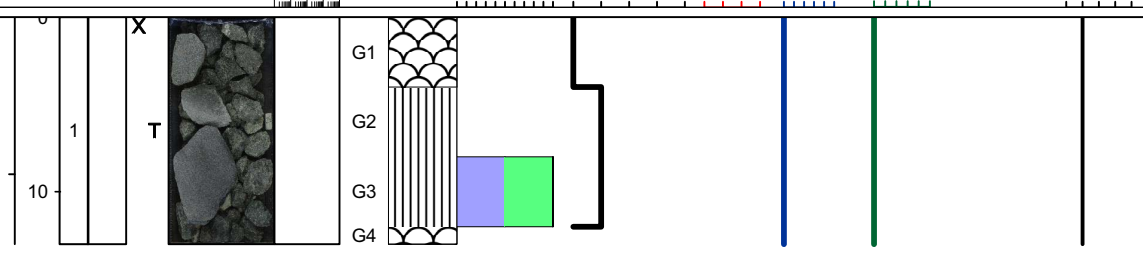
Hole 345-U1415J-2G Section 1, Top of Section: 10.0 m (CSF-A)



LITHOLOGIC INTERVAL: G1
SECTION: 345-U1415J-2G-1-A
ROCK NAME: aphyric basalt
GRAIN SIZE: less than fine grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: olivine - 0.1%, 0.1 mm min, 2 mm max, 1 mm mode, euhedral-subhedral, subequant. plagioclase - 0.1%, 0.1 mm min, 0.5 mm max, 0.1 mm mode, euhedral-subhedral, tabular.
ALTERATION: Olivine is completely replaced by serpentine with minor amounts of tremolite, magnetite, and pyrite; clinopyroxene is completely replaced by green amphibole; plagioclase is moderately replaced by prehnite and chlorite.

LITHOLOGIC INTERVAL: G2
SECTION: 345-U1415J-2G-1-A
ROCK NAME: dolerite
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: olivine - 2%, 0.1 mm min, 1 mm max, 1 mm mode, euhedral-subhedral, subequant.
ALTERATION: Olivine is completely replaced by serpentine with minor amounts of tremolite, magnetite, and pyrite; clinopyroxene is completely replaced by green amphibole; plagioclase is moderately replaced by prehnite and chlorite.
STRUCTURE: Clay veins.

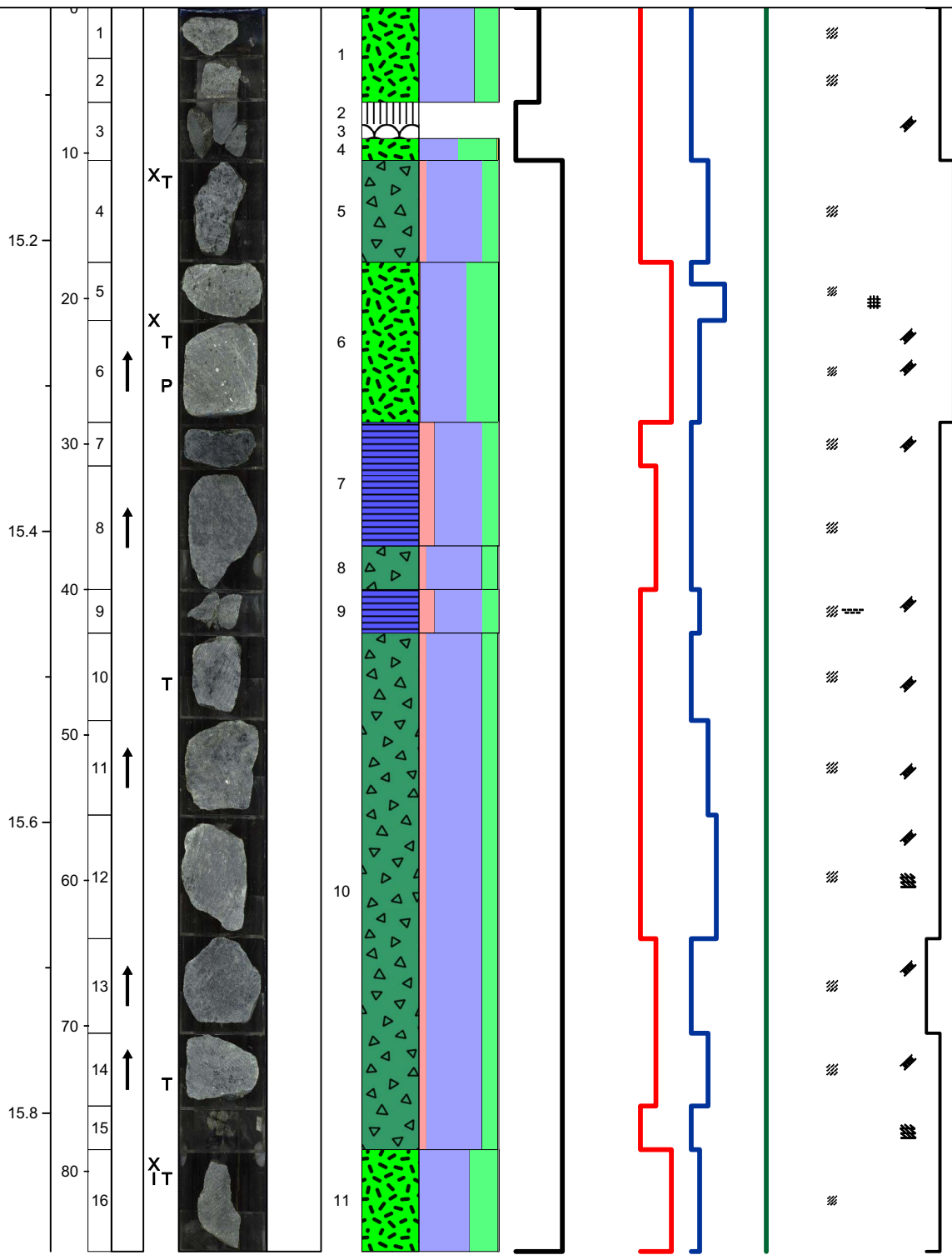
LITHOLOGIC INTERVAL: G3
SECTION: 345-U1415J-2G-1-A
ROCK NAME: dolerite
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
plagioclase	50.0	0.5	euhedral-subhedral	tabular
clinopyroxene	50.0	0.1	anhedral	interstitial

COMMENTS
ALTERATION: Abundant green amphibole, clay minerals, and oxides. Primary mineralogy is difficult to discern.

LITHOLOGIC INTERVAL: G4
SECTION: 345-U1415J-2G-1-A
ROCK NAME: basalt
GRAIN SIZE:
TEXTURE:
PIECES: #1
CONTACTS: contact not recovered
COMMENTS
ALTERATION: Very fine grained, alteration mineralogy is impossible to determine from hand sample. Disseminated pyrite is abundant.

Hole 345-U1415J-3R Section 1, Top of Section: 15.0 m (CSF-A)



LITHOLOGIC INTERVAL: 1
SECTION: 345-U1415J-3R-1-A
ROCK NAME: gabbro
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #1, #2
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	0.1	2.0	euhedral-subhedral	subequant
plagioclase	70.0	2.0	euhedral-subhedral	tabular
clinopyroxene	30.0	4.0	anhedral	subequant
sulfide	0.1	0.2	anhedral	subequant

COMMENTS
ALTERATION: Moderately altered; olivine is completely replaced by serpentine with minor amounts of talc and pyrite; clinopyroxene replaced by amphibole along cleavage planes; plagioclase slightly replaced by secondary plagioclase and chlorite.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO.

LITHOLOGIC INTERVAL: 2
SECTION: 345-U1415J-3R-1-A
ROCK NAME: olivine bearing dolerite
GRAIN SIZE: less than fine grained
TEXTURE: granular
PIECES: #3
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: Olivine- 5%, 0.1 mm min, 0.5 mm max, 0.5 mm mode, euhedral-subhedral, subequant. Plagioclase - 55%, 0.1 mm min, 1 mm max, 0.5 mm mode, euhedral-subhedral, lath-shaped. Clinopyroxene- 40%, 0.1 mm min, 0.1 mm max, 0.1 mm mode, anhedral, interstitial. oxide - 0.1%, 0.1 mm min, 0.1 mm max, 0.1 mm mode, subhedral, subequant.
ALTERATION: Moderately altered; olivine is completely replaced by serpentine with minor amounts of talc and pyrite; clinopyroxene replaced by amphibole along cleavage planes; plagioclase slightly replaced by secondary plagioclase; thin massive clay vein.

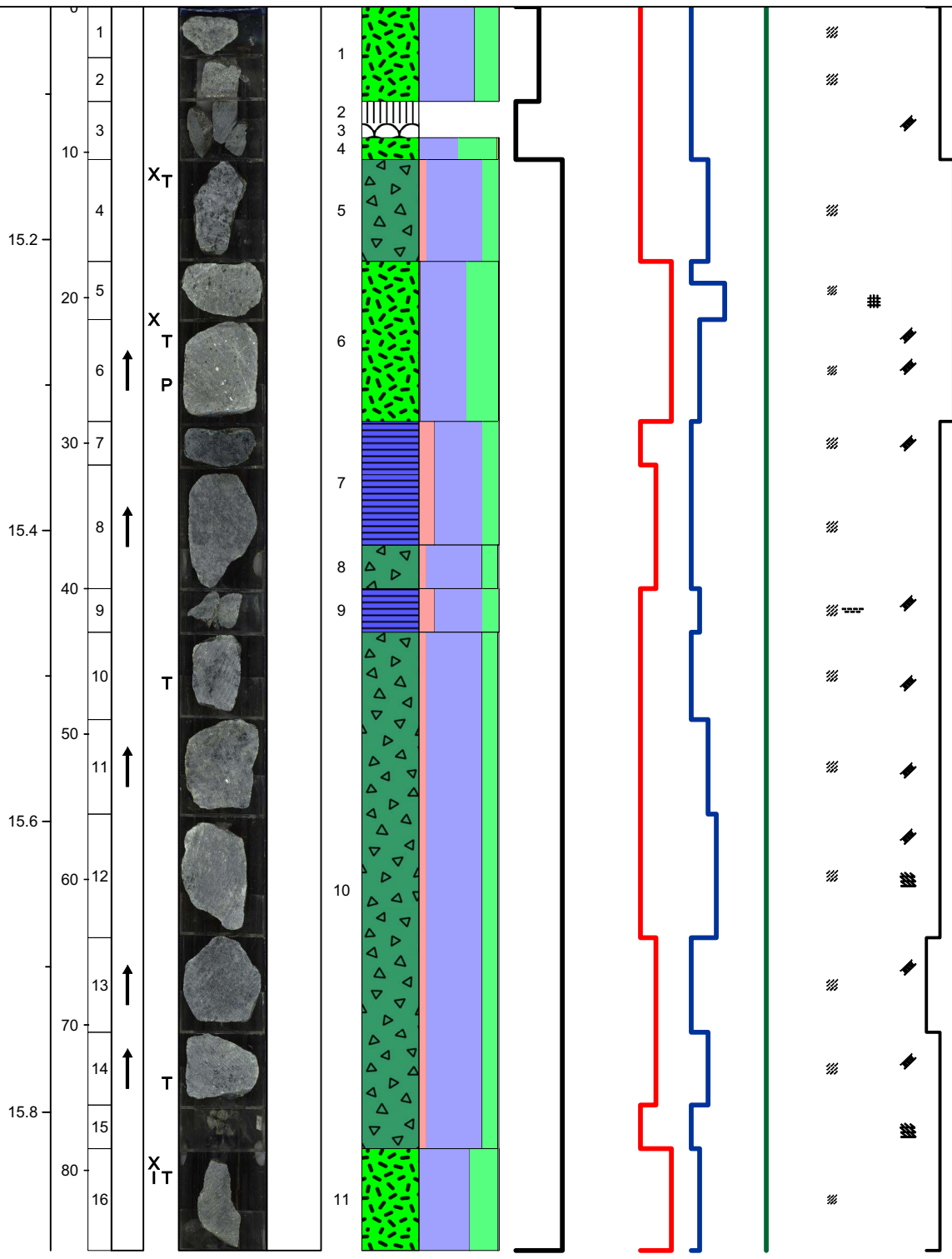
LITHOLOGIC INTERVAL: 3
SECTION: 345-U1415J-3R-1-A
ROCK NAME: aphyric basalt
GRAIN SIZE: less than fine grained
TEXTURE: intersertal
PIECES: #3
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: aphyric basalt, less than fine grained, equigranular, intersertal.
ALTERATION: Moderately altered; olivine is completely replaced by serpentine with minor amounts of talc and pyrite; clinopyroxene replaced by amphibole along cleavage planes; plagioclase slightly replaced by secondary plagioclase.

LITHOLOGIC INTERVAL: 4
SECTION: 345-U1415J-3R-1-A
ROCK NAME: doleritic gabbro
GRAIN SIZE: less than fine grained
TEXTURE: granular
PIECES: #3
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
plagioclase	50.0	1.5	euhedral-subhedral	lath-shaped
clinopyroxene	48.0	0.1	anhedral	interstitial
orthopyroxene	2.0	4.0	subhedral	prismatic
oxide	0.1	0.1	subhedral	subequant

COMMENTS
ALTERATION: Moderately altered; olivine is completely replaced by serpentine with minor amounts of talc and pyrite; clinopyroxene replaced by amphibole; plagioclase slightly replaced by secondary plagioclase; orthopyroxene altered to clay and talc.

Hole 345-U1415J-3R Section 1, Top of Section: 15.0 m (CSF-A)



LITHOLOGIC INTERVAL: 5
SECTION: 345-U1415J-3R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #4
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	5.0	euhedral-subhedral	subequant
plagioclase	70.0	4.0	euhedral-subhedral	tabular
clinopyroxene	20.0	6.0	anhedral	oikocryst
sulfide	0.1	0.3	anhedral	subequant

COMMENTS

ALTERATION: Moderately altered; olivine is partially replaced by serpentine with minor amounts of talc, tremolite, clay, and pyrite; clinopyroxene replaced by amphibole; plagioclase slightly replaced by secondary plagioclase.

LITHOLOGIC INTERVAL: 6
SECTION: 345-U1415J-3R-1-A
ROCK NAME: olivine-bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #5, #6
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	3.0	euhedral-subhedral	subequant
plagioclase	58.0	3.0	euhedral-subhedral	tabular
clinopyroxene	40.0	4.0	anhedral	subequant

COMMENTS

ALTERATION: Moderately altered; olivine is partially replaced by serpentine with minor amounts of talc, tremolite, clay, and pyrite; clinopyroxene replaced by amphibole; plagioclase slightly replaced by secondary plagioclase.

STRUCTURE: Moderate magmatic foliation defined by plagioclase and pyroxene SPO in pieces #5 and 6. Cohesive breccia (19-21.5 cm, piece #5),cut by multiple generations of prehnite and zeolite veins.

LITHOLOGIC INTERVAL: 7
SECTION: 345-U1415J-3R-1-A
ROCK NAME: clinopyroxene-bearing oikocryst troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #7, #8
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	2.0	euhedral-subhedral	tabular
clinopyroxene	20.0	6.0	anhedral	oikocryst
oxide	0.1	0.1	subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

COMMENTS

ALTERATION: Moderately altered; olivine is slightly replaced by serpentine with minor amounts of tremolite, clay, and pyrite; clinopyroxene slightly altered to amphibole; plagioclase slightly replaced by secondary plagioclase and chlorite along grain boundaries and microcracks.

STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO in piece #7. Cut by clay veins.

LITHOLOGIC INTERVAL: 8
SECTION: 345-U1415J-3R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #8
CONTACTS: contact not recovered

MODAL ABUNDANCES

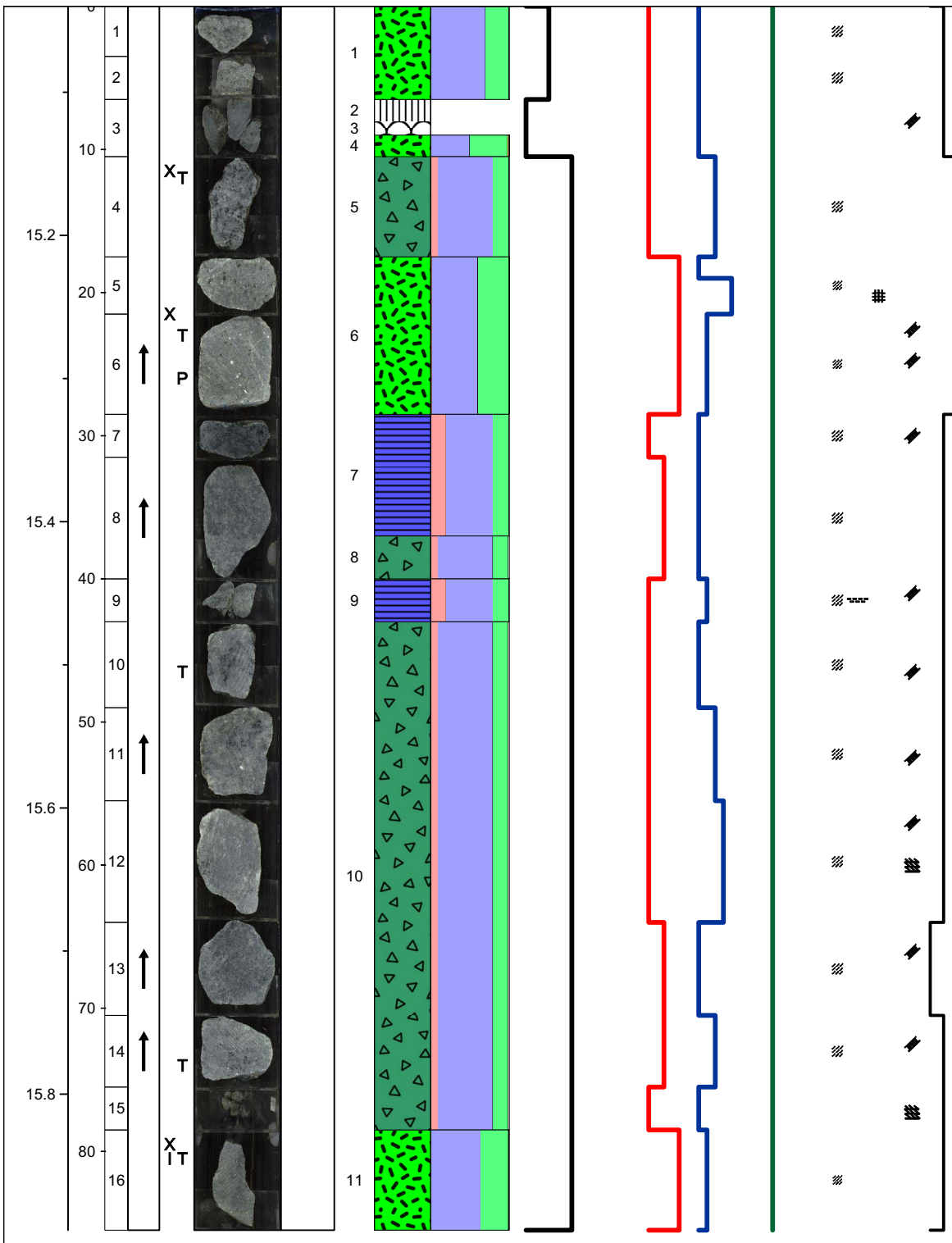
Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	4.0	subhedral-anhedral	amoeboid
plagioclase	70.0	2.0	euhedral-subhedral	tabular
clinopyroxene	20.0	5.0	anhedral	subequant
oxide	0.1	0.1	subhedral	subequant
sulfide	0.8	1.0	anhedral	subequant

COMMENTS

ALTERATION: Moderately altered; olivine is slightly replaced by serpentine with minor amounts of tremolite, clay, and pyrite; clinopyroxene slightly altered to amphibole; plagioclase slightly replaced by secondary plagioclase and chlorite along grain boundaries and microcracks.

STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO in piece #7. Cut by clay veins.

Hole 345-U1415J-3R Section 1, Top of Section: 15.0 m (CSF-A)



LITHOLOGIC INTERVAL: 9
SECTION: 345-U1415J-3R-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #9
CONTACTS: modal contact
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	2.0	euhedral-subhedral	tabular
clinopyroxene	20.0	5.0	anhedral	oikocryst
oxide	0.1	0.1	subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

COMMENTS
ALTERATION: Moderately altered; olivine is highly replaced by serpentine with lesser amounts of tremolite, talc, clay, and pyrite; clinopyroxene slightly altered to amphibole; plagioclase slightly replaced by secondary plagioclase and chlorite along grain boundaries and microcracks.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO. Cut by prehnite and amphibole veins.

LITHOLOGIC INTERVAL: 10
SECTION: 345-U1415J-3R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #10, #11, #12, #13, #14, #15
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	4.0	subhedral-anhedral	amoeboid
plagioclase	70.0	4.0	euhedral-subhedral	tabular
clinopyroxene	20.0	10.0	anhedral	oikocryst
orthopyroxene	0.1	15.0	anhedral	interstitial
oxide	0.1	0.5	subhedral	subequant
sulfide	0.8	0.2	anhedral	subequant

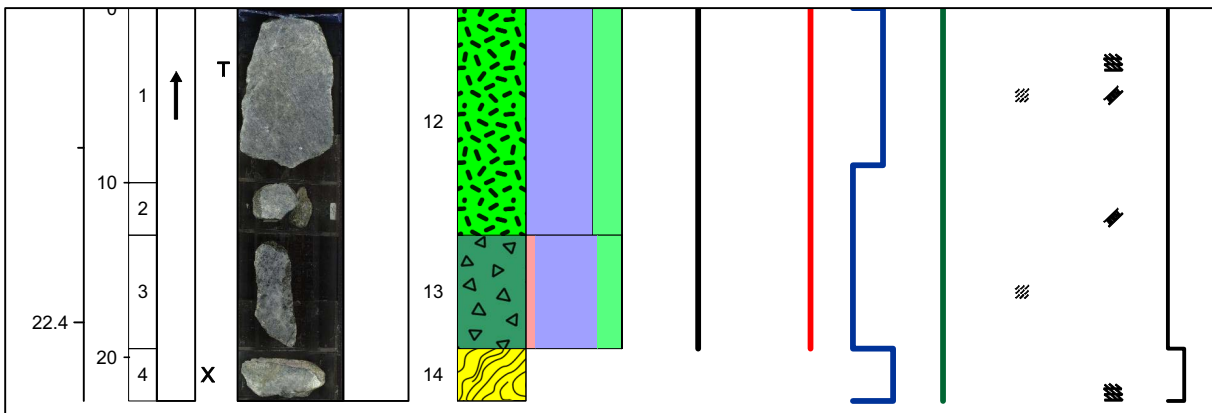
COMMENTS
ALTERATION: Slightly to moderately altered; olivine is replaced by serpentine with lesser amounts of tremolite, talc, clay, and pyrite; clinopyroxene slightly altered to amphibole; plagioclase slightly replaced by secondary plagioclase and chlorite along grain boundaries and microcracks. Disseminated pyrite occurs in piece 13. Prehnite replaces plagioclase in vein halos.
STRUCTURE: Weak to moderate subvertical magmatic foliation defined by plagioclase and olivine SPO in pieces #12 and 13. Moderate to dense fractures at 49 to 64 cm, and 70-75 cm. Cut by prehnite and zeolite veins; albite, amphibole and clay veins (55.5-64 cm), and chlorite (70.5-75.5 cm).

LITHOLOGIC INTERVAL: 11
SECTION: 345-U1415J-3R-1-A
ROCK NAME: gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #16
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	0.1	3.0	euhedral-subhedral	subequant
plagioclase	64.0	3.0	euhedral-subhedral	tabular
clinopyroxene	35.0	4.0	anhedral	subequant
orthopyroxene	1.0	2.0	subhedral	prismatic
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Moderately altered, plagioclase is altered to prehnite along microcracks and along grain boundaries near veins in this interval.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and pyroxene SPO in piece #16. Cut by albite and epidote veins.

Hole 345-U1415J-4R Section 1, Top of Section: 22.2 m (CSF-A)



LITHOLOGIC INTERVAL: 12
SECTION: 345-U1415J-4R-1-A
ROCK NAME: gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1, #2
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	0.1	3.0	euhedral-subhedral	subequant
plagioclase	70.0	4.0	euhedral-subhedral	tabular
clinopyroxene	30.0	3.0	anhedral	subequant
oxide	0.1	0.1	subhedral	subequant

COMMENTS
ALTERATION: Very fresh although cut by many thin prehnite/epidote, chlorite/amphibole, and zeolite veins. Enhanced alteration associated with cataclasite zone, including alteration of plagioclase to prehnite and chlorite along microcracks, alteration of olivine to serpentine and talc, and replacement of clinopyroxene to amphibole along cleavage planes.
STRUCTURE: Dense, subvertical anastomosing fractures 1 mm thick (between 0-9 cm). Cut by prehnite, epidote and zeolite veins. Amphibole, chlorite and prehnite (10-13 cm).

LITHOLOGIC INTERVAL: 13
SECTION: 345-U1415J-4R-1-A
ROCK NAME: clinopyroxene oikocryst-bearing olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #3
CONTACTS: contact not recovered

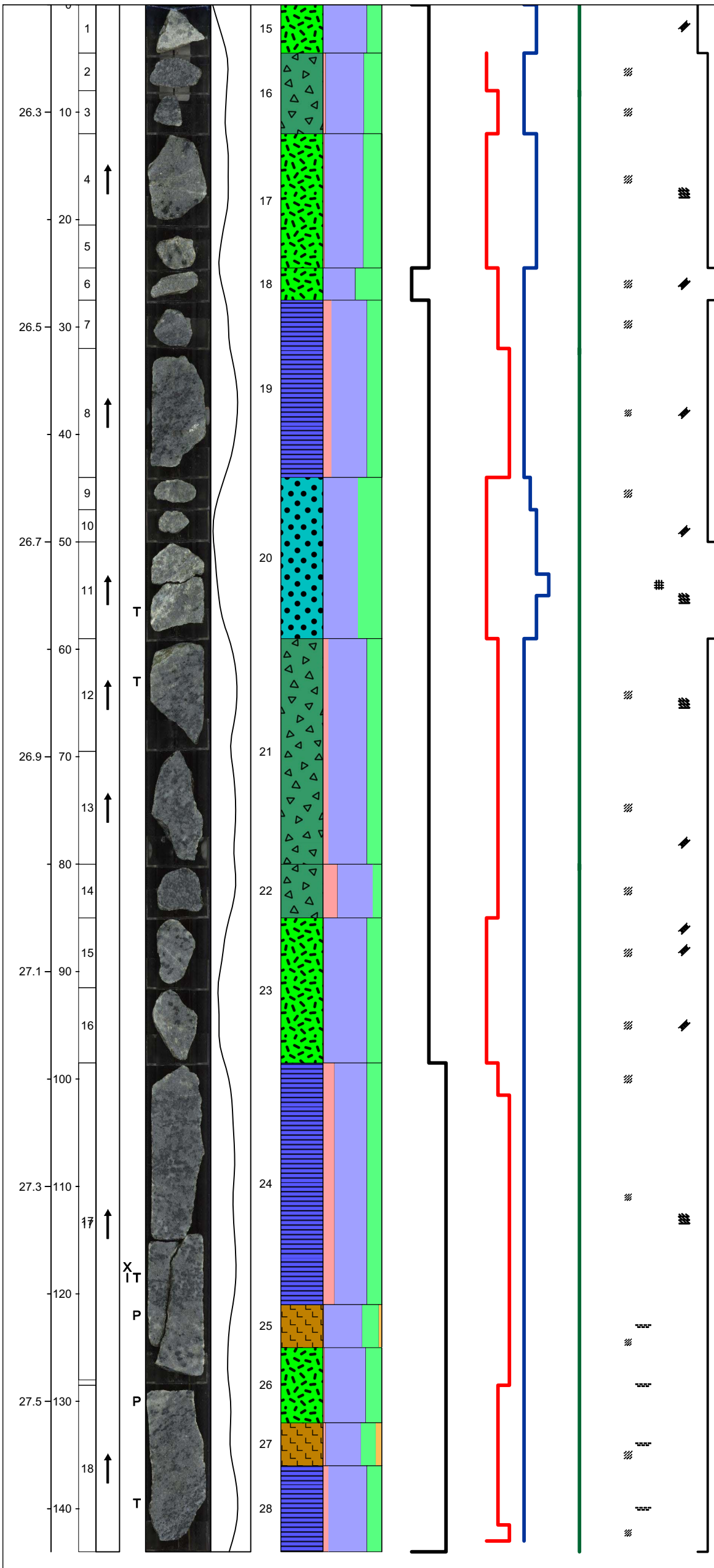
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	5.0	subhedral-anhedral	amoeboid
plagioclase	65.0	4.0	euhedral-subhedral	tabular
clinopyroxene	25.0	5.0	anhedral	oikocryst

COMMENTS
ALTERATION: Moderately altered; olivine is replaced by serpentine with lesser amounts of clay; clinopyroxene slightly altered to amphibole; plagioclase slightly replaced by chlorite and prehnite along grain boundaries and microcracks. Minor disseminated pyrite.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO.

LITHOLOGIC INTERVAL: 14
SECTION: 345-U1415J-4R-1-A
ROCK NAME: alteration vein
GRAIN SIZE:
TEXTURE:
PIECES: #4
CONTACTS: contact not recovered
COMMENTS
ALTERATION: Entire interval appears to be clinozoisite vein and vein halo, plagioclase is highly altered to secondary plagioclase, prehnite, chlorite, and clay.
STRUCTURE: Cohesive fault breccia with veining (19.5-22.5 cm). Cut by epidote, prehnite, chlorite and zeolite veins.

Hole 345-U1415J-5R Section 1, Top of Section: 26.2 m (CSF-A)



LITHOLOGIC INTERVAL: 15
SECTION: 345-U1415J-5R-1-A
ROCK NAME: gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	0.0			
plagioclase	75.0	3.0	euhedral-subhedral	tabular
clinopyroxene	25.0	10.0	anhedral	subequant
oxide	0.1	0.1	subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

COMMENTS
ALTERATION: Slightly altered, plagioclase slightly altered to chlorite, clinopyroxene moderately altered to amphibole and lesser amounts of clay, orthopyroxene completely altered to amphibole, talc, and clay. Pyrite + chlorite in crack; vuggy fracture is present; chlorite fills fracture in plagioclase; amphibole replacing orthopyroxene is possibly reaction rim.
STRUCTURE: Moderate fracturing. Cut by prehnite and sulfide veins.

LITHOLOGIC INTERVAL: 16
SECTION: 345-U1415J-5R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #2, #3
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	3.0	subhedral-anhedral	amoeboid
plagioclase	65.0	4.0	euhedral-subhedral	tabular
clinopyroxene	30.0	6.0	anhedral	subequant
sulfide	0.2	1.0	subhedral	equant

COMMENTS
ALTERATION: Olivine is serpentinized with mesh texture; plagioclase is slightly altered to secondary plagioclase, clinopyroxene is slightly altered to amphibole.
STRUCTURE: Weak to moderate magmatic foliation defined by plagioclase and olivine SPO.

LITHOLOGIC INTERVAL: 17
SECTION: 345-U1415J-5R-1-A
ROCK NAME: olivine and orthopyroxene- bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #4, #5
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	3.0	3.0	subhedral-anhedral	amoeboid
plagioclase	66.0	2.0	euhedral-subhedral	lath-shaped
clinopyroxene	30.0	5.0	anhedral	subequant
orthopyroxene	1.0	4.0	subhedral	prismatic
oxide	0.1	0.1	subhedral	subequant

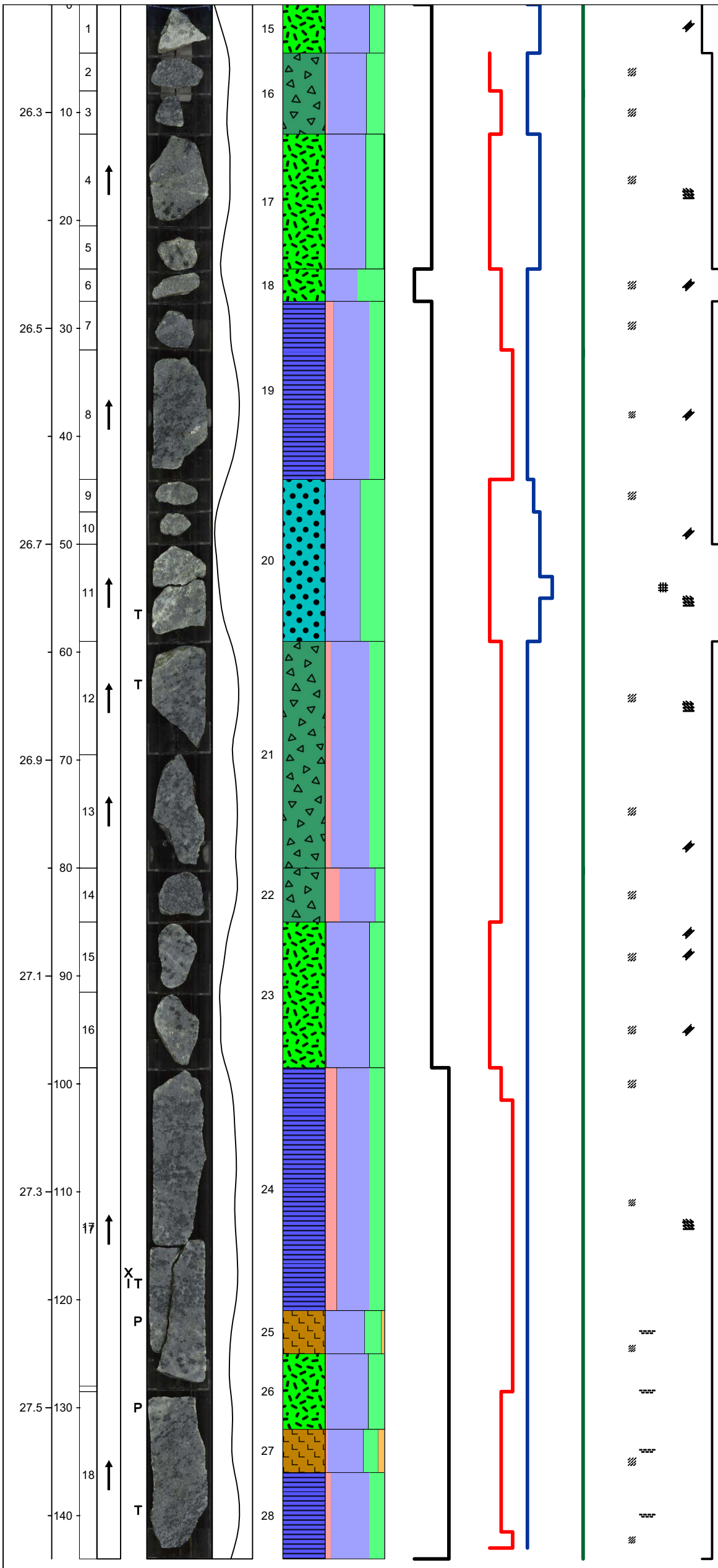
COMMENTS
ALTERATION: Moderately altered; olivine highly altered to serpentine with lesser amounts of talc, amphibole, pyrite. Olivine coronae are visible. Orthopyroxene is moderately altered to amphibole and talc; plagioclase is slightly altered to secondary plagioclase, prehnite, and chlorite. Rocks are highly altered along thin chlorite-amphibole veins, and in cataclastic zone in piece 5.
STRUCTURE: Weak magmatic foliation defined by plagioclase and pyroxene SPO. Moderate fracturing. Cut by chlorite, amphibole, and prehnite veins.

LITHOLOGIC INTERVAL: 18
SECTION: 345-U1415J-5R-1-A
ROCK NAME: gabbro
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #6
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	0.1	1.0	euhedral-subhedral	subequant
plagioclase	55.0	2.0	euhedral-subhedral	tabular
clinopyroxene	45.0	2.0	anhedral	subequant
oxide	0.1	0.1	subhedral	subequant

COMMENTS
ALTERATION: Moderately altered; plagioclase is altered to secondary plagioclase and prehnite; clinopyroxene is highly altered to amphibole.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and pyroxene SPO. Cut by amphibole and zeolite veins.

Hole 345-U1415J-5R Section 1, Top of Section: 26.2 m (CSF-A)



LITHOLOGIC INTERVAL: 19
SECTION: 345-U1415J-5R-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #7, #8
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	4.0	subhedral-anhedral	amoeboid
plagioclase	60.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	10.0	anhedral	oikocryst

COMMENTS
ALTERATION: Moderately altered; plagioclase is slightly altered to secondary plagioclase and prehnite along microcracks; clinopyroxene is altered to amphibole. Olivine is altered to serpentine and in some places clay minerals.
STRUCTURE: Weak to moderate magmatic foliation defined by plagioclase and olivine SPO. Decimeter scale layering. Cut by epidote and albite veins.

LITHOLOGIC INTERVAL: 20
SECTION: 345-U1415J-5R-1-A
ROCK NAME: oikocryst gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #9, #10, #11
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	0.1	1.0	euhedral-subhedral	subequant
plagioclase	60.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	40.0	8.0	anhedral	subequant
oxide	0.1	0.1	subhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Moderately altered; plagioclase is altered to secondary plagioclase and prehnite along microcracks; clinopyroxene is altered to amphibole. Some white pseudomorphs after plagioclase show similar appearance to talc pseudomorphs after orthopyroxene. In the cataclastic zone in piece 11, the cataclastic matrix has patches of zeolite.
STRUCTURE: Well-developed fault breccia and moderate fracturing (47-59 cm). Cut by prehnite, amphibole and chlorite veins.

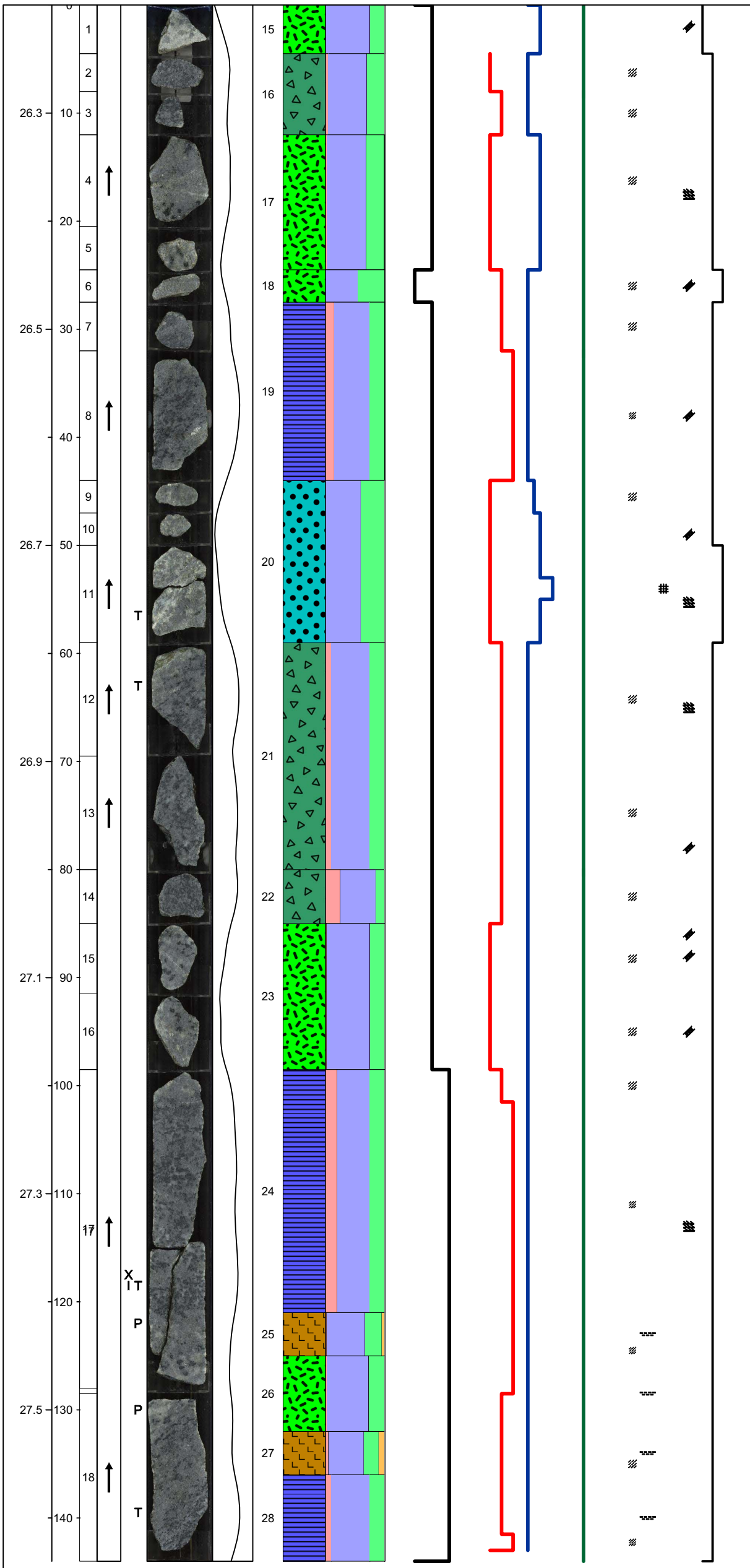
LITHOLOGIC INTERVAL: 21
SECTION: 345-U1415J-5R-1-A
ROCK NAME: clinopyroxene oikocryst bearing olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #12, #13
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	4.0	subhedral-anhedral	amoeboid
plagioclase	65.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	8.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture, and also unevenly altered to clay minerals; incipient coronae are present. Plagioclase is slightly altered to secondary plagioclase and chlorite; clinopyroxene is altered to amphibole.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and pyroxene SPO. Modal layering. Large elongate orthopyroxene oikocrysts (0.5 to 1 cm) in piece #12. Cut by prehnite and serpentine veins.

Hole 345-U1415J-5R Section 1, Top of Section: 26.2 m (CSF-A)



LITHOLOGIC INTERVAL: 22
SECTION: 345-U1415J-5R-1-A
ROCK NAME: clinopyroxene oikocryst-bearing olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #14
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	25.0	4.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	tabular
clinopyroxene	15.0	4.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS

ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture, and also unevenly altered to clay minerals. Plagioclase is slightly altered to secondary plagioclase and chlorite; clinopyroxene is altered to amphibole.

STRUCTURE: Moderate magmatic lamination defined by plagioclase and pyroxene. Weak modal layering. Cut by prehnite veins.

LITHOLOGIC INTERVAL: 23
SECTION: 345-U1415J-5R-1-A
ROCK NAME: olivine-bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #15, #16
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	5.0	euhedral-subhedral	subequant
plagioclase	73.0	3.0	euhedral-subhedral	tabular
clinopyroxene	25.0	7.0	anhedral	subequant
orthopyroxene	0.1	3.5	subhedral	prismatic
sulfide	0.1	0.1	anhedral	subequant

COMMENTS

ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture, and also unevenly altered to clay minerals. Plagioclase is slightly altered to secondary plagioclase and chlorite; clinopyroxene is altered to amphibole.

STRUCTURE: Weak modal layering. Cut by prehnite veins.

LITHOLOGIC INTERVAL: 24
SECTION: 345-U1415J-5R-1-A
ROCK NAME: clinopyroxene oikocryst-bearing troctolite
GRAIN SIZE: coarse grained
TEXTURE: poikilitic-granular
PIECES: #17
CONTACTS: contact not recovered

MODAL ABUNDANCES

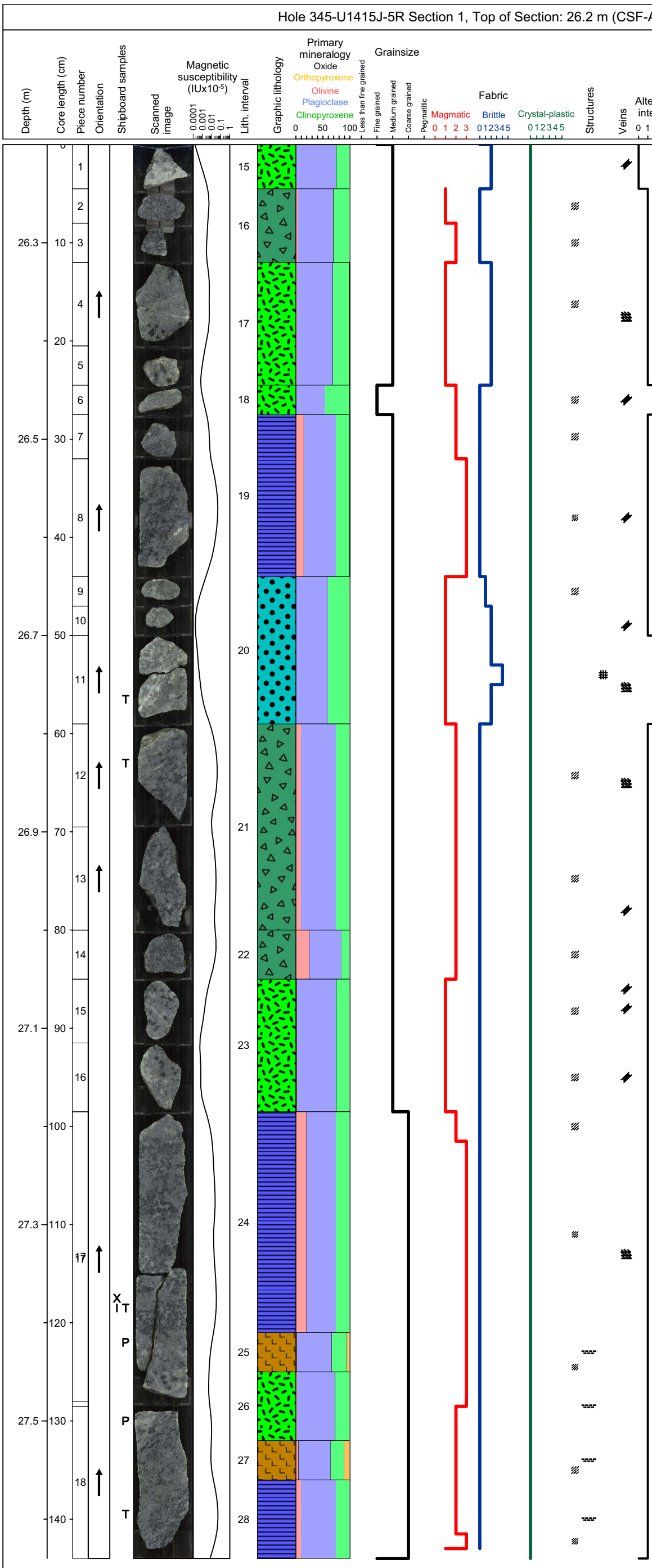
Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	4.0	subhedral-anhedral	amoeboid
plagioclase	55.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	5.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS

ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture, and also unevenly altered to clay minerals. Plagioclase is slightly altered to secondary plagioclase and chlorite; clinopyroxene is slightly altered to amphibole.

STRUCTURE: Moderate magmatic foliation defined by plagioclase and pyroxene SPO. Modal layering defined by olivine rich and olivine poor horizons. Cut by prehnite and serpentine veins.

Hole 345-U1415J-5R Section 1, Top of Section: 26.2 m (CSF-A)



LITHOLOGIC INTERVAL: 25
SECTION: 345-U1415J-5R-1-A
ROCK NAME: olivine bearing gabbronorite
GRAIN SIZE: coarse grained
TEXTURE: granular
PIECES: #17
CONTACTS: modal contact
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	4.0	euhedral-subhedral	subequant
plagioclase	65.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	28.0	4.0	anhedral	subequant
orthopyroxene	5.0	3.0	subhedral	prismatic
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
IGNEOUS: 121 cm - contact between clinopyroxene-oikocryst bearing troctolite and olivine-bearing gabbronorite
ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture, and also unevenly altered to clay minerals. Plagioclase is slightly altered to secondary plagioclase and chlorite; clinopyroxene is slightly altered to amphibole.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and pyroxene SPO. Modal layering defined by olivine rich and olivine poor horizons.

LITHOLOGIC INTERVAL: 26
SECTION: 345-U1415J-5R-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: coarse grained
TEXTURE: granular
PIECES: #17, #18
CONTACTS: modal and textural contact
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	3.0	4.0	euhedral-subhedral	subequant
plagioclase	70.0	6.0	euhedral-subhedral	lath-shaped
clinopyroxene	27.0	4.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

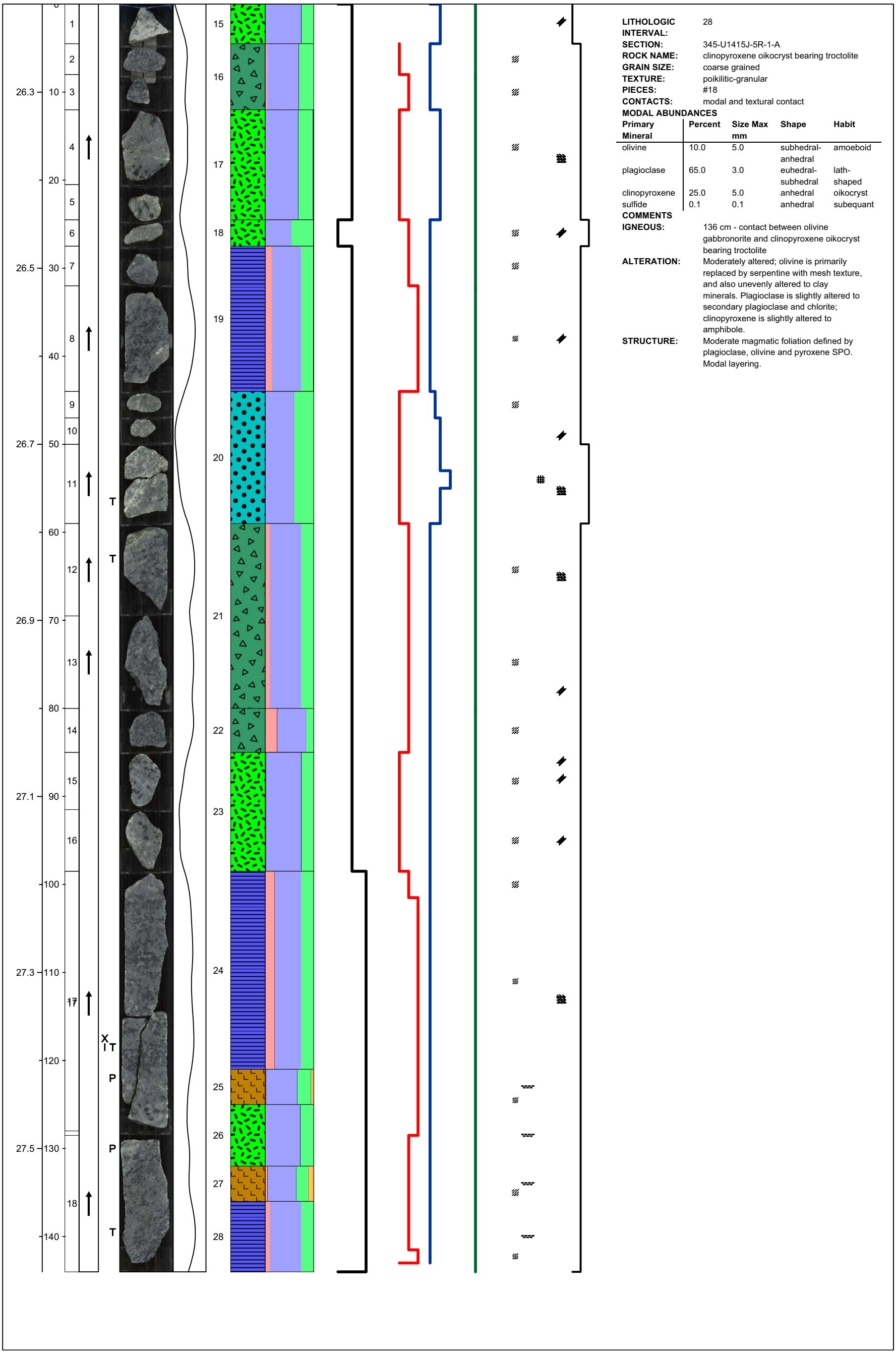
COMMENTS
IGNEOUS: 125 cm - contact between olivine-bearing gabbronorite and olivine-bearing gabbro
ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture, and also unevenly altered to clay minerals. Plagioclase is slightly altered to secondary plagioclase and chlorite; clinopyroxene is slightly altered to amphibole.
STRUCTURE: Moderate magmatic foliation defined by plagioclase, olivine and pyroxene SPO. Modal layering.

LITHOLOGIC INTERVAL: 27
SECTION: 345-U1415J-5R-1-A
ROCK NAME: olivine bearing gabbronorite
GRAIN SIZE: coarse grained
TEXTURE: granular
PIECES: #18
CONTACTS: modal and textural contact
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	tabular
clinopyroxene	25.0	3.0	anhedral	subequant
orthopyroxene	10.0	3.5	subhedral	prismatic
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
IGNEOUS: 132 cm - contact between olivine-bearing gabbro and olivine gabbronorite
ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture, and also unevenly altered to clay minerals. Plagioclase is slightly altered to secondary plagioclase and chlorite; clinopyroxene is slightly altered to amphibole.
STRUCTURE: Moderate magmatic foliation defined by plagioclase, olivine and pyroxene SPO. Modal layering.

Hole 345-U1415J-5R Section 1, Top of Section: 26.2 m (CSF-A)



LITHOLOGIC INTERVAL: 28
SECTION: 345-U1415J-5R-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: coarse grained
TEXTURE: poikilitic-granular
PIECES: #18
CONTACTS: modal and textural contact

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	5.0	subhedral-anhedral	amoeboid
plagioclase	65.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	5.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

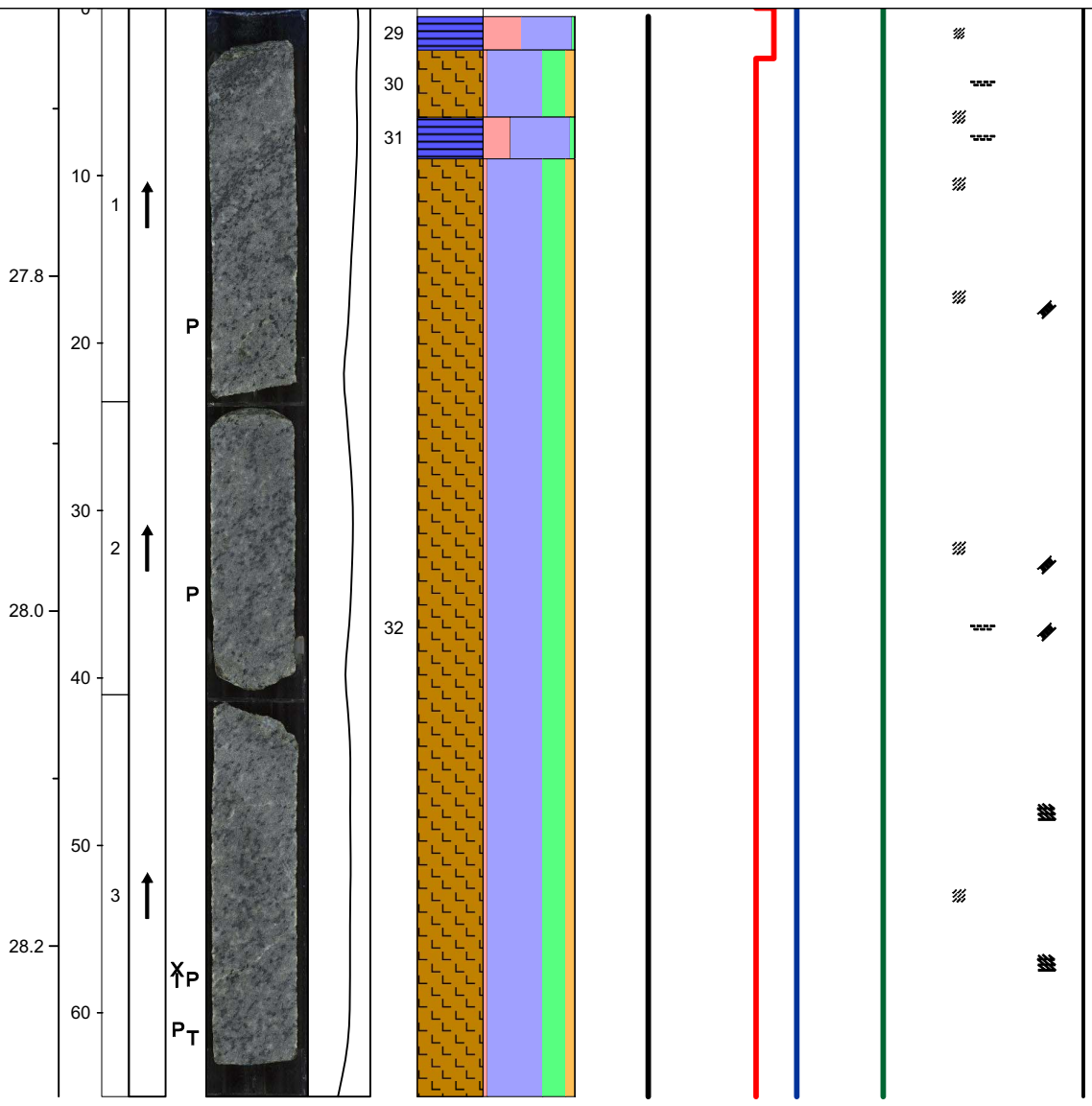
COMMENTS

IGNEOUS: 136 cm - contact between olivine gabbronorite and clinopyroxene oikocryst bearing troctolite

ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture, and also unevenly altered to clay minerals. Plagioclase is slightly altered to secondary plagioclase and chlorite; clinopyroxene is slightly altered to amphibole.

STRUCTURE: Moderate magmatic foliation defined by plagioclase, olivine and pyroxene SPO. Modal layering.

Hole 345-U1415J-5R Section 2, Top of Section: 27.64 m (CSF-A)



LITHOLOGIC INTERVAL: 29
SECTION: 345-U1415J-5R-2-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	42.0	4.0	subhedral-anhedral	amoeboid
plagioclase	55.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	3.0	4.0	anhedral	interstitial
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture. Plagioclase is mainly fractured, but not strongly altered; clino- and orthopyroxene are slightly altered to amphibole and clay minerals.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO. Modal layering. Prehnite veins.

LITHOLOGIC INTERVAL: 30
SECTION: 345-U1415J-5R-2-A
ROCK NAME: olivine bearing gabbronorite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1
CONTACTS: modal and textural contact
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	4.0	anhedral	subequant
orthopyroxene	10.0	9.5	subhedral	prismatic
sulfide	0.1	0.1	anhedral	subequant

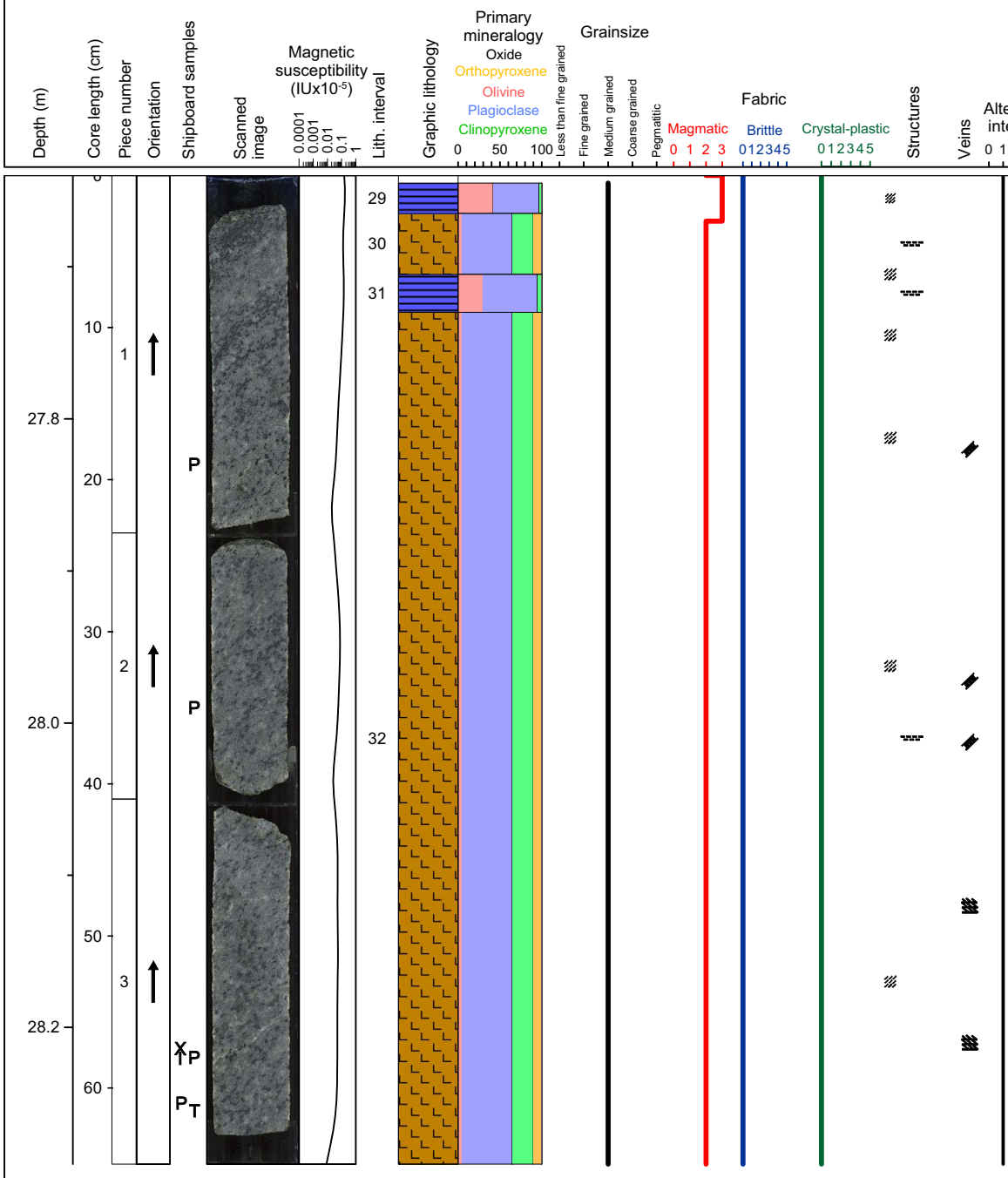
COMMENTS
IGNEOUS: 2.5 cm - contact between troctolite and olivine gabbronorite
ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture. Plagioclase is mainly fractured, but not strongly altered; clino- and orthopyroxene are slightly altered to amphibole and clay minerals.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO. Modal layering. Prehnite and chlorite veins.

LITHOLOGIC INTERVAL: 31
SECTION: 345-U1415J-5R-2-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1
CONTACTS: modal and textural contact
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0	4.0	subhedral-anhedral	amoeboid
plagioclase	65.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	5.0	4.0	anhedral	interstitial
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
IGNEOUS: 6.5 cm - contact between olivine gabbronorite and troctolite
ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture. Plagioclase is mainly fractured, but not strongly altered; clino- and orthopyroxene are slightly altered to amphibole and clay minerals.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO. Modal layering. Prehnite and chlorite veins.

Hole 345-U1415J-5R Section 2, Top of Section: 27.64 m (CSF-A)



LITHOLOGIC INTERVAL: 32
SECTION: 345-U1415J-5R-2-A
ROCK NAME: olivine bearing gabbronorite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1, #2, #3
CONTACTS: modal and textural contact

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	4.0	anhedral	subequant
orthopyroxene	10.0	10.0	anhedral	interstitial
sulfide	0.1	0.1	anhedral	subequant

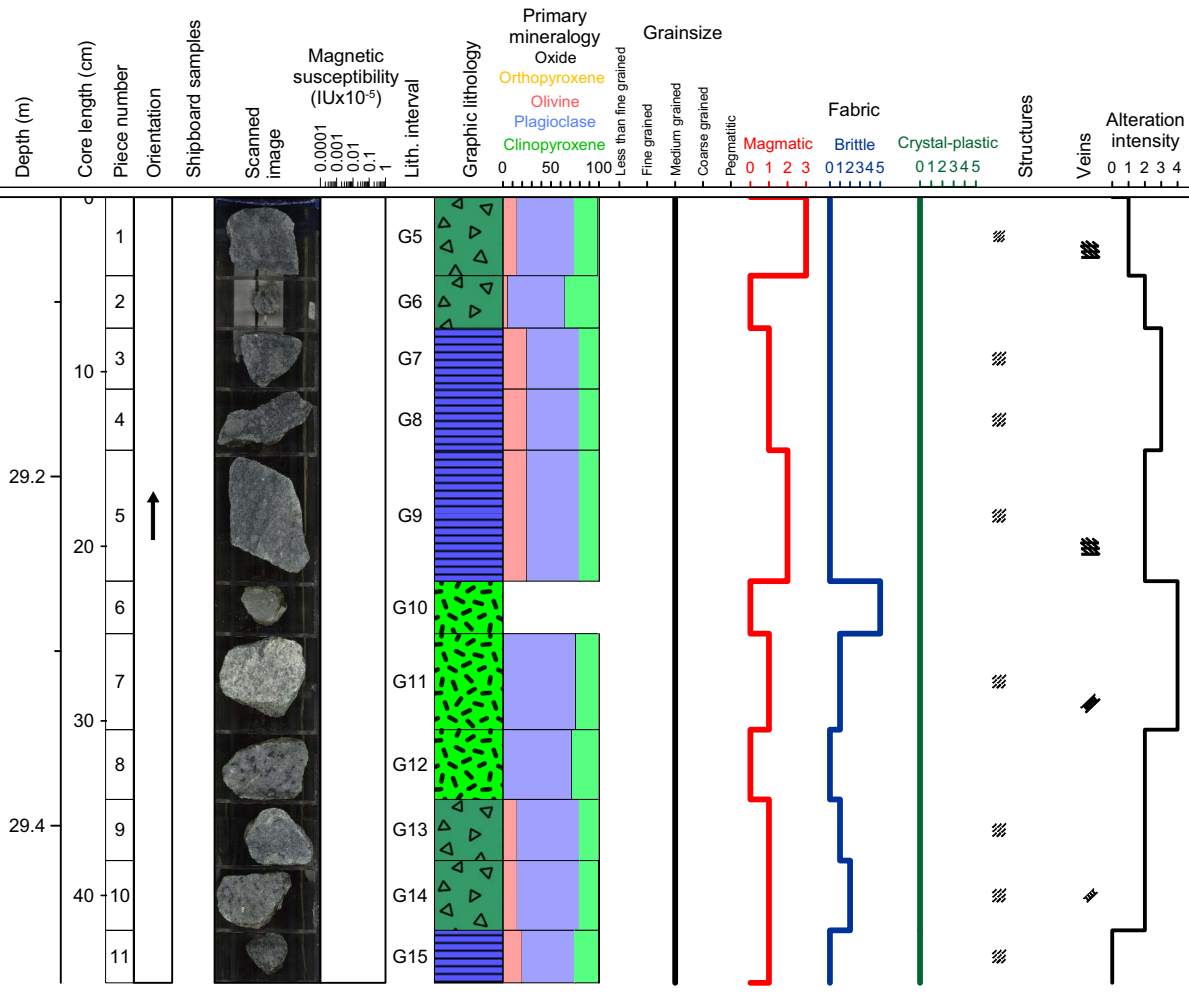
COMMENTS

IGNEOUS: 9.0 cm - contact between troctolite and olivine gabbronorite

ALTERATION: Moderately altered; olivine is primarily replaced by serpentine with mesh texture. Plagioclase is mainly fractured, but not strongly altered; clino- and orthopyroxene are slightly altered to amphibole and clay minerals.

STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO. Modal layering. Prehnite and serpentine veins.

Hole 345-U1415J-6G Section 1, Top of Section: 29.0 m (CSF-A)



LITHOLOGIC INTERVAL: G5
SECTION: 345-U1415J-6G-1-A
ROCK NAME: clinopyroxene oikocryst bearing olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	2.0	euhedral-subhedral	lath-shaped
clinopyroxene	24.0	8.0	anhedral	interstitial
orthopyroxene	1.0	0.5	anhedral to subhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is primarily replaced by serpentine with mesh texture and also talc and pyrite. Plagioclase is moderately altered to chlorite, more intensely altered near chlorite-prehnite vein. Clinopyroxene is slightly altered to amphibole and clay minerals.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Aligned tabular olivine. Cut by chlorite and prehnite veins.

LITHOLOGIC INTERVAL: G6
SECTION: 345-U1415J-6G-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #2
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	tabular
clinopyroxene	35.0	5.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Aligned tabular olivine. Cut by chlorite and prehnite veins.

LITHOLOGIC INTERVAL: G7
SECTION: 345-U1415J-6G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #3
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	25.0	4.0	subhedral-anhedral	amoeboid
plagioclase	55.0	3.0	euhedral-subhedral	tabular
clinopyroxene	20.0	6.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

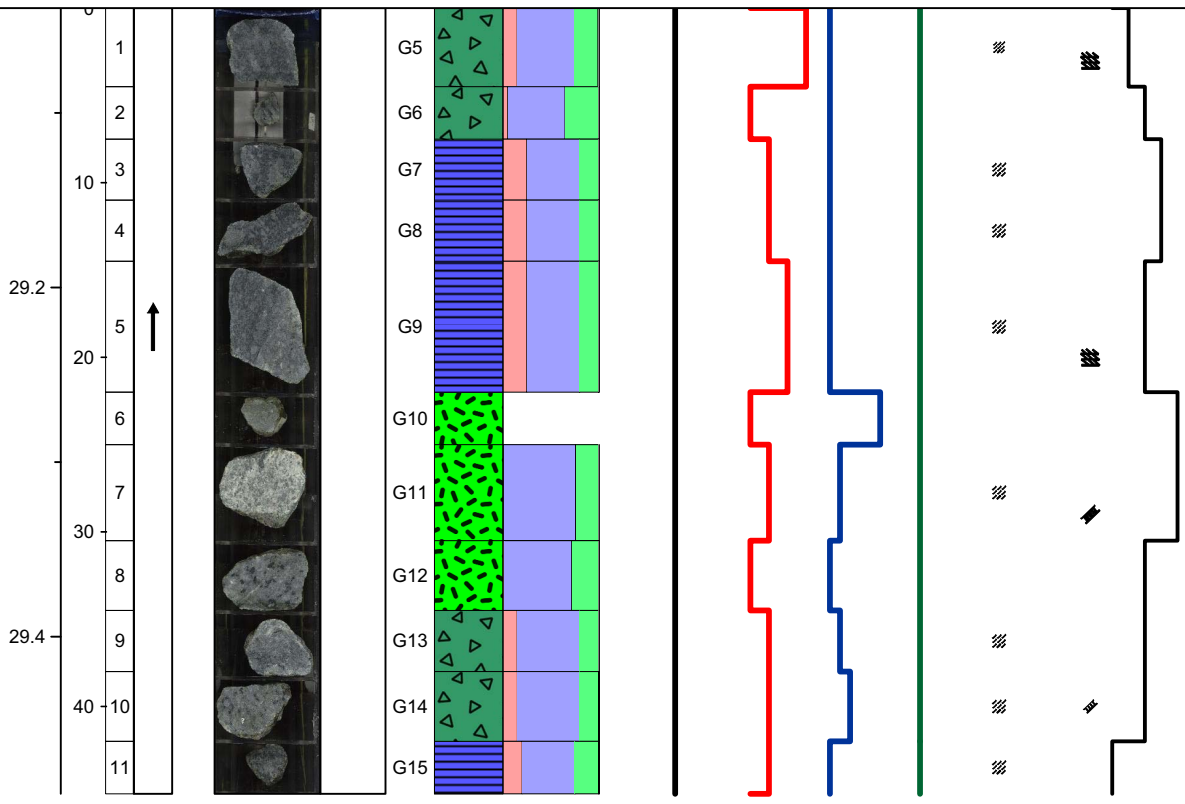
COMMENTS
ALTERATION: Olivine is primarily replaced by serpentine with mesh texture and also talc and pyrite. Plagioclase is moderately altered to chlorite and secondary plagioclase; plagioclase chadacrysts are fresh. Clinopyroxene is slightly altered to amphibole and clay minerals.
STRUCTURE: Weak magmatic foliation defined by plagioclase and tabular olivine SPO. Cut by prehnite veins.

LITHOLOGIC INTERVAL: G8
SECTION: 345-U1415J-6G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #4
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	25.0	4.0	subhedral - anhedral	ameoboid
plagioclase	55.0	4.0	euhedral-subhedral	tabular
clinopyroxene	20.0	10.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is primarily replaced by serpentine with mesh texture and also talc and pyrite. Plagioclase is moderately altered to chlorite and secondary plagioclase; plagioclase chadacrysts are fresh. Clinopyroxene is slightly altered to amphibole and clay minerals.
STRUCTURE: Weak magmatic foliation defined by plagioclase and tabular olivine SPO.

Hole 345-U1415J-6G Section 1, Top of Section: 29.0 m (CSF-A)



LITHOLOGIC INTERVAL: G9
SECTION: 345-U1415J-6G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #5
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	25.0	4.0	subhedral-anhedral	amoeboid
plagioclase	55.0	3.0	euhedral-subhedral	tabular
clinopyroxene	20.0	5.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is primarily replaced by serpentine with mesh texture and also talc and pyrite. Plagioclase is moderately altered to chlorite and secondary plagioclase; plagioclase chadacrysts are fresh. Clinopyroxene is slightly altered to amphibole and clay minerals.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO. Modal layering. Cut by prehnite and serpentine veins.

LITHOLOGIC INTERVAL: G10
SECTION: 345-U1415J-6G-1-A
ROCK NAME: cataclastic gabbro
GRAIN SIZE:
TEXTURE:
PIECES: #6
CONTACTS: contact not recovered
COMMENTS
ALTERATION: Intense alteration makes it difficult to discern primary mineralogy; plagioclase is highly altered to secondary plagioclase, prehnite, zeolite and chlorite.
STRUCTURE: Cohesive cataclasite (22-25 cm).

LITHOLOGIC INTERVAL: G11
SECTION: 345-U1415J-6G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #7
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	1.0	2.0	subhedral-anhedral	amoeboid
plagioclase	75.0	4.0	euhedral-subhedral	lath-shaped
clinopyroxene	24.0	2.5	anhedral	subequant
oxide	0.1	0.1	subhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

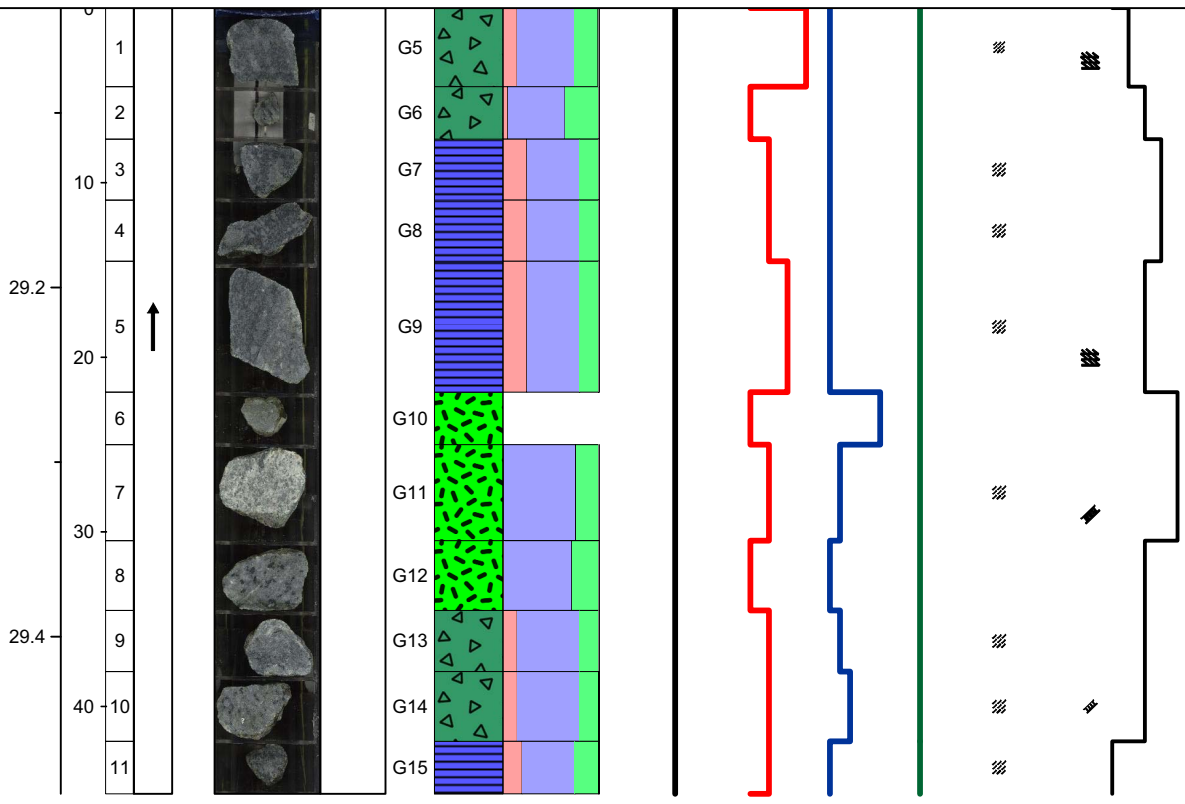
COMMENTS
ALTERATION: Plagioclase is highly altered to secondary plagioclase, prehnite, zeolite and chlorite, pyroxene is completely altered to amphibole and chlorite. Massive vuggy vein filled with prehnite.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO. Cut by prehnite veins.

LITHOLOGIC INTERVAL: G12
SECTION: 345-U1415J-6G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #8
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	3.0	subhedral-anhedral	amoeboid
plagioclase	70.0	4.0	euhedral-subhedral	tabular
clinopyroxene	28.0	4.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is primarily replaced by talc, pyrite, and clay (the olivine alteration assemblage is rather different from previous olivine alteration observed). Plagioclase is moderately altered to prehnite, chlorite and secondary plagioclase. Clinopyroxene is slightly altered to amphibole.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO. Cut by prehnite veins.

Hole 345-U1415J-6G Section 1, Top of Section: 29.0 m (CSF-A)



LITHOLOGIC INTERVAL: G13
SECTION: 345-U1415J-6G-1-A
ROCK NAME: clinopyroxene oikocryst bearing olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #9
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	4.0	subhedral-anhedral	amoeboid
plagioclase	65.0	3.0	euhedral-subhedral	tabular
clinopyroxene	20.0	6.0	anhedral	oikocryst
orthopyroxene	0.1	4.0	subhedral	prismatic
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is primarily replaced by talc, pyrite, and clay. Plagioclase is moderately altered to prehnite, chlorite and secondary plagioclase. Clinopyroxene is slightly altered to amphibole.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO. Cut by prehnite veins.

LITHOLOGIC INTERVAL: G14
SECTION: 345-U1415J-6G-1-A
ROCK NAME: clinopyroxene oikocryst bearing olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #10
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	4.0	subhedral-anhedral	amoeboid
plagioclase	65.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	20.0	4.0	anhedral	subequant

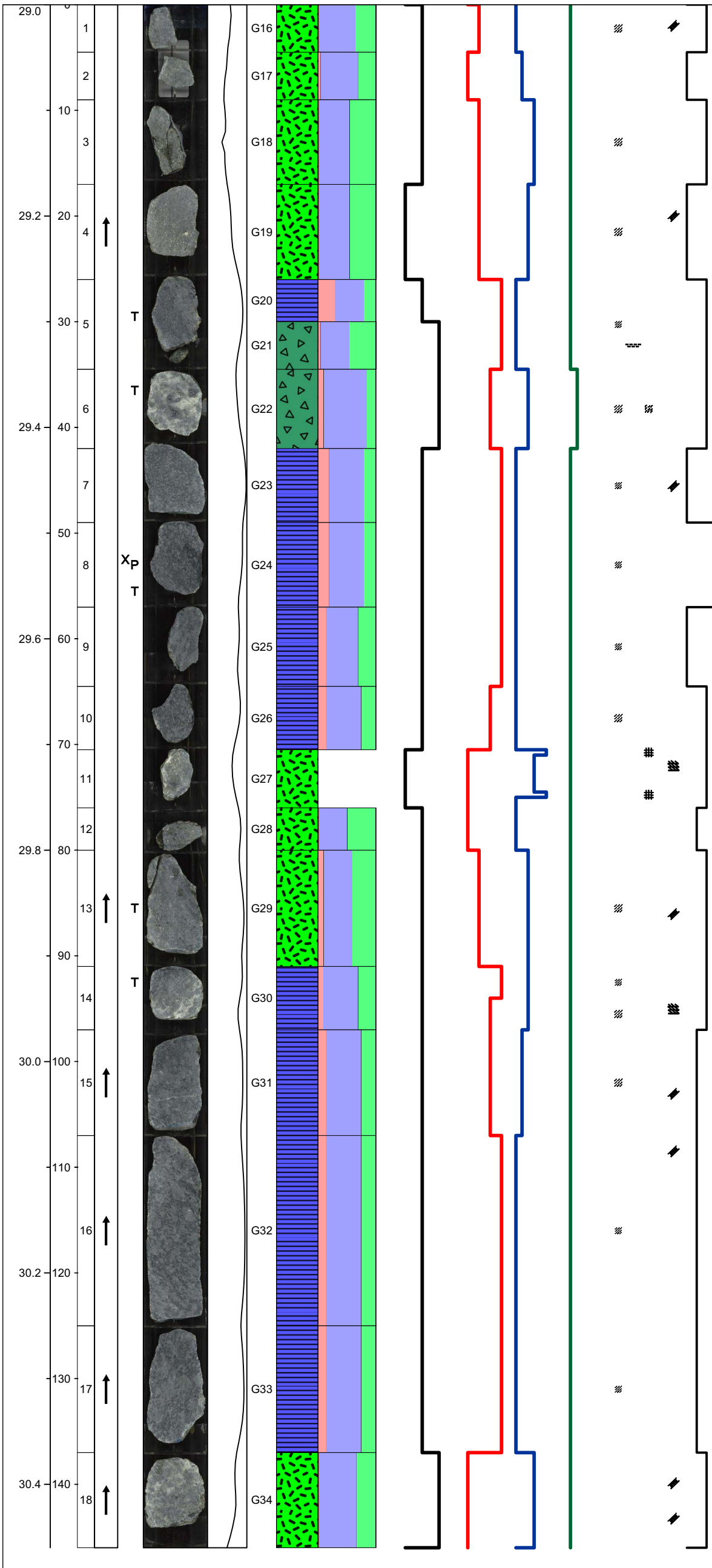
COMMENTS
ALTERATION: Olivine is primarily replaced by talc, pyrite, and clay. Plagioclase is moderately altered to prehnite, chlorite and secondary plagioclase. Clinopyroxene is slightly altered to amphibole.
STRUCTURE: Moderate fracturing.

LITHOLOGIC INTERVAL: G15
SECTION: 345-U1415J-6G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #11
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	4.0	subhedral-anhedral	amoeboid
plagioclase	55.0	2.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	5.0	anhedral	subequant

COMMENTS
ALTERATION: Olivine is primarily replaced by serpentine with mesh texture and clay minerals. Plagioclase and clinopyroxene are fresh.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO.

Hole 345-U1415J-7G Section 1, Top of Section: 29.0 m (CSF-A)



Description

LITHOLOGIC INTERVAL: G16
SECTION: 345-U1415J-7G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	3.0	euhedral-subhedral	subequant
plagioclase	63.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	35.0	3.0	anhedral	subequant

COMMENTS
ALTERATION: Olivine is primarily replaced by talc and clay minerals. Plagioclase is slightly altered to secondary plagioclase. Pyroxene is moderately altered to amphibole.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO. Cut by clay veins.

LITHOLOGIC INTERVAL: G17
SECTION: 345-U1415J-7G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #2
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	3.0	euhedral-subhedral	subequant
plagioclase	65.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	30.0	2.5	anhedral	subequant

COMMENTS
ALTERATION: Olivine is primarily replaced by serpentine and talc. Plagioclase alteration occurs only on grain margin. Pyroxene is moderately altered to amphibole. Open crack with euhedral crystals (wairakaite?).
STRUCTURE: Cut by albite and prehnite veins.

LITHOLOGIC INTERVAL: G18
SECTION: 345-U1415J-7G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #3
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	3.0	euhedral-subhedral	subequant
plagioclase	53.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	45.0	3.0	anhedral	subequant

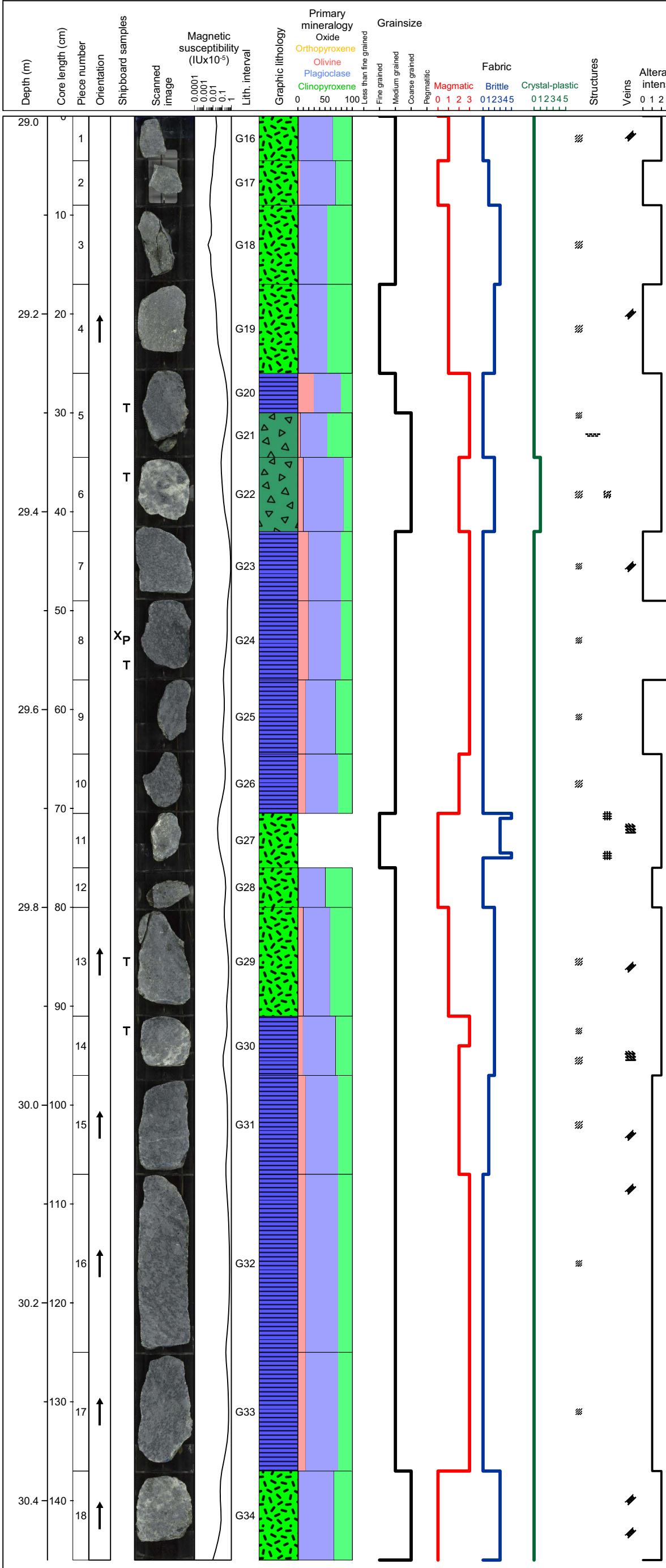
COMMENTS
ALTERATION: Plagioclase alteration occurs only on grain margin. Clinopyroxene is moderately altered to amphibole. Orthopyroxene altered to layers of talc and green amphibole.
STRUCTURE: Dense anastomosing fractures.

LITHOLOGIC INTERVAL: G19
SECTION: 345-U1415J-7G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #4
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	3.0	euhedral-subhedral	subequant
plagioclase	53.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	45.0	1.5	anhedral	subequant

COMMENTS
ALTERATION: Single alteration spot of talc rimmed by chlorite, otherwise interval is fresh.
STRUCTURE: Weak magmatic foliation defined by plagioclase and pyroxene SPO. Moderate fracturing. Cut by clay veins.

Hole 345-U1415J-7G Section 1, Top of Section: 29.0 m (CSF-A)



LITHOLOGIC INTERVAL: G20
SECTION: 345-U1415J-7G-1-A
ROCK NAME: clinopyroxene-oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #5
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0	3.0	subhedral-anhedral	ameboid
plagioclase	50.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	20.0	1.5	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is primarily replaced by talc, pyrite, and clay. Plagioclase is moderately altered to prehnite, chlorite and secondary plagioclase.
STRUCTURE: Weak magmatic foliation defined by plagioclase and pyroxene SPO. Moderate fracturing. Cut by clay veins.

LITHOLOGIC INTERVAL: G21
SECTION: 345-U1415J-7G-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: coarse grained
TEXTURE: granular
PIECES: #5
CONTACTS: modal and textural contact
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	3.0	subhedral-anhedral	ameboid
plagioclase	50.0	3.0	euhedral-subhedral	tabular
clinopyroxene	45.0	10.0	anhedral	oikocryst
orthopyroxene	0.1	0.5	anhedral-subhedral	equant

COMMENTS
ALTERATION: Plagioclase is moderately altered to prehnite, chlorite and secondary plagioclase. Clinopyroxene is slightly altered to amphibole and clay minerals.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO. Modal layering. Subvertical olivine-poor, oikocryst rich boundary.

LITHOLOGIC INTERVAL: G22
SECTION: 345-U1415J-7G-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE:
TEXTURE: granular
PIECES: #6
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	6.0	euhedral-subhedral	subequant
plagioclase	75.0	3.0	euhedral-subhedral	tabular
clinopyroxene	15.0	12.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

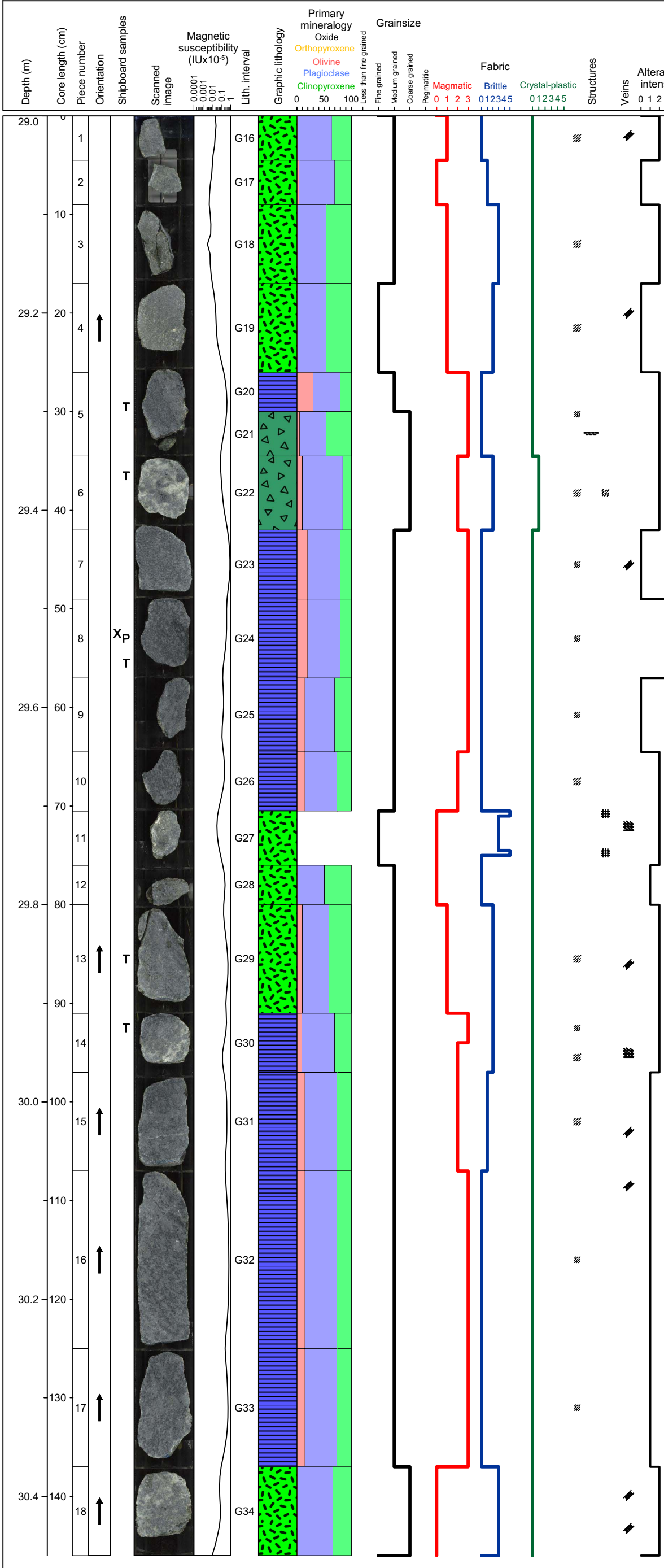
COMMENTS
ALTERATION: Olivine is primarily replaced by talc, clay minerals, serpentine, and pyrite. Abundant pyrite is associated with olivine replacement; heterogeneous degree of plagioclase alteration to secondary plagioclase, prehnite, and chlorite.
STRUCTURE: Moderate fracturing. Cut by amphibole and albite veins.

LITHOLOGIC INTERVAL: G23
SECTION: 345-U1415J-7G-1-A
ROCK NAME: clinopyroxene-oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #7
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	3.0	subhedral-anhedral	ameboid
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	20.0	5.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Plagioclase altered to chlorite near serpentinized olivine, olivine altered to serpentine mesh.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Cut by chlorite and clay veins.

Hole 345-U1415J-7G Section 1, Top of Section: 29.0 m (CSF-A)



Description

LITHOLOGIC INTERVAL: G24
SECTION: 345-U1415J-7G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #8
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	3.0	subhedral-anhedral	ameboid
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	20.0	4.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is primarily replaced by serpentine, talc, and clay minerals. Plagioclase is highly fractured, and moderately altered to secondary plagioclase.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO.

LITHOLOGIC INTERVAL: G25
SECTION: 345-U1415J-7G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #9
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.0	subhedral-anhedral	ameboid
plagioclase	55.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	30.0	6.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine altered to serpentine mesh. Plagioclase replaced by chlorite adjacent to altered olivine.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagiolase and tabular olivine SPO. Fabric appears to wrap around large pyroxene oikocrysts.

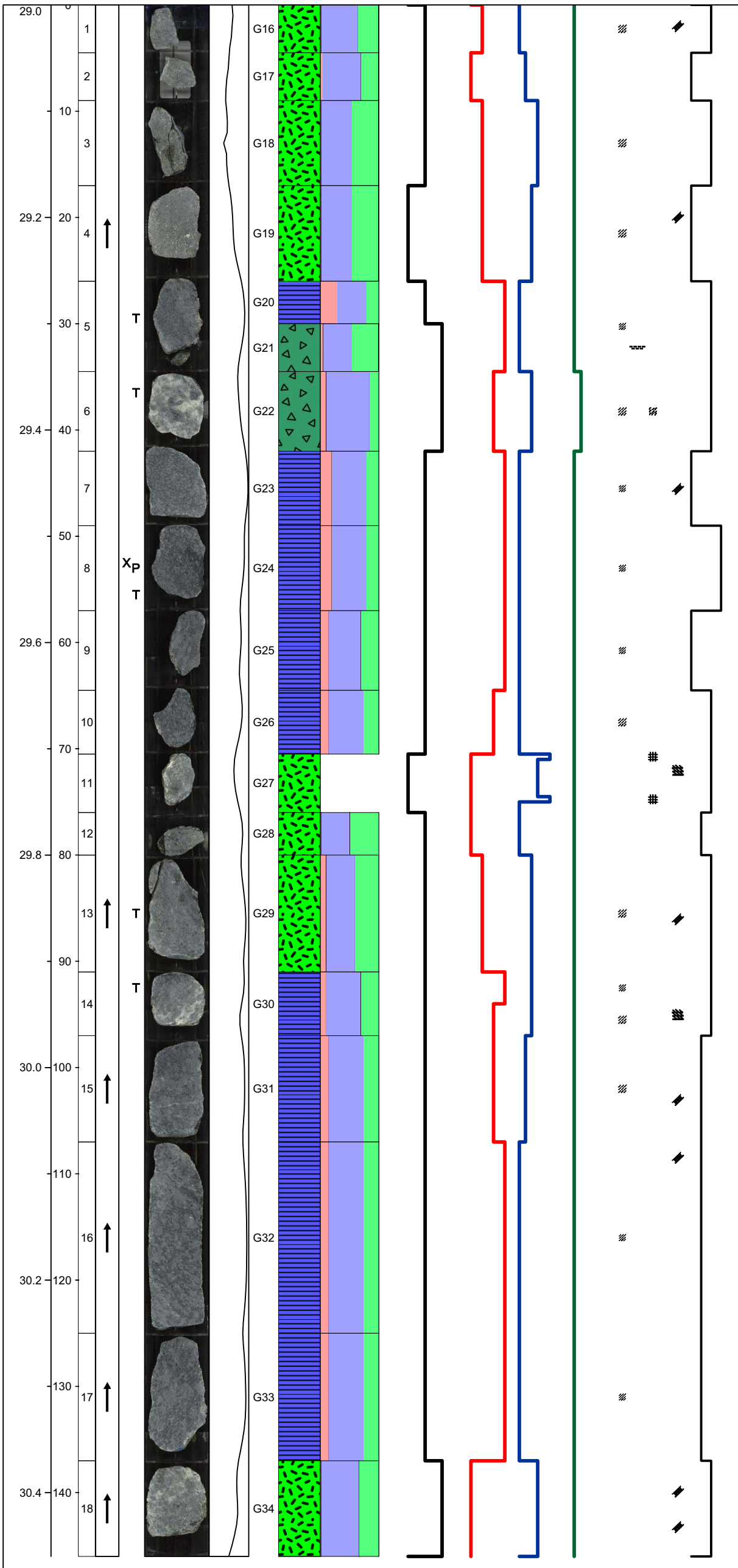
LITHOLOGIC INTERVAL: G26
SECTION: 345-U1415J-7G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #10
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.0	euhedral-subhedral	subequant
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	5.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is primarily replaced by serpentine mesh and pyrite. Plagioclase is highly fractured, and moderately altered to secondary plagioclase. Clinopyroxene is altered to amphibole.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Cut by prehnite veins.

LITHOLOGIC INTERVAL: G27
SECTION: 345-U1415J-7G-1-A
ROCK NAME: cataclastic gabbro
GRAIN SIZE:
TEXTURE:
PIECES: #11
CONTACTS: contact not recovered
COMMENTS
ALTERATION: Olivine is primarily replaced by serpentine mesh, clay minerals, and pyrite. Plagioclase moderately altered to prehnite and chlorite. Clinopyroxene is altered to prehnite and amphibole.
STRUCTURE: Cohensive green cataclasite, 2 mm thick surrounded by fractured gabbro. Foliated cataclasite (74.5-75 cm). Cut by chlorite, amphibole, prehnite and epidote veins.

Hole 345-U1415J-7G Section 1, Top of Section: 29.0 m (CSF-A)



LITHOLOGIC INTERVAL: G28
SECTION: 345-U1415J-7G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #12
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	3.0	euhedral-subhedral	subequant
plagioclase	49.0	3.0	euhedral-subhedral	tabular
clinopyroxene	49.0	2.5	anhedral	subequant
sulfide	0.3	0.5	anhedral	subequant

COMMENTS
STRUCTURE: Cohensive green cataclasite, 2 mm thick surrounded by fractured gabbro. Foliated cataclasite (74.5-75 cm). Cut by chlorite, amphibole, prehnite and epidote veins.

LITHOLOGIC INTERVAL: G29
SECTION: 345-U1415J-7G-1-A
ROCK NAME: clinopyroxene-oikocryst bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #13
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	4.0	subhedral-anhedral	amoeboid
plagioclase	50.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	40.0	14.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
IGNEOUS: first use of oikocryst gabbro; > 40+% of clinopyroxene occur as oikocrysts
ALTERATION: Olivine is primarily replaced by serpentine mesh, talc, and clay minerals. Plagioclase moderately altered to secondary plagioclase and chlorite. Clinopyroxene is altered to amphibole. Orthopyroxene replaced by talc surrounded by chlorite, but also layers of talc and green amphibole.
STRUCTURE: Weak magmatic foliation defined by plagioclase and tabular olivine SPO. Moderate fracturing. Cut by amphibole and chlorite veins.

LITHOLOGIC INTERVAL: G30
SECTION: 345-U1415J-7G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #14
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	4.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	30.0	8.0	anhedral	oikocryst
sulfide	0.3	0.5	anhedral	subequant

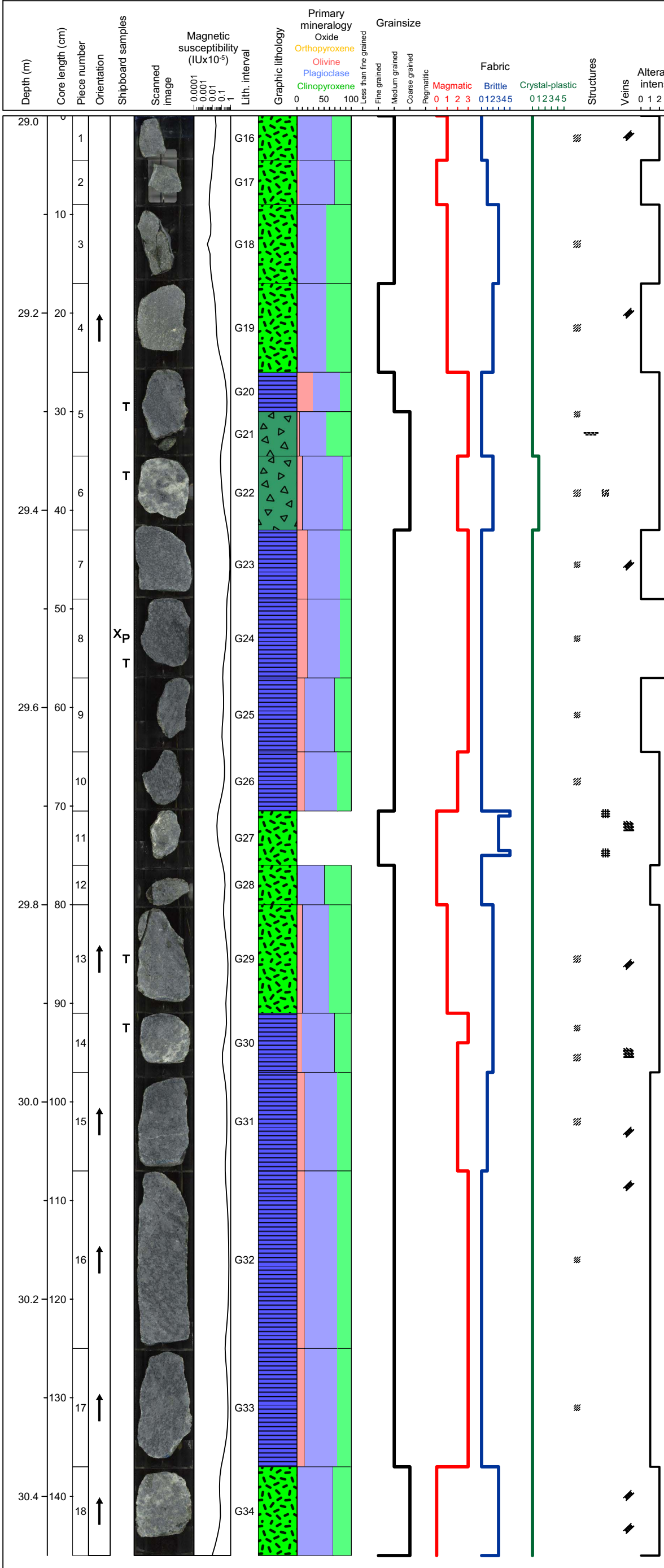
COMMENTS
ALTERATION: Olivine is replaced by talc, clay minerals, serpentine and pyrite. Plagioclase moderately altered to prehnite and chlorite. Clinopyroxene is altered to prehnite and amphibole.
STRUCTURE: Modal layering. Moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Moderate fracturing. Cut by prehnite, albite and amphibole veins.

LITHOLOGIC INTERVAL: G31
SECTION: 345-U1415J-7G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #15
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	15.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is replaced by serpentine, clay minerals, talc, and pyrite. Plagioclase moderately altered to prehnite and chlorite. Pyroxene is altered to prehnite and amphibole.
STRUCTURE: Weak magmatic foliation defined by plagioclase and tabular olivine SPO. Cut by albite veins.

Hole 345-U1415J-7G Section 1, Top of Section: 29.0 m (CSF-A)



LITHOLOGIC INTERVAL: G32
SECTION: 345-U1415J-7G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #16
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	15.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is replaced by serpentine, and clay minerals. Plagioclase slightly altered to secondary plagioclase. Large phenocrysts of orthopyroxene and clinopyroxene are relatively fresh.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO.

LITHOLOGIC INTERVAL: G33
SECTION: 345-U1415J-7G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #17
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	15.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

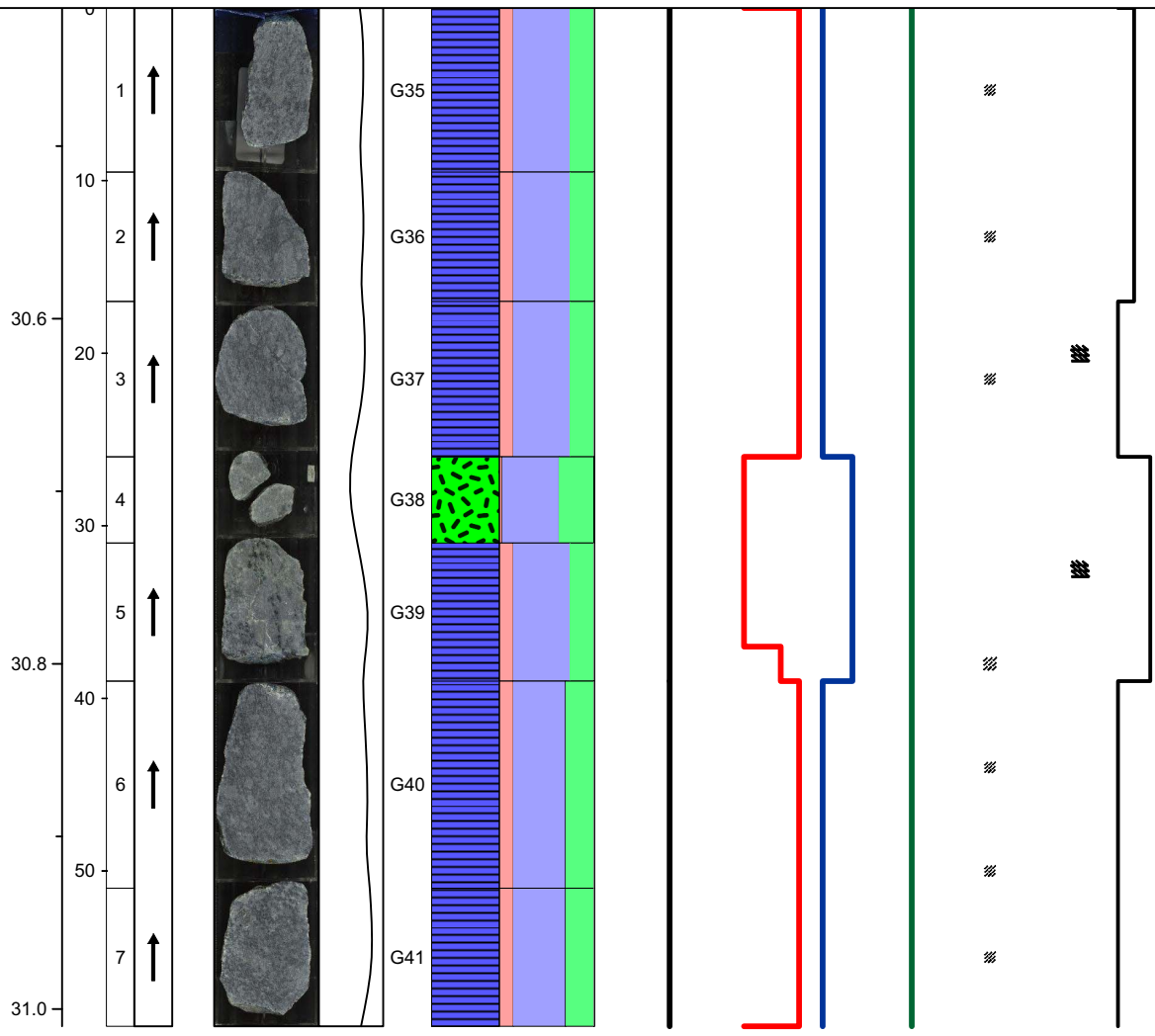
COMMENTS
ALTERATION: Olivine is replaced by serpentine, talc, clay minerals, and pyrite. Plagioclase slightly altered to chlorite and secondary plagioclase. Large phenocrysts of clinopyroxene are altered to amphibole along fractures.
STRUCTURE: Strong magmatic foliation defined by plagioclase and tabular olivine SPO. Cut by amphibole and albite veins.

LITHOLOGIC INTERVAL: G34
SECTION: 345-U1415J-7G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: coarse grained
TEXTURE: granular
PIECES: #18
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	3.0	subhedral-anhedral	amoeboid
plagioclase	65.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	33.0	15.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is replaced by serpentine, talc, clay minerals, and pyrite. Plagioclase moderately altered to secondary plagioclase and prehnite. Clinopyroxene is slightly altered to amphibole; orthopyroxene is highly altered to amphibole and talc.
STRUCTURE: Dense anastomosing fractures. Cut by prehnite, amphibole and clay veins.

Hole 345-U1415J-7G Section 2, Top of Section: 30.46 m (CSF-A)



LITHOLOGIC INTERVAL: G35
SECTION: 345-U1415J-7G-2-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #1
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	12.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Serpentine mesh texture after olivine; pyrite rims around olivine
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagiolase and tabular olivine SPO. Fabric appears to wrap around large pyroxene oikocrysts.

LITHOLOGIC INTERVAL: G36
SECTION: 345-U1415J-7G-2-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #2
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	12.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine and pyrite. Plagioclase is altered to prehnite and chlorite. Radial fractures in plagioclase near olivine, possible chalcopyrite as well as pyrite present. Clinopyroxene moderately altered to amphibole.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagiolase and tabular olivine SPO. Fabric appears to wrap around large pyroxene oikocrysts.

LITHOLOGIC INTERVAL: G37
SECTION: 345-U1415J-7G-2-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #3
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	12.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine, clay minerals, talc and pyrite. Plagioclase is altered to prehnite and chlorite. Plagioclase chadacrysts in clinopyroxene oikocrysts are essentially unaltered. Clinopyroxene moderately altered to amphibole.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Fabric appears to wrap around large pyroxene oikocrysts. Cut by prehnite and serpentine veins.

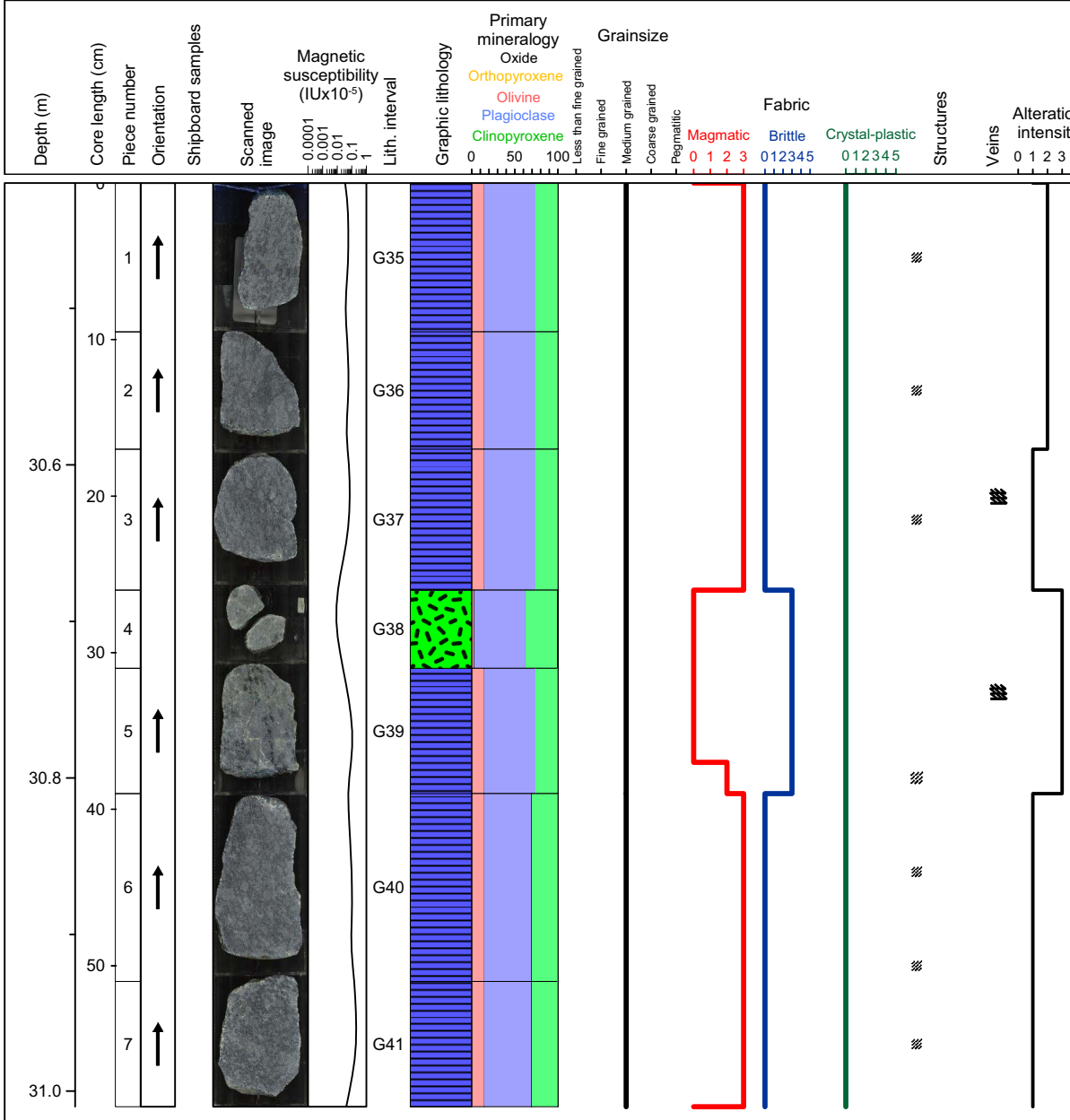
LITHOLOGIC INTERVAL: G38
SECTION: 345-U1415J-7G-2-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #4
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	3.0	3.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	37.0	12.0	anhedral	oikocryst

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine, clay minerals and talc. Plagioclase is altered to chlorite, secondary plagioclase and prehnite. Orthopyroxene completely altered to amphibole. Clinopyroxene moderately altered to amphibole and chlorite. Moderately well developed coronae, more alteration in cataclasite zone of this interval. Possibly chalcopyrite in addition to pyrite.
STRUCTURE: Dense anastomosing fractures.

Hole 345-U1415J-7G Section 2, Top of Section: 30.46 m (CSF-A)



LITHOLOGIC INTERVAL: G39
SECTION: 345-U1415J-7G-2-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #5
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	4.0	subhedral-anhedral	amoeboid
plagioclase	60.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	12.0	anhedral	oikocryst
sulfide	0.1	1.0	anhedral	subequant

COMMENTS
ALTERATION: Plagioclase is moderately fresh, mafic minerals are intensely altered in the cataclastic zone of this piece. There is a network of prehnite and amphibole veins.
STRUCTURE: Modal layering boundary at 37cm; similar to pieces 1, 2 and 3. Boundary parallel to foliation. Cut by dense anastomosing fractures, and prehnite and amphibole veins.

LITHOLOGIC INTERVAL: G40
SECTION: 345-U1415J-7G-2-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #6
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.0	subhedral-anhedral	amoeboid
plagioclase	55.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	30.0	12.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

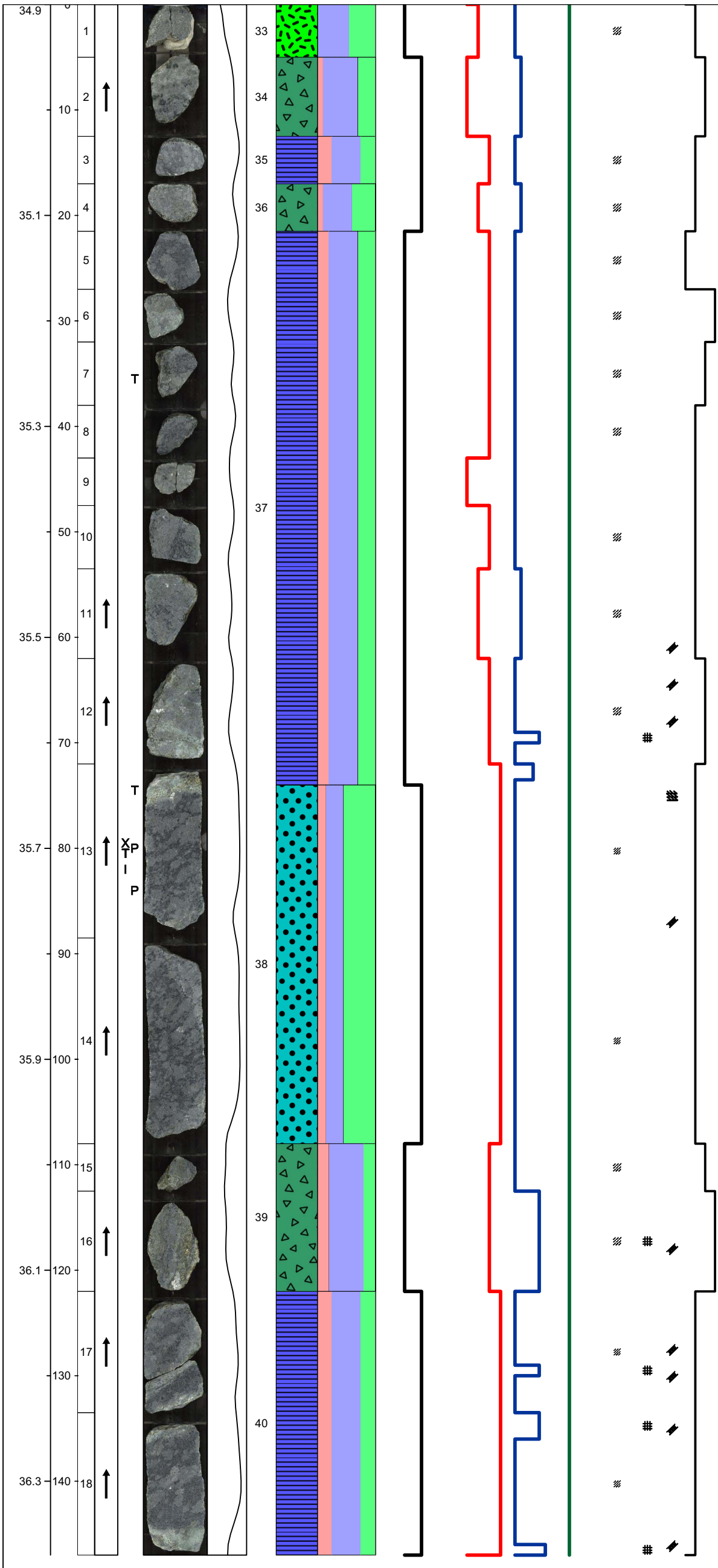
COMMENTS
ALTERATION: Olivine is moderately altered to serpentine, pyrite and magnetite. Plagioclase is altered to prehnite and secondary plagioclase. Clinopyroxene is fresh.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagiolase and olivine SPO. Fabric appears to wrap around large pyroxene oikocrysts.

LITHOLOGIC INTERVAL: G41
SECTION: 345-U1415J-7G-2-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #7
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.0	subhedral-anhedral	amoeboid
plagioclase	55.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	30.0	12.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine, clay minerals and tremolite. Plagioclase is altered to chlorite and prehnite. Clinopyroxene is fresh.
STRUCTURE: Strong magmatic foliation defined by plagioclase and tabular olivine SPO.

Hole 345-U1415J-8R Section 1, Top of Section: 34.9 m (CSF-A)



LITHOLOGIC INTERVAL: 33
SECTION: 345-U1415J-8R-1-A
ROCK NAME: gabbro
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	0.1	0.1	anhedral	
plagioclase	55.0	2.0	euhedral-subhedral	tabular
clinopyroxene	45.0	2.0	anhedral	subequant
oxide	0.1	0.1	subhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is completely altered to serpentine, talc and tremolite. Plagioclase is altered to prehnite and secondary plagioclase. Clinopyroxene is moderately altered to pale green amphibole. Coronae are well developed around olivine, plagioclase alteration is more intense near chlorite vein.
STRUCTURE: Cut by chlorite veins.

LITHOLOGIC INTERVAL: 34
SECTION: 345-U1415J-8R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #2
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	8.0	anhedral	amoeboid
plagioclase	60.0	2.0	euhedral-subhedral	tabular
clinopyroxene	30.0	6.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is completely altered to serpentine, talc, tremolite, and pyrite. Plagioclase is altered to prehnite, zeolite, and chlorite. Clinopyroxene is moderately altered to pale green amphibole. Intensity of olivine alteration is variable.
STRUCTURE: Cut by chlorite and amphibole veins.

LITHOLOGIC INTERVAL: 35
SECTION: 345-U1415J-8R-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #3
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	25.0	2.5	anhedral	amoeboid
plagioclase	50.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	6.0	subhedral-anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

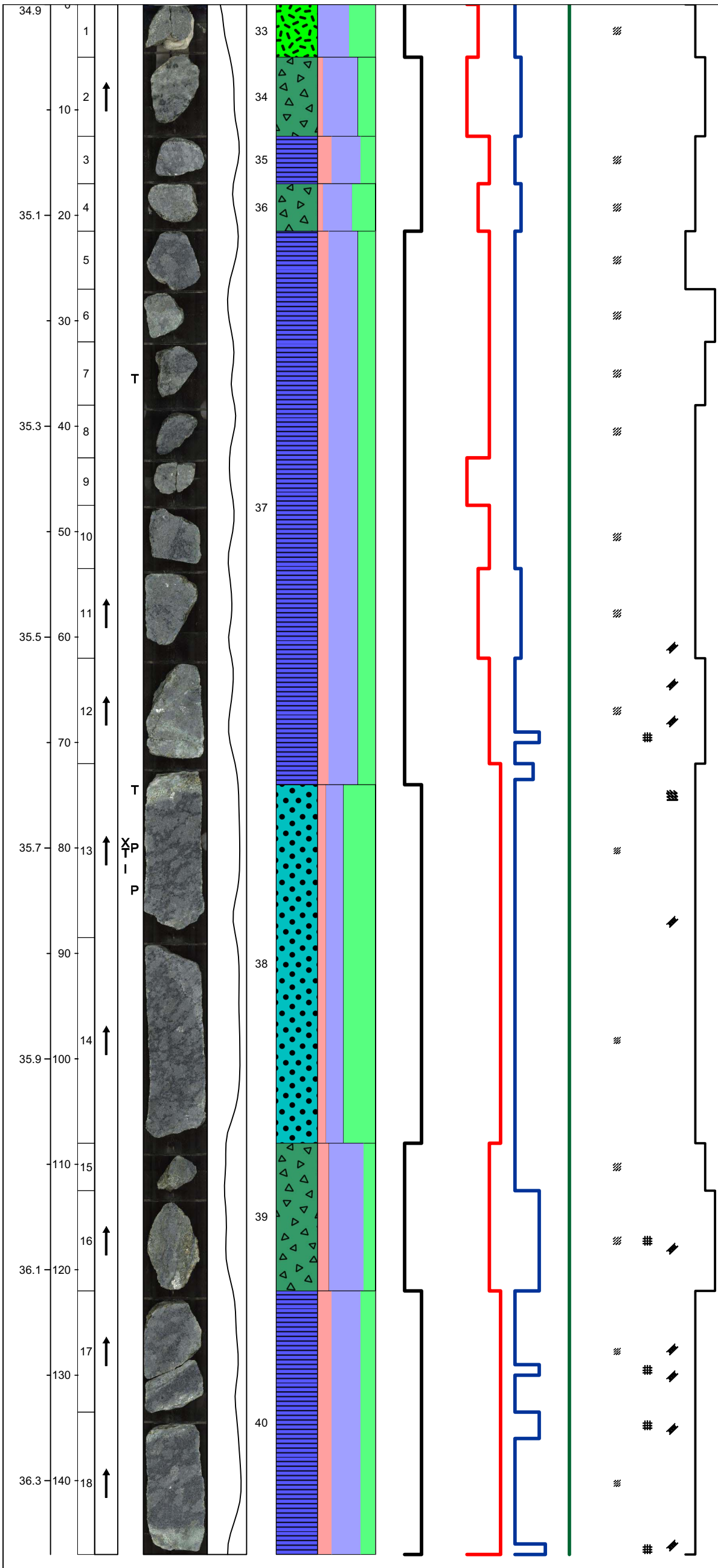
COMMENTS
ALTERATION: Olivine is moderately altered to serpentine, tremolite, and pyrite. Plagioclase is slightly altered to chlorite and amphibole. Clinopyroxene is moderately altered to pale green amphibole.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO

LITHOLOGIC INTERVAL: 36
SECTION: 345-U1415J-8R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #4
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	3.0	subhedral-anhedral	subequant
plagioclase	50.0	7.0	euhedral-subhedral	tabular
clinopyroxene	40.0	4.0	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to clay minerals, talc, tremolite, and serpentine. Plagioclase is moderately altered to prehnite, zeolite, chlorite and secondary plagioclase. Clinopyroxene is moderately altered to pale green amphibole.
STRUCTURE: Cut by chlorite and clay veins.

Hole 345-U1415J-8R Section 1, Top of Section: 34.9 m (CSF-A)



LITHOLOGIC INTERVAL: 37
SECTION: 345-U1415J-8R-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: fine grained
TEXTURE: poikilitic-granular
PIECES: #5, #6, #7, #8, #9, #10, #11, #12, #13
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	7.0	subhedral-anhedral	subequant
plagioclase	50.0	4.0	euhedral-subhedral	lath-shaped
clinopyroxene	30.0	20.0	anhedral	oikocryst
sulfide	0.1	0.5	anhedral	subequant

COMMENTS
ALTERATION: Olivine is slightly to totally altered to a variety of alteration assemblages including serpentine+ clay minerals+ talc and talc+ pyrite. Olivine is more intensely altered when in proximity to clinopyroxene oikocrysts and near veins. Plagioclase is slightly to moderately altered to prehnite, zeolite, chlorite and secondary plagioclase. Clinopyroxene is moderately altered to pale green amphibole. Pyrite is commonly disseminated in this interval. Veins include chlorite, chlorite+ prehnite, and chlorite+ amphibole veins; alteration is more intense in vein halos, but mineralogy is the same.
STRUCTURE: Anastomosing and planar magmatic foliation defined by plagioclase and tabular olivine SPO. Cataclasite developed along prehnite vein (69-70 and 72-73.5cm). Cut by prehnite and clay veins.

LITHOLOGIC INTERVAL: 38
SECTION: 345-U1415J-8R-1-A
ROCK NAME: oikocryst gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #13, #14
CONTACTS: color contact
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.5	anhedral	elongate
plagioclase	30.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	55.0	20.0	anhedral	oikocryst

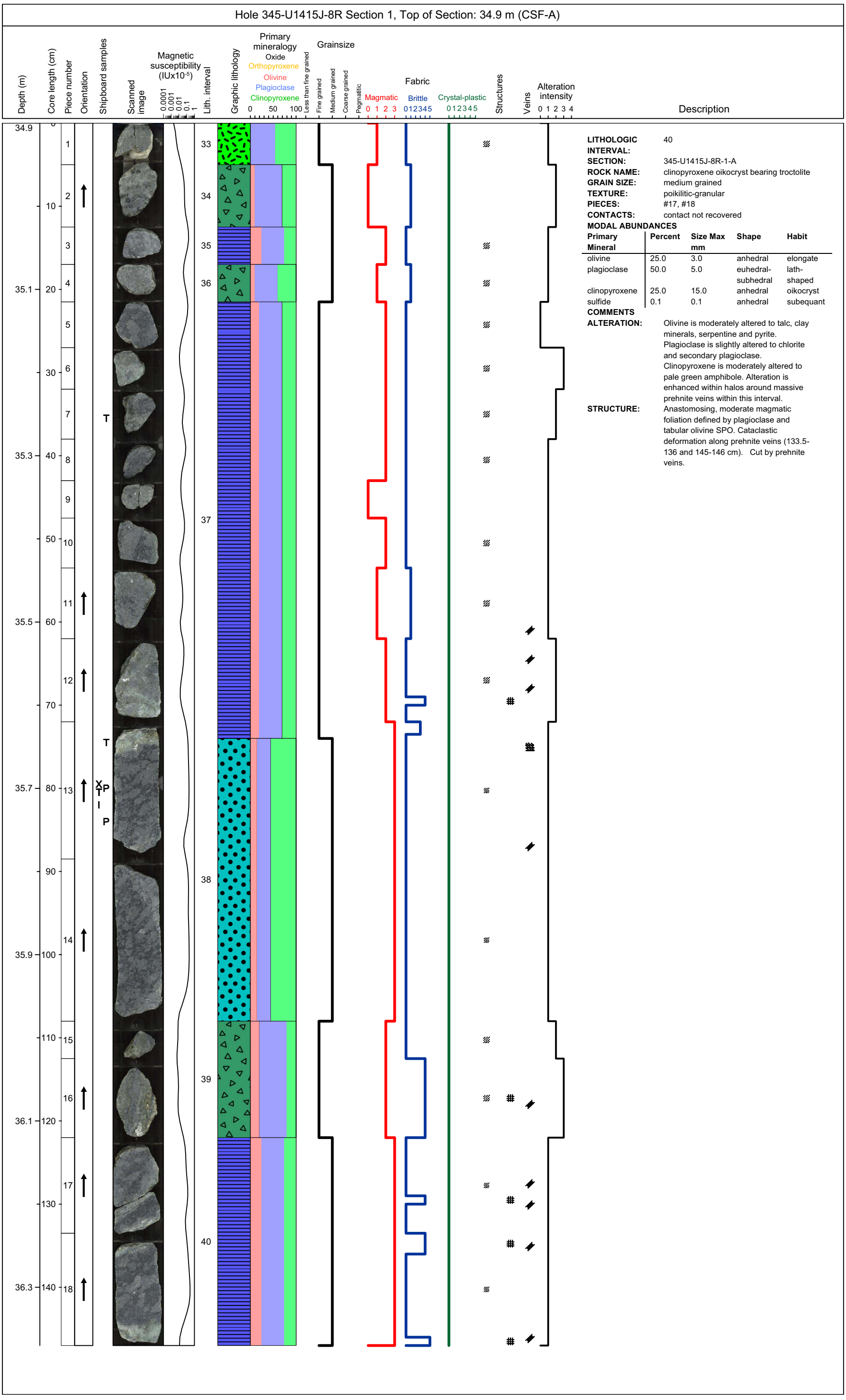
COMMENTS
IGNEOUS: 74 cm - contact between clinopyroxene-oikocryst bearing troctolite and oikocryst gabbro
ALTERATION: Olivine is moderately altered to talc, clay minerals, serpentine and pyrite. Plagioclase is slightly altered to chlorite and secondary plagioclase. Clinopyroxene is moderately altered to pale green amphibole. A conspicuous vein halo occurs at the top of piece 13.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Cut by prehnite and clay veins.

