

LOG NO:	NOV 25 1993 RD.
ACTION:	
FILE NO:	

ASSESSMENT REPORT  
ON THE 1993  
GEOLOGICAL AND GEOCHEMICAL SURVEYS OF THE JEAN PROPERTY  
NATION LAKES AREA, B.C.

OMINECA M. D.

LATITUDE: 55 05' NORTH

LONGITUDE: 124 56' WEST

N.T.S. 93N/2W

BY

RAGNAR U. BRUASET B.Sc.

BURNABY B.C.

REPORT: November 03, 1993

FIELD WORK DONE: July 12, 13, 1993

CLAIMS ON WHICH WORK WAS DONE:



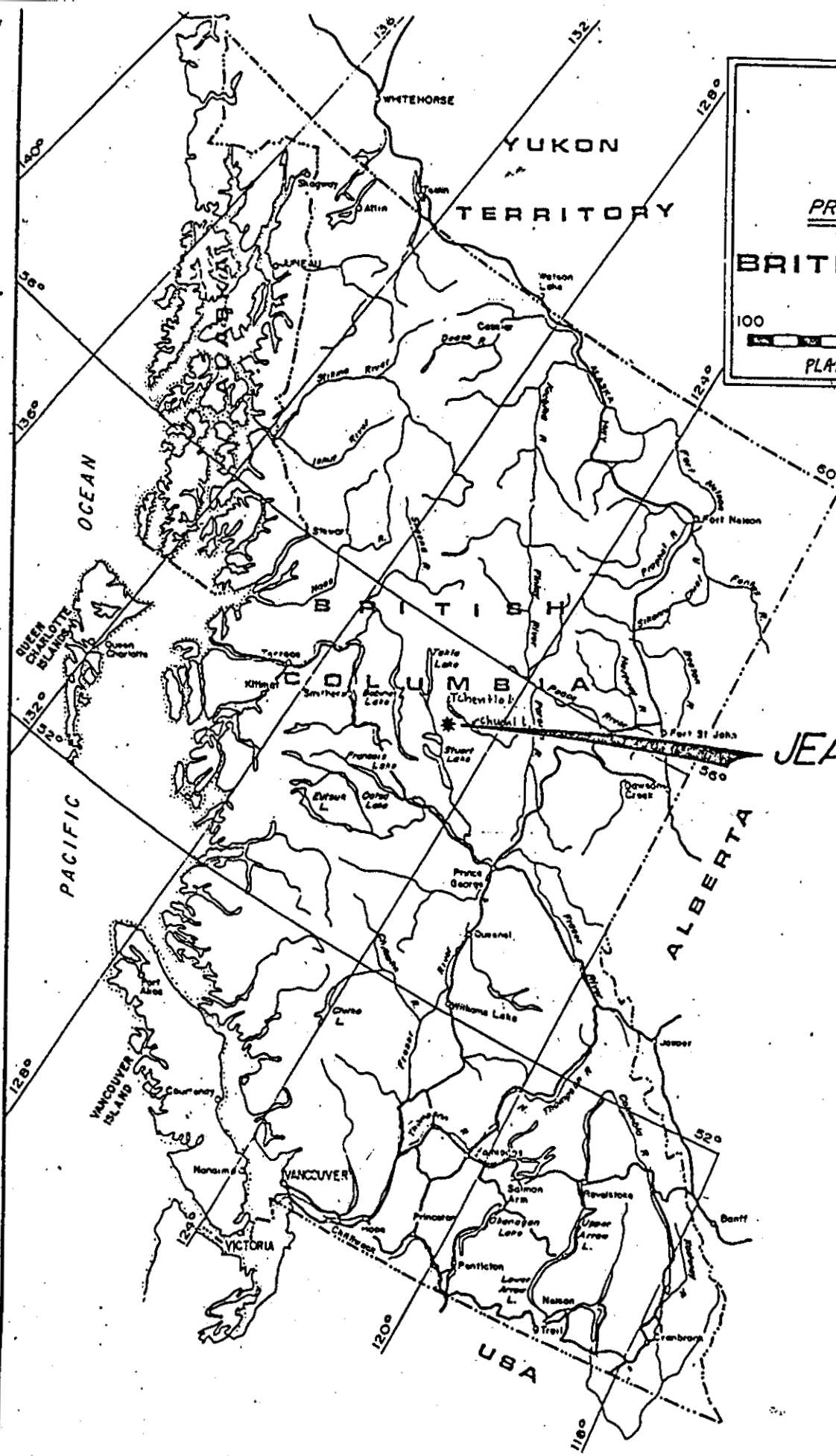
Claim	Units	Tenure Nos.	Month of Record
JW 100	6	303956	September
JW 109	1	312220	August
JW 110	1	312221	August
JW 112	1	312229	August
JW 114	1	312223	August
JW 115	1	312224	August
JW 117	1	312226	August
JW 137	1	89071	August
JW 140	1	89074	June

**GEOLOGICAL BRANCH**  
**ASSESSMENT REPORT**  
**23,118**

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PROPERTY LOCATION

**BRITISH COLUMBIA**

MILES

100 0 100M; 200

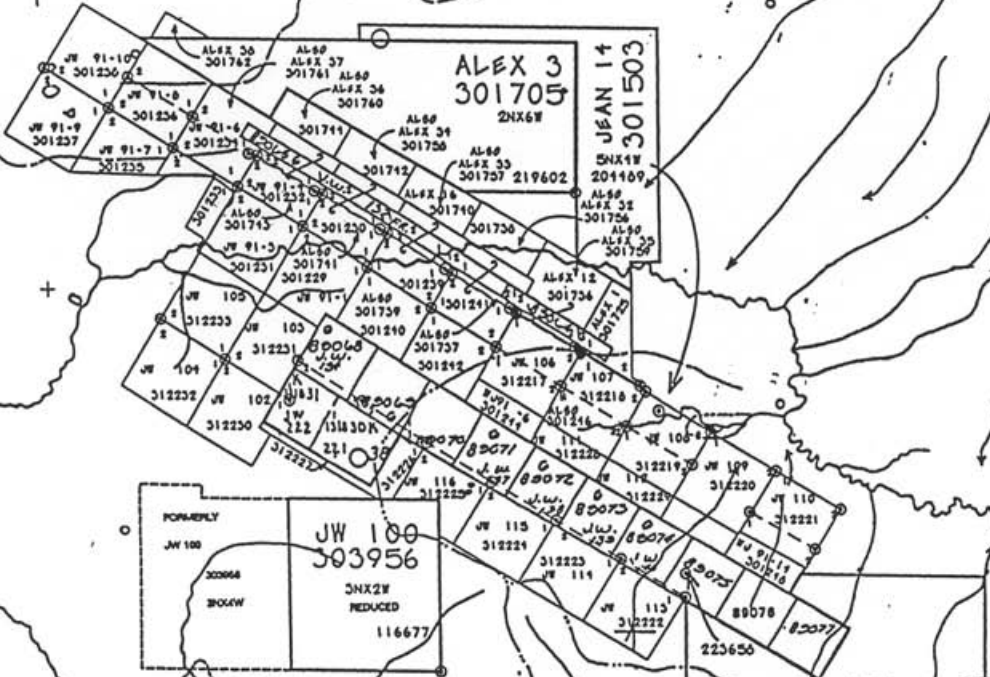
160Km

PLATE: J 92-1

*JEAN*

PHIL 20  
6488 (7)  
4N x 5W

MT. ALEXAN



FORMI  
JEAN  
1088'  
4N

REDUCED  
JEAN  
7  
241030  
10667'  
2N x 5W

JE.  
108'  
4N

MARIE 3  
9193 (11)  
5N x 4W

October 1913

## SUMMARY

The Jean property is a porphyry copper-molybdenum prospect with gold potential situated on the southern contact of the Jean Marie stock, an intrusive outlier of the southern Hogem batholith located about 6 km south of Tchentlo Lake, Nation Lakes area, northcentral B. C.

Fracture controlled and disseminated pyrite, chalcopyrite and molybdenite occur in several mineralized zones situated astride the faulted contact of the E. Cretaceous Jean Marie stock with the Upper Triassic volcanics of the Takla Group. This batholith is zoned with its core consisting of granodiorite and its margins of diorite and quartz diorite. While the principal rocks are of calc-alkaline composition, monzonitic dykes occur in some of the mineralized areas where they may contain heavy chalcopyrite and be geochemically anomalous in gold. The volcanic rocks consist of andesite flows and pyroclastics.

The present Jean property is a partial relocation of a former N.B.C. Syndicate property with the same name. That syndicate was comprised of Cominco, Duval, Granby and Noranda at different times, Conwest and Chevron as well as a prospecting group, notably Messrs. C.J. Stephen, W. Bacon and Jack Crowhurst. From the time of initial interest in 1969 as a result of the geochemical work of Mr. Stephen through the last geochemical program in 1983, the Jean property underwent substantial programs of soil geochemistry, geological mapping, IP, road building and testing variously by diamond and percussion drilling. The author was intimately involved in all phases of work on the Jean during the years 1973 through 1979. Together with David L. Cooke he commissioned the re-staking of the key portion of the property following its abandonment in 1991.

B. C. Assessment reports 2241, 2242, 3899, 4774, 5343, 5590, 5633, 5737, 6948 comprise most of the readily available public data from the N.B.C. Syndicate period. This data deals mostly with IP but including data from geochemical surveys and drilling. The present owners submitted an assessment report dealing with mapping and biogeochemistry in 1991 (Cooke and Bruaset, 1992). The current report describes the most recent sampling and mapping which extends the geological and biogeochemical coverage to the south west from the main 1970 soil anomaly.

Rock sampling in 1991 in the principal mineralized areas in the western portions of the property gave gold values to 945 ppb in association with copper mineralization (Cooke, Bruaset, 1992). The objective of the current owners is to locate undiscovered areas of copper-gold porphyry deposition.

## INTRODUCTION

The Jean property was discovered in the late 1960.s by the N. B. C. Syndicate which was organized by W. Bacon and J. Crowhurst, two well known local consultants at that time. A group of majors financed exploration over a period of 14 years up to 1983 after which the claims became dormant, and remained so, until forfeiture or sale in 1991.

