

THIN SECTION LABEL ID **369-U1513A-11F-2-W 5/8-TSB-TS22**

Thin section no.: 22

Observer: CW

Unit/subunit: Unit II

Thin section summary: This limestone is classified as a floatstone with innoceramid shells and foraminifera. Components comprise abundant calcitic innoceramid shells that are > 2mm in size and partially replaced by microcrystalline silica. Common foraminifera (both benthic and planktonic) are present as complete specimens, are generally <300 microns in size and infilled with micrite. Quartz, clay and sponge spicules are present in trace amounts throughout the limestone. All components are matrix supported. Circular burrows maybe present, however, the majority of voids are likely a by-product of the thin-sectioning processes owing to the soft character of the limestone.

Plane-polarized: 44091601

Cross-polarized: 44091621



Sediments and Sedimentary Rock

Complete Lithology Name: floatstone with shells

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	50	0	10	40

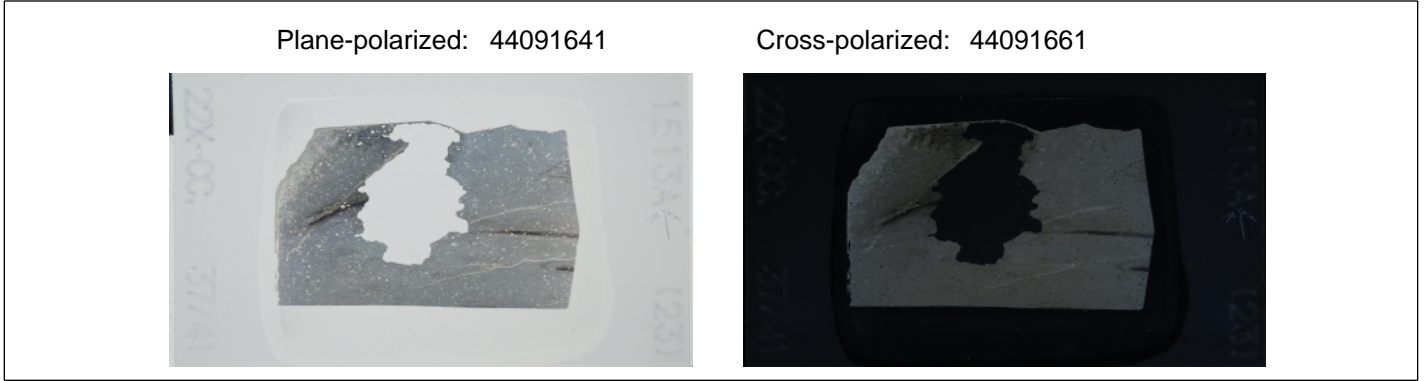
COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	20	79	1
Cement (%)	0	0	0

Mineral grain	Abundance
Quartz	A
Clay	R
Calcite	D

Biogenic material	Abundance
Foraminifers	C
Sponge spicules	T

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID **369-U1513A-22X-CC-W 37/41-TSB-TS23** Thin section no.: 23
 Observer: CW Unit/subunit: Unit II
 Thin section summary: This limestone is classified as a wackestone with foraminifera. Components comprise mostly of common foraminifera (mostly benthic) and rare radiolarians that are supported in a micritic matrix. Traces of quartz and clay are present throughout. Circular burrows with a spary calcite or microcrystalline infill maybe present, however, the majority of voids with no infill are likely a by-product of the thin-sectioning processes owing to the soft character of the limestone.



Sediments and Sedimentary Rock

Complete Lithology Name: wackestone with foraminifers

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	0	10	90

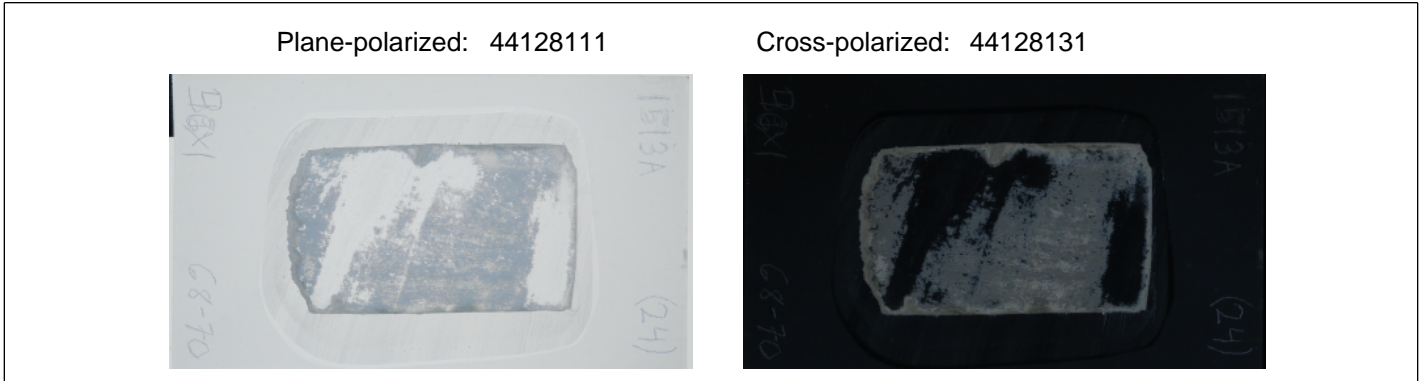
COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	1	99	0
Cement (%)	0	0	0

Mineral grain	Abundance
Quartz	T
Clay	R
Calcite	D

Biogenic material	Abundance
Foraminifers	C
Radiolarians	R

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID **369-U1513A-36X-1-W 68/70-TSB-TS24** Thin section no.: 24
 Observer: CW Unit/subunit: Unit II
 Thin section summary: This limestone could not be classified with confidence because of the soft, brittle nature of the sample. With the material remaining on thin section, it could be a mudstone owing to the near absence of any components with only traces of small foraminifera and radiolaria in a micritic matrix.



Sediments and Sedimentary Rock

Complete Lithology Name: mudstone

Remarks: The thin sectioning process has destroyed the original depositional texture of this limestone.

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	0	1	99

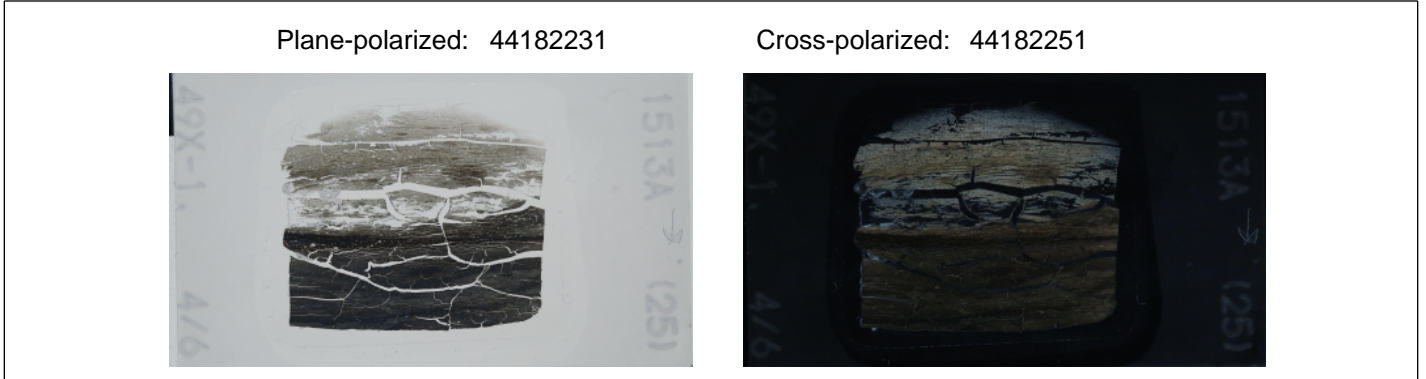
COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	0	100	0
Cement (%)	0	0	0

Mineral grain	Abundance
Calcite	D

Biogenic material	Abundance
Foraminifers	T
Radiolarians	T

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513A-49X-1-W 4/6-TSB-TS25	Thin section no.: 25
Observer:	CW	Unit/subunit: Unit IV
Thin section summary:	This fine grained siliclastic rock is classified as a chlorite claystone comprising dominant clay, abundant silt-sized chlorite mica with traces of quartz, radiolarians and foraminifera shells. Grains and bioclasts are matrix supported. Chlorite mica is present in thin or medium laminations between layers of clay minerals. Grains appear laminated, however, the soft nature of the rock makes thin sectioning of these rocks difficult leaving many voids in the slide thus making their recognition difficult.	



Sediments and Sedimentary Rock

Complete Lithology Name: chlorite claystone

Remarks: Chlorite resides mainly in thin to medium laminae.

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	0	40	60

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	99	0	1
Cement (%)	0	0	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
well rounded	very well

Mineral grain	Abundance
Quartz	T
Chlorite	D
Clay	A

Biogenic material	Abundance
Foraminifers	T
Nannofossils	T

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-10R-CC-PAL-TSB-TS40	Thin section no.: 40
Observer:	CW	Unit/subunit: Unit II
Thin section summary:	This limestone is classified as a wackestone with foraminifera. Components (all <2 mm in size) comprise common foraminifera and traces of radiolarians and siliclastic clay minerals supported in a micrite matrix.	

Plane-polarized: 44397561



Cross-polarized: 44397581



Sediments and Sedimentary Rock

Complete Lithology Name: foraminiferal wackestone

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	0	10	90

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	1	98	1
Cement (%)	0	100	0

Mineral grain	Abundance
Clay	T
Glauconite	T
Calcite	D

Biogenic material	Abundance
Foraminifers	C
Radiolarians	T

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-12R-CC-PAL-TSB-TS41	Thin section no.: 41
Observer:	CW	Unit/subunit: Unit II
Thin section summary:	This limestone could not be classified with confidence due to the soft nature of the rock and plucking during the thin sectioning process. From the remaining material on the slide, it could be a mudstone.	

Plane-polarized: 44397601



Cross-polarized: 44397621



Sediments and Sedimentary Rock

Complete Lithology Name: mudstone

Remarks: Sample lost during the thin-sectioning process.

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID **369-U1513D-13R-CC-PAL-TSB-TS42**

Thin section no.: 42

Observer: CW

Unit/subunit: Unit II

Thin section summary: This limestone is classified as a foraminiferal wackestone. Components (all < 2 mm in size) comprise abundant foraminifera, common radiolarian fragments with rare shell fragments. Clay minerals are only present in trace amounts. Components are supported in a micrite matrix.

Plane-polarized: 44397641

Cross-polarized: 44397661



Sediments and Sedimentary Rock

Complete Lithology Name: foraminiferal mudstone

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	5	30	65

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	0	90	10
Cement (%)	0	100	0

Mineral grain	Abundance
Clay	T

Biogenic material	Abundance
Foraminifers	A
Radiolarians	C
Shell fragments	R

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID **369-U1513D-14R-CC-PAL-TSB-TS43**

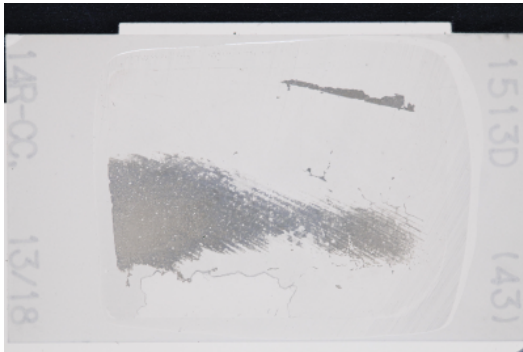
Thin section no.: 43

Observer: CW

Unit/subunit: Unit II

Thin section summary: This limestone could not be classified with confidence due to the soft nature of the rock and plucking during the thin sectioning process. From the remaining material on the slide, it could be a mudstone.

Plane-polarized: 44397681



Cross-polarized: 44397701



Sediments and Sedimentary Rock

Complete Lithology Name: mudstone**Remarks:** Sample lost during the thin-sectioning process.

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID 369-U1513D-16R-CC-PAL-TSB-TS44

Thin section no.: 44

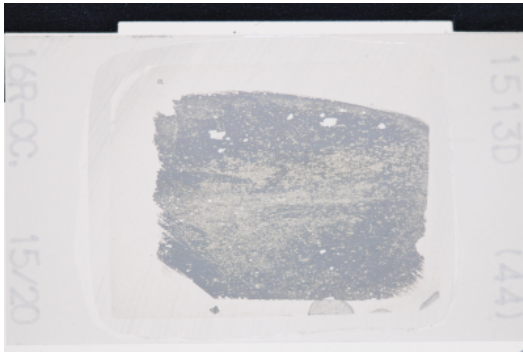
Observer: CW

Unit/subunit: Unit II

Thin section summary: This limestone could not be classified with confidence due to the soft nature of the rock and plucking during the thin sectioning process. From the remaining material on the slide, it could be a mudstone.

Plane-polarized: 44397741

Cross-polarized: 44397721



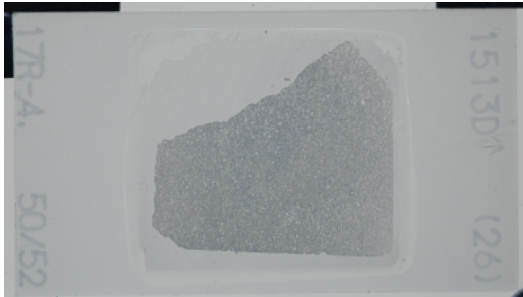
Sediments and Sedimentary Rock

Complete Lithology Name: mudstone**Remarks:** Sample lost during the thin-sectioning process.

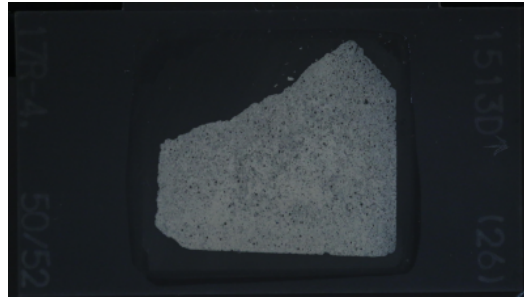
D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-17R-4-W 50/52-TSB-TS26	Thin section no.: 26
Observer:	CW	Unit/subunit: Unit II
Thin section summary:	This limestone is classified as a foraminiferal wackestone. Components (<2 mm in size) comprise abundant foraminifera, rare siliceous bioclasts and nannofossils with traces of radiolarians, diatoms, sponge spicules and very thin shell fragments supported in a micrite matrix. No clastic sediments are present in this sample.	

Plane-polarized: 44290651



Cross-polarized: 44290671



Sediments and Sedimentary Rock

Complete Lithology Name: foraminiferal wackestone

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	20	10	60

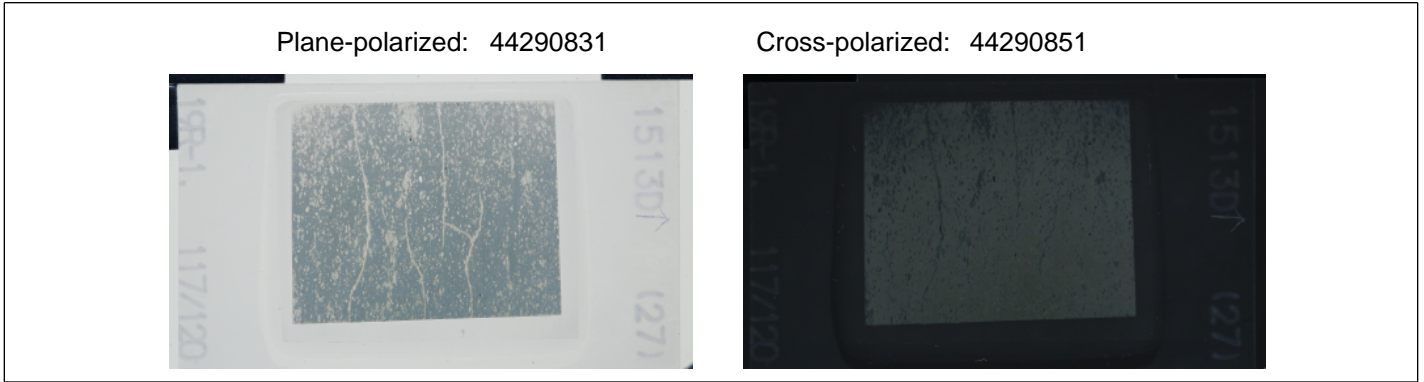
COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	0	95	5
Cement (%)	0	0	0

Mineral grain	Abundance
Calcite	D

Biogenic material	Abundance
Foraminifers	A
Nannofossils	R
Radiolarians	R
Diatoms	T
Shell fragments	T

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID **369-U1513D-19R-1-W 117/120-TSB-TS27** Thin section no.: 27
 Observer: CW Unit/subunit: Unit II
 Thin section summary: (WARNING - MAY HAVE AN INCORRECT SAMPLE CODE AS IT IS CARBONATE-RICH) This fine grained rock is a claystone with dolomite (or a dolomitic mudstone in accordance to the Dunham scheme). Components comprise dominant clay, abundant dolomite? with traces of foraminifera and radiolarians. Components are matrix supported. Dolomitization has taken place evident with rare rhomboidal crystals with a similar birefringence color to calcite. Where dolomitization is complete, crystals have joined together and the euhedral shape of the crystal(s) is lost. Subparallel alignment of bioclast grains and burrows are observed. Bioclasts are poorly preserved but look like radiolarians, with few foraminifera. Matrix composed mostly of clay, with some silica lining the margins and filling the bioclasts.



