SITE 836 HOLE A CORE 1H
CORED 0.0-1.2 mbsf

Textured summary (%):

- Sand
- Silt
- Clay

Composition:

- Accessory minerals
- Clay
- Detrital
- Feldspar
- Foraminifers
- Glass
- Nanofossils
- Radiolarians
- Siliquarcale
- Spicules

Age:
- Upper Pleistocene

Major lithology: CLAYEY NANNOFOSSIL OOZE, dark brown (10 YR 4/3). The sediment is homogenous but contains clasts of pumice 1-2 cm in diameter.

Minor lithologies: VOLCANIC SILT WITH CLAY AND NANNOFOSSILS occurs in Section 1, 68-69 cm. FORAM VOLCANIC SAND occurs in Section 1, 84-86 cm. CLAYEY NANNOFOSSIL MIXED SEDIMENT WITH GLASS occurs in Section 1, 96-100 cm. These three layers are all normally graded.
SMEAR SLIDE SUMMARY (%):

<table>
<thead>
<tr>
<th>Component</th>
<th>Section</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
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<tr>
<td>Diatoms</td>
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<tr>
<td>Feldspar</td>
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<td>Foraminifers</td>
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<td>Glass</td>
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<tr>
<td>Nannofossils</td>
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<tr>
<td>Radiolarians</td>
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<td>Spicules</td>
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<td>Tr</td>
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</tbody>
</table>

Description:

CLAYEY NANNOFOSIL OOZE, AND  
CLAYEY NANNOFOSIL OOZE WITH GLASS

Major lithologies: CLAYEY NANNOFOSIL OOZE and CLAYEY NANNOFOSIL OOZE WITH GLASS, brown to dark brown (10YR 4/3 to 10YR 5/3).

Minor lithologies: VITRIC CLAY WITH NANNOFOSILS AND FORAMS, brown to dark brown (10YR 4/3), CLAYEY NANNOFOSIL OOZE WITH FORAMS, grayish brown (10YR 5/2), VITRIC VOLCANIC SILT WITH CLAY, very pale brown (10YR 7/3) and CLAST-SUPPORTED PUMICE.

LA PILLI brown to dark brown (10YR 4/3), VITRIC SILT WITH CLAY occurs in Section 1, 76-78 cm, Section 2, 137-139 cm, and Section 6, 35-40 cm, VITRIC NANNOFOSIL MIXED SEDIMENT occurs in Section 5, 35-39 cm, and VITRIC CLAYEY NANNOFOSIL MIXED SEDIMENT occurs in Section 5, 92-95 cm.
### SMEAR SLIDE SUMMARY (%): SITE 836 HOLE A CORE 3H

**TEXTURE:**
- Sand: 15, 15, 15, 15, 15, 15, 15, 15, 15, 15
- Clay: 55, 55, 55, 55, 55, 55, 55, 55, 55, 55

**COMPOSITION:**
- Accessory minerals: Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr
- Feldspar: 5, 5, 5, 5, 5, 5, 5, 5, 5, 5
- Foraminifers: 10, 10, 10, 10, 10, 10, 10, 10, 10, 10
- Glass: 4, 4, 4, 4, 4, 4, 4, 4, 4, 4
- Nannofossils: 58, 58, 58, 58, 58, 58, 58, 58, 58, 58
- Radiolarians: Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr

### SMEAR SLIDE SUMMARY (%): SITE 836 HOLE A CORE 3H

**TEXTURE:**
- Clay: 55, 55, 55, 55, 55, 55, 55, 55, 55, 55

**COMPOSITION:**
- Accessory minerals: Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr
- Feldspar: 5, 5, 5, 5, 5, 5, 5, 5, 5, 5
- Foraminifers: 10, 10, 10, 10, 10, 10, 10, 10, 10, 10
- Glass: 4, 4, 4, 4, 4, 4, 4, 4, 4, 4
- Nannofossils: 58, 58, 58, 58, 58, 58, 58, 58, 58, 58
- Radiolarians: Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr

### SMEAR SLIDE SUMMARY (%): SITE 836 HOLE A CORE 3H

**TEXTURE:**
- Clay: 55, 55, 55, 55, 55, 55, 55, 55, 55, 55

**COMPOSITION:**
- Accessory minerals: Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr
- Feldspar: 5, 5, 5, 5, 5, 5, 5, 5, 5, 5
- Foraminifers: 10, 10, 10, 10, 10, 10, 10, 10, 10, 10
- Glass: 4, 4, 4, 4, 4, 4, 4, 4, 4, 4
- Nannofossils: 58, 58, 58, 58, 58, 58, 58, 58, 58, 58
- Radiolarians: Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr

### SMEAR SLIDE SUMMARY (%): SITE 836 HOLE A CORE 3H

**TEXTURE:**
- Clay: 55, 55, 55, 55, 55, 55, 55, 55, 55, 55

**COMPOSITION:**
- Accessory minerals: Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr
- Feldspar: 5, 5, 5, 5, 5, 5, 5, 5, 5, 5
- Foraminifers: 10, 10, 10, 10, 10, 10, 10, 10, 10, 10
- Glass: 4, 4, 4, 4, 4, 4, 4, 4, 4, 4
- Nannofossils: 58, 58, 58, 58, 58, 58, 58, 58, 58, 58
- Radiolarians: Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr

### SMEAR SLIDE SUMMARY (%): SITE 836 HOLE A CORE 3H

**TEXTURE:**
- Clay: 55, 55, 55, 55, 55, 55, 55, 55, 55, 55

**COMPOSITION:**
- Accessory minerals: Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr
- Feldspar: 5, 5, 5, 5, 5, 5, 5, 5, 5, 5
- Foraminifers: 10, 10, 10, 10, 10, 10, 10, 10, 10, 10
- Glass: 4, 4, 4, 4, 4, 4, 4, 4, 4, 4
- Nannofossils: 58, 58, 58, 58, 58, 58, 58, 58, 58, 58
- Radiolarians: Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr, Tr

### DESCRIPTION:
- **CLAYEY NANNOFOSIL OOZE WITH FORAMS, CLAYEY NANNOFOSIL VITRIC MIXED SEDIMENT and HYALOCLASTITE**

Major lithologies: CLAYEY NANNOFOSIL OOZE, both with and without forams, dark brown (10YR 3/3), MIXED SEDIMENT with varying proportions of clay, glass, and nannofossils. CLAYEY NANNOFOSIL VITRIC MIXED SEDIMENT, dark gray (10YR 4/1) to brown (10YR 4/3), and CLAYEY VITRIC NANNOFOSIL MIXED SEDIMENT, dark brown (10YR 3/3) to black (10YR 2/1) are common. HYALOCLASTITE, black (5YR 2.5/1).

Minor lithologies: Graded layers of VOLCANIC SAND and VOLCANIC SILT with varying percentages of glass, nannofossils, and clay occur within the mixed sediments. Their color varies from dark gray brown (2.5YR 4/2) to black (10YR 2/1).
### SITE 836 HOLE A CORE 4H
CORED 20.2 - 21.2 mbsf

<table>
<thead>
<tr>
<th>Meter</th>
<th>Lith.</th>
<th>Section</th>
<th>Age</th>
<th>Structure</th>
<th>Disturb</th>
<th>Sample</th>
<th>Color</th>
<th>Description</th>
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<tr>
<td>20.2</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>BASALTIC BRECCIA</td>
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<td></td>
<td></td>
<td></td>
<td>Major lithology: BASALTIC BRECCIA, black (10YR 2/1), unconsolidated, unsorted and structureless with clasts up to 23 mm in diameter. Minor lithology: None.</td>
</tr>
</tbody>
</table>

### 836A 5X HARD ROCK

#### SITE 836 HOLE A CORE 6X
CORED 22.7 - 25.7 mbsf

<table>
<thead>
<tr>
<th>Meter</th>
<th>Lith.</th>
<th>Section</th>
<th>Age</th>
<th>Structure</th>
<th>Disturb</th>
<th>Sample</th>
<th>Color</th>
<th>Description</th>
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<tr>
<td>22.7</td>
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<td></td>
<td>NANNOSIL CHALK WITH FORAMS AND CLAY</td>
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</table>

### 836A 7X THROUGH 9X HARD ROCK
**SITE 836 HO*E B CORE 1**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>10YR 3/3</td>
<td>CLAYEY NANNIFOSIL MIXED SEDIMENT WITH GLASS, NANNIFOSIL VITRIC MIXED SEDIMENT WITH CLAY and VITRIC NANNIFOSIL MIXED SEDIMENT WITH CLAY</td>
</tr>
<tr>
<td>10YR 5/3</td>
<td>VITRIC NANNIFOSIL MIXED SEDIMENT WITH CLAY, brown (10YR 5/3)</td>
</tr>
<tr>
<td>10YR 6/2</td>
<td>VITRIC VOLCANIC SILT, light brownish gray (10YR 6/2) occurs in Section 2, 40-47 cm, and in Section 3, 19-28 cm and 44-53 cm.</td>
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</tbody>
</table>

**TEXTURE:**

<table>
<thead>
<tr>
<th>Sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>M</td>
<td>M</td>
</tr>
</tbody>
</table>

**COMPOSITION:**

<table>
<thead>
<tr>
<th>Accessory minerals</th>
<th>Clay</th>
<th>Diatoms</th>
<th>Diorite</th>
<th>Feldspar</th>
<th>Foraminif.</th>
<th>Glass</th>
<th>Radiolarians</th>
<th>Spicules</th>
<th>Replacement</th>
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</thead>
<tbody>
<tr>
<td>7</td>
<td>35</td>
<td>-</td>
<td>2</td>
<td>21</td>
<td>5</td>
<td>15</td>
<td>35</td>
<td>35</td>
<td>15</td>
</tr>
</tbody>
</table>

**Description:**

- Major lithologies: CLAYEY NANNIFOSIL MIXED SEDIMENT WITH GLASS and NANNIFOSIL VITRIC MIXED SEDIMENT WITH CLAY, dark brown (10YR 3/3) to brown (10YR 5/3).

