REPORT ON THE 1997 CORUNDUM EXPLORATION PROGRAM

of the

TASEKO PROPERTY

WESTPINE METALS LTD.

Vancouver, BC

Clinton Mining Division, BC

NTS 920/3W

Latitude 51 05', Longitude 123 24'W

WILLIS W. OSBORNE, M.Sc., FGAC

December 5, 1997

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SUMMARY

Property - The Taseko Property is located 225 km north of Vancouver in southwestern British Columbia along the eastern flank of the Coast Range. The property consists of 108 units and is in the Clinton Mining Division. Access is by four-wheel drive vehicle from Williams Lake (270 km) through the town of Hanceville, south to Taseko Lakes, then east along Taseko River.

History - Gold was discovered at the Taylor-Windfall mine in the 1920's. The area in and around the Taseko Property was actively explored between 1969 - 1976 as a porphyry copper-molybdenum target, and again in 1985, for its epithermal gold potential. Geochemical, geophysical and drilling programs were carried out during these periods. From 1988 through 1991 a new phase of geochemical, prospecting and drilling was implemented by Westpine Metals Ltd., the present owner of the property, and associated companies. A small program of mapping, whole-rock analysis and diamond drilling was completed in 1993.

Property Geology - The property occurs along an east-west contact between Cretaceous-age granitic intrusives of the Coast Plutonic Complex to the south and a thick sequence of volcanic strata of the Taylor Creek Formation to the north and west. An intense alteration zone up to 3 km in width occurs within the volcanic assemblage north of and adjacent to intrusive rock.

The main showing occurs in the Empress area where copper-gold mineralization is found in intensely altered volcanic rock. A pre-feasibility study of the Empress, using a cut-off of 0.40% cooper (not copper equivalent) showed in situ resources to be 11,078,000 tons of 0.61% copper and 0.023 opt gold. The East Zone, 3,300 feet east of the Empress, is similar to the Empress, but only three holes have been drilled into it. The Buzzer and Rowbottom zones consist of chalcopyrite and molybdenite which is disseminated and in vugs in granitic rock.

1997 Program & Results - Westpine, in collaboration with the Geological Survey Branch of the BC Ministry of Employment and Investment, is currently undertaking a study to determine the area of occurrence and to assess the quality of sapphires which are found on the Taseko Property. In 1996, drill core was examined, rock in the Empress area was observed and core, rock and silt samples were taken.

In 1997, large samples of unconsolidated material were taken and concentrated on site for further study. Also in 1997, the samples collected in 1996 were concentrated, using heavy liquids, and were examined by a binocular microscope. Several grains were examined by means of a scanning electron microscope for identification.

So far, blue (sapphire), colorless and gray corundum have been identified.

Recommendation - The next step is to study coarse heavy mineral concentrates of 1997 samples using jigs and/or heavy liquids in combination with microscopic examination and to evaluate the corundum.

INTRODUCTION

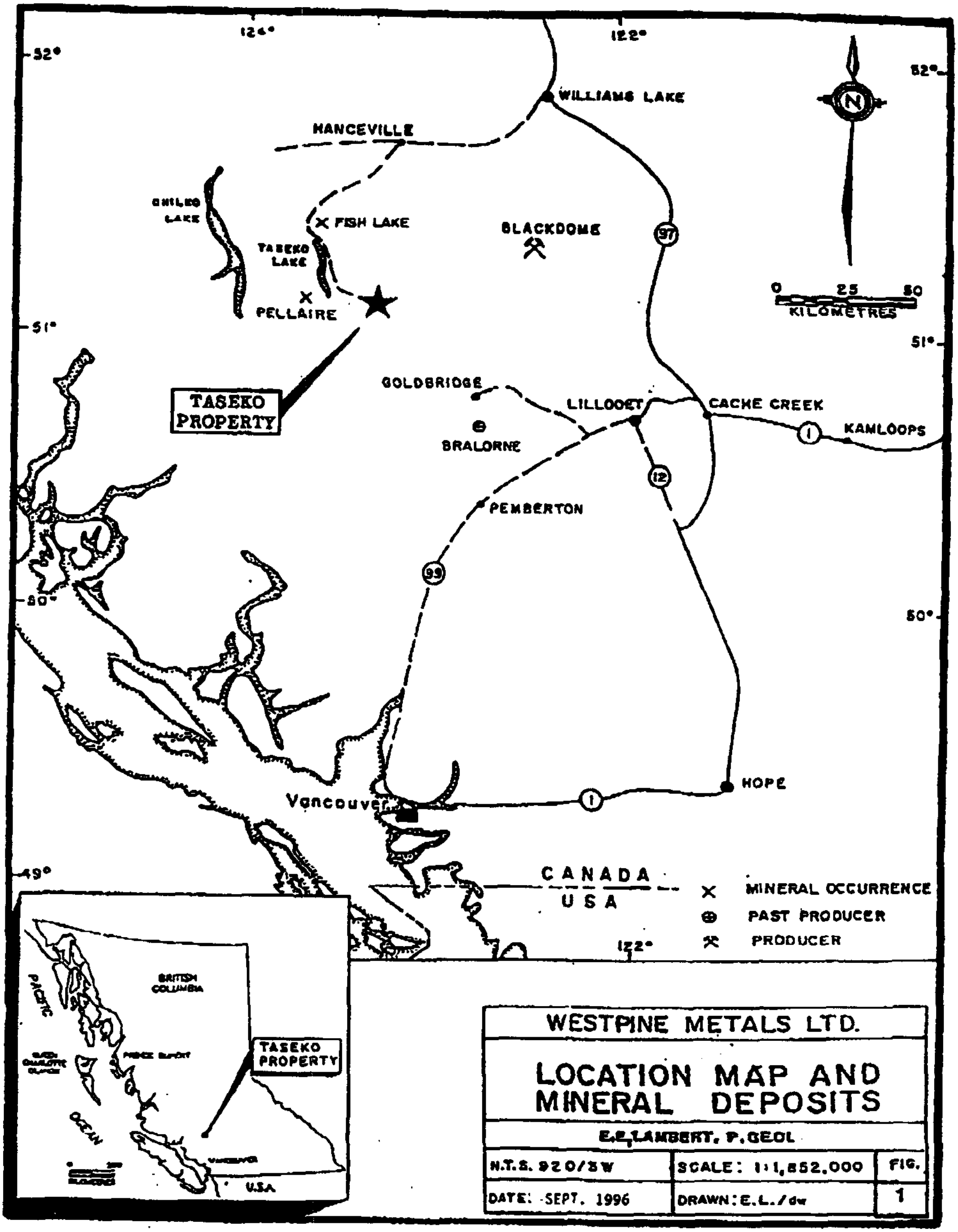
Program - Westpine Metals Ltd., in collaboration with the Geological Survey Branch of the BC Ministry of Employment and Investment, is conducting a study of the occurrence of corundum, especially the sapphire variety, on the Taseko Property.

In August, a Westpine geologist and a geologist and assistant from the Geological Survey Branch of the BC Ministry of Employment and Investment spent 3 days on the property. In addition, a study was completed on the heavy mineral fraction of samples collected in 1996 using a scanning electron microscope and chemical analysis.

Location - The Taseko Property is located 225 km north of Vancouver, British Columbia, in the Clinton Mining Division (Figure 1). It lies 10 km southeast of the southern end of Upper Taseko Lake along the Taseko River, at 51°05' latitude and 123°24' west longitude, NTS Map 92O/3W.

Access - The property can be reached by road from Williams Lake (270 km) or by helicopter from Gold Bridge (48 km), Pemberton (100 km), Lillooet (120 km) or Williams Lake (215 km). Access to the property from Williams Lake is via Route 20 west to Hanceville on paved roads, southwesterly along dirt roads to the Taseko Lakes, then southeasterly along the Taseko River to the claim area. Four-wheel drive vehicles are necessary for sections of the road south of Hanceville, and approximate travel time from Williams Lake is 6 hours. At the present time there is no bridge over the Taseko River for access to the southern portion of the property. The river can be forded in the vicinity of Granite Creek by a 4WD truck during low water levels, but it is risky when water level rises during spring runoff and after major rain storms. A second crossing exists near Battlement Creek and is the preferred crossing during high water. The property contains a network of old mining roads in various stages of overgrowth which provides easy access to trenches, drill sites and mineralized showings in the area.

Physiography - Physiography of the claims area consists of a broad, U-shaped valley occupied by the Taseko River and its numerous tributaries. Elevation on the property ranges from 4,900' (1,500 m) in the valley to 7700' (2350 m) at mountain crests. At lower elevations the terrain is covered by lodgepole pine trees, with balsam fir and white pine occurring at higher elevations. Glacial cover consists of morainal deposits and glacial drift that appear to be relatively thin but extensive (typical depth is 3-8 m). Rock exposures are scarce and generally confined to creeks and peaks on ridges.


124°
122°
52°
51°
50°
49°
WILLIAMS LAKE
HANCEVILLE
CHILKO LAKE
X FISH LAKE
TASEKO LAKE
BLACKDOME
97
PELLAIRE
0 25 50
KILOMETRES
TASEKO PROPERTY
GOLDBRIDGE
LILLOOET
CACHE CREEK
KAMLOOPS
BRALORNE
12
PEMBERTON
99
HOPE
Vancouver
CANADA
USA
MINERAL OCCURRENCE
PAST PRODUCER
PRODUCER
BRITISH COLUMBIA
PACIFIC
OCEAN
U.S.A.
WESTPINE METALS LTD.
LOCATION MAP AND MINERAL DEPOSITS
E.E. LAMBERT, P.GEOL
N.T.S. 92 O/3W
SCALE: 1:1,852,000
FIG. 1
DATE: SEPT. 1996
DRAWN: E.L./dw

