## 

## REPORT

ON

## LETAIN CREEK PROPERTY

## N.T.S. 104I/7E

March 10, 1978
B. W. Downing

Vancouver, B. C.

The Letain Creek Property (held by Wesfrob Mines Limited during the period when the woik was carried out) is situated approximately 700 miles N.N.W. of Vancouver (latitude $58^{\circ} 18^{\prime}$, longitude $128^{\circ} 40^{\prime}$ ) in the Liard Mining District.

The geological settting is one of complexity involving the folding and faulting of six rock units of Mississippian to Permian age - serpentinized peridotite, gabbro, siltstone, sandstone, sericite schist/metarhyolite, and basic tuffs. Metamorphism is of the lower greenschist facies.

Several high copper silt values occur predominantly in three areas, as do anomalous copper soil values. Zinc values are quite low. Geophysical surveys (I.P., EM 16, EM 17, magnetometer) outlined six anomalous areas which coincide with the geochem anomalies. Three of the anomalies were tested by four drill holes. No significant mineralization was encountered in any hole.

## RECOMMENDATIONS

1. The actual source of the copper contributing to the high . anomalous silt and soil values has not been located. Further geochem work should be done in order to define further the geochemistry of the area and hopefully the ultimate copper source. Rock geochemistry should be done; for example, Na and $\mathrm{SiO}_{2}$, and Cu and Zn analyzed for using assay pulps and outcrop samples. This would indicate any Na and $\mathrm{SiO}_{2}$ depletion and/or increase in the rocks and give background data pertaining to Cu and Zn values. This data would help in the interpretation of mineralization in the area.
2. More soil pits should be dug and sampled and mapped properly to define further the soil geochemistry.
3. The other geophysical anomalies should be drilled and the anomaly at line 80 E drilled in a southerly direction. Because this area may not be a Kutcho Creek type deposit, it should not be dismissed as it maybe of another type (i.e. different geological setting, age, etc.).

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## LETAIN CREEK PROPERTY

## 1. INTRODUCTION

Interest in the area began in 1976 when several copper showings were found by prospector A. Jensen, and subsequently examined by the company geologists. The showings proved to be small chalcocite veins in serpentinized peridotite, but of more interest were the nearby siliceous schists which appeared to be similar to those at Kutcho Creek, Imperial Oil - Sumitomo's massive copper-zinc deposit approximately 12 miles to the southeast. The area was silt sampled and several anomalous copper values indicated. Thirty-six claim units were staked and a grid totalling 26 miles was cut in September-October. Adjoining property was optioned from A. Jensen and a base camp estab1ished in May, 1977 from which geophysical, geochemical and geological surveys were conducted. Four anomalous areas were subsequently drilled.
2. LOCATION AND ACCESS

The Letain Creek Property (1atitude $58^{\circ} 18^{\prime}$, longitude $128^{\circ} 40^{\prime}$; UTM coordinates Zone $9,646250 \mathrm{~N}, 523700 \mathrm{E}$; N.T.S. $104-\mathrm{I}-7 / \mathrm{E}$ ) is situated approximately 700 miles NNW of Vancouver or 50 miles east of Dease Lake in the Liard Mining District (Figure 1). Elevation ranges from 3500 to 5500 feet.


Access is by helcopter from the Dease Lake airstrip or by fixed wing aircraft to the Wolverine airstrip about four miles to the northeast of the Letain camp. The property may also be reached by a winter road from Dease Lake.

## 3. VEGETATION

The property occurs along the southern edge of Letain Creek in a low valley immediately north of the Spatsizi Plateau. Vegetation is sparse to moderately heavy in the valley and on the lower slopes to approximately the 4500 foot elevation. Above this, tree cover is sparse to absent.

## 4. CLAIMS

The Letain Creek area claim status is shown in Table 1. The claims are shown on Map 1 (see map pocket).

## 5. CLAIM AND TOPOGRAPHICAL SURVEY

In July, a partial claim survey of the Let, Tain, Lurk, Meg, Lisa, and Sul claims was conducted by Highe Surveys Limited, Terrace. The base line as well as six cross lines in the vicinity of the anomalies were surveyed for topographic profiling. The maps are shown in a separate report submitted by Highe Surveys.
6. GEOCHEMISTRY

The area has been well covered by silting of all creeks and seepages, while the grid was soil sampled (B. horizon) every

## TABLE I LETAIN CREEK AREA CLAIM STATUS

| Claim Name | No. Units | Recorded | Claim Status |
| :---: | :---: | :---: | :---: |
| LET | 16 | 7, Sept 1976 | 7, Sept 1981 |
| TAIN | 8 | 9, Sept 1976 | 9, Sept 1981 |
| CREEK | 12 | 9, Sept 1976 | 9, Sept 1981 |
| LISA | 20 | 10, May 1977 | 10, May 1978 |
| MEG | 20 | 10, May 1977 | 10, May 1978 |
| CITE | 6 | 10, May 1977 | 10, May 1978 |
| ANNA | 20 | 10, May 1977 | 10, May 1978 |
| WOOD | 20 | 5, July 1977 | 5, July 1978 |
| EYE | 20 | 5, July 1977 | 5, July 1978 |
| LURK | 8 | 5, July 1977 | 5, July 1978 |
| SUL | 4 | 1977 | (covered by the Meg claims) |

100 feet along the cut lines using 400 foot line intervals. Standards were included with approximately every 50 samples as an internal check. Duplicate soil samples were taken every tenth sample. Lead and silver analyses were corrected for background interference. Statistical analysis of the silt and soil data and method of analysis are presented in Appendix $I$.

### 6.1 Water/Silt Survey

Water samples together with silt sampling were collected by I Elliott from selected sites, Figure 2, in order to determine whether mineralization was being leached by acid groundwater and dumped onto the sediments and soils in the areas of seepage where high geochem values occur.
6.2 Silt Survey

Reconnaissance silt sampling done in 1976 (75 samples) showed several anomalous copper values. Detailed sampling was carried out in 1977 (260 samples). Sample locations and $\mathrm{Cu}-\mathrm{Zn}$ values are plotted on maps 1 and 2 respectively.
6.3 Soil Survey

A soil survey was conducted over the grid in hope of further delineating the anomalous areas. A total of 1816 samples


LEGEND


- Let $2=$ Woter $32070=$ Sediment

FALCONBRIDGE NICKEL MINES LTD.
PROPERTY: Lefain Creek
LOCATION: Dease Lako Area
TYPE OF MAP: Geochem Water G Sediment
BASED ON: Felldwork by ILEIHal
DATE OF WORK: Summer 1977
DRAWN BY: G.Thomassen January 1978
SCALE: $1^{\prime \prime}=1000^{\circ}$
N.T. S $=104-1-7$

Figure 2

TABLE 2. GEOCHEMICAL DATA PERTAINING TO FIGURE 2.
(analysis in ppm)

$\mathrm{CxCu}:$ cold extractable copper
were collected and analyzed for $\mathrm{Cu}, \mathrm{Pb}, \mathrm{Au}$ and Ag , the results of which are plotted on Map 3.

