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MEMORANDUM

DATE: April 26, 1990

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DE FROM: C.J. Clayton

SUJET SUBJECT: 1990 Samatosum Reverse Circulation Drilling Orientation Survey

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OBJECTIVE: A reverse circulation drilling orientation survey was begun March 3, 1990 and completed March 10, 1990 on the Samatosum grid approximately 500 metres downslope (northwest) of the Samatosum mine near Barriere, B.C. Twenty-two holes along lines 105+00mW, 106+00mW, and 107+00mW were drilled in order to evaluate the feasibility of this particular geochemical prospecting method to applications in similar areas of extensive glacial overburden and limited outcrop exposure. The survey was designed to determine:

1) An effective and efficient sampling procedure for this geochemical prospecting method.
2) An appropriate method of presentation providing useful information for the purposes of further exploration.
3) The optimum size fraction to be analysed providing the best contrast between background values and anomalous results.
4) The optimum sampling medium, either basal/lodgement till, or the overlying ablation till.
5) The optimum analytical technique providing the greatest contrast between anomalous and background values.
6) Background and threshold values for the area from statistical analysis.
7) The nature of the geochemical response over an area of known mineralisation, the 266 Zone.
8) Glacial dispersion pattern/direction from the 266 Zone response.
9) Multielemental trends in association with mineralised zones.
10) The effectiveness of this method as a geological mapping tool.

Not only did the survey result in the delineation of the dispersion pattern associated with the 266 Zone, but it defined a new zone of extremely anomalous Ag, Pb, and Zn in till values possibly indicating a new area of mineralised subcrop in an area which has yet to be drill tested by standard diamond drilling techniques. A diamond drill program is currently underway to test this area.

SAMPLING PROCEDURE

A variety of sampling procedures and techniques were evaluated during the survey. Drilling was attempted dry initially to provide better recovery and reduce the possibility of loss of fines due to the addition of water. However, the high clay content of much of the till required water be added. Attempts to use a splitter under the cyclone to produce a representative sample in a manageable sample size was ineffective, again a result of the high clay content and loss of fines due to the requirement for water. The following procedure and techniques were found to produce the best results in obtaining representative samples of the desired level in till stratigraphy.

1) The first hole of each line was used as a test hole. with constant sampling to bedrock and collection of samples in 12" x 20", 6 mil plastic bags. Bags are labelled with hole number and 5 foot interval over which the sample was collected.

2) Till stratigraphy should be logged directly at the rig by the geologist, paying particular attention to colour, silt, sand and/or gravel content, clay content, and viscosity. In this way important stratigrpahyic markers in till may be recognised providing information as to approximate position of the drill bit in subsequent holes with respect to bedrock.

3) Once depth to bedrock has been established for the first hole, subsequent holes should be sampled based on the assumption that overburden thickness will remain more or less constant between holes of the same line.

4) Subsequent holes may now be sampled as follows. One sample bag should be taken per 5 foot interval down to a level roughly 15 to 20 feet above the estimated bedrock depth. At this point it is suggested three sample bags per 5 foot interval be used down to a level 10 feet above bedrock. In this way should bedrock depth change significantly, the three sample bags will ensure an adequate amount of material is available for analysis.

At an estimated level 10 feet above bedrock continuous sampling is undertaken. This continues to the bedrock/till interface. Once bedrock is reached, buckets may be substituted for bags for sampling 10 feet into bedrock providing a fairly fresh representative sample of the bedrock.

Careful logging of till through this process allows the geologist to make decisions on number of samples per interval based on possible changes in stratigraphy, as observed in the first hole, indicating proximity to bedrock.

PRESENTATION OF TILL PROFILE

Till in the area is reasonably stratified between holes along lines, and to a lesser degree between lines. Careful logging of till stratigraphy at the drill site lends itself to a visual presentation of the till profile in cross section with the vertical scale exagerrated over the horizontal.

Overburden stratigraphy was predominantly gravel till with distinction between stratigraphic horizons based primarily on increased or decreased clay, silt, and/or sand content of the gravel.

Of note is the pervasive, extremely viscous clay rich basal layer. This layer is distinctive occurring just before bedrock and varies from up to five feet thick to roughly one foot in thickness. This layer appears to be well comminuted rock flour with a high clay content. Soil surveys over the area previously did nopt yield significant results, and it is possible that this pervasive clay layer may have prevented hydromorphic dispersion of ions up through till stratigraphy. As is evident from the survey glacial dispersion of elements does not appear to be affected by this layer as indicated by geochemical responses in level 2, the stratigraphic interval overlying the basal/lodgement till layer.

