

# MINNOVA

MEMORANDUM

DATE: December 13, 1990

TO: ✓ J. D. Pirie

COPIES A  
COPIES TO:

DE FROM: J. D. Kapusta

SUBJECT: Moraga Res. Ltd./Expo Prop. & Port Hardy Au-Cu Porphyry Action

Expo 924/12

826867

The recent activity in the Port Hardy area, gold-copper porphyry belt has been spurred on by the recent developments at BHP-Utah's Island Copper Mine and recent discoveries at Mt. Milligan and Mt. Polley.

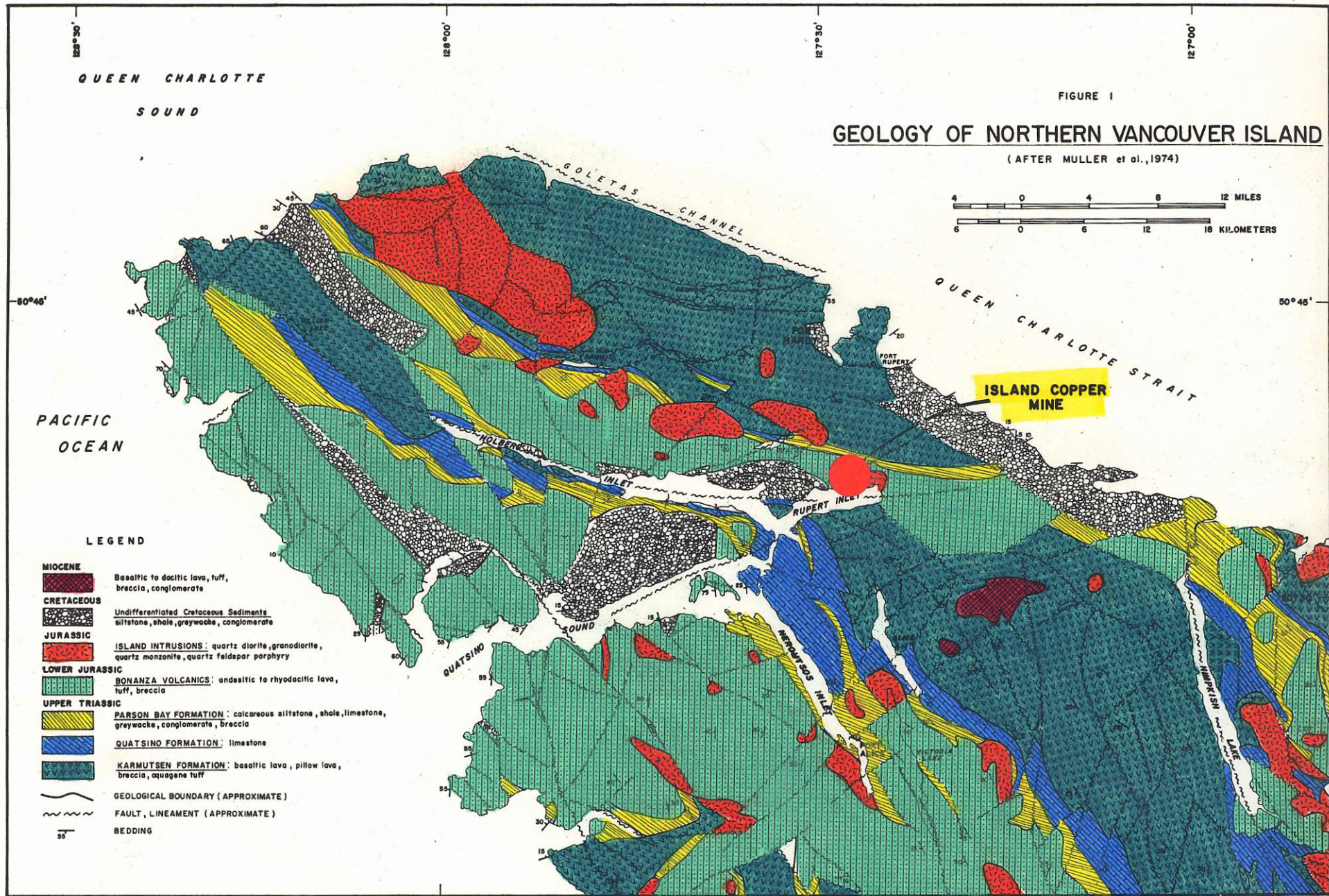
At Island Copper the in-pit mining of ore will soon stop so that stripping operations can commence to access higher grade ore situated beneath the foot of the existing pit south wall. In-pit production is expected to resume in early 1994 (with approx. grades of 0.37% Cu, 0.006 opt Au) and should continue till 1997. Early in 1991 Island Copper will treat a mixture of its low grade stockpile (0.20% Cu and minor Au) and ore from the excavated pit wall. Island Copper may require immediate mill feed or will require mill feed around 1997.

A series of Jurassic, Island Intrusives and related dykes occur in centres spaced at 7-10 km intervals along the north edge of Holberg and Rupert Inlets (Figure 1). These centres are, starting from the southeast, Island Copper, Apple Bay, Pemberton Hills, Hushamu, Red Dog and Knob Hill to the northwest. Faulting in the region is extensive with block faults having displacements of many hundred of metres. This block faulting has raised the intrusive centres so that different levels of each system are now exposed. Island Copper, Hushamu and Red Dog are possibly the only centres that have had sufficient erosion to expose the copper porphyry zones.

Exploration programs on both the Hushamu and Red Dog deposits are indicating that potentially large tonnage deposits may exist on these properties. Recent reserve calculations published for the **Hushamu deposit** (GCNL Nov 5/90) are in the order of **87,000,000 tons of 0.297% Cu, 0.01 opt Au and 0.023% Mo**, with a



FIGURE 1 — Geology of Northern Vancouver Island — setting for the Island Copper Mine.



stripping ratio of 0.8:1 (waste:ore) with a possible mineral inventory of 456,000, 000 tons at 0.26% Cu, 0.011 opt Au and 0.011% Mo. At the Red Dog deposit a potential mineral inventory of 47,700,000 tonnes of 0.30% Cu and 0.45 g/T Au is present of which 13,100,000 tonnes can be considered proven, at the same grade. The exploration potential of both these properties should still be considered excellent. The Red Dog deposit extends onto Moraga's holdings and has received limited work, as well, a number of targets remain untested on the Red Dog property.

Moraga Resources Ltd.

Location: #1030 - 609 Granville St., Vancouver, V7Y 1G5  
Phone: 688-1508 Fax: 688-7034

President: M. J. Young  
Secretary: R. Ditto  
Directors: R. H. D. Philp (Vancouver), P. J. Furlong (Vancouver), D. Fraser; (Monaco), G. Keevil

Incorporated: 1986, B.C. Charter

Transfer Agent: Royal Trust

Capitalization: 10,000,000 shares; 4,194,015 issued (750,000 escrowed)

Stock: 1988 high .47 low .35  
1989 high .38 low .15  
1990 high 1.45 low .15

Properties:

1. EXPO property: 526 claims, Port Hardy (Island Copper)  
-Porphyry gold, copper, molybdenum  
-option to acquire 45% from BHP-Utah
2. HOUSE property: Halifax City, N. Carolina  
-gold prospect  
-option to lease
3. AZURITE Property: 118 mi. NE of Reno, NV.  
-gold/copper prospect  
-50% interest, 50% owned by Mishibishu Gold Corp.\*



4. OWEN property: Mojave City AZ.
  - gold prospect
  - option to acquire 100% interest
  - option 60% interest to 3rd party

\*Mishibishu Gold Corp: #1030 - 609 Granville St., Vancouver, 688-1508; R.H.D. Philp, president; R. Ditto, secretary; D. Fraser, F. Petryshen, M. Young, B. Hasker, G. Dacre, directors; Incorporated 1989.

### Expo Property

Moraga has acquired an option to earn a 45% interest in the Expo property (~ 526 claims; 30,000 acres) from BHP-Utah. The Expo property is a porphyry gold-copper-molybdenum target, similar in nature to Island Copper. The property was extensively explored by BHP-Utah from 1967 to 1985, who expended in excess of \$5,000,000 CDN. During that period, BHP-Utah discovered the Hushamu deposit, with drill proven and probable reserves of 57,000,000 tons grading 0.32% Cu, 0.012 opt Au and 0.008% Mo, with a stripping ratio of 2.2:1 (waste:ore). These reserves are part of an overall geological reserve of 157,000,000 tons with the same grade.