LITHOLOGIC INTERVAL: 39
SECTION: 345-U1415J-8R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #15, #16
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	3.5	subhedral-anhedral	elongate
plagioclase	60.0	2.0	euhedral-subhedral	lath-shaped
clinopyroxene	20.0	15.0	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to talc, clay minerals, serpentine and pyrite. Plagioclase is slightly altered to prehnite, secondary plagioclase, and chlorite. Clinopyroxene is moderately altered to pale green amphibole.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Well developed, subvertical breccia (112.5-122 cm). Cut by prehnite and clay veins.

Hole 345-U1415J-8R Section 1, Top of Section: 34.9 m (CSF-A)



LITHOLOGIC INTERVAL: 40
SECTION: 345-U1415J-8R-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #17, #18
CONTACTS: contact not recovered

MODAL ABUNDANCES

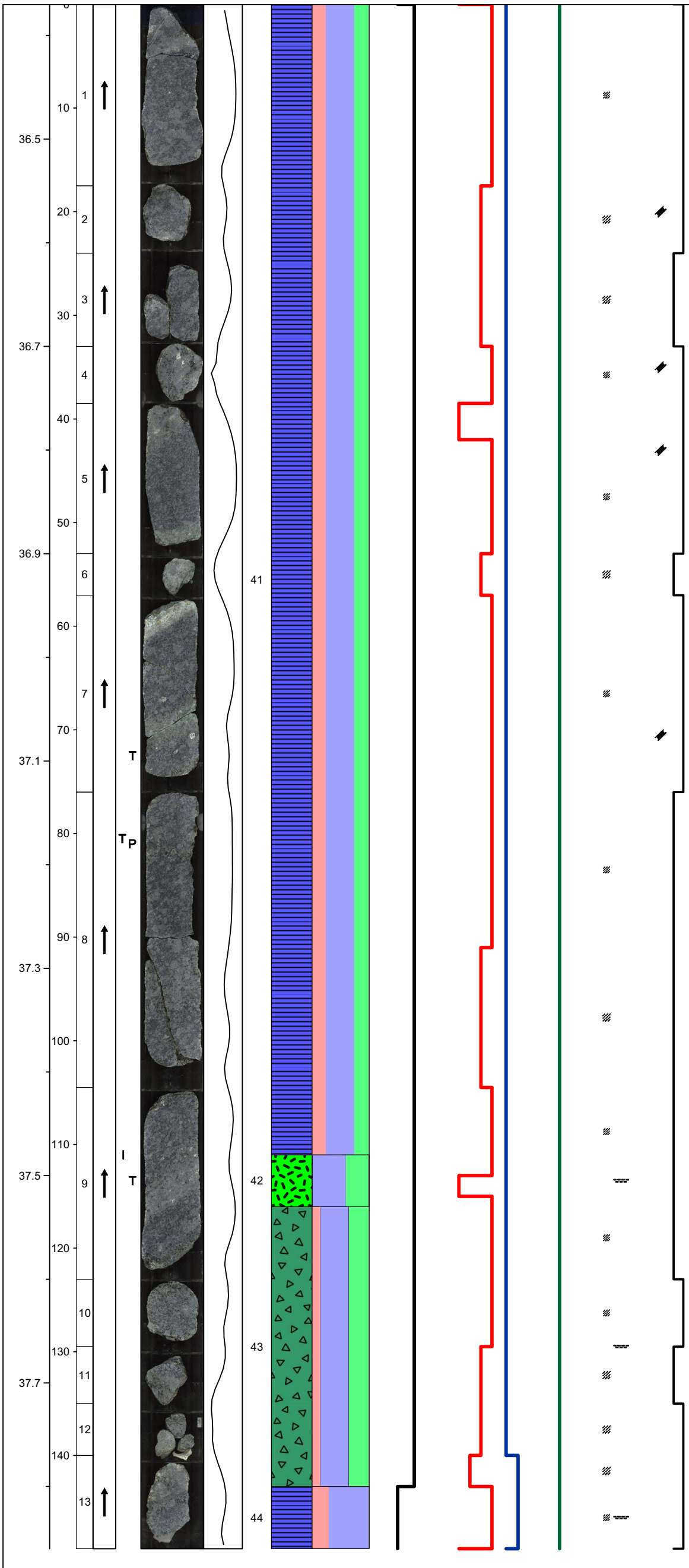
Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	25.0	3.0	anhedral	elongate
plagioclase	50.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	15.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS

ALTERATION: Olivine is moderately altered to talc, clay minerals, serpentine and pyrite. Plagioclase is slightly altered to chlorite and secondary plagioclase. Clinopyroxene is moderately altered to pale green amphibole. Alteration is enhanced within halos around massive prehnite veins within this interval.

STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Cataclastic deformation along prehnite veins (133.5-136 and 145-146 cm). Cut by prehnite veins.

Hole 345-U1415J-8R Section 2, Top of Section: 36.37 m (CSF-A)



LITHOLOGIC INTERVAL: 41
SECTION: 345-U1415J-8R-2-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #1, #2, #3, #4, #5, #6, #7, #8, #9
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	25.0	5.5	anhedral	elongate
plagioclase	50.0	7.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	12.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately to completely altered to serpentine, (talc), and pyrite. Serpentine mesh textures after olivine have been deformed and foliated. Plagioclase is fresh to slightly altered to chlorite and secondary plagioclase. Clinopyroxene is fresh to slightly altered to amphibole. Orthopyroxene is moderately altered to amphibole in piece 1, and very slightly altered to serpentine in pieces 3-7.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagioclase and tabular olivine SPO (0-42 cm). Modal layering in isotropic, oikocryst-rich unit (42-53 cm). Moderate magmatic foliation defined by plagioclase and tabular olivine SPO (53-111 cm). Serpentine mesh texture partially pseudomorphs often equant olivine deformed into anastomosing bands of serpentine that weave around relict now lens-shaped fragments of olivine aggregates with aspect ratios of 1:4 and 1:5. Cut by clay (piece #2); chlorite, amphibole and prehnite veins (piece #5), and zeolite (piece #7) veins.

LITHOLOGIC INTERVAL: 42
SECTION: 345-U1415J-8R-2-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #9
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	1.0	7.0	subhedral	elongate
plagioclase	59.0	4.0	euhedral-subhedral	tabular
clinopyroxene	40.0	5.0	anhedral	subequant

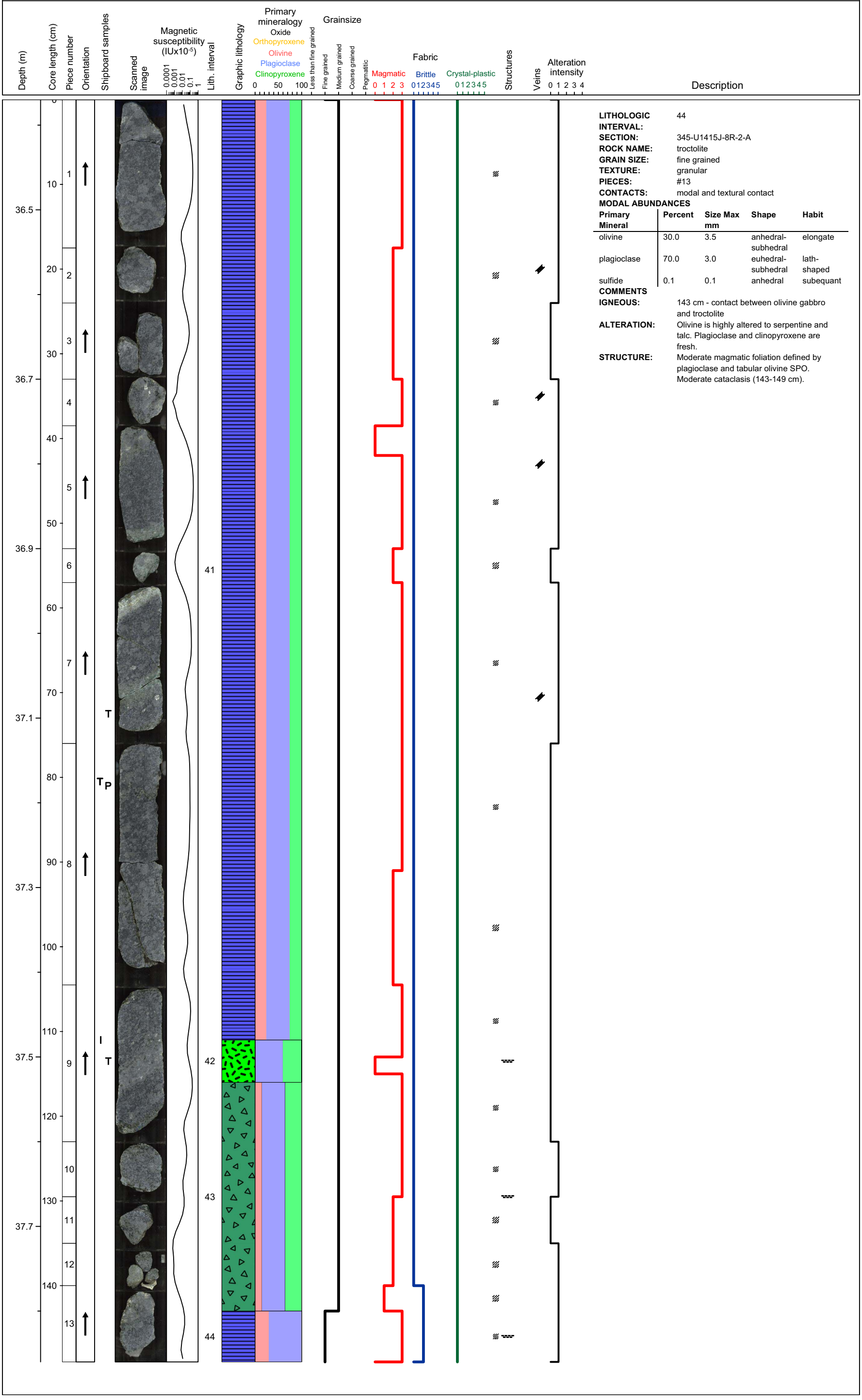
COMMENTS
IGNEOUS: 111 cm - contact between clinopyroxene-oikocryst bearing troctolite and olivine-bearing gabbro
ALTERATION: Olivine is highly altered to serpentine, talc, and pyrite. Olivine is completely replaced in vein halos. Plagioclase and clinopyroxene are fresh.
STRUCTURE: Modal layering; no obvious foliation.

LITHOLOGIC INTERVAL: 43
SECTION: 345-U1415J-8R-2-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #9, #10, #11, #12, #13
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	3.5	anhedral	elongate
plagioclase	50.0	5.0	euhedral-subhedral	tabular
clinopyroxene	35.0	5.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
IGNEOUS: 116 cm - contact between olivine-bearing gabbro and olivine gabbro
ALTERATION: Olivine is highly altered to serpentine and talc. Talc replaces cores of mesh texture after olivine. Plagioclase and clinopyroxene are fresh.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO (116-123 cm). Anastomosing, moderate magmatic foliation defined by plagioclase and tabular olivine SPO (123--143 cm). Cut by chlorite veins.

Hole 345-U1415J-8R Section 2, Top of Section: 36.37 m (CSF-A)



LITHOLOGIC INTERVAL: 44
SECTION: 345-U1415J-8R-2-A
ROCK NAME: troctolite
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #13
CONTACTS: modal and textural contact

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0	3.5	anhedral-subhedral	elongate
plagioclase	70.0	3.0	euhedral-subhedral	lath-shaped
sulfide	0.1	0.1	anhedral	subequant

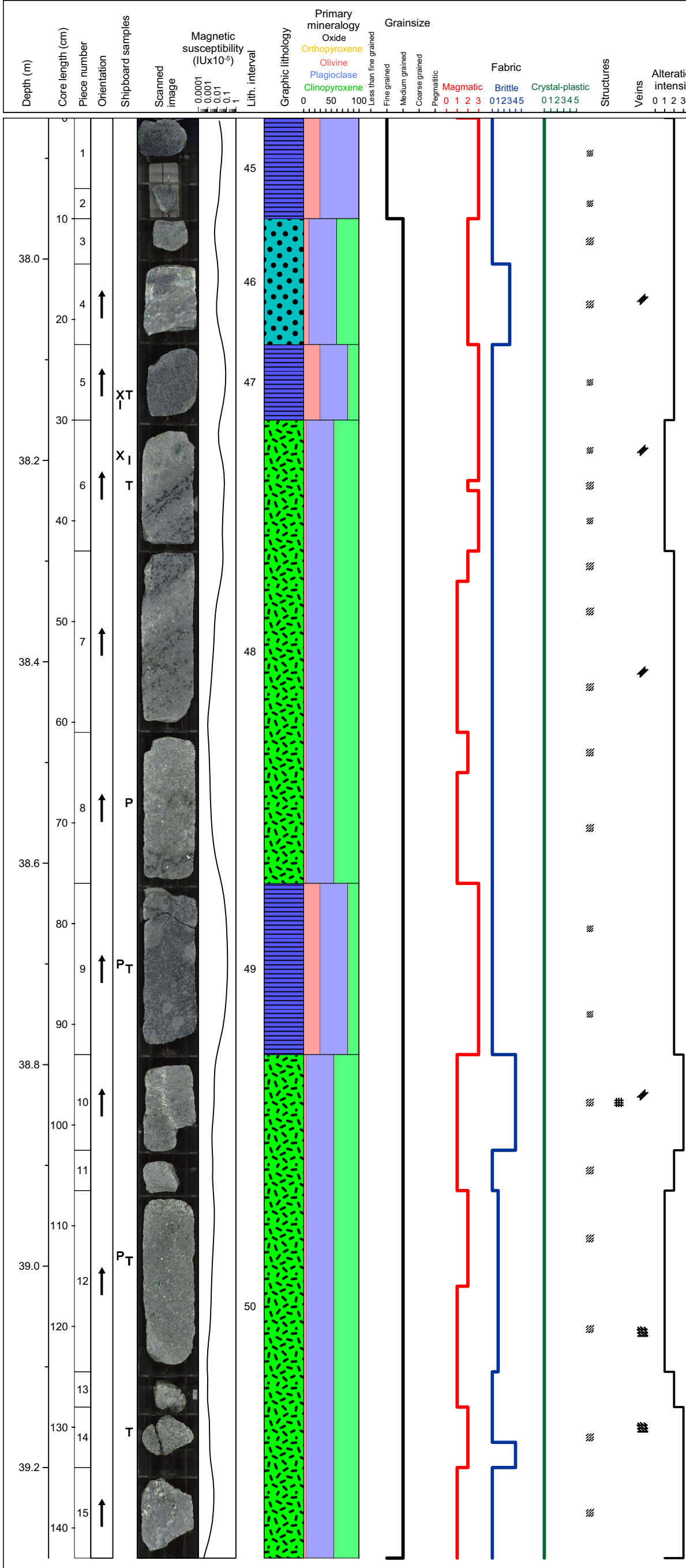
COMMENTS

IGNEOUS: 143 cm - contact between olivine gabbro and troctolite

ALTERATION: Olivine is highly altered to serpentine and talc. Plagioclase and clinopyroxene are fresh.

STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Moderate cataclasis (143-149 cm).

Hole 345-U1415J-8R Section 3, Top of Section: 37.86 m (CSF-A)



Description

LITHOLOGIC INTERVAL: 45
SECTION: 345-U1415J-8R-3-A
ROCK NAME: troctolite
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #1, #2
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0	4.5	anhedral	elongate
plagioclase	70.0	5.0	euhedral-subhedral	lath-shaped
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine and pyrite. Plagioclase is slightly altered to chlorite and secondary plagioclase. Olivine is altered to talc in the halo of a chlorite-zeolite vein.
STRUCTURE: Moderate to strong magmatic foliation defined by plagioclase and tabular olivine SPO. Cut by chlorite and zeolite veins.

LITHOLOGIC INTERVAL: 46
SECTION: 345-U1415J-8R-3-A
ROCK NAME: oikocryst gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #3, #4
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	3.5	anhedral-subhedral	subequant
plagioclase	50.0	2.0	euhedral-subhedral	tabular
clinopyroxene	40.0	15.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is completely altered to talc with lesser amounts of serpentine and clay minerals. Plagioclase is slightly altered to chlorite and secondary plagioclase. Localized deformation along talc-rich zones next to clinopyroxene oikocrysts.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Cataclastic deformation along veins and zones of alteration (14-22 cm). Cut by zeolite veins.

LITHOLOGIC INTERVAL: 47
SECTION: 345-U1415J-8R-3-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #5
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0	3.5	anhedral-subhedral	subequant
plagioclase	50.0	4.0	euhedral-subhedral	lath-shaped
clinopyroxene	20.0	20.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

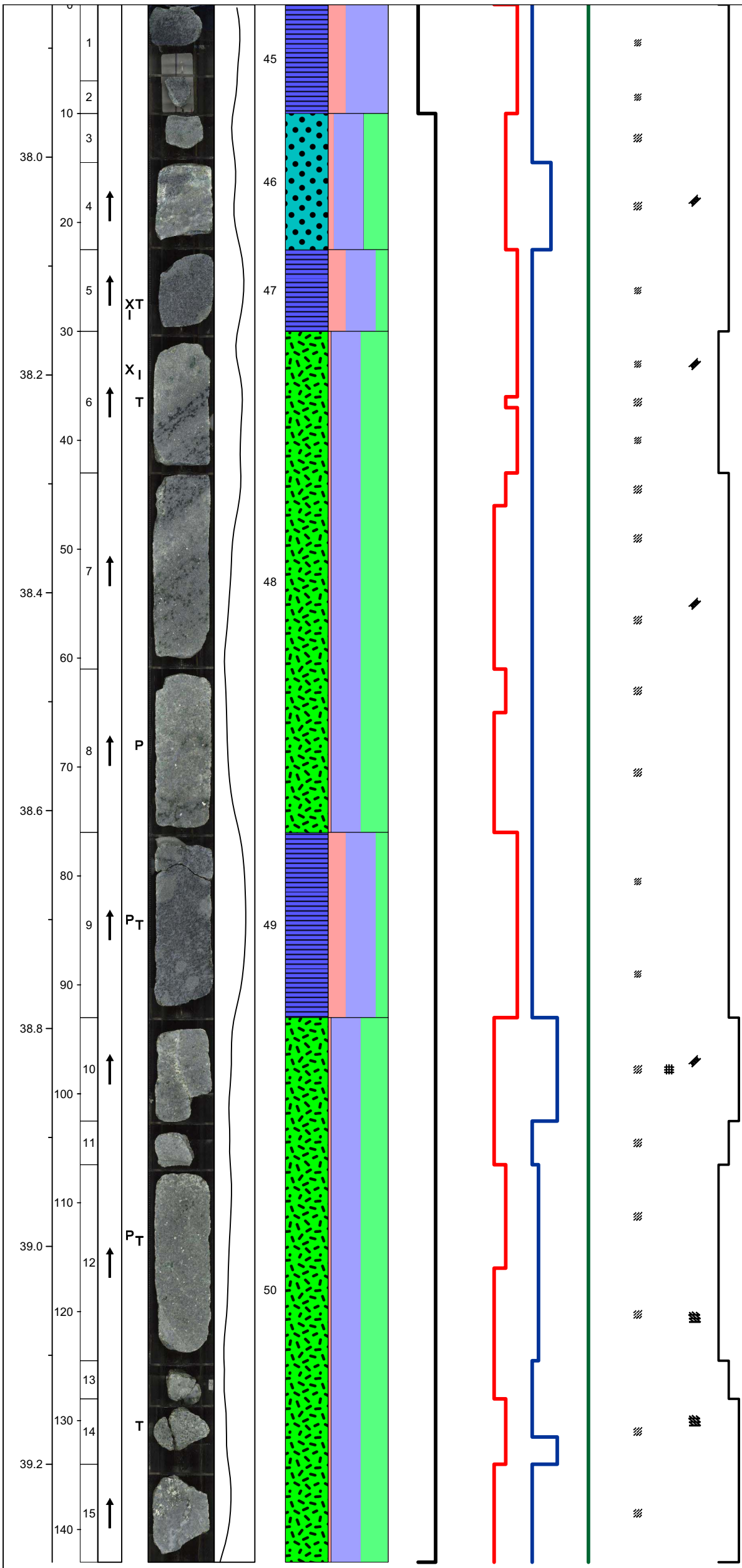
COMMENTS
ALTERATION: Olivine is completely altered to talc with lesser amounts of serpentine and clay minerals. Plagioclase is slightly altered to chlorite and secondary plagioclase. Localized deformation along talc-rich zones next to clinopyroxene oikocrysts.
STRUCTURE: Modal layering. Strong magmatic foliation defined by plagioclase and tabular olivine SPO.

LITHOLOGIC INTERVAL: 48
SECTION: 345-U1415J-8R-3-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #6, #7, #8
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	11.0	anhedral-subhedral	subequant
plagioclase	50.0	5.0	euhedral-subhedral	lath-shaped
clinopyroxene	45.0	3.0	anhedral	subequant
sulfide	0.1	0.2	anhedral	subequant

COMMENTS
ALTERATION: Olivine is completely altered to talc with lesser amounts of serpentine and clay minerals. In olivine rich band, olivine is also altered to primarily serpentine. Plagioclase is slightly to highly altered to chlorite, prehnite, and secondary plagioclase. Clinopyroxene is slightly altered to amphibole.
STRUCTURE: Grain size layering. Weak to moderate magmatic foliation defined by plagioclase and olivine, or plagioclase and pyroxene SPO. Cut by zeolite veins.

Hole 345-U1415J-8R Section 3, Top of Section: 37.86 m (CSF-A)



Description

LITHOLOGIC INTERVAL: 49
SECTION: 345-U1415J-8R-3-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #9
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0	4.5	anhedral	elongate
plagioclase	50.0	6.0	euhedral-subhedral	lath-shaped
clinopyroxene	20.0	10.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

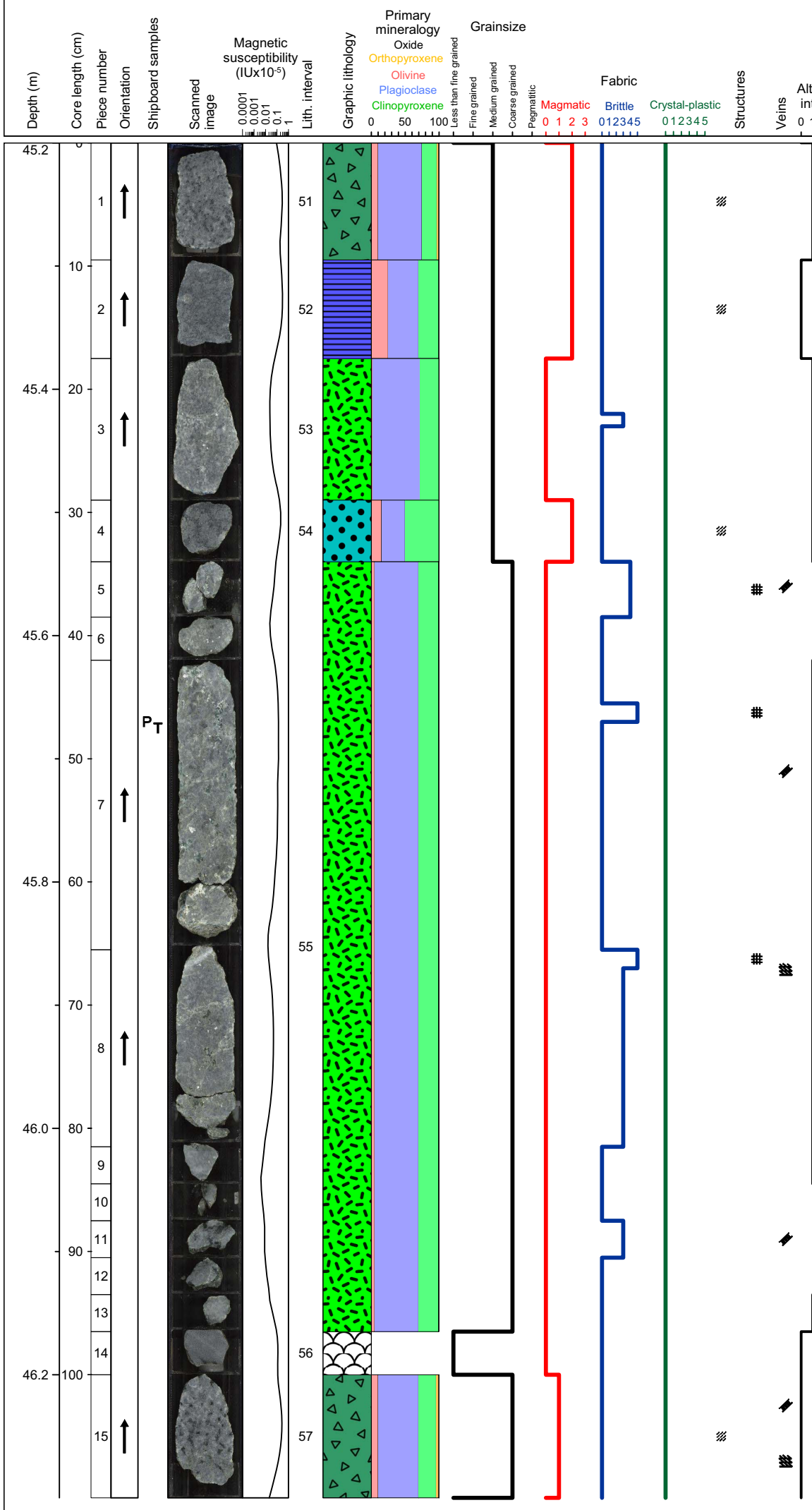
COMMENTS
ALTERATION: Olivine is highly altered to serpentine, clay minerals and pyrite. Plagioclase is moderately altered to chlorite and secondary plagioclase. Clinopyroxene is slightly altered to amphibole.
STRUCTURE: Anastomosing, strong magmatic foliation defined by plagioclase and tabular olivine SPO. Fabric appears to wrap around large pyroxene oikocrysts.

LITHOLOGIC INTERVAL: 50
SECTION: 345-U1415J-8R-3-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #10, #11, #12, #13, #14, #15
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	12.0	anhedral-subhedral	subequant
plagioclase	50.0	10.0	euhedral-subhedral	tabular
clinopyroxene	45.0	10.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is completely altered to talc and serpentine. Plagioclase is moderately altered to chlorite and secondary plagioclase. Clinopyroxene is moderately altered to amphibole. In vein halos of zeolite+ prehnite, zeolite, and chlorite veins, plagioclase is intensely altered to secondary plagioclase and prehnite.
STRUCTURE: Weak magmatic foliation defined by plagioclase and pyroxene SPO (106-125 cm); moderate to strong magmatic foliation defined by plagioclase and olivine SPO (128-143 cm). Cataclastic deformation localized along subvertical prehnite vein (93-102.5 cm). Cut by zeolite, prehnite and chlorite veins.

Hole 345-U1415J-9R Section 1, Top of Section: 45.2 m (CSF-A)



LITHOLOGIC INTERVAL: 51
SECTION: 345-U1415J-9R-1-A
ROCK NAME: orthopyroxene bearing olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	4.0	anhedral to subhedral	amoeboid
plagioclase	65.0	5.0	euhedral-subhedral	tabular
clinopyroxene	22.0	3.0	anhedral	subequant
orthopyroxene	3.0	3.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine with lesser amounts of talc and clay minerals. Plagioclase and clinopyroxene are unaltered. Orthopyroxene is slightly altered to talc.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Cut by zeolite veins.

LITHOLOGIC INTERVAL: 52
SECTION: 345-U1415J-9R-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #2
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	25.0	4.0	anhedral to subhedral	elongate
plagioclase	45.0	4.0	euhedral-subhedral	lath-shaped
clinopyroxene	30.0	13.0	anhedral	oikocryst
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine. Plagioclase and clinopyroxene are unaltered. Orthopyroxene is slightly altered to talc.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO.

LITHOLOGIC INTERVAL: 53
SECTION: 345-U1415J-9R-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #3
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	2.0	subhedral	equant
plagioclase	70.0	5.0	euhedral-subhedral	tabular
clinopyroxene	28.0	3.0	anhedral	subequant

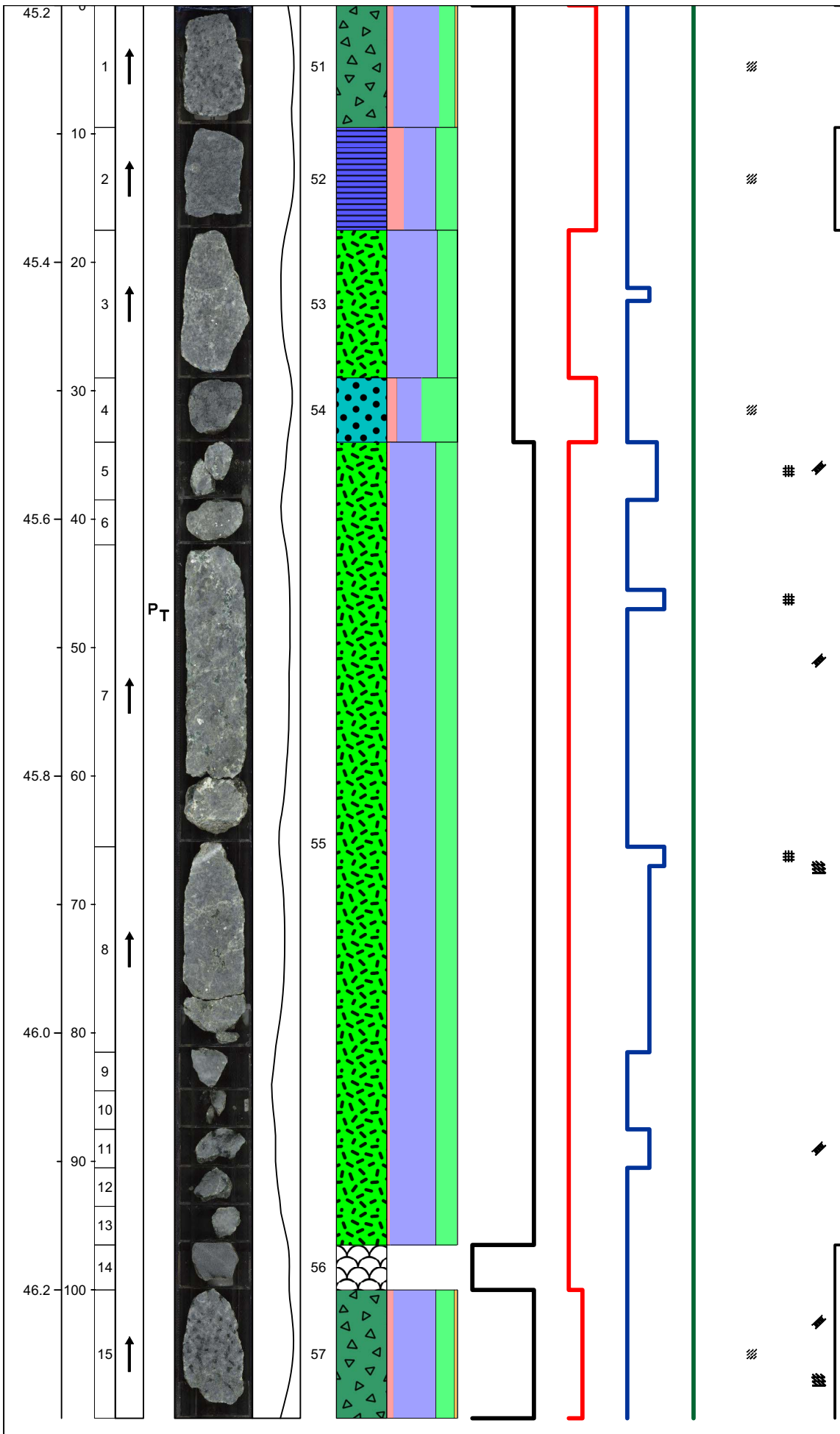
COMMENTS
ALTERATION: Olivine is moderately altered to serpentine and talc. Plagioclase is slightly altered to chlorite. Clinopyroxene is unaltered.
STRUCTURE: Zone of cataclasis along prehite vein (22-23 cm). Cut by prehnite and chlorite veins.

LITHOLOGIC INTERVAL: 54
SECTION: 345-U1415J-9R-1-A
ROCK NAME: oikocryst gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #4
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	4.0	anhedral to subhedral	elongate
plagioclase	35.0	5.0	euhedral-subhedral	tabular
clinopyroxene	50.0	15.0	anhedral	oikocryst

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine, clay minerals, and pyrite. Plagioclase and clinopyroxene are unaltered. Orthopyroxene is slightly altered to serpentine.
STRUCTURE: Cut by prehnite and chlorite veins.

Hole 345-U1415J-9R Section 1, Top of Section: 45.2 m (CSF-A)



Description

LITHOLOGIC INTERVAL: 55
SECTION: 345-U1415J-9R-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: coarse grained
TEXTURE: granular
PIECES: #5, #6, #7, #8, #9, #10, #11, #12, #13
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	14.0	anhedral to subhedral	amoeboid
plagioclase	65.0	10.0	euhedral-subhedral	tabular
clinopyroxene	30.0	8.0	anhedral	subequant
oxide	0.1	0.1	subhedral	equant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine and talc. Plagioclase is moderately altered to prehnite, chlorite, zeolite and secondary plagioclase. Clinopyroxene is slightly to moderately altered to fibrous amphibole. Olivine corona textures are poorly developed. Piece 12 includes brecciated gabbro that has somewhat enhanced alteration relative to the rest of this interval.
STRUCTURE: Irregular cataclasite (45.5-47 cm), parallel prehnite (67-81.5 and 87.5 to 90.5 cm), chlorite and zeolite veins.

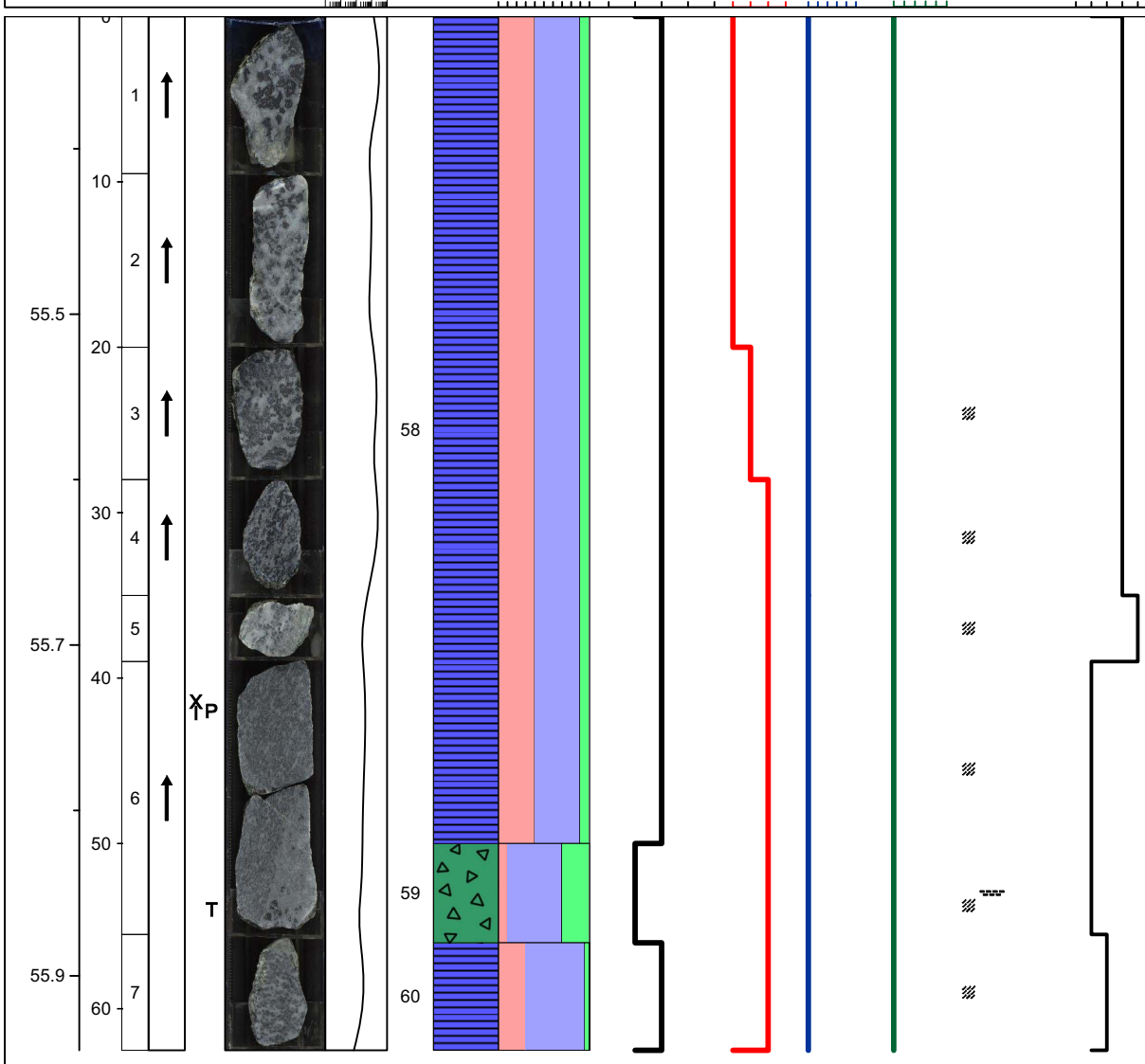
LITHOLOGIC INTERVAL: 56
SECTION: 345-U1415J-9R-1-A
ROCK NAME: aphyric basalt
GRAIN SIZE: less than fine grained
TEXTURE: granular
PIECES: #14
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: olivine: 0.1%, 0.1mm min size, 0.1mm max size, 0.1mm size mode, subhedral, subequant. plagioclase: 0.1%, 0.1mm min size, 0.5 max size, 0.1mm size mode, euhedral-subhedral, lath-shaped. sulphide: 0.8%, 0.1mm min size, 0.5mm max size, 0.1mm size mode, anhedral, subequant.
ALTERATION: Olivine is moderately altered to serpentine. Interval is otherwise fresh
STRUCTURE: Cut by chlorite and zeolite veins.

LITHOLOGIC INTERVAL: 57
SECTION: 345-U1415J-9R-1-A
ROCK NAME: orthopyroxene bearing olivine-gabbro
GRAIN SIZE: coarse grained
TEXTURE: granular
PIECES: #15
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	3.0	anhedral	amoeboid
plagioclase	60.0	5.0	euhedral-subhedral	tabular
clinopyroxene	26.0	8.0	anhedral	subequant
orthopyroxene	4.0	5.0	anhedral	interstitial
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine. Interval is otherwise fresh
STRUCTURE: Cut by amphibole, prehnite, and clay veins.

Hole 345-U1415J-10R Section 1, Top of Section: 55.3 m (CSF-A)



LITHOLOGIC INTERVAL: 58
SECTION: 345-U1415J-10R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1, #2, #3, #4, #5, #6
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	40.0	10.0	euhedral-subhedral	equant
plagioclase	50.0	5.0	euhedral-subhedral	tabular
clinopyroxene	10.0	8.0	anhedral	subequant
oxide	0.1	0.4	anhedral	subequant
sulfide	0.1	0.4	subhedral-anhedral	subequant

COMMENTS
ALTERATION: Olivine is highly to completely altered to serpentine, clay minerals, talc, tremolite, and pyrite. Plagioclase is moderately altered to prehnite, chlorite, and secondary plagioclase. Clinopyroxene is moderately to highly altered to amphibole. Piece 5 is a cataclasite that has enhanced alteration relative to the rest of this interval.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Modal layering (28-35 cm), grain size layering (35-52 cm). Cut by chlorite and clay veins.

LITHOLOGIC INTERVAL: 59
SECTION: 345-U1415J-10R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #6
CONTACTS: modal and textural contact
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	2.0	subhedral-anhedral	subequant
plagioclase	60.0	2.0	euhedral-subhedral	tabular
clinopyroxene	30.0	5.0	anhedral	network
sulfide	0.1	0.2	subhedral-anhedral	subequant

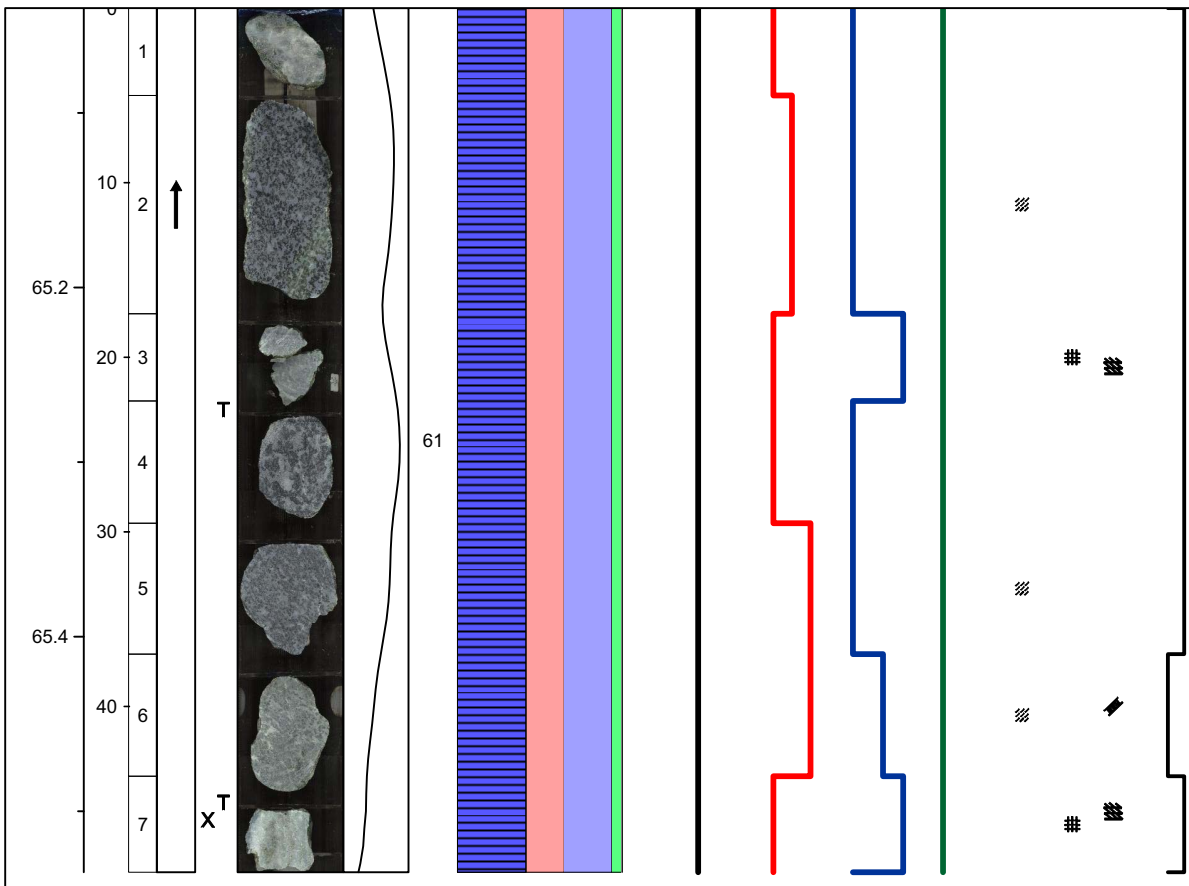
COMMENTS
IGNEOUS: 45-55 cm - subvertical contact between troctolite and olivine gabbro
ALTERATION: Olivine is highly altered to serpentine. Clinopyroxene is slightly altered to amphibole. Plagioclase is slightly altered to chlorite and secondary plagioclase.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Grain size layering (35-52 cm). Cut by chlorite and clay veins.

LITHOLOGIC INTERVAL: 60
SECTION: 345-U1415J-10R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #7
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0	3.0	subhedral-anhedral	subequant
plagioclase	65.0	5.0	euhedral-subhedral	tabular
clinopyroxene	5.0	10.0	anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine, clay minerals, and pyrite. Clinopyroxene is slightly altered to amphibole. Plagioclase is highly altered to secondary plagioclase.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO.

Hole 345-U1415J-11R Section 1, Top of Section: 65.0 m (CSF-A)



LITHOLOGIC INTERVAL: 61
SECTION: 345-U1415J-11R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1, #2, #3, #4, #5, #6, #7
CONTACTS: contact not recovered

MODAL ABUNDANCES

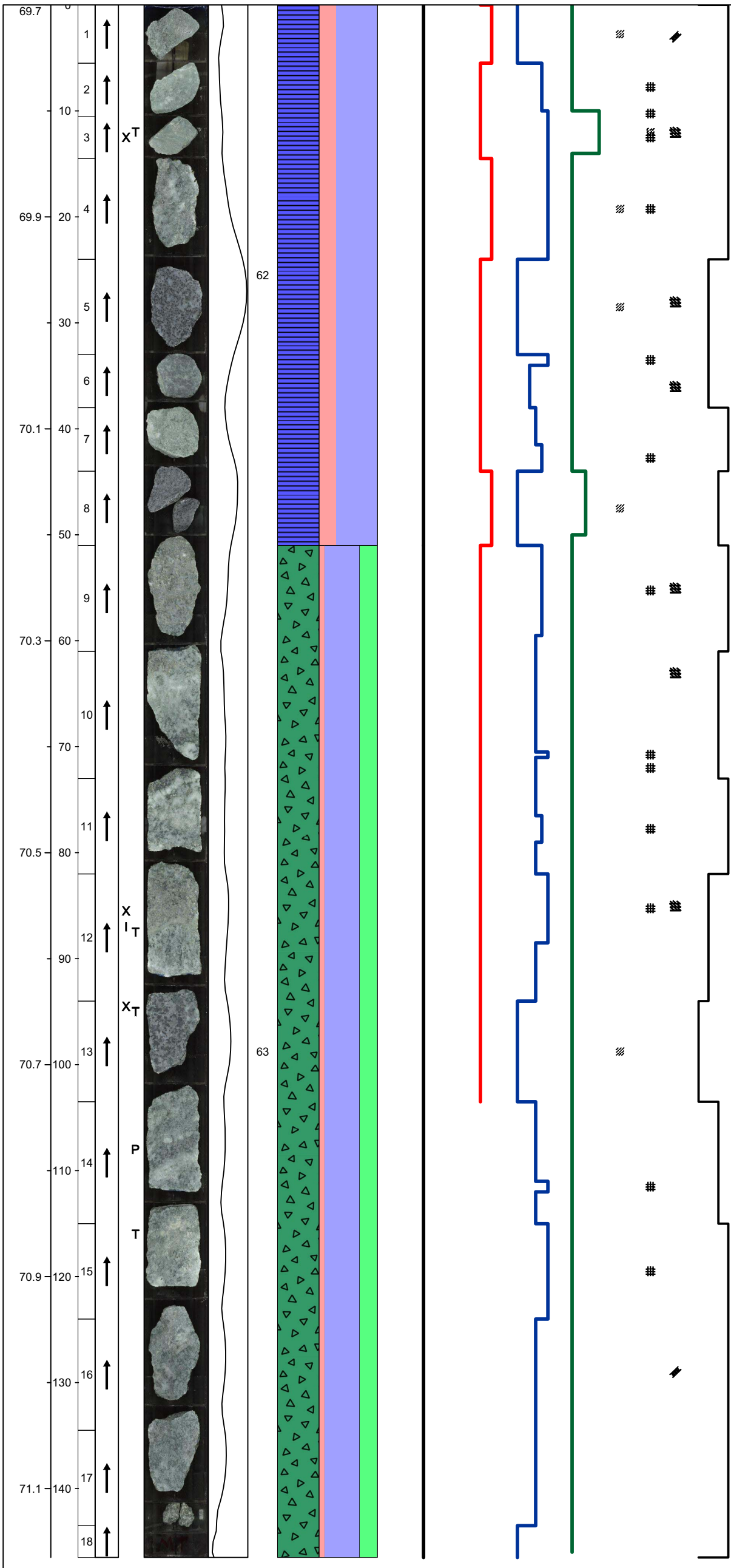
Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	40.0	9.0	subhedral	subequant
plagioclase	50.0	5.0	euhedral-subhedral	tabular
clinopyroxene	10.0	12.0	anhedral	subequant
oxide	0.1	0.9	subhedral-anhedral	subequant
sulfide	0.1	0.9	subhedral-anhedral	subequant

COMMENTS

ALTERATION: Olivine is highly altered to talc or to serpentine, clay minerals, talc and tremolite. Clinopyroxene is variably altered to amphibole. Plagioclase is moderately to highly altered to secondary plagioclase, prehnite, and chlorite. Pieces 3 and 7 are cataclasite and completely altered.

STRUCTURE: Isotropic (0-29.5 cm); moderate magmatic foliation defined by plagioclase and olivine SPO (29.5-44 cm). Zone of cohesive cataclasite along vein (17.5-22.5 cm). Cut by chlorite, zeolite, prehnite and albite veins; amphibole veins 37-44 cm, epidote veins 44-49.5 cm.

Hole 345-U1415J-12R Section 1, Top of Section: 69.7 m (CSF-A)



LITHOLOGIC INTERVAL: 62
SECTION: 345-U1415J-12R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1, #2, #3, #4, #5, #6, #7, #8
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0	3.0	subhedral-anhedral	subequant
plagioclase	70.0	6.0	euhedral-subhedral	tabular
oxide	0.1	0.6	anhedral	subequant
sulfide	0.1	0.2	subhedral-anhedral	subequant

COMMENTS

ALTERATION: Olivine is highly altered to talc and pyrite or to serpentine, talc, clay minerals, tremolite, and pyrite. Clinopyroxene is slightly altered to pale amphibole. Plagioclase is highly altered to secondary plagioclase, chlorite, prehnite, and/or zeolite. Thin zeolite (wairakite?) veins with magnetite. Many rocks in this interval are cataclasites with zeolite replacing fine grained matrix (probably comminuted plagioclase). Alteration is enhanced along veins, chlorite veins are common in this interval.

STRUCTURE: Weak to moderate magmatic foliation defined by plagioclase and olivine SPO (0-5.5 cm, 14.5-24 cm, 44-51 cm). Zone (10-14 cm) of semi-brittle deformation of weak minerals including talc, serpentine and chlorite. Dense anastomosing fractures define a narrow zones of cohesive cataclasite~ 1mm thick along veins (37-44 cm). Cut by zeolite, prehnite, chlorite, epidote, and talc veins.

LITHOLOGIC INTERVAL: 63
SECTION: 345-U1415J-12R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #9, #10, #11, #12, #13, #14, #15, #16, #17, #18
CONTACTS: contact not recovered

MODAL ABUNDANCES

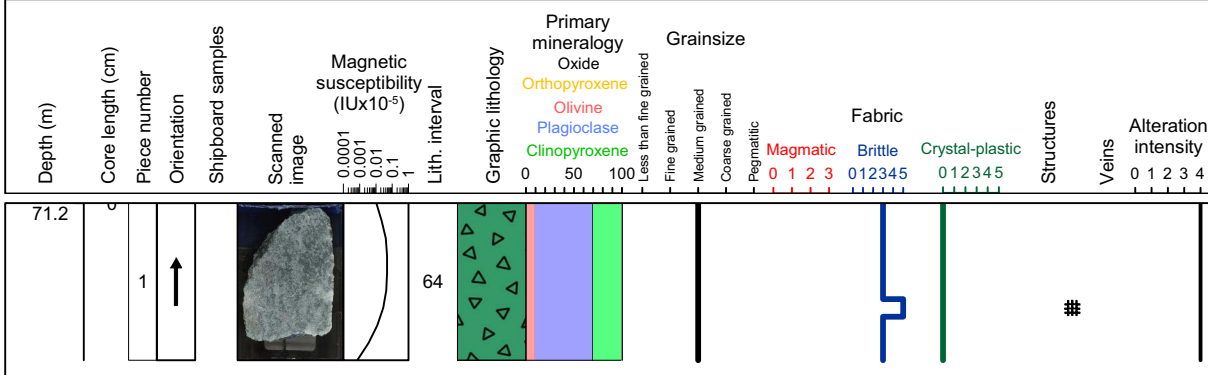
Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	6.0	euhedral-subhedral	subequant
plagioclase	60.0	6.0	euhedral-subhedral	tabular
clinopyroxene	30.0	10.0	anhedral	subequant
oxide	0.1	0.3	anhedral	subequant
sulfide	0.1	2.0	subhedral-anhedral	subequant

COMMENTS

ALTERATION: Olivine is highly altered to talc, tremolite, and pyrite or to serpentine and clay minerals. When talc replaces olivine, serpentine mesh textures commonly remain. Clinopyroxene is slightly altered to green and possibly a small amount of brown amphibole. Plagioclase is moderately altered to secondary plagioclase, chlorite, prehnite, and/or zeolite. Many rocks in this interval are cataclasites with zeolite replacing fine grained matrix (probably comminuted plagioclase). Thin zeolite (wairakite?) and chlorite veins. Alteration is enhanced along veins. Within cataclasite: zeolite replacing fine grained matrix, also abundant amphibole in matrix, tension gashes filled with zeolite and amphibole, possibly zeolite.

STRUCTURE: Cataclasite, locally subvertical ultracataclasite (~1 mm thick) associated with prehnite veins in pieces # 9-12, 14-18. Cut by epidote, prehnite, talc and amphibole veins.

Hole 345-U1415J-12R Section 2, Top of Section: 71.165 m (CSF-A)



Description

LITHOLOGIC INTERVAL: 64
SECTION: 345-U1415J-12R-2-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered

MODAL ABUNDANCES

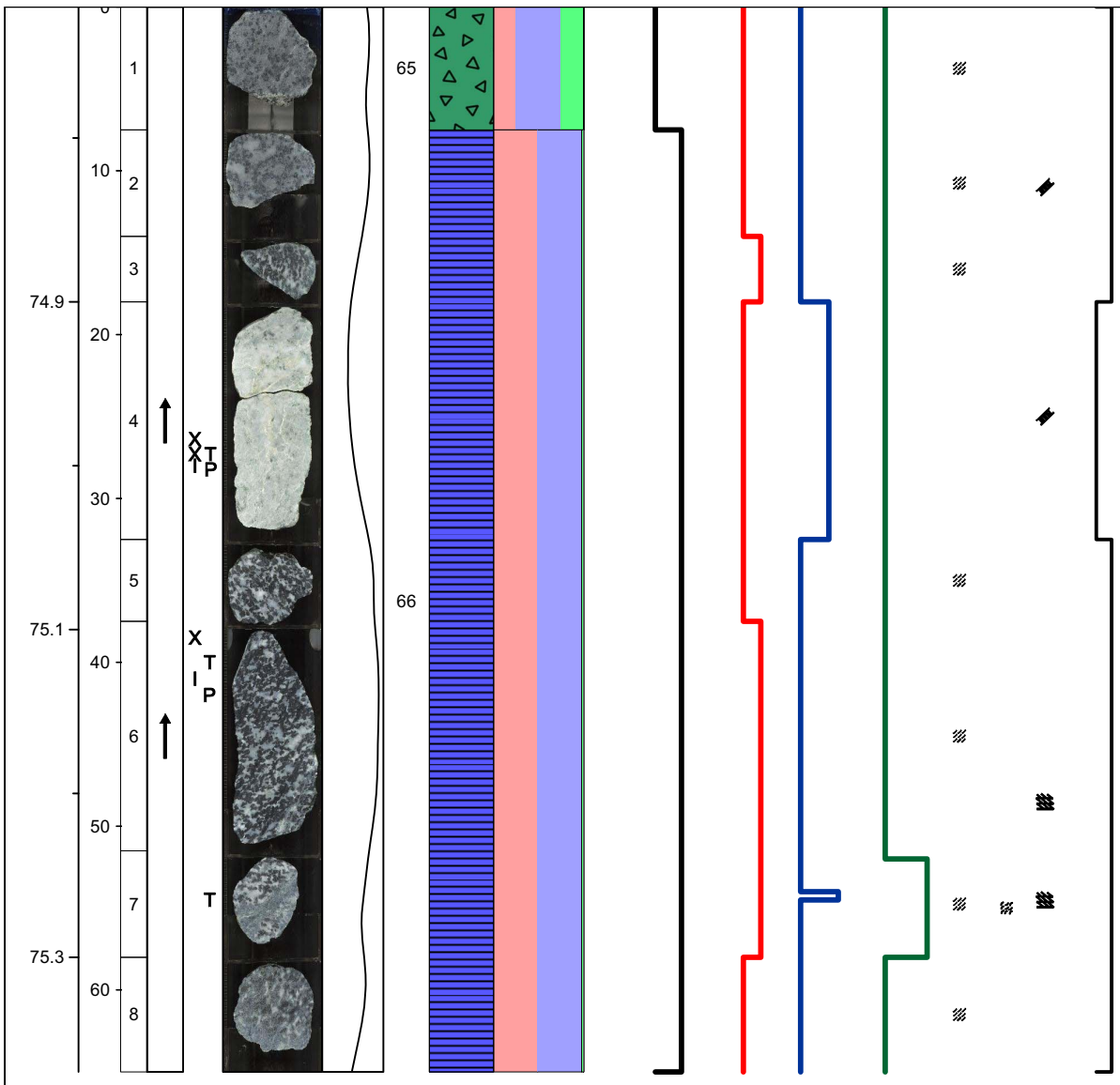
Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	6.0	euhedral-subhedral	subequant
plagioclase	60.0	6.0	euhedral-subhedral	tabular
clinopyroxene	30.0	10.0	anhedral	subequant
oxide	0.1	1.0	anhedral	subequant
sulfide	0.1	0.5	subhedral-anhedral	subequant

COMMENTS

ALTERATION: Cataclastic interval. Olivine is completely altered to talc, plagioclase is completely altered to secondary plagioclase, chlorite, and prehnite, clinopyroxene is completely replaced by amphibole. Minor disseminated pyrite occurs in the cataclastic matrix.

STRUCTURE: Thin cataclasite (5.5-6.5 cm), cut by fibrous talc veins.

Hole 345-U1415J-13R Section 1, Top of Section: 74.7 m (CSF-A)



LITHOLOGIC INTERVAL: 65
SECTION: 345-U1415J-13R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	25.0	5.0	euhedral-subhedral	equant
plagioclase	50.0	3.0	euhedral-subhedral	lath-shaped
clinopyroxene	25.0	8.0	anhedral	interstitial
oxide	0.1	0.1	anhedral	subequant

COMMENTS

ALTERATION: Olivine is highly altered to serpentine, talc, clay minerals, and pyrite. Clinopyroxene is moderately altered to amphibole. Plagioclase is moderately altered to chlorite and secondary plagioclase.

STRUCTURE: Thin cataclasite (5.5-6.5 cm), cut by fibrous talc veins.

LITHOLOGIC INTERVAL: 66
SECTION: 345-U1415J-13R-1-A
ROCK NAME: troctolite
GRAIN SIZE: coarse grained
TEXTURE: granular
PIECES: #2, #3, #4, #5, #6, #7, #8
CONTACTS: contact not recovered

MODAL ABUNDANCES

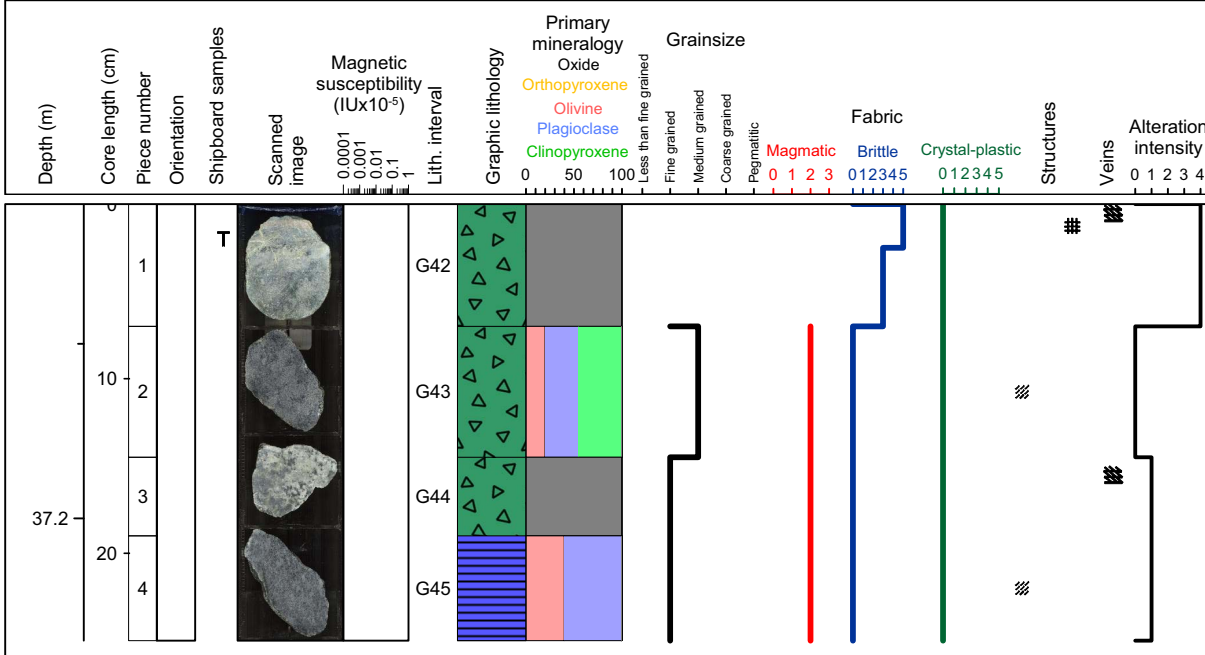
Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	50.0	9.0	euhedral	prismatic elongated
plagioclase	50.0	4.0	euhedral-subhedral	tabular
clinopyroxene	2.0	6.0	anhedral	network
oxide	0.1	1.0	subhedral-anhedral	subequant
sulfide	0.1	1.0	subhedral-anhedral	subequant

COMMENTS

ALTERATION: Olivine is highly altered to serpentine, talc, clay minerals, and pyrite and also to talc without serpentine. Both styles of olivine alteration have corona textures. Clinopyroxene is moderately altered to amphibole. Plagioclase is moderately to highly altered to chlorite, prehnite, and secondary plagioclase. Piece 4 is completely altered to prehnite and chlorite, with chlorite-smectite and prehnite veins cutting cataclastic zones. Piece 7 is characterized by a prominent amphibole vein that lacks an alteration halo.

STRUCTURE: Weak to moderate magmatic foliation defined by plagioclase and olivine SPO. Thin zone (52-58 cm) defined by plastic deformation of weak minerals including serpentine and chlorite. Thin zone of subvertical cataclasis (18-32.5 cm), and inside serpentine vein (54-54.5 cm). Cut by chlorite, prehnite, talc, serpentine, and amphibole veins.

Hole 345-U1415J-14G Section 1, Top of Section: 37.0 m (CSF-A)



LITHOLOGIC INTERVAL: G42
SECTION: 345-U1415J-14G-1-A
ROCK NAME: cataclastic gabbro
GRAIN SIZE:
TEXTURE:
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
oxide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Cataclasite with prominent clinozoisite vein (confirmed by XRD). Olivine is completely replaced by talc and serpentine, plagioclase is replaced by prehnite, zeolites, secondary plagioclase with lesser chlorite and epidote/clinozoisite. Clinopyroxene is highly altered to amphibole.
STRUCTURE: Cataclastic deformation localized between fragmented prehnite, epidote and zoisite veins.

LITHOLOGIC INTERVAL: G43
SECTION: 345-U1415J-14G-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #2
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	2.0	anhedral	interstitial
plagioclase	35.0	5.0	euhedral-subhedral	tabular
clinopyroxene	45.0	4.0	anhedral	oikocryst
sulfide	0.1	0.1	subhedral-anhedral	subequant

COMMENTS
ALTERATION: Olivine corona structure: serpentine rim around talc + clay in core, plagioclase is slightly altered to chlorite, orthopyroxene is slightly altered to talc, clinopyroxene is fresh.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagioclase and olivine SPO.

