

823886

GEOLOGICAL EVALUATION REPORT

HAIL - HARPER CREEK COPPER PROSPECT

84 M/12W

Kamloops Mining Division, British Columbia

for

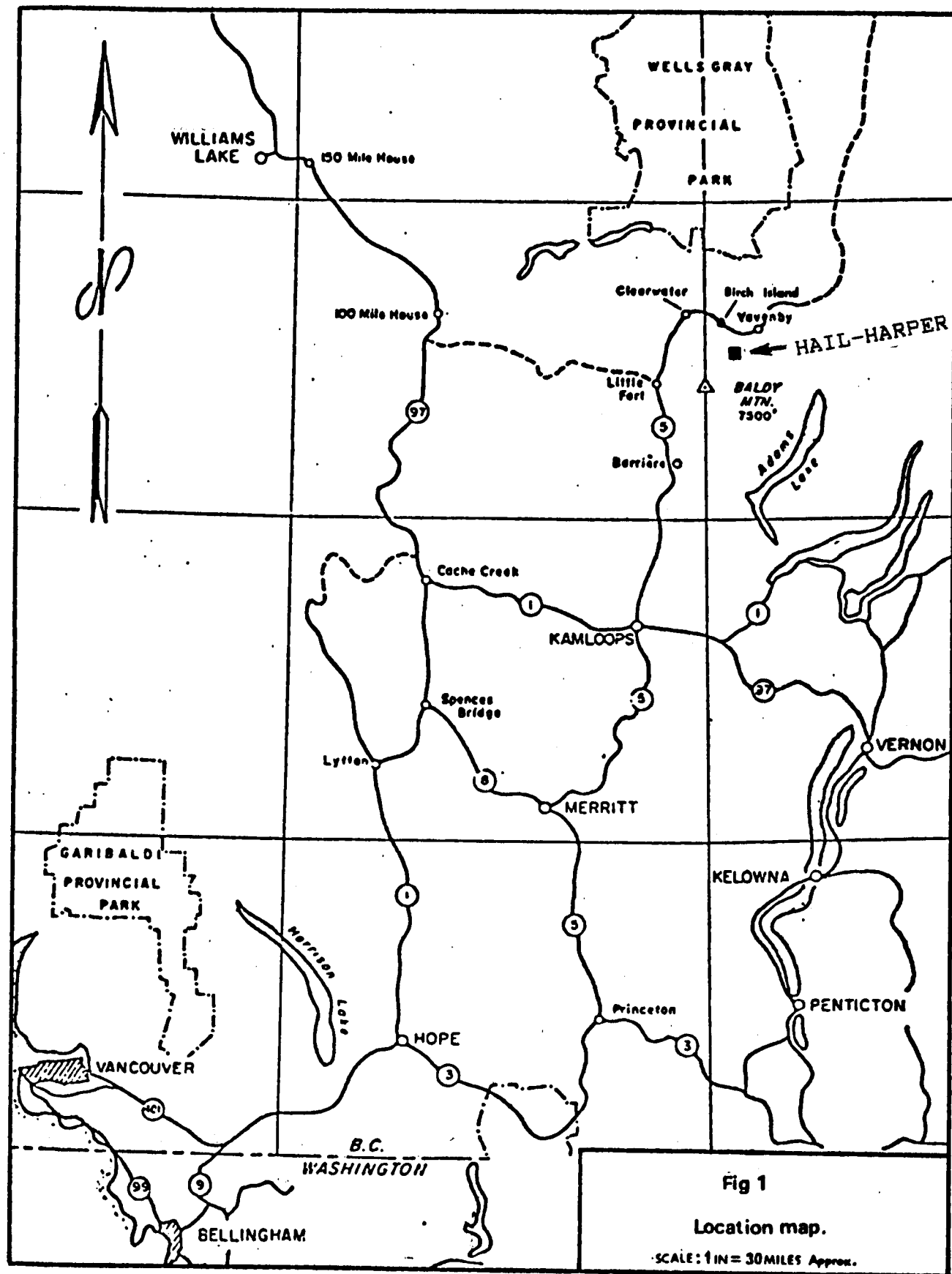
AURUN MINES LTD

P.O. Box 602, Aldergrove, B.C.  
VOX 1A0

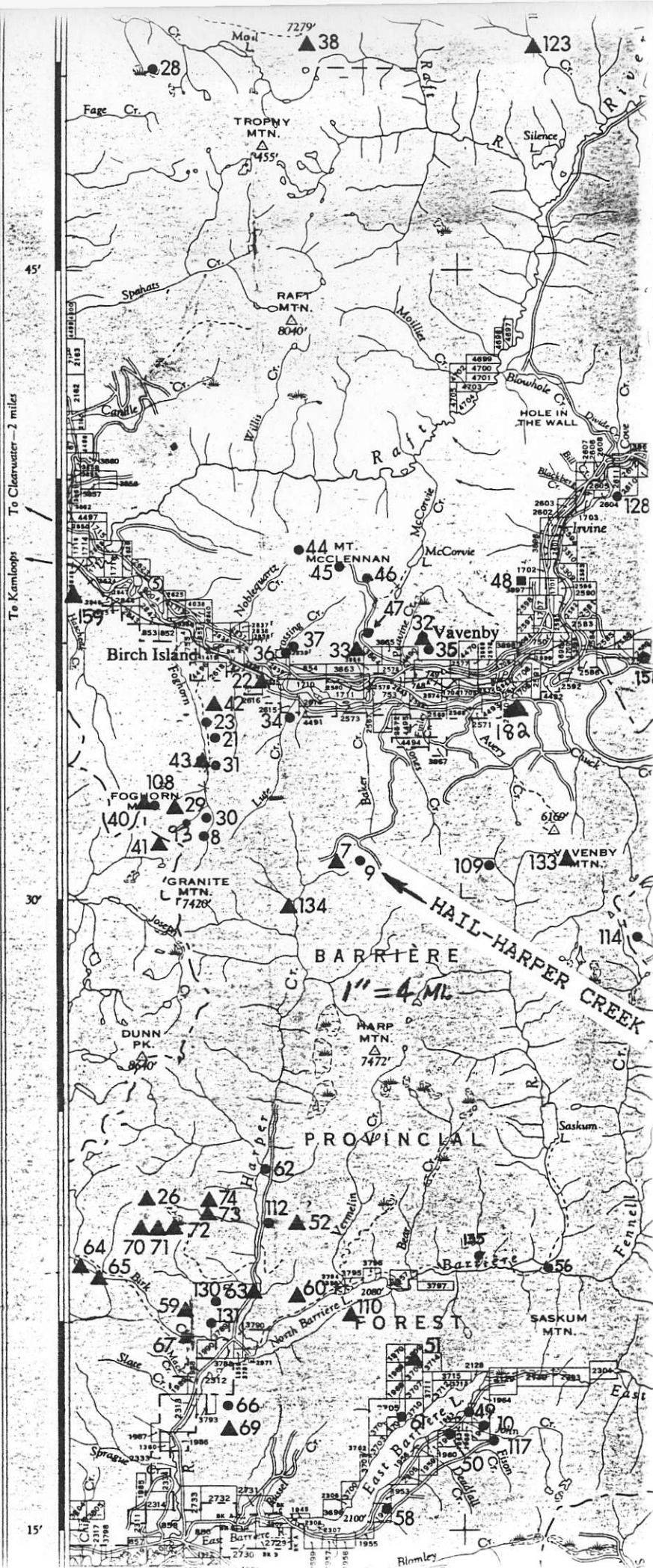
by

Charles A.R. Lammle, PEng.

