ASSESSMENT REPORT

GEOLOGICAL BRANCH
ASSESSMENT REPORT

16,754

ASSESSMENT REPORT FOR THE 1987 BELL MINE FAME GRANT (REF. NO. 10963-M15)

Claims: Mineral Leases - M134 and M135
Claims - GC2, GC4, GC1, GC3, GC5
GC13, GC15, GC17, GC19, GC21
GC23, GC25, GC12, GC14, GC16
GC18, GC20, GC22, GC24, GC28
New, Arch 1-154, Arch 1-153,

Mining Division: Omineca M.D.

NTS Location: 93M/IE, 93L/16E

Latitude: 55 deg.N Longitude: 126 deg. 14 min. W

Owners: Noranda Minerals Inc.

Free Miners License: 299656 NORMI 3

Operators: Bell Mine

Consultants: Peter O'Gryzlo - Geologist
Anthony L'Orsa - Geologist
Chris Kloeren - Geologist

Author: Brian Anderson (BSc.-Mine Engineering)

Date Submitted: Feb. 15, 1988

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1.0 INTRODUCTION

The Bell Copper Mine, owned and operated by Noranda Inc., is located on the Newman Peninsula, in Babine Lake, British Columbia. This open pit mine-mill complex is approximately 55 degrees North Latitude and 126.23 degrees West Longitude (NTS 93M/1E - 93L/16E) at an elevation of 2390 feet (728 m) A.S.L. Babine Lake is located on the Nechako Plateau which is part of the Interior Plateau physiographic region of the province. Climatic conditions are typical of the interior of British Columbia despite the moderating effects of Babine Lake.

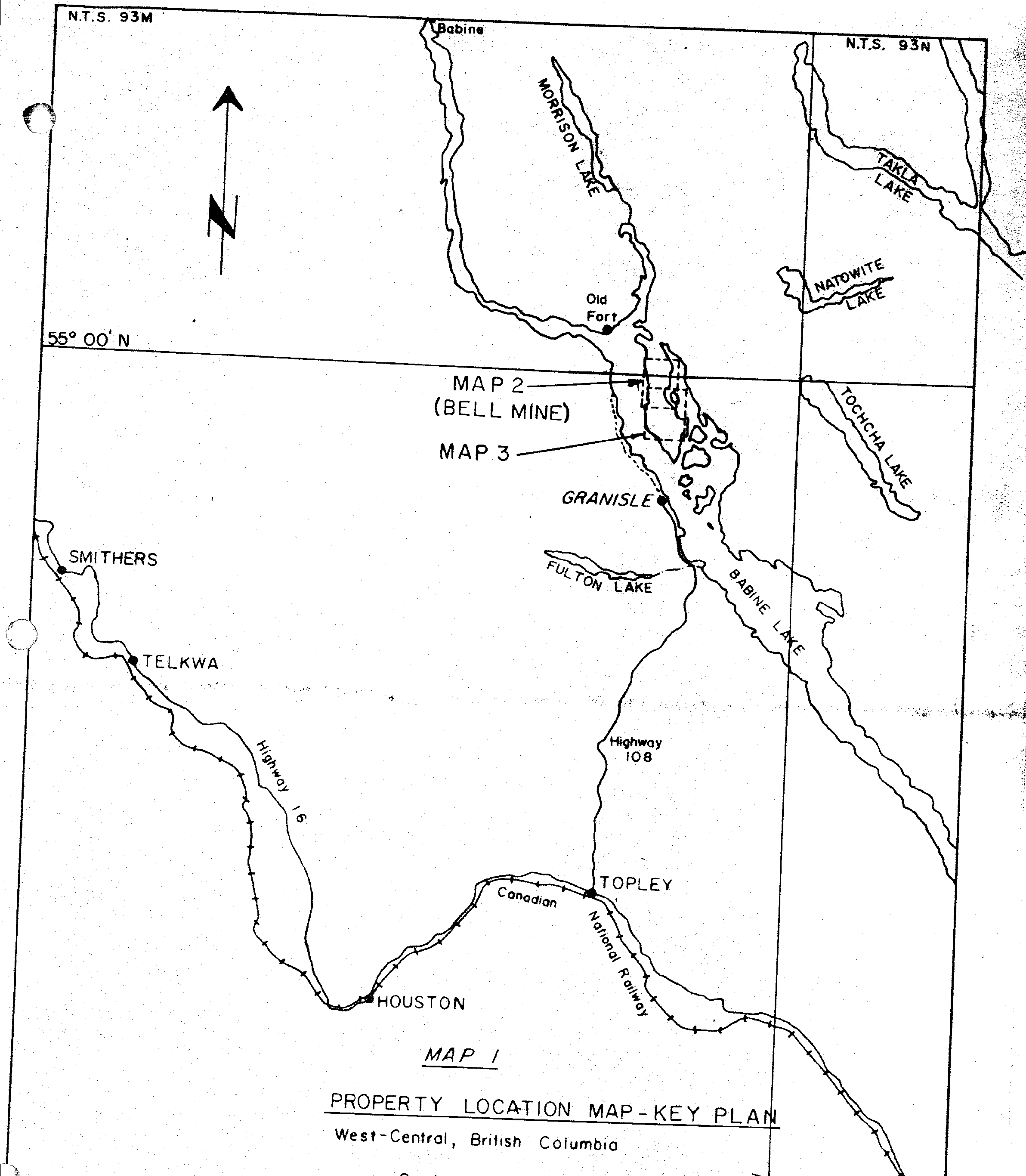
The minesite is located approximately 8 miles (13 km) north-east of the Village of Granisle which is at the north end of Highway 118. This highway is a 30 mile (48 km) paved road travelling north from Highway 16 (Yellowhead Route) at Topley, B.C. Access from Granisle to the minesite is by an 8 mile (13 km) all season gravel road along the west shore of and a 2.5 mile (4 km) tug-barge route across Babine Lake (see Map 1).

The Bell Mine mineral deposit was originally examined by C. Newman during the mid 1920's. After years of intermittent prospecting the property was staked by Noranda Mines Ltd. in 1962. Geochemical and geophysical surveys established anomalous - targets for drilling. Drilling results provided sufficient reserves to justify the construction of the Bell Mine and mill. Pre-production stripping commenced in 1970 and milling started in 1972 at 10,000 Short Tons per Day. In 1979 and 1980 Bell expanded the dimensions of the original open pit limits and upgraded milling capacity to what exists today. Milling tonnages at this time were increased to 16,500 Short Tons per Day which continued regularly until the mine closure in October 1982. At this closure approximately 38 million tons of sub-economic mineralized material, with a near equal amount of waste material, were available for mining.

In October of 1983 an 8 month, 4.1 million ton pre-stripping program was undertaken. The mine-mill operations resumed in August 1985 using a restricted ore reserve which reduced the mine life to three years. This ore reserve optimized the amount of readily available ore and minimized the amount of associated waste material.

In 1986 a 2,285 m diamond drilling program defined sufficient reserves to extend the mine life by one year. In 1987 the following work was completed.

1. Drilling - 16 N.Q Diamond Drill holes totaling 1589 m. (Claims - M134 and M134)



MAP 1

PROPERTY LOCATION MAP-KEY PLAN

West-Central, British Columbia

Scale: 1 in. = 8 mi.

2. Geological survey - 8.5 million sq. meters of mapping. The scale of the map submitted is 1:12000. (Claims - M134, GC2, GC4, GC1, GC3, GC5, GC13, GC15, GC17, GC19, GC21, GC23, GC25, GC12, GC14, GC16, GC18, GC20 GC22, GC24, GC26, GC28, NEW, Arch 1-154 and Arch 1-153)

2.0 DESCRIPTION AND RESULTS OF 1987 EXPLORATION PROGRAM

In March of 1987 a former Bell Mine geologist, Mr. P. O'Gryzlo outlined his views in a report entitled '<u>Exploration and Mineral Potential - Bell Mine and Area</u>'. (See Appendix A). Based on this report a 1987 exploration program was undertaken with the following goals:

1. To better define and test the extent of ore in the pit trending the southeast.

2. To locate and to test for mineralization along the south east limits of the Bell porphyry system.

3. To assess an area to the south of the Bell Mine tailings pond (Ketza Lake area)for a small to medium-sized porphyry system.

2.1 ORE DEFINITION IN THE PIT

Blast hole data from mining activities have revealed that the ore in the south east corner of the pit was dipping to the south east and that some low grade ore was present in this area which was previously thought to be barren(see figure 1). This occurrence lead to the belief that there was a potential for increasing ore reserves. Nine holes (87-11, 87-4, 87-12, 87-5, 87-7, 87-8, 87-9, 87-10 and 87-13) totaling 883 m. were drilled to test these trends(see map 2) .
Mr. T. L'Orsa was contracted to log core and analyze results. The results are recorded in appendix B. Holes 87-11, 87-4 and 87-13 encountered high grade material and confirmed the vertical extension of known ore zones. Hole 87-9 indicated a medium grade ore zone in the south wall. The remaining holes indicated that the southeast dip is unfortunately not continuous and the ore/waste contact steepens to near vertical. The conclusion is that in general the ore and waste zones will continue at depth in a vertical fashion and hence no significant increase in reserves is warranted. However the known ore body combined with the vertical extensions identified in holes 87-11, 87-4 and 87-13 are being evaluated for a one to one and a half year mine life extension.

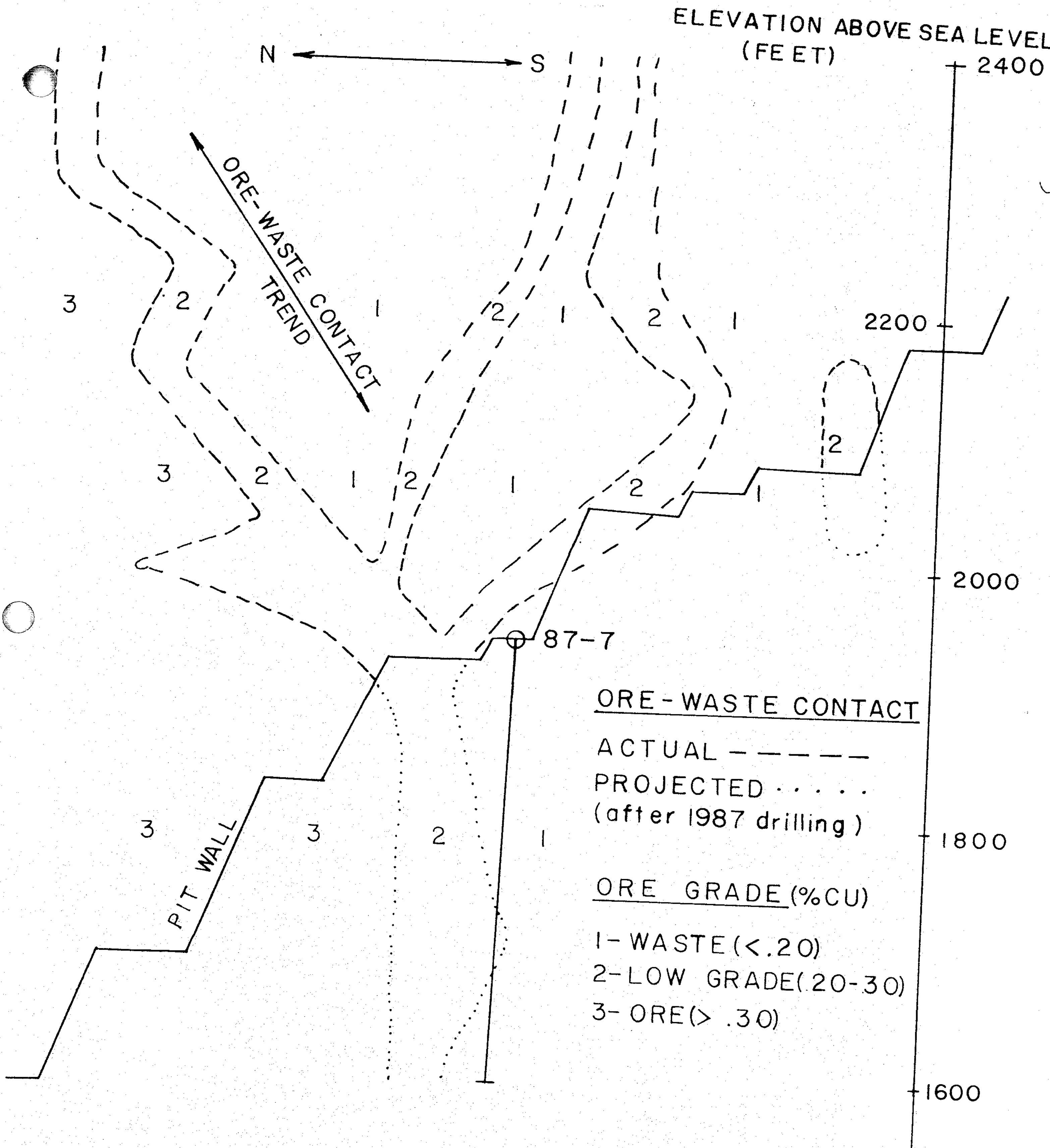


FIG. I TYPICAL CROSS-SECTION OF SOUTH PIT WALL (1:1200)

2.2 BELL PORPHYRY LIMITS

The southeast Bell porphyry system limits had never been defined due to a heavy overburden cover. Six holes (87-1, 87-2, 87-3, 87-6, 87-14, 87-15 and 87-16) totaling 706 m were drilled to locate this limit in the hope that significant copper or gold mineralization was present (see Map 2). Initially holes were drilled at 45 degrees however the heavy overburden cover (up to 40m thick) necessitated some vertical drilling. The holes were spaced so that any Bell sized ore zone would be intersected.

Mr. T. L'Orsa also logged this core and analyzed the results. Details of the drill results can be found in Appendix B. The porphyry system limit was crossed in three locations. No significant mineralized areas were identified although quartz and quartz flooding was a common occurrence. It appears that the southeastern porphyry limit is occupied by an extensive explosion breccia, possibly post ore. The conclusion was that no large ore zone exists along this section of the porphyry system.

2.3 Mapping South of the Tailings Dam (Ketza Lake Area)

After a review of existing geological records, it was found that the area shown in the attached Map 3 was not thoroughly mapped. Much of this area had been recently logged and had exposed new outcrops. Mr. C. Kloeren from Mine Gaspe in Quebec was contracted to map this area. His goal was to identify areas of significant alteration or pyrite halo, which are diagnostic for a Bell type porphyry system. The results of the mapping are shown in Appendix C. While weakly altered rock was found in previously thought barren areas,it was judged insignificant. It was concluded that this area would not warrant further exploration work.

2.4. Conclusion

In general the exploration goals were achieved with negative results. However the ore reserves at Bell are more clearly defined and these reserves are the basis of an evaluation study to extend the mine life by one to one and a half years. This work has also allowed Bell personnel to now focus on other mine life extension projects having more potential.

3.0 Itemized Cost Statement

1. Wages

Core Logging- (124 hours x $40/hour)	$4960.00
Core Crushing and Splitting-(154hours x $10.97)	$1690.20
Mapping - ($278/day x 34 days)	$9449.90
	$16,100.10

2. Food and Accommodations

Not Applicable

3. Transportation

Rental of truck for Mapping (1.6 months x $958.24/mon.)	$1533.18
Travel Expenses for Mapping Geologist (From Gaspe, Quebec to Granisle, B.C. and Return)	$2093.59
	$3,626.77

4. Instrument Rental

No Charges applied

5. Surveys

No Charges applied

6. Analyses

204 Cu determinations x $3.67 =	$748.68
204 Cu & Au determinations x $8.49 =	$1731.96
	$2,480.64

7. Report Preparation

Engineering Department In-House=	$ 2,000
	$ 2,000

8. Other

Diamond Drilling (1,589m x$64.586/m) =	$102,626.80
Operating Supplies=	$1,988.66
Aerial Photographs(50 prints x $8.40 ea.)=	$420.00
	$105,035.46

9. Total Expenses $129,242.97

4.0 Author's Qualifications

Brian Anderson is the Pit Engineer at the Bell Mine. He is a graduate of Queen's University (BSc - Mine Engineering, 1979). The author has been actively employed in the mining industry since graduation at several locations in Canada and the United States. During this time the author was involved in all aspects of mining including ore reserves and mine feasibility studies.

11/02/88
BA/ee

EXPLORATION AND MINERAL POTENTIAL-
BELL MINE AND AREA

PETER O'GRYZLO- 24/03/87

APPENDIX
A

MEMORANDUM

To: Ross MacArthur
Brian Anderson
Noranda Minerals- Bell Mine

From: Peter Ogryzlo

Date: 24/03/87

Subject: Exploration and Mineral Potential- Bell Mine and Area

Prior to a brief geological survey of the Bell Mine for the purposes of structural mapping, a request was made by Brian Anderson if a review of the mineral potential around Bell could be done at the same time.