To earn the 45% interest, Moraga must spend \$2,700,000 CDN on exploration over seven years (from April, 1987\*) and make a cash payment of \$260,000 US.

Presently Island Copper contains reserves of approx. 130,000,000 tonnes of about 0.3% Cu. These reserves are sufficient for operations until 1996 or 1997. Present mill capacity is 55,000 t.p.d. and has reached peak production of 70,000 t.p.d. Since 1971 it has produced 267,000,000 tonnes of ore with an average grade between 0.40 and 0.45% Cu, In an average year Island Copper produces 275,000 tonnes of Cu concentrate, 4,600 tonnes of Mo concentrate and between 40,000 to 60,000 ounces of gold.

The Expo property is located 26 km from Island Copper; so that any delineated reserves could easily be trucked to Island Copper's facilities.

\*This has also been quoted as April, 1989



As of November 5, 1990 a 10,000' infill drill program is underway on the Hushamu deposit.

Moraga began drilling the Hushamu zone in July, 1990; the program consisted of nine holes. As compiled from news releases, Figure 2 is a "best guess" as to the hole locations (location of EC177 unknown, somewhere in the NE extension of the zone).

Drilling was carried out between the Hushamu zone and McIntosh Mountain, in an area where BPH-Utah had completed three holes (EC 70, EC 69, EC 154,?). The following table lists Moraga's holes and results.

Table 1: Expo Drill Results 1990

<u>Hole</u>	<u>Interval</u>	<u>Length</u> (m)	<u>Cu</u> %	<u>Au</u> opt	<u>Mo</u> %	<u>T.D.</u> (m)
EC-171	6.7-254.0	247.30	0.36	0.015	0.008	290.00
EC-172	247.5-253.50 262.5-274.50	6.00 12.00	0.14 0.20	0.004 0.007	0.013 0.005	459.00
EC-173	101.00-134.00 326.00-456.00 326.00-338.00 338.00-365.00 365.00-456.3	33.00 130.30 12.00 27.00 91.00	0.08 0.22 0.50 0.04 0.24	0.014 0.010 0.014 0.006 0.010	0.005 0.012 0.011 0.014 0.012	456.00
EC-174	lost in fault at 87.50 m					
EC-175	126.00-162.00 365.00-456.30	36.00 91.00	0.22 0.24	0.008 0.010	0.021 0.012	
EC-176	15.20-234.00 45.00-204.00 78.0 - 189.00	218.80 159.00 111.00	0.27 0.32 0.36	0.010 0.012 0.014		256.00 -45° S
EC-177	6.10-231.00 24.00-177.00 48.00-168.00	224.90 153.00 66.00	0.27 0.32 0.43	0.004 0.006 0.007		275.80
EC-178	65.00-77.0 89.0-113.00 126.0-155.0 221.0-242.00	12.00 24.00 29.00 21.00	0.16 0.16 0.28 0.15	0.004 0.006 0.008 0.008		242.0
EC-179	246.0-496.0 378.0-496.0 378.0-414.0 492.0-496.0	250.00 118.00 36.00 4.00	0.33 0.34 0.36 0.55	0.013 0.016 0.020 0.029		496.00 -57 N
EC-154 BHP-Utah	164.90-259.0	94.10	0.26	0.016	0.015	

It is interesting to follow throughout the new releases on the Expo property and see how the grade and tonnage increases.

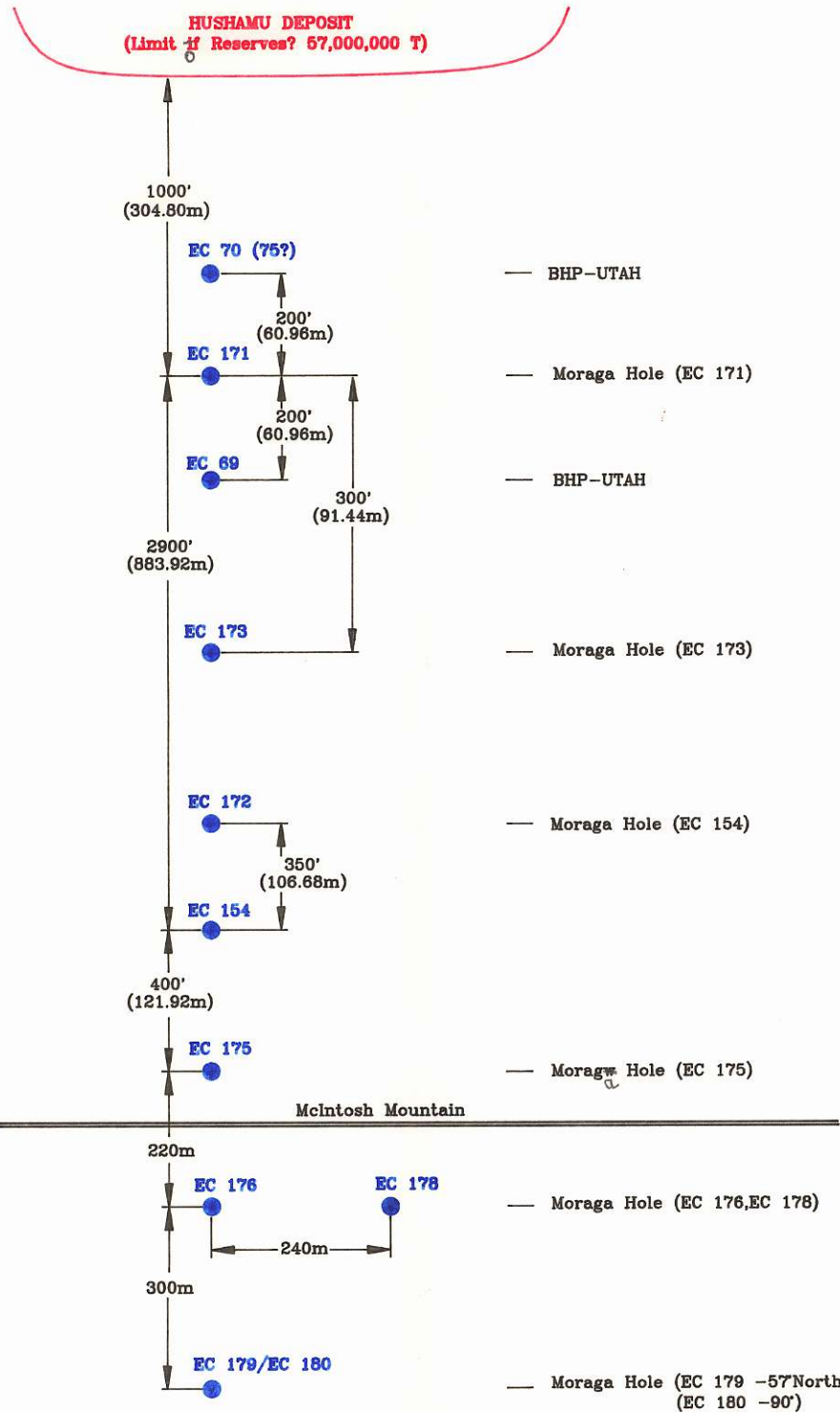
	<u>Proven/ Probable</u>	<u>Cu %</u>	<u>Au opt</u>	<u>Mo %</u>	<u>Geologic</u>	<u>Cu %</u>	<u>Au opt</u>	<u>Mo %</u>
BHP-Utah	57 M	.32	.012	.008	157M	.32	.012	.008
July 17/90 GCNL after EC-173					300M			
August 2/90 GCNL after EC-178					300M			
August 10/90 GCNL after EC-179					+300M			
August 31/90 GCNL after EC-179					+300M			
October 30/90 GCNL*					456M 87M	.26 .295	.011 .01	.011 .023

\*These are a Open Pit Mineral Resource, completed by Steffen, Robertson and Kirsten Inc., the 456,000,000 tons has a stripping ratio of 1.5:1 and the 87,000,000 tons has a stripping ratio of 0.8:1

By using a copper price of \$1.20 US/lb and gold at \$390 US/oz then the per ton value at 456,000,000 tons is \$10.53 US and at 87,000,000 is \$10.98 US. The original BHP-Utah tonnage outline of 57,000,000 would be worth \$12.36 US/ton.

