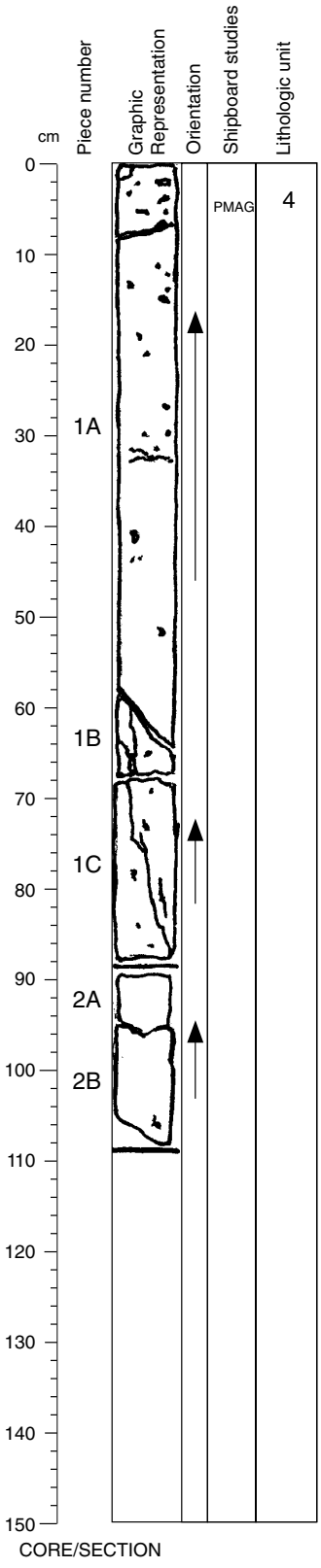
STRUCTURE: Massive.

ALTERATION: Slight; some reddish alteration products in the groundmass; olivine phenocrysts are altered to green clay.

VEINS/FRACTURES: Very rare; veinlet in upper part is filled with same material as vesicles.

COMMENTS:

Core Photo



183-1137A-32R-2 **Section top: 276.97 (mbsf)**

UNIT 4: MODERATELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1, 2

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	5	5	0.5	1.5	Subhedral; blocky (~0.5 mm), laths (1-4 mm long), and equant (~0.5 mm)
Olivine:	<1	2	0.5	<1	Euhedral; some with fresh (?) relicts
Clinopyroxene:	<1	1	0.5	0.5	Subhedral, pinkish brown

GROUNDMASS: Fine grained.

VESICLES: Sparse. Some vein-like trails of interconnected and isolated, irregular vesicles occur in Piece 1. Vesicle fillings include green clay, zeolite, and amorphous silica.

COLOR: Gray.

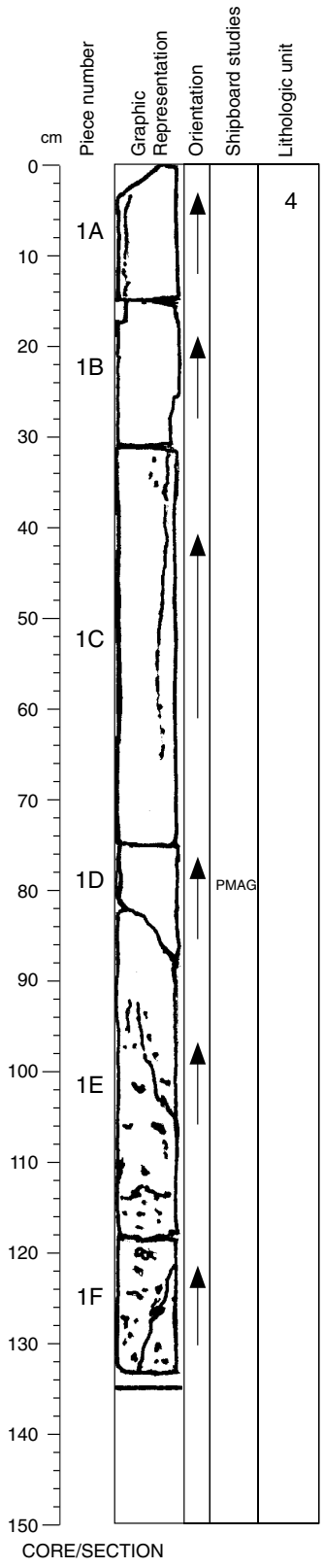
STRUCTURE: Massive.

ALTERATION: Slight.

VEINS/FRACTURES: Numerous thin (<0.5mm) fractures lined with green clay.

COMMENTS:

Core Photo



183-1137A-32R-3 **Section top: 278.06 (mbsf)**

UNIT 4: MODERATELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1, 2

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	5	5	0.5	1.5	Subhedral; blocky (~0.5 mm), laths (1-4 mm long), and equant (~0.5 mm)
Clinopyroxene:	<1	2	0.5	<1	Subhedral; some with fresh (?) relicts
Olivine:	<<1	1	0.5	0.5	Euhedral, replaced by clays

GROUNDMASS: Fine grained.

VESICLES: Very sparse from 0-90 cm; this interval has small vesicles, some flattened, ≤3 mm long. Sparsely to moderately vesicular from 90-135 cm; vesicles are 1-7 mm and have round to irregular shapes. Vesicles typically have a dark green clay rim with inner fill of medium green clay. Amorphous silica and zeolites also are present.

COLOR: Gray.

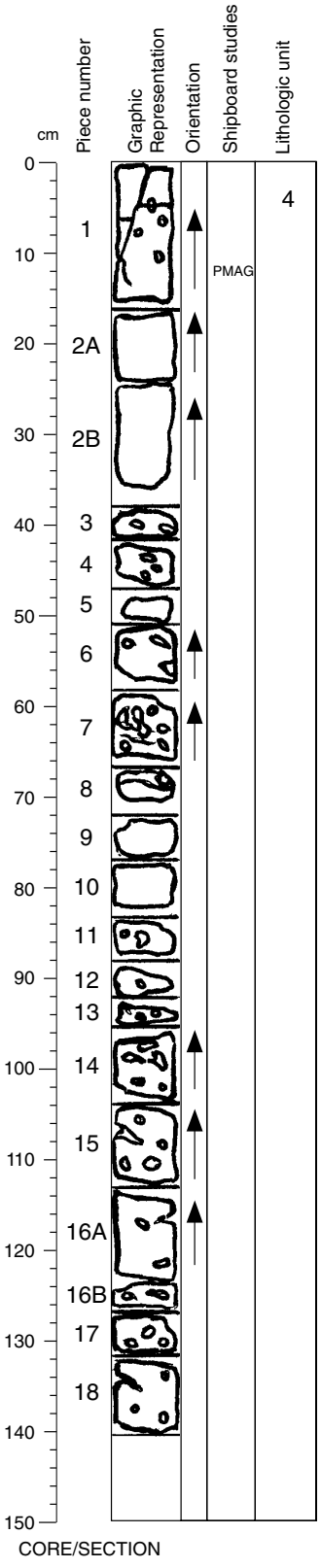
STRUCTURE: Massive.

ALTERATION: Slight, but increases down section, to moderately altered at bottom, where patches of pinkish red alteration are present throughout the groundmass.

VEINS/FRACTURES: Sparse hairline cracks and veins are present throughout section; filled with clay and zeolite.

COMMENTS: Phenocryst abundance increases downward to ~10% in lower part of section. For plagioclase, the increase is caused by an increased abundance of the largest type of phenocryst (blocky); olivine also increases slightly in abundance.

Core Photo



183-1137A-32R-4 **Section top: 279.40 (mbsf)**

UNIT 4: MODERATELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-18

CONTACTS: No flow contacts, but an internal chill zone is at 36 cm (Piece 2B).

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	5	5	0.5	1.5	Subhedral; blocky (~0.5 mm), laths (1-4 mm long), and equant (~0.5 mm)
Clinopyroxene:	<1	2	0.5	<1	Subhedral, some with fresh (?) relicts
Olivine:	<<1	1	0.5	0.5	Euhedral, replaced by clays

GROUNDMASS: Fine grained at top of section, grading to aphanitic at 36 cm, then back to fine grained.

VESICLES: Sparse in Pieces 1-3; round, flattened and slightly irregular shapes, 1-6 mm. Pieces 4-18 are moderately vesicular, with elongate, mostly irregular vesicles, 1 mm to >40 mm; the latter form irregular cavities (e.g., Pieces 8, 14-16). Vesicle fill is variable and includes green clay, zeolite, and amorphous silica.

COLOR: Dark red, with grayish red color increasing down section.

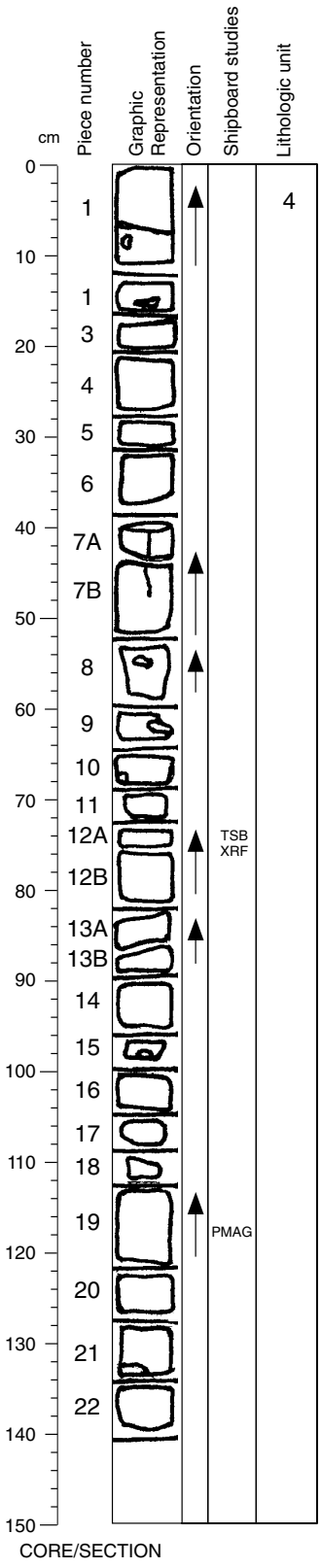
STRUCTURE: Massive.

ALTERATION: Moderate. Red to pink groundmass alteration at base of Section 32R-3 continues into this section and increases down to the internal chill zone at the base of Piece2B. Below this, alteration continues to increase, becoming moderate to high.

VEINS/FRACTURES: Veins and fractures, ≤1 mm wide, are filled with green clay and zeolite.

COMMENTS: Between 0 and 36 cm, phenocryst abundance increases dramatically down section, from ~5% to 15%, mainly because of an increase in glomerocrystic laths of plagioclase. At the top, these are as large as 5 mm but decrease to 2-3 mm at the base of Piece 2B. Groundmass grain size decreases downward, and the base of Piece 2B is interpreted as a possible internal chill zone. Groundmass grain size in Pieces 3-13 increases downward, away from the chill zone. Large plagioclase phenocrysts are less abundant in Pieces 14-18, and phenocryst abundance decreases to ~5% of that in top of section.

Core Photo



183-1137A-32R-5 **Section top: 280.81 (mbsf)**

UNIT 4: MODERATELY TO HIGHLY PLAGIOCLASE-CLINOPYROXENE-OLIVINE-PHYRIC BASALT

Pieces: 1-22

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	5-20	5	0.4	2	Stubby to elongate laths
Cinopyroxene:	1	0.8	0.3	0.5	Subhedral
Olivine:	1	0.8	0.3	0.5	Euhedral, equant

GROUNDMASS: Fine grained.

VESICLES: Sparsely to moderately vesicular (2-10%), subspherical to irregular; vesicles are filled with amorphous silica, calcite, and clay. Large (>4 cm) subhorizontal vesicles or vesicle sheets are at 7, 40, 83, and 133 cm.

COLOR: Medium gray with green and white vesicle fillings.

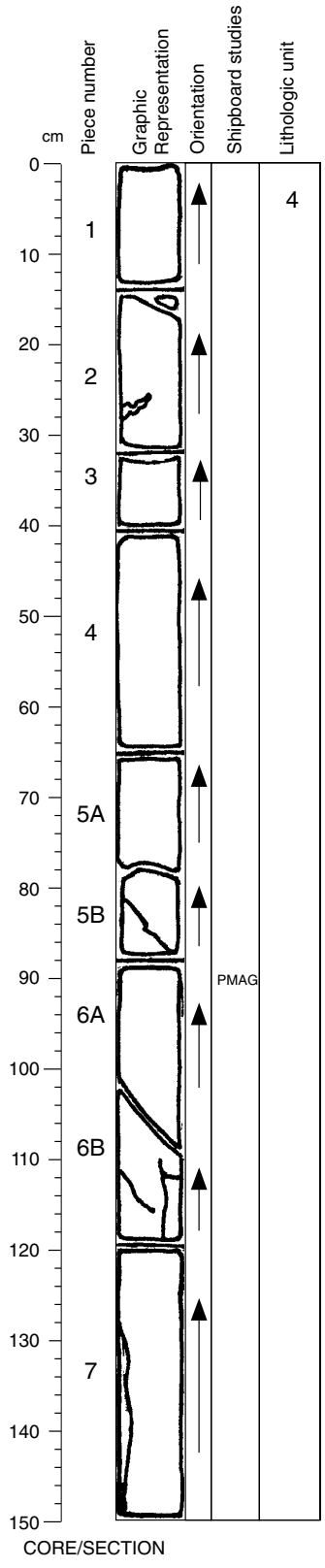
STRUCTURE: Massive.

ALTERATION: Moderate; most igneous minerals are well preserved.

VEINS/FRACTURES: Veins up to 2 mm wide are present, and are filled with green clay, zeolite, and calcite.

COMMENTS: Abundant black patches (~0.5 mm wide) in groundmass are probably altered glass. The interval between 54 and 62 cm has more abundant plagioclase phenocrysts in a darker colored, finer groundmass than elsewhere. Contacts are not preserved, but Piece 7B and the top of Piece 12B are vesicle sheets.

Core Photo



183-1137A-32R-6 **Section top: 282.22 (mbsf)**

UNIT 4: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1-7

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	5-8	8	0.4	1	Stubby to elongate laths
Clinopyroxene:	4	1.5	0.3	0.6	Subhedral
Olivine:	0-1	0.5	0.2	0.3	Euhedral, equant

GROUNDMASS: Fine grained.

VESICLES: Sparse, irregular, 2 mm to 2 cm; filled with green clay, quartz, amorphous silica, and zeolite.

COLOR: Medium gray.

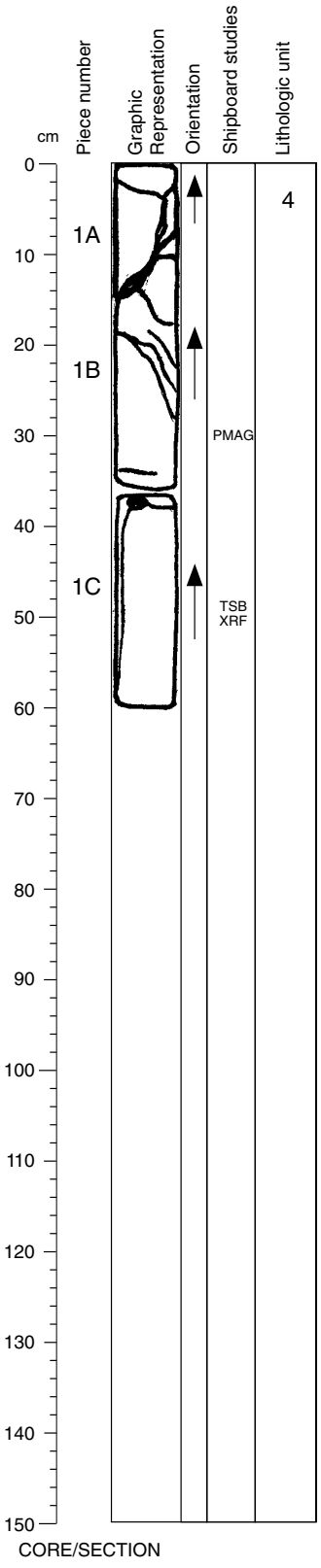
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Several veins up to 1 mm wide are present, filled with clay and zeolite.

COMMENTS:

Core Photo



183-1137A-32R-7 **Section top: 283.72 (mbsf)**

UNIT 4: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:

	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	4	8	0.4	1	Subhedral laths
Clinopyroxene:	2	2	0.4	0.6	Euhedral prisms
Olivine:	trace				Euhedral, altered

GROUNDMASS: Fine grained, but coarser than in previous sections.

VESICLES: Very sparse; filled with green clay.

COLOR: Medium gray.

STRUCTURE: Massive.

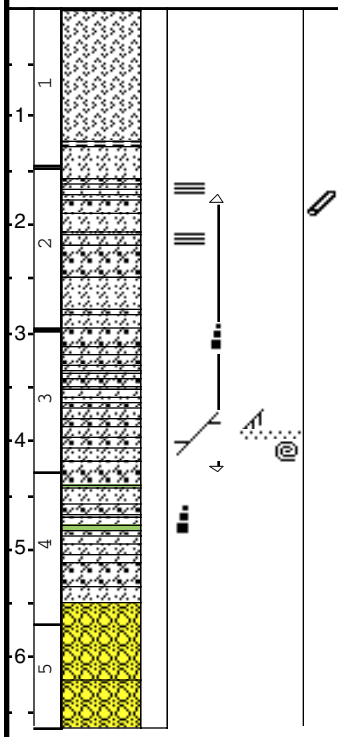
ALTERATION: Moderate.

VEINS/FRACTURES: Horizontal to steeply dipping veins, <1 to 3 mm wide; filled with zeolite and green clay.

COMMENTS:

Core Photo

Hole 1137A Core 33R **285.5-294.7 mbsf**

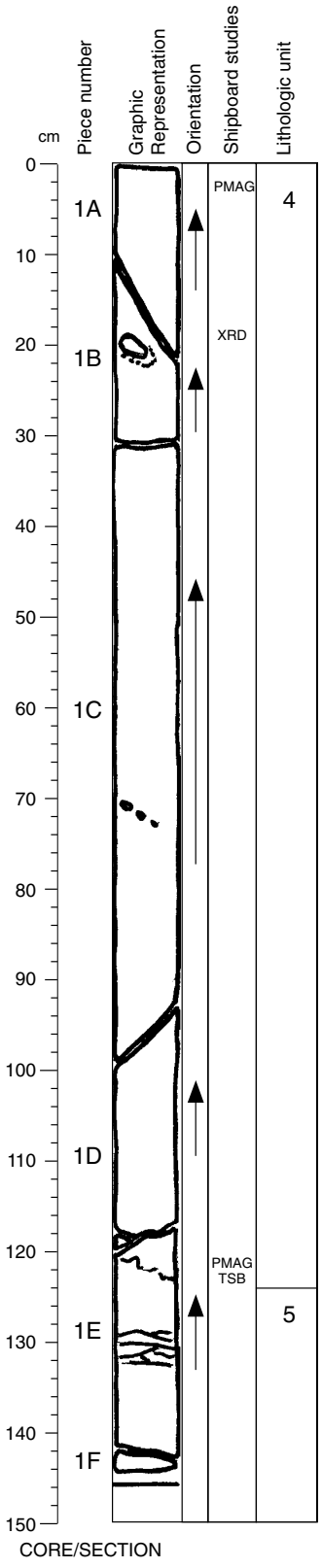


VOLCANIC SILTSTONE AND SANDSTONE, VOLCANIC CONGLOMERATE and BASALT

Age: Cretaceous

General Description:
Most of this core is green VOLCANIC SILTSTONE AND SANDSTONE. The siltstone in Section 1, 123-129 cm is black and dense and appears to have been metamorphosed by the overlying lava flow. The siltstone and sandstone beds are thin to medium bedded, and most of the sandstone beds are normally graded with sharp basal contacts. Sedimentary structures include rare parallel laminations, cross-stratification, rare burrows, and rare disturbed layers. The VOLCANIC CONGLOMERATE in Section 4, 120 cm to base of the core, consists of well-rounded, clast-supported cobbles and boulders The matrix is moderately well-sorted medium to coarse sandsone with calcareous cement. The top of this core contains the base o a BASALT lava flow.

Core Photo



183-1137A-33R-1 **Section top: 285.50 (mbsf)**

UNIT 4: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHRYIC BASALT

Pieces: 1

CONTACTS: Base of Unit 4 is at 122-124 cm, within Piece 1E.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	3-5	8	1	1.5	Subhedral to euhedral laths; relatively fresh
Clinopyroxene:	1-2	2.5	0.5	1.5	Subhedral, some alteration

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular from 0-65 cm; moderately vesicular from 65-123 cm; vesicles become irregular in shape and subparallel to base of flow going down section. Generally <0.5 cm across; toward the bottom, the size increases to as much as 1 cm. A large vesicle (3 x 4 cm) is at 20 cm, partly filled with dark material and partly with green clay, amorphous silica, and zeolite.

COLOR: Medium gray.

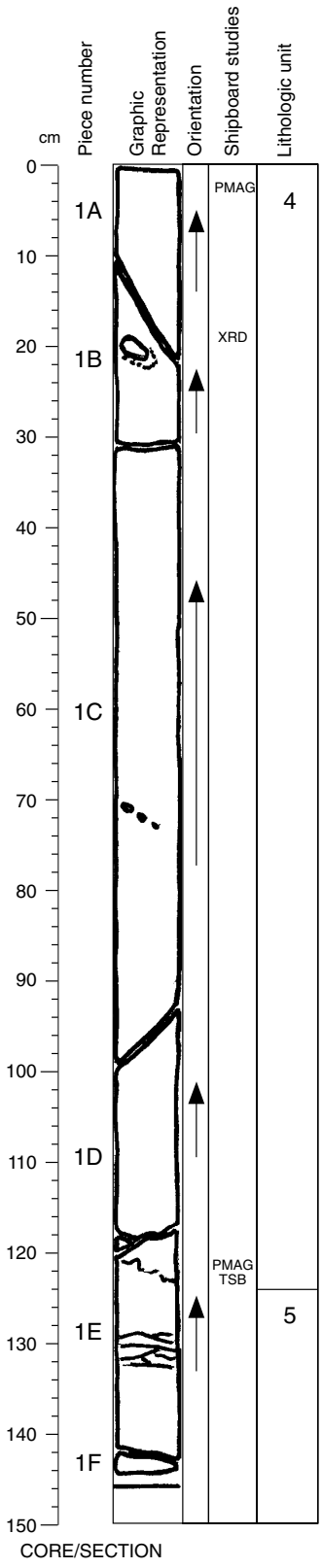
STRUCTURE: Massive.

ALTERATION: Slight; increases to moderate near chill zone (starting at about 113 cm).

VEINS/FRACTURES: A few veins are present, filled with clay and calcite.

COMMENTS: The chill zone at the base of this unit is 0.7-2.5 cm thick, and the contact is perfectly preserved. The underlying unit, from ~122-145 cm, is a massive volcanic siltstone.

Core Photo



183-1137A-33R-1 **Section top: 285.50 (mbsf)**

UNIT 5: VOLCANIC SANDSTONE

Pieces: 1E, 1F

CONTACTS: Contact with Unit 4 is at 122-124 cm.

GENERAL DESCRIPTION: Immediately below the contact, the portion from 122-135 cm appears to be baked by the overlying lava and grades to darker green, then black; several fine white calcite veins, <0.5 to 2 mm thick, also present in this zone. Below 129 cm, the color is pale greenish gray. Plagioclase grain size and abundance increase downward from 92 cm.

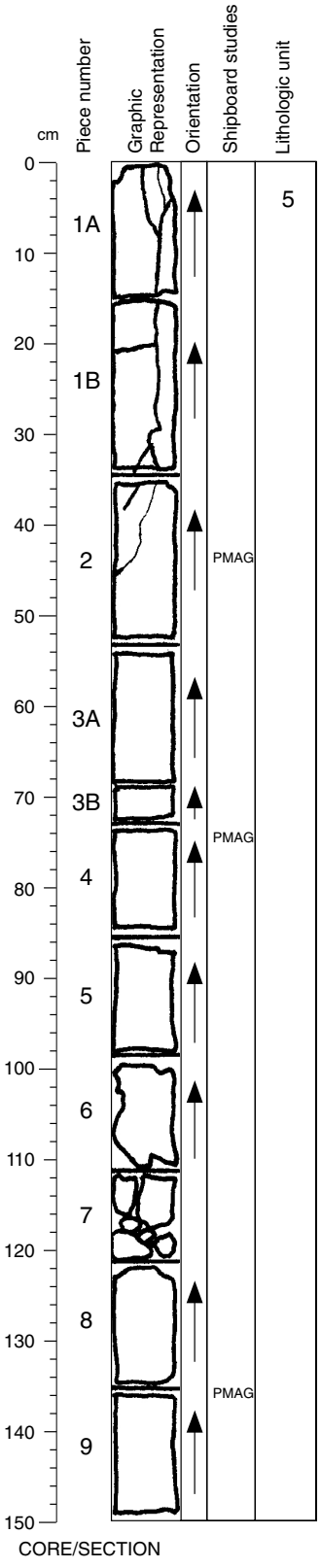
Unit 5 is composed of interbedded volcanic siltstone and sandstone. Beds in this unit range from a few millimeters to tens of centimeters in thickness. Many beds are normally graded. Sandstone intervals commonly have sharp irregular bases and gradational tops, but some have sharp irregular tops. Some siltstones and sandstones have planar lamination and low-angle cross-stratification. Rare burrows are present. Thin, bladed flakes (<5%), possibly organic material, are scattered through the siltstone and sandstone, and in places form more concentrated intervals. Small-scale faulting offsets bedding in some sections.

COLOR: Dark greenish gray siltstone and light gray sandstone.

COMPONENTS:

65-70% lithic fragments, dominated by volcanic detritus.
10-15% feldspar, dominated by sanidine.
5-10% clay minerals; interstices commonly stained by iron oxide (hematite) and oxyhydroxide (goethite).
~5% quartz.
<5% opaques and isotropic minerals, including some garnet grains.
<5% organic matter.

Core Photo



183-1137A-33R-2 **Section top:286.97 (mbsf)**

UNIT 5: VOLCANIC SANDSTONE

Pieces: 1-9

CONTACTS: Internal contacts only.

GENERAL DESCRIPTION: Unit 5 is composed of interbedded volcanic siltstone and sandstone. Beds in this unit range from a few millimeters to tens of centimeters in thickness. Many beds are normally graded. Sandstone intervals commonly have sharp irregular bases and gradational tops, but some have sharp irregular tops. Some siltstones and sandstones have planar lamination and low-angle cross-stratification. Rare burrows are present. Thin, bladed flakes (<5%), possibly organic material, are scattered through the siltstone and sandstone, and in places form more concentrated intervals. Small-scale faulting offsets bedding in some sections.

COLOR: Dark greenish gray siltstone and light gray sandstone.

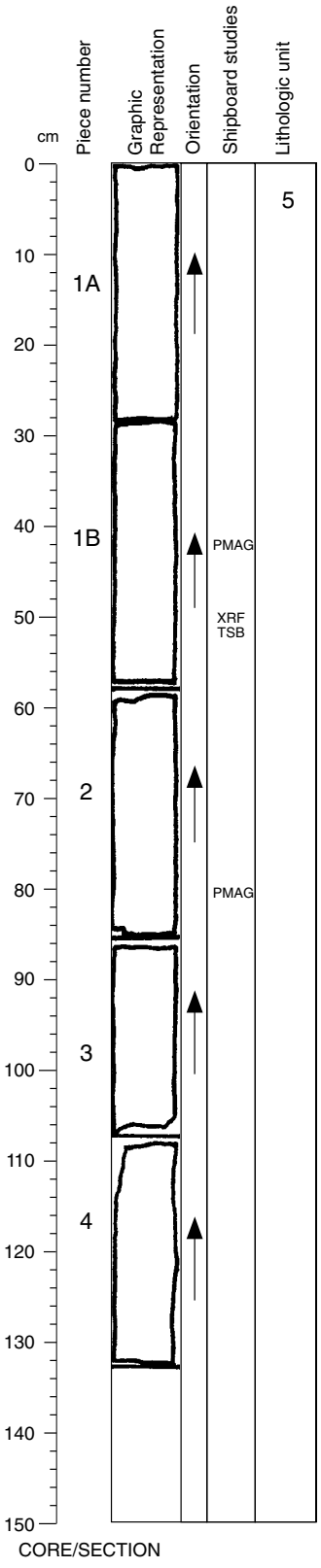
COMPONENTS:

65-70% lithic fragments, dominated by volcanic detritus.
10-15% feldspar, dominated by sanidine.
5-10% clay minerals; interstices commonly stained by iron oxide (hematite) and oxyhydroxide (goethite).
~5% quartz.
<5% opaques and isotropic minerals, including some garnet grains.
<5% organic matter.

SEDIMENTARY FEATURES:

Interval 0-10 cm: coarse silt with wisps of fine black material, possibly organic matter or clay. A disturbed interval at 5-8 cm.
Interval 10-17 cm: fine sand.
Interval 17-21 cm: coarse silt with faint parallel laminations.
Interval 21-24 cm: fine medium sand with undulating top and bottom contacts.
Interval 24-31 cm: coarse silt to silt, appears graded and bioturbated. Lower contact has 2 mm of fine dark clay; the contact is cut by a burrow infilled with overlying sediment.
Interval 31-44 cm: fine to medium sand with a gradational lower contact.
Interval 44-62 cm: sand to silt, normally graded; some convolute bedding at base (58-62 cm).
Interval 62-64 cm: fine sand.
Interval 64-66 cm: several coarse (4 mm) parallel laminations.
Interval 66-76 cm: succession of graded beds a few cm thick. Sharp upper contact of normally graded bed at 66 cm.
Interval 76-96 cm: very fine to fine sand.
Interval 96-101 cm: medium sand interval with a sharp base.
Interval 101-112 cm: very fine to fine sand with 3 mm of dark green fine silt at lower contact.
Interval 112-148 cm: sand to fine sand with two normally graded beds near the base of the section.

Core Photo



183-1137A-33R-3 **Section top: 288.47 (mbsf)**

UNIT 5: VOLCANIC SANDSTONE

Pieces: 1-4

CONTACTS: None.

GENERAL DESCRIPTION: Unit 5 is composed of interbedded volcanic siltstone and sandstone. Beds in this unit range from a few millimeters to tens of centimeters in thickness. Many beds are normally graded. Sandstone intervals commonly have sharp irregular bases and gradational tops, but some have sharp irregular tops. Some siltstones and sandstones have planar lamination and low-angle cross-stratification. Rare burrows are present. Thin, bladed flakes (<5%), possibly organic material, are scattered through the siltstone and sandstone, and in places form more concentrated intervals. Small-scale faulting offsets bedding in some sections.

COLOR: Dark greenish gray siltstone and light gray sandstone.

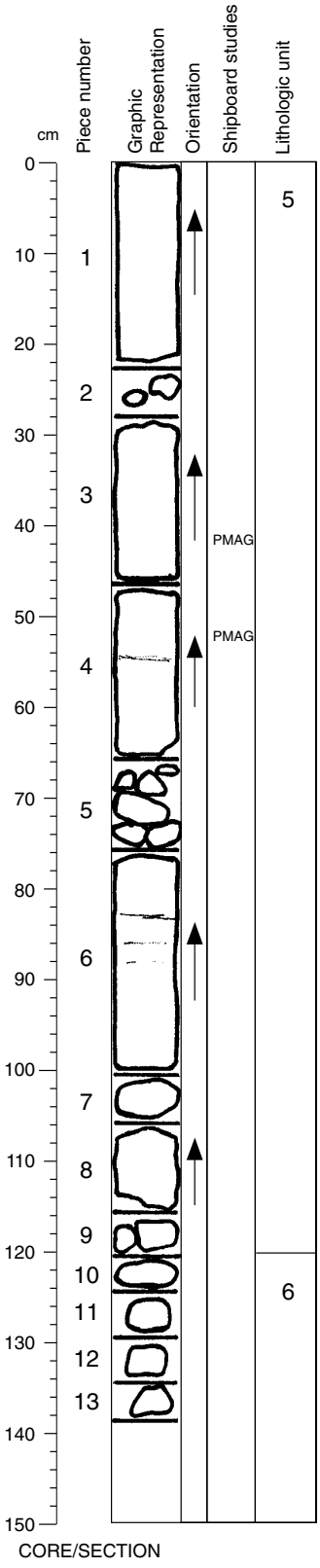
COMPONENTS:

65-70% lithic fragments, dominated by volcanic detritus.
10-15% feldspar, dominated by sanidine.
5-10% clay minerals; interstices frequently stained by iron oxide (hematite) and oxyhydroxide (goethite). ~5% quartz.
<5% opaques and isotropic minerals, including some garnet grains.
<5% organic matter.

SEDIMENTARY FEATURES:

Interval 0-18 cm: gray medium sand with a sharp base.
Interval 18-34 cm: fine sand to silty clay, normally graded bed.
Interval 34-42 cm: fine sand to silty clay, normally graded bed.
Interval 42-53 cm: medium to coarse sand, normally graded bed, sharp base.
Interval 53-62 cm: sand, normally graded bed.
Interval 62-73 cm: sand with a 4-mm-thick, dark, fine-grained layer at 70 cm.
Interval 73-79 cm: sand to silt, normally graded bed.
Interval 79-90 cm: sand to silt, normally graded bed. Very low-angle cross-lamination in sand.
Interval 90-104 cm: sand with two intervals of dark silty mud between 90 and 95 cm and between 95 and 97 cm.
Interval 104-110 cm: normally graded sand bed.
Interval 110-121 cm: light coarse silt to dark mud, normally graded bed; somewhat disturbed.
Interval 121-133 cm: fine sand, normally graded bed, 5 mm of dark mud at top.

Core Photo



183-1137A-33R-4 **Section top: 289.80 (mbsf)**

UNIT 5: VOLCANIC SANDSTONE

Pieces: 1-9

CONTACTS: Not recovered; contact between Units 5 and 6 is inferred to be between Pieces 9 and 10.

GENERAL DESCRIPTION: Unit 5 is composed of interbedded volcanic siltstone and sandstone. Beds in this unit range from a few millimeters to tens of centimeters in thickness. Many beds are normally graded. Sandstone intervals commonly have sharp irregular bases and gradational tops, but some have sharp irregular tops. Some siltstones and sandstones have planar lamination and low-angle cross-stratification. Rare burrows are present. Thin, bladed flakes (<5%), possibly organic material, are scattered through the siltstone and sandstone, and in places form more concentrated intervals. Small-scale faulting offsets bedding in some sections.

COLOR: Dark greenish gray siltstone and light gray sandstone.

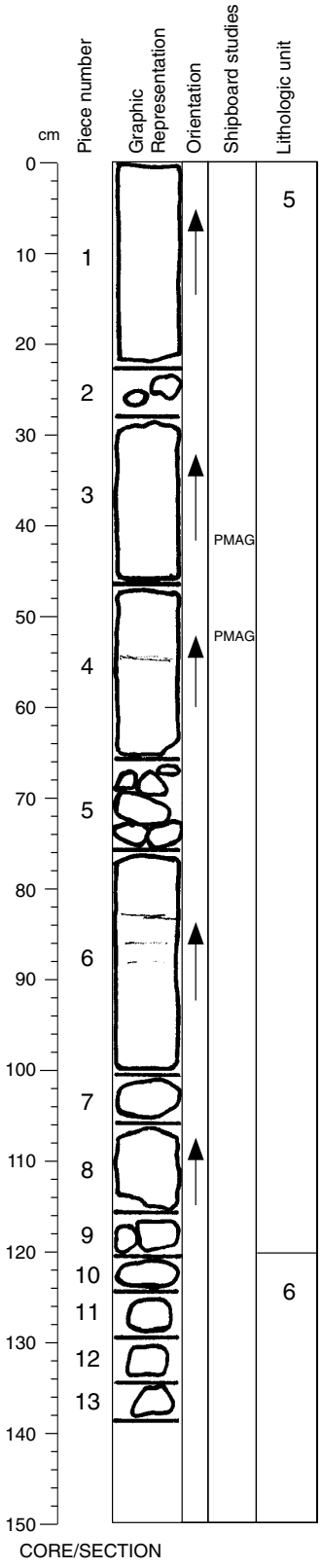
COMPONENTS:

65-70% lithic fragments, dominated by volcanic detritus.
10-15% feldspar, dominated by sanidine.
5-10% clay minerals; interstices frequently stained by iron oxide (hematite) and iron oxyhydroxide (goethite).
~5% quartz.
<5% opaques and isotropic minerals, including some garnet grains.
<5% organic matter.

SEDIMENTARY FEATURES:

Interval 0-13 cm: gray fine sand with dark organic or mud flakes; a dark mud interval at10 cm.
Interval 13-39 cm: fine sand to light coarse silt.
Interval 39-40 cm: dark mud with diffuse contacts.
Interval 40-50 cm: fine sand, normally graded bed.
Interval 50-54 cm: dark mud, sharp lower contact.
Interval 54-57 cm: light fine sand.
Interval 57-60 cm: dark coarse silt.
Interval 60-66 cm: light fine sand.
Interval 66-76 cm: coarse silt.
Interval 76-106 cm: fine sand to very fine sand.
Interval 106-120 cm: silt.

Core Photo



183-1137A-33R-4 **Section top: 289.80 (mbsf)**

UNIT 6: VOLCANIC CONGLOMERATE

Pieces: 10-13

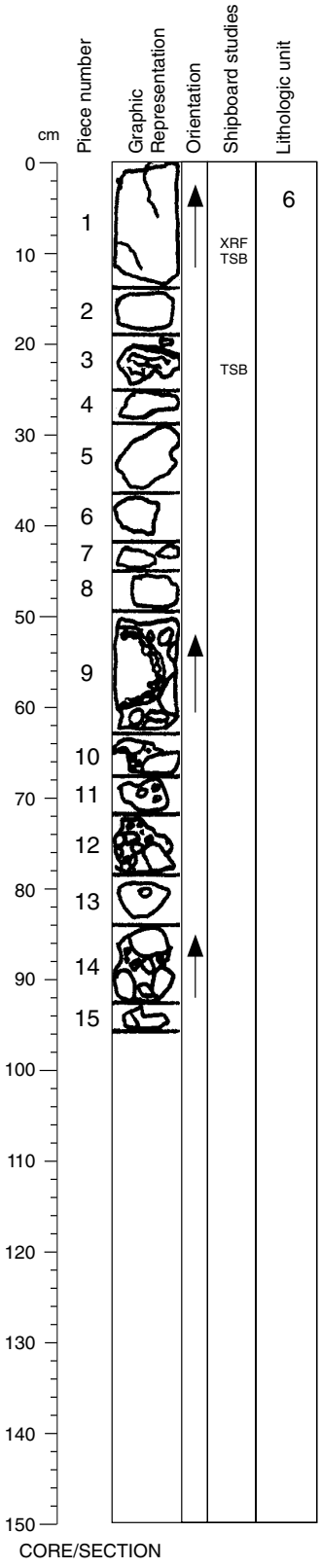
CONTACTS: Not recovered; the contact between Units 5 and 6 is inferred to be between Pieces 9 and 10.