The objective of this season's work was to determine the effectiveness of biogeochemical sampling in the exploration for copper and gold deposits in the eastern and southeastern property areas. Biogeochemical sampling directed at gold had been conducted in the western property area in 1991 with limited encouragement (Cooke, Bruaset 1992). A pilot program designed to test the effectiveness of copper determination on conifer outer barks was carried out on available samples. This study indicated that the more prominent copper soil anomalies of the 1970 era also had corresponding anomalous biogeochemical expressions. Field work in 1993 extended the biogeochemical data base southwest from the unusually strong copper-molybdenum soil anomaly situated in the area of JW 109 and 110. This soil anomaly had been extensively tested by diamond drilling in 1970, generally prior to being surveyed by IP. The source of this transported anomaly remains unresolved inspite of extensive IP surveying of the southern contact area. The results of the biogeochemical work are discussed in Part 2 of this report. The previous geochemical surveys on the subject claims had largely been confined to the contact area.

## THE 1993 EXPLORATION PROGRAM

The author operated out of a camp on the Inzana Lake logging road about 10 km south of the Jean claims. He reached the property by means of a motor-bike ride (6 km) and walking (5 km) along a series of overgrown logging roads and through re-planted cut-blocks. The first part of this report discusses geological mapping conducted in the course of the biogeochemical survey. Few outcrops occur in the survey area. The cost of the program is hereby submitted for assessment credits.

## LOCATION, ACCESS, PHYSIOGRAPHY

The Jean property is situated near the headwaters of Jean Marie Creek.

Land access is via about 100 km of logging roads northwesterly from Fort St. James in north-central B. C. Miscellaneous logging roads, now extensively reclaimed or overgrown, occur in the broad valley of the Pinchi Fault zone to the south of the Jean Marie stock.

The property is characterized by gently rolling hills with elevations ranging from about 975m to 1597m. Maximum relief (450m) occurs in the NE part of JW 101 M.C. Typical forest cover consists of white spruce, balsam fir and lodgepole pine. No logging has yet taken place on the property.

Physiographically, the property is located in the northern portion of the division known as the Nechako Lowland (GSC map 1701A).

#### PROPERTY AND OWNERSHIP

The property consists of 46 claims totalling 66 units. A claim list is attached. The property is owned equally by Cooke and Bruaset.

#### REGIONAL GEOLOGY

The Jean Property occurs in a belt of largely Upper Triassic volcanic rocks and coeval intrusions bounded by highly deformed Proterozoic and Paleozoic strata to the east and deformed Upper Paleozoic strata to the west. This belt now considered a part of the Quesnellia Terrane extends southeasterly into southern B.C. and northwesterly into the Yukon. This is the most productive copper belt in B. C. and is widely known in pre-terranic terminology as the Quesnel Trough. Alkaline and calc-alkaline porphyry camps such as Nation Lakes (Mt. Milligan, Jean deposits), Quesnel River (Mt. Polly, QR deposits), Iron Mask (Afton, Ajax deposits), Highland Valley (Bethlehem Copper, Lornex, Valley Copper, J-A deposits), Copper Mtn. (Copper Mtn., Ingerbelle deposits), Hogem Batholith (Lorraine deposit), as well as the Toodaggone Camp (El Condor's Kemess North and Kemess South deposits) all occur, at least partly in rocks of the Upper Triassic island arc volcanic assemblage known regionally as the Takla and Nicola Groups and widely referred to as the Quesnel trough.

The Jean stock is the southern most outlier of the Southern Hogem batholith. It is located about 10 km east of the Pinchi Fault; a fault of regional extent paralleling the western contact of the Hogem batholith and separating the Upper Triassic Takla Group from the Cache Creek Terrane to the west. A hornblende date for Jean granodiorite is  $131 \pm 4$  Ma (Garnett, 1978). This is comparable to the age of mineralization of the Endako molybdenum system. There mineralization is dated at about 135 Ma (K. Dawson, pers. comm.)

JEAN CLAIM LIST

NTS 93 N/2W

CLAIM	RECORD No.	TENURE No.	UNITS
JW 131FR	245031	89064	1
132FR	32	89065	1
134	33	89068	1
135	34	89069	1
136	35	89070	1
137	36	89071	1
138	37	89072	1
139	38	89073	1
140	39	89074	1
141	40	89075	1
142	41	89076	1
143	245042	89077	1
221	245950	131830	1
222	245951	131831	1
JW 91-1		301229	1
2		30	1
3		31	1
4		32	1
5		33	1
6		34	1
WJ 91-1		301239	1
2		40	1
3		41	1
4		42	1
6		44	1
8		46	1
14		301248	1
JW 100		303956	6
JW 101		312234	16
102		312230	1
103		231	1
104		232	1
105		233	1
106		312217	1
107		218	1
108		219	1
109		220	1
110		221	1
111		312228	1
112		229	1
113		312222	1
114		223	1
115		224	1
JW 116		225	1



JEAN PROPERTY

CLAIM LIST p.2 of 2

117	226	1
JW 118	227	1
	---	-----
TOTAL ABOVE	46	66 units

## PROPERTY GEOLOGY AND MINERALIZATION

A description of the geology and mineralization of the Jean property is provided in Cooke and Bruaset, 1992 PART 1. The mapping that formed the basis of that report was done on the Jean Property as it existed in 1991. Since then, the property has been enlarged in the southeasterly and southerly directions. During the course of this season's biogeochemical sampling we encountered a few outcrops in the southeastern property area. A few specimens were collected for slabbing, etching and staining (Appendix 2).

The property geology description of Cooke (Cooke, Bruaset, 1992) is as follows:

" The Jean property covers the southwest portion of the Jean Marie stock and adjacent Takla volcanic rocks (Figure 4). The stock consists mainly of granodiorite and diorite. Locally both intrusives and volcanic rocks are intruded by monzonite dikes along the northwest trending contact between volcanic and intrusive rocks. The intruded Takla volcanic rocks consist of dark augite andesite flows, green lapilli tuff, and minor agglomerate.

Adjacent to the intrusion, the volcanic rocks are altered to a brownish hornfels. Locally the volcanic rocks have been dioritized or converted to a black biotite-rich rock or green epidote-garnet-calcite skarn. Hydrothermal activity is accompanied by quartz, pyrite, chalcopyrite and molybdenite as disseminations within the intrusions, and as fracture-fillings within the volcanic rocks along the northwest trending contact area.

The contact area between the volcanic and intrusive rocks is marked by a major fault structure and moderate to abundant amounts of sulphides. Drilling so far indicates three zones of copper and molybdenum mineralization within the contact area. Two of these zones occur on the Jean property (1993 NOTE: as it was known in 1991). These zones straddle the northwest trending contact area and are separated by a single low grade drill hole. Further drilling will be required to determine if these zones are a part of a single mineralized body.

Rock sampling of a monzonite porphyry dike on the southwest flanks of the A zone (the most westerly area of percussion drilling on Plate 3) returned good copper grades and associated gold values (Appendix III). Values range from 39 to 945 ppb gold. Assays of altered and sulphide-mineralized volcanic rock returned lower, yet weakly, anomalous gold values. "

Mapping carried out by Bruaset in 1973 and 1974 while employed by Cominco on behalf of the N.B.C Syndicate extended the geological mapping to the eastern limits of the current claims. The current

owners acquired Chevron's data on the original N.B.C. Syndicate Jean property with the purchase of the last Syndicate claims in 1991.

Our 1993 survey encountered a few outcrops in the southeastern property area. These consist of non-magnetic lithic tuff including very subordinate biotite crystal fragments. Several of these outcrops of Upper Triassic Takla Group contain coarse fragments in the range 3 to 3.5 inches indicating volcanic breccia. Weak potassic alteration in the form of potash feldspar (2 and 5%) occur in hairline fractures and as replacement in the groundmass of the tuff. Traces of pyrite and chalcopyrite were found in these outcrops. Potash in this form and biotite are considered possible source of potash enrichment in conifer outer bark.

#### CONCLUSIONS

K-feldspathization of the rocks in the map area suggest the need for a broader geological coverage to the north and south. This data should be viewed in light of past diamond drilling result and IP.

Report by:

Ragnar U. Bruaset & Associates Ltd.

  
Ragnar U. Bruaset, B.Sc.

Endorsed by:

  
David L. Cooke, Ph.D., P. Eng.

November 03, 1993

REFERENCES

- Cooke, D. L., Bruaset, R. U. (1992) 1991 ASSESSMENT REPORT ON JW  
AND WJ AND JW CLAIMS.  
2 parts: geology, biogeochemistry
- Garnett, J. A., 1978      Geology and Mineral Occurrences of the  
Southern Hogem Batholith  
B. C. M. M. P. Bull. 70

APPENDIX 2

DESCRIPTION OF ROCK SAMPLES

In the course of the bark sampling we obtained three hand specimens from a total of two outcrop areas. The specimens were slabbed on a diamond saw with cut surfaces etched in hydrofluoric acid and stained in sodium cobaltinitrite to reveal K-spar.

SAMPLE

J-93-7 1 of 2

Lithic tuff with very subordinate crystals  
-----

The sample consists mainly of volcanic rock fragments ranging from 0.5 mm to 1 mm. Traces (0.1 %) biotite. Non-magnetic to pencil-magnet. Staining reveals about 5 % K-spar in the ground mass.

J-93-7 2 of 2

Lithic tuff with very subordinate crystals  
-----

Similar to J-93-7 1 of 2 except 2 % K. Non-magnetic. Moderate limonite developed along fractures, including cubic boxwork containing trace pyrite and chalcopyrite. Shear fabric strongly developed.

J-93-10

Lithic tuff with very subordinate crystal

Similar to the above. Rock fragments predominantly < 1 mm. Rare biotite crystal fragments. Moderately strong limonite development along fractures. Crackle brecciation. Minor calcite in fractures.

