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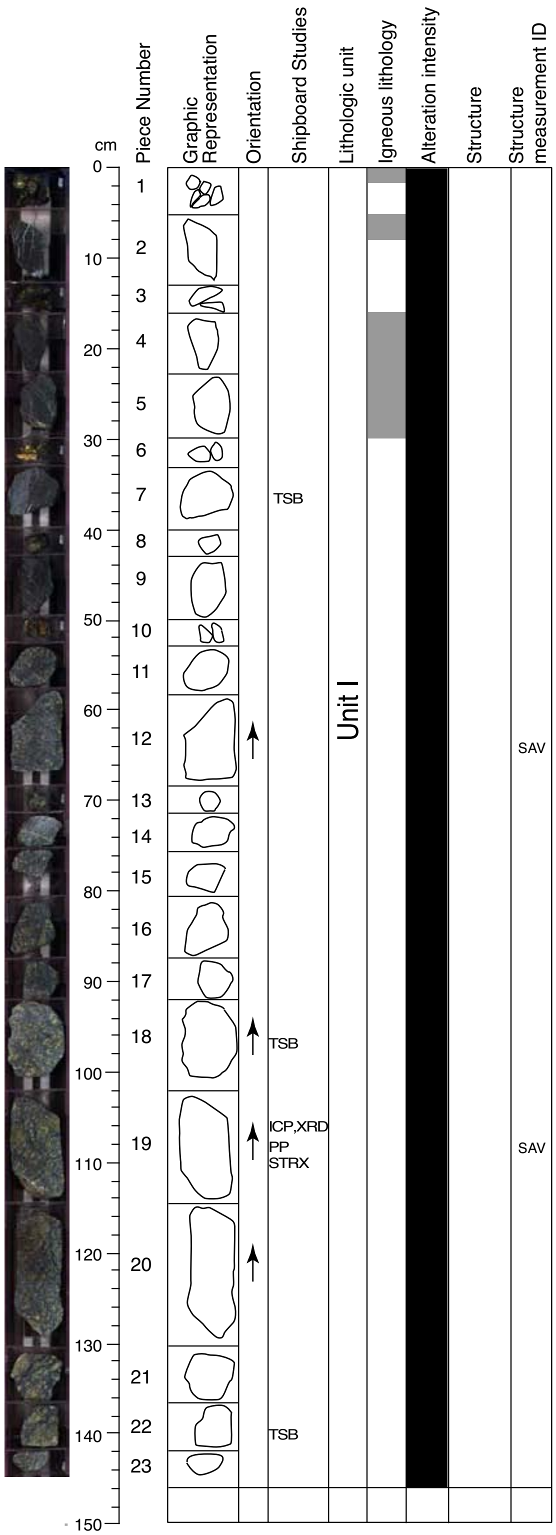

209-1270A-1R-1 (Section top: 0.00 mbsf)

UNIT-1: Serpentinized Harzburgite / dunite

Pieces 1–23

COLOR: Dark green

PRIMARY MINERALOGY: Harzburgite
Olivine Mode 69%–76%
Orthopyroxene Mode 23%–30%
Size 5–15 mm
Shape/Habit Anhedral
Clinopyroxene Mode 2%–3%?
Size < 1 mm
Shape/Habit Anhedral / interstitial
Spinel Mode 1%

PRIMARY MINERALOGY: Dunite
Olivine Mode 94%–97%
Orthopyroxene Mode 2%–5%
Size 5-–0 mm
Shape/Habit Anhedral
Spinel Mode 1%

COMMENTS: This section consists of ultramafic rocks with a bimodal distribution of altered dunite in Pieces 2, 4-5, 7, and 9 and harzburgite in Pieces 2-3, 6, and 7-15. Piece 1 is represented by pebbles of dunite and harzburgite. A dunite in Piece 7 is fresh and probably mylonitic in texture because of smaller grain size of orthopyroxene. Altered harzburgites are characterized by protogranular texture with coarse orthopyroxene grains. Holly leaf-shaped spinel grains are enclosed in coarse orthopyroxene grains at 62 cm and at 73 cm. Clinopyroxene pseudomorphs are present in a small amount. A thin orthopyroxenite dike is present at the top of Piece 2 and contacts to dunite. Coarse orthopyroxene crystals intergrown with spinel form patches in Pieces 18, 19, and 22; they are interpreted as boudinaged orthopyroxenite.

SECONDARY MINERALOGY:

COMMENTS: Pieces 1-9 are completely serpentinized, dark green to black harzburgites and dunites with variable orthopyroxene content. Mesh textured serpentine is prominent after olivine and orthopyroxene is completely replaced by bastite. Piece 7 is peculiar since it consists of a dark brown orthopyroxene-rich domain with a sharp contact to a dark amphibole-rich domain. Pieces 11-23 are green completely serpentinized harzburgites. Olivine shows a prominent black mesh texture with light green kernels. Orthopyroxene is altered to green to light green serpentine with locally prominent spinel. Piece 20 contains a completely serpentinized orthopyroxene-nodule.

VEIN ALTERATION: Veining in this section is variable with higher vein density in serpentinized dunites up section. Fine, wispy paragranular chrysotile veinlets are common. Talc veins occasionally cut paragranular chrysotile veins. Talc veins mostly occur in the metapyroxenite (Pieces 7 and 9). Pieces 11 and 23 are serpentinized harzburgite with well developed cross-fiber veins of chrysotile occasionally cutting across talc veins.

THIN SECTIONS: Samples 1270A-1R-1, 35-35 cm, 1270A-1R-1, 96-99 cm, and 1R-1, 139-141 cm.

STRUCTURE:
The section consists of porphyroclastic serpentinized harzburgite and serpentinized dunite (Pieces 4, 5, 7). The harzburgite is characterized by a strong to weak crystal-plastic (CP) fabric. The strongest foliations defined by the preferred dimensional orientation of pyroxene occur in Pieces 11, 12, 14, 15, 21, and 22. The CP foliation is inclined approximately 45° in the cut core face. Pieces 1, 2, 3-5, and 8 contain moderate intensity cross-fiber serpentine foliation (SF). Pieces 11-17, 18-20, 21, and 22 contain weak cross-fiber serpentine foliation. Modal variations in pyroxene occur in Piece 2 grading to a dunite band. Two generations of serpentine veins (SAV1 and SAV2) with crosscutting relationships occur in Pieces 5, 9, 12, 14, and 21. Piece 5 shows serpentine filled sinistral tension cracks orthogonally cutting an earlier phase of serpentine vein. Pieces 2, 5, 10, and 16 exhibit brittle late fractures filled with serpentine. Piece 9 contains a normal fault (Ft) cutting serpentine veins. No magmatic veins were observed. Crosscutting relationships indicate CP>SF>SAV1>SAV2>FT.

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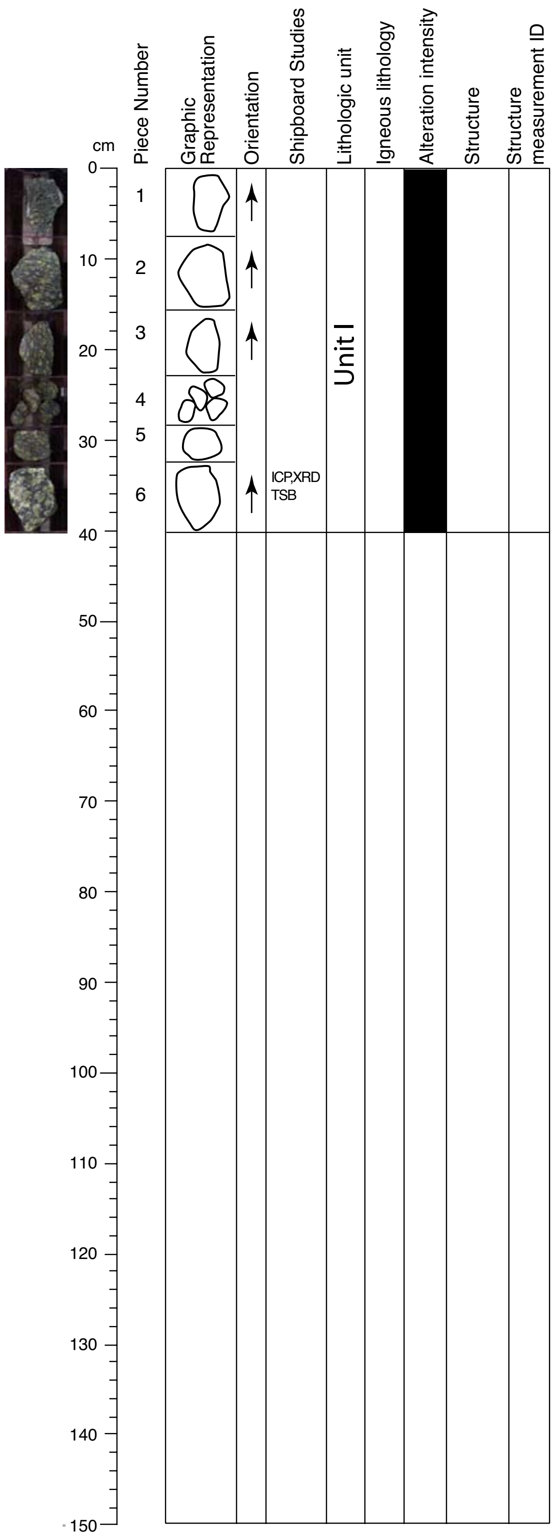

209-1270A-1R-2 (Section top: 1.50 mbsf)

UNIT 1: Harzburgite

Pieces 1–6

COLOR: Green to dark green

PRIMARY MINERALOGY:

Olivine	Mode 69%–76% (79%?)
Orthopyroxene	Mode (20%?) 25%–30%
	Size 5–15 mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 2%–3%?
	Size < 1 mm
	Shape/Habit Anhedral / interstitial
Spinel	Mode 1%

COMMENTS: This short section consists of altered harzburgite with a gradual change in texture from the top to the bottom from a foliated porphyroclastic texture to a protogranular texture. Holly leaf-shaped coarse spinel grains are commonly enclosed in coarse orthopyroxene grains. Clinopyroxene pseudomorphs are present in a small amount. The modal amount of orthopyroxene is high (25-30 vol%), except in Piece 1 that appears to be poorer in orthopyroxene (20%?); however, the mode estimate of this strongly deformed and foliated sample is certainly unreliable.

SECONDARY MINERALOGY:
COMMENTS: This section contains only gray to green completely serpentinized harzburgite, which shows a very homogenous appearance. Light green serpentinized orthopyroxene often has centers of fresh spinel. Serpentinization of olivine created mesh texture of black serpentine and magnetite rims around whitish kernels.

VEIN ALTERATION: Similar to the bottom of Section 1270A-1R-1. Weakly veined by cross-fiber sigmoidal chrysotile veins with rare coarse magnetite. In Piece 1 massive transgranular picrolite veins cut paragranular veins of chrysotile.

THIN SECTIONS: Sample 1270A-1R-2, 34-37 cm

STRUCTURE:
The section is characterized by moderately well foliated porphyroclastic serpentinized harzburgite. It also contains coarser grained pyroxene with higher than average modal abundance. Pieces 1- 6 contain weak intensity cross-fiber serpentine foliation. A second phase of green serpentine cuts the cross-fiber serpentine foliation in Pieces 1 and 3. There are no brittle structural features present in this section. There are no magmatic veins in the section. Alteration veins are post-kinematic with respect to the crystal-plastic deformation. Crosscutting relationships indicate that CP>SF>SAV.

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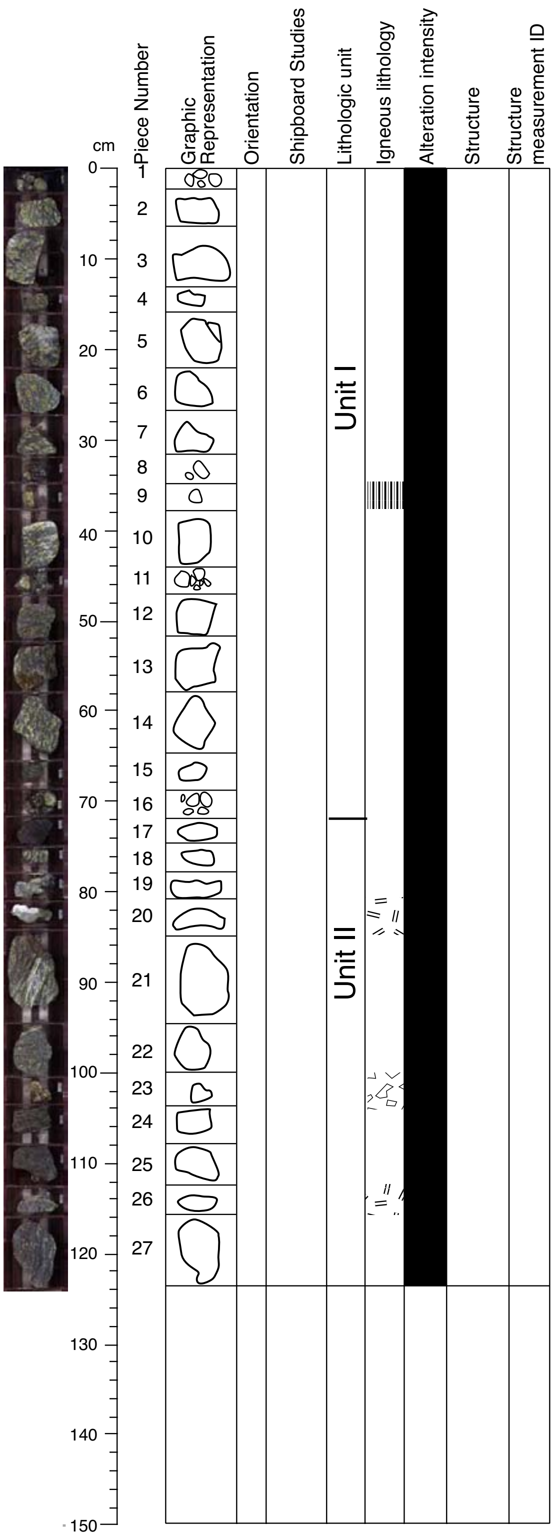

209-1270A-2R-1 (Section top: 11.40 mbsf)

UNIT I: Serpentinized harzburgite

Pieces 1–16

COLOR: Green to dark green

PRIMARY MINERALOGY:

Olivine	Mode 72%–74%
Orthopyroxene	Mode 25%
	Size 5–15 mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 2%–3%?
	Size < 1 mm
	Shape/Habit Anhedral / interstitial
Spinel - Mode 1%	

COMMENTS: This section mostly consists of altered harzburgite with coarse-grained protogranular texture made of olivine and orthopyroxenes. Holly leaf-shaped spinel grains are frequently enclosed in coarse orthopyroxene grains. Clinopyroxene pseudomorphs may be present in a small amount.

SECONDARY MINERALOGY:
COMMENTS: The section is dominated by completely serpentinized harzburgite. However, there are intervals (Pieces 9 and 15) of talc-altered harzburgite rubble. Pieces 20 and 26 are completely talc-altered gabbro. Piece 23 is a completely altered microgabbro.

VEIN ALTERATION: The upper part of the section (Pieces 1-14) contains sigmoidal paragranular veins of cross-fiber chrysotile. The density of veins is low in this section. The bottom of the section (Pieces 14-27) also contains variable intensity of paragranular cross-fiber chrysotile veins that are cut by later picrolite veins.

STRUCTURE:
The section is characterized by strongly foliated porphyroclastic serpentinized harzburgite. Piece 17 is a dunite and Piece 26 is an altered pyroxenite. All pieces in the core are unoriented and there are no magmatic veins. Networks of fine anastomosing shear fractures filled with talc are parallel the anastomosing serpentine foliation (SF) from 91 cm to 93 cm in Piece 21. Pieces 2-8, 10-14, and 27 contain weak cross-fiber serpentine foliation. Pieces 16-18, and 21 contain moderate strength cross-fibered serpentine foliation. The early cross-fiber serpentine foliation is cut by later pale green serpentine alteration veins (SAV1) and later by chrysotile alteration veins (SAV2) in Pieces 21, 24, and 25. Later composite chrysotile veins also occur in Pieces 18 and 19 Piece 21 and consist of sigmoidal green serpentine veins (SAV3). One small pebble in Piece 1 is a cohesive, unfoliated fault breccia. Pieces 9 and 23 are pieces of carbonate-matrix sedimentary breccia. Piece 15 is a fine-grained cataclasite with carbonate matrix. All magmatic and alteration veins are post-kinematic with respect to the crystal-plastic deformation. Crosscutting relationships demonstrate that CP>SF>SAV1>SAV2>SAV3>CC.

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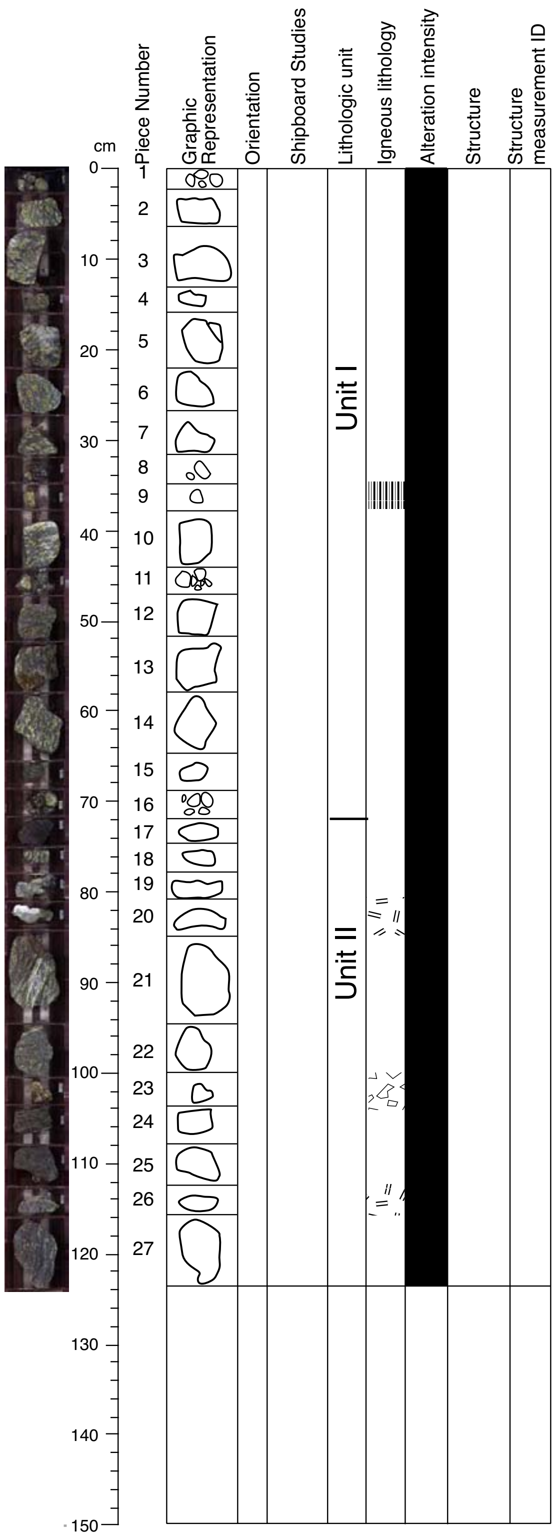

209-1270A-2R-1 (Section top: 12.12 mbsf)

UNIT II: Serpentinized harzburgite / Gabbro

Pieces 17-27

COLOR: Dark green to dark gray

PRIMARY MINERALOGY: Harzburgite

Olivine - Mode 78-84%
Orthopyroxene - Mode 15-20%
Size 2-10 mm
Shape/Habit Anhedral
Clinopyroxene Mode 1-2%?
Size < 1 mm
Shape/Habit anhedral / interstitial
Spinel - Mode 1-2%

COMMENTS: This section mostly consists of altered harzburgite with minor amounts of altered gabbroic pegmatite (Piece 20), volcanic breccia (Piece 23) and altered gabbro pebble (Piece 26). A thin dunite level is present in Piece 17. The harzburgites are variably deformed with texture varying from mylonitic at the top of the unit to porphyroclastic with a foliation in Pieces 18-19 and 21, to protogranular–porphyroclastic in Pieces 22 to 27. The original grain size is smaller than in Unit I.

PRIMARY MINERALOGY: Gabbro

Plagioclase Mode 45-80%
Size 6 - 35 mm
Shape/Habit Sub- Euhedral
Clinopyroxene Mode 20-35%
Size 10-35 mm
Shape/Habit Sub- Euhedral
Olivine Mode 0-10 %
Size 10-30 mm
Shape/Habit Sub- Euhedral

SECONDARY MINERALOGY:
COMMENTS: The section is dominated by completely serpentinized harzburgite. However, there are intervals (Pieces 9 and 15) of talc-altered harzburgite rubble. Pieces 20 and 26 are completely talc-altered gabbro. Piece 23 is a completely altered microgabbro.

VEIN ALTERATION: The upper part of the section (Pieces 1-14) contains sigmoidal paragranular veins of cross-fiber chrysotile. The density of veins is low in this section. The bottom of the section (Pieces 14-27) also contains variable intensity of paragranular cross-fiber chrysotile veins that are cut by later picrolite veins.

STRUCTURE:
The section is characterized by strongly foliated porphyroclastic serpentinized harzburgite. Piece 17 is a dunite and Piece 26 is an altered pyroxenite. All pieces in the core are unoriented and there are no magmatic veins. Networks of fine anastomosing shear fractures filled with talc are parallel the anastomosing serpentine foliation (SF) from 91 cm to 93 cm in Piece 21. Pieces 2-8, 10-14, and 27 contain weak cross-fiber serpentine foliation. Pieces 16-18, and 21 contain moderate strength cross-fibered serpentine foliation. The early cross-fiber serpentine foliation is cut by later pale green serpentine alteration veins (SAV1) and later by chrysotile alteration veins (SAV2) in Pieces 21, 24, and 25. Later composite chrysotile veins also occur in Pieces 18 and 19 Piece 21 and consist of sigmoidal green serpentine veins (SAV3). One small pebble in Piece 1 is a cohesive, unfoliated fault breccia. Pieces 9 and 23 are pieces of carbonate-matrix sedimentary breccia. Piece 15 is a fine-grained cataclasite with carbonate matrix. All magmatic and alteration veins are post-kinematic with respect to the crystal-plastic deformation. Crosscutting relationships demonstrate that CP>SF>SAV1>SAV2>SAV3>CC.

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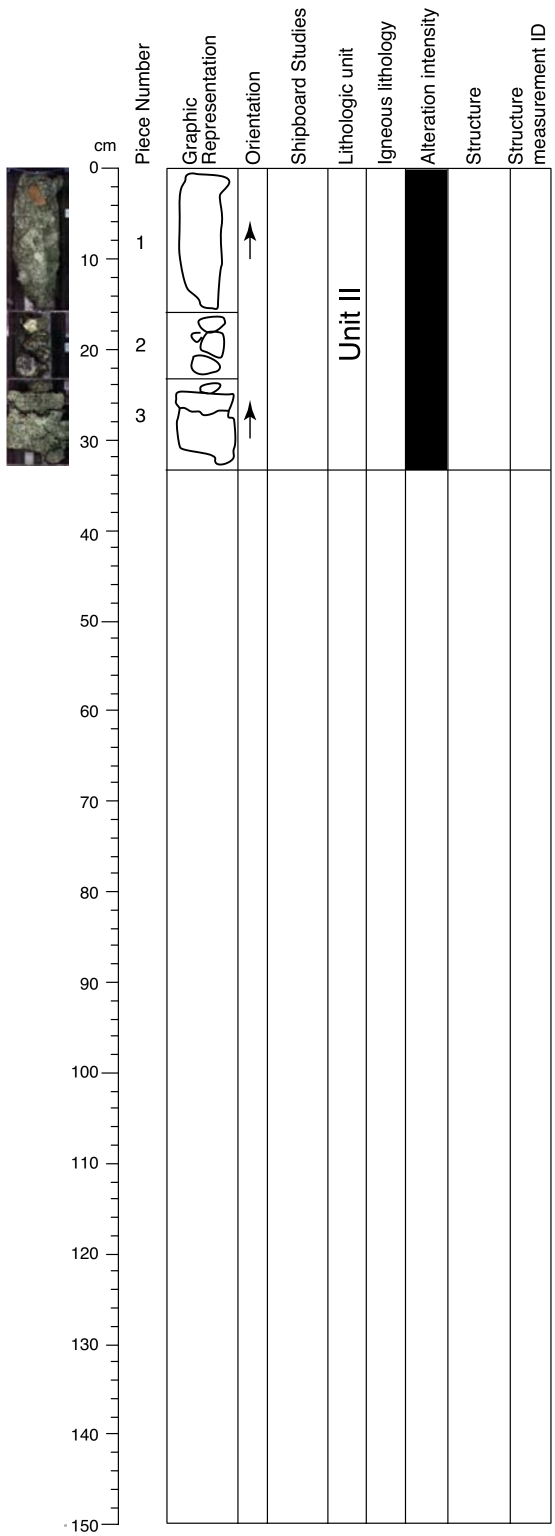

209-1270A-3R-1 (Section top: 17.40 mbsf)

UNIT II: Serpentinite fault gouge

Piece 1–3

COLOR: Green to gray

PRIMARY MINERALOGY:

COMMENTS: This section consists of altered ultramafic fault gouge. Altered harzburgite pebbles and altered mafic minerals are included in serpentine sand in Pieces 1 and 3. Several pieces of altered harzburgite in Piece 2. The protolith is not identifiable.

SECONDARY MINERALOGY:
COMMENTS: Complete serpentinization in a fault gouge.

VEIN ALTERATION: No veins.

STRUCTURE:
Piece 2 consists of small fragments of serpentinized harzburgite and pyroxenite with serpentine alteration veins. Piece 1 is a fine-grained, matrix-supported, noncohesive, unfoliated fault gouge. Grain size of clasts in gouge range from 0.05 cm to 0.1 cm. The matrix in the breccia is clay with possible talc. The gouge is uniformly fine grained with no outsized clasts. Piece 3 is a fine-grained, clast-supported, non-cohesive, unfoliated fault gouge. Grain size of clasts in gouge range from 0.05 cm to 0.3 cm. The matrix in the breccia is clay with possible talc. The gouge is uniformly fine grained with no outsized clasts. No crosscutting relationships were observed.

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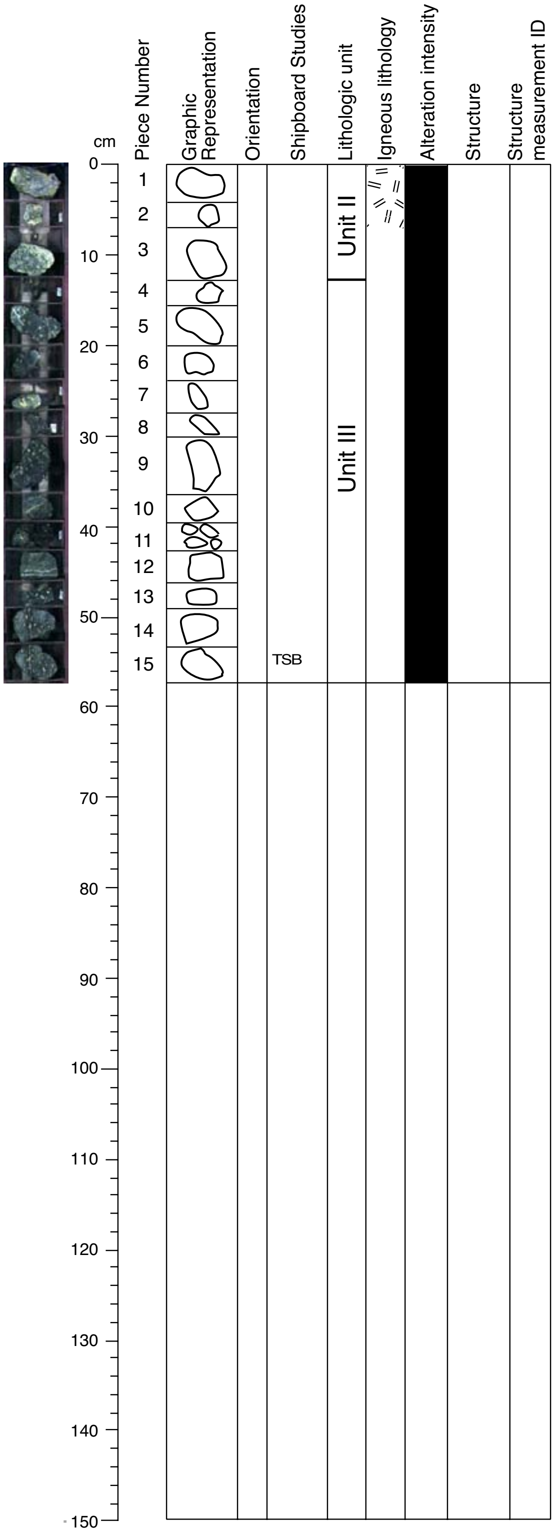

209-1270A-4R-1 (Section top: 21.90 mbsf)

UNIT II: Serpentinized Harzburgite and Gabbro

Pieces 1–2

COLOR: Dark green to gray

PRIMARY MINERALOGY: Gabbro

Plagioclase Mode 65%
Size 6–15 mm
Shape/Habit Subhedral to euhedral
Clinopyroxene Mode 35%
Size 10–20 mm
Shape/Habit Subhedral to euhedral

COMMENTS: The top of this section consists of two small pieces of gabbro.

Piece 3

PRIMARY MINERALOGY: Harzburgite

Olivine Mode 77%
Orthopyroxene Mode 20%
Size 2–8 mm
Shape/Habit Anhedral
Spinel Mode 3%

COMMENTS: The harzburgite was strongly deformed, with a porphyroclastic texture and a foliation. Modal spinel, is exceptionally high.

SECONDARY MINERALOGY:
COMMENTS: Pieces 1 and 2 are completely altered gabbro with perfectly pseudomorphed pyroxene crystals. The remaining pieces (Pieces 3-15) are completely serpentinized harzburgite with minor preserved olivine (<3%) in kernels of the well developed mesh texture. Piece 12 contains a 1-cm wide amphibolite band near its top.

VEIN ALTERATION: Vein density is low in this section. Most veins occur in serpentinized harzburgite. Paragranular veins of cross-fiber chrysotile are crosscut by a second generation of transgranular chrysotile veins (e.g., Piece 5). A talc-rich vein runs parallel to the amphibolite band in Piece 12.

THIN SECTIONS: Sample 1270A-4R-1, 54-56 cm

STRUCTURE:
The section is characterized by foliated porphyroclastic serpentinized harzburgite with a strong crystal plastic fabric, although Piece 1 is an undeformed pyroxenite. All pieces are unoriented. There are no brittle deformation features within this section.

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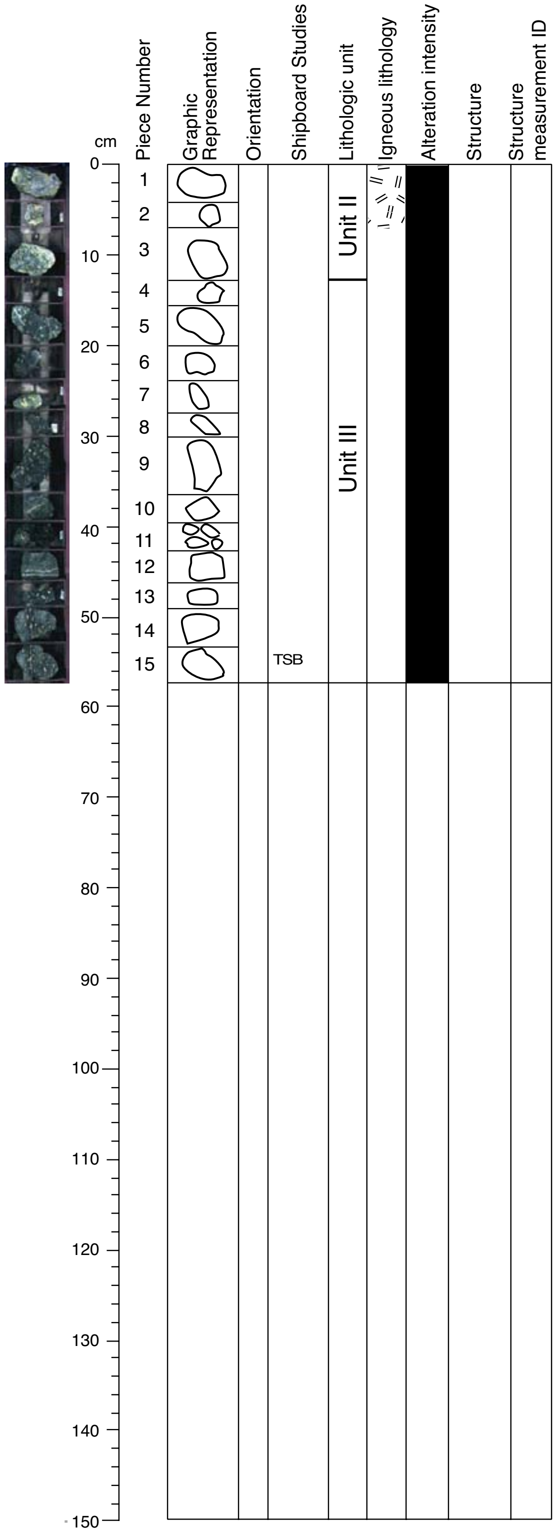

209-1270A-4R-1 (Section top: 21.90 mbsf)

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UNIT III Serpentinized Orthopyroxene–poor harzburgite (interval top 22.03 mbsf)

Pieces 4-15

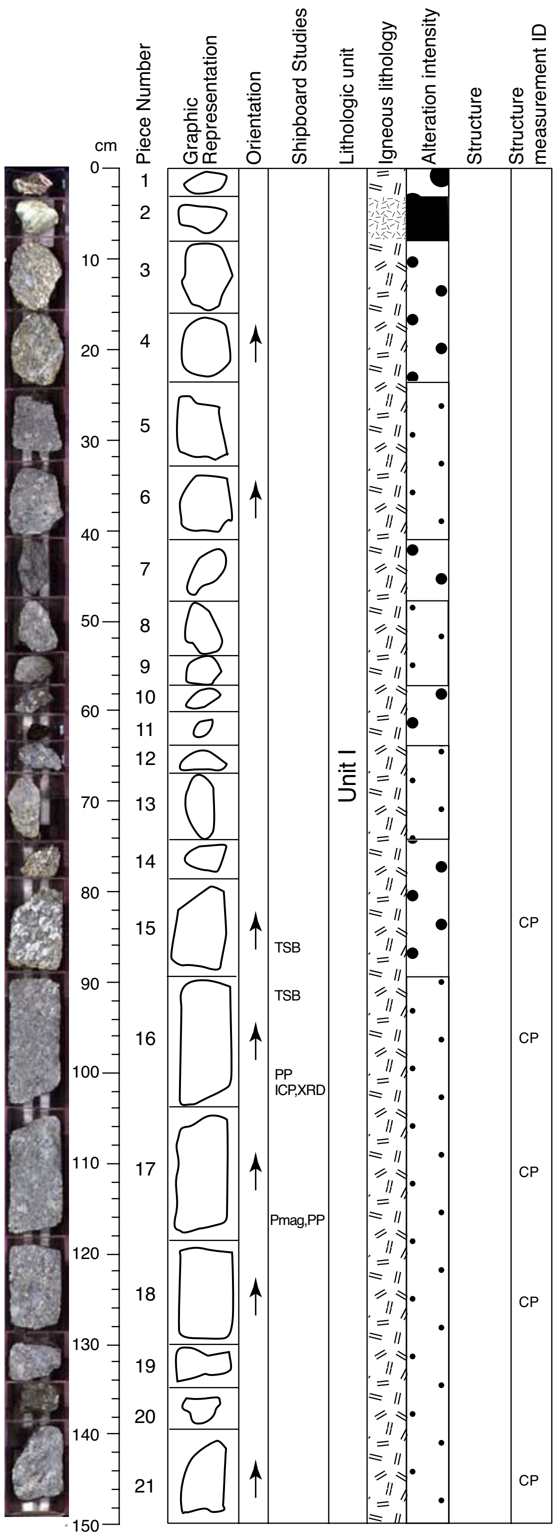
PRIMARY MINERALOGY:

Olivine	Mode 89%
Orthopyroxene	Mode 10%
	Size 1–12 mm
	Shape/Habit Anhedral
Spinel	Mode 1%
	Size 0.1–0.5 mm
	Shape/Habit Anhedral to euhedral

COMMENTS: This section consists of altered peridotite falling at the harzburgite–dunite boundary, with porphyroclastic texture. Holly leaf-shaped or euhedral coarse spinel grains are frequently enclosed in coarse orthopyroxene grains. Amphibole-bearing pyroxenite dikelet cut through Pieces 14 and 15.

Structure:
The section is characterized by foliated porphyroclastic serpentinized harzburgite with a strong crystal plastic fabric. Piece 5 and 7 are undeformed pyroxenite. All pieces are unoriented. Pieces 5 and 6 are cut by altered pyroxenitic magmatic veins (PMV) and Pieces 14 and 15 are cut by an altered gabbroic magmatic veins (GMV). Serpentine-filled tension cracks (SAV) extending into host harzburgite cut the gabbro veins in these pieces. Oxide veins are present in Pieces 12 and 15. There are no brittle deformation features within this section. All magmatic and alteration veins are post-kinematic with respect to the crystal-plastic deformation. Crosscutting relationships demonstrate that CP>PMV>SAVand CP>GMV >SAV

Core Photo



209-1270B-1R-1 (Section top: 0.00 mbsf)

UNIT I: Oxide Gabbro/Gabbro

Pieces 1–21

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 40%
	Size 1–15 mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 50%
	Size 1-25 mm
	Shape/Habit Anhedral
Oxide	Mode 10%

COMMENTS: This section consists of oxide gabbronorite with gneissic texture formed by shear deformation. Large clinopyroxene grains (10~25 mm) in the gabbronorite are augen shaped. Fine-grained oxides are distributed along grain boundaries between clinopyroxene-rich and plagioclase-rich bands. Piece 3 is a microgabbro.

SECONDARY MINERALOGY:
COMMENTS: This section consists mainly of slightly altered oxide-rich gabbro (Pieces 5, 6, 8, 9, 13, and 16-21). However, in Pieces 1, 7, 10, 11, and 12 about half of the pyroxene is replaced by chlorite-amphibole±talc aggregates. In Pieces 3, 4, 14, and 15, as much as 30% of the plagioclase is altered by secondary plagioclase, amphibole, and chlorite. Piece 2 is an exceptional, completely talc-altered microgabbro.

VEIN ALTERATION: The section is weakly veined. Minor talc-chlorite-amphibole veins occur occasionally and trend parallel to the gneisic foliation of the gabbro.

THIN SECTIONS: Samples 1270B-1R-1, 83-88 cm and 1270B-1R-1, 90-93 cm

STRUCTURE:
Piece 1 is a small fragment of fine-grained cohesive fault breccia. Clasts ranging in size from 0.05 to 0.4 cm are contained in a fine-grained cohesive matrix. Piece 2 is a highly altered serpentinized dunite. The remainder of the section (Pieces 3-21) consists of a strongly foliated porphyroclastic oxide metagabbro which has not undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism. Porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which generally form the finer-grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. The foliation is inclined steeply at~62° in the cut face of the core in oriented Pieces 15-18 and 21. The texture is defined as protomylonitic based on the fact that in most cases less than 50 percent of the rock volume has undergone grain size reduction. Piece 10 contains dense arrays of shear fractures with minimal offset. Ductile deformation in Pieces 15 and 16 has minor brittle (CC) overprint. Alteration veins (AV) are scarce and include chlorite veins in pieces 7 and 8 and small oxide veins in piece 14. Crosscutting relationship indicate CP>AV>CC.