**WASHED 4.5-18.0 mbsf**
**SITE 836 HOLE B CORE 2R**

**CORED 18.0 - 23.0 mbsf**

<table>
<thead>
<tr>
<th>Minor Lith.</th>
<th>Structure</th>
<th>Disturb</th>
<th>Sample</th>
<th>Color</th>
<th>Description</th>
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<tbody>
<tr>
<td>Clay</td>
<td></td>
<td>D</td>
<td>S</td>
<td></td>
<td>CLAYEY NANNOFOSIL MIXED SEDIMENT WITH GLASS</td>
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<td></td>
<td></td>
<td>Major lithology: CLAYEY NANNOFOSIL MIXED SEDIMENT WITH GLASS, dark brown (10YR 3/3), slightly indurated, mollified sediment with some mm-sized yellow intraclasts.</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Minor lithology: None.</td>
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</tbody>
</table>

**SITE 836 HOLE B CORE 3R**

**CORED 23.0 - 28.5 mbsf**

<table>
<thead>
<tr>
<th>Minor Lith.</th>
<th>Structure</th>
<th>Disturb</th>
<th>Sample</th>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>VITRIC CLAYSTONE</td>
</tr>
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<td></td>
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<td></td>
<td>Major lithology: VITRIC CLAYSTONE, light yellowish brown (2.5Y 6/4) to light greenish gray (10Y 5/2). The sediment is mollified due to bioturbation and shows cross-lamination and planar-lamination. Graded layers occur as well as pebbly intervals.</td>
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<tr>
<td></td>
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<td></td>
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<td></td>
<td>Minor lithology: None.</td>
</tr>
</tbody>
</table>
UNIT 1: APHYRIC BASALTIC GLASS GRAVEL

Pieces 8–99 cm

CONTACTS: None.

PHENOCRYSTS:
Plagioclase: 1%–2%; <1 mm; euhedral.

GROUNDMASS: Glassy.

VESICLES: Common, many fragment vesicular.

COLOR: Black.

STRUCTURE: N/A.

ALTERATION: Fresh.

VEINS/FRACTURES: None.

ADDITIONAL COMMENTS: A deposit of fresh, angular glass fragments. Preservation of sharp edged conchoidal fractures indicates that this material has not been transported far (if at all) from its source. Fragments range in size from <1 mm to 2 cm in length.

Glassy basalt gravel
(coarse fragments)

= Graded layers of black volcanic sand
UNIT 2: APHYRIC BASALTIC GLASS GRAVEL

Pieces 50–150 cm

CONTACTS: N/A.

PHENOCRYSTS:
- Plagioclase: 1%–2%; <1 mm; euhedral.

GROUNDMASS: Glassy.

VESICLES: Common, many fragments vesicular.

COLOR: Black.

STRUCTURE: N/A.

ALTERATION: Fresh.

VEINS/FRACTURES: None.

ADDITIONAL COMMENTS: A deposit of fresh, angular, basaltic glass. Excellent conchoidal fracturing is preserved, indicating that the fragments have been deposited very close to their origin. Fragments range from <1 mm up to 1.5 cm in length.
UNIT 3: APHYRIC BASALT

Piece 1

CONTACTS: None, but contains glass rinds on three sides.

PHENOCRYSTS:
- Plagioclase: Trace~1%; <1 mm; euhedral.
- Olivine: Trace; <1 mm; subhedral.

GROUNDMASS: Fine-grained, microlitic to glassy.

VESICLES: 0%-10%; <1 mm; round-irregular; variable distribution; sulfides (and their alteration products) occur in vesicles close to fractures. Vesicles absent in the glass but grade rapidly to about 10% in the interior.

COLOR: Black, 2.5Y 2/0.

STRUCTURE: Appears to represent part of a pillow.

ALTERATION: None.

VEINS/FRACTURES: 1%; small cracks; various orientations; sulfides occur as a fine dusting close to cracks; these are altered(?) to secondary blue-purple (azurite colored) material.
UNIT 3: APHYRIC BASALT

Pieces 0–14 cm

CONTACTS: None.

PHENOCRYSTS: Plagioclase visible only in some fragments.

Plagioclase: <1%; up to 1.5 mm; glomeroporphyritic aggregates.

GROUNDMASS: Fine-grained to glassy.

VESICLES: 0%–10%; up to 2 mm; rounded; variable; some fragments vesicular.

COLOR: Black.

STRUCTURE: N/A.

ALTERATION: Fresh to slightly altered.

VEINS/FRACTURES: None.

ADDITIONAL COMMENTS: Some pieces (even chips only a few millimeters across) have well developed glassy rinds. Drilling rubble.

Basaltic glass and rock fragments
UNIT 3: APHYRIC TO SPARSELY PHYRIC PLAGIOCLASE BASALT

Pieces 1-11 cm

CONTACTS: None.

PHENOCRYSTS: Plagioclase; 1%; <1 mm; euhedral.

GROUNDMASS: Fine-grained microcrystalline.

VESICLES: 10%-20%; <0.5 mm and >1 mm; round to irregular; variable distribution; the very fine vesicles are distributed uniformly throughout, larger vesicles form pipes up to 4 cm in length.

COLOR: 10YR 5/1 gray.

STRUCTURE: Massive.

ALTERATION: Fresh to slightly altered.

VEINS/FRACTURES: None.
UNIT 3: APHYRIC BASALT

Pieces 0–10 cm

CONTACTS: Two igneous pebbles in drill rubble composed largely of sedimentary clasts

PHENOCRYSTS:
Plagioclase: Trace; 1 mm; euhedral.

GROUNDMASS: Micocrystalline.

VESICLES: 25%; < 0.5 mm; irregular; throughout.

COLOR: 7.5YR 5/0 gray.

STRUCTURE: Pebbles.

ALTERATION: Slight.

VEINS/FRACTURES: None.

ADDITIONAL COMMENTS: Drilling rubble.
UNIT 4: APHYRIC BASALT

Pieces 1–8

CONTACTS: None.

PHENOCRYSTS: None visible.

GROUNDMASS: Fine- to medium-grained, 2 mm long ophitic clinopyroxene crystals intergrown with euhedral-anhedral plagioclases. Some olivine also noted.

VESICLES: 0%–15%; <0.5 and >1 mm; round–irregular; variable; Colors vary from colorless, white, yellow, orange, brown. Fine vesicles uniformly distributed, larger ones are rare (eg. Pieces 1 and 8).

Miaroles: Nearly all small vesicles are filled with spectacular zeolites including radiating acicular clusters, bladed and wormy-globular varieties.

COLOR: 7.5YR gray (fresh) to 10YR 5/1, gray.

STRUCTURE: Massive.

ALTERATION: Slightly to highly (Piece 6) altered; very sharply defined alteration fronts.

VEINS/FRACTURES: None.

ADDITIONAL COMMENTS: Piece 2 contains glassy fragments indicating a flow boundary.

Yellow gray altered material
UNIT 4: APHYRIC BASALT

Pieces 1–12

CONTACTS: None.
PHENOCRYSTS: None.
GROUNDMASS: Subophitic plagioclase/augite intergrowth, rare olivine(?).
VESICLES: 8%–20%; 1–3 mm; irregular; increase toward bottom of section; irregular miaroles in all pieces 0.05–0.08 mm; larger, spherical vesicles widely scattered at top of section.

Miaroles: Vesicle walls show projecting plagioclase; overgrowth of zeolites.
COLOR: 7.5YR 5/0, gray (fresh) to 10YR 5/2 yellow-gray (altered).
STRUCTURE: Massive.
ALTERATION: Fresh to moderately altered (low-T oxidation).
VEINS/FRACTURES: None.
ADDITIONAL COMMENTS: Very sharp alteration boundaries; control not obvious. Pieces 1 and 2 more finely vesicular and finer grained than remaining fragments suggesting proximity to a flow top. Piece 12 is distinctly diabasic in texture.

/ / Altered (low temperature oxidation)
UNIT 4: APHYRIC BASALT

Pieces 1–9

CONTACTS: None.

PHENOCRYSTS: Plagioclase phenocrysts not well-defined; grade into groundmass feldspar.
  Plagioclase: <1%; 1–2 mm; euhedral.


VESICLES: 15%–20%; 0.5–5 mm; rounded to coalescing; disseminated; higher concentrations of larger vesicles in Pieces 1 and 2.
  Miaroles: Linings of bluish-green encrusting zeolites; additional Fe-oxide in vesicles in weathered zone.

COLOR: 10YR 4/1, dark gray.

STRUCTURE: Massive.

ALTERATION: Zone of brown weathered and highly altered core runs nearly vertically down one edge of core length; otherwise moderately altered.

VEINS/FRACTURES: Margin of Piece 1 is a fracture surface coated with yellow-brown clay(?) and Fe-oxide.

ADDITIONAL COMMENTS: Diabasic appearance.

- - Altered brown basalt

- - Strongly vesiculated-coarser vesicles
UNIT 4: APHYRIC BASALT

Pieces 1–4

CONTACTS: None.