APPENDIX 1

STATEMENT OF QUALIFICATIONS

I certify that:

1. I am a 1967 graduate of the University of British Columbia with a B. Sc. degree in geology. I am a Member of The Association of Exploration Geochemists and the Society of Economic Geologists.
2. I have practiced my profession as an exploration geologist from 1967 to the present.
3. This report is based on biogeochemical sampling and geological mapping carried out by myself under the direction of D. L. Cooke Ph.D., P. Eng. I have conducted biogeochemical surveys on clients' properties as well as on my wholly or partly owned properties since 1989.
4. I am the author of this report.
5. I participated in geological, geochemical, diamond and percussion drilling and major access developing programs on the former N. B. C. Syndicate Jean property during all programs carried out between 1973 and 1981 namely programs of: 1973, 74, 75, 77, 78 and 79 in the capacity of party chief.



-----  
Ragnar U. Bruaset B. Sc.  
November 3, 1993

PART 2

BIOGEOCHEMICAL REPORT

JEAN PROPERTY

NOV. 1993

IMPORTANT NOTE:

ALL BIOGEOCHEMICAL data IN THIS REPORT ARE EXPRESSED AS "DRY WEIGHT VALUES", i. e. THE ACTUAL ELEMENTAL CONCENTRATIONS, unless otherwise indicated. COPPER VALUES PLOTTED ON PLATE 3 ARE THE ASH WEIGHT EQUIVALENTS WHICH ARE APPROXIMATELY EQUAL TO THE DRY WEIGHT VALUES MULTIPLIED BY THE CONCENTRATION FACTOR 50. THE SAME CONVERSION IS APPLICABLE TO THE OTHER ELEMENTS IN THE DATA. CONVERSION IS RECOMMENDED TO READERS WHO ARE MOST FAMILIAR WITH CONCENTRATIONS IN THE ASH (ASH VALUES).

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## SUMMARY

The western portion of Jean porphyry Cu-Mo-Au prospect underwent first-time reconnaissance biogeochemical sampling in 1991 with conifer outer bark as the sampling media (Cooke, 1992). The objective of that program was to indicate areas of gold enrichment in the vegetation which could be indicative of near surface gold potential. The survey indicated normal levels of gold based on Dunn's common concentrations (Dunn, 1991).

Claims acquired by staking in 1992 to the east and south of the ground surveyed in 1991 underwent biogeochemical sampling in 1993. Interesting anomalies in copper, gold, and potassium are indicated in conifer outer bark in the 1992 acquisitions.

## INTRODUCTION

A soil survey by the N.B.C. Syndicate in 1970 on the original Jean property had indicated a large coincident Cu-Mo anomaly in the general northeastern part of the present property (Plate 3). This soil anomaly was unsuccessfully tested with a ten-hole diamond drilling program in 1971. Subsequent re-sampling did confirm the anomaly but the source remains unknown. Ensuing exploration programs become polarized on certain IP anomalies within a strong sulphide system located in the western parts of the present property. After pursuing this area vigorously for two years, new target definition became the priority. The Syndicate continued in that direction with modest budgets for several years. Further development was suspended pending access development from the south. Individuals who had been the driving force became disassociated with the project. The unusually widely disbursed ownership of the property, with the largest position at 22%, was unattractive to any major and was probably the principal reason for the abandonment of the property in 1991.

In 1993, we analyzed the available bark samples for copper in order to assess the effectiveness of biogeochemistry in tracking the illusive source of the 1970 copper soil anomaly. The author had obtained a reference suite of conifer outer barks from the Mt. Milligan deposits in 1989. This provided some general indication of the copper concentration in bark which might be considered anomalous on the Jean, the general character of the vegetation in both areas being the same. These preliminary analyses indicated increasing copper responses easterly in the direction of the 1970 copper soil anomaly. On the strength of this, we decided to extend the biogeochemical coverage to the SW of this anomaly into areas that had received little, or no, attention during the N. B. C. era.

A substantial area of copper enriched vegetation is now indicated in the 1993 survey area, including anomalies in gold and potassium. There is good basis to continue with this type of sampling in order to define these anomalies more accurately.

TABLE 1. p. 1 of 3

SUMMARY OF BARK RESULTS FROM JEAN PROPERTY BASED ON 1993 SAMPLING  
A L L D A T A E X P R E S S E D A S D R Y W E I G H T S

ELEMENT AND			COMMON CONC. IN OUTER BARK FROM			CU BY A.A. AND INAA DATA FROM JW 100,109,110,111,112,114,115 117,137,140 LAB. 5352BB,5352CC		
DETECT. LIMIT			C. DUNN, 1991 (ref. current Table 2)			D L **:		
(values are dry weight equivalents i.e. Dunn's values divided by 50			SPRUCE			LODGE-POLE		
ppm, except where otherwise indicated (n=hundreds of analyses			PINE			except as shown		
			(n=18)			(n=5)		
			{ number of values at, or above Dunn's common concentration)					
Ag	.1	<0.1	<0.1	.3	<.3	<.3	{0}	{0}
As	.01	.04-.08	.08-.16	.01	.06-.26	.10-.12	{10}	{0}
Au	.1	.1-.3	.2-.4 ppb	.05 ppb	.14-.70 ppb	.30-.52 ppb	{9}	{4}
Ba	3	60-100	10-20	5	51-350	20-58	{13}	{5}
Br	.01	2.4-4.8*	.8-4.0 *	.01	2.4-7.4	3.7-6.7	{7}	{5}
Ca	.01	.5-.7	.3-.6 %	.01%	.77-1.59 %	.38-.90 %	{18}	{3}
Co	.02	.1-.2	.1-.2	.1	<.1-.3	.2-.3	{9}	{5}
Cr	.04	.2-.4	.2-.6	.3	<.3-0.5	<.3-.4	{2}	{0}
Cs	.01	.02-.06	.04-.08	.05	<.05-.27	.08-.58	{12}	{5}
Fe	.0004%	.004-.03%	.01 -.04 %	.005 %	<.005-.016%	<.005-.009%	{0}	{0}
Hf	.02	<.02	.02-.04	.05	<.05-.06	<.05	{1}	{0}
Mo	.05	<.05	<.05	.05	<.05-.09	<.05-.05	{4}	{0}
Na	2	highly	variable	.5	12.4-64.6	18.9-40.0	{ND}	{ND}

TABLE 1. p.2 of 3

Ni	4	<4	<4	5	<5 {0}	<5 {0}
Rb	.4	1-2	1-3	1	<1-8 {16}	1-3 {3}
Sb	.004	.01-.03	.02-.08	.005	<.005-.046 {1}	.015-.025 {0}
Sc	.002	.02-.06	.04-.08	.01	<.01-.03 {1}	.01-.03 {0}
Se	.06	<.06	<.06	.1	<.1 -0.1 {1}	<.1 {-}
Sr	10	10-30	<10-20	10	18-64 {14}	<10-22 {1}
Ta	.02	<.02	<.02	.05	<.05-0.05 {-}	<.05 {_}
Th	.01	.02-.04	.02-.06	.1	<.1 {-}	<.1 {-}
U	.01	.01-.02	.01-.04	.01	<.01-0.04 {1}	<.01 {0}
W	.02	<.02	<.02	.05	<.05-.06 {1}	<.05 {-}
Zn	.4	20-40	20-40	2.0	43-120 {18}	34-45 {2}
La	.01	.08-.16	.08-.24	.01	.02-.15 {0}	.04-.07 {0}
Ce	.06	.12-.24	.2-.4	.1	<.1-.2 {0}	<.1 {0}
Nd	.1	<.1	.1-.2	.3	<.3 {0}	<.3 {0}
Sm	.002	.01-.03	.02-.04	.001	.002-.016 {0}	.005-0.009 {0}
Eu	.01	<.01	.01-.02	.05	<.05 {0}	<.05 {0}
Yb	.004	.004-.012	.006-.02	.005	<.005-.006 {0}	<.005 {0}
Lu	.001	.001-.002	.001-.003	.001	<.001-.002 {1}	<.001 {0}
No data in Dunn's table ; reference data from Dunn pers. comm. :						
Hg	.05	<.05	<.05	.05	.10-.39 {18}	.14-.19 {5}
Cu		N/D	N/D		4.2-7.4	3.8-5.7

Mics. data available in ACT. LAB. Certs. 5352 BB, CC. No Dunn references provided for the following:

Ir				.1	<.1	<.1
Tb				.1	<.1	<.1
K%				.001%	.085-.334%	.080-.102%

TABLE 1. p.3 of 3

\* Br values corrected for losses in the order of 75% due to ashing

\*\* Ref. to general specs. on INAA DETECT. LIMITS.

NOTES RE. DETECTION LIMIT DIFFERENCES BETWEEN DATA FROM DUNN, 1991, AND RPT. 5352. For some of the elements, such as Co, Cr, Fe, Sc and Zn the difference in detection limit between the two sets of data is a reflection of the overall background in the counting laboratory. This background is created in part by the permanent sample storage (in concrete) which is located in the order of 70 feet from the counting facility. This illustrated the extreme sensitivity of the analytic method. In other instances, such as for silver, the detection limit given (0.1) is somewhat tenuous, or difficult to reproduce. It is stated that the lab. is more comfortable with 0.3. (Dr. E. Hoffman, Activation Laboratories Ltd. pers. comm.).

The reference data on elemental abundances from Dunn, 1991 appears in his publications at least as far back as 1985. His determinations were obtained from Nuclear Activation Services Ltd.

The detection limits given by Activation Laboratories Ltd. are those THEY are comfortable with presently. Obviously, it is highly desirable to have meaningful AND low detection limits with values that are to be assigned to an anomalous category being at least several times higher than the detection limit. To illustrate, in the case of gold in lodgepole pine outer bark, we are finding that values at least as low as 0.4 ppb can be clearly related to significant gold mineralization as determined by rock sampling of nearby mineralized outcrop. Such values at 8 X the detection limit of 0.05 ppb are obviously analytically significant. There is also evidence that still lower values for gold in conifer outer bark, such as 0.3 ppb, may also be indicative of significant gold mineralization.

TABLE 2  
(from Dunn, 1991)

Dry weight equivalents = table values for ①, ② divided by 50.

