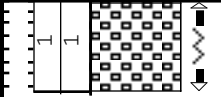



Core Photo

187-1164A-1W (0.0 - 138.5 mbsf)					
METERS	CORE AND SECTION	GRAPHIC LITH.	DISTURB.	COLOR	DESCRIPTION
				lt BR	<p>CLAY</p> <p>Core 187-1164A-1W contains 75 cm of severely drilling disturbed, light brown to very light brown, carbonate-rich clay. The entire section consists of drilling-induced pellets and fragments of densely packed clay. From 0 to 7 cm is very fine grained pellets in a soupy clay matrix. From 7 to 43 cm is a very poorly sorted, but normally graded interval with fragments from sub-mm to 3 cm. One small (3 x 5 cm) piece of rounded basalt is embedded in the sediment. From 47 to 75 cm is another normally graded, poorly sorted interval of 0.5 cm-to-3-cm-sized, drilling-induced clay fragments. Millimeter sized chips of basalt, fresh basaltic glass, and palagonite with and without attached indurated clay are present throughout the section. These chips are sparse in the upper half of the section, but more abundant in the lower half, and account for 1-2% of the volume of the core.</p>

Core Photo

cm	Piece number	Graphic representation	Orientation	Shipboard studies	Lithologic unit	Alteration	Structure
0	1				1		
50							
100							
150							

CORE/SECTION

187-1164A-2R-1

UNIT 1: APHYRIC BASALT

PIECE 1

INTERNAL CONTACTS: Piece 1 has 1.5-mm-thick glassy margin with a 4-mm-wide spherulitic quench zone.

GROUNDMASS: Microcrystalline

COLOR: Light gray

VESICLES:

Abundance %	Size (mm)			Shape
	avg.	max.	min.	
3	0.4	0.6	0.2	round

Filling: Lined with whitish-green silica within alteration halo, otherwise unfilled.

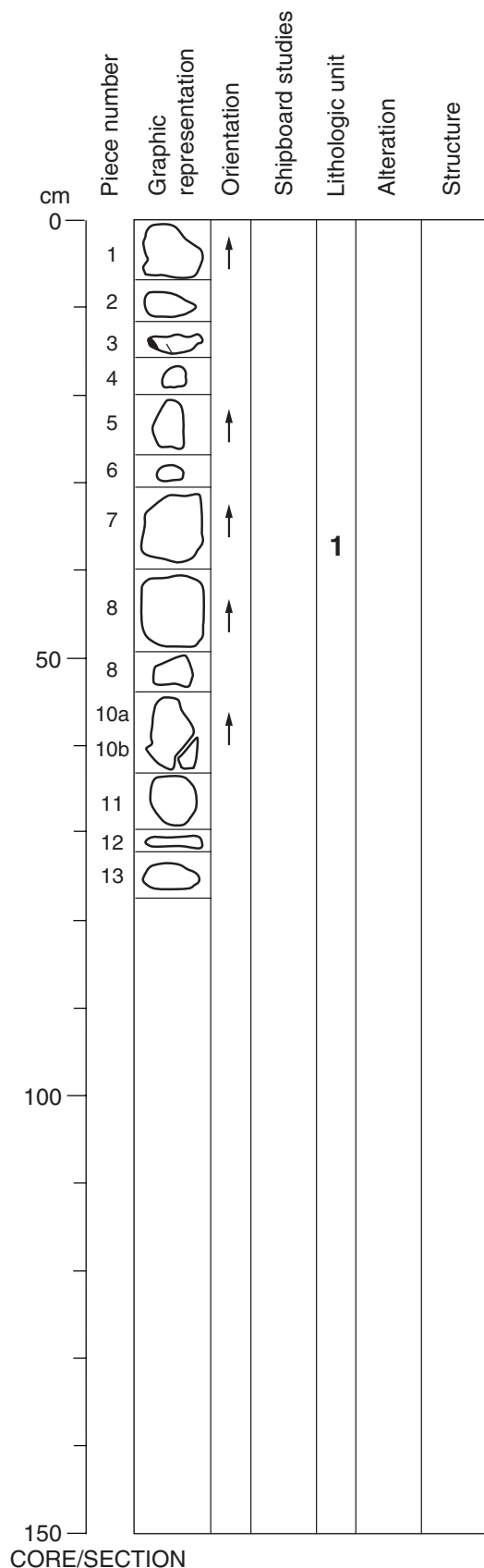
VEINS/FRACTURES: Very small (<0.3 mm) fracture filled with silica(?).

ALTERATION: Overall slightly altered (5%). Alteration halo mimics quenched margins and extends 1 cm from the bottom of the spherulitic quench zone toward the fresher interior of the piece. Within the halo, olivine microphenocrysts are completely replaced by Fe oxyhydroxide and vesicles are lined with silica. The fresher interior is surrounded by a 4-mm-wide alteration zone in which olivine microphenocrysts are partially (20%-40%) replaced by Fe oxyhydroxide. The outer surface of the piece is covered with Mn oxide spots (< 0.5 mm in diameter) and patches (1 cm wide).

STRUCTURE: Chilled glassy margin and V-shape of piece indicate it is a piece from a lava pillow.

ADDITIONAL COMMENTS: The piece contains ~3% olivine microphenocrysts (crystals < 0.5 mm) and fresh plagioclase microlites (<1% crystals < 1 mm).

Core Photo



187-1164A-3R-1

UNIT 1: APHYRIC BASALT

PIECES 1-13

INTERNAL CONTACTS: Piece 3 has a chilled margin consisting of a thin layer of palagonite, followed by a spherulitic quench zone; ~50% of the glass in this zone is replaced by palagonite. The spherulites are small (<0.2 mm).

GROUNDMASS: Microcrystalline

COLOR: Light gray

VESICLES:

Abundance %	Size (mm)			Shape
	avg.	max.	min.	
1	0.4	0.5	0.2	round

Filling: Lined with green clay in alteration halos; otherwise unfilled.

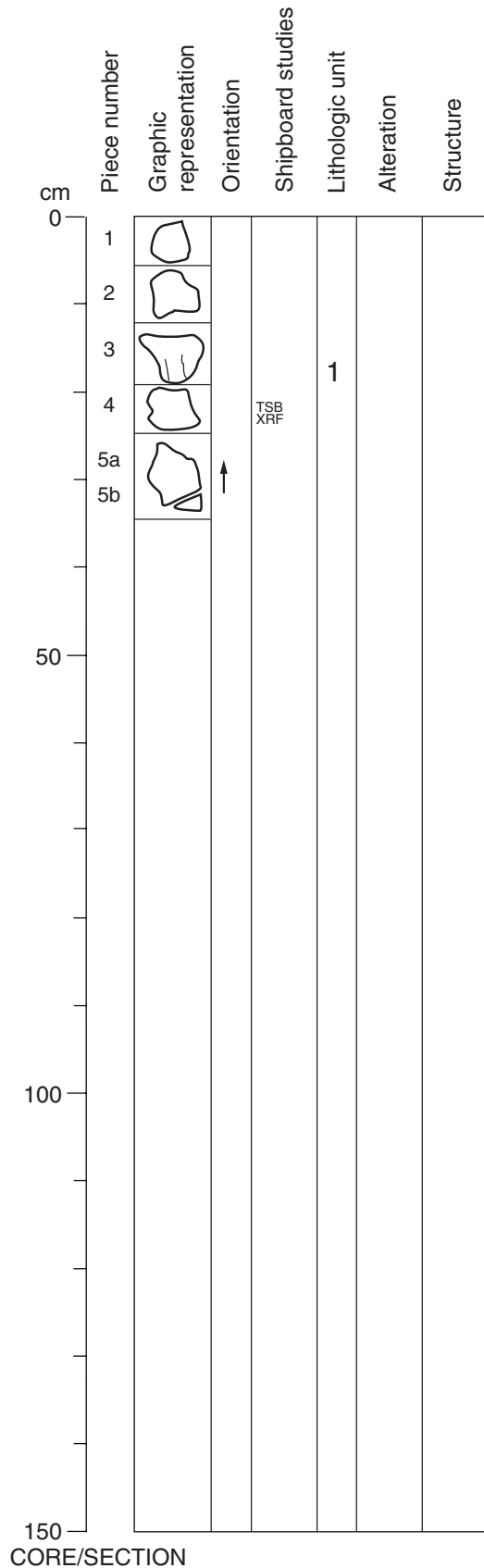
VEINS/FRACTURES: Piece 10 is broken along a fracture, partially lined with blue cryptocrystalline silica/clay and Mn oxide.

ALTERATION: Overall the section is slightly altered; Piece 4 is moderately altered. Alteration is characterized by concentric halos that tend to mimic the edges of pieces. The halos have two parts. The outermost part is grayish brown and ranges from <1 mm (Pieces 1, 7, and 8) to 1.5 cm (Piece 4) wide and consists of replacement of groundmass and olivine microphenocrysts (100% altered) by Fe oxyhydroxides + clay. Inward from this is a zone that is darker gray than the rest of the piece, and there is patchy replacement of groundmass by smectite, with partial (~20%-50%) alteration of olivine to white to green clay. The light gray interior of the piece has fresh groundmass olivine, but also has a patchy occurrence of calcite (<1%), which may be filling miarolitic cavities. The alteration halos make up between 10% and 40% of the rock and the rock is 15%-30% altered in these halos. Pieces 3 and 6 have small patches of clay + Mn oxide (spots and dendritic growth) on outer surfaces. Piece 2 has a thin film of blue cryptocrystalline silica + Mn oxide on an outer surface.

STRUCTURE: Not distinguished

ADDITIONAL COMMENTS: The rocks contain fresh olivine and plagioclase microphenocrysts, < 1 mm in size.

Core Photo



187-1164A-4R-1

UNIT 1: APHYRIC BASALT

PIECES 1-5

INTERNAL CONTACTS: Piece 3 has a chilled margin ~3 mm thick, containing microphenocrysts of plagioclase and olivine.

GROUNDMASS: Microcrystalline

COLOR: Light gray

VESICLES:

Abundance %	Size (mm)			Shape
	avg.	max.	min.	
1	0.5	2	<1	round to elongate

Filling: Most vesicles are unfilled, but this is variable, even within a single piece; fillings include blue cryptocrystalline silica, calcite, Fe oxyhydroxide, Mn oxides and light green clays.

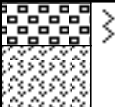
VEINS/FRACTURES: There are two fractures orthogonal to the chilled margin in Piece 3.

ALTERATION: Overall the section is slightly altered. Oxidized alteration halos are present along the edges of Pieces 1, 2, and 3; these range from 1 mm wide in Piece 2 to 17 mm in Piece 3. Olivine is totally replaced by Fe oxyhydroxides in the oxidized margins (e.g., Piece 1). Patchy replacement of the groundmass by calcite occurs in Pieces 1 and 3. A coating of Fe oxyhydroxides is present on the outer surface of Piece 3.

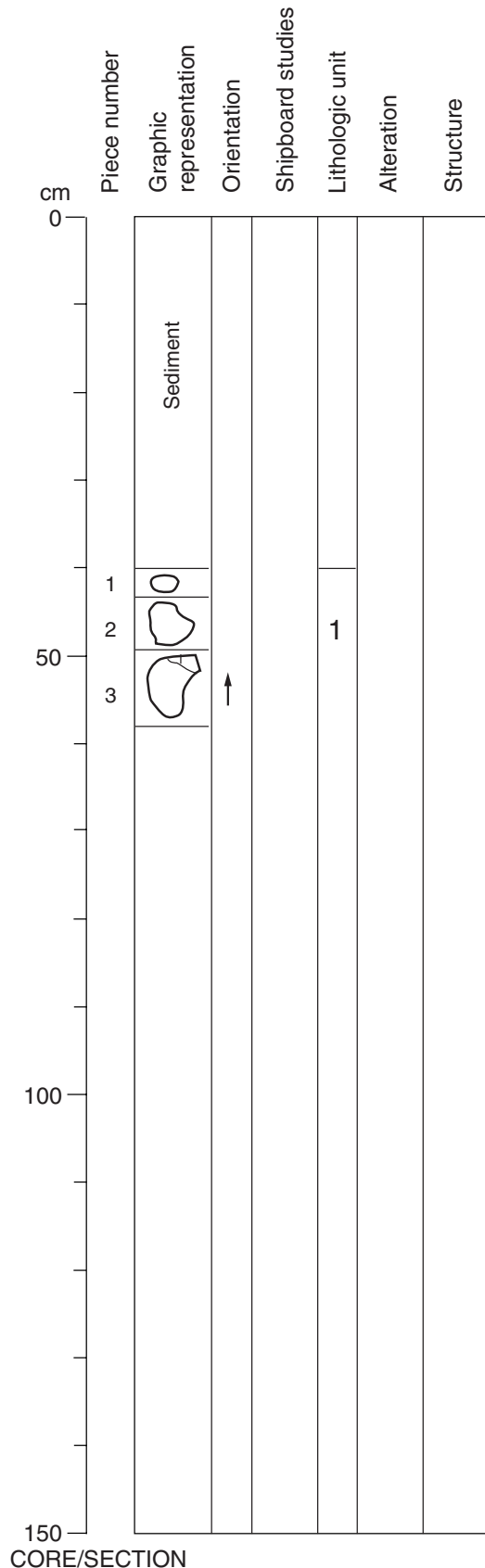
STRUCTURE: Not distinguished

ADDITIONAL COMMENTS: Microphenocrysts of olivine and plagioclase (<1 mm in size) occur throughout the section. Scarce plagioclase phenocrysts up to 3 mm in size are present in Pieces 2 and 4.

Core Photo

187-1164B-1W (0.0 - 150.4 mbsf)					
METERS	CORE AND SECTION	GRAPHIC LITH.	DISTURB.	COLOR	DESCRIPTION
1 2	1			vlt BR	<p>CLAY</p> <p>From 0 to 29 cm in Section 187-1164B-1W-1 is soupy, very light brown, carbonate-rich clay. This interval includes two, 3 cm, angular fragments of light brown, densely packed, stiff carbonate-rich clay. From 29 to 39 cm in the same section is severely drilling disturbed, light brown, carbonate-rich clay. The contact between these units is obscured by drilling disturbance. From 39 cm in Section 1 to the bottom of the core catcher section is several pieces of basalt.</p>

Core Photo



187-1164B-1W-1

UNIT 1: BASALTIC RUBBLE

PIECES 1-3

INTERNAL CONTACTS: Piece 1 has a chilled margin consisting of a thin layer (<1 mm) of partially palagonitized glass containing plagioclase microphenocrysts, followed by a spherulitic quench zone 5 mm thick.

GROUNDMASS: Microcrystalline

COLOR: Buff to light gray

VESICLES:

Abundance %	Size (mm)		Shape
	avg.	max. min.	
<1	0.4	1 <1	round

Filling: Most vesicles are unfilled, but this is variable, even within a single piece; fillings include blue cryptocrystalline silica, Fe oxyhydroxides and light green clays.

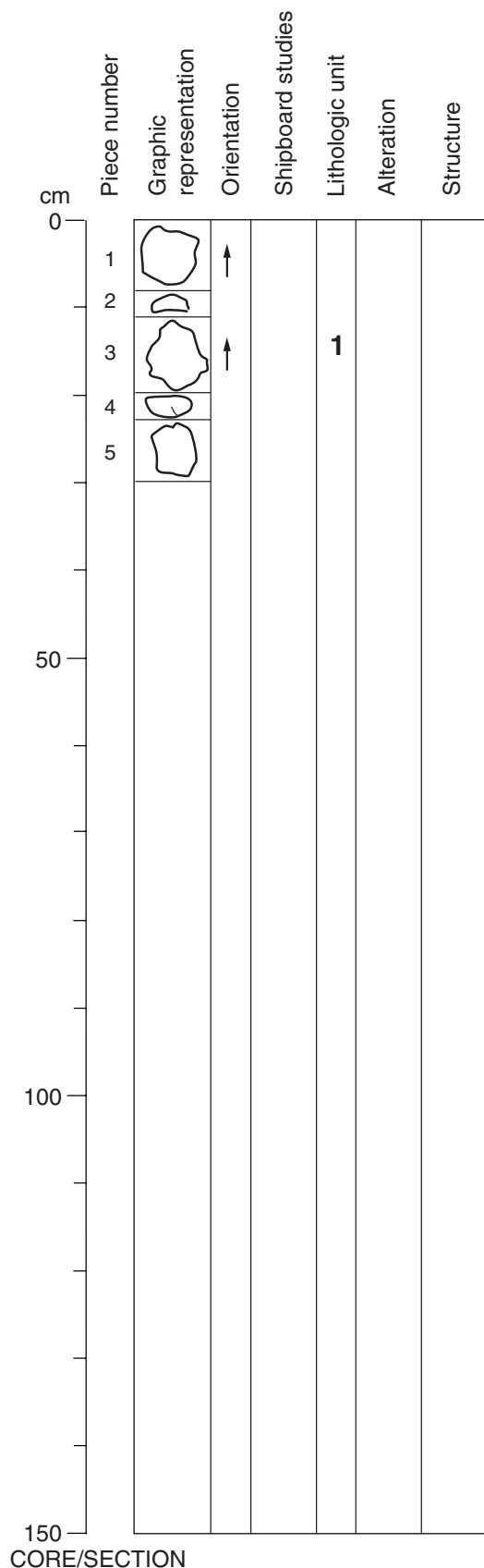
VEINS/FRACTURES: There is a fracture (0.2 mm width) in Piece 3.

ALTERATION: Overall the section is slightly altered, except for Piece 1 which is moderately altered. An oxidized alteration halo (9 mm wide) is present along the margin of Piece 2. Two large alteration halos occur on Piece 3 with widths of 3 and 3.5 cm, respectively. Piece 3 has patchy occurrence of calcite in the groundmass. A patchy coating of Mn oxides and Fe oxyhydroxides occurs on an outer surface of Piece 3; a patchy coating of white clays with scarce Mn oxide nodules occurs on Pieces 2 and 3. Most olivine is totally replaced by Fe oxyhydroxides throughout.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Microphenocrysts of olivine and fresh plagioclase are present throughout the section.

Core Photo



187-1164B-1W-CC

Unit 1: BASALTIC RUBBLE

PIECES 1-5

Pieces 1 and 5 are aphyric basalt. Pieces 2, 3, and 4 are moderately plagioclase olivine phyric basalts.

Pieces 1 and 5: Aphyric basalt

INTERNAL CONTACTS: Piece 5 includes a chilled margin ~4 mm thick, but with no glass recovered.

GROUNDMASS: Microcrystalline

COLOR: Light gray (unaltered) to brown (altered).

VESICLES:

Abundance %	Size (mm)		Shape
	avg.	max. min.	
1	0.3	1 <1	round

Filling: Most of the vesicles are unfilled, but some are lined by blue cryptocrystalline silica.

ALTERATION: Overall the pieces are slightly to moderately altered. Piece 5 has a 2-cm-wide band of oxidative alteration below the chilled margin. Oxidized alteration halo 1 cm wide and 1.5 cm long occurs on the edge of Piece 1.

Patchy coatings of Mn oxide and white clay are present on Piece 1. Olivine is entirely replaced by Fe oxyhydroxide in alteration halos.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Microphenocrysts of olivine and fresh plagioclase are present in both pieces.

Pieces 2, 3, and 4: Moderately plagioclase-olivine phyric basalt

INTERNAL CONTACTS: Piece 4 has a chilled margin with a layer of palagonite 3 mm thick, followed by a layer of glass 5 mm thick that contains plagioclase microphenocrysts.

PHENOCRYSTS:

	Abundance %	Size (mm)		Shape
		avg.	max. min.	
Plagioclase	4	1.5	4 <1	prismatic
Olivine	2	~1	1.5 <1	equant
Total	6			

GROUNDMASS: Microcrystalline

COLOR: buff to medium gray

VESICLES:

Abundance %	Size (mm)		Shape
	avg.	max. min.	
1	0.4	1 <1	round

Filling: Most of the vesicles are unfilled, but some are lined by blue cryptocrystalline silica and filled by Fe oxyhydroxide in altered areas.

