BC Geological Survey
Assessment Report
37658

ASSESSMENT REPORT TITLE PAGE AND SUMMARY

TITLE OF REPORT: **Technical Report on the Yreka Mineral Claims, Vancouver Island, BC**

Dr. H. A. WASTENEYS
#32102

TOTAL COST: 15816

AUTHOR(S): Hardolph Wasteneys
SIGNATURE(S):

NOTICE OF WORK PERMIT NUMBER(S)/DATE(S):
STATEMENT OF WORK EVENT NUMBER(S)/DATE(S): 5703005:/ July 5, 2018; 571899 / November 8, 2018

YEAR OF WORK: 2018

PROPERTY NAME: Yreka

CLAIM NAME(S) (on which work was done): 943990, 944052, 954784, 1010698, 1011334, 1011538, 1011539, 1011540, 1011541, 101206, 1012793, 1012960, 1013518, 1017384, 1026664, 1029041(FEKK8), 1061432

COMMODITIES SOUGHT: Copper, Silver, Gold, Molybdenum

MINERAL INVENTORY MINFILE NUMBER(S),IF KNOWN: 092L-052; 092L-105; 092L-336; 092L-236

MINING DIVISION: Alberni Mining Division
NTS / BCGS 92L/5
LATITUDE: 50° 27' 30"
LONGITUDE: 127° 34' 00" (at centre of work)
UTM Zone: 9 EASTING: 5590250 NORTHING: 601600

OWNER(S): Karmamount Mineral Exploration Inc.

MAILING ADDRESS: 1703 West 5th Avenue, Vancouver, BC V6J 1P1

OPERATOR(S) Karmamount Mineral Exploration Inc.

MAILING ADDRESS: 1703 West 5th Avenue, Vancouver, BC V6J 1P1

REPORT KEYWORDS: Yreka, Port Alice, Bonanza group, LeMare Volcanics, Quatsino Limestone, Parsons Bay Formation, Clyde workings, skarn, crystal tuffs, Kloochlimmis Pluton

REFERENCES TO PREVIOUS ASSESSMENT WORK AND ASSESSMENT REPORT NUMBERS:
Baldys 1999, 25797; Eden & Li 2016, 36110; Hicks , 1999, 26040; Bradshaw, 1993, 22804; Ball 1980, 07981; Crossley 1972, 4425, Wasteneys, 2018,

TYPE OF WORK IN THIS REPORT	EXTENT OF WORK (in metric units)	ON WHICH CLAIMS	PROJECT COSTS APPORTIONED (incl. support)	
GEOLOGICAL (scale, area)				
Ground, mapping	1:1000 500 ha	943990, 1012506, 944052, 1012793, 954784, 1012960, 1010698, 1013518, 1011334, 1017384, 1011538, 1026664, 1011539, 1029041, 1011540, 1061432 1011541	13316	
Photo interpretation				
GEOPHYSICAL (line-kilometres)				
Magnetic				
Electromagnetic				
Induced Polarization				
Radiometric				
Seismic				
Other				
Airborne				
GEOCHEMICAL (number of samples analysed for …)				
Soil				
Silt				
Rock			2500	
Other				
PROSPECTING (scale/area)				
PREPATORY / PHYSICAL				
Line/grid (km)				
Topo/Photogrammetric (scale, area)				
Legal Surveys (scale, area)				
Road, local access (km)/trail				
Trench (number/metres)				
Underground development (metres)				
Other				
		TOTAL COST	**15816**	

Page 2 of 2

Technical Report
on the
Yreka Mineral Claims

Statement of Work Event Numbers: 5703005
(Geological, Geochemical),
Period: **June 26, 2018 to October 1, 2018**

Location:
Northern Vancouver Island,
Nanaimo Mining Division

NTS 92 L/5E
Latitude: 50° 27’ 30” N, Longitude: 127° 34’ 00” W
NAD 83

Field Project Period:
June - September, 2018

Owner and Operator:
Karmamount Mineral Exploration Ltd
1703 West 5th Avenue, Vancouver, BC V6J 1P1

Author:
Hardolph Wasteneys, Ph.D., P.Geo.
Campbell River, BC

November 6, 2018

Frontispiece

View NE from Comstock Ridge above the old Yreka Mine

Table of Contents

List of Figures

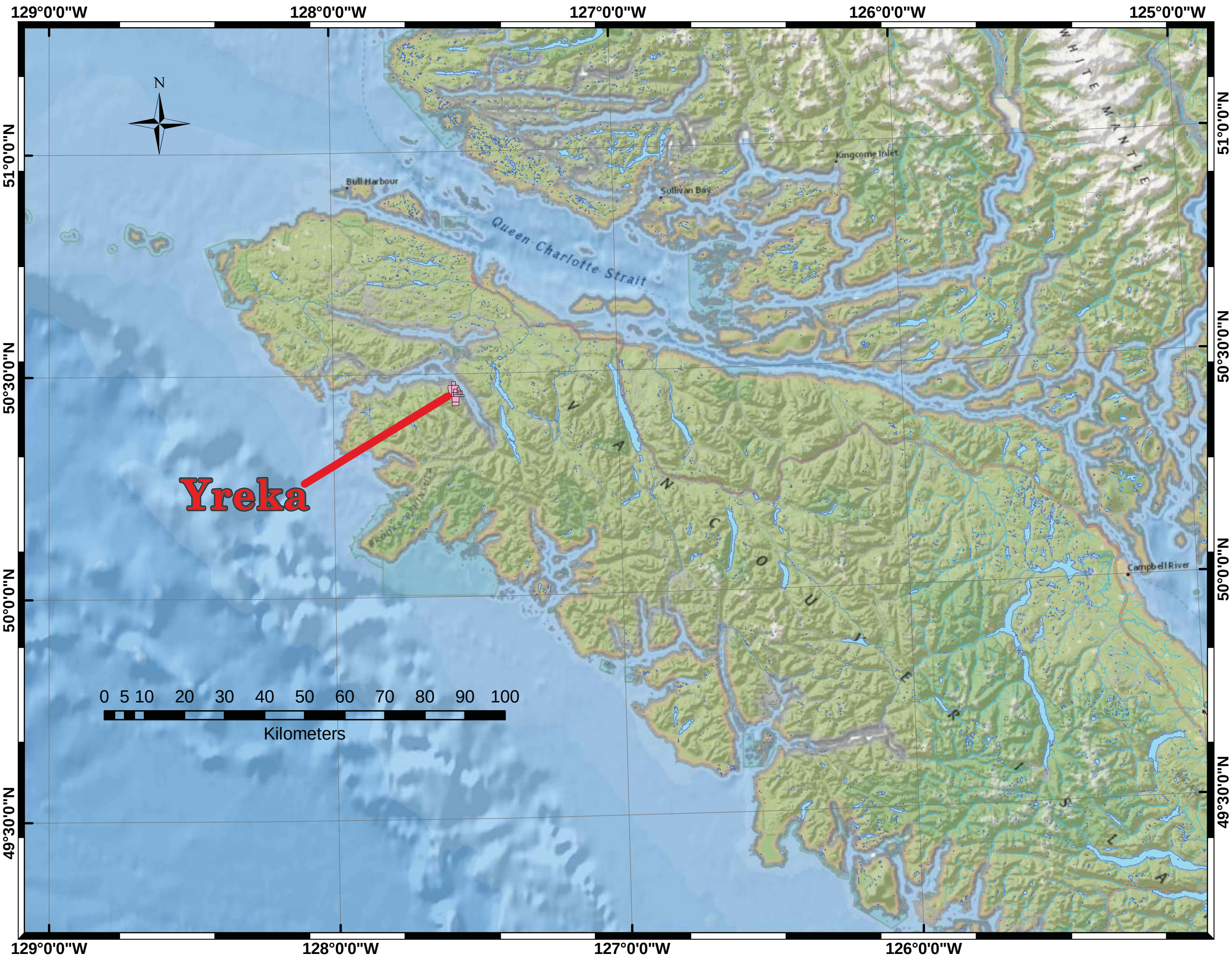


Figure 1: The Yreka claim group on northwestern Vancouver Island.
The claims are on the western slope of Neroutsos Inlet, which is a south branch of Quatsino Sound.

INTRODUCTION

The Yreka mineral claims cover an area around a copper skarn mineral deposit from which about 150,000 tonnes of copper-gold-silver mineralization was mined by Noranda in the 1960s. The property is located on the west side of Neroutsos Sound of northern Vancouver Island near Port Alice. The property has high potential for concealed skarn and possibly stockwork porphyry mineralization within the host stratigraphic sequence, which dips moderately to the west in an undeformed homocline capped by the Le Mare Lake volcanics of the Bonanza Group.

Property Description and Location

The Yreka Property is located on northern Vancouver Island on the mountainous west slope of Neroutsos Sound and west of the old logging town of Port Alice, British Columbia. The property is centred at Latitude: 50° 27’ 30” N, Longitude: 127° 34’ 00” W NAD 83 datum, UTM Zone 9, 42 E, 6050518 N, in the NTS map sheet 92 L/5 , BCGS Map 092L043 in the Nanaimo Mining Divisions (Figure 3). It consists of 17 variously named cell claims listed in Table 1 issued between January 2012 and July 2018 and currently all with Good To Dates of July 31, 2019. The total area of the tenures is 2366 hectares. Several Crown Granted claims are within the area of the claim group Figure 3..

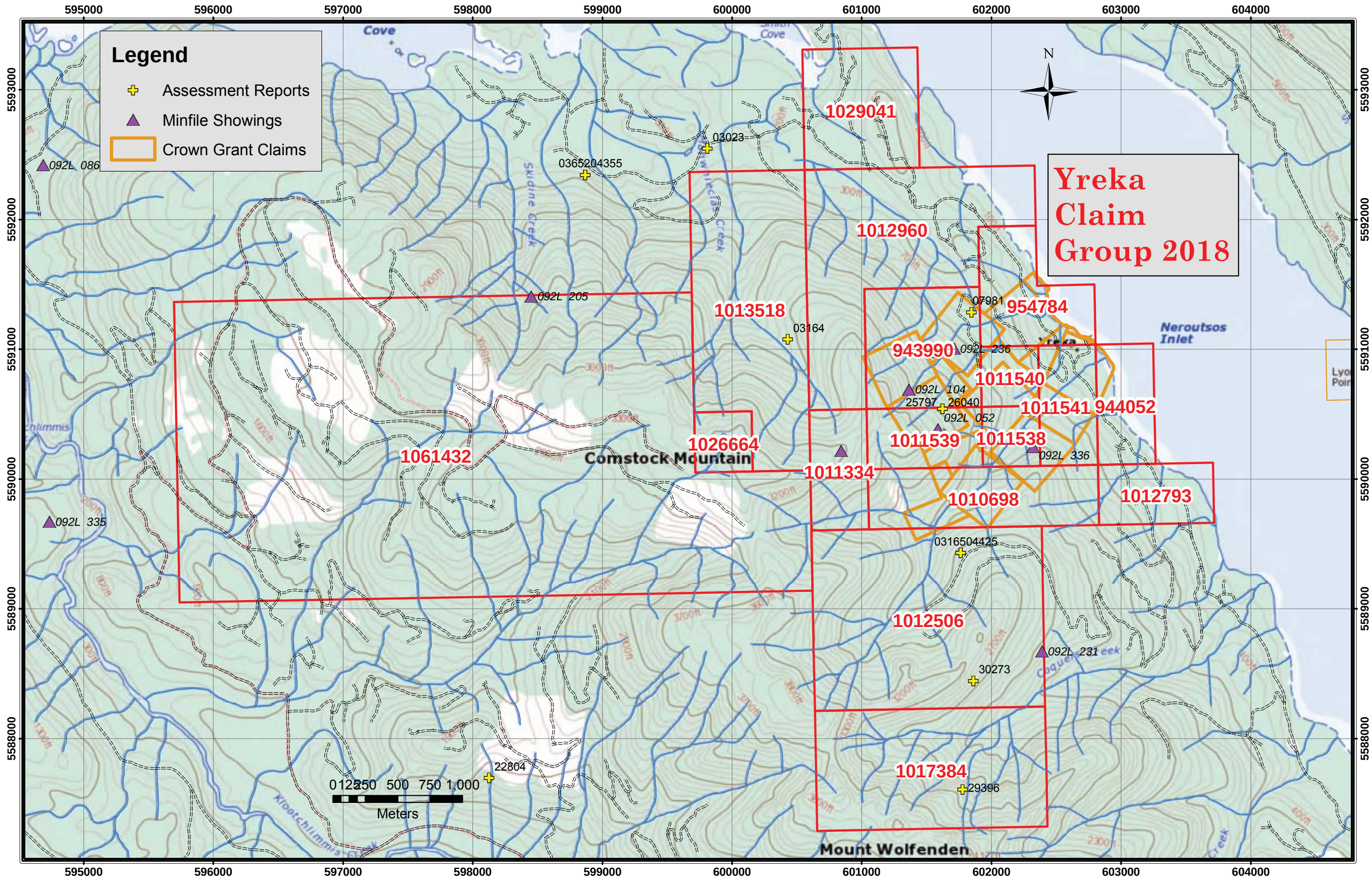
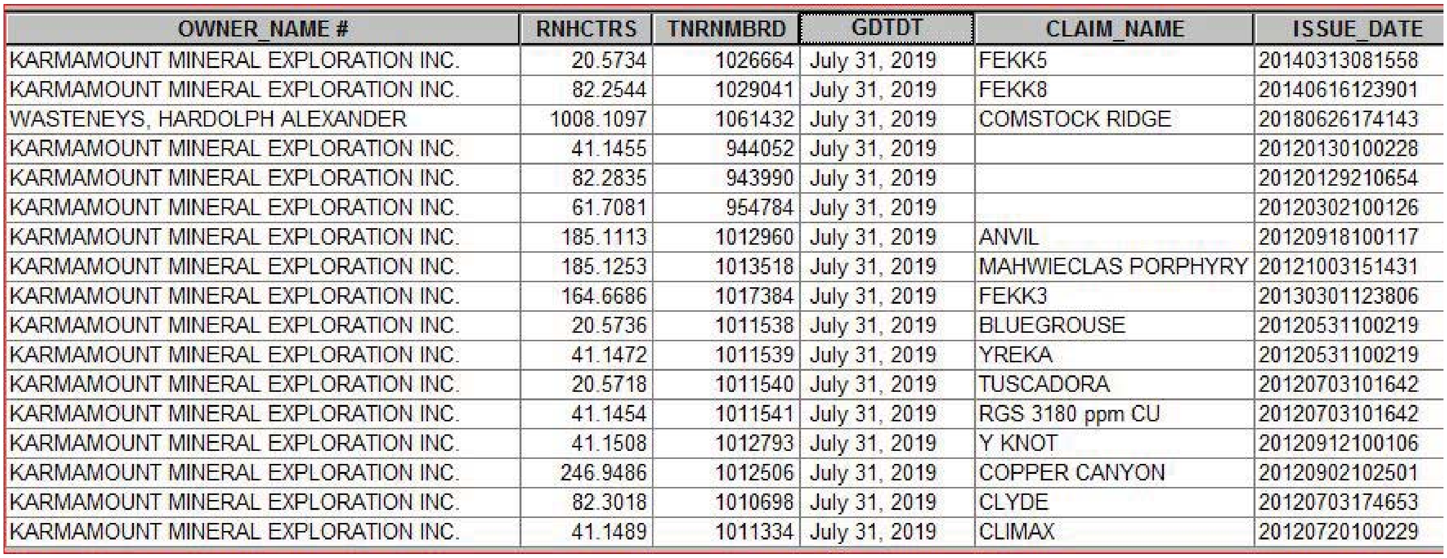


Figure 3: Yreka Claim Group Map

Map base is Toporama series with elevations and contours in feet. Yreka claims and tenure numbers are show in red; other claims in orange. Quatsino Sound is the water body in the NW opening to the west into the Pacific. Jeuane Landing and Rumble Beach are a few km north of the community of Port Alice on the east side of the inlet



OWNER_NAME #	RNHCTRS	TNRNMBRD	GDTDT	CLAIM_NAME	ISSUE_DATE
KARMAMOUNT MINERAL EXPLORATION INC.	20.5734	1026664	July 31, 2019	FEKK5	20140313081558
KARMAMOUNT MINERAL EXPLORATION INC.	82.2544	1029041	July 31, 2019	FEKK8	20140616123901
WASTENEYS, HARDOLPH ALEXANDER	1008.1097	1061432	July 31, 2019	COMSTOCK RIDGE	20180626174143
KARMAMOUNT MINERAL EXPLORATION INC.	41.1455	944052	July 31, 2019		20120130100228
KARMAMOUNT MINERAL EXPLORATION INC.	82.2835	943990	July 31, 2019		20120129210654
KARMAMOUNT MINERAL EXPLORATION INC.	61.7081	954784	July 31, 2019		20120302100126
KARMAMOUNT MINERAL EXPLORATION INC.	185.1113	1012960	July 31, 2019	ANVIL	20120918100117
KARMAMOUNT MINERAL EXPLORATION INC.	185.1253	1013518	July 31, 2019	MAHWIECLAS PORPHYRY	20121003151431
KARMAMOUNT MINERAL EXPLORATION INC.	164.6686	1017384	July 31, 2019	FEKK3	20130301123806
KARMAMOUNT MINERAL EXPLORATION INC.	20.5736	1011538	July 31, 2019	BLUEGROUSE	20120531100219
KARMAMOUNT MINERAL EXPLORATION INC.	41.1472	1011539	July 31, 2019	YREKA	20120531100219
KARMAMOUNT MINERAL EXPLORATION INC.	20.5718	1011540	July 31, 2019	TUSCADORA	20120703101642
KARMAMOUNT MINERAL EXPLORATION INC.	41.1454	1011541	July 31, 2019	RGS 3180 ppm CU	20120703101642
KARMAMOUNT MINERAL EXPLORATION INC.	41.1508	1012793	July 31, 2019	Y KNOT	20120912100106
KARMAMOUNT MINERAL EXPLORATION INC.	246.9486	1012506	July 31, 2019	COPPER CANYON	20120902102501
KARMAMOUNT MINERAL EXPLORATION INC.	82.3018	1010698	July 31, 2019	CLYDE	20120703174653
KARMAMOUNT MINERAL EXPLORATION INC.	41.1489	1011334	July 31, 2019	CLIMAX	20120720100229

Figure 2: Mineral Cell Claims in the Yreka Claim Group

Claims are held by Karmamount and Hardolph Wasteneys (agent for Karmamount) forming the Yreka Property; Claim Name, Tenure numbers (TNRNMBRD), Issue dates, current good to dates (GTDT) and area in hectares (RNHCTRS) are shown

Access, Climate, Local Resources, and Physiography

The main access to the Yreka property is via the Vancouver Island Highway system to Port Alice and thence via logging roads controlled by Western Forest Products based out of a division in Port McNeill. Driving time to the property from Campbell River was about 3.5 hours. From Port Alice access is via Marine Drive south around the inlet and then north to Marine Drive “zero” at a log loading terminal where rafts are assembled. Marine Drive is coextensive with Teeta Main from which Yreka 500 leads to the property. The logging road network along the west shore of Neroutsos Inlet branches from the Yreka 500 main line that runs parallel; to the shore north to Kultus Cove on the south shore of Quatsino Sound. Alternate access is via logging roads from Mahatta River on Quatsino Sound and water accessible from Coal Harbour. Personnel from LeMare Logging commonly travel by a short boat ride to Mahatta River rather than by the long winding Highway 30 from Highway 19 to Port Alice. From Mahatta River the Koochlimmis Valley is traversed by the K500 logging road which connects on a 604 meter altitude pass to the Teeta 500 road which descends by switchbacks to Teeta Main. Branch roads from the K500 main access logging areas on the west side of the ridge near the Yreka deposit and were used for exploration of the western part of the property extended by the Comstock Ridge Claim. From the highest point of these roads a travers was completed into the upper slopes above the old Yreka mine (Figure 2). Helicopter access is recommended in the higher parts of area.

Yreka is located on the eastern flanks of the 12 km long ridge that runs NW from Teeta Creek to Kultus Cove with 1300 m peaks at Mount Wolfenden and Comstock Mountain (Figure 2). The ridge is steep sided with slopes up to 40 degrees and intermittent cliffs. However, a few intervals at the northern extent and on the backside of Comstock Mountain have steep easterly and much shallower westerly aspects possibly reflecting the moderate westerly dip of cliff-forming sedimentary and volcanic strata. Creeks in the Yreka property are all steep with canyon-like forms in many places inhibiting access.

The lower slopes above Neroutsos Inlet along the Yreka 500 mainline have been mechanically logged typically by feller bunchers and in steeper parts, for example just south of the Yreka mine, using spar pole systems. Logging debris greatly inhibits traverses especially in the steeper terrane and in particular along creeks where logging debris combined with natural deadfall across the creek has created a nearly impassable maze of large trunks and brush.

The area is heavily forested within the Coastal Hemlock Zone and most of it is old growth hemlock and fir trees. Annual precipitation is up to a few meters mainly as rain. Winters are mild, but snowfall accumulation can be several meters above 600 meters altitude.

Property History

The area of the Yreka claim group has a history of exploration, development and production dating back to the late 18th century. The first claims were recorded in 1898 and by 1903 a few thousand tonnes of copper silver ore was shipped from the Clyde workings, which lie just south of the main Yreka orebody. This mining operation, like others that followed utilized an aerial tramway to transport ore from adits, at 700 meters altitude, into the steep face of the ridge running between Mount Wolfenden and Comstock Mountain down to Neroutsos Inlet, at sea level. However, production ceased until 1917 when high copper prices during the First World War provided incentive to ship another 900 tonnes, although from new facilities.

Noranda Exploration Company Ltd. took over the property in 1952 and initiated the first diamond drilling programs on the property, which eventually led to the discovery of the main Yreka deposit. Underground development and drilling continued through 1956 with over 40 thousand feet of core and 6 thousand feet of drifting. Between 1958 and 1964 the property was dormant, but was reactivated by Minoca Mines in 1965 based on reserves of about 150,000 tonnes of 3.7% copper and 41 g/t silver plus some additional indicated resources. Production over the period from 1965 to 1967 was 133,000 tonnes grading 2.9% C, 32.8 g/t Ag and 0.36 g/t Au mainly from the "A" zone, a lens measuring 15 by 49 and 60 meters high.

Thereafter, although significant exploration programmes were conducted both locally around the deposit and peripherally on new showings involving EM and magnetic geophysical surveys, geochemistry and geological mapping no further production was recorded. A series of option arrangements occurred from 1970 with Green Eagle Mines and ISO Explorations Ltd.

Much of the exploration work was focused on defining the limits of the skarn horizon that hosted the Yreka deposit. In 1971 and 72, 1844 feet of diamond drilling tested copper silver showings near the Yreka deposit at the Comstock-Edison and North Arm Creek prospects. Work ceased until 1979 when Uke Resources drilled 300 feet in 3 holes on the Tuscarora prospect. In 1988 Teck Exploration expanded the exploration area using regional stream silt surveys that reveal anomalous gold and zinc southwest of Mt Wolfenden leading to detailed anomalous zones on the northeastern slopes of that mountain along the same slope as Yreka. In 1998 Talltree Resources initiated a reassessment of the resource potential of the area mainly by prospecting, rock assaying and soil sampling.

Figure 4: Upper Canyon Creek near Comstock Ridge.
The creek bed is in old growth well above the Yreka and Clyde workings.Dead fall and logging debris jam the creek bed below recent logging clear cuts.

Since the late 90s no significant development work or exploration work has been completed on the property. The main block of present mineral tenures were acquired by Eden Investment on December 13, 2012 and transferred to Karmamount Mineral Exploration on March

16, 2015. A new claim, Comstock Ridge 1061432, was staked to cover the western aspect of the ridge above Yreka to explore for magmatic connections to the Kloochlimmis Pluton in the valley to the west . Karmamount completed a couple of evaluation programs in the period from 2012 to 2016 (Eden and Li, 2016, and Wasteneys, 2018). By the summer of 2016, Western Forest Products, which hold a TFL in the area, had completed several new logging roads along the lower

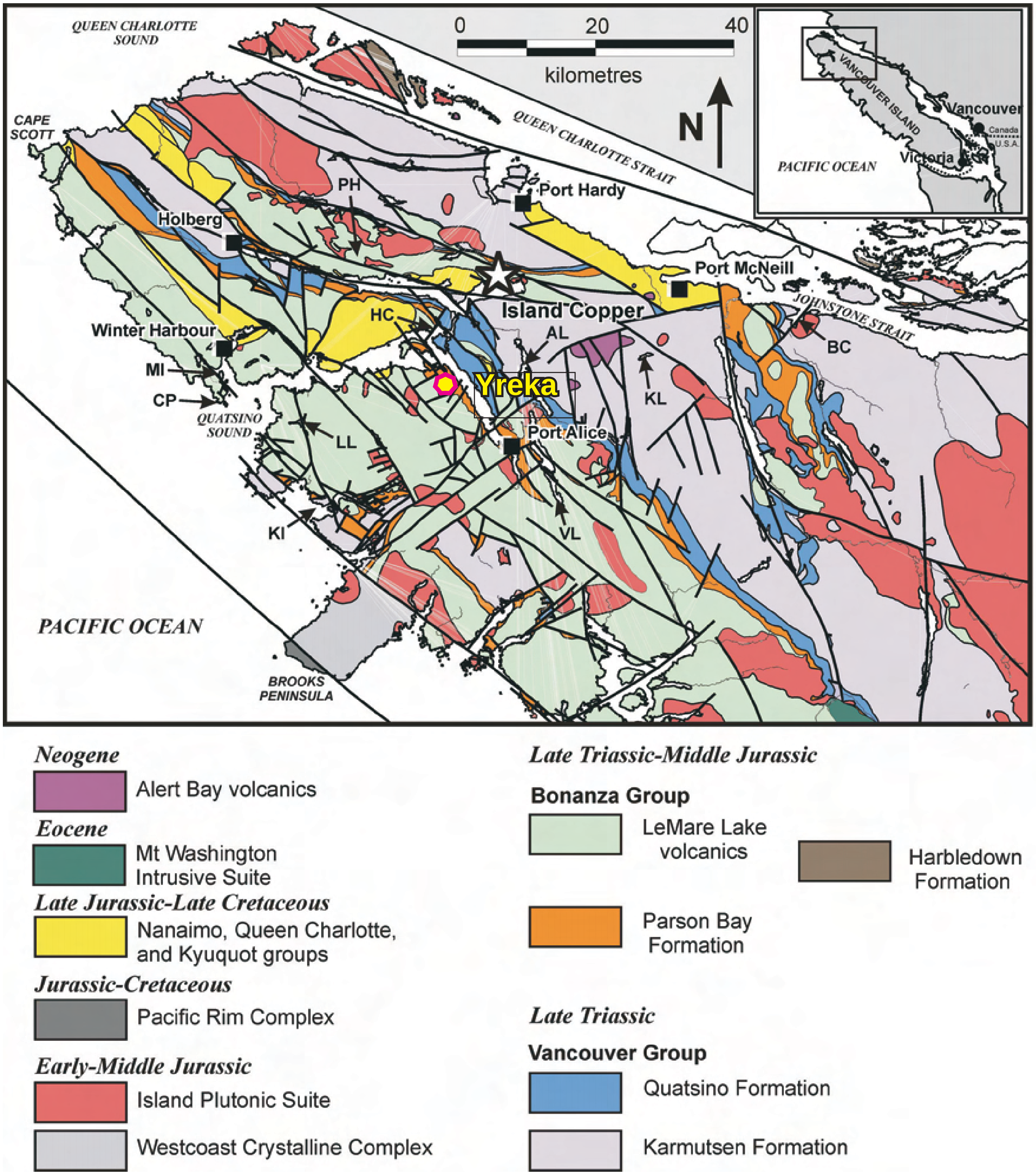


Figure 5: Regional Geology of northern Vancouver Island (from Nixon & Orr, 2007, after Massey et al. 2005)
Yreka is indicated by yellow polygon and label along a northwesterly trending belt of Quatsino Parson Bay and Le Mare Lake Formations that form homoclinal blocks copping the edge of Karmutsen basalts.

parts of the claim group towards Quatsino Sound that have provided new exposures of rocks within the host stratigraphic section.

The 2016 Exploration Program

Previous work in 2015 by Karmamount on the Yreka claims involved soil sampling south of the old Yreka and Clyde portals and rock sampling along the Y400 logging road ((Eden and Li, 2016). New logging roads branching from Yreka Main have exposed significant outcrops on Banter and Pender Points at the north end of the claims that are along strike with the stratigraphic section underlying the property. Other branch roads north of the Yreka deposit also expose new outcrops that have not previously been examined or mapped.

Figure 6: Tyler Ruks surveying a traverse route in upper Canyon Creek
This September 7, 2016 traverse took 5 hours to complete a 1 km circuit through logging slash and a debris choked creek bed. Felsic dykes form the east wall of canyon sections of the creek. Strata mapped are in upper parts of the Volcaniclastic-Sedimentary Unit of the Parson Bay Formation.

Two property visits were completed in 2016: The first involved geological mapping on the new logging roads at the north end of the property over a two day period on July 27th and 28th. This work has not changed the existing geological contacts or unit designations on maps of Nixon et al. (2007), although several dikes have been recorded. The trip was made by road from Strathcona Park Lodge on Upper Campbell Lake west of Campbell River with overnight camping on the property. The second visit was made over 3 days on September 5th to 7th to more closely examine stratigraphic units exposed on the Y400 road on the recommendation of Graham Nixon (pers. comm. 2016). This later work was done accompanied by Tyler Ruks, a geologist from Seven Devil's Exploration, in a collaborative effort on the geology of the area. Accommodation was provided in the Seven Devil's camp on the Teeta Main road. The highlight of the work took place in wet weather on September 7th, 2016, when a one kilometer return traverse was completed from the Y400 road to the major junction in Canyon Creek about one kilometer south of the old Yreka mine. The objective was to evaluate reported showings of porphyry style mineralization in upper Canyon Creek, but terrane obstacles and dense regrowth of logging slash caused extremely slow progress and prevented extending the traverse to examine the North Arm showings upstream from the creek junction in the time available. Large tree trunks, up to 4 feet in diameter, blocked the southern branch creek bed in places causing jams of debris while the northern creek branch was nearly impassable with mesh of interwoven tree tops either from blow downs or dropped in the logging operations. However, some well exposed outcrop was mapped in the creek bed including felsic dykes.

