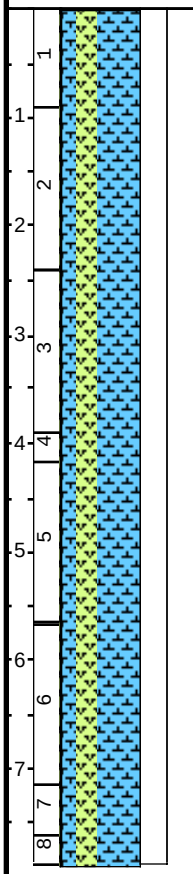
Core Photo

Site 1139 Hole A Core 1R **Cored 0-9.5 mbsf**

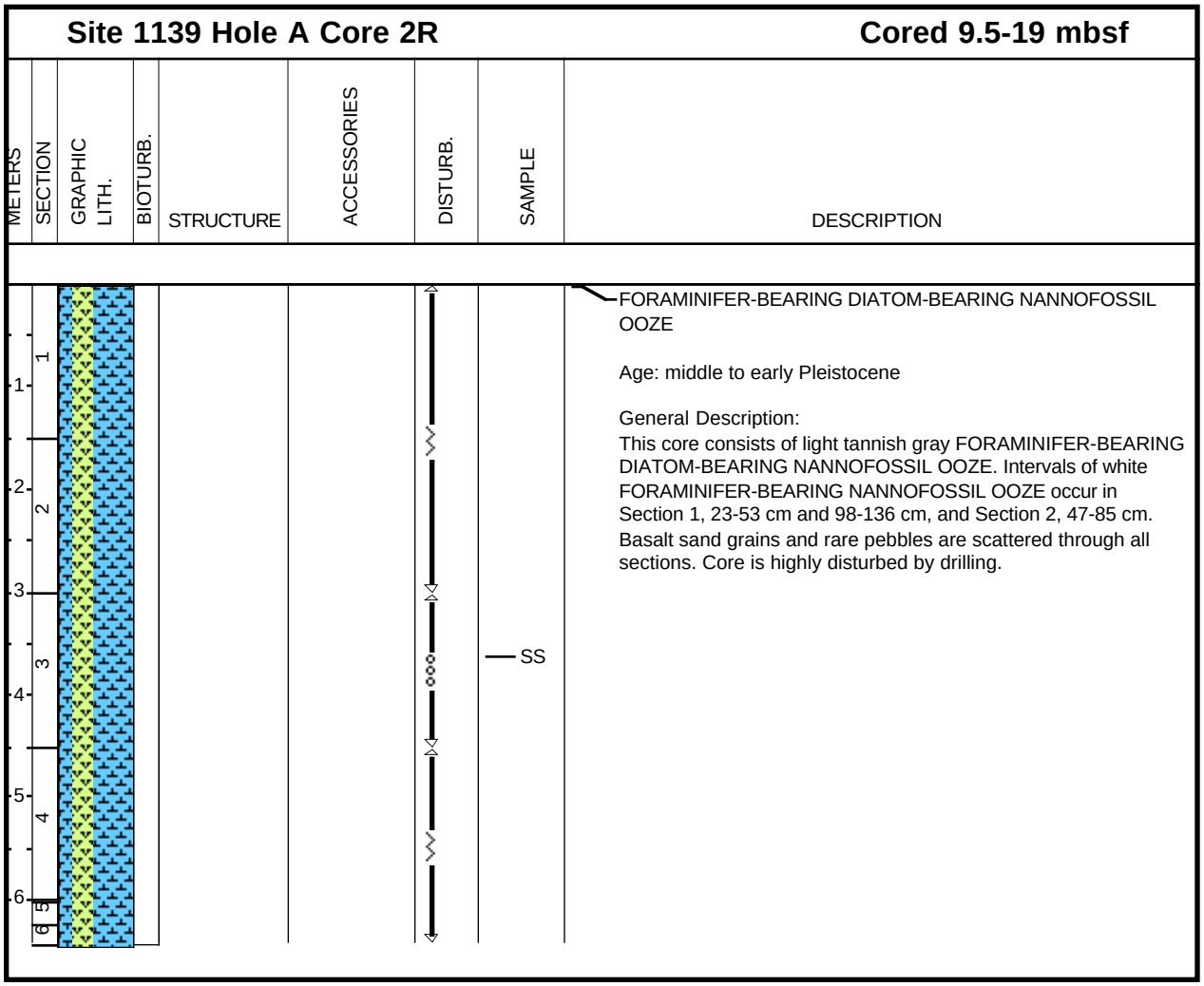


FORAMINIFER-BEARING DIATOM-BEARING NANNOFOSSIL OOZE

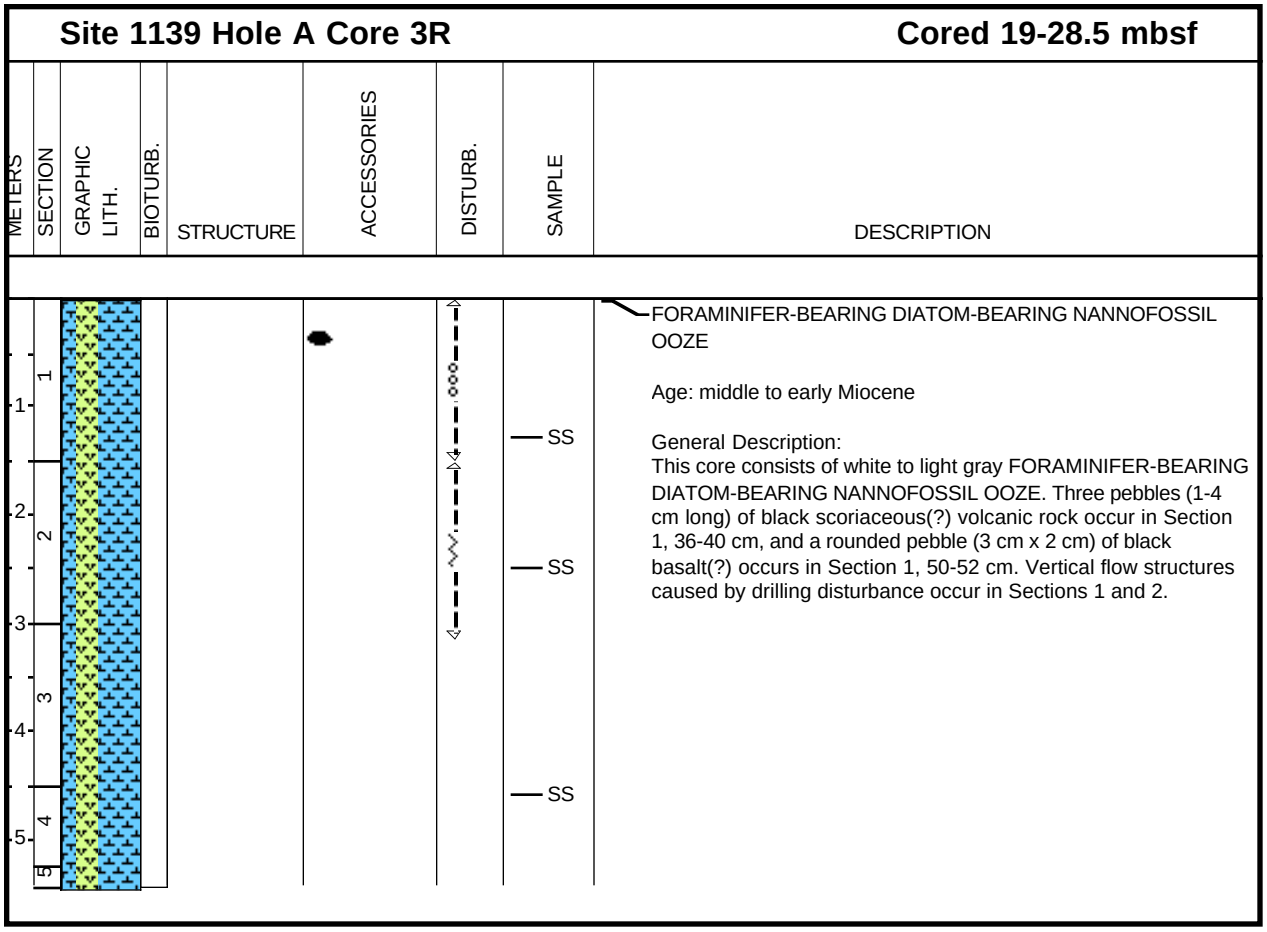
Age: middle to early Pleistocene

General Description:
This core consists of tan to light gray FORAMINIFER-BEARING DIATOM-BEARING NANNOFOSSIL OOZE. The ooze is white in Section 3, 48-95 cm and dark gray in Section 5, 110-120 cm. The grayish color in Section 5 comes from abundant radiolarians. Sand-sized grains and rare pebbles of basalt are disseminated in all sections. Core is highly disturbed by drilling and has soupy intervals.

Core Photo

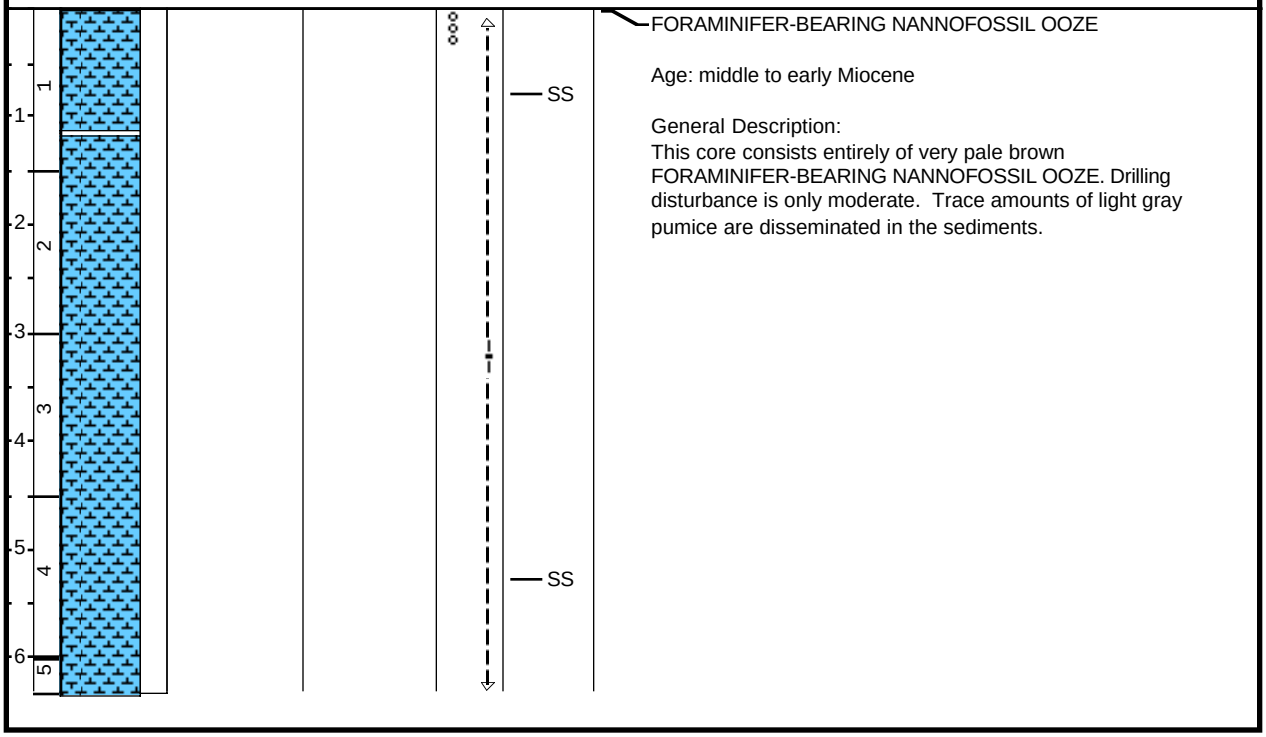

Site 1139 Hole A Core 2R
Cored 9.5-19 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
SS
FORAMINIFER-BEARING DIATOM-BEARING NANNOFOSSIL OOZE
Age: middle to early Pleistocene
General Description:
This core consists of light tannish gray FORAMINIFER-BEARING DIATOM-BEARING NANNOFOSSIL OOZE. Intervals of white FORAMINIFER-BEARING NANNOFOSSIL OOZE occur in Section 1, 23-53 cm and 98-136 cm, and Section 2, 47-85 cm. Basalt sand grains and rare pebbles are scattered through all sections. Core is highly disturbed by drilling.

Core Photo

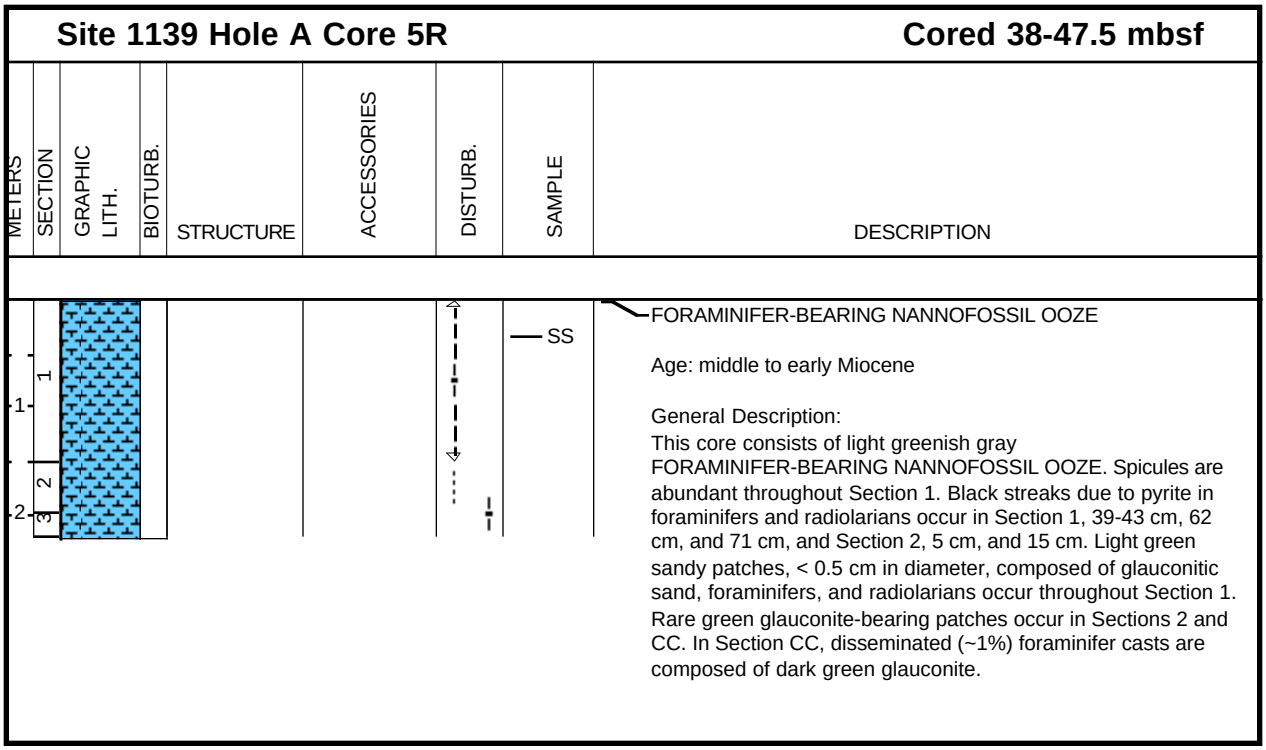

Site 1139 Hole A Core 3R
Cored 19-28.5 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
SS
SS
SS
FORAMINIFER-BEARING DIATOM-BEARING NANNOFOSSIL OOZE
Age: middle to early Miocene
General Description:
This core consists of white to light gray FORAMINIFER-BEARING DIATOM-BEARING NANNOFOSSIL OOZE. Three pebbles (1-4 cm long) of black scoriaceous(?) volcanic rock occur in Section 1, 36-40 cm, and a rounded pebble (3 cm x 2 cm) of black basalt(?) occurs in Section 1, 50-52 cm. Vertical flow structures caused by drilling disturbance occur in Sections 1 and 2.

Core Photo

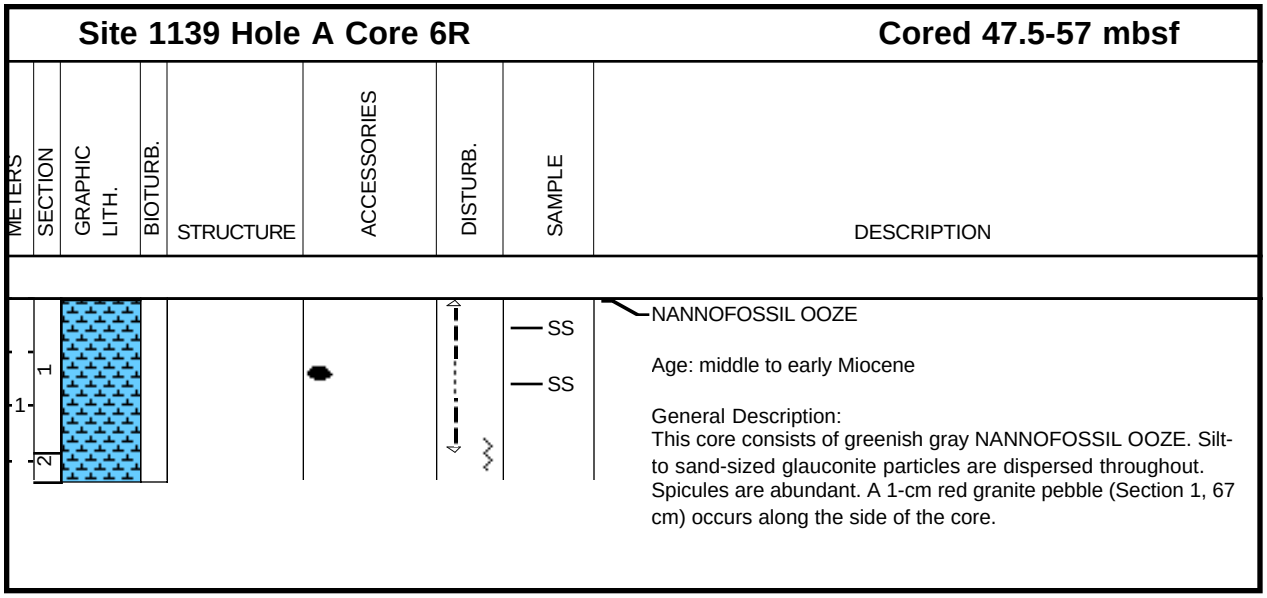
Site 1139 Hole A Core 4R **Cored 28.5-38 mbsf**



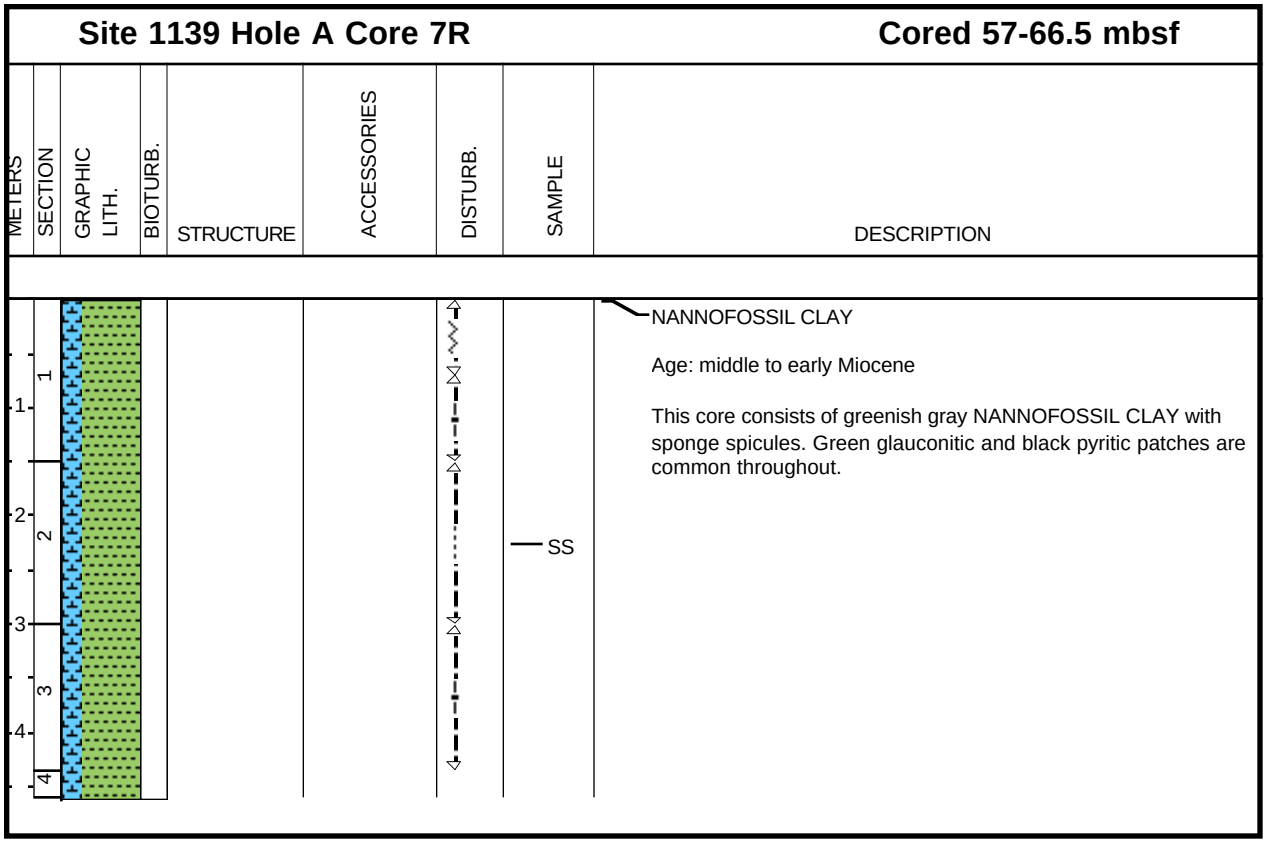
Core Photo


Site 1139 Hole A Core 5R
Cored 38-47.5 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
1
2
3
SS
FORAMINIFER-BEARING NANNOFOSSIL OOZE
Age: middle to early Miocene
General Description:
This core consists of light greenish gray FORAMINIFER-BEARING NANNOFOSSIL OOZE. Spicules are abundant throughout Section 1. Black streaks due to pyrite in foraminifers and radiolarians occur in Section 1, 39-43 cm, 62 cm, and 71 cm, and Section 2, 5 cm, and 15 cm. Light green sandy patches, < 0.5 cm in diameter, composed of glauconitic sand, foraminifers, and radiolarians occur throughout Section 1. Rare green glauconite-bearing patches occur in Sections 2 and CC. In Section CC, disseminated (~1%) foraminifer casts are composed of dark green glauconite.

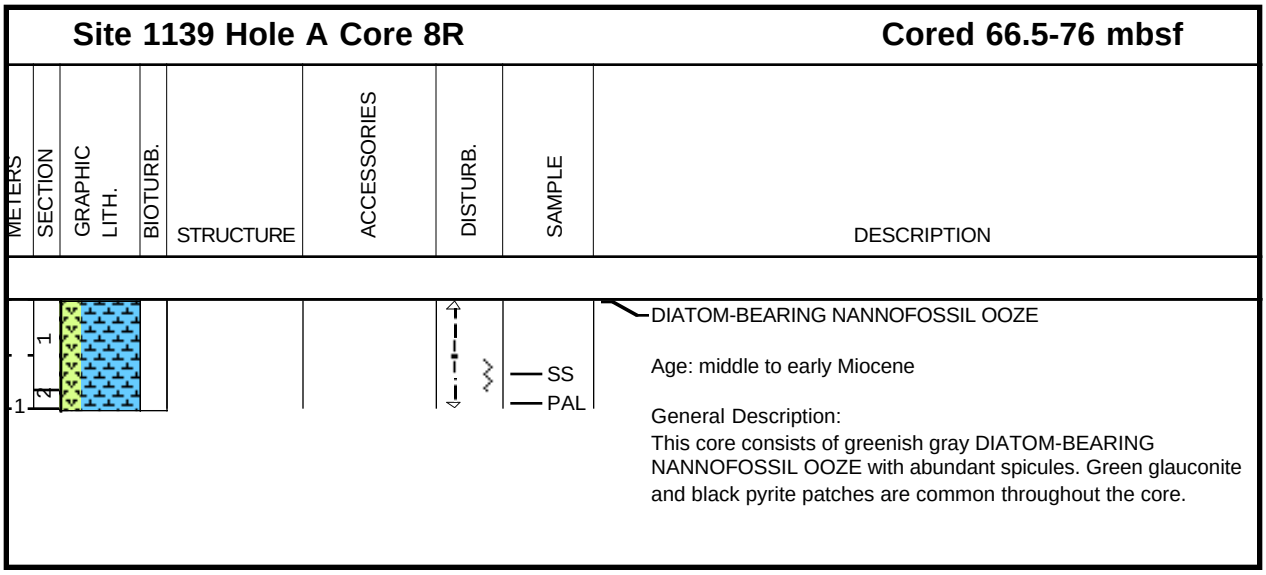
Core Photo


Site 1139 Hole A Core 6R
Cored 47.5-57 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
1
2
SS
SS
NANNOFOSSIL OOZE
Age: middle to early Miocene
General Description:
This core consists of greenish gray NANNOFOSSIL OOZE. Silt- to sand-sized glauconite particles are dispersed throughout. Spicules are abundant. A 1-cm red granite pebble (Section 1, 67 cm) occurs along the side of the core.

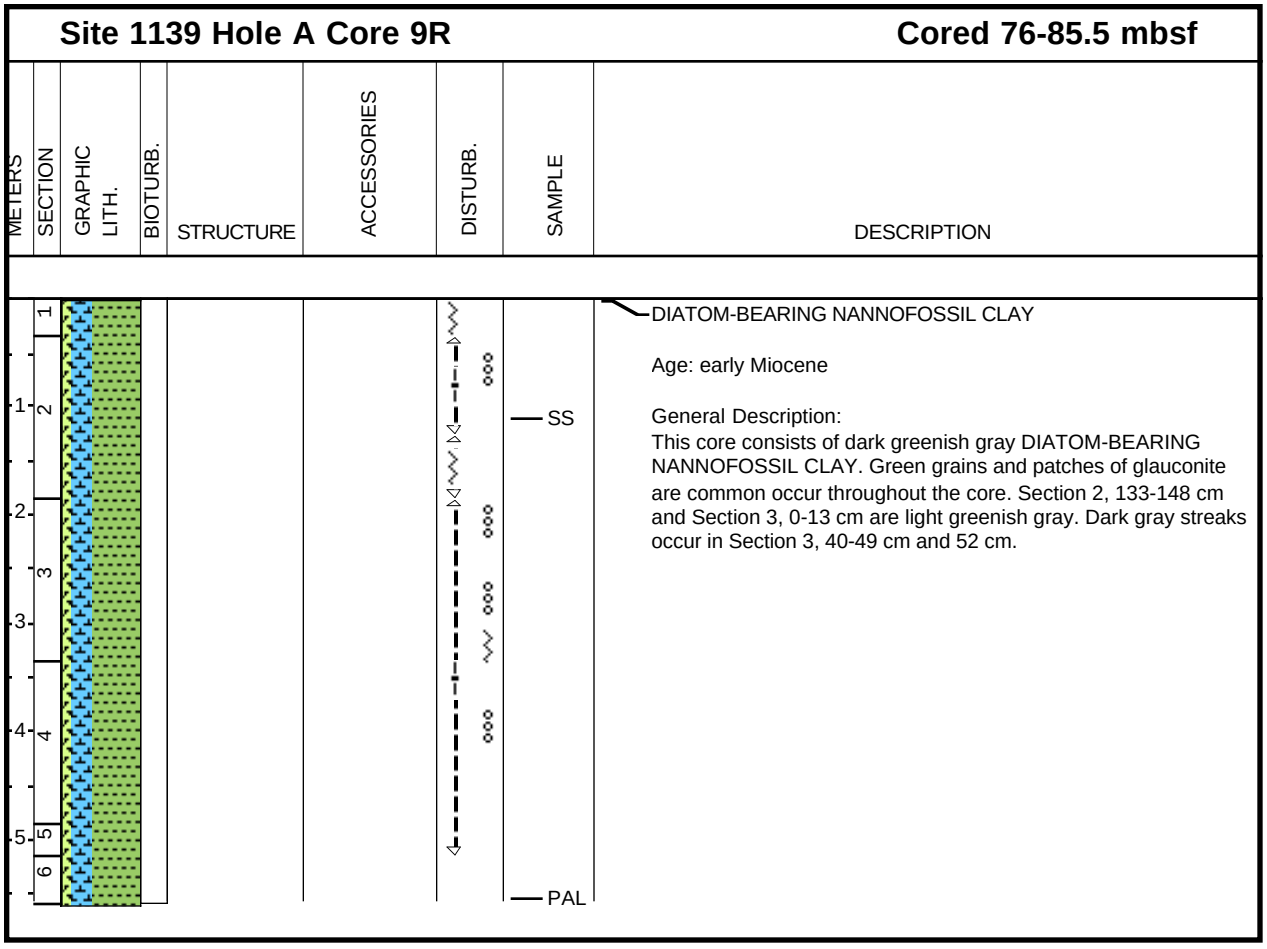
Core Photo


Site 1139 Hole A Core 7R
Cored 57-66.5 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
3
4
SS
NANNOFOSSIL CLAY
Age: middle to early Miocene
This core consists of greenish gray NANNOFOSSIL CLAY with sponge spicules. Green glauconitic and black pyritic patches are common throughout.

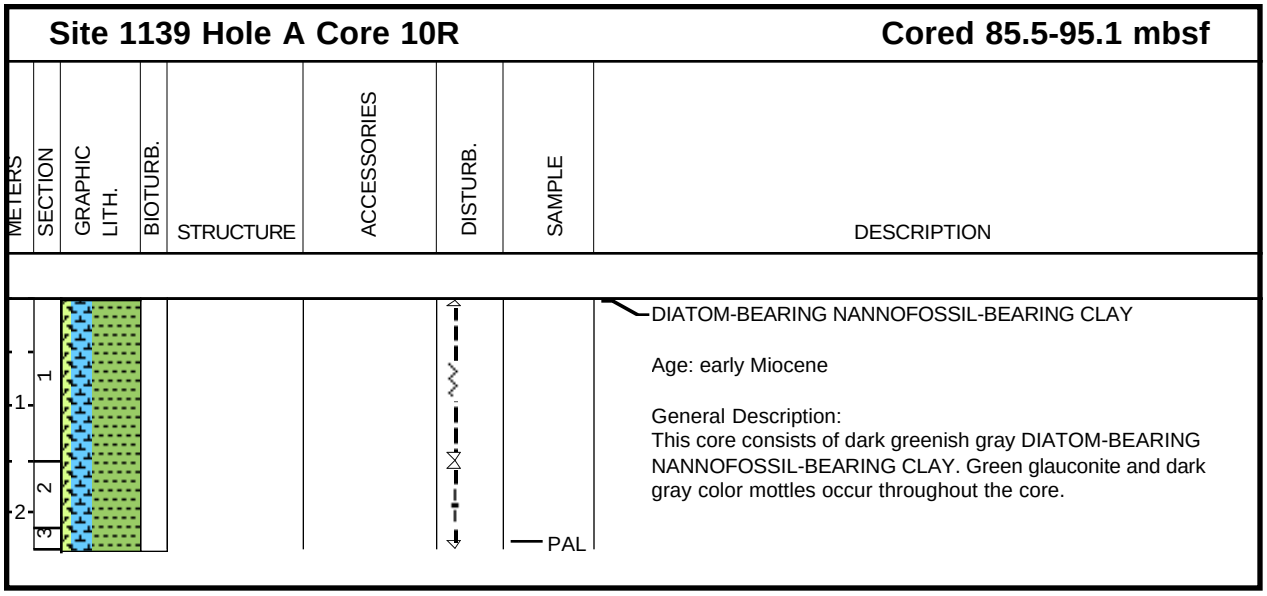
Core Photo


Site 1139 Hole A Core 8R
Cored 66.5-76 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
1
SS
PAL
DIATOM-BEARING NANNOFOSSIL OOZE
Age: middle to early Miocene
General Description:
This core consists of greenish gray DIATOM-BEARING NANNOFOSSIL OOZE with abundant spicules. Green glauconite and black pyrite patches are common throughout the core.

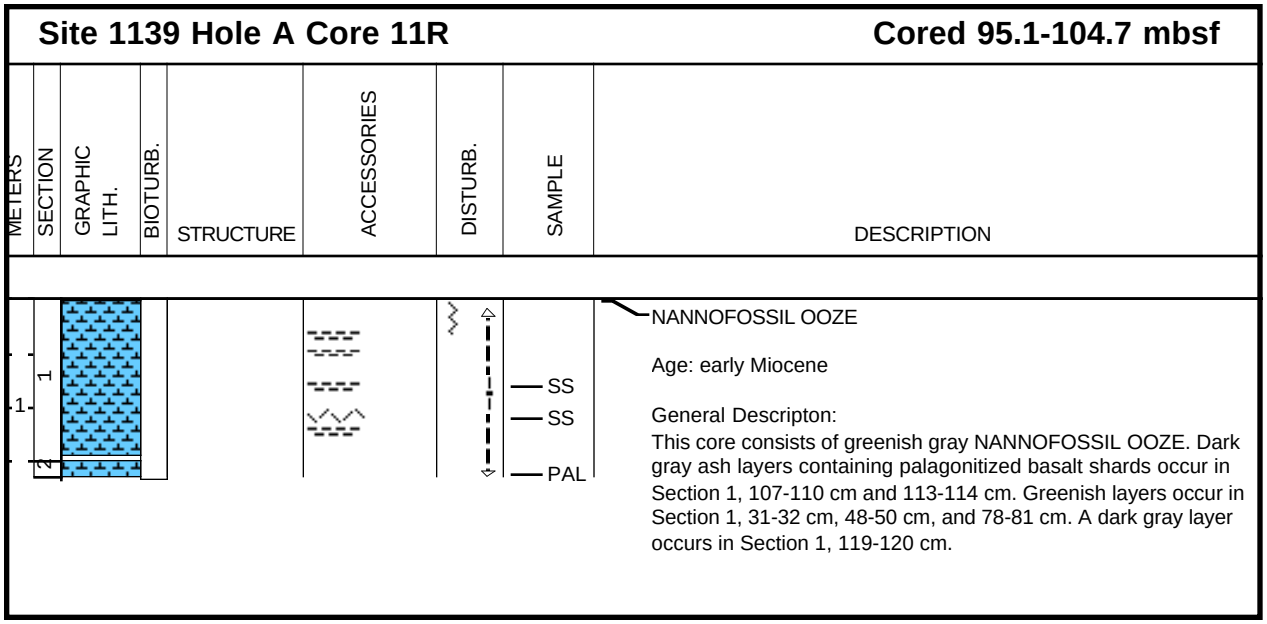
Core Photo


Site 1139 Hole A Core 9R
Cored 76-85.5 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
3
4
5
6
SS
PAL
DIATOM-BEARING NANNOFOSSIL CLAY
Age: early Miocene
General Description:
This core consists of dark greenish gray DIATOM-BEARING NANNOFOSSIL CLAY. Green grains and patches of glauconite are common occur throughout the core. Section 2, 133-148 cm and Section 3, 0-13 cm are light greenish gray. Dark gray streaks occur in Section 3, 40-49 cm and 52 cm.

Core Photo

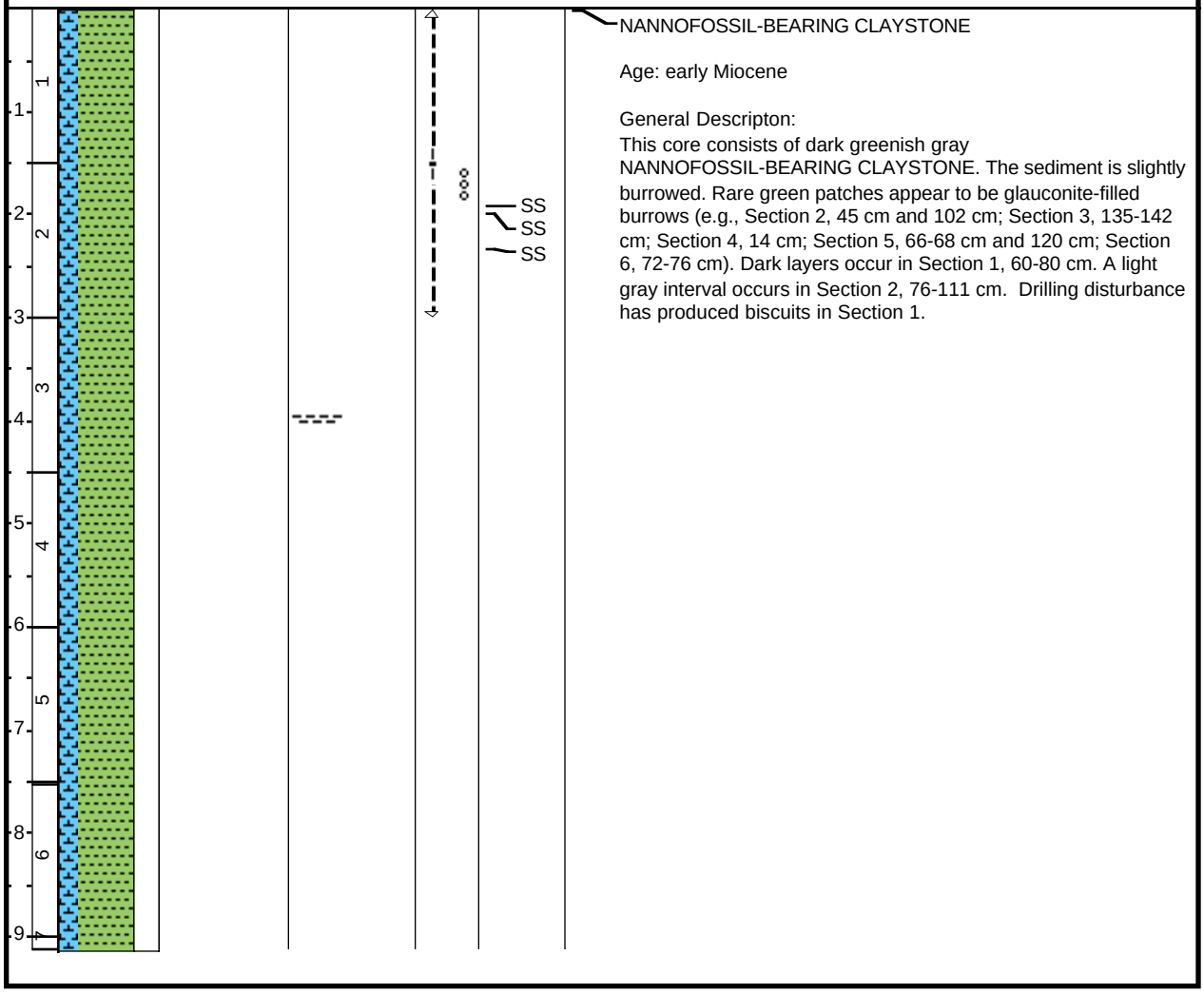

Site 1139 Hole A Core 10R
Cored 85.5-95.1 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
1
2
3
PAL
DIATOM-BEARING NANNOFOSSIL-BEARING CLAY
Age: early Miocene
General Description:
This core consists of dark greenish gray DIATOM-BEARING NANNOFOSSIL-BEARING CLAY. Green glauconite and dark gray color mottles occur throughout the core.

Core Photo

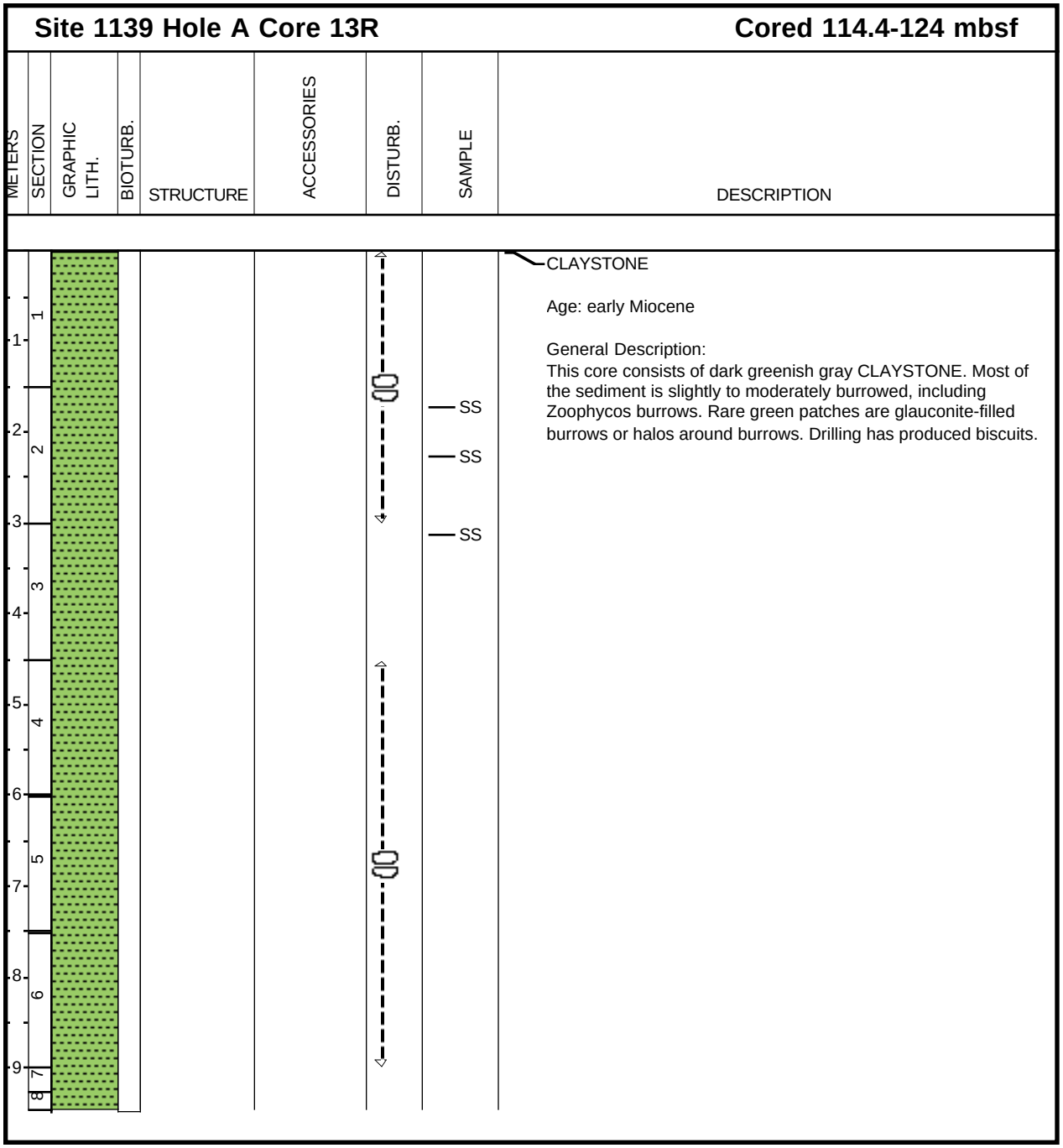

Site 1139 Hole A Core 11R
Cored 95.1-104.7 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
1
2
SS
SS
PAL
NANNOFOSSIL OOZE
Age: early Miocene
General Descripton:
This core consists of greenish gray NANNOFOSSIL OOZE. Dark gray ash layers containing palagonitized basalt shards occur in Section 1, 107-110 cm and 113-114 cm. Greenish layers occur in Section 1, 31-32 cm, 48-50 cm, and 78-81 cm. A dark gray layer occurs in Section 1, 119-120 cm.

Core Photo

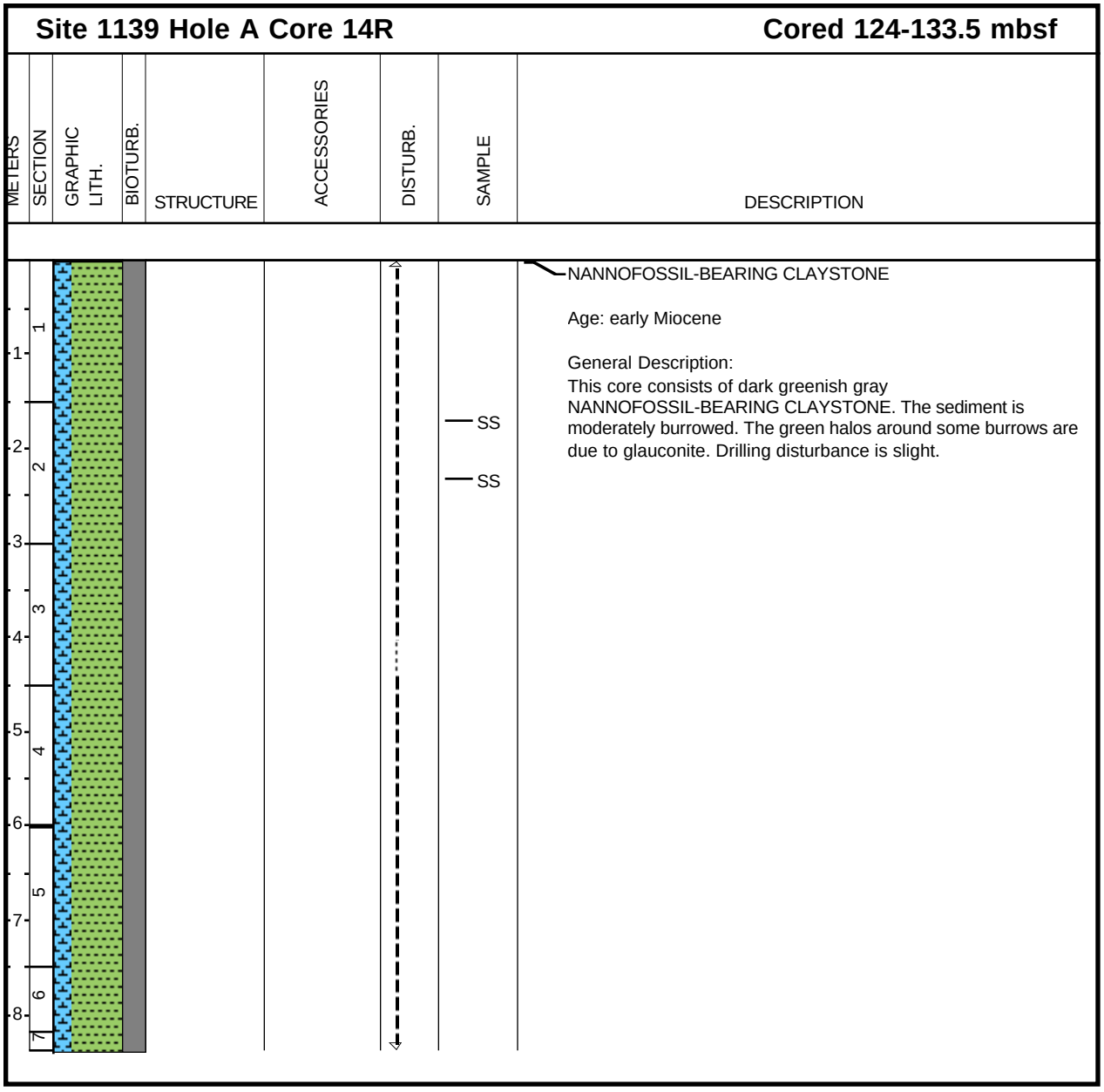
Site 1139 Hole A Core 12R **Cored 104.7-114.4 mbsf**



Core Photo

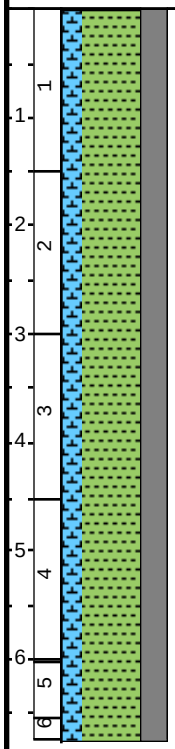

Site 1139 Hole A Core 13R
Cored 114.4-124 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
SS
SS
SS
CLAYSTONE
Age: early Miocene
General Description:
This core consists of dark greenish gray CLAYSTONE. Most of the sediment is slightly to moderately burrowed, including Zoophycos burrows. Rare green patches are glauconite-filled burrows or halos around burrows. Drilling has produced biscuits.

Core Photo


Site 1139 Hole A Core 14R
Cored 124-133.5 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
SS
SS
NANNOFOSSIL-BEARING CLAYSTONE
Age: early Miocene
General Description:
This core consists of dark greenish gray NANNOFOSSIL-BEARING CLAYSTONE. The sediment is moderately burrowed. The green halos around some burrows are due to glauconite. Drilling disturbance is slight.

Core Photo

Site 1139 Hole A Core 15R **Cored 133.5-143.2 mbsf**



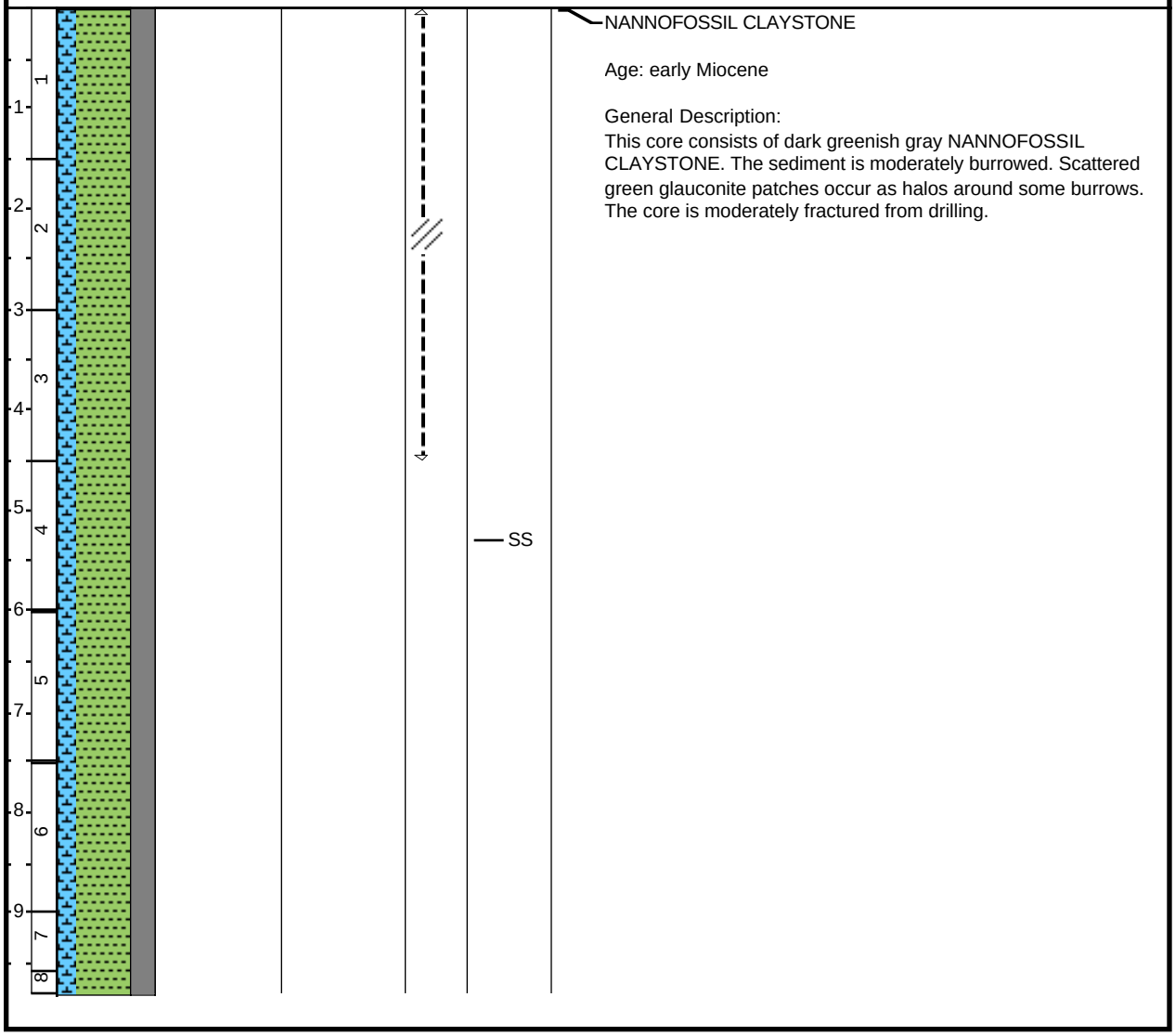
NANNOFOSSIL-BEARING CLAYSTONE

Age: early Miocene

General Description:
This core consists of dark greenish gray NANNOFOSSIL-BEARING CLAYSTONE. The sediment is moderately burrowed. The green halos around some burrows are from glauconite. Section 3 is slightly lighter gray than the other sections. A 1.5 cm piece of black rock (scoria?) occurs in Section 3, 15 cm. Drilling has produced slight fracturing and some biscuits.