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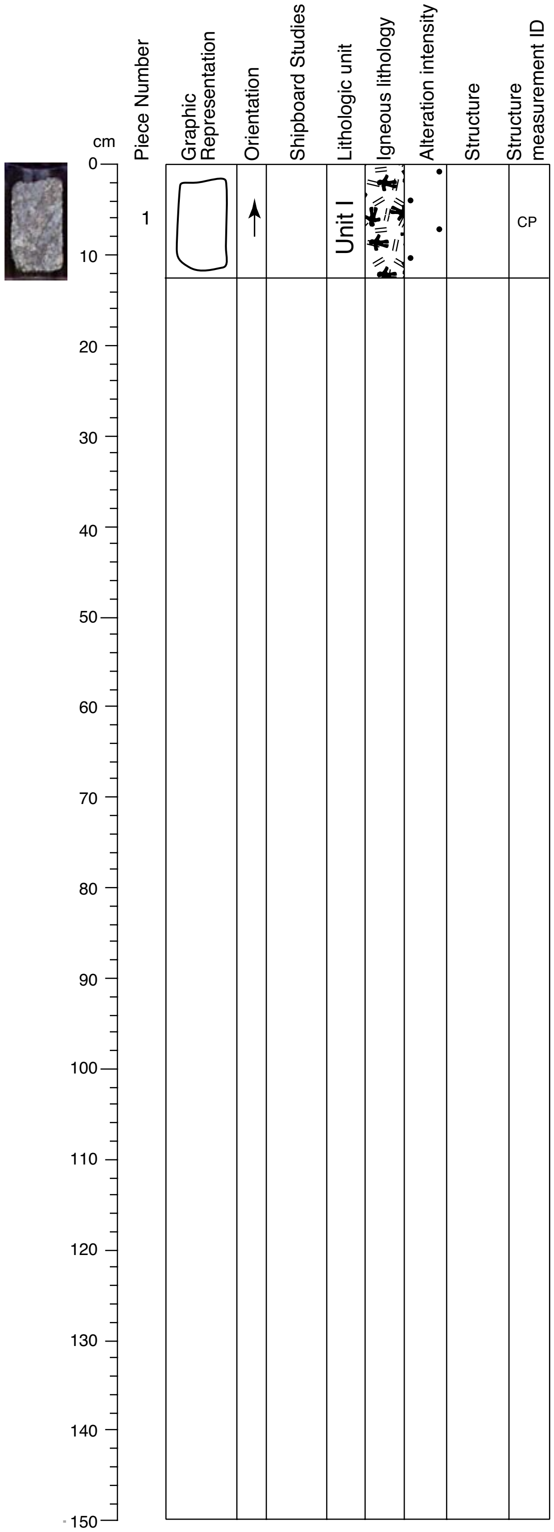


209-1270B-1R-2 (Section top: 1.50 mbsf)

UNIT I: Oxide Gabbro/Gabbro

Pieces 1

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 40%
	Size 5–10 mm
	Shape/Habit Subhedral
Clinopyroxene	Mode 50%
	Size 2–17 mm
	Shape/Habit Subhedral
Oxide	Mode 15%

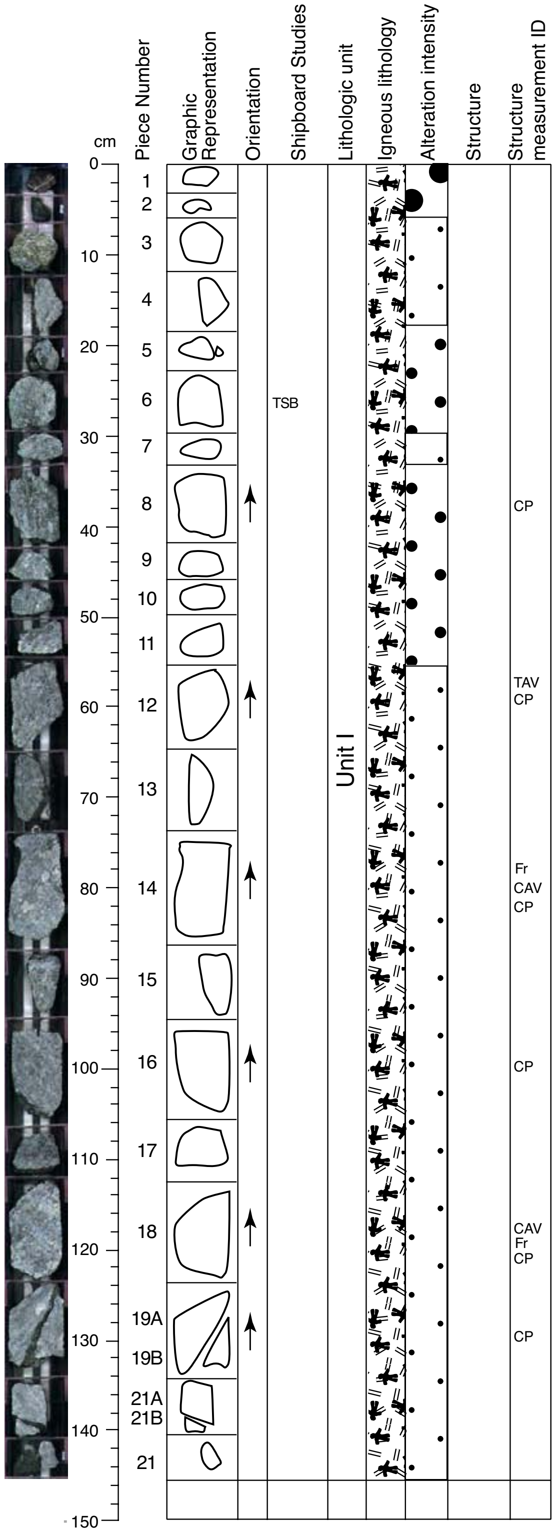
COMMENTS: This short section consists of oxide gabbro with gneissic texture formed by shear deformation. Fine-grained oxides are distributed along grain boundaries between clinopyroxene-rich and plagioclase-rich bands.

SECONDARY MINERALOGY:
COMMENTS: This section consists of one piece of slightly altered oxide-rich gabbro.

VEIN ALTERATION: This piece of coarse-grained gabbro contains an irregular banded vein (approximately 2-mm wide). The center consists of talc and rims are chlorite and possibly amphibole.

STRUCTURE:
The piece in the section consists of a strongly foliated porphyroclastic oxide metagabbro, which has not undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism. Porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer-grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. The texture is defined as protomylonitic based on the fact that in most pieces within the section less than 50 percent of the rock volume has undergone grain size reduction. The foliation is inclined steeply at ~64 degrees in the cut face of the core. There is no brittle deformation within this section. One chlorite-talc alteration vein (AV) cuts Piece 1.

Core Photo



209-1270B-2R-1 (Section top: 12.40 mbsf)

UNIT I: Oxide Gabbro/Gabbro

Pieces 1–21

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 40%–45 %
	Size 2–15 mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 45%
	Size 1–17 mm
	Shape/Habit Anhedral
Oxide	Mode 10%–15%

COMMENTS: This section consists of oxide-rich gneissic gabbro. The upper part of the section (0-55 cm) is cataclastically deformed to a much finer grain size. The lower part of the section (55-146 cm) has been deformed to a gneissic texture with variable grain-size reduction. Fine-grained oxides are distributed along grain boundaries between clinopyroxene-rich and plagioclase-rich bands throughout the section.

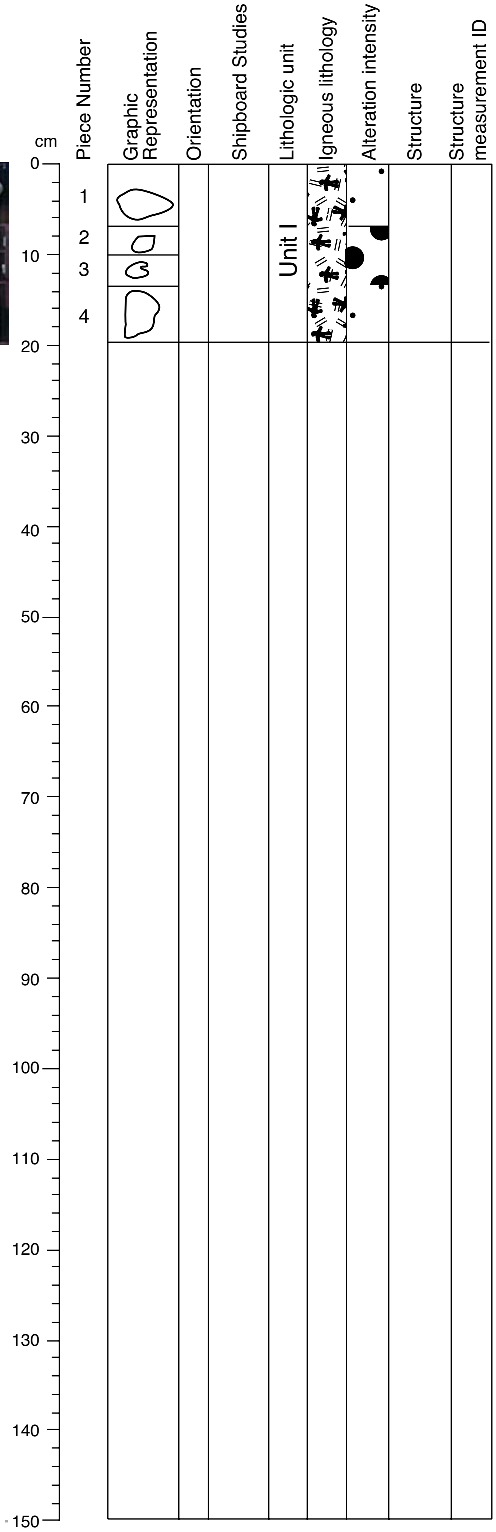
SECONDARY MINERALOGY:
COMMENTS: This section consists mainly of slightly altered oxide gabbro. However, in Pieces 5 to 11 the pyroxene is variably replaced by chlorite-amphibole-talc aggregates. In this interval (19 to 55 cm) up to 80 % of the pyroxene crystals are pseudomorphed and locally plagioclase has been slightly altered (secondary plagioclase-chlorite-quartz). Pieces 1 and 2 are small fragments of exceptional, completely altered, talc-rich gabbro.

VEIN ALTERATION: Most of the section is weakly veined. Massive irregular chlorite-talc veins have variable talc/chlorite ratios and some veins may contain amphibole. Piece 6A contains a prominent example of the chlorite-talc veins. These veins crosscut the tectonic fabric of the gabbro and locally they are branched, following grain boundaries of pyroxenes.

THIN SECTIONS: Sample 1271B-2R-1, 24-27 cm

STRUCTURE:
Pieces 1 and 2 consist of highly altered serpentinized harzburgite. Piece 1 contains dense arrays of shear fractures and incipient brecciation. Crosscutting alteration vein relationships visible in Piece 2 (pebble). The remainder of the section consists of a strongly foliated porphyroclastic oxide metagabbro, which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. Porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. The foliation is inclined steeply at ~50° in the cut face of the core. Pieces 14 and 18 each contain open fractures (FR) with rough surfaces suggestive of little or no shear displacement. These brittle deformation textures represent only a small degree of brittle shear deformation. Alteration veins are limited. Chlorite alteration veins (AV) cut Pieces 7, 14, 18, and 19, sulfide veins (SuV) cut Piece 4, and talc alteration veins (SAV) cut Piece 12. Crosscutting relationships indicate CP>AV>FR, CP>SuV.

Core Photo



209-1270B-2R-2 (Section top: 13.86 mbsf)

UNIT I: Oxide Gabbro/Gabbro

Pieces 1–21

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 40%–45 %
	Size 2–15 mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 45%
	Size 1–17 mm
	Shape/Habit Anhedral
Oxide	Mode 10%–15%

COMMENTS: This section consists of oxide-rich gneissic gabbro. The upper part of the section (0-55 cm) is cataclastically deformed to a much finer grain size. The lower part of the section (55-146 cm) has been deformed to a gneissic texture with variable grain-size reduction. Fine-grained oxides are distributed along grain boundaries between clinopyroxene-rich and plagioclase-rich bands throughout the section.

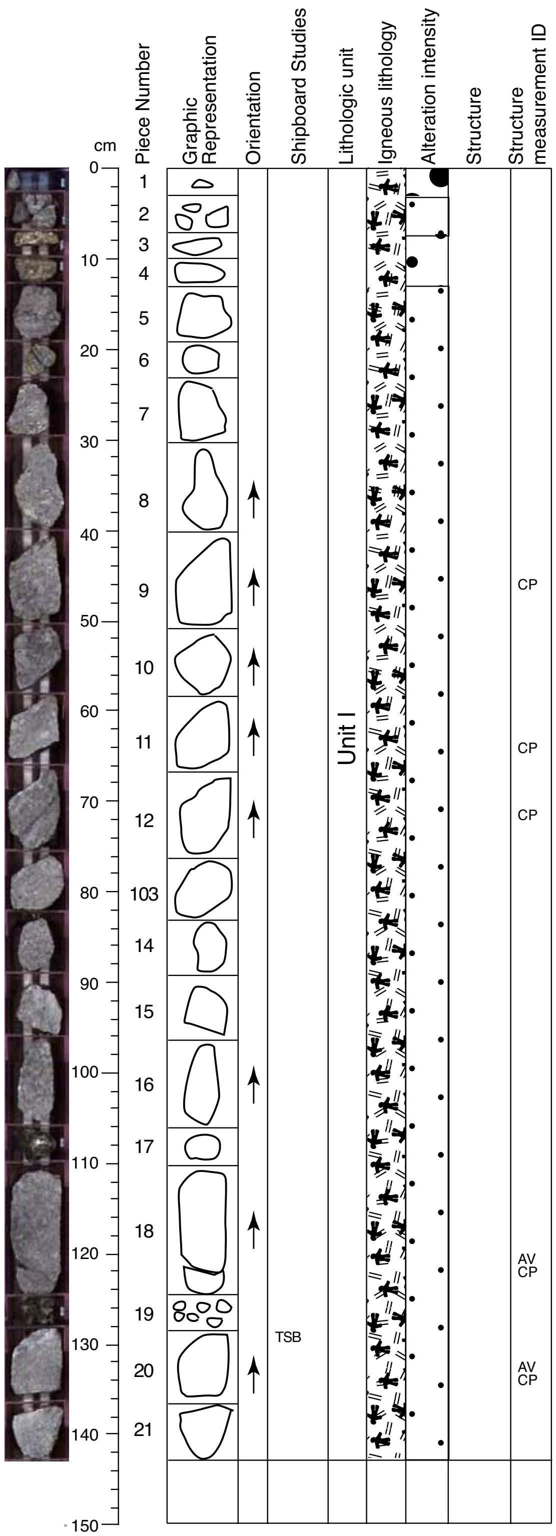
SECONDARY MINERALOGY:
COMMENTS: This section consists mainly of slightly altered oxide gabbro. However, in Pieces 5 to 11 the pyroxene is variably replaced by chlorite-amphibole-talc aggregates. In this interval (19 to 55 cm) up to 80 % of the pyroxene crystals are pseudomorphed and locally plagioclase has been slightly altered (secondary plagioclase-chlorite-quartz). Pieces 1 and 2 are small fragments of exceptional, completely altered, talc-rich gabbro.

VEIN ALTERATION: Most of the section is weakly veined. Massive irregular chlorite-talc veins have variable talc/chlorite ratios and some veins may contain amphibole. Piece 6A contains a prominent example of the chlorite-talc veins. These veins crosscut the tectonic fabric of the gabbro and locally they are branched, following grain boundaries of pyroxenes.

THIN SECTIONS: Sample 1271B-2R-1, 24-27 cm

STRUCTURE:
Pieces 1 and 2 consist of highly altered serpentinized harzburgite. Piece 1 contains dense arrays of shear fractures and incipient brecciation. Crosscutting alteration vein relationships visible in Piece 2 (pebble). The remainder of the section consists of a strongly foliated porphyroclastic oxide metagabbro, which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. Porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. The foliation is inclined steeply at ~50° in the cut face of the core. Pieces 14 and 18 each contain open fractures (FR) with rough surfaces suggestive of little or no shear displacement. These brittle deformation textures represent only a small degree of brittle shear deformation. Alteration veins are limited. Chlorite alteration veins (AV) cut Pieces 7, 14, 18, and 19, sulfide veins (SuV) cut Piece 4, and talc alteration veins (SAV) cut Piece 12. Crosscutting relationships indicate CP>AV>FR, CP>SuV.

Core Photo



209-1270B-3M-1 (Section top: 17.4 mbsf)

UNIT I: Oxide Gabbro/Gabbro

Pieces 1–8

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 40%–43 %
	Size 1–10 mm
	Shape/Habit Anhedral to euhedral
Clinopyroxene	Mode 50%
	Size 1–12 mm
	Shape/Habit Anhedral
Oxide	Mode 7%–10 %

COMMENTS: This section consists of sheared oxide gabbronorite. The fabric in these rocks is entirely metamorphic with variations in the amount of shear and grain-size reduction throughout the entire core. An undeformed dike of gabbronorite with less oxide occurs at 130 cm. Fine-grained oxides are distributed along grain boundaries between clinopyroxene-rich and plagioclase-rich domains throughout the section.

SECONDARY MINERALOGY:
COMMENTS: This section consists of slightly altered oxide-rich gabbro with minor pseudomorph of pyroxenes by chlorite and amphibole and some replacement of plagioclase by secondary plagioclase, chlorite, and amphibole. In Pieces 3 and 4 the alteration of plagioclase is somewhat more intense. Piece 1 is a small fragment of exceptionally talc-rich, completely altered gabbro.

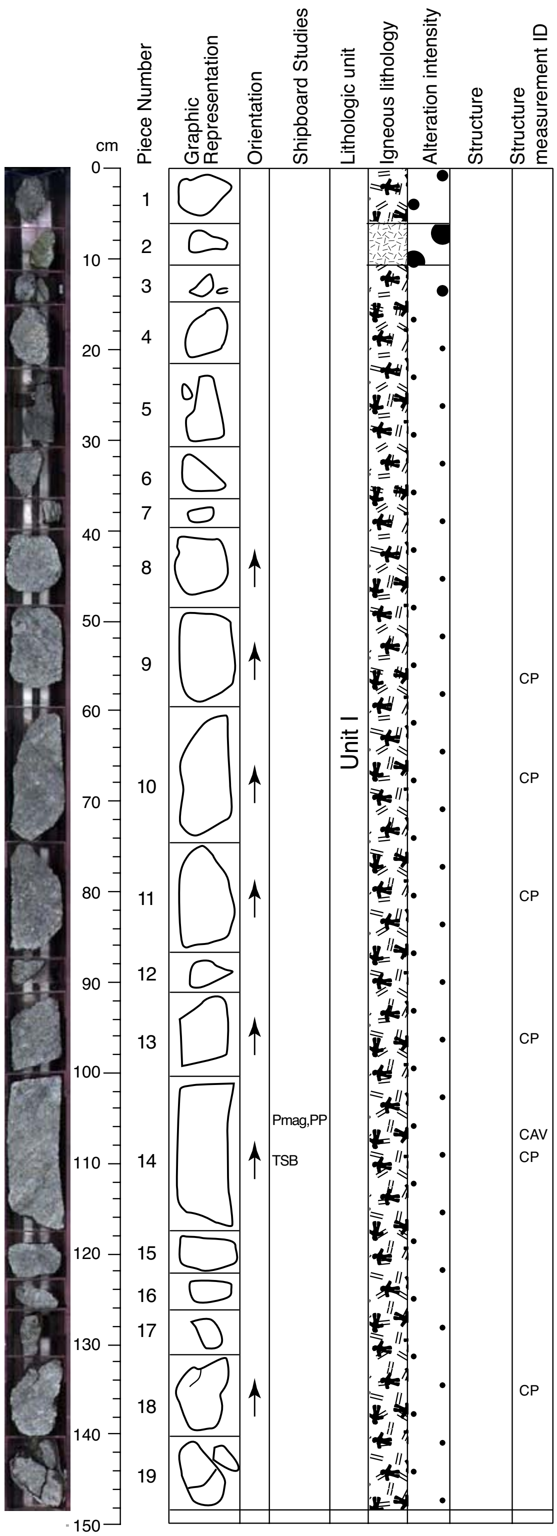
VEIN ALTERATION: Veining in this section is weak with localized development of banded chlorite-talc(-amphibole) veins.

THIN SECTIONS: Sample 1270B-3M-1, 129-131 cm

STRUCTURE:
The section consists of a strongly foliated porphyroclastic oxide metagabbro, which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. Porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. The foliation is inclined steeply at ~52 degrees in the cut face of the core. Pieces 12 and 20 contain higher strain shear zones inclined at 40 degrees in the cut face of the core. In Piece 20 greater than 50% of the rock has undergone more significant grain size reduction than the remainder of the section (porphyroclastic mylonites). The small shear zones deflect the main foliation in the section that dips more steeply. Piece 6 contains two parallel sets of vein-filled shear fractures with offset <0.1 cm. Minor brittle overprint of ductile shear in Pieces 18, 19, 20, and 21. There are several open shear fractures present in Pieces 18, 19 20, and 21. Alteration veins are sparse, filling late fractures. Crosscutting relationships are visible in Piece 20. Talc vein occurs in Pieces 2, 5, and 17. Chlorite veins occur in Pieces 12, 13, 14, and 15.

NOTE: Core 1270B-3M represents rock recovered in generally same interval as Core 1270B-2R, but contains >1 m of cut core cylinders.

Core Photo



209-1270B-4M-1 (Section top: 17.5 mbsf)

UNIT I: Oxide Gabbro/Gabbro

Pieces 1-19

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 40%–45 % Size 1–10 mm Shape/Habit Anhedral to euhedral
Clinopyroxene	Mode 50% Size 1–10 mm Shape/Habit Euhedral to anhedral
Oxide	Mode 5%–10%

COMMENTS: This section is composed of oxide gabbro/gabbronorite with gneissic texture. The entire core has been variably sheared so that no igneous grain sizes are preserved. Fine-grained oxides are distributed along grain boundaries between orthopyroxene-rich and plagioclase-rich domains throughout the section. Large apparently euhedral clinopyroxene crystals that have been broken into smaller pieces are found between 105 and 110 cm.

SECONDARY MINERALOGY:
COMMENTS: Pieces 4-19 are slightly altered oxide gabbronorite with minor replacement of pyroxene by chlorite and amphibole. Pieces 1-3 are exceptional small fragments (rubble) that show moderate intensity of pyroxene and plagioclase alteration (chlorite, amphibole and talc).

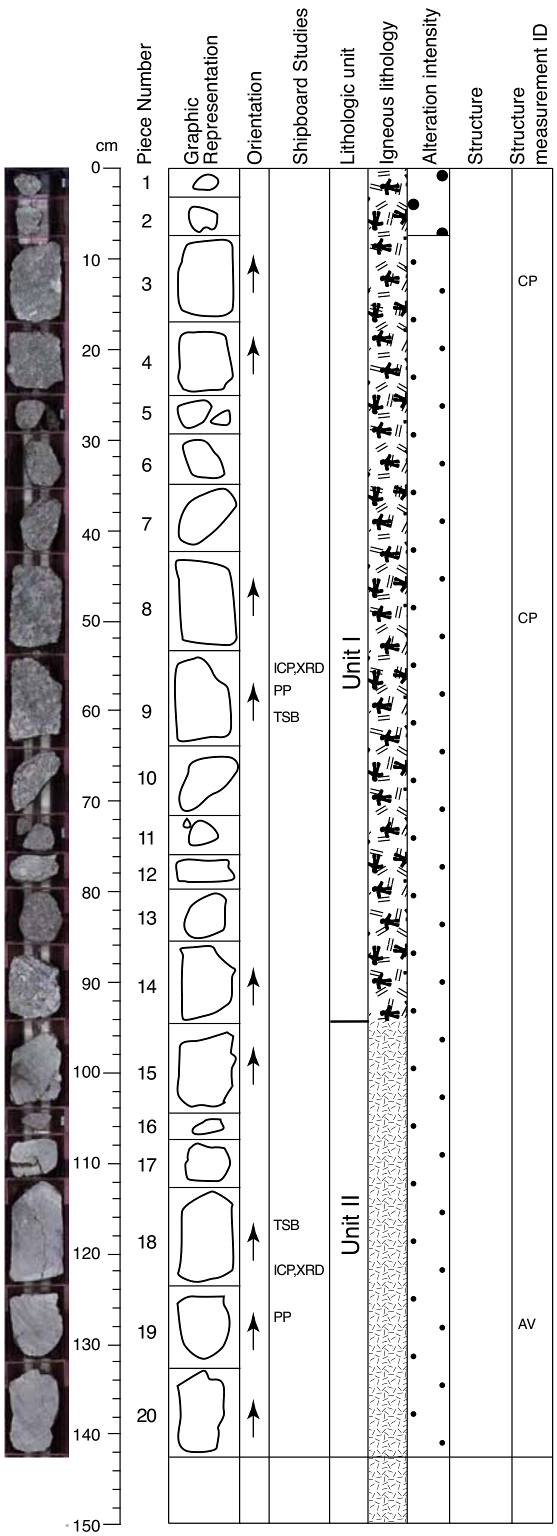
VEIN ALTERATION: Veining is weak and homogeneously distributed through this section. Thin talc-chlorite veins with talc in the center are typical. Also, light green chlorite-amphibole veins are present a prominent example of which is located in the upper part of Piece 6.

THIN SECTIONS: Sample 1270B-4M-1, 108-111 cm

STRUCTURE:
The section consists dominantly of a strongly foliated porphyroclastic oxide metagabbro, which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. Porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone significant grain size reduction, the texture of the section is protomylonitic. The foliation is inclined steeply at ~43 degrees in the cut face of the core. Piece 7 is a small fragment of mylonitic gabbro. Alteration veins (AV) are sparse, filling late fractures. Talc veins occur in Pieces 13 and 19. Chlorite veins occur in Pieces 2, 14, and 17. Piece 2 contains a small zone of hydrothermal brecciation with shear fractures cutting clasts. Piece 14 contains sets of parallel chlorite filled shear fractures with < 0.1 cm each. There are several open fractures (Fr) in Pieces 8 and 19.Crosscutting relationships indicate CP>AV>Fr.

NOTE: Since we redrilled the upper part of the interval, the recovered core was curated as Core 1270B-4M.

Core Photo



209-1270B-4M-2 (Section top: 19.00 mbsf)

UNIT I: Oxide Gabbro/Gabbro

Pieces 1–14

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 55%
	Size 1–5 mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 40%
	Size 4–20 mm
	Shape/Habit Euhedral
Oxide	Mode 5%

COMMENTS: This section is composed of oxide gabbro with gneissic texture. The entire core has been variably sheared so that no igneous grain size is preserved. Fine-grained oxides are distributed along grain boundaries between orthopyroxene-rich and plagioclase-rich domains throughout the section. Micrograbbros are present in Pieces 15-20. Local segregation of crystals and slight grain size variations suggest either deformation or flow alignment.

UNIT-II Microgabbro

Pieces 15–20

COLOR:

COMMENTS: This section is composed of microgabbro and is too fine-grained to estimate modal proportions in hand sample. Thin-section analyses reveal that it has subequal proportions of plagioclase and pyroxene. Most of the fresh pyroxene is clinopyroxene but the alteration precludes estimates of the amount of orthopyroxene. Less than 0.5% oxide minerals are present. Local segregation of crystals (porphyroclasts?) and slight grain size variations suggest deformation.

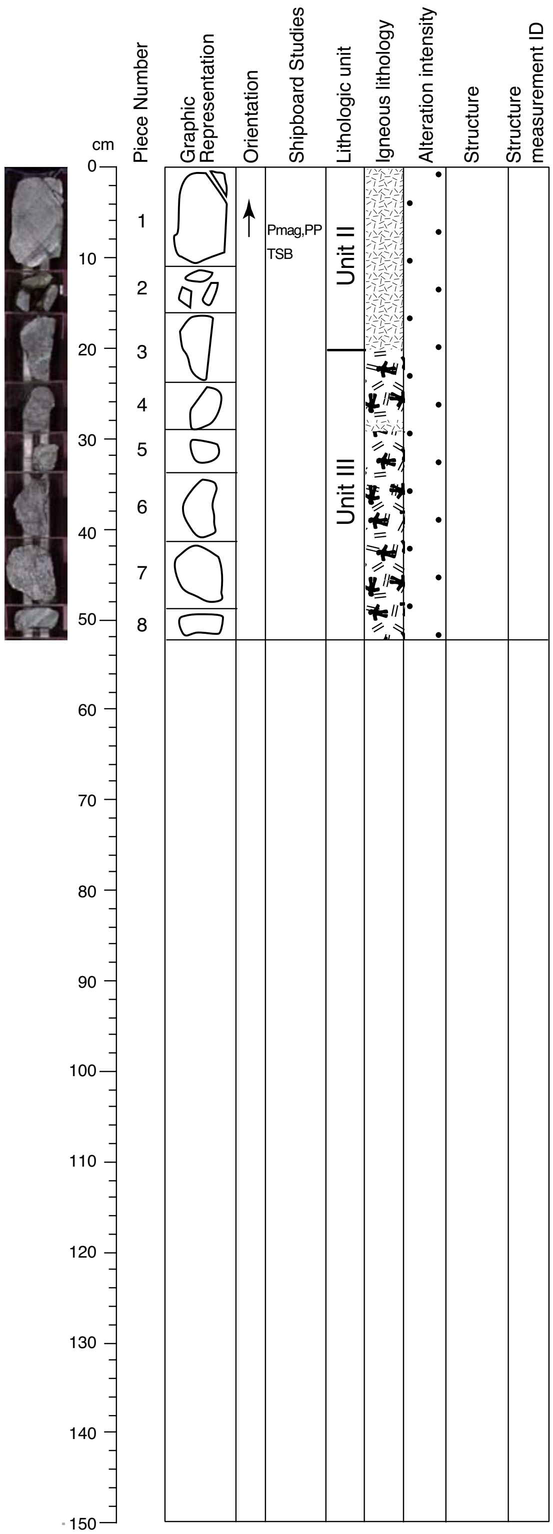
SECONDARY MINERALOGY:
COMMENTS: Oxide gabbro and microgabbro are both slightly altered in this section. However, replacement by chlorite-amphibole±talc assemblages has affected about 10% to 20 % of the pyroxene crystals in Pieces 1, 2, and 6.

VEIN ALTERATION: Veins in this section are rare (<0.2%). They are massive and irregular and composed of chlorite and talc. The veins crosscut the both the undeformed gabbro and the sheared gabbro and clearly post-date the formation of the plastic fabric.

THIN SECTIONS: Samples 1270B-4M-2, 60-62 cm and 1270B-4M-2, 116-119 cm

STRUCTURE:
Pieces 1-14 consist of a strongly foliated porphyroclastic oxide metagabbro, which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. Porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase and forms the dominant porphyroclasts. Because less than 50 percent of the rock volume has generally undergone significant grain size reduction, the texture of the section is protomylonitic. The foliation is inclined steeply at ~45 degrees in the cut face of the core. Pieces 15 through 20 consist of a fine-grained, equigranular gabbro with a strong foliation. Whether these pieces attained their fine grain size due to dynamic recrystallization or it was inherited from the original protolith is unknown. Although foliated, they are not banded; typical of fine-grained mylonitic rocks. Piece 17 may have one larger porphyroclastic pyroxene remnant. The foliation matches the foliation in Pieces 1-14. Minor shear fractures with < 0.1cm offset cut Pieces 8, 9 and 10. Pieces 13, 14, 15, 16, 17, 18, 19, and 20 contain several irregular-shaped open fractures. Alteration veins are sparse, filling late fractures. Chlorite veins occur in Pieces 2, 4, 9, and 10. Pyrite occurs in Pieces 8 and 10.

Core Photo



209-1270B-4M-3 (Section top: 20.43 mbsf)

UNIT II: Microgabbro

Pieces 1–3

COMMENTS: Piece 1-3 are composed of microgabbro with a contact with oxide gabbro found at 20 cm in Piece 3. The fabric in the microgabbro is parallel to the contact with oxide gabbro and the grain size becomes smaller toward the contact. The gabbro in Piece 3 is sheared to show gneissic texture similar to that in Section 1270B-4M-2.

UNIT-III Oxide Gabbro

Pieces 4-8

PRIMARY MINERALOGY:

Plagioclase	Mode 55%–60%
	Size 1–5 mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 35%–40%
	Size 3–8 mm
	Shape/Habit Euhedral to anhedral
Oxide	Mode 5%

COMMENTS: Gabbro in the lower part of the section (Pieces 9-8) is less deformed so that igneous texture is partially preserved. Fine-grained oxides are distributed along grain boundaries between orthopyroxene-rich and plagioclase-rich domains in the gabbro. A small thickness (1 cm thick) of microgabbro occurs in Piece 4.

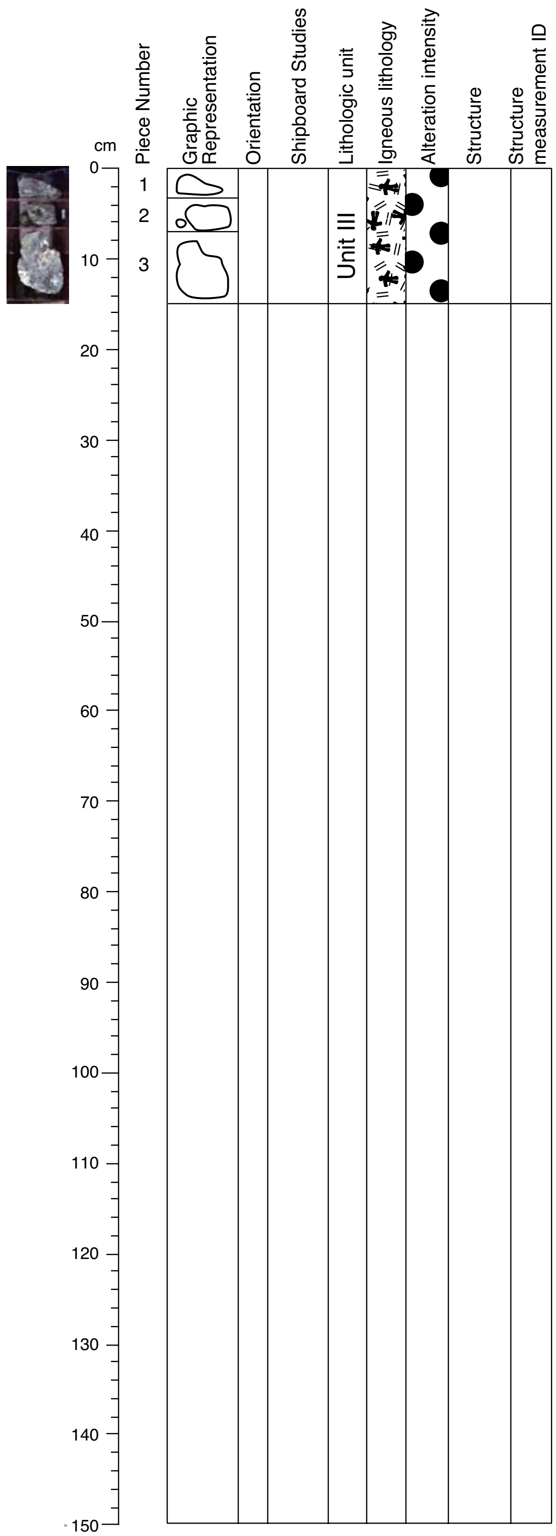
SECONDARY MINERALOGY:
COMMENTS: This section consists of slightly altered gabbro and microgabbro. In both rock types pyroxene and plagioclase are locally replaced by chlorite and amphibole along grain margins and cracks. The lower part of Piece 1, a shear band, is more intensely altered, showing chlorite-talc pseudomorphs after pyroxene.

VEIN ALTERATION: This section contains minor chlorite-amphibole-talc veins similar to those observed in Section 1270B-4M-2. In Piece 1 the chlorite-amphibole-talc veins fade out close to the sheared area which is characterized by more intense alteration.

THIN SECTIONS: Sample 1270B-4M-3, 9-11 cm

STRUCTURE:
Pieces 1 through 4 consist of a fine-grained, equigranular gabbro with a strong foliation. Whether these pieces attained their fine grain size due to dynamic recrystallization or it was inherited from the original protolith is unknown. Although foliated, they are not banded, typical of fine-grained mylonitic rocks. Pieces 5-8 consists of a strongly foliated medium-grained porphyroclastic oxide metagabbro which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. Porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase and forms the dominant porphyroclasts. Because less than 50 percent of the rock volume has generally undergone significant grain size reduction, the texture of the section is protomylonitic. The foliation is inclined steeply at ~50 degrees in the cut face of the core. Piece 8 contains a small fault that cuts mylonitic foliation with approximately 0.2-cm lateral offset. This section contains no major brittle shear deformation features. Alteration veins are sparse, filling late fractures. Talc veins occur in Pieces 1, 6, and 8.

Core Photo



209-1270B-5R-1 (Section top: 22.00 mbsf)

UNIT III: Oxide Gabbro

Pieces 1–3

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 70%
	Size 1–10 mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 20%
	Size 3–12 mm
	Shape/Habit Anhedral
Oxides	Mode 5%

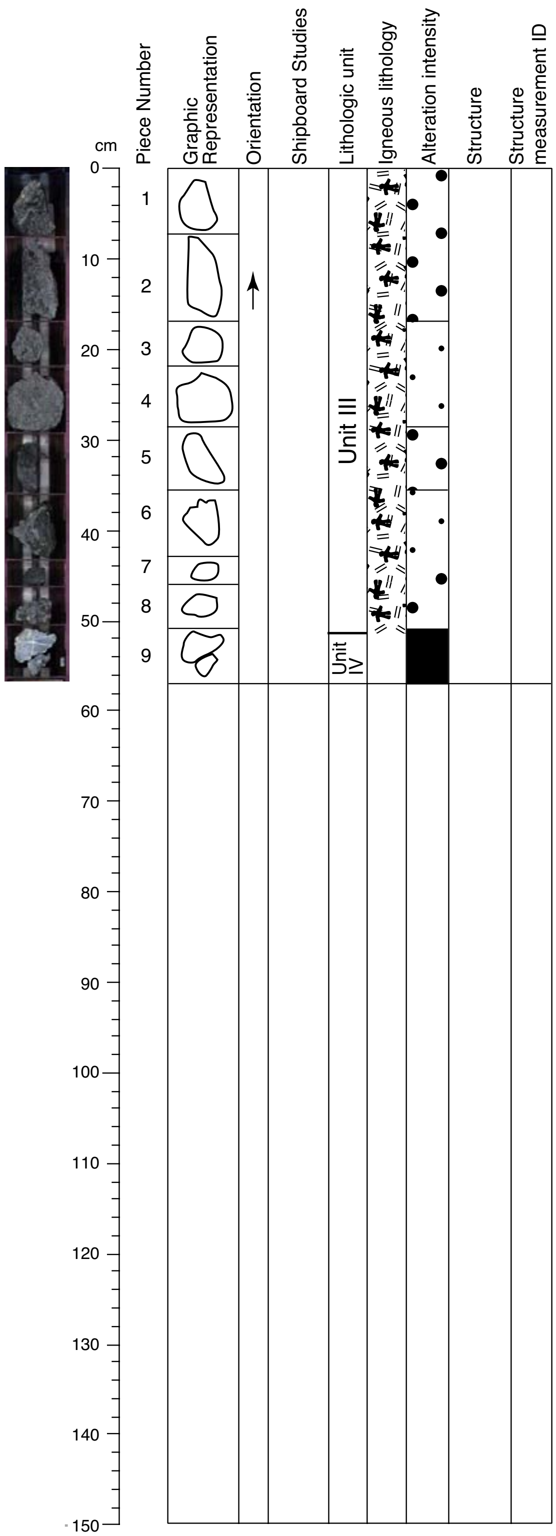
COMMENTS: This section consists of altered oxide gabbro with cataclastic deformation and variable grain size.

SECONDARY MINERALOGY:
COMMENTS: The three small pieces making up this section are moderately altered. About half of the pyroxene and plagioclase crystals have been replaced by a variety of alteration minerals dominated by chlorite, talc, amphibole (tremolite?) and serpentine.

VEIN ALTERATION: The section shows a weak imprint of mm-sized, sigmoidal talc-serpentine veins.

STRUCTURE:
The section consists of a strongly foliated porphyroclastic oxide metagabbro, which is significantly altered. , Porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. The are no oriented pieces in the section. Piece 3 contains thin (<1 cm wide) stringers of cataclastic matrix-supported breccia composed of 0.1 mm to 0.3 mm pyroxene clasts in a fine-grained white matrix. Crosscutting relationships indicate CP>CC.

Core Photo



209-1270B-6R-1 (Section top: 27.00 mbsf)

UNIT III: Oxide Gabbro/Gabbro

Pieces 1-8

PRIMARY MINERALOGY:

Plagioclase	Mode 45%–50%
	Size 1–7 mm
	Shape/Habit Elongate
Clinopyroxene	Mode 25%–45%
	Size 1–7 mm
	Shape/Habit Anhedral
Oxides	Mode 5%–15%

COMMENTS: This section consists of gabbro with variable grain size from fine grained to medium grained. Texture goes from porphyroclastic elongated (from 0 to 39 cm) to equigranular (22-36 cm).