LITHOLOGIC INTERVAL: G44
SECTION: 345-U1415J-14G-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE:
TEXTURE:
PIECES: #3
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
oxide	0.1	0.1	anhedral	subequant

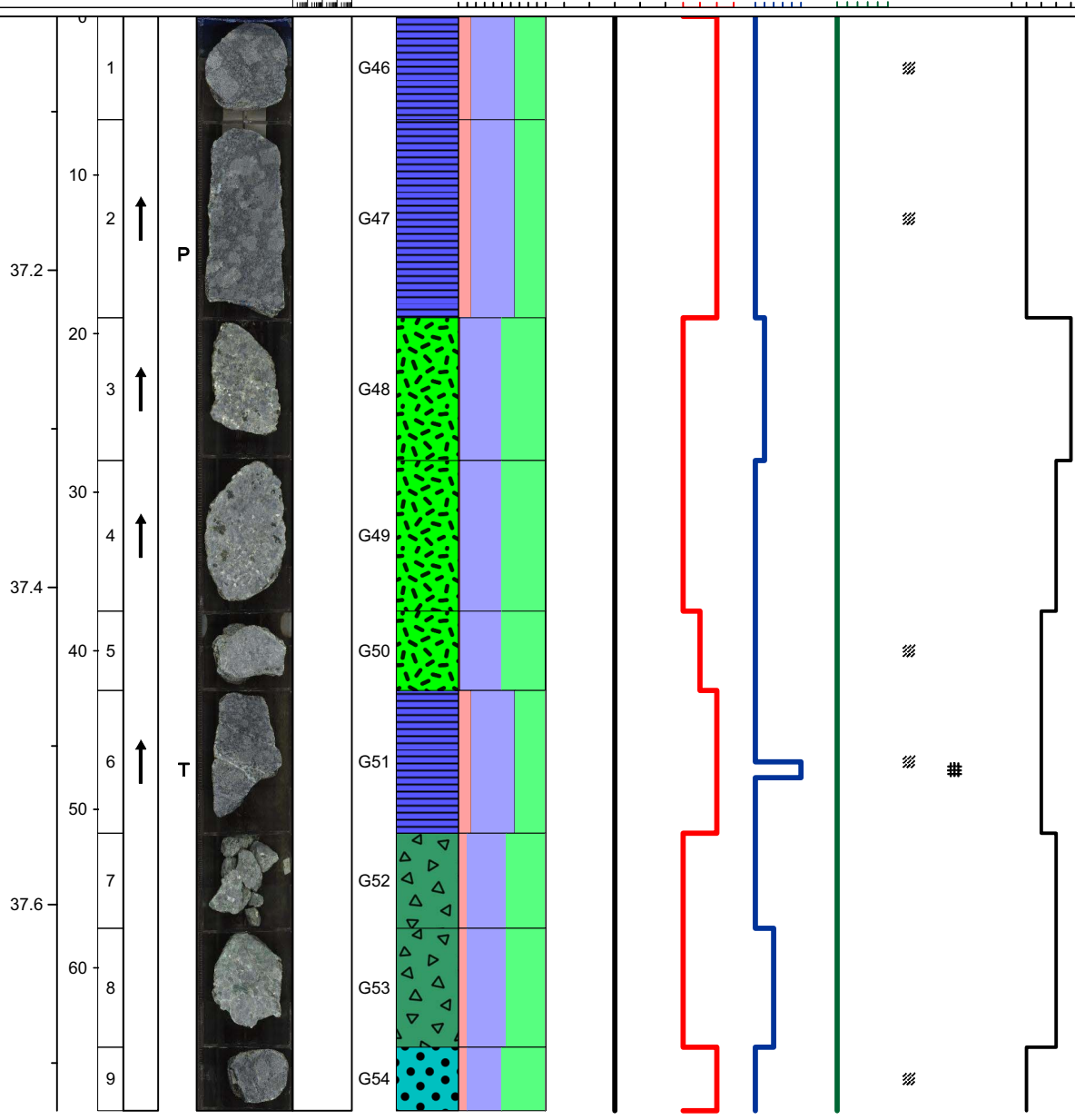
COMMENTS
ALTERATION: Olivine is highly altered to amphibole and chlorite, plagioclase is slightly replaced by chlorite and secondary plagioclase, clinopyroxene is moderately replaced by amphibole. Amphibole and zoisite veins are present.
STRUCTURE: Cut by amphibole and prehnite veins.

LITHOLOGIC INTERVAL: G45
SECTION: 345-U1415J-14G-1-A
ROCK NAME: troctolite
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #4
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	40.0	1.5	subhedral	subequant
plagioclase	60.0	3.0	euhedral-subhedral	tabular
sulfide	0.1	0.1	subhedral-anhedral	subequant

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine, clay, and pyrite. Olivine alteration is more intense adjacent to clay minerals vein. Plagioclase is slightly altered to chlorite, amphibole, and secondary plagioclase.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO. Cut by prehnite vein? Open crack?

Hole 345-U1415J-15G Section 1, Top of Section: 37.0 m (CSF-A)



LITHOLOGIC INTERVAL: G46
SECTION: 345-U1415J-15G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	2.0	subhedral-anhedral	subequant
plagioclase	50.0	3.0	euhedral-subhedral	tabular
clinopyroxene	35.0	13.0	anhedral	oikocryst
sulfide	0.1	0.02	anhedral	subequant

COMMENTS
ALTERATION: Olivine is highly altered to serpentine, talc, clay minerals, and pyrite. Clinopyroxene is moderately altered to amphibole. Plagioclase is moderately altered to chlorite and secondary plagioclase. Plagioclase appears fresher when in clinopyroxene-oikocryst.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Cut by prehnite veins.

LITHOLOGIC INTERVAL: G47
SECTION: 345-U1415J-15G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #2
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	2.0	subhedral-anhedral	subequant
plagioclase	50.0	3.0	euhedral-subhedral	tabular
clinopyroxene	35.0	13.0	anhedral	oikocryst
sulfide	0.1	0.02	anhedral	subequant

COMMENTS
ALTERATION: Olivine is highly altered to serpentine talc, clay minerals, and pyrite. Olivine is completely altered to talc in the halo of a thin prehnite vein. Clinopyroxene is moderately altered to amphibole. Plagioclase is moderately altered to chlorite and secondary plagioclase. Plagioclase appears fresher when in clinopyroxene-oikocryst.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagioclase and tabular olivine SPO.

LITHOLOGIC INTERVAL: G48
SECTION: 345-U1415J-15G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #3
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	15.0	subhedral	subequant
plagioclase	48.0	4.0	euhedral-subhedral	tabular
clinopyroxene	50.0	4.0	anhedral	subequant
oxide	0.1	0.02	anhedral	subequant

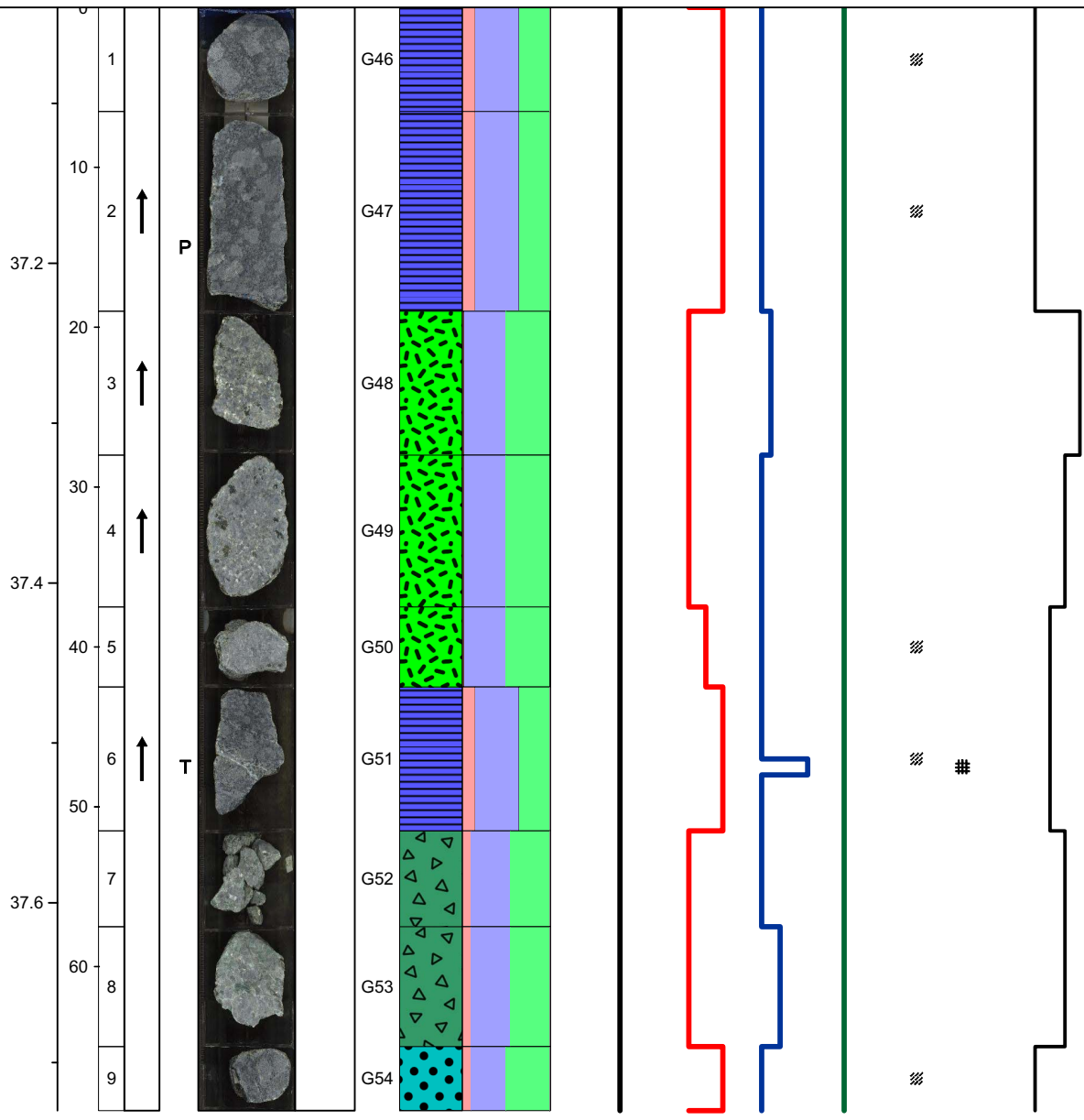
COMMENTS
ALTERATION: Olivine is completely altered to talc. Clinopyroxene is completely altered to amphibole. Plagioclase is highly altered to prehnite, chlorite, and secondary plagioclase. Almost no igneous textures or primary minerals remain.

LITHOLOGIC INTERVAL: G49
SECTION: 345-U1415J-15G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #4
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	15.0	subhedral	subequant
plagioclase	48.0	6.0	euhedral-subhedral	tabular
clinopyroxene	50.0	4.0	anhedral	subequant
oxide	0.1	0.02	anhedral	subequant

COMMENTS
ALTERATION: Olivine is highly altered to serpentine and clay minerals. Clinopyroxene is highly altered to amphibole. Plagioclase is highly altered to chlorite and secondary plagioclase.

Hole 345-U1415J-15G Section 1, Top of Section: 37.0 m (CSF-A)



LITHOLOGIC INTERVAL: G50
SECTION: 345-U1415J-15G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #5
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	15.0	subhedral	subequant
plagioclase	48.0	6.0	euhedral-subhedral	tabular
clinopyroxene	50.0	4.0	anhedral	subequant
oxide	0.1	0.02	anhedral	subequant

COMMENTS
ALTERATION: Olivine is highly altered to serpentine and clay minerals. Clinopyroxene is moderately altered to amphibole. Plagioclase is moderately altered to prehnite, chlorite, and secondary plagioclase.

LITHOLOGIC INTERVAL: G51
SECTION: 345-U1415J-15G-1-A
ROCK NAME: clinopyroxene oikocryst bearing troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #6
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	2.0	subhedral-anhedral	subequant
plagioclase	50.0	5.0	euhedral-subhedral	tabular
clinopyroxene	35.0	18.0	anhedral	oikocryst
sulfide	0.1	0.02	anhedral	subequant

COMMENTS
ALTERATION: Olivine is highly altered to talc and clay minerals, although the mesh texture after serpentine still remains. Clinopyroxene is moderately altered to amphibole. Plagioclase is moderately altered to chlorite and secondary plagioclase. Olivine is more highly altered to talc in halo of prehnite-zeolite vein network.
STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagioclase and tabular olivine SPO. Narrow zone of cataclasis (47-48 cm). Cut by prehnite and zeolite veins.

LITHOLOGIC INTERVAL: G52
SECTION: 345-U1415J-15G-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #7
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	5.5	subhedral-anhedral	subequant
plagioclase	45.0	3.0	euhedral-subhedral	tabular
clinopyroxene	45.0	7.0	anhedral	subequant
sulfide	0.1	0.01	anhedral	subequant

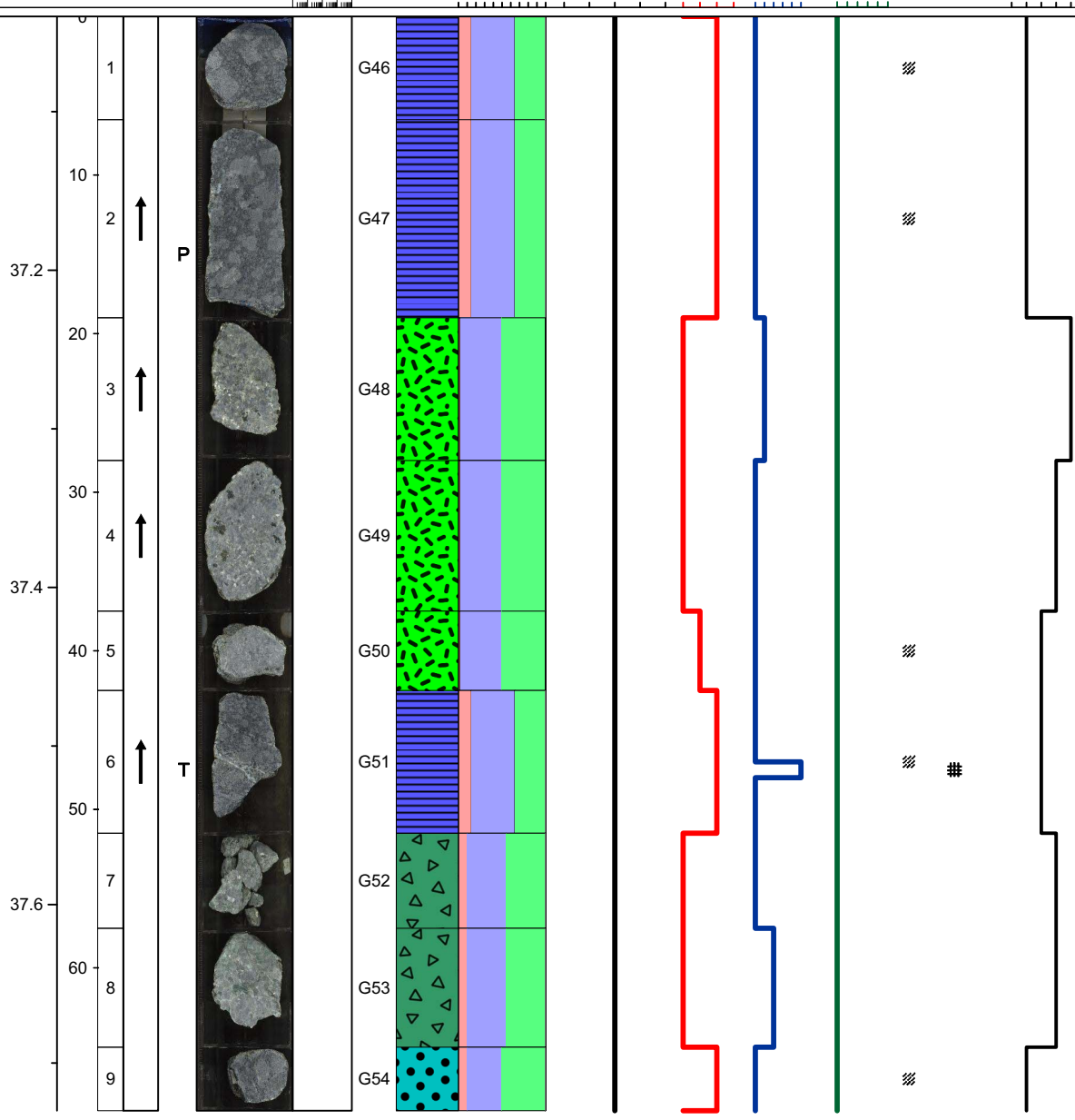
COMMENTS
ALTERATION: Clinopyroxene is highly altered to amphibole. Plagioclase is highly altered to chlorite, prehnite, and secondary plagioclase. Disseminated pyrite. Chlorite and talc also occur in non-pseudomorphic assemblages.

LITHOLOGIC INTERVAL: G53
SECTION: 345-U1415J-15G-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #8
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	11.0	anhedral	subequant
plagioclase	45.0	6.0	euhedral-subhedral	tabular
clinopyroxene	45.0	7.0	anhedral	subequant
sulfide	0.1	0.01	anhedral	subequant

COMMENTS
ALTERATION: Clinopyroxene is highly altered to amphibole. Plagioclase is highly altered to chlorite, prehnite, and secondary plagioclase. Disseminated pyrite. Chlorite and talc also occur in non-pseudomorphic assemblages.
STRUCTURE: Cut by talc veins.

Hole 345-U1415J-15G Section 1, Top of Section: 37.0 m (CSF-A)



LITHOLOGIC INTERVAL: G54
SECTION: 345-U1415J-15G-1-A
ROCK NAME: oikocryst gabbro
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #9
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0	2.2	subhedral-anhedral	subequant
plagioclase	40.0	3.0	euhedral-subhedral	tabular
clinopyroxene	50.0	15.0	anhedral	oikocryst
sulfide	0.1	0.02	anhedral	subequant

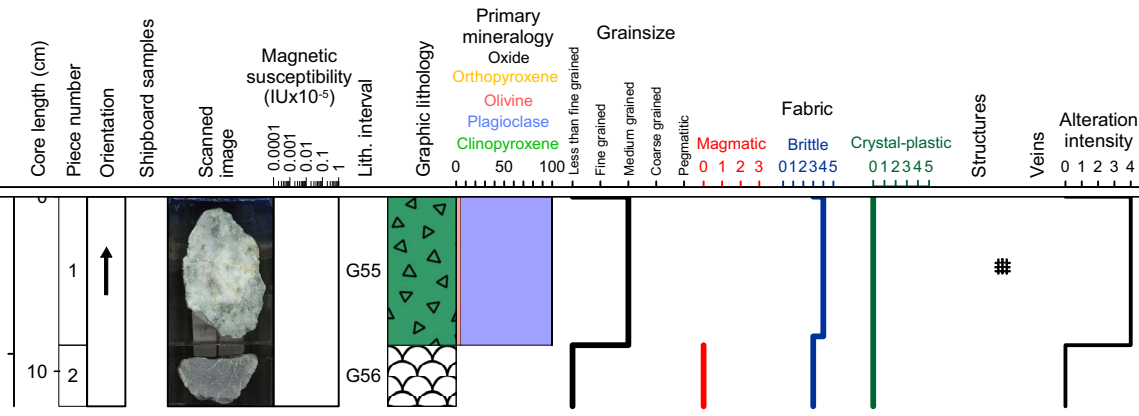
COMMENTS

ALTERATION: Olivine is highly altered to serpentine, clay minerals, and pyrite. Olivine is altered to talc in a localized band, likely along a vein. Clinopyroxene is slightly altered to amphibole. Plagioclase is slightly altered to chlorite and secondary plagioclase.

STRUCTURE: Anastomosing, moderate magmatic foliation defined by plagioclase and tabular olivine SPO.

U1415J-162 Drilled interval

Hole 345-U1415J-17G Section 1, Top of Section: 79.4 m (CSF-A)



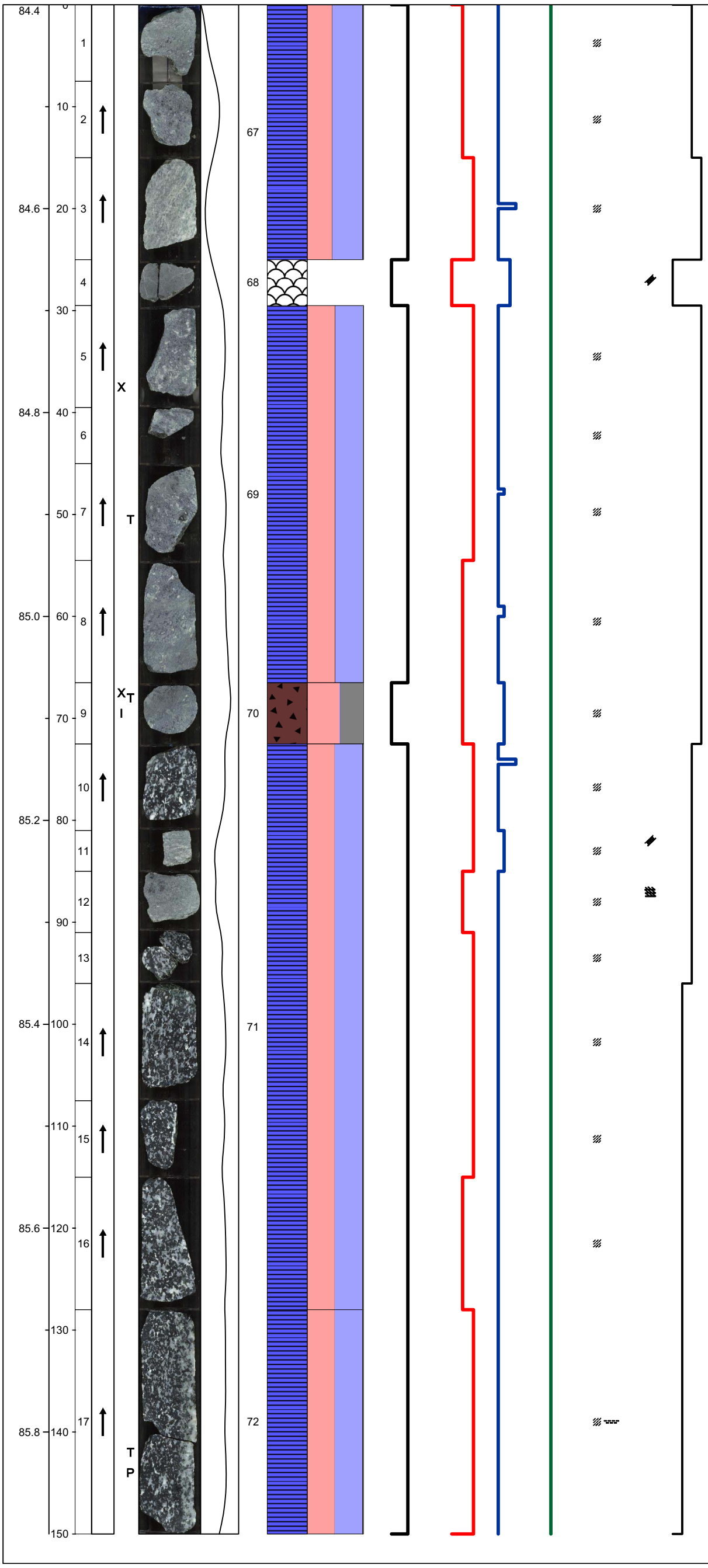
LITHOLOGIC INTERVAL: G55
SECTION: 345-U1415J-17G-1-A
ROCK NAME: cataclastic olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	3.0	anhedral	irregular
plagioclase	95.0	8.0	anhedral-subhedral	tabular
oxide	0.1	0.02	anhedral	subequant

COMMENTS
ALTERATION: Olivine is completely altered to talc. Plagioclase is highly altered to prehnite, secondary plagioclase, epidote, and chlorite. Secondary oxides are present, as well as a network of thin epidote and prehnite veins.
STRUCTURE: Cut by epidote veins.

LITHOLOGIC INTERVAL: G56
SECTION: 345-U1415J-17G-1-A
ROCK NAME: aphyric basalt
GRAIN SIZE: less than fine grained
TEXTURE: granular
PIECES: #2
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: Olivine: 0.5%, 0.1mm min size, 0.6mm max size, 0.2mm size mode, anhedral-subhedral, subequant, occurs only as phenocrysts. Plagioclase: 0.5%, 0.1mm min size, 0.6mm max size, 0.2mm size mode, euhedral-subhedral, lath-shaped.
ALTERATION: Olivine is serpentinized, a network of thin prehnite veins crosscut this piece.
STRUCTURE: Cataclastic deformation along veins through entire piece. No preferred orientation. Cut by prehnite and chlorite veins.

Hole 345-U1415J-18R Section 1, Top of Section: 84.4 m (CSF-A)



Description

LITHOLOGIC INTERVAL: 67
SECTION: 345-U1415J-18R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1, #2, #3
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	45.0	5.0	euhedral-subhedral	subequant
plagioclase	54.0	8.0	euhedral-subhedral	tabular
clinopyroxene	1.0	3.0	anhedral	interstitial
oxide	0.1	1.0	euhedral-subhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is highly altered to amphibole, talc, clay minerals, and pyrite with only minor amounts of chlorite. Coronae are conspicuous around olivine. Plagioclase is variably altered to chlorite and prehnite. Thin chlorite veins are present. Olivine in vein halos is more commonly replaced by serpentine+ tremolite, and further from veins is replaced by talc.
STRUCTURE: Weak to moderate magmatic foliation defined by plagioclase and olivine SPO. Cut by prehnite and chlorite veins.

LITHOLOGIC INTERVAL: 68
SECTION: 345-U1415J-18R-1-A
ROCK NAME: olivine moderately phyric basalt
GRAIN SIZE: fine grained
TEXTURE: porphyritic
PIECES: #4
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: Olivine occurs as phenocrysts. 6.0%, 0.1mm min size, 2mm max size, 1mm size mode, euhedral-subhedral, subequant.
ALTERATION: Olivine is completely altered to clay minerals. Plagioclase is fresh. Clinopyroxene is highly altered to amphibole.
STRUCTURE: Cataclastic deformation along vein network.

LITHOLOGIC INTERVAL: 69
SECTION: 345-U1415J-18R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #5, #6, #7, #8
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	50.0	5.0	euhedral-subhedral	subequant
plagioclase	50.0	15.0	euhedral-subhedral	tabular
oxide	0.1	0.5	euhedral-subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

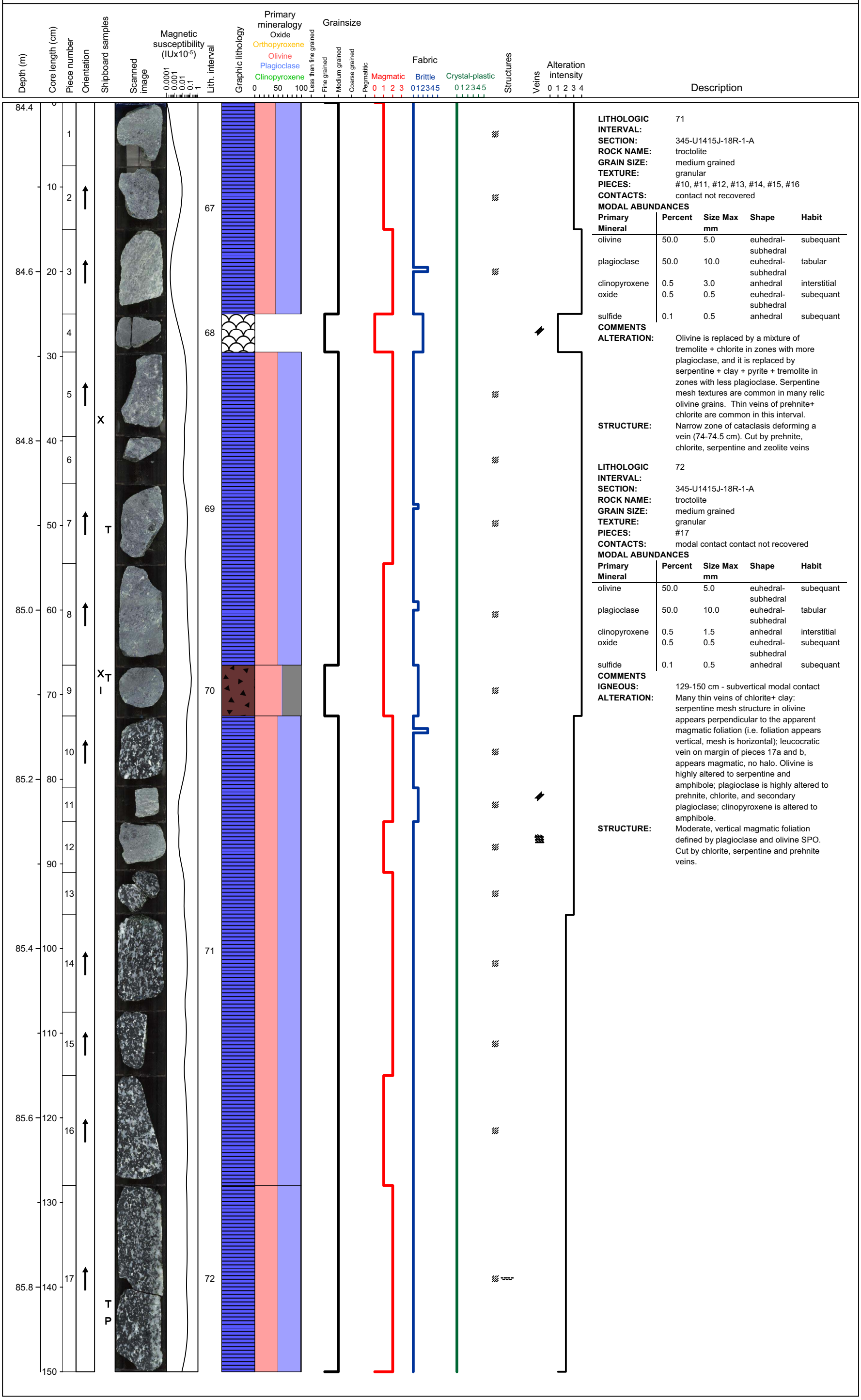
COMMENTS
ALTERATION: Olivine is highly altered to amphibole, serpentine, clay minerals, and talc. Coronae are conspicuous around olivine. Plagioclase is highly altered to chlorite and prehnite. Thin chlorite veins are present.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO. Cut prehnite, chlorite, amphibole, and magnetite veins.

LITHOLOGIC INTERVAL: 70
SECTION: 345-U1415J-18R-1-A
ROCK NAME: chromitite
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #9
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	58.0			
plagioclase	2.0	6.0	euhedral-subhedral	tabular
oxide	40.0	4.0	euhedral-subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

COMMENTS
ALTERATION: Olivine is mainly altered to clay + pyrite in core, surrounded by a mixture of tremolite + chlorite. Plagioclase is highly altered to prehnite + chlorite.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO. Cut by chlorite veins.

Hole 345-U1415J-18R Section 1, Top of Section: 84.4 m (CSF-A)



LITHOLOGIC INTERVAL: 71
SECTION: 345-U1415J-18R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #10, #11, #12, #13, #14, #15, #16
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	50.0	5.0	euhedral-subhedral	subequant
plagioclase	50.0	10.0	euhedral-subhedral	tabular
clinopyroxene	0.5	3.0	anhedral	interstitial
oxide	0.5	0.5	euhedral-subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

COMMENTS

ALTERATION: Olivine is replaced by a mixture of tremolite + chlorite in zones with more plagioclase, and it is replaced by serpentine + clay + pyrite + tremolite in zones with less plagioclase. Serpentine mesh textures are common in many relic olivine grains. Thin veins of prehnite+ chlorite are common in this interval.

STRUCTURE: Narrow zone of cataclasis deforming a vein (74-74.5 cm). Cut by prehnite, chlorite, serpentine and zeolite veins

LITHOLOGIC INTERVAL: 72
SECTION: 345-U1415J-18R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #17
CONTACTS: modal contact contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	50.0	5.0	euhedral-subhedral	subequant
plagioclase	50.0	10.0	euhedral-subhedral	tabular
clinopyroxene	0.5	1.5	anhedral	interstitial
oxide	0.5	0.5	euhedral-subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

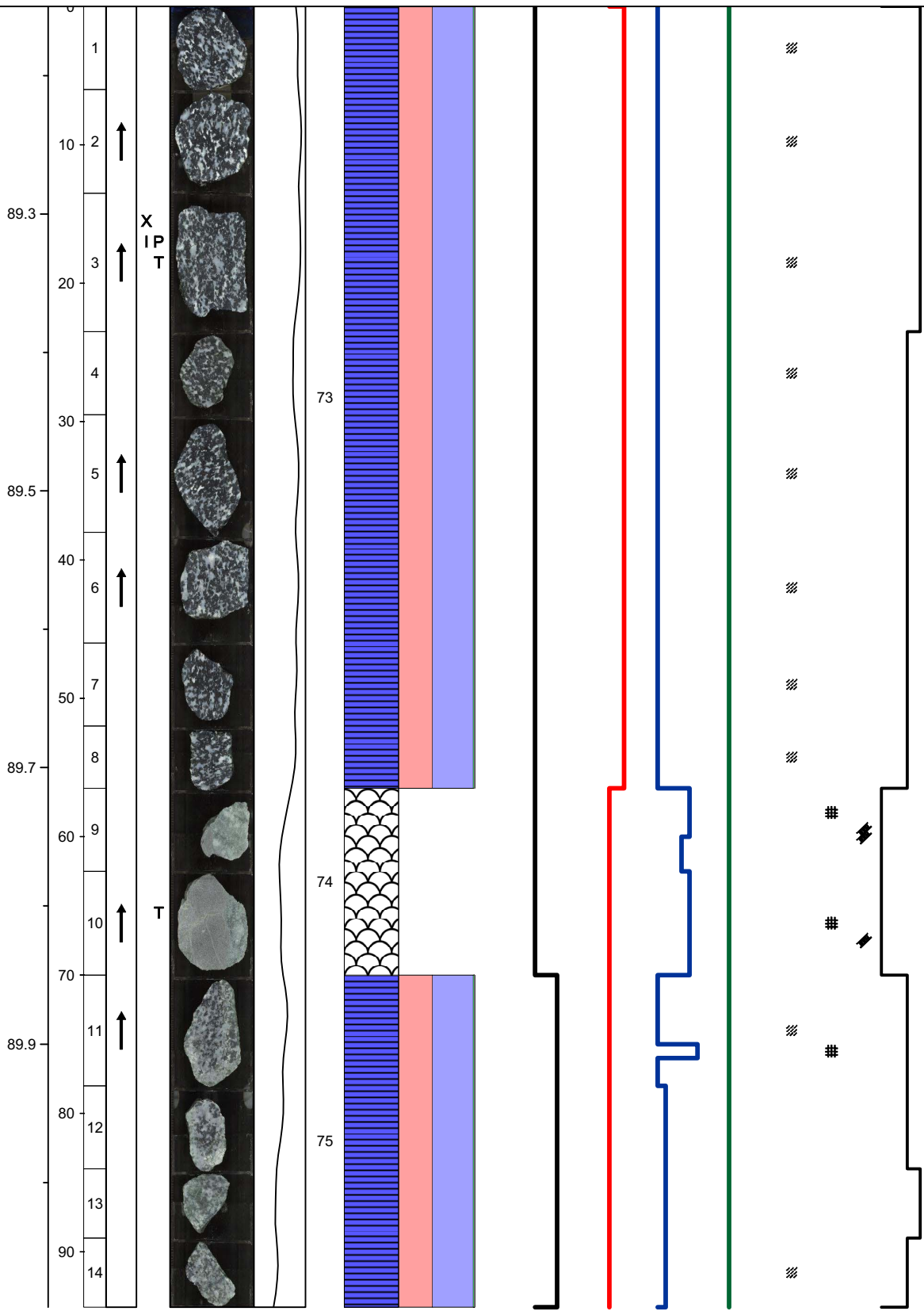
COMMENTS

IGNEOUS: 129-150 cm - subvertical modal contact

ALTERATION: Many thin veins of chlorite+ clay: serpentine mesh structure in olivine appears perpendicular to the apparent magmatic foliation (i.e. foliation appears vertical, mesh is horizontal); leucocratic vein on margin of pieces 17a and b, appears magmatic, no halo. Olivine is highly altered to serpentine and amphibole; plagioclase is highly altered to prehnite, chlorite, and secondary plagioclase; clinopyroxene is altered to amphibole.

STRUCTURE: Moderate, vertical magmatic foliation defined by plagioclase and olivine SPO. Cut by chlorite, serpentine and prehnite veins.

Hole 345-U1415J-19R Section 1, Top of Section: 89.1 m (CSF-A)



LITHOLOGIC INTERVAL: 73
SECTION: 345-U1415J-19R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1, #2, #3, #4, #5, #6, #7, #8,
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	45.0	5.0	euhedral-subhedral	subequant
plagioclase	54.0	9.0	euhedral-subhedral	tabular
clinopyroxene	1.0	3.0	anhedral	interstitial
oxide	0.5	0.5	euhedral-subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

COMMENTS
ALTERATION: Olivine is highly altered to serpentine, talc, clay minerals, and pyrite with only minor amounts of chlorite. Plagioclase is moderately altered to prehnite and chlorite. Clinopyroxene is highly altered to amphibole.
STRUCTURE: Moderate magmatic foliation defined by plagiolase and olivine SPO (vertical dip; 13.5-23.5 cm). Cut by chlorite, prehnite, serpentine and epidote veins.

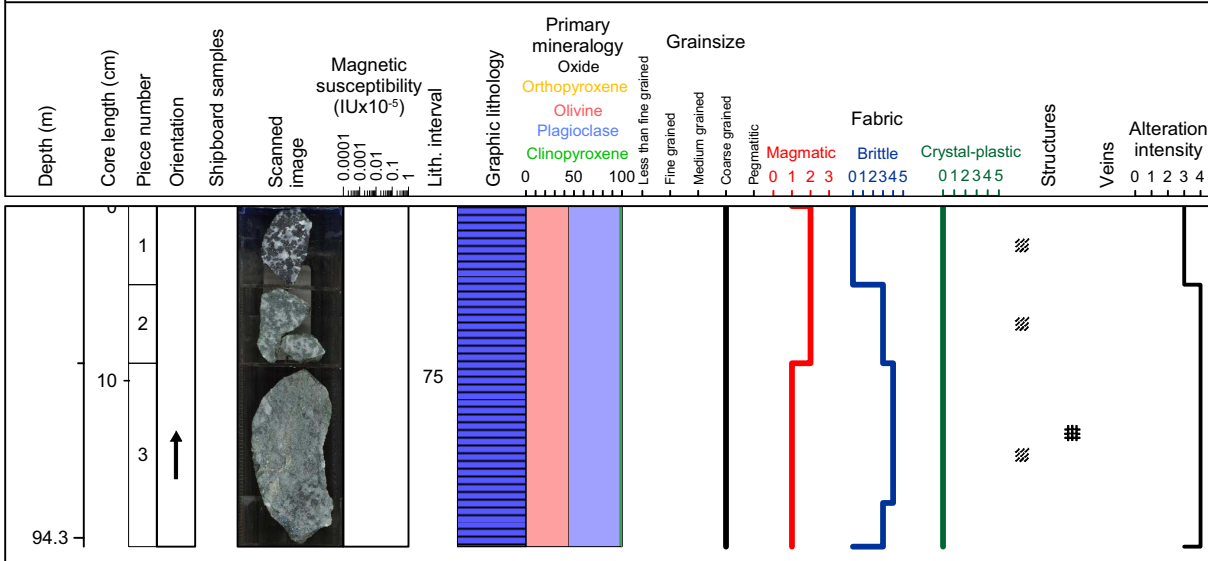
LITHOLOGIC INTERVAL: 74
SECTION: 345-U1415J-19R-1-A
ROCK NAME: cataclasite
GRAIN SIZE:
TEXTURE:
PIECES: #9, #10
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: contains basalt clast
ALTERATION: Cataclasite with dolerite dike rock. In cataclasite, olivine is completely altered to talc with lesser amounts of clay; plagioclase is highly altered to prehnite and chlorite. Dolerite is fine grained and minimally altered. Dike and cataclasite are cut by prehnite-chlorite veins and epidote veins.
STRUCTURE: Zone of cataclasis. Subvertical diabase dike and gabbro both fractured and veined (56.5-70 cm). Cut by prehnite, epidote and chlorite veins.

LITHOLOGIC INTERVAL: 75
SECTION: 345-U1415J-19R-1-A
ROCK NAME: troctolite
GRAIN SIZE: coarse grained
TEXTURE: granular
PIECES: #11, #12, #13, #14
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	45.0	5.0	euhedral-subhedral	subequant
plagioclase	54.0	10.0	euhedral-subhedral	tabular
clinopyroxene	1.0	2.0	anhedral	interstitial
oxide	0.5	0.5	euhedral-subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

COMMENTS
ALTERATION: Olivine is highly altered to serpentine and clay minerals, or talc. Plagioclase is moderately altered to prehnite and chlorite. Thin chlorite veins are present.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO (81-94 cm). Cut by chlorite and prehnite veins.

Hole 345-U1415J-20R Section 1, Top of Section: 94.1 m (CSF-A)



LITHOLOGIC INTERVAL: 75
SECTION: 345-U1415J-20R-1-A
ROCK NAME: troctolite
GRAIN SIZE: coarse grained
TEXTURE: granular
PIECES: #1, #2, #3
CONTACTS: contact not recovered

MODAL ABUNDANCES

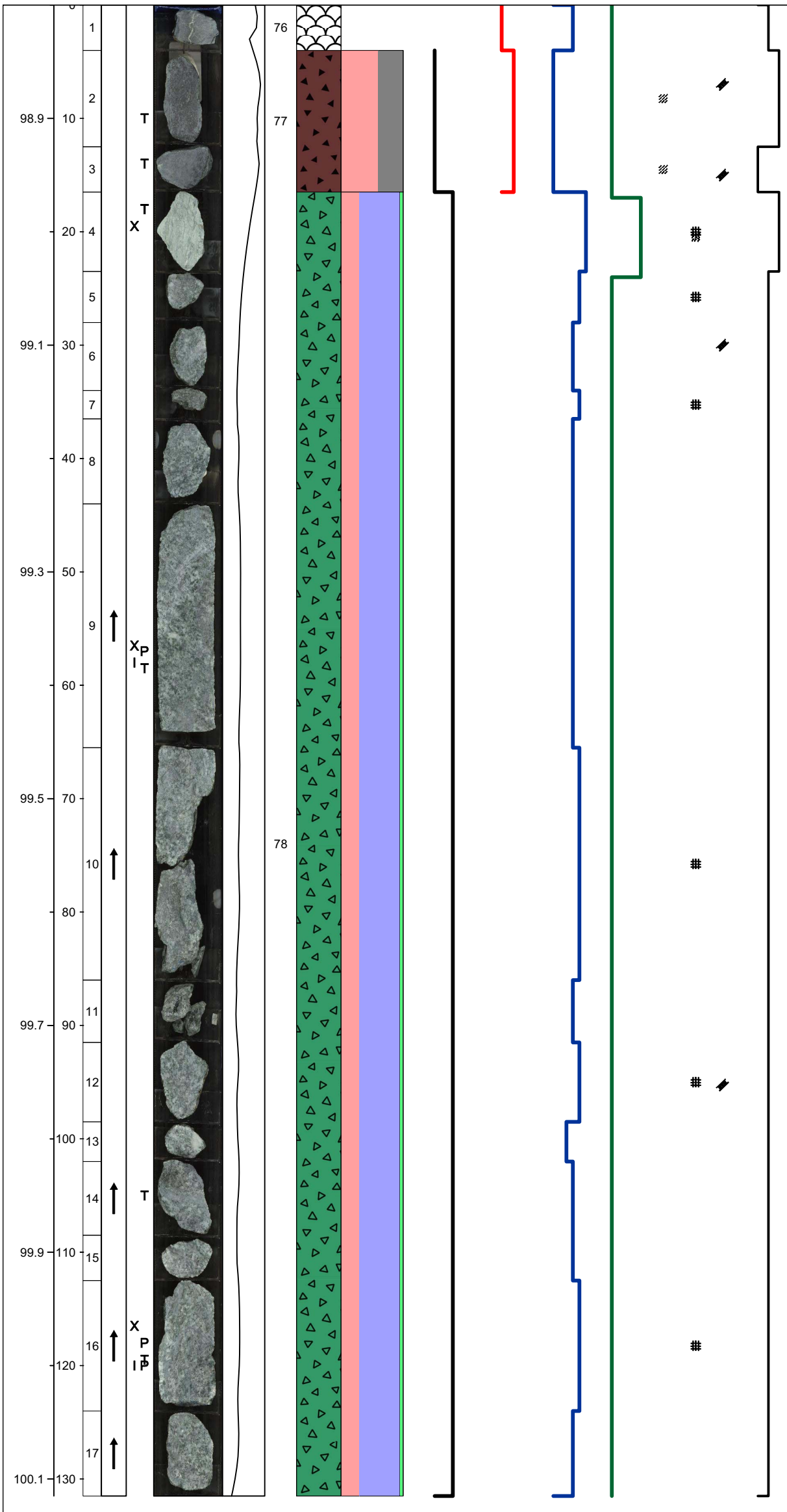
Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	45.0	5.0	euhedral-subhedral	subequant
plagioclase	54.0	10.0	euhedral-subhedral	tabular
clinopyroxene	1.0	2.0	anhedral	interstitial
oxide	0.5	0.5	euhedral-subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

COMMENTS

ALTERATION: Interval includes highly altered olivine replaced by serpentine, clay minerals, and magnetite; plagioclase replaced by prehnite and chlorite, and clinopyroxene replaced by amphibole. Piece 3 is from cataclasite zone cut by prominent epidote (?) vein, pervasive replacement by prehnite, clinopyroxene-oikocryst (?) completely replaced by amphibole

STRUCTURE: Weak to moderate magmatic foliation defined by plagioclase and olivine SPO. Zones of brecciation/cataclasis commonly with veins.

Hole 345-U1415J-21R Section 1, Top of Section: 98.8 m (CSF-A)



LITHOLOGIC INTERVAL: 76
SECTION: 345-U1415J-21R-1-A
ROCK NAME: cataclastic basalt
GRAIN SIZE:
TEXTURE:
PIECES: #1
CONTACTS: contact not recovered
COMMENTS
ALTERATION: Cataclasite with olivine completely replaced by serpentine and amphibole, plagioclase highly replaced by chlorite, clinopyroxene completely replaced by amphibole. Prominent prehnite-chlorite vein cuts this interval.

LITHOLOGIC INTERVAL: 77
SECTION: 345-U1415J-21R-1-A
ROCK NAME: chromitite
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #2, #3
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	60.0			
plagioclase	0.1	4.0	euhedral-subhedral	tabular
oxide	40.0	4.0	subhedral-anhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

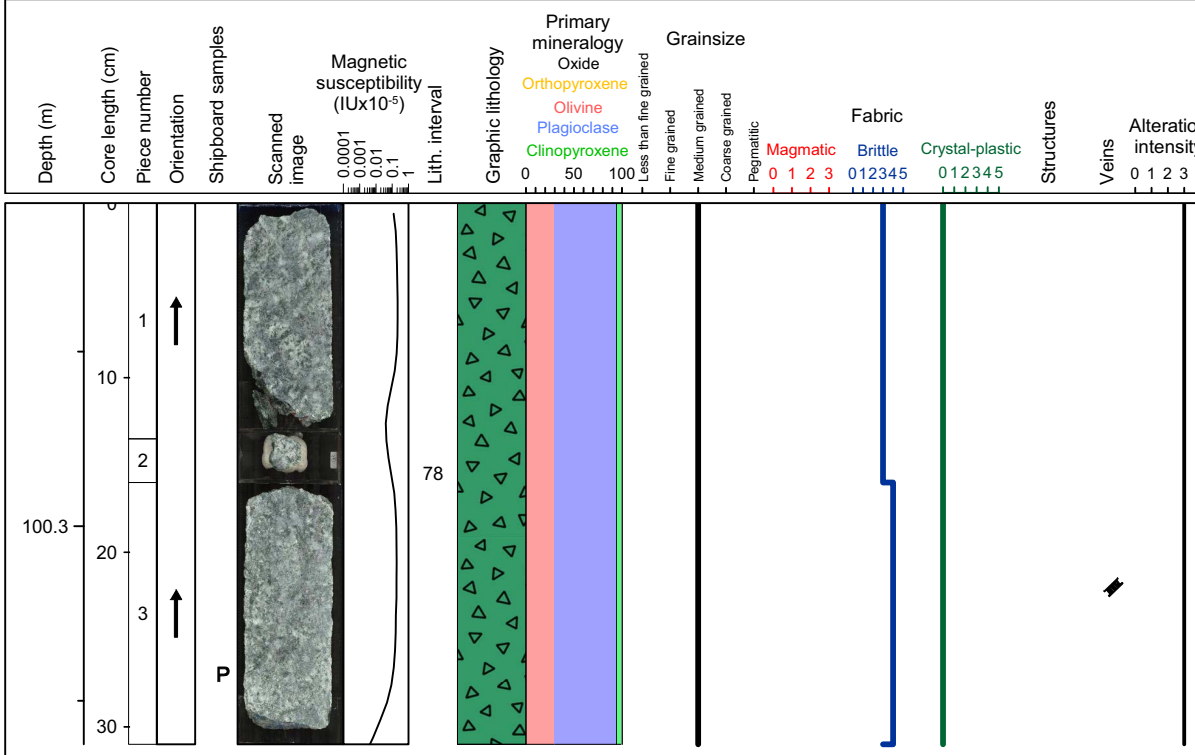
COMMENTS
ALTERATION: Primary mineralogy is completely replaced by magnetite, chlorite, and amphibole, epidote is also present. Olivine is replaced by chlorite and amphibole, clinopyroxene is replaced by amphibole. Two types of amphibole are present: hornblende (?) and tremolite. Oxides (magnetite ?) are abundant.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO (12.5-16.5 cm). Cut by prehnite veins.

LITHOLOGIC INTERVAL: 78
SECTION: 345-U1415J-21R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #4, #5, #6, #7, #8, #9, #10, #11, #12, #13, #14, #15, #16, #17
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0			
plagioclase	65.0		euhedral-subhedral	tabular
clinopyroxene	5.0	4.0	anhedral	interstitial
oxide	0.1	0.1	euhedral-subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

COMMENTS
ALTERATION: Cataclastic interval in which olivine is completely replaced by talc, with lesser amounts of serpentine, tremolite, and pyrite. Trace mesh texture is visible in some talc pseudomorphs after olivine. Plagioclase is moderately altered to prehnite and chlorite. Clinopyroxene is altered to amphibole. The interval is cut by numerous chlorite + prehnite veins, as well as a prominent, cm-wide plagioclase-prehnite vein. Clasts of fine grained felsic rock are included within the cataclasite matrix.
STRUCTURE: Interval of variably fractured/cataclastic deformation; hosting common chlorite and prehnite veins, locally subvertical. Intense cataclasis and reaction weakening of mafic minerals in piece 4. Cut by chlorite, epidote, prehnite, amphibole and clay veins.

Hole 345-U1415J-21R Section 2, Top of Section: 100.115 m (CSF-A)



LITHOLOGIC INTERVAL: 78
SECTION: 345-U1415J-21R-2-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1, #2, #3
CONTACTS: contact not recovered

MODAL ABUNDANCES

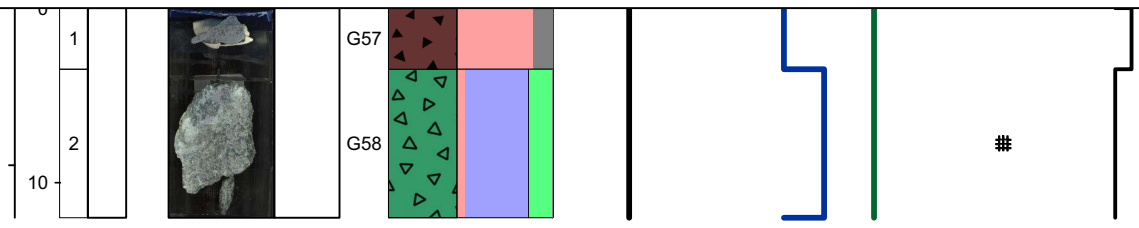
Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0			
plagioclase	65.0	10.0	euhedral-subhedral	tabular
clinopyroxene	5.0	4.0	anhedral	interstitial
oxide	0.1	0.1	euhedral-subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

COMMENTS

ALTERATION: Cataclasite, almost no magmatic fabrics or textures left, poorly defined grain shapes, multiple chlorite + prehnite filled veins. Olivine is completely replaced by talc, tremolite, clay minerals, and pyrite. Plagioclase is highly altered to prehnite and chlorite. Clinopyroxene is highly altered to amphibole.

STRUCTURE: Continuation of locally subvertical zone of cataclasis and veining from above. Cut by chlorite and prehnite.

Hole 345-U1415J-22G Section 1, Top of Section: 82.0 m (CSF-A)



LITHOLOGIC INTERVAL: G57
SECTION: 345-U1415J-22G-1-A
ROCK NAME: chromitite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	80.0			
oxide	20.0	3.0	anhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

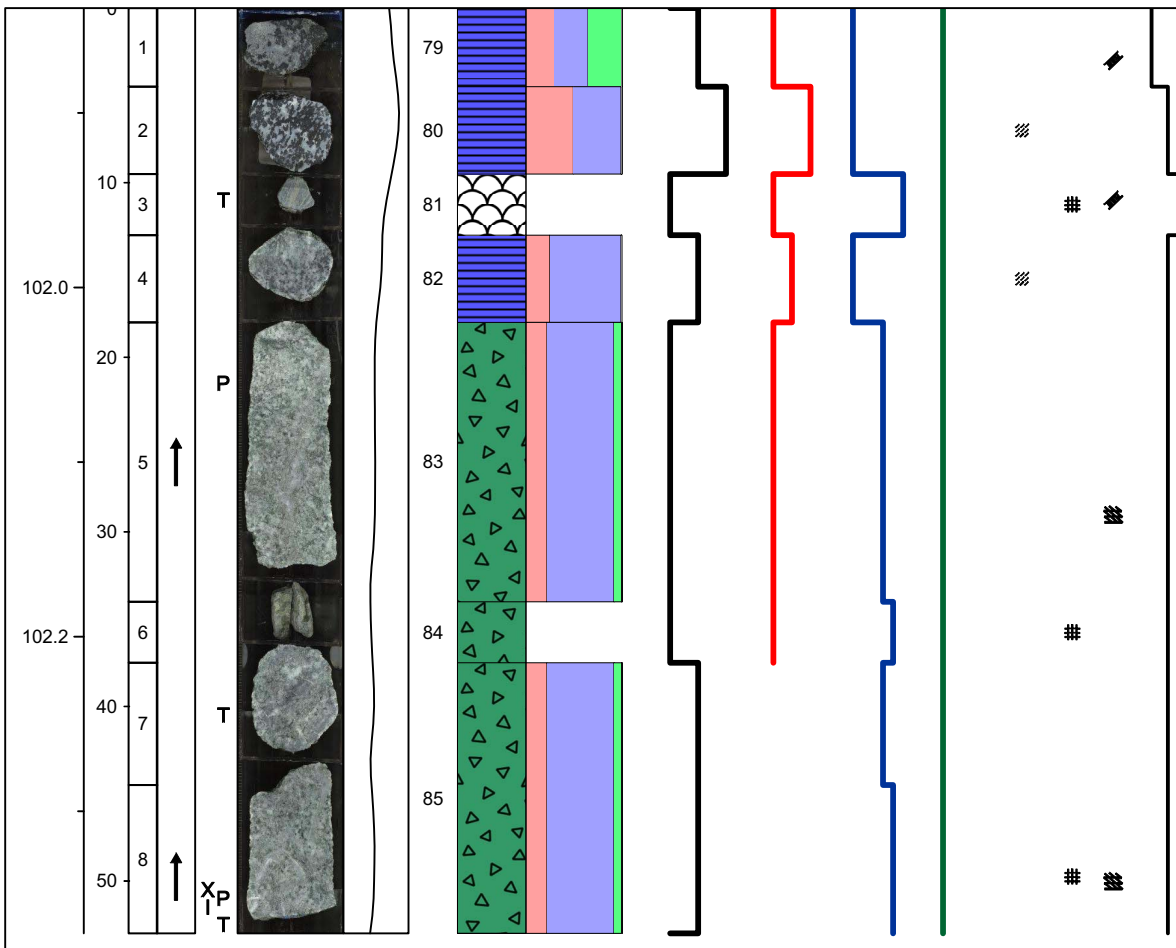
COMMENTS
IGNEOUS: oxides have been identified as magnetite
ALTERATION: Very fine grained matrix of relict olivine, altered to chlorite+ amphobole, in the matrix abundant oxides form a boxwork texture.

LITHOLOGIC INTERVAL: G58
SECTION: 345-U1415J-22G-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #2
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	10.0			
plagioclase	65.0	8.0	euhedral-subhedral	tabular
clinopyroxene	25.0	5.0	anhedral	subequant
oxide	0.1	0.1	euhedral-subhedral	subequant
sulfide	0.1	0.5	anhedral	subequant

COMMENTS
ALTERATION: Cataclasite, olivine is completely replaced by talc and chlorite, plagioclase is highly replaced by prehnite and chlorite, clinopyroxene is highly replaced by amphibole. Many thin veins filled with chlorite + prehnite.
STRUCTURE: Chlorite and prehnite associated with cataclasis, cut by epidote filled fracture and re-fractured.

Hole 345-U1415J-23R Section 1, Top of Section: 101.8 m (CSF-A)



LITHOLOGIC INTERVAL: 79
SECTION: 345-U1415J-23R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: poikilitic-granular
PIECES: #1
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0	5.0	euhedral-subhedral	amoeboid
plagioclase	35.0	3.0	subhedral-anhedral	tabular
clinopyroxene	35.0	20.0	anhedral	oikocryst
sulfide	0.1	1.0	subhedral	equant

COMMENTS
ALTERATION: Olivine is moderately altered to serpentine, talc, and pyrite. Plagioclase is slightly altered to chlorite and lesser amounts of prehnite. Clinopyroxene is moderately altered to amphibole.
STRUCTURE: Cut by clay veins.

LITHOLOGIC INTERVAL: 80
SECTION: 345-U1415J-23R-1-A
ROCK NAME: troctolite
GRAIN SIZE: coarse grained
TEXTURE: granular
PIECES: #2
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	49.5	5.0	euhedral-subhedral	amoeboid
plagioclase	50.0	6.0	subhedral-anhedral	tabular
clinopyroxene	0.5	1.0	anhedral	interstitial
oxide	0.1	0.5	subhedral	subequant
sulfide	0.1	0.3	anhedral	subequant

COMMENTS
ALTERATION: Olivine is highly altered to serpentine, clay minerals, and pyrite. Plagioclase is moderately altered to prehnite and chlorite.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO. Cut by chlorite veins.

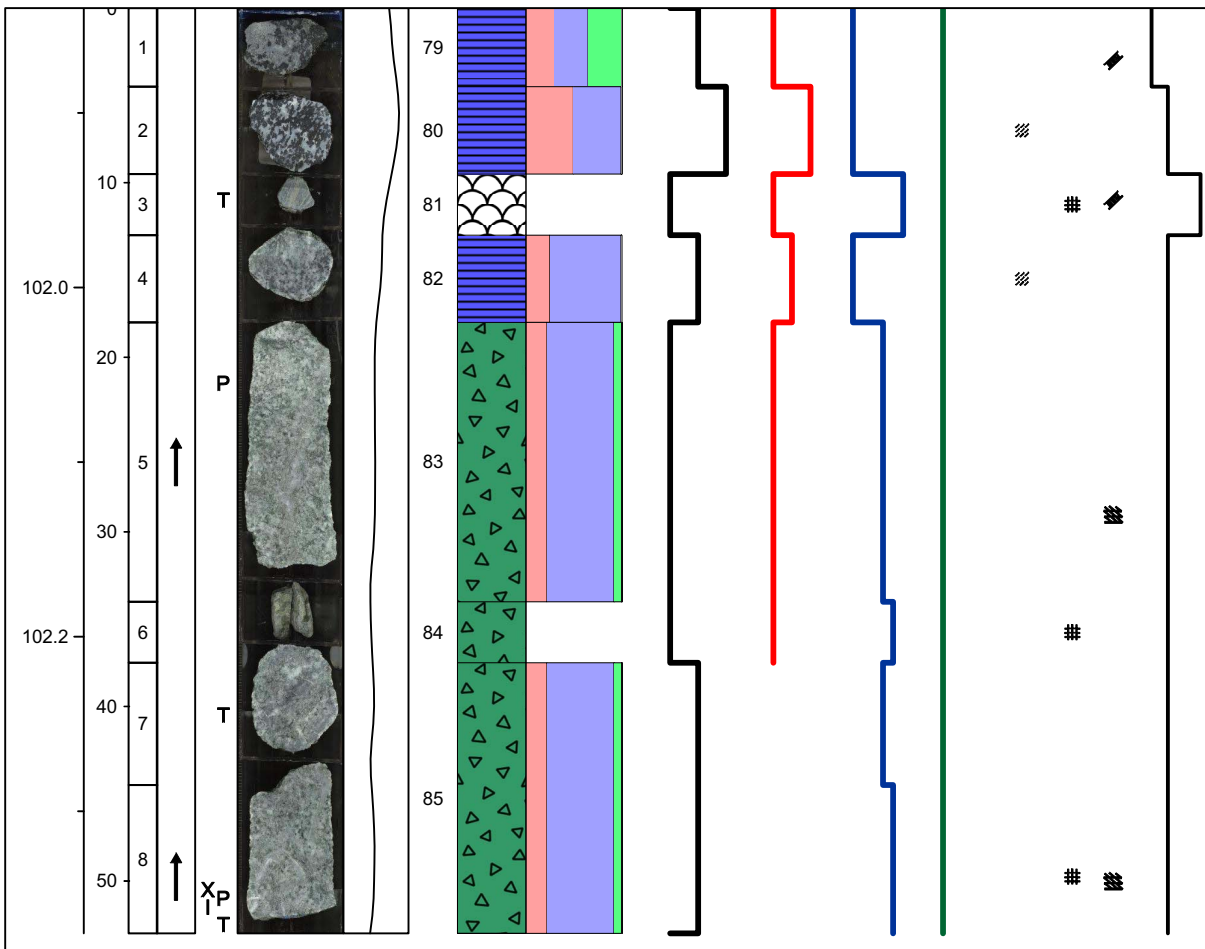
LITHOLOGIC INTERVAL: 81
SECTION: 345-U1415J-23R-1-A
ROCK NAME: cataclastic basalt
GRAIN SIZE:
TEXTURE:
PIECES: #3
CONTACTS: contact not recovered
COMMENTS
ALTERATION: Weakly foliated cataclasite with replacement (local) by epidote, one epidote vein. Olivine completely replaced by talc; plagioclase completely replaced by secondary plagioclase, chlorite, and epidote.
STRUCTURE: Cut by epidote and prehnite veins.

LITHOLOGIC INTERVAL: 82
SECTION: 345-U1415J-23R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #4
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	25.0	2.0	euhedral-subhedral	amoeboid
plagioclase	75.0	5.0	subhedral-anhedral	tabular
oxide	0.1	0.25	subhedral	equant
sulfide	0.5	0.5	anhedral	subequant

COMMENTS
ALTERATION: Olivine is highly altered to serpentine, talc, clay minerals, and pyrite. Plagioclase is moderately altered to prehnite and chlorite.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO. Cut by chlorite and prehnite veins.

Hole 345-U1415J-23R Section 1, Top of Section: 101.8 m (CSF-A)



LITHOLOGIC INTERVAL: 83
SECTION: 345-U1415J-23R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #5
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	22.0			
plagioclase	70.0	5.0	subhedral-anhedral	tabular
clinopyroxene	8.0	2.0	anhedral	interstitial
oxide	0.1	0.1	subhedral	subequant

COMMENTS
ALTERATION: Olivine is completely pseudomorphically replaced by talc, with no relict mesh texture. Plagioclase is moderately replaced by chlorite and prehnite, clinopyroxene is moderately altered to amphibole. One 1-4 mm wide plagioclase vein is fractured, also a 1 mm wide vein of plagioclase+ phyllosilicate is present.
STRUCTURE: Cut by chlorite veins.

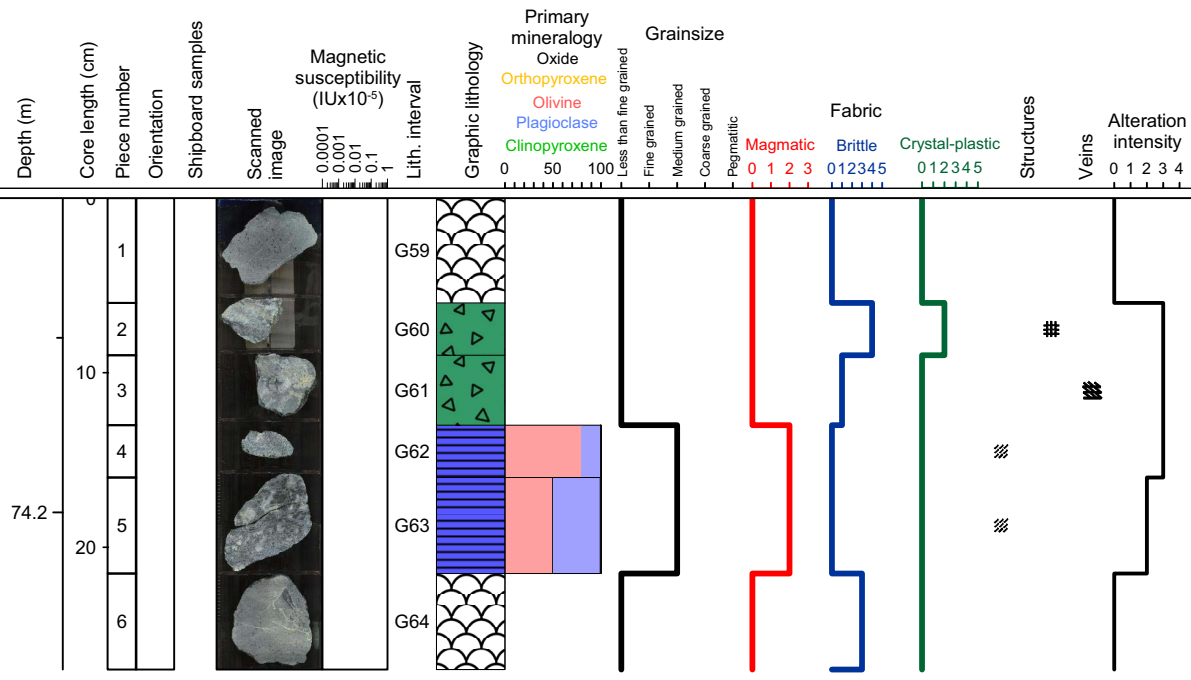
LITHOLOGIC INTERVAL: 84
SECTION: 345-U1415J-23R-1-A
ROCK NAME: cataclastic olivine gabbro
GRAIN SIZE:
TEXTURE:
PIECES: #6
CONTACTS: contact not recovered
COMMENTS
ALTERATION: Fine grained felsite, olivine is replaced by talc and serpentine. Plagioclase is slightly altered to prehnite and chlorite.
STRUCTURE: Cut by prehnite veins.