CLAIMS INFORMATION

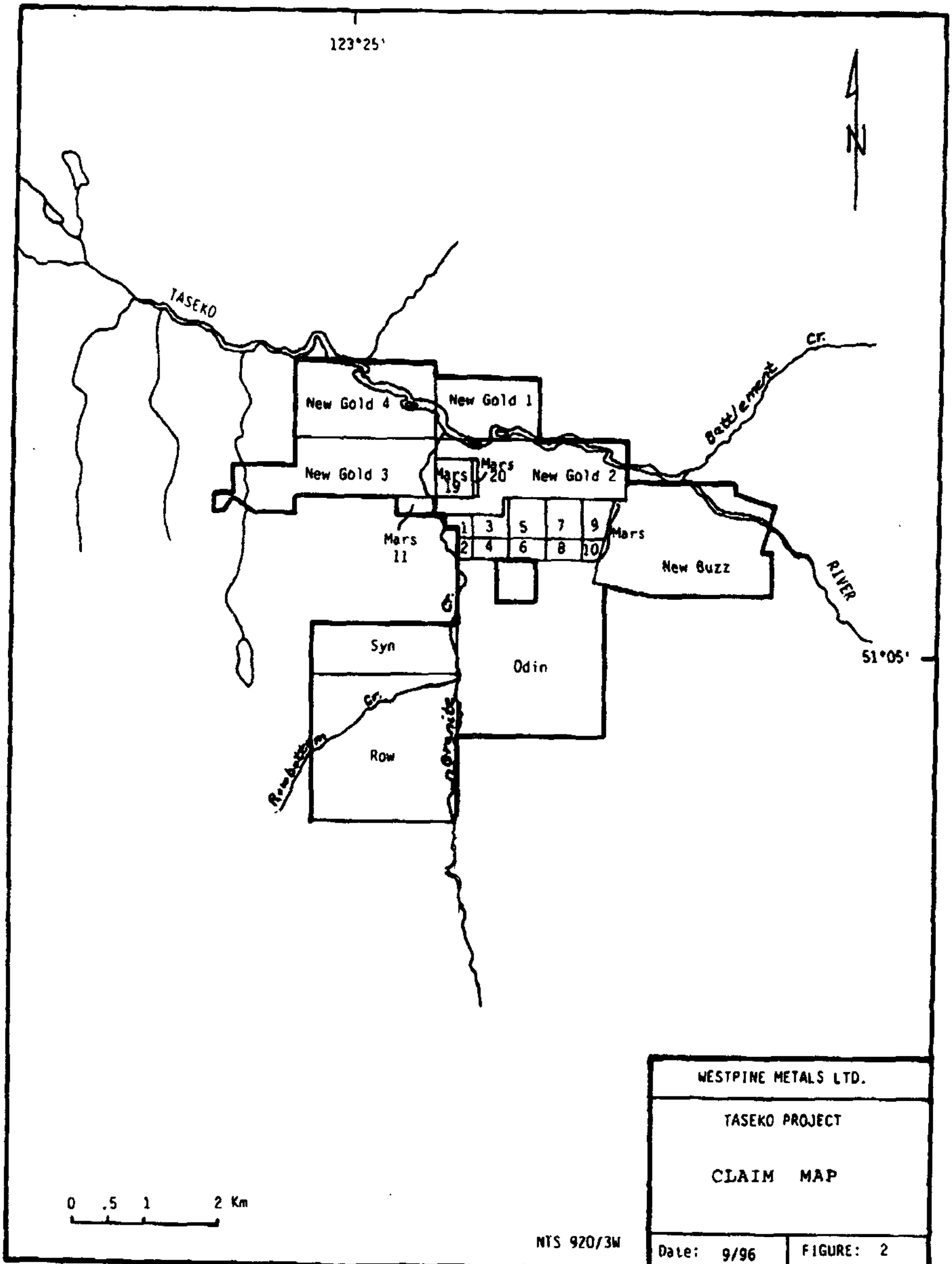
The property is comprised of 8 four-post and 13 two-post mineral claims totalling 108 units held by Westpine Metals Ltd. The claims are as follows (Figure 2):

Claim Name	Units	Record #	Expiry Date
New Gold 1	6	208506	Sep. 24, 1998
New Gold 2	10	208503	Aug. 30, 1998
New Gold 3	12	208502	Sep. 12, 1998
New Gold 4	8	208507	Sep. 24, 1998
New Buzz	15	208505	Sep. 26, 1998
Mars 1	1	208579	Oct. 21, 1998
Mars 2	1	208580	Oct. 21, 1998
Mars 3	1	208581	Oct. 21, 1998
Mars 4	1	208582	Oct. 21, 1998
Mars 5	1	208583	Oct. 21, 1998
Mars 6	1	208584	Oct. 21, 1998
Mars 7	1	208585	Oct. 21, 1998
Mars 8	1	208586	Oct. 21, 1998
Mars 9	1	208587	Oct. 21, 1998
Mars 10	1	208588	Oct. 21, 1998
Mars 11	1	208589	Oct. 21, 1998
Mars 19	1	208590	Oct. 21, 2000
Mars 20	1	208591	Oct. 21, 2000
Row	16	208791	Aug. 14, 2000
Syn	8	208601	Nov. 4, 1999
Odin	20	209156	Jul. 13, 1999

PROPERTY HISTORY

Between 1909 and 1920, may large, bog-iron deposits were discovered by prospectors in the Taseko Lakes area. Gold was discovered at the Taylor-Windfall mine in the 1920's, followed by the discovery of copper-gold porphyry mineralization in the vicinity of the current Taseko Property, in 1922. From 1930 - 1969, sporadic exploration for copper-gold mineralization was conducted in the Taseko River basin by numerous companies. Activity increased between 1969 - 1976 when the area was investigated for its porphyry copper-molybdenum potential by Scurry Rainbow Oils Ltd., Sumitomo Metals Mining Canada Ltd., and Quintana Minerals Corp. In the mid-1980's, Westmin Resources Limited and Esso Minerals Canada explored for epithermal gold-silver mineralization in the Taylor Windfall area, which also included a program of surface mapping and geophysical surveys on part of the Taseko Property.

Alpine Exploration Corporation and Westley Mines Limited optioned the Taseko Property from New World Mines Development Ltd. in 1988 after Scurry Rainbow allowed the claims to expire. A small exploration program was implemented that field season, then in early 1989 the two companies vended their interest in the property to Westpine Metals Ltd. The property was then optioned to ASARCO Exploration Company of Canada Limited in 1990 and 1991. ASARCO funded approximately one million dollars of exploration in search of copper-gold porphyry systems but dropped the option in 1992. Westpine has continued to conduct small drilling, geophysical and sampling programs to the present.


123°25'
N
TASEKO
RIVER
Battlement
cr.
New Gold 4
New Gold 1
New Gold 3
New Gold 2
Mars 19
Mars 20
Mars 11
1
2
3
4
5
6
7
8
9
10
Mars
New Buzz
Syn
Odin
Row
cr.
51°05'
0 .5 1 2 Km
NTS 920/3W
WESTPINE METALS LTD.
TASEKO PROJECT
CLAIM MAP
Date: 9/96
FIGURE: 2

REGIONAL GEOLOGIC SETTING AND MINERALIZATION

Regional Geology

The Taseko Property occurs on the northeastern margin of the Coast Plutonic Complex (CPC), as mapped by Tipper (1969, 1978), Glover and Schiarizza (1987), Glover et al. (1986) and McLaren and Rouse (1989). Granitic magma of the CPC intruded Middle Jurassic to Upper Cretaceous sedimentary and volcanic strata that had accumulated within the Tyaughton basin. Coarse clastic sedimentary rocks, which dominate the axial regions of the trough, interfinger with volcanic lithologic in the Taseko to Chilko Lake area (McLaren and Rouse). The volcanic rock includes three main groups: intermediate to felsic pyroclastics and flows correlative with the late-Lower Cretaceous Taylor Creek Group; conglomerates, sandstones, argillite and volcanic flows of the Upper Cretaceous Silverquick Formation; and a thick succession of massive volcanic breccias, agglomerate, tuffs and basic flows of the Upper Cretaceous Powell Creek Formation (Figure 3).

Intrusive rocks in the Taseko area include quartz diorite to quartz monzonite. An extensive, advanced argillic alteration zone exists at the contact between the CPC intrusives and adjacent volcanic - sedimentary strata, and can be traced for over 18 km in an east-west direction.

Extensive thrust faulting of Late Cretaceous age has been documented in rocks adjacent to the CPC. The Tyaughton basin underwent west-vergent thrusting from ca 100 Ma to 90 Ma, closely followed by east-vergent thrusting (Rusmore and Woodsworth, 1991). As much as 100 km of crustal shortening occurred across the basin. The youngest structural patterns that dominate the area are strike-slip faults that developed in Early Tertiary, which include the Yalakom and Tchaikazan faults. The Tchaikazan fault has been interpreted as trending east-southeast along the Taseko River valley (Glover, et al., 1986).

Significant mineral deposits in the region east of the Coast Ranges and within 100 km of the Taseko Property include Blackdome, Bralorne, and Fish Lake (see Figure 1).

PROPERTY GEOLOGY

Geology

The Taseko Property and surrounding area has been mapped in detail by a number of company and government geologists (see References). Because of an extensive blanket of glacial till covering most areas below treeline, outcrops are sparse and geologic mapping has been confined to exposures in creeks and the upper parts of ridges and mountain tops. A wealth of information exists, however, in diamond drill core which totals over 11,000 m (37,000 ft) to date.

The property is underlain mainly by the Late Lower Cretaceous Taylor Creek Formation and late Cretaceous to Tertiary quartz monzonite, granodiorite and quartz diorite of the Coast Plutonic Complex (Figure 3). The contact between the intrusive and volcanic rock is not exposed but is inferred from drilling and geophysics to trend roughly east-west across the property. The contact dips steeply to the north then becomes sub-horizontal at a depth of 100 to 200 m for a distance of at least 640 metres. This sub-horizontal, granitic "bench" has been defined by drill holes to extend at least 1480 m east and 2800 m west of the Empress area.

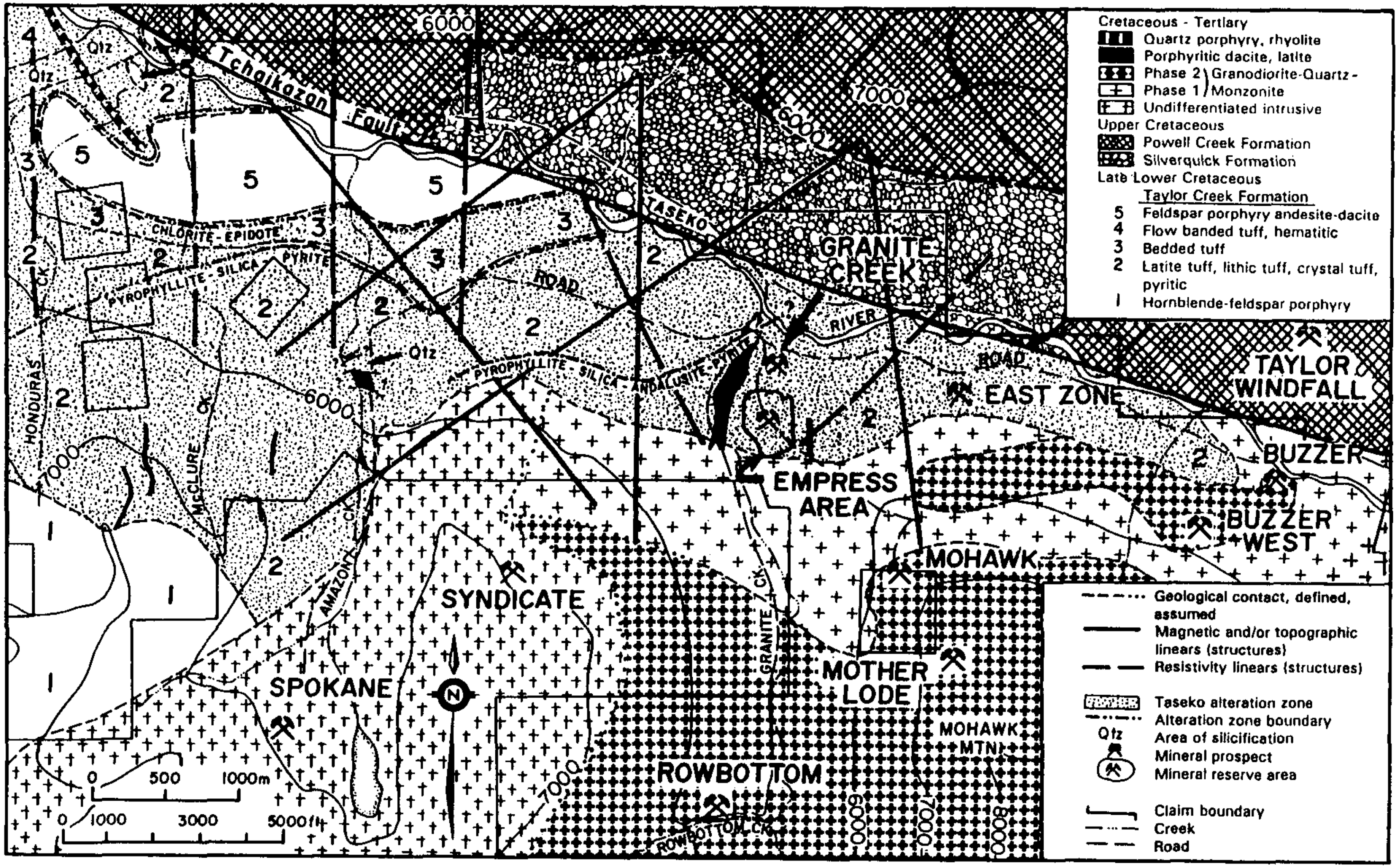


FIGURE 3: Geological Map of the Taseko Property and surrounding area (From Osborne and Allen, 1995).