Sediments and Sedimentary Rock

Complete Lithology Name: calcareous claystone

Remarks: WARNING - SAMPLE NUMBER MAYBE INCORRECT (MAYBE A DOLOMITIC MUDSTONE). In places, silt-sized rhomboidal crystals are visible, however, where calcite crystals have been completely replaced by dolomite, they have grown together and the euhedral shape has been lost.

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	5	5	90

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	60	39	1
Cement (%)	0	0	0

Mineral grain	Abundance
Clay	A
Calcite	T
Dolomite	D

Biogenic material	Abundance
Foraminifers	T
Radiolarians	T

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID **369-U1513D-38R-1-W 71/74-TSB-TS29**

Thin section no.: 29

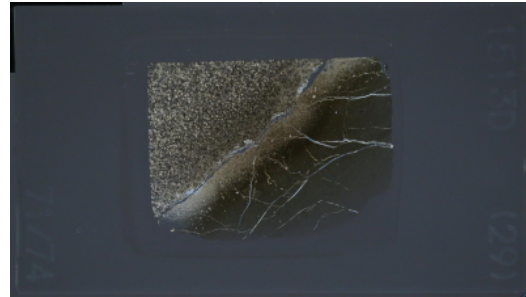
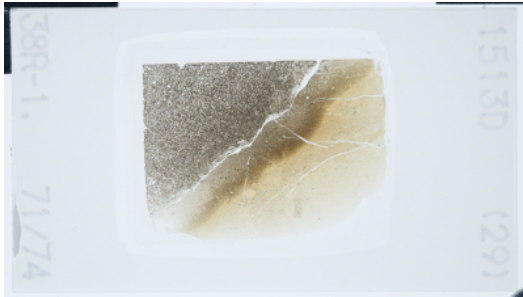
Observer: mgt/CW

Unit/subunit: Unit IV

Thin section summary: This siliclastic rock is classified as a sideritized claystone cut by siderite vein (2 domains). The rock sample comprises dominant diagenetic siderite with common clay and silt-sized quartz grains. One part of the slide is light brown in PPL and opaque in XPL with fine grained minerals in the groundmass. This maybe a variant of siderite but needs further analysis to confirm this.

Plane-polarized: 44333301

Cross-polarized: 44333381



Sediments and Sedimentary Rock

Complete Lithology Name: claystone with siderite

Remarks: cement is siderite near the vein

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	16	4	80

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	20		4
Cement (%)			

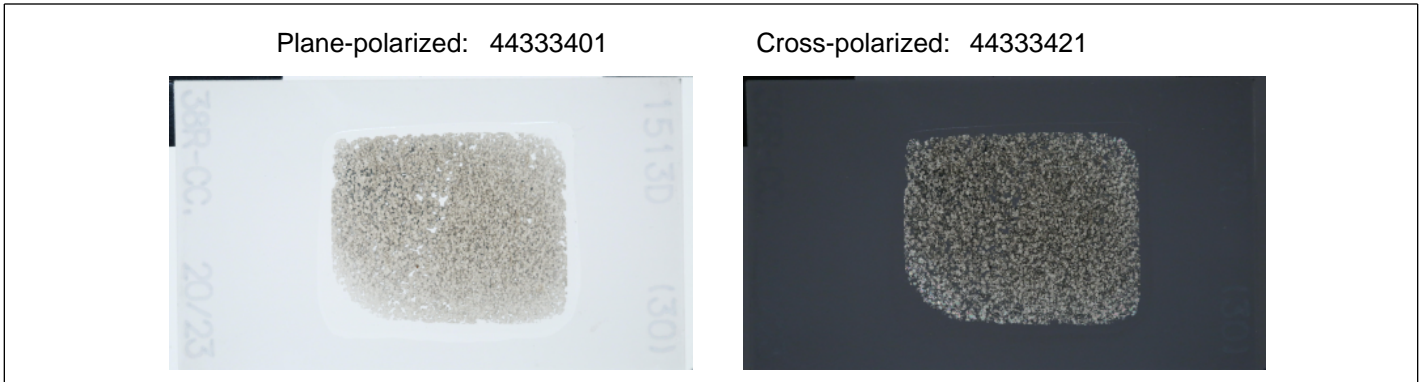
MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
subangular	well

Mineral grain	Abundance
Quartz	T
Muscovite mica	R
Clay	A

Biogenic material	Abundance
Foraminifers	R
Radiolarians	C

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-38R-CC-W 20/23-TSB-TS30	Thin section no.: 30
Observer:	mgt/CW	Unit/subunit: Unit IV
Thin section summary:	This sand-sized clastic rock is composed mostly of siderite aggregates. The rock sample comprises dominant diagenetic siderite with common clay and silt-sized quartz grains. Siderite grains form rounded aggregates of finer grains.	



Sediments and Sedimentary Rock

Complete Lithology Name: siderite
Remarks: Siderite is diagenetic.

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	85	5	10

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	10	0	0
Cement (%)	0	90	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
rounded	very well

Mineral grain	Abundance
Quartz	C
Clay	R
Siderite	D

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID **369-U1513D-41R-1-W 24/27-TSB-TS45**

Thin section no.: 45

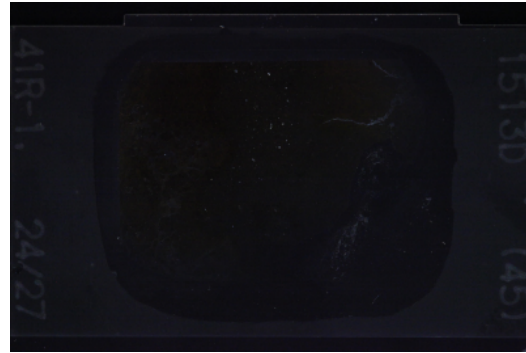
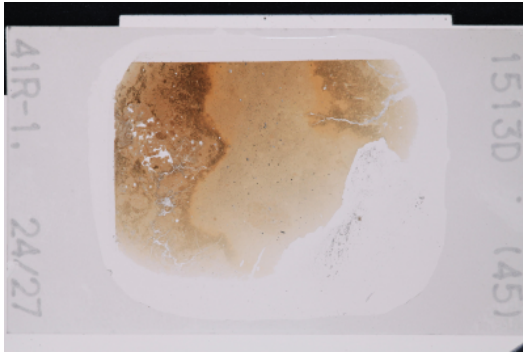
Observer: CW

Unit/subunit: Unit IV

Thin section summary: This siliclastic rock is classified as a siderite claystone. The rock has been nearly completely replaced by diagenetic microcrystalline siderite. The rock consists of dominant siderite and common silt-sized plant fragments. Clay minerals, quartz, muscovite mica and radiolarians are present in trace amounts.

Plane-polarized: 44438221

Cross-polarized: 44438241



Sediments and Sedimentary Rock

Complete Lithology Name: siderite claystone

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	0	10	90

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	5	0	5
Cement (%)	0	0	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
sub-rounded	well

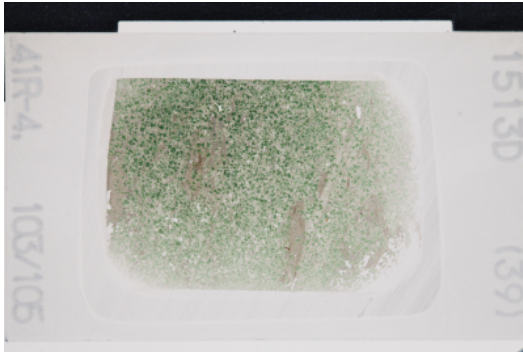
Mineral grain	Abundance
Quartz	T
Muscovite mica	T
Clay	T
Siderite	D

Biogenic material	Abundance
Plant material	A
Radiolarians	T

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-41R-4-W 103/105-TSB-TS39	Thin section no.: 39
Observer:	CW	Unit/subunit: Unit V
Thin section summary:	This siliclastic rock is classified as a subrounded, moderately sorted glauconitic sandstone consisting of abundant and common glauconite, chlorite and clay minerals. Mineral grains present with rare and trace amounts include quartz, muscovite and biotite mica. Grains are bound in places by a silty clay matrix but are predominately cemented by microcrystalline quartz.	

Plane-polarized: 44397961



Cross-polarized: 44397941



Sediments and Sedimentary Rock

Complete Lithology Name: glauconitic sandstone

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	60	10	30

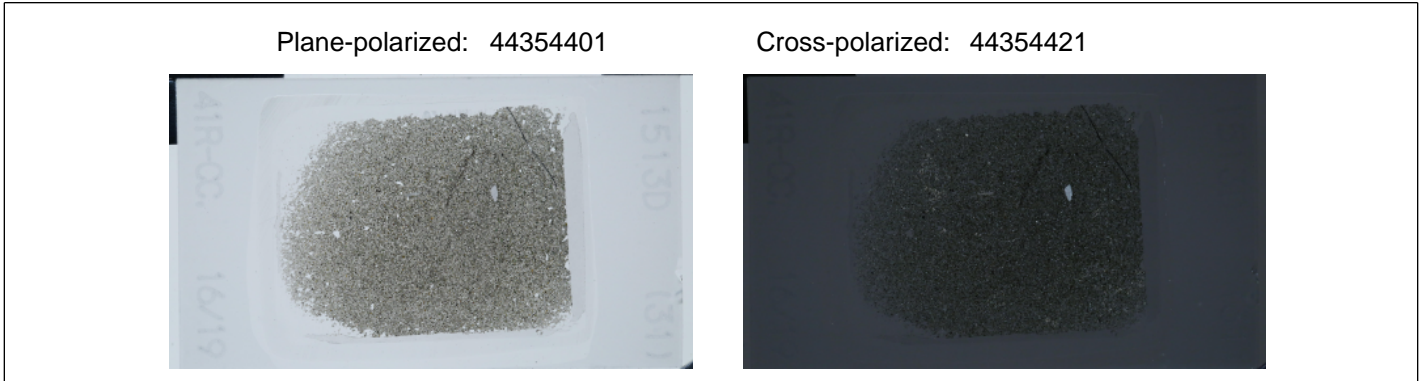
COMPOSITION	Siliclastic	Calcareous	Biosiliceous
Mineral grains (%)	100	0	0
Cement (%)	100	0	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
sub-rounded	moderate

Mineral grain	Abundance
Quartz	R
Muscovite mica	T
Biotite mica	T
Chlorite	C
Clay	A
Glauconite	D

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-41R-CC-W 16/19-TSB-TS31	Thin section no.: 31
Observer:	mgt/CW	Unit/subunit: Unit V
Thin section summary:	This siliclastic rock is classified as poorly sorted fine-grained volcanic-rich sandstone consisting of angular to subangular chlorite and plagioclase feldspars, anhedral to rounded altered glass, and anhedral to subhedral oxides in a matrix of calcareous clay and ash. Minor pyroxene grains present are partially altered to chlorite. Glass fragments are altered to brown palagonite with a few grains rimmed by glauconite. Plagioclase grains are clear to partially altered to clay. Mineral and biogenic grains present in rare and trace amounts include glauconite, clay, pyrite, hematite and wood fragments.	



Sediments and Sedimentary Rock

Complete Lithology Name: volcanic-rich sandstone

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	70	10	20

COMPOSITION	Siliclastic	Calcareous	Biosiliceous
Mineral grains (%)	70	0	0
Cement (%)	20	0	0

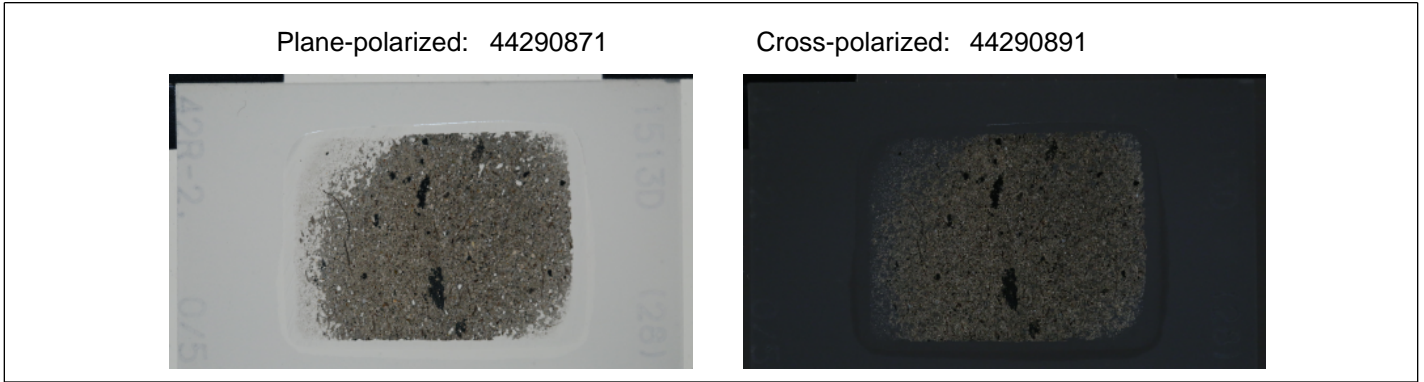
MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
subangular	very poor

Mineral grain	Abundance
Plagioclase feldspar	A
Chlorite	A
Clay	A
Glauconite	R
Calcite	T
Glass	A
Magnetite	C
Hematite	R
Lithic fragments	T
Other mineral grains	T

Biogenic material	Abundance
Wood	T

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-42R-2-IW(138-143)-TSB-TS28	Thin section no.: 28
Observer:	mgt/CW	Unit/subunit: Unit V
Thin section summary:	This siliclastic rock is classified as a poorly sorted medium-grained sandstone consisting of sand-sized angular plagioclase feldspar, subangular to subrounded glass fragments and angular to subangular basaltic clasts (~350 um in size), cemented by clay and carbonate. Pyrite dissemination and clusters are common. Angular grains, silt to medium in size, are varied consisting of glass, glauconite, calcite, plagioclase and other mineral grains that have been altered (olivine and pyroxene). Glass fragments are brownish when clear and often altered to darker brown palagonite. Some glass show vugs filled with glauconite. Plagioclases are fresh to weakly altered by clay. Radiolarians are present in trace amounts. The rock is clast supported and cemented by authigenic clays.	



Sediments and Sedimentary Rock

Complete Lithology Name: volcanic-rich sandstone with lithics

Remarks: A poorly sorted sandstone consisting of sand-sized angular plagioclase, subangular to subrounded glass fragments and angular to subangular basaltic clasts, cemented by clay and carbonate, Pyrite dissemination and clusters are common. Glass fragments are brownish when clear and often altered to darker brown palagonite. Some glass show vugs filled with glauconite. Plagioclases are fresh to weakly altered by clay.

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	60	15	25

COMPOSITION	Siliclastic	Calcareous	Biosiliceous
Mineral grains (%)	50	0	0
Cement (%)	5	25	

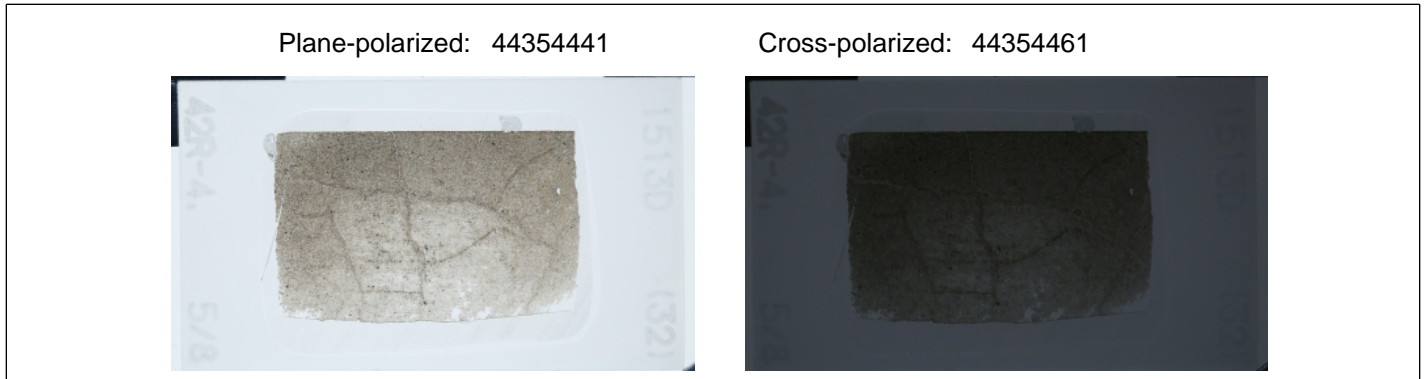
MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
subangular	very poor

Mineral grain	Abundance
Plagioclase feldspar	C
Chlorite	T
Clay	R
Glauconite	T
Calcite	C
Glass	C
Pyrite	R
Lithic fragments	R

Biogenic material	Abundance
Radiolarians	R

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-42R-4-W 5/8-TSB-TS32	Thin section no.: 32
Observer:	mgt/CW	Unit/subunit: Unit V
Thin section summary:	A non-laminated poorly-sorted volcanic-rich siltstone dominated with silt-sized feldspars, chlorite and some oxide and pyrite grains in a matrix of clay. Some volcanic glass altered to palagonite and glauconite are also present together with traces of poorly-preserved radiolarian fragments. Glauconite, pyrite, magnetite and glass are present in rare and trace mounts. All grains are matrix supported.	