PHENOCRYSTS:
- Plagioclase: Trace–1%; 0.9–1.5 mm; euhedral.

GROUNDMASS: Fine- to medium-grained; microcrystalline; plagioclase microlites (to 1.2 mm, average about 0.6 mm), intergranular to subophitic clinopyroxene, rare olivine(?)

VESICLES: 8%–12%; 0.3–1.7 mm; rough, irregular; random distribution; large vesicles (around 1 mm) slightly more abundant in Piece 3.
- Miaroles: Small zeolite linings common; altered zones in Pieces 1 to 4 have some orange to yellow-brown clayey linings of vesicles.

COLOR: 7.5YR 6/0 gray (fresh) to 2.5YR 6/0 and 10YR 6/0 grays (altered).

STRUCTURE: Massive.

ALTERATION: Zeolite vesicle linings in both fresh and altered varieties; Pieces 1 to 3 and the top corner of Piece 4 have the mesostasis altered to a clay giving the rock a greenish brown cast. Rock is moderately altered.

VEINS/FRACTURES: Trace; < 1 mm; near vertical; near vertical; one fracture break is Piece 2; its surface is coated with dark greenish brown zeolites and clays.

ADDITIONAL COMMENTS: Surface coating in Piece 6 of white irregular layer of zeolite(?) next to basalt; then a patchy coating of yellow-orange clay(?) spotted with Mn-oxides.

Weathered, brownish basalt
135-836B-2R-1

UNIT 3: SPARSELY PHYRIC PLAGIOCLASE BASALT

Piece 2

CONTACTS: None, but one chip shows a textured surface consistent with a flow top.

PHENOCRYSTS:
Plagioclase: 1%-2%; up to 2.5 mm; euhedral tabular crystals.

GROUNDMASS: Fine-grained.

VESICLES: 5%-10%; <0.5 and >1.5; round to irregular; variable; some lined with dark gray material (Mn-oxide).

COLOR: 2.5Y 5/0, gray.

STRUCTURE: Massive.

ALTERATION: Fresh to slightly altered.

VEINS/FRACTURES: None.

ADDITIONAL COMMENTS: Two small black fragments, and very fine-grained and vesicular, suggesting near flow top material. Drilling rubble.
UNIT 4A: APHYRIC BASALT

Pieces 8–17

CONTACTS: Piece 8 has a glassy rind and underlies the sediment interval, but no actual contacts are observed.

PHENOCRYSTS:
Plagioclase: Trace; <1 mm; as quenched laths in the glass and more rectangular euhedral crystals in the interior crystalline matrix.

GROUNDMASS: Fine-grained intergrowth of plagioclase laths and clinopyroxene (large oikocrysts?). Rare yellowish glassy grains may be olivine.

VESICLES: 5%–15%; <0.5 mm and >1; round to irregular; variable; estimates of vesicle content are almost meaningless owing to the high degree of zeolite infilling. Small vesicles appear to be uniformly distributed, while larger vesicles form pipes and randomly distributed clusters.

Miaroles: Zeolites fill most vesicles. Varieties include cream white hexagonal plates, radiating white acicular crystals and blue-white globules. White crystals appear Fe-stained in the more altered areas.

COLOR: 2.5Y 5/0, gray (fresh) to 10YR 6/1, gray (altered).

STRUCTURE: Massive.

ALTERATION: Slight to high. Alteration halos are sharply defined but are not related to obvious fracturing.

VEINS/FRACTURES: None.
UNIT 4A: APHYRIC BASALT

Pieces 1–18

CONTACTS: None.

PHENOCRYSTS:
- Plagioclase: Trace; <1 mm; euhedral.

GROUNDMASS: Fine-grained intergrowth of plagioclase laths and clinopyroxene.

VESICLES:
- 5%–15%; <0.5 and >1 mm; round to irregular; random distribution; estimates of vesicle percentages is largely meaningless owing to the high degree of zeolite infilling. Smaller vesicles appear to be uniformly distributed, while larger ones are rare and sometimes form pipes.

Miaroles: Larger cavities are filled with a variety of zeolites, including spectacular radiating acicular clusters. Most vesicles are lined with zeolites of some description (e.g. blue-white, white, orange).

COLOR: 2.5Y 5/0, gray (fresh) to 10YR 6/1, gray (altered).

STRUCTURE: Massive.

ALTERATION: Slight to moderate.

VEINS/FRACTURES: <1%; <1 mm wide; steeply dipping; irregular surfaces are coated with Fe-oxyhydroxides and Mn-oxide.

Altered, brown basalt

Highly vesicular zones (Pieces 1 and 10B)
UNIT 4B: APHYRIC BASALT

Pieces 2–9

CONTACTS: None.
PHENOCRYSTS: None.
GROUNDMASS: Fine-grained, euhedral plagioclase laths intergrown with large clinopyroxenes (oikocrysts?). Possible rare olivines (yellowish, glassy grains).
VESICLES: 5%–15%; <0.5 and >1 mm; round to irregular; variable; the percentage of vesicles present is difficult to estimate owing to the large amount of zeolite infilling. Small vesicles are essentially uniformly distributed; however, the larger vesicles are more randomly scattered. Sometimes their distribution is higher in the more altered yellowish halos, which may indicate that material has been leached out. Miaroles: Most vesicles are filled with white to orange zeolites.
COLOR: 2.5YR 5/0, gray (fresh), to 10YR 6/1, gray (altered).
STRUCTURE: Massive.
ALTERATION: Generally moderate, some patches are more bluish gray and look to be only slightly altered.
VEINS/FRACTURES: None.
ADDITIONAL COMMENTS: This basalt looks the same as that in Core 135-836B-3R. Therefore, despite the occurrence of a sediment clast at the top of this section, the unit has been called 4B rather than 5.

```
\textbf{Yellow gray alteration}
```
UNIT 4B: APHYRIC BASALT

Pieces 1–5B

CONTACTS: None; one chip in Piece 1 shows a 2 mm thick glassy rim.

PHENOCRYSTS: None visible.

GROUNDMASS: Fine-grained plagioclase laths intergrown with clinopyroxene grains and rare olivine.

VESICLES: 5%–15%; <0.5 and >1.0 mm; round to irregular; random distribution; fine vesicles are distributed uniformly throughout the rock. The larger vesicles tend to be distributed in patches.

Miaroles: Most vesicles are devoid of infilling, however white hexagonal plates and long, acicular zeolites are commonly observed.

COLOR: 2.5Y 4/0, grey.

STRUCTURE: Massive.

ALTERATION: Fresh to slightly altered (Piece 1 has alteration halos on two sides) up to moderately altered.

VEINS/FRACTURES: <1%; <1 mm wide; subhorizontal; clear, irregular surfaces; possibly broken during drilling.

ADDITIONAL COMMENTS: Possibly slightly coarser grained compared with samples from higher in the hole.
UNIT 4B: APHYRIC BASALT

Pieces 1A–3B

CONTACTS: None visible.

PHENOCRYSTSH: None.

GROUNDMASS: Fine-grained; euhedral plagioclase intergrown with clinopyroxene and rare olivine.

VESICLES: 5%–15%; <0.5 and up to 4 mm; round to irregular; random distribution; small vesicles are uniformly distributed. Large cavities are more patchy in their distribution and may form long pipes (i.e., over 10 cm long; see back of Piece 1B). Miaroles: Relatively clear vesicles, occasionally spectacular radiating acicular zeolites, others include orange globular and white wormy zeolites.

COLOR: 2.5Y 4/0, gray.

STRUCTURE: Massive.

ALTERATION: Generally fresh to slightly altered; alteration halos on Pieces 3A and 3B tend to be moderately altered.

VEINS/FRACTURES: <1%; <1 mm wide; steeply dipping; The fracture between Pieces 1A and 1B is irregular and clean. That dividing Pieces 3A and 3B is spotted with Fe-oxhydroxides and an alteration halo extends for 1.5 to 2 cm on either side of the break.
UNIT 4B: APHYRIC BASALT

Pieces 1B-8

CONTACTS: None visible.

PHENOCRYSTS: None visible.

GROUNDMASS: Fine-grained interlocking lath shaped plagioclase and clinopyroxene with rare olivine.

VESICLES: 5%-15%; <0.5 and >1 mm; round to irregular; random distribution; small vesicles are dominant and appear to be uniformly distributed. Larger vesicles are more dominant in the more altered areas.

Miaroles: A large cavity in Piece 1A (6 mm diameter) is filled with a spectacular set of radiating colorless zeolites. Small orange, red, white zeolites also observed in smaller vesicles.

COLOR: 2.5Y 4/0, gray to 10YR 6/1, gray (altered).

STRUCTURE: Massive.

ALTERATION: Fresh to moderately altered.

VEINS/FRACTURES: <1%; <1 mm wide; random orientations; generally associated with wide (2-4 cm) wide alteration halos. Coated with orange- brown Fe-oxyhydroxides and acicular, colorless zeolites.

Yellowish brown alteration front
UNIT 4B: APHYRIC BASALT

Pieces 1A–1B

CONTACTS: None visible.
PHENOCRYSTES: None visible.
GROUNDMASS: Fine-grained, interlocking euhedral plagioclase with clinopyroxene and rare olivine.
VESICLES: 5%–15%; <0.5 and >1.0 mm; round to irregular; random distribution; small vesicles are uniformly distribute. Larger vesicles occur in patches (see above). Most have at least some zeolite infill. Mioroles: Large coalesced vesicles form cavities up to 2 cm long which are parts of pipe features. These are filled with white radiating acicular zeolites as well as black globular and orange-brown zeolites.
COLOR: 2.5Y 4/0, gray (fresh) to 10YR 6/1, gray (altered).
STRUCTURE: Massive.
ALTERATION: Slightly to moderately altered
VEINS/FRACTURES: One edge of Piece 1A appears to be an old fracture. It contains Fe-oxyhydroxides on its surface.

\[ \text{Yellowish brown altered basalt} \]

\[ \text{Highly vesicular zones of zeolites} \]

\[ \text{filling large vesicles} \]
UNIT 4B: APHYRIC BASALT

Pieces 1–7

CONTACTS: None visible.

