EQUITY SILVER MINES LIMITED
Exploration Division

Report on Operations to
November 30, 1987

Prepared for Mr. R.B. Pease

862484

EQUITY SILVER MINES LIMITED
EXPLORATION DIVISION

December 1, 1987

Mr. J. J. Thompson
General Manager - B.C. Mining Operations
Placer Dome Inc.
1600 - 1055 Dunsmuir Street
Vancouver, BC

Dear Mr. Thompson:

RE: 1987 Exploration Review, Budget Summary and Expenditure Forecasts through 1990.

To November 30, we have looked at 178 mineral properties. Including the Equity mine site and Faraway Gold contract, we are currently working, on or have worked on, 25, under either direct ownership or some form of legal agreement or understanding. By year end we will have drilled nine properties for a total footage of 96,000. From a brief analysis of incomplete data it appears that only one project, Cameron River, N.W.T., will be dropped.

We have currently spent $3.456 million and are projecting expenditures to December 31 of $4.838 million. Proposed expenditures for 1988 including the Equity mine site are $11.586 million. Total exposure to Equity through 1990 is $23.064 million.

The following sections of this booklet are tagged for reference. They contain a budget summary, cost statement as of November 30, property evaluation and status, list of properties examined by Province, individual summaries of current projects, and a section of possible additional prospects for 1988 follow-up.

Yours very truly,

R. T. Heard, P. Eng.
General Manager - Exploration

lm

Copies as per distribution following.

708 - 1155 West Pender Street, Vancouver, B.C. V6E 2P4 (604) 681-5521 Telex 04-508440 (Observus VCR)

DISTRIBUTION

W.W. Bennett
A.J. Petrina
J. Racich
C.A. Grandison
H.J. Matheson
C.A. Pinette
G.A. Hodgson
S.A. Thomson
C.H. Brehaut
D.W. Zandee
R.B. Pease

CURRENT PROJECTS - BUDGET SUMMARY AND PROJECTS COSTS
FINANCIAL OBLIGATIONS - IN THOUSANDS

PROVINCE COMPANY NAME - Project Name	Mineral	Equity % Ownership	1987			1988		1989 Proposed - P Required - R	1990 Proposed - P Required - R	Totals
			Budgeted	Costs To Date	Projected	Contractual Obligations	Proposed Expend-itures			
BRITISH COLUMBIA										
EQUITY SILVER										
- Mine Site	Ag	100	700	785*	785	-	3,000+	TO BE DETERMINED		3,785
* FAME Grant = 50								TO BE DETERMINED		
+ Surface 400, U/G = 2,600										
- Regional Exploration			150							
- Rookie		100		10	10	-	-	-	-	
- Berr		100		15	15	-	~~15~~ 0	TO BE DETERMINED		
- Kate		100		15	15	-	100	TO BE DETERMINED		
- Wing		100		15	15	-	~~10~~ 25	TO BE DETERMINED		
- Troy		100		15	15	-	15	TO BE DETERMINED		
- Tableland		100		25	25	-	75	TO BE DETERMINED		
- Urn		100		5	5	-	25	TO BE DETERMINED		
- Regional Geochemistry				40	40	-	50	TO BE DETERMINED		
- General - Property Examination				10	10	-	10	TO BE DETERMINED		
- Bob & Bill Claims		TBD		-	-	5c	155	TO BE DETERMINED		
- Regional Exploration - Sub Total			850	150	150	5	455			605
- Grand Total			850	935	935	5	3455			4,390
C Cash payment = 5 Non Flow Through (NFT)										
TECK(39.1%) PIONEER(39.1)										
EQUITY (~~28.1%~~) 21.8										26
- Gaul Claims	Ag	21.8	-	-	26	-	TBD	TO BE DETERMINED		
EQUITY SILVER										
- Thibert Creek	Au/Pt	100	460*	221	360	-	240	TO BE DETERMINED		600
* Includes Cash = 10 NFT										
EQUITY SILVER										
- Tuleric Lake	Au/Ag	100	15*	13	13	10+	20	10R	10R	53
* Includes Cash = 10 NFT										
+ = 10 NFT										
			1475	1169	1334		3715	10	10	5,069

CURRENT PROJECTS - BUDGET SUMMARY AND PROJECTS COSTS

FINANCIAL OBLIGATIONS - IN THOUSANDS

PROVINCE COMPANY NAME - Project Name	Mineral	Equity % Ownership	1987			1988		1989	1990	
			Budgeted	Costs To Date	Projected	Contractual Obligations	Proposed Expend- tures	Proposed - P Required - R	Proposed - P Required - R	Totals
BRITISH COLUMBIA										
ANGLO CANADIAN	Base									
- Red Claim Group	Metals	50-J.V.	100	71	105*	-	200	TO BE DETERMINED		305
* Includes Property Payment = 5 NFT										
FARAWAY GOLD										
- Sam Claim	Ag/Pb/Zn	0*	-	-	-	-	-	-	-	-
* Equity is supervising drill program on contract basis for a total of 500 which is not included in these totals.										
YUKON										
FAIRFIELD MINERALS										
- Ram Project	Au/Ag	60-J.V.	400	426	460	440	800	390R	750R	2,400R
TALLY HO EXPLORATION										
- La Forma Mine	Au	8	200	192	200	-	-	TO BE DETERMINED		200
NORTHWEST TERRITORIES										
HOMESTAKE MINERALS										
- SY Project	Au/Ag	50-J.V.	840	587	810	540	300	240R	TBD	1,350R
TANQUERAY RESOURCES										
- Cameron River	Au/Ag	60-J.V.	100	72	100	-	-	-	-	100
			1640	1380	1675	980	1300	630	750	4,355

CURRENT PROJECTS - BUDGET SUMMARY AND PROJECTS COSTS
FINANCIAL OBLIGATIONS - IN THOUSANDS

PROVINCE COMPANY NAME - Project Name	Mineral	Equity % Ownership	1987 Budgeted	Costs To Date	Projected	1988 Contractual Obligations	Proposed Expenditures	1989 Proposed - P Required - R	1990 Proposed - P Required - R	Totals
ONTARIO										
EQUITY SILVER										
- George Lake	Base Metals	100	10	7	7	-	15	TO BE DETERMINED		22
ST. JOE CANADA										
- Jewett Lake	Au/Ag	50-J.V.	1000	360	1060*	940	1940	1000	1000	5,000
* Includes property payment = 10 NFT and Claim Staking; 311 claims = 36 NFT										
QUEBEC										
SOQUEM										
- Freeman Project	Au/Ag	40-J.V.	400	293	440	-	200	TO BE DETERMINED		640
NEWFOUNDLAND AND LABRADOR										
EQUITY SILVER										
- Saglek Project	Au/Ag	100	25	2	22*	211+	850	TO BE DETERMINED		872
* Staking costs refundable = 20										
+ Minimum assessment requirements through 1990										
SPRINGDALE SYNDICATE										
- Caldera Project	Au/Ag	80	200	54*	54	250	1946	TO BE DETERMINED		2,000
- 4 Claim Blocks of 40, 515, 792, and 431 claims for a total of 1778 claims.										
* staking costs = 50,090 NFT										
NORANDA EXPLORATION										
- Cape Ray East (147 claims)	Au/Ag	50-J.V.	100	-	-	500	500	500P	-	1,000
- La Scie Project (467 claims)	Au/Ag	50-J.V.	-	-	-	-	500	500P	500P	1,500
- Gander Outflow Project (367 claims)	Au/Ag	50-J.V.	-	-	-	-	500	500P	1000P	2,000
			1735	716	1583	1901	6451	2500	2500	13,034

CURRENT PROJECTS - BUDGET SUMMARY AND PROJECTS COSTS
FINANCIAL OBLIGATIONS - IN THOUSANDS

			1987			1988		1989	1990	
PROVINCE COMPANY NAME - Project Name	Mineral	Equity % Ownership	Budgeted	Costs To Date	Projected	Contractual Obligations	Proposed Expenditures	Proposed - P Required - R	Proposed - P Required - R	Totals
SUB TOTALS	-	-	4850	3233	4592	2896	11466	3140	3260	22,458
VANCOUVER OFFICE * Through Dec 31, 1987	-	-	250	223	246*	120	120	120	120	606
GRAND TOTALS			5100*	3456	4838	3016	11586	3260	3380	23,064

* Includes approved Non Flow Through = 100.

EQUITY SILVER MINES LIMITED
EXPLORATION REPORT
COSTS AT NOVEMBER 30, 1987

	Mineral	1987 Budget	Actual Costs	Totals
Mine Office		$ 850,000	$ 935,000.00	$ 935,000.00
THIBERT CREEK - B.C.	Au/Pt	200,000		
- site costs			55,012.03	
- transportation			30,771.47	
- field data collection			93,130.89	
- data analysis			3,750.00	
- lab work			6,306.65	
- surface penetration			14,190.50	
- economic analysis			7,902.34	
- ownership & holding			400.00	
- option payments (non allowable)			10,000.00	221,463.88
TULERIC LAKE - B.C.	Au/Ag	15,000		
- site costs			688.26	
- economic analysis			2,143.27	
- option payments (non allowable)			10,000.00	12,831.53
RED CLAIM - B.C.	Au/Ag	100,000		
- lab work			3,163.00	
- surface penetration			67,318.62	
- ownership & holding			836.40	71,318.02
FARAWAY GOLD - B.C.	Ag/Pb/Zn			
- transportation			393.40	393.40
RAM PROJECT - Yukon	Au/Ag	460,000		
- site costs			35,089.58	
- transportation			85,591.80	
- field data collection			115,401.39	
- data analysis			40,554.45	
- lab work			14,765.50	
- surface penetration			--	
- economic analysis			31,937.80	
- ownership & holding			13,657.50	
- overhead			40,023.31	
- administrative			8,697.51	
- not coded			40,442.33	426,161.17
LA FORMA MINE - Yukon	Au/Ag	200,000		
- not coded			192,994.72	192,994.72

EQUITY SILVER MINES LIMITED
EXPLORATION REPORT
COSTS AT NOVEMBER 30, 1987

	Mineral	1987 Budget	Actual Costs	Totals
SY PROJECT - NWT	Au/Ag	$ 850,000		
- site costs			54,364.61	
- transportation			244,263.88	
- field data collection			103,881.34	
- data analysis			3,143.25	
- lab work			11,981.75	
- surface penetration			104,370.10	
- economic analysis			27,005.19	
- ownership & holding			--	
- overhead			25,871.96	
- administrative			12,476.35	587,358.43
CAMERON RIVER - NWT	Au/Ag	100,000		
- transportation			15,410.81	
- field data collection			25,000.00	
- surface penetration			29,581.17	
- economic analysis			1,628.12	71,620.01
GEORGE LAKE - Ontario	Au	10,000		
- site costs			2,970.00	
- transportation			1,914.68	
- field data collection			400.00	
- lab work			320.00	
- economic analysis			957.43	6,562.11
JEWETT LAKE - Ontario	Au/Ag	1,060,000		
- site costs			44,372.13	
- transportation			35,906.00	
- field data collection			243,742.51	
- data analysis			89.07	
- lab work			5,544.25	
- surface penetration			--	
- economic analysis			11,448.81	
- ownership & holding			214.36	
- overhead			17,342.61	
- administrative			--	358,884.47
SOQUEM - Quebec	Au/Ag	400,000		
- transportation			2,032.12	
- field data collection			218,702.18	
- data analysis			2,363.74	
- lab work			1,403.22	
- surface penetration			30,625.90	
- economic analysis			--	
- ownership & holding			6,429.75	
- overhead			30,987.10	292,544.01

EQUITY SILVER MINES LIMITED
EXPLORATION REPORT
COSTS AT NOVEMBER 30, 1987

	Mineral	1987 Budget	Actual Costs	Totals
SAGLEK BAY - Newfoundland	Au	$ 25,000		
- transportation			1,277.68	
- ownership & holding			51.00	
- general (maps & GSC receipts)			380.58	1,709.26
CALDERA PROJECT - Newfoundland	Au			
- transportation			2,713.00	
- economic analysis			1,245.00	
- ownership & holding			50,090.00	54,048.00
VANCOUVER OFFICE		250,000		
- general exploration			125,651.24	
- exploration office costs			88,152.71	
- non-allowable costs			9,423.95	223,227.90
	TOTAL:	$4,320,000		$3,456,116.50

MEMORANDUM

November 19, 1987

To: Engineering Supervisor

From: Exploration Geologist

Re: Review of 1987 Exploration Expenditures and Projects to Accompany a Supplemental Form 5

INTRODUCTION

The purpose of this Form 5 is to allocate additional exploration expenditures of $ 235,000 from Terry Heard's budget to the minesite managed exploration program.

The original approved minesite exploration budget was $ 650,000. This was supplemented by a $ 50,000 FAME grant. Additional funds, in the order of $ 235,000, were allocated verbally by Terry Heard over the year for additional drilling at the minesite and for expanded off-property work.

SUMMARY OF PROJECTS

The 1987 exploration expenditures on projects which were managed by the minesite are estimated to be $ 935,000. These expenditures include on-property and off-property projects, namely:

On-property; Equity Minesite

Off-property; Rookie, Berr, Kate, Wing, Tab, Troy, Urn, Regional (Heavy Minerals), and General exploration

Excluded are some other projects managed by the minesite, namely; the Red Project, the Faraway/Sam claim project, and the Teck/Gaul claims joint venture. The Red and Teck/Gaul projects are funded by Terry Heard, and no net costs will be realized on the Faraway/Sam project as Faraway Gold Mines are providing 100 % of the funding.

On-Property

1. Equity Minesite
   - program of diamond drilling, 61 holes, 13,014.3 metres

a) North Zone
   - 26 holes, 4386.2 metres
   - zone was extended to depth and to north
   - geologic reserve re-calculated to 545,000 tonnes of 0.62 % Cu, 159 g/t Ag, and 4.16 g/t Au at 130 g/t AgEq cut-off
   - exploration decline planned in 1988, drilling will continue from surface and underground

b) Main Zone
   - 13 holes, 4241.4 metres
   - target was deeper extensions of zone
   - results discouraging as generally only low grade material was intersected
   - no further work planned

c) Southern Tail Zone
   - 13 holes, 2875.6 metres
   - target was relately high grade zone plunging to north, partially defined by previous drilling
   - results encouraging as several high grade intersections, averaging approximately 10 metres true width, were found
   - geologic reserve is pending
   - zone is open to depth, 3000 metres over 10 holes is planned for 1988

d) Waterline Zone
   - 6 holes, 323.4 metres
   - delineation drilling, results generally as prior interpretation

e) Hope Zone
   - 2 holes, 640.1 metres
   - relatively low grade intersections obtained
   - depth of zone prohibitive for further exploration

f) Zest Zone
   - 3 holes, 547.6 metres
   - no significant mineralization intersected

2. Faraway/Sam Claim Project
   - agreement reached with Faraway Gold Mines in October to manage a 5800 metre, 35 hole, diamond drill program on Sam claim which adjoins Equity's minesite property to the southwest
   - Faraway providing 100 % funding, Equity as manager earns a first right of refusal should property prove interesting
   - several narrow zones 0.3 to 2.6 metres wide assaying up to 692 g/t Ag, but most in 10 to 70 g/t Ag range, have

been intersected
  - drilling continuing

3. Gaul Claims Project
   - Teck/Pioneer/Equity joint venture
   - program of 1200 metres, 6 holes, of diamond drilling to commence December 1
   - drilling will concentrate on southerly extension of Superstition zone on to Gaul claims

Off-Property

1. Rookie Project
   - 120 soil samples collected, fill-in from 1986 sampling
   - anomalous zones confirmed, 21 test pits dug with backhoe failed to reach bedrock
   - no further work planned

2. Berr Project
   - new property, 447 soil samples on grid, geologic mapping
   - soil anomalies in Cu, Zn, Ag, Au, As determined
   - recommend fill-in soil sampling, geophysics, and more mapping

3. Kate Project
   - new property, 147 soil samples on 4 lines, geologic mapping
   - sulphide pods up to 5 x 0.35 metres of pyrite, sphalerite, arsenopyrite, chalcopyrite, and galena
   - chip samples across pods assayed up to 3.36 % Cu, 30.6 % Zn, 62 g/t Ag, and 1.26 g/t Au
   - recommend more soil sampling and mapping, trenching and geophysics

4. Wing Project
   - new property, 156 soil samples on 4 lines, geologic mapping
   - data interpretation pending, several soil samples have low level Ag anomalies

5. Troy Project
   - new property, 115 soil samples on 3 lines, geologic mapping
   - data interpretation pending, several soil samples contain anomalous levels of Cu, Zn, Ag, and As

6. Tableland Project
   - 220 soil samples on grid, follow-up to 1986 sampling, plus geologic mapping
   - strong Ag, As soil anomaly determined, also a zone of anomalous Ag in rock not covered by 1987 soil grid
   - recommend more soil sampling and mapping, plus trenching and geophysics

7. Urn Project
   - staked on Ag/Au anomaly from government silt geochem release
   - preliminary prospecting located a zone seven metres wide with chalcopyrite and malachite occuring in narrow fractures, assays averaged 3.83 % Cu, 44 g/t Ag, and 0.1 g/t Au
   - soil sampling and geologic mapping are recommended

8. Regional Geochemistry
   - 98 heavy mineral samples were collected
   - analyses are pending, hopefully some anomalies will be defined

9. General Exploration
   - several "grass-roots" prospects were examined
   - two are being considered for optioning and work programs in 1988

Other Projects

1. Red Project
   - optioned and funded by T. Heard, managed by minesite
   - 7 holes, 857.3 metres, were drilled on VLF conductors
   - discovered zone 40 to 50 metres wide of discontinuous massive pyrite/pyrrhotite mineralization, but with no significant economic metal values
   - more geophysics and follow-up drilling are recommended elsewhere along the strike of the conductor

SUMMARY OF EXPENDITURES

(* estimate)

1.	Diamond Drilling, direct costs (Minesite Project)	623,188.41
2.	Claim Staking (Kate, Troy, Wing, Berr projects)	10,292.00
3.	Cat Work (Minesite Project)	15,158.00
4.	Truck Rental (All Projects)	15,500.00*
5.	Helicopter Charter (Berr, Kate, Urn, Troy, Wing, Regional, General Projects)	36,267.00
6.	Backhoe Rental (Rookie Project)	2,053.00
7.	Down-hole Survey Equipment Rental (Minesite Project)	3,500.00*
8.	Misc. Supplies (All Projects)	5,000.00*
9.	Recording and Claim Fees (Minesite and Urn Projects)	9,363.00
10.	Placer Lab Charges (All Projects)	38,000.00*
11.	Equity Lab Charges (All Projects)	46,000.00*
12.	Heavy Mineral Sample Preparation (Regional Project)	15,000.00*
13.	Equity Labour Charges (All Projects)	115,500.00*
		934,821.41
		say 935,000.00*

Approximately $ 785,000 on-property projects
$ 150,000 off-property projects

R. Pease

THIBERT PROJECT

INTRODUCTION

The Thibert project encompasses 223 claim units covering the Thibert fault from the north end of Dease Lake to Defot Creek, a strike length of approximately 16 miles. The claim groups follow the strike of an elevated stream channel which has recorded production of over 90,000 ounces of placer gold since its discovery in 1873. Two hard rock gold sources are noted to occur on Thibert Creek. The "Keystone Showing" is described as being on Thibert Creek between Berry and Boulder Creeks. Open cutting and stripping reportedly exposed a zone of quartz stringers in quartz porphyry with values of 0.25 opt au across a width of 40 feet. A flat pack sack drill hole drilled to the south from the Boulder Pit in 1962 reportedly carried gold values in poorly recovered core. Assays by the Provincial Minerologist in 1902 of the nonmagnetic portion of black sands from hydraulic operations from this area show this fraction to contain 43 percent platinum group minerals.

Lode type gold and platinum mineralization is the exploration target.

REGIONAL GEOLOGY

The Thibert Creek project is located on the north-eastern boundary of the Atlin Terrane, a fault bounded area of upper paleozoic rocks. Structural evidence suggests that the Atlin Terrane is a large thrust sheet affected by compressional forces and marked at least on the southern edge by thrust or reverse faults.

The upper Paleozoic rocks have been effected by two distinct stages of deformation. The older phase is marked by penetrative foliation and associated pumpellyite-chlorite regional metamorphism. The second phase consists of crumbing associated with strain-slip cleavage.

LOCAL GEOLOGY

A long narrow envelope of ultramafic rocks follows the Thibert fault throughout the length of the claim blocks. Mississipian to Permian rocks of the Kedahda formation lie to the south. This formation consists of schistose quartzite and black, platey argillite. The strike of the well developed schistosity generally dips 60 to 70 degrees southerly.

Late Triassic and early Jurassic granitic rocks underlie the northern portion of the claims.

The ultamafic rocks along Thibert Creek can be divided into three types, from predominate to least these are:

1. quartz - carbonate - mariposite altered
2. serpentine and serpentinite
3. unaltered, fine grained black dunite

Quartz - Carbonate- Mariposite Alteration

These rocks are the most predominate along the Thibert fault. Outcrops of this rock are characteristically bright with orange goethite. Outcrops are often laced with abundant quartz veinlets generally less than 1 cm thick. These veinlets carry rare traces of pyrite. Occasionally silvery-grey arsenopyrite occurs on some fracture surfaces. Some chalcopyrite with characteristic copper stain was sampled on the east side of Boulder Creek.

Silica appears to be the predominate constituent. Emerald green mariposite is always present, guite often in amounts approaching 20 percent. Small amounts of calcite and magnesite are present.

Serpentine and Serpentinite

Dark green waxy serpentine comprises a significant portion of the ultramafic rocks between Porcupine Lake and the mouth of Thibert Creek. In places, the serpentine is extremely black and hard.

Peridotite

Small pockets of black, fine grained peridotite are found within most of the ultramafics. Such pockets vary from a few feet to a few inches in width. Peridotite comprises less than 1 percent of the ultramafics.

ECONOMIC GEOLOGY

The source rocks of the placer gold mined in the Thibert Creek appear to be the narrow ultramafic band of rocks along Thibert fault. The only gold producing creeks in the area either follow or cross the Thibert fault. Where the creeks flow in all other rock formations, they are non productive. Best gold values were recovered from the gravels in Thibert east of Berry Creek.

1987 FIELD PROGRAM

The 1987 field program consisted of:

1. a review of all available data including Noranda's 1983 and 1984 data
2. detailed prospecting and sample collection
3. geological mapping with structual detailing in areas of first interest
4. dozer and backhoe trenching

Work to date has outlined two major areas of interest on the property. These are:

1. Porcupine Lake Prospect
2. Boulder-Berry Creek Prospect

PORCUPINE PROSPECT

This prospect covers a portion of the ultramafic quartz-mariposite along the Thibert fault on the east side of Porcupine Lake. Geochemical sampling for both Au and As has located a coincidental Au and As anomaly covering an intense quartz stockwork in the ultramafics. Gold values as high as 430 ppb and As values to 1100 ppm were encountered. The structure is complicated and is currently being detail mapped and sampled. This prospect is in a drillable stage.

BOULDER-BERRY CREEK PROSPECT

The Boulder-Berry Creek prospect is in the general vicinity of the government reported Keystone showing. As of this date, the Keystone showing as reported has not been located.

Prospecting and sampling in the area has located a wide 40-50 foot graphitic shear zone on the south side of the pit which carries anomolous values in Au (0.018 opt). This is approximately 100 feet south of the area that was drilled by the Barrington Development Co. Ltd. in 1962-63. Unfortunately, their drilling was done at -10 and -15°. Needless to say recovery was practically non-existent in the holes. However, they do report that visible gold was encountered in Hole No.3 below 175 feet.

Prospecting, sampling and detailed mapping in this area should be completed by mid to late October. It is my opinion that 2 or 3 drill holes should be planned for this area to crosscut the structure.

NOTE: Heavy glacial gravel and till in this area precludes geochemical soil sampling.

TULERIC LAKE PROJECT

Summary

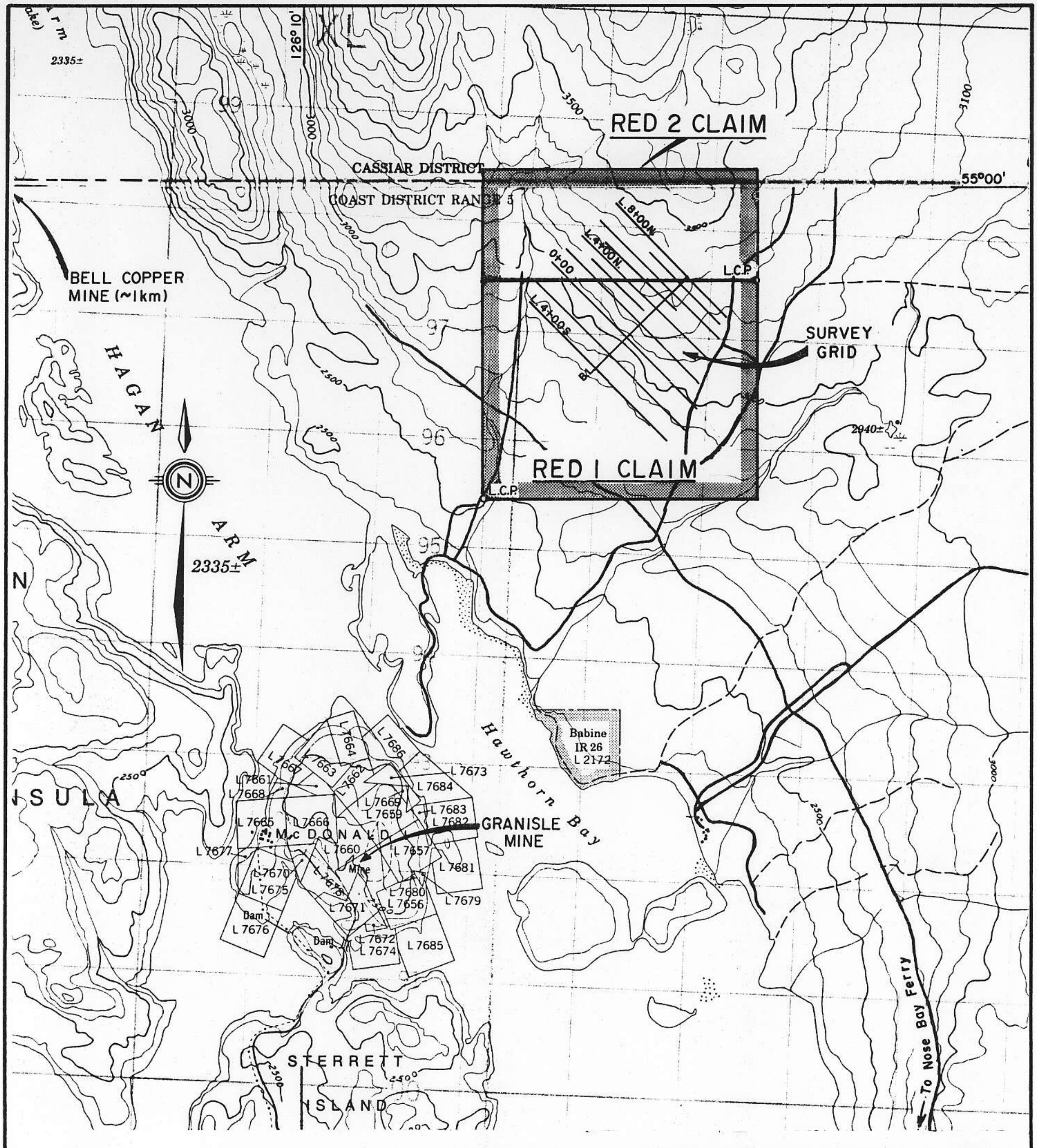
A quartz vein with associated silica-carbonate mariposite alteration occupies a shear zone in Nicola volcanics 60 km northwest of Kamloops. Vein material varies from a few inches to 5 feet in width. A short adit (slumped) and several small trenches trace the vein for over 600 feet of strike length. Assays across the width of the vein are in the 0.13 oz/t Au range. Grabs from the dump are reported to range up to 0.4 oz/t Au. If the property ownership can be clarified, the vein system warrants testing by a comprehensive program including diamond drilling. The property has potential for discovery of several hundred thousand tons grading in the order of 0.20 oz/t Au which might economically mined underground.

RED CLAIM PROJECT

See Bob Pease' summary above under mine site.

Recommendations

Geophysical surveys along strike of VII conductor (see compilation map)	$ 50,000
Additional diamond drilling	150,000
	$200,000



KILOMETRES

0 1 2

GEOTRONICS SURVEYS LTD.