Element	Detection Limits	Common Concentrations in Ash		
		Alder Twig	Outer Bark Scales	
			Spruce (1)	Jack Pine (2)
Ag	5 ppm		<5	
As	0.5 ppm	<5 - 1	2 - 4	4 - 8
Au	5 ppb	10 - 20	5 - 15	10 - 20
Ba	150 ppm	1000 - 3000	3000 - 5000	500 - 1000
Br <sup>2</sup>	0.5 ppm	20 - 40	30 - 60	10 - 50
Ca	0.5%	15 - 25	25 - 35	15 - 30
Co	1 ppm	5 - 20	5 - 10	5 - 10
Cr	2 ppm	<2 - 5	10 - 20	10 - 30
Cs	0.5 ppm	1 - 3	1 - 3	2 - 4
Fe	0.02%	0.1 - 0.2	0.2 - 1.5	0.5 - 2
Hf	1 ppm	<1	<1	1 - 2
Mo	1 ppm	1 - 5	<2	<2
Na	100 ppm		Highly variable	
Ni	200 ppm		<200	
Rb	20 ppm	100 - 500	50 - 100	50 - 150
Sb	0.2 ppm	<2	.5 - 1.5	1 - 4
Sc	0.1 ppm	0.1 - 0.3	1 - 3	2 - 4
Se	3 ppm		<3	
Sr	500 ppm	500 - 2000	500 - 1500	<500 - 1000
Ta	1 ppm		<1	
Th	0.5 ppm	<5	1 - 2	1 - 3
U	0.5 ppm	<5	0.5 - 1	0.5 - 2
W	1 ppm		<1	
Zn	20 ppm	500 - 1500	1000 - 2000	1000 - 2000
La	0.5 ppm	1 - 3	4 - 8	4 - 12
Ce	3 ppm	<3	6 - 12	10 - 20
Nd	5 ppm	<5	<5	5 - 10
Sm	0.1 ppm	0.1	0.5 - 1.5	1 - 2
Eu	0.5 ppm	<0.5	<0.5	0.5 - 1
Yb	0.2 ppm	<0.2	0.2 - 0.6	0.3 - 1
Lu	0.05 ppm	<0.05	0.05 - 0.1	0.05 - 0.15
Ash	%	1.5 - 2.5	2 - 3	1 - 2

Table 8: Typical element concentrations in ashed vegetation from the Precambrian Shield. Detection limits are those that were commercially available by INAA in the mid-1980s; limits have been appreciably lowered for Ag, Ba, Ca, Na, Ni, Rb, Sr, Th, U, and most of the rare earths. Other elements now available with this analytical package include Ir (2ppb) and Hg (1 ppm), and K (0.05%).

## TABLE 3

The procedures, the precautions, and the reasons for them can be summarized in just six key points that are outlined in Table 5.

<u>Basic Rules</u>	<u>Reasons</u>
1. Collect same species.	Every species has a different chemical composition, and trace element requirements and tolerances.
2. Collect same plant organ.	Each plant organ has different capacity to store trace elements.
3. Collect same amount (i.e. age) of growth, from same area of tree (e.g. chest height), preferably from all sides.	There are chemical variations along a twig (see Table 4). Heterogeneity in bark scales can be minimized by scraping from around the tree.
4. Try to collect samples from plants of similar age and appearance.	This is the basic inter-site consistency that is required for any geochemical sample medium.
5. If living tissue is the selected medium, collect at same time of year (i.e. conduct survey in 2-3 week period).	There are significant seasonal changes in plant chemistry.
[Dead tissue (e.g. outer bark) can be collected at any time	No appreciable seasonal change]
6. Do not return to a previously sampled tree and expect to obtain exactly the same analyses.	This is unrealistic in view of the heterogeneity of element distributions and seasonal variations in composition (and to a lesser extent annual variations). Be satisfied if an anomaly is the same order of magnitude.

**Table 5:** *Basic rules to be applied at each sampling station when conducting a biogeochemical survey.*

Dunn, 1991

## GENERAL INFORMATION ON BIOGEOCHEMICAL SURVEYING

As early as 1900, E.E. Lungwitz first suggested analysis of trees for gold may assist in gold exploration (Dunn, 1992). Gold occurring in ash of plants grown in aqueous solution, to which soluble gold had been added, was noted in the Soviet Union in the 1930.s (Kovalevskii, 1981). Kovalevskii determined that NATIVE GOLD occurs in plant ash using the method of direct scintillation emission spectroscopy (SES) without preliminary chemical treatment of samples. This method is capable of identifying individual grains of gold weighing more than 1 to 5 micro grams and with approximate isometric dimensions of more than 4 to 7 micro meter. There are limitation to this type of gold detection if the gold is in colloidal form.

The Soviet Union was the world leader in biogeochemical research and application. In the West, extensive research took place from the mid. 1940.s. Important western researchers included H. V. Warren (UBC), R.E Delavault (UBC), H.T. Shacklette (USGS), T. Vogt (Norway), and R.R. Brooks (New Zealand). Brooks is the author of two major texts on the subject (Brooks, 1972, 1983). In spite of the compelling reasons that now exist to use biogeochemical methods, acceptance has been slow. Colin E. Dunn of the GSC is one of the chief proponents of biogeochemical exploration methods in the world. He is heavily engaged in sampling, publishing and international "workshopping". Dunn is responsible for many recent publications, including Open Files, dealing with regional surveys in Canada. He has also tested an innovative biogeochemical reconnaissance sampling technique using helicopter (Dunn, 1989b). With the large body of Canadian research now available, including convincing case histories, there are compelling reasons for the uninitiated to try out the various biogeochemical methods currently available, perhaps starting with bark sampling of a favorite showing or prospect.

In the last ten years, major advances in biogeochemical exploration for gold have been possible because of improvements in analytical instrumentation. With the advent of Instrumental Neutron Activation Analysis, it has become possible to obtain precise, and relatively low cost, multi-element analysis in relatively short turn-around time.

What is probably needed in order for broad local acceptance of biogeochemical techniques to occur, is a local discovery clearly attributable to these methods. A notable exception to the generally slow catch on of biogeochemical methods has been the widespread collection of sagebrush in the western U.S. gold areas (Dunn, 1992b).

It appears that anomaly definition comparable to that of soil sampling, or better, can be achieved with fewer samples using conifer outer bark. Some ideas of the relative effectiveness of biogeochemical and conventional methods of sampling at QR can be obtained by comparing the gold results of Dunn, 1989b with Fox, 1986. The cost of Dunn's survey was about four thousand dollars and the results were available in about one month (Dunn, pers. comm.)

While a soil sample is typically a handful of material from a particular soil horizon, a biogeochemical sample, such as outer bark, reflects the integrated geochemical signature of several cubic meters of substrata including several soil horizons. Arguably, the comparison between soil and bark sampling is not a fair one for reasons elaborated on in the last paragraph under the current heading. It is stressed that the comparison is made with CONVENTIONAL soil geochemistry. There are procedures currently available using B Horizon soils that may dramatically enhance the effectiveness of sampling that horizon. An example of the new technology that holds considerable promise is the ENZYME LEACH techniques of J. R. Clark. Bark sampling permits a large operational radius by virtue of the small mass of each sample and the fact that effective sample coverage may be achieved with a relatively low sample density. A 200 m sample spacing along 200 m spaced lines is common in bark sampling.

The author's initial bark sampling included determining the biogeochemical signatures of several types of mineralizing environments found in B. C. Included were alkaline Cu-Au porphyry, stockwork molybdenum and epithermal gold. The author now relies on bark sampling as the primary geochemical method in reconnaissance. Reference sampling by the author in areas of known mineralization has tended to support the findings in Table 2 from Dunn, 1991. This table is an indispensable reference, particularly in the early stages of sampling when few data may be available. It is the biogeochemical sampler's equivalent to Table 2-1 in Levinson, 1980.

Dunn, (1991) describes trees and shrubs as the above surface extension of the geological substrata with chemical elements present in the plant organs extracted from soils, sediments rocks and groundwater. Gold is highly mobile in plants, and most have the capacity to extract gold from rocks, soils, including tills, and from groundwater accessible by roots (Dunn, 1986 b). It is noted that roots are exceedingly corrosive, locally producing micro-environments of pH <1. Individual plants may have tens of km of roots and rootlets and these in turn have millions of apertures through which essential and non-essential elements enter the tree.

Dunn, 1988b indicates that trees and other plants selectively extract from soils, groundwater and bedrock those elements essen-



tial for growth. They also absorb non-essential elements and deposit them, as much as possible in parts of the tree, such as the outer bark, twigs and tree tops, where they will not interfere with metabolic processes. This partitioning of essential and nonessential elements is likened to the human body which tends to push toxic elements, such as lead and arsenic, to the hair and fingernails (Dunn, 1986b). A large tree is a powerful geochemical sampling system capable of integrating the geochemical signature of several cubic meters of substratae (Dunn, 1986b). The amount of gold that can accumulate in plants vary with species, plant organ and the seasons. Our own survey utilized conifer outer bark scales as sampling medium for several reasons, not the least of which is the fact that bark is dead tissue and as such, has no significant seasonal variation (Dunn, 1991). The elements which tend to be enriched in the outer bark of red spruce of eastern Nova Scotia are Au, Ba, Ca, Co, K, Rb, and possibly Zn (Dunn, 1988b). It is expected that these patterns apply to other conifers as well, including those we find in B. C. It is noted that the basis for the conifer data in Dunn's table (Table 2) is sampling in the La Ronge belt, Saskatchewan where the chief spruce species is black spruce and the pine species is jackpine. In north central B. C. we sample mainly white spruce, occasionally black spruce (bog spruce, swamp spruce) and in the southern part of the province, Engelmann spruce. The common pine found in the Interior of B. C. is lodgepole pine, there being no jackpine west of Alberta (J. G. Worrall, U. B. C. Forestry, pers. comm.). It is assumed that no significant difference exists in the elemental uptakes of the various spruce species found in Canada and the same is expected to apply to the pines. Widespread hybridization in the spruce may tend to average out any actual difference. Therefore, we readily apply Dunn's table to our own areas. The fact that we tend to obtain backgrounds comparable to that of Dunn's, suggests this assumption is valid.

