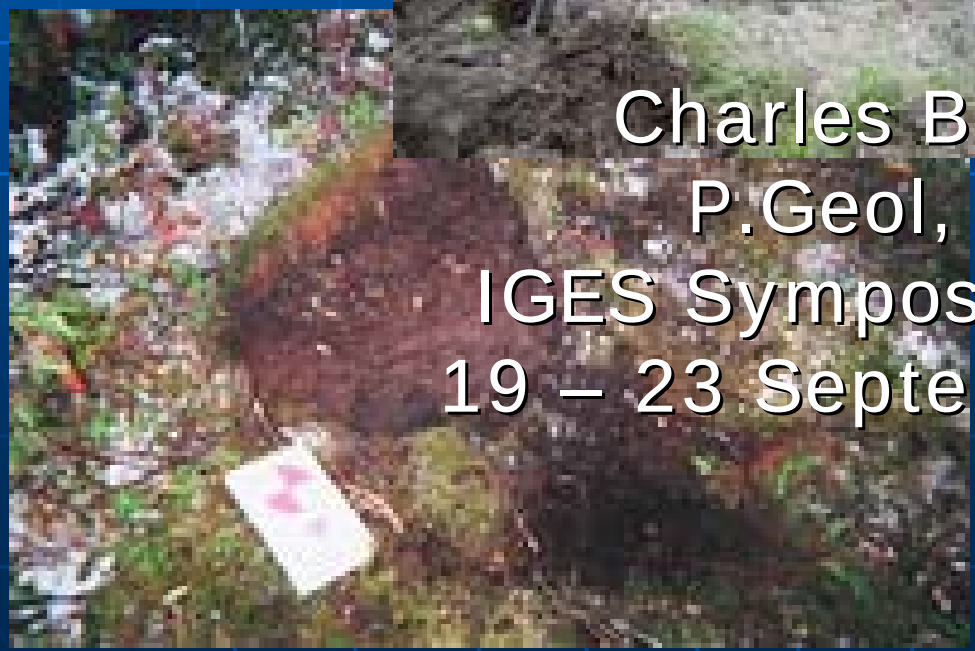
Partial/Selective Extraction Soil Geochemical Survey, Renaissance Deposit, McLeod Grid, Matagami, Quebec



Charles Beaudry
P.Geol, Géo.

IGES Symposium, Perth
19 – 23 September, 2005

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.

Simplified Geology - Abitibi Belt

Ontario

Québec

Opatica Sub-Province

Harricana-Turgeon Belt

Chibougamau

Matagami

Grenville

100 km

Rouyn-Noranda

Val-d'Or

- Proterozoïc
- Granite
- Mafic Complex
- Sedimentary Rocks
- Ultramafic Rocks
- Volcanic Rocks

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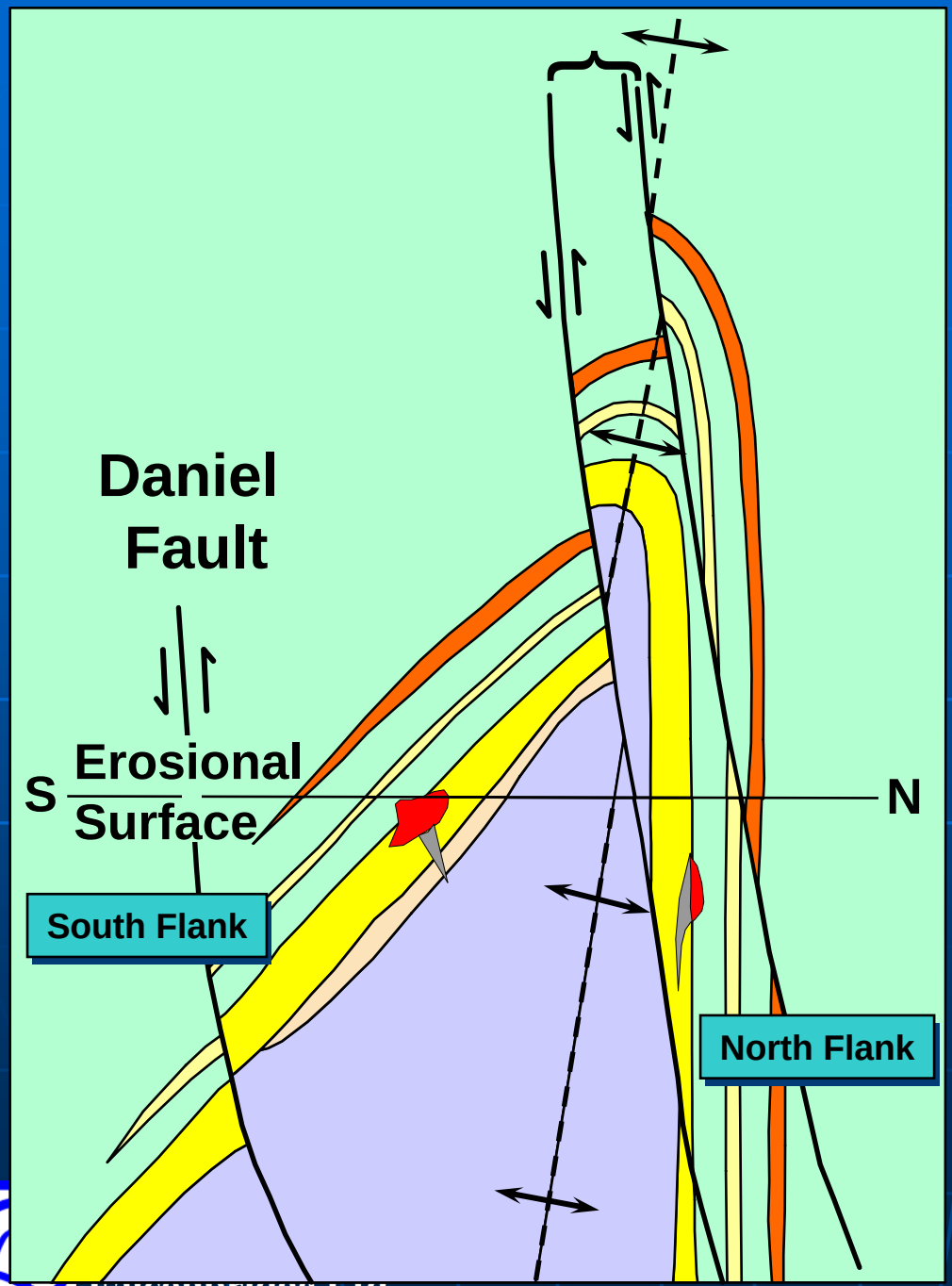
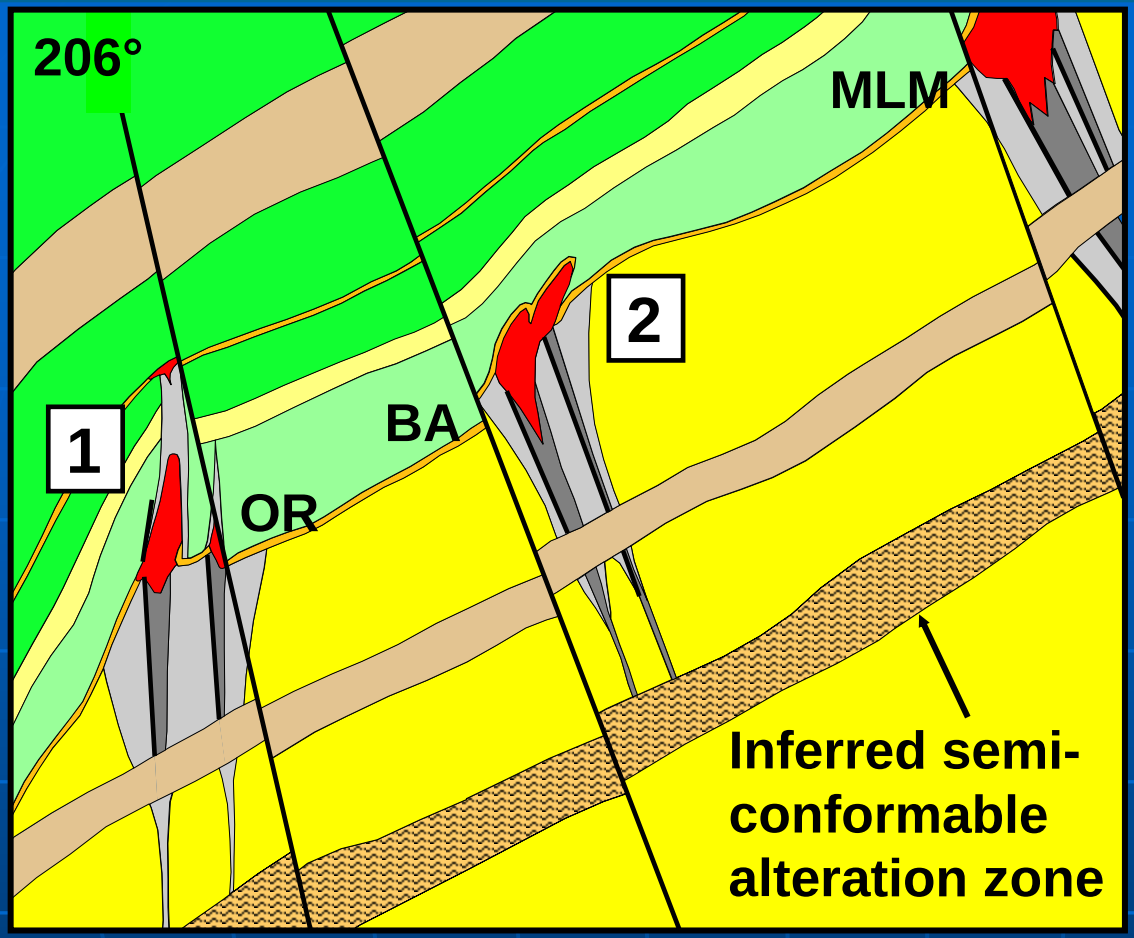
Regional Geology - Matagami Area