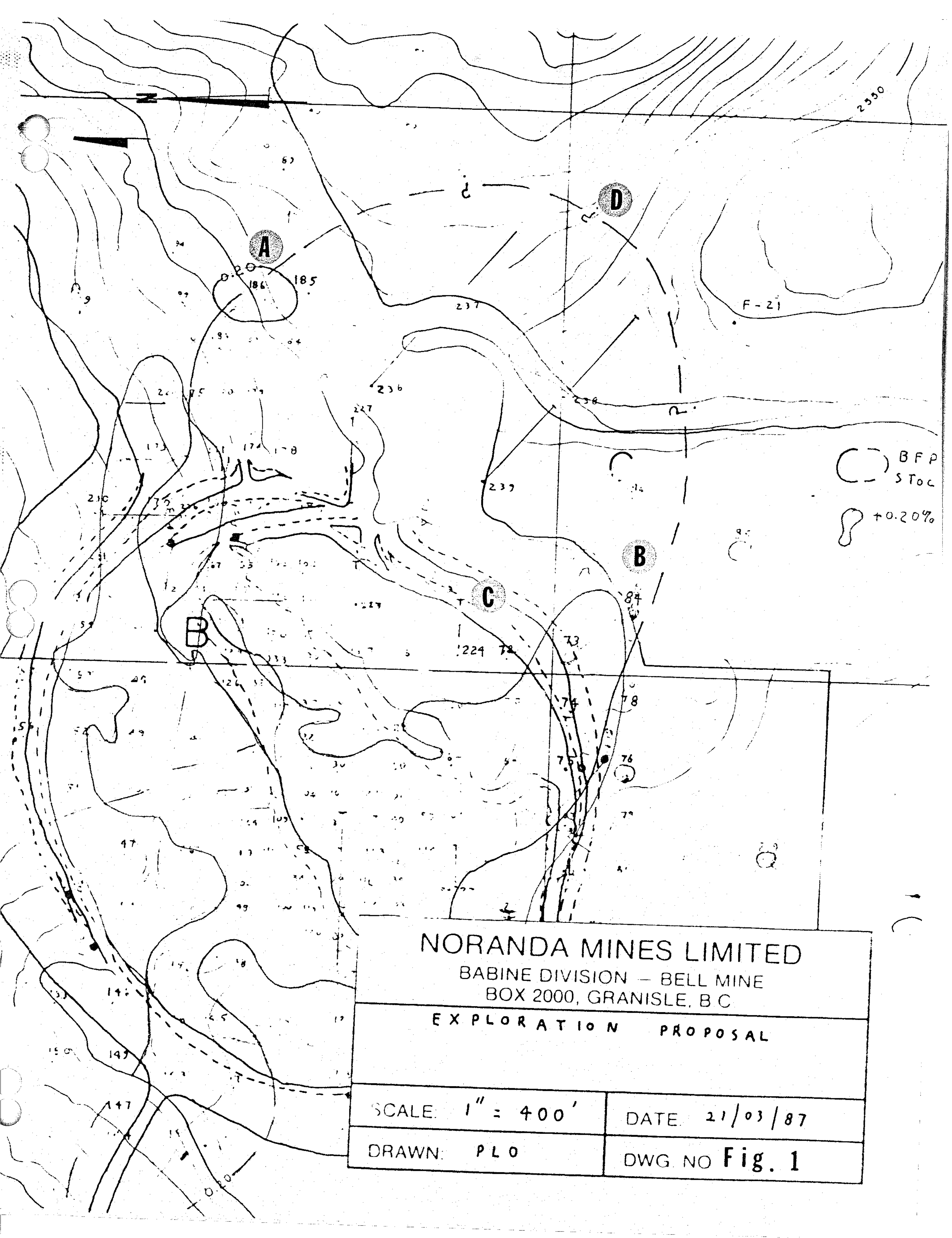
The results of this review may be summarized as follows. Targets are listed in order of priority as to the probability of success.

1. Bell Mine east of pit 2c.
2. Bell Mine south of pit 2c.
3. Bell Mine within pit 2c.
4. Bell Mine -contact of BFP stock to south and east.
5. Bell Mine - below and around pit 2c.
6. Granisle Copper.
7. Ketza prospect between Bell and Granisle.
8. North Newman.

Each of these will be discussed in detail below.

1. Bell Mine east of pit 2c. Fig. 1, "A".

The singular characteristic of porphyry copper deposits is their annular symmetry. In plan, they are commonly doughnut shaped, with concentric zones of mineralization and alteration.
The Bell orebody straddles the western and northern contact of the stock and has been extensively explored. Grade and tonnage seem to diminish to the south and east, so exploration was limited in these areas. At present, approximately one third of this contact is unexplored, and the southeastern contact has not been found. This represents the most interesting target. The reasoning behind this is straightforward. The conditions of temperature, pressure, and structure that prevailed on one side of the stock are most likely to be found on the other side of the stock.
The first recommendation is to diamond drill across this contact between DDH 185 and DDH 186. DDH 186 was in low grade ore, averaging around 0.30% Cu. DDH 185 averaged around 0.05% Cu, typical of the barren core of the deposit.


A
B
C
D
F - 21
BFP STOC
+0.20%
NORANDA MINES LIMITED
BABINE DIVISION — BELL MINE
BOX 2000, GRANISLE, B.C.
EXPLORATION PROPOSAL
SCALE: 1" = 400'
DATE: 21/03/87
DRAWN: PLO
DWG. NO. Fig. 1

Experience at Bell has shown how sharp the inner contact of the barren core is with the ore zone, with grades going from 0.05 to 0.50 within a few meters. Vertical holes drilled on 200 foot centers can easily straddle this contact. Once the contact is found, it should be projected eastward and explored with more diamond drilling. Holes should be inclined -45 and azimuths should be designed to cross the projected contact at right angles. They should be spotted to begin in barren BFP and should be continued until they cross into the country rock, which appear to be greenish tuffs with some siltstone. If the holes do not cross the contact by the time a reasonable depth of around 400 feet is reached, they should be stepped out to cross the contact at a higher elevation.

The mineralization in DDH 186 is of further interest. Now that abundant blasthole assay data is available, the mineralization on 2420 bench can be seen trailing off in a northeasterly direction. DDH 186 is considerably south of this trend, and shows no connection with it at this elevation. This is also worth further study, as the possibility of fault displacement, either vertical or lateral, should not be ignored.

2.Bell Mine -south of pit 2c. Fig. 1, "B".

The same comments and reasoning apply to the southern contact of the stock. The contact should be defined between DDH 84 and DDH 78 and between DDH 86 and DDH 85.

3.Bell Mine - within pit 2c. Fig. 1 "C".

Blasthole assays have revealed a zone of mineralization within the pit on the south side grading 0.10% to 0.30% that is some 400 feet wide by 500 feet long. This is a low grade, but it is in an area that was not sampled by any diamond drilling. The only hole that came close was DDH 224. A review of the log shows the closing comment that the degree of alteration and the number of fractures mineralized with chalcopyrite indicate a nearby zone of mineralization. This zone is entirely within the BFP in what has always been considered the "barren" core, and could be easily sampled by diamond drilling from within the pit boundaries.
In addition, the style of mineralization appears to be changing with depth. Erratic high grade blasthole assays are appearing, some as high as 1.00% Cu within the "barren" core. These are usually averaged in with the surrounding waste assays and mined as waste.
This deserves more examination.

Vertical mineralized fractures are appearing that are unlike the stockwork mineralization of the ore zone. Sampling to date has been extremely simple, with almost any sample of blasthole cuttings being more than adequate due to the even distribution of mineralization among the dense network of quartz veins.
This is clearly not the case in sampling vertical fractures with vertical holes. Grade distribution is far more erratic. Once again this is in areas where sampling by diamond drill was scarce or absent. As most drill holes were vertical, they would easily suffer from the same bias.
See photo 1.
There is not sufficient information on these zones to plan any diamond drilling. A detailed study of the blast holes should be done, accompanied by geological mapping to better understand this mineralization.

Photo 1: Vertical mineralized fractures with alteration envelopes in "barren" BFP core.

4.Bell Mine to the southeast. Fig 1 "D".

Once the trend of the contact is clarified at "A" and "B", there should be enough information to plan the further exploration of the Bell stock to the south and east. Four holes were drilled looking for this contact, DDH 236,237,238 and 239. All four holes were within the stock for their entire length, and the contact was not found. A new exposure on the ramp from 2460 to 2420 on the south side of the pit has clarified the geology in this area. The rocks are an intrusion breccia, with boulders of altered BFP enclosed within altered BFP and fresh dykes. Grades are low, but are characteristic of the barren core.

This area should be systematically drilled until the contact with the country rock is crossed. There is no outcrop to give any evidence of the location of this contact. This need not be an elaborate program. Six to ten holes, each 400 to 500 feet in length should provide enough initial information to pursue this further or abandon it.

A number of geophysical maps were taken from the file at Bell and given in a separate file to Brian Anderson. All of these provide some information in assessing this project. Of particular interest is

BABINE MORRISON AREA
HELICOPTER VLF EM
DECEMBER 1974.

This survey shows the ore zone and the pyrite halo clearly. There is an apparent anomaly to the southeast that is ambiguous in that it may be part of the halo or may indicate another ore zone. The scale is too large to use to plan any diamond drilling.

Also of interest is

NEWMAN PROPERTY
J.E.M. PROFILES

This shows the southeast area to be expressionless in comparison to the ore zone. This survey dates from the early 1960's.

In addition, an ASKANIA magnetometer survey shows annular symmetry over the deposit.

A later Induced Polarization survey could not be found in the file. If you need additional information on any of these, Mr. Gavin Dirom of Noranda Exploration has experience and knowledge of all of them.

5.Bell Mine- below and surrounding pit 2c. Fig. 1.

It should never be over looked that despite years of mining the proven geological reserves at Bell remain large, and that probable and possible reserves at a lower cutoff of 0.20% Cu are in the hundreds of millions of tons, although at a lower average grade. This material is little explored as there was never a strong reason to explore it. The operations have achieved remarkable success with milling rates of up to 20,000 TPD with few alterations to a mill with a design capacity of 10,000 TPD. With an idle mill facility 5 miles away, Bell could be re-examined at milling rates of 30,000 to 40,000 TPD.
These are engineering considerations and I hesitate to comment on them further, other than to restate that large reserves at a lower cut-off may be predicted with a high degree of confidence at Bell. Another factor that should not be over looked is the presence and continuity of the high grade zone. It has been drilled to a depth of 2000 feet and is consistently present. This has always been a positive factor, as this zone can often be selectively mined during periods of adverse economic conditions to raise cash flows.

6.Granisle Copper- Fig. 2.

The comments on annular symmetry apply to the Granisle deposit as well. My own knowledge of the deposit is limited to technical papers and several site visits. Fig. 2 suggests a possibility of mineralization to the north and west. This may already have been tested. A review of the diamond drill data and the blasthole assays should be done before planning any further exploration.

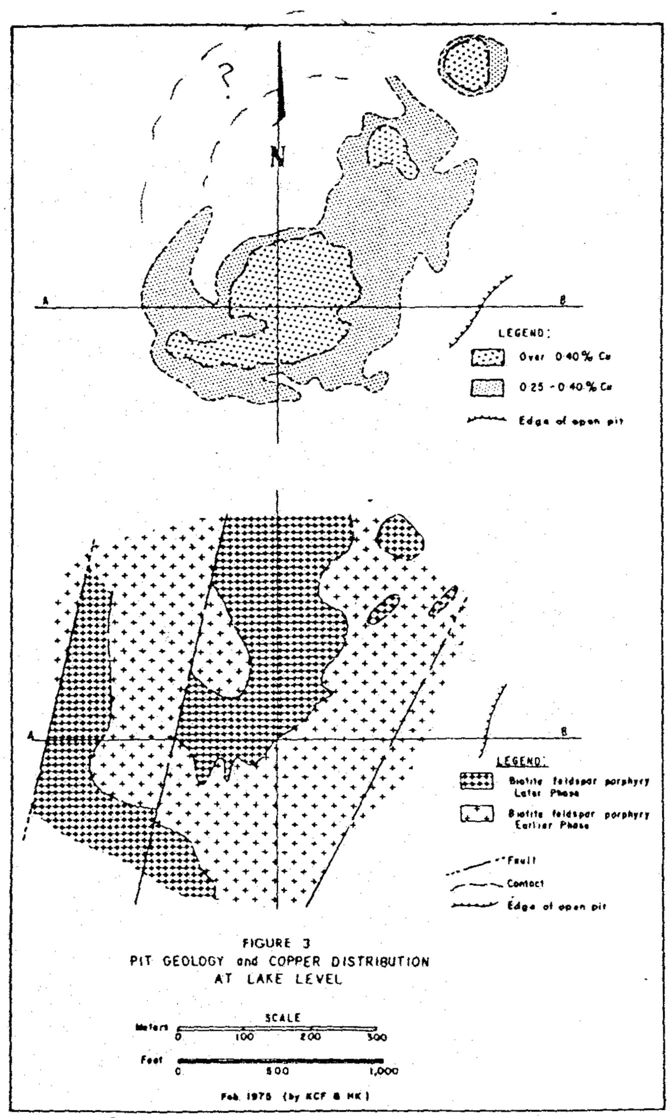


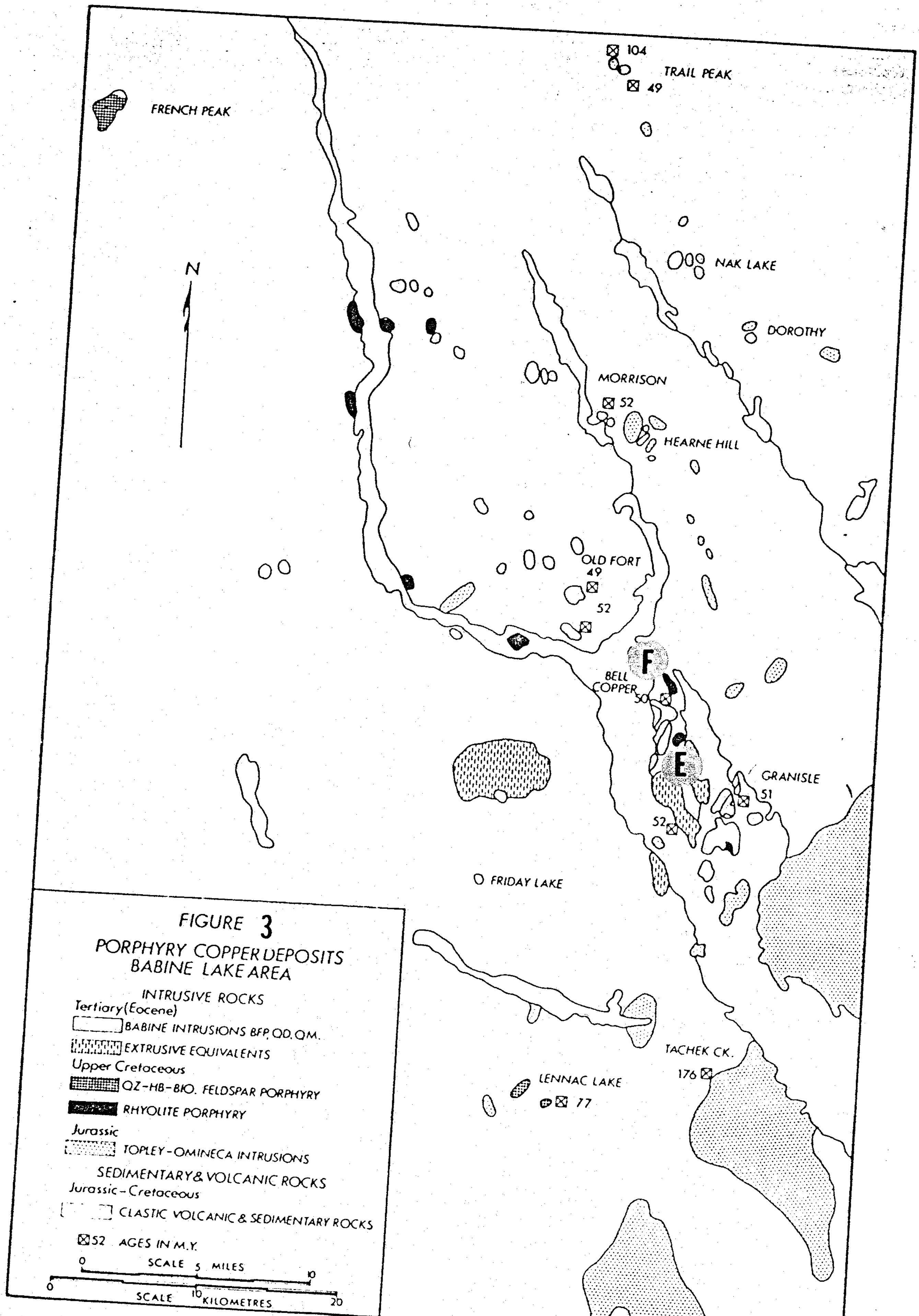
FIGURE 2 – Pit geology and copper distribution at Granisle.

7.Ketza prospect. Fig. 3, "E".

This prospect is on the eastern side of a small lake on Newman peninsula south of the Bell tailings pond. Exploration in the 1960's revealed a geochemical anomaly near the Babine lakeshore. Assessment reports are on file in the Ministry of mines in Smithers and are listed below. In addition, the 1974 helicopter VLF EM survey mentioned above showed an anomaly over a rounded point on the north eastern shore of the small lake. Air photos support this circular structure, which suggest a plug or subvolcanic structure.
Another feature of interest is the regional fault pattern. The Newman fault has always been taken as the fault which localized the Granisle, Bell, North Newman, and possibly the Old Fort deposits. This fault crosses Bell and into the ravine east of no. 5 tailings dam and dissappears into Hagan arm. See Fig. 4. Mapping at Bell, however, revealed that this is not the fault with the greatest throw, or vertical displacement. Another fault splays off from the Bell deposit and passes under the tailings pond and continues south east into the next lake on the peninsula beside the Ketza showing. This fault places Jurassic and Cretaceous rocks in juxtaposition and would require a throw of at least 3000 feet. This is most likely the fault which preceded the Bell intrusion. An exploration program here would be more involved than for the targets outlined above. Initial work would involve at least geological mapping and a geophysical survey. A liason should be made with Mr. Ron MacArthur of the Noranda Exploration office in Prince George, who may have some knowledge of the property. A Mr. P. McCarter of Noranda Exploration made an excellent map of the claims immediately to the south in 1981.
The claims over the Ketza showing forfiet in 1990, so some work should be planned at least by next season. Maurice Ethier at Bell should read these recommendations as well, as in a personal communication he queried the possibilty of mineralization in this area as the lake was being considered for additional tailings storage.

8.North Newman- Fig. 3, "F".

This deposit is some 2 1/2 miles northwest of Bell on a point on the west side of the peninsula. It was discovered and drilled at the same time as the Bell deposit. No mineable reserves were developed, but one hole did have grades of 0.30% Cu to 0.50% Cu. The drill logs are in the same file as the Newman (Bell) logs. The deposit is worth re-examination if it is felt that reserves are dwindling at Bell. The claims forfeit in 1996.