Sediments and Sedimentary Rock

Complete Lithology Name: volcanic-rich siltstone

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	5	60	35

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	45	0	1
Cement (%)	35	0	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
subangular	moderate

Mineral grain	Abundance
Plagioclase feldspar	A
Chlorite	C
Clay	A
Glauconite	R
Glass	R
Pyrite	R
Magnetite	R
Hematite	R
Lithic fragments	T

Biogenic material	Abundance
Radiolarians	T

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID **369-U1513D-42R-5-W 59/61-TSB-TS33**

Thin section no.: 33

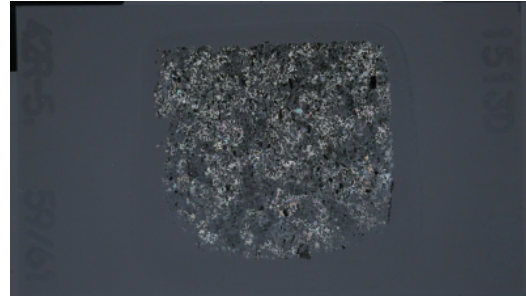
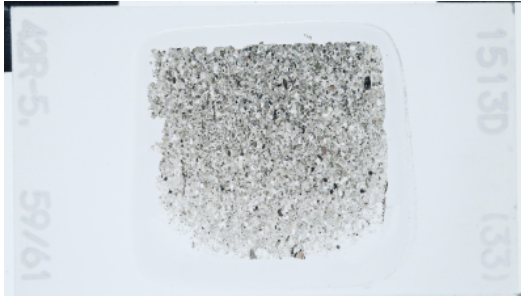
Observer: mgt/CW

Unit/subunit: Unit V

Thin section summary: This siliclastic rock is classified as a poorly sorted, subrounded volcanic-rich lithic sandstone. Lithic clasts consist of abundant seriate basalt (fresh and altered consisting of plagioclase, glass, skeletal olivine and chlorite) and intersertal basalt (mafic crystals set in glass). Altered glass fragments and chlorite are common throughout. Many of the basalts lithic exhibit carbonate pseudomorphs where olivine has been replaced by calcite. Volcanic glass are brownish when clear and darker brown to mottled green when altered. Traces of biosiliceous and calcareous fragments. All clasts are bound by a spary calcite cement.

Plane-polarized: 44354481

Cross-polarized: 44354501



Sediments and Sedimentary Rock

Complete Lithology Name: volcanic-rich sandstone with lithics

Remarks: Mostly lithic fragments.

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	60	20	0

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	10	0	0
Cement (%)	0	20	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
sub-rounded	moderate

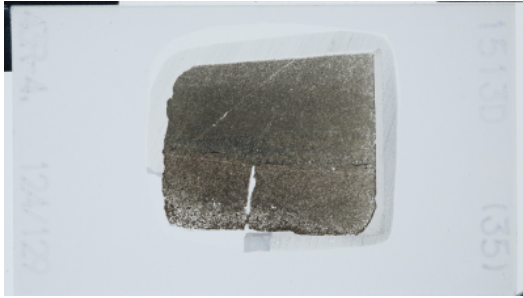
Mineral grain	Abundance
Plagioclase feldspar	R
Chlorite	R
Calcite	A
Glass	R
Pyrite	R
Magnetite	R
Hematite	R
Lithic fragments	A

Biogenic material	Abundance
Foraminifers	T
Radiolarians	T

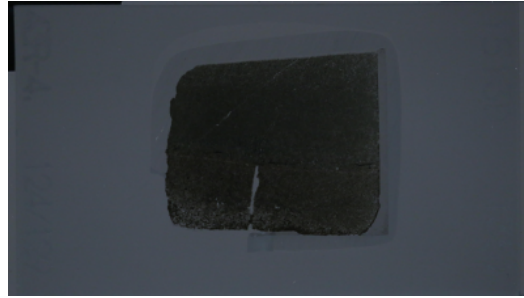
D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-43R-4-W 124/129-TSB-TS35	Thin section no.: 35
Observer:	mgt/CW	Unit/subunit: Unit V
Thin section summary:	This thin section shows thinly bedded green and maroon silty claystones and their boundary. The boundary is marked by a discontinuous laminae of opaque minerals. Green claystone is dominated by green clay/chlorite and less amount of opaque minerals. Maroon claystone is dominated by brown clay and reddish-brown Fe-oxide. Both are moderately sorted consisting of abundant and common clay minerals, chlorite, plagioclase feldspar and glass. Mineral grains present in rare and trace amounts include pyrite, hematite, glass and quartz, Grains are supported by a clay-rich matrix. In places, faint laminations and horizontal burrows are present. A vein cuts across the thin section.	

Plane-polarized: 44354561



Cross-polarized: 44354581



Sediments and Sedimentary Rock

Complete Lithology Name: silty claystone

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	0	10	90

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	90	0	0
Cement (%)	0	0	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
subangular	well

Mineral grain	Abundance
Plagioclase feldspar	R
Chlorite	R
Clay	A
Glauconite	T
Glass	T
Pyrite	T
Hematite	R

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID **369-U1513D-44R-2-W 89/91-TSB-TS34**

Thin section no.: 34

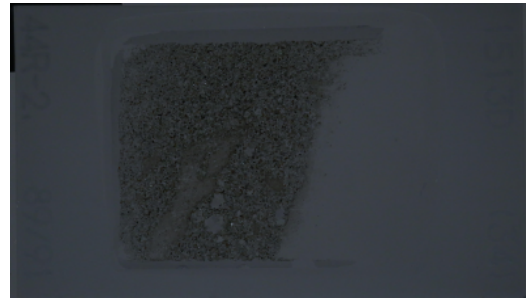
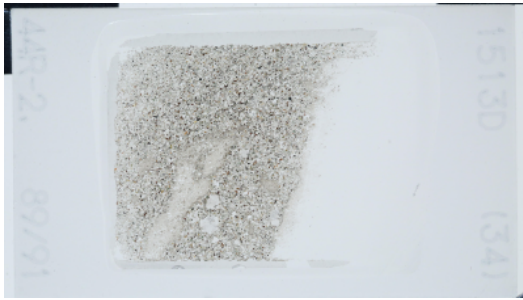
Observer: mgt/CW

Unit/subunit: Unit V

Thin section summary: This siliclastic rock is classified as a fine to medium grained, poorly sorted volcanic-rich sandstone with a ripped up clast of mudstone and some basaltic clasts. Chlorite dominates and partially to completely alters mafic minerals, possibly pyroxene. Some clear brownish glass fragments are present some are brown (palagonitized) and show bubble-wall structure lined with fibrous glauconite and zeolite, pyrite, and magnetite. Fewer feldspar grains are fragmented and angular. Grains and clasts are supported by a clay-rich matrix.

Plane-polarized: 44354521

Cross-polarized: 44354541



Sediments and Sedimentary Rock

Complete Lithology Name: volcanic-rich sandstone with lithics

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	10	50	10	30

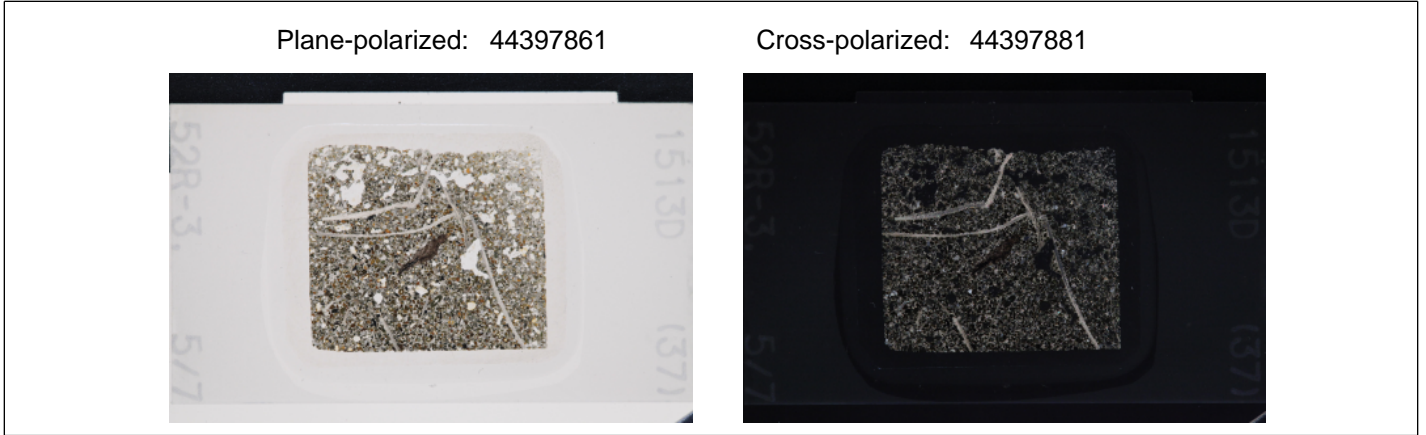
COMPOSITION	Siliclastic	Calcareous	Biosiliceous
Mineral grains (%)	79		1
Cement (%)	0	0	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
angular	poor

Mineral grain	Abundance
Plagioclase feldspar	R
Chlorite	A
Clay	A
Glauconite	R
Glass	R
Zeolite	T
Pyrite	R
Magnetite	R
Hematite	R
Lithic fragments	R

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-52R-3-W 125/127-TSB-TS37	Thin section no.: 37
Observer:	CW	Unit/subunit: Unit V
Thin section summary:	This siliclastic rock is classified as a subrounded, poorly sorted lithic sandstone with shells consisting of basaltic lithic fragments (fresh and altered, some exhibiting a seriate texture), glass, chlorite and shells fragments. Minerals present in rare and trace amounts include glauconite, quartz, plagioclase feldspar and pyrite. Grains are bound by a spary calcite cement.	



Sediments and Sedimentary Rock

Complete Lithology Name: lithic sandstone with shells

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	90	10	0

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	85	5	0
Cement (%)	0	100	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
sub-rounded	poor

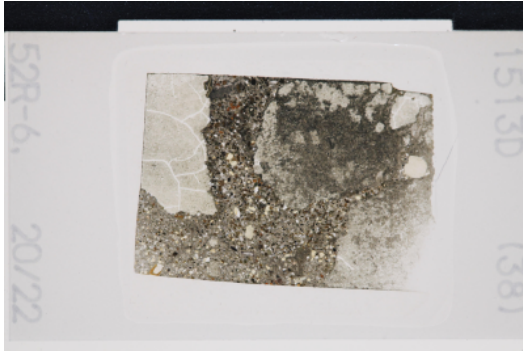
Mineral grain	Abundance
Quartz	T
Plagioclase feldspar	C
Chlorite	C
Glauconite	R
Calcite	D
Glass	A
Pyrite	T
Lithic fragments	A

Biogenic material	Abundance
Shells	C

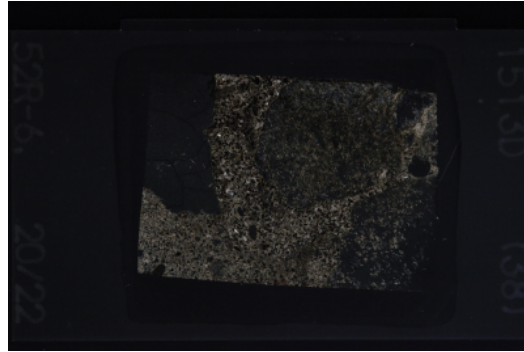
D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-52R-6-W 20/22-TSB-TS38	Thin section no.: 38
Observer:	CW	Unit/subunit: Unit V
Thin section summary:	This siliclastic rock is classified as a subrounded, poorly sorted volcanic-rich sandstone with clasts. Constituents include abundant to common clay minerals, chlorite, glass, basaltic lithic fragments (fresh and altered, some exhibiting a seriate and spherulitic texture), Mineral grains present in rare and trace amounts include quartz, plagioclase feldspar, pyrite and glauconite. Grains are bound in part by a clay matrix but is mostly cemented by spary calcite.	

Plane-polarized: 44397901



Cross-polarized: 44397921



Sediments and Sedimentary Rock

Complete Lithology Name: volcanic-rich sandstone with clasts

Remarks: The large, fine grained clasts are comprised of silty claystone.

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	70	20	10

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	88	1	1
Cement (%)	0	100	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
sub-rounded	poor

Mineral grain	Abundance
Quartz	T
Plagioclase feldspar	R
Chlorite	C
Clay	C
Glauconite	T
Calcite	D
Glass	C
Pyrite	T
Lithic fragments	C

Biogenic material	Abundance
Radiolarians	T
Other biogenic fragments	R

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID **369-U1513D-54R-CC-W 0/5-TSB-TS36**

Thin section no.: 36

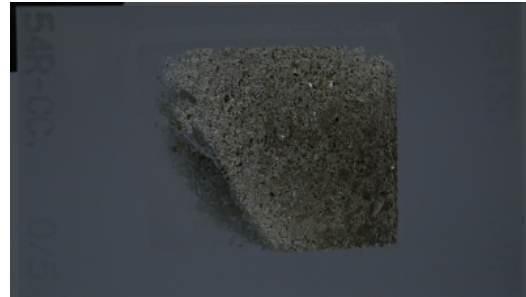
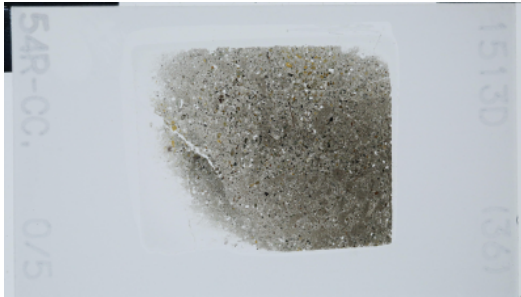
Observer: CW

Unit/subunit: Unit V

Thin section summary: This siliclastic rock is classified as a subrounded, poorly sorted volcanic-rich sandstone with lithics consisting of chlorite, clay minerals, glass and basaltic lithic fragments (fresh and altered, some of which are seriate). Minerals present in rare and trace amounts include quartz, glauconite, pyrite and plagioclase feldspar. Grains are bound by spary calcite cement.

Plane-polarized: 44354621

Cross-polarized: 44354641



Sediments and Sedimentary Rock

Complete Lithology Name: volcanic-rich sandstone with lithics

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	60	20	20

COMPOSITION	Siliclastic	Calcareous	Biosiliceous
Mineral grains (%)	95	0	0
Cement (%)	0	100	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
sub-rounded	poor

Mineral grain	Abundance
Quartz	R
Plagioclase feldspar	R
Chlorite	C
Clay	C
Glauconite	T
Calcite	D
Glass	C
Pyrite	T
Lithic fragments	C

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-55R-7-W 100/103-TSB-TS46	Thin section no.: 46
Observer:	CW	Unit/subunit: Unit V
Thin section summary:	This siliclastic rock is classified as a subrounded, poorly sorted volcanic-rich sandstone with abundant plagioclase feldspar with common chlorite and n glauconite and basaltic lithic fragments. Minerals present in rare and trace amounts include quartz, clay minerals, pyrite and glass. Grains are bound by spary calcite cement.	



Sediments and Sedimentary Rock

Complete Lithology Name: volcanic-rich sandstone with feldspar

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	5	80	15	0

COMPOSITION	Siliclastic	Calcareous	Biosiliceous
Mineral grains (%)	80	20	0
Cement (%)	0	100	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
subangular	poor

Mineral grain	Abundance
Plagioclase feldspar	A
Chlorite	C
Clay	T
Glauconite	C
Calcite	D
Glass	R
Pyrite	R
Lithic fragments	C

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID **369-U1513D-60R-6-W 54/56-TSB-TS47**

Thin section no.: 47

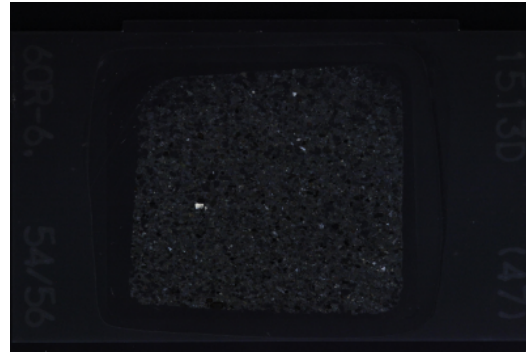
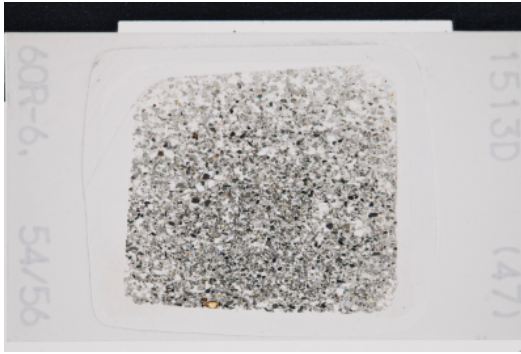
Observer: CW

Unit/subunit: Unit V

Thin section summary: This siliclastic rock is classified as a subrounded, moderately sorted volcanic-rich sandstone with lithics consisting of abundant clay minerals (altered glass) with common chlorite, plagioclase feldspar and basaltic lithic fragments. Minerals present in rare and trace amounts include quartz, glauconite, pyrite and glass. Grains are bound by spary calcite cement.