Other interests in the Island Copper Area

On May 5, 1990, Moraga acquired a 55% interest in the Wanda and Stat claims (78 units) from Acheron Resources Ltd. (see Figure 3). Moraga has to make payments to Acheron of \$50,000 and spend \$350,000 on exploration over two years (\$125,000 by Mar 1/91; \$225,000 by Mar 1/92; Option payments; \$25,000 by Mar 15/91; \$25,000 by Mar 15/92 and a 3-5% NSR burden to vendors). Acheron Resources Ltd. is located at #1030-609 Granville St., phone: 688-1508, fax: 688-7034, R.H.D Philp, pres.; R. Ditto, sec.; M.



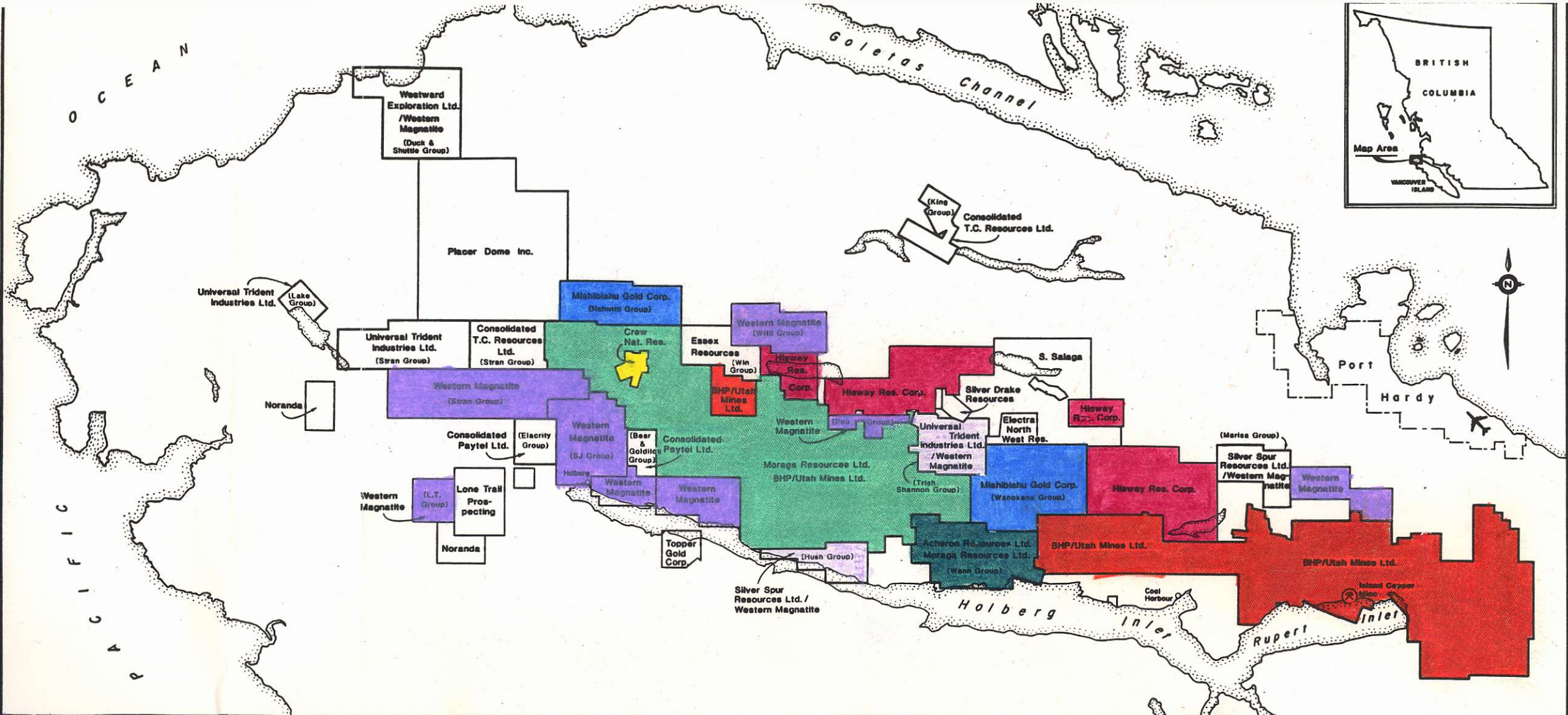


Stadnyk, F. Petryshen, M. Young, directors; C.M. Takkas, v.p.; G. Zahalan, v.p., D. Fraser v.p.; incorp. 1982, B.C., Trading Agent: Central Guaranty Trust In March, 1990 Acheron entered into an option with to acquire 100% of the Wanda and Stat claims. Moraga commenced a 7000' drill program on the Wann Group, September 24, 1990.

On June 5, 1990 Moraga entered into an agreement with Crew Natural Resources, by which it has an option to acquire a 45% working interest in the Red Dog deposit. The agreement calls for Moraga to spend \$2,500,000 CDN on exploration and development before November 30, 1993. The expenditures are based on the following schedule: \$750,000 CDN by April 30, 1992; \$1,000,000 CDN from May 1, 1992 to April 30, 1993; \$750,000 CDN from May 1, 1993 to November 30, 1993. In addition to the work commitments, Moraga is also required to make cash payments to the original vendors of the property as per Crew's agreement with them. These are \$60,000 in Feb/91 and \$75,000 per annum afterwards (these payments form part of Moraga's expenditures). Once these requirements have been met, Moraga will then have a further option to earn an additional 5% working interest by expending a further \$1,000,000 on the property (or by paying cash to Crew) by July 30, 1994. To earn the right to enter into the original agreement for a 45% working interest, Moraga had to expend \$450,000 CDN on "mutually agreed activity on the Red Dog claim" and make a cash payment of \$50,000 CDN to Crew by April 30, 1991.

To earn a 45% interest, Moraga must make work expenditures of \$3,000,000 CDN and cash payments of \$260,000 CDN by November 30, 1993. If Moraga does not make the \$3,000,000 work commitment it has the option to make a cash payment to Crew for the difference. If this option is not met then Crew will retain its 100% interest and Moraga will not earn any partial interest.

Once Moraga has earned a 45% working interest, Crew and Moraga will enter into a joint venture agreement to develop the property to commercial production, until that time, Crew and Moraga will act as joint project operators.



WESTERN MAGNETITE

## NORTHERN VANCOUVER ISLAND, BRITISH COLUMBIA PORPHYRY COPPER-GOLD BELT

	BHP/UTAH MINES
	MORAGA
	CREW
	ACHERON
	MISHIBISHU
	HISWAY

While we believe this information to have been obtained in accordance with standard industry practices, we make no representation with respect to, nor do we assume any responsibility for the correctness thereof.

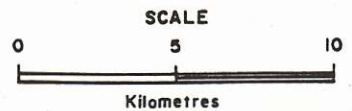
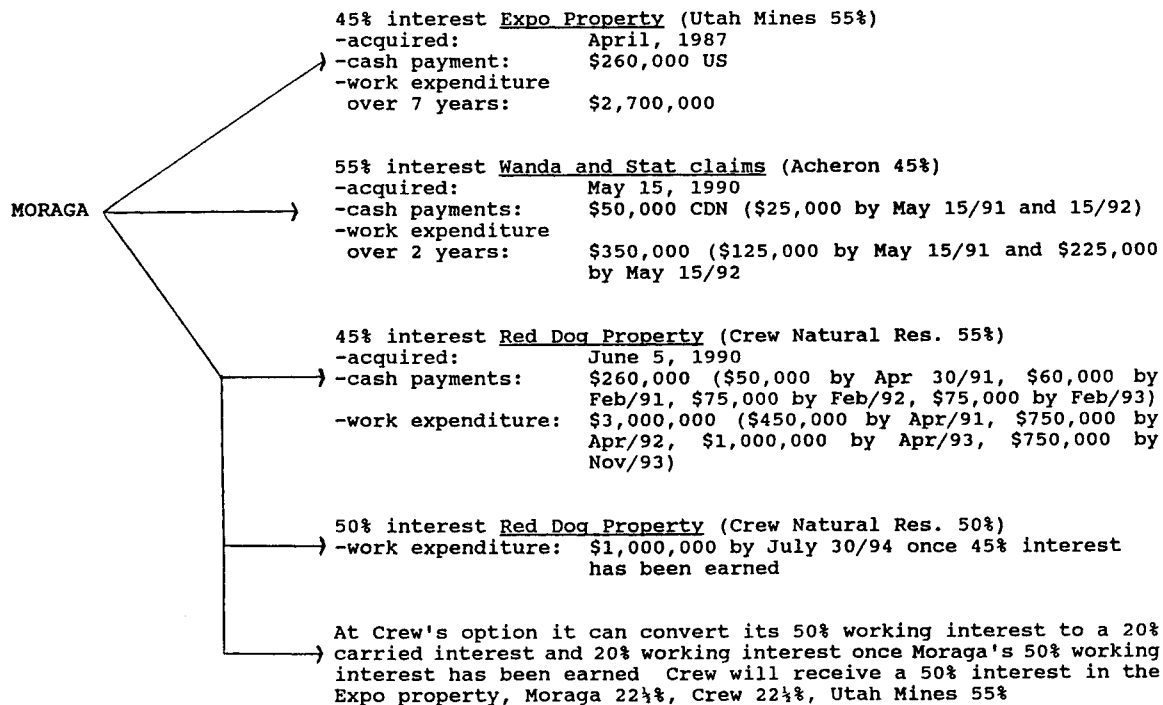


