

**Ministry of Energy, Mines & Petroleum Resources**  
Mining & Minerals Division  
BC Geological Survey

**Assessment Report**  
**Title Page and Summary**

TYPE OF REPORT [type of survey(s)]: Geochemistry

TOTAL COST: \$9,373.25

AUTHOR(S): John A. McClintock P. Eng SIGNATURE(S): \_\_\_\_\_

NOTICE OF WORK PERMIT NUMBER(S)/DATE(S): na YEAR OF WORK: 2017

STATEMENT OF WORK - CASH PAYMENTS EVENT NUMBER(S)/DATE(S): \_\_\_\_\_

PROPERTY NAME: Pemberton Hills Group

CLAIM NAME(S) (on which the work was done): 513931, 516078, 374744, 513929, 398335, 515277, 516527, 515281

COMMODITIES SOUGHT: Copper, gold

MINERAL INVENTORY MINFILE NUMBER(S), IF KNOWN: \_\_\_\_\_

MINING DIVISION: Nanaimo NTS/BCGS: 94L 12

LATITUDE: 50 ° 37.8 ' \_\_\_\_\_ " LONGITUDE: 127 ° 46.2 ' \_\_\_\_\_ " (at centre of work)

OWNER(S):

1) North Island Mining 2) \_\_\_\_\_

MAILING ADDRESS:

15th Floor, 1040 West Georgia Street

Vancouver, B.C.

OPERATOR(S) [who paid for the work]:

1) Northisle Copper and Gold Inc. 2) \_\_\_\_\_

MAILING ADDRESS:

as above

PROPERTY GEOLOGY KEYWORDS (lithology, age, stratigraphy, structure, alteration, mineralization, size and attitude):

Bonanza Group Volcanic rocks, andesite, Island Intrusions, advanced argillic alteration, propylitic alteration, TerraSpec analysis.

REFERENCES TO PREVIOUS ASSESSMENT WORK AND ASSESSMENT REPORT NUMBERS: 22374, 21053, 15876, 2190

TYPE OF WORK IN THIS REPORT	EXTENT OF WORK (IN METRIC UNITS)	ON WHICH CLAIMS	PROJECT COSTS APPORTIONED (incl. support)
<b>GEOLOGICAL (scale, area)</b>			
Ground, mapping	_____	_____	_____
Photo interpretation	_____	_____	_____
<b>GEOPHYSICAL (line-kilometres)</b>			
<b>Ground</b>			
Magnetic	_____	_____	_____
Electromagnetic	_____	_____	_____
Induced Polarization	_____	_____	_____
Radiometric	_____	_____	_____
Seismic	_____	_____	_____
Other	_____	_____	_____
<b>Airborne</b>			
_____	_____	_____	_____
<b>GEOCHEMICAL (number of samples analysed for...)</b>			
Soil	_____	_____	_____
Silt	_____	_____	_____
Rock	_____	_____	_____
Other TerraSpec spectral analysis	_____	see page one	\$9,373.25
<b>DRILLING (total metres; number of holes, size)</b>			
Core	_____	_____	_____
Non-core	_____	_____	_____
<b>RELATED TECHNICAL</b>			
Sampling/assaying	_____	_____	_____
Petrographic	_____	_____	_____
Mineralographic	_____	_____	_____
Metallurgic	_____	_____	_____
<b>PROSPECTING (scale, area)</b>			
_____	_____	_____	_____
<b>PREPARATORY / PHYSICAL</b>			
Line/grid (kilometres)	_____	_____	_____
Topographic/Photogrammetric (scale, area)	_____	_____	_____
Legal surveys (scale, area)	_____	_____	_____
Road, local access (kilometres)/trail	_____	_____	_____
Trench (metres)	_____	_____	_____
Underground dev. (metres)	_____	_____	_____
Other	_____	_____	_____
		<b>TOTAL COST:</b>	<b>\$9,373.25</b>

# 2017 TECHNICAL ASSESSMENT REPORT On SPECTRAL ANALYSIS at PEMBERTON HILLS

**Nanaimo Mining Division  
British Columbia**

NTS 94D/12 50° 37.8' N/127° 46.2' W

**Event # 5642805**

**Tenure #'s:**

**518531, 512122, 515277, 516527, 513929,  
515281, 398335, 516078, 374744, 513931,  
506021, 512091**

**Prepared for:  
Northisle Copper and Gold Inc.**

**Prepared by:  
John McClintock, P.Eng,**

**May 2017**

1.0	SUMMARY .....	1
2.0	INTRODUCTION AND TERMS OF REFERENCE.....	1
3.0	PROPERTY DESCRIPTION AND LOCATION .....	2
3.1	Location and Access .....	2
3.2	Mineral Tenure Information .....	2
3.3	Physiography and Climate.....	3
4.0	HISTORY .....	4
5.0	REGIONAL GEOLOGY.....	5
6.0	TERRASPEC SURVEY.....	7
6.1	Survey.....	7
6.2	Results.....	8
7.0	CONCLUSIONS.....	9
8.0	RECOMMENDATIONS.....	9
9.0	STATEMENT of COSTS .....	9
10.0	REFERENCES.....	10
11.0	CERTIFICATION.....	122

**Tables**

<b>Table 1: Mineral Tenures.....</b>	<b>2</b>
<b>Table 2: Alteration Classification.....</b>	<b>8</b>

**Figures**

<b>Figure 1: Location Map Red Dog East Property.....</b>	<b>3</b>
<b>Figure 2: Claim Location Map.....</b>	<b>4</b>
<b>Figure 3: Regional Geology.....</b>	<b>5</b>
<b>Figure 4: Location of TerraSpec Samples.....</b>	<b>7</b>
<b>Figure 5: Alteration.....</b>	<b>8</b>

**Appendices**

- Appendix I: Report on TerraSpec Spectral Analysis Analyses by K. Heberlein, P. Geo**
- Appendix II Geographical Co-ordinates of Spectral Samples**
- Appendix III: Sample location map**

## **1.0 SUMMARY**

The Pemberton Hills claims are owned by North Island Mining, a fully owned subsidiary of Northisle Copper and Gold Inc.

The property covers a monotonous sequence of andesitic to basaltic flows, tuff-breccia and tuffs of the lower Jurassic-age Bonanza Group, which have been intruded by quartz diorite and granodiorite of the Island Intrusions of Jurassic age. Past exploration of the area has identified an area of silicification and clay alteration measuring roughly 3.5 kilometres by 1.5 kilometres centred on a topographic feature referred to as the Pemberton Hills. Previous work including, prospecting, large scale mapping, shallow drilling and geophysical surveying have been inconclusive with respect to determining the cause of the alteration. Early work surmised the alteration was largely epithermal in nature while more recent work viewed the alteration as being related to a deeply buried porphyry copper system. To better understand the exact nature of the alteration, 88 samples of rock were collected from outcrops spread over the 3.5 by 1.5 kilometre alteration zone and sent to Ms. Kim Heberlein, PGeo for TerraSpec spectral analyses.

The TerraSpec analyses shows a range of alteration types present in the samples from propylitic to advanced argillic alteration. Of most interest is the presences of pyrophyllite, zunyite and topaz, minerals that are present in the high level alteration overlying the southern part of the nearby Hushamu Deposit and also present in high level alteration at the Red Dog Deposit. Three locations within the broader altered appear to be more intensely altered and may be above buried intrusions and related porphyry – type copper mineralization.

Three proof of concept drill holes each 500 metre deep are recommended to be drilled as shown on Figure 5.

## **2.0 INTRODUCTION AND TERMS OF REFERENCE**

The Pemberton Hills area has long been known as large area of strong hydrothermal alteration of uncertain origin. Initially thought to be related to an epithermal gold system, recent workers have thought the alteration could be related to a deeply buried porphyry copper system. To help characterize the alteration types present at Pemberton Hills, a spectral analysis study of rocks collected from outcrops and road cuts was carried out from 17 February to 19 February 2017.

## 3.0 PROPERTY DESCRIPTION AND LOCATION

### 3.1 LOCATION AND ACCESS

The Pemberton Hills claim group area is located at the northern end of Vancouver Island, in British Columbia, Canada. Geographic coordinates are 50° 37.8' north latitude and 127° 46.2' west longitude. The claims are owned by North Island Mining a wholly owned subsidiary of Northisle Copper and Gold Inc.

Access to the claim block is from Coal Harbour by the Coal Harbour Forrest Access Road, then by the Wanokana Road. From the Wanokana Road, the central part of the area is accessible from the Pemberton 100 spur and the Hushamu spur roads. Tide water is within 4 kilometres from any part of the area of interest.