Lead and silver values are low with a few scattered highs (average $\mathrm{Pb}-10 \mathrm{ppm}$, average $\mathrm{Ag}-0.2 \mathrm{ppm}$ ).

A soil pit (L80E/0 +75 N ) was dug to test element distribution with depth (sampled at $0,1,2,3,4,5$ foot depths). Copper, zinc and lead values (see Map 3) are low and silver high at the surface. A sharp increase in $\mathrm{Cu}, \mathrm{Zn}$ and Pb and decrease in Ag occurs at the one foot level and generally remains the same to the bottom except for Cu which is higher at the four and five foot levels.

### 6.4 Rock Geochemistry

Four fresh rock samples were analyzed for $\mathrm{Cu}, \mathrm{Pb}, \mathrm{Zn}$ and Ag , the results of which are shown in Table 3. There are no significant values except possibly for LT6 which has a high of 27 ppm Cu.

### 6.5 Conclusions

The drainage in the map area is to the northwest with the majority of creeks draining from the hills bordering the property to the south and flowing onto glacial/fluvial debris which covers approximately 75 percent of the grid.

The map area has a rather large number of anomalous silts. The anomalous silt (copper) values form three dispersion shaped fans, in the southeastern (L 64 - 104E), northeastern (L 120-128) and southwestern ( $\mathrm{L} 16-40 \mathrm{E}$ ) sections of the grid. The later two drain serpentinite, the former drains predominantly metavolcanics and some of the serpentinite.

Anomalous soil (copper) values coincide with the anomalous silt values. Scattered highs also occur.

Copper values in the silts and soils are quite high and do not reflect the rocks where copper values are very low.

The high cold extractable to total copper ratio values (Table 2) are considered to indicate leaching of copper-bearing sulphides since the unmineralized rocks themselves do not carry abnormally high values. The low cold extractable zinc values suggest that very little zinc mineralization is present.

The copper silt and soil values have a bimodal distribution, while zinc appears to be unimodal. This maybe interpreted to suggest that zinc occurs as a rock mineral component whereas copper occurs both as a silicate component and as a sulphide.

## 7. GEOPHYSICS

Geophysical work consisted of MF1 magnetometer, EM 16, EM 17 and IP surveys. The magnetometer and electromagnetic surveys were conducted by $S$. Presunka and the IP survey by P. Smith. The magnetometer and EM 16 surveys were conducted over

TABLE 3. GEOCHEMICAL ANALYSES OF THE SILICEOUS AND BASIC VOLCANIC UNITS

Sample

| Cu | Pb | Zn | Ag |
| :---: | :---: | :---: | :---: |
| $(\mathrm{ppm})$ | $(\mathrm{ppm})$ | $(\mathrm{ppm})$ | $(\mathrm{ppm})$ |

1. albite-quartz porphyritic schist (5) 1
2. LT 2 - L100E/4S
3. R - boulder
4. LT 4 - L99E/12S
5. LT $6-L 96 E / 18 S$
the entire grixd while EM 17 work was conducted over the EM 16 anomalies:- The initial reconnaissance IP survey indicated several anomalies which were subsequently covered in detail. The results of the surveys together with the maps are written as separate reports by Presunka and Smith of which the texts are incorporated in this report in Appendices II and III respectively.

### 7.1 Conclusions

The magnetometer survey was useful in outlining the peridotite.

The EM 16 survey outlined seven conductive zones, the strongest (5) of which were delineated further by EM 17. The EM 16 also delineated zones that coincided with faults, shears, folds and contacts which were observed during the mapping.

Six anomalous zones were outlined by the IP survey which coincided with the EM 16 anomalies.
8. GEOLOGY

### 8.1 Introduction

The Letain Creek property was mapped at one inch to 200 feet based on the cut grid (Map 4), and reconnaissance work was carried out in the area adjacent to the property. The area has been mapped on a regional scale by the B.C.D.M. $(1: 1,000,000$,

Iskut River, Openfile Report 214, 1974). The G.S.C. was involved in mapping of the area this year, to further define the stratigraphy especially in the Kutcho Creek area.

### 8.2 General Geology

The property occurs within the Cassiar Mountains of the Omineca Intermontane Belt. The geological setting is one of complexity involving the folding and faulting of several rock units. Contacts between the various units are not exposed and in many places outcrop is quite broken and/or constitutes rubble. Outcrop in the northwestern part of the grid is sparse (5-10\%). Six major rock units were recognized and mapped and 19 thin sections prepared and studied. Since the regional geology has not been mapped in any detail, correlation of these units on a regional scale in not possible. According to the G.S.C., the mapped units belong to the Cache Creek Group (Mississippian to Permian age) while the ultramafic is either 1ate Paleozoic or early Mesozoic (time of emplacement). Metamorphism is of the lower greenschist facies.

### 8.3 Rock Units

### 8.3.1 Peridotite (Unit 1)

Peridotite outcrops on the eastern end of the property and was intersected in DDH 2 and 3. Regionally, it surrounds the map area. It is massive, medium-grained and serpentinized;
however, apparent layering was observed at one location. An irregular two to six inch wide chalcocite vein in serpentinite occurs at coordinates $109 \mathrm{E} / 2 \mathrm{~N}$; no other similar veins were observed. The serpenteinite is comprised of fibrous antigorite which contains abundant acicular grains of diopside. A colourless, fibrous amphibole appears as an alteration product of the clinopyroxene. The contact with units 5 and 6 appears to be sharp as no alteration was observed. Scattered boulders of serpentinite/peridotite and jade occur in the northern parts of the grid.