#### SUMMARY OF THRESHOLDS

This section summarizes the thresholds utilized in this report. Reference is made to Tables 1 and 2. In biogeochemistry, one is frequently dealing with subtle anomalies. In fact, values above Dunn's "common concentrations" may be regarded as anomalous (Dunn, pers. comm.).

Thresholds levels were determined in several ways. Please refer to DISCUSSION OF THRESHOLDS below for added information. The following summarizes thresholds considered in this survey.

#### THRESHOLDS IN OUTER BARK OF:

ELEMENTS	SPRUCE	LOGEPOLE PINE	NOTES
Au	.3 ppb	.4 ppb	Based on Table 2 expressed as D.W.E.*

Hg	.15 ppm	By inspection of data. Typically common Hg conc. in outer bark is less than the 0.05 ppm detection limit (Dunn pers. comm.)
Cu	245 ppm    220 ppm * A.W.E.   *A.W.E.	These are the lowest Cu values in barks within the two 1970 soil anomalies on Plate 3.
K	0.090%    0.080%	Based on inspection of the data and comparison to areas where potassic alteration is evident in drill holes.

\* D.W.E. = DRY WEIGHT EQUIVALENTS OF OUTER BARK = DRY WEIGHT VALUES i.e. ACTUAL VALUES FROM APPENDIX 2, MULTIPLIED BY THE CONCENTRATION FACTOR 50 COMMON TO SPRUCE AND LODGEPOLE PINE. THE BASIS FOR THIS CONVERSION IS AS FOLLOWS: ASHING OF SPRUCE OR LODGEPOLE PINE OUTER BARK TYPICALLY YIELDS ABOUT 2 % ASH, HENCE A CONCENTRATION FACTOR OF ABOUT 50 WOULD APPLY TO THOSE ELEMENTS WHICH ARE NOT SIGNIFICANTLY LOST DUE TO ASHING. Hg AND Br, BOTH HIGHLY VOLATILE, TEND TO BE LOST DURING PRE-CONCENTRATION ASHING. WE HAVE CONVERTED THE COPPER VALUES TO ASH WEIGHT EQUIVALENTS FOR THE BENEFIT OF READERS WHO ARE MOST FAMILIAR WITH ASH BASED DATA. THE SAME CONVERSION COULD BE MADE FOR ANY OTHER ELEMENT IN THIS DATA.

## DETERMINATIONS OF THRESHOLDS

## GOLD

The thresholds listed above reflect to some extent the author's experience in the sampling of conifer outer bark in the vicinity of mineralization. In one instance, he obtained 0.40 ppb Au in lodgepole pine outer bark from a multi-tree sample on the side of a bulldozer trench excavated to locate the source of copper bearing rubble. The overburden is about 50 cm thick. Bedrock in the bottom of the trench was found to contain geochemically anomalous gold in the range of 1 to 2 g/tonne. The same group of trees was re-sampled about a year later, with care taken not to scrape bark from the original sampling surface. This sample contained 0.31 ppb Au. This is considered to be in reasonably close agreement for check samples and suggests values as low as 0.3 ppb could be of interest. In this case, the trees sampled were probably at least partly rooted in the gold bearing bedrock. A "B" Horizon soil collected between the trees that yielded these bark samples contains 31 ppb Au. This sampling was done with the owners' written consent, including permission to release. While such gold levels in bark do not establish threshold for gold, they tend to indicate levels of gold that might be of interest. The author believes on the basis of the foregoing and other similar case histories, that gold values in lodgepole pine bark in the range 0.3-0.4 ppb may be worthy of further investigations. Accordingly, the concentrations that we have selected as threshold for gold based on Dunn's table are arguably on the high side. In another example, a suite of 4 outer bark samples were collected in 1989 from a variety of species growing on the Mt. Milligan deposits. The gold concentrations in these barks average 0.51 ppb Au with comparatively small sample variation. Half of the Mt. Milligan samples were obtained from lodgepole pine stumps shortly after clear-cut logging; one sample was collected from a standing spruce and another from a standing lodgepole pine. One of the samples was collected from the Esker Zone. The author's sampling was done with the owners' written consent including permission to release the data.

Sampling by Colin Dunn in 1991 in the Mt. Milligan deposit area yielded 8 bark samples in the general areas previously sampled by the author. The corresponding mean of Dunn's data is 0.56 ppb Au. D.W.E. Dunn's data included 2 samples from the Esker Zone. This data was released at Dunn's 1992 poster session at the Cordilleran Exploration Round-Up. In the case of the Mt. Milligan area, the present author sampled, with Placer's permission an area in 1991 extending up to 1.5 km NW of the deposit in order to define background. He obtained gold values in the mid. range of Dunn's common concentrations for the particular species involved. In

Dunn's data, a sample of lodgepole pine collected about 100 m east of the deposit gave background at 0.18 ppb D. W. E.

From the total Mt. Milligan data, Dunn's and my own, a very interesting biogeochemical pattern emerges inspite of the relatively few samples involved. Rapid helicopter based biogeochemical reconnaissance was done at QR (Dunn, Scagel, 1989). A lodgepole pine outer bark survey, also by Dunn, has confirmed the helicopter-based Douglas fir tree top anomaly; the lodgepole pine data having been released at the 1991 Cordilleran Exploration Round-Up. Gold concentrations over the QR Main Zone based on the bark converted to D.W.E. are: 0.80, 1.16, 1.22, 1.68 and 20.9 ppb. The more immediate background is highly variable with samples up to 0.68 ppb D.W.E. but averaging about 0.29 ppb D.W.E., when ignoring a sample containing less than the detection limit. Background values quickly decrease to about 0.2 ppb, or less. The picture that is emerging from the two biogeochemical sorties of Dunn to QR is that both Douglas fir tree top sampling, and Lodgepole pine outer bark sampling are effective tool in the search for gold in glaciated terrain. An example of the outstanding capability of low density regional outer bark sampling to detect gold camps in Nova Scotia is a given in Dunn, Banville, Adcock, 1989.

#### MERCURY

The application of mercury geochemistry in exploration relates to the high volatility of mercury and consequently its high mobility through cover-rocks and overburden. Mercury is commonly association with faults and epithermal gold deposits but occurs in other mineralizing environments, as well. Geochemical anomalies in mercury may therefore indicate structures and buried mineralization. A second element that is similarly mobile is Br (Dunn, pers. comm.). The mercury contents of Jean conifer outer bark are generally quite highly anomalous. For comparison, the normal levels of mercury in outer bark tend to be less than the detection limit of 0.05 ppm (Dunn, pers. comm.). Mercury values higher than 0.15 ppm would certainly be analytically significant at this detection level.

#### COPPER

The ashed conifer outer barks of Dunn's Mt. Milligan survey were analyzed for copper. Lodgepole pine samples yielded the following copper concentrations (in the ash): over the deposit-206, 212, and 227 ppm; background 100 m east of deposit- 146ppm; and in the Esker Zone area, and extending about 1 km to the west- 190, 261, 234, 300, and 409 ppm (Dunn, 1992 Cordilleran Round Up). The apparent existence of mineralization of unknown configuration to the west of the Mt. Milligan deposit complicates the interpretation of Dunn's data to the west of the Esker Zone.

## POTASSIUM

Potassium is highlighted on the attached plan because the broad pattern of elevated values seem to correlate in a general way to the biogeochemical copper anomalies. Geological basis for this correlation exist based on past petrographic work by Ian Paterson, logging of percussion drill cutting by Chuck Fipke and considerable etching and staining of drill core and surface rocks. K-spar and biotite are the principal potassium bearing alteration minerals found in the Jean mineralizing system. A good summary on potassium, as well as for a large number of other elements, is found in Dunn, 1992b. In this reference, he eludes to possible causes of relatively high levels of K in the vegetation suggesting K-rich clays or felsic rocks. Given the highly corrosive nature of root-ends, with pH <1, obtaining K from the local alteration suite presents little problem.

## OTHER ELEMENTS

Table 1 indicates a number of other elements that may occur in anomalous concentration in this data. The right side of the table indicate that in the case of some elements, a large proportion of the samples are above Dunn's common concentrations. These include As, Ba, Br, Ca, Co, Cs, Rb, Sr and Zn. When further sampling has been carried out, it may be worthwhile to study the distribution of some of these.

## BARK SAMPLING METHODOLOGY

Dunn, 1992 stresses the need for consistency in biogeochemical sampling and gives six basic rules to follow (Table 3, attached). The importance of these rules relates in part to the complex interrelationships that exist between elements in vegetation, including the greatly varying elemental requirements and uptakes of different species. Ignoring the rules may restrict the utilization of the data. For a broad treatment of the factors involved, refer to Brooks, 1983. The relative importance of these rules vary somewhat with the type of biogeochemical survey that is undertaken and how the samples are processed. Sampling of spruce or lodgepole pine outer bark with analysis of briquettes by INAA can simplify matters somewhat. The choice of outer bark as a sampling medium effectively eliminate the sampling problems associated with seasonal variation in elemental uptake. Preparation of samples by briquetting, a non-destructive process, and INAA determinations, yield ACTUAL elemental concentrations. On the other hand, the classic methods of sample preparation is by ashing and a great deal of work is still done this way. The latter yields pre-concentrated values. These values are in part, a function of the ash yield of the material i.e. the concentration factor as well as the "survivability" of the elements in the ashing process. Some elements, such as Hg and Br, are significantly lost in ashing.

A problem with mixed species data and preparation by ashing is that while the concentrations of certain elements may be almost the same in the bark, the relative concentration in the ash may vary greatly. For instance, in the case of Douglas fir and lodgepole pine, both outer barks having been ashed, the Douglas fir concentration factor would be about 100 while in lodgepole pine it would be 50. Accordingly, ashed outer barks of these species are not comparable. Data for some elements that have similar concentrations in lodgepole pine and Douglas fir may be treated together on a first approximation basis if the data is in the form of ACTUAL concentrations i.e. reduced to dry weight equivalents by dividing the ash weights by the respective concentration factors. Fortunately in our area there is a reasonably good distribution of white spruce in the SW part of the property and lodgepole pine in the western parts. Lodgepole pine is the choice species because its tap roots are longer than for spruce. Having to sample two species out of necessity, we need to set different thresholds in the case of gold. Once thresholds are known, all anomalous samples contribute equally to the overall anomalous outline. If one is fortunate to have single species data the data may reveal trends. Sometimes several elements yield superimposing tell-tale patterns.