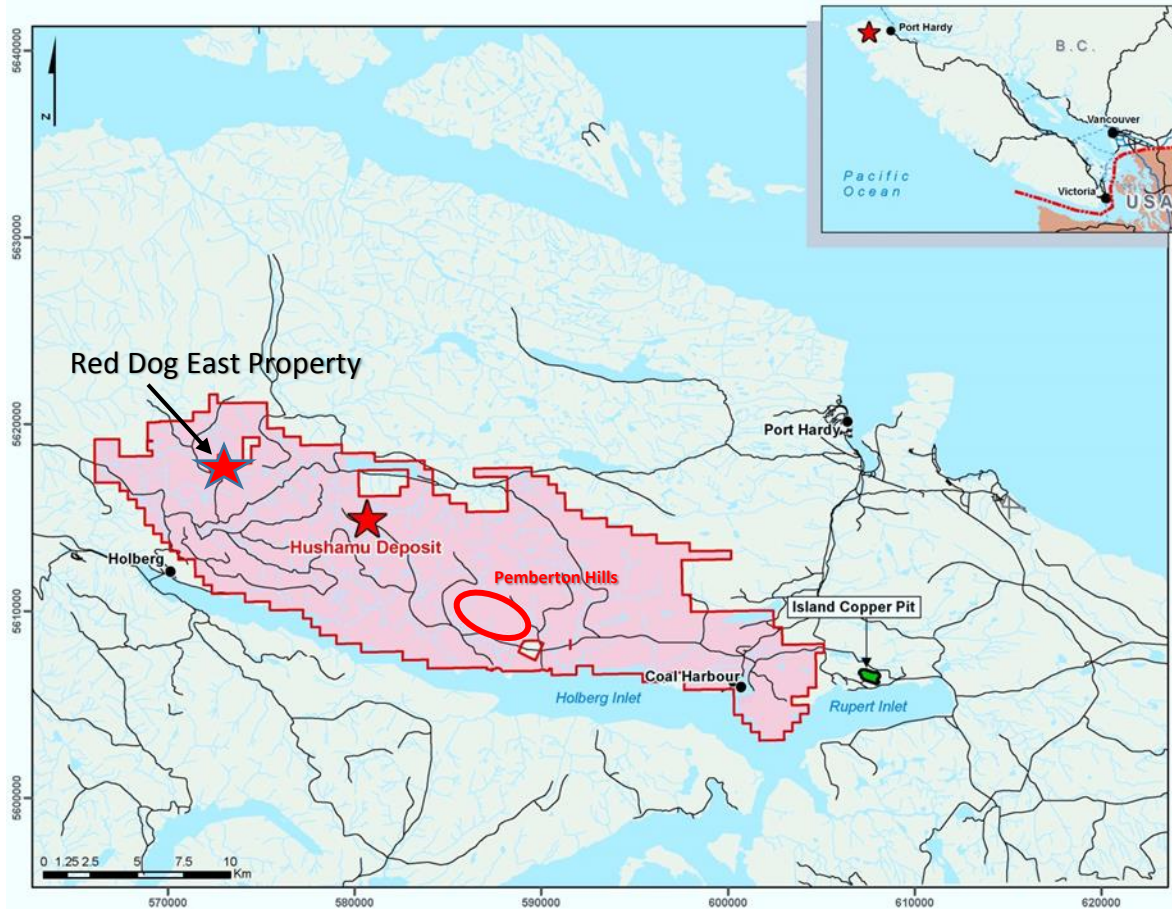
### 3.2 MINERAL TENURE INFORMATION

The Pemberton Hills claim group area consists of twelve (12) mineral claims totaling 4,956.8 has. (Table 1). The property is located on NTS map sheet 94L/12W in the Nanaimo Mining Division, approximately 20 km southwest of Port Hardy, BC, Vancouver Island B.C. The geographic coordinates of the approximate property centre are 50 42.5' N latitude 127 57.8' W longitude (Figures 2).

**Table 1: Mineral Tenures**

Record No.	Claim Name	Issue Date	Good to Date	New Good to Date	Area Has.
518531		2005/JUL/29	2017/APR/01	2018/APR/01	511.76
512122	FIL 25	2005/MAY/05	2017/APR/01	2018/APR/01	245.75
515277		2005/JUN/25	2017/DEC/11	2017/DEC/11	245.85
516527		2005/JUL/09	2017/DEC/11	2017/DEC/11	163.94
513929		2005/JUN/04	2018/DEC/11	2018/DEC/11	430.36
515281		2005/JUN/25	2017/DEC/11	2017/DEC/11	614.93
398335	Apple Bay Twenty	2002/NOV/16	2017/DEC/11	2017/DEC/11	500
516078		2005/JUL/05	2018/DEC/11	2018/DEC/11	286.99
374744	Apple Bay Four	2000/MAR/11	2017/DEC/11	2017/DEC/11	400
513931		2005/JUN/04	2018/DEC/11	2018/DEC/11	696.95
506021	Wanakana Central	2005/FEB/06	2017/DEC/11	2017/DEC/11	348.31
512091	FILL 5	2005/MAY/05	2018/DEC/11	2018/DEC/11	511.96

The claims are currently registered in the name of North Island Mining Corp., a wholly owned subsidiary of Northisle Copper and Gold Inc.



**Location Map, Fig. 1**

NAD 83 Zone 9

### 3.3 PHYSIOGRAPHY AND CLIMATE

The area is characterized by moderate to steep relief in the order of 250 metres between valley bottoms and hill tops. Much of the area is best described as a plateau dissected by steep walled creeks, which from east to west are known as Steves and Younghan creeks.

Much of the area has been logged with only a few stands of old growth remaining. Secondary growth has established in some areas. Traversing can be difficult particularly in areas of the most recent logging.

Climate in the area of the Property is typical of coastal areas of British Columbia with an annual precipitation of 2,500 mm, and a daily average temperature of 8.8°C (Environment Canada, 1971-2000). Winters are very wet, with 75% of the annual precipitation occurring from October to March, mostly as rainfall at lower elevation, but with significantly increasing percentage of snowfall accumulation above 300 m in elevation. Generally, exploration and development work is possible for most of the year, allowing for a long exploration field season.





Since the work by Moraga, little exploration has been carried out on the property. In 2012, Northisle completed a limited induced polarization survey and large scale mapping. The visual similarity of the alteration at Pemberton Hills with that on Mount Macintosh, where the alteration overlies copper – gold porphyry mineralization at depth, prompted the current TerraSpec Xray diffraction study. The objective was to confirm the mineralogical similarities between the two alteration systems.

## **5.0 REGIONAL GEOLOGY**

The regional geology of the Rupert area was mapped by Nixon et al. (2006) and the following summary is a synopsis of Nixon's paper. Figure 3 shows the bedrock geology of northern Vancouver Island. Vancouver Island is comprised of Upper Paleozoic to Lower Mesozoic rocks of Wrangellia – a tectonostratigraphic terrane that occurs discontinuously northward as far as central Alaska. This terrane was amalgamated to the Alexander Terrane of the Alaskan Panhandle (together comprising the Insular Superterrane) by Late Carboniferous time. Subsequently, these terranes were accreted to North America between the Middle Jurassic and the mid-Cretaceous. Thus, Vancouver Island records an early allochthonous history, and a later history with commonality to the North American margin.

The pre-accretion history of Wrangellia is represented by the Paleozoic Sicker Group and the Middle Triassic Karmutsen Formation. The Sicker Group comprises marine Devonian to Early Permian volcanic and sedimentary rocks that host VMS deposits such as at Myra Falls. The Karmutsen conformably overlies the Sicker Group and comprises basaltic and minor sedimentary rocks that underlie about 50% of Vancouver Island. This unit is up to 6000 m thick. Richards et al. (1991) argued that the Karmutsen was initiated by, and extruded above a mantle plume and recent geochemical data support an oceanic plateau origin for the Karmutsen (Greene et al., 2006). The Karmutsen is in turn conformably overlain by the Quatsino Formation of limestone consistent with a period of quietude following impingement of a mantle plume.

The Bonanza Arc (DeBari et al., 1999) formed along the length of Vancouver Island during accretion of Wrangellia. Owing to later tiling, products of this arc from various crustal depths are all preserved. These include the Westcoast Crystalline Complex, Island Intrusions and the Bonanza Group volcanic rocks. DeBari et al. (1999) argue that all these components have similar ages and geochemical signatures and that they are therefore all products of a single arc. Ages for these rocks range from ca 190 to 169 Ma. Intrusive rocks of the Island Intrusions are responsible for porphyry copper mineralization on Vancouver Island.