Present Work: the 2018 Exploration Program

Work in 2018 focused on mapping areas above the Yreka deposit and the slopes on the west side of Comstock Ridge. One new mineral claim was staked to cover the western area as shown in Figure 2. Work consisted of several days of mapping and sampling along a network of logging roads and one traverse through a pass in Comstock Ridge to access the area above the old Yreka Mine as displayed in Figure 6. The crew consisted of the writer and one assistant who was skilled in mountaineering in light of possibilities of difficult terrain on the eastern slopes of Comstock Ridge. Considerable travel time was saved by camping along the inactive logging roads. Most roads were in passable condition for a 4 wheel drive Subaru except for a few washouts and deeper crossditches. One traverse entered the upper reaches of Canyon Creek and

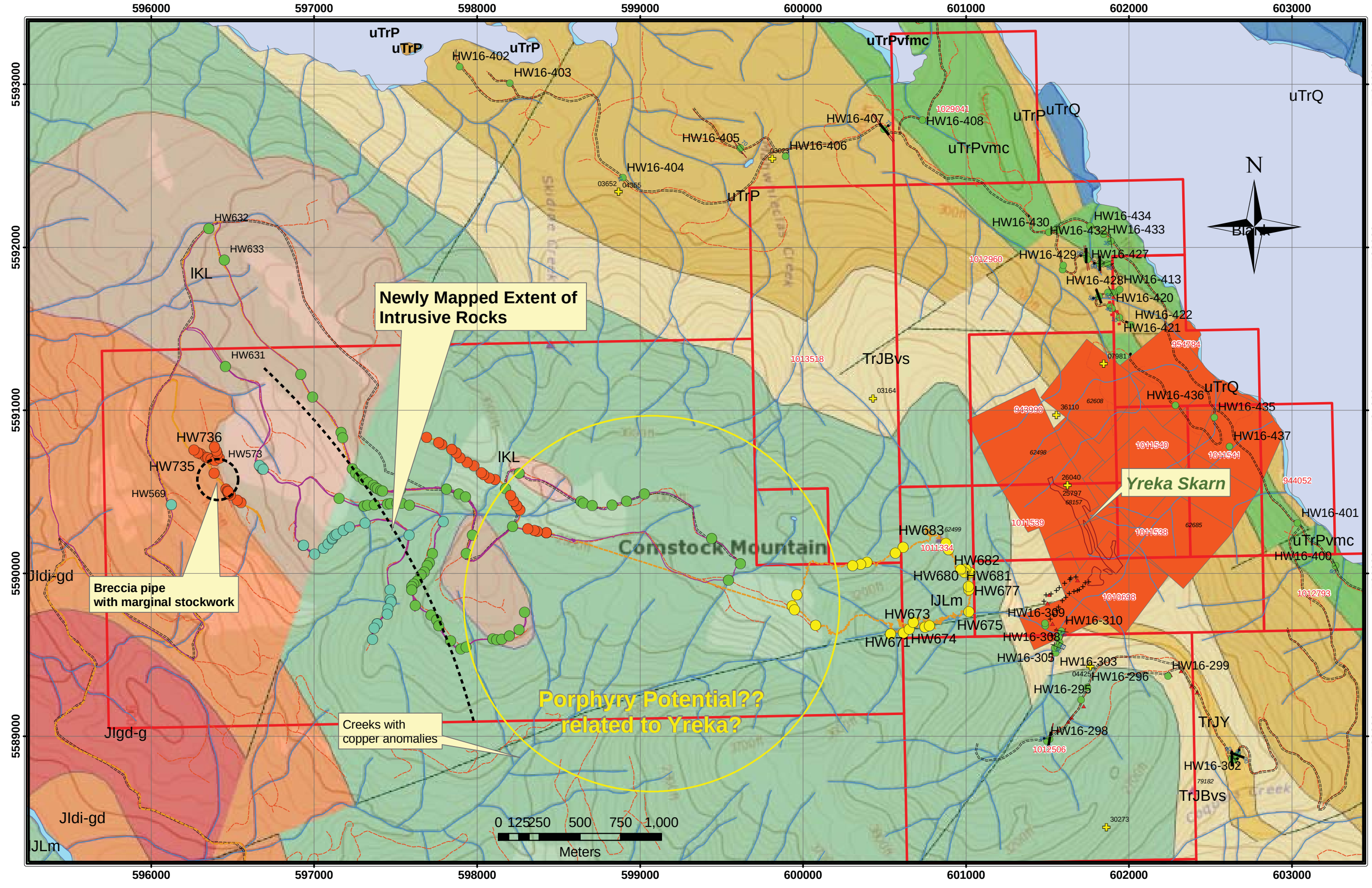


Figure 7: Geological Map showing the geology stations from the 2018 work.
New 2018 stations are large red, green, yellow and blue dots each colour representing a different field day and intermittently labelled (for clarity at the scale) HW681. Old station are labelled HW16-xxx and located along the coast slope and road systemt

descended to with 600 meters of the old workings. Surprisingly, the terrain was not as steep as expected and the bush remains in old growth forest with little undergrowth.

The objective of the new work was to explore geological connections between the Yreka skarn deposits and the Kloochlimmis Pluton which is exposed in the Mahatta River Valley about 5 kilometers to the west. No significant intrusive bodies have been identified in proximity to the Yreka skarn deposits on the eastern slopes of Comstock Ridge to which the genesis of the skarns could be attributed. Figure 6 shows the Mahatta River Map of Nixon et al. (2007) without revision, and 2018 traverse stations and speculation notes on the interpretation of the greater extent of intrusive unit of the Klootchlimmis Pluton. At a couple of location phreatic and phreato-magmatic breccias were recognized that may have implication for porphyry mineralization potential. The geology of the western slopes is described below.

Costs incurred by the 2018 work amount to $15.816.00 and were filed on the claims to bring the current Good To Dates to July 31, 2019 in two SOWs, events 5703005 on July 5, 2018 and 5718799 on November 8, 2018.

Figure 8: Upper Canyon Creek
Outcrops are common along the upper reaches of the creek and many samples of rusty silicified volcanics were found in the creek bed.

REGIONAL GEOLOGY

Vancouver Island is a significant transect across the southern part of the Mid-Paleozoic to Early Mesozoic Wrangellian tectonostratigraphic terrane that extends northward though the Queen Charlotte Island into southern Alaska. On Vancouver Island Wrangellia is intruded to the east rocks of the Coast Plutonic Complex and tectonically sliced to the west by the Pacific Rim Terrane and the Westcoast Crystalline Complex (Wheeler and McFeely, 1991). The Wrangellian terrane on Vancouver Island is essentially composed of two oceanic volcanic arcs separated by voluminous flood basalts that formed an oceanic plateau. The earliest arc, forming the basement of the island geology is exposed in several fault bounded tectonic uplifts in the central part of the island, most notably around Buttle Lake where the prolific massive sulphide deposits of Myra Falls are located in felsic volcanics of the Devonian to Early Permian Sicker and Buttle Lake Groups. The basement uplifts are engulfed by the voluminous flood basalts of the Karmutsen Formation, the lower part of the Vancouver Group, that dominates the alpine skyline of much of the central Vancouver Island. A return to volcanic arc magmatism came in the Triassic with the onset of the Bonanza Group that deposited a series of increasingly volcanic dominated strata on the Quatsino Formation limestones that mark the upper part of the Vancouver Group that capped the Karmutsen flood basalt plateau. The Bonanza Group is mainly composed of the basal Parson Bay Formation and the Bonanza Volcanics. The Parson Bay Formation is mixed carbonate-clastic-volcanic succession with a significant island-arc volcanic and volcaniclastic affinity that separates it conformably from the earlier limestone strata of the Quatsino Formation and indicates the onset of the Bonanza volcanic arc volcanism culminating in the volcanic dominated LeMare Lake Volcanics. Coeval granitoid intrusions of the Island Plutonic Suite cut rocks of the Karmutsen Formation as well as those of the Bonanza Group and result in both porphyry copper deposits and, where intruding limestones, significant skarn deposits of magnetite and at Yreka, copper sulphides.

The stratigraphy of northern Vancouver Island is founded upon the Triassic tripartite sequence of Karmutsen flood basalt dominating the northeastern side of the island and overlain to the west in series of homoclinal fault blocks by Quatsino limestone, Parson Bay Formation and LeMare Volcanics, which are diagnostic of Wrangellia.

The Bonanza Arc rocks were eroded following a major Jurassic contractional event and covered unconformably by clastic sedimentary rocks of the terrigeneous Nanaimo Group that include coal bearing conglomerates in places along the eastern side of Vancouver Island. The history of faulting on northern Vancouver Island is complex and embodies Cretaceous transpression and Tertiary extension. The present crustal architecture exhibits a dominant northwesterly-trending structural grain manifested by the distribution of major lithostratigraphic units and granitoid plutons (Figure 3). Numerous fault-bounded blocks of homoclinal, Early Mesozoic strata such as that around Yreka on the east shore of Neroutsos Inlet, generally dip to the south west and west whereas Jura-Cretaceous clastic strata are preserved as disparate fault bounded remnants of formerly more extensive Cretaceous basins on the north side of Quatsino Sound, to the north of Yreka (Nixon and Orr, 2007).

Geology of the Yreka Property

The eastern slopes of the Comstock- Wolfenden Ridge from the shores of Neroutsos Inlet to the ridge crest is underlain by a homoclinal sequence (Figure 6) consisting in ascending order of the Quatsino Limestone, Parson Bay Formation and LeMare Lake volcanics. The base of the sequence is presumably laid on Karmutsen Formation that is not exposed within the inlet, but forms much of the outcrop on Vancouver Island and is the major unit in the Vancouver Group. The Quatsino Formation Limestone caps the Karmutsen Formation that forms the major vol-

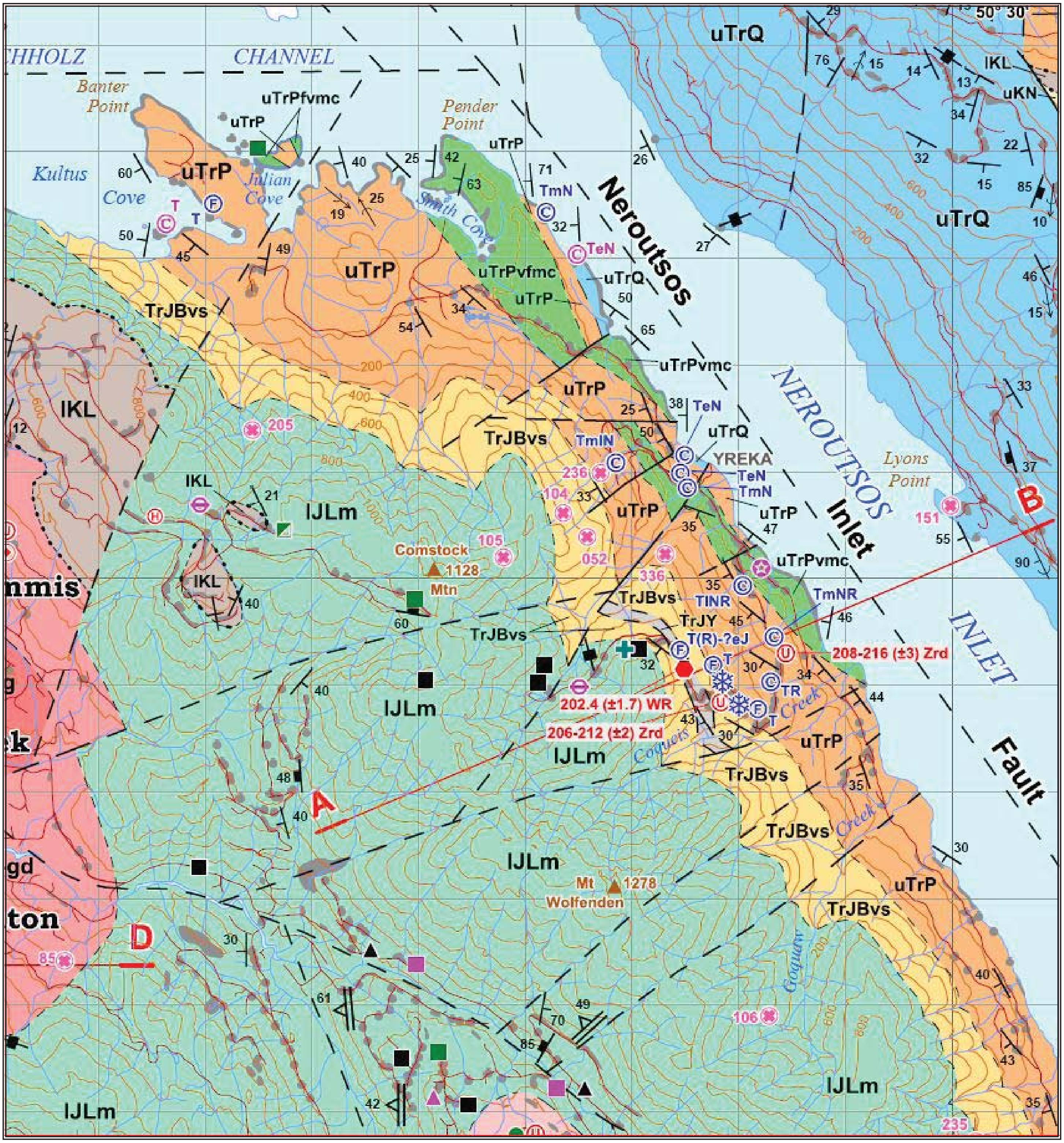
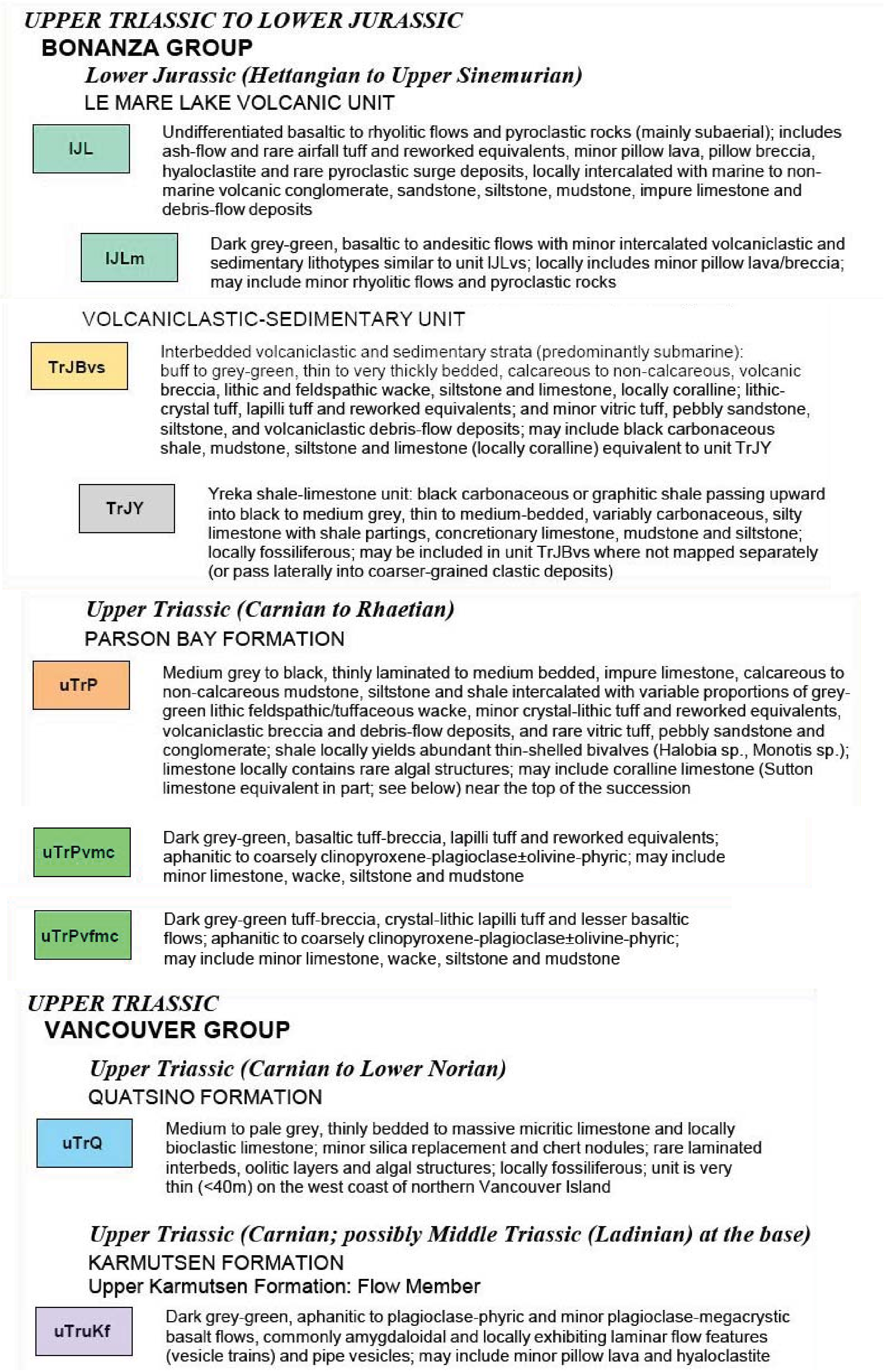


Figure 9: Part of Map GM2011-3 of Nixon et al. (2011) showing Yreka area along Neroutsos Inlet. Location of cross section in Figure 3 is shown at red line A-B. Symbols: back and green squares; basalts unaltered and altered; blue circles with letter fill: C = conodont date, U = U-Pb zircon date, F = macrofossil. Pink circles with pink X; Minfile localities with code number



UPPER TRIASSIC TO LOWER JURASSIC

BONANZA GROUP

Lower Jurassic (Hettangian to Upper Sinemurian)

LE MARE LAKE VOLCANIC UNIT

lJL	Undifferentiated basaltic to rhyolitic flows and pyroclastic rocks (mainly subaerial); includes ash-flow and rare airfall tuff and reworked equivalents, minor pillow lava, pillow breccia, hyaloclastite and rare pyroclastic surge deposits, locally intercalated with marine to non-marine volcanic conglomerate, sandstone, siltstone, mudstone, impure limestone and debris-flow deposits
lJLm	Dark grey-green, basaltic to andesitic flows with minor intercalated volcaniclastic and sedimentary lithotypes similar to unit lJLvs; locally includes minor pillow lava/breccia; may include minor rhyolitic flows and pyroclastic rocks

VOLCANICLASTIC-SEDIMENTARY UNIT

TrJBvs	Interbedded volcaniclastic and sedimentary strata (predominantly submarine): buff to grey-green, thin to very thickly bedded, calcareous to non-calcareous, volcanic breccia, lithic and feldspathic wacke, siltstone and limestone, locally coralline; lithic-crystal tuff, lapilli tuff and reworked equivalents; and minor vitric tuff, pebbly sandstone, siltstone, and volcaniclastic debris-flow deposits; may include black carbonaceous shale, mudstone, siltstone and limestone (locally coralline) equivalent to unit TrJY
TrJY	Yreka shale-limestone unit: black carbonaceous or graphitic shale passing upward into black to medium grey, thin to medium-bedded, variably carbonaceous, silty limestone with shale partings, concretionary limestone, mudstone and siltstone; locally fossiliferous; may be included in unit TrJBvs where not mapped separately (or pass laterally into coarser-grained clastic deposits)

Upper Triassic (Carnian to Rhaetian)

PARSON BAY FORMATION

uTrP	Medium grey to black, thinly laminated to medium bedded, impure limestone, calcareous to non-calcareous mudstone, siltstone and shale intercalated with variable proportions of grey-green lithic feldspathic/tuffaceous wacke, minor crystal-lithic tuff and reworked equivalents, volcaniclastic breccia and debris-flow deposits, and rare vitric tuff, pebbly sandstone and conglomerate; shale locally yields abundant thin-shelled bivalves (Halobia sp., Monotis sp.); limestone locally contains rare algal structures; may include coralline limestone (Sutton limestone equivalent in part; see below) near the top of the succession
uTrPvmc	Dark grey-green, basaltic tuff-breccia, lapilli tuff and reworked equivalents; aphanitic to coarsely clinopyroxene-plagioclase±olivine-phyric; may include minor limestone, wacke, siltstone and mudstone
uTrPvfmc	Dark grey-green tuff-breccia, crystal-lithic lapilli tuff and lesser basaltic flows; aphanitic to coarsely clinopyroxene-plagioclase±olivine-phyric; may include minor limestone, wacke, siltstone and mudstone

UPPER TRIASSIC

VANCOUVER GROUP

Upper Triassic (Carnian to Lower Norian)

QUATSINO FORMATION

uTrQ	Medium to pale grey, thinly bedded to massive micritic limestone and locally bioclastic limestone; minor silica replacement and chert nodules; rare laminated interbeds, oolitic layers and algal structures; locally fossiliferous; unit is very thin (<40m) on the west coast of northern Vancouver Island

Upper Triassic (Carnian; possibly Middle Triassic (Ladinian) at the base)

KARMUTSEN FORMATION

Upper Karmutsen Formation: Flow Member

uTruKf	Dark grey-green, aphanitic to plagioclase-phyric and minor plagioclase-megacrystic basalt flows, commonly amygdaloidal and locally exhibiting laminar flow features (vesicle trains) and pipe vesicles; may include minor pillow lava and hyaloclastite

Figure 10: Geological Units on cross section A-B

Unit descriptions are from GM2011-3 Map by Nixon et al. (2011)

ume of the Vancouver Group. It underlies much of the east side of Neroutsos Inlet and outcrops in the Yreka area in a few fault bounded blocks along the coast. Unconformably overlying the Vancouver Group, the Bonanza Group consists in the Parson Bay Formation sedimentary rocks, the Volcaniclastic-Sedimentary Unit and the LeMare Lake Formation volcanics. The Parson Bay Formation occupies about half of the slope up to the Wolfenden - Comstock ridge crest. It is subdivided into volcanic- and limestone-dominant units. The Volcaniclastic-Sedimentary Unit and LeMare Lake Formation volcanics complete the section to the crest of the ridge and hosts the skarn deposits at Yreka. The LeMare Lake volcanics range in composition from felsic to mafic with pyroclastic and coherent flow dominated units.

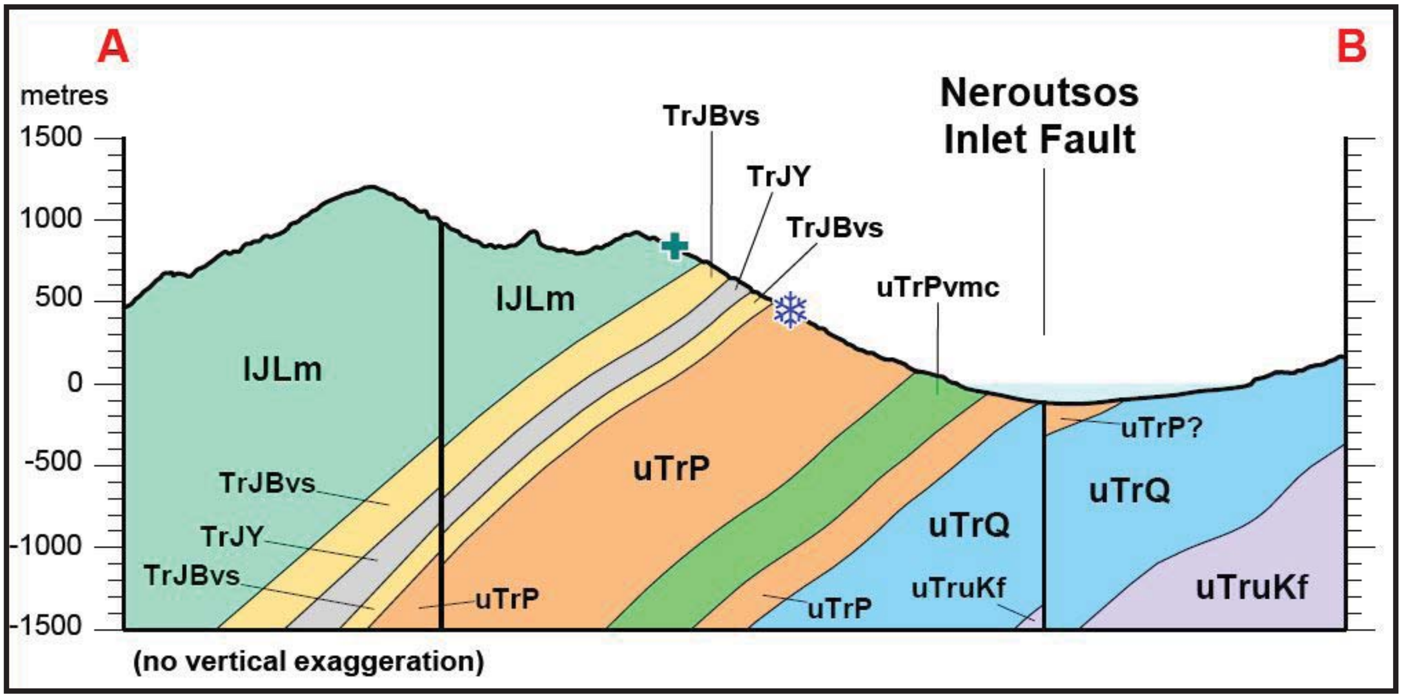


Figure 11: Cross section through homoclinal sequence at Yreka from Map GM2011 (Nixon et al., 2011)

Observation stations by the writer along road cuts in through the Parson Bay Formation are plotted in Figures 11 and 14 and described below. The geological boundaries and units on the map are from the digital geological polygon files for the GM2011-3 map (G. Nixon, pers comm. 2017) and are used as a basis for comparison with the new observations within each unit.

Quatsino Formation (uTrQ)

The Upper Triassic, Carnian to lower Norian Quatsino Formation was only mapped by Nixon et al. (2011) at two restricted shoreline locations in the Yreka area and none overlap with new geological stations from this work. Quatsino Formation is the upper-most formation in the Vancouver Group, which largely consists of the voluminous basalt flows and volcaniclastics of the Upper Triassic Karmutsen Formation. The Quatsino caps the flood basalts of the Karmutsen oceanic flood basalt plateau that itself is built on island arc volcanics of the Permian Sicker Group, now exposed only in structural uplifts at the south end of Buttle Lake and near Port Alberni. The Quatsino is described by Nixon et al, as a medium to pale grey, thinly bedded to massive micritic and locally bioclastic limestone with minor silica replacement and chert nodules. It has rare laminated interbeds, oolitic layers and algal structures and is locally fossiliferous. Its restricted occurrence in the area corresponds to its lack of thickness (<40m) on the west coast of northern Vancouver Island.

Bonanza Group: Parson Bay Formation (uTrP)

The main unit of the Parson Bay Formation uTrP was mapped by Nixon et al. (2011) in a near continuous band along the coast of Neroutsos Inlet from Kultus Cove south. It is subdivided into two additional volcanic dominated units, uTrPvfmc and uTrPvmc that form a series of fault delimited blocks within the main formation from Smith Cove south to the coast a few km south of Yreka. The main Parson Bay Formation described by Nixon et al. (2011) consists of medium grey to black, thinly laminated to medium bedded, impure limestone, calcareous to non-calcareous mudstone, siltstone and shale intercalated with variable proportions of grey-green lithic feldspathic/tuffaceous wacke, minor crystal-lithic tuff and reworked equivalents, volcaniclastic breccia and debris-flow deposits, and rare vitric tuff, pebbly sandstone and conglomerate. Shale units locally yield abundant thin-shelled bivalves (Halobia sp., Monotis sp.), and limestone locally contains rare algal structures; may include coralline limestone described as the Sutton limestone equivalent, near the top of the succession.

Figure 12: Road cuts in new logging areas within Parson Bay Formation
Dark weathering limestones and calcareous crystal tuffs are poorly bedded through much of the section that dips into the foreground.

Only one station appears to be within the lowermost section of mapped Parson Bay Formation, but no outcrop was observed. In the upper part of the formation above the volcanic dominated units, which will be dealt with below, numerous geological stations were established. In the Kultus Cove block, stations HW16-402 to HW16-407, show a mix of grey massive limestone and gritty limestone with zones of dark green calcareous crystal tuffs that weather brick red. All are cut by E-W calcite veins. To the east along the road, stations within the formation revealed non-calcareous sediments with rusty tuffaceous zones, dark grey, finely fractured massive limestone interbedded with calcareous volcanic grit and limestone conglomerate. One station (HW16-407) shows a white weathering hornblende feldspar porphyritic felsic dyke cutting the limestone steeply at 160 degree strike.

In an adjacent fault block of the upper Parson Bay Formation, 16 geological stations from the 2016 program described the formation in outcrops within a logging slash: HW16-413 to HW16-429 on Figures 12 and 14. . Predominantly, these stations show this block to consist of calcareous tuffs, commonly massive bedded with some beds up to 10 m thick and grading upward to agglomerates with rounded porphyritic clasts. In places limestone occurs as a host to dark grey calcareous crystal tuffs and crystal-lithic breccias with vesicular lapilli, but the units surveyed are predominantly of volcanic origin within the 20 hectare area traversed by new logging roads. Two felsic dykes were observed cutting the calcareous tuffs and limestones: one dyke was up to 10 meters wide with a N-S strike and steep dip and the other about 3 to 5 meters wide with a 160 strike. Both contain altered hornblende laths partially replaced by pyrite. Thin veins of pyrite were observed in the region of the dykes cutting the tuffs. One set consisted of quartz and pyrite with pyrite forming a core zone.

Figure 13: Moderately west dipping conglomerates in the Parson Bay Formation. Station HW16-414 on logging roads in central part of property. Clasts are porphyritic volcanics. Rock weathers brown as in the photo, but is dark green on fresh surfaces.