UNIT IV :Harzburgite/Gabbro

Pieces 9

PRIMARY MINERALOGY:

Olivine	Mode 85%
Orthopyroxene	Mode 15%
Spinel	Mode Trace

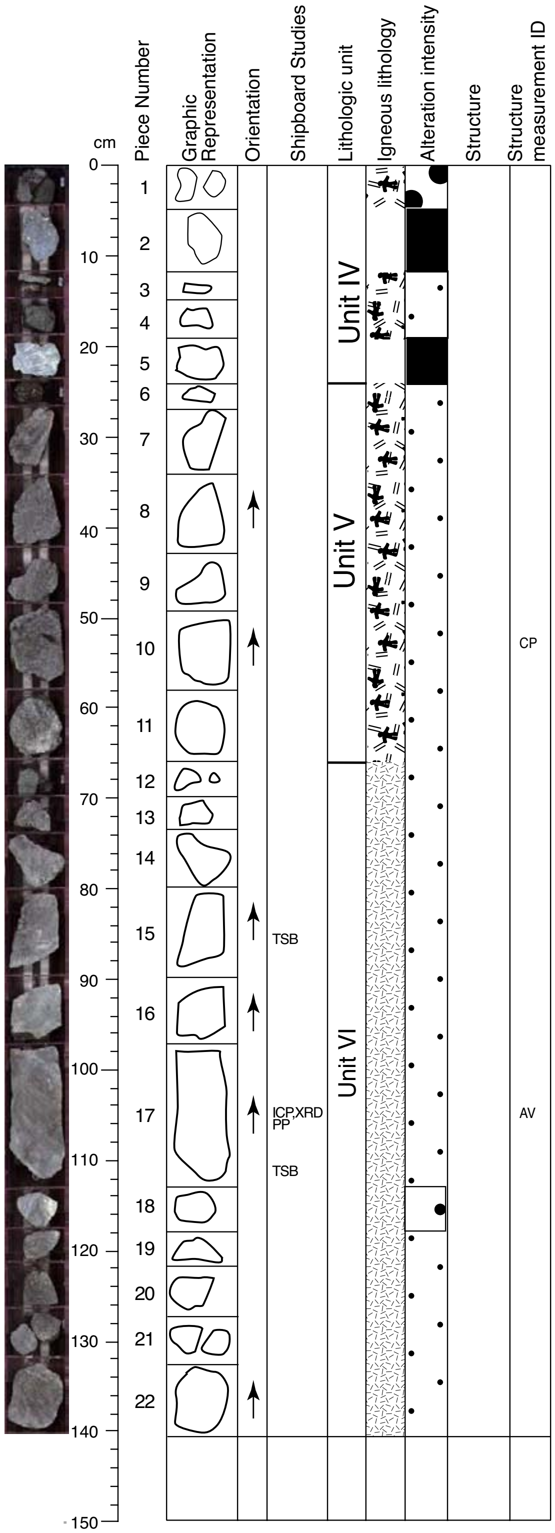
COMMENTS: This single piece of altered harzburgite marks the top of Unit-IV. The sample has been completely converted to talc.

SECONDARY MINERALOGY:
COMMENTS: The alteration of gabbro in this section alternates between slight and moderate reflecting the variable degrees to which pyroxene and plagioclase are replaced. Chlorite, amphibole and talc are formed at the expense of pyroxene and plagioclase is altered to assemblages including secondary plagioclase, chlorite and amphibole. Piece 9 is exceptional, because it is completely talc-altered harzburgite similar to the vuggy talc alteration of harzburgite observed in Hole 1268A.

VEINS: This section contains rare talc veins. The completely talc altered harzburgite at the bottom of the section shows two cross cutting talc veins.

STRUCTURE:
The section consists of strongly foliated porphyroclastic oxide metagabbro (Pieces 1-5, 8), which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. The section also contains serpentinized harzburgite and pyroxenite (Pieces 5-7, and 9). In Pieces 1-5 and 8 porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts also, serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of this part of the section is protomylonitic.
Piece 5 exposes a contact between pyroxenite or plagioclase pyroxenite (now strongly altered) and harzburgite. This potentially could represent the edge of a simple vein or the edge of the overlying section of gabbro with the harzburgite. The piece is unoriented. Pieces 6 are a strongly foliated harzburgite, also with a pyroxenite vein. Pieces 7-9 consist of foliated harzburgite. There is no brittle deformation in this section. Alteration veins are sparse, filling late fractures. Chlorite veins occur in Piece 1. Crosscutting serpentine and talc veins are present in Pieces 6, 7, and 9.

Core Photo



209-1270B-7R-1 (Section top: 31.50 mbsf)

UNIT IV: Harzburgite/Gabbro

Pieces 1–5

PRIMARY MINERALOGY:

Olivine	Mode 85%
Orthopyroxene	Mode 15%
Spinel	Mode Trace

COMMENTS: The first five pieces of this core are composed of altered harzburgite in Pieces 2 and 5 (modal proportions above) and sheared gabbro (see below).

UNIT V: Gabbro

Pieces 6-11

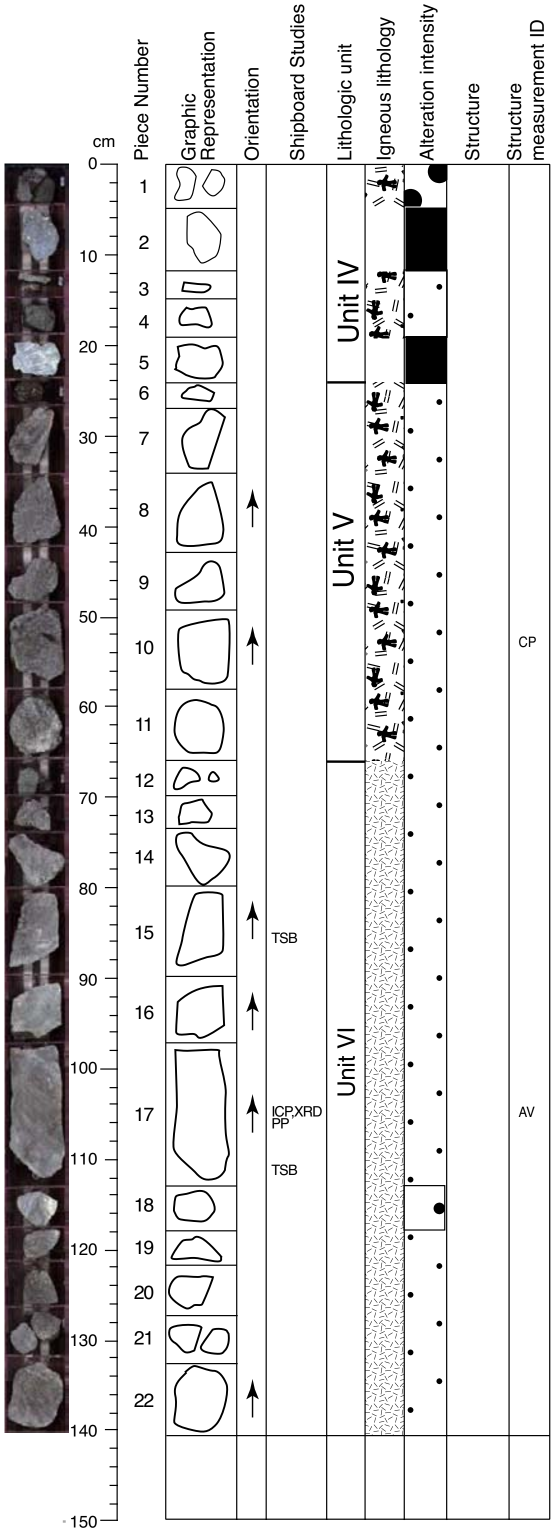
PRIMARY MINERALOGY:

Plagioclase	Mode 45%–50%
	Size 1–9 mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 40%
	Size 1–6 mm
	Shape/Habit Anhedral
Oxides	Mode 10%–15%

COMMENTS: Pieces 6 and 11 are gabbro that has been variably sheared and now has a porphyroclastic elongated to gneissic texture.

Continued on next page.

Core Photo



209-1270B-7R-1 (Section top: 31.50 mbsf)

Continued from previous page.

UNIT VI: Microgabbro

Pieces 11–22

PRIMARY MINERALOGY:

Plagioclase	Mode 45%–50% Size 1–9 mm Shape/Habit Anhedral
Clinopyroxene	Mode 40% Size 1–6 mm Shape/Habit Anhedral
Oxides	Mode 10%–15%

COMMENTS: Pieces 15 to 22 are a very fine-grained microgabbro. There is some grain size variations from very fine to fine best shown at 114 cm.

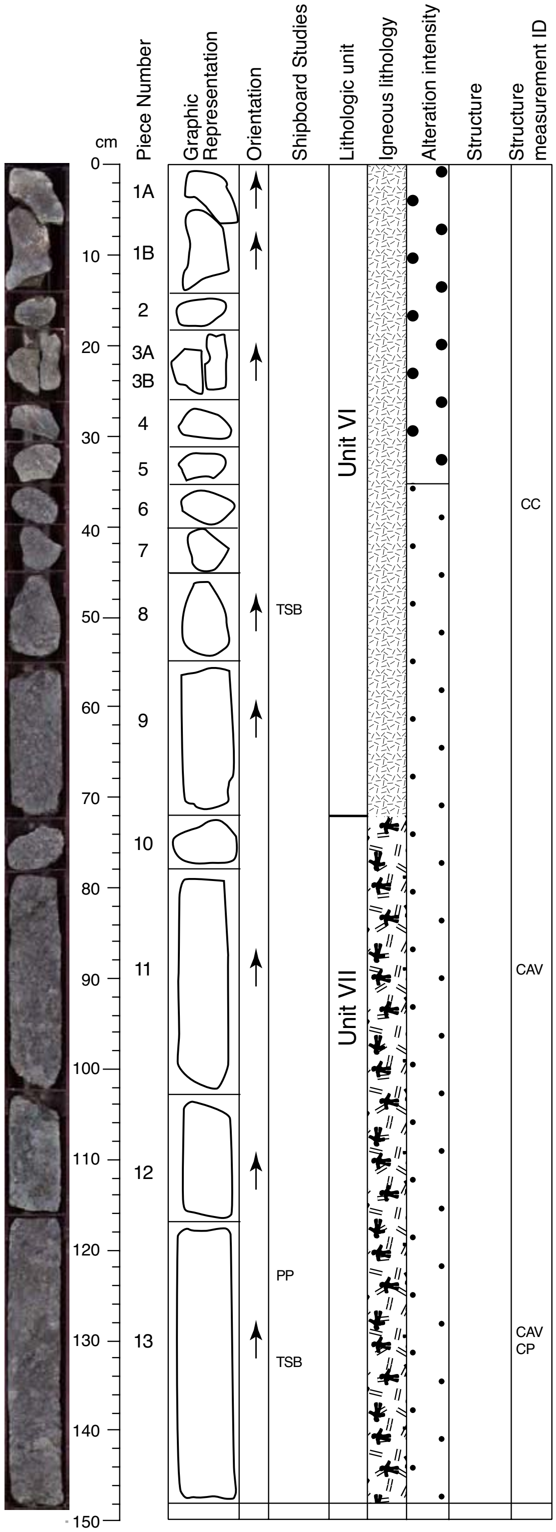
SECONDARY MINERALOGY:
COMMENTS: Most of the section is slightly altered oxide-rich gabbro and microgabbro with some notable exceptions. Pieces 2 and 5 are exceptional, because they are completely talc-altered harzburgite similar to the vuggy talc alteration of harzburgite observed in Hole 1268A. Piece 1 is highly altered gabbro with about half of the pyroxene and plagioclase replaced. Pyroxene has been pseudomorphed by chlorite, amphibole and talc; plagioclase has been replaced by secondary plagioclase, chlorite, and amphibole. At the margin of Piece 18 there is a patch of complete talc alteration with a 1-cm wide halo.

VEIN ALTERATION: Thin veinlets of chlorite-amphibole-talc occur in coarse-grained gabbro and in the microgabbro. Occasionally, these form anastomosing veinlets (e.g., Piece 17). Veins in the talc altered harzburgite (Pieces 2 and 5) are massive and mainly composed of talc. An exceptional vein (4 mm wide) of chalcopyrite (30%), talc, and pentlandite crosscuts the gabbro in Pieces 10 and 11.

THIN SECTIONS: Samples 1270B-7R-1, 84-86 cm and 1270B-7R-1, 110-112

STRUCTURE:
The section consists of three pieces of harzburgite (Pieces 2-5), coarse-grained porphyroclastic oxide gabbro (Pieces 1, 6-10) and foliated fine-grained gabbro (Pieces 11-23). Piece 3 appears to be a mylonitized harzburgite. In coarser gabbros, the porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation in coarse gabbros. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. Pieces 11 through 23 consist of a fine-grained equigranular gabbro with lower oxide content and with a strong foliation. Whether these pieces attained their fine grain size due to dynamic recrystallization or it was inherited from an original fine-grained protolith is unknown. Although foliated in the same orientation as the coarse gabbros, they are not banded, typical of fine-grained mylonitic rocks. The foliation is inclined 40 degrees in the cut face of the core. Piece 8 contains a 3-cm wide zone of dense shear fracture arrays with incipient brecciation. Alteration veins are sparse, filling late fractures. Composite sulfide veins in Pieces 10 and 11. Chlorite veins occur in Pieces 15, 20 and 22. Crosscutting serpentine and talc veins are present in Piece 5. Moderate, black, serpentine (?) veining in Piece 17. Crosscutting relationships indicate CP>AV

Core Photo



209-1270B-7R-2 (Section top: 32.90 mbsf)

UNIT VI: Microgabbro

Pieces 1–9

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 50%
	Size 1–25 mm
	Shape/Habit Euhedral to anhedral
Clinopyroxene	Mode 40%–45%
	Size 1–20 mm
	Shape/Habit Euhedral to anhedral
Oxides	Mode 5%–10%

COMMENTS: This section consists of gabbro with different grain size, from fine to coarse-grained intercalated downhole. Between 126 and 142 cm the gabbro is foliated with a gneiss-like structure. Plagioclase is as large as 2.5 cm in the coarser part of the core.

UNIT VII: Oxide Gabbro/Gabbro

Pieces 9–13

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 55%
	Size 1–25 mm
	Shape/Habit Euhedral to anhedral
Clinopyroxene	Mode 35%–42%
	Size 1–20 mm
	Shape/Habit Euhedral to anhedral
Oxides	Mode 5%–10%

COMMENTS: Piece 9 between 73–95 cm is less deformed than the lower portion of this core and still may preserve some igneous textures. Between 126 and 142 cm the gabbro is foliated with a gneiss-like structure. There are very large plagioclase crystals (as large as 2.5 cm) in the coarser part of the core.

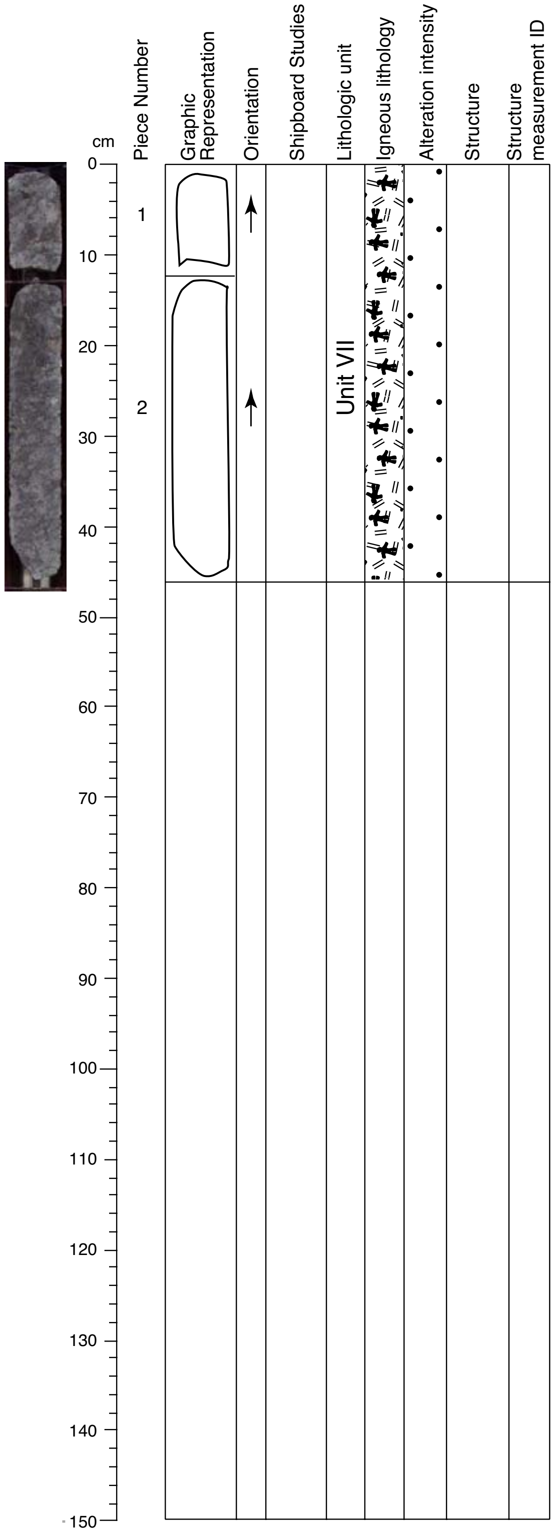
SECONDARY MINERALOGY:
COMMENTS: The upper portion of this section (Pieces 1-5) is moderately altered. Here, the pyroxenes have been pseudomorphed by chlorite-amphibole- talc? assemblages. The lower portion of the core (Pieces 6 to 13) is slightly altered with chlorite-amphibole alteration concentrated along grain contacts of plagioclase and pyroxene. This section also contains disseminated sulfides (pyrite and chalcopyrite) which may represent primary phases.

VEIN ALTERATION: Veining is weakly developed in this section. Talc-chlorite veins (less than 1 mm in width) occur sporadically. At the top of the section, chlorite-talc veins crosscut the microgabbro and in Piece 3A a vein halo is developed.

THIN SECTIONS: Samples 1270B-7R-2, 47-49 cm and 1270B-7R-2, 131-137 cm

STRUCTURE:
The section consists of strongly foliated porphyroclastic oxide metagabbro (Pieces 1-5) grading to relatively undeformed coarse oxide gabbro (Pieces 5-13), which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. In Pieces 1-5 porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of this part of the section is protomylonitic. Pieces 6-13 are undeformed except for a ductile shear zone that cuts Pieces 13 between 130-144 cm. Within the shear zone the gabbro has a gneissic foliation that is inclined 15 degrees in the cut face of the core. The bottom of Piece 13 is also undeformed. The foliation is becoming less penetrative with depth in the section. There is no brittle deformation in this section. Alteration veins are sparse, often filling late fractures. Chlorite veins in Pieces 1, 3, 5, 11, and 13.

Core Photo



209-1270B-7R-3 (Section top: 34.87 mbsf)

UNIT VII: Oxide Gabbro/Gabbro

Pieces 1–2

PRIMARY MINERALOGY:

Plagioclase	Mode 55% Size 5–15 mm Shape/Habit Euhedral to anhedral
Clinopyroxene	Mode 32% Size 5–20 mm Shape/Habit Euhedral to anhedral
Oxides	Mode 5%

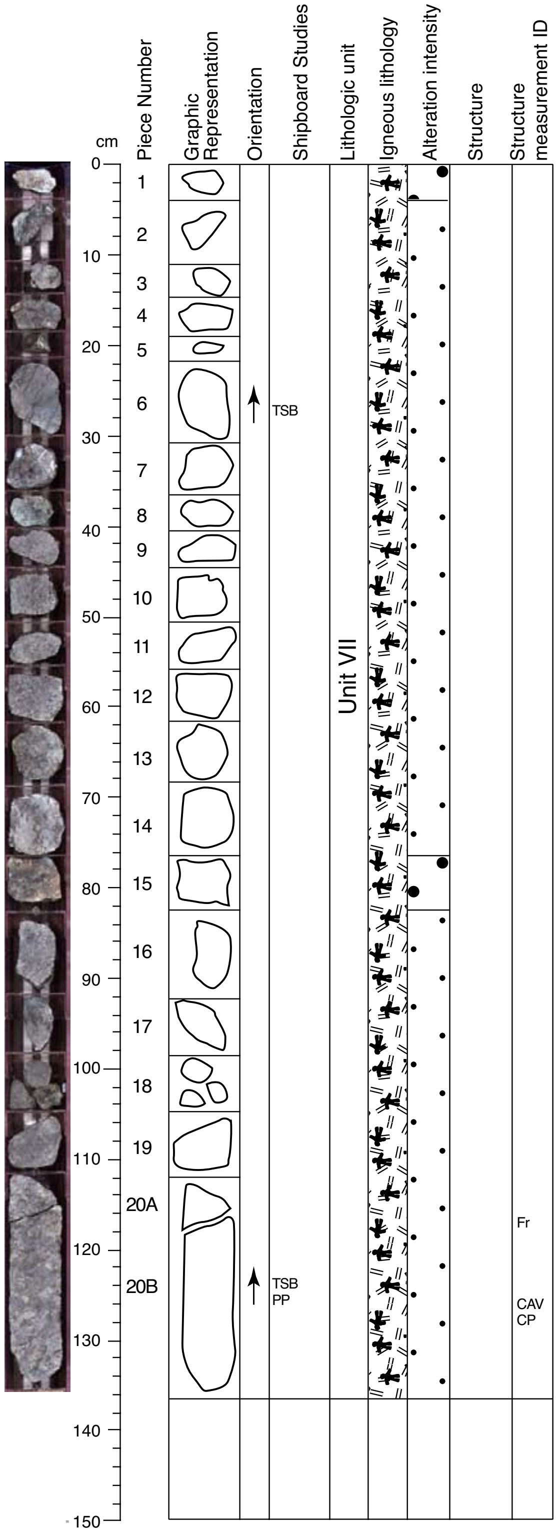
COMMENTS: This core consists of coarse-grained gabbro with very large plagioclase crystals, as large as 25 mm. The texture is gneissic below 24 cm.

SECONDARY MINERALOGY:
COMMENTS: The two pieces of this section are almost fresh. The disseminated sulfides (pyrite and chalcopyrite) in this gabbro may represent primary phases.

VEIN ALTERATION: This section has a very low imprint of chlorite-talc veining (e.g., top of Piece 1)

STRUCTURE:
The section consists of a strongly foliated porphyroclastic oxide metagabbro, which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism. The top of Piece 1 is a relatively undeformed oxide gabbro, but the remainder of the section has undergone crystal plastic deformation. Porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation.Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. The foliation is inclined gently inclined at ~18° in the cut face of the core. There is no brittle deformation in this section.

Core Photo



209-1270B-8R-1 (Section top: 36.50 mbsf)

UNIT VII: Oxide Gabbro/Gabbro

Pieces 1–20

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 45%–55%
	Size 1 - 15 mm
	Shape/Habit Euhedral to anhedral
Clinopyroxene	Mode 40%
	Size 1–15 mm
	Shape/Habit Euhedral to anhedral
Oxides	Mode 5%–15%

COMMENTS: This core consists of coarse-grained and medium-grained gabbro with very variable grain size and metamorphic foliation. Grain size alternates between medium and coarse all along the section. Pieces 5 and 6 are mylonitic/sheared gabbronorite with coarse pyroxenes-rich layers. Piece 15 is also a sheared gabbro.

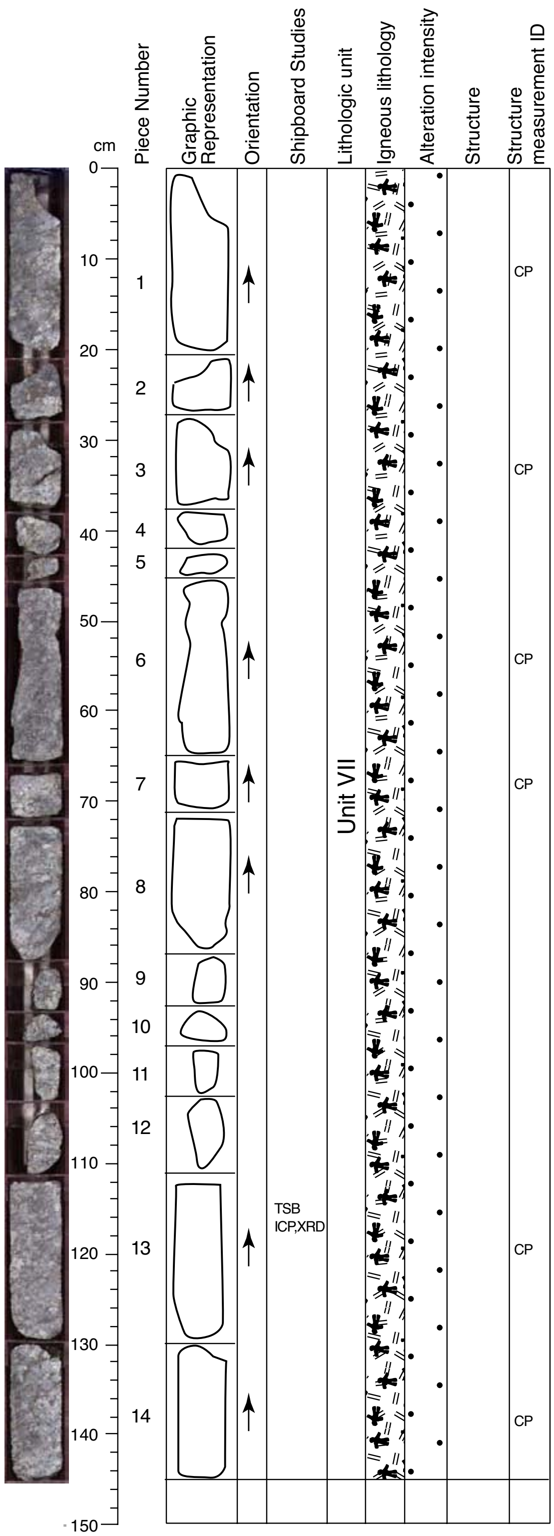
SECONDARY MINERALOGY:
COMMENTS: Most of this section consists of slightly altered gabbro of variable grain size, however, some pieces are more strongly altered. In Piece 1, about half of the pyroxene is altered to chlorite-amphibole-talc assemblages. Pieces 5, 6, and 15 are sheared/mylonitic zones with highly focused alteration in talc-rich bands.

VEIN ALTERATION: Veining is restricted to rare, thin (less than 1 mm in width) talc-chlorite veins.

THIN SECTIONS: Samples 1270B-8R-1, 26-29 cm and 1270B-8R-1, 124-126 cm

STRUCTURE:
The section consists of a strongly to weakly foliated porphyroclastic oxide metagabbro which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. The strength of the foliation appears more variable in the section and the grain size is also more variable ranging from fine, to medium to coarse, possibly reflecting variable strain and grain size reduction. Porphyroclasts of pyroxene have shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. The foliation is inclined gently at ~25° in the cut face of the core. Piece 2 is a semi-brittle shear zone in which grain scale brecciation was partially annealed by growth of fibrous greenschist-facies alteration minerals. Pieces 7, 8, 9, 10, 11, 12, 13, and 14 contain zones of dense, randomly oriented shear fractures and incipient brecciation. These are irregular-shaped 0.3 cm to 1 cm wide shear zones with sulfides in the matrix of brecciated intervals. Piece 21 contains an open, irregular-shaped shear fracture. Alteration veins are sparse, commonly filling late fractures and confined to Pieces 13-20. Chlorite veins in Pieces 14, 15, 16, 18, and 20.

Core Photo



209-1270B-8R-2 (Section top: 37.86 mbsf)

UNIT VII: Oxide Gabbro/Gabbro

Pieces 1–14

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 50%
	Size 3–15 mm
	Shape/Habit Euhedral to anhedral
Clinopyroxene	Mode 40%
	Size 2–10 mm
	Shape/Habit Anhedral
Oxides	Mode 5%–15%
	Size up to 4 cm aggregates(?)

COMMENTS: This core consists of mixed medium- and coarse-grained gabbro, and is basically a continuation of the gabbro of Section 1270B-8R-01.The core is coarse-grained (0-46 cm), medium grained (46-72 cm), and then coarse grained (72-146). In the lower portion the core is less deformed between 112–122 cm and then again deformed throughout the remaining length.

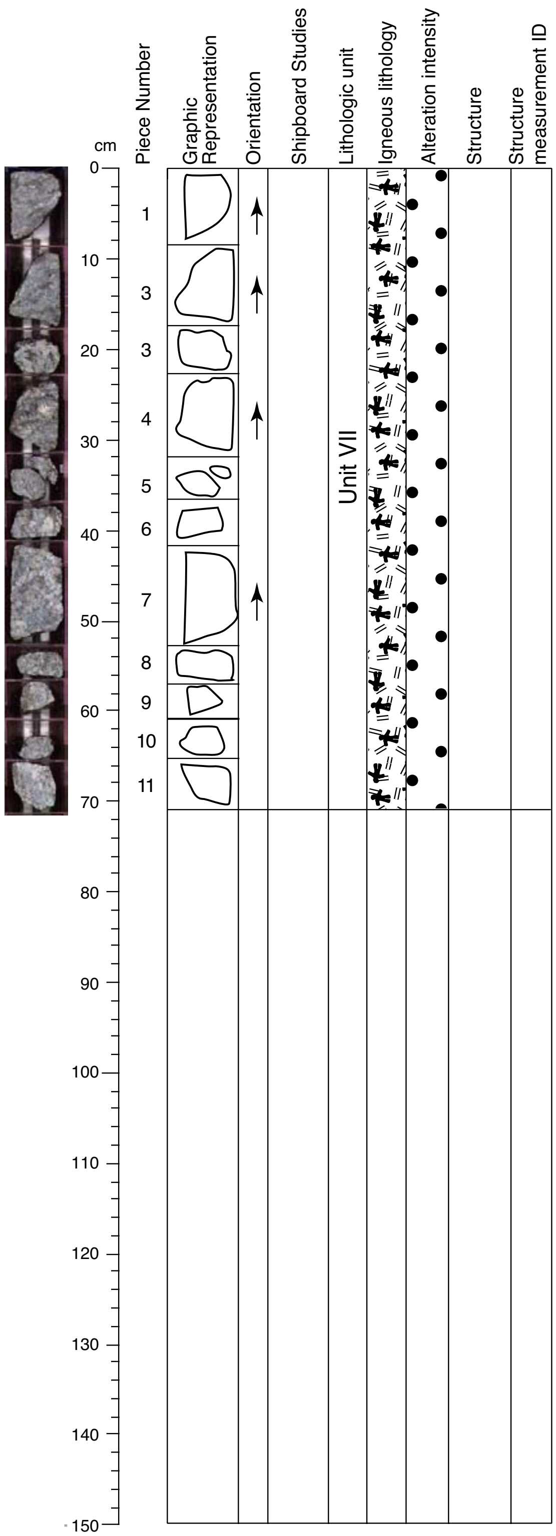
SECONDARY MINERALOGY:
COMMENTS: The gabbro in this section is slightly altered. Chlorite±amphibole±talc assemblages occur locally along the grain contacts of pyroxene and plagioclase.

VEIN ALTERATION: Veining is restricted to rare, thin (less than 1 mm in width) talc-chlorite veins.

THIN SECTIONS: Sample 1270B-8R-2, 114-116

STRUCTURE:
The section consists of a strongly foliated medium to coarse-grained porphyroclastic oxide metagabbro, which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. Porphyroclasts of pyroxene have shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. The foliation is inclined gently at ~15° in the cut face of the core, which continues to be shallower than the upper sections of the core. There is no brittle deformation in this section. Thin talc alteration veins occur in fractures in Pieces 3, 6, and 10.

Core Photo



209-1270B-8R-3 (Section top: 39.32 mbsf)

UNIT VII: Oxide Gabbro/Gabbro

Pieces 1–11

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 40%
	Size 3–15 mm
	Shape/Habit Euhedral to anhedral
Clinopyroxene	Mode 40%
	Size 2–10 mm
	Shape/Habit Euhedral to anhedral
Oxides	Mode 10%
	Size up to 15 mm

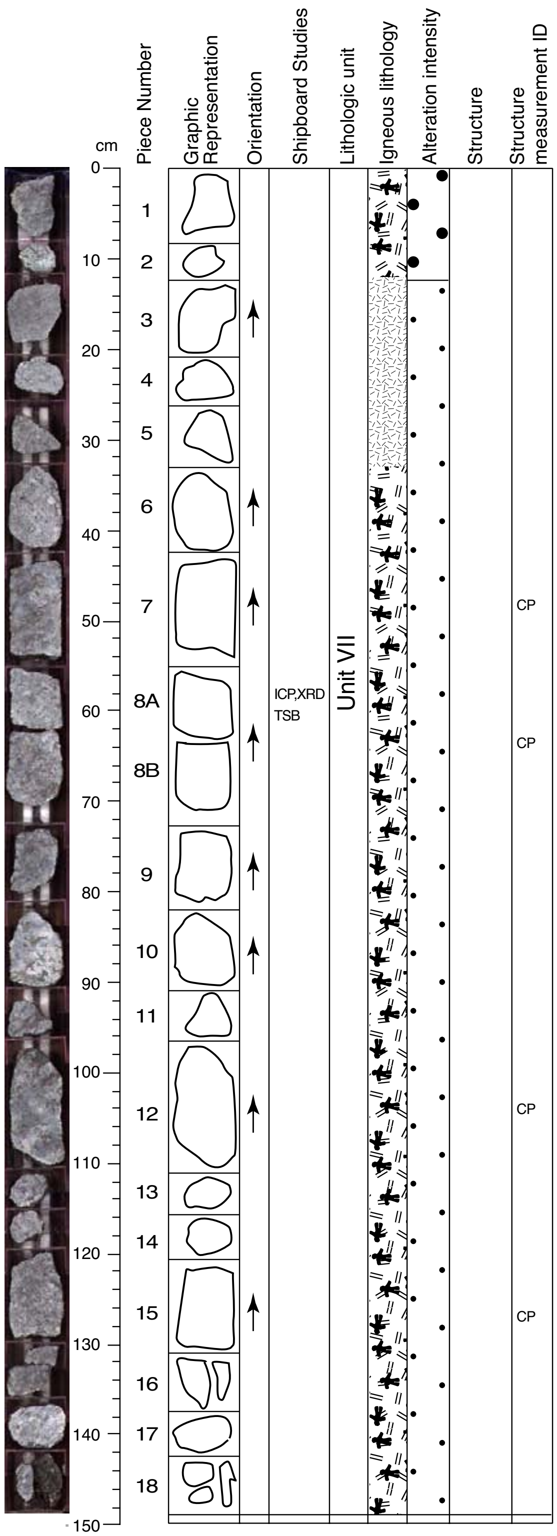
COMMENTS: This core consists of coarse-grained gabbro, continuation of the coarse grained gabbro of Section 1270B-8R-2. The gabbro is less foliated than the previous section. Oxides patches are interstitial and up to 1.5 cm in size.

SECONDARY MINERALOGY:
COMMENTS: This section consists of moderately altered gabbro. Chlorite-amphibole assemblages are replacing up to half of the pyroxenes. Some of the plagioclase has been recrystallized to secondary plagioclase, minor chlorite and amphibole.

VEIN ALTERATION: Veining is restricted to rare, thin (less than 1 mm in width) chlorite-talc veins.

STRUCTURE:
The section consists of a strongly to moderately foliated porphyroclastic oxide metagabbro, which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. Porphyroclasts of pyroxene have strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. The foliation is inclined gently at ~25 degrees in the cut face of the core. There is no brittle deformation in this section. Sparse, thin chlorite alteration veins in cracks in Pieces 2, 4, 7, and 9.

Core Photo



209-1270B-9R-1 (Section top: 40.80 mbsf)

UNIT VII: Oxide Gabbro/Gabbro

Pieces 1–18

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 55%
	Size 3–7 mm
	Shape/Habit Euhedral to anhedral
Clinopyroxene	Mode 45%
	Size 2–15 mm
	Shape/Habit Euhedral to anhedral
Oxides	Mode 5%

COMMENTS: This core consists predominately of coarse-grained and moderately sheared gabbro. Small pieces of oxide and severely weathered lithologies are included in Pieces 1-3 but these are likely to have fallen down the hole and may not be in place.

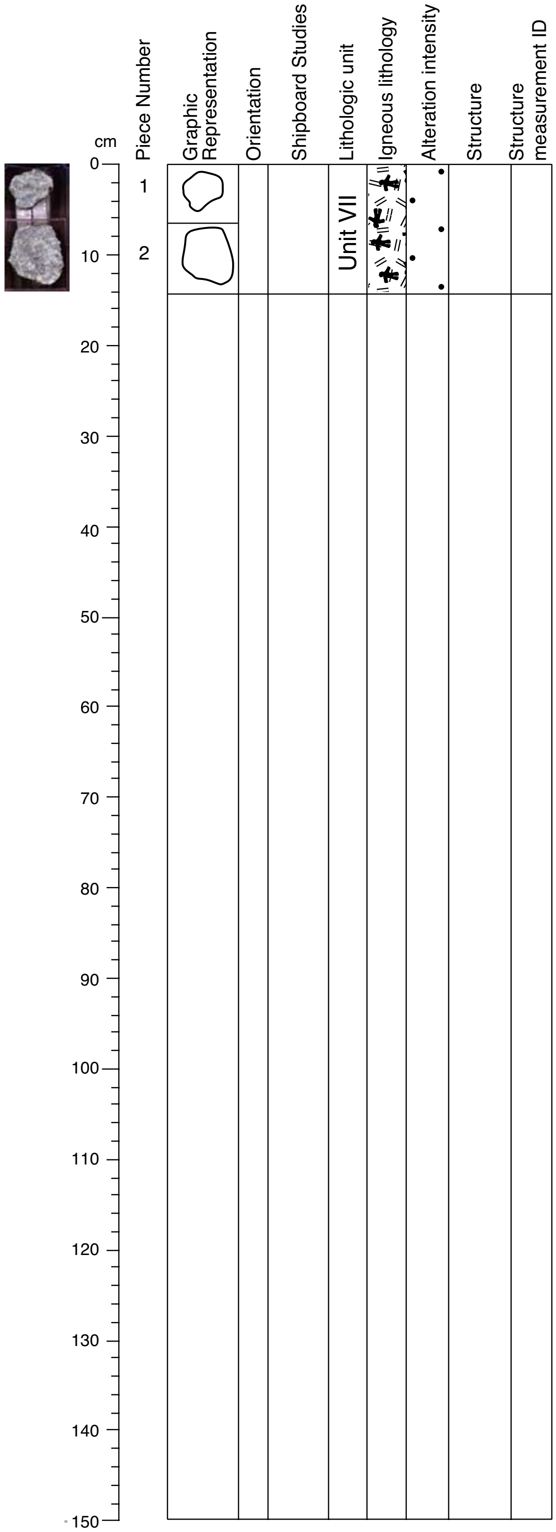
SECONDARY MINERALOGY:
COMMENTS: This section is mainly slightly altered gabbro. Pieces 1 and 2 show moderate replacement of pyroxene by talc-amphibole-chlorite and formation of secondary feldspar and minor chlorite in plagioclase.

VEIN ALTERATION: This section displays a very weak imprint of talc-chlorite veins (less than 1mm in width). Piece 2 is exceptional and contains several talc-chlorite veins as well as moderate, talc-rich background alteration.

THIN SECTIONS: Sample 1270B-9R-1, 60-62 cm

STRUCTURE:
The section consists of a strongly foliated medium to coarse porphyroclastic oxide metagabbro, which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. Porphyroclasts of pyroxene have moderate to strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer-grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal-plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. Pieces 3 and 5 appear to have undergone more severe grain size reduction. The foliation is inclined gently at ~19° in the cut face of the core. Pieces 1-11 contain widely spaced randomly oriented shear fractures with <0.1-cm offset each. Alteration veins are sparse, often filling late fractures. Chlorite veins occur in Pieces 6 and 17, Sulfide veins in Pieces 1 and 5 and thin talc alteration veins in cracks in Pieces 10, and 15 to 17.
Pieces 14 and 18 each contain open fractures (FR) with rough surfaces suggestive of little or no shear displacement. These brittle deformation textures represent only a small degree of brittle shear deformation. Alteration veins are limited. Chlorite alteration veins (AV) cut Pieces 7, 14, 18, and 19; sulfide vein (SuV) cut Piece 4 and talc alteration veins (SAV) cut in Piece 12. Crosscutting relationships indicate CP>AV>FR,CP>SuV.