### 8.3.2 Gabbro (Unit 2)

An elongate, medium-grained equigranular hornblende gabbro plug (2a) outcrops at the western end of the property. At $10 \mathrm{E} / 3 \mathrm{~S}$, narrow proxenite lenses occur within the gabbro; however, their extent is not readily apparent. In thin section, the majority of the hornblende is altered to epidote with minor chlorite, while the plagioclase is heavily altered to sericite/ muscovite. No opaque grains were observed.

A narrow zone of medium-grained mafic gabbro (2b) outcrops in the southeastern part of the grid (L103E/42S).

A small outcrop of fine to medium-grained, equigranular diorite (2c) occurs at $96 \mathrm{E} / 19 \mathrm{~N}$.

### 8.3.3 Metasediments (Units 3 and 4)

Two narrow, metasedimentary units outcrop towards the western end of the grid.

Unit 3 (siltstone) is fine-grained, brown to beige in colour, and has a laminated texture in outcrop. In thin section, it is composed predominantly of quartz grains producing a mosaic texture with minor muscovite which occurs predominantly along the bedding/parting planes. Many of the beds are graded and weakly crenulated.

Unit 4 (sandstone) is thinly bedded, fine-grained, light grey to grey black and contains minor amounts of graphite. In thin section, the beds are crenulated and contain minor folds. Compositionally, this unit is composed of quartz with minor chlorite, muscovite and sphene. Iron staining occurs along many of the bedding/ parting planes as does muscovite.

### 8.3.4 Sericite Schist, Meta-rhyolite (Unit 5)

This fine-grained brown coloured unit occurs throughout the map area and varies from weakly to strongly schistosic and from meta-rhyolite to sericite schist.

From thin section, the meta-rhyolite contains blastoporphyritic grains of plagioclase and quartz up to three millimeters across (average one millimeter) in a fine-grained quartz-plagioclase matrix with minor muscovite/sericite. Minor epidote alteration
is associated with some of the plagioclase blastophenocrysts.
The sericite schist contains no blastophenocrysts but does have a pitted weathering surface; the scattered pits are somewhat elongate and parallel to the schistosity. Fine-grained quartzplagioclase - sericite/muscovite with scattered carbonate pits and scattered iron-stained fractures constitute the schist.

### 8.3.5 Basic Metavolcanics (Unit 6)

This unit comprises approximately 50 percent of the total outcrop area. It can be subdivided into three major subunits; namely, porphyrcblastic epidote schist (6a, 6b), porphyroblastic chlorite schist (6c) and amphibolite (6d). Subunits 6 c and 6 d occur as scattered outcrops throughout the metavolcanic unit.

The porphyroblastic epidote schist contains subrounded epidotized porphyroblasts in a fine=grained quartz-muscovitefeldspar (plagioclase) - chlorite matrix. The porphyroblasts appear to be lapilli, hence, this unit is a lapilli or crystal tuff. This unit can be further subdivided according to porphyroblast size; namely, unit 6 a with average porphyroblast $>1 \mathrm{~mm}$, and unit 6 b with average porphyroblast < 1 mm . In many places, the two sizes occur together and were mapped as unit $6 a$. Unit $6 b$ also contains a few plagioclase laths up to 0.05 mm to length. A small area of altered (chlorite alteration) unit 6 b outcrops south
of the baseline from line 64 E to 72 E . In thin section, this subunit ( 6 ba ) contains up to $\frac{1}{2}$ percent opaque grains as compared to the relatively opaque-barren subunits 6 a and 6 b .

Subunit 6c contains elongate chlorite porphyroblasts up to three millimeters in length parallel to the schistosity and epidote porphyroblasts up to one millimeter across in a finegrained quartz-muscovite-feldspar (plagioclase) - chlorite matrix.

### 8.4 Structure

The structural style of the map area is difficult to assess as there is not enough structural information available. Regionally, the property lies between two large faults, the Kutcho (transcurrent) fault to the northeast and the northerly dipping Nahlin thrust fault to the south.

Foliation is parallel to the strike of the units, with the average attitude being $146 / 50^{\circ} \mathrm{S}$ (poles to foliation are plotted and contoured, and shown on Map 4). Some dips are to the north and appear to be the result of displacement by faulting. Minor folds were observed, the fold axes of which when plotted on a stereonet (Map 4) are scattered but suggest a cluster trending to the southeast. In one location (L88E/7N), the relationship of foliation and folding was observed whereby the foliation was parallel to the axial plane of the fold possibly reflecting regional


Figure 9
Thrust foult
(See mop5 for geology)
folding. In several areas, the type of fold noted was chevron or isoclinal. Fold directions in outcrop appear to coincide with the EM 16 anomaly patterns in the eastern part of the grid.

The faults observed in the map area are readily apparent from the topography but the sense and amount of displacement could not be determined. These faults cut all rock units and do not appear to be thrusts. A southerly dipping thrust fault occurs immediately to the south of the southeastern part of the grid. (Figure 9). Two cross-sectional traverses were made over the fault (Map 5). A strong linear IP break occurs at location 60 to 80 E and 15S, in an area covered by talus. A possible explanation may be either a contact zone or fault (thrust) zone.

## 9. DRILLING

Four holes totalling 1237 feet were drilled (AQ core) to test four geophysical and geochemical anomalies (see Map 4). The drill logs and assays are presented in Appendix IV.
10. MINERALIZATION

Mineralization in outcrop is rather sparse and scattered with only three showings observed - northwestern end of the grid on Letain Creek (chalcopyrite - unit 6b), L91E/28S (chalcopyrite -
unit 5), and L109E/2N (chalcocite - Unit 1). The first two showings consist of scattered grains of chalcopyrite and pyrite over a small area, while the last showing is an irregular chalcocite vein in serpentinite. A polished thin section examination of the latter shows massive chalcocite penetrated by magnetite with minor replacement of the chalcocite by bornite. Minute hazelwoodite inclusions occur within the more blocky magnetite grains. Covellite and chalcopyrite are rare. No opaque grains were noted in thin sections of the gabbro, metasediments and metavolcanics except for the altered metavolcanics (subunit 6ba) which had up to $\frac{1}{2}$ percent in one sample.

Mineralization in the drill core consists of up to 1 - $2 \%$ disseminated blebs of pyrrhotite with minor pyrite and trace chalcopyrite. Irregular pyrite-pyrrhotite filled fractures are present. No significant copper mineralization occurs in any of the drill holes, the highest value being $0.03 \% \mathrm{Cu}$ with an average of $0.01 \%$. Nickel values are low including a high of $0.10 \%$ and an average of $0.01 \%$.