Plane-polarized: 44397841

Cross-polarized: 44397821



Sediments and Sedimentary Rock

Complete Lithology Name: volcanic-rich sandstone with lithics

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	0	65	20	15

COMPOSITION	Siliclastic	Calcareous	Biosiliceous
Mineral grains (%)	85	10	0
Cement (%)	0	100	0

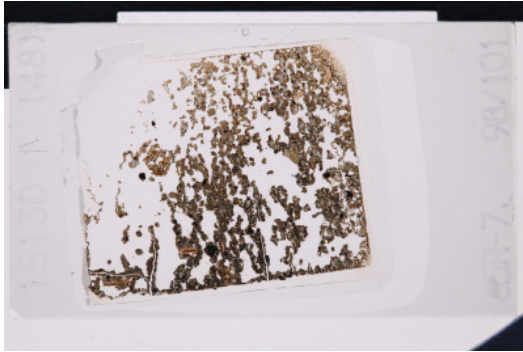
MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
sub-rounded	moderate

Mineral grain	Abundance
Quartz	R
Plagioclase feldspar	C
Chlorite	C
Clay	A
Glauconite	R
Calcite	D
Lithic fragments	A

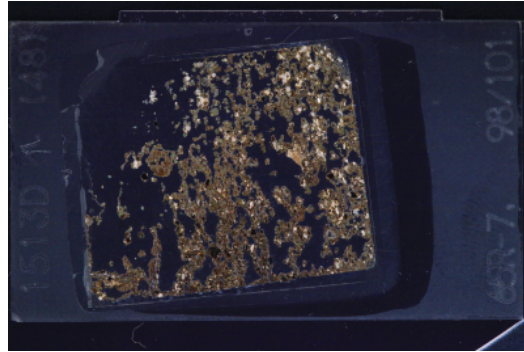
D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-65R-7-W 98/101-TSB-TS48	Thin section no.: 48
Observer:	MGT	Unit/subunit: Unit V
Thin section summary:	This siliclastic rock is a volcanic-rich breccia with volcanic lithic fragments and mineral grains in a matrix of poorly sorted silt and clay. It is matrix supported. Gravel-sized fragments include basalt with plagioclase microlites, palagonitized glass and large plagioclase crystals that are partially to completely altered to calcite. Mineral grains include partially to completely altered plagioclases, and completely altered pyroxene and olivine. Both mineral grains and matrix are replaced by Fe-hydroxide and hematite.	

Plane-polarized: 44943201



Cross-polarized: 44943151



Sediments and Sedimentary Rock

Complete Lithology Name: volcanic-rich breccia

Remarks:

Lithic fragments include basalt with plagioclase microlites, silicified vein fragments, and palagonitized glass. Calcite replaced large plagioclase phenocrysts, chlorite replaced pyroxenes; brown clay and glauconite replaced olivines and matrix is completely replaced by Fe-hydroxide and hematite.

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	5	60	15	20

COMPOSITION	Siliclastic	Calcareous	Biosiliceous
Mineral grains (%)	60	0	0
Cement (%)	20		

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
subangular	very poor

Mineral grain	Abundance
Plagioclase feldspar	R
Chlorite	R
Clay	R
Glauconite	T
Glass	T
Magnetite	T
Hematite	D
Lithic fragments	R

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID: **369-U1513D-66R-1-W 19/22-TSB-TS49**

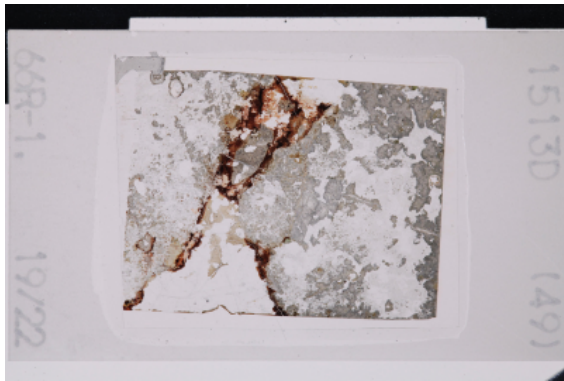
Thin section no.: 49

Observer: CW and MGT

Unit/subunit: Unit 1A

Thin section summary: The section shows the clasts and matrix of a highly altered flow top breccia. Three different clasts of basalts are identified from their remnant texture and the matrix contains fine- to coarse-sized mineral grains of feldspar, pyroxene, and altered olivine. Two big clasts are porphyritic basalts that are partially serpentinized, with megacryst of feldspar and microphenocrystic olivine (altered) in the groundmass, Feldspar and olivine are pseudomorphs and totally altered to calcite and oxide, respectively. In the groundmass, serpentine exhibit a mesh texture. A small clast in between has a similar texture as the clasts with big phenocryst, showing smaller, 2 mm long plagioclase laths. The material cementing the clasts is light brown and displays isotropic to anomalous birefringence and the plagioclase feldspar crystals exhibit a trachytic texture. Crosscutting veins with calcite are common throughout this specimen and the matrix is totally replaced by haematite.

Plane-polarized: 44442151



Cross-polarized: 44442171



Igneous Petrology

Lithology: basalt

Avg. grain size: fine grained

Texture: porphyritic / porphyry

Max grain size: Coarse grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine	1	2	0	
Plagioclase	30	10	35	0.07
Clinopyroxene			0	0
Amphibole	1	1	N/A	N/A
Fe-Ti oxide	N/A	N/A	5	0.05
Altered minerals			60	

Alteration comment: Serpentinized basalt/dolerite. Pyroxenes has been altered to chlorite and the olivines to serpentine and haematite.

THIN SECTION LABEL ID: **369-U1513D-66R-3-W 66/69-TSB-TS50**

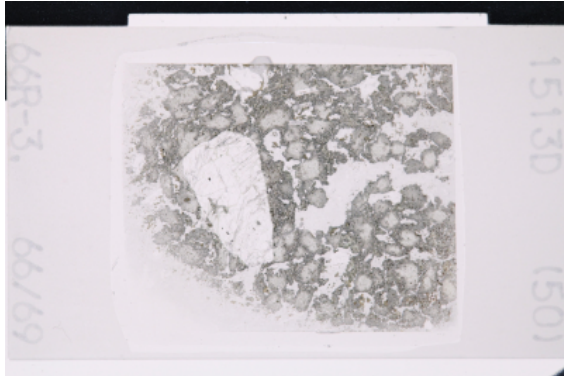
Thin section no.: 50

Observer: CW and MGT

Unit/subunit: Unit 1B

Thin section summary: This igneous rock is a plagioclase-phyric dolerite with a fine-grained groundmass consisting of plagioclase feldspar, clinopyroxene, orthopyroxene (some altered to chlorite) and haematite. Groundmass is partially altered, with islands of fresh patches remaining, consisting of intergranular pyroxene enclosed in feldspath laths visible as pseudo-phenocrysts. In several places, subophitic textures are present where pyroxenes have partially enclosed plagioclase feldspar laths. Phenocrysts of large plagioclase feldspar are common in core samples and, as shown here, is up to 10 mm in size. Crosscutting veins with calcite are common throughout the section.

Plane-polarized: 44442211



Cross-polarized: 44442191



Igneous Petrology

Lithology: dolerite

Avg. grain size: fine grained

Texture: subophitic

Max grain size: Coarse grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine			0	
Plagioclase	20	10	40	0.5
Clinopyroxene			12	0.4
Fe-Ti oxide	N/A	N/A	8	0.01
Altered minerals			20	

Alteration comment: Islands of fresh material remains in partially altered groundmass, showing intergranular and subophitic textures. Isolated pyroxene crystals in the groundmass are altered to chlorite.

THIN SECTION LABEL ID: **369-U1513D-66R-4-W 43/46-TSB-TS51**

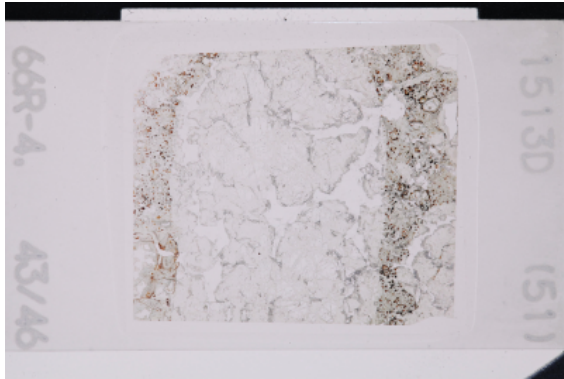
Thin section no.: 51

Observer: CW and MGT

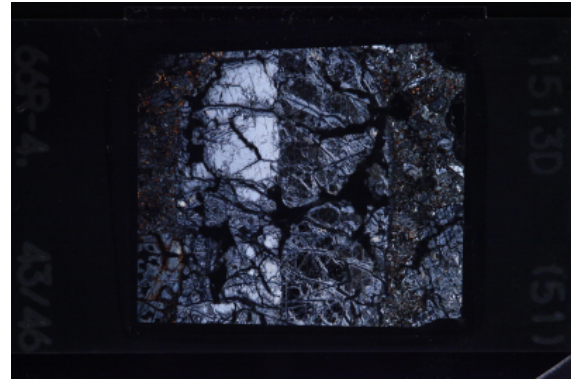
Unit/subunit: Unit 1B

Thin section summary: This igneous rock is a porphyritic basalt that has a medium-grained altered groundmass of originally olivine, pyroxene, plagioclase feldspa and Fe-Ti oxide with one large phenocrysts of plagioclase, Alteration minerals form pseudomorphs after clinopyroxene a(chlorite and sericite) and olivine (haematite and possibly serpentine and chlorite). This rock has a dominant porphyritic texture with megacrystic (up to 30 mm) plagioclase feldspar phenocrysts that have been hydrothermally altered to sericite, chlorite, and calcite.

Plane-polarized: 44454891



Cross-polarized: 44454931



Igneous Petrology

Lithology: basalt

Avg. grain size: medium grained

Texture: porphyritic / porphyry

Max grain size: Coarse grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine			2	0.2
Plagioclase	65	13	20	3
Clinopyroxene			8	0.5
Fe-Ti oxide	N/A	N/A	3	0.03
Altered minerals			2	

Alteration comment: Alteration minerals are mostly chlorite, sericite and hematite. Chlorite and hematite completely altered olivines preserving only original outlines. Some original fragments of brown pyroxene survive in the groundmass but largely replaced by chlorite and sericite.

THIN SECTION LABEL ID: **369-U1513D-67R-1-W 26/29-TSB-TS54**

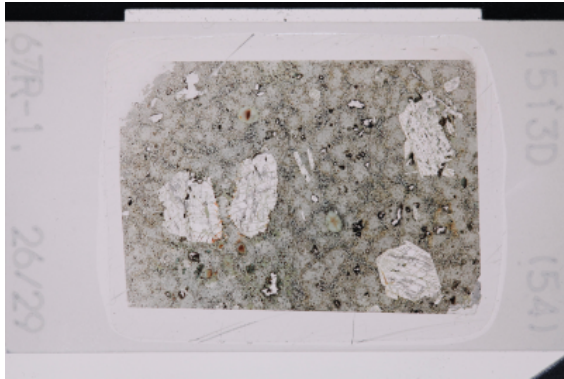
Thin section no.: 54

Observer: CW and MGT

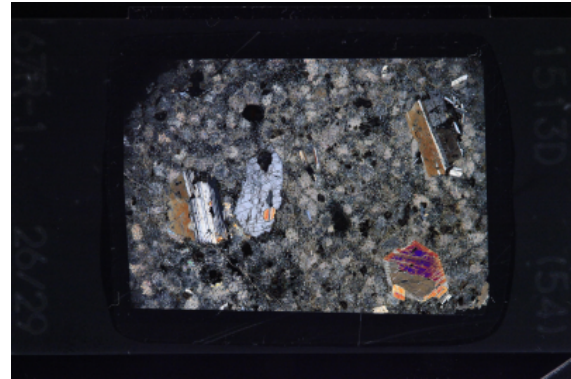
Unit/subunit: Unit 1C,
dike

Thin section summary: This igneous rock is a plagioclase-phyric dolerite with a fine-grained groundmass that has been partially altered resulting in pseudo-porphyratic texture. Pseudo-phenocrysts are less altered patches of groundmass consisting of plagioclase feldspar, clinopyroxene, olivine (pseudomorph) with haematite outlines. In several places, subophitic textures are present where pyroxenes have partially enclosed plagioclase feldspar crystals. Phenocrysts of plagioclase feldspar and olivine and/or serpentine are common and up to 7 mm in size.

Plane-polarized: 44454971



Cross-polarized: 44454951



Igneous Petrology

Lithology: dolerite

Avg. grain size: fine grained

Texture: subophitic

Max grain size: Coarse grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine	10	0.4	0	
Plagioclase	25	7	30	0.8
Clinopyroxene			20	0.4
Fe-Ti oxide	N/A	N/A	5	0.1
Altered minerals			10	

Alteration comment: Some pyroxenes altered to chlorites.

THIN SECTION LABEL ID: **369-U1513D-67R-3-W 18/21-TSB-TS55**

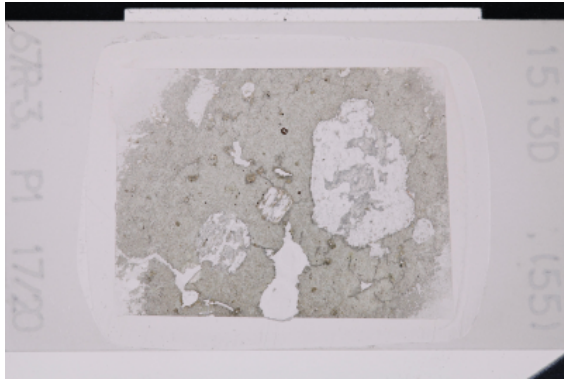
Thin section no.: 55

Observer: CW and MGT

Unit/subunit: Unit 1C,
dike

Thin section summary: This igneous rock is an olivine pyroxene-plagioclase-phyric dolerite with trace serpentized olivine (pseudomorph), plagioclase (partially altered to sericite and calcite) and pyroxene (pseudomorph, replaced by chlorite) in a coarse-grained groundmass, displaying intergranular to trachytic textures. Groundmass clinopyroxenes are interstitial between long plagioclase laths and are partially altered to chlorite. Groundmass plagioclases give this rock a dominant trachytic texture with plagioclase laths aligned with the preferential direction of the flow, especially around large phenocrysts. Some phenocrysts of plagioclase feldspar are poikilitic enclosing pyroxenes that have altered to chlorite.

Plane-polarized: 44454991



Cross-polarized: 44455011



Igneous Petrology

Lithology: basalt

Avg. grain size: coarse grained

Texture: trachytic

Max grain size: coarse grained

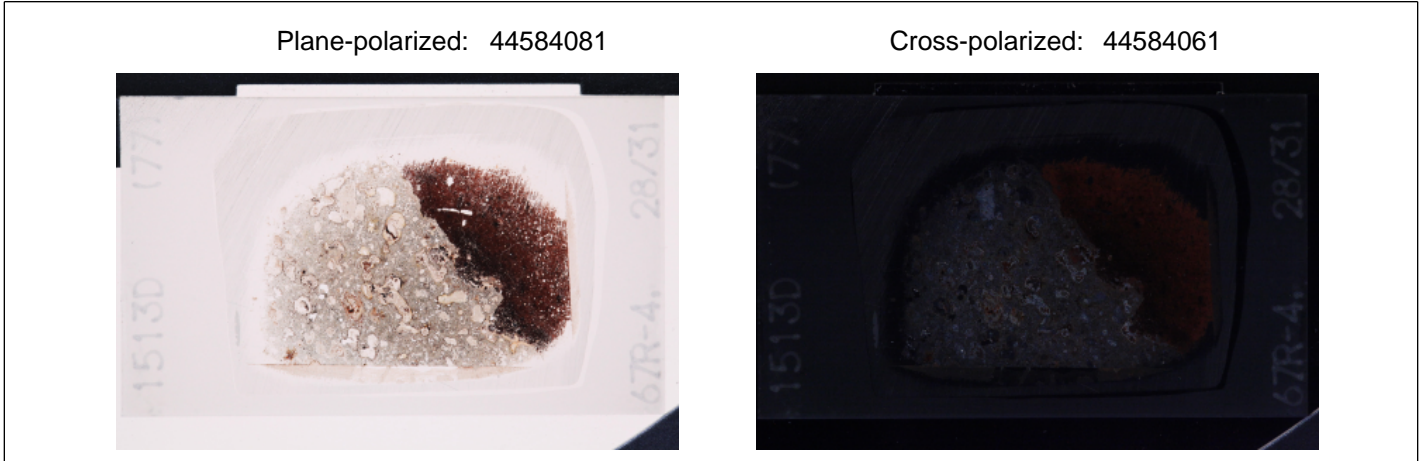
Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine	1	0.3	0	
Plagioclase	15	10	44	0.25
Clinopyroxene	4	1	24	0.2
Fe-Ti oxide	N/A	N/A	4	0.03
Altered minerals			8	

Alteration comment: alteration mostly affected the large phenocrysts

THIN SECTION LABEL ID: **369-U1513D-67R-4-W 28/31-TSB-TS77** Thin section no.: 77

Observer: CW and MGT Unit/subunit: baked contact

Thin section summary: This section shows the sharp contact between basalt and breccia. The contact is irregular, showing darker chilled, cryptocrystalline boundary. Chilled selvage shows plagioclase microlites. The igneous rock side shows a highly altered olivine-phyric basalt with common, large olivine phenocryst pseudomorphs, up to 3 mm in long dimension. Groundmass shows relict intersertal texture with interstitial material completely replaced by secondary oxides and plagioclase laths partially replaced with clay. A relict trachytic texture is still visible in the groundmass. The volcanic breccia consists of grains of secondary minerals including chlorite, sericite, haematite, plagioclase feldspar (pseudomorphs and secondary?) and basaltic clasts in a matrix of oxidized (hematized) clay minerals.