LITHOLOGIC INTERVAL: 85
SECTION: 345-U1415J-23R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #7, #8
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	22.0			
plagioclase	70.0	10.0	subhedral-anhedral	tabular
clinopyroxene	8.0	3.0	anhedral	interstitial
oxide	0.1	0.1	subhedral	subequant

COMMENTS
ALTERATION: Olivine is completely replaced by talc and amphibole, plagioclase is slightly altered to chlorite and prehnite. One plagioclase vein, 2 mm wide, fractured and bent.
STRUCTURE: Heterogeneous fracturing and veining distributed throughout entire interval (44.5-55 cm). Cut by chlorite, amphibole and prehnite.

Hole 345-U1415J-24G Section 1, Top of Section: 74.0 m (CSF-A)



LITHOLOGIC INTERVAL: G59
SECTION: 345-U1415J-24G-1-A
ROCK NAME: olivine moderately phyric basalt
GRAIN SIZE: less than fine grained
TEXTURE: porphyritic
PIECES: #1
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: Olivine: 7%, 0.1mm min size, 2mm max size, 1mm size mode, euhedral-subhedral, subequant, occurs as phenocrysts. Oxides are probably spinel.
ALTERATION: Olivine is completely replaced by amphibole, talc, serpentine and clay minerals; plagioclase is fresh. Thin prehnite veins cut this interval.
STRUCTURE: Cut by prehnite and zeolite veins.

LITHOLOGIC INTERVAL: G60
SECTION: 345-U1415J-24G-1-A
ROCK NAME: cataclastic olivine gabbro
GRAIN SIZE:
TEXTURE:
PIECES: #2
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: altered troctolite?
ALTERATION: Cataclasite, olivine is completely replaced by amphibole, talc, and chlorite; plagioclase is slightly altered to chlorite and prehnite. Interval is banded by stretched serpentine/talc-rich lavers that also disaggregate one epidote vein, 3 epidote filled veins.
STRUCTURE: Well-developed brecciation cut by epidote; both cut by chlorite and prehnite veins.

LITHOLOGIC INTERVAL: G61
SECTION: 345-U1415J-24G-1-A
ROCK NAME: cataclastic olivine gabbro
GRAIN SIZE:
TEXTURE:
PIECES: #3
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: altered troctolite?
ALTERATION: Clinopyroxene is almost completely replaced by dark amphibole, olivine completely replaced by talc in the core, surrounded by chlorite rim, plagioclase altered to prehnite and chlorite and locally to epidote, multiple epidote filled veins.
STRUCTURE: Cut by chlorite, epidote and prehnite veins.

LITHOLOGIC INTERVAL: G62
SECTION: 345-U1415J-24G-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #4
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	80.0			
plagioclase	20.0	3.0	subhedral-anhedral	tabular
oxide	0.1	0.1	subhedral	subequant

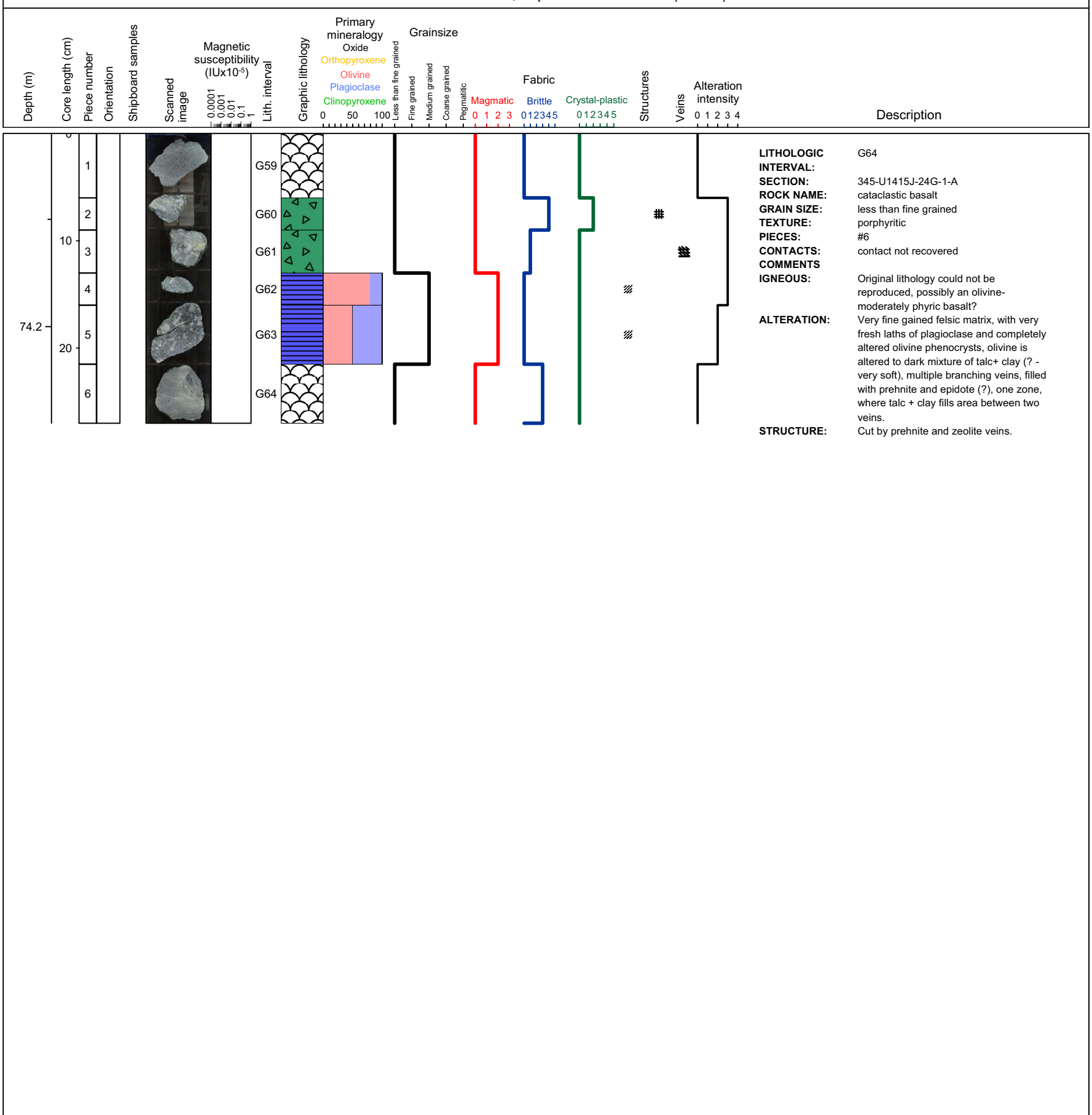
COMMENTS
ALTERATION: Olivine is completely altered to talc as well as serpentine and tremolite needles, surrounded by a rim of chlorite, plagioclase altered to prehnite and chlorite.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO. Cut by chlorite and clay veins.

LITHOLOGIC INTERVAL: G63
SECTION: 345-U1415J-24G-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #5
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	50.0			
plagioclase	50.0	3.0	subhedral-anhedral	tabular
clinopyroxene	0.5	1.0	anhedral	interstitial
oxide	0.1	0.1	subhedral	subequant

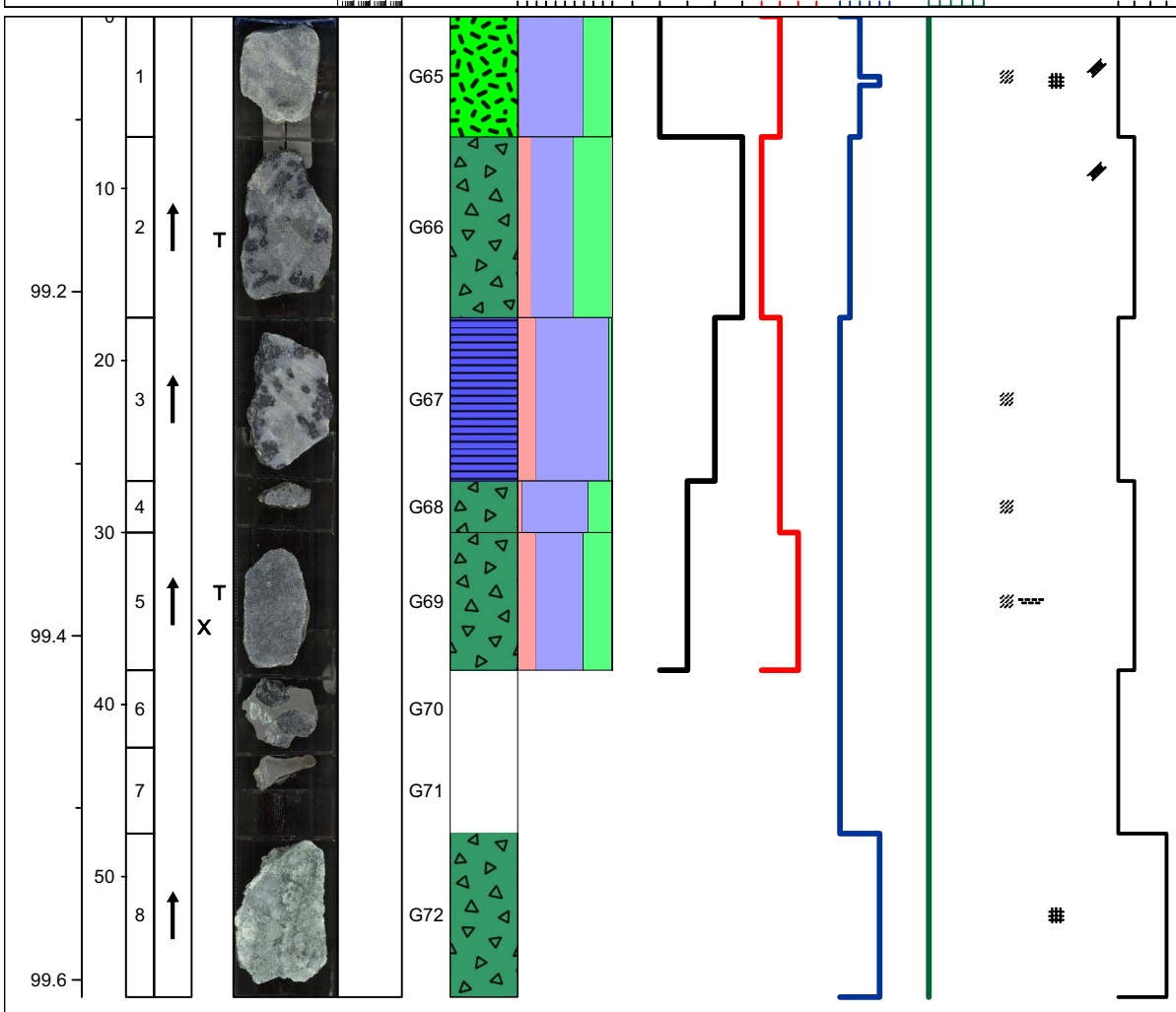
COMMENTS
ALTERATION: Well developed corona textures around olivine: in some olivine grains the core is replaced by a serpentine mesh, associated with pyrite, surrounded by a rim of tremolite and talc, this is surrounded by a rim of chlorite after plagioclase, in other grains the core is completely replaced by talc and serpentine, plagioclase is replaced by prehnite and chlorite.
STRUCTURE: Moderate magmatic foliation defined by plagioclase and olivine SPO. Cut by chlorite and clay veins.

Hole 345-U1415J-24G Section 1, Top of Section: 74.0 m (CSF-A)



LITHOLOGIC INTERVAL: G64
SECTION: 345-U1415J-24G-1-A
ROCK NAME: cataclastic basalt
GRAIN SIZE: less than fine grained
TEXTURE: porphyritic
PIECES: #6
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: Original lithology could not be reproduced, possibly an olivine-moderately phyric basalt?
ALTERATION: Very fine gained felsic matrix, with very fresh laths of plagioclase and completely altered olivine phenocrysts, olivine is altered to dark mixture of talc+ clay (? - very soft), multiple branching veins, filled with prehnite and epidote (?), one zone, where talc + clay fills area between two veins.
STRUCTURE: Cut by prehnite and zeolite veins.

Hole 345-U1415J-25G Section 1, Top of Section: 99.0 m (CSF-A)



LITHOLOGIC INTERVAL: G65
SECTION: 345-U1415J-25G-1-A
ROCK NAME: olivine bearing gabbro
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #1
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	2.0	5.0	subhedral-anhedral	skeletal
plagioclase	68.0	2.0	anhedral-subhedral	tabular
clinopyroxene	30.0	10.0	anhedral	oikocryst
oxide	0.1	0.1	subhedral	subequant

COMMENTS
ALTERATION: Chlorite replaces plagioclase along grain boundaries, 1 clinozoisite vein, discontinuous with small splays - clinozoisite locally replaces plagioclase.
STRUCTURE: Weak magmatic foliation defined by plagioclase and olivine SPO. Moderately fractured. Cut by epidote and prehnite veins.

LITHOLOGIC INTERVAL: G66
SECTION: 345-U1415J-25G-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: pegmatitic
TEXTURE: poikilitic-granular
PIECES: #2
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	15.0	10.0	subhedral-anhedral	skeletal
plagioclase	45.0	8.0	subhedral-anhedral	tabular
clinopyroxene	40.0	25.0	anhedral	oikocryst
oxide	0.1	0.1	subhedral	subequant
sulfide	0.5	0.8	subhedral	subequant

COMMENTS
ALTERATION: Plagioclase is relatively fresh in contrast to mafic minerals, olivine is highly altered to serpentine, clay minerals, talc, amphibole, and pyrite. Clinopyroxene is moderately altered to amphibole. Branching clay minerals veins without visible halo.
STRUCTURE: Moderately fractured. Cut by clay veins.

LITHOLOGIC INTERVAL: G67
SECTION: 345-U1415J-25G-1-A
ROCK NAME: troctolite
GRAIN SIZE: coarse grained
TEXTURE: poikilitic-granular
PIECES: #3
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	13.0	anhedral	skeletal
plagioclase	77.0	1.0	subhedral-anhedral	tabular
clinopyroxene	3.0	5.0	anhedral	interstitial
oxide	0.1	0.1	subhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Chlorite replaces plagioclase only adjacent to olivine, well developed serpentine mesh textures after olivine. Plagioclase is slightly altered to chlorite, clinopyroxene is slightly altered to amphibole.
STRUCTURE: Cut by prehnite veins.

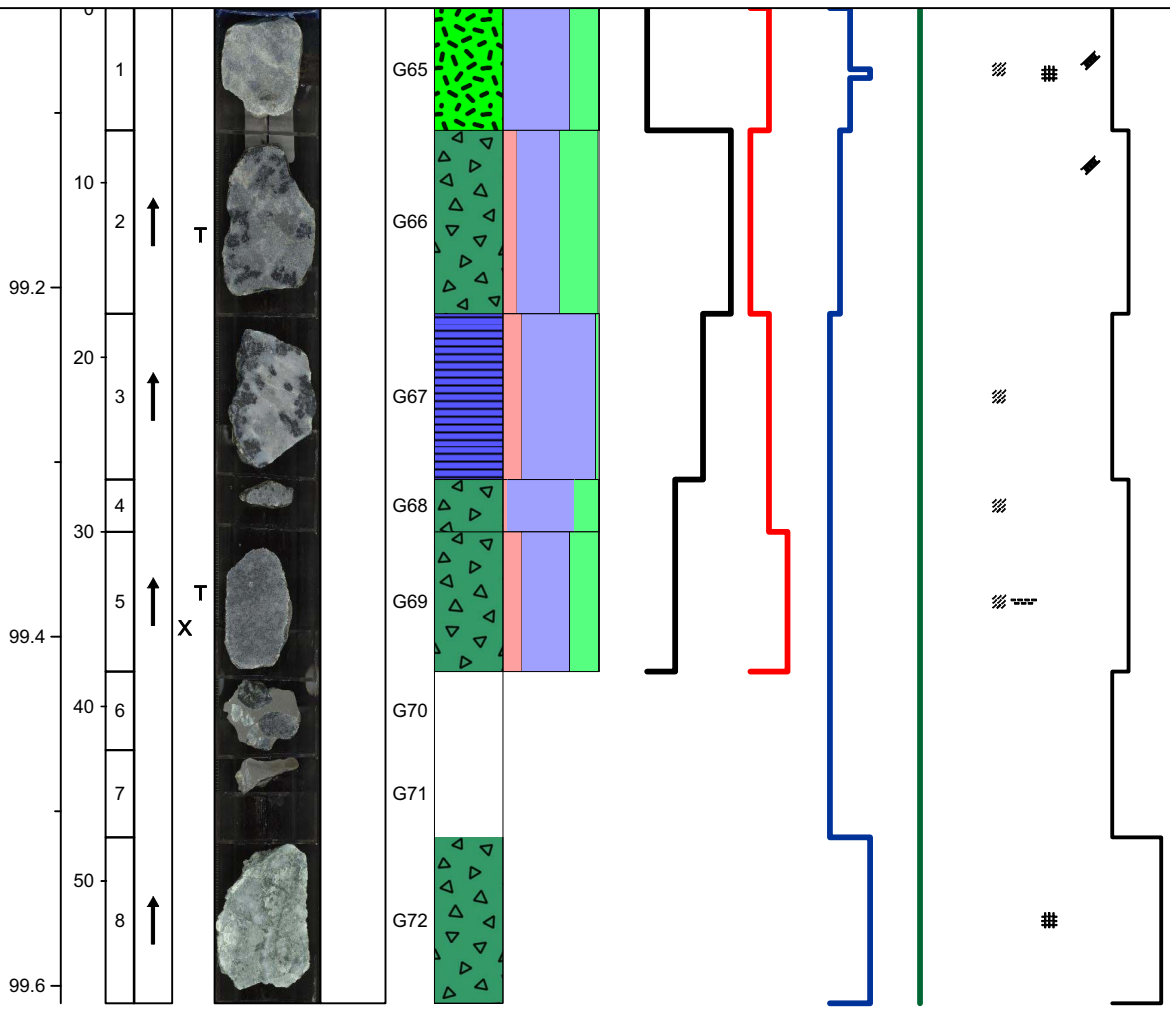
LITHOLOGIC INTERVAL: G68
SECTION: 345-U1415J-25G-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #4
CONTACTS: contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	5.0	3.0	subhedral-anhedral	subequant
plagioclase	70.0	5.0	subhedral-anhedral	tabular
clinopyroxene	25.0	3.0	anhedral	subequant
oxide	0.1	0.1	subhedral	subequant

COMMENTS
ALTERATION: Very fresh plagioclase, slightly fractured and altered to chlorite and prehnite along fractures, clinopyroxene slightly altered to amphibole, olivine altered to serpentine mesh, often surrounded by chlorite rim.

Hole 345-U1415J-25G Section 1, Top of Section: 99.0 m (CSF-A)



Description

LITHOLOGIC INTERVAL: G69
SECTION: 345-U1415J-25G-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #5
CONTACTS: modal and textural contact
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	1.0	subhedral-anhedral	amoeboid
plagioclase	50.0	3.0	subhedral-anhedral	tabular
clinopyroxene	30.0	6.0	anhedral	subequant
oxide	0.5	0.3	subhedral	subequant

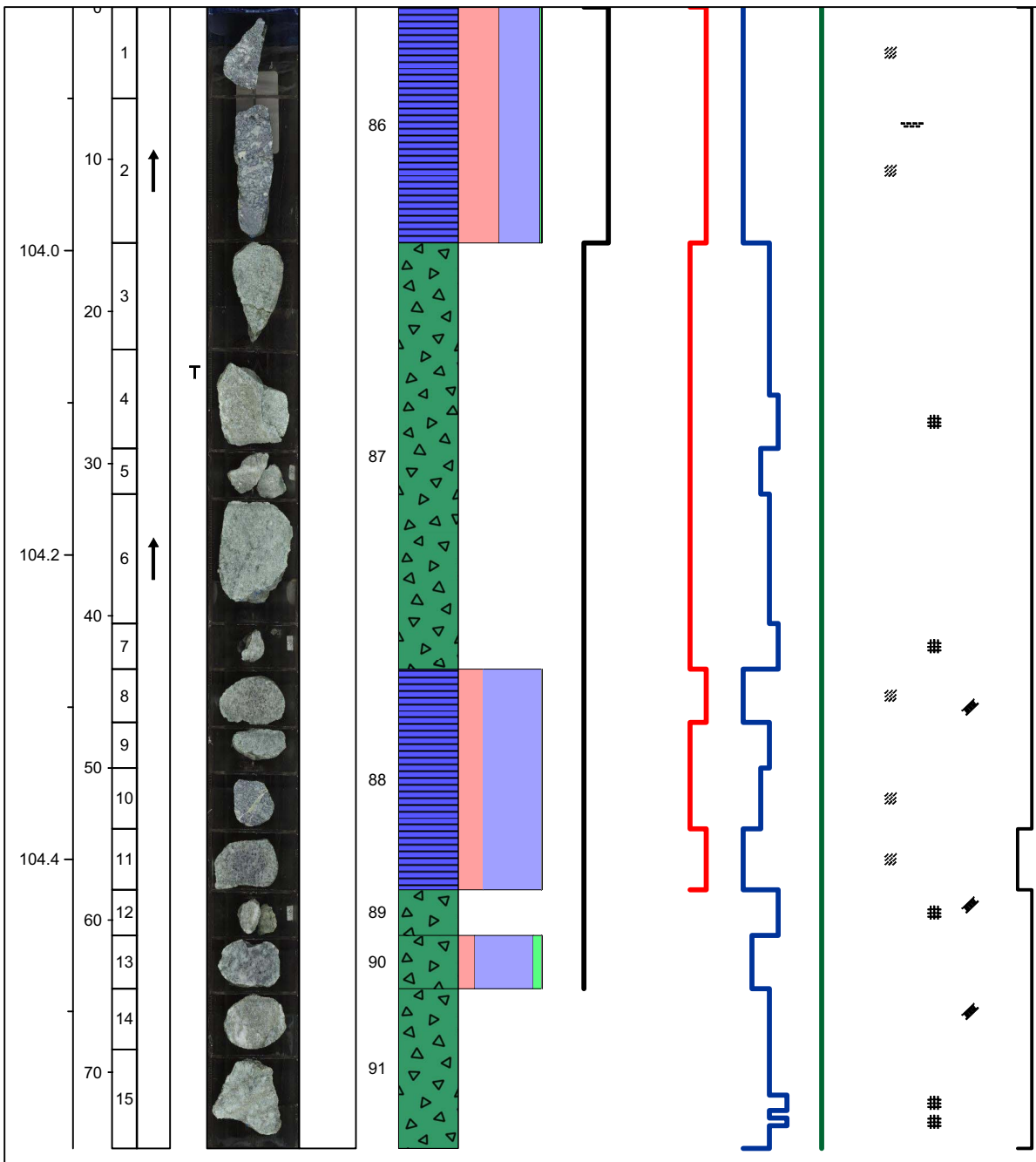
COMMENTS
IGNEOUS: clinopyroxene-oikocryst rich layer as igneous contact
ALTERATION: Very fresh plagioclase, slightly fractured and altered to chlorite along fractures, clinopyroxene slightly altered to amphibole, olivine altered to serpentine mesh, often surrounded by chlorite rim.
STRUCTURE: Moderate magmatic foliation defined by plagiolase and olivine SPO. Modal layering with subhorizontal fabric. Cut by chlorite and prehnite veins.

LITHOLOGIC INTERVAL: G70
SECTION: 345-U1415J-25G-1-A
ROCK NAME:
GRAIN SIZE:
TEXTURE:
PIECES: #6
CONTACTS: contact not recovered
COMMENTS
ALTERATION: Several clasts in cement from cementing the hole, clasts have different lithologies and different degrees of alteration (ranging from rank 1 to rank 4).

LITHOLOGIC INTERVAL: G71
SECTION: 345-U1415J-25G-1-A
ROCK NAME:
GRAIN SIZE:
TEXTURE:
PIECES: #7
CONTACTS: contact not recovered
COMMENTS
ALTERATION: Cement from cementing the hole.

LITHOLOGIC INTERVAL: G72
SECTION: 345-U1415J-25G-1-A
ROCK NAME: cataclastic olivine gabbro
GRAIN SIZE:
TEXTURE:
PIECES: #8
CONTACTS: contact not recovered
COMMENTS
ALTERATION: Cataclasite, almost no igneous textures preserved, olivine completely altered to talc, plagioclase altered to prehnite and chlorite.
STRUCTURE: Subvertical zone of cataclasis. Cut by chlorite, prehnite and zeolite veins.

Hole 345-U1415J-26R Section 1, Top of Section: 103.8 m (CSF-A)



LITHOLOGIC INTERVAL: 86
SECTION: 345-U1415J-26R-1-A
ROCK NAME: troctolite
GRAIN SIZE: medium grained
TEXTURE: granular
PIECES: #1, #2
CONTACTS: modal contact contact not recovered

MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	49.0			
plagioclase	49.0	7.0	subhedral-anhedral	tabular
clinopyroxene	2.0	3.0	anhedral	subequant
oxide	0.3	0.1	subhedral	subequant

COMMENTS
IGNEOUS: Piece #2 has a modal contact
ALTERATION: Intensively altered, olivine completely altered to form corona textures with talc in the core and tremolite at the outside, surrounded by rim of chlorite, some olivine altered to serpentine mesh in core, plagioclase replaced by prehnite and chlorite.
STRUCTURE: Cut by chlorite, epidiote, sulfide and prehnite veins.

LITHOLOGIC INTERVAL: 87
SECTION: 345-U1415J-26R-1-A
ROCK NAME: cataclastic olivine gabbro
GRAIN SIZE:
TEXTURE:
PIECES: #3, #4, #5, $6, #7
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: original mode is indeterminable; possibly troctolite or olivine gabbro
ALTERATION: Plagioclase highly fractured and altered to chlorite, prehnite, and secondary plagioclase; olivine is completely replaced by talc. Network of branching epidote(?) veins, 1 cm wide plagioclase vein. This interval also includes cataclasite (piece 6), with fractured plagioclase in talc+ chlorite.
STRUCTURE: Moderately fractured, cut by chlorite, prehnite and amphibole veins.

LITHOLOGIC INTERVAL: 88
SECTION: 345-U1415J-26R-1-A
ROCK NAME: troctolite
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #8, #9, #10, #11
CONTACTS: contact not recovered

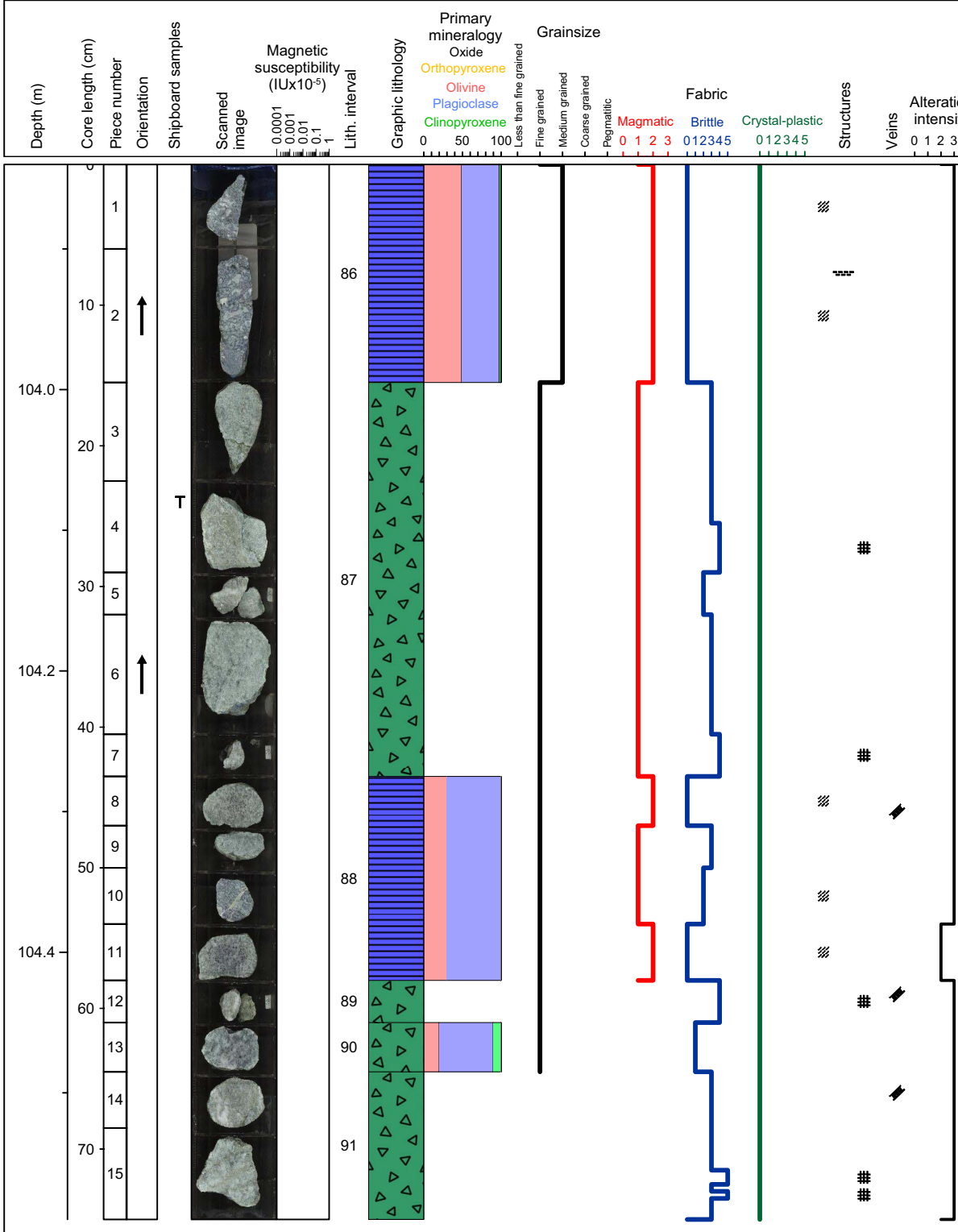
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	30.0	1.0	subhedral-anhedral	amoeboid
plagioclase	70.0	3.0	subhedral-anhedral	tabular
oxide	0.1	0.1	subhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
IGNEOUS: piece #10 has higher modal amount of olivine
ALTERATION: Olivine completely altered to serpentine+ talc+ pyrite, also tremolite and chlorite coronae. Disseminated pyrite occurs throughout the interval. Plagioclase moderately to highly altered to chlorite and prehnite. Veins of epidote and layered talc occur throughout the interval.
STRUCTURE: Moderately fractured (47-54 cm). Cut by chlorite, prehnite, and epidote veins.

LITHOLOGIC INTERVAL: 89
SECTION: 345-U1415J-26R-1-A
ROCK NAME: cataclastic olivine gabbro
GRAIN SIZE:
TEXTURE:
PIECES: #12
CONTACTS: contact not recovered
COMMENTS
ALTERATION: Olivine is completely replaced by talc, plagioclase is highly altered to prehnite and chlorite, clinopyroxene is altered to amphibole. Network of branching epidote veins and 1 cm wide plagioclase vein.
STRUCTURE: Cut by prehnite veins.

Hole 345-U1415J-26R Section 1, Top of Section: 103.8 m (CSF-A)



LITHOLOGIC INTERVAL: 90
SECTION: 345-U1415J-26R-1-A
ROCK NAME: olivine gabbro
GRAIN SIZE: fine grained
TEXTURE: granular
PIECES: #13
CONTACTS: contact not recovered
MODAL ABUNDANCES

Primary Mineral	Percent	Size Max mm	Shape	Habit
olivine	20.0	3.0	subhedral-anhedral	amoeboid
plagioclase	70.0	7.0	subhedral-anhedral	tabular
clinopyroxene	10.0	8.0	anhedral	subequant
sulfide	0.1	0.1	anhedral	subequant

COMMENTS
ALTERATION: Olivine is completely replaced by talc, serpentine, and pyrite. Plagioclase is moderately altered to prehnite and chlorite. Clinopyroxene is altered to amphibole.
STRUCTURE: Cut by chlorite veins.

LITHOLOGIC INTERVAL: 91
SECTION: 345-U1415J-26R-1-A
ROCK NAME: cataclastic olivine gabbro
GRAIN SIZE:
TEXTURE:
PIECES: #14, #15
CONTACTS: contact not recovered
COMMENTS
IGNEOUS: original mode is indeterminable; possibly olivine gabbro
ALTERATION: Cataclasite interval, olivine is completely replaced by talc; plagioclase is highly altered to prehnite and chlorite; clinopyroxene is highly altered to amphibole. Disseminated pyrite occurs within this interval. Network of epidote veins along foliation of former clinopyroxene.
STRUCTURE: Moderately fractured. Cut by epidote, chlorite and prehnite veins.

THIN SECTION: 345-U1415J-2G-1-W 0/13-TSB_Aphyric_Basalt-TS_25 **Thin Section no.:** 25
Rock name: sparsley phyric basalt
Rock comment: moderately altered
Lithologic interval: G1
Piece No.: #1 **Authors: JK, AM**
Billet request comment: Ig: primary minerals; MetPet: Alt. in basalt. Loose pieces

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** sparsley phyric basalt
Domain grain size: less than fine grained **Grain size distribution:** seriate
Domain texture: intergranular **Relative abundance (%):** 100
Domain comment: mode estimation: olivine and plagioclase as phenocrysts; groundmass: 97 vol%; groundmass consists of approx. 60% plagioclase, 40% clinopyroxene and 20% (former) ol plus oxides + a few grains of spinel

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine (phenocryst)	0	1	1	0.5	anhedral to subhedral	equant			aggregates	only pseudomorphs present; olivine as phenocrysts, but also in the groundmass
Plagioclase (phenocryst)	2	2	0	0.1	subhedral to euhedral	tabular as phenorysts, lath-shaped in the groundmass	continuous zoning		fast crystal growth (long needles of plagioclase present)	both phenocrysts grading into groundmass; some glomerocrysts
Groundmass	50	97	47	0.5						consists of approx. 60% plagioclase, 40% clinopyroxene and 20 % (former) olivine; oxides in groundmass (< 1%) + a few grains of euhdral to subhedral spinel

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 30
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	1	olivine 1%	Olivine	10	100	green amphibole 80%, chlorite 10%, clay minerals 10%	very green euhedral pseudomorphs of phenocrysts inferred to be olivine
clay minerals	1	olivine 1%	Plagioclase	60	10	secondary plagioclase 100%	little obvious alteration but marginal zones are probably secondary and there are thin secondary plagioclase veins in places.
ferric oxyhydroxide	0.1	oxide 0.1%	Clinopyroxene	30	50	green amphibole 100%	some plumose relics
green amphibole	23	olivine 8%, clinopyroxene 15%	Oxide	2	5	ferric oxyhydroxide 100%	spinel grains are sometimes rimmed by dark oxidation
secondary plagioclase	6	plagioclase 6%					
domain total alteration %:	**31.1**						

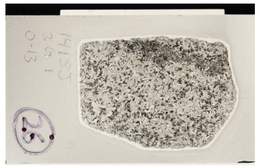
Vein summary
vein 1 chlorite-smectite cross-fiber vein

ALTERATION COMMENT: Greenschist and sub-greenschist altered basaltic rock. Abundant sulfide in talc and clay replacements of olivine, in chlorite-amphibole diffuse veins and patches, and on cleavages of partially altered clinopyroxene.
Some very fine sulfide of unresolvable composition.

STRUCTURE COMMENT: Magmatic: Xenocrysts of plagioclase with deformation twins, bent, locally undulose extinction.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: No brittle deformation.
Veins/alteration: Two en echelon planar crack seal veins with altered margins.
Cross-cutting Relationships (as apparent in thin section):
1) Entrainment of deformed plagioclase grains from host gabbroic rocks.
2) Low temperature veins filled with clays (after a fibrous mineral growing from the vein walls) and scattered carbonate. Vein crosses plagioclase microliths.

PHOTOMICROGRAPHS: 345_U1415J_2G_1_TS_25.JPG
345_U1415J_2G_1_TS_25-2.JPG

THIN SECTION: 345-U1415J-2G-1-W 0/13-TSB_Dolerite-TS_26 **Thin Section no.:** 26
Rock name: dolerite
Rock comment: contains a layer-like patch with much smaller grain size; moderately altered
Lithologic interval: G2
Piece No.: #1 **Authors: JK, AM**
Billet request comment: Ig. Pet: primary minerals; MetPet: granoblastic?



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** dolerite
Domain grain size: fine grained **Grain size distribution:** equigranular
Domain texture: intergranular to subophitic **Relative abundance (%):** 100
Domain comment: the finer-grained patch shows higher oxide content

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase	60	65	5	0.5	subhedral to euhedral	lath-shaped	continuous zoning		fast crystal growth	one larger grain shows sieve-structure
Clinopyroxene	28	30	2	0.5	anhedral	elongate		colorless	interstitial	tends to form subophitic structures
Oxide	1	1	0	0.1						

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 20
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	0.7	plagioclase 0.7%
clay minerals	1	olivine 1%
epidote/zoisite	2	plagioclase 2%
green amphibole	1.5	clinopyroxene 1.5%
pale/colorless amphibole	0.7	plagioclase 0.7%
secondary plagioclase	3.3	plagioclase 3.3%
talc	1	olivine 1%
domain total alteration %:	**10.2**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	2	100	clay minerals 50%, talc 50%	talc rich patches may have been olivine
Plagioclase	66	10	pale/colorless amphibole 10%, chlorite 10%, secondary plagioclase 50%, epidote/zoisite 30%	
Clinopyroxene	30	5	green amphibole 100%	cpx in ophitic texture is mainly very fresh

ALTERATION COMMENT: Greenschist and sub-greenschist altered dolerite. Disseminated fine pyrite < 20 micron in blebby clinopyroxene and secondary plagioclase. Some very fine sulfide, unresolvable.

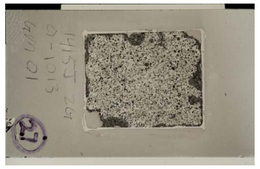
STRUCTURE COMMENT: Magmatic: Composite dike: host fine-grained diabase with radiating glomerocrysts of plagioclase, and plagioclase phenocrysts, intruded by very fine-grained magnetite-rich (up to 5% locally) diabase.
Crystal Plastic: Minor undulose extinction in plagioclase.
Brittle: No brittle deformation.
Veins/alteration: No veins.
Cross-cutting Relationships (as apparent in thin section):
1) Intrusion of fine-grained diabase.
2) Intrusion of very-fine grained, magnetite-rich diabase.

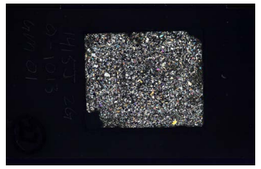
PHOTOMICROGRAPHS: 345_U1415J_2G_1_TS_26.JPG
345_U1415J_2G_1_TS_26-2.JPG

THIN SECTION: 345-U1415J-2G-Sand-TSB_Grain_Mount_01-TS_27
Rock name: olivine bearing gabbro
Rock comment: grain mount; igneous mode reconstructed from point counting and alteration minerals
Lithologic interval:
Piece No.: #1
Billet request comment:

Thin Section no.: 27

Authors: AM, AM





PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: **Domain lithology:**
Domain grain size: **Grain size distribution:**
Domain texture: **Relative abundance (%):**
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0.2	11	10.8							
Plagioclase	24	57	33							
Clinopyroxene	13	32	19							includes some orthopyroxene

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 53
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	8.3	olivine 1.7%, plagioclase 6.5%
clay minerals	5.6	olivine 5.6%
epidote/zoisite	1.6	plagioclase 1.6%
green amphibole	15	clinopyroxene 15%
pale/colorless amphibole	3.6	olivine 3.6%
prehnite	4.2	plagioclase 4.2%
secondary plagioclase	8.2	plagioclase 8.2%
zeolite	2.8	plagioclase 2.8%
domain total alteration %:	**49.3**	

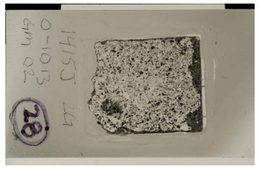
PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	11	99	pale/colorless amphibole 33%, chlorite 16%, clay minerals 51%	pieces of corona texture seen
Plagioclase	57	41	chlorite 28%, prehnite 18%, zeolite 12%, secondary plagioclase 35%, epidote/zoisite 7%	high proportion of secondary plagioclase is typical of cataclastic zones where prehnite alteration is not intense
Clinopyroxene	32	47	green amphibole 100%	

ALTERATION COMMENT: Grain mount of drill cuttings; High proportion of cataclastic clasts suggests a fault zone may have been sampled, but the amount of prehnite is low compared to similar samples in Hole U1415I. Contains 4% doleritic and basaltic clasts. Tiny euhedral pyrite in secondary plagiocalse clasts and irregular pyrite patches in volcanic clasts.

STRUCTURE COMMENT: 11 % of the material consists of grains of cataclasite rank 4 and above, which is higher than the percentage in recovered core.

PHOTOMICROGRAPHS: 345_U1415J_2G_Sand_TS_27.JPG
345_U1415J_2G_Sand_TS_27-2.JPG

THIN SECTION: 345-U1415J-2G-Sand-TSB_Grain_Mount_02-TS_28 **Thin Section no.:** 28
Rock name: olivine bearing gabbro
Rock comment: grain mount: primary mode reconstructed from point counting of primary and secondary minerals
Lithologic interval:
Piece No.: #1 **Authors: AM, AM**
Billet request comment:



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: **Domain lithology:**
Domain grain size: **Grain size distribution:**
Domain texture: **Relative abundance (%):**
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0.6	12	11.4							
Plagioclase	28	63	35							
Clinopyroxene	10	25	15							includes some orthopyroxene

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 48
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	13	olivine 2.1%, plagioclase 10.9%
clay minerals	5.6	olivine 5.6%
epidote/zoisite	1.8	plagioclase 1.8%
green amphibole	14.8	clinopyroxene 14.8%
pale/colorless amphibole	3.4	olivine 3.4%
prehnite	5.6	plagioclase 5.6%
secondary plagioclase	11.3	plagioclase 11.3%
serpentine	0.3	olivine 0.3%
zeolite	5.3	plagioclase 5.3%
other	0.4	plagioclase 0.4%
domain total alteration %:	**61.5**	

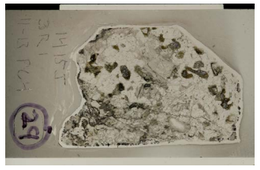
PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	12	95	pale/colorless amphibole 30%, chlorite 18%, clay minerals 49%, serpentine 3%	pieces of corona texture seen
Plagioclase	63	56	chlorite 31%, prehnite 16%, zeolite 15%, secondary plagioclase 32%, epidote/zoisite 5%, other 1%	other = carbonate; high proportion of secondary plagioclase is typical of cataclastic zones where prehnite alteration is not intense
Clinopyroxene	25	59	green amphibole 100%	

ALTERATION COMMENT: Grain mount of drill cuttings; High proportion of cataclastic clasts suggests a fault zone may have been sampled, but the amount of prehnite is low compared to similar samples in Hole U1415I. Contains 5% doleritic and basaltic clasts. Mainly in secondary plagioclalse clasts.

STRUCTURE COMMENT: 14 % of the material consists of grains of cataclasite rank 4 and above, which is higher than the percentage in recovered core.

PHOTOMICROGRAPHS: 345_U1415J_2G_Sand_TS_28.JPG
345_U1415J_2G_Sand_TS_28-2.JPG

THIN SECTION: 345-U1415J-3R-1-W 11/13-TSB_Piece_4-TS_29 **Thin Section no.:** 29
Rock name: gabbro
Rock comment: moderately altered with highly altered cataclasite zone
Lithologic interval: 5
Piece No.: #4 **Authors: NA, AM**
Billet request comment: Ig. Pet: primary mineralogy



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	3	5	2	3	anhedral to subhedral	irregular				
Plagioclase	50	71	21	2.5	anhedral to subhedral	tabular				chadacrysts (in clinopyroxene oikocrysts)
Clinopyroxene	20	20	0	2	anhedral	interstitial		colorless	poikilitic	
Orthopyroxene	3	4	1	2	anhedral	interstitial		colorless		

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 70 **Estimated total % alteration:** 20
Alteration domain number: 1 **Domain type:** little deformed olivine gabbro

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	3.1	olivine 0.7%, plagioclase 2.4%	Olivine	10	70	pale/colorless amphibole 10%, chlorite 10%, clay minerals 50%, oxide 2%, sulfide 1%, serpentine 17%, talc 10%	olivine coronas hard to tell from orthopyroxene; more amphibole in orthopyroxene coronas
clay minerals	4.8	olivine 3.5%, orthopyroxene 1.3%	Plagioclase	60	10	chlorite 40%, prehnite 40%, zeolite 20%	chlorite veins and coronas, prehnite dusting locally and patches of zeolite
oxide	0.6	olivine 0.1%, orthopyroxene 0.5%	Clinopyroxene	20	15	pale/colorless amphibole 100%	
pale/colorless amphibole	5.2	olivine 0.7%, clinopyroxene 3%, orthopyroxene 1.5%	Orthopyroxene	10	50	pale/colorless amphibole 30%, clay minerals 25%, oxide 10%, serpentine 10%, talc 20%	Both olivine and orthopyroxene have coronas. It is difficult to distinguish between the two; orthopyroxene coronas have less chlorite, more amphibole, patchy talc, large oxide blebs.
prehnite	2.4	plagioclase 2.4%					
serpentine	1.7	olivine 1.2%, orthopyroxene 0.5%					
sulfide	0.1	olivine 0.1%					
talc	1.7	olivine 0.7%, orthopyroxene 1%					
zeolite	1.2	plagioclase 1.2%					
domain total alteration %:	**20.8**						

Vein summary
vein 1 thin chlorite veins in plagioclase link coronas

ALTERATION COMMENT: Moderately altered rock with olivine strongly altered to corona textures, talc and clay. Euhedral to anhedral 10 micron pyrite mainly in chlorite microveins, secondary plagioclase, and talc after olivine, coexisting with magnetite.

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 30 **Estimated total % alteration:** 50
Alteration domain number: 2 **Domain type:** cataclastic olivine gabbro

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	5.4	orthopyroxene 1.8%, plagioclase 3.6%	Olivine	10	100	pale/colorless amphibole 15%, clay minerals 54%, oxide 1%, sulfide 1%, serpentine 29%	
clay minerals	9	olivine 5.4%, orthopyroxene 3.6%	Plagioclase	60	30	chlorite 20%, prehnite 10%, zeolite 70%	
oxide	0.1	olivine 0.1%	Clinopyroxene	20	60	pale/colorless amphibole 100%	
pale/colorless amphibole	15.3	olivine 1.5%, clinopyroxene 12%, orthopyroxene 1.8%	Orthopyroxene	10	90	pale/colorless amphibole 20%, chlorite 20%, clay minerals 40%, serpentine 20%	
prehnite	1.8	plagioclase 1.8%					
serpentine	4.7	olivine 2.9%, orthopyroxene 1.8%					
sulfide	0.1	olivine 0.1%					
zeolite	12.6	plagioclase 12.6%					
domain total alteration %:	**49**						

Vein summary
vein 1 cross fibre veins of chlorite and clay (?)
vein 2 massive zeolite veins with square subgrains of zeolite

ALTERATION COMMENT: Cataclastic zone with more intense alteration. Euhedral to anhedral 10 micron pyrite mainly in chlorite microveins, secondary plagioclase, and talc after olivine, coexisting with magnetite.

STRUCTURE COMMENT: Magmatic: Weak magmatic foliation defined by plagioclase SPO, with annealed grain boundaries. Rare deformation twins, subgrains, and bending in plagioclase.
Crystal Plastic: Minor undulose extinction in plagioclase.
Brittle: Cut by one well-developed, anastomosing zone of localized cataclastic deformation; clast rotation (<20% matrix).
Veins/alteration: Curved crack seal veins filled with chlorite/serpentine (with fibrous growth from the vein walls) overprint zone of cataclasis and cuts the primary igneous minerals.
Cross-cutting Relationships (as apparent in thin section):
1) Minor magmatic fabric development.
2) Cataclasis.
2) Minor low-temperature veins cut zones of cataclasis, and igneous minerals.

PHOTOMICROGRAPHS: 345_U1415J_3R_1_TS_29.JPG
345_U1415J_3R_1_TS_29-2.JPG

THIN SECTION: 345-U1415J-3R-1-W 22/24-TSB_Piece_6-TS_30 **Thin Section no.:** 30
Rock name: gabbro
Rock comment: moderately altered with highly altered cataclasite zone
Lithologic interval: 6
Piece No.: #6 **Authors: TH, KF**
Billet request comment: Ig. Pet: pri. min; MetPet: Pyx replace; Struct: Pyx orient. fab. looking for lineation of fab; Adjacent to PMAG

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: Two types of clinopyroxene; one with high aspect ratio, one is relatively equant

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0.05	1	0.95	1	anhedral	subequant				highly altered
Plagioclase	59	59	0	0.8	anhedral to subhedral	subequant				
Clinopyroxene	40	40	0	1.6	anhedral to subhedral	subequant		colorless	twinning	some clinopyroxene crystals are anomalously elongtated
Oxide	0.1	0.1	0	0.1	anhedral	subequant				

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 15
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	4.3	olivine 2.5%, plagioclase 1.8%
clay minerals	1	olivine 1%
green amphibole	5.3	clinopyroxene 5.3%
pale/colorless amphibole	5.3	clinopyroxene 5.3%
prehnite	1.2	plagioclase 1.2%
secondary plagioclase	3	plagioclase 3%
serpentine	1.5	olivine 1.5%
domain total alteration %:	**21.6**	

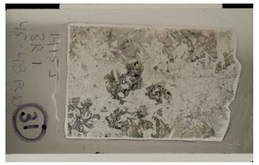
PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	5	100	chlorite 50%, clay minerals 20%, serpentine 30%	core of relict olivine replaced by clay and serpentine, surrounded by chlorite
Plagioclase	60	10	chlorite 30%, prehnite 20%, secondary plagioclase 50%	plagioclase mainly altered to fine grained minerals along fractures and grain boundaries.
Clinopyroxene	35	30	green amphibole 50%, pale/colorless amphibole 50%	

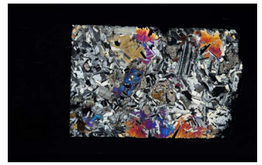
ALTERATION COMMENT: Slightly to moderately altered gabbroic rock. Olivine is completely replaced by a mixture of serpentine and clay in the core, surrounded by a thin rim of chlorite when in contact with plagioclase. Clinopyroxene is moderately alterd to amphibole. Plagioclase is mainly fractured and altered to fine grained minerals (prehnite, secondary plagioclase and chlorite) along these micro-fractures and it is altered to form chlorite rims when in contact with olivine. Irregular pyrite 5-70 microns in size mainly in secondary plagioclase.

STRUCTURE COMMENT: Magmatic: Strong magmatic lineation defined by elongate, prismatic clinopyroxene SPO; most large clinopyroxene twinned, bent, locally with subgrains. Plagioclase with very well developed annealed grain boundaries, weak foliation defined by SPO. Rare deformation twins, subgrains, and bending in plagioclase.
Crystal Plastic: None.
Brittle: Cut by a few well-developed orthogonal, roughly planar, zones of localized cataclastic deformation (cataclasite to ultracataclasite; clast rotation (<20% matrix).
Veins/alteration: Curved crack seal prehnite and zeolite veins overprint zone of cataclasis.
Cross-cutting Relationships (as apparent in thin section):
1) Strong magmatic (foliation and lineation) fabric development.
2) Cataclasis.
2) Minor prehnite veins cut zones of cataclasis.

PHOTOMICROGRAPHS: 345_U1415J_3R_1_TS_30.JPG
345_U1415J_3R_1_TS_30-2.JPG

THIN SECTION: 345-U1415J-3R-1-W 45/48-TSB_Piece_10-TS_31 **Thin Section no.:** 31
Rock name: olivine gabbro
Rock comment: clinopyroxene and olivine oikocrysts; moderately altered
Lithologic interval: 10
Piece No.: #10 **Authors: TH, AM**
Billet request comment: lg. Pet: pri. min; MetPet: plag. replace. phases; Struct: lg. Fabric





PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** olivine gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: poikilitic **Relative abundance (%):** 100
Domain comment: clinopyroxene oikocryst bears a relativeley small amount of plagioclase chadacrysts

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	4	14	10	4	anhedral	irregular-amoeboid				subgrain structure observed
Plagioclase	70	70	0	1.2	subhedral	tabular	oscillatory			subgrain structure observed; chadacrysts
Clinopyroxene	16	16	0	5	anhedral	interstitial		colorless		
Oxide	0.1	0.1	0	0.1	anhedral	subequant				

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 20
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	7.5	olivine 1.5%, plagioclase 6%
clay minerals	0.8	olivine 0.8%
epidote/zoisite	0.3	plagioclase 0.3%
oxide	0.2	olivine 0.2%
pale/colorless amphibole	2.2	olivine 0.8%, clinopyroxene 0.5%, orthopyroxene 1%
prehnite	3.5	plagioclase 3.5%
secondary plagioclase	3.3	plagioclase 3.3%
sulfide	0.6	olivine 0.6%
talc	3.8	olivine 3.8%
domain total alteration %:	**22.2**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	15	50	pale/colorless amphibole 10%, chlorite 20%, clay minerals 10%, oxide 2%, sulfide 8%, talc 50%	
Plagioclase	65	20	chlorite 46%, prehnite 27%, secondary plagioclase 25%, epidote/zoisite 2%	crack-related alteration and coronas adjacent to olivine. Some quite intense areas of secondary plag + clinozoisite needles
Clinopyroxene	15	3	pale/colorless amphibole 100%	
Orthopyroxene	5	20	pale/colorless amphibole 100%	

Vein summary
vein 1 chlorite veins related to coronas
vein 2 some thin prehnite

ALTERATION COMMENT: Slight to moderate alteration mainly affecting olivine with weak corona development and extensive talc replacement of olivine. Plagioclase is fractured and replaced by chlorite, prehnite, secondary plagioclase, and trace epidote/zoisite. Irregular pyrite grains up to 150 micron in size are intergrown with talc replacing olivine, with magnetite apparently defining an earlier serpentine mesh texture. Fine pyrite occurs in secondary plagioclase and in clinopyroxene.

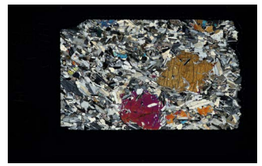
STRUCTURE COMMENT: Magmatic: Weak magmatic foliation defined by plagioclase SPO. Rare submagmatic deformation twins and/or bent grains of plagioclase. Large, well developed interlobate /skeletal olivine.
Crystal Plastic: None.
Brittle: Minor chlorite-filled and open fractures.
Veins/alteration: Thin prehnite veins.
Cross-cutting Relationships (as apparent in thin section):
1) Minor magmatic fabric development.
2) Minor fracturing, prehnite veining.

PHOTOMICROGRAPHS: 345_U1415J_3R_1_TS_31.JPG
345_U1415J_3R_1_TS_31-2.JPG

THIN SECTION: 345-U1415J-3R-1-W 73/75-TSB_Piece_14-TS_32
Rock name: clinopyroxene oikocryst-bearing olivine gabbro
Rock comment: contains two different lithologies; moderately altered
Lithologic interval: 10
Piece No.: #14
Billet request comment: Ig. Pet: Pyx Oikocrysts

Thin Section no.: 32

Authors: MMJ, KF



PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** contact between two lithologies

Igneous domain number: 1
Domain grain size: medium grained
Domain texture: granular
Domain comment:

Domain lithology: olivine gabbro
Grain size distribution: equigranular
Relative abundance (%): 60

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	10	20	10	1	anhedral to subhedral	elongate			corona	clay or oxide rich
Plagioclase	55	60	5	1	subhedral	tabular	discontinuous zoning			
Clinopyroxene	10	20	10	1.5	anhedral to subhedral	elongate		pale green	corroded	
Orthopyroxene	0.1	0.1	0	1	anhedral to subhedral	subequant		pinkish brown		
Oxide	0.1	0.1	0	0.1	anhedral to subhedral	subequant			inclusions	inclusions in olivine

Igneous domain number: 2
Domain grain size: coarse grained
Domain texture: poikilitic
Domain comment: oikocryst clinopyroxene in this domain

Domain lithology: oikocryst clinopyroxene oikocryst-bearing
Grain size distribution: seriate
Relative abundance (%): 40

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	1	10	9	1	anhedral				overgrowth	
Plagioclase	45	50	5	1	subhedral	tabular	discontinuous zoning			
Clinopyroxene	35	40	5	7	subhedral to euhedral	equant		pale green	poikilitic	clinopyroxene oikocryst with plagioclase chadacrysts

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 10
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	2	plagioclase 2%
clay minerals	1.4	olivine 1.4%
green amphibole	1	clinopyroxene 1%
oxide	0.4	olivine 0.4%
pale/colorless amphibole	3.1	olivine 2.1%, clinopyroxene 1%
prehnite	0.5	plagioclase 0.5%
serpentine	1.4	olivine 1.4%
sulfide	0.4	olivine 0.4%
talc	1.4	olivine 1.4%

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	10	70	pale/colorless amphibole 30%, clay minerals 20%, oxide 5%, sulfide 5%, serpentine 20%, talc 20%	very heterogeneous degree of olivine alteration, some grains have about 80% relict olivine, others are completely replaced, also different abundance of replacement associations, probably indicating different conditions during olivine replacement.
Plagioclase	50	5	chlorite 80%, prehnite 20%	
Clinopyroxene	40	5	green amphibole 50%, pale/colorless amphibole 50%	large clinopyroxene-oikocrysts

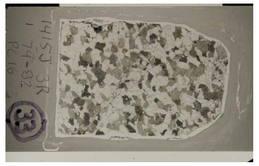
domain total alteration %: 11.6

ALTERATION COMMENT: Olivine is altered to tremolite and chlorite near the clinopyroxene oikocrysts. Away from the oikocrysts, alteration of olivine is dominantly to serpentine. Other minerals are nearly fresh. Abundant sulfide in talc and clay replacements of olivine, in chlorite-amphibole diffuse veins and patches, and on cleavages of partially altered clinopyroxene.

STRUCTURE COMMENT: Moderate magmatic foliation defined by plagioclase SPO. Very common submagmatic deformation twins and/or bent grains of plagioclase (some regions of the thin section every grain with deformation twins). Plagioclase grains wrap around clinopyroxene oikocrysts (hosting very high aspect ratio plagioclase inclusions). Some plagioclase bent (despite no plastic deformation of clinopyroxene). Olivine shows subgrain development.
Crystal Plastic: None.
Brittle: Minor open fractures.
Veins/alteration: Rare chlorite/serpentine veins.
Cross-cutting Relationships (as apparent in thin section):
1) Strong magmatic fabric development.
2) Minor fracturing with chlorite/serpentine fill.

PHOTOMICROGRAPHS: 345_U1415J_3R_1_TS_32.JPG
345_U1415J_3R_1_TS_32-2.JPG

THIN SECTION: 345-U1415J-3R-1-W 79/82-TSB_Piece_16-TS_33 **Thin Section no.:** 33
Rock name: gabbro
Rock comment: slightly altered
Lithologic interval: 11
Piece No.: #16 **Authors: NA, KF**
Billet request comment: lg. Pet: OPX pre.



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: homogeneous distribution of clinopyroxene & pl, remarkable granular texture

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase	64.5	64.5	0	3	subhedral to anhedral	tabular			120° triple junction	deformation twin
Clinopyroxene	35	35	0	2.5	subhedral to euhedral	subequant		colorless		
Orthopyroxene	0.1	0.5	0.4	1	anhedral	subequant		colorless		
Oxide	0.1	0.1	0	0.01	anhedral-subhedral	subequant				

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 10
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	6.4	clinopyroxene 3.4%, plagioclase 3%	Olivine	1	70	clay minerals 10%, serpentine 10%, talc 80%	only one olivine grain found; surrounded by chlorite rim
clay minerals	0.3	olivine 0.1%, orthopyroxene 0.3%	Plagioclase	60	5	chlorite 100%	
green amphibole	8	clinopyroxene 8%	Clinopyroxene	38	30	green amphibole 70%, chlorite 30%	
serpentine	0.1	olivine 0.1%	Orthopyroxene	1	50	clay minerals 50%, talc 50%	only one orthopyroxene grain found
talc	0.8	olivine 0.6%, orthopyroxene 0.3%					
domain total alteration %:	**15.6**						

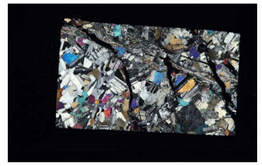
Vein summary
vein 1 1 thin vein (zeolite?)

ALTERATION COMMENT: Slighlty altered. Many chlorite microveinlets in plagioclase. Disseminated fine pyrite < 20 micron in blebby clinopyroxene and secondary plagioclase.

STRUCTURE COMMENT: Magmatic: Moderate magmatic foliation defined by plagioclase SPO. Common submagmatic deformation twins and/or bent grains of plagioclase, with moderate annealing. Olivine shows subgrain development.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: One "↵pull-apart' fracture system, and late open fractures.
Veins/alteration: Minor vein formation with chlorite and zeolite fill.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Minor fracturing and vein formation.

PHOTOMICROGRAPHS: 345_U1415J_3R_1_TS_33.JPG
345_U1415J_3R_1_TS_33-2.JPG

THIN SECTION: 345-U1415J-4R-1-W 2/5-TSB_Piece_1-TS_34 **Thin Section no.:** 34
Rock name: gabbro
Rock comment: slightly altered
Lithologic interval: 12
Piece No.: #1 **Authors: JM, RW**
Billet request comment: Ig. Pet: pri. mineral; MetPet: zeolite veins of cata; Struct: cataclastic zones



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase	55	75	20	2	subhedral	tabular	continuous zoning			weakely foliated, twin lamellae bended
Clinopyroxene	20	25	5	2	anhedral	subequant		colorless	interstitial	

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 5
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	2.9	plagioclase 2.9%	Plagioclase	80	6	chlorite 60%, zeolite 40%	microcrystalline chlorite replaces plagioclase in microfractures
zeolite	1.9	plagioclase 1.9%	Clinopyroxene	20	0		
domain total alteration %:	**4.8**						

Vein summary

vein 1 antitaxial prehnite vein
vein 2 parallel branching zeolite veins crosscut all other veins
vein 3 thin chlorite veins are cut by zeolite veins offset by brecciation.

ALTERATION COMMENT: Highly fractured sample with mainly vein filling alteration. 10-20 micron pyrites disseminated mainly in secondary plagioclase.

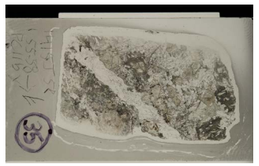
STRUCTURE COMMENT: Magmatic: Moderate magmatic foliation defined by plagioclase SPO. Common submagmatic deformation twins and/or bent grains of plagioclase, with moderate annealing.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Thin zone of weak cataclasis and open fractures.
Veins/alteration: Branching network of subparallel prehnite + chlorite + zeolite veins. The three minerals can fill the same veins. No clear cross-cutting relationships.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development
2) Minor cataclasis.
3) Alteration vein intrusion
4) Minor open fractures.

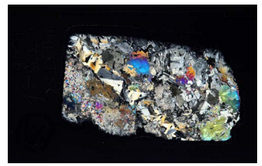
PHOTOMICROGRAPHS: 345_U1415J_4R_1_TS_34.JPG
345_U1415J_4R_1_TS_34-2.JPG

THIN SECTION: 345-U1415J-5R-1-W 55/58-TSB_Piece_11b-TS_35
Rock name: gabbro
Rock comment: moderately altered
Lithologic interval: 20
Piece No.: #11
Billet request comment: Ig. Pet: Primary minerology; Met. Pet: Alt w/ cataclastic zon; Struct: Cataclastic Zone

Thin Section no.: 35

Authors: JM, RW





PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1
Domain grain size: medium grained
Domain texture: granular
Domain comment: The gabbro is cut by a prehnite vein and highly altered.