The Taylor Creek Formation consists of 5 units within the Taseko area. Osborne and Allen (1994) differentiated six types of intrusive rock within the batholithic complex exposed on the property, including varieties of quartz diorite, granodiorite and quartz monzonite. Quartz monzonite-granodiorite is thought to underlie much of the area beneath the alteration zone. North of the Taseko River the Upper Cretaceous Silverquick Formation, mainly chest-pebble conglomerate, sandstone and argillite, and the Powell Creek Formation, mainly volcanic breccia and tuff, occur.

Breccia pipes and andesite to felsic dikes and stocks that postdate the batholith and alteration occur within the plutonic and volcanic units. Dike trends closely match those of prominent joint sets in the area: NW-SE and NE-SW. Faults exposed in outcrop generally trend northwesterly (Allen, 1991), and fault zones in drill core are common.

Structure

The main structural element on the Taseko are on the Tchaikazan which goes along the Taseko River. This fault has not been identified in field work in the area.

Evidence for other faults comes from field work, geophysical information and drill core. West of Amazon creek faults are fairly common and trend mainly northwesterly. Geophysical information from a Dighem Survey was interpreted by Windels (1991). He concluded that major northerly - trending resistivity linears dominate west of Amazon creek, whereas east of Amazon creek there is one northeasterly and one northwesterly linear. The major magnetic linears are north, northeasterly and northwesterly.

Many examples of brecciation and gouge were seen in drill core.

Alteration

A large portion of the Taseko Property covers the 3 km wide alteration zone within the volcanic rocks north of the batholith (see Figure 4). Rocks within this zone have undergone silicification and propylitic, argillic and aluminosilicate alteration. A description of alteration of surface outcrops is found in Allen's (1991) report, and the remainder of this report will concentrate on alteration seen in drill core.

Alteration of rock seen in most drill holes is so intense that determination of original lithologies is difficult if not impossible. In these strongly altered zones, the degree of alteration and mineral variety is very diverse, often changing over short distances (sometimes only tens of centimetres), which results in a very complex suite of rock types. For this reason many units have been divided and labelled according to the dominant minerals present rather than by protolith (see descriptions below). Enough drilling has been completed in adjacent, less altered areas to indicate that these intensely altered lithologies were most likely original volcanic rocks. One of the main reasons for suspecting this is the preservation of volcanic textures, which include breccias, compositional banding, and porphyritic features.

Overall, the most pervasive type of alteration observed from drilling is a fine grained overprint of quartz and a pale green mica. The green mica occurs locally within the Empress area as coarse clusters and has been identified by x-ray diffraction to be pyrophyllite. Staining of numerous pieces of core from this area showed only minor potassium, which suggests that pyrophyllite is prevalent here. It is not known, however, whether all of the green mica seen throughout the property is pyrophyllite, or if some of it is instead sericite. Pyrophyllite-bearing rocks appear to be an advanced argillic alteration assemblage. Alunite has also been identified in this assemblage from surface outcrops (Bradford, 1985).

Other alteration minerals include quartz, pyrophyllite, andalusite, plagioclase, perthite(?), clay, chlorite, magnetite, hematite, and more rarely corundum. Accessory minerals include dumortierite(?), tourmaline, fluorite, rutile, sericite, apatite, and bastnaesite (a mineral identified by x-ray analysis containing the rare-earth elements lanthanum and cerium). Gypsum, quartz, calcite and white or green clay are common as fracture fillings.

Some totally altered rock units have a consistent mineralogy and are repeatedly encountered in drill holes. The following is a description of these units:

(1) **QAS**[1]: QUARTZ-ANDALUSITE-PYROPHYLLITE ROCK: this rock is characterized by a mainly equigranular texture composed of these three minerals in varying proportions. Additional minerals in QAS include finely disseminated magnetite, clots of chlorite, specks of clay, and gypsum veining (locally up to 1 m in width). It is assumed that QAS represents an altered tuffaceous unit, probably crystal-rich and mafic in original composition.

(2) **PQSA**: PLAGIOCLASE-QUARTZ-PYROPHYLLITE-ANDALUSITE ROCK: rocks of this unit are the most complex mineralogically of any on the property due to multiple interconnected textures and wide diversity of mineral assemblages. It is presumed at this point that the complexity is a result of multiple episodes of fracturing of the QAS unit with additional alteration imposed from subsequent hydrothermal activity. The mineralogy of PQSA consists of plagioclase (which is white, green or pink in colour) and quartz that appear to have been introduced along fractures in QAS. Associated minerals include pyrophyllite, andalusite, magnetite, chlorite, carbonate, corundum, and clay (commonly an alteration product of plagioclase).

(3) **QR**: QUARTZ ROCK: QR is presently thought to represent intense silicification. Typical mineralogy consists of over 90% quartz with the remaining 10% being comprised of one or more of the following minerals: interstitial pyrophyllite, clay, magnetite, chlorite, carbonate, rutile, or sphene. The quartz in QR frequently occurs as fine to coarse surrounded grains with a texture resembling quartzite. Numerous volcanic features are perfectly preserved by the quartz and include breccias, compositional banding and welded-tuff textures.

(4) **QM**: QUARTZ-MAGNETITE ROCK: this unit is very similar to QR, but contains greater than 5% magnetite. Chlorite, hematite and sulphides are common in this unit. Magnetite constitutes 10 to 20% by volume of the rock and is locally massive, reaching 50 to 75%. It occurs interstitial to quartz grains or as fracture fillings. Intervals on the order of tens of meters of brecciated QR healed by a magnetite matrix are common. QM is typically the deepest altered unit intersected in drill holes, situated below quartz rock and above quartz diorite.

In addition to these units, vugs are common and contain coarse-grained minerals (>1 cm in size) of white quartz (often as terminated crystals), plagioclase, calcite, books of chlorite, euhedral magnetite and pyrite and gobs of chalcopyrite. Other, more rare minerals are molybdenite, apatite, sphene and rutile.

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[1]Note: S stands for pyrophyllite.

Mineralization

Prior to 1991, copper-gold mineralization was known to occur in four localities on the Taseko Property, historically referred to as the Empress, Buzzer, Rowbottom and Mother Lode Showings (Figure 3). In 1991, two new zones were discovered through drilling and are referred to as the Granite Creek Zone and East Zone.

Empress Showing: this is the main mineralized zone discovered to date on the property. Here, sulphides of pyrite and chalcopyrite and, more rarely, molybdenite, pyrrhotite, bornite and native copper, are typically disseminated or in fractures within intensely altered, alumino-silicate units. Microscopic examination of gravity concentrates of mineralized core indicates the additional presence of trace galena, spalerite and free gold (Harris, 1988). In situ resources are currently estimated to be 11,078,000 tonnes grading 0.61% Cu and 0.023 oz/t AU (using a cutoff of 0.4% Cu - not copper-equivalent). A study by James Askew Associates, Inc. of Englewood, Colorado (1991) calculated 9,502,000 tonnes of mineable reserves in an open pit operation grading 0.582% Cu and 0.754 g/t Au.

East Zone: this zone is located 1000 m east of the Empress Showing and has been defined by three holes to date. Here, copper-gold mineralization occurs over significant widths within altered volcanic strata. The geological setting is similar to that found in the Empress area.

Buzzer, Rowbottom, Motherlode and Granite Creek Zones: these zones occur within the intrusive rock of the batholith. Mineralization typically consists of pyrite, chalcopyrite, molybdenite and microscopic gold, either disseminated or as replacements of mafic minerals. Another recently discovered zone, the Buzzer West Zone, consists of chalcopyrite and molybdenite in intrusive rock.

1997 PROGRAM AND RESULTS

Westpine Metals Ltd., in collaboration with the Geological Survey Branch of the BC Ministry of Employment and Investment, is in the process of conducting a study on the occurrence of sapphire, a variety of corundum, on its Taseko property. The study has two phases:

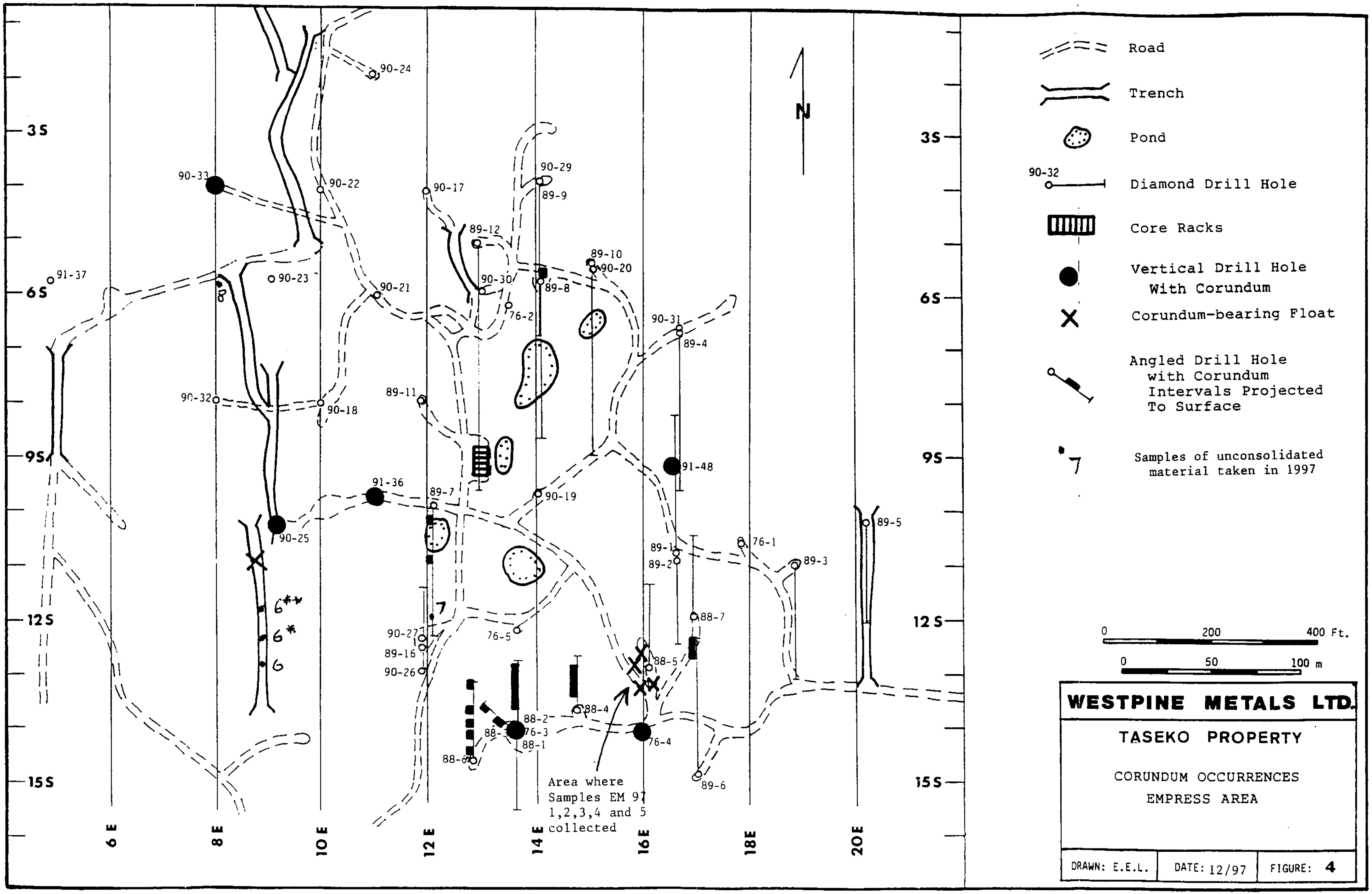
Phase I

a. Visit the property, examine core samples and take samples of core, rock and stream sediments.
b. Identify the composition and proportion of heavy minerals from samples through the use of a scanning electron microscope and chemical analysis.

Phase II

a. Return to the property, collect larger samples of unconsolidated material and concentrate the samples on site.
b. Study coarse heavy mineral concentrate using jigs and/or heavy liquids in combination with a microscope examination.
c. Document extracted corundum through personnel of the Geological Survey and further evaluate the findings by two impartial experts.

In 1996, the first set of samples was collected. This study was reported by E. Lambert, 1996. In 1997, the scanning electron microscope study and chemical analyses were carried out, results of phase I are enclosed, and the second set of samples was collected. Figure 4 is a map showing the location of the 1997 samples.



Road
Trench
Pond
Diamond Drill Hole
Core Racks
Vertical Drill Hole With Corundum
Corundum-bearing Float
Angled Drill Hole with Corundum Intervals Projected To Surface
Samples of unconsolidated material taken in 1997
Area where Samples EM 97 1,2,3,4 and 5 collected
N
3S
6S
9S
12S
15S
6E
8E
10E
12E
14E
16E
18E
20E
0 200 400 Ft.
0 50 100 m
WESTPINE METALS LTD.
TASEKO PROPERTY
CORUNDUM OCCURRENCES
EMPRESS AREA
DRAWN: E.E.L.
DATE: 12/97
FIGURE: 4

During the 1997 field program, 9 large samples of unconsolidated material were collected, sieved and washed to pro-concentrate the heavy minerals. Table 1 is a table showing the volume of samples before treatment and the weight after sieving. These samples will be used for subsequent tests.

In addition, heavy mineral concentrates from the 1996 samples were studied by means of a scanning electron microscope and chemically analyzed. Blue, gray and colorless corundum were found. A report on this part of the program, written by Dr. Simandl follows as an addendum to this report.

TABLE 1

Sample number		**Volume (L) Before sieving**		**Weight after sieving (Kg)**	
EM97-1		either 92 or 69		61	
EM97-2		23		22.5	
EM97-3		23		18.5	
EM97-4		23		24	
EM97-6		23		19	
EM97-6*		23		20	
EM97-6**		23		19	
EM97-8		23		22	
EM97-9		23		21	

DATA FOR SAMPLES COLLECTED IN 1997 PROGRAM

Data from G.J. Simandl

DISCUSSION

The search and evaluation of the occurrence of sapphires on the Taseko property is more than an esoteric scientific study. Blue (sapphire), gray and colorless corundum has been found on the Taseko Property. Corundum is second in hardness only to diamond. Sapphires have been used as jewel bearings in watches and other precision instruments in manufacturing plants and chemical plants, in aircraft, boats, high-tech weapons systems and as connectors for optical fibres. The reason for their desirability as bearings is because of their high hardness, their lack of cleavage (making them highly durable), their very low coefficient of friction when highly polished, and the fact that they are chemically inert and can be cut and polished without great difficulty. Because of their hardness, sapphires have also been used as an abrasive, especially in the lens-polishing industry (i.e. eyeglasses). The use of natural stones for jewel bearings has been largely replaced by inexpensive synthetic gemstones.

According to Austin's 1993 report, the average US 1992 wholesale purchase price of fine-quality, 1-carat sapphire gem was $1,400 (US$). The average annual value of sapphire imports for the 10-year period ending in 1992 was $22.40 per carat. The average annual value of sapphire imports for the 10-year period ending in 1992 was $83 million.

RECOMMENDATIONS

Results of the study presently underway provide important information as to the quality of the sapphires occurring on the Taseko Property. If it is found that the sapphires of medium to high gem quality, and if it is found that they can be economically mined and extracted, then further field work is warranted to better define the extent of the corundum-rich zone in the Empress area.

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STATEMENT OF COSTS

Geologist (4 days at $400 per day)	2,000	
Helicopter (4.5 hours at $660 per hour, plus gas and oil)	3,305	
Food and Lodging	155	
Use of Vehicle	156	
Sample preparation, electron microscope, x-ray analysis and model analysis of 86 samples at $34.88 per sample	3,000	
Report	400	
		$ 9,016

STATEMENT OF QUALIFICATIONS

I, Willis W. Osborne of 905 - 2324 West First Avenue, Vancouver, British Columbia, hereby certify that:

1. I am a Fellow of the Geological Association of Canada.

2. I have a B.Sc. in geology from the University of Minnesota (1961) and a M.Sc. in geology from the University of British Columbia (1966).

3. I have practiced as a geologist full and part-time since 1963 in Canada and the United States. Since 1980 I have managed small companies involved in mineral exploration as well as being involved in the geological mapping and interpretation etc. of the projects.

4. I am the President of Westpine Metals Ltd. as well as acting as a Director. I directly and indirectly own 255,459 shares in Westpine as well as an option on 200,000 shares.

5. I have been responsible for managing the program on the Taseko Property from 1988 through 1997. My management style is a hands-on approach. This report is based on all of the data available on the Taseko Property as well as the experience picked-up over the years on the project.

December 5, 1997

Willis W. Osborne
M.Sc., FGAC

ADDENDUM

Report by: G.J. Simandl, Ph.D.

Subject: Use of Heavy Minerals in Exploration for Sapphires and Metalliferous Mineralization, Empress Deposit, British Columbia.

Mr. J.W. Osborne
President
Westpine Metals Limited, Vancouver, B.C.
Fax: 604-684-5854

November, 19. 1997.

RE: Heavy Minerals, Empress Deposit, SEM, Sapphire Potential ?

Dear Sir:

Here enclosed is the preliminary draft of the paper " Use of Heavy Minerals in Exploration for Sapphires and Metalliferous Mineralization, Empress Deposit, British Columbia - a Preliminary Report." *It incorporates results of the scanning ellectron microscope (SEM) work that you financed.* Because of the mail strike you will have to get satisfied with the faxed copy at this stage. Any comments, and improvements will be appreciated and considered for incorporation into second version of this document. The improved version will be submitted for publication in the Fieldwork 1996, later this month. We appreciate your support and hope that you find this draft to your expectations.

Best Regards

George J. Simandl
B.C. Geological Survey

Fax: 250-952-0381

Use of Heavy Minerals in Exploration for Sapphires and Metalliferous Mineralization, Empress Deposit, British Columbia - a preliminary report.

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[3] Geological Survey of Canada, Pacific Geoscience Center, Sidney, B.C.
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[5] Cominco Ltd. Laboratory, Vancouver, B.C.

Key words: corundum, sapphire, heavy minerals, gold, base metals, exploration methodology.

Introduction:
One of the most commonly used exploration methods in regional reconnaissance is the sampling of stream sediments. In most cases, stream sediment anomalies are due to mechanical dispersion of metallic minerals or indicator minerals and to a lesser extent to transport of metals in solution followed by their reprecipitation or adsorption on iron oxides and hydroxides, clay particles or organic material. The extent of stream sediment anomalies regardless of their origin is generally restricted and decreases rapidly due to dilution by sterile sedimentary particles (Wilhelm and Artignan, 1988). In northern environments, heavy mineral sampling amplifies anomalies that could have been missed using stream sediments. These days, heavy mineral surveys have become an important component in exploration for base-metals, niobium, tantalum, gold, tin (Fletcher and Loh , 1996), barite, chromite, platinum group elements (Salpeteur and Jezequel, 1996), kimberlite pipes (Fipke, 1989 and Schulze, 1994) and other mineral commodities. This paper describes a heavy-mineral survey over the Empress, a copper-gold-molybdenum porphyry deposit located 225 kilometres north of Vancouver and 50 kilometres northwest of Goldbridge and the Bralorne mining camp (**Figure 1**). The primary objective of the survey was to determine if corundum mineralization described by Simandl et al. (1997) could be detected. A secondary objective was to test the detectability of porphyry copper-molybdenum-gold deposit described by Osborne and Allen (1995)

Corundum is an alumina-rich mineral (Al_2O_3) that may be of variable color due to substitution of metal ions for Al^{3+}. It is usually grey, blue-grey, brown, yellow, green or colourless. Its gemstones are known by their colours, red for ruby and blue for sapphire. The red colour is linked to Cr^{3+} content, while blue and green corundum have significant content of Ti^{4+}, Fe^{3+} and Fe^{2+} and in some cases V^{5+}, Co^{2+} or Ni^{2+} (Phillips and Griffen, 1981). Most corundum gemstones are produced from placer or residual deposits derived by weathering and reworking of primary corundum bearing rocks. In the Empress deposit area, corundum, in association with andalusite-pyrophyllite rock, was reported in several drill holes (Lambert, 1989, 1991a and b) and a boulder containing coarse corundum was found in a trench in 1990. New concentrations of boulders containing corundum coarser than 3 millimetres were found during the 1996 field season. Except for recent studies by Simandl et al. (1997), the potential for gem-corundum mineralization in porphyry-type deposits has not been previously examined.