104
TRAIL PEAK
49
FRENCH PEAK
N
NAK LAKE
DOROTHY
MORRISON
52
HEARNE HILL
OLD FORT
49
52
F
BELL
COPPER
50
E
GRANISLE
51
52
FRIDAY LAKE
TACHEK CK.
176
LENNAC LAKE
77
FIGURE 3
PORPHYRY COPPER DEPOSITS
BABINE LAKE AREA
INTRUSIVE ROCKS
Tertiary (Eocene)
BABINE INTRUSIONS BFP, QD, QM.
EXTRUSIVE EQUIVALENTS
Upper Cretaceous
QZ-HB-BIO. FELDSPAR PORPHYRY
RHYOLITE PORPHYRY
Jurassic
TOPLEY-OMINECA INTRUSIONS
SEDIMENTARY & VOLCANIC ROCKS
Jurassic-Cretaceous
CLASTIC VOLCANIC & SEDIMENTARY ROCKS
52 AGES IN M.Y.
0 SCALE 5 MILES 10
0 SCALE 10 KILOMETRES 20

The Babine Igneous Suite was emplaced during the latter stages of major block-fault tectonism, which, in part, formed the prominent north-northwest structural grain in the region. The BFP intrusions and their genetically related copper deposits appear to have been emplaced along faults which have the greatest vertical displacement. Movement on some of these faults, such as the Newman fault at Bell Copper (Figs. 1, 3), ceased after BFP emplacement. However, movement continued on some other faults after the igneous event, as is evident from the juxtaposition of the BFP-related volcanics against older rock units, and from the major offset of the Morrison porphyry copper deposit (Carson and Jambor, this volume).

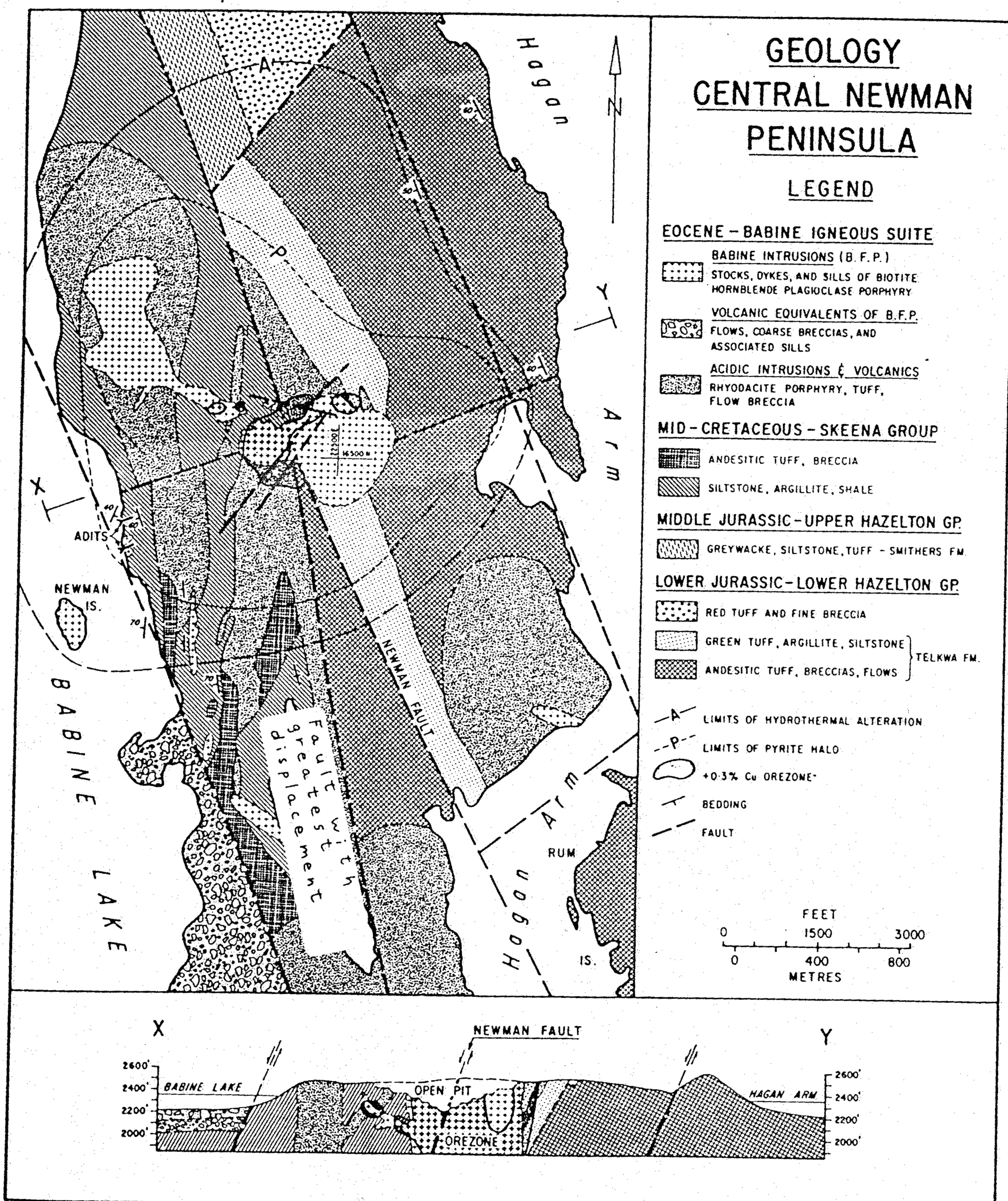


FIGURE 4 - Geology and Cross Section of Central Newman Peninsula.

RECOMMENDATIONS

The cheapest exploration has already been done at Bell, namely the blasthole assays. These hold a wealth of information on metal zoning and trends. A study of these Should reveal more exploration targets.

1.Reduce all 50 scale blast plans to 100 scale, that is 1:1200. This has already been started, with current planning using 100 scale plans. Once all bastholes have been plotted on 100 scale, the results should be contoured with isopleths or lines of equal grade at 0.10, 0.20, 0.30, 0.40, 0.50, 0.75, and 1.00% Cu. This will give a clear picture of both low- grade and high grade trends. The reductions can be done photographically at a very low cost, and the plotting and contouring would involve a few weeks drafting time.

2.Plot all diamond drilling on the latest 500 scale pit topography. The 400 scale diamond drill plan has suffered greatly from neglect, and the topography is out of date. If a diamond drill program is begun, it will be helpful to have a plan with current road and dump locations to plot hole locations and to plan drill moves.

3.An initial diamond drilling program to explore targets at Bell, which are A,B,C, and D on Figure 1 would require 8,000 to 10,000 feet of BQ drilling. Any success would require additional development drilling, which should be planned and budgeted separately.
If any drilling is completed, it is highly recommeded that if the core is not split, but completely crushed and assayed, that a few representative portions from each hole be retained for thin sections. The alteration mineralogy is well known at Bell, and if drill resuls are ambiguous, alteration can serve as a guide to decide the direction of further work.

4.Begin engineering studies to see if the operation would be economic at higher milling rates and lower grades. If the results are positive, plan an exploration program to define reserves at a lower cutoff below and around pit 2c.

5.Review diamond drilling and blasthole assays at the Granisle mine.

6.Do a property examination of the Ketza showing, and follow up with geological mapping and a geophysical survey. This should be begun during the 1987 field season.

7.Review diamond drilling at North Newman. Additional geological mapping would be timely in the light of expertise gained at the Bell Mine.

KETZA PROSPECT

ASSESSMENT REPORT NUMBERS

On file at the Ministry of Mines, Smithers.

Omineca Mining Division Reports

664
844
1072
1115
2646
6780
10333

DISCUSSION

GEOLOGICAL RESERVES AT BELL

Geological reserves below 31 Dec 86 surface at a 0.20% Cu cut-off were (to 1420 elevation):

110,000,000 tons @ 0.43% Cu.

Of this, mineable reserves within pit 2c were:

22,000,000 tons @ 0.48% Cu.

Therefore proven and probable reserves around and below pit 2c are :

88,000,000 tons @ 0.42% Cu.

Since few holes drilled low-grade (+0.20% Cu) for more than 500 feet, between 2000' elevation and 1420 there may be additional potential reserves in the order of 30,000,000 tons at an estimated grade of 0.40% Cu.
The deepest holes bottomed in ore grades around 500' elevation. Assuming that the same distribution of grades as in the upper portion of the deposit, the potential reserves between 1420 and 500 are in the order of 170,000,000 tons at 0.42% Cu. None of this is included in the MIF.

This would give potential reserves around and below pit 2c (to 500' elevation) at a 0.20% Cu cut-off of:

288,000,000 tons at 0.42% Cu.

Contained metal would be 1,210,000 tons Cu
2,900,000 ounces Au

To put these potential reserves in perspective, the contained metals are of the same order of magnitude as the large massive sulphide deposits of the Canadian shield.

If any exploration success is achieved in the outer portions of the stock as outlined in this report, this potential could double.

Obviously most of this will never be mined. Conversely these reserves should not be overlooked. The purpose of this discussion is to demonstrate that there is no shortage of reserves at Bell. The problems are engineering and technical in nature, in planning how to extract these reserves. If expenditures are being contemplated for exploration, a similar amount of time and energy should be given to engineering studies of the deposit.

DIAMOND DRILL HOLE SUMMARY AND LOGS

ANTHONY L'ORSA, M.Sc., F.G.A.C., GEOLOGIST

R.R. 2
SMITHERS, B.C.
V0J 2N0
TEL (604) 847-9580

15 Sept. 1987

Ross McArthur
Brian Anderson
Bell Mine
Granisle, B.C.

Dear Ross and Brian:

Enclosed please find diamond drill logs and summaries for 1987 drilling, and my invoice. Below are a few short observations on the drilling.

1. 87-11, in the section 79-110 ft., passed through a breccia that formed early enough to trap some copper mineralization. It is not quite a pre-ore breccia because it carries fragments of chalcopyrite-bearing quartz veins, but there is chalcopyrite in the breccia matrix and there are a few chalcopyrite and quartz veinlets with a little bornite cutting the breccia. I don't want to exaggerate the possible significance of this breccia, but to give you an extreme example of what can happen in an early breccia, consider La Colorada breccia pipe at Cananea which yielded 7 million metric tons grading 6% Cu plus Mo, Au and Ag. No profit sharing there, I suppose.

2. The southeastern contact of the BFP is occupied by an extensive explosion breccia. It would have made a beautiful ore trap - if only ore solutions had found their way into it, which was not the case at the level we investigated. All known explosion breccias at the Bell mine appear to be post-ore, except for the one intersected in 87-11.

3. Quartz-sericite alteration found in the southwestern sector of the pit appears to extend out along the southwestern

contact of the BFP. The alteration is still present at well-silicified 87-15. Some 1300 ft. of contact zone between 87-9 and 87-15 remain virtually (DDH 85 came close) untested, i.e. most of area "B" in Peter Ogryzlo's memorandum dated 24 Mar.87.

Although Dave Carson's alteration studies appear to provide no encouragement in this direction, 87-15 indicates that quartz-sericite alteration occurs much farther out along the south-western BFP contact than is shown in Carson's 1976 figures. My inclination, suject to data review, would be to drill another hole in the DDH 85-86 area, as Peter has recommended. The odds are that you will hit post-ore explosion breccia, but I think it is worth a try.

4. In the drill logs I have not attempted to separate the "barren dyke" found in the pit but, of course, you can spot it by referring to the RQD. This BFP phase tends to show less feldspar alteration than surrounding rocks but it does contain hydrothermal biotite and a little copper, and it exhibits a low RQD. Why? Does the rock occupy a zone of recurrent faulting that earlier served as a conduit for copper-bearing solutions?? It will be interesting to see how Cu assays plot in the vicinity of this rock.

Thank you for giving me the opportunity to help with this interesting project.

Good luck,

Tony

Anthony L'Orsa

cc to PLO

SUMMARIES OF 1987 DIAMOND DRILL HOLES.

87-1 260 ft. at 45° in BFP and explosion breccia. Sericite to quartz-sericite zones. Pyrite halo.

87-2 618 ft. at 45° in explosion breccia, volcanic breccia and tuff. Quartz-sericite zone. Pyrite halo. Intense alteration in much of the hole makes it difficult to determine that the rock is a breccia and impossible to identify the breccia fragments in hand specimen. Somewhat decreasing alteration from 540 ft. to end of hole reveals volcanic breccia and tuff.

87-3 410 ft. at 45° in BFP, explosion breccia in contact zone, and volcanic rocks. Sericite to chlorite-carbonate zones. Pyrite halo.

87-4 297 ft. at 90° in BFP. Biotite zone. Gypsum. Pyrite and chalcopyrite to chalcopyrite dominant zone at depth. Rock tends to break horizontally in sections with gypsum veins.

87-5 350 ft. at 45° in BFP. Biotite zone. Gypsum. Pyrite and chalcopyrite. Anhydrite vein at 304 ft.

87-7 350 ft. at 90° in BFP. Biotite zone with local quartz-sericite alteration. Gypsum. Pyrite and chalcopyrite, including chalcopyrite dominant zones.

87-8 250 ft. at 90° in BFP. Biotite and sericite zones. Gypsum. Both chalcopyrite and pyrite occur in this hole but the total sulphide content is low; generally about 1% or less.

87-9 550 ft. at 62° in BFP, but upper 285 ft. of hole is so altered that original rock type is uncertain. Quartz-sericite to sericite zones. Gypsum at depth suggests early biotitization, now sericitized. Pyrite is generally more abundant than chalcopyrite. Chalcocite and covellite are common in upper parts of hole, and small amounts of chalcocite are present to the end.

87-10 250 ft. at 75° in BFP and explosion breccia. Quartz-sericite zone. Minor gypsum and local sericitized fine-grained biotite suggest an earlier biotitized zone. Much of the core in this hole is so intensely altered that I can only guess at the original rock. Pyrite is more abundant than chalcopyrite. Small amounts of molybdenite are present.

87-11 300 ft. at 45° in BFP. Biotite zone. Chalcopyrite is much more abundant than pyrite. An explosion breccia cut between 79 and 110 ft. was formed early enough to trap some chalcopyrite and bornite, and it could constitute a significant ore zone. See accompanying letter.

87-12 300 ft. at 51° in BFP. Biotite zone. Gypsum. Chalcopyrite is more abundant than pyrite, but the sulphide content is low.

87-13 250 ft. at 76^{o} in BFP. Biotite zone. Gypsum. Local superimposed quartz-sericite alteration. Chalcopyrite and pyrite. Minor molybdenite.

87-14 160 ft. at 45^{o} in tuff and volcanic breccia. Chlorite-carbonate zone. Pyrite halo.

87-15 530 ft. at 45^{o} in BFP and explosion breccia. Quartz-sericite zone. Pyrite halo. Intense silicification (quartz flooding and quartz stockworks) in much of this hole suggests a possibly significant extension of the hydrothermal system along the BFP contact in a south-easterly direction from the southwestern sector of the pit.

87-16 140 ft. at 90^{o} in andesitic and felsic volcanic rocks. Chlorite-carbonate (propylitized) zone. Pyrite halo.

A. L'O

Anthony L'Orsa, Geologist

Dip test 280' - 49°

noranda MINES LIMITED BELL COPPER DIVISION DIP TEST 280 49°

Collared 19 Aug 87	Completed 20 Aug 87	Core Size NQ	Logged by	Project No	Date 20 Aug 87
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 1 of 1
Lat.	Elev.	Dip	Lat.	Elev.	Dip
Dep.	Depth	Bearing	Dep.	Depth M1F	Bearing

Hole No. 87-1

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au		Roc
115		CASING			11						libra
120	60%	BFP light grey to light olive grey	Pyrite is main sulphide.	2	41			.02	.0013		11
130	95	Feld. ≤ 3mm. Sericit. wk-mod. Bio, local, relict, chl. to seri.	Diss. & veinlets Chalcopyrite sparse -	1	"			.01			
140	100	< 1mm Qz-rich bands @ 30° Qz veinlet swarms @ 35°, Mi bx.	Diss. & veinlets.	1	"			.02	.0010		
150	"	EXPLOSION BRECCIA · 144 –	cp - diss. - [illegible] Mi. rust in frac. to 150'	1	81			.09			
160	"	• Frags. ang. to subround. end Several BFP types, seri + Qz	Calcite + Qz · local	2	"			.16	.0018		
170	"	Frags. Qz veins & Qz flood rock. • General colour; light grey		3	"			.04			
180	"	• vugs + clear Qz x'ls, loc. + py x'ls.	Py diss. > frac. fill.	5	"			.01	.0015		
190	"	Local Qz flooding 180-211 broken, gen. < 10 cm	Few ± 5mm py masses.	5	"			.00			
200	99	↓		5	"			.00	.0011		
210	100	BFP frags. dominate Bx - Seri + Qz		5	"			.00			
220	"	Post ore fault. FAULT 210-211 @ 35°. Much gouge	Py diss. > frac. fill.	7	"			.00	.0012		
230	"	Qz-rich matrix in Bx		5	"			.00			
240	"	Top 55° Dyke, pale olive, BFP @ base: 30°	Mi. Cp in diss. & veinlets	3	"			.09	.0009		
250	"	FAULT 240' ± 4" + gouge, @ 35° Bx includes frags of an earlier,	Mi. diss. hematite (?)	5	"	Back up Cu: .01		.01			
260	"	hematitic Bx.									