PRESENTATION OF TILL AND BEDROCK ANALYSES

A variety of different methods of presentation were tried for both till analyses and bedrock analyses. Plotting of separate till size fractions as log scale histograms and overlaying these on to till profiles proved time consuming and produces a large number of maps not easily interpretted or manipulated. The most useful form of presentation is graphical, creating plots directly from Lotus files containing analytical data. This allows rapid manipulation and production of graphs showing comparisons of various parameters and allowing for quick interpretation of results. By plotting analytical results for each size fraction and element against the samples' respective position along a certain line, multielemental trends may immediately be spotted visually, and an assessment may be made with respect to the optimum size fraction analysed for, and the particular interval, or till horizon analysed, as well as which analytical technique provides the greatest contrast of anomalous values to background. This same graphical presentation is used for heavy mineral concentrates of bedrock chip samples, and for whole rock samples analyses.

Presentation of data in contoured plan form for this area is not appropriate for a number of reasons. Firstly, the information obtained over the three lines, altough useful in a general sense, is insufficient for the detail required for plan presentation.

Secondly, the determination of representative background and threshold values for the area was complicated by ground conditions restricting access to areas that might provide sufficient and more meaningful data regarding background and threshold. Finally, the discovery of a new zone of anomalous till at the northerly ends of the lines occurred in an area that may have been used for the establishment of background values. The magnitude increase of analytical results for this zone compared with those in the vicinity of the 266 zone creates further problems in assessing a valid threshold value for the area. By example, whereas Zn values in the -150 mesh till fraction in the vicinity of the 266 zone reach values of between one thousand and two thousand ppm, the new zone, subsequently called the 107-2 zone, reaches values in excess of 60,000 ppm Zn, in effect a zinc concentrate. For this reason, further statistical analysis of the data will require the separation of each area into individual populations.

Although detailed contouring is not possible, broadly anomalous zones of dispersion may be recognised and these are effective in determining geochemical trends and spatial relations of dispersion to mineralisation.

OPTIMUM SIZE FRACTION FOR ANALYSIS

Till samples from the upper two sampling intervals above bedrock were sent to Min-En Labs of North Vancouver. The samples were dried, sieved to three different size fractions (-60, -150, -200 mesh) and analysed individually for a 7 element (+Au and Ba) ICP trace element geochemical package.

By plotting the analytical results of each element for each size fraction against the sample location for each interval above bedrock as described previously, a quick visual assessment of the size fraction most suitable for analysis is possible.

Presentation of results of the orientation surveyindicate the particular size fraction analysed is not of great importance in terms of distinguishing multielemental trends. For the most part analytical results from the various size fractions parallel each other in trend, but not in magnitude. Furthermore, the -150 mesh size fraction appears to be less subjected to geochemical noise producing a cleaner, more defined response than the other two size fractions.

Results from heavy mineral concentrates of bedrock chip samples, and whole rock analyses are plotted in the same manner. Elements providing the most useful information are As, Cu, Pb, Zn, Ag, and Sb. Initial observations indicate results from the non-magnetic heavy mineral concentrate of bedrock chip samples are most informative. Generally geochemical response somewhat mimics that of till, however an approximate 50 metre northerly shift of peak response of bedrock geochemistry from till geochemistry peak response is observable. Another observation is a reversal in elementa providing peak response comparing till response to bedrock response. This indicates till response is not directly influenced by underlying bedrock, nor are the bedrock sample analyses affected by overlying anomalous till. This is particularly noticeable on line 107+00mW. The till geochemistry response shows high Pb, Zn, Ag, values around 8+00N and high As, Cu, Ba values at 7+00N. Compared with heavy mineral bedrock chip analyses the reverse pattern is observed, save for Ag which remains high in bedrock at 8+00N.

OPTIMUM SAMPLING MEDIUM

In general, for orientation surveys of this nature the basal, or lodgement till is sampled. In this particular area, however, it appears that the ablation till directly overlying the basal till provides the sharpest contrast with background, and the most defined multielementatl trends. Basal till is extremely clay rch and viscous providing geochemically 'noisy', and, in some cases, inconsistant results. Attenuation of background geochemical noise in the directly overlying ablation till appears to be more prevalent.

OPTIMUM ANALYTICAL TECHNIQUE

As stated previously till samples were sent to Min-En Labs of North Vancouver to be dried and then split into three size fractions for analysis. Analysis was by standard geochemical methods as for soil samples. The magnetic fraction was separated and a non-magnetic heavy mineral concentrate, produced by heavy liquid separation techniques, was prepared for the geochemical analysis. In addition a whole till sample was analysed.