Schematic Section through Galinée Anticline



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

(Piché et al 1993)



Schematic Section Central South Flank

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

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

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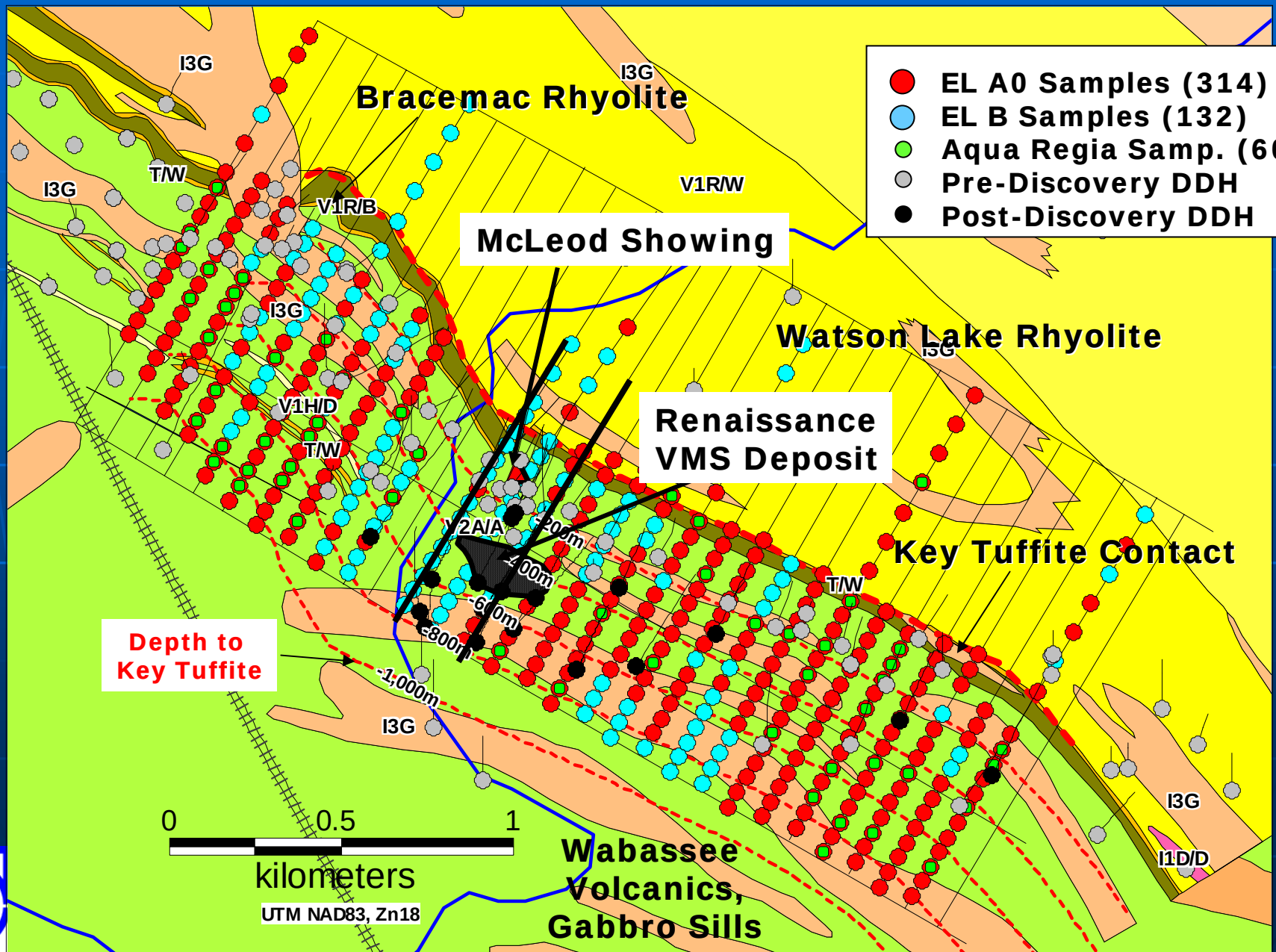
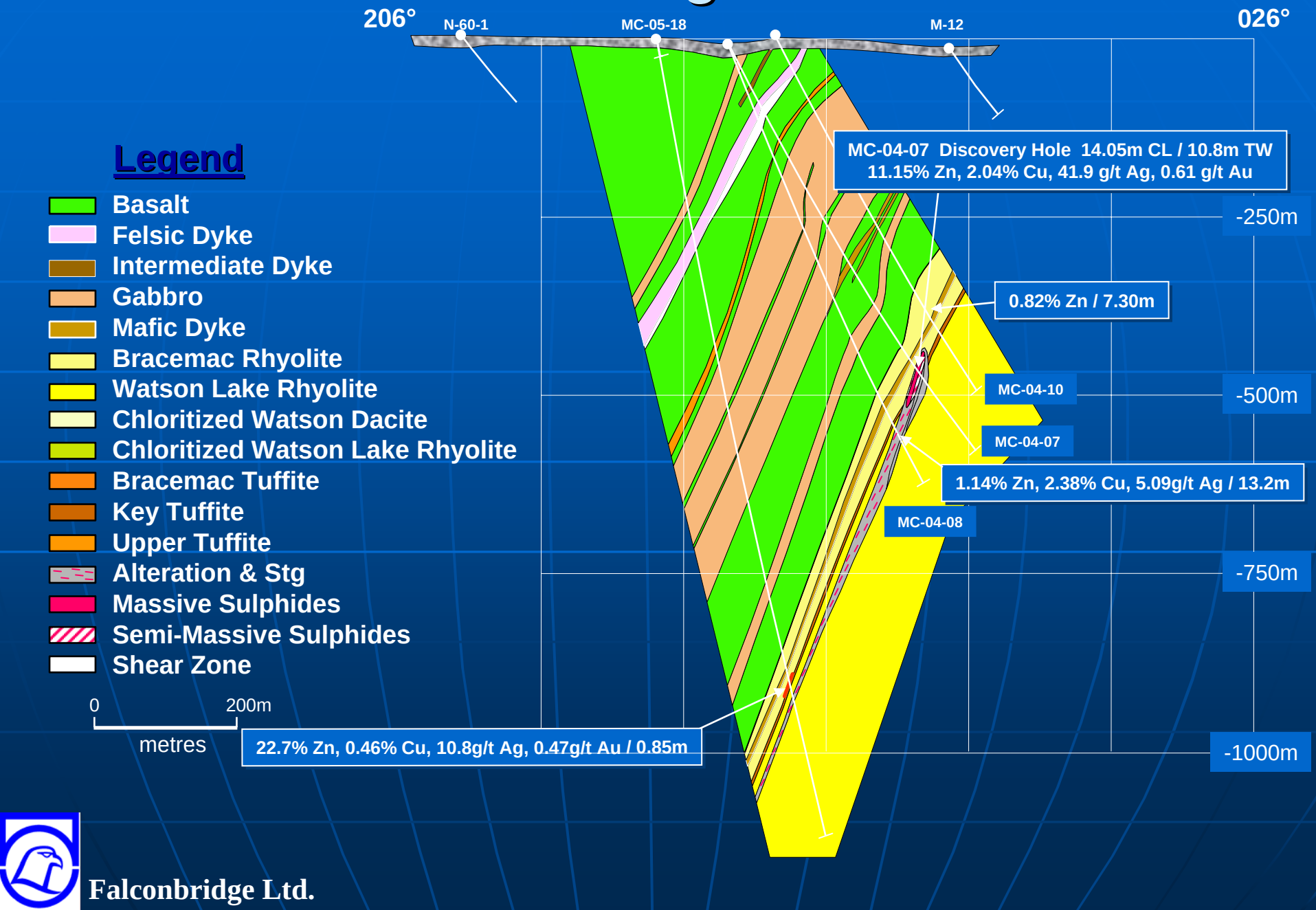
noranda