Dip test 300' - 50.5°
618' - 50.0°

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Collared 18/8/87	Completed 19/8/87	Core Size NQ	Logged by A. L'ORSA	Project No	Date 18-19/8/87
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 1 of 4
Lat.	Elev.	Dip 45°	Lat. 15558.3 / Elev. 2547.8	Dip 45°	Hole No.
Dep.	Depth	Bearing	Dep. 23.558.2 / Depth 618' HIF	Bearing S 45° E	87-2

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au		Libra
0-166		CASING - 80' left in hole			11						
170		EXPLOSION BRECCIA to ± 530' ??	Pyrite & minor cp in <1 to 5 mm frac. fill.	≤5	81			.01	.0024		
180	98	Intense sericite &, locally, quartz alteration;	+ quartz ± parallel to core	"	"			.00			
190	100	General colour: light grey	MoS2 + quartz + py @ 0° in minor amounts.	"	"			.01	.0019		
200	"	Bx includes angular sericitized fragments & rounded quartz-rich pyritic frags. Rounded	Pyritohedra ≤ 8mm in	"	"			.02			
210	"	to subrounded prob. felsic vol.	vuggy py + calcite + qz. veins ≤ 1cm dia. @20-50°	"	"			.01	.0020		
220	"	Matrix gen. quartz-rich + sericite.	Mi. prob. specularite diss. Py veins @ 0° to 85°	"	"			.01			
230	"	Few thin quartz veinlets Qz clear to grey.	gen. less than 1/ft. + diss.	"	"			.01	.0025		
240	"	• Much of core looks like	Minor chalcopyrite	≤8	"			.01			
250	"	quartz-sericite matrix	Py diss. & in frac. fillings throughout.	±5	"			.01	.0017		
260	"	without frags.		"	"			.00			
270	90	265-268 badly broken. Includes 3 cm dia. tuff frag.		"	"			.01	.0020		
280	100		Py frac. fill. ≤ 5mm dia.	"	"			.01			
290	"	288-298 broken, ≤ 5 cm		"	"			.01	.0022		
300	"	Quartz more abundant than seri.	Mi. MoS2 + py + qz - vein		"			.00	.0023		

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Collared	Completed	Core Size	Logged by	Project No	Date

FIELD COORDINATES			SURVEYED COORDINATES			Sheet 2 of 4
Lat.	Elev.	Dip	Lat.	Elev.	Dip	Hole No.
Dep.	Depth	Bearing	Dep.	Depth HIF	Bearing	87-2

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est Grade	Sample No.	Lt.	% Cu	OPT Au		Libre
300 -											
310	100	EXPLOSION BRECCIA (cont.) (Rock library sample @ 315')	Pyrite in diss. & frac. fill. chalcopyrite minor.	±10	81			.00			
320	"	Seri. > qz. Local qz flood. & stockworks. Local red hematite.	318' - 4mm py vein @ 0° Mi. red hematite	"	"			.01	.0019		31
330	"	Qz > Seri.; qz flood. & " "	Local vuggy py veins ≤ 1 cm	"	"			.01			
340	"	316-320' badly broken; gen. < 5cm	Py frac. fill. @ ±0° & ±45°	"	"			.01	.0013		
350	"	Qz sheeting local, @ 65° : 2/cm " 3/cm	Few gen. < 1mm red hem. veins cut py veins.	"	"			.01			
360	"			5	"			.00	.0022		
370	"	Quartz much more abundant than seri.	Vuggy Qz-py veins @ 10° ≤ 5mm with pyritohedra	"	"			.00			
380	"	Sericite > quartz	Mi. red hem. continues	7	"			.01	.0016		
390	"	Qz-sericite rock. Bx only locally apparent.		5	"			.01			
400	"	Locally light olive grey.	Local small Qz stockworks	"	"			.00	.0018		
410	"	Gen. light grey to yellowish		"	"			.00			
420	"	light grey.	Py veinlets form 2 populations: 50° & 15°	8	"			.00	.0014		
430	90	Bx obvious locally	Mi. early stage very fine grained Py.	5	"			.00			
440	100	Possible alt. BFP frags. ?	Qz flooding + py	10	"			.01	.0018		
450	"	light to med. light grey	Cubic py in vugs	5	"			.00			

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date
					Sheet 3 of 4

FIELD COORDINATES			SURVEYED COORDINATES			Hole No.
Lat.	Elev.	Dip	Lat.	Elev.	Dip	87-2
Dep.	Depth	Bearing	Dep.	Depth HIF	Bearing	

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au		Libr
450 - 460	98	EXPLOSION Bx (cont.)	Pyrite, disseminations >	7	81			.01	.0020		
470	100	Light grey to med. light grey Frag. size <1cm to boulders	fracture fillings	5	"			.01			
480	"	to unbrecciated? Too altered to identify frags. Qz > Seri.	Local early, very fine grained Py	5	"			.00	.0017		
490	"	Qz. flooding 478-490 Tectonic Bx, Post Qz flood. →	→ vuggy Py ≤ 1 cm.	"	"			.01			
500	"	Altered vol.? Qz + seri + py Qz. flooding, Very mi. calcite		"	"			.01	.0018		
510	"	Very light olive grey to med. light grey	Hi. white Qz. (generally	"	"			.01			
520	"	sericite > Qz Small Qz. Stockwork. Seri. Matrix	clear to grey) Early very fine py cont.	"	"			.01	.0018		
530	"	Qz + sericite alteration decreasing Prob. vol. frags., med. greyish orange		"	"			.01			
540	"	Post-sulphide shearing. VOLCANIC BRECCIA - Qz flooded	Very mi. calcite + Qz + Py	"	"			.01	.0014		
550	"	matrix. Frags. gen. sericitized. Light grey to light olive grey	Diss. > frac. py continues	"	"			.01			
560	99	Highly silicified & sericitized 557 4cm Qz-Seri. rock @ 60°-80°		"	"			.01	.0013		
570	100	557-585 Broken core, gen. <6 cm. TUFF, silicified. Few Seri. frags	Hi. light green chlorite? Py frac. fill. > diss.	3	31			.00			
580	"	Probably felsic originally. Frags. ≤ ± 1 cm	—"—	5	"			.01	.0017		
590	"	No calcite Minor Bx	Very mi. $CaCO_3$ + Qz in <1mm veins cut Py veins	10	"			.01			
600	99	Light olive grey, Qz-Seri. rock Tuff, very fine grained	Py veins @ 15°	5	"			.01	↑		

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Collared	Completed	Core Size	Logged by	Project No	Date
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 4 of 4
Lat.	Elev.	Dip	Lat.	Elev.	Dip
Dep.	Depth	Bearing	Dep.	Depth MIF	Bearing

Hole No. 87-2

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	~~Est.~~ Grade	Sample No.	Lt.	% Cu	OPT Au
600 - 610	100	TUFF. Frags. to 15 cm	Pyrite	5	31			.02	.0018
618	98	light olive grey to light grey	. Frac. fill. > diss.	10	"			.01	↓
END		Post mineral shearing	. Minor early fine py						
		Quartz + sericite	. Qz + Py veins cut						
		alteration continues.	by mass. py veins.						

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Collared 19 Aug 87	Completed 19 Aug 87	Core Size NQ	Logged by A. LORSA	Project No	Date 20 Aug 87

FIELD COORDINATES			SURVEYED COORDINATES			Sheet 1 of 2
Lat.	Elev.	Dip − 45°	Lat. 16,422.3	Elev. 2484.2	Dip 45°	Hole No.
Dep.	Depth	Bearing	Dep. 23,545.4	Depth 410' HIF	Bearing N 88° E	87-3

0 -

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au		Roc Libr Sam
155'		CASING			11						
160	20'	BFP sericitized but little Qz	Pyrite is most abundant.	3	41			.03	.0014		
170	98	Biotite seri. but recognizable Very light grey to light grey	Diss. - few veinlets. Chalcopyrite ± rare	"	"			.00			17
180	100	seri. feldspars ≤ 2 mm. 177-178 Bx	throughout	"	"			.00	.0016		
190	98	Local faults @ ± 20° to core	Py diss.; veinlets rare	"	"			.00			
200	100	" Qz-lined vugs 193-198 Bx. sericite matrix	↓	5	"			.00	.0014		
210	"	Bio. chloritized. Feld - seri. BFP. Med. grey - Feld ≤ 5 mm		"	"			.02			2(
220	"	BFP(?) light grey, intense seri.		"	"			.01	.0018		
230	98	23% and — " — CaCO₃ moderate	Py diss only, no veins	"	"			.02			
240	100	white Qz veins @ 45° No CaCO₃	Mi. cp	"	"			.04	.0025		23
250	98	Top contact @ 25° to core EXPLOSION BRECCIA - start 240'	Py diss.; few veins	"	81			.04			24
260	100	Light to med. light grey Fragments rounded to angular		"	"			.01	.0028		
270	"	include seri. BFP + diss. Py grey Qz frags. Tuff? med. yellow brown		"	"			.16			
280	"	Q-rich matrix, locally (?) green Dyke @ 50° - 181-182 greyish olive	↓ Few bands heavily diss.	"	"			.02	.0023		
290	98	relict mafics & a few feldspars.	Py @ 65° to core	"	"	Backu Cu .03		.03			

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 2 of 2
Lat.	Elev.	Dip	Lat.	Elev.	Dip
Dep.	Depth	Bearing	Dep.	Depth MIF	Bearing

Hole No. 87-3

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	~~Est~~ Grade	Sample No.	Lt.	% Cu	OPT Au		Libra
290 - 300	98%	Bx (cont.) 294-320+ Strong seri. Med. to very light grey	Pyrite, disseminated,	5	81			.01	.0017		
310	100	Local relict sericitized bio.	Local fracture control. diss. but no veins	"	"			.01			
320	"	Frags. hard to distinguish "ghosts"	— , —	7	"			.01	.0021		
330	"		— , —	5	"			.01			
340	99		Rare veins, < 1mm	"	"			.00	.0020		34
350	100	BFP dyke(?) 346-350 dk greenish grey, Base contact @ 65°	Few < 1mm Qz veins + mi. CaCO3 Cp - Mi, diss, Mi. Magnetite	"	"			.03			34
360	"	Bx darkened to olive grey with weak grey Qz stockwork		4	"			.02	.0025		36
370	"	Incl. BFP with chl. biotite " few grey Qz frags + Py veins.	Py + Cp. Calcite common	3				.08			
380	"	chloritized - to dk greenish grey include Vol. frags. Vol. Bx?	3 cm Qz vein @ 25° - pinkish margins, white interior + spec.	1	81? / 31?			.05	.0023		
390	"	Dark greyish green - general	First specularite in hole	"	31			.06			
400	"	ANDESITE (?) pyroclastic,	Spec. + red hem. > sulphides	"	"			.09	.0021		
410	"	chloritized with minor epidote	Mi. diss. cp in matrix & in Qz veins.	"	"			.08			4
END											
		Andesite (?) upper contact undetermined; may be in 380' section									

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Dip test 180' - 86

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Collared	Completed	Core Size NQ	Logged by A. L'ORSA	Project No	Date 24 Aug 8
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 1 of 2
Lat.	Elev.	Dip 90°	Lat. 17,034.1 / Elev. 1977.0	Dip 90°	Hole No. 87-4
Dep.	Depth	Bearing	Dep. 22,445.6 / Depth 297' MIF	Bearing —	

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libr
0 - 10		CASING									
20	95	BFP Med. dark grey to med. grey	Pyrite + chalcopyrite	<1	41			.29	.0041	88	
30	100	Feld. ≤ ± 4mm, weak to mod. seri. Biotite ± black ± 1mm	Minor calcite Hematite locally abundant	"	"			.27	.0038	80	
40	"	Two populations of biotite in most of hole ① Books	in < 1mm veinlets + Qz	"	"			.23		79	
50	"	② fine grained (alteration) Local feld. ≤ 5mm	Py > cp	"	"			.20	.0036	91	4
60	"	Quartz is translucent grey Med. dark grey	Qz-hem-py-cp cut by py-Qz	"	"			.17		70	
70	"	Feldspars ± fresh	Local sulphide joint fillings	"	"			.19	.0033	75	
80			& in few Qz veins.	"	"			.19		78	
90	"	Grey Qz veins + spec. + cp Mi. magnetite	Py > cp	1	"			.24	.0030	16	
100	"	BFP, dyke? ± fresh Plagioclase twinning visible,	← Hydrothermal biotite in dyke (?) veins Qz + hem + cp, few	"	"			.15		0	10
110	"	Bio. books show incipient seri. 109-112 Seri. increase, bleaching	Mi. cp in joints & in dk grey Qz Very minor MoS_2	"	"			.23	.0030	3	
120	"	Local silicification + cp	grey Qz vein ≤ 1cm + mi. cp @ ± 40°	"	"			.17		80	
130	"	123-128 bleached; 15mm Qz-Calcite sheared vein	Loc. hem. & mi. diss cp	"	"			.24	.0040	55	
140	"		± Massive hem > cp vein cut by mass. cp vein. All < 5mm	"	"			.23		40	
150	"	Bleaching 142-144 - Qz-$CaCO_3$ vein + shearing	cp in grey Qz veins	"	"			.23	.0064	76	

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Collared	Completed	Core Size	Logged by	Project No	Date

FIELD COORDINATES			SURVEYED COORDINATES			Sheet 2 of 2
Lat.	Elev.	Dip	Lat.	Elev.	Dip	Hole No.
Dep.	Depth	Bearing	Dep.	Depth M/F	Bearing	87-4

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libr
150-160	100	BFP (continues) med. grey	Chalcopyrite main sulphide. Pyrite present	2	41			.87	.0064	88	
170	"	Biotites range from almost fresh to completely seric.	Hematite, diss., abundant	2	"			.94	.0091	63	
180	"	Qz stockworks	cp veins (+ py) ± 2mm subsidiary diss.	2	"			.90		32	
190	"	" No obvious bio. books <185-212	Translucent grey Qz veins host much of cp & py throughout	4	"			1.00	.0071	60	
200	"	Strong Qz stockwork, local flood.		3	"			.89		92	20
210	"	" dark chloritic(?) spots < 1cm	Mi. magnetite in hem.-py vein (≤ 1mm). Less cp in hematitic sections	4	"			.74	.0095	60	
220	"	Qz stockworks + cp to end hole. Dominant vein trend @ 0° → watch misleading ASSAYS!		5	"	Back up Cu: .55		.57		96	
230	98	Specularite, diss., fine grained. 220 - soft, 1cm, Qz-$CaCO_3$-zeolite(?) fracture fill. @ 20°		3	"			.58	.0103	99	
240	100	Sericite present, much less abundant than Qz.		3	"			.76		97	
250	"	242 gypsum xls on fracture	grey Qz vein xenolith? slice? with cp	3	"			.72	.0106	30	
260	"	Gypsum (usually satin spar) veins ≤ 1mm @ 90°-45° to 293'	Spec. abundant, diss. cp > py; veinlets > diss.	5	"			.97		50	
270	90	Generally @ 90° & core tends to break along these veins	Local mass. cp + mi hem. veins ≤ 2mm	6	"			1.44	.0184	45	
280	100	Quartz veins or flooding occupy most of core to end?	Few, gen. ≤ 1mm, massive cp veins at various angles (20°-90°)	5	"			1.36		80	
290	"	Local fresh-looking bio. books		10	"			1.38	.0192	70	
297	85	Biotites [illegible]		6				1.15		64	29

END

Dip test 350' - 19.5°

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Collared 24 Aug 87	Completed 25 Aug 87	Core Size NQ	Logged by A. LORSA		Project No	Date 25 Aug 87
FIELD COORDINATES			SURVEYED COORDINATES			Sheet 1 of 3
Lat.	Elev.	Dip -45°	Lat. 16,195.3	Elev. 1939.6	Dip 45°	Hole No.
Dep.	Depth	Bearing	Dep. 22,215.8	Depth 350' MIF	Bearing S 51° E	87-5

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Lib.
0-10		CASING									
20	98%	BFP to end hole,	chalcopyrite + pyrite	2	41			.24	.0032	36	
30	100	Gen. dark to med. dark grey with local bleached sections	In veinlets with or without Qz & in local diss.	1	"			.22		43	
40	"	Biotite: ① Books ② Fine grained	Calcite: local & white Quartz: translucent grey	1	"			.32	.0056	0	
50	"	Plagioclase: Fresh, twinning visible. Locally sericitized	Few hem. veinlets + magnetite	<1	"			.25		22	5
60	"	Quartz pheno. <1mm Local bleaching to light olive grey	Cp diss. on joints	<1	"			.21	.0038	51	
70	"	Darker greys predominate ↓	Few Qz-sulph. veinlets <1mm	<1	"			.24		60	
80	"		Few calcite veinlets <1mm	<1	"			.16	.0036	0	
90	"		chalcopyrite > pyrite	<1	"			.31		0	
100	"			<1	"			.14	.0023	10	
110	"	sericitized plagioclase	Cp on joints & diss. matrix	1	"			.20		0	16
120	"	light olive grey dominant		1	"			.24	.0032	5	
130	"		120-126' Qz + sulphides vein <1.5cm dia., vuggy + 3mm calcite xls.	3	"			.15		3	
140	"	Feldspars strongly seri.	Local hem. Py > Cp?	<1	"			.15	.0023	23	
150	"		Local py diss. on joints	<1	"			.17		0	

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Collared	Completed	Core Size	Logged by	Project No	Date

FIELD COORDINATES			SURVEYED COORDINATES			Sheet 2 of 3
Lat.	Elev.	Dip	Lat.	Elev.	Dip	Hole No. 87-5
Dep.	Depth	Bearing	Dep.	Depth HIF	Bearing	