Core Photo



209-1270B-9R-2 (Section top: 42.30 mbsf)

UNIT VII: Oxide Gabbro/Gabbro

Pieces 1–2

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 55%
	Size 3–7 mm
	Shape/Habit Euhedral to anhedral
Clinopyroxene	Mode 45%
	Size 2–15 mm
	Shape/Habit Euhedral to anhedral
Oxides	Mode 5%

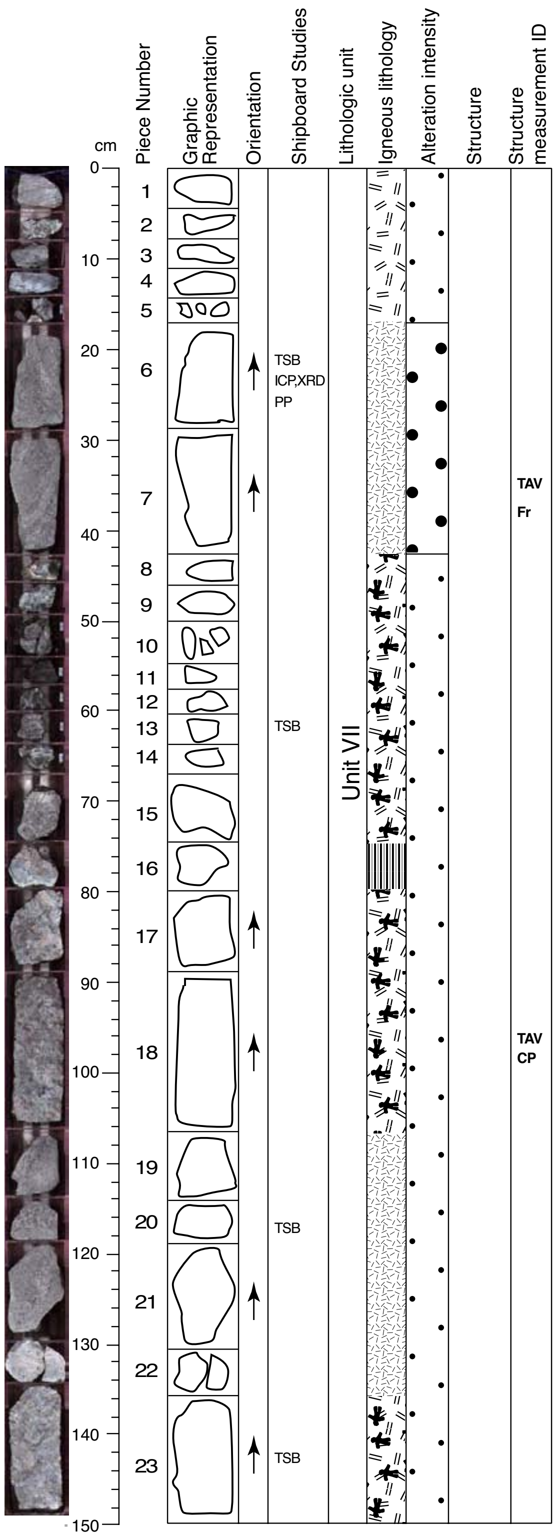
COMMENTS: The two pieces in this section are the same as those in Section 1270B-9R-1.

SECONDARY MINERALOGY:
COMMENTS: Alteration in this section is weak.

VEIN ALTERATION: Only Piece 1 shows a thin, 1mm wide, talc-chlorite vein.

STRUCTURE:
The section consists of a strongly foliated coarse porphyroclastic oxide metagabbro, which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism. Porphyroclasts of pyroxene have moderate to strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer-grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. The foliation is inclined gently at ~20° in the cut face of the core. There is no brittle deformation in this section.

Core Photo



209-1270B-10M-1 (Section top: 45.80 mbsf)

UNIT VII: Oxide Gabbro/Gabbro

Pieces 1–23

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 50%–60% Size 3–7 mm Shape/Habit Euhedral to anhedral
Clinopyroxene	Mode 40%–45% Size 2-15 mm Shape/Habit Euhedral to anhedral
Oxides	Mode 2%–8%

COMMENTS: The upper part of this core is a mixture of fine (Pieces 1, 6, and 7) and coarse (Pieces 2-5) oxide gabbro. Pieces 1, 6, and 7 have some grain-size variability even within individual Pieces. The lower portion of this section is the least deformed of any part of Hole 1270B. There is a very large ophitic clinopyroxene crystal in Piece 23 (70 by 40 mm).

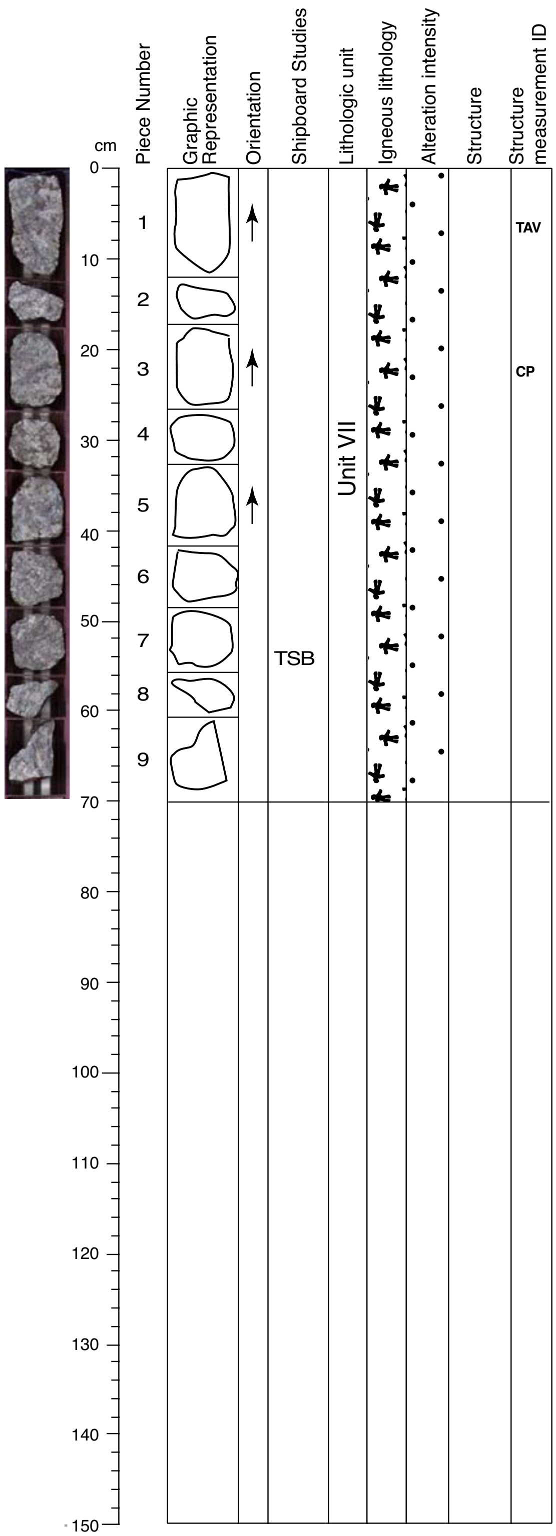
SECONDARY MINERALOGY:
COMMENTS: This section consists of fresh to slightly altered gabbro. Disseminated pyrite is locally present.

VEIN ALTERATION: The vein imprint is very weak in this section. Rare massive talc-chlorite veins occur at the lower margin of Piece 18A.

THIN SECTIONS: Samples 1270B-10M-1, 21-23 cm, 1270B-10M-1, 60-62 cm, 1270B-117-120 cm, and 1270B-10M-1, 142-144 cm.

STRUCTURE:
The section consists of undeformed microgabbro (Pieces 7 and 8), to strongly foliated porphyroclastic oxide metagabbro (Pieces 1-5, and 9-15), to very mildly or weakly deformed medium- to coarse grained oxide gabbro (Pieces 16-24), which have not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. Porphyroclasts of pyroxene in deformed rocks have moderate to strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic, however grain size reduction is very weak in Pieces 16-24 and there is only a weak foliation in these pieces. At the base of Piece 24, the weak foliation is subhorizontal Ductile shear zones in Pieces 3 and 4 are partially overprinted by brittle deformation in which shear fractures with unknown offset are filled and partially annealed by greenschist-grade alteration minerals. Alteration veins are sparse, often filling late fractures. Piece 7 contains irregular-shaped unfilled shear fracture and talc alteration vein. Pieces 3 and 16 contain sulfide veins. Pieces 7, 9, and 11; 14-19 contain sparse alteration veins.

Core Photo



209-1270B-10M-2 (Section top: 46.28 mbsf)

UNIT VII: Oxide Gabbro/Gabbro

Pieces 1–9

COLOR: Gray

PRIMARY MINERALOGY:

Plagioclase	Mode 50%–55%
	Size 3–7 mm
	Shape/Habit Euhedral to anhedral
Clinopyroxene	Mode 40%–45%
	Size 2–15 mm
	Shape/Habit Euhedral to anhedral
Oxides	Mode 5%–10%

COMMENTS: This section consists of a mixture of sheared oxide gabbro (Pieces 1-3) medium-grained gabbro (Pieces 4 and 5) and coarse-grained relatively undeformed gabbro (Pieces 6 to 9).

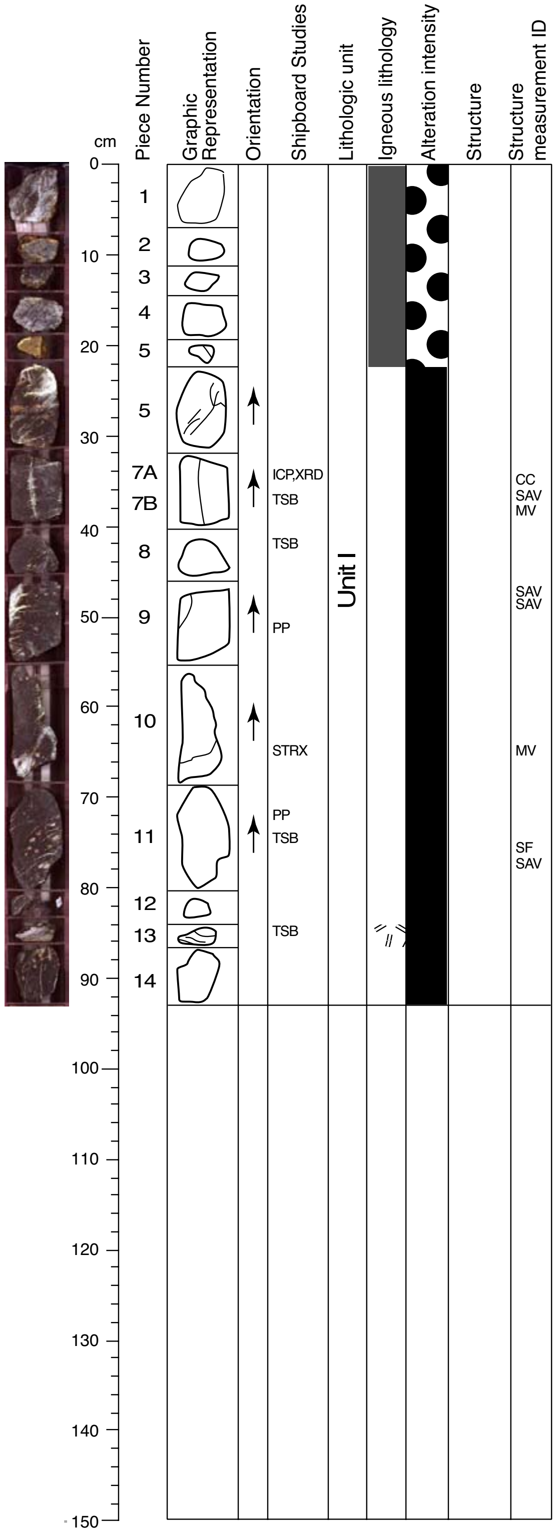
SECONDARY MINERALOGY:
COMMENTS: The alteration of this section is weak. Alteration minerals have been estimated to represent 2% of the core.

VEIN ALTERATION: The section is weakly veined with rare composite veins with talc in the central part and chlorite-amphibole on the margins.

THIN SECTIONS: Sample 1270B-10M-2, 53-56 cm

STRUCTURE:
The section consists of a strongly foliated medium to coarse porphyroclastic oxide metagabbro, which has not generally undergone a significant lower-temperature secondary amphibolite or greenschist facies static metamorphism, except as noted above. Porphyroclasts of pyroxene have moderate to strong shape-preferred dimensional orientations that define the crystal plastic (CP) foliation. Bands of recrystallized plagioclase and oxides and smaller plagioclase porphyroclasts, which form the finer grained matrix around clinopyroxene porphyroclasts, also serve to define the crystal plastic foliation. Clinopyroxene is seldom as significantly recrystallized as plagioclase. Because less than 50 percent of the rock volume has generally undergone grain size reduction, the texture of the section is protomylonitic. Piece 5, however, is weakly foliated. The foliation is inclined gently at ~20 degrees in the cut face of the core. Sparse alteration veins occur in Pieces 1, 2, 3, 5, 6, 8, and 9.

Core Photo



209-1270C-1R-1 (Section top: 0.00 mbsf)

UNIT 1: Harzburgite/dunite with gabbro

Pieces 1–14

COLOR: Black to gray with red to brown patches

PRIMARY MINERALOGY:

Olivine	Mode 70%–98%
Orthopyroxene	Mode 1%–30%
	Size 1–9 mm
	Shape/Habit Anhedral
Spinel	Mode <1%

COMMENTS: This section is composed of altered dunite and harzburgite with a minor amount of gabbroic dikes. The lithology changes from dunite in the upper 22 cm to harzburgite in the lower 65-cm. Medium-sized orthopyroxene porphyroclasts (1-7 mm) are heterogeneously distributed in the dunite. The harzburgite is deformed and shows porphyroclastic to mylonitic textures. Thin gabbroic dikes (0.5 cm thick) occur at several places (at 5, 28, 47, 66, 85 and 88 cm). They contain fine-grained plagioclase and clinopyroxene associated with fine-grained brown amphibole (<0.1 cm). These dikes have been extensively sheared to a mylonitic texture with some asymmetric structure.

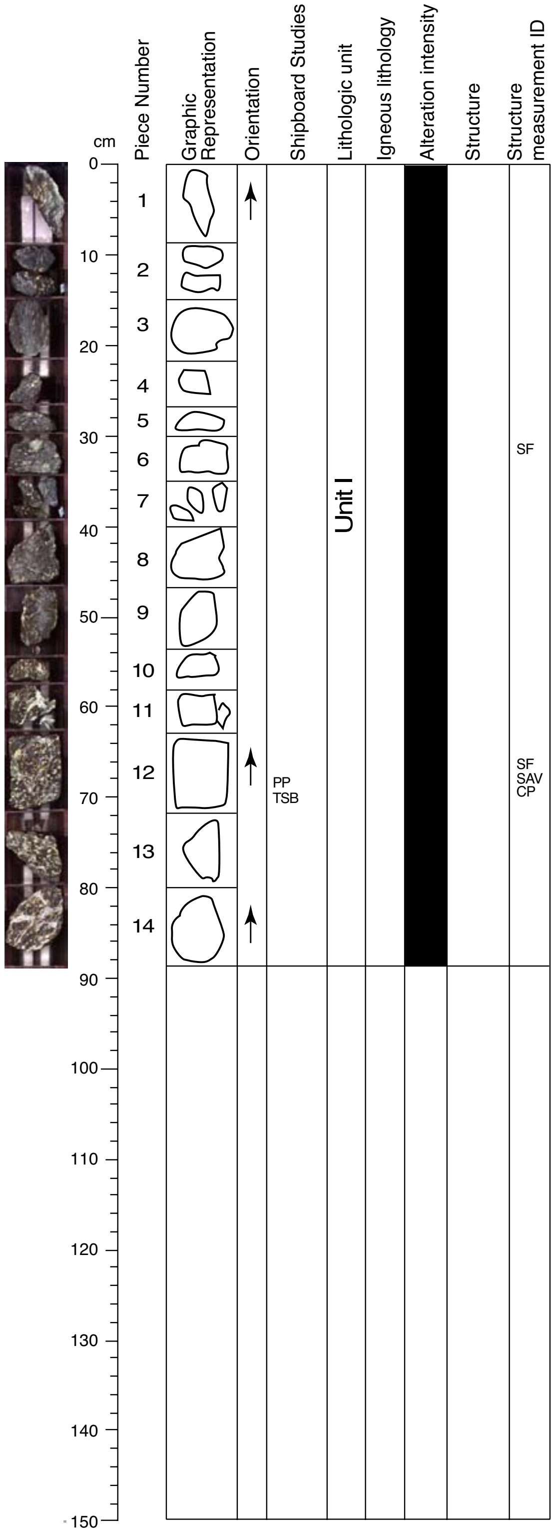
SECONDARY MINERALOGY:
TOTAL ROCK ALTERATION 93%-96%
The section consists of mottled, black to dark gray, completely serpentinized harzburgite with local red and brown Fe-oxyhydroxide baring weathering of olivine. The rocks were highly serpentinized and underwent further oxidative seawater alteration near the seafloor. Nevertheless, fresh olivine and orthopyroxene are present in small amounts. Serpentine mesh-texture is well developed, and orthopyroxene is commonly pseudomorphed by serpentine (bastite). Piece 5 is orange-brown due to exceptionally strong weathering.

VEINS:
The upper section (Pieces 1-5) contain irregular, transgranular serpentine veins cutting the peridotite foliation. Pieces 7A to 14 display sigmoidal veins of cross-fiber and massive serpentine. These veins are sub-parallel to the peridotite foliation. Many pieces have small Fe-oxide veins that cut serpentine veins.

THIN SECTIONS: Samples 1270C-1R-1, 36-39 cm, 1270C-1R-1, 40-42 cm, 1270C-1R-1, 72-75 cm, and 1270C-1R-1, 83-85 cm

STRUCTURE:
The section is characterized by porphyroclastic serpentinized harzburgite. The crystal plastic foliation is weak to strong and defined by the preferred dimensional orientation of pyroxene. Serpentinized harzburgite with moderate to strong foliation occur in Pieces 9-14. Weaker foliations occur in Pieces 1-9, but foliations are masked by alteration and pyroxene magmatic veins. Harzburgites are cut by numerous pyroxenitic to gabbroic veins. Pyroxenite magmatic veins occur in Pieces1, 2, 6, 7, 9, 10, and a gabbroic-pyroxenitic composite vein is in Piece 10. Porphyroclastic mylonitic shear bands apparently nucleate and localize within and along magmatic veins and extensively modify textures within the veins. The presence of plagioclase within the pyroxenite or gabbroic veins may promote failure by ductile shear that appears to extend throughout the amphibolite facies. Pieces 1, 2, 6, 9, 10, 13, and 14 contain shear zones in which greenschist-grade semibrittle to brittle deformation overprints ductile deformation within the gabbroic veins. Shear zones include schistose arrays of syntectonically-grown tremolite and talc aligned parallel to the crystal plastic foliation. Pieces 6, 9, 11, and 12 have weak intensity cross fiber serpentine foliation. magmatic veins crosscut pyroxene foliation and appear to be deformed in places (Pieces 6,10, and 13). Two to three generations of crosscutting serpentine veins and thin oxide veins are present in most pieces. Serpentine crosscutting relations visible in Pieces 4 and 6. Serpentine filled tension cracks in magmatic veins extending into host harzburgite visible in Pieces 7, 9, and 10. Brittle, normal faults cutting a white serpentine vein occurs in Piece 6 and normal sense of shear is shown by serpentine veins across a gabbro vein in Piece 9.

Core Photo



209-1270C-2R-1 (Section top: 12.50 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1–14

COLOR: Dark gray

PRIMARY MINERALOGY:

Olivine	Mode 79%–89%
Orthopyroxene	Mode 10%–20%
	Size 1–10 mm
	Shape/Habit Anhedral
Spinel	Mode 1%

COMMENTS: This section is composed of altered harzburgite with a minor amount of gabbroic dikes. The harzburgite has been deformed to show porphyroclastic to mylonitic texture. Thin gabbroic dikes (0.5 cm thick) occur at four places (at 65, 68, 77, and 84 cm). They contain fine-grained plagioclase and clinopyroxene associated with fine-grained brown amphibole (<1 mm). These dikes have been mylonitized and some have an asymmetric structure.

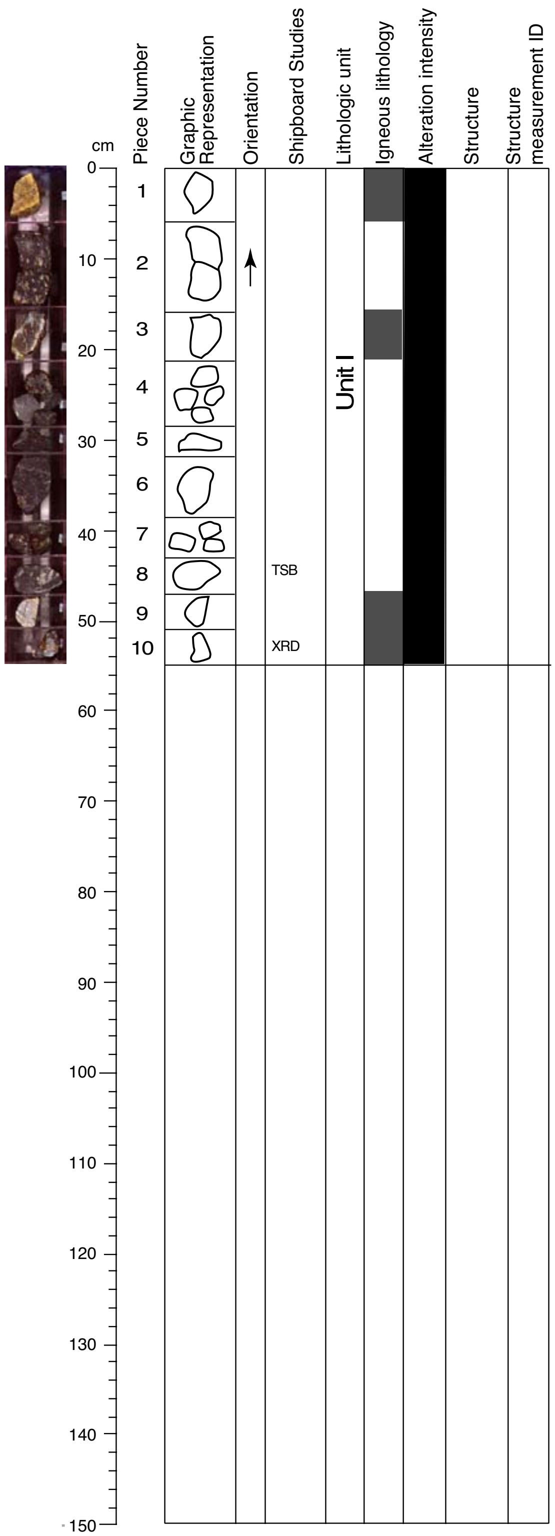
SECONDARY MINERALOGY:
TOTAL ROCK ALTERATION 100%
The section consists of completely serpentinized dark gray harzburgite with variable amounts of orthopyroxene pseudomorphed by serpentine. Red spots in Piece 1 indicate weathering of relict olivine. Piece 1 has 1%–2% of fresh orthopyroxene. Pieces 11 and 14 contain completely altered gabbroic dikelets consisting of talc, serpentine, and chlorite.

VEINS:
This section is uniformly veined by white, sigmoidal, paragranular cross-fiber chrysotile veins that are cut by transgranular, green serpentine veins.

THIN SECTIONS: Sample 1270C-2R-1, 69-71 cm

STRUCTURE:
The section is characterized by porphyroclastic serpentinized harzburgite with a strong crystal-plastic (CP) foliation defined by the preferred dimensional orientation of pyroxene. Piece 1 contains a semibrittle shear zone in which greenschist-grade semibrittle to brittle deformation overprints ductile deformation within gabbroic veins. Pieces 8, 9, 12, and 14 are cut by pyroxenite and or composite pyroxenite-gabbroic magmatic veins (MV) that are highly altered and can localize small mylonitic shear zones. Oriented Piece 12 show a strong foliation inclined ~35 degrees in the cut face of the core. The remainder of the section is devoid of magmatic veins, but small serpentine veins are ubiquitous and prominent veins are present in Pieces 8, 9, 11, and 14. Shear zones include schistose arrays of syntectonically-grown tremolite and talc aligned parallel to the crystal plastic foliation. Pieces 3, 4, 5, 6, 7, 10, 11, 12, 13, and 14 have weak- to moderate-strength cross-fiber serpentine foliation (SF). Serpentine filled tension cracks in magmatic veins extending into host harzburgite visible in Piece 8. The magmatic and alteration veins are post-kinematic with respect to the crystal plastic fabric. Crosscutting relationships indicate CP> MV>SF>SAV

Core Photo



209-1270C-3M-1 (Section top: 18.50 mbsf)

UNIT 1: Harzburgite/dunite with gabbro

Pieces 1–10

COLOR: Gray to black (brown where weathered)

PRIMARY MINERALOGY:

Olivine	Mode 79%–99%
Orthopyroxene	Mode 5%–20%
	Size 1–10 mm
	Shape/Habit Anhedral
Spinel	Mode 1%

COMMENTS: The lithology in this short section varies from altered dunites to harzburgites depending on the heterogeneous distribution of orthopyroxene porphyroclasts. The rocks have been deformed to a porphyroclastic to mylonitic texture. Thin gabbroic dikes (0.5 cm thick) occur at 18 and 46 cm. The dikes contain fine-grained plagioclase and clinopyroxene associated with fine-grained brown amphibole (<0.1 cm).

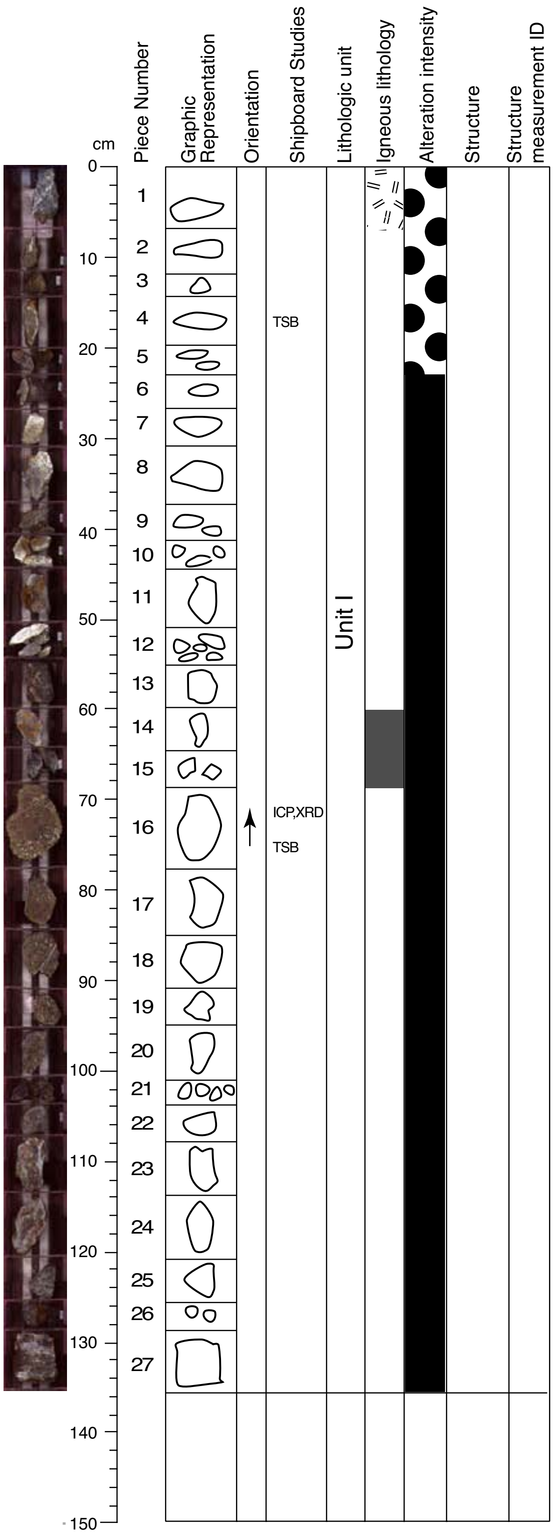
SECONDARY MINERALOGY:
TOTAL ROCK ALTERATION 96%-99%
The harzburgites and gabbro dikes in this section are completely serpentinized and weathered. The top of the section, in particular Pieces 9 and 10, show the most distinct weathering of olivine to brown clay/iron oxyhydroxides. Olivine is mostly serpentinized/weathered, although traces of relict olivine may be preserved. Orthopyroxene is locally preserved (Pieces 2 and 8), but is more commonly altered to bastite pseudomorphs (e.g., Pieces 5 and 6). Pieces 3 and 8 contain completely serpentine-talc-chlorite altered gabbro veinlets.

VEINS:
This section is weakly veined with white paragranular chrysotile veins cut by transgranular veins of green serpentine.

THIN SECTIONS: Sample 1270C-3M-1, 44-46 cm

STRUCTURE:
The section is characterized by porphyroclastic serpentinized harzburgite with a strong crystal-plastic (CP) foliation defined by the preferred dimensional orientation of pyroxene. Pieces 3, 6 and 8 are cut by pyroxenitic to gabbroic magmatic veins that are strongly altered. Brittle-ductile shear zones (DSZ-CC) in Pieces 3, 4, 8, and 9 are overprinted by minor greenschist-grade, semibrittle to brittle deformation. Piece two displays weak serpentine foliation. Section contains serpentinized harzburgite with porphyroclastic texture and strong foliations defined by the preferred dimensional orientation of pyroxene. Small serpentine veins are common in all pieces. Two generations of veins with cross cutting relationships are visible in Piece 3. Very thin, late oxide veins are present in Piece 1. Crosscutting relationships indicate CP>MV>DSZ>SAV>CC.

Core Photo



209-1270D-1R-1 (Section top: 0.00 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1–27

COLOR: Green where harzburgitic, orange where clay weathered, gray where talc altered.

PRIMARY MINERALOGY:

Olivine	Mode 80%–90%
Orthopyroxene	Mode 8%–20%
	Size 1–15 mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 3%–4% (observed in thin section)
	Size 2.5 mm
	Shape/Habit Anhedral
Spinel	Mode 1%

COMMENTS: This section is composed of serpentinized porphyroclastic to mylonitized harzburgite with minor dunite. The harzburgite was intruded by gabbroic melts prior to mylonitization as the gabbroic intrusions are stretched and metamorphosed together with the host rock. Layers of dunite and harzburgite alternate in Piece 16 (Sample 1270D-1R-1, 75-78 cm). Fresh orthopyroxene, clinopyroxene (observed in thin section) and spinel relics suggest that the harzburgite had coarse-grained former texture. Fresh recrystallized olivine is also present in very minor abundance (less than 1%). Gabbroic impregnation consists of former plagioclase, clinopyroxene, and possibly brown pargasitic amphibole that are still preserved in rounded grains. Modal estimates of the mineral abundance are indicative of composition but not very reliable because of the strong deformation.

SECONDARY MINERALOGY:

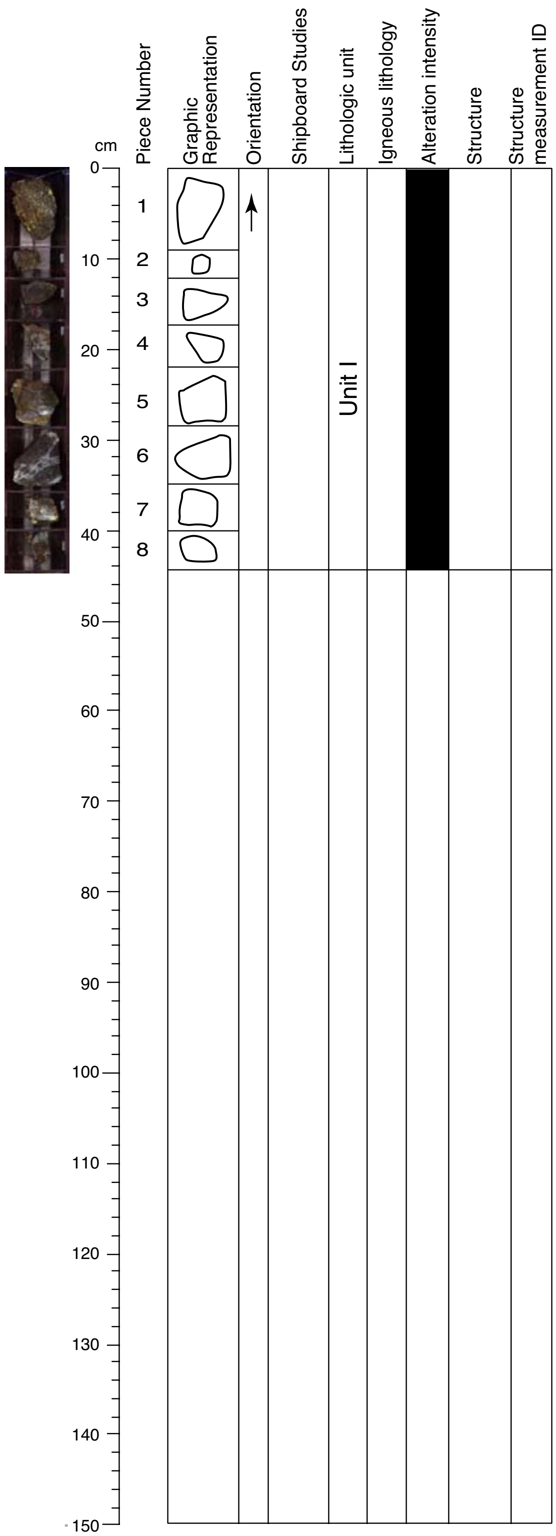
The harzburgite in this section is completely altered/weathered. The section consists of three different alteration styles: serpentinization (Pieces 11 and 13), talc alteration (Pieces 7-8, 10, and 12) and orange clay-Fe-oxide weathering (Pieces 2-4, 11, and 14). The lower part of the section (Pieces 16 to 27) shows orange clay-Fe-oxide weathering overprinting dark gray serpentinization.

VEINS:
Throughout the section veining is infrequent. Where present the veins contain chrysotile and iron hydroxide/oxides in varying proportions (as much as 50% iron hydroxides). Despite having very similar mineralogy the veins throughout the section show a great variety in color, ranging from green in the less altered gabbro of Piece 6 to mostly red brown in the highly weathered Piece 5.

THIN SECTIONS: Samples 1270D-1R-1 16-18 cm and 1270D-1R-1 75-78 cm

STRUCTURE:
Many small pieces of serpentinized porphyroclastic harzburgite and dunite are phacoidally shaped and have smooth outer surfaces with serpentine slickenfibers, suggesting a possible faults zone was drilled at this interval. These features are observed in Pieces 1-15. Pieces 13, 23, 25, and 27 are cut by magmatic pyroxene (or gabbroic) veins (MV), now very strongly altered. A strong crystal-plastic (CP) foliation is defined by the preferred dimensional orientation of pyroxene. Piece 10 contains a dunite band parallel to the crystal plastic foliation and bounded on both sides by harzburgite. Pyroxenites are commonly cut by early tapered orthogonal serpentine veins (Pieces 13 and 27). Piece 4 is an intensely deformed tremolite schist (DSZ) with strong foliation defined by shape preferred orientation of fibrous amphibole. Alteration veins are common in most pieces with at least two to three generations of serpentine veining and late oxide veining. Pieces 18, 19, and 27 exhibit crosscutting serpentine veins and Piece 16 has dark serpentine-magnetite vein cut by white serpentine vein. The last phase of serpentine fracture filling occurs in Piece 18 which shows serpentine slickenfibers that occur within an echelon zones. Piece 2 contains a fault (FT) with a sharp boundary between veined serpentine and serpentinized harzburgite. No sense of offset possible. Piece 4 exhibits a boudinaged/faulted serpentine vein. It is not possible to orient any of the pieces. Magmatic veins appear postkinematic with respect to the crystal plastic deformation, except for Piece 24 where it appears synkinematic. Crosscutting relationships indicate CP>MV>DSZ>SAV>FT.

Core Photo



209-1270D-2R-1 (Section top: 13.9 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1–8

COLOR: Green where harzburgitic, orange where clay weathered, gray where talc altered.

PRIMARY MINERALOGY:

Olivine	Mode 80%
Orthopyroxene	Mode 20%
	Size 2–10 mm
	Shape/Habit Anhedral
Spinel	Mode 1%

COMMENTS: This section is similar to Section 1270D-1R-1and is composed of serpentinized porphyroclastic to mylonitized harzburgite intruded by gabbroic melts prior to mylonitization. Modal estimates of the mineral abundance are indicative of composition but not very reliable because of the strong deformation.

SECONDARY MINERALOGY:

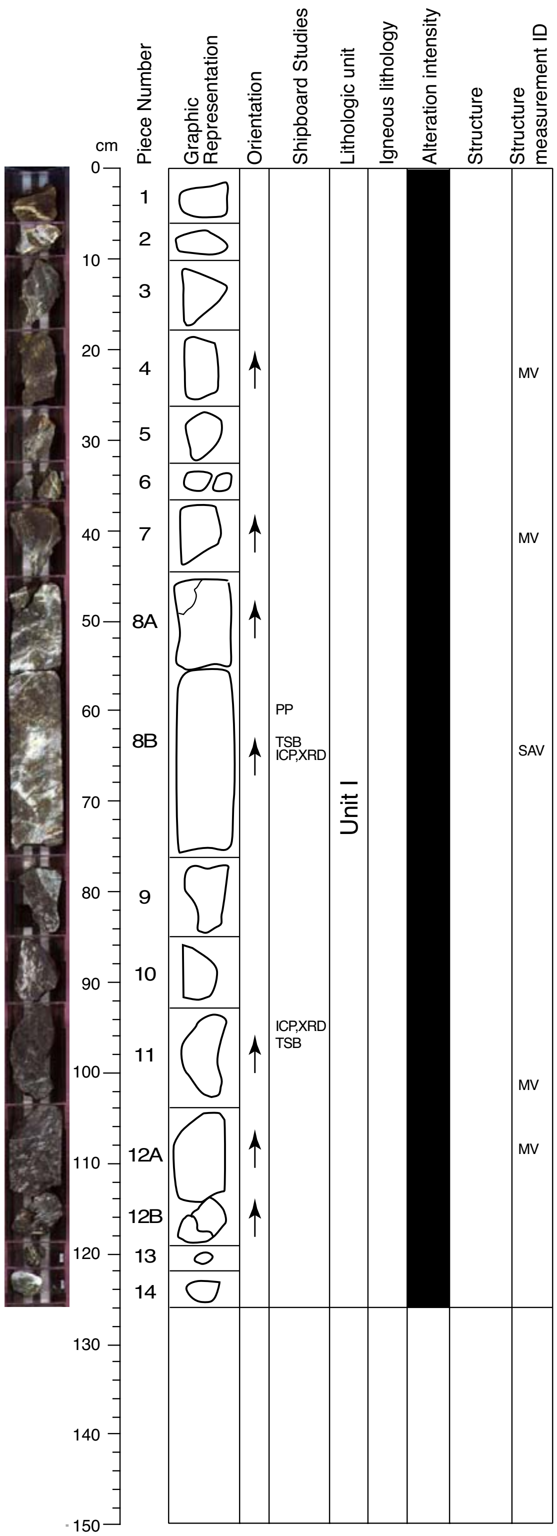
This section shows similar features to Section 1270D-1R-1, with serpentinization (Piece 6), talc alteration (Pieces 7 and 8) and weathering to Fe oxides/hydroxides. In Piece 6 completely altered gabbroic veinlets occur within the harzburgite matrix.

VEINS:

Throughout the section veining is infrequent. Where present it includes chrysotile and iron oxides/hydroxides in varying proportions (as much as 50% iron oxides/hydroxides in Piece 5). Despite having very similar mineralogy the veins throughout the section show a great deal of color variability. This ranges from green in the less altered gabbro of Piece 6 to mostly red/brown in the highly weathered (?) Piece 5.

STRUCTURE:
The section consists of highly weathered and altered serpentinized harzburgite with porphyroclastic texture. Piece 5 contains a composite pyroxenite/gabbroic vein. Pieces 6 and 8 contain pyroxenite veins. Pieces 5 and 6 seem especially riddled with these veins, which appear mylonitized without significantly affecting the adjacent harzburgite. Pieces 4 and 6 also contains tapered serpentine cross-fibered veins (SAV) orthogonally crosscutting the deformed pyroxenites and tapering into serpentinized peridotite. Later hematite/smectite veins commonly cut serpentine veins. Deformed magmatic vein foliations in Pieces 5 and 6 are somewhat oblique to the CP foliation within the harzburgite. Ductile shearing of gabbro veins is overprinted by semi-brittle to brittle shear (CC) in Pieces 4, 5, 6, and 8. Crosscutting relationships indicate CP>MV>SAV>CC

Core Photo



209-1270D-3R-1 (Section top: 18.90 mbsf)

2UNIT I: Harzburgite/dunite with gabbro

Pieces 1–14

COLOR: Green where harzburgitic, gray where gabbroic.

PRIMARY MINERALOGY:

Olivine	Mode 65%–80%
Orthopyroxene	Mode 20%–25%
	Size 2–10 mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 3%–4%
	Size 2 mm
	Shape/Habit Interstitial
Spinel	Mode 1%

COMMENTS: This section is composed of serpentinized porphyroclastic to mylonitized harzburgite intruded by gabbroic melts prior mylonitization (deformation is somewhat less than cores up section). Large harzburgite porphyroclastic domains are preserved showing that the primary grain size was coarse and granular. Fresh clinopyroxene has been found in thin section (Sample 1270D-3R1, Piece 11, 94-97 cm) in discontinuous parallel veins cutting through the serpentine matrix.

SECONDARY MINERALOGY:
In this section completely serpentinized harzburgite is intensively intruded by irregular gabbroic dikelets. The gabbroic material is completely altered to albite + chlorite/smectite. Locally prehnite may be present. Some Fe-oxides in Pieces 1-5 are due to minor weathering.