PHENOCRYSTs: None visible.

GROUNDMASS: Interlocking plagioclase and clinopyroxene with rare olivine (subophitic). Plagioclase is tabular, subhedral; clinopyroxene is anhedral.

VESICLES: 5%–15%; 0.5–1 mm; subrounded; random distribution; tend to be aligned parallel to fracture in Pieces 2A to 2D.

Miaroles: Irregular cavities 0.02 to 0.05 mm diameter; tend to be partly or completely filled by zeolite.

COLOR: 2.5Y 4/0, gray (fresh) to 10YR 6/1, gray (altered).

STRUCTURE: Massive.

ALTERATION: Most intense in Piece 1; alteration boundary parallels fracture. Most of rock is slightly to moderately altered.

VEINS/FRACTURES: <1%; 20 cm; vertical; vein coated with zeolite; gray dense zone about 1–1.5 cm wide adjacent to fracture, possibly silicified.

ADDITIONAL COMMENTS: Alteration consists of oxidation and deposition of Fe-oxides in vesicles; plagioclase becomes chalky.
UNIT 4B: APHYRIC BASALT

Pieces 1A-1D

CONTACTS: See comments.

PHENOCRYSTST: None visible.

GROUNDMASS: Dominantly intergrown plagioclase and clinopyroxene with minor olivine.

VESICLES: 1%-10%; 0.3-1 mm; subrounded; random distribution.

Miaroles: Irregular cavities 0.05-0.5 mm merge with vesicles.

COLOR: 2.5YR 5/2, yellow-gray when altered; dark blue-gray when fresh.

STRUCTURE: Massive.

ALTERATION: Slightly to moderately altered, most intense in 6 cm area at the bottom of Piece 1D.

VEINS/FRACTURES: 2%; 55 mm wide; near vertical orientation; this is an internal flow contact, quenched on one side, and with deformed quenched boundaries on both sides of lower part of boundary zone.

ADDITIONAL COMMENTS: Alteration at bottom of Piece 1D appears to be from low T oxidation, as at top of 135-836B-6R-1.
UNIT 4B: APHYRIC BASALT

Pieces 1–2

CONTACTS: Bottom of Unit 4.

PHENOCRYSTS: No clearly defined phenocrysts visible - note seriate texture with some crystals near phenocrystal size.

GROUNDMASS: Fine-grained interlocking network of plagioclase and clinopyroxene; rare euhedral olivine; seriate, holocrystalline, subophitic.

VESICLES: 10%–15%; 0.1–6.0 mm; rounded to coalescive; occur throughout; These two pieces of Unit 4 are at the base of Unit 4. They are significantly less vesicular than any of the overlying portions of Unit 4. Both vesicle size and vesicle distribution is less. Largest vesicles are sporadically distributed and relatively scarce.

PHENOCRYSTS: Most are partially filled with acicular to globular zeolites of various colors; some Fe-oxide and Mn-oxide coatings.

COLOR: 2.5Y 6/2 gray.

STRUCTURE: Massive.

ALTERATION: Moderate; slightly weathered (low-temperature alteration).

VEINS/FRACTURES: None.

ADDITIONAL COMMENTS: There is a prominent banding across Piece 1, but it is probably due to differential alteration.

UNIT 5: MODERATELY PHYRIC CLINOPYROXENE PLAGIOCLASE BASALT

Pieces 3–20

CONTACTS: Very fine to "glassy" botryoidal surface on Piece 9 has sediment embedded in cavities; relict (altered) glassy rim on Piece 4.

PHENOCRYSTS:
- Plagioclase: 1%–2%; <2.0 mm; fine laths.
- Olivine: 1%–2%; <2.0 mm; subhedral to anhedral grains.
- Clinopyroxene: 1%–2%; <2.0 mm; anhedral, isolated grains.

GROUNDMASS: Fine-grained.

VESICLES: 25%–30%; <0.1 to 6 mm; round to irregular; uniform distribution; most vesicles are relatively clear of infilling. Piece 7 has a large void with yellow-green clays. Piece 5 also shows Fe-oxide coatings fillings.

COLOR: 2.5Y 3/0, dark gray.

STRUCTURE: Massive.

ALTERATION: Fresh to slightly altered.

VEINS/FRACTURES: None.

HIGHLY VESICULAR ZONE (LOCAL)

RELICT GLASSY MARGIN (ALTERED)

VERY VESICULAR SAMPLES (THROUGHOUT)
UNIT 5: SPARSELY TO MODERATELY PHYRIC
CLINOXYROXENE PLAGIOCLASE BASALT

Pieces 1–9

CONTACTS: None visible.

PHENOCRYSTS:
Plagioclase: 1%–2%; <2.0 mm; elongate laths.
Olivine: Trace–1%; <1.5 mm; anhedral grains.
Clinopyroxene: 1%–2%; <2.0 mm; anhedral, isolated grains.

GROUNDMASS: Fine-grained.

VESICLES: 25%–30%; <0.1 to 4 mm; round to irregular; uniform distribution; larger vesicles (>2 mm) are rare but randomly distributed and empty.

COLOR: 2.5Y 3/0, dark gray.

STRUCTURE: Massive.

ALTERATION: Fresh to slightly altered.

VEINS/FRACTURES: Piece 1 has a very irregular side which may be a fracture surface.
There are green and yellow-orange clays in the depressions along this side.
UNIT 5: SPARSELY TO MODERATELY PHYRIC CLINOPYROXENE PLAGIOCLASE BASALT

Pieces 1–12

CONTACTS: None.

PHENOCRYSTS:
- Plagioclase: 1%–2%; up to 2.0 mm; euhedral tabular crystals.
- Olivine: Trace–1%; up to 1.5 mm; euhedral to subhedral crystals.
- Clinopyroxene: 1%–2%; up to 1.5 mm; anhedral, isolated grains.

GROUNDMASS: Seriate, holocrystalline, subophitic. Plagioclase and subordinate pyroxene visible.

VESICLES: 25%–30%; 0.1 to 7.0 mm; rounded to coalescing; disseminated; largest vesicles sporadically distributed and relatively scarce.
- Miaroles: Very rare yellowish brown and brown clay and Fe-oxide linings.

COLOR: 2.5YR 4/0 dark gray.

STRUCTURE: Massive.

ALTERATION: Fresh to slight.

VEINS/FRACTURES: No veins seen.
UNIT 5: SPARSELY TO MODERATELY PHYRIC CLINOPYROXENE PLAGIOCLASE BASALT

Pieces 1–16

CONTACTS: Glassy rind on Piece 13.
PHENOCRYSTS: Olivine crystals tend to occur in localized groupings of phenocrysts (not as glomerocrysts).
  Plagioclase: 1%–2%; up to 2 mm; euhedral tabular crystals.
  Olivine: Trace–1%; up to 1.5 mm; euhedral to subhedral isolated crystals.
  Clinopyroxene: 1%–2%; up to 1.5 mm; subhedral to anhedral.
GROUNDMASS: Very fine-grained.
VESICLES: 25%–40%; 0.1 to 7.0 mm; rounded to coalescive; disseminated; coarsest vesicles occur more commonly in Pieces 2 and 5.
  Miaroles: Rare infillings and linings of yellow-brown and brown clays(?) and Fe-oxides.
COLOR: 2.5YR 5/0 gray.
STRUCTURE: Massive.
ALTERATION: None to slight.
VEINS/FRACTURES: None visible.
ADDITIONAL COMMENTS: Core has no stratigraphic significance as the drill bit did not advance.
SITE 836

135-836A-3H-04 (85 cm)  OBSERVER: KRI  WHERE SAMPLED: Unit 2

ROCK NAME: Aphyric basaltic glass

GRAIN SIZE: None

TEXTURE: Glassy, sparsely microphenocrystal

<table>
<thead>
<tr>
<th>MINERALOGY</th>
<th>PRIMARY MINERALOGY</th>
<th>PERCENT</th>
<th>PERCENT SIZE</th>
<th>COMPOSITION</th>
<th>MORPHOLOGY</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHENOCRYST</td>
<td>Plagioclase</td>
<td>&lt;1</td>
<td>&lt;1 mm</td>
<td></td>
<td>subhedral</td>
<td>quench textures, sodic rims common</td>
</tr>
<tr>
<td></td>
<td>Clinopyroxene</td>
<td>&lt;1</td>
<td>&lt;0.6 mm</td>
<td></td>
<td>subhedral</td>
<td>quench textures, some in small glomerocrystic clusters with plagioclase, many with growth imperfections</td>
</tr>
<tr>
<td></td>
<td>Orthopyroxene</td>
<td>&lt;1</td>
<td>&lt;0.7 mm</td>
<td></td>
<td>subhedral</td>
<td>lath shaped</td>
</tr>
<tr>
<td>GROUNDMASS</td>
<td>Tan glass</td>
<td>60</td>
<td>60%</td>
<td>n/a</td>
<td>n/a</td>
<td>extremely fresh to spherulitic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VESICLES/CAVITIES</th>
<th>PERCENT</th>
<th>LOCATION</th>
<th>SIZE</th>
<th>FILLING</th>
<th>SHAPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesicles</td>
<td>40</td>
<td>occur</td>
<td>&lt;1.4 mm</td>
<td>rare opaque globular infillings</td>
<td>rounded</td>
<td>the largest vesicles are clearly the result of several smaller ones coalescing; in some fragments vesicles are very elongate; the fillings could be Mn-oxides or goethite</td>
</tr>
</tbody>
</table>