Figure 14: Dyke intruding Parson Bay Formation
Light coloured felsic dyke in center of photo

Parson Bay Formation volcanic units (uTrPvfmc and uTrPvmc)

The mapped volcanic dominated sections within the Parson Bay Formation included units uTrPvfmc and uTrPvmc and are described by Nixon et al. (2011) as follows: uTrPvfmc is a dark grey-green tuff-breccia, crystal-lithic lapilli tuff and lesser basaltic flows that are aphanitic to coarsely clinopyroxene-plagioclase±olivine-phyric. The unit may include minor limestone, wacke, siltstone and mudstone. The unit uTrPvmc consists of dark grey-green, basaltic tuff-breccia, lapilli tuff and reworked equivalents that is aphanitic to coarsely clinopyroxene-plagioclase±olivine-phyric and may include minor limestone, wacke, siltstone and mudstone.

Geological stations were established in two fault blocks of this unit, one near Smith Cove, which also includes occurrences of subunit uTrPvfmc on some small islands in the cove. This sub unit (uTrPfvmc) is described as "dark grey-green basaltic flows and lesser volcaniclastic breccia and lapilli tuff; aphanitic to coarsely clinopyroxene-plagioclase±olivine-phyric,", which differs from the uTrPvfmc unit in predominance of flows over tuffs.

Stations in the Smith Cove uTrPvmc block included HW16-408 to HW16-412. On the peninsula overlooking Smith Cove four stations record variations from predominantly dark grey gritty limestone varying to lithic and crystal lithic tuffs. Epidote alteration and pyrite and chalcopyrite mineralization are common, but sporadic forming veinlets and disseminations. The epidote generally indicates the presence of altered plagioclase feldspar crystals in volcanics in this case tuffs and helps differentiate the calcareous tuffs from gritty limestones.

The southern block of uTrPvmc was observed at 3 stations along the main Yreka Road

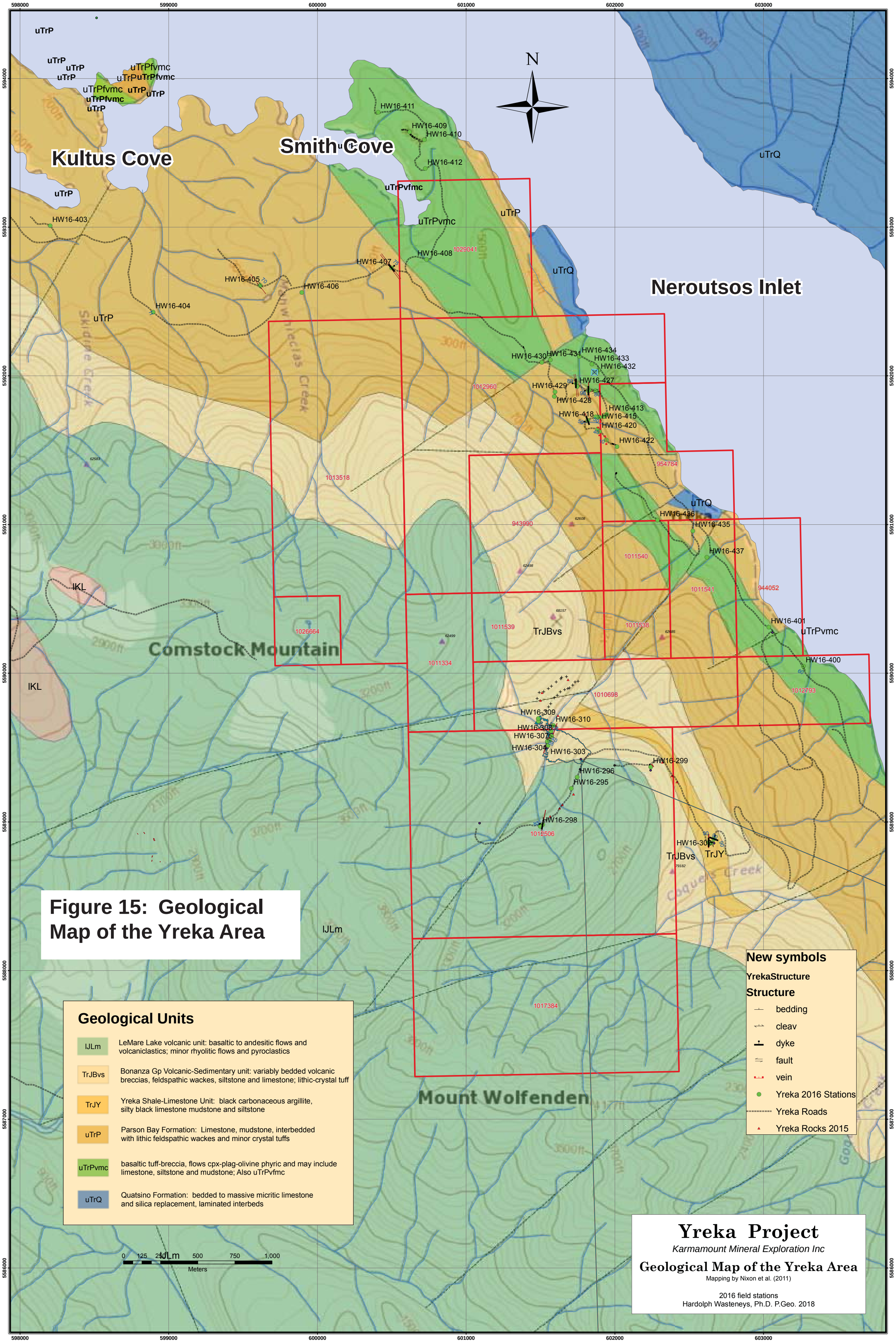


Figure 15: Geological Map of the Yreka Area

north of the Yreka site at HW16-431 to HW26-433. These outcrops all consist in crystal- lithic lapilli tuffs that are generally calcareous and display sporadic epidote and chlorite alteration. Generally, these new observations corroborate the designation and description of the units on the GM2011 map of Nixon et al. (2011)

South of Yreka, one roadside outcrop at HW16-400 within the mapped boundaries of uTrPvmc consists of grey weathering, well bedded siltstone to sandstone, but varying over 30 meters to the north to amygdaloidal feldspar-phyric intermediate flows.

Bonanza Group: Volcaniclastic-Sedimentary Unit (TrJBvs)

The Parson Bay Formation is stratigraphically overlain by the Volcaniclastic -Sedimentary Unit of which exposures are found along the Y400 logging branch road that winds about 600 meters upwards into the valley south of the old Yreka workings (Figure 13). The main unit is described by Nixon et al. (2011) as "Interbedded volcaniclastic and sedimentary strata (predominantly submarine): buff to grey-green, thin to very thickly bedded, calcareous to non-calcareous,

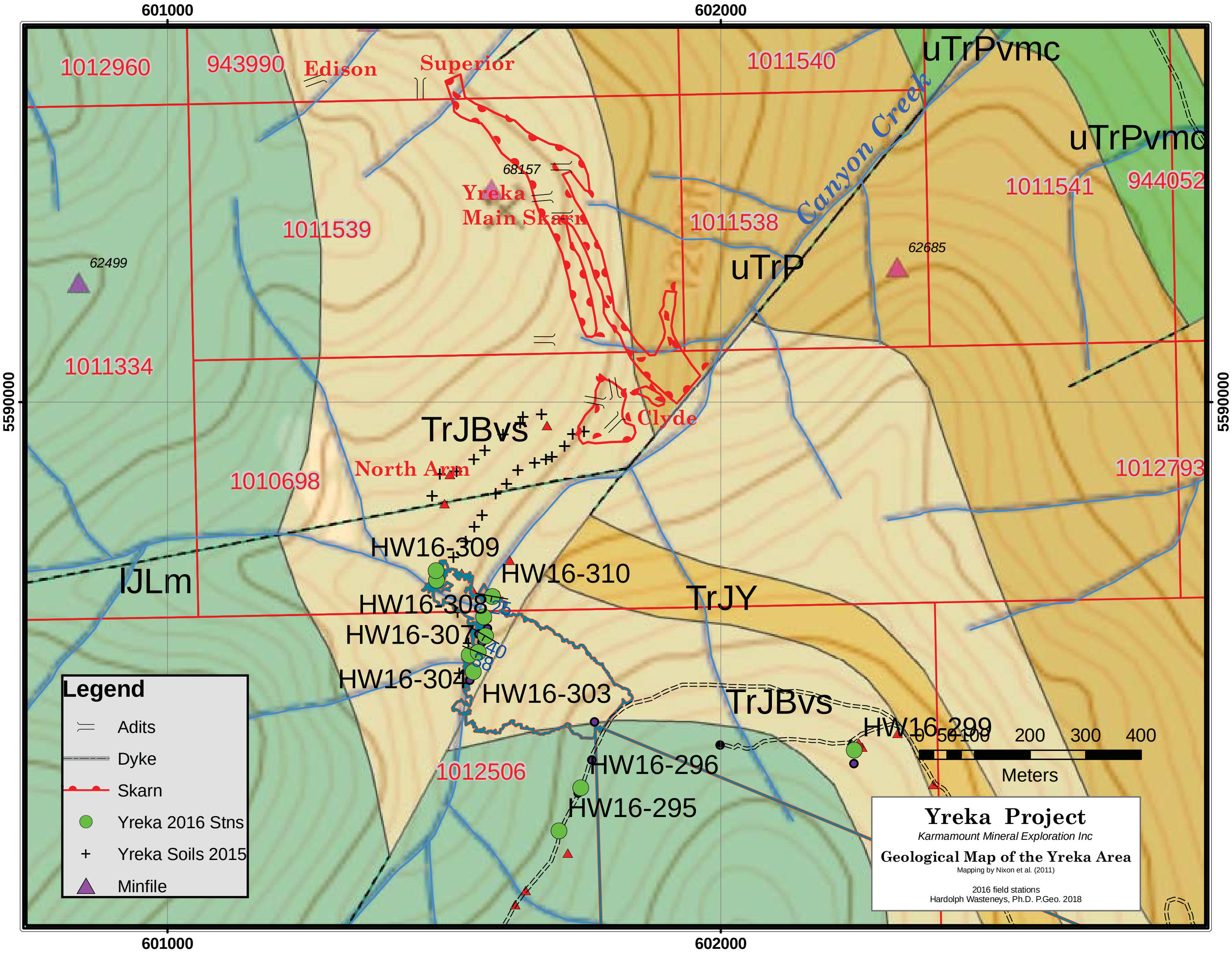


Figure 16: Geology of the Yreka Mine area.
Red line with half circles encloses surface area of mapped skarn assemblages in the main skarn area surrounding the Yreka sulphide lens. Adits from old working indicate other areas of mineralization. New map stations are shown in green circles. Geological Units are explained in text and legend of map in Figure 8 and Appendix B (full size).

volcanic breccia, lithic and feldspathic wacke, siltstone and limestone, locally coralline; lithic-crystal tuff, lapilli tuff and reworked equivalents; and minor vitric tuff, pebbly sandstone, siltstone, and volcaniclastic debris-flow deposits; may include black carbonaceous shale, mudstone, siltstone and limestone (locally coralline) equivalent to unit TrJY “. Only one station within the unit was located along Y400 logging road, but a traverse down into the valley below the historic Clyde workings south of Yreka (Figure 14is within the unit. The road outcrop at HW16-299 consists of brown weathering, coherent volcanics with fine grained epidote chlorite alteration.

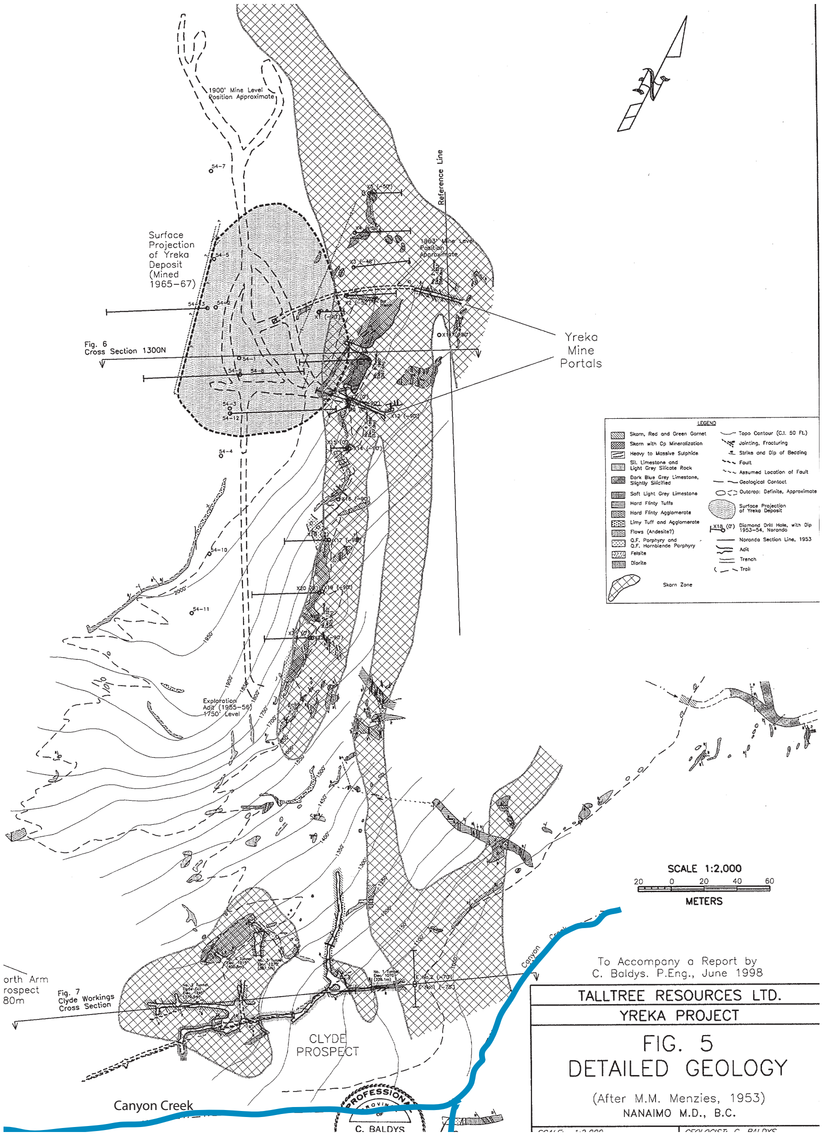


Figure 17: Historical Geological map of the Yreka Mine and Clyde Workings area. Map is from Baldys (1998) after sections and plans in internal Noranda reports by Menzies (1953).   The map shows the surface extent of the skarn horizon (diagonal hatched area) north of Canyon Creek and the vertical projection to surface of the mine developments and skarn sulphide mineralization. The traverse of September 7, 2016 reached the southern edge of the skarn zones at the junction of the west and south reaches of the creek (Figure 14). Sections through the Clyde and Yreka zones show the skarn dipping west within the stratigraphic units.

The off road traverse started along the Y400 Road and descended into the creek through densely overgrown logging slash. The creek bed had good outcrops, but progress was impeded by heavy deadfall of old growth trees that created dams across the creek bed. Stations HW16-303 to HW16-310 were recorded along the creek within the mapped TrJBvs unit. Large porphyritic felsic dykes occupied much of the base of the creek and formed some of its steep banks.   Two dykes of about 3 meters width were mapped for over 200 meters along the creek. Both displayed altered to pyrite-replaced acicular hornblende phenocrysts, feldspar phenocrysts in a light coloured matrix. Host rocks to the dykes were finely bedded orange to yellow weathering tuffs with moderate north and west dips. Sulphide impregnations were observed in the tuffs in places appearing bleached or varying to a white cherty tuff.

One outcrop at HW16-306 to the south of the creek junction was described as a black, variably deformed argillite with pyritic veinlets and locally rusty weathering. The unit may correspond to the TrJY - Yreka shale-Limestone unit observed along the Y400 road, and presumed to terminate against a fault farther downstream in the creek. Possibly this could be the continuation of the unit in the adjacent fault block.

The subunit TrJY named the Yreka shale-limestone unit, consists of black carbonaceous or graphitic shale passing upward into black to medium grey, thin to medium-bedded, variably carbonaceous, silty limestone with shale partings, concretionary limestone, mudstone and siltstone; locally fossiliferous. This unit occurs along Y400 within the larger Volcaniclastic-Sedimentary unit and was examined at Station HW16-300 to HW16-302. There it is described as a black slate to black argillite in contact with amygdaloidal basalt with sulphides concentrated at the contact. Dykes of feldspar porphyry cut the Yreka shale-limestone unit at these outcrops.

Bonanza Group: LeMare Lake Volcanic Unit (lJLm)

Above the volcaniclastic-sedimentary unit is the volcanic dominated LeMare Lake volcanics. This unit is described by Nixon et al. (2011) as dark grey-green, basaltic to andesitic flows with minor intercalated volcaniclastic and sedimentary lithotypes and locally includes minor pillow lava/breccia, minor rhyolitic flows and pyroclastic rocks. Within the mapped areas stations from the 2016 work were located along the Y400 road near its upper end in the NE trending valley south of Yreka. Four stations; HW16-295 to HW16-298 were located along a 500 meter stretch of the road and describe feldspar porphyritic volcanic flows and volcaniclastics. At one station a dyke intrudes a phyllosilicate-altered quartz-feldspar porphyritic felsic volcanic in which hornblende mafic phenocrysts are replaced by epidote and pyrite and the feldspars are altered. A nearby fault zone is mineralized with black sphalerite and pyrite-quartz in a white clay gouge.

The new 2018 work examined extensive areas of Le Mare Lake Formation in road cuts on the western slopes of Comstock Ridge within the eponymous new mineral claim. The objective was to explore the contacts of the Kloochlimis Pluton with the Le Mare Lake Volcanics for breccias, dykes, alteration effects, and mineralization.

Figure 18: Pink feldspars in monzonite
The rock is located near the eastern contact of the pluton (HW18-593) in an area of volcanic inclusions stoped from the overlying Le Mare Lake volcanics..

Kloochlimmis Pluton and other Intrusive Rocks

Dykes constitute the main intrusive rocks evident in the eastern part of the claims explored in 2016 and were mapped at about a dozen stations shown on the geological map (Figure 8). Dykes dominantly have near north-south strikes (azimuths range from 190 to 160) and steep dips. It is not clear if the dykes pre or post-date the fault blocks mapped on GM2011 since they were not traced from one block into another. Dykes in the south reach of Canyon Creek appear to form a swarm and parallel fault structures mapped at the southern end of Y400.

The new work in 2018 borders onto the Kloochlimmis pluton in the west side of the new claim 1061432. Significant pluton bodies extend well beyond the previously mapped extent of

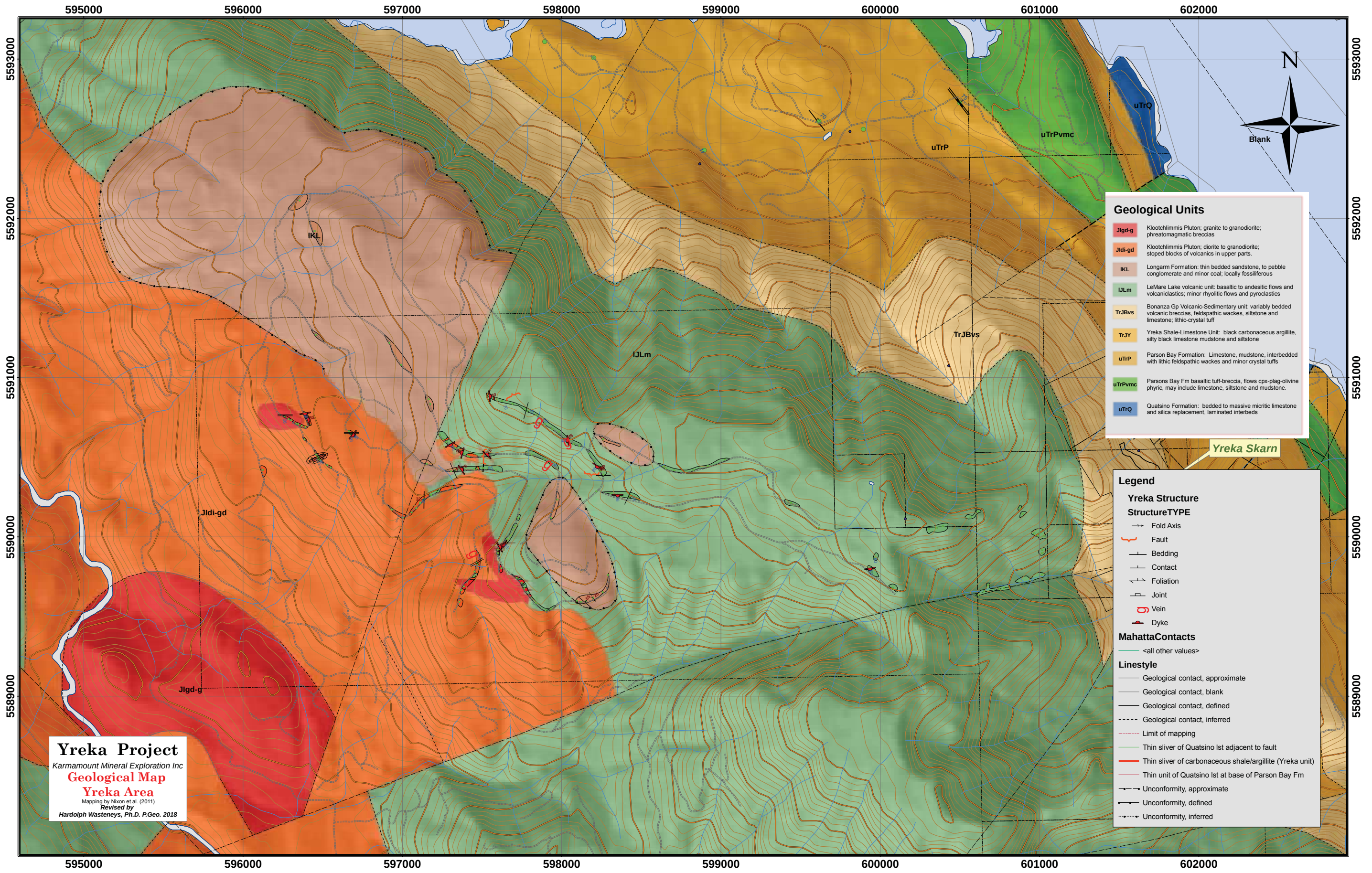


Figure 19: Geological Map of the Yreka Property 2018
Mapping utilized the network of logging roads in the new Comstock Ridge claim to revise contact of the Klootchlimmis pluton eastward. Breccia bodies, skarns, and stoped block of volcanics characterize the intrusive contact zone of the pluton under the Le Mare Lake Volcanics. Numerous granitoid dykes are present in the volcanics above the contact

the pluton shown on the maps of Nixon et al. (2007) on the lower slopes in the Mahatta Valley and dykes, probably from the pluton, cut Le Mare Lake volcanics on the high slopes of Comstock Ridge. The new work is summarized in Figure 6 (above) showing geological mapping stations and some of the results of the work as well as speculations that prompted the work.

The Klootchlimmis Pluton is divided into two main phases (within the map area): a biotite hornblende phyric diorite that contains accessory sphene and magnetite, and a granitic to granodioritic phase that has variable proportions of conspicuously pink orthoclase feldspar. Grain size variation from fine to coarse was observed over narrow intervals indicating multiple intrusive events and of finer grain. The contact zone between the Le Mare Lake volcanics and the Klootchlimmis Pluton is characterized by extensive dyking into the volcanics and by stoping of volcanic blocks into larger masses of the pluton. Some contact zone alteration was also possibly observed in the form of apparently silicified volcanics with a rhyolitic appearance. Skarn assemblages were also observed near the contact in stoped blocks of mafic volcanics and consisting of garnet, epidote, calcite, and pyrite.

Breccias of both phreatic and phreatomagmatic types and spatially associated stockwork fracture zone were observed within 50 meters of the intrusive contact. The phreatic breccias were observed mainly in dioritic phases and vary from fracture networks with minor rock flour injection to jigsaw puzzle breccias on subangular host rock fragments suspended in mixtures of

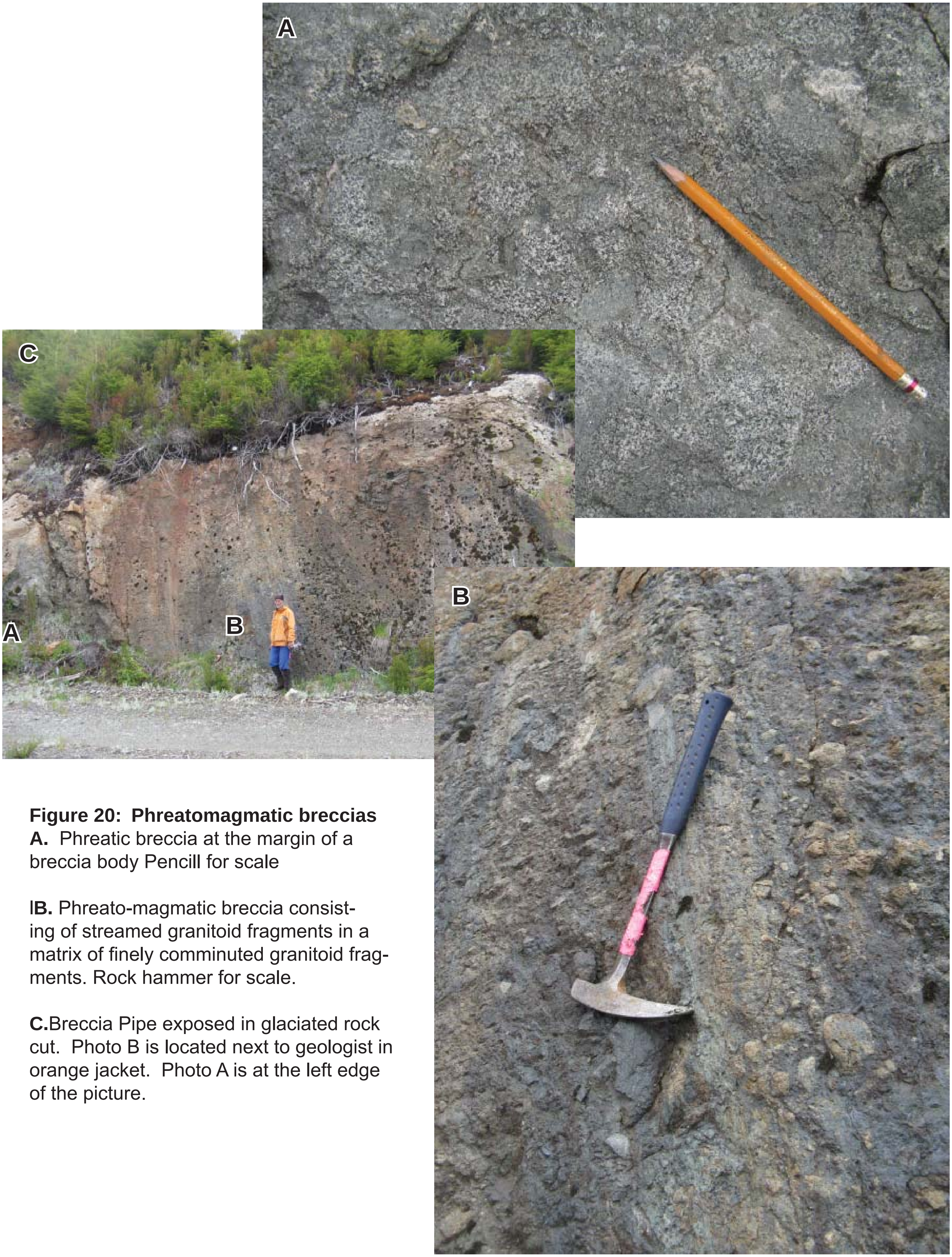


Figure 20: Phreatomagmatic breccias
A. Phreatic breccia at the margin of a breccia body Pencill for scale

IB. Phreato-magmatic breccia consisting of streamed granitoid fragments in a matrix of finely comminuted granitoid fragments. Rock hammer for scale.

C.Breccia Pipe exposed in glaciated rock cut. Photo B is located next to geologist in orange jacket. Photo A is at the left edge of the picture.

rock flour and granular breccia. In one location at HW18-720, as large body of pebble breccia displaying vertical flow structures was bordered by phreatic breccia zone several meters wide that graded into stockwork veins of pyrite. The stockwork fractures were densely spaced and not preferentially aligned and veining consisted of 1 to 2 mm pyrite veins with minor chalcopyrite. The breccia body was observed in the face of a long rock cut, but could not be traced through logging slash to adjacent rock cuts on higher roads. The pebble breccia is interpreted as a phreatomagmatic breccia. Pebbles consist of granitoid lithologies presumably transported vertically from lower parts of the pluton during explosive interactions between magmas and groundwater or release of magmatic fluids. The marginal phreatic breccias, or jigsaw puzzle breccias, are generated by explosive release of pressure in rocks that have been supercritically charged with fluids by some containment mechanism. The rock flour is created by the explosive decompression of rock that has been saturated along internal grain boundaries and by high pressure fluid. When the pressure is released, the fluids explode from within the rock, instantaneously shattering it on a crystal scale. Stockwork fracturing generates the jigsaw fragments that are usually several cm in size and the rock flour spalls from the rocks margins into the void spaces between fragments.