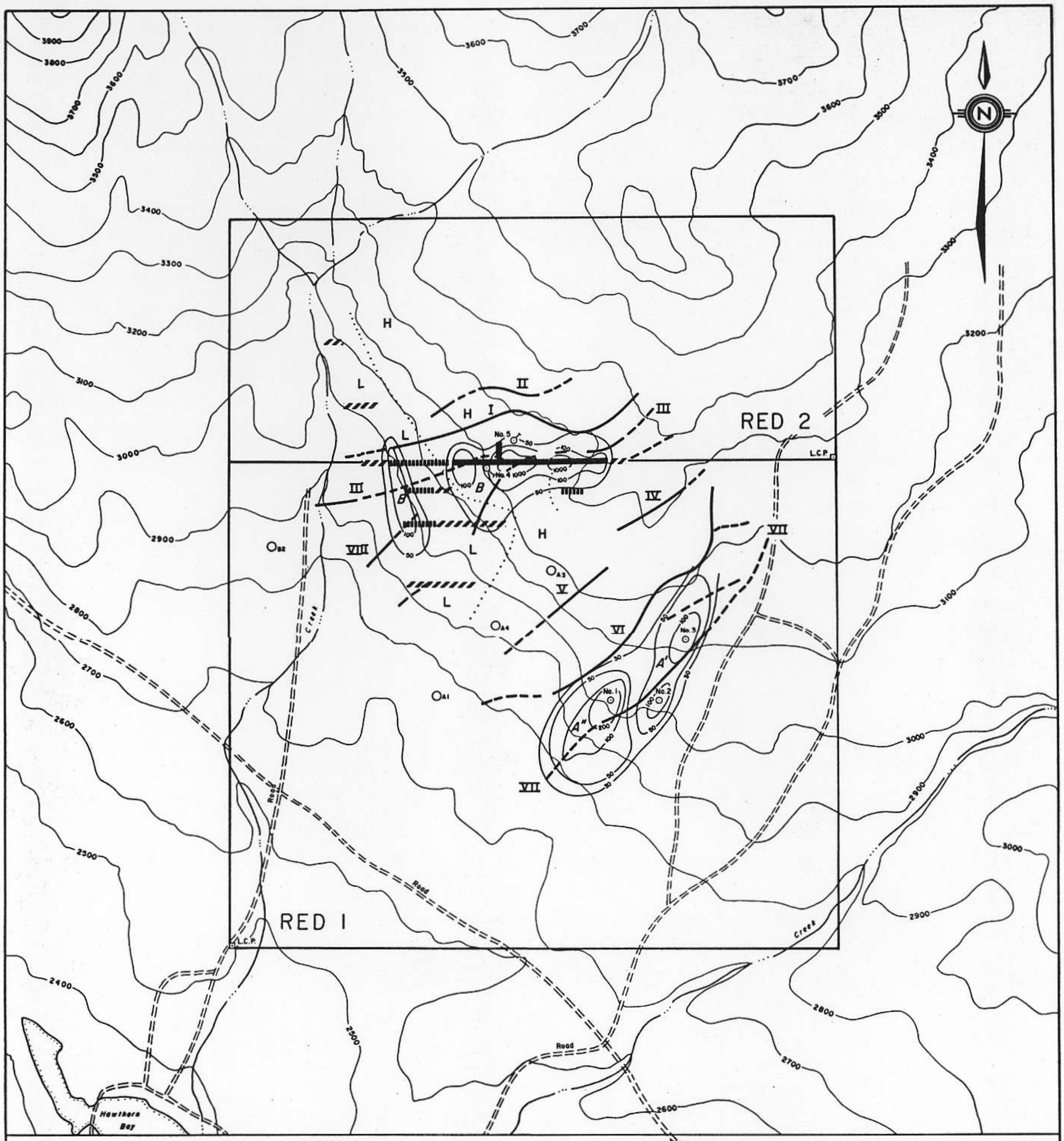
ANGLO CANADIAN MINING CORPORATION

RED CLAIM GROUP

HAWTHORN BAY, BABINE LAKE AREA
OMINECA M.D., B.C.

CLAIM MAP

SCALE:	DATE	N.T.S.	PROJECT No.	MAP No.
1:50,000	MARCH, 1986	93L/16E	86-02	2



LEGEND

1966 I.P. - RESISTIVITY SURVEY

METAL FACTOR CONTOURS

1967 DRILLING

⊙ DRILL HOLE

1972 I.P. - RESISTIVITY SURVEY

▬ DEFINITE ANOMALY (METAL FACTOR)

PROBABLE ANOMALY (METAL FACTOR)

▨ POSSIBLE ANOMALY (METAL FACTOR)

L RESISTIVITY LOW (below 100 ohm - ft.)

H RESISTIVITY HIGH (above 100 ohm - ft.)

1985 AIRBORNE E M SURVEY

○A4 AIRBORNE E M CONDUCTORS

1986 HORIZONAL LOOP E M SURVEY

DEFINITE CONDUCTOR

POSSIBLE CONDUCTOR

Note: Work from 1966 to 1972 has yet to be field-verified onto present grid system.

METRES
0 100 200 300 400 500

TO ACCOMPANY GEOPHYSICAL REPORT BY DAVID G. MARK, GEOPHYSICIST, MARCH 25, 1986.

GEOTRONICS SURVEYS LTD.

ANGLO CANADIAN MINING CORPORATION

RED CLAIM GROUP

HAWTHORN BAY, BABINE LAKE AREA

OMINECA M.D., B.C.

COMPILATION MAP

SCALE:	DATE:	N.T.S.	PROJECT No.	MAP No.
1 : 10,000	MAY, 1986	93L/16E	86 - 02	6

TECK EXPLORATIONS LIMITED

1199 WEST HASTINGS STREET
VANCOUVER, B.C. V6E 2K5

TEL: (604) 687-1117
TELEX: 04-507709

October 19, 1987

Pioneer Metals Corporation
Suite 1770 - 885 West Georgia St.
Vancouver, B.C.
V6B 5A1

Equity Silver Mines Limited
1600 - 1055 Dunsmuir St.
Vancouver, B.C.
V7X 1P1

Re: Gaul Group

The Gaul Group of 20 claims and fractions in the Omineca Mining Division adjoin the Equity Silver Mines property to the south in the Omineca Mining Division. The claims are held by a joint venture between Teck Corporation (39.1%), Pioneer Metals (39.1%) and Equity Silver Mines (21.8%). Teck Corporation is the operator.

The property is underlain by Upper Cretaceous Goosly lake volcanics which are the host rocks for the Equity Silver deposits immediately to the north. Exploration programs have been carried out intermittently during the period 1969 to 1985 and are summarized in a repert by A. I. Betmanis, P.Eng., dated August 30, 1985. Pertinent results from past drilling programs are summarized on the attached Drill Hole Location Map.

In the 1985 diamond drill program, two widely-spaced drill holes (85TG17 and 85TG18) intersected significant but sub-economic silver-copper mineralization over widths of 10 to 69 metres. This zone of mineralization occurs along the southern projection of Equity's South Tail deposit. It is proposed to further test this zone with a series of six NQ diamond drill holes drilled to a depth of 200 metres as shown on the attached plan map.

The overall cost of drilling at this location is estimated to be $100/meter for a total cost of $120,000.00. All parties have agreed to participate pro rata to their interest and therefore the costs will be distributed as follows:

Teck (39.1%)	-	$46,920
Pioneer metals (39.1%)	-	$46,920
Equity Silver (21.8%)	-	$26,160
		$120,000

CORDILLERAN ENGINEERING LTD.

1980 GUINNESS TOWER, 1055 WEST HASTINGS STREET, VANCOUVER, B.C. V6E 2E9 TEL: (604) 681-8381

October 9, 1987

Mr. J. W. Stollery, President
Fairfield Minerals Ltd.
1980 - 1055 W. Hastings Street
Vancouver, B. C.
V6E 2E9

copy to: → Mr. R. T. Heard
Equity Silver Mines Limited
708 - 1155 W. Pender St.
Vancouver, B. C. V6E 2P4

Dear John:

RAM PROJECT - PROGRESS REPORT
PERIOD: SEPTEMBER, 1987

Field exploration on the Ram property is complete for 1987. The snow line was at 5000 feet elevation from September 14 on.

GEOCHEMISTRY

A total of 7940 soil samples were collected and sent for analysis. Complete results have been received for 7360 of these; the remainder are expected by October 16. Soil anomalies defined from these results were prospected, and in many cases detail sampled.

MAPPING AND PROSPECTING

The area of the Trout showing, located on the southern edge of the Seagull grid, was mapped, prospected and soil sampled. The showing consists of a massive sulphide vein 4.5 m thick exposed in a creek cut. It can be traced northwards in the creek valley for about 100 m, using float boulders.

A second showing was found on the east side of Seagull Creek, between lines 5600N and 5800N. This one, called the Mouse, consists of rusty massive pyrrhotite, pyrite and minor arsenopyrite in altered syenite. Samples were obtained from all exposures, and a soil sample line run along the strike.

Between the Trout and the Mouse are a strong soil geochemical anomaly (Pb, Ag, Au, As) and a magnetic anomaly. Old diamond drill pads were found near the Mouse showing and the combined geochemical/magnetic anomaly.

A large Pb, Ag, Zn soil anomaly was defined north of the Bnob barite showing. Follow-up work in this area included additional soil sampling and led to the discovery of two small "kill zones" and an old diamond drill site.

October 9, 1987

Ram Project - Progress Report - October 9, 1987

The North Skarn area, which includes the P-zone and Wood sulphide showings, was traced 1600 m to the south before the area was covered with snow. Numerous sulphide-rich exposures were sampled.

STAKING

Thirty eight additional claims were staked in late September to fill the gap between the Ram and Mat claims and Cominco's Tay claims, on the west side of the Ram claim block. Cominco were diamond drilling on the east edge of their claims in late September. The new claims, Ram 759-796, will be recorded in mid October.

CAMP DEMOBILIZATION

The Ram camp equipment was demobilized by helicopter and pickup truck to Ross River on September 25.

Compilation of results is underway.

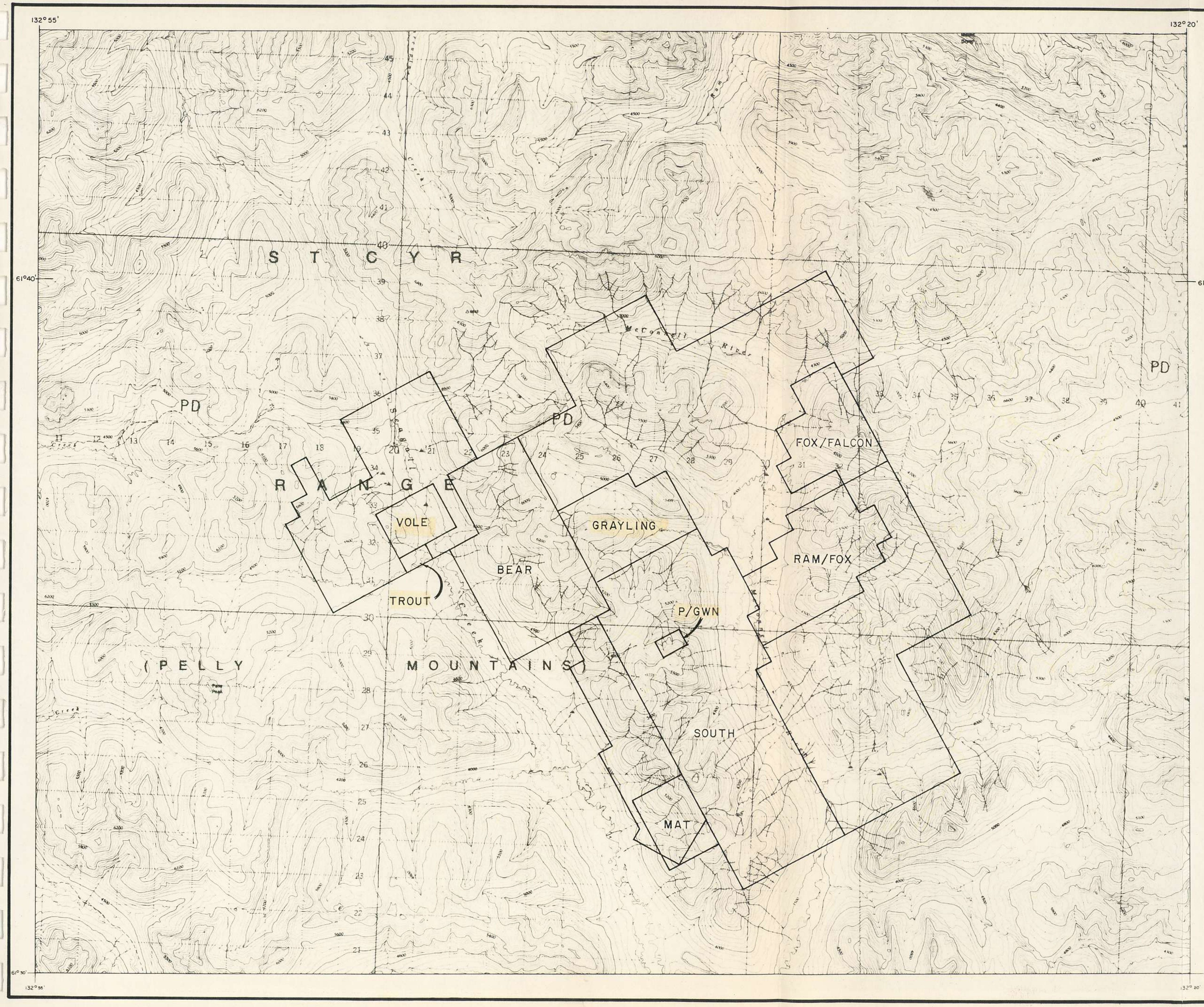
Yours very truly,

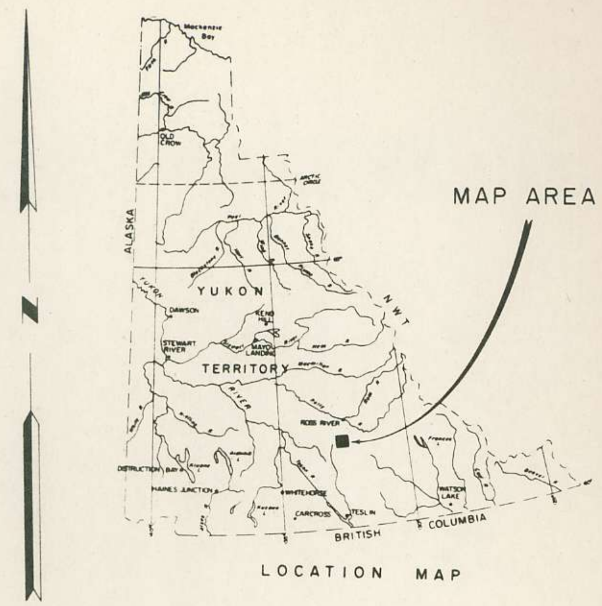
CORDILLERAN ENGINEERING LTD.

Hylands

J. J. Hylands, P. Eng.
Project Manager

JJH/l





LOCATION MAP

FAIRFIELD MINERALS LTD.
EQUITY SILVER MINES LIMITED
GRID MAP
RAM PROPERTY AREA

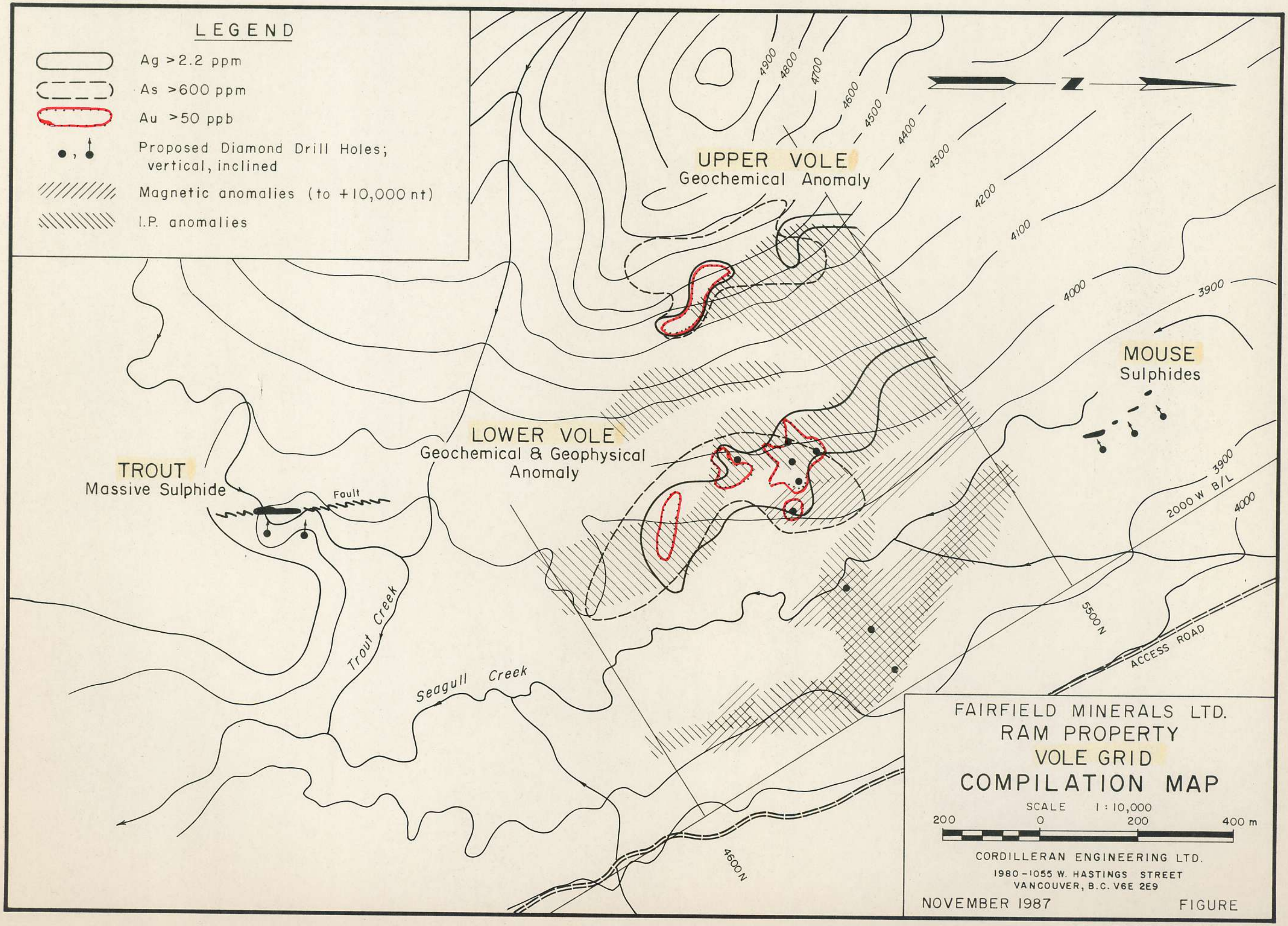
WATSON LAKE MINING DISTRICT, YUKON TERRITORY
NTS 105F-9,10
1 : 100,000

1000 500 0 1000 2000 3000 4000
SCALE IN METRES

BY
CORDILLERAN ENGINEERING LTD.
1980 - 1055 W. HASTINGS STREET
VANCOUVER, B.C. V6E 2E9

NOVEMBER 1987

FIGURE



FAIRFIELD MINERALS LTD.

RAM PROPERTY

VOLE GRID

COMPILATION MAP

SCALE 1 : 10,000

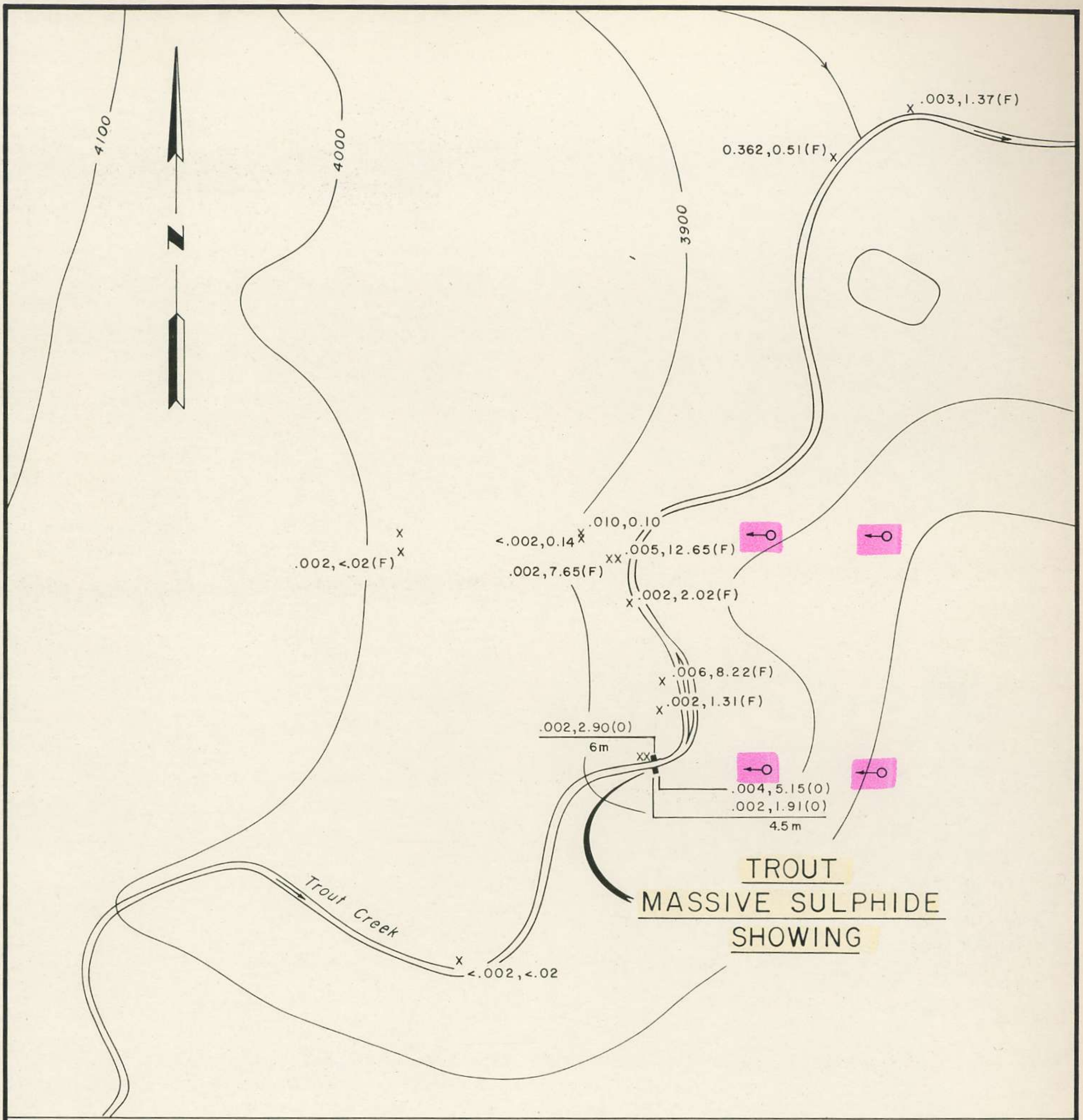
200 0 200 400 m

CORDILLERAN ENGINEERING LTD.

1980 - 1055 W. HASTINGS STREET
VANCOUVER, B.C. V6E 2E9

NOVEMBER 1987

FIGURE



L E G E N D

○→ Proposed diamond drill hole

x Grab sample location

■ Chip sample location

$\frac{.002, 2.90}{6\,\text{m}}$ Au oz/t, Ag oz/t
chip sample length

(O) Outcrop sample

(F) Float sample

Contour interval in feet

FAIRFIELD MINERALS LTD.
RAM PROPERTY
SEAGULL GRID
TROUT SHOWING

SCALE 1 : 2,500

50 0 50 100 METRES

CORDILLERAN ENGINEERING LTD.
1980-1055 W. HASTINGS STREET
VANCOUVER, B.C. V6E 2E9

NOVEMBER 1987

FIGURE

CHIP SAMPLES

ZONE	LENGTH m	Pb %	Zn %	Ag oz/t	Au oz/t
1	6.2	21.82	1.69	15.24	0.176
1	6.0	17.12	2.12	12.18	0.094
2	1.6	27.25	2.23	18.10	0.108
2	1.6	20.85	0.68	14.55	0.092
DDH #1	2.3	8.07	1.12	6.26	0.28
DDH #4	3.6	8.95	4.95	6.41	0.047

LEGEND

8	Syenite
7	Metasiltstone
M	Marble
●	Massive Sulphides
1	Upper Sulphide zone Po - Gn - Py - Sp - As
2	Lower Sulphide zone Po - Gn - Sp - Py - As
▨	I.P. anomaly
○	Outcrop
x	Sulphide float
— —	Assumed Contacts
←○ 1+2	1969 Diamond Drill Holes
✱	Proposed Diamond Drill Holes

FAIRFIELD MINERALS LTD.

RAM PROPERTY
GRAYLING GRID

GRAYLING SHOWING
COMPILATION MAP

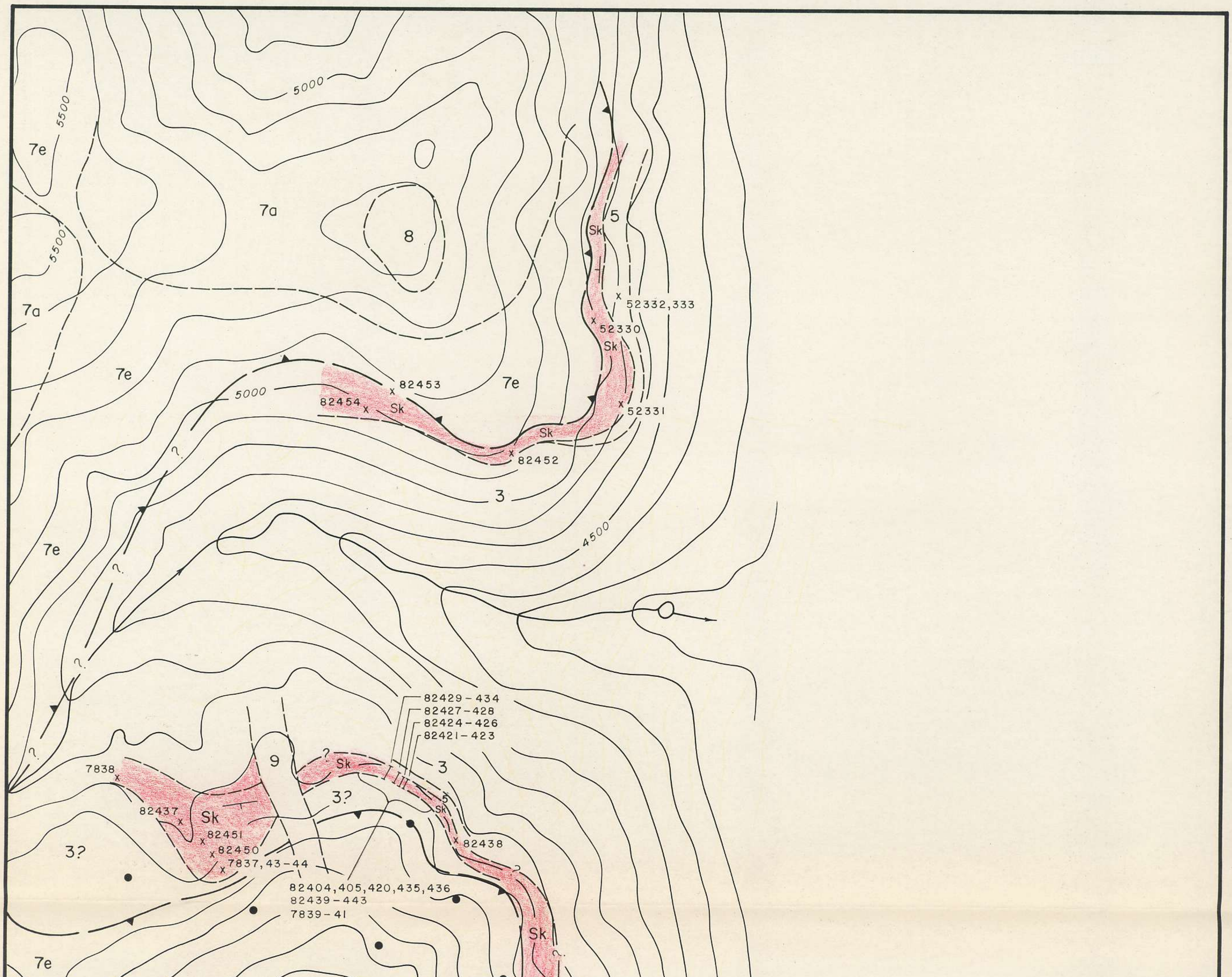
SCALE 1 : 1,000

20 0 20 40 METRES

CORDILLERAN ENGINEERING LTD.
1980 - 1055 W. HASTINGS STREET
VANCOUVER, B.C. V6E 2E9

NOVEMBER 1987

FIGURE



LEGEND

9	Andesite dykes
Mississipian	
8	Syenite
7a	Intermediate flows and tuffs
7e	Siltstone, phyllite
Devonian	
5	Carbonate
Siluro Devonian	
3	Quartzite

🟥 Sk	Skarn
x 7838	Sample point with number
⌇⌇⌇	Normal fault
▲	Thrust fault
– – –	Contact
●	Proposed drill hole
⊥	Relative attitude of skarn

Contour Interval = 100 feet

N

FAIRFIELD MINERALS LTD.