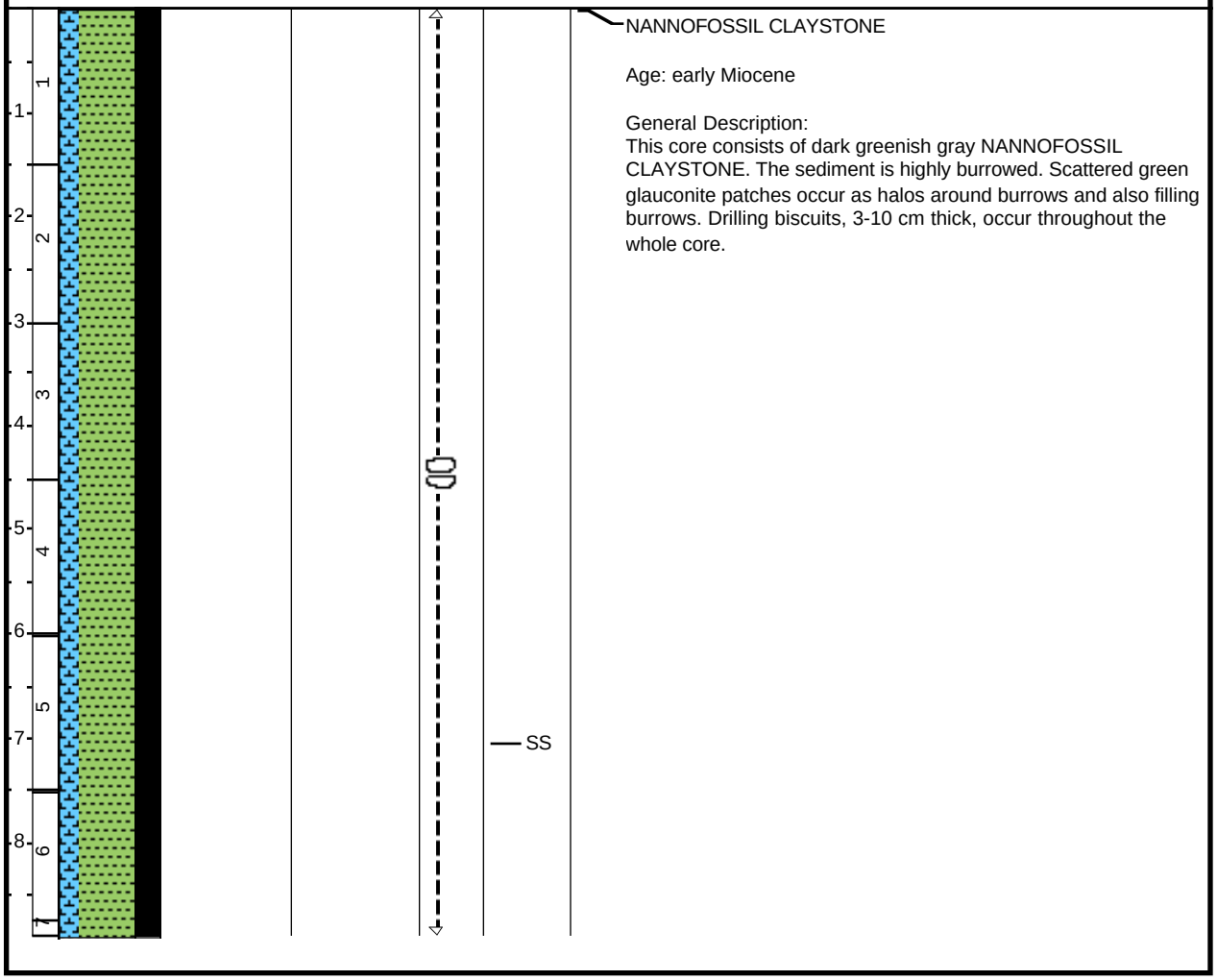
Core Photo

Site 1139 Hole A Core 16R **Cored 143.2-152.8 mbsf**



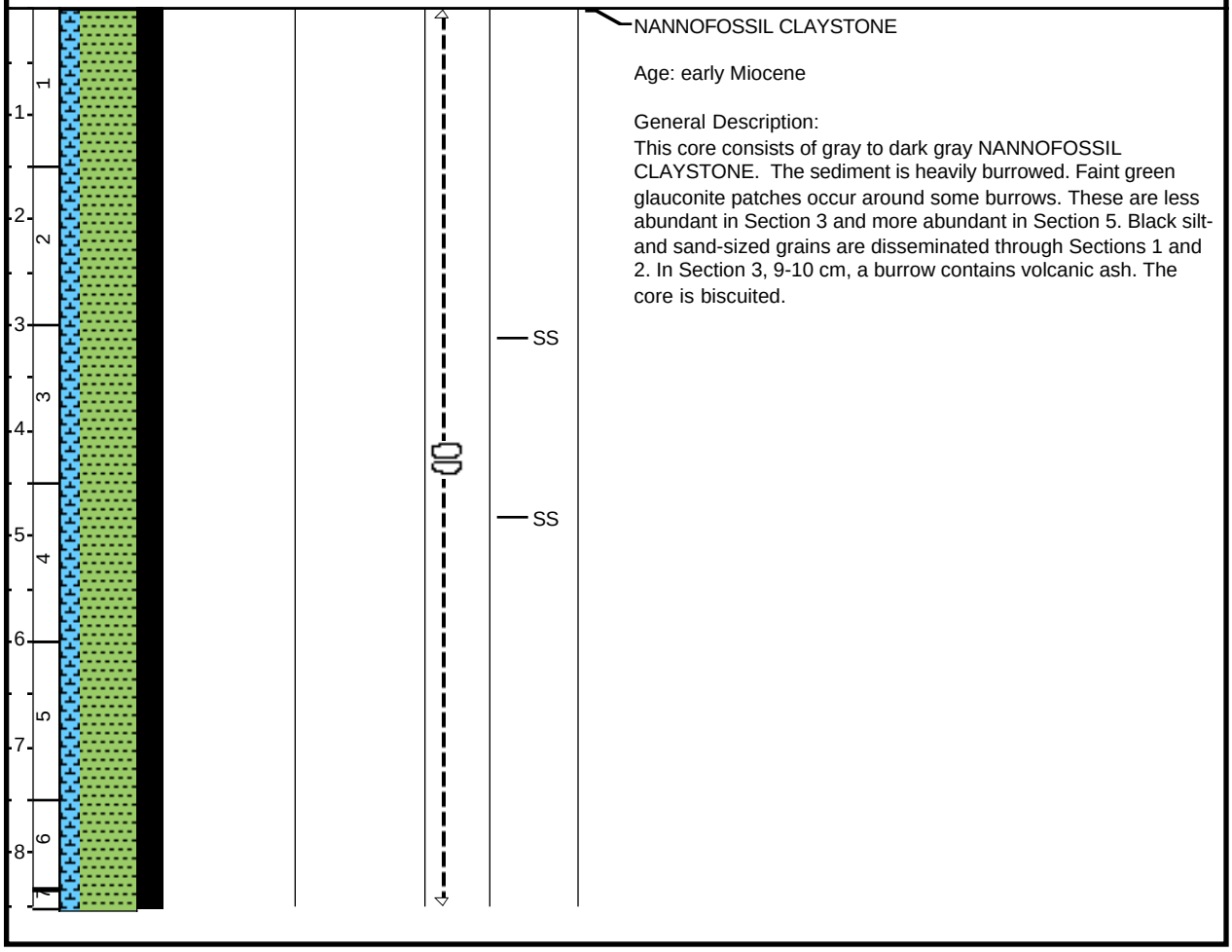
Core Photo

Site 1139 Hole A Core 17R **Cored 152.8-162.5 mbsf**



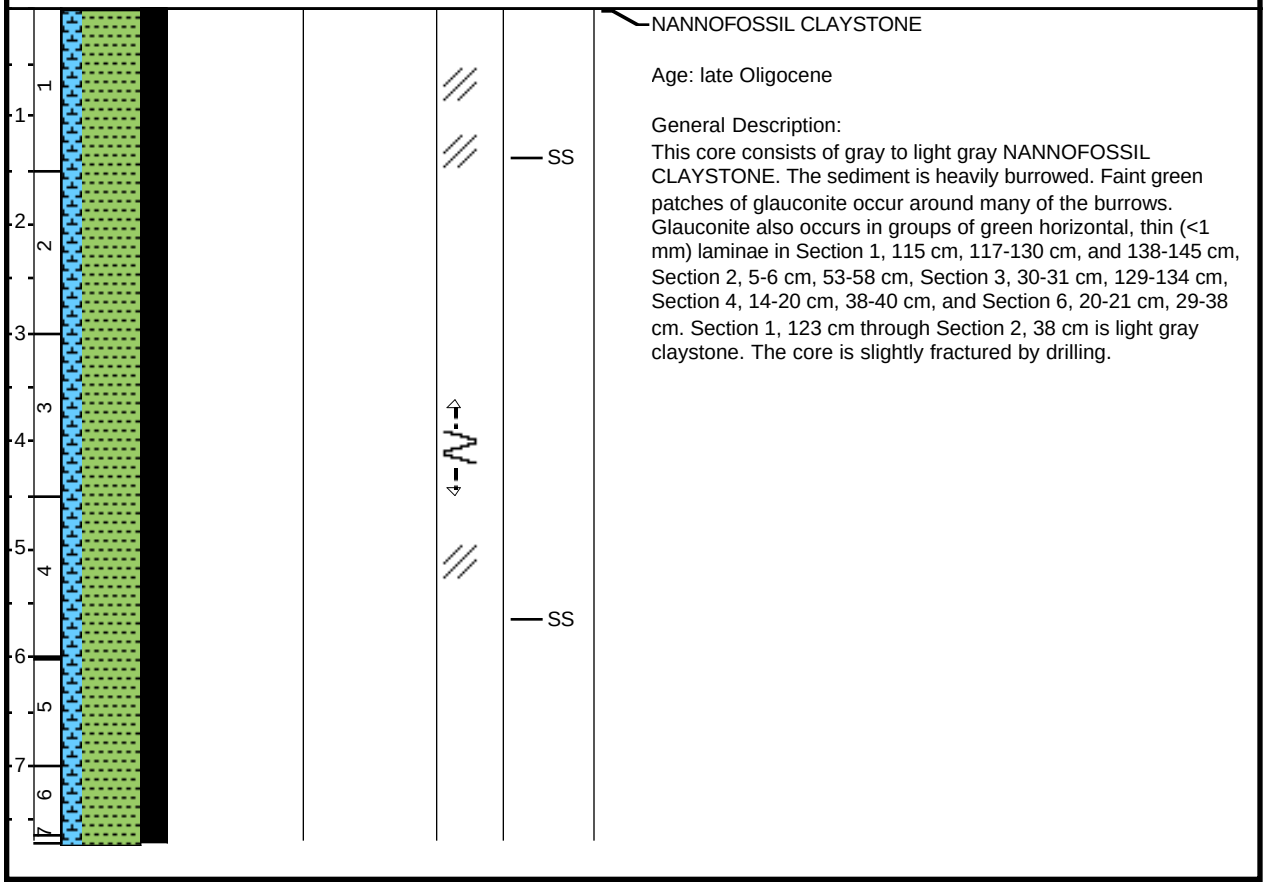
Core Photo

Site 1139 Hole A Core 18R **Cored 162.5-172.1 mbsf**



Core Photo

Site 1139 Hole A Core 19R **Cored 172.1-181.7 mbsf**

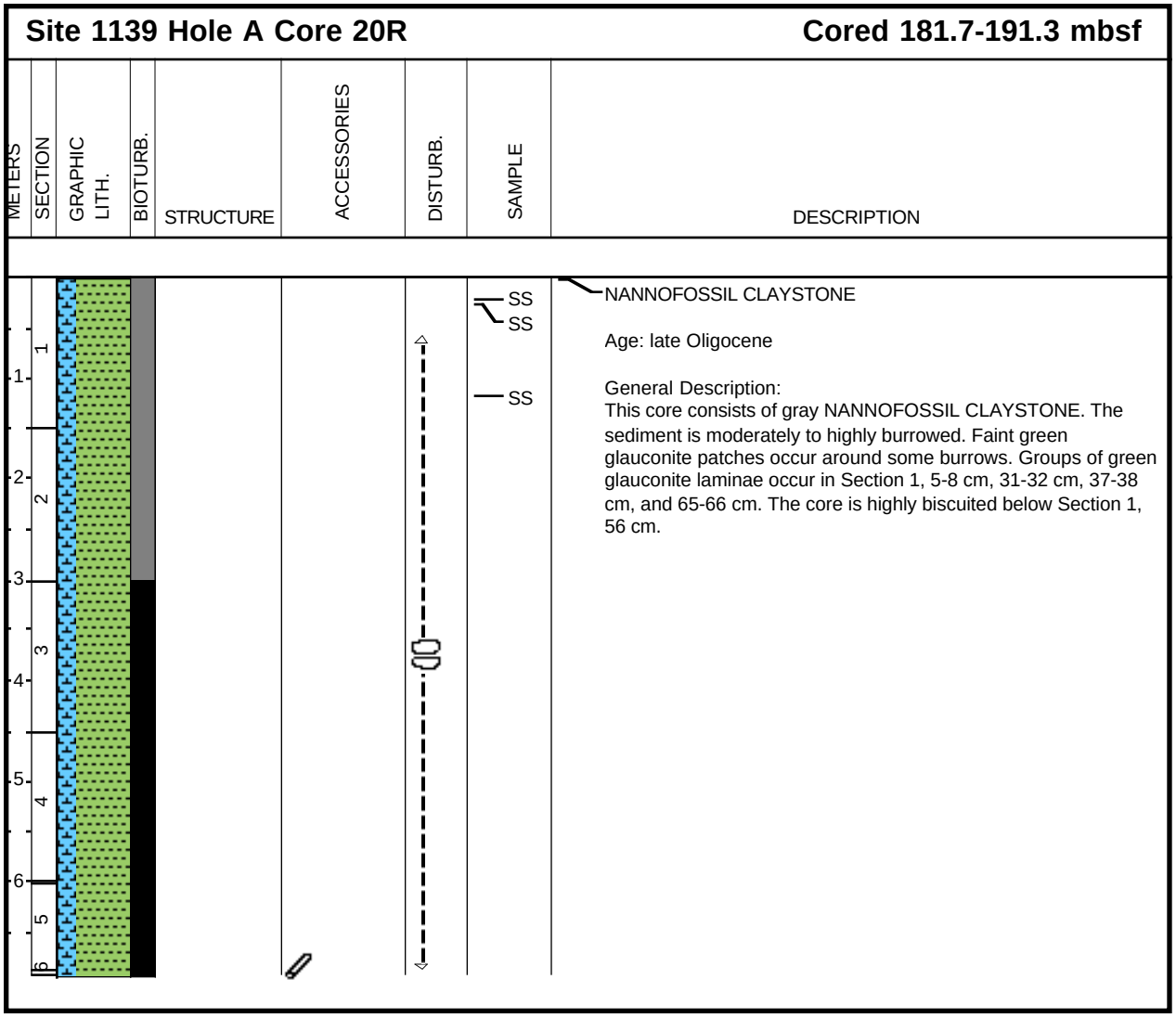


NANNOFOSSIL CLAYSTONE

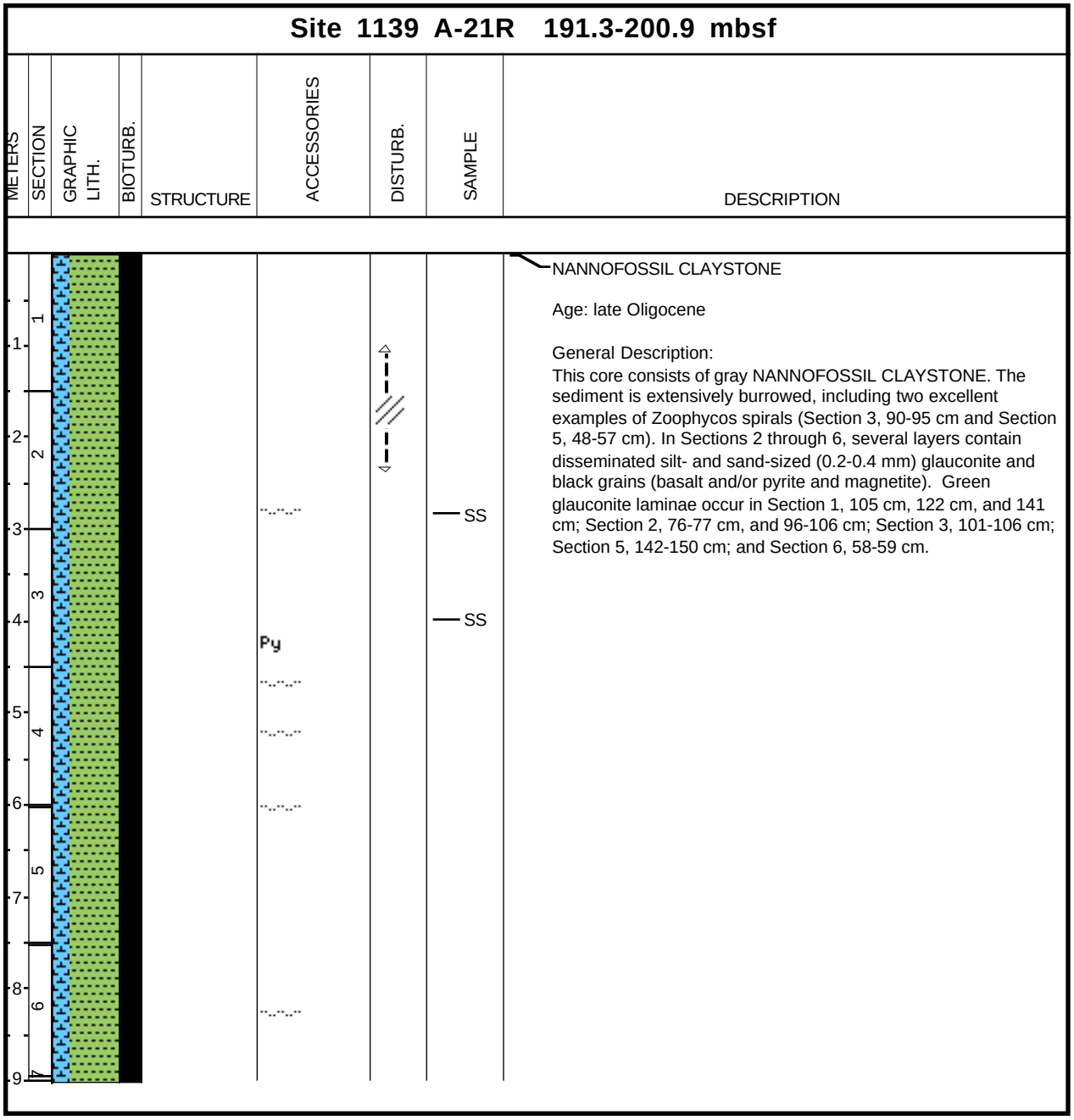
Age: late Oligocene

General Description:
This core consists of gray to light gray NANNOFOSSIL CLAYSTONE. The sediment is heavily burrowed. Faint green patches of glauconite occur around many of the burrows. Glauconite also occurs in groups of green horizontal, thin (<1 mm) laminae in Section 1, 115 cm, 117-130 cm, and 138-145 cm, Section 2, 5-6 cm, 53-58 cm, Section 3, 30-31 cm, 129-134 cm, Section 4, 14-20 cm, 38-40 cm, and Section 6, 20-21 cm, 29-38 cm. Section 1, 123 cm through Section 2, 38 cm is light gray claystone. The core is slightly fractured by drilling.

Core Photo

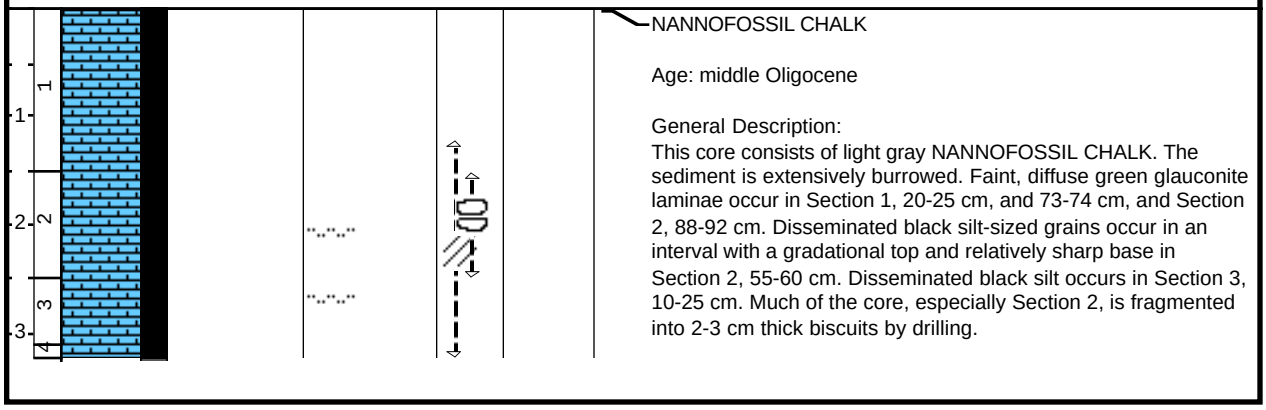

Site 1139 Hole A Core 20R
Cored 181.7-191.3 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
SS
SS
SS
NANNOFOSSIL CLAYSTONE
Age: late Oligocene
General Description:
This core consists of gray NANNOFOSSIL CLAYSTONE. The sediment is moderately to highly burrowed. Faint green glauconite patches occur around some burrows. Groups of green glauconite laminae occur in Section 1, 5-8 cm, 31-32 cm, 37-38 cm, and 65-66 cm. The core is highly biscuited below Section 1, 56 cm.

Core Photo


Site 1139 A-21R 191.3-200.9 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
SS
SS
Py
NANNOFOSSIL CLAYSTONE
Age: late Oligocene
General Description:
This core consists of gray NANNOFOSSIL CLAYSTONE. The sediment is extensively burrowed, including two excellent examples of Zoophycos spirals (Section 3, 90-95 cm and Section 5, 48-57 cm). In Sections 2 through 6, several layers contain disseminated silt- and sand-sized (0.2-0.4 mm) glauconite and black grains (basalt and/or pyrite and magnetite). Green glauconite laminae occur in Section 1, 105 cm, 122 cm, and 141 cm; Section 2, 76-77 cm, and 96-106 cm; Section 3, 101-106 cm; Section 5, 142-150 cm; and Section 6, 58-59 cm.

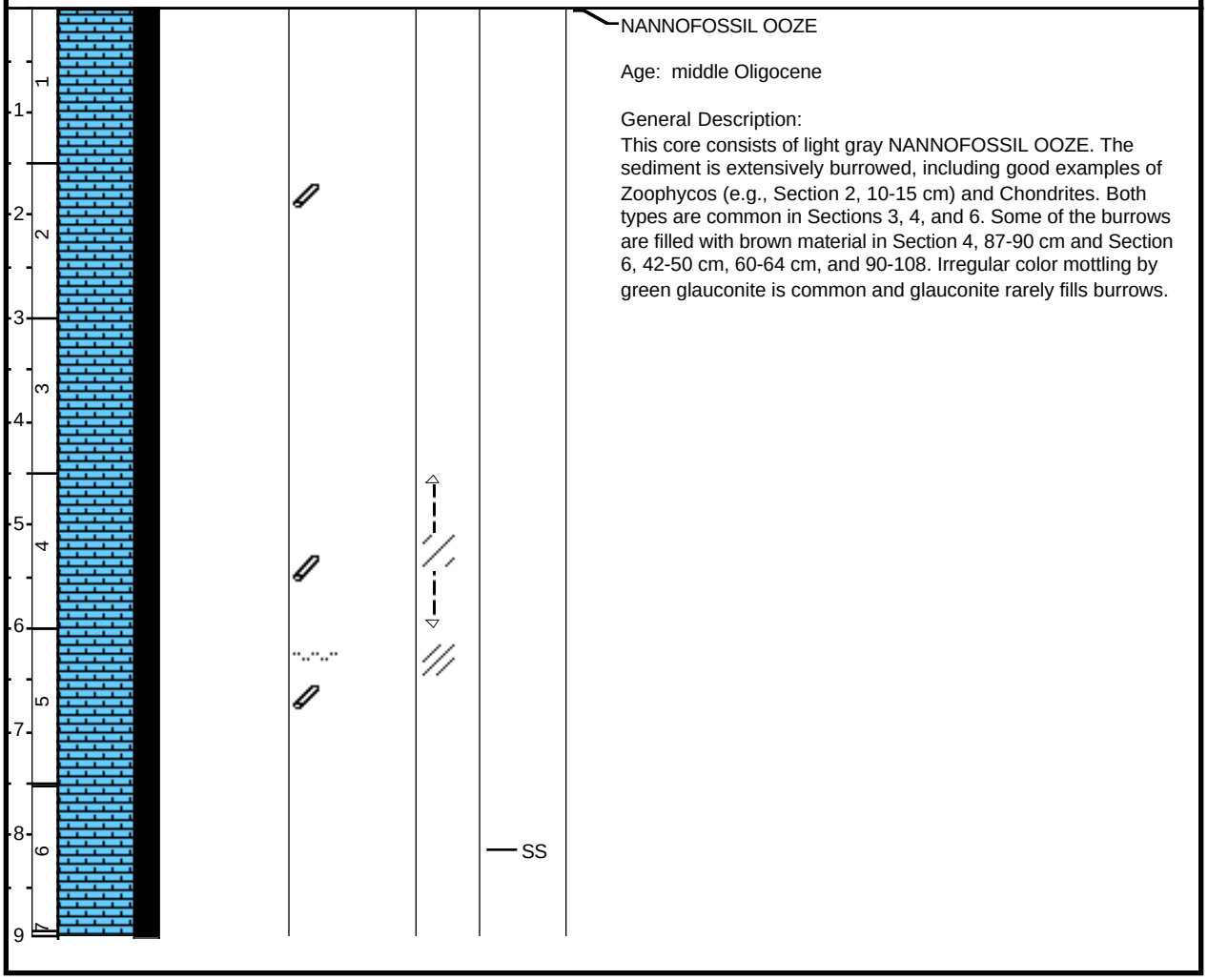
Core Photo

Site 1139 Hole A Core 22R **Cored 200.9-210.5 mbsf**



Core Photo

Site 1139 Hole A Core 23R **Cored 210.5-220.1 mbsf**

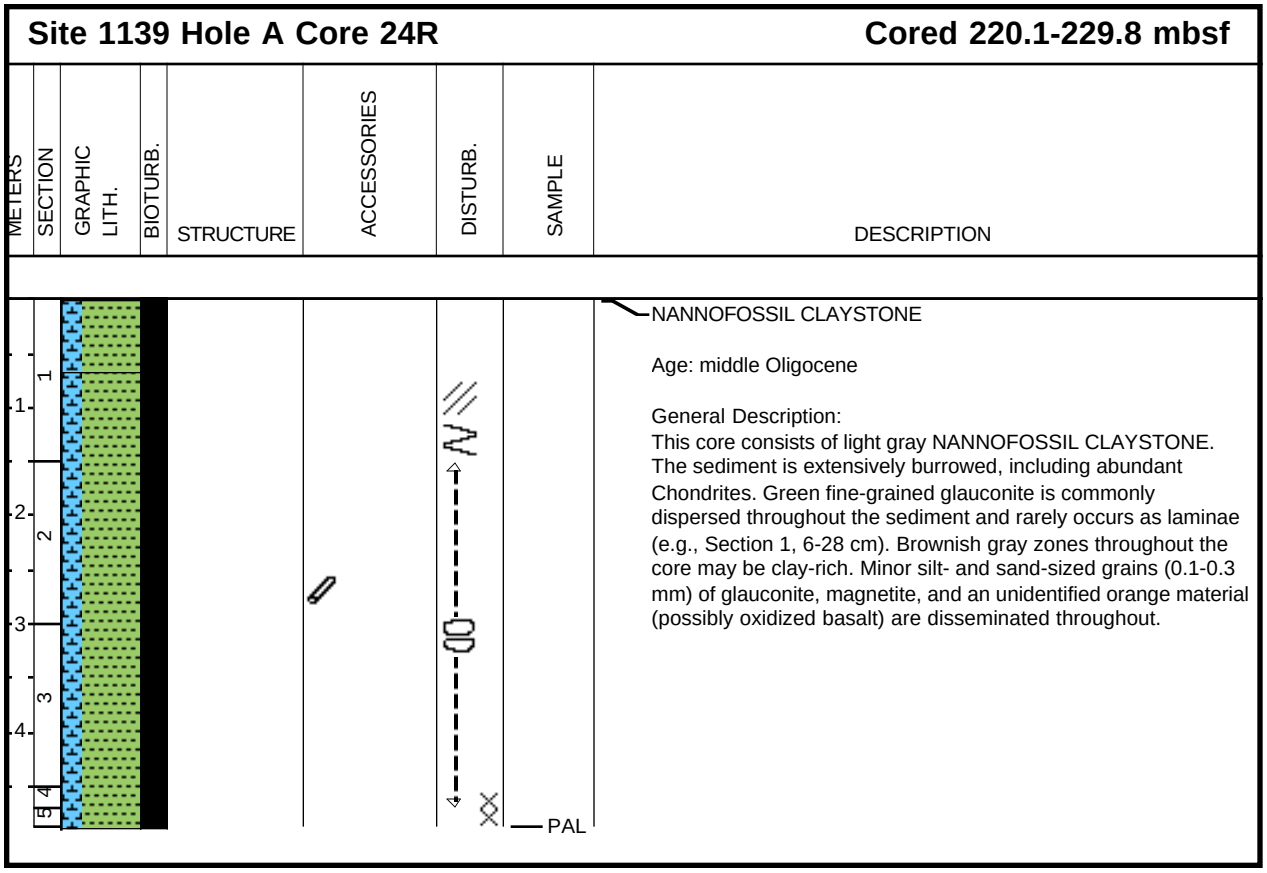


NANNOFOSSIL OOZE

Age: middle Oligocene

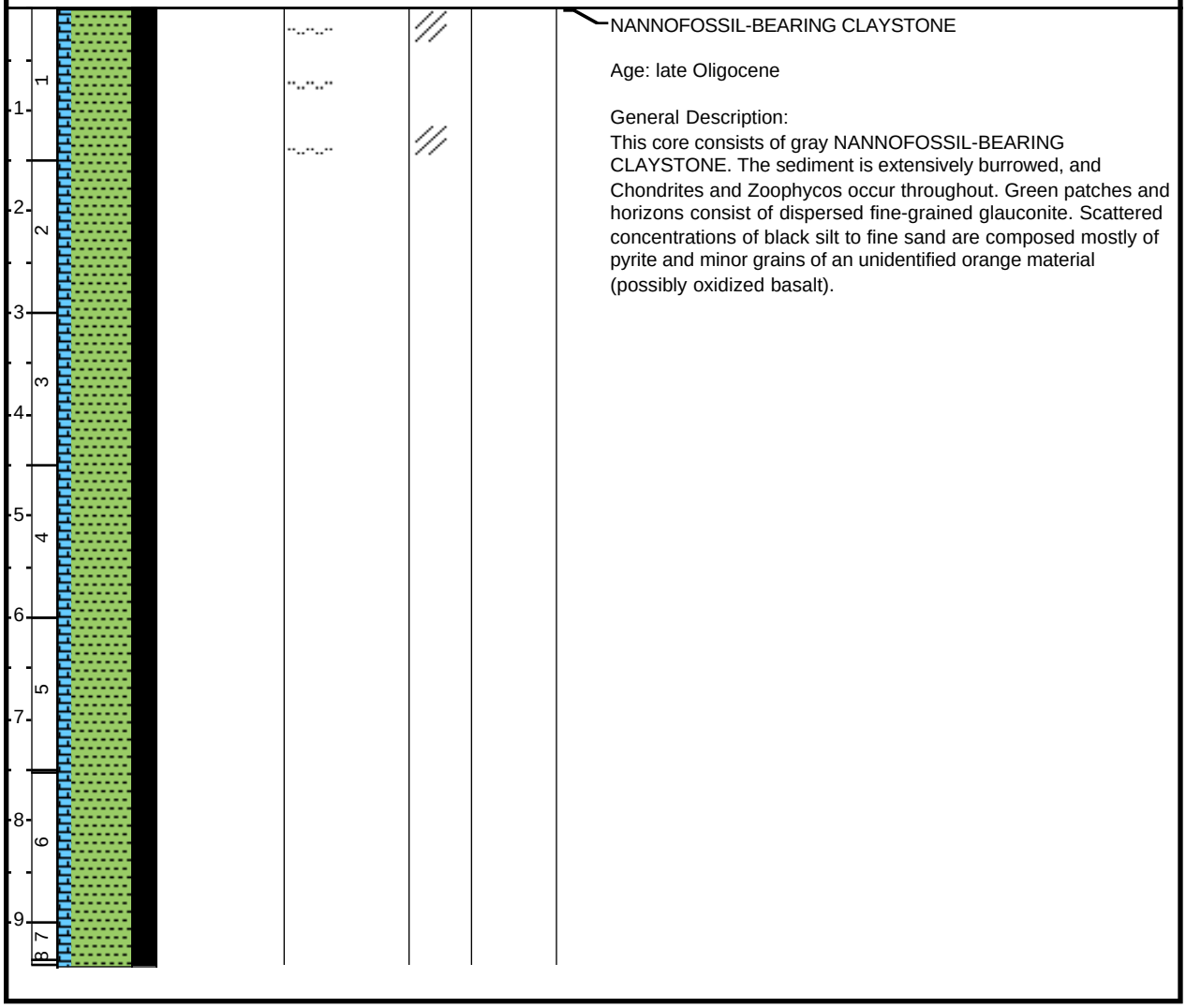
General Description:
This core consists of light gray NANNOFOSSIL OOZE. The sediment is extensively burrowed, including good examples of Zoophycos (e.g., Section 2, 10-15 cm) and Chondrites. Both types are common in Sections 3, 4, and 6. Some of the burrows are filled with brown material in Section 4, 87-90 cm and Section 6, 42-50 cm, 60-64 cm, and 90-108. Irregular color mottling by green glauconite is common and glauconite rarely fills burrows.

Core Photo

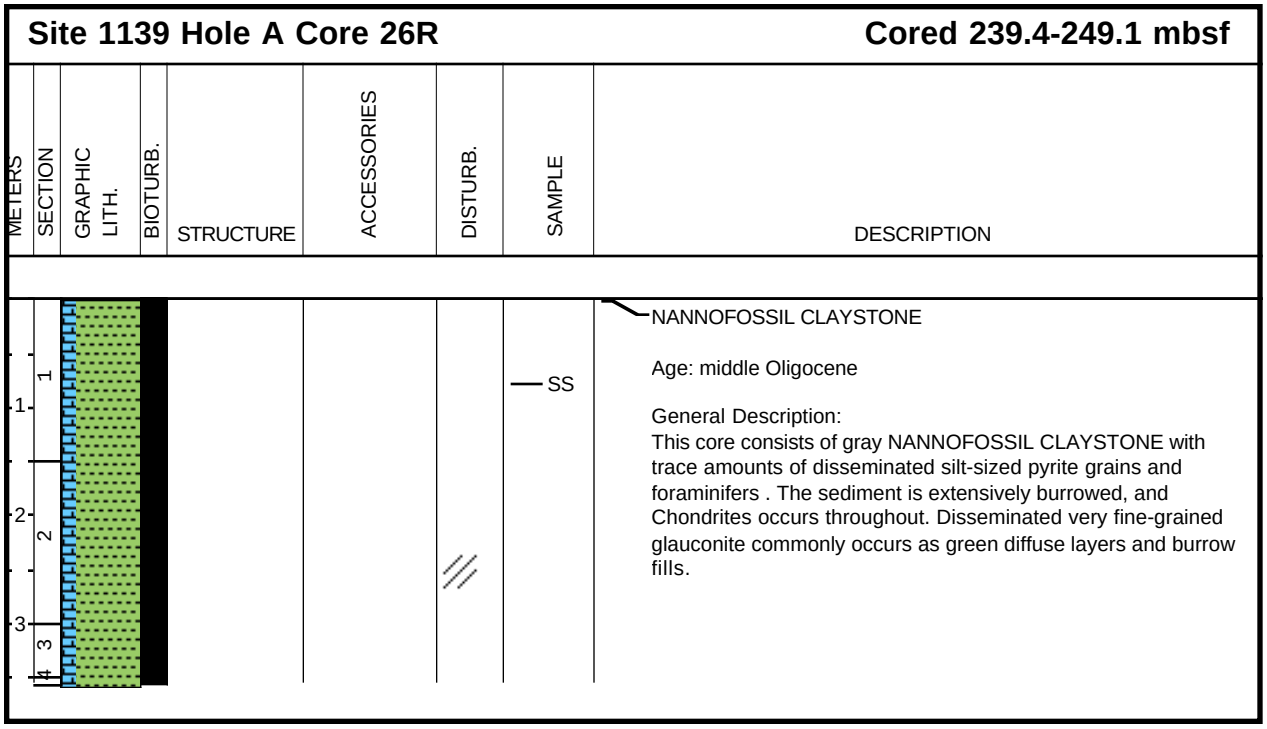

Site 1139 Hole A Core 24R
Cored 220.1-229.8 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
3
4
5
PAL
NANNOFOSSIL CLAYSTONE
Age: middle Oligocene
General Description:
This core consists of light gray NANNOFOSSIL CLAYSTONE. The sediment is extensively burrowed, including abundant Chondrites. Green fine-grained glauconite is commonly dispersed throughout the sediment and rarely occurs as laminae (e.g., Section 1, 6-28 cm). Brownish gray zones throughout the core may be clay-rich. Minor silt- and sand-sized grains (0.1-0.3 mm) of glauconite, magnetite, and an unidentified orange material (possibly oxidized basalt) are disseminated throughout.

Core Photo

Site 1139 Hole A Core 25R **Cored 229.8-239.4 mbsf**

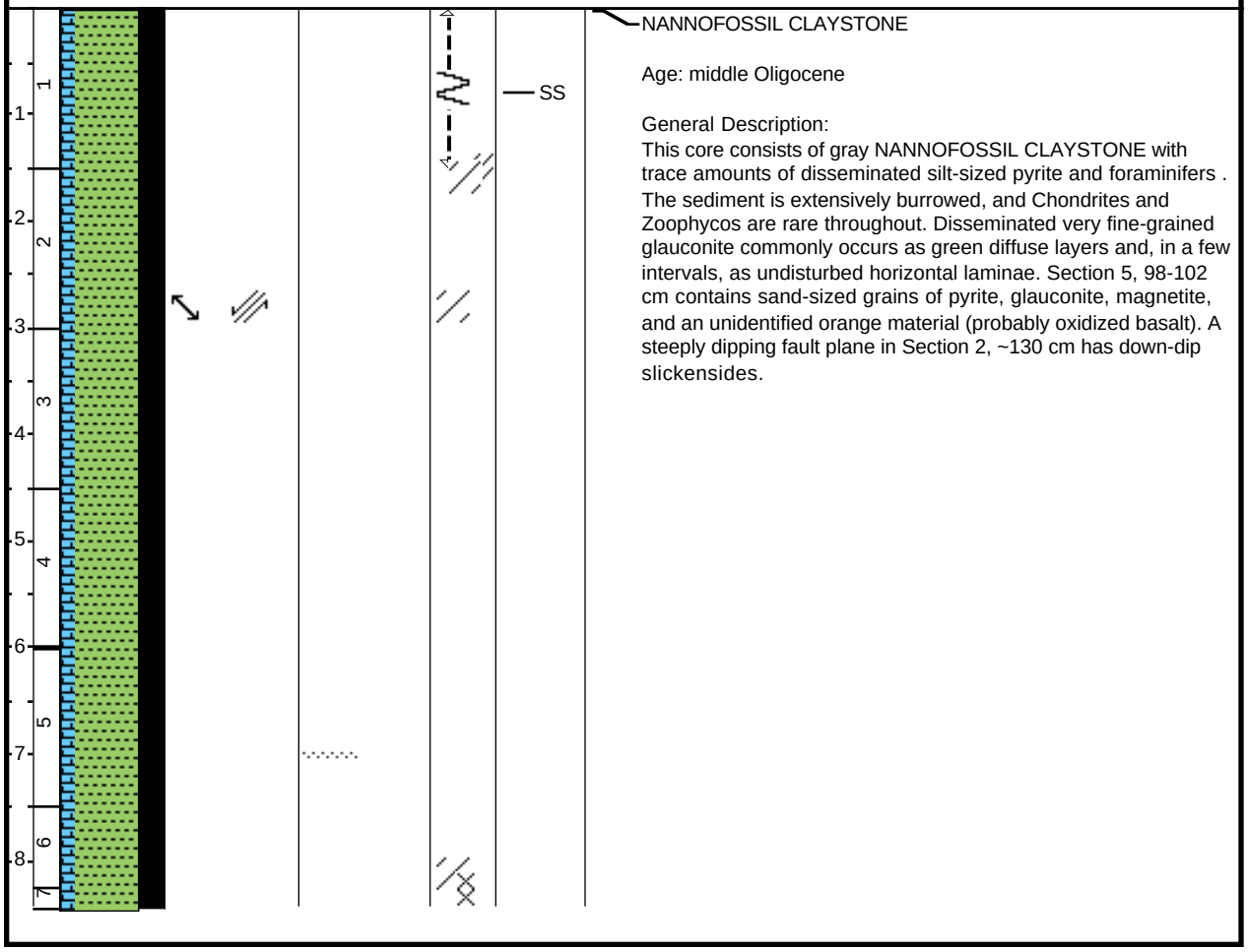


Core Photo


Site 1139 Hole A Core 26R
Cored 239.4-249.1 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
3
4
SS
NANNOFOSSIL CLAYSTONE
Age: middle Oligocene
General Description:
This core consists of gray NANNOFOSSIL CLAYSTONE with trace amounts of disseminated silt-sized pyrite grains and foraminifers . The sediment is extensively burrowed, and Chondrites occurs throughout. Disseminated very fine-grained glauconite commonly occurs as green diffuse layers and burrow fills.

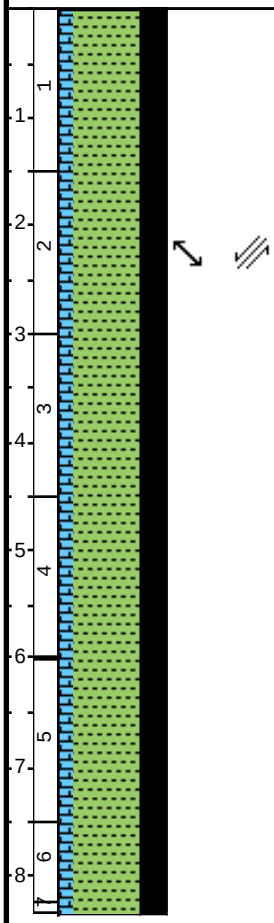
Core Photo

Site 1139 Hole A Core 27R **Cored 249.1-258.7 mbsf**



Core Photo

Site 1139 Hole A Core 28R **Cored 258.7-268.3 mbsf**



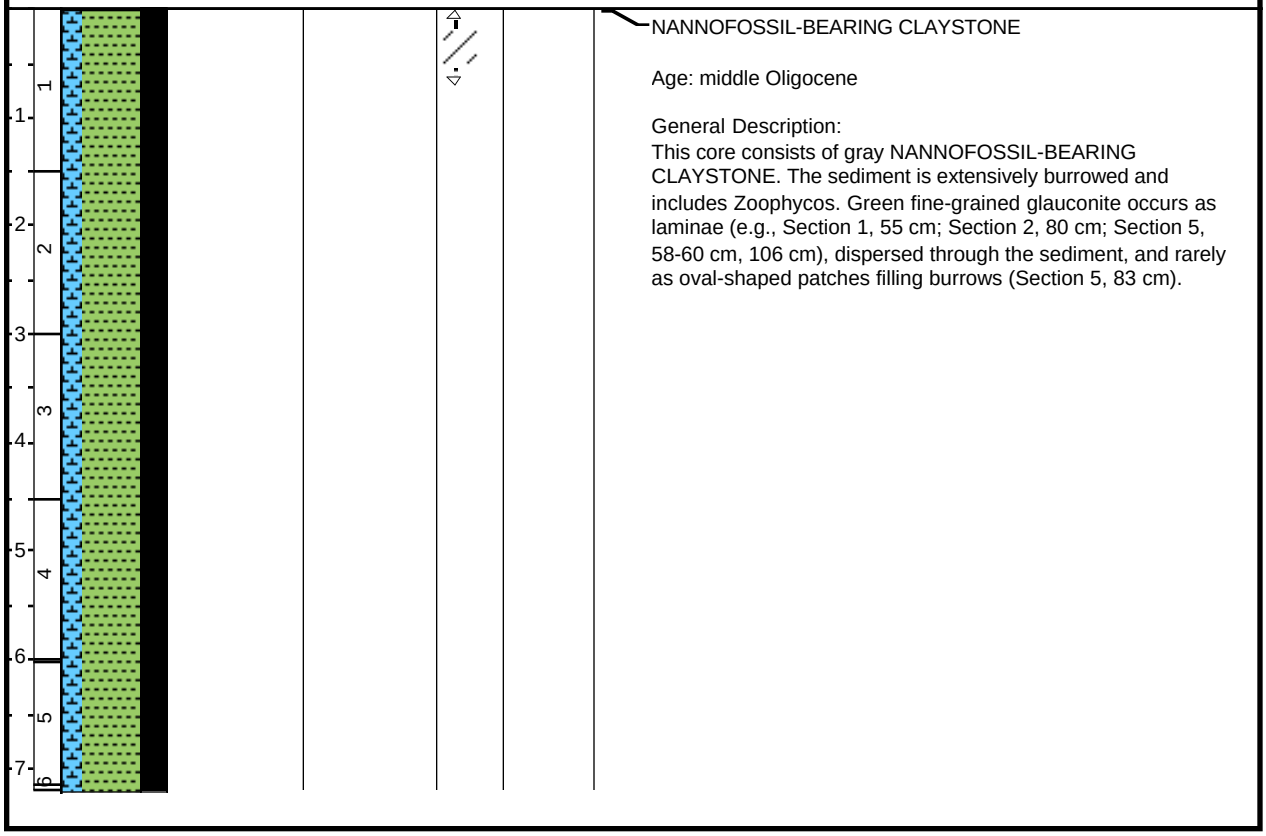
NANNOFOSSIL-BEARING CLAYSTONE

Age: middle Oligocene

General Description:
This core consists of gray NANNOFOSSIL-BEARING CLAYSTONE with trace amounts of disseminated silt-sized pyrite and foraminifers . The sediment is extensively burrowed, and Chondrites and Zoophycos are rare through most of the sections. Disseminated very fine-grained glauconite commonly occurs as laminae and irregular color mottling. A fault dipping 45 degrees with down-dip slickensides occurs in Section 2, 75 cm.

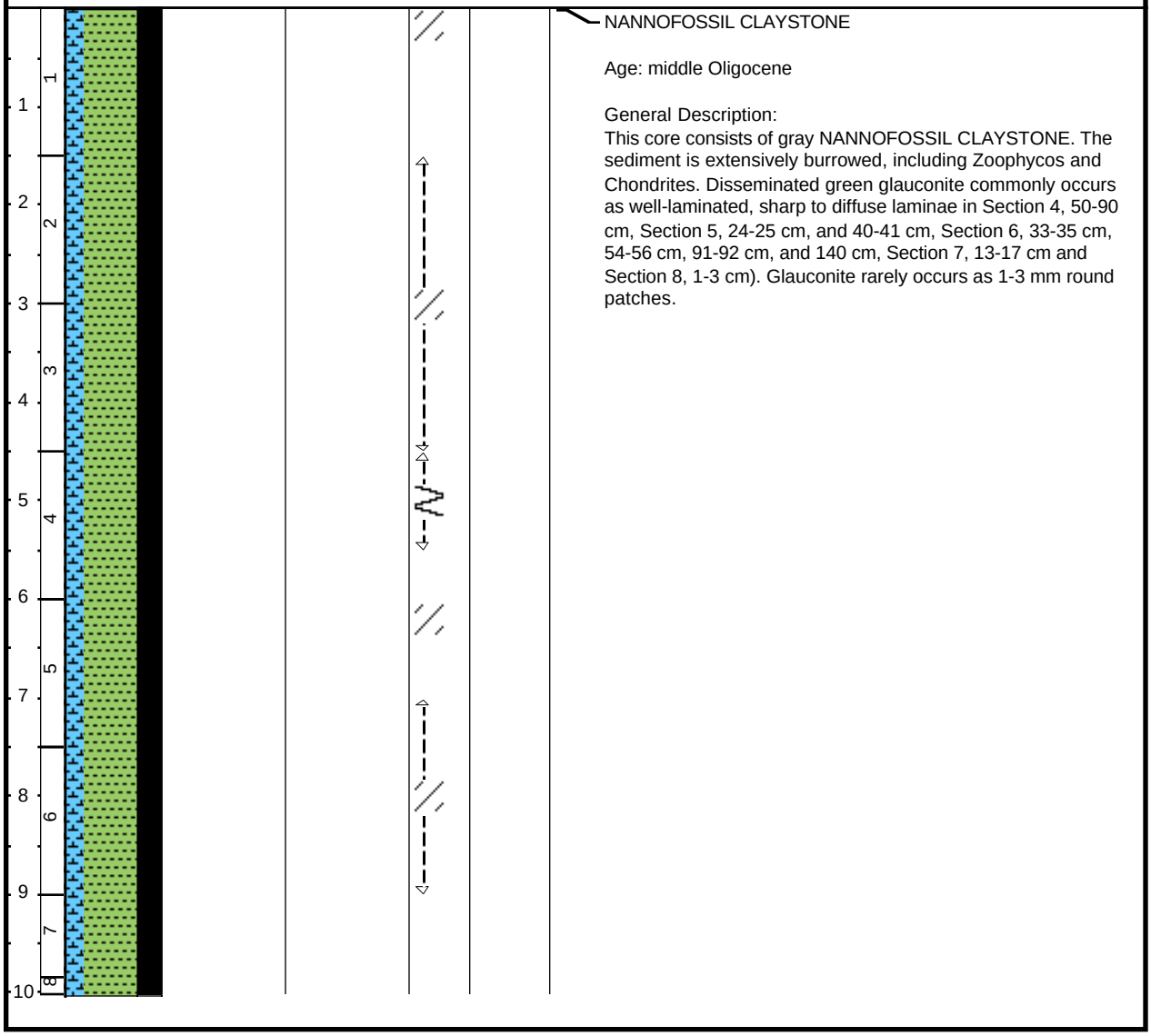
Core Photo

Site 1139 Hole A Core 29R **Cored 268.3-277.9 mbsf**



Core Photo

Site 1139 Hole A Core 30R **Cored 277.9-287.5 mbsf**

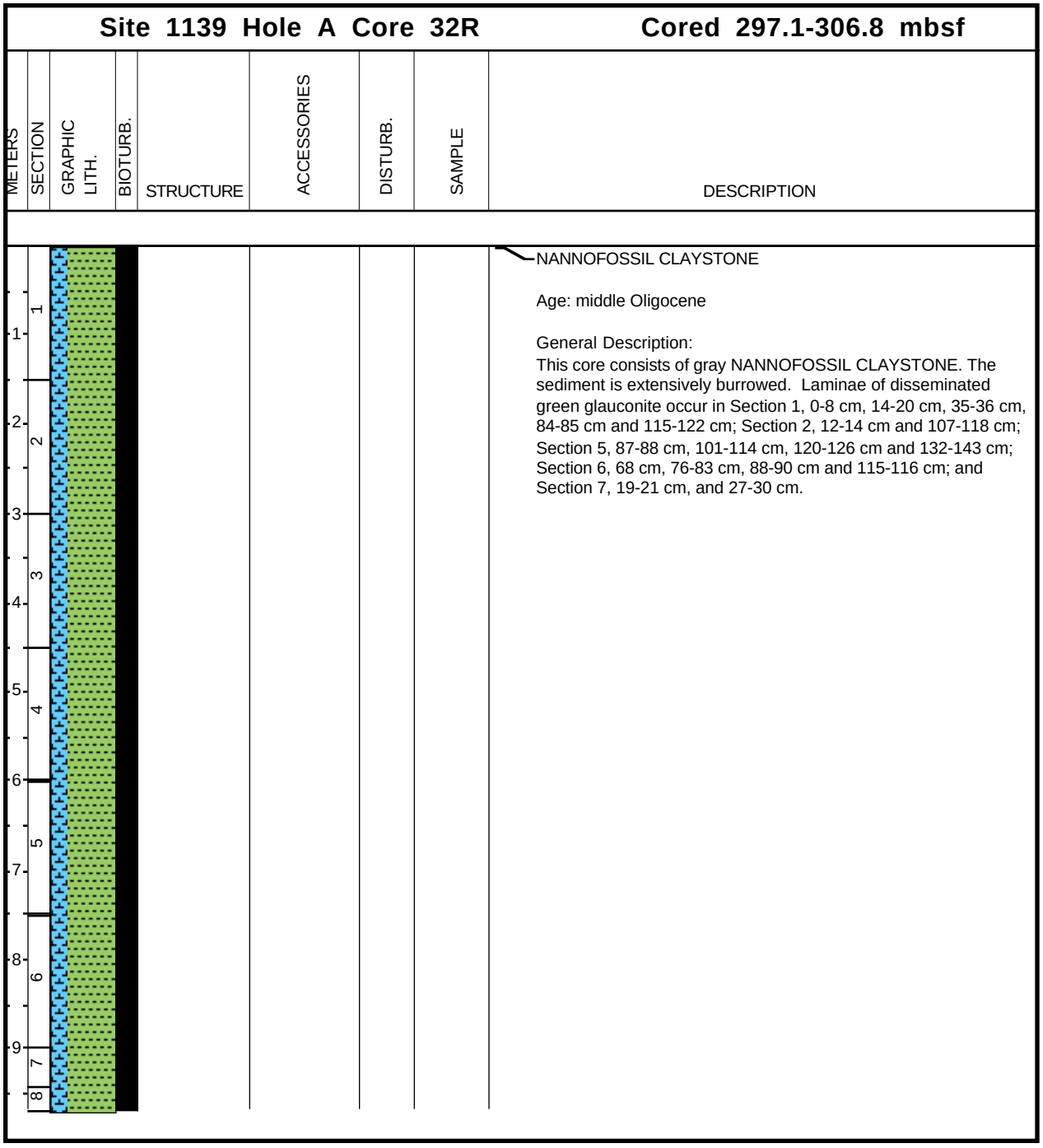


Core Photo

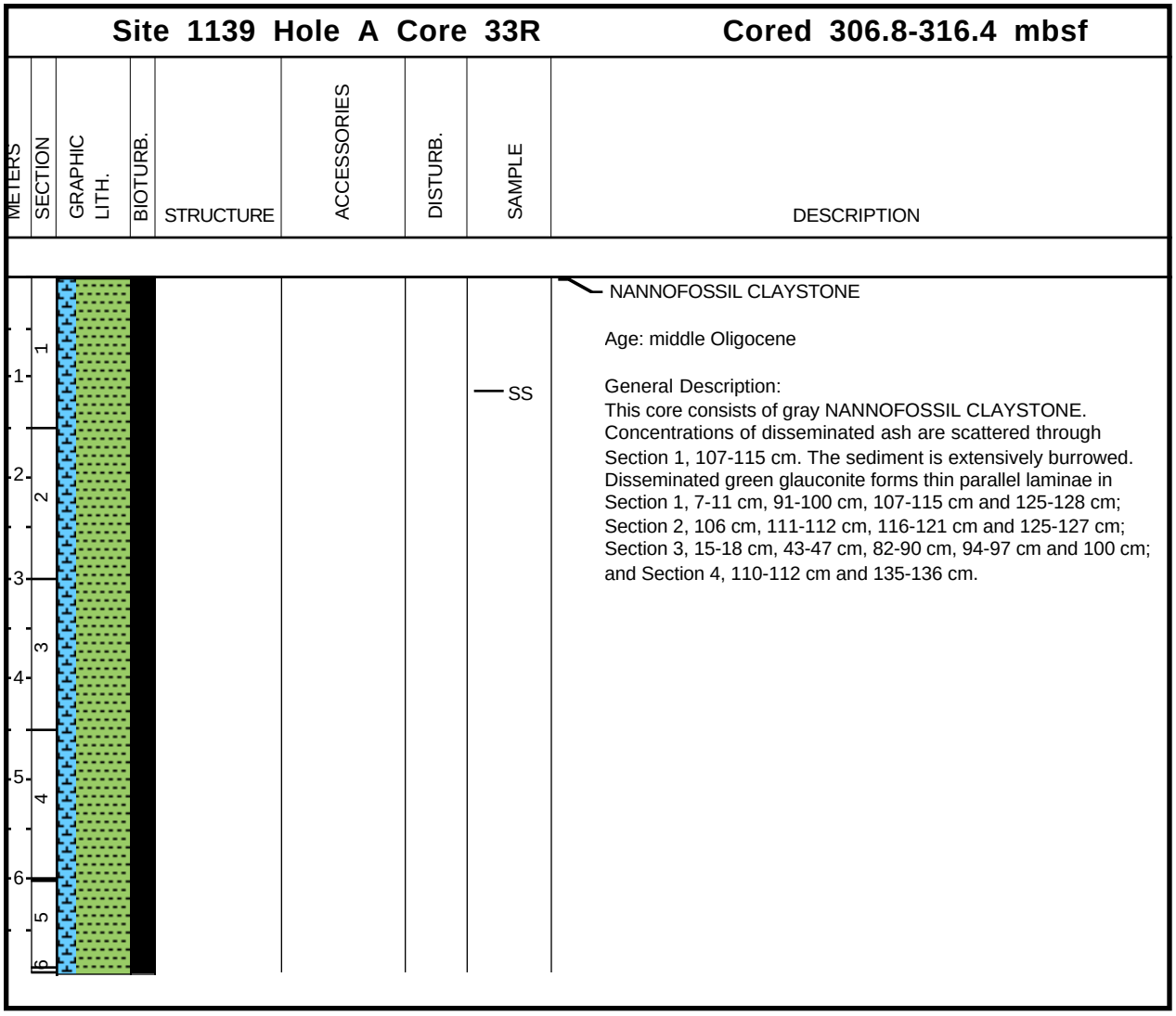
Site 1139 Hole A Core 31R **Cored 287.5-297.1 mbsf**

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
1 2 3 4	1 2 3 4 5						SS	NANNOFOSSIL CLAYSTONE Age: middle Oligocene General Description: This core consists of gray NANNOFOSSIL CLAYSTONE. The sediment is extensively burrowed, including Zoophycos and Chondrites. Disseminated green glauconite occurs as undisturbed groups of <1 mm laminae in Section 1, 15-20 cm, 49-50 cm, 74-78 cm, 90-94 cm, 102-103 cm, and 109-110 cm; Section 2, 4-10 cm, 41-42 cm, 98cm, and 121-128 cm; Section 3, 1-4 cm, 53-54 cm, 83-86 cm, 101-106 cm, 110-113 cm, and 141-149 cm; and Section 4, 33-39 cm. Glauconite also commonly occurs as patches filling burrows and halos around burrows.

Core Photo

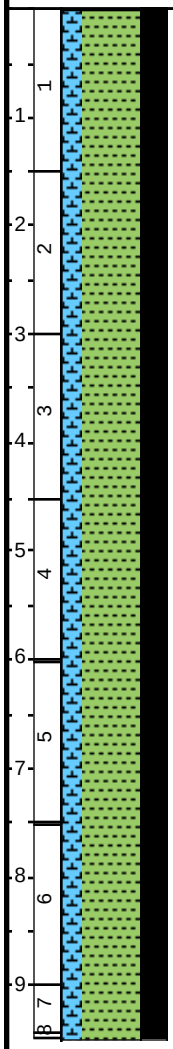

Site 1139 Hole A Core 32R
Cored 297.1-306.8 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
NANNOFOSSIL CLAYSTONE
Age: middle Oligocene
General Description:
This core consists of gray NANNOFOSSIL CLAYSTONE. The sediment is extensively burrowed. Laminae of disseminated green glauconite occur in Section 1, 0-8 cm, 14-20 cm, 35-36 cm, 84-85 cm and 115-122 cm; Section 2, 12-14 cm and 107-118 cm; Section 5, 87-88 cm, 101-114 cm, 120-126 cm and 132-143 cm; Section 6, 68 cm, 76-83 cm, 88-90 cm and 115-116 cm; and Section 7, 19-21 cm, and 27-30 cm.

Core Photo


Site 1139 Hole A Core 33R
Cored 306.8-316.4 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
SS
NANNOFOSSIL CLAYSTONE
Age: middle Oligocene
General Description:
This core consists of gray NANNOFOSSIL CLAYSTONE. Concentrations of disseminated ash are scattered through Section 1, 107-115 cm. The sediment is extensively burrowed. Disseminated green glauconite forms thin parallel laminae in Section 1, 7-11 cm, 91-100 cm, 107-115 cm and 125-128 cm; Section 2, 106 cm, 111-112 cm, 116-121 cm and 125-127 cm; Section 3, 15-18 cm, 43-47 cm, 82-90 cm, 94-97 cm and 100 cm; and Section 4, 110-112 cm and 135-136 cm.

Core Photo

Site 1139 Hole A Core 34R **Cored 316.4-326.1 mbsf**



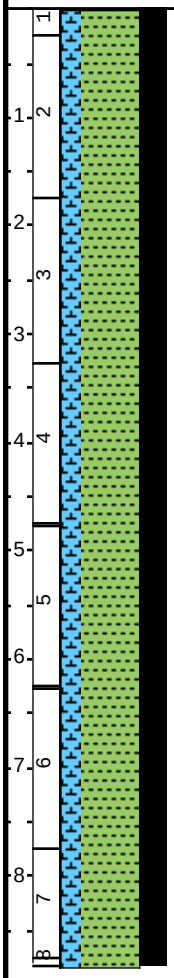
Age: middle Oligocene

General Description:
This core consists of gray NANNOFOSSIL CLAYSTONE. The sediment is extensively burrowed. Green glauconite in and around burrows is common. Thin green glauconitic laminae occur in Section 1, 62-65 cm; Section 2, 34-43 cm, 123-129 cm and 133-137 cm; Section 3, 29-33 cm, 42-51 cm, 133-134 cm and 149 cm; Section 4, 74-78 cm, 115-120 cm, 129-130 cm, 136-138 cm and 147-148 cm; Section 5, 96-114 cm and 122-126 cm; and Section 6, 12 cm, 16-21 cm, 27-32 cm, 53-55 cm and 149 cm.

