

Mineral Resources Tasmania

Mineralogy/Petrology Report

LJN2017-118,

LJN2017-129

LJN2018-004

**PETROPHYSICAL AND
MINERALOGICAL TESTS
HUSKISSON (TRIBUTARY CK)
DDH TCG-A01**

**An unpublished Mineral Resources Tasmania report for
M Duffett & D Bombardieri, MRT**

by R S Bottrill, R Woolley & R King

6 November 2023

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ABSTRACT

Fifteen rock samples were collected from TCGA01 drillhole near Tributary Ck in the Huskisson River area, for physical property measurements, mineralogy and petrology; with details listed in Table 1 below. The samples are all serpentinised ultramafics, with locally anomalous hydrothermal carbonates and magnetite, but with no base metal mineralisation or definitive links to granites.

INTRODUCTION

Fifteen rock samples were collected from the TCGA01 drillhole near Tributary Ck in the Huskisson River area, by M Duffett and Daniel Bombardieri, for physical property measurements, mineralogy, petrography and ore petrology; with details listed in Table 1 below.

Table 1: Sample Details

Registration Number	Drillhole, depth	Sample Description
G407508	68438 TCGA01/581.5	Serpentinite
G407509	68438 TCGA01/580.1	Serpentinite
G407510	68438 TCGA01/574.6	Serpentinite
G407511	68438 TCGA01/567.8	Serpentinite
G407512	68438 TCGA01/558.05	Serpentinite
G407513	68438 TCGA01/548	Serpentinite
G407514	68438 TCGA01/535.65	Serpentinite
G407515	68438 TCGA01/530.2	Serpentinite
G407516	68438 TCGA01/518.8	Serpentinite
G407517	68438 TCGA01/510.8	Serpentinite
G407518	68438 TCGA01/507	Serpentinite
G407519	68438 TCGA01/492.2	Serpentinite
G407520	68438 TCGA01/487.2	Serpentinite
G407521	68438 TCGA01/476.2	Serpentinite
G407522	68438 TCGA01/473	Serpentinite
G407523	68438 TCGA01/470.8	Serpentinite
G407524	68438 TCGA01/465.4	Serpentinite
G407525	68438 TCGA01/462.5	Serpentinite
G407526	68438 TCGA01/460.2	Serpentinite
G407527	68438 TCGA01/457.9	Serpentinite
G407528	68438 TCGA01/565.4	Serpentinite
G407529	68438 TCGA01/571.7	Serpentinite

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LABORATORY TESTS

The samples were weighed dry, wet and in water, and density (specific gravity) was determined by standard gravimetric methods in the MRT core store, with an electronic balance accurate to 0.1g. Porosity was determined by soaking for 24 hrs. The accuracy of the results is probably ~1%. The results are shown in Appendix 1.

Representative samples of the core were analysed by X-ray Diffraction (XRD) in the Mineral Resources Tasmania (MRT) laboratories, Rosny Park.

Some samples were also prepared as polished thin sections and analysed by SEM in the CSL, University of Tasmania.

DESCRIPTION

G407508 68438 TCGA01/581.5

This sample is a massive, crudely banded light to dark green serpentinite with white carbonate veins to a few mm thick and a few small magnetite spots (Fig 1). There is no indication of any sulphides.



Fig. 1. G407508. Green to black banded serpentinite with white (carbonate?) veins. FOV 150mm.

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G407509 68438 TCGA01/580.1

This sample is a massive, mottled green serpentinite with large black crystals of magnetite (<6mm) and spotty white (carbonate?) alteration (Fig 2). There is no indication of any sulphides.



Fig. 2. G407509. Mottled green serpentinite with black crystals of magnetite and white (carbonate?) alteration. FOV 80mm.

G407510 68438 TCGA01/574.6

This sample is a massive, mottled green serpentinite with black veins (magnetite rich?) (<3mm) and spotty white (carbonate?) alteration (Fig 3). There is no indication of any sulphides.



Fig. 3. G407510. Mottled green serpentinite with black veins (magnetite rich?) and white (carbonate?) alteration. The white stripe is glue. FOV 120mm.

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G407511 68438 TCGA01/567.8

This sample is a massive, mottled green-black serpentinite with black spotting (magnetite rich?) (<1mm) and no veining (Fig 4). There is no indication of any sulphides.



Fig. 4. G407511. Mottled green-black serpentinite with black magnetite spotting. FOV 120mm.

G407512 68438 TCGA01/558.05

This sample is a massive, mottled green-black serpentinite with black crystals of magnetite (<2mm) and a breccia vein of white (carbonate) (Fig 5). There is no indication of any sulphides.

In thin section the matrix appears to be serpentinised peridotite with skeletal chromites, about 0.2-1mm, some with red translucency, but mostly opaque (Fig. 6). The original grainsize was similar to the chromites. There are fine grained carbonate-magnetite veins to a few mm thick (Fig. 7). Under reflected light the chromites show magnetite veining (Fig. 8) and some magnetite overgrows chromite and is disseminated in the matrix, as fine grained, skeletal aggregates (Fig. 9).



Fig. 5. G407512. Mottled green-black serpentinite with a white carbonate vein. FOV 150mm.

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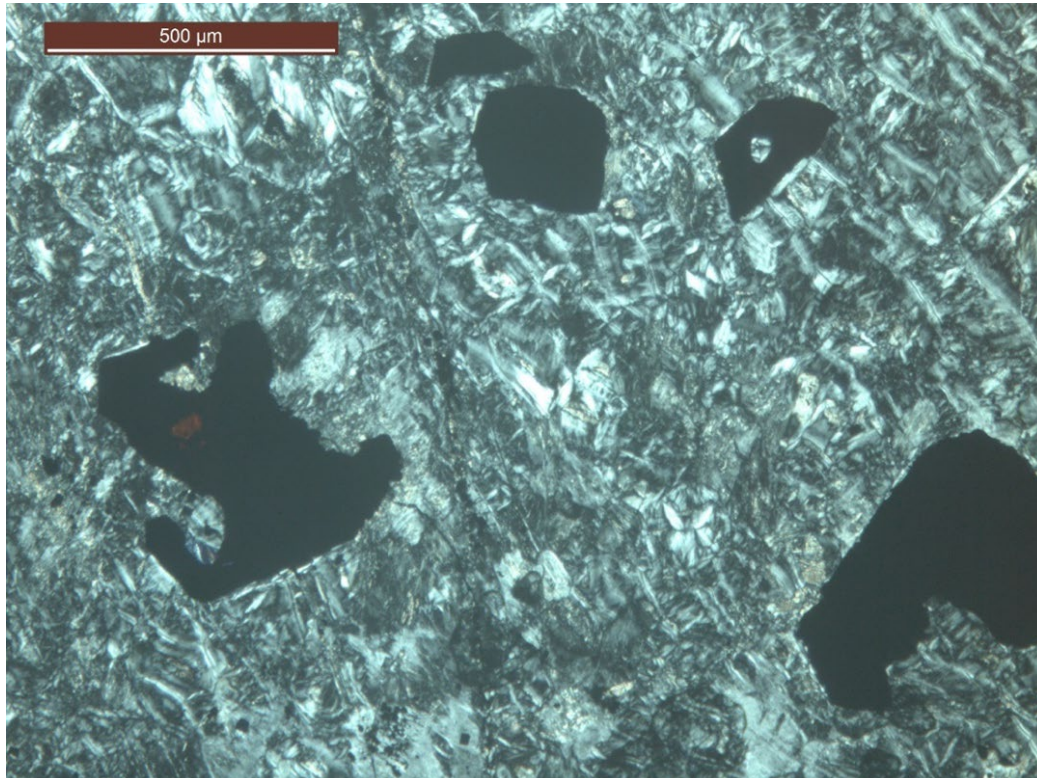


Fig. 6. G407512. Skeletal chromite (black) in serpentinite (serpentine-brucite) groundmass (grey-white). Cross-polarised transmitted light.

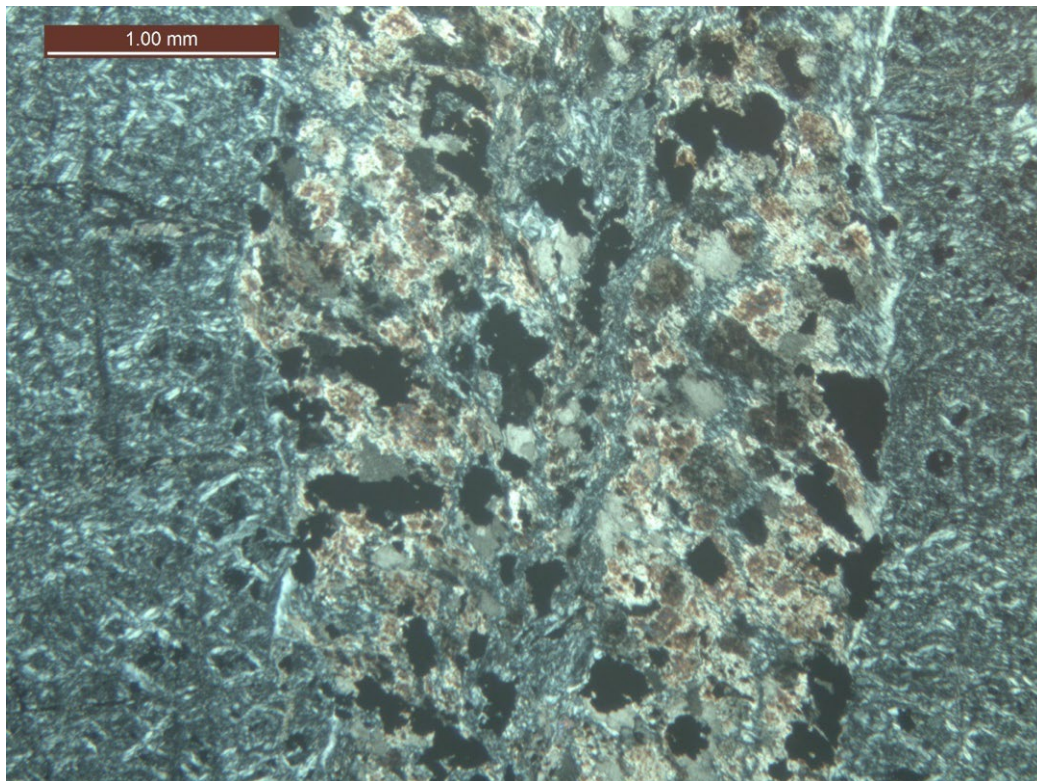


Fig. 7. G407512. Magnetite (black) in carbonate (brown-white) vein in serpentinite (grey white) matrix. Cross-polarised transmitted light.