Figure 3

September, 1990

At such a time that Moraga earns a 50% working interest, then Crew will have the option to convert its 50% working interest to a 40% interest. The 40% interest will be a 20% carried interest and a 20% working interest. This leaves Moraga with a 80% working interest subject to certain conditions. Moraga must earn a 50% interest in BHP-Utah's Expo claims and that it grants Crew a 50% interest in "Moraga's property interest on a portion of the adjacent Moraga Expo claim block".\*

Mishibishu Gold Corp. is another active player in the area. It has several of the same people involved in it as does Moraga.



\*I can not presently locate any information stating that Moraga can earn 50% of the Expo property from BHP-Utah; 45% is the number being thrown around.



Crew Natural Resources Ltd.

Location: #615-800 W. Pender St., Vancouver, B.C. V6C  
2V6, Phone: 681-3338, Fax: 662-3180

President: G. D. Wright  
Secretary: J. M. Darch  
Directors: W. H. Fallis (Vancouver), R. B. Anderson  
(Vancouver)

Incorp.: 1985 (B.C.)  
Transfer Agent: Montreal Trust

Capitalization: 10,000,000 shares, issue 6,648,815  
G.D. Wright, J.M. Darch control 29.2% of the  
company's issued shares; it is estimated that  
Crew's management and associates control  
approx. 51% of the company's equity.

Stock: 1988 High: .59 Low: .25  
1989 High: .80 Low: .25  
1990 High: .79 Low: .30

- Properties:
1. Placer-gold prospect  
57 claims, Ballarat Creek, Dawson
  2. Porphyry gold, copper molybdenum  
Red Dog property, N. Vancouver Is., Port  
Hardy (Island Copper)
  3. Gold-silver prospect  
46 claims, 373 ha, Lakewood district,  
Province of Zamboanga Del Sur, Mindanao  
Island, Philippines
  4. Porphyry gold-copper  
Kalder Lake, 15 miles southwest of Mt.  
Milligan, has 100% ownership
  5. Sawa Creek  
abandoned Ag, Pb, Zn mine, vein type, 11  
metres wide

## Red Dog Property

The Red Dog property is considered to be Crew's main asset and has been valued at \$12 M CDN. Crew's total holdings have been valued at \$15 M CDN.

The Red Dog property consists of 28 claims and fractions surrounded by BHP-Utah/Moraga's Expo holdings. Crew owns 100% of the Red Dog Property but has a 3% NSR burden to the original vendors (Mr. Veerman + Mr. Botel).

There are three known areas of mineralization on the property, the Red Dog Hill Zone, located about 39 km from the Island Copper Mine, the Slide Creek zone 800 m east of Red Dog Hill and the M-2 zone northeast of Red Dog Hill.

A regional geochemical exploration program in 1962 outlined the Red Dog area as being perspective, follow-up field work in 1966 led to the discovery of copper, molybdenum mineralization in Slide Creek and the subsequent staking of the Red Dog claims. Between 1967 and 1983, West Coast Mining and Exploration Ltd., City Services Ltd., Westminex and Utah Mines Ltd. all explored the claims. The Slide Creek Zone was discovered by West Coast Mining in 1967 and the Red Dog Hill Zone by Utah Mines. Early in 1988 Crew acquired the property from BHP-Utah who believed that the Slide Creek and Red Dog Zones had limited depth potential due to relatively flat lying intrusive contacts.

BHP-Utah has drilled 50 holes totalling 24,000 m on the Red Dog zone. Limited drilling had been carried out on the Slide Creek Zone, while no holes have been drilled into the M-2 Zone. The Red Dog Zone extends onto the Expo property (Figures 4,5).

In June, 1990 Crew entered into an option and joint venture agreement with Moraga to jointly explore and develop the Red Dog property. As part of the agreement Moraga had to spend \$450,000 CDN by April 30, 1991. The first phase of Moraga's 1990 drill program consisted of ten drill holes (totalling 1850 m) into the Red Dog Zone. The second phase will also consist of nine or ten infill and extension holes to close the spacing on the Red Dog Zone to 200 feet.