With regard to till samples standard geochemical analysis on the -150 mesh fraction yields the most significant contrast between background and anomalous results. For rock samples ICP analysis of heavy mineral concentrates of bedrock chip samples provides the most informative results.

BACKGROUND AND THRESHOLD VALUES FOR THE AREA FROM STATISTICAL ANALYSIS

As stated, statistical analysis of the data set treated as one population is not appropriate due to the considerabel differences in magnitude of results for the two zones of anomalous till geochemistry. The data set must therefore be divided into two populations and treated separately. Elementary statistics of som e of the elements analysed for, for ezch size fraction, are located at the end of this report.

GEOCHEMICAL DISPERSION PATTERNS AND MULTIELEMENTAL TRENDS IN TILL ASSOCIATED WITH THE 266 ZONE, AND THE 107-2 ZONE

266 ZONE

The glacial dispersion train of the 266 Zone was encountered on lines 105+00mW and 106+00mW at around 5+50N, and is defined by moderately anomalous Cu and As in till values on line 106+00mW, and Pb and Zn in till on line 105+00mW.

Line 106+00mW: up to 300 ppm As, 400 ppm Cu in -150 mesh
Line 105+00mW: up to 200 ppm Pb, Zn

Although difficult to locate the exact position of the mineralized subcrop of the 266 Zone from bedrock analyses of trace elements, the use of %S defines the subcrop of this zone well.

The projection of this subcrop is seen to parallel the gross geochemically anomalous dispersion pattern, trending roughly 115o, or paralleling inferred ice flow direction. The centre of the dispersion pattern is roughly 75 metres southwest of the subcropping mineralization. This may imply the following:

1) The glacially transported dispersion train fo the 266 Zone has undergone subsequent mechanical and chemical transport downslope.

2) The inferred direction of ice movement may be in a more north-south direction than previously thought.

Knowledge of how the 266 Zone dispersion pattern is spatially related to its subcropping mineralization can therefore be used to infer the approximate location of mineralized subcrop associated with the 107-2 Zone.

107-2 ZONE

This zone of highly anomalous till roughly 50 metres wide was first encountered in hole RC107-2 at 8+00N. Analysis of samples from the basal till in the -150 mesh fraction returned the following values:

Ag	39.9	ppm
As	100	ppm
Cu	200	ppm
Pb	2285	ppm
Zn	66320	ppm
Ba	900	ppm
Au	150	ppm

Glacial dispersion has, in effect, produced a zinc concentrate.

An aside of note is the sudden increase in Ba on line 106+00mW and Ba and Au on line 105+00mW in the northernmost holes, 8+50N:

Line 106+00mW:	Ba 1800 ppm
Line 105+00mW:	Ba 5100 ppm
	Au 2950 ppm

From knowledge gained from the dispersion pattern of the 266 Zone mineralization the probable mineralised subcrop exposure of the source of this dispersion pattern may be inferred as approximately 75 metres in a north-northeasterly direction from this pattern, and trending northwesterly towards the settling pond. This area has, to date, not been drill tested by conventional diamond drilling techniques. Hole RG-263, collared in massive pyrite at 9+70N, 108+50mW and drilled at an azimuth of 225o did not intersect this zone and this fence was discontinued in favour of more detailed drilling in the vicinity of the 266 Zone. A coincident Max-Min conductor exists in this area as well, and the contact between mafics and sediments is projected through this area.

REVERSE CIRCULATION AS A GEOLOGICAL MAPPING TOOL

Reverse circulation drilling is a cost effective method of geological mapping of subcrop in areas of extenxive overburden. The speed with which drilling is conducted allows up to four holes drilled per day, based on an average overburden thickness of approximately 25 metres, and provides information as to bedrock type, mineralization, and alteration. In the area of the test survey, sediments (primarily sericitic tuff, and some cherty argillite) were encountered in all holes except 106-6 in which mafics were encountered. In other areas of deep overburden and limited outcrop exposure, inferred geology and structure may be tested using this method.

SUMMARY AND RECOMMENDATIONS

The reverse circulation orientation survey over 266 Zone mineralisation on the Samatosum grid was successful in delineation of a broadly anomalous dispersion pattern associated with this zone in both basal till and ablation till, and most noticeably in the -60 and -150 mesh fraction of the till. Furthermore, another broadly anomalous zone of glacial dispersion was discovered at the northerly ends of lines 105+00mW and 106+00mW. Based on spatial proximity of the 266 Zone dispersion pattern to its subcropping mineralisation, the subcrop of the new 107-2 Zone may be inferred as roughly 75 metres north-northeasterly of the dispersion pattern and 100 to 200 metres downslope (northwest).