Location of the major anomalous zones are shown in Figures 10 and 11.
11. SUMMARY

No significant mineralization was encountered in either outcrop or drill core. Three of the six geophysical anomalies have been drilled which subsequently have been explained as caused by


Figure 10 Eastern part of grid ( L-48E to 100 E )


Figure 11

Northwestern part of grid
( L-4E
(20E )
either disseminated pyrrhotite/pyrite, graphite, peridotite and/or faulting. From the geophysical surveys, the anomaly at L80E apparently dips to the north whereas the geology and core bedding angles indicate a southerly dip, and it, subsequently was drilled in a northerly direction which maybe down dip. The source(s) of the high copper silt and soil values has not be located, but a possible explanation maybe the occurrence of small chalcocite veins in the serpentinized peridotite. It should be noted that the drainage in the area of $\mathrm{L} 64-104 \mathrm{E}$ on the northern slope of the ridge appears to be groundwater seeping from near the base of the ridge which maybe coincidental with the strong, possibly mineralized, IP conductor.

Geologically, basic lapi11i tuffs, rhyolite (or possibly rhyolite lapilli tuffs) siltstone and sandstone were isoclinally folded with the emplacement of the peridotite and later metamorphosed. Regional tectonics produced a pervasive axial plane foliation followed by faulting.

No comparison of the Letain property can be made with the Kutcho Creek massive $\mathrm{Cu}-\mathrm{Zn}$ depoist as Kutcho is of early Mesozoic age and apparently has a different geological setting. Both properties, however, have the same pervasive foliation with similar strike but dip in opposite directions; Letain - southerly, Kutcho - northerly. Rocks similar to those at Letain occur to the south of the Kutcho Creek deposit and have the same foliation direction and dip (northerly). as Letain.

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## APPENDIX I Statistical Analysis of Silt and Soil Geochem Data and Method of Arralysis of Samples.

The silt and soil data were analyzed using probability graphs (see Sinclair, 1976) in order to define and interpret anomalous values. The statistics are shown in Table 4 .

## Silt Survey

The copper values when plotted in a histogram, Figures 3 and 3 a; indicate a bimodal distribution while the zinc appears to be unimodal (approximates a normal distribution), Figure 4.

A cumulative probability plot of copper values, Figure 5, also indicates a bimodal distribution. The two populations are distributed in the ratio $42: 58$, with 42 percent or 135 values from the upper (A) group and 58 percent of 186 values in the lower (B) group. Assuming a threshold at the 1.0 and 99.0 cumulative percentile of the $B$ and $A$ populations respectively, these percentiles coincide with values of 76 and 44 ppm Cu respectively. Hence, the data are divided into three groups, an upper group of predominantly anomalous values, a lower group of predominantly background values and an intermediate group containing both anomalous and background values. Of the 321 values, about 135 are anomalous and 186 are background; $92 \%$ or about 124 of the anomalous values are above the 76 ppm threshold, as are one or two background values. The remaining




Figure 4 : Histogrom of silt zinc values

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11 values are contained in the intermediate group with about 60 background values. The lower group consists of $68 \%$ of the background values ( 126 values). Two ranges of Cu that contain anomalous values are those values $>76 \mathrm{ppm}$ and those between 44 and 76 ppm because 11 are anomalous. Thus, a few anomalous values are caused by the lower (B) population. If the samples were analyzed for Ni , then the Cu values attributable to the peridotite could be determined and the anomalies defined further.

## Soil Survey

From Figure 6, the copper values approximate a bimodal distribution, the second group of which is dispersed over a wide range. Zinc values, Figure 7, approximate a normal distribution (unimodal).

A cumulative probability plot of copper values, Figure 8, also indicates a bimodal distribution. The two populations are distributed in the ratio $30: 70$, with 30 percent or 524 values from the upper (A) group and 70 percent or 1224 values in the lower (B) group. Assuming a threshold at the 1.0 and 99.0 cumulative percentile of the $B$ and A populations respectively, these percentiles coincide with values of 53 and 25 ppm Cu respectively. Hence, the data are divided into three groups, anc upper group of predominantly anomalous values, a lower group of predominantly background values and an intermediate group
containing both anomalous and background values. Of the 1748 values, about 524 are anomalous and 1224 are background; $89 \%$ or about 466 of the anomalous values are above the 53 ppm threshold, as are one or two background values. The remaining 58 values are contained in the intermediate group with about 196 background values. The lower group consists of $84 \%$ of the background values (1028 values). Two ranges of Cu that contain anomalous values are those values > 53 ppm , and those between 25 and 53 ppm because 58 are anomalous. Thus, a few anomalous values are caused by the lower (B) population.

Lead and silver values, 10 and 0.2 ppm respectively, are plotted together with copper and zinc on Map 3. Forty one samples were analyzed for nickel (not plotted). Nickel is quite low ( $\leq 400 \mathrm{ppm}$ ) and reflects the serpentinized peridotite.

TABLE 4. STATISTICS FOR SILT AND SOIL DATA


[^0]Method of Sample Analysis

The samples were prepared and analyzed at the BondarClegg Laboratories, Vancouver.

Method of determination for $\mathrm{Cu}, \mathrm{Pb}, \mathrm{Zn}, \mathrm{Ag}, \mathrm{Mo}, \mathrm{Ni}, \mathrm{Co}, \mathrm{Fe}$, and Mn (semi-quant.).

Samples are:

1. Dried in infra-red driers
2. Sieved to -80 mesh
3. Weighed on 0.5 gm .
4. Digested in LeFort aqua regia for three hours
5. Bulked to $20 \%$ acid concentration and homogenized
6. Allowed one hour setting time
7. Analyzed bt atomic absorption in constant comparison with both synthetic and matrix standards
8. Permanently recorded on chart páper.
9. Pb and Ag corrected for background interference.

APPENDIX II MAGNETOMETER, EM16 AND EM17 SURVEYS

## 1. Introduction

The geophysical survey of Wesfrob's Letain Creek properties consisted of MF1 magnetometer and EM16, EM17 electromagnetic.work. The survey was carried out by Steve and Peter Presunka of Presunka Geophysics during late June and early July, 1977.

The magnetometer was adjusted to read 400 gammas background and magnetic bases were established along the base line with readings taken every 50 feet. The corrected magnetic readings were plotted and contoured on a plan scale one inch to four hundred feet.