COMMENTS: This section was made from pieces of a basaltic gravel layer. It includes six 1 cm fragments. The above description is an average over all of the pieces. Textures range from glassy to spherulitic. An 1121 point count gives: 57.9% glassy mesostasis, 41% vesicles, 0.5% plagioclase phenocrysts, 0.3% clinopyroxene and 0.3% orthopyroxene phenocrysts. Microphenocrysts (<0.1%) of magnetite are also present. The count was an average over all of the pieces. The pyroxene phenocrysts consist of both clinopyroxene and orthopyroxene (note green-brown pleochroism, straight extinction, and high 2V). Some crystals contain clinopyroxene-orthopyroxene intergrowths.
**SITE 836**

135-836A-5X-01 (Piece 1.0-11 cm)  
**ROCK NAME:** Sparsely phyric olivine-plagioclase basalt  
**GRAIN SIZE:** Fine grained to variolitic  
**TEXTURE:** Vesicular, seriate porphyritic  

### PRIMARY MINERALOGY

<table>
<thead>
<tr>
<th>MINERAL</th>
<th>PLATE SIZE</th>
<th>COMPOSITION</th>
<th>MORPHOLOGY</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>1-2 (0.2-1) An68</td>
<td>euhedral to anhedral</td>
<td>blocky, tabular crystals; largest appear partly resorbed; at least some with more sodic rims</td>
<td></td>
</tr>
<tr>
<td>Olivine</td>
<td>tr-2 (0.2-0.4)</td>
<td>euhedral to skeletal</td>
<td>single crystals and intergrown with plagioclase</td>
<td></td>
</tr>
<tr>
<td>Plagioclase</td>
<td>20-25 (0.05-0.5) An65-68</td>
<td>euhedral to subhedral</td>
<td>long laths intergrown with olivine and in bundles with clinopyroxene; zoning common; serve as nucleation sites for quench clinopyroxenes</td>
<td></td>
</tr>
<tr>
<td>Clinopyroxene</td>
<td>15-20 (0.05-0.25)</td>
<td>anhedral</td>
<td>intergrown with plagioclase, quench morphologies common; grades into quench crystallites included in mesostasis</td>
<td></td>
</tr>
<tr>
<td>Olivine</td>
<td>1-2 (0.05-0.3)</td>
<td>euhedral to subhedral</td>
<td>intergrown with plagioclase and as single crystals</td>
<td></td>
</tr>
<tr>
<td>Opaques</td>
<td>2-4 (0.01)</td>
<td>subhedral</td>
<td>disseminated in groundmass; all magnetite included in plagioclase</td>
<td></td>
</tr>
</tbody>
</table>

### SECONDARY REPLACING/MORPHOLOGY

<table>
<thead>
<tr>
<th>MINERAL</th>
<th>PERCENT</th>
<th>MORPHOLOGY</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green clay</td>
<td>2</td>
<td>vesicle linings</td>
<td>lignin vesicles along a distinct band or a hematite-stained clay? occurs as a filling on top of the green clay</td>
</tr>
<tr>
<td>Red-brown hematite</td>
<td>1</td>
<td>vesicle linings</td>
<td></td>
</tr>
</tbody>
</table>

### VESICLES/CAVITIES

<table>
<thead>
<tr>
<th>SIZE</th>
<th>PERCENT</th>
<th>LOCATION</th>
<th>FILLING</th>
<th>SHAPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-20 (0.07-1.2)</td>
<td>partial linings in some</td>
<td>ovoid (large) to irregular (small)</td>
<td>concentrated in areas with dark quench fill; largest also sometimes in elongate patches almost forming cavities; smaller ones sometimes coalesce to form larger ones</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### COMMENTS:

Mesostasis is 30-35% and maybe 1-2% altered. The groundmass has a seriate texture of coalescing plagioclase bundles intergrown with clinopyroxene and olivine. Vesicular with a large amount of fresh groundmass formed by clinopyroxene-plagioclase-magnetite crystallites. There are discrete patches of darker quench material (aphyric, few microlites, coarsely vesicular) as patches (4-6 mm across), linings to vesicles, and as a band cutting across the sample. Clay linings in vesicles are concentrated along distinct lines, one of which is also a zone characterized by large vesicles. 1035 point count gives: Mesostasis (includes some cpx crystallites) 32.1%; Plagioclase groundmass 22.3%; Clinopyroxene groundmass 19.4%; Olivine groundmass 1.5%; Opaques 3.9%; Plagioclase phenocrysts 1.4%; Olivine phenocrysts 0.4%; Open vesicles 18.2%; Filled vesicles 0.8%; Total vesicles 19.0.
**SITE 836**

**135-836A-7X-01 (Piece 4,42-43 cm) **

**OBSERVER:** EWE  
**WHERE SAMPLED:** Unit 4

**ROCK NAME:** Aphyric basalt  
**GRAIN SIZE:** Fine grained  
**TEXTURE:** Vesicular, ophitic, diabasic

---

**PRIMARY MINERALOGY**

<table>
<thead>
<tr>
<th>MINERAL</th>
<th>PRESENT</th>
<th>PERCENT</th>
<th>SIZE (mm)</th>
<th>COMPOSITION</th>
<th>MORPHOLOGY</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>30-35</td>
<td>30-35</td>
<td>0.1-1.6</td>
<td>An60-65</td>
<td>euhedral to subhedral</td>
<td>elongated laths, normally zoned; interlocking mosaic, intergrown with pyroxene and olivine ophitic to poikilitic; zoned</td>
</tr>
<tr>
<td>Clinopyroxene</td>
<td>20</td>
<td>20</td>
<td>0.1-2.5</td>
<td></td>
<td>subhedral to subhedral</td>
<td></td>
</tr>
<tr>
<td>Olivine</td>
<td>2-3</td>
<td>2-3</td>
<td>up to 1</td>
<td></td>
<td>anhedral</td>
<td>interstitial with intergrown and included plagioclase mostly interstitial; some skeletal</td>
</tr>
<tr>
<td>Magnetite</td>
<td>2-3</td>
<td>2-3</td>
<td>0.05-0.35</td>
<td></td>
<td>subhedral to anhedral</td>
<td>microcrystalline, interseptal, with fibrous growths and microspherulitic aggregates; largely altered possibly to (or with) fine fibrous actinolite</td>
</tr>
<tr>
<td>Mesostasis</td>
<td>0</td>
<td>15-20</td>
<td>n/a</td>
<td></td>
<td>interstitial</td>
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**SECONDARY MINERALOGY**

<table>
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<tr>
<th>MINERAL</th>
<th>PERCENT</th>
<th>REPLACING/ FILLING</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aragonite</td>
<td>1-2</td>
<td>vesicle filling</td>
<td></td>
</tr>
<tr>
<td>Chlorite/actinoite</td>
<td>12-15</td>
<td>vesicle filling, mesostasis replacement</td>
<td></td>
</tr>
<tr>
<td>Fe-oxyhydroxide</td>
<td>tr</td>
<td>vesicle linings</td>
<td></td>
</tr>
</tbody>
</table>

**VESICLES/CAVITIES**

<table>
<thead>
<tr>
<th>VESICLES/CAVITIES</th>
<th>PERCENT</th>
<th>LOCATION (mm)</th>
<th>FILLING</th>
<th>SHAPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesicles</td>
<td>20-25</td>
<td>evenly distributed</td>
<td>complete to partial</td>
<td>subrounded mostly filled by secondary minerals</td>
<td>interconnected</td>
</tr>
</tbody>
</table>

**COMMENTS:** Traces of dark brown Cr-spinel occur included in plagioclase laths. Spinels are euhedral grains, about 0.03 mm in size. In spite of extensive vesicle infilling and alteration of mesostasis the primary mineral phases are very fresh. Continuous variations of grain size typify the texture, with no obvious phenocrystal grains. The mesostasis alteration product has been termed fine-grained clay aggregates by SHE in other slides from this unit. Rock is moderately altered.
**SITE 836**

135-836A-9X-02 (Piece 4, 45-47 cm)  
**ROCK NAME:** Aphyric basalt  
**GRAIN SIZE:** Fine grained  
**TEXTURE:** Vesicular, diabasic

---

**OBSERVER:** JAN  
**WHERE SAMPLED:** Unit 4

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### PRIMARY MINERALOGY

<table>
<thead>
<tr>
<th>PHENOCRYSTS</th>
<th>PERCENT PRESENT</th>
<th>SIZE ORIGINAL (mm)</th>
<th>COMPOSITION</th>
<th>MORPHOLOGY</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>tr</td>
<td>tr</td>
<td>1.5</td>
<td>euhedral</td>
<td>large, blocky crystals rather than long laths; zoned</td>
</tr>
</tbody>
</table>

**GROUNDMASS**

| Plagioclase | 25-30 | 30-40 | 0.2-1.5 | subhedral   | some as long as phenocrysts but narrow laths rather than euhedral phenocrysts; undulose extinction common |
| Clinopyroxene | 20-30 | 20-30 | 0.1-0.9 | subhedral to anhedral | |
| Opaque | 1 | 1 | 0.05-0.3 | irregular | some rod-like crystals in the mesostasis, mainly irregular blobs |
| Olivine? | tr | tr | 0.1 mm | anhedral | |