GENERAL DESCRIPTION: This volcanic conglomerate consists of well-rounded, granule- to pebble-size clasts in a poorly to moderately sorted, coarse to fine sand-size matrix of volcanilithic fragments. Minerals in the matrix include altered clinopyroxene and possibly olivine and titanomagnetite. The matrix is altered to varying amounts and cemented with green clay, carbonate, and silica. Some veins of calcite are present. Clasts are of various volcanic lithologies. Many of the larger clasts have oxidation rims as wide as 1 cm. Dominant clast types are highly plagioclase-phyric basalt; sanidine-plagioclase-clinopyroxene-phyric massive trachyte with fairly fresh feldspar phenocrysts set in a fine-grained groundmass that is partially altered to clay; and potassium-feldspar-plagioclase-phyric, flow-banded rhyolite with an aphanitic groundmass. This section contains four large (~5 cm) clasts of massive trachyte with ~20 modal % feldspar phenocrysts (1-2 mm, subhedral, fresh) and ~5 modal % clinopyroxene phenocrysts (0.5-1 mm, euhedral to subhedral).

CONGLOMERATE CLAST GRANULOMETRY:

Average Clast Size (short x long, mm)	28 x 50
Maximum Clast Size (short x long, mm)	30 x 55
Rounding	
Framework	Loose pebbles, possibly part of a larger clast
Sphericity	
Elongate/Equant	Elongate
Matrix (%)	
Sorting Indicator (std. dev.)	

Core Photo



183-1137A-33R-5 **Section top: 291.19 (mbsf)**

UNIT 6: VOLCANIC CONGLOMERATE

Pieces: 1-15

CONTACTS: None.

GENERAL DESCRIPTION: This volcanic conglomerate consists of well-rounded, granule- to cobble-size clasts in a poorly to moderately sorted, coarse to fine sand-size matrix of volcanilithic fragments. Minerals in the matrix include altered clinopyroxene and possibly olivine and titanomagnetite. The matrix is variably altered and cemented with green clay, carbonate, and silica. Some veins of calcite are present. Clasts are of various volcanic lithologies. Many of the larger clasts are surrounded by oxidation rims as wide as 1cm. Dominant clast types are highly plagioclase-phyric basalt; sanidine-plagioclase-clinopyroxene-phyric massive trachyte with relatively fresh feldspar phenocrysts set in a fine-grained groundmass that is partially altered to clay; and potassium-feldspar-plagioclase-phyric, flow-banded rhyolite with an aphanitic groundmass.

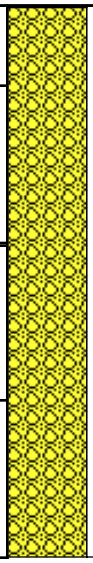
CLAST LITHOLOGIES:
Piece 1: Massive trachyte; clinopyroxene is partially altered.
Piece 2: Plagioclase-phyric basalt with relatively fresh plagioclase; groundmass altered to brown clay.
Piece 3: Flow-banded glassy rhyolite; sulfide blebs are present along one flow segregation.
Piece 4: Flow-banded glassy rhyolite; feldspar and mafic phenocrysts are present but altered.
Piece 5: Massive trachyte; clinopyroxene is partially altered.
Piece 6: Highly plagioclase-phyric basalt; sparsely vesicular with variable alteration of plagioclase; phenocrysts; gray-green clays partly line the vesicles.
Piece 7: Highly plagioclase-phyric basalt pebble.
Piece 8: Highly plagioclase-phyric basalt; rare clinopyroxene mostly altered to clay.
Piece 9: Massive trachyte.
Piece 10: Highly plagioclase-phyric basalt with thick, oxidized weathering rind.
Piece 11: Lithology uncertain.
Piece 12: Several rounded to subrounded clasts. Two clasts (one ~5 cm) of massive trachyte; the larger has several oxidation rims; both clasts are moderately to highly altered. Clasts of highly altered basalt and flow-banded rhyolite are also present.
Piece 13: Highly plagioclase-phyric basalt; relatively fresh plagioclase in an aphanitic groundmass.
Piece 14: Massive trachyte.
Piece 15: Plagioclase-phyric basalt; partly altered plagioclase in an aphanitic groundmass.

CONGLOMERATE CLAST GRANULOMETRY:

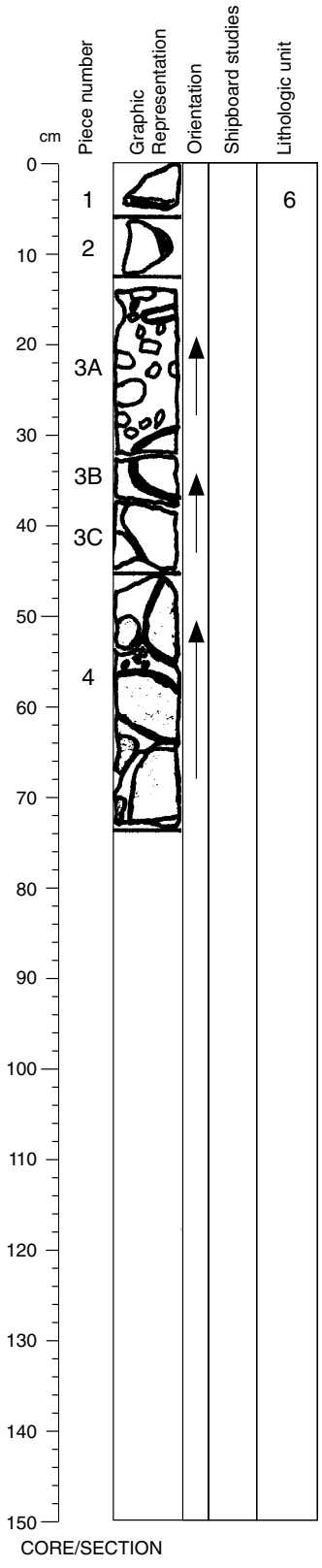
Average Clast Size (short x long, mm)	21 x 35
Maximum Clast Size (short x long, mm)	30 x 90
Rounding	Subrounded to rounded
Framework	Closed (clast supported)
Sphericity	Medium
Elongate/Equant	Equant
Matrix (%)	10
Sorting Indicator (std. dev.)	Pooly sorted (19.8); n=27

Core Photo

Hole 1137A 34R **294.7-304.2 mbsf**

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
0-5	1-4							VOLCANIC CONGLOMERATE Age: Campanian or older General Description: This core consists entirely of CONGLOMERATE. The CONGLOMERATE is mostly clast-supported, and most clasts are in the cobble-size range (4-64 mm). Sorting of the clasts is moderate. Most clasts are equant and well-rounded. The matrix i moderately well sorted sand with calcareous cement. The CONGLOMERATE is slightly polymictic. The clasts are mainly basalt and a few are rhyolite.

Core Photo



183-1137A-34R-1 **Section top: 294.70 (mbsf)**

UNIT 6: VOLCANIC CONGLOMERATE

Pieces: 1-4

CONTACTS: None.

COLOR: Varies from medium gray to bluish gray to brownish.

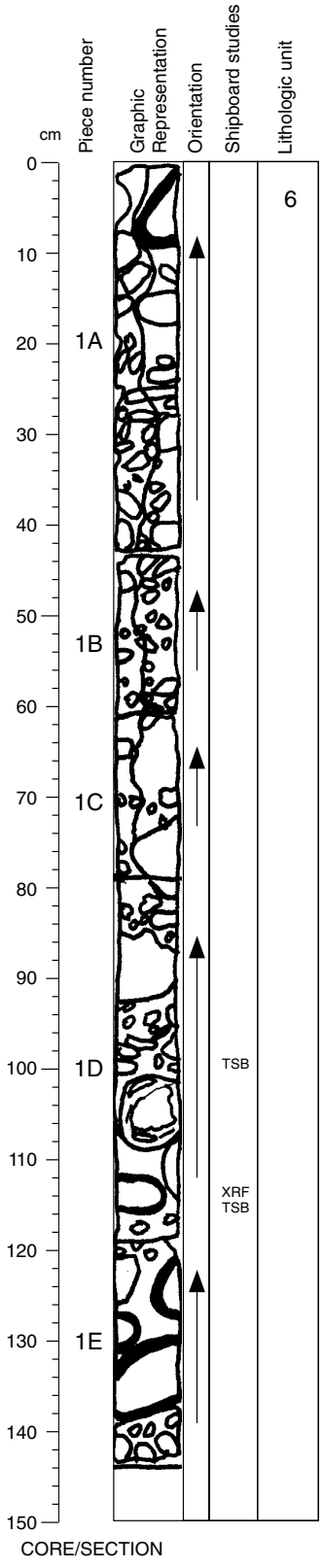
GENERAL DESCRIPTION: See Section 33R-5 for a general description of the conglomerate.

CLAST LITHOLOGIES:
Piece 1: Massive trachyte with opaques and sulfides in the groundmass; clinopyroxene is generally altered.
Piece 2: Massive trachyte; contains sulfides; altered groundmass similar to that of Piece 1.
Piece 3A: Clasts from <0.5 to 4.2 cm; lithologies include (a) massive trachyte; (b) clinopyroxene-phyric basalt; (c) flow-banded rhyolite with altered plagioclase and ferromagnesian phenocrysts; (d) oxidized vesicular basalt (vesicles filled with clays); (e) fine-grained aphyric basalt; (f) opaque-bearing quartz (from a granitoid?); (g) small andesitic or dacitic clast.
Piece 3B: Lithologies include (a) massive trachyte with sulfide and altered clinopyroxene in the groundmass and an ~5-mm-thick brick-red oxidation rim; (b) flow-banded rhyolite (5.5 x 8 cm) with an altered ferromagnesian mineral (red and yellow; limonite?) and notable alteration along flow bands.
Piece 4: Lithologies include (a) massive trachyte (3.5 x 8.5 cm) with sparse amygdules and red oxidation rind, ~0.5 mm-thick; (b) dark gray plagioclase-phyric basalt (5.5 x 10.5 cm) with 0.3-mm-thick oxidation rind; plagioclase is altered; sulfide in groundmass; (c) flow-banded rhyolite (4.3 x 6.2 cm) with altered plagioclase and ferromagnesian phenocrysts; spherulites in bands of altered glass; oxidation rind ~0.1 cm thick.

CONGLOMERATE CLAST GRANULOMETRY:

Average Clast Size (short x long, mm)	22 x 36
Maximum Clast Size (short x long, mm)	40 x 110
Rounding	Subrounded to rounded
Framework	Closed (clast supported)
Sphericity	Medium
Elongate/Equant	Elongate
Matrix (%)	70
Sorting Indicator (std. dev.)	Poorly sorted (30.6); n=24

Core Photo



183-1137A-34R-2 **Section top: 295.44 (mbsf)**

UNIT 6: VOLCANIC CONGLOMERATE

Pieces: 1

CONTACTS: None.

COLOR: Varies from medium gray to dark reddish brown to blue-green gray.

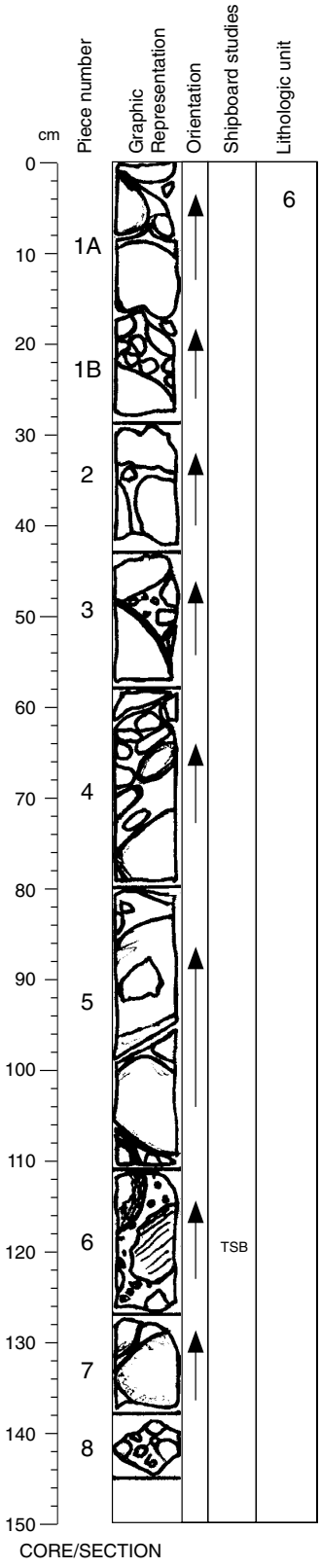
GENERAL DESCRIPTION: See Section 33R-5 for a general description of the conglomerate. In Section 34R-2, the matrix is poorly sorted coarse sand.

CLAST LITHOLOGIES:
Piece 1A: Small (≤8 mm), moderately to highly altered clasts of plagioclase-phyric basalt, aphyric and vesicular volcanic rocks, and a "granitoid".
Piece 1B: Clasts are 2-3 cm in size and consist of vesicular basalt, a granitoid pebble, massive trachyte, and flow-banded rhyolite; all are moderately altered.
Piece 1C: Two large clasts of massive trachyte, one (6 cm) highly altered, the other (2 x 3 cm) moderately to highly altered; most remaining clasts (all ≤1 cm) are moderately to highly altered flow-banded rhyolite, aphyric basalt, and coarse-grained basalt.
Piece 1D: Predominantly large (≤6 cm) clasts of moderately altered flow-banded rhyolite; one gneiss (?); smaller clasts include a coarse-grained (granitic?) rock and moderately altered massive trachyte.
Piece 1E: Three moderately altered massive trachyte clasts ≤6 cm in diameter; also moderately altered aphyric basalt, highly altered vesicular basalt, flow-banded rhyolite, and coarse-grained basalt.

CONGLOMERATE CLAST GRANULOMETRY:

Average Clast Size (short x long, mm)	22 x 34
Maximum Clast Size (short x long, mm)	50 x 110
Rounding	Subrounded to rounded
Framework	Dominantly closed (clast supported); open granular (matrix supported) in 60-70 cm interval
Sphericity	Medium to high
Elongate/Equant	Elongate to equant
Matrix (%)	60
Sorting Indicator (std. dev.)	Poorly sorted (27.2); n=45

Core Photo



183-1137A-34R-3 **Section top: 296.89 (mbsf)**

UNIT 6: VOLCANIC CONGLOMERATE

Pieces: 1-8

CONTACTS: None.

COLOR: Varies from medium gray to dark reddish brown to blue-green gray.

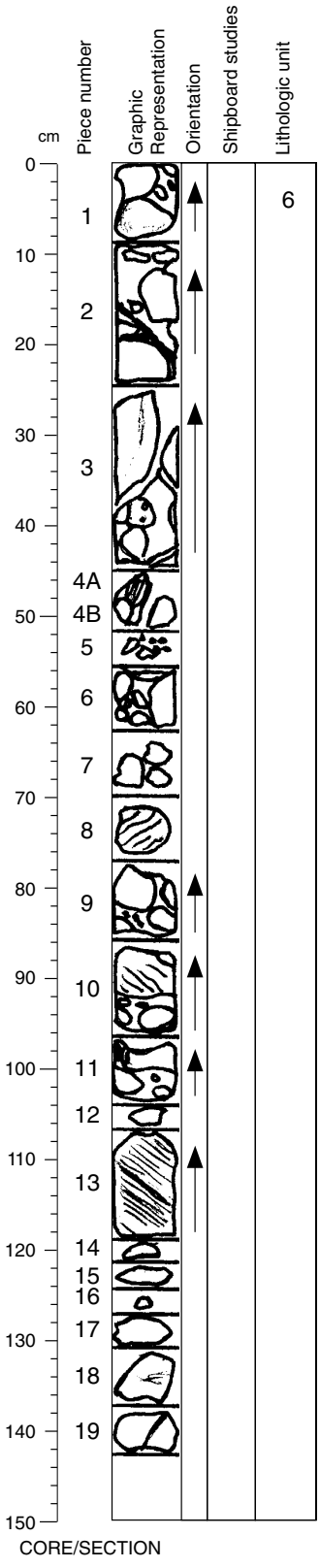
GENERAL DESCRIPTION: See Section 33R-5 for a general description of the conglomerate. The matrix in Section 34R-3 is poorly sorted, medium to coarse sand.

CLAST LITHOLOGIES:
Piece 1A: Three clasts (3-6 cm) of moderately altered flow-banded rhyolite; one clast (5 cm) of moderately altered massive trachyte.
Piece 1B: Largest clast (10 cm) is moderately to highly altered flow-banded rhyolite; other clasts (2 x 2 cm to 3 x 5 cm) are moderately to highly altered aphyric basalt and moderately altered massive trachyte.
Piece 2: Main clast (8 cm) is moderately to highly altered flow-banded rhyolite; also a 5-cm clast of moderately to highly altered, massive trachyte and another (2 x 2 cm) of highly altered, fine-grained olivine-phyric basalt.
Piece 3: Dominated by two large clasts, one a highly altered, 4 cm, flow-banded rhyolite, the other a slightly altered, 6 cm, massive trachyte; smaller clasts are a 1 x 2 cm vesicular plagioclase-phyric basalt and a 2 cm vesicular aphyric basalt, both highly altered.
Piece 4: Dominantly massive trachyte ranging from 6 cm to 1 x 2 cm; also a 1 x 3 cm, fine- to medium-grained aphyric basalt, a 1 x 4 cm fine-grained aphyric basalt, and a 2 x 3 cm aphanitic vesicular basalt, all moderately to highly altered.
Piece 5: Two large (7 and 11 cm), moderately altered clasts and seven smaller, highly altered clasts of massive trachyte.
Piece 6: Two large (3 x 4 cm) clasts of flow-banded rhyolite and one large clast of massive trachyte, all higly altered; smaller clasts of the same lithologies and one aphyric basalt.
Piece 7: Two large, highly altered clasts of massive trachyte; one has a fine (chilled) margin around a coarser interior.
Piece 8: Many small clasts, all highly altered.

CONGLOMERATE CLAST GRANULOMETRY:

Average Clast Size (short x long, mm)	27 x 40
Maximum Clast Size (short x long, mm)	90 x 158
Rounding	Subrounded to rounded
Framework	Closed (clast supported)
Sphericity	Medium
Elongate/Equant	Elongate
Matrix (%)	20
Sorting Indicator (std. dev.)	Poorly sorted (31.8); n=45

Core Photo



183-1137A-34R-4 **Section top: 298.34 (mbsf)**

UNIT 6: VOLCANIC CONGLOMERATE

Pieces: 1-19

CONTACTS: None.

COLOR: Varies from medium gray to reddish brown to blue-green gray.

GENERAL DESCRIPTION: See Section 33R-5 for a general description of the conglomerate. The matrix in Section 34R-4 is medium-coarse to very coarse sand. Almost no matrix is present in Pieces 12-19.

CLAST LITHOLOGIES:
Piece 1: Contains two 4 cm clasts, one a highly altered flow-banded rhyolite, the other a moderately altered, sparsely plagioclase-phyric basalt.
Piece 2: Clasts clasts are moderately to highly altered flow-banded rhyolite, massive trachyte, aphyric basalt, and plagioclase-olivine-phyric basalt. A silica-filled vein (5-10 mm wide) cuts this piece.
Piece 3: Large clasts of highly altered flow-banded rhyolite (9 cm and 3 x 3 cm) and moderately altered massive trachyte (5 cm and 1 x 2 cm).
Piece 4: Three clasts of highly altered flow-banded rhyolite (1 x 3 cm, 3 x 5 cm, and 2 cm).
Piece 5: Small chips of conglomerate matrix.
Piece 6: Two clasts of highly altered flow-banded rhyolite (4 cm and 1.5 x 2 cm), and four clasts of moderately altered massive trachyte (1 to 4 cm).
Piece 7: Three small, moderately altered clasts of massive trachyte and flow-banded rhyolite.
Piece 8: One highly altered 3 cm clast of flow-banded rhyolite.
Piece 9: Four moderately altered 2-5 cm clasts of massive trachyte.
Piece 10: One 5 cm clast of moderately altered flow-banded rhyolite; 1.5 cm and 1.5 x 2 cm clasts of highly altered massive trachyte; one small clast of moderately altered, sparsely olivine-phyric, fine-grained basalt.
Piece 11: 3.5 cm and 1 x 1 cm clasts of highly altered flow-banded rhyolite and massive trachyte; also a moderately altered, sparsely olivine-phyric fine-grained basalt.
Piece 12: Moderately altered 1 x 2 cm clast of massive trachyte.
Piece 13: Moderately altered 10 cm clast of flow-banded rhyolite.
Piece 14: Moderately altered 2 cm clast of massive trachyte.
Piece 15: Moderately altered 1 x 3 cm clast of massive trachyte.
Piece 16: 2 x 3 cm clast of massive trachyte.
Piece 17: 2 x 3 cm clast of silicified massive trachyte.
Piece 18: Highly altered 3 x 4 cm clast of flow-banded rhyolite.
Piece 19: Highly altered 3 x 4 cm clast of flow-banded rhyolite.

CONGLOMERATE CLAST GRANULOMETRY

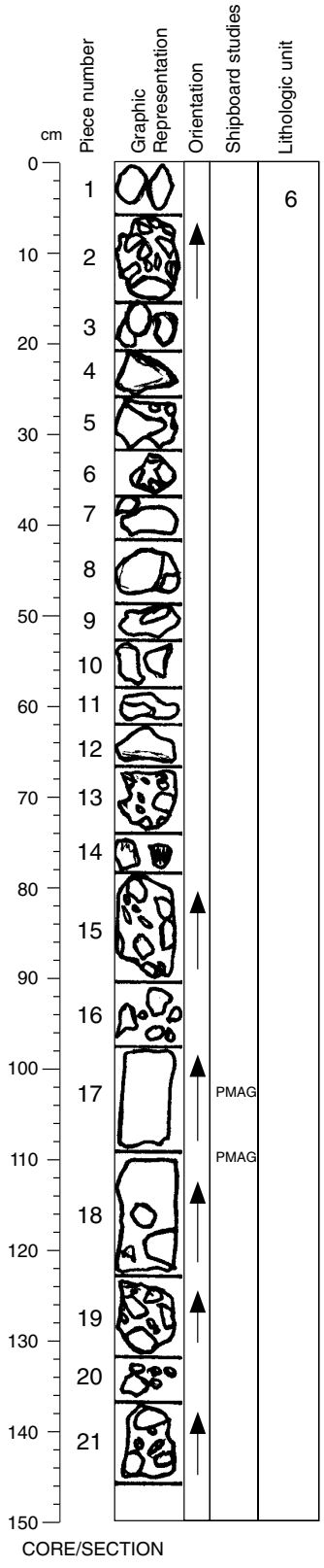
Average Clast Size (short x long, mm)	22 x 35
Maximum Clast Size (short x long, mm)	40 x 150
Rounding	Subrounded to rounded
Framework	Closed (clast supported)
Sphericity	Medium
Elongate/Equant	Elongate
Matrix (%)	30
Sorting Indicator (std. dev.)	Poorly sorted (24.3); n=54

Core Photo

Hole 1137A Core 35R **304.2-313.6 mbsf**

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
1	1							VOLCANIC CONGLOMERATE Age: Campanian or older General Description: This core consists entirely of CONGLOMERATE. The CONGLOMERATE is mostly clast-supported, and most clasts are in the cobble-size range (4-64 mm). Sorting of the clasts is moderate. Most clasts are equant and well-rounded. The matrix i moderately well sorted sand with calcareous cement. The CONGLOMERATE is slightly polymictic. The clasts are mainly basalt and a few are rhyolite.
2	2							

Core Photo



183-1137A-35R-1 **Section top: 304.20 (mbsf)**

UNIT 6: VOLCANIC CONGLOMERATE

Pieces: 1-21

CONTACTS: None.

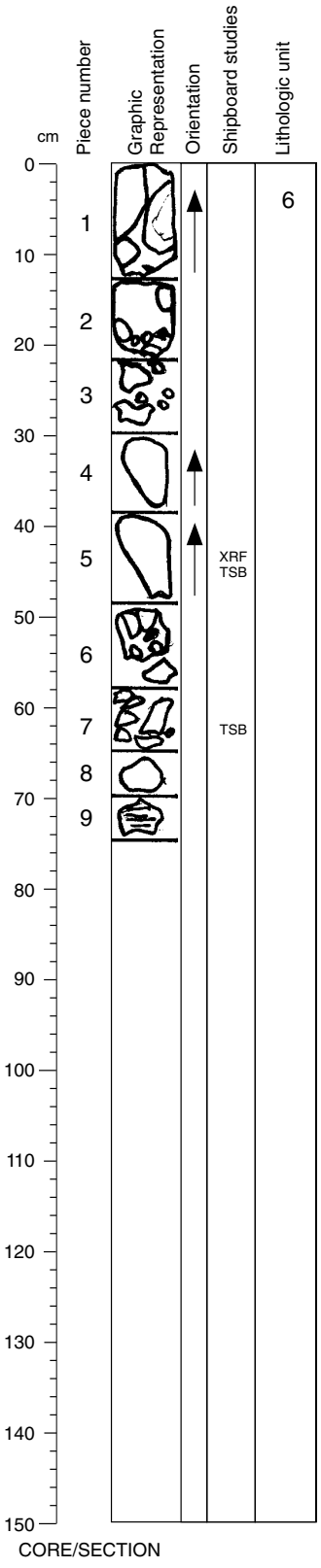
COLOR: Variable from medium gray to dark reddish brown to blue-green gray.

GENERAL DESCRIPTION: Clast lithologies and matrix are very similar in both composition and proportion to those described in detail in Core 34R. The maximum clast size is smaller (5 cm) and the clasts are generally more altered. There are few clasts in Pieces 16-18; Piece 17 and Piece 18, 110-115 cm, are entirely medium-grained, well sorted, volcaniclastic sandstone. Sorting of the sand grains in the conglomerate varies from poor to good.

CONGLOMERATE CLAST GRANULOMETRY:

Average Clast Size (short x long, mm)	15 x 22
Maximum Clast Size (short x long, mm)	40 x 60
Rounding	Subrounded to rounded
Framework	Closed (clast supported)
Sphericity	Medium
Elongate/Equant	Elongate
Matrix (%)	50
Sorting Indicator (std. dev.)	Moderately to poorly sorted (13.5); n=71

Core Photo



183-1137A-35R-2 **Section top: 305.66 (mbsf)**

UNIT 6: VOLCANIC CONGLOMERATE

Pieces: 1-9

CONTACTS: None.

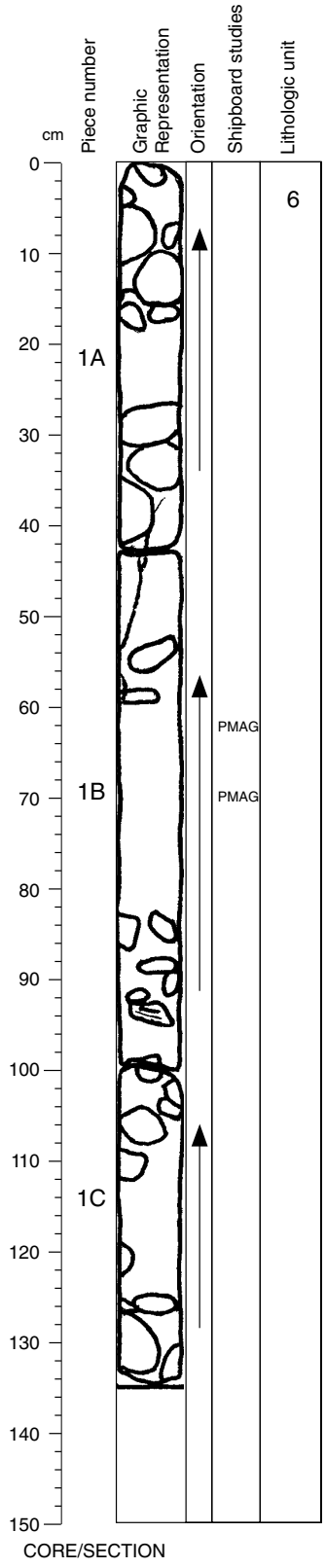
COLOR: Varies from medium gray to reddish brown to blue-green gray.

GENERAL DESCRIPTION: Clast lithologies are very similar in both composition and proportion to those described in detail in Core 34R. The maximum size is smaller (5 cm) and the clasts are generally more altered. Piece 8 is a silicified clast of massive trachyte. The matrix is moderately sorted medium sand.

CONGLOMERATE CLAST GRANULOMETRY:

Average Clast Size (short x long, mm)	21 x 32
Maximum Clast Size (short x long, mm)	46 x 85
Rounding	Rounded
Framework	Closed (clast supported)
Sphericity	Medium
Elongate/Equant	Elongate
Matrix (%)	20
Sorting Indicator (std. dev.)	Moderately to poorly sorted (24.4); n=25

Core Photo



183-1137A-36R-1 **Section top: 313.60 (mbsf)**

UNIT 6: VOLCANIC CONGLOMERATE

Pieces: 1

CONTACTS: None.

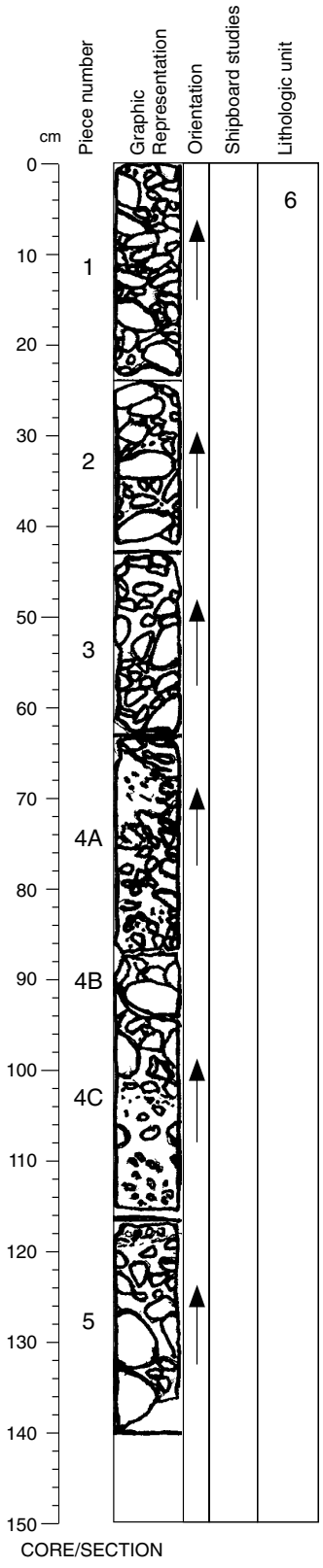
COLOR: Varies from medium gray to reddish brown to blue-green gray.

GENERAL DESCRIPTION: Clast lithologies are very similar in both composition and proportion to those described in detail in Core 34R. The maximum size is smaller (5 cm) but clasts are altered to a similar degree (moderate to commonly high). The matrix in this section is poorly sorted, medium to coarse sand.

CONGLOMERATE CLAST GRANULOMETRY:

Average Clast Size (short x long, mm)	13 x 20
Maximum Clast Size (short x long, mm)	50 x 73
Rounding	Subrounded to rounded
Framework	Closed (clast supported)
Sphericity	Medium
Elongate/Equant	Elongate to equant
Matrix (%)	60
Sorting Indicator (std. dev.)	Poorly sorted (13.5); n=96

Core Photo



183-1137A-36R-2 **Section top: 314.95 (mbsf)**

UNIT 6: VOLCANIC CONGLOMERATE

Pieces: 1-5

CONTACTS: None.

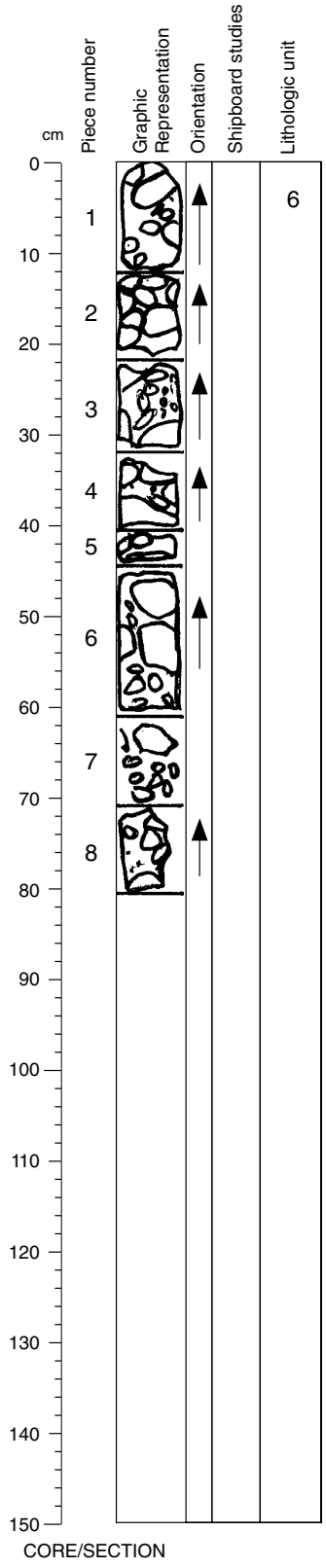
COLOR: Varies from medium gray to dark reddish brown to blue-green gray.

GENERAL DESCRIPTION: Maximum clast sizes are 5 to 6 cm. The lithologies observed in Core 34R are represented, but the proportion of flow-banded rhyolite has decreased whereas that of massive trachyte has increased. The degree of alteration is generally moderate, commonly high. New lithologies observed are fine- to medium-grained, slightly altered, plagioclase-phyric basalt in Piece 1, and vesicular, moderately altered plagioclase-phyric basalt in Piece 4. The matrix varies from granular to coarse sand and from moderately to poorly sorted. Calcite locally replaces plagioclase.

CONGLOMERATE CLAST GRANULOMETRY:

Average Clast Size (short x long, mm)	14 x 22
Maximum Clast Size (short x long, mm)	44 x 122
Rounding	Rounded
Framework	Closed (clast supported)
Sphericity	Medium
Elongate/Equant	Elongate to equant
Matrix (%)	30
Sorting Indicator (std. dev.)	Poorly sorted (17.3); n=108

Core Photo



183-1137A-36R-3 **Section top: 316.35 (mbsf)**

UNIT 6: VOLCANIC CONGLOMERATE

Pieces: 1-8

CONTACTS: Not recovered; the contact between Units 6 and 7 is inferred to be between Sections 36R-3 and 37R-1.

GENERAL DESCRIPTION: The proportion and types of clasts are very different from those in stratigraphically higher sections. No flow-banded rhyolite is present, and both the proportion and size of massive trachyte clasts is smaller. The clasts in this section are round to subround; maximum clast size is 4-6 cm. The matrix is mostly poorly to moderately sorted, medium sand.

CLAST LITHOLOGIES:
Piece 1: Vesicular aphyric basalt (3 x 4 cm), slightly altered; clinopyroxene-phyric basalt (2 x 3 cm), moderately altered; massive trachyte (1.5 x 2 cm and 1 x 2 cm), highly altered and moderately altered; also several small clasts of uncertain lithologies.

Piece 2: Variolitic basalt with clinopyroxene and plagioclase (3 x 3.5 cm), alteration low to moderate; vesicular highly aphyric basalt (2 x 3 cm and 1.5 x 2 cm), low to moderate alteration; highly oxidized red-brown clinopyroxene-phyric vesicular basalt (2.5 x 2.5 cm); aphanitic aphyric basalt (2 x 3 cm), moderately altered; highly altered massive trachyte (1 x 2.5 cm).

Piece 3: Highly to moderately altered clinopyroxene-phyric basalt (4 cm); massive trachyte (2 x 2 cm), moderately altered; plagioclase-phyric basalt (2.5 cm, highly altered, and one 1.5 x 3 cm, moderately altered).

Piece 4: Sparsely plagioclase-phyric vesicular basalt (5 cm), moderately altered; silicified plagioclase-phyric basalt (?), white to green color, highly altered (plagioclase is altered to pinkish brown color; clinopyroxene-phyric basalt (1.5 x 2 cm, and 5 cm), moderately altered; aphyric basalt (2 cm), moderately altered.

Piece 5: Olivine-clinopyroxene-plagioclase-phyric basalt (1 x 1 cm); massive trachyte (2 cm), highly altered.

Piece 6: Highly altered, sparsely olivine- (clinopyroxene-?) phyric vesicular basalt (4 x 5 cm); moderately altered, highly vesicular aphyric basalt (4.5 x 5 cm); highly altered massive trachyte (1 x 2 cm); highly altered, highly vesicular clinopyroxene-phyric basalt (1 x 1.5 cm); moderately altered variolitic basalt with plagioclase variolites and fine- to medium-grained clinopyroxene (1 x 2 cm and 1.5 x 3 cm clasts); moderately altered clinopyroxene-phyric aphanitic basalt (1.5 x 2 cm).

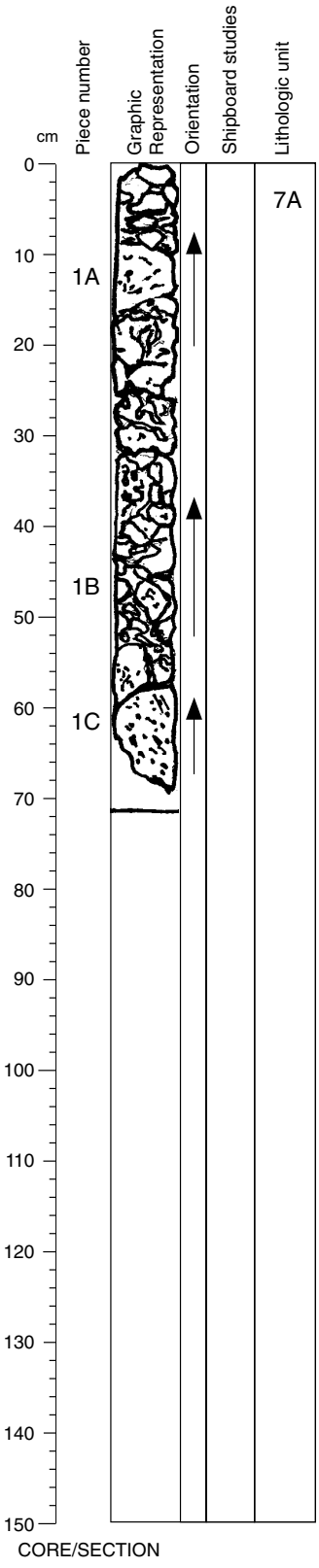
Piece 7: Many small chips; one 3 x 3 x 4 cm piece is a slightly to moderately altered massive trachyte.

Piece 8: Major clasts are sparsely clinopyroxene-phyric, fine-grained to aphanitic basalts, moderately altered. The largest is 1.5 x 1.5 cm. A moderately to highly altered plagioclase-olivine-phyric basalt (2 x 2 cm) is also present.