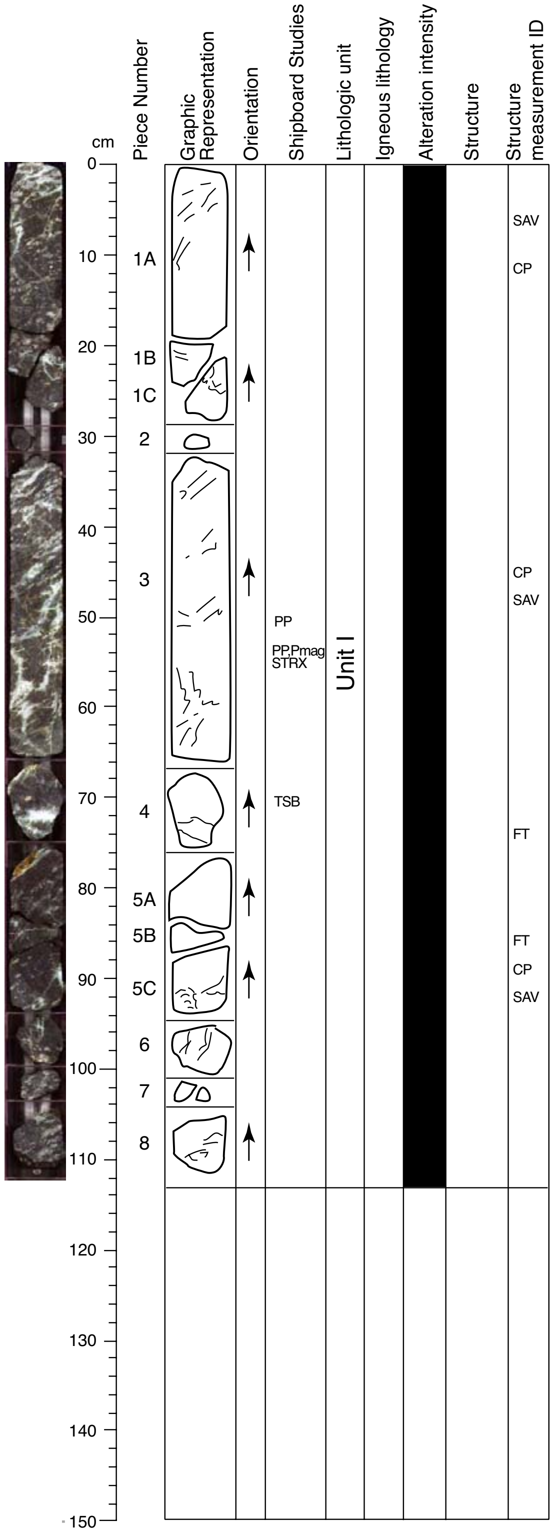
VEINS:
Sigmoidal, semi-continuous, en echelon serpentine veins that crosscut, and are perpendicular to, former igneous features and mylonite zones dominate the veins in this section. These serpentine veins commonly contain varying proportions of hematite, either as rims or as cores completely surrounded by more massive serpentine. A very fine network of hematite veinlets is also present which crosscuts both the sigmoidal serpentine veins and the former igneous and mylonitic structures. Hematite veinlets join serpentine veins and appear to use them to propagate.

THIN SECTIONS: Samples 1270D-1R-1, 63-65 cm and 1270D-1R-1, 94-97 cm.

STRUCTURE:

The section consists of serpentinized harzburgite in which foliation and porphyroclastic textures are better-developed downhole (Pieces 8-14). The foliation in oriented pieces is inclined approximately 30 degrees to the cut core face. Pieces 2-12 and 14 are characterized by pyroxenitic or composite pyroxenite-gabbro magmatic veins. Piece 2, 7 and 8 are especially permeated with magmatic vein material. Piece 8 has a white clot, which was probably gabbroic in the center of the pyroxenite veins, but now it is completely altered. Magmatic veins in Pieces 2, 5, 7, and 8 are deformed and mylonitized during crystal plastic deformation and are therefore synkinematic with respect to ductile deformation. Thin magmatic veins cut obliquely to the foliation within harzburgite in Pieces 2-5, 7-12, and 14. Piece 8 has a network of magmatic veins that are generally near parallel to the foliation at top and base of the piece, with some crosscutting branches. The near-parallel veins appear to localize deformation within the section. Ductile shear zones in gabbro veins are overprinted by semi-brittle to brittle shear in Pieces 1 and 2. Discrete microfaults with less than 0.2 cm offset are present in Pieces 3, 5, 6, and 7. At least two generations of serpentine alteration veins (SAV) are present, but alteration veining is generally only of moderate intensity, except when related to the magmatic veins. Pieces 1, 3, 4, 7, and 12 also contain tapered serpentine veins orthogonally crosscutting magmatic veins. Late hematite veins are also present.

Core Photo



209-1270D-3R-2 (Section top: 20.16 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1–8

COLOR: Green where harzburgitic, gray where gabbroic.

PRIMARY MINERALOGY:

Olivine	Mode 75%–90%
Orthopyroxene	Mode 10%–25%
	Size 2–15mm
	Shape/Habit Anhedral
Clinopyroxene	Mode 2%?
Spinel	Mode 1%

COMMENTS: This section is similar to Sections 1270D-1R-1 to 209-1270D-3R-1 and consists of serpentinized porphyroclastic to mylonitized harzburgite intruded by gabbroic melts prior to mylonitization. Large harzburgite porphyroclastic domains are preserved showing that the primary grain size was coarse and granular. A 1.5-cm thick dunite layer with relics of orthopyroxene and a big spinel grain is present in Piece 4 at 68-71 cm. Modal estimates are not reliable because of the strong deformation.

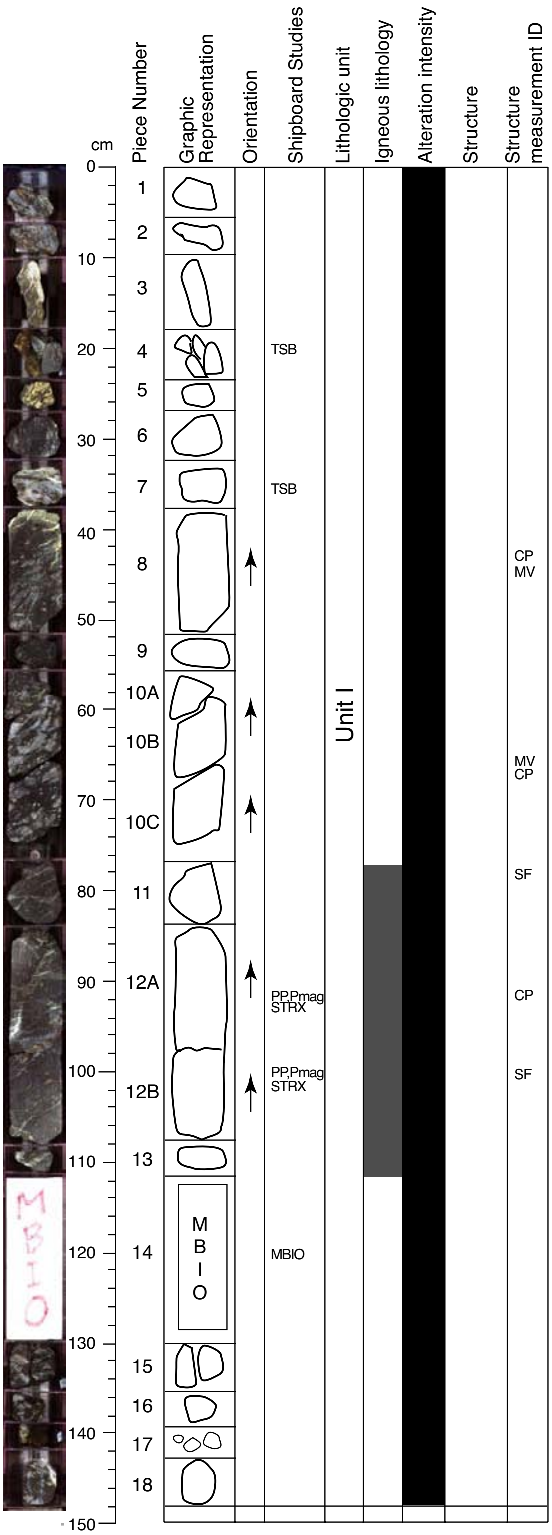
SECONDARY MINERALOGY:
The mottled appearance in this section is due to the abundance of white irregular completely altered gabbroic dikelets within the harzburgite. Locally minor fresh olivine is present.

VEINS:
Veining is reasonably uniform throughout this core and comprises two vein generations in varying proportions. Light green semi-continuous serpentine veins, oriented perpendicular to the fabric of the pervasive igneous intrusions, dominate the veining. A small amount of hematite is commonly present either in cores of sigmoidal veins or around their margins. Pieces 2-8 contain a fine network of hematite veins that crosscut all other features in this section, but in places join with serpentine veins and propagate either parallel to or actually within these sigmoidal veins. Rare pockets of chrysotile fibers are still present within the serpentine veins.

THIN SECTIONS: Sample 1270D-3R-2, 68-71 cm.

STRUCTURE:
The section consists of porphyroclastic harzburgite cut by many pyroxenitic and gabbric magmatic veins (PMV and GMV), some of which are involved in high temperatue mylonitzation. They appear to localize strain to the confines of the vein or the immediately adjacent wall rock. In some pieces they are particularly dense (e.g., Pieces 1 and 3). Straight and irregular veins that approach the foliation plane of the harzburgites in terms of orientation, typically form ductile shear zones within the vein and parallel to the vein margin. In thin section the veins are characterized by mylonitized plagioclase and clinopyroxene that has been replaced by brown amphibole. Brown amphibole forms the predominant porphyroclasts, with plagioclase usually recrystallized. The deformed vein material incorporates euhedral to subhedral zircon and apatite indicating somewhat eveolved compositions of melt within some of the veins that have been mylonitized at amphibolite facies of above. Deformation appears to continue into the upper greenschist facies. Magmatic veins cut all pieces in the section and many have been transposed as schlieren into the foliation plane, but some remain undeformed. Deformed veins typically show banded structure, typical of mylonites, parallel to the vein walls. The veins typically engulf enclaves of harzburgite which appear stronger and less deformed than the mylonitized veins, still preserving coarser porphyroclastic textures. The enclaves are less recrystallized and preserve coarser grain sizes of olivine and pyroxne in excess of 4 mm. The crystal plastic (CP) foliation is inclined 32 degrees within harzburgite in the cut face of the core. Thicker magmatic veins tend to be oriented subparallel to pyroxene foliation in the harzburgites and thinner veins cut steeply across foliation and appear to join thicker ones Piece 1A contains a thinner (pyroxenite) vein cut and offset by a thicker (gabbroic) vein. The gabbroic vein is sheared and apparently produces the offset, which indicates a reversed sense on the cut face of the core. Many of the magmatic veins are cut by orthogonal sets of serpentine alteration veins (SAV1), which are in turn cut by later green to white serpentine talc alteration veins (SAV2) Magmatic vein formation appears synkinematic with respect to crystal plastic deformation. Alteration veins are typically postkinematic with respect to the crystal plastic deformation. Narrow discrete fault surfaces with slickenfibers indicating strike slip motion are present in Pieces 4 and 5. Pieces 1 through 8 contain sporadic concentrations of shear fractures with little or not offset near boundaries of gabbroic veins. The top of Piece 5 is a mylonitized magmatic pyroxenitic vein coated with slickenfibers on the top of the piece. The slickenfibers are made of serpentine with the surface inclined 45° in the cut face of the core. The slickenfibers are nearly horizontal on the inclined fault (FT) surface and would indicate strike-slip motion in the present day reference frame. Offset could not be determined on the fault. Crosscutting relationships indicate CP> MV>SAV1>SAV2>FT.

Core Photo



209-1270D-4R-1 (Section top: 23.40 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1–18

COLOR: Green where harzburgitic, gray where gabbroic.

PRIMARY MINERALOGY:

Olivine	Mode 85%–90%
Orthopyroxene	Mode 10%–15%
	Size 2–10 mm
	Shape/Habit Anhedral
Spinel	Mode 1%

COMMENTS: This section consists of serpentinized porphyroclastic to mylonitized harzburgite intruded by gabbroic melts prior to mylonitization. The strong deformation of the rock makes the modal estimates unreliable. The upper part of the section (0 to 77 cm) and the lower part (last 20 cm of the section) are very deformed with harzburgite domains preserved within the network of gabbroic intrusion(s). Coarse-grained clasts of recrystallized olivine have been observed in thin section (Sample 1270D-4R-1, 33-37 cm). Between 77 and 112 cm the harzburgite looks less deformed and orthopyroxene is distributed in bands. Between 112 and 131 cm a sample for microbiology analyses was taken. Orthopyroxenes and spinels appear to be fresh throughout the section. Abundant zircons have been found in thin section in Piece 7 (Sample 1270D-4R-1, 33-37 cm) within the gabbroic domains.

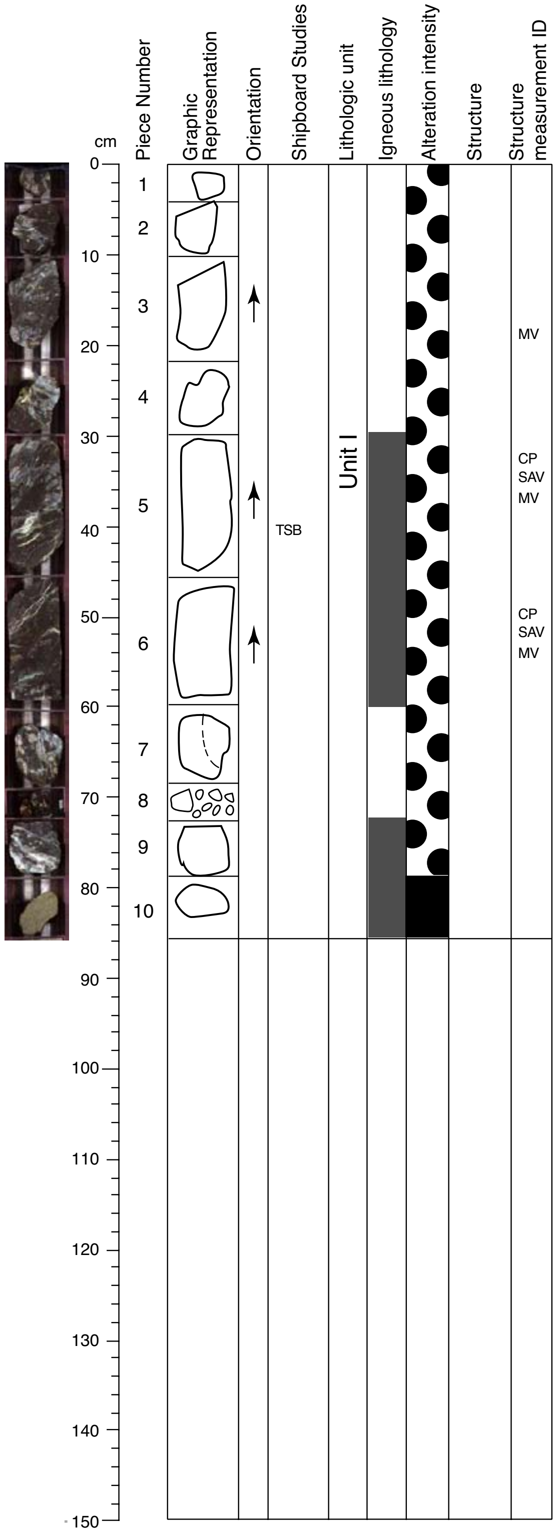
SECONDARY MINERALOGY:
This section is mainly composed of highly serpentinized, slightly weathered harzburgite with significant relict olivine and orthopyroxene in reddish-black patches. Rodingitized gabbro veins are developed in Pieces 4-7 and 9. In Piece 5 and 9 these are sigmoidal and orientated ± parallel to the foliation. Gabbro is dominated by Ca-silicates and chlorite. Some veins (Piece 6) change in mineralogy from amphibole-rich to chlorite-prehnite rich.

VEINS:
The veining in this section, like the other sections at Hole 1270D, is dominated by serpentine/chrysotile veining ± varying proportions of hematite. Vein distribution and morphology also change systematically down the section. At the top are two generations of serpentine/chrysotile veins that appear to be closely related in terms of their composition and time of emplacement. Further down the core (e.g., Pieces 8-13) these two generations appear to be a single continuous generation of veins with fine cross-fiber chrysotile vein networks extending from the tips of the more massive sigmoidal veins. Rare magnetite may be present in less heavily oxidized chrysotile veins (e.g., Piece 7). Hematite veins form a fine network that either crosscuts or joins earlier generations of serpentine/chrysotile veins and therefore postdates them. By Piece 8 this fine-grained network becomes so intense as to grade into the background iron oxide / hydroxide alteration.

THIN SECTIONS: Samples 1270D-4R-1, 33-37 cm and 1270D-4R-1, 19-22 cm.

STRUCTURE:
The section consists of porphyroclastic harzburgite cut by many pyroxenitic and gabbric magmatic veins (PMV and GMV), some of which are involved in high temperatue mylonitzation. They appear to localize strain to the confines of the vein or the immediately adjacent wall rock. In some pieces they are particularly dense (e.g., Piece 3 and 7). Straight and irregular veins that approach the foliation plane of the harzburgites in terms of orientation, typically form ductile shear zones within the vein and parallel to the vein margin. In thin section the veins are characterized by mylonitized plagioclase and clinopyroxene that has been replaced by brown amphibole. Brown amphibole form the predominant porphyroclasts, with plagioclase usually recrystallized. The deformed vein material incorporates euhedral to subhedral zircon and apatite indicating somewhat evolved compositions of melt within some of the veins that have been mylonitized at amphibolite facies of above. Deformation appears to continue into the upper greenschist facies. Magmatic veins cut all pieces in the section and many have been transposed as schlieren into the foliation plane, but some remain undeformed. Deformed veins typically show banded structure, typical of mylonites, parallel to the vein walls. The veins typically engulf enclaves of harzburgite which appear stronger and less deformed than the mylonitized veins, still preserving coarser porphyroclastic textures. The enclaves are less recrystallized and preserve coarser grain sizes of olivine and pyroxne in excess of 4 mm. The crystal plastic (CP) foliation is inclined 30 degrees within harzburgite in the cut face of the core. Thicker magmatic veins (Piece 7) tend to be oriented subparallel to pyroxene foliation in the harzburgites and thinner veins cut steeply across foliation and appear to join thicker ones. Serpentine veins are generally only of moderate intensity and intimately associated with the magmatic veins, At least two generations of serpentine veins visible in Pieces 8, 10, and 12. Late oxide veins are also present. Most of the pale green serpentine veins orthogonally crosscut the magmatic veins with good examples visible in Pieces 11, 12, and 15. Piece 8 shows reverse faulting of serpentine vein. Dilatational cross fibers are present in chrysotile veins in Pieces 7 and 8. Piece 8 contains a narrow, high-intensity semi-brittle tremolite-talc schist shear zone that likely is overprinting a gabboic vein. Ductile shear zones in Pieces 2, 12, and 15 are overprinted by minor degrees of brittle and/or semi-brittle strain. Weak to moderate cross-fiber serpentine foliation intensity is present in Pieces 11, 12, and 13. Crosscutting relationships indicate CP> MV>SAV1>SAV2>FT.

Core Photo



209-1270D-4R-2 (Section top: 24.90 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1–10

COLOR: Green where harzburgitic, gray where gabbroic.

PRIMARY MINERALOGY:

Olivine	Mode 80%
Orthopyroxene	Mode 20%
	Size 2–10mm
	Shape/Habit Anhedral
Spinel	Mode 1%

COMMENTS: This section (as the previous cores of Hole 1270D) is composed of serpentinized porphyroclastic to mylonitized harzburgite mixed with gabbroic dikes. Two thin intervals of dunite are present in the sequence between 43-50 cm and 79-86 cm. Trains of spinel not parallel to mylonitization have been observed in the harzburgite. Coarse-grained clasts of recrystallized olivine were found in thin section (Sample 1270D-4R-2, Piece 5, 38-43 cm).

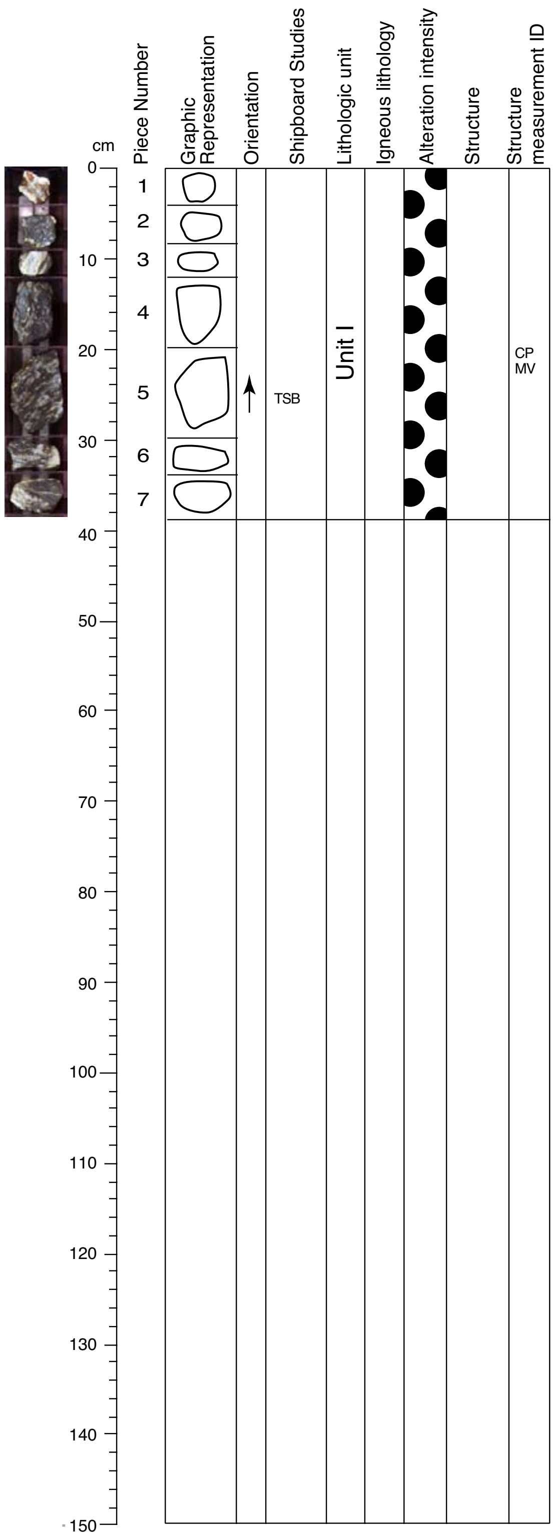
SECONDARY MINERALOGY:
This section is mainly composed of highly serpentinized, slightly weathered harzburgite with significant relict olivine and orthopyroxene in reddish-black patches. Rodingitized gabbro veins are developed in Pieces 4-7, and 9. In Piece 5 and 9 these are sigmoidal and orientated ± parallel to the foliation. Gabbro is dominated by Ca-silicates and chlorite. Some veins (Piece 6) change in mineralogy from amphibole-rich to chlorite-prehnite rich.

VEINS:
Veining in this section of core is dominated by serpentine/chrysotile veins, (possibly two semi-continuous generations), that appear to be strongly related to the deformation events to which the rock has been subjected. Throughout the core a set of sigmoidal serpentine veins are present oriented perpendicular to shear zones with the orientation of their tips providing clear evidence of shear sense. At greater distances from the shear zone chrysotile veins with cross fibers are oriented subparallel to shear zones. In Pieces 1 to 3 the tips of the sigmoidal veins crosscutting the shear zone are commonly filled with chrysotile cross fibers and extend into a branched network of chrysotile veins (elsewhere described as a separate generation). This suggests that most of the serpentine veins in this core are roughly synchronous and associated with the deformation event(s). Locally, e.g., Pieces 4 to 6, a very fine network of hematite veins transitional to the highly oxidized background alteration is also present.

THIN SECTIONS: Sample 1270D-4R-2, 38-43 cm.

STRUCTURE:
The section conists of porphyroclastic harzburgite and dunite (Pieces 11) cut by many pyroxenitic and gabbric magmatic veins (PMV and GMV), some of which are involved in high temperatue mylonitzation. They appear to localize strain to the confines of the vein or the immediately adjacent wall rock.. In some pieces they are particularly dense (e.g., Pieces 1 and 3). Straight and irregular veins that approach the foliation plane of the harzburgites in terms of orientation, typically form ductile shear zones within the vein and parallel to the vein margin. In thin section the veins are characterized by mylonitized plagiocclase and clinopyroxene that has been replaced by brown amphibole. Brown amphibole form the predominant porphyroclasts, with plagioclase usually recrystallized. The deformed vein material incorporates euhedral to subhedral zircon and apatite indicating somewhat eveolved compositions of melt within some of the veins that have been mylonitized at amphibolite facies of above. Deformation appears to continue into the upper greenschist facies. Magmatic veins cut all pieces in the section, except Piece 6 and Piece 10) and many have been transposed as schlieren into the foliation plane, but some remain undeformed. Deformed veins commonly show banded structure, typical of mylonites, parallel to the vein walls. Some veins appear to be composites of gabbro (center) and pyroxenite (e.g., Piece 5). The veins typically engulf enclaves of harzburgite which appear stronger and less deformed than the mylonitized veins, still preserving coarser porphyroclastic textures. The enclaves are less recrystallized and preserve coarser grain sizes of olivine and pyroxne in excess of 4mm. The strong crystal plastic (CP) foliation is inclined 45° within harzburgite in the cut face of the core. Serpentine veins are generally only of moderate intensity and intimately associated with the magmatic veins. Two generations of serpentine veins visible in pieces 3 and 6. Late oxide veins also present. Some of the pale green serpentine veins orthogonally crosscut the magmatic veins with good examples visible in Pieces 2 and 3. Pieces 1 and 2 shows normal faulting of serpentine vein. Ductile shear zones within veins appear to have been overprinted by variable degrees of brittle to semi-brittle shear. There is a weak cross fiber serpentine foliation in Piece 10. Magmatic vein formation appears synkinematic with respect to crystal plastic deformation. Alteration veins are typically postkinematic with respect to the crystal-plastic deformation. Crosscutting relationships indicate CP> MV>SAV1>SAV2>FT.

Core Photo



209-1270D-5R-1 (Section top: 28.40 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1–7

COLOR: Green where harzburgitic, gray where gabbroic.

PRIMARY MINERALOGY:

Olivine	Mode 80%
Orthopyroxene	Mode 20%
	Size 2–10mm
	Shape/Habit Anhedral
Spinel	Mode 1%

COMMENTS: This section is composed of serpentinized porphyroclastic to mylonitized harzburgite intruded by gabbroic melts prior mylonitization. Because of the amount of deformation and recrystallization, however, the modal composition is not reliable. Large harzburgite domains are preserved showing that the primary grain size was coarse and granular. Neoblasts of orthopyroxene recrystallized associated with recrystallized olivine have been observed in thin section (Sample 1270D-5R-1, Piece 5, 23-28 cm)

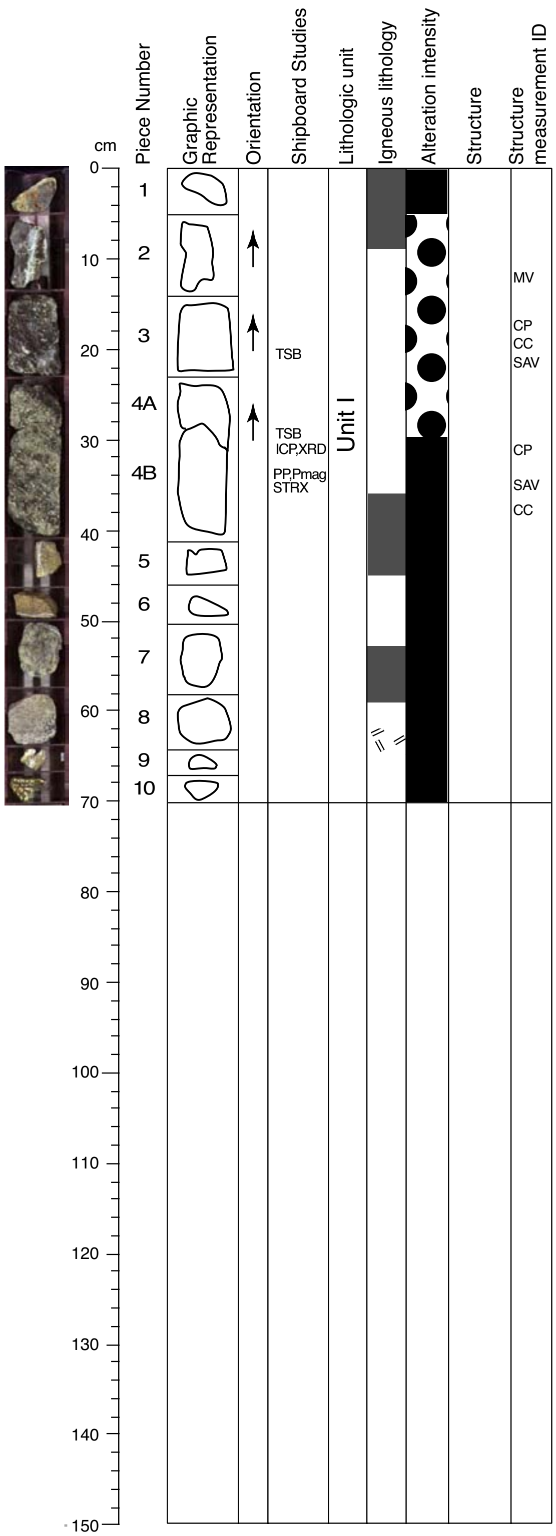
SECONDARY MINERALOGY:
This section consists of highly altered harzburgite containing abundant amounts of fresh olivine and orthopyroxene. Piece 2 has a sulfide veinlet and Piece 1 is highly Fe-oxide weathered. Pieces 3 and 7 show rodigitization and the gabbroic intrusion appears to be sheared, producing foliation.

VEINS:
Sigmoidal, semi-continuous serpentine veins dominate the veining in this core and account for up to 3% of its volume. Mostly they are subparallel to the foliation of the rock (shear induced?) although rarely they are perpendicular to areas of shear and the orientation of the tips gives a good sense of shear direction. Piece 2 contains a generation of veins not previously encountered at Hole 1270D. A box-like network cuts a fresher area of serpentinized harzburgite that comprises pyrite, chalcopyrite, and hematite. Pyrite and chalcopyrite tend occur along the vein rims whereas hematite is commonly seen in the core. This is contrary to the relationship observed at Hole 1268A.

THIN SECTION: Sample 1270D-5R-1, 23-28 cm

STRUCTURE:
The section conists of porphyroclastic harzburgite and dunite (Pieces 11) cut by many pyroxenitic and gabbroic magmatic veins (PMV and GMV), some of which are involved in high temperature mylonitization. Most veins in this section have been transposed into the crystal plastic foliation direction in the harzburgite and appear as irregular schlieren, some with more felsic veins with brown amphibole nested within pyroxenitic or pyroxene-rich gabbroic material. In some cases, the original pyroxenitic vein material appears boudinaged. The gabbroic veins appear to localize strain to the confines of the vein or the immediately adjacent wall rock. In some pieces they are particularly dense (e.g., Piece 1, 3, and 7). Deformation appears to continue into the upper greenschist facies. Ductile deformation in a gabbro vein in Piece 1 appears to have been overprinted by minor semi-brittle deformation (SB) and growth of syntectonic greenschist-facies alteration minerals. Schlieren of deformed magmatic veins cut all pieces in the section. Deformed veins commonly show banded structure, typical of mylonites, parallel to the vein walls. The strong crystal plastic (CP) foliation is inclined ~45 degrees within harzburgite in the cut face of the core (in Piece 5). Serpentine veins are generally only of moderate intensity and intimately associated with the magmatic veins. Piece 3 shows serpentine veins bounding magmatic veins. Late oxide veins also present in Piece 4.Two generations of serpentine veins are visible in Piece 5. Crosscutting relationships indicate CP=MV>SB>SAV.

Core Photo



209-1270D-6R-1 (Section top: 32.90 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1-10

COLOR: Green where harzburgitic, gray where gabbroic.

PRIMARY MINERALOGY:

Olivine	Mode 75%–80%
Orthopyroxene	Mode 20%–25%
	Size 2–10mm
	Shape/Habit Anhedral
Spinel	Mode 1%

COMMENTS: This section is consists of mylonitic serpentinized harzburgite with gabbro dikes similar to all the cores above. Small harzburgite and dunite domains are preserved within the rocks cut by the gabbros dikelets, but are too small for reliable modal composition. Piece 4 is a beautiful example of porphyroclastic elongated to mylonitic harzburgite without any gabbro intrusion. Dunites are present in the upper and lower end of the core. Dunitic Piece 8 contains a 2 cm domain of anhedral interstitial orthopyroxene associated with spinel. A gabbroic dike is present in the dunite of Piece 2.

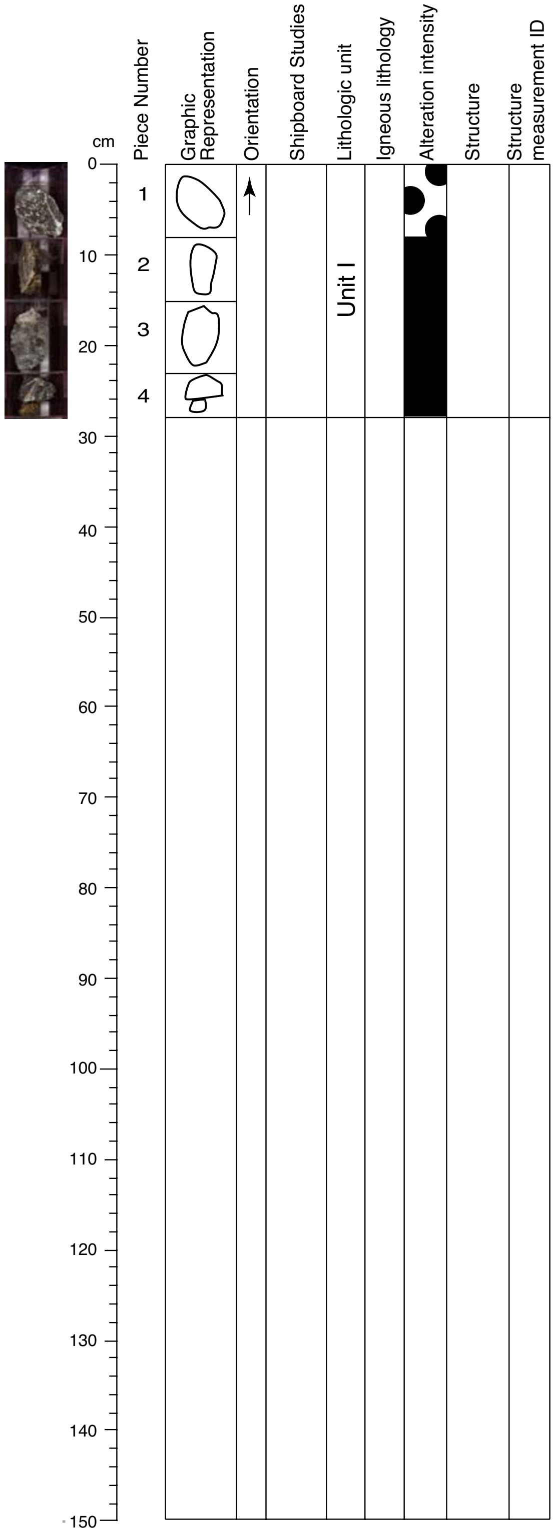
SECONDARY MINERALOGY:
This section is composed of highly to completely serpentinized harzburgite and dunite with high weathering overprinting Pieces 1, 5 and 6. In Pieces 6 and 8 weathering can be related to mm-wide veins of prismatic aragonite. Piece 2 contain a completely rodingitized gabbroic vein. Piece 2 and the top of Piece 4 have relict olivine and orthopyroxene.

VEINS:
Pieces 1 and 4A show a gently folded generation of serpentine (?) veins cut by late cross-fiber chrysotile veins subparallel to the foliation. Pieces 5 and 6 show a thick (3mm) vein of crystalline aragonite. A network of hematite veins occurs in Piece 10.

THIN SECTIONS: Samples 1270D-6R-1, 18-21 cm and 1270D-6R-1, 29-32 cm

STRUCTURE: The section conists of porphyroclastic harzburgite and ozthopyroxene-bearing dunite (Pieces 5 and 6). A large pyroxenitic vein (PMV) cuts Piece 2. Piece 9 is appears to be a fragment of gabbroic vein material. The pyroxenitic vein appears postkinematic with respect to a strong crystal plastic fabric in the harzburgite that is inclined at 50 degrees in the cut face of the core. Pieces 4, 7 and 8 contain well-developed cross fiber serpentine foliation (SF). Two generations of crosscutting serpentine alteration veins (SAV) are associated with magmatic veins. Serpentine veins in Piece 1 are cut by a fault (FT) with normal slip. Pieces 3 to 10 show limited serpentine veining. Pieces 5, 6, 7, and 8 are cut by sparse late aragonite veins and Piece 10 contains a network of oxide/smectite veins. Piece 9 is cut by a zone of dense fracturing with incipient brecciation. Piece 1 is cut by several sets of closely spaced shear fractures with little offset. Crosscutting relationships indicate CP>MV>SB>SF>SAV>CC

Core Photo



209-1270D-7R-1 (Section top: 37.90 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1–4

COLOR: Green where harzburgite, gray where gabbroic.

PRIMARY MINERALOGY:

Olivine	Mode 80%
Orthopyroxene	Mode 20%
	Size 2–8mm
	Shape/Habit Anhedral
Spinel	Mode 1%

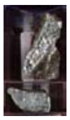
COMMENTS: This short section consists of mylonitic serpentinized harzburgite with gabbro dikes similar to previous cores of Hole 1270D.

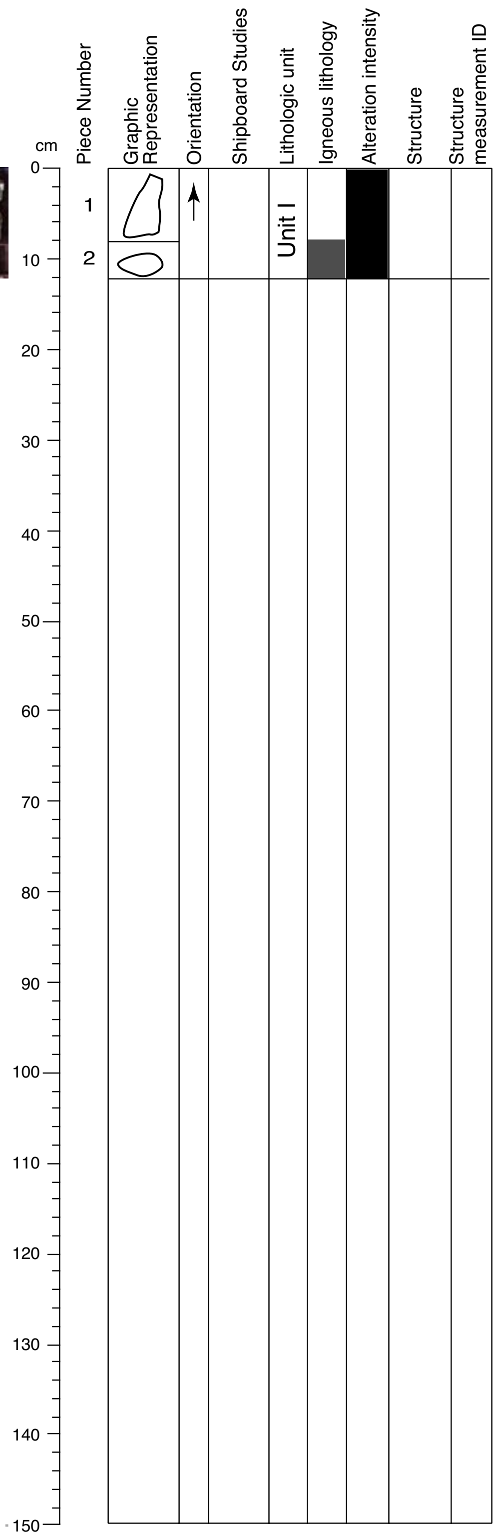
SECONDARY MINERALOGY:
This section consists of four pieces of variably oxidized very highly to completely serpentinized harzburgite. Piece 2 has a gabbroic vein (identified by the presence of a stringer of hard Ca-silicate and dark gray hard amphibole). Piece 4 is cut by a dark, hard vein that could be amphibolite (clinopyroxene?).

VEINS:
The veining in this section of the core is predominantly chrysotile. In Piece 4 this is developed parallel to the mylonitic foliation. A former clinopyroxenite metamorphosed to amphibolite may be present in Piece 4.

STRUCTURE:
The section consists of strongly porphyroclastic harzburgite with schlieren of magmatic vein material (pyroxenite and gabbro) that appear deformed and transposed into an orientation close to the crystal plastic foliation plane or somewhat oblique to it. All pieces are unoriented. A small felsic vein cuts across schlieren in Piece 1. An aragonite vein cuts Piece 3 and serpentine alteration veins cut Pieces 1,2, and 4. Pale green serpentine and white chrysotile is visible in Piece 4. Ductile shear zones within gabbro veins in Pieces 2 and 4 are overprinted by semi-brittle deformation. Schistose alignment of tremolite and talc within gabbro veins suggests some greenschist-facies deformation. Crosscutting relationships indicate CP>MV>SAV.