GEOLOGICAL SETTING

The Empress deposit is located near the eastern margin of the Coast Plutonic Complex in rocks of the Tyaughton basin. The regional geology of the area has been described by Tipper (1978), Glover *et al.* (1986), McLaren and Rouse (1989) and Schiariazza *et al.* (1997). Rocks outcropping in the deposit area belong to the Upper Cretaceous Powell Creek and Lower to Upper(?) Cretaceous Paradise formations. The deposit is located within an alteration zone that is 11 kilometres long and up to 3 kilometres wide (Figure

2). There are substantial changes in the nature and intensity of alteration within the outlined area (McMillan, 1976; Bradford, 1985; Price, 1986). Because of the high degree of alteration and few outcrops, the nature of the protolith within the alteration zone in the Empress area is not well established. Large masses of Late Cretaceous granodiorite of the Coast Plutonic Complex outcrop south of the alteration zone. Smaller intrusions of Early Cretaceous to Early Tertiary age consist of hornblende-feldspar porphyry which locally grades into diorite and quartz diorite.

DRAFT

DEPOSIT GEOLOGY

The Empress deposit occurs in an area with very little outcrop and nearly all information was acquired from drill core. There are three copper-gold-molybdenum bearing zones totaling 10 004 000 tonnes grading 0.61% Cu and 0.789 grams per tonne Au using cut-off grade of 0.4 % Cu (Osborne and Allen, 1995). Near surface, the contact between rocks of the Powell Creek Formation and the Late Cretaceous granodiorite is nearly subvertical. Drilling indicates that it is sub-horizontal at depth, towards the Taseko River. Westpine Metals Ltd. geologists divide the host rocks into four alteration assemblages and one intrusive unit: quartz rock, quartz-magnetite rock, plagioclase-quartz-pyrophyllite-andalusite rock, quartz-andalusite-pyrophyllite rock and granodiorite-quartz monzonite (Osborne and Allen, 1995). These rock types are the product of hydrothermal alteration, in a porphyry system, of a volcanic or volcaniclastic protolith (McMillan, 1976). A brief description of these lithological units follows.

Quartz rock (QR) is typically light grey and weathers brown. It consists of quartz grains (90 to 95%), minor quantities of magnetite (1 to 5%) and trace amounts of pyrophyllite, clay, chlorite, carbonate, titanite, pyrite and chalcopyrite. In various areas of the property, Westpine geologists interpret QR as an altered volcanic rock, explaining relict planar textures as banded rhyolite and welded tuff (Lambert, 1988, 1989, 1991a and b).

Quartz magnetite (QM) rock consists mainly of quartz and magnetite with chlorite and hematite as minor constituents. The magnetite content varies from 5 to 70 percent by volume, but typical content varies from 10 to 20 volume percent. The distinction between the QM and QR units is based on the magnetite content.

The plagioclase-quartz-pyrophyllite-andalusite (PQSA) unit consists of several distinct alteration assemblages that are too limited in extent to be treated separately at the current scale. The most characteristic lithology of this unit is relatively coarse-grained (2 mm to 150 mm) cream-coloured, grey or white plagioclase lenses, layers or irregular masses. These masses are rarely more than a few metres in apparent thickness in drill core. At surface, large blocks of this material are several metres across. They are intimately associated with pale green, fine-grained to aphanitic zones consisting mainly of muscovite and pyrophyllite, fine sericite and andalusite-rich areas that are highly irregular in shape. The pyrophyllite-andalusite zones are bluish grey. Corundum, magnetite and chlorite are the most common accessory minerals. Corundum typically occurs in quartz-free zones within this rock unit. Detailed examination of corundum-bearing rocks indicates that this mineral is found adjacent to a light grey or pinkish, coarse-grained feldspathic rock comprised mainly of albite and strongly zoned orthoclase. Corundum comprises trace amounts to two percent of the rock over widths of generally 0.6 to 21 metres, with one intersection of 34 metres, most of it within andalusite-pyrophyllite-sericite rock. Usually, corundum occurs within andalusite but a few corundum grains are encased directly in feldspar. The corundum observed in drill core is dark to light blue in colour and the grains are commonly less than two millimetres in size. However, blue-black, euhedral crystals up to 3 centimetres in length with hexagonal prism or steep hexagonal dipyramidal forms, approaching barrel-shaped crystals, occur in surface float overlying the 76 zone. A heavy mineral concentrate of overburden from the 76 zone contains dark-blue corundum and colorless corundum crystals that have commonly light blue patches or blue, hexagonal cores. Petrographic examination of corundum from the host rock indicates that most of the fine-grained crystals are microfractured or contain inclusions of pyrophyllite or diaspore. Some of the coarser crystals have relatively fracture free zones several millimetres across that may be gem quality. Individual corundum crystals are separated from the host by pale grey halos, 2 to 5 millimetres wide, that consist mainly of coarse muscovite. Some corundum grains within copper-gold mineralized zones are rimmed by sulphides (Simandl et al. 1997), others are chemically zoned.

Quartz-andalusite-pyrophyllite (QAS) rock is equigranular with grains less than 1 millimetre in size to aphanitic. Minor mineral constituents include magnetite, clay, chlorite and gypsum. Weathered surfaces are typically yellow-stained from the weathering of pyrite and fresh surfaces are sugary and grey. This unit does not contain the coarse plagioclase observed in PQSA.

Granodiorite-quartz monzonite weathers buff and is white to bluish on fresh surface. It is medium to coarse grained and equigranular. It consists of feldspar, quartz, hornblende and biotite with minor titanite. This intrusive rock is the footwall to the deposit and forms the southern limit to the deposit.

Heavy sediment sampling and laboratory procedure

Sediments from the several active streams draining the deposit area (Figure 2) were sampled. Sample sites were chosen in areas that favoured the deposition of heavy sediments. Naturally concentrated gravel and fines were screened to less than 6 millimetres. The standard volume of sediment sampled equalled 7.0 litres. The samples were washed, removing light minerals and leaving enriched heavy sediment concentrate and the size of the samples was reduced to approximately 1/4 of their original volume. This on site pre-concentration was necessary to permit transport of samples for a period of 8 hours in backpacks, as the program was not helicopter-supported.

Samples were dried in the oven and screened into-100 mesh, +100 to -20 mesh and +20 mesh fractions. The finest fraction was analysed for major and trace elements using INA and ICP.

The +100 to -20 mesh fraction was passed through a magnetic separator. Tetrabromethane (TBE) was subsequently used to separate minerals with a density greater than 2.96 g/cm^3 and methylene iodine (MI) was used to separate heavy minerals with density greater than 3.32 g/cm^3. The heavy liquid methodology used is similar to that described by Muller (1977). The mixture of mineral particles and appropriate heavy liquid is stirred inside a beaker to ensure complete wetting. The minerals with densities greater than heavy liquid (in our case TBE first and then with MI) sink. The float and sink are recovered and washed with acetone.

The heavy mineral concentrates (the sink from MI heavy liquid separation stage) were examined using binocular microscope and transparent corundum was identified in 4 samples. Other heavy minerals readily identified include bright red-rutile, sulphides, epidote and magnetite. Selected grains were removed, placed on electrically conductive carbon tape, and coated with a 250 angstrom conductive film of carbon. The grains were then placed in the vacuum chamber of the SEM (scanning electron microscope) and examined. Identification of the grains was made by examining the x-ray spectrum collected from each specimen. Several corundum grains were confirmed in a number of samples by this method.

For each heavy element concentrate, a representative aliquot was selected, mixed with epoxy and glued to a standard petrographic glass slide. The epoxy was then cured on a hot plate and the slide ground on a precision Buehler Petro-Thin to a thickness of about 40 microns. A series of polishing stages then followed to produce a polished thin section. These slides were then coated with conductive carbon and viewed in the electron microscope in BSE (back-scattered electron) mode. In this mode, minerals with a high mean atomic number reflect back more electrons than minerals with a low atomic number. These variations in brightness (grey-level) are most useful in discriminating between mineral species in polished thin sections. Within the context of this study, corundum appears dark grey when viewed in BSE mode. Rutile, Fe-oxides, and sulphides are much brighter (Figure 3).

In one mode of analysis, a digital image is collected by the x-ray analyser and the electron beam placed upon the grain or grains of interest using the computer mouse. An x-ray spectrum is collected and the mineral identified from its spectrum. This combination of BSE imaging and x-ray analysis is effective in mapping a section and in order to obtain quantitative proportions of mineral constituents within a given sample.

Specimens were analysed on a JEOL 6400 digital scanning electron microscope interfaced to a Link Systems eXL x-ray analyser equipped with stage automation and digital beam control. Operating conditions were 20 kv accelerating potential and a beam current of 2 nanometres.

Results

The stream sediment samples contained between 271 and 1557 grams of non-magnetic heavy fraction in category -20 to + 100 mesh after TBE separation.. After MI processing this translated to 1.2 to 40 grams of heavy minerals denser than 3.32 g/cm^3.

The selected trace element composition of fine-fraction (-100 mesh) not treated by heavy liquids is presented in Table 1. The copper, molybdenum, gold and tungsten values are also displayed on Figures 4a, b, c and d. These results indicate that the metal concentrations in the Empress deposit area are high, and probably the deposit would have been detected using this methodology. However, only a small portion of the regional halo was covered and therefore it is impossible to compare our results with truly regional background values. The high gold concentrations are particularly interesting, however silver remains below the detection limit. Follow-up work will be carried out to locate gold-bearing grains using the scanning electron microscope. Anomalous concentrations of tungsten are also of interest. Tungsten was not analysed for during the exploration or the development drilling of the Empress deposit.

In summary, we can say that the sample size that we have chosen is quite appropriate for prospecting in environments similar to the Empress area. However, larger samples would be necessary if the sample density was lesser or the catchment area was larger. Rigorous statistical interpretation will be made when a complete suite of trace elements and major oxides will be available.

Corundum occurs either as gray, colourless or bluish, angular grains, transparent under binocular microscope or as white translucent aggregate grains with a sugary appearance. Corundum was detected in 17 out of 26 samples (Table 2, Figure 4e) and represents 1-30% of all heavy mineral particles denser than 3.32 g/cm^3. Several samples contain a transparent variety of corundum, either as colorless, blue or colorless with blue core grains. The large number of composite grains and their angular shape indicate that corundum is locally derived.

Yellowish and light green epidote (0 to 75%), iron oxides other than magnetite (0-100%) pink rutile (0 to 30%), ilmenite (0-17.8%), orthopyroxene (0 to 26%), clinopyroxene (0 to 14%), amphibole (0-7.8%), titanite (0 to 7%), aluminosilicate (0 to 7%) (kyanite, andalusite should probably have been eliminated during heavy liquid separation), barite (<1%), zircon (0 to 1.8%), allanite (<1%) and unidentified silicate are other minerals observed. The variations in the proportion of the heavy minerals over a small area demonstrate the importance of large samples and the need for careful microscopic examination. Minerals that are characteristic of the metalliferous Empress deposit are pyrite, magnetite, chalcopyrite and pink rutile.

Of particular interest is the presence of scheelite detected in samples TA96-4, 10, 11, and 13 and coinciding with above normal tungsten content in the fine fraction detected by chemical analyses.

Conclusions:

Corundum is present in most of the heavy mineral concentrates from the stream sediments collected. The Empress deposit is covered almost entirely by overburden, that contains, at least locally, corundum.