Core Photo

Site 1139 Hole A Core 35R Cored 326.1-335.4 mbsf

METERS | SECTION | GRAPHIC LITH. | BIOTURB. | STRUCTURE | ACCESSORIES | DISTURB. | SAMPLE | DESCRIPTION

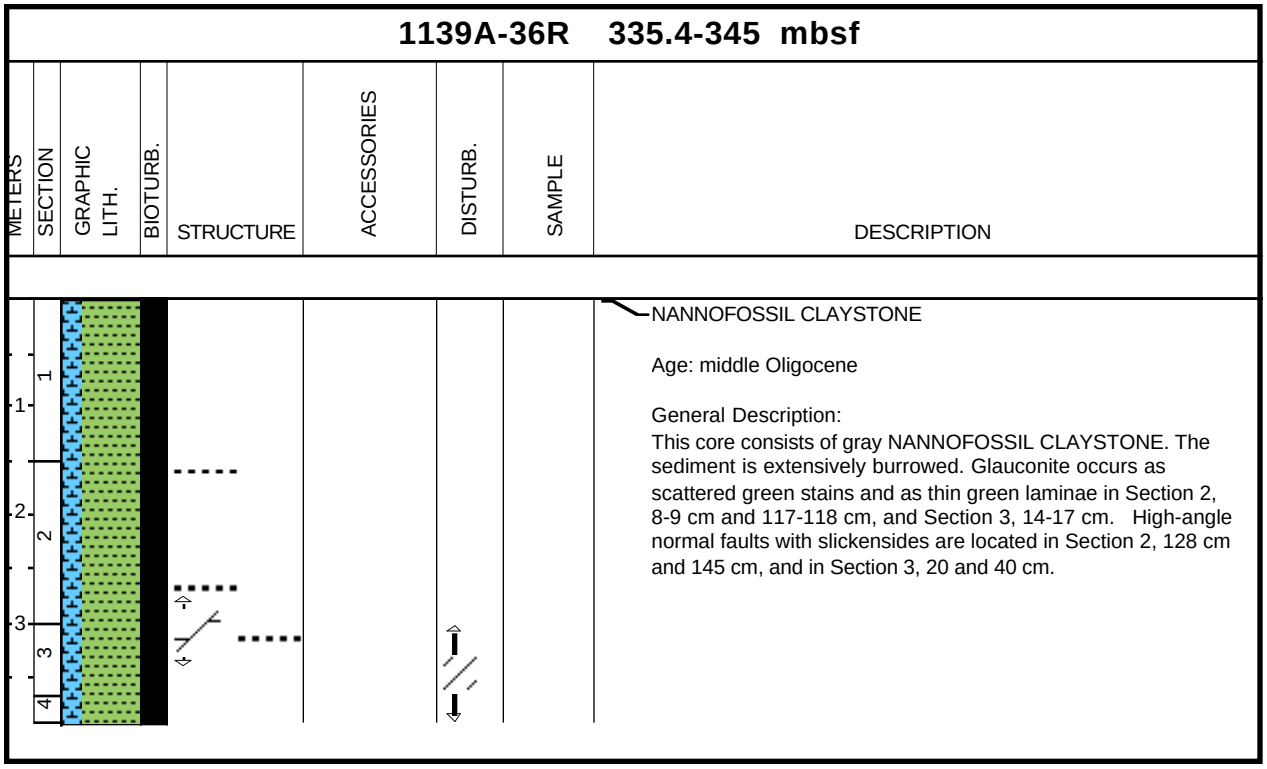


NANNOFOSSIL CLAYSTONE

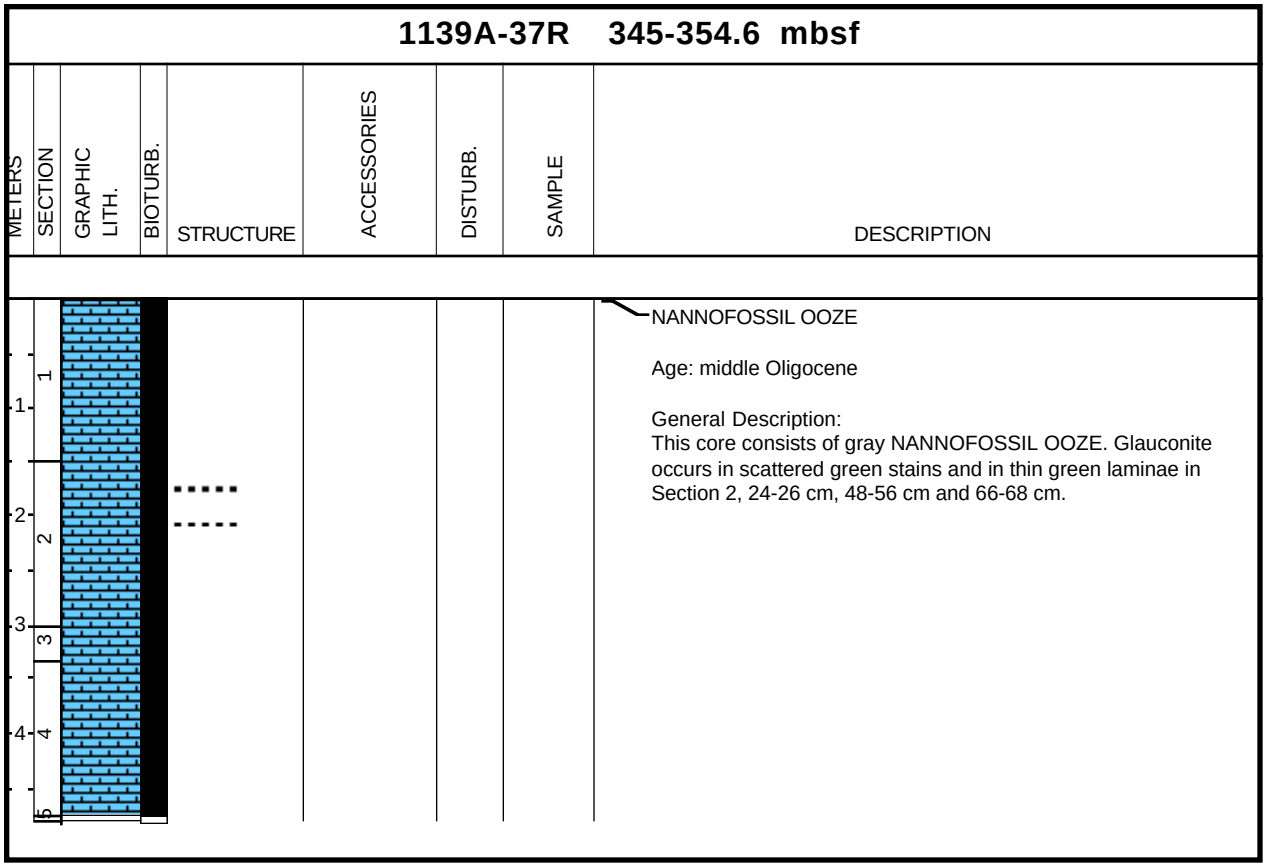
Age: middle Oligocene

General Description:
This core consists of gray NANNOFOSSIL CLAYSTONE. The sediment is extensively burrowed. Green glauconite occurs around burrows and, to a lesser extent, within some burrows. Thin green glauconic laminae occur in Section 1, 20 cm and 25 cm; Section 2, 76-82 cm, 87-88 cm, 91 cm, 95-96 cm, 101 cm, 104 cm, 106 cm, 112-113 cm, 125-129 cm, 134-135 cm and 147 cm; Section 3, 1-17 cm; Section 5, 62-67 cm; Section 6, 25-29 cm and 140-142 cm; and Section 7, 10-12 cm.

Core Photo

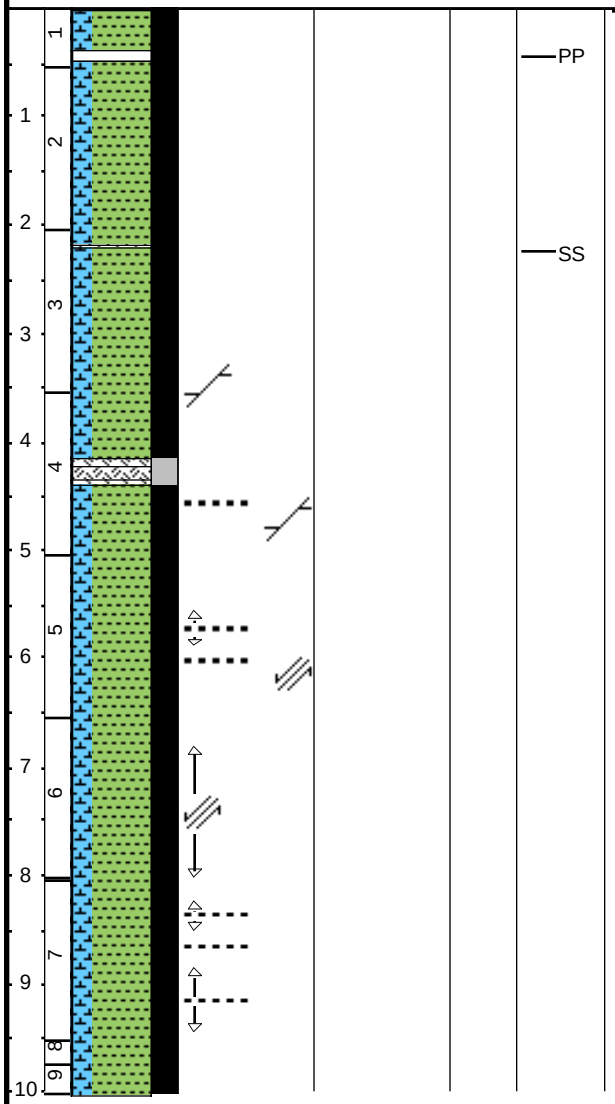

1139A-36R 335.4-345 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
3
4
NANNOFOSSIL CLAYSTONE
Age: middle Oligocene
General Description:
This core consists of gray NANNOFOSSIL CLAYSTONE. The sediment is extensively burrowed. Glauconite occurs as scattered green stains and as thin green laminae in Section 2, 8-9 cm and 117-118 cm, and Section 3, 14-17 cm. High-angle normal faults with slickensides are located in Section 2, 128 cm and 145 cm, and in Section 3, 20 and 40 cm.

Core Photo


1139A-37R 345-354.6 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
NANNOFOSSIL OOZE
Age: middle Oligocene
General Description:
This core consists of gray NANNOFOSSIL OOZE. Glauconite occurs in scattered green stains and in thin green laminae in Section 2, 24-26 cm, 48-56 cm and 66-68 cm.

Core Photo

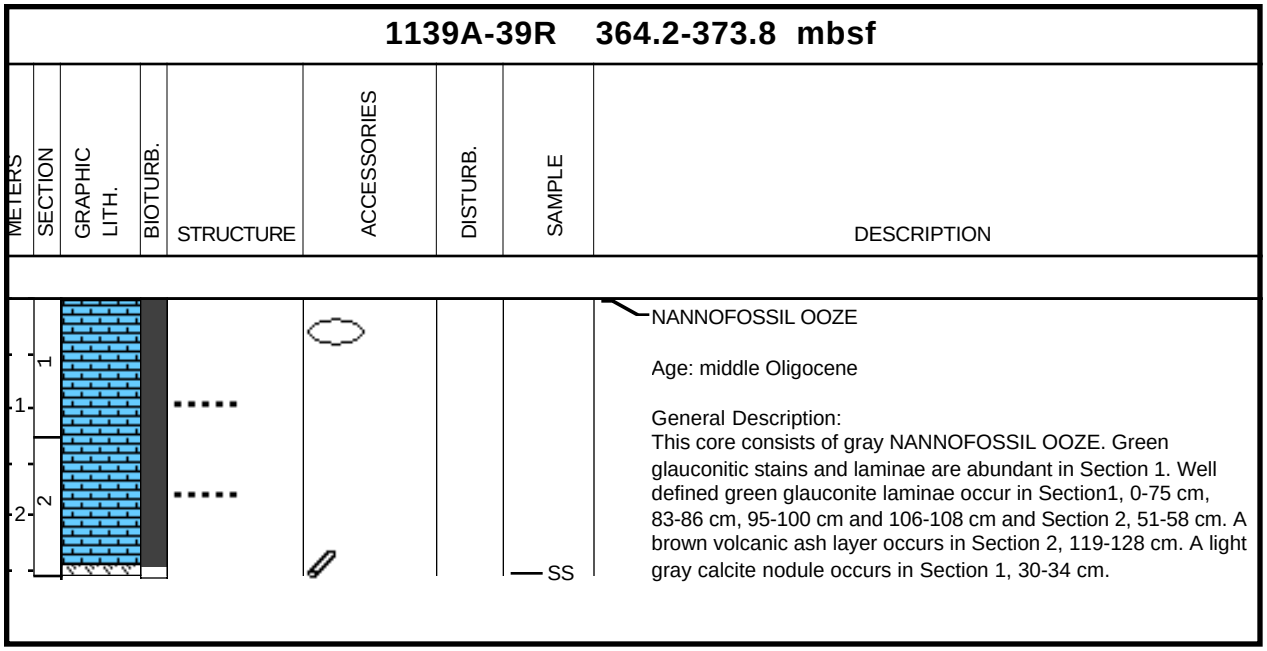
1139A-38R 354.6-364.2 mbsf



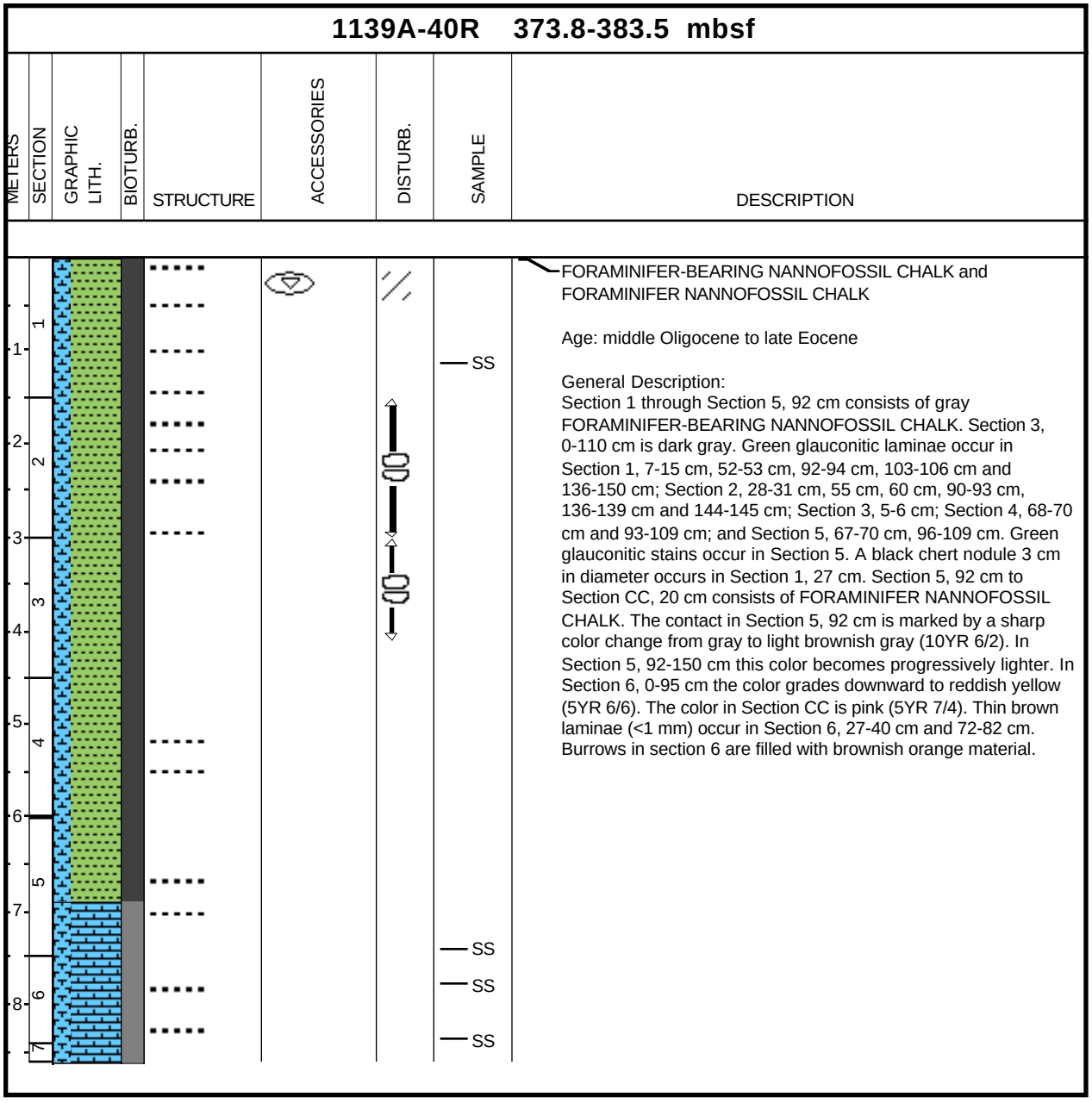
Age: middle Oligocene

General Description:
This core consists of gray NANNOFOSSIL CLAYSTONE. Section 2, 118-150 cm, Section 3 and Section 5 are slightly lighter gray. Green glauconite stains are common. Green glauconitic laminae occur in Section 4, 92-101 cm and 105-110 cm, Section 5, 52-55 cm, 58-59 cm, 61-65 cm, 71-74 cm, 76-86 cm and 99-104 cm, and Section 7, 20-25 cm, 35-40 cm, 45-48 cm, 58-67 cm, 80-88 cm, 101-107 cm, 111-123 cm and 129-142 cm. In Section 6 green laminae are common but diffuse. A volcanic ash layer (possibly graded) occurs in Section 3, 0-19 cm, which is very dark gray at the base and becomes progressively lighter gray upwards. The basal contact is sharp, but the upper contact is gradational. A brown layer with disseminated volcanic glass occurs in Section 4, 62-88 cm. Normal faults are observed in Section 3, 145 cm, Section 4, 93-96 cm, 110-113 cm (with slickensides) and 132-142 cm, and Section 6, 26-31 cm. Section 5, 110-135 cm and Section 6, 50-150 cm are fractured. Some vertical fractures also occur in Section 7 and Section 8.

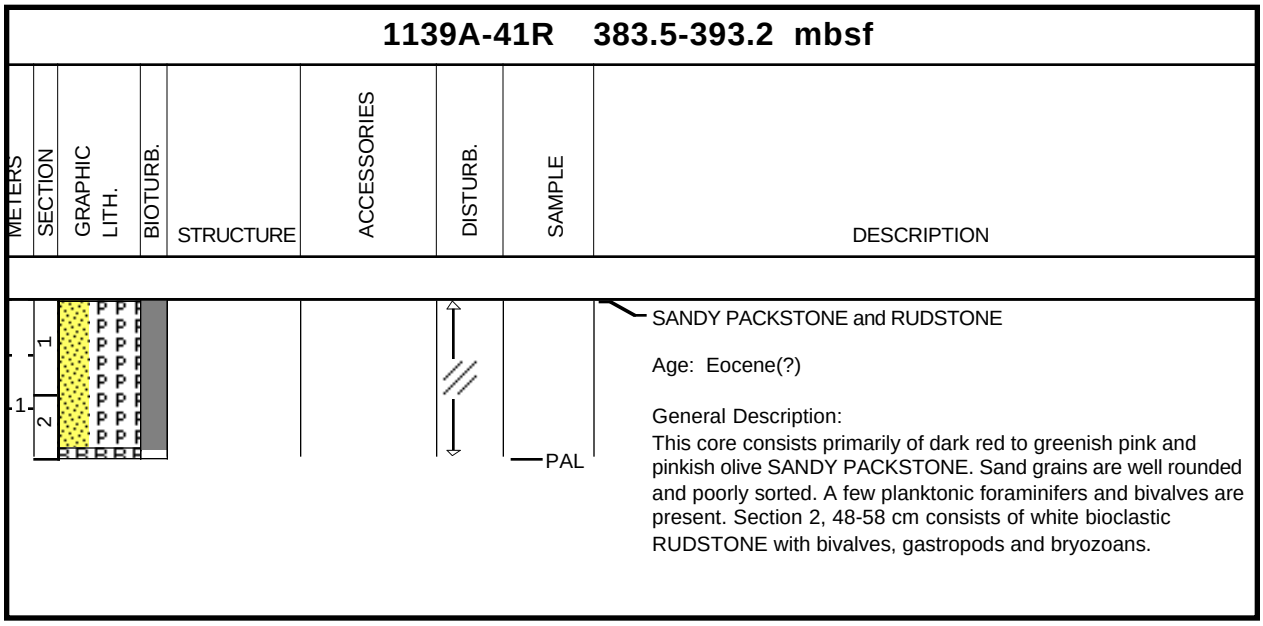
Core Photo


1139A-39R 364.2-373.8 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
2
1
2
SS
NANNOFOSSIL OOZE
Age: middle Oligocene
General Description:
This core consists of gray NANNOFOSSIL OOZE. Green glauconitic stains and laminae are abundant in Section 1. Well defined green glauconite laminae occur in Section1, 0-75 cm, 83-86 cm, 95-100 cm and 106-108 cm and Section 2, 51-58 cm. A brown volcanic ash layer occurs in Section 2, 119-128 cm. A light gray calcite nodule occurs in Section 1, 30-34 cm.

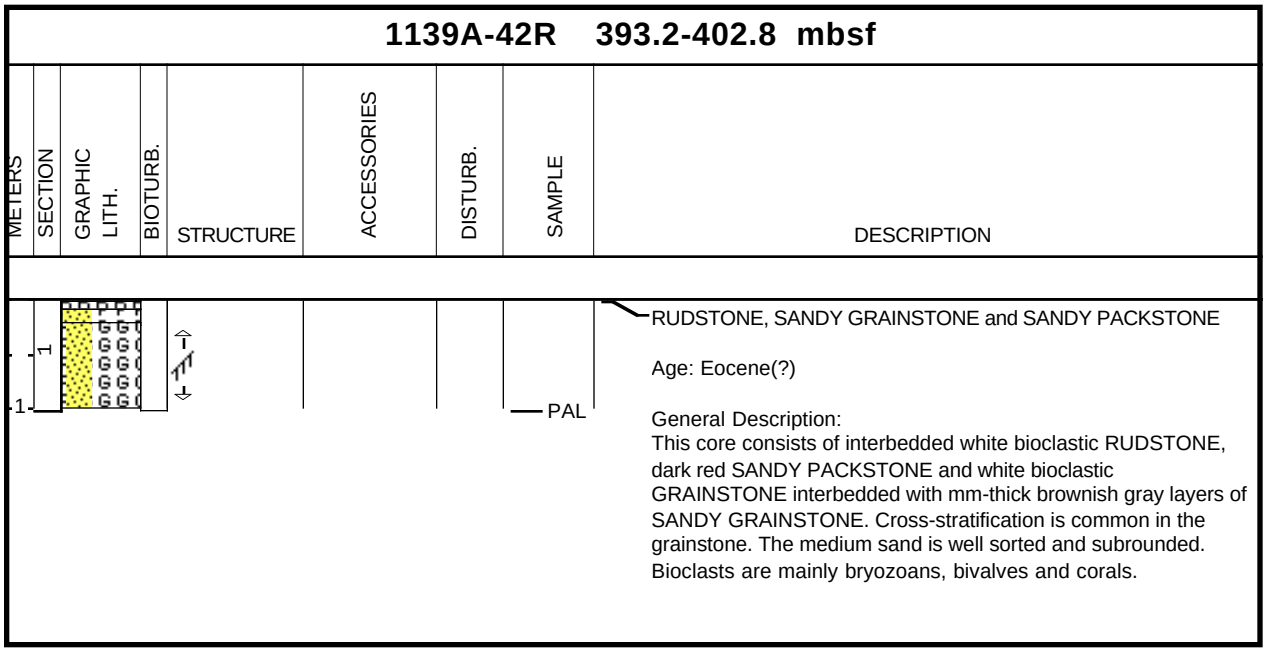
Core Photo


1139A-40R 373.8-383.5 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
SS
SS
SS
SS
FORAMINIFER-BEARING NANNOFOSSIL CHALK and FORAMINIFER NANNOFOSSIL CHALK
Age: middle Oligocene to late Eocene
General Description:
Section 1 through Section 5, 92 cm consists of gray FORAMINIFER-BEARING NANNOFOSSIL CHALK. Section 3, 0-110 cm is dark gray. Green glauconitic laminae occur in Section 1, 7-15 cm, 52-53 cm, 92-94 cm, 103-106 cm and 136-150 cm; Section 2, 28-31 cm, 55 cm, 60 cm, 90-93 cm, 136-139 cm and 144-145 cm; Section 3, 5-6 cm; Section 4, 68-70 cm and 93-109 cm; and Section 5, 67-70 cm, 96-109 cm. Green glauconitic stains occur in Section 5. A black chert nodule 3 cm in diameter occurs in Section 1, 27 cm. Section 5, 92 cm to Section CC, 20 cm consists of FORAMINIFER NANNOFOSSIL CHALK. The contact in Section 5, 92 cm is marked by a sharp color change from gray to light brownish gray (10YR 6/2). In Section 5, 92-150 cm this color becomes progressively lighter. In Section 6, 0-95 cm the color grades downward to reddish yellow (5YR 6/6). The color in Section CC is pink (5YR 7/4). Thin brown laminae (<1 mm) occur in Section 6, 27-40 cm and 72-82 cm. Burrows in section 6 are filled with brownish orange material.

Core Photo


1139A-41R 383.5-393.2 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
1
2
PAL
SANDY PACKSTONE and RUDSTONE
Age: Eocene(?)
General Description:
This core consists primarily of dark red to greenish pink and pinkish olive SANDY PACKSTONE. Sand grains are well rounded and poorly sorted. A few planktonic foraminifers and bivalves are present. Section 2, 48-58 cm consists of white bioclastic RUDSTONE with bivalves, gastropods and bryozoans.

Core Photo


1139A-42R 393.2-402.8 mbsf
METERS
SECTION
GRAPHIC LITH.
BIOTURB.
STRUCTURE
ACCESSORIES
DISTURB.
SAMPLE
DESCRIPTION
1
1
PAL
RUDSTONE, SANDY GRAINSTONE and SANDY PACKSTONE
Age: Eocene(?)
General Description:
This core consists of interbedded white bioclastic RUDSTONE, dark red SANDY PACKSTONE and white bioclastic GRAINSTONE interbedded with mm-thick brownish gray layers of SANDY GRAINSTONE. Cross-stratification is common in the grainstone. The medium sand is well sorted and subrounded. Bioclasts are mainly bryozoans, bivalves and corals.

Core Photo

1139A-43R 402.8-412.4 mbsf

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
0	1						PAL	GRAINSTONE, SANDY GRAINSTONE and RUDSTONE

Age: Eocene(?)

General Description:
This core consists of white bioclastic GRAINSTONE interbedded with mm-thick brownish SANDY GRAINSTONE laminae and cm-thick RUDSTONE beds. Bioclasts are mainly bryozoans, bivalves and echinoids. The medium-to-coarse sand is subrounded and well sorted. Cross-stratification is common. Isolated pebbles of light brown CHERT occur at 20 cm and 29 cm, but may have been emplaced by drilling.

Core Photo

1139A-44R 412.4-422 mbsf

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
1	1						PAL	GRAINSTONE, SANDY GRAINSTONE and RUDSTONE Age: Eocene(?) General Description: This core consists of brownish gray SANDY GRAINSTONE interbedded with bioclastic GRAINSTONE and RUDSTONE. Bioclasts are mainly bryozoans, bivalves and echinoids. The medium sand grains are subrounded and well-sorted. Cross-stratification is very common. A bivalve shell occurs at the top of the core.

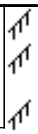
Core Photo

1139A-45R 422-431.7 mbsf

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
1	1						PAL	GRAINSTONE and SANDY GRAINSTONE Age: Eocene(?) General Description: This core consists of brown and tan layered SANDY GRAINSTONE with few interlayers of white bioclastic GRAINSTONE. The medium sand is well-sorted and subrounded. Bioclasts are mainly bryozoans, bivalves and echinoids. Cross-stratification is very common. Burrows occur at 55 cm and 65 cm. A pebble of greenish gray fine-grained siliceous rock occurs at the top of the core and was probably emplaced by drilling.

Core Photo

1139A-46R 431.7-441.3 mbsf

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
1	1						PAL	SANDY GRAINSTONE and RUDSTONE Age: Eocene(?) General Description: Section 1, 0-66 cm consists of brown and tan layered SANDY GRAINSTONE with few bioclastic RUDSTONE interbeds. The medium-to-coarse sands are subrounded, well-sorted. Cross-stratification is common. Burrows occur at 30 cm and 40 cm. An oyster shell occurs at the top of the core. Section 1, 66-101 cm consists of brown and yellow layered pebbly SANDY GRAINSTONE and RUDSTONE. A flat brown chert pebble, 3 cm in diameter and a 2 cm oyster shell occur in the RUDSTONE at 70 cm. Granules and pebbles are subangular to well-rounded lithic fragments. Bioclasts are echinoids, bryozoa and bivalves. Section 1, 101-111 cm consists of cross-stratified brown SANDY GRAINSTONE with interlaminated bioclastic GRAINSTONE. The fine-grained sand is subrounded and well-sorted. Bioclasts are coarse-grained and subangular.

Core Photo

1139A-47R 441.3-450.9 mbsf

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
	1						PAL	SANDY GRAINSTONE and RUDSTONE

Age: Eocene(?)

General Description:
This core consists of brown and yellow interbedded pebbly SANDY GRAINSTONE and RUDSTONE. Granules and pebbles are subangular to well-rounded lithic fragments. Bioclasts are echinoids, bryozoa and bivalves. Isolated pebbles of red volcanic breccia and light brown claystone occur at the base of the core and may have been emplaced by drilling.

Core Photo

1139A-48R 450.9-460.6 mbsf

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
	1						PAL	SANDY GRAINSTONE

Age: Eocene(?)

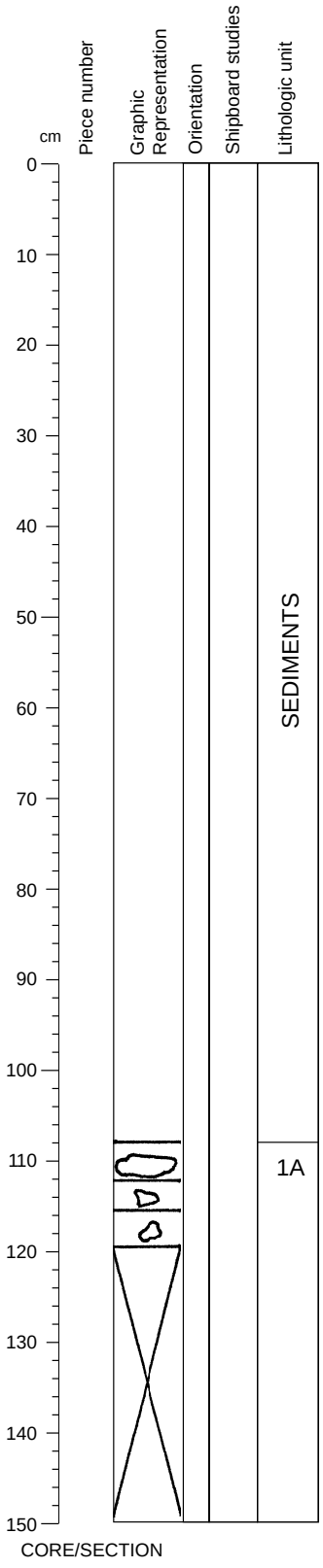
General Description:
Yellow and brown interlaminated bioclastic SANDY GRAINSTONE. Cross-stratification is present. Pebbly layers occur. The medium-to-coarse sand is subrounded to rounded and well-sorted. An isolated 4-cm pebble of red felsic volcanic rock occurs at the bottom of the core.

Core Photo

1139A-49R 460.6-469.9 mbsf

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
1	1							SANDY PACKSTONE and RUDSTONE Age: Eocene(?) General Description: This core consists predominantly of yellow and brown interlaminated bioclastic SANDY PACKSTONE with some bioclastic RUDSTONE layers. The sand layers are medium sand, which is well-sorted and rounded. The bioclasts are angular. Cross-stratification is common. Burrows occur at 30 cm, 60 cm and 66 cm. Three isolated rounded pebbles of volcanic rock occur at the base of the core in Section 1, 109-113 cm.

Core Photo



183-1139A-49R-1 **Section top: 460.60 (mbsf)**

UNIT 1A: RHYOLITE

CONTACTS: Not recovered; the inferred contact between Unit 1 and the overlying bioclastic sandstone is at 109 cm.

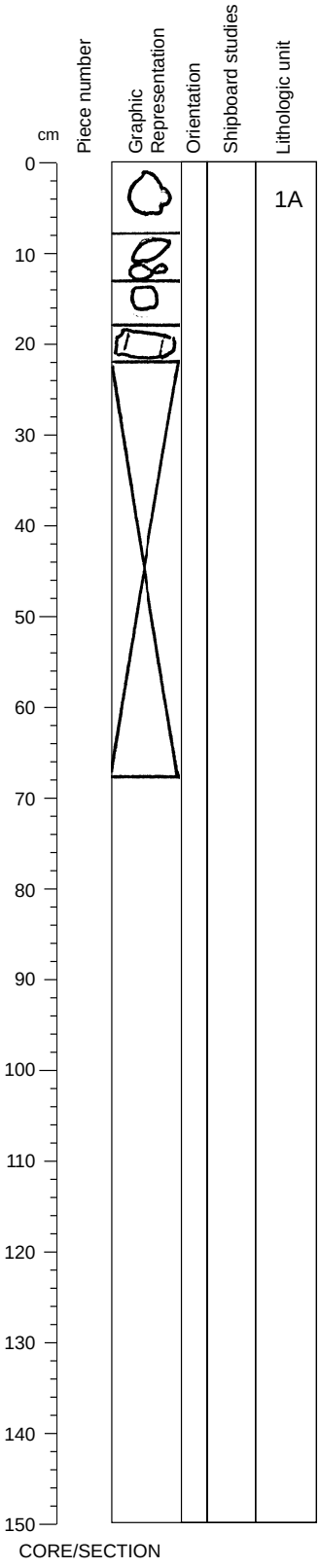
COLOR: Pale orange to dark red.

ALTERATION: High.

GENERAL DESCRIPTION: The section contains three pieces of flow-banded felsic lava with abraded and subround shapes.

LITHOLOGIC AND TEXTURAL FEATURES:
109-113 cm: Pale orange, subround, flow-banded pebble.
113-117 cm: Pale orange to pale green, subangular to subround pebble with contorted flow banding.
117-120 cm: Subangular to subround pebble with alternating pale orange and dark red banding (flow banding?); some preferential dissolution has occurred along banding.

Core Photo



183-1139A-50R-1 **Section top: 469.90 (mbsf)**

UNIT 1A: RHYOLITE

CONTACTS: None.

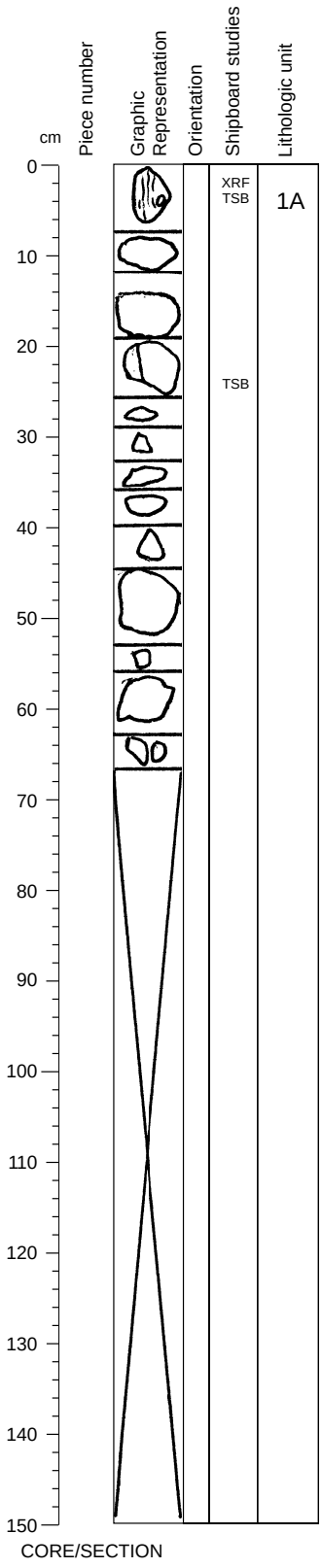
COLOR: Pale orange to pale green.

ALTERATION: High.

GENERAL DESCRIPTION: The section has many pieces of massive and flow-banded felsic lava with abraded and subround to subangular shapes.

LITHOLOGIC AND TEXTURAL FEATURES:
0-8 cm: Pale orange, subangular to subrounded, silicified pebble with contorted flow banding.
8-18 cm: Pale orange to pale green, subangular to subrounded, silicified pebble-sized rubble.
18-22 cm: Pale orange, subangular to subrounded, altered and silicified, equigranular, flow-banded pebble.

Core Photo



183-1139A-51R-1 **Section top: 479.50 (mbsf)**

UNIT 1A: RHYOLITE

CONTACTS: None.

COLOR: Pale orange to pale green.

ALTERATION: High.

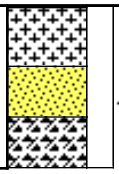
GENERAL DESCRIPTION: The section contains many pieces of massive, flow-banded, and laminated rhyolite, as well as other lithologies. All of the clasts in this section are abraded and subround to subangular in shape.

LITHOLOGIC AND TEXTURAL FEATURES:

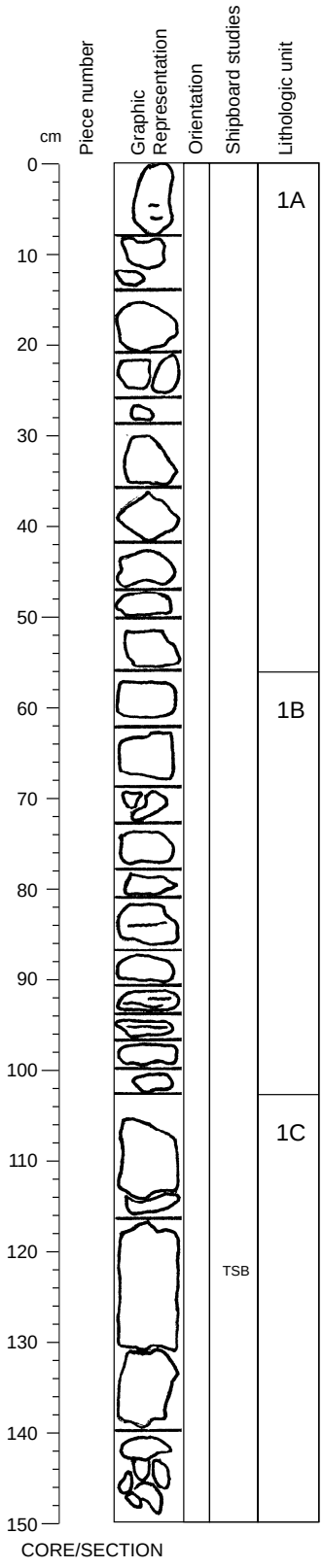
0-8 cm:	Pale orange to brown flow-banded rhyolite with <3-mm phenocrysts and an 11 x 16 mm xenolith; flow banding is subplanar, and continuous around the xenolith and phenocrysts.
8-12 cm:	Pale orange to greenish brown, intensely altered, formerly crystalline clast with a subplanar fabric.
12-19 cm:	Pale orange to pale green, altered, massive clast; contains red (oxidized) angular, <2-mm phenocrysts and a hematite-stained veinlet.
19-27 cm:	Altered, equigranular cobble with feldspar(?) crystals and discrete reddish brown and pale orange domains.
27-46 cm:	Pebble-size rubble with colors ranging from pale green to dark red; some pieces have flow banding.
46-53 cm:	Altered, pale to dark orange, equigranular cobble with <2-mm feldspar(?) crystals.
53-56 cm:	Very pale orange, massive clast with some red (oxidation) of phenocrysts.
56-63 cm:	Pale green, flow-banded clast with dark red alteration along flow bands.
63-67 cm:	Pale green, massive and flow-banded, pebble-size rubble.

Core Photo

1139A-52R 489.1-498.8 mbsf

METERS	SECTION	GRAPHIC LITH.	BIOTURB.	STRUCTURE	ACCESSORIES	DISTURB.	SAMPLE	DESCRIPTION
1	1							VOLCANIC ROCK, SANDSTONE and VOLCANICLASTIC BRECCIA Age: Eocene(?) General Description: Section 1, 0-56 cm consists of cobbles of massive, flow-banded felsic VOLCANIC ROCK composed mainly of rhyolite pebbles. Section 1, 56-103 cm consists of yellow and brown laminated bioclast-bearing SANDSTONE with cross-stratification. The sand is subrounded to rounded and sorting is intermediate. Whether this SANDSTONE is stratigraphically in place is uncertain. Section 1, 103-150 cm consists of felsic VOLCANIC BRECCIA composed mainly of rhyolite and pumice.

Core Photo



183-1139A-52R-1 **Section top: 489.10 (mbsf)**

UNIT 1A: RHYOLITE
UNIT 1B: BIOCLASTIC SANDSTONE
UNIT 1C: FELSIC PUMICE BRECCIA

CONTACTS: Not recovered; the inferred contact between Subunits 1A and 1B is at 56 cm; the inferred contact between Subunits 1B and 1C is at 103 cm.

COLOR: Pale orange (Subunit 1A), yellowish brown (Subunit 1B), pale green (Subunit 1C).

ALTERATION: High.

GENERAL DESCRIPTION: Subunit 1A contains many pieces of massive, flow-banded, and laminated felsic lava. Subunit 1B is a yellowish brown, laminated, bioclastic sandstone similar to that at the base of the sedimentary sequence overlying basement. Subunit 1C is pale green, altered breccia with clasts of flow-banded lava or pumice.

LITHOLOGIC AND TEXTURAL FEATURES:

Unit 1A:

0-8 cm:	Pale green flow-banded felsic lava; this interval includes a pebble with a small fault that offsets the banding.
8-21 cm:	Dark red breccia of disrupted and broken, banded clasts (volcanic?); the clasts have orange oxidation margins.
21-36 cm:	Massive, equigranular, altered, pebble (volcanic?) with pale orange and dark red, oxidized zones.
36-42 cm:	Highly silicified, pink to white to orange rock with black flecks.
42-47 cm:	Reddish gray, equigranular, massive, crystalline (volcanic?) rock.
47-56 cm:	Pale orange, equigranular to flow-banded, altered rhyolite clasts.

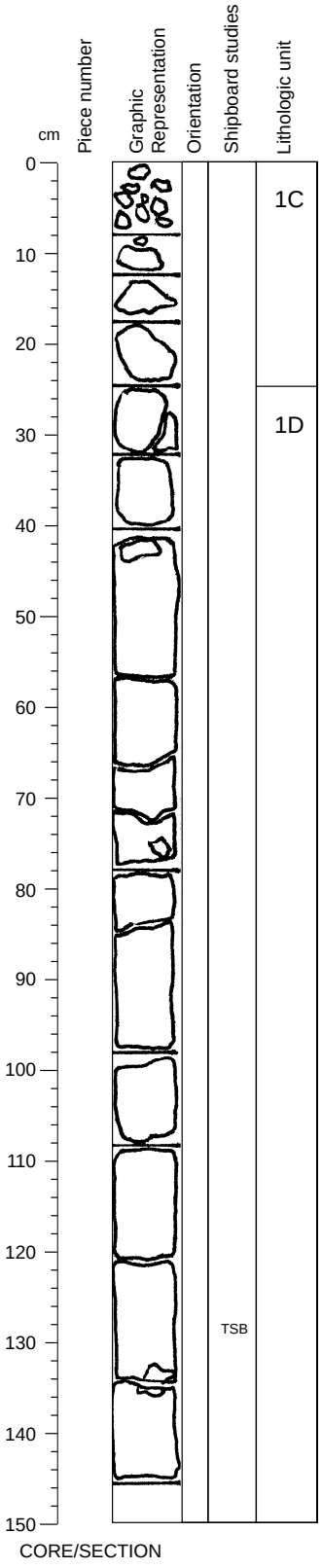
Unit 1B:

56-103 cm:	Laminated, bioclast-bearing sandstone composed of coarse, loosely cemented shell fragments. Low-angle cross-stratification is evident at 81-88 cm and 97-100 cm; planar lamination is present between 94 and 103 cm.

Unit 1C:

103-150 cm:	Breccia with variably altered, flow-banded rhyolite, massive rhyolite, and pumice in a pale green, amorphous-silica (hard) matrix. Clasts are angular to subangular, with a maximum size of 25 x 50 mm and an average size of 9 x 16 mm. Clasts are not aligned, and are softer than the enclosing matrix.

Core Photo



183-1139A-53R-1 **Section top: 500.27 (mbsf)**

UNIT 1C: FELSIC PUMICE BRECCIA
UNIT 1D: PERLITIC FELSIC GLASS WITH LITHICS

CONTACTS: Not recovered; the inferred contact between Subunits 1C and 1D is at 25 cm.

COLOR: Reddish orange, pale green, and gray.

ALTERATION: High.

GENERAL DESCRIPTION: Subunit 1C contains pieces of various rock types. Subunit 1D is dark reddish orange, subhorizontally fractured, altered perlitic felsic glass with multiple subspheroidal fracture sets. A cross-cutting set of subhorizontal fractures is filled with alteration products.

LITHOLOGIC AND TEXTURAL FEATURES:

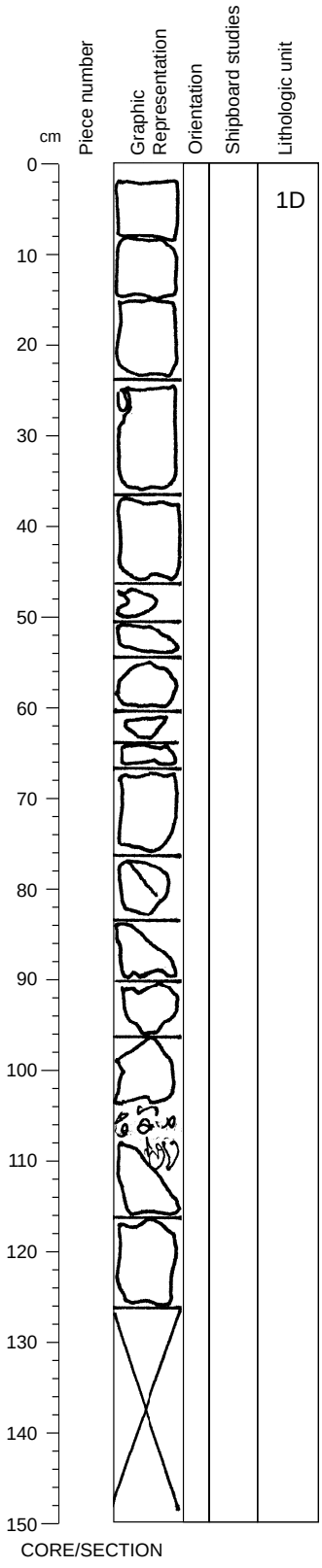
Unit 1C:

0-8 cm:	Round to subround, abraded rubble.
8-13 cm:	Subangular to subround, massive, green, flow-banded felsic lava with some dark reddish brown oxidation along flow bands.
18-25 cm:	Highly silicified red, pink, and dark gray altered volcanic rock (mafic?).

Unit 1D:

25-147 cm:	Domains of reddish orange (oxidized), felsic, perlitic volcanic glass. From 25-80 cm, the domains are cross-cut by subhorizontal fractures and the matrix material is pale green, amorphous silica (hard). Alteration is associated with perlitic fractures in the glass, and clay minerals surround kernels of altered glass. Enclosed lithic fragments (~10% of rock) are angular to subangular, dark gray, hard, and probably silicified.

Core Photo



183-1139A-53R-2 **Section top: 500.27 (mbsf)**

UNIT 1D: PERLITIC FELSIC GLASS AND SILICIFIED VOLCANIC BRECCIA

CONTACTS: None.

COLOR: Reddish orange, pale green, and gray.

ALTERATION: High.

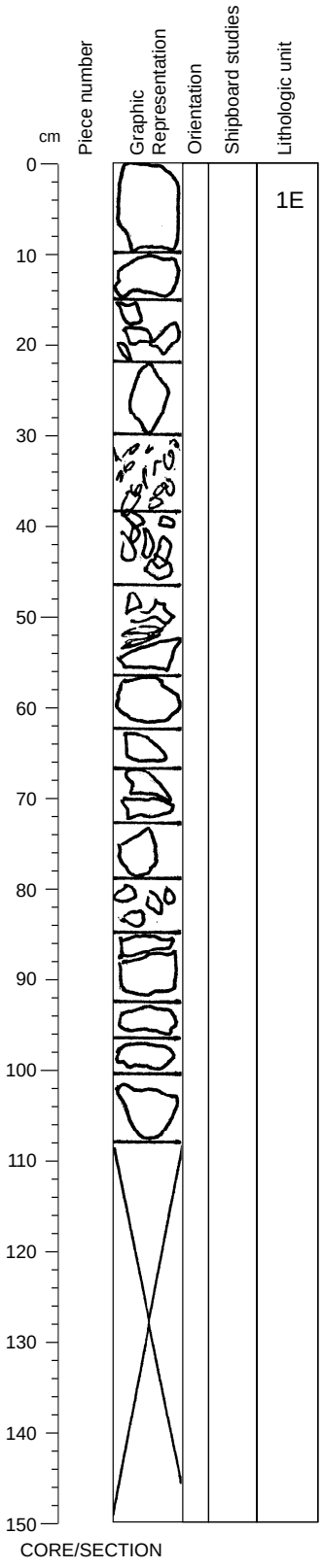
GENERAL DESCRIPTION: The upper part of the section (0-38 cm) is dark reddish orange, subhorizontally fractured, altered, perlitic felsic glass with multiple subspheroidal fracture sets. A cross-cutting set of subhorizontal fractures is intimately associated with alteration products. The lower part of the section (38-127 cm) is silicified volcanic breccia which retains original textures in places, although clasts are variably altered.

LITHOLOGIC AND TEXTURAL FEATURES:
0-24 cm: Consists of domains of reddish orange (oxidized), felsic, perlitic volcanic glass, similar to the material in Section 53R-1. Domains have been cross-cut by subhorizontal fractures and the matrix is pale green, amorphous silica (hard). A green clay- and silica-bearing vein cuts across this interval and alteration is greater near the vein. Alteration follows perlitic fractures in the glass, and clay minerals surround kernels of altered glass. The interval contains two large lithic fragments; one is gray and subround (16 x 31 mm), the other dark red and round (14 x 18 mm).

24-38 cm: This piece is mostly pale green, amorphous silica with some reddish orange, glassy domains. The piece is wholly silicified. Spheroidal shapes within the glassy areas reflect alteration associated with perlitic fracturing. One dark red, subangular lithic fragment (11 x 30 mm) is present.

38-127 cm: Felsic breccia with variably altered, volcanic lithic fragments is suspended in a matrix of pale green, amorphous silica (hard), and lesser amounts of orange to red (oxidized) matrix. Some pieces have a subhorizontal fabric delineated by alternating red and green colors. Lithic clasts become more abundant toward the base of the section.

Core Photo



183-1139A-54R-1 **Section top: 508.00 (mbsf)**

UNIT 1E: VOLCANICLASTIC ROCKS

CONTACTS: Not recovered; the inferred contact between Subunits 1D and 1E is between Sections 53R-2 and 54R-1.

COLOR: Pale orange, bright orange, pale green, dark green.

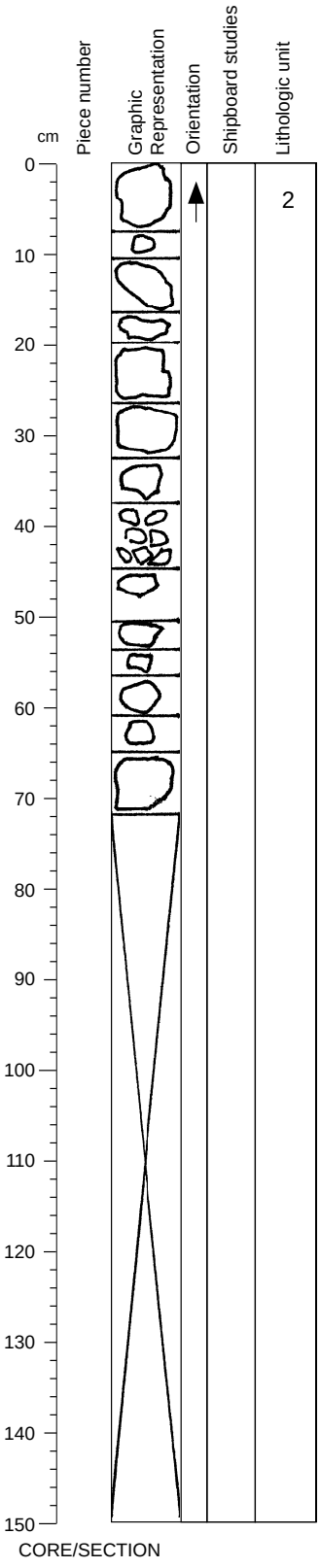
ALTERATION: Very high.

GENERAL DESCRIPTION: The upper (0-22 cm) and lower (56-108 cm) parts of the section are composed of loose pieces of variable lithology. At the top of the section, many pieces appear to be genetically unrelated and may indicate heterogeneous lithologies in the core and/or material that fell downhole. Highly altered, green, resinous, clay-rich, and sheared material indicates a fault zone in the 22-56 cm interval. Clasts adjacent to this zone are variably altered. Many of the pieces below this zone have volcaniclastic textures, although the original mineralogy is difficult to identify because of alteration.

LITHOLOGIC AND TEXTURAL FEATURES:

0-10 cm:	Massive, pale orange, altered, medium-grained, equigranular, silicic volcanic rock (57 x 92 mm).
10-15 cm:	Bright orange, massive, clay-rich rock (43 x 55 mm) with lithic fragments, similar in texture to the breccia at the base of Section 53R-1; highly oxidized and altered.
15-22 cm:	Brownish orange, fine-grained, massive pebbles (10 x 17 mm, 15 x 20 mm, 18 x 30 mm, 21 x 30 mm, 27 x 42 mm) with a possible fragmental texture.
22-30 cm:	Sheared, resinous to powdery, green, clay-rich material; possibly associated with a fault.
30-38 cm:	Sheared, gray-green, resinous, clay-rich material; possibly associated with a fault.
38-56 cm:	Sheared, green and red (oxidized) clay-rich material; possibly associated with a fault.
56-62 cm:	Dark and pale green, altered and silicified volcanic rock with subhorizontal fabric delineated by pale green, wispy clasts (flattened pumice/scoria?); a red, subangular lithic fragment (3 x 6 mm) also is present.
62-73 cm:	Dark and pale green, altered and silicified volcanic rock with subhorizontal fabric delineated by pale green clasts. Near the base of the interval, clasts are subangular and <4 mm.
73-80 cm:	Contains a contact between fine-grained, green, altered and silicified volcanic rock with a subhorizontal fabric and a zone with partially flattened, formerly glassy fragments. This interval also contains one gray lithic fragment (3 x 5 mm).
80-85 cm:	Massive green clay pebbles and one green clay pebble with subhorizontal fabric. The clay is paler at the margins of some pebbles.
85-93 cm:	Massive green clay and green clay with subhorizontal fabric.
93-97 cm:	Pale green clay with one irregular siliceous clast (20-30 mm) and a thick vein or wallrock alteration zone of amorphous silica and minor clay.
97-100 cm:	Pale green clay with scattered phenocrysts (<2 mm, feldspar?).
100-108 cm:	Green tectonic (cataclastic) breccia, altered to laminated clay with <2-mm (feldspar?) crystals.

Core Photo



183-1139A-55R-1 **Section top: 517.60 (mbsf)**

UNIT 2: WELDED RHYOLITE LAPILLI

CONTACTS: Not recovered; the inferred contact between Units 1 and 2 is between Sections 54R-1 and 55R-1.

COLOR: Dark red.

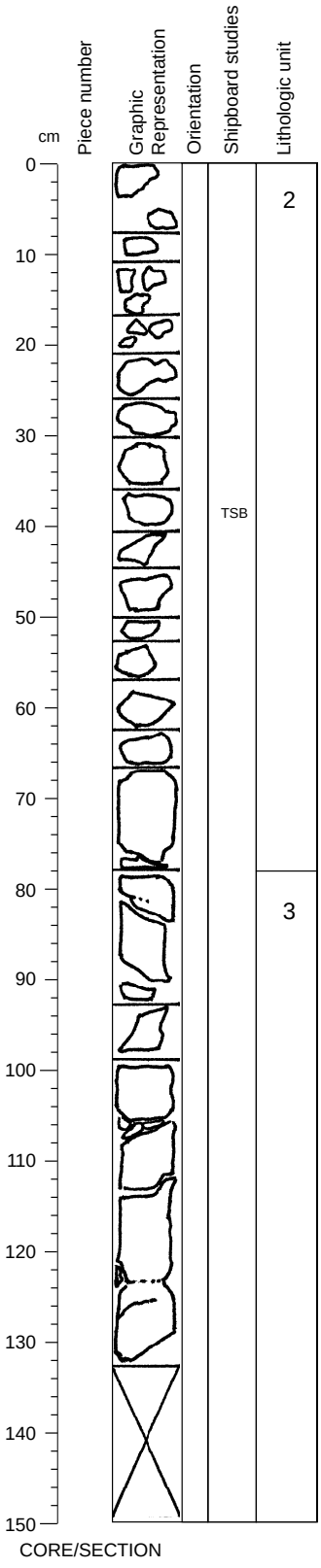
ALTERATION: High.