The Electomagnetic survey consisted mainly of EM 16 , using two V.L.F. Stations, 17.8 and 18.6 (Maine and Seattle). The stronger EM 16 conductors were checked out by EM 17 (Horizontal loop) using 200, 300 and 400 foot cable separations. The EM 16 results are plotted on 400 scale with extra detail in anomalous areas.
2. Summary
2.1 EM 16 (Station 17.8), EM 17 and Magnetometer Surveys

There are numerous conductive zones located. Seven conductors are selected for possible drill targets.

NO. 1

This multiple conductive zone is located between Lines 76 E and 88 E , south of the base line. A multiple series of northwesterly striking conductors suggest an echeloned conductive zone. The horizontal loop survey on L. SOE indicated a broad anomaly, approximately 125 feet wide, from 1025S to 880S. A fair magnetic anomaly which starts on L. 80E extends to the west. The horizontal loop anomaly is primarily an out-of-phase type with only weak response on the inphase.

The inphase is affected by magnetite which gives positive results over magnetic zones. The out-of-phase is not affected by magnetite. The horizontal loop results on 80 E indicate the conductor to be approximately $10 \%+$ sulphides with 10 to $12 \%$ magnetite. The EM 16 results indicate depth to the conductive zone to be 175 feet. The 200 foot horizontal loop survey showed only:a slight anomaly but the 300 foot cable response was good. Line 84 E indicates a weak horizontal loop response due to depth, likely in excess of 200 feet. This very likely is the same conductor as on Line 80 E plunging to the east. These conductors are on both V.L.F. stations.

NO. 2

The EM 16 and Mag indicated conductor is coincidental with the major I.P. anomaly. Horizontal loop gave no discernible response suggesting mineralization to be less than $8 \%$ sulphides. Depth to this conductor is about 150 feet and extends from L. $4 \mathbb{V} / 3 \mathrm{~N}$ to line
$16 E / 5 N$ - a swampy area.

NO. 3

This zone has a northwest strike, starting on Line 76 E some 800 feet north to L. 64E at 1300 feet north. A fair conductor is indicated by EM 16. Depth to this conductor is approximately 250 feet. Horizontal loop survey with 400 foot cable separation did not respond. The length of this conductor is approximately 1200 feet.

NO. 4

The conductor starts on Line $68 \mathrm{E} / 26 \mathrm{~N}$ and trends in a north-east direction to L. $88 \mathrm{E} / 18 \mathrm{~N}$. It weakens to the east suggesting a gentle eastern plunge. Depth to this conductor on L. $76 \mathrm{E} / 21+50 \mathrm{~N}$ is estimated to be about 150 feet.

NO. 5

The conductor stretches from L. $20 \mathrm{~W} / 11 \mathrm{~N}$ to L. $56 \mathrm{E} / 27 \mathrm{~N}$ and is likely due to a weakly mineralized fault.

NO. 6

A weak conductive zone extends from Lin00E $\not 222$ toc L .
32E/8S. Depth to the conductor on L. $32 \mathrm{E} / 4 \mathrm{~S}$. is about 125 feet.

NO. 7

This EM 16 conductive zone which crosses L. $72 \mathrm{E} / 27 \mathrm{~S}$ trends in an eastern direction and continues off the grid.
2.2 EM 16 (Station 18.6) Survey
№. 1

This zone is detailed with both V.L.F. stations with similar results. The echeloned northwesterly conductors are more evident using ST. 18.6. The long N.W. conductor starts on L. $92 \mathrm{E} / 10$ S and ends on $\mathrm{L} .68 \mathrm{E} / 2 \mathrm{~N}$. This conductor is faulted off between lines 64 and 68E some 700 feet north, then starts on line $76 \mathrm{~W} / 8 \mathrm{~N}$ and continues in a northwest direction to L. $60 \mathrm{E} / 15 \mathrm{~N}$ for a length of 1700 feet. This conductor has a depth likely to be in excess of 200 feet. 'The V.L.F. Station 17.8 anomaly (No.3) coincides with this zone.

NO. 2

This anomaly coincides with anomaly \#2 using Station 17.8, but has a different strike. The conductor starts on L. 16E/11S crosses the base line at 20E, then continues in a northwest direction along L. $8 E$, at 82 S , then continues off the grid in a northern direction along L. 8E. It crosses the I. P. anomaly nearly at right angles. This conductor likely represents a mineralized fault.

## NO. 3

This conductor crosses the No. 5 anomaly using station 17.8 at right angles. It starts on $32 \mathrm{E} / 5 \mathrm{~N}$ and continues in a northwest direction to L. $24 \mathrm{E} / 22$. It is 1 ikely caused by a weakly。 mineralized shear or fault.

NO. 4

This anomaly is located on the southwestern end of the grid.

NO. 5

This conductor located on the east end of the grid continues off the grid to the north and south. The conductor crosses the base line at 106 E trending in a southerly direction and continues off the grid along L. 112E some 2800 feet south. A good I.P. anomaly occurs along this conductor from 6 S to 12 S between Lines 108 and 112E.

NO. 6

This conductor starts on L. 56E some 1250 feet south and stiking in northwesterly direction crosses L. 48E at 2600 feet to continue south off the grid. It should be.followed up to the scuth.

Fraser Filter Method

Six anomalous areas were outlined using the Fraser filter method of contouring the EM 16 (Station 18.6) data (Map 6). Area 1

This anomaly coincides with the serpentinized peridotite metavolcanic contact.

Area 2

Two parallel northwesterly trending zones occur which coincide with a strong I.P. anomaly (zone D). Two holes were drilled (DBH $1+\operatorname{DDH} 4)$ in this area both of which do not appear to have intersected the strongest portion of the anomaly. A weaker WNW trending anomaly occurs to the west of line $76 \mathrm{E} / 12 \mathrm{~S}$.

## Area 3

This northwesterly trending anomaly coincides with an I.P. anomaly (zone B) and was tested by drilling (DDH 3). The anomaly is caused by metavolcanics faulted against serpentinized peridotite.

Area 4

This anomaly is parallel to area 3 and is probably caused by similar geology.

## Area 5

The anomaly is small and similarly caused by faulting as at area 3.

Area 6

Several small irregular anomalies occur in this area, one of which was drilled (DDH 2) and intersected metavolcanics faulted against serpentinized peridotite.