30 April 1986



NO.	NAME	PRODUCT (S)
82M-		
1	RIVER JORDON (KING FISSURE)	Zn, Pb, Ag, Ba, Fl
2	MOUNT COPELAND (JOAN, KNOX)	Mo, REAM, NPLN, FL
3	J & L (VIEW; RAINDOR, 98)	Au, Ag, Pb, Zn
	OPPER QUEEN (S)	Cu, Zn
4	MASTODON	Zn, Pb, Cd, Ba, Fl
6	LITTLE SLIDE	Pb, Zn, Ag
7	GOOF, SUE	Cu, Zn, Pb
8	FH (FOGHORN; LYDIA)	Cu
9	HAIL	Cu, Zn, Pb
10	BEX	Cu, Ni, Pb, Zn
11	BIG BEN (PETE ?)	Pb, Zn, Cu
12	MCGILLIVRAY (Lucky Coon)	Pb, Zn, Ag, Au, As
13	KING TUT	Ag, Pb, Zn, Au
14	SPEEDWELL	Pb, Zn, Ag
15	DONNAMORE (LUND)	Pb, Zn, Ag
16	MOSQUITO KING (PAT)	Pb, Zn, Ag
17	EX 1 (SPAR)	Pb, Zn, Ag, Cu
18	BEL	Zn
19	ELMOORE (WALLACE; LINCOLN)	Pb, Zn, Ag, Cu
20	TWIN MOUNTAIN (STAR)	Ag, Pb, Zn, Cu, Au, barite
21	REXSPAR (SPAR; SMUGGLER)	Fluorite, strontium sulphate
22	G. ZONE	U
23	SMUGGLER	Ag, Pb, Mn
24	GC, AMA	Li
25	HOMESTAKE (DELL, FRED)	Ag, Pb, Zn, Au, Cu, barite
26	BIRMOLY (JANE)	Mo
27	RIP	Mo
28	TIM	Mo
29	FOGHORN	Ag, Pb, Zn
30	SHAMROCK (FH)	Pb
31	MINNESOTA GIRL (BLACK DIAMOND ?)	Ag, Pb, Zn
32	TINKIRK	Ag, Pb
32	BEARSDEN	Ag, Au, Cu, Pb
	JLLION	U, fluorite
35	BIG CHIEF - CHIEFTAN (DREADNOUGHT)	Au, Ag, Cu, Pb
36	LEONIE, BRENDA, SONJA	Au, Ag, Pb, Cu
37	ELVA - SONJA	Pb, Zn, Cu, Ag
38	SUMMIT (ADY)	Ag, Cu, Pb, Zn
39	CARIBOO	Ag, Mn
40	CHIDGRIN	Pb, Zn, Cu
41	KELLY'S (FH ?)	Pb, Zn
42	MILLAR'S	Pb, Zn, Mo
43	FOGHORN CR. MOLY (JANE)	Mo
44	RED TOP	Pb, Zn, Ag, Cu
45	SNOW (NAOMI)	Cu, Pb, Zn
46	SUNRISE (NAOMI)	Cu, Pb, Zn, Au
47	MORRISON ?	Au
48	LAST CHANCE	Pb, Ag, Au
49	GRIZZLY	Cu, Ag, Zn
50	RENNING	Cu, Ag, Zn, Pb
51	EBL, REM	Cu
52	H	Mo
53	AGATE (TRY ME; RANKIN)	Pb, Zn, Cu, Ag
54	GLEN	Ag, Pb, Cu, Zn, Au
55	RHODE ISLAND, TOM; AD, DAY	Ag, Pb, Cu, Zn, Au
56	LEEMAC, BOOMAC (W.R.)	Ag, Pb, Zn
57	ROSE	Zn
58	JUNE	Ag, Pb, Zn, Cu
59	CC	Cu
60	HARPER - ULTIMA (LUCKY BOY, WAH WAH)	Cu, Pb, Zn
61	RUTH	Cu, Pb, Zn, Ag
	IR - BARRIERE	Mo, Cu
63	SITTING BULL (COUGAR ?)	Cu, Ag
64	NORTH STAR NORTH (ACE ?)	Ag, Pb, Cu ?
65	NORTH STAR SOUTH (ENARGITE ?)	Ag, Pb, Zn, Au, Cu ?
66	WHITE ROCK	Ag, Pb, Zn, Au
67	OK (IRON CAP - ANACONDA)	Cu, Pb, Zn, Ag
	ANACONDA - LYNX	
68	EAST LEMHI	Ag, Pb, Zn
69	SILVER MINERAL (SILVER MINNOW)	Ag, Pb