CONGLOMERATE CLAST GRANULOMETRY:

Average Clast Size	15 x 23
Maximum Clast Size	40 x 72
Rounding	Subrounded to rounded
Framework	Closed (clast supported)
Sphericity	Medium
Elongate/Equant	Equant
Matrix (%)	20
Sorting Indicator	Poorly sorted (13.7); n=58

Core Photo



183-1137A-37R-1 **Section top: 322.80 (mbsf)**

UNIT 7A: SPARSELY PLAGIOCLASE-PHYRIC BASALTIC BRECCIA

Pieces: 1

CONTACTS: Not recovered; contact between Units 6 and 7 is inferred to be between Sections 36R-3 and 37R-1.

PHENOCRYSTS IN CLASTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	2	2.5	0.1	1	Laths, tablets, and other euhedral forms, commonly as glomerocrysts
Olivine:	trace	2.5			Euhedral pseudomorphs; altered to clay
Clinopyroxene:	trace				

GROUNDMASS: Aphanitic; pale pinkish brown.

VESICLES: Moderately vesicular; vesicularity varies among clasts.

COLOR: Basalt clasts are reddish black.

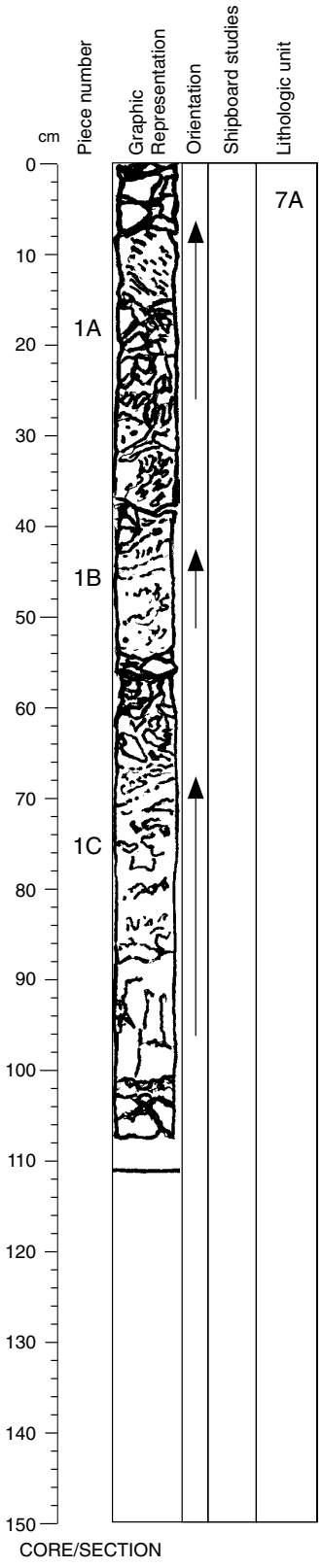
STRUCTURE: Brecciated; clasts are cemented with green (dominantly) and red clay.

ALTERATION: High to complete. Plagioclase phenocrysts are relatively fresh but locally altered to calcite; the matrix consists of clay and calcite.

VEINS/FRACTURES: None.

COMMENTS: Interpreted to be an autobrecciated flow top. Clasts range from <1 to 15 cm. The interval from 0-10 cm contains smaller, more rounded clasts.

Core Photo



183-1137A-37R-2 **Section top: 323.53 (mbsf)**

UNIT 7A: SPARSELY PLAGIOCLASE-PHYRIC BASALTIC BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS IN CLASTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	2	4	0.1	1.5	Laths, tablets, and other euhedral forms; some glomerocrysts; 0.1 mm grains are equant
Clinopyroxene:	<<1			0.2	Subhedral

GROUNDMASS: Aphanitic, pale pink-brown (lighter in Piece 1C). Groundmass grains are large enough to be visible in some clasts. Groundmass in large clast in Piece 1C is riddled with tiny, irregular vesicles.

VESICLES: Moderately vesicular; vesicles are all filled with green clay similar to that in the matrix.

COLOR: Basalt clasts are reddish black (except in Piece 1C, which is greenish gray).

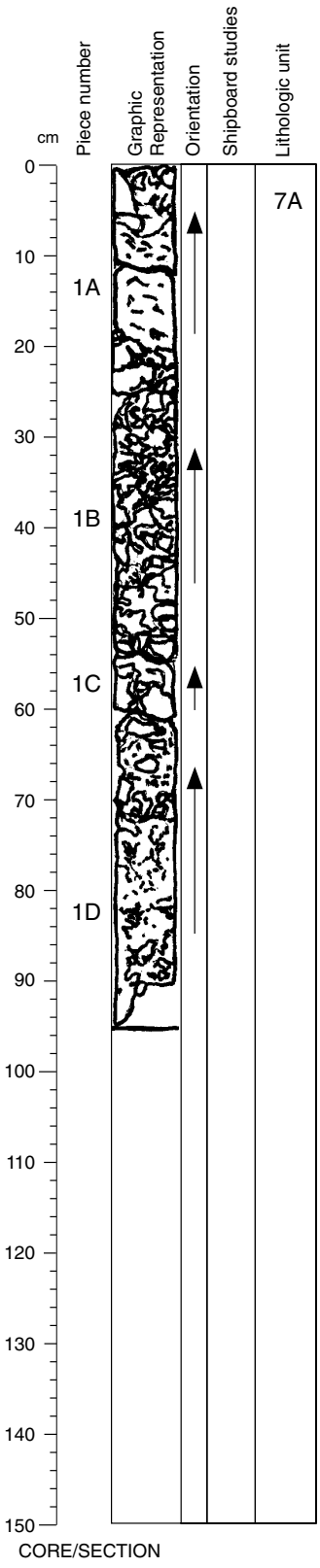
STRUCTURE: Brecciated and cemented with green (dominantly) and red clay.

ALTERATION: High to complete. Some plagioclase phenocrysts appear fresh but are locally altered to calcite; the matrix is green clay, calcite and zeolite.

VEINS/FRACTURES: None.

COMMENTS: Interpreted to be part of an autobrecciated flow top. Clasts range from <1 to 30 cm. Several subhorizontal horizons are defined by smaller (1-10 cm) clasts (e.g., at 46-48 cm, 69-71 cm, and 104-106 cm).

Core Photo



183-1137A-37R-3 **Section top: 324.72 (mbsf)**

UNIT 7A: MODERATELY PLAGIOCLASE-PHYRIC BASALTIC BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS IN CLASTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	2-3	4	0.2	2	Laths (mostly) and other euhedral forms, commonly as glomerocrysts; some crystals are greenish
Clinopyroxene:	<1	0.25	<0.1	0.2	Subhedral to euhedral, stubby laths; black or brown

GROUNDMASS: Fine grained to aphanitic; pinkish brown, with bright orange (oxidized) streaks and patches associated with vesicles or vesicle trails.

VESICLES: Variable, but generally moderately vesicular; filled with green clay.

COLOR: Slightly reddish black; greenish toward base.

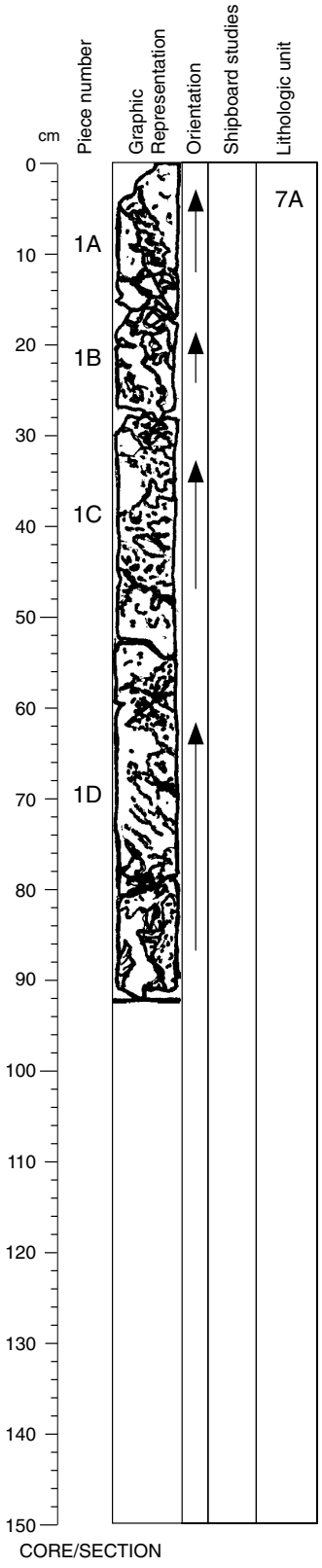
STRUCTURE: Brecciated and cemented with green (dominantly) and red clay. Calcite cement from 20-60 cm.

ALTERATION: High to complete. The matrix is calcite, clay, and zeolite.

VEINS/FRACTURES: None.

COMMENTS: Interpreted to be an autobrecciated flow top. Most clasts are 1-20 cm in size. Finer-grained horizons (with 1-10 cm clasts) are at 18-44, 62-70, and 87-88 cm. Some small clasts in these horizons show “jigsaw” fit.

Core Photo



183-1137A-37R-4 **Section top: 325.67 (mbsf)**

UNIT 7A: SPARSELY PLAGIOCLASE-PHYRIC BASALTIC BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS IN CLASTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	2	3.5	0.25	1.5	Laths and other euhedral forms, commonly as glomerocrysts; many green crystals
Olivine:	<1	4	0.1	0.25	Euhedral to anhedral pseudomorphs; milky gray to green with bronze-colored internal fractures
Clinopyroxene:	trace			0.2	Stubby prisms; black and brown

GROUNDMASS: Aphanitic; pinkish brown with patches of dusky red.

VESICLES: Moderately vesicular; vesicularity varies among clasts. Vesicles are filled with green clay.

COLOR: Basaltic clasts are reddish black and greenish black.

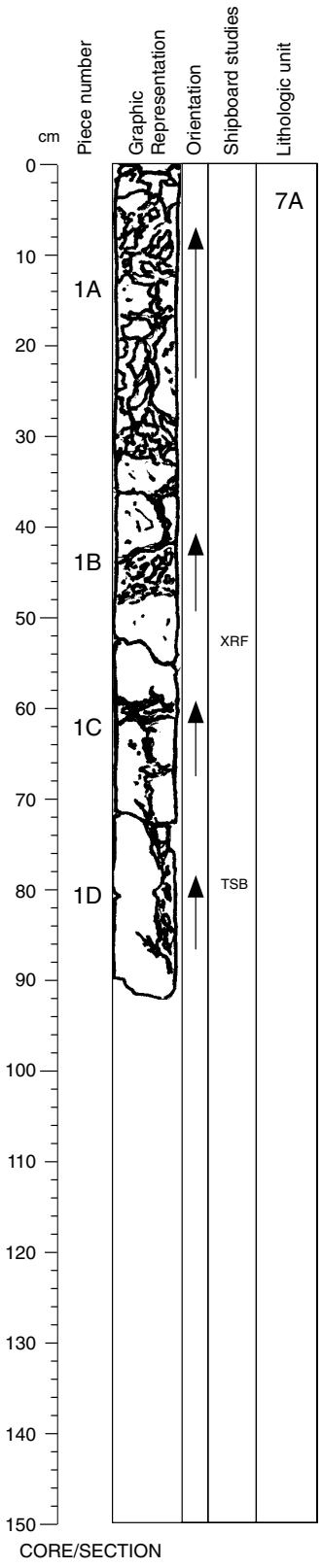
STRUCTURE: Brecciated and cemented with green clay and calcite. Red clay cement is present in the upper half of the section; from ~40 cm downard orange-brown clay is present.

ALTERATION: High to complete. Matrix is calcite, clay, and zeolites.

VEINS/FRACTURES: None.

COMMENTS: Interpreted to be an autobrecciated flow top. Clasts range from <1 cm to 10 cm. Larger clasts are surrounded by finer-grained, randomly oriented breccia horizons; finer breccia clasts are 1-15 mm. Olivine is more abundant in the clast at the bottom of Piece 1C and top of Piece 1D.

Core Photo



183-1137A-37R-5 **Section top: 326.59 (mbsf)**

UNIT 7A: SPARSELY PLAGIOCLASE-PHYRIC BASALTIC BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS IN CLASTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	2	5	0.1	2	Laths and other euhedral forms, glomerocrysts common; green
Olivine:	<1	3.5	0.2	0.5	Euhedral pseudomorphs with edges and internal fractures lined by iddingsite
Clinopyroxene:	trace	0.5		0.2	Subhedral to anhedral

GROUNDMASS: Mostly fine grained; a few clasts are aphanitic; color Is pinkish brown with reddish streaks and patches.

VESICLES: Most clasts are slightly vesicular; vesicles are mainly small (<2 mm) and irregular. A few clasts are moderately vesicular. Vesicles are filled with green clays..

COLOR: Basaltic clasts are reddish black.

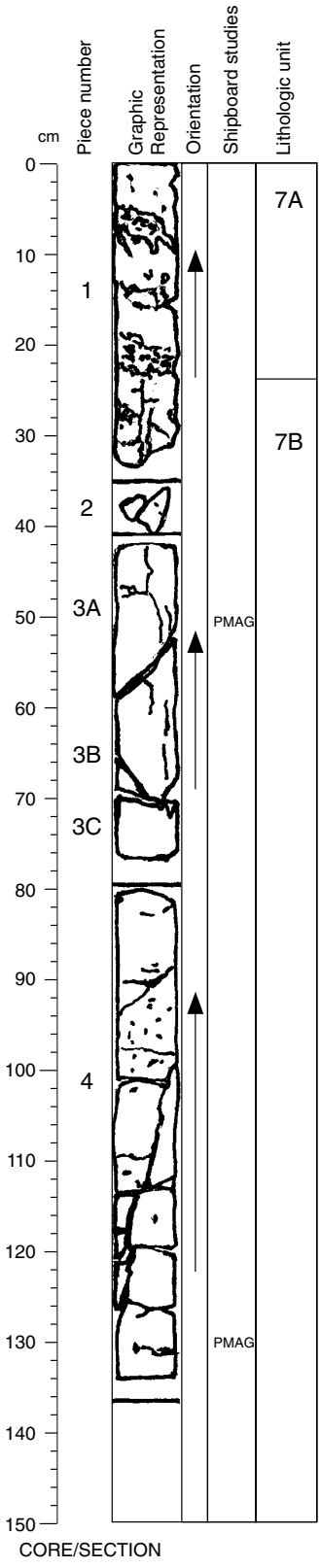
STRUCTURE: Brecciated and cemented with zeolite, green and red clay, and calcite.

ALTERATION: High to complete. The matrix is calcite, zeolite, and clay.

VEINS/FRACTURES: Subvertical zeolite veins are present from 67-90 cm.

COMMENTS: Interpreted to be an autobrecciated flow top. The larger clasts (1-30 cm) are surrounded by finer-grained breccia, mainly of clasts <20 mm in size. In the uppre 30 cm of the section, the largest clasts are in the 1-5 cm range.

Core Photo



183-1137A-38R-1 **Section top: 327.50 (mbsf)**

UNIT 7A: SPARSELY PLAGIOCLASE-PHYRIC BASALTIC BRECCIA

Pieces: 1

CONTACTS: Contact with Subunit 7B is at 23 cm, within Piece 1.

PHENOCRYSTS IN CLASTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	2	3	0.2	1	Large tabular forms, typically in glomerocrysts; small laths; larger crystals are green
Olivine:	<<1	2	0.2	0.5	Euhedral pseudomorphs
Clinopyroxene:	<<1			0.2-0.3	Stubby laths

GROUNDMASS: Very fine grained; pinkish brown to reddish orange, with reddish streaks and patches throughout.

VESICLES: The clasts are slightly to moderately vesicular; vesicles are clay-filled.

COLOR: Greenish black and variably reddish, especially in areas of finer breccia; major clasts are only slightly red.

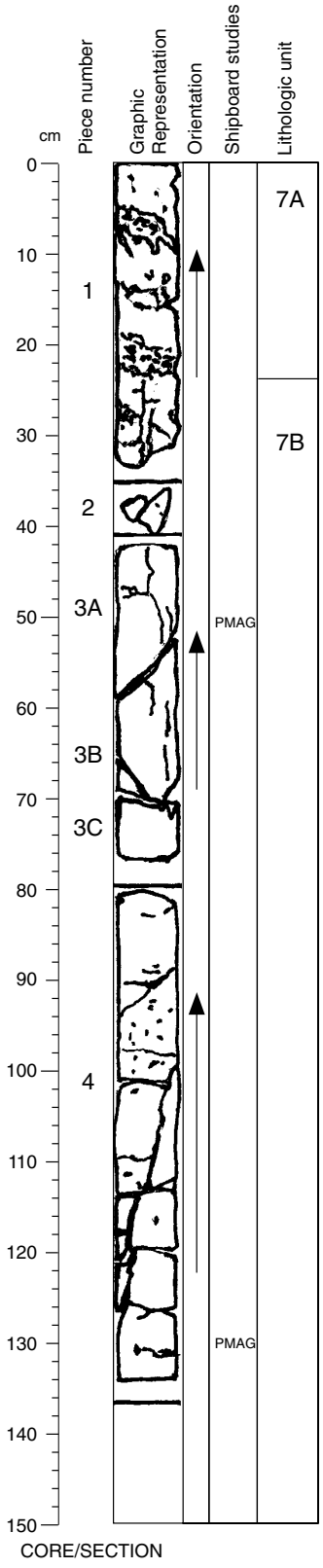
STRUCTURE: Brecciated and cemented with mix of zeolite and red and green clay.

ALTERATION: High to complete. The matrix is clay and zeolite.

VEINS/FRACTURES: Several subvertical zeolite-filled veins are present.

COMMENTS: Interpreted to be an autobrecciated flow top. The larger clasts (5-10 cm) are set in a finer- grained breccia, mainly made up of 1-20 mm clasts. In the upper 23 cm of the section, the largest clasts are in the 5-10 cm size range. The brecciated flow-top zone changes to massive basalt at ~23 cm, where the clasts are all welded together.

Core Photo



183-1137A-38R-1 **Section top: 327.50 (mbsf)**

UNIT 7B: MODERATELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-4

CONTACTS: Contact with Subunit 7A is at 23 cm, within Piece 1.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	3-5	8	0.5	2	Euhedral to subhedral laths; rare glomerocrysts
Olivine:	trace	5	0.5	1	Euhedral pseudomorphs
Clinopyroxene:	trace	1			Subhedral, commonly in plagioclase- clinopyroxene glomerocrysts

GROUNDMASS: Aphanitic.

VESICLES: Sparse; irregular and ovoid vesicles, up to 8 mm; filled concentrically with pale blue-green clay, zeolite, and calcite.

COLOR: Gray to grayish green.

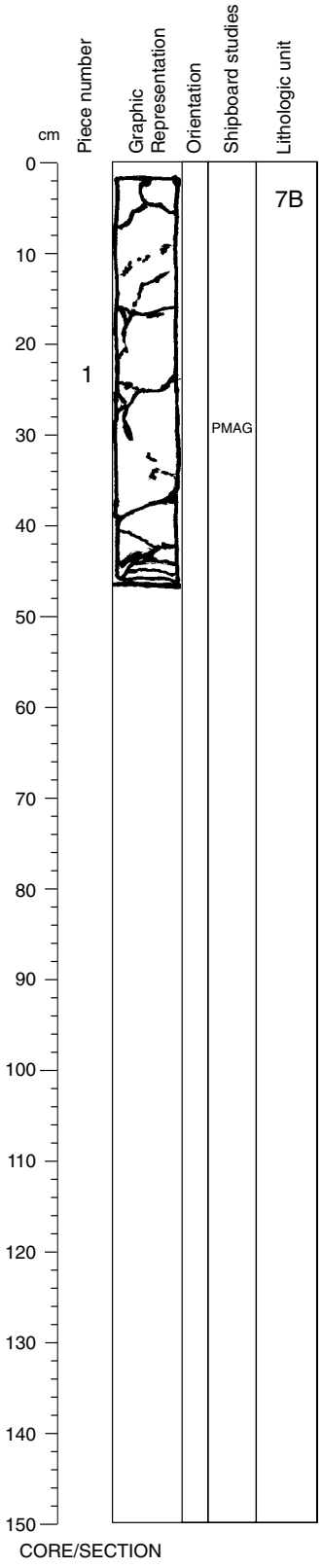
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Conjugate joint fractures begin in Piece 4 at ~100 cm. Veins up to 1.5 mm are present, filled with clay, calcite, and zeolite.

COMMENTS: This portion of the flow is interpreted to be the massive interior; the contact with Subunit 7A (Piece 1, 23 cm) is denoted by welding of breccia clasts.

Core Photo



183-1137A-38R-2 **Section top: 328.85 (mbsf)**

UNIT 7B: MODERATELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	3-5	8	0.5	2	Euhedral to subhedral laths; rare glomerocrysts
Olivine:	trace	5	0.5	1	Euhedral pseudomorphs
Clinopyroxene:	trace	1			Subhedral, in plagioclase-clinopyroxene glomerocrysts

GROUNDMASS: Aphanitic to very fine grained.

VESICLES: Sparse; irregular and ovoid vesicles, ≤8 mm; filled concentrically with pale blue-green clay and zeolite.

COLOR: Gray to grayish green.

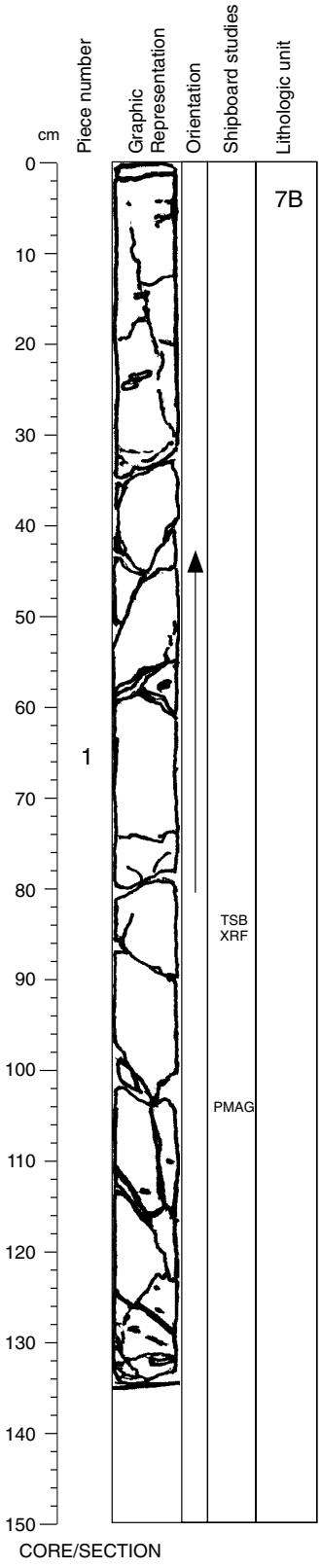
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Well fractured; moderately dipping conjugate joint sets, filled with thin (<1 mm) dark green clay. Zeolite-filled, ≤1.5-mm-wide veins are present.

COMMENTS:

Core Photo



183-1137A-38R-3 **Section top: 329.32 (mbsf)**

UNIT 7B: MODERATELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	4-5	8	0.5	2-3	Euhedral to subhedral laths; rare glomerocrysts
Olivine:	trace	5	0.5	1	Euhedral pseudomorphs
Clinopyroxene:	trace	1			Subhedral, often in plagioclase-clinopyroxene glomerocrysts

GROUNDMASS: Aphanitic to very fine grained.

VESICLES: Sparse; irregular and ovoid vesicles, ≤8 mm; filled concentrically with pale blue-green clay, zeolite, and amorphous silica. Rare larger vesicles (≤3 cm) at 23 and 54 cm are filled with amorphous silica.

COLOR: Gray.

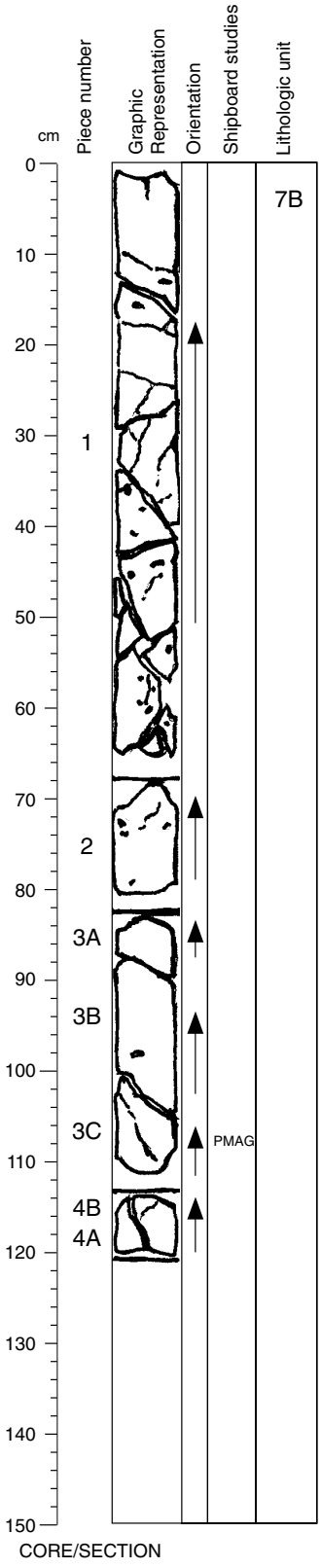
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Well fractured; moderately dipping conjugate joint sets, filled with thin (<1 mm) dark green clay. Veins up to 5 mm wide contain zeolite, amorphous silica, and quartz.

COMMENTS: Subhorizontal, “wispy” banding throughout the section probably represents <0.3-mm-wide, groundmass segregations (glass-rich).

Core Photo



183-1137A-38R-4 **Section top: 330.68 (mbsf)**

UNIT 7B: MODERATELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-4

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	4-5	8	0.5	2-3	Euhedral to subhedral laths; rare glomerocrysts
Olivine:	trace	5	0.5	1	Euhedral pseudomorphs
Clinopyroxene:	trace	1			Subhedral, often in plagioclase-clinopyroxene glomerocrysts

GROUNDMASS: Aphanitic to very fine grained.

VESICLES: Sparse; irregular and ovoid vesicles, ≤8 mm, filled concentrically with pale blue-green clay, clear zeolite, and amorphous silica.

COLOR: Gray.

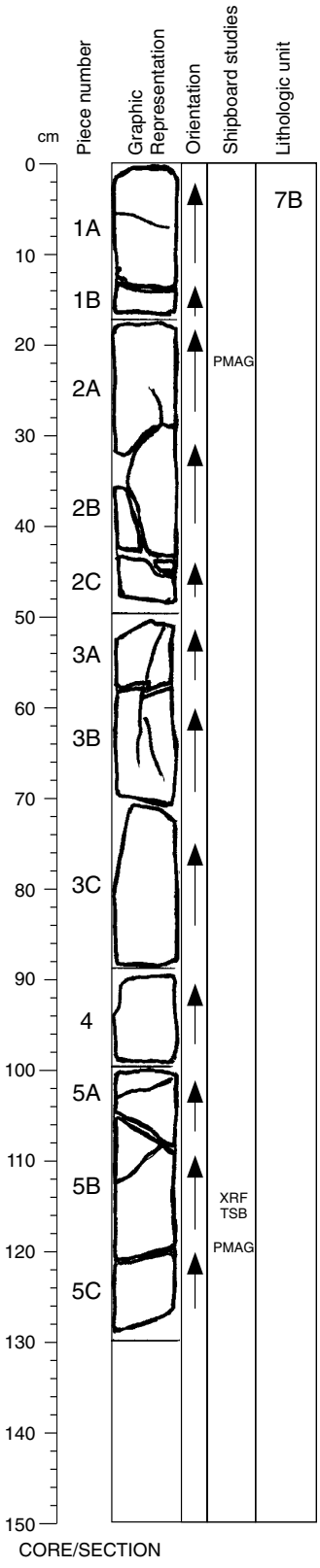
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Well fractured; moderately dipping conjugate joint sets, filled with thin (<1 mm) layer of dark green clay and zeolite; traces of pyrite are present in some veins.

COMMENTS: Subhorizontal “wisps” are less abundant than in Section 38R-3.

Core Photo



183-1137A-39R-1 **Section top: 332.20 (mbsf)**

UNIT 7B: MODERATELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-5

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	4-5	8	0.5	2-3	Euhedral to subhedral laths; rare glomerocrysts
Olivine:	trace	5	0.5	1	Euhedral pseudomorphs
Clinopyroxene:	trace	1			Subhedral, often in plagioclase-clinopyroxene glomerocrysts

GROUNDMASS: Aphanitic to very fine grained.

VESICLES: Rare irregular and ovoid vesicles, up to 8 mm, filled concentrically with pale blue-green clay.

COLOR: Gray.

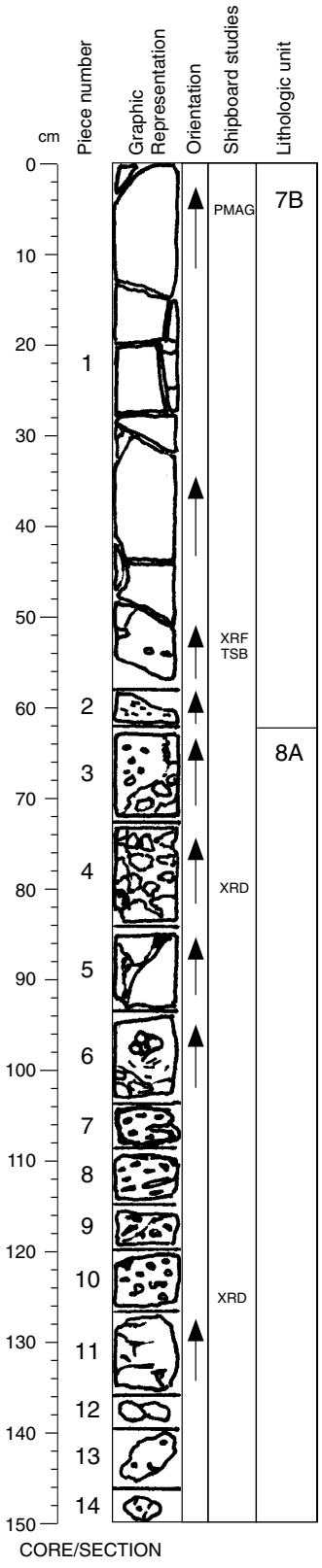
STRUCTURE: Massive.

ALTERATION: Slight; subhorizontal bands of altered mesostasis are evident.

VEINS/FRACTURES: Numerous thin (<0.5 mm) clay-filled fractures are present.

COMMENTS: Mesostasis wisps are present, dipping ~20°.

Core Photo



183-1137A-39R-2 **Section top: 333.50 (mbsf)**

UNIT 7B: MODERATELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1, 2

CONTACTS: The contact between Units 7 and 8 is between Pieces 2 and 3 at ~63 cm (see Comments below).

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	4-5	8	0.5	2-3	Euhedral to subhedral laths; rare glomerocrysts
Olivine:	trace	5	0.5	1	Euhedral, rarely embayed
Clinopyroxene:	trace	1			Subhedral, often in plagioclase- clinopyroxene glomerocrysts

GROUNDMASS: Aphanitic to very fine grained; mesostasis wisps decrease in abundance from 20-50 cm and are absent below 50 cm.

VESICLES: Rare irregular and ovoid vesicles, ≤8 mm, filled concentrically with pale blue-green clay and clear zeolite. Rare larger vesicles (maximum 3 cm) at 23 and 54 cm are filled with silica. Abundance of 0.1-10 mm vesicles increases from 50-60 cm.

COLOR: Gray to grayish green.

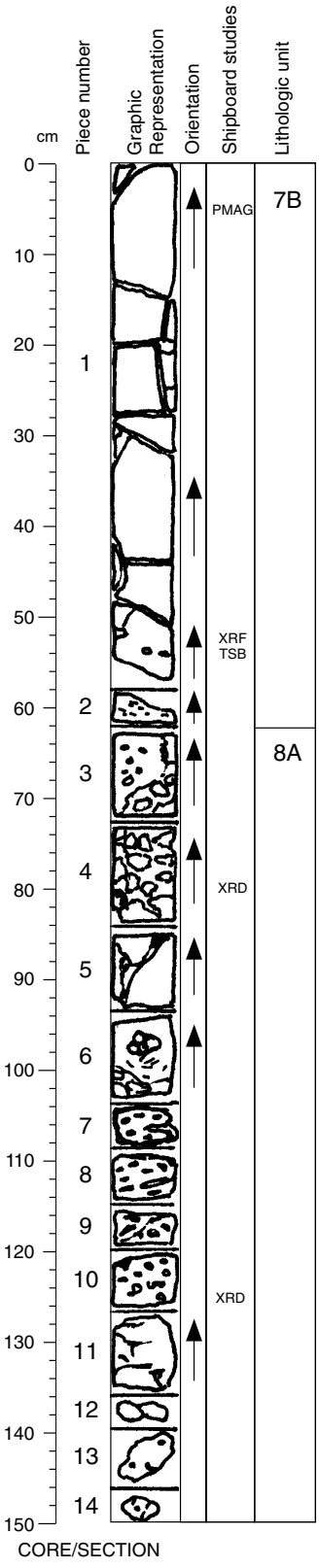
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Well fractured; moderately dipping conjugate joint sets filled with thin (< 1 mm) layer of dark green clay.

COMMENTS: Top of Unit 8A is interpreted to be a basal breccia for the lava flow of Unit8.

Core Photo



183-1137A-39R-2 **Section top: 333.50 (mbsf)**

UNIT 8A: SPARSELY PLAGIOCLASE-PHYRIC BASALTIC BRECCIA

Pieces: 3-14

CONTACTS: The top contact of Unit 8 is between Pieces 2 and 3 (see Comments below).

PHENOCRYSTS IN CLASTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	2	2.5	0.2	1.5	Laths; glomerocrysts with euhedral to subhedral forms
Olivine:	trace			≤0.6	Euhedral, fresh (?) cores, green clay rims
Clinopyroxene:	trace			≤0.2	Anhedral

GROUNDMASS: Very fine-grained to aphanitic pinkish brown; contains very fine-grained sulfide.

VESICLES: Sparse to moderate. Vesicles (≤8 mm) are mostly filled with dark to light green clay, calcite, and zeolite. Brecciated zones in Pieces 9 and 11 contain what appear to be crushed vesicles.

COLOR: Dark greenish to reddish black.

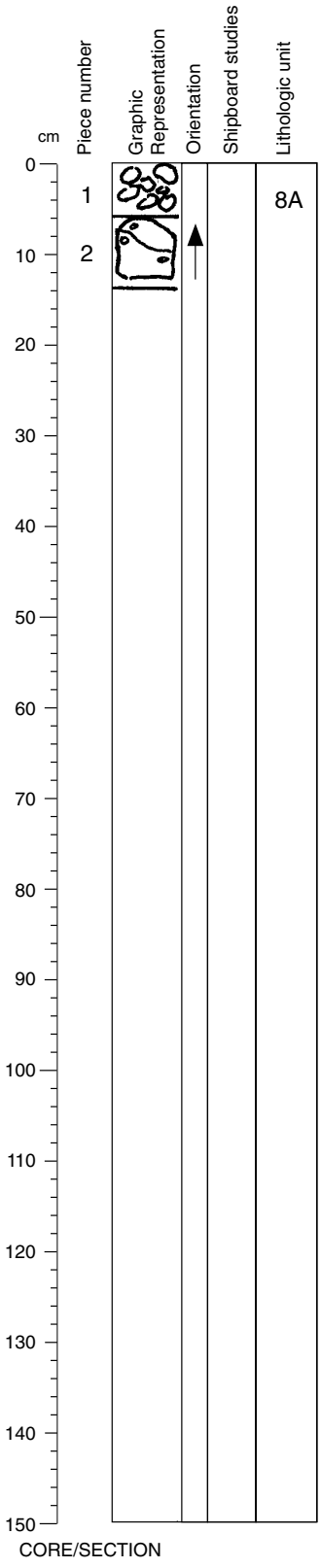
STRUCTURE: Brecciated and vesicular massive.

ALTERATION: Moderate to high. Breccia matrix includes calcite, clay, and zeolite; sulfide with square cross-section is evident in places.

VEINS/FRACTURES: None.

COMMENTS: The clasts in the breccia from 63-104 cm are identical in morphology to the flowtop breccia of Unit 7A. From 104 cm downward, the lava is coherent with collapsed large vesicles.

Core Photo



183-1137A-39R-3 **Section top: 335.00 (mbsf)**

UNIT 8A: MODERATELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1, 2

CONTACTS: Not recovered; the inferred contact between Subunits 8A and 8B is between Sections 39R-3 and 40R-1.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	10	3	1		Euhedral; some glomerocrysts
Clinopyroxene:	<1	2	0.5	1	Subhedral, altered to green clay

GROUNDMASS: Fine-grained.

VESICLES: Sparsely vesicular; vesicles are round (0.5-1 mm) and filled with dark green and blue-green clay.

COLOR: Medium greenish gray.

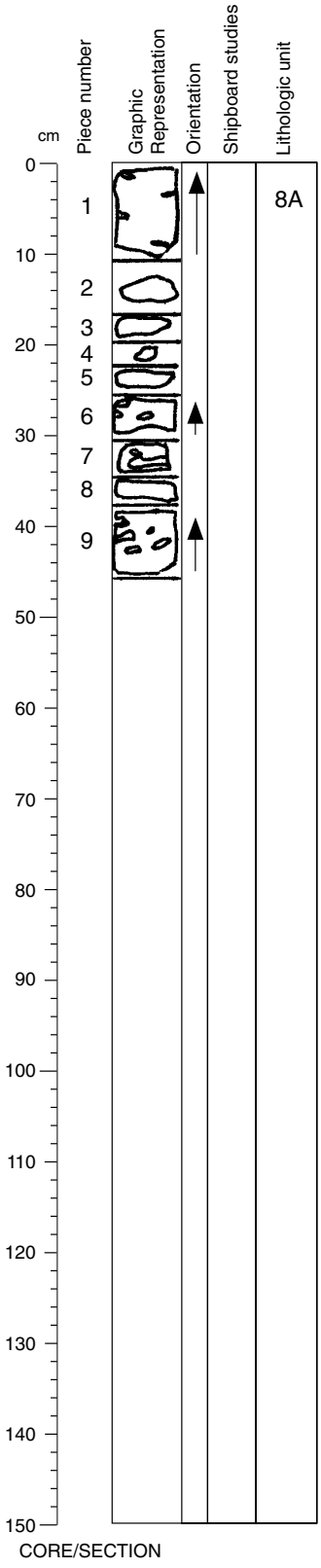
STRUCTURE: Massive.

ALTERATION: Moderate to high.

VEINS/FRACTURES: Several fine (0.1 mm) veins filled with clay and zeolite.

COMMENTS: Piece 1 consists of several 1-2 cm, highly altered basalt chips.

Core Photo



183-1137A-40R-1 **Section top: 337.60 (mbsf)**

UNIT 8B: MODERATELY PLAGIOCLASE-PHYRIC BASALT

Pieces: 1-9

CONTACTS: Not recovered; the inferred contact between Subunits 8A and 8B is between Sections 39R-3 and 40R-1.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	5	2	0.5	1	Euhedral to subhedral
Clinopyroxene:	< 1	0.5			Subhedral, replaced with dark green clay

GROUNDMASS: Fine-grained.