Core Photo





209-1270D-8R-1 (Section top: 42.40 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1–2

COLOR: Green where harzburgitic, light gray where rodingitized.

PRIMARY MINERALOGY:

Olivine	Mode 80%
Orthopyroxene	Mode 20%
	Size 2–8mm
	Shape/Habit Anhedral
Spinel	Mode 1%

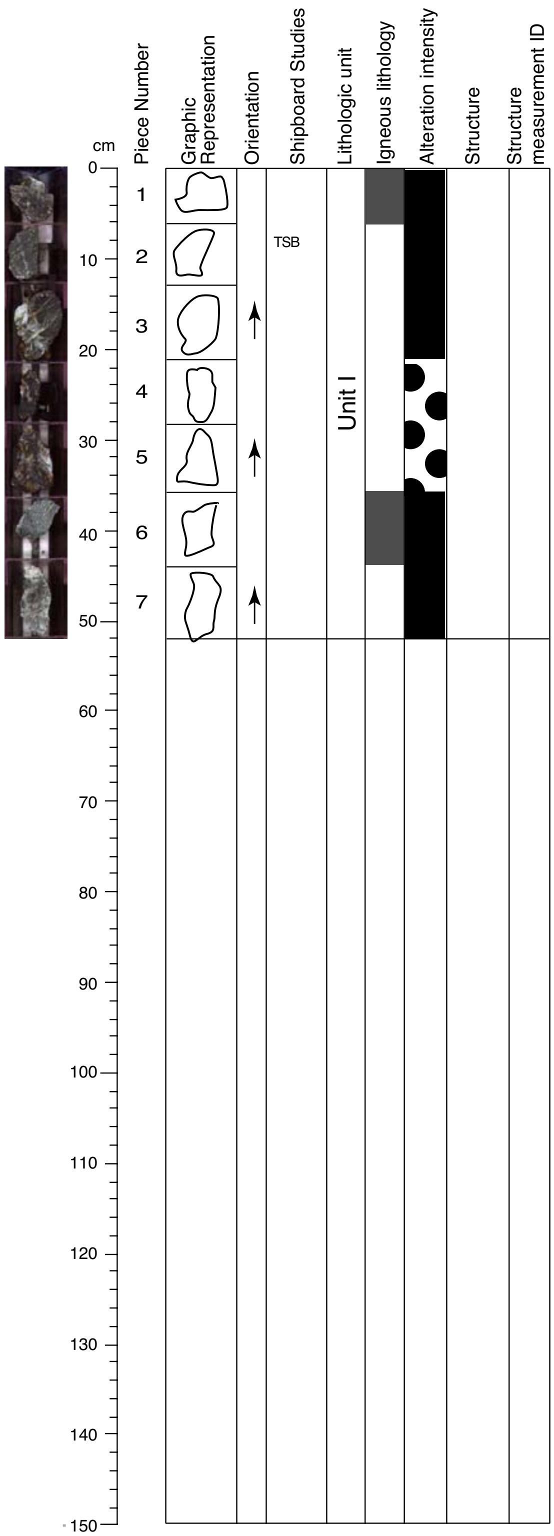
COMMENTS: This section consists of two samples. The first sample is mylonitic serpentinized harzburgite with a thick gabbro dike. Because of the size of the sample and the thickness of the dike we could not attempt a modal estimation of mineral phases. The second sample is a dunite with a few dispersed crystals of orthopyroxene.

SECONDARY MINERALOGY:
This section consists of two small pieces of completely serpentinized harzburgite with a 1 to 1.5 cm wide rodingitized gabbro vein in Piece 1. Rodingitization alters plagioclase into white, hard Ca-silicates and chlorite and orthopyroxene into amphibole, diopside (green glassy), and chlorite with some talc. Orthopyroxene in a red halo has some amphibole and talc.

VEINS:
The two pieces of this core are rodingitized, the bottom piece of which is dunite with infrequent serpentine veins.

STRUCTURE:
The section consists of two pieces of porphyroclastic serpentinized harzburgite with strong crystal plastic (CP) foliations. Piece 1 is cut by a postkinematic altered gabbro and pyroxenitic magmatic vein (MV) with euhedral to subhedral laths of plagioclase. Piece 1 is cut by a green serpentine alteration vein (SAV) that also cuts the gabbro vein. Piece 2 is cut by a planar white chrysotile vein. Later a brittle fault (FT) displaced the alteration vein systems. Crosscutting relationships demonstrate CP>MV>SAV>FT.

Core Photo



209-1270D-9R-1 (Section top: 47.40 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1–7

COLOR: Green

PRIMARY MINERALOGY:

Olivine	Mode 80%–85%
Orthopyroxene	Mode 15%–20%
	Size 2–8mm
	Shape/Habit Anhedral
Spinel	Mode 1%

COMMENTS: This section consists mostly of mylonitic serpentinized harzburgite crossed by gabbro dikes similar to previous cores of Hole 1270D, alternating with porphyroclastic harzburgite with orthopyroxene-rich bands. One sample of dunite is found between 37 and 44 cm. Interstitial clinopyroxene in discontinuous domains cutting through the serpentinite matrix has been observed in thin section (Sample 1270D-9R-1, 7-10 cm). Because of the amount of deformation and recrystallization the modal composition is not very reliable.

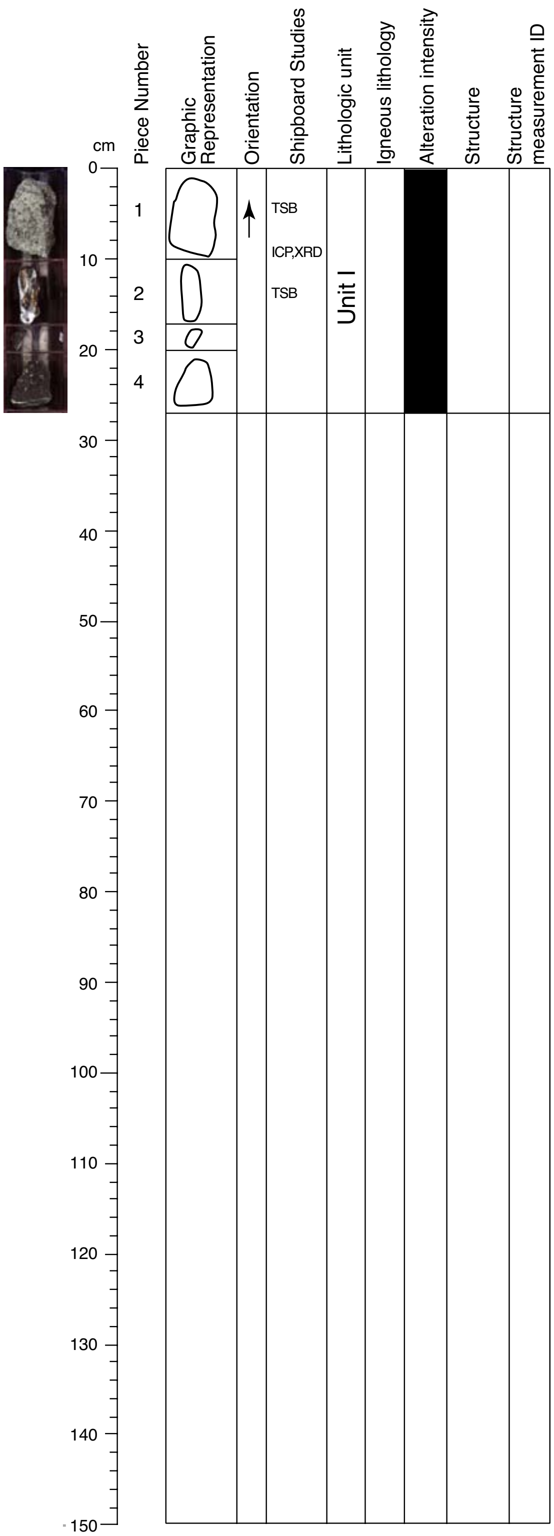
SECONDARY MINERALOGY:
This section includes very highly to completely serpentinized harzburgite with patchy weathering overprint partially iddingsitizing(?) the relict olivine. Piece 3 includes a boudinaged gabbroic vein that is cut by swarms of late serpentine veins.

VEINS:
Veining in this section of the core is most intense in Piece 3 where up to three generations of veining is present. Massive serpentine appears to be crosscut by wispy sigmoidal cross-fiber chrysotile that in places also runs parallel and within the massive serpentine veins. Rare hematite veins are also present, both as discrete veins (100% hematite), and where they appear to use generation 2 as a conduit (hence <30% chrysotile in places).

THIN SECTION: Sample 1270D-9R-1, 7-10 cm

STRUCTURE:
The section consists of porphyroclastic serpentinized harzburgite. Schlieren of altered pyroxenitic and gabbroic magmatic veins subparallel to the crystal-plastic foliation in the harzburgite and croscutting veins are oberved in Pieces 1, 3-5. Pieces 2, 6, and 7 are devoid of these features. Most magmatic veins appear plastically deformed and cut by numerous serpentine veins. Piece 4 appears to contain brown amphibole within the magmatic veins. Pieces 1, 3, 4, and 5 are cut by serpentine alteration veins associated with magmatic veins. Piece 3 reveals three generations of crosscutting serpentine veins. Pieces 2, 6, and 7 exhibit small white serpentine veins parallel to the serpentine foliation (SF), which is a nearly planar serpentine-magnetite foliation in the section best displayed in Pieces 2 and 3. Pieces 1, 4, 5, and 6 are cut by a semibrittle shear zones. Some of the pieces are shaped as phacoids with evidence of semi-brittle shear rimming each. Crosscutting relationships indicate CP>MV>SF>SAV.

Core Photo



209-1270D-10R-1 (Section top: 51.60 mbsf)

UNIT I: Harzburgite/dunite with gabbro

Pieces 1–4

COLOR: Green

PRIMARY MINERALOGY:

Olivine	Mode 85%–95%
Orthopyroxene	Mode 15%–20%
	Size 2-8mm
	Shape/Habit Anhedral
Spinel	Mode 1%

COMMENTS: This short section consists of serpentinized harzburgite. Piece 1 is a dunite with bands enriched in orthopyroxene and spinel. Piece 2 is a small sample of mylonitic serpentinized harzburgite cut by gabbro dikes similar to cores higher in this hole. Apatite dispersed in the gabbroic intrusion has been observed in thin section in Sample 1270D-10R-1, 11-17 cm. Pieces 3 and 4 are mylonitic to porphyroclastic serpentinized harzburgite similar to Piece 2 but with very small amount of gabbro dikes.

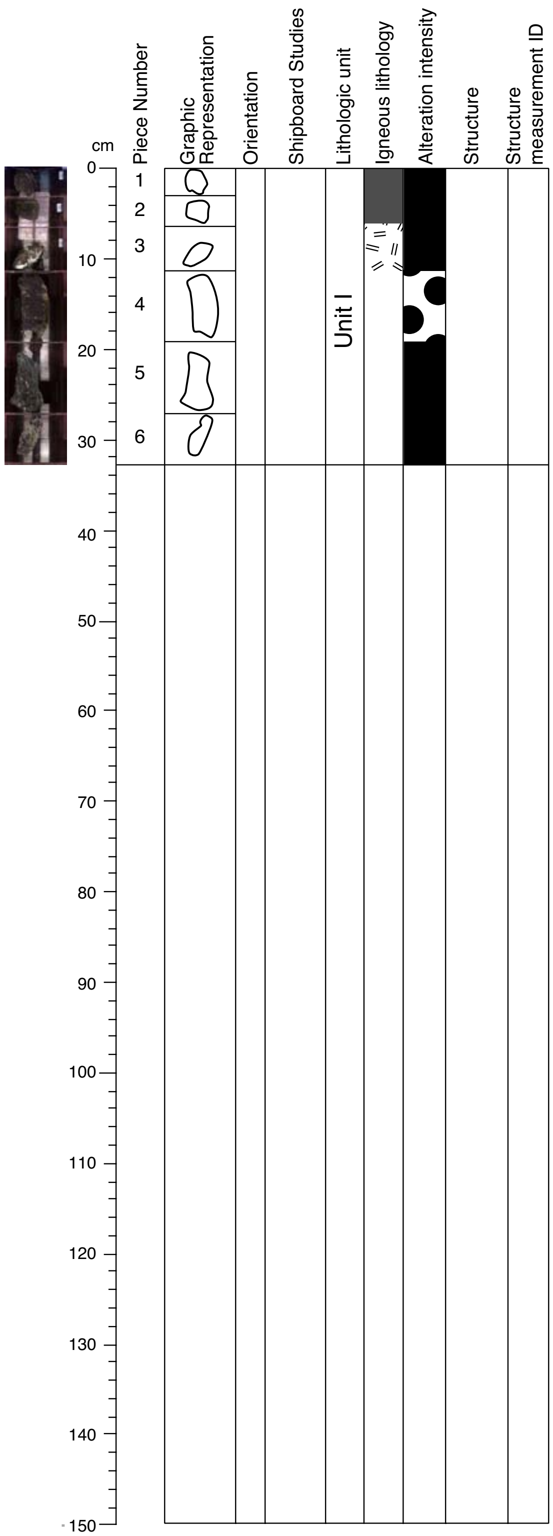
SECONDARY MINERALOGY:
This section consists of completely serpentinized harzburgite and sheared harzburgite. Piece 2 is strongly sheared and contains white completely altered rodingitized gabbro veins.

VEINS:
Most of this section of core contains no veins. Where present, e.g., Piece 4, they comprise paragranular sigmoidal veins of chrysotile.

THIN SECTIONS: Samples 1270D-10R-1, 4-6 cm and 1270D-10R-1, 11-17 cm.

STRUCTURE:
The section consists of serpentinized porphyroclastic harzburgite. The harzburgite is cut complexly by pyroxenitic and gabbroic veins or composite veins in Piece 2. The original magmatic veins in Piece 2 are now highly deformed and mylonitized. They appear to be composite veins of gabbro in the center rimmed by pyroxenite at the margins. Thin sections show that the vein material has been mylonitized at amphibolite facies or higher. The mylonites contain porphyroclasts of brown amphibole within a recrystallized matrix that is typically strongly altered to tremolite and talc. The mylonitized veins also contain zircon and apatite indicating an evolved composition that apparently localized strain within the harzburgite. The enclaves of harzburgite contained within the network of veins is not strongly affected by the deformation within the veins except at their margins where minor recrystallization of olivine or orthopyroxene or subgrain formation and rotation, and kinking of olivine occurs. Both Pieces 3 and 4 contain brittle shear zones (FT) with serpentine fibers (slickenfibers) parallel to the vein walls. Piece 4 contains a 0.5-cm wide zone of fine-grained cataclastic breccia with the slickenfibers on its face. Crosscutting relationships indicate CP=MV>SAV>FT=CC.

Core Photo



209-1270D-11R-1 (Section top: 56.60 mbsf)

UNIT 1: Harzburgite/dunite with gabbro

Pieces 1–6

COLOR: Green where harzburgitic, light gray where rodingitized.

PRIMARY MINERALOGY:

Olivine	Mode 80%–98%
Orthopyroxene	Mode 2%–20%
	Size 2–10 mm
	Shape/Habit Anhedral
Spinel	Mode 1%

COMMENTS: This section consists of serpentinized porphyroclastic to mylonitized harzburgite intruded by gabbroic melts prior to mylonitization as seen in previous cores of Hole1270D plus a 6 cm thick interval of dunite. Modal estimates of the mineral abundance are indicative of composition but not very reliable because of the deformation and recrystallization in the rock.

SECONDARY MINERALOGY:
This section consists of completely serpentinized harzburgite and dunite with minor Fe-oxides/hydroxides in Piece 4. A small Piece of gabbro (Piece 3) is completely altered (Ca-metasomatized).

VEINS:
Other than Piece 3, veining is volumetrically insignificant here. This core comprises six small pieces of what appear to be different textures. It is possible that these have fallen into the hole rather than been drilled.

STRUCTURE:
The section consists of serpentinized porphyroclastic harzburgite with the exception of Piece 3, which is a highly altered gabbroic rock. Pieces 1, 2, 3, and 4 are highly riddled with serpentine alteration veins. Pieces 1, 2, and 6 are cut be a very strong anastomosing serpentine foliation. Piece 2 is cut by hematite veins and Piece 1 shows at least two generations of serpentine alteration veins.

THIN SECTION: **209-1270A-1R-1, Piece 7, 35-38 cm** **TS#64** **Observer: MS**
ROCK NAME: **SERPENTINIZED HARZBURGITE**
GRAIN SIZE: **Coarse**
TEXTURE: **Porphyroclastic-mylonitic**

PRIMARY MINERALOGY	MODE (Visual estimate) PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)	MORPHOLOGY	COMMENTS
Olivine	0	74			
Orthopyroxene	0	25	1.0-10	Anhedral	Recrystallized into subgrains.
Clinopyroxene	0	?			
Spinel	0.8	1	<0.1-0.3	Rectangular, anhedral	Disseminated and vermiform with orthopyroxene.
Plagioclase	?	<1	0.2	Anhedral	Neoblast.

GENERAL COMMENTS
Beginning of mylonitization marked by fine-grained mosaic crosscutting some orthopyroxene porphyroclasts, and possibly contains plagioclase.
A few altered pyroxenes (<2%) could have been clinopyroxene.

SECONDARY MINERALS	PERCENT PRESENT	REPLACING	MORPHOLOGY	COMMENTS
Talc	1	Serpentine	Fibrous	In patch near contact to mylonite.
Serpentine	80	Olivine, orthopyroxene	20% bastite	Preserving kink banding.
Antigorite?	17	Serpentine	Interpenetrating needles in mylonite	
Magnetite	1	Olivine, spinel	Subhedral to euhedral	Along with serpentine in anastomosing veinlets.
Pyrite	Trace	Olivine, spinel	Subhedral to euhedral	After spinel along with magnetite. In blebs that could be recrystallized primary sulfides.

VEIN / FRACTURE FILLING	PERCENT PRESENT	MORPHOLOGY	COMMENTS

Early chrysotile vein that are in part cut by serpentine+ magnetite veins and are deformed into the mylonite.
Late chrysotile veins that crosscut earlier veins and into the mylonite.

STRUCTURE
Texture
Crystal Plastic:
Moderate crystal plastic deformation; significant kink banding of pyroxene and minor recrystallization and neoblast formation along kink bands.

Brittle:
Strong brittle and semi-brittle deformation fabrics; Sample contains a zone of antigorite mylonite in which shearing was accommodated by a combination of cataclasis of preexisting serpentine, diffusive mass transfer in the growth of fibrous antigorite, and crystal plastic deformation of antigorite.
Brittle deformation of serpentine and pseudomorphed pyroxene porphyroclasts increases near the boundary of the antigorite mylonite zone.

Joints:
Late shear fractures are filled with serpentine; cut mylonite.

Foliation:
Strong foliations defined antigorite mylonite is oblique to weak anastomosing ribbon serpentine foliation.

Crosscutting Relationships (as are apparent in thin section):
1) High temperature crystal plastic deformation of pyroxene
2) Serpentinization
3) Brittle deformation and formation of antigorite mylonite
4) Late shear fractures filled with serpentine veins

THIN SECTION:	**209-1270A-1R-1, Piece 18, 96-99 cm**	**TS#65**	**Observer: MS**
ROCK NAME:	**SERPENTINIZED HARZBURGITE WITH ORTHOPYROXENITIC LAYER**		
GRAIN SIZE:	**Coarse**		
TEXTURE:	**Porphyroclastic-mylonitic**		

	MODE (Visual estimate)				
PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	0	69			
Orthopyroxene	0	30	2.0-10	Anhedral	Ragged crystals.
Clinopyroxene	0				
Spinel	0.8	1	<0.1-1	Anhedral	
ORTHO-PYROXENITE					
Olivine	0	8	0.5-1.0	Anhedral	Interstitial to orthopyroxene.
Orthopyroxene	0	> 86	1-5	Anhedral	Recrystallization of very coarse (>10 mm) grains.
Clinopyroxene	0	2-3?	0.2-0.3	Interstitial	Possible.
Spinel	2.5	3	1-2	Anhedral	Co-crystallized with the orthopyroxene grains.

COMMENTS Totally altered, except spinel, harzburgite containing a cm-thick layer of orthopyroxene + spinel agregate, interpreted as recrystallized orthopyroxenite; some large altered pyroxenes could have been primary clinopyroxene. The rock displays a high temperature lineation (orthopyroxene layering).

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Serpentine	98	Olivine, orthopyroxene		Transitional texture, serrate veins.
Carbonate	Trace	Serpentine	Blotchy	Near clay veins.
Hematite	Trace	Serpentine	Anhedral	Along clay veins.
Magnetite	Trace	Olivine, orthopyroxene	Anhedral	
Tremolite	Trace	Orthopyroxene	Acicular	Rare very narrow rims around bastite.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	MORPHOLOGY	COMMENTS
Chrysotile veins.			
Clay veins, reopening chrysotile veins.			

STRUCTURE

Brittle:
Brittle shear zone cuts serpentinite in thin section, serpentine fibers grown oblique to walls of shear zone and truncated by partially healed shear fractures.

Foliation:
Very faint foliation defined by alignment of parallel magnetite veins formed during serpentinization.

Crosscutting Relationships (as are apparent in thin section):
1) Serpentinization
2) Brittle shear zone
3) Thin serpentine veins

THIN SECTION:	**209-1270A-4R-1, Piece 15, 54-56 cm**	**TS#66**	**Observer: MS / CG**	
ROCK NAME:	**SERPENTINIZED HARZBURGITE WITH AMPHIBOLE-BEARING PYROXENITIC DIKE**			
GRAIN SIZE:	**Coarse**			
TEXTURE:	**Granular-porphyroclastic**			

PRIMARY MINERALOGY	**MODE (Visual estimate)** PERCENT PRESENT	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	0	89			Also as euhedral inclusions in orthopyroxene.
Orthopyroxene	4	10	1.0-12	Anhedral, rounded	Recrystallized into subgrains.
Clinopyroxene	1	2	<0.1-1.0	Interstitial, rounded	At orthopyroxene subgrain grain boundaries and in matrix.
Spinel	0.8	1	<0.1-3	Anhedral	
ULTRAMAFIC DIKE					
Olivine	10	20	0.5	Anhedral	Small equant grains.
Orthopyroxene	10	20	0.5	Anhedral	Small equant grains.
Clinopyroxene	40	50	1	Subhedral	Oriented parallel to the dike borders.
Amphibole	3	5	0.1	Interstitial	Brown pargasite (primary).
Oxides	2	2	0.2		Oxides of Fe or Fe-Ti.
Phlogopite	3				

GENERAL COMMENTS

Serpentinized harzburgite with relicts of fresh pyroxenes and spinel.
It is crosscut by a 3 mm wide ultramafic dike (images 1270A_059-061)
Beginning of mylonitization (associated with the dike)

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Serpentine	85	Olivine, Pyroxenes		Mesh texture replacing olivine. Bastite pseudomorph after orthopyroxene.
Magnetite	8	Olivine		Mesh texture.
Talc	2	Orthopyroxene		Replacing orthopyroxene and core of serpentine mesh-textures.
Amphibole	Trace	Pyroxenes		
Ferritchromite	Trace	Spinel		
Ultramafic Dike:				
Chlorite	16	Pyroxenes, Amphibole, Mica		
Serpentine	20	Olivine, Pyroxenes		
Talc	5	Pyroxenes		
Secondary Amphibole	4	Pyroxenes, Primary Amphibole		
Opaque Minerals	2	Olivine		

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Cross-fiber chrysotile		Sigmoidal	

STRUCTURE

Crystal Plastic:
Sample suffered moderate intensity crystal plastic deformation; Remanant pseudomorphed pryoxenes contain kink bands, and coarsely recrystallized.
Neoblasts and ghosts of recrystallized tails.
Faint foliation defined by remnant crystal plastic deformation textures, parallel to ribbon serpentinite foliation and pyroxenite vein.

Magmatic Fabric:
Altered pyroxenite vein is parallel to shear foliation and serpentinite foliation.

Crosscutting Relationships (as are apparent in thin section):

1) Ductile deformation
2) Intrusion of pyroxene vein
3) Serpentinization

THIN SECTION: 209-1270B-1R-1, Piece 16, 90-93 cm **TS#67** **Observer: WM,WB**
ROCK NAME: OXIDE GABBRO
GRAIN SIZE: Coarse-grained
TEXTURE: Porphyroclastic

PRIMARY MINERALOGY	MODE (Visual estimate) PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)	MORPHOLOGY	COMMENTS
Olivine	0	0			
Plagioclase	41	42	>5		
Orthopyroxene	1	1	<10		
Clinopyroxene	43	49	14	Euhedral	
Oxide (magnetite)	8	8		Equant	

GENERAL COMMENTS
This gabbro has been severely deformed. Porphyroclasts provide the only information on the original grain size.
A single plagioclase grain that is unstrained is preserved in a large pocket of oxide.
There are several examples of oxide infilling fractures in crystals both clinopyroxene and plagioclase.

SECONDARY MINERALS	PERCENT PRESENT	REPLACING	MORPHOLOGY	COMMENTS
Green Amphibole	1.5	Brown amphibole, clinopyroxene	Acicular to fibrous	
Chlorite	1.5	Clinopyroxene, plagioclase	Fibrous	
Brown amphibole	1	Appears primary	Euhedral	Along with oxides in shear zones.
Sphene	Trace	Ilmenite	Euhedral	
Hematite	Trace	Ilmenite	Euhedral	

VEIN / FRACTURE FILLING	PERCENT PRESENT	MORPHOLOGY	COMMENTS
Chlorite veinlets.			

STRUCTURE

Crystal Plastic:
Moderate to strong intensity, granulite-grade crystal plastic deformation.
Pyroxene porphyroclasts range in size from 7 mm to 2 mm; Show kink bands, radically bent cleavage and kink bands recrystallized rims with neoblasts ranging from 0.05 mm to 0.2 mm.
Plagioclase shows deformation twins, undulose extinction and significant recrystallization in the fine-grained matrix
.Elongate plagioclase porphyroclasts are aligned with the mylonitic foliaton and range in size from 8 mm to 0.5 mm.
Polygonal recrystallized neobalsts range in size from 0.03 mm to 0.08 mm.

Brittle:
Minor late brittle deformaton caused minor shear fractures in plagioclase porphyroclasts.

Foliation:
Protomylonitic foliatoin defined by elongate porphyroclasts and compositionally segregated bands of recrystallized plagioclase and pryoxene neoblasts.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Minor brittle deformation
3) Some clinopyroxene statically altered to amphibole
4) Oxy-exsolution lamellae of ilmenite grow in magnetite after all deformation has ceased

THIN SECTION:	**209-1270B-1R-1, Piece 15, 83-88 cm**	**TS#68**	**Observer: WM**
ROCK NAME:	**OXIDE GABBRO**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	58	60	>9		
Orthopyroxene	1	1	<5		
Clinopyroxene	28	33	17	Equant	
Oxide (magnetite)	6	6		Equant	

COMMENTS This gabbro has been severely deformed. Porphyroclasts provide the only information on the original grain size.
Oxides enclosed in clinopyroxene are subhedral to euhedral and equant while those in the matrix have been elongated by deformation.

Observer: WB

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Albite	Trace	Plagioclase		Along cracks.
Chlorite	3	Plagioclase, pyroxene		On plagioclase-pyroxene grain boundaries, along cracks, and in patches.
Green amphibole	3	Pyroxene, plagioclase		On plagioclase-pyroxene grain boundaries and patchy after pyroxene.
Iron oxides	Trace	Ti-magnetite		Rare in domains of trellis-like exsolution of ilmenite.
Brown amphibole	1	Probably primary		Associated with oxide.
Pyrite	Trace			Along with oxides.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
No veins.			

STRUCTURE

Crystal Plastic:
Moderate to strong ductile deformation; pyroxene is weakly deformed, with minor kink banding and recrystallization around the margins of several grains. Plagioclase shows strong crystal plastic deformation textures; Elongate porphyroclasts have undulose extinction and deformation twins (range in size from 2 mm to 5 mm) core and mantle texture; porphyroclasts are surrounded by polygonal neoblasts with common triple junctions (0.03 mm to 0.1mm).

Brittle:
Very minor brittle overprint, several brittle shear fractures run though zones finely recrystallized plagioclase.

Foliation:
Moderate foliation defined by elongate plagioclase porphyroclasts, shear fabric in neoblasts and shape preferred orientation of pyroxene.

Impregnation Textures:
Possible late magma intrusion along brittle shear fractures to precipitate oxides.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Infusion of oxide magma during minor brittle deformation
3) Static greenschist facies alteration

THIN SECTION:	**209-1270B-2R-1, Piece 6, 24-27 cm**	**TS#69**	**Observer: WM,WB**
ROCK NAME:	**GABBRO**		
GRAIN SIZE:	**Coarse grained**		
TEXTURE:	**Porphyroclastic**		

	MODE (Visual estimate)				
PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	52	55	>8		
Orthopyroxene	5	5			
Clinopyroxene	32	39	12	Equant	
Oxide (magnetite)	1	1		Equant	

GENERAL COMMENTS
This gabbro has been severely deformed and is now segregated into plagioclase-rich and pyroxene-rich bands.
The plagioclase-rich bands may be crystals that are now sheared porphyroclasts provide the only information on the original grain size.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Green amphibole	15	Pyroxene, plagioclase	Fibrous, prismatic	
Chlorite	30	Pyroxene, plagioclase		
Secondary oxides	2	Ti-magnetite	Secondary oxides between ilmenite lamellae.	Exsolution/oxidation lamellae of ilmenite.
Albite	2	Plagioclase		
Quartz	2	Plagioclase		
Sphene	Trace	Ti-magnetite	Between ilmenite lamellae	

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Abundant chlorite veins			

STRUCTURE
Crystal Plastic:
Moderate intensity, granulite-grade crystal plastic deformation;
Pyroxene porphyroclasts range in size from 4 mm to 2 mm. Show kink bands, and minor recrystallization around rims from 0.05 mm to 0.2 mm.
Plagioclase shows deformation twins, undulose extinction and significant recrystallization in the fine-grained matrix.
Plagioclase porphyroclasts range in size from 4 mm to 0.5 mm. Polygonal recrystallized neoblasts range in size from 0.05 mm to 0.1 mm.

Brittle:
Minor late shear fracture filled with serpentine; fibers indicate 45 degree oblique opening angle.

Foliation:
Weak foliation defined by shear fabric in plagioclase neoblasts.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Static alteration of pyroxene to amphibole
3) Late shear fractures filled with serpentine

THIN SECTION:	**209-1270B-3M-1, Piece 20, 129-131 cm**	**TS#70**	**Observer: WM,WB**
ROCK NAME:	**OXIDE GABBRO**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	43	50	>4		
Orthopyroxene					
Clinopyroxene	40	48	8	equant	
Oxide (magnetite)	2	2		equant	

GENERAL COMMENTS This gabbro has been severely deformed and has a shear zone on one side of the slide with a plagioclase lattice-preferred orientation. Porphyroclasts provide the only information on the original grain size.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Albite	1	Plagioclase		Along cracks.
Chlorite	2	Plagioclase, pyroxene		On plagioclase-pyroxene grain boundaries, mostly along chlorite vein.
Green amphibole	4	Pyroxene, plagioclase		Mostly on plagioclase-pyroxene grain boundaries.
Iron oxides	Trace	Ti-magnetite		Rare in domains of trellis-like exsolution of ilmenite.
Brown amphibole	Trace	probably primary		Associated with oxide.
Pyrite	Trace			A large crystal in a patch of brown amphibole and oxide.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**

Chlorite veins with slight increased chlorite alteration in halos.

STRUCTURE

Crystal Plastic:
Moderate intensity, granulite-grade crystal plastic deformation.
Pyroxene porphyroclasts range in size from 7 mm to 2 mm; Show kink bands, radically bent cleavage and kink bands recrystallized rims with neoblasts ranging from 0.05 mm to 0.2 mm.
Plagioclase shows deformation twins, undulose extinction and significant recrystallization in the fine-grain matrix;
Elongate plagioclase porphyroclasts are aligned with the mylonitic foliaton and range in size from 15 mm to 1 mm; Polygonal recrystallized.
Neoblasts range in size from 0.01 mm to 0.2 mm; recrystallized grain size varies widely across thin section with deformation intensity.

Brittle:
Minor late brittle deformaton caused minor shear fractures in plagioclase porphyroclasts

Foliation:
Protomylonitic foliation defined by elongate porphroclasts and compositionally segregated bands of recrystallized plagioclase and pryoxene neoblasts

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Minor brittle deformation
3) Some clinopyroxene statically altered to amphibole
4) Oxy-exsolution lamellae of ilmenite grow in magnetite after all deformation has ceased

THIN SECTION:	**209-1270B-4M-1, Piece 14, 108-111 cm**	**TS#71**	**Observer: WM/WB**	
ROCK NAME:	**OXIDE GABBRO**			
GRAIN SIZE:	**Coarse-grained**			
TEXTURE:	**Porphyroclastic**			

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	27	30	>10		
Orthopyroxene	2	3			
Clinopyroxene	58	62	12	Equant	
Oxide (magnetite)	5	5		Equant	

GENERAL COMMENTS

This gabbro has been less severely deformed than many others from 1270B.
Clinopyroxene crystals are large relatively strain free.
Euhedral oxides grains present in some clinopyroxene grains.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Albite	1	Plagioclase		Along cracks.
Chlorite	4	Plagioclase, pyroxene		On plagioclase-pyroxene grain boundaries, along cracks, and in patches.
Green amphibole	4	Pyroxene, plagioclase		On plagioclase-pyroxene grain boundaries and spotty in pyroxene.
Iron oxides	Trace	Ti-magnetite		Rare in domains of trellis-like exsolution of ilmenite.
Brown amphibole	Trace	Probably primary		Associated with oxide.
Sphene	Trace	Ti-magnetite		

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Veinlet of chlorite and green amphibole.			

STRUCTURE

Crystal Plastic:
Moderate to strong intensity, granulite-grade crystal plastic deformation. Ductile deformation is localized into narrow bands within recrystallized plagioclase and away from large pyroxene porphyroclasts.
Pyroxene porphyroclasts range in size from 10 mm to 4 mm; show minor kink banding and minor recrystallization around grain margins.
Plagioclase shows deformation twins, undulose extinction and significant recrystallization in the fine-grain matrix;
Elongate plagioclase porphyroclasts are aligned with the mylonitic foliaton and range in size from 8 mm to 0.5 mm; Polygonal recrystallized neoblasts range in size from 0.02 mm to 0.08 mm.

Brittle:
Where narrow bands of plagioclase are isolated between clinopyroxene porphyroclasts, brittle deformation and cataclasis reduces grain size in partially recrystallized neoblasts
Narrow shear bands cut portions of finely recrystallized plagioclase

Foliation:
Protomylonitic foliation defined by elongate plagioclase porphyroclasts and shear fabric in plagioclase neoblasts

Crosscutting Relationships (as are apparent in thin section):

1) Ductile deformation
2) Minor brittle deformation
3) Some clinopyroxene statically altered to amphibole
4) Oxy-exsolution lamellae of ilmenite grow in magnetite after all deformation has ceased

THIN SECTION:	**209-1270B-4M-2, Piece 9, 60-62 cm**	**TS#72**	**Observer: WM,WB**	
ROCK NAME:	**OXIDE GABBRO**			
GRAIN SIZE:	**Coarse-grained**			
TEXTURE:	**Porphyroclastic**			

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	52	55	>12		
Orthopyroxene					
Clinopyroxene	37	40	20	Equant	
Oxide (magnetite)	5	5		Equant	

GENERAL COMMENTS
Strain in this gabbro has been relatively concentrated into shear bands.
Euhedral oxides grains present in some clinopyroxene grains.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Albite	Trace	Plagioclase		Along cracks.
Chlorite	3	Plagioclase, pyroxene		On plagioclase-pyroxene grain boundaries, along cracks, and in patches.
Green amphibole	3	Pyroxene, plagioclase		On plagioclase-pyroxene grain boundaries and patchy after pyroxene.
Iron oxides	Trace	Ti-magnetite		Rare in domains of trellis-like exsolution of ilmenite.
Brown amphibole	Trace	Probably primary		Associated with oxide.
Pyrite	Trace	Clinopyroxene	Globular	Could be recrystallized primary sulfides.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Chlorite-actinolite veinlets			

GENERAL COMMENT
Alteration intensity is higher in coarse-grained, less deformed part of the rock. Alteration is distinctly static.

STRUCTURE

Crystal Plastic:
Moderate to low-intensity, granulite-grade crystal plastic deformation is localized into narrow bands within plagioclase.
Pyroxene porphyroclasts range in size from 13 mm to 5 mm; Show minor deformation in kink bands and narrow recrystallized margins in some locations.
Plagioclase shows deformation twins, undulose extinction and significant recrystallization in the fine-grain matrix.
Elongate plagioclase porphyroclasts are aligned with the mylonitic foliaton and range in size from 8 mm to 0.5 mm.
Plagioclase neoblast grain size varies widely across thin section depending on deformation temperature and intensity (0.6 mm to 0.02 mm),

Brittle:
Several zones of recrystallized plagioclase show grain size reduction by cataclasis,

Foliation:
Protomylonitic foliatoin defined by bands of recrystallized plagioclase,

Impregnation Textures:
Magma impregnates along brittle shears-results in precipitation of Fe-Ti oxides,

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Minor brittle deformation during oxide infusion
3) Possible further ductile deformation
3) Oxy-exsolution lamellae of ilmenite grow in magnetite after all deformation has ceased
4) Alteration of pyroxene to amphibole and plagioclase to chlorite

THIN SECTION:	**209-1270B-4M-2, Piece 18, 116-119 cm**	**TS#73**	**Observer: WM**	
ROCK NAME:	**GABBRO**			
GRAIN SIZE:	**Fine-grained**			
TEXTURE:	**Porphyroclastic**			

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	48	50	>12		
Orthopyroxene	4	8			
Clinopyroxene	33	42	20	Equant	
Oxide (magnetite)	Trace	Trace		Equant	

COMMENTS This section is of a sheared gabbro with a banded of less deformed oxide gabbro included in it.
The modal proportions and grains sizes noted above are for the gabbro as too little of the oxide is present to assess.
Lattice-preferred orientation is developed in the sheared gabbro.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Albite	3	Plagioclase		Along cracks
Chlorite	8	Plagioclase, pyroxene		On plagioclase-pyroxene grain boundaries, along cracks, and in patches.
Green amphibole	8	Pyroxene, plagioclase		On plagioclase-pyroxene grain boundaries and spotty in pyroxene.
Iron oxides	Trace	Ti-magnetite		Rare in domains of trellis-like exsolution of ilmenite.
Brown amphibole	Trace	Probably primary		Associated with oxide.
Sphene	Trace	Ti-magnetite		
Pyrite	Trace	?		Dispersed, some large aggregates could be recrystallized primary sulfides.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Chlorite-actinolite veinlets.			

STRUCTURE

Crystal Plastic:
Moderate ductile deformation; Sample has a faint S-C fabric: Schistosity plane defined by shape preferred orientation of weakly elongate plagioclase is cut by discrete shear planes in which pyroxene is finely recrystallized parallel to brittle shears.
Plagioclase is internally deformed in medium grained porphyroclasts (0.1 mm to 0.3 mm) with undulose extinction and strong deformation twins, but has not been significantly recrystallized.
Clinopyroxene with widely varying grain size (0.05 to 0.4mm) is interspersed with plagioclase and brown amphibole. Clinopyroxene are finely recrystallized (0.01mm neoblasts) within shear planes.

Brittle:
Minor brittle overprint of ductile deformation within shear planes.

Foliation:
S-C fabric in foliation indicates reverse sense shear.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation during formation of S-C fabric
2) Minor brittle overprint
3) Coarse grained oxide gabbro vein cuts foliation
4) Minor static greenschist facies alteration

THIN SECTION:	**209-1270B-4M-3, Piece 1, 9-11 cm**		**TS#74**	**Observer: WM,WB**	
ROCK NAME:	**GABBRO**				
GRAIN SIZE:	**Fine-grained**				
TEXTURE:	**Porphyroclastic**				

	MODE (Visual estimate)				
PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	48	50			
Orthopyroxene	4	8			
Clinopyroxene	33	42		Equant	
Oxide (magnetite)	1	1		Equant	

GENERAL COMMENTS This section is of a sheared gabbro that is more altered downhole.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Albite	3	Plagioclase		Along cracks.
Chlorite	12	Plagioclase, pyroxene		Mostly after plagioclase along with quartz, enriched in patches.
Green amphibole	3	Pyroxene, plagioclase		On plagioclase-pyroxene grain boundaries and spotty in pyroxene.
Iron oxides	Trace	Ti-magnetite		Rare in domains of trellis-like exsolution of ilmenite.
Quartz	2	Probably primary		Associated with oxide.
Chalcopyrite	Trace	Clinopyroxene		
Pyrite	Trace	?		Dispersed, some large aggregates could be recrystallized primary sulfides.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Chlorite-actinolite veinlets.			