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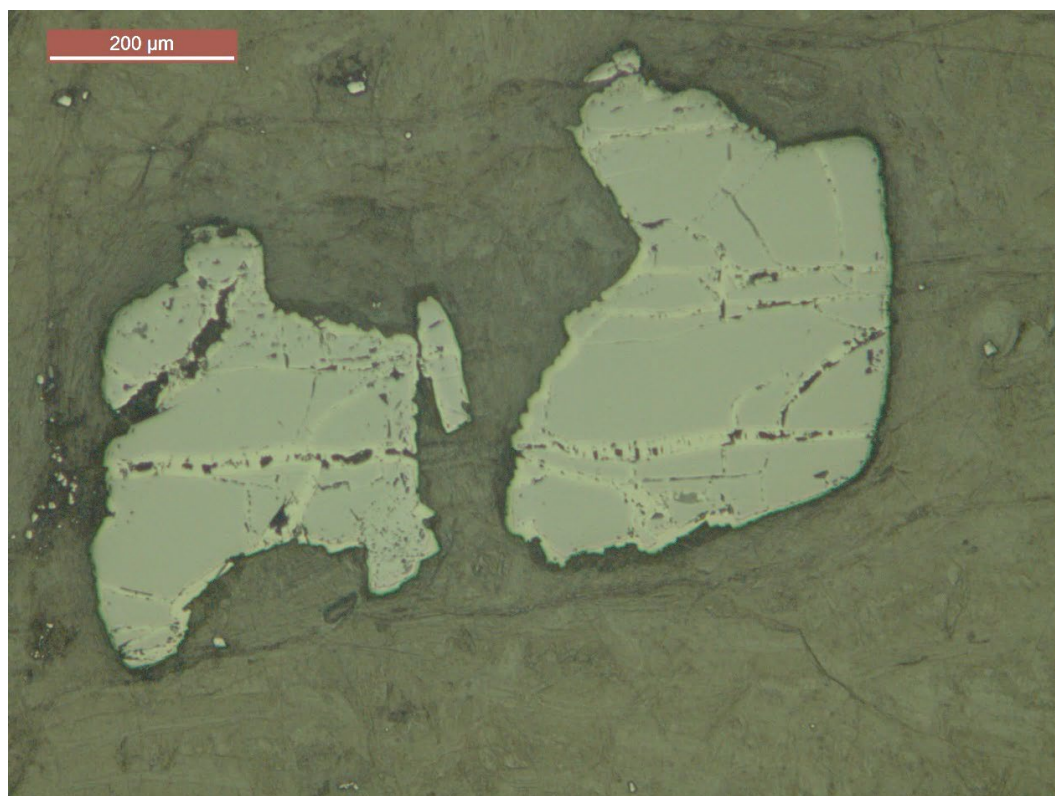


Fig. 8. G407512. Magnetite (very light grey) veins in brecciated chromite (medium grey) in serpentinite (dark grey). Plain-polarised reflected light.

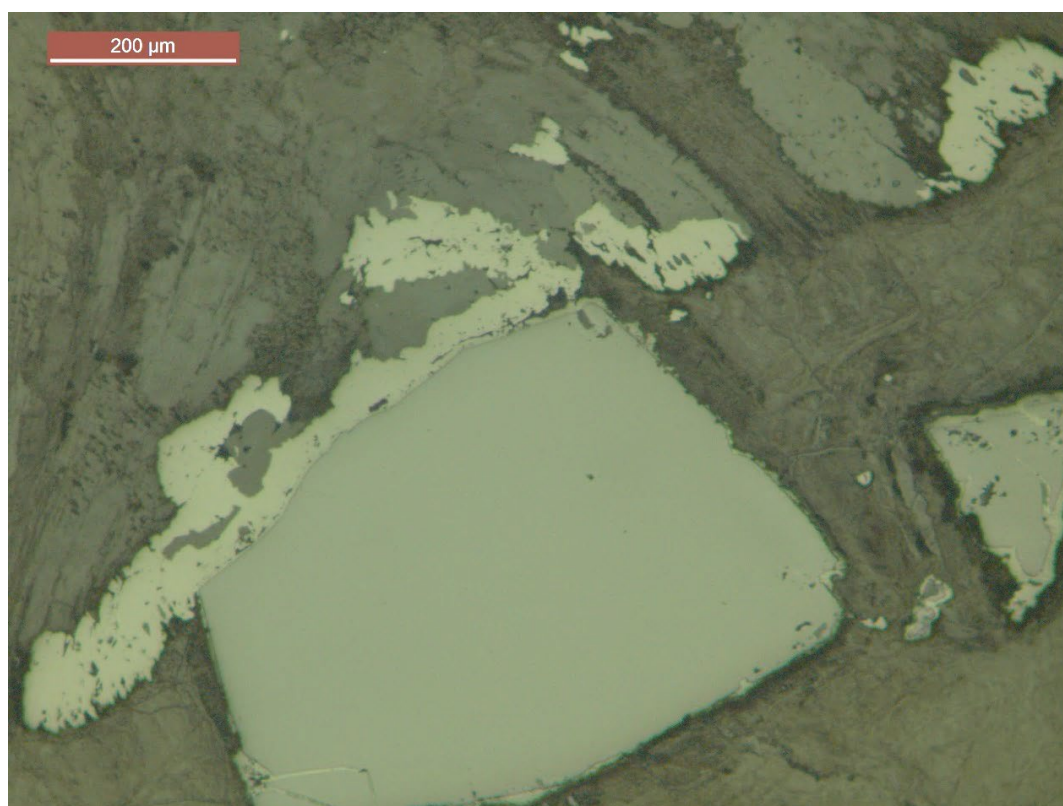


Fig. 9. G407512. Magnetite (very light grey) as fine grained to skeletal aggregates replacing chromite (medium grey) in serpentine and carbonate matrix (dark grey). Plain-polarised reflected light

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G407513 68438 TCGA01/548

This sample is a massive, mottled green-black serpentinite with black crystals of magnetite (<2mm) and a vein of white carbonate and magnetite (Fig 10). There is no indication of any sulphides.



Fig. 10. G407513. Mottled green-black serpentinite with white and black (carbonate + magnetite rich?) veins. FOV 100mm.

G407514 68438 TCGA01/535.65

This sample is a massive, mottled green-black serpentinite with sparse black crystals of magnetite (<2mm) and no veining (Fig 11). There is no indication of any sulphides.



Fig. 11. G407514. Mottled green-black serpentinite. FOV 120mm.

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G407515 68438 TCGA01/530.2

This sample is a massive, mottled green-black serpentinite with black crystals of magnetite (<2mm) and veins of black magnetite and white carbonate (Fig 12). There is no indication of any sulphides.



Fig. 12. G407515. Mottled green-black serpentinite with white carbonate? spotting and black magnetite rich veining. The bright white material is mostly glue. FOV 100mm.

G407516 68438 TCGA01/518.8

This sample is a massive, mottled green-black serpentinite with sparse black crystals of magnetite (<2mm) and no veins (Fig 13). There is no indication of any sulphides.

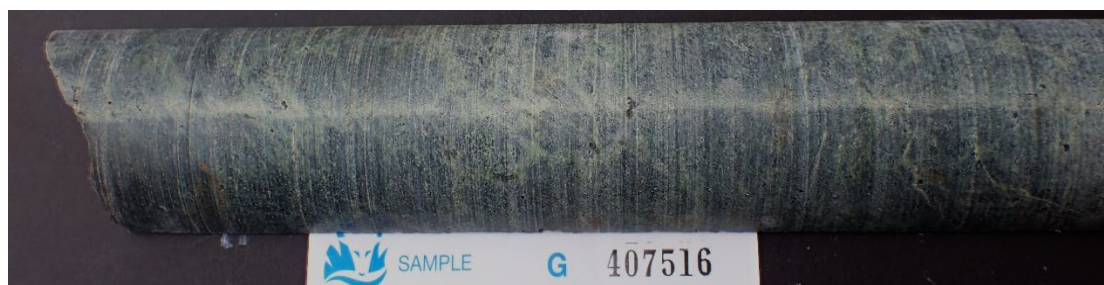


Fig. 13. G407516. Mottled green-black serpentinite. FOV 150mm.

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G407517 68438 TCGA01/510.8

This sample is a massive, mottled green-black serpentinite with sparse black crystals of magnetite (<2mm) and black magnetite rich veining (Fig 14). There is no indication of any sulphides.



Fig. 14. G407517. Mottled green-black serpentinite with white carbonate? spotting and black magnetite rich veining. FOV 120mm.

G407518 68438 TCGA01/507

This sample is a massive, mottled green-black serpentinite with abundant black crystals of magnetite (<12mm) and white carbonate-rich veining (Fig 15). There is no indication of any sulphides.

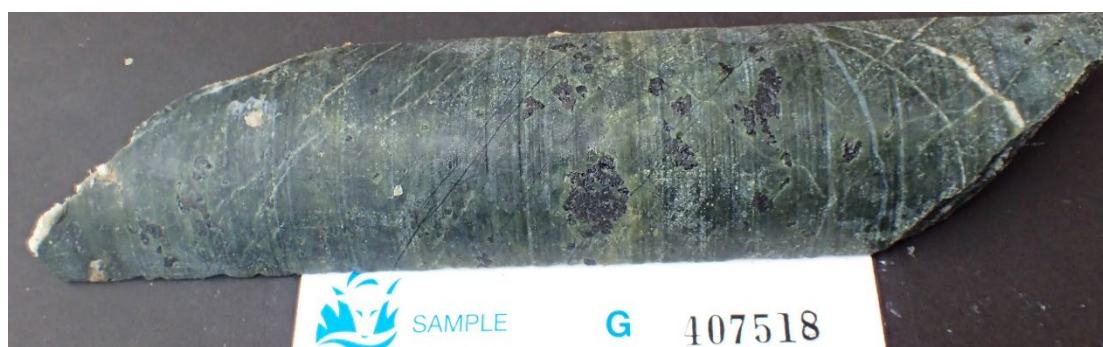


Fig. 15. G407518. Mottled green-black serpentinite with black magnetite patches and white carbonate veins. FOV 120mm.

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G407519 68438 TCGA01/492.2

This sample is a massive, weakly mottled green-black serpentinite with small black crystals of magnetite (<2mm) (Fig 15). There is no indication of any sulphides.



Fig. 16. G407519. Weakly mottled green serpentinite with black magnetite spots and white carbonate? veins. FOV 100mm.

G407520 68438 TCGA01/487.2

This sample is a massive, mottled green-black serpentinite with abundant black crystals of magnetite (<2mm) (Fig 15). There is no indication of any sulphides.



Fig. 17. G407520. Mottled green-black serpentinite with black magnetite spots. FOV 100mm.

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G407521 68438 TCGA01/476.2

This sample is a very pale green serpentinite with abundant black magnetite - rich veining (Fig 18). There is no indication of any sulphides.

In thin section the matrix appears to be serpentinitised peridotite with skeletal chromites, about 0.2-1mm, some with red translucency, but mostly opaque (Fig. 19-23). The original grainsize was similar to the chromites. There are fine grained carbonate-serpentine-magnetite veins to a few mm thick (Fig. 19-21). There are some rounded aggregates of fine grained carbonates (Fig. 20).



Fig. 18. G407521. White serpentinite with black magnetite veining. FOV 120mm.

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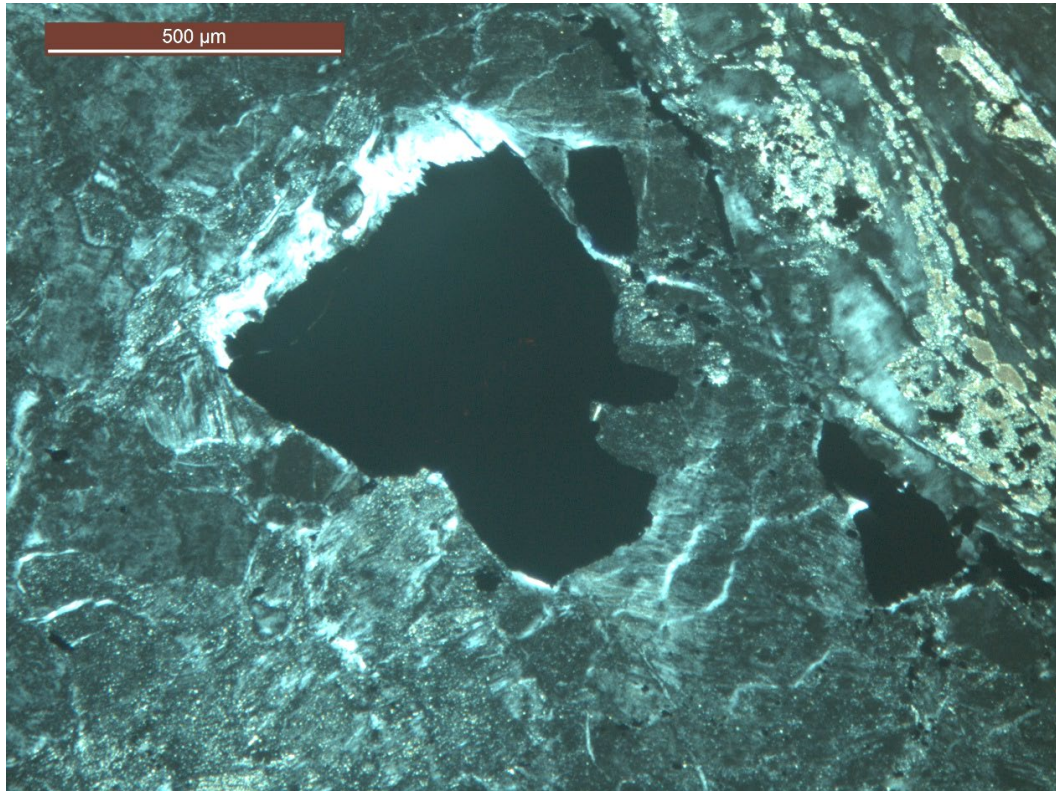


Fig. 19. G407521. Chromite (black) in serpentinite matrix with some very fine disseminated to vein carbonate (pinkish white). Cross-polarised transmitted light.