Domain lithology: gabbro
Grain size distribution: seriate
Relative abundance (%): 100

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	0.1	0.1	1.2		irregular			corona	completely altered
Plagioclase	60	70	10	1.5	anhedral to subhedral	tabular	continuous zoning			
Clinopyroxene	20	30	10	4	anhedral	subequant		colorless	poikilitic	

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 28
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	1.5	olivine 0.2%, plagioclase 1.3%
pale/colorless amphibole	12.8	clinopyroxene 12.8%
prehnite	6.6	plagioclase 6.6%
secondary plagioclase	4	plagioclase 4%
sulfide	0	olivine < 0.1%
talc	1.8	olivine 1.8%
zeolite	1.3	plagioclase 1.3%
domain total alteration %:	**28**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	2	100	chlorite 8%, sulfide 2%, talc 90%	
Plagioclase	66	20	chlorite 10%, prehnite 50%, zeolite 10%, secondary plagioclase 30%	
Clinopyroxene	32	40	pale/colorless amphibole 100%	

Vein summary

vein 1 bladed zeolite vein adds 15 % by volume to the rock. Cuts clay veins.
vein 2 thin clay veins with radiating brownish fibres growing from walls

ALTERATION COMMENT: The background alteration of this gabbro is strongest adjacent to olivine where the original olivine grain is completely replaced by amphibole, and it and the neighboring plagioclase are replaced by chlorite. One large vein and other related cracks are filled with prehnite or chlorite. These minerals appear to fill fractures with a minimum of replacement of adjacent minerals. Pyrite and rare chalcopyrite occur in talc replacing olivine, and in secondary plagioclase, but not associated with zeolite and clay veins.

STRUCTURE COMMENT: Magmatic: Weak magmatic foliation defined by plagioclase SPO. Rare submagmatic deformation twins and bent grains of plagioclase; annealed. Locally well-developed subgrains in plagioclase.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Very minor cracking associated vein formation.
Veins/alteration: Large zeolite vein cuts prehnite (and finer branching prehnite+ chlorite) veins. Zeolite veins partially transformed into clay minerals.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Veining.

PHOTOMICROGRAPHS: 345_U1415J_5R_1_TS_35.JPG
345_U1415J_5R_1_TS_35-2.JPG

THIN SECTION: 345-U1415J-5R-1-W 62/64-TSB_Piece_12-TS_36
Rock name: clinopyroxene oikocryst-bearing, olivine-bearing gabbro
Rock comment: contains clinopyroxene oikocrysts; moderately altered
Lithologic interval: 21
Piece No.: #12
Billet request comment: Ig. Pet: Primary minerology; Struct: Magmatic Foliation

Thin Section no.: 36

Authors: TF, KF

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1
Domain grain size: medium grained
Domain texture: poikilitic
Domain comment:

Domain lithology: clinopyroxene oikocryst-bearing, olivine-bearing gabbro
Grain size distribution: seriate
Relative abundance (%): 100

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	1.5	3	1.5	1	subhedral to anhedral	amoeboid				
Plagioclase	54	55	1	1.5	subhedral to euhedral	tabular	patchy zoning			deformation evident; triple junctions present
Clinopyroxene	34	42	8	5	anhedral	elongate			poikilitic	oikocrysts contain resorbed and sometimes deformed plagioclase chadacrysts

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 20
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	2.5	plagioclase 2.5%
clay minerals	0.1	olivine 0.1%
green amphibole	14	olivine 0.5%, clinopyroxene 13.5%
oxide	0	olivine <0.1%
prehnite	1.3	plagioclase 1.3%
secondary plagioclase	1.3	plagioclase 1.3%
serpentine	0.3	olivine 0.3%
sulfide	0	olivine <0.1%
talc	0.1	olivine 0.1%
domain total alteration %:	**19.6**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	5	20	green amphibole 50%, clay minerals 5%, oxide 3%, sulfide 2%, serpentine 30%, talc 10%	different degree of olivine alteration, some grains have more than 80% relict olivine, others are completely replaced.
Plagioclase	50	10	chlorite 50%, prehnite 25%, secondary plagioclase 25%	plagioclase replaced by fine grained minerals along fractures (probably prehnite and secondary plagioclase), along grain boundaries replaced by chlorite when in contact with olivine.
Clinopyroxene	45	30	green amphibole 100%	clinopyroxene altered along fractures and cleavage planes

Vein summary
vein 1 chlorite veins

ALTERATION COMMENT: Plagioclase strongly fractured and altered to chlorite and prehnite. Some pyrite and chalcopyrite in amphibole after olivine and a few large (150 micron) chalcopyrites in chlorite patches after plagioclase.

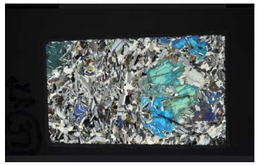
STRUCTURE COMMENT: Magmatic: Moderate magmatic foliation defined by plagioclase and clinopyroxene SPO. Twinned elongate clinopyroxene oikocrysts, hosting very elongate plagioclase grains w/ 20:1 aspect ratio. Common submagmatic deformation twins and/or bent grains of plagioclase, with moderate annealing. Subgrains in plagioclase with curved grain boundaries.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Network of subparallel open fractures.
Veins/alteration: Thin irregular branching chlorite veins with fibrous growth normal to vein walls.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Minor fracturing.
3) Chlorite vein formation.
4) Open fractures.

PHOTOMICROGRAPHS: 345_U1415J_5R_1_TS_36.JPG
345_U1415J_5R_1_TS_36-2.JPG

THIN SECTION: 345-U1415J-5R-1-W 117/120-TSB_Piece_17b-TS_37
Rock name: clinopyroxene oikocryst-bearing troctolite
Rock comment: oikocryst and matrix were described as two different domains; slightly altered
Lithologic interval: 24
Piece No.: #17
Billet request comment: Ig. Pet: Magm. Foliation Olv. Gabbro; Struct: Magmatic Contact

Thin Section no.: 37

Authors: TH, TN



PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** oikocrysts/ matrix

Igneous domain number: 1
Domain grain size: medium grained
Domain texture: granular
Domain comment:

Domain lithology: troctolite matrix
Grain size distribution: equigranular
Relative abundance (%): 72

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	12	17	5	1.5	anhedral	amoeboid				
Plagioclase	81	82	1	1.2	subhedral to anhedral	tabular	oscillatory			plagioclase grains aligned according foliation
Clinopyroxene	1	1	0	3	anhedral	irregular				
Oxide	0.1	0.1	0	0.1	anhedral	subequant				

Igneous domain number: 2
Domain grain size: medium grained
Domain texture: poikilitic
Domain comment: Amphibole bearing globules in clinopyroxene oikocrysts

Domain lithology: clinopyroxene oikocryst
Grain size distribution: seriate
Relative abundance (%): 28

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase	6	6	0	1	subhedral	tabular			chadacrysts (in clinopyroxene oikocrysts)	
Clinopyroxene	94	94	0	9	anhedral	subequant			poikilitic	oikocrysts contain sometimes deformed plagioclase crystals.
Orthopyroxene	0.05	0.1	0.05	0.5	anhedral	subequant		colorless		
Oxide	0.1	0.1	0	0.1	anhedral	subequant				

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 10
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	0.5	plagioclase 0.5%
clay minerals	3	olivine 3%
green amphibole	0.3	clinopyroxene 0.2%, plagioclase 0.2%
oxide	0.2	olivine 0.2%
pale/colorless amphibole	1.4	clinopyroxene 1.4%
prehnite	2.4	plagioclase 2.4%
serpentine	2.4	olivine 2.4%
sulfide	0.1	olivine 0.1%
talc	0.3	olivine 0.3%

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	10	60	clay minerals 50%, oxide 3%, sulfide 2%, serpentine 40%, talc 5%	uneven alteration, minimal development of corona texture.
Plagioclase	60	5	green amphibole 5%, chlorite 15%, prehnite 80%	fracture fillings
Clinopyroxene	30	5	green amphibole 10%, pale/colorless amphibole 90%	along cleavage surface

domain total alteration %: 10.6

Vein summary
vein 1 branching chlorite vein
vein 2 clay mineral

ALTERATION COMMENT: Uneven olivine alteration with fracturing sub parallel to magmatic foliation. Pyrite occurs in talc replacing olivine (intergrown with magnetite), as tiny grains in amphibole replacing clinopyroxene along cleavages, and together with chalcopyrite in chlorite veins and patches replacing plagioclase.

STRUCTURE COMMENT: Magmatic: Moderate magmatic foliation defined by plagioclase and clinopyroxene SPO. Twinned elongate clinopyroxene oikocrysts, hosting very elongate plagioclase grains w/ 20:1 aspect ratio. Common submagmatic deformation twins and/or bent grains of plagioclase, with moderate annealing. Subgrains in plagioclase with curved grain boundaries.
Crystal Plastic: No recognizable crystal plastic deformation
Brittle: Network of subparallel open fractures
Veins/alteration: Thin branching chlorite + serpentine veins.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development
2) Minor fracturing
3) Chlorite + serpentine vein formation
4) Open fractures

PHOTOMICROGRAPHS: 345_U1415J_5R_1_TS_37.JPG
345_U1415J_5R_1_TS_37-2.JPG

THIN SECTION: 345-U1415J-5R-1-W 138/141-TSB_Piece_18-TS_38
Rock name: olivine gabbro / orthopyroxene-bearing gabbro
Rock comment: contact between two lithological Intervals; slightly altered
Lithologic interval: 27/28
Piece No.: #18
Billet request comment: Ig. Pet: Primary mineralogy

Thin Section no.: 38

Authors: JM, KF

PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** contact between two lithological Intervals

Igneous domain number: 1
Domain grain size: medium grained
Domain texture: granular
Domain comment: lith. Interval 28

Domain lithology: olivine gabbro
Grain size distribution: seriate
Relative abundance (%): 55

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	15	18	3	2	anhedral	irregular-amoeboid				Longer axes are almost parallel to the foliation due to alignment of plagioclase. Olivines enclosed in clinopyroxene have rounded shape in contrast to irregular-shaped other olivine.
Plagioclase	66	70	4	1..5	subhedral to euhedral	tabular	continuous zoning			foliated
Clinopyroxene	10	12	2	2	anhedral	subequant		colorless	poikilitic	tend to form oikocrysts
Oxide	0.1	0.1	0	0.1	anhedral to subhedral	equant				

Igneous domain number: 2
Domain grain size: medium grained
Domain texture: granular
Domain comment: lith. Interval 27, contains clinopyroxene oikocrysts

Domain lithology: orthopyroxene -and- olivine-bearing gabbro
Grain size distribution: equigranular
Relative abundance (%): 45

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0.7	1	0.3	1	anhedral	equant				
Plagioclase	54	55	1	1.5	subhedral to euhedral	tabular	continuous zoning			foliated
Clinopyroxene	40	42	2	2.3	anhedral	subequant		colorless	poikilitic	
Orthopyroxene	1.5	2	0.5	1	subhedral	subequant		colorless		

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 10
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	0.9	plagioclase 0.9%
clay minerals	0.3	olivine 0.3%
green amphibole	1.2	olivine 1.2%
oxide	0.1	olivine 0.1%
pale/colorless amphibole	6	clinopyroxene 6%
prehnite	1.2	plagioclase 1.2%
secondary plagioclase	0.9	plagioclase 0.9%
serpentine	1.2	olivine 1.2%
sulfide	0.1	olivine 0.1%
talc	0.2	olivine 0.2%
domain total alteration %:	**12.1**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	10	30	green amphibole 40%, clay minerals 10%, oxide 3%, sulfide 2%, serpentine 40%, talc 5%	serpentine mesh texture after olivine, in some places amphibole forms mesh texture
Plagioclase	60	5	chlorite 30%, prehnite 40%, secondary plagioclase 30%	plagioclase altered to fine grained minerals along fractures
Clinopyroxene	30	20	pale/colorless amphibole 100%	clinopyroxene altered along cleavage planes and along fractures

Vein summary
vein 1 chlorite veins that crosscut plagioclase and clinopyroxene, but can not be traced in olivine grains

ALTERATION COMMENT: Very low degree of alteration in this thin section. Pyrite (up to 100 micron) occurs in talc and clay replacements of olivine, and with chalcopyrite enclosed in plagioclase and more commonly associated with chlorite veins and patches replacing plagioclase.

STRUCTURE COMMENT: Magmatic: Boundary between olivine gabbro and orthopyroxene-bearing gabbro.
Olivine gabbro - Strong magmatic foliation defined by plagioclase SPO. Common submagmatic deformation twins and/or bent grains of plagioclase; strong annealing. Cliopyroxene host to plagioclase and olivine inclusions. Subgrains in olivine, showing curved grain boundaries. Undulose extinction in plagioclase.
Orthopyroxene-bearing gabbro. - Moderate magmatic foliation defined by plagioclase SPO, questionably sigmoidal. Orthopyroxene host to plagioclase inclusions. Outside oikocrysts, see obliquity in plagioclase fabric to that in adjacent olivine gabbro. Common submagmatic deformation twins and/or bent grains of plagioclase, with strong annealing.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Network of subparallel fractures. Open fractures
Veins/alteration: Thin crack seal, pull-apart, irregular chlorite veins, showing fibrous growth from vein walls.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development (fabric in olivine gabbro parallels contact, whereas that in orthopyroxene-bearing gabbro? sigmoidal: olivine gabbro younger ???)
2) Minor fracturing.
3) Chlorite vein formation.
4) Open fractures.

PHOTOMICROGRAPHS: 345_U1415J_5R_1_TS_38.JPG
345_U1415J_5R_1_TS_38-2.JPG

THIN SECTION: 345-U1415J-5R-2-W 60/63-TSB_Piece_3-TS_39 **Thin Section no.:** 39
Rock name: olivine-bearing gabbro
Rock comment: slightly altered
Lithologic interval: 32
Piece No.: #3 **Authors: JM, KF**
Billet request comment: Ig. Pet: Primary mineralogy; Struct: Magm. Foliation

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** olivine-bearing gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	2	3	1	2	anhedral	irregular				olivine sometimes encloses or surrounds tabular plagioclase. Although olivine grains are very irregular in shape, their longer axes are almost parallel to the foliation due to alignment of plagioclase.
Plagioclase	70	73	3	1.5	subhedral to euhedral	tabular	continuous zoning			foliated
Clinopyroxene	20	23.7	3.7	2.5	anhedral	subequant		colorless	interstitial	Longer axes are almost parallel to the foliation due to alignment of plagioclase; poikilitic enclosing of plagioclase in some cases.
Orthopyroxene	0.3	0.3	0	0.5	anhedral	subequant		colorless		

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 10
Alteration domain number: 1 **Domain type:** background

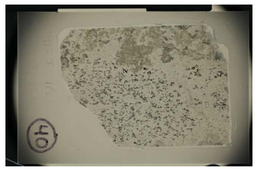
SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	1.1	plagioclase 1.1%
clay minerals	0.1	olivine 0.1%
green amphibole	0.8	olivine 0.8%
oxide	0.1	olivine 0.1%
pale/colorless amphibole	7.5	clinopyroxene 7.5%
prehnite	1.4	plagioclase 1.4%
secondary plagioclase	1.1	plagioclase 1.1%
serpentine	0.8	olivine 0.8%
sulfide	0	olivine <0.1%
talc	0.2	olivine 0.2%
domain total alteration %:	**13.1**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	5	40	green amphibole 40%, clay minerals 4%, oxide 4%, sulfide 2%, serpentine 40%, talc 10%	serpentine mesh textures after olivine, no corona texture.
Plagioclase	70	5	chlorite 30%, prehnite 40%, secondary plagioclase 30%	plagioclase altered along fractures
Clinopyroxene	30	25	pale/colorless amphibole 100%	clinopyroxene altered along fractures and cleavage planes

ALTERATION COMMENT: Very low degree of alteration. Pyrite and chalcopyrite occur in talc and clay after olivine, and also in chlorite patches after plagioclase.
STRUCTURE COMMENT: Magmatic: Moderate -to strong magmatic foliation defined by plagioclase SPO. Common submagmatic deformation twins and/or bent grains of plagioclase; strong annealing. Subgrains in olivine and clinopyroxene showing curved grain boundaries. Undulose extinction in plagioclase.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Minor filled fractures.
Veins/alteration: Thin chlorite veins.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Minor fracturing, and vein formation.

PHOTOMICROGRAPHS: 345_U1415J_5R_2_TS_39.JPG
345_U1415J_5R_2_TS_39-2.JPG

THIN SECTION: 345-U1415J-7G-1-W 28/31-TSB_Piece_5-TS_40 **Thin Section no.:** 40
Rock name: clinopyroxene oikocryst bearing troctolite/gabbronorite
Rock comment: contact between troctolite and gabbronorite; clinopyroxene oikocryst-bearing; slightly altered
Lithologic interval: G20
Piece No.: #5 **Authors: MMJ, TN**
Billet request comment: Lg. Fmt; Ig. Pet: Ig. Contact



PRIMARY MINERALOGY **No. of Igneous domains:** 3 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: fine grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 70
Domain comment: after domain separation, rock name is troctolite, no oikocrysts

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	30	40	10	0.8	anhedral	equant			corroded	olivine shows varying degrees of alteration
Plagioclase	50	60	10	1	subhedral to euhedral	tabular	discontinuous zoning			plagioclases are foliated
Oxide	0.1	0.1	0	0.1	anhedral	equant			interstitial	

Igneous domain number: 2 **Domain lithology:** clinopyroxene-oikocryst bearing troctolite
Domain grain size: medium grained **Grain size distribution:** seriate
Domain texture: poikilitic-granular **Relative abundance (%):** 20
Domain comment: oikocryst clinopyroxene in this domain; zone between domain 1 and 3

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	15	30	15	0.5	subhedral to euhedral	equant			overgrowth	
Plagioclase	40	45	5	0.6	subhedral to euhedral	tabular	discontinuous zoning			plagioclases are equant
Clinopyroxene	18	25	7		subhedral to euhedral	equant		pale green	poikilitic	oikocrysts
Oxide	0.1	0.1	0	0.1	anhedral	equant			interstitial	

Igneous domain number: 3 **Domain lithology:** gabbronorite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 10
Domain comment: Macroscopically identified with olivine present. No olivine present in domain.

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine										
Plagioclase	45	50	5	0.8	subhedral to euhedral	tabular	discontinuous zoning			
Clinopyroxene	20	35	15		subhedral to euhedral	equant		pale green	poikilitic	
Orthopyroxene	10	15	5	2	subhedral	subequant		pinkish brown		associated with clinopyroxene

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 40 **Estimated total % alteration:** 20
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	3.3	orthopyroxene 1%, plagioclase 2.3%	Plagioclase	50	5	green amphibole 10%, chlorite 90%	
green amphibole	1.5	clinopyroxene 1.2%, plagioclase 0.3%	Clinopyroxene	40	30	green amphibole 10%, pale/colorless amphibole 90%	
pale/colorless amphibole	12.3	clinopyroxene 10.8%, orthopyroxene 1.5%	Orthopyroxene	10	50	pale/colorless amphibole 30%, chlorite 20%, talc 50%	
talc	2.5	orthopyroxene 2.5%					
domain total alteration %:	**19.6**						

ALTERATION COMMENT: Heterogeneous alteration intensity. Minor sulfides in clinopyroxene.

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 60 **Estimated total % alteration:** 15
Alteration domain number: 2 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	4	olivine 1.2%, plagioclase 2.8%	Olivine	30	40	pale/colorless amphibole 25%, chlorite 10%, clay minerals 10%, oxide 4%, sulfide 1%, serpentine 30%, talc 20%	corontic assemblage near chlorite vein; clay replacement near clay vein
clay minerals	1.2	olivine 1.2%	Plagioclase	70	5	chlorite 80%, prehnite 10%, secondary plagioclase 5%, other 5%	other: prehnite, calcite, dusty tiny inclusion
oxide	0.5	olivine 0.5%					
pale/colorless amphibole	3	olivine 3%					
prehnite	0.4	plagioclase 0.4%					
secondary plagioclase	0.2	plagioclase 0.2%					
serpentine	3.6	olivine 3.6%					
sulfide	0.1	olivine 0.1%					
talc	2.4	olivine 2.4%					
other	0.2	plagioclase 0.2%					
domain total alteration %:	**15.6**						

Vein summary
vein 1 irregular-shaped, branching chlorite vein
vein 2 irregular-shaped clay vein

ALTERATION COMMENT: Alteration intensity and mineralogy after olivine are variable: tremolite + chlorite and talc are abundant near chlorite vein and clay minerals are near clay vein. Sulfides, sometimes associated with magnetite, are contained within talc and tremolite replacing olivine.

STRUCTURE COMMENT: Magmatic: Boundary between fine-grained troctolite and clinopyroxene oikocyrst-bearing troctolite
Fine-grained troctolite -Strong magmatic foliation defined by plagioclase SPO. Rare submagmatic deformation twins, rare undulose extinction in plagioclase; very strong annealing. Subgrains in olivine with curved grain boundaries. Rare large grains of poikilitic plagioclase with inclusions of olivine.
Clinopyroxene oikocryst-bearing troctolite - Weak magmatic foliation defined by plagioclase SPO. Clinopyroxene oikocrysts host to extremely bent plagioclase inclusions locally. Common submagmatic deformation twins and/or bent grains of plagioclase, and moderate annealing.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Rare fractures.
Veins/alteration: None.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development .
2) Very minor fracturing.

PHOTOMICROGRAPHS: 345_U1415J_7G_1_TS_40.JPG, 345_U1415J_7G_1_TS_40-2.JPG, 345_U1415J_7G_1_TS_40-3.JPG, 345_U1415J_7G_1_TS_40-4.JPG, 345_U1415J_7G_1_TS_40-5.JPG, 345_U1415J_7G_1_TS_40-6.JPG, 345_U1415J_7G_1_TS_40-7.JPG, 345_U1415J_7G_1_TS_40-8.JPG, 345_U1415J_7G_1_TS_40-9.JPG

THIN SECTION: 345-U1415J-7G-1-W 35/38-TSB_Piece_6-TS_41 **Thin Section no.:** 41
Rock name: clinopyroxene oikocryst-bearing olivine gabbro
Rock comment: contains a 2 cm sized elongated clinopyroxene oikocryst; slightly altered
Lithologic interval: G22
Piece No.: #6 **Authors: TH, RW**
Billet request comment: Ig. Pet: Breccia; Met. Pet: Pervasive Alteration; Struct: Ign. Fabric

PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** oikocrysts/ matrix

Igneous domain number: 1 **Domain lithology:** olivine gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 85
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0.7	5	4.3	4	anhedral	irregular				
Plagioclase	82	82	0	2.5	anhedral to subhedral	tabular	oscillatory			
Clinopyroxene	13	13	0	1	anhedral	subequant				elongated clinopyroxene (>20mm)

Igneous domain number: 2 **Domain lithology:** clinopyroxene oikocryst
Domain grain size: medium grained **Grain size distribution:** seriate
Domain texture: poikilitic **Relative abundance (%):** 15
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase	4	4	0	1.5	anhedral to subhedral	tabular			chadacrysts (in clinopyroxene oikocrysts)	Plagioclase crystals in clinopyroxene are rounded and smaller than those in the matrix.
Clinopyroxene	96	96	0	20	anhedral to subhedral	elongate				

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 10
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	2.8	olivine 0.3%, clinopyroxene 0.3%, plagioclase 2.2%	Olivine	8	75	pale/colorless amphibole 5%, chlorite 5%, oxide 1%, sulfide 4%, talc 85%	
oxide	0.1	olivine 0.1%, clinopyroxene <0.1%	Plagioclase	74	3	pale/colorless amphibole 2%, chlorite 98%	
pale/colorless amphibole	0.9	olivine 0.3%, clinopyroxene 0.5%, plagioclase <0.1%	Clinopyroxene	18	5	pale/colorless amphibole 60%, chlorite 38%, oxide 2%	
sulfide	0.2	olivine 0.2%					
talc	5.1	olivine 5.1%					
domain total alteration %:	**9.1**						

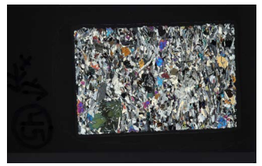
Vein summary
vein 1 Thin zeolite veins

ALTERATION COMMENT: Olivine is replaced by talc intergrown with trace sulfide minerals. Some grains are further altered to serpentine associated with magnetite. Plagioclase is altered to chlorite where it is adjacent to a former olivine grain. Background alteration is limited to chlorite growth in very thin fractures that cut the slide in parallel sets. Pyrite concentrated in talc replacing olivine, which appears to overprint a magnetite-bearing serpentine mesh texture. Minor pyrite in altered clinopyroxene.

STRUCTURE COMMENT: Magmatic: Moderate foliation defined by plagioclase SPO, well developed along the margins of elongate clinopyroxene, parallel throughout entire section. Common submagmatic deformation twins and/or bent grains of plagioclase; moderate annealing. Undulose extinction in plagioclase.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Minor parallel fracture/vein system, with zeolite.
Veins/alteration: Thin, zeolite veins crosscutting primary igneous minerals; talc + actinolite replacing some olivine
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Minor fracturing, and vein formation.

PHOTOMICROGRAPHS: 345_U1415J_7G_1_TS_41.JPG
345_U1415J_7G_1_TS_41-2.JPG

THIN SECTION: 345-U1415J-7G-1-W 55/56-TSB_Piece_8-TS_45 **Thin Section no.:** 45
Rock name: clinopyroxene oikocryst-bearing olivine gabbro
Rock comment: oikocryst and matrix were described as two different domains; fresh
Lithologic interval: G24
Piece No.: #8 **Authors: JM, RW**
Billet request comment: IgPet: Primary mineralogy; Structure: magmatic fractionation



PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** oikocrysts / matrix

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: medium grained **Grain size distribution:** seriate
Domain texture: granular **Relative abundance (%):** 93
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	13	15	2	1	anhedral	irregular-amoeboid				olivine sometimes encloses or surrounds tabular plagioclase. Although olivine grains are very irregular in shape, their longer axes are almost parallel to the foliation due to alignment of plagioclase.
Plagioclase	59	60	1	1.5	subhedral to euhedral	tabular	continuous zoning			Bending of twinning plane and of elongated grains
Clinopyroxene	25	25	0	5	anhedral	subequant		colorless	poikilitic	

Igneous domain number: 2 **Domain lithology:** clinopyroxene oikocryst
Domain grain size: coarse grained **Grain size distribution:**
Domain texture: **Relative abundance (%):** 7
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase	5	5	0	0.6	subhedral to euhedral	elongate	continuous zoning		chadacrysts	
Clinopyroxene	95	95	0	7	anhedral	equant		colorless		clinopyroxene oikocryst is deformed and distorted into several domains; wavy extinction; interstitial to matrix plagioclase at the margin of the oikocryst.

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 2.4
Alteration domain number: 1 **Domain type:** background

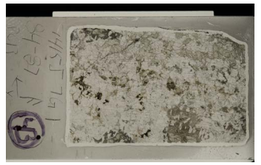
SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	0.6	plagioclase 0.6%	Olivine	12	10	clay minerals 47%, oxide 2%, sulfide 1%, serpentine 50%	
clay minerals	0.6	olivine 0.6%	Plagioclase	59	1	chlorite 100%	
oxide	0	olivine < 0.1%	Clinopyroxene	25	0		
serpentine	0.6	olivine 0.6%	Orthopyroxene	4	0		
sulfide	0	olivine < 0.1%					
domain total alteration %:	**1.8**						

ALTERATION COMMENT: Olivine is slightly replaced by serpentine intergrown with trace amounts of magnetite. Replacement by amphibole and talc is largely absent, while plagioclase and clinopyroxene are fractured without significant alteration. 100 micron sulfide in chlorite-amphibole patches in plagioclase, and also in secondary plagioclase. Minor sulfide with magnetite in serpentine mesh texture.

STRUCTURE COMMENT: Magmatic: Strong magmatic foliation defined by plagioclase SPO. Common submagmatic deformation twins and bent grains of plagioclase; annealed, and locally wraps around clinopyroxene. Imbricate plagioclase grains adjacent to large clinopyroxene grains and oikocrysts. Subgrains in clinopyroxene, olivine, and plagioclase.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Very minor cracking.
Veins/alteration: Very minor serpentine veining.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Minor fracturing; serpentine veins.

PHOTOMICROGRAPHS: 345_U1415J_7G_1_TS_45.JPG
345_U1415J_7G_1_TS_45-2.JPG

THIN SECTION: 345-U1415J-7G-1-W 84/87-TSB_Piece_13-TS_43 **Thin Section no.:** 43
Rock name: olivine gabbro
Rock comment:
Lithologic interval: G29
Piece No.: #13 **Authors: JM, NM**
Billet request comment: Ig. Pet: Primary mineralogy; Met. Pet: Alt. of Opx and Ol



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** olivine gabbro
Domain grain size: medium grained **Grain size distribution:** seriate
Domain texture: granular **Relative abundance (%):** 100
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	15	15	1.2	anhedral	equant				
Plagioclase	66	70	4	1.5	anhedral to subhedral	tabular	continuous zoning			chadacysts in clinopyroxene oikocrysts
Clinopyroxene	9	15	6	3.8	anhedral	subequant		colorless	poikilitic	
Oxide	0	0.1	0.1	0.1	anhedral	equant				

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 35
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	7.4	clinopyroxene 0.5%, plagioclase 6.8%
clay minerals	1.6	plagioclase 1.6%
oxide	0.6	olivine 0.6%, clinopyroxene < 0.1%
pale/colorless amphibole	7.4	olivine 5.3%, clinopyroxene 2.1%
prehnite	2.1	plagioclase 2.1%
secondary clinopyroxene	0.3	clinopyroxene 0.3%
serpentine	7.5	olivine 7.5%
sulfide	0.2	olivine 0.2%, clinopyroxene 0%
talc	1.5	olivine 1.5%
domain total alteration %:	**28.6**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	15	100	pale/colorless amphibole 35%, oxide 4%, sulfide 1%, serpentine 50%, talc 10%	
Plagioclase	70	15	chlorite 65%, clay minerals 15%, prehnite 20%	
Clinopyroxene	15	20	pale/colorless amphibole 70%, chlorite 18%, oxide 1%, sulfide 1%, secondary clinopyroxene 10%	

Vein summary

vein 1 Network of thin chlorite veins cut across plagioclase and also follows plagioclase grain boundaries.
vein 2 Branching zeolite veins cut chlorite rims in plagioclase and also cut chlorite veins.
vein 3 Very thin veins filled with clay minerals cut across plagioclase and olivine.

ALTERATION COMMENT: Olivine is completely replaced by serpentine, amphibole, talc, magnetite and sulfide. Large blades of amphibole replace olivine. Chlorite rims relict plagioclase. Plagioclase is altered to (mostly) chlorite along grain boundaries, but is also altered along fractures. Branching prehnite veins postdate the network of thin chlorite veins and clay minerals veins. Minor sulfides in olivine alteration products, overgrown by magnetite in iddingsite in one case.

STRUCTURE COMMENT: Magmatic: Isotropic to weakly defined magmatic foliation. Rare deformation twins of plagioclase, locally with annealed grain boundaries. Minor subgrains in plagioclase and clinopyroxene.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Minor cracking.
Veins/alteration: Primary igneous minerals cut by abundant but very thin and short chlorite veins. A few zeolite or albite veins zig-zag through the thin section and cut fresh and altered minerals.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Pervasive fracturing with zeolite or albite filling.
3) Zeolite or albite vein injection.

PHOTOMICROGRAPHS: 345_U1415J_7G_1_TS_43.JPG
345_U1415J_7G_1_TS_43-2.JPG

THIN SECTION: 345-U1415J-7G-1-W 91/94-TSB_Piece_14-TS_42 **Thin Section no.:** 42
Rock name: troctolite/clinopyroxene oikocryst-bearing gabbro
Rock comment: contains two different lithologies; moderately altered
Lithologic interval: G30
Piece No.: #14 **Authors: TF, RW**
Billet request comment: Ig Pet: Primary mineralogy

PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** contact between two lithologies

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 40
Domain comment: troctolitic with well developed foliation defined by tabular plagioclase and ameoboid olivine

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	4	40	36	1	subhedral to anhedral	amoeboid				
Plagioclase	59	60	1	1.5	euhedral to subhedral	tabular	patchy zoning			

Igneous domain number: 2 **Domain lithology:** clinopyroxene oikocryst-bearing gabbro
Domain grain size: medium grained **Grain size distribution:** seriate
Domain texture: pokilitic **Relative abundance (%):** 60
Domain comment: domain 2 contains no olivine, interstitial clinopyroxene which appears to be forming at plagioclase triple junctions. Clinopyroxene oikocrysts. Plagioclase rich areas with well developed triple junctions and more random less foliated orientation

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase	64	65	1	1.5	subhedral to euhedral	tabular	patchy zoning			chadacrysts in clinopyroxene oikocrysts
Clinopyroxene	5	35	30	5	anhedral	irregular		colorless	poikilitic	

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 30 **Estimated total % alteration:** 8
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	1.8	plagioclase 1.8%
oxide	1.2	olivine 1.2%
pale/colorless amphibole	4.8	olivine 4.8%
domain total alteration %:	**7.8**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	10	60	pale/colorless amphibole 80%, oxide 20%	
Plagioclase	90	2	chlorite 100%	

ALTERATION COMMENT: Olivine in this slide is mantled by a rim of randomly oriented needles of amphibole with larger grains in the interior. Inside these rims talc occurs, leaving the amphibole euhedral. In other grains serpentine with finely intergrown magnetite replaces relic olivine. Plagioclase alteration to chlorite occurs along the interfaces with former olivine, and along other fractures and grain boundaries as a background alteration.

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 70 **Estimated total % alteration:** 29
Alteration domain number: 2 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	26	olivine 22.3%, clinopyroxene 0.1%, orthopyroxene 0.1%, plagioclase 3.5%
green amphibole	0.7	clinopyroxene 0.7%
oxide	0.3	olivine 0.3%
pale/colorless amphibole	2.6	olivine 2.5%, orthopyroxene 0.1%
domain total alteration %:	**29.6**	

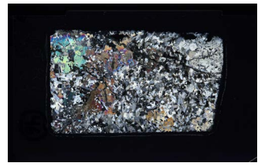
PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	25	100	pale/colorless amphibole 10%, chlorite 89%, oxide 1%	
Plagioclase	69	5	chlorite 100%	
Clinopyroxene	4	20	green amphibole 85%, chlorite 15%	
Orthopyroxene	2	10	pale/colorless amphibole 30%, chlorite 70%	

ALTERATION COMMENT: Olivine completely altered. Pyrite associated with talc pseudomorph after olivine.

STRUCTURE COMMENT: Magmatic: Boundary between fine-grained troctolite and gabbro.
Troctolite - Strong magmatic foliation defined by plagioclase SPO. Common submagmatic deformation twins in plagioclase; strong annealing. Subgrains and undulose extinction in olivine.
Gabbro - Moderate magmatic foliation defined by plagioclase SPO; common deformation twins and minor bent grains, in medium grained plagioclase (relative to the olivine gabbro); moderate annealing, and subgrains in plagioclase.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Minor cracking.
Veins/alteration: Two thin, low birefringence (albite?) veins cut but locally fill clay-filled brittle fractures in the gabbro (prehnite partially replaced by clay).
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Minor fracturing and vein formation.

PHOTOMICROGRAPHS: 345_U1415J_7G_1_TS_42.JPG
345_U1415J_7G_1_TS_42-2.JPG

THIN SECTION: **345-U1415J-8R-1-W 34/37-TSB_Piece_7-TS_46** **Thin Section no.:** **46**
Rock name: clinopyroxene oikocryst-bearing troctolite
Rock comment: oikocryst and matrix were described as two different domains; highly altered
Lithologic interval: 37
Piece No.: #7 **Authors: TH, MP**
Billet request comment: IgPet: Primary mineralogy; MetPet: Ol alt. process



PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** oikocrysts/ matrix

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 65
Domain comment: Highly altered

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0.2	17	16.8	0.6	anhedral	subequant				altered
Plagioclase	68	83	15	1	anhedral to subhedral	tabular	oscillatory			

Igneous domain number: 2 **Domain lithology:** clinopyroxene oikocryst
Domain grain size: medium grained **Grain size distribution:** seriate
Domain texture: poikilitic **Relative abundance (%):** 35
Domain comment: Clinopyroxene oikocrysts are connected with each other.

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase	17	18	1	0.6	anhedral to subhedral	tabular			chadacrysts (in clinopyroxene oikocrysts)	plagioclase crystals in clinopyroxene oikocrysts form a network; altered
Clinopyroxene	82	82	0	7	anhedral	irregular		colorless	poikilitic	oikocrysts contain sometimes deformed plagioclase crystals.

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 50
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	4.3	olivine 1.5%, clinopyroxene 2.8%
clay minerals	5.3	plagioclase 5.3%
epidote/zoisite	0.4	plagioclase 0.4%
ferric oxyhydroxide	0.1	oxide 0.1%
green amphibole	8.4	clinopyroxene 8.4%
oxide	1.4	clinopyroxene 1.4%
pale/colorless amphibole	22.4	olivine 7%, clinopyroxene 15.4%
sulfide	1.5	olivine 1.5%
zeolite	1.9	plagioclase 1.9%
domain total alteration %:	**45.7**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	10	100	pale/colorless amphibole 70%, chlorite 15%, sulfide 15%	
Plagioclase	50	15	clay minerals 70%, zeolite 25%, epidote/zoisite 5%	
Clinopyroxene	40	70	green amphibole 30%, pale/colorless amphibole 55%, chlorite 10%, oxide 5%	
Oxide	1	5	ferric oxyhydroxide 100%	Presence of rare chromite often associated to olivine. Alteration rim with probable transformation into ferric-chromite or magnetite.

Vein summary

vein 1 Presence of thin cross fiber chlorite veins crosscutting plagioclase, pyroxene, and olivine. The thickness of the veins slightly decrease when in former olivine, probably due to contemporaneous fracturing to an alteration of olivine accompanied by increase in volume.

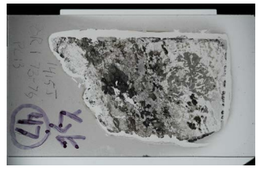
ALTERATION COMMENT: Olivine totally altered to amphibole, chlorite and sulfide. Clinopyroxene oikocrysts are moderately to highly altered to amphibole. Pyrite associated with talc pseudomorph after olivine, and along clinopyroxene cleavage surfaces.

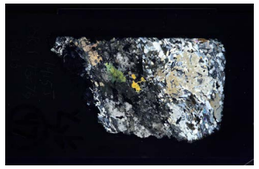
STRUCTURE COMMENT: Magmatic: Moderate magmatic foliation defined by plagioclase SPO. Common submagmatic deformation twins in plagioclase; strongly annealed. Subgrain development in clinopyroxene oikocrysts.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Cracking.
Veins/alteration: Conjugate (?) veins sealed with serpentine partially transformed to clay, showing multiple opening events.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Fracturing and cataclasis.
3) Chlorite crack seal veining, and alteration of the seal to clay.

PHOTOMICROGRAPHS: 345_U1415J_8R_1_TS_46.JPG
345_U1415J_8R_1_TS_46-2.JPG

THIN SECTION: 345-U1415J-8R-1-W 73/76-TSB_Piece_13-TS_47
Rock name: clinopyroxene oikocryst-bearing troctolite
Rock comment: oikocryst and matrix were described as two different domains; highly altered vein halo
Lithologic interval: 38
Piece No.: #13
Billet request comment: IgPet: Primary mineralogy; MetPet: Vein and Halo

Thin Section no.: 47
Authors: JM, TN





PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** oikocrysts / matrix

Igneous domain number: 1
Domain grain size: medium grained
Domain texture: granular
Domain comment:
Domain lithology: troctolite
Grain size distribution: equigranular
Relative abundance (%): 85

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	3	20	17	1	anhedral	irregular				
Plagioclase	35	77	42	1	subhedral	tabular	continuous zoning			foliated
Clinopyroxene	1	3	2	1	anhedral	subequant		colorless	interstitial	
Oxide	0.1	0.1	0	0.1	anhedral	equant				

Igneous domain number: 2
Domain grain size: coarse grained
Domain texture:
Domain comment:
Domain lithology: clinopyroxene oikocryst
Grain size distribution:
Relative abundance (%): 15

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	0.1	0.1	0.4	anhedral	equant				
Plagioclase	9	11	2	0.6	subhedral	elongate	continuous zoning		chadacrysts	
Clinopyroxene	80	89	9	6	anhedral	equant		colorless	poikilitic	

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 50 **Estimated total % alteration:** 25
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
carbonate	0.1	olivine 0.1%
chlorite	1.5	olivine 0.3%, plagioclase 1.2%
clay minerals	3.6	olivine 3.6%
green amphibole	1.5	clinopyroxene 1.5%
oxide	0.3	olivine 0.3%
pale/colorless amphibole	13.7	olivine 0.2%, clinopyroxene 13.5%
prehnite	1.5	plagioclase 1.5%
serpentine	1.8	olivine 1.8%
sulfide	0.1	olivine 0.1%
talc	2.7	olivine 2.7%
other	0.3	plagioclase 0.3%
domain total alteration %:	**27.1**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	10	90	pale/colorless amphibole 2%, chlorite 3%, clay minerals 40%, oxide 3%, sulfide 1%, serpentine 20%, talc 30%, carbonate 1%	
Plagioclase	60	5	chlorite 40%, prehnite 50%, other 10%	other: carbonate
Clinopyroxene	30	50	green amphibole 10%, pale/colorless amphibole 90%	along cleavage surface

Vein summary
vein 1 chlorite irregular vein

ALTERATION COMMENT: Alteration intensity increases toward vein halo. Pyrite associated with talc/clay pseudomorph after olivine, and along clinopyroxene cleavage surfaces.

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 50 **Estimated total % alteration:** 90
Alteration domain number: 2 **Domain type:** halo

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	12.7	clinopyroxene 7%, plagioclase 5.7%
clay minerals	17	olivine 17%
garnet	5.7	plagioclase 5.7%
pale/colorless amphibole	7	clinopyroxene 7%
prehnite	45.6	plagioclase 45.6%
serpentine	2	olivine 2%
sulfide	1	olivine 1%
domain total alteration %:	**91**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	20	100	clay minerals 85%, sulfide 5%, serpentine 10%	
Plagioclase	60	95	chlorite 10%, prehnite 80%, garnet 10%	
Clinopyroxene	20	70	pale/colorless amphibole 50%, chlorite 50%	

Vein summary
vein 1 zeolite masssive vein

ALTERATION COMMENT: Vein halo with intense alteration. Olivine is completely replaced by clay minerals, serpentine, and pyrite. Clinopyroxene is highly altered to pale amphibole and chlorite.

STRUCTURE COMMENT:
Magmatic: Moderate -to- strong magmatic foliation defined by plagioclase SPO. Rare submagmatic deformation twins and bent grains of plagioclase; locally annealed, commonly hosted in clinopyroxene oikocrysts.
Plagioclase wraps around clinopyroxene oikocrysts. Locally well-developed subgrains in plagioclase, and olivine.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Very cracking normal to foliation.
Veins/alteration: Zone of intense alteration (chlorite and abundant carbonate), bound on one side by strained (?) zeolite vein that cuts prehnite oriented subparallel to magmatic foliation.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development
2) Cracking
3) Veining

PHOTOMICROGRAPHS: 345_U1415J_8R_1_TS_47.JPG, 345_U1415J_8R_1_TS_47-2.JPG, 345_U1415J_8R_1_TS_47-3.JPG, 345_U1415J_8R_1_TS_47-4.JPG, 345_U1415J_8R_1_TS_47-5.JPG

THIN SECTION: 345-U1415J-8R-1-W 79/82-TSB_Piece_13-TS_49
Rock name: clinopyroxene oikocryst-bearing troctolite
Rock comment: contains cm-sized oikocrysts; moderately altered
Lithologic interval: 38
Piece No.: #13
Billet request comment: IgPet: Primary mineralogy; MetPet: Magmatic Foliation

Thin Section no.: 49

Authors: JK, RW

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1
Domain grain size: medium grained
Domain texture: granular, poikilitic
Domain comment: granular textured troctolite with cm-sized oikocrysts

Domain lithology: clinopyroxene oikocryst-bearing troctolite
Grain size distribution: inequigranular
Relative abundance (%): 100

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	9	10	1	2	anhedral	elongate			films of orthopyroxene	elongated grains parallel to foliation; subgrain structure
Plagioclase	53	55	2	1	subhedral	tabular	continuous to patchy zoning		chadacrysts (in clinopyroxene oikocrysts)	equilibrated texture with triple junctions in troctolite matrix; resorption features in the oikocrysts
Clinopyroxene	33	35	2	5	anhedral	irregular		colorless	poikilitic	oikocrysts are deformed (subgrain structure; strong undulose extinction); thin films of clinopyroxene around olivine in the troctolite matrix
Orthopyroxene	0.1	0.1	0		anhedral	irregular		pale pinkish brown	rim growth, interstitial	thin film around olivine in the troctolite matrix

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 11
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	1.2	plagioclase 1.2%
clay minerals	1.7	olivine 1.7%
pale/colorless amphibole	7.2	clinopyroxene 7.2%
serpentine	1.3	olivine 1.3%
talc	0.8	olivine 0.8%
domain total alteration %:	**12.2**	

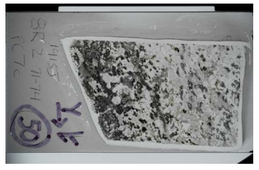
PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	15	25	clay minerals 45%, serpentine 35%, talc 20%	serpentine replaces olivine with mesh texture, clay minerals and talc occur on the edge of olivine grains.
Plagioclase	60	2	chlorite 100%	chlorite replacement primarily along cracks
Clinopyroxene	24	30	pale/colorless amphibole 100%	amphibole pseudomorphs after clinopyroxene
Orthopyroxene	1	0		

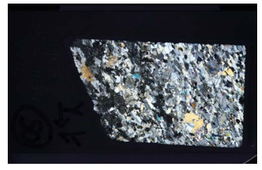
ALTERATION COMMENT: Slightly altered with clay minerals, serpentine, and talc after olivine; pale/colorless amphibole after clinopyroxene. Plagioclase is slightly altered to chlorite along cracks. Pyrite associated with talc/clay replacing olivine, and along clinopyroxene cleavage surfaces.

STRUCTURE COMMENT: Magmatic: Olivine gabbro with clinopyroxene oikocrysts w/ swirly strong plagioclase SPO; rare submagmatic deformation twins in plagioclase; annealed. Subgrain formation in olivine and large clinopyroxene oikocrysts with slightly curved grain boundaries.
Crystal Plastic: No evidence of subsolidus crystal plastic deformation.
Brittle: Very minor cracking.
Veins/alteration: Cut by rare chlorite veins.
Cross-cutting Relationships (as apparent in thin section):
1) Submagmatic deformation; no recognizable magmatic fabric development.
2) Minor cracking and veining.

PHOTOMICROGRAPHS: 345_U1415J_8R_1_TS_49.JPG
345_U1415J_8R_1_TS_49-2.JPG

THIN SECTION: 345-U1415J-8R-2-W 71/74-TSB_Piece_7c-TS_50 **Thin Section no.:** 50
Rock name: orthopyroxene-bearing olivine gabbro
contains clinopyroxene oikocrysts in troctolite matrix; interstitial orthopyroxene; moderately altered pervasive alteration; strongly altered vein halo
Rock comment:
Lithologic interval: 41
Piece No.: #7
Billet request comment: IgPet: Primary mineralogy; MetPet: Vein halo w/o cataclasis
Authors: TF, AM





PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** orthopyroxene-bearing olivine gabbro
Domain grain size: mediumgrained **Grain size distribution:** seriate
Domain texture: granular, poikilitic **Relative abundance (%):** 100
Domain comment: some clinopyroxene is oikocrystic like with resorbed deformed plagioclase chadacrysts

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	12	25	13	1	anhedal	amoeboid			films of orthopyroxene	
Plagioclase	50	60	10	1.5	subhedral	tabular	continuous to patchy zoning		chadacrysts (in clinopyroxene oikocrysts)	equilibrated texture with triple junctions in troctolite matrix; resorption features in the oikocrysts
Clinopyroxene	8	10	2	1	anhedral	irregular			interstitial, pokilitic	oikocrysts are deformed (subgrain structure; strong undulose extinction); thin films of clinopyroxene around olivine in the troctolite matrix
Orthopyroxene	4	5	1	1	anhedral	irregular		pale pinkish brown	rim growth, interstitial	thin film around olivine in the troctolite matrix

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 50 **Estimated total % alteration:** 20
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	4.1	olivine 0.5%, plagioclase 3.6%	Olivine	30	30	chlorite 5%, clay minerals 10%, oxide 2%, serpentine 15%, talc 68%	much more altered near chlorite veins. No coronas
clay minerals	0.9	olivine 0.9%	Plagioclase	60	20	chlorite 30%, prehnite 70%	locally dense prehnite vein networks replace plagioclase
green amphibole	1.5	clinopyroxene 1.5%	Clinopyroxene	5	30	green amphibole 100%	patchy alteration around cracks and palgioclase inclusions
oxide	0.2	olivine 0.2%	Orthopyroxene	5	10	pale/colorless amphibole 50%, serpentine 50%	orthopyroxene rims around olivine are sometimes altered - otherwise fresh
pale/colorless amphibole	0.3	orthopyroxene 0.3%					
prehnite	8.4	plagioclase 8.4%					
serpentine	1.6	olivine 1.4%, orthopyroxene 0.3%					
talc	6.1	olivine 6.1%					
domain total alteration %:	**23.1**						

Vein summary
vein 1 polycrystalline chlorite veins, sometimes fine prehnite with unresolvable time relations. narrow halos show intense talc alteration of olivine
vein 2 prehnite vein networks radiate around olivine

ALTERATION COMMENT: Moderately altered especially along veins. No coronas, although talc and serpentine replace olivine.

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 50 **Estimated total % alteration:** 79
Alteration domain number: 2 **Domain type:** halo

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	39.1	olivine 9%, clinopyroxene 0.7%, plagioclase 29.4%	Olivine	30	100	chlorite 30%, clay minerals 15%, serpentine 50%, talc 5%	
clay minerals	4.5	olivine 4.5%	Plagioclase	60	70	chlorite 70%, prehnite 30%	plagioclase altered to aggregates of microfibrous chlorite (?) and prehnite possibly after chlorite. In some areas fresh plagioclase is replaced by prehnite along microfractures.
green amphibole	2.8	clinopyroxene 2.8%	Clinopyroxene	5	70	green amphibole 80%, chlorite 20%	
pale/colorless amphibole	3.5	orthopyroxene 3.5%	Orthopyroxene	5	70	pale/colorless amphibole 100%	
prehnite	12.6	plagioclase 12.6%					
serpentine	15	olivine 15%					
talc	1.5	olivine 1.5%					
domain total alteration %:	**79**						

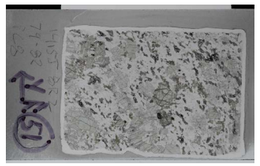
Vein summary
vein 1 prehnite rosettes on edge of slide
vein 2 chlorite cross-fibre vein near edge of halo. locally contains prehnite on the outside. Probably antitaxial

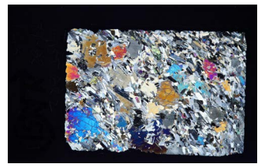
ALTERATION COMMENT: Strongly altered halo of prehnite vein. Pyrite associated with serpentine/clay replacing olivine, along clinopyroxene cleavage surfaces, inclusions in amphibole, and in chlorite +/- calcite-filled fractures in plagioclase.

STRUCTURE COMMENT: Magmatic: Olivine gabbro with clinopyroxene oikocrysts showing strong plagioclase SPO; rare submagmatic deformation twins in plagioclase; annealed. Subgrain formation in olivine and large clinopyroxene oikocrysts with slightly curved grain boundaries.
Crystal Plastic: Subsolidus crystal plastic deformation of plagioclase and clinopyroxene includes subgrain formation in both, and undulose extinction in plagioclase.
Brittle: Moderate fracturing overprinting radiating cracks surrounding olivine.
Veins/alteration: Serpentine/chlorite vein roughly parallel to the magmatic foliation. Serpentine/chlorite fibers perpendicular to the vein walls. Evidence for multiple growth events. Local shearing of the vein and of the vein filling material.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Minor cracking and veining.
3) Serpentine/chlorite veining, and local shearing.

PHOTOMICROGRAPHS: 345_U1415J_8R_2_TS_50.JPG
345_U1415J_8R_2_TS_50-2.JPG

THIN SECTION: 345-U1415J-8R-2-W 79/82-TSB_Piece_8-TS_51 **Thin Section no.:** 51
Rock name: clinopyroxene oikocryst-bearing olivine gabbro
Rock comment: oikocryst and matrix were described as two different domains
Lithologic interval: 41
Piece No.: #8 **Authors: TH, MP**
Billet request comment: lgPet: Primary mineralogy





PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** oikocrysts/ matrix

Igneous domain number: 1 **Domain lithology:** olivine gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: poikilitic **Relative abundance (%):** 80
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	18	21	3	1	anhedral to subhedral	subequant				subgrain
Plagioclase	71	71	0	1.5	anhedral to subhedral	tabular	oscillatory			
Clinopyroxene	8	8	0	4	anhedral	subequant		colorless		
Oxide	0.1	0.1	0	0.01	anhedral	subequant				

Igneous domain number: 2 **Domain lithology:** clinopyroxene oikocryst
Domain grain size: medium grained **Grain size distribution:** seriate
Domain texture: poikilitic **Relative abundance (%):** 20
Domain comment: orthopyroxene occurs adjacent to the domain of clinopyroxene oikocryst and is assigned to the oikocryst domain; some clinopyroxene oikocrysts are connected with each other.

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0.4	1	0.6	0.7	anhedral	subequant				
Plagioclase	10	10	0	1	subhedral	tabular			chadacrysts (in clinopyroxene oikocrysts)	Some plagioclase crystals in clinopyroxene oikocrysts sometimes form aggregates.
Clinopyroxene	87	87	0	8	anhedral to subhedral	subequant		colorless	poikilitic	Some clinopyroxene oikocrysts form larger cluster
Orthopyroxene	2	2	0	2	subhedral	subequant		colorless		
Oxide	0.1	0.1	0	0.01	anhedral	subequant				

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 10
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	1.2	clinopyroxene 0.1%, plagioclase 1.1%
clay minerals	0.3	olivine 0.3%
green amphibole	0.3	olivine 0.3%
oxide	0.2	olivine 0.2%, clinopyroxene <0.1%
pale/colorless amphibole	1.3	clinopyroxene 1.3%
prehnite	4.4	plagioclase 4.4%
serpentine	0.8	olivine 0.8%, clinopyroxene 0.1%
talc	1.5	olivine 1.5%

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	15	20	green amphibole 10%, clay minerals 10%, oxide 5%, serpentine 25%, talc 50%	
Plagioclase	55	10	chlorite 20%, prehnite 80%	
Clinopyroxene	30	5	pale/colorless amphibole 89%, chlorite 5%, oxide 1%, serpentine 5%	

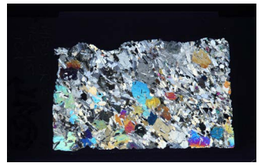
domain total alteration %: 10

ALTERATION COMMENT: Minimal alteration. No veins, no coronae Pyrite associated with talc/serpentine/clay replacing olivine, along clinopyroxene cleavage surfaces, and in chlorite-filled fractures in plagioclase.

STRUCTURE COMMENT: Magmatic: Olivine gabbro with clinopyroxene oikocrysts, showing strong plagioclase SPO; rare submagmatic deformation twins and bent grains in plagioclase; annealed. Elongate/skeletal clinopyroxene oikocrysts hosting inclusions of plagioclase, but no olivine. Clinopyroxene 'rims' common along olivine and plagioclase grain boundaries. Tabular olivine.
Crystal Plastic: No evidence of subsolidus crystal plastic deformation.
Brittle: Very minor cracking associated with olivine.
Veins/alteration: Cut by rare chlorite veins.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Minor cracking and chlorite veining.

PHOTOMICROGRAPHS: 345_U1415J_8R_2_TS_51-2.JPG
345_U1415J_8R_2_TS_51-3.JPG
345_U1415J_8R_2_TS_51-4.JPG

THIN SECTION: 345-U1415J-8R-2-W 112/115-TSB_Piece_9-TS_52 **Thin Section no.:** 52
Rock name: olivine-bearing gabbro/olivine gabbro
Rock comment: contact between two lithological Intervals; slightly altered
Lithologic interval: 42/43
Piece No.: #9 **Authors: JM, MP**
Billet request comment: lgPet: Primary mineralogy; MetPet: Alt. along igneous contact



PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** contact between two lithological Intervals

Igneous domain number: 1 **Domain lithology:** olivine-bearing gabbro
Domain grain size: medium grained **Grain size distribution:** seriate
Domain texture: granular **Relative abundance (%):** 60
Domain comment: This thin section contains boundary between subunit 42 and 43, which is not sharp but sutured. This domain is subunit 42.

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	5	5	1.5	anhedral	irregular				Olivine is completely altered.
Plagioclase	42	45	3	1.5	anhedral to subhedral	tabular	continuous zoning			tabular grains of plagioclase show foliation
Clinopyroxene	47	50	3	2.3	anhedral	subequant		colorless	poikilitic	clinopyroxene grains are interstitial with the plagioclase framework
Orthopyroxene	0.1	0.1	0	0.5	anhedral	irregular		colorless	reaction rim	

Igneous domain number: 2 **Domain lithology:** olivine gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 40
Domain comment: This thin section contains boundary between subunit 42 and 43, which is not sharp but sutured. This domain is subunit 43.

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	8	10	2	1.3	anhedral	irregular				
Plagioclase	72	75	3	1.5	anhedral to subhedral	tabular	continuous zoning			tabular grains of plagioclase show foliation
Clinopyroxene	14	15	1	2.2	anhedral	subequant		colorless	poikilitic	clinopyroxene grains are interstitial with the plagioclase framework
Orthopyroxene	0.1	0.1	0	0.1	anhedral	irregular		colorless	reaction rim	

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 60 **Estimated total % alteration:** 20
Alteration domain number: 1 **Domain type:** background: olivine bearing gabbro

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	0.4	olivine 0.4%,
green amphibole	2.4	clinopyroxene 2.4%
oxide	0.1	olivine 0.1%
pale/colorless amphibole	0.3	olivine 0.1%, orthopyroxene 0.2%
prehnite	9	plagioclase 9%
talc	4.5	olivine 4.5%
domain total alteration %:	**16.7**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	5	100	pale/colorless amphibole 2%, chlorite 7%, oxide 1%, talc 90%	
Plagioclase	45	20	prehnite 100%	
Clinopyroxene	48	5	green amphibole 100%	
Orthopyroxene	2	10	pale/colorless amphibole 100%	

ALTERATION COMMENT: Slightly altered with talc, chlorite, amphibole, and magnetite after olivine. Clinopyroxene is replaced by green amphibole, orthopyroxene is replaced by colorless amphibole, plagioclase is replaced by prehnite. Pyrite is associated with talc/serpentine replacing olivine, along cleavage surfaces of clinopyroxene, and inclusion in amphibole.

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 40 **Estimated total % alteration:** 10
Alteration domain number: 2 **Domain type:** background: olivine gabbro

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	0.2	olivine 0.2%
clay minerals	0.1	olivine 0.1%
green amphibole	0.7	clinopyroxene 0.7%
oxide	0.1	olivine 0.1%
pale/colorless amphibole	0.1	orthopyroxene 0.1%
prehnite	9	plagioclase 9%
serpentine	0.2	olivine 0.2%
talc	1.4	olivine 1.4%
zeolite	2.3	plagioclase 2.3%
domain total alteration %:	**14.1**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	10	20	chlorite 10%, clay minerals 5%, oxide 5%, serpentine 10%, talc 70%	
Plagioclase	75	15	prehnite 80%, zeolite 20%	
Clinopyroxene	13	5	green amphibole 100%	
Orthopyroxene	2	5	pale/colorless amphibole 100%	

ALTERATION COMMENT: Slightly altered with talc, chlorite, serpentine, clay minerals, and magnetite after olivine. Clinopyroxene is replaced by green amphibole, orthopyroxene is replaced by colorless amphibole, plagioclase is replaced by prehnite and zeolite. Pyrite is associated with talc/serpentine replacing olivine, along cleavage surfaces of clinopyroxene, and inclusion in amphibole.

STRUCTURE COMMENT: Magmatic: Contact between medium-grained olivine gabbro and olivine-bearing gabbro

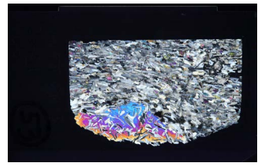
Medium-grained olivine gabbro - Very strong magmatic foliation defined by plagioclase and olivine SPO. Rare submagmatic deformation twins, rare undulose extinction in plagioclase; annealed. Rounded/lobate olivine showing subgrains with curved grain boundaries. Intercumulus clinopyroxene, locally from larger oikocrysts.

Coarse grained, olivine-bearing gabbro (up) - Weak magmatic foliation defined by plagioclase SPO. Clinopyroxene oikocrysts showing subgrain formation, host to plagioclase inclusions locally. Common submagmatic deformation twins and/or bent grains of plagioclase, and moderate annealing.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Cut by fractures roughly perpendicular to the magmatic foliation.
Veins/alteration: Crack-seal fractures filled with zeolite partially transformed to clay.

Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Minor fracturing and vein formation.

PHOTOMICROGRAPHS: 345_U1415J_8R_2_TS_52.JPG
345_U1415J_8R_2_TS_52-2.JPG

THIN SECTION: 345-U1415J-8R-3-W 26/29-TSB_Piece_5-TS_53 **Thin Section no.:** 53
Rock name: clinopyroxene oikocryst-bearing troctolite
Rock comment: oikocryst and matrix were described as two different domains; moderately to highly altered with halo
Lithologic interval: 47
Piece No.: #5 **Authors: TF, KF**
Billet request comment: IgPet: Primary mineralogy; MetPet: Olv. alt. near Oiko



PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** oikocrysts/ matrix

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 80
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	14	25	11	1	subhedral to anhedral	amoeboid				
Plagioclase	70	75	5	1.5	euhedral to subhedral	tabular				
Clinopyroxene	0.1	0.1	0	0.1	anhedral	irregular		colorless	interstitial	

Igneous domain number: 2 **Domain lithology:** clinopyroxene oikocryst
Domain grain size: coarse grained **Grain size distribution:** seriate
Domain texture: poikilitic **Relative abundance (%):** 20
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase	20	20	0	1.5	subhedral to anhedral	tabular	patchy			
Clinopyroxene	80	80	0	10	anhedral	irregular		colorless	poikilitic	

ALTERATION / METAMORPHISM **No. of alteration domains:** 3 **Domain rel. abund %:** 75 **Estimated total % alteration:** 20
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	1.1	plagioclase 1.1%
green amphibole	1.8	olivine 1.8%
oxide	0.7	olivine 0.7%
prehnite	9.5	plagioclase 9.5%
serpentine	6.3	olivine 6.3%
sulfide	0.2	olivine 0.2%
domain total alteration %:	**19.6**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	30	30	green amphibole 20%, oxide 8%, sulfide 2%, serpentine 70%	serpentine mesh after olivine, sometimes some amphibole towards the rim
Plagioclase	70	15	chlorite 10%, prehnite 90%	plagioclase highly fractured and altered to fine grained prehnite along these fractures, rarely altered to chlorite when in contact with olivine.

Vein summary
vein 1 cross fibered, colorless, low interference colors - zeolite?

ALTERATION / METAMORPHISM **No. of alteration domains:** 3 **Domain rel. abund %:** 5 **Estimated total % alteration:** 40
Alteration domain number: 2 **Domain type:** band close to clinopyroxene-oikocryst

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	1.1	plagioclase 1.1%
clay minerals	1.4	olivine 1.4%
oxide	1.1	olivine 1.1%
prehnite	9.5	plagioclase 9.5%
serpentine	8.1	olivine 8.1%
sulfide	0.3	olivine 0.3%
talc	16.2	olivine 16.2%
domain total alteration %:	**37.7**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	30	90	clay minerals 5%, oxide 4%, sulfide 1%, serpentine 30%, talc 60%	serpentine mesh, but relict olivine in mesh core altered to talc
Plagioclase	70	15	chlorite 10%, prehnite 90%	plagioclase highly fractured and altered to fine grained prehnite along these fractures, rarely altered to chlorite when in contact with olivine

ALTERATION COMMENT: 1-2 mm wide band, characterized by higher degree of olivine alteration, olivine going to serpentine and talc.

ALTERATION / METAMORPHISM **No. of alteration domains:** 3 **Domain rel. abund %:** 20 **Estimated total % alteration:** 7
Alteration domain number: 3 **Domain type:** clinopyroxene-oikocryst

SECONDARY MINERALOGY	%	REPLACING / FILLING
pale/colorless amphibole	7	clinopyroxene 7%
other	1.5	plagioclase 1.5%
domain total alteration %:	**8.5**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Plagioclase	30	5	other 100%	plagioclase slightly altered along grain boundaries, almost unfractured
Clinopyroxene	70	10	pale/colorless amphibole 100%	clinopyroxene altered along cleavage planes and fractures

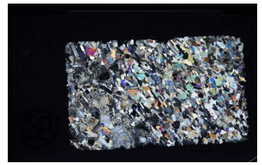
Vein summary
vein 1 cross fibered, colorless, low interference colors, seems to be filled in two stages

ALTERATION COMMENT: Large clinopyroxene-oikocryst with chadacrysts of fresh plagioclase. Clinopyroxene is slightly altered to amphibole. Sulfide is widely disseminated with plagioclase, and other sulfide is associated with talc, partially overgrown by oxide, all replacing olivine.

STRUCTURE COMMENT: Magmatic: Strong magmatic foliation defined by plagioclase SPO (more elongate than elsewhere in the hole). Common submagmatic deformation twins, and rare bent grains of plagioclase; annealed, and hosted by clinopyroxene oikocrysts. Locally well-developed subgrains in plagioclase. Plagioclase wraps around clinopyroxene oikocryst. Rounded/lobate olivine showing subgrains with curved grain boundaries. Intercumulus clinopyroxene.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Radiating cracks from olivine filled with clay ? Cut by roughly perpendicular to the magmatic foliation.
Veins/alteration: Crack-seal fractures filled with serpentine/chlorite partially replaced by clay.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Minor fracturing and vein formation.