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	~~Est Grade~~	Sample No.	Lt.	% Cu	OPT Au	RQD	Libra
150 - 160	100	BFP, dark grey (cont.)	Chalcopyrite + pyrite	<1	41			.24	.0026	0	
170	"	Plag. twinning visible 2nd biotite	Fractures & diss.; 170' - ~10 cm Qz + cp vein	1	"			.30		31	
180	"	170-178 light olive green	@ 30° Mi. red hem.	2	"			.17	.0024	75	
190	"	Weak Qz stockwork		1	"	Back up Cu: .16		.09		40	
200	"	195 FAULT + gouge	Local mass. Py veinlets Few Qz veins + cp @ various	2	"			.16	.0024	30	20
210	"	Mod. sericitization light olive green to dark grey	orientations Few Qz - hem - sulph veins	2	"			.29		68	
220	"	- " -	+ central calcite e.g. ≤ 3 mm	2	"			.23	.0038	30	
230	"	- " -		2	"			.20		97	
240	"	- " -		2	"			.19	.0020	100	
250	"	Dark greys predominate	Cp mostly as joint diss.	1	"			.16		100	
260	"		Local magnetite	1	"			.19	.0026	80	
270	"		Rare white Qz veinlets	1	"			.38		92	
280	"	Gypsum 1mm vein @ 60°	cut grey Qz " . Qz + mi. cp veinlets - e.g.	1	"			.19	.0025	99	
290	"	" continues to end hole " 284'. 4mm @ 30°, slickensides	7 gen. < 1mm / 10 cm	2	"			.14		100	
300	"			2	"			.14	.0026	98	30

SEE-MOORE PRINT . SMITHERS FORM #10-

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 3 of 3
Lat.	Elev.	Dip	Lat.	Elev.	Dip
Dep.	Depth	Bearing	Dep.	Depth MIF	Bearing

Hole No. 87-5

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	~~Est~~ Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libr
300 - 310	100	BFP med. dark grey predomination 2nd biotite	Py > Cp (?) diss. on joints & in Qz veinlets	3	41			.15	.0026	100	30
320	"	Quartz abundant in matrix	304' ANHYDRITE vein, 7cm @15° light bluish purple	3	"			.17	.0029	97	3[illegible]
330	"	Gypsum veinlets gen ≤ 1mm especially common 300-345'	315 Magnetite vein, 1mm @ 40°	3	"			.15		100	
340	"	Gen. @ high angles - e.g. 80° Local frac. with gyp. xls.		3	"			.16	.0023	100	
350	"	Plagioclase twinning visible to mod. seri. 2 biotites		3	"			.19		94	35

Dip test 250' - 85

noranda MINES LIMITED BELL COPPER DIVISION

Collared 23 Aug 87	Completed 23 Aug 87	Core Size NQ	Logged by A. L'ORSA	Project No	Date 24 Aug 87
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 1 of 3
Lat.	Elev.	Dip -90°	Lat. 16,603.2 / Elev. 1942.7	Dip 90°	Hole No. 87-7
Dep.	Depth	Bearing	Dep. 21,919.6 / Depth 350' HIF	Bearing —	

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	~~Est.~~ Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libr
0 - 10		CASING									
20	% 100	BFP to end Med. dk. grey to light olive grey	Pyrite & Chalcopyrite	<1	41			.08	.0028	20	
30	"	Feld.: variable seri. ≤ 5mm Bio is fresh to seri., ① books	in veinlets + Qz & in diss. Quartz is translucent grey	1	"			.24		20	
40	"	② fine grained. Rust in fractures to 27'	cp > py in Qz veinlets. Few white calcite veinlets	1	"			.15	.0055	55	
50	"	42' contact @ 45° dk grey / med grey & lighter	Hematite, minor & local Erratically distributed Qz veins	1	"			.17		92	
60	"	Qz. sericite alteration 59-60' Bx + dk grey Qz fill. + BFP frags		2	"	Back up Cu = .12		.08	.0028	72	51
70	"	Qz - seri.		2	"			.12		78	
80	"	79. Bx, 10 cm, silicified ± 5% diss. py	Early sulphide microfractures (0.1mm) trend @ 0° & cut by	4	"			.12	.0036	77	
90	"	Bio looks fresh. Feld. seri.	Qz-sulphide veinlets @ 40-80°. Py > Cp. Few hem. veinlets	2	"			.10		72	
100	"	93 contact @ 30° med. grey to light olive gy / dark grey	Hi. diss. Cp. Local magnetite	1	"			.13	.0030	93	10
110	"	Hydrothermal biotite 108.5-113' Bx, py fill. + vugs, xls	Few sulphide veinlets + Qz	2	"			.06		98	
120	"	& BFP + Qz frags. rounded to ang. (explosion breccia)		2	"			.05	.0035	90	
130	"	Sericitized. Light olive grey	Py > Cp + grey Qz, + white Qz & calcite centre - vein	1	"			.04		82	
140	"	132-134 dark grey	Few Qz-sulphide veins - e.g.	1	"			.18	.0060	100	
150	"	Variable alteration continues	4/ft ≤ 3mm diameter. Local calcite & dolomite	<1	"			.09		100	

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date

FIELD COORDINATES			SURVEYED COORDINATES			Sheet 2 of 3
Lat.	Elev.	Dip	Lat.	Elev.	Dip	Hole No.
Dep.	Depth	Bearing	Dep.	Depth MIF	Bearing	87-7

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Lib.
150 - 160	100%	BFP - locally brecciated + calcite ± med. grey to light olive grey	Chalcopyrite & Pyrite in veinlets & dissem.	<1	≤1			.13	.0046	98	
170	"		Hematite - local + Qz	1	"			.14		97	
180	"		Qz vein + diss. cp + mass. red hem. ≤2.5 cm, cut by Py-Qz <1mm	1	"			.16	.0059	89	
190	"	180-210 Med. grey with well-sericitized feld. No mag. (?)	Local calcite veinlets	1	"			.10		84	
200	"	"Graniteware" appearance	Local Qz + cp + red hem. veins	1	"			.14	.0024	80	20
210	"	Hydrothermal biotite • Gypsum: 205 to end of hole	— " —	1	"			.14		80	
220	"	205-218 ± 1mm veinlets @ 80°-30° e.g. 4/10 cm	— " —	1	"			.31	.0037	90	
230	"	222-238 Light olive grey >	More diss. sulphides in matrix Weak Qz stockwork + cp ↓	1	"			.18		88	
240	"	Local gypsum veins ≤ 4mm @ 90°	Py > cp ? Diss + Qz veins	2	"			.21	.0026	96	
250	"	Med. dark grey	Red hem. + cp + Qz @ 0° for 4'	3	"			.15		100	
260	"	Gypsum veinlets common Med. grey > light olive grey which		2	"			.23	.0018	88	
270	"	is associated with Qz veins		2	"			.16		100	
280	"	Feld. ± hard - barely sericitized		2	"			.13	.0028	100	
290	"	Hydrothermal biotite	Py + cp + red hem. + Qz @ 0°, 2½'	3	"			.13		95	
300	"	Med. dark grey. Mod. magnetite	cp joint coatings	2	"			.22	.0031	100	30

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date
FIELD COORDINATES			**SURVEYED COORDINATES**		Sheet 3 of 3
Lat.	Elev.	Dip	Lat.	Elev.	Dip
Dep.	Depth	Bearing	Dep.	Depth MIF	Bearing

Hole No. 87-7

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. ~~Grade~~	Sample No.	Lt.	% Cu	OPT Au	RQD	Libr.
300-310	100%	BFP Med. darkgrey to med. grey. Bio. books to 2mm thick	Chalcopyrite in few	2	41			.16	.0031	100	
320	"	Gypsum veinlets <1mm @ 0°-70°	Qz veinlets & as	2	"			.04		98	
330	"	to end of hole. Some veinlets slickensided	joint coatings & joint disseminations	1	"			.05	.0025	100	
340	"	Plagioclas looks fresh	Few Qz + red hem. + py	1	"			.06		99	
350	"	Hydrothermal biotite continues	+ cp veinlets. Local white Qz + py veinlets	1	"			.12	.0026	100	35

SEE-MOORE PRINT - SMITHERS FORM #108

Dip test 250' - 85.5

noranda MINES LIMITED BELL COPPER DIVISION

Collared 25 Aug 87	Completed 25 Aug 87	Core Size NQ	Logged by A. LORSA	Project No	Date 26 Aug 8[illegible]
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 1 of 2
Lat.	Elev.	Dip -90°	Lat. 16,332.9	Elev. 2073.3	Dip 90°
Dep.	Depth	Bearing	Dep. 21,992.2	Depth 250' MIF	Bearing —

Hole No. 87-8[illegible]

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libr
0 - 20		CASING									
30	% 100	BFP to end hole. Feld. ≤ 4 mm±	Pyrite & chalcopyrite in diss. & veinlets	1	A1			.03	.0020	10	
40	"	Generally med. grey to light olive grey. Sericitized in lighter sections	Gypsum veinlets erratically distributed throughout ±	1	"			.09		0	
50	"	Biotitized in darker " Hi RUST on fractures to 32'	Quartz is translucent grey unless otherwise noted.	1	"			.08	.0029	0	
60	"	Late phase BFP dyke (?) Rock breaking along joints @ 65-50° which control some veins & colour.	Mod. red mineral - unidentified - @ 45' + py veinlet + below ↓	1	"			.06		0	
70	"	± light olive grey - sericitized	Hi. py & cp; diss. on joints, in matrix & in Qz v.	1	"			.03	.0034	38	
80	"	Feld. ≤ 9mm (rare), gen. ± 2mm	Few Qz veins, gen. @ 35°	1	"			.05		48	
90	"	sericitized		<1	"			.05	.0022	85	
100	"	Light olive grey / Med. grey @ 30°	Few < 10mm long magnetite lenses in Qz veins.	<1	"			.05		70	10
110	"	•105' Explosion Bx for 1' Linear frags may trend 55°. BFP, Qz v. & light yellowish brown seds?	Py, diss., vf grain. Pyritized bio. books. Bx cut by vuggy gyp-py veins	2	"			.07	.0031	89	
120	"	Med. grey to light olive grey		1	"			.06		50	
130	"		Sulphide diss > frac. fill.	1	"			.06	.0016	53	
140	"	Light olive grey, sericitized, predominates	Few mass. hematite veinlets cut Qz - hem. - veinlets	1	"	Back up Cu = .05		.05		73	
150	"		2 generations of Qz veinlets	<1	"			.10	.0015	79	
160	"	Gypsum becoming common	Local vugs + dolomite xls + calcite + py	1	"			.07	.0024	76	

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date

FIELD COORDINATES			SURVEYED COORDINATES			Sheet 2 of 2
Lat.	Elev.	Dip	Lat.	Elev.	Dip	Hole No. 87-8
Dep.	Depth	Bearing	Dep.	Depth MIF	Bearing	

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libr.
160 – 170	% 100	BFP light olive grey > med. grey	Py + Cp, in small amounts	1	41			.08	.0024	80	
180	"	Feldspar: mod. sericitization. Bio.: Seri (very pale orange brown)	Local vugs + calcite xls. Few white Qz veins in grey Qz	1	"			.07	.0022	95	
190	"	Swarm of gypsum veins @ 80-90° to core	Local hematite incl.,	1	"			.05		26	
200	"	Two generations of gyp. (satin spar) ±40° veinlets cut (offset) by ±90° v.	diss. specularite. White Qz vein, 5mm @ 45°	1	"			.05	.0033	82	20
210	"	Colour darkening ± 212' ↓	Few py only (?) veins ± 1mm	2	"			.07		70	
220	"	Locally dark grey with med. dk. grey bands @ 45°	Mi. diss cp. Few gypsum xls.	1	"			.09	.0026	45	
230	"	222-227 ± rubble: Dyke? dk grey base. contact @ 40° ←	Incl. Qz with very light purple colour. Biotitized. Diss Cp + py	1	"			.08		30	
240	"	234- last gypsum noted. • Highly seric & silicified, Strong Qz		2	"			.26	.0050	81	
250	"	stockwork with dominant vein trend 50-70°. Exp. Bx? End 234'	Mi. diss. Py + Cp.	2	"			.52		100	25
END		234' to end of hole: light olive grey to med grey (biotitized)	Few Qz veinlets — " —								

Dip test EOH - 62°

noranda MINES LIMITED BELL COPPER DIVISION

Collared 21 Aug 87	Completed 22 Aug 87	Core Size NQ	Logged by A. LORSA	Project No	Date 22 Aug 8
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 1 of 4
Lat.	Elev.	Dip − 62°	Lat. 15,889.4 · Elev. 2418.6	Dip 62°	Hole No. 87-9
Dep.	Depth	Bearing 346°	Dep. 21,834.6 · Depth 550' MIF	Bearing N13°30W	

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD.	Libr.
0 – 20		CASING									
30	75 %	QUARTZ- SERICITE RX	Pyrite & chalcopyrite	5	41?			.33	.0030	45	
40	100	Probably altered BFP • Qz translucent grey to clear	in diss. & frac. fillings throughout	5	"			.16	.0028	57	
50	"	veins ≤ 5cm dia., @15-35° gen. vugs + Qz xls, Mod. stockwx	Py > cp – this sector • Chalcocite to end (Minor)	5	"			.35		59	4
60	"	Flooding cut by Qz veinlets. At least 2 generations of Qz vein	• Covellite to ± 430' " • Local mi. RUST to 330'	5	"			.32	.0033	68	
70	96	• Tourmaline(?) radiating, dk green • Local massive, soft, sericite		5	"			.30		76	
80	75	• Medium light grey. 78' FAULT	74-78' spec. diss. + veins + Qz loc. joints + pyritohedra ≤ 3mm	4	"			.23	.0038	62	
90	100	Qz flooding	cp + Py diss. > veinlets	5	"			.50		80	
100	99	Soft seri. + Qz flooding		5	"			.38	.0036	60	
110	100		Local, hem., fracture related	5	"			.29		84	
120	"	Intense seri. + mod. Qz flood & stockworks.	Diss. sulphides > mass. veinlets, e.g. 1mm @ 35°	5	"			.22	.0024	78	
130	"			5	"			.11		74	1[illegible]
140	"	Qz > seri		7	"			.16	.0022	55	
150	"		Qz microfractures cut spec. + Qz veinlets	5	"			.33		81	
160	"	Few vugs + Qz xls + sulphides	Qz-spec-cp veinlets – e.g. 5mm @ ± 10°	5	"			.38	.0048	81	

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 2 of 4
Lat.	Elev.	Dip	Lat.	Elev.	Dip
Dep.	Depth	Bearing	Dep.	Depth MIF	Bearing

Hole No. 87-9

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est Grade	Sample No.	Lt.	% Cu	OPT Au	R.Q.D	Libra
160 – 170	% 100	Quartz - Sericite Rock (cont)	Py + Cp diss > veinlets	7	41?			.31	.0048	58	
180	"	Med. light to light grey strong Qz stockworks	continue ↓ Mi chalcocite & covellite	7	"			.36	.0052	64	
190	"	—"— cut by few mass. sulphide veinlets, ≤ 1mm @ 40°	in fractures - continues 181-182 Sulphide vein	7	"			.42		57	
200	"	—"—	± 5mm @ 0° to core Qz veinlets cut mass.	7	"			.47	.0040	84	20?
210	"	"	Py veinlets.	7	"			.39		76	
220	"	Very local Qz flooding,		8	"			.49	.0043	73	
230	"	Qz stockworks continue	Mi Fe oxides	6	"			.55		87	
240	98	↓		6	"			.37	.0041	46	
250	100			5	"			.39		79	
260	"	Few vugs + Qz xls + sulph		6	"			.50	.0057	87	
270	"			6	"			.63		79	
280	"	Qz vein, 7mm @ 10°		10	"			.79	.0057	76	
290	"	BFP Mi. tourmaline (?) obvious as alt. decreases ←	±285 marks end of intense Q-seri. alt. above	6	41			.62		95	
300	"	Bio. sericitized with inter-plate sulphide.	Mi hematite in Qz	5	"			.86	.0088	83	30
310	"	Feld. greyish orange (limonite stained ? sericite)	Hematite common in Qz	3	"			.38		88	

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date

FIELD COORDINATES			SURVEYED COORDINATES			Sheet 3 of 4
Lat.	Elev.	Dip	Lat.	Elev.	Dip	Hole No.
Dep.	Depth	Bearing	Dep.	Depth MIF	Bearing	87-9

Footage	Rec'y %	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	R.Q.D.	Libre
310-320	100	BFP gen. greyish orange to med. light grey.	Py + Cp diss & frac. fillings continue.	3	41			.45	.0051	62	
330	"	Qz stockwork weak	Fracture fill. >> diss.	2	"			.14		96	
340	"	Qz stockwork ± gone –	Hem. ± common to end	2	"			.18	.0029	100	
350	"	few Qz veins	Hem., dark red, diss.	2	"			.12		84	
360	"		" increase → sulphide decrease (Local?)	2	"			.15	.0044	76	
370	"	Brownish grey to greyish	5mm sulphide vein. @25°	2	"			.18		71 [9]	
380	"	orange to med. light grey		2	"			.19	.0028	97	
390	"			3	"			.35		94	
400	"	Few Qz veins continue	Tourmaline (?) very dark green, radiating xls	4	"			.32	.0052	89	40
410	"		coarser than other occurrences of Tour. (?)	4	"			.31		80	
420	"			4	"			.18	.0023	43	
430	"	422-423.7 BFP dyke @ 15° 423.7-428.5 Exp. Bx. incl. BFP &	Cp + Py diss > veinlets	2	"			.23		67	42.
440	"	Qz vein frags. + sulphides, Matrix-rich Bx		4	"			.20	.0042	48	
450	"	mi. tourmaline?		3	"			.29		64	
460	"	Qz increasing – mod. stockworks & local flooding		3	"			.50	.0050	83	

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 4 of 4
Lat.	Elev.	Dip	Lat.	Elev.	Dip	Hole No. 87-9
Dep.	Depth	Bearing	Dep.	Depth MIF	Bearing	

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	~~Est~~ Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libra
460-470	% 100	Seri. + Qz alteration BFP med. light grey >	Pyrite, Cp & chalcocite (mi)	5				.27	.0050	74	
480	"	Two 5mm brown zeolite (??) veins + Qz rims: 40° & 35°	continue to end Qz stockwork 463	5				.28	.0034	66	
490	"	Diss. green tourmaline?	Few small Qz veins	2				.19		62	
500	"	Qz abundant in matrix Few veins, light olive ± brown mineral ≤5mm	Sulphide veinlets >> diss.	3				.19	.0025	64	50
510	"	General colour; med, light grey	Few vuggy Qz + Py veins	4				.19		70	
520	"	510-515 Brecciated + mass. to vuggy Py filling		5		Back up Cu = .28		.24	.0023	54	
530	"	Gypsum (satin spar) mi, 1mm veins @ ±0°, + Py		2				.19		90	
540	"			2				.24	.0038	95	
550	"	544 silicification increases Good Qz stockworks + Qz flood.	Py & lesser Cp increase in silicified rock	6				.39		89	55
END		Local very light grey, 'chalky' sericite.									
		Local gypsum veinlets, ± clear.									