RAM PROPERTY
SOUTH GRID

**SKARN SHOWINGS
COMPILATION MAP**

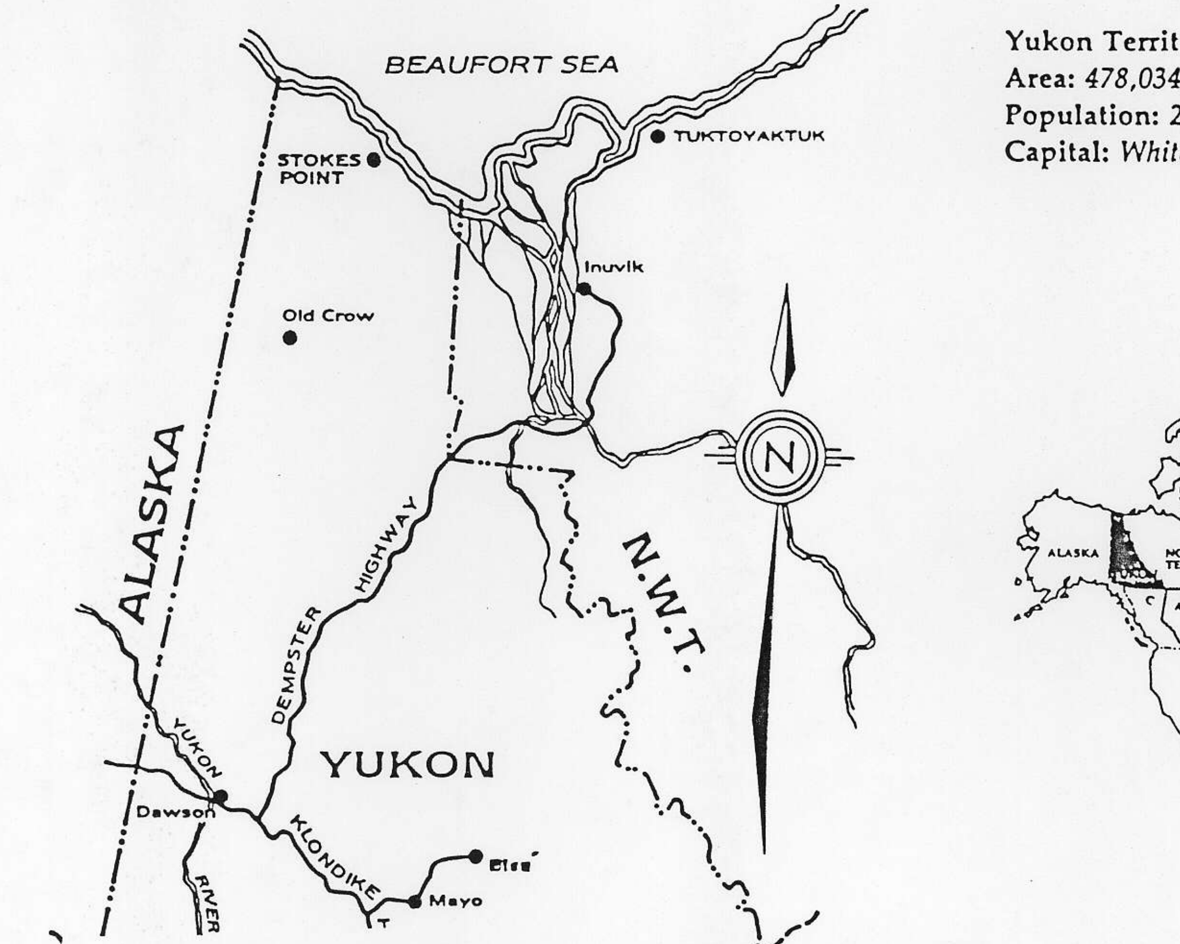
SCALE 1:10,000
200 0 200 400 METRES

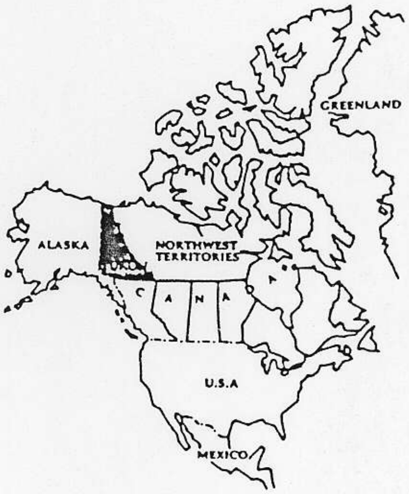
CORDILLERAN ENGINEERING LTD.
1980-1055 W. HASTINGS STREET
VANCOUVER, B.C. V6E 2E9

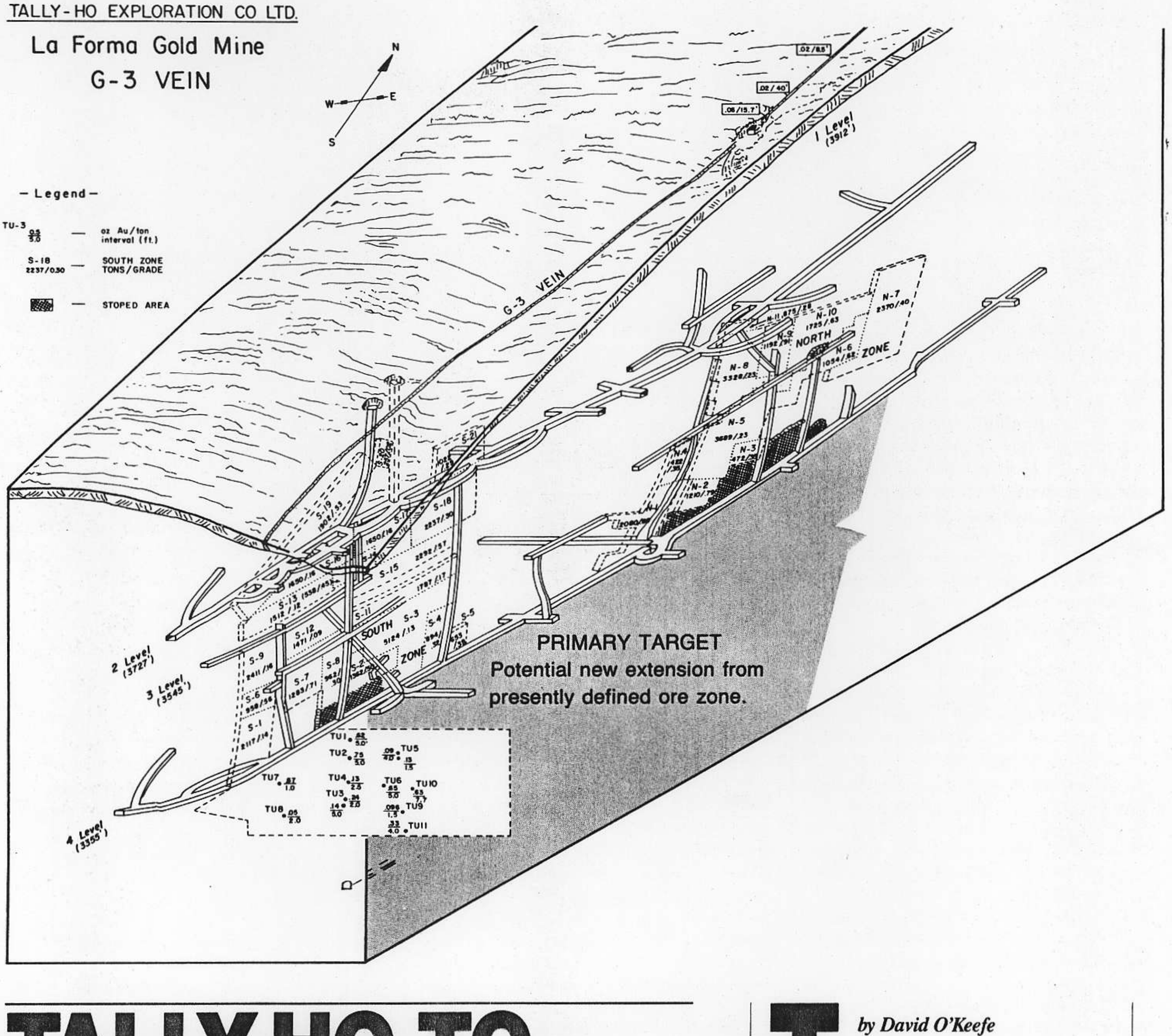
NOVEMBER 1987

FIGURE

Yukon Territory
Area: *478,034 sq. km.*
Population: *25,000*
Capital: *Whitehorse*







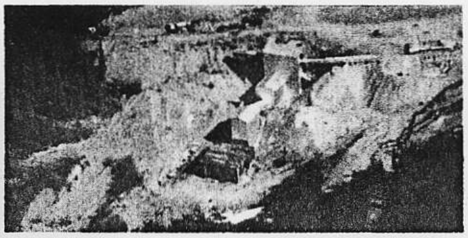
PRIMARY TARGET
Potential new extension from presently defined ore zone.

TALLY-HO TO SPEND $1.6 MILLION ON THE LA FORMA MINE

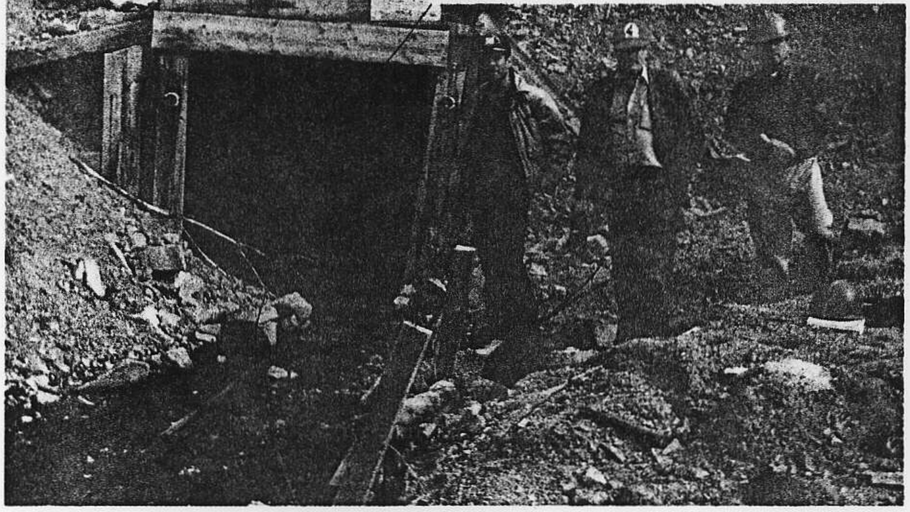
by David O'Keefe

The much explored La Forma gold mine, 42 miles from Carmacks in the Yukon, is poised to finally yield its gold to Tally-Ho Explorations which has optioned the property from Toronto-based Discovery Mines.

Located on the south slope of Mt. Freegold, the property was first recognized in 1930 when lode gold was discovered on the mountain's northwest slope. In 1931 the mines "G-3" vein was developed and mined at ten tons a day in 1939-40. Discovery Mines re-opened the La Forma



The site of La Forma's old surface facilities and the location of Tally Ho's current drilling program.



Company president Glen MacDonald at the #4 portal with two of Merryl Lynch's financial consultants.

in 1965 and mined at the rate of 100 tons per day until 1966.

It is generally agreed that Discovery was hasty bringing the mine into production but it was rapidly approaching a deadline that would enable it to qualify for Federal Government assistance. Consequently the deposit was not sufficiently understood and there were more than normal start-up problems. From the beginning there was an imbalance between the calculated grade of the mine run ore and the grade of the mill feed. At mine closure calculated reserves above the 4th level stood at 68,546 tons of an average grade of 0.44 ounces a ton over a 5.5 feet mining width.

In a recently completed evaluation on the La Forma by professional engineer J.E. Wallis, he draws upon the Arctic Red Resources drill program completed in 1983, which calculated mine reserves below the 4th level to be 125,000 tons grading 0.353 ounces per ton. Because of the strength and consistency of the G3 vein system so far tested, Wallis feels that the Arctic Red estimates are conservative and that further drilling down dip and to the north has the potential of at least doubling the reserves.

As it presently stands, Tally-Ho claims proven reserves of 80,000 ounces of gold and the inferred extension of the main zone to contain a further 80-100,000 ounces of gold, both from an average cut and diluted ore grade of 0.40 ounces per ton.

Tally-Ho's exploration program consists of three major parts, 2,000 feet of large diameter drilling to test a new zone, the G-3 Extension, offset some 1,400 feet northeast along the Pal Fault, the driving of a 5th level below the old workings and further drilling of the north zone.

With the recommendation for the new #5 level drift, which will in itself cost well over a million dollars, Mr Wallis has outlined a number of advantages this new adit would have over alternative methods of extending the reserves. The drift would examine a long geologic structure before reaching the G-3 zone and could result in finding additional ore zones. It would also allow for accurate sampling when the main zone is reached, possible down dip reserves could be drill tested, it would also provide drainage and give the workings a means of natural ventilation.

The G-3 extension is considered to be a major exploration target with a potential strike length of 1,500 feet. In 1974 a four hole drill program was undertaken to test this structure. Core recovery was poor but considerable visible gold was seen in quartz pebbles that were recovered.

The strength of the structure was confirmed when two of the holes intersected a narrow vein, with hole 75-16 assaying 8.13 ounces of gold over 1.3 feet. A third hole, 75-14, intersected a wide shear zone of blue grey quartz and assayed 0.37 ounces over 5.2 feet and 0.38 ounces across four feet. The experience of past explorers and the accumulated knowledge of the property's geological characteristics shows that large, HQ, diamond drills will enhance core recovery.

The other important target is the extension of the north zone, down dip and to the north below the 4th level. Tally-Ho's consultants feel this has the greatest potential for expanding reserves as it is open to the north and to depth. Four alternative methods of exploring this zone have been proposed, two include cross cutting from #4 level to establish drill stations, a third to sink a 400 foot internal shaft and drift 3,400 feet north and then west and fourth to continue the #5 level drift northerly, establishing drill stations every 300 feet to test above and below this new level.

Although much of the company time has been spent on the La Forma project, it is not neglecting its high grade silver property in the Yukon's Rancheria District.

The Rancheria District is rapidly becoming an important area for exploration. Tally-Ho's property, joint ventured with Croesus Resources appears to justify the attraction. There are three potential ore zones on the property that have returned assays ranging from 20.3 to 172.8 ounces of silver per ton. The property lies to the east of one controlled by Silver Hart Mines on which we understand a production decision is expected this year.

Tally Ho also has an interest in production from a Wheaton River property that is under option to Academy Resources. Initial results from Academy show very high grade gold values from grab samples from the vein quartz, two of the four samples exceeded 5 ounces of gold per ton, a third returned 1.234 ounces of gold over a six foot six inch width and the fourth 0.328 ounces of gold over 20 feet.

Tally-Ho is well served by its considerable depth in mining experience and business management. President is Professional Geologist Glen Macdonald, with fifteen years experience in exploration and working at management level with major Canadian mining companies. He has a first rate knowledge of northern mining, studying for a time at the University of Alaska and is a Past President of the Yukon Chamber of Mines.

Macdonald is backed-up by George Camsell, a geological consultant who has had better than forty years of exploration experience with major mining companies and retired mining engineer Bob Kilgour, also with over forty years experience in managing mines in northern Canada and Ireland.

For further information on Tally-Ho contact Mr. Glen MacDonald, Suite 214-475 Howe Street, Vancouver, B.C. V6C 2B7. Telephone (604) 684-2305.

SY PROJECT

Summary

Twenty-one diamond drill holes were located for a total of 2099.1 m. to test for gold bearing iron formations at depth based on geophysical, geological and geochemical data. Two drill holes on the Jaeger East Zone extended the strike length of known iron formations and returned gold values and thicknesses comparable to those encountered in 1986. These values are not economic at present price levels.

Drilling en the other zones intersected thin iron formations with only barren to anomalous gold values (less than 2 gpt). A number of shear, alteration and sulphide rich zones encountered in the drilling also returned very poor gold values (less than 0.5 gpt).

No further drilling is recommended on the iron formation type prospects.

Results of the 1987 exploration program in the Reconnaissance area indicate some modest encouragement with locally encouraging results. Further work such as an airborne mag survey over the south boundary of the SY volcano-sedimentary belt and follow-up ground geophysics and possible soil sampling or prospecting is warranted. However, in light of the remoteness of this property and high operating costs a program involving drilling is not recommended for 1988.

CAMERON RIVER PROJECT

Northwest Territories

Location:

The AP property on Cameron River is 43 air miles northeast of Yellowknife. Access is by aircraft but the property is close to a winter road route used to service Lupin Mine.

1987 Work Program

1. Airborne geophysics - VLF, EM & Mag - 300 line km.
2. Ground geophysics - VLF to detail airborne anomalies.
3. Four diamond drill holes - 1500 feet.

Results

Sulphides were found in every drill hole, explaining geophysical anomalies.

Assay values ranged from .002 to 0.020 o/t gold.

Conclusions & Recommendations

Gold values are uneconomic, therefore no further work should be done. The recommendation is to return the property to the original vendor.

N.C. CARTER, Ph.D., P.Eng.

Consulting Geologist

1410 Wende Road
Victoria, B.C. V8P 3T5
(604) 477-0419

September 28,1987

Mr. R.T. Heard,P.Eng.
General Manager - Exploration
Equity S lver Mines Limited
708 - 1155 West Pender Street
Vancouver,B.C.
V6E 2P4

Dear Mr. Heard:

Re: George Lake Project
Octopus Lake
Kenora Mining Division, Ontario

This prospect, on the Trans-Canada highway 30 miles east of Kenora, was examined with G. Irving and R.T. Heard September 24, 1987.

The property consists of 16 mining claims north and south of the Trans-Canada highway in the east-central part of Tustin Township. Country rocks are fine-grained biotite schists which have an overall northerly trend with moderate westerly dips.

A pyrrhotite-pyrite sulfide zone, exposed in highway rock cuts, can be traced 1500 ft. north and 1.5 miles south to a point just north of the CP railway line. While much of the zone has a northerly trend, roughly conformable with enclosing host rocks, it has an apparent east-northeast trend at both its known north and south limits.

Recent stripping for assessment purposes has been undertaken on claims 1011164 and 940308. The sulfide zone, which is locally massive and contains chalcopyrite and bornite in addition to pyrite and pyrrhotite, is usually associated with dark grey-blue quartz. Excellent new exposures were seen in recent trenching for twinning the existing natural gas pipeline just south of the highway. Apparent widths of the zone were in the order of 20 feet.

1500 feet north of the highway, on a peninsula on Octopus Lake, the sulfide zone is exposed in a number of old pits and a 20 ft. shaft. Three short holes (40-76 ft.) at 100 ft. spacings, drilled in this area in 1953, intersected banded pyrrhotite-pyrite-chalcopyrite over 7 to 17.5 ft. lengths. No assays were reported.

At this point, the strike of the zone abruptly changes from northerly to east-northeast, parallel to a fault shown on the geological map. Old sketch maps show additional pits along this trend, 1500 ft. east and outside the present property boundary.

Conclusions and Recommendations

The sulfide zone is intermittently exposed over a strike length of nearly 2 miles. Where exposed, widths are in the order of 10 to 20 feet and parallel zones are exposed in the highway cuts. Local concentrations of chalcopyrite and bornite suggest at least good copper grades in addition to low nickel, cobalt and platinum group metals grades indicated by previous sampling.

It would be surprising if at least some precious metals values were not present in a few of the samples collected during the property examination.

It may be significant that most of the earlier work was done in the area of the abrupt change in strike of the zone near its known northern limits. Additional work may be warranted in the southern end of the zone where a similar situation may exist.

Several old pits are indicated in an area which is outside the present claims area. Additional claims may be required.

NCarter

ST. JOE CANADA INC.
111 RICHMOND STREET WEST, SUITE 1116
TORONTO, CANADA M5H 2J4
(416) 367-1031

MEMORANDUM

To: Terry Heard Date: November 25, 1987

From: Rob Giberson

Re: Information Request, Jewett Lake J.V.

Summer 1987

Jewett Lake Property

Linecutting	318 km
Geological Mapping	536 km
Max-Min II	260 km
Magnetometer	260 km

Drum Lake Property

Linecutting	148 km
Max-Min II	129 km
Magnetometer	124 km

Fall 1987

Diamond Drilling (3985m)

Jewett North	18 drill holes
Jewett South	10 drill holes
Knupp Grid	5 drill holes
Drum Lake	7 drill holes
Total	40 drill holes

1,000 samples for Au

JEWETT LAKE FALL '87 DRILL PROGRAM SUMMARY

as of November 24, 1987

Hole	Westing	Northing	Depth	Azimuth	Dip	Start	Finish	Property
J87.01	25+00E	66+00N	40.5	180	-45	03/10/87	04/10/87	Jewett North
J87.03	34+25E	64+40N	94.2	215	-45	04/10/87	05/10/87	Jewett North
J87.04	35+25E	63+70N	72.5	215	-45	05/10/87	06/10/87	Jewett North
J87.05	40+00E	58+75N	118.3	180	-45	06/10/87	08/10/87	Jewett North
J87.06	41+00E	57+20N	124.7	180	-45	08/10/87	09/10/87	Jewett North
J87.07	35+00E	55+90N	103.3	180	-45	09/10/87	10/10/87	Jewett North
J87.08	34+00E	56+20N	102.4	180	-45	10/10/87	11/10/87	Jewett North
J87.09	33+00E	47+90N	106.4	180	-45	11/10/87	12/10/87	Jewett North
J87.10	32+00E	52+65N	112.4	180	-45	12/10/87	13/10/87	Jewett North
J87.11	28+00E	57+85N	91.2	180	-45	13/10/87	14/10/87	Jewett North
J87.12	26+00E	58+25N	110.0	180	-45	14/10/87	15/10/87	Jewett North
J87.02	7+00E	64+40N	110.0	180	-45	15/10/87	16/10/87	Jewett North
J87.13	20+00E	48+35N	110.0	180	-45	16/10/87	17/10/87	Jewett North
J87.14	21+00E	48+55N	100.3	180	-45	17/10/87	18/10/87	Jewett North
J87.15	34+00E	38+05N	110.0	180	-45	18/10/87	19/10/87	Jewett North
J87.16	45+00E	41+92N	100.8	180	-45	19/10/87	20/10/87	Jewett North
J87.17	55+00E	38+95N	95.0	180	-45	20/10/87	21/10/87	Jewett North
J87.18	58+00E	41+50N	97.2	180	-45	21/10/87	22/10/87	Jewett North
J87.19	51+00E	25+05N	82.0	180	-45	22/10/87	23/10/87	Jewett South
J87.20	50+00E	26+25N	90.0	180	-45	23/10/87	24/10/87	Jewett South
J87.21	69+00E	16+75N	213.1	180	-45	24/10/87	26/10/87	Jewett South
J87.22	70+00E	17+10N	100.3	180	-45	26/10/87	27/10/87	Jewett South
J87.23	7+00E	0+40N	97.2	145	-45	27/10/87	28/10/87	Knupp Grid
J87.24	24+00E	0+10N	95.0	145	-45	28/10/87	29/10/87	Knupp Grid
J87.25	24+00E	1+85N	95.0	145	-45	29/10/87	30/10/87	Knupp Grid
J87.26	26+00E	1+90N	90.0	145	-45	30/10/87	31/10/87	Knupp Grid
J87.27	31+00E	4+35S	95.0	145	-45	31/10/87	01/11/87	Knupp Grid
J87.28	112+00E	44+40N	95.0	180	-45	01/11/87	02/11/87	Jewett South
J87.29	125+00E	51+80N	90.2	180	-45	02/11/87	03/11/87	Jewett South

Hole	Westing	Northing	Depth	Azimuth	Dip	Start	Finish	Property
J87.30	102+00E	49+65N	94.2	180	-45	04/11/87	05/11/87	Jewett South
J87.31	83+00E	43+80N	91.2	180	-45	05/11/87	06/11/87	Jewett South
J87.32	74+00E	37+20N	68.0	180	-45	06/11/87	07/11/87	Jewett South
J87.33	75+00E	33+30N	92.0	180	-45	07/11/87	09/11/87	Jewett South
J87.34	19+00S	0+70E	80.0	270	-45	09/11/87	10/11/87	Drum Grid
J87.35	8+00S	5+25E	90.5	270	-45	11/11/87	12/11/87	Drum Grid
J87.36	2+00S	6+90E	90.2	270	-45	12/11/87	13/11/87	Drum Grid
J87.37	9+00W	6+15N	90.2	180	-45	13/11/87	14/11/87	Drum Grid
J87.38	8+00W	0+60N	153.3	200	-45	14/11/87	15/11/87	Drum Grid
J87.39	13+00W	1+30S	100.3	200	-45	15/11/87	17/11/87	Drum Grid
J87.40	34+00W	5+25S	90.8	200	-45	17/11/87	18/11/87	Drum Grid

PROGRESS REPORT
Freeman-Buteux (111036)
April - October 1987

The field work is about completed except for some sampling of core from drilling done by Shell in 1977-1978.

- Line cutting has been done on six different grids for a total of 154.3 km.

  Magnetometer surveys have been done on all of the grids (144.1 km) plus horizontal E.M. (max.-min.) for 113.7 km.

  One grid has been covered with I.P. since the ground is rather swampy and no "Input" anomalies were revealed by Shell's airborne survey.

- Prospection was done on all of the grids plus reconnaissance outside the grids. A total of 610 samples were taken for analysis.

- Geological survey was conducted on all of the grids and about 200 samples were taken for different tests.

- Thirteen diamond drill holes for a total of 1114 meters have been done on five of the six grids. These holes were to test geophysical anomalies.

  All the results were received from the laboratories for the prospection, diamond drilling and geology. A promising target came from the reconnaissance prospection where a value of 4.17 gr/t in gold was found in a shear zone. This zone is parallel to one of Shell's airborne anomaly but 80-100 meters north. Since the crews were out of the field when the results came, no detail was done. From Shell's ground geophysics, a weak magnetic anomaly coincides with the shear zone and can be traced for at least 700 meters.

- Another promising target is from the sampling of Shell's core which was drilled in 1977-78. From one of the holes we have an anomalous gold zone of some 17.1'. The following values were reported in an intermediate tuf with 5-12% Py, Po.