The study of bulk samples collected from overburden is required to determine if there is coarse-grained corundum with gem potential. Assuming conclusive positive results of coarse fractions collected in 1997 but not yet processed, a systematic overburden and bedrock sampling program will be required. It is probable that "sugary" corundum will be widespread throughout the altered area shown on Figure 2 reflecting regional alteration, however the number of samples containing angular transparent corundum fragments, indicating gem potential, will be limited to immediate proximity of local coarse corundum sources.

As a by-product of this gemstone survey, the chemical analyses of -100 mesh fraction of panned mineral concentrate was successful in establishing that 7 litres samples are adequate, but larger samples are preferable for regional study in the Taseko Lake area. As expected the survey also detected the signature of the Au-Cu-Mo deposit in terms of metallic elements and more rigorous interpretation is in progress. Scheelite grains detected near the deposit, coinciding with the above background W content in samples not upgraded by heavy liquids came as a surprise. The source of the sheelite in the heavy sediments remains to be established. The methodology developed during this study could be used in exploration for gem-quality corundum in the Taseko Lake area, and with appropriate modification elsewhere.

DRAFT

Acknowledgement:

The manuscript benefited from reviews by Dr. David Lefebure and Dr. W. McMillan from B.C. Geological Survey. The SEM work was financed by Westpine Metals Ltd. and carried out at Carleton

University, Ottawa. Kirk D. Hancock formerly with B.C. Geological Survey helped in the collection of stream sediment samples and with on site pre-concentration. Heavy liquid separation was carried out by Cominco Ltd. Laboratory.

List of Figures

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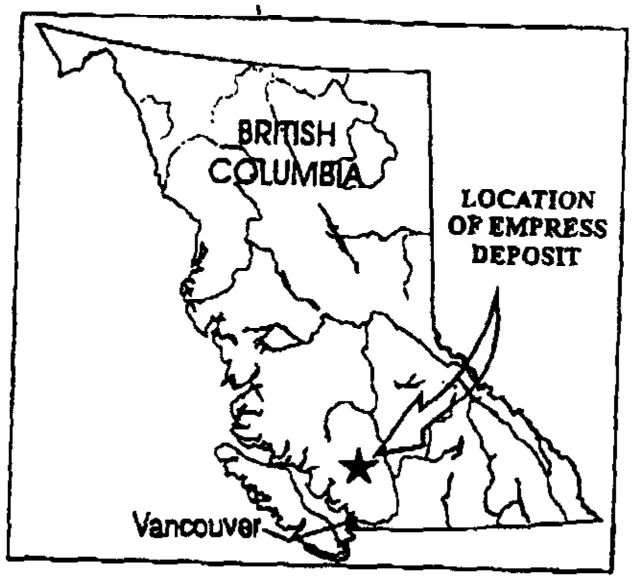

Figure 1: Location of the Empress Cu-Au-Mo deposit with an associated [illegible] occurrence.

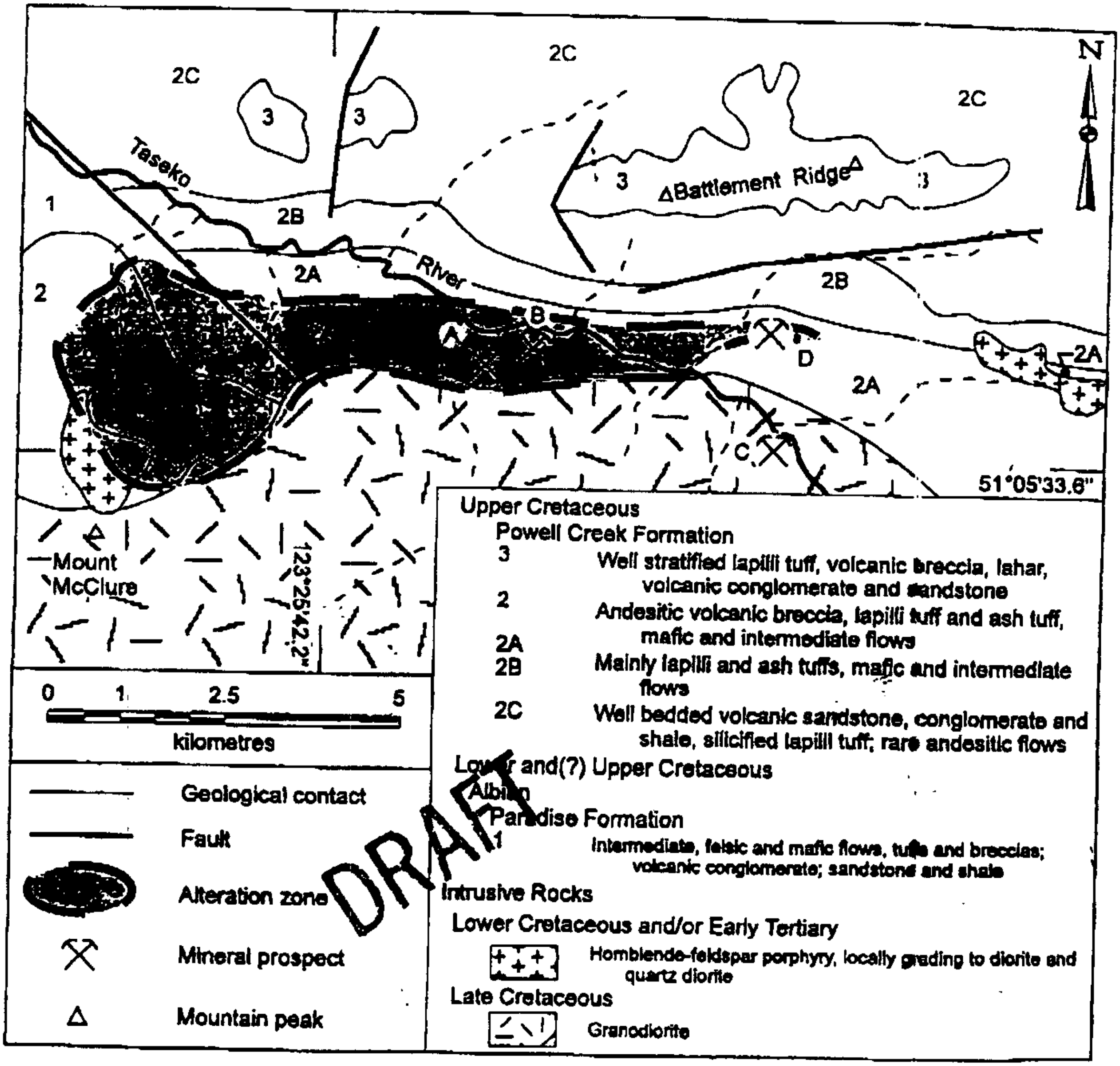

Figure 2: Geological setting of the Empress Cu-Au-Mo deposit with an associated corundum occurrence; modified from Schiariazza (1973).

Figure 3: Backscatter microphotograph of the corundum/rutile concentrate.

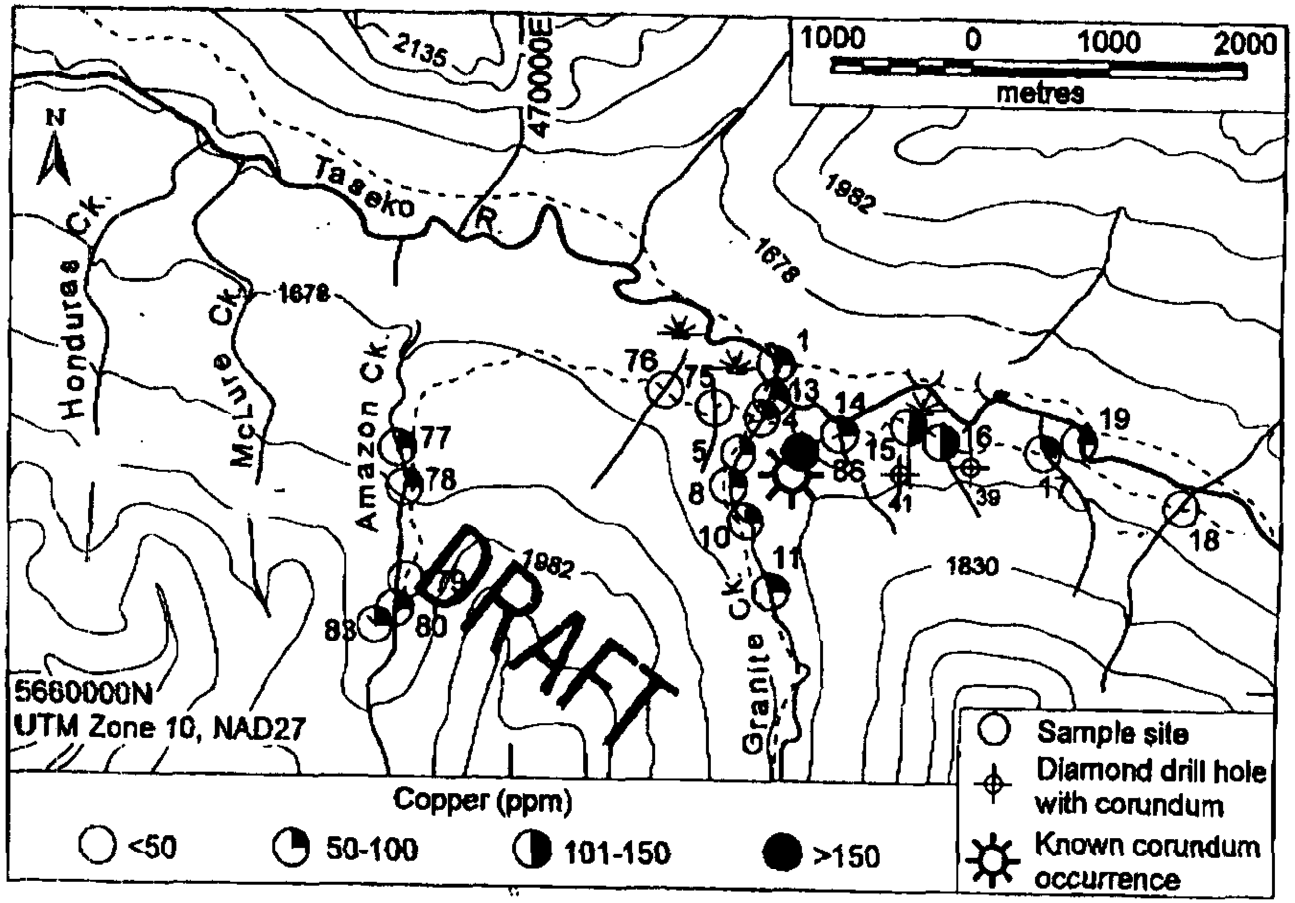

Figure 4a: Geographic distribution of samples, and summary of Cu concentrations in the heavy mineral fraction (-100 mesh size) produced by panning only, Empress deposit area.