Collection of calibration samples may help to develop correlation factors between species. It may be possible by sampling "forked" trees to determine that one species has substantially higher, lower or about the same elemental concentration compared to another. This can be extremely useful information when assessing multi-species data, although be fairly warned that consistent pattern are very difficult to obtain and one is paying for a great deal of extra analysis.

It is not cost effective, or desirable to skip a sample site because the desired species is not present. The existence of a non-conforming sample may support the other data keeping in mind that biogeochemical sample spacings are often large. There are considerable overlap in the various background populations and the same can be said for the anomalous populations. If one is dealing with dry weight data, the typical range in values that one gets is often small.

Bark samples are obtained by scraping about 100 g of the outer bark flakes into a plastic dustpan by means of a dedicated paint scraper whose cutting edge had been dulled with a file. The edge of the scraper is dulled for safety and to reduce any scraper tendency to gouge the bark. The desired action on the scraper are light strokes with bark recovered from all sides of the tree. The dustpan contains a crescent cut-out so that it fits the curvature of typical tree in the forest. By tilting the dustpan it can be utilized on trees of greatly varying thickness. Bark is poured from the dustpan into a soil sample envelope which is then folded tight and collected in a large, clean and sturdy plastic bag within the pack-sack. It is important that there be no hand contact with the bark.

This paint-scraper-plastic dustpan combination is also used by the crews working for Dr. Dunn, (pers. comm.). It is very quick and efficient, permitting a high rate of bark recovery. Since bark samples are easily contaminated, utmost care is necessary during sampling and packing for shipment to the lab. It is imperative that the sampler wears no gold jewelry such as rings and chains during any biogeochemical sampling, or related activity.

It is useful to collect check samples, especially if one is tying into another survey. Check samples may also reveal contamination.

When shipping samples to the laboratory, it is usually good practice to tape the sample bags shut and sending them tightly packed in their upright position. This will generally prevent loss of bark such as often occurs with the settling of loosely packed bags in a box. The dust that may otherwise accumulates on the outside of the bags may cause contamination during handling at the laboratory.

#### ANOMALIES

Anomalies for copper, gold, potassium and mercury are indicated in the outer bark data.

#### COPPER (NOTE: DATA CONVERTED TO ASH WEIGHT EQUIVALENTS)

This data is expressed as ASH WEIGHT EQUIVALENT. A.W.E. is the product of the DRY WEIGHT Cu concentration (the ACTUAL copper content of the bark) MULTIPLIED by 50 which is the approximate CONCENTRATION FACTOR for ASHED LODGEPOLE PINE OUTER BARK. The same factor is applicable to the SPRUCE outer bark conversion, according to DUNN, pers. comm.).

The principal biogeochemical copper anomaly extends southwesterly from the main 1970 soil anomaly. The extension of this anomaly westward along the contact of the Jean stock is consistent with established patterns of copper mineralization on the property. The western extremity of the bark anomaly (in the area of sample J 91-35, J) is also in the vicinity of a copper showing with 0.2-0.4 grade copper on the surface (Cooke, 1992). Copper mineralization intersected in percussion holes westward of this bark anomaly has Upper Triassic cover rocks which are in turn drift covered. About 2 km westerly along this contact at station J 91-101, J a bark sample collected at a copper showing hosted by monzonite gave 225 ppm Cu. (Cooke, 1992). This showing occurs in the base of a vertical cliff. Samples J 91-103, S and J 91-104, J were collected from trees perched on the edge of the cliff about 6 m into the hangingwall of the mineralized zone and gave 190 and 120 ppm Cu (D.W.E.), respectively. The hangingwall contains no appreciable copper mineralization.

## GOLD

The data is expressed as DRY WEIGHT, i. e. actual concentrations of gold in the bark. Again, the data may be converted to ASH WEIGHT EQUIVALENTS by multiplying each analysis by 50. Anomalous gold occur in many of the bark samples collected in 1993. Anomalous values in lodgepole pine are  $>0.4$  and include values  $>0.35$  which are rounded up to 0.4 ppb. The range in anomalous values is 0.38 to 0.52 ppb. In the case of spruce, anomalous values are  $>0.3$  ppb. The range of anomalous values is 0.25 - 0.70 ppb.

## POTASSIUM

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A broad potassium anomaly is generally coincident with the biogeochemical copper anomaly. Other areas of anomalous potassium occur over parts of the percussion targets located in the western property area. The mineralization has associated potassic alteration in the form of K-spar and secondary biotite. Biotite is also found in the hangingwall volcanics of one of the mineralized zones.

## MERCURY

-----

With few exception, the data is anomalous. This enhancement of mercury in the local vegetation may be the result of the proximity of the property to a throughgoing fault which is semi-parallel to the Pinchi Fault located about 10 km to the west. Based on mercury, these two structures could be related. The association of mercury with the Pinchi is well known. H.V. Warren utilized mercury biogeochemistry to trace this structure as far south as the Logan Lake area in southern B. C (Warren, 1984).

Mercury is more erratic than the other elements considered and therefore patterns are more difficult to define with the existing coverage.

## CONCLUSIONS

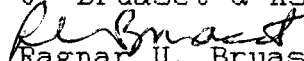
1. Biogeochemical methods utilizing outer bark are capable of detecting copper anomalies indicated by soil sampling.
2. Potassic alteration such as K-spar and biotite may be detected by an outer bark survey such as this.
3. Gold anomalies are indicated within areas of anomalous copper and potassium.



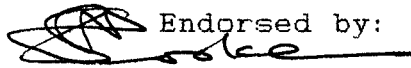
4. Fill-in sampling should be carried out in order to define the anomalies more accurately.

Report by:

Ragnar U. Bruaset & Associates Ltd.

  
Ragnar U. Bruaset B. Sc.

Endorsed by:

  
David L. Cooke, Ph.D., P. Eng.

Date Nov 8, 1993.

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## STATEMENT OF COST

Biogeochemical sampling and mapping	2 days @ \$300	\$600
Demobilization	1 day @ \$300	\$300
Field equipment		\$96.04
Transportation		\$674.52
Analyze 20 bark by INAA and AA for Cu. 5352		\$481.50
Drafting supplies, cutting, etching and staining		\$201.23
Preparing maps, interpretation and reporting.		
	7 days @\$300	\$2100
		-----
	TOTAL	\$4453.29

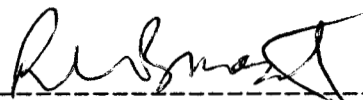


APPENDIX 1

STATEMENT OF QUALIFICATIONS

I certify that:

1. I am a 1967 graduate of the University of British Columbia with a B. Sc. degree in geology. I am a Member of The Association of Exploration Geochemists and the Society of Economic Geologists.
2. I have practiced my profession as an exploration geologist from 1967 to the present.
3. This report is based on biogeochemical sampling and geological mapping carried out by myself under the direction of D. L. Cooke Ph.D., P. Eng. I have conducted biogeochemical surveys on clients' properties as well as on my wholly or partly owned properties since 1989.
4. I am the author of this report.
5. I participated in geological, geochemical, diamond and percussion drilling and major access developing programs on the former N. B. C. Syndicate Jean property during all programs carried out between 1973 and 1981 namely programs of: 1973, 74, 75, 77, 78 and 79 in the capacity of party chief.



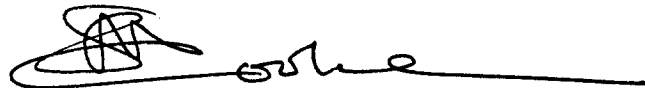
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Ragnar U. Bruaset B. Sc.  
November 3, 1993

APPENDIX 1

STATEMENT OF QUALIFICATION (D. L. COOKE)

I, DAVID LAWRENCE COOKE, of the City of Surrey in the Province of British Columbia, hereby certify:

1. That I am a Consulting Geologist, residing at 16331-59th Avenue, Surrey, B. C. V3S 1J9, with a business office at 811-675 West Hastings Street, Vancouver, B. C. V6B 1N2
2. That I graduated with a B. Sc. degree in Geology from the University of New Brunswick in 1959, and with M. A. and Ph. D. degrees in Geology from the University of Toronto in 1961 and 1966, respectively.
3. That I have practiced my profession as an exploration geologist from 1959 to the present time in Canada, the U. S. A., Mexico, the Caribbean and South America.
4. That I am a Registered Member in good standing of the Association of Professional Engineers and Geoscientists of the Province of British Columbia and was a Registered Member of the Association of Professional Engineers of the Province of British Columbia since 1970.
5. That I visited the Jean property in 1991 to carry out mapping and sampling.
6. That I have reviewed this report and concur with its findings.



---

David L. Cooke, Ph. D., P. Eng.  
November 8, 1992

APPENDIX 2

COPPER ANALYSIS OF OUTER BARK: 1991 SERIES SAMPLES,  
INAA DATA FOR 1993 SAMPLES AND COPPER

Activation Laboratories Ltd.    Work Order: 5158    Report: 5133B

Sample description	CU PPM
J91-203B	5.6
J91-204B	4.3
J91-205B	3.2
J91-206B	2.1
J91-207B	3.9
J91-208B	5.8
J91-210B	1.9
J91-211B	1.8
J91-102B	3.8
J91-103B	3.8
J91-126B	6.6
J91-127B	4.6
J91-135B	4.9
J91-136B	8.1
J91-138B	5.4
J91-155B	4.0
J91-156B	3.9
J91-158B	8.0
J91-209B	2.8
J91-212B	6.5
J91-119B	5.2
J91-120B	4.0
J91-121B	4.9
J91-122B	4.7
J91-123B	5.5
J91-124B	4.4
J91-125B	5.4
J91-152B	6.0
J91-153B	6.7

for species: see Plate 3

Cu - HNO<sub>3</sub> Digestion followed by A.A.