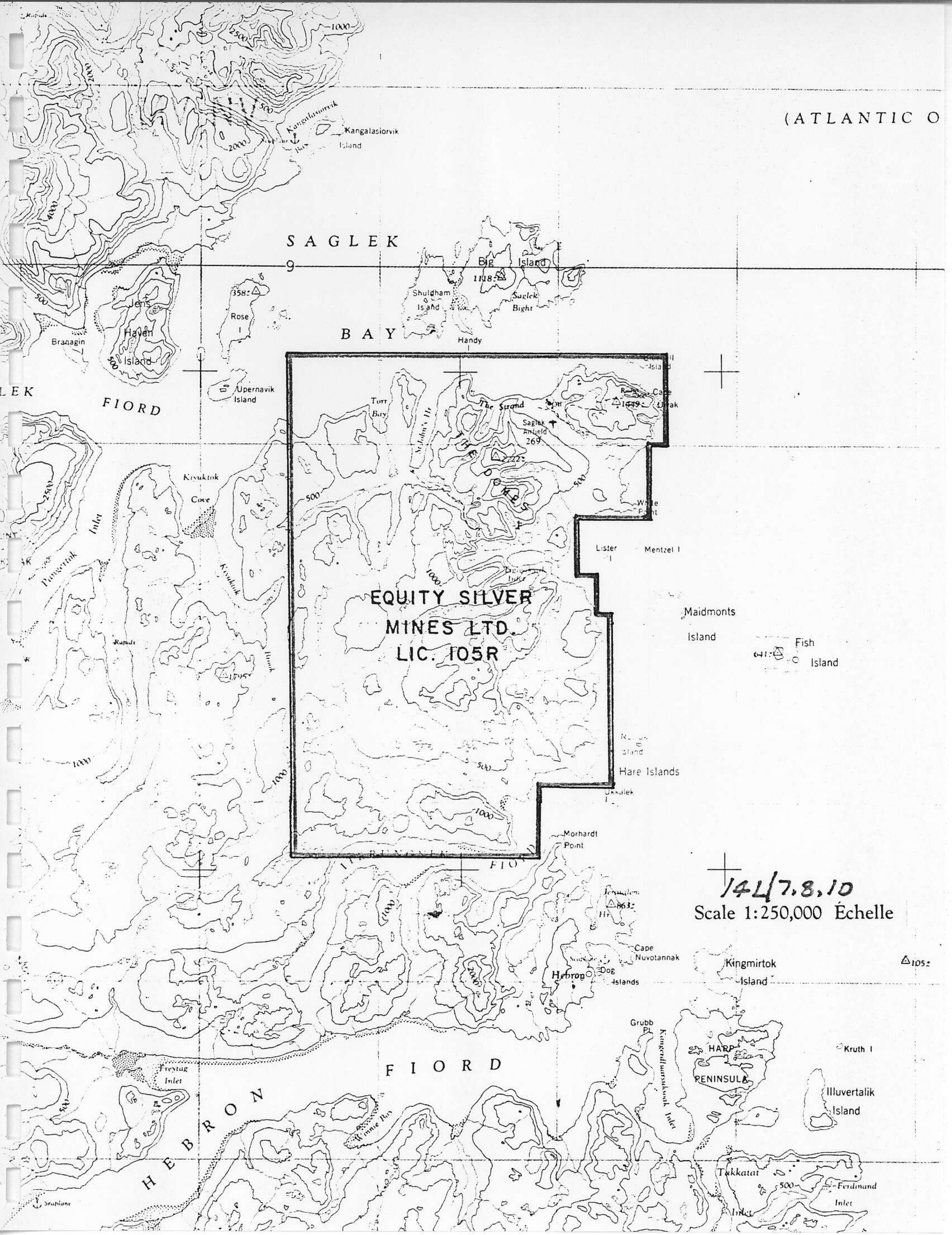
(Mainly Quartz)	149.0'-151'0 (2')	2.530 P.P.B.
	151.0'-154.0' (3')	6.500 P.P.B.
	154.0'-157.5' (3.5')	1.530 P.P.B.
	157.5'-162.5' (5')	970 P.P.B.
	162.5'-166.1' (3.6')	900 P.P.B.

The airborne geophysical survey shows an anomaly with a strike lenght of 800 meters which would be coinciding with the intersection. The magnetic survey shows a structure with extends for at least 1.5 km.

The reports are now being written and should be completed in December.

658 , 40 acre claims .

Gérald Thériault
Project Manager


(ATLANTIC O
SAGLEK
BAY
Kangalasiorvik
Kangalasiorvik Island
Big Island
1118
Shuldham Island
Saglek Bight
358
Rose I
Jens Haven Island
Branagin
FIORD
Upernavik Island
Handy I
Torr Bay
The Strand
Saglek Airfield 269
THE DOMES
2722
Cape Uivak
1449
White Point
Lister I
Mentzel I
EQUITY SILVER
MINES LTD.
LIC. 105R
Maidmonts Island
Fish Island
641
Hare Islands
Ukkalek I
Morhardt Point
Kiyuktok Cove
Kiyuktok
Pangertok Inlet
Rapids
1795
Jerusalem Hr
863
Cape Nuvotannak
Hebron
Dog Islands
Kingmirtok Island
105
Grubb Pt
HARP PENINSULA
Kruth I
Illuvertalik Island
Kangerdluarsuksoak Inlet
FIORD
HEBRON
Freytag Inlet
Winnie Bay
Takkatat
Ferdinand Inlet
Seaplane
500
1000
2000
2500
4000
Scale 1:250,000 Échelle

14L/7.8.10

Geology of the Springdale Group: a newly recognized Silurian epicontinental-type caldera in Newfoundland

MARYLOU COYLE AND D. F. STRONG

Department of Earth Sciences and Centre for Earth Resources Research, Memorial University of Newfoundland, St. John's, Nfld., Canada A1B 3X5

Received May 16, 1986

Revision accepted November 26, 1986

Volcanic–sedimentary facies and structural relationships of the Silurian Springdale Group in west-central Newfoundland are indicative of a large collapse caldera with an area of more than 2000 km². Basaltic flows, andesite flows and pyroclastic rocks, silicic ash-flow tuffs, high-silica rhyolite domes, and volcanically derived debris flows and breccias, fluviatile red sandstones, and conglomerates make up the group. It is bounded on the east and west by up-faulted basement rocks, which include gneisses, amphibolites, and pillow lavas, and in the northwest it unconformably overlies Lower Orodovician submarine volcanics. These margins are intruded by cogenetic and younger granitoid rocks. The volcanic rocks form a calc-alkaline series, although gaps in silica content at 52–56, 67–68, and 73–74% separate them into four groups: basalts, andesites–dacites, rhyolites, and high-silica rhyolites.

The high-silica rhyolites are chemically comparable to melts thought to form the upper parts of large, layered silicic magma chambers of epicontinental regions. Such an environment is also suggested by the large area of the Springdale caldera and the fact that it is one of a number of calderas that make up a large Silurian volcanic field in western Newfoundland. An epicontinental tectonothermal environment for central Newfoundland in Silurian–Devonian times is readily explained by the fact that this magmatic activity followed a period of destruction and closure of the early Paleozoic Iapetus Ocean, with trapped heat and basaltic magma causing large-scale melting of thickened and subducted continental crust in an overall transpressional tectonic regime.

Le faciès volcano-sédimentaire et les relations structurales du groupe de Springdale, d'âge silurien, dans la partie centre-ouest de Terre-Neuve témoignent de l'existence d'une immense caldeira d'effondrement qui occupe une aire de plus de 2000 km². Ce group est formé de coulées basaltiques, de coulées andésitiques et de roches pyroclastiques, de coulées de cendre siliceuse, de dômes de rhyolite hypersiliceuse, de coulées de débris et de brèches d'origine volcanique de grès rouges fluviatiles et de conglomérats. Le groupe se bute à l'est et à l'ouest contre les roches du socle soulevées par des failles incluant des gneiss, des amphibolites et des laves en coussins, et au nord-ouest il repose en discordance sur les volcanites subaquatiques d'âge ordovicien inférieur. Ces bordures sont recoupées par des intrusions de roches granitoïdes cogénétiques. Les roches volcaniques forment une séquence calco-alcaline, quoique l'absence de contenu en silice à 52–56, 67–68 et 73–74% autorise une division en quatre groupes : basaltes, andésites–dacites, rhyolites et rhyolites hypersiliceuses.

Les rhyolites hypersiliceuses sont chimiquement analogues aux magmas qui se forment vraisemblablement dans les parties supérieures des grandes chambres à magma silicique stratifié des régions épicontinentales. Cette hypothèse est appuyée par la grande surface occupée par la caldeira de Springdale, qui en réalité ne représente qu'une parmi plusieurs caldeiras qui forment le vaste champ volcanique silurien dans la partie occidentale de Terre-Neuve. Un environnement tectonothermique épicontinental au centre de Terre-Neuve au Silurien–Dévonien s'explique aisément par le fait que cette activité volcanique s'est manifestée postérieurement à une période de destruction et de fermeture de l'océan Iapetus du Paléozoïque inférieur, où le piégeage de chaleur et le magma basaltique provoquèrent une fusion à grande échelle de l'épaisse croûte continentale subductée au sein d'un régime de tectonique de transpression.

[Traduit par la revue]

Can. J. Earth Sci. 24, 1135–1148 (1987)

Introduction

Calderas are the topographic and volcanological manifestations of shallow magma chambers and result from deeper seated thermal processes that ultimately reflect global-scale tectonic activity. Accordingly, the documentation of ancient calderas and their products provides essential magmatic and tectonic insights into the evolution of ancient terranes. Calderas have been described or inferred at a few localities in the Silurian–Devonian volcanic belts of the Appalachians from Scotland to Maine (Fig. 1), but they have received little study. Because of the differing structural levels at which they are now exposed, they may exhibit a wider range of features than seen in more recent volcanic fields and have much to offer for understanding the tectonothermal evolution of the orogen.

In Scotland and northern England (Fig. 1), volcanic rocks are associated with the Silurian–Devonian Old Red Sandstone series of continental sediments. They have received contrasting interpretations, basically centering around their being subduction related or not. Stillman and Francis (1979) considered these volcanic rocks continental and probably not related to subduction, although they did recognize them as a high-potassium calc-alkaline suite. Other workers, e.g., Groome and Hall (1974), French *et al.* (1979), and Thirlwall (1981), interpreted the chemistry of these suites as indicating a subduction-related origin, although they recognized that not all characteristics of such subduction are present.

The correlative rocks in Maine and Quebec are similarly controversial. The Lower Devonian Piscataquis volcanic belt of Maine (Fig. 1) was interpreted by Rankin (1968) as part of "a real island arc system," and he suggested that garnet phenocrysts in the rhyolites reflect their "generation from partial melting of the sediments in the deeper parts of the Appalachian geosyncline." He subsequently rejected this interpretation (Rankin 1980), although he did not suggest any precise alternative. Other Silurian–Devonian volcanic–sedimentary sequences of Maine (e.g., the Spider Lake volcanics,

Printed in Canada / Imprimé au Canada

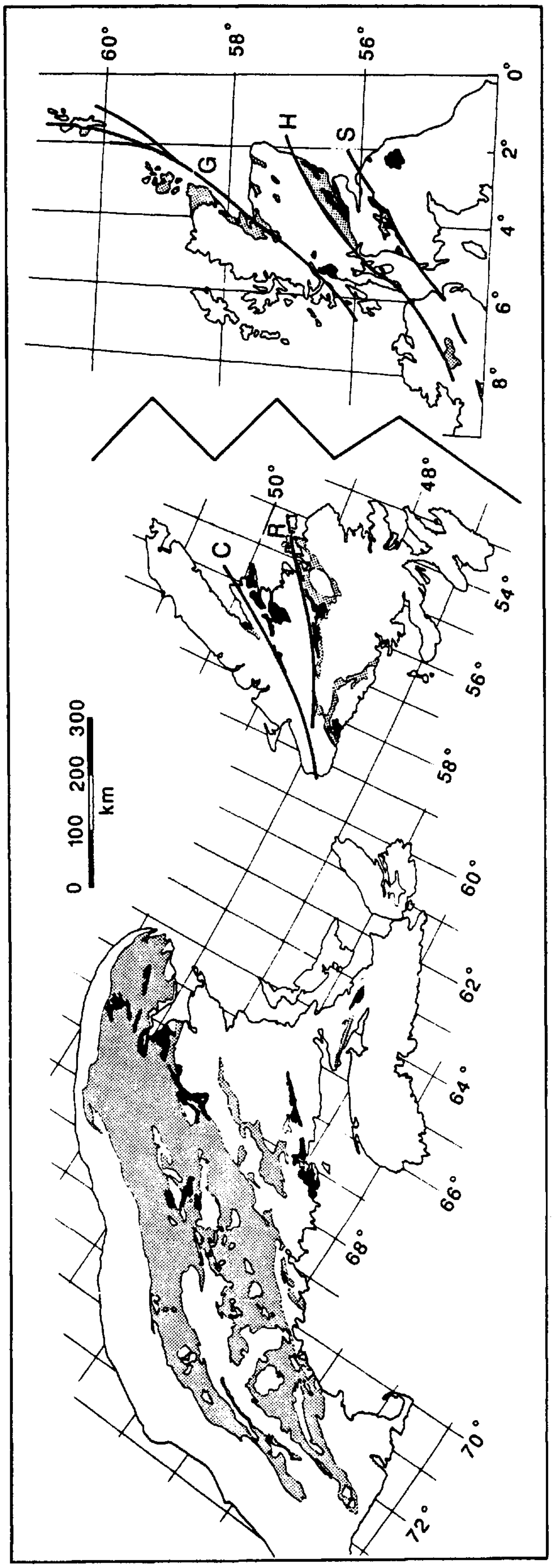


FIG. 1. Distribution of Silurian–Devonian volcanic (black) and sedimentary (shaded) rocks in the northern Appalachians (Williams 1980) and of correlative volcanic and sedimentary rocks of northern Britain (Thirlwall 1981). Lines show major faults in Britain (G, Great Glen; H, Highland Boundary; S, Southern Uplands) and Newfoundland (C, Cabot; R, Reach).

the Hedgehog Formation, the Debouille stock, the Five-mile Brook Formation) appear to represent similar volcanic centres.

Similar-aged rocks in Quebec and northern New Brunswick contain a larger proportion of basaltic and andesitic rocks than some of the centres in Maine, and recent studies in Quebec have provided new interpretations. According to Laurent and Belanger (1984), Silurian–Devonian volcanism of the Gaspé area took place under an intracontinental or continental border regime of compression and was controlled by strike-slip faults. They suggested that the volcanic rocks are richer in Ti, P, and other incompatible elements than those of arc–trench systems, and they proposed a tectonic model analogous to that of the Alpine system in northern Anatolia and Iran, where Quaternary volcanism is associated with major transcurrent fault zones. This model provides an elegant resolution to the problem of contrasting Siluro-Devonian volcanic types and is comparable to that suggested by Strong (1980) for granitoid rocks of similar age throughout the Appalachian–Caledonian orogen.

The Springdale Group is one of a number of Silurian subaerial volcanic–sedimentary–plutonic suites occurring along the western margin of Newfoundland's lower Paleozoic Central Volcanic Belt (Figs. 1 and 2). Despite their extent and potential importance to an understanding of post-orogenic magmatic activity in the Appalachians, they have not previously been geochemically studied, except for the correlative Cape St. John Group, which was interpreted by DeGrace *et al.* (1976) as calc-alkaline. We report here the first geochemical data for the Springdale Group and demonstrate that the rocks are similarly calc-alkaline, somewhat comparable to orogenic calc-alkaline suites of circum-Pacific regions (cf. Ewart 1982).

However, we further show that the group includes a series of high-silica rhyolites that are similar to those derived from large, layered, siliceous magma chambers of continental regions, such as the Basin and Range area of southwestern United States (cf. Lipman *et al.* 1978). The Springdale caldera is unlike any found with orogenic calc-alkaline suites in that its large size, representing a minimum eruption volume of 10^3-10^4 km^3, is matched only by the largest of epicontinental calderas, like those of the southwestern United States. This implies a similar tectonothermal environment for west-central Newfoundland during the Silurian–Devonian, as do the high-silica rhyolite compositions.

Geology of the Springdale Group

Setting

The Springdale Group is one of nine different belts of Silurian–Devonian rocks recognized on the island of Newfoundland (Williams 1967). It can be traced for at least 60 km along strike and possibly a further 100 km southwestward if volcanic inliers within the Topsails complex are included (see Fig. 2.2 of Whalen and Currie (1983*b*)) and reaches a maximum width of 35 km across the centre of the belt (Fig. 2). Comparable Silurian volcanic–plutonic rocks occur in the King's Point complex and the Cape St. John Group, found up to 50 km to the north, and the Mic Mac Lake, Sheffield Lake, and Sops Arm groups to the west (Fig. 2).

The Springdale Group (Fig. 3) is not fossiliferous, so its Silurian age has only been indirectly inferred through correlation with lithologically similar fossiliferous rocks of the Botwood Belt. Chandler *et al.* (in press) have now provided a U/Pb date of 429^{+6}_{-5} Ma for zircon from our unit 10, which is interbedded with sandstone at the top of the Springdale Group

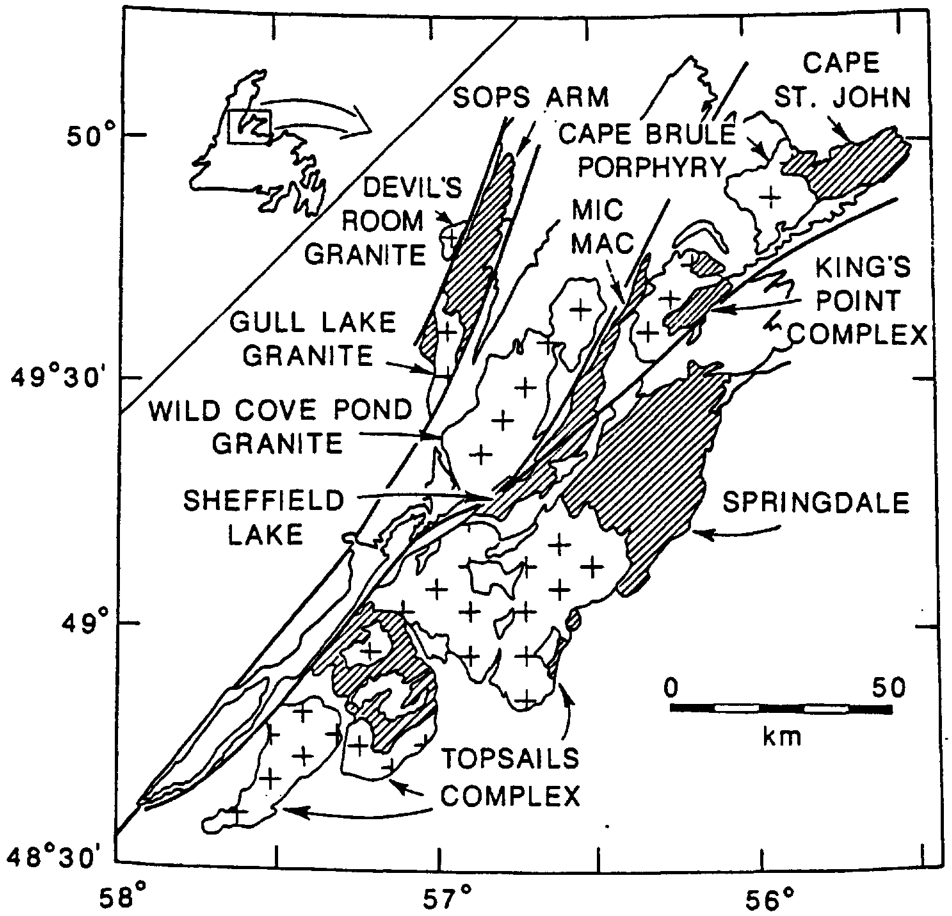


FIG. 2. Distribution of the Springdale Group and correlative volcanic (cross-hatched) and plutonic (crosses) rocks of west-central Newfoundland.

and thus provides an upper limit on its age. This date also supports the correlation of the Springdale Group with rhyolites of southern Newfoundland, which have a U/Pb zircon date of 431 ± 5 Ma (Chandler and Dunning 1983). The Springdale Group volcanic and sedimentary rocks lie unconformably on Lower Ordovician pillow lavas and pyroclastics of the Lushs Bight, Catchers Pond, and Roberts Arm groups, the latter giving a maximum age of ~470 Ma (Nowlan and Thurlow 1984).

Along both its eastern and western boundaries (Fig. 3), the Springdale Group lies unconformably on a basement of foliated granodiorite and diorite comparable to the Mansfield Head complex (Bostock *et al.* 1979) and (or) the Hungry Mountain complex (Thurlow 1981). Intrusive contacts are intermittently exposed and are locally fault modified, but it is clear that both the basement rocks and the Springdale Group are intruded by granitoid rocks, which we correlate with various phases of the Topsails complex.

Rocks of the Springdale Group generally show no penetrative deformation but are folded about a main northerly-plunging synformal axis, which is locally marked by a steeply dipping spaced fracture cleavage. Sedimentary rocks of the group are gently dipping but locally inclined up to 50° on either side of the fold axis. If all units were folded to the same degree, this would indicate across-strike structural shortening of up to about 20%, which would have contributed to the present elongate distribution pattern of the group (Fig. 3).

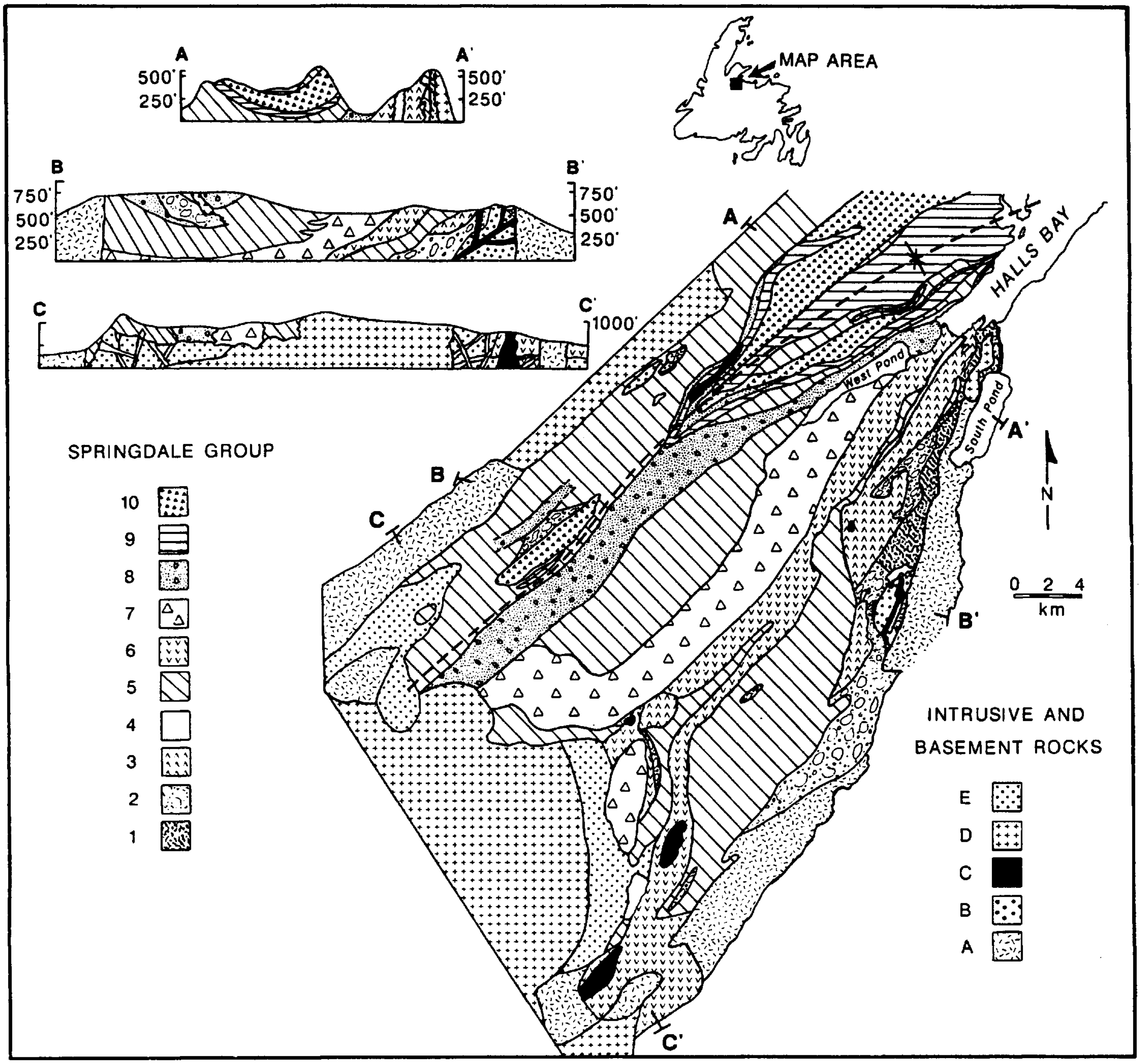
The eastern and western boundaries of the group (Fig. 3), although locally intruded by granitoid rocks, mark early boundary faults along which the group was down-dropped and that partially controlled volcanism, sedimentation, and intrusion of the granitoids.

Map units

Although the numbering sequence for the map units described below is probably in stratigraphic order for exposures in the northern part of the map area (Fig. 3), the intermittent exposure precludes exact correlation and stratigraphic control throughout the group. Accordingly, the units are presented in the legend of Fig. 3 only as lithological groupings and not necessarily in a stratigraphic order. As the lithological features of each unit are summarized in the legend of Fig. 3, the following describes only their geological relationships and highlights their similarities and differences.

Unit 1, the lowermost volcanic unit, has a fault-modified unconformable relationship with the older granodiorite (unit A) and is intruded by younger granitoid rocks (unit E). It is commonly highly fractured or sheared along its eastern margin, probably the result of southeastward thrusting. It differs from the other overlying ash flows in that fractured and broken crystals of both plagioclase and K-feldspar are present, along with accessory biotite, quartz and rare opaques. The lithic component includes clasts of plagiophyric basalts, andesite, ultramafics, red jasper, and granophyric to perlitic felsic fragments. Its restricted distribution and similarity to the South Pond Granite suggest that the two are cogenetic.

Unit 2 is a distinctive and complex assemblage of clastic lithologies best developed along the eastern margin of the



Legend

Springdale Group

10. *Crystal-lithic tuff.* Densely welded and massive; large phenocrysts of quartz and K-feldspar; clasts of mafic and ultramfic lithologies
9. *Calstic sedimentary rocks.* Red conglomerate, sandstone, sandy siltstone, local caliche horizons; cross-bedding, ripples, laminations, rip-up horizons, scour channels, etc. indicate stream-flood and proximal and distal fluviatile origin; clasts are essentially of volcanic provenance, with rare basement lithologies, especially in the northwest
8. *Rhyolitic-vitric ash-flow tuffs and breccias.* Welded, devitrified, locally massive; areas of unwelded vitroclastic air-fall scoria with large, individually devitrified shards, locally passing into sandstone; alternating centimetre-thick basaltic and silicic bands may indicate magma mixing
7. *Dacitic to rhyolitic ash-flow tuff, vitroclastic breccias, and domes.* Massive vitric, strongly welded; curviplanar joint surfaces in the domes with internal plastic shear zones, local brecciation, and flow folds; tuffs locally have crystals of plagioclase and rare quartz
6. *Silicic ash-flow tuffs.* Basal lithophysae-rich horizons grade upwards into partially welded, crystal-lithic lapilli tuff; flattened pumice bombs up to a metre long by several centimetres thick; clasts of silicic volcanics, andesite, and rare basalt; crystal fragments of plagioclase, K-feldspar, and quartz
5. *Flows.* Mainly basalt, some of intermediate composition; locally plagiophyric; display regional propylitic alteration; amygdales of quartz, calcite, and chlorite
4. *Crystal-lithic and lapilli ash-flow tuffs.* Felsic to intermediate, but dominantly dacitic; clasts of andesite, dacite, rhyolite; angular and flattened pumice; variably welded
3. *Flows.* Mainly andesite to dacite, both locally plagiophyric; massive to flow foliated to brecciated; locally massive andesite may be small intrusions
2. *Mesobreccia.* Laharic flows, tuffites, and pepperites, volcanic conglomerates, and breccias; red sandstones
1. *Welded lithic-crystal tuff.* Crystals of plagioclase and K-feldspar, accessory biotite, quartz, and rare opaques; clasts of granophyre, plagiophyric basalt, ultramafics, and jasper

group as elongate lenses, irregularly shaped lobate areas, and separate elongate ridges in contact with basement rocks. The western equivalent is equally extensive along the western margin but is intermittently exposed in marginal fault blocks against basement rocks and intruded by marginal granites. Their distribution indicates that these lithologies have been generated along the margins of the Springdale Group throughout its volcanic and depositional history.

Unit 2 was produced by a variety of physical mechanisms. The predominant feature in all of its lithologies is the large size of the clasts suspended in a finer matrix, i.e., with a strongly bimodal size distribution. These lithologies represent facies developed during volcanic activity and range from near-source explosion deposits to more distal, fluvially reworked sediments. Some debris flows may have been activated on unstable slopes and rapidly deposited, whereas others could have had long periods of reworking. The lithologies of unit 2 are unique to those seen at caldera margins, and as discussed below, this unit is important as a marginal facies marker for the Springdale caldera.

Unit 3 includes intermediate composition flows and flow breccias, interbedded with units 1, 2, 4, and 5, and massive andesite intrusions in unit 5. This unit also includes a linear series of elongate dacitic domal intrusions that trend northeast and represent a vent fracture along the eastern margin. Some phases of the andesites contain blebs of basalt thought to represent the remnants of melt due to mixing of more mafic and silicic magmas.