GENERAL DESCRIPTION: Unit 2 was recovered as a series of pebble- to cobble-size pieces; thus, the relationship among pieces is difficult to determine. Many pieces near the top of the section (0-16 cm) may not be related to the rhyolite below (16-72 cm). The pieces are dominated by massive but banded, welded rhyolite that is agglutinated and indurated. Flattening of rhyolitic clasts and alignment of spaces between welded clasts has produced a fabric. The clasts contain ≥10% feldspar phenocrysts.

LITHOLOGIC AND TEXTURAL FEATURES:

0-8 cm:	Pink, gray, and white (silicified?), massive volcanic rock (53 x 70 mm clast); interpreted to be debris fallen downhole during drilling.
8-11 cm:	White pebble (20 x 27 mm) with feldspar phenocrysts; interpreted to be debris fallen downhole.
11-16 cm:	Pink, gray, and white (silicified?), massive volcanic rock (38 x 71 mm clast); interpreted to be debris that fell downhole.
16-45 cm:	Dark red, oxidized and silicified(?), welded rhyolite pieces (23 x 50 mm, 56 x 67 mm, 53 x 60 mm, 52 x 58 mm).
38-45 cm:	Dark red, oxidized and silicified(?), welded rhyolite pebbles (10 x 20 mm, 18 x 33 mm, 20 x 30 mm, 20 x 31 mm, 22 x 25 mm, 25 x 27 mm, 35 x 35 mm).
45-72 cm:	Dark red, oxidized and silicified(?), welded rhyolite pieces (30 x 45 mm, 32 x 45 mm, 20 x 30 mm, 36 x 45 mm, 36 x 36 mm, 53 x 60 mm).

Core Photo



183-1139A-56R-1 **Section top: 527.30 (mbsf)**

UNIT 2: WELDED RHYOLITE LAPILLI

CONTACTS: The contact between Units 2 and 3 is at 78 cm.

COLOR: Dark red.

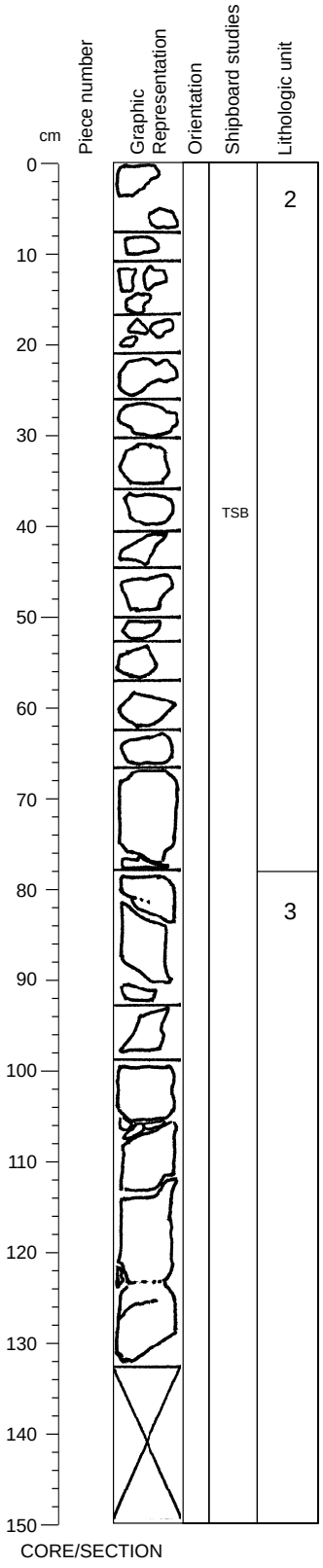
ALTERATION: High to complete.

GENERAL DESCRIPTION: This unit was recovered as a series of pebble- to cobble-size pieces; thus, the relationship among pieces is difficult to determine. Pieces are dominated by massive but banded, welded rhyolite that is agglutinated and indurated. Flattening of rhyloite clasts and alignment of spaces between welded clasts has produced a fabric. A sheared texture is evident at the contact, which dips ~35°. The clasts contain ≥10 modal% feldspar phenocrysts. Several pieces in the upper part of the section may not be related to the pumice/scoria.

LITHOLOGICAL AND TEXTURAL FEATURES:

0-8 cm:	Pale green, subangular to subround, silicified breccia pebbles (36 x 36 mm, 36 x 50 mm); clasts are orange-rimmed and flow-banded.
8-11 cm:	Gray, angular, hard (silicified?) lithic fragment (22 x 34 mm).
11-67cm:	Dark red and white, welded rhyolite. Welded rhyolite pieces in the 11-14 cm and 58-63 cm intervals have a network of fine, white veinlets (clast sizes in the 11-14 cm interval: are 18 x 25 mm, 25 x 30 mm, and 30 x 38 mm; clast sizes in the 58-63 mm interval are 43 x 53 mm, and 40 x 55 mm).
67-78 cm:	Dark red cataclastic breccia (dark green near the sheared contact with Unit 3) with a particulate texture; welded texture is absent. Slickensides are abundant.

Core Photo



183-1139A-56R-1 **Section top: 527.30 (mbsf)**

UNIT 3: CRYSTAL-VITRIC TUFF BRECCIA

CONTACTS: The contact between Units 2 and 3 is at 78 cm.

COLOR: Pale orange to pale green.

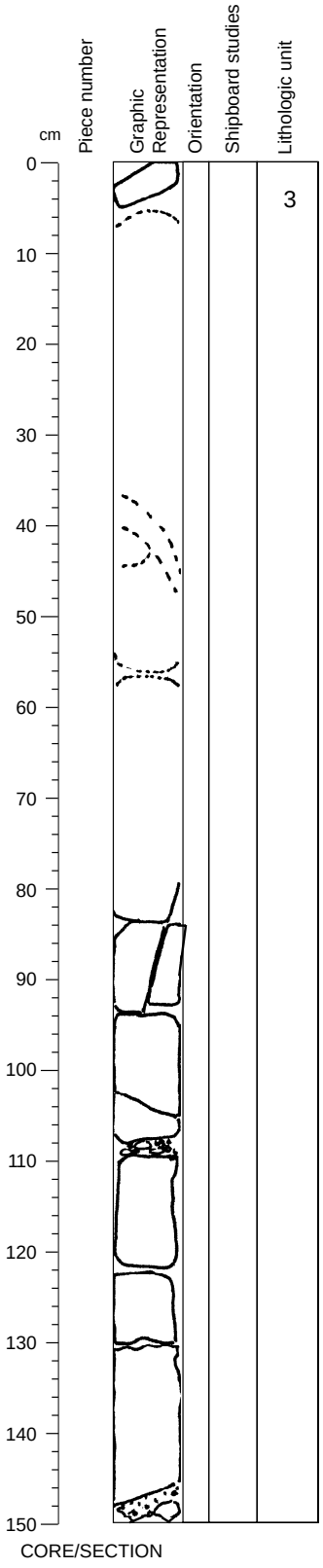
ALTERATION: Very high.

GENERAL DESCRIPTION: This section contains highly altered, green, crystal-vitric tuff breccia. The contact, probably a fault zone, is marked by green clay and a sheared texture. The clastic texture of the unit results from alteration of coherent volcanic rock.

LITHOLOGIC AND TEXTURAL FEATURES:

78-110 cm:	Orange to pinkish brown and green, variably oxidized and silicified.
110-134 cm:	Much of this interval is banded internally. It is crystal-rich (40-50%) and variably consolidated. In less consolidated intervals it crumbles to feldspar crystals and relict perlite kernels. Matrix is pale green and clay-rich. Highly silicified lithic fragments are common.

Core Photo



183-1139A-56R-2 **Section top: 528.64 (mbsf)**

UNIT 3: CRYSTAL-VITRIC TUFF BRECCIA

CONTACTS: None.

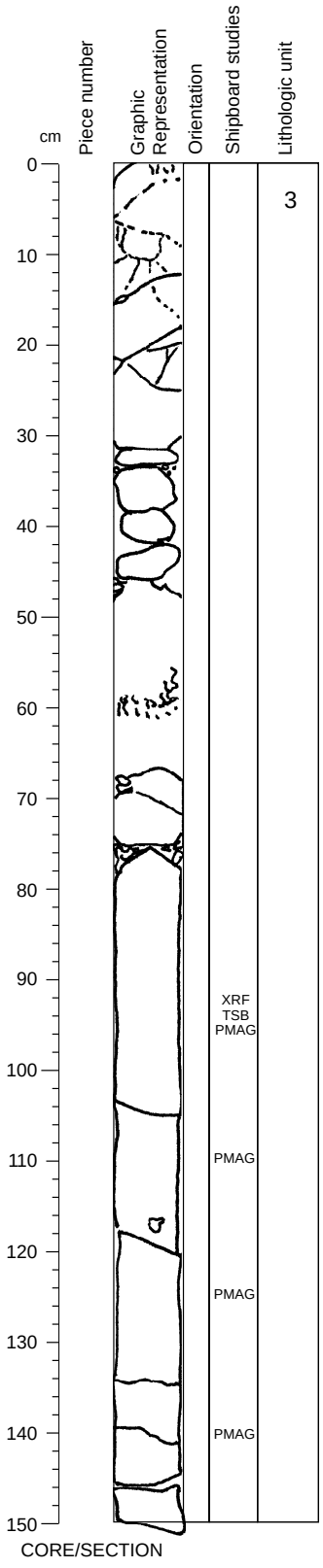
COLOR: Pale green.

ALTERATION: Very high.

GENERAL DESCRIPTION:

This section contains highly altered , green crystal-vitric tuff-breccia. Much of the section is massive internally, although portions are laminated. It is unclear whether the laminations are primary (internal, within clasts) or reflect shearing; sllckensides are common. The interval from 0-36 cm is disturbed, with more intact domains preserved in a pale green, crystal-rich, clayey matrix; extrapolation of textures across pieces is difficult. Overall, the material is crystal-rich (40-50%), and in less consolidated intervals crumbles to feldspar crystals (<2 mm) and relict perlite kernels, in a pale green, clay-rich matrix. This matrix probably formed by alteration of volcanic glass. The clastic texture may have formed by alteration of coherent volcanic rock to clay. The section is more consolidated below 36 cm. The intervals from 72 to 82 cm and 136 and 144 cm are banded. Dark gray, massive rock between 86 cm and 92 cm may be a relict clast. Breccia “ghosts” and pebble-size clasts are present from 110 to 128 cm.

Core Photo



183-1139A-56R-3 **Section top: 530.14 (mbsf)**

UNIT 3: CRYSTAL-VITRIC TUFF BRECCIA

CONTACTS: None.

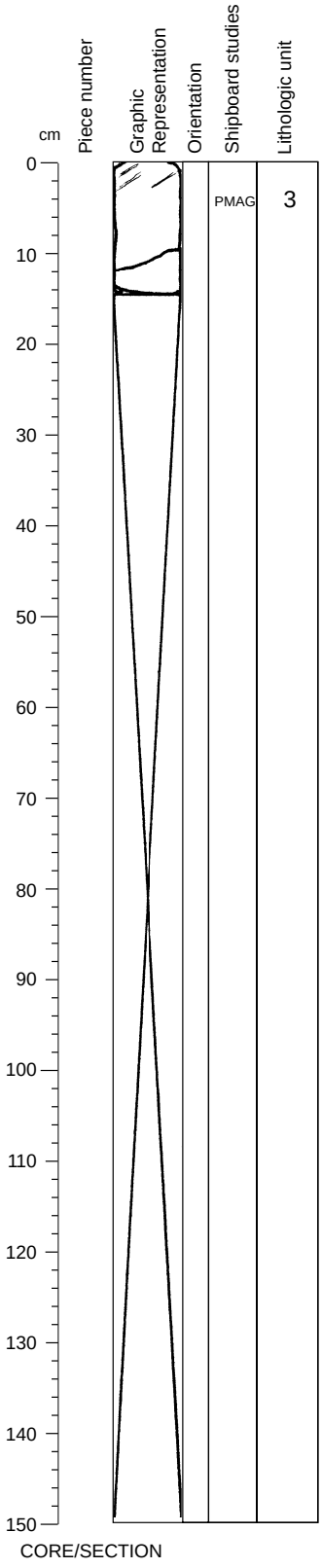
COLOR: Pale green.

ALTERATION: Very high.

GENERAL DESCRIPTION:

This section contains highly altered, green, crystal-vitric tuff breccia. Much of the section is massive internally, although portions are laminated. It is unclear whether the laminations are primary (internal, within clasts) or reflect shearing; slickensides are present. From 0-18 cm, the section is slightly disturbed, with intact domains preserved in a pale green, crystal-rich, clayey matrix; extrapolation of textures across pieces is difficult. The material is crystal-rich (40-50%), and less consolidated intervals crumble to feldspar crystals (<2 mm) and relict perlite kernels in a pale green clay-rich matrix. This matrix probably formed by alteration of volcanic glass. The clastic texture may have formed by alteration of coherent volcanic rock to clay. Lithic clasts are present (e.g.,a gray, lithic pebble, 12 x 23 mm, at 118 cm depth). The lithic fragments are subangular and variably altered. Several faint, pale green “ghosts” of clasts are preserved at 6-8 cm, and a red patch at 146 cm may be the remnant of a clast. Pieces between 68 and 76 cm have banded textures, and subhorizontal banding is present from 127-142 cm.

Core Photo



183-1139A-56R-4 **Section top: 531.64 (mbsf)**

UNIT 3: CRYSTAL-VITRIC TUFF BRECCIA

CONTACTS: None.

COLOR: Pale green.

ALTERATION: Very high.

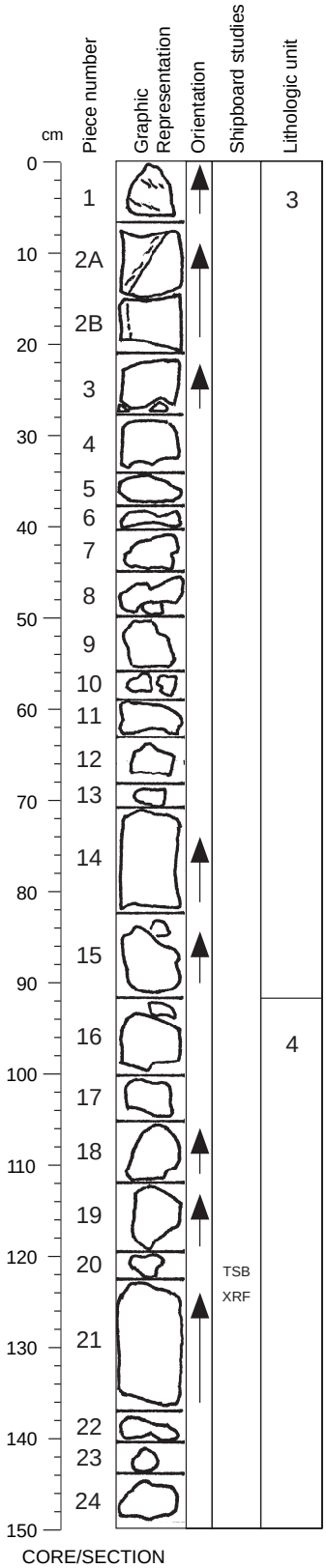
GENERAL DESCRIPTION:

This section contains highly altered, green crystal-vitric tuff breccia. Most of the section is massive internally, but some banding is present near the top. The material is crystal-rich, and less consolidated intervals crumble to a very coarse sand dominated by feldspar crystals and relict perlite kernels in a pale green, clay-rich matrix. This matrix probably formed by alteration of volcanic glass. The clastic texture may have formed by alteration of coherent volcanic rock to clay. The rock is dissected by numerous fault planes and contains abundant slickensides.

LITHOLOGIC AND TEXTURAL FEATURES:

0-15 cm:	Pale green, banded (on a mm scale), crystal-rich, moderately indurated, tuff breccia; crystals are ≤2 mm.

Core Photo



183-1139A-57R-1 **Section top: 536.90 (mbsf)**

UNIT 3: CRYSTAL-VITRIC TUFF BRECCIA

Pieces: 1-15

CONTACTS: Not recovered; the contact between Units 3 and 4 is inferred to be at 92 cm, between Pieces 15 and 16.

COLOR: Pale green to dark green.

ALTERATION: Very high.

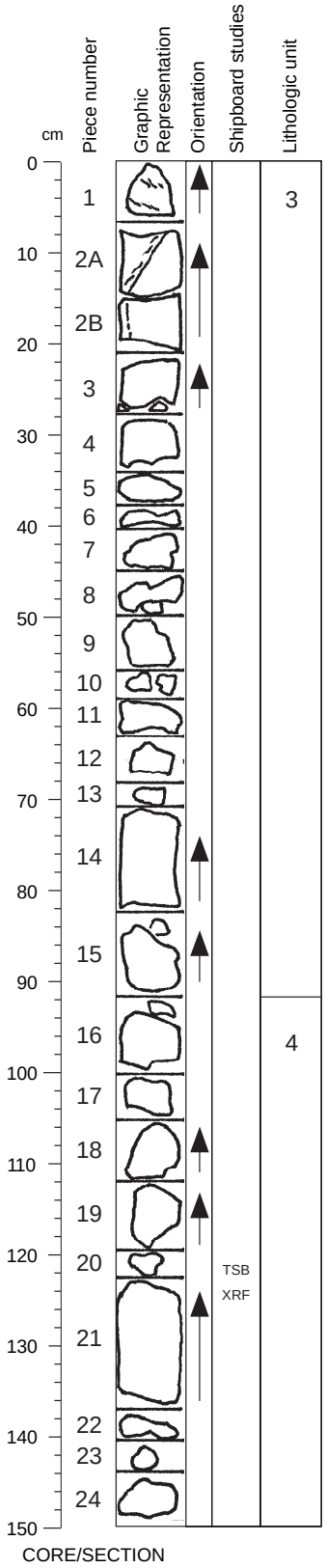
GENERAL DESCRIPTION:

This section contains highly altered, green crystal-vitric tuff breccia. Much of the section is massive internally, although it contains some cobbles and boulders (e.g., at 7-40 cm) and laminations. Whether the laminations are primary, internal within clasts, or caused by shearing is unclear. Recovery consisted of many small pieces (and some more-indurated larger pieces); extrapolation of textures across pieces is difficult. The material is crystal-rich, and less consolidated sections crumble to feldspar crystals and relict perlite kernels in a pale green, clay-rich matrix. The matrix probably formed by alteration of volcanic glass. Toward the base of the section, the sand is more coarsely crystalline and a darker green. The clastic texture may result from alteration of coherent volcanic rock to clay. Part of a large, finer-grained clast may be present from 7-40 cm (Pieces 2A-6).

LITHOLOGIC AND TEXTURAL FEATURES:

0-7 cm:	Pale green, banded (on a mm scale), crystal-rich (crystals ≤2 mm), indurated, tuff breccia with sheared, cataclastic fabric.
7-14 cm:	A contact is present between tuff breccia and a more massive, pale green, altered and silicified, crystal-rich clast with slightly smaller crystals (<1.5 mm).
14-38 cm:	Pale green, altered and silicified, crystal-rich clast (crystals <1.5 mm).
38-40 cm:	A transitional piece (Piece 6); tuff similar to that at 7-14 cm, but darker green and more similar to material along fractures in clasts between 40 and 92 cm.
40-45 cm:	Half of this interval is breccia and half is a massive, dark matrix with preserved crystals, similar to that in clasts in the underlying interval. Some red oxidation is present along fractures in clasts.
45-80 cm:	Dark green, massive, crystal-rich (crystals <3mm), indurated, tuff.
80-82 cm:	Pale green, finer-grained base to the 45-80 cm interval.
82-92 cm:	An irregular but sharp contact between pale green, fine-grained, crystal-rich (feldspar and quartz) clast and dark green, less-crystal-rich tuff present; the boundary includes an irregular, oxidized "flame" structure.

Core Photo



183-1139A-57R-1 **Section top: 536.90 (mbsf)**

UNIT 4: SPARSELY SANIDINE-PHYRIC RHYOLITE

Pieces: 16-24

CONTACTS: Not recovered; the contact between Units 3 and 4 is inferred to be at 92 cm, between Pieces 15 and 16.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Sanidine:	2	3	0.5	1.2	Subhedral, tabular, and anhedral, equant; relatively fresh
Oxides:	trace			<0.5	Anhedral, equant

GROUNDMASS: Fine grained, with poorly developed, aphanitic, bands.

VESICLES: None.

COLOR: Reddish brown with golden patches and streaks.

STRUCTURE: Massive in Pieces 17-23; brecciated in Pieces 16 and 24. Piece 21 has subvertical banding.

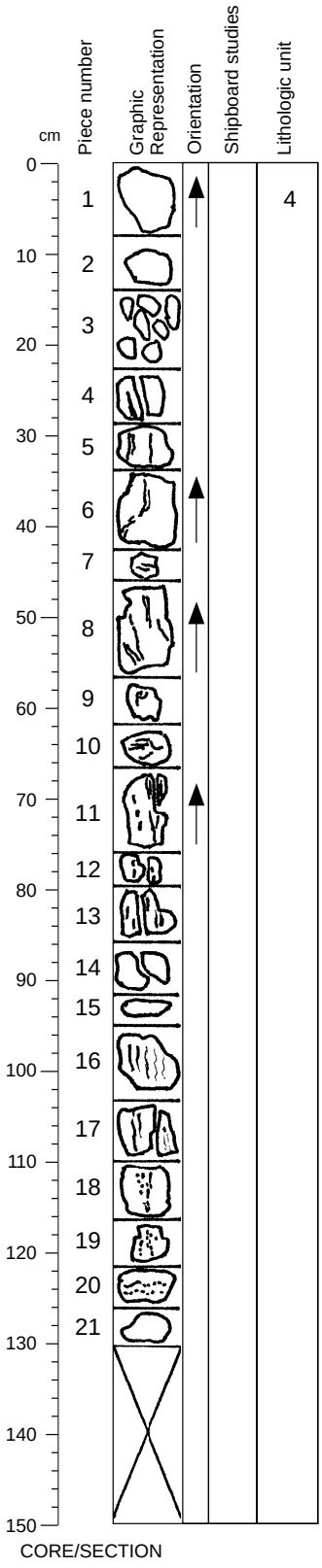
ALTERATION: Moderate to high.

VEINS/FRACTURES: All pieces have irregular, <1-mm-wide veins filled with reddish brown to yellowish clay; veins form a network in Piece 16. Light brown oxidation haloes surround most veins.

COMMENTS:

Unit 4 was recovered as a series of pebble- to cobble-size pieces; thus, the relationship among pieces is difficult to determine. The pieces in the upper part of Unit 4 are dominated by massive but banded, welded rhyolite that is agglutinated and indurated. Flattening of rhyolitic clasts and alignment of spaces between welded clasts has produced a fabric. Some larger (<10 cm) clasts are fused along subvertical sutures. This part of Unit 4 is texturally very similar to Unit 2 (welded rhyolite lapilli).

Core Photo



183-1139A-57R-2 **Section top: 538.40 (mbsf)**

UNIT 4: MODERATELY SANIDINE-PHYRIC RHYOLITE

Pieces: 1-21

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	10	3	1	2	Euhedral to anhedral

GROUNDMASS: Fine grained.

VESICLES: Sparsely to moderately vesicular. Vesicles are highly irregular, <1 mm to 10 mm; most are empty.

COLOR: Reddish brown with yellowish orange patches and streaks. Most pieces have a poorly developed, yellowish orange banding (oxidation).

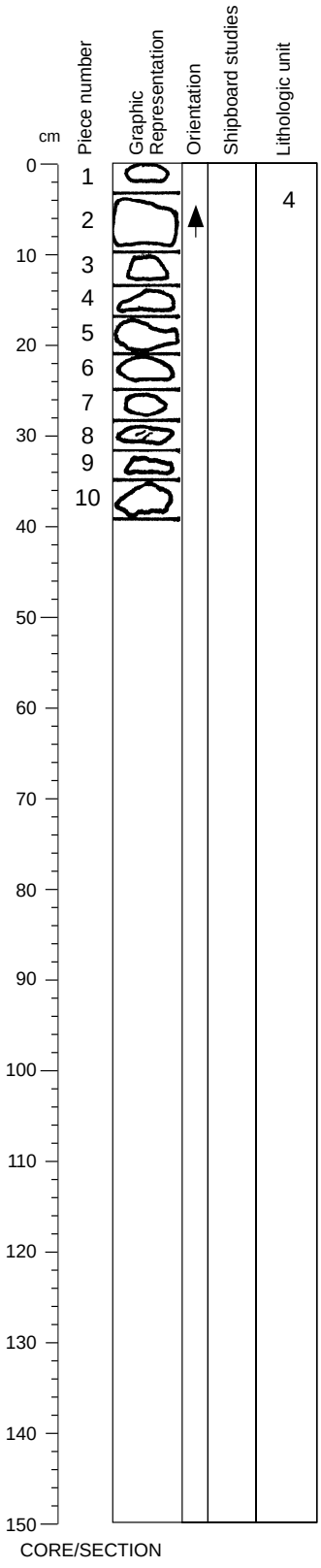
STRUCTURE: Pieces 2-21 are massive; Piece 1 is brecciated.

ALTERATION: Moderate.

VEINS/FRACTURES: None.

COMMENTS: The pieces in the central part of Unit 4 are massive (welded) to brecciated rhyolite that does not show agglutination textures. Slickensides are common.

Core Photo



183-1139A-58R-1 **Section top: 546.50 (mbsf)**

UNIT 4: MODERATELY SANIDINE-PHYRIC RHYOLITE

Pieces: 1-10

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	10	2	0.7	1.2	Euhedral to anhedral

GROUNDMASS: Fine grained.

VESICLES: Sparsely to moderately vesicular.

COLOR: Reddish brown to pale reddish gray, with orange streaks.

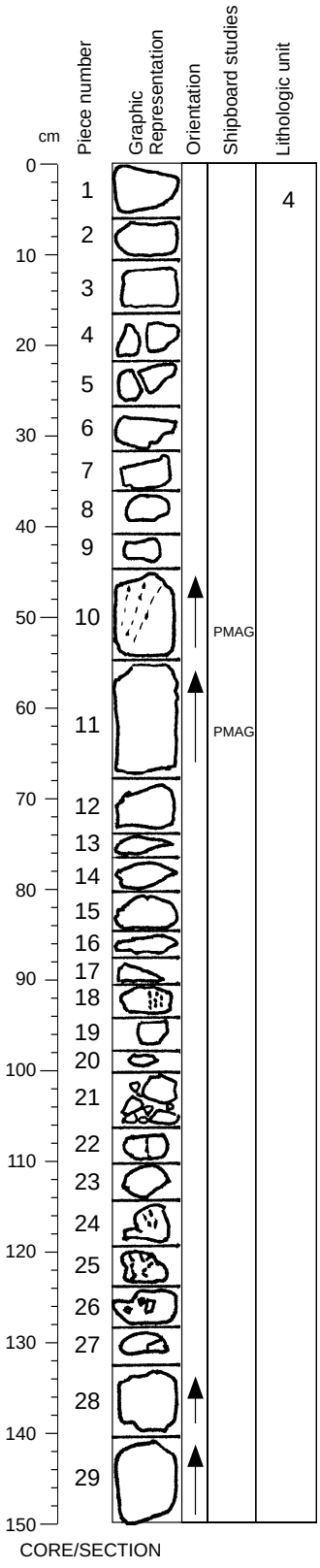
STRUCTURE: Massive, with minor brecciation.

ALTERATION: High.

VEINS/FRACTURES: None.

COMMENTS:

Core Photo



183-1139A-59R-1 **Section top: 556.00 (mbsf)**

UNIT 4: MODERATELY SANIDINE-PHYRIC RHYOLITIC BRECCIA

Pieces: 1-29

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	5	3	0.3	0.5	Round, anhedral

GROUNDMASS: Aphanitic.

VESICLES: Very sparsely vesicular to nonvesicular.

COLOR: Orange.

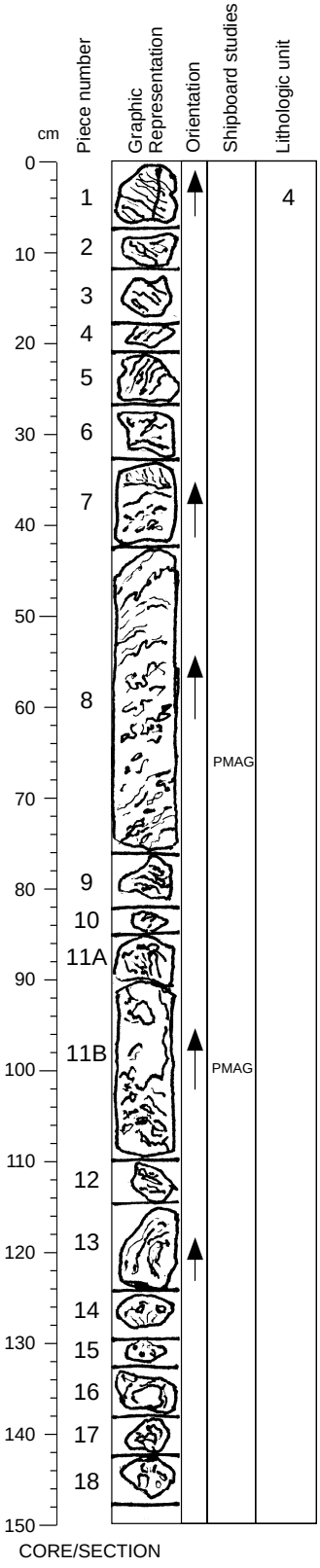
STRUCTURE: Dominantly brecciated (with some cataclasis); locally massive.

ALTERATION: High to moderate.

VEINS/FRACTURES: None.

COMMENTS: Round, 1-5 mm, whitish patches of radiating, devitrified glass are delineated by fine grains of secondary iron oxide.

Core Photo



183-1139A-60R-1 **Section top: 565.60 (mbsf)**

UNIT 4: MODERATELY SANIDINE-PHYRIC RHYOLITIC BRECCIA

Pieces: 1-18

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	5	2	0.3	0.5	Subhedral to anhedral, elongate and round

GROUNDMASS: Aphanitic.

VESICLES: Nonvesicular to very sparsely vesicular.

COLOR: Orange.

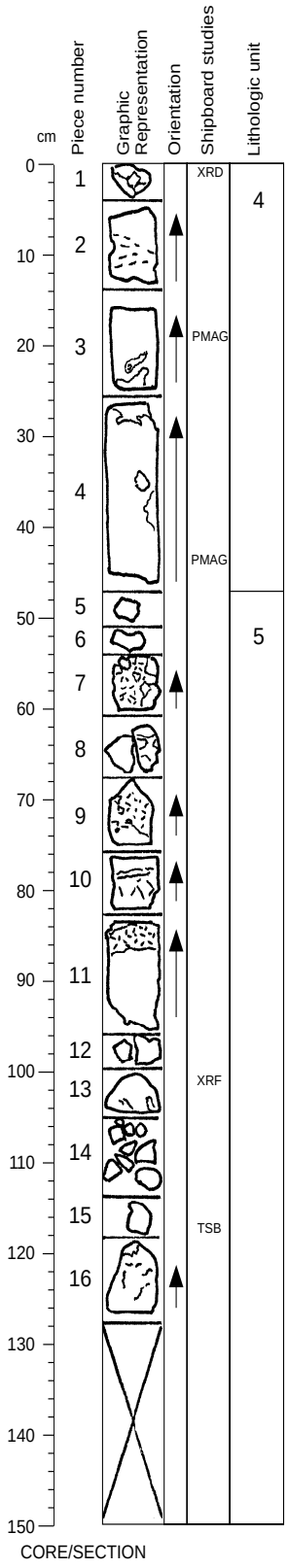
STRUCTURE: Brecciated.

ALTERATION: High.

VEINS/FRACTURES: None.

COMMENTS: Round, 1-5 mm, whitish patches of radiating, devitrified glass are delineated by fine grains of secondary iron oxide.

Core Photo



183-1139A-60R-2 **Section top: 567.08 (mbsf)**

UNIT 4: MODERATELY SANIDINE-PHYRIC RHYOLITE BRECCIA

Pieces: 1-4

CONTACTS: Not recovered; the inferred contact between Units 4 and 5 is between Pieces 4 and 5, at ~47 cm.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Sanidine:	5	2	0.3	0.5	Anhedral and subhedral, round and laths

GROUNDMASS: Aphanitic.

VESICLES: Nonvesicular.

COLOR: Orange.

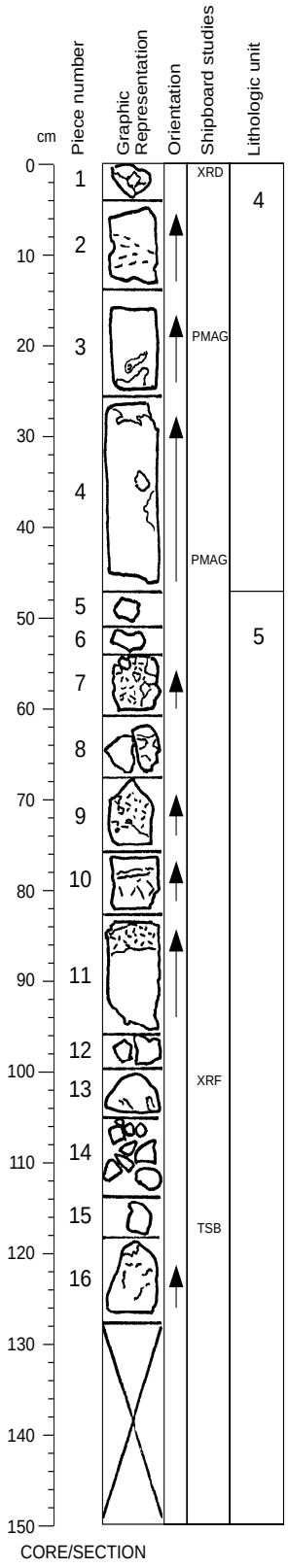
STRUCTURE: Brecciated.

ALTERATION: High.

VEINS/FRACTURES: None.

COMMENTS: Round, 1-5 mm, whitish patches of radiating, devitrified glass are delineated by fine grains of secondary iron oxides.

Core Photo



183-1139A-60R-2 **Section top: 567.08 (mbsf)**

UNIT 5: MODERATELY FELDSPAR-PHYRIC TRACHYTE BRECCIA

Pieces: 5-16

CONTACTS: Not recovered; the inferred contact between Units 4 and 5 is between Pieces 4 and 5, at ~47 cm.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Feldspar:	10	5	1	2	Euhedral to anhedral, elongate and round

GROUNDMASS: Aphanitic.

VESICLES: Sparsely vesicular. Vesicles are small, irregular, and filled with pale green clay.

COLOR: Reddish brown with paler brown clasts.

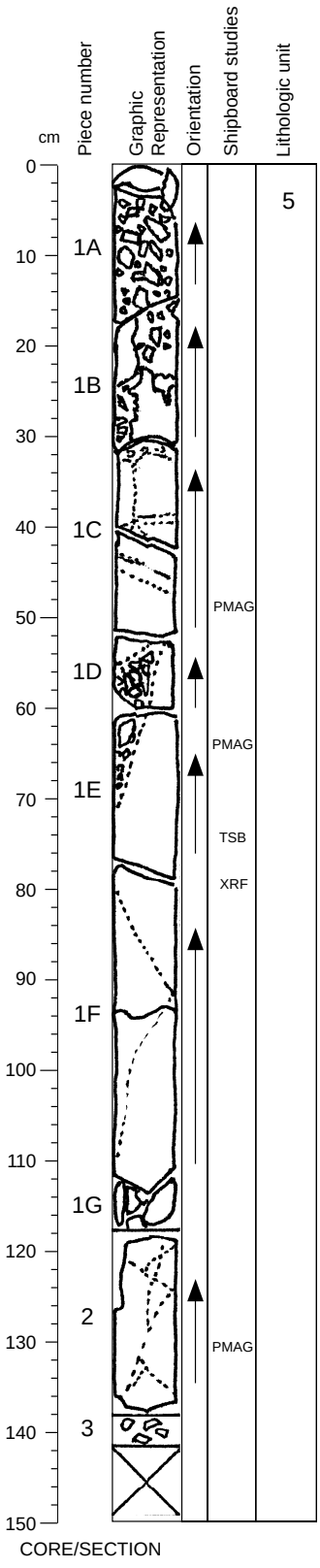
STRUCTURE: Brecciated. Clasts are subround (mostly 1-3 cm) in an aphanitic matrix.

ALTERATION: High. Clasts commonly have a 1- to 2-mm-thick green alteration rim that does not extend into the matrix of red clay and small wall rock fragments.

VEINS/FRACTURES: An irregular subvertical vein with white, slightly silicified margins is present.

COMMENTS: Feldspar grains are fresher than in Sections 59R-1 through 60R-1.

Core Photo



183-1139A-61R-1 **Section top: 575.20 (mbsf)**

UNIT 5: MODERATELY FELDSPAR-PHYRIC TRACHYTE AND TRACHYTE BRECCIA

Pieces: 1-3

CONTACTS: Not recovered.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Feldspar:	5	6	1	3.5	Euhedral laths; commonly in glomerocrysts; brownish red
White clay pseudomorphs:	<1	1.5	0.25	0.75	Euhedral laths and octagons, and anhedral equant; commonly with feldspar in glomerocrysts
Clinopyroxene and mafic pseudomorphs:	trace	1	0.25	0.5	Suhedral, equant; commonly in glomerocrysts with feldspar; pseudomorphs are green
Oxides:	trace			<0.25	Anhedral; isolated crystals and in glomerocrysts with feldspar

GROUNDMASS: Fine grained. In places, alignment of groundmass feldspars forms trachytic texture.

VESICLES: None.

COLOR: Pinkish gray, with green clast rims and green streaks in brecciated and vein-networked areas.

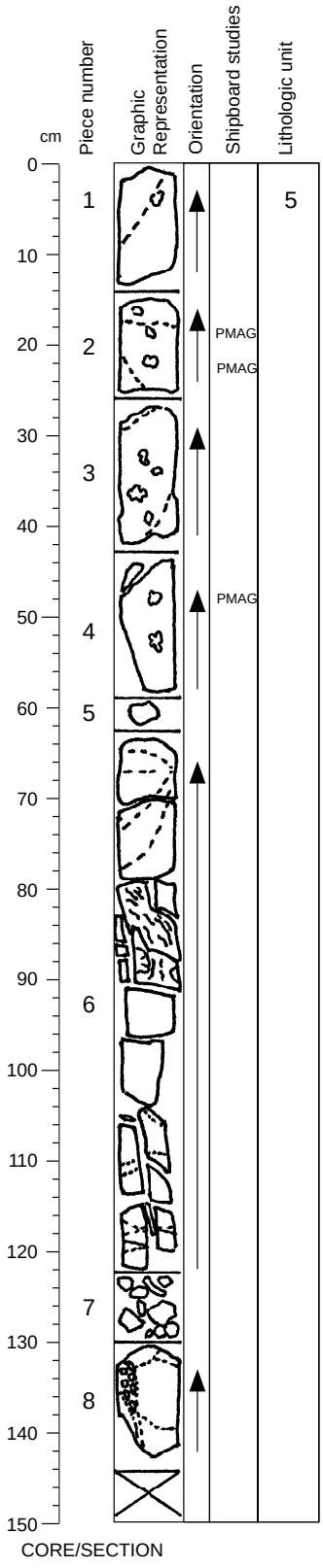
STRUCTURE: Brecciated from 0-32 cm, 52-69 cm, 83-90 cm, and in all of Piece 2. Massive between brecciated intervals.

ALTERATION: High.

VEINS/FRACTURES: Numerous veins form a network in most of the section. Dark red, 1- to 2-mm-wide clay veins have 1- to 2-mm-wide haloes of pale green (bleached) wallrock.

COMMENTS: Interpreted as a fault zone with breccia clasts dissected by fracturing.

Core Photo



183-1139A-61R-2 **Section top: 576.62 (mbsf)**

UNIT 5: MODERATELY FELDSPAR-PHYRIC TRACHYTE AND TRACHYTE BRECCIA

Pieces: 1-8

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Feldspar:	5	6	05	2	Euhedral laths; commonly in glomerocrysts
White clay pseudomorphs:	<1	0.5	0.13	0.25	Anhedral, equant
Clinopyroxene and mafic pseudomorphs:	<1	2	0.25	0.5	Subhedral to anhedral, equant; pseudomorphs are greenish brown

GROUNDMASS: Fine grained; a trachytic groundmass texture is evident in places.

VESICLES: None.

COLOR: Pinkish gray; some parts are greenish gray, particularly in more highly brecciated areas.

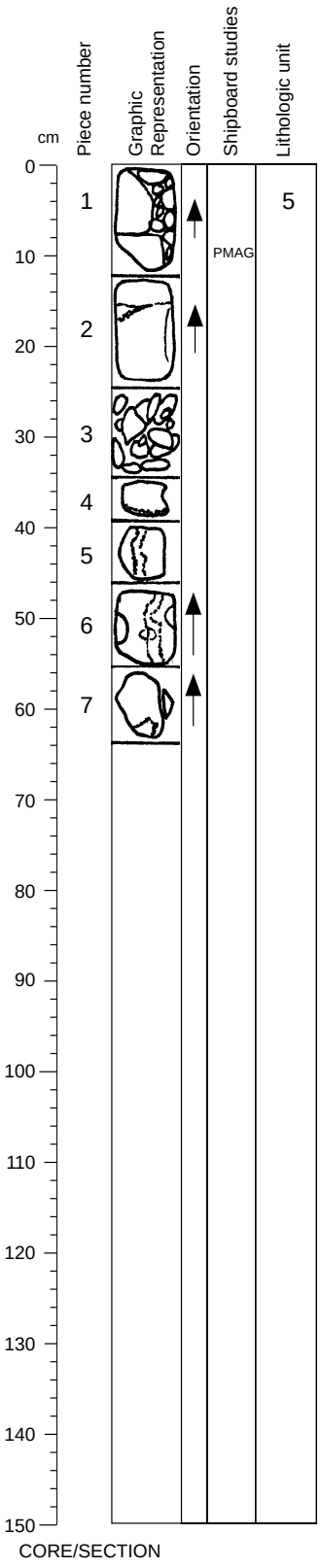
STRUCTURE: Massive from 0-63 cm and 91-102 cm. Brecciated from 63-91 cm and 102-143 cm.

ALTERATION: High; locally very high. White, irregular, 1- to 2-cm patches contain clay that is similar to clay in the white phenocryst pseudomorphs. In heavily veined areas, clasts are completely altered to clay.

VEINS/FRACTURES: Numerous, dark red, clay-filled veins form a network; green alteration haloes surround veins.

COMMENTS: Glomerocrysts are mostly feldspar. Abundant veining enhances brecciated structure from 63-91 cm and 102-143 cm.

Core Photo



183-1139A-61R-3 **Section top: 578.07 (mbsf)**

UNIT 5: MODERATELY FELDSPAR-PHYRIC TRACHYTE BRECCIA

Pieces: 1-7

CONTACTS: Not recovered; the contact between Units 5 and 6 is inferred to be between Sections 61R-3 and 62R-1.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Feldspar:	5	5	0.5	1.5	Euhedral laths; commonly in glomerocrysts; yellowish red
Mafic pseudomorphs:	<1	1	0.25		Subhedral to anhedral, equant; commonly in glomerocrysts with feldspar; yellow
Oxide:	trace			<0.25	In glomerocrysts with feldspar

GROUNDMASS: Fine grained.

VESICLES: None.

COLOR: Greenish gray clasts are in a reddish brown matrix.

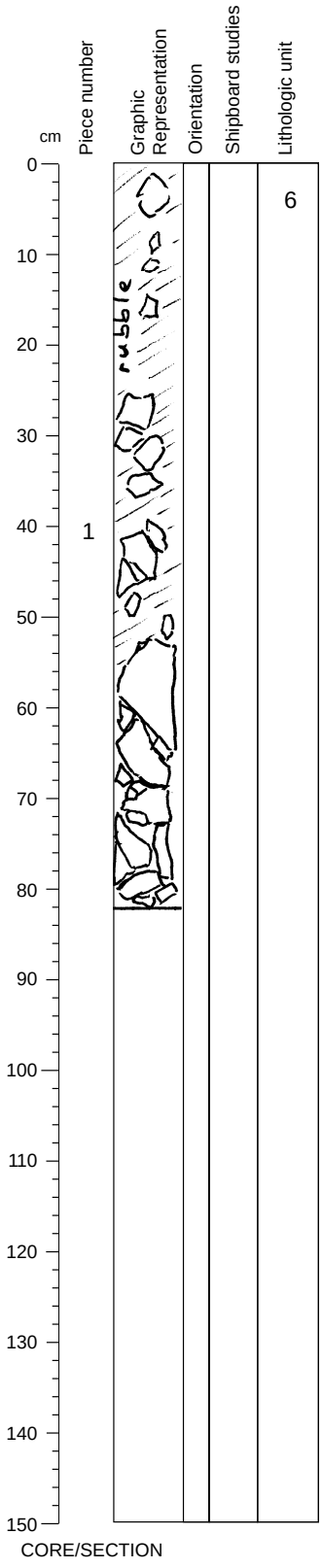
STRUCTURE: Brecciated.

ALTERATION: High; locally very high.

VEINS/FRACTURES: Less-brecciated areas are networked by hairline veins filled with dark red clay.

COMMENTS: Rare, white clay patches in the cores of the yellow mafic-phenocryst pseudomorphs are similar to clay in the white phenocryst pseudomorphs in Sections 61R-1 and 61R-2.

Core Photo



183-1139A-62R-1 **Section top: 584.90 (mbsf)**

UNIT 6: APHYRIC TRACHYBASALT AND TRACHYBASALT BRECCIA

Pieces: 1

CONTACTS: Not recovered; the contact between Units 5 and 6 is inferred to be between Sections 61R-3 and 62R-1.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	<1	0.4	0.1		Euhedral laths

GROUNDMASS: Aphanitic.

VESICLES: Sparsely vesicular; vesicles are ≤2 mm, elliptical, and filled with white clay.

COLOR: Dark gray to dark brown.

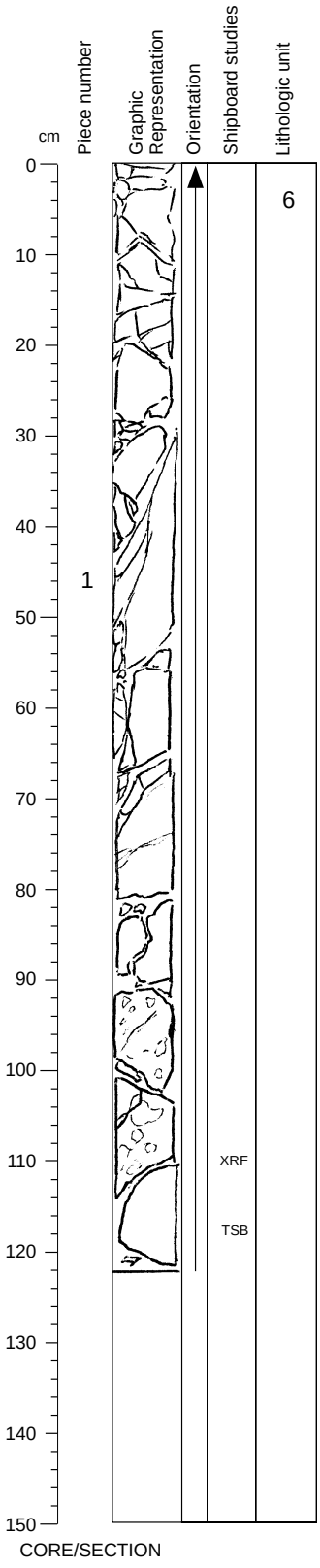
STRUCTURE: From 0-50 cm, the rock is ~70% massive and ~30% brecciated; from 50-83 cm, it is brecciated. In the 56-70 cm interval, the breccia clasts are subangular to irregular with rounded protrusions; below 72 cm, they are subangular to angular. Slickensides are abundant on the edges of many clasts.

ALTERATION: High to complete. Clasts are altered to clay.

VEINS/FRACTURES: Extremely fractured; most of the section is shattered to fine angular fragments, obscuring many of the rock's original characteristics.

COMMENTS:

Core Photo



183-1139A-62R-2 **Section top: 585.73 (mbsf)**

UNIT 6: APHYRIC TRACHYBASALT BRECCIA AND TRACHYBASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	4	0.5		Euhedral laths and anhedral equant

GROUNDMASS: Aphanitic.

VESICLES: Sparsely vesicular; vesicles are <1 mm and filled with white clay.

COLOR: Dark gray to dark brown.

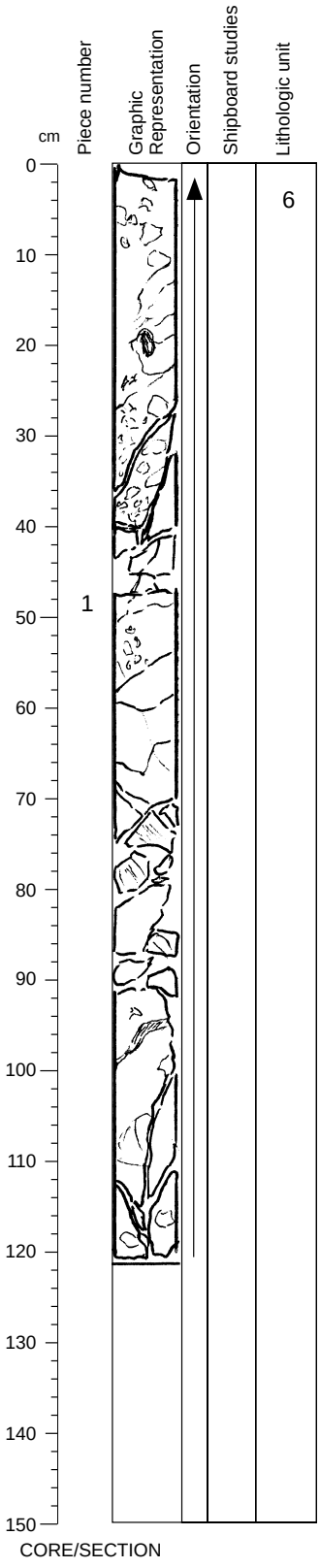
STRUCTURE: Brecciated from 0-16 cm, 34-50 cm, and 92-112 cm; massive elsewhere. A fault surface dips ~60° in the 67-74 cm interval.

ALTERATION: High to complete.

VEINS/FRACTURES: Numerous irregular fractures are present, particularly in the upper part of the section.

COMMENTS: Section consists of highly altered clasts in a red clay matrix, and becomes more coherent in intervals where clasts are more abundant than matrix.

Core Photo



183-1139A-62R-3 **Section top: 586.93 (mbsf)**

UNIT 6: APHYRIC TRACHYBASALT BRECCIA

Pieces: 1

CONTACTS: None.

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

GROUNDMASS: Aphanitic.

VESICLES: Many clasts are highly vesicular; vesicles are <0.5 mm, irregular to elongate, and filled with white clay.

COLOR: Medium gray to reddish brown fragments in reddish brown matrix.

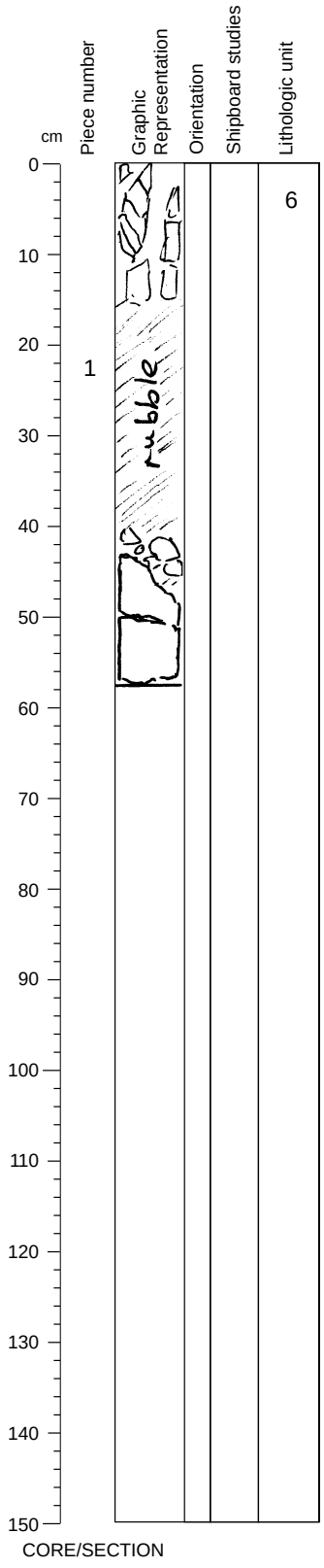
STRUCTURE: Brecciated. Clasts (<1 to 5 mm) are rounded. Banded texture is present at ~75 cm.

ALTERATION: High to complete.

VEINS/FRACTURES: Abundant fractures with irregular orientations and slickensides.

COMMENTS: Irregular and elongate vesicles in clasts suggest plastic deformation.

Core Photo



183-1139A-62R-4 **Section top: 588.13 (mbsf)**

UNIT 6: APHYRIC TRACHYBASALT BRECCIA

Pieces: 1

CONTACTS: None.

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

GROUNDMASS: Aphanitic.

VESICLES: Sparsely vesicular; vesicles are <1 mm and, in some fragments, clay-filled.

COLOR: Dark grayish brown.

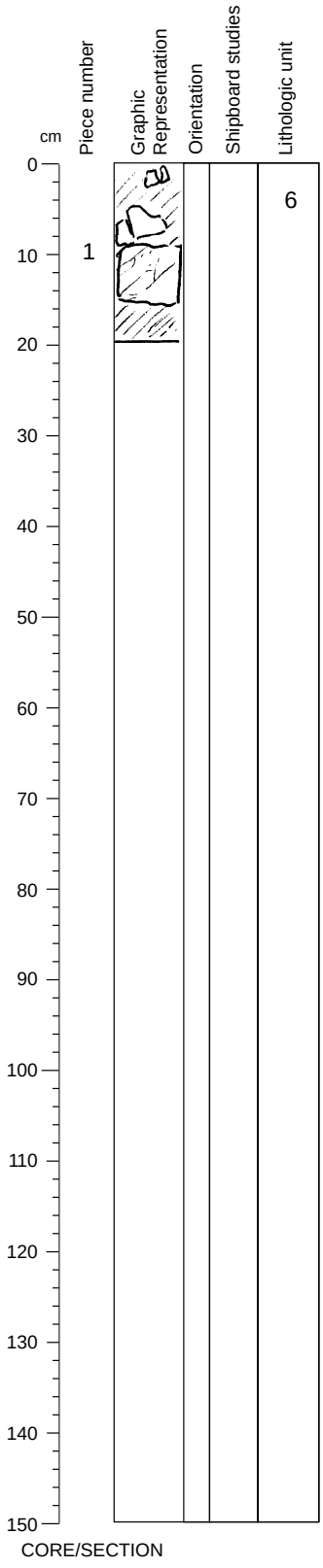
STRUCTURE: Brecciated; clasts are 1-3 cm and irregular with rounded protrusions.

ALTERATION: High to complete.

VEINS/FRACTURES: Numerous fractures with slickensides throughout section; rock is shattered from 0-45 cm.

COMMENTS: Description of section is based mainly on the unshattered interval below 45 cm.

Core Photo



183-1139A-62R-5 **Section top: 588.69 (mbsf)**

UNIT 6: APHYRIC TRACHYBASALT BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS: None.

GROUNDMASS: Aphanitic.

VESICLES: Very sparsely vesicular to nonvesicular.

COLOR: Dark gray and dark brown.

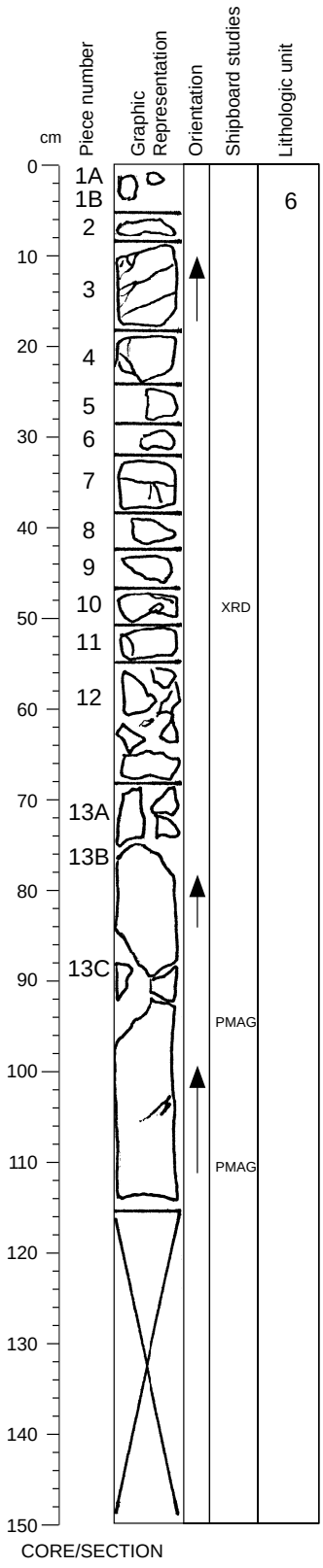
STRUCTURE: Brecciated.

ALTERATION: High to complete.

VEINS/FRACTURES: Section is shattered, except for several fragments; largest fragment contains numerous thin, subhorizontal veins filled with white clay. Slickensides are common.

COMMENTS:

Core Photo



183-1139A-63R-1 **Section top: 594.60 (mbsf)**

UNIT 6: APHYRIC TRACHYBASALT AND TRACHYBASALT BRECCIA

Pieces: 1-13

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	trace	4			Euhedral

GROUNDMASS: Fine grained. Groundmass of Piece 4 is rich in oxides. In Pieces 12 and 13, oxides are concentrated near vesicles.