Dip test 150' - 72.5°

noranda MINES LIMITED BELL COPPER DIVISION

Collared 24 Aug 87	Completed	Core Size NQ	Logged by A. LORSA	Project No	Date 26 Aug. 8'
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 1 of 2
Lat.	Elev.	Dip 75°	Lat. 16,305.9 / Elev. 1940.2	Dip 75°	Hole No. 87-10
Dep.	Depth	Bearing	Dep. 21,653.4 / Depth 250' MIF	Bearing 57° W	

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	libr.
0 - 10		CASING	Pyrite > chalcopyrite								
20	90	QUARTZ-SERICITE Rock	Fracture fillings > diss. Minor epidote??	5	41?			.16	.0021	61	2(
30	100	Too altered to identify Qz > sericite	At least two generations	4	"			.25		26	
40	"	Strong Qz stockworks, to ± 103' Qz translucent med. light grey to colourless	of sulphide-bearing Qz vein Gypsum - 1 veinlet, ± 1mm	5	"			.35	.0032	65	
50	"	& tends to be slightly lighter colour than cu zone to NE (e.g. 87-4)	Vuggy 2mm py vein @ 15°	5	"			.25		68	
60	"	Medium light grey dominant.	Much diss. py in sericite	5	"			.26	.0031	90	
70	"	63-75 extreme silicification		5	81?	Back up Cu=.15		.16		80	
80	"	EXPLOSION BRECCIA, incl.	Local calcite " heavy py in matrix	5	81			.07	.0021	80	7
90	"	rounded to subrounded BFP & prob. sed. rx frags, r'd to sub. ang.	Gypsum - Minor	3	81?			.20		70	
100	"	Bx contacts are lost in alteration		4	"			.33	.0035	98	
110	"	103 BFP. Biotite books & hydro. bio. are seri.	Less sulphides & hematite becomes abundant	3	41			.29		97	11
120	"	Qz stockworks greatly reduced. Tourmaline (?), local Qz stockwks	Mi. diss. calcite	4	"			.35	.0029	100	
130	"		Hi MoS_2 diss. in 1mm Qz vein	4	"			.37		90	
140	"	135' intense silicification - contact @ 52° (?)	Py > cp	4	"			.19	.0015	98	
150	"	EXPLOSION Bx? or brecciated with Qz flooding ??	py abundant in BFP frags.	4	81?			.11		98	

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date

FIELD COORDINATES			SURVEYED COORDINATES			Sheet 2 of 2
Lat.	Elev.	Dip	Lat.	Elev.	Dip	Hole No. 87-10
Dep.	Depth	Bearing	Dep.	Depth HIF	Bearing	

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	~~Est.~~ Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libra
150 – 160	% 100	LARGE QUARTZ VEIN ? Mostly grey Qz + loc. BFP frags(?)	Py > Cp, Scattered, gen. < 1mm veinlets @ 30° or more.	4	81?			.15	.0019	91	
170	"	161 – basal contact @ 7° ± BFP (?), intense Qz - Seri. alt.	Plus disseminations, & short "crackle" frac. in grey Qz	5	41?			.36		100	
180	"	169 – 170 (more?) includes Expl. Bx + ang. Qz vein frags + BFP frags	Mi. MoS_2 (?) diss. in Qz	6	"			.53	.0040	100	
190	"	Med. light grey (Qz) to ± white (seri) BFP - Highly sil. + Qz stockworks	Several ± 1mm Py > cp veins @ 0° for 3½'	7	41			.39		94	
200	"	Local white calcite veinlets	Py > Cp. Mi. diss. MoS_2	5	"			.31	.0029	100	20
210	"	Dominant Qz stockwork trend cuts core at low angles	Qz very light grey to colourless	5	"			.22		91	
220	"	212 – Bx + vuggy py + $CaCO_3$ fill.	Py > cp veins ave. 5mm, @ 0° for 2' Mi MoS_2 (?) in Qz vein + Py	6	"			.16	.0030	79	21
230	"	BFP - hi. sil. 224 FAULT @ 25° mi gouge	Mi. calcite + dolomite	5	"			.06		81	
240	"	230 FAULT @ 20° + gouge Qz stockwork veining pred. 10°	– veinlets Py > cp to end - diss.	4	81?			.02	.0021	80	
250	"	EXPLOSION BRECCIA (?)	215' Massive calcite vein	6	81?			.05		85	25

Dip test 280' - 50.5°

noranda MINES LIMITED BELL COPPER DIVISION

Collared 22 Aug 87	Completed 22 Aug 87	Core Size NQ	Logged by A. L'ORSA	Project No	Date 23 Aug 87
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 1 of 2
Lat.	Elev.	Dip — 45°	Lat. 17,256.0	Elev. 1982.3	Dip 45°
Dep.	Depth	Bearing	Dep. 22,405.7	Depth 300' MIF	Bearing N 39°48' E
					Hole No. 87-11

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libr
0 - 10		CASING									
20	% 75	BFP ± Med. light grey	Pyrite in ≤ 2mm Qz veins	< 1	41			.07	.0013	22	
30	100	Feldspar gen. < 5 mm sericitized - variable	Py + Cp + Qz veinlets, few	1	"			.08	.0016	50	
40	"	Biotite - ① Books - 2 generat.? ② Fine grained	Local hematite, minor	1	"			.08		53	
50	"	Bio. sericitized to 'fresh' Feld. slight to mod. seri.	" diss. cp. Very mi. diss. bornite	1	"			.13	.0034	75	5
60	"	Qz abundant in matrix	Hem. frac. fill. loc. abundant Local dark sil. zones + diss. cp	1	"			.58		75	
70	"	Feld. sericitized, Bio. 'fresh', 2mm		< 1	"			.25	.0038	95	
80	"	69.5 - 72.3 Expl. Bx with Bleached BFP frags, Qz vein frags	cp in dark sil. zones as as diss. + 'crackle' fillings	3	"			.61		95	
90	"	Biotitized EXPLOSION BRECCIA 79' to 110'	Hem. loc. abundant	1	81			.69	.0061	80	
100	"	96 - FAULT, 15 cm @ 45° Dark grey. Includes ang. Qz vein frags	Minor bornite, —"— Few cp + Qz veinlets @ 85°	3	"			.72		92	10
110	"	& altered BFP in siliceous matrix Top contact 25°? Base = sil. zone	cp in Bx matrix & in few Qz veins cutting Bx	4	"			1.00	.0079	85	
120	"	119 - Base siliceous zone - 45°	Local magnetite " specularite, incl. xls	< 1	41			.50		99	
130	"	BFP. Dyke? Qz vein frags. Fresh Bio. 124' Base @ 50°. Feld. seri., Dk gy.	120' Qz vein xenoliths in BFP!! Local good Qz stockworks	2	"			.69	.0052	92	
140	"	Intense hydrothermal biotitization Dark grey continues	cp diss., in Qz veins & as joint coatings. >> Py	2	"			.84		91	
150	"	BFP silicified in bands. Qz stockworks	Hem. abundant Loc. strong magnetite	1	"			.99	.0077	91	

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 2 of 2
Lat.	Elev.	Dip	Lat.	Elev.	Dip
Dep.	Depth	Bearing	Dep.	Depth HIF	Bearing

Hole No. 87-11

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libr
150 - 160	% 100	BFP Dark grey to med. grey	Chalcopyrite gen. > pyrite	1	41			1.04	.0077	97	
170	"	to local light olive grey. Biotite: Hydrothermal continues	in diss. & in Qz veins. Hematite in diss. & veinlets	3	"			.98	.0065	85	
180	"	Books also present. Feldspar - variable seri.	Local soft, sericitic, sections. Good Qz stockworks	2	"			.70		90	
190	"	Dark grey & silicified	Cp >> Py	3	"			.89	.0058	92	
200	"	Qz-rich matrix, mi. chlorite	Local purplish Qz. Very mi. calcite, edge Qz vein	1	"			.86		97	20
210	"		Spec. in veinlets & diss. Mi. mag. Cp veinlets, ± 1mm, @ 0° for ± 3'	2	"			.91	.0048	100	
220	"	Local bleaching. Qz xenoliths (?) in BFP		1	"			.41		100	
230	"	End silicification 226. TOP @ 35° 226-263 BFP dyke. Base. 40°?	Qz - calcite - py > cp veinlets	<1	"			.17	.0029	80	
240	"	Distinctive "graniteware" look. Med. grey, with prominent		<1	71			.07		91	
250	"	white (sericitized) feldspars ≤ 5mm. Bio - blk ± & ≤ 3mm	Qz veinlets + mi. calcite + hem.	<1	"	Back up Cu = .10		.10	.0025	90	
260	"	Local bleaching & local dark siliceous bands (e.g. 8cm)		<1	"			.22		97	
270	"	261-263, Porous & vuggy Bx zone BFP, silicified, as above 226'	Local magnetite to end. Cp in & adjacent to Qz v.	1	41			.59	.0049	86	
280	"	Good Qz stockworks from		1	"			.55		20	
290	"	263 to end of hole.	Diss. Cp	2	"			.60	.0056	17	
300	"	Feldspars ± fresh to slightly seri.	Local hem + cp veins cut by cp - Qz veins - all < 1mm	2	"			.58		20	30

END

Dip test 190' → 52.0°

noranda MINES LIMITED BELL COPPER DIVISION

Collared 22 Aug 87	Completed 23 Aug 87	Core Size NQ	Logged by A. L'ORSA		Project No	Date 23 Aug 8
FIELD COORDINATES			SURVEYED COORDINATES			Sheet 1 of 2
Lat.	Elev.	Dip 51°	Lat. 17,030.0	Elev. 1977.0	Dip 51°	Hole No.
Dep.	Depth	Bearing	Dep. 22,449.3	Depth 300' MIF	Bearing S46°45'E	87-12

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Lihr.
0 - 10		CASING									
20	80%	BFP to end of hole.	Pyrite + chalcopyrite	<1	41			.15	.0045		
30	100	Med. grey to light grey Biotite; 2 populations ① Books	in quartz vein Rarely disseminated	1	"			.21	.0021	10	
40	"	② fine grained Feld.: fresh with poly. twin.	Magnetite, mod. to strong Hem. + sulphide vein cut by	1	"			.18		0	
50	"	visible, sericitized in some section	sulphide + Qz vein. Few hem. vein ≤ 2mm dia.	<1	"			.18	.0018	0	
60	"	Quartz is translucent grey. BFP includes a late phase	Cp > py in joints & Qz v.	1	"			.18		0	
70	"	with a low RQD.	& mi. diss.	1	"	Back up Cu = .18		.24	.0026	0	
80	"	Locally sericitized		1	"			.25		0	
90	"	Local bleached zones; sericite,	Mi. calcite	1	"			.19	.0023	65	
100	"	Qz vein, chlorite (?)		<1	"			.23		60	
110	"	108' Qz + Calcite + zeolite (?) vein	Few Qz veins ≤ 5mm + py + cp	<1	"			.28	.0031	10	11(
120	"	± 10cm @ 30° to core	e.g. @ 30° to core Mi. diss. cp. Loc. py vein	<1	"			.28		10	
130	"	129' calcite vein, 3cm @ 90°, vuggy	Py > cp on joints	1	"			.26	.0022	30	
140	"	Biotites: blackish green Medium dark grey	Hematite continues	1	"			.24		10	
150	"			1	"			.15	.0022	0	

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 2 of 2
Lat.	Elev.	Dip	Lat.	Elev.	Dip
Dep.	Depth	Bearing	Dep.	Depth HIF	Bearing

Hole No. 87-12

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	~~Est.~~ Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libr.
150 -									.0022		
160	100	BFP continues	Chalcopyrite & Pyrite	1	41			.22		40	
170	"	Locally sericitized Generally med, dark grey	continue; diss + veins Mi. spec. & magnetite	1	"			.14	.0021	50	
180	"	•Gypsum (gen. satinspar) veins gen. < 1mm to end of hole	vugs in places. cp + py + Qz veins ≤ 2mm	2	"			.12		100	
190	"	Late stage; cut Qz-sulph. veins cut hem. veins	e.g. 4 veins/10cm; genilers Local cp-rich silic. zones	1	"			.16	.0021	100	
200	"			2	"			.21		100	
210	"	Local gyp. veins @ 45°		1	"			.13	.0020	100	
220	"	Fresh looking biotites		1	"			.16		100	220
230	"		229-230 Qz + sulph. vein @ 0°	1	"			.13	.0028	100	
240	"	Local gypsum veins < 1mm @ 0°		< 1	"			.16		100	
250	"	Plagioclase twinning visible	pyritohedra in Qz veins + cp	< 1	"			.12	.0024	100	
260	"			1	"			.16		100	
270	"			< 1	"			.13	.0016	100	
280	"		•2 Qz + sulphide vein populations early @ 0° Late @ 85° ±	< 1	"			.14		100	
290	"	Local sericitization		1	"			.11	.0012	97	
300	"	Gypsum veins ≤ 1mm @ ± 50°, spaced ± 4 cm apart in last 3' of core	Feld : weak seri. Biotites ; ± dark green	1	"			.09		95	300

END

Dip test 250' - 79.5°

noranda MINES LIMITED BELL COPPER DIVISION

Collared 24 Aug 87	Completed 24 Aug 87	Core Size NQ	Logged by A. LORSA
Project No	Date 27 Aug 87	Sheet 1 of 2	Hole No. 87-13

FIELD COORDINATES		
Lat.	Elev.	Dip 76°
Dep.	Depth	Bearing

SURVEYED COORDINATES		
Lat. 16,359.8	Elev. 1941.9	Dip 76°
Dep. 21,280.3	Depth 250' M.F	Bearing S 31°30' W

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libr.
0 - 10		CASING									
20	95%	Light grey to med. grey BFP to light olive grey	Chalcopyrite & Pyrite in Qz stockworks, joint coat.	2	41			.63	.0110	81	
30	100	Biotite ① Books ② Fine-grained Both gen. sericitized, upper hole	& diss. (to < 0.1mm). Hematite common	2	"			.85		87	
40	"	Qz grey to clear, Qz stockworks variable	Bio. books pyritized Qz veins thicker than	3	"			.77	.0098	100	
50	"	47' - slickensides @ 50°	above - eg. 5mm dia. + @ 15°-20°	3	"			.77		100	5(
60	"	strong Qz stockworks	Few mass. sulphide veins ± 4mm @ 10°	3	"			.56	.0062	94	
70	"	Dk green Tourmaline (?) clusters radiat. xls	↑ 15 cm brecciated, with sulphide + Qz + calcite	3	"			.38		95	
80	"	Med. light grey to med. dark grey.		3	"			.43	.0058	89	
90	"	Hydrothermal biotite	Qz + sulphide vein @ 0°	4	"			.51		96	
100	"	95 - Rock matrix thoroughly seri, but biotite dk green ① Books &	Cp + Py in diss. & veinlets	4	"			.70	.0112	67	10(
110	"	② fine grained, including veinlets of ± 0.1mm biotite flakes.	Mi. MoS_2 in Qz vein	3	"			.61		80	
120	"	Feld. well-sericitized (soft) but matrix much less altered.	Cp > Py. Local mag.	3	"			.51	.0122	40	
130	"	Qz stockworks ± gone by 130'	Very mi. MoS_2	3	.			.87		42	
140	"	Gypsum starts at ± 130' " veinlets ± 1mm,	Py + gyp. on joints	2	"	Back up Cu: .25		.31	.0051	95	
150	"	gen. @ 80°-90° to core	Cp + hem. diss. in matrix	3	"			.38		97	

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date

FIELD COORDINATES			SURVEYED COORDINATES			Sheet 2 of 2
Lat.	Elev.	Dip	Lat.	Elev.	Dip	Hole No. 87-13
Dep.	Depth	Bearing	Dep.	Depth MIF	Bearing	

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au	RQD	Libw
150-160	% 100	BFP Med. light grey	Cp + Py cut, to end	2	41			.31	.0049	0	
170	"	Badly broken 150' ± 172' Some fractures in ± 50°-65° range	Diss, & frac. fillings	1	"			.29		0	
180	"	150-172 - Feld. mod. seri. Matrix appears little alt.; hard Bio: ① Coarse books ② fine, dk green		1	"			.25	.0081	82	
190	"	Very pale orange to light olive grey 182-204 Qz Stockworks	Late stage white Qz + CaCO3	2	"			.40		78	
200	"	Rock includes some Qz vein frags. Prob. xenoliths rather than Bx	veins cut grey Qz + cp. MoS2 - mi, Dark purplish Qz + Py + Cp	2	"			.42	.0091	100	20
210	"	204' irregular contact, base of	Few ± 1.5 cm Qz veins + sulphides trend down core	4	"			.60		97	
220	"	Stockwork zone @ ± 35° to	1.5 cm Q + sulphide vein @ 30°	2	"			.50	.0097	97	
230	"	Medium grey to med.	1 cm sulph. + Qz vein @ 0° for 2'	3	"			.47		100	
240	"	light grey	Sulphide frac. fill. > diss.	2	"			.44	.0101	100	
250	"	Hydrothermal bio. continues	cp diss., Spec. diss.	3	"			.61		100	25

Dip test 160' - 47.5°

noranda MINES LIMITED BELL COPPER DIVISION

Collared 18/8/87	Completed 19/8/87	Core Size NQ	Logged by A. LORSA	Project No	Date 19/8/87
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 1 of 1
Lat.	Elev.	Dip - 45°	Lat. 15,019.3	Elev. 2588.8	Dip 45°
Dep.	Depth	Bearing	Dep. 24,134.0	Depth 160'	Bearing S 42°30'E