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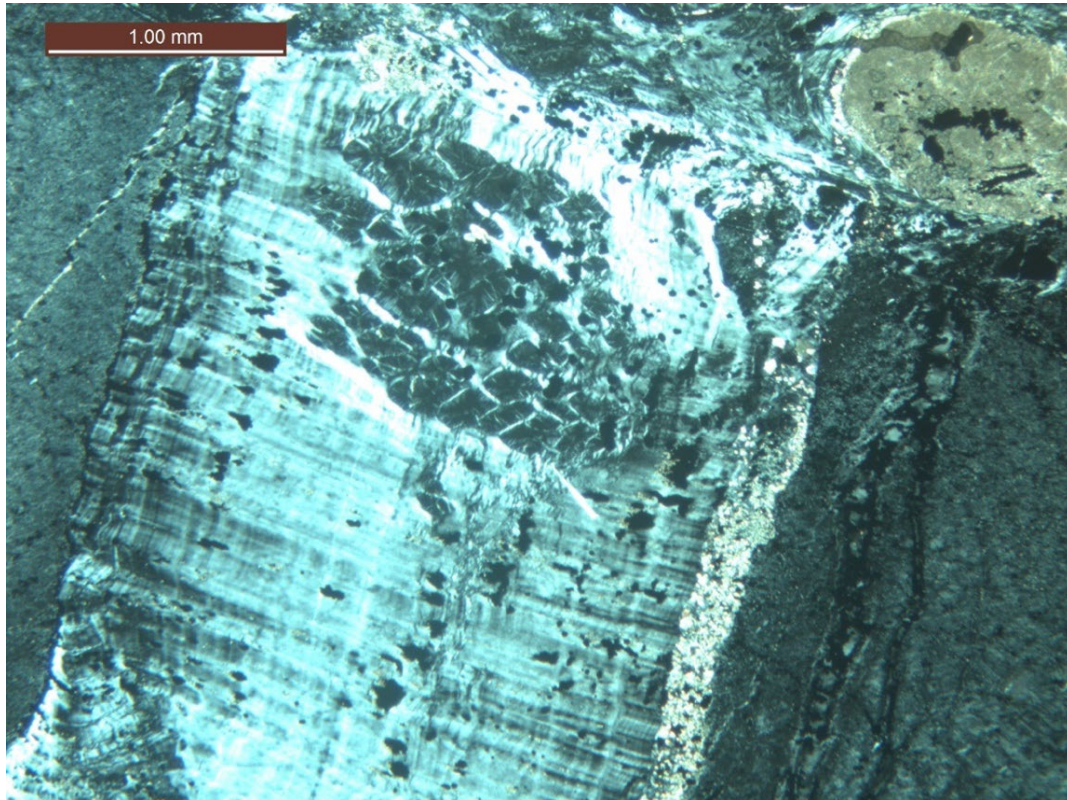


Fig. 20. G407521. Fibrous chrysotile vein (pale blue-white) with some disseminated magnetite (black) in serpentine matrix with some rounded blebs and veinlets of very fine carbonate (pinkish white). Cross-polarised transmitted light.

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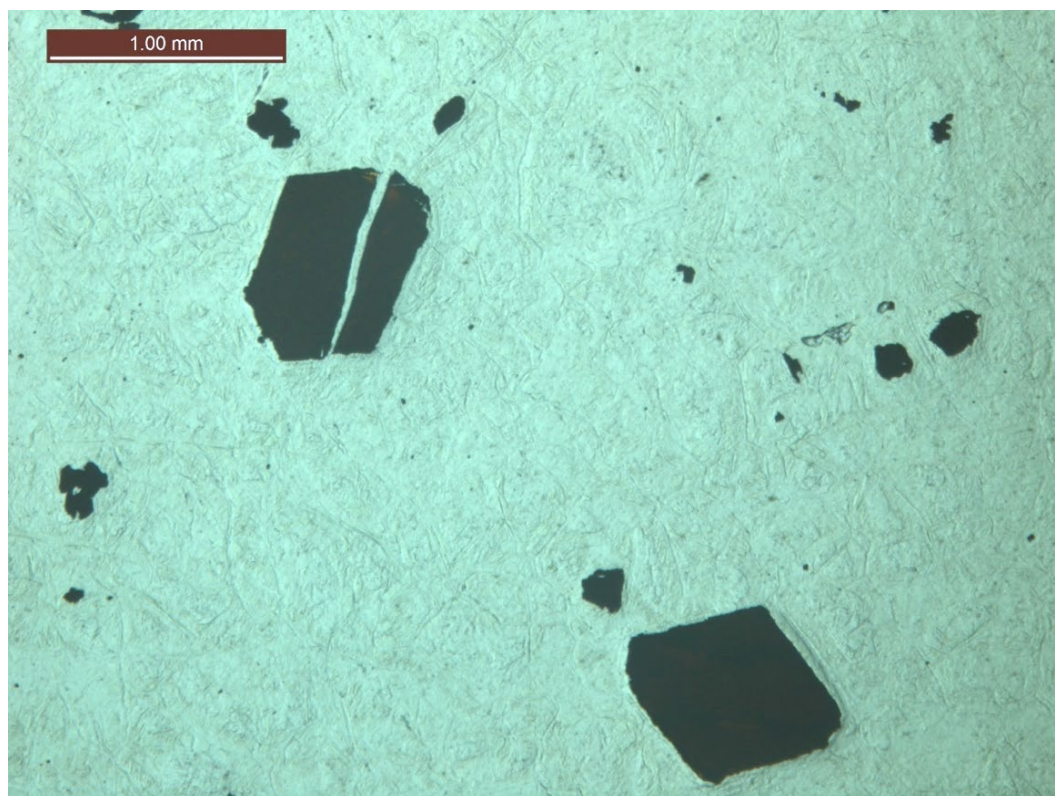


Fig. 21. G407521. Euhedral chromite (black, coarse) and magnetite (fine black aggregates) in serpentine matrix (white). Plain-polarised transmitted light.

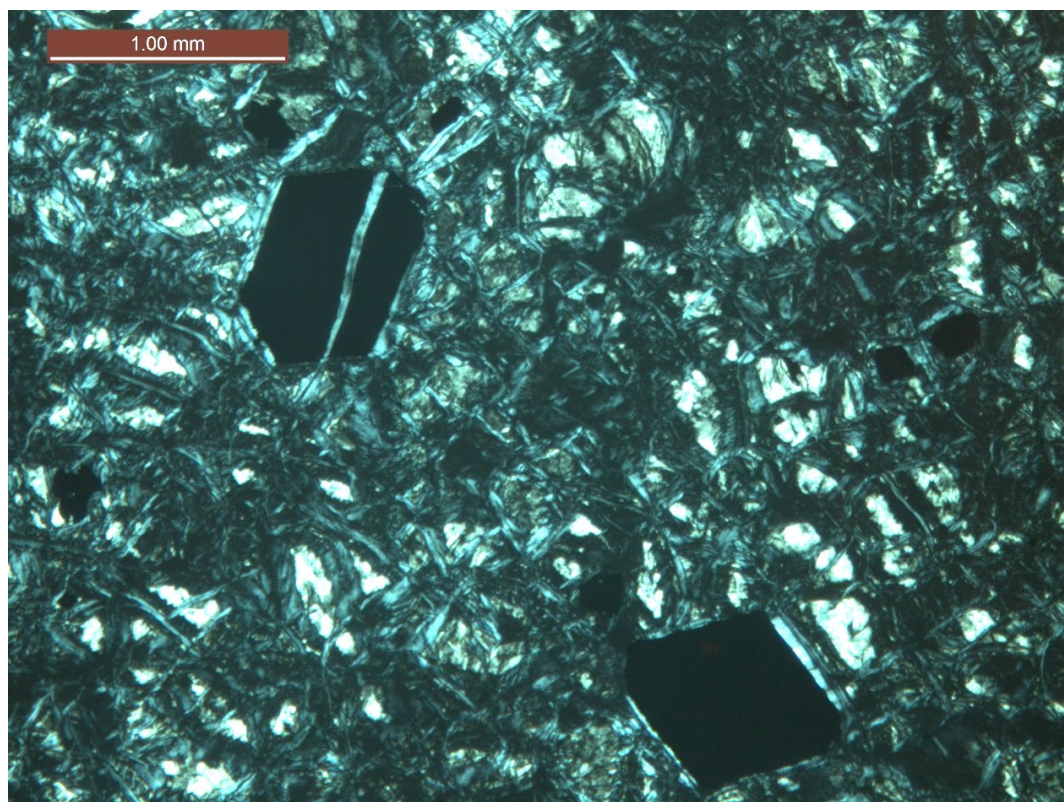


Fig. 22. G407521. Euhedral chromite (black, coarse) and magnetite (fine black aggregates) in serpentine matrix (brucite, serpentine, grey-white), replacing olivine. Cross-polarised transmitted light.

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G407522 68438 TCGA01/473

This sample is a massive, mottled light-dark green serpentinite with sparse black crystals of magnetite (<2mm) (Fig 23). There is no indication of any sulphides.



Fig. 23. G407522. Mottled light-dark green serpentinite with black magnetite spots and white veining. FOV 150mm.

G407523 68438 TCGA01/470.8

This sample is a mottled breccia with light green serpentinite clasts in white carbonate, cutting black, sheared magnetite-rich zones (Fig 24). There is no indication of any sulphides.

In thin section the matrix is a highly sheared and veined carbonate – serpentine rock, probably an altered peridotite (Fig. 24). There are sparse rounded chromites, about 0.2-1mm, some with red translucency, but mostly opaque (Fig. 25-26). There are some rounded aggregates of brucite (Fig. 27).

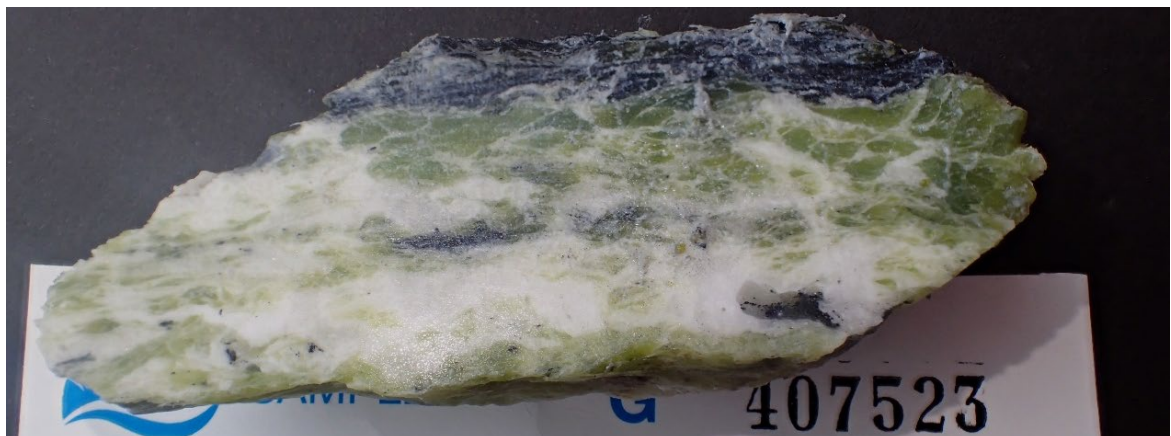


Fig. 24. G407523. Mottled breccia with light green serpentinite clasts in white carbonate with black magnetite-rich zones. FOV 80mm.