The induced polarization and resistivity survey was conducted by J. MacNeil and M. Lunn of Mertens $\mathcal{G}$ MacNeil, assisted by company employees K. Dennis and P. Walker.
A. McPhar model P-660 transmitter, Phoenix IPV1 receiver and a 2.5 KVA motor generator comprised the I.P. equipment. Frequencies of 0.3 hz and 5.0 hz were employed throughout. Reconnaissance work consisted of 300 ft . dipole-dipole coverage to $\mathrm{n}-4$ on lines spaced 800 ft. apart. The second stage of the program consisted of 100 ft. dipole-dipole detail over selected anomalous areas. Steel rods were employed as transmitting electwodes with non-polarizing porous pots used in the receiver (potential) circuit. Currents were generally poor, less than 0.2 amperes, due to high impedance contacts in frozen ground and/or alluvial cover. Coarse talus and snow cover precluded effective I.P. coverage of the southeastern portion of the grid during the reconnaissance phase of the survey. A later attempt (late June) to obtain more complete coverage in this area, met with moderate success.

The crew maintained an excellent rate of data production despite adverse weather conditions typical to the area. Average daily coverage amounted to 20 dipoles per day.

The I.P. results have been presented in psuedo-section format, and are appended to this report. Plan maps at a scale of $1^{\prime \prime}=400^{\prime}$ have been included to show the surface projections of I.P. anomalies and the geophysical compilation which includes the major magnetic and VLF-EM anomalies.

DISCUSSION OF RESULTS
The initial reconnaissance work at 300 ft . electrode intervals on 800 ft . lines, located 6 anomalous trends, of which 4 were detailed using 100 ft . dipole intervals. These have been designated Zones A through F ; and are identified on the accompanying plan map (Fig. 1). A brief discussion of the individual zones follows:

## Zone A

Zone A consists of a long linear feature which extends in a general ESE direction from the western end of the grid (line 12 W at $7+50 \mathrm{~N}$ ) to line 24E at the baseline and possibly as far as 32 E . The zone appears to pinch and swell along its length, with the strongest I.P. responses occurring over the central portion near 8 E and 12E. A VLF anomaly (17.8) occurs over the main I.P. anomaly from line 0 to line 16E, coincident with a moderately strong magnetic response of 1400 gamas from 10 E to 16 E . On line $8 E$, the I.P. data suggest a narrow, nearly vertical conductor below $3+50 \mathrm{~N}$, within a broad zone of disseminated material. A drill hole collared at $1+80 \mathrm{~N}$ on line 8 E , drilled minus $45^{\circ}$ to the north, intersected a graphitic
schist, minor pyrrhotite, pyrite and magnetite, with trace amounts of chalcopyrite. The disseminated sulphides are adequate to explain the broad frequency effect anomaly while the graphitic schist probably causes the apparent decrease in resistivity which was also detected with the VLF system.

## Zone $B$

Zone $B$ consists of a four line response which extends from $14+00 \mathrm{~N}$ on line 64 E to $8+50 \mathrm{~N}$ on line 76 E . The geophysical results on Zone $B$ are very similar to those over Zone $A$ indicating a narrow conductor surrounded by a broad zone of disseminated, weakly magnetic sulphides. This is confirmed by a hole drilled north from $12+48 \mathrm{~N}$ on line 64 E which intersected a graphitic schist and minor magnetite. A fault zone encountered in the same hole is probably part of a main northeast-southwest. feature which extends from line 64 E at the western limit of Zone $B$ to the south end of line 40 E , which was indicated by the 18.6 khz VLF survey.

Zone C
The outline of the I.P. anomaly obtained with the 300 ft . dipole reconnaissance survey, correlates extremely well with the 2000 gamma magnetic contour, which appears to represent the schist/serpentinite contact as determined by geological mapping. Although the I. P. anomaly is probably due in part to the magnetite content of the serpentinite, the proximity of a chalcocite showing warrants at least one drill hole, particularly if there is any support from geochemical work. The high frequency effects between 12 N to 24 N on lines 92 E and 96 E suggest a broad zone of approximately $5-7 \%$ sulphides which hosts the central core of higher conductivity ( 15 N to 18 N )
as evidenced by the lower resistivities. Detail work at 100 ft . dipole intervals may have helped to locate narrow conductors within the broad anomalous zone. Both VLF stations give anomalous indications near 16 N on line 92E, coincident with the strongest portion of the I.P. anomaly. The very strong magnetic response of 5600 gammas suggests this zone is probably due to concentrations of magnetite; however, one hole is probably warranted on this line to intersect the zone at approximately 200 ft . below station 16.5 N. Zone D

The limits of Zone $D$ are not clearly defined, but it appears to extend from $13+50 \mathrm{~S}$ on line 56 E , ENE to, and beyond, line 104 E near the baseline. Eastern and western portions of this anomaly are coincident with a strong magnetic expression, which may be due to the high magnetite content of the serpentinized peridotite. The central portion, however, which contains the strongest I.P. response, is relatively non-magnetic, indicating graphite as a probable cause. The anomaly characteristics are similar on line 80 E and 88 E near 9S to 10 S , but line 84 E seems to be much wider, indicating a broad zone of polarizable material. Although coverage on line 92E is incomplete to the south, it is possible that Zone D bifurcates east of line 84 E .

The detailed geophysics carried out over the strong central portion of this anomaly, outlines 2 conductors; one which parallels the southern limit of the I.P. anomaly between lines 80 E and 88 E and the other which transects the main anomaly axis from $8+50 S$ on line 78 E to $12+50 \mathrm{~S}$ on line 82 E . Although the strongest I.P. anomaly occurs beneath $9+50 S$ on line $80 E$, a hole was drilled on line 83 E from station 125 to check the VLF anomaly which parallels the southern flank of the I.P. zone. This hole intersected $2-3 \%$
pyrrhotite, minor pyrite and a graphitic schist. Another hole drilled from $4+06$ on line $80+10 \mathrm{E}$ to check a strong VLF response, intersected: minor graphite, pyrrhotite, pyrite with trace chalcopyrite. It appears unlikely that the amounts of conductive material in this hole would be sufficient to explain the very strong VLF response at 35 , however, according to the 17.8 khz VLF profile, the zone appears to be dipping to the north, suggesting this hole may have been drilled down dip. The strongest portion of Zone D does not appear to have been adequately tested by either of these holes, and further consideration should be given to one more hole to check the cause of the anomaly approximately 50 ft . below station $9+50 \mathrm{~S}$ on line 80 E .