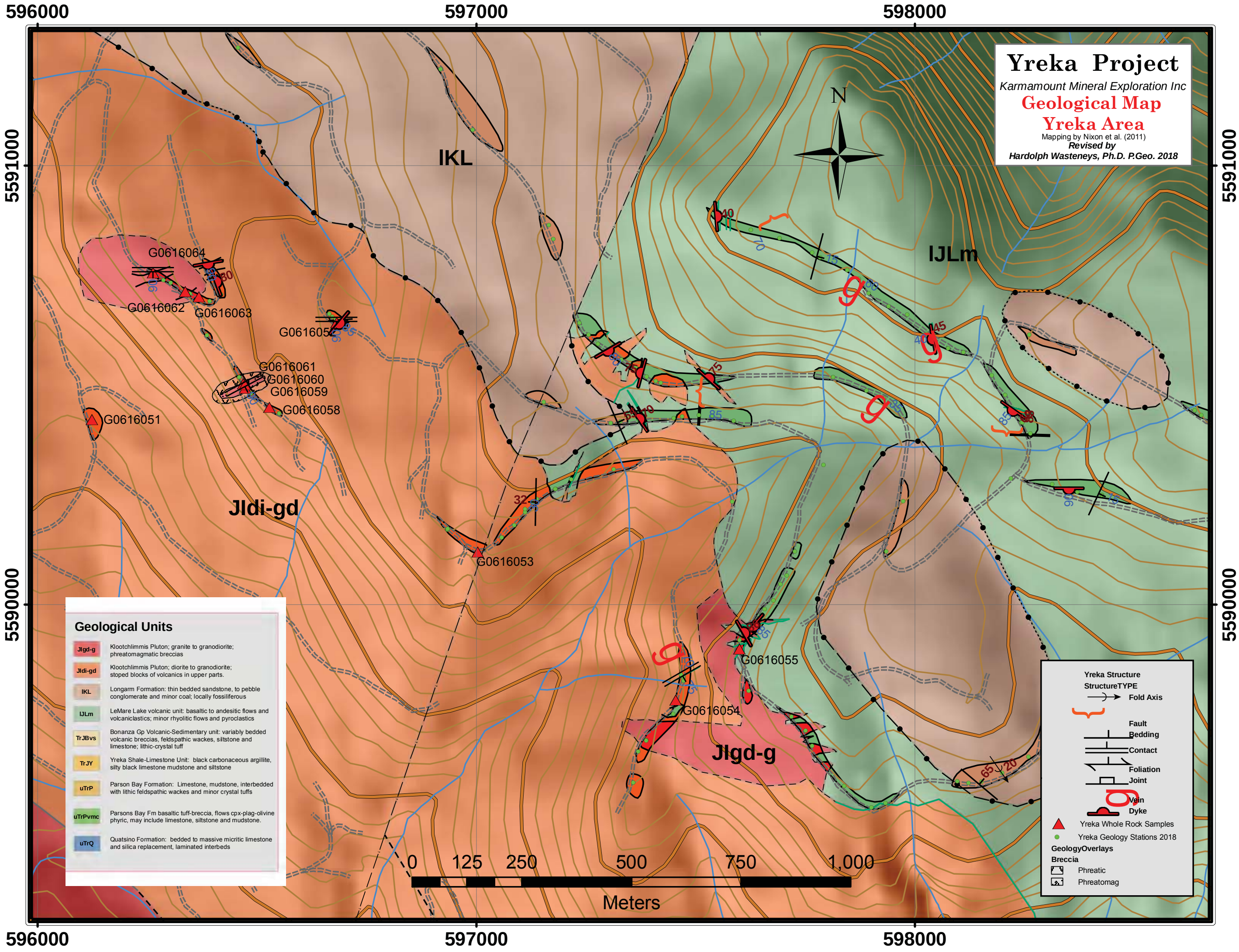


Figure 21: Klootchlimmis Pluton contact zone.
In the upper left of the map are two areas of breccias, the more northerly one involves a possible granitic stock coring a zone of phreatic breccias in diorite. Three hundred meters south is a breccia dyke or pipe of probably diorite composition with margina phreatic breccias. Geology stations and geochemical samples are marked.

The higher the energy released the greater the separation of the large fragments and the greater the volume of rock flour generated to separate them resulting in the characteristic jigsaw puzzle textures. Here this process appear to have taken place in a few locations near the upper part of the pluton.

At one location, granitic compositions were analysed in an intrusive body that cuts a dioritic host and is adjacent to phreatic and possibly phreato-magmatic breccias in the diorite. It was inferred from these relations that granitic phases of the pluton were late and associated with phreato-magmatic brecciation.

At higher elevations in the road system above the main intrusive contact, granitoid dykes were observed cutting Le Mare Lake volcanics. Dykes extend as far as the ridge crest, but the density of dyking is not high with about 6 observed over a one kilometer series of rock cuts.

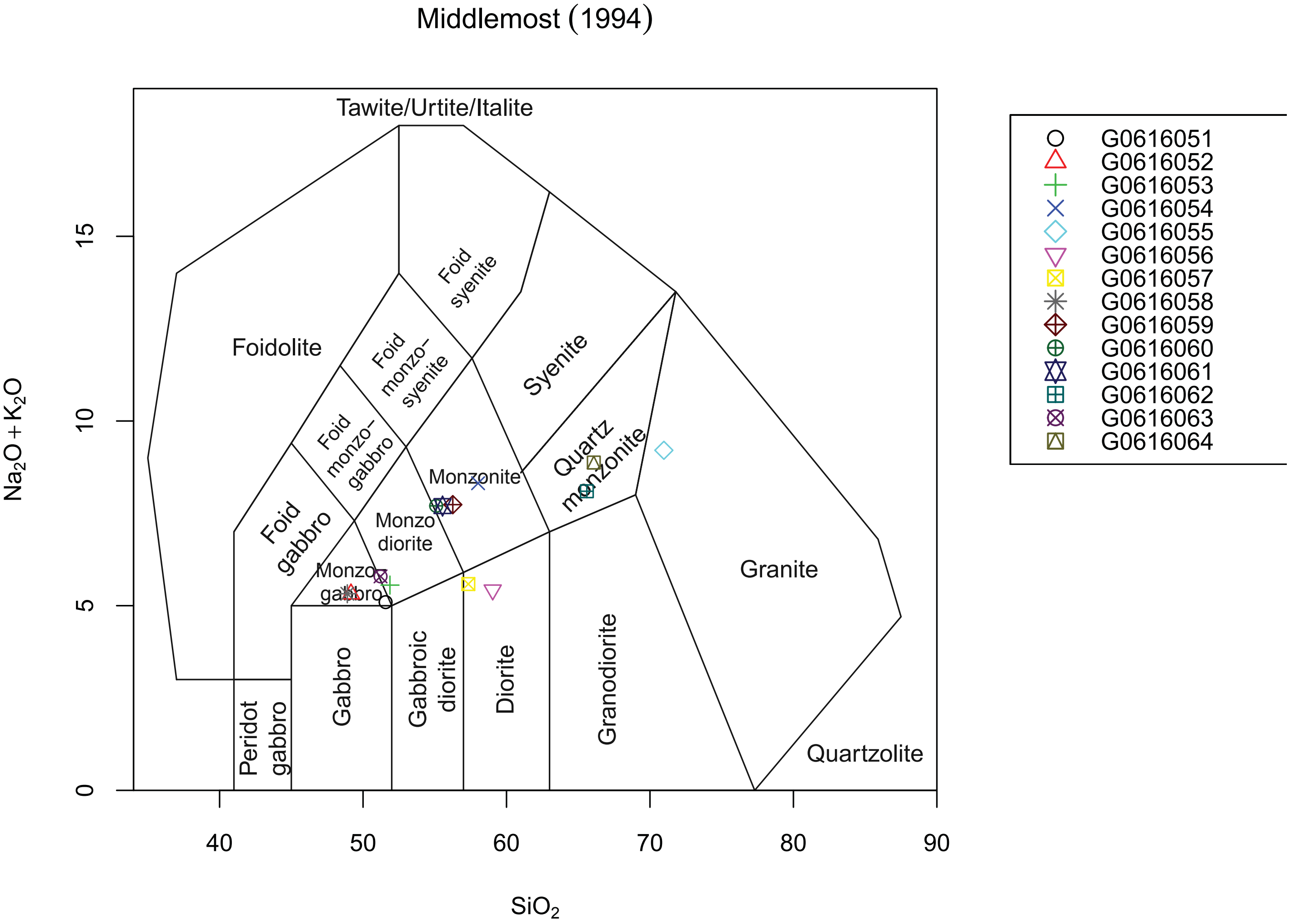


Figure 22: Total alkali silica plot of Middlemost (1994) for Yreka granitoids
Sample numbers are keyed to symbols plotted in the diagram and compositional data can be found in Figure 18.

Figure 23: Table of Compositional Data for the Klootchlimmis pluton and other rocks

Station	**HW569**	**HW572**	**HW577**	**HW593**	**HW608**	**HW679**	**HW681**	**HW716**	**HW720**	**HW723**	**HW724**	**HW727**	**HW729**	**HW736**
SAMPLE	G0616051	G0616052	G0616053	G0616054	G0616055	G0616056	G0616057	G0616058	G0616059	G0616060	G0616061	G0616062	G0616063	G0616064
Northing	5599864	5600039	5599492	5599119	5599223	5599076	5599076	5599860	5599908	5599919	5599917	5600138	5600123	5600187
Easting	170289	170864	171143	171565	171720	175123	175090	170695	170644	170640	170644	170525	170556	170456
lithology	diorite	diorite	hb diorite	kf diorite	granite	porphyry	sili volcani	diorite	breccia	breccia	bx diorite	kf granodi	cg diorite	granite
SiO_2	50.0	47.9	50.6	58.2	72.0	56.7	54.1	47.5	54.4	52.5	54.2	65.3	50.4	65.0
Al_2O_3	16.55	13.30	16.05	15.70	14.15	16.60	17.80	14.50	15.95	15.20	16.60	15.10	13.35	15.35
Fe_2O_3	10.55	15.20	10.25	3.50	3.39	8.04	8.87	14.75	9.21	9.51	9.48	8.05	14.75	6.88
CaO	7.82	8.41	8.59	9.02	1.29	5.10	1.14	7.97	4.28	5.97	4.69	1.81	7.04	1.13
MgO	5.20	4.97	4.73	3.52	0.68	3.36	5.55	4.85	3.78	3.10	3.33	0.68	4.54	0.75
Na_2O	4.01	4.34	4.70	4.44	5.29	3.07	3.83	4.41	6.66	6.48	6.24	7.98	4.57	8.49
K2O	0.93	0.84	0.72	3.90	4.05	2.14	1.44	0.76	0.82	0.86	1.27	0.08	1.13	0.24
Cr_2O_3	0.01	0.00	0.01	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TiO_2	1.28	2.16	1.44	1.58	0.47	0.78	1.20	1.98	1.00	1.04	1.15	0.39	2.10	0.39
MnO	0.18	0.17	0.15	0.10	0.04	0.10	0.24	0.12	0.07	0.09	0.07	0.02	0.16	0.01
P_2O_5	0.43	0.15	0.31	0.35	0.09	0.15	0.18	0.29	0.53	0.54	0.55	0.13	0.36	0.12
SrO	0.06	0.03	0.02	0.03	0.01	0.05	0.04	0.02	0.03	0.03	0.04	0.01	0.02	0.01
BaO	0.03	0.02	0.02	0.10	0.06	0.11	0.06	0.02	0.02	0.03	0.04	0.01	0.04	0.01
LOI	1.66	1.80	2.23	1.45	0.38	4.01	4.82	2.32	2.76	4.73	2.11	2.21	2.16	0.48
Total	**98.71**	**99.29**	**99.82**	**101.89**	**101.90**	**100.23**	**99.28**	**99.49**	**99.51**	**100.08**	**99.77**	**101.76**	**100.62**	**98.86**
C %	0.03	0.13	0.01	0.11	0.02	0.31	0.11	0.1	0.16	0.61	0.09	0.29	0.16	0.02
S %	0.06	0.29	0.28	0.01	0.01	1.35	0.14	0.5	0.54	1.12	0.26	1.15	0.54	0.24
Co	26	28	22	7	2	21	22	37	23	30	19	49	45	16
Ni	21	27	24	9	0.5	37	34	15	2	3	4	25	12	2
Cr	70	20	110	30	10	130	60	10	0.5	0.5	10	10	0.5	10
V	299	567	285	211	13	163	273	496	83	89	81	15	438	2.5
Ba	256	201	202	900	572	1095	580	201	207	224	339	19.1	351	59.3
Rb	20.9	19.9	13.2	55.7	65.7	30.9	24.9	11.8	12.5	13.7	15.5	1.3	16.5	1.9
Sr	555	276	172	275	136	449	348	213	252	254	323	125	212	111
Y	30.5	62.4	31.7	55.2	108	49.2	36.9	34.8	44.2	46	38.8	37.8	47.4	67.1
Nb	3.3	9.8	4.7	9.7	21.8	7.7	3.6	3.5	4.7	5.3	4.7	6.4	9.7	15
Zr	104	192	108	134	610	232	95	115	182	163	152	592	149	604
Hf	2.6	5.1	3	3.8	15.4	5.8	2.4	3.1	4.5	4.2	3.5	14.2	4.3	14.5
La	11.4	17.4	6	13.9	35	15.3	9.4	8.2	14.6	16.7	14.4	12.4	11.8	18.7
Ce	27.1	61.5	13.4	36.8	83.4	36.2	19	21	37.1	41.1	34.4	35.4	32.4	54.5
Pr	3.86	10.1	2.07	5.52	11.7	5.11	3.33	3.09	5.44	5.95	4.86	5.05	4.75	7.97
Nd	18.6	48.2	10.8	26.4	54.1	23.8	16.8	16.1	26.5	27.8	23.5	23.9	22.8	37.5
Sm	5.1	12.3	3.76	7.75	15.5	6.5	4.81	5.17	6.78	8.01	6.2	5.92	6.69	10.05
Eu	1.49	3.19	1.39	1.91	2.43	1.77	1.67	1.51	2.21	2.3	1.96	2.2	1.79	2.62
Gd	5.48	12.1	4.83	8.63	16.55	7.39	5.69	5.79	8.09	8.05	6.98	6.03	7.64	10.85
Tb	0.89	1.96	0.88	1.48	2.91	1.34	0.95	0.95	1.31	1.38	1.13	1.01	1.31	1.77
Dy	5.56	12.55	5.49	9.39	19.25	8.46	6.24	6.16	8.13	8.15	6.88	6.63	8.57	11.75
Ho	1.17	2.54	1.15	1.97	4.08	1.78	1.3	1.34	1.6	1.66	1.38	1.32	1.71	2.48
Er	3.11	7.19	3.21	5.54	12.25	5.29	3.46	3.85	4.61	4.67	3.85	4.23	4.94	7.23
Tm	0.5	1.11	0.48	0.87	1.9	0.82	0.52	0.56	0.68	0.67	0.6	0.66	0.75	1.11
Yb	2.96	6.98	3.24	5.61	12.5	5.29	3.24	3.52	4.3	4.44	3.49	4.7	4.67	7.68
Lu	0.46	1.04	0.51	0.85	1.96	0.87	0.51	0.53	0.65	0.64	0.51	0.79	0.73	1.3
Th	1.21	1.59	1.26	2.54	7.18	2.33	0.78	1.03	1.54	1.48	1.69	2.75	2.04	3.94
U	0.6	3.83	0.36	1.15	2.88	1.26	0.4	0.5	1.31	1.18	0.86	1.23	0.92	1.28
Sc	26	41	30	23	7	19	25	36	12	14	14	14	40	14
Hg	0.059	0.01	0.006	0.0025	0.0025	0.008	0.007	0.068	0.026	0.077	0.011	0.051	0.017	0.009
Sb	0.025	0.09	0.08	0.08	0.08	0.57	0.86	0.07	0.07	0.1	0.06	0.08	0.07	0.06
As	1.2	0.8	0.7	0.6	0.6	1.5	2.8	1.3	2.2	3.8	1.4	1.6	1.2	0.5
Se	0.2	0.1	0.2	0.1	0.1	1.4	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Bi	0.02	0.03	0.02	0.02	0.02	1.93	0.64	0.03	0.03	0.03	0.02	0.03	0.03	0.02
Te	0.005	0.02	0.005	0.005	0.005	0.06	0.01	0.005	0.02	0.01	0.005	0.005	0.005	0.005
W	1	1	1	1	1	2	3	1	2	1	1	1	1	0.5
Sn	1	9	1	3	3	2	2	2	2	2	1	5	3	6
Ta	0.2	0.6	0.3	0.6	1.4	0.5	0.2	0.2	0.3	0.3	0.3	1	0.6	1.1
Li	20	10	10	10	0.5	10	30	10	10	10	10	0.5	10	0.5
Re	0.003	0.003	0.001	0.003	0.003	0.003	0.003	0.002	0.001	0.001	0.001	0.004	0.001	0.002
Mo	0.5	0.5	0.5	1	0.5	1	0.5	0.5	0.5	1	0.5	3	2	3
Cu	33	191	57	4	7	201	97	98	58	63	56	76	70	16
Pb	1	1	1	1	1	4	1	1	1	1	1	1	1	1
Cd	0.25	0.25	0.25	0.25	0.25	1.2	0.9	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Zn	54	30	25	19	8	289	258	20	28	32	15	7	40	4
Ag	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Cs	0.58	0.1	0.03	0.12	0.07	0.51	0.48	0.07	0.16	0.08	0.15	0.02	0.05	0.005

Station	Sample Number	Description	TAS class	CeN/YbN	UTM Zone 9	SiO_2 Na_2O K_2O
HW18-569	G0616051	Gray, salt & pepper medium - coarse grained hornblende diorite - leucodiorite; massive crystalline txt; unaltered primary magnetite and sphene	Monzogabbro	2.41	5599863 N 170289 E 419 mASL	50.0 4.01 0.93
HW18-572	G0616052	coarse diorite w pyrite magnetite-sphene gradational veins lenses and pods in a finer diorite	Monzogabbro	2.32	5600039 N 170863 E 612 mASL	47.9 4.34 0.84
HW18-577	G0616053	medium grained hornblende diorite	Monzodiorite	1.09	5599492 N 171142 E 639 mASL	50.6 4.7 0.72
HW18-593	G0616054	diorite with distinct pink patches; appears to be a variant of adjacent diorites, coarse pink feldspar and large altered mafic minerals	Monzonite	1.73	5599118 N 171565 E 625 mASL	58.2 4.44 3.9
HW18-608	G0616055	Irregular dykes; granite-granodiorite; leucocratic, pale grey 10% quartz	Granite	1.76	5599222 N 171720 E 715 mASL	72 5.29 4.05
HW18-679	G0616056	silicified feldspar porphyry w disseminated pyrrhotite; generally stockwork fractured, but unmineralized	diorite	1.8	5599075 N 175122 E 811 mASL	56.7 3.07 2.14
HW18-681	G0616057	very unusual resistant ridge on steep wooded slope; silicified volcanic w stockwork fractures and abundant pyrrhotite	diorite	1.54	5599075 N 175090 E 822 mASL	54.1 3.83 1.44
HW18-716	G0616058	diorite coarse grained, fresh accessory pyrrhotite and magnetite; grey plagioclase, equigranular equant stubby hornblende	Monzogabbro	1.57	5599859 N 170695 E 560 mASL	47.5 4.41 0.76
HW18-720	G0616059	Streamed, laminated breccia; Phreato-magmatic; angular granitoid clasts entrained in altered matrix parallel to contact	Monzonite	2.27	5599908 N 170644 E 544 mASL	54.4 6.66 0.82
HW18-723	G0616060	Breccia with minor disseminated chalcopyrite; coarse brecciated feldspars in dark matrix.	Monzonite	2.44	5599918 N 170640 E 548 mASL	52.5 6.48 0.86
HW18-724	G0616061	breccia w disseminated chalcopyrite and pyrite; massive diorite fragments with thin chalcopyrite veinlets	Monzonite	2.6	5599916 N 170644 E 548 mASL	54.2 6.24 1.27
HW18-727	G0616062	fine grained pink and green granite w chlorite slips randomly placed forming finely stockwork fractured rock with fine veinlets of pyrite, chalcopyrite and magnetite	Quartz Monzonite	1.98	5600137 N 170525 E 546 mASL	65.3 7.98 0.08
HW18-729	G0616063	coarse grained granite w pegmatite veins; disseminated pyrite and chalcopyrite; contacts with finer grained granites	Monzodiorite	1.83	5600122 N 170555 E 550 mASL	50.4 4.57 1.13
HW18-736	G0616064	Stockwork fractured fine grained granodiorite wi disseminated pyrite and chalcopyrite	Quartz Monzonite	1.87	5600186 N 170456 E 544 mASL	65 8.49 0.24

Figure 24: Lithogeochemistry Sample Descriptions

Summary of Station, Lab Sample number (in certificates) field description, classification by the Total Alkali Silica Plot of Middlemost (1994), CeN/YbN Cerium / Ytterbium (normalized by Primitive Mantle values) for LREE/HREE ratios, UTM zone 9 coordinate and SiO_2 - Na_2O - K_2O (wt%).

Samples highlighted in yellow are from silicified volcanics on theYreka slope

Lithogeochemistry of the Plutonic rocks

The composition of the Klootchlimmis pluton was analysed in 12 of 14 samples analysed from various parts of the upper pluton and from dykes into the Le Mare Lake volcanics. The compositions for the rocks are tabulated in Figure 18 which includes major and trace rock forming elements, REEs, Carbon, Sulphur and metals of economic significance. By their major element composition the plutonic rocks of the Klootchlmmis pluton and probably related dykes adjacent Le Mare Lake volcanics they show a alkaline granitoids range from monzogabbros to

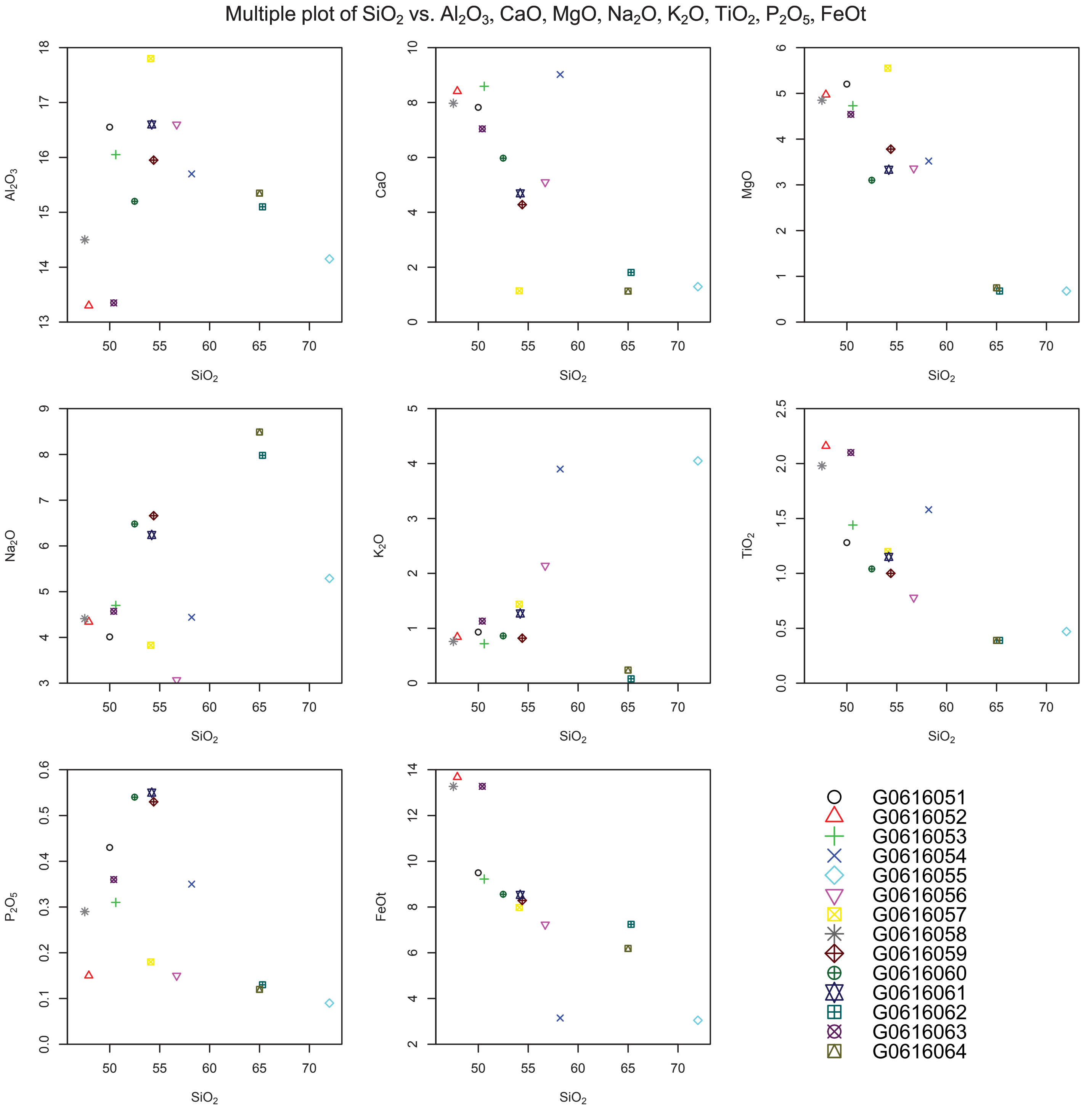


Figure 25: Harker variation diagrams for the Yreka Klootchlimmis Pluton granitoids
Compositions of the rocks are tabulated in Figure 20 and described in Figure 20 using sample numbers indicated by symbols, which are also used in Figure 19.

quartz monzonites by the Total Alkali Silica classification of Middlemost (1994) shown in Figure 19. The compositions of the 12 rocks forms apparent clusters in the monzogabbro, monzonite and quatrtx monzonite fields with one lone rock in the granite field. Two rocks that plot in the diorite field, below the alkaline line, are from silicified volcanics above the Yreka skarn and appear to deviate from the fractionation trend of the granitoids. The Klootchlimmis rocks are quite high in Na_2O plus K_2O total and most have very high Na_2O and corresponding low $K_2O/(K_2O+Na_2O)$ ratios. However, two rocks, a monzonite and the granite have K_2O ca, 4 wt% while the remainder range from 0.06 wt% to 1.27 wt%. It is not clear what effect metasomatism or hydrothermal alterations has had on the rocks, but the wide range of K_2O suggests both depletion and enrichment have been involved in different situations. This does bring into question classifications of the rocks by schemes that involve relatively mobile elements such as K, Na and Si. Indicators of volatile action in the evolution of the compositional may be data for Loss on Ignition (LOI), and sulphur (S) in the analyses. Both are moderate but variable with LOIs ranging from 0.38 wt% to 4 .73 and S from 0.01 to 1.35 wt% and showing covariance with each other.

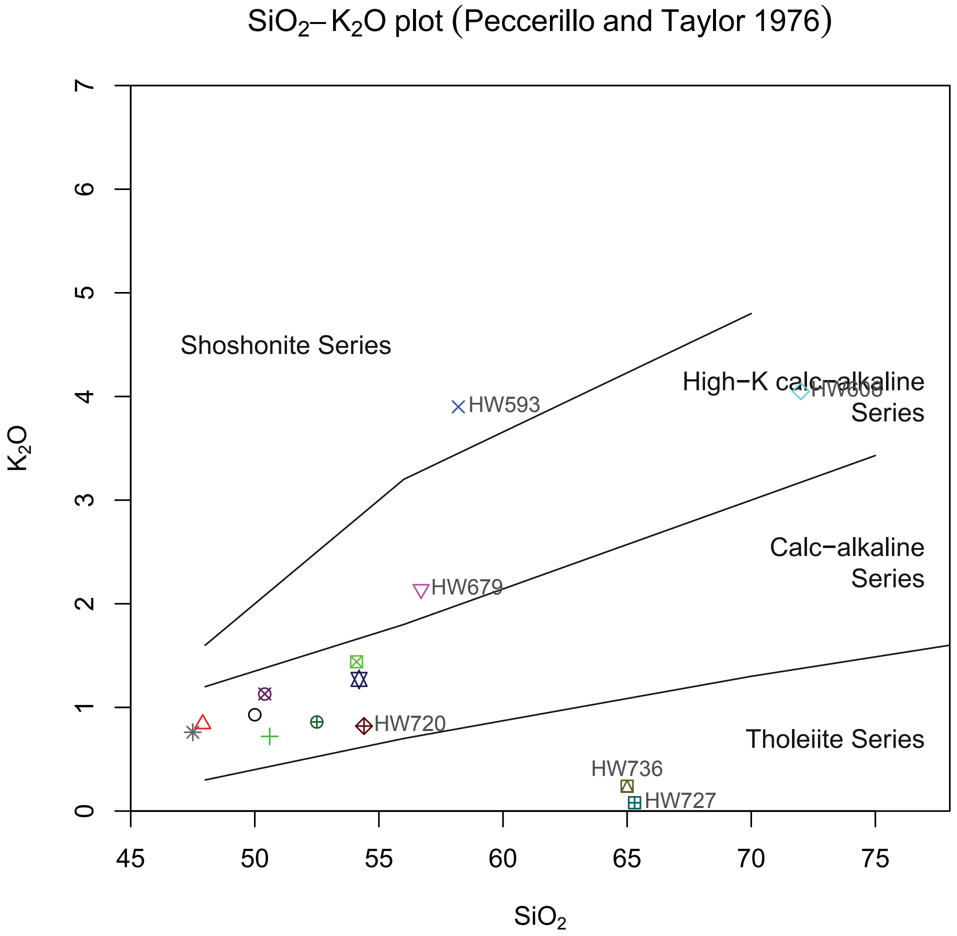


Figure 26: K2O vs SiO2 variations for the Yreka Suite

Symbols used are the same as those in the TAS diagram. Labels can be found in the table of rock descriptions above.

Harker diagrams of the variance of major elements against SiO_2 (Figure 24), which is the most commonly used fractionation index, show relatively normal spreads for compatible elements such as Mg (as MgO) and Ca (as CaO), which decline sharply towards very low concentrations with increasing SiO_2 as a result of incorporation in olivine, pyroxenes and plagioclase. In contrast sodium (Na_2O) and potassium (K_2O) both behave incompatibly and display increase with SiO_2, but at also show a wide variance at the felsic end of the range. This is revealed in the commonly used K_2O vs SiO_2 classification scheme of Peccerrillo and Taylor (1977) for volcanic rock shown in Figure 25. Here most of the rocks plot in the Calc-Alkaline Series at low SiO_2 compositions, but variably in the Tholeiite Series (HW736 and HW 727) for two rocks classified as quartz monzonite in the TAS diagram of Figure 21, or for 3 other rocks the High-K Calc-alkaline and Shoshonite Series.