McLeod Sampling, Soil Type and Geology



Renaissance Showing - Section 13375E



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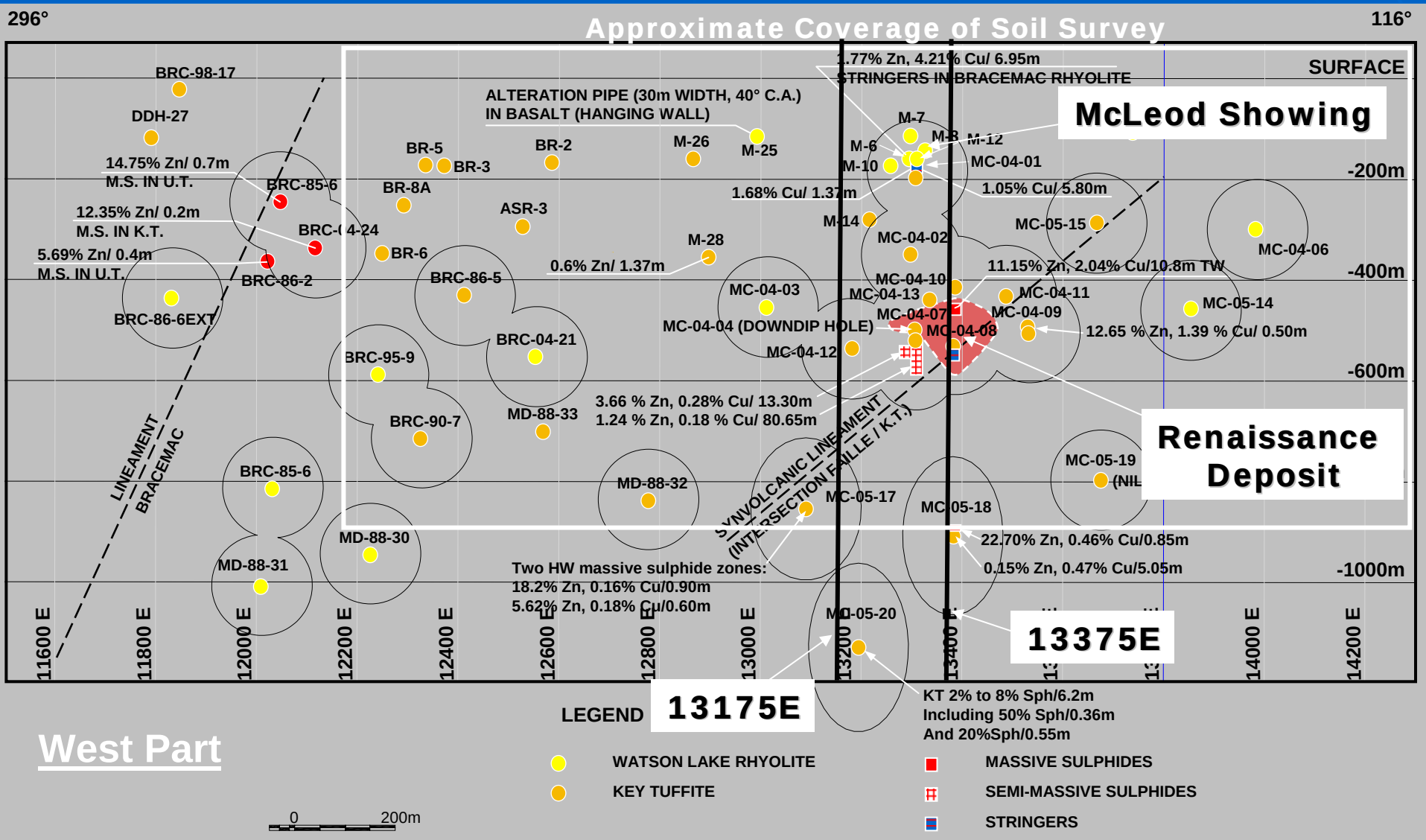
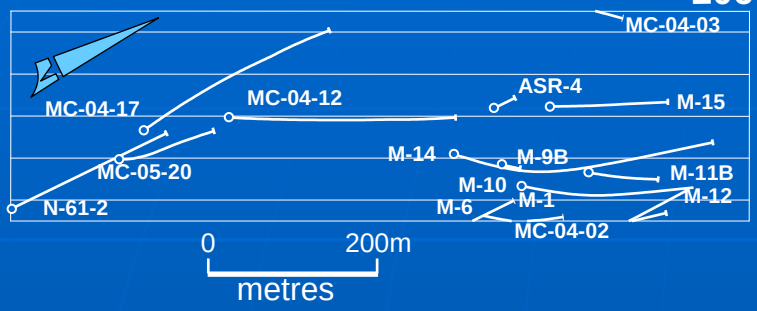
Renaissance Longitudinal
Key Tuffite / Watson Lake Rhyolite Contact