PHOTOMICROGRAPHS: 345_U1415J_8R_3_TS_53.JPG
345_U1415J_8R_3_TS_53-2.JPG

THIN SECTION: **345-U1415J-8R-3-W 35/38-TSB_piece_6-TS_54** **Thin Section no.:** **54**
Rock name: olivine gabbro
Rock comment: moderately altered with branching prehnite-chlorite vein
Lithologic interval: 48
Piece No.: #6 **Authors: TH, NM**
Billet request comment: IgPet: Primary mineralogy; MetPet: Different Oliv. Alt.



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** olivine gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: An olivine-bearing layer is contained in the edge of the thin section.

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	9	9	4	anhedral	subequant				Olivine crystals form modal layering.
Plagioclase	50	54	4	1.4	anhedral to subhedral	tabular	continuous			foliated
Clinopyroxene	35	37	2	1.4	anhedral to subhedral	equant		colorless		

ALTERATION / METAMORPHISM **No. of alteration domains:** **1** **Domain rel. abund %:** 100 **Estimated total % alteration:** 20
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	0.6	plagioclase 0.6%
clay minerals	0.9	olivine 0.9%
green amphibole	1.3	olivine 1.3%
oxide	0.2	olivine 0.2%
pale/colorless amphibole	6	clinopyroxene 6%
prehnite	5.7	plagioclase 5.7%
serpentine	3.2	olivine 3.2%
sulfide	0.1	olivine 0.1%
talc	0.6	olivine 0.6%
domain total alteration %:	**18.6**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	7	90	green amphibole 20%, clay minerals 15%, oxide 3%, sulfide 2%, serpentine 50%, talc 10%	Olivine occurs in only one domain of the thin section.
Plagioclase	63	10	chlorite 10%, prehnite 90%	plagioclase is altered to fine grained prehnite along fractures and to chlorite along grain boundaries, particularly with olivine.
Clinopyroxene	30	20	pale/colorless amphibole 100%	altered along cleavage planes and fractures

Vein summary
vein 1 <0.5mm chlorite-prehnite-carbonate vein
vein 2 thin clay minerals with chlorite vein

ALTERATION COMMENT: This thin section is cut by a branching vein that has prehnite and chlorite on one side, and a chlorite carbonate vein on the other side. It appears that the veins are connected; and that the carbonate succeeds the chlorite, which is then succeeded by prehnite, followed by clay minerals. The olivine in this section shows variable replacement by serpentine and also by talc and tremolite, frequently rimmed by chlorite after plagioclase. Sulfide is widely disseminated within plagioclase, and other sulfide is associated with talc, replacing olivine; magnetite is associated with serpentine.

STRUCTURE COMMENT: Magmatic: Boundary between olivine-bearing gabbro layers and gabbro.

Gabbro - Strong magmatic foliation defined by plagioclase and clinopyroxene SPO. Common submagmatic deformation twins; weakly annealed.

Coarse grained, olivine-bearing gabbro layers - Moderate magmatic foliation defined by plagioclase and olivine SPO. Common submagmatic deformation twins and/or bent grains of plagioclase; weakly annealed.

Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Cracking (in part likely due to hydration of olivine).
Veins/alteration: Crack seal veins normal to magmatic foliation with multiple opening events. Crack seal veins normal to magmatic foliation with multiple opening events; center of veins commonly hosting chlorite/serpentine, prehnite, and calcite, with zeolite rosette. Clay minerals locally replace chlorite/serpentine in some veins. Segments of some veins show apparent alignment or shear deformation.

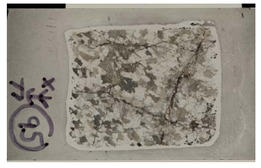
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development (grain size and modal layering) and foliation.
2) Fracturing, and cataclasis.
3) Crack seal veining, and possible late, low-temperature shear.

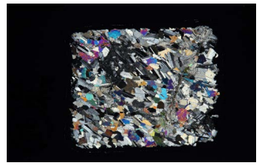
PHOTOMICROGRAPHS: 345_U1415J_8R_3_TS_54.JPG
345_U1415J_8R_3_TS_54-2.JPG

THIN SECTION: 345-U1415J-8R-3-W 67/69-TSB_Piece_8-TS_95
Rock name: olivine-bearing gabbro
Rock comment:
Lithologic interval: 48
Piece No.: #8
Billet request comment: Met. Pet: Sulfide Identification

Thin Section no.: 95

Authors: TF, AM





PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1
Domain grain size: medium grained
Domain texture: granular
Domain comment:

Domain lithology: olivine-bearing gabbro
Grain size distribution: equigranular
Relative abundance (%): 100

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	2	2	2	anhedral	amoeboid				one single large altered grain
Plagioclase	45	55	10	0.5	euhedral to subhedral	tabular				
Clinopyroxene	42	43	1	0.5	subhedral to anhedral	subequant		colorless		

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 39
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	12.7	olivine 5.6%, clinopyroxene 4%, plagioclase 3.1%	Olivine	8	100	pale/colorless amphibole 5%, chlorite 70%, clay minerals 25%	minor corona relics. chlorite to clay ratio hard to estimate
clay minerals	5	olivine 2%, clinopyroxene 2%, plagioclase 1%	Plagioclase	52	20	chlorite 30%, clay minerals 10%, prehnite 30%, zeolite 20%, secondary plagioclase 10%	very heterogeneous plagioclase alteration mainly near veins of clay etc
pale/colorless amphibole	14.4	olivine 0.4%, clinopyroxene 14%	Clinopyroxene	40	50	pale/colorless amphibole 70%, chlorite 20%, clay minerals 10%	minor sulfide in clinopyroxene replacement
prehnite	3.1	plagioclase 3.1%					
secondary plagioclase	1	plagioclase 1%					
zeolite	2.1	plagioclase 2.1%					
domain total alteration %:	**38.3**						

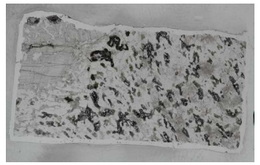
Vein summary
vein 1 complex 0.5 mm prehnite/clay/zeolite/chlorite veins - clay replaces prehnite locally but may also grow with it. Often cross-fibre but also radiating growths.

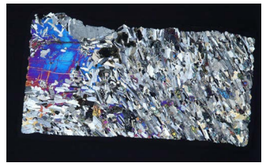
ALTERATION COMMENT: Olivine completely replaced by clay/chlorite with no oxide. Texture suggests clay minerals and chlorite may be replacing talc. The same alteration affects clinopyroxene close to veins. Clay and zeolite replace plagioclase near veins. Sulfide is present in partially altered clinopyroxene along cleavages, and locally in secondary plagioclase.

STRUCTURE COMMENT: Magmatic: Strong magmatic foliation defined by plagioclase SPO. Plagioclase shows common submagmatic deformation twins, weak undulose extinction, with subgrains showing curved grain boundaries. Weakly annealed grain boundaries. Clinopyroxene locally with scalloped grain boundaries. Altered skeletal olivine.
Crystal Plastic: No crystal plastic deformation.
Brittle: Orthogonal vein systems, one set associated with bent/kinked clinopyroxene in thin zones of cataclasis.
Veins/alteration: Prehnite and zeolite veins associated with cataclasis. Zeolite growing in open space; prehnite late.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Cataclasis and vein formation.

PHOTOMICROGRAPHS: 345_U1415J_8R_3_TS_95.JPG
345_U1415J_8R_3_TS_95-2.JPG

THIN SECTION: **345-U1415J-8R-3-W 83/86-TSB_Piece_9b-TS_55** **Thin Section no.:** **55**
Rock name: clinopyroxene oikocryst bearing troctolite
Rock comment: moderately altered
Lithologic interval: 49
Piece No.: #9 **Authors: MMJ, TN**
Billet request comment: IgPet: Primary mineralogy; Struct: Magmatic Foliation





PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** clinopyroxene-oikocryst bearing troctolite
Domain grain size: medium grained **Grain size distribution:** seriate
Domain texture: poikilitic-granular **Relative abundance (%):** 100
Domain comment: Macroscopic description follows microscope observation

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	20	25	5	1	anhedral to subhedral	elongate				olivine is moderately altered; few olivines are mantled by clinopyroxene
Plagioclase	40	50	10	1	subhedral to euhedral	tabular	discontinuous zoning		chadacrysts	
Clinopyroxene	22	25	3	4				pale green	poikilitic	clinopyroxene oikocrysts are euhedral, while interstitial clinopyroxene is anhedral. Same observations for habit; interstitial clinopyroxene is irregular and oikocrysts are equant.

ALTERATION / METAMORPHISM **No. of alteration domains:** **1** **Domain rel. abund %:** 100 **Estimated total % alteration:** 10
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	2.8	plagioclase 2.8%
clay minerals	2.1	olivine 2.1%
green amphibole	0.1	clinopyroxene 0.1%
oxide	0.2	olivine 0.2%
pale/colorless amphibole	1.4	olivine 0.3%, clinopyroxene 1.1%
prehnite	2.8	plagioclase 2.8%
serpentine	3	olivine 3%
sulfide	0.1	olivine 0.1%
talc	0.3	olivine 0.3%
domain total alteration %:	**12.8**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	20	30	pale/colorless amphibole 5%, clay minerals 35%, oxide 3%, sulfide 2%, serpentine 50%, talc 5%	variable in degree and in mineralogy between olivine grains
Plagioclase	55	10	chlorite 50%, prehnite 50%	chlorite forming corona texture, prehnite fills cracks
Clinopyroxene	25	5	green amphibole 10%, pale/colorless amphibole 90%	

Vein summary
vein 1 chlorite irregular vein

ALTERATION COMMENT: Olivine alteration is heterogeneous; prehnite fills micro-cracks in plagioclase surrounding serpentinized olivine. Sulfide is widely disseminated within clinopyroxene and plagioclase, and other sulfide is associated with talc replacing olivine; oxides are associated with serpentine rarely also forming rims on sulfides.

STRUCTURE COMMENT: Magmatic: Strong magmatic foliation defined by plagioclase SPO; more elongate grains than elsewhere up the hole. Submagmatic deformation twins, and bent grains of plagioclase; annealed, and hosted by clinopyroxene oikocrysts. Plagioclase wraps around clinopyroxene oikocrysts, locally shows imbrication, or tiling. Rare undulose extinction in plagioclase. Very lobate/skeletal olivine showing subgrains with curved grain boundaries. Significant intercumulus clinopyroxene surrounding olivine (optically continuous).
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Radiating cracks from olivine filled with prehnite. Thin zone of cataclasis hosting chlorite (+/-serpentine) in fractures roughly perpendicular to the magmatic foliation.
Veins/alteration: Crack-seal fractures filled with chlorite, partially replaced by clay.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Minor fracturing and chlorite vein formation.

PHOTOMICROGRAPHS: 345_U1415J_8R_3_TS_55-2.JPG
345_U1415J_8R_3_TS_55-3.JPG

THIN SECTION: **345-U1415J-8R-3-W 112/115-TSB_Piece_12-TS_56** **Thin Section no.:** **56**
Rock name: olivine-bearing gabbro
Rock comment: moderately altered
Lithologic interval: 50
Piece No.: #12 **Authors: JM, KF**
Billet request comment: lgPet: Primary mineralogy; Struct: Magmatic Foliation

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** olivine-bearing gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	2	2	2	anhedral	irregular				Olivine is completely altered.
Plagioclase	65	68	3	2.3	anhedral to subhedral	tabular	continuous zoning			foliated
Clinopyroxene	27	30	3	1.5	anhedral	subequant		colorless		
Oxide	0	0.1	0.1	0.1	anhedral	equant				

ALTERATION / METAMORPHISM **No. of alteration domains:** **1** **Domain rel. abund %:** 100 **Estimated total % alteration:** 30
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	12.7	olivine 0.1%, plagioclase 12.6%
clay minerals	0.1	olivine 0.1%
green amphibole	5.8	clinopyroxene 5.8%
oxide	0	olivine < 0.1%
pale/colorless amphibole	5.8	clinopyroxene 5.8%
prehnite	1.4	plagioclase 1.4%
serpentine	0.8	olivine 0.8%
sulfide	0	olivine < 0.1%
domain total alteration %:	**26.6**	

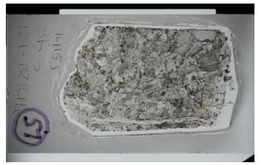
PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	1	100	chlorite 10%, clay minerals 5%, oxide 3%, sulfide 2%, serpentine 80%	only one grain of olivine found in thin section
Plagioclase	70	20	chlorite 90%, prehnite 10%	plagioclase altered along fractures
Clinopyroxene	29	40	green amphibole 50%, pale/colorless amphibole 50%	

ALTERATION COMMENT: Homogeneous alteration intensity, except for one small localized zone with higher degree of alteration with abundant talc and prehnite. It is unclear what mineral talc is replacing, possibly olivine? Pyrite associated with serpentin replacing olivine, along clinopyroxene cleavage surfaces, and in chlorite-filled fractures in plagioclase.

STRUCTURE COMMENT: Magmatic: Moderate magmatic foliation defined by plagioclase SPO. Very common submagmatic deformation twins and bent grains of plagioclase, with weakly annealed grain boundaries. Moderately well-developed undulose extinction in plagioclase, with subgrains showing serrate grain boundaries. Clinopyroxene with very serrate grain boundaries, and rare subgrains.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Cracking.
Veins/alteration: Tiny veins filled with chlorite. Crack seal with fibers perpendicular to the vein walls.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development (grain size and modal layering) and foliation.
2) Minor cracking.

PHOTOMICROGRAPHS: 345_U1415J_8R_3_TS_56.JPG
345_U1415J_8R_3_TS_56-2.JPG

THIN SECTION: 345-U1415J-8R-3-W 129/132-TSB_piece_14a-TS_57 **Thin Section no.:** 57
Rock name: olivine gabbro
Rock comment: highly altered
Lithologic interval: 50
Piece No.: #14 **Authors: TH, KF**
Billet request comment: lgPet: Primary mineralogy; Struct: High Temp. Shear Zone



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** olivine gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: Highly altered.

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	13	13	1.8	anhedral to subhedral	subequant				
Plagioclase	30	60	30	1.5	subhedral	tabular				
Clinopyroxene	22	27	5	2	anhedral	irregular		colorless	interstitial	
Oxide	0.1	0.1	0	0.1	anhedral to subhedral	equant				possibly spinel

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 65
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	9.9	plagioclase 9.9%
green amphibole	6.3	clinopyroxene 6.3%
oxide	0.8	olivine 0.8%
pale/colorless amphibole	7	olivine 0.8%, clinopyroxene 6.3%
prehnite	19.8	plagioclase 19.8%
secondary plagioclase	3.3	plagioclase 3.3%
serpentine	10.5	olivine 10.5%
talc	3	olivine 3%
domain total alteration %:	**60.6**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	15	100	pale/colorless amphibole 5%, oxide 5%, serpentine 70%, talc 20%	
Plagioclase	55	60	chlorite 30%, prehnite 60%, secondary plagioclase 10%	altered along microfractures and also pervasively replaced
Clinopyroxene	25	50	green amphibole 50%, pale/colorless amphibole 50%	

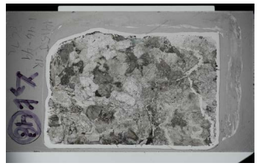
Vein summary
vein 1 sub-parallel network of prehnite veins up to 1 mm wide.
vein 2 thin zeolite filled cracks

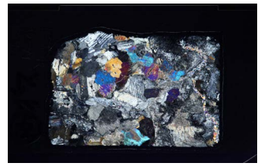
ALTERATION COMMENT: Cataclastically deformed rock with intense fracturing and comminution of plagioclase. Plagioclase is replaced by prehnite and chlorite, and pyroxene is slightly altered to amphibole. The cataclasite matrix minerals are pervasively altered to prehnite. Sulfide is locally present where it is associated with serpentine and chlorite apparently having replaced olivine; all grains are rimmed by oxides.

STRUCTURE COMMENT: Magmatic: Isotropic magmatic foliation (difficult to recognize due to semi-brittle and brittle overprint). Broken tabular, elongate plagioclase.
Crystal Plastic: ? Semi-brittle deformation, characterized by plagioclase hosting deformation twins and subgrains, locally bent and/or fractured; bent clinopyroxene, also with subgrains.
Brittle: Cataclasite, showing possible multiple slip events, evidenced by anastomosing fractured chlorite, clay, prehnite, and a second generation of prehnite.
Veins/alteration: Intimate relationship between vein formation and cataclasis: prehnite veins form a sub-parallel network of wiggling veins. A few late cracks filled with zeolite.
Cross-cutting Relationships (as apparent in thin section):
1) Semi-brittle deformation, including cracking, bending, twinning, and vein formation.
2) Additional cracking and vein formation.
3) Late cracking with zeolite filled veinlets.

PHOTOMICROGRAPHS:
345_U1415J_8R_3_TS_57.JPG
345_U1415J_8R_3_TS_57-2.JPG
345_U1415J_8R_3_TS_57-3.JPG
345_U1415J_8R_3_TS_57-4.JPG

THIN SECTION: 345-U1415J-9R-1-W 46/49-TSB_piece_7-TS_48 **Thin Section no.:** 48
Rock name: olivine-bearing gabbro
Rock comment: highly altered
Lithologic interval: 55
Piece No.: #7 **Authors: JM, TN**
Billet request comment: IgPet: Primary mineralogy; MetPet: Higher Temp. Alt.





PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** olivine-bearing gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: Igneous petrology group doesn't see any evidence for the presence of primary orthopyroxene; olivine is probable since piece #7 is from a coherent lithological interval of olivine-bearing gabbro

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	2	2	3	anhedral	equant				Olivine is completely altered.
Plagioclase	20	50	30	4.5	anhedral to subhedral	tabular	patchy zoning			
Clinopyroxene	30	48	18	3.5	anhedral	subequant		colorless		

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 70
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	10	orthopyroxene 4%, plagioclase 6%
green amphibole	3.6	clinopyroxene 3.6%
pale/colorless amphibole	30.4	clinopyroxene 14.4%, orthopyroxene 16%
secondary plagioclase	16.5	plagioclase 16.5%
zeolite	6	plagioclase 6%
other	1.5	plagioclase 1.5%
domain total alteration %:	**68**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Plagioclase	60	50	chlorite 20%, zeolite 20%, secondary plagioclase 55%, other 5%	other: tiny grain of oxide (?)
Clinopyroxene	20	90	green amphibole 20%, pale/colorless amphibole 80%	heterogeneous alteration
Orthopyroxene	20	100	pale/colorless amphibole 80%, chlorite 20%	similar appearance to coronitic pseudomorph after olivine, but much higher amount of tremolite

Vein summary
vein 1 prehnite irregular vein

ALTERATION COMMENT: Tremolite + chlorite pseudomorph after orthopyroxene looks similar to that after olivine, but has much higher amounts of tremolite; plagioclase and clinopyroxene show variable degree of alteration. Sulfide is widely disseminated within clinopyroxene and less commonly in plagioclase and in amphibole-chlorite intergrowths after olivine; where along grains boundaries, sulfide is rimmed by chlorite.

STRUCTURE COMMENT: Magmatic: Coarse-grained gabbro showing well-developed submagmatic deformation twins and bent grains of plagioclase; undulose extinction
Crystal Plastic: Possible subsolidus deformation twins and bent plagioclase grain formation
Brittle: Cracking and minor cataclasis.
Veins/alteration: One late prehnite vein cross cuts the primary igneous and altered minerals
Cross-cutting Relationships (as apparent in thin section):
1) Submagmatic deformation; no recognizable magmatic fabric development
2) Pervasive alteration of (mostly) large olivine(?)
3) Cracking and minor cataclasis
3) Prehnite vein injection

PHOTOMICROGRAPHS: 345_U1415J_9R_1_TS_48.JPG
345_U1415J_9R_1_TS_48-2.JPG

THIN SECTION: 345-U1415J-10R-1-W 53/55-TSB_Piece_6b-TS_58 **Thin Section no.:** 58
Rock name: contact between troctolite and gabbro
Rock comment: rock contains two different lithologies; moderately altered
Lithologic interval: 58
Piece No.: #6 **Authors: TF, KF**
Billet request comment: IgPet: Primary mineralogy; Struct: Magmatic Fabric

PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** two lithologies

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 75
Domain comment: troctolitic matrix

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	15	20	5	1	subhedral-anhedral	amoeboid				
Plagioclase	77	77	0	1.5	subhedral to euhedral tabular		continuous to patchy zoning			
Clinopyroxene	3	3	0	1	anhedral	irregular		colorless	interstitial	

Igneous domain number: 2 **Domain lithology:** gabbro
Domain grain size: coarse grained **Grain size distribution:** seriate
Domain texture: poikilitic **Relative abundance (%):** 25
Domain comment: clinopyroxene in domain 2 is optically continuous throughout domain 1 as interstitial phase

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	1	20	19	2	euhedral-subhedral	subequant				
Plagioclase	40	40	0	1.5	subhedral to euhedral tabular		continuous to patchy zoning		chadacrysts	
Clinopyroxene	40	40	0	40	anhedral	irregular		colorless	poikilitic	clinopyroxene in this section forms one cm-sized continuous crystal phase

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 60 **Estimated total % alteration:** 15
Alteration domain number: 1 **Domain type:** troctolite background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	1.3	plagioclase 1.3%	Olivine	30	8	oxide 3%, sulfide 2%, serpentine 95%	olivine is replaced by serpentine (mesh texture)
oxide	0.1	olivine 0.1%	Plagioclase	65	20	chlorite 10%, prehnite 90%	plagioclase is altered to fine grained prehnite along fractures, and rarely to chlorite along the grain boundaries when in contact with olivine
pale/colorless amphibole	1.5	clinopyroxene 1.5%	Clinopyroxene	5	30	pale/colorless amphibole 100%	
prehnite	11.7	plagioclase 11.7%					
serpentine	2.3	olivine 2.3%					
sulfide	0	olivine < 0.1%					
domain total alteration %:	**16.9**						

Vein summary
vein 1 thin (<0.1 mm wide) chlorite vein

ALTERATION COMMENT: Generally low degree of pervasive alteration, olivine less than 10% serpentinized, plagioclase

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 35 **Estimated total % alteration:** 40
Alteration domain number: 2 **Domain type:** Cpx-oikocryst

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
clay minerals	4.1	olivine 4.1%	Olivine	30	90	pale/colorless amphibole 60%, clay minerals 15%, serpentine 20%, talc 5%	olivine is much more strongly altered than in the matrix, olivine is replaced by serpentine mesh and amphibole and clay minerals in the mesh core, some talc is present at the edges of the former olivine grains, the serpentine mesh is associated with almost no oxides or sulfides.
pale/colorless amphibole	16.2	olivine 16.2%	Plagioclase	30	40	prehnite 100%	plagioclase is more altered than in the matrix, plagioclase is altered to fine grained prehnite along fractures, the degree of fracturing of plagioclase is not homogeneous within the clinopyroxene oikocryst and appears to be localized to certain areas.
prehnite	12	plagioclase 12%	Clinopyroxene	40			
serpentine	5.4	olivine 5.4%					
talc	1.4	olivine 1.4%					
domain total alteration %:	**39.1**						

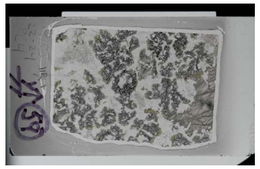
Vein summary
vein 1 2 thin (<0.1 mm wide) veins, filled with prehnite and clay

ALTERATION COMMENT: Higher degree of olivine and plagioclase alteration than in the matrix.

STRUCTURE COMMENT:
Magmatic: Boundary between fine-grained troctolite and gabbro.
Fine-grained troctolite - Moderate magmatic foliation defined by plagioclase and olivine SPO. Common submagmatic deformation twins, bent grains, and undulose extinction in plagioclase; annealed grain boundaries. Rounded/skeletal olivine showing rare subgrains. Locally see intercumulus clinopyroxene along plagioclase and olivine grain boundaries, apparently emanating from clinopyroxene in adjacent unit. Along the boundary with gabbro; proportion of intercumulus clinopyroxene increase toward the coarse grained gabbro.
Coarse-grained gabbro - Moderate magmatic foliation defined by plagioclase SPO. No fabric defined by olivine (possibly originally skeletal). Intercumulus clinopyroxene hosting plagioclase showing a strong magmatic foliation again defined by SPO. Rare submagmatic deformation twins and/or bent grains of plagioclase, and moderate annealing.
Crystal Plastic: None.
Brittle: Minor fracturing.
Veins/alteration: Crack seal chlorite/serpentine, partially replaced by clay veins.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development (foliation, modal and grain size layering); contact above the solidus.
2) Minor fracturing and vein formation.

PHOTOMICROGRAPHS:
345_U1415J_10R_1_TS_58.JPG
345_U1415J_10R_1_TS_58-2.JPG

THIN SECTION: 345-U1415J-11R-1-W 22/24-TSB_Piece_4-TS_59 **Thin Section no.:** 59
Rock name: troctolitic gabbro
Rock comment: contains a 1 cm-sized oikocryst, moderately altered
Lithologic interval: 61
Piece No.: #4 **Authors: NA, KF**
Billet request comment: lgPet: Primary mineralogy



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** troctolitic gabbro
Domain grain size: coarse grained **Grain size distribution:** inequigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	25	25	0	8	anhedral to subhedral	irregular				dentritic texture
Plagioclase	65	65	0	1	anhedral to subhedral	tabular				may occur as chadacrysts
Clinopyroxene	10	10	0	10	anhedral	interstitial		colorless		big clinopyroxene oikocryst; may also occur interstitial
Oxide	0.1	0.1	0	0.05	anhedral to subhedral	subequant				spinel

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 30
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	5.9	plagioclase 5.9%
clay minerals	0.8	olivine 0.8%
oxide	0.2	olivine 0.2%
pale/colorless amphibole	1	clinopyroxene 1%
prehnite	9.8	plagioclase 9.8%
serpentine	6	olivine 6%
sulfide	0.2	olivine 0.2%
talc	0.4	olivine 0.4%
other	0.7	plagioclase 0.7%
domain total alteration %:	**25**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	25	30	clay minerals 10%, oxide 3%, sulfide 2%, serpentine 80%, talc 5%	olivine replaced by serpentine mesh
Plagioclase	65	25	chlorite 36%, prehnite 60%, other 4%	plagioclase altered to fine grained prehnite, chlorite, and rarely calcite along fractures.
Clinopyroxene	10	10	pale/colorless amphibole 100%	large clinopyroxene-oikocryst

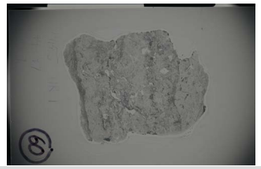
Vein summary
vein 1 thin chlorite/serpentine filled veins

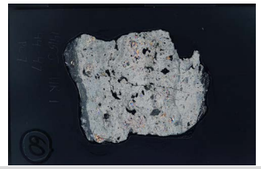
ALTERATION COMMENT: Olivine is altered to serpentine with mesh textures, with cores of fresh olivine. Plagioclase is minimally altered with prehnite forming along fractures. Calcite also occurs within the most fractured plagioclase. Sulfide is widely disseminated within plagioclase and between plagioclase and olivine grains; oxides intergrown with serpentine replace olivine and rim most sulfides.

STRUCTURE COMMENT: Magmatic: Troctolitic gabbro - Dendritic olivine fabric showing undulose extinction and minor subgrain formation. Bimodal grain size distribution of plagioclase including large bent grains, with submagmatic deformation twins, undulose extinction, and numerous small subgrains. Fine grained plagioclase shows greater annealing. Locally see intercumulus clinopyroxene along plagioclase and olivine grain boundaries.
Crystal Plastic: None.
Brittle: Minor fracturing, parallel to pyroxene cleavage.
Veins/alteration: Two generations of en echelon crack seal veins with fibrous serpentine/chlorite fill.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic fabric development.
2) Vein formation.
3) Minor cracking.

PHOTOMICROGRAPHS: 345_U1415J_11R_1_TS_59.JPG
345_U1415J_11R_1_TS_59-2.JPG

THIN SECTION: 345-U1415J-11R-1-W 44/47-TSB_Piece_7-TS_60 **Thin Section no.:** 60
Rock name: cataclastic and completely altered gabbro
Rock comment: 100% altered, contains lithic fragments of altered gabbro; estimation of primary mode not possible
Lithologic interval: 61
Piece No.: #7 **Authors: NA, AM**
Billet request comment: lgPet: Primary mineralogy; MetPet: Alt. mineralogy; Struct: Shear Zone Fabric





PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** cataclastic and completely altered gabbro
Domain grain size: coarse grained **Grain size distribution:** inequigranular
Domain texture: **Relative abundance (%):**
Domain comment:

ALTERATION / METAMORPHISM **No. of alteration domains:** 3 **Domain rel. abund %:** 10 **Estimated total % alteration:** 90
Alteration domain number: 1 **Domain type:** cataclasite

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	28.2	olivine 9%, plagioclase 19.2%	Olivine	10	100	pale/colorless amphibole 10%, chlorite 90%	chlorite clasts assumed to be former olivine
green amphibole	18	clinopyroxene 18%	Plagioclase	60	40	chlorite 80%, prehnite 20%	
pale/colorless amphibole	1	olivine 1%	Clinopyroxene	30	60	green amphibole 100%	
prehnite	4.8	plagioclase 4.8%	Oxide	1			fine oxide present
domain total alteration %:	**52**						

Vein summary
vein 1 prehnite veins at both high and low angles to the foliation, and also a prehnite veins parallel to foliation that may be isoclinally folded but is internally undeformed.
vein 2 cross-fiber chlorite or serpentine or clay veins at a high angle to foliation contain prehnite in vein centers and appear to be truncated by a cataclastic zone

ALTERATION COMMENT: Cataclasite zones are preserved at both ends of the slide. They show highly comminuted plagioclase and pyroxene, with chlorite networks growing in the matrix. On the margins of one zone inclusion-filled plagioclase is being replaced by chlorite - this is the only plagioclase remaining in this slide. Prehnite from adjacent zones appears to be consuming the cataclasite at its margin, but prehnite also occurs in some clasts within the cataclasite.

ALTERATION / METAMORPHISM **No. of alteration domains:** 3 **Domain rel. abund %:** 75 **Estimated total % alteration:** 90
Alteration domain number: 2 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	11	olivine 4.5%, plagioclase 6.5%	Olivine	5	100	pale/colorless amphibole 10%, chlorite 90%	very conjectural!
green amphibole	12	clinopyroxene 12%	Plagioclase	65	100	chlorite 10%, prehnite 90%	no relict plagiocalse so very conjectural
pale/colorless amphibole	0.5	olivine 0.5%	Clinopyroxene	30	50	green amphibole 80%, other 20%	Other = prehnite
prehnite	58.5	plagioclase 58.5%	Oxide	1	0		oxide is present
other	3	clinopyroxene 3%					
domain total alteration %:	**85**						

Vein summary
vein 1 irregular undeformed coarse prehnite veins contain relict porosity

ALTERATION COMMENT: This domain has a very complex internal structure, but is not foliated. There are clasts of coarse prehnite and of chlorite containing needles of amphibole, which in one case may contain relict corona. textures completely overprinted by chlorite. Late veins of prehnite often contain relict porosity. Large clasts of clinopyroxene partly altered to amphibole are present. Pyrite and lesser amounts of chalcopyrte are disseminated within the prehnite matrix of this cataclasite, and subhedral grains of chalcopyrite occurs in veins.

ALTERATION / METAMORPHISM **No. of alteration domains:** 3 **Domain rel. abund %:** 15 **Estimated total % alteration:** 90
Alteration domain number: 3 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	11	olivine 4.5%, plagioclase 6.5%	Olivine	5	100	pale/colorless amphibole 10%, chlorite 90%	very conjectural!
green amphibole	12	clinopyroxene 12%	Plagioclase	65	100	chlorite 10%, prehnite 90%	no relict plagiocalse so very conjectural
pale/colorless amphibole	0.5	olivine 0.5%	Clinopyroxene	30	50	green amphibole 80%, other 20%	Other = prehnite
prehnite	58.5	plagioclase 58.5%	Oxide	1	100	other 100%	oxide and sulphide not present outside clasts
other	4	clinopyroxene 3%, oxide 1%					
domain total alteration %:	**86**						

Vein summary
vein 1 irregular undeformed coarse prehnite veins contain relict porosity

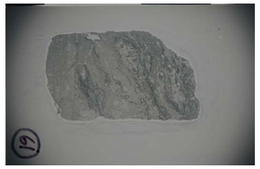
ALTERATION COMMENT: This domain consists of clear prehnite surrounding clasts of darker material similar to domain 2. Veins and patches of coarser prehnite often contain relict porosity. The clasts contain finely disseminated sulfide and oxide. Relict clast of clinopyroxene, sometimes pseudomorphed by pale green amphibole, occur both in the clasts and in the clear matrix, but in concentrations less than expected in a gabbro, but similar to some troctolitic rocks. This domain shows both sharp and gradational boundaries with domain 2.

STRUCTURE COMMENT: Magmatic: None remaining.
Crystal Plastic: None remaining.
Brittle: Intense cataclasis and alteration of original gabbroic protolith.
Veins/alteration: Prehnite veins cataclasized. Some cracks are not completely filled (geode-like voids).

Cross-cutting Relationships (as apparent in thin section):
1) Cataclasis.
2) Prehnite veining.
3) Repeated cataclasis.

PHOTOMICROGRAPHS: 345_U1415J_11R_1_TS_60.JPG 345_U1415J_11R_1_TS_60-3.JPG 345_U1415J_11R_1_TS_60-5.JPG
345_U1415J_11R_1_TS_60-2.JPG 345_U1415J_11R_1_TS_60-4.JPG 345_U1415J_11R_1_TS_60-6.JPG

THIN SECTION: 345-U1415J-12R-1-W 11/13-TSB_Piece_3-TS_61 **Thin Section no.:** 61
Rock name: troctolite
Rock comment: primary mode is very vague due to very strong alteration and strong cataclasis; highly altered
Lithologic interval: 62
Piece No.: #3 **Authors: MMJ, NM**
Billet request comment: IgPet: Primary mineralogy; MetPet: Timing and mineralogy of Alt. Struct: Shear Zone



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: fine grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):**
Domain comment: Defined as troctolite in macroscopic description. Piece 3 is completely altered. Grain size is Fine to Medium

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0.1	35	34.9	0.1	anhedral					100% replacement by secondary phases
Plagioclase	2	60	58	0.1	anhedral to subhedral	tabular				100% replacement by secondary phases
Clinopyroxene	0.1	5	4.9	0.1	anhedral	equant		colorless		100% replacement by secondary phases

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 90
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	15.5	clinopyroxene 3.6%, plagioclase 11.9%
clay minerals	2.4	clinopyroxene 2.4%
pale/colorless amphibole	6	clinopyroxene 6%
prehnite	41.7	plagioclase 41.7%
zeolite	6	plagioclase 6%
domain total alteration %:	**71.6**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine				No olivine apparent, could be completely gone though.
Plagioclase	85	70	chlorite 20%, prehnite 70%, zeolite 10%	plagioclase is relatively fresh where intact, maybe only 10-15% altered. Where comminuted, it is as much as 100% replaced by prehnite.
Clinopyroxene	15	80	pale/colorless amphibole 50%, chlorite 30%, clay minerals 20%	clinopyroxene is bent along cleavage planes, and where most highly fractured, it is also most altered.
Oxide	0.5	0		

Vein summary

vein 1 Chlorite-prehinite veins cross cut cataclastic fabric. The veins are thin (<0.5mm), have sharp boundaries with the cataclastite, and typically have chlorite centers and prehnite selvages.
vein 2 Anastamosing chlorite-clay minerals veins follow the foliation in this piece and typically surround plagioclase fragments. These veins both cut, and are cut by the prehnite veins.

ALTERATION COMMENT: Cataclasite with shattered plagioclase lathes, and matrix is replaced by prehnite and chlorite. Replacement is nearly complete. Very rare sulfide occurs in an epidote vein cutting this foliated cataclasite, and locally disseminated in the chlorite + plagioclase matrix of this cataclasite.

STRUCTURE COMMENT: Magmatic: None remaining.
Crystal Plastic: None.
Brittle: Semi-brittle deformation, cataclasite to ultracataclasite. Zones of greater and lesser comminution (20%) with a fine chlorite matrix (80%) cut by deformed, anastomosing prehnite vein system.
Shows fluidal structure of large, fractured prehnite and plagioclase clasts, angular fractured and bent clinopyroxene, including folded/fractured and rotated cleavage in clinopyroxene, in a fine chlorite matrix.
Veins/alteration: Cut by curved, irregular anastomosing zoisite, prehnite + chlorite vein system (zoned parallel to the vein margin), ? deformed, cut by late irregular prehnite + chlorite veins, in turn showing deformation/strain localization (see thin section). Prismatic prehnite crystals grow on vein walls, the veins interior is filled with a blocky assemblage of prehnite + chlorite.

Cross-cutting Relationships (as apparent in thin section):
1) Cataclasis.
2) Veining.
3) Repeated cataclasis.

PHOTOMICROGRAPHS:
345_U1415J_12R_1_TS_61.JPG
345_U1415J_12R_1_TS_61-2.JPG
345_U1415J_12R_1_TS_61-3.JPG
345_U1415J_12R_1_TS_61-4.JPG
345_U1415J_12R_1_TS_61-5.JPG
345_U1415J_12R_1_TS_61-6.JPG

THIN SECTION: 345-U1415J-12R-1-W 86/89-TSB_Piece_12-TS_62 **Thin Section no.:** 62
Rock name: gabbro
Rock comment: highly altered and tectonized
Lithologic interval: 63
Piece No.: #12 **Authors: JM, KF**
Billet request comment: IgPet: Primary mineralogy; MetPet: Cataclasis/fault zone

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: highly altered

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase	8	50	42	1.5	subhedral	tabular				
Clinopyroxene	8	50	42	1.5	anhedral	subequant		colorless	poikilitic	

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 75
Alteration domain number: 1 **Domain type:** cataclasite

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	8	plagioclase 8%	Plagioclase	50	80	chlorite 20%, prehnite 80%	plagioclase replaced by fine grained prehnite
pale/colorless amphibole	35	clinopyroxene 35%	Clinopyroxene	50	70	pale/colorless amphibole 100%	some clinopyroxene grains strongly bent, others fractured
prehnite	32	plagioclase 32%					
domain total alteration %:	**75**						

Vein summary

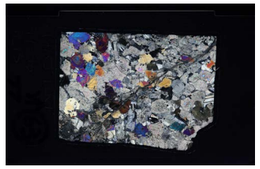
vein 1 thin prehnite veins cut cataclasite zones, some larger prehnite veins are cut by cataclasis.
vein 2 massive anastamosing chlorite veins

ALTERATION COMMENT: High degree of alteration and deformation. Cataclasite matrix is replaced by chlorite and prehnite. Pyrite associated serpentinite replacing olivine, and in chlorite-filled fractures.
STRUCTURE COMMENT:
Magmatic: Gabbro cut by two to three zones of cataclasis to ultracataclasis.
Relict annealed plagioclase; little else preserved.
Crystal Plastic: None.
Brittle: Two to three branching zones of cataclasis to ultracataclasis, with 20-70% clay(?) matrix, hosting angular clasts of altered plagioclase and bent/fractured clinopyroxene.
Veins/alteration: Prehnite vein with porosity, cut by a zone of cataclasis/ultracataclasis, showing significant grain size reduction

Cross-cutting Relationships (as apparent in thin section):
1) Cataclasis.
2) Prehnite veining.
3) Repeated cataclasis.

PHOTOMICROGRAPHS: 345_U1415J_12R_1_TS_62.JPG 345_U1415J_12R_1_TS_62-3.JPG
345_U1415J_12R_1_TS_62-2.JPG 345_U1415J_12R_1_TS_62-4.JPG

THIN SECTION: 345-U1415J-12R-1-W 94/96-TSB_Piece_13-TS_63 **Thin Section no.:** 63
Rock name: olivine gabbro
Rock comment: highly altered and tectonized
Lithologic interval: 63
Piece No.: #13 **Authors: TH, TN**
Billet request comment: IgPet: Primary mineralogy



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** olivine gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: Highly altered.

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	35	35	4	anhedral to subhedral	subequant				completely altered
Plagioclase	16	41	25	2	anhedral to subhedral	tabular				
Clinopyroxene	20	24	4	3	anhedral to subhedral	equant		colorless		

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 70
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	1.8	plagioclase 1.8%
clay minerals	4	olivine 4%
garnet	0.6	plagioclase 0.6%
pale/colorless amphibole	24.8	olivine 2%, clinopyroxene 22.8%
prehnite	3.6	plagioclase 3.6%
serpentine	2	olivine 2%
sulfide	3.2	olivine 2%, clinopyroxene 1.2%
talc	30	olivine 30%
domain total alteration %:	**70**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	40	100	pale/colorless amphibole 5%, clay minerals 10%, sulfide 5%, serpentine 5%, talc 75%	mesh-like texture by talc
Plagioclase	30	20	chlorite 30%, prehnite 60%, garnet 10%	
Clinopyroxene	30	80	pale/colorless amphibole 95%, sulfide 5%	intense alteration at rim and along cleavage surfaces

Vein summary
vein 1 slip fiber vein of chlorite and clay
vein 2 thin serpentine vein

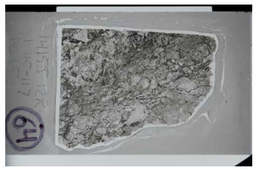
ALTERATION COMMENT: Intense alteration of olivine by talc, showing mesh-like texture. Pyrite associated talc/clay replacing olivine, along cleavage surfaces in clinopyroxene, inclusions in amphibolite, and in chlorite-filled fractures.

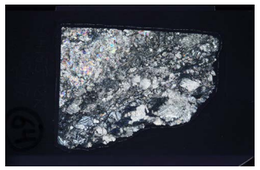
STRUCTURE COMMENT: Magmatic: Partially annealed plagioclase; little else preserved.
Crystal Plastic: None.
Brittle: Minor zone of cataclasis, dipping ~45°, showing normal slip. Vein-fill slip zone includes chlorite, and clay (at least two generations of veining). Cut by zones of fine grained cataclasite to ultracataclasite.
Veins/alteration: At least two generations of veins. Early serpentine veins preserved in pyroxene and interrupted at the contact with olivine ghosts (now talc). A late serpentine + chrlorite vein, at least one shows shearing (fibers oblique to the walls with sigmoidal figures).

Cross-cutting Relationships (as apparent in thin section):
1) Alteration with serpentine/chlorite veins preserved across pyroxene
2) Cracking, with pervasive alteration of olivine by talc.
3) Veining.
4) Minor shearing.

PHOTOMICROGRAPHS: 345_U1415J_12R_1_TS_63.JPG
345_U1415J_12R_1_TS_63-2.JPG

THIN SECTION: 345-U1415J-12R-1-W 115/117-TSB_Piece_15-TS_64 **Thin Section no.:** 64
Rock name: cataclastic gabbro
Rock comment: contains lithic fragments of altered gabbro; estimation of primary mode not possible; highly altered
Lithologic interval: 63
Piece No.: #15 **Authors: JM, AM**
Billet request comment: lgPet: Primary mineralogy; Struct: Metamorphic Fabric





PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** cataclastic gabbro
Domain grain size: **Grain size distribution:**
Domain texture: **Relative abundance (%):**
Domain comment: This is almost completely altered (99%) and brecciated gabbroic rocks. Primary minerals confirmed under the microscope are anhedral, tabular plagioclase (~2.5 mm in size) and tiny intersittial-shaped clinopyroxene (~0.5 mm) and oxides. Although olivine (100% altered and strongly deformed) may be present, estimation of the original shape and size is impossible.

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 30 **Estimated total % alteration:** 85
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	20.2	olivine 2.5%, clinopyroxene 8.4%, plagioclase 9.3%
epidote/zoisite	6.2	plagioclase 6.2%
green amphibole	10.5	clinopyroxene 10.5%
pale/colorless amphibole	5.6	olivine 2.5%, plagioclase 3.1%
prehnite	37.1	plagioclase 37.1%
secondary plagioclase	3.1	plagioclase 3.1%
zeolite	3.1	plagioclase 3.1%
other	2.1	clinopyroxene 2.1%
domain total alteration %:	**87.9**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	5	100	pale/colorless amphibole 50%, chlorite 50%	some clasts contain corona amphibole. Chlorite patches are assumed to be after olivine
Plagioclase	65	95	pale/colorless amphibole 5%, chlorite 15%, prehnite 60%, zeolite 5%, secondary plagioclase 5%, epidote/zoisite 10%	all prehnite is assumed to replace plagioclase
Clinopyroxene	30	70	green amphibole 50%, chlorite 40%, other 10%	Other: epidote/clinozoisite probably partly after clinopyroxene

ALTERATION COMMENT: Domain is characterized by replacement of plagiclase by fine grained prehnite. There are relict clinopyroxenes but otherwise the protolith of many of the secondary minerals is uncertain. Coarse clasts of prehnite are probably vein material. Original igneous percentages are highly uncertain. Matrix is replaced by prehnite and chlorite. Several grains of sulfide occur in a foliated chlorite vein cutting this locally cataclastic rock; oxides are absent.

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 70 **Estimated total % alteration:** 75
Alteration domain number: 2 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	22.2	olivine 12%, clinopyroxene 3.6%, plagioclase 6.6%
epidote/zoisite	4.4	plagioclase 4.4%
green amphibole	12.6	clinopyroxene 12.6%
pale/colorless amphibole	1.5	olivine 1.5%
prehnite	28.6	plagioclase 28.6%
secondary plagioclase	4.4	plagioclase 4.4%
serpentine	1.5	olivine 1.5%
other	1.8	clinopyroxene 1.8%
domain total alteration %:	**77**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	15	100	pale/colorless amphibole 10%, chlorite 80%, serpentine 10%	chlorite has overprinted a mesh texture in some grains and islands in the mesh are probably clay/chlorite/serpentine intergrowths
Plagioclase	55	80	chlorite 15%, prehnite 65%, secondary plagioclase 10%, epidote/zoisite 10%	
Clinopyroxene	30	60	green amphibole 70%, chlorite 20%, other 10%	Other: epidote/clinozoisite probably partly after clinopyroxene

Vein summary

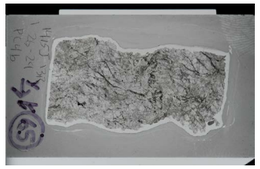
vein 1 numerous thin chlorite veins
vein 2 numerous thin prehnite veins

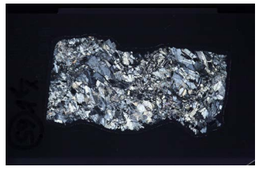
ALTERATION COMMENT: A more olivine-rich rock where olivine is mainly replaced by chlorite. Matrix is strongly replaced by prehnite and chlorite.
STRUCTURE COMMENT: Magmatic: Partially annealed plagioclase; little else preserved.
Crystal Plastic: None.
Brittle: Fine- to coarse-grained zones of cataclasite and ultracataclasite, dipping ~20°. Cuts prehnetized plagioclase, filled by chlorite, and locally refractured.
Veins/alteration: Numerous chlorite veins, many sheared. A late prehnite vein cross cuts part of the thin section.

Cross-cutting Relationships (as apparent in thin section):
1) Alteration plagioclase to prehnite).
2) Cataclasis.
3) Veining including chlorite veins.
4) Minor shearing.
5) Prehnite vein injection.

PHOTOMICROGRAPHS: 345_U1415J_12R_1_TS_64.JPG 345_U1415J_12R_1_TS_64-3.JPG
345_U1415J_12R_1_TS_64-2.JPG 345_U1415J_12R_1_TS_64-4.JPG

THIN SECTION: 345-U1415J-13R-1-W 26/29-TSB_Piece_4b-TS_65 **Thin Section no.:** 65
Rock name: olivine-bearing anorthosite
Rock comment: highly altered and tectonized; moderately altered cataclasite
Lithologic interval: 66
Piece No.: #4 **Authors: ABE, TN**
Billet request comment: IgPet: Primary mineralogy; MetPet: Alt. mineralogy





PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** olivine-bearing anorthosite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):**
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	4	4	2	anhedral	subequant			corona	completely altered
Plagioclase	70	95	25	2	anhedral	tabular				
Oxide	0.8	0.8	0	0.3	subhedral	subequant				chromian spinel

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 35
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	15.4	olivine 4%, plagioclase 11.4%
pale/colorless amphibole	1	olivine 1%
prehnite	12.8	plagioclase 12.8%
secondary plagioclase	2.9	plagioclase 2.9%
other	1.4	plagioclase 1.4%
domain total alteration %:	**33.5**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	5	100	pale/colorless amphibole 20%, chlorite 80%	highly deformed pseudomorph
Plagioclase	95	30	chlorite 40%, prehnite 45%, secondary plagioclase 10%, other 5%	other: tiny oxide (?)

Vein summary
vein 1 chlorite-smectite slip fiber
vein 2 prehnite branching

ALTERATION COMMENT: Olivine is totally altered to pale/colorless amphibole, plagioclase is moderately altered to prehnite, chlorite, secondary plagioclase, and oxides (magnetite ?). Prehnite and chlorite fill vein and cataclasite matrix. A few grains of pyrite in dusty secondary plagioclase.

STRUCTURE COMMENT: Magmatic: Cohesive cataclasite to ultracataclasite, cemented by chlorite ? Looks significantly different than all previous cataclastic/fault rocks, as little altered. Protolith originally coarse grained (plagioclase > 1 cm, now fractured). Hosts minor opaque minerals.
Relict annealed plagioclase; little else preserved.
Crystal Plastic: None.
Brittle: Zone of intense cataclasis to ultracataclasis, shattered appearance. Cut by zones of fine grained cataclasite to ultracataclasite.
Veins/alteration: Locally prehnitization of plagioclase, and prehnite veining. Rare zeolite alteration. A wiggly vein made (likely) of actinolite pervasively altered into clay cuts all the thin section. Ghost of actinolite fibers parallel vein walls and are curved (sheared?). Thinner chlorite veins show also evidence for shearing.

Cross-cutting Relationships (as apparent in thin section):
1) Cataclasis.
2) Prehnite veining.
3) Repeated cataclasis + vein shearing.

PHOTOMICROGRAPHS:
345_U1415J_13R_1_TS_65.JPG
345_U1415J_13R_1_TS_65-2.JPG
345_U1415J_13R_1_TS_65-3.JPG
345_U1415J_13R_1_TS_65-4.JPG
345_U1415J_13R_1_TS_65-5.JPG

THIN SECTION: 345-U1415J-13R-1-W 39/41-TSB_Piece_6-TS_66 **Thin Section no.:** 66
Rock name: orthopyroxene-bearing troctolite
Rock comment: Highly altered
Lithologic interval: 66
Piece No.: #6 **Authors: ABE, KF**
Billet request comment: IgPet: Primary mineralogy

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** orthopyroxene-bearing troctolite
Domain grain size: medium-grained **Grain size distribution:** equigranular
Domain texture: granular/poikilitic **Relative abundance (%):** 100
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	25	55	30	3	anhedral to subhedral	subequant			thin corona	include chromian spinel
Plagioclase	2	41	39	1	anhedral to subhedral	tabular				
Orthopyroxene	3	3.2	0.2	30	anhedral	interstitial		colorless		one cm-sized interstitial orthopyroxene crystal
Oxide	0.7	0.8	0.1	0.2	subhedral	subequant				chromian spinel

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 60
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	3.2	plagioclase 3.2%
clay minerals	1.5	olivine 1.5%
oxide	0.9	olivine 0.9%
pale/colorless amphibole	5	clinopyroxene 5%
prehnite	28.4	plagioclase 28.4%
serpentine	27	olivine 27%
sulfide	0.6	olivine 0.6%
domain total alteration %:	**66.6**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	60	50	clay minerals 5%, oxide 3%, sulfide 2%, serpentine 90%	very well developed serpentine mesh after olivine
Plagioclase	35	90	chlorite 10%, prehnite 90%	plagioclase almost completely replaced by fine grained prehnite, plagioclase altered to chlorite along the grain boundaries when in contact with olivine.
Clinopyroxene	5	100	pale/colorless amphibole 100%	

Vein summary
vein 1 thin serpentine veins

ALTERATION COMMENT: Highly altered rock in which plagioclase is almost completely replaced by prehnite and lesser amounts of chlorite, while olivine is less altered to serpentine in mesh texture. Pyrite in serepntine replacing olivine.

STRUCTURE COMMENT: Magmatic: Moderate magmatic foliation defined by olivine SPO. Rare submagmatic deformation twins, and weakly annealed grain boundaries in plagioclase. Intercumulus clinopyroxene minimum of 5 cm across.
Crystal Plastic: Well-developed serpentine foliation parallel to magmatic foliation.
Brittle: Minor cracking due to serpentinization.
Veins/alteration: Plagioclase mostly prehnetized, cut by serpentine veins

Cross-cutting Relationships (as apparent in thin section):
1) Magmatic foliation.
2) Serpentinization (foliation development and cracking).
3) Prehnitization.

PHOTOMICROGRAPHS: 345_U1415J_13R_1_TS_66.JPG
345_U1415J_13R_1_TS_66-2.JPG

THIN SECTION: 345-U1415J-13R-1-W 53/56-TSB_Piece_7-TS_67 **Thin Section no.:** 67
Rock name: strongly altered olivine gabbro
Rock comment: estimation of primary mode is very vague due to strong alteration; highly altered possible high T alteration
Lithologic interval: 66
Piece No.: #7 **Authors: MMJ, TN**
Billet request comment: IgPet: Primary mineralogy; MetPet: HT Vein; Struct: veins w/shear indices

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** strongly altered olivine gabbro
Domain grain size: coarse grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):**
Domain comment: Defined as troctolite in macroscopic description. Piece 7 is almost completely altered. Possibly an olivine gabbro.

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	5	30	25	1	anhedral	amoeboid			overgrowth	Some olivine are fresh, but the majority are entirely replaced
Plagioclase	15	60	45	1	subhedral	tabular				
Clinopyroxene	2	10	8		anhedral	interstitial		colorless	interstitial	
Oxide	0.1	0.1	0	0.1	subhedral	equant				

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 70
Alteration domain number: 1 **Domain type:** halo

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	17.8	olivine 9%, plagioclase 8.8%
clay minerals	9	olivine 9%
epidote/zoisite	1.6	plagioclase 1.6%
garnet	1.6	plagioclase 1.6%
oxide	0.9	olivine 0.9%
pale/colorless amphibole	13.5	olivine 13.5%, clinopyroxene <0.1%
prehnite	3.2	plagioclase 3.2%
serpentine	7.2	olivine 7.2%
sulfide	0.9	olivine 0.9%, clinopyroxene <0.1%
talc	4.5	olivine 4.5%
other	0.8	plagioclase 0.8%
domain total alteration %:	**61**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	50	90	pale/colorless amphibole 30%, chlorite 20%, clay minerals 20%, oxide 2%, sulfide 2%, serpentine 16%, talc 10%	
Plagioclase	40	40	chlorite 55%, prehnite 20%, garnet 10%, epidote/zoisite 10%, other 5%	other: green spinel with chlorite and amphibole, and tiny oxide (?) grain
Clinopyroxene	5		pale/colorless amphibole 98%, sulfide 2%	
Oxide	5			

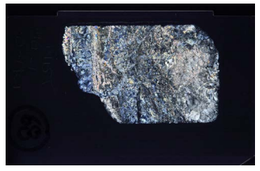
Vein summary
vein 1 pale brown (amphibole + chlorite or clay?) slip-fiber vein

ALTERATION COMMENT: Green spinel with coronitic assemblage (amphibole + chlorite) suggests high T alteration. Pyrite associated with tremolite and talc replacing olivine.
STRUCTURE COMMENT: Magmatic: Moderate- to weak magmatic foliation defined by plagioclase and olivine SPO. Common submagmatic deformation twins and bent grains of plagioclase; locally annealed. Locally well-developed subgrains in plagioclase, and olivine. Locally, olivine rimmed by intercumulus clinopyroxene.
Crystal Plastic: None.
Brittle: Cracking associated with vein intrusion.
Veins/alteration Composite serpentine, chlorite, tremolite/actinolite(?) vein array cutting serpentinized olivine, and altered plagioclase. Tremolite/actinolite fibers parallel vein walls and have a wiggly shape that mirror the shape of the vein walls. Chlorite fibers are perpendicular to the vein wall and show evidence of moderate shearing.

Cross-cutting Relationships (as apparent in thin section):
1) Magmatic foliation development.
2) Veining.
3) Moderate shearing of the late veins.

PHOTOMICROGRAPHS: 345_U1415J_13R_1_TS_67.JPG 345_U1415J_13R_1_TS_67-3.JPG
345_U1415J_13R_1_TS_67-2.JPG 345_U1415J_13R_1_TS_67-4.JPG

THIN SECTION: **345-U1415J-14G-1-W 0/4-TSB_Piece_1-TS_68** **Thin Section no.:** **68**
Rock name: cataclastic and completeley altered gabbro
Rock comment: former gabbro, now completely altered with some primary relics; completely altered
Lithologic interval: G42
Piece No.: #1 **Authors: JK, MP**
Billet request comment: Ig Pet: Primary mineralogy; MetPet: Clinozoisite vein



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** cataclastic and completeley altered gabbro
Domain grain size: medium grained **Grain size distribution:** seriate
Domain texture: granular/poikilitic **Relative abundance (%):**
Domain comment: description of the texture on the basis of few relics; protolith was probably Clinopyroxene oikocryst bearing gabbro; now very rich in clinozoisite and prehnite; not possible to estimate primary mode.

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine										not clear, whether primary olivine was present
Plagioclase										equilibrated texture with triple junctions
Clinopyroxene										poikilic clinopyroxene grows interstitially

ALTERATION / METAMORPHISM **No. of alteration domains:** **2** **Domain rel. abund %:** 35 **Estimated total % alteration:** 90
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	1.3	olivine 0.5%, clinopyroxene 0.8%
clay minerals	0.2	clinopyroxene 0.2%
epidote/zoisite	10.2	plagioclase 10.2%
green amphibole	1	clinopyroxene 1%
pale/colorless amphibole	7	clinopyroxene 7%
prehnite	37.4	plagioclase 37.4%
serpentine	5	olivine 4%, clinopyroxene 1%
talc	0.5	olivine 0.5%
zeolite	20.4	plagioclase 20.4%
domain total alteration %:	**83**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	5	100	chlorite 10%, serpentine 80%, talc 10%	The mesh texture suggests that the primary mineral was olivine.
Plagioclase	85	80	prehnite 55%, zeolite 30%, epidote/zoisite 15%	
Clinopyroxene	10	100	green amphibole 10%, pale/colorless amphibole 70%, chlorite 8%, clay minerals 2%, serpentine 10%	

Vein summary
vein 1 Clinozoisite vein with secondary injection of prehnite at the bottom of the section. The vein itself is massive with relatively large crystals of clinozoisite. the rims of the vein are outlined by cataclastic prehnite.
Presence of some kind of halo with partial destruction of the original texture and abundant clinozoisite.
vein 2 Clinozoisite veins with massive texture crosscutting plagioclase.
vein 3 Late prehnite and clay veins crosscutting the other formations.

ALTERATION COMMENT: Total alteration of primary minerals. The primary texture is more or less preserved where there is no vein. Pyrite in zoisite vein, in amphibole grain and in chlorite-filled fractures in plagioclase.

ALTERATION / METAMORPHISM **No. of alteration domains:** **2** **Domain rel. abund %:** 65 **Estimated total % alteration:** 100
Alteration domain number: 2 **Domain type:** halo

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	5.5	olivine 0.5%, clinopyroxene 5%
clay minerals	8.6	clinopyroxene 0.1%, plagioclase 8.5%
epidote/zoisite	42.5	plagioclase 42.5%
pale/colorless amphibole	2	clinopyroxene 2%
prehnite	34	plagioclase 34%
serpentine	7.5	olivine 4.5%, clinopyroxene 3%
domain total alteration %:	**100.1**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	5	100	chlorite 10%, serpentine 90%	The mesh texture suggests that the primary mineral was olivine.
Plagioclase	85	100	clay minerals 10%, prehnite 40%, epidote/zoisite 50%	
Clinopyroxene	10	100	pale/colorless amphibole 20%, chlorite 50%, clay minerals 1%, serpentine 30%	

ALTERATION COMMENT: The primary lithology is completely replaced. Partial destruction of the original texture.

STRUCTURE COMMENT: Magmatic: Little original magmatic fabric remains, but rare visible submagmatic deformation twins in plagioclase; locally annealed. Locally well-developed subgrains in plagioclase, and olivine.
Crystal Plastic: None.
Brittle: Cataclasite, overprinted by veining, and refracture.
Veins/alteration: Composite vein history showing repeated anastomosing veins of prehnite (locally sheared, showing grain size reduction and development of semi-brittle 'fish' with subgrain development), zoisite, prehnite, zoisite veins and fracturing.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic foliation development.
2) Cataclasitic deformation.
3) Repeated vein fill (prehnite and zoisite).
4) Cataclastic deformation.

PHOTOMICROGRAPHS: 345_U1415J_14G_1_TS_68.JPG 345_U1415J_14G_1_TS_68-3.JPG
345_U1415J_14G_1_TS_68-2.JPG 345_U1415J_14G_1_TS_68-4.JPG

THIN SECTION: 345-U1415J-15G-1-W 46/49-TSB_Piece_6-TS_69 **Thin Section no.:** 69
Rock name: clinopyroxene oikocryst-bearing troctolite
Rock comment: oikocryst and matrix were described as two different domains; highly altered vein halo, slightly altered background
Lithologic interval: G51
Piece No.: #6 **Authors: JM, RW**
Billet request comment: Ig Pet: Primary mineralogy; MetPet: vein oikocryst interaction

PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** oikocrysts/ matrix

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 75
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	8	15	7	1.2	anhedral	irregular			hopper texture	Olivine encloses tabular plagioclase in some cases.
Plagioclase	80	84.5	4.5	1.2	anhedral	tabular	continuous zoning			foliated
Orthopyroxene	0.3	0.5	0.2	0.4	anhedral	irregular		colorless	possible reaction with clinopyroxene	irregular shaped orthopyroxene is associated with olivine.
Oxide	0.1	0.1	0	0.1	anhedral	equant				

Igneous domain number: 2 **Domain lithology:** clinopyroxene oikocryst
Domain grain size: coarse grained **Grain size distribution:**
Domain texture: **Relative abundance (%):** 25
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase	5	5	0	0.8	anhedral	elongate	continuous zoning		chadacrysts	
Clinopyroxene	95	95	0	18	anhedral	equant		colorless	poikilitic	two grains of clinopyroxene possibly compose one large oikocryst.

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 75 **Estimated total % alteration:** 3
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	0.2	plagioclase 0.2%
clay minerals	1.2	clinopyroxene 1.2%
serpentine	0.3	olivine 0.3%
talc	1.2	olivine 1.2%
domain total alteration %:	**2.9**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	10	15	serpentine 20%, talc 80%	
Plagioclase	22	1	chlorite 100%	
Clinopyroxene	60	2	clay minerals 100%	
Orthopyroxene	1	0		

ALTERATION COMMENT: Background alteration is minimal. Olivine is moderately altered to talc and serpentine. Clinopyroxene is slightly altered to clay minerals. Plagioclase is slightly altered to chlorite. Pyrite associated with clay replacing olivine; pyrite inclusions in clinopyroxene and plagioclase may be magmatic.

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 25 **Estimated total % alteration:** 74
Alteration domain number: 2 **Domain type:** vein halo

SECONDARY MINERALOGY	%	REPLACING / FILLING
clay minerals	21	olivine 7.5%, clinopyroxene 13.5%
prehnite	2.1	plagioclase 2.1%
serpentine	42.5	olivine 42.5%
zeolite	8.4	plagioclase 8.4%
domain total alteration %:	**74**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	50	100	clay minerals 15%, serpentine 85%	
Plagioclase	35	30	prehnite 20%, zeolite 80%	
Clinopyroxene	15	90	clay minerals 100%	

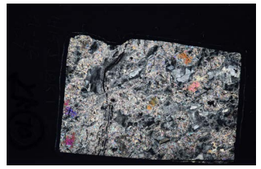
Vein summary
vein 1 zeolite 90 %; calcite 10 %

ALTERATION COMMENT: Highly altered vein halo. Olivine is completely altered to serpentine and clay minerals. Pyrite in chlorite-filled fractures in plagioclase; pyrite inclusions in clinopyroxene and plagioclase may be magmatic.

STRUCTURE COMMENT:
Magmatic: Heterogeneous oikocrystic clinopyroxene olivine gabbro.
Moderate magmatic foliation defined by plagioclase SPO. Very common submagmatic deformation twins, bent grains and undulose extinction in plagioclase between clinopyroxene oikocrysts. Submagmatic deformation twins in plagioclase hosted by clinopyroxene. Annealed grain boundaries throughout. Clinopyroxene with undulose extinction, and rare subgrain development. Olivine locally 'hopper' morphology with subgrain development.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: None
Veins/alteration: Branching crack seal veins of zeolite and clay, associated static alteration (including euhedral carbonate grains). Zeolite vein shows evidence of moderate shearing.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic foliation development.
2) Repeated crack-seal vein fill, and static alteration (subparallel to magmatic foliation).
3) Moderate shearing.