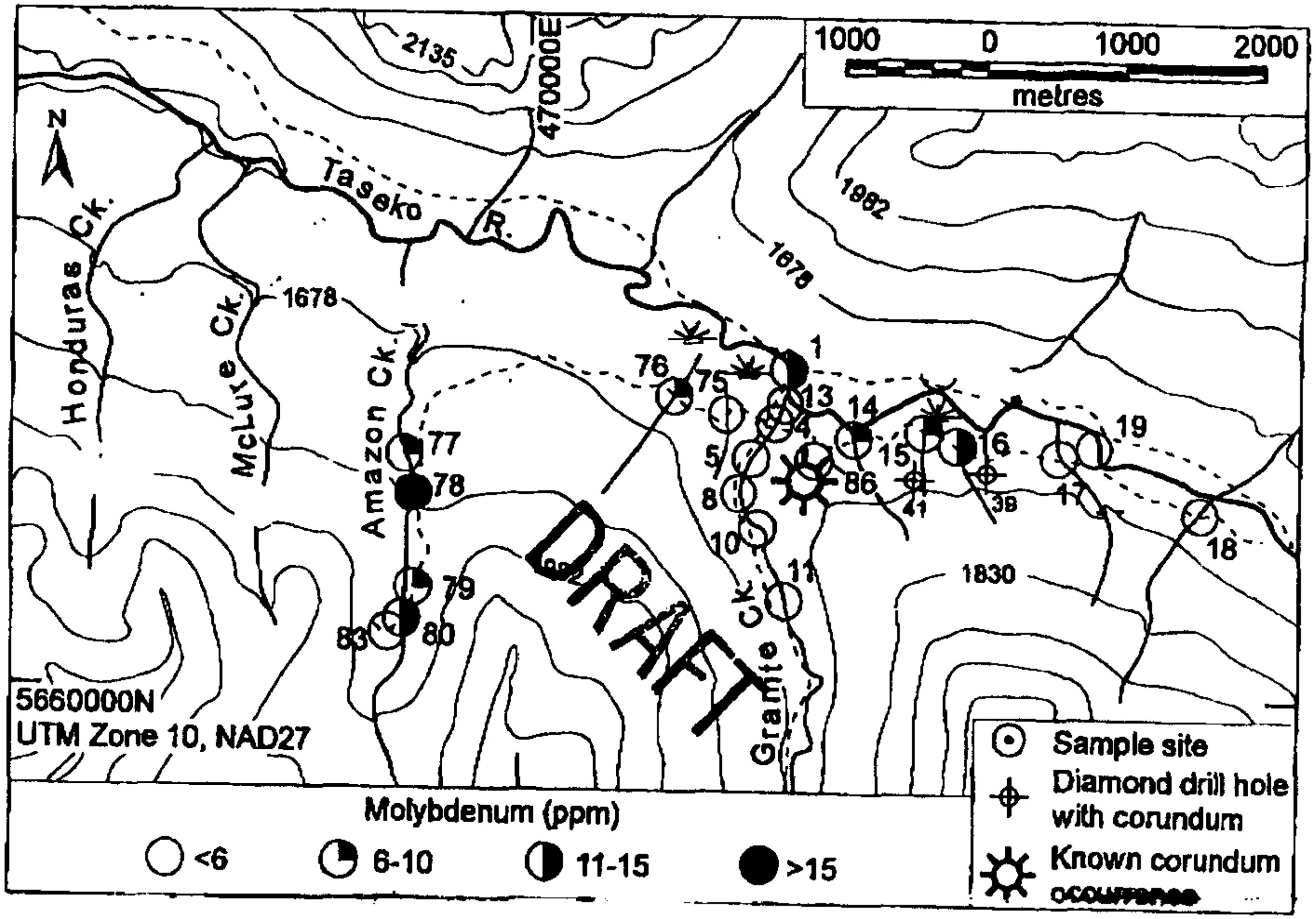

Figure 4b: Geographic distribution of samples, and summary of Mo in the heavy mineral fraction (-100 mesh) analysed was produced by panning only, Empress deposit area.

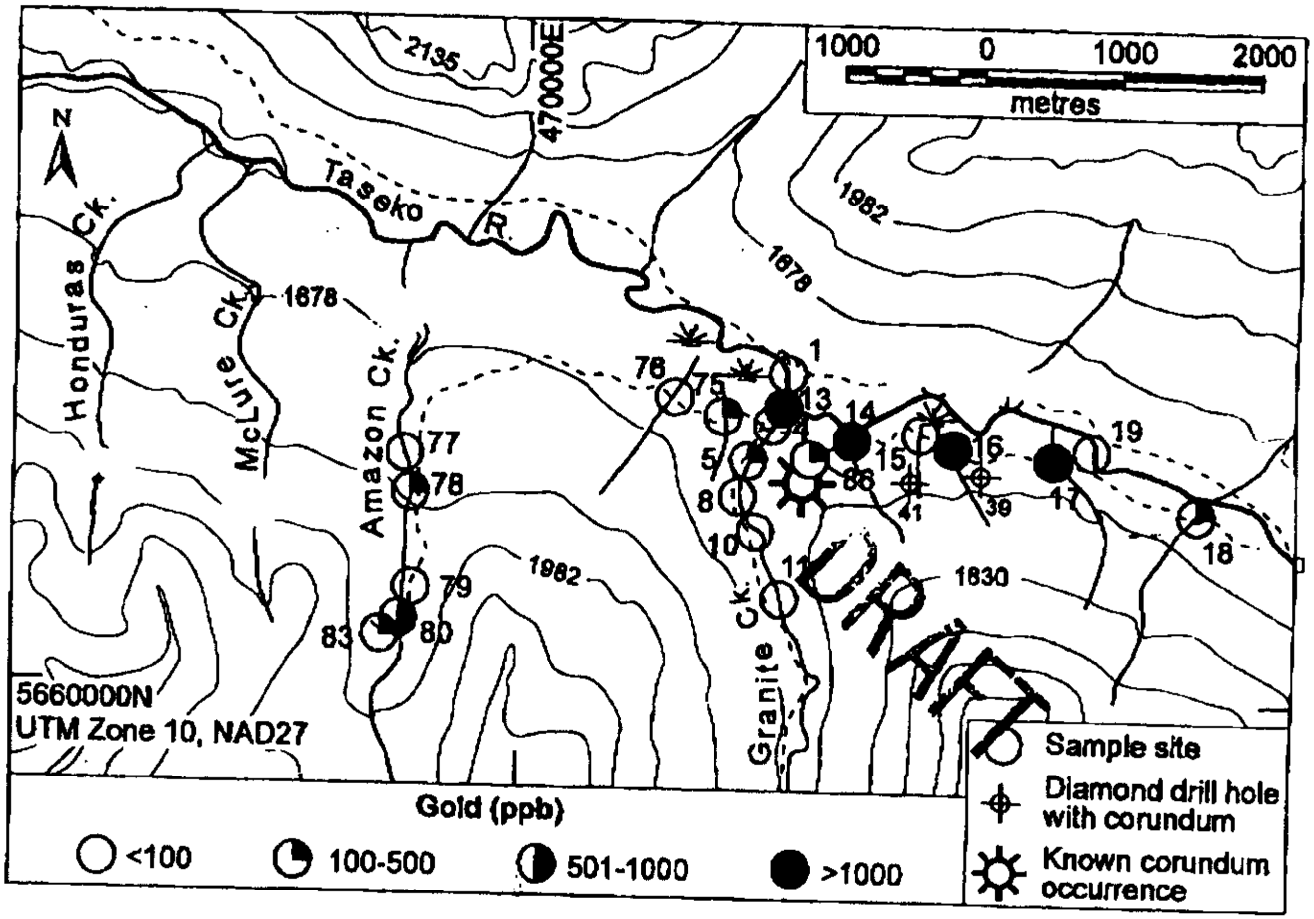

Figure 4c: Distribution of samples showing gold concentrations. Au in heavy mineral concentrates (pre-concentration by panning only, -100 mesh grain size), Empress deposit area.

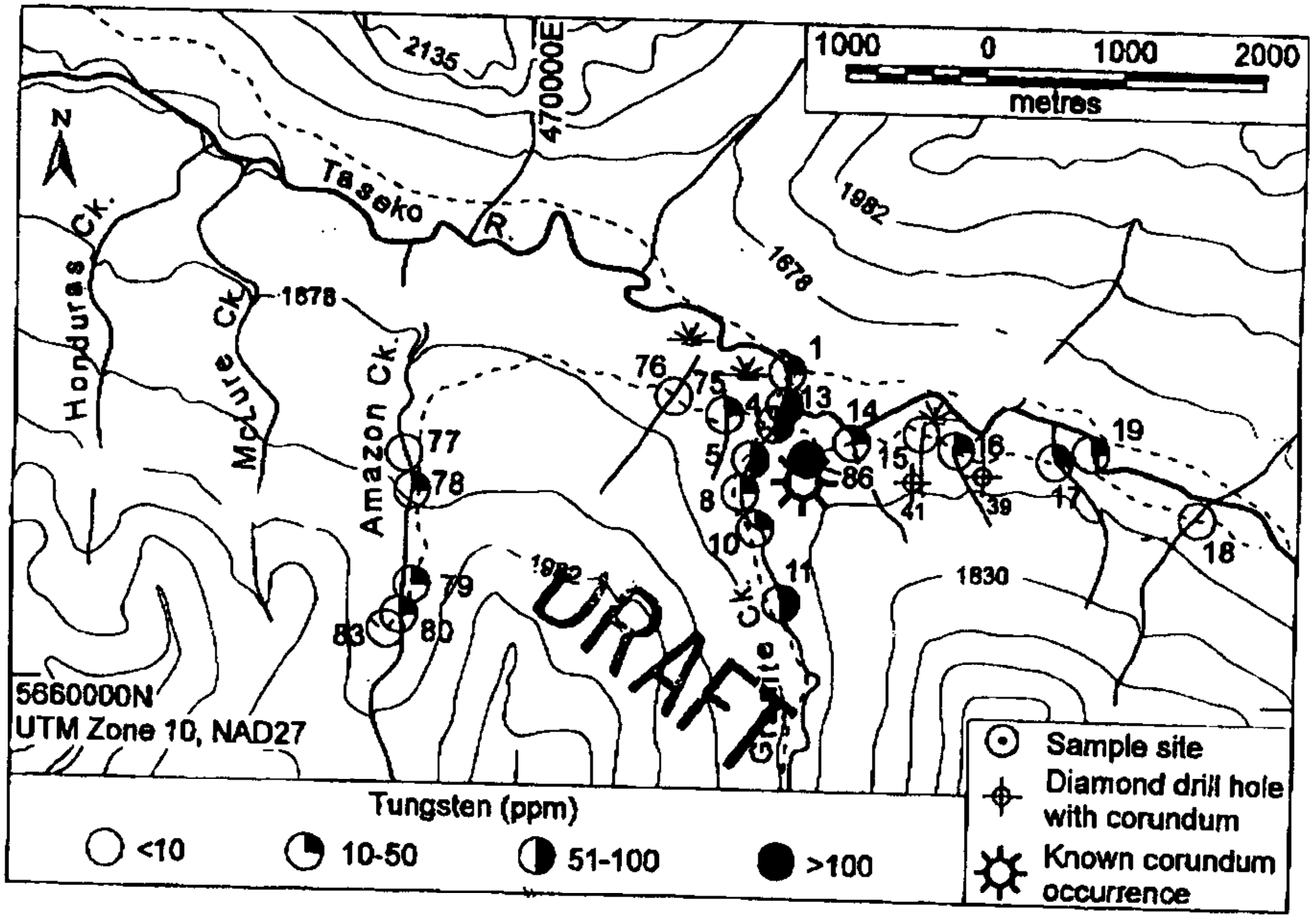

Figure 4d: Distribution of samples analysed for W. Heavy mineral concentrate (-100 mesh fraction) was produced by panning only), Empress deposit area.