VEINS/FRACTURES: Piece 4 is crosscut by a very thin vein (<~0.2 mm) filled with quartz and lined by Mn oxides.

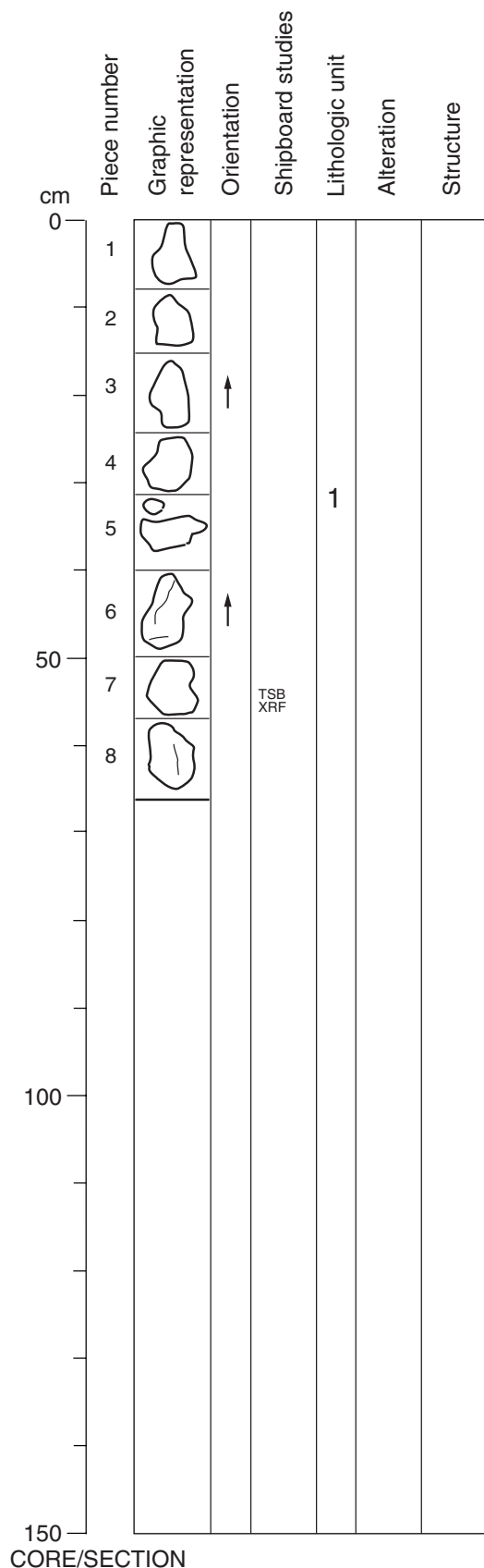
ALTERATION: Piece 4 is highly altered, the other pieces are slightly altered. Oxidative alteration halos are present on Pieces 2 and 3, and range from 2 mm to 7 mm in width. Patchy coatings of white clay occur on Pieces 2 and 4.

A patchy coating of Mn oxide is present on Piece 2. There is dendritic growth of Mn oxide from the edge of the piece into the interior in Piece 4.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Glomerocrysts of plagioclases and olivine are present in Piece 3.

Core Photo



187-1164B-2R-1

Unit 1: BASALTIC RUBBLE

PIECES 1-8

Pieces 1 to 4 are aphyric basalt, containing ~3% olivine microphenocrysts. Pieces 5 to 8 are sparsely to moderately plagioclase olivine phyric basalt.

Pieces 1-4: Aphyric basalt

INTERNAL CONTACTS: Piece 3 includes a chilled margin consisting of ~2 mm of glass + discrete spherulites, followed by ~3 mm of coalesced spherulites with interstitial palagonite.

GROUNDMASS: Microcrystalline

COLOR: Light gray (unaltered) to brown (altered).

VESICLES:

Abundance %	Size (mm)		Shape
	avg.	max. min.	
1	0.3	1 <1	round

Filling: Most of the vesicles are unfilled, but some are filled with calcite or clay in Pieces 1 and 2.

VEINS/FRACTURES: Piece 3 has a radial fracture lined with dendritic Mn oxide; the Mn oxide dendrites extend for ~3 mm into the piece from each side of the fracture.

ALTERATION: Overall the pieces are moderately (Pieces 1 and 4) to highly altered (Pieces 2 and 3). Except for Piece 1, alteration is characterized by pervasive replacement of olivine microphenocrysts and groundmass by Fe oxyhydroxides + clay ± calcite; Piece 1 has a 1.5 cm wide oxidized (brown) margin, similar to the pervasive alteration of the other pieces, accompanied by a more narrow alteration halo, medium gray in color and ~5 mm wide, where groundmass is partially replaced by clay (~15% altered). The less altered interior of Piece 1 contains calcite in the groundmass. Fresh olivine occurs in the interior of Piece 1, but elsewhere, olivine is totally altered to Fe oxyhydroxides + clay. Plagioclase is unaltered throughout.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Microphenocrysts of olivine occur in all pieces, form ~3% of the mode, and are generally less than 1 mm in size. Clusters of small plagioclase crystals (~1 mm long) occur in clusters that are ~2-3 mm across; total plagioclase microphenocryst abundance is ~1% of the mode.

Pieces 5-8: Sparsely to moderately plagioclase olivine phyric basalt

INTERNAL CONTACTS: Piece 6 has a chilled margin consisting of 1-2 mm of glass + discrete spherulites, followed by 3 mm of coalesced spherulites with interstitial palagonite.

PHENOCRYSTS:

	Abundance %	Size (mm)			Shape
		avg.	max.	min.	
Plagioclase	1-2	2	5	0.5	tabular to prismatic
Olivine	1	1	4	0.5	equant
Total	2-3				

GROUNDMASS: Microcrystalline

COLOR: Light gray (unaltered) to brown (altered)

VESICLES: Vesicles are rare, unfilled or lined with grayish white cryptocrystalline silica/clay and <0.5 mm in diameter.

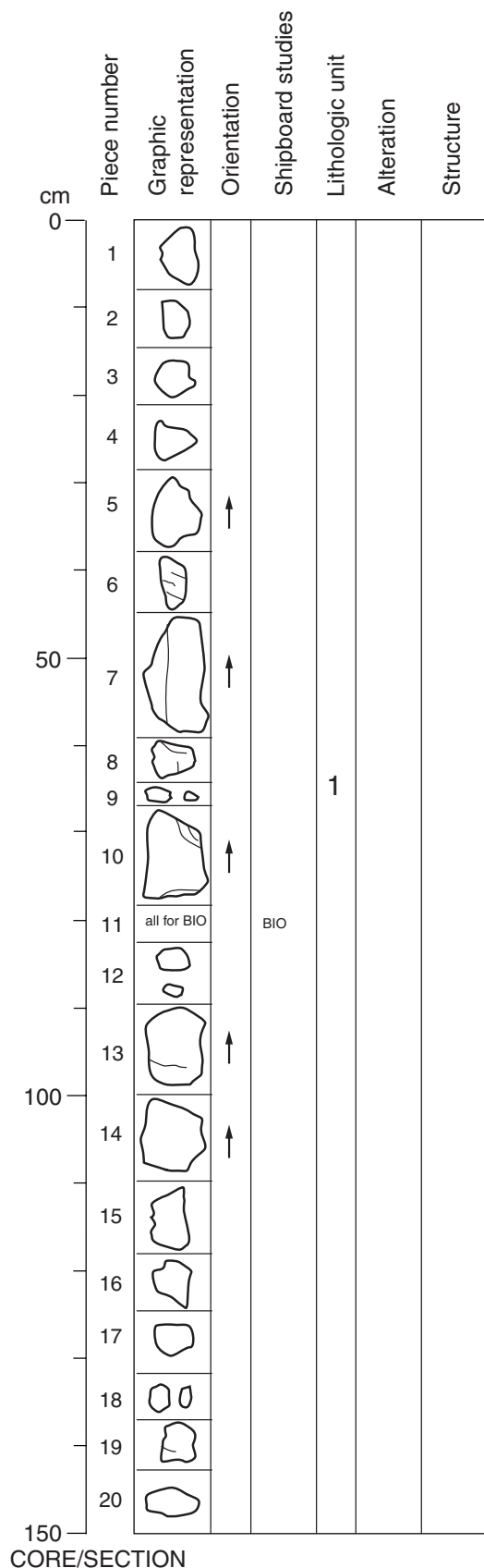
VEINS/FRACTURES: The chilled margin of Piece 6 is crosscut several Mn oxide-lined radial fractures.

ALTERATION: The pieces are slightly (Pieces 5 and 7) to moderately (Pieces 6 and 8) altered. Moderately altered pieces have wide (up to 3 cm) oxidized zones where groundmass is extensively (~50%) replaced by Fe oxyhydroxides + clay. Elsewhere, groundmass is partially replaced by smectite (20%-30%) and olivine ranges from 10% to totally replaced by clay.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Olivine and plagioclase have spinel inclusions in Piece 5. Approximately 10% of phenocrysts occur in glomerocrysts of plagioclase, olivine, or plagioclase + olivine.

Core Photo



187-1164B-3R-1

Unit 1: BASALTIC RUBBLE

PIECES 1-20

Pieces 1 to 5 are sparsely to moderately plagioclase-olivine phyric basalt. Pieces 6 to 8, 10, 13 to 20, and one pebble in Piece 12 are aphyric basalt with 1%-5% olivine microphenocrysts. Piece 9 and one pebble in Piece 12 are basaltic breccia.

Pieces 1-5: Sparsely to moderately plagioclase olivine phyric basalt

PHENOCRYSTS:	Abundance	Size (mm)		Shape
	%	avg.	max. min.	
Plagioclase	1	<1	3 0.5	tabular
Olivine	1	<1	2 0.5	equant
Total	2			

GROUNDMASS: Microcrystalline

COLOR: Light gray (unaltered) to brown (altered)

VESICLES: Vesicles are rare, unfilled or lined with grayish white cryptocrystalline silica/clay and <0.5 mm in diameter.

ALTERATION: The pieces range from slightly (Pieces 4 and 5) to moderately (Piece 1) to highly (Pieces 2 and 3) altered. Highly altered pieces are pervasively altered or have wide (up to 3 cm) oxidized zones where groundmass is extensively (~50%) replaced by Fe oxyhydroxides + clay ± Mn oxide; olivine is totally replaced by Fe oxyhydroxides + clay. The moderately altered piece has a less extensive alteration halo (~1.5 cm) and the total amount of groundmass alteration is less (<~30%). In slightly altered pieces there is only patchy replacement of groundmass by clay.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Approximately 30% of phenocrysts occur in glomerocrysts.

Pieces 6-8, 10, 13-20 and one pebble in Piece 12: Aphyric basalt

INTERNAL CONTACTS: One pebble of Piece 18 includes a small fragment (<1 mm) of glass, but the chilled margin is mostly palagonite. Piece 8 includes a chilled margin that consists of palagonite + spherulites (no glass).

GROUNDMASS: Microcrystalline

COLOR: Light gray (unaltered) to brown (altered).

VESICLES:	Abundance	Size (mm)		Shape
	%	avg.	max. min.	
	<1	0.3	1 <0.3	round

Filling: Most of the vesicles are unfilled, but some are filled with calcite in Pieces 6 and 16. In Piece 14, a few vesicles have bulbous MnO deposits in them.

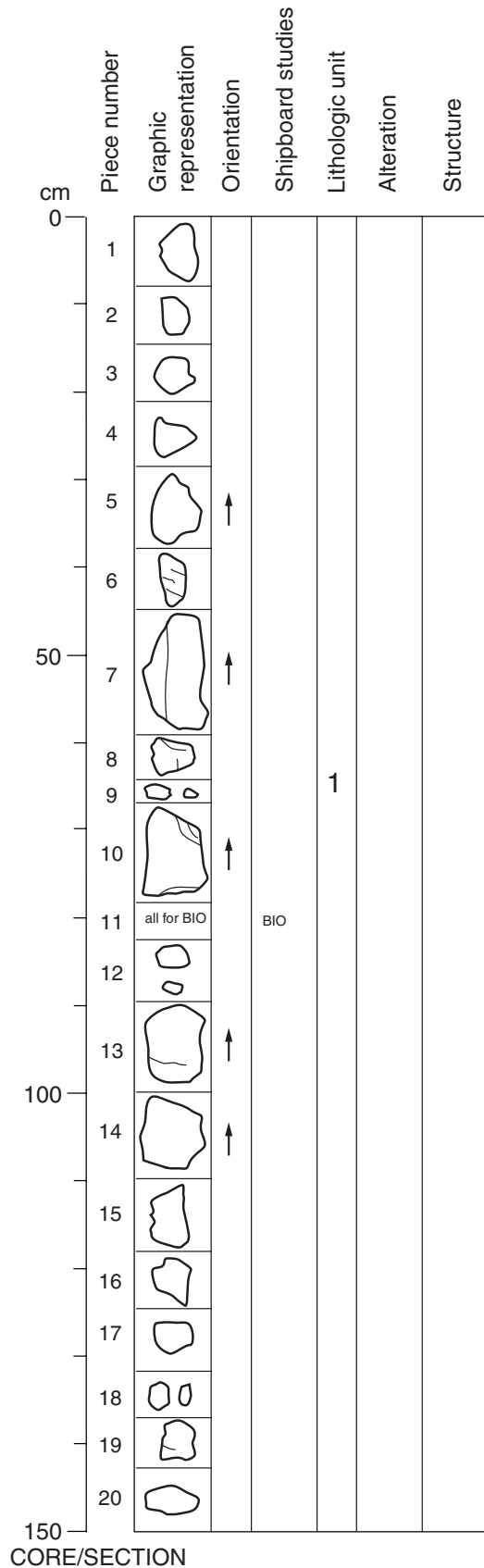
VEINS/FRACTURES: Mn oxide-lined fractures occur in Pieces 6 and 13.

ALTERATION: Overall the pieces range from slightly (Pieces 9, and 12 to 15) to moderately (Pieces 6 to 8, 11, 16, 17, and 19) to highly (Piece 20) altered. Alteration is characterized by replacement of olivine microphenocrysts and groundmass by Fe oxyhydroxides + clay in alteration halos that range from 0.5 to 1.5 cm wide; the interiors of these pieces range from fresh to slightly altered with patchy groundmass replacement by clay; Pieces 6, 16, and 19 also have some calcite. Slightly altered pieces have narrow alteration halos; the highly altered piece (Piece 20) has pervasive alteration of the same style as that seen in the alteration halos. Fresh olivine occurs in the interior of slightly altered pieces, but elsewhere it is totally altered to Fe oxyhydroxides + clay. Plagioclase is unaltered throughout.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Microphenocrysts of olivine (<1 mm) are common and form ~1% (e.g., Piece 10) to 5% (e.g., Piece 20) of the mode. Plagioclase microphenocrysts/phenocrysts up to 2 mm long are present, but significantly <1% of the mode. Glomerocrysts of small plagioclase crystals (~1 mm long) are present.

Core Photo



187-1164B-3R-1 (cont'd)

UNIT 1: BASALTIC RUBBLE

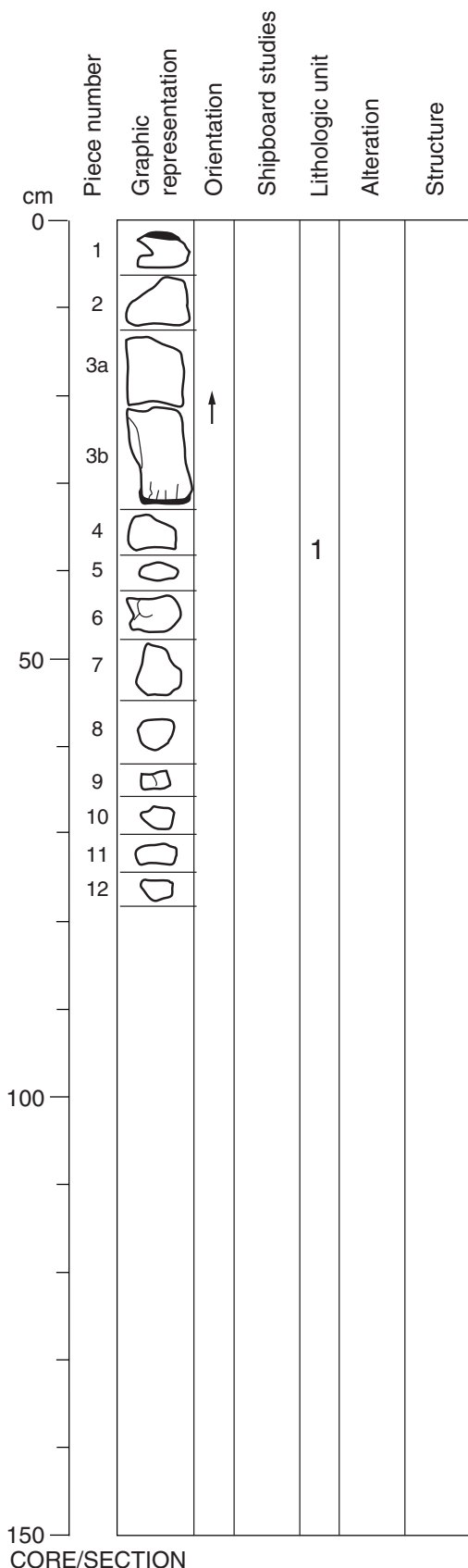
Piece 9 and one pebble in Piece 12: Basaltic Breccia

Piece 9 (two pebbles) and Piece 12 (one of two pebbles) are poorly sorted, clast supported basaltic breccias; a similar sediment is found adhering to basalt rubble clasts, Pieces 7, 8, and 10.

Clasts: The breccia is made up entirely of material of basaltic derivation (i.e., aphyric basalt and palagonite ± glass). The clasts are angular (mostly basalt) to subrounded (mostly palagonite) and range up to 2 cm in size for basalt clasts. Palagonite dominates in the 2-3 mm size range; it may form as much as ~60% of the rock in total, since it appears to be the major source of material less than 1 mm in size. Some basaltic clasts have concentric alteration halos, but most do not; basalt clasts range from slightly to moderately altered.

Matrix: The matrix is a soft, honey-brown material, probably derived from the breakdown of palagonite clasts. The sediment is loosely cemented by clay and/or quartz. In one of the pebbles of Piece 9, the quartz cement forms a drusy to botryoidal lining in some voids.

Core Photo



187-1164B-3R-2

Unit 1: BASALTIC RUBBLE

PIECES 1-12

Pieces 1, 3, 6, and 9 are aphyric basalt, containing ~1%-4% olivine microphenocrysts and 1%-5% plagioclase microphenocrysts. Pieces 2, 4, 7, 8, 10, 11, and 12 are sparsely plagioclase olivine phyric basalt. Piece 5 is uncut and was tentatively included with the aphyric basalt.

Pieces 1, 3, 6, and 9: Aphyric basalt

INTERNAL CONTACTS: Pieces 1, 3b, 5, and 6 have chilled margins with 0.5 to 2 mm of glass, followed by a 10 mm wide spherulitic quench zone in Piece 3b. The chilled margins of Pieces 5 and 6 are dominated by up to 4-mm-thick layers of palagonite plus sediment.

GROUNDMASS: Microcrystalline

COLOR: Light gray (unaltered) to brown (altered).

VESICLES:

	Abundance %	Size (mm)			Shape
		avg.	max.	min.	
	1	0.3	1	<1	round

Filling: Most of the vesicles are unfilled, but some are filled with calcite or clay.

VEINS/FRACTURES: Pieces 1 and 3 have several 1- to 5 cm-long fractures aligned perpendicular to the chilled margin (Piece 3 only) that are lined with Mn oxide. Minute veins filled with Mn oxide occur in Pieces 6 and 9. The latter is surrounded by a 2-mm-wide alteration halo.