## TABLE OF CONTENTS

	Page
INTRODUCTION	3
CONCLUSIONS AND RECOMMENDATIONS	5
ESTIMATED COSTS OF RECOMMENDED WORK	6
PROPERTY AND LOCATION	7
AURUN - QUEBEC CARTIER LEASE	8
GENERAL GEOLOGY	8
LOCAL GEOLOGY	8
Rock types	
Structure	
Mineralization	
Mineral reserves	
PREVIOUS WORK	10
MINERAL ECONOMICS	10
METALLURGICAL CONSIDERATIONS	10
REFERENCES	12
CERTIFICATE AND PERMISSION TO USE REPORT	13
APPENDICIES	
Location Map	faceplate
Mineral Inventory Location Map	faceplate

## GEOLOGICAL EVALUATION REPORT

### HAIL - HARPER CREEK COPPER PROSPECT

Charles A.R. Lammle, PEng.  
30 April 1986

**INTRODUCTION** The Hail - Harper Creek copper (zinc, lead) prospect is located in the Adams Lake Map Area at the headwaters of Harper Creek, which is about 7 airmiles southeast of Birch Island and a like distance southwest of Vavenby, British Columbia. These two villages are in the valley of the North Thompson River, about 75 airmiles north from Kamloops, and accordingly along British Columbia Highway 5 and the main line of the Canadian National Railway.

The prospect was discovered geochemically and extensively trench- ed and drilled during the late 1960's and early 1970's by Quebec Cartier Mining Company and by Noranda Exploration Company. Mineral reserves of two sub-jacent potential pit areas, the main one on Quebec Cartier ground and the subordinate but slightly higher grade one being on Noranda's ground, have been calculated by hand and verified by computer methods; the tons and grade figures for the then optimum pit being:

85,000,000 tons grading 0.43% Cu & 0.016% Mo

This tonnage and grade were judged to be sub-economic at conditions prevailing in 1972, and metal prices have since dropped and costs have increased. Accordingly, it is clear that the mineral economics of the deposit, given the same large scale evaluation parameters, are still sub-economic. However, some changes in geological thought on the nature of the deposit, and some resulting new geological possibilities, bear importantly on the deposit, and have resulted in the acquisition by Aurun Mines Ltd. of a mining lease agreement from Quebec Cartier Mining Company for that company's mineral interest in the area.

The new geological concepts relating to the deposit relates to the genesis of the deposit: at the time of discovery and development work the deposit was generally regarded as being metamorphic-hydrothermal in origin; now it is widely regarded as being volcanogenic-exhalative. This new geological theory opens up new possibilities for the deposit, particularly the likelihood of strata-bound massive sulphides which are known to be present, and also the possibility of precious metals being associated with such massive sulphide. During the development work only the most cursory work, almost negligible in extent was done to determine the presence and/or amounts of gold and silver, if any, associated with the mineralization, and no effort was made to pursue and develop smaller workable tonnages of the massive sulphide lenses. Additionally, more recent work

has disclosed the presence of appreciable titanium in the mineralized zone, generally in amounts of 1% to 3%, but locally much higher. Titanium-bearing minerals are rutile and sphene in unknown relative amounts, and consequently of unknown relative economics, if any, bearing on the worth of the deposit. Furthermore, there is some possibility that near surface oxidized portions of the deposit may be heap leachable.