Igneous Petrology

Lithology: basalt **Avg. grain size:** fine grained

Texture: aphanoporphyritic **Max grain size:** medium grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine	5	3		
Plagioclase			50	3
Altered minerals			45	

Alteration comment: oxide completely replaced glassy interstices between plagioclase laths; plagioclases partially altered to clay along center line.

Alteration

Rock name (informal): Highly altered basalt on a volcanic breccia contact

Total alteration in rock, bulk estimate (%): 80

Recrystallization extent: weak [recryst]

Alteration intensity: moderate [Al]

Alteration mineral	Percent	Comment
Chlorite	50	
Clay, brown	2	
Oxide, hematite	10	
Plagioclase, secondary	5	Possible secondary plagioclase feldspar.
Sericite	32	

THIN SECTION LABEL ID **369-U1513D-67R-4-W 28/31-TSB-TS77-SED** Thin section no.: 77
 Observer: CW and MGT Unit/subunit: dike-
 Thin section summary: This section shows the sharp contact between dolerite dike and breccia. The contact is irregular, showing darker chilled, cryptocrystalline boundary. Chilled selvage shows plagioclase microlites. The igneous rock side shows a highly altered olivine-phyric basalt with common, large olivine phenocryst pseudomorphs, up to 3 mm in long dimension. Groundmass shows relict intersertal texture with interstitial material completely replaced by secondary oxides and plagioclase laths partially replaced with clay. A relict trachytic texture is still visible in the groundmass. The volcanic breccia consists of grains of secondary minerals including chlorite, sericite, haematite, plagioclase feldspar (pseudomorphs and secondary?) and basaltic clasts in a matrix of oxidized (hematized) clay minerals.



Sediments and Sedimentary Rock

Complete Lithology Name: volcaniclastic breccia
Remarks: Highly altered volcaniclastic breccia

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	2	20	30	48

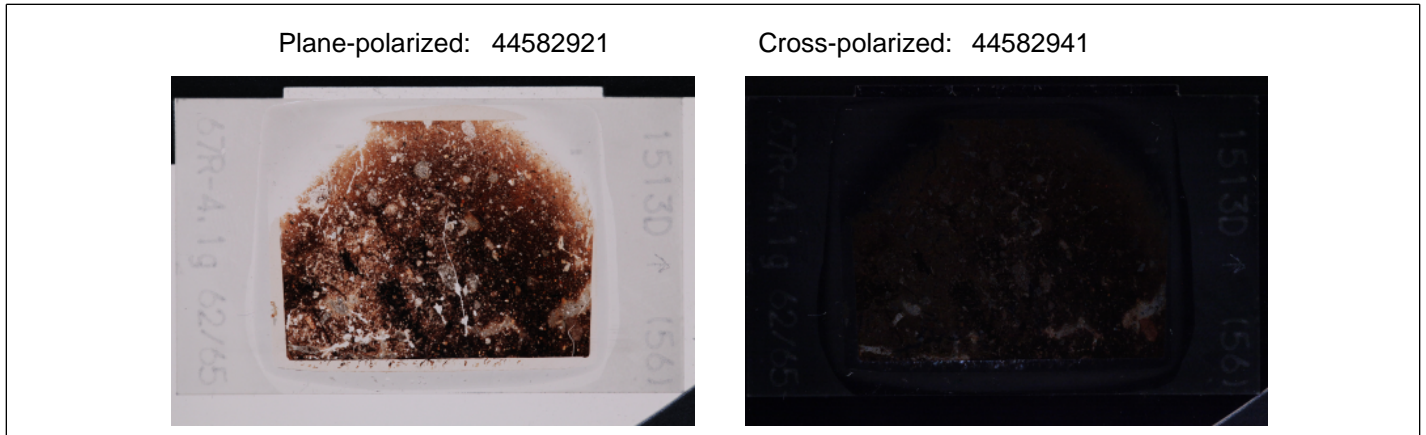
COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	0	0	0
Cement (%)	0	0	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
subangular	very poor

Mineral grain	Abundance
Chlorite	R
Clay	A
Glass	C
Magnetite	T
Hematite	D
Lithic fragments	C
Other mineral grains	A

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID	369-U1513D-67R-4-W 62/65-TSB-TS56	Thin section no.: 56
Observer:	CW	Unit/subunit: Unit 2,
Thin section summary:	This volcanoclastic rock is classified as a volcanic lithic breccia that has been highly altered by hydrothermal activity. Constituents of this rock comprises dominant to abundant haematite/clay, common basaltic lithic fragments (often altered with a relict trachytic texture), altered glass with trace and rare amounts of magnetite and chlorite. Pseudomorphs of mafic minerals (likely plagioclase feldspar and pyroxene) are present throughout. The rock is poorly sorted and consists of subangular grains/lithic clasts that are matrix supported. Vesicles maybe present, but they maybe a relict feature from the thin sectioning process.	



Sediments and Sedimentary Rock

Complete Lithology Name: volcanoclastic breccia
Remarks: Highly altered volcanoclastic breccia

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	2	20	30	48

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	0	0	0
Cement (%)	0	0	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
subangular	very poor

Mineral grain	Abundance
Chlorite	R
Clay	A
Glass	C
Magnetite	T
Hematite	D
Lithic fragments	C
Other mineral grains	A

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID: **369-U1513D-68R-1-W 11/14-TSB-TS62**

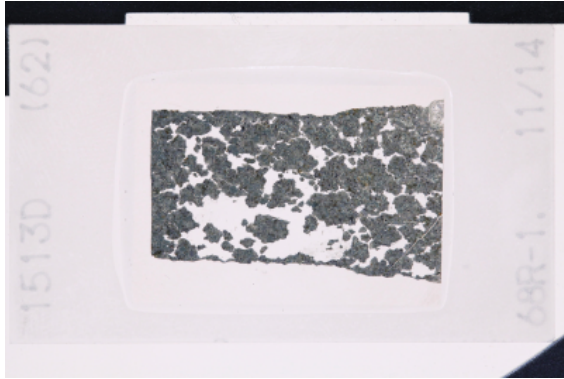
Thin section no.: 62

Observer: CW

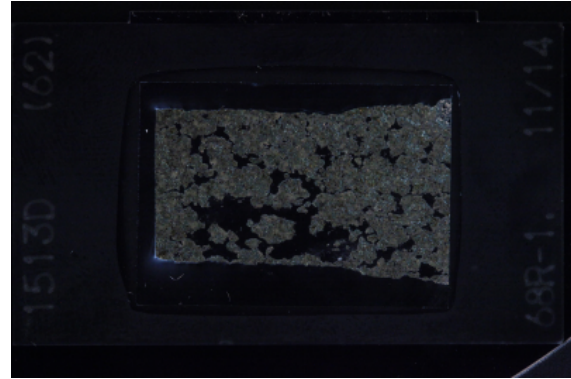
Unit/subunit: Unit 3A

Thin section summary: This igneous rock is a highly altered basalt. The rock is dominated by partially altered palagonite, Other constituents (mostly secondary minerals) that are present include haematite, sericite, serpentine, chlorite, altered pyroxene and actinolite.

Plane-polarized: 44582981



Cross-polarized: 44582961



Alteration

Rock name (informal): Highly altered basalt

Total alteration in rock, bulk estimate (%): 70

Recrystallization extent: strong

Alteration intensity: high

Alteration mineral	Percent	Comment
Amphibole - actinolite	1	
Chlorite	5	
Dusty CPX	2	
Oxide, hematite	20	Difficult to differentiate from clay.
Palagonite	55	Outer edges altered to chlorite.
Sericite	10	Altered plagioclase feldspar.
Serpentine	8	Large crystal in one corner of the slide.

THIN SECTION LABEL ID: **369-U1513D-68R-1-W 28/30-TSB-TS78**

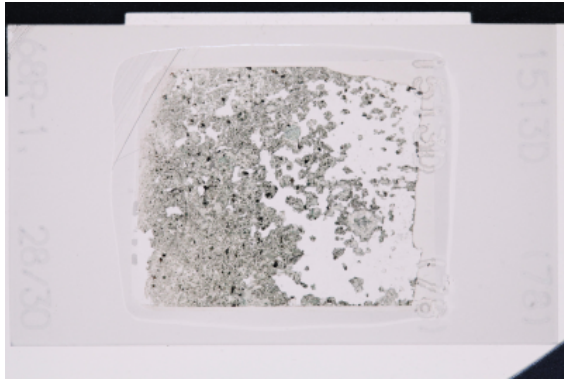
Thin section no.: 78

Observer: CW and MGT

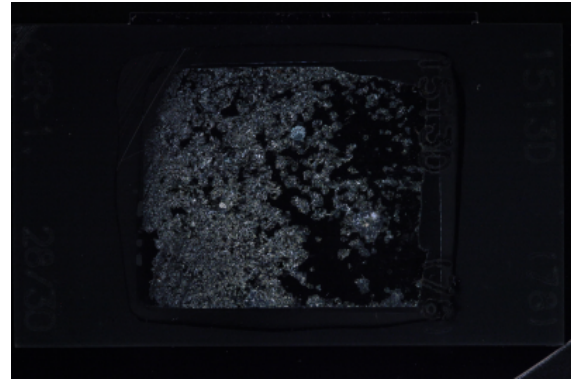
Unit/subunit: Unit 3A

Thin section summary: This igneous rock is classified as an sparsely phyric dolerite with phenocrysts of olivine (0.5 mm, altered to serpentine)-plagioclase (up to 1.8 mm long, altered sericite+albite?) in a medium-grained groundmass. The groundmass consists of secondary minerals including chlorite, plagioclase feldspar (primary and secondary), haematite, and calcite. Relict spherulites are present throughout. Two types of pyroxenes: one possibly phenocrystic (anhedral to subhedral with brown and dark green color, possibly glauconite alteration) and anhedral groundmass grains that are mostly altered to chlorite. Semi-spherical vugs up to 2 mm in width lined with glauconite-brown clay-chlorite are sporadic throughout the slide.

Plane-polarized: 44585601



Cross-polarized: 44585581



Igneous Petrology

Lithology: dolerite

Avg. grain size: medium grained

Texture: ophitic

Max grain size: coarse grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine	1	0.5		
Plagioclase	2	18	40	0.5
Clinopyroxene			30	0.3
Fe-Ti oxide	N/A	N/A	3	0.1
Altered minerals			22	

Alteration comment: hematite, glauconite and brown clay in interstices; sericite, albite, replacing plagioclases and serpentine replacing olivine

Alteration

Rock name (informal): Altered dolerite

Total alteration in rock, bulk estimate (%): 60

Recrystallization extent: weak

Alteration intensity: moderate

Alteration mineral	Percent	Comment
Calcium carbonate	1	
Chlorite	55	
Oxide, hematite	10	
Plagioclase, secondary	30	Mix of primary and secondary plagioclase feldspar.
Serpentine	5	Some olivines are only partially altered to serpentine.

THIN SECTION LABEL ID: **369-U1513D-68R-4-W 122/125-TSB-TS79**

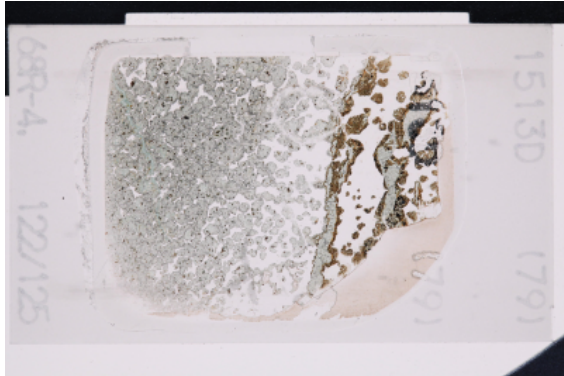
Thin section no.: 79

Observer: CW and MGT

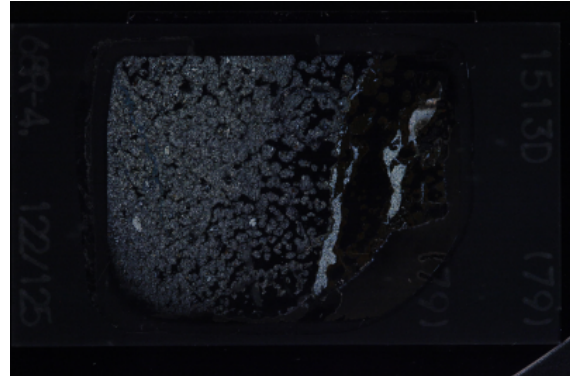
Unit/subunit: Unit 3C

Thin section summary: This igneous rock is classified as a highly altered basalt with an original glass selvage. Alteration affects both phenocrysts and groundmass. The original texture varies from aphyric to hyalopilitic in the glassy selvage and to intersertal to intergranular in the crystalline portion of the section. The original glass selvages are completely replaced by palagonite, then glauconite and chlorite. Plagioclase laths in the selvage show trachytic texture in glassy matrix now completely replaced by hematite and Fe-hydroxide. The crystalline interior consists of secondary minerals including chlorite, sericite, haematite, plagioclase feldspar and serpentine. Relict spherulitic are present throughout.

Plane-polarized: 44585621



Cross-polarized: 44585641



Igneous Petrology

Lithology: basalt

Avg. grain size: microcrystalline

Texture: intergranular

Max grain size: medium grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine			5	0.1
Plagioclase	10	0.5	15	0.3
Clinopyroxene			10	0.2
Fe-Ti oxide	N/A	N/A	10	0.2
Altered minerals			50	

Alteration comment: alteration affects both phenocrysts and groundmass; original glass selvages are completely transformed to hematite/Fe-hydroxide; original glass selvages totally replaced by palagonite, then glauconite and chlorite

Alteration

Rock name (informal): Highly altered dolerite

Total alteration in rock, bulk estimate (%): 90

Recrystallization extent: strong

Alteration intensity: high

Alteration mineral	Percent	Comment
Chlorite	60	
Oxide, hematite	5	
Plagioclase, secondary	5	Mix of primary and secondary plagioclase feldspar.
Sericite	25	Altered plagioclase feldspar.
Serpentine	5	

THIN SECTION LABEL ID: **369-U1513D-68R-6-W 46/49-TSB-TS63**

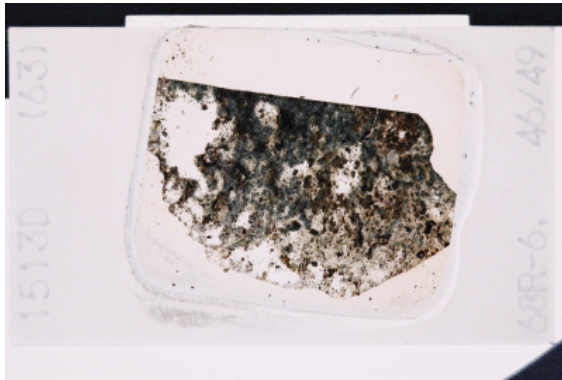
Thin section no.: 63

Observer: CW

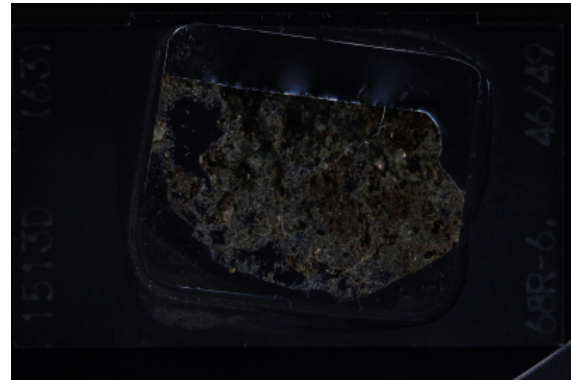
Unit/subunit: Unit 4,
breccia
clast

Thin section summary: This igneous rock is a highly altered basalt clast in the volcanic breccia. The composition is complex consisting predominately secondary minerals including clay (brown to green), haematite, chlorite and possible xenoliths of older basalt. Other minerals present include palagonite, altered clinopyroxene, secondary plagioclase feldspar, magnetite and actinolite. The poor quality of the thin section makes identification of some minerals difficult to deduce.

