Partial/Selective Extraction
Soil Geochemical Survey,
Renaissance Deposit, McLeod Grid, Matagami, Quebec

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Outline

- Regional and Local Geology
- Survey Parameters
  - Sampling
  - QAQC
  - Analytical
- Interpretation
  - Response Ratios
  - Normalization
- Conclusions
Introduction

- Partial/Selective Extraction (Enzyme Leach) soil geochemical sampling done on McLeod property to accelerate evaluation of Key Tuffite stratigraphy.
- Part of deep penetrating soil geochemistry initiative at Noranda/Falconbridge.
- Orientation survey in 2003 indicated likely presence of bedrock signal in data.
- Sampling program consisted of over 500 samples of A0 and B-horizon material on a 50x100m grid.
Regional Geology - Matagami Area

- Granite
- Peridotite
- Diabase
- Sulphides
- Bell River Complex
- Gabbro
- Watson Lake Rhyolite
- Wabassee Basalt
- Andesite
- Sediments

- Town of Matagami
- Norita
- Mattagami Lake
- Bell Allard Mine
- McLeod Grid
- North Flank
- South Flank
- Isle Dieu
- Perseverance
- Norita
- McLeod Grid

5km

Falconbridge Ltd.
Schematic Section through Galinée Anticline

Daniel Fault

Erosional Surface

South Flank

North Flank

Basalt, Andesite
New Hosco Tuff
Dumagami Rhyolite
Watson Lake Rhyolite
Dacite
Bell River Complex

VMS Deposit

(Piché et al 1993)
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Schematic Section

Central South Flank

1 - Reactivated
(Orchan Mine, Orchan West)
- Chloritized basalt, schistose
- Stringer mineralization in HW
- Steeply dipping sulphide spires

2 - Non-Reactivated
(Isle-Dieu, Bell Allard)
- Semi-concordant sulphide lenses
- Alteration absent in the hangingwall

Inferred semi-conformable alteration zone

206°

MLM

Gabbro
Basalt
Dumagami rhyolite
Watson Lake rhyolite
Lower basalt (Allard)
Exhalite (Key Tuffite)
Sulphides
Talc-chlorite alteration
Chlorite

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McLeod Sampling, Soil Type and Geology

- Bracemac Rhyolite
  - Burgundy circles: EL A0 Samples (314)
  - Light blue circles: EL B Samples (132)
  - Green circles: Aqua Regia Samp. (60)
  - Gray circles: Pre-Discovery DDH
  - Black circles: Post-Discovery DDH
- McLeod Showing
- Renaissance VMS Deposit
- Wabassee Volcanics, Gabbro Sills
- Key Tuffite Contact

Depth to Key Tuffite

UTM NAD83, Zn18
Renaissance Showing - Section 13375E

Legend
- Basalt
- Felsic Dyke
- Intermediate Dyke
- Gabbro
- Mafic Dyke
- Bracemac Rhyolite
- Watson Lake Rhyolite
- Chloritized Watson Dacite
- Chloritized Watson Lake Rhyolite
- Bracemac Tuffite
- Key Tuffite
- Upper Tuffite
- Alteration & Stg
- Massive Sulphides
- Semi-Massive Sulphides
- Shear Zone

206° N-60-1  MC-05-18  M-12

-500m
-750m
-1000m

MC-04-07  Discovery Hole  14.05m CL / 10.8m TW
11.15% Zn, 2.04% Cu, 41.9 g/t Ag, 0.61 g/t Au

0.82% Zn / 7.30m

1.14% Zn, 2.38% Cu, 5.09g/t Ag / 13.2m

22.7% Zn, 0.46% Cu, 10.8g/t Ag, 0.47g/t Au / 0.85m
McLeod Sampling Protocol

- OMET Soil Sampling Protocol Used: Samples collected of B-horizon between 10 and 25cm or if B-horizon sample was too deep the A0-horizon was collected between 10 and 20cm.
- Frozen ground frequently resulted in collection of sample deeper than 25cm (for A0 Horizon) but no data on depth was recorded.
- Samples were collected on 50m spacing on lines 100m apart.
Field Descriptions and Analytical Methods

- Field descriptions recorded for each Site and each Sample.
- pH and Conductivity measured on each sample.
- All samples analysed by Enzyme Leach at Actlabs.
- 60 randomly selected samples analysed by Aqua Regia/ICP-ES.
OMET Sampling Protocol

(FROM Hamilton et al., 2003)
### Statistics of Sample Collection

<table>
<thead>
<tr>
<th></th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samples</td>
<td>452</td>
<td>87%</td>
</tr>
<tr>
<td>Standards</td>
<td>13</td>
<td>2.5%</td>
</tr>
<tr>
<td>Field Duplicates</td>
<td>28</td>
<td>5%</td>
</tr>
<tr>
<td>Lab duplicates</td>
<td>29</td>
<td>6%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>522</strong></td>
<td></td>
</tr>
</tbody>
</table>

317 (70%) A0 and 135 (30%) B-horizon samples
QAQC

- Quality Control consisted of a drift monitor (standard) along with lab preparation and field duplicates.
- Field duplicates were collected from similar site between 2 and 3 meters from original sample.
- All samples randomized and re-numbered prior to batch assembly.
Drift Monitor Control Chart

2003 orientation survey

2004 survey
Analytical, Sub-Sampling and Field Sampling Precision

- Drift Monitor: 5 – 20%
- Sample Preparation Dups: 15 – 25%
- Field Dups: 30 to > 60%

- 18 A0, 10 B-horizon
Element Concentrations by Field Randomized Sequential Assay Order

Cu_ppb

Zn_ppb

Pb_ppb

Cd_ppb
Element Concentrations by Field
Randomized Sequential Assay Order

As_ppb

Se_ppb

Mo_ppb

Sb_ppb

Sample Nos.
95728 to 95770
QAQC Conclusions

- Drift monitor response was different than results obtained in 2003 but batch to batch variations acceptable.
- Analytical and Lab Preparation Precision Good for most elements but Field Duplicate precision poor for Zn, Pb, Cd, and some other elements (RSD% > 60%).
- Some problems highlighted by randomized samples but errors do not lead to bias in survey.