These concepts and possibilities which induced Aurun to acquire its interest in the area are real, particularly the massive sulphide and precious metals aspects, and of potentially significant economic consequence. Accordingly, Aurun has commissioned the author for this geological evaluation.

The report will briefly cover the geological nature of the area and of the deposit, the work history, and the geological and economic possibilities. Conclusions and recommendations will be drawn, and a two staged program designed to evaluate the possibilities will be presented.

The first stage program is estimated to cost \$71,900; the second stage, contingent on obtaining adequate encouragement from the first, \$355,000. Total costs of the two stages if carried out to completions would therefore be \$426,900.

## CONCLUSIONS AND RECOMMENDATIONS

1. There is a distinct possibility that layers or lenses of massive sulphides of economically significant size might be present in the widespread, evenly disseminated area of copper mineralization already delimited, and possibly near enough to surface, to permit early smaller-scale mining.
2. There is also a distinct possibility that such massive sulphide bodies might contain significant gold and silver values that would have the effect of markedly improving the insitu value and economics of the mineralization. Previous work to determine the potential of such precious metals can be said to have been very cursory if not negligible.
3. Many of the rocks in the mineralized zone contain appreciable amounts of titanium in the form of rutile and sphene. The economic significance of the titanium mineralization, if any, is not known, but warrants study and more definitive determination.
4. Some of the chalcopyrite-pyrite-pyrrhotite mineralization, particularly that near surface where some oxidation has occurred may be amenable to heap leaching. This possibility merits study and more detailed evaluation.

Accordingly, it is recommended that thorough and detailed geological, geophysical and additional physical work be done to more accurately assess the above geological and economic possibilities.

## ESTIMATED COSTS OF RECOMMENDED WORK

### STAGE 1:

1. Review available data, computerize	\$ 3,000
2. Geological work: trenching and assays	22,000
3. Geophysical work: EM, Mag, IP	10,000
4. Metallurgical testing	7,500
5. Project reports, drafting, etc.	7,500
6. Head office, administration, etc.	7,500
7. Preliminary feasibility evaluation	14,400
	-----
Stage 1 Estimated costs	\$71,900

The following second stage of work as outline would be contingent on obtaining generally positive and sufficiently encouraging results from the the first stage, outline above:

### STAGE 2.

1. Geophysics	\$ 35,000
2. Geology	25,000
3. Large core metallurgical sampling, fill-in	120,000
4. Bulldozer support and trenching	40,000
5. Metallurgical testing	50,000
6. Assays	30,000
7. Transportation, freight, etc	15,000
8. Supervision	20,000
9. Head office overhead	20,000
	-----
Stage 2 Estimated costs	\$355,000

Combined Stage 1 and Stage 2 Estimates	\$426,900
	-----

C.A.R. Lammle, PEng.  
30 April 1986



PROPERTY AND LOCATION      The property is located south of and overlooks the valley of the North Thompson River. B.C. Highway 5 and the main line of the Canadian National Railroad follow the river. Local communities providing some services are Birch Island and Vavenby; Kamloops the main supply center for the area is some 75 airmiles to the south.

The property consists of some 116 claims (some 4000 acres), having been staked some 20 years ago by the old 2-post system. A number of the original claims have been allowed to lapse over the years, some have assessment work recorded up to 1999 and others to 1993 and 1987. Assessment work is required on some 55 claims prior to 13 July 1986, and this work is in part planned by this report.