205,000 E

EXPO CLAIM BOUNDARY

# RED DOG PROPERTY \*

> 70M. Tonnes - 0.32% Cu, 0.413 gm/T. Au

EC 135  
Au, Cu

EC 134  
Au, Cu

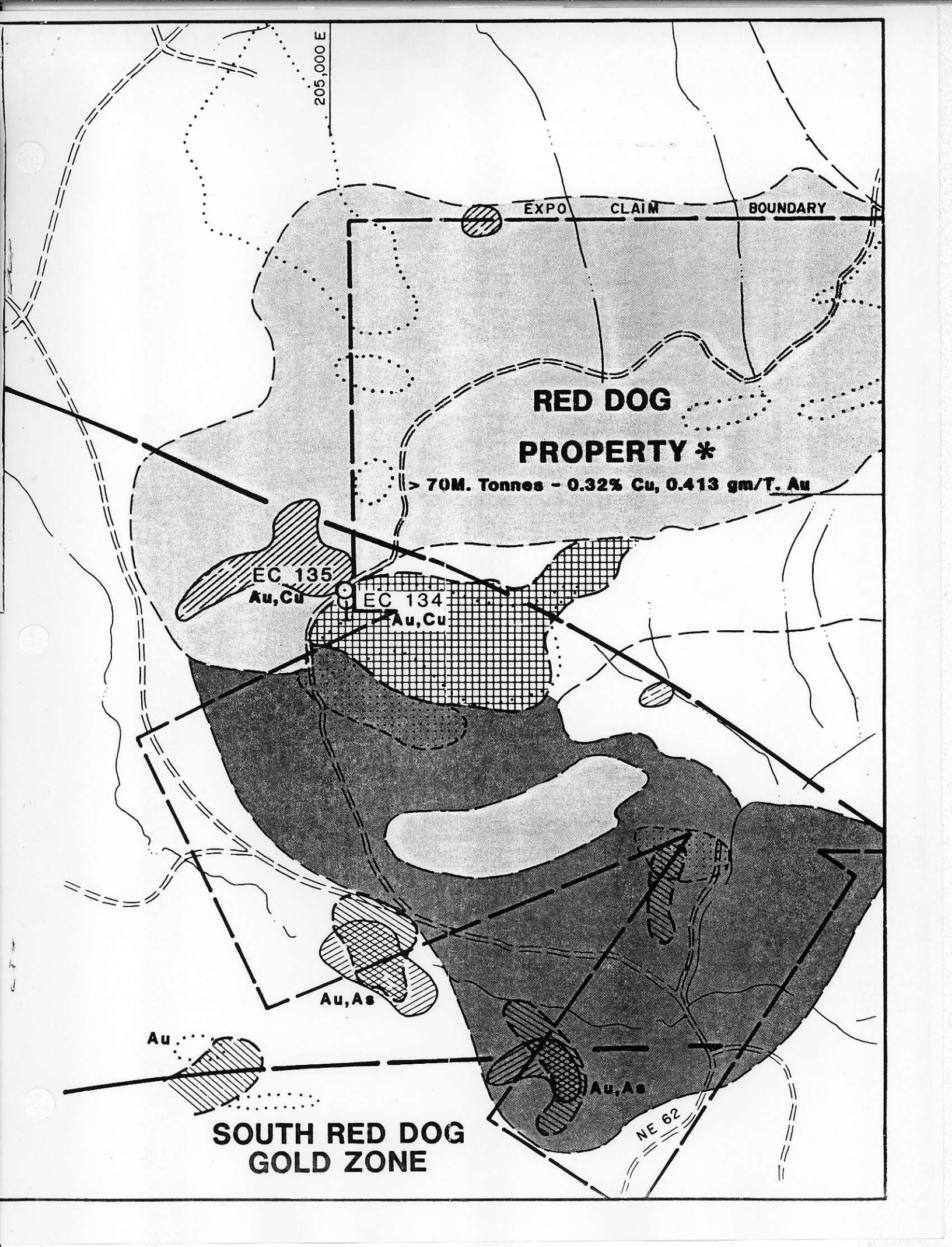
Au, As

Au

Au, As

## SOUTH RED DOG GOLD ZONE

NE 62





205,000 E

EXPO CLAIM BOUNDARY

# RED DOG PROPERTY \*

● EC-133  
> 70M. Tonnes - 0.32% Cu, 0.413 gm/T. Au

● EC 134, 135

EC 135  
Au, Cu

EC 134  
Au, Cu

● 90-10

● 90-2

● 90-6

● 023, 024

● 90-3

● 90-5

● 90-7

● 88-2

● 90-4

● 86-1A

● 88-3

● 90-8

● EC-143

● 90-9

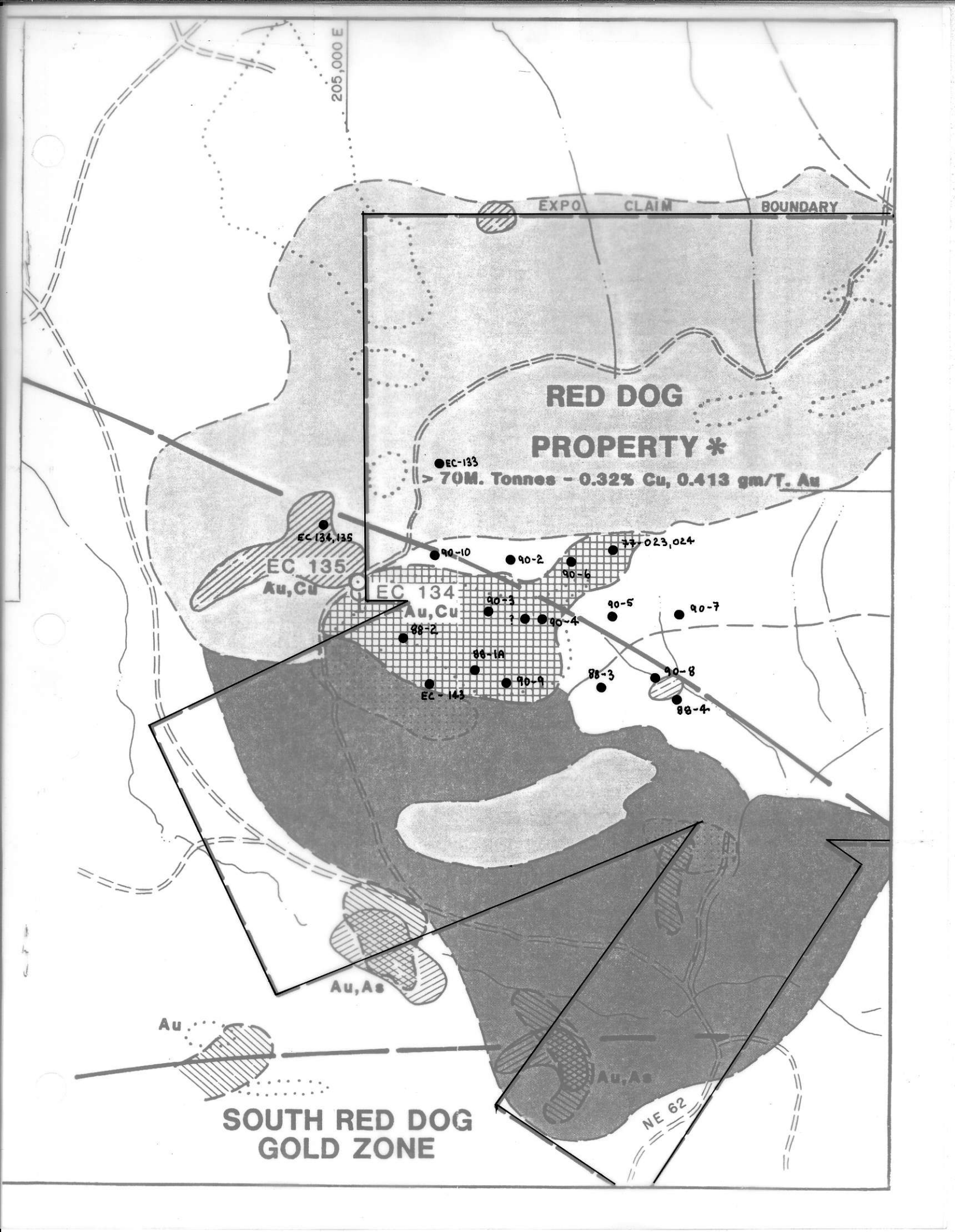
● 88-4

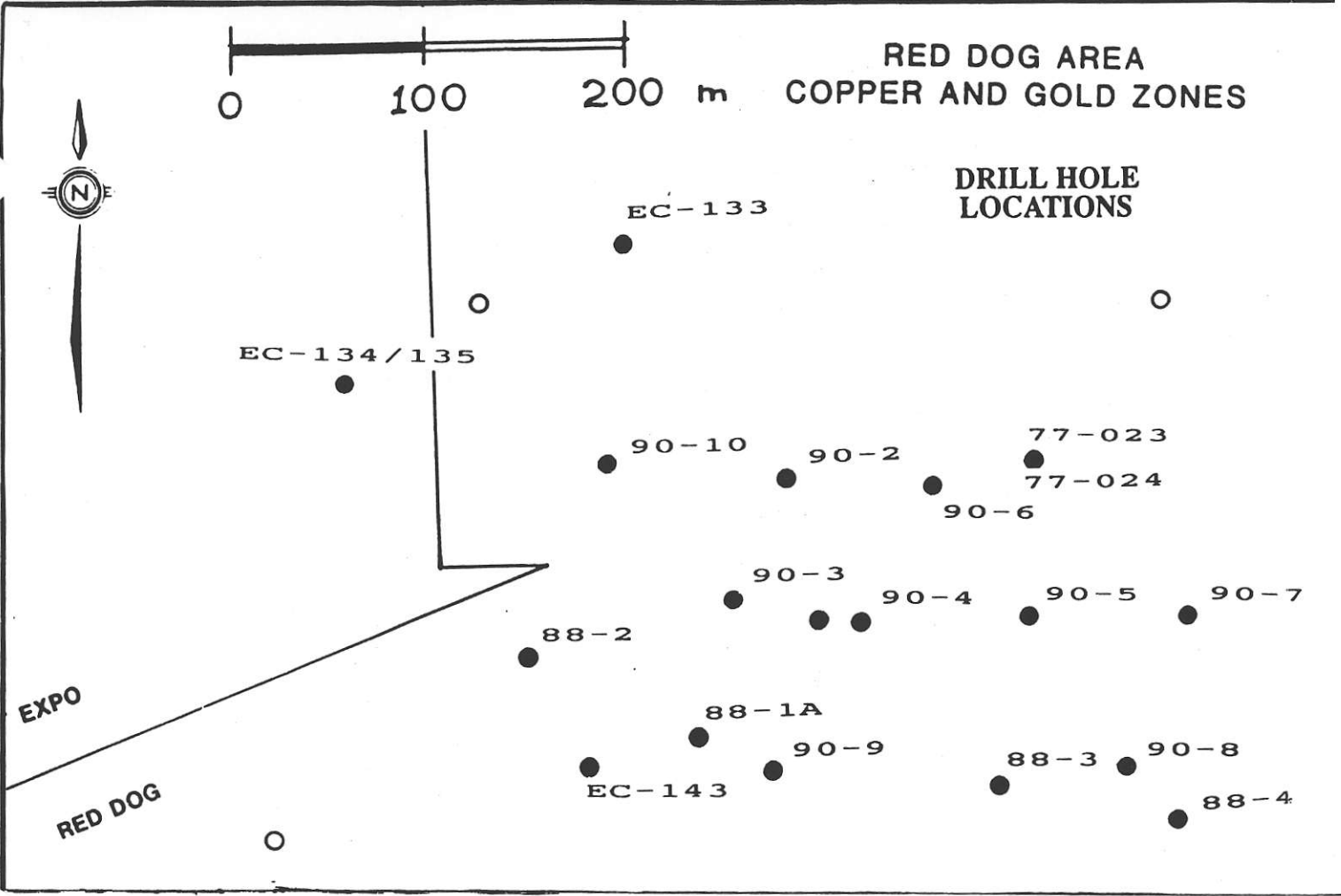
Au, As

Au
















## SOUTH RED DOG GOLD ZONE

NE 62





**LEGEND**

-  Geological Contact (approximate)
-  RED DOG Copper-Gold Deposit
-  Fault
-  Drill Holes Referred To
-  Propylitic Alteration / Pyrophyllite
-  Siliceous Breccia
-  Bonanza Volcanics
-  Diorite, Quartz - Diorite, Monzonite
-  Quartz Feldspar Porphyry
-  Gold Anomaly
-  Arsenic Anomaly
-  Ground Magnetics Anomaly
-  Claim Boundary
-  Creek
-  Road



Reproduced from BHP - Utah Mines Ltd.

**RED DOG AREA  
COPPER AND GOLD ZONES  
GEOLOGY - ALTERATION ZONES**

Red Dog Hill Zone: Significant Drilling Results

<u>Hole</u>	<u>Interval</u>	<u>Length</u>	<u>Copper %</u>	<u>Gold opt</u>
77-023	0.61-37.19	36.58	0.38	no assay
77-024	3.66-54.86	51.20	0.20	no assay
EC-133	27.43-155.45	128.02	0.30	0.012
EC-134/5	1.22-31.70	30.48	0.45	0.020
EC-141	21.64-117.65	96.01	0.16	0.010