With respect to future reverse circulation programs, the orientation survey revealed the most useful size fraction for analysis to be the -150 mesh fraction from the ablation till directly overlying basal till. The use of either till may be taylored to differing conditions in other surveys. Removal of the magnetic fraction from the till and creating a heavy mineral concentrate for analysis completes the preparation required for analysis by ICP providing optimum results for exploration purposes. In regard to bedrock samples, a heavy mineral concentrate of bedrock chips subjected to multielement ICP again provides the most useful information. Retaining a sample of the bedrock chips allows geological intepretation of areas not amenable to field mapping procedures.

RECOMMENDATIONS FOR EXPLORATION

Reverse circulation overburden drilling has proven a successful exploration technique as revealed from the orientation survey of the 266 Zone. The method is ideal for areas of limited outcrop exposure and deep overburden where conventional exploration methods are greatly restricted, and offers several advantages:

1) Results of the survey may delineate glacial dispersion patterns from subcropping mineralisation providing target areas for more detailed diamond drilling programs. This is extremely useful in areas which have no significant targets defined by conventional methods and thus helps in refining target areas and contributes to an overall integrated and systematic exploration program.

2) In areas of conductive overburden this method provides important information on direction to mineralisation where geophysical methods may fail.

3) The method provides information on geology, structure (from geology), and alteration in areas where such information can only be inferred.

4) Finally, reverse circulation provides wide exploration coverage of areas due to the self propelled design of the drill.

It is recommended, therefore, reverse circulation drilling be incorporated as part of systematic, integrated exploration programs in areas of deep overburden where conventional exploration methods are restricted, or have proven ineffective in delineating potential target areas for diamond drill testing.

Following is a cost breakdown of the orientation survey expressed on a $ per metre drilled basis. The relatively high cost of the orientation survey was necessary in meeting all objectives of the survey. Following the cost breakdown a comparison with what would be a similar survey taking into account knowledge of sampling procedures, analytical techniques, and sampling medium as determined by the orientation survey is presented. As is evident the cost of an exploration program, as differentiated from an orientation survey, is reasonable and the information obtained in areas of particular ground conditions as emphasized in this report is considerable in quantity, and invaluable in quality in terms of assessing potential target areas.

COST BREAKDOWN

REVERSE CIRCULATION ORIENTATION SURVEY

Field Geologist	15 days @ $153 per	= $ 2,295
Compilation/Interpretation	14 days @ $153 per	= $ 2,142
Field Assistant	15 days @ $110 per	= $ 1,650
	TOTAL SALARIES	**= $ 6,077**
Total Drilling Costs	(500 m @ $43.67 per)	= $21,835
Road Access Costs		= $ 6,110
Total Analytical Costs		= $10,945
Logistical Costs		= $1,425
	TOTAL COSTS	**= $46,392**
	TOTAL COST PER METRE	**= $ 93**

FUTURE ANTICIPATED TOTAL COST PER METRE FOR A SIMILAR PROGRAM FOR EXPLORATION

Field Geologist	15 days @ $153 per	= $ 2,295
Compilation/Interpretation	5 days @ $153 per	= $ 765
Field Assistant	15 days @ $110 per	= $ 1,650
	TOTAL SALARIES	**= $ 4,710**
Total Drilling Costs	(500 m @ $43.67 per)	= $21,835
Road Access Costs		= $ 1,000
Total Analytical Costs		= $ 3,438
Logistical Costs		= $ 1,425
	TOTAL COSTS	**= $32,408**
	TOTAL COST PER METRE	**= $ 65**

SAMATOSUM Elementary Statistics Tue
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SAM RC TILL

Variable:AG60 PPM

Number of Samples Selected:	62
Number of Missing or Null Values:	0
Minimum:	0.100
Maximum:	49.200
Range:	49.100
Mean:	2.860
Median:	1.800
Variance:	37.506
Standard Deviation:	6.124
Standard Error:	0.778
Coefficient of Variation (%):	214.158
Coefficient of Skewness:	7.018
Coefficient of Kurtosis:	52.919
Log 10 Transformed Mean:	0.269
Log 10 Variance:	0.367
Log 10 Standard Deviation:	0.606

Number of samples Selected for Log Statistics 0