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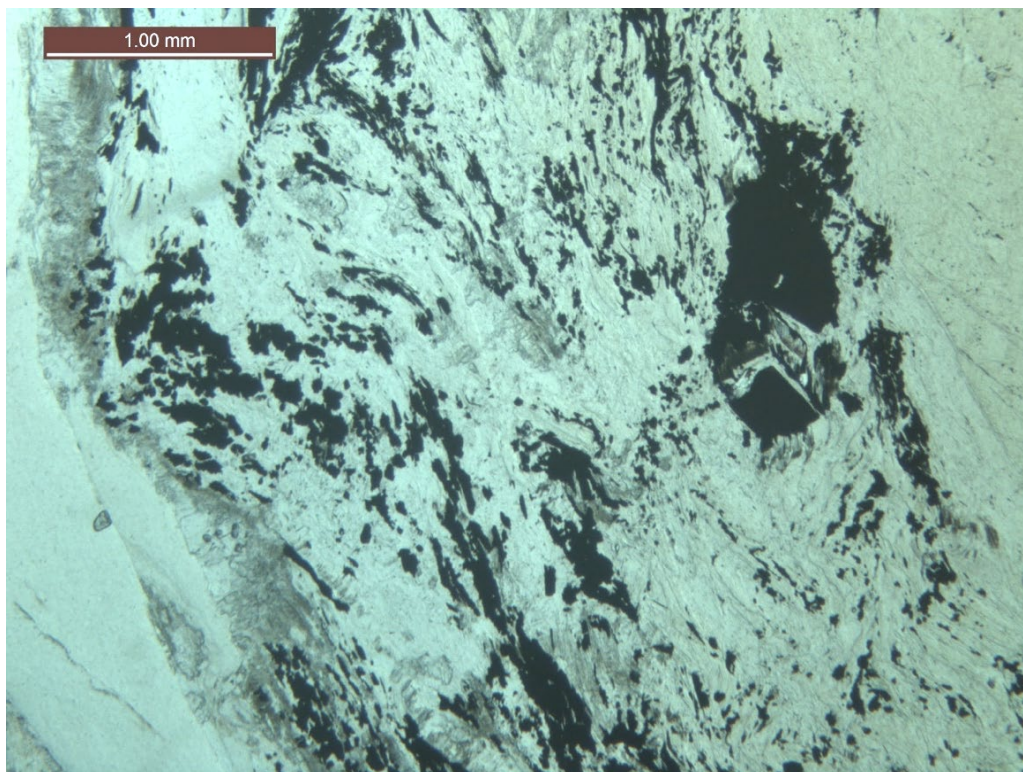


Fig. 25. G407523 Sheared and veined serpentinite (white) with a coarse rounded chromite and fine disseminated magnetite (both black),, partly carbonate-altered (pale brown). Cross-polarised transmitted light.

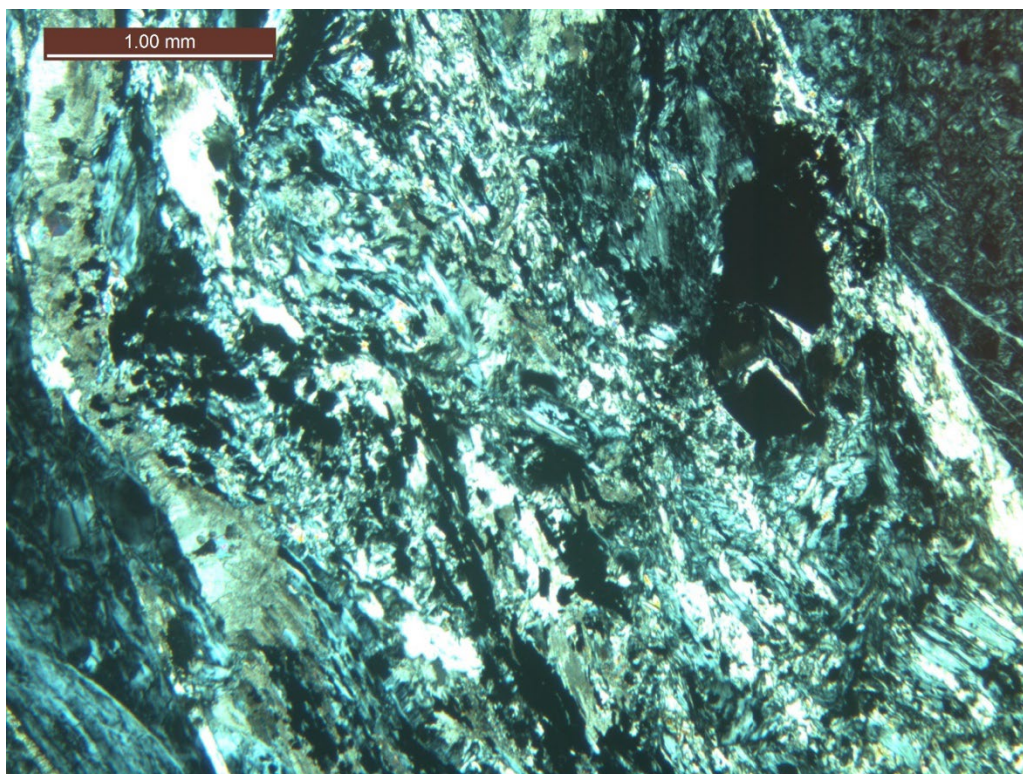


Fig. 26. G407523 Sheared and veined serpentinite (white) with a coarse rounded chromite and fine disseminated magnetite (both black) plus pale brown carbonate). Cross-polarised transmitted light.

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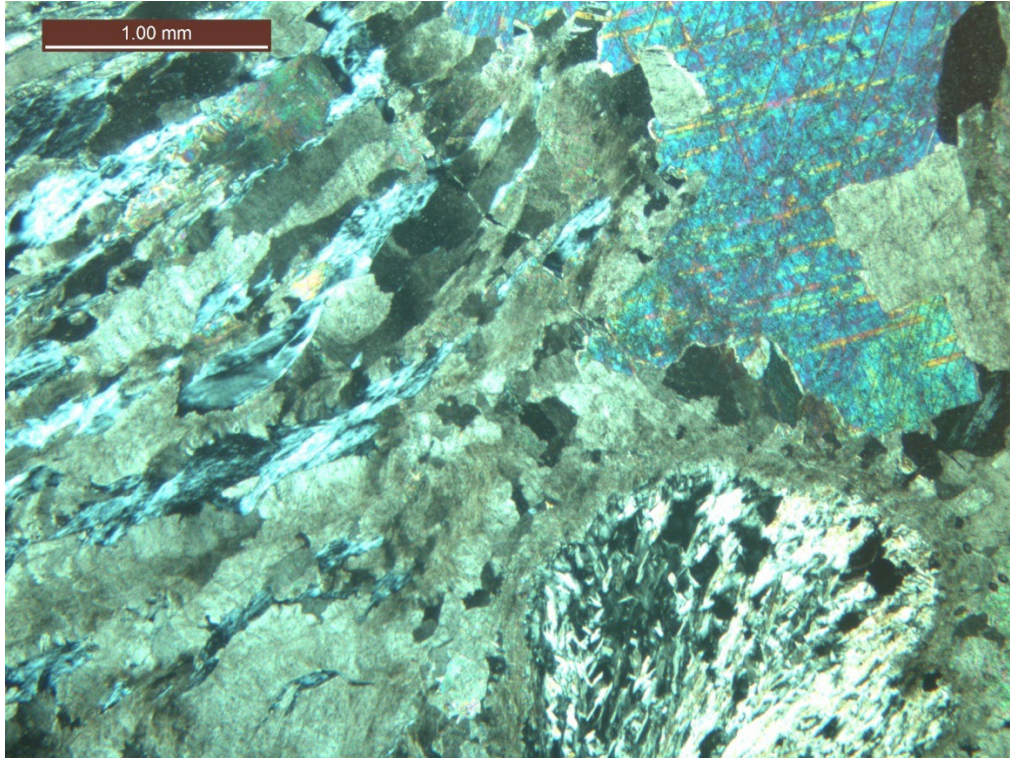


Fig. 27. G407523 Granular dolomite (pale brown and blue) with flakes of serpentine (pale blue) and granular aggregates of brucite (grey-white). Cross-polarised transmitted light.

G407524 68438 TCGA01/465.4

This sample is a green serpentinite with fine black magnetite-rich veins (Fig 28). There is no indication of any sulphides.



Fig. 28 G407524. Green serpentinite with black magnetite-rich veins. The bright white material is mostly glue. FOV 120mm.

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G407525 68438 TCGA01/462.5

This sample is a Pale to dark green serpentinite with white carbonate veins with sparse black crystals of magnetite (<2mm) (Fig 29). There is no indication of any sulphides.



Fig. 29. G407525. Pale to dark green serpentinite with black magnetite-rich and white carbonate veins. Pink material appears to be a soil contamination. FOV 150mm.

G407526 68438 TCGA01/460.2

This sample is a pale to dark green serpentinite with white carbonate veins with black veins of magnetite (<2mm) (Fig 30). There is no indication of any sulphides.



Fig. 30. G407526. Pale to dark green serpentinite with black magnetite-rich veins. The bright white material is mostly glue. FOV 120mm.

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G407527 68438 TCGA01/457.9

This sample is a pale to dark green serpentinite with black magnetite-spots and white carbonate veins (<2mm) (Fig 31). There is no indication of any sulphides.



Fig. 31. G407527. Brecciated pale to dark green serpentinite with black magnetite-spots. The bright white material is mostly glue. FOV 180mm.

G407528 68438 TCGA01/565.4

This sample is a pale to dark green serpentinite with black magnetite and white carbonate veins (<20mm) (Fig 32). There is no indication of any sulphides.



Fig. 32. G407528. Pale to dark green serpentinite with black magnetite-rich and white carbonate veins. FOV 100mm.

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G407529 68438 TCGA01/571.7

This sample is a pale to dark green serpentinite with black magnetite spots (<2mm) (Fig 33). There is no indication of any sulphides.

In thin section the matrix is a highly sheared and veined carbonate – serpentine rock, probably an altered peridotite (Fig. 34). There are sparse euhedral chromites, about 0.2-1mm, some with red translucency, but mostly opaque (Fig. 34). There is common disseminated aggregates of fine grained magnetite (Fig. 35).



Fig. 33. G407529. Medium to dark green serpentinite with white carbonate spots. FOV 120mm.

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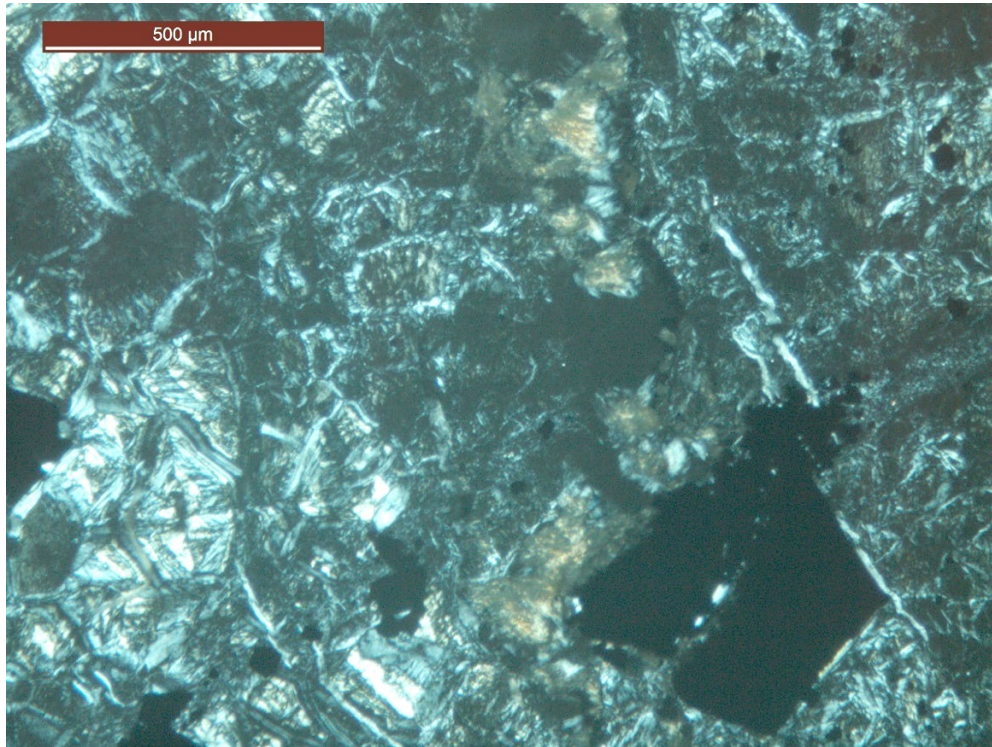


Fig. 34. G407529 Euhedral chromite(black) with fine grained brown carbonate in serpentine- brucite matrix (grey-white). Cross-polarised transmitted light.