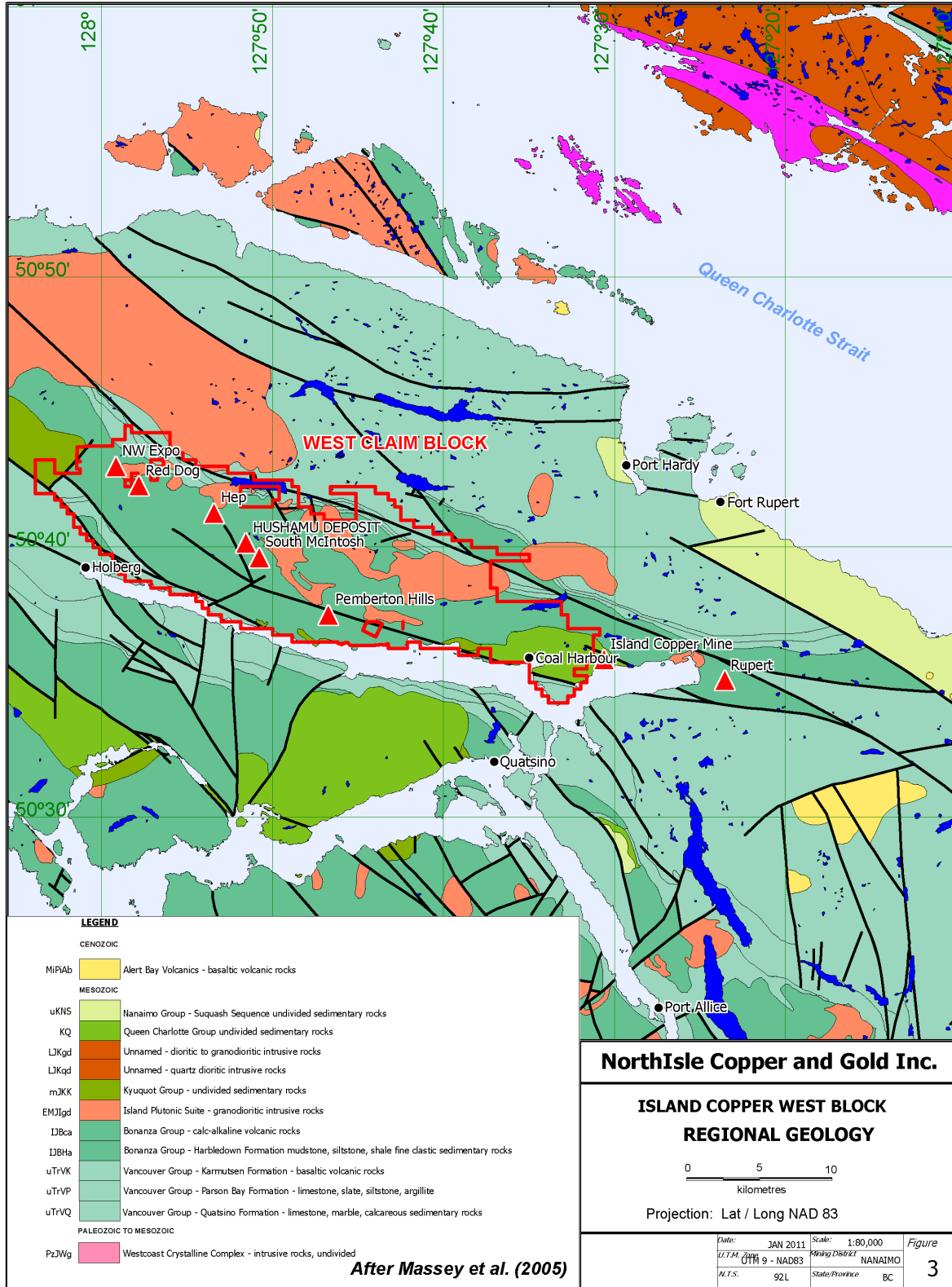


Fig. 3 Regional Geology

# 6.0 TERRASPEC SURVEY

## 6.1 SURVEY

This year’s study focussed on collecting rock samples over a broad area of the Pemberton Hills Alteration Zone. The objective was to characterize the alteration through TerraSpec spectral analysis so that the rocks could be compared with the alteration overlying the Hushamu porphyry copper deposit. A total of 88 rock samples were selected for TerraSpec spectral analysis. Appendix III shows the site location of TerraSpec samples. The geographic co-ordinates of the site locations of the TerraSpec samples are in Appendix II. A report by K Heberlein, P. Geo describing the results of the spectral analysis is provided in Appendix I.

Rock samples used in the spectral analysis were collected from outcrops using a geological hammer. Specimens were trimmed using the hammer to ensure at least two clean faces were exposed. The sample was then placed into a cloth bag, numbered with a felt marker pen and the location of the sample measured with a handheld GPS unit.

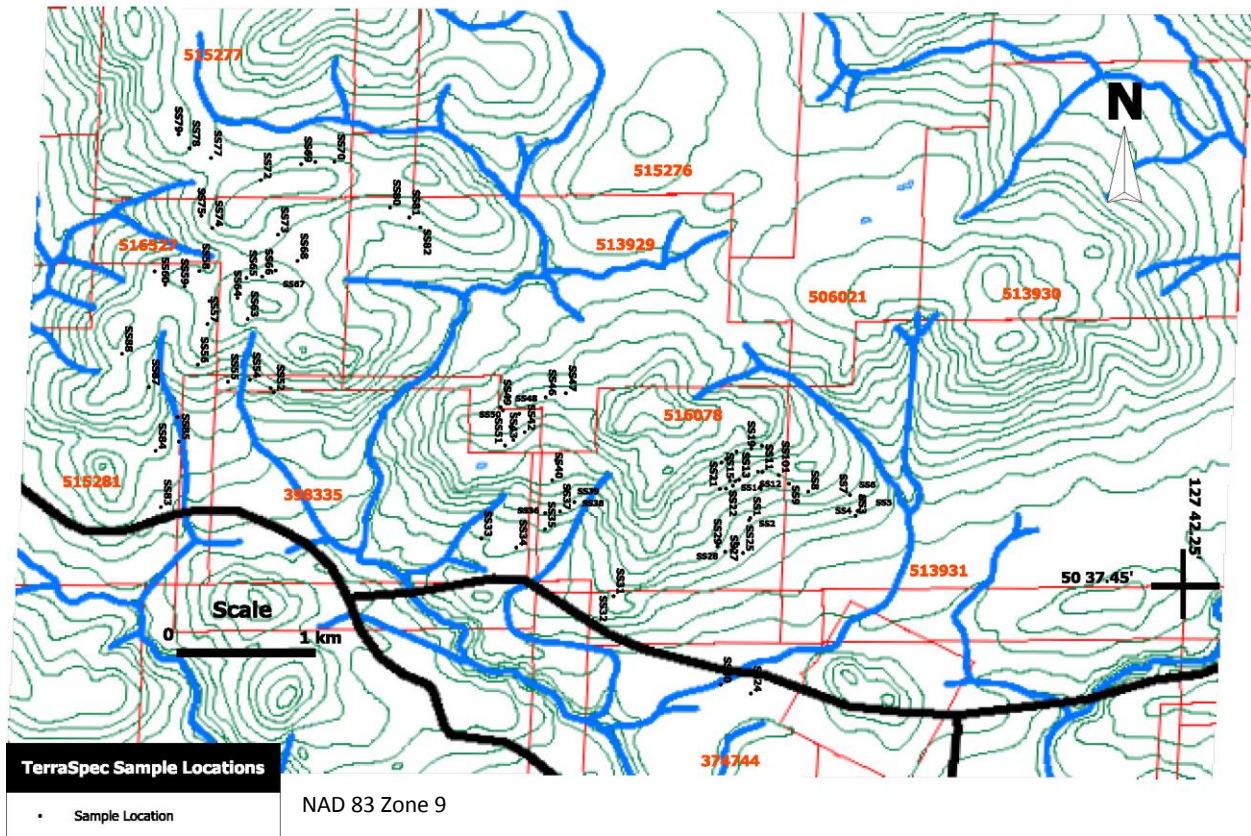


Fig. 4

## 6.2 RESULTS

The results of the TerraSpec analyses were grouped by key mineralogical suites into categories of porphyry copper related alteration types summarized in Table 2 and shown in Figure 5.

**Table 2 Alteration Classification**

Alteration Type	Diagnostic Minerals
Advanced Argillic	Pyrophyllite, dickite, diaspore +/-zunyite, topaz
Phyllic	Illite,
Intermediate Argillic	Illite, chlorite
Propylitic	Chlorite, epidote