Activation Laboratories Ltd.    Work Order: 5158    Report: 5133B

Sample description	CU PPM	dry weight	Ash weight equivalents = ① × 50
	①	②	
J91-25B	3.7		
J91-26B	4.0		
J91-27B	1.8		
J91-35B	4.4		
J91-30B 20B	4.2		
J91-56B	3.3		
J91-58B	1.9		
J91-59B	3.8		
J91-101B	4.5		
J91-104B	2.4		
J91-105B	2.2		
J91-110B	2.8		
J91-111B	3.7		
J91-112B	4.2		
J91-114B	1.5		
J91-115B	1.7		
J91-116B	2.7		
J91-117B	1.6		
J91-118B	2.5		
J91-128B	2.7		
J91-129B	2.1		
J91-130B	2.7		
J91-133B	2.6		
J91-134B	4.5		
J91-137B	3.4		
J91-139B	4.1		
J91-140B	2.9		
J91-141B	1.9		
J91-142B	2.6		
J91-143B	2.4		
J91-144B	2.8		
J91-145B	2.9		
J91-146B	3.8		
J91-147B	2.4		
J91-148B	2.9		
J91-151B	1.7		
J91-154B	5.8		
J91-157B	3.1		
J91-159B	2.7		
J91-160B	3.9		
J91-161B	2.5		
J91-162B	2.3		
J91-200B	3.5		
J91-201B	4.4		
J91-202B	3.7		

Activation Laboratories Ltd. Work Order: 5414 Report: 5352BB

Sample description	AU PPB	AG PPM	AS PPM	BA PPM	BR PPM	CA %	CO PPM	CR PPM	CS PPM	FE %	HF PPM	HG PPM	IR PPB	K %	MO PPM	NA PPM	NI PPM	RB PPM	SB PPM	SC PPM	SE PPM	SR PPM	TA PPM	TH PPM
J93-8B S	0.38	<0.3	0.07	84	3.5	1.59	0.1	<0.3	0.13	<0.005	<0.05	0.13	<0.1	0.186	<0.05	18.8	<5	4	0.010	0.01	<0.1	27	<0.05	<0.1
J93-9B S	0.36	<0.3	0.09	160	4.2	0.99	0.2	<0.3	0.27	<0.005	<0.05	0.18	<0.1	0.182	<0.05	20.4	<5	8	0.011	0.01	<0.1	23	<0.05	<0.1
J93-11B S	0.32	<0.3	0.08	280	4.4	0.97	0.2	<0.3	0.19	<0.005	<0.05	0.14	<0.1	0.199	<0.05	22.3	<5	6	0.010	<0.01	<0.1	39	<0.05	<0.1
J93-13B S	0.45	<0.3	0.12	35	6.7	0.79	0.3	<0.3	0.27	0.006	<0.05	0.18	<0.1	0.083	<0.05	27.9	<5	3	0.025	0.02	<0.1	11	<0.05	<0.1
J93-14B S	0.34	<0.3	0.09	280	4.3	1.34	0.1	<0.3	0.17	<0.005	<0.05	0.16	<0.1	0.178	<0.05	20.9	<5	5	0.011	0.01	<0.1	42	<0.05	<0.1
J93-15B S	0.17	<0.3	0.07	250	3.7	1.38	0.1	<0.3	0.06	<0.005	<0.05	0.12	<0.1	0.183	<0.05	19.5	<5	3	0.007	<0.01	<0.1	46	<0.05	<0.1
J93-16B S	0.17	<0.3	0.06	170	2.4	0.87	<0.1	<0.3	0.13	<0.005	<0.05	0.14	<0.1	0.104	<0.05	12.4	<5	3	0.007	<0.01	<0.1	53	<0.05	<0.1
J93-17B S	0.52	<0.3	0.10	34	4.5	0.38	0.2	<0.3	0.08	0.005	<0.05	0.17	<0.1	0.080	<0.05	20.5	<5	3	0.019	0.01	<0.1	<10	<0.05	<0.1
J93-18B S	0.38	<0.3	0.10	25	4.4	0.54	0.2	<0.3	0.14	<0.005	<0.05	0.14	<0.1	0.082	0.05	21.2	<5	2	0.021	0.01	<0.1	<10	<0.05	<0.1
J93-19B J	0.43	<0.3	0.11	20	4.1	0.59	0.2	<0.3	0.10	<0.005	<0.05	0.19	<0.1	0.102	<0.05	18.9	<5	3	0.015	0.01	<0.1	<10	<0.05	<0.1
J93-22B S	0.25	<0.3	0.06	330	3.1	1.15	<0.1	<0.3	<0.05	<0.005	<0.05	0.10	<0.1	0.187	0.07	17.1	<5	4	0.009	<0.01	<0.1	48	<0.05	<0.1
J93-23B S	0.32	<0.3	0.06	330	2.8	1.10	<0.1	<0.3	<0.05	<0.005	<0.05	0.11	<0.1	0.160	0.06	16.7	<5	3	0.006	<0.01	<0.1	64	<0.05	<0.1
J93-24B S	0.24	<0.3	0.07	240	4.2	1.19	0.1	<0.3	<0.05	<0.005	<0.05	0.12	<0.1	0.286	<0.05	18.6	<5	4	0.008	<0.01	<0.1	35	<0.05	<0.1
J93-25B S	0.14	<0.3	0.07	350	3.3	1.05	<0.1	<0.3	<0.05	<0.005	<0.05	0.11	<0.1	0.314	<0.05	14.6	<5	5	<0.005	<0.01	<0.1	48	<0.05	<0.1
J93-26B S	0.22	<0.3	0.11	180	4.9	0.92	0.2	<0.3	0.12	<0.005	<0.05	0.12	<0.1	0.239	<0.05	23.1	<5	4	0.011	<0.01	<0.1	38	<0.05	<0.1
J93-27B S	0.25	<0.3	0.11	230	5.5	1.33	0.2	<0.3	0.06	<0.005	0.05	0.27	<0.1	0.170	<0.05	23.6	<5	2	0.012	0.01	<0.1	42	<0.05	<0.1
J93-28B S	0.14	<0.3	0.11	170	6.2	1.06	0.3	<0.3	<0.05	<0.005	<0.05	0.24	<0.1	0.184	<0.05	26.5	<5	2	0.014	0.02	<0.1	30	<0.05	<0.1
J93-29B J	0.30	<0.3	0.11	58	3.7	0.90	0.2	0.4	0.58	0.009	<0.05	0.14	<0.1	0.082	<0.05	40.0	<5	1	0.023	0.03	<0.1	22	<0.05	<0.1
J93-30B S	0.35	<0.3	0.07	220	3.1	1.03	0.1	<0.3	0.10	<0.005	<0.05	0.21	<0.1	0.150	<0.05	19.4	<5	1	0.008	<0.01	<0.1	42	<0.05	<0.1
J93-31B S	0.70	<0.3	0.13	51	4.8	0.77	0.2	<0.3	0.05	0.008	<0.05	0.28	<0.1	0.085	<0.05	32.0	<5	<1	0.022	0.03	<0.1	18	<0.05	<0.1

J = lodgepole pine  
S = white spruce

Activation Laboratories Ltd.    Work Order: 5414    Report: 5352BB

Sample description	U PPM	N PPM	ZN PPM	LA PPM	CS PPM	ND PPM	SH PPM	KO PPM	TB PPM	YE PPM	LU PPM	CU PPM	Mass g
J93-8B	<0.01	<0.05	52	0.03	<0.1	<0.3	0.004	<0.05	<0.1	<0.005	<0.001	5.6	30.06
J93-9B	<0.01	<0.05	54	0.04	<0.1	<0.3	0.004	<0.05	<0.1	<0.005	<0.001	5.5	30.20
J93-11B	<0.01	<0.05	92	0.04	<0.1	<0.3	0.003	<0.05	<0.1	<0.005	<0.001	4.9	30.06
J93-14B	<0.01	<0.05	83	0.04	<0.1	<0.3	0.004	<0.05	<0.1	<0.005	<0.001	6.0	30.12
J93-15B	<0.01	<0.05	70	0.03	<0.1	<0.3	0.003	<0.05	<0.1	<0.005	<0.001	5.8	30.30
J93-16B	<0.01	<0.05	58	0.02	<0.1	<0.3	0.002	<0.05	<0.1	<0.005	<0.001	6.3	30.02
J93-22B	<0.01	<0.05	78	0.03	<0.1	<0.3	0.003	<0.05	<0.1	<0.005	<0.001	4.9	30.21
J93-23B	<0.01	<0.05	120	0.03	<0.1	<0.3	0.003	<0.05	<0.1	<0.005	<0.001	7.4	30.07
J93-24B	<0.01	<0.05	91	0.03	<0.1	<0.3	0.003	<0.05	<0.1	<0.005	<0.001	4.9	30.10
J93-25B	<0.01	0.06	82	0.02	<0.1	<0.3	0.002	<0.05	<0.1	<0.005	<0.001	5.0	30.05
J93-26B	<0.01	<0.05	100	0.03	<0.1	<0.3	0.003	<0.05	<0.1	<0.005	<0.001	6.5	30.07
J93-27B	<0.01	<0.05	93	0.04	<0.1	<0.3	0.004	<0.05	<0.1	<0.005	<0.001	4.2	30.05
J93-28B	<0.01	<0.05	69	0.05	0.1	<0.3	0.007	<0.05	<0.1	<0.005	<0.001	5.2	30.26
J93-30B	<0.01	<0.05	69	0.04	<0.1	<0.3	0.004	<0.05	<0.1	<0.005	<0.001	4.5	30.44
J93-31B	<0.01	<0.05	43	0.07	0.1	<0.3	0.009	<0.05	<0.1	0.004	<0.001	4.6	30.05