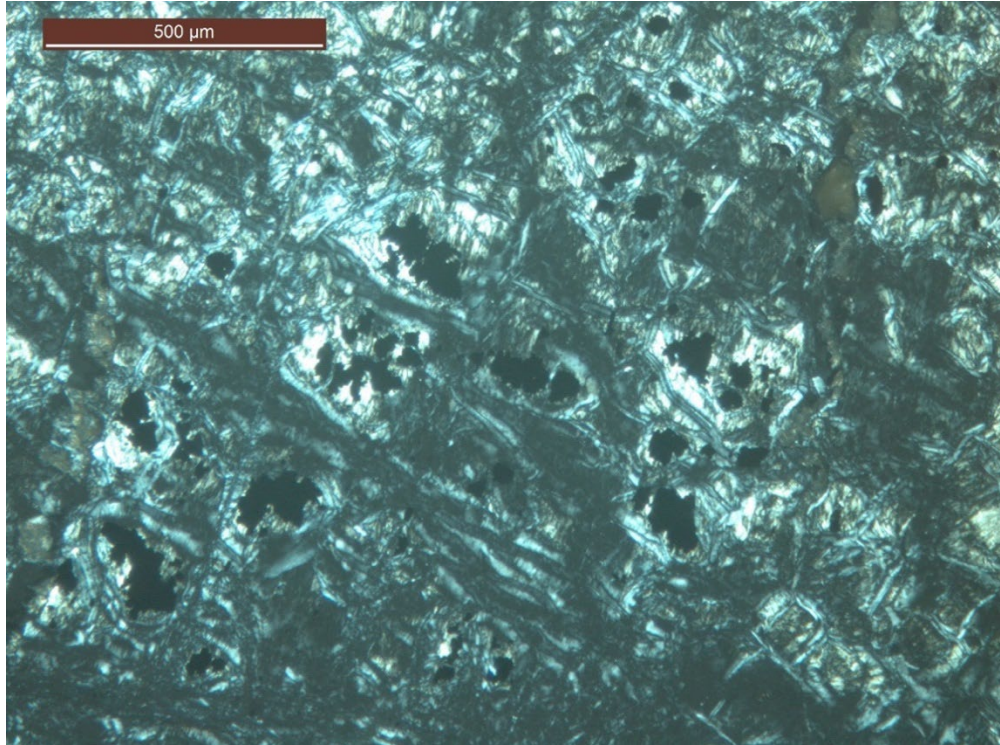


Fig. 35. G407529 Fine grained aggregates of magnetite(black) in serpentine-brucite matrix (grey-white). Cross-polarised transmitted light.

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XRD

A representative portion of each sample was separated, prepared, examined and analysed on an automated Philips X-Ray diffractometer system: PW 1729 generator, PW 1050 goniometer and PW 1710 microprocessor with nickel-filtered copper radiation at 40kV/30mA, a graphite monochromator (PW1752), sample spinner and a proportional detector (sealed gas filled PW1711). The PW1710 system is presently driven by the CSIRO XRD software: "PW1710 for Windows" and "XPLOT for Windows". The results are calculated semi-quantitatively using numerous standards comprising mixtures of natural minerals to indicate the approximate percentages of the individual mineral components.

The XRD analyses are shown in Appendix 2, including some representative scans. The main minerals determined are:

Brucite: $(\text{Mg}(\text{OH})_2)$

Chromite-magnesiochromite: $(\text{Fe},\text{Mg})\text{Cr}_2\text{O}_4$

Dolomite: $\text{CaMg}(\text{CO}_3)_2$

Magnesite (Ferroan) : $(\text{Mg},\text{Fe})\text{CO}_3$

Magnetite: Fe_3O_4

Serpentine (including Chrysotile) : $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$

Sjogrenite/Pyroaurite/Brugnatellite: Mg-Fe hydroxycarbonates

The mineralogy is typical of serpentinised peridotites.

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SCANNING ELECTRON MICROSCOPY (SEM)

One sample (G407512) was examined by SEM including EDS (Energy dispersive spectroscopy) to look for evidence of hydrothermal alteration. The analytical conditions and analytical results are shown in Appendix 1.

The results confirms that the sample contains serpentine, chromite, magnetite, dolomite and ferroan magnesite. Magnetite and dolomite is shown in Fig. 36, and chromite altering to magnetite shown in Fig, 37. The magnetite is commonly slightly nickel rich (<2 at.% Ni) and some serpentine also contains trace nickel (<0.1 at.% Ni), typical of ultramafics. Otherwise there is no detectable base metal anomalism.

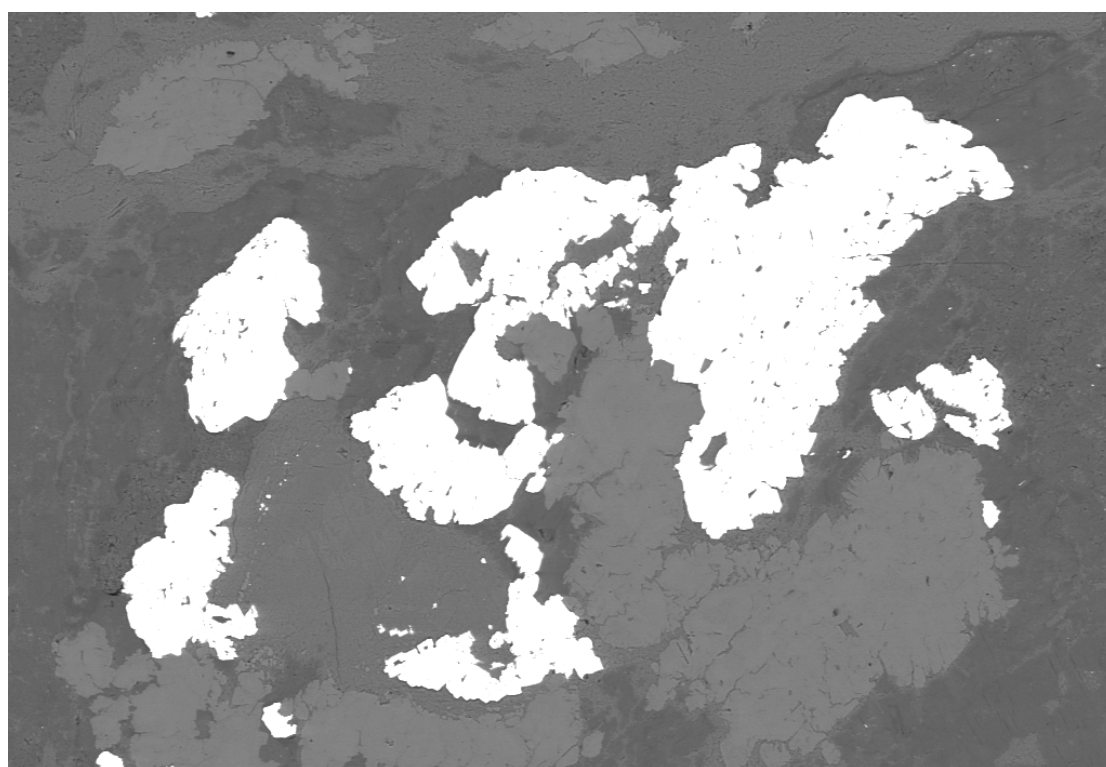


Fig 36. G407512 Granular aggregates of magnetite (white) with carbonate (medium grey) and serpentine-brucite (dark grey). Backscattered electron image.

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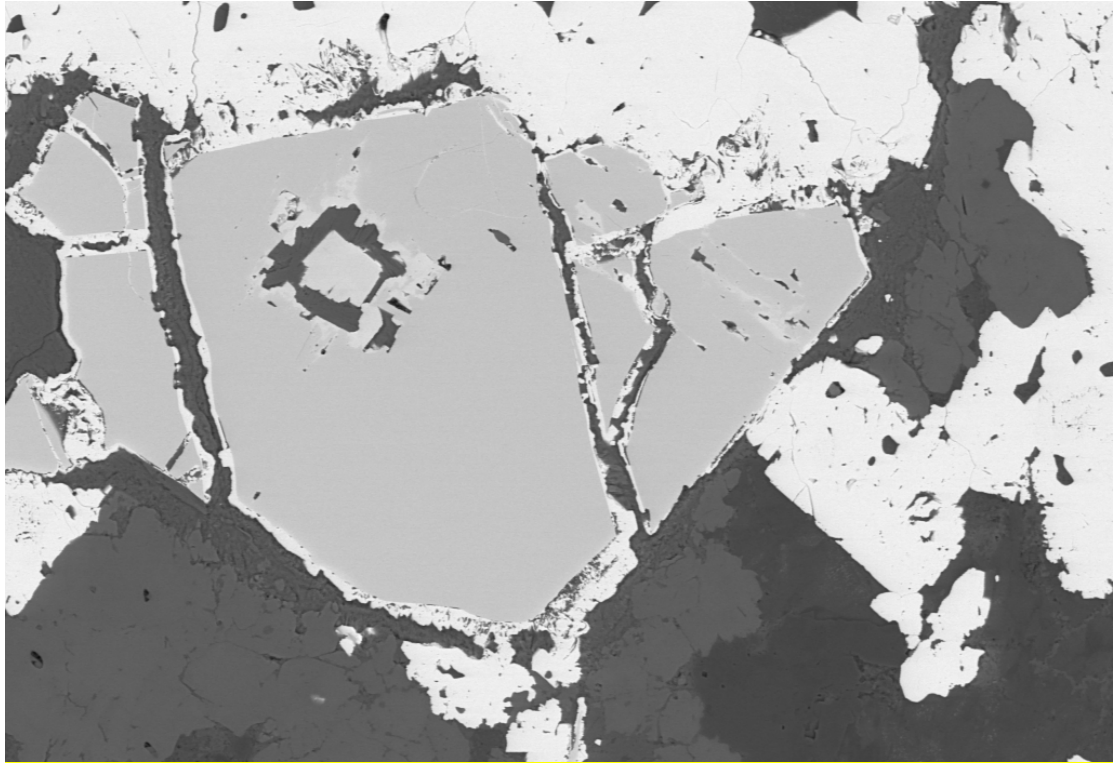


Fig 37. G407512 Granular aggregates of magnetite (white) replacing brecciated chromite (bright grey) with carbonate (medium grey) and serpentine-brucite (dark grey). Backscattered electron image.

DISCUSSION

Petrography and mineralogical analysis indicates the samples examined are probably all serpentinised peridotites, now altered to serpentine (mostly lizardite), brucite, magnesite-siderite, dolomite and magnetite. The only remnant primary mineral is some chromite. This mineralogy is consistent with Cambrian ultramafics.

The mineralogy indicates a high amount of carbonate alteration from externally derived metamorphic or hydrothermal fluids, and the samples are also locally anomalous in nickel-bearing magnetite. This alteration may be related to the nearby Devonian granites but there is no indication of any sulphides or anomalous base metals, and no definitive links.