ALTERATION: Pieces 1, 3, 6, and 9 are highly altered to yellowish brown. They are either thoroughly altered (Piece 6 and 9) or alteration is concentrated in 1-3 cm wide halos aligned subparallel to the piece margin (Piece 3) or parallel to the pillow margins immediately below the spherulitic quench zone. Alteration is characterized by pervasive replacement of olivine microphenocrysts and groundmass by Fe oxyhydroxide + clay. Olivine microphenocrysts are totally altered to Fe oxyhydroxide + clay. Plagioclase microphenocrysts are unaltered throughout, but some show black discoloration by Mn oxide lined on crystal faces.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Microphenocrysts of olivine occur in all pieces, are 1%-4% of the mode, and are generally less than 1 mm in size, usually ~0.5 mm. Plagioclase microphenocryst are prismatic and up to 1 mm long and are 15% of the mode. The total plagioclase microphenocryst abundance is 1%-2%, but reaches 7% in Piece 6. Sediment consisting of subrounded yellowish green clasts of palagonite and clay are attached to Piece 6. The outer uncut surfaces of Pieces 1, 6 and 9 are weathered to yellow brown and contain spots (0.2-0.5 mm) and/or centimeter-sized patches of Mn oxide.

Pieces 2, 4, 7, 8, 10, 11 and 12: Sparsely plagioclase-olivine phyric basalt

PHENOCRYSTS:

	Abundance %	Size (mm)			Shape
		avg.	max.	min.	
Plagioclase	1	2	5	0.5	tabular to prismatic
Olivine	<1	1	2	0.5	equant
Total	1-1.5				

GROUNDMASS: Microcrystalline

COLOR: Light gray (unaltered) to brown (altered)

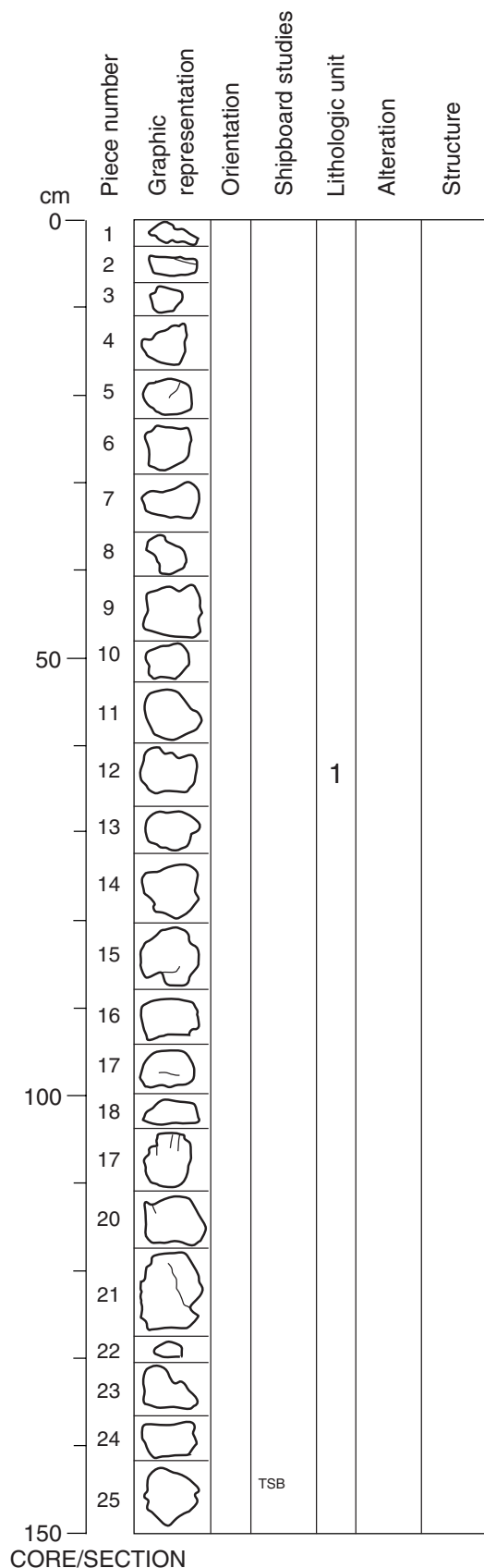
VESICLES: Vesicles are rare, unfilled or lined with Mn oxide and <0.5 mm in diameter.

ALTERATION: All pieces are highly altered, except for Pieces 10 and 12 which are slightly altered. The highly altered pieces are altered to yellowish brown, reflecting pervasive groundmass replacement by Fe oxyhydroxides and clay. Pieces 4 and 8 have very small (5 mm) moderately altered area in their centers. Piece 10 and 12 are slightly altered and the freshest pieces of this section. They contain fresh olivine and plagioclase phenocrysts. Elsewhere olivine phenocrysts and groundmass olivine are totally replaced by Fe oxyhydroxide and clay. Plagioclase is fresh throughout, but often shows black discoloration, possibly by Mn oxide lining on crystal faces.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Glomerocrysts of plagioclase or plagioclase + olivine are common and make up 10%-20% of the phenocrysts. The majority of pieces have weathered uncut surfaces that contain spots or patches of Mn oxide or have small 0.5-1 cm patches (1-2 mm thick) of sediment attached.

Core Photo



187-1164B-4R-1

Unit 1: BASALTIC RUBBLE

PIECES 1-25

Pieces 1, 2, 7, 9, 12, 13, 14, 17, and 19 are sparsely plagioclase olivine phyric basalt. Pieces 3-6, 8, 10, 11, 15, 16, 18, and 20 to 25 are aphyric basalt with 1%-5% olivine microphenocrysts and <1% plagioclase microphenocrysts. All pieces have subrounded shapes and range from 3 to 8 cm in diameter.

Pieces 1, 2, 7, 9, 12, 13, 14, 17, and 19: Sparsely plagioclase-olivine phyric basalt

INTERNAL CONTACTS: Piece 9 and 17 have small, less than 1-mm-thick glassy margins with very little fresh glass. The spherulitic quench zone is ~5 mm wide on both pieces.

	Abundance		Size (mm)		Shape
	%	avg.	max.	min.	
Plagioclase	1	<1	3	0.5	tabular
Olivine	<1	<1	2	0.5	equant
Total	1				

GROUNDMASS: Microcrystalline

COLOR: Light gray (unaltered) to brown (altered)

VESICLES: Vesicles are rare, unfilled or lined with grayish white cryptocrystalline silica/clay and <0.5 mm in diameter. Calcite-filled vesicles occur in Piece 13.

VEINS/FRACTURES: Small fractures are lined with Mn oxide in several pieces.

ALTERATION: Pieces 1, 2, 9, 17, and 19 are highly altered to yellow-brown.

Pieces 12-14 have 2- to 3-cm-wide alteration halos on one side of the piece, followed by a zone of patchy (2-5 mm) groundmass replacement. Piece 7 is moderately altered (30%-40%). Alteration is expressed by pervasive or partial replacement of groundmass and olivine by Fe oxyhydroxides and clay.

Plagioclase appears fresh throughout, but some show black discoloration, possibly by Mn oxide lined on crystal faces.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Approximately 30% of phenocrysts occur in glomerocrysts. The outside of all pieces is weathered to yellow-brown, with minor Mn oxide spots.

Pieces 3-6, 8, 10, 11, 15, 16, 18, and 20: Aphyric basalt

INTERNAL CONTACTS: Piece 3 and 17 have small, less than 1 mm wide, glassy rims. On Piece 17, a ~0.3 mm thick layer of orange palagonite covers the fresh glass. A 5-mm-wide spherulitic quench zone is developed in this piece as well.

GROUNDMASS: Microcrystalline

COLOR: Light gray (unaltered) to brown (altered).

	Abundance		Size (mm)		Shape
	%	avg.	max.	min.	
	<<1	0.4	1	<0.3	round

Filling: Most of the vesicles are unfilled, but some are filled with calcite and clay or lined with Mn oxide.

VEINS/FRACTURES: Not observed

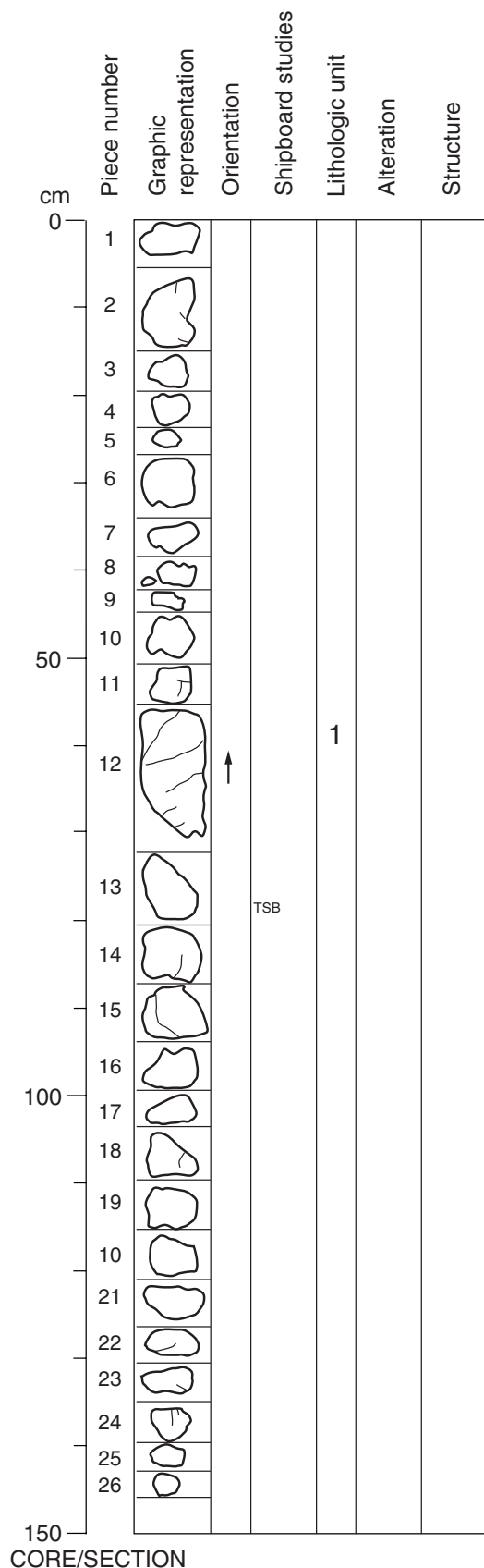
ALTERATION: The majority of pieces (Pieces 5, 10, 11, 15, 16, 18, and 20 to 25) have 1-3 cm wide, concentric to asymmetric halos of highly altered basalt. The centers of most pieces are less altered (i.e., 30%-40%).

Throughout, alteration is characterized by pervasive alteration of groundmass and olivine microphenocrysts. The groundmass in Piece 3 is completely altered to yellow brown. Pieces 4, 6, and 8 are moderately altered (30%-40%) and have no alteration halos.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Microphenocrysts of olivine (<1 mm) are common and are ~1% (e.g., Piece 11) to 5% (e.g., Piece 6) of the mode. Plagioclase microphenocrysts/phenocrysts up to 2 mm long are present, but significantly <1% of the mode. Glomerocrysts of small plagioclase crystals (~1 mm long) are present.

Core Photo



187-1164B-4R-2

Unit 1: BASALTIC RUBBLE

PIECES 1-26

Pieces 1 to 12 and 16 to 26 are aphyric basalt with 1%-3% olivine microphenocrysts. Pieces 13-15 are predominantly basaltic breccia; Pieces 8, 11, and 12 have fragments of breccia adhering to a large basalt clast.

Pieces 1-12 and 16-26 : Aphyric basalt

INTERNAL CONTACTS: Portions of chilled margins occur on Pieces 2, 9, 12 (bottom of oriented piece), 23, and 24. Clear glass was recovered only on Pieces 12 and 24 (1-2 mm). Elsewhere the margins consist of 2-3 mm of spherulites + glass or palagonite. The spherulites are small (<0.2 mm) in all cases.

GROUNDMASS: Microcrystalline

COLOR: Brown (altered) to medium gray (unaltered)

VESICLES: Vesicles are rare and small (<0.5 mm); where present they tend to be unfilled; some vesicles in Piece 5 are filled with calcite; some vesicles in Piece 6 are filled with clay. Pieces 10, 18 have unfilled miarolitic cavities.

VEINS/FRACTURES: Mn oxide-lined fractures occur in Pieces 11, 18, 20, and 22; in Piece 12 fractures are horizontal relative to the core. Radial fractures across chilled margins occur in Pieces 2, 23, and 24.

ALTERATION: The pieces range from slightly (Pieces 8, 10, and 11) to moderately (Pieces 4, 6, 7, and 25) to highly (Pieces 1-3, 5, 9, 16 to 24, and 26) altered. Highly altered pieces are characterized by pervasive replacement of groundmass (>50%) by Fe oxyhydroxides + clay ± dendritic to patchy Mn oxide (Pieces 1, 3, 16, and 18 to 20); olivine is totally replaced by Fe oxyhydroxides + clay. Alteration of moderately altered pieces is similar to highly altered pieces, but concentrated in alteration halos 1-2 cm wide rather than being pervasive; Piece 6 also has calcite in the groundmass. In slightly altered pieces there is only patchy replacement of groundmass by clay ± Fe oxyhydroxides. Plagioclase appears fresh throughout, but some show black discoloration, possibly by Mn oxide on crystal faces or lining microcracks. In Piece 23, part of the glass is altered to a white clay.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Microphenocrysts of olivine (<1 mm) form 1%-3% of the mode. Piece 20 is borderline to sparsely olivine aphyric and contains ~1% equant to skeletal olivine phenocrysts ~1 mm in size. Plagioclase microphenocrysts/phenocrysts up to 2 mm long are present, but significantly <1% of the mode.

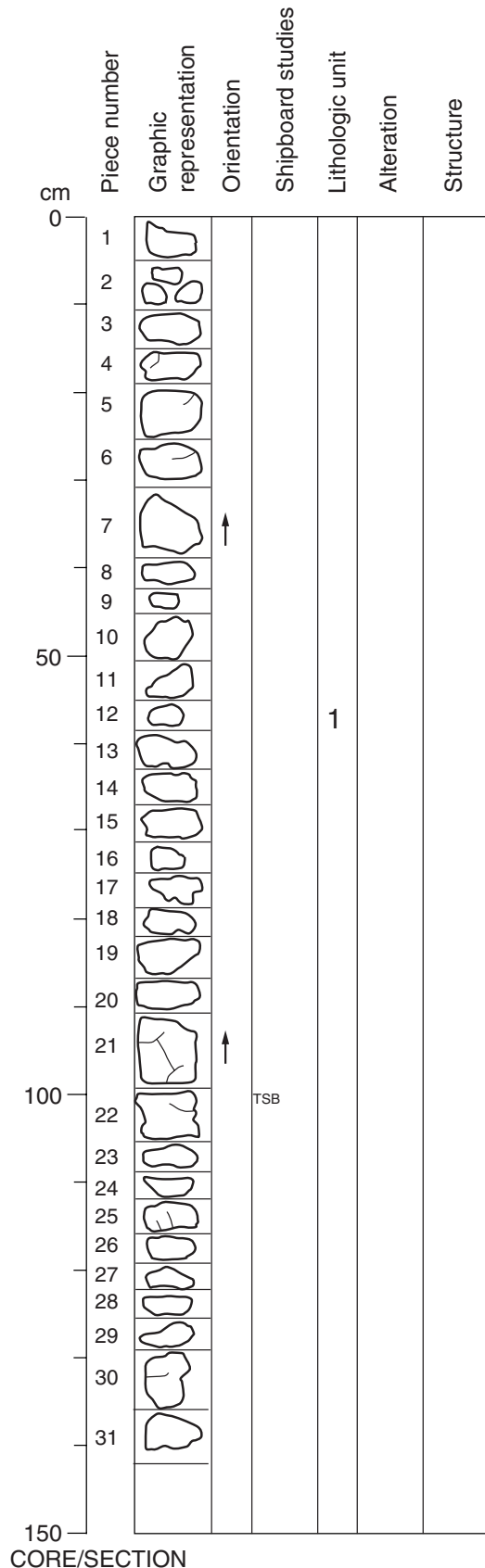
Pieces 13-15: Basaltic Breccia

Pieces 13 to 15 are poorly sorted, matrix supported basaltic breccias; a similar sediment is found adhering to basalt rubble clasts (Pieces 8, 11, and 12). Piece 12 has a subvertical, tube shaped pocket (2.5 cm x 1 cm x 0.5 cm) in which the sediment is inversely graded, i.e., a buff-colored clay and silt layer 4-5 mm thick on the bottom and ~1-2 mm thick on the sides of the pocket grades into a 1.5 cm thick layer of sand-size lithic clasts, mostly palagonite.

Clasts: The breccia is made up entirely of material of basaltic derivation (i.e., aphyric basalt and palagonite ± glass). The clasts are angular (mostly basalt) to subrounded (mostly palagonite) and range up to 4 cm in size for basalt clasts. Yellow palagonite forms ~10%-30% of the 2-3 mm size range; white clay after palagonite is also common in this size range and smaller. Clasts of unaltered glass are present in the breccia, but most have concentric rims of yellow palagonite or white clay. Some basaltic clasts have concentric alteration halos (e.g., Piece 13), but most do not; basalt clasts range from slightly to moderately altered.

Matrix: The matrix is composed predominantly of gray to white silt to sand size particles of unknown origin; the matrix also includes ~10-20% particles of glass, white clay after palagonite and basalt. The sediment is loosely cemented by clay and/or quartz(?)

Core Photo



187-1164B-5R-1

Unit 1: BASALTIC RUBBLE

PIECES 1-31

All pieces in this section are aphyric basalt with 1%-3% olivine microphenocrysts, interpreted as basaltic rubble based on the degree of alteration along with the small piece size and rounded to subrounded weathered outer surfaces.

Pieces 1-31 : Aphyric basalt

INTERNAL CONTACTS: Piece 6 has a chilled margin consisting of a thin layer of palagonite on the outer surface, ~1 mm of clear glass, with the rest of the chilled margin being made up of spherulites, glass and palagonite.

GROUNDMASS: Microcrystalline

COLOR: Brown (altered) to medium gray (less altered)

VESICLES: Vesicles are rare and < 1 mm in diameter; most are unfilled; some vesicles in Piece 11 are filled with calcite and some in Piece 31 are filled with clay. Mirolitic cavities occur in Pieces 8 and 11.

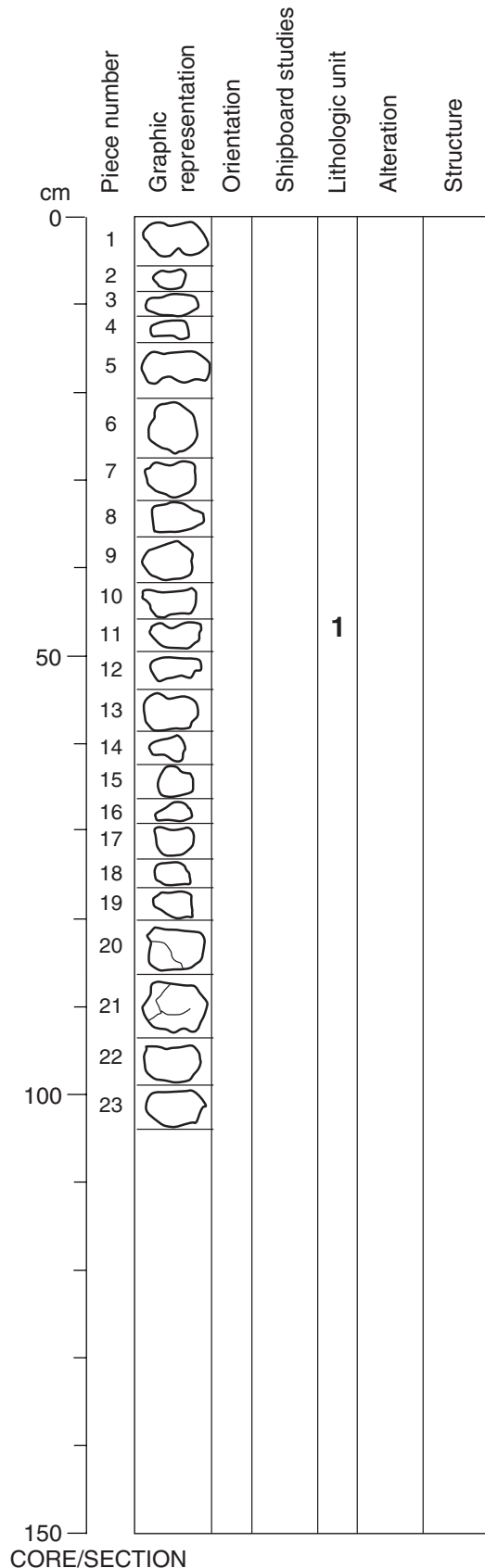
VEINS/FRACTURES: Mn oxide-lined fractures occur in Piece 3. Radial fractures across a chilled margin occur in Piece 6. Clay lined fractures occur in Pieces 21 and 23.