PHOTOMICROGRAPHS:
345_U1415J_15G_1_TS_69.JPG
345_U1415J_15G_1_TS_69-2.JPG

THIN SECTION: 345-U1415J-18R-1-W 49/52-TSB_Piece_7-TS_70 **Thin Section no.:** 70
Rock name: troctolite
Rock comment: highly altered
Lithologic interval: 69
Piece No.: #7 **Authors: NA, RW**
Billet request comment: lgPet: Primary mineralogy; MetPet: Oliv. Alteration; Struct: Deformation



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: medium grained **Grain size distribution:** equiglanular
Domain texture: granular **Relative abundance (%):** 100
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	3	50	47	2	anhedal	subequant				
Plagioclase	5	50	45	2	anhedral to subhedral	tabular				
Oxide	0.1	0.1	0	0.1	subhedral to euhedral	subequant			poikilitic	chromian spinel

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 64
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	28.6	plagioclase 28.6%
clay minerals	11.6	olivine 11.6%
oxide	1.7	olivine 1.7%
pale/colorless amphibole	13.2	olivine 13.2%
serpentine	6.6	olivine 6.6%
other	0.1	oxide 0.1%
domain total alteration %:	**61.8**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	55	60	pale/colorless amphibole 40%, clay minerals 35%, oxide 5%, serpentine 20%	
Plagioclase	44	65	chlorite 100%	
Oxide	1	10	other 100%	

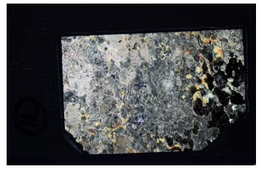
Vein summary
vein 1 Vein has a core of chlorite and rims of oriented clay.

ALTERATION COMMENT: The olivine and plagioclase in this troctolite have reacted to form amphibole and chlorite respectively. Bands of these replacement minerals surround cores that contain relic olivine or plagioclase unless the replacement is complete. Significant amounts of magnetite are associated with a vein cross cutting this thin section. Magnetite is also present in the olivine replacement textures.

STRUCTURE COMMENT: Magmatic: Highly altered troctolite, with relict weak magmatic foliation defined by plagioclase SPO. Submagmatic deformation twins and undulose extinction in plagioclase common. Weakly equilibrated.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: Serpentinization along cracks in olivine, through going crack
Veins/alteration: Two subparallel, curved crack seal veins of actinolite, chlorite, sulfides and zoisite. Actinolite micro-fibrous crystals on the vein walls associated with sulfides, zoisite filling in the vein interior.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic foliation development.
2) Repeated crack-seal vein fill, and static alteration.

PHOTOMICROGRAPHS: 345_U1415J_18R_1_TS_70.JPG
345_U1415J_18R_1_TS_70-2.JPG

THIN SECTION: 345-U1415J-18R-1-W 67/69-TSB_Piece_9-TS_71 **Thin Section no.:** 71
Rock name: completeley altered chromitite
Rock comment: protolith was probably chomitite/dunite/troctolite association; some grains of chromian spinel preserved, rock is completely altered
Lithologic interval: 70
Piece No.: #9 **Authors: ABE, TN**
Billet request comment: IgPet: Primary Mineralogy; MetPet: Oliv. Alt.



PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** two lithologies

Igneous domain number: 1 **Domain lithology:** completeley altered chromitite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 40
Domain comment: former chomitite; chomian spinel converted to magnetite; some grains of chromian spinel preserved

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	60	60	3	anhedral to subhedral	subequant				
Plagioclase	0	1	1	1	anhedral	tabular				
Oxide		39		3	abhedral	subequant				former chromite; orbicular

Igneous domain number: 2 **Domain lithology:** completeley altered troctolite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 60
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	50	50	3	anhedral to subhedral	subequant				
Plagioclase	0	50	50	2	anedral	tabular				
Oxide		0.5		0.2	anhedral	subequant				chromian spinel present

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 98
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	32.4	olivine 6%, plagioclase 26.4%
epidote/zoisite	7	plagioclase 7%
green amphibole	2.4	clinopyroxene 2.4%
oxide	2	olivine 2%
pale/colorless amphibole	32.6	olivine 32%, clinopyroxene 0.6%
prehnite	1.4	plagioclase 1.4%
other	20.4	plagioclase 0.4%, oxide 20%
domain total alteration %:	**98.2**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	40	100	pale/colorless amphibole 80%, chlorite 15%, oxide 5%	amphibole pseudomorph
Plagioclase	37	95	chlorite 75%, prehnite 4%, epidote/zoisite 20%, other 1%	other: green spinel
Clinopyroxene	3	100	green amphibole 80%, pale/colorless amphibole 20%	amphibole has zonal structure
Oxide	20	100	other 100%	chromite (?) altered to magnetite and chlorite

ALTERATION COMMENT: Primary minerals have been almost completely altered. Green spinel suggests a high temperature condition of metamorphism. Amphibole shows a variation in gamma-absorption color: colorless, green and bluish green. Chromite or chromian spinel is a possible primary phase altered to hollow magnetite grains and chlorite with uncommon pale-bluish green color. Zone (~20% of thin section area) with up to 25% magnetite and some relict chromite, some minor amounts of pyrite are present in this zone as well. In the other 80% of that thin section, magnetite is less abundant (but still around 2 Vol%) and is associated with the alteration of olivine.

STRUCTURE COMMENT: Magmatic: Highly altered? troctolite, with relict weak magmatic foliation defined by prehnitized plagioclase SPO. Note, ghost intercumulus pyroxene.
Crystal Plastic: No recognizable crystal plastic deformation.
Brittle: No recognizable brittle deformation.
Veins/alteration: Euhedral, blue-green amphibole (riebekite ?) laths replacing plagioclase. Magnetite + ilmenite+ sulfides after olivine, or pyroxene; no veins
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic foliation development.
2) Alteration.

PHOTOMICROGRAPHS: 345_U1415J_18R_1_TS_71.JPG
345_U1415J_18R_1_TS_71-2.JPG

THIN SECTION: 345-U1415J-18R-1-W 141/143-TSB_Piece_17b-TS_72 **Thin Section no.:** 72
Rock name: troctolite
Rock comment: contains a layer richer in plagioclase, highly altered
Lithologic interval: 72
Piece No.: #17 **Authors: TF, KF**
Billet request comment: lgPet: Primary mineralogy; MetPet: Vein relationships; Struct: Magm. Fabric

PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** modal and grain size

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 60
Domain comment: more coarser grained troctolite

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	5	50	45	1.5	euhedral to subhedral	subequant				
Plagioclase	1	50	49	1	anhedral	intertitial				
Clinopyroxene	0.05	0.1	0.05	0.1	anhedral	interstial		colorless		clinopyroxene form smal rims around olivine
Oxide	0.1	0.1	0	0.1	euhedral to anhedral	subequant				

Igneous domain number: 2 **Domain lithology:** plagioclase-rich troctolite

Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 40
Domain comment: finer grained, foliation in plagioclase more evident, plagioclase rich

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	1	20	19	1	subeuhedral to anhedral	suequant to ameoboid				
Plagioclase	5	80	75	1	euhedral to subhedral	tabular				
Clinopyroxene	0.05	0.1	0.05	0.1	anhedral	interstial		colorless		
Oxide	0.1	0.1	0	0.1	euhedral to anhedral	subequant				

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 50 **Estimated total % alteration:** 75
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	2.7	plagioclase 2.7%
clay minerals	14.7	olivine 14.7%
pale/colorless amphibole	1	clinopyroxene 1%
prehnite	16.2	plagioclase 16.2%
secondary plagioclase	8.1	plagioclase 8.1%
serpentine	34.3	olivine 34.3%
domain total alteration %:	**77**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	70	70	clay minerals 30%, serpentine 70%	olivine replaced by serpentine mesh texture, rarely some clay replacing olivine in the mesh core, in some places, serpentine in the mesh core shows blue pleochroism.
Plagioclase	30	90	chlorite 10%, prehnite 60%, secondary plagioclase 30%	plagioclase is almost completely altered to fine grained secondary plagioclase and prehnite, and is altered to a thin rim of chlorite along grain boundaries when in contact with olivine.
Clinopyroxene	5	20	pale/colorless amphibole 100%	clinopyroxene only occurs as a very small rim between some plagioclase and olivine grains, probably formed from interstitial melt?

Vein summary
vein 1 Plagioclase veins, connecting two former plagioclase grains which each other that are now completely altered to fine grained secondary plagioclase.
vein 2 Clay veins, crosscutting former olivine.

ALTERATION COMMENT: This domain is characterized by a high modal abundance of relict olivine, which is mainly altered to serpentine mesh, plagioclase is almost completely replaced by prehnite, clinopyroxene only occurs as small rims between plagioclase and olivine and is only slightly altered. Pyrite associated with serpentine/clay replacing olivine, and with chlorite replacing plagioclase.

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 50 **Estimated total % alteration:** 70
Alteration domain number: 2 **Domain type:** halo?

SECONDARY MINERALOGY	%	REPLACING / FILLING
clay minerals	20	olivine 20%
green amphibole	4	olivine 4%
prehnite	35	plagioclase 35%
serpentine	16	olivine 16%
domain total alteration %:	**75**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	50	80	green amphibole 10%, clay minerals 50%, serpentine 40%	one one side of the shear zone: olivine mainly replaced by serpentine mesh, but this time olivine in the mesh core is mainly replaced by clay, in other parts, olivine is completely altered to form tremolite and chlorite (together with former plagioclase), on the other side of the shear zone: olivine is much less altered (only 50%) to serpentine.
Plagioclase	50	70	prehnite 100%	on one side of the shear zone: plagioclase is completely altered to prehnite, on the other side of the shear zone: plagioclase is only completely altered to prehnite close to the part where the shear zone is filled with clay, further away from this part, plagioclase is much less altered, here it is altered to fine grained prehnite along fractures.

Vein summary
vein 1 sheared chlorite vein, chlorite minerals are imbricated, some parts of the vein were later replaced by clay, the clay is crosscutting another branching part of the chlorite vein.

ALTERATION COMMENT: More plagioclase rich than domain 1, this domain is cut by a sheared chlorite filled vein. The degree of alteration is higher on one side of this shear zone than on the other side. On one side of the shear zone olivine is completely altered to serpentine and clay, and plagioclase is completely replaced by prehnite. On the other side of the shear zone olivine is only 50% altered to serpentine; plagioclase is also less altered (to more fine grained prehnite along fractures). Pyrite associated with serpentine/clay replacing olivine, and with chlorite replacing plagioclase.

STRUCTURE COMMENT: Magmatic: Boundary between coarse troctolite and gabbro.
Coarse troctolite - Moderate magmatic foliation defined by olivine and plagioclase SPO. Rare intercumulus clinopyroxene. Undulose extinction and subgrain olivine.
Gabbro - Rare submagmatic deformation twins, bent grains of plagioclase, and undulose extinction. Some annealing.
Crystal Plastic: Strong serpentine foliation in olivine roughly orthogonal to magmatic foliation in coarse troctolite.
Brittle: No recognizable brittle deformation.
Veins/alteration: Thin, planar microveins of serpentine. Thicker irregular serpentine veins and one thicker serpentine vein cutting gabbro, dies into anastomosing branches in the troctolite. Varies in mineralogy along its length. Fibrous vein filling material perpendicular to the vein wall moderately sheared in some serpentine veins.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic foliation development.
2) Alteration, and veining.

PHOTOMICROGRAPHS: 345_U1415J_18R_1_TS_72.JPG
345_U1415J_18R_1_TS_72-2.JPG

THIN SECTION: 345-U1415J-19R-1-W 18/19-TSB_Piece_3-TS_73 **Thin Section no.:** 73
Rock name: troctolite
Rock comment: highly altered
Lithologic interval: 73
Piece No.: #3 **Authors: JM, KF**
Billet request comment: IgPet: Primary mineralogy; MetPet: Oliv. Alt; Struct: Magm. Foliation

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment:

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	3	49	46	3	anhedral	irregular				partly enclosing tabular plagioclase
Plagioclase	3	50	47	0.8	anhedral	tabular				
Clinopyroxene	0.5	1	0.5	0.4	anhedral	irregular		colorless		
Oxide	0.1	0.1	0	0.1	subhedral to euhedral	equant				spinel, mostly in plagioclase and plagioclase-olivine contacts

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 65
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
clay minerals	3.6	olivine 3.6%	Plagioclase	40	80	chlorite 20%, prehnite 80%	plagioclase is almost completely replaced by prehnite, plagioclase is altered to fine grained chlorite along the grain boundaries, when it is in contact with (former) olivine.
green amphibole	7.2	olivine 7.2%					
prehnite	25.6	plagioclase 25.6%					
serpentine	25.2	olivine 25.2%					
domain total alteration %:	**68**						

Vein summary

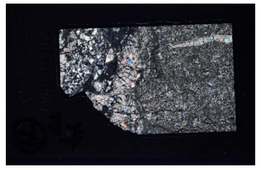
vein 1 Branching prehnite vein, rimmed by two more phases, the first one is brownish and looks crumbly (maybe clay), the outermost one is greenish-brown, with low interference colors and low refractive index (amphibole?).
vein 2 The outermost rim of vein type 1 branches off and forms its own vein.
vein 3 Serpentine veins, cross cutting multiple, different olivine grains.

ALTERATION COMMENT: Olivine is moderately altered to serpentine mesh, plagioclase is almost completely replaced by prehnite and chlorite, the alteration is pervasive. Large (~0.1 mm) euhedral grains of magnetite are present in completely replaced plagioclase and intensively altered olivine. Disseminated magnetite and small amounts of pyrite are associated with serpentine mesh after olivine.

STRUCTURE COMMENT: Magmatic: Moderate magmatic foliation defined by olivine SPO. Undulose extinction and subgrains in olivine. Rare intercumulus clinopyroxene.
Crystal Plastic: Mesh texture serpentine fabric.
Brittle: No recognizable brittle deformation.
Veins/alteration: Thick serpentine vein network, cut by conjugate prehnite + clay vein with vein tips preserved. . Most veins with serpentine/chlorite filling, with fibers perpendicular to the vein walls. One vein with multiple filling: serpentine/chlorite on the wall and prehnite and carbonate inside. Veins are not sheared.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic foliation development.
2) Alteration and veining.

PHOTOMICROGRAPHS: 345_U1415J_19R_1_TS_73.JPG
345_U1415J_19R_1_TS_73-2.JPG

THIN SECTION: **345-U1415J-19R-1-W 64/67-TSB_Piece_10-TS_74** **Thin Section no.:** **74**
Rock name: cataclasite with basaltic fragment
Rock comment: eventually tectonized gabbro/dike contact; moderately latered
Lithologic interval: 74
Piece No.: #10 **Authors: MMJ, AM**
Billet request comment: IgPet: Cataclastic; MetPet: Contact and veins; Struct: Contact



PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** two or more lithologies

Igneous domain number: 1 **Domain lithology:** basalt
Domain grain size: fine grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 55
Domain comment: was discussed as an intrusion; however, no chilled margin; cataclasite fabric; interpreted as basaltic clast

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	5	5	0.3		elongate				olivine habit varies; some anhedral, some subhedral, some euhedral
Plagioclase	40	55	15	0.5	subhedral to euhedral	lath-shaped	continuous zoning			
Clinopyroxene	35	40	5							
Oxide	0.1	0.1	0	0.1	euhedral	isometric				oxide is spinel

Igneous domain number: 2 **Domain lithology:** cataclasite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 45
Domain comment: former olivine, relict clinopyroxene, and plagioclase are present; difficult to estimate original lithology; probably gabbroic; estimation of primary mode not possible

ALTERATION / METAMORPHISM **No. of alteration domains:** **2** **Domain rel. abund %:** 60 **Estimated total % alteration:** 50
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	7	clinopyroxene 4%, plagioclase 3%
clay minerals	4	clinopyroxene 4%
epidote/zoisite	4.5	plagioclase 4.5%
green amphibole	10	clinopyroxene 10%
secondary plagioclase	22.5	plagioclase 22.5%
other	2	clinopyroxene 2%
domain total alteration %:	**50**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Plagioclase	60	50	chlorite 10%, secondary plagioclase 75%, epidote/zoisite 15%	Plagioclase is often turbid and appeasr to be quite extensivley altered to secondary plagioclase + clinozoisite. Epidote is ofetn present in cataclastic zones
Clinopyroxene	40	50	green amphibole 50%, chlorite 20%, clay minerals 20%, other 10%	Other = epidote

Vein summary
vein 1 Epidote/clinozoisite vein with radiating texture postdates cataclasis. Narrows from 2 to 0 mm within slide, mainly in domain 1.
vein 2 Several thin chlorite veins postdate cataclasis.

ALTERATION COMMENT: moderately altered fine grained dike rock.

ALTERATION / METAMORPHISM **No. of alteration domains:** **2** **Domain rel. abund %:** 40 **Estimated total % alteration:** 55
Alteration domain number: 2 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	21	olivine 9%, clinopyroxene 2%, plagioclase 10%
epidote/zoisite	6	plagioclase 6%
green amphibole	3.5	olivine 1%, clinopyroxene 2.5%
prehnite	14	plagioclase 14%
secondary plagioclase	10	plagioclase 10%
other	0.5	clinopyroxene 0.5%
domain total alteration %:	**55**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	10	100	green amphibole 10%, chlorite 90%	former presence of olivine inferred on the basis of clinopyroxene rims and relicts of corona texture
Plagioclase	80	50	chlorite 25%, prehnite 35%, secondary plagioclase 25%, epidote/zoisite 15%	
Clinopyroxene	10	50	green amphibole 50%, chlorite 40%, other 10%	Other=epidote (not pseudomorphic)

Vein summary
vein 1 Epidote/clinozoisite vein cuts domain 1 and the marginal cataclasite.
vein 2 Chlorite-epidote/clinozoisite veins cut prehnitized plagioclase.

ALTERATION COMMENT: Cataclastic zone rich in chlorite and secondary plagioclase separates the dolerite from cataclased and altered olivine gabbro. This contains bands of relatively unaltered coarse plagioclase grains separated by a network of fibrous chlorite, and of prehnite-rich breccias cut by chlorite-epidote/clinozoisite veins. Locally chlorite replaces olivine (or its successors), plagioclase and clinopyroxene, while clinozoisite replaces chlorite. Very rare magnetite, associated with chlorite.

STRUCTURE COMMENT: Magmatic: Contact between dike and gabbro cataclasite - dike with sheared/cataclasized margin, cut by veins and zones of cataclasis.

Dike - diabase; relatively fresh w/ plagioclase, clinopyroxene ± olivine.
Gabbro - No magmatic fabric remaining.
Crystal Plastic: None.
Brittle: Cohesive gabbro cataclasite; alternates prehnitized, and little altered, with chlorite (± clay) matrix cementing very angular clasts of fractured plagioclase and pyroxene. Possible chlorite matrix. Non-altered cataclasite much like thin section #65.
Diabase cut by branching chlorite-filled zones of cataclasite. Possible the chlorite veins cut cataclastic deformation. Thicker prehenite and ? zeolite veins crack seal. Dike margin sheared.
Veins/alteration: Chlorite, prehnite and zeolite veins cut diabase, cataclasite and prehnitized cataclastic gabbro, and sheared dike/gabbro contact. Chlorite fibers is sheared in most veins. Prehnite and zeolite veins not sheared, some zeolite fibers are as long as the vein width.

Crosscutting Relationships (as apparent in thin section):
1) Prehnite alteration, and cataclastic deformation of gabbro
2) Dike intrusion.
3) Chlorite veining, and cataclasis of both (dike and gabbro)
4) Prehnite/zeolite veining

PHOTOMICROGRAPHS: 345_U1415J_19R_1_TS_74.JPG
345_U1415J_19R_1_TS_74-2.JPG

THIN SECTION: **345-U1415J-21R-1-W 9/11-TSB_Piece_2-TS_75** **Thin Section no.:** **75**
Rock name: completeley altered chromitite
Rock comment: former chomitite; now metamorphic rock composed of magnetite, chlorite and amphibole; rock is completely altered
Lithologic interval: 77
Piece No.: #2 **Authors: MMJ, AM**
Billet request comment: lgPet: Prim. mineralogy; MetPet: Alt. of Chromite/Magnetite

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** chromitite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: Chromite has been identified as magnetite; origin of matrix surrounding magnetite cannot be determined, possibly former olivine; matrix now consisting of green-blue pleochroitic amphibole, chlorite and epidote (mostly on veins); primary modal chromite content is very vague; mode estimation of primary silicate minerals not possible

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Oxide	50	50	0	0.3	euhedral	aggregates			cluster of tiny grains	Cannot determine max size, many magnetite crystals intergrown

ALTERATION / METAMORPHISM **No. of alteration domains:** **1** **Domain rel. abund %:** 100 **Estimated total % alteration:** 100
Alteration domain number: 1 **Domain type:** patch

Vein summary
vein 1 Several brown fibrous clay veins cut the slide. Green chlorite with anomalous blue interference colors is locally developed adjacent to these veins.

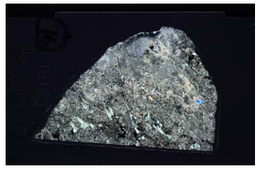
ALTERATION COMMENT: Completely altered rock with no igneous texture visible. Oxide forms radiating sprays and curved aggregates of lath-like grains showing pleochroism in reflected light. The rock attracts a magnet and the streak is dark. In between the oxides are vermicular/spherulitic intergrowths of bluish grey birefringent but pale chlorite. Blue to green pleochroic amphibole and highly birefringent epidote occur along parallel zones that may be the remnants of layering. Bladed rosettes of magnetite dominate this rock, while thin sulfide seams occupy veins and grain boundaries in the magnetite and host chlorite.

STRUCTURE COMMENT: Magmatic: Ghost olivine (?) replaced by magnetite (?).
Crystal Plastic: None preserved.
Brittle: Minor fracturing.
Veins/alteration: Replacement chlorite, hosting magnetite sprays, cut by epidote and blue amphibole veinlets and sprays..

Crosscutting Relationships (as apparent in thin section):
1) Ghost olivine replaced by magnetite.
2) Minor fracturing.
2) Vein formation @ chlorite, epidote, blue amphibole

PHOTOMICROGRAPHS: 345_U1415J_21R_1_TS_75.JPG
345_U1415J_21R_1_TS_75-2.JPG

THIN SECTION: 345-U1415J-21R-1-W 13/15-TSB_Piece_3-TS_76 **Thin Section no.:** 76
Rock name: troctolite
Rock comment: with 2% of chromian spinel altered to magnetite; completely altered
Lithologic interval: 77
Piece No.: #3 **Authors: NA, TN**
Billet request comment: IgPet: Prim. mineralogy; MetPet: Potential High T Alt.



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: medium **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: Chromian spinel is present as relic; most chromite is completely altered to magnetite; chromite veins are present

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	5	47	42	1.5	euhedral to subhedral	subequant				
Plagioclase	10	48	38	2	subhedral to anhedral	tabular				
Oxide	3	5	2	0.2	subhedral to euhedral	equant				chromian spinel, vein-like magnetite

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 98
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	40.5	olivine 12%, plagioclase 28.5%
epidote/zoisite	1.9	plagioclase 1.9%
green amphibole	4	clinopyroxene 4%
pale/colorless amphibole	36.6	olivine 28%, clinopyroxene 1%, plagioclase 7.6%
other	10	oxide 10%
domain total alteration %:	**93**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	40	100	pale/colorless amphibole 70%, chlorite 30%	Tremolite + chlorite pseudomorphically replace olivine.
Plagioclase	40	95	pale/colorless amphibole 20%, chlorite 75%, epidote/zoisite 5%	
Clinopyroxene	5	100	green amphibole 80%, pale/colorless amphibole 20%	Colorless and bluish green amphibole.
Oxide	10	100	other 100%	other: magnetite and pale blue-green chlorite

ALTERATION COMMENT: Olivine and plagioclase have been completely altered to tremolite and chlorite; pseudomorphs after plagioclase contain more abundant chlorite than pseudomorphs after olivine. Original grain boundary between olivine and plagioclase can be inferred by alignment of tremolite grains. Relatively large crystals of amphibole show variation in color from colorless to bluish green. Aggregates of magnetite and pale-bluish green chlorite are possibly pseudomorphs of chromite or chromian spinel. A patch of epidote replaces secondary plagioclase and may coexist with pale green amphibole. Abundant sulfide along grain boundaries, likely pyrite. At least three oxides are present, dominantly magnetite commonly rimmed by a second phase with higher bireflectance, and rarely ilmenite in the cores of grain aggregates.

STRUCTURE COMMENT: Magmatic: Ghost olivine (?) replaced by magnetite (?), undulose extinction and deformation twins preserved in plagioclase. Less replacive texture than TS #75
Crystal Plastic: None preserved.
Brittle: Minor fracturing.
Veins/alteration: Replacement chlorite, hosting magnetite sprays and blue amphibole sprays, cut by epidote, actinolite and chlorite/serpentine veinlets. Some veinlets are filled with sulfides.

Crosscutting Relationships (as apparent in thin section):
1) Ghost olivine replaced by magnetite.
2) Fracturing, and magnetite vein formation.

PHOTOMICROGRAPHS: 345_U1415J_21R_1_TS_76.JPG
345_U1415J_21R_1_TS_76-2.JPG

THIN SECTION: 345-U1415J-21R-1-W 17/19-TSB_Piece_4-TS_77 **Thin Section no.:** 77
Rock name: cataclasite
Rock comment: protolith was probably olivine gabbro, completely altered
Lithologic interval: 78
Piece No.: #4 **Authors: TH, RW**
Billet request comment: IgPet: Prim. mineralogy; MetPet: Alt. of Calcite; Struct: Deformation Fabric

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** cataclasite
Domain grain size: medium grained **Grain size distribution:**
Domain texture: ophitic (based on very few primary relics) **Relative abundance (%):** 100
Domain comment: due to very strong tectonic overprint, estimation of primary mode was not possible

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase					subhedral	tabular				
Clinopyroxene					anhedral	irregular		colorless	interstitial	
Oxide				0.01	anhedral	subequant				

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 98
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	62.4	olivine 20%, clinopyroxene 19.6%, plagioclase 22.8%	Olivine	20	100	chlorite 100%	No olivine can be identified with confidence.
prehnite	28.5	plagioclase 28.5%	Plagioclase	60	95	chlorite 40%, prehnite 50%, secondary plagioclase 10%	Relic plagioclase is highly fractured and the shards are closely associated with prehnite.
secondary plagioclase	5.7	plagioclase 5.7%	Clinopyroxene	20	98	chlorite 100%	Only a very few original clinopyroxene shards can be identified.
domain total alteration %:	**96.6**						

Vein summary
vein 1 One vein cuts the margin of the thin section. It is filled by euhedral prehnite that locally grows into an open pore. Locally calcite as a single crystal fills the open space.

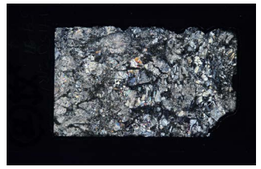
ALTERATION COMMENT: Foliated cataclasite mechanically thoroughly digested. Porphyroclasts of prehnite are more common than plagioclase are less than 100 micrometers in diameter, and the grain size of the chlorite + prehnite matrix is typically less than 10 micrometers. No oxides or sulfides have been observed in this thin section.

STRUCTURE COMMENT: Magmatic: Ultracataclasite, no magmatic fabric remaining.
Crystal Plastic: None.
Brittle: Cataclasis - plagioclase replaced by prehnite; aragonite rimmed by prehnite, surrounded by angular clasts of ultracataclasite in a prenite matrix, showing local grain size reduction. Porphyroclasts of relict plagioclase replaced by prehnite (?), fractured via semi-brittle deformation, surrounded by sheared chlorite.
Veins/alteration: Prehnite clasts cut by sheared chlorite veins, cut by undeformed prehnite vein. Composite crack seal chlorite vein deformed.

Crosscutting Relationships (as apparent in thin section):
1) Ghost olivine replaced by magnetite.
2) Fracturing, and magnetite vein formation.

PHOTOMICROGRAPHS: 345_U1415J_21R_1_TS_77.JPG 345_U1415J_21R_1_TS_77-3.JPG
345_U1415J_21R_1_TS_77-2.JPG 345_U1415J_21R_1_TS_77-4.JPG

THIN SECTION: 345-U1415J-21R-1-W 58/59-TSB_Piece_9-TS_78 **Thin Section no.:** 78
Rock name: cataclastic olivine-bearing gabbro
Rock comment: highly altered
Lithologic interval: 78
Piece No.: #9 **Authors: JK, KF**
Billet request comment: IgPet: Prim. mineralogy



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** cataclastic olivine-bearing gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: consists of different clasts; protolith was probably olivine gabbro; olivines are completely altered and sheared

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	4	4							completely sheared and altered; grain size estimation not possible; modal estimation very vague
Plagioclase	50	75	25	1.5	subhedral	tabular	patchy zoning			crystal-plastic deformation; bent crystals
Clinopyroxene	10	21	11	1	anhedral	irregular		colorless	interstitial	optical continuity among interstitial grains suggesting network-like single crystals up to 2 cm in size
Oxide				0.1	anhedral to subhedral	subequant				not clear whether these are primary; larger grains could be originate from chromite

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 59
Alteration domain number: 1 **Domain type:** cataclasite

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	16.8	plagioclase 16.8%	Plagioclase	80	70	chlorite 30%, prehnite 60%, secondary plagioclase 10%	Plagioclase is fractured and broken up into clasts, commonly it is replaced by a fine grained mixture of secondary plagioclase, prehnite and chlorite.
pale/colorless amphibole	10	clinopyroxene 10%	Clinopyroxene	20	50	pale/colorless amphibole 100%	Clinopyroxene is fractured and appears as small clasts or a larger clasts associated with larger clasts of plagioclase, alteration occurs along cleavage planes.
prehnite	33.6	plagioclase 33.6%					
secondary plagioclase	5.6	plagioclase 5.6%					
domain total alteration %:	**66**						

Vein summary
vein 1 Network of chlorite+clay veins appear to flow around larger clasts of plagioclase within cataclasite.

ALTERATION COMMENT: Thin section consists of clasts of altered comminuted plagioclase and clinopyroxene, within a matrix of fine grained prehnite and chlorite, and a network of veins filled with chlorite and clay, modal abundance of original minerals is difficult to estimate. Rare sulfide is widely disseminated with plagioclase and clinopyroxene; and other sulfide is associated with chlorite apparently with the former presence of olivine; mottled texture opaque minerals are also associated with chlorite, but not with sulfides.

STRUCTURE COMMENT: Magmatic: No magmatic fabric preserved. Coarse fractured plagioclase. Rare intercumulus clinopyroxene.
Crystal Plastic: Subgrain, undulose extinction, and deformation twins in plagioclase.
Brittle: Cataclasis; zones of high strain ultracataclasite, and low strain, cataclasite. Clay and chlorite alteration surrounds plagioclase, and are present in cataclasite/ultracataclasite.
Veins/alteration: Prehnite after clinopyroxene, chlorite, serpentine and clay-rich matrix in cataclasite and ultracataclasite. Vein filling chlorite fibers are sheared (sigmoid figures). Some late zeolite veinlets..

Crosscutting Relationships (as apparent in thin section):
1) Alteration of igneous minerals to prehnite, chlorite and serpentine.
2) Fracturing, and magnetite vein formation.
3) Cataclasis

PHOTOMICROGRAPHS: 345_U1415J_21R_1_TS_78.JPG 345_U1415J_21R_1_TS_78-3.JPG
345_U1415J_21R_1_TS_78-2.JPG 345_U1415J_21R_1_TS_78-4.JPG

THIN SECTION: 345-U1415J-21R-1-W 103/107-TSB_Piece_14-TS_79 **Thin Section no.:** 79
Rock name: cataclastic olivine gabbro
Rock comment: with basaltic fragment, moderately altered
Lithologic interval: 78
Piece No.: #14 **Authors: TH, MP**
Billet request comment: lgPet: Prim. mineralogy; MetPet: Vein Halo; lt. of Clasts w/in Cataclastic; Struct: Deformation Fabric

PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** two lithologies

Igneous domain number: 1 **Domain lithology:** olivine gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: poikilitic **Relative abundance (%):** 96
Domain comment: strongly cataclastic; contains different clasts of gabbro

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0.1	10	9.9	1	anhedral	subequant				
Plagioclase	40	70	30	1.8	subhedral	tabular	continuous			
Clinopyroxene	4	19	15	5	anhedral	irregular		colorless	interstitial	highly deformed
Amphibole	1	1	0	0.4	anhedral	subequant		green to brown	interstitial growth	
Oxide	0.1	0.1	0	0.1	anhedral	subequant				

Igneous domain number: 2 **Domain lithology:** basalt
Domain grain size: < fine grained **Grain size distribution:** inequigranular
Domain texture: dendritic **Relative abundance (%):** 4
Domain comment: due to quenched plagioclase structures, this basaltic fragment is interpreted as a former chilled margin; primary mode estimation not possible; protolith was probably olivine- and plagioclase phyric; eventually pseudotachylite structures

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Plagioclase										microphenocrysts with rapid quench structures
Oxide	2	2	0	0.1	euhedral	isometric				

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 25
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
brown amphibole	0.2	clinopyroxene 0.2%
chlorite	5.9	olivine 2.5%, plagioclase 3.4%
clay minerals	11.4	clinopyroxene 0.2%, plagioclase 11.3%
epidote/zoisite	1.1	plagioclase 1.1%
green amphibole	1.3	olivine 1.3%
oxide	1.3	olivine 1.3%
pale/colorless amphibole	1.2	clinopyroxene 1.2%
secondary clinopyroxene	1.5	clinopyroxene 1.5%
zeolite	6.8	plagioclase 6.8%

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	5	100	green amphibole 25%, chlorite 50%, oxide 25%	If present, olivine is totally altered. Deformed mesh texture with oxides, chlorite and tremolite may be observed regularly in the section. Probably derives from olivine and was deformed after alteration
Plagioclase	75	30	chlorite 15%, clay minerals 50%, zeolite 30%, epidote/zoisite 5%	
Clinopyroxene	20	15	pale/colorless amphibole 40%, clay minerals 5%, secondary clinopyroxene 50%, brown amphibole 5%	

domain total alteration %: 30.7

Vein summary

vein 1 Large prehnite vein occupying about 15% of the section. Presence of a chlorite rich wall. Chlorite rich zones with less abundant zoisite appear sporadically.

ALTERATION COMMENT: Relatively strongly altered gabbro with brittle deformation. Patches of chlorite may be observed at grain boundaries, they may derive either from former chlorite veins or from the transformation of deformed plagioclase/pyroxene. The background alteration is concentrated in cracks in minerals and in grain boundaries. The thin sections additionally contains a completely altered volcanic, doleritic clast (5% of the section area) with altered glassy matrix. Irregularly shaped grains of pyrite and chalcopyrite are associated with chlorite replacing plagioclase. Rare abundance of aggregates of different oxides (magnetite+?) associated with deformed replacement textures after olivine.

STRUCTURE COMMENT: Magmatic: Contact between olivine gabbro and basaltic/diabase dike.

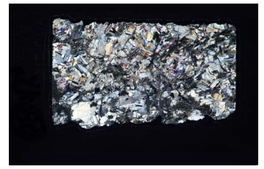
Basalt/diabase - Sheared intrusive contact/chilled margin; fractured. Originally glass now altered, and cut by chlorite; host to brown spinel, tiny microlites of plagioclase.

Olivine gabbro - No magmatic fabric preserved. Coarse fractured plagioclase; deformation twins, subgrains with curved boundaries in plagioclase. Amphibole after clinopyroxene, and rare intercumulus clinopyroxene. Annealed.
Crystal Plastic: No crystal plastic deformation recognized.
Brittle: Cataclasis-zones of high strain cataclasite to ultracataclasite, ? cutting zones of prehnite.
Veins/alteration: Little deformed prehnite veins and patches after clinopyroxene, cut by chlorite-rich shear zones.

Cross-cutting Relationships (as apparent in thin section):
1) Fracturing /cataclasis and prehnite alteration.
2) Intrusion of basaltic/diabase dike (basalt hosts clast with prehnite).
3) Continued fracturing/cataclasis contemporaneous with late prehnite vein injection.

PHOTOMICROGRAPHS: 345_U1415J_21R_1_TS_79.JPG
345_U1415J_21R_1_TS_79-2.JPG

THIN SECTION: 345-U1415J-21R-1-W 118/121-TSB_Piece_16-TS_80 **Thin Section no.:** 80
Rock name: olivine gabbro
Rock comment: moderately altered
Lithologic interval: 78
Piece No.: #16 **Authors: JM, AM/RW**
Billet request comment: IgPet: Prim. mineralogy; MetPet: Vein relationships; Struct: Nature of Oikocryst



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** olivine gabbro
Domain grain size: **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: consists of different clasts

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	10	10	1.5	anhedral	equant				deformed and completely altered
Plagioclase	50	75	25	2	subhedral	tabular				
Clinopyroxene	8	15	7	0.5	anhedral	irregular		colorless	interstitial	optical continuity among interstitial grains suggesting network-like single crystals up to 2 cm in size
Amphibole	0.1	0.1	0	0.2	anhedral	irregular		brown	overgrowth	overgrowth on interstitial clinopyroxene, possibly late-stage magmatic origin
Oxide	0.1	0.1	0		subhedral	subequant				magnetite?

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 22
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
brown amphibole	0.1	clinopyroxene 0.1%
chlorite	14.3	olivine 1%, clinopyroxene 0.4%, plagioclase 12.9%
clay minerals	1	olivine 1%
pale/colorless amphibole	0.9	olivine 0.4%, clinopyroxene 0.5%
prehnite	4.3	plagioclase 4.3%
serpentine	1.6	olivine 1.6%
domain total alteration %:	**22.2**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	4	100	pale/colorless amphibole 10%, chlorite 25%, clay minerals 25%, serpentine 40%	Olivine alteration includes mixed layer phyllosilicates, very minor coronas.
Plagioclase	86	20	chlorite 75%, prehnite 25%	
Clinopyroxene	10	10	pale/colorless amphibole 50%, chlorite 40%, brown amphibole 10%	Brown hornblende locally pseudomorphically replaces parts of pyroxene oikocrysts.

Vein summary

vein 1 Discontinuous chlorite + prehnite
vein 2 Fibrous serpentine, oblique fibers, possibly intergrown with chlorite?

ALTERATION COMMENT: Moderately altered, minor brown to green hornblende replacing clinopyroxene, olivine completely altered to serpentine, chlorite and clay preceded by minor corona development. Plagioclase contains networks of
STRUCTURE COMMENT: Magmatic: Clinopyroxene oikocryst-bearing olivine-bearing gabbro.
Isotropic. Coarse fractured plagioclase; deformation twins, subgrains with curved boundaries in plagioclase. Annealed.
Crystal Plastic: No crystal plastic deformation recognized.
Brittle: Multiple zones of fracture and veining/cataclasite (? originally conjugate, now mutually cross-cutting).
Veins/alteration: Chlorite veining associated with fracture/cataclasis.
Cross-cutting Relationships (as apparent in thin section):
1) Fracturing/cataclasis and chlorite alteration.

PHOTOMICROGRAPHS: 345_U1415J_21R_1_TS_80 .JPG
345_U1415J_21R_1_TS_80 -2.JPG

THIN SECTION: 345-U1415J-23R-1-W 10/12-TSB_Piece_3-TS_81 **Thin Section no.:** 81
Rock name: cataclastic basalt
Rock comment: with mostly basaltic clasts of different origin; one is probably a former chilled margin, completely altered
Lithologic interval: 81
Piece No.: #3 **Authors: JK, MP**
Billet request comment: IgPet: Breccia; MetPet: Epidote Vein

PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** cataclastic basalt
Domain grain size: **Grain size distribution:**
Domain texture: **Relative abundance (%):** 100
Domain comment: with mostly basaltic clasts of different origin; one is probably a former chilled margin; estimation of primary mode not possible; mineral calasts: clinopyroxene (now epidote), olivine (now mostly chlorite), and brown chromian spinel.

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Other										clasts of broken spinel, brownish; sometimes altered to magnetite

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 10 **Estimated total % alteration:** 100
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	20	clinopyroxene 20%	Plagioclase	80	100	prehnite 100%	Original proportion of plagioclase is hard to determine. The prehnite-rich characteristics of the final cataclastic rock suggests a total replacement by prehnite.
prehnite	80	plagioclase 80%	Clinopyroxene	20	100	chlorite 100%	Original proportion of clinopyroxene is hard to estimate. Total alteration to chlorite.
domain total alteration %:	**100**						

Vein summary
vein 1 Series of 3 chlorite cross-fiber veins cross cutting the epidote clasts and matrix. Veins commonly end in chlorite rich clast, numerous tips are visible.

ALTERATION COMMENT: Probably former gabbro but entirely transformed into a cataclasite of prehnite. Presence of

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 90 **Estimated total % alteration:** 100
Alteration domain number: 2 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	20	clinopyroxene 4%, plagioclase 16%	Plagioclase	80	100	chlorite 20%, clay minerals 30%, prehnite 50%	
clay minerals	24	plagioclase 24%	Clinopyroxene	20	100	green amphibole 20%, pale/colorless amphibole 60%, chlorite 20%	
green amphibole	4	clinopyroxene 4%					
pale/colorless amphibole	12	clinopyroxene 12%					
prehnite	40	plagioclase 40%					
domain total alteration %:	**100**						

Vein summary
vein 1 Epidote vein formed almost entirely of epidote with lesser amounts of clinozoisite and chlorite. The vein is deformed and shows variation of thickness and intra-crystalline deformations. Massive texture with well developed crystals. One can see one relatively large vein near the center of the section and one, thinner and more linear vein at the edge of the section opposed to the chilled margin.

vein 2 Presence of one large prehnite vein injected along the thinner epidote vein. Does not really cross-cut the epidote vein but clinozoisite alignment may be observed at the opposite side. Sub-cataclastic texture with large mineral near the rim of the vein and fine grains at the center.

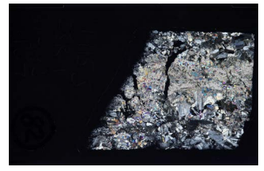
vein 3 Thin clinozoisite vein with tips along the large prehnite vein. Radiating blue clinozoisite forming a massive vein with an irregular shape. Possible presence of minor epidote in association with the clinozoisite.

ALTERATION COMMENT: Former dolerite totally altered, with a chilled margin at the contact with the cataclasic gabbro. The texture of the dolerite is more or less conserved and the former matrix and minerals are totally transformed into a mixture of prehnite, oxides, clays, chlorite. Veins are numerous and rich in epidote, clinozoisite, prehnite.

STRUCTURE COMMENT: Magmatic: Rare diabasic texture preserved, including chilled margin locally.
Crystal Plastic: No crystal plastic deformation recognized.
Brittle: Multi-generation fault rock - Multiple zones of fracture and veining/cataclasite (? originally conjugate, now mutually cross-cutting).
Veins/alteration: A set of parallel veins with contrasting compositions: some are filled with a single mineral species (epidote, prehnite, chlorite) some with a mixture of these minerals. Most veins are sheared but a few remain undeformed (some epidosites and prehnitites). Very few tiny chlorite veins cross cut the cataclasite at high angle and are likely tension cracks.
Cross-cutting Relationships (as apparent in thin section):
1) Fracturing /cataclasis, chlorite alteration and vein injection.
2) Late crack formation (filled with chlorite) at high angle to the cataclastic foliation.

PHOTOMICROGRAPHS: 345_U1415J_23R_1_TS_81.JPG
345_U1415J_23R_1_TS_81-2.JPG

THIN SECTION: 345-U1415J-23R-1-W 39/42-TSB_Piece_7-TS_82 **Thin Section no.:** 82
Rock name: olivine gabbro
Rock comment:
Lithologic interval: 85
Piece No.: #7 **Authors: TH, KF**
Billet request comment: IgPet: Prim. mineralogy; MetPet: Suture Vein



PRIMARY MINERALOGY **No. of Igneous domains:** 1 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** olivine gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 100
Domain comment: cataclastic and highly altered;

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	0	7	7	2.5	anhedral	subequant				
Plagioclase	55	87	32	2.5	anhedral to subhedral	tabular	continuous			
Clinopyroxene	4	6	2	2	anhedral	irregular		colorless	interstitial	

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 70 **Estimated total % alteration:** 40
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
brown amphibole	1	clinopyroxene 1%
chlorite	12	plagioclase 12%
clay minerals	2	olivine 2%
green amphibole	2.5	clinopyroxene 2.5%
pale/colorless amphibole	2.5	olivine 1%, clinopyroxene 1.5%
prehnite	7.2	plagioclase 7.2%
secondary plagioclase	4.8	plagioclase 4.8%
serpentine	7	olivine 7%
domain total alteration %:	**39**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	10	100	pale/colorless amphibole 10%, clay minerals 20%, serpentine 70%	Olivine is completely replaced by corona textures with a mixture of serpentine and clay in the core, surrounded by a thin rim of tremolite and a rim of chlorite on the outside.
Plagioclase	80	30	chlorite 50%, prehnite 30%, secondary plagioclase 20%	Plagioclase is fractured an replace by fine grained chlorite, prehnite and secondary plagiolcase along these micro-fractures. Plagioclase is altered to thin chlorite rims along the grain boundaries when in contact with former olivine.
Clinopyroxene	10	50	green amphibole 50%, pale/colorless amphibole 30%, brown amphibole 20%	Clinopyroxene is moderately altered to different types of amphibole (green, brown and pale amphibole), that are intergrown into each other.

Vein summary
vein 1 Network of chlorite veins, connecting pseudomorphs after olivine with each other.

ALTERATION COMMENT: This domain represents the background alteration of this rock, but is probably affected by the

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 30 **Estimated total % alteration:** 85
Alteration domain number: 2 **Domain type:** cataclastic zone

SECONDARY MINERALOGY	%	REPLACING / FILLING
brown amphibole	2.8	clinopyroxene 2.8%
chlorite	21.6	plagioclase 21.6%
epidote/zoisite	14.4	plagioclase 14.4%
green amphibole	7	clinopyroxene 7%
pale/colorless amphibole	4.2	clinopyroxene 4.2%
prehnite	36	plagioclase 36%
domain total alteration %:	**86**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Plagioclase	80	90	chlorite 30%, prehnite 50%, epidote/zoisite 20%	Plagioclase is intensively fractured and ground up and altered to fine grained minerals of prehnite, chlorite, secondary plagioclase and patches of epidote.
Clinopyroxene	20	70	green amphibole 50%, pale/colorless amphibole 30%, brown amphibole 20%	Clinopyroxene is intensively altered to different types of amphibole (green, brown and pale amphibole), that are intergrown into each other.

Vein summary
vein 1 Prehnite veins, parallel to the direction of the cataclastic zone, the grain size of the prehnite crystals varies within the same vein.
vein 2 Fractured epidote veins, parallel to the prehnite veins. Epidote veins are probably earlier than the prehnite veins.

ALTERATION COMMENT: The domain is characterized by a fine grained matrix of comminuted and altered plagioclase and clinopyroxene with several prehnite and chlorite veins oriented parallel to the cataclastic zone. The original abundance of igneous minerals in this zone is hard to estimate. Some clasts of relict plagioclase and clinopyroxene are present and intensively altered (clinopyroxene is altered to green and brown amphibole, plagioclase is altered to prehnite, chlorite and epidote). This matrix is cut by prehnite and epidote veins that are parallel to the cataclastic zone. Open fractures perpendicularly cross-cut this cataclastic zone.

STRUCTURE COMMENT: Magmatic: Isotropic ? Elongate clinopyroxene oikocrysts, and elongate plagioclase, host to undulose extinction, subgrain boundaries, and deformation twins. Annealed grain boundaries.
Crystal Plastic: Common, conspicuous deformation twins and/or bent grains of plagioclase.
Brittle: Zones of cataclasis/shattering, showing little shearing - ? pure opening associated with prehnite veining. Cut by later thin fault/shear zone. Locally chlorite associated with thin zone of cataclasite.
Veins/alteration: Actinolite/ternolite after clinopyroxene; blue/green amphibole and prehnite vein, chlorite, and prehnite veins fracture/cataclasis. Veins are often undeformed/little sheared.
Cross-cutting Relationships (as apparent in thin section):
1) Semi-brittle deformation of plagioclase.
2) Fracturing /cataclasis and veining.
3) Fracturing /cataclasis of prehnite.

PHOTOMICROGRAPHS: 345_U1415J_23R_1_TS_82.JPG
345_U1415J_23R_1_TS_82-2.JPG

THIN SECTION: 345-U1415J-23R-1-W 52/53-TSB_Piece_8-TS_83 **Thin Section no.:** 83
Rock name: cataclasite with fragments of gabbro
Rock comment: primary mode estimation not possible
Lithologic interval: 85
Piece No.: #8 **Authors: MMJ, KF**
Billet request comment: IgPet: Prim. mineralogy; MetPet: Vein relationships

PRIMARY MINERALOGY **No. of Igneous domains:** 3 **Nature of ign. domains:**

Igneous domain number: 1 **Domain lithology:** cataclasite
Domain grain size: **Grain size distribution:**
Domain texture: **Relative abundance (%):** 50
Domain comment: many gabbro clasts included in domain 1; many prehnite clasts

Igneous domain number: 2 **Domain lithology:** cataclasite
Domain grain size: **Grain size distribution:**
Domain texture: **Relative abundance (%):** 35
Domain comment: more coherent gabbro preserved in this domain

Igneous domain number: 3 **Domain lithology:** cataclasite
Domain grain size: **Grain size distribution:**
Domain texture: **Relative abundance (%):** 15
Domain comment: strong cataclastic fabric; separating domain 1 from domain 2

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 50 **Estimated total % alteration:** 50
Alteration domain number: 1 **Domain type:** fractured less deformed than domain 2

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
brown amphibole	3	clinopyroxene 3%	Olivine	20	100	pale/colorless amphibole 15%, chlorite 5%, clay minerals 30%, serpentine 50%	Relict olivine is completely pseudomorphically replaced by a mixture of serpentine+clay and minor amphibole and chlorite.
chlorite	6.4	olivine 1%, plagioclase 5.4%	Plagioclase	60	30	chlorite 30%, prehnite 70%	Highly fractured and altered to fine grained prehnite and chlorite along fractures.
clay minerals	6	olivine 6%	Clinopyroxene	20	50	green amphibole 30%, pale/colorless amphibole 40%, brown amphibole 30%	Clinopyroxe is moderately altered to different types of amphibole (brown, green and pale amphibole).
green amphibole	3	clinopyroxene 3%					
pale/colorless amphibole	7	olivine 3%, clinopyroxene 4%					
prehnite	12.6	plagioclase 12.6%					
serpentine	10	olivine 10%					
domain total alteration %:	**48**						

Vein summary
vein 1 Network of chlorite and clay bearing veins, apparently chlorite was first and overprinted by clay.

ALTERATION COMMENT: This domain is moderately altered and strongly fractured and cross cut by multiple clay and

ALTERATION / METAMORPHISM **No. of alteration domains:** 2 **Domain rel. abund %:** 50 **Estimated total % alteration:** 60
Alteration domain number: 2 **Domain type:** zone of more localized deformation

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	12.6	plagioclase 12.6%	Olivine				No relict olivine or unambiguous pseudomorphs after olivine could be observed.
pale/colorless amphibole	20	clinopyroxene 20%	Plagioclase	60	70	chlorite 30%, prehnite 40%, secondary plagioclase 30%	Highly fractured, comminuted, and altered to fine grained prehnite, chlorite and secondary plagioclase. A few larger clasts of plagioclase are present, which are fractured and replaced by chlorite along micro-fractures.
prehnite	16.8	plagioclase 16.8%	Clinopyroxene	40	50	pale/colorless amphibole 100%	Clinopyroxene is moderately altered to amphibole (in this domain, only pale amphibole was observed).
secondary plagioclase	12.6	plagioclase 12.6%					
domain total alteration %:	**62**						

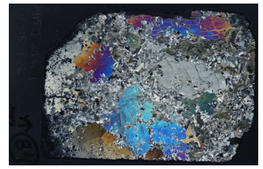
Vein summary
vein 1 Two 0.5 to 1 cm wide prehnite veins, cross cut by network of chlorite+clay veins. The prehnite veins also contain clasts of clinopyroxene and in general have a high porosity.
vein 2 network of chlorite and clay bearing veins, apparently chlorite was there first and got overprinted by clay

ALTERATION COMMENT: This domain is characterized by two 0.5 to 1 cm wide bands of prehnite (probably veins?), separated by a matrix of broken clasts of plagioclase and clinopyroxene, mixed with chlorite and clay. The original mode of minerals in this domain is hard to estimate. Plagioclase and clinopyroxene clasts are moderately to intensively altered (larger clasts are less altered than smaller ones). No olivine or unambiguous pseudomorphic replacements after olivine could be observed. Rare sulfides occur within plagioclase grains or in fractures associated with chlorite or prehnite; rare oxide grains occur in with chlorite in microbreccia zones.

STRUCTURE COMMENT: Magmatic: Moderate magmatic fabric defined by plagioclase SPO. Elongate oikocryst with clinopyroxene hosting elongate plagioclase host to undulose extinction, subgrain boundaries, and deformation twins.
Moderate annealed grain boundaries.
Crystal Plastic: Common, conspicuous deformation twins and/or bent grains of plagioclase.
Brittle: Zones of cataclasis (showing little shear/displacement), cut by rare fractures.
Veins/alteration: Static prehnitization of plagioclase. A few tiny veins filled with zeolite and clay (after serpentine?).
Cross-cutting Relationships (as apparent in thin section):
1) Semi-brittle deformation of plagioclase.
2) Static prehnitization of plagioclase.
3) Cataclasis.
4) Fracturing with zeolite + clay filling.

PHOTOMICROGRAPHS: 345_U1415J_23R_1_TS_83.JPG
345_U1415J_23R_1_TS_83-2.JPG

THIN SECTION: 345-U1415J-25G-1-W 11/15-TSB_Piece_2-TS_84 **Thin Section no.:** 84
Rock name: clinopyroxene oikocryst -bearing gabbro
Rock comment: oikocryst and matrix were described as two different domains, the rock is slightly altered
Lithologic interval: G66
Piece No.: #2 **Authors: TH, AM**
Billet request comment: Lg. Fmt. IgPet: Prim. Mineralogy



PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** oikocrysts/ matrix

Igneous domain number: 1 **Domain lithology:** troctolite
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 50
Domain comment: more coarser grained troctolite

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	1	12	11	2.5	anhedral	irregular				partly or totally contains some plagioclase crystals
Plagioclase	87	87	0	1	anhedral to subhedral	tabular	continuous			chains formed by some aligned plagioclase crystals
Clinopyroxene	1	1	0	1	anhedral	irregular		colorless	interstitial	

Igneous domain number: 2 **Domain lithology:** clinopyroxene oikocryst
Domain grain size: pegmatitic **Grain size distribution:** equigranular
Domain texture: ophitic **Relative abundance (%):** 50
Domain comment: clinopyroxene oikocrysts include finer-grained plagioclase; some clinopyroxene oikocrysts contain a network or chain composed of smaller plagioclase and clinopyroxene crystals than those from the troctolitic matrix

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine										
Plagioclase	15	15	0	0.5	subhedral to euhedral	lath-shape	continuous			
Clinopyroxene	85	85	0	14	anhedral	subequant		colorless	ophitic	cm-sized cluster of clinopyroxene oikocrysts

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 10
Alteration domain number: 1 **Domain type:**

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	1.2	clinopyroxene 0.2%, plagioclase 1%
clay minerals	2.1	olivine 2.1%
green amphibole	0.6	clinopyroxene 0.6%
oxide	0.1	olivine 0.1%
pale/colorless amphibole	1.8	olivine 0.5%, clinopyroxene 1.3%
prehnite	1.3	plagioclase 1.3%
secondary plagioclase	0.3	plagioclase 0.3%
serpentine	1.1	olivine 1.1%
talc	1.6	olivine 1.6%
domain total alteration %:	**10.1**	

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	6	90	pale/colorless amphibole 10%, clay minerals 38%, oxide 2%, serpentine 20%, talc 30%	mesh texture is oriented subhorizontal in core and is better developed in the sub horizontal band of olivines
Plagioclase	51	5	chlorite 40%, prehnite 50%, secondary plagioclase 10%	
Clinopyroxene	43	5	green amphibole 30%, pale/colorless amphibole 60%, chlorite 10%	

Vein summary
vein 1 clay-chlorite fibrous veins
vein 2 a few chorite veins and replacemnt patches

ALTERATION COMMENT: The rock is generally slightly altered, but olivine shows very localized corona development but mainly clay and serpentine replacement. Microfracture-related prehnite in plagioclase is observed locally. Sulfides are commonly associated with corona structures including talc that replaced olivine; sulfide inclusions in plagioclase are rare. Oxide in commonly associated with mesh textures replacing olivine.

STRUCTURE COMMENT: Magmatic: Isotropic, showing a bimodal grain size distribution with very coarse-grained clinopyroxene oikocrysts and coarse-grained olivine, with fine to medium grained plagioclase, with fine plagioclase grains commonly between and along grain boundaries of larger clinopyroxene oikocrysts. Large plagioclase host to undulose extinction, subgrain development (with irregular boundaries), and deformation twins (more common on larger plagioclase grains). Strongly annealed grain boundaries. Lobate olivine includes plagioclase, hosts subgrains and undulose extinction.
Crystal Plastic: Clinopyroxene shows subgrain formation and undulose extinction. Mesh texture serpentine fabric.
Brittle: Minor cracking with chlorite.
Veins/alteration: Very thin crack seal chlorite veinlets with fibers perpendicular to the vein walls. Unsheared.
Cross-cutting Relationships (as apparent in thin section):
1) Magmatic foliation development.
2) Very minor cracking and chlorite veining.

PHOTOMICROGRAPHS: 345_U1415J_25G_1_TS_84.JPG
345_U1415J_25G_1_TS_84-2.JPG

THIN SECTION: 345-U1415J-25G-1-W 32/35-TSB_Piece_5-TS_85 **Thin Section no.:** 85
Rock name: olivine gabbro
Rock comment: with a domain poor in olivine; slightly altered
Lithologic interval: G69
Piece No.: #5 **Authors: JM, TN**
Billet request comment: IgPet: Prim. mineralogy; Struct: Magm. Fabric

PRIMARY MINERALOGY **No. of Igneous domains:** 2 **Nature of ign. domains:** two or more lithologies

Igneous domain number: 1 **Domain lithology:** olivine gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 65
Domain comment: Two domains due to difference in modal abundance; no clear boundary

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	5	7	2	0.8	anhedral	irregular			groundmass crystal	partly enclosing or surrounding tabular plagioclase
Plagioclase	68	68	< 0.1	1.3	anhedral to subhedral	tabular			occurs in groundmass and as chadacryst	foliated; twin lamellae bended
Clinopyroxene	25	25	< 0.1	1.8	anhedral	equant		colorless	poikilitic	
Oxide	0.1	0.1	< 0.1	0.1	anhedral to subhedral	equant				

Igneous domain number: 2 **Domain lithology:** olivine-bearing gabbro
Domain grain size: medium grained **Grain size distribution:** equigranular
Domain texture: granular **Relative abundance (%):** 35
Domain comment: Two domains due to difference in modal abundance; no clear boundary

	Present (%)	Original (%)	Vol. repl. (%)	Size mode (mm)	Shape	Habit	Zoning	Color	Special features	Comment
Olivine	1	2	1	0.8	anhedral	irregular				partly enclosing or surrounding tabular plagioclase
Plagioclase	63	63	< 0.1	1.5	anhedral to subhedral	tabular				foliated; twin lamellae bended
Clinopyroxene	35	35	< 0.1	1.8	anhedral	equant		colorless	poikilitic	
Orthopyroxene	0.5	0.5	< 0.1	0.6	anhedral	prismatic		colorless		
Oxide	0.1	0.1	< 0.1	0.1	anhedral to subhedral	equant				

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 10
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING
chlorite	2.4	plagioclase 2.4%
clay minerals	0.4	olivine 0.4%
green amphibole	1.8	clinopyroxene 1.4%, plagioclase 0.5%
oxide	0.1	olivine 0.1%
pale/colorless amphibole	3.1	olivine 1.6%, clinopyroxene 1.5%
serpentine	0.3	olivine 0.3%
sulfide	0.2	olivine <0.1%, clinopyroxene 0.2%
talc	1.6	olivine 1.6%
other	0.2	plagioclase 0.2%

PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
Olivine	10	40	pale/colorless amphibole 40%, clay minerals 9%, oxide 2%, sulfide 1%, serpentine 8%, talc 40%	Variable mineral assemblage.
Plagioclase	60	5	green amphibole 15%, chlorite 80%, other 5%	other: calcite
Clinopyroxene	30	10	green amphibole 45%, pale/colorless amphibole 50%, sulfide 5%	Alteration along cleavage surfaces.

domain total alteration %: 10.1

ALTERATION COMMENT: Alteration of olivine is variable in intensity and mineralogy; clinopyroxene is replaced around rims and along cleavage surfaces; plagioclase has fractures filled with chlorite, which partially replaced by green amphibole; chlorite-filled fractures in plagioclase cut magmatic foliation with high angle. Rare sulfides occur within plagioclase and clinopyroxene grains; sulfide is more common associated with amphibole of talc where they replace olivine; oxides are common occurring with serpentine where they form a mesh texture in olivine.

STRUCTURE COMMENT: Magmatic: Boundary between olivine gabbro and coarser grained (0.75 cm thick band) of clinopyroxene-rich gabbro

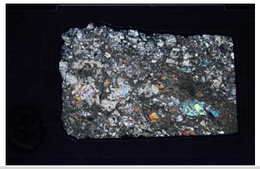
Olivine gabbro - Moderate magmatic foliation defined by plagioclase and olivine SPO. Submagmatic deformation twins, subgrains, and bent plagioclase; annealed, and hosted by small clinopyroxene oikocrysts. Lobate/skeletal olivine showing subgrains with curved grain boundaries. Rare intercumulus clinopyroxene surrounding olivine and plagioclase.

Clinopyroxene-rich gabbro -
Moderate magmatic foliation defined by plagioclase SPO. Host to both clinopyroxene and othropyroxene. Minor submagmatic deformation twins, subgrains, and bent plagioclase.
Crystal Plastic: No crystal plastic deformation recognized.
Brittle: Minor cracks normal to foliation, filled with chlorite.
Veins/alteration: Very minor chlorite, actinolite and prehnite veinlets.

Cross-cutting Relationships (as apparent in thin section):
1) Magmatic foliation development.
2) Very minor cracking and veining.

PHOTOMICROGRAPHS: 345_U1415J_25G_1_TS_85.JPG 345_U1415J_25G_1_TS_85-3.JPG
345_U1415J_25G_1_TS_85-2.JPG

THIN SECTION: 345-U1415J-26R-1-W 23/25-TSB_Piece_4-TS_86 **Thin Section no.:** 86
Rock name: cataclastic gabbro
Rock comment: with clasts of gabbro, plagioclcase and clinopyroxene, highly altered
Lithologic interval: 87
Piece No.: #4 **Authors: JK, MP**
Billet request comment: lgPet: Prim. mineralogy; MetPet: INTENSE replacement by epidote



PRIMARY MINERALOGY **No. of Igneous domains:** **Nature of ign. domains:**

Igneous domain number: **Domain lithology:** cataclastic gabbro
Domain grain size: medium grained **Grain size distribution:** inequigranular
Domain texture: **Relative abundance (%):** 100
Domain comment: with clasts of gabbro, plagioclcase and clinopyroxene; dominant protolith was gabbro; estimation of primary mode not possible

ALTERATION / METAMORPHISM **No. of alteration domains:** 1 **Domain rel. abund %:** 100 **Estimated total % alteration:** 70
Alteration domain number: 1 **Domain type:** background

SECONDARY MINERALOGY	%	REPLACING / FILLING	PRIMARY MINERAL REPLACED	% ORIGINAL	% ALTERED	REPLACEMENT MINERAL	ALTERATION COMMENTS
chlorite	14	clinopyroxene 7%, plagioclase 7%	Plagioclase	50	70	chlorite 20%, prehnite 60%, zeolite 20%	
green amphibole	17.5	clinopyroxene 17.5%	Clinopyroxene	50	70	green amphibole 50%, pale/colorless amphibole 30%, chlorite 20%	
pale/colorless amphibole	10.5	clinopyroxene 10.5%					
prehnite	21	plagioclase 21%					
zeolite	7	plagioclase 7%					
domain total alteration %:	**70**						

Vein summary
vein 1 Thin chlorite veins with cross fiber texture cutting clasts and matrix. The veins are relatively short with two tips often visible in the section.

ALTERATION COMMENT: Replacement of plagioclase primarily by prehnite and of clinopyroxene by amphibole. The level of alteration is irregular with higher degree within cataclastic fractures. Cataclastic deformation with rolling extinctions and broken clinopyroxene and plagioclases; partial alteration in the fine grained zone. The strongly deformed zones are surrounded by high alteration zones. Rare sulfides occur within plagioclase and clinopyroxene grains; sulfide is more common associated with amphibole of talc where they replace olivine; oxides are common occurring with serpentine where they form a mesh texture in olivine.

STRUCTURE COMMENT: Magmatic: No magmatic fabric preserved.
Crystal Plastic: No crystal plastic deformation recognized.
Brittle: Crosscutting and anastomosing cataclastic deformation showing repeated cracking, zeolite, chlorite and prehnite. Semi-brittle deformation includes isoclinal bending of clinopyroxene, cut by prehnite vein.
Veins/alteration: Cracking and zeolite vein fill now clasts in sheared chlorite; multiple periods of static prehnite formation, cut by prehnite veins.
Cross-cutting Relationships (as apparent in thin section):
1) Cataclasis and zeolite vein fill.
2) Prehnite and additional cataclasis.

PHOTOMICROGRAPHS: 345_U1415J_26R_1_TS_86.JPG
345_U1415J_26R_1_TS_86-2.JPG