As an alternative to assess the meaning of the range of compositions where hydrothermal alteration is suspected, the systematics of High Field Strength Elements (HSFE) are commonly employed. The HFSEs include Zr, Ti, Nb, P, Y, Nb and Ta and are commonly used in assessing suites of volcanic rocks. One such discriminant diagram is the Nb/Y vs Z/Ti discriminant diagram originally by Floyd and Winchester (1977) and modified by Pearce (1994) shown in Figure 26. The nomenclature is for volcanic rocks and the corresponding plutonic rocks have the same compositional subdivisions: basalt = gabbro; andesite =diorite; dacite= granodiorite; rhyolite = granite. The monzonitic association (monzogabbro, monzodiorite, monzonite and syenite) shown in the TAS diagram is equivalent to the alkali basalt through trachyte field compositions. The cause of the difference in the plutonic classification of the rocks in the two discriminate schemes may be attributed to the relative immobility of the HFSEs Nb, Ti, Y and Zr used in the Nb/Y - Zr/Ti diagram compared to LFSEs Si, Na and K in the TAS diagram. From this it is suspected that alkali metasomatism has enriched the rocks and contributed to shifting their classification to the monzonitic fields.

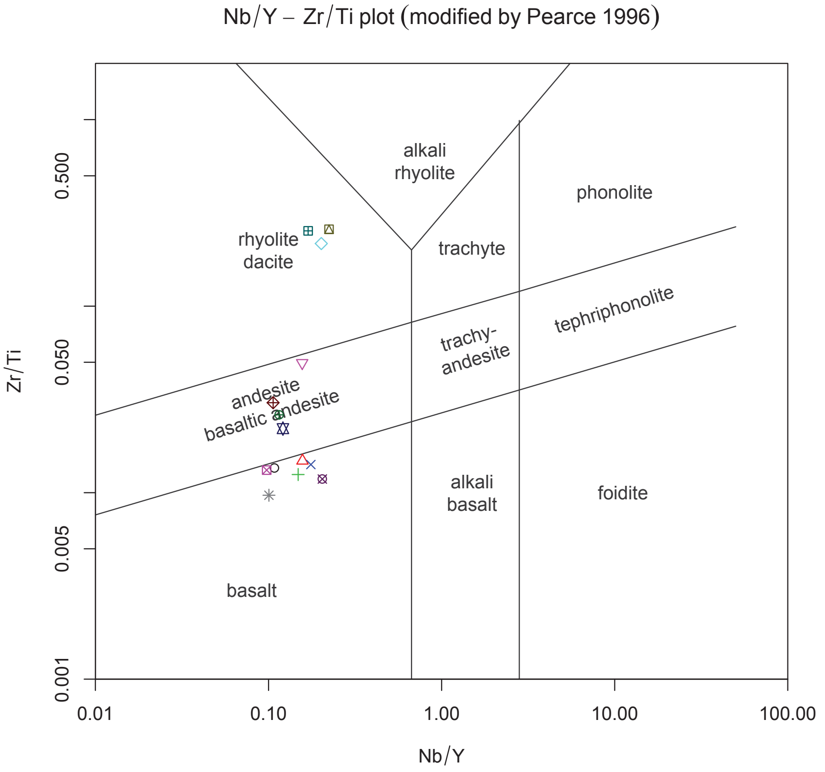


Figure 27: Nb/Y vs Zr/Ti discriminant diagram: Klootchlimmis pluton

Symbols are common to previous diagrams. Sample numbers in legend are keyed to table of compositional data, Figure 21, and rock descriptions in Figure 22.

More interpretation of the evolution of the igneous is revealed by variation between Zr and P_2O_5 and TiO_2 in binary diagrams in Figure 27. Crystal fractionation or igneous evolution trends for consanguinous suite of plutonic rocks should form linear arrays of P_2O_5 vs Zr and Zr vs TiO_2 because of the relatively incompatible and immobile nature of these elements. On the P_2O_5 vs Zr diagram (Figure 27B) markedly different trends separate the mafic to intermediate rocks (monzogabbros and diorites) from felsic rocks (quartz monzonites and granite). The mafic array is linear over a wide range of P_2O_5 concentrations between 0.15 and 0.6 wt% and all fall below 200 ppm Zr. The quartz monzonites contrast by plotting in a cluster at about 0.1 wt% P_2O_5 and 600 ppm Zr. These relations are corroborated in the Zr vs TiO_2 diagram (Figure 27B) where again the quartz monzonites plot in a small cluster well away from any possibility of being in the

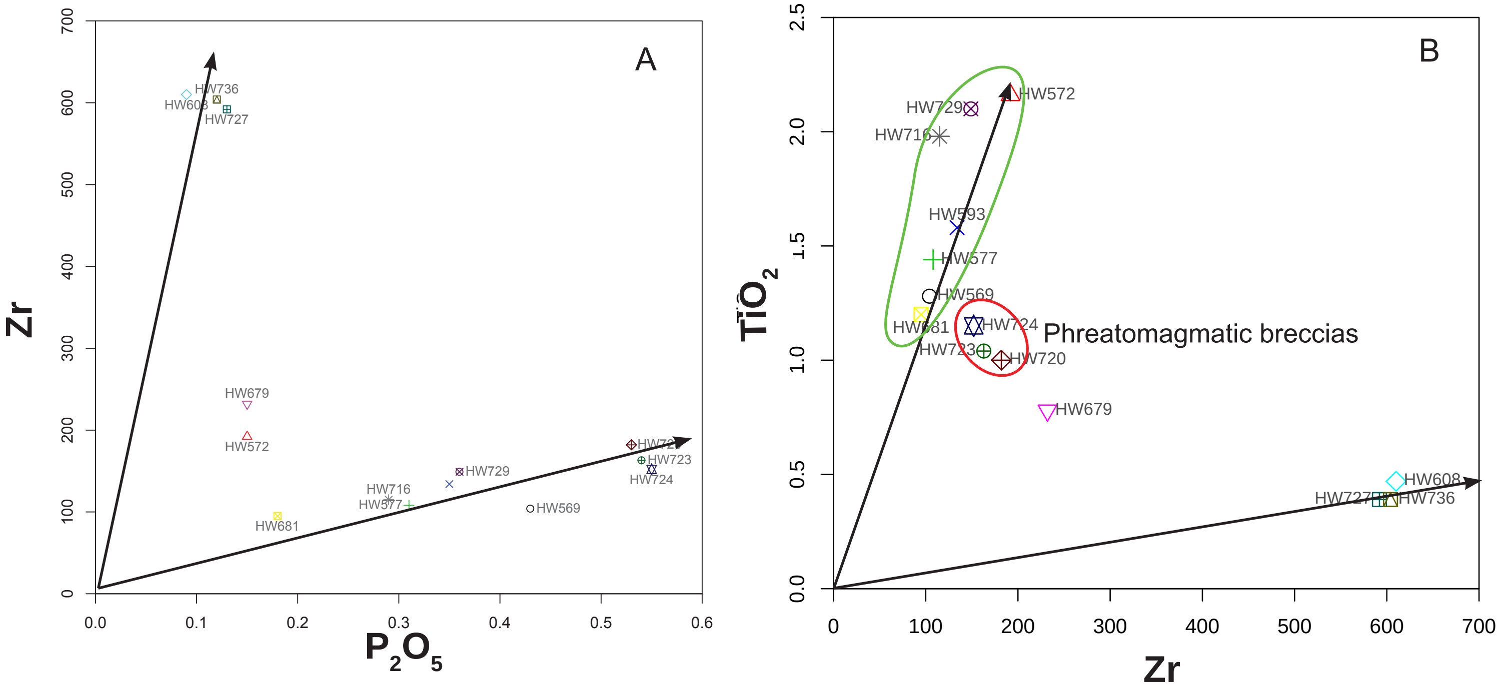


Figure 28: Binary variations of HFSEs: Klootchlimmis pluton
A. P_2O_5 vs Zr and B. Zr vs TiO_2 diagrams both show separate grouping of HW608, HW727 and HW736 from all the other rocks. These three are classified as quartz monzonite and granite. Igneous trends are expected to show linear arrays from the origin in Zr - TiO_2 and P2O5 vs Zr compositions. Separate trends are indicated by the arrowed lines. A cluster of points in the red ellipse on B are all phreato-magmatic breccias from a single pipe or dike feature. The green outlined field is the remaining rocks many of which are magnetite and sphene or pyrrhotite - bearing Monzogabbros and Monzodiorite by the TAS or Gabbros and Diorites by the Pearce (1996) Nb/Y-Zr/Ti classification.

same trend as the monzogabbros and monzodiorites. In addition, in Zr-TiO_2 space 3 rocks from a breccia pipe, classified as monzonites in the TAS diagram (Figure 21), all cluster slightly off the linear array formed by the monzogabbros and diorites suggesting either that they have slightly different parent magma or that breccia fragments are from diverse basement rocks and have contaminated the analysis. One rock HW679 that plots midfield on both diagrams is a silicified volcanic from an altered rock body on the Yreka slope probably within the Le Mare Lake Volcanics. A similar rock from the same weakly mineralized structure, HW 681, plots closely with the linear array, but it is not clear if this indicates consanguineity of the two altered rocks.

A fundamental question raised by the apparent separate igneous fractionation trends of the quartz monzonite and the Monzogabbro to Monzonite series is what petrological relationship the two groups have. Nixon et all (2011) mapped granodioritic to granitic rocks at the core of the Klootchlimmis pluton and it is assumed that they represent the Quartz Monzonites in this study. Normalized spider diagrams Rare Earth Element systematics of the rocks were also investigated using various spider diagrams that plot ratios of element concentrations in the sample normalized by concentrations of elements representing various tectonic environments as reference points. Rare Earth Element (REEs), and the suite of immobile and HFSEs are most commonly used, but some LILE can be incorporated for contrast. The normalizing data is published from identified sources such as, e.g. primitive mantle, chondrites or upper continental crust where researchers have analysed suites of representative rocks and calculated average values for each element. Differences in the patterns generated distinguish between rocks such as Mid Ocean Ridge Basalts (MORBs) from calc-alkaline or tholeiitic basalts, by relative enrichment or depletion of certain elements.

The Klootchlimmis suite is shown in a spider diagram normalized by REEs from primitive mantle rocks in Figure 28. The negative slope from Light REEs (Ce, La) to Heavy REEs is typical of calc-alkaline arc rocks as is the sharp depletion at Europium for some samples indicative of removal of quadralent Eu by plagioclase crystallization. The most evolved rocks, the granite and quartz monzonite, have the highest REE concentrations and the sharpest Eu anomaly. The lowest REE concentrations are in monzodiorites, which also have relatively low LREE:HREE ratios plotting as nearly flat lines. Generally, all the samples have positive ratios of LREE:HREE normalized by primitive mantle compositions.

Other primitive mantle elemental compositions can be compared using the data of McDonough and Sun (1995) as shown in Figure 29. Their scheme includes some LILE elements (Cs, Rb, Ba Th, U), HFSEs (Ta, P, Zr, Ti, Y), and REEs (Ce, La Pr, Nd, Sm, Eu, Dy, Yb, Lu), which show a wide range of contrasting chemical behaviours during magmatic evolution. In Figure 28A the Klootchlimmis granitoids show the REE enrichment in the granite and quartz monzonites like in Figure 28, but contrasting depletions in HFSEs Ti and P and LILEs Cs, Rb and Ba. The granite shows the greatest enrichment across most elements but strongly depleted in Sr, P, and Ti, as seen in Figure 27 for P_2O_5 and TiO_2 vs Zr. The quartz monzonites which were grouped with the granite in Figure 29, show strong depletion in Cs, Rb and Ba by comparison to all the rocks including the granite, but otherwise the same enrichment in Zr, and REEs and depletion non Ti, P and Sr as the granite. The contrasts are emphasized in Figure 29B where the rocks have been grouped by the TAS classifications (SiO_2 vs $Na_2O + K_2O$) of Middlemost (1994) in Figure 21. Although the granite does not plot for lack of a range in the group the quartz monzonites stand out from the other groups suggesting that they share a unique magmatic evolution distinct from the monzonite series (monzogabbros, monzodiorites, monzonites) and the two altered diorites from the weakly mineralized structure above Yreka.

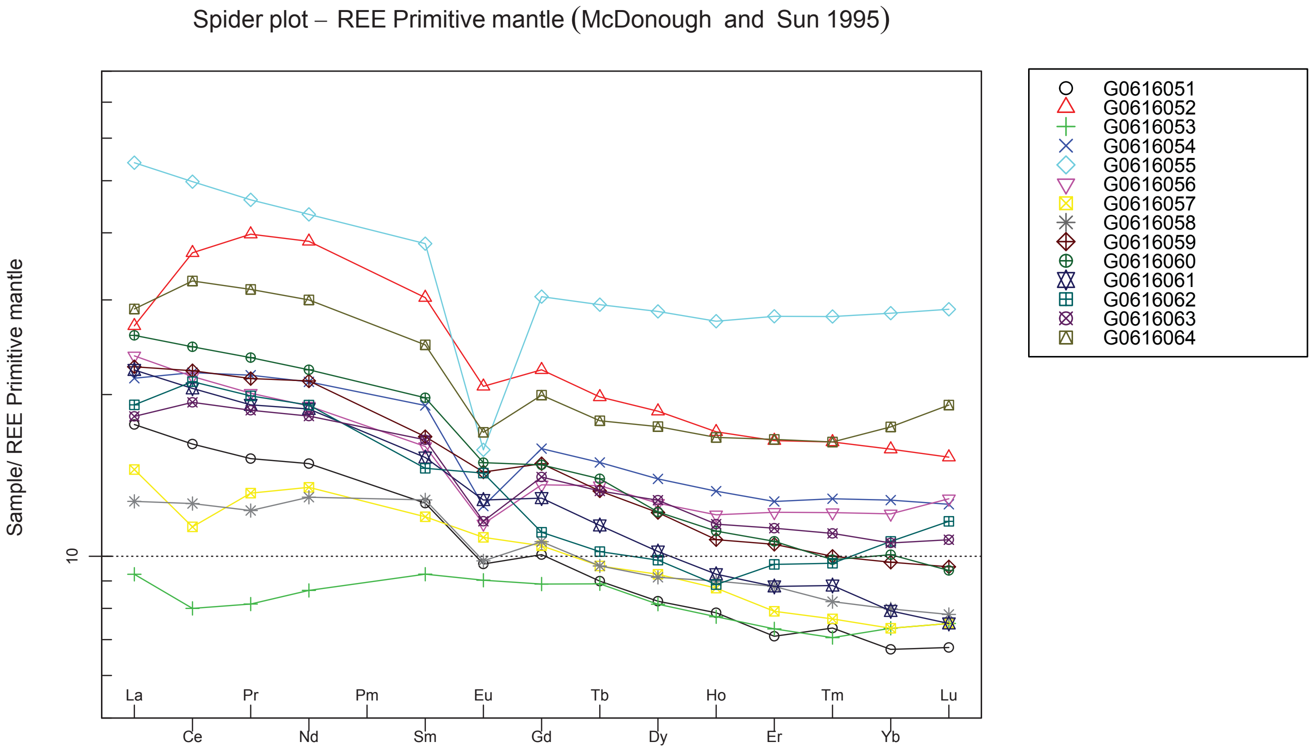


Figure 29: REE Primitive Mantle normalized plot for Klootchlimmis pluton
Symbols used are keyed to sample numbers in the legend. Vertical axis is in ratios of concentration in sample divided by concentration in primitive mantle and plotted logarithmically. The axis ranges from 5 to 70. The quartz monzonites and granite have the highest REE contents and the granite the strongest Eu anomaly.

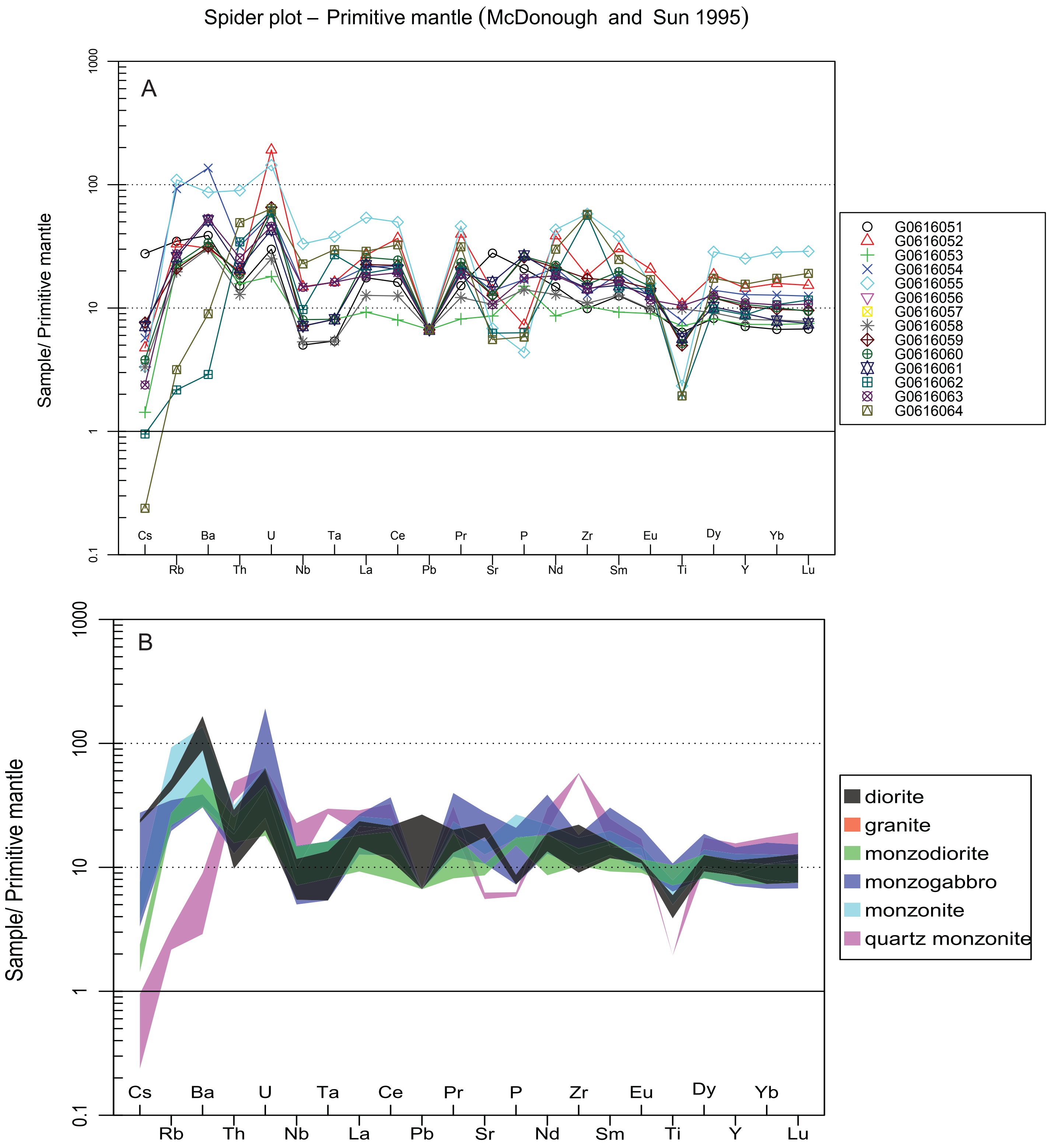


Figure 30: Spider Plot Primitive Mantle normalization of Klootchlimmis pluton granitoids
A . Individual sample plots for 14 rocks (McDonough and Sun, 1995).
B grouped fields determined by TAS classification in Figure 20 are indicated in the legend box. No field is shown in the plot for granite due to lack of a second sample.

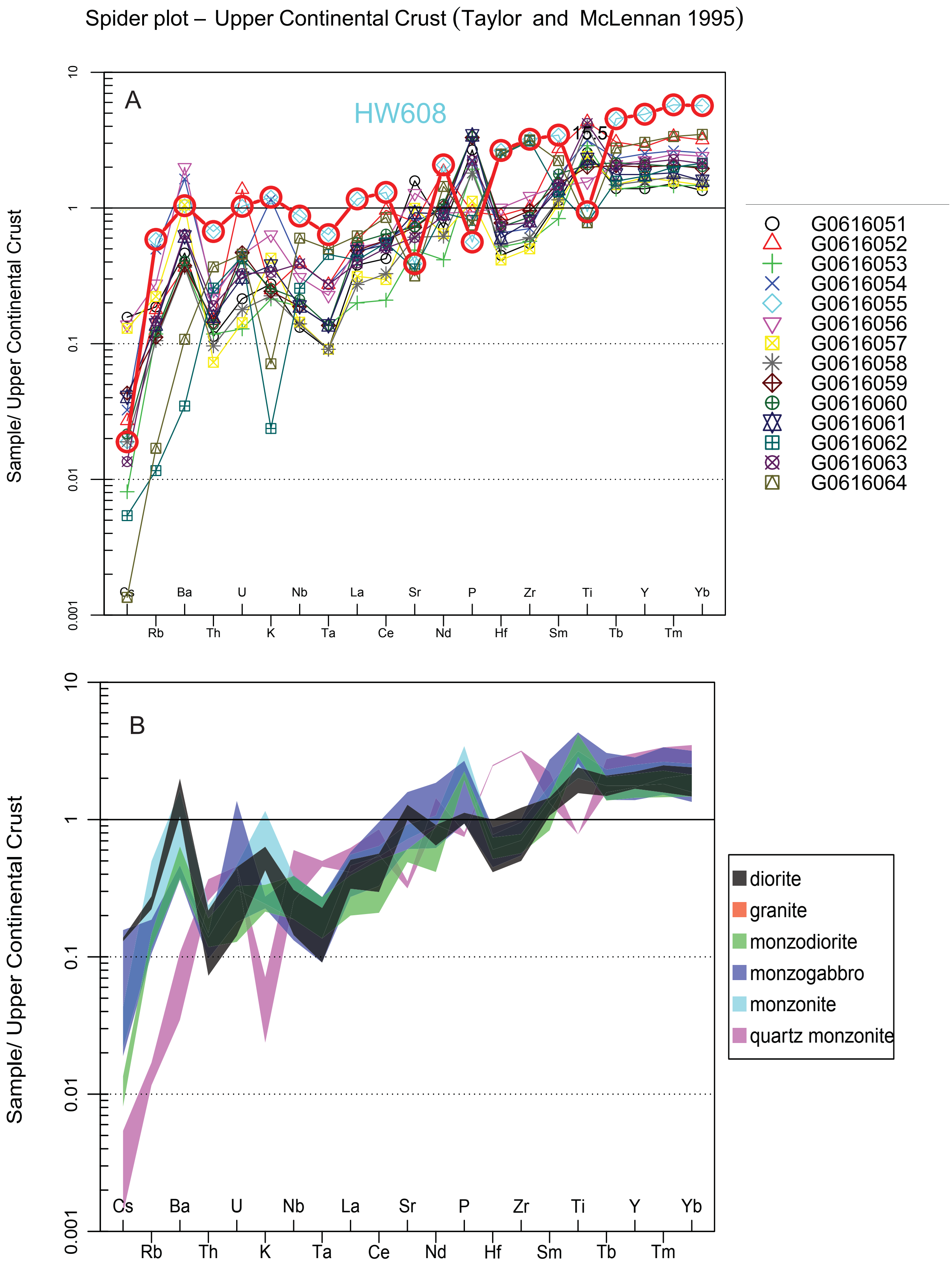


Figure 31: Spider Plot Upper Continental Crust normalization of Klootchlimmis pluton granitoids

A . Individual sample plots for 14 rocks, with granite sample highlighted in red circles and connecting line.

B grouped fields determined by TAS classification in Figure 20 are indicated in the legend box. The field for granite does not plot because of the lack of a second sample to complete a range to be coloured in.

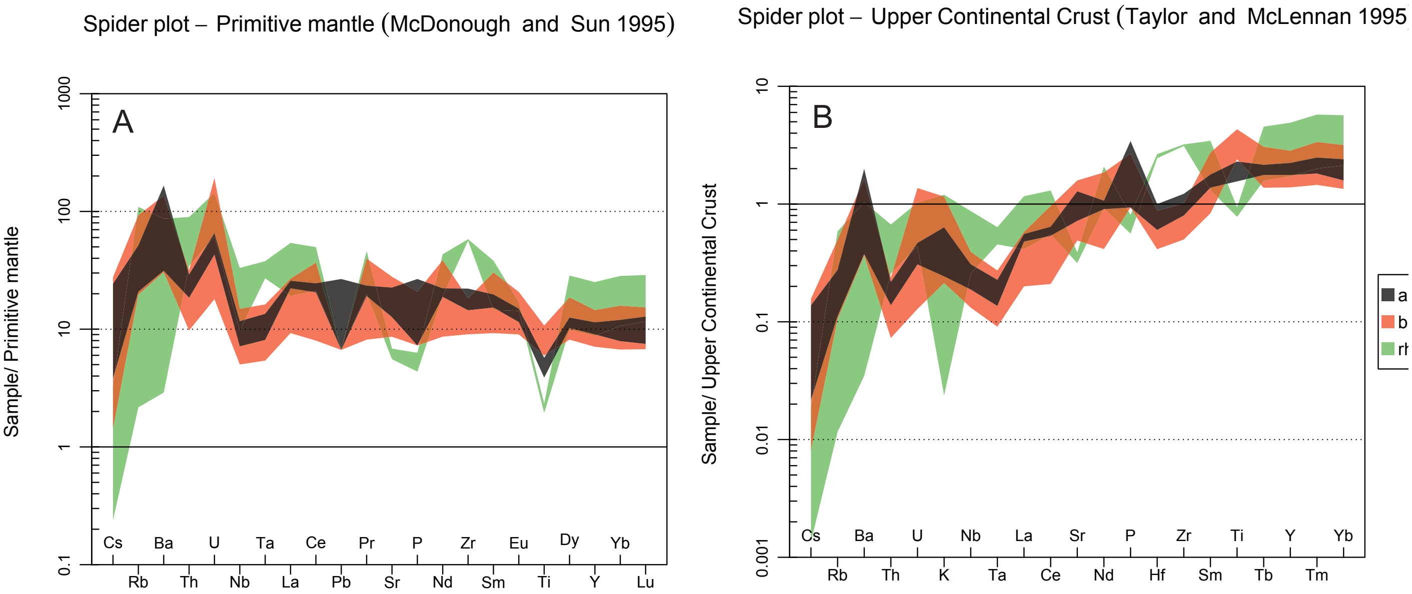


Figure 32: Spider Diagrams using Nb/Y vs Ti/Zr classification groupings.
A. Shows samples normalized by Primitive Mantle composition of McDonough and Sun (1995) and grouped by the divisions on Figure 25, basalt in red, andesite, basaltic andesite in black and rhyolite and dacite in green. The rhyolite group includes the granite (G0616055) and Quartz monzonite (G0616062, 64) groups from previous spider plots (Figures 28B , 29B)
B. Spider plot samples normalized by Upper Continental Crust compositions of Taylor and McLennan (1995). Colour field are same as in A.

The contrasting evolution of the quartz monzonites and the granite from the monzonite series can also be seen in other spider plots for compositions from the upper continental crust (Taylor and McLennan, 1995) in Figure 30 A and B. Like the scheme of McDonough and Sun (1995) this diagram employs LILE and HFSEs, but fewer REEs, which emphasizes some of the same depletions and enrichments for the quartz monzonites and the one granite relative to the rest of the suite. Figure 30A shows that the granite is more enriched in almost elements in the scheme except the HFSEs Sr, P and Ti for which it is more depleted. The quartz monzonites have similar enrichments to the granite except for strong depletions in LILEs Cs, Ba, Rb and K.

An alternative grouping of the granitoids was shown in the Nb/Y - Zr/Ti diagram of Peace (1996) (Figure 26), which avoids the problems inherent in mobility of Si, K and Na under hydrothermal conditions. The spider diagrams for Primitive Mantle compositions (Figure 29) and the Upper Continental Crust (Figure 30) are shown using the basalt, andesite, and rhyolite chemical subdivisions of Figure 26 in Figures 32 A and B. A similar contrast remains between the rhyolite group, which is equivalent to the quartz monzonite-granite groups with the rest of the rocks. The simplified grouping emphasizes the consanguineity of the monzogabbro to monzonite series or alternatively, by a less alkaline classification the gabbro to diorite series. Meanwhile the quartz monzonites (or granodiorite-granites) appear to be derived from a Zr-Nb enriched, Sr, Ti, P and LILE depleted source or different degrees of partial melting and assimilation than the gabbros- diorite series. Plagioclase fractionation is indicated suggesting high level magma chambers for the source of the quartz monzonite-granite rocks. The change in chemistry between the suites probably reflects a change in tectonic environment as result of increased rates of convergence and resultant tectonic thickening or changes in the geometry of subduction or perhaps even crustal duplexing resulting in tectonic collapse in the later Jurassic similar to the situation on the Oligocene through Miocene of the Central Andes (Wasteneys, 1990). The implications of a distinctly later felsic suite may change the approach to solving the puzzle of the source of mineralization at Yreka and the potential for development of related porphyry style deposits.

DISCUSSION

The stratigraphy of the Yreka area between the shoreline of Neroutsos Inslet and the Comstock Peak-Wolfenden Mountain ridgeline is dominated by Lower Jurassic and Upper Triassic age units of the Bonanza Group. Most of the section is characterized by limestones and calcareous rocks including limy crystal tuffs and volcaniclastics although the top of the section along the ridgeline displays coherent volcanic flows and tuffs. Geological mapping of road cuts in the Yreka area during the 2016 field season contributed to the stratigraphic description of units within the Parson Bay Formation and possibly to minor revision of geological boundaries on the existing BCGS map. Many of the outcrops included crystal tuffs interbedded or varying to limestones and limey sediments even within the main limestone unit of the Parson Bay Formation as well as in the designated uTrPvmc and uTrPvfmc units that are described as dominated by pyroclastic and volcaniclastic rocks principally crystal tuffs. Minor zones of alteration and trace mineralization were noted within the calcareous rocks with possible skarning in zones with higher tuffaceous content.