Unit 4 overlies unit 3, is succeeded by basaltic flows of unit 5, and may be locally gradational into unit 6.

Unit 5 consists mainly of basaltic flows, although some of a probable intermediate composition are too small for separation on the scale of Fig. 3. They are interbedded with other lithologies and are intruded by younger granitoid rocks in the south and west, where they are hornfelsed as a result of contact metamorphism.

Unit 6 is in conformable contact with basaltic flows of unit 5, exposed discontinuously over a strike length of about 44 km. A particular feature of these rocks seen in the northern exposures along Barneys Brook is a 1–2 m thick lithophysae-rich horizon resting on irregular flow tops of unit 5. The individual lithophysae may be as large as 10 cm in diameter, with central cavities partially or completely filled with radiating quartz crystals, microlites, and chalcedony. This horizon grades up over several metres into a partially welded crystal-lithic lapilli tuff.

Unit 7 exhibits welding on weathered surfaces; the welding is flat lying in the southern exposures and becomes more steeply inclined toward the north. Curviplanar joint surfaces are very common in the massive portions of the unit, and internal plastic shear zones and local brecciation can be seen, as well as flow folds, features indicative of domes. Vitroclastic autobrecciated debris is interpreted as the cogenetic pyroclastic aprons of domes in some areas.

Unit 8 extends via intermittent exposures throughout the centre of the map area (Fig. 3). Certain parts of this unit are very massive because of intense welding, and others consist of unwelded vitroclastic tephra with large, individually devitrified axiolitic shards, each showing independent development of spherules. Other parts of this ash-flow tuff breccia have internal auto- and (or) gas-brecciation with clasts of plastically deformed rhyolitic lava and pumice. Mixed magmas are found within the breccias, with alternating thin basaltic–silicic and "mixed" bands. The unit is locally intruded by rhyolitic domes, which may be cogenetic.

Unit 9 forms belts up to 25 km long, 3 km wide in the northeast and narrowing to 500 m at the inner fold closure (Fig. 3). It is interbedded with units 5, 8, and 10 and grades into unit 8 in a few locations. These sedimentary rocks have been described in detail by Wessel (1975), who interpreted them as stream-flood and proximal and distal fluviatile deposits.

Unit 10 is the youngest volcanic unit of the Springdale Group and is interbedded with the sandstones of unit 9 and basalts of unit 5 (Fig. 3). It has a number of unique characteristics that separate it from the rest of the group, i.e., very massive and so strongly welded as to look like an intrusive porphyry, clasts of mafic and ultramafic lithologies, and phenocrysts of quarts and zoned and fractured feldspar, which together can constitute up to 60% of the rock. The clasts are found in a red, brown, or orange vitric aphanitic matrix, are commonly angular, and may have reaction halos, especially around the ultramafic clasts. The fact that these features are exactly matched with those of vent-facies rocks of the King's Point complex suggests that this unit is an outflow facies of the King's Point caldera.

Basement rocks

Unit A, the oldest of the area, is composed of rocks that correlate with the Hungry Mountain complex of Thurlow (1981) and range in origin from presumed Precambrian continental crust to Cambro-Ordovician ophiolitic and island-arc material. The former are mainly foliated amphibolite and gabbro occurring as large screens and xenoliths in foliated diorite and granodiorite. Green and black, medium- to fine-grained diorite, with hornblende and biotite, is intruded or net veined by a pale fine-grained granite, with a typical tectonic fabric emphasized by amphibole alignment. These may be intruded by variably deformed tonalite and amphibole–biotite granite.

Three groups of Lower Ordovician volcanic rocks form the basement along the northern margin of the Springdale Group. They are the Lushs Bight, Catchers Pond, and Roberts Arm groups, all dominated by submarine pillow lavas. The Lushs Bight Group is derived from Iapetus oceanic crust, and it is

INTRUSIVE AND BASEMENT ROCKS

E. *Granite.* Medium- to coarse-grained crystals of quartz and pink K-feldspar and finer grained black amphibole; intruded by finer grained grey–white granite, with local riebeckitic pegmatite and abundant amphibole-lined miarolitic cavities and fractures; offshoots of the Topsails complex

D. *Granite – quartz syenite.* Red, medium grained, with phenocrysts of quartz, K-feldspar, amphibole, and biotite

C. *High-silica domes, dykes, and sills.* Microphenocrysts of quartz and feldspar with finely disseminated groundmass riebeckite; flow foliated, autobrecciated; zones with intense development of spherules and other indications of gas streaming

B. *Microdiorite.* Black, fine grained, and massive

A. *Amphibolite, gabbro, diorite, granodiorite, and granite.* Foliated amphibolite and gabbro screens and xenoliths in foliated diorite and granodiorite, intruded by variably deformed tonalite and amphibole–biotite granite; intruded and net veined by pale, fine-grained granite

FIG. 3. Simplified geological map of the Springdale caldera, Newfoundland (modified from Coyle and Strong 1986).

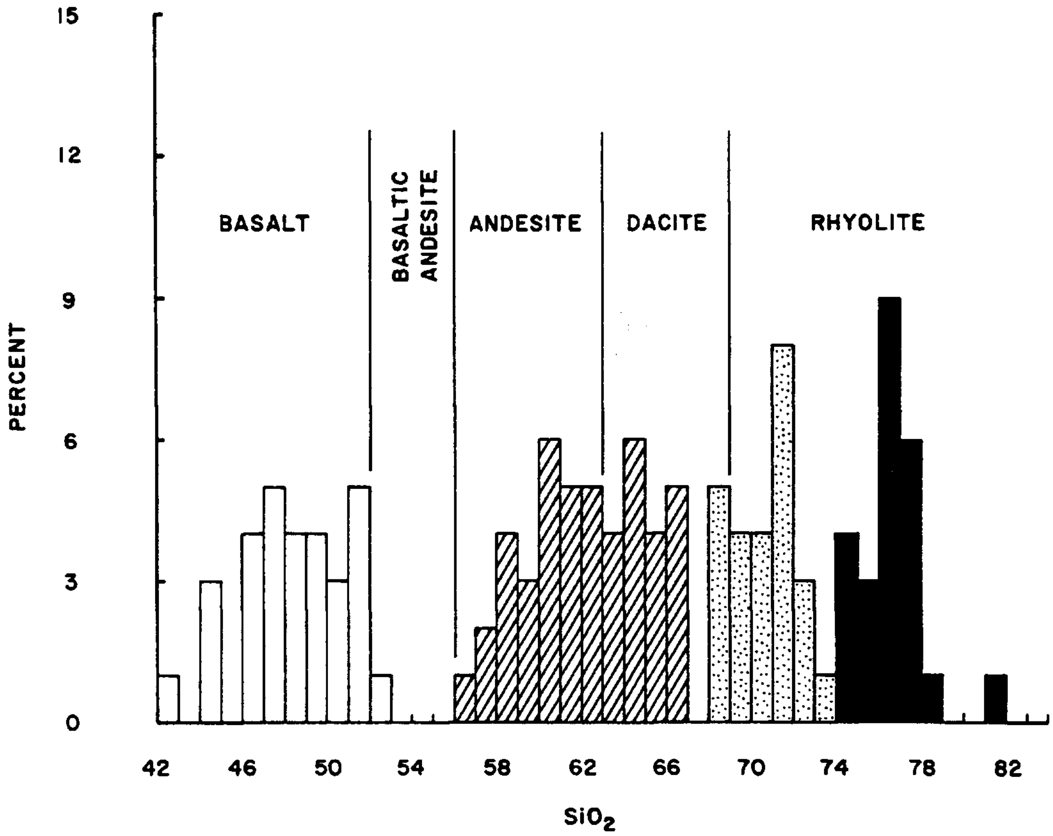


FIG. 4. Histogram of silica distribution in 133 volcanic rock samples of the Springdale Group. Classification boundaries are after Peccerillo and Taylor (1976).

assumed that these ophiolitic rocks were the source of mafic and ultramafic clasts within the ash flows of units 1 and 10. Silicic pyroclastic rocks are found with the pillow lavas of the Catchers Pond and Roberts Arm groups, and they are probably of island-arc origin.

Intrusive rocks

The intrusive rocks around the margins of the Springdale Group have not been studied in detail, but they have been sampled, and their contacts with the volcanic units have been delineated. Some of the information about these rocks has been compiled from Whalen and Currie (1983*b*), Thurlow (1981), Kalliokoski (1953, 1955), and Coyle *et al.* (1985).

Unit B is a black massive microdiorite that intrudes units A and 3 and is contemporaneous with or intruded by unit C. Unit D also may intrude it in the west, although this contact is obscured by faulting.

Unit C is composed of rhyolitic dykes, sills, and domes that intrude units 3, 6, and 8, as well as the microdiorite of unit B, and are all similar in composition and texture. Curviplanar jointing and ductile flow−shear features are found within the domes.

Units D and E, the younger granitoid rocks, were intruded along faults bounding the Springdale Group in the east and west and truncate much of the stratigraphy in the south as part of the Topsails complex (Fig. 2). The Topsails complex exhibits a contact aureole of major extent and intensity, although it has not been distinguished on Fig. 3. Along the eastern and western boundaries with the volcanics, the granites tend to be highly sheared and altered along faults.

Petrography of the volcanic rocks

The following phenocryst assemblages are seen in the basalts: plagioclase, olivine, plagioclase + olivine, plagioclase + clinopyroxene, and plagioclase + olivine + clinopyroxene.

Most of the basalts have plagioclase as the dominant and possibly first phenocryst phase, followed by olivine and clinopyroxene. This sequence is similar to that experimentally determined for the alkali series of Hawaiian and Hebridean lavas by Tilley *et al.* (1965). Except for the lack of orthopyroxene, it is also much like calc-alkaline series reviewed by Ewart (1982). Olivine is found as a single phenocryst phase in only a few samples.

The intermediate rocks range from andesitic basalt to dacite and have the same range of phenocrysts, although some contain opaque phenocrysts along with plagioclase + olivine + clinopyroxene, and amphibole pseudomorphs are ubiquitous in the andesites. The andesites have trachytic and felty textures, whereas the dacites tend to be pilotaxitic, hyalopilitic, or glassy and can have K-feldspar or plagioclase phenocrysts. The felsic volcanic rocks display the full range of textures seen in modern analogues: from fragmental to granular to glassy (now devitrified or altered) to eutaxitic to granophyric to trachytic. They generally contain phenocrysts of quartz and (or) sanidine, with rare anorthoclase, and albite and biotite found only in unit 1. Accessory zircon is common.

All mafic and intermediate rocks of the Springdale Group are altered generally at zeolite to greenschist facies on a regional scale but hornfelsed near the southern contacts with the Top-

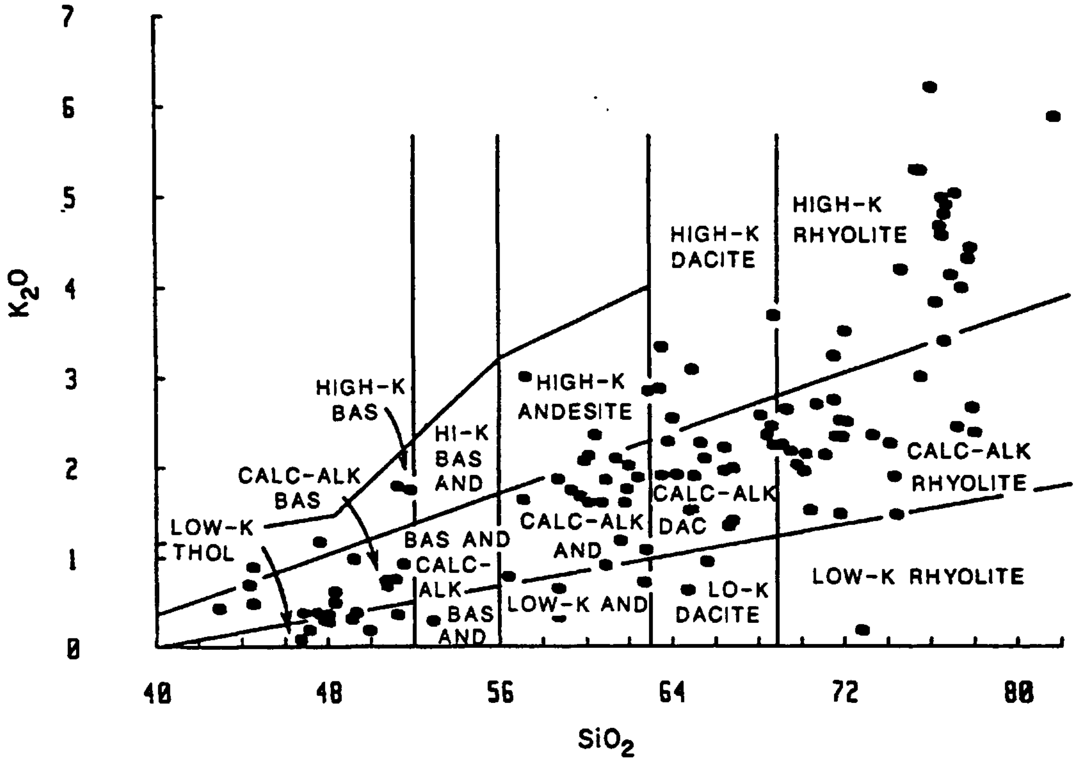


FIG. 5. Plot of K_2O vs. SiO_2 for rocks of the Springdale Group, with classification divisions after Peccerillo and Taylor (1976).

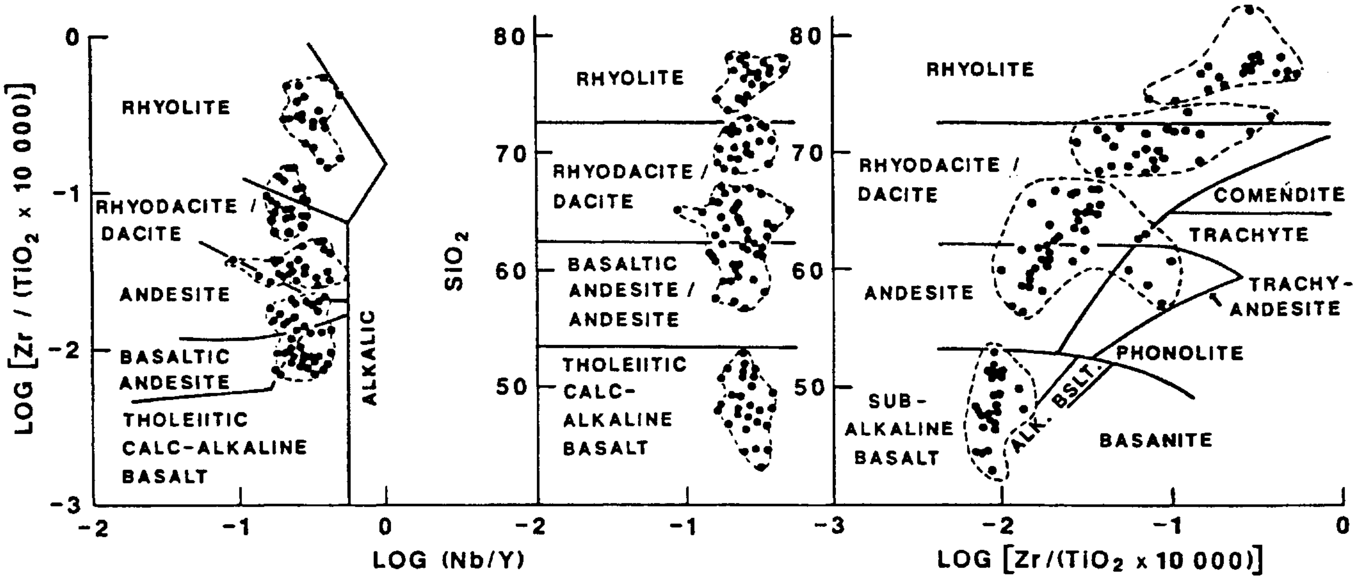


FIG. 6. Classification of volcanic rocks of the Springdale Group in terms of silica and a number of "immobile" trace elements (boundaries after Winchester and Floyd 1977).

sails complex. The greenschist alteration is synonymous with the "regional propylitic" alteration typically seen in calderas.

Geochemistry

Of some 1500 samples collected from the rocks described above, 165 have so far been analysed for the major-element oxides and 18 trace elements. Of these, 155 samples are volcanic and associated subvolcanic rocks from throughout the map area, and the others are from a variety of intrusive and other lithologies not directly related to the Springdale Group. Care was taken to exclude any rocks containing xenoliths or lithic clasts or amygdales or any rocks showing evidence of exceptional alteration. The following interpretations can be taken as preliminary and may be modified by isotopic and other studies that are now in progress.

A histogram of silica distribution (Fig. 4) confirms our earlier suggestion (Coyle *et al.* 1985), based on field and petrographic observations, that intermediate compositions are well represented in the Springdale Group. In fact, one can see from Fig. 4 that there are four groups, separated by silica gaps at 53–56, 67–68, and 73–74% SiO_2. In the terminology of Peccerillo and Taylor (1976), the lowest silica group is basalts, the intermediate group is andesites–dacites, and both of the higher silica groups are rhyolites. For present purposes, the latter are termed low-silica and high-silica rhyolites. Only basaltic andesites are missing from making up a full calc-alkaline suite.

Using the Peccerillo and Taylor (1976) plot of K_2O versus SiO_2 (Fig. 5), these rocks would be clearly classified as a calc-alkaline suite ranging from calc-alkaline basalts through andesites and dacites to the low-silica rhyolites. The high-silica rhyolites show a much wider range of K_2O up to more than 6% and would thus be termed high-K rhyolites. This is a characteristic primary feature of high-silica magmas with more than 74% SiO_2, and in many cases is associated with economic mineralization (see review by Tuach *et al.* 1986). Although some of the lower silica rocks have anomalous K_2O concentrations, we suggest that this results from some secondary redistribution of alkalis in the volcanic rocks as a whole and should not be used to classify the whole Springdale Group as a high-potassium suite.

Other less mobile elements (Fig. 6) also clearly indicate that the Springdale Group is calc-alkaline. With regard to the precise terminology, however, the Winchester and Floyd (1977) boundaries based on less mobile elements and SiO_2 content are different from those of Peccerillo and Taylor (1976), and the rocks are grouped under different names. For example, on the plot of (Zr/Ti) versus SiO_2, the silica gap at basaltic andesites is spanned by the basaltic rocks, the andesites–dacites are classified as dacites, and the low-silica rhyolites are classified as rhyodacites–dacites.

The distinctive group of high-silica rhyolites merits further comment from both a petrogenetic and an economic viewpoint. With regard to the latter, they correspond precisely to those "specialized" volcanic and plutonic rocks that host economic deposits of Sn, W, Mo, and other granophile elements and are well known in both eastern Canada and western Europe (e.g., Strong 1980). These rocks are most readily recognized by their high silica content, and indeed Tuach *et al.* (1986) show that 74% SiO_2 is a critical minimum value for the host rocks of this kind of granite-related mineralization. In the case of the Springdale high-silica rhyolites, we further note that most of them are associated with small domes and their pyroclastic aprons and appear to have been emplaced late in the sequence.

The high-silica and low-silica rhyolites are compared in more detail in Fig. 7, where a number of trace elements are plotted against niobium. These elements were chosen because they are typically strongly enriched or depleted in high-silica rhyolites (e.g., Hildreth 1981) or peralkaline granites (e.g., Taylor *et al.* 1981). It is clear from Fig. 7 that there is virtually a complete separation of the two types in terms of their Nb contents, as well as Zr, Sr, and Y. The high-silica rhyolites also tend to have higher concentrations of Rb and Zn, but there is some overlap of the two groups.

Given that the peralkalinity of the King's Point complex (and Sheffield Lake Group) is at least partly a result of metasomatic (fenitization) processes near intrusive contacts (Taylor *et al.* 1981; Strong and Taylor 1984; Mercer *et al.* 1985), its presence in the high-silica rhyolite domes of the Springdale Group may suggest that similar intrusions are associated with the Springdale. Although such intrusions are not exposed, their presence implies a similar evolutionary history for both the King's Point and Springdale calderas.

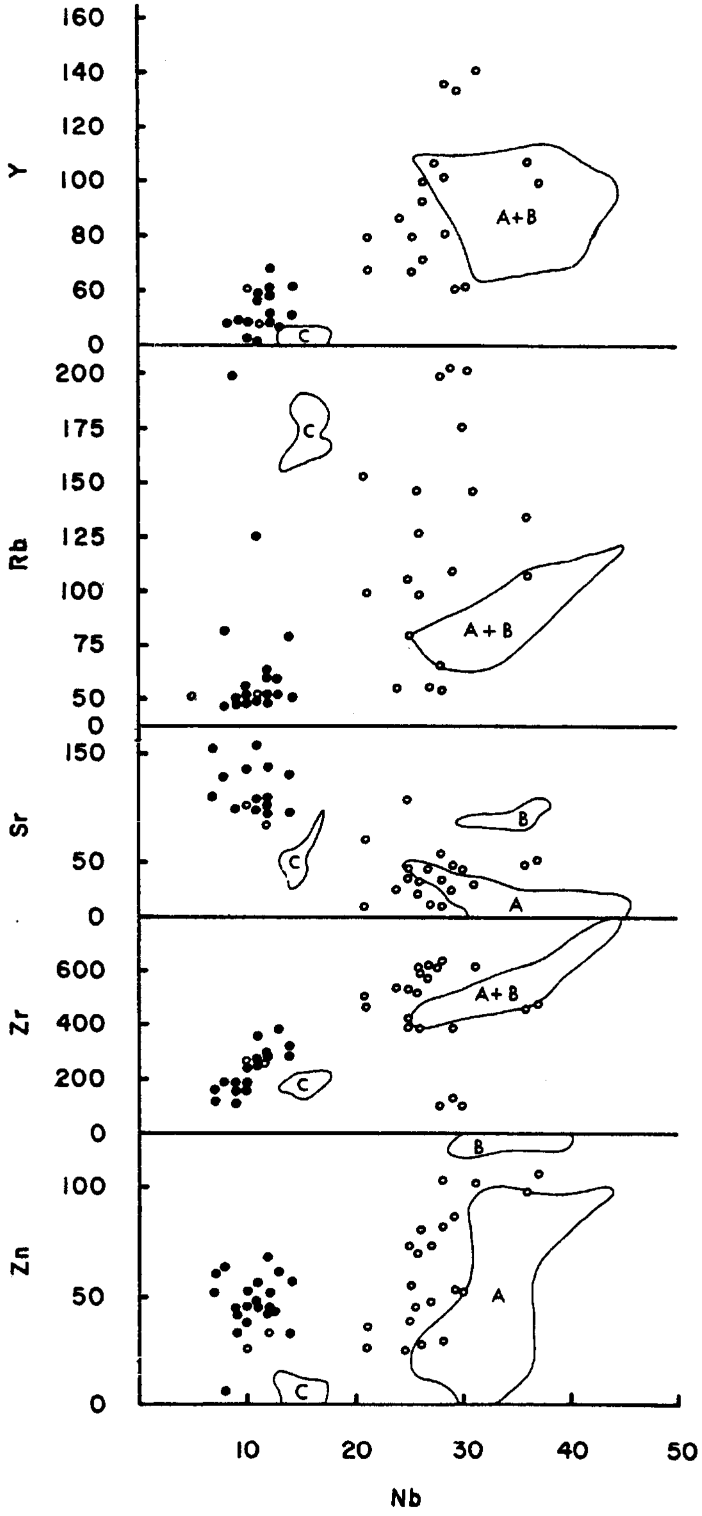


FIG. 7. Variation of selected elements with niobium in the high-silica (circles) and low-silica (dots) rhyolites of the Springdale Group. Fields from the King's Point area are shown for ignimbrites and porphyries (A), quartz–feldspar dykes (B), and granitic rocks (C) (from Kontak and Strong 1986).

Discussion

General features of calderas

Before presenting our interpretation that the volcanic, plutonic, and sedimentary facies described above represent the products of caldera collapse and fill, it is useful to review the features and terminology upon which we base our conclusions.

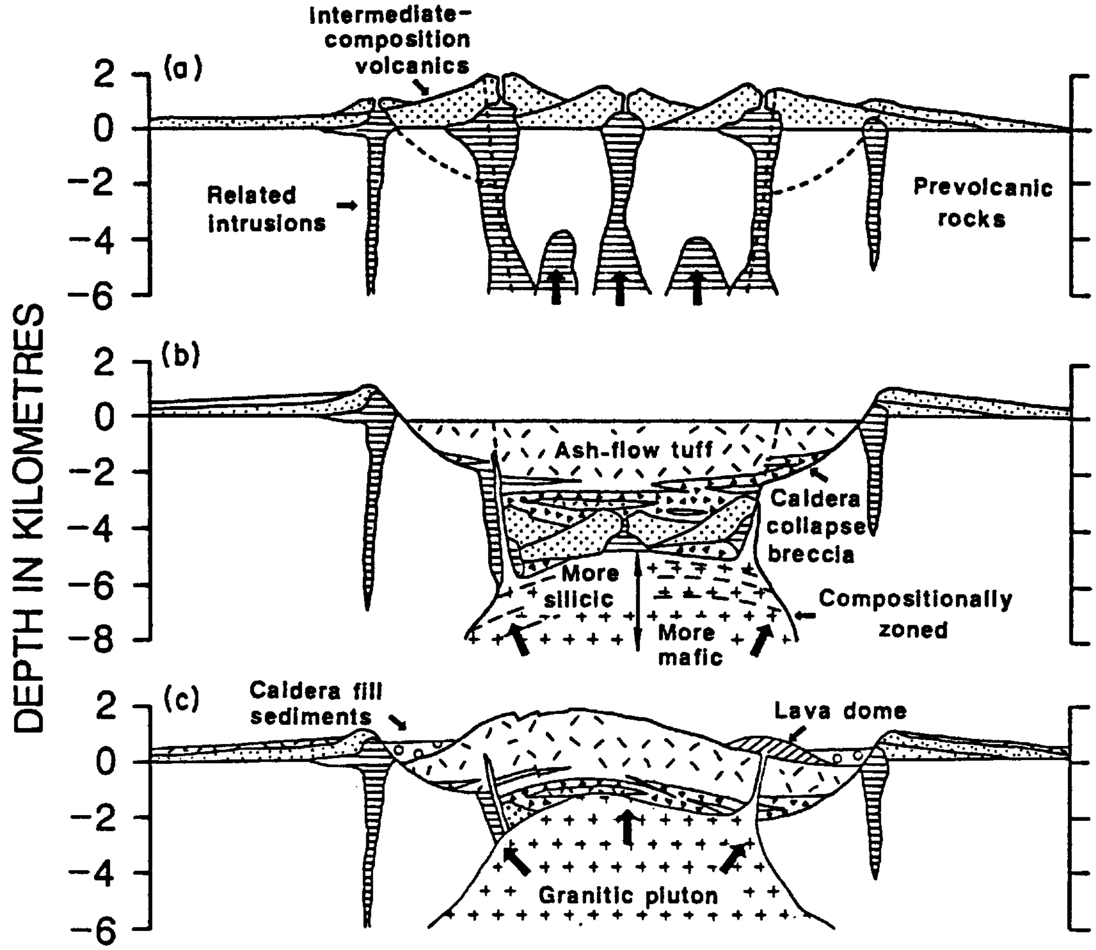


FIG. 8. A generalized ash-flow caldera cycle based on a composite of features from a number of calderas (after Lipman 1984). (*a*) Pre-collapse volcanism. Clustered intermediate-composition stratovolcanoes form over isolated, small, high-level plutons that mark the beginning of accumulation of a batholith-sized silicic magma body that will feed ash-flow eruptions. Uplift related to emplacement of the plutons leads to the development of arcuate-ring fractures, which form the sites of subsequent caldera collapse (dotted lines). Heavy arrows indicate upward movement of magma. (*b*) Caldera geometry just after ash-flow eruptions and concurrent caldera collapse. Central area of clustered earlier volcanoes caves into collapsed caldera. Intracaldera tuff ponds during subsidence and is an order of magnitude thicker than cogenetic outflow ash-flow sheet. Initial collapse along ring faults is followed by slumping of oversteepened caldera walls and accumulation of voluminous collapse breccias that interfinger with ash-flow tuffs in the caldera fill sequence. Caldera floor subsides asymmetrically and is tilted to the left of the diagram. Main magma body underlies entire caldera area and is compositionally zoned prior to eruption, becoming more mafic downward. (*c*) Resurgence and post-caldera deposition. Resurgence is asymmetrical, with greatest uplift in area of greatest prior collapse. Extensional graben faults form over crest of the dome. Some resurgent uplift is accommodated by movement along ring faults in the sense opposite of that during caldera subsidence. Magma body has risen into volcanic pile and intrudes cogenetic intracaldera welded tuff. Original caldera floor has been almost entirely obliterated by rise of the magma chamber to near the level of prevolcanic land surface. Caldera moat is partly filled by lava domes and volcaniclastic sediments. Hydrothermal activity and mineralization become dominant late in the cycle.