West Part

Renaissance - Composite Section 13175E



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

0 200m

206° 026°

N-61-2

Massive Sulphides
60% Py/ 0.05m

M-11B
M-15
M-6
M-14
M-12
M-10
ASR-4

-250m

Massive Sulphides
18.2% Zn, 0.16% Cu, 15.5g/t Ag/ 0.9m

-500m

Massive Sulphides
5.62% Zn, 0.18% Cu/ 0.6m

MC-04-02
2.06% Cu, 23.59g/t Ag / 1.1m

MC-04-03
MC-04-12
Alteration Pipe / Chloritite
1.7% Cu/8.3m

-750m

Altered Rhyolite
With Miner Pipe
1.32% Cu, 5.87g/t Ag/1.7m

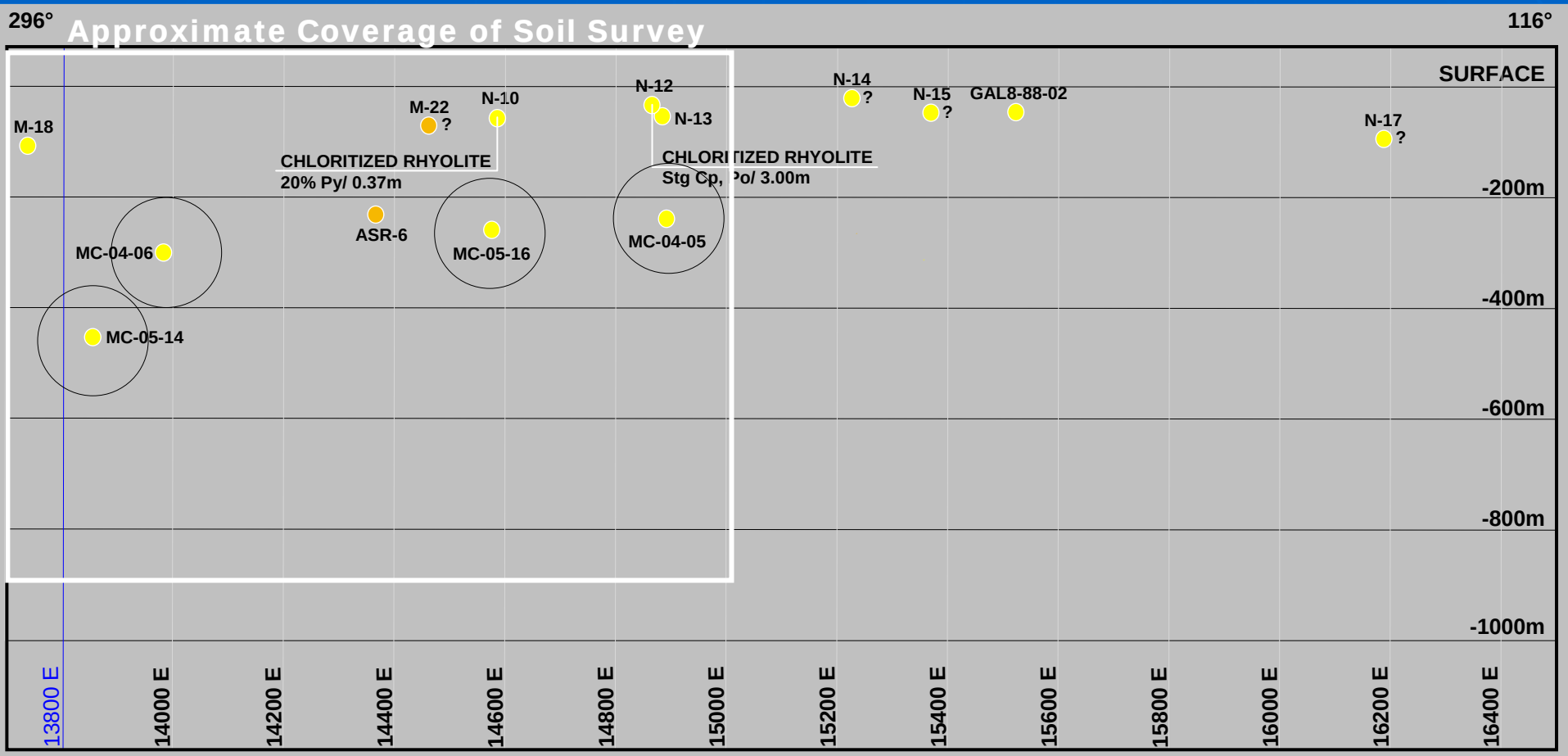
-1000m

MC-04-17

KT 2% to 8% Sph/6.2m
Including 50% Sph/0.36m
And 20%Sph/0.55m

MC-05-20 (150m South East Of MC-04-17)