Hole No. 87-14

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au
0 - 130		CASING Brownish red to							
		Blackish red to dk grey	Hematitized (red) in part.						
140	75	TUFF incl. Lapilli. Felsic	Pyrite - veinlets &	<1				.01	.0009
		143' contact @ 55°							
150	100	VOLCANIC BRECCIA	disseminations incl.	<1				.01	.0015
		greenish grey to light							
160	60	greenish grey, Chlorite.	very fine grained.	2				.00	
END		Fragments include	Calcite veinlets <1mm						
		green grey to red grey							
		tuffs, angular to	Magnetite in tuff but						
		subrounded	not in breccia						

SEE-MOORE PRINT - SMITHERS FORM #103

Dip test 400' - 47.5°

noranda MINES LIMITED BELL COPPER DIVISION

Collared 20 Aug 87	Completed 21 Aug 87	Core Size NQ	Logged by A. L'ORSA	Project No	Date 20 Aug 87
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 1 of 2
Lat.	Elev.	Dip -45°	Lat. 15,486.6 / Elev. 2537.9	Dip 45°	Hole No.
Dep.	Depth	Bearing	Dep. 23,077.2 / Depth 530' M.F.	Bearing S 0°22' W	87-15

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au		Ro... Libr...
0 - 150		CASING 80' left in hole			11						
150 - 260		CLAY Black to brown			11						
270	100	Qz flood. + stock. to 265' BFP Med. light grey to dk greenish grey	Pyrite is the dominant	3	41			.01	.0014		
280	96	Few feldspars ≤ 5 mm chlorite. Incipient seri. bio.	sulphide by far & occurs throughout	2	"			.01	.0026		
290	100	Fe oxides 280-293 FAULT @ 35°, gouge.	as disseminations & fracture fillings.	1	"			.13			
300	"	Mafics chloritized - mi. seri. Feld. show slight sericite.	Chalcopyrite is present	< 1	"			.02	.0014		30
310	"		in small amounts. Hematite occurs mainly	< 1	"			.01			
320	"	Fault @ 35° marks top. BRECCIA 320' - 530'	as specularite.	< 1	81			.02	.0011		
330	"	Explosion. May be discontinuous. Qz. flooding intense	cp + py + Qz veinlets	2	"			.03			
340	"	Med. light grey is general colour Frags. hi. seri. BFP (?) angular	341 Red-orange Zeolite (?)	5	"			.04	.0012		
350	70	to rounded. Matrix = translucent grey Qz.	specularite, diss. Sulphides mostly in frags.	"	"			.00			
360	100	Stockworks — " —	little in Qz - but a few py veins cut both.	"	"			.00	.0019		35
370	"	Qz variable but high to EOH	Red-orange Zeolite (?)	3	"			.01			
380		Some Bx frags. not rotated	cp - local & minor Py - diss > veins (rare & < 1 mm	5	"	Back up Cu = .01		.01	.0012		
390		Mi. Post-sulphide Shearing Generally broken core throughout hole.	Small py veins cut hem. veins 388-395 Spec., diss. & common but little py.	2	"			.01			38

SEE-MOORE PRINT . SMITHERS FORM #108

noranda MINES LIMITED BELL COPPER DIVISION

Collared	Completed	Core Size	Logged by	Project No	Date
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 2 of 2
Lat.	Elev.	Dip	Lat.	Elev.	Dip
Dep.	Depth	Bearing	Dep.	Depth MIF	Bearing

Hole No. 87-15

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	~~Est~~ Grade	Sample No.	Lt.	% Cu	OPT Au		Lib
390 - 400	100	Bx continues to end. Med, light grey	Pyrite, vugs + xls	3	81			.01	.0017		
410		Qz flooding + stockworks	common throughout	"	"			.02			
420		Few vol.? dyke? frags. Sericitization continues		2	"			.02	.0019		
430		Hematitized sections carry less Qz & less sulphide.	Sections of strong hematitization. Local vugs + pyritohedra + Qz xls.	1	"			.02			42
440				1	"			.01	.0012		
450		± Quartz-sericite rock	Mi. Marcasite (?)	3	"			.01			
460				5	"			.01	.0017		
470				"	"			.01			
480		473-474 FAULT + gouge Top @ 20° Base @ 40°	Py diss. > veins	3	"			.01	.0022		
490			commonly - ± No gangue. Py veins ≤ 5mm dia.	4	"			.01			
500		Frags, sericitized, are still porphyries, but several.	xls common throughout	3	"			.02	.0024		
510		Mi. rust on fractures	specularite → less Py	2	"			.02			
520		Weak Qz stockwork		"	"			.01	.0016		
530		Tourmaline (?) dk green, radiating acicular xls. clusters ± 1mm	Cp - minor - diss.	"	"			.01			53
		Bx re-brecciated with reddish hematite & Qz matrix.									

noranda MINES LIMITED BELL COPPER DIVISION

Collared 27/8/87	Completed 27/8/87	Core Size NQ	Logged by A. LORSA	Project No	Date 27/8/87
FIELD COORDINATES			SURVEYED COORDINATES		Sheet 1 of 1
Lat.	Elev.	Dip 90°	Lat. 14,598.9 / Elev. 2563.5	Dip 90°	Hole No.
Dep.	Depth	Bearing	Dep. 23,260.6 / Depth 140' MIF	Bearing —	87-16

Footage	Rec'y	Rock Type/Alteration	Mineralization	% Sulp.	Est. Grade	Sample No.	Lt.	% Cu	OPT Au		Lib
0 - 110		CASING			MIF 11						
120	100	Volcanic rocks of the	• Py in diss. & fracture	4	31			.01	.0007		12
130	"	outer, propylitized, zone.	fill ings; locally in	4	"			.01	.0009		
140	"	Includes andesitic & felsic	thin quartz veins.	4	"			.01			14
		pyroclastics. A lapilli	Locally ± 3% of py								
		tuff was noted.	occurs in very fine								
		The rocks vary in colour	(<0.1mm) diss.								
		from medium dark grey	• Cp is diss. in minor								
		to dark greenish grey to	amounts.								
		greyish green & greenish	• calcite in frac. fill ings								
		black.	≤ 1 cm.								
		Epidote & chlorite are									
		present.									

GEOLOGICAL ASSESSMENT OF THE KETZA LAKE AREA
SOUTH OF THE BELL MINE
ON THE NEWMAN PENINSULA,B.C.

C.J.KLOEREN- OCT. 1987

NORANDA MINERALS INC.

GEOLOGICAL ASSESSMENT OF THE KETZA LAKE AREA
SOUTH OF THE BELL MINE
ON THE NEWMAN PENINSULA, B.C.

Submitted by : C.J.Kloeren
Chief Geologist
NORANDA MINERALS INC.
Mines Gaspe Division
Murdochville, P.Q.
GOE 1WO

October 1987

SUMMARY

Geological mapping, immediately to the south of the Bell mine tailings pond, failed to identify relevant hydrothermal alteration and copper mineralization. Consequently, no further mining exploration work is recommended on this part of the Newman peninsula.

INTRODUCTION

The mapped area is centred approximately seven kilometres north of the town of Granisle and four kilometres south of the Bell pit. The most recent geological maps, adjacent to the south and north of the present mapping, were done by P.McCarter (1981) and by D.J.T. Carson et al. (1976) respectively, of Noranda Exploration Co.Ltd. The present mapping fills the gap between the 1976/1981 campaigns. It concentrates on the recently logged ground east of the axis Ketza lake - Tailings disposal lake and on the shores of Babine lake.

REGIONAL GEOLOGY

Jurassic volcanic rocks of the Hazelton Group are the oldest rocks exposed on the Newman Peninsula. They are intruded by Eocene stocks, dikes and sills of Biotite-Feldspar-Porphyre (BFP) and overlain by volcanic BFP-equivalents. The intrusive rocks have been localized by a system of NNW-trending faults and by a subsidiary set of NE-trending faults (McCarter 1981). The NNW-striking Newman fault, which cuts through the Bell copper deposit, the South Newman alteration halo and the Granisle copper deposit parallels the overall trend of the easterly shore line.

LOCAL ROCK UNITS

The mapped area is underlain by intermediate to felsic volcanic rocks of the Jurassic Hazelton Group and by members of the Eocene Babine Igneous Suite of intrusive and volcanic rocks (fig.1).

Hazelton Group rocks are exposed immediately to the east of Ketza lake. According to Carson et al.(1976), the rocks are light green flows, aquagene tuff, lapilli tuff and breccia that contain clasts of chilled, microporphyritic and amygdaloidal basalt and minor rhyolite. These rocks have a fine, green, dense aphanitic matrix of chlorite, epidote, calcite and prehnit. Few flows are amygdaloidal and bedding is massive except in the finer tuffaceous units. Dark green argillite, interbedded with siltstone, was observed in the most northerly outcrops of the group.

Three main types of **Eocene Babine Igneous rocks** are found in the mapped area : **Rhyodacite** intrusions to the NE, **Biotite-Feldspar-Porphyry (BFP)** stocks or sills SW and NW of Ketza Lake and **Pyroclastics** which are most plausibly the extrusive equivalents of the Rhyodacite and BFP intrusions (Carson et al.1976).

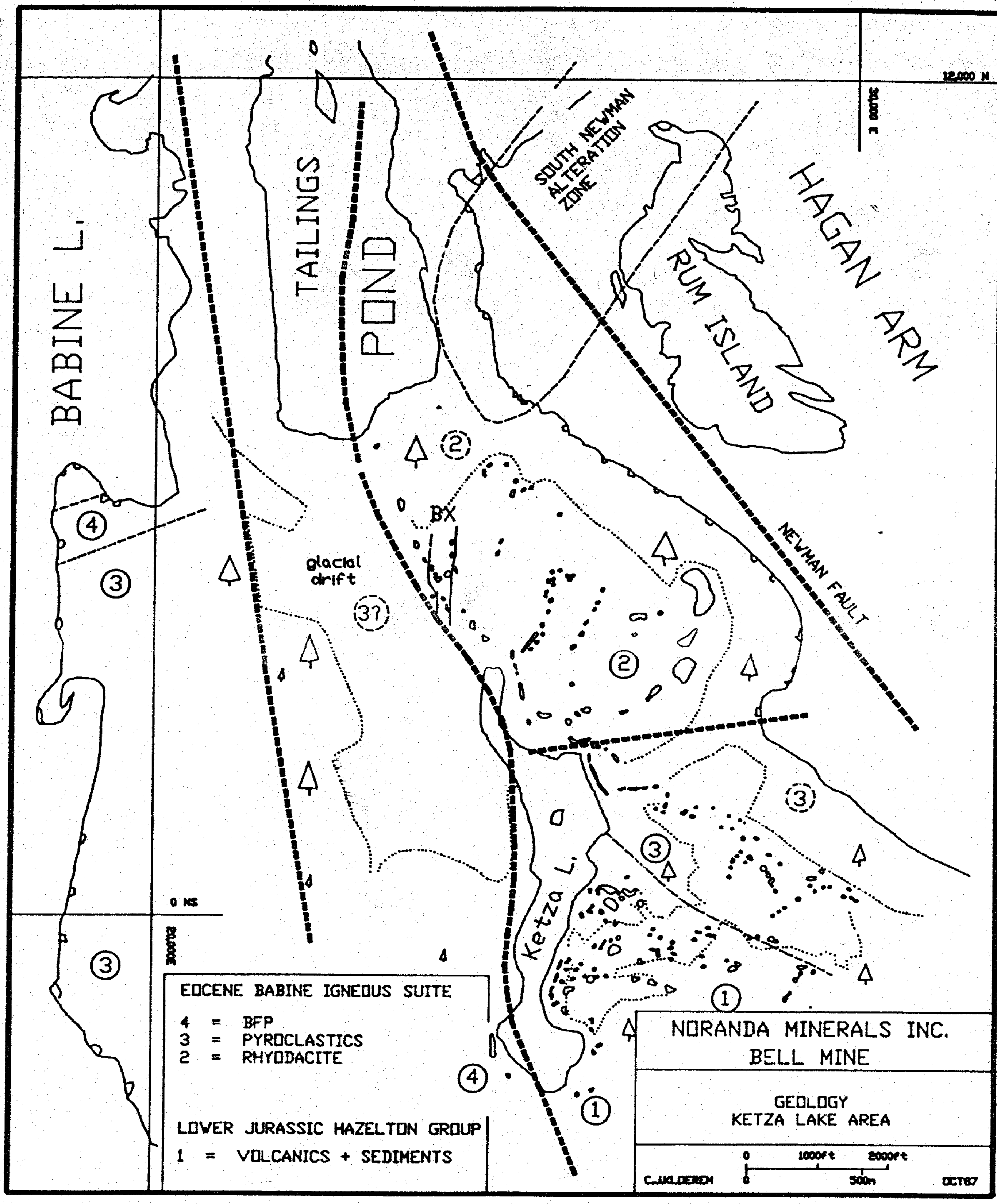


fig.1 : 1987 Geological Mapping

LOCAL STRUCTURES

Two of the NNW-trending faults, observed by Carson in the Bell mine area, are interpreted to continue through the mapped area. The westerly fault is represented by a valley. The easterly fault is believed to be located, from north to south, under the slope west of the most westerly line of rhyodacite outcrops, near the westerly Ketza lake shore line, and between the BFP - Hazelton group outcrops to the south of Ketza lake. A N83E trending fault is interpreted to mark the contact between the Eocene pyroclastics and rhyodacites. The fault's shearing can be observed in the partly washed out road gully, immediately NE of Ketza lake.

ALTERATION AND MINERALIZATION

The most significant alteration and mineralization observed is extensive, late carbonate veining together with pyrite and trace copper sulfides in the rhyodacites on the shore line immediately to the east of the Bell mine tailings pond. The shore line outcrops are located in the SW part of the South Newman alteration zone (Jambor 1974). Beyond its boundary, in SW direction, only minor to moderate sericitization,chloritization and little silicification was observed with local traces of pyrite and with oxide filled fractures (breccia zone). Beth Clemson, of Noranda Exploration Co., has compiled a summary (appendix) of petrographic observations on eleven thin sections of "rhyodacite" samples of the area (fig.2).

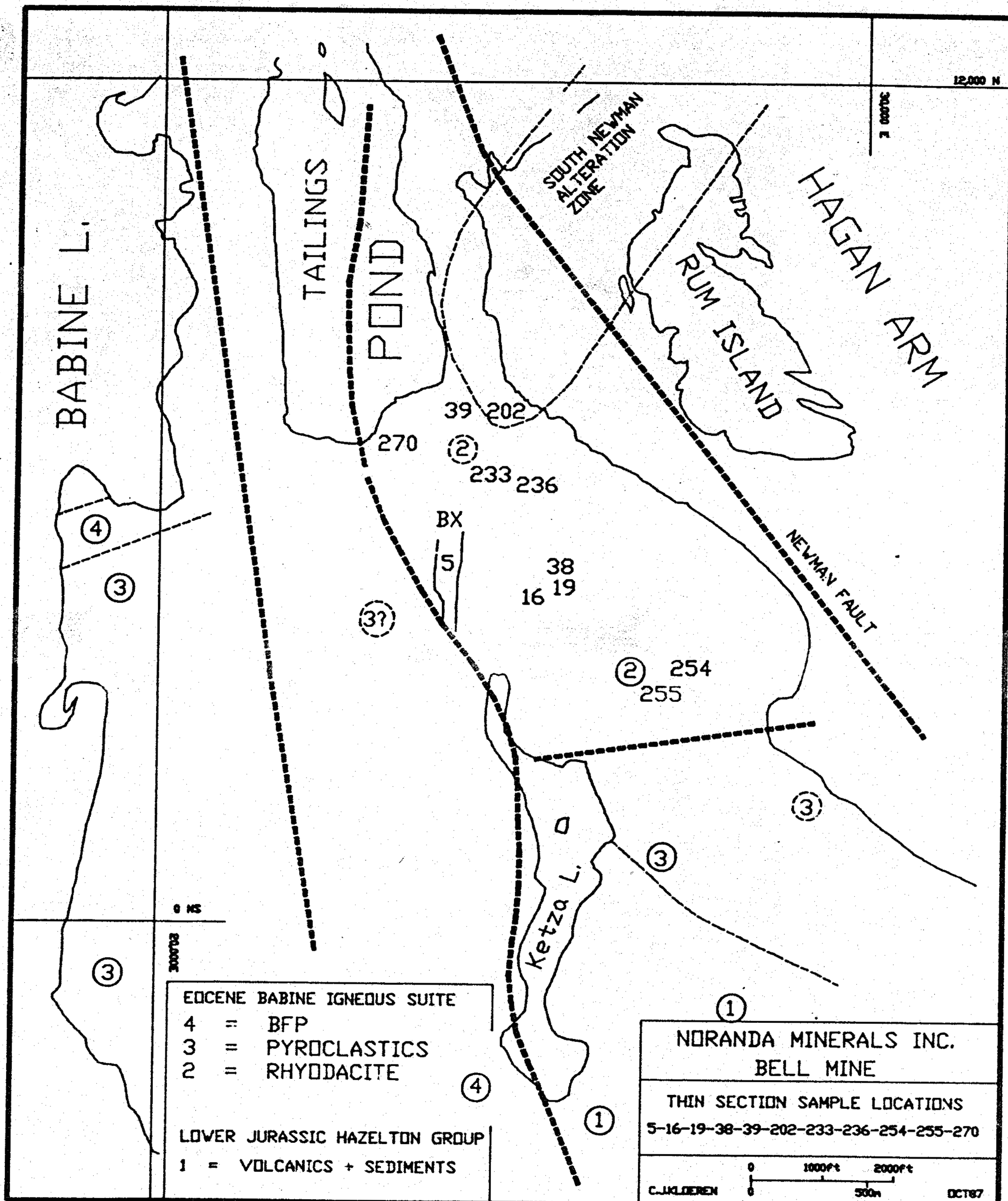


fig.2 : Thin Section Sample Locations

RECOMMENDATION

The geological mapping has not outlined new outcrops with hydrothermal alteration and mineralization that might suggest the presence of a deposit comparable with the Bell and Granisle porphyry copper deposits. To become economic, this type of low grade copper deposit has to be located close to surface. If that is the case, such a deposit normally can be recognized by means of a characteristic pyrite halo measuring more than 1500m in diameter. Unfortunately, no such halo was found in the easterly area where outcrops are abundant. With regard to the westerly area, where glacial drift is covering most of the bed rock, it is difficult to imagine that a halo could be hidden without being visible locally on the Babine lake shore line. Consequently, no further exploration work is recommended on this part of the peninsula.