## Zone E

Zone consists of a weak and deep response from 15+00S on line 96E to $17+00$ on 108 E . The coincident magnetic response of +2000 gammas indicates this anomaly may due to a deep zone of disseminated magnetite. There is no coincident VLF anomaly due to the apparent depth and disseminated nature of the target. This zone may be a part of Zone $D$ but this cannot be confirmed due to a gap in I.P. information on Line 92 E in this vicinity.

## Zone F

A relatively strong but incomplete anomaly occurs at the southern extremity of lines 92 E through 104 E , south of station 52 S . This correlates with a strong erratic magnetic expression which varies from +2800 gammas to -2400 gammas on line 100 E . Although this zone is possibly due to concentrations of magnetite with possible graphite, it should be checked by drilling. CONCLUSIONS AND RECOMMENDATIONS

The I.P. survey located 6 anomalous zones of which three have been checked by diamond drilling. The I.P. results generally suggest narrow
conductors (low resistivities) within a broad zone of disseminated sulphides (broad frequency effects). The VLF-EM method was useful in locating the conductor axes while the magnetic survey helped to outline zones containing magnetite and/or magnetic sulphides.

Of the four holes drilled, all intersected minor amounts of magnetic sulphides and/or graphite, with little or no chalcopyrite. The three zones which have not been drilled, $C, E$ and $F$, are associated with moderate to strong magnetic expression and are possibly due to similar zones of combined graphite/ magnetite. However, these zones should be checked by diamond drilling, pareticularly if there are any geochemical anomalies in the vicinity.

P. A. Smith

PAS:ols

December 19, 1977

## Geophysical Equipment

Induced Polarization

| Instrument | McPhar Model P-660 (Freq. Domain) I.P. transmitter, <br> Phoenix IPV-1 receiver |
| :--- | :--- |
| Measurement | Apparent resistivity (ohm-ft.) and frequency effect (\%) |
| Configuration | Dipole-dipole array |
| Electrode Separation: $\mathrm{X}-100$, or $300, \mathrm{n}=1,2,3$, and 4 |  |
| Frequencies | 0.3 and 5.0 hz. |
| Scale Range | 10 v to $0.1 \mathrm{mv} ;-10 \%$ to $20 \%$ |
| Accuracy | $\pm 0.2 \%$ |
| Power Supply | $2.5 \mathrm{KVA}, 130 \mathrm{VAC}, 400 \mathrm{hz}$. |
| Electrodes | Steel Rods (Tx); non polarizing porous pots (Rx) |

## Magnetometer

Instrument
Measurement
Scale Range
Accuracy
Power Supply
Level

VLF-EM
Instrument
Measurement

Frequencies
Accuracy

Geonics EM-16
$\%$ in-phase and quadrature components of vertical secondary field

Seattle 18.6 khz and Cutler 17.8 khz
$\pm 1 \%$

## STATISTICAL DATA

| Line | Spread | Distance | Ft. $\times 100$ | Line | Spread | Distance | Ft. $\times 100$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 12W | 100 | 2S - 18N | 20 | 60 E | 300 | $33 \mathrm{~S}-6 \mathrm{~N}$ | 39 |
| 8W | 100 | 2S - 19N | 21 | 60E | 100 | 7N-23N | 16 |
| 4W | 100 | 1S - 11N | 12 | 64 E | 300 | 15S - 36N | 51 |
| 00 | 300 | 4S-17N | 21 | 64 E | 100 | 20S-5S | 15 |
| 00 | 100 | $3 \mathrm{~S}-13 \mathrm{~N}$ | 16 | 64 E | 100 | 5N-21N | 16 |
| 4E | 100 | 3S-12N | 15 | 68 E | 100 | 20s-5s | 15 |
| 8E | 300 | 30S - 21N | 51 | 68 E | 100 | 4N-20N | 16 |
| 8E | 100 | 4S-12N | 16 | 72E | 300 | 15S - 36 N | 51 |
| 12E | 100 | $5 \mathrm{~S}-10 \mathrm{~N}$ | 15 | 72E | 100 | 20S-5S | 15. |
| 16E | 300 | 30S-24N | 54 | 72E | 100 | 3N-19N | 16 |
| 16E | 100 | $6 \mathrm{~S}-11 \mathrm{~N}$ | 17 | 76 E | 100 | 20S-4S | 16 |
| 24E | 300 | 30S - 27N | 57 | 76 E | 100 | $2 \mathrm{~N}-18 \mathrm{~N}$ | 16 |
| 24E | 100 | 9S-7N | 16 | 80 E | 300 | 15S - 36 N | 51 |
| 32E | 300 | $30 \mathrm{~S}-33 \mathrm{~N}$ | 63 | 80E | 100 | 18S-1S | 17 |
| 32E | 100 | 15S - 1N | 16 | 80 E | 100 | 1N-17N | 16 |
| 40E | 300 | 30S - 36 N | 66 | 84 E | 300 | 15S-30N | 45 |
| 40E | 100 | 15N-29N | 14 | 84E | 100 | 17S-1S | 16 |
| 44 E | 300 | $30 \mathrm{~S}-36 \mathrm{~N}$ | 66 | 84E | 100 | $2 \mathrm{~N}-18 \mathrm{~N}$ | 16 |
| 44E | 100 | 13N-29N | 16 | 88E | 300 | 18S-36N | 54 |
| 48 E | 300 | 27S-36N | 63 | 88E | 100 | $16 S-0$ | 16 |
| 48 E | 100 | 13N-28N | 15 | 88E | 100 | 4N-21N | 17 |
| 52 E | 100 | $8 \mathrm{~N}-23 \mathrm{~N}$ | 15 | 92E | 300 | 57S-33N | 90 |
| 56E | 300 | 27S-36N | 63 | 96E | 300 | 57S-33N | 90 |
| 56 E | 100 | 5N-22N | 17 | 100E | 300 | $57 \mathrm{~S}-0$ | 57 |