Renaissance Longitudinal
Key Tuffite / Watson Lake Rhyolite Contact



East Part

LEGEND

- WATSON LAKE RHYOLITE
- KEY TUFFITE
- MASSIVE SULPHIDES
- SEMI-MASSIVE SULPHIDES
- STRINGERS

0 200m

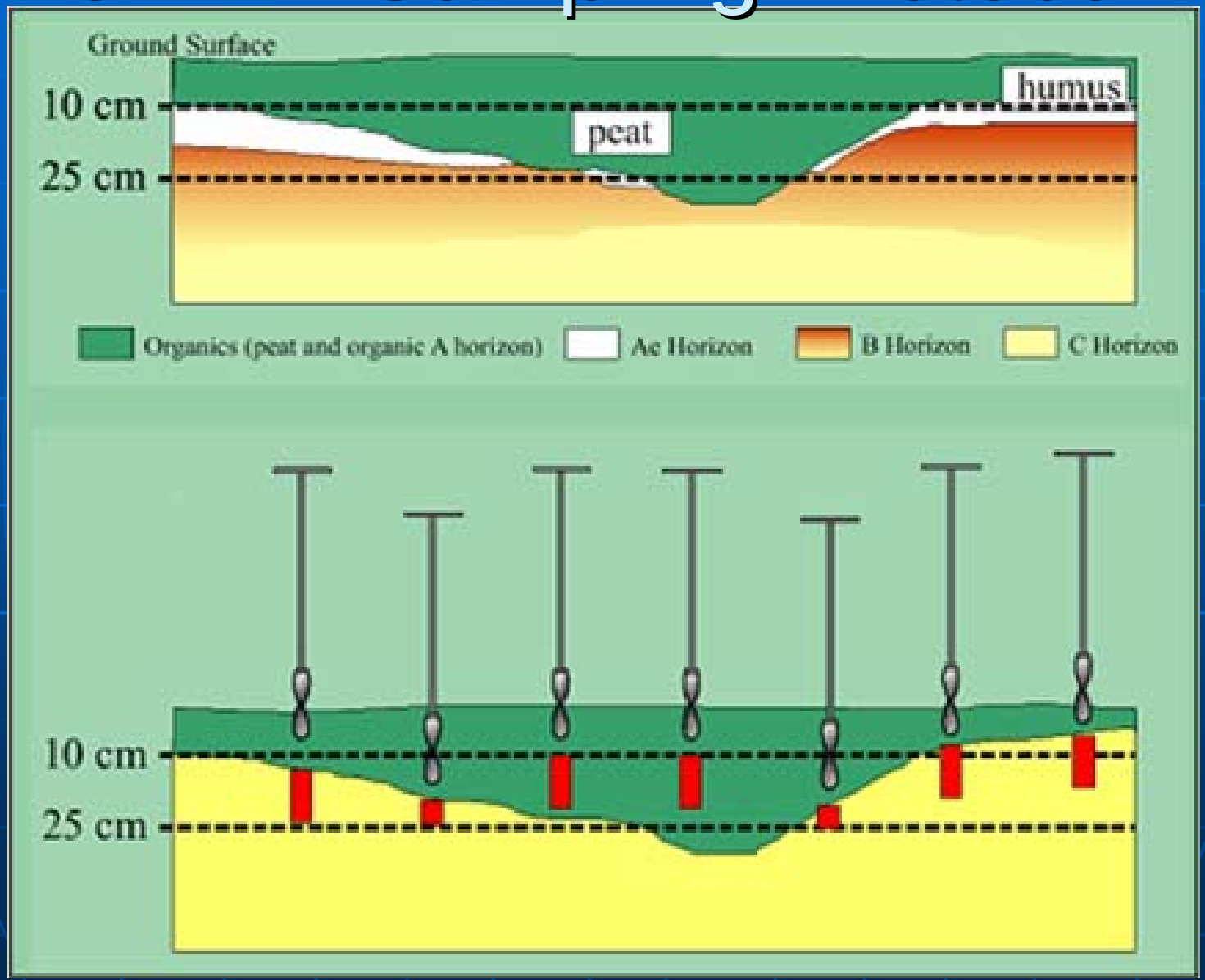
McLeod Sampling Protocol

- 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



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(From Hamilton et al., 2003)

Statistics of Sample Collection

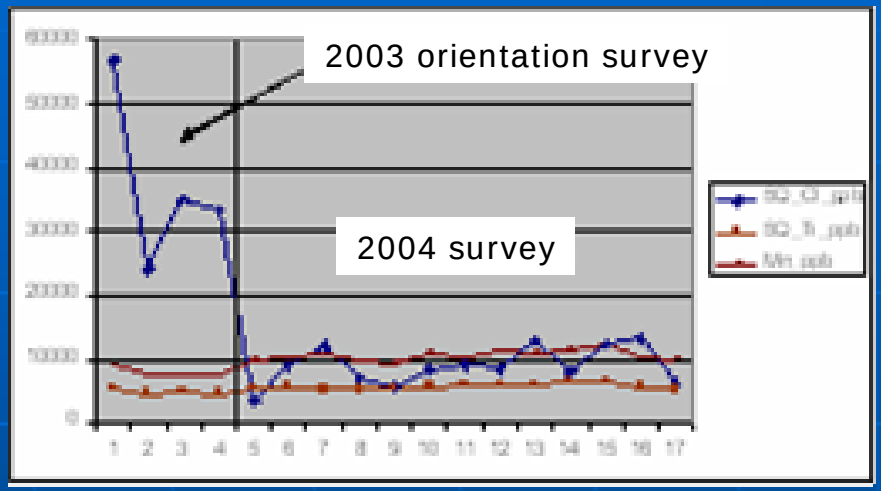
		No.	%
Samples		452	87%
Standards		13	2.5%
Field Duplicates		28	5%
Lab duplicates		29	6%
	TOTAL	**522**	

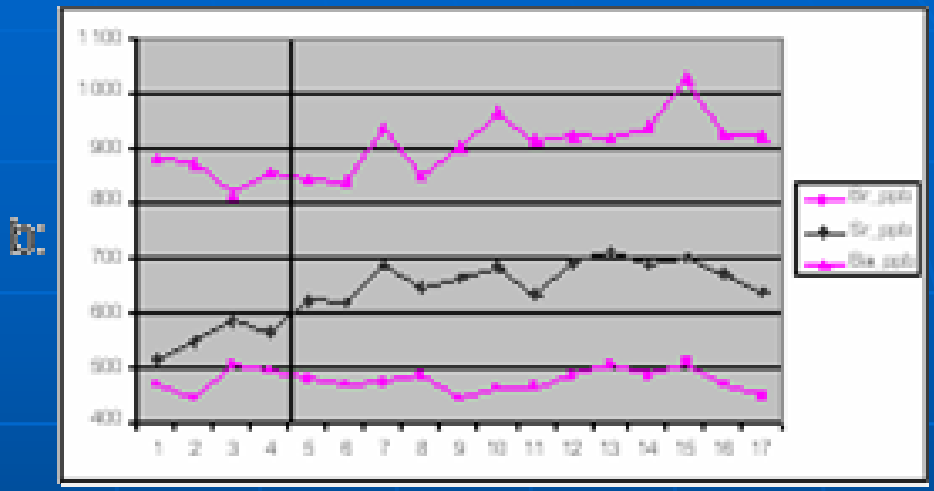
317 (70%) A0 and 135 (30%) B-horizon samples

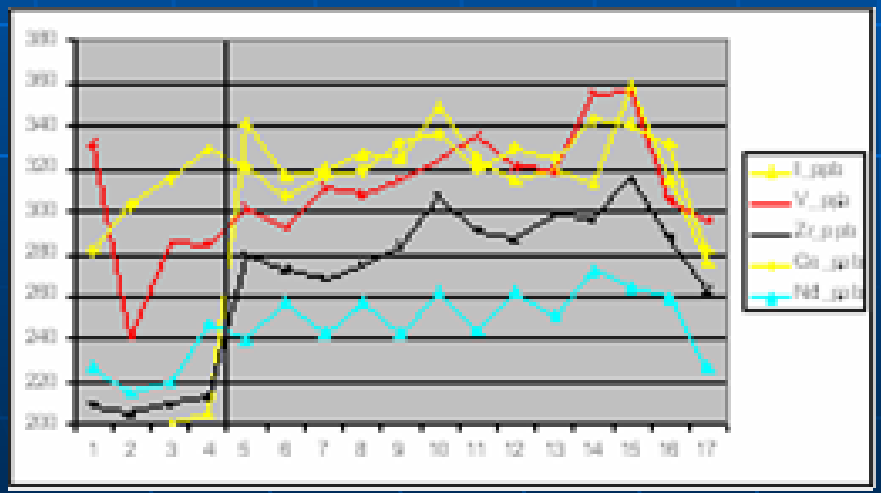
QAQC

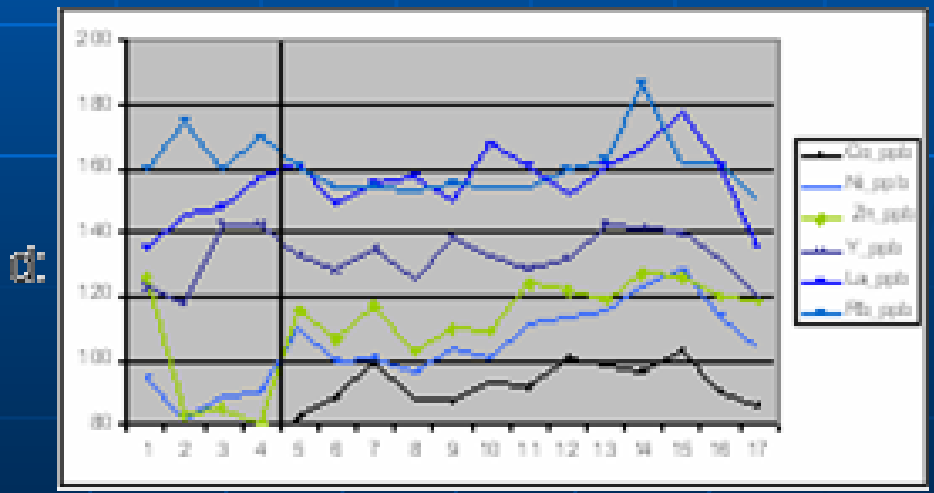
- Quality Control consisted of a drift monitor (standard) along with lab preparation and field duplicates.
- Field duplicates were collected from similar site between 2 and 3 meters from original sample.
- All samples randomized and re-numbered prior to batch assembly.