VESICLES: Sparsely vesicular; vesicles are subround to elongate to subangular, and filled with concentric bands of brownish orange zeolite.

COLOR: Medium blue gray.

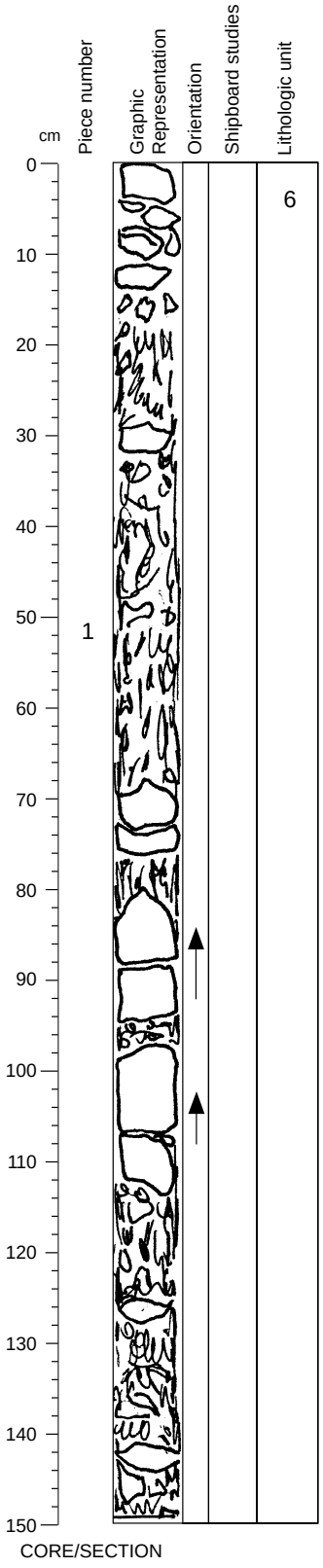
STRUCTURE: Pieces 1-11 and 13C are massive. Pieces 12-13B are brecciated; clasts are ≤2 cm and angular.

ALTERATION: Moderate to locally high.

VEINS/FRACTURES: Numerous ≤1-mm-thick veins are filled with amorphous white clay.

COMMENTS: Piece 4 has subparallel, reddish brown (hematite and/or goethite?) alteration bands following either originally glass-rich zones or zones of weakness; vesicles in this piece are aligned in the same plane.

Core Photo



183-1139A-63R-2 **Section top: 595.77 (mbsf)**

UNIT 6: APHYRIC TRACHYBASALT AND TRACHYBASALT BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS: None.

GROUNDMASS: Fine grained. Contains sparse (~1%), ~0.4-mm, anhedral to euhedral feldspar microphenocrysts. Trace amounts of ~0.3-mm (secondary?) oxides occur near vesicle boundaries.

VESICLES: Moderately vesicular. Vesicles are ≤6 mm and subround to subangular. Some contain trace amounts of oxide.

COLOR: Medium bluish gray; purplish and brownish gray in the brecciated zones.

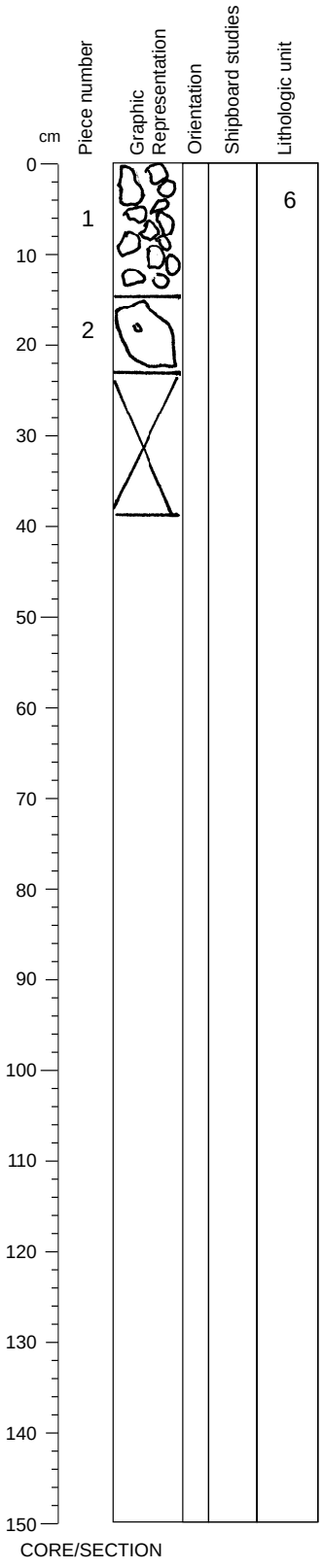
STRUCTURE: Massive from 0-10 cm; brecciated from 80-113 cm; brecciated and/or shattered rubble between 10 and 80 cm.

ALTERATION: High to complete. Both clasts and matrix are altered to clay and white zeolite.

VEINS/FRACTURES: Clay-filled veins are pervasive, especially from 80-113 cm; veins are generally <2 mm thick, but rarely as large as 1 cm.

COMMENTS:

Core Photo



183-1139A-63R-3 **Section top: 597.28 (mbsf)**

UNIT 6: APHYRIC TRACHYBASALT

Pieces: 1-2

CONTACTS: Not recovered; the contact between Units 6 and 7 is inferred to be between Sections 63R-3 and 64R-1.

PHENOCRYSTS: None.

GROUNDMASS: Fine grained.

VESICLES: Piece 2 is sparsely vesicular; Piece 1 is moderately vesicular. Vesicles are round (≤2.5 mm) to irregular (1-5 mm), and filled with amorphous green and white carbonate, commonly with colliform texture.

COLOR: Medium bluish gray.

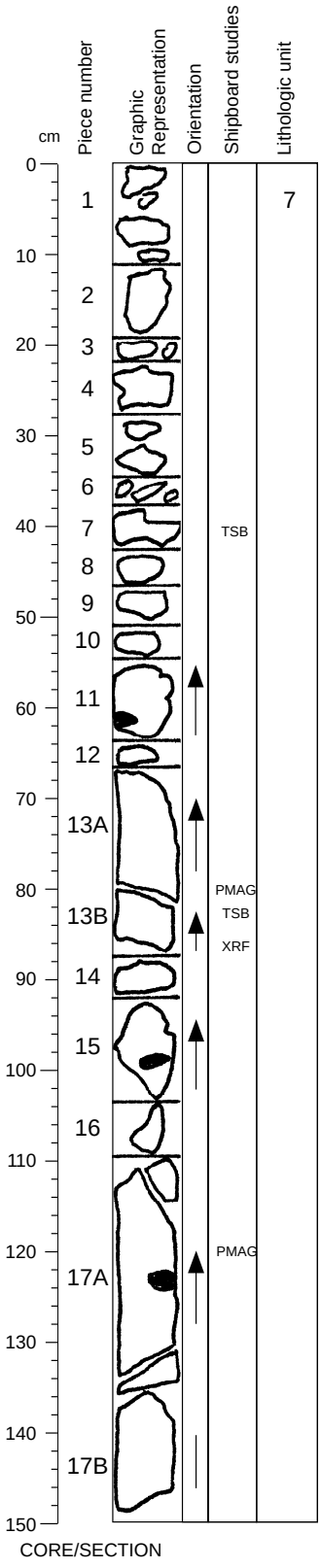
STRUCTURE: Massive.

ALTERATION: Moderate to locally high. Goethite and hematite patches are present.

VEINS/FRACTURES: In the interval from 20-22 cm, a network of <2-mm-thick veins is filled with white carbonate.

COMMENTS:

Core Photo



183-1139A-64R-1 **Section top: 604.20 (mbsf)**

UNIT 7: SPARSELY FELDSPAR-PHYRIC TO APHYRIC BASALTIC TRACHYANDESITE BRECCIA

Pieces: 1-17

CONTACTS: Not recovered; the contact between Units 6 and 7 is inferred to be between Sections 63R-5 and 64R-1.

PHENOCRYSTS (PIECES 9-17):	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Feldspar:	1	3	0.5	1	Euhedral to subhedral
Clinopyroxene:	<1	0.5	0.1		Subhedral

GROUNDMASS: Aphanitic in Pieces 1-6; fine grained in Pieces 7-17.

VESICLES: Sparsely (Pieces 1-6, 9-17) to moderately (Pieces 7, 8) vesicular. Horizontal trains of small vesicles (0.5-1 mm) are filled with orange clay and calcite, zeolite, or amorphous silica.

COLOR: Pieces 1-6 are dark brown with red streaks; Pieces 7 and 8 are pale brown with black bands; Pieces 9-17 are medium to light gray.

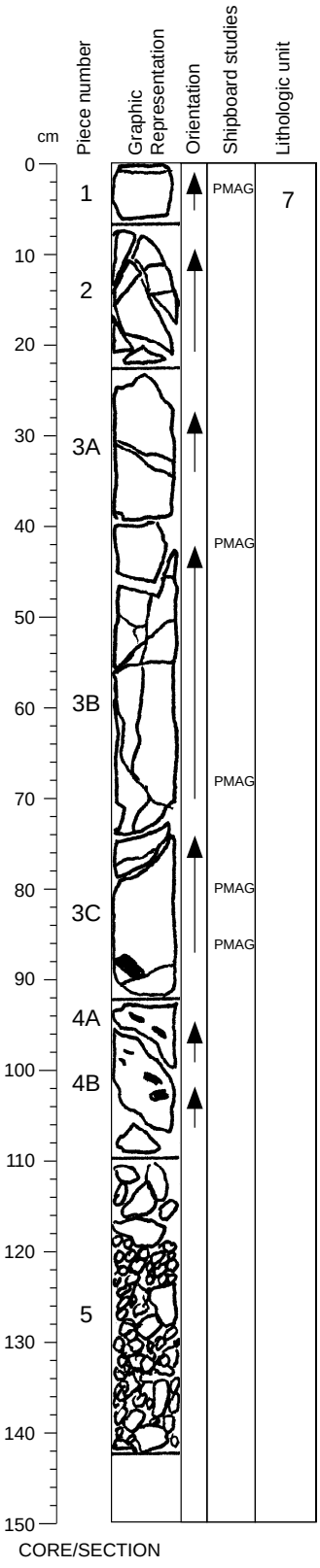
STRUCTURE: Brecciated, except for Piece 8, which is massive.

ALTERATION: Complete in Pieces 1-6; very high in Pieces 7 and 8; high in Pieces 9-17 (clay replaces much of the original groundmass).

VEINS/FRACTURES: None in Pieces 1-8. Pieces 9-17 have horizontal hairline fractures; a 5-mm, inclined fracture in Piece 17A is filled with calcite. Slickensides are common.

COMMENTS: Pieces 1-6 are aphyric; originally glassy breccia is completely replaced by several generations of clay. Pieces 7 and 8 contain indurated sandstone filling spaces around clasts. Pieces 9-17 are sparsely feldspar-phyric.

Core Photo



183-1139A-64R-2 **Section top: 605.70 (mbsf)**

UNIT 7: APHYRIC BASALTIC TRACHYANDESITE

Pieces: 1-5

CONTACTS: Not recovered; the contact between Units 7 and 8 is inferred to be between Sections 64R-2 and 64R-3.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Feldspar:	< 1	1	0.5		Euhedral to subhedral
Clinopyroxene:	< 1	0.5	0.1		Anhedral to subhedral

GROUNDMASS: Fine grained to aphanitic. Abundant carbonate produces a bleached appearance.

VESICLES: Sparsely to moderately vesicular. Vesicles (1-5 mm) are subhorizontally flattened and filled with calcite. Vesicle size and abundance increase from Piece 1 to base of Piece 4.

COLOR: Light gray.

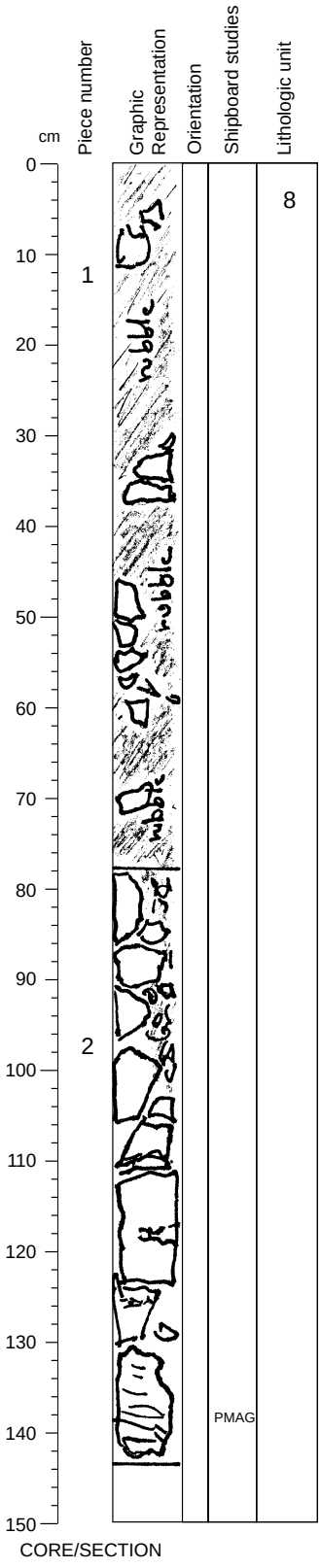
STRUCTURE: Pieces 1-4 are massive; Piece 5 is brecciated rubble.

ALTERATION: Moderate, except in Piece 5, which is highly altered.

VEINS/FRACTURES: Highly fractured. Subvertical and subhorizontal veins (1-10 mm wide) are filled with calcite and orange to red clay, and surrounded by halos of oxidized groundmass. Piece 5 is coated with green and pale gray clay, and has moderately dipping slickensides.

COMMENTS: Base of Piece 4 contains a chill zone.

Core Photo



183-1139A-64R-3 **Section top: 607.14 (mbsf)**

UNIT 8: SPARSELY PLAGIOCLASE-PHYRIC TRACHYBASALT AND TRACHYBASALT BRECCIA

Pieces: 1, 2

CONTACTS: Not recovered; the contact between Units 7 and 8 is inferred to be between Sections 64R-2 and 64R-3.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	1	4	2	2.5	Subhedral laths; fresh

GROUNDMASS: Fine grained.

VESICLES: Sparsely to moderately vesicular from 0-15 cm; moderately vesicular from 77-125 cm; sparsely vesicular from 125-138 cm. Vesicles are ~0.5 mm, round to elongate, and filled with carbonate, green amorphous zeolite, and iron oxyhydroxide.

COLOR: Piece 1 is pinkish pale brown from 0-15 cm and brownish gray from 15-79 cm. Piece 2 is medium gray.

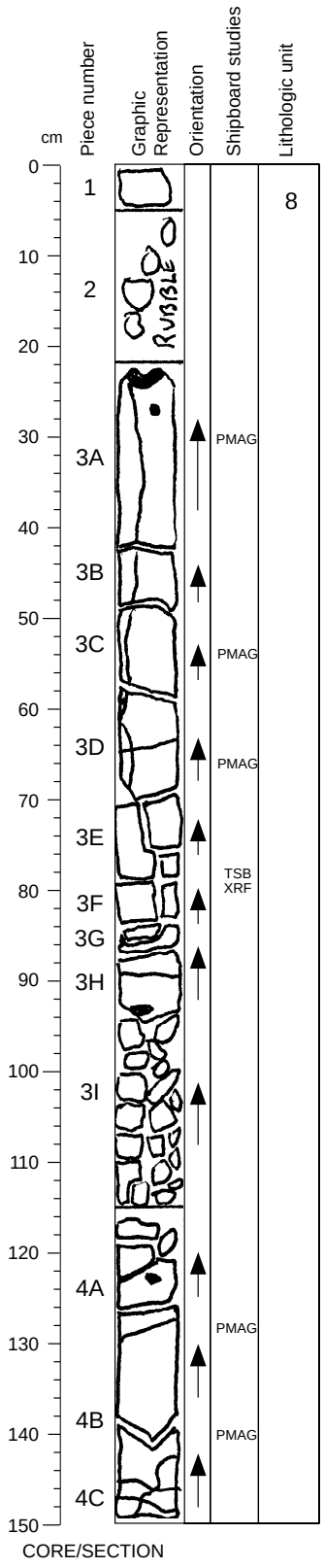
STRUCTURE: Brecciated rubble from 0-95 cm; clasts are angular. Massive (possibly welded breccia) from 95-143 cm.

ALTERATION: Complete in Piece 1; moderate in Piece 2.

VEINS/FRACTURES: Upper part of section is shattered. Veining is pervasive in lower part of section. Veins are filled with carbonate, green and blue clay, zeolite, and iron oxyhydroxide. From 12-78 cm, black clay (probably replacing glass) is veined by blue clay. Slickensides are evident on the surface of a fractured vein.

COMMENTS: Much of the brecciation appears to be a secondary feature, probably caused by veining and fracturing.

Core Photo



183-1139A-64R-4 **Section top: 608.64 (mbsf)**

UNIT 8: APHYRIC TRACHYBASALT

Pieces: 1-4

CONTACTS: None.

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

GROUNDMASS: Fine grained. Contains plagioclase, clinopyroxene, and originally glassy stringers (elongate segregations) now completely altered to dark green clay.

VESICLES: Sparsely vesicular; vesicles are round, 0.5-25 mm in diameter, and filled with carbonate and colliform-textured zeolite.

COLOR: Light gray.

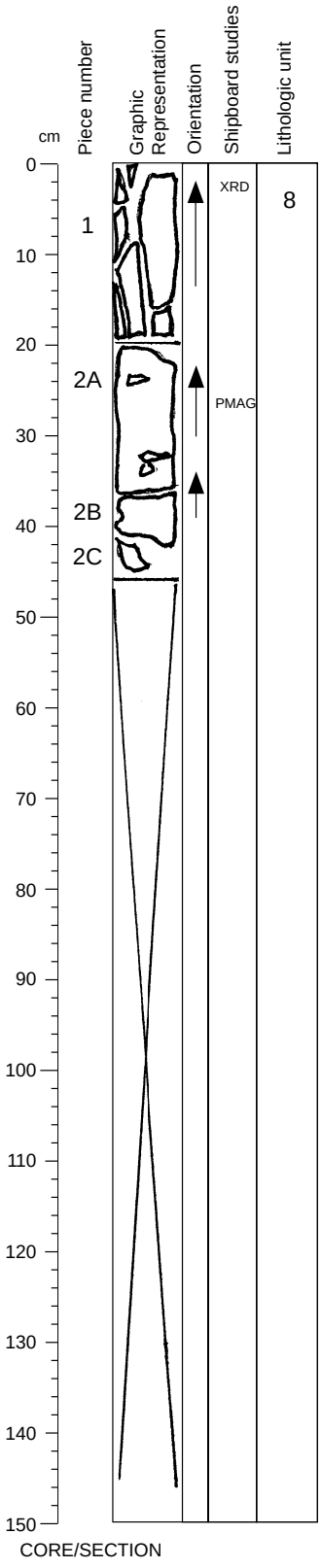
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Numerous carbonate-filled veins are present. In Piece 3, orthogonal <1-mm-wide, clay-filled veinlets have broken the rock into numerous pieces.

COMMENTS:

Core Photo



183-1139A-64R-5 **Section top: 610.14 (mbsf)**

UNIT 8: APHYRIC TRACHYBASALT

Pieces: 1, 2

CONTACTS: Not recovered; the contact between Units 8 and 9 is inferred to be between Sections 64R-5 and 65R-1.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	trace				

GROUNDMASS: Fine grained. Contains plagioclase, clinopyroxene, and originally glassy stringers now completely altered to dark green clay.

VESICLES: Vesicularlity varies from sparse at top to moderate at base of section. Vesicles (1-30 mm) are elongate and subhorizontal, particularly in Piece 2; filled with carbonate, zeolite, and less abundant clay.

COLOR: Medium light gray; light brownish gray in lower part of Piece 2.

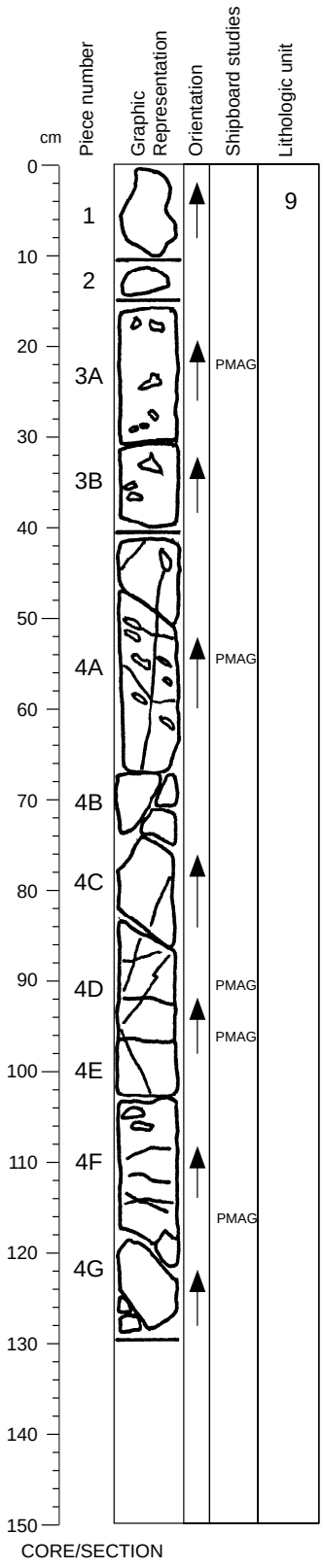
STRUCTURE: Massive.

ALTERATION: Slight to moderate. High in the more vesicular areas of Piece 2.

VEINS/FRACTURES: Vertical carbonate-filled veins (1-2 mm wide) extend through both pieces. Several subhorizontal veins (<1 mm wide) are also present.

COMMENTS:

Core Photo



183-1139A-65R-1 **Section top: 613.90 (mbsf)**

UNIT 9: APHYRIC TRACHYBASALT

Pieces: 1-4

CONTACTS: Not recovered; contact between Units 8 and 9 is inferred to be between Sections 64R-5 and 65R-1.

PHENOCRYSTS: None.

GROUNDMASS: Fine grained. Contains plagioclase, clinopyroxene, and originally glassy stringers now completely altered to dark green clay.

VESICLES: Pieces 1-4A are highly vesicular; Pieces 4B-4G are moderately vesicular. Vesicles are 1-35 mm, round to elongate ovoids which, in Piece 4A, form trails dipping ~45°. Carbonate and zeolite fill vesicles (less zeolite is present toward the base of the section).

COLOR: Pieces 1 and 2 are brownish gray; Pieces 3 and 4 are medium gray.

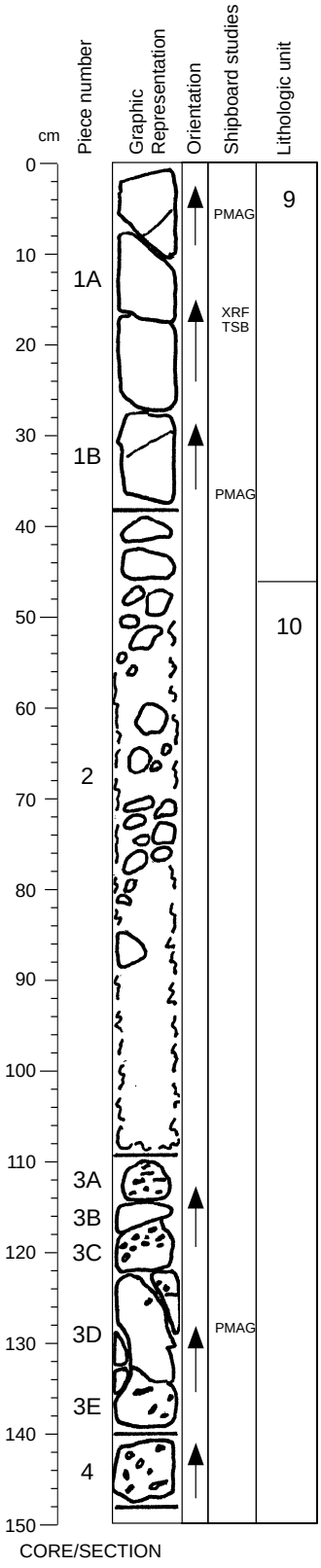
STRUCTURE: Pieces 2-4 are massive; Piece 1 is brecciated.

ALTERATION: Moderate to high.

VEINS/FRACTURES: Veins are pervasive, 1-2 mm wide, and filled with carbonate and some clay.

COMMENTS: A chilled clast margin is present at the top of Piece 1.

Core Photo



183-1139A-65R-2 **Section top: 615.20 (mbsf)**

UNIT 9: APHYRIC TRACHYBASALT AND TRACHYBASALT BRECCIA

Pieces: 1, 2

CONTACTS: Not recovered; the contact between Units 9 and 10 is inferred to be at ~46 cm depth, within Piece 2.

PHENOCRYSTS: None.

GROUNDMASS: Very fine grained to aphanitic. Original glass, altered to dark green clay, forms stringers ~1 cm long.

VESICLES: Piece 1 is sparsely vesicular. Piece 2 is moderately vesicular, with a highly vesicular region from 40-50 cm. Vesicles are 1-10 mm, angular to round or elongate, and filled with carbonate.

COLOR: Piece 1 is medium light gray; Piece 2 is greenish black.

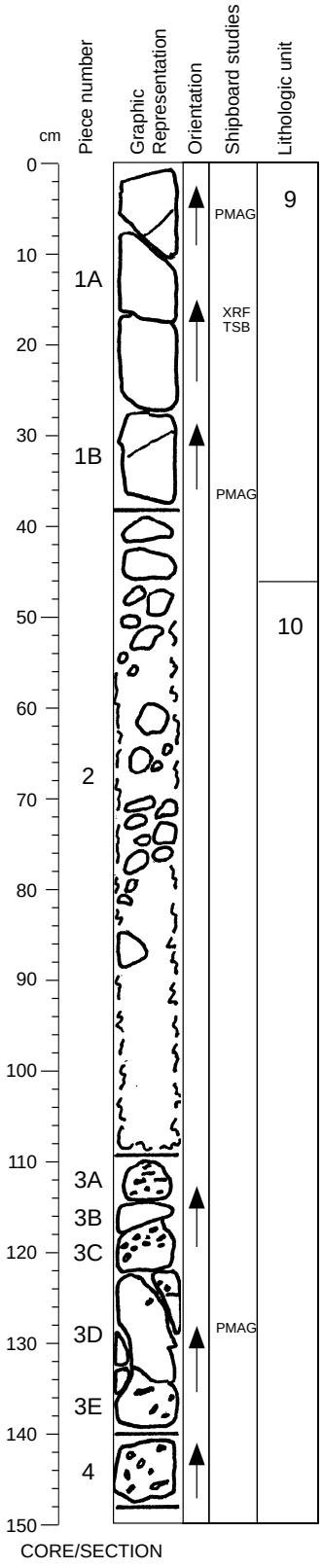
STRUCTURE: Piece 1 is massive; Piece 2 is faulted and brecciated.

ALTERATION: Moderate to complete.

VEINS/FRACTURES: Carbonate-filled veins (0.5-1.5 mm wide) are pervasive. Piece 2 is shattered.

COMMENTS: Piece 1B has a 1 x 1.5 cm segregation of aphyric material. Upper part of Piece 2 has a chill zone.

Core Photo



183-1139A-65R-2 **Section top: 615.20 (mbsf)**

UNIT 10: APHYRIC TRACHYBASALT AND TRACHYBASALT BRECCIA

Pieces: 2-4

CONTACTS: Not recovered; the contact between Units 9 and 10 is inferred to be at ~46 cm depth, within Piece 2.

PHENOCRYSTS: None.

GROUNDMASS: Very fine grained to aphanitic. Original glass, altered to dark green clay, forms stringers ~1 cm long.

VESICLES: Fragments in the lower part of Piece 2 are sparsely to highly vesicular; Pieces 3 and 4 are highly vesicular. Vesicles are 1-10 mm, angular to round or elongate, and filled with zeolite, and some carbonate and clay.

COLOR: Piece 2 is medium light gray; Pieces 3A to 3C are brownish gray; Pieces 3D, 3E, and 4 are medium gray.

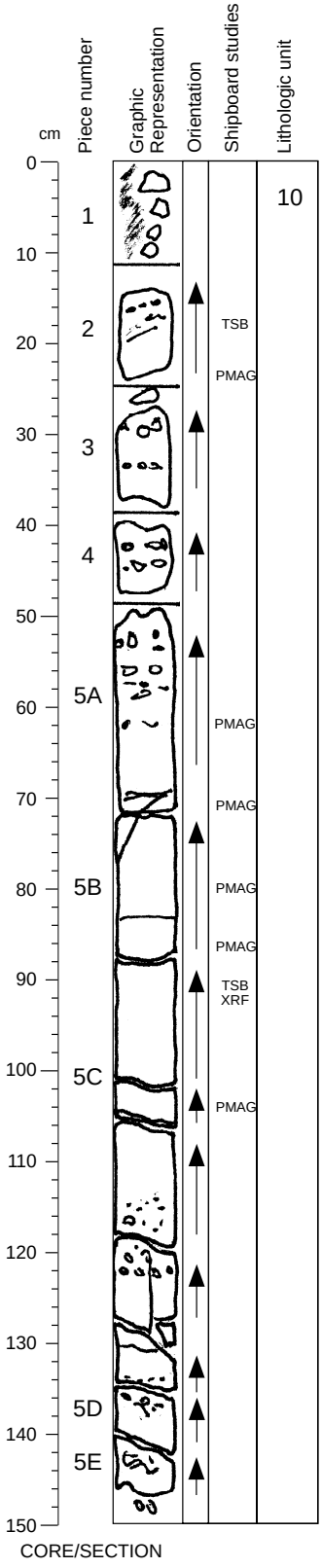
STRUCTURE: Piece 2 is brecciated; Pieces 3 and 4 are massive.

ALTERATION: Moderate to complete.

VEINS/FRACTURES: Carbonate-filled veins (0.5-1.5 mm wide) are pervasive. Piece 2 is shattered.

COMMENTS: Interpreted to be the vesicular flow top of Unit 10.

Core Photo



183-1139A-65R-3 **Section top: 616.70 (mbsf)**

UNIT 10: APHYRIC TRACHYBASALT

Pieces: 1-5

CONTACTS: Not obviously recovered; the contact between Units 10 and 11 is inferred to be between Sections 65R-3 and 65R-4 (see comments below).

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	trace	1.5	1.0	1.0	Euhedral laths (abundance ~1% in Piece 5C); relatively fresh

GROUNDMASS: Fine grained. Contains plagioclase, opaques, and stringers of altered glass.

VESICLES: Sparsely (Pieces 5B-5D) and highly (Pieces 1-5A, 5E) vesicular. Vesicles are 1-20 mm, subround to irregular, and filled with green zeolite and carbonate in radial or colliform arrangement.

COLOR: Pieces 1-5C are light gray; Pieces 5D and 5E are medium gray.

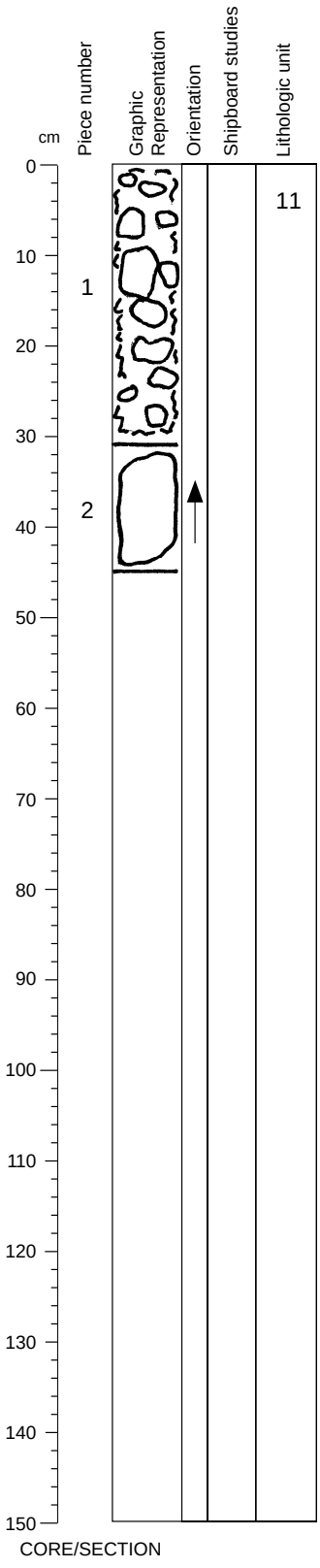
STRUCTURE: Pieces 2-5 are massive; Piece 1 is brecciated.

ALTERATION: Moderate to complete (Pieces 1 and 5E). Iron oxyhydroxide defines alteration haloes around vesicles.

VEINS/FRACTURES: Numerous, subhorizontal, 1-4 mm wide, carbonate-filled veins are present.

COMMENTS: The lower part of Piece 5E is the base of a lobe that partially enveloped two 1- to 2-cm, subround breccia clasts. The highly vesicular interval at 135-145 cm is underlain by a chill zone ~2 cm thick, with an aphanitic, slightly oxidized groundmass; another chilled region is present at 138 to 140 cm. This chill zone is likely to be the bottom of the Unit 10 pahoehoe lobes, and the underlying pebbles probrably belong to the brecciated top of Unit 11. However, for simplicity, the Unit 10/11 boundary was placed at the section break.

Core Photo



183-1139A-65R-4 **Section top: 618.20 (mbsf)**

UNIT 11: APHYRIC TRACHYBASALT AND TRACHYBASALT BRECCIA

Pieces: 1, 2

CONTACTS: Not obviously recovered; the contact between Units 10 and 11 is inferred to be between Sections 65R-3 and 65R-4. (See comments.)

PHENOCRYSTS: None.

GROUNDMASS: Very fine grained to aphanitic.

VESICLES: Moderately vesicular. Vesicles are 1-3 mm, irregular, and filled with zeolite and a small amount of carbonate.

COLOR: Very dark red to brownish black.

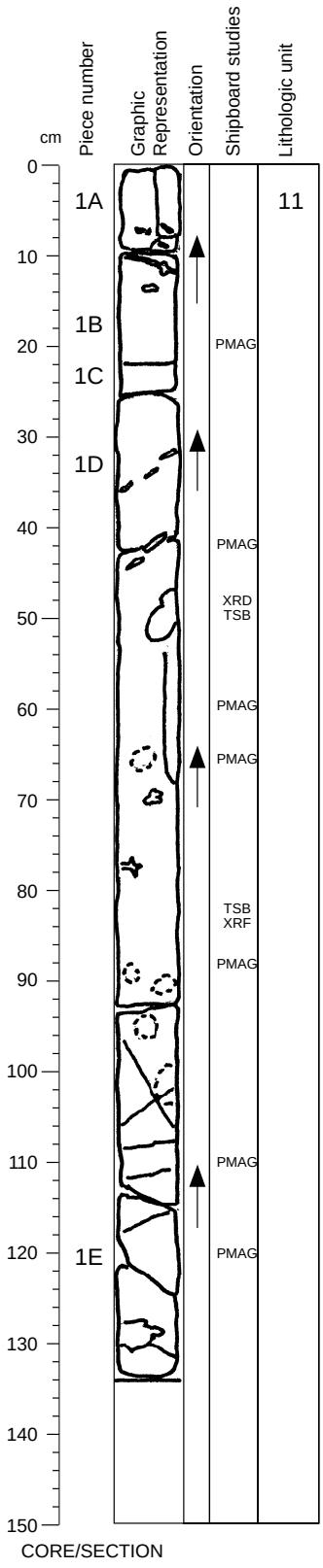
STRUCTURE: Piece 1 is sheared and brecciated; Piece 2 is massive.

ALTERATION: High to complete.

VEINS/FRACTURES: Piece 1 is rubble. Veins in larger pieces of Piece 1 are filled with bright to dark green clay or carbonate. Veins in Piece 2 are <1 mm wide and filled with carbonate.

COMMENTS: Piece 1 is interpreted as the completely altered, brecciated flow top of Unit 11. The two small clasts at the bottom of 65R-3 probably are part of this breccia.

Core Photo



183-1139A-65R-5 **Section top: 618.64 (mbsf)**

UNIT 11: APHYRIC TRACHYBASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS: None.

GROUNDMASS: Fine grained. Contains plagioclase, including 0.2-0.3 mm, subhedral lath-shaped microphenocrysts, and clinopyroxene. Piece 1A has stringers of glass altered to clay.

VESICLES: Sparsely to highly vesicular; vesicularity generally decreases down section. Vesicles are 1-40 mm, angular to subround or elongate, and filled with carbonate and brownish green zeolite. Pieces 1D and 1E have several 1-5-cm vesicle-rich zones in a dark gray groundmass.

COLOR: Pieces 1A and 1B are medium dark gray; Pieces 1C-1E are medium light gray.

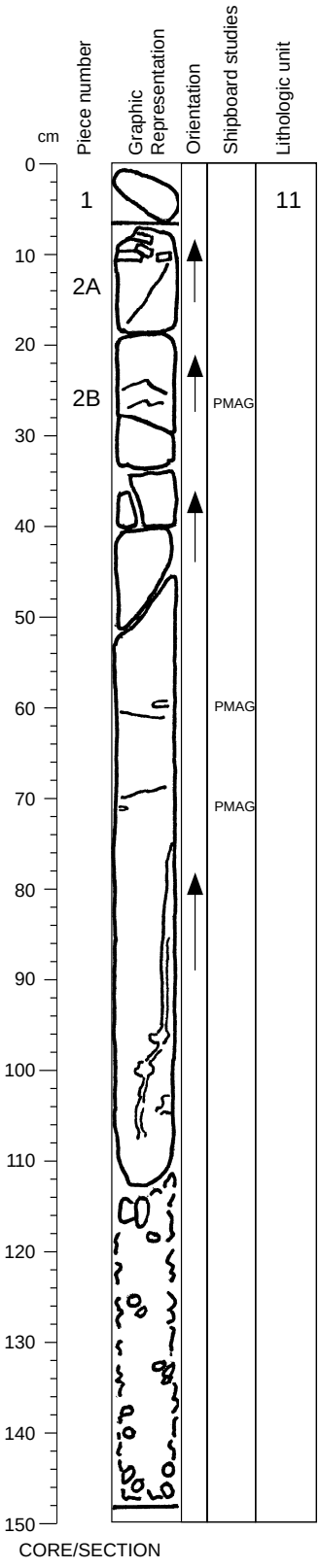
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Numerous carbonate- and clay-filled veins (<2 mm wide) are present, spaced 5-10 cm apart.

COMMENTS:

Core Photo



183-1139A-66R-1 **Section top: 623.50 (mbsf)**

UNIT 11: APHYRIC TRACHYBASALT AND TRACHYBASALT BRECCIA

Pieces: 1, 2

CONTACTS: Not recovered; the inferred contact between Units 11 and 12 is between Sections 66R-1 and 66R-2 (see comments below).

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	<< 1			1.2	Subhedral laths; only in massive basalt

GROUNDMASS: Fine grained. Contains plagioclase, clinopyroxene, oxides, and stringers of glass now completely altered to dark green clay.

VESICLES: Massive lava is sparsely vesicular; breccia is moderately vesicular. Vesicles are ≤1 cm, flattened and ovoid, and filled with carbonate and a small amount of zeolite.

COLOR: Medium light gray to light gray in massive basalt (0-113 cm); base of massive basalt is grayish black. Brecciated zone (113-149 cm) varies from dark reddish brown at top to pale bluish green at base.

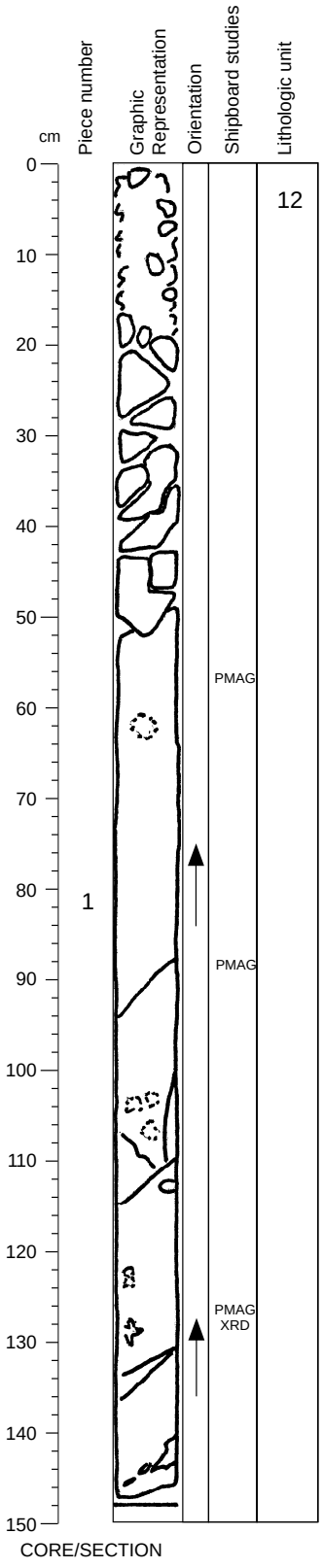
STRUCTURE: Massive from 0-113 cm. Brecciated from 113-149 cm; slickensides are common.

ALTERATION: Moderate in massive basalt (0-113 cm); complete in brecciated zone (113-149 cm). Piece 2B has nearly vertical oxidation bands.

VEINS/FRACTURES: Sparse in massive portion, increasing to moderately abundant close to the brecciated zone. The top of Piece 2A has numerous ~4-mm-wide, subhorizontal veins. Vein fill is carbonate and minor zeolite in the massive portion and bluish geen clay in the brecciated zone.

COMMENTS: The massive basalt just above the brecciated zone is very fine grained and moderately vesicular, suggesting proximity to a flow contact. The breccia in the lower part of the section is interpreted to be a basal aa breccia; because the rubble of the brecciated zone continues into Section 66R-2 and no contact is preserved intact, the Unit 11-12 boundary is placed arbitrarily between this section and Section 66R-2.

Core Photo



183-1139A-66R-2 **Section top: 624.98 (mbsf)**

UNIT 12: APHYRIC TRACHYBASALT AND TRACHYBASALT BRECCIA

Pieces: 1

CONTACTS: Not recovered; the inferred contact between Units 11 and 12 is between Sections 66R-1 and 66R-2.

PHENOCRYSTS: None.

GROUNDMASS: Fine grained.

VESICLES: Brecciated zone (0-50 cm) contains clasts of sparsely to highly vesicular basalt, with ≤3-mm vesicles. Vesicularity of massive zone (50-149 cm) decreases downward from high to sparse near base of section; most vesicles are 1-4 mm and flattened; a few are cm-size. Carbonate and zeolite fill vesicles.

COLOR: Dark gray in brecciated zone; medium light gray in massive zone.

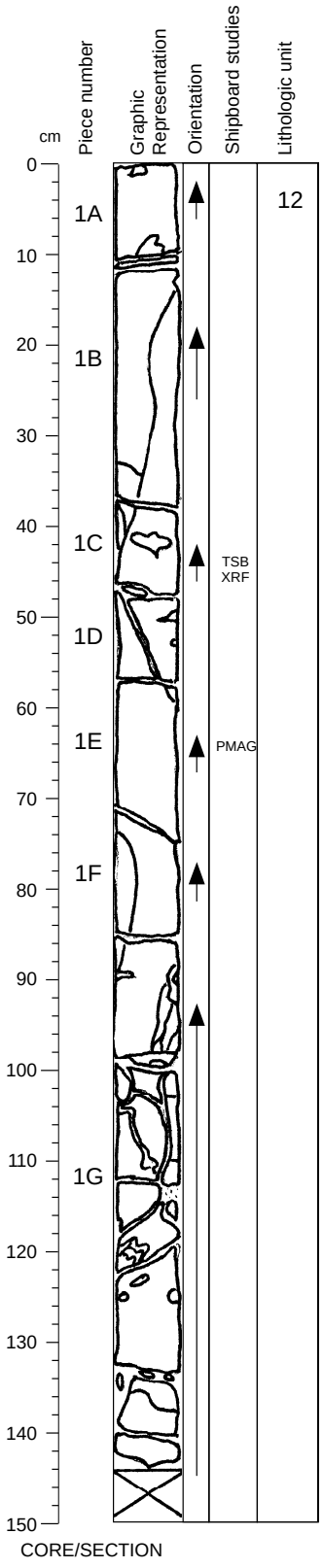
STRUCTURE: Brecciated from 0-50 cm; slickensides are common. Massive from 50-149 cm.

ALTERATION: Complete in brecciated portion of section; moderate in massive portion, with several zones of oxidation.

VEINS/FRACTURES: Brecciated portion contains several <1-mm-wide veins filled with pale bluish-green clay; massive portion has sparse, 1-3 mm wide veins filled with carbonate.

COMMENTS:

Core Photo



183-1139A-66R-3 **Section top: 626.48 (mbsf)**

UNIT 12: APHYRIC TRACHYBASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS: None.

GROUNDMASS: Fine grained.

VESICLES: Generally sparsely vesicular; vesicles are elongate to irregular, 1-40 mm, and filled with green clay, calcite, amorphous silica, or zeolite. Piece 1B is moderately vesicular, with <10-mm, highly irregular vesicles.

COLOR: Pieces 1A-1G are pale gray. The highly fractured interval (100-144 cm) is mottled pale gray and, near veins and fractures, dark purplish gray.

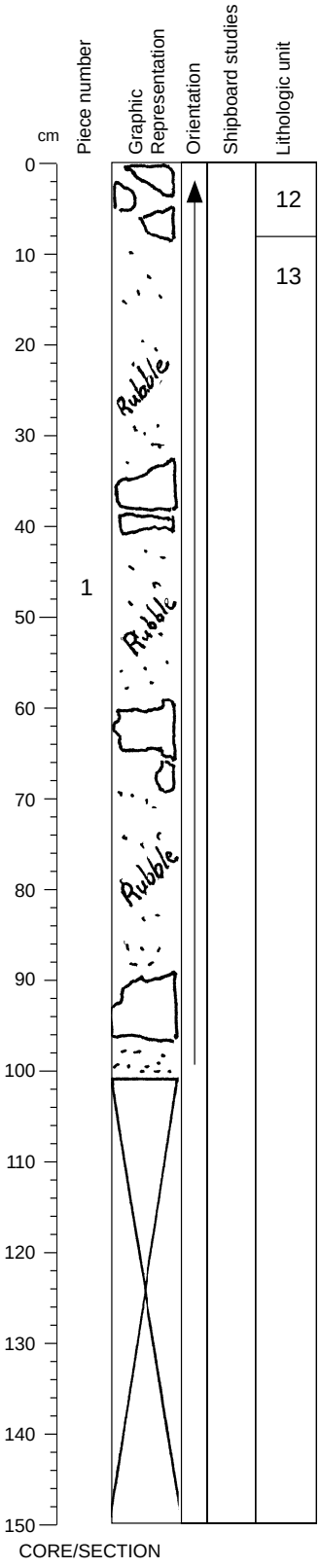
STRUCTURE: Massive from 0-100 cm; brecciated from 100-144 cm. Subhorizontal banding is defined by dark, wispy streaks in groundmass of massive portion.

ALTERATION: Moderate from 0-100 cm; moderate to high below 100 cm.

VEINS/FRACTURES: Numerous fractures are present below ~100 cm. Pieces 1A-1F have several <3-mm-wide, subvertical, anastomosing veins. Piece 1G has abundant veins forming a network; some continue to the base of section. Fill is calcite or white to reddish white zeolite. Veins have oxidation haloes.

COMMENTS: The large piece in the rubbly zone at 122-135 cm is a very fine-grained, moderately vesicular, pahoehoe lobe that intrudes sediments and has a chill zone wrapping in and out of the core.

Core Photo



183-1139A-66R-4 **Section top: 627.92 (mbsf)**

UNIT 12: APHYRIC TRACHYBASALT BRECCIA

Pieces: 1

CONTACTS: Not recovered; the contact between Units 12 and 13 is inferred to be at ~9 cm, within Piece 1 (see comments below).

PHENOCRYSTS: None.

GROUNDMASS: Very fine grained.

VESICLES: The three larger pieces at the top of the section are moderately vesicular; vesicles are mostly <1-mm and filled with dark green clay and white zeolite. The remainder of the section is too altered to determine vesicularity.

COLOR: Dark red.

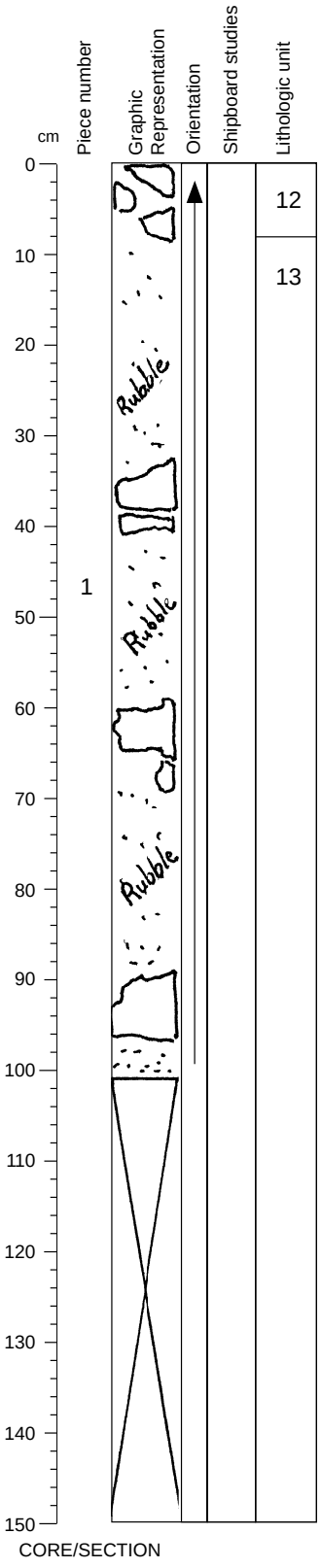
STRUCTURE: Brecciated.

ALTERATION: Complete.

VEINS/FRACTURES: Fractured into rubble. Very sparse, <1-mm-wide veins are filled with carbonate.

COMMENTS: The three larger pieces at the top of the section are similar to material at the base of Section 66R-3, and are included with Unit 12.

Core Photo



183-1139A-66R-4 **Section top: 627.92 (mbsf)**

UNIT 13: APHYRIC TRACHYBASALT BRECCIA

Pieces: 1

CONTACTS: Not recovered; the contact between Units 12 and 13 is inferred to be at ~9 cm, within Piece 1.

PHENOCRYSTS: None.

GROUNDMASS: Aphanitic.

VESICLES: Basalt clasts contain sparse, 1-2 mm, subround to elongate vesicles filled with carbonate.

COLOR: Very dark red to black.

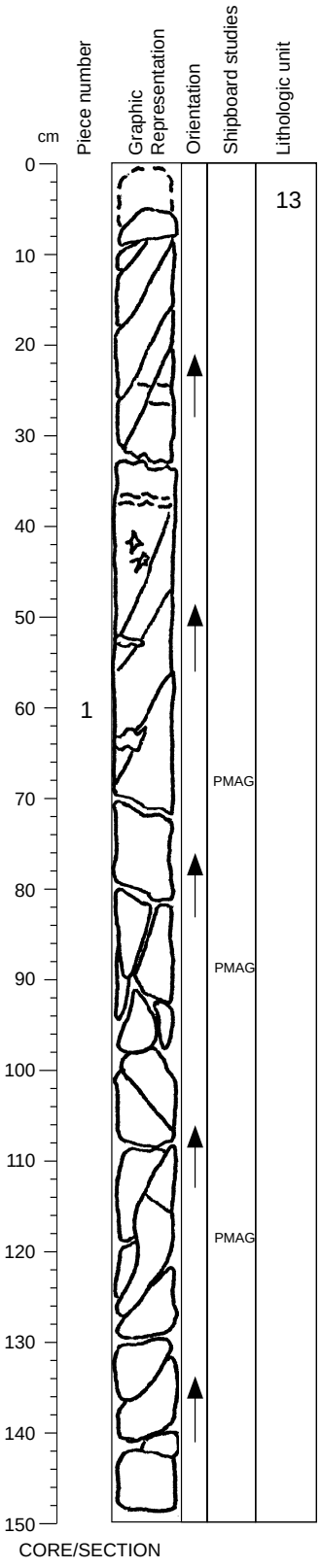
STRUCTURE: Brecciated.

ALTERATION: Complete. Clasts are altered to clay; matrix is carbonate, bluish green clay, and zeolite.

VEINS/FRACTURES: Shattered. Carbonate-filled veins are numerous; many are pale bluish green.

COMMENTS:

Core Photo



183-1139A-66R-5 **Section top: 628.92 (mbsf)**

UNIT 13: APHYRIC TRACHYBASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS: None.

GROUNDMASS: Fine grained. Trachytic groundmass texture is present in upper part of section. Groundmass contains plagioclase, clinopyroxene, oxides, and originally glassy stringers completely altered to dark green clay.

VESICLES: Upper part of section is moderately vesicular; lower part is sparsely vesicular. In the upper part of the section, vesicles are 0.5-5 mm and elongate to ovoid; near the base of section they are 1-35 mm and subround to round. Vesicles are filled with carbonate, zeolite, and clay.

COLOR: Brownish black to medium gray from 0-40 cm; light gray to medium light gray from 40-150 cm.

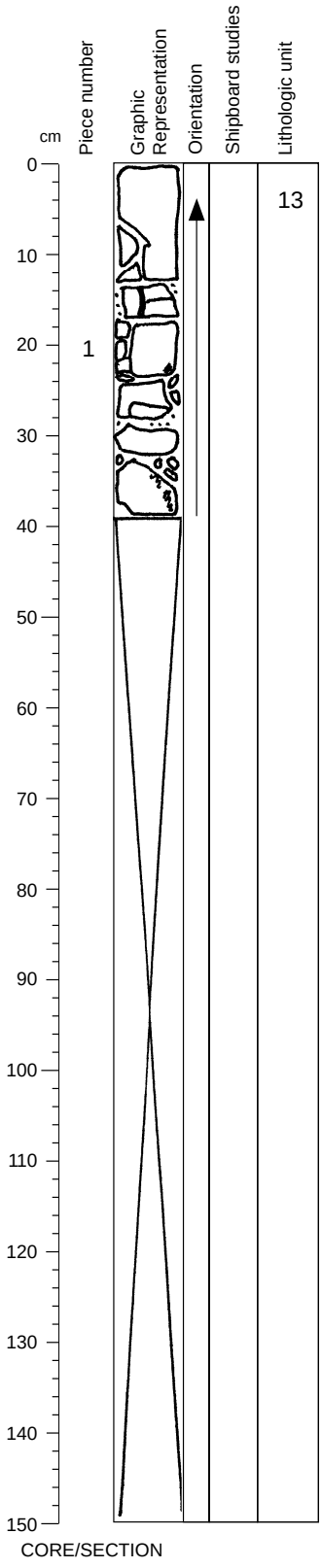
STRUCTURE: Massive. Brecciated by orthogonal veins from 0-40 cm.

ALTERATION: Moderate to high.

VEINS/FRACTURES: Subhorizontal to vertical carbonate- and zeolite-filled veins are pervasive. The section has broken into many pieces along veins.

COMMENTS:

Core Photo



183-1139A-66R-6 **Section top: 630.32 (mbsf)**

UNIT 13: APHYRIC TRACHYBASALT

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:

	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	trace				

GROUNDMASS: Fine grained. Contains plagioclase, clinopyroxene, oxides, and subhorizontal stringers of glass that are completely altered to dark green clay.

VESICLES: Sparsely vesicular. Vesicles are 5-8 mm, elongate to ovoid, and filled with carbonate and zeolite.

COLOR: Light gray.

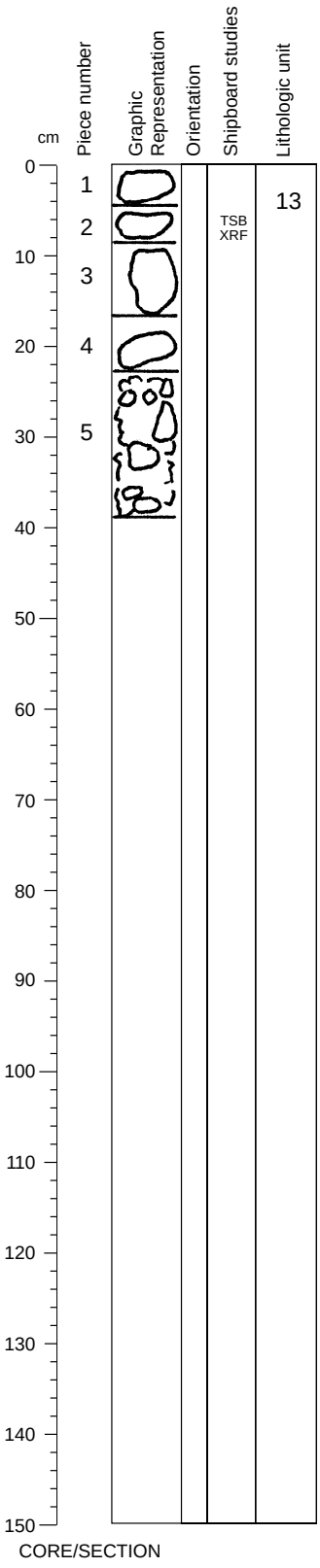
STRUCTURE: Fractured, massive basalt.

ALTERATION: Moderate.

VEINS/FRACTURES: Subhorizontal to subvertical, ≤3-mm-wide, carbonate-, clay-, and zeolite-filled veins are pervasive. Extensively fractured.

COMMENTS:.