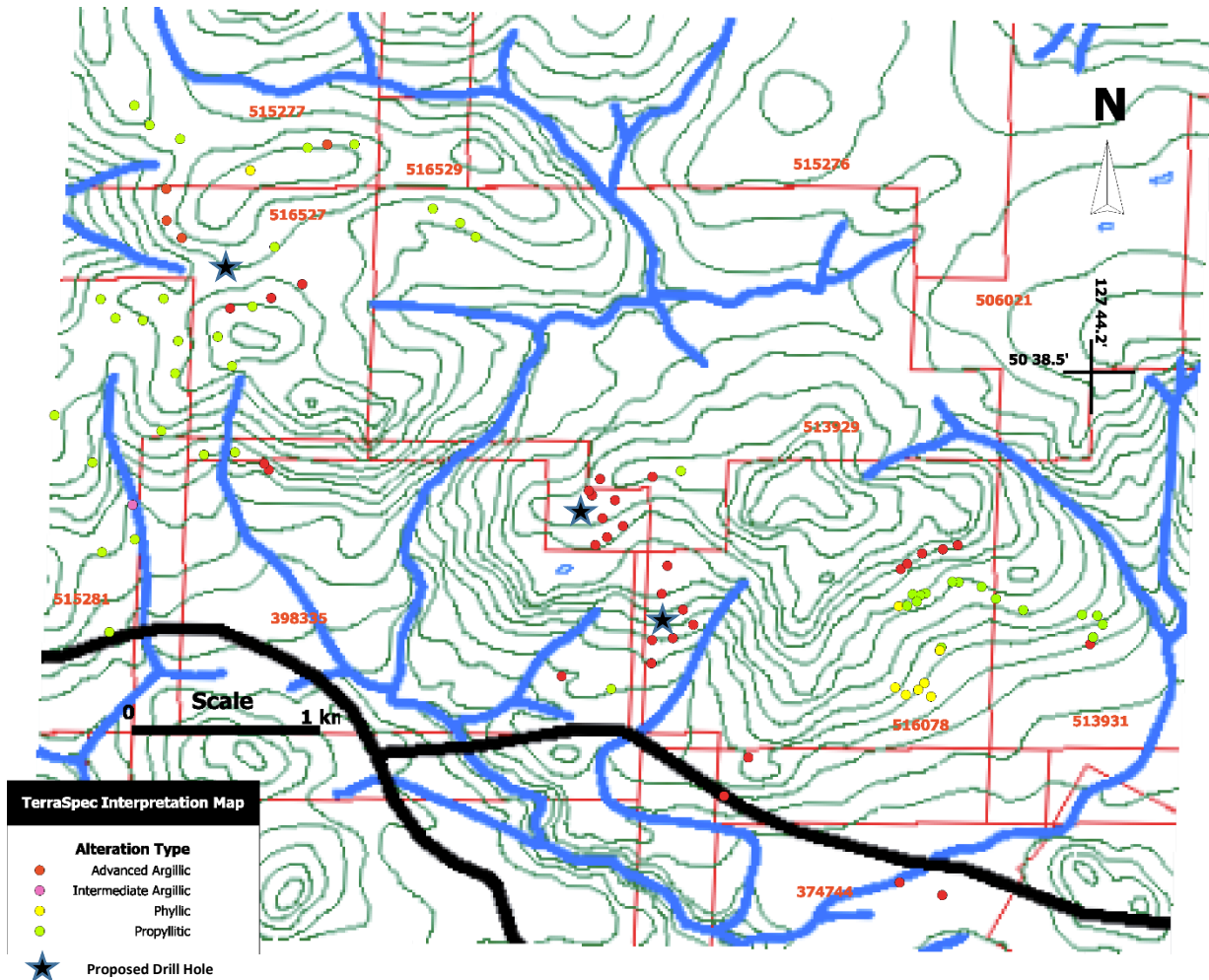


Fig. 5 Alteration

NAD 83 Zone 9

## 7.0 CONCLUSIONS

The TerraSpec analyses shows a range of alteration types present in the samples from propylitic to advanced argillic alteration. Of most interest is the presences of pyrophyllite, zunyite and topaz, minerals that are also present in the high level alteration overlying the southern part of the nearby Hushamu Deposit and as well in high level alteration at the Red dog Deposit. Three locations within the broader altered appear to be more intensely altered and may be above buried intrusions and related porphyry – type alteration.

## 8.0 RECOMMENDATIONS

Three proof of concept drill holes each 500 metre deep are recommended to be drilled as shown on Fig. 5

## 9.0 STATEMENT of COSTS

### Preparatory Work

9 February 2017

J. McClintock: Planning / Maps / Supplies 2hrs@ \$100/ hr **\$ 200.00**

### Field Related

John McClintock P. Eng: Sampling and travel

17 February through 19 February: 29hrs @ \$100 / hr \$2,900.00

Santiago Seilers, BSc Sampling and travel

16 February through 19 February: 32 hrs @ \$56 / hr \$1,792.00

Accommodation Port Hardy	\$207.00	
Meals Port Hardy	\$150.50	
Truck and fuel, 3.25 days @ \$75 per day	\$243.75	
TerraSpec Spectral Analysis K Heberlein	\$3080.00	
		<b>\$ 8,373.25</b>
<b>Report Preparation</b>		
J. McClintock P.Eng 24 May, 8hrs@\$100/hr	\$800.00	
<b>Total Expenditures</b>		<b>\$9,373.25</b>

## 10.0 REFERENCES

**Clouthier, G., 1983:** B.C.D.M. Assessment Report #3402.

**Dasler, P.O., and Sutton, G.A. 1991:** Assessment Report of Reverse Circulation Drilling on the WANN Property, Northern Vancouver Island, British Columbia; Assessment Report #21053

**DeBari, S. M., Anderson, R. G., and Mortensen, J. K., 1999,** Correlation among lower to upper crustal components in an island arc: the Jurassic Bonanza arc, Vancouver Island, Canada: Canadian Journal of Earth Sciences, v. 36, p. 1371-1413.

**Greene, A. R., Scoates, J. S., Nixon, G. T., and Weis, D., 2006,** Picritic Lavas and Basal Sills in the Karmutsen Flood Basalt Province, Wrangellia, Northern Vancouver Island, BC. British Columbia Geological Survey, pp. 39-54.

- Jones, H.M., 1988,** A report filed on the Expo property Holberg Inlet, for Moraga Resources ltd. Files V.S.E. Qualifying Report.
- Nixon, G. T., Hammack, J. L., Koyanagi, V. M., Payie, G. J., Haggart, J. W., Orchard, M. J., Tozer, T., Archibald, D. A., Friedman, R. M., Palfy, J., and Cordey, F., 2000,** Geology of the Quatsino-Port McNeill Map Area, Northern Vancouver Island, B.C. Ministry of Energy and Mines Geoscience Map 2000-6.
- Nixon, G. T., Hammack, J. L., Payie, G. J., Snyder, L. D., Koyanagi, V. M., Hamilton, J. V., Panteleyev, A., Massey, N. W. D., Haggart, J. W., and Archibald, D. A., 1997,** Geology of Northern Vancouver Island: Preliminary Compilation, B.C. Ministry of Energy and Mines Open File 1997-13.
- Nixon, G. T., Kelman, M. C., Stevenson, D., Stokes, L. A., and Johnston, K. A., 2006,** Preliminary Geology of the Nimpkish Map Area (NTS 092L/07), Northern Vancouver Island, British Columbia. British Columbia Geological Survey, pp. 135-152.
- Nixon, G.T., et al. 2006:** Geology of the Holberg – Winter Harbour area, northern Vancouver Island; BC Ministry of Energy Mines and Petroleum Resources, Geoscience Map 20011-3.
- Northcote, K.E., 1970:** Rupert Inlet – Cape Scott Map – Area in BC Dept of Mines Petrol. Res. G.E.M. 1972. Pp 293-298
- Kesler, S.E. 1985:** Report on Geological Review of the Macintosh – Pemberton Precious Metal Exploration Area. Private Report to BHP-Utah Mines Ltd., June 1985.
- Pawliuk, D.J., 1992:** Assessment Report Diamond Drilling on the WANN Property North Vancouver Island B.C. Assessment Report B.C.D.M. #22374
- Pearson B.D. 1983:** Geology, Petrography, silt and rock geochemistry of Wanda Claims B.C.D.M. Assessment Report March 22, 1983.
- Pearson, D.B. 1987:** Rock and Soil Geochemistry Stat – Wanda Claims March 14, 1987. B.C.D.M. Assessment Report # 15876
- Richards, M. A., Jones, D. L., Duncan, R. A., and DePaolo, D. J., 1991,** A mantle plume initiation model for the Wrangellia flood basalt and other oceanic plateaus: Science, v. 254, p. 263-267.
- Young, M., 1969:** Geological and Geochemical Assessment Report on the Expo Claim Group for Utah Mines Ltd. Assessment Report #2190.

## 11.0 CERTIFICATION

I, John McClintock, residing at 902 – 1470 Pennyfarthing Drive, Vancouver, British Columbia, do hereby certify that:

1. I am a consulting Geologist;
2. I obtained a BSc (Hons) from the University of British Columbia in 1973 and an MBA from Simon Fraser University in 1989;
3. I have continually practised my profession as a geologist since 1973;
4. I am a member in good standing of the Association of Professional Engineers and Geoscientists of British Columbia registration number 12078;
5. I visited the property from 17 February to 19 February, 2017 and am responsible for the work carried out on the property;
6. I own shares and have share options in Northisle Copper and Gold Inc. and am the President of the company.

Dated at Vancouver, British Columbia, May 24, 2017

Signed and Sealed

*John A. McClintock*

John McClintock P. Eng



**Appendix I**  
**Report by K. Heberlein P.Ge**

Kim Heberlein  
21146 Stonehouse Avenue  
Maple Ridge, B.C.  
Canada V2X 8L9  
Cell: 778-228-5231  
Tel: 604-466-2087

6<sup>th</sup> March 2017

Northisle Copper and Gold Inc  
1800 – 570 Granville Street  
Vancouver, BC  
V6C 3P1

Attn: Jack McClintock  
Re: TerraSpec Analysis (KH236/Pemberton)

TerraSpec spectral analysis was run on 88 grab samples from the Pemberton property. A minimum of two readings were taken off each sample. Spectral quality is mostly good to excellent. Some readings were aspectral due to the presence of disseminated sulphides or possibly to a lack of infrared active minerals. The results are on the attached Excel sheet.

Minerals identified include alunite, pyrophyllite, diaspore, topaz, dickite, kaolinite, illite, smectite, chlorite, epidote, zeolite, prehnite, Fe oxy/hydroxides, probable silica and amphibole.

There are two distinct types of alteration, one smectite-chlorite dominant and the other pyrophyllite-alunite dominant.

Smectites include montmorillonite and beidellite (Al smectite).

Illite composition ranges from “normal” potassic to high Al (paragonitic; wavelengths below 2200nm). Crystallinity varies from smectite-illite to moderately crystalline.

Chlorite compositions range from intermediate Mg>Fe to Fe-rich. Intermediate FeMg composition is most common.

Amphibole is weakly indicated in a number of spectra; unfortunately all of these were very noisy in the upper wavelengths to the point that no positive identification could be made. Identification is based more on the shape of the spectrum in the visible wavelengths.

Zeolite is common, generally on fracture surfaces and associated with smectite.

Carbonates are likely present in a few samples but do not show up well as they are mixed with mafic minerals. The shape of the spectra in the VIS range suggests Fe carbonate (e.g. SS09).