ALTERATION: The pieces range from moderately (Pieces 1, 5, 11 and 14) to highly (all other pieces) altered. Highly altered pieces are characterized by pervasive replacement of groundmass (>50%) by Fe oxyhydroxides + clay ± dendritic to patchy Mn oxide; olivine is totally replaced by Fe oxyhydroxides + clay. Alteration of moderately altered pieces is similar to highly altered pieces, but concentrated in alteration halos 5-15 mm wide rather than pervasive; Pieces 11, 14, and 15 also have calcite in the groundmass. Plagioclase appears fresh throughout, but some show black discoloration, possibly due to Mn oxide on crystal faces.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Microphenocrysts of olivine (<1 mm) form 1%-3% of the mode. Plagioclase microphenocrysts/phenocrysts up to 3 mm long are present, but significantly <1% of the mode. Piece 5 has a tabular (anhedral) plagioclase phenocryst, 3 mm in size, with a sieve textured core.

Core Photo



187-1164B-6R-1

Unit 1: BASALTIC RUBBLE

PIECES 1-23

All pieces in this section are aphyric basalt with 1%-3% olivine microphenocrysts, interpreted as basaltic rubble based on the degree of alteration along with the small piece size and rounded to subrounded weathered outer surfaces.

Pieces 1-23: Aphyric basalt

INTERNAL CONTACTS: Piece 1 has a chilled margin consisting of a thin (~1 mm) layer of palagonite on the outer surface, ~1 mm of clear glass, with the rest of the chilled margin being made up of spherulites.

GROUNDMASS: Microcrystalline

COLOR: Brown (altered) to medium gray (less altered)

VESICLES: Vesicles are scarce, less than 1% and < 1 mm in diameter. Most of the vesicles are unfilled. Where they are filled, the filling is variable: calcite, Fe oxyhydroxides ± clays, light green clays, Mn oxides and blue cryptocrystalline silica.

VEINS/FRACTURES: Fractures occur in Pieces 20 and 21. Two thin veins (0.1 mm width) filled with Mn oxides are present in Piece 10.

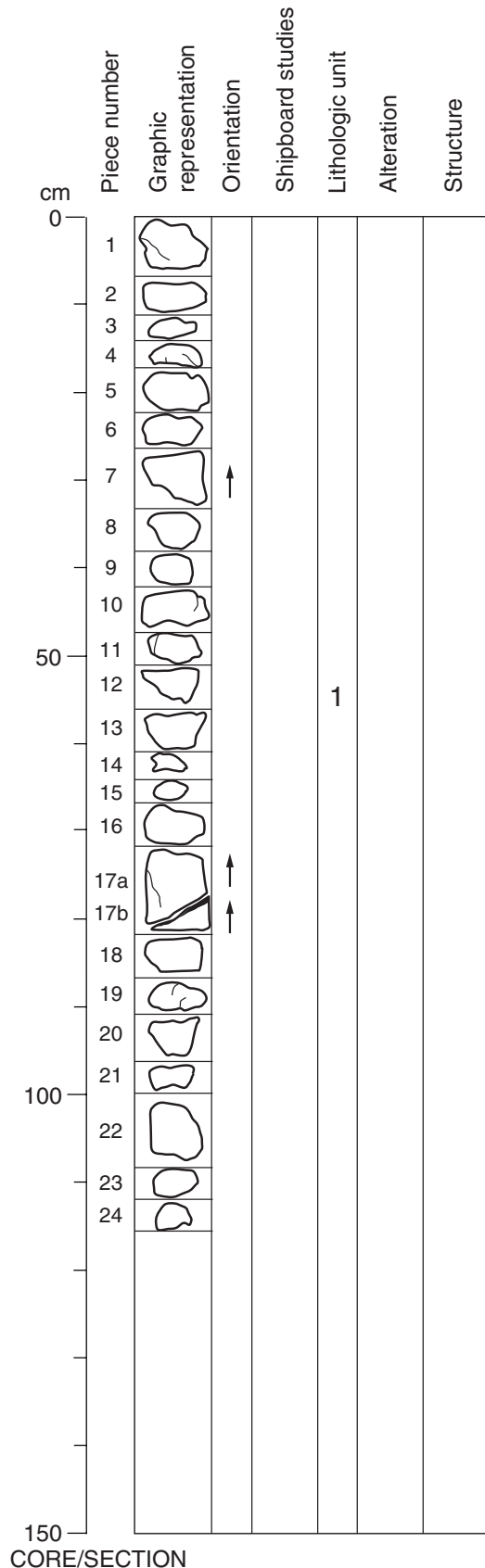
ALTERATION: The pieces range from moderately (Pieces 2, 5, 20, 22 and 23) to highly (all other pieces) altered. Highly altered pieces are characterized by pervasive replacement of groundmass (>50%) by Fe oxyhydroxides + clay ± dendritic to patchy Mn oxide; olivine is totally replaced by Fe oxyhydroxides + clay. Alteration of moderately altered pieces is similar to highly altered pieces, but concentrated in alteration halos 4-16 mm wide rather than pervasive.

Pieces 20 and 22 have calcite in the groundmass. Patchy coatings of Mn oxide occur on outer surfaces of Pieces 1, 6, 7, and 18.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Microphenocrysts of olivine (<1 mm) form 1%-3% of the mode. Plagioclase microphenocrysts/phenocrysts up to 1.5 mm long are present, but significantly <1% of the mode.

Core Photo



187-1164B-7R-1

Unit 1: BASALTIC RUBBLE

PIECES 1-24

Pieces 1-24 are aphyric basalt with 2%-3% olivine microphenocrysts.

Pieces 1-24: Aphyric basalt

GROUNDMASS: Microcrystalline

COLOR: Brown (altered) to medium gray (less altered)

VESICLES: Vesicles are scarce, and most are <1 mm in diameter. Most are unfilled, but some are filled with Fe oxyhydroxides ± clays, Mn oxides and blue cryptocrystalline silica.

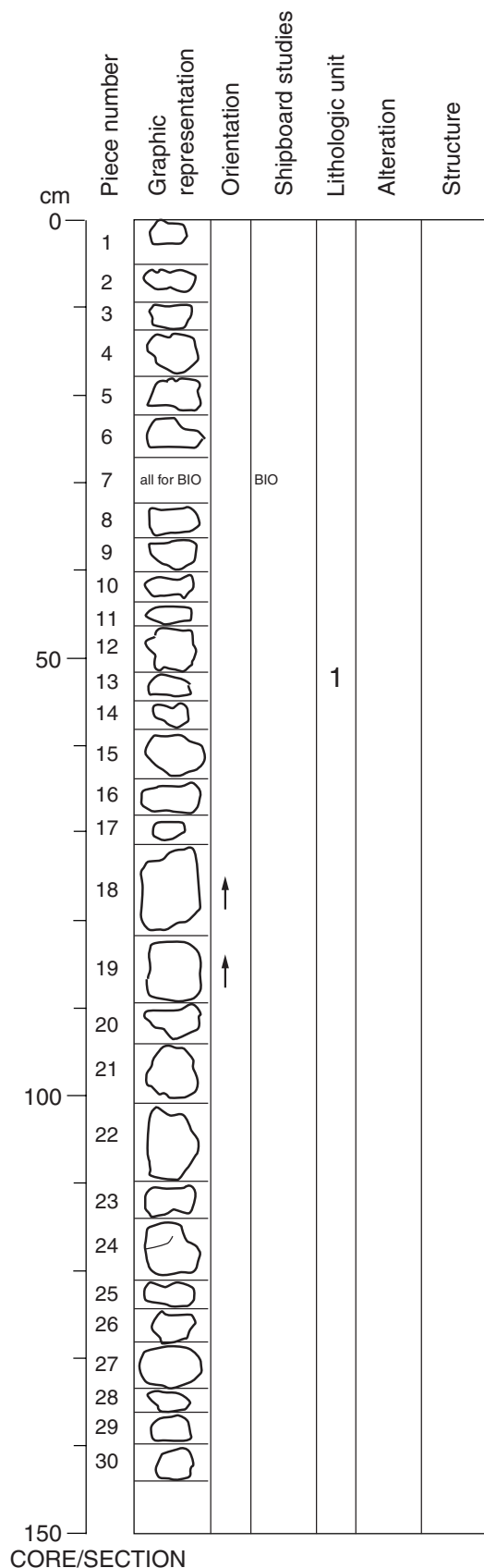
VEINS/FRACTURES: Fractures (~0.1 mm wide) are present in Pieces 11 and 22. A fracture in Piece 19 is lined with Fe oxyhydroxides. Thin veins (0.2 mm width) are filled with Mn oxide in Pieces 1 and 4.

ALTERATION: Overall, the section is moderately (Pieces 5, 7 to 11, 13, 15, 16, 18, 20, and 22 to 24) to highly (Pieces 1 to 4, 6, 12, 14, 17, 19, and 20) altered. Alteration is characterized by alteration halos 5-20 mm wide that parallel the edges of the pieces combined with patchy replacement of groundmass by Fe oxyhydroxides + clay in the piece interior; olivine is totally replaced by Fe oxyhydroxides + clay. Pieces 5, 8, 18, and 17 also have calcite in the groundmass. Patchy coatings of Mn oxide occur on outer surfaces of Pieces 5, 8, 17, and 18.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Microphenocrysts of olivine (<1 mm) form 2%-3% of the mode. Plagioclase microphenocrysts are present throughout the unit, but they represent less than 1% of the mode.

Core Photo



187-1164B-8R-1

UNIT 1: BASALTIC RUBBLE

PIECES 1-30

All pieces in this section are aphyric basalt, interpreted as basaltic rubble based on the high degree and pervasive nature of alteration along with the small piece size (avg. <5 cm long) and rounded to subrounded weathered outer surfaces.

INTERNAL CONTACTS: Pieces 5, 6, 8, 9, 10, 11, 12, 13, 17, 18, 19, 20, 24, 26, and 28 have chilled margins and mixed glass/palagonite rinds. These rinds range in thickness from <1 mm (Pieces 10, 11, 18, and 26) to 1 cm (Pieces 9 and 13). Pieces 5, 6, 8, 12, 17, and 19 have rinds 1-3 mm thick. Pieces 20, 24 and 28 have rinds 7-9 mm thick. The glass/palagonite rinds on Pieces 18 and 26 are very small patches, <5 mm across, occurring on the corner and back side (opposite cut face), respectively. Between the glassy margins and the crystalline interiors are zones of discrete and coalesced spherulites, ~5 mm wide. The spherulites are small, <0.25 mm in diameter. Plagioclase microlites, <1 mm long, are commonly associated with the chilled margins, but present as <3% of the in these areas (e.g., Piece 5).

GROUNDMASS: Microcrystalline

COLOR: Light brown (where pervasively altered) to light gray where less altered

VESICLES:

Abundance %	Size (mm)		Shape
	avg.	max. min.	
<1	0.25	0.4 0.2	spherical

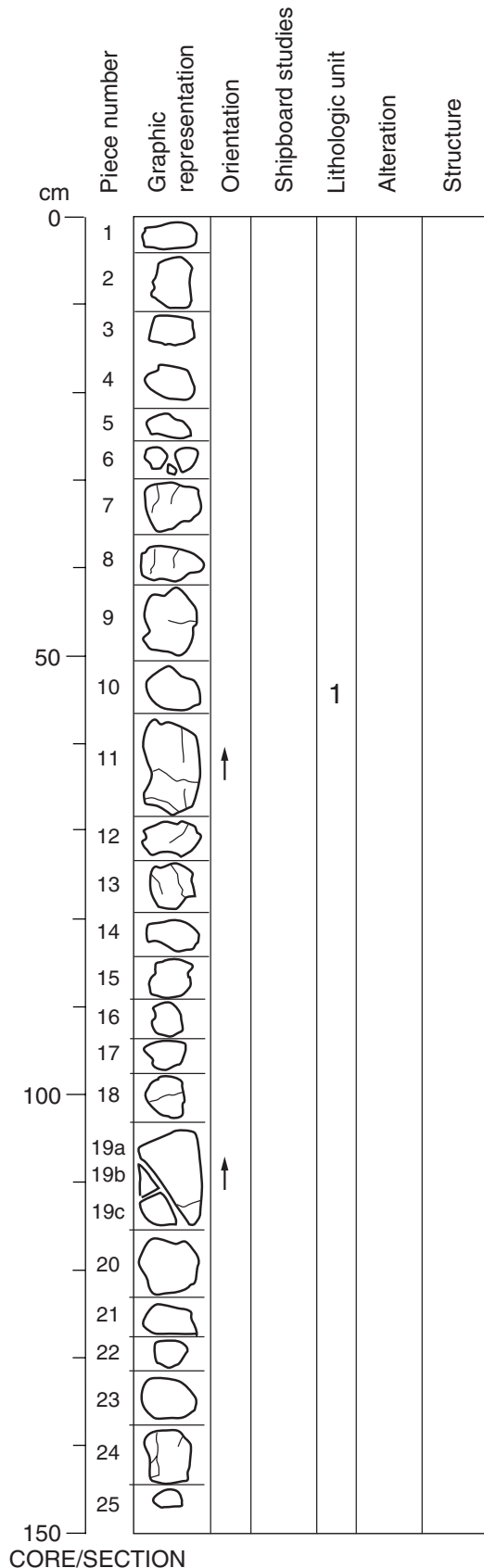
Filling: Lined with light gray clay/cryptocrystalline quartz or Fe oxyhydroxides.
VEINS/FRACTURES: Piece 5 has a fracture 0.25 mm wide and ~3 cm long lined with Mn oxide and oriented perpendicular to the chilled margin.

ALTERATION: Overall the section is highly altered. Pieces 1, 2, 5, 6, 10, 11, 12, 13, 22, 28, and 29 are very highly altered with the entire groundmass pervasively altered to a light brown color. Pieces 3, 4, 8, 9, 14, 15, 19, 20, 21, 23, 24, 27, and 30 are highly altered with <60% of the piece not altered to a light brown color. Pieces 16, 18, 25 and 26 are moderately to highly altered with >60% of the piece not altered to a light brown color. Most pieces have Mn oxide on their outer surfaces occurring as pervasive patches and as disseminated spots ~0.3 mm in diameter; these commonly occur with cryptocrystalline quartz.

STRUCTURE: Rubble pile derived from pillow lavas; Piece 6 has a classic V-shape with a chilled margin and Piece 19 has an arcuate chilled margin.

ADDITIONAL COMMENTS: Rare, subhedral, prismatic plagioclase phenocrysts (up to 2.5 mm long) occur throughout the section (e.g., Piece 8).

Core Photo



187-1164B-9R-1

UNIT 1: BASALTIC RUBBLE

PIECES 1-25

All pieces in this section are aphyric basalt, interpreted as basaltic rubble based on the degree of alteration along with the small piece size and rounded to subrounded weathered outer surfaces.

INTERNAL CONTACTS: Piece 6, 8, 9, 14, 15, and 24 have glass/palagonite rinds and chilled margins. Piece 6 is a set of two small pebbles, ~1 cm across, with one of the pieces having a 2 mm thick glass/palagonite rind on its outer surface; because this pebble is not cut, the chilled margin could not be described in detail. The remaining pieces have glass/palagonite rinds ranging from <1 mm thick (Pieces 9 and 16) to 1 cm thick (Piece 14). Pieces 8, 15 and 24 have rinds 4-6 mm thick. With the exception of Piece 6, a ~3 mm wide zone of discrete spherulites occurs inward from the glass/palagonite rind, followed by an ~5 mm wide band of coalesced spherulites. In both zones the spherulites are typically ~0.2 mm in diameter. Plagioclase microlites, up to 0.8 mm long, are common in the chilled margins of these pieces.

GROUNDMASS: Microcrystalline

COLOR: Light brown (where altered) to medium gray (where less altered)

VESICLES:

Abundance %	Size (mm) avg.	Size (mm) max.	Shape min.
<1	0.2	0.4	spherical

Filling: Vesicles are typically lined with gray clay/cryptocrystalline quartz or Fe oxyhydroxides. Pieces 1 and 11 have ~2% miarolitic cavities with cryptocrystalline quartz, zeolites and clay.

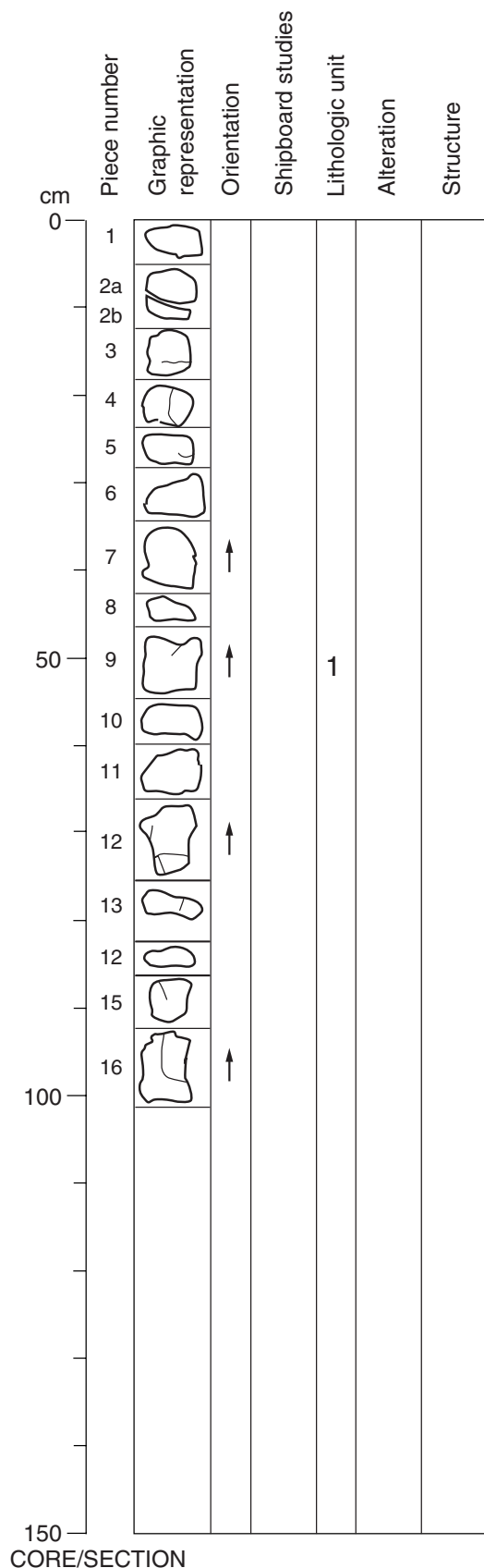
VEINS/FRACTURES: Piece 14 has a 0.25-mm-wide cryptocrystalline quartz vein with patchy cryptocrystalline quartz coating the outside of the piece. Pieces 8, 9, 11, 15, 18, 19, and 24 have small, ~0.3 mm wide, fractures with Mn oxide lining the fracture. Piece 19 is broken into 3 subpieces along fractures.