Core Photo



183-1139A-66R-7 **Section top: 630.69 (mbsf)**

UNIT 13: APHYRIC TRACHYBASALT AND TRACHYBASALT BRECCIA

Pieces: 1-5

CONTACTS: Not recovered; the contact between Units 13 and 14 is inferred to be between Sections 66R-7 and 67R-1.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	<1	2	1		Subhedral; partially altered

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular; vesicles are 1-10 mm, generally elongate, and are filled with clay, calcite, and zeolite.

COLOR: Medium light gray to brownish gray.

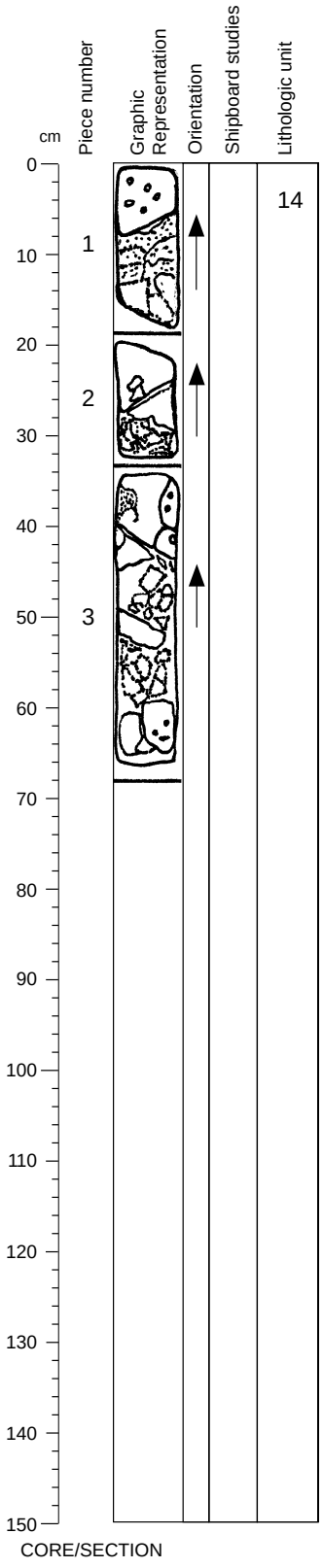
STRUCTURE: Upper half of section is massive; bottom half is brecciated.

ALTERATION: Moderate to high.

VEINS/FRACTURES: None.

COMMENTS:

Core Photo



183-1139A-67R-1 **Section top: 633.10 (mbsf)**

UNIT 14: SPARSELY PLAGIOCLASE-PHYRIC TRACHYANDESITE BRECCIA

Pieces: 1-3

CONTACTS: Not recovered; the contact between Units 13 and 14 is inferred to be between Sections 66R-7 and 67R-1

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Plagioclase:	1	3			Subhedral laths
Clinopyroxene:	trace	1			Prismatic grains; partially replaced by clay

GROUNDMASS: Aphanitic. Contains quench-textured plagioclase microlites.

VESICLES: Sparsely to highly vesicular; vesicles are <1 mm to 10 mm, round to ovoid or irregular, and filled with green clay or zeolite (?).

COLOR: Medium brown to pale green.

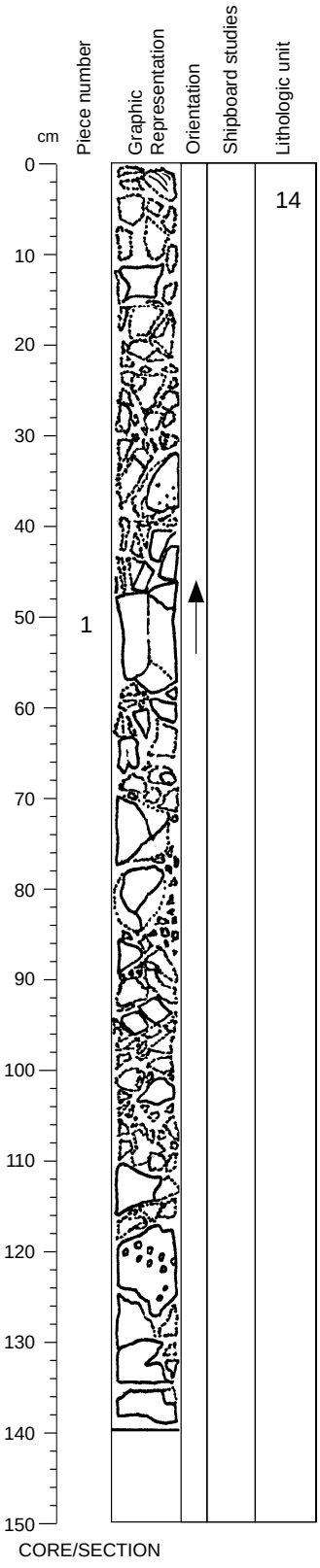
STRUCTURE: Brecciated. Fragments are <5 mm to 5 cm, and round to irregular; matrix is very fine grained.

ALTERATION: High to complete. Altered lava clasts are in a matrix of clay and some carbonate.

VEINS/FRACTURES: Numerous irregular fractures are present; parts of the core are shattered. Slickensides are abundant.

COMMENTS: An unidentified phenocryst phase (<0.3 mm) with blocky, euhedral shapes is completely replaced with white clay. Piece 3 contains part of a microgabbro xenolith.

Core Photo



183-1139A-67R-2 **Section top: 633.78 (mbsf)**

UNIT 14: APHYRIC BASALTIC TRACHYANDESITE BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	5			Subhedral, subequant

GROUNDMASS: Aphanitic.

VESICLES: Sparsely to highly vesicular. Vesicles are <1 to 10 mm, round to irregular and elongate, and filled with green clay, zeolite, and carbonate.

COLOR: Dark brown to light blue.

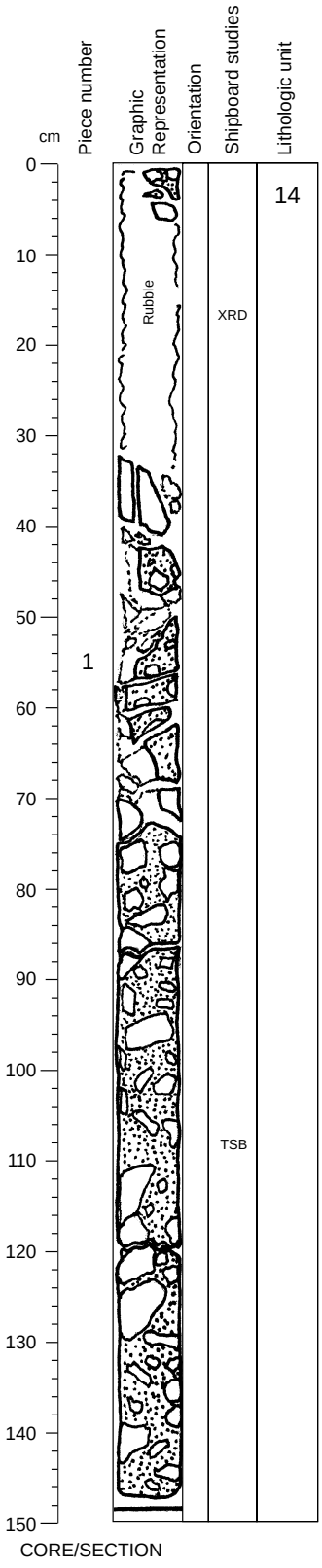
STRUCTURE: Intact pieces include both massive and brecciated lava.

ALTERATION: High to complete. Altered clasts are in a matrix of carbonate, zeolite, and clay.

VEINS/FRACTURES: Nearly the entire section is shattered. An irregular vein filled with speckled, dark green and white, fine-grained material is present at 121 cm.

COMMENTS:

Core Photo



183-1139A-67R-3 **Section top: 635.18 (mbsf)**

UNIT 14: SPARSELY PLAGIOCLASE-PHYRIC BASALTIC TRACHYANDESITE BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	3	0.6	0.2	0.3	Euhedral laths

GROUNDMASS: Aphanitic. Plagioclase microlites form a quench texture.

VESICLES: Sparsely to highly vesicular; vesicles are <1 to 15 mm, round to irregular, and filled with green clay or zeolite. Vesicularity varies considerably among fragments.

COLOR: Brown, gray, and pale blue. Matrix is pale gray.

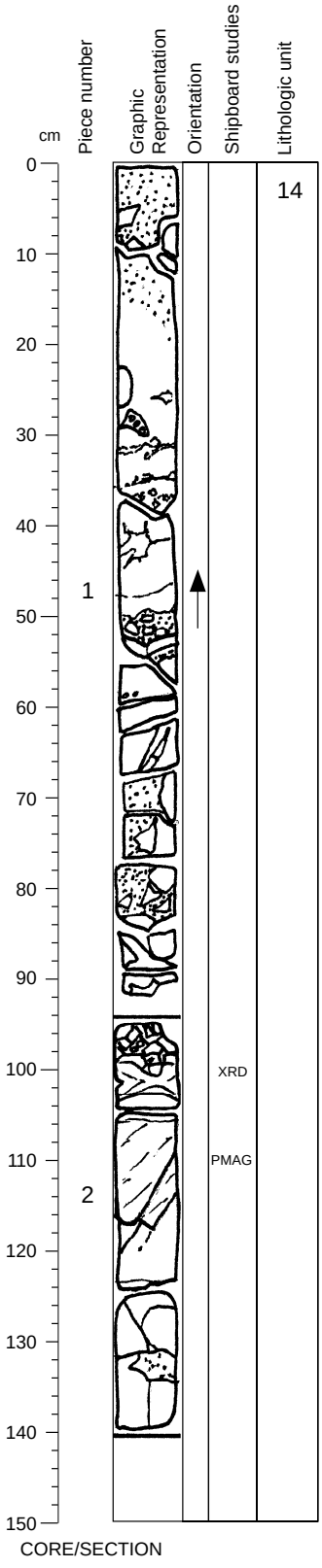
STRUCTURE: Brecciated. Fragments have a continuous size range from <1 mm to 5 cm; they are subangular to irregular, and some small fragments are cuspate.

ALTERATION: Moderate to complete. Clasts are altered to clay; matrix is clay and zeolite.

VEINS/FRACTURES: Rock is shattered above 50 cm, well-fractured from 50-73 cm, and intact below 73 cm. Slickensides are numerous on fracture surfaces. No veins are present.

COMMENTS: At 40 cm, a clast contains a smaller clast, suggesting that at least some of the brecciation occurred during flow emplacement.

Core Photo



183-1139A-67R-4 **Section top: 636.68 (mbsf)**

UNIT 14: SPARSELY PLAGIOCLASE-PHYRIC BASALTIC TRACHYANDESITE BRECCIA

Pieces: 1, 2

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	1	5	0.2	0.5	Round glomerocrysts and subhedral laths
Clinopyroxene:	trace	0.5	0.3	0.4	Prismatic grains in glomerocrysts; altered to clay

GROUNDMASS: Aphanitic. Texture is granular; quench microlites are absent.

VESICLES: Fragments in brecciated portion (0-100 cm) are moderately to highly vesicular. Massive portion (104-140 cm) is sparsely vesicular. Vesicles are round and <1 mm in diameter, except in one breccia fragment with larger (≤3 mm) vesicles. Vesicles are filled with green clay, zeolite, or carbonate.

COLOR: Brecciated portion is medium brownish gray; massive portion is pale gray.

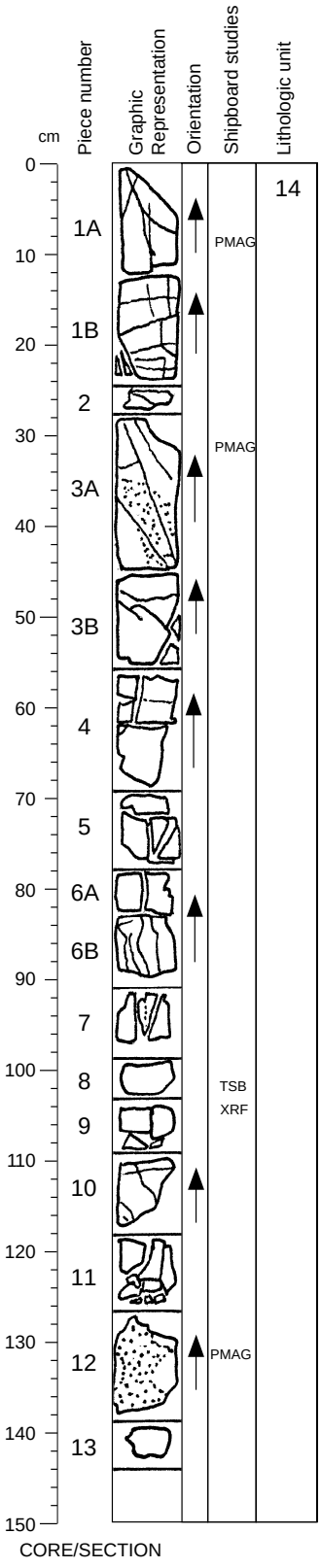
STRUCTURE: Two types of breccia are present: (1) from 0-60 cm, subround vesicular fragments; (2) from 94-100 cm, angular fragments in sheared green clay matrix. From 104-140 cm, the basalt is massive.

ALTERATION: Slight in massive portion; moderate to complete in brecciated portion.

VEINS/FRACTURES: Section is shattered from 63-73 cm, and abundantly fractured below 110 cm. Carbonate fills matrix of angular breccia. Piece 2 has a swarm of fine (<1 mm), zeolite-filled veins dipping ~65°.

COMMENTS:

Core Photo



183-1139A-67R-5 **Section top: 638.10 (mbsf)**

UNIT 14: APHRYIC BASALTIC TRACHYANDESITE

Pieces: 1-13

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	1.5	0.2	0.5	Subhedral to euhedral laths
Clinopyroxene:	trace				

GROUNDMASS: Aphanitic.

VESICLES: Sparsely vesicular in upper part of section; moderately vesicular in lower part of section. Vesicles are <1 mm, irregular, and filled with zeolite and carbonate.

COLOR: Pale gray.

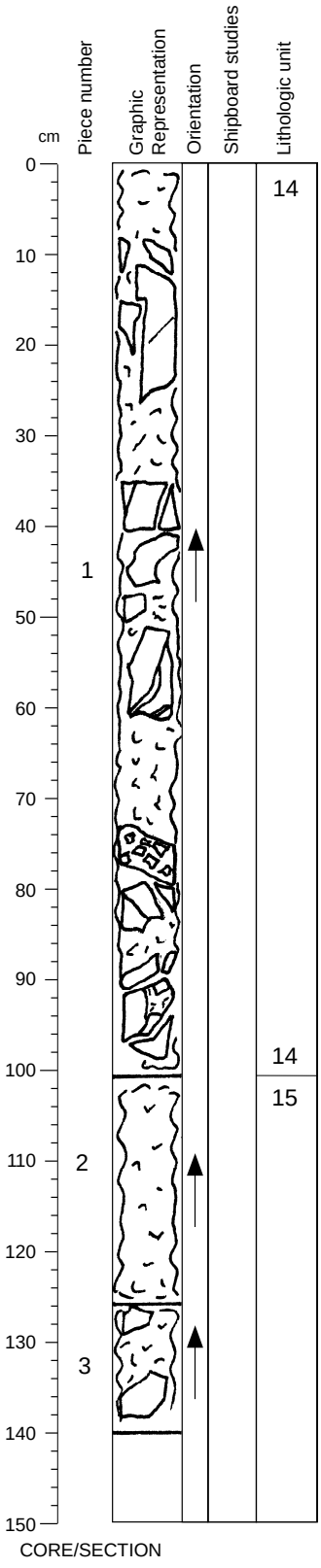
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Numerous short (<1 cm), wispy, white veins (coalesced vesicles?) dip 10-30° in Pieces 1A and 1B. Irregular, carbonate- or zeolite-filled veins (0.5-2 mm wide) and fractures are present throughout the section.

COMMENTS: Groundmass is rich in plagioclase.

Core Photo



183-1139A-68R-1 **Section top: 642.60 (mbsf)**

UNIT 14: APHYRIC BASALTIC TRACHYANDESITE BRECCIA

Pieces: 1

CONTACTS: Not recovered; the contact between Units 14 and 15 is inferred to be between Pieces 1 and 2, at ~101 cm.

PHENOCRYSTS:	%	Grain Size (mm): Mode	Max	Min	Avg.	Shape/Habit
Plagioclase:	<1		5			Subround glomerocrysts

GROUNDMASS: Aphanitic. Breccia fragments in lowermost part of Piece 1 are very fine grained, with chilled margins.

VESICLES: Nonvesicular, except for fragments at base of section which contain abundant, <0.5-mm, clay-filled vesicles.

COLOR: Greenish gray to pale brownish gray.

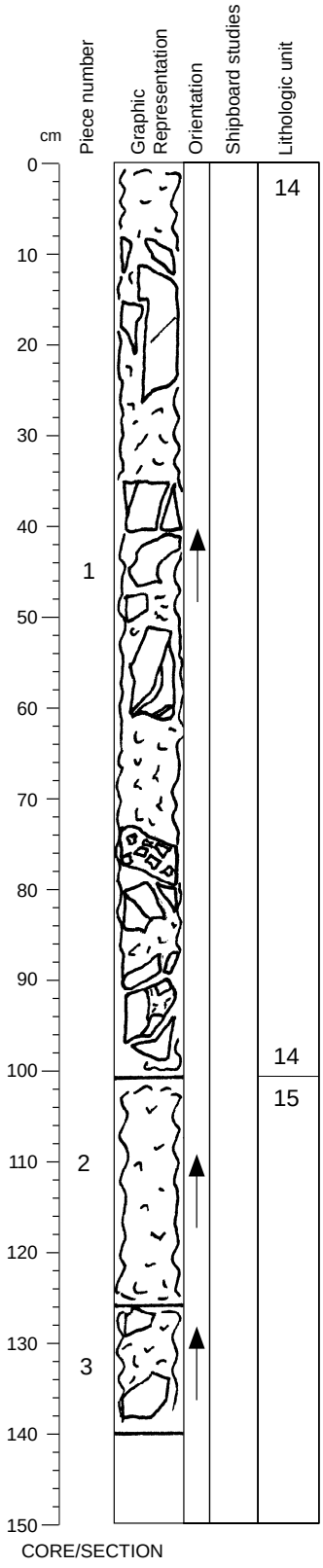
STRUCTURE: Brecciated.

ALTERATION: Moderate to complete.

VEINS/FRACTURES: Rock is nearly completely shattered. Breccia fragments have slickensides.

COMMENTS: The contact is inferred from a change in color from greenish gray to dark reddish brown between Pieces 1 and 2. Brecciation may be either volcanic or tectonic.

Core Photo



183-1139A-68R-1 **Section top: 642.60 (mbsf)**

UNIT 15: APHYRIC BASALTIC TRACHYANDESITE BRECCIA

Pieces: 2, 3

CONTACTS: Not recovered; the contact between Units 14 and 15 is inferred to be between Pieces 1 and 2, at ~101 cm.

PHENOCRYSTS: None.

GROUNDMASS: Aphanitic.

VESICLES: None.

COLOR: Dark reddish brown fragments in a pale green matrix.

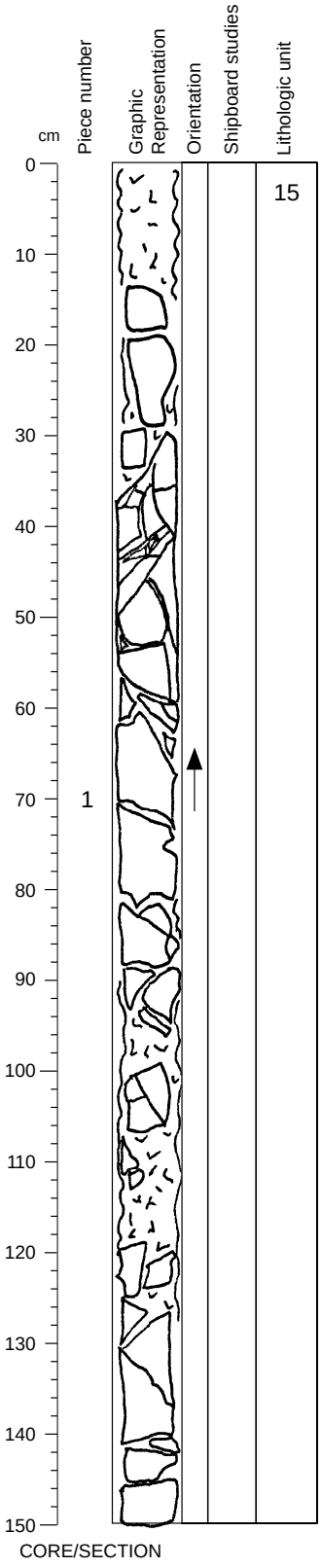
STRUCTURE: Brecciated.

ALTERATION: Complete.

VEINS/FRACTURES: Shattered. Surfaces of breccia fragments commonly have slickensides

COMMENTS:

Core Photo



183-1139A-68R-2 **Section top: 644.00 (mbsf)**

UNIT 15: APHYRIC BASALTIC TRACHYANDESITE BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	8	0.5		Subhedral grains; rare glomerocrysts

GROUNDMASS: Aphanitic.

VESICLES: Most of section is highly vesicular; base of section is nonvesicular. Vesicles are 0.1-20 mm and irregular. Small vesicles (<1 mm) are filled with green clay, larger vesicles with zeolites and carbonate.

COLOR: Medium to dark greenish to brownish gray.

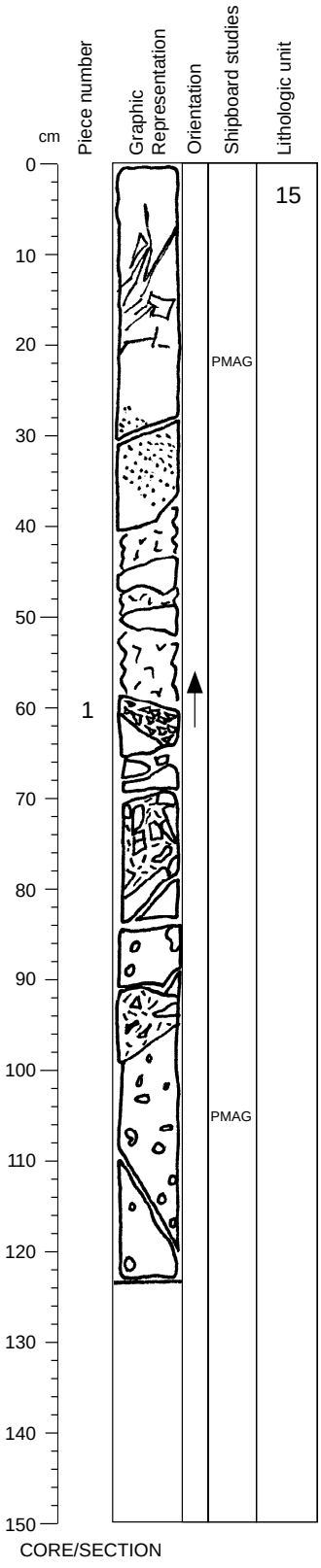
STRUCTURE: Brecciated.

ALTERATION: Moderate to high.

VEINS/FRACTURES: HIghly fractured; parts of the section are shattered. Lower part of section has irregular, zeolite-filled veins (<1 to 2 mm wide) with variable orientations. Slickensides are present.

COMMENTS:

Core Photo



183-1139A-68R-3 **Section top: 645.51 (mbsf)**

UNIT 15: APHYRIC BASALTIC TRACHYANDESITE BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	5	0.5		Subhedral grains; altered
Clinopyroxene:	trace	0.8			

GROUNDMASS: Aphanitic.

VESICLES: Much of the section is too brecciated to permit identification of sparsely vesicular areas. Three zones of moderate vesicularity are present: (1) 30-40 cm; most vesicles are round and <1-mm; some are ovoid to irregular and ≤6 mm; (2) 87-91 cm; vesicles are ovoid and ≤30 mm; (3) 100-120 cm; vesicles are round and ovoid to irregular, <8 mm. Small (<1 mm) vesicles are filled with green clay, larger vesicles with zeolite and carbonate.

COLOR: Medium to dark greenish to brownish gray.

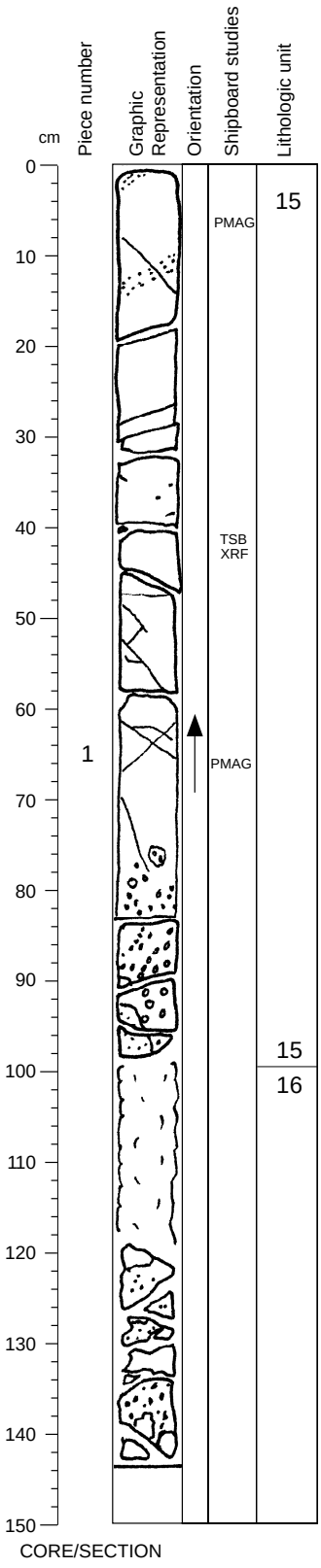
STRUCTURE: Massive, except for brecciated intervals with angular clasts at 0-20 cm, 60-85 cm, and 93-100 cm.

ALTERATION: Moderate to complete.

VEINS/FRACTURES: In massive portions, veins (<2 mm) and fractures are filled with zeolite, carbonate, and clay. A 3-cm-thick zeolite- and carbonate-filled fracture is at 16 cm.

COMMENTS:

Core Photo



183-1139A-68R-4 **Section top: 646.76 (mbsf)**

UNIT 15: SPARSELY PLAGIOCLASE-PHYRIC BASALTIC TRACHYANDESITE

Pieces: 1

CONTACTS: Not recovered; the contact between Units 15 and 16 is inferred to be at 100 cm.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	1	0.6	0.3	0.4	Euhedral laths; rare glomerocrysts

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular from 0-79 cm; moderately vesicular from 79-100 cm. Vesicles are 1-20 mm, angular to flattened, and filled with zeolite and calcite.

COLOR: Light gray to greenish gray to brownish gray.

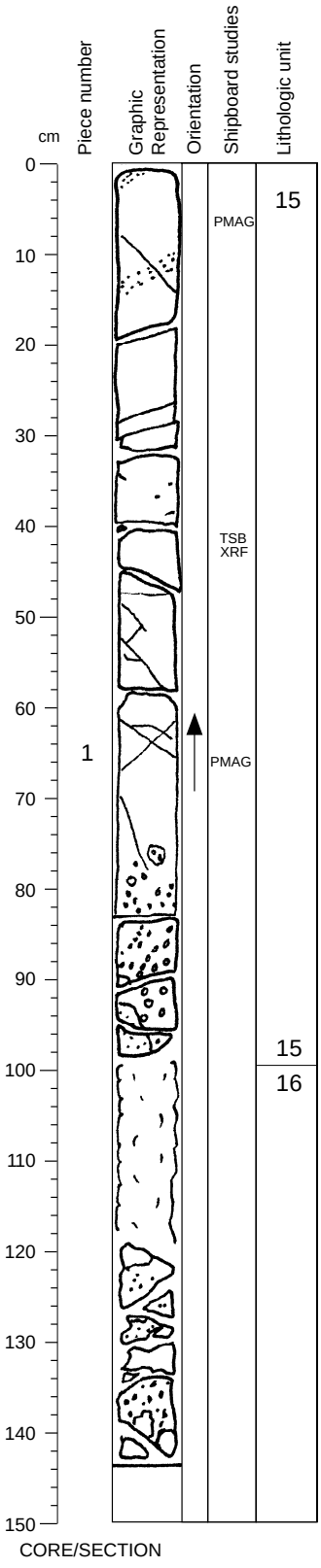
STRUCTURE: Massive.

ALTERATION: Moderate to high. Several zones of green and light red alteration are present.

VEINS/FRACTURES: Numerous veins and fractures, <1 mm wide, are filled with zeolite, calcite and clay.

COMMENTS: The moderately vesicular interval from 79-100 cm is interpreted to be the lower vesicular crust of the Unit 15 flow.

Core Photo



183-1139A-68R-4 **Section top: 646.76 (mbsf)**

UNIT 16: SPARSELY FELDSPAR-PHYRIC BASALTIC TRACHYANDESITE BRECCIA

Pieces: 1

CONTACTS: Not recovered; the contact between Units 15 and 16 is inferred to be at 100 cm.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Feldspar:	1			0.4	Euhedral laths

GROUNDMASS: Fine grained to aphanitic.

VESICLES: Nonvesicular to sparsely vesicular (?); some vesicles are present, but alteration of breccia fragments makes estimation of vesicle abundance difficult.

COLOR: Brownish gray to black.

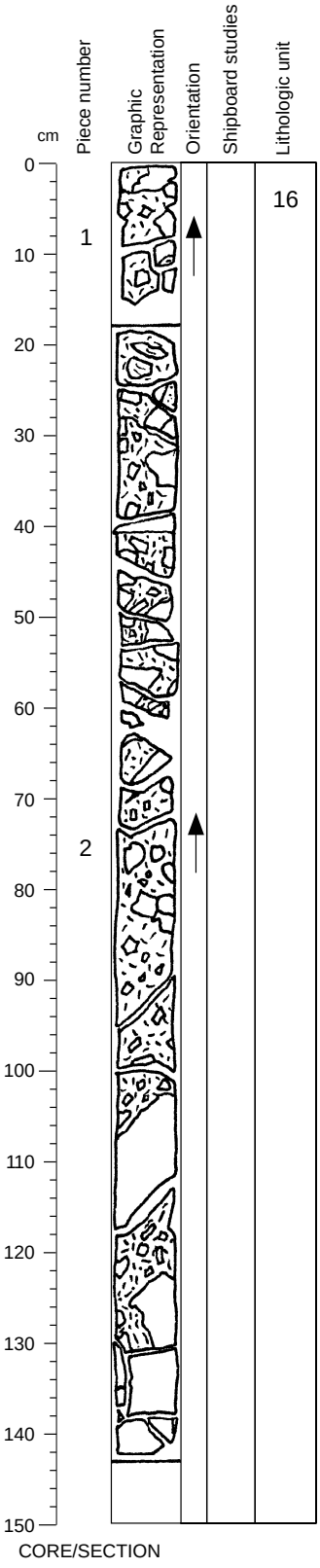
STRUCTURE: Brecciated.

ALTERATION: Complete.

VEINS/FRACTURES: Rock is highly fractured. Slickensides are present on breccia clasts.

COMMENTS: This section is interpreted to be the brecciated flow top of Unit 16, but could be the basal breccia of Unit 15.

Core Photo



183-1139A-68R-5 **Section top: 648.21 (mbsf)**

UNIT 16: APHYRIC BASALTIC TRACHYANDESITE BRECCIA

Pieces: 1, 2

CONTACTS: None.

PHENOCRYSTS:

	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Feldspar:	<1	1	0.5		Euhedral laths; completely altered

GROUNDMASS: Aphanitic.

VESICLES: Sparsely vesicular; vesicles (<1-mm) are filled with zeolite, calcite, and clay.

COLOR: Clasts are very dark grayish green; matrix is grayish red and white; veins are white.

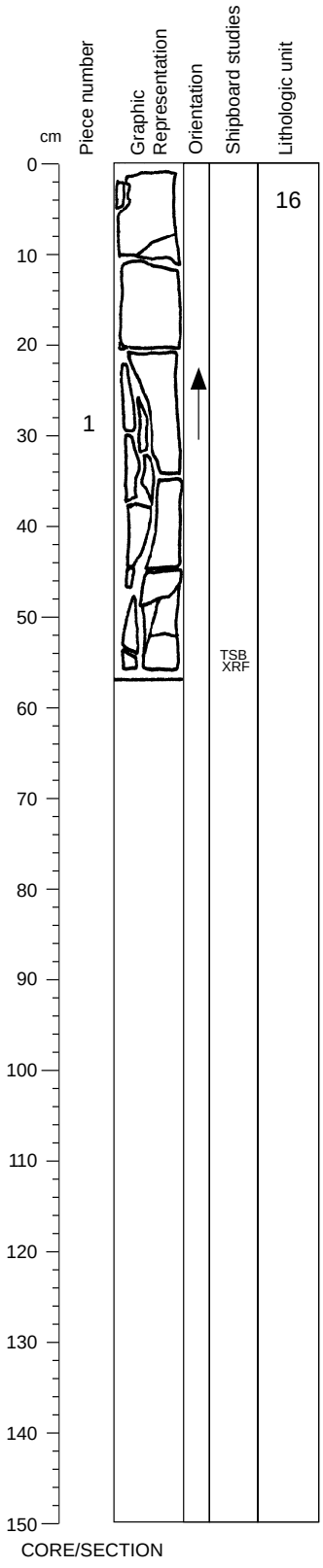
STRUCTURE: Brecciated. Clasts are 1-50 mm.

ALTERATION: Very high to complete. Clasts are replaced by clay.

VEINS/FRACTURES: Numerous hairline veins surround breccia clasts in Piece 1 and upper 40 cm of Piece 2.

COMMENTS: Interpreted as the brecciated upper part of flow Unit 16.

Core Photo



183-1139A-68R-6 **Section top: 649.65 (mbsf)**

UNIT 16: APHYRIC BASALTIC TRACHYANDESITE

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Feldspar:	<1	1	0.5		Euhedral laths; replaced by clay

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular. Vesicles are <1 mm, and filled with zeolite and clay.

COLOR: Medium dark gray to brownish gray.

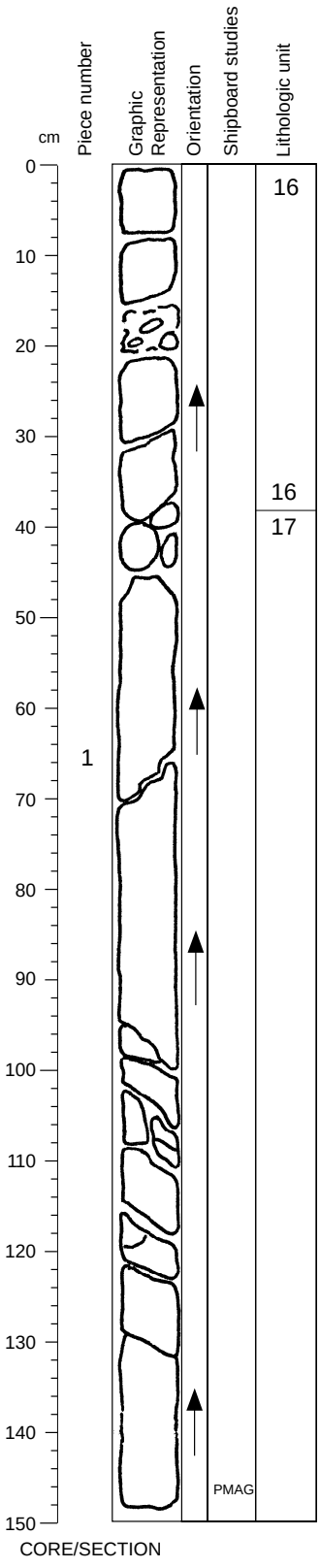
STRUCTURE: Massive.

ALTERATION: Moderate to high. Groundmass is largely replaced by clay.

VEINS/FRACTURES: Numerous veins and fractures are filled with clay and carbonate.

COMMENTS: Interpreted as the massive portion of the Unit 16 flow.

Core Photo



183-1139A-68R-7 **Section top: 650.23 (mbsf)**

UNIT 16: APHYRIC BASALTIC TRACHYANDESITE

Pieces: 1

CONTACTS: Not recovered; the boundary between Units 16 and 17 is inferred to be in the brecciated zone at ~38 cm.

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

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular. Vesicles are angular and elongate, 1-3 mm, and filled with calcite.

COLOR: Medium gray.

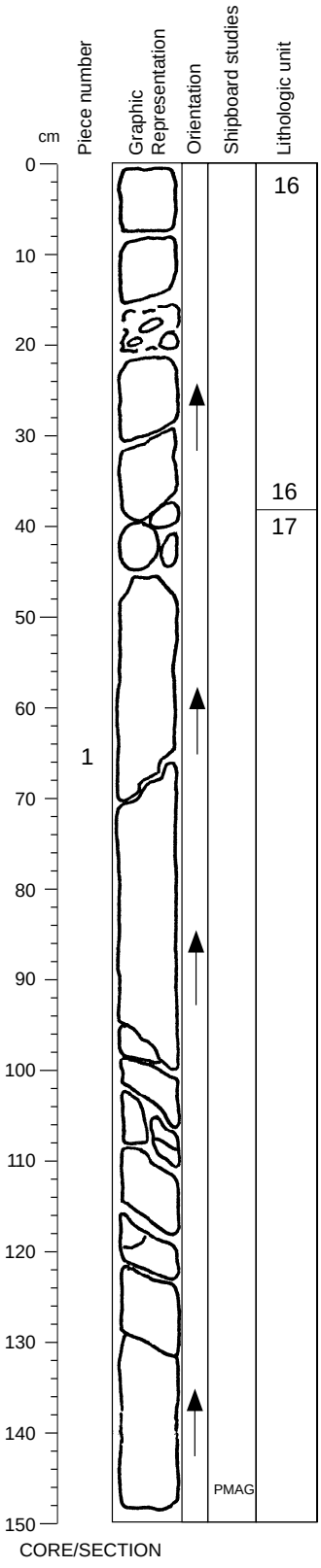
STRUCTURE: Massive.

ALTERATION: Moderate.

VEINS/FRACTURES: Thin fractures are pervasive and partially lined with clay and carbonate.

COMMENTS: Rock contains plagioclase microphenocrysts (<0.4 mm).

Core Photo



183-1139A-68R-7 **Section top: 650.23 (mbsf)**

UNIT 17: APHYRIC BASALTIC TRACHYANDESITE AND BRECCIA

Pieces: 1 (below ~38 cm)

CONTACTS: Not recovered; the boundary between Units 16 and 17 is inferred to be in the brecciated zone at ~38 cm.

PHENOCRYSTS: None.

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular. Vesicles are angular and elongate, 1-3 mm, and filled with calcite.

COLOR: Brownish gray (breccia) to medium light gray (massive).

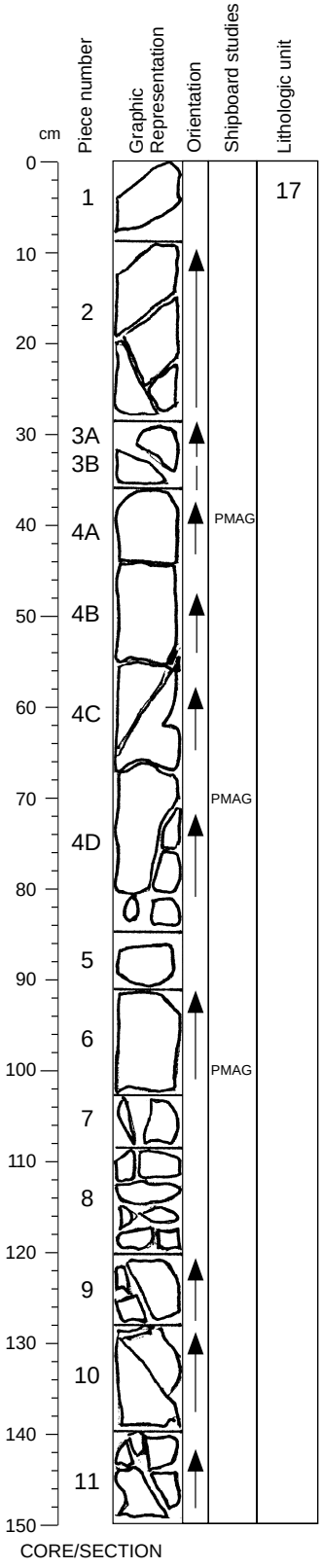
STRUCTURE: Brecciated from 38-135 cm; massive from 135-149 cm.

ALTERATION: High in massive portion; complete in brecciated portion.

VEINS/FRACTURES: Thin fractures, partially filled with clay and carbonate, pervade the massive portion; breccia contains a pervasive network of thin, clay-lined veins.

COMMENTS: Massive portion and breccia clasts contain a few plagioclase microphenocrysts (<0.4 mm); those in breccia clasts are altered to pale green clay. Some of the breccia assigned to Unit 17 may be a basal breccia for Unit 16.

Core Photo



183-1139A-69R-1 **Section top: 652.00 (mbsf)**

UNIT 17: APHYRIC BASALTIC TRACHYANDESITE

Pieces: 1-11

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<1	2.5	0.6	0.8	Subhedral to euhedral

GROUNDMASS: Fine grained. Contains stringers of glass completely altered to brown and green clay.

VESICLES: Pieces 1-6 are nonvesicular; Pieces 7-11 are sparsely to moderately vesicular. Vesicles are <1 mm, flattened and elongate, and filled with clay.

COLOR: Light gray to medium light gray.

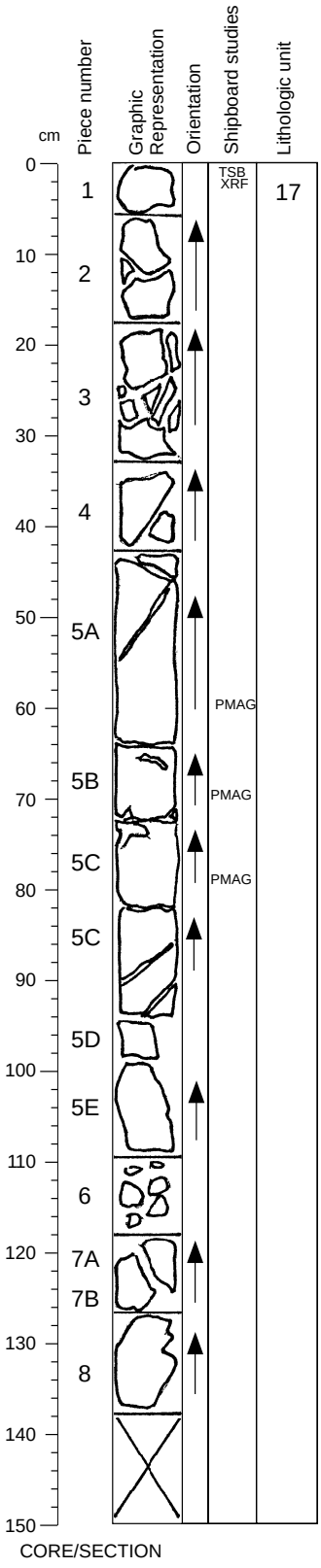
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Subhorizontal and subvertical fractures and veins (<1 to 3 mm wide) are filled with clay and calcite.

COMMENTS:

Core Photo



183-1139A-69R-2 **Section top: 653.50 (mbsf)**

UNIT 17: APHYRIC BASALTIC TRACHYANDESITE

Pieces: 1-8

CONTACTS: None.

PHENOCRYSTS: None.

GROUNDMASS: Fine grained. Originally glassy stringers are replaced by dark brown clay.

VESICLES: Very rare (<0.1%) vesicles are filled with zeolite and carbonate.

COLOR: Light gray to medium light gray.

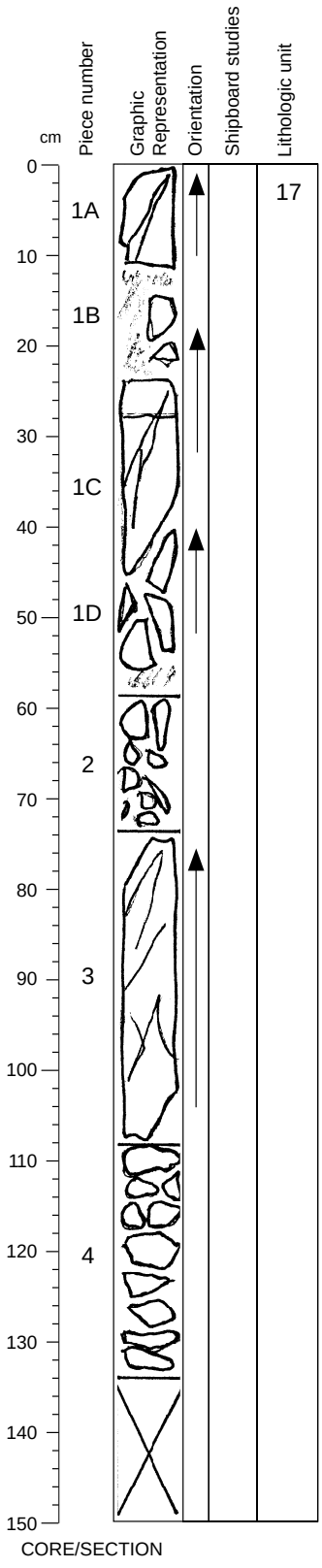
STRUCTURE: Massive.

ALTERATION: Slight.

VEINS/FRACTURES: Pervasive sinuous veins (<1 to 8 mm wide) are filled with clay and calcite. Fractures are more abundant toward base of section.

COMMENTS: Rare lath-shaped plagioclase microphenocrysts (<0.4 mm) decrease in abundance down section.

Core Photo



183-1139A-69R-3 **Section top: 654.90 (mbsf)**

UNIT 17: APHYRIC BASALTIC TRACHYANDESITE

Pieces: 1-4

CONTACTS: Not recovered; the contact between Units 17 and 18 is inferred to be between Sections 69R-3 and 70R-1.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	<0.5	1.2	0.4		Subhedral to euhedral laths

GROUNDMASS: Fine grained. Originally glassy stringers are replaced by dark brown clay.

VESICLES: Nonvesicular. Vesicles are angular to elongate, <1 mm, and filled with clay, calcite, and zeolite.

COLOR: Light gray to medium light gray.

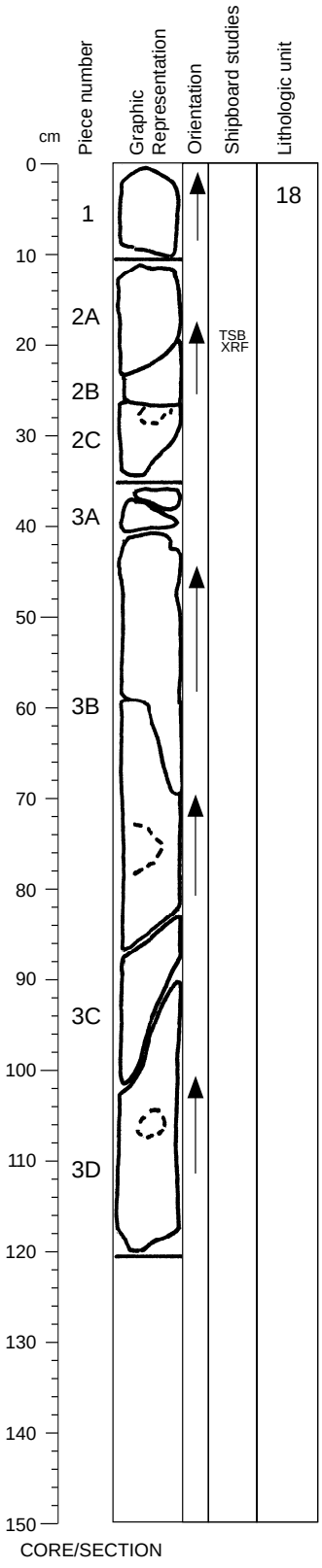
STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: Moderately fractured and veined; veins are 1-3 mm wide, and filled with calcite, zeolite, and clay.

COMMENTS:

Core Photo



183-1139A-70R-1 **Section top: 661.50 (mbsf)**

UNIT 18: MODERATELY SANIDINE-PHYRIC TRACHYANDESITE BRECCIA

Pieces: 1-3

CONTACTS: Not recovered; the contact between Units 17 and 18 is inferred to be between Sections 69R-3 and 70R-1.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Sanidine:	5	7	1.5	3	Euhedral crystals; some glomerocrysts

GROUNDMASS: Fine grained.

VESICLES: Sparsely to moderately vesicular. Vesicles are round to angular, < 0.5 mm, and filled with clay and zeolite.

COLOR: Dark red to very dark red and brownish black. Breccia matrix is white.

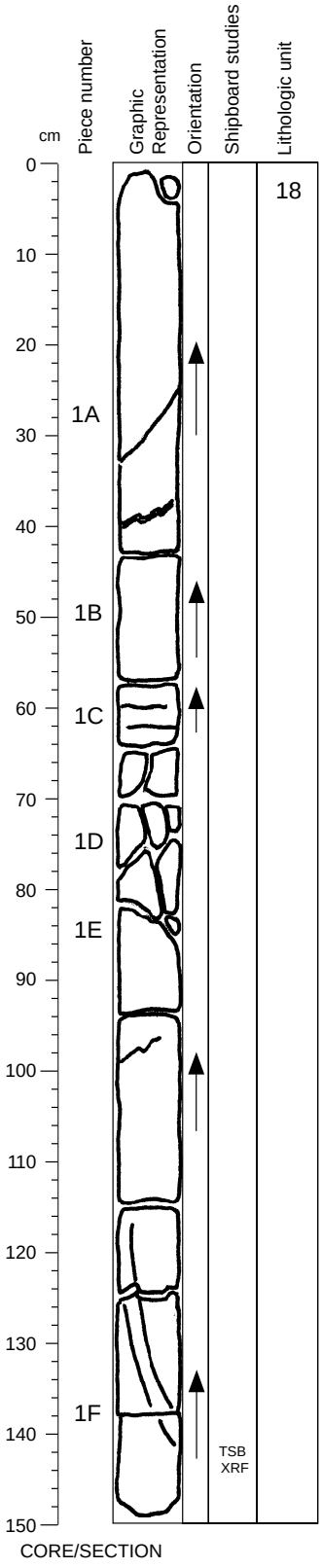
STRUCTURE: Brecciated. Layered texture is produced in clasts by pale greenish blue clay that replaces originally glassy groundmass stringers.

ALTERATION: High.

VEINS/FRACTURES: The section is fractured along 1- to 2-mm-wide, clay-, calcite-, and zeolite-filled veins. Numerous small veins cut clasts and matrix.

COMMENTS: Isolated sanidine phenocrysts are altered and can be confused with vesicles. Sanidine in glomerocrysts is relatively fresh; a subordinate mafic mineral(s) is altered to clay.

Core Photo



183-1139A-70R-2 **Section top: 662.72 (mbsf)**

UNIT 18: MODERATELY SANIDINE-PHYRIC TRACHYANDESITE

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	5	8	0.5	3	Suhedral to euhedral; some glomerocrysts

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular. Vesicles are angular to flattened, 1-3 mm, filled with green clay, and most abundant at 68 cm..

COLOR: Major color changes occur below a vein from 24-34 cm and at 68 cm. Above the vein, the color is medium dark gray to brownish gray; below the vein, it is grayish red to very dusky red. Below 68 cm, the color is very light gray to light green (producing a bleached appearance).

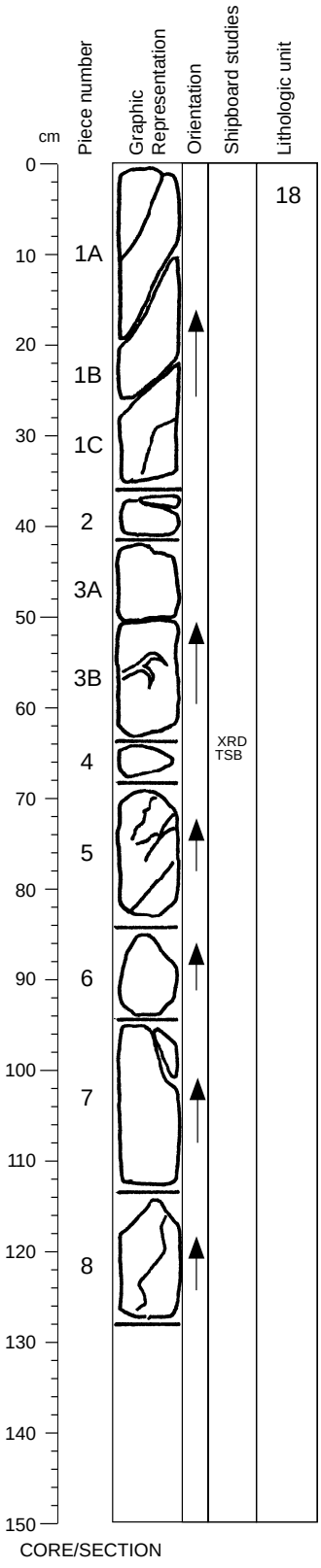
STRUCTURE: Massive.

ALTERATION: High to complete.

VEINS/FRACTURES: Veins are 1-5 mm wide, subvertical and subhorizontal. Vein fillings include clay, zeolite, carbonate, and quartz.

COMMENTS: Oxidation haloes are present at ~30, 40, and 60 cm. Below 68 cm, concentric color bands and "bleached" areas surround veins. Above the vein at 24-34 cm, stringers of glass are completely altered to pale bluish green clay; sanidine phenocrysts and glomerocrysts are partially altered. Below this vein, the stringers are the same color but defined better because of greater groundmass alteration. Below 68 cm, the stringers are pale green; the sanidine phenocrysts and glomerocrysts are partially altered. The sanidine contains bluish green inclusions (altered mafic phases?).

Core Photo



183-1139A-70R-3 **Section top: 664.22 (mbsf)**

UNIT 18: MODERATELY SANIDINE-PHYRIC TRACHYANDESITE

Pieces: 1-8

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	3	6	2	4	Euhedral crystals, some glomerocrysts; surrounded by gray alteration haloes

GROUNDMASS: Fine grained. Contains some clay stringers that have completely replaced original glass.

VESICLES: No obvious vesicles are preserved, but some of the stringers in the groundmass may be vesicles.

COLOR: Pale pink to grayish pink to grayish red.

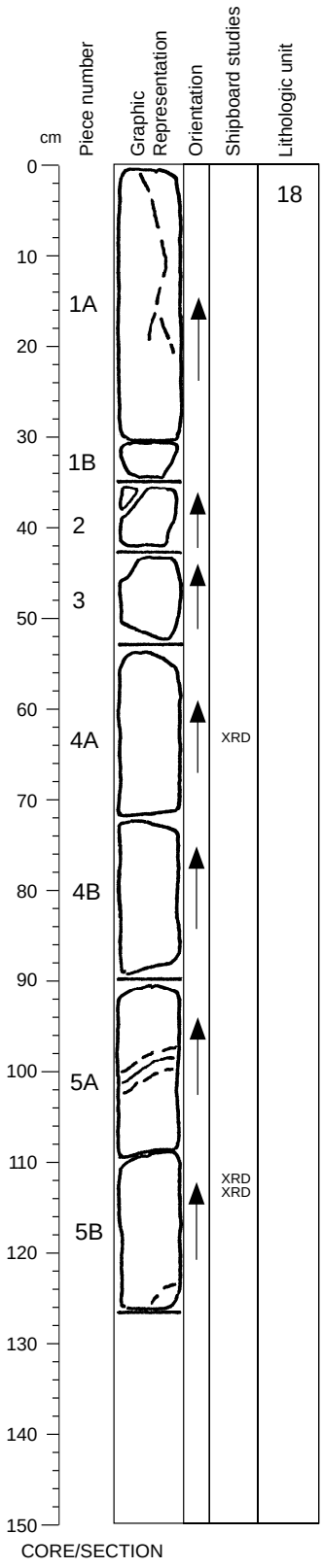
STRUCTURE: Massive.

ALTERATION: High to complete. Concentric, subvertical alteration haloes are present.

VEINS/FRACTURES: Moderately veined and fractured. Thin (≤1 mm wide) veins and fractures are filled with clay, quartz, and subordinate carbonate.

COMMENTS: Late-stage oxidation appears to have followed the alteration that imparted the light color to the rock. The oxidation affected groundmass mafic minerals, sanidine phenocrysts and glomerocrysts, and colored originally glassy areas dark reddish brown.

Core Photo



183-1139A-70R-4 **Section top: 665.51 (mbsf)**

UNIT 18: MODERATELY TO HIGHLY SANIDINE-PHYRIC TRACHYANDESITE

Pieces: 1-5

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	5-15	10	1		Euhedral; relatively fresh to completely altered (see comments below)

GROUNDMASS: Fine grained.

VESICLES: Piece 3 is highly vesicular; Pieces 4-5A are moderately vesicular. Vesicles are ≤10 mm, irregular, elongate, and filled with zeolite, clay, and quartz.

COLOR: White overall; locally varies from white to grayish pink to light red in Pieces 1-4B, and from light grayish to dusky red in Piece 5 and part of Piece 4B.

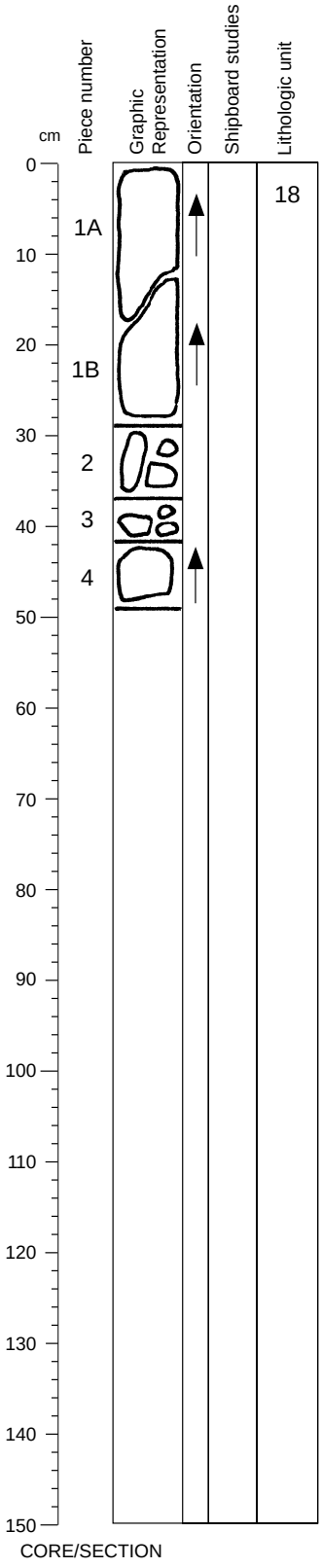
STRUCTURE: Massive.