**Mesostasis**

| 0-1 | 15 | n/a | interstitial | cryptocrystalline; almost completely altered to clays |

---

### SECONDARY REPLACING/MINERALOGY

**MINERALOGY**

| Greenish-brown | 15-20 | replacing mesostasis and plagioclase |

---

### VESICLES/CAVITIES

<table>
<thead>
<tr>
<th>PERCENT FILLING SIZE</th>
<th>LOCATION (mm)</th>
<th>FILLING</th>
<th>SHAPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesicles</td>
<td>15-20</td>
<td>throughout</td>
<td>0.4-2.0</td>
</tr>
</tbody>
</table>

**COMMENTS:** Appears to be some incipient breakdown of plagioclase; the rock is moderately altered. A 1057 point count gives 18.2% mesostasis, 35% groundmass plagioclase, 33.0% groundmass clinopyroxene, 2.2% groundmass olivine, 2.1% groundmass oxides, 16.3% open vesicles, 2.6% filled vesicles, 0.3% plagioclase phenocrysts, 0.3% clinopyroxene phenocrysts, 0.1% olivine phenocrysts. Phenocrysts were defined on the basis of shape and relative size.
ROCK NAME: Moderately phryic olivine-plagioclase basalt

GRAIN SIZE: Fine grained

TEXTURE: Porphyritic

<table>
<thead>
<tr>
<th>PRIMARY MINERALOGY</th>
<th>PERCENT PERCENT SIZE</th>
<th>COMPOSITION</th>
<th>MORPHOLOGY</th>
<th>COMMENTS</th>
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</thead>
<tbody>
<tr>
<td>Phenocrysts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plagioclase</td>
<td>3-5</td>
<td>0.1-0.4</td>
<td>An70-75</td>
<td>euhedral to subhedral; elongated laths, mostly in glomeroporphyritic aggregates; narrow more sodic rims; some of the larger angular grains may be xenocrysts isolated crystals, some skeletal</td>
</tr>
<tr>
<td>Olivine</td>
<td>2-3</td>
<td>0.1-0.9</td>
<td>subhedral</td>
<td></td>
</tr>
<tr>
<td>Groundmass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plagioclase</td>
<td>10-15</td>
<td>up to 0.1</td>
<td>An65-70</td>
<td>euhedral to subhedral; laths to microlites; many in skeletal and swallowtail forms mostly isolated crystals in groundmass and partly included in olivine; dark brown skeletal quench textures plus clinopyroxene-plagioclase intergrowths plus many very fine complex magnetite granular aggregates</td>
</tr>
<tr>
<td>Olivine</td>
<td>1-2</td>
<td>up to 0.1</td>
<td>subhedral</td>
<td></td>
</tr>
<tr>
<td>Cr-spinel</td>
<td>tr</td>
<td>0.02</td>
<td>microphenocrysts</td>
<td></td>
</tr>
<tr>
<td>Mesostasis</td>
<td>60-65</td>
<td>60-65</td>
<td>interstitial</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECONDARY MINERALOGY</th>
<th>PERCENT FILLING</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red-orange</td>
<td>tr lining vesicles</td>
<td>could be hematite/clay aggregates, occur in one corner of the slide lining and perhaps filling some small vesicles; may also have replaced a bit of the groundmass; not common</td>
</tr>
<tr>
<td>Hematite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red/green clays</td>
<td>tr lining vesicles</td>
<td></td>
</tr>
</tbody>
</table>

VESICLES/CAVITIES

<table>
<thead>
<tr>
<th>PERCENT</th>
<th>LOCATION</th>
<th>FILLING</th>
<th>SHAPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-15</td>
<td>disseminated 0.01-4</td>
<td>none</td>
<td>subrounded larger vesicles to erratically coalescing distributed</td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS: Very nice, fresh sample. Phenocryst definition for point count was somewhat subjective and accounts for the difference in estimates. Total olivine content is 2.3%, but all could be considered phenocrysts, plagioclase is seriate making distinction between phenocrysts and groundmass rather arbitrary. This accounts for difference between hand sample and thin section descriptions and names. 1069 point count gives:

- Mesostasis (includes some cpx crystallites) 66.7%
- Open vesicles 14.2%
- Filled vesicles 0.2%
- Plagioclase groundmass 12.1%
- Clinopyroxene groundmass 0.6%
- Olivine groundmass 1.5%
- Opaques 1.8%
- Plagioclase phenocrysts 1.0%
- Olivine phenocrysts 0.8%
- Other (alteration) 0.1%
135-836B-3R-01 (Piece 11,68-70 cm)  
OBSERVER: SHE  
WHERE SAMPLED: Unit 4

**ROCK NAME:** Sparsely phyric plagioclase basalt  
**GRAIN SIZE:** Fine grained  
**TEXTURE:** Vesicular, subophitic, intersertal

---

### PRIMARY MINERALOGY

<table>
<thead>
<tr>
<th>Phenocrysts</th>
<th>Percent Present</th>
<th>Percent Original</th>
<th>Composition</th>
<th>Morphology</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>1-2</td>
<td>1-2</td>
<td>0.4-1.0</td>
<td>subhedral to anhedral</td>
<td>some partially rounded tabular, equant crystals with oscillatory zoning</td>
</tr>
<tr>
<td>GROUNDMASS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plagioclase</td>
<td>28-38</td>
<td>30-40</td>
<td>&lt;0.1-0.7 An50-60?</td>
<td>subhedral to anhedral</td>
<td>laths partially enclosed in clinopyroxene and altered mesostasis</td>
</tr>
<tr>
<td>Clinopyroxene</td>
<td>15-20</td>
<td>15-20</td>
<td>&lt;0.1-0.8</td>
<td>subhedral</td>
<td>subhopic to granular zoning, particularly sector zoning, is common small grains, isolated in groundmass</td>
</tr>
<tr>
<td>Olivine</td>
<td>1-2</td>
<td>2-3</td>
<td>0.05-0.4</td>
<td>subhedral to anhedral</td>
<td>subhedral to anhedral</td>
</tr>
<tr>
<td>Opaques</td>
<td>3-4</td>
<td>3-4</td>
<td>&lt;0.01-0.05</td>
<td>subhedral to anhedral</td>
<td>commonly intergranular; skeletal forms common</td>
</tr>
<tr>
<td>Mesostasis</td>
<td>0-5</td>
<td>25-35</td>
<td>n/a</td>
<td>interstitial</td>
<td>largely altered to clays; may be some pyroxene crystalilitas left</td>
</tr>
</tbody>
</table>

### SECONDARY MINERALOGY

<table>
<thead>
<tr>
<th>Mineralogy</th>
<th>Percent</th>
<th>Replacing/Filling</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aragonite</td>
<td>1-2</td>
<td>replacing mesostasis, filling vesicles</td>
<td>aggregates up to 0.1 to 0.5 mm</td>
</tr>
<tr>
<td>Brownish clays</td>
<td>25-30</td>
<td>replacing mesostasis</td>
<td>fine-grained aggregates replacing mesostasis; some may be vesicle fill but it is hard to separate from altered groundmass</td>
</tr>
</tbody>
</table>

### VESICLES/CAVITIES

<table>
<thead>
<tr>
<th>VESICLES/CAVITIES</th>
<th>Percent</th>
<th>Location (mm)</th>
<th>Filling</th>
<th>SHAPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesicles</td>
<td>10-15</td>
<td>throughout 0.05-1</td>
<td>partially with clays</td>
<td>irregular</td>
<td>largest may form by coalescence of smaller ones</td>
</tr>
</tbody>
</table>

**COMMENTS:** Section is thin and rather badly plucked; rare sulfide (?) in groundmass and edge of some vesicles. Rock is moderately altered.
SITE 836

135-836B-3R-02 (Piece 5,32-36 cm)  OBSERVER: SHE  WHERE SAMPLED: Unit 4

ROCK NAME: Aphyric basalt

GRAIN SIZE: Fine to medium grained

TEXTURE: Vesicular, ophitic, intersertal

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**PRIMARY MINERALOGY**

<table>
<thead>
<tr>
<th>MINERAL</th>
<th>PERCENT</th>
<th>PERCENT SIZE</th>
<th>COMPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>24-29</td>
<td>25-30</td>
<td>An60</td>
</tr>
<tr>
<td>Clinopyroxene</td>
<td>15-20</td>
<td>15-20</td>
<td>0.9-2.0</td>
</tr>
<tr>
<td>Olivine</td>
<td>1-2</td>
<td>2-3</td>
<td>0.05-0.2</td>
</tr>
<tr>
<td>Opaques</td>
<td>2-3</td>
<td>2-3</td>
<td>n/a</td>
</tr>
<tr>
<td>Mesostasis</td>
<td>0-2</td>
<td>25-30</td>
<td></td>
</tr>
</tbody>
</table>

**SECONDARY MINERALOGY**

<table>
<thead>
<tr>
<th>MINERAL</th>
<th>PERCENT</th>
<th>REPLACING/ FILLING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown clays</td>
<td>25-30</td>
<td>replacing groundmass</td>
</tr>
<tr>
<td>Aragonite</td>
<td>tr-1</td>
<td>filling vesicles, replacing groundmass</td>
</tr>
</tbody>
</table>

**COMMENTS**

- Anhedral to euhedral zoned laths enclosed in clinopyroxene or by mesostasis
- Anhedral, ophitic, sector zoned
- Euhedral to subhedral
- Euhedral to anhedral interstitial magnetite
- Interstitial replaced by clays