## -50-

## STATISTICAL DATA

| Line | Spread | Distance | Ft. $\times 100$ |
| :--- | :--- | :--- | :--- |
| 104 E | 300 | $57 \mathrm{~S}-0$ | 57 |
| 108 E | 300 | $33 \mathrm{~S}-0$ | 33 |
| 112 E | 300 | $30 \mathrm{~S}-0$ | 30 |
| 112 E | 300 | $32 \mathrm{~N}-65 \mathrm{~N}$ | 33 |
| 116 N | 300 | $29 \mathrm{~S}-1 \mathrm{~N}$ | 30 |
| 120 N | 300 | $30 \mathrm{~S}-0$ | 30 |
| 120 N | 300 | $32 \mathrm{~N}-65 \mathrm{~N}$ | 33 |
| 128 E | 300 | $32 \mathrm{~N}-65 \mathrm{~N}$ | 33 |
| 136 E | 300 | $33 \mathrm{~N}-66 \mathrm{~N}$ | 33 |
| l |  |  |  |

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NORTH _ $10 \& 68$ _ STARTED July 18, 1977

FALCONBRIDGE DIAMOND DRILL RECORD

PROPERTY
EAST $\qquad$ completed July 24, 1977

| PURPOSE TOTEST | HOLE No. | DDH 1 |
| :---: | :---: | :---: |
| GEOPHYSICAL |  | LET |
| ANOMALIES |  |  |
| LOGGED BY T. TERRIFF | OFFS |  |


| FOOTAGE | DESCRIPTION | SAMPLE | FOOtAGE | C.L. |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $60.0-81.1$ 6 (1) 98.0 80.1 $98.0-115.7$ | - minor pyrite and pyrrhotite occurs as smal slightly elongate blebs along foliation <br> - foliation run at $43^{\circ}$ to the core <br> FELDSPATHIC LAMINATED SCHIST (3) <br> - light grey, with occasional dark laminations <br> - minature folds noted in laminations <br> - laminations run at $41^{\circ}$ to the core at $60^{\prime}, 62^{\circ}$ at 70 , and $56^{\circ}$ at $80^{\prime}$ <br> - trace pyrite and pyrrhotite along laminations <br> - gradual change over $1.0^{\prime}$ to next unit <br> QUARTZO - FELDSPATHIC GRAPHITIC SCHIST (4) <br> - description as above <br> - foliated to the core $42^{\circ}$ at $90^{\prime}$ and $47^{\circ}$ at $98^{\circ}$ <br> - minor pyrite and pyrrhotite along foliation and fractures - uneven distribution through section <br> FELDSPAR PORPHRY META-VOLCANIC ( 60 ) <br> - feldspar porphro blasts with fine grained quartz-feldspar matrix <br> - greyish in color with a salt and pepper appearance <br> - weakly foliated at $46^{\circ}$ at 105 and $31^{\circ}$ |  |  |  |  |  |  |  |



D. D. H. \#1 CORE RECOVERY ESTIMATION





## LETAIN CREEK

D. D. H. \#2 Hole recovery estimation



PURPOSE To Test HOLE No. 3
$\frac{\text { Geophysical }}{\text { Anomalie }}$ cla CION

OFFSET
PLOTTED



## LETAIN CREEK

D. D. H. \#3 CORE RECOVERY ESTIMATION

| Box \# 1 | 8-20 | 90\% |
| :---: | :---: | :---: |
|  | 20-24 | 100\% |
|  | 24-34 | 95\% |
| Box \# 2 | 34-44 | 95\% |
|  | 44-52 | 85\% |
|  | 52-70 | 60\% |
| Box \# 3 | 70-88 | 90\% |
|  | 88-93 | 90\% |
|  | 93-94 | 80\% |
|  | 94-105 | 100\% |
| Box \# 4 | 105-109 | 95\% |
|  | 109-117 | 100\% |
|  | 117-119 | 100\% |
|  | 119-124 | 100\% |
|  | 124-128 | 95\% |
|  | 128-132 | 25\% |
| Box \# 5 | 132-136 | 90\% |
|  | 136-141 | 90\% |
|  | 141-147 | 100\% |
|  | 147-164 | 95\% |
| Box \# 6 | 164-183 | 90\% |
| Box \# 7 | 183-196 | 80\% |




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LETAIN CREEK
D. D. H. \# 4 CORE RECOVERY ESTIMATION

| Box \# 1 | 0-6 | 1.4/6 | 26\% | Box \# 8 | 192-200 | 99\% |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 6-27 | 18.2/21 | 92\% |  | 200-203 | 99\% |
|  | 27-34 | 7/7 | 100\% |  | 203-208 | 99\% |
| Box \# 2 | 34-42 | 5.2/8 | 64\% | Box \# 9 | 208-218 | 83\% |
|  | 42-50 | 9/8 | 112\% |  | 218-228 | 99\% |
|  | 50-61 | 11.2/11 | 102\% |  | 228-238 | 99\% |
| Box \# 3 | 61-67 | 6.2/6 | 103\% |  | 238-248 | 99\% |
|  | 67-71 | 4/4 | 100\% |  | 248-254 | 92\% |
|  | 71-75 | 4/4 | 100\% |  | 254-264 | 90\% |
|  | 75-78 | 2.5/3 | 85\% |  | 264-274 | 99\% |
|  | 78-84 | 5/6 | 83\% |  | 274-295 | 99\% |
|  | 84-91 | 6/7 | 85\% |  | 295-316 | 95\% |
| Box \# 4 | 91-108 | 17/17 | 100\% |  | 316-336 | 99\% |
|  | 108-117 | 9/9 | 100\% |  | 336-346 | 95\% |
| Box \# 5 | 117-120 |  | 83\% |  | 346-356 | 99\% |
|  | 120-124 |  | 99\% |  |  |  |
|  | 124-128 |  | 90\% |  |  |  |
|  | 128-133 |  | 99\% |  |  |  |
|  | 133-138 |  | 99\% |  |  |  |
| Box \# 6 | 138-144 |  | 99\% |  |  |  |
|  | 144-148 |  | 75\% |  |  |  |
|  | 148-152 |  | 99\% |  |  |  |
|  | 152-158 |  | 99\% |  |  |  |
| Box \# 7 | 158-172 |  | 99\% |  |  |  |
|  | 172-180 |  | 99\% |  |  |  |
|  | 180-182 |  | 85\% |  |  |  |
|  | 182-192 |  | 99\% |  |  |  |










[^0]:    $\overline{\mathrm{X}}$ mean
    $\overline{\mathrm{X}}+\mathrm{SL}$ mean +1 std. dev. (84 cumulative percentile)
    $\overline{\mathrm{X}}-\mathrm{SL}$ mean -1 std. dev. ( 16 cumulative percentile)