VESICLES: Sparsely vesicular. Two varieties: small (0.5-1 mm), round, clay-filled; large (1-3 cm), subhorizontal, filled with clay, zeolite and amorphous silica.

COLOR: Medium greenish gray.

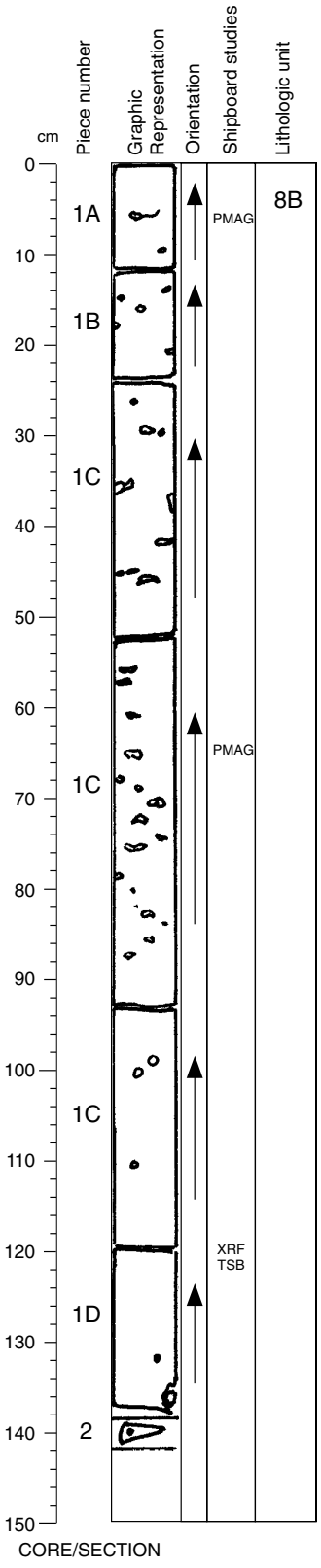
STRUCTURE: Massive.

ALTERATION: Slight to moderate, with clay replacing clinopyroxene.

VEINS/FRACTURES: Rare, fine (0.5 mm), filled with clay.

COMMENTS: Massive flow interior; broken into pieces, perhaps along subhorizontal vesicle boundaries.

Core Photo



183-1137A-40R-2 **Section top: 338.03 (mbsf)**

UNIT 8B: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1, 2

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	3-5	5	0.5	1.5	Subhedral to anhedral, fresh; some glomerocrysts with clinopyroxene
Clinopyroxene:	1	2.5	0.5		Subhedral, slightly altered

GROUNDMASS: Fine-grained.

VESICLES: Moderately vesicular with greatest abundance from 66-83 cm. Sparsely vesicular from 91-142 cm, where vesicles are also more round; fill includes amorphous silica, green clay, and zeolite.

COLOR: Medium greenish-gray.

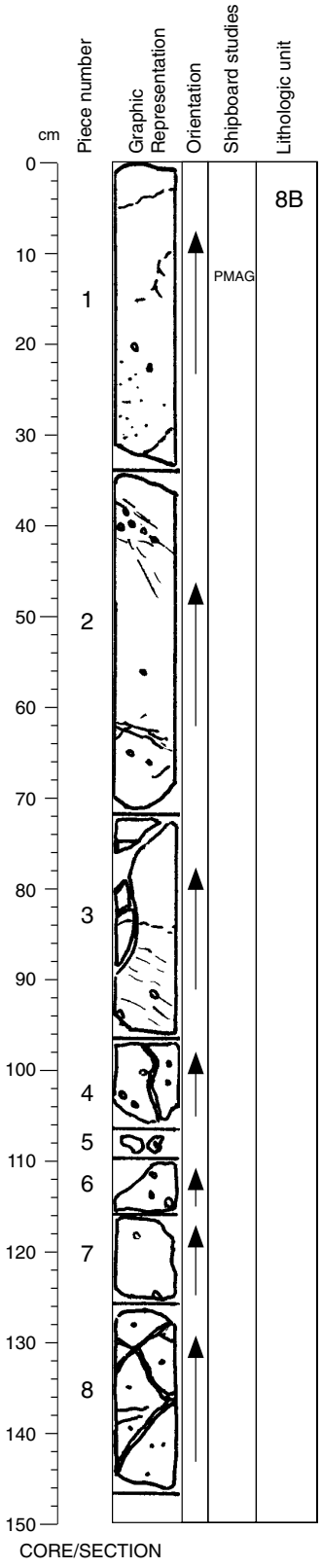
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Narrow (<0.5 mm) veins and fractures filled with clay, zeolite, and trace of pyrite.

COMMENTS:

Core Photo



183-1137A-40R-3 **Section top: 339.45 (mbsf)**

UNIT 8B: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1-8

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	2	4	1		Subhedral
Clinopyroxene:	1	1	0.5		Anhedral, replaced by clays

GROUNDMASS: Fine-grained.

VESICLES: Sparsely to moderately vesicular; vesicles are round (0.5-3 mm) and filled with clay and zeolite.

COLOR: Light greenish gray.

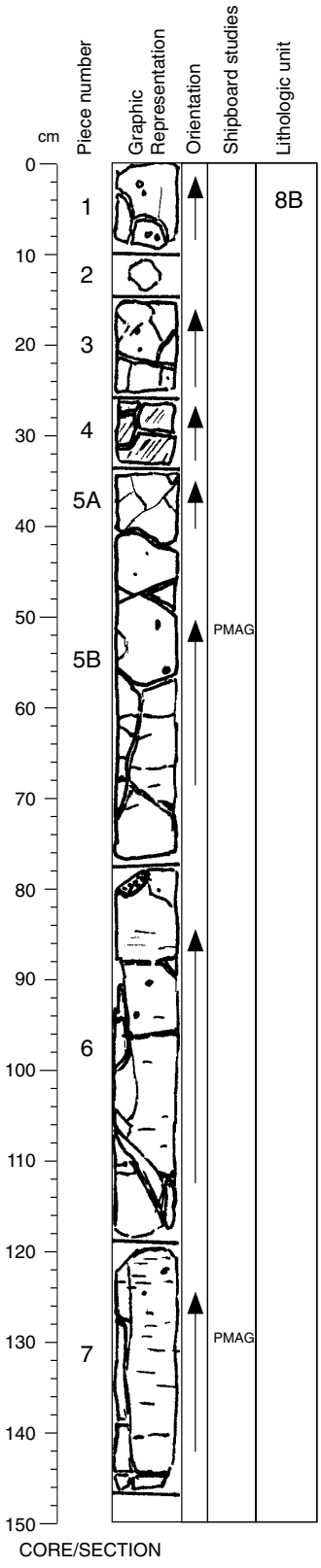
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Numerous, thin (<0.5 mm) veins are filled with clay and zeolite.

COMMENTS: Vesicle-rich zone dipping 45° in Piece 1. Glomerocrysts of plagioclase and clinopyroxene in Piece 7.

Core Photo



183-1137A-40R-4 **Section top: 340.92 (mbsf)**

UNIT 8B: SPARSELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1- 7

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	1	1.5	0.6	1	Euhedral, fresh
Clinopyroxene:	1	1	0.3		Euhedral to subhedral, partially replaced by clay

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular, round (0.5-3 mm) and filled with clay, amorphous silica, and zeolite.

COLOR: Medium greenish gray.

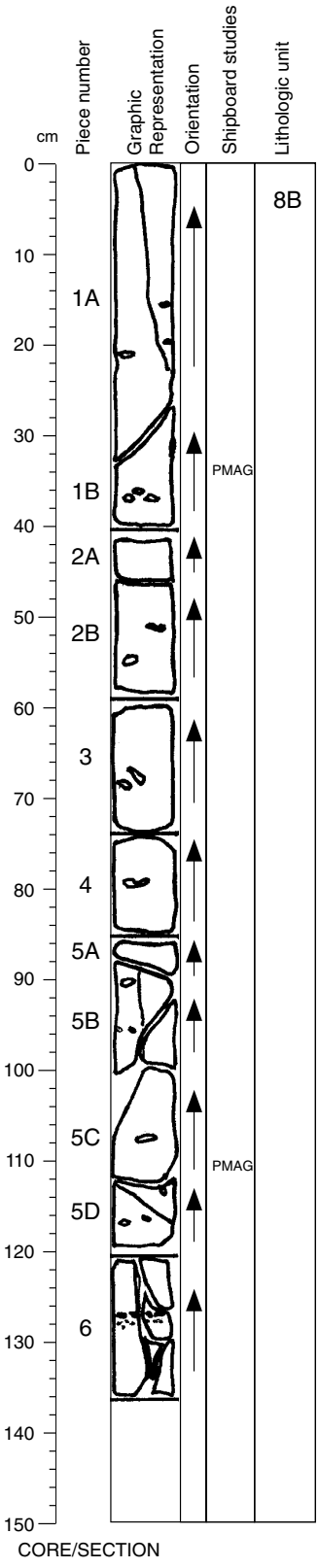
STRUCTURE: Massive

ALTERATION: Moderate.

VEINS/FRACTURES: Numerous thin (<0.5 mm) fractures in all pieces; filled with clay and, rarely, zeolite.

COMMENTS: Black streaks of altered groundmass (originally glass segregations?) are aligned subhorizontally, particularly in Piece 7.

Core Photo



183-1137A-40R-5 **Section top: 342.37 (mbsf)**

UNIT 8B: SPARSELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1-6

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	1	1.5	0.5	0.7	Euhedral to subhedral
Clinopyroxene:	1	0.7	0.4	0.5	Subhedral, partially replaced by clay

GROUNDMASS: Fine-grained.

VESICLES: Sparsely vesicular; round to flattened (1-20 mm) vesicles, filled with clay, zeolite, amorphous silica, and calcite. Vesicle-rich zone in Piece 6.

COLOR: Medium greenish gray.

STRUCTURE: Massive.

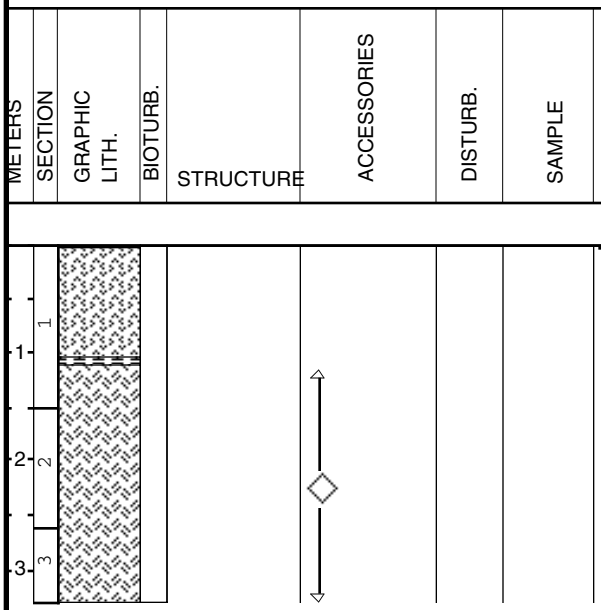
ALTERATION: Slight to moderate.

VEINS/FRACTURES: Several long subvertical fractures in most pieces, <0.5 mm wide, filled with clay and zeolite.

COMMENTS: Black streaks of altered groundmass (originally glass segregations?) are aligned subhorizontally.

Core Photo

1137A-41R 343-347.6 mbsf

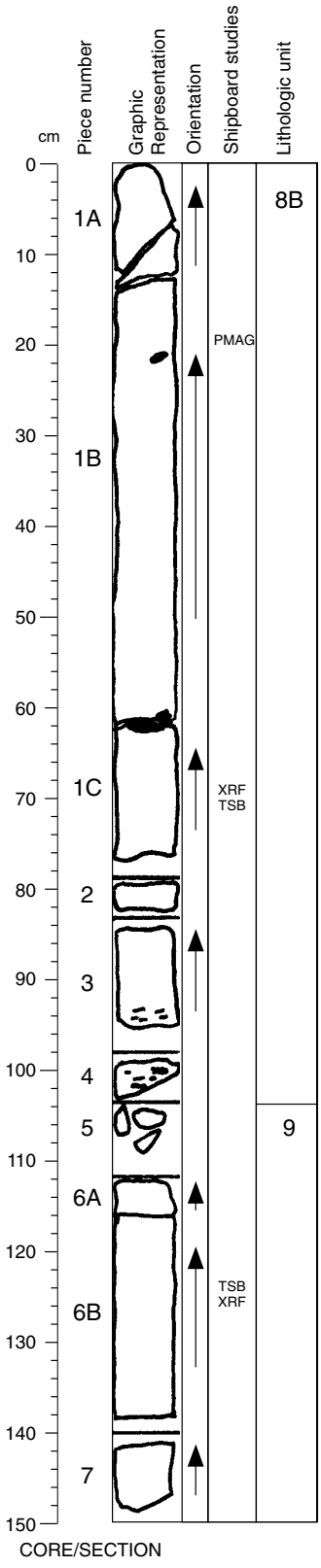


BASALT and CRYSTAL-VITRIC TUFF

Age: Campanian or older

General Description:
The top of this core contains the base of a BASALT lava flow (Basement Unit 8). Most of the core consists of green plagioclase CRYSTAL-VITRIC TUFF. Angular plagioclase crystals (1-2 mm) constitute about half of the components and are enclosed in a dense matrix inferred to have been derived fro vitric components. Dark green blebs (~ 1 mm) are common in thi matrix; in some sections, they are elongate and define a weak horizontal fabric. Dispersed lithic fragments make up a few per cent of the tuff, and include both rounded pebbles and angular fragments of mostly basalt and minor felsic materials. The tuff is very massive (unstratified). The TUFF in Sections 1 and 2 contains <5% oxidized clinopyroxene(?) crystals (causing an overall oxidized appearance). The top cm of the TUFF (Interval 41R-1, 112-113 cm) is brown and vitric (<5% crystals). Interval 41R-1, 104-112 cm contains several pieces of a black dense material, with a few scattered small feldspar crystals (METAMORPHIC ROCK on graphic log). Lack of internal structures suggests reworking and/or redeposition of the TUFF.

Core Photo



183-1137A-41R-1 **Section top: 343.00 (mbsf)**

UNIT 8B: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1-4

CONTACTS: Not recovered; thecontact between Units 8 and 9 is inferred to be between Pieces 4 and 5 at 103 cm.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	2-5	6	1	3	Subhedral to anhedral, isolated phenocrysts and glomerocrysts with clinopyroxene
Clinopyroxene:	1	1	0.5		Euhedral to subhedral, largely altered to dark green clay

GROUNDMASS: Fine-grained.

VESICLES: Sparsely vesicular; vesicles are round to flattened, and partially to completely filled with dark green clays, zeolite and amorphous silica. Flattened, subhorizontal vesicles in Piece 4 are filled with white zeolite.

COLOR: Medium greenish gray.

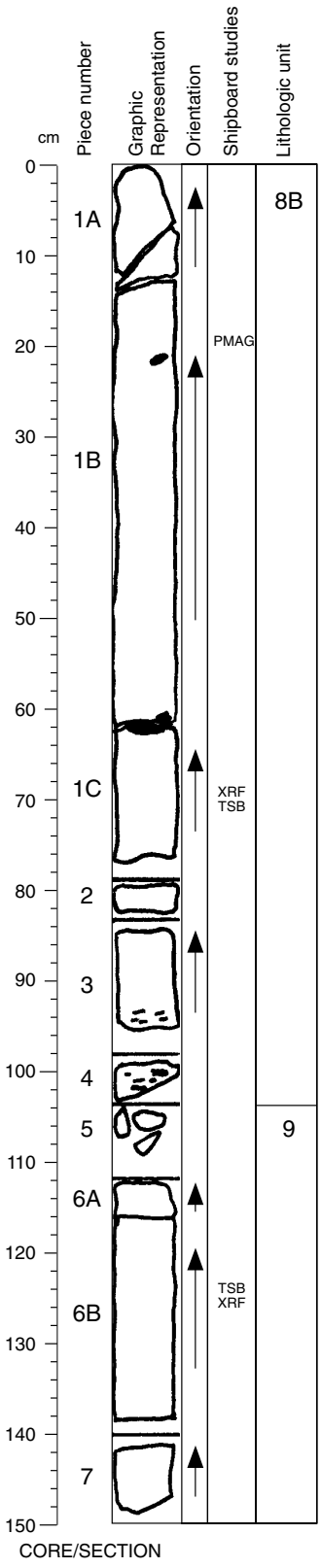
STRUCTURE: Massive.

ALTERATION: Slight to moderate, increasing toward the bottom of Piece 4.

VEINS/FRACTURES: None.

COMMENTS: Piece 4 appears to be near the basal contact of the flow on the basis of vesicles and alteration; phenocryst content increases from 2% to 5 % in Piece 4.

Core Photo



183-1137A-41R-1 **Section top: 343.00 (mbsf)**

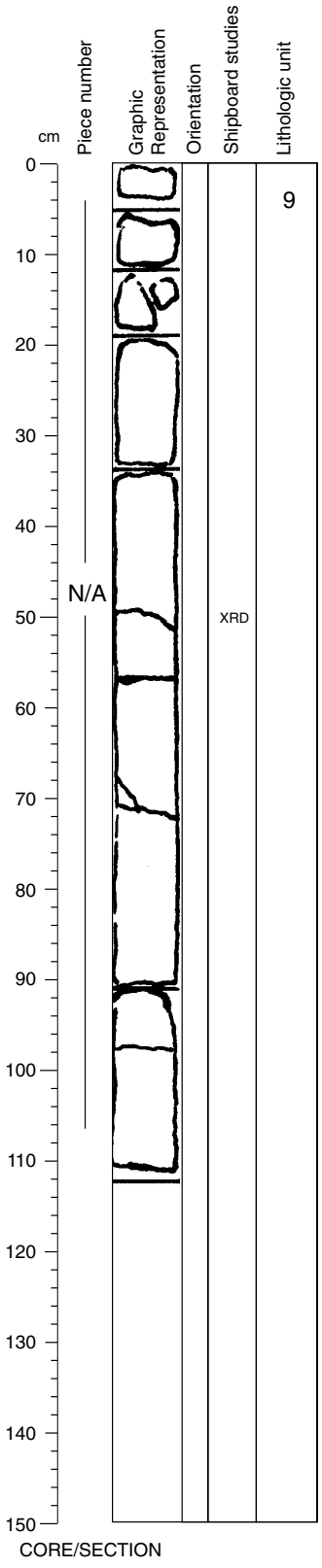
UNIT 9: CRYSTAL-VITRIC TUFF

Pieces: 5-7

CONTACTS: Not recovered; the contact between Units 8 and 9 is inferred to be between Pieces 4 and 5.

GENERAL DESCRIPTION: Altered crystal-vitric tuff consisting of ~50% angular, euhedral (broken?) sanidine crystals and ~5% rounded to elongate basaltic lithics (≤2 cm) in a green clay matrix. Some of the smaller lithic fragments are oxidized (reddish orange). The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 1.5 mm). Slight oxidation has produced some irregular orange patches within the matrix. The upper interval of the tuff is more indurated than the underlying parts and has a slightly darker color, suggesting the top has been baked by the overlying basalt. In the uppermost interval (Piece 5, 104-112 cm), the tuff is very fine grained and black, with <5% scattered, broken sanidine crystals. Internal structures suggest redeposition, possibly as a debris flow.

Core Photo



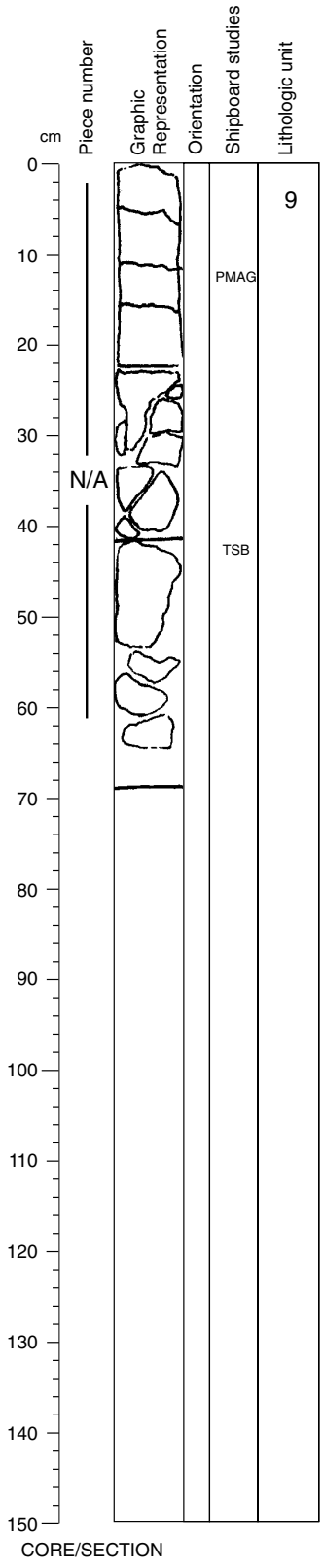
183-1137A-41R-2 **Section top: 344.50 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

CONTACTS: None.

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% elongate to rounded, highly oxidized basaltic lithics (≤2 cm) in an olive greenish-brown clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 1.5 mm). Slight oxidation has produced some irregular orange patches within the matrix. An orange oxidation band 0.5 cm wide extends across the core from 94-108 cm. Internal structures suggest redeposition, possibly as a debris flow.

Core Photo



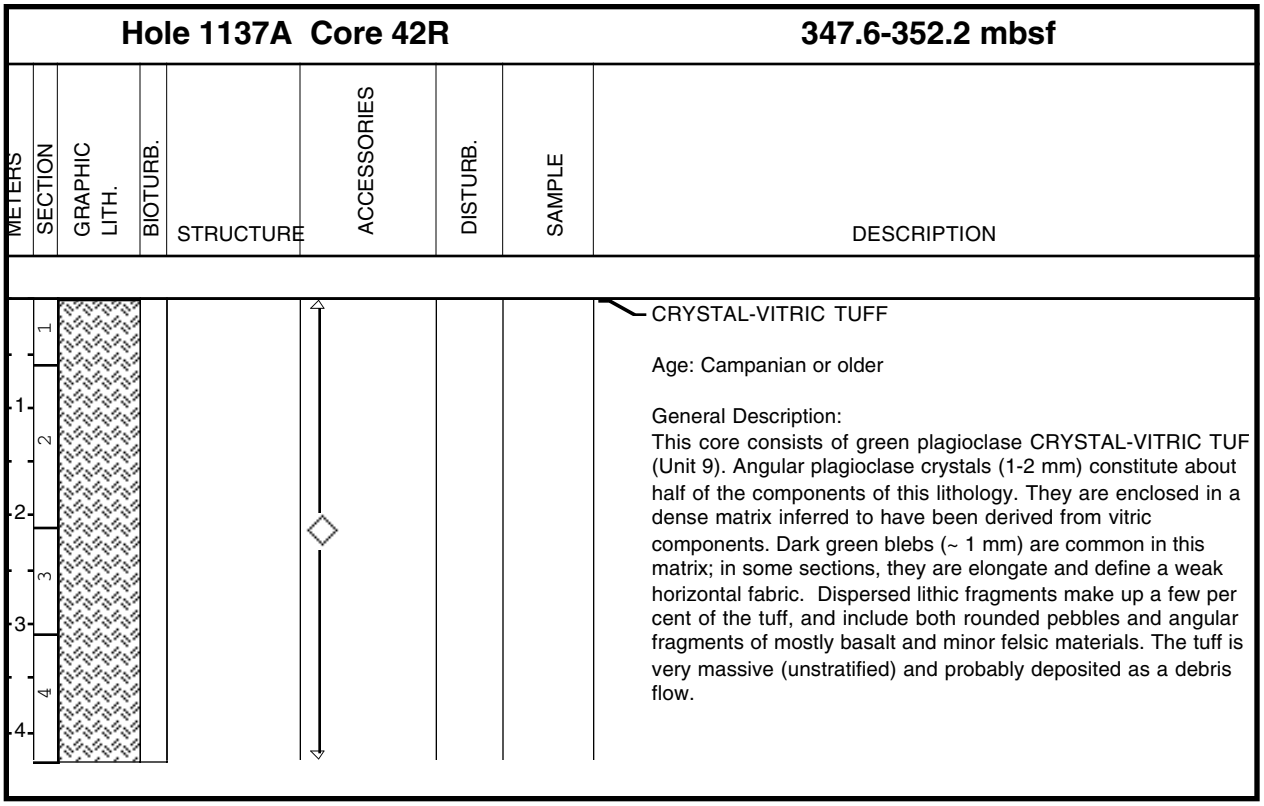
183-1137A-41R-3 **Section top: 345.62 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

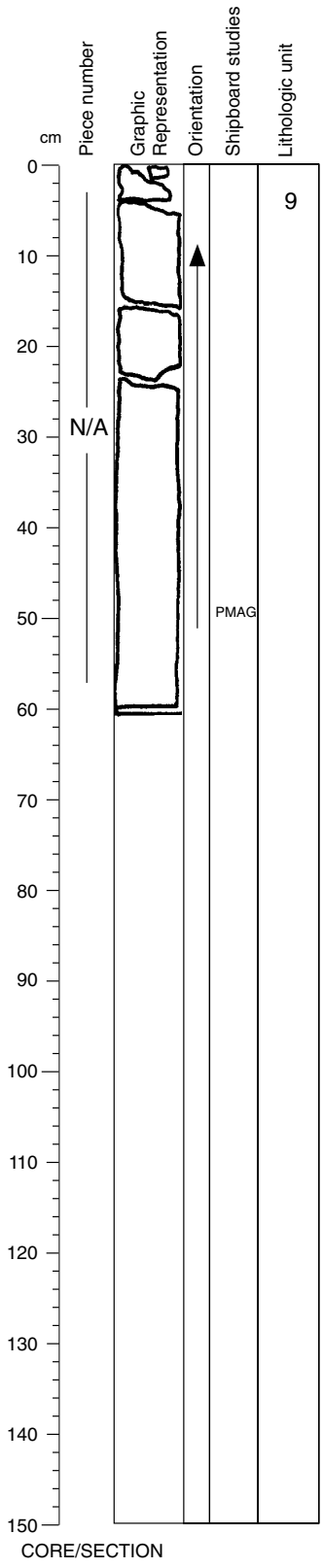
CONTACTS: None.

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% elongate to rounded, highly oxidized basaltic lithics (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, unstratified, and has a grain size of very coarse sand (1 to 1.2 mm). This section is greener and less oxidized than overlying sectins (41R-1, 41R-2), incidating a downward decrease in extent of oxidation. Internal structures suggest redeposition, possibly as a debris flow.

Core Photo


Hole 1137A Core 42R
347.6-352.2 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
3
4
CRYSTAL-VITRIC TUFF
Age: Campanian or older
General Description:
This core consists of green plagioclase CRYSTAL-VITRIC TUF (Unit 9). Angular plagioclase crystals (1-2 mm) constitute about half of the components of this lithology. They are enclosed in a dense matrix inferred to have been derived from vitric components. Dark green blebs (~ 1 mm) are common in this matrix; in some sections, they are elongate and define a weak horizontal fabric. Dispersed lithic fragments make up a few per cent of the tuff, and include both rounded pebbles and angular fragments of mostly basalt and minor felsic materials. The tuff is very massive (unstratified) and probably deposited as a debris flow.

Core Photo



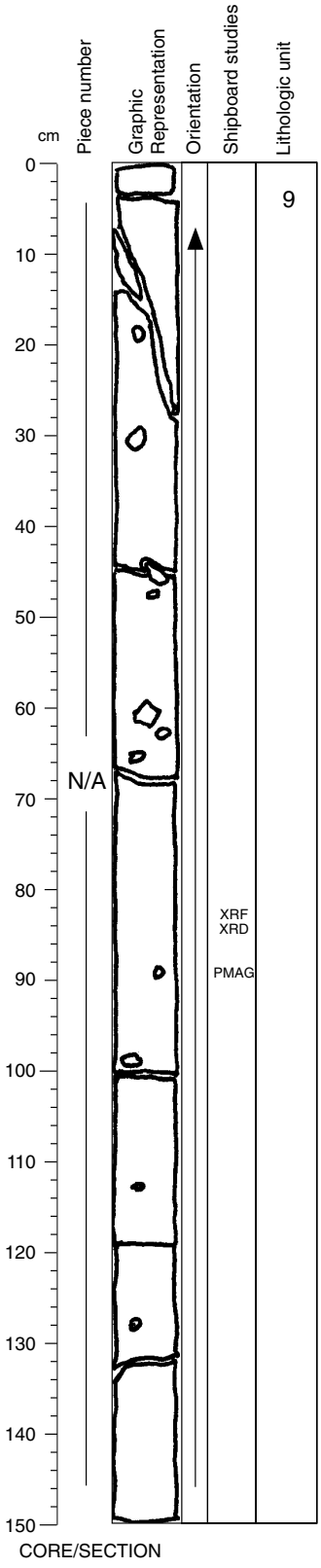
183-1137A-42R-1 **Section top: 347.60 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

CONTACTS: None.

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% rounded to elongate, basaltic lithics (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, unstratified, and has a grain size of very coarse sand (1 to 3 mm). Internal structures suggest redeposition, possibly as a debris flow.

Core Photo



183-1137A-42R-2 **Section top: 348.21 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

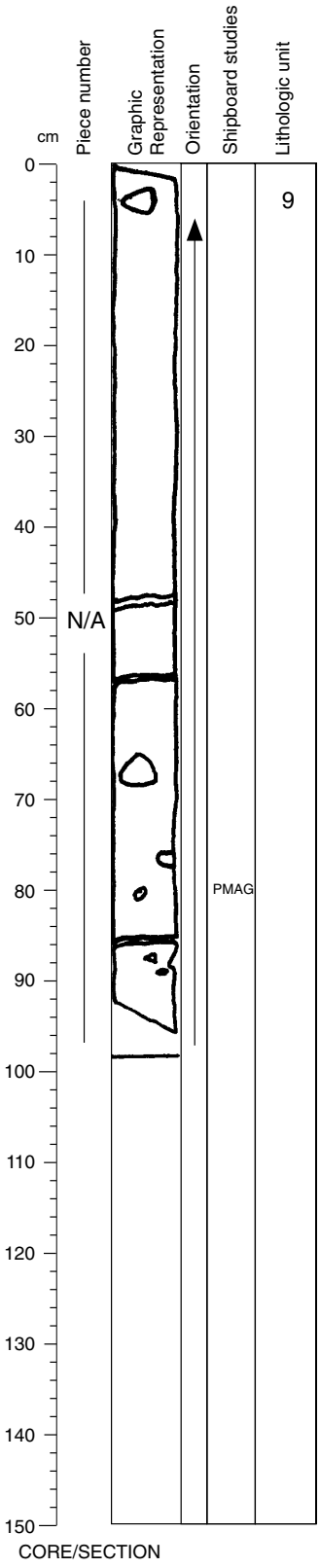
CONTACTS: None.

COLOR: Varies from dark green (0-4 cm) and medium to dark green (35-96 cm) to light green (4-35 cm, 96-150 cm).

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of~50% angular, euhedral (broken?) sanidine crystals and ~1-2% lithic fragments (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 3 mm); it is unstratified but has a pervasive, weak horizontal fabric caused by alignment of dark green grains. Lithic clasts larger than 1 cm are described below. Internal structures suggest redeposition, possibly as a debris flow.

CLAST LITHOLOGIES:
Interval 30-32 cm: Massive trachyte (1.5 x 2 cm clast); fresh center with 2-mm oxidized rind.
Interval 44-46 cm: Moderately altered, medium-grained aphyric basalt (1 x 3 cm).
Interval 59-62 cm: Slightly altered, fine-grained, sparsely plagioclase-phyric basalt (3 x 3 cm).
Interval 62-63 cm: Scoriaceous, moderately altered, fine-grained plagioclase-phyric basalt (1 x 2 cm).
Interval 98-100 cm: Moderately altered, vesicular, aphanitic, massive trachyte (1 x 3 cm).

Core Photo



183-1137A-42R-3 **Section top: 349.71 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

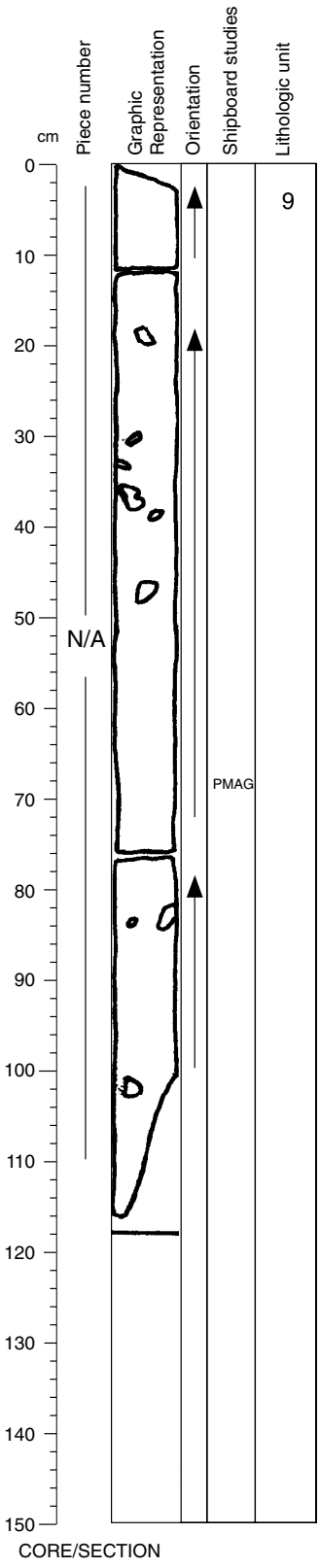
CONTACTS: None.

COLOR: Varies from light green (0-71 cm) to dark green (71-97 cm).

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% lithic fragments (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 3 mm); it is unstratified but has a pervasive, weak horizontal fabric caused by alignment of dark green grains. Lithic clasts larger than 1 cm are described below. Internal structures suggest redeposition, possibly as a debris flow.

CLAST LITHOLOGIES:
Interval 3-5 cm: Rounded aphyric basalt (2 x 3 cm clast); slightly altered interior with 2-mm oxidized rind.
Interval 66-70 cm: Scoriaceous, moderately altered, aphanitic, aphyric basalt (3 x 4 cm).
Interval 77-78 cm: Moderately altered, sparsely plagioclase-clinopyroxene-phyric basalt (1.5 x 1.5 cm clast) with megacrysts (3-6 mm) in a fine-grained groundmass.

Core Photo



183-1137A-42R-4 **Section top: 350.69 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

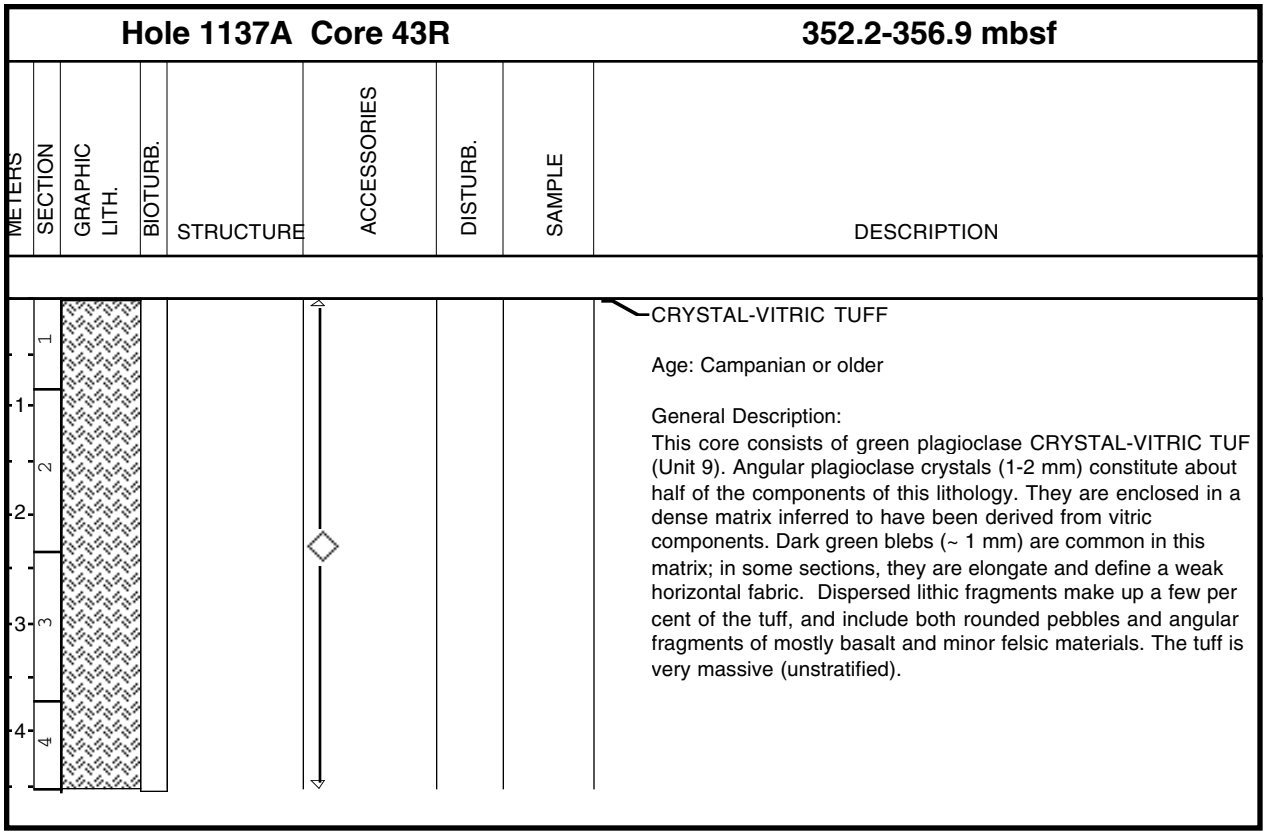
CONTACTS: None.

COLOR: Grayish blue-green.

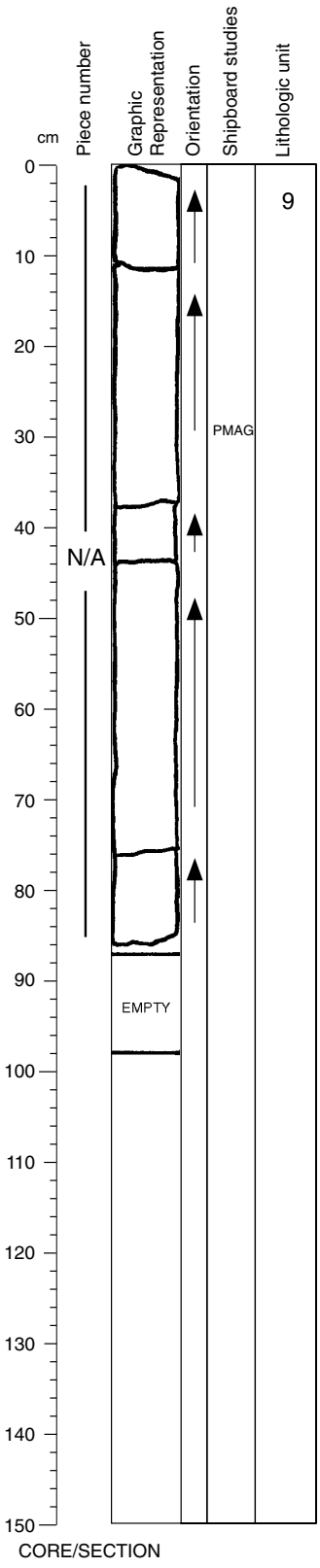
GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% lithic fragments (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 3 mm); it is unstratified but has a pervasive, weak horizontal fabric caused by alignment of dark green grains. Lithic clasts larger than 1 cm are described below. Internal structures suggest redeposition, possibly as a debris flow.