Drift Monitor Control Chart

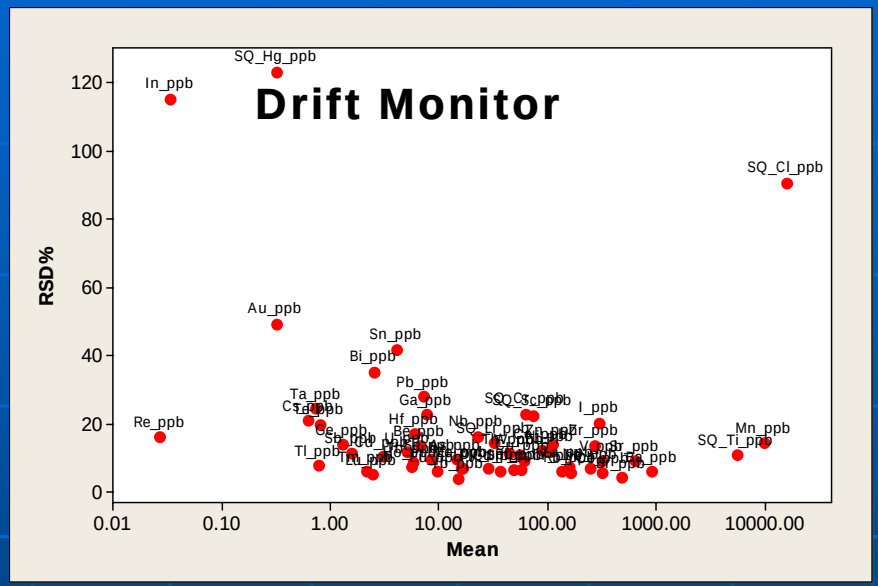


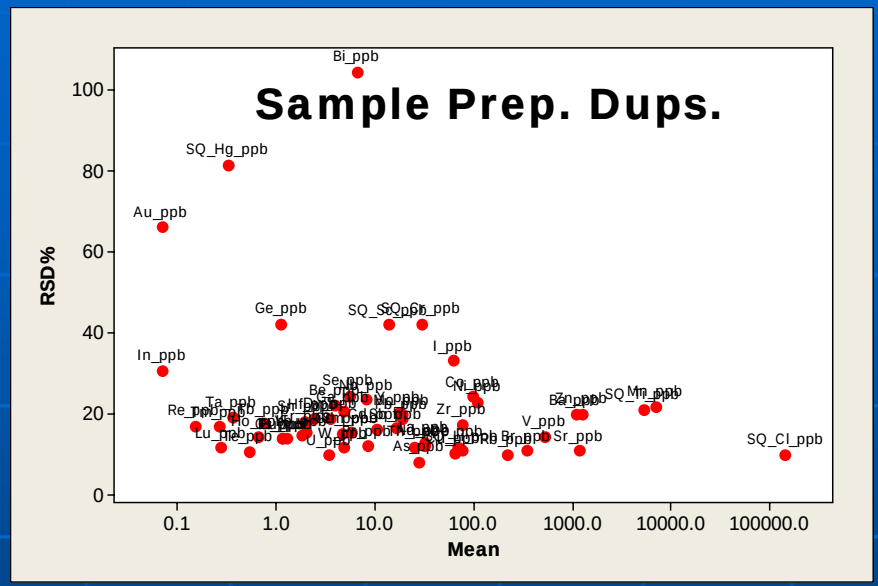






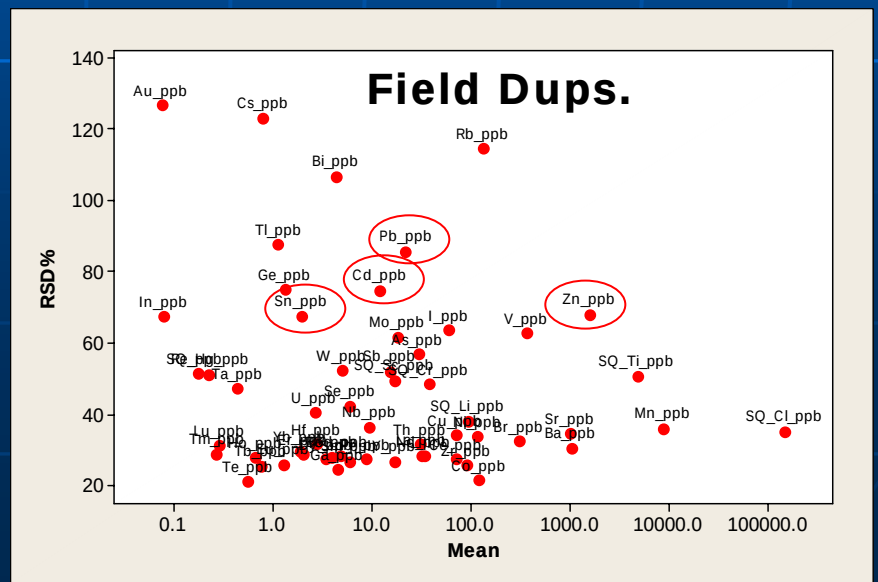
Analytical, Sub-Sampling and Field Sampling Precision





Precision (RSD%)

- Drift Monitor: 5 – 20%
- Sample Preparation Dups: 15 – 25%
- Field Dups: 30 to > 60%
  - 18 A0, 10 B-horizon