Epidote is also likely present in more samples than it was definitely identified in, as it is mixed with chlorite.

Pyrophyllite is present in a number of samples with diaspore, kaolinite and/or possible dickite.

Alunite is identified in a few samples. Composition is mainly potassic, but one sample (SS20) shows a slight double peak indicating the probable presence of both potassic and sodic alunite together.

Fe oxyhydroxides include goethite and hematite.

Silica is not infrared active but is suggested by the presence of large water features in the spectra. Identification is visually confirmed.

If you have any questions regarding this analysis, please don't hesitate to contact me.

Best Regards

Kim Heberlein, P.Geol.  
[kimheberlein@telus.net](mailto:kimheberlein@telus.net)

TSP SPECTRAL ANALYSIS  
Pemberton

SAMPLE ID	2200 WAVE	2250 WAVE	2300 WAVE	Fe E WAVE	ALUN WAVE	ALUN	PYRO	DIAS	TOPAZ	DIK	KAO	ILL	SMEC	CHL	EPID	AMPH	CAR	GOE	HEM	ZEO	PREH	SIL	COMMENTS	Mineral ID_1	Mineral ID_2	Mineral ID_3	
SS01.000	2207	2249	2350	787									X	x				x					fg granitic, gy/wh/pink mottled/ diss sus	Montmorillonite	MgFe Chlorite		
SS01.001	NULL	NULL	NULL	797																X			Pink	Zeolite			
SS02.000	2200	2248	2343	NULL								X		x									Lt gngy mod hard fg, f.diss sus	Illite	MgFe Chlorite		
SS02.001	2201	2249	2349	NULL							q	X	x	Tr									Fract	Illite	Montmorillonite	Tr Chlorite	
SS03.000	2201	2260	2347	804							x		X	p				x		x			Pink/gy fg intrus	Montmorillonite	Zeolite	Kaolinite	
SS03.001	NULL	NULL	NULL	NULL																X			White fract	Zeolite			
SS04.000	2201	2251	2347	NULL									X	x									GnGy fg mod hard	Montmorillonite	FeMg Chlorite		
SS04.001	2207	2252	2345	NULL							q		X	x											Montmorillonite	FeMg Chlorite	
SS05.000	2210	2247	2322	NULL									x	p		p				X			Gngy mod hard/wh speckled/xln	Zeolite	Montmorillonite	Amphibole?	
SS05.001	2236	NULL	2358	798														x		X	x		White Fract	Zeolite	Prehnite		
SS06.000	2203	2255	2332	NULL									X	x								q	Gngy mod hard/wh speckled/xln. Strong 678nm feature in VIS unidentified	Montmorillonite	Fe Chlorite		
SS06.001	NULL	NULL	NULL	NULL																X			White Fract. Strong feature at 678nm related to zeolite?	Zeolite			
SS07.000	2209	2253	2347	NULL									X	x	q					p			Pink/gy xln intr, gn mottled. All fs	Montmorillonite	FeMg Chlorite	Zeolite	
SS07.001	2211	2255	NULL	NULL									Tr	p						X			White Fract	Zeolite			
SS08.000	2203	2251	2341	NULL									x	X								x?	Med gy fg dac. V noisy spectra	FeMg Chlorite	Montmorillonite		
SS08.001	2201	2254	2345	NULL									X	X									Gy mod soft/white mottled. diss sus/FeOx fract	FeMg Chlorite	Montmorillonite		
SS09.000	2210	2244	2350	710								x	X	Tr		p							Gngy fg mod soft. Weak suggestion of Fe carbonate?	Montmorillonite	Illite_low Al	Tr Chlorite	
SS09.001	2211	2249	2349	735								x	X	Tr					x				Gngy fg mod soft	Montmorillonite	Illite_low Al	Tr Chlorite	
SS10.000	2205	2257	NULL	NULL									Tr	Tr						X			Pink/gy/gn speckled	Zeolite	Tr Montmorillonite	Tr Chlorite	
SS10.001	NULL	NULL	NULL	NULL										Tr						X			White fract	Zeolite		Tr Chlorite	
SS11.000	2207	2251	NULL	792									X	Tr				x					Gy/white mottled	Montmorillonite		Tr Chlorite	
SS11.001	2207	NULL	NULL	802									Tr					x		X			Fract	Zeolite		Tr Montmorillonite	
SS12.000	2211	2253	NULL	NULL									x	Tr						X			Gy/white mottled	Zeolite	Montmorillonite	FeMg Chlorite	
SS12.001	NULL	2252	NULL	NULL										Tr						X			Pink white fract	Zeolite		Tr Chlorite	
SS13.000	2213	2251	2345	NULL									X	x									Dk gy fg/mod soft, diss sus	Montmorillonite	FeMg Chlorite		
SS13.001	2217	2251	2341	NULL									X	x											Montmorillonite	FeMg Chlorite	
SS14.000	2212	2253	2341	NULL									X	x									Dk gy fg/mod soft, diss sus. V noisy	Montmorillonite	FeMg Chlorite		
SS14.001	2213	2251	2341	NULL									X	x											Montmorillonite	FeMg Chlorite	
SS15.000	2209	2253	NULL	710									p	p		q				X			Gy/white powdery altn	Zeolite		Tr Chlorite	
SS15.001	2215	NULL	NULL	NULL									X	Tr											Montmorillonite		Tr Chlorite
SS16.000	2167	NULL	NULL	702			X				x											x?	White soft dusty/soapy altn	Pyrophyllite	Kaolinite	Silica?	
SS16.001	2167	NULL	NULL	711			X				x											x?		Pyrophyllite	Kaolinite	Silica?	
SS17.000	2198	2241	2341	NULL							p	q	x	Tr			X					x?	Gy fg/massive mod soft, f diss sus	Beidellite	Fe Carbonate	Tr Chlorite	
SS17.001	2199	2247	2347	NULL							Tr		x	Tr			X					x?		Fe Carbonate	Beidellite	Tr Kaolinite	
SS18.000	2208	NULL	NULL	800	1480	Tr					X							x				x?	Pk/gy fg diss sus, mod soft. Well xld kaolinite	Kaolinite	Alunite	Silica?	

X=major spectral component;x=minor component;Tr=Trace;p=probable;q=questionable

K. Heberlein

**TSP SPECTRAL ANALYSIS**  
**Pemberton**

SAMPLE ID	2200 WAVE	2250 WAVE	2300 WAVE	Fe E WAVE	ALUN WAVE	ALUN	PYRO	DIAS	TOPAZ	DIK	KAO	ILL	SMEC	CHL	EPID	AMPH	CAR	GOE	HEM	ZEO	PREH	SIL	COMMENTS	Mineral ID_1	Mineral ID_2	Mineral ID_3	
SS18.001	2208	NULL	NULL	766	1482	Tr				x	X							x				x?		Kaolinite	Alunite	Dickite	
SS19.000	2167	NULL	NULL	NULL	1482	x	X				x											x?	Pk/gy fg diss sus, mod soft	Pyrophyllite	Alunite	Kaolinite	
SS19.001	2169	NULL	NULL	NULL	1481	X	x			q	x													Yellow fract dusting. Double peak 1481/1488nm suggests both K and Na alunite present	Alunite	Pyrophyllite	Kaolinite
SS20.000	2208	NULL	NULL	NULL	1481	Tr				X	X													Gy mod hard/white earthy patches	Kaolinite	Dickite	Tr Alunite
SS20.001	2208	NULL	NULL	NULL	1481	Tr				X	X													Good xln kaolinite	Kaolinite	Dickite	Tr Alunite
SS21.000	2207	2244	2347	NULL	NULL						x	x	X	x			q							Gy mod hard/white speckled	Montmorillonite	Illite	MgFe Chlorite
SS21.001	2207	2249	2343	NULL	NULL								X	x			q								Montmorillonite	MgFe Chlorite	
SS22.000	2209	2253	2341	NULL	NULL								Tr	x						X					Gngy fg mod hard	Zeolite	FeMg Chlorite
SS22.001	2199	2251	NULL	NULL	NULL								Tr	Tr						X					Pink fract	Zeolite	Tr Chlorite
SS23.000	NULL	2255	NULL	NULL	NULL									q	q										Gngy fg mod hard/pink mottled	Zeolite	
SS23.001	NULL	2257	NULL	NULL	NULL									q	q											Zeolite	
SS24.000	2205	NULL	NULL	NULL	NULL					X		q											x?	Gy/offwhite banded/hard. Diss sus	Dickite		
SS24.001	2207	NULL	NULL	NULL	NULL					X													x?	White fract	Dickite	Silica?	
SS25.000	2190	NULL	2351	NULL	NULL							x	X												Gy/white v soft, strong FeOx fract	Beidellite	Illite_Hi Al
SS25.001	2190	NULL	2347	760	NULL							X						x					X?		Silica?	Illite_Hi Al	
SS26.000	2193	NULL	2347	796	NULL							x	X					x							Gybn mod soft fg	Beidellite	Illite_Hi Al
SS26.001	2194	NULL	2347	796	NULL							x	X					x								Beidellite	Illite_Hi Al
SS27.000	2210	2251	2347	NULL	NULL							X		x											Gngy fg/white speckled	Illite_low Al	FeMg Chlorite
SS27.001	2209	2251	2341	NULL	NULL							X		x												Illite_low Al	FeMg Chlorite
SS28.000	2196	NULL	2347	NULL	NULL							X													Gy/white dusty altn mod hard, diss sus	Illite_Hi Al	
SS28.001	2198	NULL	2351	766	NULL							X						x								Illite_Hi Al	
SS29.000	2195	NULL	2347	762	NULL							X						x							White hard leached altn/abund FeOx Speckled	Illite_Hi Al	
SS29.001	2196	NULL	2347	765	NULL							X						x								Illite_Hi Al	
SS30.000	2207	NULL	NULL	702	NULL					X	x												x?	Offwhite/gy mottled hard, diss sus	Dickite	Kaolinite	Silica?
SS30.001	2207	NULL	NULL	NULL	NULL					X	x												x?		Dickite	Kaolinite	Silica?
SS31.000	2207	NULL	NULL	NULL	NULL					q	Tr												X	White hard	Silica		Tr Kaolinite
SS31.001	2205	NULL	NULL	NULL	NULL					q	Tr												X	White hard	Silica		Tr Kaolinite
SS32.000	NULL	NULL	NULL	NULL	NULL																		X	White hard	Silica		
SS32.001	2205	NULL	NULL	NULL	NULL					q	q												X		Silica		Clay
SS33.000	2205	NULL	NULL	804	NULL						x		X					x							Bkbn soft/white speckled/lim	Montmorillonite	Kaolinite
SS33.001	2205	NULL	NULL	791	NULL						x		X					x								Montmorillonite	Kaolinite
SS34.000	2209	NULL	NULL	789	NULL								q	q		p									Bk aph/clear fs, mod soft/white speckled. Features in VIS look similar to amphibole?	Aspectral	
SS34.001	2200	NULL	NULL	793	NULL								q	q		p										Aspectral	
SS35.000	2207	NULL	NULL	NULL	NULL					x													X	Bngy silic	Silica	Dickite	
SS35.001	2207	NULL	NULL	NULL	NULL					x													X		Silica	Dickite	