CLAST LITHOLOGIES:
Interval 19-20 cm: Round, completely altered aphyric basalt (1.2 cm).
Interval 34-35 cm: Scoriaceous, highly altered aphyric basalt (1.3 cm); aphanitic.
Interval 37-38 cm: Moderately altered, moderately vesicular aphyric basalt (3 cm); fine-grained groundmass.
Interval 46-48 cm: Completely altered aphyric basalt (1.6 cm).
Interval 82-84 cm: Moderately altered, highly plagioclase-phyric basalt (1.3 cm).
Interval 103-104 cm: Slightly altered, aphyric, aphanitic basalt (1.3 cm).

Core Photo


Hole 1137A Core 43R
352.2-356.9 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
CRYSTAL-VITRIC TUFF
Age: Campanian or older
General Description:
This core consists of green plagioclase CRYSTAL-VITRIC TUF (Unit 9). Angular plagioclase crystals (1-2 mm) constitute about half of the components of this lithology. They are enclosed in a dense matrix inferred to have been derived from vitric components. Dark green blebs (~ 1 mm) are common in this matrix; in some sections, they are elongate and define a weak horizontal fabric. Dispersed lithic fragments make up a few per cent of the tuff, and include both rounded pebbles and angular fragments of mostly basalt and minor felsic materials. The tuff is very massive (unstratified).

Core Photo



183-1137A-43R-1 **Section top: 352.20 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

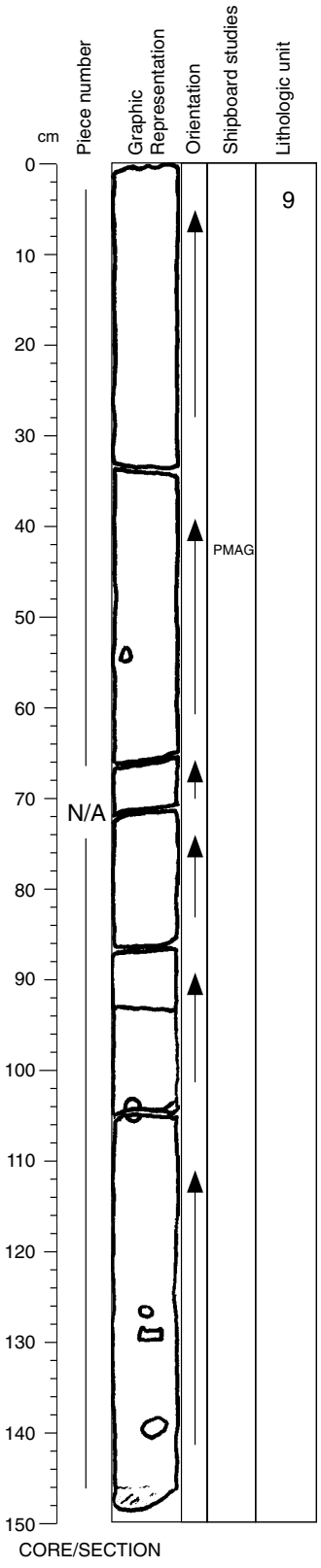
CONTACTS: None.

COLOR: Grayish blue-green.

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% lithic fragments (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 3 mm). Lithic clasts in this section have rims of dark green clay and native copper. Clasts larger than 1 cm are described below. Internal structures suggest redeposition, possibly as a debris flow.

CLAST LITHOLOGIES:
Interval 34-36 cm: Round, highly altered, highly vesicular, aphyric, aphanitic basalt (1.5 cm).
Interval 36-37 cm: Vesicular, highly altered, fine-grained, aphyric basalt (1 cm).
Interval 48-50 cm: Highly altered, highly altered, white massive trachyte or granitoid (2.5 cm clast) with subhedral feldspar (≤1.5 mm) and clinopyroxene (≤0.8 mm).
Interval 56-57 cm: Round, highly altered, vesicular, fine-grained clinopyroxene-phyric basalt (1 cm clast) with subhedral to anhedral clinopyroxene (~0.3 mm grain size).

Core Photo



183-1137A-43R-2 **Section top: 353.05 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

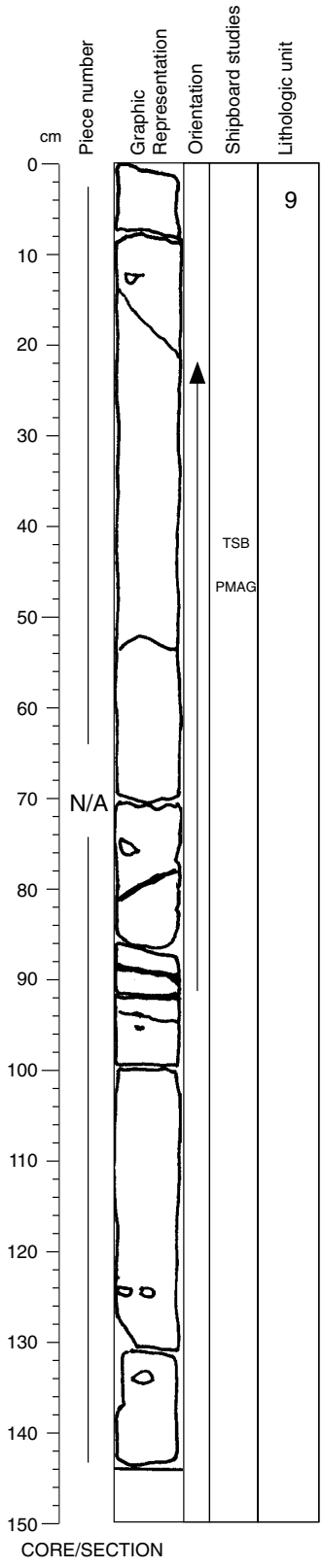
CONTACTS: None.

COLOR: Grayish blue-green.

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% lithic fragments (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 3 mm). Clasts larger than 1 cm are described below. Internal structures suggest redeposition, possibly as a debris flow.

CLAST LITHOLOGIES:
Interval 54-56 cm: Highly altered, aphyric fine-grained basalt (1.5 cm clast) with continuous 2-mm-wide oxidation rim.
Interval 56-57 cm: Moderately altered, subangular plagioclase-clinopyroxene-phyric scoria with aphanitic matrix (1 cm clast).
Interval 103-106 cm: Two clasts: (1) round, highly altered fine-grained plagioclase-phyric basalt (2.5 cm); (2) round, highly altered, vesicular, aphyric, aphanitic basalt (1.5 cm) with blue-green clay in amygdules.
Interval 127-128 cm: Round, moderately altered, fine-grained, massive trachyte (2 cm clast); contains subhedral to euhedral feldspar (grain size 0.8 mm) and subhedral clinopyroxene (grain size≤0.6 mm).
Interval 128-130 cm: Angular, highly altered massive trachyte (2.5 cm clast); contains subhedral feldspar and clinopyroxene (grain size≤0.8 mm).
Interval 138-140 cm: Highly altered (white), medium-grained, clinopyroxene-phyric basalt (2 cm clast) with subhedral to euhedral clinopyroxene (grain size ≤1 mm).

Core Photo



183-1137A-43R-3 **Section top: 354.52 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

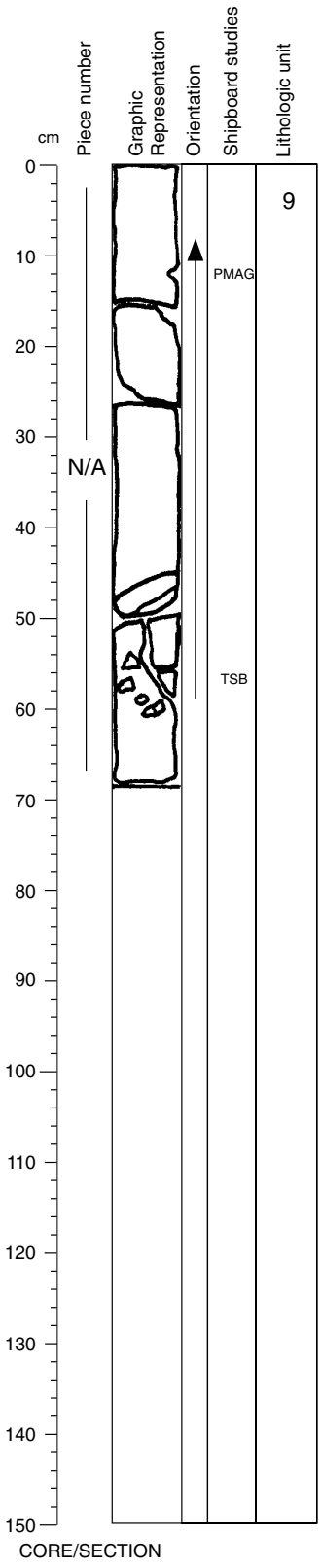
CONTACTS: None.

COLOR: Grayish blue-green.

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% lithic fragments (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 3 mm). In this section, lighter green zones are present, possibly representing recrystallized shear zones. Clasts larger than 1 cm are described below. Internal structures suggest redeposition, possibly as a debris flow.

CLAST LITHOLOGIES:
Interval 11-12 cm: Subangular, highly altered, fine-grained aphyric basalt (2.5 cm).
Interval 19-20 cm: Round, moderately altered, aphyric, aphanitic basalt (1 cm).
Interval 54-55 cm: Subround, moderately altered, plagioclase-phyric basalt (1 cm); plagioclase is ~1 mm.
Interval 74.5-76 cm: Round, moderately altered, vesicular, aphanitic, aphyric basalt (2.5 cm clast); vesicles filled with, and glass altered to, dark green-blue clay; discontinuous oxidation rim (2-4 mm thick).
Interval 89-90 cm: Rectangular plagioclase “cumulate” (1.5 cm clast) with one altered mafic mineral (0.3 mm).
Interval 124-125 cm: Highly altered, aphyric, vesicular basalt (1 cm).
Interval 133-134 cm: Vesicular, moderately altered, fine-grained massive trachyte (1 cm clast); feldspar (≤0.7 mm) is subhedral to anhedral; clinopyroxene (0.3-0.5 mm) is subhedral.

Core Photo



183-1137A-43R-4 **Section top: 355.93 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

CONTACTS: None.

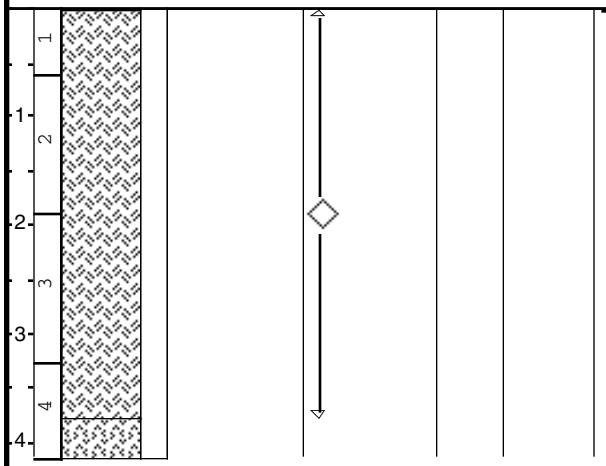
COLOR: Grayish blue-green.

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% lithic fragments (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 3 mm). Clasts larger than 1 cm are described below. Internal structures suggest redeposition, possibly as a debris flow.

CLAST LITHOLOGIES:
Interval 47-50 cm: Round, highly altered, fine-grained massive trachyte (5 cm clast), with subhedral feldspar (≤2 mm) and clinopyroxene (≤1.5 mm).
Interval 53-54 cm: Subangular, moderately altered, fine-grained plagioclase-phyric basalt (2 cm clast) with a 3-mm-thick oxidation rim.
Interval 55-56 cm: Subround, slightly to moderately altered, fine-grained clinopyroxene-phyric basalt (1 cm clast) with subhedral clinopyroxene (≤0.5 mm long).
Interval 57-58 cm: Angular, slightly altered clast (2 cm) containing pink translucent mineral (quartz?) and mica (muscovite?) in a plagioclase-rich matrix.

Core Photo

Hole 1137A Core 44R **356.9-361.7 mbsf**

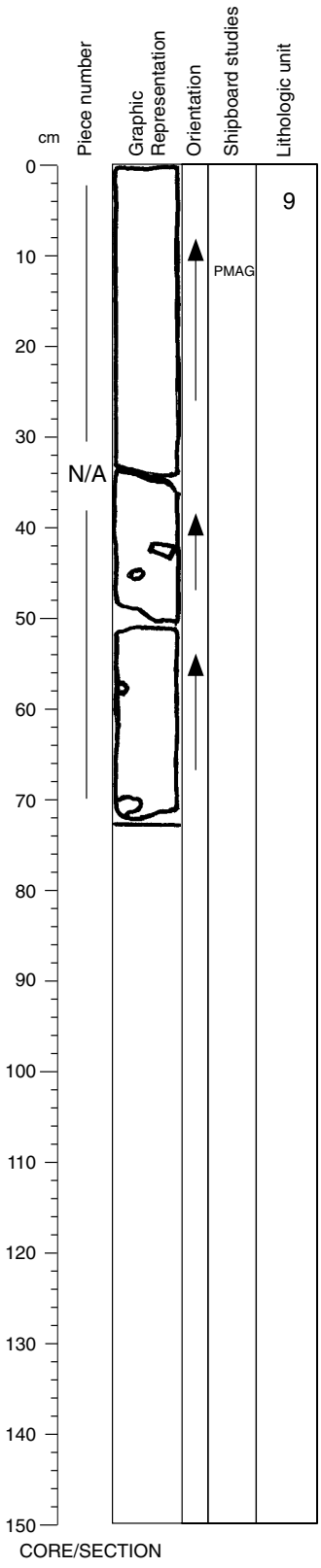


CRYSTAL-VITRIC TUFF and BASALT

Age: Campanian or older

General Description:
The bottom of this core contains the top of a BASALT lava flow (Unit 10). Most of the core consists of green plagioclase CRYSTAL-VITRIC TUFF (Unit 9). Angular plagioclase crystals (1-2 mm) constitute about half of the components of this lithology. They are enclosed in a dense matrix inferred to have been derived from vitric components. Dark green blebs (~ 1 mm) are common in this matrix; in some sections, they are elongate and define a weak horizontal fabric. Dispersed lithic fragments make up a few per cent of the tuff, and include both rounded pebbles and angular fragments of mostly basalt and minor felsic materials. The tuff is very massive (unstratified). A rounded pebble (1 cm x 2 cm) of biotite granite occurs in Interval 44R-4, 47-48 cm. A ~1 cm dark silt layer occurs at the base of the TUFF however, the contact with the BASALT was not recovered.

Core Photo



183-1137A-44R-1 **Section top: 356.90 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

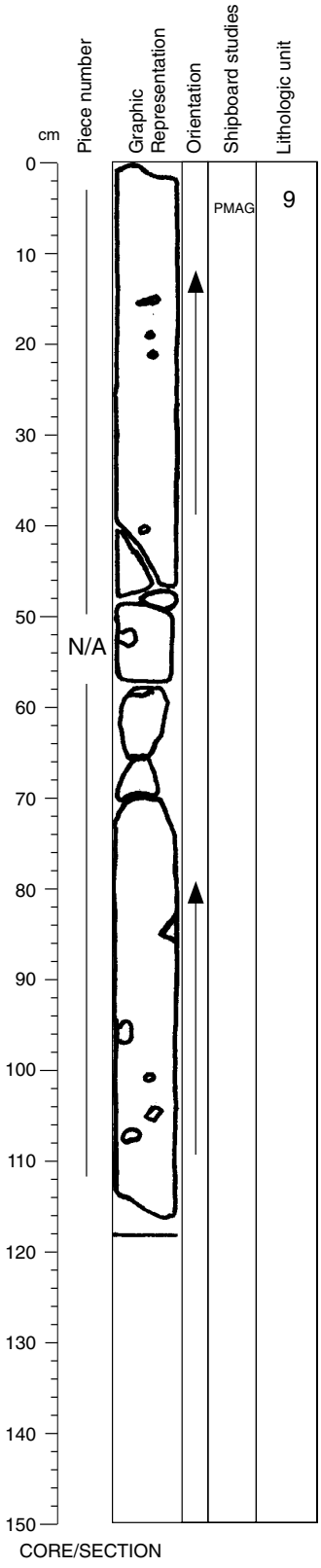
CONTACTS: None.

COLOR: Grayish blue-green.

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% lithic fragments (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 3 mm). Clasts larger than 1 cm are described below. Internal structures suggest redeposition, possibly as a debris flow.

CLAST LITHOLOGIES:.
Interval 41-42 cm: Angular, highly altered, fine-grained clinopyroxene-phyric basalt (1 x 2 cm).
Interval 44-46 cm: Highly altered, fine-grained aphyric basalt (1 x 1 cm).
Interval 67-68 cm: Highly altered, fine-grained aphyric basalt (2 cm).

Core Photo



183-1137A-44R-2 **Section top: 357.52 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

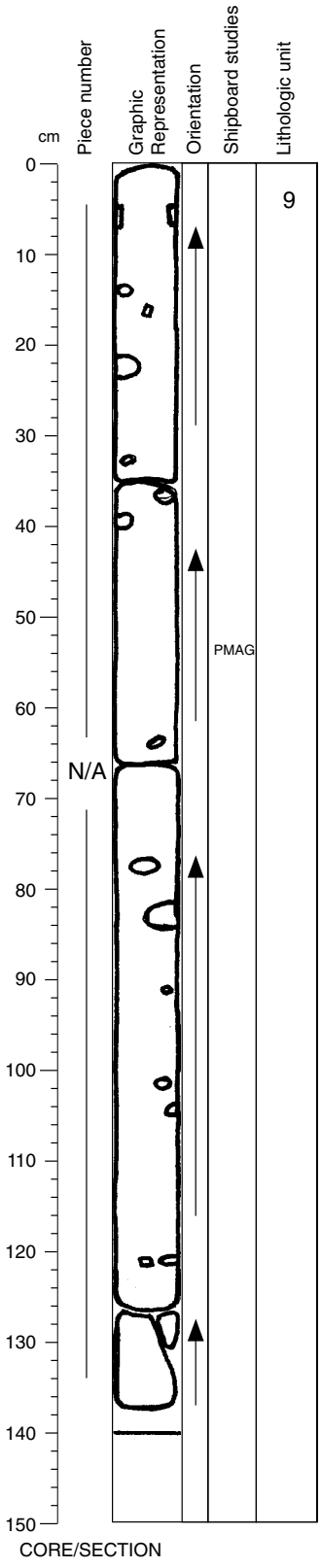
CONTACTS: None.

COLOR: Grayish blue-green.

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% lithic fragments (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 3 mm). Clasts larger than 1 cm are described below. Internal structures suggest redeposition, possibly as a debris flow.

CLAST LITHOLOGIES:
Interval 51-52 cm: Subround, moderately altered, fine-grained aphyric basalt (1 x 2 cm) with oxidation rind.
Interval 95-97 cm: Round, moderately altered, fine-grained, aphyric basalt (2 x 2.5 cm) with oxidation rind.
Interval 84-86 cm: Highly altered plagioclase-phyric basalt (2 cm).
Interval 106-107 cm: Subangular, moderately altered, fine-grained, aphyric basalt (1 x 2 cm).
Interval 107-108 cm: Angular, moderately altered, highly vesicular aphyric basalt (1 x 2 cm).

Core Photo



183-1137A-44R-3 **Section top: 358.80 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

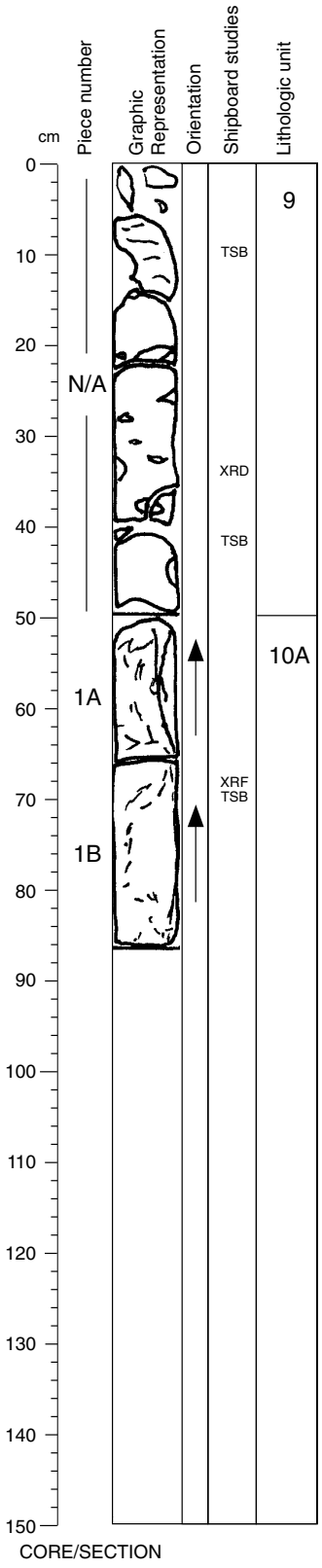
CONTACTS: None.

COLOR: Grayish blue-green.

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~5% pebble-size lithic fragments (≤2 cm) in a green clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 3 mm). In this section, the lithic fragments have dark green alteration rinds. Clasts larger than 1 cm are described below. Internal structures suggest redeposition, possibly as a debris flow.

CLAST LITHOLOGIES:
Interval 5-6 cm: Slightly altered aphyric basalt (1 x 2 cm).
Interval 14-15 cm: Slightly altered aphyric basalt (2 x 3 cm).
Interval 20-23 cm: Moderately altered massive trachyte (2 x 3 cm).
Interval 38-40 cm: Moderately altered aphyric basalt (2 x 2 cm).
Interval 77-79 cm: Highly altered, vesicular, aphyric basalt (2 x 4 cm).
Interval 81-83 cm: Moderately altered, moderately vesicular, aphyric basalt (2 x 4 cm).
Interval 101-102 cm: Moderately altered aphyric basalt (1 cm).
Interval 104-106 cm: Moderately altered clinopyroxene-phyric basalt (1 x 1 cm).
Interval 120-121 cm: Moderately altered, medium-grained aphyric basalt (1 x 2 cm).

Core Photo



183-1137A-44R-4 **Section top: 360.18 (mbsf)**

UNIT 9: CRYSTAL-VITRIC TUFF

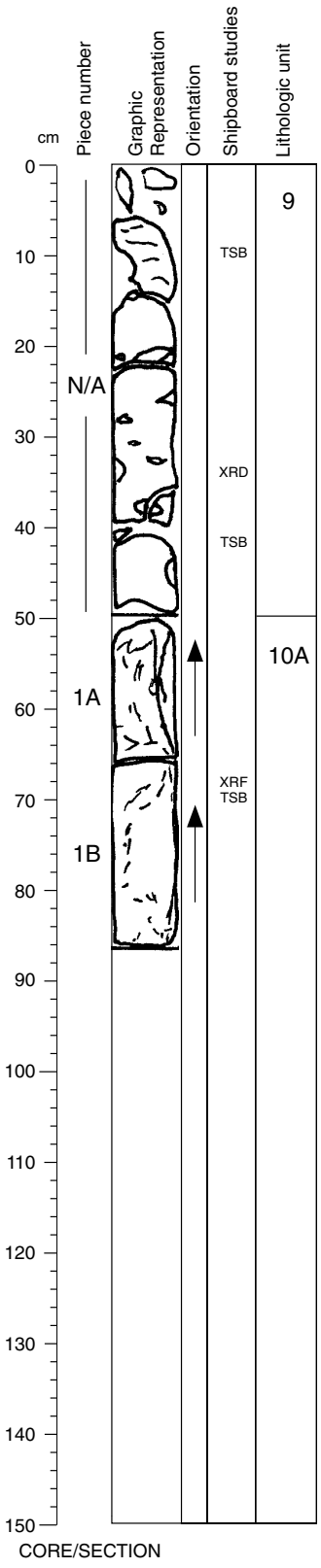
CONTACTS: None recovered; the contact between Units 9 and 10 is inferred to be between the base of the tuff (49 cm) and above igneous Piece 1A.

COLOR: Grayish blue-green.

GENERAL DESCRIPTION: This section consists of altered crystal-vitric tuff composed of ~50% angular, euhedral (broken?) sanidine crystals and ~1-2% lithic fragments (≤2 cm) in a green to blue-green clay matrix. The tuff is indurated, well sorted, and has a grain size of very coarse sand (1 to 3 mm). Approximately 1 cm of dark silt is preserved at the base of the tuff. Clasts larger than 1 cm are described below. Internal structures suggest redeposition, possibly as a debris flow.

CLAST LITHOLOGIES:
Interval 19-21 cm: Highly altered, fine-grained plagioclase-phyric basalt (2 x 3.5 cm).
Interval 23-25 cm: Subangular, highly altered massive trachyte (1 x 2 cm).
Interval 29-30 cm: Moderately altered plagioclase-phyric basalt (1 x 1.5 cm).
Interval 33-34 cm: Subangular, moderately altered, vesicular fine-grained basalt (1 x 2 cm).
Interval 37-38 cm: Highly altered, fine-grained aphyric basalt (2 x 4 cm).
Interval 39-41 cm: Moderately altered, medium-grained aphyric basalt (1 x 3 cm) with oxidation rind.
Interval 44-47 cm: Slightly to moderately altered granitic(?) clast (1 x 2 cm) with plagioclase, alkali feldspar, and biotite.

Core Photo



183-1137A-44R-4 **Section top: 360.18 (mbsf)**

UNIT 10A: HIGHLY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALTIC BRECCIA

Pieces: 1

CONTACTS: None recovered; the contact between Units 9 (crystal-vitric tuff) and 10 is inferred to be above Piece 1A and the bottom of the tuff (44R-4, 49 cm).

PHENOCRYSTS:	% Mode	Max	GRAIN SIZE (mm) Min	Avg	Shape
Plagioclase:	15-20	12	2	7	Subhedral to euhedral; some glomerocrysts
Clinopyroxene:	2	1	0.5		Subhedral

GROUNDMASS: Fine-grained groundmass of Piece 1B contains ≤0.3-mm plagioclase laths. Groundmass is aphanitic near the contact with the overlying tuff.

VESICLES: Moderately vesicular; vesicles arepartially filled with dark blue-green clays.

COLOR: Medium gray.

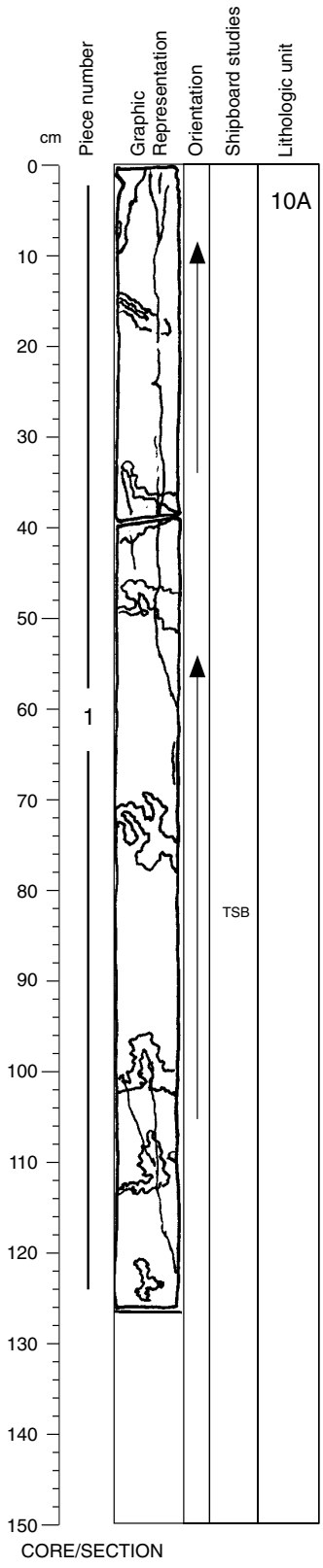
STRUCTURE: Brecciated; a massive lobe within the breccia at the top of Piece 1 has irregular margins.

ALTERATION: Moderate; groundmass is only slightly altered.

VEINS/FRACTURES: One anastamosing calcite-filled vein (0.5-1 mm).

COMMENTS: Unit 10A may be a sill or flow top that was brecciated when magma intruded into wet sediment. Alternatively, the brecciated flow top may have been reworked by sedimentary processes and infilled by silty sand. The basalt is more highly brecciated near the top of the section.

Core Photo



183-1137A-45R-1 **Section top: 361.70 (mbsf)**

UNIT 10A: HIGHLY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALTIC BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:

	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	15	2	0.5	7.5	Euhedral laths, single crystals, and in glomerocrysts
Clinopyroxene:	2	1	0.5		Subhedral
Olivine:	<1				

GROUNDMASS: Fine-grained.

VESICLES: Moderately vesicular; small irregular vesicles are filled with calcite and green clay. Vesicle sheets (concentrations of round vesicles) are present between 58 and 63 cm.

COLOR: Dark gray clasts (lobes) with some reddish patches near clast margins. Veins are mottled gray- green to blue-green and white. Some voids are filled with fine-grained green silty sand.

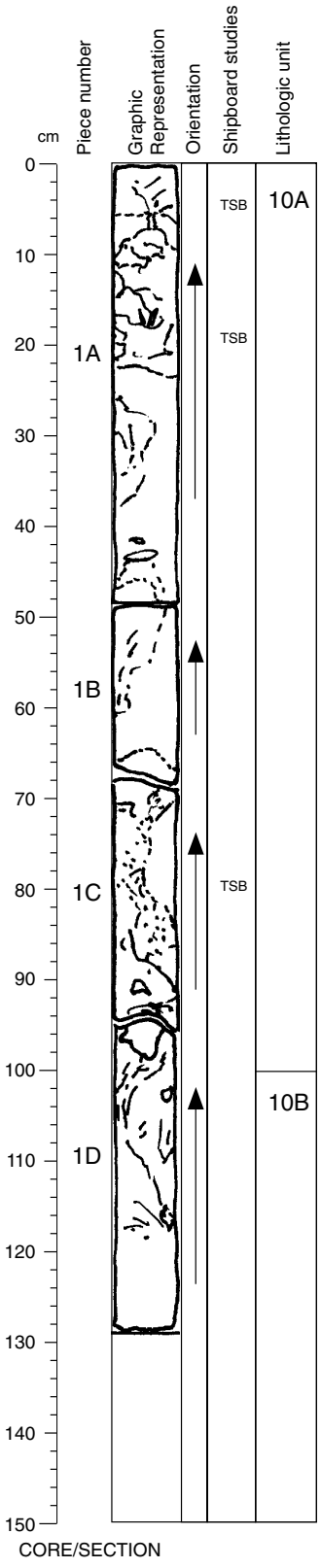
STRUCTURE: Brecciated.

ALTERATION: Moderate to high in groundmass of clasts; plagioclase phenocrysts are moderately altered (locally to calcite).

VEINS/FRACTURES: Steeply dipping calcite-filled veins, ≤2 mm wide. Some fractures are filled with blue-green fine-grained silty sand.

COMMENTS: The larger plagioclase crystals commonly have a broken appearance. The margins of lava domains are irregular and mingled with blue-green silty sand. Large domains of massive gray plagioclase-clinopyroxene-phyric basalt in the breccia are more phenocryst- and vesicle-rich near the centers and show fine-grained chilled and quenched, dark-colored to granulated margins. These domains are interpreted to be lobes or spalled fragments. Unit 10A may be a sill or flow top that was brecciated when magma intruded into wet sediment. Alternatively, the brecciated flow top may have been reworked by sedimentary processes and infilled by silty sand.

Core Photo



183-1137A-45R-2 **Section top: 362.97 (mbsf)**

UNIT 10A: HIGHLY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALTIC BRECCIA

Pieces: 1

CONTACTS: The contact between Subunits 10A and 10B is in Piece 1D, at 100 cm depth in the section.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	15	2	0.5	7.5	Euhedral laths, single crystals, and in glomerocrysts
Clinopyroxene:	1	1	0.5		Subhedral
Olivine:	<1				

GROUNDMASS: Fine-grained.

VESICLES: Moderately vesicular; small irregular vesicles are filled with calcite, zeolite, and green clay. Some vesicles are filled with fine-grained, blue-green silty sand.

COLOR: Mainly dark gray clasts with some red clasts and reddish granulated patches around clast margins (especially between 50 and 54 cm). Veins are mottled gray-green to blue-green and white.

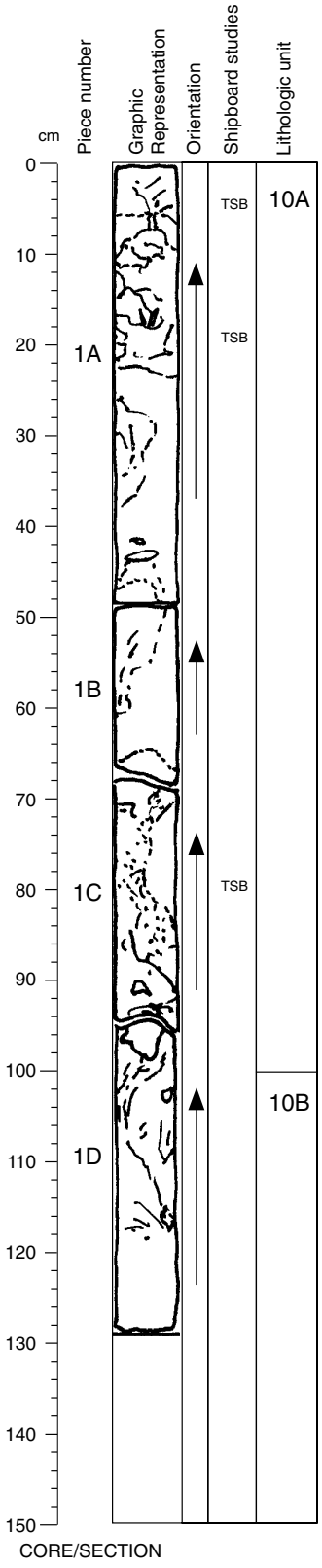
STRUCTURE: Brecciated.

ALTERATION: Moderate to high in groundmass of clasts; plagioclase phenocrysts are moderately altered.

VEINS/FRACTURES: Calcite-filled veins are ≤1 mm wide. Many fractures are filled with fine-grained, blue-green silty sand.

COMMENTS: Larger plagioclase crystals rarely have a broken appearance. The margins of clasts are irregular and in places (e.g., 50-54 cm) show a jigsaw-fit relationship with adjacent clasts, with silty sand between clasts. Higher in the section (5-20 cm), the breccia may be matrix-supported, with blue-green silty sand separating individual clasts. Large domains of massive gray plagioclase-clinopyroxene-phyric basalt in the breccia are more phenocryst-and vesicle-rich near the center and show fine-grained chilled and quenched, dark-colored to red oxidized, granulated margins. These domains may be lobes or spalled lobe fragments. Unit 10A may be a sill or flow top that was brecciated when magma intruded into wet sediment. Alternatively, the brecciated flow top may have been reworked by sedimentary processes and infilled by silty sand.

Core Photo



183-1137A-45R-2 **Section top: 362.97 (mbsf)**

UNIT 10B: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1

CONTACTS: The contact between Subunits 10A and 10B is in Piece 1D at 100 cm depth in the section.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	15	2	0.5	7.5	Dominantly euhedral laths; some other euhedral forms; glomerocrysts common
Clinopyroxene:	1	1.5	0.1	0.5	Subhedral to anhedral pseudomorphs; discrete and in glomerocrysts with plagioclase
Olivine:	<<1	1			Subhedral.

GROUNDMASS: Fine-grained.

VESICLES: Sparsely vesicular; vesicles are ≤8 mm, irregularly shaped, and filled concentrically with light and dark green clays, zeolite, and calcite.

COLOR: Gray to dark gray, reddish gray in patches.

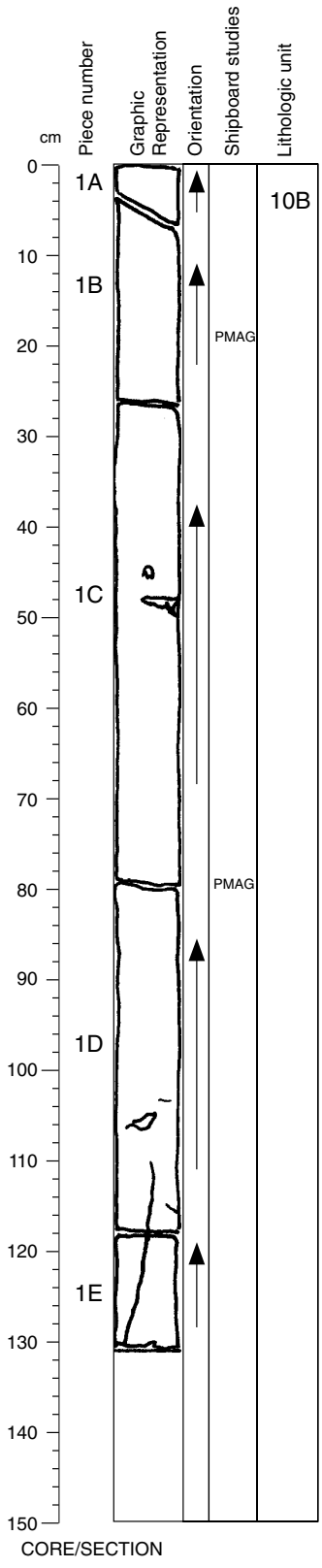
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Thin veins filled with calcite and green clay.

COMMENTS:

Core Photo



183-1137A-45R-3 **Section top: 364.27 (mbsf)**

UNIT 10B: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	5-10	12	0.5	5	Dominantly euhedral laths; some other euhedral forms; glomerocrysts common
Clinopyroxene:	2	1.5	0.1	0.5	Subhedral to anhedral pseudomorphs; discrete and in glomerocrysts with plagioclase
Olivine:	<1	1			Subhedral

GROUNDMASS: Fine-grained.

VESICLES: Sparsely vesicular; vesicles are ≤8 mm, irregularly shaped, and filled concentrically with light and dark green clay, zeolite, and calcite. In the upper 17 cm, tiny irregular vesicles filled with dark green clay are moderately abundant and scattered throughout the groundmass.

COLOR: Gray; groundmass in the upper 13 cm is pinkish gray.