"Epicontinental-type" calderas are characterized by large diameter and high volumes of pyroclastic eruptions. Smith (1979) assessed the relationships between these two parameters and showed a correlation between volumes of eruption and volumes and compositions of the associated magma chambers. Such magma chambers are commonly envisaged as being zoned by processes such as crystal fractionation, thermodiffusion, and volatile and liquid complexing, which may produce specialized fractionates such as low-viscosity high-silica rhyolitic magma (e.g., Hildreth 1981).

The by-products of these large magma reservoirs are the collapse caldera-type eruptions resulting in ash-flow volcanism and related plutonism. Such systsms may be represented by zoned ash-flow sheets, like the Bishop tuff (Hildreth 1981), and caldera and subsidence structures that are seen at different levels of exposure. In many areas, e.g., the Oslo graben (Ihlen *et al.* 1982), the Rio Grande rift (Chapin *et al.* 1978), and the Taupo depression (Cole 1985), they occur as linear arrays situated along rifts or other major structural discontinuities and are commonly associated with extensional or transpressional tectonic environments. In other areas, such as the Arabian Shield (Roobol and White 1986), there does not appear to be such a strong linear distribution.

Collapse calderas are produced by the collapse of a magma chamber roof because of eruption of the magma as pyroclastic material and lava flows (Bates and Jackson 1980). The collapse structures are generally circular, as with the typical San Juan or Oslo calderas, but in other cases may strongly elongate because of control by regional faults, Toba being a particularly outstanding example (Smith and Bailey 1968). These eruptive products are characterized by near-source and intermediate-source facies rocks that accumulate both within and outside the caldera walls. Cunningham and Steven (1979) termed these the intracaldera facies and the caldera outflow facies, respectively, related to eruption and outlfow of pyroclastic material with concurrent collapse of the source area. Such collapse may be followed by development of a resurgent cauldron, or there may be continuous collapse and formation of inner ring fractures without resurgence. Lipman (1984) produced an elegant summary of these features in the context of caldera evolution, and his full explanation is reproduced in the caption to Fig. 8.

As summarized by Fisher and Schmincke (1984, p. 361)

> The intra-caldera facies may include ignimbrite deposits measuring hundreds of metres in thickness. If resurgence occurs, the resulting moat may be filled by pyroclastic rocks, lava flows, lake sediments, epiclastic volcanic sediments, and particularly landslide or talus breccias from the caldera wall. The caldera-outflow facies is characterized by ignimbrite sheets that may extend for many tens of kilometres outside the caldera. Resurgence may occur without filling, and filling may occur without resurgence. Moreover, fills within calderas can be derived from younger ash flows from any nearby younger source.

Other important features to be noted are associated marginal ring or linear faults considered the major conduits of eruption and the location of late intrusions and (or) "nesting" in complex areas. Perhaps the most diagnostic signature of these complex structures is the combination of post-caldera collapse volcanic facies, associated plutonic rocks, and specific structural elements, such as ring dykes and structural boundaries of the caldera-collapse block. Preservation of all caldera features is rare, and it is often necessary to make comparisons between a number of reasonable models for the interpretation of a given caldera and its setting.

Caldera model for the Springdale Group

The details of different features of the Springdale Group have been presented above, and the separate lines of evidence can be readily interpreted in the context of caldera facies. The pre-caldera history of the area is not easily determined, as most of its products are covered with collapse and post-collapse lithologies. However, the broad expense of andesitic rocks and interbedded laharic breccias in the southern part of the map area and their abundance on both eastern and western margins are typical of pre-collapse lithologies, such as stratovolcanoes associated with many epicontinental calderas (as shown in Fig. 8*a*). This andesitic suite of lithologies may have a similar significance for the Springdale Group. Their occurrence across the southern parts of the caldera and outside its margins to the west of Fig. 3 (see Coyle *et al.* 1986) may reflect deeper levels of exposure resulting from resurgence associated with granitoid intrusion. However, more detailed studies are needed before such an interpretation can be made with confidence.

One of the most obvious features of well-preserved modern calderas is their topographic wall and (or) collapse margin. The Springdale Group is bounded by such a structural feature along its eastern and western margins, where it is in fault contact with the basement rock types and intruded by later granitoid rocks. Basement material is found as detrital clasts in the lowermost marginal sedimentary facies. The lack of Springdale Group lithologies outside the margins and the distinctive mesobreccias seen along it all suggest that they mark the topographic rim of the caldera (cf. Fig. 8*b*).

The southern limits of the Springdale Group are extensively and pervasively intruded and up-tilted by the granitoid rocks of the Topsails complex, so that any structural margin that may have existed there is obscured and probably eroded. However, along the eastern margin of the Springdale Group, and to some extent the western margin, the unit 2 mesobreccia is closely associated with a series of elongate domal intrusions exposed at various depths in a linear array. These may represent collapse breccias along intracaldera multiple-vent fractures. In stratigraphically higher positions, however, unit 2 includes mass-wasting deposits and sediments possibly associated with resurgence, analogous to those shown in Figs. 8*b* and 8*c*.

In the north, units of the Springdale Group rest unconformably and are in fault contact with Ordovician submarine volcanic rocks. This relationship and the type of sedimentary and volcanic facies seen there suggest that the northern margin was breached or possibly down-dropped as a small graben structure and filled with coarse debris flows and volcanic outflow-facies rocks. Like the other margins, detrital material within the group there represents a range of lithologies, including some from the basement rocks, as well as marginal granites that attest to their relatively late deposition.

In most cases, the individual ash-flow tuffs of the Springdale Group can be interpreted as distinctive eruption and (or) cooling units, most of which are proximal or intermediate intracaldera facies. The one exception is unit 10, which appears to be an outflow facies from the King's Point caldera, as discussed below. The intrusive rocks of the group include rhyolite domes, which are seen in some cases to cut the ash-flow tuffs, and these are typical of and well documented in many caldera settings, e.g., as shown in Fig. 8*c* and discussed above.

Regional and tectonic implications

In large volcanic fields, a number of overlapping centres and (or) calderas are commonly found together, especially within a particular period of geological time. At least three such centres, and possibly more, can be demonstrated in west-central Newfoundland, with the various volcanic and intrusive exposures respresenting different structural levels of the individual calderas and subjacent plutons. In the King's Point complex (Fig. 2), for example, a composite ring dyke (Neale *et al.* 1960; Kontak and Strong 1986) provides definite evidence for cauldron subsidence. This complex represents a caldera exposed at a depth intermediate between that of the Springdale caldera and that of the Topsails complex.

Although it is fairly clear from the above descriptions that an abundance of volcanic facies typical of cauldron subsidence and related pyroclastic volcanism is represented in the Springdale and correlative groups, the precise tectonic controls of caldera collapse may well have been of more regional significance. It is well known that calderas tend to be controlled by basement structures and regional tectonics, and it is not likely that those of west-central Newfoundland in Silurian–Devonian times were any exception. The detailed evaluation of such questions awaits comprehensive mapping of all of these different suites, but their elongate pattern of distribution suggests that they are ultimately related to the northeast-trending faults and other structures seen in the basement rocks (Fig. 2).

Precise correlations between units of the Sprindale Group and those of the adjacent Silurian–Devonian sequences of west-central Newfoundland (Fig. 2) must be based on further detailed geological mapping, as well as on geochemical studies and isotopic age determinations now in progress. Hibbard (1983) reviewed the available radiometric dates and showed that few are reliable and consistent with field relations. Nevertheless, several features allow us to make some correlations and to group these rocks into a number of calderas by reconstruction along major faults in the area, as shown in Fig. 9. For example, the Springdale Group biotite-bearing ash flows, the intermediate andesitic-dacitic flows and pyroclastic deposits,

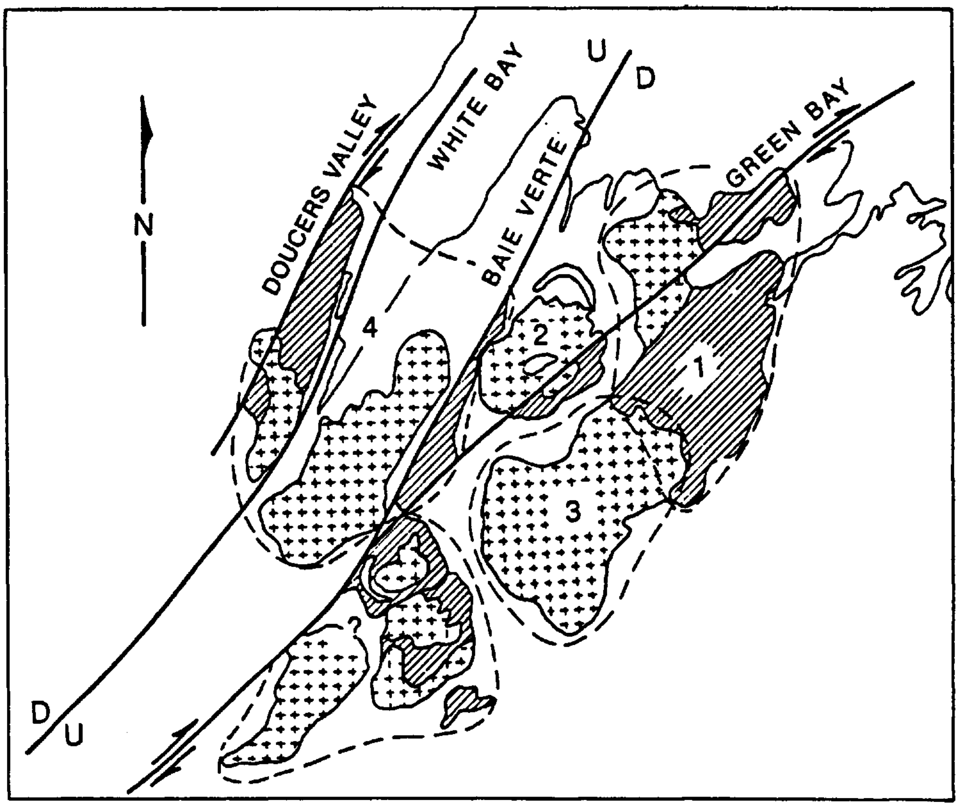


FIG. 9. Proposed reconstruction of Silurian (–Devonian?) volcano-plutonic sequences of western Newfoundland. It is possible that the dominantly dextral strike-slip faulting that affected this area, although extending into the Carboniferous, was active during volcanism and provided some control of caldera development. This reconstruction allows for at least five large calderas and possibly a number of smaller nested ones. "Caldera No. 1" includes the Springdale and Cape St. John groups and the Cape Brule porphyry. No. 2 includes the King's Point complex and Sheffield Lake Group. No. 3 is the mainly plutonic northern lobe of the Topsails complex. No. 4 includes the Wild Cove Pond, Gull Lake, and Devil's Room plutons and the Sops Arm and Mic Mac Lake groups. The question mark area encloses a number of volcano-plutonic circular structures that may represent smaller nested cauldrons.

and the basaltic flows are similar to lithologies of the Cape St. John Group and the Cape Brule porphyry, which grades into it (Hibbard 1983). These three suites may be correlative and possibly related to the same caldera, with part of the Cape Brule porphyry forming a subvolcanic asymmetrically resurgent pluton. This caldera would have been exceptionally large, on the scale of the Platoro caldera of Colorado (Steven and Lipman 1976), and would have been dissected by dextral displacement about 50 km along the Green Bay Fault. This is in accord with the observation that a similar displacement would be appropriate for separating the island-arc sequences of the Lower Ordovician Snooks Arm and Western Arm groups (see review by Hibbard 1983, pp. 187–188).

As described above, the striking similarity between unit 10 of the Springdale Group and rocks of the King's Point complex strongly implies that this unit is an outflow facies of the King's Point caldera. Its position at the top of the Springdale Group indicates that the King's Point complex (or at least this phase of it) is somewhat younger than, but overlapping in time with, the Springdale caldera volcanism. Compelling similarities between the oikocrystic comendites and porphyries of the King's Point complex and the Sheffield Lake Group (Coyle *et al.* 1985) strongly suggest that the two were part of the same caldera, which was also dissected and displaced about 50 km by dextral movement along the Green Bay Fault (Fig. 9).

The Topsails complex, on the southern boundary of the Springdale Group (Fig. 3), has both peralkaline and metaluminous granitoid suites (Taylor *et al.* 1980, 1981), and Whalen and Currie (1983*a*) considered the peralkaline rocks younger. Both suites cut the Springdale Group, but it is not presently possible to say just how much younger they are. According to the map of Whalen and Currie (1983*b*), there are a number of volcanic–plutonic assemblages within the Topsails complex, some of which are distributed in a circular pattern, which we tentatively interpret as indicating a caldera setting, and we suggest that the complex includes at least two calderas.

Ash-flow tuffs of the Sops Arm Group (Fig. 2) are interbedded with fossiliferous marine sediments of middle to late Silurian age (Lock 1972), overlapping the age of the Devil's Room and the Gull Lake granites, which give a combined U/Pb zircon date of 398^{+37}_{-7} Ma and Pb/Pb dates on apatites, sphenes, and K-feldspars of about 405 Ma (Erdmer 1986 and personal communication, 1986), and the K/Ar date of 392 ± 16 Ma for the Wild Cove Pond Granite (Wanless *et al.* 1972). Clasts of King's Point-like comendite within conglomerates of the Mic Mac Lake Group imply that they are also younger than the King's Point, and we tentatively suggest that they are correlative with the late Silurian Sops Arm Group. Altogether, we suggest that these rocks constitute a cogenetic volcanic–plutonic suite, and we tentatively refer to them as making up the Sops Arm caldera. It can be seen from Fig. 2 that separation of the Devil's Room and Gull Lake granites implies a sinistral displacement of about 15 km along the Doucers Valley fault, as suggested by Lock (1969), and this has been allowed for in Fig. 9. We see no strong evidence for lateral displacement along either the White Bay or Baie Verte fault, and we suggest that exposure of the relatively coarse grained Wild Cove Pond igneous suite in juxtaposition with the Sops Arm and Mic Mac Lake volcanics can be readily explained by their vertical uplift as a central horst between these two faults (Fig. 9). This is also indicated by the much higher metamorphic grade of country rocks within this block, compared with those outside it (Hibbard 1983).

It is well established that Silurian–Devonian magmatic activity in Newfoundland followed closure of the early Paleozoic Iapetus Ocean (e.g., Strong, 1977). This ocean closure, accompanied by westward obduction of ophiolites and eastward subduction of continental crust, would have trapped both heat and basaltic magma that continued to rise from the overridden upper mantle and, in turn, caused large-scale crustal melting. The inherent structural weaknesses at the continent–ocean suture zone and the subducted continental crust may have focussed these processes, providing an explanation for the distribution of the post-closure calderas close to this suture zone. The incongruous petrochemical assemblages observed in the Springdale and correlative suites, i.e., andesitic to peralkaline, could be explained by diverse source compositions and local variations from extensional to compressional tectonics, as suggested by Strong (1980) to explain similar patterns in granitoid rocks of the Appalachians.

Different levels of the magmatic system may have been tapped to produce the two-feldspar–biotite-bearing crystal tuffs, the quartz-alkali feldspar tuffs, the ultramafic-xenolith-bearing tuffs, and the others. The different compositions of lithic clasts, such as the ultramafic material in units 1 and 10, also indicate abrupt changes in the sources between different eruptions. This is not surprising because the Springdale Group, and indeed most correlative rocks from Scotland to Maine, are found near the suture zone between the continental crust of ancient North America and the oceanic crust–mantle assemblages of Iapetus.

Local tectonic variations would be expected in an overall transpressional regime, as suggested by Laurent and Belanger (1984) for the Silurian volcanics of the Quebec Appalachians, based on analogy with the tectonic setting and volcanic products of Anatolia. This overall tectonic setting is also somewhat analogous to that of New Zealand, where strike-slip movement along the Alpine Fault gives way on North Island to the Taupo depression, an extensional ensialic marginal basin associated with the Taupo volcanic arc (Cole 1985). It differs from these areas, however, in that evidence such as the continuity of Silurian onlap sequences across the orogen suggests subduction was not operative at that time. The nature and complexity of the volcanic products and the large size of the calderas are also reminiscent of other continental areas of extensive continental volcanism, such as the Rio Grande rift and the San Juan Mountains of Colorado (e.g., Steven and Lipman 1976) and the Oslo graben (Oftedahl 1978). Clearly, the recognition of the Springdale and associated calderas, with their wide range of volcanic and intrusive products, raises numerous questions about tectonic and magmatic processes in western Newfoundland during the Silurian. Detailed geochemical, isotopic, and paleomagnetic studies are continuing to address these questions and to assess their implications for other parts of the Appalachian–Caledonian orogen.

Acknowledgments

We thank Dr. K. L. Currie for his continuing support of this project; Dr. P. Erdmer for sharing his unpublished radiometric dates; A. A. Burgoyne and R. Hewton of Brinco Mining Ltd. and J. O'Sullivan of Esso Minerals Ltd. and Noranda Exploration Co. Ltd. for logistic support; G. Andrews, D. Press, and G. Veinott for chemical analyses; and S. J. P. Burry and L. Nolan for drafting. We thank H. S. Swinden and Drs. H. Williams and B. P. Kokelaar for comments on an earlier version of this paper and Dr. P. Lipman for his perceptive review. We benefitted greatly from the Cruson and Pansze field course on volcanology and ore deposits of the San Juan volcanic field. This study was funded mainly by the Geological Survey of Canada and Canewf Resources Ltd. (project no. 840024), with additional support from Memorial University of Newfoundland and the Natural Sciences and Engineering Research Council of Canada (operating grant No. A7975). We are especially grateful to Viking Helicopters Ltd. for the award of a "flying scholarship" to the first author.

Bates, R. L., and Jackson, J. A. 1980. Glossary of geology. 2nd ed. American Geological Institute, Falls Church, VA.

Bostock, H. H., Currie, K. L., and Wanless, R. K. 1979. The age of the Roberts Arm Group, north-central Newfoundland. Canadian Journal of Earth Sciences, 16: 599–606.

Chandler, F. W., and Dunning, G. R. 1983. Fourfold significance of an Early Silurian U–Pb zircon age from rhyolite in redbeds, southwest Newfoundland, NTS 12 A/4. *In* Current research, part B. Geological Survey of Canada, Paper 83-1B, pp. 419–421.

Chandler, F. W., Sullivan, R. W., and Currie, K. L. In press. Age of the Springdale Group western Newfoundland, and correlative rocks—evidence for a Llandovery overlap assemblage in the Canadian Appalachians. Transactions of the Royal Society of Edinburgh.

Chapin, C. E., Chamberlain, R. M., Osburn, G. R., White, D. L., and Sanford, A. R. 1978. Exploration framework of the Socorro geothermal area, New Mexico. *In* Field guide to selected cauldrons and mining districts of the Datil-Mogollon field. New Mexico Geological Society, Special Publication 7, pp. 114–129.

Cole, J. W. 1985. Taupo–Rotorua depression: an ensialic marginal basin of North Island, New Zealand. *In* Marginal basin geology. *Edited by* B. P. Kokelaar and M. F. Howells. Geological Society of London, pp. 109–119.

Coyle, M., and Strong, D. F. 1986. Geology of the southern and northern margins of the Springdale caldera, Newfoundland. *In* Current research, part A. Geological Survey of Canada, Paper 86-1A, pp. 499–506.

Coyle, M., Strong, D. F., Gibbons, D., and Lambert, E. 1985. Geology of the Springdale Group, central Newfoundland. *In* Current research, part A. Geological Survey of Canada, Paper 85-1A, pp. 157–163.

Coyle, M., Strong, D. F., and Dingwell, D. B. 1986. Geology of the Sheffield Lake area. *In* Current research, part A. Geological Survey of Canada, Paper 86-1A, pp. 455–459.

Cunningham, C. G., and Steven, T. A. 1979. Mount Belknap and Red Hills calderas and associated rocks, Marysvale volcanic field, west-central Utah. United States Geological Survey, Bulletin 1468, pp. 1–34.

DeGrace, J. R., Kean, B. F., Hsu, E., and Green, T. 1976. Geology of the Nippers Harbour map area (2 E/13), Newfoundland, Newfoundland Department of Mines and Energy, Report 76-3.

Erdmer, P. 1986. Geology of the Long Range inlier, Sandy Lake map area (12 H), west Newfoundland. *In* Current research, part B. Geological Survey of Canada, Paper 86-1B, pp. 19–27, and Geological Survey of Canada, Open File 13-10, map with marginal notes.

Ewart, A. 1982. The mineralogy and petrology of Tertiary–Recent orogenic volcanic rocks: with special reference to the andesitic–

basaltic compositional range. *In* Andesites. *Edited by* R. S. Thorpe. John Wiley & Sons, New York, NY, pp. 25–95.

Fisher, R. V., and Schmincke, H. U. 1984. Pyroclastic rocks. Springer-Verlag, Berlin.

French, W. J., Hassan, M. D., and Westcott, J. 1979. The petrogenesis of Old Red Sandstone volcanic rocks of the western Ochils, Stirlingshire. *In* The Caledonides of the British Isles—reviewed. *Edited by* A. L. Harris, C. H. Holland, and B. E. Leake. Geological Society of London, Special Publication 8, pp. 635–642.

Groome, D. R., and Hall, A. 1974. The geochemistry of the Devonian lavas of the Lorne Plateau, Scotland. Mineralogical Magazine, 39: 621–640.

Hibbard, J. 1983. Geology of the Baie Verte Peninsula, Newfoundland. Newfoundland Department of Mines and Energy, Memoir 2.

Hildreth, W. 1981. Gradients in silicic magma chambers: implications for lithospheric magmatism. Journal of Geophysical Research, 86: 10 153–10 192.

Ihlen, P. M., Tronnes, R., and Vokes, F. M. 1982. Mineralization, wall rock alteration and zonation of ore deposits associated with the Dramman granite in the Oslo region, Norway. *In* Metallization associated with acid magmatism. *Edited by* A. M. Evans. John Wiley & Sons, New York, NY, pp. 111–136.

Kalliokoski, J. 1953. Springdale, Newfoundland. Geological Survey of Canada, Paper 53-5.

——— 1955. Gull Pond, Newfoundland (secondary preliminary map). Geological Survey of Canada, Paper 54-4.

Kontak, D. J., and Strong, D. F. 1986. The King's Point volcano-plutonic complex, Newfoundland. *In* Current research, part X. Geological Survey of Canada, Paper 86-1A. pp. 465–470.

Laurent, R., and Belanger, J. 1984. Geochemistry of Silurian–Devonian alkaline basalt suites from the Gaspe Peninsula, Quebec Appalachians. Maritime Sediments and Atlantic Geology, 20: 67–78.

Lipman, P. W. 1984. The roots of ash flow calderas in western North America: windows into the tops of granite batholiths. Journal of Geophysical Research, 89: 8801–8841.

Lipman, P. W., Doe, B. R., Hedge, C. E., and Steven, T. A. 1978. Petrologic evolution of the San Juan volcanic field, southwestern Colorado: Pb and Sr isotope evidence. Geological Society of America Bulletin, 89: 59–82.

Lock, B. E. 1969. The lower Paleozoic geology of western White Bay, Newfoundland. Ph.D. thesis, Cambridge University, Cambridge, UK.

——— 1972. Lower Paleozoic history of a critical area: eastern margin of the St. Lawrence Platform in White Bay, Newfoundland, Canada. 24th International Geological Congress, Section 6, Montréal, Que., pp. 310–324.

Mercer, B., Strong, D. F., Wilton, D. H. C., and Gibbons, D. 1985. The King's Point volcano-plutonic complex, western Newfoundland. *In* Current research, part A. Geological Survey of Canada, paper 85-1A, pp. 737–741.

Neale, E. R. W., Nash, W., and Innes, G. M. 1960. King's Point, Newfoundland. Geological Survey of Canada, Map 35-1960.

Nowlan, G., and Thurlow, J. G. 1984. Middle Ordovician conodonts from the Buchans Group, central Newfoundland, and their significance for regional stratigraphy of the central volcanic belt. Canadian Journal of Earth Sciences, 21: 284–296.

Oftedahl, C. 1978. Cauldrons of the Permian Oslo rift. Journal of Volcanology and Geothermal Research, 3: 343–371.

Peccerillo, A., and Taylor, S. R. 1976. Geochemistry of Eocene calc-alkaline volcanic rocks from the Kastamonu area, northern Turkey. Contributions to Mineralogy and Petrology, 58: 63–81.

Rankin, D. 1968. Volcanism related to tectonism in the Piscataquis volcanic belt, an island arc of Early Devonian age in north-central Maine. *In* Studies of Appalachian geology: northern and maritime. *Edited by* E-An Zen, J. B. Hadley, W. S. White, and J. B. Thompson, Jr. Wiley Interscience, New York, NY, pp. 355–369.

——— 1980. The Traveller rhyolite and its Devonian setting, Traveller Mountain area, Maine. *In* Geology of northeastern Maine and neighbouring New Brunswick. *Edited by* D. C. Roy and R. S. Naylor. New England Inter-Universities Geological Conference Guidebook. pp. 98–113.

Roobol, M. J., and White, D. L. 1986. Cauldron-subsidence structures and calderas above Arabian felsic plutons: a preliminary survey. Journal of African Earth Sciences, 4: 123–134.

Smith, R. L. 1979. Ash flow magmatism. Geological Society of America, Special Paper 180, pp. 5–27.

Smith, R. L., and Bailey, R. A. 1968. Resurgent cauldrons. *In* Studies in vulcanology. *Edited by* R. R. Coats, R. L. Hay, and C. A. Anderson. Geological Society of America, Memoir 116, pp. 613–662.

Steven, T. A., and Lipman, P. W. 1976. Calderas of the San Juan volcanic field, southwestern Colorado. United States Geological Survey, Professional Paper 958, pp. 1–35.

Stillman, C. J., and Francis, E. H. 1979. Caledenide volcanism in Britain and Ireland. *In* The Caledonides of the British Isles—reviewed. *Edited by* A. L., Harris, C. H. Holland, and B. E. Leake. Geological Society of London, Special Publication 8, pp. 557–577.

Strong, D. F. 1977. Volcanic regimes of the Newfoundland Appalachians. *In* Volcanic regimes in Canada. *Edited by* W. R. A. Baragar, L. C. Coleman, and J. M. Hall. Geological Association of Canada, Special Paper 16, pp. 61–90.

——— 1980. Granitoid rocks and associated mineral deposits of eastern Canada and western Europe. *In* The continental crust and its mineral deposits. *Edited by* D. W. Strangway. Geological Association of Canada, Special Paper 20, pp. 741–769.

Strong, D. F., and Taylor, R. P. 1984. Magmatic-subsolidus and oxidation trends in composition of amphiboles from silica-saturated peralkaline igneous rocks. Tschermaks mineralogische und petrographische Mitteilungen, 32: 211–222.

Taylor, R. P., Strong, D. F., and Kean, B. F. 1980. The Topsails igneous complex: Silurian–Devonian peralkaline magmatism in western Newfoundland. Canadian Journal of Earth Sciences, 17: 425–439.

Taylor, R. P., Strong, D. F., and Fryer, B. J. 1981. Volatile control of contrasting trace element distribtions in peralkaline granitic and volcanic rocks. Contributions to Mineralogy and Petrology, 77: 267–271.

Thirlwall, M. F. 1981. Implications for Caledonian plate tectonic models of chemical data from volcanic rocks of the British Old Red Sandstone. Journal of the Geological Society, London, 139: 123–138.

Thurlow, J. G. 1981. The Buchans Group: its stratigraphic and structural setting. *In* The Buchans orebodies: fifty years of geology and mining. *Edited by* E. A. Swanson, D. F. Strong, and J. G. Thurlow. Geological Association of Canada, Special Paper 22, pp. 79–90.

Tilley, C. E., Yoder, H. S., and Schairer, J. F. 1965. Phase equilibrium studies of silicate and oxide systems. Carnegie Institution of Washington, Yearbook, 64: 69–82.

Tuach, J., Davenport, P. H., Dickson, W. L., and Strong, D. F. 1986. Geochemical trends in the Ackley Granite, southeast Newfoundland: their relevance to magmatic–metallogenic processes in high-silica granitoid systems. Canadian Journal of Earth Sciences, 23: 747–765.