Plane-polarized: 44583351



Cross-polarized: 44583371



Alteration

Rock name (informal): Highly altered basalt

Total alteration in rock, bulk estimate (%): 90

Recrystallization extent: strong

Alteration intensity: high

Alteration mineral	Percent	Comment
Amphibole - actinolite	1	Isolated needles of actinolite only present in trace amounts.
Chlorite	20	From the alteration of pyroxene.
Clay, brown	30	The poor quality of this thin section makes this nearly impossible to deduce and differentiate from haematite.
Clay, green	10	
Dusty CPX	5	
Oxide, hematite	20	Difficult to differentiate from clay.
Oxide, magnetite	2	
Palagonite	5	
Plagioclase, secondary	2	
Other	10	Xenoliths of older basalts?

THIN SECTION LABEL ID: **369-U1513D-69R-1-W 80/82-TSB-TS65**

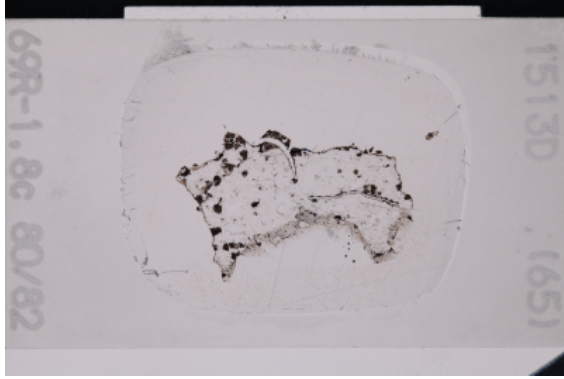
Thin section no.: 65

Observer: CW

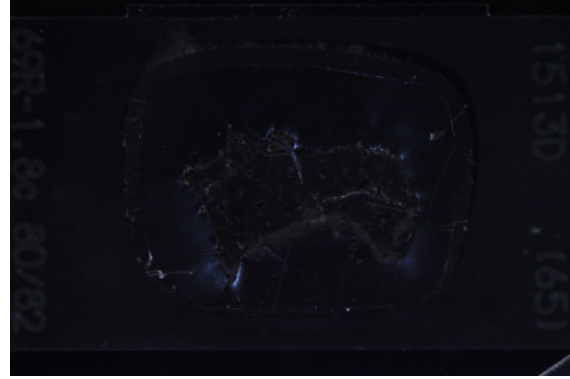
Unit/subunit: Unit 5A

Thin section summary: The thin section could not be described owing to damage during the thin sectioning process.

Plane-polarized: 44455031



Cross-polarized: 44455051



Igneous Petrology

Alteration comment: Thin section could not be described owing to damage during the thin sectioning process.

THIN SECTION LABEL ID: **369-U1513D-69R-2-W 66/68-TSB-TS66**

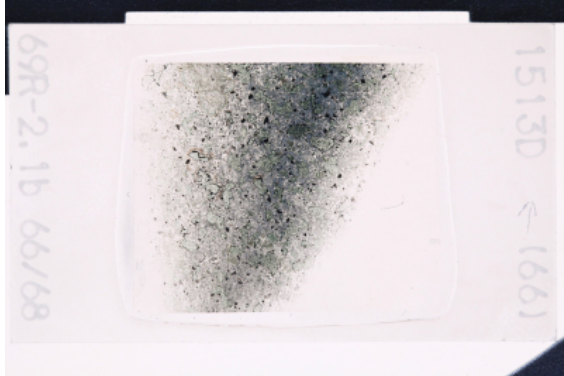
Thin section no.: 66

Observer: CW

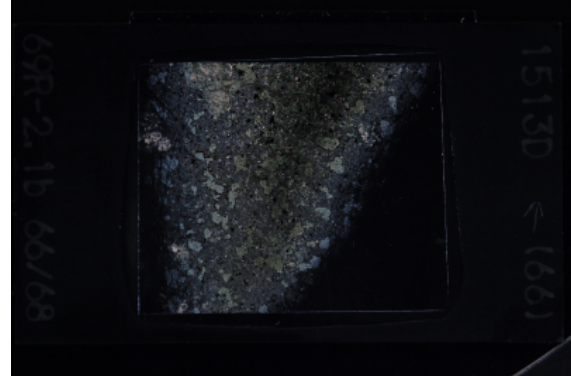
Unit/subunit: Unit 5A

Thin section summary: This igneous rock is a partially altered basalt. The primary texture has been moderately preserved evident with the preservation of plagioclase feldspars (seriate, trachytic). Approximately 50% of the rock comprises secondary minerals including chlorite, altered palagonite, sericite, iron, clay quartz and altered pyroxenes.

Plane-polarized: 44583431



Cross-polarized: 44583451



Alteration

Rock name (informal): Altered basalt

Total alteration in rock, bulk estimate (%): 50

Recrystallization extent: weak

Alteration intensity: moderate

Alteration mineral	Percent	Comment
Chlorite	30	Some in the groundmass, some in palagonites.
Clay, brown	5	
Dusty CPX	3	
Oxide, hematite	10	
Palagonite	20	Mostly altered to chlorite (relict grains).
Plagioclase, secondary	20	
Quartz	2	
Sericite	15	

THIN SECTION LABEL ID: **369-U1513D-69R-4-W 59/61-TSB-TS67**

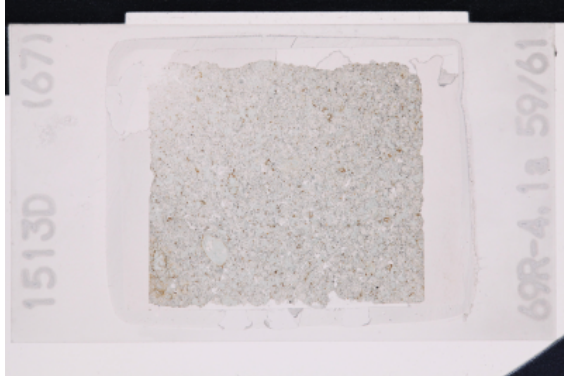
Thin section no.: 67

Observer: CW

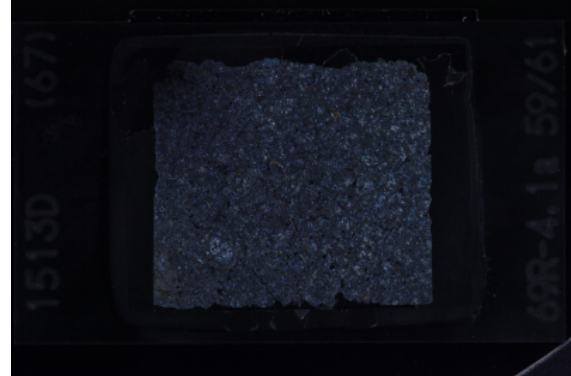
Unit/subunit: Unit 5A

Thin section summary: This igneous rock is classified as a highly altered basalt. The rock is dominated by secondary minerals including chlorite, sericite, serpentine, clay and haematite. Other constituents that are present include pseudomorphs of palagonite that have been replaced by chlorite.

Plane-polarized: 44583491



Cross-polarized: 44583471



Alteration

Rock name (informal): Completely altered basalt

Total alteration in rock, bulk estimate (%): 100

Recrystallization extent: strong

Alteration intensity: complete

Alteration mineral	Percent	Comment
Calcium carbonate	1	
Chlorite	30	
Clay, brown	5	
Oxide, hematite	5	
Palagonite	5	
Sericite	24	Altered plagioclase feldspar.
Serpentine	5	

THIN SECTION LABEL ID: **369-U1513D-70R-1-W 70/72-TSB-TS68**

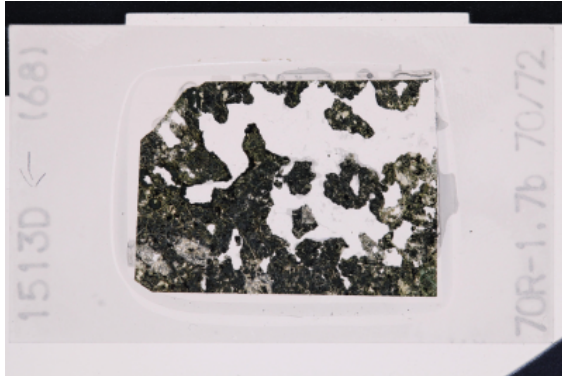
Thin section no.: 68

Observer: CW

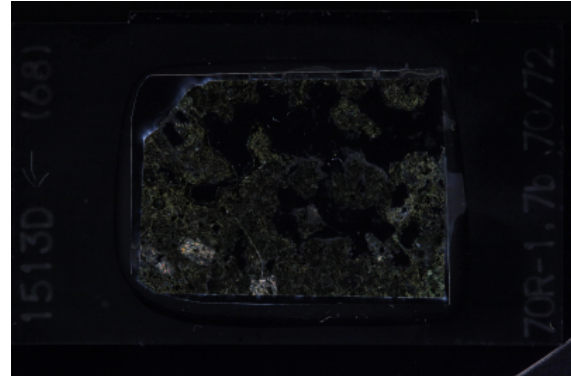
Unit/subunit: Unit 5B

Thin section summary: This section shows a dark-green (chloritized) olivine-phyric basalt. Olivine grains are coarse-grained (up to 5 mm), partially fresh, showing characteristic shape, interference colors, and cracks that are serpentinized. The primary texture has been preserved (e.g. spherulitic), however, all the primary minerals have been replaced owing to hydrothermal activity. The rock comprises predominately of secondary minerals including chlorite, serpentine, partially altered olivine and haematite with trace amounts of quartz. The groundmass is dominated by oxidized (hematized) and chloritized pyroxene and plagioclase (partially replaced by clay) in intergranular texture.

Plane-polarized: 44583511



Cross-polarized: 44583531



Igneous Petrology

Lithology: basalt

Avg. grain size: fine grained

Texture: intergranular

Max grain size: medium grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine	5	5		
Plagioclase			40	0.3
Clinopyroxene			5	0.1
Fe-Ti oxide	N/A	N/A	20	0.1
Altered minerals			30	

Alteration comment: Groundmass mostly altered to chlorites and hematite replacing pyroxenes. Plagioclase feldspars are partially altered to clay and olivine phenocrysts are serpentinized along cracks.

Alteration

Rock name (informal): Partially serpentinised basalt/dolerite

Total alteration in rock, bulk estimate (%): 70

Recrystallization extent: complete

Alteration intensity: complete

Alteration mineral	Percent	Comment
Chlorite	50	
Oxide, hematite	18	
Quartz	2	
Serpentine	30	Some olivines are only partially altered to serpentine.

THIN SECTION LABEL ID: **369-U1513D-70R-3-W 2/5-TSB-TS69**

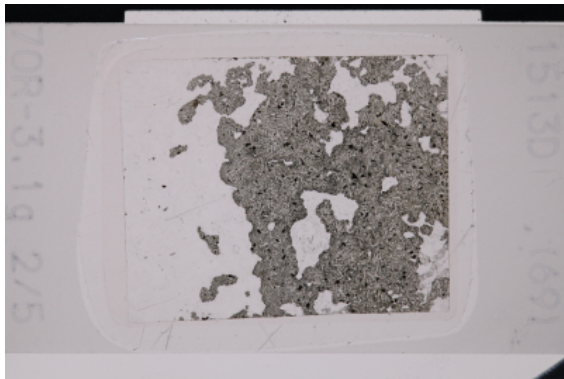
Thin section no.: 69

Observer: CW and MGT

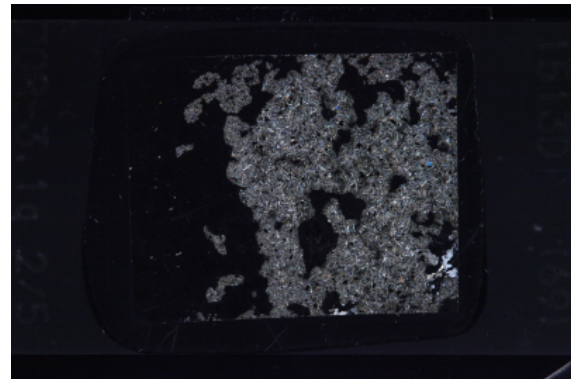
Unit/subunit: Unit 5C,
dike

Thin section summary: This igneous rock is a fine grained aphyric dolerite with traces of large (0.4 mm) olivine and pyroxene (augite) and plagioclase (up to 1 mm long). It is mostly composed of a moderately altered groundmass of plagioclase feldspar and clinopyroxene with glauconite-palagonite-lined interstices and magnetite (some altered to haematite). This rock exhibits both a subophitic texture where pyroxene partially enclose plagioclase feldspars, and in places, a spherulitic texture where aggregates of plagioclase feldspars radiate out from a single nucleus of either olivine or pyroxene. The high birefringence and presence of twinning suggest that the clinopyroxene is augite. Large phenocrysts still largely fresh, like most of groundmass. Glauconite and brown palagonite lining interstitial spaces between plagioclase laths in the groundmass are possibly altered glass.

Plane-polarized: 44455091



Cross-polarized: 44455071



Igneous Petrology

Lithology: dolerite

Avg. grain size: fine grained

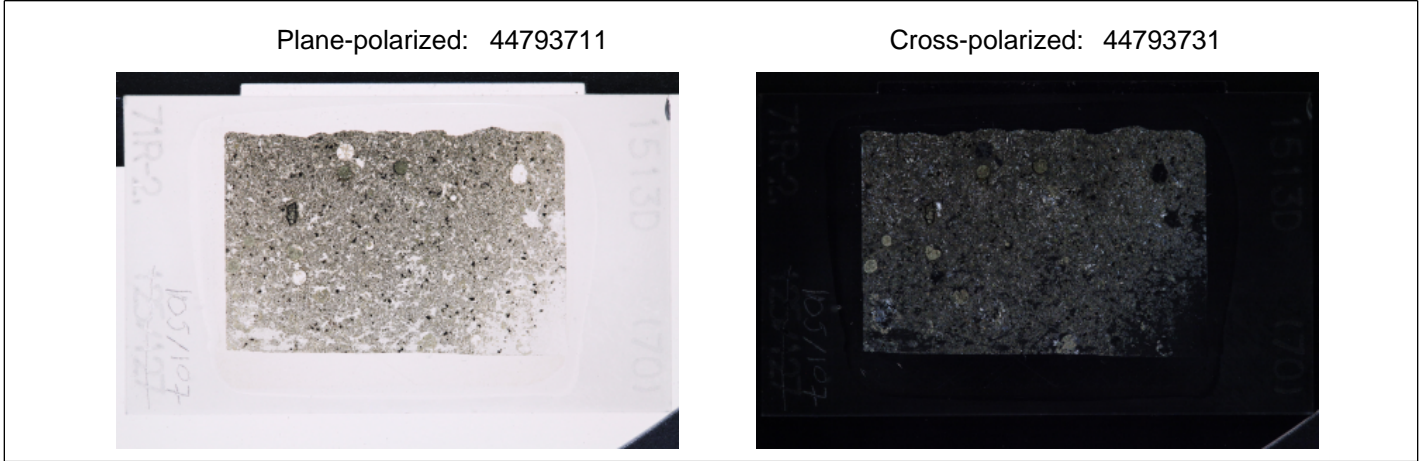
Texture: intergranular

Max grain size: fine grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine			1	0.05
Plagioclase			45	0.3
Clinopyroxene			5	0.05
Fe-Ti oxide	N/A	N/A	19	0.02
Altered minerals			30	

Alteration comment: Interstices in groundmass mostly altered to chlorites and glauconite replacing pyroxenes and glass?. Plagioclase feldspars are partially altered to clay and olivine phenocrysts are poorly preserved and replaced by hematite.

THIN SECTION LABEL ID: **369-U1513D-71R-2-W 105/107-TSB-TS70** Thin section no.: 70
 Observer: CW and MGT Unit/subunit: Unit 5D
 Thin section summary: This igneous rock is a fine grained dolerite that has been partially altered and consists of chlorite, plagioclase feldspar, haematite and pseudomorphs of olivine (and possibly serpentine). This rock exhibits a relic subophitic texture, however, in many places this is not overly apparent.



Igneous Petrology

Lithology: basalt **Avg. grain size:** fine grained

Texture: subophitic **Max grain size:** medium grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine			15	0.3
Plagioclase			30	0.25
Clinopyroxene			10	0.3
Fe-Ti oxide	N/A	N/A	5	0.2
Altered minerals			40	

Alteration comment: Most pyroxenes altered to chlorites; glass? altered to glauconite, olivines are pseudomorphed or completely altered to chlorite and oxide

THIN SECTION LABEL ID: **369-U1513D-71R-3-W 125/127-TSB-TS75**

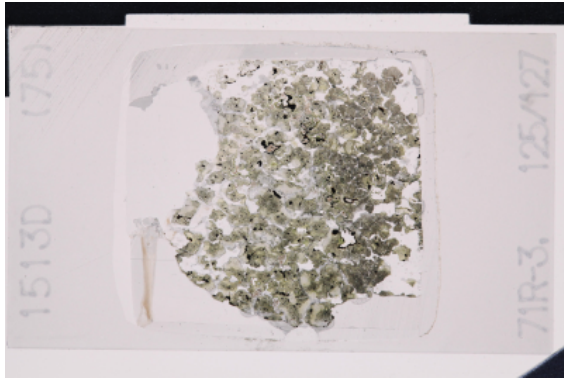
Thin section no.: 75

Observer: CW

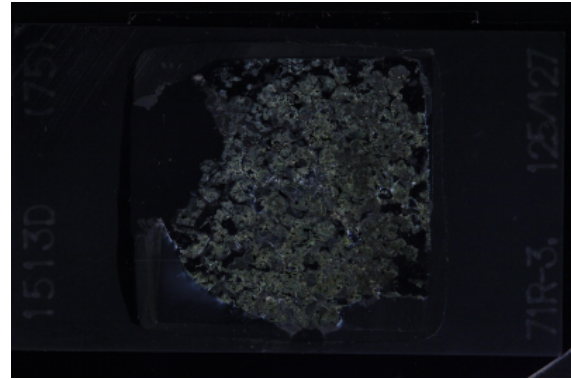
Unit/subunit: Unit 5D

Thin section summary: This igneous rock is classified as a completely altered basalt consisting of secondary minerals that include chlorite, haematite, altered palagonite, sericite and zeolite. From the microcrystalline nature of the groundmass, and the clear green-brown fragments of possibly altered glass, it is likely that this was probably once a glass-rich basalt flow breccia (hyaloclastite).