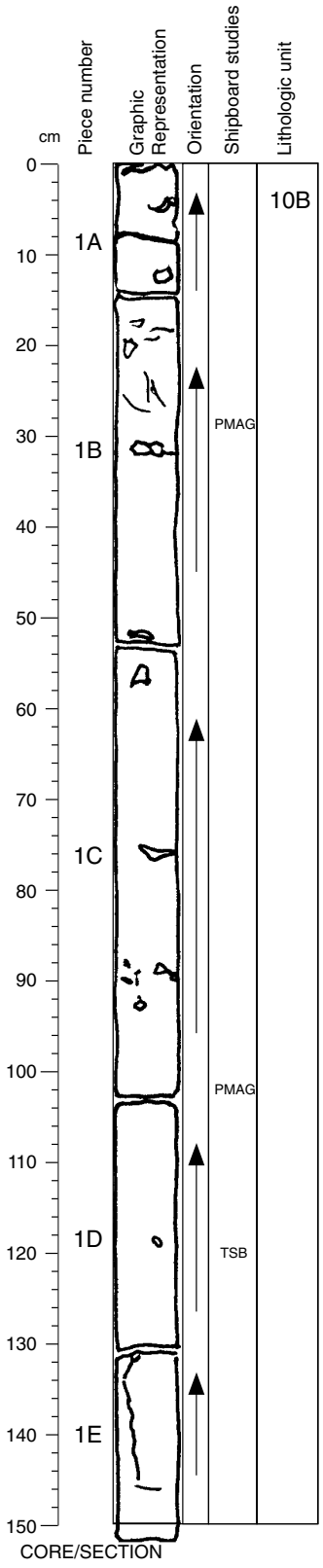
STRUCTURE: Massive.

ALTERATION: Slight overall, but moderate in the upper 13 cm of the section.

VEINS/FRACTURES: Thin (≤1 mm) anastomosing veins are filled with light and dark green clay.

COMMENTS:

Core Photo



183-1137A-45R-4 **Section top: 365.57 (mbsf)**

UNIT 10B: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	5-10	12	0.5	7	Dominantly euhedral laths; some other euhedral forms; glomerocrysts common
Clinopyroxene:	1	5	<0.5	0.5	Subhedral to anhedral pseudomorphs in glomerocrysts and as isolated crystals
Olivine:	<1	1	<0.5	0.5	Subhedral.

GROUNDMASS: Fine-grained, with a slight coarsening downward.

VESICLES: Sparse. Two types are present: (1) <5 mm, filled with medium and dark green clay, sometimes aligned subhorizontally in trails, and associated with dark groundmass haloes; (2) large (5-30 mm), irregular and filled concentrically with narrow outer rim of dark green clay, a narrow zone of zeolite, and inner filling of amorphous silica.

COLOR: Gray; groundmass is slightly pinkish gray.

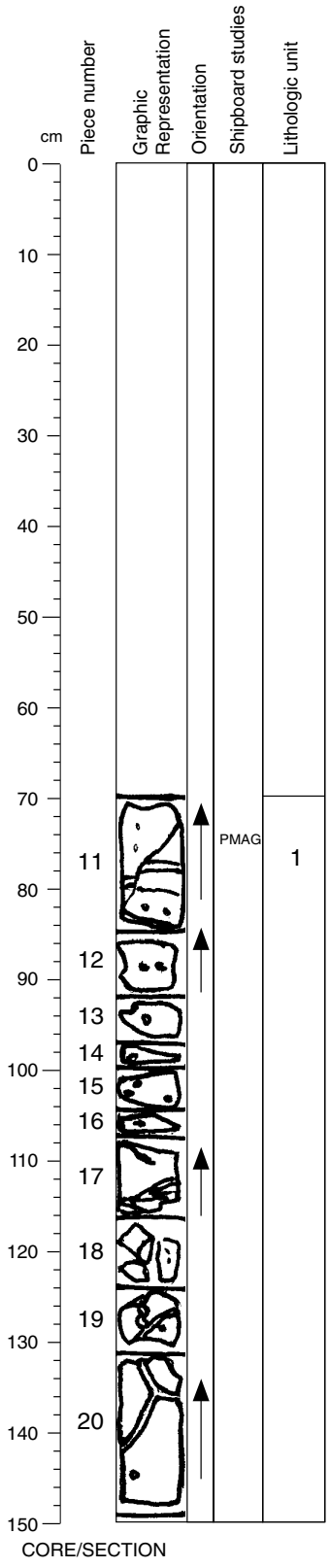
STRUCTURE: Massive.

ALTERATION: Slight. Plagioclase phenocrysts are commonly green near vesicles and vesicle trails. Trace of native copper observed.

VEINS/FRACTURES: Rare hairline cracks are filled with dark green clays.

COMMENTS:

Core Photo



183-1137A-46R-1 **Section top: 367.00 (mbsf)**

UNIT 10B: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1, 2

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	5-10	25	1	10	Euhedral individual laths; euhedral to subhedral laths in glomerocrysts
Clinopyroxene:	1	3	0.8	1-2	Euhedral
Olivine:	<1	2	0.5	0.8	Euhedral to subhedral, mostly in plagioclase-rich glomerocrysts

GROUNDMASS: Fine-grained.

VESICLES: Sparse, round to ovoid vesicles 1-10 cm in diameter; filled with dark blue-green clay and amorphous silica. Both isolated vesicles and vesicle-rich horizontal (at ~44 cm) and vertical (~60-80 cm) zones are present.

COLOR: Gray, with clear to white patches of plagioclase.

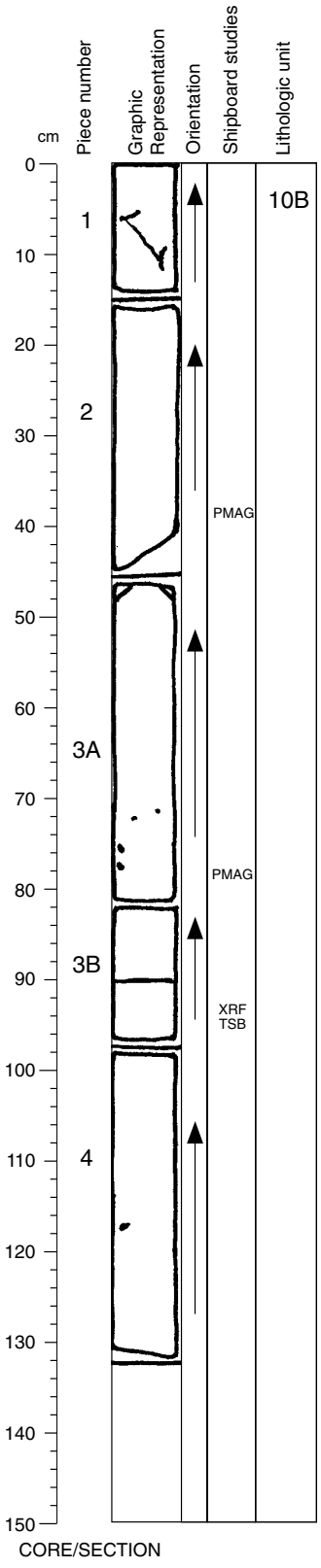
STRUCTURE: Massive.

ALTERATION: Slight.

VEINS/FRACTURES: Thin (<1 mm wide) fractures are lined with dark green clay.

COMMENTS:

Core Photo



183-1137A-46R-2 **Section top: 368.47 (mbsf)**

UNIT 10B: MODERATELY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1-4

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	5-10	25	1	10	Euhedral laths; euhedral to subhedral laths in glomerocrysts
Clinopyroxene:	2	3	0.8	1-2	Euhedral
Olivine:	<1	2	0.5	0.8	Euhedral to subhedral, mostly in plagioclase-rich glomerocrysts

GROUNDMASS: Fine-grained.

VESICLES: Sparse, round to ovoid vesicles 1-10 cm in diameter; filled with dark blue-green clay.

COLOR: Gray, with clear to white patches of plagioclase.

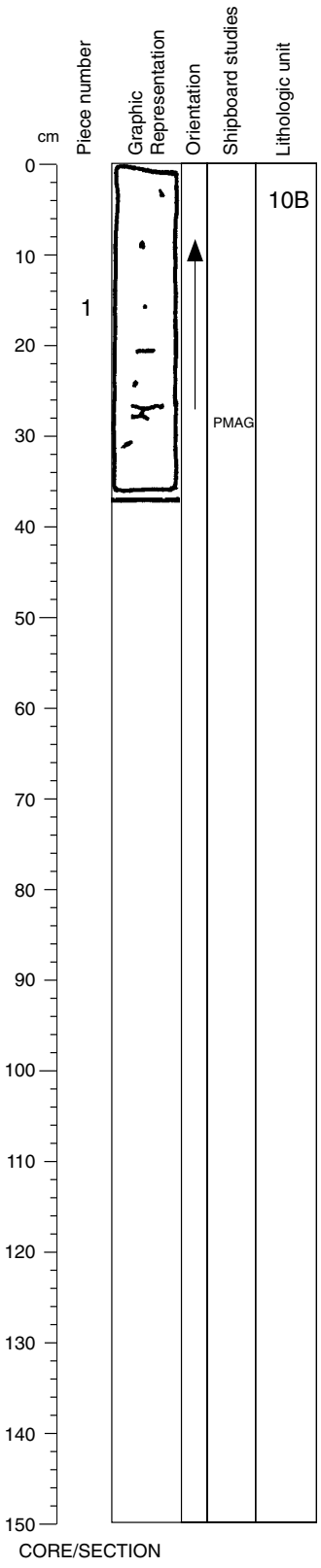
STRUCTURE: Massive.

ALTERATION: Slight.

VEINS/FRACTURES: Thin (<0.5 mm) fractures are lined with dark green clay.

COMMENTS:

Core Photo



183-1137A-46R-3 **Section top: 369.80 (mbsf)**

UNIT 10B: MODERATELY TO HIGHLY PLAGIOCLASE-CLINOPYROXENE-PHYRIC BASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	10-15	25	1	10	Euhedral laths; euhedral to subhedral laths in glomerocrysts
Clinopyroxene:	3	3	0.8	1-2	Euhedral
Olivine:	<1	2	0.5	0.8	Euhedral to subhedral, mostly in plagioclase-rich glomerocrysts

GROUNDMASS: Fine-grained.

VESICLES: Sparse, round to ovoid vesicles 1-10 cm in diameter; filled with dark blue-green clay.

COLOR: Gray, with clear to white patches of plagioclase.

STRUCTURE: Massive.

ALTERATION: Slight.

VEINS/FRACTURES: Thin (<0.1 mm) fractures are filled with dark green clay.

COMMENTS:

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Sample									Texture			Mineral			Biogenic										Rock		Other		
Leg	Site	H	Core	CT	Sct	Top	Depth	Lithology	Sand	Silt	Clay	Glauconite	Palagonite	Pyrite	Benthic Forams	Diatoms	Discoaster	Foraminifers	Nannofossils	Plant Debris	Radiolarians	Silicoflagellates	Skeletal Debris	Sponge Spicules	Calcareous Fragments	Volcanic Fragments	Rad/Diatom/Dino Spines	Unknown	Comments
183	1137	A	1	R	1	30	0.3	D		D						D		C			R	P					C		
183	1137	A	1	R	1	135	1.35	D		D						D		C			P	P	A						
183	1137	A	1	R	2	85	2.35	D		D						D		C			C	P	A						
183	1137	A	1	R	4	60	5.1	D		D						D		C			R								
183	1137	A	1	R	5	60	6.6	D		D						D		C			R		A	P					
183	1137	A	1	R	6	75	8.25	D		D						D		A			P			P					
183	1137	A	2	R	1	60	10.1	D			D					C		P	A		*			R			P		
183	1137	A	2	R	2	10	11.1	D			D					*		P	D					*			C		
183	1137	A	2	R	3	143	13.93	D			D					P		A	D	*							P		
183	1137	A	3	R	1	20	18.8	D			D					C		C	D			*					C		
183	1137	A	3	R	6	60	26.7	D			D					P		P	D								P		
183	1137	A	4	R	1	10	27.7	D			D					C			D								P		
183	1137	A	4	R	2	80	29.9	D			D					P		R	D								P		
183	1137	A	5	R	1	40	37.2	D			D					P		P	D					P			P		
183	1137	A	5	R	4	46	41.76	D			D					C		C	D					R			R		
183	1137	A	6	R	1	85	46.85	D			D		P			C		C	D					R			R		
183	1137	A	7	R	2	6	56.76	D			D					C		C	D					R			P	*	
183	1137	A	8	R	2	70	67	D			D					P	P	P	D					*					
183	1137	A	9	R	3	50	78	D			D					C	R	C	D					P			R		
183	1137	A	11	R	3	30	97	D			D							P	D		P								
183	1137	A	11	R	5	30	100	D			D							P	D										
183	1137	A	12	R	1	30	103.6	D			D							P	D		R			P			P		
183	1137	A	13	R	1	10	113	D			D							C	D										
183	1137	A	13	R	4	40	117.8	D			D							C	D										
183	1137	A	13	R	6	100	121.4	M			D			P				P	D										
183	1137	A	14	R	1	10	122.7	D			D				P			P	D					R					Sponge spicules are calcitic?
183	1137	A	14	R	3	40	126	D			D		*		*			P	D										
183	1137	A	15	R	1	10	132.3	D			D				R			P	D										
183	1137	A	15	R	3	33	135.53	D			D							P	D										
183	1137	A	15	R	3	41	135.61	M			D							P	D							*			
183	1137	A	16	R	1	20	142	M			D							P	D										
183	1137	A	16	R	2	80	144.1	D			D							C	D										
183	1137	A	16	R	4	100	147.3	D			D							C	D										
183	1137	A	17	R	1	61	152.01	D			D				R			C	D										
183	1137	A	18	R	1	70	161.7	D			D							P	D										
183	1137	A	19	R	1	70	171.4	D			D				R			C	D										
183	1137	A	19	R	2	20	172.4	D			D							C	D						C	P			
183	1137	A	19	R	2	40	172.6	D			D							C	D										
183	1137	A	20	R	1	14	180.44	D			D							C	D						P				
183	1137	A	21	R	1	70	190.6	D			D							C	D						P				
183	1137	A	21	R	CC	5	191.29	M	D			R	*		P			D											Coarse fraction

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THIN SECTION: 183-1137A-25R-1, 105-106, Piece 4 — **Unit 1** — **OBSERVER: RD, CRN**
ROCK NAME: Sparsely plagioclase-phyric basalt.
WHERE SAMPLED: Least-altered interior of Unit 1.
GRAIN SIZE: Medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic with an intersertal to intergranular groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	1	1	1	0.5	1	An60	Euhedral to subhedral	Isolated crystals and clots, with minor clinopyroxene; regular zoning.
Clinopyroxene	0	<1	0.5				Subhedral	Replaced by dark brown clay.
GROUNDMASS								
Plagioclase	45	45	0.5	0.1		An55	Euhedral	Unaltered.
Clinopyroxene	30	35	0.5	0.1			Subhedral	Generally unaltered; partly replaced by brown clay.
Glass	5	16					Intersertal pools	Largely devitrified and replaced with brown clay.
Titanomagnetite	1	1	0.3	0.1			Subhedral to anhedral	Skeletal, acicular, and tabular (stubby octahedra) forms.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	20				Clinopyroxene and glass	Dark and light brown varieties.
Silica	1				Vesicle filling	Radiating.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	1	random		1		Clay margins, silica filled	

COMMENTS : No sulfide observed.

THIN SECTION: 183-1137A-25R-3, 90-93, Piece 8C — **Unit 1** — **OBSERVER: NTA, JB, CRN**
ROCK NAME: Sparsely olivine-phyric basalt.
WHERE SAMPLED: Base of Unit 1.
GRAIN SIZE: Medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic with an intersertal groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	<1	<1	1	3	1.5		Subhedral laths, some skeletal or corroded	A few loose clusters with clinopyroxene.
Clinopyroxene	<1	<1	1	2	1.5		Stubby subhedral	
Olivine	0	8	0.2	0.4	0.3		Subhedral	Microphenocrysts, totally altered.
GROUNDMASS								
Plagioclase	40	40	<0.1	0.3	0.1	An65	Subhedral laths	Range of grain sizes down to microlites in the mesostasis.
Clinopyroxene	10	20	<0.1	0.2	0.1		Almost equant subhedral prisms	Partially altered to clay.
Titanomagnetite	5	5	<0.01	0.02	0.01		Subhedral equant and fine branching dedritic grains	Restricted to glassy areas, concentrated at margins of larger glassy pools.
Glass	0	25					Irregular to polygonal pools of brown-green glass, interstitial areas of paler glass.	Altered to clay. Note: Some of these patches could be relicts of olivine grains.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	45				Glass and clinopyroxene	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	<1	irregular	0.5	2		Clay and zeolite	

COMMENTS : A fine-grained, sparsely porphyritic little-altered rock. In one small area, the plagioclase size is bimodal with a larger phenocryst population (average size 1 mm) and a very fine second population (average size <10 mm). In this region equant patches of clay could be relict olivine grains.

No sulfide observed.
Photomicrograph #:
1137A-36 = Basal section of fresh clinopyroxene (x10 objective, ppl);
1137A-37 = As 36, but xpl;
1137A-38 = Altered olivines (x10 objective, ppl);
1137A-39 = Close-up of altered olivine with oxide alteration (x50 objective, ppl).

THIN SECTION: 183-1137A-25R-4, 11-13, Piece 1 Unit 2A **OBSERVER: LM, JB, CRN**
ROCK NAME: Oxidized volcanic breccia with clasts of plagioclase-clinopyroxene-olivine-phyric basalt.
WHERE SAMPLED: Top of flow, Unit 2A. Clasts/lobes with different degrees of oxidation.
GRAIN SIZE: Red oxidized, and dark gray basalt clasts, both have fine-grained phenocrysts in a glassy groundmass.
TEXTURE: Porphyritic with a hypohyaline groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS		Variable						
Plagioclase	8	20	0.1	1.2	0.6		Subhedral	The basalt clasts in this thin section have similar textures to those in 183-1137A-25R4, 33-35. However olivine is more abundant in both clasts and includes a few large grains (0.4 mm), and clinopyroxene is more abundant in the more oxidized clast where it is stained bright orange by iron (hydr)oxide. The olivine in the less oxidized clast is pseudomorphed by a dark yellow clay which in turn, in the cores, is replaced by a green clay. In the more oxidized clast it is pseudomorphed by opaque minerals and iron (hydr)oxide. The quench texture in the mesostasis is best seen in the less oxidised clast.
Clinopyroxene	3	5	0.1	0.2	0.15		Subhedral to anhedral	
Olivine	0	5	0.1	0.2	0.15		Subhedral	
GROUNDMASS								
Mesostasis	0	60						
Titanomagnetite	10	10			<0.01		Anhedral	

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Hematite	5				Staining clay minerals	Pervasive red color in the red basalt clast is due to hematite staining of secondary minerals. In the gray clast, red color is more concentrated around oxidized phenocrysts (mafic) and along veinlets.
Zeolite	2				Void linings	Clinoptilolite/heulandite(?).
Calcite	5				Infilling voids	Crystalline.
Clay minerals	75				Pyroxene and glass. Groundmass and void fillings.	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	15		2	12	5	Zeolites, Clay, calcite/round to ovoid	

COMMENTS : This sample was taken to illustrate the different clasts in this autobreccia. It appears that the red, more oxidized clast is from an earlier generation of brecciation than the darker gray lobe material penetrating the sediment, although petrographically they are very similar. The red clast is assumed to be cool by the time the grey basalt intruded as there are no agglutination or welding textures to indicate that both were hot. This is a spectacular slide for the observation of void filling during alteration. There were large cavities in this breccia and they have been infilled by multiple generations of well formed crystalline phases (mostly zeolite and calcite).
The vesicle fillings consist of euhedral zeolites lining voids with late stage calcite infill.

THIN SECTION: 183-1137A-25R-4, 33-35, Piece 1 Unit 2A **OBSERVER: LM, JB, CRN**
ROCK NAME: Volcanic breccia with clasts of plagioclase-clinopyroxene-olivine-phyric basalt.
WHERE SAMPLED: Top of flow, Unit 2A. Clasts/lobes showing contact relationships.
GRAIN SIZE: Both dark gray basalt clasts have fine-grained phenocrysts in a glassy groundmass.
TEXTURE: Porphyritic with a hypohyaline groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	20	25	0.02	0.8	0.2		Subhedral Laths	Frequently occurs in loose glomerocrysts. Many of the smallest grains are swallow-tailed, hollow quench crystals. Some grains in the more oxidised clast are partly or completely replaced by calcite. Only one grain in the less oxidized clast has calcite replacement.
Clinopyroxene	3	3	0.08	0.2	0.1		Anhedral	
Olivine	0	3	0.05	0.2	0.075		Euhedral to subhedral	Pseudomorphs after olivine are different in the two clasts. In the less oxidized clast olivine is replaced by a pale yellow clay, has orange fractures and its cleavage and outline are picked out by sub-micron-size opaque grains. In the more oxidized clast the olivine is similar but is not rimmed by opaque grains.
GROUNDMASS								
Mesostasis	0	55					Crystalites and devitrified glass	The mesostasis consists of fronds of a colourless mineral (plagioclase? max. 80 microns long) picked out by submicron equant grains of an opaque mineral. These are enclosed by a red-brown iron (hydr)oxide-stained clay mineral. In the "less" oxidized clast the colorless fronds cannot be distinguished and clay is not iron-(hydr)oxide stained. However, submicron sized red iron (hydr)oxide grains are present. The proportions of the mesostasis components are difficult to estimate due to the extremely fine grainsize.
Opaques	15	15			<0.01		Anhedral	Many small anhedral oxide opaques in the groundmass.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay minerals	60				Glass and olivine and lining voids	Smectite clays - possibly nontronite and/or saponite.
Calcite	0.5				Plagioclase	
Zeolite	15				Inner void lining	
Opaque mineral	1				Olivine	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	20			10		Clay lining and zeolite partially infilling	Irregular coalesced vesicles with clay mineral linings, and later euhedral zeolite sheaf formation (heulandite/clinoptilolite?).

COMMENTS : This sample was taken to see if there were agglutination textures between these two domains in the volcanic breccia. The contact between them is tight and there is evidence of a very thin cryptocrystalline margin on both. Alteration veining has penetrated along much of the contact, and the slide is a little thin around the contact, making it difficult to see the relationship between the two clasts. There is no granulated material between them. The difference in oxidation suggests that the more oxidized clast was probably cool when the other one was emplaced. Agglutination between two hot clasts is not apparent in this thin section.
Photomicrograph #:
1137A-40 = Altered olivine or clinopyroxene? (x50 objective, ppl).

THIN SECTION: 183-1137A-25R-4, 77-81, Piece 3 — Unit 2A — OBSERVER: LM, CRN
ROCK NAME: Volcanic breccia with clasts of plagioclase-clinopyroxene+/-altered olivine-phyric basalt
WHERE SAMPLED: Microbrecciated margin between clasts in the volcanic breccia at top of flow, Unit 2A.
GRAIN SIZE: Both dark gray basalt clasts have fine-grained phenocrysts in an altered glassy groundmass.
TEXTURE: Porphyritic, altered hypohyaline groundmass. One clast is more vesicular than the other.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	10	20	0.02	0.8	0.2		Laths	Loose glomerocrysts and individual grains with swallow-tailed,morphology.
Clinopyroxene	2.5	2.5	0.08	0.2	0.1		Anhedral	Mostly altered to orange-red clay minerals but some birefringant cores remain.
Olivine	0	2.5	0.05	0.2	0.075		Euhedral to subhedral	Olivine is replaced by a pale yellow to orange red clay minerals. Its outline may be picked out by sub-micron size opaque grains. However, most are difficult to distinguish amidst the altered mesostasis.
GROUNDMASS								
Mesostasis	0	75					Crystalites and devitrified glass	The mesostasis consists of red-brown iron (hydr)oxide-stained clay minerals. Proportions of the mesostasis components are difficult to estimate due to the extremely fine grainsize.
Opaque Minerals								None primary.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Hematite/goethite	2				Coloring clay minerals	
Clay minerals	84				Mesostasis, mafic silicate minerals, lining vesicles	
Zeolite	2		1		Infilling some vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles				6		Brown clay mineral lining, some have tabular zeolite crystals infilling.	Subspherical to irregular coalesced vesicles. More prominent in one clast.

COMMENTS : This sample was taken to illustrate the contact relationships between clasts in an area where a microbreccia was identified at clast margins. This microbreccia may have formed due to grinding of clasts against each other during formation of the autobreccia. See photomicrograph 1137A-30 for marginal microbreccia between clasts. This slide also shows preferred oxidation along the (more permeable) microbrecciated contacts between clasts. It is useful to distinguish these features from hydraulic brecciation during alteration after emplacement of the breccia. Examples of hydraulic brecciation are seen at a larger scale in the core adjacent to large areas of zeolite and calcite fill (e.g., 25R-4, 17-20 cm).

Photomicrograph #:

1137A-30 = Clast contact in flow top breccia. Boundary shows evidence of granulation; clasts therefore not agglutinated (x2.5 objective, ppl).

THIN SECTION: 183-1137A-25R-5, 113-115, Piece 11 — **Unit 2B** — **OBSERVER: KN, CRN**
ROCK NAME: Aphyric basalt.
WHERE SAMPLED: Chilled contact.
GRAIN SIZE: Fine- to medium-grained.
TEXTURE: Intersertal to hypohyaline.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	<1	<1	0.8	1.2	1		Subhedral laths	Rare phenocrysts and glomerocrysts that contain melt inclusions.
Clinopyroxene	<1	<1	0.2	0.5	0.3		Subhedral to anhedral	
GROUNDMASS								
Plagioclase	45	45	0.05	0.2	0.1		Subhedral to euhedral	Trachytic texture.
Clinopyroxene	8	10	0.05	0.2	0.1		Anhedral to subhedral	Larger crystals show undulatory extinction.
Titanomagnetite	5	5	0.05	0.8	0.2		Subhedral	Often acicular (skeletal) and occasionally tabular. Ilmenite is exsolving from the titanomagnetite.
Glass	0	40						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay and zeolites	50				Filling vesicles and replacing some groundmass.	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	3	dispersed	1	2.5	2	Clay and zeolite	Round.

COMMENTS : A fine-grained, aphyric, slightly-altered rock. Quench or chill texture is indicated by the skeletal oxides and glassy groundmass. The plagioclase groundmass shows flow-alignment (trachytic) texture.
No sulfide observed.
Photomicrograph #:
1137A-41 = Ilmenite exsolution in titanomagnetite (x100 objective, reflected light).

THIN SECTION: 183-1137A-26R-1, 140-142, Piece 12 **Unit 2B** **OBSERVER: RD, JB, MSP, CRN, NTA**
ROCK NAME: Aphyric basalt with micrograbbro xenolith.
WHERE SAMPLED: Mid-flow, bottom of the piece.
GRAIN SIZE: Coarse-grained xenolith in a fine-grained basalt.
TEXTURE: Largely intergranular to subordinate intersertal.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
XENOLITH (Characteristics and proportions of constituent minerals)								
Plagioclase	65	65	0.5	3		An70	Anhedral to subhedral	Anhedral where intergrown with clinopyroxene, otherwise rounded and subhedral laths.
Clinopyroxene	35	35	0.5	2			Anhedral to subhedral	Anhedral where intergrown with plagioclase, otherwise rounded and subhedral blocky. One crystal exhibits a simple twin.
PHENOCRYSTS								
Plagioclase	<1	<1	0.5	1			Euhedral to subhedral	Isolated crystals.
Olivine	0	<1		0.5			Euhedral, equant	Replaced by dark brown clay.
GROUNDMASS								
Plagioclase	50	50	0.1	0.5			Euhedral	Unaltered.
Clinopyroxene	25	30	0.1	0.5			Subhedral	Generally fresh; partly replaced by brown clay.
Glass	0	20					Intersertal pools	Partly devitrified and replaced with brown clay.
Titanomagnetite	2	2	0.1	0.3			Subhedral to anhedral	Skeletal (acicular) and tabular (stubby octahedra) crystals.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	25				Clinopyroxene and glass	Dark and light brown varieties
Silica	<1				Vesicle filling	Radiating

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	<1	random		1		Clay margins and partly silica filled	

COMMENTS : This is a fine-grained, aphyric basalt with a large (3 cm) aggregation of plagioclase and clinopyroxene. In the interior of the aggregation the grains are tightly intergrown, toward the margins they are loosely clustered. This feature is interpreted as a xenolith that partially disaggregated on incorporation into the host magma where it acted as a focus of aggregation and growth of its constituent crystals.
Groundmass is fresh enough for whole rock dating. Coarse-grained xenolith probably best for Ar-Ar dating.
No sulfide observed.
Photomicrograph #:
1137A-57 = Micrograbbro xenolith in basalt (x2.5 objective, ppl);
1137A-58 = As -57, but xpl.

THIN SECTION: 183-1137A-26R-2, 7-8, Piece 1 — **Unit 2B** — **OBSERVER: KN, MSP, CRN**
ROCK NAME: Sparsely plagioclase-clinopyroxene-olivine-phyric basalt.
WHERE SAMPLED: Flow interior.
GRAIN SIZE: Fine- to medium-grained.
TEXTURE: Porphyritic with an intergranular groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	1	1	0.5	1.2	0.6		Subhedral laths	
Olivine	0	1	0.2	0.5	0.3		Subhedral	Microphenocrysts - totally altered.
Clinopyroxene	0.5	1	0.3	0.7	0.5		Subhedral	
GROUNDMASS								
Plagioclase	25	40	0.05	0.3	0.2		Subhedral to euhedral	
Clinopyroxene	10	30	<0.1	0.2	0.1		Anhedral to subhedral	
Titanomagnetite	5	5	<0.1	0.2	0.15		Subhedral	Skeletal (acicular) and tabular (stubby octahedra) are present.
Sulfide	<1	<1		0.02	0.01		Subhedral	Primary tiny sulfide present, likely pyrite or pentlandite.
Glass	0	20					Dark brown to pale olive-brown	Some fresh glass present in rare intersertal pockets.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	65				Fills two slender cross-cutting veins.	Slight to moderate alteration of the groundmass. Complete alteration of olivine (brown clay).

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicle	1			0.7		Subrounded	

COMMENTS : One plagioclase+clinopyroxene+olivine(?) glomerocryst observed. In this case, the ferromagnesian mineral consists of several anhedral crystals (0.2 mm) which have melt inclusions. The larger plagioclase microphenocrysts contain melt inclusions.
Photomicrograph #:
1137A-42: Altered olivine with a rim of clinopyroxene (x10 objective, ppl);
1137A-43: As -42, but xpl.

THIN SECTION: 183-1137A-26R-2, 38-40, Piece 4 — **Unit 2B** — **OBSERVER: CRN**
ROCK NAME: Sparsely plagioclase-clinopyroxene-phyric basalt.
WHERE SAMPLED: Around a sulphide segregation near the base of Unit 2B.
GRAIN SIZE: Medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic with an intergranular to intersertal groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	2	2	4	6	5	An65	Subhedral to euhedral masses.	Composed of plagioclase crystals (2-5 mm). Nice optic axis figure on one crystal. Several crystals are zoned.
PHENOCRYSTS								
Plagioclase	1	1	0.8	1.5	1	An65	Subhedral	
Clinopyroxene	1	1	0.6	1.4	0.8		Subhedral	
GROUNDMASS								
Plagioclase	40	40	0.1	0.4	0.3		Subhedral	
Clinopyroxene	25	30	0.05	0.3	0.15			
Titanomagnetite	10	10	0.1	0.3	0.25		Subhedral to anhedral	Skeletal (accicular) and tabular (stubby octahedra) crystals.
Pentlandite	5	5					Anhedral masses	Vein fill and also interstitial in the basalt groundmass. Primary concentrations occur around the vein. Scattered blebs (<0.05 mm) are randomly scattered throughout. Abundance decreases away from the vein. Sulfide is isotropic and could be pyrite as it does not appear to take a good polish.
Glass	0	14						Patchy occurrences in small hyalopilitic pools.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Brown clay	15				Glass and clinopyroxene	
Green clay	1				Glass and clinopyroxene	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vein	5		0.5	1.5		Empty, except for sulfide	See Groundmass above.

COMMENTS : Plagioclase looks fresh - Occasional inclusions.
Generally low to moderate degree of alteration.
Photomicrograph #:
1137A-44 = Sulfide vein with titanomagnetite crystals in basalt groundmass (x10 objective, reflected light).

THIN SECTION: 183-1137A-27R-2, 24-27, Piece 7 — Unit 3A — OBSERVER: LM, CRN
ROCK NAME: Plagioclase-phyric basalt contact with green altered fine sand.
WHERE SAMPLED: Within Unit 3A lava, sediment infilling a void.
GRAIN SIZE: Fine to medium-grained (up to 1 mm) phenocrysts in a fine-grained groundmass. Sediment is very fine to fine sand.
TEXTURE: Porphyritic, sparsely vesicular with an intersertal groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	3	5	0.5	1.3	0.8	An60	Subhedral	Partially altered to sercite.
Olivine	0	3	0.2	0.4	0.25		Subhedral to euhedral	Totally altered.
GROUNDMASS								
Plagioclase	10	15	0.05	0.25	0.1		Subhedral	
Titanomagnetite	0	0						
Glass		75						Opaque - totally altered to clay.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Hematite	5				Staining clay minerals	Secondary minerals are pervasively hematite stained imparting a red color to the basalt. The green color in the sediments and partially overprinting the basalt is attributed to alteration after emplacement.
Sericite	2					
Clay	80				Pyroxene and glass, filling vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	2	Random		0.5		Pale green clay linings and dark green clay filling	

COMMENTS : This sample was taken to confirm that the green granular material was sand infilling voids in the basalt rather than alteration veining. There is no evidence of quenching at the sediment-basalt interface and phenocrysts go right to the contact, implying that the sediment came into contact with the basalt when it was already cool. Internal sedimentary structures in the sand (laminations and low angle cross-stratification) are consistent with passive infilling and settling from water passing through voids in the basalt. The sand has feldspar fragments, lithic (basalt) fragments and altered glassy material: a crystal-vitric fine sand with lithics. This slide is also useful for observing the internal texture of red oxidized basalt. Secondary minerals are pervasively stained red due to the presence of hematite. The sand is indurated but does not appear baked, implying cementation during alteration.

Photomicrograph #:

1137A-13 = Contact between basalt and infilling sediment - also can see cross-bedding and lamination in the sediment (x10 objective, ppl).

THIN SECTION: 183-1137A-27R-4, 66-68, Piece 6 — **Unit 3B** — **OBSERVER: CRN**
ROCK NAME: Sparsely plagioclase-phyric basalt.
WHERE SAMPLED: Vesicle trail in Unit 3B.
GRAIN SIZE: Medium-grained phenocrysts, fine- to medium-grained groundmass.
TEXTURE: Porphyritic, seriate, intergranular to intersertal and trachytic.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	0.5	1	1.5	2.2	1.8	An60-65	Subhedral	Several look like they are reacting with the magma. Occasional sieve textures seen.
GROUNDMASS								
Plagioclase	35	40	0.5	1.2	1	An60-65	Subhedral	
Clinopyroxene	15	25	0.2	0.6	0.4		Subhedral to anhedral	Clinopyroxenes look like olivines under cross-polarized light - slide is a little thick.
Glass	0	30						
Titanomagnetite	5	5	0.1	1	0.4		Subhedral to anhedral	Predominatly skeletal (acicular) crystals. Concentration of skeletal crystals (elongate with serated rims) around vesicles.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Zeolite	9				Vesicles	
Brown clay	45				Glass, clinopyroxene, plagioclase, filling vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	5		3	12	7	Round to ovoid, zeolite filled	

COMMENTS : Around vesicles grain size coarsens from 0.1-0.3 mm to 0.2-0.5 mm. Mineralogy remains the same. Proportion of glass increases and texture becomes predominantly intersertal.
Plagioclase looks moderately altered.
Olivine not positively identified - clinopyroxene can easily be confused for olivine in this section because it is a little thick. Clinopyroxene only occurs in the groundmass. Only plagioclase is seen as a phenocryst phase.
No sulfide observed.

THIN SECTION: 183-1137A-28R-4, 30-32, Piece 5 — **Unit 3B** — **OBSERVER: RD, CRN**
ROCK NAME: Sparsely plagioclase-phyric basalt.
WHERE SAMPLED: Least-altered interior of Unit 3B.
GRAIN SIZE: Medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Largely intergranular to subordinate intersertal.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	1	1	1	0.5	1	An60	Euhedral to subhedral	Isolated crystals, embayed, in reaction.
Olivine	0	0.5	0.5				Subhedral	Replaced by dark brown clay.
GROUNDMASS								
Plagioclase	45	45	0.5	0.1			Euhedral	Unaltered.
Clinopyroxene	30	35	0.5	0.1			Subhedral	Generally fresh; partly replaced by brown clay.
Glass	10	15					Intersertal pools	Largely devitrified and replaced with light brown clay.
Titanomagnetite	2	2	0.3	0.1			Anhedral	Skeletal and tabular (stubby octahedral) forms.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	15				Glass, clinopyroxene and olivine	Dark and light brown varieties; patchy occurrence.
Silica	<1				Vesicle filling	Radiating.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	<1	random		1		Clay margins, silica filled	

COMMENTS : This is a fine-grained, aphyric basalt with rare fragmented and embayed phenocrysts of plagioclase in reaction with the groundmass. The significant proportion of poorly-crystallized groundmass (glassy mesostasis) makes this less suitable for whole rock dating.
No sulfide observed.

THIN SECTION: 183-1137A-29R-2, 35-38, Piece 1 — **Unit 3B** — **OBSERVER: RD, CRN**
ROCK NAME: Vesicular aphyric basalt.
WHERE SAMPLED: Base of Unit 3B, chilled margin.
GRAIN SIZE: Fine-grained.
TEXTURE: Intergranular to intersertal, trachytic.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	1	1	0.5	0.8	0.7	An60	Subhedral laths	
Clinopyroxene	0	1	0.5	1.5			Euhedral to subhedral	Completely replaced by dark brown clays.
GROUNDMASS								
Plagioclase	40	45	0.1	1	0.5		Euhedral to subhedral	Laths strongly aligned in direction of flattened vesicles; incipient alteration to clay along central cleavage.
Clinopyroxene	25	30						
Titanomagnetite	<1	<1	0.1	0.2	0.15		Subhedral to anhedral	Generally skeletal (acicular), with occasional tabular (stubby octahedra) forms.
Glass	0	20						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	24				Groundmass, vesicles, veins	Brown and green.
Zeolite	5				Vesicles, veins	Fibrous, radiating packets.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	4	random	1	10		Clay, zeolite	Large, flattened, oriented horizontally.
Veins	<1	oblique	0.5	1		Clay, zeolite	Sinuous.

COMMENTS : This fine-grained, aphyric rock shows evidence of chilling and flow alignment of groundmass feldspar near the base of Unit 3. A small number of completely replaced phenocrysts are interpreted to have been clinopyroxene based on their euhedral shapes.
No sulfide observed.