Considerable previous work has been completed on tracing out skarn rocks within the Volcaniclastic-Sedimentary Unit and Yreka Shale- Unit of the Bonanza Group during and after the mining operations on the main Yreka deposit and these have been thoroughly reviewed in Baldys (1998) along with projection of the underground resources. More surface delineation work on skarn horizons in the immediate vicinity of the Yreka and Clyde working will not likely lead to any significant increase in understanding of resource potential as this work has been substantially completed.

New geological mapping in 2018 at Yreka focused on the western slopes of Comstock Ridge within the Le Mare Lake volcanics and the Kootchlimmis Pluton. Geological mapping along logging roads identified phreatomagmatic intrusive bodies at the eastern exposed extent of the Kloochlimmis pluton, that imply explosive release of volatiles during late stages of crystallization of the pluton. Spatially associated phreatic breccias and stockworks were probably caused by the phreato magmatic eruptions and have positive implications for the generating mineralization of a magmatic hydrothermal nature. The eastern contact of the Klotchlimmis Pluon has been extended to the east both as continuous plutons and marginal breccias in the Le Mare Lake volcanics. The contact is characterized by increasing proportions of stoped blocks of variably assimilated volcanics transitioning to zones of predominantly granitoid dykes cutting intact section of volcanics. Locally skarn assemblages were observed including garnet - pyroxene with sulphides. The full lateral extent of the pluton remains undetermined because it is obscured by increasing depth of volcanics towards the ridge crest and by outliers of unconformably overlying sedimentary rocks of the Cretaceous Longarm Formation. The gap between the known eastern extent of the pluton delineated copper skarn mineralization at Yreka is about 3 km. The source of dykes in the Yreka area was previously assumed to be a small stock on Comstock Ridge, but BCGS mapping revealed that no such stock existed.

The lithogeochemical composition of the Klootchlimmis Pluton ranges from monzogabbros to granites defined by high total alkaline concentrations of Na_2O and K_2O. However, the ratio of $K_2O : Na_2O$ varies widely suggesting that hydrothermal alteration may locally have depleted or enriched the alkalis. Petrological systematics revealed by High Field Strength Elements (HFSE) and REEs indicate that the igneous compositional range cannot be produced by a single fractionation trend and instead represent two distinct calc-alkaline suites. The more voluminous and probably earliest consanguinous suite is represented by monzogabbros, monzodiorites, and monzonites which were derived by low degrees of partial melting of a Ti-P enriched peridotitic mantle wedge. The more felsic rocks were probably derived after a period of uplift and crustal thickening from high level magmas chambers undergoing plagioclase fractionation.

The source of fluids at the Yreka skarn deposit may be related to phases of the Klotchlimmis Pluton. Extension of the boundaries of the pluton to the east encourages the idea that phases of the pluton may lie buried beneath Cretaceous cover and thick sections of the Le Mare Lake Formation volcanics and be the source of the mineralization. The Yreka skarn is developed in calcareous strata of the lower Bonanza Group underlying the Le Mare Lake Formation. The strata dip moderately to the west towards the pluton bringing the calcareous strata into closer proximity to the intrusion, but also dipping beneath its upper extent. The geometry favours increased interaction between fluids from upper parts of the pluton and volcanic rocks instead of carbonate rich rocks which may lessen the chances of carbonate neutralizing reactions.   Evidence of explosive magmatism in the Klootchlimmis increases the possibility that stockworked hydrothermal system may have developed in the volcanic rocks and thus potential for porphyry copper deposits.

RECOMMENDATIONS

Future work should focus on the gap between the Klootchlimmis pluton and the Yreka skarn deposits. The known skarn ore deposits indicate probable proximity to a mineralizing granitoid intrusion that either underlies the Wolfenden-Comstock Ridge or has been eroded away up-dip of Yreka on the Neroutsos Inlet side.   Assuming the down-dip scenario there appears to be a high potential for additional deposits at least of skarn if not larger porphyry stockworks hidden under the extensive area of LeMare Lake volcanics to the west. The volcanics form the dip slope covering the host rocks of the Yreka skarn namely the Volcaniclastic-Sedimentary Unit and the Parson Bay Formation as well as any trace of a mineralizing granitoid intrusive. The potential is enhanced by the extensive area that remains unexposed to the west. Alteration zoning in the volcanics may also create a vector towards an intrusive if the volcanics are not too thick. In the absence of direct geological indicators, reconnaissance scale geophysics might be useful in target generation.

Exploration methods might involve deep penetrating geophysical surveys such as Induced Polarization with long array spacings that would be required to sense through several hundred meters of the Le Mare Lake volcanics. The western slopes of Comstock Ridge are generally accessible by existing logging roads some of which might be used directly for reconnaissance IP lines.   The terrain between Yreka and the ridge crest is mainly in open old growth forest much of which is pleasantly traversable if a bit steep in places. Magnetic surveys on the dip slope might be overwhelmed by the high magnetic susceptibility of mafic volcanics of the Le Mare Lake Formation, but might also fruitfully indicate domains where hydrothermal alteration has been magnetite destructive.

Ground exploration should also focus on mapping the forest slopes above Yreka where extensive zones of silicified and sulphide enriched volcanics were observed. These warrant follow-up work including reconnaissance soil geochemical surveys. Geological mapping should also be extended south into of the present work into the west draining valley where lower structural levels might be encountered in the Klootchlimmis pluton. High sensitivity stream silt sampling should also be employed in this drainage to reexamine previous work that showed higher copper concentrations.

REFERENCES

Ball, C.W. (1980) Assessment Work, Tuscarora Mineral Claim Yreka Copper - Zinc Property, Nanaimo M.D., British Columbia, Assessment Report 798 1

Betmanis, A.I. (1989) Report on Geochemical Surveys, Wolf Claim Group Nanaimo Mining Division, Teck Exploration Ltd Assessment Report 19,248

Betmanis, A,I. (2007) Technical Report on the Geochemical and Geological Evaluation of the Wolfenden Property Tneure #553019, Geological Survey Branch Assessment Report 29396.

Betmanis, A,I. (2007) Geological and Geochemical Technical report including Magnetic Evaluation of the Wolfenden Property; Wolfenden Tenure #553019, Coquis Tenure #577450 and Wolfqueis Tenure #590479; Geological Survey Branch Assessment Report 30273

Brown, Alex C. 2006 Genesis of Native Copper Lodes in the Keeweenaw District, Northern Michigan: A Hybrid Evolved Meteoric and Metamorphogenic Model. Economic Geology, V. 101, pp. 1437–1444

Crossley, R.V. (1972) Report on Exploration, Yreka (Green Eagle Mines Ltd. Option), IS0 Explorations Ltd., Assessment Report 4425

Eden, Fred, Li, Bin 2016. Technical Report on the Yreka Property BC Geological Survey Assessment Report #36110.

Geo Data Solutions GDS Inc. (2013): Heliborne High Resolution Aeromagnetic Survey: Northern Vancouver Island, BC; Geoscience BC, Report 2013-02, 26 p.

Greene, A.R., Scoates, J.S., Nixon, G.T. and Weis, D. (2006):Picritic lavas and basal sills in the Karmutsen flood basalt province, northern Vancouver Island; in Geological Fieldwork 2005, BC Ministry of Energy, Mines and Petroleum Resources, Paper 2006-1, pages 39–51.

Hart, C.J.R., Baker, T. and Burke, M. (2000): New exploration concepts for country-rock-hosted, intrusion-related gold systems: Tintina Gold belt in Yukon; in the Tintina Gold Belt: Concepts, Exploration and Discoveries, Tucker, T.L. and Smith, M.T., Editors, British Columbia and Yukon Chamber of Mines, Special Volume 2, pages 145–172.

Hart, Craig J.R., 2005. Classifying, Distinguishing and Exploring for Intrusion-Related Gold Systems. The Gangue, GAC-CIM October 2005 issue 87.

Lincoln, Timothy N., 1981. The Redistribution of Copper During Low-Grade Metamorphism of The Karmutsen Volcanics, Vancouver Island, British Columbia. Economic Geology Vol. 76, 1981, Pp. 2147-2161

Muller, J.E., Northcote, K.E., and Carlisle, D. (1974) Geology and Mineral Deposits of Alert Bay - Cape Scott Map Area, Vancouver Island, B.C.; GSC Paper 74-8.

Nixon, G.T. and Orr, A.J. (2007): Recent revisions to the Early Mesozoic stratigraphy of northern Vancouver Island (NTS 102I; 092L) and metallogenic implications, British Columbia; in Geological Fieldwork 2006, BC Ministry of Energy, Mines and Petroleum Resources, Paper 2007-1, pages 163–177.

Nixon, G.T., Hammack, J.L., Koyanagi, V.M., Payie, G.J., Snyder,L.D., Panteleyev, A., Massey, N.W.D., Archibald D.A.,Haggart, J.W., Or chard, M.J., Fried man, R.M., Tozer, E.T.,Tip per, H.W., Poulton, T.P., Palfy, J., Cordey, F and Barron,D.J. (2006c): Geology of the Holberg – Winter Harbour area, northern Vancouver Island; BC Ministry of Energy, Mines and Petroleum Resources, Geoscience Map 2006-3,scale 1:50 000.

Nixon, G.T., Snyder, L.D., Payie, G.J., Long, S., Finnie, A., Friedman, R.M., Archibald D.A., Orchard, M.J., Tozer, E.T.,Poulton, T.P. and Haggart, J.W. (2006d): Geology of the Alice Lake area, northern Vancouver Island; BC Ministry of Energy, Mines and Petroleum Resources, Geoscience Map 2006-1, scale 1:50 000

Nixon, G.T. Larocque, J. Pals, A., Styan, J.,Greene, A.R., and Scoates, J.S. (2008) High-Mg Lavas in the Karmutsen Flood Basalts, Northern Vancouver Island (NTS 092L): Stratigraphic Setting and Metallogenic Significance. in Geological Fieldwork 2007, Paper 2008-1

Kish, S.A. and Stein, H.J.. 1989. Post-Acadian Metasomatic Origin For Copper-Bearing Vein Deposits of the Virgilina District, North Carolina and Virginia Economic Geology Vol. 84, 1989, pp. 1903-1920

Jeletzky, J.A. (1976) Mesozoic and Tertiary Rocks of Quatsino Sound, Vancouver Island, British Columbia; Geological Survey of Canada, Bulletin 242.

Mechanic, N.D. (1953) British Columbia, Report of the Minister of Mines, Annual Report of Mines, 1953

Massey, N.W.D. (1995) The Vancouver Island Mineral Potential Project (92B,C,E,F,G,K,L, and 1021), Geological Fieldwork 1994, Paper 1995-l , Mineral Resources Division GSB, Government of British Columbia

Minfile Report (1989) Mineral Resource Division GSB, Government of British Columbia, MINFILE NO. 92LO52

Meinert, D.L. (1992) Skam Deposits in the Porphyry Copper Environment, Short Course “Porphyry Copper Model” Abstracts, Northwest Mining Association, 1992

Menzies, M.M. (1954-55) Property File, British Columbia Energy, Mines and Petroleum Resources, Yreka Property (1954 - 1955):Assay & Geological Plans, 1:600, 1953, Yreka Mine, 1900’ Level 1:120, 1955, Cross Sections 1:600, 1955. Noranda Explorations Company Limited

Nixon, G.T. et al (1993) Preliminary Geology of the Mahatta Creek Area (92 1 L/5); B.C. Ministry of Energy, Mines and Petroleum Resources, Open File 1993-10, scale 1:50 000.

Nixon, G.T. et al (1993) Quatsino - San Josef Map Area, Northern Vancouver Island; Geological Overview (921L/12W, 1021/8,9) Geological Fieldwork 1994, Paper 1995- 1, Mineral Resources Division GSB, Government of British Columbia

Panteleyev, A. et al (1945) 40 AR/39 Ages of Hydrothermal Minerals in Acid Sulphate Altered Bonanza Volcanics, Northern Vancouver Island (NTS 92L/12), Geological Fieldwork 1994, Paper 1995-1, Mineral Resources Division GSB, Government of British Columbia

Poloni, J.R. (1971) Assessment Report on the Green Eagle Mines Ltd. Claims, Nanaimo M.D., British Columbia, Assessment Report 3165

Ray, G.E., Webster, ICI 1995 The Geochemistry of Mineralized Skams in British Columbia, Geological Fieldwork 1994, Paper 1995-l) Mineral Resources Division GSB, Government of British Columbia

Robinson, W.C. (1967) British Columbia Mines and Petroleum Resources, Annual Report 1967.

Wasteneys, Hardolph, 1990. Epithermal Silver Mineralization Associated with a Mid-Tertiary Diatreme: Santa Barbara, Santa Lucia District, Puno, Peru. unpublished Ph.D. thesis, Queen’s University, Kingston. 367 p.

Wasteneys, Hardolph, and Yang, Wanjin, 2013. Technical Report on Geology, Stream Sediment Geochemistry and Airborne Geophysics at the Zymoetz River Claims Northern Zymoetz River, Ventura Peak Area, Hazelton Mountains, Omineca Mining Division . EMPRBC ARIS report #33733.

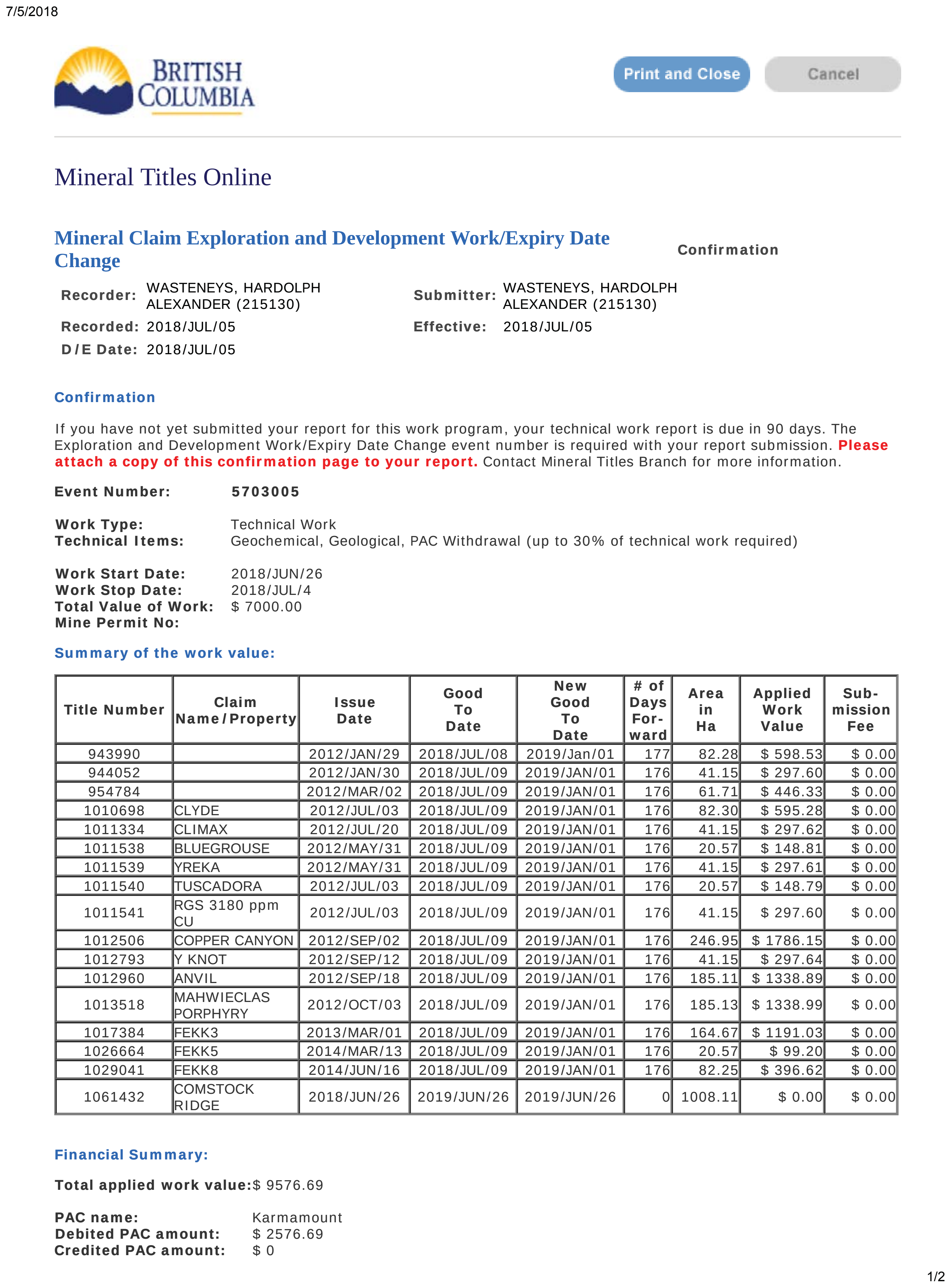
Wasteneys, Hardolph, 2015. Technical Report on Induced Polarization Geophysics and Soil Geochemistry: Zymoetz River Claims, BC. Hazelton Mountains, Omineca Mining Division . EMPRBC ARIS report #35770.

Wasteneys, Hardolph, 2018. Technical Report on the Yreka Mineral Claims, Northern Vancouver Island EMPRBC ARIS number

Wheeler, J.O. and McFeely, P. (1991): Tectonic Assemblage Map of the Canadian Cordillera and adjacent parts of the United States of America, Geological Survey of Canada, Map 1712A

Wilson, P.R. (1955) The Geology and Mineralogy of the Yreka Copper Property, Quatsino Sound, British Columbia, Unpublished M.Sc. Thesis, University of British Columbia

Appendix A Costs Statements



7/5/2018

Mineral Titles Online

Mineral Claim Exploration and Development Work/Expiry Date Change

Confirmation

Recorder:	WASTENEYS, HARDOLPH ALEXANDER (215130)	**Submitter:**	WASTENEYS, HARDOLPH ALEXANDER (215130)
Recorded:	2018/JUL/05	**Effective:**	2018/JUL/05
D/E Date:	2018/JUL/05		

Confirmation

If you have not yet submitted your report for this work program, your technical work report is due in 90 days. The Exploration and Development Work/Expiry Date Change event number is required with your report submission. **Please attach a copy of this confirmation page to your report.** Contact Mineral Titles Branch for more information.

Event Number:	**5703005**
Work Type:	Technical Work
Technical Items:	Geochemical, Geological, PAC Withdrawal (up to 30% of technical work required)
Work Start Date:	2018/JUN/26
Work Stop Date:	2018/JUL/4
Total Value of Work:	$ 7000.00
Mine Permit No:	

Summary of the work value:

Title Number	Claim Name/Property	Issue Date	Good To Date	New Good To Date	# of Days For-ward	Area in Ha	Applied Work Value	Sub-mission Fee
943990		2012/JAN/29	2018/JUL/08	2019/Jan/01	177	82.28	$ 598.53	$ 0.00
944052		2012/JAN/30	2018/JUL/09	2019/JAN/01	176	41.15	$ 297.60	$ 0.00
954784		2012/MAR/02	2018/JUL/09	2019/JAN/01	176	61.71	$ 446.33	$ 0.00
1010698	CLYDE	2012/JUL/03	2018/JUL/09	2019/JAN/01	176	82.30	$ 595.28	$ 0.00
1011334	CLIMAX	2012/JUL/20	2018/JUL/09	2019/JAN/01	176	41.15	$ 297.62	$ 0.00
1011538	BLUEGROUSE	2012/MAY/31	2018/JUL/09	2019/JAN/01	176	20.57	$ 148.81	$ 0.00
1011539	YREKA	2012/MAY/31	2018/JUL/09	2019/JAN/01	176	41.15	$ 297.61	$ 0.00
1011540	TUSCADORA	2012/JUL/03	2018/JUL/09	2019/JAN/01	176	20.57	$ 148.79	$ 0.00
1011541	RGS 3180 ppm CU	2012/JUL/03	2018/JUL/09	2019/JAN/01	176	41.15	$ 297.60	$ 0.00
1012506	COPPER CANYON	2012/SEP/02	2018/JUL/09	2019/JAN/01	176	246.95	$ 1786.15	$ 0.00
1012793	Y KNOT	2012/SEP/12	2018/JUL/09	2019/JAN/01	176	41.15	$ 297.64	$ 0.00
1012960	ANVIL	2012/SEP/18	2018/JUL/09	2019/JAN/01	176	185.11	$ 1338.89	$ 0.00
1013518	MAHWIECLAS PORPHYRY	2012/OCT/03	2018/JUL/09	2019/JAN/01	176	185.13	$ 1338.99	$ 0.00
1017384	FEKK3	2013/MAR/01	2018/JUL/09	2019/JAN/01	176	164.67	$ 1191.03	$ 0.00
1026664	FEKK5	2014/MAR/13	2018/JUL/09	2019/JAN/01	176	20.57	$ 99.20	$ 0.00
1029041	FEKK8	2014/JUN/16	2018/JUL/09	2019/JAN/01	176	82.25	$ 396.62	$ 0.00
1061432	COMSTOCK RIDGE	2018/JUN/26	2019/JUN/26	2019/JUN/26	0	1008.11	$ 0.00	$ 0.00

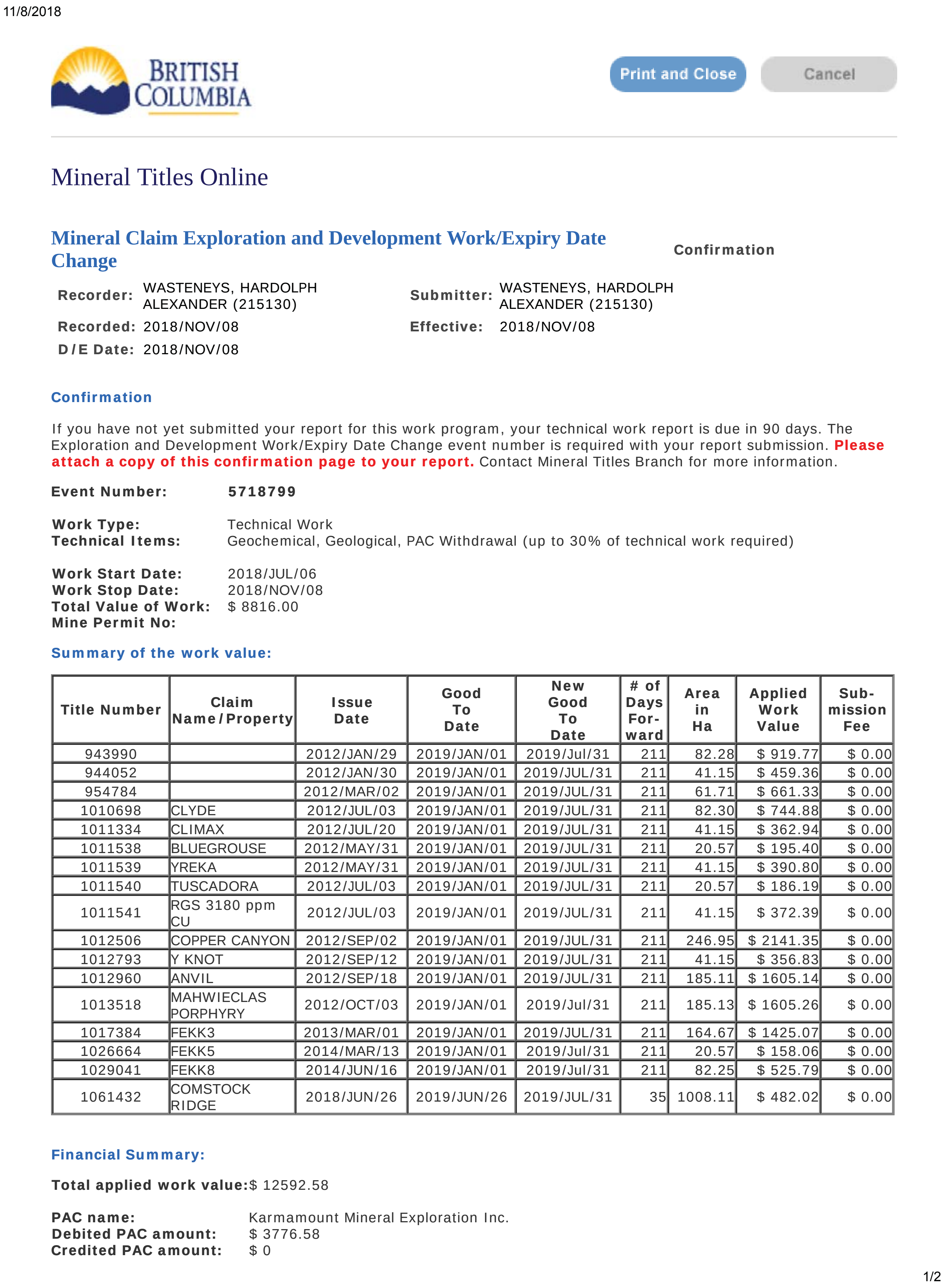
Financial Summary:

Total applied work value: $ 9576.69

PAC name:	Karmamount
Debited PAC amount:	$ 2576.69
Credited PAC amount:	$ 0

1/2

Appendix A Costs Statements



11/8/2018

Mineral Titles Online

Mineral Claim Exploration and Development Work/Expiry Date Change

Confirmation

Recorder:	WASTENEYS, HARDOLPH ALEXANDER (215130)	**Submitter:**	WASTENEYS, HARDOLPH ALEXANDER (215130)
Recorded:	2018/NOV/08	**Effective:**	2018/NOV/08
D/E Date:	2018/NOV/08		

Confirmation

If you have not yet submitted your report for this work program, your technical work report is due in 90 days. The Exploration and Development Work/Expiry Date Change event number is required with your report submission. **Please attach a copy of this confirmation page to your report.** Contact Mineral Titles Branch for more information.