ALTERATION: Complete in Pieces 1-4; very high to complete in Piece 5.

VEINS/FRACTURES: Multiple generations of <3-mm-wide veins are present; some have prominent haloes. Vein fillings include zeolite, clay, and quartz.

COMMENTS: No remnants of mafic igneous minerals are present in the white areas. The reddish oxidation in Piece 5 appears to have followed the whitish alteration (see Section 70R-3). Sanidine phenocrysts vary from clear to grayish white or translucent yellow; these colors are associated with variations in groundmass alteration. In the grayish and dusky red parts of Piece 5, completely altered euhedral laths of groundmass feldspar are aligned.

Core Photo



183-1139A-70R-5 **Section top: 666.79 (mbsf)**

UNIT 18: MODERATELY SANIDINE-PHYRIC TRACHYANDESITE

Pieces: 1-4

CONTACTS: None.

PHENOCRYSTS:	**%**	**Grain Size (mm):**			
	Mode	**Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	5	10	1	4	Pseudomorphs of euhedral phenocrysts and glomerocrysts

GROUNDMASS: Fine grained.

VESICLES: Piece 1 is highly vesicular. Vesicles are irregular, ≤12 mm, and filled with zeolite and clay.

COLOR: Grayish red in Piece 1; white to grayish pink in Piece 2; very light gray in Pieces 3 and 4.

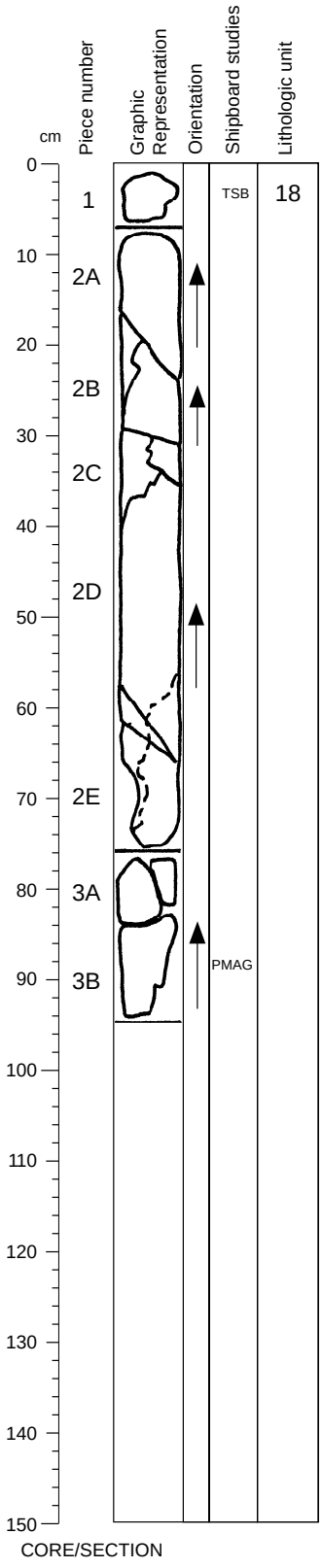
STRUCTURE: Massive.

ALTERATION: Complete in Pieces 2-4; very high in Piece 1.

VEINS/FRACTURES: Pieces 1A and 1B are separated by a prominent red vein (~0.7 mm thick) filled with iron oxide and clay.

COMMENTS: Sanidine pseudomorphs have a few cleavage planes.

Core Photo



183-1139A-71R-1 **Section top: 670.90 (mbsf)**

UNIT 18: MODERATELY SANIDINE-PHYRIC TRACHYANDESITE

Pieces: 1-3

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	5-107		1	4	Euhedral laths and glomerocrysts; relatively fresh to altered

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular.

COLOR: Light grayish white to grayish red.

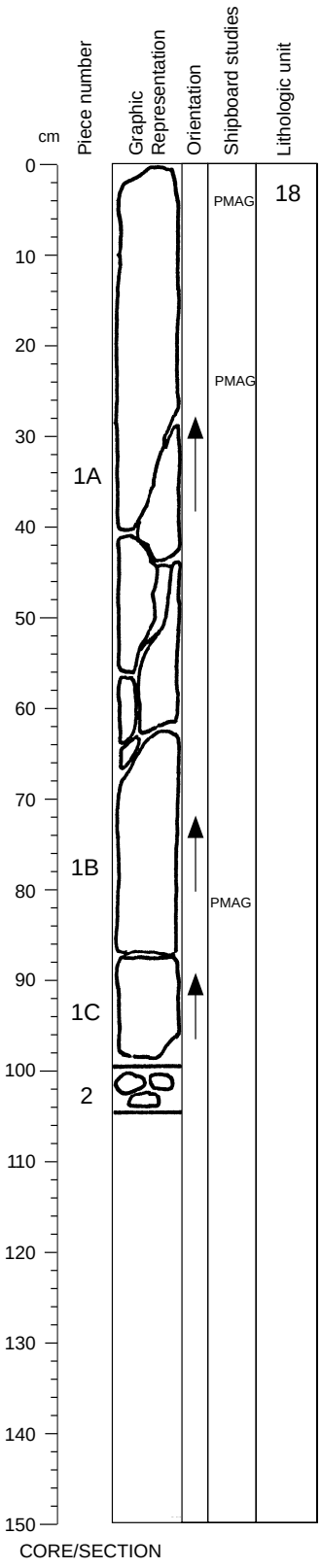
STRUCTURE: Massive.

ALTERATION: Very high to complete.

VEINS/FRACTURES: Numerous veins, some with prominent haloes, are filled with calcite, clay, and hematite.

COMMENTS: Oxides (≤0.2 mm) are disseminated in Piece 1; some are euhedral and equant. The rock has a complex alteration history involving multiple events, including early "bleaching" and late oxidation.

Core Photo



183-1139A-71R-2 **Section top: 671.85 (mbsf)**

UNIT 18: MODERATELY SANIDINE-PHYRIC TRACHYANDESITE

Pieces: 1, 2

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	10	6	1	3-4	Subhedral laths; highly altered.

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular, except for lower part of Piece 1B (81-95 cm), which is moderately vesicular. Vesicles are elongate and irregular, ≤1 mm.

COLOR: Pinkish white to grayish red and pale red.

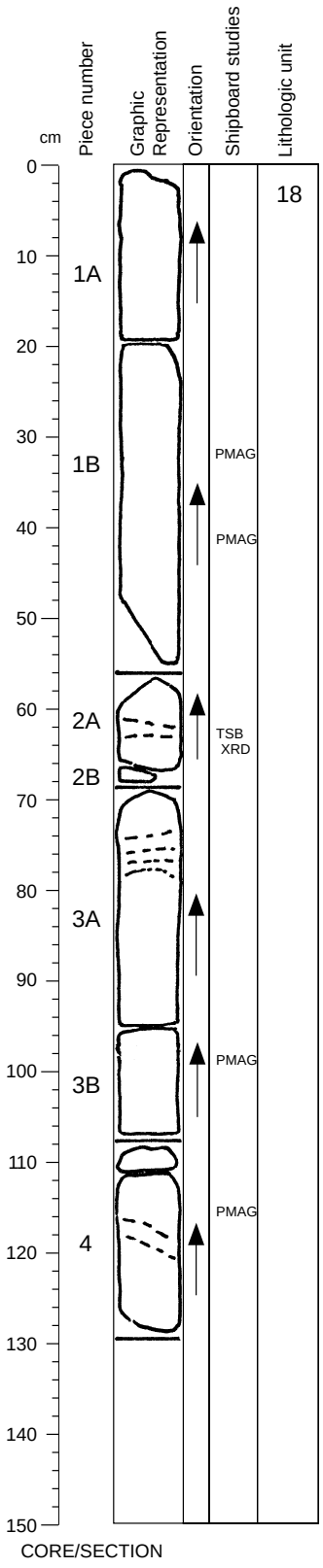
STRUCTURE: Massive.

ALTERATION: Very high to complete.

VEINS/FRACTURES: Pieces 1A and 1B have two networks of veins and associated alteration haloes. Vein filling includes zeolite and clay.

COMMENTS: The rock has a complex alteration history involving multiple events. In contrast to Section 71R-1, "bleaching" in this section postdates reddish oxidation.

Core Photo



183-1139A-71R-3 **Section top: 672.90 (mbsf)**

UNIT 18: MODERATELY SANIDINE-PHYRIC TRACHYANDESITE

Pieces: 1-4

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	5-10	12	1	4-6	Subhedral to euhedral altered
Mafic (?) phase:	1	2	1	1	Completely altered anhedral pseudomorphs

GROUNDMASS: Fine grained. Clay stringers (replacing original glass) dip ~35° in Piece 1B from 12-50 cm.

VESICLES: Sparsely vesicular. Vesicles are filled with zeolite, clay, and hematite.

COLOR: Grayish red to dusky red.

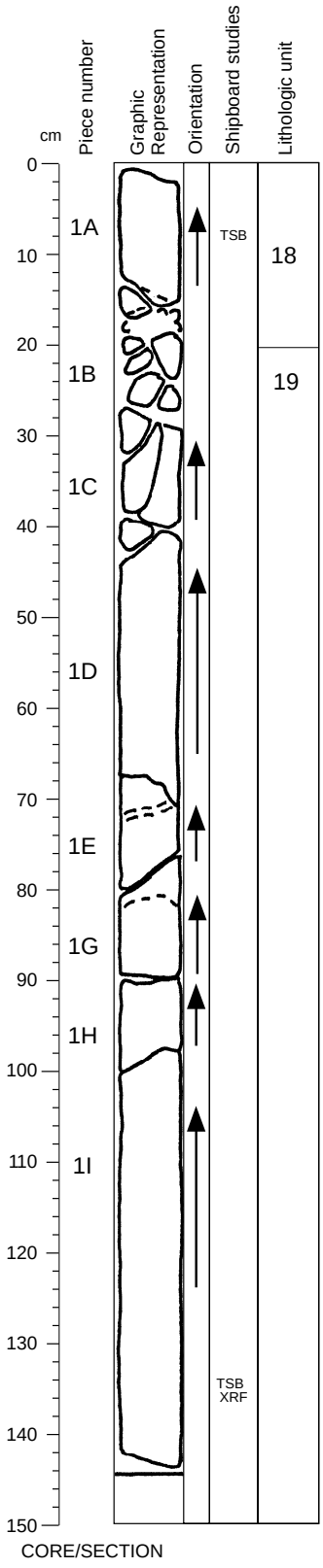
STRUCTURE: Massive, except for the interval from 67-70 cm, which is brecciated.

ALTERATION: Complete. The most severe alteration is between 52 and 79 cm (in Pieces 1B, 2A and 3A).

VEINS/FRACTURES: Veins (<3 mm wide) are filled with calcite and clay.

COMMENTS: Traces of an altered ferromagnesian mineral (< 0.6 mm) are present. Piece 1B contains a 1-cm-diameter xenolith with three feldspar pseudomorphs and a groundmass distinct from that of the host rock; alteration has obscured other igneous features of this xenolith. The thin breccia zone from 67-70 cm might mark a boundary between two flow lobes.

Core Photo



183-1139A-71R-4 **Section top: 674.20 (mbsf)**

UNIT 18: MODERATELY SANIDINE-PHYRIC TRACHYANDESITE

Pieces: 1

CONTACTS: Not recovered; the contact between Units 18 and 19 is inferred to be at ~20 cm, within Piece 1B.

PHENOCRYSTS:	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Sanidine:	3-5	8	0.5	3	Euhedral to subhedral crystals; some glomerocrysts

GROUNDMASS: Fine grained. Contains finely disseminated sulfides.

VESICLES: Sparsely vesicular; vesicles are 0.5-5 mm, round to ovoid, and filled with clay.

COLOR: Light brownish gray to pale red.

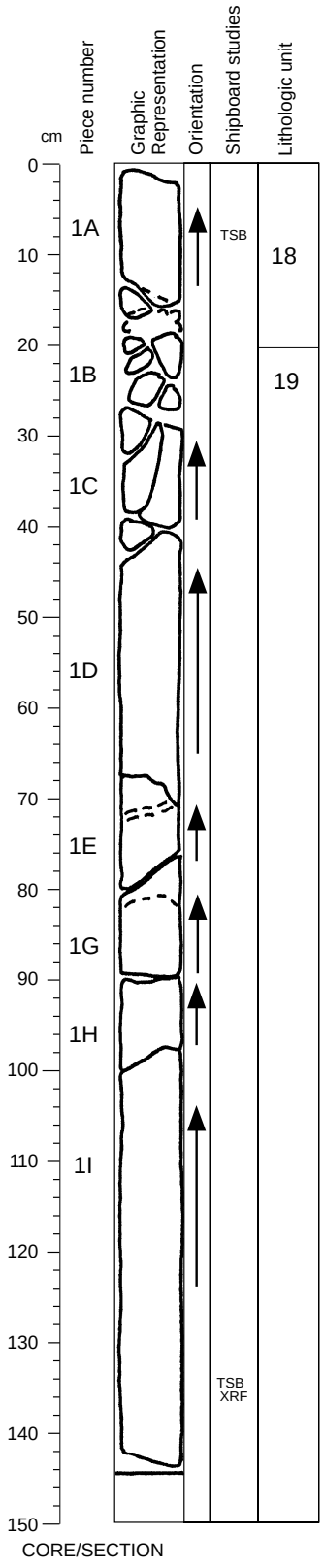
STRUCTURE: Massive.

ALTERATION: Moderate to high; groundmass is highly altered. Alteration haloes are present.

VEINS/FRACTURES: Sparsely veined and fractured. Fine (<0.5 mm wide) veins filled with clay and zeolite form a network.

COMMENTS:

Core Photo



183-1139A-71R-4 **Section top: 674.20 (mbsf)**

UNIT 19: MODERATELY SANIDINE-PHYRIC TRACHYTE BRECCIA

Pieces: 1

CONTACTS: Not recovered; the contact between Units 18 and 19 is inferred to be at ~20 cm, within Piece 1B.

PHENOCRYSTS:

	% Mode	Grain Size (mm): Max	Min	Avg.	Shape/Habit
Sanidine:	5	2	0.5	1	Euhedral to subhedral; moderately to highly altered

GROUNDMASS: Fine grained.

VESICLES: Moderately vesicular. Vesicles are angular to subround, 0.5-2 mm, and filled with dark clay.

COLOR: From 19-80 cm, grayish red; from 80-144 cm, pale blue green to pinkish gray.

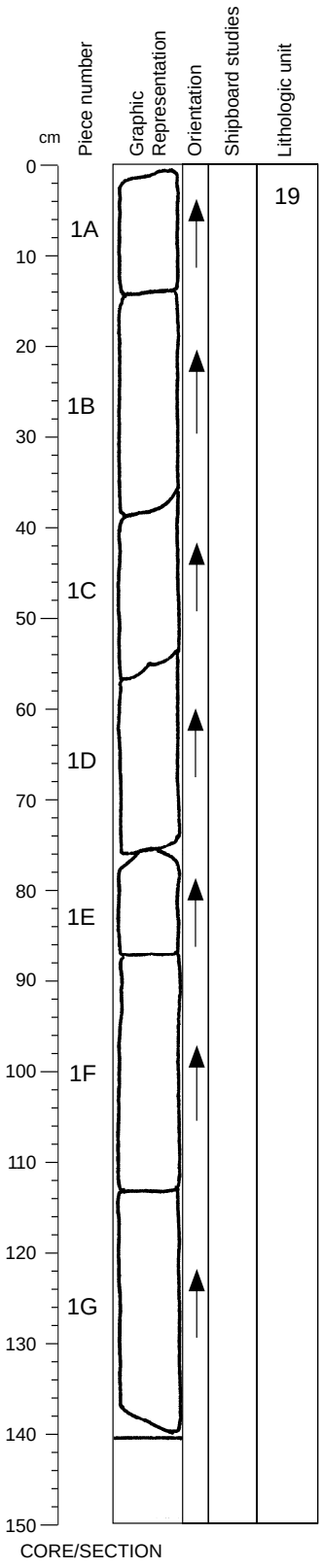
STRUCTURE: Brecciated.

ALTERATION: High to complete.

VEINS/FRACTURES: Sparsely veined and fractured. Several subhorizontal to subvertical veins (1-5 mm wide) are filled with pale bluish green clay and calcite.

COMMENTS: The matrix contains feldspar grains. An oxidation halo is present in the grayish red breccia. Some of the breccia at the top of the section assigned to Unit 19 could be a basal breccia for Unit 18.

Core Photo



183-1139A-71R-5 **Section top: 675.66 (mbsf)**

UNIT 19: MODERATELY TO HIGHLY SANIDINE-CLINOPYROXENE-PHYRIC TRACHYTE AND TRACHYTE BRECCIA

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	8-10	3.5	0.5	1-2	Euhedral; altered
Clinopyroxene:	1-2	1.5	0.5	1	Euhedral; altered

GROUNDMASS: Fine grained.

VESICLES: Sparsely vesicular. Vesicles are subround to elongate, 0.5-2 mm, and filled with dark brown and reddish brown clay.

COLOR: Pale red from 0-45 cm; grayish blue-green to pinkish gray from 45-110 cm; pale red to grayish red from 110-138 cm.

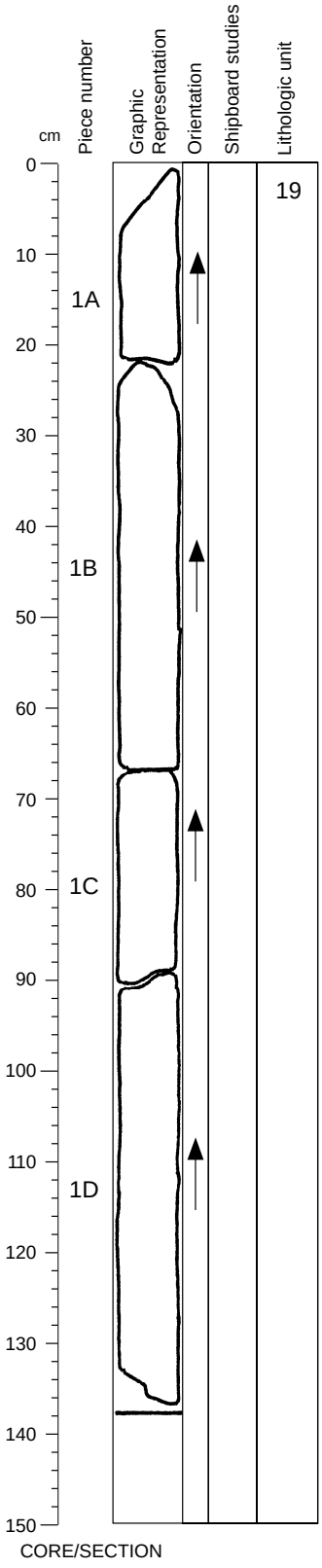
STRUCTURE: Brecciated from 0-90 cm; massive from 90-140 cm.

ALTERATION: High. Groundmass is highly to completely altered.

VEINS/FRACTURES: Sparse <1-mm-wide veins are filled with calcite and clay.

COMMENTS: Sanidine phenocrysts are highly to completely altered in the lighter-colored areas. The clinopyroxene phenocrysts are in the massive portion of the section.

Core Photo



183-1139A-71R-6 **Section top: 677.07 (mbsf)**

UNIT 19: MODERATELY TO HIGHLY SANIDINE-CLINOPYROXENE-PHYRIC TRACHYTE

Pieces: 1

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	8-10	3.5	0.4	1-2	Subhedral; altered
Clinopyroxene:	1-2	1.2	0.5	0.7	Euhedral to subhedral; completely altered

GROUNDMASS: Fine grained. Contains small amount of sulfide.

VESICLES: Sparsely vesicular. Vesicles are <1 to 2 mm, subround to ovoid or flattened, and filled with reddish brown clay.

COLOR: Pieces 1B and 1C are pale red (color is lighter near vein); Pieces 1A and 1D are pinkish gray to light brown.

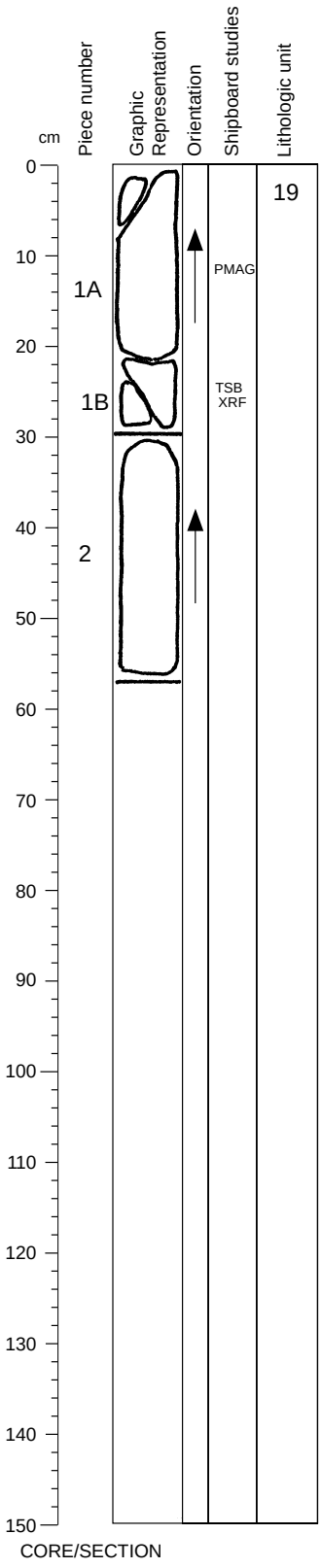
STRUCTURE: Massive. The branching vein traversing Pieces 1B and 1C produces abrecciated appearance.

ALTERATION: High to complete; groundmass is highly to completely altered.

VEINS/FRACTURES: Sparse veins, <1 mm wide, are filled with clay.

COMMENTS: Sanidine phenocrysts are highly altered in the pale areas near veins.

Core Photo



183-1139A-71R-7 **Section top: 678.45 (mbsf)**

UNIT 19: MODERATELY SANIDINE-PHYRIC TRACHYTE

Pieces: 1, 2

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	8-10	2	0.5	1.5	Subhedral to euhedral; moderately altered
Clinopyroxene:	1	1.5	0.5	0.8	Euhedral; altered

GROUNDMASS: Fine grained.

VESICLES: Sparsely to locally moderately vesicular. Vesicles are <1 mm and filled with brown clay.

COLOR: Grayish red.

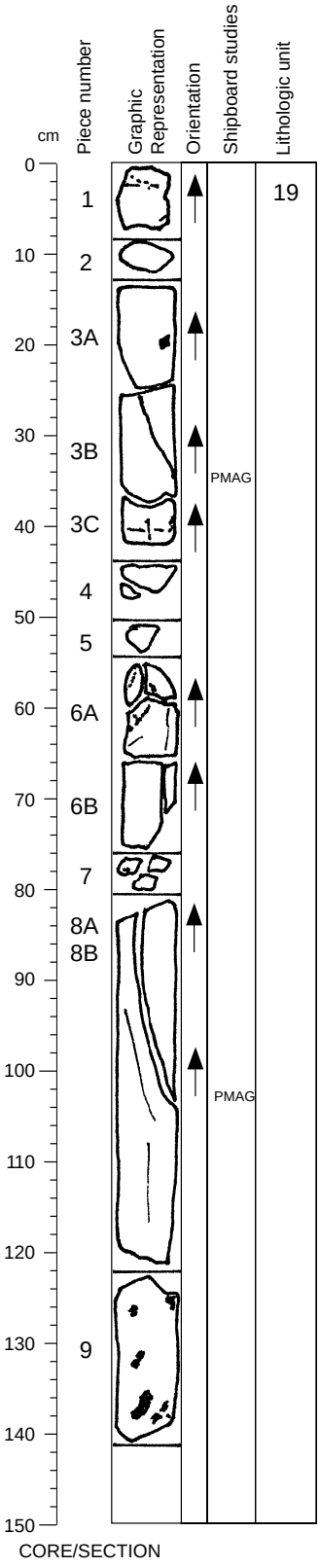
STRUCTURE: Massive.

ALTERATION: High.

VEINS/FRACTURES: Sparsely veined and fractured; veins are filled with clay.

COMMENTS: Clinopyroxene abundance decreases downward in the section to only trace amounts in Piece 2E.

Core Photo



183-1139A-72R-1 **Section top: 680.30 (mbsf)**

UNIT 19: HIGHLY SANIDINE-PHYRIC TRACHYTE

Pieces: 1-9

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	10-153		0.2	1	Euhedral laths; partially altered
Clinopyroxene:	trace				In clusters with sanidine; altered to clay

GROUNDMASS: Aphanitic.

VESICLES: Sparsely vesicular. Vesicles are subround to irregular, 0.2-0.6 mm, and filled with clay.

COLOR: Grayish brown.

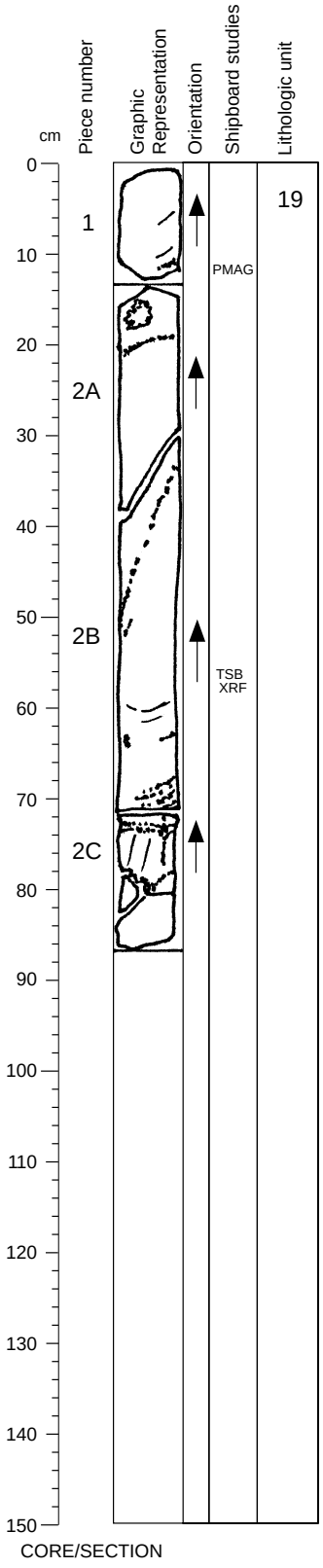
STRUCTURE: Massive.

ALTERATION: Moderate. Groundmass is highly altered to clay.

VEINS/FRACTURES: Moderately abundant; subvertical veins, ~1 mm wide, are filled with brown and white clay and calcite.

COMMENTS: An angular ~2-cm-wide xenolith of aphyric basalt is present at 20 cm.

Core Photo



183-1139A-72R-2 **Section top: 681.73 (mbsf)**

UNIT 19: MODERATELY SANIDINE-PHYRIC TRACHYTE

Pieces: 1, 2

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	10	3	0.2	1	Euhedral laths
Clinopyroxene:	trace				Patches of clay pseudomorphs

GROUNDMASS: Aphanitic.

VESICLES: Sparsely vesicular. Vesicles are subround, 0.2-0.6 mm, and filled with clay.

COLOR: Pale brownish gray to reddish brown.

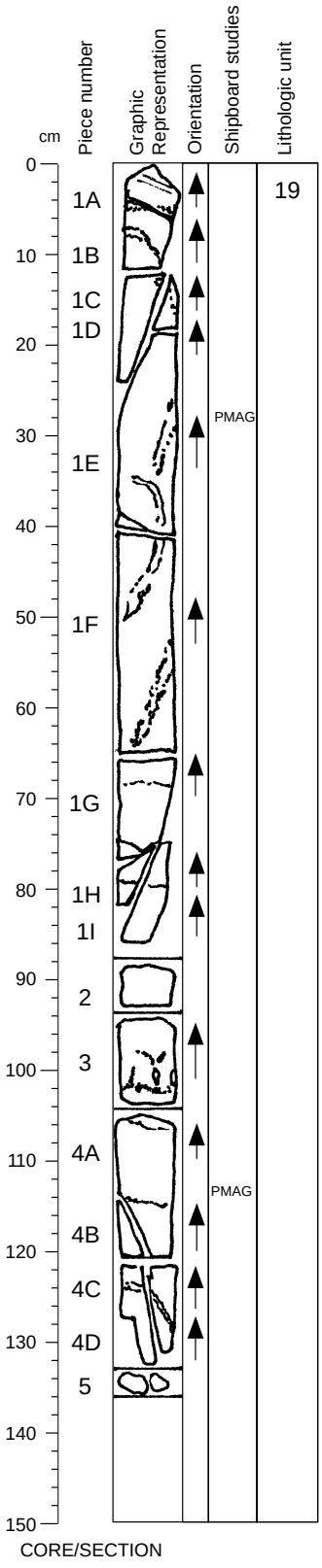
STRUCTURE: Massive.

ALTERATION: Moderate.

VEINS/FRACTURES: Steeply inclined veins and fractures are <2 mm wide, and filled with clay, calcite and, rarely, zeolite.

COMMENTS:

Core Photo



183-1139A-72R-3 **Section top: 682.62 (mbsf)**

UNIT 19: MODERATELY SANIDINE-PHYRIC TRACHYTE

Pieces: 1-5

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	5-10	2	0.2	1	Euhedral laths
Clinopyroxene:	trace				Patches of clay pseudomorphs

GROUNDMASS: Aphanitic.

VESICLES: Sparsely vesicular. Vesicles are subround, 0.2-0.6 mm, and filled with clay.

COLOR: Pale brownish gray to reddish brown.

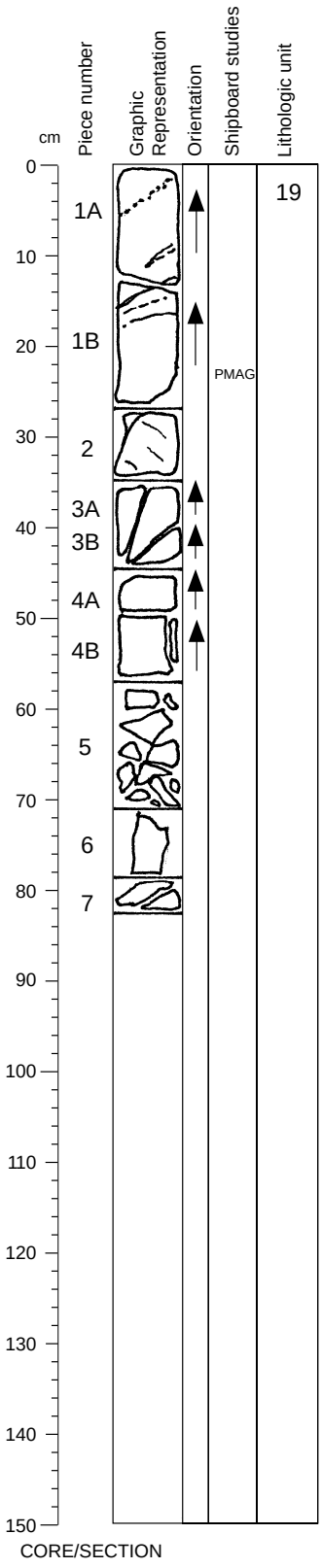
STRUCTURE: Massive.

ALTERATION: Moderate. Curved, concentric, steeply inclined alteration bands are manifested in different shades of brown. Dispersed ~1-mm-wide patches composed of flakes of dark green and reddish brown minerals are common near base of section.

VEINS/FRACTURES: Steeply inclined fractures and veins are <3 mm wide, and filled with calcite and clay.

COMMENTS:

Core Photo



183-1139A-72R-4 **Section top: 684.00 (mbsf)**

UNIT 19: MODERATELY SANIDINE-CLINOPYROXENE-PHYRIC TRACHYTE

Pieces: 1-7

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	5-10	4	0.5	1	Euhedral laths
Clinopyroxene:	1	0.5			Dark green clay pseudomorphs

GROUNDMASS: Aphanitic to fine grained.

VESICLES: Sparsely vesicular. Vesicles are irregular, 0.5-2 mm, filled with dark green and brown clay, and are largely in cm-size bands. In Piece 1, these bands dip ~30°. Much of the section is nonvesicular.

COLOR: Pale to medium brownish gray. Color bands in Piece 1 are aligned with vesicle bands.

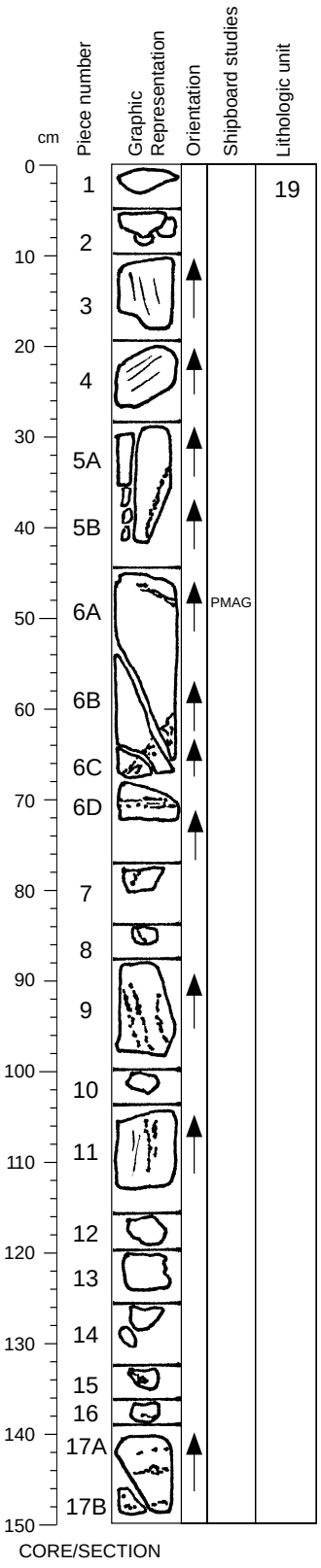
STRUCTURE: Massive.

ALTERATION: Moderate.

VEINS/FRACTURES: Sparse, randomly oriented fractures are lined with clay.

COMMENTS: Banding caused by vesicle alignment is accentuated by alteration.

Core Photo



183-1139A-73R-1 **Section top: 689.50 (mbsf)**

UNIT 19: MODERATELY SANIDINE-PHYRIC TRACHYTE

Pieces: 1-17

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	5-105		0.5	1	Euhedral laths and glomerocrysts
Clinopyroxene:	trace				Dark green clay pseudomorphs

GROUNDMASS: Fine grained to aphanitic.

VESICLES: None.

COLOR: Pale gray to reddish brown.

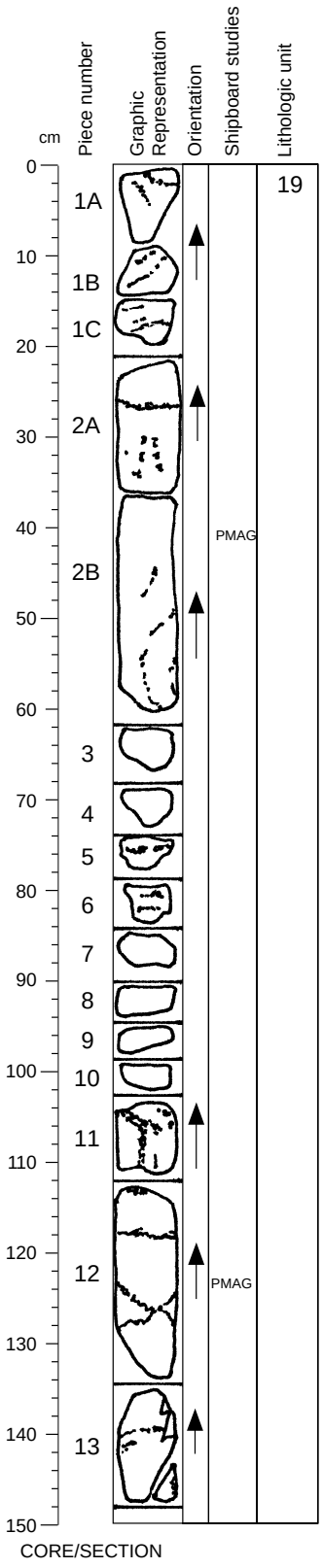
STRUCTURE: Massive.

ALTERATION: Moderate.

VEINS/FRACTURES: Sparse subvertical fractures are lined with clay.

COMMENTS:

Core Photo



183-1139A-73R-2 **Section top: 691.00 (mbsf)**

UNIT 19: MODERATELY SANIDINE-CLINOPYROXENE-PHYRIC TRACHYTE

Pieces: 1-13

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Sanidine:	5-10	5	0.5	1	Euhedral laths and glomerocrysts
Clinopyroxene:	0-2	1			Euhedral, dark green clay pseudomorphs; isolated and associated with plagioclase

GROUNDMASS: Fine grained.

VESICLES: None.

COLOR: Pale gray to reddish brown, with several areas of well-defined color banding on mm- to cm-scales.

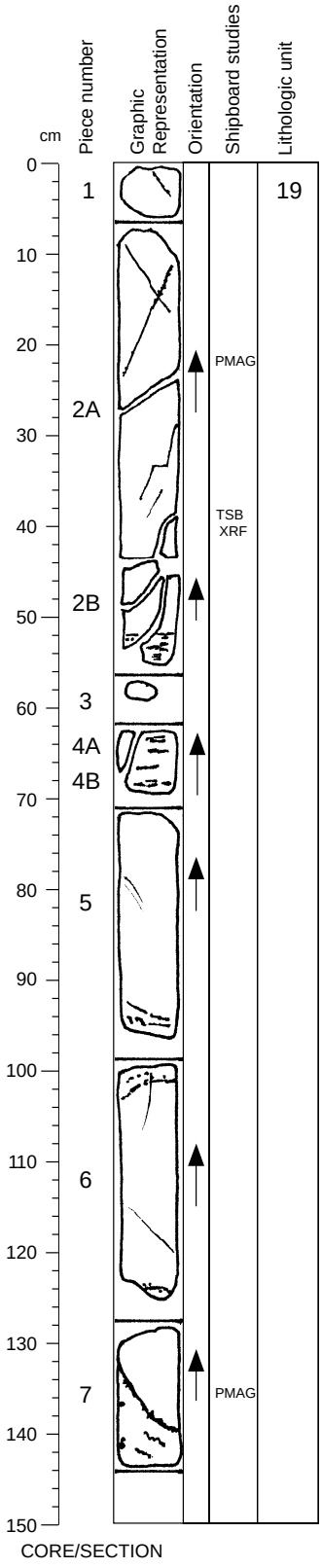
STRUCTURE: Massive.

ALTERATION: Moderate.

VEINS/FRACTURES: Clay-lined, <1-mm-wide, moderately dipping fractures are present.

COMMENTS: Irregular patches (~1 mm) of dark green clay could be clots of secondary minerals or altered clinopyroxene phenocrysts. Vivid color banding is probably secondary, because bands (including those with sharp boundaries) pass indiscriminately through phenocrysts.

Core Photo



183-1139A-73R-3 **Section top: 692.50 (mbsf)**

UNIT 19: MODERATELY SANIDINE-PHYRIC TRACHYTE

Pieces: 1-7

CONTACTS: None.

PHENOCRYSTS:	**% Mode**	**Grain Size (mm): Max**	**Min**	**Avg.**	**Shape/Habit**
Plagioclase:	5-10	3	0.5	1	Euhedral laths and glomerocrysts
Clinopyroxene:	trace				Dark green clay pseudomorphs

GROUNDMASS: Fine grained.

VESICLES: None.

COLOR: Pale gray to reddish brown, with several zones of alternating cm-scale color bands.

STRUCTURE: Massive.

ALTERATION: Moderate to high.

VEINS/FRACTURES: Sparse fractures and sparse, thin (<1 to 2 mm wide), steeply dipping brown-clay-filled veins are present; some have prominent oxidation haloes.

COMMENTS:

Sample										Texture			Mineral																		Biogenic												Rock						Other		
Leg	Site	H	Cor	CT	Sct	Top	Depth	Lithology	Sand	Silt	Clay	Amphibole	Chlorite	Clay	Clinopyroxene	Feldspar	Glauconite	Magnetite	Mica	Palagonite	Pyrite	Pyroxene	Quartz	Volcanic Glass	Zeolite	Benthic Forams	Calcispheres	Diatoms	Discoaster	Foraminifers	Nannofossils	Plant Debris	Radiolarians	Silicoflagellates	Skeletal Debris	Sponge Spicules	Basalt Fragments	Calcareous Fragments	Carbonate Particles	Packstone Clast	Silt	Volcanic Fragments	Rad/Diatom/Dino Spines	Unknown	Comments
183	1139	A	1	R	2	20	1.1	D		D	P																	D		C	P		P			P										
183	1139	A	1	R	3	50	2.9	D		P	D																	A		C	D		P	*		P										
183	1139	A	1	R	5	70	4.86	D		D	P													*				D		P			C	C	*	R								P		
183	1139	A	2	R	3	60	13.1	D		D	*																	D		A	*		R	P		P								R		
183	1139	A	3	R	1	125	20.25	D		D														P				A		C	A		C	R		R								P		
183	1139	A	3	R	2	95	21.45	D		D														R				A		A	A		C			C								P		
183	1139	A	3	R	4	5	23.55	D		D																		A		A	D		C			C								R		
183	1139	A	4	R	1	75	29.25	D			D													P				P		C	D					C										
183	1139	A	4	R	4	75	33.75	D			D		*			R												R		P	D					R										
183	1139	A	4	R	4	140	34.4	M			D																			C	D					C										
183	1139	A	5	R	1	32	38.32	M			D			P										P				R		C	D					C										
183	1139	A	6	R	1	26	47.76	M			D			A										P					P	R	A		P			C										
183	1139	A	6	R	1	75	48.25	D			D			D										P					C	R	A		P			C										
183	1139	A	7	R	2	75	59.25	D			D			A										R				P			A					C										
183	1139	A	8	R	1	65	67.15	D			D			A										P				C			A					C										
183	1139	A	9	R	2	75	77.09	D		C	D			A				C						P				C			A					P										
183	1139	A	11	R	1	80	95.9	D			D			A										P						P	A		P	*		P										
183	1139	A	11	R	1	110	96.2	M		D	A													D				R		R	A			R		P										
183	1139	A	12	R	1	40	105.1	D			D			D				P						P				P			C		R			P										
183	1139	A	12	R	2	49	106.69	D			D		P	D							C			C	P			R			A		R			R										
183	1139	A	12	R	2	80	107	D		P	A			A			*				P			C				P			D		R	*		C										
183	1139	A	13	R	2	20	116.1	D			A			A		R					P			P				R			C		R			P										
183	1139	A	13	R	2	75	116.65	D			D			D							P			R				R			P					R										
183	1139	A	13	R	3	12	117.52	D			D			D							C										P					R								R		
183	1139	A	14	R	2	19	125.69	D		D	P			P							R			A				R		*	D		R	R		P								P		
183	1139	A	14	R	2	80	126.3	D			D			D		R					R			R	R						P		*			*										
183	1139	A	15	R	2	106	136.06	D			D			A		R	*				R			C				P		*	D		P	R		R										
183	1139	A	15	R	3	40	136.9	D			D			D		R	*				P							C			C		P	R		R								R		
183	1139	A	15	R	4	59	138.59	D			D			C			R				P			R				R		*	D		R			R										
183	1139	A	16	R	4	78	148.48	D			D			C		*					R			P				A			A		P	*		P								*		
183	1139	A	17	R	5	103	159.83	D			D			P		P					R			C				P		R	D		P	*		P								P		
183	1139	A	18	R	3	10	165.6	D			D			P		R								P	R			P			D		P			P								P		
183	1139	A	18	R	4	30	167.3	D			D			P										R				P		*	D		R			P								P		
183	1139	A	19	R	1	136	173.46	D			D													R						P	D		R			P								P		
183	1139	A	19	R	4	110	177.7	D			D			P		*	R														R	D		P			P								P		
183	1139	A	20	R	1	20	181.9	D			D			D							P									R	R	C														
183	1139	A	20	R	1	24	181.94	D			D			P		R								P							P	D													C		
183	1139	A	20	R	1	117	182.87	D			D			P							R							R				D													P		
183	1139	A	21	R	2	133	194.13	M	C	C	D			A		P							P		P	P					P	P															
183	1139	A	21	R	3	96	195.26	M			D			D					*		P						R				P	C															
183	1139	A	21	R	3	###																																										
183	1139	A	23	R	6	63	218.63	M			D	*		D		*		P			P			R							R	C															
183	1139	A	26	R	1	75	240.15	D			D		*	D							P			*							R	C															
183	1139	A	27	R	1	75	249.85	D			D			A	R						C				*							A															
183	1139	A	31	R	3	68	291.18	D			D			P										P	R					P	D														C		
183	1139	A	33	R	1	112	307.92	D			D		*											P	P			R			A				*									C		
183	1139	A	38	R	3	19	356.82	D		D						A								D							R															
183	1139	A	38	R	4	74	358.87	D		D														D																							
183	1139	A	39	R	2	124	366.7	D		D	R			R										D	P						P															

Sample									Texture			Mineral															Biogenic											Rock					Other		
Leg	Site	H	Cor	CT	Sct	Top	Depth	Lithology	Sand	Silt	Clay	Amphibole	Chlorite	Clay	Clinopyroxene	Feldspar	Glauconite	Magnetite	Mica	Palagonite	Pyrite	Pyroxene	Quartz	Volcanic Glass	Zeolite	Benthic Forams	Calcispheres	Diatoms	Discoaster	Foraminifers	Nannofossils	Plant Debris	Radiolarians	Silicoflagellates	Skeletal Debris	Sponge Spicules	Basalt Fragments	Calcareous Fragments	Carbonate Particles	Packstone Clast	Silt	Volcanic Fragments	Rad/Diatom/Dino Spines	Unknown	Comments
183	1139	A	40	R	1	110	374.9	D			D																		*	R	D												R	
183	1139	A	40	R	5	140	381.2	D			D													P						C	D												P	
183	1139	A	40	R	6	28	381.58	D			D					P								R						C	D												P	
183	1139	A	40	R	6	86	382.16	D			D													R					*	A	D		P									P	

THIN SECTION:	**183-1139A-41R-1, 40-43**					**Unit IV**	**OBSERVER: FB, DR, LM**	
ROCK NAME:	**Sandy packstone.**							
WHERE SAMPLED:	**Middle of Unit IV.**							
GRAIN SIZE:	**Coarse to very coarse sand size (0.4-1.2 mm).**							
TEXTURE:	**Poorly sorted.**							
PRIMARY MINERALOGY	**PERCENT category**	**PERCENT item**	**SIZE (mm) min.**	**max.**	**av.**	**APPROX. COMP.**	**MORPHOLOGY**	**COMMENTS**
MINERAL	6							
Iron ooids		2					Rounded to subrounded	Dark red, hematite-stained.
Feldspar		3					Subangular	Simple twins.
Polycrystalline quartz		1						
LITHIC	39							
Vesicular basalt		10					Rounded to subrounded	Black, with well preserved spheroidal vesicles.
Altered volcanic rocks		30						Partially replaced by pale brown clay, red and brown iron oxides and opaque oxides.
BIOCLASTIC	5							
Benthic foraminifers		1						Partially replaced by micrite/microsparite.
Planktonic foraminifers		1						Partially replaced by micrite/microsparite.
Echinoderms		1						Goes to extinction as a single piece.
Shell fragments		1						Includes bivalves.
Ostracods		1						
MATRIX	45	45						Pale brown calcite micrite.
			SIZE (mm) min.	**max.**	**av.**			
CEMENT	5						**REPLACING / FILLING**	**COMMENTS**
Microsparite		2					Filling voids	
Drusy calcite		1					Filling voids	
Fibrous calcite		1					Filling voids	Rare
Silica		1					Filling voids	Rare
Total	100	100						

COMMENTS : Grains are predominantly volcanic lithic and include a few vesicular grains. Most of the volcanic material is highly altered. A single grain of silt-sized polycrystalline quartz with triple-junction crystal boundaries is present and is proably igneous rather than metamorphic. Bioclasts are rare (~5%) and are strongly recrystallised. Cements are rare and mostly drusy calcite. A few very thin fringes of fibrous calcite can be observed. Part of the cements are silicified.

Photomicrograph#:

1139A-28 = Packstone with grain of altered vesicular basalt (x5 objective, ppl).

THIN SECTION: 183-1139A-41R-2, 50-54 **Unit V** **OBSERVER: FB, DR, LM**
ROCK NAME: Sandy grainstone
WHERE SAMPLED: From near the top of the unit.
GRAIN SIZE: Very coarse sand size (2 mm)
TEXTURE: Well sorted, no matrix.

PRIMARY MINERALOGY	PERCENT category	PERCENT item	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
					2			
MINERAL	2							
Alkali feldspar		1					Small, angular	Angular broken fragments.
Opaque grains		1						
LITHIC	2							
Basalt		1					Angular	One grain has a small lath-shaped feldspar(?) microcrystal, otherwise grains are dark and altered. One grain has vesicles.
Opaque grains		1					Subangular	Broken, altered lithic fragments.
BIOCLASTIC	66							
Bryozoans		30						Random sections through bryozoans.
Bivalves		20						Some sections through shell.
Echinoderms		11						Syntaxial overgrowths.
Benthic foraminifers		5						

CEMENT			SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Calcite	10	10				Voids, epitaxial overgrowths	Dog tooth.
Calcite	5	5				Voids	Blocky.
Void space	15	15					
Total	100	100					

COMMENTS : This coarse grainstone is very well sorted, porosity is high (~20-30%) and approximately half the pores are filled with calcite cement. Bioclasts are highly fragmented and many shells are micritized. Most of the bioclastic grains are angular. Rock fragments and mineral grains, including feldspar- bearing lava fragments, make up only about 4% of the total volume.
Photomicrograph#:
1139A-30 = Typical field of view in the sandy grainstone (x5 objective, ppl). Note dogtooth cement.

THIN SECTION: 183-1139A-42R-1, 67-70 **Unit V** **OBSERVER: FB, DR, LM**
ROCK NAME: Sandy grainstone.
WHERE SAMPLED: Near the top of the unit.
GRAIN SIZE: Coarse sand size (1 mm).
TEXTURE: Well sorted, no matrix.

PRIMARY MINERALOGY	PERCENT category	PERCENT item	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
MINERAL	1							
Alkali feldspar		1					Angular	Broken fragments.
LITHIC	2							
Basalt		1					Angular	A few grains have small lath-shaped feldspar(?) microcrystals, otherwise these fragments are dark and altered.
Opaque grains		1					Subangular	Broken, altered lithic fragments.
BIOCLASTIC	67							
Bryozoans		25						Random sections through bryazoan.
Shell fragments		16						Some sections through shell.
Serpulid worm tubes		11						Oblique sections through worm tubes.
Echinoderms		10						Syntaxial overgrowths.
Benthic foraminifers		5						

CEMENT			SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Calcite	15	15					Dog tooth
Void	15	15					
Total	100	100					

COMMENTS : This coarse grainstone is very well sorted, porosity is high (~20-30%) and approximately half the pores are filled with calcite cement. Bioclasts are highly fragmented and many shells are micritized. Most of the bioclastic grains are angular. Mineral and rock fragment grains, including feldspar-bearing lava fragments, make up approximately 4% of the total volume.

THIN SECTION: 183-1139A-51R-1, 3-5, Piece 1 — **Unit 1A** — **OBSERVER: JB**
ROCK NAME: Flow-banded sanidine-quartz-phyric rhyolite containing lithic clasts.
WHERE SAMPLED: Cobble.
GRAIN SIZE: Glassy rhyolite containing fine grained lithic clasts
TEXTURE: Flow-banded, possibly pyroclastic.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
LITHIC CLASTS								
Trachyte(?)	20	20	0.4	14			Sub-angular to rounded	Highly recrystallised and variably altered. Sanidine, quartz and plagioclase(?) phenocrysts seen in some clasts. Occasional patches of trachytic texture preserved in largest clast, protoliths of other clasts could be different lithologies, possibly even sedimentary in the case of the most quartz rich clast.
MICROPHENOCRYSTS								
Sanidine	1	1	0.02	0.3	0.05		Subangular to rounded	
Quartz	1	1	0.02	0.2	0.05		Subangular to rounded	
GROUNDMASS								
Glass	0	75						Devitrified.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	75				Replacing glass and filling voids	
Zeolite	2					

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

COMMENTS : Banding is developed between cryptocrystalline areas of devitrified glass, which are in turn banded by red iron oxy-hydroxide grain trails and staining, and two kinds of fine grained more felsic bands. One type consists of zeolite and clay which appear from their radiating morphology, to be filling former voids. The other are trails of primary(?) quartz and sanidine grains.
Some of the flow-banding textures look sedimentary, but this may be due to alteration. Presence of included clasts is unusual for a lava.

THIN SECTION: 183-1139A-51R-1, 23-25 **Unit 1A** **OBSERVER: JB**
ROCK NAME: Sparsely sanidine-phyric rhyolite.
WHERE SAMPLED: Cobble.
GRAIN SIZE: Fine grained
TEXTURE: Porphyritic with a groundmass displaying patchily developed trachytic texture.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	2	2	0.1	5	1.5		Euhedral to subhedral; rounded blocky laths and rhombs; some angular fragments	The low negative 2V identifies this alkali feldspar as sanidine. Grains typically have normal extinction although a few are strained or have incipient exsolution. A few form glomerocrysts. Grains have well developed parallel fractures filled with reddish to dark brown, iron oxy-hydroxide stained clay minerals but are otherwise fresh.
Biotite(?)	0	Trace	0.1	1				Two grains totally pseudomorphed by brown and golden brown clay minerals; one a lath the other equant. A similar rounded golden-brown clay pseudomorph (80 microns) occurs as an inclusion in sanidine.
GROUNDMASS								
Alkali felspar	40	60	0.05	0.1	0.075		Anhedral, equant	The relative proportion of the two feldspars is difficult to estimate; however, alkali felspar is much more abundant than plagioclase. The feldspars are intergrown giving the groundmass a felted appearance. The more acicular laths, identified as plagioclase, are patchily flow aligned. The alkali feldspar has a more blocky or interstitial character.
Plagioclase	20	30	0.05	0.05	0.1		Laths	
Titanomagnetite	<1	<1	0.025	0.2	0.05		Euhedral to anhedral; laths, rhombs and irregular patches; groundmass grains, equant	Bimodal size distribution. The size range given (as seen in reflected light) is for the larger population of what could be termed microphenocrysts. In plane polarised light the fresh cores are enclosed in opaque alteration(?) minerals; the grains therefore appear larger. The maximum size of true groundmass grains is 10 microns.
Amphibole(?)	0	5					Laths	Flow aligned lath-like aggregates (100 - 200 micons long) of dark brown clay minerals. The morphology suggests that these may have been amphibole rather than clinopyroxene.
Quartz	1	1	0.05	0.2	0.1		Anhedral	Often occurs in aggregates.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Brown clay	35				Feldspar, amphibole, biotite.	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
None							

COMMENTS :

THIN SECTION: 183-1139A-52R-1, 120-123 **Unit 1C** **OBSERVER: LM**
ROCK NAME: Flow-banded rhyolite breccia.
WHERE SAMPLED: Center of a thin interval of flow banded rhyolite breccia.
GRAIN SIZE: Granule to pebble-size clasts; sand to clay-size matrix.
TEXTURE: Clast-supported breccia.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
CLASTS								
Flow-banded glass	35	90			>20			Clasts are glassy, highly altered and do not preserve phenocrysts. Well developed banded perlitic texture is preserved. Flow-banding is also clear.
MATRIX	0	10						Clay and sand-sized fragments of flow-banded glass from the clasts.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay minerals	64				Volcanic glass	Fills the interstices between glassy kernels, bounded by perlitic fractures, and forms part of the matrix material between clasts.
Hematite/goethite	1				Filling voids between perlite kernels, staining clay minerals	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
None							

COMMENTS : This slide was taken to identify whether the clasts in this breccia were pumice or flow-banded rhyolite, because when altered in core it is hard to distinguish the banding from pseudomorphing after tube vesicles. In thin section the flow-banding is preserved, indicating that clasts are flow-banded felsic volcanic glass.
Photomicrograph#:
1139A-34 = Banded perlite (x2.5 objective, ppl)

THIN SECTION: 183-1139A-53R-1, 127-130 **Unit 1D** **OBSERVER: LM**
ROCK NAME: Felsic volcanic glass.
WHERE SAMPLED: Interior of perlitised glass interval.
GRAIN SIZE: Glassy.
TEXTURE: Holohyaline exhibiting multiple spheroidal fracture sets (perlite).

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GROUNDMASS								
Glass	90	98						Extremely good examples of spheroidal perlitic fractures in this volcanic glass

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Yellow clay mineral	8				Glass	Glass is largely devitrified to clay minerals, however, both are isotropic, and preserve primary textures.

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

COMMENTS : This is an excellent example of the development of spheroidal perlitic fractures in felsic volcanic glass. There are many examples of kernels of glass bounded by perlitic fractures nested within other kernels. There is one relatively large (2 mm) included lithic clast around which the glass shows flowage textures. Within these zones of flowage there are also some small (0.2 mm) feldspar fragments. There is another domain (10 x 10 mm) of banded perlite which appears to be a clast of flow banded glass. This domain contains alkali-feldspar phenocrysts.