X=major spectral component;x=minor component;Tr=Trace;p=probable;q=questionable

K. Heberlein

**TSP SPECTRAL ANALYSIS**  
**Pemberton**

SAMPLE ID	2200 WAVE	2250 WAVE	2300 WAVE	Fe E WAVE	ALUN WAVE	ALUN	PYRO	DIAS	TOPAZ	DIK	KAO	ILL	SMEC	CHL	EPID	AMPH	CAR	GOE	HEM	ZEO	PREH	SIL	COMMENTS	Mineral ID_1	Mineral ID_2	Mineral ID_3			
SS36.000	2207	NULL	NULL	NULL	NULL					x	X												X?	Gy/offwhite stripey altn, mod hard	Silica?	Kaolinite	Dickite		
SS36.001	2207	NULL	NULL	NULL	NULL					x	X												X?		Silica?	Kaolinite	Dickite		
SS37.000	2207	NULL	NULL	NULL	NULL					X	x														Gy/white dusty altn	Dickite	Kaolinite		
SS37.001	2207	NULL	NULL	770	1493	Tr				X								x							White soft mass. Small single feature at 1493nm probable natroalunite?	Dickite	Silica?	Natroalunite?	
SS38.000	2207	NULL	NULL	714	NULL					X	x												x?	Gy/white speckled hard/diss sus	Dickite	Kaolinite	Silica?		
SS38.001	2207	NULL	NULL	701	NULL					X	x												x?	Gy/white mottled, diss sus	Dickite	Kaolinite	Silica?		
SS39.000	2208	NULL	NULL	NULL	NULL					X	x														Pink mass	Dickite	Kaolinite		
SS39.001	2208	NULL	NULL	713	NULL					X	x																Dickite	Kaolinite	
SS40.000	2210	NULL	NULL	NULL	NULL																		X	Cream/off white silic	Opal?				
SS40.001	2205	NULL	NULL	NULL	NULL																		X		Opal?				
SS41.000	2208	NULL	NULL	763	NULL					X								x					x?	Gy/white mottled silic, open spaces FeOx lined	Dickite	Silica?			
SS41.001	2208	NULL	NULL	774	NULL					X								x					x?		Dickite	Silica?			
SS42.000	2208	NULL	NULL	NULL	NULL					X	x												x?	Offwhite/white mottled	Dickite	Kaolinite	Silica?		
SS42.001	2208	NULL	NULL	785	NULL					X	x							x								Dickite	Kaolinite	Silica?	
SS43.000	2208	NULL	NULL	NULL	NULL						X												x?	Offwhite/bn, mod soft	Kaolinite		Silica?		
SS43.001	2208	NULL	NULL	722	NULL						X												x?	Yellowish sfce	Kaolinite		Silica?		
SS44.000	2205	NULL	NULL	711	NULL					X	Tr												x?	Gy/white dusty mottled	Dickite	Silica?	Tr Kaolinite		
SS44.001	2205	NULL	NULL	NULL	NULL					X	Tr															Dickite		Tr Kaolinite	
SS45.000	2207	NULL	NULL	702	NULL					X													x?	Gy/pale gn mottled soft altn, f diss sus	Dickite	Silica?			
SS45.001	2207	NULL	NULL	703	NULL					X	Tr												x?	Yellowish sfce	Dickite	Silica?	Tr Kaolinite		
SS46.000	2208	NULL	NULL	729	NULL					x	X												x?	Bngy silic, f diss sus	Kaolinite	Dickite	Silica?		
SS46.001	2208	NULL	NULL	712	NULL					x	X												x?	Pinker area	Kaolinite	Dickite	Silica?		
SS47.000	NULL	NULL	NULL	NULL	NULL								x	q		p									Dk bngy mod soft, clear fs unaltd? VIS features strong. Amph/Chlorite?	Montmorillonite		Amphibole?	
SS47.001	NULL	NULL	NULL	NULL	NULL								x	q		p										V. poor noisy spectra	Montmorillonite		Amphibole?
SS48.000	2208	NULL	NULL	NULL	NULL					x	X												x?	Gy qzy, abundant pink earthy altn throught	Kaolinite	Dickite	Silica?		
SS48.001	2208	NULL	NULL	NULL	NULL					x	X												x?	gy qzy area	Kaolinite	Dickite	Silica?		
SS49.000	2208	NULL	NULL	NULL	NULL					Tr	X												x?	Bx,gy gm,varied clasts. Both gm clasts leached	Kaolinite	Silica?	Tr Dickite		
SS49.001	2208	NULL	NULL	NULL	NULL						X												x?	White earthy masses	Kaolinite		Silica?		
SS50.000	2208	NULL	NULL	NULL	NULL					X													x?	Bx, gy varied w dusty buff altn throught	Dickite		Silica?		
SS50.001	2208	NULL	NULL	NULL	NULL					X	q												x?		Dickite		Silica?		
SS51.000	2205	NULL	NULL	820	NULL					X													x?	Gy/pale bn mottled variably soft altn	Dickite		Silica?		
SS51.001	2206	NULL	NULL	800	NULL					X	q												X?	Fract	Dickite		Silica?		
SS52.000	2207	NULL	NULL	NULL	NULL					X															Dk gy aph mod soft f diss sus	Dickite			
SS52.001	2207	NULL	NULL	NULL	NULL					X													x?	vn selvage?	Dickite		Silica?		
SS53.000	2207	NULL	NULL	NULL	NULL					X													x?	Offwhite mass variably soft altn	Dickite		Silica?		
SS53.001	2207	NULL	NULL	NULL	NULL					X													x?		Dickite		Silica?		
SS54.000	2214	NULL	NULL	NULL	NULL								x	q												Gngy m xln clear fs. Very noisy flat spectra	Montmorillonite		
SS54.001	NULL	NULL	NULL	NULL	NULL								p	q													Aspectral		