Event Number: **5718799**

Work Type: Technical Work
Technical Items: Geochemical, Geological, PAC Withdrawal (up to 30% of technical work required)

Work Start Date: 2018/JUL/06
Work Stop Date: 2018/NOV/08
Total Value of Work: $ 8816.00
Mine Permit No:

Summary of the work value:

Title Number	Claim Name/Property	Issue Date	Good To Date	New Good To Date	# of Days For-ward	Area in Ha	Applied Work Value	Sub-mission Fee
943990		2012/JAN/29	2019/JAN/01	2019/Jul/31	211	82.28	$ 919.77	$ 0.00
944052		2012/JAN/30	2019/JAN/01	2019/JUL/31	211	41.15	$ 459.36	$ 0.00
954784		2012/MAR/02	2019/JAN/01	2019/JUL/31	211	61.71	$ 661.33	$ 0.00
1010698	CLYDE	2012/JUL/03	2019/JAN/01	2019/JUL/31	211	82.30	$ 744.88	$ 0.00
1011334	CLIMAX	2012/JUL/20	2019/JAN/01	2019/JUL/31	211	41.15	$ 362.94	$ 0.00
1011538	BLUEGROUSE	2012/MAY/31	2019/JAN/01	2019/JUL/31	211	20.57	$ 195.40	$ 0.00
1011539	YREKA	2012/MAY/31	2019/JAN/01	2019/JUL/31	211	41.15	$ 390.80	$ 0.00
1011540	TUSCADORA	2012/JUL/03	2019/JAN/01	2019/JUL/31	211	20.57	$ 186.19	$ 0.00
1011541	RGS 3180 ppm CU	2012/JUL/03	2019/JAN/01	2019/JUL/31	211	41.15	$ 372.39	$ 0.00
1012506	COPPER CANYON	2012/SEP/02	2019/JAN/01	2019/JUL/31	211	246.95	$ 2141.35	$ 0.00
1012793	Y KNOT	2012/SEP/12	2019/JAN/01	2019/JUL/31	211	41.15	$ 356.83	$ 0.00
1012960	ANVIL	2012/SEP/18	2019/JAN/01	2019/JUL/31	211	185.11	$ 1605.14	$ 0.00
1013518	MAHWIECLAS PORPHYRY	2012/OCT/03	2019/JAN/01	2019/Jul/31	211	185.13	$ 1605.26	$ 0.00
1017384	FEKK3	2013/MAR/01	2019/JAN/01	2019/JUL/31	211	164.67	$ 1425.07	$ 0.00
1026664	FEKK5	2014/MAR/13	2019/JAN/01	2019/Jul/31	211	20.57	$ 158.06	$ 0.00
1029041	FEKK8	2014/JUN/16	2019/JAN/01	2019/Jul/31	211	82.25	$ 525.79	$ 0.00
1061432	COMSTOCK RIDGE	2018/JUN/26	2019/JUN/26	2019/JUL/31	35	1008.11	$ 482.02	$ 0.00

Financial Summary:

Total applied work value:$ 12592.58

PAC name: Karmamount Mineral Exploration Inc.
Debited PAC amount: $ 3776.58
Credited PAC amount: $ 0

1/2

Appendix A Costs Statements

Yreka2018

Exploration Work type	**Comment**	**Days**			**Totals**
Personnel (Name)* / Position	**Field Days (list actual days)**	**Days**	**Rate**	**Subtotal***	
Hardolph Wasteneys / Chief Geo	June 26,to July 1, 2018	6	$800.00	$4,800.00	
Peter Ravensbergen		5.5	$420.00	$2,310.00	
		.		$7,110.00	**$7,110.00**
Office Studies	**List Personnel (note - Office only, do not include field days**				
Literature search		0.0	$800.00	$0.00	
Database compilation	Hardolph Wasteneys	0.0	$800.00	$0.00	
Reprocessing of data		0.0	$800.00	$0.00	
General research	Hardolph Wasteneys	2.0	$800.00	$1,600.00	
Report preparation	Hardolph Wasteneys	5.0	$800.00	$4,000.00	
Other (specify)					
				$5,600.00	**$5,600.00**
Remote Sensing	**Area in Hectares / Enter total invoiced amount or list personnel**				
Aerial photography			$0.00	$0.00	
LANDSAT			$0.00	$0.00	
Other (specify)			$0.00	$0.00	
				$0.00	**$0.00**
Ground Exploration Surveys	**Area in Hectares/List Personnel**				
Geological mapping	500 / HW				
Reconnaissance		20	*should be captured in Personnel*		
Prospect		30	*field expenditures above*		
Geochemical Surveying	**Number of Samples**	**No.**	**Rate**	**Subtotal**	
Stream sediment			$0.00	$0.00	
Soil			$0.00	$0.00	
Rock			$0.00	$0.00	
Whole rock		14.0	$98.10	$1,373.40	
Other (specify)			$0.00	$0.00	
				$1,373.40	**$1,373.40**
Transportation		**No.**	**Rate**	**Subtotal**	
Airfare			$0.00	$0.00	
truck rental			$0.00	$0.00	
kilometers	2 trips SPL to Courtenay to Port Alice and Yre	1,620	$0.55	$891.00	
fuel			$250.00	$250.00	
Helicopter (hours)			$0.00		
Fuel (litres/hour)			$0.00	$0.00	
BC Ferries				$0.00	
				$1,141.00	**$1,141.00**
Accommodation & Food	**Rates per day**				
Hotel			$0.00		
			$0.00	$0.00	
Camp	Camp supplies			$350.00	
Meals	groceries mainly and some meals		$0.00	$200.00	
				$550.00	**$550.00**
Miscellaneous					
Telephone			$0.00	$0.00	
Other (Specify)					
				$0.00	**$0.00**
Equipment Rentals					
Field Gear (Specify)	Radios VHF	2	$25.00	$50.00	
	InReach satellite comms	1	$75.00	$75.00	
Other (Specify)				$0.00	
				$125.00	**$125.00**
Freight, rock samples					
	sample shipping		$50.00	$50.00	
			$0.00	$0.00	
				$50.00	**$50.00**
TOTAL Expenditures					**$15,949.40**

STATION	Northing	Easting	Altitude	Sample	Field Description
HW18-569	5599864	170289	420	G0616051	pit on logging road up Comstock; gray salt & pepper. Mg - cg hb diorite - leucodiorite; massive crystalline txt; unaltered primary magnetite sphene
HW18-571	5600047	170863	612		5 km s.; massive grey diorite; varies to cg w pyrite-sphene-magnetite calcite
HW18-572	5600039	170864	612	G0616052	coarse variant of diorite w pyrite magnetite-sphene gradational veins lenses and pods in mg diorite; at contact diorite (N)/volc (S)
HW18-573	5600061	170849	613		approx. northern ed of diorite along E side road
HW18-574	5600037	170870	614		middle of 4 m wide diorite with white chalky wx dyke 040/85; then screen of fg diorite rusty wx then more mg diorite
HW18-575	5599549	171078	636		rusty wx subcrop of fg diorite w calcite altn wx mag on fine fx surfaces. ? possible volcanic fg but weathering to white clay cap-like diorite
HW18-576	5599550	171079	636		mg diorite chalky wx on exposed surfaces poss. diagnostic of the feldspar breakdown; photo (in recent slash area; lots of diorite); one 5 m.? dyke of glassy black volcanic along 30 m section of road
HW18-577	5599492	171143	639	G0616053	from HW 576; continuous oc of mg hb diorite (to sharp left turn of road)
HW18-578	5599521	171200	651		oc of cg diorite with subhorizontal qtz veinlets; qtz (epidote in core)
HW18-579	5599546	171231	659		altered diorite possible gypsum veinlets in tan wx near suface OC rock cut; photo of ? gypsum veinlets; photos of Peter in blue shirt
HW18-580	5599573	171257	665		? rhyolite rusty wx; wx gypsum veinlets; white fg on fresh surface/punky
HW18-581	5599580	171259	665		back into cg diorite similar veining gypsum
HW18-582	5599595	171276	668		b 181/32 W; well layered section in rock cut; photo w Peter holding hammer; possible rhyolite flow; alternating layers of fg black material and cg light clastic w coarse disseminated pyrite quartzitic layers; ? possible skarn ?
HW18-583	5599602	171287	669		? layered section at HW 582? coarse diorite ? biotite-hb diorite? cut by fxs 100/30
HW18-584	5599621	171332	670		5 m interval layering 170/71 W? photo of ruty banded layered rock w talcy layer in centre (white) wavy layering intense ochrous wx and black; adjecent to stkwk veined cg diorite highly altd
HW18-585	5599621	171331	670		another section of layered altered rock ? primary layering ochre goethite talc
HW18-586	5599639	171369	666		photo of diorite dyke cutting long section of layered vcs 6 m wide beyond altered cg diorite w white gypsum veinlets and rusty altn
HW18-587	5599654	171468	663		end of rock cut into till and ??? across valley
HW18-588	5599560	171731	634		culverts in ravine bottom
HW18-589	5599236	171587	630		start of road cut; black fg mafic volcn; lapilli tuff cut by thin diorite vein 5 cm thick on 065/70
HW18-590	5599170	171587	627		mg fresh diorite contact irregular 060/75 volcanics fxd and veined w gypsum within 1 m contact
HW18-591	5599175	171583	627		start of volcanic inclusion veined with aphanitic fg diorite dykes pyritic altn in patches
HW18-592	5599161	171587	626		SKARN LITH; skarn zone in volcanics; garnet epidote pyrite calcite paatches and veining; adjacent to black epidote; photo of Peter; Fault running along OC face 008/35
HW18-593	5599119	171565	626	G0616054	diorite with distinct pink patches appears to be a variant with coarse pink felds and large altered mafics
HW18-594	5599088	171558	625		mafic volc enclave w some skarning

Figure 33: Table of Geological Observations in the Yreka area.
Northing and Easting are in UTM Zone 9 NAD 83.

HW18-595	5599033	171492	623		pink diorite ? syenite
HW18-596	5599032	171491	623		normal hb diorite w magnitite accesorie rusty wx OC w abund fxs
HW18-597	5599008	171471	625		end of diorite and OC; chalky wx under soil cover
HW18-598	5598939	171454	622		diorite massive grey like 597
HW18-599	5599627	171945	680		Camp at Creek
HW18-600	5599435	171864	701		small OC massive black fg volcanic coherent flow
HW18-601	5599381	171842	706		start long OC rock cut; massive black volc like 600, breccia veins w wallrock frags 10 cm wide epidote minor qtz feldsp in vein very fg veins 005/80
HW18-602	5599363	171826	705		end of OC; beginning of slide
HW18-603	5599327	171806	706		OC black very fg qtzite or mafic volcanic (aphitic?) glossy fx surfaces but fresh banks show vfg granular textured volcanics
HW18-604	5599274	171758	707		25 cm diorite dyke in fg mafic; volcanic highly fx
HW18-605	5599273	171757	706		pink diorite granodiorite dykes with volcanic frag D 040/85. 2 photos of irregular dykes)
HW18-606	5599258	171734	708		dykes of granodiorite in black mafic volcanic; dyke 330/86 photo straight on
HW18-607	5599243	171722	713		irregular bodies of granodiorite intruding black volcanics; felds pinkish accesory pyrite hb biotite
HW18-608	5599223	171720	716	G0616055	WR photo of more irregular dykes; granite-granodiorite; leucocratic pale grey 10% qtz
HW18-609	5599060	171826	739		passed scattered OC of mafic vol; volc w granodiorite dykes of irregular polygonal slope and numerous qtz-felds veins in volcn
HW18-610	5599026	171856	741		large body of granite granodiorite pinkish feldspar 10 % qt continues to
HW18-611	5598989	171868	740		stoped blocks of feldspar porphyritic andesite aphanitic matrix euhedral phenocryst to 4 mm, photos with pencil, block continues, intervals w qtz feld veins 055/90
HW18-612	5598892	171933	738		contact in volcanics felds porphyry over fg aph flow subhorizontal epidote patches in black mafic flow below
HW18-613	5598839	171991	734		LITH, ? rhyolite ? qtz vein massive qtz-rich pods with crystalline qtz; ? aplite, maybe massive qtz felds vein system blocks of mafic volc cut by qtz veins
HW18-614	5598846	172024	732		end of OC and qtz rhyolitic body? silicified zone above pluton; qtz vein networks intense in zones of grey altered volcanics
HW18-615	5598883	172192	736		finely laminated limestone grey 1-2 mm laminations chert nodules b 175/82; mix grey green siltstone and finely laminated limestone
HW18-616	5598876	172216	740		subhorizontal sediments b 180/10 sandstones + siltstones
HW18-617	5598876	172246	743		b 310/65 E (10 m W) grey thin bedded silty lamination with grey green siltstones at fold hinge to E b 025/25 W ratty thin bedded siltstones
HW18-618	5598893	172295	745		wavy fold hinge fold axis 325-20 W; photo of hinge
HW18-619	5598925	172358	747		black poorly bedded siltstone w conchoidal wx
HW18-620	5599029	172400	760		End of spur road still in soft siltstones like HW 619; clear cut regrowth 10 yr to north on low slope bush; old growth in ravine to south
HW18-621	5599126	171734	719		Walk Back spur road; granodiorite with blocks of aph black volc green to pinkish mg matrix; matrix 20% altered chlorite
HW18-622	5599760	171469	702		Move back along road 1/2 km; conglomerate small highly rounded pebbles packed in dark green matrix; no bedding/subhorizontal lenses; volcanic fragments
HW18-623	5599763	171492	702		b 336/55 E; very poorly bedded black vitreous vfg siltstone-arg magnetic in places
HW18-624	5599763	171534	703		intrusive contact with granitic dyke 326/70 3 m wide followed by more volc with small dykes of granite

HW18-625	5599760	171614	702		irregular dyke follows joints in massive black volcanics; granite: qtz felds (5% mafics) weakly altered; volc mostly aph; here: minor porphyritic flows
HW18-626	5599763	171633	702		broad zone of stoped blocks and breccia in granite; angular volc clasts from few cms to m size
HW18-627	5599763	171671	700		clay ochre? fault gouge F 004/85
HW18-628	5599759	171702	697		wx bands in ? rhyolite dyke; punky wx leucocratic rock 5 m wide
HW18-629	5599743	171749	695		End of OC to beyond creek
HW18-630	5599820	171320	696		Drive; OC peddle grit 5 mm pebbles rounded like conglomerate at HW 622 but finer
HW18-631	5600683	170690	599		mudstone, conchoidal fx, poor bedding, concrertions - white calcareous cement
HW18-632	5601534	170657	600		fine grit in pit, greenish grey rusty wxm massive bedded at base but appears well bedded xxx? 5 m up at top of exposure b flat. small coal lens or carbon replaced organics/occurrence 15 cm long
HW18-633	5601335	170735	634		grey massive fine ss-mudstone with sporadic random concretions same as HW 631
HW18-634	5600597	171147	674		Grit, subrounded 3-5 mm clasts red wx pebbles in dark green matrix; massive bedded
HW18-635	5600453	171209	684		continuous grit from HW 634 5 mm subrounded clasts; coarse massive appearance
HW18-636	5600222	171365	720		pebble conglomerate; pebbles maroon and green mostly 1 cm, rare clasts to 5 cm
HW18-637	5600190	171372	722		Pit 5 m; massive brown-rusty wx silicious? fg sediment w disseminated pyrite
HW18-638	5599994	171416	729		granite dykes in black volcanic irregular - follow fxs
HW18-639	5599965	171435	737		granite cg pink orthoclase sphene dyke in black volcanics irreg. cont. pyrite abundant in fxs to volcanics near contact
HW18-640	5599943	171454	740		granite body dyke? irreg contacts
HW18-641	5599927	171477	742		granite dyke, dyke 060/80
HW18-642	5599919	171482	742		dyke edge finer grained; diss?? pyrite abundant
HW18-643	5599903	171505	743		continous granitic dyke in medium volc to here from HW 641
HW18-644	5599881	171536	742		vfg granite massive silicious
HW18-645	5599868	171549	744		black ? gabbroic dyke, dark hb diorite mafic 2 m wide 195/75 generally magnetic
HW18-646	5599859	171559	745		fg black mafic volcanic conchoidal fx cut by thin granitic dykes
HW18-647	5599848	171579	748		more granitic dyke complex; block of volcanics stoped into massive?? granite
HW18-648	5599843	171590	748		x? of larger granite body thin dykelets in black volcanics
HW18-649	5599843	171701	753		granite dyke 3 m wide fg dyke 312/75 sucrose? fracture rhyolitic
HW18-650	5599824	171983	763		passed through volcanics from 649; at 659 angular breccia lithic tuff breccia volcanic frags heterolithic up to 2 cm size
HW18-651	5599766	172096	766		back into fg massive volcanics black aphanitic
HW18-652	5599766	172095	766		veins/fractures 040/35; network of fine qtz feldspar veinlets
HW18-653	5599529	172119	782		massive fg pale green gritty sediment; possible coal/carbonaceous debris
HW18-654	5599419	172072	804		small pebble arenite/ grit; rounded 3-5 mm pebbles dark black, massive bedded dark grey matrix
HW18-655	5599560	172369	844		road Y ; slash above looks like no ? road
HW18-656	5599686	172403	855		porphyritic mafic volcanic; massive fg pyritic volcanics
HW18-657	5599799	172344	871		Y in road, right branch grassy steep, left connects to north upper branch
HW18-658	5599884	172437	905		Grit near horizontal cg to pebbly beds; dark greenish grey; continued along road bed; continues to new HW 659
HW18-659	5599681	172800	957		fine amygdaloidal volcanic /or glassy shards; massive flows

HW18-660	5599670	172814	962		Distinct amygdaloidal flows w green glassy filled amygdules irreg. amoeboid shapes an cavities filled with calcite and epidote, ? andesitic
HW18-661	5599651	172867	972		feldsp porphyritic amygdaloidal volcanic flows
HW18-662	5599644	172988	992		very large amygdules to 3 cm in fg mafic volcanics
HW18-663	5599661	173080	1001		basaltic flow dark grey w epidote tinge; fine amygdules w black glass
HW18-664	5599696	173191	1004		white wx mg altered hb-diorite greenish matrix xx feldspar phyric + hb; both sparse
HW18-665	5599389	173582	998		grey pebbly grit; small pebbles to 4 mm all rounded, bedded cg greenstone black mafic volc
HW18-666	5599221	173745	985		End of Road
HW18-667	5599125	173664	938		Cross to Lower Road
HW18-668	5598806	174177	995		Th. May 24, 2018 At end of logging rd; coarse lithic tuff breccia; pinkish red wx; frags leucocratic
HW18-669	5598715	174630	783		descend below pass 200 m in creek bed; OC massive chl-epidote alt mafic volc. (at 784 elev.); prominent fxs 024/69 E
HW18-670	5598716	174709	756		OC on left/South side of creek; large OC mafic volcanics; massive tan-brown wx; pervasive weak epidote-chl altn
HW18-671	5598737	174747	754		rusty cobble in creek; grey silicified vol w diss py _ pyrite veinlets
HW18-672	5598775	174776	740		orange wx blocks in creek, grey silicified volc? w patchy diss. pyrite
HW18-673	5598741	174845	732		veinlets of zoned pyrite in core w pale brown vein in sevages in silicified volc. also blocks w diss. patch of po in silicified volc
HW18-674	5598749	174872	725		large black grey green feldsp porphyry w stockwork veins qtz +/- 3 ? oriented w 20 D. of parallel
HW18-675	5598812	175120	638		farthest point down creek today; elev. 639 m; blocks of feldspar porphyry abundant blocks orange wx, qtz-carb altn pyrite diss. volc
HW18-676	5598947	175132	712		feldsar porphyritic int volc wi diss. pyrite
HW18-677	5598968	175131	721		OC rusty wx along fxs silicfied feldspar porphyry w diss. po
HW18-678	5599052	175149	796		OC silicified grey fg volc w qtz felds veining + diss. po=py in rusty fx zones
HW18-679	5599076	175123	812	G0616056	at crest of narrow ridge in silicified folds porphyry w diss. po. OC is generally stockwork fxd through nothing visible in cracks
HW18-680	5599057	175113	804		less rusty wx OC to South or East face of ridge; silicified mafic volc. Some muted-out zones w trace py, abundant diss po in 2 m clefts; Ridge runs E-W and maybe resistant to N sharp ravine parallel to ridge
HW18-681	5599076	175090	823	G0616057	in steep cleft uphill of very unusual resistant ridge; sample silicified volcanics stkwk fxs and abundant po, cleft 070 D.
HW18-682	5599203	175027	882		pale grey fg massive volc locally wx stockwork fxs and silicification
HW18-683	5599243	175014	901		OC massive dacitic volc à with local stockwork zones w intenes silicification and pyrrhotite (po)
HW18-684	5599239	174750	1017		black aph mafic volc massive
HW18-685	5599209	174700	1041		black msv volc no py, pale grey wx amygdaloidal locally on ridge crest
HW18-686	5599167	174522	1071		more msv black fg volc
HW18-687	5599156	174481	1079		more msv black fg volc magnetic
HW18-688	5599154	174432	1089		mafic volcanics fg black weakly magnetic
HW18-689	5599001	174077	1031		OC in slash; amygdaloidal basalt; fxs 081/60
HW18-690	5598938	174042	1003		feldspar porphyritic diorite dyke 080/90; tapers and splits; cutting masv basalt fg
HW18-691	5598913	174053	1004		Park, EOT
HW18-692	5599506	172573	880		OC brown- ruty wx; amygdaloidal basalt; b 025/15 approx. vesicular layer above more msv vc - very crumbly

HW18-693	5599507	172573	879		25 m. from 692; msv mg basalt
HW18-694	5599518	172517	871		contact between agglomerate and msv flow above convoluted but near horizontal
HW18-695	5599527	172500	866		white wx dyke 090/90 rhyolite few m wide; rusty wx in places; OC poss downhill
HW18-696	5599539	172462	859		rusty wx ?rhyolite or silicified basalt
HW18-697	5599659	172421	849		up next road to ___ + North; cg basalt altered punky chloritic fault 274/85, 20 cm wide fault gouge ochre and bleached clay
HW18-698	5599685	172406	853		amygdaloidal basalt dk green amygdules round to ameoboid cut by fxs 316/60 in narrow zone. pyritic zones in bxs; small fault 010/75 clay filled
HW18-699	5599716	172387	858		msv grey dyke appears more silicious than basalt and microfxd dioritic; 125/85 3 m wide; bordered by basalt, highly broken with white fx fills
HW18-700	5599752	172372	863		cg felds porph basalt crumbly OC
HW18-701	5599857	172285	869		msv flow fg brown wx basalt 2 mm sporadic amygdules w epidote calcite fills 347/62 breccial filled silicious veinlet swarm at top of flow
HW18-702	5599869	172250	877		distinct from 701; flow dark grey green; msv fg weakly por mag zones of epidote altn; continues up hill to north; pods of epidozite oriented along fxs
HW18-703	5599907	172204	884		laminated flow dyke or base in porphyritic basalt with 170/40 west, 1 m wide glomero porphyritic possibly dacitic cuts msv basalts
HW18-704	5599896	172217	883		msv cg basalt with round phenocryst-like pale blebs, thick flow, white gougy veins wx out 340/45
HW18-705	5599974	172126	890		msv cg basalt w distinct xtal txt and sparse phenocrysts of feldspar; thick msv flow
HW18-706	5599974	172120	890		move back 40 m. new cg porphyritic flow like 705; flow top zone in poor OC between and below this
HW18-707	5600008	172080	890		fg msv basalt sparsely porphyritic; conchoidal fx nearby; phenos, maybe amygdules with pale green ill
HW18-708	5600042	172060	894		highly veined fx OC of fg basalt; veins are fine bx of silicious material 030/60; continues w very highly bxcd zones
HW18-709	5600065	172035	898		crumbly wx basaltic bx-tuff coarse tuff bx (rusty wx)
HW18-710	5600098	171976	906		distinct tuff bx OC angular bx frag to 4 cm; lithic lapilli-tuff bx; b 015/15
HW18-711	5600111	171959	909		basaltic bx under HW710; all basalt bx frags; dark wx angular 3 cm epidote altered zones
HW18-712	5600150	171887	915		msv black mg amygdaloidal basalt flow
HW18-713	5600174	171823	913		band of high rock cut from HW 712; zoes of epidote altn; shears at 065/70
HW18-714	5600210	171747	903		fg black basalt cut by fg porphyry dykes 355/40
HW18-715	5599843	170716	564		lower spur road; hb diorite; altered nodes acc. magnetite
HW18-716	5599860	170695	561	G0616058	diorite cg fresh acc pyùmagnetite; grey plag equigranular equant stubby hb
HW18-718	5599894	170656	556		diorite breccia; PHOTO; weak jigsaw texture; DIAGRAM - coarse diorite clast separated by finer diorite
HW18-719	5599902	170646	545		continuous contact w fg volcanic appearing breccias
HW18-720	5599908	170644	545	G0616059	sharp contact verticle 062/90 w streamed laminated breccia ? Phreato-magmatic ? angular clast entrained parallel to contact; granitic clasts in altered matrix
HW18-570	5600053	170856	612		
HW18-721	5599920	170640	547		contact of phreatomagnetic breccia w diorite phreatic breccia same as HW 718; angular fxd diorite in fg interstitial matrix continuous toà.
HW18-722	5599933	170632	545		finer grained phreatic bx deatic? greenish mixed zones w diorite bx; DIAGRAM PLUS PHOTO with Peter at HW 720

HW18-723	5599919	170640	548	G0616060	adjacent to 720; new sample w cpy diss in breccia; coarse brecciated feldspars in dark matrix bx to fine scale
HW18-724	5599917	170644	548	G0616061	breccia w diss cpy + py mostly msv diorite with bx veins minor cpy
HW18-725	5600035	170567	542		msv white wx granodiorite
HW18-726	5600161	170494	544		msv mg hb-bi granodiorite 15% mafics accessory mag and sphene continues toà
HW18-727	5600138	170525	547	G0616062	fg pink and green granite w chlastic slips randomly placed finely stockwork fxd w fg veinlets with py and cpy and magnetite
HW18-728	5600133	170536	547		contact w cg granodiorite like other side; sharp verticle; 2 m wide thru more fg granite with fine stockwork fxs; carries to breccia dyke zones; angular granite clasts in rock flour matrix
HW18-729	5600123	170556	551	G0616063	contact fb granite to north ; cg granite to south; sample of cg granite w peg veins; py-mag + cpy; becomes fg to south
HW18-730	5600112	170579	557		rusty wx cg diorite phreatic fx- bxs in places
HW18-731	5600124	170606	563		rusty wx OC, fg-mg granite w sparse fxs like below in 727
HW18-732	5600154	170597	567		msv mg diorite-granodiorite; leucocratic in 5% mafics, narrow phreatic dyke 340/80 approx 10 cm
HW18-733	5600170	170592	569		phreatic breccia in diorite (leucodiorite) rusty wx
HW18-734	5600197	170582	569		granite mg phreatic breccia zone forms 1 m dyke trending 080/90
HW18-735	5600168	170478	545		grad contact with fg granite to North of diorite mix intervals/dykes of cg + fg granite
HW18-736	5600187	170456	544	G0616064	contact mg granite (N) and fg granite (S); some stockwork fxs on fg granite and diss py + cpy

AFM plot (Irvine and Baragar 1971)

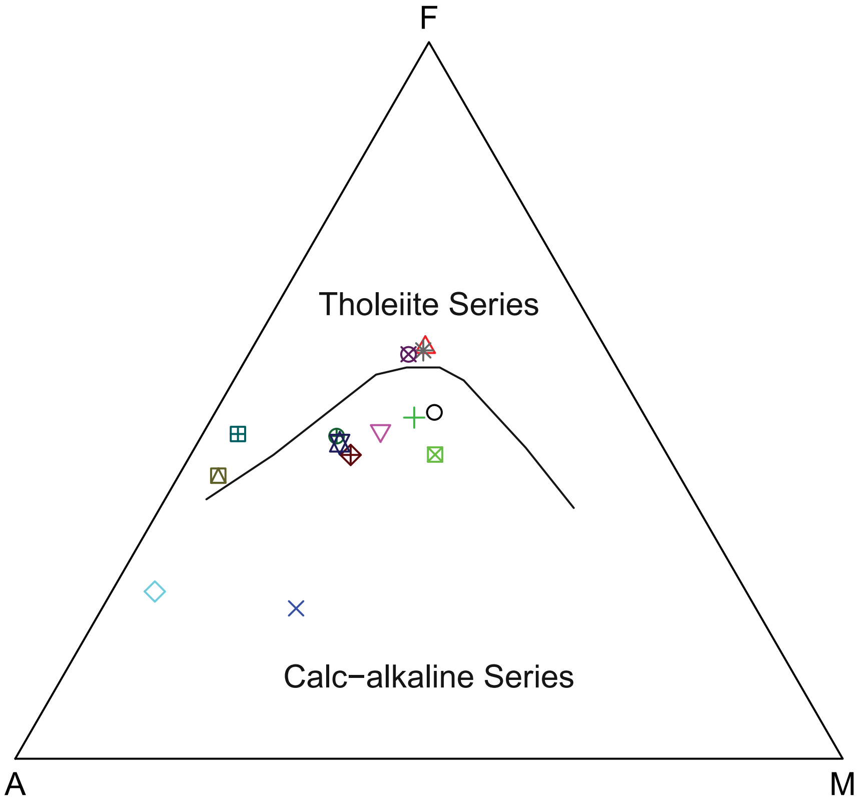


Figure 34: AFM diagram for the Klootchlimmis granitoids.

Oddly the two quartz monzonites plot in the tholeiite field.

○ G0616051
△ G0616052
+ G0616053
× G0616054
◇ G0616055
▽ G0616056
⊠ G0616057
✳ G0616058
◈ G0616059
⊕ G0616060
✡ G0616061
⊞ G0616062
⊗ G0616063
⧅ G0616064

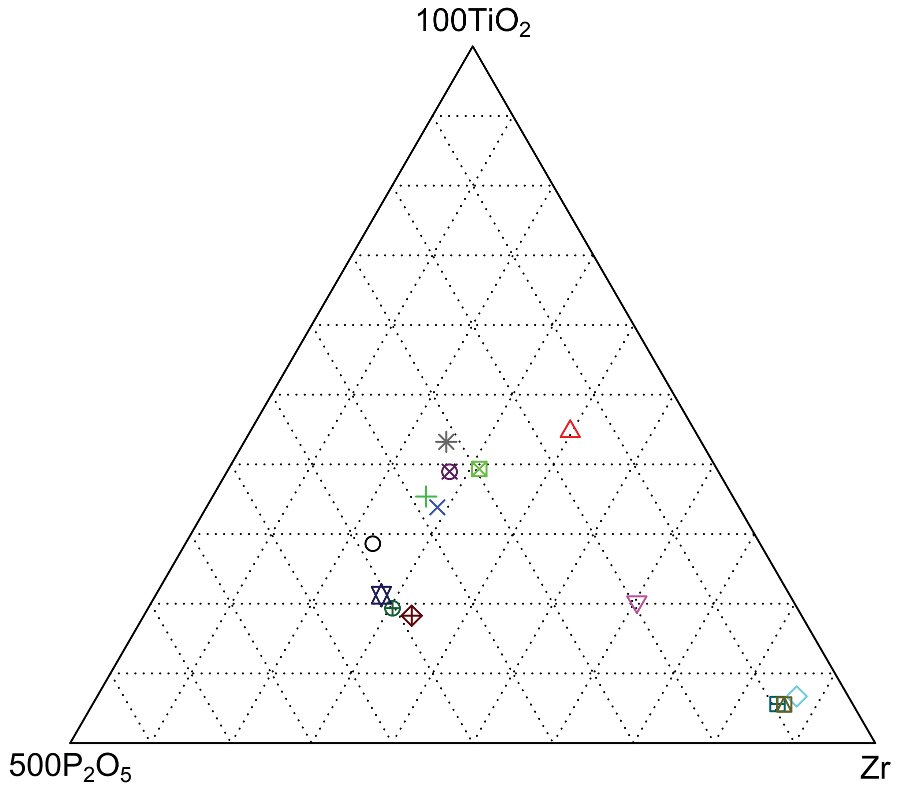
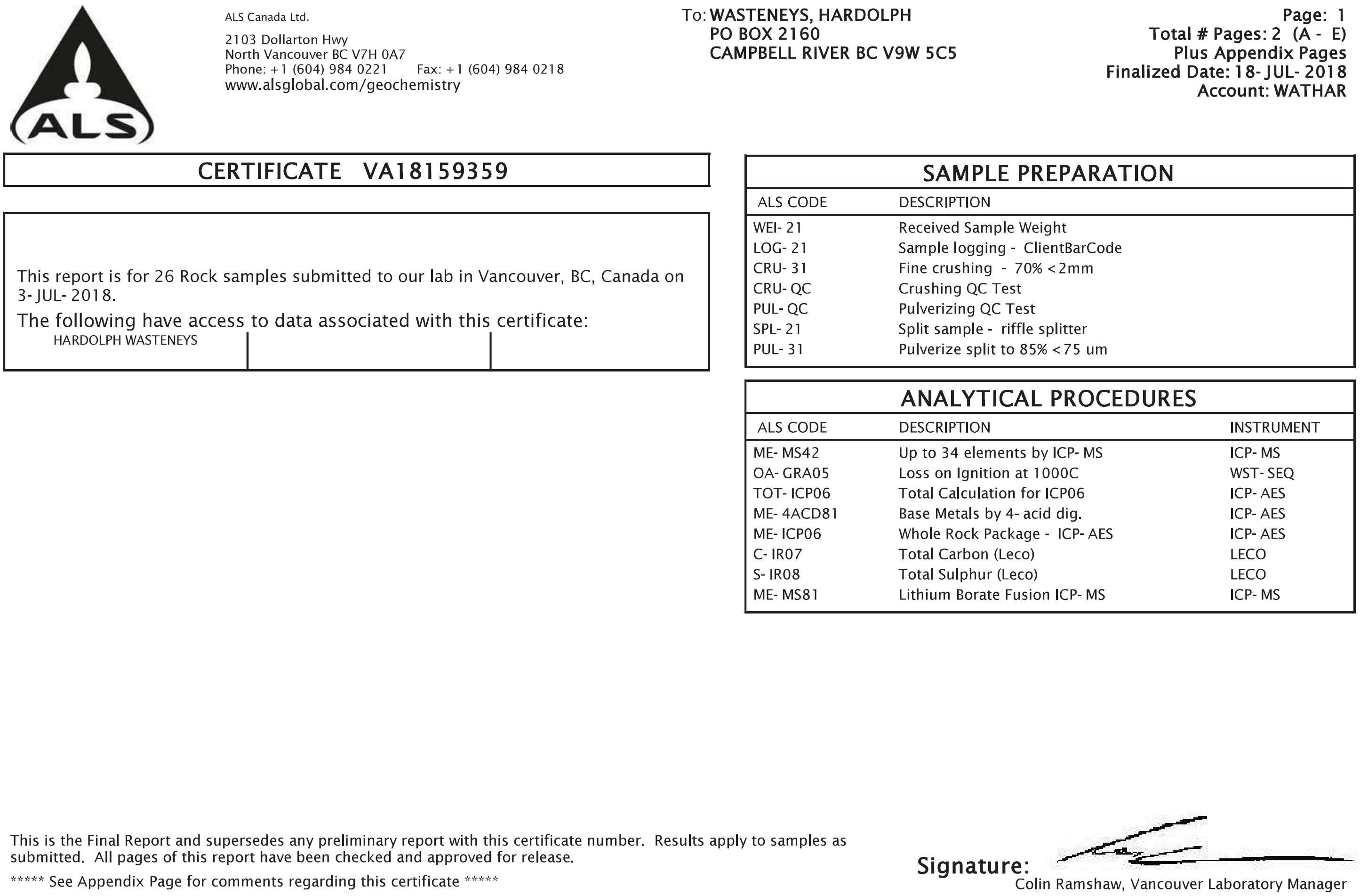


Figure 35: Ti-P-Zr ternary for the Klootchlimmis rocks

the quartz monzonites and granit plot as a group distinct from the monzogabbros to monzonites

Appendix-C: Geochemistry



ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
www.alsglobal.com/geochemistry

To: WASTENEYS, HARDOLPH
PO BOX 2160
CAMPBELL RIVER BC V9W 5C5

Page: 1
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 18- JUL- 2018
Account: WATHAR

CERTIFICATE VA18159359

This report is for 26 Rock samples submitted to our lab in Vancouver, BC, Canada on 3- JUL- 2018.