STRUCTURE

Crystal Plastic:
Low intensity crystal plastic deformation; plagioclase shows undulose extinction, deformation twins and minor dynamic recrystallization near grain boundaries; pyroxene shows kink bands and minor recrystallization.

Brittle:
Very little brittle overprint of crystal plastic fabric apparent in thin section.

Foliation:
Moderate intensity foliation is defined by shape preferred orientation of elongate plagioclase crystals.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Static alteration

THIN SECTION:	**209-1270B-7R-1, Piece 15, 84-86 cm**	**TS#75**	**Observer: WM**
ROCK NAME:	**OXIDE GABBRO/GABBRO**		
GRAIN SIZE:	**Medium/fine grained**		
TEXTURE:	**Porphyroclastic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	40/40	50/50			
Orthopyroxene					
Clinopyroxene	0/0	42/48		Equant	
Oxide (magnetite)	8/2	8/2		Equant	

GENERAL COMMENTS This section is of contact between a medium-grained oxide gabbro and a fine-grain gabbro (both deformed). In the abundance percentage the first number is for the medium grained oxide gabbro The second number is for the fine grained gabbro

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Albite	5	Plagioclase		Along cracks.
Chlorite	10	Plagioclase, pyroxene		On plagioclase-pyroxene grain boundaries, mostly after plagioclase along with chlorite.
Green amphibole	40	Pyroxene, plagioclase		Pyroxenes are completely altered, mostly to green amphibole.
Iron oxides	Trace	Ti-magnetite		Rare in domains of trellis-like exsolution of ilmenite.
Brown amphibole	1	Probably primary		Associated with oxide.
Sphene	Trace	Ti-magnetite		
Pyrite	1	Clinopyroxene		Some large aggregates could be recrystallized primary sulfides.
Quartz	2	Plagioclase		Along with chlorite.
Chalcopyrite	Trace	Clinopyroxene		Along with pyrite in aggregates.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
No veins			

GENERAL COMMENTS Coarse-grained gabbro is rich in oxides and sulfides.

STRUCTURE

Crystal Plastic:
Moderate ductile deformation; weak recrystallization of pyroxene around grain boundaries and bent cleavage, but no significant grain size reduction. Pyroxenes appear to have been rotated partially into shear foliation while not being strongly internally deformed. Plagioclase is moderately recrystallized around the margins of grains and within higher intensity sheared bands; neoblast grain size ranges from 0.02 mm to 0.05 mm; Plagioclase porphyroclast size varies widely between coarse and fine grained sections of the sample.

Brittle:
Sample has been affected to moderate brittle deformation; that followed crystal plastic deformation. Partial grain size reduction of plagioclase by cataclasis along shear fractures; Some brittle fracture zones cut across the distance of the sample Later stages of brittle deformation appear to have corresponded with greenschist facies alteration, some chlorite and amphibole are grown parallel to shear. foliation and into the void space of shear fractures

Foliation:
Moderately strong foliation defined by aligned pyroxene and plagioclase porphyroclasts, parallel alignment of ductile shear zones, and brittle shear fractures.

Crosscutting Relationships (as are apparent in thin section):
1) Crystal plastic deformation
2) Brittle deformation
3) Greenschist alteration during final stages of brittle deformation

THIN SECTION: **209-1270B-7R-1, Piece 17,110-112 cm** **TS#76** **Observer: AC, WM, HP**
ROCK NAME: **GABBRO**
GRAIN SIZE: **Fine-grained**
TEXTURE: **Granular**

	MODE (Visual estimate)				
PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	30	50	1-2		
Orthopyroxene		5		Subhedral	Altered not really distinguishable from clinopyroxene
Clinopyroxene		45	2	Subhedral	Altered not really distinguishable from orthopyroxene
Oxide (magnetite)	1	1		Equant	

GENERAL COMMENTS No preferred orientation

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Green amphibole	30	Pyroxene, plagioclase		Pyroxenes are completely altered, mostly to green amphibole
Brown amphibole	2	Probably primary		Associated with oxide in a vein/dikelet cutting across the altered gabbro.
Chlorite	20	Plagioclase, pyroxene		On plagioclase-pyroxene grain boundaries, mostly after plagioclase along with chlorite.
Quartz	2	Plagioclase		Along with chlorite.
Albite?	5	Plagioclase		Along cracks.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Brown amphibole vein/dikelet.			

STRUCTURE

Crystal Plastic:
Weak ductile deformation; weak recrystallization of pyroxene around grain boundaries and bent cleavage, but no significant grain size reduction.
Plagioclase grains display undulose extinction, deformation twins, and weak recrystallization around grain boundaries.

Brittle:
Weak brittle deformation followed ductile deformation; minor grain size reduction by cataclasis within distinct zones.
Later stages of brittle deformation appear to have corresponded with greenschist facies alteration, some chlorite and amphibole are grown parallel to shear foliation.

Foliation:
Moderately strong foliation defined by aligned pyroxene and plagioclase porphyroclasts, parallel alignment of ductile shear zones, and brittle shear fractures.

Crosscutting Relationships (as are apparent in thin section):
1) Crystal plastic deformation
2) Brittle deformation
3) Greenschist alteration during final stages of brittle deformation

THIN SECTION:	**209-1270B-7R-1, Piece 8, 47-49 cm**	**TS#77**	**Observer: AC/WB**
ROCK NAME:	**OXIDE GABBRO**		
GRAIN SIZE:	**Medium-grained to fine-grained**		
TEXTURE:	**Granular**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	45	50	>5		
Orthopyroxene					
Clinopyroxene	45	50	>4	Elongated	
Oxide (magnetite)	5	5		Equant	

GENERAL COMMENTS

This gabbro has seen limited deformation; the grain size is minimum size for the coarse grained part of the rock.
Modal proportion are similar for both grain sizes.
Igneous contact between medium-grained and fine-grained oxide gabbros.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Green amphibole	3	Pyroxene, plagioclase		On plagioclase-clinopyroxene grain boundaries and replacing pyroxene (chiefly orthopyroxene).
Chlorite	3	Plagioclase, pyroxene		On plagioclase-clinopyroxene grain boundaries
Albite	2	Plagioclase		Fine-grained rims inbetween plagioclase crystals of the oxide-rich zone.
Chalcopyrite	Trace			Primary phase? (inclusions in plagioclase and clinopyroxene).
Iron oxides	Trace	Ti-magnetite		Between ilmenite exsolution lamellae.
Pyrite	1			Probably recrystallized primary sulfides.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
One chlorite veinlet			

STRUCTURE

Crystal Plastic:
Weak ductile deformation; Bent crystal lattice of plagioclase and pyroxene plagioclase, undulose extinction, deformation twins in plagioclase and minor dynamic recrystallization along plagioclase grain boundaries.
Ductile deformation may have also rotated grains into a faint planar foliation, but did not result in grain size reduction.

Brittle:
Minor brittle deformation; several shear fractures and broken grains. One fracture in a plagioclase grain is filled with Fe-Ti Oxide.
Late brittle fractures are associated with chlorite alteration.

Foliation:
Faint foliation defined by grain shape preferred orientation of plagioclase and pyroxene.

Crosscutting Relationships (as are apparent in thin section):

1) Minor ductile deformation
2) Brittle shearing of plagioclase
3) Late shear fracturing and chlorite alteration

THIN SECTION:	**209-1270B-7R-2, Piece 13, 131-137 cm**	**TS#78**	**Observer: wm, hp**
ROCK NAME:	**OXIDE GABBRO**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	50	50	>50	Equant	
Orthopyroxene	2	3	>5	Equant	
Clinopyroxene	45	50	>20	Equant	
Oxide (magnetite)	12	12		Equant	

GENERAL COMMENTS

This gabbro has undergone extreme grain size reduction.
Composed of a few very large grains, most of the slide has been reduced to submillimeter scale neoblasts
The size is minimum size for the coarse crystals.
Oxides form a matrix in which the silicate neoblasts are hosted
Rounded sulfides locally in the magnetite

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Green amphibole	5	Pyroxene, plagioclase		On margins and along internal fractures.
Chlorite	2	Plagioclase, pyroxene		On margins and along internal fractures.
Albite	3	Plagioclase		Fine-grained rims in-between plagioclase crystals of the oxide-rich zone.
Chalcopyrite	0.5			Primary phase (droplets?)

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Chlorite vein.			

STRUCTURE

Crystal Plastic:
Moderate to high intensity protomylonitic granulite-grade crystal plastic deformation.
Pyroxene porphyroclasts range in size from 7 mm to 15 mm; Show kink bands, bent cleavage and kink bands recrystallized rims with neoblasts ranging from 0.05 mm to 0.2 mm.
Plagioclase porphyroclasts range in size from 5 to 15 mm with moderate degrees of internal deformation.
Over 50% of plagioclase has been recrystallized to fine polygonal equant neoblasts ranging in size from 0.03 to 0.08 mm.

Brittle:
Moderate brittle overprinting of ductile deformation associated with oxide magma intrusion. Plagioclase and pyroxene neoblasts in many locations appear to have been brecciated by intruding magma and are now suspended in a matrix of oxide.

Foliation:
Protomylonitic foliation defined by elongate porphroclasts and compositionally segregated bands of recrystallized plagioclase and pryoxene neoblasts.

Impregnation Textures:
Oxide impregnation along brittle structures with brecciation of plagioclase and pyroxene neoblasts.

Crosscutting Relationships (as are apparent in thin section):

1) Ductile deformation
2) Brittle deformation during oxide magma intrusion
3) Static alteration

THIN SECTION:	**209-1270B-8R-1, Piece 6, 26-29 cm**	**TS#79**	**Observer: wm, hp**
ROCK NAME:	**OLIVINE GABBRO**		
GRAIN SIZE:	**Fine-grained**		
TEXTURE:	**Mylonitic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	15	35	>1	Equant	
Olivine	10	15	>1	Equant	
Orthopyroxene		?	>1		
Clinopyroxene	45	50	>1	Equant	
Oxide (magnetite)	0.5	0.5	>1	Equant	

GENERAL COMMENTS
This mylonitized gabbroic rock has two discrete bands composed primarily of olivine with minor oxides.
Other bands in the mylonite are composed of plagioclase and clinopyroxene.
This rock is substantially altered but the olivine is very fresh.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Talc	20	Pyroxene, plagioclase, olivine		Forming discreet bands with locally recognizable pyroxene relics.
Chlorite	10	Pyroxene		On margins of pyroxenes as in patches.
Green amphibole	15	Pyroxene, plagioclase		On margins of pyroxenes and brown amphiboles.
Brown amphibole	5	Probably primary		In association with green amphibole and chlorite.
Pyrite	2	Olivine		In talc-rich bands
Magnetite	Trace	Olivine		
Hematite	Trace	Olivine		
Quartz	Trace	Olivine		

GENERAL COMMENTS
Bands (sub-mm to ca. 5 mm in width) with strikingly variable mineralogy. Contacts between the bands are generally sharp. A band of fresh olivine is enclosed by talc-rich bands.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**

STRUCTURE

Crystal Plastic:
Moderate to strong crystal deformation; clinopyroxene, orthopyroxene, olivine, and plagioclase are coarsely recrystallized and segregated into compositional bands defining the shear foliation.
Recrystallized grain size of clinopyroxene ranges from 0.2 mm to 0.5 mm in mafic rich bands.
Plagioclase rich bands have a bimodal grain size; Larger grains average between 0.1 mm and 0.2 mm, and fine neoblasts forming boundaries between larger grains average between 0.01 and 0.02 mm. Dynamic recrystallization appears to have been inhibited in plagioclase, with many highly strained grains and limited strain recovery.

Brittle:
Brittle deformation is evident in plagioclase grains, with shear fractures cutting many highly strained crystals.
Brittle behavior is not evident in olivine or pyroxenes phases.

Foliation:
Strong foliation defined by shape preferred orientation of crystals and compositionially segregated bands.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation and formation of protomylonitic fabric
2) Minor brittle deformation occurring concurrently with late stages of ductile deformation and alteration of clinopyroxene to brown hornblende
3) Talc alteration

THIN SECTION:	**209-1270B-8R-2, Piece 13, 114-116 cm**	**TS#80**	**Observer: AC, WM, HP**
ROCK NAME:	**OXIDE GABBRO**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	40	45	>15	Subequant	
Orthopyroxene	?	2	>5		
Clinopyroxene	25	38	>10	Subequant	
Oxide (magnetite)	15	15	>1	Subequant	

GENERAL COMMENTS
This gabbro has been deformed; Plagioclase recrystallized in very small grains
The deformation has been strongly localized preserving some big grains, resulting in through going bands of plagioclase neoblasts.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Chlorite	10	Plagioclase, pyroxene.		At contacts between pyroxene and plagioclase or oxide and plagioclase.
Brown amphibole	Trace	Pyroxene		Locally in association with green amphibole.
Green amphibole	5	Pyroxene		On pyroxene margins.
Quartz	Trace	Plagioclase		In association with chlorite in plagioclase.
Secondary plagioclase	15	Plagioclase		Fine-grained aggregates at margins of large plagioclase crystals and in deformation bands.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Very fine chlorite veins.			

STRUCTURE

Crystal Plastic:
Moderate to weak intensity, granulite-grade crystal plastic deformation. Ductile deformation is localized into narrow bands within recrystallized plagioclase and away from large pyroxene porphyroclasts.
Pyroxene porphyroclasts range in size from 10 mm to 4 mm. Show kink banding, bent cleavage and minor recrystallization around grain margins.
Plagioclase shows deformation twins, undulose extinction and significant recrystallization in the fine-grain matrix.
Elongate plagioclase porphyroclasts are aligned with the mylonitic foliaton and range in size from 13 mm to 3 mm.
Polygonal recrystallized neoblasts range in size from 0.02 mm to 0.08 mm.

Brittle:
Brittle shear fractures and minor brecciation associated with infiltration of magma depositing Fe-Ti Oxides and brown hornblende.
Shear fractures cut dominantly through plagioclase-rich horizons and may create breccias of plagioclase neoblasts within an oxide matrix.

Foliation:
Foliation defined by elongate plagioclase porphyroclasts and shear fabric in plagioclase neoblasts.

Impregnation Textures:
Oxide-rich magma permeated along brittle shear fractures.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Minor brittle deformation and infusion of oxide-rich magma
3) Some clinopyroxene statically altered to amphibole
4) Oxy-exsolution lamellae of ilmenite grow in magnetite after all deformation has ceased

THIN SECTION:	**209-1270B-9R-1, Piece 8A,** 60-62 **cm**	**TS#81**	**Observer: AC, WM, HP**
ROCK NAME:	**OXIDE GABBRO**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic**		

	MODE (Visual estimate)				
PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	45	50	>15	Subequant to subhedral	
Orthopyroxene				Subequant	
Clinopyroxene	40	45	>10	Ophitic	
Oxide (magnetite)	5	5	>1	Subequant	

COMMENTS This gabbro has been deformed. Plagioclase and pyroxene are recrystallized in small crystals.
Oikocryst of clinopyroxene with plagioclase chadcrysts.
A domain of relatively undeformed gabbro is preserved

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Chlorite	10	Plagioclase, pyroxene.		Pleochroic chlorite (brown interference colors) at contacts between pyroxene and plagioclase together with green and brown amphibole. Light green chlorite (blue interference colors) is replacing plagioclase on margins and along cracks.
Brown amphibole	3	Pyroxene		In association with green amphibole and chlorite.
Green amphibole	8	Pyroxene		On pyroxene margins in association with chlorite and brown amphibole.
Secondary plagioclase	15	Plagioclase		Fine grained aggregates at margins of large plagioclase crystals and in deformation bands.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
No veins.			

STRUCTURE

Crystal Plastic:
Moderate to weak intensity, granulite-grade crystal plastic deformation.
Ductile deformation is localized into narrow bands within recrystallized plagioclase and away from large pyroxene porphyroclasts.
Pyroxene porphyroclasts range in size from 8 mm to 3 mm. Show kink banding, bent cleavage and minor recrystallization around grain margins.
Plagioclase shows deformation twins, undulose extinction and significant recrystallization in the fine-grain matrix.
Elongate plagioclase porphroclasts are aligned with the mylonitic foliaton and range in size from 6 mm to 2 mm.
Polygonal recrystallized neoblasts range in size from 0.02 mm to 0.08 mm.

Brittle:
Brittle shear fractures and minor brecciation associated with infiltration of magma depositing Fe-Ti Oxides and brown hornblende.
Shear fractures cut dominantly through plagioclase-rich horizons and may create breccias of plagioclase neoblasts within an oxide matrix.

Foliation:
Foliation defined by elongate plagioclase porphroclasts and shear fabric in plagioclase neoblasts.

Impregnation Textures:
Oxide-rich magma permeated along brittle shear fractures.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Minor brittle deformation and infusion of oxide-rich magma
3) Some clinopyroxene statically altered to amphibole
4) Oxy-exsolution lamellae of ilmenite grow in magnetite after all deformation has ceased

THIN SECTION:	**209-1270B-10M-1, Piece 6, 21-23 cm**	**TS#82**	**Observer: AC, WM, HP**
ROCK NAME:	**OXIDE GABBRO**		
GRAIN SIZE:	**Medium-grained**		
TEXTURE:	**Equigranular**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	45	50	3	Euhedral	
Orthopyroxene	1	2	2	Subhedral to euhedral	
Clinopyroxene	38	43	3	Subhedral to euhedral	
Oxide (magnetite)	5	5		Interstitial	

GENERAL COMMENTS

Shockingly not deformed; igneous foliation that is parallel to the drillhole direction.
Some incipient recrystallization occurs as neoblasts around some plagioclase grain boundaries.
Strong evidence of strain preserved in the plagioclase.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Chlorite	8	Pyroxene, plagioclase		Pleochroic chlorite (brown interference colors) at contacts between pyroxene and plagioclase together with green and brown amphibole. Light green chlorite (blue interference colors) is replacing plagioclase on margins and along cracks.
Green amphibole	5	Pyroxene, plagioclase		Together with chlorite on pyroxene margins.
Brown amphibole	2	Pyroxene		Replacing pyroxene along cracks.
Quartz	2	Plagioclase		Along with chlorite.
Pyrite	1	Clinopyroxene		

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
No veins			

STRUCTURE

Crystal Plastic:
Weak ductile deformation; Plagioclase and pyroxene both show undulose extinction and distorted crystal lattice.
Plagioclase also has deformation twins and minor recrystallization around occasional grain boundaries and within discreet shear planes.
Clasts may have also been rotated into shear foliation during weak ductile deformation

Brittle:

Foliation:
Weak foliation is defined by shape preferred orientation of long grains of mineral axes and by discrete shear planes.

Impregnation Textures:
Magma infiltrated and brecciated rock along brittle shears during late-stages of ductile deformation.

Crosscutting Relationships (as are apparent in thin section):

1) Ductile deformation
2) Oxide infiltration during late ductile and brittle deformation
3) Static greenschist-grade alteration

	209-1270B-10M-1, Piece 13, 60-62 cm		**TS#83**	**Observer: AC, WM**	
ROCK NAME:	**OXIDE GABBRO**				
GRAIN SIZE:	**Coarse-grained**				
TEXTURE:	**Granular**				

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	75	80	>25	Subhedral to euhedral	
Orthopyroxene					
Clinopyroxene	10	18	>15	Subhedral to euhedral	
Oxide (magnetite)	2	2		Interstitial	

GENERAL COMMENTS
Moderately deformed but part of it is mostly undeformed.
The area of the section is very small compared to the grain size so modal estimates are unreliable,

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Chlorite	10	Pyroxene,		
Amphibole	20	Pyroxene		Most of the pyroxenes have been completely altered to amphibole.
Secondary plagioclase	3	Plagioclase		Albite(?)
Sphene	Trace	Oxide		Between the ilmenite exsolution lamellae.
Quartz	1	Plagioclase		

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Chlorite veins.			

STRUCTURE

Crystal Plastic:
Weak ductile deformation. Plagioclase and pyroxene show undulose extinction and distorted crystal lattice; plagioclase contains deformation twins.
Minor recrystallization of plagioclase along discrete shear planes, no significant grain size reduction.

Brittle:
Several brittle shear fractures cut through plagioclase porphyroclasts and neoblasts. Shear fractures are preferentially localized into fine grained plagioclase neoblasts.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Minor brittle deformation during late stages of ductile deformation
3) Greenschist grade alteration

THIN SECTION:	**209-1270B-10M-1, Piece 20 117-120 cm**	**TS#84**	**Observer: AC, WM, WB**
ROCK NAME:	**OXIDE GABBRO/GABBRO**		
GRAIN SIZE:	**Medium- to fine-grained**		
TEXTURE:	**Granular**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	45/45	50/50	3	Equant	
Orthopyroxene	0/1	0/2	2	Equant	
Clinopyroxene	30/40	40/48	3	Equant	
Oxide (magnetite)	10/2	10/2		Interstitial	

GENERAL COMMENTS

Incipient deformation for the coarse grained part of the section.
Fine-grained part has little area with neoblasts, mostly is not deformed.
Primary zoning is optically preserved in plagioclase.
The contact between the coarse-grained material and the fine-grained occurs by gradation of grain size but it takes place in 1 cm.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Albite	1	Plagioclase		Along grain boundaries and cracks.
Chlorite	3	Plagioclase, pyroxene		On plagioclase-pyroxene grain boundaries, along cracks in plagioclase.
Green amphibole	5	Pyroxene, plagioclase		On plagioclase-pyroxene grain boundaries and patchy after pyroxene
Iron oxides	Trace	Ti-magnetite		Rare in domains of trellis-like exsolution of ilmenite.
Brown amphibole	Trace	probably primary		Associated with oxide.
Pyrite	Trace	Ti-magnetite		

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
No veins.			

STRUCTURE

Crystal Plastic:
Weak ductile deformation; plagioclase and pyroxene show undulose extinction and distorted crystal lattice. Plagioclase contains deformation twins.
Minor recrystallization of plagioclase along discrete shear planes, no significant grain size reduction.

Brittle:
Several brittle shear fractures cut through plagioclase porphyroclasts and neoblasts.
Shear fractures are preferentially localized into fine grained plagioclase neoblasts.

Foliation:
Very weak foliation defined by shape preferred orientation of plagioclase and pyroxene.

Impregnation Textures:
Late evolved magma infiltrated along brittle fractures, precipitated Fe-Ti oxides.

Crosscutting Relationships (as are apparent in thin section):

1) Ductile deformation
2) Minor brittle deformation during magma impregnation
3) Growth of ilmenite oxy-exsolution lamellae in magnetite
4) Static alteration

THIN SECTION:	**209-1270B-10M-2, Piece 7,53-56 cm**	**TS#85**	**Observer: AC, WM, WB**
ROCK NAME:	**OXIDE GABBRO**		
GRAIN SIZE:	**Medium-grained**		
TEXTURE:	**Granular**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	35	40	>15	Equant	
Orthopyroxene	1	2	>2	Equant	
Clinopyroxene	35	45	>10	Equant	
Amphibole	1	2			Late magmatic amphibole.
Oxide (magnetite)	15	15		Equant	

GENERAL COMMENTS
The rock has been deformed.
It has primary brown amphibole at the margins of some clinopyroxenes.
The amphibole is a reaction product of the clinopyroxene plus liquid to amphibole.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Albite	Trace	Plagioclase		Along cracks.
Chlorite	3	Plagioclase, pyroxene		On plagioclase-pyroxene grain boundaries, along cracks, and in patches.
Green amphibole	5	Pyroxene, plagioclase		On plagioclase-pyroxene grain boundaries and patchy after pyroxene.
Iron oxides	Trace	Ti-magnetite		Rare in domains of trellis-like exsolution of ilmenite.
Brown amphibole	1	Probably primary		Associated with oxide, along clinopyroxene.
Pyrite	Trace	Clinopyroxene	Globular	Could be recrystallized primary sulfides.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
No veins.			

STRUCTURE

Crystal Plastic:
Weak to moderate ductile deformation. Plagioclase and pyroxene show undulose extinction and distorted crystal lattice.
Plagioclase contains deformation twins.
Recrystallization of plagioclase along bands of higher intensity shearing, grain size reduction of plagioclase by recrystallization of polygonal neoblasts (grain size 0.03 to 0.05 mm).

Brittle:
Several brittle shear fractures cut through plagioclase porphyroclasts and neoblasts.
Shear fractures are preferentially localized into fine grained plagioclase neoblasts.
Significant brecciation in zones of oxide magma infiltration.

Foliation:
Weak to moderate foliation defined by shape preferred orientation of plagioclase porphyroclasts and sheared bands of plagioclase neoblasts.

Impregnation Textures:
Late evolved magma infiltrated along brittle fractures, precipitated Fe-Ti oxides in zones of breccaition of plagioclase neoblasts.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Minor brittle deformation during magma impregnation
3) Growth of ilmenite oxy-exsolution lamellae in magnetite
4) Static alteration

THIN SECTION:	**209-1270C-1R-1, Piece 7B, 36-39 cm**	**TS#86**	**Observer: ET,WB**
ROCK NAME:	**SERPENTINIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic to protogranular**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	0	85			
Orthopyroxene	0	15	1.0-10	Anhedral	Recrystallized into subgrains.
Spinel	0.4	0.5	<0.1-0.3	Rectangular, anhedral	Disseminated and vermiform with orthopyroxene.
plagioclase					

GENERAL COMMENTS Totally altered except spinels. Grain boundaries between orthopyroxenes and olivines are well preserved. Some orthopyroxene porphyroclasts show wavy extinction with irregular-shaped grain boundary.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Magnetite	2	Olivine, spinel		Forming network in serpentine.
Serpentine	97	Olivine, orthopyroxene	14% bastite	Preserving kink banding.
Green amphibole	1	Orthopyroxene		Rims on bastite.
Talc	Trace	Orthopyroxene		Rims on bastite.
Pyrite	Trace	Olivine	Subhedral to euhedral	

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Chlorite+actinolite vein	50:50	Single vein	Cut by chrysotile veins.
Chrysotile veins			

STRUCTURE

Crystal Plastic:
Weak ductile deformation. Kink bands in several pyroxene grains.

Brittle:
A small fault cuts a portion of the thin section. Unknown total offset. Serpentine fibers near the boundaries of the fault are parallel to its trace.

Joints:
Several late en-echelon shear fractures are filled with serpentine.

Crosscutting Relationships (as are apparent in thin section):

1) Ductile deformation
2) Serpentinization
3) Minor brittle fault
4) Large serpentine veins
5) Late shear fractures filled with serpentine

THIN SECTION:	**209-1270C-2R-1, Piece 12, 69-71 cm**	**TS#87**	**Observer: ET / WB**	
ROCK NAME:	**SERPENTINIZED HARZBURGITE WITH AMPHIBOLE GABBRO INTRUSION**			
GRAIN SIZE:	**Coarse-grained**			
TEXTURE:	**Porphyroclastic to mylonitic**			

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Harzburgite					
Olivine	0	84			
Orthopyroxene	0	15	1.0-10	Anhedral	
Spinel	0	1	<0.1-0.3	Rectangular, anhedral	Disseminated and vermiform with orthopyroxene.
Amphibole gabbro					
Clinopyroxene	20	40		Anhedral	Neoblast.
plagioclase	0	40	0.2	Anhedral	Neoblast.
Amphibole	15	20		Anhedral	Neoblast.

GENERAL COMMENTS Mylonitic amphibole gabbroic intrusions that consist of brown amphibole porphyroclasts surrounded by fine-grained mosaic clinopyroxene, amphibole and plagioclase locally brecciate harzburgite.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Harzburgite				
Magnetite	1	Olivine, spinel		
Serpentine	90	Olivine, orthopyroxene		Ribbon textured.
Green amphibole	Trace	Orthopyroxene		Rims on bastite.
Talc	10	Olivine, orthopyroxene		In veins and near gabbro.
Pyrite	Trace	Olivine	Subhedral to euhedral	
Amphibole gabbro				
Quartz	2	Plagioclase		Along with chlorite in patches.
Chlorite	30	Plagioclase, pyroxene		Mainly after plagioclase.
Green amphibole	20	Pyroxene, plagioclase, brown amphibole		
Talc	30	Pyroxene		

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Talc veins			Irregular network.
Chrysotile veins			Cutting talc veins.

STRUCTURE

Crystal Plastic:
Weak ductile deformation of pyroxene porphyroclasts in main body of peridotite.
Strong ductile deformation within a shear zone contained within a gabbro vein. Deformation occurs to diffusive mass transfer in growth of schistose brown amphibole and tremolite.

Semi- Brittle:
Strong semi-brittle overprint on ductile shear zone within gabbro vein.
Brown amphibole is fractured and replaced by schitose tremolite with minor chlorite.

Foliation:
Strong foliation in gabbro vein shear zone defined by shape preferred orientation of amphibole and compositional banding.
Weak foliation in peridotite is defined by ribbon texture serpentinite.

Impregnation Textures:
Gabbro impregnates and reacts with peridotite within shear zone to generate amphibole and chlorite.

Crosscutting Relationships (as are apparent in thin section):
1) Early ductile deformation
2) Infusion of gabbroic melt or magmatic fluids into ductile/semi-brittle shear zone
3) Semi-brittle overprint of shear zone
4) Serpentinization
5) Serpentine veins
6) Talc veins

THIN SECTION:	**209-1270A-1R1, Piece 22,139-141 cm**	**TS#88**	**Observer: MS, CG**
ROCK NAME:	**SERPENTINIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic**		

	MODE (Visual estimate)				
PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	0	69			
Orthopyroxene	0	30	2.0-10	Anhedral	
Clinopyroxene	0	3-4?	<2	Anhedral	Possible.
Spinel	0.8	1	<0.1-1	Anhedral	

GENERAL COMMENTS
Totally altered harzburgite, except spinel
Some altered pyroxenes have the shape of common clinopyroxene in harzburgite.

SECONDARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**MORPHOLOGY**	**COMMENTS**
Serpentine	86	Olivine, orthopyroxene		Ribbon and mesh texture.
Amphibole	7	Orthopyroxene, clinopyroxene		Rims and pseudomorphs after orthopyroxene. Also interstitial in serpentine matrix.
Magnetite	3	Olivine, spinel		Dispersed. Rims in chromian-spinel.
Clays	3	Olivine, serpentine		
Chlorite	Trace	Plagioclase?		Tiny flaky aggregates in serpentinite matrix.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Cross-fiber chrysotile veins partly replaced by clays.			

STRUCTURE

Brittle:
Disjointed hourglass texture serpentine suggests minor fracturing during serpentinization.

Foliation:
Faint foliation defined by ribbon texture serpentinite.

Crosscutting Relationships (as are apparent in thin section):
1) Serpentinization
2) Late veining

THIN SECTION:	**209-1270A-1R2, Piece 11, 34-37cm**	**TS#89**	**Observer:MS, CG**
ROCK NAME:	**COMPLETELY SERPENTIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	0	69			
Orthopyroxene	0	30	2.0-15	Anhedral	
Clinopyroxene	0				
Spinel	0.8	1	<0.1-1	Anhedral	

GENERAL COMMENTS Totally altered harzburgite, except spinel

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Serpentine	74	Olivine		Mesh texture
Bastite	21	Orthopyroxene, clinopyroxene		Pseudomorphs.
Magnetite	3	Olivine, spinel		Rims of serpentine mesh texture.
Ferritchromite	0.3	Spinel		Rims around fresh chromian spinel.
Clays	1	Olivine		
Talc	Trace	Pyroxenes		

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Cross-fiber chrysotile veins.	3		

STRUCTURE
Sample is not deformed.

Crosscutting Relationships (as are apparent in thin section): 1) Serpentinization

THIN SECTION:	**209-1270C-1R-1, Piece 8, 40-42 cm**	**TS#90**	**Observer: ET,WB**
ROCK NAME:	**SERPENTINIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	1	85			
Orthopyroxene	2	15	1.0-10	Anhedral	Recrystallized into subgrains.
Spinel	0.2	0.5	<0.1-0.3	Rectangular, anhedral	Disseminated and vermiform with orthopyroxene.

GENERAL COMMENTS Totally altered except some grains.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Chlorite	2	Olivine		In patches.
Talc	7	Orthopyroxene, olivine		Along orthopyroxene rims, replacing a few orthopyroxene crystal completely, and in patches.
Serpentine	75	Olivine, orthopyroxene		Some bastite.
Green amphibole	1	Orthopyroxene		Along orthopyroxene rims.
Magnetite	1	Olivine, spinel		In anastomosing vein network with serpentine
Brown clay	1	Olivine		Orange in hand specimen.
Fe-oxyhydroxide	1	Olivine		With clay (iddingsite).

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Serpentine-chlorite		coarse, fibrous chlorite	Change mineralogy from serpentine to chlorite.
Chrysotile		cross-fiber	Cut serpentine chlorite veins.

GENERAL COMMENTS Some fresh olivine left in patches of iddingsitization.
Talc and tremolite are early in the sequence of alteration and veining. Talc is cut by chrysotile veins. Different timing than in Hole 1268A.

STRUCTURE

Brittle:
Late en-echelon shear fracture filled with serpentine.

Crosscutting Relationships (as are apparent in thin section):
1) Serpentinization
2) Serpentine veins
3) Late shear fractures filled with serpentine

THIN SECTION:	**209-1270C-1R-1, Piece 11, 72-75 cm**	**TS#91**	**Observer: ET,WB**	
ROCK NAME:	**SERPENTINIZED HARZBURGITE**			
GRAIN SIZE:	**Coarse-grained**			
TEXTURE:	**Porphyroclastic**			

PRIMARY MINERALOGY	MODE (Visual estimate) PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)	MORPHOLOGY	COMMENTS
Olivine	Trace	85			
Orthopyroxene	1	15	0.5-3.0	Anhedral	Recrystallized into subgrains.
Spinel	0.4	0.5	<0.1-0.3	Rectangular, anhedral	Disseminated and vermiform with orthopyroxene.

GENERAL COMMENTS Mostly altered except some grains of olivine, orthopyroxene and vermicular spinels enclosed in orthopyroxenes. The boundaries between orthopyroxenes and olivines are preserved.

SECONDARY MINERALS	PERCENT PRESENT	REPLACING	MORPHOLOGY	COMMENTS
Serpentine	90	Olivine, orthopyroxene		Some relic mesh texture.
Talc	4	Orthopyroxene, olivine		On orthopyroxene rims and patchy after olivine.
Chlorite	Trace	Olivine		Rare in small patches.
Green amphibole	2	Orthopyroxene		Mostly on rims.
Magnetite	1	Olivine		In serpentine+magnetite network.
Brown clay	1	Olivine		Weathering product of olivine.
Fe-oxyhydroxides	1	Olivine		Weathering product of olivine.
Carbonate	Trace	Olivine		Weathering product of olivine.

VEIN / FRACTURE FILLING	PERCENT PRESENT	MORPHOLOGY	COMMENTS
Chlorite veinlet			One tiny veinlet.
Chrysotile veins			Cut chlorite veinlet, cut talc alteration.

STRUCTURE

Crystal Plastic:
Moderate ductile deformation; pseudomorphed pyroxene porphyroclasts have pressure shadow tails of recrystallized neoblasts and kink bands.

Brittle:
Numerous late en-echelon shear fractures are filled with serpentine

Foliation:
Faint foliation defined by ribbon texture serpentinite is parallel to remnants of crystal plastic foliation.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Serpentinization
3) Serpentine veins
4) Shear fractures filled with serpentine

THIN SECTION: 209-1270C-1R-1, Piece 13, 83-85 cm **TS#92** **Observer: ET / CG**
ROCK NAME: MODERATELY ALTERED HARZBURGITE AND GABBRO MYLONITE
GRAIN SIZE:
TEXTURE: Mylonitic

PRIMARY MINERALOGY	MODE (Visual estimate) PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)	MORPHOLOGY	COMMENTS
Harzburgite:					
Olivine	50	74	0.02-1.0		
Orthopyroxene	7	15	0.01-4	Anhedral	
Spinel	0.2	1	0.05-1.0	Rectangular, anhedral	Disseminated.
Gabbro:					
Clinopyroxene	20	55	0.05-25	Anhedral	Neoblast, porphyroclast.
Plagioclase	10	40	0.01-5	Anhedral	Neoblast.
Oxides	3	5	0.2-1.2	Anhedral	
Zircon	Trace	Trace	0.01-0.05	Subhedral	
Apatite	Trace	Trace	0.01	Subhedral	Inclusion in amphibole.

GENERAL COMMENTS Mylonitic mixture of harzburgite and gabbro intrusion that consists of clinopyroxene porphyroclasts surrounded by fine-grained mosaic clinopyroxene and plagioclase. Brown amphibole it is possibly secondary.
Coarse clinopyroxene grain (partly transformed to brown olivine) poikilitically encloses fine-grained plagioclase.

SECONDARY MINERALS	PERCENT PRESENT	REPLACING	MORPHOLOGY	COMMENTS
Gabbro boudins:				
Brown amphibole	15	Pyroxenes		Replacing pyroxenes.
Green amphibole	2	Pyroxenes, Ilmenite		Locally surrounding ilmenite.
Tremolitic amphibole	10	Plagioclase		Flaky crystals intergrown with chlorite.
Albite	2	Plagioclase		Rims of plagioclase.
Chlorite	10	Plagioclase		Associated with chlorite.
Talc	2	Plagioclase, Pyroxenes		Rims and along cleavages/twins of pyroxenes and plagioclase.
Peridotite matrix:				
Serpentine	7	Olivine, Pyroxenes		Mesh texture (deformed?).
Brown amphibole	15	Pyroxenes		Replacing pyroxene porphyroclasts and neoblasts.
Talc	13	Serpentine, Pyroxenes		Mostly spatially associated to shear ribbons.
Magnetite	0.8	Spinel?		Dispersed equant grains in mylonitic-talc ribbons.

GENERAL COMMENTS Pervasive talc alteration occurs in shear bands but not in boudins of fresh harzburgite. Apatite and likely zircon, occur as inclusions in amphiboles and as equant grains dispersed in the mylonitic matrix.

VEIN / FRACTURE FILLING	PERCENT PRESENT	MORPHOLOGY	COMMENTS
Vein 1- Carbonates	85	equant	Vein core. The vein is folded and carbonates have wavy extinction.
Vein 1 - Chrysotile	15	Cross-fiber	Rims of veins.
Vein 2 - Chrysotile	100	Cross-fiber	Pre-kinematics relative to late talc-bearing shear ribbons. Fibers are folded and display wavy extinction.

GENERAL COMMENTS Complex set of veins. Cross-cutting relationships are obscured in mylonitic shear bands. Early generation of serpentine veins is cut by composite carbonate-chrysotile veins.
Carbonate veins dies out toward the mylonitic ribbons. Other veins seems late synchronous (folded serpentine-chrysotile) to late relative to deformation.
Talc is everywhere associated with ultramylonitic ribbons.

STRUCTURE
Crystal Plastic:
Intense ductile and semi-brittle shear zone within gabbro vein cutting peridotite; within the mylonitic shear zone, pyroxene, plagioclase, and amphibole are segregated into distinct compositional bands with deformation mechanisms specific to each mineral.
Deformation of olivine, clinopyroxene and orthopyroxene occurred dominantly by ductile processes; plagioclase and amphibole deformed by a combination of ductile and brittle processes.
Pyroxene recrystallized grain size varies widely in segregated bands across thin section from 0.01 mm to 0.3 mm.
Plagioclase is partially recrystallized and partially grain size reduced by cataclasis.
Amphibole bands are deformed by semi-brittle processes that included fracturing along cleavage planes and diffusive mass transfer; amphibole porphyroclasts are boudined parallel to shear foliation.

THIN SECTION:	**209-1270C-1R-1, Piece 13, 83-85 cm**	**TS#92**	**Observer: ET / CG**
ROCK NAME:	**MODERATELY ALTERED HARZBURGITE AND GABBRO MYLONITE**		
GRAIN SIZE:			
TEXTURE:	**Mylonitic**		

STRUCTURE CONTINUED

Brittle:
Shear zone appears to have been affected by late, low-temperature brittle deformation.
Shear fractures containing fine grained talc bound phacoidal clinopyroxene segregations.
Late randomly oriented tremolite overgrowths of serpentine suggest a late phase of state alteration.

Foliation:
Strong foliation defined by mylonitic banding in shear zone.

Impregnation Textures:
Gabbro vein likely permeated rock during high temperature brittle/ductile deformation; lead to ductile-brittle mylonitic shear zone.