EC-142	73.15-94.49	21.34	0.20	0.011
EC-143	6.10-44.50	38.40	0.56	0.035
88-1A	3.05-149.35	146.30	0.44	0.014
88-2	4.57-106.68	102.11	0.43	0.013
88-3	4.57-48.77	44.20	0.17	0.009
88-4	3.66-98.15	94.49	0.24	0.008
90-2	3.66-131.98	128.32	0.18	0.006
90-3	3.05-206.96	203.91	0.36	0.017
90-4	3.66-125.88	122.22	0.31	0.013
90-5	11.89-50.90	39.01	0.23	0.010
90-6	6.10-17.68	11.58	0.32	0.010
90-7	11.89-104.85	92.96	0.21	0.010
90-8	42.06-68.88	26.82	0.18	0.007
90-9	3.66-99.06	95.40	0.29	0.013
90-10	5.49-91.74	86.25	0.32	0.017

After Moraga has completed its first phase of drilling the total estimated expenditure in 1990 dollars on the property is around \$3.59 M CDN.

Reserves

<u>BHP-Utah</u>	<u>Tonnage</u>	<u>Cu (%)</u>	<u>Au (g/t; opt)</u>
Red Dog Hill Zone	11 M*	0.387	0.72; 0.021
Slide Creek Zone	3.3 M	0.46	0.27; 0.008

\*BHP-Utah's work assumed that the zone was cut off at depth by flat lying, dish-like intrusives

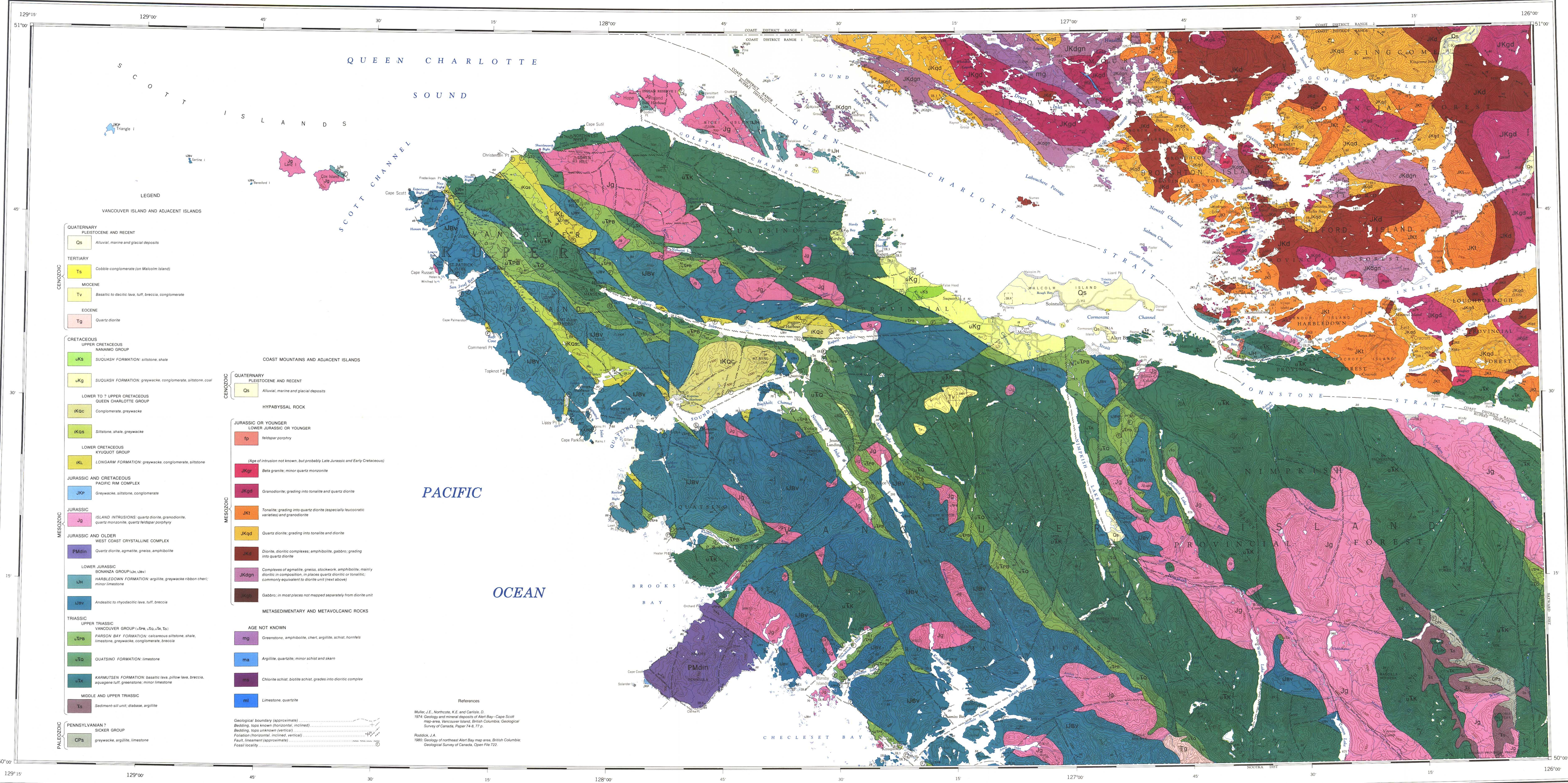


<u>Crew**</u>	<u>Tonnage</u>	<u>Cu (%)</u>	<u>Au (g/t; opt)</u>
Red Dog Hill Zone			
Proven	13.1 M	0.30	0.45; 0.013
Probable	21 M	0.30	0.45; 0.013
Possible	13.6 M	0.30	0.45; 0.013
Total	47.7 M	0.30	0.45; 0.013

\*\*compiled by David Williamson Associates Ltd, October 1990; includes data from Moraga's drilling; crew estimates a stripping ratio of 0.36:1 (waste:ore)

By using a copper price of \$1.20 US/lb and gold at \$390 US/oz the per tonne value of 47,700,000 would be \$11.68