REFERENCES

Carson,D.J.T. et al., 1976 : Bell Copper:Geology,Geochemistry and Genesis of a Supergene-Enriched, Biotitized Porphyry Copper Deposit with a Superimposed Phyllic Zone,CIM Spec.Vol.15

Jambor,J.L.,1974 : Trace Element Variations in Porphyry Copper Deposits, Babine Lake Area, B.C., GSC 74-9

McCarter,P.,1981 : Geology and Geochemistry of the Mac and Pen Mineral Claims South Newman Peninsula, Assessment Report, Noranda Exploration Company Limited

APPENDIX

September 30, 1987

MEMO TO: Chris Kloeren

FROM: Beth Clemson

SUBJECT: Bell Copper Samples
Summary of Petrographic Observations

Thin Sections of the Bell Copper samples were examined in transmitted light using a microscope. The mineralogy, alteration products and textural features are briefly summarized below. The rocks range from porphyritic to fine-grained extrusive volcanic flows which ranged from dacite to quartz latite to rhyodacite in composition. The sections were not stained and therefore the presence of postassium feldspar can only be roughly estimated.

SAMPLE 255

Feldspar Phenocrysts

- euhedral, up to 3 mm in size
- occur as single lath-shaped crystals and in glomeroporphyritic aggregates up to 8 mm in size
- plagioclase moderately twinned - albite and carlsbad
- the margins of some grains appear to be zoned
- much of the plagioclase is dusty-looking
- Plagioclase is altered - most frequently replaced by patches of irregular carbonate, trace sericite, coarser muscovite, chlorite, sphene, plus minor opaques and oxides
- chlorite has blue birefringence and is green in colour
- chlorite-carbonate alteration of plagioclase is relatively minor, but generally present for all phenocrysts
- the phenocrysts appear to be perthitic

Groundmass

- the feldspar phenocrysts are randomly orientated in a fine-grained matrix of albite, chlorite, plus minor quartz
- the groundmass laths may locally be orientated in a subparallel manner
- minor constituents include chlorite, quartz, sphene, calcite and opaques
- the groundmass feldspar laths are cloudy & buff coloured and relatively unaltered (i.e. not replaced by carbonate), but there is a fair bit of chlorite occurring interstitial to feldspar and in somecases may be replacing feldspar along twin planes
- some minor quartz (interstitial to plagioclase) occurs in irregular equant grains.
- chlorite and quartz commonly replacing primary

hornblende (have a hexagonal outline)
- rock characterized by a low content of primary biotite and hornblende

Opaques
- no sulfides, no pyrite
- abundant irregular hematite and sphene are scattered throughout

Alteration
- minor chlorite-carbonate alteration of feldspar, hornblende and biotite

BELL 39

Phenocrysts
- the sample contains up to 30% subhedral phenocrysts of feldspar
- the rock is glomeroporphyritic (phenocrysts are intergrown)
- the feldspar phenocrysts appear to be perthitic
- the feldspar is somewhat dusty and commonly contains irregular patches of oxide
- very little chlorite alteration of feldspar (as seen in 255)
- the feldspar phenocrysts are weakly to moderately sericitized and are characterized by irregular patches of oxides
- no carbonate observed replacing feldspar
- no primary hornblende or biotite observed
- trace primary biotite replaced by muscovite, oxides and sphene

Groundmass
- the groundmass is extremely fine-grained
- it consists of an interlocking mosaic of feldspar and quartz
- groundmass is generally devoid of any euhedral or subhedral grains
- the groundmass is slightly sericitized
- irregular patches of disseminated oxide occur in the groundmass
- contains disseminated grains of sphene and zircon
- minor, irregular patches of quartz occur in the groundmass
- no sulfides
- main oxide is goethite which has brown to ochre internal reflections

Alteration
- minor to moderate sericitization of feldspar phenocrysts and minor sericitization of groundmass feldspar

BELL 202A

- the rock is extensively altered
- alteration in the form of an anastomosing network of veinlets of fine carbonate
- irregular patches of carbonate occur along fractures, grain boundaries and in veinlets
- the carbonate veining appears to be late - i.e. crosscuts and parallels earlier quartz veins
- the carbonate veinlets cut across some pyrite aggregates
- the host rock is composed of mainly feldspar and quartz
- feldspar occurs in anhedral, untwinned, lath-shaped grains with serrated margins; subgrains occur along the margins
- feldspar has undulatory extinction; rock looks slightly deformed
- the host rock to the veins is slightly cloudy but the feldspars are not sericitized, carbonatized or chloritized

Opaques
- Pyrite occurs as disseminated euhedral and subhedral grains, some are fractured & fragmented
- Chalcopyrite, Bornite, Chalcocite, Covellite } single grain - bn + cc replacing cp

Alteration
- extensive, late carbonate veining (+pyrite and trace copper sulfides)

BELL 254

- fine-grained, massive
- microporphyritic feldspar phenocrysts up to 1/2 mm long occur in a fine matrix of feldspar and quartz
- all the feldspars including the matrix feldspars are dusty and clouded in appearance
- a few phenocrysts are weakly sericitized
- the matrix shows no preferred orientation
- composed of albite twinned laths of plagioclase
- all ferromagnesian minerals have been replaced by fine-grained aggregates of pale green chlorite with blue birefringence
- chlorite commonly preserves the euhedral outline of hornblende
- chlorite also occurs in small patches in the matrix interstitial to the fine-grained laths of plagioclase
- abundant disseminated sphene
- minor carbonate is present, particularly in and around microfractures
- carbonate was not observed replacing ferromagnesian

minerals
- trace pyrite has been oxidized to hematite

Alteration
- moderate chlorite alteration of primary hornblende
- the rock is characterized by a low primary mafic mineral content
- minor chloritization of feldspathic groundmass

BELL 233

- the sample is fine-grained and characterized by numerous irregular, disseminated grains of oxide (may be hematite + geothite)
- These oxides occur along grain boundaries replacing feldspar phenocrysts (in patches and along irregular fractures)
- the rock is microporphyritic, feldspar phenocrysts are just visible to the eye
- the rock contains 15% phenocrysts up to 2.5 mm in size, the bulk of them are in the Ø.5 mm size range
- the phenocrysts occur in a fine-grained matrix of feldspar and quartz
- in the matrix laths of cloudy feldspar are surrounded by quartz
- rich in quartz - contains euhedral crystals as well as overgrowths on feldspar
- no sulfides
- trace sericite

Alteration
- little alteration observed

BELL 16B

- microporphyritic - contains 1Ø% scattered phenocrysts of feldspar
- phenocrysts range up to 3 mm in size, most in the 1/2 mm range
- the phenocrysts are euhedral and subhedral and appear to be perthitic
- minor oxides (yellowish orange; probably goethite) occur throughout the section and partly replace feldspar
- minor colourless to pale green chlorite with grey interference colours partly replaces feldspar phenocrysts along fractures
- the feldspar pheonocrysts occur in a fine "felted" matrix of lath-like feldspar grains and minor interstitial quartz
- the feldspar laths are orientated in a subparallel manner
- quartz may form rims or halos to the laths of feldspar (similar to 233)

- disseminated oxides throughout groundmass occurring along fractures replacing feldspar
- minor very pale chlorite occurs in matrix, may be stained pale yellow from nearby oxides

Alteration

- little alteration observed

BELL 270

- the rock is extremely rich in quartz (in comparison with the other rocks) - contains approximately 25%
- the rock contains abundant quartz microphenocrysts up to 0.5 mm in size in a matrix of fine, felted plagioclase needles and laths
- most of the quartz phenocrysts are single crystals, some of the larger grains are polycrystalline
- the feldspar in the matrix is orientated and intergrown in a subparallel manner wrapping around phenocrysts
- there are some minor lath-like grains that are replaced by abundant fine-grained disseminated opaques
- the matrix feldspar appears to be albite
- fine-grained colourless chlorite occurs in the matrix
- there are several long bladed grains (which may have been hornblende) which are replaced by chorite, sphene and carbonate
- rock is very siliceous
- very little mafic minerals

Alteration

- trace primary mafic minerals are replaced by chlorite
- minor chloritization of groundmass
- overall alteration is minor

BELL 5

- very fine-grained
- rich in quartz, composed of up to 20-25% crystals of subhedral, hexagonal quartz crystals up to 1/4 mm in size
- some of the quartz has euhedral outlines
- the quartz grains are scattered throughout the rock which consists of randomly orientated laths and aggregates of feldspar and minor chlorite
- the feldspar is cloudy
- minor quartz may rim the margin of feldspar
- colourless, very fine-grained aggregates of chlorite (grey birefringence) occur along grain margins & partly replace feldspar
- a lot of the fine-grained chlorite is developed along the fractures which carry oxides
- moderate sericitization of feldspars
- no primary mafic constituents
- chlorite appears related to microfractures

- similar to the rocks which have quartz mantles on groundmass blades of feldspar

Alteration
- minor to moderate sericitization of feldspar laths
- minor chloritization of fine-grained groundmass
- chlorite developed along fractures

BELL 38

- non-porphyritic
- very fine-grained
- very uniform in texture
- contains numerous round quartz-filled vescicles
- rock consists of a microcrystalline plagioclase (k'spar?) and quartz
- all grains are anhedral to subhedral
- some plagioclase grains are lath-shaped
- quartz is interstitial to plagioclase
- abundant finely disseminated oxides
- the rock has been pervasively but weakly sericitized, needles of sericite occur along grain boundaries and locally small patches of sericite may completely replace plagioclase
- no sulfides
- minor disseminated sphene

Alteration
- weak, pervasive sericitization of feldspar

BELL 236

- micropophyritic, contains only minor fine plagioclase microphenocrysts
- contains irregular patches of quartz which may represent quartz-filled vescicles
- consists of minor plagioclase phenocrysts in a very fine, felted network of elongate laths of plagioclase plus quartz and chlorite
- the plagioclase phenocrysts have been almost totally replaced by fine-grained sericite
- the finer feldspar in the matrix is partly (i.e. 50%) replaced by an extremely fine network of sericite
- chlorite occurs interstitial to plagioclase
- chlorite is colourless with a slight brownish tint
- no sulfides
- abundant oxides - goethite
- minor disseminated sphene

Alteration
- intense sericitization of plagioclase

SAMPLE 19

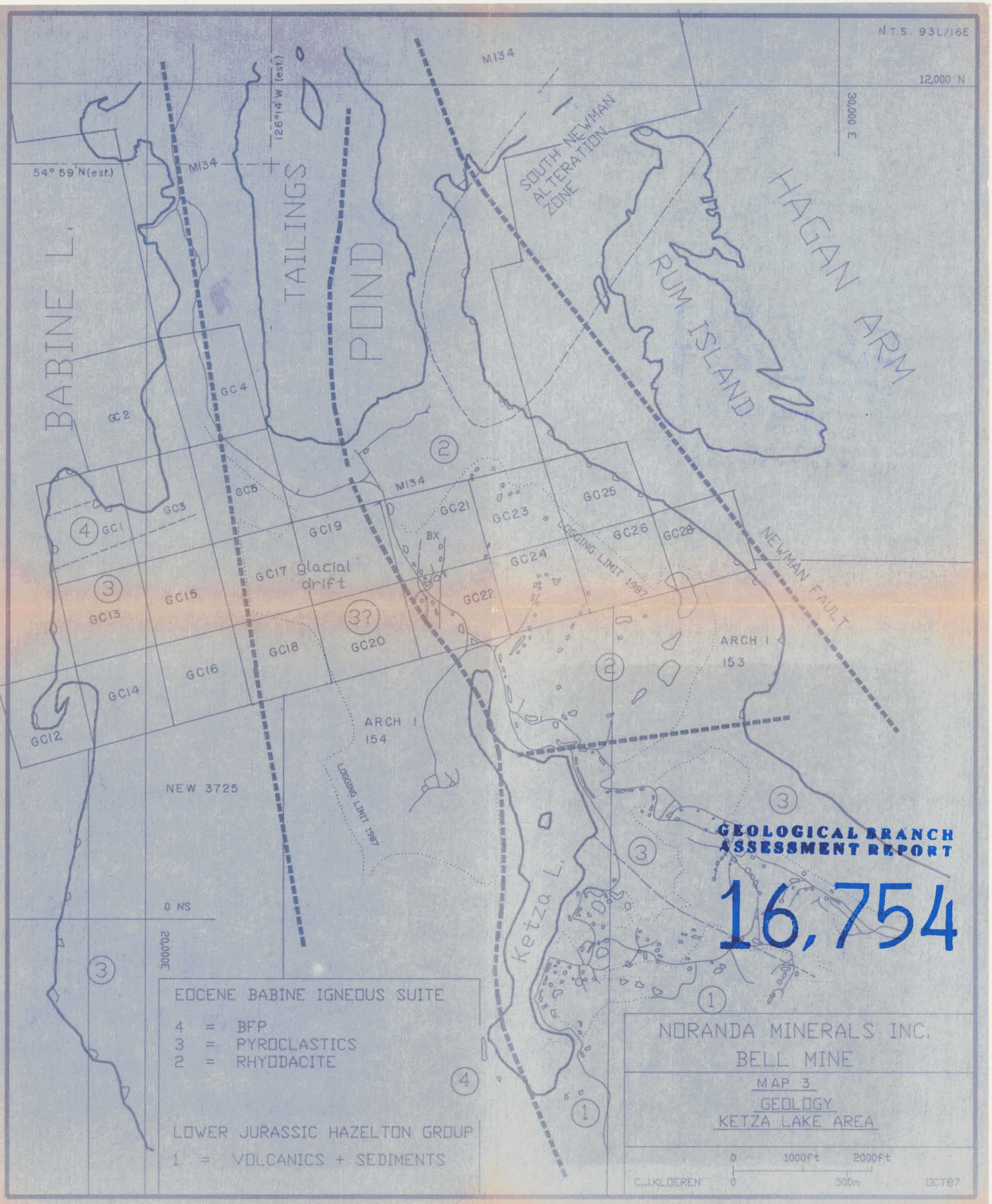
- very fine-grained
- non-porphyritic
- contains minor, irregular disseminations of hematite and goethiite
- rock consists of anhedral intergrown quartz and feldspar
- feldspar blades and patches appear to be enveloped by patches of optically continuous quartz
- textures suggest that the rock may have consisted of mainly feldspar laths and has been subsequently silicified
- minor relict disseminated pyrite, now partly oxidized
- pyrite occurs in the cores of hematite grains

Alteration

- silicification

7

ATTACHED
MAPS



N.T.S. 93L/16E
12,000 N
30,000 E
M134
54° 59' N(est.)
126°14' W (est.)
TAILINGS POND
BABINE L.
SOUTH NEWMAN ALTERATION ZONE
HAGAN ARM
RUM ISLAND
NEWMAN FAULT
GC1
GC2
GC3
GC4
GC5
GC12
GC13
GC14
GC15
GC16
GC17 glacial drift
GC18
GC19
GC20
GC21
GC22
GC23
GC24
GC25
GC26
GC28
BX
LOGGING LIMIT 1987
ARCH I 153
ARCH I 154
NEW 3725
0 NS
20,000E
Ketza L.
GEOLOGICAL BRANCH ASSESSMENT REPORT
16,754
EOCENE BABINE IGNEOUS SUITE
4 = BFP
3 = PYROCLASTICS
2 = RHYODACITE
LOWER JURASSIC HAZELTON GROUP
1 = VOLCANICS + SEDIMENTS
NORANDA MINERALS INC.
BELL MINE
MAP 3
GEOLOGY
KETZA LAKE AREA
0 1000ft 2000ft
0 500m
C.J.KLOEREN
OCT87


Hogan Arm
N.T.S. 93M/1E
N.T.S. 93L/16E
55° 00' N (est)
HS 15 M.C.
HS 16 M.C.
VIEW 1 Fraction M.C.
Rum Island
Rum Bay
Newman Peninsula
CG 27 M.C.
CG 26 M.C.
CG 25 M.C.
CG 24 M.C.
CG 23 M.C.
22
CG 21 M.C.
CG 19 M.C.
CG 17 M.C.
CG 5 M.C.
CG 4 M.C.
CG 15
CG 3 M.C.
CG 2 M.C.
CG 1 M.C.
M 134
M 135
TAILINGS IMPOUNDMENT AREA
North Dump
87-14
87-2
87-3
87-16
87-1
87-15
87-6
87-11
87-12
87-4
87-5
87-7
87-8
87-9
87-10
87-13
126° 14' W (est)
28,000 E
26,000 E
24,000 E
22,000 E
20,000 E
18,000 E
Newman Island
Babine Lake
LEGEND
D.D. Holes in Grant Application
87-10
Mineral Lease Boundaries
Located Claim Boundaries
Scale 1 in. = 500 ft.
0 500 1000 1500 2000
GEOLOGICAL BRANCH
ASSESSMENT REPORT
16,754
maclaren FOREST PRODUCTS INC.
BABINE MINING DIVISION
MAP 2 BELL MINE
General Location Plan Showing Diamond Drill Hole Collars and Mineral Lease and Claim Boundaries for:
ACCELERATED MINE EXPLORATION PROGRAM - Number 10963-M15
SCALE 1" = 500'
DATE FEB. 9, 1988
DRAWN BER
DRWG. No.