ALTERATION: Overall the section is moderately altered. Pieces 3 and 15 are very highly altered with their entire groundmass altered to a light brown. Pieces 1, 13, and 14 are highly altered with >50% of the groundmass altered to a light brown. The remaining pieces are moderately altered with oxidized margins 5 mm to 1 cm wide. Mn oxide occurs as patches on the outsides of about half the pieces. The fracture in Piece 11 has a 5 mm wide oxidation halo and the fracture in Piece 19 has an ~9 mm wide oxidation halo. Piece 1 has a vug with euhedral quartz crystals, up to 0.25 mm long, along with Mn oxide and Fe oxyhydroxide.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: Rare prismatic plagioclase phenocrysts, up to 2 mm long, occur throughout (e.g., Piece 24).

Core Photo



187-1164B-9R-2

UNIT 1: BASALTIC RUBBLE

PIECES 1-16

All pieces in this section are aphyric basalt with ~2%-3% olivine microphenocrysts, interpreted as basaltic rubble based on the high degree of alteration and small piece size.

INTERNAL CONTACTS: Chilled margins were recovered on Pieces 1, 5, 15, and 16. Pieces 1 and 5 consist of 3-4 mm of clear glass + microphenocrysts, 1-2 mm of discrete spherulites in glass and 2 mm of coalesced spherulites; in Piece 5 the glass in between the spherulites is palagonitized. Piece 15 retained only a palagonitized spherulitic zone. Piece 16 consists of a thick layer (2-3 mm) of partially palagonitized glass + quartz, followed by 2-3 mm of clear glass, followed by a palagonitized spherulitic zone.

GROUNDMASS: Microcrystalline

COLOR: Light brown (where altered) to medium gray (where less altered)

VESICLES: Vesicles are rare, occurring only in Pieces 10 and 16. In Piece 10 they are small (<~0.1 mm). In Piece 16 they range up to 2 mm in size and form ~1% of the mode in a band ~1 cm wide near the chilled margin on this piece; outside this band, vesicles are small and rare. All vesicles are unfilled. Mirolitic cavities occur in Pieces 2, 11, and 12; these are partially filled with calcite.

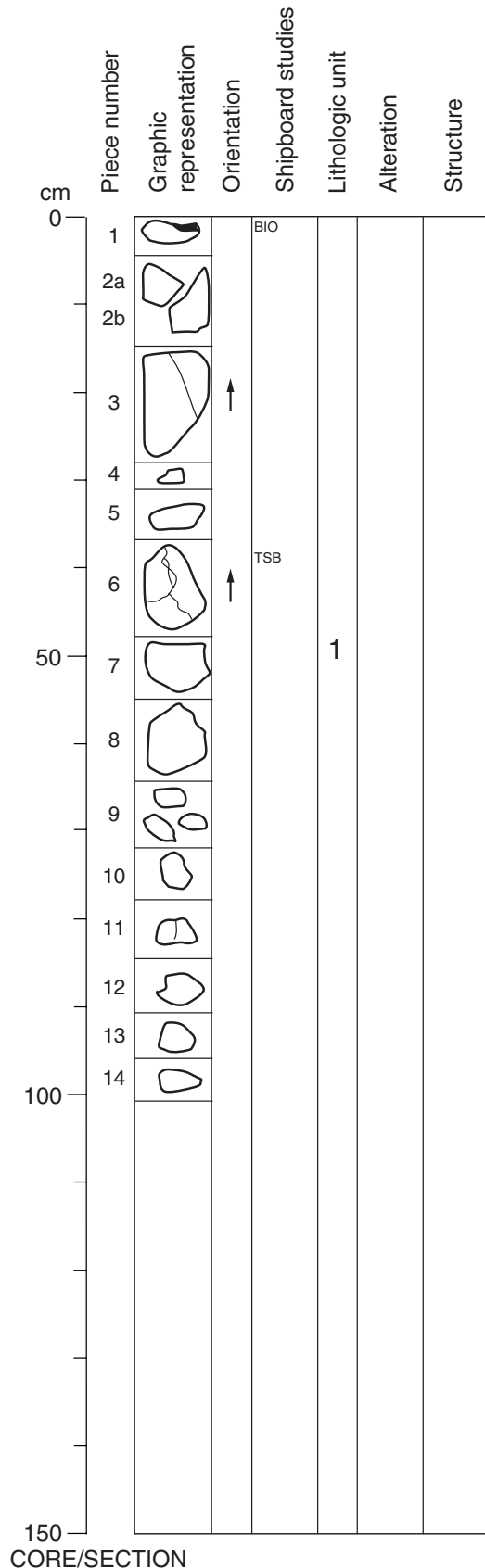
VEINS/FRACTURES: Pieces 4, 6, 10, 12, 13, 15, and 16 have Mn oxide-lined fractures; Piece 2 is broken along an Mn oxide-lined fracture. Piece 12 has a diffuse vein of Fe oxyhydroxides that crosscuts the piece. Piece 5 has a radial fracture crosscutting the chilled margin.

ALTERATION: Overall the section is moderately (Piece 1 to 3, 5, 11, 12, and 16) to highly (Pieces 4, 6 to 10, and 13 to 15) altered. Highly altered pieces are characterized by pervasive replacement of groundmass (>50%) by Fe oxyhydroxides + clay. Many of these pieces also have patches of Mn oxide in the groundmass and dendritic growth of Mn oxide extending from outer surfaces for ~3 mm into the interior of the piece. Olivine is totally replaced by Fe oxyhydroxides + clay. Alteration of moderately altered pieces is similar to highly altered pieces, but concentrated in alteration halos 5 mm to 4.5 cm wide. Away from the alteration halos, olivine is totally unaltered. The alteration halos make up between 15 and 75% of the rock and the rock is ~50% altered in these areas. In Pieces 1 and 5 the alteration halos, which are ~5-6 mm wide along the side of the piece, turn and follow a band of similar thickness just below the chilled margin; in spite of the alteration in this area, the glass in the chilled margins tends to be relatively unaffected. Moderately altered pieces tend to have patchy occurrences of calcite in the groundmass (e.g., Pieces 2, 3, 11, 12, and 16).

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: The rocks contain ~3% olivine microphenocrysts (<1 mm in size); some pieces with slightly larger average crystal sizes are borderline sparsely olivine plagioclase aphyric (e.g., Piece 6). Groundmass olivine and plagioclase tend to form clusters up to 1.5 mm across consisting of ~3-5 crystals; acicular groundmass plagioclase may be up to 4 mm long.

Core Photo



187-1164B-10R-1

UNIT 1: BASALTIC RUBBLE

PIECES 1-14

All pieces in this section are aphyric basalt with ~2%-3% olivine microphenocrysts. Based on lithologic continuity with overlying cores, this section is interpreted as basaltic rubble. However, the overall degree of alteration less and there are fewer small, round pieces.

INTERNAL CONTACTS: Piece 1 includes a fragment of a chilled margin consisting of 1-2 mm of palagonite covered by a layer of drusy quartz. This is followed by 3 mm of clear glass, 1 mm of discrete spherulites in glass and 2 mm of spherulites in palagonite.

GROUNDMASS: Microcrystalline

COLOR: Light brown (where altered) to medium gray (where unaltered)

VEICLES: Rare and unfilled throughout

VEINS/FRACTURES: Pieces 6 and 11 have Mn oxide-lined fractures; Piece 2 is broken along an Mn oxide-lined fracture. Piece 3 has a thin vein (<0.2 mm) filled with quartz + Mn oxide.

ALTERATION: Overall the section is slightly altered (Pieces 2 to 7, 9 to 12, and 14). Pieces 1 and 13 are highly altered and Piece 8 is moderately altered. In most pieces alteration is characterized by thin (2-6 mm) alteration halos that parallel the edges of the pieces and form 10%-15% of the piece. In the halos groundmass is ~40%-50% replaced (with olivine totally replaced) by Fe oxyhydroxides + clay; elsewhere the rock is relatively unaltered and contains fresh groundmass olivine. Pieces 2 to 6, 8, and 9 have patchy occurrences of calcite. The moderately altered piece has a more extensive patchy replacement of groundmass by smectite and olivine is replaced by greenish white clay. The highly altered pieces have wider alteration halos (e.g., Piece 13, halo 1.5 cm wide, which makes up ~75% of the rock) or pervasive oxidative alteration to Fe oxyhydroxides + clay (e.g., interior of Piece 1 away from glassy margin). Pieces 7 and 8 have patchy coatings of clay + Mn oxide on outer surfaces and Piece 4 has a coating of clay + Mn oxide + drusy quartz.

STRUCTURE: Rubble pile

ADDITIONAL COMMENTS: The rocks contain ~3% olivine microphenocrysts (0.5-1 mm in size); in Pieces 10 to 14 the olivines are consistently smaller (<~0.3 mm) than elsewhere in this section. Piece 3 has one euhedral olivine phenocryst 2 mm in size.

187-1164A-4R-1, 20-22 cm (TS#88)			Unit: 1			OBSERVER:	Kempton	
ROCK NAME:	Aphyric basalt							
WHERE SAMPLED:	piece 4							
GRAIN SIZE:	microcrystalline							
TEXTURE:	plumose quench textures							
PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)			APPROX. COMP.	MORPHOLOGY	COMMENTS
			min.	max.	av.			
PHENOCRYSTS								
Plagioclase	~1	~1	0.2	2			prismatic to tabular	Discontinuous zoning in tabular crystal; prismatic crystals generally unzoned; long prismatic crystals commonly have sieve textures parallel to crystal faces or twin planes; all have albite twins.
Olivine Clinopyroxene	<<1	<1	0.2	1.5			subhedral to euhedral	Partially to totally replaced by calcite and/or clay.
GROUNDMASS								
Olivine								Olivine was not positively identified as a groundmass phase; all small birefringent crystals in the groundmass appear to be clinopyroxene.
Plagioclase	25	25		1.5			prismatic	Sieve textured cores with melt pockets elongate and aligned parallel to cleavage planes or twin planes.
Clinopyroxene	10	10		0.6			anhedral to euhedral	Occurs as anhedral crystals in subophitic textural relationships with plagioclase and as euhedral crystals.
Opaque Minerals	2	2		<20 microns			equant to skeletal	Occurs in areas of dark mesostasis.
Glass								
Cr spinel	tr	tr		25 microns				
Mesostasis	60	61						Modal estimate includes plumose quench growth + glass; the ratio of plumose quench crystals to dark brown glassy areas is about 5:1. The quench crystals appear to be made of a 50:50 mixture of plagioclase and clinopyroxene.
SECONDARY MINERALOGY	PERCENT	LOCATION	SIZE (mm)			REPLACING / FILLING	COMMENTS	
			min.	max.	av.			
Clays	<1						partially replacing olivine	
Calcite	1						replacing olivine and groundmass, filling vesicles	
VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm)			FILLING / MORPHOLOGY	COMMENTS	
			min.	max.	av.			
Vesicles	1		0.4	1	0.6	calcite and refilled with melt / spherical	Most vesicles have been re-filled with melt; a few are filled with calcite.	
COMMENTS :	Plagioclase is seriate from crystals ~2 mm long to groundmass microlites ~0.1 mm in size; most crystals are prismatic and <~1 mm. Distinguishing groundmass and phenocrysts is therefore arbitrary and whether this rock qualifies as aphyric or sparsely plagioclase-olivine basalt is a matter of semantics. Olivine appears to be partially replaced by calcite (+ clay?) throughout, but the calcite has been largely plucked out during polishing. Modal estimates for olivine and calcite are therefore less accurate than would otherwise be possible.							

187-1164B-2R-1, 50-53 cm (TS#89)			Unit: 1			OBSERVER:	Kempton	
ROCK NAME:	Moderately plagioclase-olivine phyric basalt							
WHERE SAMPLED:	typical piece							
GRAIN SIZE:	microcrystalline							
TEXTURE:	intersertal							
PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)			APPROX. COMP.	MORPHOLOGY	COMMENTS
			min.	max.	av.			
PHENOCRYSTS								
Plagioclase	4	4	0.5	3	1.5		tabular (anhedral) to prismatic (subhedral)	Many crystals showing disequilibrium texture, e.g. sieve, concentric oscillatory zoning; Tabular crystals show evidence for partial resorption.
Olivine	1.5	2	0.5	1.6			equant, some skeletal	Partially replaced by Fe oxyhydroxides + clay; one crystal contains a euhedral Cr spinel inclusion (30 microns).
Clinopyroxene								
Cr spinel	tr	tr		0.4			subhedral	Close to subhedral olivine.
GROUNDMASS								
Olivine	2	3		0.5			equant, anhedral	
Plagioclase	40	40		0.5			acicular, skeletal to prismatic	Some box shapes.
Clinopyroxene	1	1		<50 microns			anhedral	Occurs as plumose quench growth and anhedral crystals in miarolitic cavities.
Opaque Minerals	1	1		<10 microns			equant	
Glass								
Mesostasis	44	49						
SECONDARY MINERALOGY	PERCENT		SIZE (mm)				REPLACING / FILLING	COMMENTS
			min.	max.	av.			
Clays	3						filling miarolitic cavities, replacing groundmass and olivine	Yellow clay filling miarolitic cavities and replacing plagioclase across fractures; pale brown where altering olivine.
Calcite	3			0.4			filling miarolitic cavities	
VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm)				FILLING / MORPHOLOGY	COMMENTS
			min.	max.	av.			
Vesicles	<1	distributed		0.2			some refilled with melt; clay	
Miarolitic cavities		distributed					some filled with secondary calcite, some with yellow clay	Very common (mode not estimated, since this is reflected in the modes of calcite + clay).
COMMENTS : Second observer comment: Olivine partially replaced by yellow-brown (ppl) mineral with anomalous interference colors which is cut by cracks lined with similar material. Replacement appears to proceed along square sections along fractures, producing a regular step-morphology. Plagioclase and olivine are seriate, so boundary between phenocryst and groundmass is arbitrary.								

187-1164B-4R-1, 143-145 cm (TS#90)			Unit: 1			OBSERVER:		Kempton/Gee	
ROCK NAME: Aphyric basalt (sparsely plagioclase-olivine phyric basalt)									
WHERE SAMPLED: piece 25									
GRAIN SIZE: microcrystalline									
TEXTURE: sheaf quench crystal morphologies									
PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)			APPROX. COMP.	MORPHOLOGY	COMMENTS	
			min.	max.	av.				
PHENOCRYSTS									
Plagioclase	1	1		1.5	1.2		subhedral laths to prismatic	Microphenocrysts Clay alteration along fractures, disequilibrium textures, e.g. strain extinction, swallowtail quench plagioclase is concentrically zoned.	
Olivine	1	1		0.7			skeletal euhedral, equant	Some alteration, equant crystals usually in glomerocrysts.	
Clinopyroxene									
Cr-spinel	tr	tr		0.4			anhedral	Some Cr-sp have melt inclusions up to 0.08 mm across which have crystals in them; one large spinel is partially enclosed by olivine.	
GROUNDMASS									
Olivine									
Plagioclase	35	40					acicular to skeletal, hollow plagioclase plumose textured	Interlocking plagioclase define the groundmass.	
Clinopyroxene	5	40							
Opaque Minerals									
Glass									
Mesostasis	8	17						Includes glass + quench crystals of olivine and clinopyroxene; olivine and glass are largely replaced by clay and Fe oxyhydroxides; clinopyroxene is relatively unaltered.	
SECONDARY MINERALOGY	PERCENT	SIZE (mm)			REPLACING / FILLING	COMMENTS			
		min.	max.	av.					
Clays + Fe oxyhydroxides	~48				replacing groundmass phases and olivine				
Mn oxide	<1					Patches in groundmass.			
VESICLES/CAVITIES	PERCENT	SIZE (mm)			FILLING / MORPHOLOGY	COMMENTS			
		min.	max.	av.					
Vesicles	~0.5	0.08	0.8	0.4	partially lined with carbonate filled with clay (and Mn oxide)	~1-2% of the rock.			
Miarolitic cavities									
COMMENTS : Plagioclase is seriate, so there are no true phenocrysts. Crystals over 0.6 mm long are included as microphenocrysts. . Glomerocrysts up to 1.5 mm long of plagioclase and olivine, include ~ 20% of the phenocrysts. Some glomerocrysts have plumose textured cpx arranged in an 'iron-filing' pattern around a magnet. Miarolitic cavities show up really well highlighted against the extensive groundmass replacement by Fe oxyhydroxides + clay									

187-1164B-4R-2, 75-79 cm (TS#91)	Unit:1	OBSERVER:	Russo/Kempton
ROCK NAME: Basalt breccia			
WHERE SAMPLED: representative piece			
GRAIN SIZE: clasts - pebble to sand; matrix - clay to silt			
TEXTURE: poorly sorted			

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)			APPROX. COMP.	MORPHOLOGY	COMMENTS
			min.	max.	av.			

PHENOCRYSTS

Plagioclase
Olivine
Clinopyroxene

GROUNDMASS

Olivine
Plagioclase
Clinopyroxene
Opaque Minerals
Glass

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

Clays

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

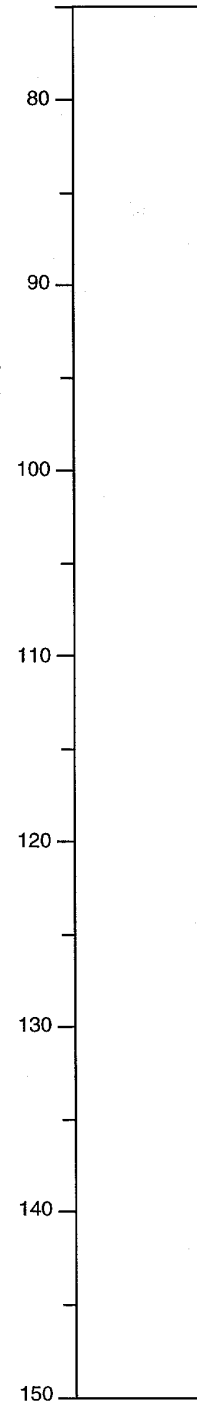
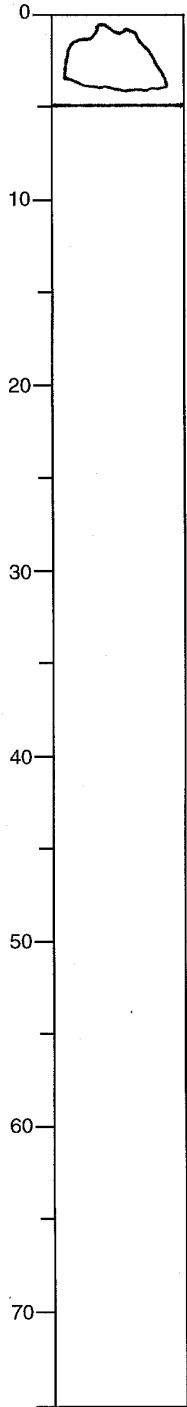
COMMENTS : The breccia is matrix supported by gray clay and consists of 30% matrix and 70% angular to subrounded clasts. Clasts range in size from 0.02 mm to 1.2 cm. Clasts vary in composition from fragments of individual mineral phases of plagioclase and olivine to aphyric basalt. The basalt is dominated by sheaf and plumose quench textures, other clasts include basaltic glass ± palagonite as well as spherulitic basaltic chilled margins. Olivine is surprisingly unaltered, as are many of the glass fragments; both are angular to subangular.