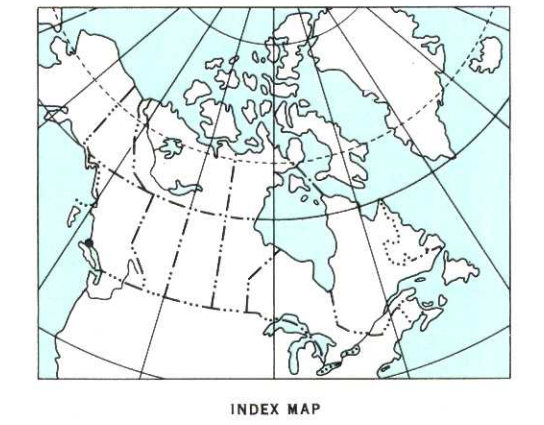


LEGEND

- QUATERNARY**  
 PLEISTOCENE AND RECENT  
 Qs Alluvial, marine and glacial deposits
- TERTIARY**  
 Ts Cobble-conglomerate (on Malcolm Island)
- MIOCENE**  
 Tv Basaltic to dacitic lava, tuff, breccia, conglomerate
- EOCENE**  
 Tg Quartz diorite
- CRETACEOUS**  
 UPPER CRETACEOUS  
 NANAIMO GROUP  
 uKs SUQUASH FORMATION: siltstone, shale  
 uKg SUQUASH FORMATION: greywacke, conglomerate, siltstone, coal  
 LOWER TO ? UPPER CRETACEOUS  
 QUEEN CHARLOTTE GROUP  
 iKoc Conglomerate, greywacke  
 iKgs Siltstone, shale, greywacke  
 LOWER CRETACEOUS  
 KYLUQUOT GROUP  
 iKl LONGARM FORMATION: greywacke, conglomerate, siltstone  
 JURASSIC AND CRETACEOUS  
 PACIFIC RIM COMPLEX  
 iKp Greywacke, siltstone, conglomerate
- JURASSIC**  
 Jg ISLAND INTRUSIONS: quartz diorite, granodiorite, quartz monzonite, quartz feldspar porphyry  
 (Age of intrusion not known, but probably Late Jurassic and Early Cretaceous)  
 JKgr Beta granite, minor quartz monzonite  
 JKgn Granodiorite; grading into tonalite and quartz diorite  
 JKt Tonalite; grading into quartz diorite (especially leucocratic varieties) and granodiorite  
 JKqd Quartz diorite; grading into tonalite and diorite  
 Jkd Diorite, dioritic complexes, amphibolite, gabbro; grading into quartz diorite  
 JKdgn Complexes of agmatite, gneiss, stockwork, amphibolite, mainly dioritic in composition; in places quartz diorite or tonalitic; commonly equivalent to diorite unit (next above)  
 Jkgp Gabbro; in most places not mapped separately from diorite unit
- JURASSIC AND OLDER**  
 WEST COAST CRYSTALLINE COMPLEX  
 PMdin Quartz diorite, argillite, gneiss, amphibolite
- LOWER JURASSIC**  
 BONANZA GROUP (uLb, uLv)  
 uLh HARLEDDOWN FORMATION: argillite, greywacke ribbon chert; minor limestone  
 uLv Andesite to rhyodacitic lava, tuff, breccia
- TRIASSIC**  
 UPPER TRIASSIC  
 VANCOUVER GROUP (uTr, uTq, uTk, uTs)  
 uTpa PARSON BAY FORMATION: calcareous siltstone, shale, limestone, greywacke, conglomerate, breccia  
 uTq QUATSIND FORMATION: limestone  
 uTk KARAMUTSEN FORMATION: basaltic lava, pillow lava, breccia, equagene tuff, greenstone, minor limestone  
 MIDDLE AND UPPER TRIASSIC  
 Ts Sediment-silt unit, diabase, argillite
- PENNSYLVANIAN ?**  
 SICKER GROUP  
 CPs greywacke, argillite, limestone
- COAST MOUNTAINS AND ADJACENT ISLANDS**  
 QUATERNARY  
 PLEISTOCENE AND RECENT  
 Qs Alluvial, marine and glacial deposits
- HYPABYSSAL ROCK**  
 JURASSIC OR YOUNGER  
 LOWER JURASSIC OR YOUNGER  
 Ip Feldspar porphyry  
 (Age of intrusion not known, but probably Late Jurassic and Early Cretaceous)  
 JKgr Beta granite, minor quartz monzonite  
 JKgn Granodiorite; grading into tonalite and quartz diorite  
 JKt Tonalite; grading into quartz diorite (especially leucocratic varieties) and granodiorite  
 JKqd Quartz diorite; grading into tonalite and diorite  
 Jkd Diorite, dioritic complexes, amphibolite, gabbro; grading into quartz diorite  
 JKdgn Complexes of agmatite, gneiss, stockwork, amphibolite, mainly dioritic in composition; in places quartz diorite or tonalitic; commonly equivalent to diorite unit (next above)  
 Jkgp Gabbro; in most places not mapped separately from diorite unit
- METASEDIMENTARY AND METAVOLCANIC ROCKS**  
 AGE NOT KNOWN  
 mg Greenstone, amphibolite, chert, argillite, schist, hornfels  
 ma Argillite, quartzite; minor actinolite and skarn  
 ms Chlorite schist, biotite schist, grades into dioritic complex  
 ml Limestone, quartzite
- Geological boundary (approximate)**  
 (Bedding, dips known (horizontal, inclined))  
 (Bedding, dips unknown (vertical))  
 (Foliation (horizontal, inclined, vertical))  
 Fault, lineament (approximate)  
 Fossil locality

References  
 Muller, J.E., Northcote, K.E. and Carlisle, D.  
 1974. Geology and mineral deposits of Alert Bay-Cape Scott  
 map-area, Vancouver Island, British Columbia. Geological  
 Survey of Canada, Paper 74-8, 77 p.  
 Roddick, J.A.  
 1965. Geology of northeast Alert Bay map area, British Columbia.  
 Geological Survey of Canada, Open File 722.

Copies of this map may be obtained from the Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario, K1A 0E8, 3303, 33rd Street, N.W., Calgary, Alberta, T2L 2A7, 100 West Pender Street, Vancouver, B.C., V6B 3B8.

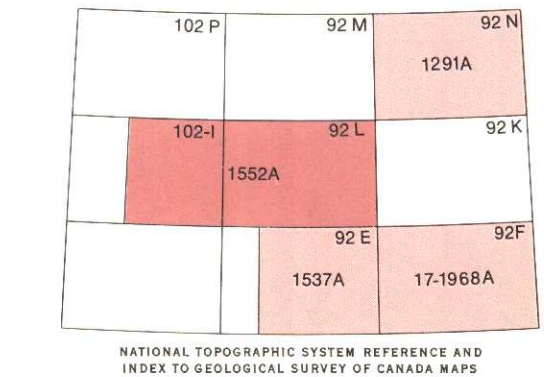


Field work, Rupert District: J.E. Muller, 1968, 1969;  
 J.A. Jeletzky, 1953, 1954; K.E. Northcote, 1968, 1969;  
 D. Carlisle, 1971; Coast District: J.A. Roddick and W.W. Hutchison, 1967  
 Compiled by J.E. Muller, 1973; J.A. Roddick, 1980  
 Geological cartography by the Geological Survey of Canada  
 Any revisions or additional geological information known to the user  
 would be welcomed by the Geological Survey of Canada  
 Base map from 1/250 000 scale maps Alert Bay 92L, and part of  
 Cape Scott 102-I published by the Army Survey Establishment,  
 R.C.E. in 1965 and 1952-1954.