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R Woolley

LABORATORY TECHNICIAN

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APPENDIX 1: LABORATORY REPORT – PHYSICAL PROPERTY ANALYSES

Client: M Duffett
Analysis: Physical Properties
Method: Gravimetric S.G. & Porosity
Location: Tributary Creek Gravity Anomaly, Drillhole TCGA01
Job No.: LJN2017/129
Date: 5/12/2017

Results:

Sample Nos	Dry Weight in Air (g)	Sub-sat Wt in water (g)	Sat. Wt. in Air (g)	Dry bulk SG	Wet bulk SG	Wet porosity (%)	Dry porosity (%)
G407508	135.0	83.6	136.0	2.58	2.60	1.91	1.95
G407509	47.4	29.5	47.6	2.62	2.63	1.10	1.12
G407510	40.6	24.7	40.8	2.52	2.53	1.24	1.26
G407511	36.5	22.3	36.8	2.52	2.54	2.07	2.11
G407512	160.2	98.6	161.0	2.57	2.58	1.28	1.30
G407513	104.5	63.9	104.9	2.55	2.56	0.98	0.99
G407514	84.6	51.6	84.8	2.55	2.55	0.60	0.61
G407515	114.2	70.3	114.5	2.58	2.59	0.68	0.68
G407516	252.8	154.0	253.7	2.54	2.54	0.90	0.91
G407517	119.2	73.0	119.8	2.55	2.56	1.28	1.30
G407518	111.0	68.0	111.6	2.55	2.56	1.38	1.40
G407519	132.0	80.5	132.5	2.54	2.55	0.96	0.97
G407520	155.3	95.0	155.9	2.55	2.56	0.99	1.00
G407521	123.3	75.4	124.2	2.53	2.55	1.84	1.88
G407522	190.0	116.4	190.7	2.56	2.57	0.94	0.95
G407523	39.9	25.1	40.2	2.64	2.66	1.99	2.03
G407524	98.6	59.7	98.9	2.52	2.52	0.77	0.77
G407525	174.7	106.5	175.6	2.53	2.54	1.30	1.32
G407526	226.4	138.8	227.0	2.57	2.57	0.68	0.68
G407527	306.1	187.4	307.1	2.56	2.57	0.84	0.84
G407528	24.2	14.6	24.3	2.49	2.51	1.03	1.04
G407529	206.5	126.3	207.2	2.55	2.56	0.87	0.87

Analyst: R King & R Bottrill
Date: 5/12/17

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APPENDIX 2.: XRD ANALYSES

Client: D. Bombardieri

Sample Source: Tributary Creek Gravity Anomaly, Drillhole TCGA01

MRT Job Number: LJN2017-129

Analysis: Approximate Mineralogy

Method: X-Ray Diffraction

Results (XRD):

<i>Sample</i>	581.5m	580.1m	574.6m	567.8m
<i>MRT Reg. No.</i>	G407508	G407509	G407510	G407511
<i>Mineral</i>	<i>Wt %</i>	<i>Wt %</i>	<i>Wt %</i>	<i>Wt %</i>
Brucite	10%-15%	15%-25%	15%-25%	15%-25%
Chromite (Magnesian)		2%-5%		<2%
Dolomite	2%-5%		2%-5%	
Magnesite (Ferroan)	10%-15%		5%-10%	
Magnetite	2%-5%	2%-5%	2%-5%	2%-5%
Serpentine (including Chrysotile)	50%-65%	65%-80%	50%-65%	65%-80%
Sjogrenite/Pyroaurite/Brugnatellite	5%-10%		5%-10%	2%-5%

<i>Sample</i>	558.1m	548.0m	535.7m	530.2m
<i>MRT Reg. No.</i>	G407512	G407513	G407514	G407515
<i>Mineral</i>	<i>Wt %</i>	<i>Wt %</i>	<i>Wt %</i>	<i>Wt %</i>
Brucite	15%-25%	15%-25%	15%-25%	15%-25%
Chromite (Magnesian)		<2%		<2%
Dolomite	2%-5%	<2%	<2%	<2%
Magnesite (Ferroan)	15%-25%		<2%	
Magnetite	2%-5%	2%-5%	2%-5%	2%-5%
Serpentine (including Chrysotile)	50%-65%	50%-65%	65%-80%	50%-65%
Sjogrenite/Pyroaurite/Brugnatellite	<2%	5%-10%	<2%	10%-15%

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<i>Sample</i>	518.8m	510.8m	507.0m	492.2m
<i>MRT Reg. No.</i>	G407516	G407517	G407518	G407519
<i>Mineral</i>	<i>Wt %</i>	<i>Wt %</i>	<i>Wt %</i>	<i>Wt %</i>
Brucite	15%-25%	25%-35%	15%-25%	15%-25%
Chromite (Magnesian)				
Dolomite			<2%	<2%
Magnesite (Ferroan)				
Magnetite	2%-5%	2%-5%	2%-5%	2%-5%
Serpentine (including Chrysotile)	65%-80%	65%-80%	65%-80%	65%-80%
Sjogrenite/Pyroaurite/Brugnatelli te		<2%	<2%	<2%

<i>Sample</i>	487.2m	476.2m	473.0m	470.8m
<i>MRT Reg. No.</i>	G407520	G407521	G407522	G407523
<i>Mineral</i>	<i>Wt %</i>	<i>Wt %</i>	<i>Wt %</i>	<i>Wt %</i>
Brucite	15%-25%	25%-35%	25%-35%	5%-10%
Chromite (Magnesian)	<2%		2%-5%	
Dolomite		<2%	<2%	35%-50%
Magnesite (Ferroan)				
Magnetite	2%-5%	5%-10%	2%-5%	<2%
Serpentine (including Chrysotile)	65%-80%	50%-65%	50%-65%	35%-50%
Sjogrenite/Pyroaurite/Brugnatelli te		<2%	5%-10%	5%-10%

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<i>Sample</i>	465.4m	462.5m	460.2m	457.9m
<i>MRT Reg. No.</i>	G407524	G407525	G407526	G407527
<i>Mineral</i>	<i>Wt %</i>	<i>Wt %</i>	<i>Wt %</i>	<i>Wt %</i>
Brucite	25%-35%	15%-25%	25%-35%	15%-25%
Chromite (Magnesian)	<2%	<2%		<2%
Dolomite	5%-10%	<2%	<2%	<2%
Magnesite (Ferroan)				
Magnetite	2%-5%	2%-5%	2%-5%	2%-5%
Serpentine (including Chrysotile)	50%-65%	65%-80%	50%-65%	65%-80%
Sjogrenite/Pyroaurite/Brugnatellite	5%-10%	<2%	5%-10%	

<i>Sample</i>	565.4m	571.7m
<i>MRT Reg. No.</i>	G407528	G407529
<i>Mineral</i>	<i>Wt %</i>	<i>Wt %</i>
Brucite	10%-15%	15%-25%
Chromite (Magnesian)		<2%
Dolomite	10%-15%	2%-5%
Magnesite (Ferroan)	10%-15%	
Magnetite	2%-5%	2%-5%
Serpentine (including Chrysotile)	35%-50%	50%-65%
Sjogrenite/Pyroaurite/Brugnatellite	5%-10%	5%-10%

NOTES:

Brugnatellite: $\text{Mg}_6\text{FeCO}_3(\text{OH})_{13} \cdot 4\text{H}_2\text{O}$

Pyroaurite: $\text{Mg}_6\text{Fe}_2\text{CO}_3(\text{OH})_{16} \cdot 4\text{H}_2\text{O}$

Sjogrenite: $\text{Mg}_6\text{Fe}_2\text{CO}_3(\text{OH})_{16} \cdot 4\text{H}_2\text{O}$

The Serpentine mineral is probably Lizardite

The main Magnesite peak is at 2.744Å - 2.746Å (Magnesite = 2.742Å; Ferroan Magnesite = 2.747Å)

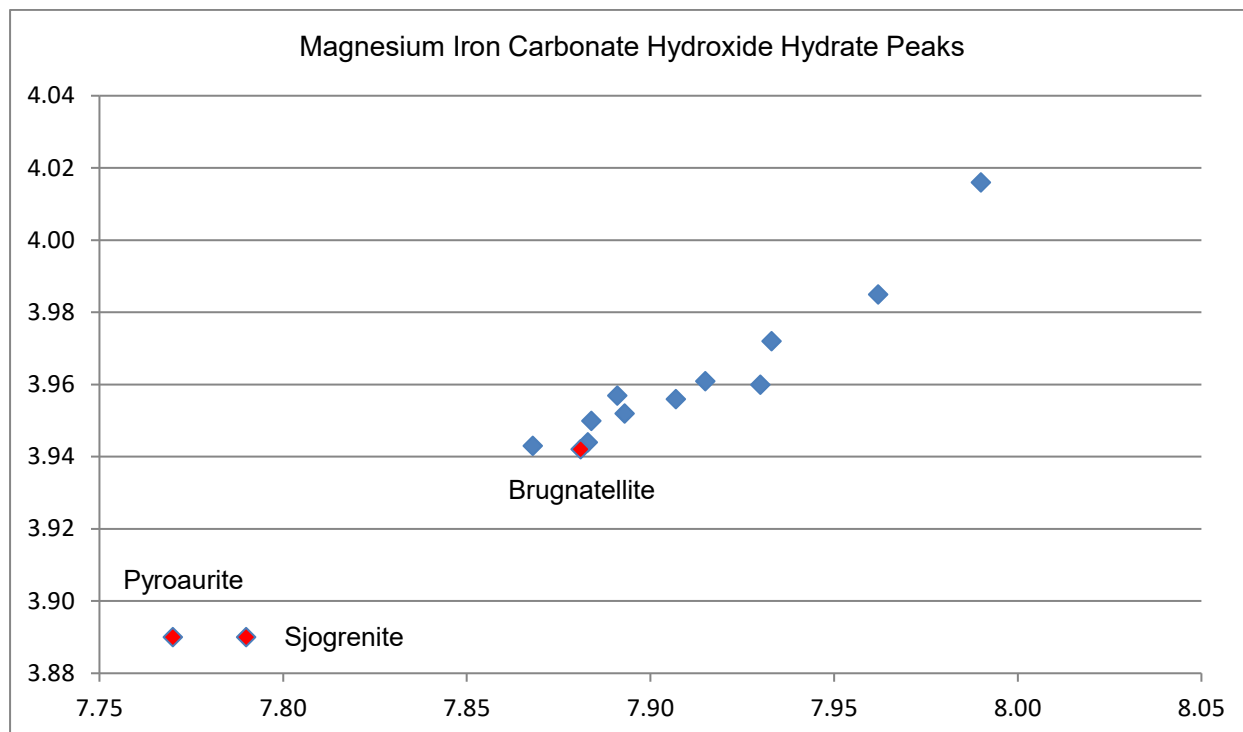
Peak overlap (e.g. Lizardite and Chrysotile) may interfere with identifications and quantitative calculations.

Amorphous minerals and minerals present in trace amounts may not be detected.