Photomicrograph #:

1139A-19 = Perlitic texture (x2.5 objective, ppl);

1139A-32 = Inclusion in perlitic glass, showing textures of glass flowing around inclusion (x2.5 objective, ppl);

1139A-33 = Banded perlite (x2.5 objective, ppl).

THIN SECTION: 183-1139A-56R-1, 37-40 **Unit 2** **OBSERVER: CRN**
ROCK NAME: Moderately sanidine-quartz-phyric flow-banded rhyolite.
WHERE SAMPLED: Interior of Unit 2.
GRAIN SIZE: Medium-grained phenocrysts in an fine-grained, glassy (partially devitrified) groundmass.
TEXTURE: Porphyritic with a flow-banded to trachytic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	7	8	1	6	2.5		Subhedral to euhedral	Partially altered along fractures.
Quartz	1	1	0.3	0.8	0.4		Subhedral	Rounded and broken phenocrysts.
GROUNDMASS								
Feldspar	0	20	0.05	0.15	0.1		Subhedral laths	Relict laths can be seen in the highly altered matrix. Altered to clay and partially recrystallized.
Quartz	10	10			<0.05		Anhedral	Recrystallized in the groundmass.
Glass	0	61						Devitrified and altered to clay.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Hematite	15				Replacing glass; filling veins	
Clay	67				Replacing glass and feldspar; filling veins	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Veins	1				0.1	Hematite, clay	
Vesicles	1	In flow bands	0.1	5	0.5	Empty; flattened-ovoid in shape	Follow the flow-banding and have hematite rims around them in the groundmass.

COMMENTS : Macroscopic observation: section has a vivid brown color with phenocrysts and vesicles. An oriented fabric is evident. This rock is highly altered.

THIN SECTION: 183-1139A-56R-3, 93-97 **Unit: 3** **OBSERVER: LM,KN**
ROCK NAME: Highly altered sanidine-quartz-phyric vitric tuff.
WHERE SAMPLED: Interior of crystal-vitric tuff.
GRAIN SIZE: Medium to fine grained phenocrysts in a microcrystalline to glassy groundmass.
TEXTURE: Porphyritic with a perlitically fractured glassy groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	15	15		2	1		Euhedral, broken	Alkali-feldspar identified as sanidine (low negative 2V). Crystals of alkali-feldspar and quartz are shattered, and the fragments displaced with respect to each other, however, the original crystal shape can still be seen.
Quartz	4	4		1.5	0.75		Euhedral, broken	
GROUNDMASS								
Alkali feldspar	2	2			0.02			
Quartz	1	1			0.02			
Glass	30	75						Spheroidal perlitic fractures.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay minerals	46				Glass	Fills the interstices between glassy kernels, bounded by perlitic fractures.
Goethite	1				Filling voids between perlite kernels, staining clay minerals	
Hematite	<1				Titanomagnetite?	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles				0.15			

COMMENTS : In the core this sample was originally described as a crystal-vitric very coarse sand, because it is so altered that when you disaggreagate it in your hands it breaks down to crystals and perlite kernels, which gives it a sandy texture. The presence of abundant felsic volcanic glass, indicated by the presence of perlitic fractures, implies that this rock was originally vitric (glassy) material.
Photomicrograph#:
1139A-26 = Perlitic texture and sanidine phenocrysts (x5 objective, xpl);
1139A-27 = Perlitic texture and sanidine phenocrysts (x5 objective, ppl).

THIN SECTION: 183-1139A-57R-1, 120-123, Piece 20 — **Unit 4** — **OBSERVER: NTA, KN, CRN, MSP**
ROCK NAME: Highly sanidine-quartz-phyric rhyolite
WHERE SAMPLED: Flow interior, Unit 4.
GRAIN SIZE: Medium grained phenocrysts in a cryptocrystalline to glassy groundmass.
TEXTURE: Porphyritic with a granular, microspherulitic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	10	11	0.4	2.4	1.5		Subhedral	Grains have rounded edges and many embayments and occur isolated or in loose to tightly packed clusters. Relatively unaltered; alteration mostly related to devitrified glass along inclusion and cleavage traces, and occasionally glass trapped in enclosed embayments. Some crystals have exsolution patches, and at least one ~ 2 mm crystal is a glomerocryst with a coarse alkali-feldspar / alkali-feldspar symplectite. 2V <10 degrees.
Quartz	6	6	0.8	5	2		Euhedral to subhedral	Some fragmented, at least one bi-pyramid, others with multiple domains.
Magnetite	Trace	Trace		0.5	0.15		Euhedral blocky to elongate grains	Sparsely distributed, unusually large grains. Subhedral magnetite grains are present and in two cases the grains are shattered.
GROUNDMASS								
Quartz	4	4	0.1	0.4			Subhedral to anhedral	Not easily distinguished from sanidine.
Sanidine	2	2	<.1	0.5	0.3		Subhedral to anhedral	Quartz/sanidine ratio (2:1) only approximate.
Microspherulites and devitrified glass	50?	77						Spherules with radiating structures, dusted with fine grains of iron-oxides; probably devitrified glass. A high proportion of interstitial material (glass) is opaque and now consists of cryptocrystalline poorly reflective material.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay and iron-oxides	30?				Glass and groundmass opaques	Delineate microspherulitic texture.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
None							

COMMENTS : Point-count for major phases (groundmass glass, groundmass quartz + sanidine, sanidine phenocrysts, quartz phenocrysts).

THIN SECTION: 183-1139A-60R-2, 100-104, Piece 13 — **Unit 5** — **OBSERVER: NTA, MSP**
ROCK NAME: Moderately sanidine-clinopyroxene(?)-phyric trachyte.
WHERE SAMPLED: Interior of Unit 5, near contact with Unit 4.
GRAIN SIZE: Medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic, with an intergranular to trachytic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	8	10	0.1	4	1		Subhedral to euhedral laths	Cut by veins of hematite and clay. 2V ~ 20-30.
Clinopyroxene(?)	0	2	0.2	1	0.4		Subhedral prisms	Completely altered to fine-grained, high-relief, high-birefringence pale brownish-green mineral, probably siderite.
Titanomagnetite	Trace	Trace	0.1	0.3			Euhedral equant	Partially to totally replaced by hematite.
GROUNDMASS								
Quartz	3	3	0.02	0.1			Equant anhedral	
Feldspar	35	75	<<.01	0.1			Laths and anhedral grains	Two habits probably correspond to plagioclase and sanidine, respectively, but the fine grain size and alteration preclude positive identification.
Clinopyroxene?	0	5		0.1			Elongate needles	Crystalline clay after another phase, clinopyroxene?
Titanomagnetite	5	5		0.02				

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate and clay	40				Feldspar and groundmass phases	Patchy replacement, fresh, nearly holocrystaline groundmass, in others, nearly complete replacement of feldspar, leaving only quartz
Goethite and hematite	10				Sanidine phenocrysts (especially along fractures) and groundmass phases	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
None							

COMMENTS :

THIN SECTION: 183-1139A-61R-1, 74-76, Piece 1E — **Unit 5** — **OBSERVER: NTA, MSP**
ROCK NAME: Moderately sanidine-clinopyroxene(?)-phyric trachyte.
WHERE SAMPLED: Interior of Unit 5.
GRAIN SIZE: Coarse and medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic with a trachytic to subtrachytic, intergranular groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	5	8	0.3	10	2		Euhedral	Most grains are isolated, some form glomerocrysts. Carsbad twins, moderately to highly altered.
Clinopyroxene(?)	0	1	0.3	2	1		Euhedral, equant and laths	Completely altered to clay and carbonate, probably siderite.
Titanomagnetite	Trace	Trace	0.1	0.25			Subhedral	Isolated or associated with clinopyroxene phenocrysts, mainly altered to translucent cherry-red hematite .
GROUNDMASS								
Plagioclase	35	40	0.05	0.3	0.2		Laths	Partially altered to carbonate and other fine-grained minerals.
Sanidine	25	25	0.05	0.3	0.2		Anhedral	
Quartz	5	5	<0.01	2	0.08		Subequant, anhedral	
??	0	10	0.01	0.2			Laths, needles and equant grains	Grains with different habits are now composed of very fine-grained, high-birefringence minerals. The laths may have been plagioclase, the needles titanomagnetite and the equant patches clinopyroxene.
Mesostasis	0	10						Irregular patches now replaced by clay.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay and carbonate	30				Clinopyroxene, feldspar	
Hematite	1				Titanomagnetite	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
None							

COMMENTS : The only high-reflectance mineral occurs as large cherry-red subhedral hematite. Any oxide originally present in the groundmass is now altered to poorly-reflecting minerals. Two relict phenocrysts replaced by yellowish clay have ~60 degree angles between crystal faces, possibly amphibole. No sulfides observed.

THIN SECTION: 183-1139A-62R-2, 117-119, Piece 1 **Unit 6** **OBSERVER: NTA, CRN**
ROCK NAME: Aphyric trachybasalt.
WHERE SAMPLED: Massive interior of Unit 6.
GRAIN SIZE: Fine-grained.
TEXTURE: Randomly oriented plagioclase laths and finer granular opaques.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	0	<1	0.2	1	0.5		Anhedral to euhedral	Completely altered to cream-colored clay; centers usually lost during polishing.
Sanidine	<1	<1		0.2			Subhedral laths	Rare.
Titanomagnetite	<1	<1	0.1	0.2			Blocky grains and irregular blades	Partially altered to hematite.
GROUNDMASS								
Feldspar	45	50	0.01	0.2	0.1		Subhedral laths	Largely altered to fine-grained, low-birefringence minerals. Laths usually are randomly oriented; only in local areas do they show preferred orientations.
Titanomagnetite	5	7	<.01	0.02	0.01		Subhedral granules	Partially altered+ to hematite.
Clinopyroxene and mesostasis	0	40		?				Complete alteration makes it very difficult to distinguish clinopyroxene from mesostasis.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay and carbonate	50				Groundmass glass and mafic minerals	
Hematite	2				Oxide minerals	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	1		0.1	30		Zeolite and carbonate	Large irregular vesicles filled with spectacular concentric layers of zeolite and carbonate
Veins						Clay and hematite	

COMMENTS : A highly altered rock retaining very little of its magmatic mineralogy. No sulfides observed.

THIN SECTION: 183-1139A-64R-1, 38-43, Piece 7 — **Unit 7** — **OBSERVER: CRN/LM**
ROCK NAME: Crystal-rich sandstone.
WHERE SAMPLED: Close to the top of the flow unit in a crystal-rich segregation.
GRAIN SIZE: Fine- to medium grained.
TEXTURE: Well sorted, clast-supported, reworked volcanic sand.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
LITHICS								
Volcanic rock	0	1	1.5	3	2		Rounded	Almost completely altered to partially crystalline clay. Relict trachytic textures seen in some fragments.
CRYSTALS								
Sanidine	65	75	0.5	3.5	2		Euhedral to subhedral	Angular to subangular crystal fragments.
Titanomagnetite	1	1	0.5	1.5	1		Euhedral to subhedral	
CEMENT								
Glass	0	23						Occurs only on grain boundaries and has been completely altered to clay and microcrystalline hematite. No glass shards can be seen due to the complete alteration.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay minerals	19				Glass, lithic fragments	
Hematite	15				Glass	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
None							

COMMENTS : Macroscopic observation: crystal-rich with a red-brown (hematite?) mineral outlining the transparent grains.
Section is made up of many grains (1-3 mm) with very little interstitial material. The crystals are angular, well-sorted, and generally clast-supported. The presence of abundant angular clasts indicates that this sandstone has a relatively limited transportation history, but the sorting implies that a fluvial or aeolian winnowing process has taken place. Although this sandstone has abundant feldspar, which suggests it probably has a volcanic origin, the close-packed, clast-supported nature of the sediment and the paucity of juvenile volcanic material indicates that this is not a primary pyroclastic sediment.

THIN SECTION: 183-1139A-64R-1, 81-84, Piece 13B — Unit 7 — OBSERVER: RD, CRN
ROCK NAME: Aphyric basaltic trachyandesite.
WHERE SAMPLED: Interior of flow, Unit 7.
GRAIN SIZE: Fine grained.
TEXTURE: Subtrachytic and intersertal groundmass texture.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Alkali-feldspar	0.5	1	1	3			Anhedral	Xenocrystic. Displays microcline twinning; rounded and embayed, sieved margins, corroded centers replaced by calcite.
Plagioclase	<1	<1	0.1	0.5		An55-60	Euhedral	Laths of microphenocryst size; virtually unaltered.
GROUNDMASS								
Plagioclase	60	60		0.3			Euhedral	Virtually unaltered; flow-aligned.
Clinopyroxene	10	25					Anhedral	Partially replaced by green clay.
Titanomagnetite	2	2	0.01	0.05			Anhedral	
Glass	0	10						Replaced by calcite.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Green clay and calcite	25				Filling veins and vesicles; replacing feldspar	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles					0.5	Irregular form	
Veins	<1	Random	0.1	0.5		Sinuous; filled with calcite and clay	

COMMENTS : Compact, feldspathic rock with xenocrystic alkali-feldspar in a trachytic groundmass, now moderately altered to clay and calcite. The plagioclase microphenocrysts are unaltered and good candidates for radiometric dating. No sulfides observed.

THIN SECTION: 183-1139A-64R-4, 77-78, Piece 3F — **Unit 8** — **OBSERVER: NTA, RD, CRN**
ROCK NAME: Aphyric trachybasalt.
WHERE SAMPLED: Massive interior of Unit 8.
GRAIN SIZE: Fine-grained.
TEXTURE: Intergranular, subtrachytic.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagiolclase	<1	<1		0.5		An50	Euhedral	Unaltered.
GROUNDMASS								
Plagioclase	30	50	0.01	0.15	0.1	An50	Subhedral laths	Randomly oriented laths, partially altered to clay.
Clinopyroxene	0	25	<.01	0.1	0.01		Subhedral	Completely altered to clay.
Titanomagnetite	5	5	<.01	0.02	0.01		Subhedral equant	
Mesostasis	0	20						Completely altered to clay.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay and carbonate	50				Clinopyroxene, mesostasis; fills vesicles and veins	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	2		0.2	2		Zeolite and carbonate	
Veins						Clay and hematite	Many irregular veins (maximum thickness 0.3 mm).

COMMENTS : This rock is called basalt because it contains a relatively high proportion of clinopyroxene (for this site); the plagioclase composition is An50; and the texture is subtrachytic.

THIN SECTION: 183-1139A-65R-2, 15-19, Piece 1A — **Unit 9** — **OBSERVER: NTA, CRN**
ROCK NAME: Aphyric trachybasalt.
WHERE SAMPLED: Massive interior of Unit 9.
GRAIN SIZE: Fine-grained.
TEXTURE: Intergranular with randomly oriented plagiclase laths.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
GROUNDMASS								
Feldspar	45	60	0.01	0.15	0.1		Subhedral laths	Probably plagioclase and sanidine, but proportion impossible to determine because of partial alteration to fine-grained, low-birefringence minerals. Laths are usually randomly oriented; only in local areas do they show preferred orientations.
Clinopyroxene	0	15	<.01	0.02	0.01		Anhedral	Completely altered to irregular patches of clay minerals.
Titanomagnetite	3	4	<.01	0.02	0.01		Subhedral granules	Partially altering to hematite.
Mesostasis	0	20						Completely altered.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay and carbonate	50				Groundmass glass and mafic minerals.	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	1		0.1	30		Zeolite and carbonate	Subspherical.
Veins						Carbonate and hematite	Several veins, maximum thickness 0.5 mm.

COMMENTS : The rock is called basalt on the basis of a relatively high pyroxene content and the absence of trachytic texture. The high degree of alteration precludes a more definitive identification of its composition. No sulfides observed.

THIN SECTION: 183-1139A-65R-2, 29-30, Piece 1B — **Unit 9** — **OBSERVER: NTA, MSP, CRN**
ROCK NAME: Aphyric trachybasalt.
WHERE SAMPLED: Massive basalt with xenolith from interior of Unit 9.
GRAIN SIZE: Very fine-grained.
TEXTURE: Trachytic.
NOTE: The xenolith is described on next page.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	1	1	0.1	1	0.5		Irregular-shaped euhedral	Abundant minute (<10 micron) crystalline and glassy inclusions.
GROUNDMASS								
Plagioclase	45	50	0.01	0.06	0.03		Subhedral laths	
Clinopyroxene	0	25	0.01	0.03	0.02		Stubby prisms	Completely altered to clay.
Titanomagnetite	4	4	<.01	0.02	0.01		Irregular equant grains and short laths.	Not all highly reflective grains are opaque; some are pale brown at edge of section.
Mesostatis		20						Complete alteration makes it very difficult to distinguish clinopyroxene from mesostasis

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay and carbonate	50				Groundmass glass, mafics	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	1		0.1	30		Zeolite and carbonate	Large irregular vesicles filled with spectacular concentric layers of zeolite and carbonate.
Veins	<1			0.05		Carbonate	Penetrating both basalt and xenolith.

COMMENTS : Titanomagnetite is point-counted.
See also separate desription of xenolith.

THIN SECTION:	**183-1139A-65R-2, 29-30 (xenolith), Piece 1B**					**Unit 9**	**OBSERVER: CRN**	
ROCK NAME:	**Aphyric trachybasalt xenolith.**							
WHERE SAMPLED:	**Enclosed in basalt from interior of Unit 9.**							
GRAIN SIZE:	**Fine grained.**							
TEXTURE:	**Holocrystalline, intergranular, occasionally trachytic.**							
NOTE:	**The host basalt is desribed on previous page.**							

PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm) min.**	**max.**	**av.**	**APPROX. COMP.**	**MORPHOLOGY**	**COMMENTS**
GROUNDMASS								
Plagioclase	30	55	0.1	0.3	0.15	An45	Subhedral laths	Partially altered to clay and replaced by calcite. Many Carlsbad twins, giving the impression of sanidine, but this is from alteration of the primary plagioclase. Relict albite twinning is present.
Clinopyroxene	0	35	0.05	0.2	0.1		Anhedral	Completely altered to clay and partially replaced with carbonate.
Titanomagnetite	10	10	<0.01	0.15	0.1		Euhedral to anhedral	Rare maghemite exsolution/replacement. Predominantly tabular forms.

SECONDARY MINERALOGY	**PERCENT**	**SIZE (mm) min.**	**max.**	**av.**	**REPLACING / FILLING**	**COMMENTS**
Clay	40				Plagioclase, clinopyroxene	
Carbonate	20				Plagioclase, clinopyroxene	

VESICLES/ CAVITIES	**PERCENT**	**LOCATION**	**SIZE (mm) min.**	**max.**	**av.**	**FILLING / MORPHOLOGY**	**COMMENTS**
None							

COMMENTS : Xenolith is angular with slightly rounded corners, and about 3 cm long. It is texturally and mineralogically very similar to the host basalt; but coarser grained. Rare (<1%) small clay patches could be pseudomorphs after olivine. It contains neither phenocrysts nor vesicles.

The contact with host basalt is sharp and characterized by: (a) discontinuous regions where the grainsize of the host basalt is far smaller than average ; (b) regions with abundant, minute (1-10 micron) opaque grains; (c) segments where plagioclase crystals of the host basalt are oriented parallel to the contact; (d) possible broken plagioclase grains at the margin of the xenolith. The xenolith appears to be a piece of cold rock incorporated in molten basalt.

Several mafic pseudomorphs have the outline of olivine and are altered to a more opaque clay than other mafics.

Possibly some altered mesostatsis, but this is a relatively well crystallized basalt and the alteration of the mafics makes positive identification of the glassy mesostasis difficult.

Rare pyrite/pentlandite observed; associated both with primary and secondary phases.

THIN SECTION: 183-1139A-65R-3, 16-18, Piece 2 — **Unit 10** — **OBSERVER: CRN, NTA**
ROCK NAME: Sparsely plagioclase-phyric trachybasalt.
WHERE SAMPLED: Flow interior.
GRAIN SIZE: Fine-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Sparsely porphyritic in a trachytic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	0.5	1	0.4	1	0.8	An45-50	Subhedral laths	Aligned with flow texture. Partially altered to sericite and partially replaced by zeolite. Alteration precludes accurate An determination.
GROUNDMASS								
Plagioclase	30	50	0.05	0.2	0.1		Subhedral laths	Moderately altered to sericite.
Clinopyroxene	5	20	0.05	0.1	0.08		Anhedral	Appears to have been replaced by carbonate with little fresh clinopyroxene remaining.
Titanomagnetite	5	5	0.01	0.1	0.08		Subhedral to anhedral	Predominantly tabular forms. Occasional maghemite exsolution.
Mesostasis	0	25						Completely altered and replaced by zeolite and clay minerals.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate	15				Clinopyroxene; fills vesicles and veins	
Clay	40				Plagioclase, mesostasis	
Zeolite	5				Mesostasis, plagioclase; fills vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	5	Coarsening to top of section	0.5	5	2	Round to ovoid (flattened), filled with carbonate and zeolite	Clay lined.
Veins	1				0.5	Carbonate	

COMMENTS : Macroscopic observation: Vesicles evident. Fine grained. Sample is highly altered with zeolite in the groundmass and carbonate replacing the clinopyroxene. Possible pseudomorphs of olivine in the section, but alteration makes a positive identification difficult.
No sulfides observed.

THIN SECTION: 183-1139A-65R-3, 90-93, Piece 5C — **Unit 10** — **OBSERVER: CRN**
ROCK NAME: Sparsely plagioclase-phyric trachybasalt.
WHERE SAMPLED: Interior of flow, Unit 10.
GRAIN SIZE: Medium-grained phenocrysts; fine-grained groundmass.
TEXTURE: Porphyritic with an intergranular to subtrachytic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	1	2	0.4	2.5	1	An60-65	Subhedral laths	The An content of the plagioclase indicates a basaltic composition for this lava. In many grains only Carlsbad twinning is apparent. Alkali-feldspar is present as a result of alteration, witnessed by the undulatory extinction of the twinned halves, rather than the clean extinction of primary sanidine.
GROUNDMASS								
Plagioclase	30	45	0.05	0.2	0.1		Subhedral laths	See comment for plagioclase phenocrysts. Partially altered to clay and replaced by carbonate.
Clinopyroxene	0	30	0.01	0.1	0.08		Anhedral	Completely altered to clay and replaced by carbonate.
Titanomagnetite		10	<0.01	0.3	0.05		Euhedral to subhedral	Many are below the surface of the slide and cannot be seen in reflected light. Mode estimated in transmitted light. Patchy alteration to maghemite (non-crystallographic). Predominantly tabular forms.
Mesostasis	0	13						Completely altered to clay and replaced by carbonate.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate					Clinopyroxene, plagioclase, mesostasis; filling vesicles	
Clay					Clinopyroxene, plagioclase, mesostasis; filling vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	5	Random	0.1	5	2	Round to ovoid-flattened, angular; filled with carbonate and clay	

COMMENTS : Macroscopic observation: fine-grained vesicular basalt. The section contains finer-grained, darker, angular areas. These areas are clasts of the same material as the basalt and probably represent clasts from the chilled margins. These areas have essentially the same mineralogy as the basalt host, but contain a higher proportion of titanomagnetite which is smaller (generally < 0.05 mm) than that in the host.
No sulfide observed.

THIN SECTION: 183-1139A-65R-5, 49-53, Piece 1D — **Unit 11** — **OBSERVER: NTA, CRN**
ROCK NAME: Aphyric trachybasalt.
WHERE SAMPLED: Vesicular clast in Unit 11.
GRAIN SIZE: Very fine-grained.
TEXTURE: Highly vesicular, seriate.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	<1	<1		0.3			Stubby laths	Sanidine appears to be xenocrystic.
Plagioclase	<1	<1		0.3			Elongate laths	Rare phenocrysts of plagioclase. Some exhibit only Carlsbad twinning, possibly as a result of compositional zoning.
GROUNDMASS								
Plagioclase	30	50	0.01	0.3	0.1		Subhedral laths	Randomly oriented laths, moderately altered. Wide range of sizes. Some sanidine may be present, but fine grain size and alteration precludes positive identification.
Clinopyroxene	0	25	<.01	0.1	0.01		Subhedral	Completely altered to clay and goethite.
Titanomagnetite	5	5	<<.01	0.02	0.01		Subhedral equant	Numerous, but very fine, grains throughout the groundmass; maghemite present.
Mesostasis	0	20						Completely altered to clay.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay and carbonate	50				Clinopyroxene, mesostasis, vesicles and veins	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	30		0.05	15	1	Carbonate, goethite, clay	Irregular shapes, dispersed throughout clast. Unusual, beautiful concentric patterns of carbonate fillings.

COMMENTS : Host rock is sparsely sanidine-phyric basalt with a pronounced trachytic texture. Sanidine xenocrysts (to 1mm long) in a groundmass of plagioclase and sanidine(?) with 0.2 mm average grain size. Clast seems to have been plastic when incorporated in host, as evidenced by diffuse, scalloped boundary and by a vesicle that extrudes from the clast into the host.

THIN SECTION: 183-1139A-65R-5, 81-85, Piece 1D — **Unit 11** — **OBSERVER: MSP, CRN**
ROCK NAME: Aphyric trachybasalt.
WHERE SAMPLED: Interior of flow, Unit 11.
GRAIN SIZE: Fine grained.
TEXTURE: Porphyritic with a trachytic 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	0.6	~An60	Subhedral laths	Sparse microphenocrysts, could simply be described as seriate rock.
GROUNDMASS								
Plagioclase	50	60	0.05	0.5	<0.1	An60	Subhedral laths	Relatively unaltered, some clay in cores and along cleavage fractures.
Clinopyroxene	15	30	<0.02	0.1	0.03		Anhedral	Partially altered to brown clay and occasionally replaced by carbonate.
Titanomagnetite	5	5	<0.01	0.05	0.02		Subhedral equant	Predominantly small tabular forms, rarely acicular. No alteration or maghemite exsolution.
Mesostatis	0	5						Altered to brown clay and partially replaced by carbonate.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	25				All phases	Mesostasis > clinopyroxene > plagioclase.
Carbonate	5				Mainly in veins and vesicles	Some replacement of primary phases.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	2		0.1	2	0.3	Round to irregular, rimmed with clay, filled with carbonate	Sparse random distribution and two distinct bands, one with vesicles all < 0.5 mm, the other with vesicles up to 2 mm
Veins						Carbonate	Several fractures, 0.02 to 0.2 mm wide

COMMENTS : Macroscopic observation: fine grained with apparent flow banding; two trains of irregular vesicles parallel to flow banding. Plagioclase is variably altered to alkali-feldspar.

THIN SECTION: 183-1139A-66R-3, 44-47, Piece 1D — **Unit 12** — **OBSERVER: MSP**
ROCK NAME: Aphyric trachybasalt.
WHERE SAMPLED: Interior of the flow unit.
GRAIN SIZE: Aphanitic.
TEXTURE: Very sparsely porphyritic in a trachytic 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	0.6		Subhedral laths	Sparse microphenocrysts, could simply be described as seriate rock.
Clinopyroxene	<<1	<<1						
GROUNDMASS								
Plagioclase	45	60	0.05	0.5	<0.1		Subhedral laths	Relatively unaltered, some clay in cores and along cleavage fractures.
Clinopyroxene	5	25	<0.02	0.1	0.03		Anhedral equant	Partially altered to brown clay and occasionally replaced by carbonate.
Titanomagnetite	5	5	<0.01	0.05	0.02		Subhedral equant	Predominantly small tabular forms, rarely acicular. No maghemite exsolution.
Mesostatis	0	10						Altered to brown clay and partially replaced by carbonate, poorly developed flow banding seen macroscopicaly mainly from mesostasis rich layers.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	40				All phases	Mesostasis > clinopyroxene > plagioclase.
Carbonate	5				Mainly in veins and vesicles	Some replacement of primary phases.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	5	See comment	0.1	12		Carbonate, zeolite, and clay	Sparse, isolated microvesicles <1 mm except for three large, flattened amygdules up to 12 mm long and 3 mm wide, subparallel to trachytic groundmass texture.

COMMENTS : Macroscopic observation: fine grained with subparallel, poorly-developed flow banding; three flattened amygdules up to 12 mm long.

THIN SECTION:	**183-1139A-66R-7, 5-8, Piece 2**	**Unit 13**	**OBSERVER: CRN, NTA**
ROCK NAME:	**Aphyric trachybasalt.**		
WHERE SAMPLED:	**Interior of Unit 13.**		
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	Trace	Trace			0.4	An70	Subhedral laths	Rare phenocrysts.
GROUNDMASS								
Plagioclase	25	40	0.05	0.1	0.09		Subhedral laths	Reasonably unaltered.
Clinopyroxene	10	35	<0.01	0.1	0.04		Anhedral	Partially altered and replaced by carbonate.
Titanomagnetite	5	5	<0.01	0.1	0.05		Anhedral to subhedral	Intersertal. Predominantly tabular forms. Occasional maghemite exsolution.
Mesostatis	0	20						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate	35				Clinopyroxene, plagioclase, vesicles	
Opaque clay	25				Veins, clinopyroxene, plagioclase	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	<0.5	Random	1	4.5	1	Ovoid; carbonate filled	
Veins	1				<0.1	Opaque clay	Higher degree of alteration of primary phases along these veins.

COMMENTS : Macroscopic observation: fine grained basalt with one or two vesicles and several veins < 0.5 mm. Section has a brown hue.
There are several alkali-feldspar xenocrysts present. These exhibit reaction relationships with the groundmass. See photomicrograph 1139A-12.
No sulphide observed.
Photomicrograph #:
1139A-12 = Alkali-feldspar xenocryst in reaction with groundmass (x10 objective, xpl).

THIN SECTION: 183-1139A-67R-3, 109-111, Piece 1 — Unit 14 — OBSERVER: JB
ROCK NAME: Basaltic trachyandesite breccia, clasts are sparsely plagioclase-(olivine)-phyric basaltic trachyandesite.
WHERE SAMPLED: Breccia occurring at top Unit 14.
GRAIN SIZE: Glassy (devitrified) to microcrystalline.
TEXTURE: Porphyritic, seriate with a glassy to hyalopilitic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	0	2	0.05	1.2	0.075		Laths and tablates	Totally pseudomorphed by sericite.
Olivine	0	<1	0.05	0.4	0.17		Euhedral	Only a few grains positively identified by classic euhedral outline. Totally pseudomorphed by light brown low birefringence clay similar to alteration of plagioclase. As a result is probably more abundant than estimated.
GROUNDMASS								
Plagioclase	0	20	0.01	0.2	0.1		High aspect ratio laths; a few swallow-tailed	Flow aligned in some clasts.
Glass	0	75						Replaced by brown clay.
Titanomagnetite	<1	1	<0.01	0.03	<0.01		Subhedral to anhedral; dominantly equant but some laths	Mostly replaced by red goethite(?) but some fresh grains seen in reflected light. Most grains are micron or sub micron sized.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Sericite					Plagioclase	
Clay					Glass	Clay replacing glass is brown with reddish patches (iron oxy-hydroxide staining).

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Veins and breccia matrix	25					Orange and brown clay	
Vesicles	5					Irregular, variably elongate; clay filled	

COMMENTS : The range of grain sizes varies from clast to clast.

THIN SECTION: 183-1139A-67R-5, 100-103, Piece 8 **Unit 14** **OBSERVER: CRN**
ROCK NAME: Sparsely plagioclase-phyric basaltic trachyandesite.
WHERE SAMPLED: Interior of flow unit.
GRAIN SIZE: Fine grained to glassy.
TEXTURE: Sparsely porphyritic with a trachytic to subtrachytic 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	2.5	1.5	An60	Anhedral to subhedral	Zonation and reaction rims present in larger crystals. Partially replaced by carbonate. Some altered to alkali-feldspar.
Clinopyroxene	<1	<1	0.8	1.5	1		Euhedral	Partially replaced by carbonate.
GROUNDMASS								
Plagioclase	40	50	0.05	0.2	0.1			
Clinopyroxene	5	30	<0.01	0.1	0.05			Partially replaced by carbonate.
Titanomagnetite	8	8	<0.01	0.1	0.03		Anhedral to subhedral	Finely disseminated throughout the groundmass. Occasional maghemite exsolution.
Glass	0	10						Partially replaced by carbonate.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate	32				Plagioclase, glass, clinopyroxene; fills vesicles	
Opaque clay	15					

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	5	Random	0.5	2	0.6	Round to ovoid; carbonate filled	

COMMENTS : Macroscopic observation: very fine-grained basalt with vesicles. Section has a gray-green color.
No sulfide observed.
There are several angular to rounded areas (1-6 mm across) with extremely fine grain size (0.01-0.02 mm) but the same mineralogy as the rest of the section. Some are moderately vesicular. Plagioclase laths have similar length but a higher aspect ratio than in the rest of the section. Abundant opaques, many of which are below the surface of the section. These are probably clasts of the chilled flow top reincorporated into the interior of the flow.
Photomicrograph #:
1139A-9 = Plagioclase phenocryst with albite twinning (x10 objective, xpl).

THIN SECTION: 183-1139A-68R-4, 42-45 **Unit 15** **OBSERVER: CRN**
ROCK NAME: Sparsely plagioclase-phyric basaltic trachyandesite.
WHERE SAMPLED: Interior of flow, Unit 15.
GRAIN SIZE: Fine-grained.
TEXTURE: Porphyritic with a trachytic to subtrachytic, 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	0.2	1	0.3	1	0.5		Subhedral laths	Partially altered and replaced by zeolite and opaque clay. The majority have been plucked out during thin section preparation. Alteration to alkali-feldspar precludes accurate An determination.
GROUNDMASS								
Plagioclase	35	50	0.01	0.2	0.1		Subhedral laths	Partially altered.
Clinopyroxene	10	30	0.01	0.1	0.08		Anhedral	Partially altered to brown clay.
Titanomagnetite	7	7	0.01	0.5	0.08		Anhedral to subhedral	Intersertal. Predominantly tabular forms. Rare maghemite exsolution. Several large (0.5 mm) lozenge-shaped grains with hollow cores.
Glass	0	12					Intersertal	Completely altered to amorphous opaque clay and partially replaced by carbonate.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Opaque clay	35				Clinopyroxene, glass, plagioclase	
Carbonate	10				Glass, vesicles	
Zeolite	5				Plagioclase	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	<0.5				2	Ovoid; carbonate fill	Clay lined.

COMMENTS : Macroscopic observation: Homogeneous fine-grained basalt. Faint greenish hue to section.
No evidence of mafic phenocrysts.
No sulfides observed.

THIN SECTION: 183-1139A-68R-6, 54-57, Piece 1 — **Unit 16** — **OBSERVER: KN**
ROCK NAME: Moderately plagioclase-phyric basaltic trachyandesite.
WHERE SAMPLED: Flow interior, Unit 16.
GRAIN SIZE: Fine grained.
TEXTURE: Trachytic and intersertal groundmass texture.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
MICROPHENOCRYSTS								
Feldspar	0	3	0.4	0.6			Euhedral	Crystal form is consistent with this being alkali-feldspar. However the feldspars have been completely replaced by sericite, zeolite and clay.
Mafic	0	1	0.1	0.2			Subhedral	Completely replaced by hematite and clay.
GROUNDMASS								
Feldspar	2	29		0.3			Euhedral	Completely altered.
Opaques	7	12		0.7			Anhedral	Magnetite microphenocrysts (0.06-0.7 mm) are almost totally replaced by hematite. However, the smallest groundmass magnetites seem less affected by the alteration.
Glass	0	55						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Sericite, green clay and zeolite	85				Filling veins and vesicles; replacing feldspar and glass	
Hematite	5				Replacing magnetite and mafic phase	
Carbonate	<1				Filling veins	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	7				0.5	Irregular	
Veins	<1				0.3	Carbonate and green clay	

COMMENTS : Texturally, the groundmass shows darker, more fine grained clasts which are interpreted as fragments of chilled margin caught up and entrained into this part of the flow. These do not seem to be remnants of less altered rock surrounded by extremely altered rock since veins cross-cut both types of groundmass. There is a high proportion of opaques throughout the rock although the chilled regions contain more than the host groundmass. Feldspar grains tend to be oriented parallel to margins of clasts; in one area a vein of host basalt penetrates a clast and contains feldspar grains oriented parallel to the vein walls+. The clast and host basalt are deformed plastically together. Probably a type of aa flow top.

THIN SECTION: 183-1139A-69R-2, 1-4, Piece 1 — **Unit 17** — **OBSERVER: CRN, MSP**
ROCK NAME: Sparsely plagioclase-clinopyroxene-phyric basaltic trachyandesite.
WHERE SAMPLED: Interior of flow, Unit 17.
GRAIN SIZE: Fine-grained phenocrysts; fine-grained to microcrystaline groundmass.
TEXTURE: Porphyritic with an intergranular to intersertal and trachytic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Plagioclase	1	1.5	0.5	1	0.8	An50-55	Subhedral laths	Partially replaced by carbonate and clay minerals.
Clinopyroxene	<1	<1	0.2	0.8	0.4		Euhedral to subhedral	Reasonably unaltered although reaction rims are evident. Definate pink color.
Olivine?	0	Trace	0.2	0.3	0.25		Euhedral to subhedral	Completely altered and replaced by brown clay.
GROUNDMASS								
Plagioclase	>55	60	0.01	0.15	0.1		Subhedral laths	At least some primary alkali-feldspar, occasional grains altered to clay.
Clinopyroxene	>15	30	<0.02	0.1	<0.05		Anhedral	Partially altered to brown clay and occasionally replaced by carbonate.
Titanomagnetite	10	5	<0.01	0.1	0.05		Subhedral to euhedral	Predominantly tabular forms. No maghemite exsolution.
Mesostatis	0	5						Altered to brown clay and partially replaced by carbonate.
Pentlandite?	Trace	Trace			<0.01		Anhedral	Inclusions in titanomagnetite and mesostasis.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	<15				Plagioclase, clinopyroxene, olivine, glass; filling veins	
Carbonate	<5				Clinopyroxene, plagioclase, glass; filling veins	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Veins	0.5				0.1	Clay, carbonate	

COMMENTS : Macroscopic observation: fine grained basalt containing a clast and several thin veins. Dark gray color.
Contains “clasts” or “segregations” of finer grained material with plagioclase and clinopyroxene phenocrysts and brown clay pseudomorphs after olivine (defined on shape only, could therefore be altered glass patches or even filled microvesicles). Clasts may be fragments of chilled crust that froze in olivine before it had a chance to be resorbed by the magma. A few ‘olivine pseudomorphs’ are seen in the main basalt. At least one alkali-feldspar xenocryst is present.

THIN SECTION: 183-1139A-70R-1, 17-20, Piece 2A — **Unit 18** — **OBSERVER: CRN**
ROCK NAME: Moderately sanidine-phyric trachyandesite.
WHERE SAMPLED: Upper flow margin - least altered of Unit 18.
GRAIN SIZE: Medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Trachytic to intergranular.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	4	5	1	6	4		Subhedral	Occasional continuous sieve-textured reaction rims present. Rounded with minor carbonate and illite (sericite) replacement.
Titaonmagnetite	<0.5	<0.5	0.1	0.3	0.2		Subhedral	Partially altered to hematite.
Clinopyroxene(?)	Trace	Trace			0.2		Subhedral	Completely altered to crystalline clay.
GROUNDMASS								
Plagioclase	5	10	0.05	0.2	0.1		Subhedral laths	
Sanidine	30	45	0.05	0.2	0.15		Subhedral laths	
Mesostasis	15	35						Crystalline (see Photos 2 & 3).
Titanomagnetite	3	5	<0.01	0.05	0.02		Subhedral	Partially altered to hematite. Much of the finely crystalline material in the mesostasis is not seen at the surface and is included with the mesostasis mode.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Illite (sericite)	7				Feldspar	Crystalline illite or sericite seen replacing sanidine in the groundmass and in phenocrysts. 2V is ~0 and the mineral is optically negative.
Smectite	20				Vesicles, clinopyroxene	This maybe crystalline green saponite.
Zeolite	5				Vesicles	Uniaxial negative.
Carbonate	5				Veins, feldspar	
Quartz	1				Veins	
Hematite	5					

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	25	Random	0.5	2	1	Angular ("stretched"); filled with green clay, zeolite	Zeolite (uniaxial negative) and pale green clay seen in vesicles. Totally filled.
Vein	2		0.1	0.5	0.3	Carbonate, quartz	Both minerals occur in the same vein.

COMMENTS : Macroscopic description: dark gray thin section with feldspar phenocrysts. Small, angular, often interconnecting vesicles seen throughout.
Groundmass is predominantlyalkali-feldspar with a significant amount of opaques and a finely crystalline mesostasis in which there are also opaque minerals. Many of the small opaques are not present at the surface and the mesostasis is altered.
Photomicrograph #:
1139A-2 = Crystalline mesostasis (x50 objective, ppl);
1139A-3 = As 2, but different view (x50 objective, ppl).

THIN SECTION: 183-1139A-70R-2, 141-145, Piece 1F — **Unit 18** — **OBSERVER: NTA, CRN, MSP**
ROCK NAME: Moderately sanidine-phyric trachyandesite.
WHERE SAMPLED: Bleached white zone in Unit 18.
GRAIN SIZE: Medium grained phenocrysts in a very fine-grained groundmass.
TEXTURE: Porphyritic with a trachytic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	3	5	0.2	5	2		Euhedral laths	Partially altered to clay.
Clinopyroxene(?)	0	trace	0.2	0.6	0.4		Subhedral prisms	Completely altered and replaced by siderite(?). These may be altered feldspars, as similar alteration of larger groundmass laths is seen.
GROUNDMASS								
Feldspar	20	65					Laths	Pervasive alteration of groundmass precludes more precise identification; however, relict trachytic textures can be seen. Altered to carbonate and clay. Some of the clay-rich areas are becoming crystalline (low to middle first order birefringence) - sericite? Quartz may be present in the groundmass, although positive identification is precluded because of the small grain size.
Mafic minerals	0	30						Evidence for these is based upon non-lath-like forms of clay and carbonate alteration/replacement products which occur between the feldspar laths.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	50				Veins, sanidine, feldspar, mafics	
Carbonate	22				Veins, sanidine, feldspar, mafics	Siderite pseudomorphs after clinopyroxene, XRD analysis suggests that the major carbonate replacing groundmass phases is also siderite.
Sulfide	Trace				Groundmass	Seen as occasional anhedral masses 0.1 mm or less. Pyrite or pentlandite.
Quartz	5				Veins, groundmass(?)	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Veins	20		<0.1	0.3	0.05	Carbonate, silica(?), clay	Seen throughout the section forming an intricate network. One large vein runs through the center of the section and contains carbonate.

COMMENTS : Macroscopic observation: section is white with a pink-brown hue. Large phenocrysts are present. A fine network of veins pervades through approximately 75% of the section.

THIN SECTION: 183-1139A-70R-3, 64-68, Piece 4 — **Unit 18** — **OBSERVER: CRN, MSP**
ROCK NAME: Moderately sanidine-phyric trachyandesite.
WHERE SAMPLED: Intensely altered area of Unit 18.
GRAIN SIZE: Medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic with a trachytic to subtrachytic, intergranular groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Feldspar	2	5	0.5	6	3		Subhedral to euhedral	No albite twinning, only Carlsbad. Partially replaced with carbonate. Groundmass plagioclase flows around the phenocrysts. Occasional reaction rims observed. 2V ~40-50, optically negative. Grains could be plagioclase altered to alkali-feldspar or sanidine.
GROUNDMASS								
Feldspar (plagioclase?)	40	55	0.05	0.8	0.4			Partially altered to an amorphous, isotropic mineral and converted to alkali-feldspar (no albite twins) - hence pinkish hue to section.
Clinopyroxene?	0	30	<0.01	0.2	0.08			Completely altered to an amorphous, isotropic mineral or carbonate.
Titanomagnetite	0	?	<0.01	0.2	?			No fresh examples seen and it appears that it has been completely altered to an amorphous, isotropic mineral, similar to clinopyroxene so estimating a modal percentage or verifying the presence of this mineral is difficult.
Mesostatis	0	10						

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Quartz	4	<0.05	0.2	0.15	Mesostasis; filling vesicles, veins	XRD analysis suggests that this petrographic estimate is a minimum.
Pyrite	0.5	<0.01	0.05	0.03	Mesostasis	
Amorphous clay	35				Clinopyroxene, mesostasis, plagioclase	
Carbonate	18.5				Plagioclase; filling vesicles	XRD suggests that siderite is a significant, if not the major, component.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	2	Random	0.2	1.5	0.8	Round to flattened; filled with microcrystalline quartz, carbonate	Quartz and carbonate are seen in the same vesicle.
Veins	2	Random	0.01	0.05	0.04	Microcrystalline quartz, carbonate	Some veins connect vesicles. Quartz-filled veins contain no carbonate and vice versa.

COMMENTS : Macroscopic observation: Large phenocrysts and several 0.1 mm veins traverse the section. Section has a pinkish hue.
Quartz fills vesicles and veins. Because of its microcrystalline form, the uniaxial interference figure appears curved.
Phenocrysts are alkali-feldspar (2V and negative optic sign). Groundmass is also dominated by alkali-feldspar. No evidence of mafic phenocrysts.
Hydrothermally altered.

THIN SECTION: 183-1139A-71R-1, 0-6, Piece 1 — **Unit 18** — **OBSERVER: CRN, MSP**
ROCK NAME: Moderately sanidine-phyric trachyandesite.
WHERE SAMPLED: Highly altered portion of Unit 18.
GRAIN SIZE: Medium-grained phenocrysts in a fine-grained groundmass.
TEXTURE: Porphyritic in an intergranular, trachytic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	5	8	0.5	8	3		Subhedral to euhedral	Reaction rims on several grains, some partially altered to clay (sericite) and replaced by carbonate.
Clinopyroxene(?)	0	0.5	0.4	1.5	0.8		Euhedral to subhedral	Completely altered to siderite and/or clay with oxide minerals. Shape is preserved - see Photo 1139A-5
Titanomagnetite	<0.5	0.5	0.15	0.25	0.2		Euhedral to subhedral	Microphenocrysts. Partially altered (see Photo 1139A-7).
GROUNDMASS								
Sanidine	30	50	0.05	0.2	0.15		Subhedral laths	Altered to clay (sericite?) and replaced by carbonate (see Photos 1139A-4,6).
Plagioclase	2	5	0.05	0.15	0.1		Subhedral to anhedral laths	Some laths are ragged and partially altered.
Mafic phases	0	5					Subhedral to euhedral	Completely altered to gray opaque clay.
Mesostasis	15	30						Altered to a gray clay with hematite staining. Crystalline areas are occasionally unaltered.
Pentlandite			0.01	0.05	0.04		Anhedral	Several small grains in the groundmass.
Titanomagnetite	<0.5	1	0.01	0.03	0.02		Euhedral to subhedral	Partially altered to hematite and maghemite.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay minerals	30				Feldspar, mafics, mesostasis; filling veins	
Carbonate	20				Feldspar, mesostasis	XRD suggests that siderite is a significant, if not the major, component.
Hematite	1				Mesostasis, titanomagnetite	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Veins	1		0.05	0.1		Crystalline and amorphous clay (illite?)	

COMMENTS : Macroscopic observation: white-pink color, phenocrysts evident.
Photomicrograph #:
1139A-4 = Altered mesostasis and flow texture (x10 objective, ppl);
1139A-5 = Altered mafic phenocryst (x10 objective, ppl);
1139A-6 = As 1139A-4, but xpl;
1139A-7 = Titanomagnetite microphenocryst partially altered to amorphous hematite/goethite (x50 objective, reflected light).

THIN SECTION: 183-1139A-71R-3, 63-66, Piece 2A — **Unit 18** — **OBSERVER: CRN**
ROCK NAME: Vein alteration.
WHERE SAMPLED: Middle of flow Unit 18.
GRAIN SIZE: Medium- to fine-grained.
TEXTURE: Veined.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	2	5	3	6	5		Subhedral to euhedral	Much of the interior of these phenocrysts has been plucked out. Sanidine inferred from remaining pieces and association with other thin sections from the same unit. One whole example is partially replaced by carbonate.
GROUNDMASS		<80						Groundmass highly to completely altered. Modes of primary mineralogy cannot be estimated. Ghosts of feldspar laths are seen. Clay minerals predominate and there is a lot of iron-oxide staining. Grain size is < 0.1 mm. Opaque minerals altered to iron-oxide.
Plagioclase	15	?						Moderately altered.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Quartz	5				Veins	
Clay	50				Plagioclase, mafics	
Carbonate	13				Plagioclase, mafics	XRD suggests that siderite is a significant, if not the major, component.
Fe-oxide	15					

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
None							

COMMENTS : Macroscopic observation: multicolored bands of red, brown and transparent material. Porphyritic basalt in top third of oriented section, remainder is vein material.
The section was taken to look at sulfide mineralization, but the main ore mineral is an oxide. Basalt is described above, the veins in the comment box.
Veins contain carbonate, silica, clay, and iron-oxide. Veins are up to 10 mm wide and zoned (generally iron-oxide and clay, microcrystalline carbonate, crystalline carbonate with silica pockets). Iron-oxides form acicular masses (crystals 0.1-0.2 mm) that are magnetite. These have been altered to amorphous hematite. Only a trace of sulfide (chalcopyrite) was observed.

THIN SECTION: 183-1139A-71R-4, 7-10, Piece 1 — **Unit 18** — **OBSERVER: CRN**
ROCK NAME: Highly sanidine-phyric trachyandesite.
WHERE SAMPLED: Chilled base of Unit 18.
GRAIN SIZE: Medium-grained phenocrysts in a glassy groundmass.
TEXTURE: Porphyritic with a holohyaline groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	2	10	0.5	8	4		Subhedral	Broken and partially replaced by carbonate and clay.
GROUNDMASS								
Glass	10	86						Partially devitrified (<0.05 mm felsic microcrystallites) opaque glass. Microcrystallites appear fresh, but the glass is altered to clay.
Titanomagnetite	4	4	<0.01	0.05	<0.01		Acicular	Extremely small needles in the partially devitrified glass. One or two larger examples are present.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate	3				Sanidine; filling veins	XRD suggests that siderite is a significant, if not the major, component.
Clay	81				Sanidine, glass; filling veins	
Zeolite	<1				Vesicles	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	<1	Random	0.5	1.5	1	Flattened-ovoid; zeolite filled	
Veins	<1	Random			0.1	Carbonate, clay	

COMMENTS : Macroscopic observation: very fine grained to glassy basalt with large feldspar phenocrysts. Section has a dark red-brown/gray hue.
Macroscopic study of the core indicated the presence of finely disseminated sulfides in this area of Unit 18. None are present in this section.

THIN SECTION: 183-1139A-71R-4, 134-135, Piece 1I — **Unit 19** — **OBSERVER: CRN, MSP**
ROCK NAME: Highly altered, moderately sanidine-phyric trachyte.
WHERE SAMPLED: Intensely altered (white) part of Unit 19.
GRAIN SIZE: Medium grained phenocrysts is a fine grained groundmass.
TEXTURE: Porphyritic with a relict trachytic texture.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	5	8	0.2	3	2		Subhedral	Partially resorbed and altered to clay.
GROUNDMASS		?						The groundmass is highly altered to very fine-grained clays which are becoming patchily crystalline (sericite?). Occasional relict plagioclase laths present. In places, a relict trachytic fabric is present as are vesicles. The original mineralogy cannot be estimated.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	~40				Feldpsar, mafics; fills vesicles, veins	XRD suggests that quartz and alkali felspar are also significant phases -- perhaps the clay mode is over-estimated.
Carbonate	~40				Feldspar	XRD suggests that siderite is a significant, if not the major, component.
Feldspar	10				Veins	
Hematite	0.5				Titanomagnetite	
Pentlandite	2	0.01	0.1	0.02	Veins	Isotropic, bright light yellow.
Chalcopyrite	0.5			<0.01	Veins	Stronger yellow than pentlandite, weakly anisotopic.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
Vesicles	Trace	Trace			0.3	Subangular; filled with green clay	
Veins	20%	Random	<0.1	3	1	Clay, recrystallized feldspar, carbonate	Ubiquitous.

COMMENTS : Macroscopic observation: highly veined giving the appearance of being brecciated. Phenocrysts still evident.
In thin section, the brecciated appearance noted macroscopically yields “clasts” that are extremely fine-grained (< 0.1 mm) material that includes sanidine phenocrysts. A few original feldspar laths can be seen in the groundmass.
Photomicrograph #:
1139A-8 = Alteration of groundmass via an intricate vein network gives the section a brecciated appearance (x10 objective, xpl).

THIN SECTION: 183-1139A-71R-7, 24-25, Piece 1B — Unit 19 — OBSERVER: MSP, CRN
ROCK NAME: Highly sanidine-phyric trachyte.
WHERE SAMPLED: Area of red alteration in interior of Unit 19.
GRAIN SIZE: Medium ti fine-grained phenocrysts in a microcrystaline, nearly cryptocrystaline groundmass.
TEXTURE: Porphyritic with a trachytic and ophitic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	10	15	0.1	3			Subhedral to euhedral tablets	Slightly to moderately altered; pronounced preferred orientation, 2V ~10-20.
Clinopyroxene	0	1	0.1	1			Subhedral	Identification not positive - completely altered to clay and carbonate (siderite).
Titanomagnetite	1	1	0.1	0.3			Subhedral, irregular forms	Partially to completely altered to hematite.
GROUNDMASS								
Feldspar	15	70	<.01	0.05	0.04		Laths	Accurate modal estimate of Plagioclase / Alkali feldspar not possible. Groundmass has been altered to clays and replaced with carbonate and quartz.
Mafics	0	15			<0.05		Anhedral masses	Only defined on the basis of alteration as being present. Percentage of original is very rough.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Quartz	20				Everything	
Clay	20				Everything	
Hematite	Trace				Mafics, opaques?	
Maghemite	Trace				Mafics, opaques?	
Carbonate	30				Everything	Both calcite (pervasive) and siderite (patches).

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
None							

COMMENTS : Macroscopic observation: Section has a pink-brown color with phenocrysts evident. Phenocrysts have a preferred orientation.
The groundmass has a "spotted" appearance due to replacement by quartz and carbonate and crystallization of these minerals into semi-coherent masses. In some cases, the masses are feldspathic, suggesting the fluids that moved through this rock carried alkalis as well as silica.

THIN SECTION: 183-1139A-72R-2, 57-60, Piece 2B — **Unit 19** — **OBSERVER: MSP, CRN**
ROCK NAME: Highly sanidine-phyric trachyte.
WHERE SAMPLED: Area of gray alteration in interior of Unit 19.
GRAIN SIZE: Medium to fine-grained phenocrysts in a microcrystaline, nearly cryptocrystaline groundmass.
TEXTURE: Porphyritic with a trachytic and ophitic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	12	15	0.1	3			Subhedral to euhedral tablets	Slightly to moderately altered; pronounced preferred orientation, 2V ~10-20.
Clinopyroxene	0	1	0.1	1			Subhedral	Identification not positive - completely altered to clay and carbonate (siderite).
Titanomagnetite	1	1	0.1	0.3	0.2		Subhedral, irregular forms	Partially altered to hematite.
GROUNDMASS								
Feldspar	10	68	<.01	0.5	0.2		Subhedral to anhedral laths	Accurate modal estimate of plagioclase:alkali-feldspar not possible.
Mafics	0	15					Anhedral masses	Only defined on the basis of alteration as being present. Percentage of original is very rough.

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Clay	15				Everything	Patches up to 0.5 mm across.
Fe-oxide	Trace				Groundmass, titanomagnetite, mafics?	The opaque gray mineral(s) seen are alteration products; possibly microcrystalline hematite or goethite. Some maghemite may be associated with these. Polish is not fine enough to distinguish and internal reflections are indistinct.
Carbonate	35				Everything	XRD suggests that siderite is a significant, if not the major, component.
Quartz	30				Everything	

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
None							

COMMENTS : Macroscopic observation: Section has a brown-gray color with phenocrysts evident. Phenocrysts have a preferred orientation.
The groundmass has a “spotted” appearance due to replacement by quartz and carbonate and crystallization of these minerals into semi-coherent masses. In some cases, the masses are feldspathic, suggesting the fluids that moved through this rock carried alkalis as well as silica.

THIN SECTION: 183-1139A-73R-3, 37-39, Piece 2B — **Unit 19** — **OBSERVER: NTA, MSP**
ROCK NAME: Highly sanidine-phyric trachyte.
WHERE SAMPLED: Interior of Unit 19.
GRAIN SIZE: Medium to fine-grained phenocrysts in a microcrystalline groundmass.
TEXTURE: Porphyritic with a trachytic and ophitic groundmass.

PRIMARY MINERALOGY	PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	APPROX. COMP.	MORPHOLOGY	COMMENTS
PHENOCRYSTS								
Sanidine	12	15	0.1	3			Subhedral to euhedral tablets	Slightly to moderately altered; pronounced preferred orientation, 2V ~10-20.
Clinopyroxene	0	1	0.1	1			Subhedral	Identification not positive - completely altered to clay and carbonate (siderite).
Titanomagnetite	1	1	0.1	0.3			Subhedral, irregular forms	Partially altered to hematite.
GROUNDMASS								
Plagioclase	30	40	<.01	0.1	0.05		Chadocryst laths	Accurate modal estimate of Plagioclase / Alkali feldspar not possible.
Alkali-feldspar	30	40	0.2	0.5	0.3		Rounded oikocrysts	

SECONDARY MINERALOGY	PERCENT	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	REPLACING / FILLING	COMMENTS
Carbonate	30				Everything	Patches up to 0.5 mm across. XRD suggests that siderite is a significant, if not the major, component.

VESICLES/ CAVITIES	PERCENT	LOCATION	SIZE (mm) min.	SIZE (mm) max.	SIZE (mm) av.	FILLING / MORPHOLOGY	COMMENTS
None							

COMMENTS : Groundmass contains abundant small well-oriented laths of one feldspar (presumably plagioclase) poikilitically enclosed by larger grains of (presumably) alkali-feldspar. No mafic phases were seen, but they could have been replaced by carbonate, which forms large patches disseminated through groundmass.