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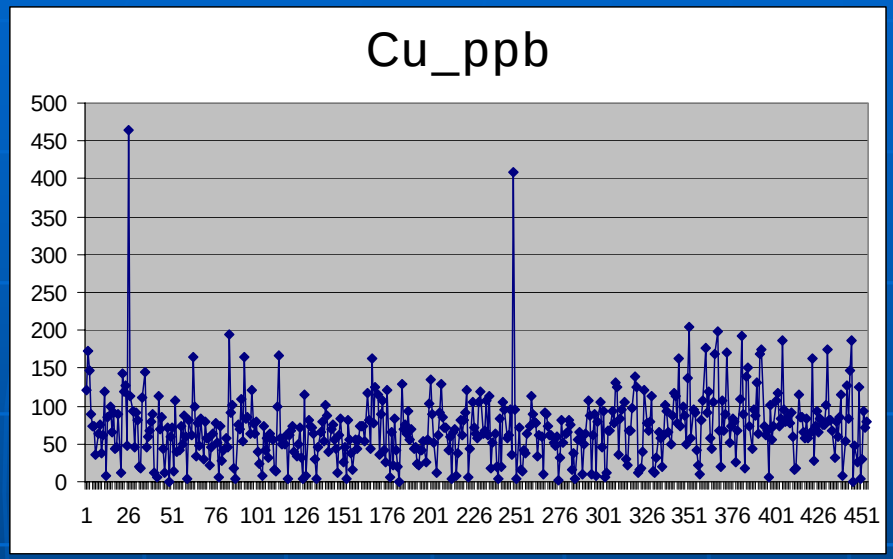
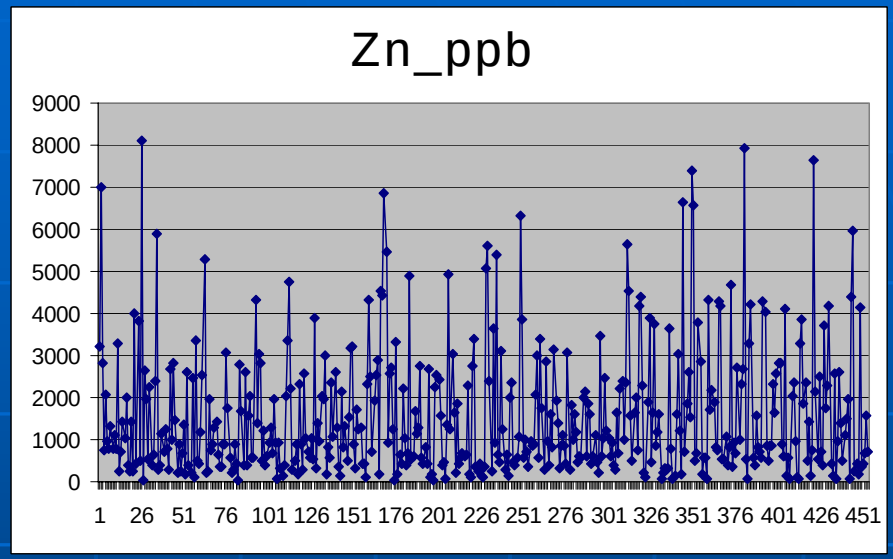
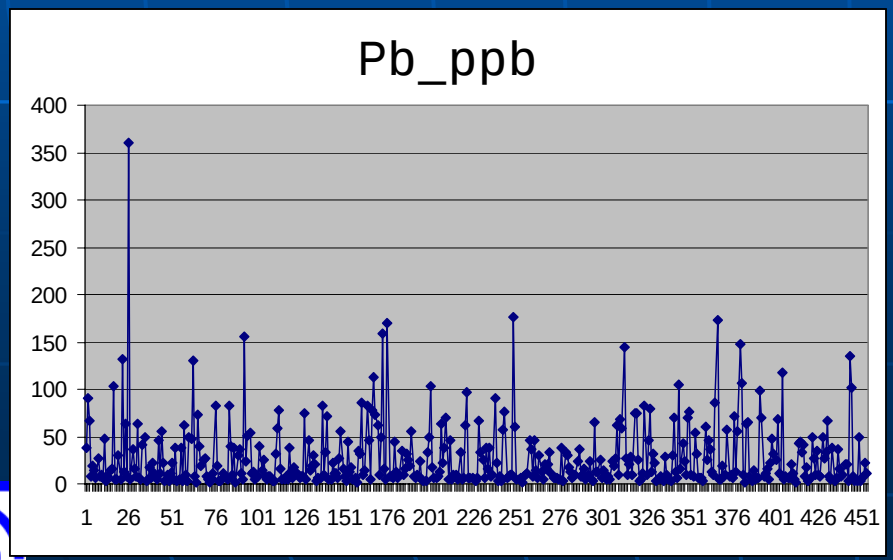
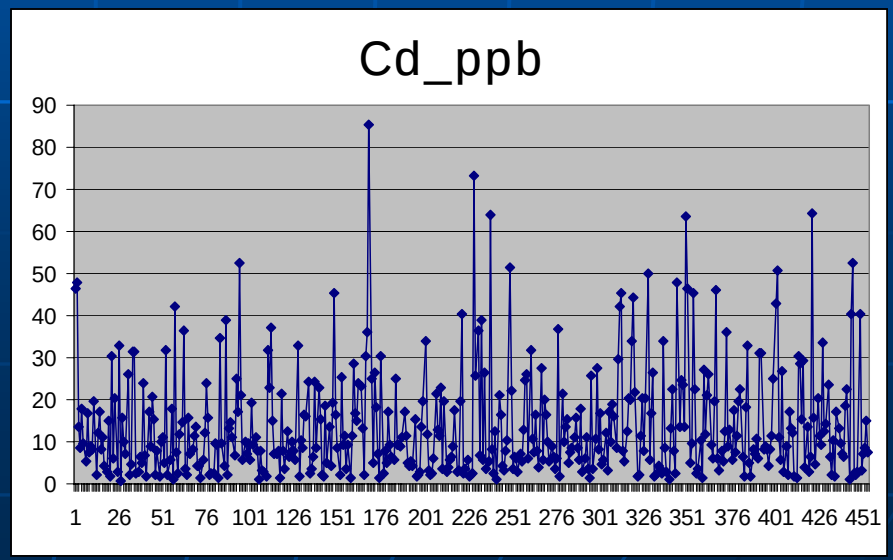
Element Concentrations by Field Randomized Sequential Assay Order