The claim details are as follows:

CLAIM NAME	RECORD NUMBER	EXPIRY DATE	
Hail 3-5	58407-409	13Jul99	
Hail 31,33,35	58435,437,439	13Jul99	
Hail 99	58824	22Jul99	
Hail 590	70210	31Jul99	
Bob 5-7 Fr.	99827-829	14Sep99	
Hail 1-2,6-7,9,11	58405-06,410-411,413,415	13Jul93	
Hail 32,34,36	58436,438,440	13Jul93	
Hail 100,102,104,106,108	58825,827,829,831,833	22Jul93	
Hail 534,538	66572,576	8 Aug93	
Hail 565-568 Fr.	66659-662	19Oct93	
Hail 570,578-578 Fr.	66664,66667-672	19Oct93	
Hail 701-711	86193-203	9 Dec87	11
Karina 1-11	96581-591	26Apr87	11 22
Hail 8,10,12	58412,414,416	13Jul86	3
Hail 15-19,28-30	58419-423,432-434	13Jul86	8
Hail 51-52,59	58449-450,457	13Jul86	3
Hail 61-62,71-72	58459-60,465-466	13Jul86	4
Hail 77-79	58469-471	13Jul86	3
Hail 80-88	58472-480	13Jul86	7
Hail 97-98	58822-823	22Jul86	2
Hail 107	58832	22Jul86	1
Hail 109-116	58834-841	22Jul86	6
Hail 531A,532,533	56569,570,571	8 Aug86	3
Hail 535-537	66573-66575	8 Aug86	3
Hail 569,572 Fr.	66663,66666	19Oct86	2
Hail 579-585 Fr.	70203-209	31Jul86	7 25

=====

#### AURUN - QUEBEC CARTIER LEASE

The Aurun - Quebec Cartier Mining Company lease is a 20 year lease with options for renewal. It entitles Quebec Cartier to a 5% net smelter return from production, and requires advance royalty payments of US\$10,000 per year for each of the first 5 years; US\$25,000 per year for each of the next 5 years, and thereafter, US\$100,000 per year.

#### GENERAL GEOLOGY

Geologically, the Hail - Harper Creek area is close to the northerly trending boundary between the intensely deformed and metamorphosed Paleozoic strata of the Eagle Bay Formation which, together with the Shuswap Metamorphic Complex form much of the so called eastern fold belt. To the west, this fold belt is flanked by relatively undeformed and unmetamorphosed Paleozoic and Mesozoic volcanic and sedimentary rocks. Batholithic and related stocks in the area are principally granodiorite and quartz monzonite of the Raft and Baldy Batholiths.

A large number of mineral prospects with an unusual variety of associated minerals occur around the periphery of the Baldy Batholith. The better known prospect is the Rexspar uranium-fluorite prospect, and perhaps the most significant in terms of metal content are the Hail - Harper Creek prospect and the Sue-Goof prospect of Noranda. Most of the prospects near the northern periphery of the Baldy Batholith are characterized by copper, those near Foghorn Mountain near the northwest portion of the batholith by lead, and many of those around the southern periphery of the batholith by lead, zinc and some precious metals. Several are characterized by molybdenite. Much work has been done in the past few years on prospects in the area of the Barriere Lakes on some massive sulphide prospects, as well as on other types of prospects, many of which have some precious metal association with the dominantly Cu-Pb-Zn mineralization.

The area at the headwaters of Harper Creek is in metamorphosed volcanic and sedimentary rocks in an easterly trending "synclinal" zone between the Baldy and Raft Batholiths. Hence the strata generally dip at low to moderate angles to the north.

#### LOCAL GEOLOGY

The Hail - Harper Creek Copper Prospect is located 2½ miles north of the northern contact of the Baldy Batholith. Here the host rocks are characteristically well foliated phyllites and schists - chlorite, sericite, quartz and carbonaceous varieties - with quartzite, impure limestone, dolomite, slates, and greenstone, presumed to be of Permian or earlier age. The section dips generally at low angles to the north. Andesite dykes are present.

Chalcopyrite with minor bornite and covellite, and with pyrite, pyrrhotite, and with minor sphalerite, galena and arsenopyrite, are associated with seams and veinlets of quartz in the mineralized zone. Chalcopyrite, the principal known economic mineral at this time has three main modes, (1) thin coatings on joints and fractures, (2) thin blebs and stringers in quartz veins, and (3) tiny specks on rock foliation planes. The tiny specks account for most of the copper value.