187-1164B-5R-1, 100-104 cm (TS#92)			Unit: 1			OBSERVER:		Kempton/Russo	
ROCK NAME:	Aphyric basalt								
WHERE SAMPLED:	rubble pile (piece 22)								
GRAIN SIZE:	microcrystalline								
TEXTURE:	intersertal								
PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)			APPROX. COMP.	MORPHOLOGY	COMMENTS	
			min.	max.	av.				
PHENOCRYSTS									
Plagioclase									
Olivine									
Clinopyroxene									
GROUNDMASS									
Olivine	2	4		0.4			equant	Partially replaced by iddingsite.	
Plagioclase	45	45	0.08	1.35	0.6		sheaf to lath-like		
Clinopyroxene	20	30		150 microns			euhedral to subhedral in miarolitic cavities; plumose quench growth elsewhere	Clinopyroxene slightly more coarse grained than normal, although still a quench texture; clinopyroxene in miarolitic cavities ranges from anhedral granules to elongate crystals to euhedral crystals.	
Opaque Minerals	1	1		<10 microns			equant	Larger in miarolitic cavities.	
Mesostasis	9	20							
Cr spinel	tr.	tr.		0.12			equant	One nestled between groundmass plagioclase in the center of the thin section ~4 mm up from the labeled edge.	
SECONDARY MINERALOGY	PERCENT		SIZE (mm)				REPLACING / FILLING	COMMENTS	
			min.	max.	av.				
Clays	20						clinopyroxene and groundmass		
Calcite	3						filling cavities		
VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm)				FILLING / MORPHOLOGY	COMMENTS	
			min.	max.	av.				
Miarolitic cavities				1.5			some filled with calcite, some with clay	Some are filled with a calcite that is full of inclusions, some may be Mn oxide(?); the calcite has a radial extinction; the cavity is lined along the edge with Fe oxyhydroxides (+Mn oxide?).	
COMMENTS :	Glomerocrysts of plagioclase. Slide is crosscut by a thin Mn oxide vein/fracture.								

187-1164B-10R-1, 43-46 cm (TS#93)			Unit: 1			OBSERVER:	Kempton/Gee	
ROCK NAME:	Aphyric basalt (sparsely plagioclase-olivine phyric basalt)							
WHERE SAMPLED:	piece 6							
GRAIN SIZE:	microcrystalline							
TEXTURE:	intersertal							
PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)			APPROX. COMP.	MORPHOLOGY	COMMENTS
			min.	max.	av.			
PHENOCRYSTS								
Plagioclase	1.5	1.5		2			subhedral prismatic	Seriate.
Olivine	<<1	1	0.8	1.5	1		equant, euhedral to skeletal	Microphenocrysts have a skeletal structure and are usually intergrown with plagioclase.; Many of the olivine phenocrysts are <1 mm long and may be more properly described as microphenocrysts.
Clinopyroxene								
Cr spinel				0.4			subhedral	Elongate discrete crystal.
GROUNDMASS								
Olivine	1	1	<50 microns	0.6	0.4		skeletal e.g. chinese lantern	
Plagioclase	39	39		0.6			acicular, skeletal to some prismatic	Hollow skeletal forms and sheafs quench morphologies.
Clinopyroxene	1	1		50-100 microns			plumose quench morphologies in mesostasis	Modal and size estimate refers only to subhedral - euhedral clinopyroxene in miarolitic cavities.
Opaque Minerals	1	1		<10 microns			equant	
Glass								
Mesostasis	48	52						Includes glass + quench crystal morphologies of plagioclase, clinopyroxene and olivine.
SECONDARY MINERALOGY	PERCENT		SIZE (mm)				REPLACING / FILLING	COMMENTS
			min.	max.	av.			
Clays + Fe oxyhydroxide	5						clinopyroxene, olivine and glass in mesostasis	
Calcite	tr						filling miarolitic cavities	
VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm)				FILLING / MORPHOLOGY	COMMENTS
			min.	max.	av.			
Vesicles	<1			0.1			lined with clay	
Miarolitic cavities	3						some filled with clay, some with calcite	Shows enhanced crystal growth of clinopyroxene and FeTi oxides.
COMMENTS :		Olivine and plagioclase commonly occur as clusters/glomerocrysts (including ~40% of all phenocrysts). Thin section is crosscut by two fractures lined with Fe oxyhydroxides.						

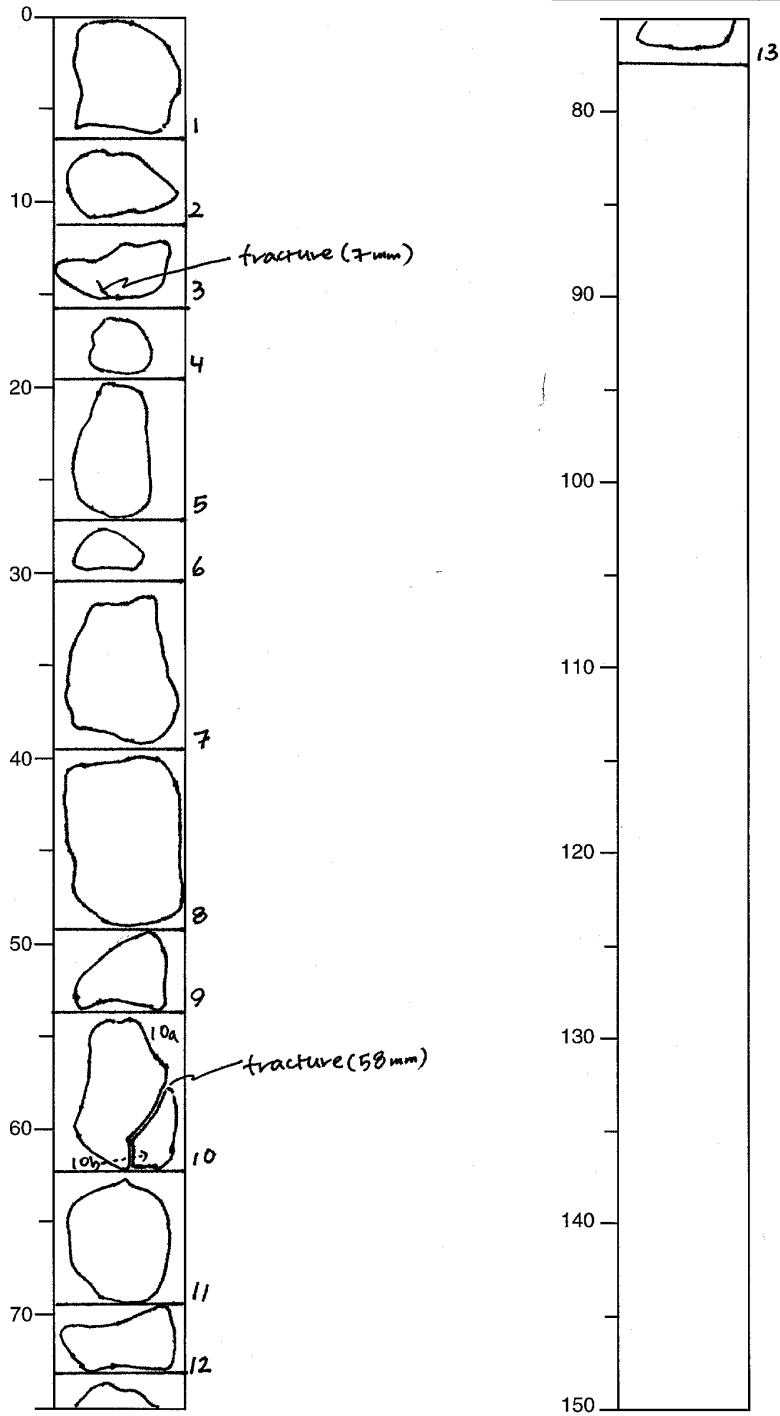
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core
107	1164A	2R



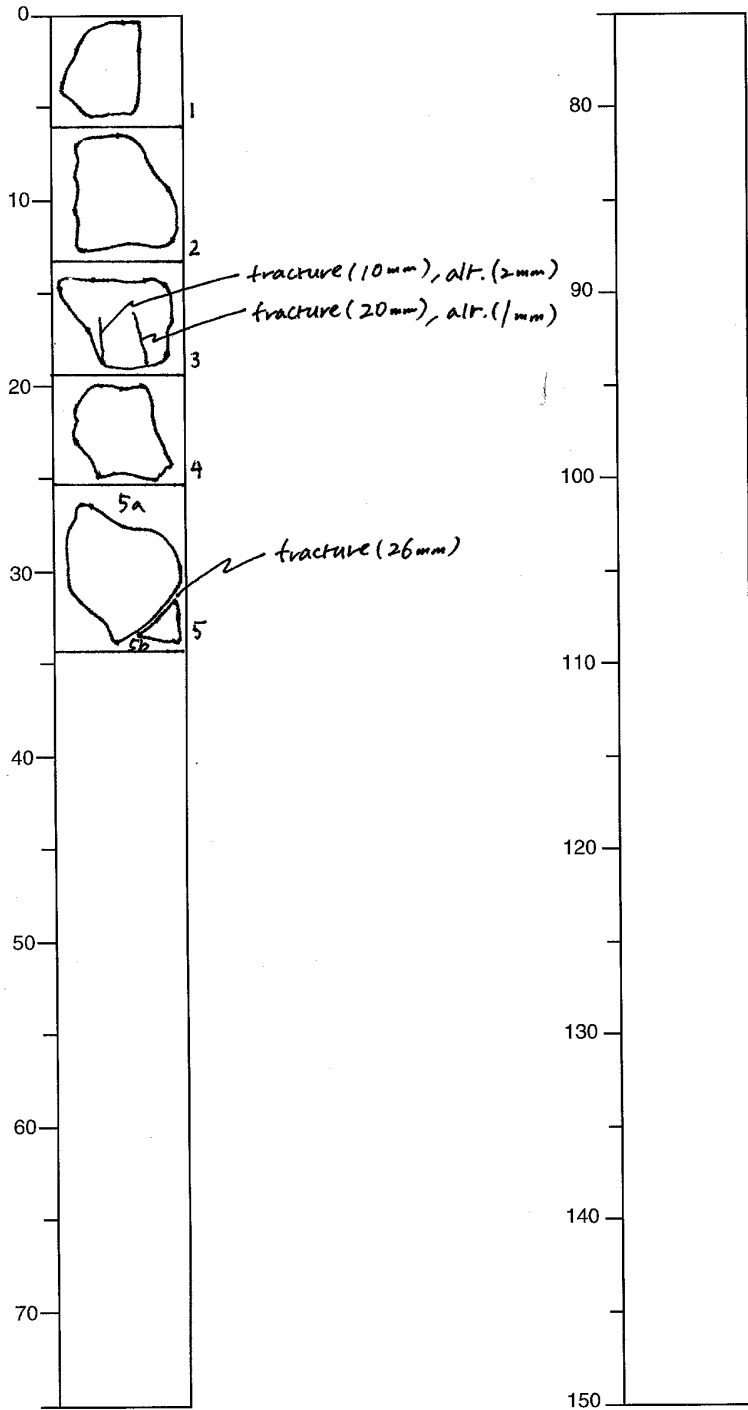
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core
187	1164A	3R



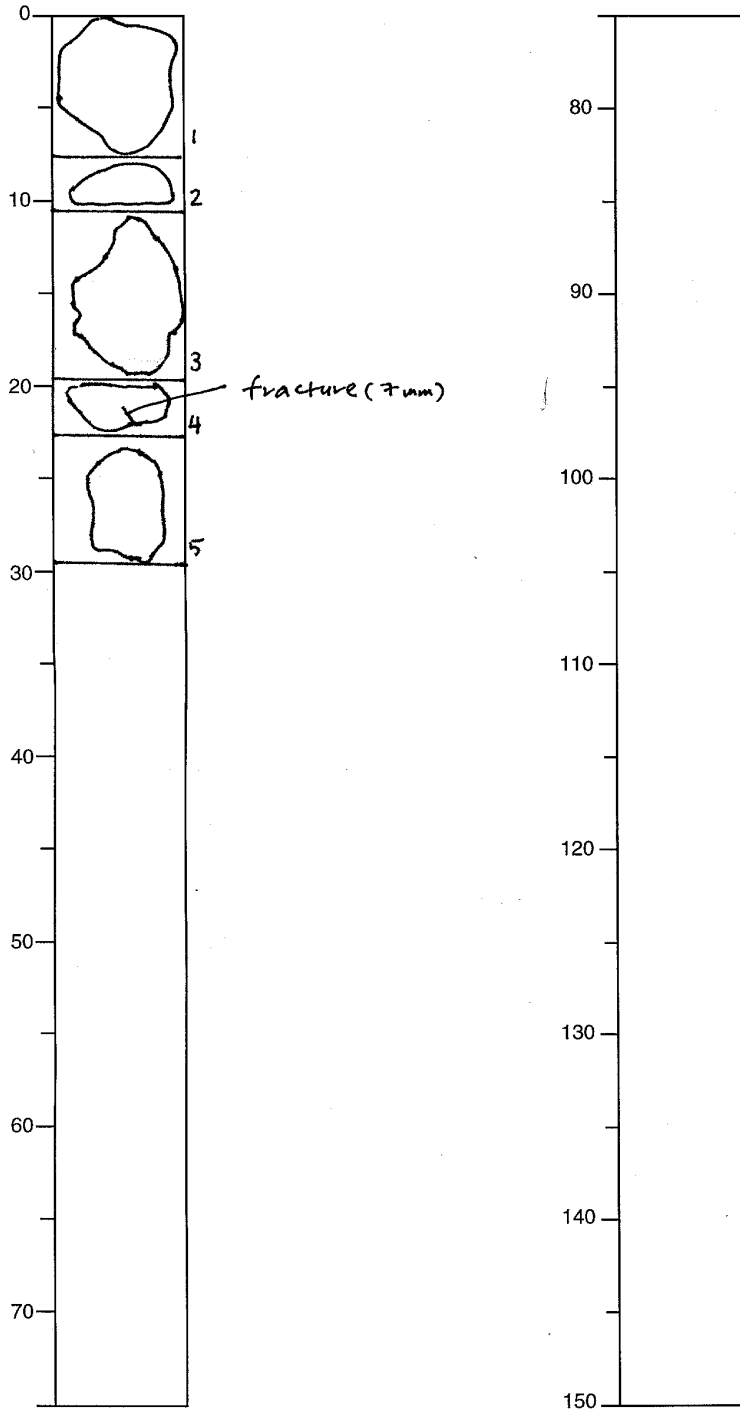
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section
187	1164A	4R	1



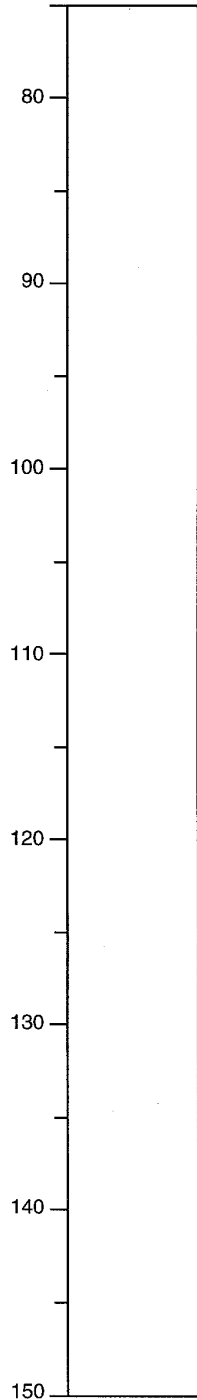
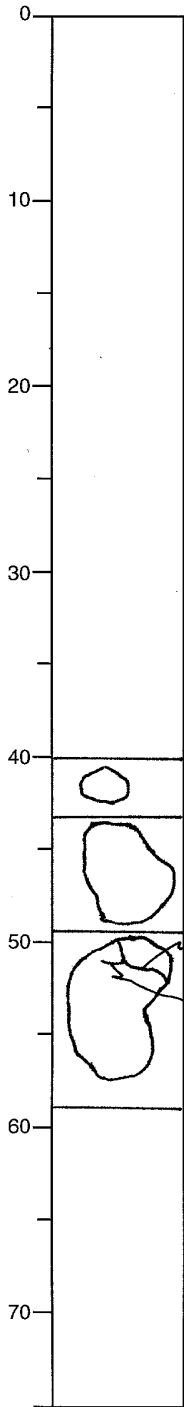
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core
187	1164B	1W



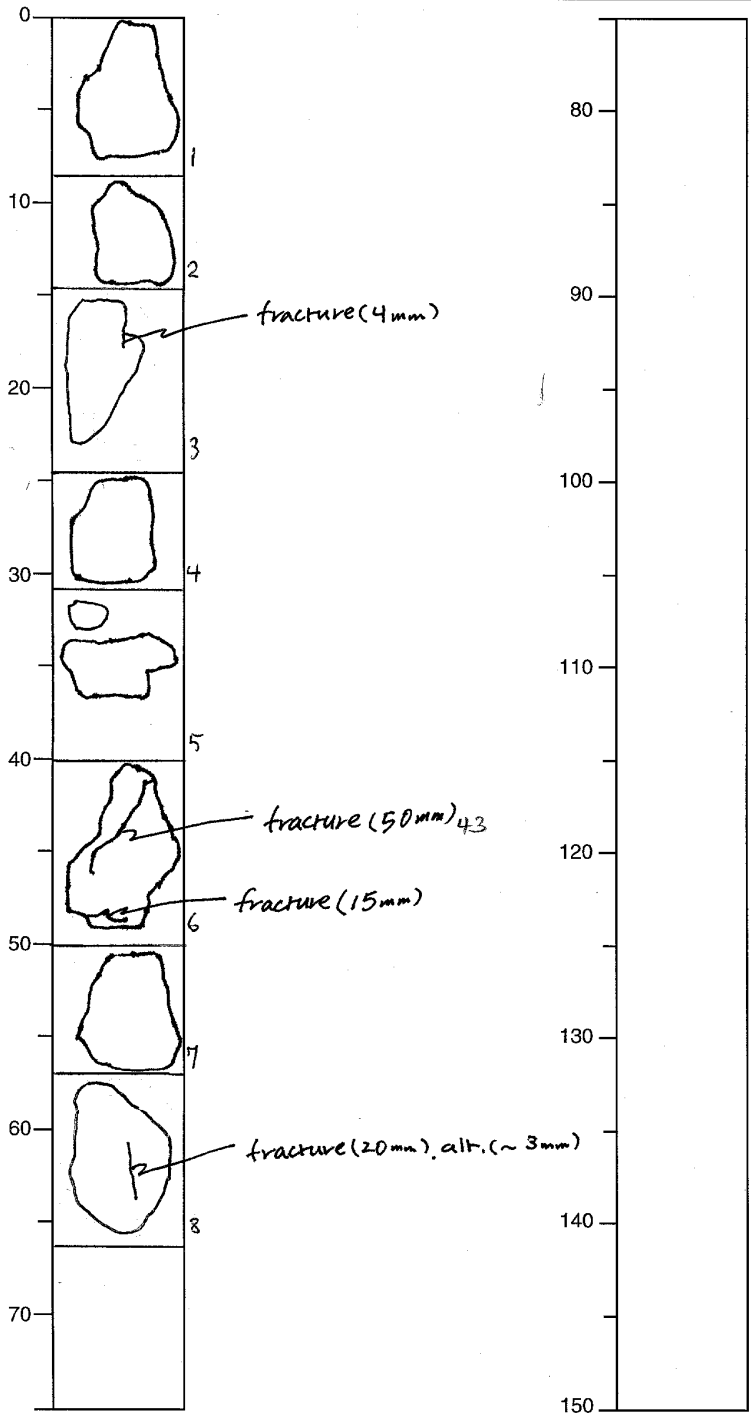
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section
187	1164B	1W	1