Activation Laboratories Ltd. Work Order: 5414 Report: 5352CC

Sample description	AU PPB	AG PPN	AS PPM	BA PPN	BR PPM	CA %	CO PPM	CR PPM	CS PPM	FE %	HF PPM	HG PPM	IR PPB	X %	MO PPM	NA PPM	NI PPM	RB PPM	SB PPM	SC PPM	SE PPM	SR PPM	TA PPM	TH PPM
J93-11B	0.40	<0.3	0.14	320	6.7	1.15	0.3	0.4	0.27	0.006	<0.05	0.27	<0.1	0.275	<0.05	33.8	<5	8	0.019	0.02	<0.1	44	<0.05	<0.1
J93-25B	0.34	<0.3	0.18	240	7.4	1.19	0.3	<0.3	0.17	0.007	0.06	0.22	<0.1	0.334	0.06	39.9	<5	5	0.022	0.02	0.1	40	<0.05	<0.1
J93-31B	0.46	<0.3	0.26	93	7.3	1.06	0.3	0.5	0.09	0.016	<0.05	0.39	<0.1	0.142	0.09	64.6	<5	2	0.046	0.06	<0.1	28	<0.05	<0.1

*Check samples run on the orig. macerated bark but new briquettes*

Activation Laboratories Ltd.    Work Order: 5414    Report: 5352CC

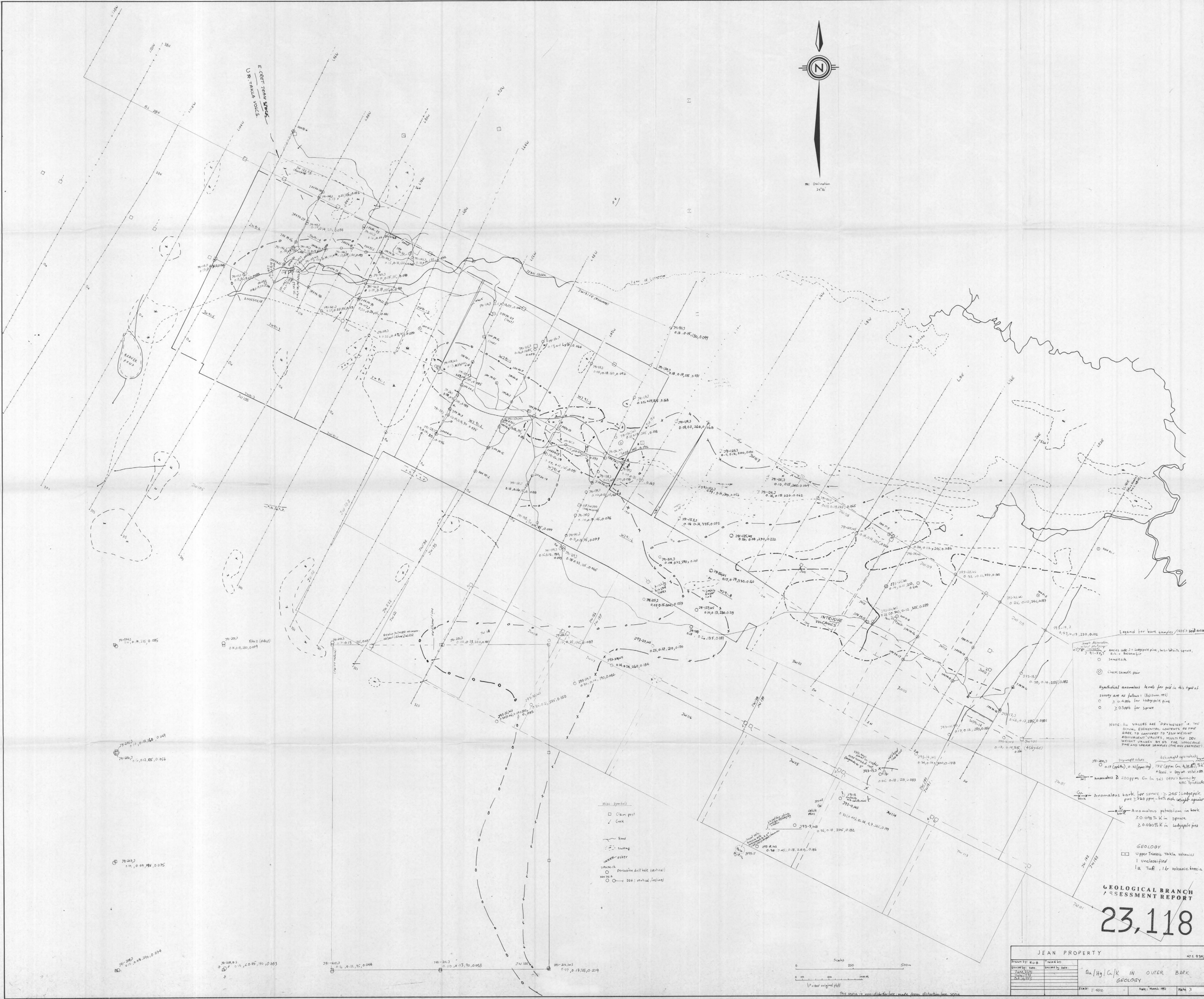
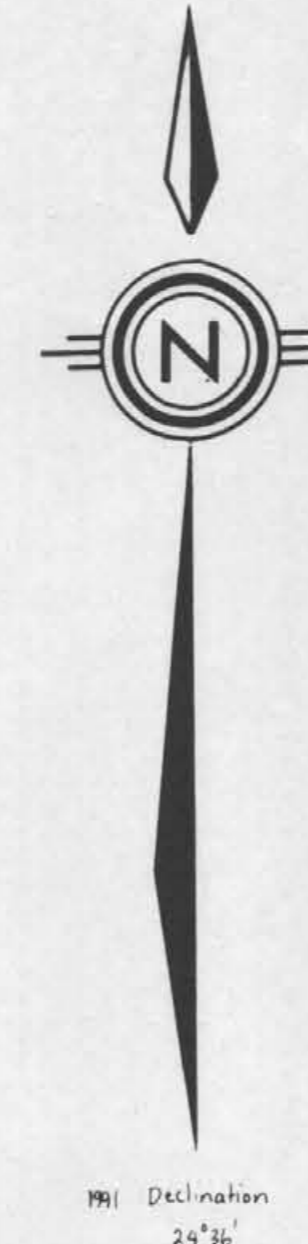
Sample description	U	W	ZN	LA	CB	ND	SM	EU	TB	YB	LU	Mass
	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	g
J93-11B	<0.01	<0.05	100	0.07	<0.1	<0.3	0.007	<0.05	<0.1	<0.005	0.001	30.10
J93-26B	<0.01	<0.05	120	0.08	0.1	<0.3	0.008	<0.05	<0.1	<0.005	<0.001	30.18
J93-31B	0.04	<0.05	63	0.15	0.2	<0.3	0.016	<0.05	<0.1	<0.005	0.002	12.12

APPENDIX 3:  
ANALYTICAL PROCEDURES

ANALYTICAL PROCEDURES FOR VEGETATION SAMPLES  
AT ACTIVATION LABORATORIES LTD.  
1336 SANDHILLS DRIVE, ANCASTER, ONTARIO, CANADA  
L9G4V5 TEL. 416 648-9611, FAX 416-648-9613

The following procedures in quotes were provided by Eric Hoffman in a FAX dated August 3, 1990 and are believed to apply to samples up to and including REPORT 2694 in the APPENDIX. Subsequently, a Retsch mill, with 1 mm sieve, replaced the Wylie mill and the briquetting press was changed to Hertzog (Ref. FAX Dec. 20, 1991).

"Samples were dried at 90 degrees C. for 24 hours. Samples were macerated in a Wylie mill (specifically designed for vegetation). 30 grams of sample were weighed on a laboratory kimwipe and then placed in a Detiert Detroit briquetting press complete with kimwipe enclosing the sample. The sample was pressed using 15 tons of pressure to form a briquette approximately 2 1/8 inches in diameter and 0.5 inch thick. The samples were placed in stacks approximately 12 inches high with flux monitors at the top, middle and bottom of the stack. The stacks of samples were irradiated for 3 hours at a flux of about  $5 \times 10^{11}$  neutrons per centimeter square per second. After a decay of 6 to 7 days to allow the Na to decay the samples were counted on high resolution germanium detectors under computer automation for 500 seconds. Results were corrected for decay and compared to calibrations developed from multiple international and synthetic standards. All anomalous samples for Au and random other samples to make up about 40 % of the total number of samples were then recounted as part of our QA/QC program".



Legend for bark samples / 1973 soil analyses

○ Sample site  
 ⊙ Check sample pair  
 ○ Hypothetical anomalous levels for gold in this report of survey are as follows: (Economic Mt)  
 ○ ≥ 0.4 ppm for lodgopole pine  
 ○ ≥ 0.3 ppm for spruce  
 NOTE: Au values are "deviations" in the actual elemental contents of pine bark to convert to "Au weight equivalent" values. Multiply the dev. weight values by 50 for unclassified pine and unclassified spruce (see also legend).  
 371-200-3 0.17 (ppm), 0.21 (ppm Hg), 175 (ppm Cu), 130 (ppm K) Rules = Dev. wt. x 50  
 Anomalous ≥ 200 ppm Cu in soil (1970's survey by KRC/Stratocad)  
 Cu bark Anomalous bark for spruce ≥ 245; Lodgopole pine ≥ 220 ppm - both soil weight equiv.  
 K bark Anomalous potassium in bark ≥ 0.09% K in spruce, ≥ 0.080% K in lodgopole pine  
 GEOLOGY  
 Upper Tertiary TANK volcanics  
 1 Unclassified  
 1a Tuff, 1b volcanic breccia

Misc Symbols

- Claim post
- ✓ Check
- Road
- Swamp
- exker
- permafrost (vertical)
- wetland
- 004: vertical, inclined

**GEOLOGICAL BRANCH  
ASSESSMENT REPORT**  
**23,118**

JEAN PROPERTY		MTS 930/6
Drawn by: RLB	Traced by:	
Checked by:	Checked by:	
Scale: 1:4000	Date: March 1972	Page: 3
Au/Hg/Cu/K IN OUTER BARK GEOLOGY		