THIN SECTION: 183-1137A-29R-2, 71-74, Piece 4A **Unit 4** **OBSERVER: LM, CRN**
ROCK NAME: Chilled margin of plagioclase-phyric basalt against volcanic siltstone
WHERE SAMPLED: Top of Unit 4, contact with overlying siltstone. Section taken to look at volcanic siltstone.
GRAIN SIZE: Medium-grained glomerocrysts and phenocrysts in a fine-grained groundmass.
TEXTURE: Glomeroporphyritic basalt with hypohyaline groundmass; laminated volcanic silt.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	2	5	3	5	4.5	An60	Angular masses	Generaly composed of subhedral to euhedral plagioclase laths with subordinate (10%) subhedral to anhedral clinopyroxene. Plagioclase partially altered to sericite.
PHENOCRYSTS								
Plagioclase	10	15	0.2	4	2	An55	Subhedral laths	Patially altered to sericite. Larger ones have a reaction rim.
Clinopyroxene	3	5	0.3	1.5	1		Subhedral to anhedral	
Olivine	0	3	0.2	0.5	0.3		Subhedral	Microphenocrysts - altered to green clay.
GROUNDMASS								
Glass	0	70 98						Glass is totally altered.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Hematite	5				Staining clay minerals	Pervasive red color in the basalt and in disaggregated glass and the silt is due to hematite staining of secondary minerals.
Sericite	5				Plagioclase	
Clay minerals	75				Pyroxene and glass, infilling vesicles, and after volcanic silt	
Calcite	15		0.5		Late phase void filling, crystalline	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	30	Under chill margin				Spherical to irregular shaped coalesced vesicles, multiple infilling by clay, silt and calcite and green alteration clay minerals.	

COMMENTS : There is a transition from the red oxidized vesicular basalt through a darker gray colored chilled zone and into a granulated area that has been broken up, in part by the infiltration of overlying silts. The silts preserve laminations and flow structures (scours, cross-lamination) consistent with infilling of voids in the basalt, however in the overlying silts there are abundant spalled glass fragments retained and there appears to be a systematic reduction in grainsize away from the chilled margin. The brecciation in the laminated silt interval is attributed to later phase alteration and disruption of silt in a brittle fashion after it was already indurated. Induration may have been caused by baking by the overlying lava.

THIN SECTION: 183-1137A-29R-4, 17-18, Piece 4 — **Unit 4** — **OBSERVER: CRN, KN, MSP**
ROCK NAME: Moderately vesicular, highly plagioclase-olivine-phyric basalt.
WHERE SAMPLED: Near the top of Unit 4.
GRAIN SIZE: Medium- to coarse-grained phenocrysts/glomerocrysts in a fine-grained to aphanitic groundmass.
TEXTURE: Porphyritic with a hypocrystalline, intersertal groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	8	10	4	9	6	An65	Angular masses	Subhedral plagioclase laths are intergrown. Plagioclase often exhibits a sieve texture and is partially altered to sericite. Large (>2 mm) plagioclase crystals are probably disaggregated from glomerocrysts (higher An content) and although are strictly phenocrysts, represent a different population to true phenocrysts. Rare anhedral cpx.
PHENOCRYSTS								
Plagioclase	6	10	0.5	2	1.2	An55	Subhedral laths	Occasional zonation and rims seen on larger examples (see Glomerocryst Comment).
Clinopyroxene	0.1	2	0.4	1	0.6		Euhedral to subhedral	Rare unaltered cores remain, otherwise altered to green or brown clay.
Olivine	0	3	0.4	1	0.6		Euhedral to subhedral	Completely altered to green clay.
GROUNDMASS								
Plagioclase	20	25	0.05	0.3	0.1		Subhedral laths	
Clinopyroxene	5	10	<0.05	0.15	0.07		Anhedral	
Titanomagnetite	7	7		0.02			Subhedral to anhedral	Largest crystals = 0.02 mm are rare. The majority are in the very fine grained groundmass as 0.01 mm or less, subhedral equant stubby octahedra or as skeletal grains.
Glass	0	35						Most of the glass is aphanitic, crystallizing micron-sized titanomagnetites. Several altered patches are seen.
		102						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Brown clay	45				Glass, mafic phenocrysts, filling vesicles	Appears to be opaque.
Green clay	5				Mafic phenocrysts, filling vesicles	
Sericite	6				Plagioclase	
Zeolite	8				Vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	15	Random	0.5	10	2.5	Round to ovoid, brown and green clay rims, zeolite clusters	Some are coalesced Partially to totally filled.

COMMENTS : Macroscopic observation: although chosen for low vesicularity, the section contains round to ovoid vesicles up to 10 mm that covers about 15% of the section. Plagioclase phenocrysts and glomerocrysts are also evident. No veins are visible.
No sulfide observed.

THIN SECTION: 183-1137A-31R-3, 3-5, Piece 1 — **Unit 4** — **OBSERVER: RD, MSP, JB, CRN**
ROCK NAME: Highly plagioclase-clinopyroxene-olivine-phyric basalt.
WHERE SAMPLED: Flow interior, in plagioclase-rich zone.
GRAIN SIZE: Medium- to coarse-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic with an intergranular to intersertal groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	20	20	0.5	6	2.5	An60-65	Euhedral to subhedral	Large plagioclase crystals in clots as well as isolated crystals. Several larger ones exhibit zonation and appear slightly corroded. Very few inclusions. The crystals look altered because the polishing has plucked out several pieces from the interior of the crystals. Smaller crystals form clots with clinopyroxene and look like the discrete phenocryst phases.
Clinopyroxene	3	5	0.2	1	0.3		Subhedral	Some twinned.
Olivine	0	2	0.2	1	0.6		Euhedral to subhedral	Completely replaced with green-brown clay. A very dark brown, opaque clay outline of the original grain is present.
GROUNDMASS								
Plagioclase	35	35						
Clinopyroxene	15	20						Clots of tiny (<0.1) equant crystals, partially bordered by felted plagioclase
Sulfide	1	1	0.1	0.2			Anhedral	Intersertal, last to crystallize
Titanomagnetite	1	1	0.1	0.2			Acicular	
Glass	10	15					Intersertal pools	Patchy distribution; entirely replaced with light green clay and homogeneous, nearly isotropic light brown clay.
Pentlandite	Trace	Trace					Anhedral masses	

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	15				Glass, olivine and clinopyroxene	Two varieties: light brown-green and dark brown.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	0						Groundmass clay described above replaces glass and quite possibly fills irregular micro-vesicles also.

COMMENTS : Intersertal, primary sulfide. Plagioclase phenocrysts are unaltered, almost inclusion-free and numerous, indicating a good candidate for dating.
While glomerocrysts are present, they appear to be the same as the discrete phases and are not broken out into a separate group.
Photomicrograph #:
1137A-3: Clots of groundmass clinopyroxene (x5 objective, xpl);
1137A-4 = as above, but ppl.

THIN SECTION: 183-1137A-31R-4, 48-51, Piece 1C — Unit 4 — **OBSERVER: RD, MSP, JB, CRN**
ROCK NAME: Sparsely plagioclase-phyric basalt.
WHERE SAMPLED: Least-altered interior of Unit 4.
GRAIN SIZE: Medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic with a largely intergranular to subordinate intersertal groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	18	18	0.5	2	1	An65	Euhedral to subhedral	Large plagioclase crystals in clots and isolated crystals, embayed, corroded cores; zoned; trains of melt inclusions. Smaller plagioclase crystals form clusters with clinopyroxene and look the same as the discrete phenocrysts.
Clinopyroxene	5	5	0.5	1.5	0.6		Subhedral	Some crystals are twinned. Glomerocrystic, but see comment above.
GROUNDMASS								
Plagioclase	35	35	0.05	0.1			Euhedral	Unaltered.
Clinopyroxene	25	30	0.05	0.1			Subhedral	Generally fresh; partly replaced by brown clay.
Glass	0	10					Intersertal pools	Largely devitrified and replaced with light brown clay.
Titanomagnetite	2	2	0.05	0.1			Anhedral to subhedral	Skeletal (acicular) crystals dominate, subordinate tabular (stubby octahedra) crystals.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	15				Glass, clinopyroxene	Dark and light brown varieties; pervasive occurrence.
Silica	<1				Vesicle filling	Radiating.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	1	random	0.5	1		Clay margins and zeolite filled	Radiating

COMMENTS : This is a porphyritic basalt with fragmented and embayed phenocrysts of plagioclase which are interpreted to be xenocrysts in reaction with the groundmass, . The significant proportion of xenocrysts and poorly-crystallized groundmass (glassy mesostasis) makes this unsuitable for whole rock dating.
There may be highly altered olivine microphenocrysts (<1%) present, but the evidence is ambiguous.
While glomerocrysts are present, they appear to be the same as the discrete phases and are not broken out into a separate group.
No sulfide observed.

THIN SECTION:	**183-1137A-32R-5, 73-75, Piece 12A**					**Unit 4**	**OBSERVER: CRN, MSP**	
ROCK NAME:	**Highly vesicular, highly plagioclase-clinopyroxene-phyric basalt.**							
WHERE SAMPLED:	**Interior of Unit 4: fine grained portion of massive interior.**							
GRAIN SIZE:	**Medium-grained phenocrysts in a fine-grained groundmass.**							
TEXTURE:	**Porphyritic with an intersertal, hypocrystalline groundmass.**							

PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm) min.**	**max.**	**av.**	**APPROX. COMP.**	**MORPHOLOGY**	**COMMENTS**
GLOMEROCRYSTS	10	12	3	8	6	An65-70	Angular masses.	Predominantly subhedral to euhedral plagioclase (~90%), many of which have sieve textures and micron-sized glass inclusions. A few are zoned. Also subhedral to euhedral clinopyroxene (~8%) and a small amount of anhedral olivine (~2%).
PHENOCRYSTS								
Plagioclase	10	12	0.5	4	1.5	An60-65	Subhedral to euhedral	Some have fractures similar to pyroxene. Many discrete plagioclase laths exhibit sieve textures.
Clinopyroxene	4	5	0.4	0.8	0.6		Subhedral	
GROUNDMASS								
Plagioclase	15	20						Plagioclase forms the only groundmass phase.
Titanomagnetite	Trace	Trace						Essentially no opaques in the groundmass. Only one small (<0.1 mm) piece observed in a glomerocryst. Other trace opaques are grinding powder remnants.
Glass	0	50						Glass predominates in this almost vitrophyric basalt.

SECONDARY MINERALOGY	**PERCENT**	**SIZE (mm) min.**	**max.**	**av.**	**REPLACING / FILLING**	**COMMENTS**
Zeolite	12				Vesicles	
Brown clay	60				Glass, filling vesicles	
Green clay	5				Vesicles	

VESICLES/ CAVITIES	**PERCENT**	**LOCATION**	**SIZE (mm) min.**	**max.**	**av.**	**FILLING / MORPHOLOGY**	**COMMENTS**
Vesicles	20		1	5	4	Round to ovoid, filled by zeolite, brown and green clay	Partially to totally filled.

COMMENTS : Macroscopic observation: round to ovoid vesicles evident (up to 5 mm diameter). Slide has a gray-brown hue. Plagioclase phenocrysts visible.
It is often difficult to distinguish phenocryst and glomerocryst phases, sieve-textured plagioclase phenocrysts may be disaggregated from glomerocrysts.
This sample appears to have quenched rapidly not allowing the groundmass to develop nor opaques to crystallize.
There may be about 1% of olivine present, but the alteration makes a positive identification very tenuous.
No sulfides observed.

THIN SECTION: 183-1137A-32R-7, 48-50 Piece 1C — **Unit 4** — **OBSERVER: KN, MSP, CRN**
ROCK NAME: Highly plagioclase-clinopyroxene-phyric basalt.
WHERE SAMPLED: Interior of massive flow, in region where clinopyroxene phenocrysts are most abundant.
GRAIN SIZE: Medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic with an intergranular to intersertal groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS			3	8	6	An65	Subhedral to euhedral masses	Predominantly plagioclase (~90%). Also subhedral to euhedral clinopyroxene (~8%) and a small amount of highly altered, anhedral olivine (~2%).
PHENOCRYSTS								
Plagioclase	11	11	0.5	3	1.5	An60	Euhedral to subhedral laths	Unaltered. Large crystals zoned ~An70 to An45 (core to rim), no detectable compositional difference between glomerocryst and isolated pheonocrysts. About 10% have sieve-texture-patches of sub-micron glass inclusions, and more rarely trains of 20-50 micron diameter inclusions of clinopyroxene and isolated melt inclusions.
Clinopyroxene	4	4	0.2	1	0.3		Subhedral equant	Twinning common.
Olivine	0	0.2	0.2	1	0.6		Euhedral to subhedral equant	Outlines only, completely replaced with green-brown clay, often seen only as holes in thin section with relict crystal outline.
GROUNDMASS								
Plagioclase	35	35	0.1	0.4	0.3		Subhedral laths	
Clinopyroxene	25	30	0.02	0.1	0.06		Subhedral equant	
Titanomagnetite	5	5	0.02	0.3	0.1		Subhedral to anhedral	Tabular to acicular
Glass	0	15					Two occurences: intersertal triangular patches typically less than 0.05 mm across and occasional hyalopilitic patches up to 0.5 mm across	Replaced by homogeneous, nearly isotropic brown green clay in the hyalopilitic patches, and a much finer-grained, light brown, green to dark brown in the mesostasis.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	20				Glass, olivine, clinopyroxene	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	rare	random		1		Brown and green clay, round to ovoid	Difficult to distinguish vesicles from formerly altered olivine filled holes in the thin section; also, some of the presumed altered hyalopilitic patches may be clay-filled, irregular microvesicles.

COMMENTS : POINT-COUNTED SAMPLE.
No sulfide observed. Larger, glomerocrystic plagioclase continued to grow with the discrete, smaller phenocrysts.
Good candidate for a plagioclase / pyroxene separate for dating and radiogenic isotopes.
Photomicrograph #:
1137A-1 = Sieve texture in plagioclase (x10 objective, xpl);
1137A-2 = Pyroxene exsolution lamellae (x50 objective, xpl).

THIN SECTION: 183-1137A-33R-1, 121-124 — **Unit 4/5** — **OBSERVER: LM, CRN**
ROCK NAME: Volcaniclastic sandy siltstone and highly plagioclase-phyric basalt.
WHERE SAMPLED: Contact between volcaniclastic sandy siltstone (Unit 5) and highly plagioclase-phyric basalt (Unit 4)
GRAIN SIZE: Silt to fine-sand-lower. Basalt has medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Moderately well sorted volcanic silt. Porphyritic, hypohyaline to intersertal basalt.

PRIMARY CLASTS	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
LITHIC FRAGMENTS	75			0.4			Angular to subangular	
CRYSTALS								
Feldspar	10			0.2			Angular to subangular	
Quartz	5			0.2			Subangular to subrounded	
Accessories	5			0.2			Subangular to subrounded	
MATRIX								
Clay Minerals	5							Some pore spaces in the matrix, between grains. See photomicrograph 1137A-26.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	1	8	4	10	5		Angular masses	Subhedral plagioclase masses. Mostly altered and replaced with carbonate.
PHENOCRYSTS								
Plagioclase	5	15	0.5	4	2		Euhedral and elongate to tabular	Mostly altered and replaced with carbonate.
Clinopyroxene	0	2					Subhedral	Completely altered to iron-oxides and clay minerals.
GROUNDMASS								
Plagioclase	2	10	0.1	0.2	0.15		Subhedral laths	Highly altered and replaced by carbonate
Glass	0	65					Red-brown, massive	Replaced by iron-oxide-stained and iron-rich clay minerals.
Opaque Minerals	Trace	Trace			<0.05		Anhedral	

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Green clay	10				Groundmass, infilling vesicles	Radiating acicular minerals either iron-oxide stained zeolites or iron-rich clay.
Zeolite?	5				Infilling vesicles	Minerals infill vesicles. Iron-oxide stained clay minerals have replaced the groundmass and mafic silicate phases.
Carbonate	25				Plagioclase	
Hematite/goethite	48				Groundmass	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Coalesced vesicles	5	random	1	10		Green clay and zeolite	Large, coalesced, irregular shapes, completely filled.

COMMENTS : Thin section over-thinned in one part of silt. Glomerocrysts (0.8 to 5 mm) of plagioclase but mafic phases observed elsewhere in Unit 4 are not well preserved here. Some of the larger plagioclase phenocrysts are broken. Vesicle fill in basalt shows radial crystal growth texture.

Photomicrograph #:
1137A-26 = Contact between basalt and baked sediment (x10 objective, ppl).

THIN SECTION: 183-1136A-33R-3, 50-53 **Unit 5** **OBSERVER: LM, DR, MSP**
ROCK NAME: Volcaniclastic sandstone and siltstone.
WHERE SAMPLED: At lower contact of a normally graded sandstone bed (on siltstone) near the base of Unit 5.
GRAIN SIZE: Fine to medium sand and silt.
TEXTURE: Silt and sand both well sorted, beds internally massive.

PRIMARY CLASTS	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
LITHIC FRAGMENTS	75			0.4			Angular-subangular	
CRYSTALS								
Feldspar	10			0.2			Angular-subangular	Contains both clear and perthitic varieties of alkali-feldspar.
Quartz	5			0.2			Subangular-subrounded	
Garnet	1			0.4	0.2		Subangular-subrounded	
Accessories	5			0.2			Subangular-subrounded	
MATRIX								
Clay Minerals	5							

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Hematite/goethite					Staining clay minerals	
Clay minerals					Replacing fine grained silty matrix material	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Pore spaces	7						Some filled by secondary clay minerals.

COMMENTS : Some pore spaces in the matrix, between grains.
Photomicrograph #:
1137A-24 = Silt and sandstone contact. Contains lithic fragment (x2.5 objective, ppl);
1137A-25 = Two grains of garnet in sandstone (x10 objective, ppl).

THIN SECTION: 183-1137A-33R-5, 10-12, Piece 1 — **Unit 6** — **OBSERVER: CRN, MSP**
ROCK NAME: Highly sanidine-plagioclase-clinopyroxene-phyric trachyte.
WHERE SAMPLED: Conglomerate clast at the top of Unit 6.
GRAIN SIZE: Phenocrysts are medium- to coarse-grained, groundmass is fine-grained.
TEXTURE: Porphyritic with a relatively holocrystalline, alkali-feldspar-rich, subhedral granular to intergranular groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	2	4	1	2.5	1.5	An50	Subhedral	A few ragged examples exhibiting disequilibrium textures. Feldspar (sodium-rich plagioclase and/or alkali-feldspar) reaction rims.
Alkali-feldspar	15	20	2	8	5		Subhedral to euhedral	Have two cleavages in some sections >90 < 120, characterisitc of the two perfect cleavages in this group of minerals. These could be anorthoclase. This has a very low 2V (~10 degrees) which indicates sanidine. Micron-sized inclusion trails in the largest crystals.
Clinopyroxene	1	2	0.5	3	2		Subhedral to euhedral	Unaltered cores persist in the middle of altered phenocrysts. Softer alteration has been occasionally plucked out during thin section preparation. Reaction rims seen on some euhedral phenocrysts.
Titanomagnetite	<1	<1	0.25	0.4	0.3		Subhedral	
GROUNDMASS								
Feldpar	40	70	0.05	0.1	0.06		Subhedral to equant	Probably alkali feldspar, but because of small size, difficult to define.
Zircon	Trace	Trace			~0.04		Anhedral	
Titanomagnetite	2	2	0.01	0.1	0.05		Subhedral to anhedral	
Glass	0	3						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Green clay	15				Clinopyroxene, groundmass, fiils vesicles	
Carbonate	1				Feldspars, fills vesicles	
Brown clay	24				Clinopyroxene, groundmass, fills vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	1	Random			1	Green and brown clay/round to irregular	Completely filled. Some can be confused with completely altered mafic phenocrysts.

COMMENTS :
POINT COUNTED MODES (PRIMARY MINERALOGY).
Macroscopic observation: phenocrysts stand out. Groundmass has a brown hue. No veins.
This was described as a "plagioclase-clinopyroxene-phyric basalt" in hand specimen. Contains rare fresh clinopyroxene phenocrysts. The clinopyroxene phenocrysts have been heavily altered and replaced with green and brown clay.
All phenocrysts have at least a reaction rim and/or display sieve textures.
Photomicrograph #:
1137A-8 = Rim on plagioclase phenocryst (x50 objective, xpl);
1137A-9 = Rim on plagioclase phenocryst (x50 objective, xpl + gypsum plate);
1137A-10 = Alkali-feldspar(?) rim on plagioclase phenocryst (x50 objective, xpl);
1137A-11 = Alkali-feldspar(?) rim on plagioclase phenocryst (x50 objective, xpl + gypsum plate).

THIN SECTION: 183-1137A-33R-5, 19-25, Piece 3 — **Unit 6** — **OBSERVER: CRN**
ROCK NAME: Sanidine-plagioclase-phyric flow-banded rhyolite.
WHERE SAMPLED: Top of Unit 6, clast in conglomerate.
GRAIN SIZE: Medium-grained phenocrysts in a glassy to fine-grained (devitrified) groundmass.
TEXTURE: Flow-banded.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	0.5	2	0.5	1	0.9	An35	Subhedral (rounded)	Partially altered (sericite?).
Sanidine	7	10	0.2	2.2	1.8		Subhedral (rounded)	Partially altered (sericite?). Broken crystals present. Low 2V and negative sign indicate sanidine.
GROUNDMASS								
Mesostatisis	0	88						Light and dark bands. Dark bands are devitrified glass (crystallites of zeolite? are evident). Light bands contain fine grained minerals that give biaxial figures, zeolite(?).

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Zeolite	55				Mesostasis	Replaces devitrified minerals in opaque areas and in light bands.
Sericite	4				Feldspars	
Opaque clay	33				Mesostasis	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS : Zeolite present - replace mesostatsis and form the light bands. However, high SiO_2 and normative quartz in the XRF analysis indicates that the crystallites in the devitrified glass are probably quartz.

THIN SECTION: 183-1137A-34R-2, 100-103, Piece 1 — Unit 6 — **OBSERVER:** RD, MSP, CRN
ROCK NAME: Actinolite gneiss.
WHERE SAMPLED: Clast in conglomerate Unit 6.
GRAIN SIZE: Fine- to medium-grained.
TEXTURE: Granoblastic with fine-grained recrystallized zones pervasive throughout the clast.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
Potassium feldspar	60	70	0.1	2	0.5		Xenoblastic	Fractured, partly replaced by clay along cleavage planes.
Quartz	20	20	0.1	1	0.5		Xenoblastic	Yellow birefringence due to thick section. Distinguished by strained extinction.
Actinolite	1	3	0.1	0.5	0.25		Xenoblastic	Green to brown, pleochroic.
Magnetite	1	1	0.1	0.5	0.2		Xenoblastic	Associated with actinolite. Exsolved maghemite in several grains.
Plagioclase	1	2	0.1	0.3	0.2			Altered grains present - altered to clay (sericite).
Zircon	Trace	Trace			<0.05		Xenoblastic	
Microcline	1	2	0.1	2.5	0.3		Xenoblastic	Distinguished by "cross-hatched" twinning.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	10				Feldspar	Light green and orangish-red - well crystallized.
Chlorite	2				Actinolite	

VEINS/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Veins	1	Random				Crystallized green clay	0.1-1 mm wide.

COMMENTS : This clast from the Unit 6 conglomerate is rounded and set in a matrix of devitrified glass and altered lithic fragments, that include free crystals of alkali-feldspar, opaques and clinopyroxene, and alteration minerals of clay and calcite.

What appear to be veins filled with small crystals of the primary metamorphic assemblage are crush zones along which recrystallization has occurred. Grain size is approximately 0.05-0.1 mm. Zones are up to 1 mm wide.

Granoblastic to gneissose fabric.

THIN SECTION: 183-1137A-34R-2, 113-117 Piece 1D — **Unit 6** — **OBSERVER: CRN, MSP**
ROCK NAME: Sanidine-phyric flow-banded rhyolite.
WHERE SAMPLED: Clast in conglomerate.
GRAIN SIZE: Medium-grained phenocrysts, flow-banded, devitrified groundmass with microspherulites and recrystallized layers.
TEXTURE: Flow-banded.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	<1	1	0.2	1.5	0.8		Subhedral to euhedral	Largely replaced by carbonate and pale green clay.
Sanidine	5	8	2	5	4		Subhedral	One section is of the acute bisectrix, which gives a 2V of 45 degrees and is optically negative. Another 2V is ~10 degrees. Suggests sanidine. Carlsbad twinning is conspicuous in most crystals. Unaltered.
GROUNDMASS								
Recrystallized Mesostasis	15	35			<0.1			Appears to contain zeolite or feldspar (biaxial 2V on coarsest groundmass crystals), but are generally quartz-rich, which may be secondary.
Devitrified glass	20	50						Patchy distribution of microspherulites; remainder of glass altered to dark clay.
Titanomagnetite	1	1	0.01	0.15	0.08		Anhedral	
Zircon	Trace	Trace			<0.05		Anhedral	
Apatite	Trace	Trace			<0.05		Subhedral to anhedral	

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Dark clay	50					Alteration product of glass.
Carbonate	1					Replacing plagioclase (rarely alkali-feldspar).
Zeolites	10					In recrystallized mesostatsis.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Veins	1					Carbonate and clay.	Cross-cutting veins (~0.5 mm wide).

COMMENTS : Macroscopic observation: bands are evident with phenocrysts mainly on one side of the section. One reddish-brown vein (~1 mm wide) is present at one corner. Section has a grayish-brown hue. Alternating light (transluscent) and dark (opaque) bands 1-3 mm wide form the groundmass. Light bands appear to contain zeolite or feldspar. Dark bands are altered glass. The bands bend around the phenocrysts. Large crystals are rounded, although generally subhedral, with some being euhedral.
Photomicrographs #:
1137A-12 = Flow banded texture (x10 objective, ppl);
1137A-14 = - - (x50 objective, xpl + gypsum plate).
1137A-59 = General texture showing Carlsbad twinned phenocrysts and groundmass (x2.5 objective, xpl).

THIN SECTION: 183-1137A-34R-3, 119-122, Piece 6 — **Unit 6** — **OBSERVER: KN, MSP, CRN**
ROCK NAME: Sanidine-phyric flow-banded rhyolite
WHERE SAMPLED: Clast in conglomerate.
GRAIN SIZE: Medium-grained phenocrysts, flow-banded, devitrified groundmass with microspherulites and recrystallized layers.
TEXTURE: Flow-banded.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	2	3	0.8	1.2	1	An35-40	Subhedral	Partially replaced by carbonate.
Sanidine	10	15	0.6	2	1		Subhedral to euhedral	Rounded to embayed, rarely euhedral, equant. Bimodal size population - phenocrysts and groundmass. Sanidine identified on the basis of 2V.
Pyroxene	<1	<1			0.5		Euhedral	One in a crystal clot with feldspar and titanomagnetite. It has been totally altered to brown clay.
GROUNDMASS								
Sulfide	<1	<1		0.025			Anhedral	Possibly pyrrhotite or pyrite.
Titanomagnetite	1	2					Subhedral and square	One included in a feldspar phenocryst. Otherwise present in groundmass and concentrated in non-spherulitic groundmass layers. Exsolving maghemite in some cases.
Recrystallized mesostasis	25	25						Light brownish gray. Quartz positively identified in recrystallized light colored areas. Elongate (0.2 x 1.2 mm) strings of quartz observed.
Devitrified glass	30	50						Elongate, discontinuous wisps that have been devitrified and altered (microspherulites present).
Apatite	<1	<1	0.05	0.2			Clear euhedral acicular laths.	Particularly visible near feldspar phenocrysts.
Zircon	<1	<1			0.06		Clear, high relief-high birefringence	Three microphenocrysts in a crystal clot with titanomagnetite. Others are scattered.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clays and rare zeolites	30				Groundmass, feldspar, pyroxene.	Brownish-red and green alteration minerals on some sanidine.
Carbonate	2				Phenocrysts	Replaces plagioclase, rarely alakali-feldspar.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS : Glomerocrysts of plagioclase and sanidine ± titanomagnetite present. Skeletal remnants of feldspar(?) phenocrysts are present in the groundmass.
Light and dark colored bands represent recrystallized, quartz rich and devitrified, altered glass. Various degrees of silica enrichment in the more recrystallized areas.
Iron staining (hematite?) on some light bands.

THIN SECTION: 183-1137A-35R-2, 46-47, Piece 5 — **Unit 6** — **OBSERVER: CRN**
ROCK NAME: Garnet-biotite gneiss
WHERE SAMPLED: Clast in conglomerate: Unit 6.
GRAIN SIZE: Medium-grained.
TEXTURE: Poikiloblastic garnets in a granoblastic to gneissose groundmass..

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
Alkali-feldspar		50	1	5				Exhibits strained extinction. Generally untwinned (distinguish using 2V).
Quartz		20	0.2	2				Some strained extinction, which affects the interference figure.
Garnet		15	1	5			Rounded to ovoid	Inclusions of feldspar up to 0.3mm. Heavily fractured.
Plagioclase		5	0.5	1			Subhedral to anhedral	Some may be untwinned.
Biotite		4	0.2	1			Anhedral sheets	
Clinopyroxene		1	0.1	0.3			Subhedral to anhedral	
Amphibole		1	0.1	0.3			Anhedral	Cleavage apparent.
Magnetite		1	0.1	1.5			Anhedral	Has maghemite exsolution features.
Zircon		<1	0.1	0.2			Anhedral	

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Chlorite	2				Mafics	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS : Section is thick at one side. Granoblastic to gneissose texture. Grains generally xenoblastic, except for garnet (hypidioblastic to idioblastic).
Photomicrograph #:
1137A-6 = Maghemite exsolution in titanomagnetite (x50 objective, rl)
1137A-7 = Garnet poikiloblasts (x10 objective, ppl).

THIN SECTION:	**183-1137A-35R-2, 66-69, Piece 8**	**Unit 6**	**OBSERVER: CRN, NTA**
ROCK NAME:	**Granite.**		
WHERE SAMPLED:	**Conglomerate clast in Unit 6.**		
GRAIN SIZE:	**Coarse-grained.**		
TEXTURE:	**Poikilitic, equigranular.**		

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
Plagioclase	30	40	1	6	5		Subhedral to anhedral	Twinning is generally absent - defined by abundant intergrowths. Poikilitically enclosed by alkali-feldspar.
Alkali-feldspar	35	50	2	10	7		Subhedral	Symplectite intergrowths of plagioclase and alkali-feldspar are abundant. Twinning is generally absent. Some sections have a 2V close to zero (anorthoclase?). The figure looks uniaxial, but there is a slight broadening of the central melatope upon rotation that indicates it's biaxial nature.
Quartz	12	12	0.5	4	3		Subhedral to anhedral	
Titanomagnetite	Trace	Trace			<0.2		Anhedral	
Zircon	Trace	Trace			<0.01		Anhedral	Small accessory. Exhibits slight reflectance and can be confused with poorly polished titanomagnetite. There are pieces next to each that can be observed in both reflected and transmitted light.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Sericite	25				Plagioclase and alkali-feldspar	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS :

Macroscopic observation: equigranular rock with few veins and a pinkish hue.
Many crystals appear to be wormy symplectitic intergrowths of two phases. The alkali-feldspar appears to be the host.
In this section, alkali-feldspar has yellow birefringence (thick section).
Inclusions (micron-sized) present in both plagioclase and alkali-feldspar (fluid? Crystallized melt?)
Hydrous minerals are absent.
Photomicrograph #:
1137A-5: Symplectitic texture in granite clast (x2.5 objective, xpl).

THIN SECTION: 183-1137A-37R-5, 80-83, Piece 1D — **Unit 7A** — **OBSERVER: CRN**
ROCK NAME: Highly plagioclase-olivine-phyric basalt.
WHERE SAMPLED: Altered flow-top breccia.
GRAIN SIZE: Fine- to medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic with an intergranular, occasionally trachytic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	4	6	3	6	4	An65	Angular masses	Subhedral laths of plagioclase. Partially altered to sericite. Looks like many have a sieve texture, but this is plucking that occurred during polishing.
PHENOCRYSTS								
Plagioclase	3	4	0.4	1.2	0.8	An65	Subhedral laths	Partially altered to sericite.
Olivine	0	2	0.1	1	0.4		Euhedral to subhedral	Microphenocrysts. Equant crystals that are totally altered and replaced by brown clay.
GROUNDMASS								
Plagioclase	30	35	0.05	0.3	0.15		Subhedral to anhedral laths	Reasonably fresh.
Clinopyroxene	25	35	0.01	0.15	0.1		Anhedral	
Titanomagnetite	5	5	<0.01	0.05	0.025		Subhedral to anhedral	Very fine grained stubby octahedra and skeletal lath-like crystals in the groundmass. Have escaped the pervasive alteration seen throughout the section.
Glass	0	15						Altered to brown clay.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate	<1				Plagioclase glomerocrysts	
Sericite	8				Plagioclase glomerocrysts	
Brown clay	25				Glass, olivine	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS : Macroscopic observation: section is porphyritic (plagioclase). No veining but the rock is brown.
Section is moderately altered.
No sulfide observed.

THIN SECTION:	**183-1137A-38R-3, 80-83, Piece 1**	**Unit 7B**	**OBSERVER: CRN, MSP**
ROCK NAME:	**Moderately plagioclase-phyric basalt**		
WHERE SAMPLED:	**Interior of Unit 7B.**		
GRAIN SIZE:	**Medium grained phenocrysts, fine grained groundmass.**		
TEXTURE:	**Porphyritic with an intersertal to intergranular groundmass.**		

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	4	4	5	8	6	An71	Subhedral masses	Glomerocryst plagioclase generally have textures that look like sieves. These are actually areas that have been plucked during polishing. Zoned plagioclase is vivid. Monomineralic, some with discontinuous overgrowths. Several contain melt inclusions (up to 0.1 mm).
PHENOCRYSTS								
Plagioclase	10	10	0.5	2	1.2	An65-70	Subhedral	Some phenocrysts are zoned; some have discontinuous rims.
Clinopyroxene	0	<1	0.4	0.6	0.5		Subhedral	A few totally altered crystals are present as phenocrysts. One or two fresh examples are present.
Olivine	0	<1	0.2	0.3	0.25		Euhedral to subhedral	Microphenocrysts. Completely altered and replaced by brown clay.
GROUNDMASS								
Plagioclase	30	30	0.05	0.3	0.15		Subhedral laths	Plagioclase is unaltered.
Clinopyroxene	30	35	<0.05	0.2	0.1		Anhedral	
Titanomagnetite	5	5	<0.05	0.15	0.08		Anhedral	Skeletal and poorly formed stubby octahedra
Glass	0	15						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Brown clay	20				Clinopyroxene, glass, olivine	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS : Macroscopic observation: Glomerocrysts and phenocrysts observed. No veins/vesicles. Section has a gray hue with a light brown tinge. No sulfide observed.

THIN SECTION: 183-1137A-39R-1, 112-115, Piece 5B — Unit 7B — OBSERVER: CRN, KN
ROCK NAME: Highly plagioclase-olivine-phyric basalt.
WHERE SAMPLED: Interior of Unit 7B at contact with segregation.
GRAIN SIZE: Medium-grained phenocrysts, fine-grained groundmass.
TEXTURE: Porphyritic with a sub-trachytic intersertal to intergranular groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	3	3	0.8	4	3			One glomerocryst contains plagioclase with bent twins and undulatory extinction. Zonation observed in several plagioclases.
PHENOCRYSTS								
Plagioclase	8	10	0.2	3	1.8	An60-62	Subhedral	The individual plagioclase phenocrysts and microphenocrysts tend to be more euhedral than the glomerocrystic plagioclase. Some larger ones exhibit a sieve texture.
Clinopyroxene	<1	<1	0.2	0.3	0.25		Subhedral	
Olivine	0	2	0.2	0.5	0.3		Euhedral to subhedral	Microphenocrysts. Completely altered and replaced by brown clay.
GROUNDMASS								
Plagioclase	35	35	0.05	0.15	0.1		Subhedral to anhedral	Plagioclase is generally fresh.
Clinopyroxene	20	25	<0.01	0.07	0.05		Anhedral	
Titanomagnetite	3	3	0.05	0.3	0.1		Subhedral to anhedral, acicular and skeletal	Tiny sulfides may be present. Skeletal varieties dominate.
Glass	0	20						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay and zeolite	30				Groundmass, olivine, filling vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	4	Dispersed	0.1	0.4		Round to subround	Generally filled with olive-brown clay and zeolite.

COMMENTS : Macroscopic observation: no veins. Glomerophenocrysts evident. Gray-brown hue.
Fast cooling indicated by grain size and skeletal titanomagnetite.
No sulfide observed.

THIN SECTION: 183-1137A-39R-2, 53-56, Piece 1D — **Unit 7B** — **OBSERVER: CRN**
ROCK NAME: Sparsely plagioclase-olivine-clinopyroxene-phyric basalt.
WHERE SAMPLED: Base of Unit 7B.
GRAIN SIZE: Phenocrysts are medium grained in a fine grained groundmass.
TEXTURE: Porphyritic with an intersertal to intergranular groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	1	5	0.8	2	1.2	An65	Subhedral	Highly altered, with only a fraction of fresh material remaining. Replaced by sericite and gray-brown opaque clay.
Clinopyroxene	<1	1	0.5	1	0.7			Not abundant - maybe some totally altered crystals, but rare fresh examples are seen.
Olivine	0	2	0.2	0.4	0.25		Euhedral to subhedral	Microphenocrysts. Completely altered and replaced by brown clay.
GROUNDMASS								
Plagioclase	25	35	0.05	0.3	0.15		Subhedral laths	Reasonably unaltered.
Clinopyroxene	20	35	0.05	0.1	0.07		Anhedral	Interstitial to plagioclase laths.
Titanomagnetite	4	4	<0.01	0.05	0.02		Anhedral	Very small, mostly elongated skeletal grains with serated rims. Looks like it just started to crystallize.
Glass	0	20						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Sericite	10				Plagioclase, vein	
Brown clay	30				Clinopyroxene, plagioclase, olivine, glass	
Green clay	10				Vesicles	
Zeolite	3				Vein, vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	5	Dispersed	0.5	10	1	Brown or green clay/ round to ovoid.	
Vein	1		0.1	0.2		Zeolite, clay, sericite	

COMMENTS : Macroscopic observation: vesicles are present; some are filled with bright green material; a thin vein traverses the width of the section. Section has a greenish hue.
Groundmass becomes finer around larger vesicles.
Moderately to highly altered.
No sulfide observed.

THIN SECTION: 183-1137A-40R-2, 121-122, Piece 1D — **Unit 8B** — **OBSERVER: MSP, CRN**
ROCK NAME: Moderately plagioclase-olivine-phyric basalt.
WHERE SAMPLED: Interior of Unit 8B.
GRAIN SIZE: Medium-grained phenocrysts, fine-grained to aphanitic groundmass.
TEXTURE: Porphyritic with intergranular to intersertal groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	3	4	5	8	7	An70-75	Angular masses	Predominantly subhedral plagioclase laths and subordinate clinopyroxene (altered, rounded, up to 1 mm). Melt inclusions present.
PHENOCRYSTS								
Plagioclase	4	5	0.5	5	1		Euhedral laths to subhedral equant	Zoned, some have sieve textures.
Olivine	0	4	0.1	0.5	0.3		Euhedral to subhedral	Microphenocrysts. Difficult to identify, completely altered to brown clay.
GROUNDMASS								
Plagioclase	35	40	0.02	0.05	0.1		Subhedral to anhedral	
Clinopyroxene	20	30	0.02	0.05	0.03		Anhedral	
Titanomagnetite	5	5	<.05	0.1	0.5		Acicular	
Glass	0	10						Completely altered to clay.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Brown clay	35				Irregular to polygonal areas of fibrous clay	Replaces, in decreasing degree, mesostasis, groundmass clinopyroxene and plagioclase, and phenocryst phases. Some of these patches could be relicts of olivine grains.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	Trace	Random	1	8		Silica filled, round; sometimes clay lined.	One complete, one partial large amygules in slide.