X=major spectral component;x=minor component;Tr=Trace;p=probable;q=questionable

K. Heberlein

**TSP SPECTRAL ANALYSIS**  
**Pemberton**

SAMPLE ID	2200 WAVE	2250 WAVE	2300 WAVE	Fe E WAVE	ALUN WAVE	ALUN	PYRO	DIAS	TOPAZ	DIK	KAO	ILL	SMEC	CHL	EPID	AMPH	CAR	GOE	HEM	ZEO	PREH	SIL	COMMENTS	Mineral ID_1	Mineral ID_2	Mineral ID_3
SS55.000	NULL	NULL	NULL	NULL	NULL								p										SAA	Aspectral		
SS55.001	NULL	NULL	NULL	NULL	NULL															X			fract	Zeolite		
SS56.000	NULL	2255	2339	NULL	NULL								x	x									SAA	Montmorillonite	FeMg Chlorite	
SS56.001	NULL	NULL	2333	NULL	NULL								p	q									v noisy spectra	Aspectral		
SS57.000	2211	2250	2328	NULL	NULL						Tr		X	Tr		q							Gywh hard silic abund vf diss sus	Montmorillonite		Tr Kaolinite
SS57.001	2213	2247	2328	NULL	NULL						Tr		X	Tr		q	q						wh earthy altn	Montmorillonite		Tr Kaolinite
SS58.000	2207	2255	2347	NULL	NULL								X	x						p			Gn/gy mottled soft altn	Montmorillonite	Fe Chlorite	
SS58.001	2211	NULL	NULL	NULL	NULL								Tr							X	x		creamwhite earthy fract	Zeolite	Prehnite	
SS59.000	2215	2254	2337	NULL	NULL								x	x	q								Dk gngy fg xln whitish fs	Montmorillonite	FeMg Chlorite	
SS59.001	2210	2251	2339	NULL	NULL								X	x										Montmorillonite	FeMg Chlorite	
SS60.000	2209	2260	NULL	NULL	NULL								x							X			Gngy gm abund wh fs/white stringers>friable	Zeolite	Montmorillonite	
SS60.001	2238	NULL	2360	NULL	NULL															X	x		White stringer	Zeolite	Prehnite	
SS61.000	2211	NULL	NULL	762	NULL								Tr					x		X			Gy silic w offwhite powdery altn	Zeolite		Tr Montmorillonite?
SS61.001	2209	2250	NULL	NULL	NULL								X	Tr										Montmorillonite		Tr Chlorite
SS62.000	2196	NULL	2324	704	NULL								p			p				X			Dk gy fg hard f diss sus. V noisy in upper waves	Zeolite	Beidellite?	Fe Carbonate?
SS62.001	2194	NULL	NULL	705	NULL								p			p				X			Weak noisy spectra	Zeolite	Beidellite?	Fe Carbonate?
SS63.000	2211	2253	2340	NULL	NULL						Tr		X	x									Dk gngy variably hard diss sus. Noisy upper waves	Montmorillonite	FeMg Chlorite	Tr Kaolinite
SS63.001	2211	2253	2324	NULL	NULL						Tr		X	x		p							2324nm possibly amphibole?	Montmorillonite	FeMg Chlorite	Tr Kaolinite
SS64.000	2213	NULL	2324	NULL	NULL								x	p									Dk gy variably soft, bk mafics. V noisy weak spectra	Montmorillonite		Chlorite?
SS64.001	2209	2251	2341	NULL	NULL								x	x									v noisy spectra	Montmorillonite	FeMg Chlorite	
SS65.000	2208	NULL	NULL	NULL	1491	Tr				x	X												Gy silic/white mottled	Kaolinite	Dickite	Tr Natroalunite?
SS65.001	2208	NULL	NULL	NULL	NULL					x	x													Dickite	Kaolinite	
SS66.000	NULL	NULL	NULL	705	NULL								p			p							Dk gy xln clear fs. Probable Fe Carbonate??	Aspectral		
SS66.001	2206	2251	2322	790	NULL						Tr		X	x	q								abund f diss sus	Montmorillonite	FeMg Chlorite	Tr Kaolinite
SS67.000	2208	NULL	NULL	NULL	NULL				X	X												X?	Gy variably soft altd abund diss sus	Dickite	Topaz	Silica?
SS67.001	2207	NULL	NULL	716	NULL				x	x												X?		Silica?	Topaz	Dickite
SS68.000	2205	NULL	NULL	716	NULL					X	x											x?	Pale bngy/buff mottled hard altd	Dickite	Kaolinite	Silica?
SS68.001	2205	NULL	NULL	708	NULL					X	x											x?		Dickite	Kaolinite	Silica?
SS69.000	2207	2251	2340	NULL	NULL								x	x	q					X			Dk gngy fg hard f diss sus	Zeolite	Montmorillonite	FeMg Chlorite
SS69.001	2205	2253	2337	NULL	NULL								x	x	q					X			Noisy upper waves	Zeolite	Montmorillonite	FeMg Chlorite
SS70.000	2194	2251	2332	797	NULL								p	q		p				X			Dk gngy hard abund f diss sus. Noisy upper waves	Zeolite		Amphibole?
SS70.001	2209	NULL	NULL	753	NULL													x		X			Offwhite fract	Zeolite		
SS71.000	2207	NULL	2330	702	NULL						x	x	X									x?	Sim to above	Montmorillonite	Ilite	Tr Kaolinite
SS71.001	2207	NULL	2353	723	NULL						x	x	X						q				Fract	Montmorillonite	Ilite	Tr Kaolinite
SS72.000	2210	2251	2335	NULL	NULL						x		X	x	q								Dk gngy hard abund f diss sus. Noisy upper waves	Montmorillonite	FeMg Chlorite	Tr Kaolinite
SS72.001	2207	2255	2339	NULL	NULL						x		X	x	q								fract	Montmorillonite	FeMg Chlorite	Tr Kaolinite

X=major spectral component;x=minor component;Tr=Trace;p=probable;q=questionable

K. Heberlein

**TSP SPECTRAL ANALYSIS**  
**Pemberton**

SAMPLE ID	2200 WAVE	2250 WAVE	2300 WAVE	Fe E WAVE	ALUN WAVE	ALUN	PYRO	DIAS	TOPAZ	DIK	KAO	ILL	SMEC	CHL	EPID	AMPH	CAR	GOE	HEM	ZEO	PREH	SIL	COMMENTS	Mineral ID_1	Mineral ID_2	Mineral ID_3	
SS73.000	2204	2249	2345	737	NULL						Tr		X	x					x				Pale bngy variably soft f diss sus	Montmorillonite	MgFe Chlorite	Tr Kaolinite	
SS73.001	2203	2247	2335	774	NULL						Tr		X	x				x						Montmorillonite	MgFe Chlorite	Tr Kaolinite	
SS74.000	2203	NULL	2339	NULL	NULL						x	x	X										Lithic tuff? Dk gy soft mx variable clasts	Montmorillonite	Illite	Kaolinite	
SS74.001	2203	2251	2351	733	NULL						Tr	x	X	q										Montmorillonite	Illite	Tr Kaolinite	
SS75.000	2197	NULL	NULL	NULL	NULL							q	q									X?	Pale bngy silic	Silica?		Beidellite?	
SS75.001	2190	NULL	2326	NULL	NULL							q	x									X?	white earthy patch	Silica?		Beidellite	
SS76.000	2167	NULL	NULL	NULL	NULL		X	x				x										x?	Gywhite perv soapy altn	Pyrophyllite	Dickite	Diaspore	
SS76.001	2167	NULL	NULL	NULL	NULL		X	x				x												Pyrophyllite	Dickite	Diaspore	
SS77.000	2209	2249	2333	NULL	NULL								X	X									Gngy silic fg sus	Montmorillonite	MgFe Chlorite		
SS77.001	2201	2249	2330	NULL	NULL								X	X										Montmorillonite	MgFe Chlorite		
SS78.000	2207	2257	2351	NULL	NULL								X	X									gygn mod hard whitish fs mafic specks	Montmorillonite	Fe Chlorite		
SS78.001	NULL	NULL	NULL	734	NULL														x	X			offwhite fract	Zeolite			
SS79.000	2211	2253	2340	NULL	NULL								x	X	p							X?	Lt gy silic hard diss sus> bk needles w sus gn replacement	Silica?	FeMg Chlorite		
SS79.001	2213	2255	2338	NULL	NULL								x	X	x		q							Gywhite hard< pale pink patches diss sus	Silica?	Epидote	FeMg Chlorite
SS80.000	2199	2253	2353	NULL	NULL								X	x										Beidellite	FeMg Chlorite		
SS80.001	2199	2255	2355	NULL	NULL								X	x									Fract	Beidellite	Fe Chlorite		
SS81.000	2205	2254	2341	NULL	NULL								X	x	x		q							Pale gngy perv w pistachio gn specks through	Montmorillonite	Epидote	FeMg Chlorite
SS81.001	2205	2253	2343	NULL	NULL								X	x	x		q					x?		Montmorillonite	Epидote	FeMg Chlorite	
SS82.000	2203	2255	2341	NULL	NULL								x	x	X		q					x?	Sim to above, more canary yellow	Epидote	Silica?	Montmorillonite?	
SS82.001	2203	2255	2341	NULL	NULL								x	x	X		q					x?		Epидote	Silica?	Montmorillonite?	
SS83.000	NULL	2253	2351	NULL	NULL								q	X									Dkgnbk v soft perv. V noisy upper waves	FeMg Chlorite		Zeolite?	
SS83.001	NULL	2259	NULL	NULL	NULL									Tr										Zeolite		Tr Fe Chlorite	
SS84.000	2211	2255	2345	NULL	NULL								X	x	x		q							Ltgygn soft<wh speckled	Montmorillonite	Fe Chlorite	Epидote
SS84.001	2211	2253	2345	NULL	NULL								X	x	x		q							Fract	Montmorillonite	Epидote	FeMg Chlorite
SS85.000	2207	2255	2347	NULL	NULL								X	x	p		q							Gygn abund wh fs	Montmorillonite	Fe Chlorite	Epидote?
SS85.001	NULL	NULL	NULL	NULL	NULL																			Pink fract	Zeolite		
SS86.000	2203	2249	2339	NULL	NULL							x		X										Dk gy mod soft. V noisy spectra	FeMg Chlorite	Illite	
SS86.001	NULL	NULL	NULL	NULL	NULL																			Fract	Aspectral		
SS87.000	2209	2249	2341	750	NULL						Tr		X	x				x						Pale bngy silic abund diss sus	Montmorillonite	MgFe Chlorite	Tr Kaolinite
SS87.001	2209	2247	2339	727	NULL						Tr		X	x					x					Montmorillonite	MgFe Chlorite	Tr Kaolinite	
SS88.000	2215	2257	2345	NULL	NULL								x	X										gygn variably soft	Fe Chlorite	Montmorillonite	
SS88.001	2211	2255	2343	NULL	NULL								x	X								x?		Fe Chlorite	Montmorillonite	Silica?	