Wanless, R. K., Steven, R. D., Lachance, G. R., and Delabio, R. N. 1972. Age determinations and geological studies: K/Ar isotopic ages, report 10. Geological Survey of Canada, Paper 71-2, pp. 89–93.

Wessel, J. M. 1975. Sedimentary petrology of the Springdale and Botwood formations, Central Mobile Belt, Newfoundland, Canada. Ph.D. thesis, University of Massachussetts, Amherst, MA.

Whalen, J. B., and Currie, K. L. 1983*a*. The Topsails igneous terrane of western Newfoundland. *In* Current research, part A. Geological Survey of Canada, Paper 83-1A, pp. 15–23.

——— 1983*b*. Geology of the Topsails igneous terrane, western

Newfoundland. Geological Survey of Canada, Open File Map 923.

WILLIAMS, H. 1967. Silurian rocks of Newfoundland. *In* Collected papers on the geology of the Atlantic region. *Edited by* M. Copeland. Geological Association of Canada, Special Paper 4, pp. 93–137.

——— 1980. Tectonic lithofacies map of the Appalachians. Memoiral University of Newfoundland, St. John's, Nfld.

WINCHESTER, J. A., and FLOYD, P. A. 1977. Geochemical discrimination of different magma series and their differentiation products using immobile elements. Chemical Geology, **20**: 325–343.

PROJECT SUMMARY

Noranda Exploration Co., Ltd.

Newfoundland District

Project: Cape Ray East

Project No: 4185

Commodity: Gold-Silver

N.T.S.: 110/15,16

Location: The project area is located 20 miles east southeast from the Trans Canada Highway near the Codroy River and 20 miles north of the south coast. The claims are on the western edge of the Long Range Plateau and access to the area is by helicopter or possibly float plane from Pasadena.

Property Status: Three ground staked licences consisting of a total of 147 claims owned 100% by Noranda Exploration Co., Ltd.

Geology: The Cape Ray fault forms the most prominent feature cutting through the claim group in an east-northeast direction. The fault separates the granitic terrrain of the Cape Ray complex to the north and gneissic Port Aux Basques complex to the south. Felsic to mafic metavolcanics and metasediments of the Windsor Point Group lie within and spatially related to the fault zone. The rocks are interpreted to have been deposited and deformed within a fault controlled basin.

Within the claim group the Port Aux Basques gneiss consists of a foliated granitic rock which becomes mylonitized and silicified near the fault zone. The Cape Ray complex to the north consists of an equigranular granite which is relatively undefromed. Chlorite and epidote alteration is common towards the Fault where the granite displays an irregular, intrusive contact with the Windsor Point Group. The Windsor Pond Group consists of strongly foliated phyllites, basic volcanics, pink felsites and quartz-carbonate breccia.

Mineralization: The Cape Ray gold deposit is located approximately 32 km to the southwest on a subsidiary shear structure divergent from the Cape Ray Fault. The gold occurs within quartz-sulphide veins within graphitic gouge which defines the shear. One mineralogy consists of disseminated galena, chalcopyrite, pyrite, sphalerite, native silver and gold. Aproximately 750,000 tons of 0.2 oz/ton recoverable gold have been reported. High grade gold values also occur in discontinuous quartz-sulphide veins in fractures in the Windowglass Hill granite adjacent to the Cape Ray Deposit.

Gold mineralization is reported at King George IV Lake approximately 45 km to the northeast along the Cape Ray Fault. Galena, sphalerite, pyrite and gold associated with quartz veins occurs in an altered granite float. A sample assayed 5% Zn, 1.5% Pb, 0.28 oz Ag/ton and 0.88 oz Au/ton.

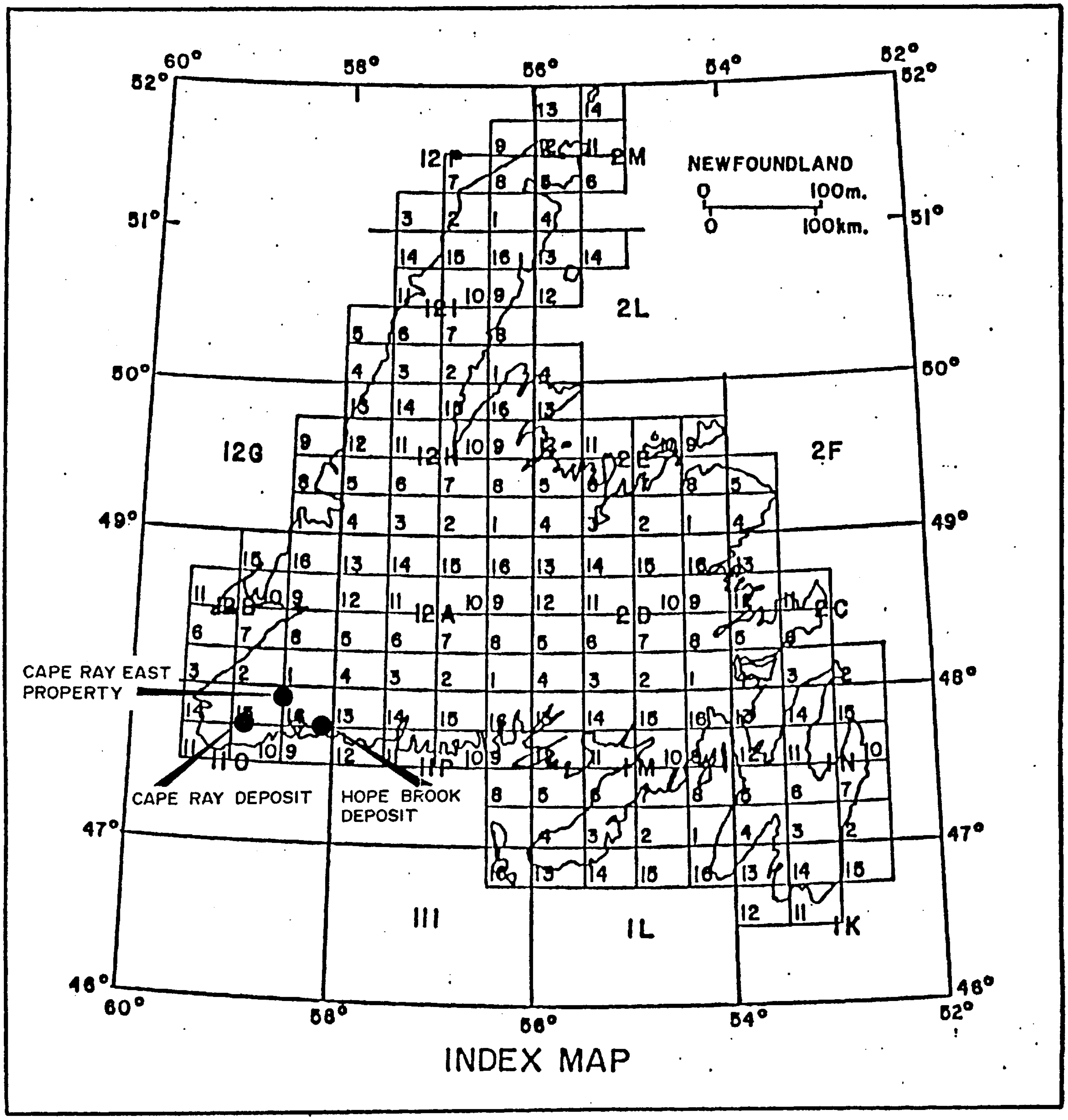
Mineralization occurs within the claim group at two locations. Chalcopyrite and galena was found in outcrop within a quartz-carbonate breccia 1/2 km east of Coon's Pond. This ran 2.6% Cu, 2.77% Pb, 0.2% Zn, 3.4 O.P.T. Ag and 0.002 O.P.T. Au. Quartz float containing sphalerite and galena ran 0.04% Cu, 1.27% Pb, 3.75% Zn, 0.28 O.P.T. Ag and 0.033 O.P.T. Au (1.5 G/T).

Anomalous gold values for panned heavy mineral concentrates from till and stream sediment occur throughout the claim group. The highest recorded value is 9893 PPB. An inspection of the actual gold grains indicates very little transport with a probable source on the property. The gold contained a high silver content which is the case at the Cape Ray Gold Deposit.

SCHEDULE I

GROUND STATUS

Licence No.	Claim Blk. No.	No. Claims	Date Issued
To be issued	5332	30	To be issued
To be issued	5333	54	To be issued
To be issued	5334	63	To be issued
	Total	147	



NEWFOUNDLAND
0 100m.
0 100km.
CAPE RAY EAST PROPERTY
CAPE RAY DEPOSIT
HOPE BROOK DEPOSIT
12P
2M
12I
2L
12G
12H
2E
2F
12B
12A
2D
2C
11O
11P
1M
1N
11I
1L
1K
60°
58°
56°
54°
52°
52°
51°
50°
49°
48°
47°
46°
INDEX MAP

Figure 1

Project Summary

La Scie

NTS 2E/13

Noranda Exploration Company, Limited

Newfoundland District

November 1987

PROJECT SUMMARY

Noranda Exploration Co., Ltd.

Newfoundland District

Project: La Scie Number: 4151

Commodity: Gold N.T.S. 2E/13

Location

The La Scie property is located on the northeastern tip of the Baie Verte Peninsula, approximately 35km east of Baie Verte, in northwestern Newfoundland (Figure 1). Good access is provided by a paved road joining Baie Verte and La Scie, which passes through the property. Relief is locally rugged and exposure is generally very good.

Property Status

The property consists of 467 claims in 10 claim blocks. Noranda has 100% ownership.

Geology

The La Scie property is underlain by the Cape St. John Group; a thick sequence of Siluro-Devonian subaerial felsic volcanic rocks, with lesser sedimentary and mafic rocks (Figure 2). They are bounded to the north and east by the Labrador Sea and Notre Dame Bay, and rest unconformably on Cambro-Ordovician ultramafic and gabbroic rocks of the Bett's Cove Ophiolite to the south. The western boundary is an intrusive, locally fault modified contact with the high level, comagmatic Cape Brule Porphyry.

The Cape St. John Group is disposed in a major upright east-trending syncline. In the northernmost area, isoclinal, overturned to nearly recumbent south-verging folding is acoompanied by lower amphibolite facies metamorphism. These diminish rapidly towards the south, such that the bulk of the Cape St. John Group is upright, moderately dipping and metamorphosed to lower greenschist facies.

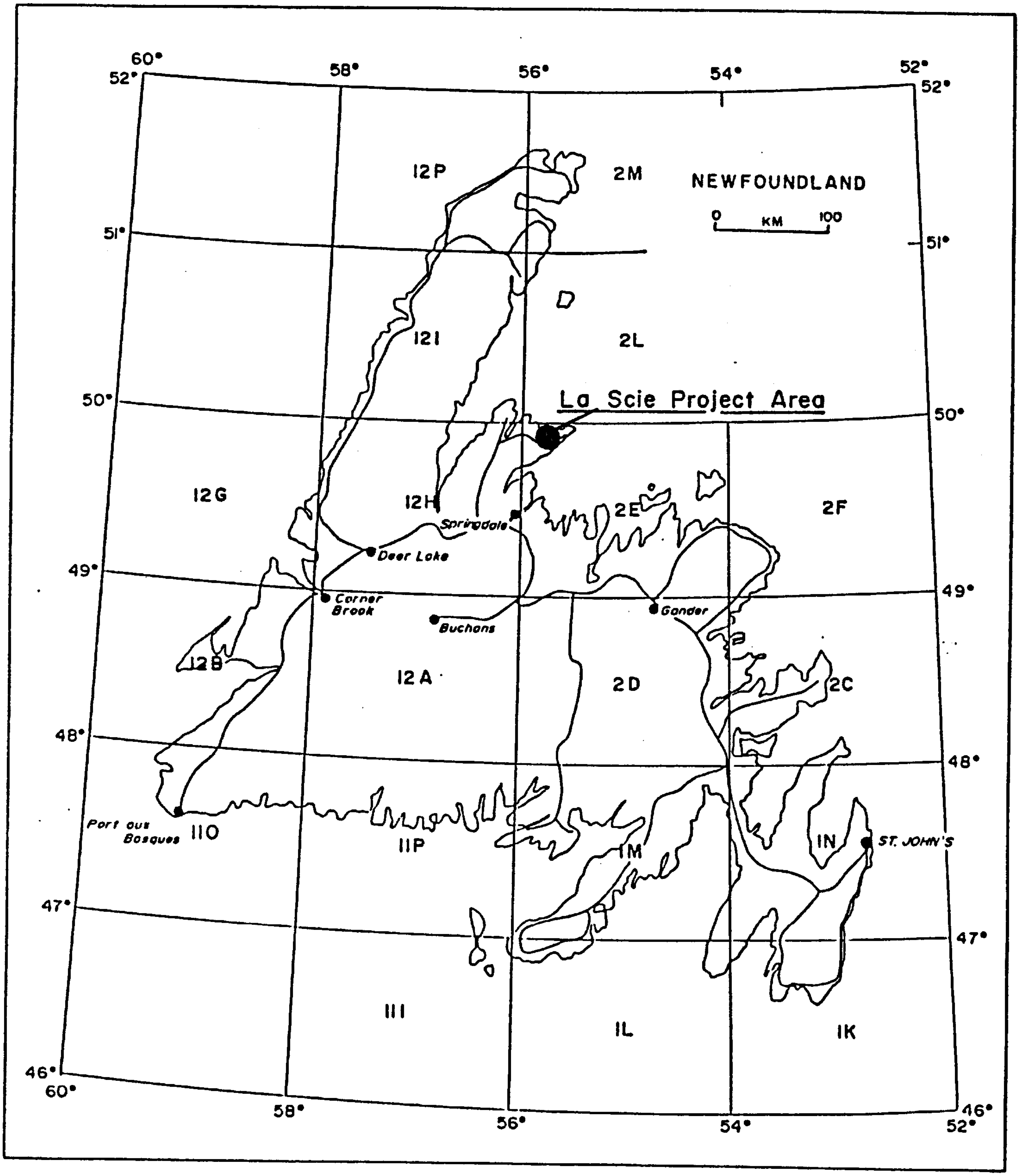


Figure 1: Location Map

Project Summary

Gander River "Outflow"

NTS 2D/15, 2E/2

Noranda Exploration Co., Ltd

Newfoundland District

November 1987

PROJECT SUMMARY

Project: Gander River Outflow **Project No:** 4111

Commodity: Gold **N.T.S.** 2D/15, 2E/2

Location

The "Outflow" project area is located 20km west of Gander. Claims have been staked along the Gander River where it "flows out" of Gander Lake (Figure 1).

Property Status

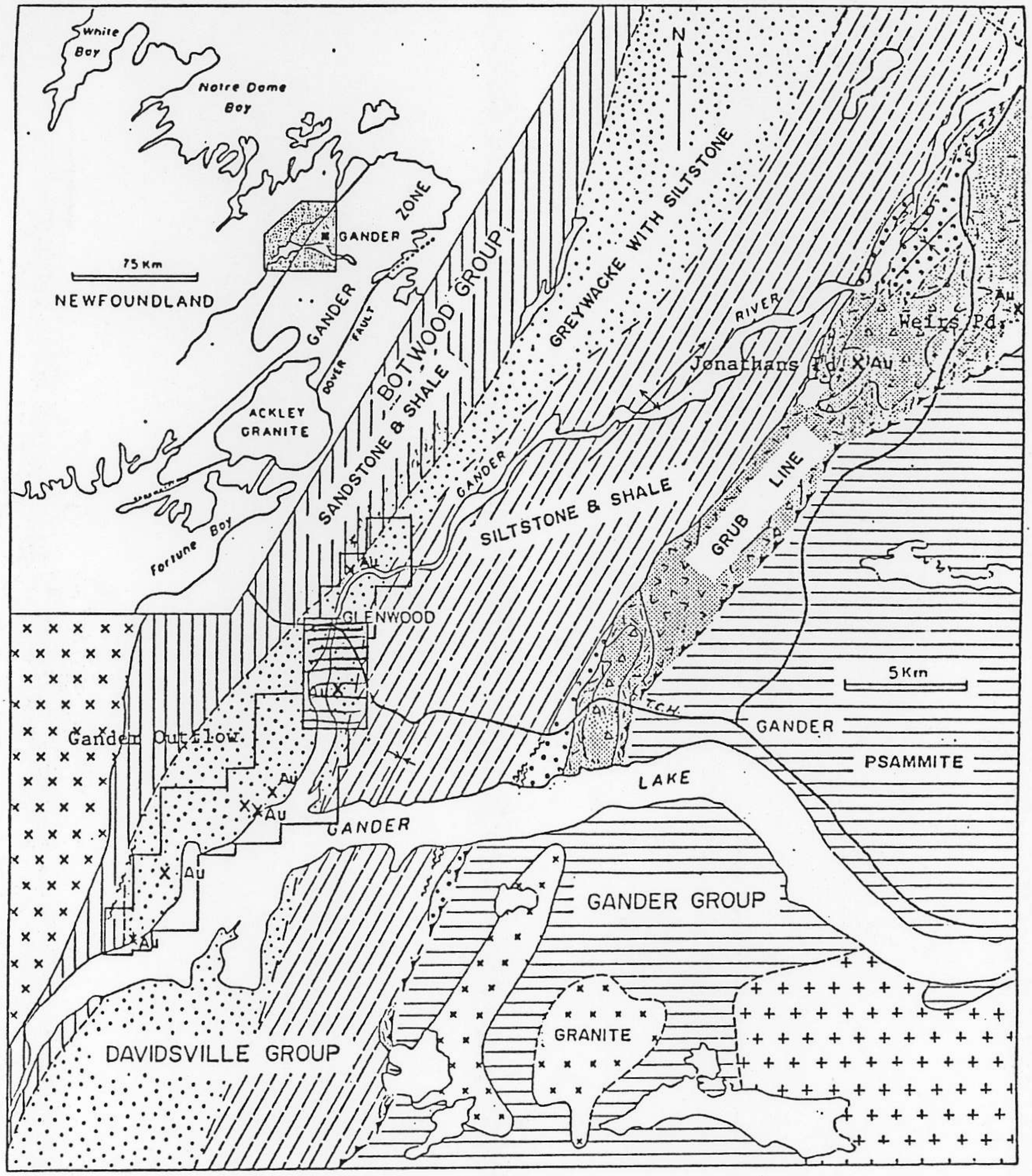
The property consists of 357 claims staked in 12 blocks held under four ground staked mineral licences. Noranda Exploration has 100% ownership (Schedule I).

Geology

The Outflow project covers sediments of the Davidsville Group. The Davidsville Group is of Ordovician age and consists of conglomerates, sandstone and shale sequences that grade up into calcareous siltstone, greywacke and grits towards the west (Figure 1). These rocks overlie ultramafic rocks of the Gander River Ultrabasic Belt (GRUB Line) and the fine grained distal sediments of the Gander Group. They are in turn overlain by Silurian sediments of the Botwood Group.

Thrusting in a northeasterly direction occurs along the GRUB Line; however, parallel thrust faults are believed to cut through the Davidsville Group. Cross faulting has also disrupted these tightly folded sediments.

The gold showings are hosted by a siliceous tuffaceous greywacke that has been brecciated and re-cemented by quartz-carbonate-pyrite veining. The tuffaceous greywacke is approximately 7m thick and is interbedded with thinly bedded shales and thickly bedded calcareous siltstones. The same horizon appears to host the Glenwood gold showing located along strike 6km to the northeast.



GLENWOOD AREA GEOLOGY

The GRUB line, boundary area of the Gander and Dunnage Zones.

Figure 1

Mineralization

Little or no prospecting for gold mineralization in sedimentary rocks has taken place in Central Newfoundland. Most of the work has concentrated on the GRUB Line where known gold occurrences are present in mafic rocks adjacent to the altered ultramafie rocks (Figure 1). In the Jonathans Pond area gold values of 5.8 g/t over 1.0m and grab samples up to 12.9 g Au/t have been reported by Noranda Exploration. Esso Minerals have gold occurrences up to 3.0 g Au/t that have been recently tested by five drill holes in the Weirs Pond area. U.S. Borax have values of up to 6.9 g Au/t from shales in the Great Bend area on strike 60km southwest of the property. U.S. Borax recently completed a drill program in the Great Bend area.

Noranda Exploration has recently optioned a 60-claim property in Glenwood to West Coast Ventures. Thie property covers clastic rocks of the Davidsville Group with siliceous pyritic veining that has returned values of 6.0 g Au/t over 2.0m in channel chip samples and grab assays returning up to 20.4 g Au/t (0.596 opt Au).

Model

Structurally controlled gold deposits found adjacent to ultramafic rocks similar to the Carolin Mine in British Columbia or possibly sediment hosted epithermal gold deposits similar to the Carlin District in Nevada. The environment of deposition for the sediments of the Glenwood-Gander area is shown in Figure 2.

1986 Work

Gold values of 2.05 g/t over 1.0m and 1.5 g/t over 1.5m have been returned from channel chip samples taken from druzy quartz-carbonate veins with up to 15% pyrite that cut siltstone-shales and grits (Figure 3). The area stripped and sampled is near C.C. Brook on the west side of the Outflow. Grab samples taken in prospecting similar rocks along strike have returned values of 5.5 g Au/t, 4.5 g Au/t, 3.3 g Au/t and 1.6 g Au/t along C.C. Brook and values of 2.3 g Au/t, 1.5 g Au/t and 1.1 g Au/t along strike 3km to the south.

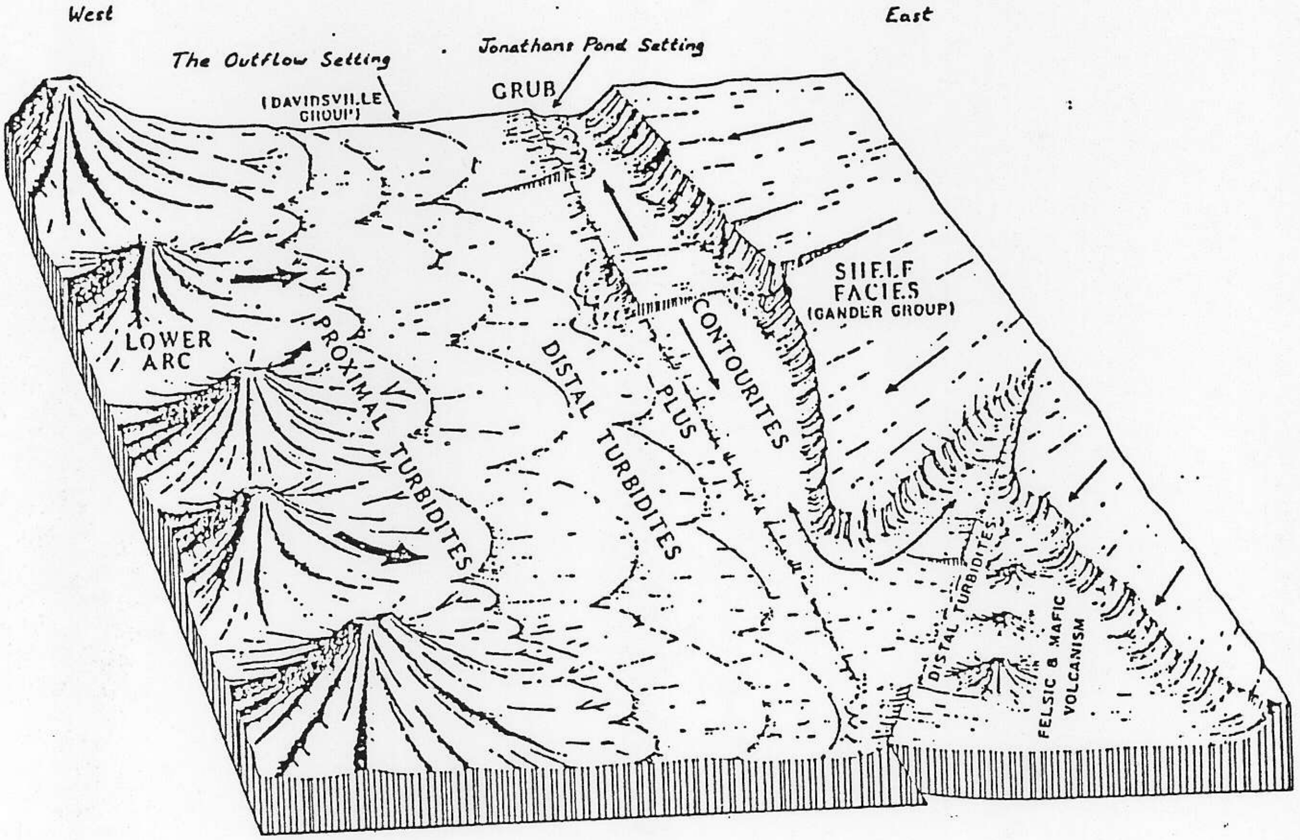
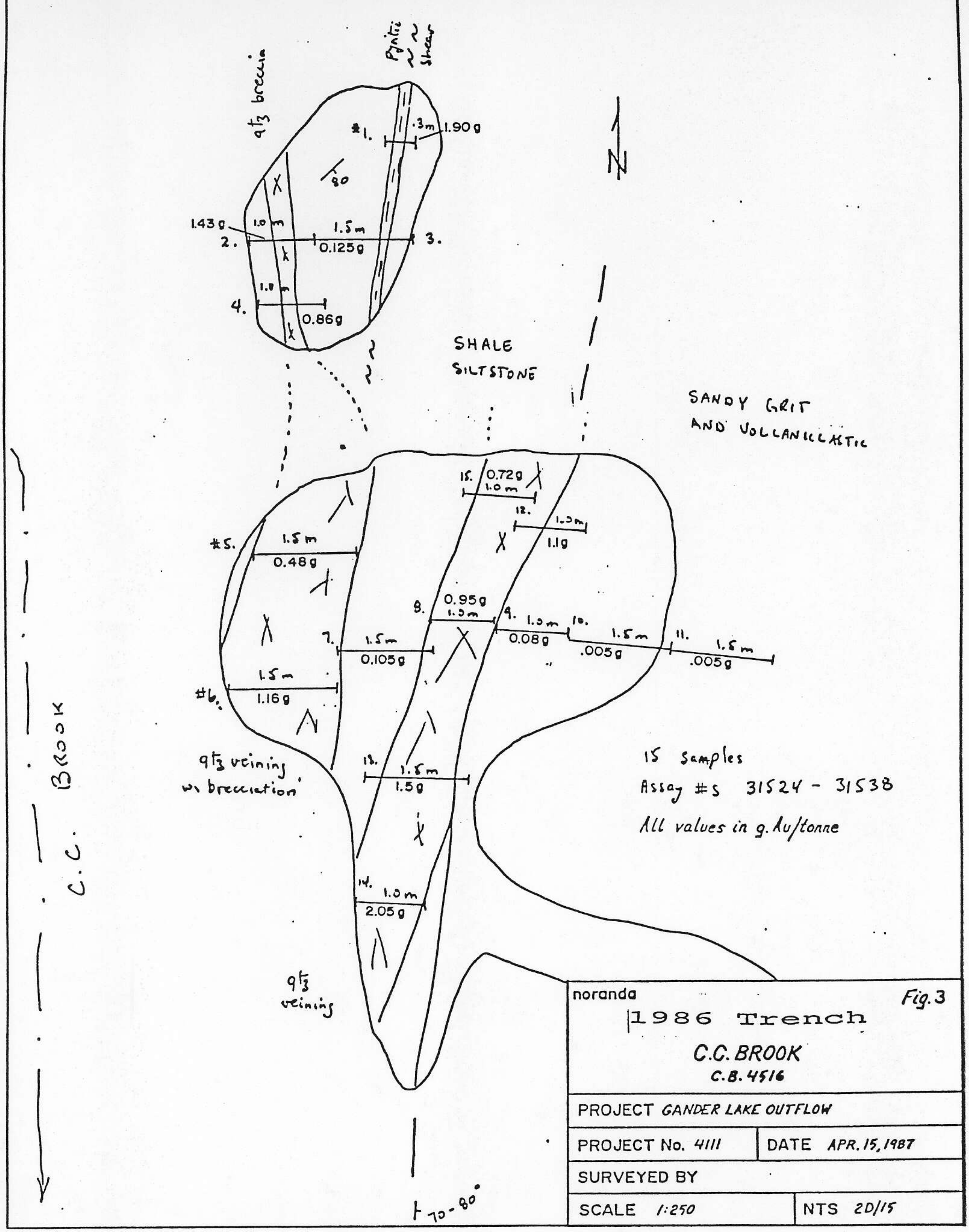


Figure 2: Schematic representation of depositional environment.