The following have access to data associated with this certificate:

HARDOLPH WASTENEYS

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
LOG- 21	Sample logging - ClientBarCode
CRU- 31	Fine crushing - 70% <2mm
CRU- QC	Crushing QC Test
PUL- QC	Pulverizing QC Test
SPL- 21	Split sample - riffle splitter
PUL- 31	Pulverize split to 85% <75 um

ANALYTICAL PROCEDURES

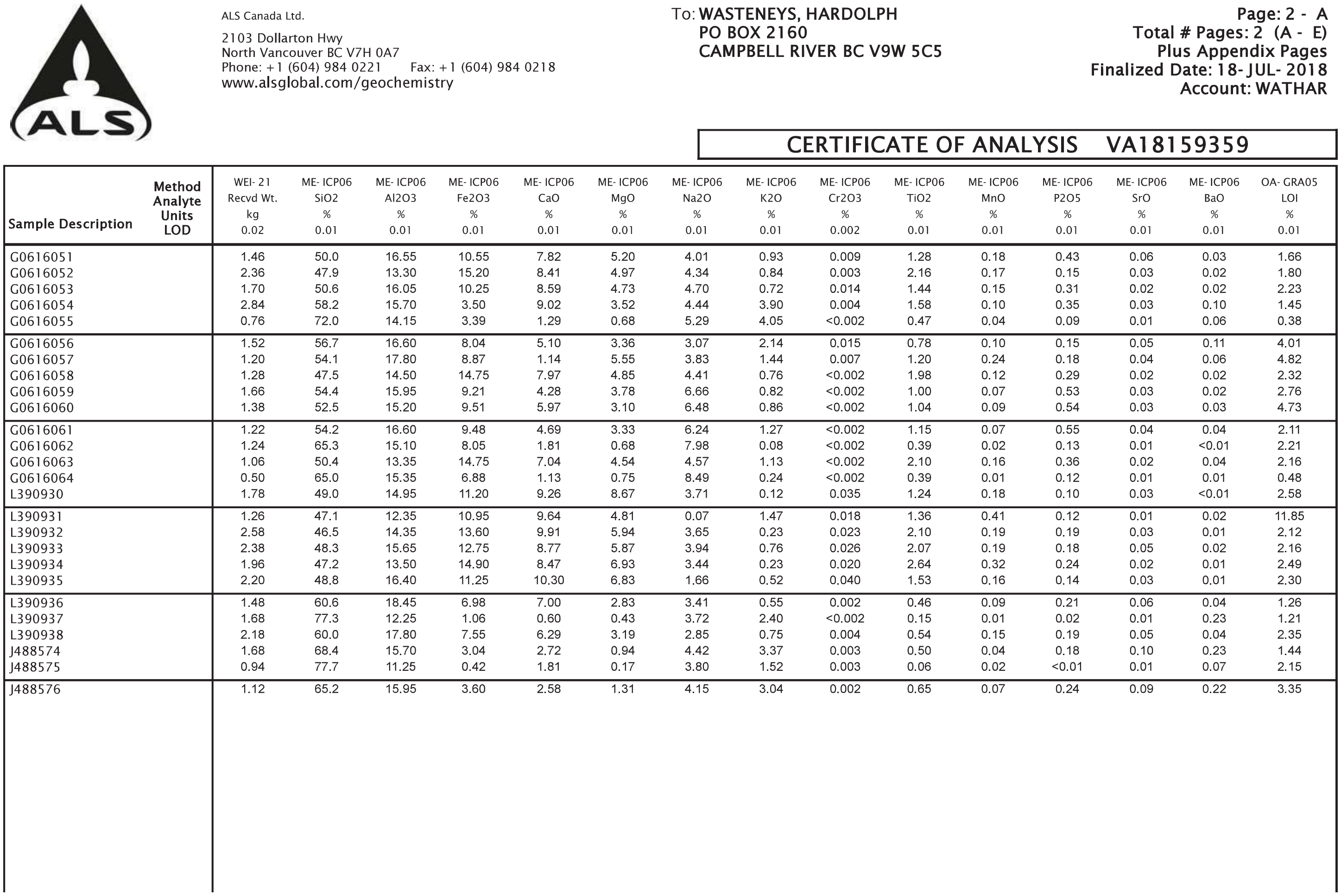
ALS CODE	DESCRIPTION	INSTRUMENT
ME- MS42	Up to 34 elements by ICP- MS	ICP- MS
OA- GRA05	Loss on Ignition at 1000C	WST- SEQ
TOT- ICP06	Total Calculation for ICP06	ICP- AES
ME- 4ACD81	Base Metals by 4- acid dig.	ICP- AES
ME- ICP06	Whole Rock Package - ICP- AES	ICP- AES
C- IR07	Total Carbon (Leco)	LECO
S- IR08	Total Sulphur (Leco)	LECO
ME- MS81	Lithium Borate Fusion ICP- MS	ICP- MS

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
www.alsglobal.com/geochemistry

To: WASTENEYS, HARDOLPH
PO BOX 2160
CAMPBELL RIVER BC V9W 5C5

Page: 2 - A
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 18- JUL- 2018
Account: WATHAR

CERTIFICATE OF ANALYSIS VA18159359

Sample Description	Method Analyte Units LOD	WEI- 21 Recvd Wt. kg 0.02	ME- ICP06 SiO2 % 0.01	ME- ICP06 Al2O3 % 0.01	ME- ICP06 Fe2O3 % 0.01	ME- ICP06 CaO % 0.01	ME- ICP06 MgO % 0.01	ME- ICP06 Na2O % 0.01	ME- ICP06 K2O % 0.01	ME- ICP06 Cr2O3 % 0.002	ME- ICP06 TiO2 % 0.01	ME- ICP06 MnO % 0.01	ME- ICP06 P2O5 % 0.01	ME- ICP06 SrO % 0.01	ME- ICP06 BaO % 0.01	OA- GRA05 LOI % 0.01
G0616051		1.46	50.0	16.55	10.55	7.82	5.20	4.01	0.93	0.009	1.28	0.18	0.43	0.06	0.03	1.66
G0616052		2.36	47.9	13.30	15.20	8.41	4.97	4.34	0.84	0.003	2.16	0.17	0.15	0.03	0.02	1.80
G0616053		1.70	50.6	16.05	10.25	8.59	4.73	4.70	0.72	0.014	1.44	0.15	0.31	0.02	0.02	2.23
G0616054		2.84	58.2	15.70	3.50	9.02	3.52	4.44	3.90	0.004	1.58	0.10	0.35	0.03	0.10	1.45
G0616055		0.76	72.0	14.15	3.39	1.29	0.68	5.29	4.05	<0.002	0.47	0.04	0.09	0.01	0.06	0.38
G0616056		1.52	56.7	16.60	8.04	5.10	3.36	3.07	2.14	0.015	0.78	0.10	0.15	0.05	0.11	4.01
G0616057		1.20	54.1	17.80	8.87	1.14	5.55	3.83	1.44	0.007	1.20	0.24	0.18	0.04	0.06	4.82
G0616058		1.28	47.5	14.50	14.75	7.97	4.85	4.41	0.76	<0.002	1.98	0.12	0.29	0.02	0.02	2.32
G0616059		1.66	54.4	15.95	9.21	4.28	3.78	6.66	0.82	<0.002	1.00	0.07	0.53	0.03	0.02	2.76
G0616060		1.38	52.5	15.20	9.51	5.97	3.10	6.48	0.86	<0.002	1.04	0.09	0.54	0.03	0.03	4.73
G0616061		1.22	54.2	16.60	9.48	4.69	3.33	6.24	1.27	<0.002	1.15	0.07	0.55	0.04	0.04	2.11
G0616062		1.24	65.3	15.10	8.05	1.81	0.68	7.98	0.08	<0.002	0.39	0.02	0.13	0.01	<0.01	2.21
G0616063		1.06	50.4	13.35	14.75	7.04	4.54	4.57	1.13	<0.002	2.10	0.16	0.36	0.02	0.04	2.16
G0616064		0.50	65.0	15.35	6.88	1.13	0.75	8.49	0.24	<0.002	0.39	0.01	0.12	0.01	0.01	0.48
L390930		1.78	49.0	14.95	11.20	9.26	8.67	3.71	0.12	0.035	1.24	0.18	0.10	0.03	<0.01	2.58
L390931		1.26	47.1	12.35	10.95	9.64	4.81	0.07	1.47	0.018	1.36	0.41	0.12	0.01	0.02	11.85
L390932		2.58	46.5	14.35	13.60	9.91	5.94	3.65	0.23	0.023	2.10	0.19	0.19	0.03	0.01	2.12
L390933		2.38	48.3	15.65	12.75	8.77	5.87	3.94	0.76	0.026	2.07	0.19	0.18	0.05	0.02	2.16
L390934		1.96	47.2	13.50	14.90	8.47	6.93	3.44	0.23	0.020	2.64	0.32	0.24	0.02	0.01	2.49
L390935		2.20	48.8	16.40	11.25	10.30	6.83	1.66	0.52	0.040	1.53	0.16	0.14	0.03	0.01	2.30
L390936		1.48	60.6	18.45	6.98	7.00	2.83	3.41	0.55	0.002	0.46	0.09	0.21	0.06	0.04	1.26
L390937		1.68	77.3	12.25	1.06	0.60	0.43	3.72	2.40	<0.002	0.15	0.01	0.02	0.01	0.23	1.21
L390938		2.18	60.0	17.80	7.55	6.29	3.19	2.85	0.75	0.004	0.54	0.15	0.19	0.05	0.04	2.35
J488574		1.68	68.4	15.70	3.04	2.72	0.94	4.42	3.37	0.003	0.50	0.04	0.18	0.10	0.23	1.44
J488575		0.94	77.7	11.25	0.42	1.81	0.17	3.80	1.52	0.003	0.06	0.02	<0.01	0.01	0.07	2.15
J488576		1.12	65.2	15.95	3.60	2.58	1.31	4.15	3.04	0.002	0.65	0.07	0.24	0.09	0.22	3.35

ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
www.alsglobal.com/geochemistry

To: WASTENEYS, HARDOLPH
PO BOX 2160
CAMPBELL RIVER BC V9W 5C5

Page: 2 - B
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 18- JUL- 2018
Account: WATHAR

CERTIFICATE OF ANALYSIS VA18159359

Method	TOT- ICP06	C- IR07	S- IR08	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81
Analyte	Total	C	S	Ba	Ce	Cr	Cs	Dy	Er	Eu	Ga	Gd	Ge	Hf	Ho
Units	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Sample Description LOD	0.01	0.01	0.01	0.5	0.1	10	0.01	0.05	0.03	0.03	0.1	0.05	5	0.2	0.01
G0616051	98.71	0.03	0.06	256	27.1	70	0.58	5.56	3.11	1.49	21.6	5.48	<5	2.6	1.17
G0616052	99.29	0.13	0.29	201	61.5	20	0.10	12.55	7.19	3.19	23.8	12.10	<5	5.1	2.54
G0616053	99.82	0.01	0.28	202	13.4	110	0.03	5.49	3.21	1.39	22.4	4.83	<5	3.0	1.15
G0616054	101.89	0.11	0.01	900	36.8	30	0.12	9.39	5.54	1.91	22.9	8.63	<5	3.8	1.97
G0616055	101.90	0.02	0.01	572	83.4	10	0.07	19.25	12.25	2.43	24.5	16.55	<5	15.4	4.08
G0616056	100.23	0.31	1.35	1095	36.2	130	0.51	8.46	5.29	1.77	27.4	7.39	<5	5.8	1.78
G0616057	99.28	0.11	0.14	580	19.0	60	0.48	6.24	3.46	1.67	20.3	5.69	<5	2.4	1.30
G0616058	99.49	0.10	0.50	201	21.0	10	0.07	6.16	3.85	1.51	24.3	5.79	<5	3.1	1.34
G0616059	99.51	0.16	0.54	207	37.1	<10	0.16	8.13	4.61	2.21	23.5	8.09	<5	4.5	1.60
G0616060	100.08	0.61	1.12	224	41.1	<10	0.08	8.15	4.67	2.30	23.0	8.05	<5	4.2	1.66
G0616061	99.77	0.09	0.26	339	34.4	10	0.15	6.88	3.85	1.96	23.2	6.98	<5	3.5	1.38
G0616062	101.76	0.29	1.15	19.1	35.4	10	0.02	6.63	4.23	2.20	29.4	6.03	<5	14.2	1.32
G0616063	100.62	0.16	0.54	351	32.4	<10	0.05	8.57	4.94	1.79	23.1	7.64	<5	4.3	1.71
G0616064	98.86	0.02	0.24	59.3	54.5	10	<0.01	11.75	7.23	2.62	29.0	10.85	<5	14.5	2.48
L390930	101.08	0.02	0.01	33.6	15.0	270	0.10	4.00	2.14	1.05	16.5	3.77	<5	2.3	0.73
L390931	100.18	2.52	0.91	201	16.6	130	0.24	3.77	2.16	0.98	19.0	3.77	<5	2.2	0.73
L390932	98.84	0.02	0.01	76.6	26.2	180	0.03	5.44	3.00	1.60	24.7	5.50	<5	3.7	1.11
L390933	100.74	0.03	0.01	191.5	25.3	190	0.30	5.21	2.83	1.49	23.2	5.17	<5	3.4	1.01
L390934	100.41	0.03	0.04	59.0	31.3	150	0.12	6.85	3.84	1.92	23.3	6.77	<5	4.5	1.36
L390935	99.97	0.02	0.01	77.7	18.4	290	0.44	3.99	2.53	1.21	20.3	3.95	<5	2.6	0.89
L390936	101.94	0.02	0.01	343	21.2	20	0.51	2.45	1.67	0.90	19.8	2.67	<5	1.7	0.57
L390937	99.39	0.05	0.01	2100	28.2	10	0.46	1.67	1.25	0.28	8.7	1.76	<5	2.6	0.37
L390938	101.75	0.03	0.78	336	24.0	30	0.77	3.24	2.01	1.03	20.4	3.10	<5	1.9	0.64
J488574	101.08	0.14	<0.01	2120	49.3	10	0.60	1.56	0.72	0.95	24.1	2.59	<5	3.8	0.26
J488575	98.98	0.39	<0.01	644	25.3	20	0.86	0.67	0.30	0.39	11.7	1.06	<5	1.7	0.13
J488576	100.45	0.34	<0.01	1970	52.4	10	1.13	2.01	0.80	1.17	23.9	2.83	<5	4.2	0.30

ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
www.alsglobal.com/geochemistry

To: WASTENEYS, HARDOLPH
PO BOX 2160
CAMPBELL RIVER BC V9W 5C5

Page: 2 - C
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 18- JUL- 2018
Account: WATHAR

CERTIFICATE OF ANALYSIS VA18159359

Method	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS81
Analyte	La	Lu	Nb	Nd	Pr	Rb	Sm	Sn	Sr	Ta	Tb	Th	Tm	U	V
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Sample Description LOD	0.1	0.01	0.2	0.1	0.03	0.2	0.03	1	0.1	0.1	0.01	0.05	0.01	0.05	5
G0616051	11.4	0.46	3.3	18.6	3.86	20.9	5.10	1	555	0.2	0.89	1.21	0.50	0.60	299
G0616052	17.4	1.04	9.8	48.2	10.10	19.9	12.30	9	276	0.6	1.96	1.59	1.11	3.83	567
G0616053	6.0	0.51	4.7	10.8	2.07	13.2	3.76	1	171.5	0.3	0.88	1.26	0.48	0.36	285
G0616054	13.9	0.85	9.7	26.4	5.52	55.7	7.75	3	275	0.6	1.48	2.54	0.87	1.15	211
G0616055	35.0	1.96	21.8	54.1	11.70	65.7	15.50	3	136.0	1.4	2.91	7.18	1.90	2.88	13
G0616056	15.3	0.87	7.7	23.8	5.11	30.9	6.50	2	449	0.5	1.34	2.33	0.82	1.26	163
G0616057	9.4	0.51	3.6	16.8	3.33	24.9	4.81	2	348	0.2	0.95	0.78	0.52	0.40	273
G0616058	8.2	0.53	3.5	16.1	3.09	11.8	5.17	2	213	0.2	0.95	1.03	0.56	0.50	496
G0616059	14.6	0.65	4.7	26.5	5.44	12.5	6.78	2	252	0.3	1.31	1.54	0.68	1.31	83
G0616060	16.7	0.64	5.3	27.8	5.95	13.7	8.01	2	254	0.3	1.38	1.48	0.67	1.18	89
G0616061	14.4	0.51	4.7	23.5	4.86	15.5	6.20	1	323	0.3	1.13	1.69	0.60	0.86	81
G0616062	12.4	0.79	6.4	23.9	5.05	1.3	5.92	5	124.5	1.0	1.01	2.75	0.66	1.23	15
G0616063	11.8	0.73	9.7	22.8	4.75	16.5	6.69	3	212	0.6	1.31	2.04	0.75	0.92	438
G0616064	18.7	1.30	15.0	37.5	7.97	1.9	10.05	6	110.5	1.1	1.77	3.94	1.11	1.28	<5
L390930	5.9	0.29	6.6	11.3	2.14	2.1	3.25	1	260	0.4	0.60	0.49	0.32	0.15	329
L390931	6.9	0.28	7.0	11.4	2.44	19.8	2.94	1	59.6	0.5	0.58	0.50	0.31	0.20	304
L390932	10.6	0.36	12.4	18.1	3.80	3.1	4.85	1	269	0.9	0.92	0.91	0.40	0.27	430
L390933	10.0	0.36	12.3	17.2	3.54	12.6	4.47	2	390	0.8	0.90	1.06	0.39	0.49	380
L390934	12.6	0.45	15.5	22.2	4.50	3.4	6.08	2	214	0.9	1.18	1.18	0.53	0.44	485
L390935	7.3	0.33	8.6	13.0	2.61	9.8	3.34	1	315	0.5	0.64	0.68	0.36	0.22	323
L390936	9.9	0.28	2.7	12.3	2.86	8.7	2.75	<1	496	0.2	0.46	1.01	0.23	0.52	101
L390937	14.0	0.25	4.3	11.5	3.10	22.3	2.35	<1	124.5	0.4	0.28	4.31	0.20	0.98	19
L390938	11.0	0.38	2.9	14.2	3.05	15.0	3.26	1	469	0.2	0.55	1.05	0.33	0.58	135
J488574	25.8	0.09	6.1	22.6	5.76	68.7	3.93	1	838	0.5	0.31	5.69	0.10	2.62	54
J488575	13.9	0.06	16.0	10.1	2.79	31.5	1.96	<1	146.5	1.3	0.14	5.27	0.05	1.00	16
J488576	27.5	0.09	6.0	23.9	6.16	64.6	4.56	1	801	0.4	0.41	5.17	0.09	2.69	74

ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
www.alsglobal.com/geochemistry

To: WASTENEYS, HARDOLPH
PO BOX 2160
CAMPBELL RIVER BC V9W 5C5

Page: 2 - D
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 18- JUL- 2018
Account: WATHAR

CERTIFICATE OF ANALYSIS VA18159359

Sample Description Method	ME- MS81	ME- MS81	ME- MS81	ME- MS81	ME- MS42	ME- MS42	ME- MS42	ME- MS42	ME- MS42	ME- MS42	ME- MS42	ME- MS42	ME- MS42	ME- 4ACD81	ME- 4ACD81
Analyte	W	Y	Yb	Zr	As	Bi	Hg	In	Re	Sb	Se	Te	Tl	Ag	Cd
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LOD	1	0.1	0.03	2	0.1	0.01	0.005	0.005	0.001	0.05	0.2	0.01	0.02	0.5	0.5
G0616051	1	30.5	2.96	104	1.2	0.02	0.059	0.018	<0.001	<0.05	0.2	<0.01	<0.02	<0.5	<0.5
G0616052	1	62.4	6.98	192	0.8	0.03	0.010	0.018	<0.001	0.09	<0.2	0.02	<0.02	<0.5	<0.5
G0616053	1	31.7	3.24	108	0.7	0.02	0.006	0.015	0.001	0.08	0.2	<0.01	<0.02	<0.5	<0.5
G0616054	1	55.2	5.61	134	0.6	0.02	<0.005	0.008	<0.001	0.08	<0.2	<0.01	<0.02	<0.5	<0.5
G0616055	1	108.0	12.50	610	0.6	0.02	<0.005	0.009	<0.001	0.08	<0.2	<0.01	<0.02	<0.5	<0.5
G0616056	2	49.2	5.29	232	1.5	1.93	0.008	0.112	0.003	0.57	1.4	0.06	0.02	<0.5	1.2
G0616057	3	36.9	3.24	95	2.8	0.64	0.007	0.051	<0.001	0.86	0.2	0.01	0.05	<0.5	0.9
G0616058	1	34.8	3.52	115	1.3	0.03	0.068	0.017	0.002	0.07	<0.2	<0.01	<0.02	<0.5	<0.5
G0616059	2	44.2	4.30	182	2.2	0.03	0.026	0.014	0.001	0.07	<0.2	0.02	<0.02	<0.5	<0.5
G0616060	1	46.0	4.44	163	3.8	0.03	0.077	0.016	0.001	0.10	<0.2	0.01	<0.02	<0.5	<0.5
G0616061	1	38.8	3.49	152	1.4	0.02	0.011	0.007	0.001	0.06	<0.2	<0.01	<0.02	<0.5	<0.5
G0616062	1	37.8	4.70	592	1.6	0.03	0.051	0.026	0.004	0.08	<0.2	<0.01	<0.02	<0.5	<0.5
G0616063	1	47.4	4.67	149	1.2	0.03	0.017	0.018	0.001	0.07	<0.2	<0.01	<0.02	<0.5	<0.5
G0616064	<1	67.1	7.68	604	0.5	0.02	0.009	0.011	0.002	0.06	<0.2	<0.01	<0.02	<0.5	<0.5
L390930	4	20.0	1.82	84	0.6	0.02	0.005	0.009	<0.001	0.08	<0.2	0.01	<0.02	<0.5	<0.5
L390931	12	19.4	1.99	84	62.0	0.14	0.141	0.060	<0.001	0.70	0.4	0.74	0.02	1.4	7.0
L390932	2	27.6	2.47	144	0.3	0.02	<0.005	0.012	<0.001	0.11	<0.2	<0.01	<0.02	<0.5	0.7
L390933	<1	26.4	2.68	134	0.3	0.02	<0.005	0.009	<0.001	0.07	0.3	<0.01	<0.02	<0.5	0.5
L390934	1	35.4	3.24	173	1.5	0.02	0.005	0.020	<0.001	0.25	<0.2	<0.01	<0.02	<0.5	0.5
L390935	1	21.9	1.99	100	1.3	0.02	<0.005	0.011	<0.001	0.06	0.2	<0.01	0.02	<0.5	0.5
L390936	1	15.7	1.87	62	0.6	0.02	0.015	0.008	<0.001	0.15	<0.2	0.01	0.02	<0.5	<0.5
L390937	6	11.5	1.51	74	0.3	0.03	0.363	<0.005	0.002	0.06	<0.2	0.01	<0.02	<0.5	<0.5
L390938	2	19.1	2.11	64	1.8	0.05	0.023	0.008	0.003	0.32	<0.2	0.04	0.02	<0.5	<0.5
J488574	2	7.8	0.68	153	0.4	0.02	<0.005	0.012	<0.001	0.12	<0.2	<0.01	0.02	<0.5	<0.5
J488575	2	3.4	0.38	52	0.1	0.02	<0.005	<0.005	<0.001	0.10	<0.2	0.01	0.03	<0.5	<0.5
J488576	3	9.3	0.71	162	0.3	0.06	<0.005	0.012	<0.001	0.24	<0.2	0.01	0.03	<0.5	<0.5

ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
www.alsglobal.com/geochemistry

To: WASTENEYS, HARDOLPH
PO BOX 2160
CAMPBELL RIVER BC V9W 5C5

Page: 2 - E
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 18- JUL- 2018
Account: WATHAR

CERTIFICATE OF ANALYSIS VA18159359

Sample Description Method	ME- 4ACD81	ME- 4ACD81	ME- 4ACD81	ME- 4ACD81	ME- 4ACD81	ME- 4ACD81	ME- 4ACD81	ME- 4ACD81
Analyte	Co	Cu	Li	Mo	Ni	Pb	Sc	Zn
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LOD	1	1	10	1	1	2	1	2
G0616051	26	33	20	<1	21	<2	26	54
G0616052	28	191	10	<1	27	<2	41	30
G0616053	22	57	10	<1	24	<2	30	25
G0616054	7	4	10	1	9	<2	23	19
G0616055	2	7	<10	<1	<1	<2	7	8
G0616056	21	201	10	1	37	4	19	289
G0616057	22	97	30	<1	34	<2	25	258
G0616058	37	98	10	<1	15	<2	36	20
G0616059	23	58	10	<1	2	<2	12	28
G0616060	30	63	10	1	3	<2	14	32
G0616061	19	56	10	<1	4	<2	14	15
G0616062	49	76	<10	3	25	<2	14	7
G0616063	45	70	10	2	12	<2	40	40
G0616064	16	16	<10	3	2	<2	14	4
L390930	44	37	10	<1	118	<2	40	107
L390931	48	153	30	<1	98	30	34	820
L390932	44	31	10	<1	89	<2	38	91
L390933	39	41	10	<1	79	<2	34	109
L390934	46	560	10	1	80	<2	41	133
L390935	39	122	10	1	107	<2	36	84
L390936	14	18	<10	1	4	<2	10	57
L390937	4	96	<10	11	4	3	3	9
L390938	18	126	<10	<1	11	<2	15	58
J488574	5	2	10	1	2	18	3	68
J488575	<1	3	<10	1	1	<2	1	9
J488576	8	12	20	<1	2	14	4	83

ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221   Fax: +1 (604) 984 0218
www.alsglobal.com/geochemistry

To: **WASTENEYS, HARDOLPH**
PO BOX 2160
CAMPBELL RIVER BC V9W 5C5

Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 18- JUL- 2018
Account: WATHAR

CERTIFICATE OF ANALYSIS   VA18159359

CERTIFICATE COMMENTS

LABORATORY ADDRESSES

Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

Applies to Method:

C- IR07   CRU- 31   CRU- QC   LOG- 21
ME- 4ACD81   ME- ICP06   ME- MS42   ME- MS81
OA- GRA05   PUL- 31   PUL- QC   S- IR08
SPL- 21   TOT- ICP06   WEI- 21

APPENDIX D: STATEMENT OF QUALIFICATIONS

Hardolph Wasteneys Ph.D., P.Geo.

I, Hardolph Wasteneys, Ph.D, P.Geo. resident at Strathcona Park Lodge, Campbell River BC, do hereby certify that:

I am a self employed Professional Geoscientist and have worked primarily in mineral exploration, mining, geological and U-Pb geochronological research, and geological education since 1976.

I am a registered member of the Association of Professional Engineers and Geoscientists of British Columbia.

I graduated with the degree of Bachelor of Science in Geological Engineering, Mineral Resources option from the Faculty of Applied Science, Queen's University, Kingston in 1979.

I graduated with the degree of Doctor of Philosophy (Geological Sciences) from Queen's University, Kingston in 1990 in the field of economic geology with research specialized in the study of epithermal ore deposits of southern Peru under the supervision of Prof. Alan H. Clark.

I conducted U-Pb geochronological research at the Jack Satterley Geochronology Laboratory in the Royal Ontario Museum directed by Dr. T. E. Krogh from 1990 to 1997 and completed numerous studies on the timing of ore deposition and regional metamorphism in collaboration with university and government survey geologists and resulting in several publications in peer reviewed international journals.

I have read the definition of "Qualified Person" set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfil the requirements to be a "Qualified Person" for the purposes of NI 43-101.

I am familiar with the Yreka property held by Karmamount Mineral Exploration Inc having completed geological mapping on the property in August and September, 2016.

signed at Upper Campbell Lake,

November 5, 2018

Hardolph W

Dr. H. A. WASTENEYS
#32102