Statement: QAQC data indicate that the results are acceptable for the purpose of identifying anomalies on the grid. Poor field sampling precision in some key elements require stronger contrast between anomalies and background for conclusive inferences to be drawn.
Response Ratio Maps

- Samples divided into two groups according to soil type (A0 and B horizons).
- 1st quartile calculated for each group.
- Each element of each sample divided by the 1st quartile value for the element of the group.
- Results were recombined and plotted by RR (response ratio)
Zn_ppb Response Ratio Normalized for Soil Type

Response Ratio _Zn_ppb
- 12 to 14.6 (6)
- 8 to 12 (17)
- 4 to 8 (105)
- 0 to 4 (318)
Pb_ppb Response Ratio Normalized for Soil Type

Response Ratio Pb_ppb
- 12 to 55.1 (29)
- 8 to 12 (40)
- 4 to 8 (76)
- 0.2 to 4 (301)
Cd_ppb Response Ratio Normalized for Soil Type

Response Ratio Cd_ppb
- 12 to 18.4 (5)
- 8 to 12 (22)
- 4 to 8 (85)
- 0.1 to 4 (334)
Cu_ppb Response Ratio Normalized for Soil Type
Section 75+00E 13375E

MC-04-07  Discovery Hole  14.05m CL / 10.8m TW
11.15% Zn, 2.04% Cu, 41.9 g/t Ag, 0.61 g/t Au
Section 73+00E 13175E
Sum of Response Ratios

Sum Response Ratios
- 18 to 200 (81)
- 12 to 18 (55)
- 6 to 12 (82)
- 0 to 6 (228)

Bracemac Domain

McLeod Domain

UTM NAD83, Zn18

kilometers
P-values of t-Tests for Domains
P-values of t-Tests for Domains
Conclusions of Response Ratio Method

- Main feature of data is presence of 2 domains defined in part by pH.
- Eastern (McLeod) domain generally much lower in average values for many elements and western (Bracemac) domain which has anomalous background in Zn, Pb, Cd, Sn, In and lower pH.
- Data tested for proximity to rail line but no correlation found.
- Difficult to resolve actual drill target anomalies in Bracemac domain even if whole area west of McLeod showing clearly anomalous.
Normalization (Sequential Regression) Method

- Second stage of interpretation consisted of normalization to remove surficial effects.
- As part of this exercise 60 randomly selected A-horizon samples were submitted for aqua regia digestion/ICP-ES analysis to test whether major components could be controlling the abundance of Enzyme Leach elements.
- This study indicated that normalization required for soil type, pH and Mn but not for Ca, Fe, K, Na, or Al, nor for C.
- It is quite possible that B-horizon samples would show corrections required for some of these elements.
Normalization for Soil Type and pH

Scatterplot of $\log_{10} \text{Cu}_{\text{ppb}}$ vs pH

Scatterplot of $\log_{10} \text{Cu}_{\text{ppb}}$ vs pH

Scatterplot of $\log_{10} \text{Zn}_{\text{ppb}}$ vs pH

Scatterplot of $\log_{10} \text{Zn}_{\text{ppb}}$ vs pH

Scatterplot of $\log_{10} \text{Zn}_{\text{ppb}}$ vs pH

Scatterplot of $\log_{10} \text{Zn}_{\text{ppb}}$ vs pH
Regression of Selected Elements on Mn_EL

- Scatterplot of Log Zn_ppb pH vs Log Mn_ppb pH
- Scatterplot of Log Cu_ppb pH vs Log Mn_ppb pH
- Scatterplot of Log Zn_ppb pH/Mn vs Log Mn_ppb pH
- Scatterplot of Log Cu_ppb pH/Mn vs Log Mn_ppb pH
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Gridded Stand.

Residual logZn_ppb

SOIL_HORIZON_CODE

A0 (313)
B (132)

Residuals of Log10_Zn_ppbEL

Standardized Residuals of logZn_ppb

vs A0-B_pH_MnEL

-20 to -1 (54)
-1 to 0 (161)
0 to 1.5 (206)
1.5 to 2 (17)
2 to 20 (7)
Conclusions

- Most obvious feature with both methods is McLeod vs Bracemac Domains.
- A number of anomalies have been outlined that differ in elemental association.
- Some of these anomalies may line up along an inferred structural lineament observed on longitudinal section.
- Some evidence that Renaissance deposit occurs within a depression surrounded by discontinuous multi-element halo.
- Possible response along sub-cropping mineralized KT horizon.
Some Outstanding Issues

- Possible contamination by railroad even if no significant relationship between concentration and distance.
- Survey done early in season; wet areas still frozen.
- A0 and B horizons not randomly distributed; Renaissance Deposit mostly covered by B samples.
- Aqua Regia digestions only done on A0 samples; B-horizons may require normalization for other elements (i.e. Fe, Ca, Mg, Al).
A total of 32 targets sampled
Including:
4 known targets
28 unknown targets
General Recommendations for Partial/Selective Extraction Surveys

- Field Duplicates and randomization essential.
- pH measurements on soil slurries very important for normalization.
- Aqua Regia digestion allows testing and normalization for major elements.
- Normalize results for whatever factors correlate strongly with elements of interest.
- Regression/Residual method had little effect on variables that do not correlate with factor.
Thank You