Plane-polarized: 44584021



Cross-polarized: 44584041



Alteration

Rock name (informal): Completely altered basalt

Total alteration in rock, bulk estimate (%): 100

Recrystallization extent: strong

Alteration intensity: complete

Alteration mineral	Percent	Comment
Chlorite	60	
Clay, brown	5	
Oxide, hematite	10	
Palagonite	10	Mostly altered to chlorite (relict grains).
Sericite	10	
Other	5	

THIN SECTION LABEL ID: **369-U1513D-71R-3-W 126/128-TSB-TS71**

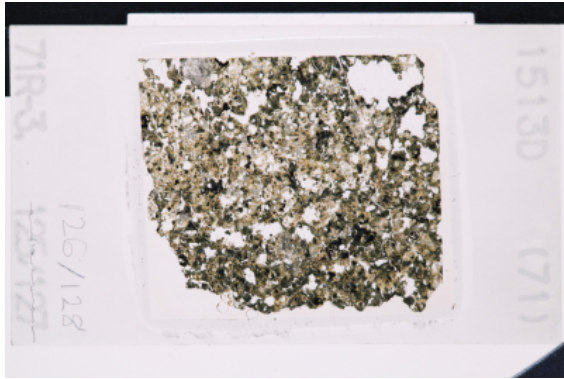
Thin section no.: 71

Observer: CW

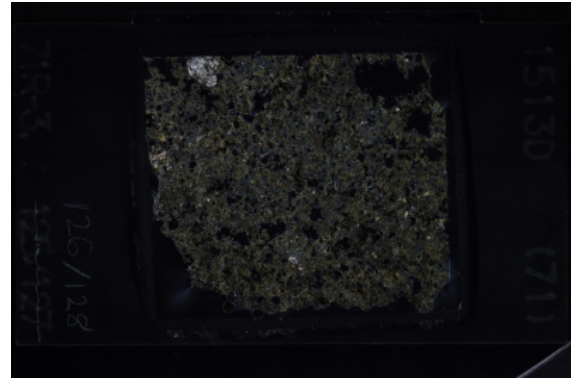
Unit/subunit: Unit 5D

Thin section summary: This igneous rock is a serpentinized basalt/dolerite. The rock comprises entirely of secondary minerals including serpentine, chlorite, haematite, magnetite, sericite and actinolite. In places, a mesh texture is apparent in the serpentine crystals. The poor quality of the thin section makes identification of some minerals and textures difficult to deduce.

Plane-polarized: 44793771



Cross-polarized: 44793751



Alteration

Rock name (informal): Partially serpentinised dolerite

Total alteration in rock, bulk estimate (%): 70

Recrystallization extent: complete

Alteration intensity: complete

Alteration mineral	Percent	Comment
Amphibole - actinolite	1	Isolated needles of actinolite only present in trace amounts.
Chlorite	25	Mostly present in the groundmass.
Oxide, hematite	10	
Oxide, magnetite	8	
Sericite	5	
Serpentine	50	Olivines and pyroxenes completely replaced.

THIN SECTION LABEL ID: **369-U1513D-72R-1-W 10/12-TSB-TS64**

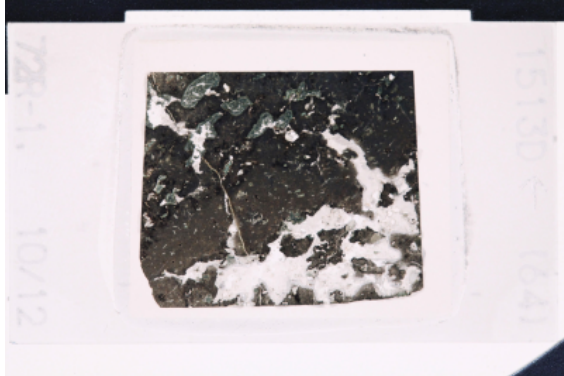
Thin section no.: 64

Observer: CW

Unit/subunit: Unit 5F

Thin section summary: This igneous rock is a highly altered basalt. The rock is dominated by secondary minerals including chlorite, clay and haematite. Other constituents that are present (also secondary minerals) include palagonite with the outer edges altered to chlorite, sericite, altered pyroxene and calcite.

Plane-polarized: 44583411



Cross-polarized: 44583391



Alteration

Rock name (informal): Highly altered basalt

Total alteration in rock, bulk estimate (%): 90

Recrystallization extent: complete

Alteration intensity: high

Alteration mineral	Percent	Comment
Calcium carbonate	2	Mostly hosted in veins.
Chlorite	40	Mostly microcrystalline.
Clay, brown	20	
Dusty CPX	2	
Oxide, hematite	20	Difficult to differentiate from clay.
Palagonite	16	Outer edges altered to chlorite.
Sericite	10	Altered plagioclase feldspar.

THIN SECTION LABEL ID: **369-U1513D-72R-3-W 107/110-TSB-TS52**

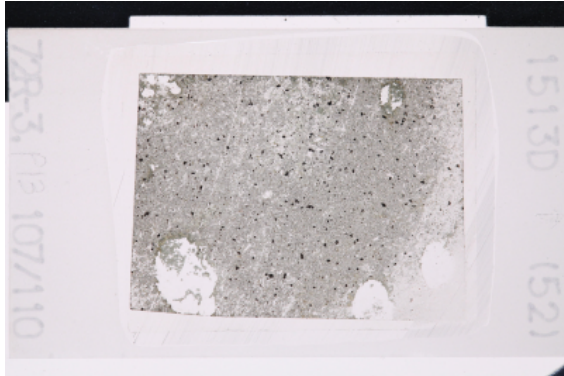
Thin section no.: 52

Observer: CW and MGT

Unit/subunit: Unit 5F

Thin section summary: This igneous rock is an olivine-pyroxene-plagioclase-phyric basalt with a microcrystalline groundmass that has been partially altered and consists of plagioclase feldspar, chlorite, clinopyroxene and haematite. It has a dominant intergranular texture with sparse vugs filled with chlorite due to alteration. Few larger sized phenocrysts of plagioclase (laths up to 1 mm in length), pyroxene (0.3 mm mode, largely replaced by chlorite), olivine (0.3 mm, completely replaced by hematite) and ilmenite (0.2 mm; partially oxidized to hematite) are present. A seriate texture is also apparent with minerals of different sizes visible across the slide.

Plane-polarized: 44442231



Cross-polarized: 44442251



Igneous Petrology

Lithology: basalt

Avg. grain size: microcrystalline

Texture: intergranular

Max grain size: fine grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine	1	0.3	0	
Plagioclase	5	1	45	0.06
Clinopyroxene	2	0.3	8	0.3
Opaques	2	0.2	N/A	N/A
Fe-Ti oxide	N/A	N/A	5	0.06
Altered minerals			32	

Alteration comment: Pyroxenes altered to chlorite.

THIN SECTION LABEL ID: **369-U1513D-73R-1-W 76/79-TSB-TS57**

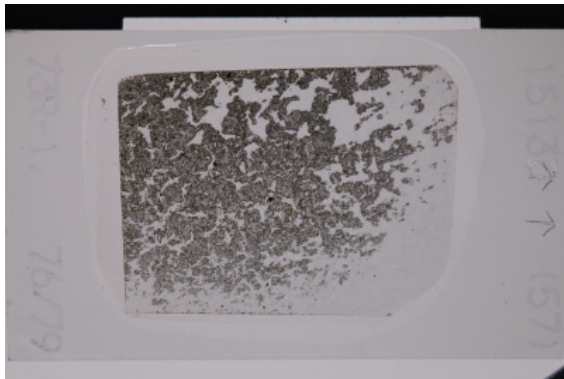
Thin section no.: 57

Observer: CW and MGT

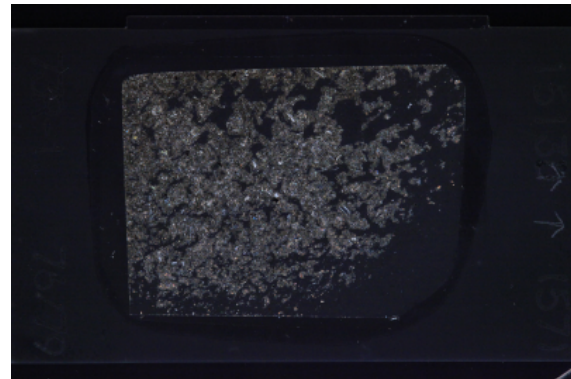
Unit/subunit: Unit 5G,
dike

Thin section summary: This igneous rock is a fine grained aphyric dolerite with traces of large (0.4 mm) olivine and pyroxene (augite) and plagioclase (up to 1 mm long). It is mostly composed of a moderately altered groundmass of plagioclase feldspar and clinopyroxene with glauconite-palagonite-lined interstices and magnetite (some altered to haematite). This rock exhibits both a subophitic texture where pyroxene partially enclose plagioclase feldspars, and in places, a spherulitic texture where aggregates of plagioclase feldspars radiate out from a single nucleus of either olivine or pyroxene. The high birefringence and presence of twinning suggest that the clinopyroxene is augite. Large phenocrysts still largely fresh, like most of groundmass. Glauconite and brown palagonite lining interstitial spaces between plagioclase laths in the groundmass are possibly altered glass.

Plane-polarized: 44437721



Cross-polarized: 44437741



Igneous Petrology

Lithology: dolerite

Avg. grain size: fine grained

Texture: subophitic

Max grain size: medium grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine	1	0.4	0	
Plagioclase	3	1	45	0.25
Clinopyroxene	1	0.4	30	0.2
Fe-Ti oxide	N/A	N/A	10	0.15
Altered minerals			10	

Alteration comment: Large phenocrysts still largely fresh, like most of groundmass; glauconite-palagonite lining interstitial spaces between plagioclase laths in the groundmass possibly altered glass

THIN SECTION LABEL ID: **369-U1513D-73R-4-W 24/27-TSB-TS58**

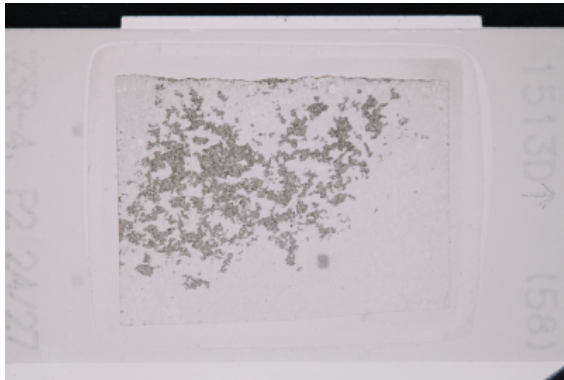
Thin section no.: 58

Observer: CW and MGT

Unit/subunit: Unit 5G,
dike

Thin section summary: This igneous rock is a fine grained aphyric dolerite that has been partially altered and consists mostly of plagioclase feldspar and clinopyroxene with magnetite and some haematite. This rock has a dominant intergranular texture with roughly equant crystals of pyroxenes in the spaces between the plagioclase feldspar crystals. A trachytic texture is apparent in some areas of the slide from the alignment of plagioclase feldspars. Some interstices between plagioclase laths are filled with glauconite.

Plane-polarized: 44437781



Cross-polarized: 44437761



Igneous Petrology

Lithology: dolerite

Avg. grain size: fine grained

Texture: trachytic

Max grain size: medium grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine			0	
Plagioclase			50	0.25
Clinopyroxene			30	0.16
Fe-Ti oxide	N/A	N/A	10	0.05
Altered minerals			10	

Alteration comment: Large phenocrysts still largely fresh, like most of groundmass; glauconite-palagonite lining interstitial spaces between plagioclase laths in the groundmass possibly altered glass

THIN SECTION LABEL ID: **369-U1513D-73R-5-W 141/145-TSB-TS53**

Thin section no.: 53

Observer: CW and MGT

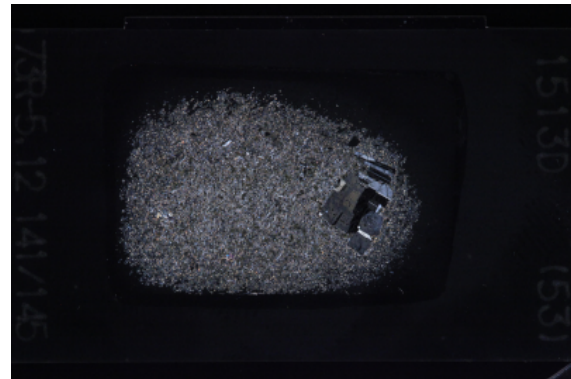
Unit/subunit: Unit 5G,
dike

Thin section summary: This igneous rock is a medium grained dolerite with large phenocrysts of plagioclase and groundmass that is partially altered and consists of plagioclase feldspar, clinopyroxene and ilmenite. This rock has a dominant intergranular texture with roughly equant crystals of pyroxenes in the spaces between the plagioclase feldspar crystals. The sample also hosts a single phenocryst of plagioclase feldspar that is 8 mm in size.

Plane-polarized: 44442311



Cross-polarized: 44442291



Igneous Petrology

Lithology: dolerite

Avg. grain size: fine grained

Texture: intergranular

Max grain size: Coarse grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine			0	
Plagioclase	15	8	41	0.3
Clinopyroxene			7	0.4
Fe-Ti oxide	N/A	N/A	5	0.2
Altered minerals			30	

Alteration comment: Most pyroxenes altered to chlorites and interstices lined with glauconite (?) or montmorillonite

THIN SECTION LABEL ID: **369-U1513D-74R-1-W 53/55-TSB-TS59**

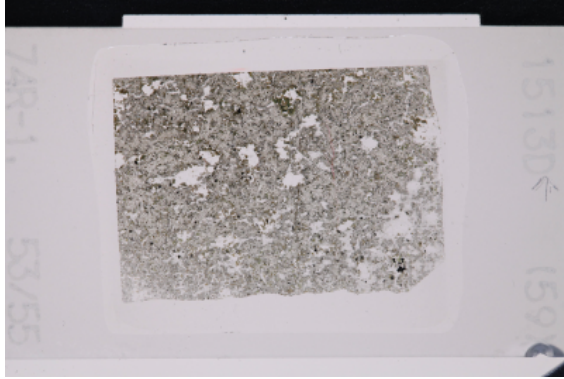
Thin section no.: 59

Observer: CW and MGT

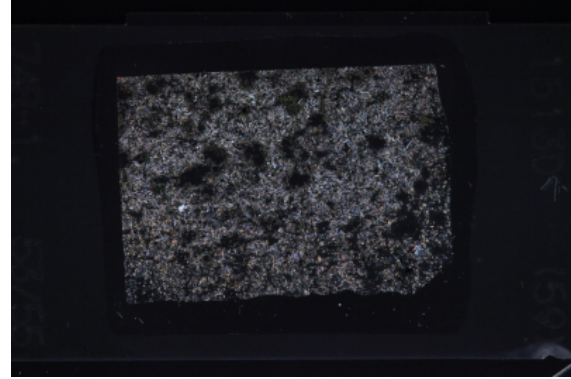
Unit/subunit: Unit 5G,
dike

Thin section summary: This igneous rock is a fine grained dolerite that has been partially altered and consists of plagioclase feldspar, chlorite, clinopyroxene, olivine (likely pseudomorphs) and haematite. This rock exhibits an intergranular texture with roughly equant crystals of pyroxenes in the spaces between the plagioclase feldspar crystals. In places, the rock exhibits a spherulitic texture where aggregates of plagioclase feldspars radiate out from a single nucleus. Larger crystals of plagioclase (up to 1.5 mm) and twinned augite (0.5 mm) are common.