**COMMENTS**

- Clearly partially filling groundmass also; in fine-grained radial to fibrous aggregates; some replacement of olivine along fractures
- Crystals to 0.5 mm occur in granular aggregates and fanned bundles of blades; aggregates up to 1.5 mm; largely filling porosity; probably some groundmass and olivine replacement too, but hard to tell

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**VESICLES/CAVITIES**

<table>
<thead>
<tr>
<th>VESICLES</th>
<th>PERCENT</th>
<th>LOCATION</th>
<th>FILLING</th>
<th>SHAPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-20</td>
<td>throughout</td>
<td>0.1 to 1</td>
<td>clays</td>
<td>irregular</td>
<td>May be significant filling of vesicles by clay but it is hard to tell from groundmass alteration</td>
</tr>
</tbody>
</table>

**COMMENTS**

- Rock is moderately to highly altered.
ROCK NAME: Aphyric basalt
GRAIN SIZE: Fine grained
TEXTURE: Vesicular, subophitic to intergranular and intersertal

<table>
<thead>
<tr>
<th>PRIMARY MINERALOGY</th>
<th>PERCENT PRESENT</th>
<th>PERCENT ORIGINAL (mm)</th>
<th>COMPOSITION</th>
<th>MORPHOLOGY</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>30-35</td>
<td>0.1-1.6</td>
<td>An60-65</td>
<td>subhedral</td>
<td>elongated laths, normally zoned, interlocking and partially enclosed by clinopyroxene</td>
</tr>
<tr>
<td>Clinopyroxene</td>
<td>20-25</td>
<td>0.05-0.8</td>
<td></td>
<td>subhedral</td>
<td>intergranular to subophitic; marked zoning including hour glass structure, though core to rim zoning is most common frequently interstitial with included plagioclase laths and an isolated crystals in groundmass; can be hard to differentiate from clinopyroxene mainly interstitial, some skeletal grains; in mesostasis some very small (&lt;0.01 mm) rod-like aggregates microcrystalline chlorite/actinolite fibrous growths plus colorless zeolite (?)</td>
</tr>
<tr>
<td>Olivine</td>
<td>3-5</td>
<td>0.04-0.8</td>
<td></td>
<td>subhedral</td>
<td></td>
</tr>
<tr>
<td>Magnetite</td>
<td>3-4</td>
<td>0.02-0.3</td>
<td></td>
<td>anhedral</td>
<td></td>
</tr>
<tr>
<td>Mesostasis</td>
<td>0-5</td>
<td>15-20</td>
<td>n/a</td>
<td>interstitial</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECONDARY MINERALOGY</th>
<th>PERCENT FILLING</th>
<th>REPLACING/FILLING</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorite/actinolite</td>
<td>10-15</td>
<td>infilling and linings</td>
<td>replacing mesostasis and infilling vesicles; very fine aggregates; SHE has these down as brown clays in radial fine-grained aggregates; proportion of replacement vs. vesicle fill is hard to determine fine globular growths, on top of clay/chlorite growths, growing into vesicles red-brown zones in chlorite/actinolite/clay? aggregates fibrous to radiating greenish-brown aggregates in vesicles</td>
</tr>
<tr>
<td>Reclite</td>
<td>&lt;1</td>
<td>lining vesicles</td>
<td></td>
</tr>
<tr>
<td>Fe-oxyhydroxide</td>
<td>&lt;1</td>
<td>infilling</td>
<td></td>
</tr>
<tr>
<td>Mixed chlorite/clay?</td>
<td>1</td>
<td>linings</td>
<td></td>
</tr>
<tr>
<td>Aragonite</td>
<td>tr</td>
<td>infilling</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VESICLES/CAVITIES</th>
<th>PERCENT</th>
<th>LOCATION</th>
<th>FILLING</th>
<th>SHAPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesicles</td>
<td>15-20</td>
<td>0.15 to 2</td>
<td>partial to complete</td>
<td>subrounded most common size is 0.4 to 1 mm; many have quench linings; linings are clays and a hematitic material</td>
<td></td>
</tr>
<tr>
<td></td>
<td>evenly</td>
<td>distributed</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS: Primary minerals are very fresh in spite of extent of mesostasis alteration and vesicle infilling. Continuous variations of grain size with no obvious phenocrystal grains. There are trace sulfides, at least two types, in the groundmass. The dark brown to black groundmass looks like unaltered devitrified mesostasis on first glance but is clearly replaced by small, radial aggregates of clays/actinolite/chlorite. Rock is moderately altered.
**SITE 836**

135-836B-5R-02 (Piece 2,92-93 cm)  
**ROCK NAME:** Aphyric basalt  
**GRAIN SIZE:** Medium grained  
**TEXTURE:** Vesicular, diabasic

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**OBSERVER:** KRI  
**WHERE SAMPLED:** Unit 4

---

<table>
<thead>
<tr>
<th>PRIMARY MINERALOGY</th>
<th>PERCENT PRESENT</th>
<th>PERCENT ORIGINAL (mm)</th>
<th>COMPOSITION</th>
<th>MORPHOLOGY</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenocrysts</td>
<td>tr-1</td>
<td>tr-1 to 1</td>
<td>An75</td>
<td>Euhedral</td>
<td>Euhedral to tabular grains; more euhedral than groundmass; some evidence of incipient alteration; commonly zoned</td>
</tr>
<tr>
<td>Plagioclase</td>
<td>30-35</td>
<td>30-35 &lt;0.8 mm</td>
<td></td>
<td>Euhedral</td>
<td>Elongate laths to tabular grains, zoned</td>
</tr>
<tr>
<td>Clinopyroxene</td>
<td>15-20</td>
<td>15-20 &lt;0.06</td>
<td></td>
<td>Subhedral to anhedral</td>
<td>Subhedral and interstitial</td>
</tr>
<tr>
<td>Olivine</td>
<td>1-2</td>
<td>1-2 &lt;0.4</td>
<td></td>
<td>Anhedral</td>
<td>Identification is difficult but these are very clear with high interference colors</td>
</tr>
<tr>
<td>Magnetite</td>
<td>1-2</td>
<td>1-2 &lt;0.2</td>
<td></td>
<td>Euhedral</td>
<td>Cruciform grains common, trace ilmenite</td>
</tr>
<tr>
<td>Mesostasis</td>
<td>0</td>
<td>10-15 n/a</td>
<td></td>
<td>Interstitial</td>
<td>Replaced by extremely fine grained green-brown clays</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>SECONDARY MINERALOGY</th>
<th>PERCENT REPLACING/ FILLING</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soicates</td>
<td>&lt;1</td>
<td>filling vesicle walls</td>
</tr>
<tr>
<td>Mixed clays</td>
<td>10-15</td>
<td>replacing mesostasis</td>
</tr>
<tr>
<td>Calcite</td>
<td>tr</td>
<td>filling vesicles</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>VESICLES/ CAVITIES</th>
<th>PERCENT LOCATION</th>
<th>SIZE (mm)</th>
<th>FILLING</th>
<th>SHAPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesicles</td>
<td>25-30 throughout to 3 mm</td>
<td>Minor</td>
<td>Irregular</td>
<td>Large, irregular shaped rods as well as small, intergranular voids; the large voids may in part be a product of plucking</td>
<td></td>
</tr>
</tbody>
</table>

**COMMENTS:** The slide is badly plucked throughout. Many of the original voids have been enlarged and a lot of fine material deposited in the vesicles and veins may be from the breaking and plucking. The vesicle percentages are therefore maximum estimates. A 787 point count (avoiding the worst plucked areas) gave: 16.3% mesostasis, 0.9% plagioclase phenocrysts (larger, blockier grains), 33.3% groundmass plagioclase, 17.8% groundmass clinopyroxene, 1.7% groundmass olivine, 1.1% groundmass opaques, 27.4% open vesicles and 1.5% filled vesicles. Rock is moderately altered.
SITE 836