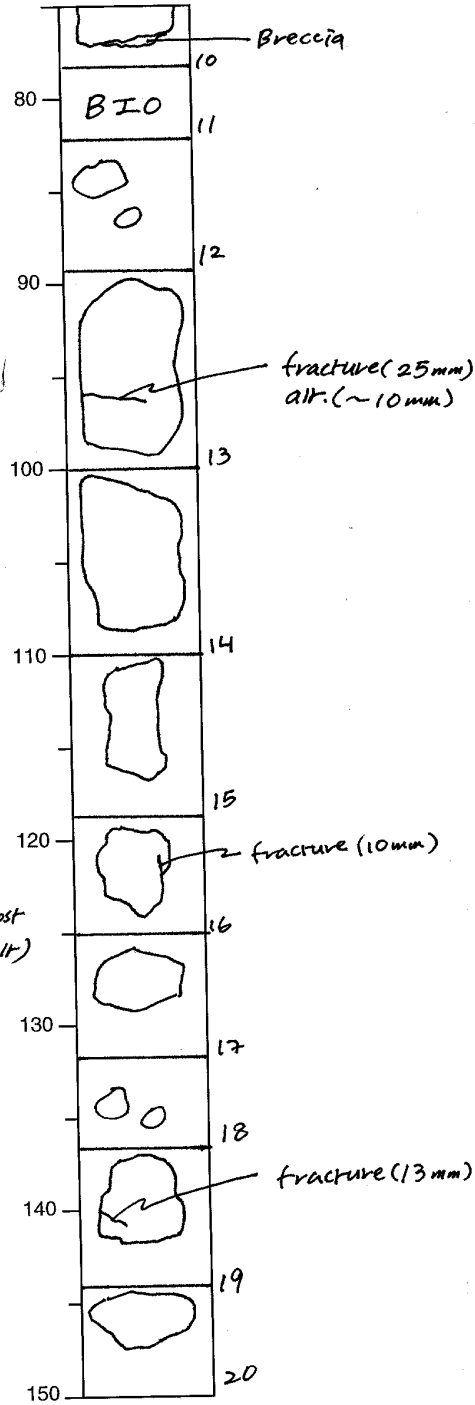
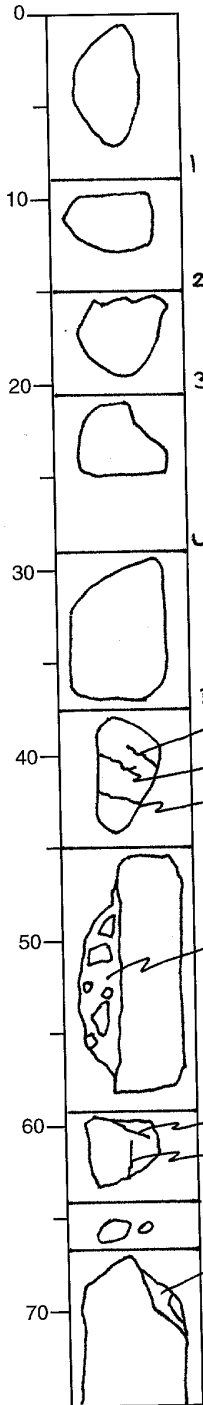
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Sec
187	1164B	2R	1



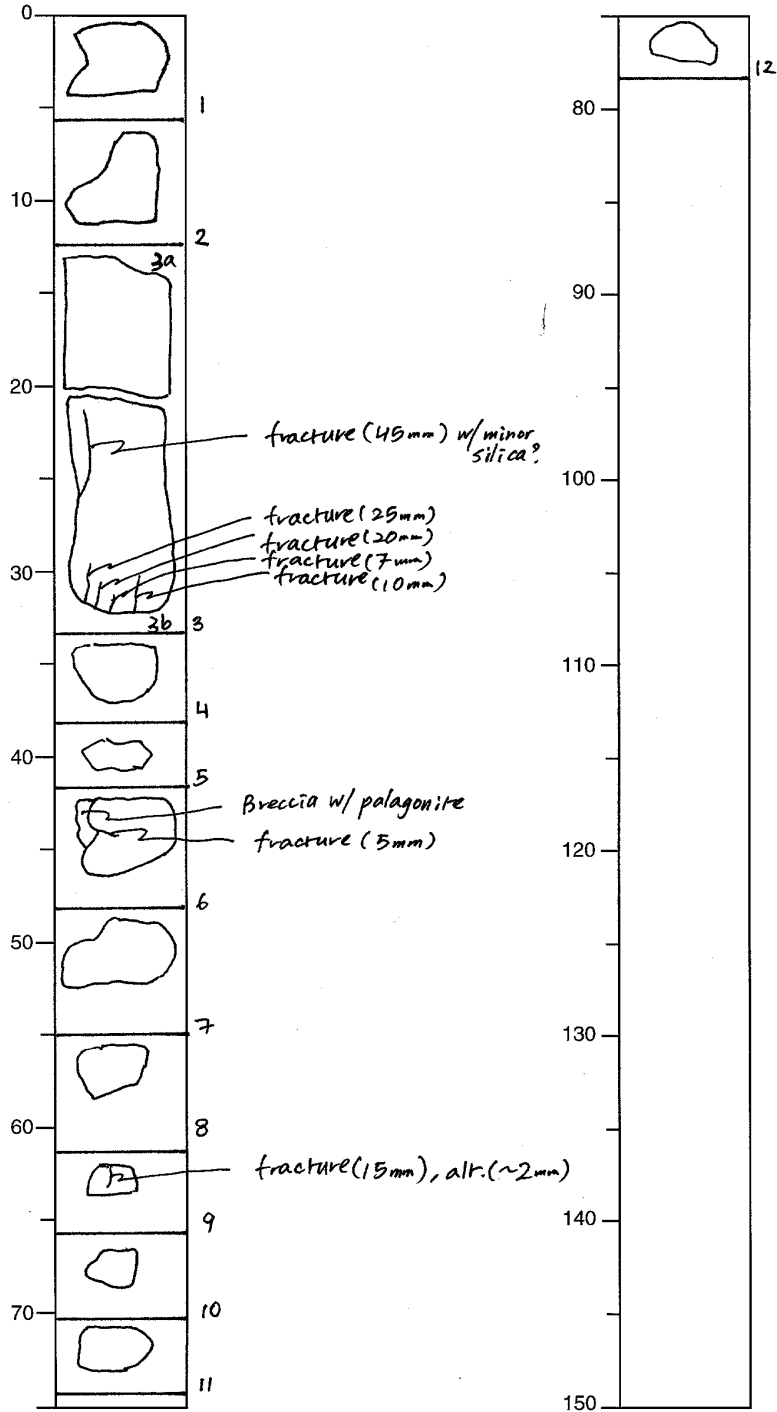
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section	Observer
187	1164B	3R	1	



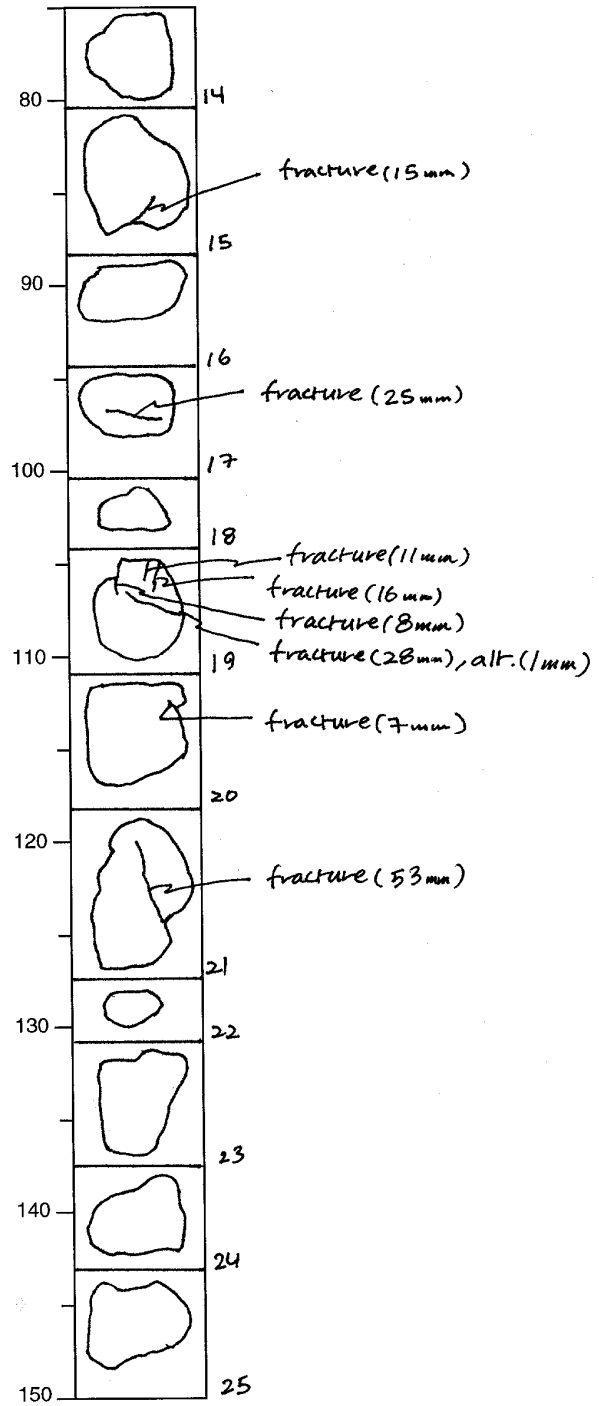
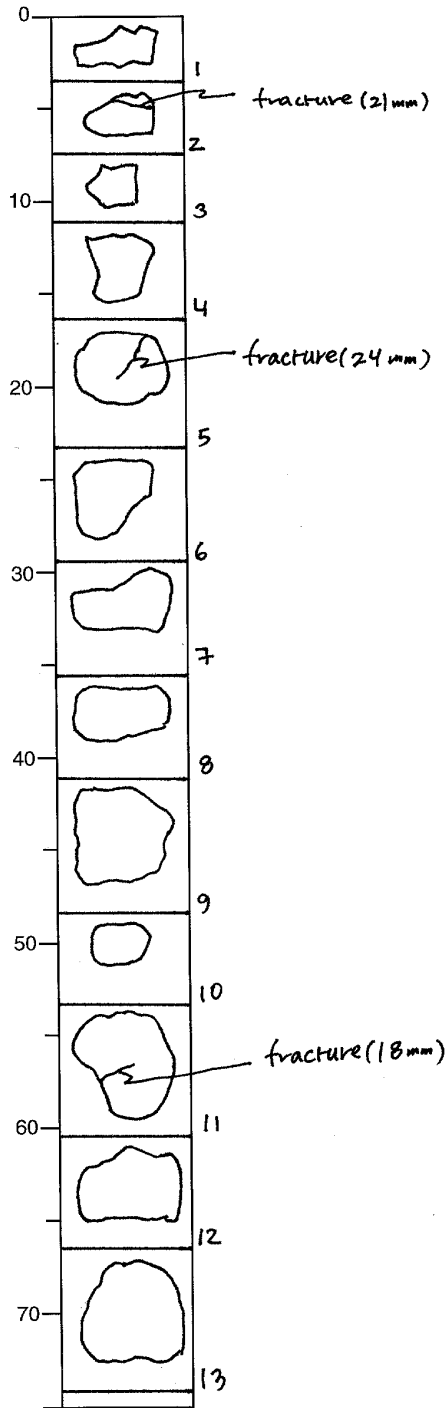
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section
107	1164B	3R	2



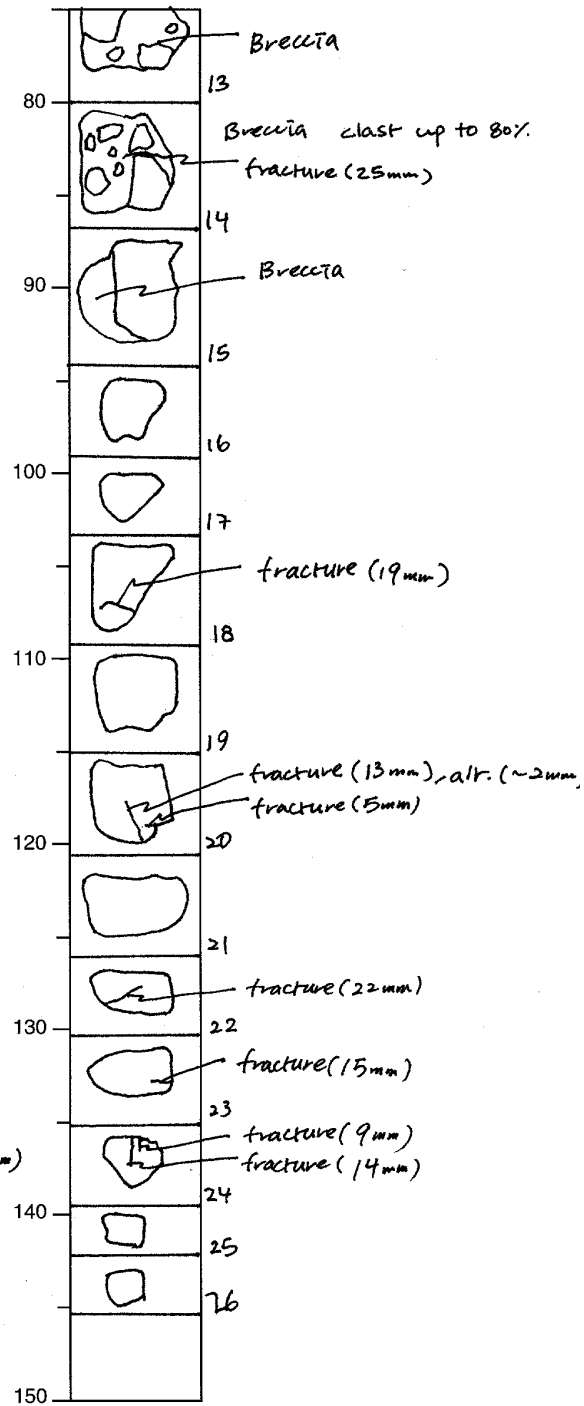
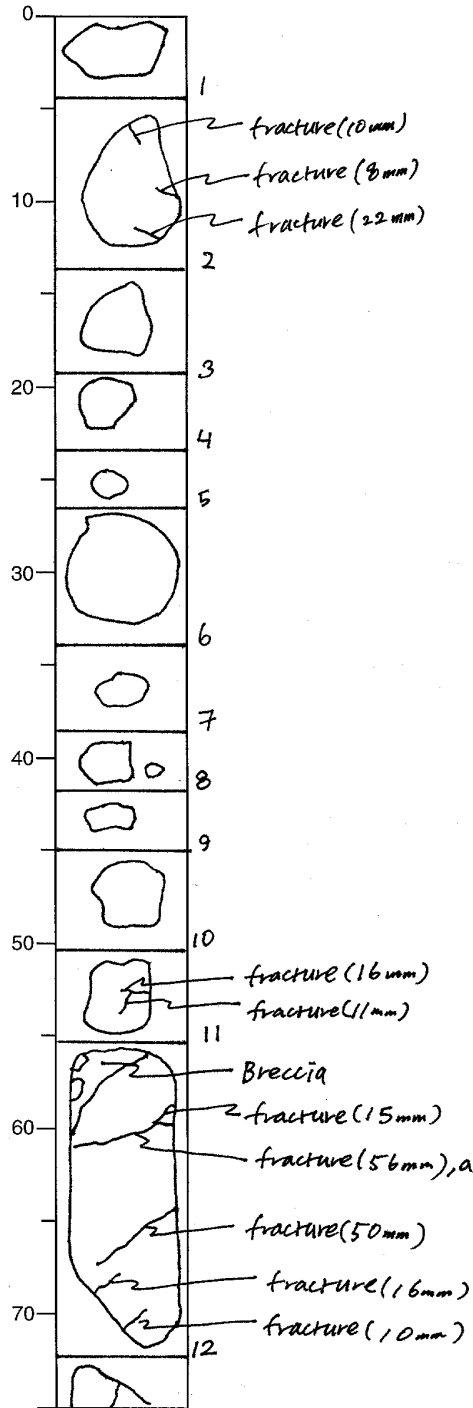
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section	Observer
187	1164B	4R	1	



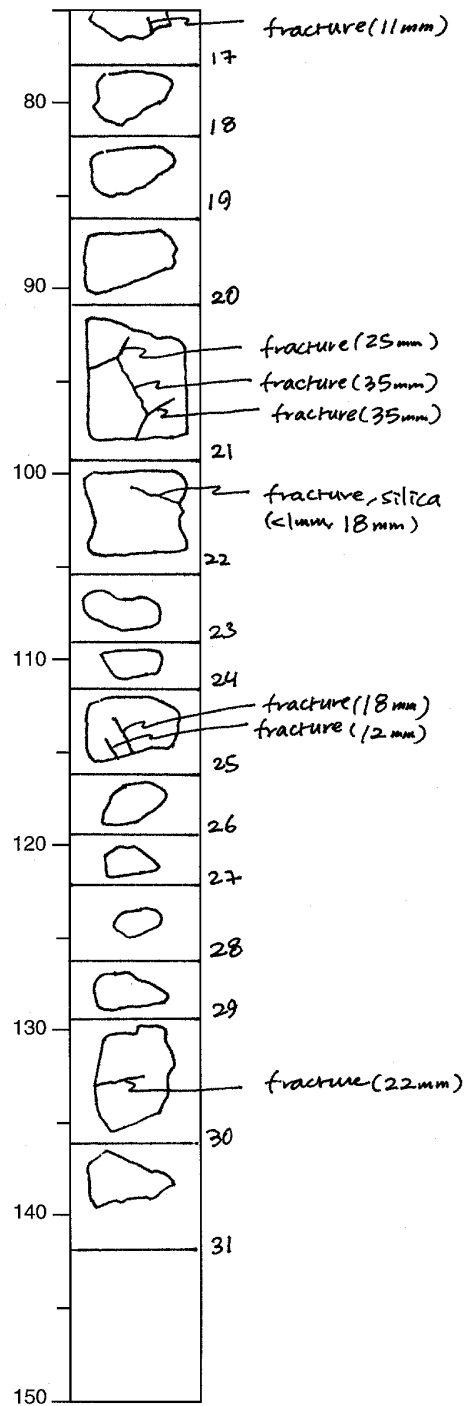
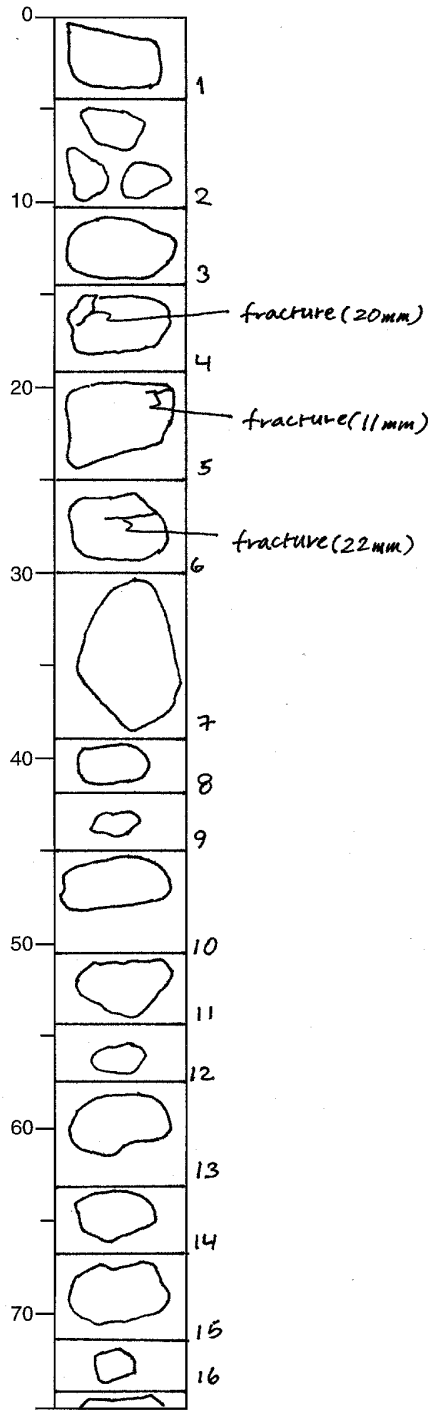
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section	Observer
187	1164B	4R	2	