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<i>Magnesium Iron Carbonate Hydroxide Hydrate Peaks*</i>		
<i>Sample</i>	<i>d (002) Å</i>	<i>d (004) Å</i>
G407508	7.962	3.985
G407510	7.907	3.956
G407511	7.884	3.950
G407513	7.868	3.943
G407515	7.883	3.944
G407522	7.891	3.957
G407524	7.893	3.952
G407526 (1 st Mineral)	7.990	4.016
G407526 (2 nd Mineral)	7.915	3.961
G407528	7.933	3.972
G407529	7.881	3.942
Pyroaurite	7.77	3.89
Sjogrenite	7.79	3.89
Brugnatellite	7.93	3.96

* Quartz added to enable peak calibration

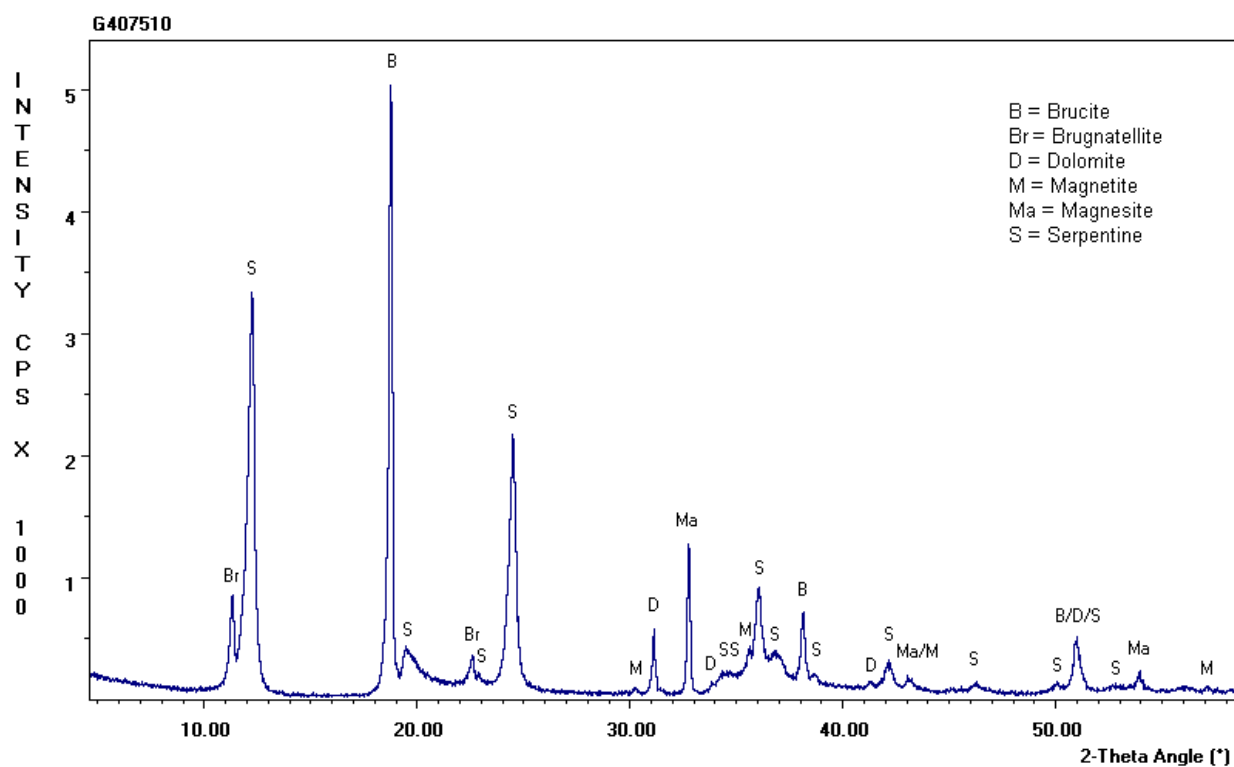
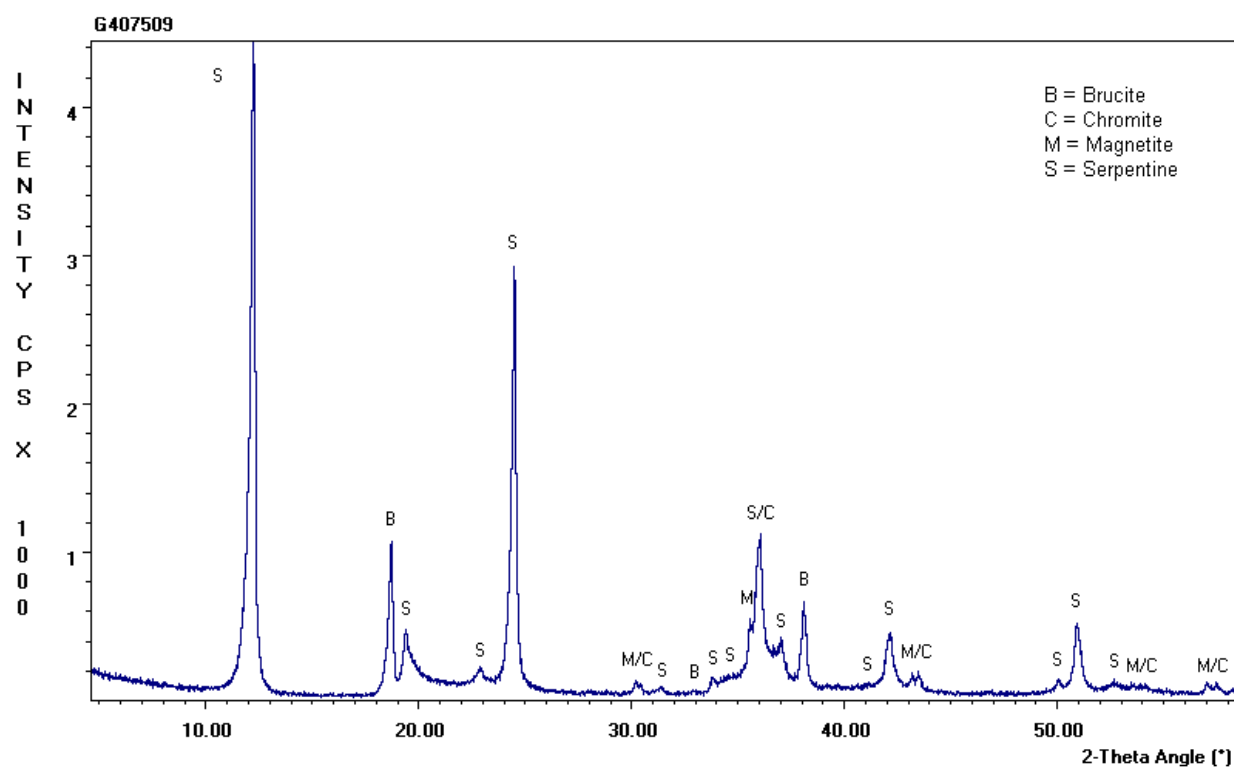


Analyst: R N Woolley

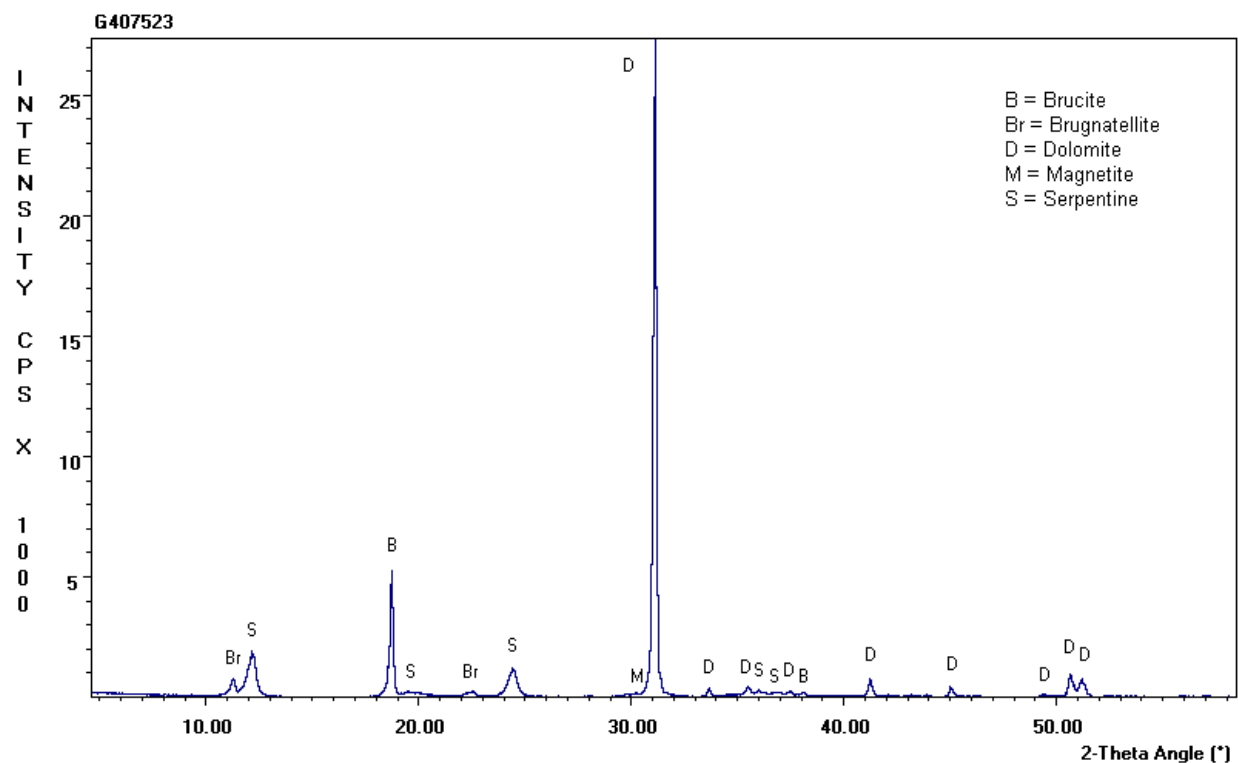
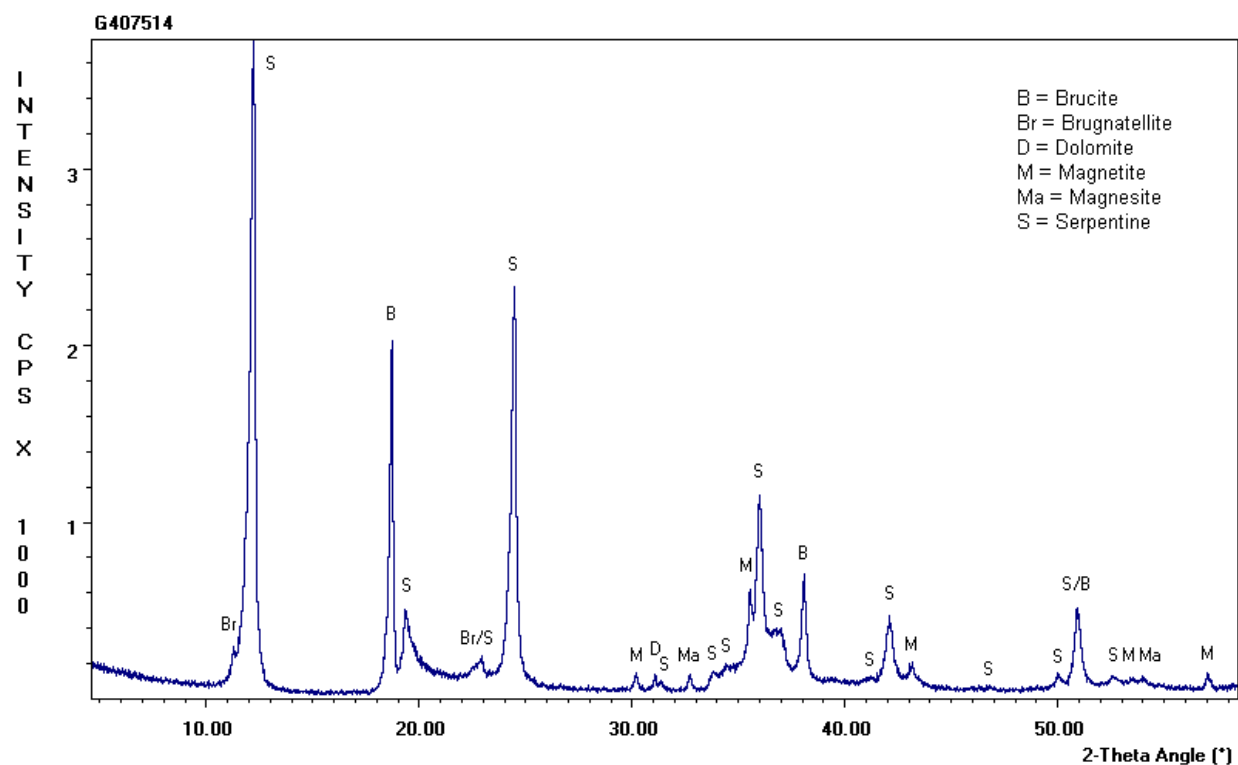
Date: 14 December 2017

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Examples of XRD Scans:



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APPENDIX 3 SEM ANALYSES

Hitachi SU-70 analytical field emission SEM

- installed February 2011
- Schottky thermal field emission source
- ultra-high resolution (1.0 nm @ 15kV, 1.6 nm @ 1kV for SE imaging)
- high vacuum operation only (i.e. no variable pressure in chamber)
- Hitachi in-chamber and in-lens scintillation detectors, Super ExB filter, beam deceleration
- Hitachi in-chamber 5-segment solid state BSE detector, retractable
- in-column Faraday cup with picoammeter for beam current measurement
- anticontamination cold plate, liquid nitrogen cooled
- 5 axis motorised fully eucentric stage, XYZ range 110x110x40mm
- Oxford AZtec EDS/EBSD system with
 - X-Max 80 SDD EDS, MnKa 125 eV resolution, elements B-U, large area hyperspectral mapping, standardless and standards-based quantification, feature analysis
 - HKL NordlysNano EBSD camera & foreshoot detector system, HKL & Channel 5 software packages, Synergy EDS/EBSD integration, HKL, ICSD & American Mineralogist phase databases
- NEW June 2017: Gatan ChromaCL2 colour cathodoluminescence imaging system with integrated BSE detector, Digital Micrograph 3 software, automated mosaic acquisition, simultaneous acquisition of SE, iBSE and colour CL images.