4d

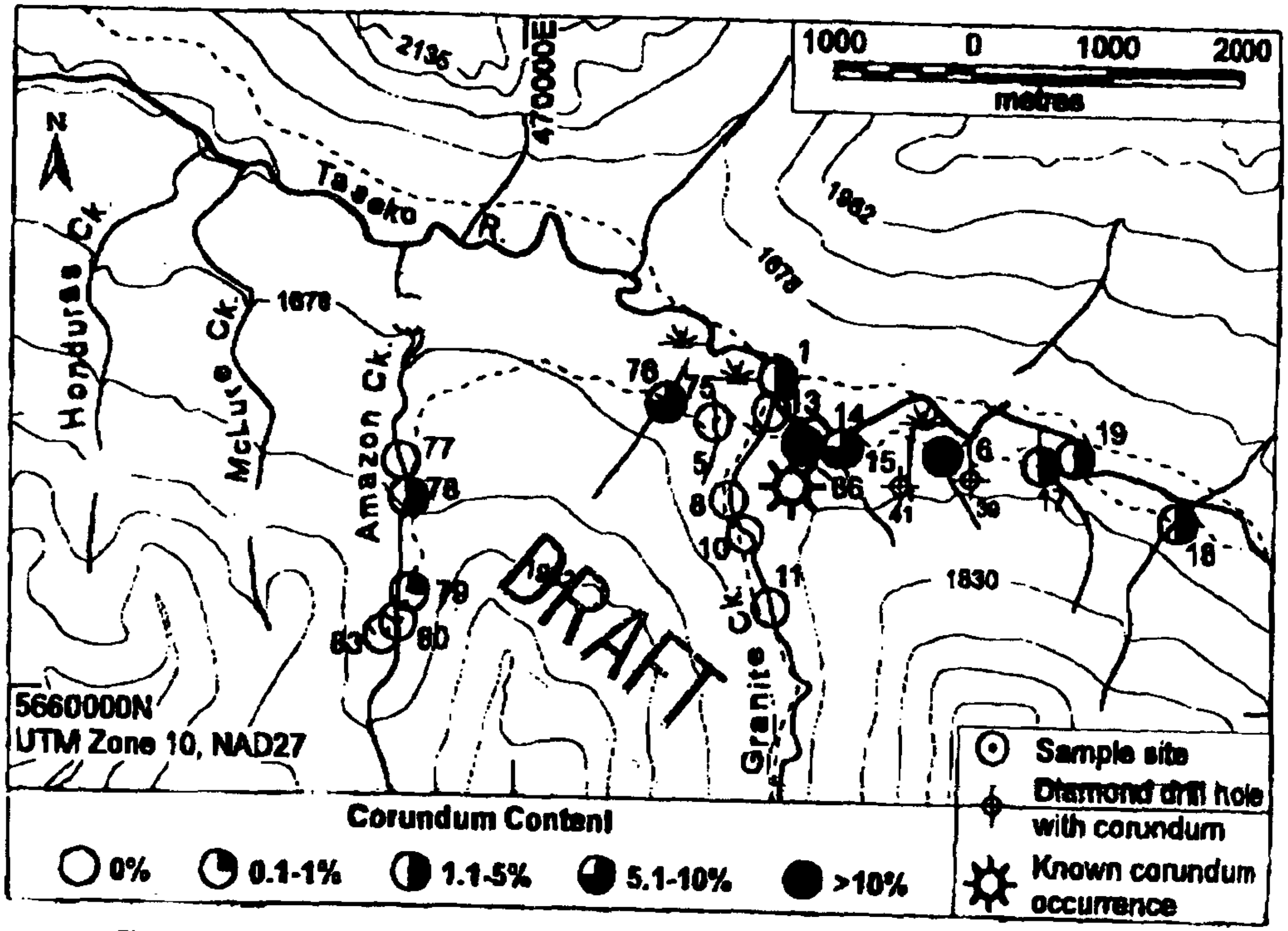

Figure 4e: Distribution of Corundum concentrations (pre-concentration by panning & heavy liquids); Empress deposit area.

Table 1: Trace element composition of heavy mineral concentrates (partially concentrated by panning only, no heavy liquids used)

Element	Au	44	As	Ba	Co	Cr	Cs	Mo	Sb	Cu	Pb	Ni	Mn	Fe*	Cd	Bi	V
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
Method	INA	INA	INA	INA	INA	INA	INA	INA	INA	TICP	TICP	TICP	TICP	TICP	TICP	TICP	TICP
Detection Limi	2	5	0.5	50	1	5	1	1	0.1	2	5	2	5	0.01	0.4	5	2
Field No.																	
TA96-1		<5	24	560	19	180	4	11	3.4	89	12	28	758	7.61	< .4	< 5	243
TA96-2																	
TA96-3																	294
TA96-4	10	<5	41	400	27	640	<1	<1	4	86	81	32	1113	12.1	2.2	< 5	449
TA96-5	170	<5	48	200	27	680	<1	<1	3.6	67	69	34	1172	15.1	< .4	< 5	582
TA96-8	<2	<5	30	480	15	260	2	<1	2.9	78	40	27	941	9.24	< .4	< 5	339
TA96-10	<2	<5	31	290	17	210	2	<1	3	68	38	20	823	5.32	0.8	< 5	183
TA96-11	14	<5	35	560	20	470	<1	4	3.4	63	46	28	1041	12.7	0.5	< 5	476
TA96-13	1360	<5	<5	<50	23	490	3	<1	3.5	77	60	33	1111	14.3	0.8	< 5	541
TA96-14	1860	<5	9.2	490	14	230	<1	6	2.2	68	< 5	23	427	8.41	< .4	< 5	335
TA96-15	18	<5	13	440	14	1[illegible]0	3	6	1.9	128	17	24	461	6.42	< 4	< 5	293
TA96-16	4850	<5	23	600	14	[illegible]10	[illegible]	15	3.1	122	18	23	484	7.53	< .4	< 5	288
TA96-17	1030	<5	16	480	9	120	[illegible]	<1	[illegible]	82	20	17	307	5.5	< .4	< 5	249
TA96-18	146	<5	19	440	14	300	[illegible]	[illegible]	3.4	[illegible]6	18	23	701	8.47	< .4	< 5	343
TA96-19	56	<5	32	590	18	150	4	[illegible]	4.6	77	16	20	618	6.62	< .4	< 5	197
TA96-75	460	<5	11	730	10	82	5	<1	[illegible]	35	21	18	591	5.05	1.7	< 5	177
TA96-76	<2	<5	15	450	13	140	2	9	3.1	39	58	20	614	7.07	1.3	< 5	277
TA96-77	71	<5	17	470	33	360	3	8	2.9	65	< 5	48	594	16.8	< 4	< 5	662
TA96-78	283	<5	21	450	56	610	2	22	3.4	64	25	71	750	24.8	< .4	< 5	982
TA96-79	11	<5	22	670	17	270	5	7	2.5	33	11	24	517	9.23	< .4	< 5	348
TA96-80	531	<5	21	100	40	620	4	12	3.4	63	13	59	771	22.3	0.9	< 5	1004
TA96-81																	
TA96-82																	
TA96-83	307	<5	22	<87	5	88	5	<3	1.5	53	7	5	116	42.4	< .4	< 5	120
TA96-84																	
TA96-86	285	<5	8.2	890	13	330	6	<1	4.1	209	20	21	291	9.03	< .4	< 5	328
Median	158		22	480	17.5	245	3	4	3.4	68	24	27.5	616	9.31	0.2		337
Mean	509		26	515	21.5	310	2.9	6.25	3.85	75.9	26.7	31.2	659	12.4	0.47		407
Std.dev	1012		17	335	12.8	188	1.61	[illegible]8.7	2	36.6	21.9	16.6	280	8.08	0.53		231

DRAFT

Table 2: Mineral composition of heavy mineral concentrates denser than 3.32 g/cm^3

Sample	Corundum	rutile	ilmenite	Fe oxides	epidote	cpx	opx	amph.	titanite	Al-Silicate	u. silicate	barite	scheelite	zircon	pyrite	cpy	allanite	
TA96-1	2.1	3.5	7.8	21.2	47.5	2.1	1.4	1.4	5.6	0.7	2.1				3.5			
TA95 2																		
TA96-3																		
TA96-4	0.5	0.5	2.8	10.3	68.5		4.7	4.2	5.1	1.4			0.5		1.4			
TA96-5		1.3	1.9	18	60	0.6	0.6	5.1	8.4					0.6	2.6		0.6	
TA96-8			1.4	13.4	69	0.7		4.2	8.3	0.7				0.7			0.7	
TA96-10			0.5	6.3	81	1.1		5.2	3.7	0.5			0.2	0.5	0.5			
TA96-11			1.3	7.2	75.1	0.6	0.8	7.8	3.9	0.6			0.3	0.6	1.9			
TA96-13			1.6	7.7	75.2	0.5	0.8	5.5	2.2	0.5			0.5		4.4		1.1	
TA96-14	8.5	14.4	8	22.5	23.1	8.6	2.3	2	2.3	0.5	0.6			0.8	4.6		0.6	
TA96-15	2.8	9.4	9.4	28.3	19.8	13.2	1.8	1.9	5.7	0.9	1.8				4.7		0.9	
TA96-16	32.4	14	9.6	35.1	0.8	1.7	0.8		2.8						2.6			
TA96-17	1.8	30.9	13.6	37.2	9	0.9		0.9	2.7	2.7								
TA96-18	4.5	8.3	14.3	41.9	9.8	11.6	0.9	1.8	1.3		1.8			1.8				
TA96-19	1.8	3	7.9	18.3	44.5	1.2	7.3	3.6	4.3	1.2	3	[illegible]			4.8			
TA96-75		6.1	9.9	23.7	33.6	10.7		0.8	6.8	0.8	1.1			0.8	3.4		0.8	
TA96-76	8.3	7.6	17.4	23.5	20.4	9.8	0.7	0.7	6	2.2					1.5			
TA96-77			12.6	34.2	2.7				6.3	4.5					38.7			
TA96-78	1.1	1.1	4.5	36.4		2.2			3.4	2.2	0.8				48.8			
TA96-79	0.8	6	12.8	37.6	4.3	26.5			6.8		1.4	0.8			0.8		0.8	
TA96-80		25.3	6.3	32.4	2.1	0.7		0.7	4.9	0.7	2.4				21.8		0.7	
TA96-81																		
TA96-82																		
TA96-83																		
TA96-84																		
TA96-85	37.1	51.5	1.8	0.6	0.6	0.6	0.3	0.5	1.2	2.4	0.6				1.2		0.6	