15 samples

Assay #s 31524 - 31538

All values in g. Au/tonne

noranda

Fig. 3

1986 Trench

C.C. BROOK

C.B. 4516

PROJECT GANDER LAKE OUTFLOW

PROJECT No. 4111

DATE APR. 15, 1987

SURVEYED BY

SCALE 1:250

NTS 2D/15

1987 Work

Preliminary prospecting, recce geology and trenching programs have been completed on the project area. Prospecting returned values of 7.8, 3.3, 3.1 and 1.3 g Au/tonne from silicified breccia zones that cut sandstones and volcaniclastic sediments of the Davidsville Group. Mineralized outcrop has been sampled over a strike length of 5km in a thick wooded area along the shore of Gander Lake (Figure 4, Back Pocket).

Trenching areas with anomalous gold values resulted in 10 trenches totalling 180m of exposure cutting a strike length of 2.1km. A total of 185 rock samples were taken and many favourable results were received. The first area of trenching on C.C. Brook exposed two parallel zones with values of 4.45 g Au over 1.0m or 2.73 g over 2.0m over one zone and 1.7 g Au in an adjacent zone with up to 5% pyrite (Figure 5, Back Pocket). All gold values are from brecciated and silicified zones that out massive sandstone and volcaniclastic-greywacke horizons.

Approximately 1.2km north of C.C. Brook trenching has exposed sediments cut by intense silicification with up to 5% disseminated pyrite and 1% arsenopyrite. Three zones of alteration up to 3.0m thick cut 12.0m of sheared and altered sediments. Assays of 10.7 g Au/t over 0.75m, 8.75 g Au/t over 2.0m and 5.2 g Au over 1.0m were returned from one zone and 1.37 g Au over 3.0m was returned from an adjacent zone (Figure 6, Back Pocket).

Wherever this altered silicified horizon was sampled it returned anomalous gold values from 250 ppb to 1,000 ppb Au. The best gold values are associated with 5-10% pyrite, arsenopyrite mineralization and intense silicification and quartz veining.

A total of 54.0km of linecutting has been completed for control of soil, mag and VLF surveys presently being carried out. To date, 3.0km of I.P. have been finished and the silicified zone with significant gold values in the sediments has an anomalous chargeability and a distinct resistivity contrast with the adjacent sediments.

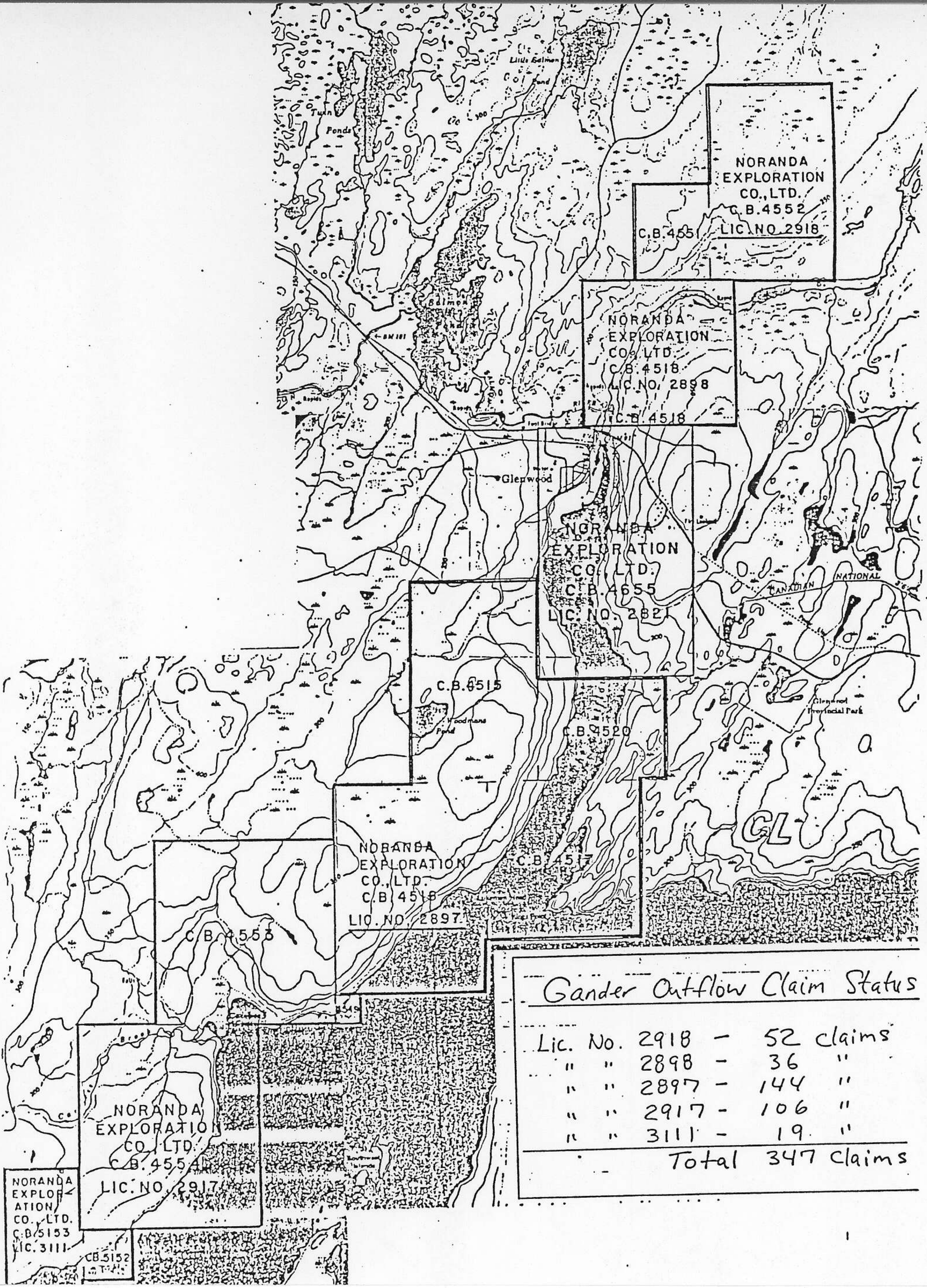
Proposed Program

Follow-up prospecting and trenching will be carried out to explain anomalous soil values and geophysical anomalies. An I.P. survey will attempt to extend the zone of anomalous chargeability and distinct resistivity contrast that is associated with the silicified sediments that host the gold mineralization. The gold showings that have been trenched to date are to be drill tested by an estimated 1,000m of NQ drilling.

Schedule I

Property of the "Outflow Project"

Licence	Claim Blocks	No. of Claims	Licence Issued
2897	4515	40	Dec. 4/86
	4516	48	
	4517	36	
	4520	20	
2898	4518	36	Dec. 4/86
2917	4553	49	Dec. 22/86
	4554	56	
	15549	1	
2918	4551	12	Dec. 22/86
	4552	40	
3111	5152	4	Aug. 6/87
	5153	15	
TOTAL	12	357	



Gander Outflow Claim Status

Lic. No. 2918 - 52 claims
" " 2898 - 36 "
" " 2897 - 144 "
" " 2917 - 106 "
" " 3111 - 19 "
Total 347 Claims

N.C. CARTER, Ph.D., P.Eng.

Consulting Geologist

1410 Wende Road
Victoria, B.C. V8P 3T5
(604) 477-0419

November 26,1987

Mr. R.T. Heard, P.Eng.
General Manager - Exploration
Equity Silver Mines Limited
708 - 1155 West Pender Street
Vancouver,B.C.
V6B 2P4

Dear Mr. Heard:

Re: Potential Projects for 1988

Herewith are brief notes regarding four potential projects. Three are gold properties in the Beardmore - Geraldton area of Ontario and the fourth is a copper-gold-silver property in northwestern B.C.

Note that no investigation has been done regarding first, the availability of these projects, and secondly, what sort of a deal might be required for participation.

1. Red-Chris Copper-Gold-Silver Property, NW B.C.

Red-Chris is situated 12 miles southeast of Eddontenajon and five miles south of the current access road linking Klappan coalfield with highway 37.

Considerable percussion and diamond drilling was carried out on this property between 1970 and 1980, principally by Texasgulf or Kidd Creek Mines (now Falconbridge - 25% equity interest held by Placer Dome) who apparently earned a 82% interest. The remaining 18% is held by Consolidated Silver Standard Mines ltd. through Western Copper Holdings Ltd.

Pyrite and chalcopyrite and some bornite occur in a quartz vein stockwork within an elongate body of altered monzonite porphyry which intrudes Takla volcanics and is in fault contact with Bowser sediments.

Gold values are reportedly significant within the deposit which has a published reserve of +40 million tons grading 0.58% copper and 0.01 oz/ton gold to a depth of 500 feet. Unconfirmed reports refer to a tonnage of considerably higher copper grades - 1-3% - plus up to 1 oz/ton silver.

2. Sturgeon River Gold Mine - Beardmore, Ontario

This former producer, 13 miles northeast of Beardmore and readily accessible by road, is owned by Phoenix Gold Mines Ltd. (78% Quebec Sturgeon River Mines Ltd.)

Between 1936 and 1942, this property produced 73,438 oz gold from 145,123 tons milled (average recovered grade 0.51 oz/ton) mainly from the No. 3 vein which has an average width of less than 2 ft. Mining was by way of a 2,000 ft. shaft and reserves below the 1600 ft. level are quoted as being 130,000 tons grading 0.306 oz/ton (average width of 1 to 2.5 ft.)

Recent work (1984-1986) on the property has located 15 new vein structures with some impressive gold values. Several of these have been explored by stripping only. One of the more attractive is 1500 ft. north of the shaft and has an average grade of 0.825 oz/ton over an average width of 1.6 ft. and a length of 500 ft.

None of the newly discovered veins have been drilled - the project is on hold and no work was done in 1987.

Phoenix apparently has (or had) major financing arranged in the U.K. which was dependent on the price of gold exceeding a certain amount ($500?) within a specified period of time.

3. Brookbank - Metalore - Beardmore, Ontario

This significant gold deposit is 10 miles northeast of Beardmore and accessible by road. The property is currently under option to Mingold (HBM&S) and is subject to a lawsuit initiated by Ontex Resources, the property vendor.

George Chilian, president of Metalore, suggests Mingold is reluctant to comply with the provisions of the agreement which includes sinking an 1800 ft. shaft within a specified period of time, and he is thinking of terminating the agreement. He has expressed interest in doing a deal with the Placer Dome group.

This deposit has at least 750,000 tons drill-indicated, grading about 0.30 oz/ton gold over widths of 15-20 ft. and at depths of between 1000 and 1800 ft. This is obviously a significant discovery but the main difficulties with it are the current lawsuit, whether or not Metalore can terminate the present agreement and the probable stiff deal Metalore would demand from a new party.

4. Portage Longlac Gold Property

This property, 3 miles west of Geraldton, consists of 21 patented claims apparently owned by T.L. Gledhill of Toronto.

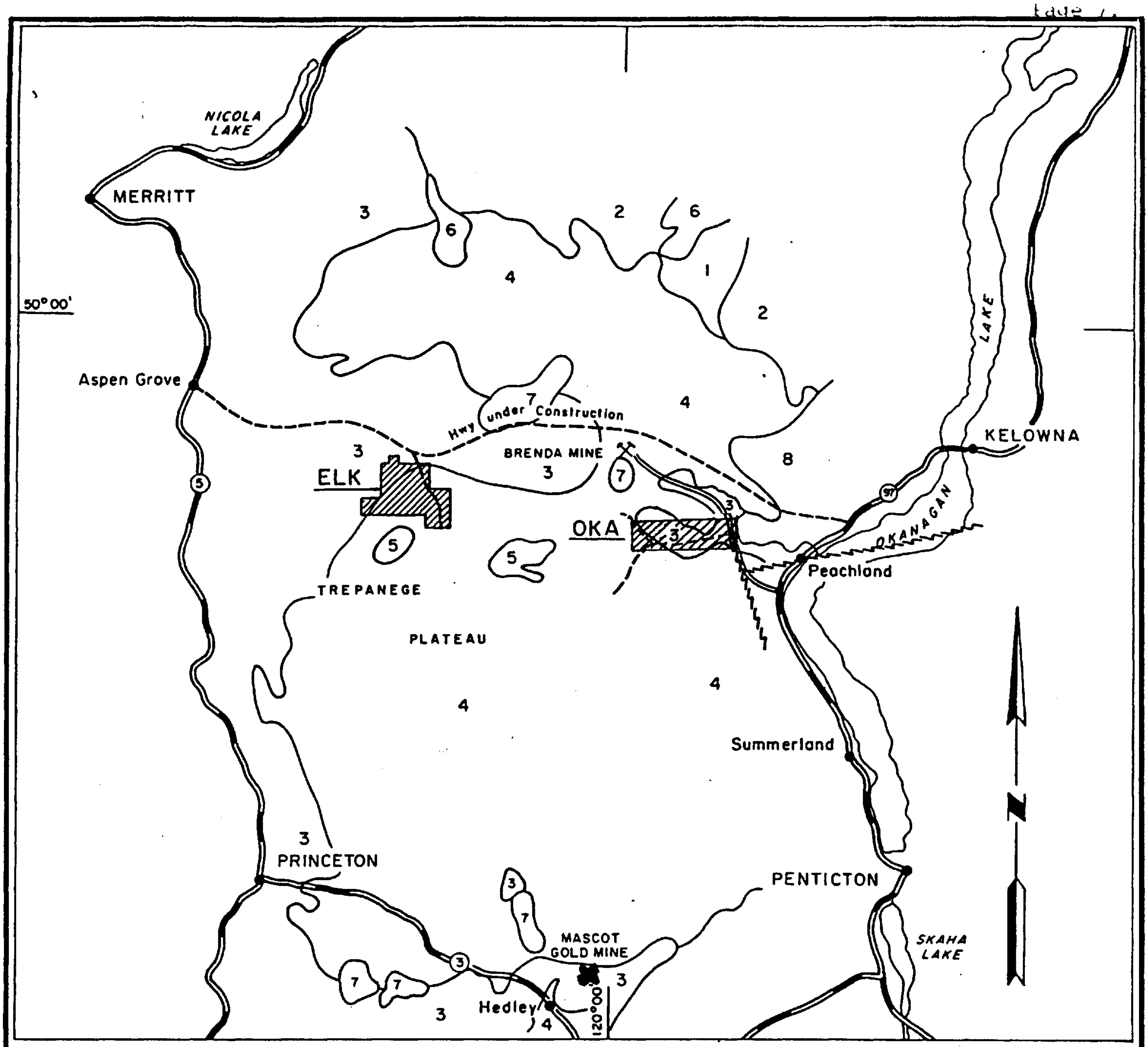
The property was shown on a map of Canada in the Placer 1986 annual report as one of their major projects but it appears that the deal fell through and no work was done on the property in 1987. There is also a report that the claims were up for tax sale in 1987 but later withdrawn.

No work has been done on the property since a 21,000 ft. drilling program in 1937. The area of interest is covered by up to 100 ft. of overburden. 25 diamond drill holes, 100 to 600 ft. apart, intersected gold values in quartz veins and stringers in sheared greywacke over a strike length of 3,600 ft. Reported values ranged from 0.03 to 0.32 oz/ton gold over 5 to 6 ft. widths.

This property is on strike with the former Little Long Lac mine (1.7 million tons of 0.34 oz/ton gold) and is attractive in view of good grades obtained from limited previous drilling 50 years ago.

NCarter.

N.C. Carter



LEGEND

8	Eocene/Oligocene	Andesite flows
7	Miocene/earlier	Princeton Group - shale, sandstone
6	Miocene/earlier	Kamloops Group - rhyolite, andesite
5	Upper Cretaceous	Otter Intrusions - granite
4	Jurassic/Cretaceous	Coast Intrusions - granite, granodiorite
3	Upper Triassic	Nicola Group - sediments, greenstone
2	Carbonaceous	Cache Creek Group - argillite, quartzite
1	Pre Permian	Chapperon Group - schist

FAIRFIELD MINERALS LTD.

REGIONAL GEOLOGY

OKA & ELK PROPERTIES
SOUTH OKANAGAN AREA

Scale 1: 633,600

10 0 10 20 30

Scale in Kilometres

FEBRUARY 1987

FIGURE 3

N.C. CARTER, Ph.D., P.Eng.

Consulting Geologist

1410 Wende Road
Victoria, B.C. V8P 3T5
(604) 477-0419

September 28,1987

Mr. R.T. Heard,P.Eng.
General Manager - Exploration
Equity Silver Mines Limited
708 - 1155 West Pender Street
Vancouver,B.C.
V6E 2P4

Dear Mr. Heard:

Re: OKA and ELK Gold Properties
Fairfield Minerals Ltd.
South Okanagan Area,B.C.

Field examinations of both of the above properties were undertaken September 17,1987.

Access to both properties is excellent, by way of a network of logging roads west from Peachland.

Both claim groups are within or adjacent to granitic rocks of the mid-Jurassic Pennask batholith.

OKA Property

The central part of the property is 15 km by road northwest of Peachland.

The principal claims cover an embayment of Upper Triassic (Nicola) sedimentary rocks along the northeast margin of the Pennask batholith. The eastern part of the embayment is comprised of calcareous sediments, mainly marble, which are variably altered to garnet skarn. These skarn zones contain irregular, 1 metre wide or less massive sulfide lenses which consist of pyrite, pyrrhotite and some chalcopyrite.

These massive sulfide lenses were drilled by Noranda in 1956 and further explored by trenching in 1966 by BrenMac Mines.

Diorite sills and dykes are spatially related to the massive sulfide lenses and to low sulfide garnet skarns. Further west, and apparently up-section, calcareous units grade to siltstones.

The geological setting is grossly similar to Hedley and locally good grades of gold mineralization is found in the low sulfide skarns (but not in massive sulfide lenses).

The principal showings area is on the Iron Horse reverted Crown granted mineral claims in the eastern property area. Chip samples collected in 1987 range from 0.16 opt gold over 10.5 ft. to 1 opt over 5 ft. and grab samples range as high as 11 opt gold.

Better grades appear to be spatially related to diorite dykes and sills while younger granitic dykes (related to the Pennask batholith) are post-mineral.

Surface sampling to date does not really give a good indication of continuity. Old Noranda drill cores have been resampled and results of this should give an indication of continuity to depth.

The Iron Horse showings are at the eastern end of an apparent east-northeast structure, 4.5 km in length, and along which three additional showings areas have been located. The entire belt is characterized by +20 ppb gold values in soils.

The Bolivar East showing, near the western end of the belt, includes hornfelsed siltstones from which a 0.21 opt gold value was obtained over a 6.5 ft. length. The thinking here is that the siltstones may be overlying more permissive (skarn) units and diorite dykes and sills at depth.

Conclusions and Recommendations

This is an attractive prospect which obviously warrants drilling. Results from samples from old drill cores should yield critical information regarding continuity of gold grades to depth.

ELK Property

The Elk claims, 30 km west of OKA, cover the western margin of the Pennask batholith.

Gold mineralization is associated with narrow (less than 1 metre wide) northeast-striking quartz veins cutting granitic rocks.

Two principal showings areas have been identified to date. The North showing consists of narrow quartz veins cutting quartz-feldspar porphyry (late Cretaceous Otter intrusions) and younger andesite dykes. The veins are central to a northeast trending zone of +50 ppb values in soils and grades from surface sampling range from 0.84 - 8.65 opt gold over widths of less than 1 metre.

The South showing includes quartz veins entirely within Pennask granitic rocks. Surface sampling has yielded grades of 0.2 - 1 opt over 0.3 to 1 metre widths. Additional trenching is planned to test a broad (900 by 450 metre) area of 100 ppb gold values in soils, partly coincident with IP anomalies. southwest of this showing.

Conclusions and Recommendations

Best gold grades obtained to date are associated with narrow quartz veins. Parallel veins or stockworks will have to be found to make significant tonnages.

Trenching planned for an area southwest of the South showing will help to explain the area of broad geochemistry - in the writer's opinion, values here may be transported from a small source area.

N C Carter

PROPERTY EVALUATION AND STATUS

	NUMBER OF PROPERTIES				
PROVINCE OR TERRITORY	EXAMINED	REJECTED	REQUIRING EXAMINATION	ACCEPTED	WITH NEGOTIATIONS PROCEEDING
		0	0	0	0
BRITISH COLUMBIA	68	51	5	11	1
MANITOBA	5	5	-	-	-
NEWFOUNDLAND & LABRADOR	12	7	-	5	-
NORTHWEST TERRITORIES	9	7	-	2	-
NOVA SCOTIA	6	6	-	-	-
ONTARIO	54	48	3	2	1
QUEBEC	9	7	-	1	1
SASKATCHEWAN	4	4	-	-	-
YUKON	11	9	-	2	-
TOTALS	178	144	8	23	2

LIST OF PROPERTIES

BRITISH COLUMBIA

0 Menika Mining - Sechelt Property
0 Edward Asp - Thibert Creek Platinum Project
0 Relay Creek Resources - Big Property
0 Pilgrim Holdings Inc. - H.J. Property
0 Silver Cloud Mines Ltd. - Yellow Project
0 Borealis Exploration Limited - Faraway
0 Wes Moll - H.D. Property
0 - Raven Property
0 Pan American Energy - J & L Project
0 Industrial Jasper Property (Au bearing) - Vancouver Island
0 Atna Resources Ltd. - J.V. (Rob Pease)
0 John Carson - Bombini Property
0 - Burnt Basin
0 - Rock Creek
0 - Three others when snow clears
0 - Tel Mineral Claim
0 Ark Energy Ltd. - Camp McKinney
0 Goldbrae Developments Ltd. - Nanaimo Lakes
0 Golden Eye Minerals - Red Bird Project
0 International Shasta - Toodoggone Au-Ag Project
0 Menika Mining Ltd. - Reliance Property
0 National Resource Exploration - Shuswap Property
0 St. Joe Canada Inc. - Silver Pond Project
0 Teck Corp. - Gaul Claims
0 Merven Boe - Tic-Tac-Ona
0 - Poison Mountain
0 Zeballos Camp
0 Gleaner & Brown Prospects - Engineer Mine Area
0 Rich Sewell - Turnagain
0 5 Properties sent to Roman Shklanka - Hedley Area
0 Equity Rob Pease project development - 7 properties - Rookie 20 units
0 - Urn 25 units
0 - Tableland 20 units
0 - Berr 20 units
0 - Wing 36 units
0 - Kate 24 units
0 - Troy 30 units
175 units

0 Anglo Canadian - Red 1 & 2 claims, Babine Lake Area
0 Dia Met Minerals - Cranbrook Area
0 Mount Defot - Dease Lake Area
0 Radcliffe Resources - Inconspicuous Property - Graham Island
0 Inzana Lake - Northwest Geological Claim

0	6 Baloil Lassiter Petroleum Ltd.	- Summit Group	30 claims
0		- Katie Group	36 claims
0		- Lemax Group	58 claims
0		- Whitewater Group	160 claims
0		- Enterprise Creek Group	152 claims
0		- Wilson Creek Group	74 claims
			510 claims

0 First Fraser Minerals
0 Hop Claims - Dease Lake
0 Pride Resources - Mountain Boy Property - Skeena
0 Harkley Silver Mines - Otter Peak - Skeena
0 Tuleric Lake Project
0 Z-N Project
0 Tungo Resource Corp.
0 Falkland Property
0 Pillar Lake Property
0 Trinity Property
0 OKA Project, Peachland area
0 Elk Project, Peachland area
0 Wes Moll - Crow Property
0 Joe Hibder - Copper Group
0 - Discovery Group
0 Bob Hamblin - Bob and Bill Claims
0 Barry Meek, Bardon Property
0 Spencer Acker - Sby Property
0 - Bee Property
0 Red-Chris Cooper-Gold-Silver

Total 68

MANITOBA

0 Bruce Dunlop - Gurney Mine Project
0 - Mid-North Resources Ltd.
0 - Bigstone Lake
0 - Sherman Lithium
0 - Beau Cage Lake

Total 5

NORTHWEST TERRITORIES

0 Chevron Minerals - NIC Prospect
0 Homestake Mineral Development Co. - SY Project
0 Borealis Exploration Limited - Fat Lake
0 Aber Resources Limited - Indin Lake
0 - Mosher Lake
0 Highwood Resources Limited - Russell Lake
0 Rapparee Resources Ltd. - Outpost Island
0 - W.T. Project
0 Tanqueray Resources - Cameron River Project

Total 9

NEWFOUNDLAND & LABRADOR

0 Saglek Bay Project - Labrador (staked 2,012 claims)
0 Caldera Project - 4 areas being staked - 1778 claims
0 Roberts Arm Area - Lewis Murphy
0 5 Varna Group - Chetwynd
0 - Burin Pennisula
0 - Baie Verte
0 - Glover Island
0 - Jacksons Arm
0 Brighton Platinum - Tickle Islands
0 Cape Ray East Gold Property - Noranda
0 La Scie Project - Noranda
0 Gander River Outflow - Noranda

Total 12

NOVA SCOTIA

0 2 Seabright Resources - joint venture negotiations
0 - examined Forest Hill & Beaver Dam Projects
0 Coxheath Resources - Tangier Mine
0 Donald Black & Avard Hudgins
0 Arisaig Explorations - Georgeville Volcanics - 127 claims
0 - 4 other properties - 114 claims

Total 6

ONTARIO

0 2 G. Meyer - Horseshoe Lake and Confederation Lake Properties - UCHI Lake
0 Hillsborough Property - (72% Stokes/28% Cassidy)
0 Bruce Dunlop - Marathon Platinum Prospect
0 Tom Conway - Tannahill Twsp.
0 Iron Horse Claims
0 O.G. Resources Limited - Cobalt
0 St. Joe Canada Inc. - a) Jewett Lake Project - Pickle Lake
b) Jack Hodge - acquiring 50 claims which adjoin and will become part of the Jewett Lake Project
c) Staking - 3-500 claims which will also become part of the Jewett Lake Project
0 15 St. Joe Canada Inc. - Webb Lake Project, 14 properties, 366 claims
0 - Pine Cone Point Property, 37 claims
0 Mono Gold Mines - Bannockburn
0 George Heard - Havelock
0 Moneta Porcupine - Timmins Area
0 Ron Bradshaw - Timmins
0 Geraldton Area - gold prospect - two man prospecting crew
0 Two Man Prospecting Crew - Ed Roberecki, Kenora Area - Florence Claims
0 - Thor Group
0 - Sultana Island
0 - Stella Claims
0 - Non Such
0 - Falcon Creek
0 - Bill Perry-Pickle Lake Crown Grants
0 - Cavelle Showing, Savant Lake Area
0 - Springer Showing, Pickle Lake Area
0 - George Lake Project
0 - Wayne McChristie - Goudreau/Misinabi Greenstone
0 Belt
0 - Shebandowan/Kashabowie
0 - Pat Culhane - Maun Lake
0 - Jack Hodge - See St. Joe above
- Diabase dyke prospect at Pickle Lake
0 - Davidson Carr/Powell Showing, Savant Lake
0 5 Beardmore - Geraldton Area - Watson Lake
0 - Kenty Au-Mo Prospect
0 - Beardmore Gold Stake
0 - Standing Stone - Archie
0 - Coulson Claims
0 2 Fort Hope Area - Gross Lake
0 - Albany River
0 Sturgeon River Gold Mine, Beardmore
0 Brookbank - Metalore, Beardmore
0 Portage Longlac Gold Property, Geraldton

Total 53

QUEBEC

0 Pan Island Resource Corp. - Casa Berardi
0 Chevron Minerals - Casa Berardi
0 Soquem - Freeman Project
0 5 Yorbeau Resources Inc. - Noranda Area
0 - Astoria Mine
0 - Ellison Mine
0 - Val d'Or Area - Vauper Project
0 - Casa Berardi
0 Soquem - Val D'Or Area

Total 9

SASKATCHEWAN

0 Lloyd Clark - Table Lake Project
0 Radcliffe Resources - La Ronge Area, 3 leases
0 Ennedai Project
0 S.M.D.C.

Total 4

YUKON

0 Fairfield Minerals - Ram Project
0 M.J. Moreau - Peso Silver Property
0 Shakwak Exploration Company Ltd. - Mt. Skukum
0 Tally Ho Resources - Mount Tally Ho
0 Chevron - Wellgreen & Canalask - Platinum
0 Yukon Revenue
0 Mount Freegold
0 Total Erickson
0 Tally Ho - La Forma Property - Carmacks
0 Tim Project - Fairfield Minerals
0 Meister Project - Fairfield Minerals

Total 11