Massive sulphides are said by a former supervisor on the prospect to be present as lenses and conformable layers, and although the location of these could not be pinpointed on the available maps, the former supervisor said he would be able to walk Aurun personnel to the particular sites where the massive sulphides were known.

Additionally, appreciable amounts of both sphene and rutile - titanium containing minerals - are present in the mineralized zone and their concentrations appear to reflect the intensity of the copper mineralization. It is believed that the titanium-bearing minerals were produced during metamorphism, the original titanium being a constituent of former mafic volcanic rocks. Molybdenite is present. Some small amounts of gold was detected in two preliminary composite samples that were used primarily for initial floatation tests to determine recoverability of chalcopyrite and molybdenite. However, there is no further indications that any other work was done to establish presence or absence of significant gold and silver. Indeed, our information from geologists who were responsible for much of the initial work, is to the effect that no material work was ever done to establish tenor of gold and silver.

The economic significance of the titanium-bearing rutile and sphene is not known. Presumably the metal might be won from the rutile if sufficient to the titanium mineral is rutile. However, the amount of the metal that might be won from sphene is very much uncertain at this time, and it is not certain whether the mineral might be concentrated effectively from other ordinary rock forming minerals.

PREVIOUS WORK Complete records of all of the work that had been done are not presently available to the writer. A crude outline is given below:

- 1967 Geochemical and geological investigations
- 1967 Diamond drilling, at least 6 holes
- 1968 Geological, geochemical, geophysical, physical
- 1969 Diamond drilling, at least 27 holes
- 1970,71 Diamond drilling, at least 44 holes

- 1971 Preliminary floatation testwork
- 1971 Optimized computer-generated open pit design
- 1972 Target Evaluation of mineralization economics
- 1974 Evaluation Review of open pit economics

Concurrently, similar work was being conducted on Noranda portion of the mineralization by that company, in part under a joint venture agreement with Quebec Cartier.

**MINERAL ECONOMICS** Base metal prices are low and have been low for a number of years now, and consequently the base metal industry is depressed. This is particularly true for the copper industry. It would probably be necessary for the price of copper to at least double before the Hail - Harper Creek deposit would become viable on the basis of contained, evenly disseminated copper alone. However, if massive sulphides can be delimited near surface, and particularly if these contain even small amounts of precious metals, a smaller scale operation than envisioned by the two major companies might well be a possibility.

Also, as mentioned, there is some possibility that some of the titanium-bearing rutile might be recoverable at a profit.

**METALLURGICAL CONSIDERATIONS** Available metallurgical data indicates that only two composite samples, one of 68 pounds and the other of 300 pounds were floatation tested in early 1971. A concentrate having a copper content of 25% was obtained from a grind down to 62% minus 200 mesh and with a recovery of 83%. Only about 20% of the known molybdenum content was recovered in these early and preliminary tests, and little further work was done at that time to improve molybdenum recovery.

The mineralized rock was found to be very friable, and to be relatively easy to grind.

The 1972 Economic target evaluations were predicated on:

- (a) determining optimum tonnage that could be mined by open pit,
- (b) determining viability of mining under 1972 conditions,
- (c) determining conditions that would be necessary to ensure an economic operation if the reserves were then found to be not viable.

The optimum pit was then defined as follows:

- (a) 85,500,000 tons with 0.43% Cu and 0.016% Mo
- (b) 165,920,000 tons waste rock
- (c) 1,870,000 cu yd overburden

On the basis of a 15,500 ton per day operation, with capital costs of \$62,700,000 and with operating costs of \$1.38 per ton (excluding overburden), the envisioned operation was determined to be not viable.