X=major spectral component;x=minor component;Tr=Trace;p=probable;q=questionable

K. Heberlein

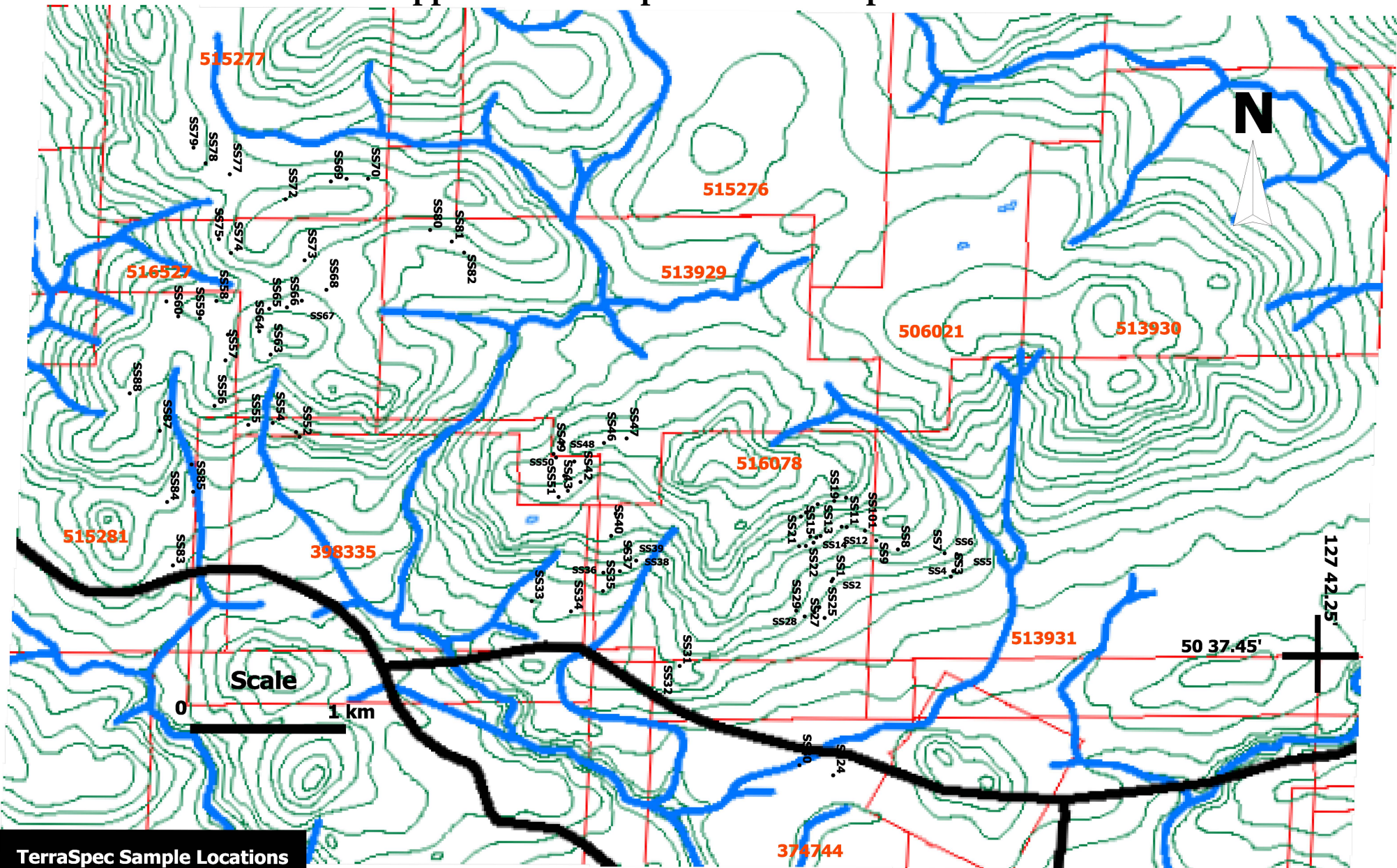


**Appendix II**  
**Geographical Co-ordinates of TerraSpec Samples**

<b>Sample site name</b>	<b>lat</b>	<b>lon</b>	<b>ele</b>	<b>Alteration type</b>
SS1	50.62856	-127.748	221.7094	PROP
SS10	50.63132	-127.745	293.2116	PROP
SS11	50.63155	-127.747	336.4353	PROP
SS12	50.63157	-127.748	341.556	PROP
SS13	50.63106	-127.75	351.338	PROP
SS14	50.63097	-127.75	356.6491	PROP
SS15	50.63103	-127.75	357.1104	PROP
SS16	50.6322	-127.751	385.1374	AdAr
SS17	50.63244	-127.751	386.6919	AdAr
SS18	50.6329	-127.75	398.0394	AdAr
SS19	50.63308	-127.748	393.5542	AdAr
SS2	50.62842	-127.749	216.17	PHYL
SS20	50.63326	-127.747	390.0735	AdAr
SS21	50.63049	-127.752	325.0368	PHYL
SS22	50.6305	-127.751	336.35	PROP
SS23	50.63068	-127.75	338.0039	PROP
SS24	50.61713	-127.749	73.87312	AdAr
SS25	50.62629	-127.749	187.458	PHYL
SS26	50.62692	-127.75	198.353	PHYL
SS27	50.62662	-127.75	220.4815	PHYL
SS28	50.62639	-127.751	221.8073	PHYL
SS29	50.62674	-127.752	242.0063	PHYL
SS3	50.62859	-127.738	167.8407	AdAr
SS30	50.61774	-127.752	105.0962	AdAr
SS31	50.62362	-127.763	230.9854	AdAr
SS32	50.62187	-127.764	164.3316	AdAr
SS33	50.62752	-127.776	237.6901	AdAr
SS34	50.62689	-127.772	241.5518	PROP
SS35	50.62805	-127.77	269.4897	AdAr
SS36	50.62912	-127.769	261.1622	AdAr
SS37	50.62919	-127.768	272.9886	AdAr
SS38	50.62979	-127.766	286.265	AdAr
SS39	50.63049	-127.767	330.3678	AdAr
SS4	50.6289	-127.737	168.3832	PROP
SS40	50.63124	-127.769	352.1027	AdAr
SS41	50.63253	-127.768	375.3953	AdAr
SS42	50.6344	-127.771	404.1117	AdAr
SS43	50.6339	-127.773	421.3064	AdAr
SS44	50.63477	-127.773	458.3147	AdAr
SS45	50.63559	-127.772	482.3487	AdAr
SS46	50.63665	-127.769	479.5113	AdAr
SS47	50.63689	-127.767	501.0926	PROP
SS48	50.63584	-127.774	480.3917	AdAr
SS49	50.63605	-127.774	483.9713	AdAr
SS5	50.62948	-127.737	183.4536	PROP
SS50	50.63659	-127.773	493.5769	AdAr

SS51	50.63355	-127.773	444.2861	AdAr
SS52	50.63726	-127.797	304.6629	AdAr
SS53	50.63755	-127.797	303.0121	AdAr
SS54	50.63809	-127.8	310.7839	PROP
SS55	50.638	-127.802	335.4705	PROP
SS56	50.63914	-127.805	379.1763	PROP
SS57	50.64177	-127.804	432.5361	PROP
SS58	50.64524	-127.805	452.3944	PROP
SS59	50.64425	-127.806	438.7792	PROP
SS6	50.6299	-127.737	191.9066	PROP
SS60	50.64437	-127.808	422.7058	PROP
SS61	50.64525	-127.809	420.0271	PROP
SS62	50.64327	-127.804	443.2378	PROP
SS63	50.64207	-127.8	494.5845	PROP
SS64	50.64344	-127.801	502.9206	PROP
SS65	50.64474	-127.8	493.5136	AdAr
SS66	50.64481	-127.798	488.9619	PROP
SS67	50.64518	-127.797	481.171	AdAr
SS68	50.6458	-127.794	471.9391	AdAr
SS69	50.65209	-127.794	525.5558	PROP
SS7	50.62995	-127.738	225.6151	PROP
SS70	50.65221	-127.79	519.3904	PROP
SS71	50.65222	-127.792	520.7691	AdAr
SS72	50.65108	-127.798	539.6248	PHYL
SS73	50.64753	-127.796	493.0591	PROP
SS74	50.64802	-127.803	480.2604	AdAr
SS75	50.64883	-127.804	480.1992	AdAr
SS76	50.65029	-127.804	477.6562	AdAr
SS77	50.65259	-127.803	481.0403	PROP
SS78	50.65325	-127.805	534.2723	PROP
SS79	50.65416	-127.806	552.3236	PROP
SS8	50.63021	-127.742	283.1861	PROP
SS80	50.64918	-127.785	438.4466	PROP
SS81	50.6485	-127.783	435.6676	PROP
SS82	50.64785	-127.782	424.5728	PROP
SS83	50.6299	-127.809	237.4345	PROP
SS84	50.63358	-127.809	280.7846	PROP
SS85	50.63415	-127.807	293.2884	PROP
SS86	50.63575	-127.807	313.3077	InAr
SS87	50.63773	-127.81	376.9595	PROP
SS88	50.63993	-127.813	410.6512	PROP
SS9	50.63075	-127.744	302.2715	PROP

# Appendix III Sample Location Map



**TerraSpec Sample Locations**

- Sample Location