Plane-polarized: 44437801



Cross-polarized: 44437821



Igneous Petrology

Lithology: dolerite

Avg. grain size: fine grained

Texture: intergranular

Max grain size: Coarse grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine			5	0.15
Plagioclase	3	1.5	45	1.2
Clinopyroxene	2	0.5	30	0.2
Fe-Ti oxide	N/A	N/A	10	0.15
Altered minerals			10	

Alteration comment: Some pyroxenes altered to chlorites but most are relatively fresh. Larger crystals appear phenocrystic

THIN SECTION LABEL ID: **369-U1513D-74R-2-W 20/22-TSB-TS60**

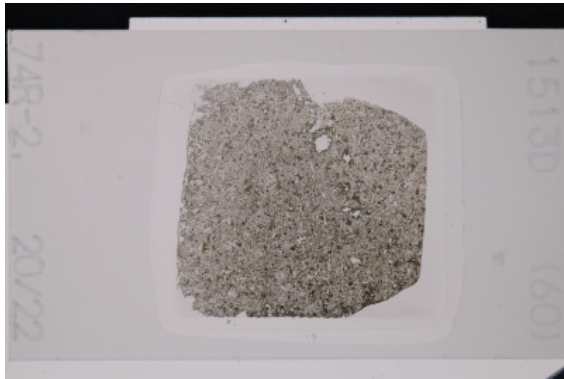
Thin section no.: 60

Observer: CW and MGT

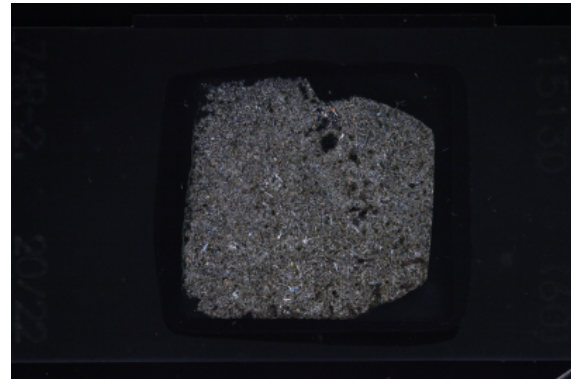
Unit/subunit: Unit 5G,
dike

Thin section summary: This igneous rock is a fine grained dolerite that has been partially altered and consists of plagioclase feldspar, chlorite, clinopyroxene and haematite. In places, the rock exhibits a spherulitic texture where aggregates of plagioclase feldspars radiate out from a single nucleus. This igneous rock is a fine grained aphyric dolerite with traces of large (0.4 mm) olivine and pyroxene (augite) and plagioclase (up to 1 mm long). It is mostly composed of a moderately altered groundmass of plagioclase feldspar and clinopyroxene (some altered to chlorite) and magnetite (some altered to haematite). This rock also exhibits an intergranular texture with roughly equant crystals of pyroxenes in the spaces between the plagioclase feldspar crystals. A subophitic texture where pyroxene partially enclose plagioclase feldspars, and in places, a spherulitic texture where aggregates of plagioclase feldspars radiate out from clustered grains of either olivine or pyroxene are observed. The high birefringence and presence of twinning suggest that the clinopyroxene is augite. Large phenocrysts still largely fresh, like most of groundmass.

Plane-polarized: 44437861



Cross-polarized: 44437841



Igneous Petrology

Lithology: dolerite

Avg. grain size: fine grained

Texture: intergranular

Max grain size: Coarse grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine	1	0.3	0	
Plagioclase	3	1.5	45	0.3
Clinopyroxene	1	0.4	30	0.15
Fe-Ti oxide	N/A	N/A	10	0.06
Altered minerals			10	

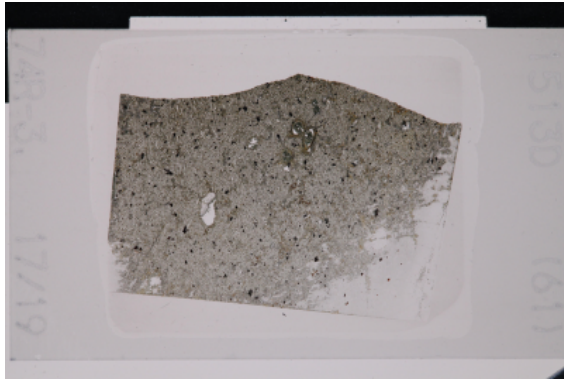
Alteration comment: Most pyroxenes altered to chlorites.

THIN SECTION LABEL ID: **369-U1513D-74R-3-W 17/19-TSB-TS61** Thin section no.: 61

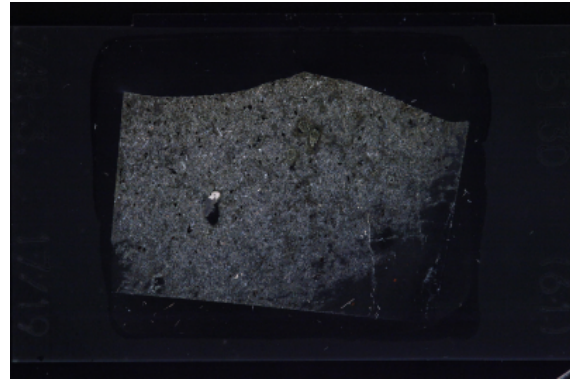
Observer: CW and MGT Unit/subunit: Unit 5G, dike

Thin section summary: This igneous rock is a more altered variety of the fine grained dolerite, with groundmass pyroxene partially replaced with chlorite and clay and plagioclases partially replaced with clay. Some large crystals of pyroxene (up to 0.5 mm, mostly replaced by brown oxide) and long laths of plagioclases (up to 1.5 mm) are observed. Traces of olivine intergrown with large plagioclase laths and oxidized pseudomorphs are also present. Most oxides are interstitial black, anhedral, possibly ilmenite but larger ones are anhedral to euhedral pseudomorphs of pyroxene or olivine and are largely hematite.

Plane-polarized: 44437881



Cross-polarized: 44437901



Igneous Petrology

Lithology: basalt Avg. grain size: fine grained
 Texture: trachytic Max grain size: coarse grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine			3	0.4
Plagioclase			50	0.1
Clinopyroxene			30	0.02
Fe-Ti oxide	N/A	N/A	5	0.06
Altered minerals			12	

Alteration comment: Most pyroxenes altered to chlorites and feldspars have alteration pits and centers. Some vugs and interstices between laths of plagioclases are filled with chlorite and green clay.

THIN SECTION LABEL ID	369-U1513D-75R-3-W 52/54-TSB-TS72	Thin section no.:	72
Observer:	CW	Unit/subunit:	Unit 6, breccia
Thin section summary:	This volcanoclastic rock is classified as an altered volcanic breccia (hydroclastite?) consisting of subrounded clasts of altered basalt, glass, haematite, clay minerals, chlorite and pseudomorphs of mafic minerals (plagioclase feldspar and pyroxene). The matrix consists of clay minerals and haematite. Components are clast supported.		



Sediments and Sedimentary Rock

Complete Lithology Name: volcanoclastic breccia

Remarks:

GRAIN SIZE	Gravel	Sand	Silt	Clay
Percent	1	55	20	24

COMPOSITION	Siliciclastic	Calcareous	Biosiliceous
Mineral grains (%)	0	0	0
Cement (%)	0	0	0

MINERAL GRAIN ROUNDNESS	MINERAL GRAIN SORTING
sub-rounded	poor

Mineral grain	Abundance
Chlorite	C
Clay	C
Glass	C
Hematite	A
Lithic fragments	A
Other mineral grains	A

D=dominant, A=abundant, C=common, R=rare, T=trace

THIN SECTION LABEL ID: **369-U1513D-75R-4-W 98/100-TSB-TS73**

Thin section no.: 73

Observer: CW and MGT

Unit/subunit: Unit 7A

Thin section summary: This igneous rock is a moderately altered olivine-phyric basalt (or a hydroclastite?) consisting of pseudomorphed olivine in an originally glassy groundmass with trachytic plagioclase microlites. It is moderately vesicular, with vesicles filled with palagonite and serpentinite, sometimes with hematite, that are highly irregular in shape. Microlites and palagonitized glass fragments with irregular shape that appear to be connected to one another form eutaxitic texture and flow banding together with some patches of stretched basalt with diffuse quenched margins. Groundmass is largely replaced by brown oxide, clay minerals, palagonite, pseudomorphs of plagioclase feldspar and zeolite. Traces of the basalt fragments have remnant primary textures (trachytic).

Plane-polarized: 44583591



Cross-polarized: 44583611



Igneous Petrology

Lithology: basalt

Avg. grain size: cryptocrystalline

Texture: aphanoporphyritic

Max grain size: cryptocrystalline

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine	4	0.2		
Plagioclase	1	0.5	5	0.05
Altered minerals			70	

Alteration comment: Original glassy groundmass completely altered to oxide; olivine are partially replaced with some remnant birefringence or totally replaced by oxide forming pseudomorphs. Plagioclase microlites still look fresh. Vesicles are filled with palagonite, serpentinite, or zeolite.

THIN SECTION LABEL ID: **369-U1513D-75R-7-W 65/67-TSB-TS74**

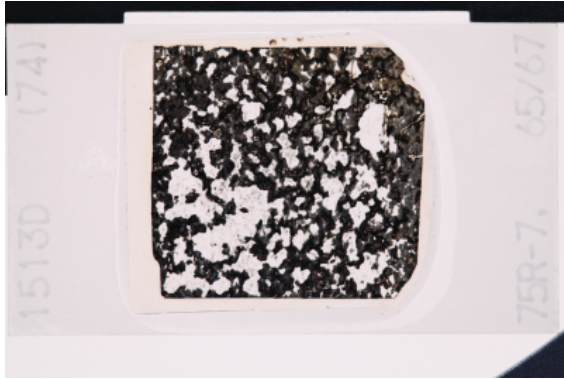
Thin section no.: 74

Observer: CW and MGT

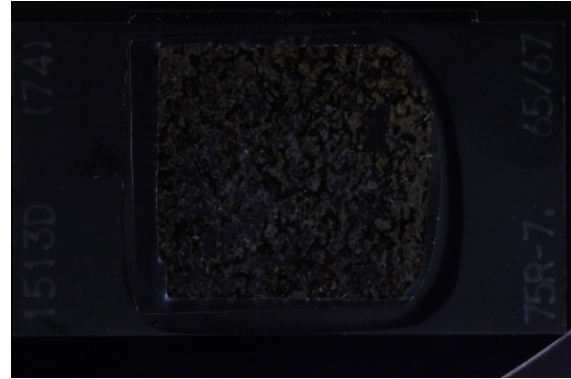
Unit/subunit: Unit 7D

Thin section summary: This igneous rock is classified as a highly altered basalt. The rock is dominated by secondary minerals including haematite, sericite and chlorite. In some places, relict primary textures are preserved (intersertal and spherulitic).

Plane-polarized: 44584001



Cross-polarized: 44583961



Alteration

Rock name (informal): Highly altered basalt

Total alteration in rock, bulk estimate (%): 100

Recrystallization extent: weak

Alteration intensity: complete

Alteration mineral	Percent	Comment
Clay, brown	20	
Oxide, hematite	20	
Palagonite	10	Mostly pseudomorphs.
Plagioclase, secondary	5	Mostly pseudomorphs
Other	40	Xenoliths of older basalts

THIN SECTION LABEL ID: **369-U1513D-75R-7-W 126/128-TSB-TS76**

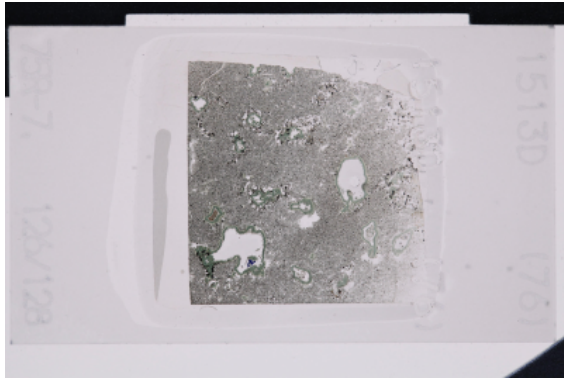
Thin section no.: 76

Observer: CW and MGT

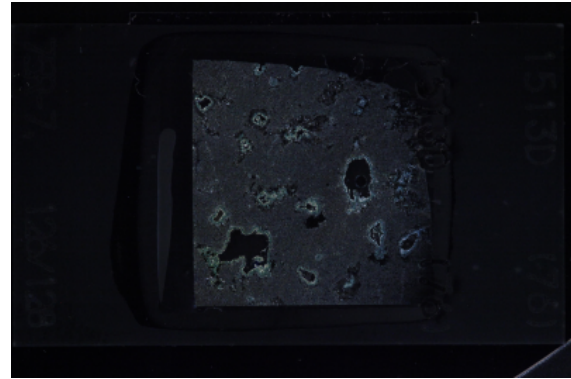
Unit/subunit: Unit 7D

Thin section summary: This igneous rock is classified as a highly altered basalt consisting of secondary minerals including chlorite, sericite, haematite, plagioclase feldspar (pseudomorphs and secondary?) and clay minerals. A relict intersertal texture is still visible in the groundmass. Irregular to elongate vesicles up to 9 mm are common and are lined with chlorite and glauconite. Oxides (magnetite?) are partially replaced by hematite.

Plane-polarized: 44585541



Cross-polarized: 44585561



Igneous Petrology

Lithology: basalt

Avg. grain size: microcrystalline

Texture: vesicular

Max grain size: fine grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Plagioclase			40	0.1
Fe-Ti oxide	N/A	N/A	10	0.1
Altered minerals			50	

Alteration comment: mafic minerals, or glass between feldspar grains are completely replaced by chlorite

Alteration

Rock name (informal): Highly altered basalt

Total alteration in rock, bulk estimate (%): 80

Recrystallization extent: weak

Alteration intensity: high

Alteration mineral	Percent	Comment
Chlorite	50	In groundmass and lining the vesicles.
Clay, brown	5	
Oxide, hematite	10	
Plagioclase, secondary	10	Possible secondary plagioclase feldspar.
Sericite	25	Altered plagioclase feldspar.

THIN SECTION LABEL ID: **369-U1513E-2R-4-W 0/2-TSB-TS87**

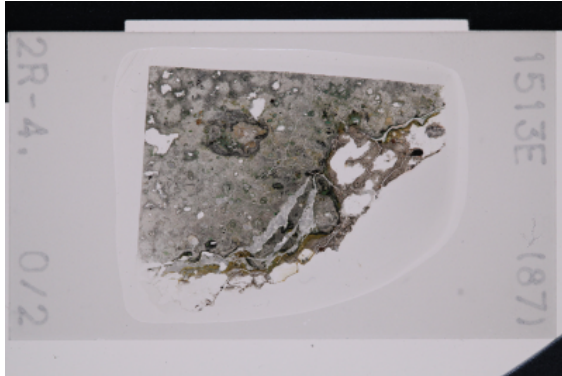
Thin section no.: 87

Observer: MGT

Unit/subunit: 1A

Thin section summary: This thin section shows a plagioclase-olivine-phyric basalt with a microcrystalline groundmass consisting of spherulitic plagioclases and pyroxene. Pyroxene forms overgrowth on olivine phenocrysts and plagioclases are mostly replaced by sparry calcite. Thin long laths of plagioclases in spherulitic and radiated arrangement comprise the groundmass with lots of interstitial anhedral to equant opaque minerals (magnetite). Pyroxene is closely intergrown with plagioclase laths. Palagonite and glauconite alteration minerals form replacement bands outlining the grains of olivine and chlorite partially replace pyroxenes in the groundmass.

Plane-polarized: 45045331



Cross-polarized: 45045351



Igneous Petrology

Lithology: basalt

Avg. grain size: fine grained

Texture: skeletal or dendritic

Max grain size: medium grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Olivine	7	0.5	0	
Plagioclase	1	15	45	0.3
Clinopyroxene	2	0.3	22	0.2
Orthopyroxene	2		N/A	N/A
Fe-Ti oxide	N/A	N/A	14	0.05
Altered minerals			9	

Alteration comment: phenocrysts are mostly pseudomorphed

THIN SECTION LABEL ID: **369-U1513E-8R-4-W 86/90-TSB-TS88**

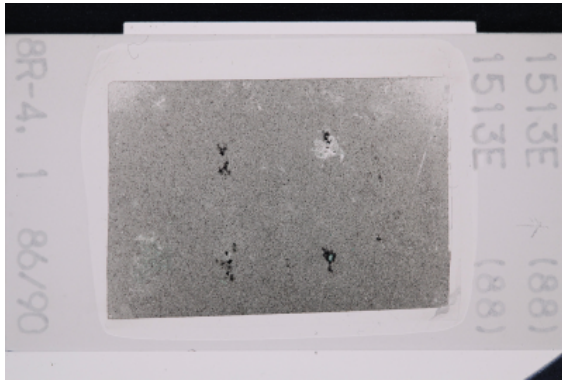
Thin section no.: 88

Observer: CW

Unit/subunit: 7F

Thin section summary: This igneous rock is a partially altered basalt comprising dominant plagioclase feldspar, common chlorite and rare hematite. Many of the the plagioclase crystals are partially altered. This basalt is equigranular and exhibits both a trachytic texture (evident from the preferential alignment of plagioclase feldspars in the slide) and a spherulitic texture (plagioclase crystals radiating out from a central point). Oxide grains form subparallel alignment.

Plane-polarized: 45067211



Cross-polarized: 45067231



Igneous Petrology

Lithology: basalt

Avg. grain size: microcrystalline

Texture: trachytic

Max grain size: fine grained

Mineral	Phenocrysts [%]	Phenocryst size [mm]	Groundmass [%]	Groundmass size [mm]
Plagioclase			50	60
Fe-Ti oxide	N/A	N/A	10	
Altered minerals			40	

Alteration comment: Pyroxene altered to chlorite