MAP 1552A  
 GEOLOGY  
**ALERT BAY - CAPE SCOTT**  
 BRITISH COLUMBIA  
 Scale 1:250 000

Universal Transverse Mercator Projection  
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Copies of the topographical editions of this map may be obtained from the Canada Map Office, Department of Energy, Mines and Resources, Ottawa, K1A 0E9  
 Mean magnetic declination 1981, 23°10.4' East, decreasing 7.6' annually. Readings vary from 22°37.7' in the SE corner to 22°28.5' in the NW corner of the map area  
 Elevation in feet above mean sea level

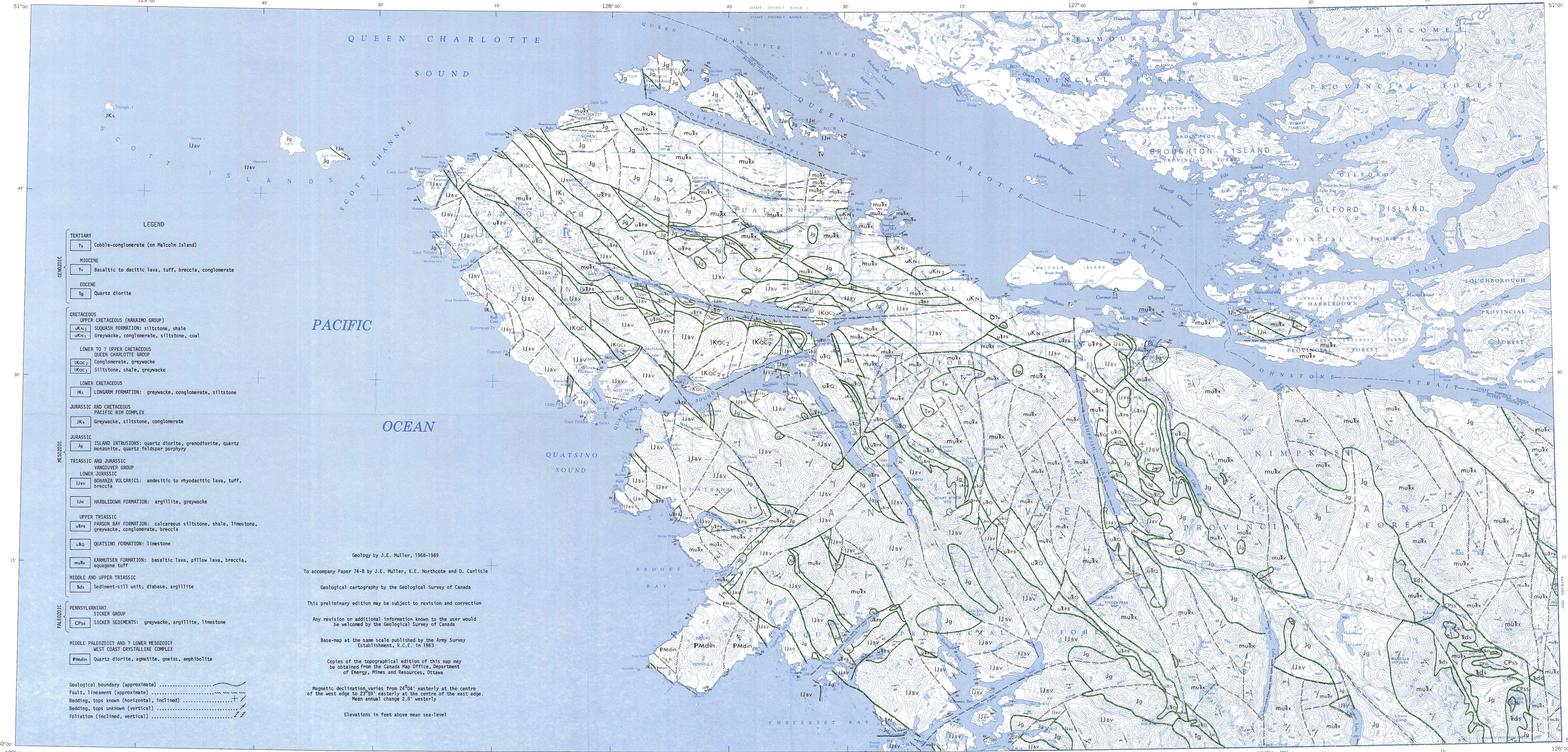






PRELIMINARY SERIES

DEPARTMENT OF ENERGY, MINES AND RESOURCES



- LEGEND**
- TERTIARY**
- Ts Cobble-conglomerate (on Malcolm Island)
- MIOCENE**
- Tv Basaltic to dacitic lava, tuff, breccia, conglomerate
- EOCENE**
- Tg Quartz diorite
- CRETACEOUS**
- UPPER CRETACEOUS (NANAIMO GROUP)**
- uKn2 SQUASH FORMATION: siltstone, shale
  - uKn1 Greywacke, conglomerate, siltstone, coal
- LOWER TO ? UPPER CRETACEOUS**
- QUEEN CHARLOTTE GROUP**
- IKoc2 Conglomerate, greywacke
  - IKoc1 Siltstone, shale, greywacke
- LOWER CRETACEOUS**
- IKL LONGARM FORMATION: greywacke, conglomerate, siltstone
- JURASSIC AND CRETACEOUS**
- PACIFIC RIM COMPLEX**
- JKs Greywacke, siltstone, conglomerate
- JURASSIC**
- Jg ISLAND INTRUSIONS: quartz diorite, granodiorite, quartz monzonite, quartz feldspar porphyry
- TRIASSIC AND JURASSIC**
- VANCOUVER GROUP**
- LOWER JURASSIC**
- BONAVAZA VOLCANICS: andesitic to rhyodacitic lava, tuff, breccia**
- IJav
- IJH HARBLEDOWN FORMATION: argillite, greywacke**
- UPPER TRIASSIC**
- PARSON BAY FORMATION: calcareous siltstone, shale, limestone, greywacke, conglomerate, breccia**
- uPps
- uQo QUATSINO FORMATION: limestone**
- uQo
- muKx KARLUTSEN FORMATION: basaltic lava, pillow lava, breccia, aquagene tuff**
- muKx
- MIDDLE AND UPPER TRIASSIC**
- ids Sediment-silt unit; diabase, argillite**
- ids
- PALEOZOIC**
- PENNSYLVANIAN?**
- SICKER GROUP**
- CPss SICKER SEDIMENTS: greywacke, argillite, limestone
- MIDDLE PALEOZOIC? AND ? LOWER MESOZOIC?**
- WEST COAST CRYSTALLINE COMPLEX**
- PMdin Quartz diorite, agmatite, gneiss, amphibolite

Geology by J.E. Muller, 1968-1969

To accompany Paper 74-8 by J.E. Muller, K.E. Northcote and D. Carlisle

Geological cartography by the Geological Survey of Canada

This preliminary edition may be subject to revision and correction

Any revision or additional information known to the user would be welcomed by the Geological Survey of Canada

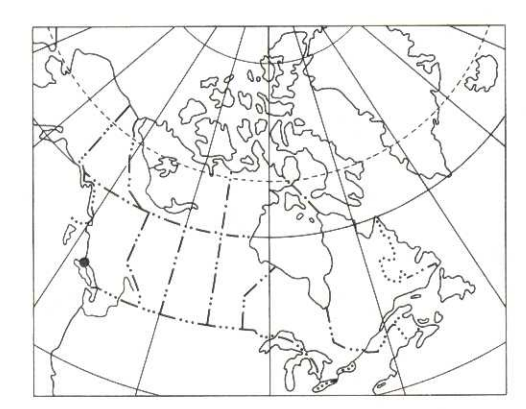
Base-map at same scale published by the Army Survey Establishment, R.C.E. in 1963

Copies of the topographical edition of this map may be obtained from the Canada Map Office, Department of Energy, Mines and Resources, Ottawa

Magnetic declination varies from 24°04' easterly at the centre of the west edge to 23°59' easterly at the centre of the east edge. Mean annual change 2.8' westerly

Elevations in feet above mean sea-level

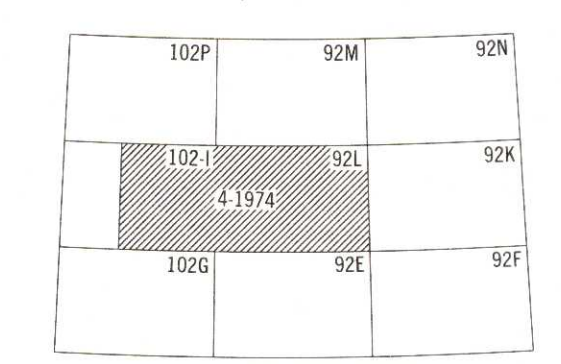
129°15' 129°00' 45' 30' 15' 128°00' 45' 30' 15' 127°00' 45' 30' 15' 126°00' 51°00' 45' 30' 15' 50°00'



MAP 4 - 1974  
PAPER 74-8  
GEOLOGY  
**ALERT BAY - CAPE SCOTT**  
BRITISH COLUMBIA  
Scale 1:250,000

Miles 4 8 12  
Kilometres 6 12 18

Universal Transverse Mercator Projection  
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MAP 4 - 1974  
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BRITISH COLUMBIA