Crosscutting Relationships (as are apparent in thin section):

1) High temperature ductile deformation during intrusion of gabbroic melt
2) Ductile and semi-brittle deformation
3) Minor brittle overprint
4) Serpentine veins
5) Talc veins
6) Carbonate veins

THIN SECTION:	**209-1270C-3M-1, Piece 8, 44-46 cm**	**TS#93**	**Observer: ET / CG**
ROCK NAME:	**SERPENTINIZED HARZBURGITE WITH GABBROIC INTRUSION**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic to mylonitic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	10	68			
Orthopyroxene	20	30	0.5-3.5	Anhedral	
Spinel	1	2	<0.1-0.3	Rectangular, anhedral	Disseminated.
Gabbroic dike					
Clinopyroxene	10	30		Anhedral	Neoblast.
Plagioclase	0	40			
Amphibole	0	30			

GENERAL COMMENTS Mixture of mylonitic harzburgite and altered gabbroic intrusion in which only fine-grained clinopyroxenes have been preserved. Coarse orthopyroxene porphyroclasts as large as 12 mm form aggregate in the harzburgite part.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Peridotite:				
Serpentine	58	Olivine, orthopyroxene		Mesh texture. Rims of bastite pseudomorphs around orthopyroxene.
Magnetite	2	Olivine, spinel		Rimming serpentine mesh texture.
Talc	5	Pyroxenes, serpentine		Replacing serpentine after olivine and rimming orthopyroxene porphyroclasts.
Amphibole	1		Veinlets in serpentine	
Clays	2	Olivine		
Gabbroic boudin:				
Talc	15	Pyroxenes, plagioclase		Fine intergrown from former gabbro pod.
Chlorite	35	Plagioclase		Fine intergrown from former gabbro pod.
Albite	1	Plagioclase		Fine intergrown from former gabbro pod.
Iron oxides	4	Pyroxenes?		Fine intergrown from former gabbro pod.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Chrysotile veins		Sigmoidal cross-fiber veins	Paragranular (subparallel to mylonitic foliation).

STRUCTURE

Crystal Plastic:
Remnants of ductile shear zones within three gabbro veins; now replaced by talc.
Can see remnants of pyroxene porphyroclasts, finely recrystallized neoblasts and mylonitic banding through static talc overprint.

Brittle:
Zones of semi-brittly deformed brown amphibole survived late talc alteration.
Late en-echelon shear fractures filled with serpentine.

Foliation:
Mylonitic foliation is obscured by talc alteration. Ribbon texture serpentine foliation is sub-parallel to mylonitic foliation.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation during gabbro intrusion
2) Serpentinization
3) Talc alteration
4) Serpentine veins
5) Shear fractures filled with serpentine

THIN SECTION:	**209-1270D-1R-1, Piece 4, 16-18 cm**		**TS#94**	**Observer:MS, AC, JH**	
ROCK NAME:	**METAMORPHIC PERIDOTITE (HARZBURGITE?)**				
GRAIN SIZE:					
TEXTURE:					

	MODE (Visual estimate)				
PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine					
Orthopyroxene					
Spinel					

GENERAL COMMENTS Completely altered except for one core of a orthopyroxene and few spinels totally replaced by magnetite.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Talc	45	Clinopyroxene	Granular to massive.	
Chlorite	2	Clinopyroxene	Patchy, irregular.	
Amphibole	30	Clinopyroxene	Irregular in former clinopyroxene cores.	
Albite	20	Plagioclase	Relict cores and smeared out patches.	
Iron oxides	3			

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
No veins.			

STRUCTURE

Crystal Plastic:
Remnants of crystal plastic deformation visible as deformation twins and bent cleavage in a few relict plagioclase grains.

Brittle:
Sample is comprised of an intense semi-brittle shear zone; foliation is defined by fibrous tremolite and talc crystals cut by phacoidal shear planes.
Strain was accommodated by diffusive mass transfer, grain boundary sliding and fracturing at dominantly greenschist facies conditions.
Early high temperature history of rock is evidenced by remnant porphyroclasts of brown hornblende; sample has been deformed over a wide temperature range.

Crosscutting Relationships (as are apparent in thin section):
1) High temperature ductile deformation
2) Intense greenschist facies deformation

THIN SECTION:	**209-1270D-1R-1, Piece 16, 75-78 cm**	**TS#95**	**Observer:MS, AC, JH, WB**
ROCK NAME:	**HARZBURGITE/DUNITE**		
GRAIN SIZE:	**Medium- to coarse-grained**		
TEXTURE:	**Protogranular/porphyroclastic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	1	68			Also fresh included in orthopyroxene.
Orthopyroxene	10	27	15	Anhedral	
Clinopyroxene	1	3-4	2.5	Anhedral	Associated with orthopyroxene, fresh.
Spinel	1.5	2	0.1-1.5	Anhedral to euhedral to vermiform	Intergrowth with orthopyroxene.

GENERAL COMMENTS
Layering of dunite and harzburgite. Both have coarse grained former texture.
The dunite has 2% of orthopyroxene.
Orthopyroxene porphyroclasts in the harzburgitic part have clinopyroxene exolutions.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Serpentine	85	Olivine/orthopyroxene	Microgranular	Patchy, commonly overprinted by talc.
Talc	4	Olivine/orthopyroxene	Very fine grained	Appears brown in many places.
Iron oxides	10	Olivine/spinel	Anhedral around grain boundaries	Dominates former grain boundaries and partially replaces some spinel.
Brown amphibole	<1	Orthopyroxene		
Carbonate	1	Orthopyroxene(?)		Patchy.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**		**MORPHOLOGY**	**COMMENTS**
Serpentine	55	Olivine	Fibrous chrysotile	In serrate veins and small sigmoidal veins, some talc overprint.
Talc/clay	30	Chrysotile	Pseudomorphic after chrysotile	Overprints chrysotile.
Magnetite	2	Olivine	Subhedral	Occurs within chrysotile veins.

GENERAL COMMENTS
Magnetite/serpentine veining grades into ribbon texture and background alteration.
Transfoliation serpentine veinlets are cut by en echelon carbonate veins that are themselves cut (and offset) by late clay+oxide veins.

STRUCTURE

Crystal Plastic:
Minor crystal plastic deformation; kind bands and minor bent cleavage in several pyroxene grains.

Foliation:
Moderate foliation in parts of thin section defined by ribbon texture serpentinite.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Serpentinization
3) Veining

THIN SECTION:	**209-1270D-3R-1, Piece 8B, 63-65 cm**	**TS#96**	**Observer: MS, AC, JH, WB, TS**	
ROCK NAME:	**SERPENTINIZED HARZBURGITE**			
GRAIN SIZE:	**Coarse-grained**			
TEXTURE:	**Porphyroclastic to mylonitic**			

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	0	75			Recrystallized, some fresh.
Orthopyroxene	0	25	1-8	Anhedral	Fresh relicts.
Spinel	0	1	<0.2	Subhedral	Very few fresh left.
Gabbroic dike					
Clinopyroxene	1	50		Anhedral	Replaced by amphibole.
Plagioclase	0	40	0.2	Anhedral	Completely altered.
Amphibole	5	10	<0.2	Equant	Fresh, prior mylonitization, fluid inclusions.

GENERAL COMMENTS

Harzburgite is intruded by gabbroic melt and mylonitize.
Large harzburgite porphyroclastic domains are preserved, showing that the primary grain size was coarse and protogranular.
The clasts are surrounded by mylonitic gabbro, with porphyroclasts of altered clinopyroxene and brown amphibole and altered recrystallized plagioclase neoblasts.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Serpentine	55	Olivine/orthopyroxene	Core and rim structures grading into ribbon texture.	Occasional fresh olivine grains
Talc	37	Serpentine	Microgranular grading to patches of coarser grains	
Chlorite	3	Pyroxenes	Patchy	Interspersed with tremolite/talc.
Magnetite	2	Olivine/spinel	Subhedral	Picks out grain boundaries, some replacement of spinel.
Green amphibole	3	Pyroxenes		

VEIN / FRACTURE FILLING	**PERCENT PRESENT**		**MORPHOLOGY**	**COMMENTS**
GABBROIC DIKE				
Talc	38	Plagioclase	Fine-grained	Extremely fine-grained aggregate completely replacing plagioclase.
Chlorite	32	Clinopyroxene	Patchy/granular, radiating clusters of fibrous crystals	Associated with tails of rotated clinopyroxene.
Green amphibole	30	Clinopyroxene	Ranges from granular to finely acicular	

STRUCTURE

Crystal Plastic:
Ductile strain was localized into a gabbroic vein cutting peridotite.
Remnant orthopyroxene grains have been boudined and display remnants of core and mantle texture.
One small patch of fresh olivine show core and mantle texture with neoblasts recrystallized to 0.05 to 0.15 mm grain size.
Patches of brown amphibole crystals surround some pyroxene porphyroclasts; these may show a slight preferred alignment parallel to vein/shear zone walls.

Brittle:
There is no brittle deformation apparent in thin section. Greenschist alteration in gabboic vein appears to have occurred under dominantly static conditions.
Weak foliation in wall rock peridotite is defined by ribbon texture serpentinite and is oblique to foliation of high temperature shear zone.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation in gabbroic vein
2) Serpentinization
3) Static greenschist facies alteration

THIN SECTION: **209-1270D-3R-1, Piece 11, 94-97 cm** **TS#97** **Observer: MS, AC, JH, WB**
ROCK NAME: **SERPENTINIZED AND METAMORPHIC HARZBURGITE**
GRAIN SIZE: **Medium- to coarse-grained**
TEXTURE: **Protogranular/porphyroclastic**

PRIMARY MINERALOGY	MODE (Visual estimate) PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)	MORPHOLOGY	COMMENTS
Olivine	0				
Orthopyroxene	0	30?	10	Anhedral	Inclusion of olivine.
Clinopyroxene	0	3-4?	2	Interstitial	Small segregation vein.
Spinel	1.5	2		Veriform	Intergrowth with orthopyroxene.

COMMENTS Ghosts of orthopyroxene and clinopyroxene that show former protogranular texture
Orthopyroxene intergrowth with spinel. Spinel is completely altered
Interstitial clinopyroxene in discontinuous parallel veins cutting through the serpentinite matrix

SECONDARY MINERALS	PERCENT PRESENT	REPLACING	MORPHOLOGY	COMMENTS
Talc	20	Serpentine	Microgranular to fine-grained	Mostly associated with alteration of orthopyroxene.
Chlorite	Trace	Orthopyroxene	Patchy	Occasional patch associated with talc alteration.
Amphibole	5	Orthopyroxene	Prismaic	Replacing orthopyroxene along cleavage.
Serpentine	74	Olivine/orthopyroxene		Textures range from mesh-rim to ribbon.
Magnetite	1	Olivine/spinel		

VEIN / FRACTURE FILLING	PERCENT PRESENT	MORPHOLOGY	COMMENTS
Serpentine		Fibrous chrysotile	Present in small sigmoidal veins occasionally along with talc.
Magnetite		Anhedral	Present with chrysotile in sigmoidal veins.
Talc		Pseudomorphic	Cuts serpentine veins and is cut by chrysotile veins.

STRUCTURE
Crystal Plastic:
Minor crystal plastic deformation; kind bands and minor bent cleavage in several pyroxenes grains.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Serpentinization
3) Serpentine veins

THIN SECTION:	**209-1270D-3R-2, Piece 4, 68-71 cm**	**TS#98**	**Observer: MS, AC, JH**
ROCK NAME:	**HARZBURGITE/DUNITE**		
GRAIN SIZE:	**Medium- to coarse-grained**		
TEXTURE:	**Protogranular/porphyroclastic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	0	68			Also fresh included in orthopyroxene.
Orthopyroxene	0	30	15	Anhedral	
Clinopyroxene	0	2?			
Spinel	1.5	2	3	Anhedral	Intergrowth with orthopyroxene.

GENERAL COMMENTS
Dunite band 1.5 cm thick in the middle of the thin section.
Relics of orthopyroxene and a big spinel in the dunite section.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Talc	2	Orthopyroxene	fine grained, powdery	
Tremolite	5	Orthopyroxene	Lath like	Replaced along cleavage planes?
Serpentine	90	Olivine/orthopyroxene	Core and rim structures grading locally into ribbon textures	
Iron oxides	3	Olivine/spinel	Subhedral around olivine grain boundaries, anhedral where replacing spinel	
GABBROIC PATCH				
Talc	35		possible edge of gabbroic patch completely altered?	
Chlorite	30			
Tremolite	25			

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Serpentine		Fine-grained in massive serpentine veins, fibrous Crysotile in serrate veins and sigmoidal veins showing shear sense (which crosscut the massive serpentine vein)	
Magnetite		Anhedral in sigmoidal veins	
Talc		Rare; along chrysotile in sigmoidal veins	

STRUCTURE
Crystal Plastic:
Minor to moderate crystal plastic deformation; kind bands, bent cleavage and possible recrystallization in several pyroxene grains.
Band of serpentinite with fine mesh cells adjacent to a band of pyroxene may have been recrystallized deformed olivine, but textures are obscured by alteration.

Brittle:
Textures in gabbroic patch indicate possible minor greenschist-grade semibrittle deformation, but the relations are not clear.

Foliation:
Faint foliation defined by ribbon texture serpentinite.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Intrusion of gabbroic melt
2) Serpentinization
3) Serpentine veins
4) Carbonate veins

THIN SECTION:	**209-1270D-4R-1, Piece 7, 33-37 cm**	**TS#99**	**Observer: MS, AC, JH, TS**
ROCK NAME:	**SERPENTINIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic- to mylonitic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	5	72	10		Coarse-grained clasts of recrystallized olivine preserved
Orthopyroxene	5	28	1-10	Anhedral	Fresh relicts
Spinel	0	1	<0.2	Subhedral	Very few fresh grains left.
Gabbroic dike					
Clinopyroxene	1	43	1.7	Anhedral	Replaced by amphibole,
Plagioclase	0	38	0.2	Anhedral	Completely altered.
Amphibole	10	15	1.5	Rounded porphyroclast	Fresh, prior mylonitization, with inclusions of epidote in the outer margin.
Zircon			0.1-0.2	Euhedral	Associated with amphiboles in the mylonitic layers.

GENERAL COMMENTS

Harzburgite is intruded by gabbroic melt and mylonitized.
Harzburgite porphyroclastic domains are preserved but small, showing that the primary grain size was coarse and protogranular.
However, modal estimate of the harzburgite is not reliable because of the strong deformation.
The clasts are surrounded by mylonitic gabbro, with porphyroclasts of altered clinopyroxene and brown amphibole and altered recrystallized plagioclase neoblasts.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**		**MORPHOLOGY**	**COMMENTS**
Epidote	Trace		<0.05	Euhedral	Occur as inclusions in the outer margin of amphibole.
Talc	25			Microgranular to fine-grained	Occurs as rims around harzburgitic clasts.
Chlorite	34			Fibrous	In discrete bands and occasional patches within large alteration halos around harzburgitic clasts.
Amphibole	20			Range of morphologies	From 0.1 mm subhedral down, some lath-like replacement of clinopyroxene, fine-grained tremolite in reaction halos.
Iron oxides	1				

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Amphibole		Acicular/ fibrous	May overprint former chrysotile margins. bands have morphology consistent with amphibole overprint of former banded serpentine veins.
Iron oxides		Anhedral	Occurs with former chrysotile fibers in vein margins.

Large areas extremely fine grained and practically isotropic.

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STRUCTURE

Crystal Plastic:
Intense crystal plastic deformation; pyroxene and olivine both show core and mantle texture with over 50% grain size reduction to fine polygonal neoblasts.
Pyroxene is rimmed by brown amphibole and has pressure shadow tails of brown amphibole parallel to the shear foliation.
Brown amphibole porphyroclasts also exhibit core and mantle texture, with elongate neoblasts forming tails and stringers of amphibole between.
porphyroclasts that are parallel to the shear foliation.
Peridotite enclaves in shear zone are serpentinized, but to not appear to have been affected by extensive dynamic recrystallization. Olivine grains are extensively kinked and subgrains show incipient recrystallization in enclaves. Pyroxene lamellae are bent.

Brittle:
Little brittle overprint of ductile deformation; greenschist facies alteration appears to be dominantly static.

Foliation:
Strong foliation defined by compositional banding, shear texture and elongate porphyroclasts.

Crosscutting Relationships (as are apparent in thin section):

1) High temperature ductile deformation in conjunction with injection of gabbroic melt and/or metasomatism of peridotite
2) Serpentinization and greenschist facies alteration
3) Talc alteration
4) Serpentine veins

THIN SECTION:	**209-1270B-8R-1, Piece 20B, 124-126cm**	**TS#100**	**Observer: CG, WM**
ROCK NAME:	**OXIDE GABBRONORITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Granular**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Plagioclase	37	40	12	Equant	
Clinopyroxene	47	52	18	Subhedral to euhedral	
Orthopyroxene	2	3	10	Subhedral to euhedral	
Oxide	5	5		Interstitial	

COMMENTS Many primary igneous features in terms of grain shapes and twinning in clinopyroxene are preserved despite significant deformation.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Amphibole	5	Clinopyroxene, plagioclase		
Chlorite	2	Clinopyroxene, plagioclase		
Brown Amphibole	1	Plagioclase		

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
No veins.			

STRUCTURE

Crystal Plastic:
Weak crystal plastic deformation of coarse-grained gabbro; plagioclase and pyroxene grains show internal plastic deformation by undulose extinction. Plagioclase and pyroxene have both been recrystallized along planar shear bands plagioclase neoblasts range from 0.05 to 0.2 mm and pyroxene neoblasts range from 0.03 to 0.1 mm.

Brittle:
No brittle overprint of ductile fabric.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Static greenschist facies alteration

THIN SECTION:	**209-1270B-10-M1, Piece 23, 142-144 cm**	**TS#101**	**Observer: JH, DG**
ROCK NAME:	**OXIDE GABBRO**		
GRAIN SIZE:	**1-20 mm**		
TEXTURE:	**Coarse**		

PRIMARY MINERALOGY	MODE (Visual estimate) PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)	MORPHOLOGY	COMMENTS
Clinopyroxene	40	55	15	Subhedral to euhedral, equant grains	Mildly strained phenocrysts.
Plagioclase	35	30	>25		Extremely large grains.
Orthopyroxene	0	0			
Oxide minerals	5	5	3	Interstitial	

GENERAL COMMENTS This sample is very coarse-grained. The deformation is most pronounced on one side of the sample.

SECONDARY MINERALS	PERCENT PRESENT	REPLACING	MORPHOLOGY	COMMENTS
Secondary plagioclase	5	Plagioclase	Subhedral, granular	Form fringes around primary plagioclase and grain boundaries.
Chlorite	Trace	Clinopyroxene	Patchy, fibrous	Associated with amphibole and trace of biotite.
Amphibole	15	Clinopyroxene?	Acicular, sometimes granular	Granular around pyroxene margins, lath-like and acicular where completely replaced. Fringes primary amphibole breakdown.
Biotite	Trace			

VEIN / FRACTURE FILLING	PERCENT PRESENT	MORPHOLOGY	COMMENTS
Quartz	3	Vein or small elongated pod?	

STRUCTURE

Crystal Plastic:
Weak crystal plastic deformation.
Plagioclase has undulose extinction, deformation twins and subgrain domains. Minor recrystallization around grain boundaries to fine polygonal neoblasts.
Pyroxene is weakly internally deformed within coarse porphyroclasts, but is recrystallized to fine neoblasts near porphyroclast boundaries.

Brittle:
Little brittle overprint of ductile deformation; greenschist facies alteration appears to be dominantly static.

Foliation:
Very weak foliation defined by elongate pyroxene and plagioclase porphyroclasts subparallel to recrystallized bands in plagioclase.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Static alteration

THIN SECTION:	**209-1270D-4R-1, Piece 4, 19-22 cm**		**TS#102**	**Observer: AC/CG/WB**	
ROCK NAME:	**SERPENTINIZED HARZBURGITE/DUNITE**				
GRAIN SIZE:					
TEXTURE:	**Granular**				

	MODE (Visual estimate)				
PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
HARZBURGITE					
Olivine	0	65			
Orthopyroxene	0	30	1-7	Anhedral	
Clinopyroxene	0	3-4?	1-5?	Anhedral	
Spinel	1	1	<1	Subhedral	Associated with orthopyroxene.
DUNITE					
Olivine	0	95			
Spinel	1	5	1	Subhedral	

GENERAL COMMENTS
No primary mineralogy is preserved.
Contact between dunite and harzburgite.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Serpentine	90	Olivine	Core and rim to ribbon texture	
Magnetite	3	Olivine	Subhedral to anhedral	Anhedral semi-continuous grain boundaries to former olivine. Grain boundaries, elsewhere, discrete subhedral grain.
Talc	5		Fine granular to pseudomorphic	Pseudomorphing former orthopyroxene grains and forming rims on bastite.
Chlorite	Trace	Orthopyroxene	Small patches of fibers	Present around ragged edges of talc altered orthopyroxenes. Also present in aggregates of spinel (after plagioclase).

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Chrysotile		Cross fibers	Form sigmoidal veins that have been variably talc overprinted.
Magnetite		Anhedral	
Talc		Pseudomorphic	Present as patchy replacement of chrysotile, not present at all in some veins.

GENERAL COMMENTS
In the lower left corner of this thin section is an aggregate of anhedral spinel grains intergrown with talc and chlorite that has roughly the outline and size of a large spinel crystal.
This could represent decompression breakdown of spinel to plagioclase and pyroxene that were subsequently altered to talc and chlorite.
Veining is intense and takes the form of subparallel, semicontinuous, sigmoidal, cross fiber veins throughout the section.

STRUCTURE
Crystal Plastic:
Weak crystal plastic deformation.
Pseudomorphed pyroxene porphyroclasts have kink bands and minor bent cleavage, but no recrystallization.

Brittle:
Minor late shear fractures filled by serpentine.

Foliation:
Weak foliation defined by ribbon texture serpentinite.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Serpentinization
3) Serpentine filled shear fractures

THIN SECTION: **209-1270D-4R-2, Piece 5, 38-43 cm** **TS#103** **Observer: MS, AC, WB**
ROCK NAME: **SERPENTINIZED HARZBURGITE**
GRAIN SIZE: **Coarse-grained**
TEXTURE: **Porphyroclastic to mylonitic**

PRIMARY MINERALOGY	MODE (Visual estimate) PERCENT PRESENT	PERCENT ORIGINAL	SIZE (mm)	MORPHOLOGY	COMMENTS
Olivine	?	?	10		Coarse grained clasts of recrystallized olivine preserved.
Orthopyroxene	?	?	1-10	Anhedral	Some fresh relics
Spinel	?	?	1	Subhedral	Train of big spinel slightly altered 1 cm long, 1 cm thick.
Gabbroic dike					
Clinopyroxene	1	43	1.7	Anhedral	Replaced by amphibole.
Plagioclase	0	38	0.2	Anhedral	Completely altered.
Amphibole	10	15	1.5	Rounded porphyroclast	Fresh, prior mylonitization.
Zircon	Trace		0.01		
Apatite	Trace				

COMMENTS
The harzburgite is completely altered.
Because of the amount of deformation and recrystallization the modal composition is not reliable.
Harzburgite is intruded by gabbroic melt and mylonitized.
Large harzburgite porphyroclastic domains are preserved showing that the primary grain size was coarse and protogranular.
The clasts are surrounded by mylonitic gabbro, with porphyroclasts of altered clinopyroxene and brown amphibole and altered recrystallized plagioclase neoblasts.
Train of spinel not parallel to mylonitization.

SECONDARY MINERALS	PERCENT PRESENT	REPLACING	MORPHOLOGY	COMMENTS
Gabbroic dike:				
Talc	27	?	Fibrous	In bands.
Chlorite	40	?	Fibrous to radiating	In bands.
Amphibole	20	?	Acicular, neoblastic	
Carbonate	Trace	Plagioclase	Prismatic	Filling vugs
Diopside	Trace	?	Prismatic	
Hydrogrossular	3	Plagioclase		Probably
Harzburgite:				
Serpentine	90	Olivine		
Talc	9	?		Most of the talc appears to be associated with the gabbroic dike
Magnetite	1	Olivine		

VEIN / FRACTURE FILLING	PERCENT PRESENT	MORPHOLOGY	COMMENTS
Late serpentine and clay veins			

STRUCTURE
Crystal Plastic:
Significant strain is localized onto veins (of likely gabbroic origin), but the full degree of crystal plastic deformation is difficult to asses due to amphibolite, greenschist alteration/deformation and late static alteration.
Small patch of fresh olivine shows deformation bands, subgrains and minor recrystallization, but no significant grain size reduction.
Relict orthopyroxene porphyroclasts are partially boudined and have pressure shadow tails of amphibole,
but do not show a significant degree of grain size reduction by crystal plastic deformation.

Brittle:
Dominant deformation preserved in sample is semi-brittle to ductile deformation during growth of schistose brown amphibole and tremolite.
Highly deformed bands of schistose amphibole are aligned parallel to walls of gabbroic veins,
probably deformation mechanism is a combination of diffusive mass transfer, cataclasis and grain boundary sliding.

Foliation:
Strong foliation defined by compositional banding in highly deformed gabbroic veins.

THIN SECTION:	**209-1270D-4R-2, Piece 5, 38-43 cm**	**TS#103**	**Observer: MS, AC, WB**
ROCK NAME:	**SERPENTINIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic to mylonitic**		

Crosscutting Relationships (as are apparent in thin section):	1) High temperature ductile deformation in conjunction with injection of gabbroic melt and/or metasomatism of peridotite 2) Amphibolite facies deformation 3) Serpentinization 4) Greenschist facies alteration with minor deformation 5) Late static alteration

THIN SECTION:	**209-1270D-5R-1, Piece 5, 23-28 cm**	**TS#104**	**Observer: MS, AC, WB**	
ROCK NAME:	**SERPENTINIZED HARZBURGITE**			
GRAIN SIZE:	**Coarse-grained**			
TEXTURE:	**Porphyroclastic to mylonitic**			

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	10	73	4		Coarse-grained clasts of recrystallized olivine preserved.
Orthopyroxene	10	25	1-15	Anhedral	Fresh relicts.
Spinel	1.5	2	3	Subhedral	Large spinel in train, 1 cm long.
Gabbroic dike					
Clinopyroxene	1	43	1.7	Anhedral	Completely altered.
Plagioclase	0	38	0.2	Anhedral	Completely altered.
Amphibole	10	15	1.5	Rounded porphyroclast	Fresh, prior mylonitization.

GENERAL COMMENTS

Harzburgite is intruded by gabbroic melt and mylonitized.
Because of the amount of deformation and recrystallization however the modal composition is not reliable.
Large harzburgite porphyroclastic domains are preserved showing that the primary grain size was coarse and protogranular.
The clasts are surrounded by mylonitic gabbro, with porphyroclasts of altered clinopyroxene and brown amphibole and altered recrystallized plagioclase neoblasts.
Neoblasts of orthopyroxene recrystallized associated with recrystallized olivine.
Euhedral inclusion of fresh olivine in fresh orthopyroxene.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Talc	20		Granular	Interspersed with amphibole in former gabbroic mylonite, forms thick alteration haloes around harzburgitic clasts.
Serpentine	25		Ribbon texture	Ribbon texture dominates serpentine morphology but pockets of antigorite needles are also present in discrete pockets.
Chlorite	1		Patchy	Typically fringe talc/amphibole alteration and present in antigorite pockets.
Amphibole	20		Prismatic to acicular	In gabbro vein.
Iron oxides	trace			
Carbonate	trace		Short prismatic	In vugs.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Banded serpentine vein cutting chrysotile veins.			
Rare chlorite veinlets.			
mm-wide aragonite vein.			

STRUCTURE

Crystal Plastic:
Significant crystal plastic strain is localized onto vein (of likely gabbroic origin) and onto peridotite wallrock of vein.
Several patches of fresh olivine show core and mantle texture with variable sized polygonal neoblasts surrounding porphyroclasts with subgrain domains.
Relict orthopyroxene porphyroclasts show moderate internal deformation and are partially recrystallized to fine neoblasts.
No plagioclase is present to determine plagioclase microtextures.

Brittle:
Moderate to high intensity semi-brittle, amphibolite facies overprint of crystal plastic deformation.
Highly deformed bands of schistose amphibole are aligned parallel to walls of gabbroic veins; probably deformation mechanism is a combination of diffusive mass transfer, cataclasis and grain boundary sliding.
Greenschist facies brittle deformation is suggested by aligned arrays of tremolite, and slight breccation of serpentinite.
Late static alteration is suggested by undeformed serpentine veins and random or radial aggregates of chlorite and tremolite.

Foliation:
Strong foliation defined by compositional banding and shear fabric in highly deformed gabbroic veins.

THIN SECTION:	**209-1270D-5R-1, Piece 5, 23-28 cm**	**TS#104**	**Observer: MS, AC, WB**
ROCK NAME:	**SERPENTINIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic to mylonitic**		

Crosscutting Relationships (as are apparent in thin section):	1) High temperature ductile deformation in conjunction with injection of gabbroic melt and/or metasomatism of peridotite 2) Amphibolite facies deformation 3) Serpentinization 4) Greenschist facies alteration with minor deformation 5) Late static alteration

THIN SECTION:	**209-1270D-6R-1, Piece 3, 18-21 cm**	**TS#105**	**Observer: AC, JH, WB**
ROCK NAME:	**SERPENTINIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic to mylonitic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	0				
Orthopyroxene	1		1-4	Anhedral	Fresh relics.
Spinel	1		<0.3	Subhedral	Dunitic domains have big spinels up to 0.2 mm.
Gabbroic dike					
Clinopyroxene	1	50		Anhedral	Completely altered.
Plagioclase	0	40	0.2	Anhedral	Completely altered.
Amphibole	5	10	0.6	Equant	Fresh, prior mylonitization, fluid inclusions.

COMMENTS
Harzburgite is intruded by gabbroic melt and mylonitized.
Small harzburgite porphyroclastic and dunite domains are preserved but too small for reliable modal composition.
The clasts are surrounded by mylonitic gabbro, with porphyroclasts of altered clinopyroxene and brown amphibole and altered recrystallized plagioclase neoblasts.
Overall the rock is orthopyroxene and spinel rich.
Relict orthopyroxene!

SECONDARY MINERALS	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Serpentine	80	Degraded core and rim structures grading into ribbon texture alteration.	
Talc	15	Microgranular to granular	Concentrated principally around margins of harzburgitic clasts and pervasively alters harzburgitic clasts.
Magnetite	Trace		
IN GABBROIC VEIN			
Talc	25	Fine-grained	Probably from breakdown of former gabbroic veining.
Amphibole	3	Granular, fine grained.	Mostly interspersed within talc alteration some secondary amphibole around margins of clinopyroxene inclusions.
Chlorite	10	Patchy	Forms discrete bands sub parallel to talc/amphibole bands locally coarser and lath-like particularly in pressure shadows of harzburgitic clasts. Another type of chlorite forms a single 10mm long patch of low birefringence.
Carbonate	Trace	After orthopyroxene	

VEIN / FRACTURE FILLING	**MORPHOLOGY**	**COMMENTS**
Magnetite		
Chrysotile		Must be at least 3 generations (see 1270D_016 and 1270D_017).
Iron oxides/hydroxides	Massive, irregular	Cross cuts gabbroic intrusion therefore post dates it. Uncertain as to how these relate to serpentine veins.
Talc	Fine-grained	Associated with former gabbroic intrusion.

STRUCTURE
Crystal Plastic:
Significant crystal plastic strain is localized onto vein (of likely gabbroic origin) and onto peridotite wallrock of vein.
No fresh olivine or pyroxene are present to asses the degree of crystal plastic deformation of primary minerals.
Relict orthopyroxene porphyroclasts show moderate internal deformation and are partially boudined during alteration to amphibole but are not grain size reduced by crystal plastic deformation.

Brittle:
Moderate to high intensity semi-brittle, amphibolite facies overprint of crystal plastic deformation.
Highly deformed bands of schistose amphibole are aligned parallel to walls of gabbroic veins,
probably deformation mechanism is a combination of diffusive mass transfer, cataclasis and grain boundary sliding.
Greenschist facies brittle deformation is suggested by aligned arrays of tremolite, and slight breccation of serpentinite.
Late static alteration is suggested by undeformed serpentine veins and random or radial aggregates of chlorite and tremolite.

THIN SECTION:	**209-1270D-6R-1, Piece 3, 18-21 cm**	**TS#105**	**Observer: AC, JH, WB**
ROCK NAME:	**SERPENTINIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic to mylonitic**		

STRUCTURE (CONTINUED)

Foliation:

Strong foliation defined by compositional banding and shear fabric in highly deformed gabbroic veins.

Crosscutting Relationships (as are apparent in thin section):	1) High temperature ductile deformation in conjunction with injection of gabbroic melt and/or metasomatism of peridotite 2) Amphibolite facies deformation 3) Serpentinization 4) Greenschist facies alteration with minor deformation 5) Late static alteration

THIN SECTION:	**209-1270D-6R-1, Piece 4B, 29-32 cm**	**TS#106**	**Observer: AC, JH, WB**
ROCK NAME:	**SERPENTINIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic-mylonitic**		

	MODE (Visual estimate)				
PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	0	80			
Orthopyroxene	1	15-20	1-10	Anhedral	Fresh relict cores.
Clinopyroxene	0	2-3?	1-5	Anhedral	
Spinel	0.5	1	0.1	Subhedral	

COMMENTS
Orthopyroxene is recrystallized in subgrains
Inclusions of altered olivine in orthopyroxene

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Serpentine	90	Orthopyroxene	Occasional core and rim structures, mostly ribbon texture	Some talc alteration in serpentine cores.
Talc	4	Olivine/orthopyroxene	Very fine-grained	Some talc alteration in serpentine, cores, partial replacement of orthopyroxene.
Magnetite	1	Olivine	Anhedral	
Carbonate	4	Orthopyroxene	Anhedral	Pseudomorphing orthopyroxene. Not twinned, could be magnesite.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Chrysotile		Cross fibers	Present in sigmoidal veins.
Talc-amphibole		Altered magmatic veins	Cut by chrysotile veins.
Iron oxides		Anhedral	Small percentage in chrysotile veins and fine grained veining grading into background alteration.
Carbonate			Connecting two talc-amphibole veins.

STRUCTURE

Crystal Plastic:
Moderate crystal plastic deformation; Relict pyroxene porphyroclasts show kink banding and minor dynamic recrystallization.

Brittle:
Very minor brittle deformation; slight fracturing during serpentinization manifested as disjointed ribbon texture.
Late shear fractures filled with serpentine and carbonate.

Foliation:
Weak foliation defined by ribbon texture serpentine.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Serpentinization
3) Serpentine veins
4) Talc alteration
5) Late serpentine and talc veins

THIN SECTION:	**209-1270D-9R-1, Piece 2, 7-10 cm**	**TS#107**	**Observer: AC, CG, WB**
ROCK NAME:	**SERPENTINIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Porphyroclastic-mylonitic**		

	MODE (Visual estimate)				
PRIMARY MINERALOGY	**PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	0	70			
Orthopyroxene	0	25	1-10	Anhedral	
Clinopyroxene	0	3-4?	1-5	Anhedral, interstitial	
Spinel	0.5	1	0.1	Subhedral	

GENERAL COMMENTS Interstitial clinopyroxene in discontinuous domains cutting through the serpentinite matrix

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Serpentine	94	Olivine, orthopyroxene		Ribbon texture after olivine, orthopyroxene replaced by high-birefringent serpentine.
Magnetite	4	Olivine		Around serpentine in mesh texture.
Amphibole	1	Pyroxenes		Pseudomorph after orthopyroxene.
Chlorite	1.5	Pyroxenes(?)		Around pyroxenes in patches commonly intergrown with flakes of amphibole. May be replacement of primary plagioclase.
Talc	Trace	Pyroxenes		In patches.

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Chrysotile veins		Sigmoidal	Cross-fiber.
Magnetite veins		Sigmoidal	Cut by chrysotile veins.

STRUCTURE

Crystal Plastic:
Minor crystal plastic deformation; Minor kink banding of pseudomorphed pyroxene porphyroclasts.

Foliation:
Moderate foliation defined by ribbon texture serpentine.

Crosscutting Relationships (as are apparent in thin section):	1) Ductile deformation 2) Serpentinization 3) Serpentine veins

THIN SECTION:	**209-1270D-10R1, Piece 1, 4-6cm**	**TS#108**	**Observer: AC, MS, CG**
ROCK NAME:	**DUNITE**		
GRAIN SIZE:			
TEXTURE:	**Granular**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	0	98			
Orthopyroxene	0	1-2			
Clinopyroxene	0	2?	1-5	Anhedral	
Spinel	0.5	0.5	0.1	Subhedral	Associated with orthopyroxene.

GENERAL COMMENTS
This dunite has a enriched band of orthopyroxene. Big spinels are associated in the band of orthopyroxene.
The mylonitization crosses at high angle the lineation of the orthopyroxene.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
Serpentine	93	Olivine, orthopyroxene		Mesh texture after olivine; bastite pseudomorphs after orthopyroxene.
Magnetite	3	Olivine		Around serpentine in mesh texture.
Amphibole	1	Orthopyroxene		
Clay minerals	2	Serpentine		
Chlorite	0.5			Around spinels.
Talc	Trace	Orthopyroxene		

VEIN / FRACTURE FILLING	**PERCENT PRESENT**	**MORPHOLOGY**	**COMMENTS**
Chrysotile veins		Sigmoidal	Cross-fiber.

STRUCTURE

Crystal Plastic:
Evidence for moderate crystal plastic deformation within an orthopyroxene-rich band across one corner of thin section.
Relict orthopyroxene porphyroclasts show kink banding and possible minor recrystallization.
Line of relict orthopyroxene are connected stringers of fine grained serpentine/bastite that may have been fine grained pyroxene neoblasts.
Pyroxenes are aligned with cleavage planes at an oblique angle to stringers of possible former neoblasts.

Foliation:
Moderate foliation defined by ribbon texture serpentine; is oblique to and deflects around faint foliation in pyroxene band.

Lineation
None visible in thin section.

Crosscutting Relationships (as are apparent in thin section):
1) Ductile deformation
2) Serpentinization
3) Serpentine veins

THIN SECTION:	**209-1270D-10R-1, Piece 2, 11-17 cm**	**TS#109**	**Observer: MS, AC**
ROCK NAME:	**SERPENTINIZED HARZBURGITE**		
GRAIN SIZE:	**Coarse-grained**		
TEXTURE:	**Mylonitic**		

PRIMARY MINERALOGY	**MODE (Visual estimate) PERCENT PRESENT**	**PERCENT ORIGINAL**	**SIZE (mm)**	**MORPHOLOGY**	**COMMENTS**
Olivine	10	<85	up to 10		Coarse-grained clasts of recrystallized olivine preserved.
Orthopyroxene	2	>15	1-6	Anhedral	Fresh little relicts.
Spinel	1	1	0.1	Subhedral	
Gabbroic dike					
Clinopyroxene	0	45		Anhedral	Completely altered.
plagioclase	0	40		Anhedral	Completely altered.
Amphibole	10	15	<5	Rounded porphyroclast	Fresh, prior mylonitization.
Apatite	1	1	0.05	Euhedral	Trains of apatite.

GENERAL COMMENTS

The original modal composition cannot be reconstituted because the rock is strongly recrystallized in neoblasts.
Harzburgite is intruded by gabbroic melt and mylonitized.
Large harzburgite porphyroclastic domains (1-cm in size) are preserved showing that the primary grain size was coarse and protogranular.
The clasts are surrounded by mylonitic gabbro, with porphyroclasts of altered clinopyroxene and brown amphibole and altered recrystallized plagioclase neoblasts.
Neoblasts of orthopyroxene recrystallized associated with recrystallized olivine.

SECONDARY MINERALS	**PERCENT PRESENT**	**REPLACING**	**MORPHOLOGY**	**COMMENTS**
HARZBURGITE CLASTS				
Serpentine	35	Olivine	Mostly ribbon texture	
Brown clays	60		Occasional degraded core and rim structures	some have relict olivine in center.
GABBRO MYLONITE				
Amphibole	16			
Talc	20		Very fine grained to scaly.	Present as halos around harzburgitic clasts and as bands along mylonite margins.
Chlorite	1			
Ca-silicate/mica	10			Mixture of hydrogrossular, prehnite, and sericite after plagioclase.

STRUCTURE

Crystal Plastic:
Significant crystal plastic strain is localized onto vein (of likely gabbroic origin) and onto peridotite wallrock of vein.
Several patches of fresh olivine show core and mantle texture with variable sized polygonal neoblasts surrounding porphyroclasts with subgrain domains.
Relict orthopyroxene porphyroclasts show moderate internal deformation and are partially recrystallized to fine neoblasts.
No plagioclase is present to determine if is was deformed crystal plastically.

Brittle:
Moderate to high intensity semi-brittle, amphibolite facies overprint of crystal plastic deformation.
Highly deformed bands of schistose amphibole are aligned parallel to walls of gabbroic veins; probably deformation mechanism is a combination of diffusive mass transfer, cataclasis and grain boundary sliding.
Late static alteration is suggested by undeformed serpentine veins.

Foliation:
Strong foliation defined by compositional banding and shear fabric in highly deformed gabbroic veins.

Cross Cutting Relationships (as are apparent in thin section):

1) High temperature ductile deformation in conjunction with injection of gabbroic melt and/or metasomatism of peridotite
2) Amphibolite facies deformation
3) Serpentinization
4) Greenschist facies alteration with minor deformation
5) Late static alteration