Label:	am 179
Element List Type:	Current Spectrum
Processing Option:	All Elements
Specimen Coating:	On
Beam Calibration Element Coating:	Off
Coating Element:	Carbon
Coating Thickness:	20 nm
Coating Density:	2.25 g/cm ³
Automatic Line Selection:	Disabled
Normalization:	Enabled
Thresholding:	Sigma level = 1
Detector Window Correction:	Enabled
Deconvolution Elements:	None
Selected Standards:	Minerals_15kV_2017-10-20 [User]
Pulse Pile Up Correction:	Succeeded
Detector file:	X-Max 3
Efficiency:	File based

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G407512 EDS analyses (At.%)

Spectrum Label	O	Mg	Al	Si	Ca	Ti	Cr	Mn	Fe	Ni	Total at%	Project Path	Mineral
dol 312	72.53	13.6			13.44			0.3	0.12		100	2018-02-16/G407512 /Site 35	dolomite
Spectrum 319	72.58	13.53			13.31			0.45	0.13		100	2018-02-16/G407512 /Site 35	dolomite
Spectrum 352	72.69	13.54		0.2	13.1			0.33	0.13		100	2018-02-16/G407512 /Site 40	dolomite
Spectrum 318	72.33	13.42		0.18	13.17			0.75	0.15		100	2018-02-16/G407512 /Site 35	dolomite
dol 299	72.2	13.47			13.76			0.42	0.16		100	2018-02-16/G407512 /Site 32	dolomite
Spectrum 351	72.79	13.31		0.13	13.11			0.48	0.17		100	2018-02-16/G407512 /Site 40	dolomite
Spectrum 348	72.55	13.35		0.07	13.16			0.68	0.19		100	2018-02-16/G407512 /Site 40	dolomite
Spectrum 349	72.76	13.46		0.07	13.34			0.18	0.19		100	2018-02-16/G407512 /Site 40	dolomite
Dol 296	72.33	13.56		0.39	13.08			0.43	0.21		100	2018-02-16/G407512 /Site 32	dolomite
Spectrum 317	63.33	21.94		14.52					0.22		100	2018-02-16/G407512 /Site 35	serpentine
srp 314	63.65	21.77		14.32					0.26		100	2018-02-16/G407512 /Site 35	serpentine
Spectrum 323	63.42	21.84		14.47					0.27		100	2018-02-16/G407512 /Site 36	serpentine
srp 305	63.51	21.85		14.36					0.28		100	2018-02-16/G407512 /Site 34	serpentine
Spectrum 341	63.58	21.95		14.16					0.3		100	2018-02-16/G407512 /Site 39	serpentine
Spectrum 307	63.29	21.94		14.46					0.31		100	2018-02-16/G407512 /Site 34	serpentine
Spectrum 310	63.19	21.97		14.53					0.31		100	2018-02-16/G407512 /Site 34	serpentine
Spectrum 340	63.27	21.93		14.46					0.34		100	2018-02-16/G407512 /Site 39	serpentine
Spectrum 345	62.62	23.02		14					0.35		100	2018-02-16/G407512 /Site 39	serpentine
srp 365	63.13	21.95		14.57					0.35		100	2018-02-16/G407512 /Site 41	serpentine

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Spectrum Label	O	Mg	Al	Si	Ca	Ti	Cr	Mn	Fe	Ni	Total at%	Project Path	Mineral
dol 357	72.33	13.48		0.53	12.75			0.55	0.36		100	2018-02-16/G407512 /Site 41	serpentine
dol 300	72.51	13.5			13.35			0.27	0.37		100	2018-02-16/G407512 /Site 32	serpentine
Spectrum 325	63	21.95		14.65					0.4		100	2018-02-16/G407512 /Site 36	serpentine
Spectrum 337	63.44	21.8		14.36					0.41		100	2018-02-16/G407512 /Site 38	serpentine
Spectrum 338	63.34	21.77		14.46					0.43		100	2018-02-16/G407512 /Site 38	serpentine
srp 361	62.87	22.94		13.74					0.45		100	2018-02-16/G407512 /Site 41	serpentine
dol 362	72.17	13.44			13.29			0.62	0.46		100	2018-02-16/G407512 /Site 41	serpentine
srp 363	62.57	22.35		14.6					0.47		100	2018-02-16/G407512 /Site 41	serpentine
srp 367	64	21.3		14.14					0.47	0.1	100	2018-02-16/G407512 /Site 41	serpentine
Spectrum 290	63.26	21.63		14.1	0.32		0.18		0.51		100	2018-02-16/G407512 /Site 32	serpentine
srp 364	63.37	21.64		14.37					0.62		100	2018-02-16/G407512 /Site 41	serpentine
Spectrum 335	63.44	21.66		14.19			0.05		0.66		100	2018-02-16/G407512 /Site 37	serpentine
Spectrum 350	63.43	21.58		14.31					0.67		100	2018-02-16/G407512 /Site 40	serpentine
Spectrum 336	63.13	21.77		14.21			0.06		0.73	0.09	100	2018-02-16/G407512 /Site 37	serpentine
Spectrum 334	63.89	21.33		13.66	0.14		0.15		0.84		100	2018-02-16/G407512 /Site 37	serpentine
Spectrum 347	65.72	32.16		0.5					1.63		100	2018-02-16/G407512 /Site 39	brucite
Spectrum 315	64.9	30.97		2.48					1.65		100	2018-02-16/G407512 /Site 35	brucite
Spectrum 339	64.74	30.68		2.88					1.7		100	2018-02-16/G407512 /Site 38	brucite
brc 368	65.76	32.3		0.21					1.73		100	2018-02-16/G407512 /Site 41	brucite
Spectrum 344	65.57	31.48		1.2					1.75		100	2018-02-16/G407512 /Site 39	brucite
Spectrum Label	O	Mg	Al	Si	Ca	Ti	Cr	Mn	Fe	Ni	Total at%	Project Path	Mineral
Spectrum 321	65.4	32.83							1.77		100	2018-02-16/G407512 /Site 35	brucite

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Spectrum 343	65.61	32.4		0.2					1.79		100	2018-02-16/G407512 /Site 39	brucite
brc 313	65.75	31.71		0.64					1.9		100	2018-02-16/G407512 /Site 35	brucite
srp 309	65.99	31.86		0.24					1.92		100	2018-02-16/G407512 /Site 34	brucite
Spectrum 306	65.47	32.38		0.22					1.93		100	2018-02-16/G407512 /Site 34	brucite
Spectrum 324	65.45	32.25		0.3					1.99		100	2018-02-16/G407512 /Site 36	brucite
brc 308	65.82	31.97		0.2					2.01		100	2018-02-16/G407512 /Site 34	brucite
brc 360	65.41	31.9		0.61				0.06	2.02		100	2018-02-16/G407512 /Site 41	brucite
Spectrum 316	65.22	32.51		0.2					2.07		100	2018-02-16/G407512 /Site 35	brucite
Spectrum 342	65.13	32.5							2.37		100	2018-02-16/G407512 /Site 39	brucite
Brc 297	65.71	31.76							2.53		100	2018-02-16/G407512 /Site 32	brucite
Spectrum 346	65.25	32.16						0.06	2.53		100	2018-02-16/G407512 /Site 39	brucite
Spectrum 320	65.52	31.03		0.84				0.06	2.54		100	2018-02-16/G407512 /Site 35	brucite
Spectrum 326	65.76	31.7							2.54		100	2018-02-16/G407512 /Site 36	brucite
Spectrum 328	58.1	7.35	4.36				22.79		7.4		100	2018-02-16/G407512 /Site 37	chromite
Spectrum 329	57.85	7.24	4.36	0.08			23.05		7.42		100	2018-02-16/G407512 /Site 37	chromite
chr 327	57.88	7.3	4.4				22.9		7.52		100	2018-02-16/G407512 /Site 37	chromite
Spectrum 288	57.4	6.62	5.34				22.21		8.43		100	2018-02-16/G407512 /Site 32	chromite
Spectrum 289	57.08	5.7	4.83	0.11			22.03		10.25		100	2018-02-16/G407512 /Site 32	chromite
Chr 287	57.93	4.22	2			0.15	24.79		10.91		100	2018-02-16/G407512 /Site 32	chromite
Spectrum Label	O	Mg	Al	Si	Ca	Ti	Cr	Mn	Fe	Ni	Total at%	Project Path	Mineral
Spectrum 356	58.77	23.73		1.96					14.8	0.74	100	2018-02-16/G407512 /Site 40	Ferroan magnesite
Spectrum 322	56.73	0.46		0.13					41.07	1.61	100	2018-02-16/G407512 /Site 36	magnetite
Spectrum 332	55.43	0.59		0.24			1.62	0.15	41.28	0.69	100	2018-02-16/G407512 /Site 37	magnetite

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mt 301	56.5	0.83		1.14					41.53		100	2018-02-16/G407512 /Site 34	magnetite
Spectrum 331	55.5	0.42		0.17			1.42		41.69	0.79	100	2018-02-16/G407512 /Site 37	magnetite
Spectrum 330	55.52	0.42		0.96			1.4		41.71		100	2018-02-16/G407512 /Site 37	magnetite
Spectrum 355	56.75								41.74	1.51	100	2018-02-16/G407512 /Site 40	magnetite
mt 366	56.45	0.5		0.12					41.75	1.18	100	2018-02-16/G407512 /Site 41	magnetite
Spectrum 293	56.41	0.57		0.18					41.76	1.08	100	2018-02-16/G407512 /Site 32	magnetite
Spectrum 291	56.49			1.01			0.52		41.99		100	2018-02-16/G407512 /Site 32	magnetite
Spectrum 333	56.27	0.9		0.51			0.28		42.04		100	2018-02-16/G407512 /Site 37	magnetite
Spectrum 302	56.26	0.54	0	1.06					42.14		100	2018-02-16/G407512 /Site 34	magnetite
Spectrum 295	55.92	0.68		0.51			0.48		42.41		100	2018-02-16/G407512 /Site 32	magnetite
Spectrum 294	56.76						0.76		42.48		100	2018-02-16/G407512 /Site 32	magnetite
Spectrum 311	55.42	0.44	0	0.1					42.6	1.44	100	2018-02-16/G407512 /Site 34	magnetite
Spectrum 354	55.66	0.42						0.15	42.62	1.14	100	2018-02-16/G407512 /Site 40	magnetite
mt 358	56.86			0.16					42.98		100	2018-02-16/G407512 /Site 41	magnetite
Spectrum 292	56.38			0.18			0.28		43.16		100	2018-02-16/G407512 /Site 32	magnetite
Spectrum 304	55.25	0.43		0.1					43.18	1.03	100	2018-02-16/G407512 /Site 34	magnetite
Spectrum 303	56.44	0.14		0.17					43.24		100	2018-02-16/G407512 /Site 34	magnetite