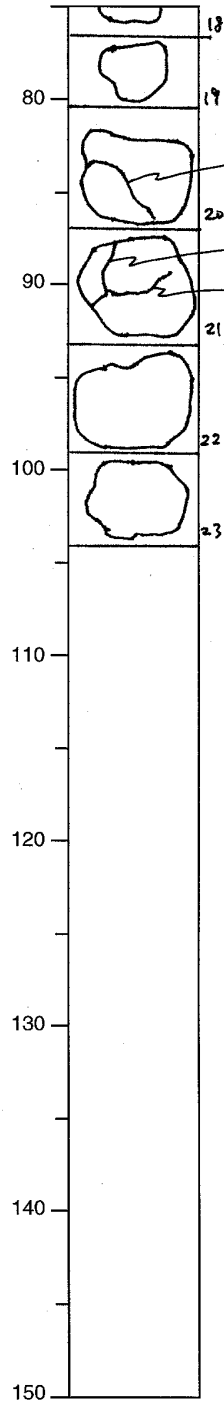
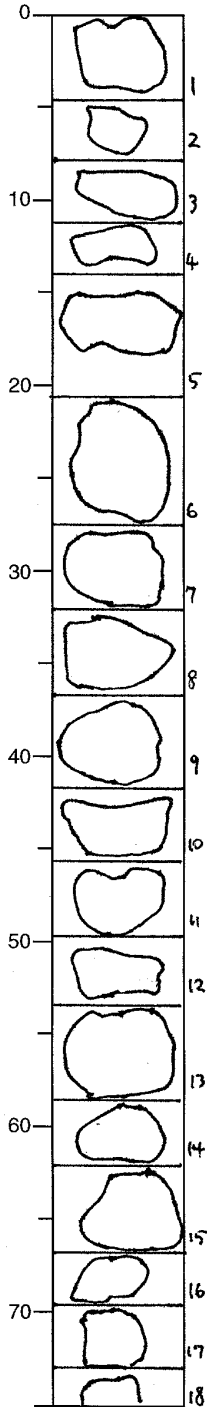
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section	Observer
187	1164B	5R	1	



STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section	Observer
187	1164B	6R	1	



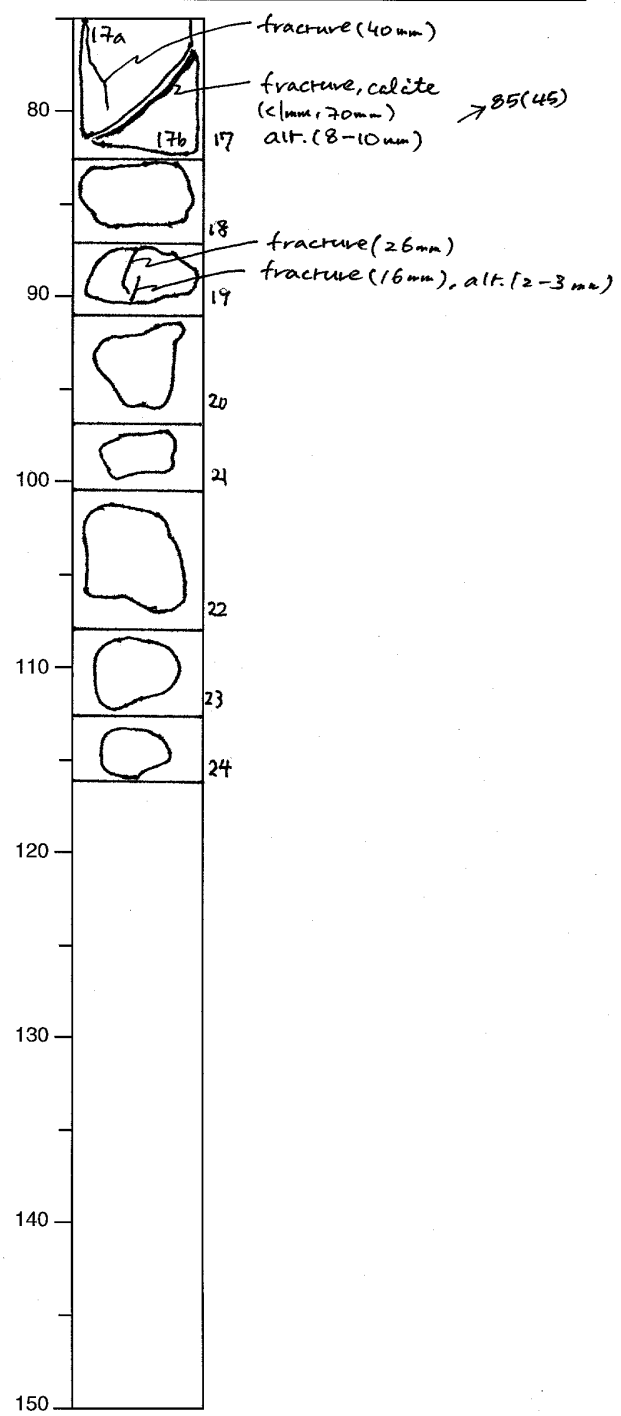
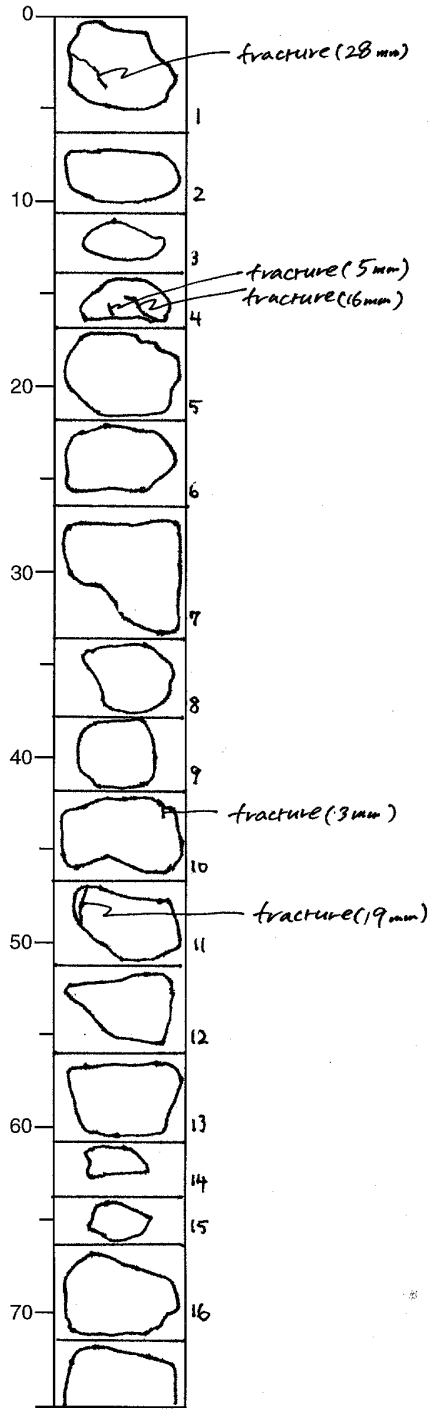
fracture (44 mm)

fracture (39 mm)

fracture (25 mm)

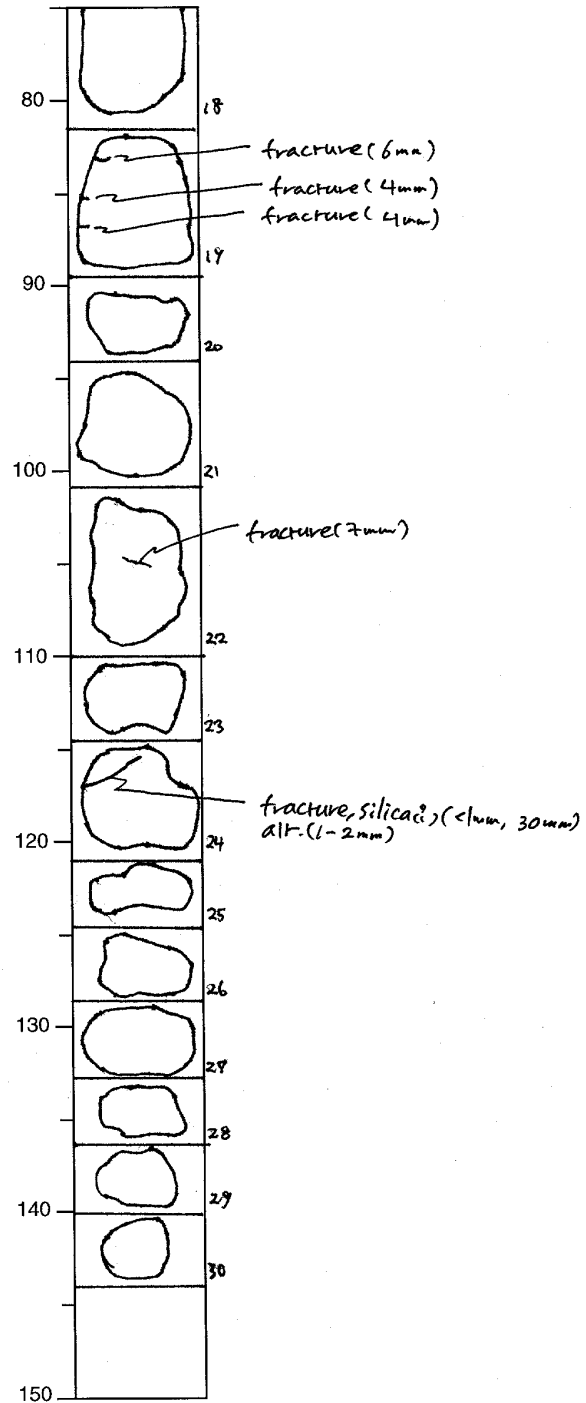
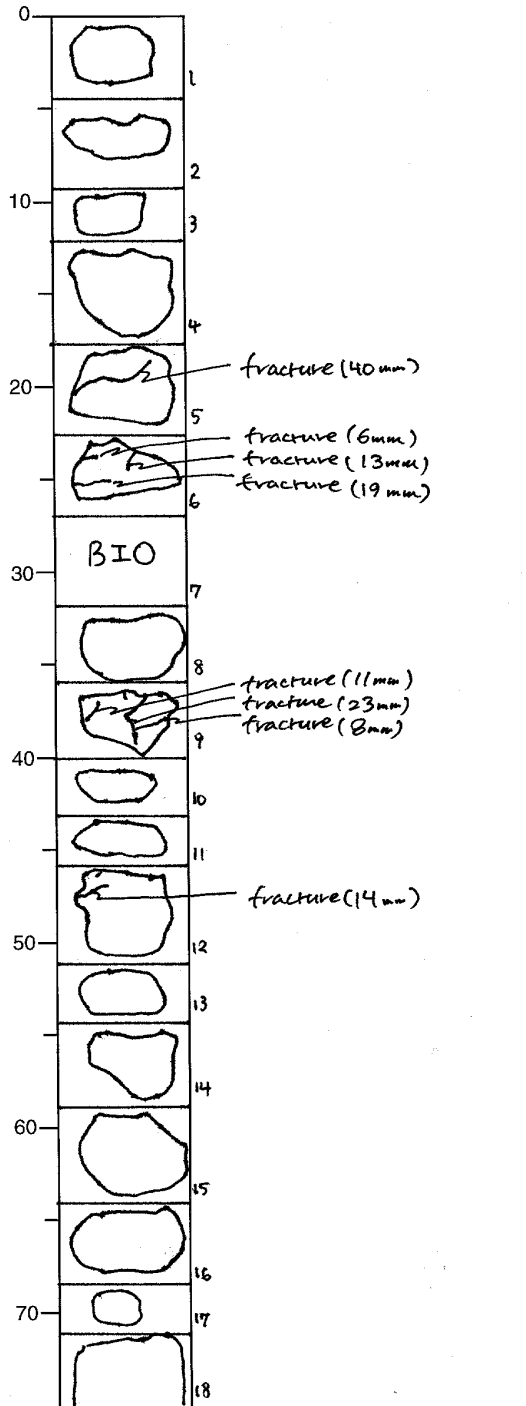
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section	Observer
187	1164B	7R	1	



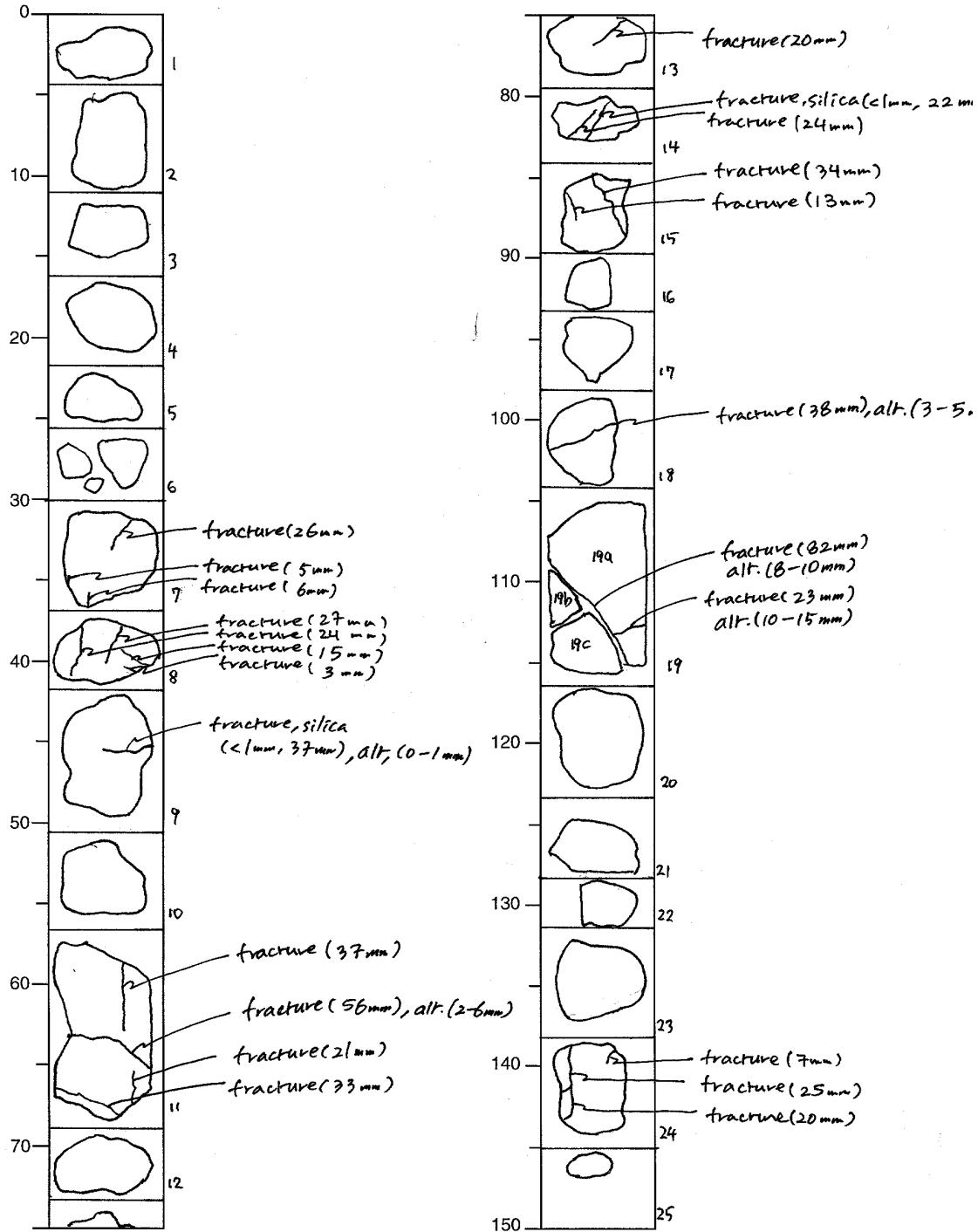
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section	Observer
187	1164B	8R	1	



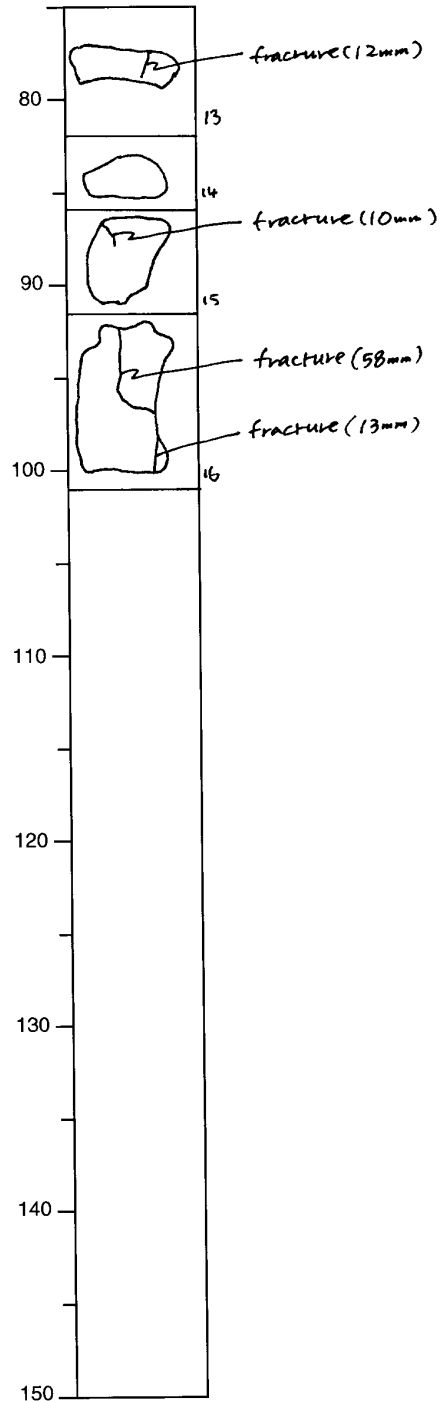
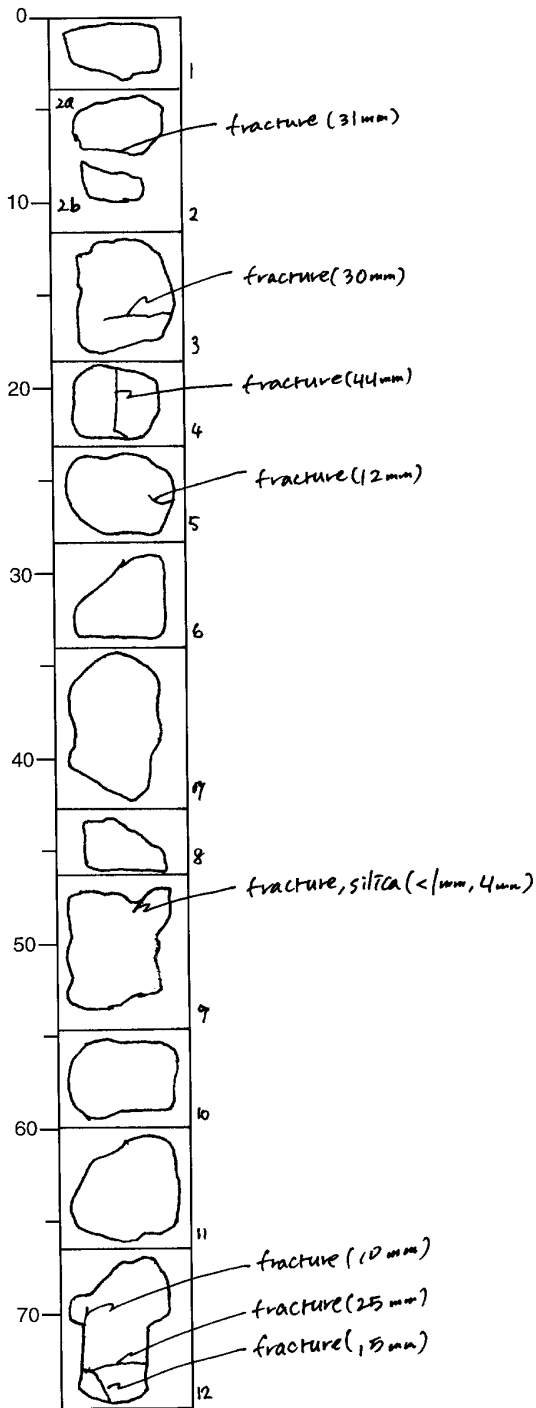
STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section	Observer
187	1164B	9R		



STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section	Observer
187	1164B	9R	2	



STRUCTURAL GEOLOGY DESCRIPTION

Leg	Hole	Core	Section	Observer
187	1164B	10R	1	