135-836B-6R-02 (Piece 1G, 59-63 cm)  OBSERVER: EWE  WHERE SAMPLED: Unit 4

ROCK NAME: Moderately to highly phytic clinopyroxene-olivine-plagioclase basalt

GRAIN SIZE: Fine grained

TEXTURE: Porphyritic, vesicular

<table>
<thead>
<tr>
<th>PRIMARY MINERALOGY</th>
<th>PERCENT PRESENT</th>
<th>PRIMARY SIZE</th>
<th>COMPOSITION</th>
<th>MORPHOLOGY</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHENOCRYSTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plagioclase</td>
<td>7-10</td>
<td>0.5-2.0</td>
<td>An70-75</td>
<td>euhedral to subhedral</td>
<td>some are zoned with sodium rims</td>
</tr>
<tr>
<td>Olivine</td>
<td>2</td>
<td>0.2-0.6</td>
<td></td>
<td>euhedral to subhedral</td>
<td>isolated crystals, some with large inclusions</td>
</tr>
<tr>
<td>Clinopyroxene</td>
<td>&lt;1</td>
<td>0.2-0.4</td>
<td></td>
<td>subhedral to anhedral</td>
<td>partly intergrown with plagioclase</td>
</tr>
<tr>
<td>Cr-spinel</td>
<td>tr</td>
<td>0.05</td>
<td></td>
<td>euhedral</td>
<td>not as a phenocryst phase but no room in groundmass field; as inclusions in plagioclase phenocrysts; have narrow magnetite rims possibly developed as the result of mixing; very rare and dark brown</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GROUNDMASS</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>35</td>
<td>up to 0.5</td>
<td></td>
<td>euhedral to anhedral</td>
<td>tabular microlites and microphenocrysts to anhedral mesostasis grains</td>
</tr>
<tr>
<td>Olivine</td>
<td>1-2</td>
<td>0.04 to 0.2</td>
<td></td>
<td>euhedral to subhedral</td>
<td>most isolated grains; some intergrown in plagioclase</td>
</tr>
<tr>
<td>Clinopyroxene</td>
<td>30-35</td>
<td>up to 0.2</td>
<td></td>
<td>subhedral to anhedral</td>
<td>mostly in granular mesostasis</td>
</tr>
<tr>
<td>Magnetite</td>
<td>1-2</td>
<td>0.002-0.010</td>
<td></td>
<td>euhedral to anhedral</td>
<td>varies from discrete grains to interstitial grains</td>
</tr>
<tr>
<td>Sulfides</td>
<td>&lt;1</td>
<td>0.002-0.010</td>
<td></td>
<td>subhedral to anhedral</td>
<td>occurs as interstitial groundmass grains and adjacent to, or in, vesicles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECONDARY MINERALOGY</th>
<th>PERCENT REPLACING/PERCENT FILLING</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clays</td>
<td>10 filling vesicles</td>
<td>vessels show beautiful zonation from brown and pale green clays to apple-green clays followed by Fe-oxyhydroxides (?) toward the center of the void. A few are completely infilled, others still show void space. colorless acicular zeolites fill center of many vesicles; sulfdies also associated with vesicle margins.</td>
</tr>
<tr>
<td>Zeolites</td>
<td>tr-1 filling vesicles</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VESICLES/CAVITIES</th>
<th>PERCENT LOCATION</th>
<th>FILLING</th>
<th>SHAPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesicles</td>
<td>19 randomly</td>
<td>partial to complete</td>
<td>irregularly brownish-green fibrous infillings; also deep green-brown fibrous material (pleochroic); also acicular zeolites</td>
<td></td>
</tr>
<tr>
<td>Fractures</td>
<td>&lt;1 crosscutting 0.1 mm wide</td>
<td>partially infilled</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS: This rock is fine-grained but the groundmass has a granular, near granoblastic texture, with coarser and finer grained intimately intermixed patches, apparently the result of internal magma mixing in the flow when the crystallization was incomplete. This mixing presumably also accounts for the granular texture reminiscent of recrystallisation textures. Finer grained lithology may be slightly pyroxene riches. Embedded in this granular groundmass are phenocrysts and microphenocryst sized and mainly euhedral to subhedral plagioclase, olivine, and minor clinopyroxene. The distinction in size between phenocrysts and microphenocrysts is arbitrary. Nevertheless, the contrasting size and shape of these crystals, compared to the granular groundmass, gives the rock a distinctly porphyritic texture. Sulfide grains are relatively abundant. Most appear to be associated with vesicles, although not necessarily inside the vesicle infillings. Other grains more rarely occur as interstitial grains.
ROCK NAME: Moderately phric clinopyroxene-plagioclase basalt

GRAIN SIZE: Aphanitic to fine grained

TEXTURE: Vesicular, seriate porphyritic, subophitic

<table>
<thead>
<tr>
<th>PRIMARY MINERALOGY</th>
<th>PERCENT PRESENT</th>
<th>PERCENT ORIG. (mm)</th>
<th>COMPOSITION</th>
<th>MORPHOLOGY</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenocrysts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plagioclase</td>
<td>3-5</td>
<td>3-5</td>
<td>0.15-0.4</td>
<td>anhedral to euhedral</td>
<td>most in glomerocrystals with or without clinopyroxene; smaller grains occur individually; glass inclusions occur but not common; a few are anhedral and resorbed; phenocrysts are equant, tabular crystals; both reverse and normal zoning in larger grains</td>
</tr>
<tr>
<td>Clinopyroxene</td>
<td>1-2</td>
<td>1-2</td>
<td>0.1-0.35</td>
<td>anhedral to subhedral</td>
<td>most commonly subophitically intergrown with plagioclase; also intergranular to plagioclase; single crystals near glomerocrysts</td>
</tr>
<tr>
<td>Olivine</td>
<td>tr</td>
<td>tr</td>
<td>0.1</td>
<td>euhedral</td>
<td></td>
</tr>
</tbody>
</table>

| Groundmass         |                 |                    |             |            |          |
| Plagioclase        | 3-5             | 3-5                | 0.01-0.3    | euhedral to skeletal | long, skinny laths and quench morphologies |
| Clinopyroxene      | 1-3             | 1-3 to 0.1 mm      | subhedral, sheaves | 1-3% well-crystallized equant, anhedral grains; much of the groundmass contains sheaflike quench clinopyroxenes |
| Olivine?           | tr              | tr                 | 0.02        | anhedral    | identification uncertain |
| Opasques           | 1-2             | 1-2                | 0.002-0.01  | anhedral to skeletal | disseminated throughout groundmass; appear to be magnetite |
| Mesostasis         | 48-53           | 50-55              | n/a         | n/a         | common quench morphologies of plagioclase-pyroxene sheaves with disseminated opasques; slight alteration |

<table>
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<tr>
<th>SECONDARY MINERALOGY</th>
<th>PERCENT REPLACING</th>
<th>FILLING</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematite/clays</td>
<td>1-2</td>
<td>replace groundmass, vesicle linings</td>
<td>occur in vesicle edges and as patches in the groundmass; these patches have a slight reddish to greenish-yellow tinge; probably incipient alteration of mesostasis to clays and hematite</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>VESICLES/CAVITIES SIZE</th>
<th>PERCENT LOCATION (mm)</th>
<th>FILLING</th>
<th>SHAPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesicles</td>
<td>30-35</td>
<td>throughout 0.1 to 5.0</td>
<td>none</td>
<td>irregular smaller ones rounded; the largest ones (3 x 5 mm) usually elongate</td>
</tr>
</tbody>
</table>

COMMENTS: The larger pyroxenes are not uncommonly curved with undulose extinction. Plagioclase and pyroxene typically in glomerocrysts of 2 to 15 grains; glomerocrysts tend to be clumped together in portions of the slide. There are unusual gently curved crystal aggregates consisting of 6 to 10 plagioclase and pyroxene crystalsstrung singly together end-to-end. The chains are 0.3 to 0.6 mm long. There are very thin glassy selvages on the inside of some of the vesicles. Darker, aphyric quench textured material occurs as 2 mm patches and lining vesicles; so abundant around vesicles on one side of slide that it makes up most of the groundmass. A 1122 point count gives 51.6% mesostasis (including crystallites) 3.1 plagioclase phenocrysts; 1.0% clinopyroxene phenocrysts, 3.2% groundmass opasques; 2.4% groundmass plagioclase; 2.8% groundmass clinopyroxene; 35.7% open vesicles; 0.2% hematitic patches. Rock is fresh to slightly altered.
SITE 836

135-836B-9M-01 (Piece 6,47-48 cm)  
OBSERVER: KRI  
WHERE SAMPLED: Unit 5

ROCK NAME: Sparsely phyric plagioclase basalt

GRAIN SIZE: Fine grained

TEXTURE: Vesicular, seriate

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<tr>
<th>PRIMARY MINERALOGY</th>
<th>PERCENT PRESENT</th>
<th>PERCENT ORIGINAL</th>
<th>COMPOSITION</th>
<th>MORPHOLOGY</th>
<th>COMMENTS</th>
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<tr>
<td>PHENOCRYSTS</td>
<td></td>
<td></td>
<td></td>
<td>euhedral</td>
<td></td>
</tr>
<tr>
<td>Plagioclase</td>
<td>1-2</td>
<td>1-2</td>
<td>0.6-1.2</td>
<td>euhedral</td>
<td></td>
</tr>
<tr>
<td>GROUNDMASS</td>
<td></td>
<td></td>
<td></td>
<td>subhedral-subhedral</td>
<td>elongate, randomly oriented grains</td>
</tr>
<tr>
<td>Plagioclase</td>
<td>30-35</td>
<td>30-35</td>
<td>&lt;1 mm</td>
<td>subhedral</td>
<td></td>
</tr>
<tr>
<td>Clinopyroxene</td>
<td>20-25</td>
<td>20-25</td>
<td>&lt;1 mm</td>
<td>subhedral</td>
<td></td>
</tr>
<tr>
<td>Olivine</td>
<td>1-2</td>
<td>1-2</td>
<td>&lt;0.3</td>
<td>subhedral</td>
<td></td>
</tr>
<tr>
<td>Mesostasis</td>
<td>10-15</td>
<td>10-15</td>
<td>n/a</td>
<td>interstitial</td>
<td>mostly occurs in vesicles filled with quenched material, very fresh beautiful skeletal and cruciform forms</td>
</tr>
<tr>
<td>Magnetite</td>
<td>3-4</td>
<td>3-4</td>
<td>&lt;0.1</td>
<td>equant-skeletal</td>
<td></td>
</tr>
</tbody>
</table>

VESICLES/CAVITIES SIZE

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<th>VESICLES</th>
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<th>(mm)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Vesicles</td>
<td>25</td>
<td>disseminated</td>
<td>&lt;2</td>
<td>empty</td>
<td>irregular</td>
</tr>
</tbody>
</table>

COMMENTS: Approximately 40-50% of this sample is extremely fine grained, vesicular, quenched material filling vesicles as has been seen in many previous samples. Small amounts of glass are preserved in this material. Sample is extremely fresh.