COMMENTS : Thick section makes groundmass look more altered than it really is.
No sulfide observed.

THIN SECTION: 183-1137A-41R-1, 68-73, Piece 1C — **Unit 8B** — **OBSERVER: CRN, MSP**
ROCK NAME: Moderately plagioclase-olivine-phyric basalt.
WHERE SAMPLED: Chilled base of Unit 8B.
GRAIN SIZE: Medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic, hypocrystalline, intersertal to intergranular basalt.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	5	7	0.6	2	1.2	An70-75	Subhedral	Zonation present in some larger crystals. Some of these could be described as glomerocrysts, but the number of individual crystals involved is usually only 2 or 3.
Olivine	0	3	0.2	1.5	0.5		Subhedral to euhedral	Microphenocrysts now completely altered.
GROUNDMASS								
Plagioclase	30	35	0.05	0.25	0.1		Subhedral laths	Reasonably fresh. A 0.2 mm microphenocryst is ~An70.
Clinopyroxene	25	35	0.05	0.15	0.1		Anhedral	Partially altered.
Titanomagnetite	5	5	0.01	0.1	0.05		Anhedral	Very fine grained skeletal grains in the crystallized groundmass.
Glass	0	15						Irregular patches randomly distributed over the section.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Brown clay	20					
Green clay	7					
Zeolite	8					

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	5	center of section	0.5	10	2	Round to flattened (ovoid), fillled with brown and green clay and zeolite.	Totally filled.

COMMENTS : Macroscopic observation: Large vesicle in center is filled with green clay. Plagioclase phenocrysts evident in a fine grained groundmass. Section has a brownish hue. No sulfides observed.

THIN SECTION: 183-1137A-41R-1, 127-128, Piece 6B — **Unit 9** — **OBSERVER: MSP, CRN, LM**
ROCK NAME: Highly feldspar-phyric vitric tuff.
WHERE SAMPLED: Top of unit 9.
GRAIN SIZE: Medium-grained feldspar phenocrysts in a clay matrix.
TEXTURE: Highly porphyritic, with a devitrified, glassy matrix.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine *	36	38	0.1	3	1		Euhedral to embayed, some fragmented	Well-crystallized, 2V < 10 degrees. Well-developed feldspar cleavage in crystals, relatively regularly spaced at 0.03-0.05 mm; most likely a result of ship board thin section preparation, but some fracturing may be a result of original eruption mechanisms. Some, especially those smaller than 0.5 mm, remain uncleaved. Occasional sympletic textures at least partially an alteration reaction with the groundmass; some xenocrystic K-feldspar likely.
Quartz	*	*	0.1	1?	~0.3		Euhedral to highly embayed	Conchoidal fractures in areas of thin section where feldspar well-cleaved
Plagioclase	2	3			1		Eudheral, some fragmented	More altered than seen lower in the unit
Mafic phases	<1	2		1			Subhedral to anhedral	Larger (up to 1 mm) iddingsite-like pseudomorphs after biotite(?), which itself maybe be replacing an earlier amphibole(?) fayalite(?). Often associated with small (0.1-0.2 mm), unaltered kaersutite, zircon, and titanomagnetite. Kaersutite (pale yellow-brown to dark brown, essentially opaque pleochrism) also occurs as rare microphenocrysts.
Titanomagnetite	<1	<1	0.05	0.8	0.02			
Zircon	tr.	tr.	0.04	0.05	0.01			
Lithic fragments	5	5	?	12	2			At least 1 highly altered basaltic fragment; some feldspar clasts?
MATRIX								
Glass	0	51						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Orange-brown to pale yellow-green clay	56				Mafic phenocrysts, patches of groundmass	Iron oxide (hematite) and oxyhydroxide (goethite) staining of smectite? clay minerals (nontronite?) and kaolinite.
Hematite/goethite					Staining clay minerals, concentration around altered mafic minerals, opaque minerals, along veinlets.	Hematite (red color) and goethite (gold to yellow-orange color)

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS : PRIMARY MINERALOGY POINT-COUNTED

* Some quartz, and possibly some plagioclase, included in the modal K-feldspar estimate (<3%). The original pyroclastic texture (cuspate and tricuspate glass shards in the matrix) seen lower in the unit has been obscured by devitrification/oxidation/alteration in this sample. Clay domains have very fine sand sized alkali feldspar fragments distributed throughout. There are some areas between larger crystals where the clay is more massive. See “Physical Volcanology” in “Site 1137” chapter for a more complete discussion.

THIN SECTION: 183-1137A-41R-2, 98-99 — **Unit 9** — **OBSERVER: MSP, LM**
ROCK NAME: Highly feldspar-phyric vitric tuff.
WHERE SAMPLED: Top of Unit 9 showing oxidized band and Cu mineralization.
GRAIN SIZE: Medium-grained feldspar phenocrysts in a clay matrix.
TEXTURE: Highly porphyritic, with a devitrified, glassy matrix.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine *	36	39	0.1	3	1		Euhedral to embayed, some fragmented	Well-crystallized, 2V < 10 degrees. Well-developed feldspar cleavage in crystals, relatively regularly spaced at 0.03-0.05 mm; most likely a result of ship board thin section preparation, but some fracturing may be a result of original eruption mechanisms. Some, especially those smaller than 0.5 mm, remain uncleaved. Occasional sympletic textures at least partially an alteration reaction with the groundmass; some xenocrystic K-feldspar likely.
Quartz	*	*	0.1	1?	~0.3		Euhedral to highly embayed	Conchoidal fractures in areas of thin section where feldspar well-cleaved
Plagioclase	<1	3			1		Eudheral, some fragmented	More altered than seen lower in the unit
Mafic phases	<1	2		1			Subhedral to anhedral	Larger (up to 1 mm) iddingsite-like pseudomorphs after biotite(?), which itself maybe be replacing an earlier amphibole(?) fayalite(?). Often associated with small (0.1-0.2 mm), unaltered kaersutite, zircon, and titanomagnetite. Kaersutite (pale yellow-brown to dark brown, essentially opaque pleochrism) also occurs as rare microphenocrysts.
Titanomagnetite	<1	<1	0.05	0.8	0.02			
Zircon	Trace	Trace	0.04	0.05	0.01			
Lithic fragments	<1	<1						
MATRIX								
Glass	0	57						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Orange-brown to pale yellow-green clay	56				Mafic phenocrysts, patches of groundmass	Iron oxide (hematite) and oxyhydroxide (goethite) staining of smectite? clay minerals (nontronite?) and kaolinite.
Hematite/goethite					Staining clay minerals, concentration around altered mafic minerals, opaque minerals, along veinlets, and in the obvious oxidised band.	Hematite (red color) and goethite (gold to yellow-orange color). Some hematitic haloes around the altered mafic silicate minerals.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS : PRIMARY MINERALOGY POINT-COUNTED

Some quartz, and possibly some plagioclase, included in the modal K-feldspar estimate (<3%). The original pyroclastic texture (cuspate and tricuspate glass shards in the matrix) seen lower in the unit has been obscured by devitrification/oxidation/alteration in this sample. Clay domains have very fine sand sized alkali feldspar fragments distributed throughout. There are some areas between larger crystals where the clay is more massive. See “Physical Volcanology” in “Site 1137” chapter for a more complete discussion.

THIN SECTION: 183-1137A-43R-3, 42-46 — **Unit 9** — **OBSERVER: CRN, MSP, LM**
ROCK NAME: Highly feldspar-phyric vitric tuff.
WHERE SAMPLED: Middle of Unit 9 (clast free).
GRAIN SIZE: Medium-grained feldspar phenocrysts in a clay matrix.
TEXTURE: Highly porphyritic, with a devitrified, glassy matrix.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine *	40	42	0.1	5	4		Euhedral to embayed, some fragmented	Well-crystallized, 2V < 10 degrees. Well-developed feldspar cleavage in crystals, relatively regularly spaced at 0.03-0.05 mm; most likely a result of ship board thin section preparation, but some fracturing may be a result of original eruption mechanisms
Quartz	*	*	0.1	1?	~0.3		Euhedral to highly embayed	Conchoidal fractures in areas of thin section where feldspar well-cleaved
Plagioclase	<1	3					Eudheral, some fragmented	Cleavage similar to that observed in the sanidine phenocrysts
Mafic phases	<1	2			0.8		Subhedral to anhedral	Larger (up to 1 mm) pseudomorphs after biotite(?), which itself maybe be replacing an earlier amphibole(?) fayalite(?). Often associated with small (0.1-0.2 mm), unaltered kaersutite, zircon, and titanomagnetite. Now completely replaced by clear to pal
Lithic fragments	1	1	0.2	5	3.5		Rounded	Altered, fine-grained basaltic fragments
Titanomagnetite	0.1	0.1	0.01	0.8	0.5			
Zircon	0.1	0.1	0.01	0.1	0.05			
MATRIX								
Glass	0	52	0.01	0.8	0.5			

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Green brown clay	5				Mafic phenocrysts, patches of groundmass	Notably much less hematite and goethite staining than in the overlying crystal vitric tuff samples.
Pale yellow green to brown clay	60				Groundmass glass shards	Original pyroclastic texture seen lower in the unit has been obscured by devitrification/oxidation/alteration. See "Physical Volcanology" in "Site 1137" chapter for a more complete discussion.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS : PRIMARY MINERALOGY POINT-COUNTED
Some quartz, and possibly some plagioclase, included in the modal K-feldspar estimate (<3%). Clay domains have very fine sand sized alkali feldspar fragments distributed throughout. There are some areas between larger crystals where the clay is more massive.

THIN SECTION: 183-1137A-43R-3, 42-44 — **Unit 9** — **OBSERVER: CRN, MSP, LM**
ROCK NAME: Highly feldspar-phyric vitric tuff.
WHERE SAMPLED: Middle of Unit 9 (clast free).
GRAIN SIZE: Medium-grained feldspar phenocrysts in a glassy matrix.
TEXTURE: Highly porphyritic, with a devitrified, glassy matrix.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine *	35	37	0.1	5	4		Euhedral to embayed, some fragmented	Well-crystallized, 2V < 10 degrees. Well-developed feldspar cleavage in crystals, relatively regularly spaced at 0.03-0.05 mm; most likely a result of ship board thin section preparation, but some fracturing may be a result of original eruption mechanisms. Some crystals, especially those smaller than 0.5 mm, remain uncleaved. Occasional sympletic textures at least partially an alteration reaction with the groundmass; some xenocrystic K-feldspar likely.
Quartz	*	*	0.1	1?	~0.3		Euhedral to highly embayed	Conchoidal fractures in areas of thin section where feldspar well-cleaved
Plagioclase	<1	1.6					Eudheral, some fragmented	Cleavage similar to that observed in the sanidine phenocrysts
Mafic phases	<1	1.3			0.8		Subhedral to anhedral	Larger (up to 1 mm) pseudomorphs after biotite(?), which itself maybe be replacing an earlier amphibole(?) fayalite(?). Often associated with small (0.1-0.2 mm), unaltered kaersutite, zircon, and titanomagnetite. Now completely replaced by clear to pale green, relatively well-crystallized, clay. Rare microphenocrysts of kaersutite; at least one broken clinopyroxexe with a reaction rim. Some of the mafic cores are filled with altered glass shards and groundmass.
Lithic fragments	1	1.4	0.2	5	3.5		Rounded	Altered, fine-grained basaltic fragments.
Titanomagnetite	0.1	0.1	0.01	0.8	0.5			
Zircon	0.1	0.1	0.01	0.1	0.05			
MATRIX								
Glass	40	59	0.01	0.8	0.5			Clear shard morphologies preserved. Shards in this sample are flattened compared with material lower in the section.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Green brown clay	5				Mafic phenocrysts, patches of groundmass	Notably much less hematite and goethite staining than in the overlying crystal vitric tuff samples.
Pale yellow green to brown clay	15				Groundmass glass shards	Partially replacing glass shards.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS : PRIMARY MINERALOGY POINT-COUNTED

*Some quartz, and possibly some plagioclase, included in the modal K-feldspar estimate (<3%). Shards are preserved in the matrix and appear flattened compared with lower in the section. Glass shards do not show evidence of welding. There is partial alteration of glass shards to clay minerals, which in overlying section becomes complete. See "Physical Volcanology" in 'Site 1137" chapter for a more complete discussion.

THIN SECTION: 183-1137A-43R-4, 57-60 **Unit 9** **OBSERVER: DW, RD, MP, LM**
ROCK NAME: Highly sanidine-phyric vitric tuff with 2 cm lithic clast.
WHERE SAMPLED: Center of unit 9, including a 2 cm lithic clast in crystal-vitric-lithic tuff
GRAIN SIZE: Medium-grained feldspar phenocrysts in a glassy matrix.
TEXTURE: Highly porphyritic, with a devitrified, glassy matrix.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine *	35	39	0.1	1.5	1		Euhedral to embayed, some fragmented	Well-developed feldspar cleavage in crystals, relatively regularly spaced at 0.03-0.05 mm. Some crystals, especially those smaller than 0.5 mm, relatively uncleaved. Well-crystallized, 2V < 10 degrees. Note: some alkali feldspar counted as phenocryst may be xenocrysts.
Quartz	*	*	0.1	1?	~0.3		Euhedral to highly embayed	Conchoidal fractures in areas of thin section where feldspar well-cleaved
Plagioclase	1	3			1			Cleavage similar to that observed in the sanidine phenocrysts
Mafic phases	<1	3					Subhedral to anhedral	Includes small (0.1-0.2 mm) fresh kaersutite and rare biotite, and larger (up to 1 mm) iddingsite-like pseudomorphs after amphibole? / clinopyroxene? / fayalite?
Titanomagnetite	1	1	0.05	0.8	0.02			
Zircon	Trace	Trace	0.05	0.15	0.1		Subhedral	Conspicuous and fresh in the altered glass matrix.
MATRIX								
Glass	10	55					0.1 to 0.2 mm cuspate and triscuspate, bubble-wall shard textures preserved	Glass shards unflattened to partially flattened but no evidence of welding. See "Physical Volcanology" in the "Site 1137" chapter for a more complete discussion.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clear to brown clay	5				Feldspar, mafic phenocrysts	Principally along cleavage planes, except for completely replaced mafic pseudomorphs
Pale green to brown clay	45				Groundmass glass shards	After bubble-wall glass shards

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS :
PRIMARY MINERALOGY POINT-COUNTED
*Some quartz, and possibly some plagioclase, included in the modal K-feldspar estimate (<3%).
Small clast (1.5-2 cm) in the vitric tuff, similar to garnetiferous gneiss described in thin section 1137A, 35R2, 46-47:
Feldspar (0.5-1 mm), relatively equigranular. K-feldspar/plagioclase ratio: 2/1 (K-spar 50 %, plag 25 %), 5-10% granophyric; quartz poor?
Garnet in rounded, heavily fractured, crystals and grouped in zones. 1-2 mm, 10 %
Biotite in small laths (0.1 x 0.5 mm) usually associated with the garnet, 5%
Zircon, euhedral - > 40 microns. Nice crystals.
Also small (< 8 mm) fragments of felsic volcanic material, similar to massive trachyte cobbles described in Unit 6.

THIN SECTION: 183-1137A-44R-4, 6-9 **Unit 9** **OBSERVER: CRN, MSP, LM**
ROCK NAME: Highly feldspar-phyric vitric tuff.
WHERE SAMPLED: Towards bottom of Unit 9.
GRAIN SIZE: Medium-grained feldspar phenocrysts in a glassy matrix.
TEXTURE: Highly porphyritic, with a devitrified, glassy matrix.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	38	45	0.1	5	4		Subhedral (rounded and broken)	Well-developed feldspar cleavage in crystals, relatively regularly spaced at 0.03-0.05 mm. Some crystals, especially those smaller than 0.5 mm, relatively uncleaved. Well-crystallized, 2V < 10 degrees. Note: some alkali feldspar counted as phenocryst may be xenocrysts.
Quartz	*	*	0.1	1?	~0.3			Conchoidal fractures in areas of thin section where feldspar well-cleaved
Plagioclase		1.1			1			Cleavage similar to that observed in the sanidine phenocrysts
Mafic		3.4						Includes small (0.1-0.2 mm) fresh kaersutite and rare biotite, and larger (up to 1 mm) iddingsite-like pseudomorphs after amphibole? / clinopyroxene? / fayalite?
Titanomagnetite	0.2	0.2	0.05	0.8	0.02			
Zircon	Trace	Trace	0.05	0.15	0.1		Subhedral	Conspicuous and fresh in the altered glass matrix.
Lithic clasts	2	2	2	5	3.5		Rounded	Primarily plagioclase-phyric basalt.
MATRIX								
Titanomagnetite	1	1						Groundmass or as inclusions in alkali-feldspar.
Glass	10	47	0.05	0.8	0.4		Subhedral to anhedral	Remnants of glass shards evident in groundmass - some relatively unaltered.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Illite/Celadonite?	10				Glass shards	
Green clay	40				Glass shards	(saponite, nontronite?)

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS : PRIMARY MINERALOGY POINT-COUNTED; some quartz, and possibly some plagioclase, included in the modal sanidine estimate (<3%).
Shards are preserved in the matrix and are relatively unflattened compared with higher in the section. Glass shards do not show evidence of welding. There is partial alteration of glass shards to clay minerals and illite/celadonite? alteration minerals.
Photomicrograph #:
1137A-21 = Biotite phenocryst in tuff (x10 objective, xpl).

THIN SECTION: 183-1137A-44R-4, 44-46 **Unit 9** **OBSERVER: CRN, MSP, LM**
ROCK NAME: Highly feldspar-phyric vitric tuff with garnet-biotite gneiss clast.
WHERE SAMPLED: Base of Unit 9.
GRAIN SIZE: Medium-grained feldspar phenocrysts in a glassy matrix, with isolated garnetiferous clast (1 X 2 cm).
TEXTURE: Highly porphyritic, with a devitrified, glassy matrix. Clast: poikilioblastic garnets in an equigranular feldspathic and biotite groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	35	37	0.1	4	2.5		Anhedral to subhedral.	Characteristic cleavage and twinning evident. Reaction with the groundmass seen in some crystals and some are broken. Crystals are generally fresh, some containing micron-sized inclusions trails. Glass inclusions up to 50 microns present - look like the oxyhornblende, but no pleochroism and are isotropic.
Plagioclase		1						
Biotite et al.	0.5	2	0.05	0.2	0.1		Anhedral	Partially altered in groundmass. Green pleochroic.
Oxyhornblende		0.1	0.05	0.2	0.1		Subhedral	Distinctly pleochroic in the groundmass. Also as inclusions in the k-spar.
Lithics (other than *)		0.7						
Titanomagnetite	0.2	0.2					Anhedral to subhedral	Occurs as discrete grains in groundmass or as inclusions in K-spar.
MATRIX								
Titanomagnetite	1	1	0.05	0.3	0.2		Anhedral to subhedral	Occurs as discrete grains in groundmass or as inclusions in K-spar.
Glass	10	59	0.1	0.5	0.3		Angular shards	Fresh glass is still present. Sizes refer to shards still visible. Transparent glass.
Pyrite	Trace	Trace			<0.1		Anhedral	
Zircon							Anhedral	Associated with opaques, as discrete grains in groundmass, or as inclusions in alkali-feldspar.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Green clay	35				Glass	
Illite/Celadonite?	5					
Brown clay	10					

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles							

COMMENTS : PRIMARY MINERALOGY POINT-COUNTED

GARNET BIOTITE GNEISS DESCRIPTION:

Garnet: poikiloblastic with inclusions of alkali-feldspar and biotite. 2-4.5 mm, subrounded. 15%
Alkali-feldspar: strained extinction in some grains. Micron-sized inclusion trails present in some crystals. Triple junctions. 0.5-3.5 mm. 55%
Plagioclase: More altered than alkali-spar (sericite). 0.3-2mm. 9%
Biotite: Highly pleochroic ragged plates of biotite in the groundmass. 0.1-1 mm. Some are kinked (Photomicrograph #: 1137A-19). 20%
Zircon: small (0.05-0.1 mm) rounded crystals are seen throughout the section. 1%
No quartz found. Trace of magnetite.
Photomicrograph #:
1137A-17 = Remnant of glass shards in crystal vitric tuff - portions still fresh (x10 objective, ppl);
1137A-18 = As 17, but xpl.
1137A-19 = Gneiss clast - biotite (some kinked), poikiloblastic garnet, K-spar, zircon (x5 objective, ppl);
1137A-20 = Melt inclusion in K-spar + crystal vitric tuff texture (x10 objective, ppl).

THIN SECTION: 183-1137A-44R-4, 71-72, Piece 1B — **Unit 10A** — **OBSERVER: CRN**
ROCK NAME: Highly plagioclase-olivine-phyric basalt.
WHERE SAMPLED: Top of Unit 10A in chilled zone.
GRAIN SIZE: Coarse-grained glomerocrysts, medium-grained phenocrysts in a fine-grained to glassy groundmass.
TEXTURE: Porphyritic (glomerocrystic) with an intersertal, hypohyaline groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	15	20	5	10	8	An70	Angular masses	Primarily subhedral plagioclase laths up to 8 mm. Altered to sericite and replaced by carbonate in patches.
PHENOCRYSTS								
Plagioclase	5	8	0.8	2	1	An65	Subhedral laths	Partially altered.
Olivine	0	2	0.1	0.3	0.25		Euhedral	Totally altered and replaced by green clay.
GROUNDMASS								
Plagioclase	5	10	0.01	0.2	0.1		Subhedral to anhedral	Partially altered.
Clinopyroxene	5	10	0.01	0.2	0.08		Anhedral	Moderately altered.
Titanomagnetite	2	2			<0.01		Subhedral to anhedral	Extremely fine grained titanomagnetite(?) in glassy groundmass. Identification is difficult.
Glass	0	50						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Sericite	**10**				Plagioclase	
Green clay	**10**				Vesicles, olivine, and glass	
Carbonate	**0.5**				Plagioclase	
Brown clay	**45**				Glass and vesicles	
Zeolite	**5**				Vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	15		1	8	3	Green and brown clay, zeolites/ round to flattened (ovoid)	Some are coalesced. Mostly totally filled.

COMMENTS : Macroscopic observation: Abundant plagioclase glomerocrysts. Groundmass is fine-grained to aphanitic. Section has a dark gray hue.
Section is a little thick.
At one end of the section there is a sand-filled vein/crack with angular quartz grains (0.1-0.2 mm) set in a green-brown clay matrix. The vein is ~ 1-2 mm wide and penetrates ~ 10 mm into the section.
No sulfides observed.

THIN SECTION: 183-1137A-45R-1, 80-84, Piece 1 **Unit 10A** **OBSERVER: LM, CRN**
ROCK NAME: Moderately plagioclase-olivine-phyric basalt; contact with sandy siltstone.
WHERE SAMPLED: Brecciated flow top where magma has mingled with sediment, quenched and fragmented.
GRAIN SIZE: Fine- to medium-grained phenocrysts in an fine grained to glassy groundmass.
TEXTURE: Porphyritic, hypohyaline basalt.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	3	12	4	9	7		Angular masses	Consists dominantly of subhedral plagioclase that has been highly altered to sericite and clay, and occasionally replaced by carbonate. The alteration has destroyed the albite twins, but preserved the Carlsbad twins. Could also be replaced by zeolite(?).
PHENOCRYSTS								
Plagioclase	3	10	0.5	1.8	1		Subhedral laths	See Glomerocryst comment.
Olivine	0	5	0.1	0.3	0.15		Euhedral to subhedral	Euhedral microphenocrysts; completely altered to green and brown clay. Similar in size to some groundmass plagioclase.
GROUNDMASS								
Plagioclase	15	20	0.01	0.2	0.08			
Glass	0	50						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate	2				Plagioclase glomerocrysts, groundmass	
Green clay	25				Vesicles, olivine	
Hematite/goethite	10				Staining clay minerals	
Brown clay	35				Groundmass glass	Color varies from brown to black (opaque).
Sericite	5				Plagioclase	
Zeolite	5				Vesicles, plagioclase	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	10		0.4	5.5	1.5	Green clay, carbonate, zeolite; vesicles are rounded to flattened.	Several are coalesced. Vesicles are generally filled. A greater proportion are in the darker, more glassy section

COMMENTS : This sample was taken to look at the contact relationships between the basaltic clasts and the enclosing sediment, and also the internal textures in the sediment. Sediment grain size ranges from silt to fine sand, and sorting is generally poor. Some discrete domains of coarser or finer grained material are associated with flowage of fluidized sand around clasts (see photomicrograph 1137A-51). There is no evidence of grading associated with passive deposition. The sandy silt is either massive internally or has fine silt distributed around and between clasts with coarser sand concentrated in stringers or domains of aligned particles farther from clasts. Basalt clasts are glassy to aphanitic and have angular polygonal shapes with some curviplanar surfaces; there is evidence of breakage across some crystals (see photomicrograph 1137A-52) and through vesicles. However, breakage seems to preferentially take place through glassy parts of the basalt. There is biotite in the silt.

Photomicrograph #:

1137A-51 = Coarse sediment stringer between clasts - evidence of fluidized flow of sediment (x5 objective, ppl);

1137A-52 = Brecciation of clasts due to sedimentation (x5 objective, ppl).

THIN SECTION: 183-1137A-45R-2, 7-10, Piece 1 **Unit 10A** **OBSERVER: LM, CRN**
ROCK NAME: Moderately plagioclase-olivine-phyric basalt; contact with sandy siltstone.
WHERE SAMPLED: Brecciated flow top where magma has mingled with sediment, quenched and fragmented.
GRAIN SIZE: Medium-grained phenocrysts in a fine grained to glassy groundmass.
TEXTURE: Porphyritic, hypohyaline basalt.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	3	10	4	9	7		Angular masses	Consists dominantly of subhedral plagioclase that has been partially altered to sericite and clay. Domains of calcite within altered laths. The plagioclase may be replaced by zeolite (very low birefringence - this has destroyed the albite twinning, but preserved the Carlsbad twins.
PHENOCRYSTS								
Plagioclase	3	5	0.5	1.8	1		Subhedral laths	See Glomerocryst comment.
Olivine	0	5	0.1	0.3	0.15		Euhedral to subhedral	Euhedral microphenocrysts; completely altered to green and brown clay. Similar in size to some groundmass plagioclase. Many show swallow-tail terminations.
GROUNDMASS								
Plagioclase	15	20	0.01	0.2	0.08			
Glass	0	60						Glass is replaced with brown clay minerals.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate	2				Plagioclase glomerocrysts, groundmass	
Green clay	18				Olivine; fills vesicles	
Hematite/goethite					Staining clay minerals	
Brown clay	50				Groundmass glass	Color varies from brown to black (opaque).
Sericite	5				Plagioclase	
Zeolite	5				Vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	10		0.4	5.5	1.5	Green clay, carbonate, zeolite, vesicles are rounded to flattened.	Several are coalesced. Vesicles are generally filled. A greater proportion are in the darker, more glassy section.

COMMENTS : This sample was taken in an area where quenched glassy fragments are starting to be rotated away from the site of in situ brecciation and become suspended in the sandy silt that the basalt is mingling with. Sediment grain size ranges from silt to fine sand, and sorting is generally poor. There is no evidence of grading associated with passive deposition. The sandy silt is either massive internally or has fine silt distributed around and between clasts with coarser sand concentrated in stringers or domains of aligned particles farther from clasts. Basalt clasts are glassy to microcrystalline. They have angular polygonal shapes with some curviplanar surfaces and there is evidence of breakage across some crystals. However, breakage seems to preferentially take place through glassy parts of the basalt. Penetrative brecciation of the glassy basalt and subsequent clast-rotation and suspension of clasts near the site of brecciation implies that the sediment was actively interacting with the magma at the time of quenching.

No opaques - grinding powder is caught in alteration minerals.

Photomicrograph #:

1137A-28 = Jigsaw-fit (in situ brecciation) texture between basalt clasts (x2.5 objective, ppl);

1137A-29 = Detail of jigsaw-fit texture - early clast rotation (x10 objective, ppl).

THIN SECTION: 183-1137A-45R-2, 19-21, Piece 1 **Unit 10A** **OBSERVER: LM, CRN**
ROCK NAME: Moderately plagioclase-olivine-phyric basalt; contact with sandy siltstone.
WHERE SAMPLED: Brecciated flow top where magma has mingled with sediment, quenched and fragmented.
GRAIN SIZE: Fine- to medium-grained phenocrysts in a fine-grained to glassy groundmass mingled with sandy silt.
TEXTURE: Porphyritic, hypohyaline basalt.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	3	5	4	9	7		Angular masses	Consist dominantly of subhedral plagioclase that has been completely altered to sericite and clay and replaced by zeolite (very low birefringence) which has preserved the Carlsbad twins, but destroyed the albite twins. Domains of calcite within altered laths.
PHENOCRYSTS								
Plagioclase	3	5	0.5	1.8	1		Subhedral laths	See Glomerocryst comment.
Olivine	0	3	0.1	0.3	0.15		Euhedral to subhedral	Euhedral microphenocrysts; completely altered to green and brown clay. Similar size to some groundmass plagioclase. Many show swallow-tail terminations.
GROUNDMASS								
Plagioclase	15	20	0.01	0.2	0.08			
Glass	0	70						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate	4				Plagioclase glomerocrysts, groundmass	
Green clay	20				Olivine; fills vesicles	
Hematite/goethite	5				Staining clay minerals	
Brown clay	40				Groundmass glass	Color varies from brown to black (opaque).
Sericite	5				Plagioclase	
Zeolite	5				Vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Veins	2		1	2		Carbonate	
Vesicles	10		0.4	5.5	1.5	Green clay, carbonate, zeolite, vesicles are rounded to flattened.	Several are coalesced Vesicles are generally filled. A greater proportion are in the darker, more glassy section.

COMMENTS : This sample was taken in an area where quenched glassy fragments have been rotated away from the site of in situ brecciation and become suspended in the sandy silt that the basalt is mingling with. Sediment grain size ranges from silt to fine sand, and sorting is generally poor. There is no evidence of grading associated with passive deposition. The sandy silt is either massive internally or has fine silt distributed around and between clasts with coarser sand concentrated in stringers or domains of aligned particles farther from clasts. Basalt clasts are glassy to microcrystalline. They have angular polygonal shapes with some curviplanar surfaces and there is evidence of breakage across some crystals. However, breakage seems to preferentially take place through glassy parts of the basalt. Penetrative brecciation of the glassy basalt and subsequent clast-rotation and suspension of clasts near the site of brecciation implies that the sediment was actively interacting with the magma at the time of quenching (peperite). Basalt clasts show oxidised rims.

No opaques - grinding powder is caught in the alteration minerals.

Photomicrograph #:

1137A-27 = Clast-rotated (locally transported) clasts in peperite (x2.5 objective, ppl).

THIN SECTION: 183-1137A-45R-2, 77-80, Piece 1C — **Unit 10A** — **OBSERVER: CRN, LM**
ROCK NAME: Moderately plagioclase-olivine-phyric basalt.
WHERE SAMPLED: Towards the top of Unit 10A; contact between coarser- and finer-grained (less porphyritic) regions of flow.
GRAIN SIZE: Fine- to medium-grained phenocrysts in a very fine-grained to glassy groundmass.
TEXTURE: Porphyritic, hypohyaline basalt.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	1	5	4	9	7		Angular masses	Consists dominantly of subhedral plagioclase that has been partially altered to sericite and zeolite(?). One plagioclase has been replaced by carbonate. Alteration has preserved the Carlsbad twins but destroyed the albite twins. One glomerocryst straddles the contact. There are fewer glomerocrysts in the glassy half of the section. There is one mafic mineral that has been completely altered to green clay minerals.
PHENOCRYSTS								
Plagioclase	3	5	0.5	1.8	1		Subhedral laths	Same proportion of phenocrysts in both halves of section.
Olivine	0	5	0.1	0.3	0.15		Euhedral to subhedral	Euhedral microphenocrysts; completely altered to green clay minerals. Similar size to some groundmass plagioclase.
GROUNDMASS								
Plagioclase	5	20	0.01	0.2	0.08			
Clinopyroxene								
Titanomagnetite	10	10	<0.01	0.1	0.01		Anhedral to subhedral	Two populations: 1) scarce anhedral crystals 0.05-0.1 mm usually (but not exclusively) found around vesicles and with rare maghemite exsolution; 2) < 10 micron ubiquitous subhedral groundmass phase, slightly more abundant in the "lighter" colored domain. Note: this is not grinding powder.
Glass	0	55						Glass is ubiquitous but within it are many tiny (0.01mm) equigranular titanomagnetite crystals.
Chalcopyrite	Trace	Trace			0.01		Anhedral	Rare patches seen in groundmass.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate	1				Plagioclase glomerocrysts, groundmass	
Green clay	20				Olivine; fills vesicles	
Brown (opaque) clay	40				Groundmass glass	
Sericite	5				Plagioclase	
Zeolite	15				Vesicles, plagioclase	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	10		0.4	5.5	1.5	Green clay, carbonate, zeolite/rounded to flattened.	Several are coalesced. Vesicles are generally filled. A greater proportion are in the darker, more glassy section.

COMMENTS :
Macroscopic observation: section is divided into dark and lighter halves, representing the contact which was sampled.
No difference in phenocryst population between the two color domains, only in glomerocryst amounts.
Difference between the textural domains is in the crystallinity of the groundmass - the "lighter" area has a very fine-grained groundmass (but has a high proportion of fine-grained opaques), whereas the "darker" area has an aphanitic groundmass.
Photomicrograph:
1137A-22 = Altered olivine phenocrysts, granular opaque-rich groundmass, plagioclase phenocryst and groundmass laths (x10 objective, ppl).

THIN SECTION: 183-1137A-45R-4, 118-120, Piece 1D — **Unit 10** — **OBSERVER: DD, CRN**
ROCK NAME: Moderately plagioclase-phyric basalt.
WHERE SAMPLED: Interior of Unit 10.
GRAIN SIZE: Coarse-grained glomerocryst, medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic, with an intersertal to intergranular groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	25	25	6	20	13	An 65	Angular masses	Consist of large subhedral to anhedral plagioclase phenocrysts (1-10 mm). One large glomerocryst exhibits complex oscillatory zoning including areas of convolute zoning and zones of numerous minute melt inclusions. The glomerocryst rim contains large glass and clinopyroxene inclusions. Embayed areas around the glomerocryst and also large inclusions within it contain altered glass, anhedral clinopyroxene and subhedral ilmenite. Plagioclase crystals resembling phenocryst plagioclase cluster against the outer rim of the large glomerocryst. Groundmass of the basalt becomes finer-grained at the contact with the glomerocrysts.
PHENOCRYSTS								
Plagioclase	2	2	1	5	1.5		Subhedral laths	Melt inclusions are very common at the outer margins. Multiple zoning is common but less developed than in the glomerocrysts.
Clinopyroxene	1	1	0.4	0.6	0.5		Anhedral to subhedral	Grains have the same habit as clinopyroxene in the glomerocrysts. Have spongy texture due to presence of melt inclusions.
Olivine	0	<1	-	-	0.5		Euhedral to subhedral	Rare microphenocrysts; completely altered and replaced by brown clay.
GROUNDMASS								
Plagioclase	25	25	0.1	0.3	0.2		Subhedral to anhedral	
Clinopyroxene	22	25	0.025	0.1	0.05		Subhedral to anhedral	
Titanomagnetite	4	4	0.05	0.5	0.15		Subhedral to anhedral	Skeletal (acicular) and tabular (stubby octahedra) forms.
Chalcopyrite	Trace	Trace			<0.01		Anhedral	Associated with alteration.
Glass	0	20						Completely altered into brown clay.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Brown Clay	25				Glass, olivine, vesicles	
Zeolite	<1				Vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	1	1	5	5	5	Flattened spherical vesicles filled with concentric layers	Perimeter: brown clay. Center: zeolite

COMMENTS : The large glomerocryst contains a peculiar melt inclusion with numerous (30%) spherical gas bubbles. Groundmass contains some small glomerocrysts of plagioclase and clinopyroxene (~50-50%, 0.6 mm) only 2-3 times larger than groundmass grain size.
Photomicrograph #:
1137A-63 & 64 = Two pictures of the same plagioclase glomerocryst showing strong zonation (x2.5 objective, xpl);
1137A-65 = Close up of zonation in plagioclase glomerocryst (x10 objective, xpl).

THIN SECTION: 183-1137A-46R-2, 95-96, Piece 3B — Unit 10 — OBSERVER: CRN, MSP
ROCK NAME: Highly plagioclase-clinopyroxene-phyric basalt.
WHERE SAMPLED: Center of Unit 10.
GRAIN SIZE: Glomerocrysts are coarse- to medium-grained, phenocrysts are fine- to medium-grained, groundmass fine-grained.
TEXTURE: Porphyritic with an intergranular to intersertal groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GLOMEROCRYSTS	5	5	5	10	8	An65	Masses of euhedral to subhedral crystals	Consist dominantly of plagioclase grains (up to 8 mm). Plagioclase is strongly zoned; inclusion bands parallel zonation in some crystals. Large glass and clinopyroxene inclusions occur in the center of larger plagioclase glomerocrysts (glass is altered to brown clay, clinopyroxene is ~0.1-0.2 mm). There are also clusters of phenocryst-size plagioclase and clinopyroxene 2-3 mm in the groundmass that look like the discrete phenocryst phases.
PHENOCRYSTS								
Plagioclase	10	10	0.6	1.9	1	An60-65	Subhedral (tabular to equant)	Phenocrysts occasionally exhibit zoning akin to the glomerocrysts.
Clinopyroxene	4	4	0.5	1.2	0.8		Subhedral to anhedral	Simple twinning in some basal sections.
Olivine	0	<1						Typical microphenocrysts are 2-3 times larger than groundmass crystals and are completely altered and replaced by brown clay.
GROUNDMASS								
Plagioclase	35	35	0.1	0.3	0.2	An60	Subhedral to anhedral	
Clinopyroxene	23	25	0.05	0.1	0.08		Anhedral	
Titanomagnetite	5	5	<0.05	0.6	0.2		Subhedral to anhedral	Skeletal to stubby octahedra.
Glass	0	15						Patchy occurrence in hyalopilitic pools. Completely altered to brown clay.
Pyrrhotite	Trace	Trace			<0.01		Anhedral	Interstitial; rare intergrowths with titanomagnetite. Anisotropic, light yellow-brown.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Brown clay	20				Glass, olivine, groundmass	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS

COMMENTS : Macroscopic observation: no vesicles or veins. Glomerocrysts are conspicuous. Brownish-gray hue.
Glass is altered, major phases are fresh.