The rate of return on the invested capital was calculated to be as follows;

with Cu at \$0.50/lb	Rate of Return	0.09%
0.65/lb		9.59%
0.70/lb		12.12%

A 1973 study based on a net smelter return of \$0.558/lb Cu and with recovery of 85% and values attributed to molybdenum and the then known small amounts of precious metals indicated a return on investment of 10.7%. It was consequently recommended that a more sophisticated computer pit design be obtained. This entailed dividing the mineralization into blocks 50' by 50' by 40', the 40' being the intended bench height, and all blocks were categorized as being 'ore', stockpile, or waste. Results were as follows:

PIT	TONS	GRADE %	WASTE tons	OVBD cu yd
West*	27,858,000	0.417	49,108,000	2,607,000
East**	56,483,000	0.372	85,217,000	2,532,000
Total	84,341,000	0.387	134,325,000	5,139,000

Cut-off grade used was 0.388% Cu

Note: \* denotes Noranda Pit  
 \*\* denotes Quebec Cartier Pit

Charles A.R. Lammle, PEng.

30 April 1986

## REFERENCES

- Reeve, Albert F., 1967, Preliminary Geochemical and Geological Investigations of the Hail "A" and Hail "C" Claim Groups, Kamloops M.D., British Columbia, BCDM Assessment Report 1035.
- Stollery, J.W., 1968, Geological, Geochemical, Geophysical and Physical Investigation, The Hail "L", "M", "N", and "O" Claim Groups, Kamloops M.D., British Columbia, BCDM Assessment Report 1612.
- , 1967, Hail Claim Group, Diamond Drill Logs, 67-H-1 through 67-H-6, Private Company Files, Quebec Cartier Mining Company.
- , 1969, Hail Claim Group, Diamond Drill Logs, 69-H-1 through 69-H-27, Private Company Files, Quebec Cartier Mining Company.
- , 1970, 1971, Hail Claim Group, Diamond Drill Logs, Holes J1 through J44, Private Company Files, Quebec Cartier Mining Company.
- Mearnes, D.W., Godbehere, P.W., and Bennett, M.J.S., 1971, Preliminary Floatation Test Work on Harper Creek Copper Property Ore Samples, Private Company Report, Noranda Ore Dressing Laboratory.
- Kraft, J.E., 1972, Target Evaluation, Harper Creek Deposits, Joint Venture, Quebec Cartier Mining Company, Noranda Exploration Company, Private Company Report, Noranda Exploration Company.
- Kraft, J.E., 1972, Optimized Computer-generated Open Pit Designs Private Company Files, Noranda Exploration Company.
- Kraft, J.E., 1974, Evaluation Review of Harper Creek Joint Venture, May 1974, Private Company Report, Noranda Exploration Company.
- Belik, G.D., 1973, Geology of the Harper Creek Copper Deposit, MSc. Theses, University of British Columbia.
- Belik, G.D., 1985, Diamond Drill Report on the TIA Group, Kamloops M.D., British Columbia, Private Company Report, Nu Crown Resources Ltd.

CERTIFICATE AND PERMISSION TO USE REPORT

I, Charles A. R. Lammle, PEng., resident of Salt Lake City, UTAH, hereby certify that:

1. I am a registered member of the Association of Professional Engineers of the Province of British Columbia.
2. I am a 1962 graduate of the University of British Columbia, BAsC. Geological Engineering.
3. I have practiced my profession nearly continuously (with the exception of a large part of the year 1985) since graduation in 1962, mostly in British Columbia and Yukon, and partly in Alaska, and in the western United States.
4. This report is based partly on general knowledge of the property gained from study of the references cited herein, and partly on knowledge of the property gained during employment with United States Steel Company, parent company of Quebec Cartier Mining Company. I have not made site inspections nor property geology and claim inspections because of current snow cover. Such examinations will be made when conditions permit, and there is no reason to expect that such examinations when made will necessitate any material changes to recommendations made herein on the basis of study of the technical reports and files.
5. I hereby grant Aurun Mines Ltd. permission to use this report for its corporate purposes.

Charles A.R. Lammle, PEng.

30 April 1986