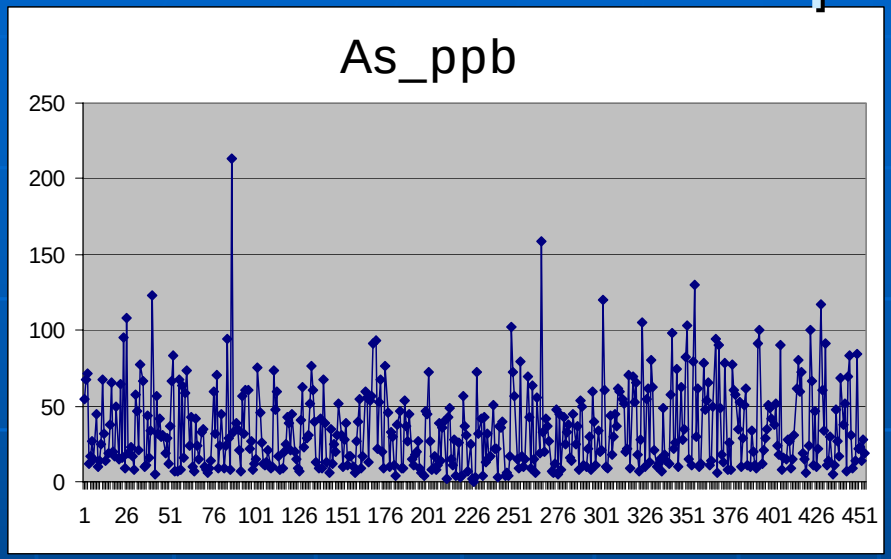


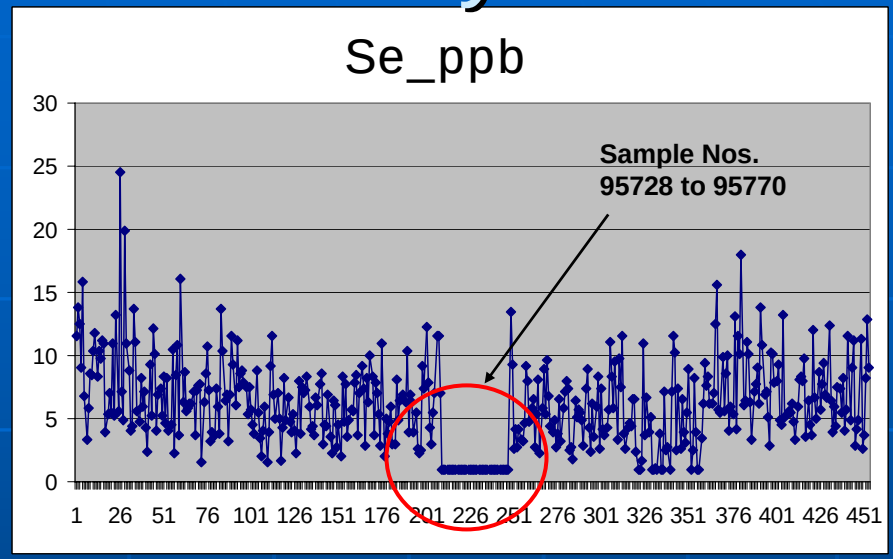


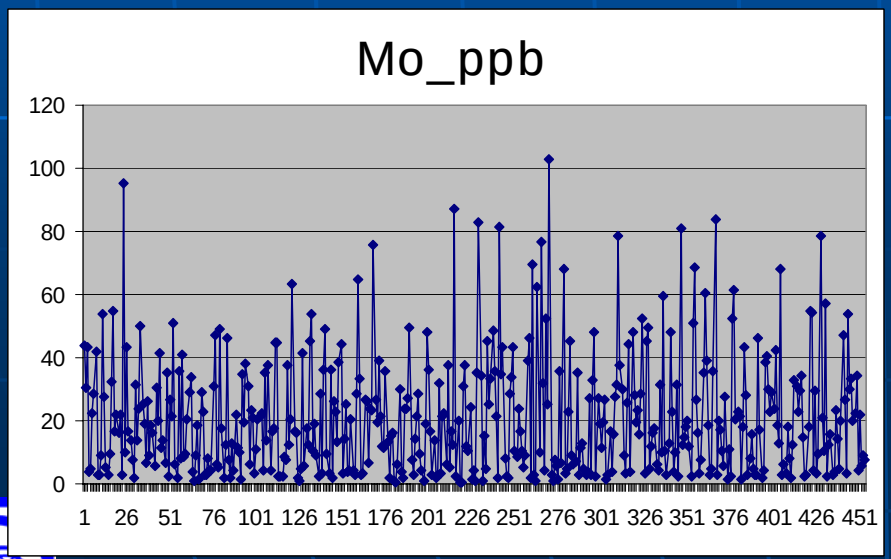


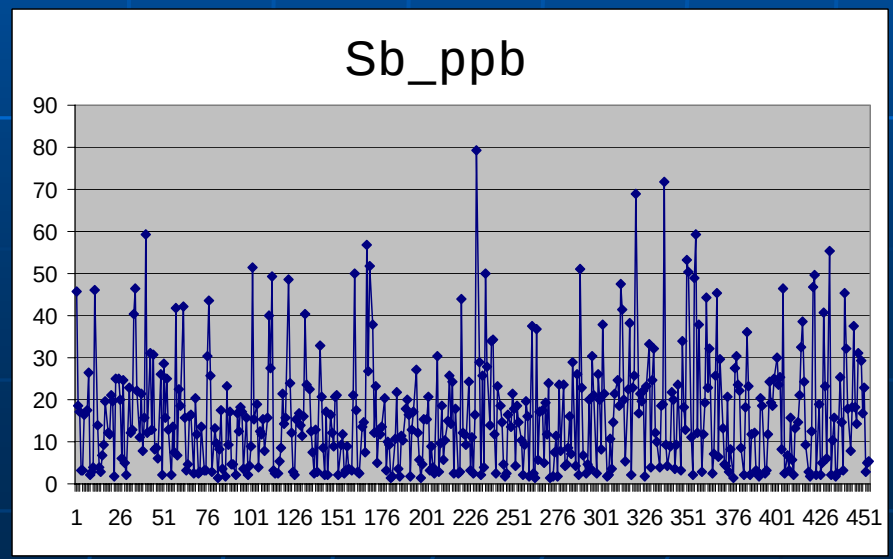


Element Concentrations by Field Randomized Sequential Assay Order









QAQC Conclusions

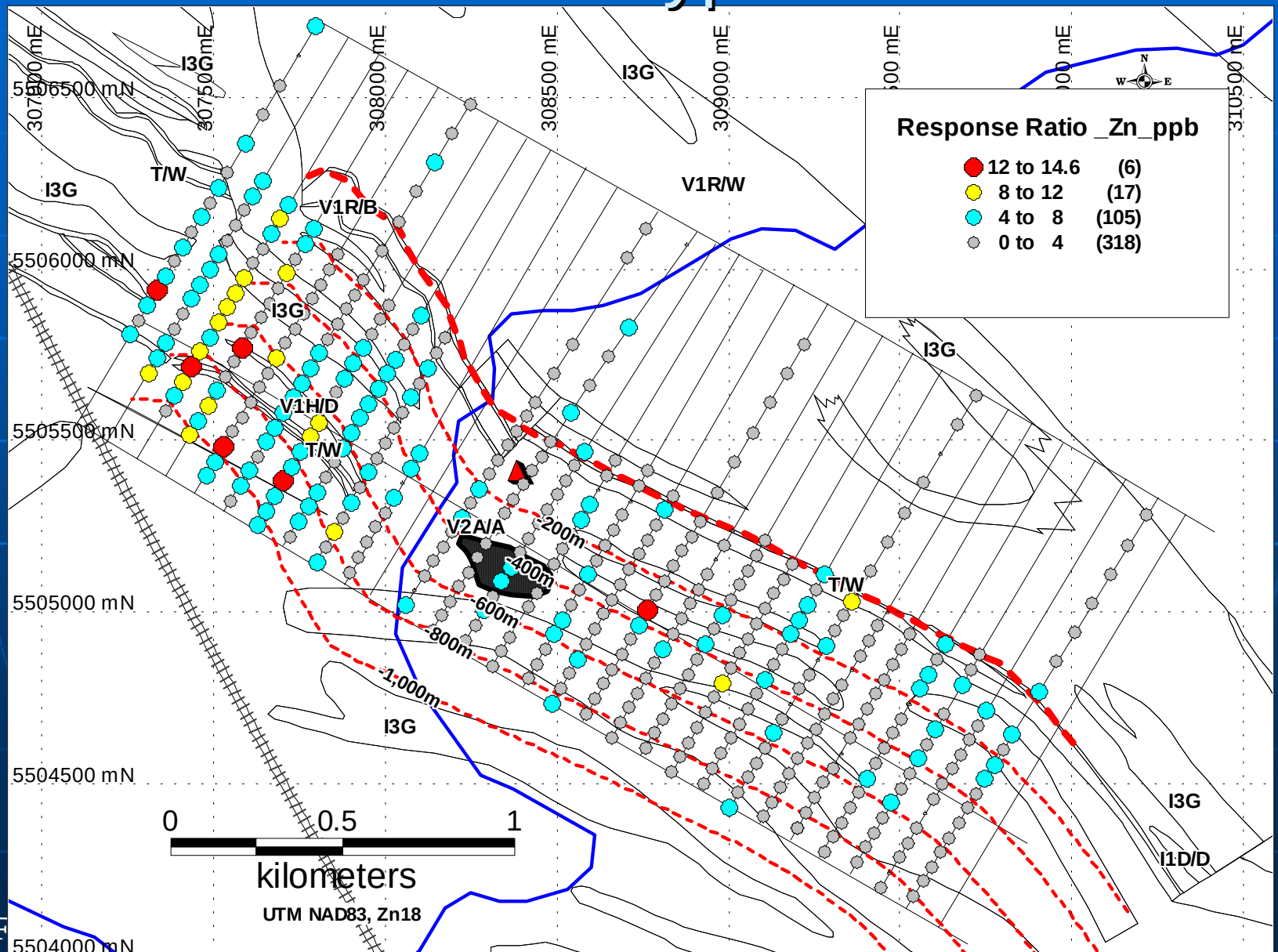
- Drift monitor response was different than results obtained in 2003 but batch to batch variations acceptable.
- Analytical and Lab Preparation Precision Good for most elements but Field Duplicate precision poor for Zn, Pb, Cd, and some other elements (RSD% > 60%).
- Some problems highlighted by randomized 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.

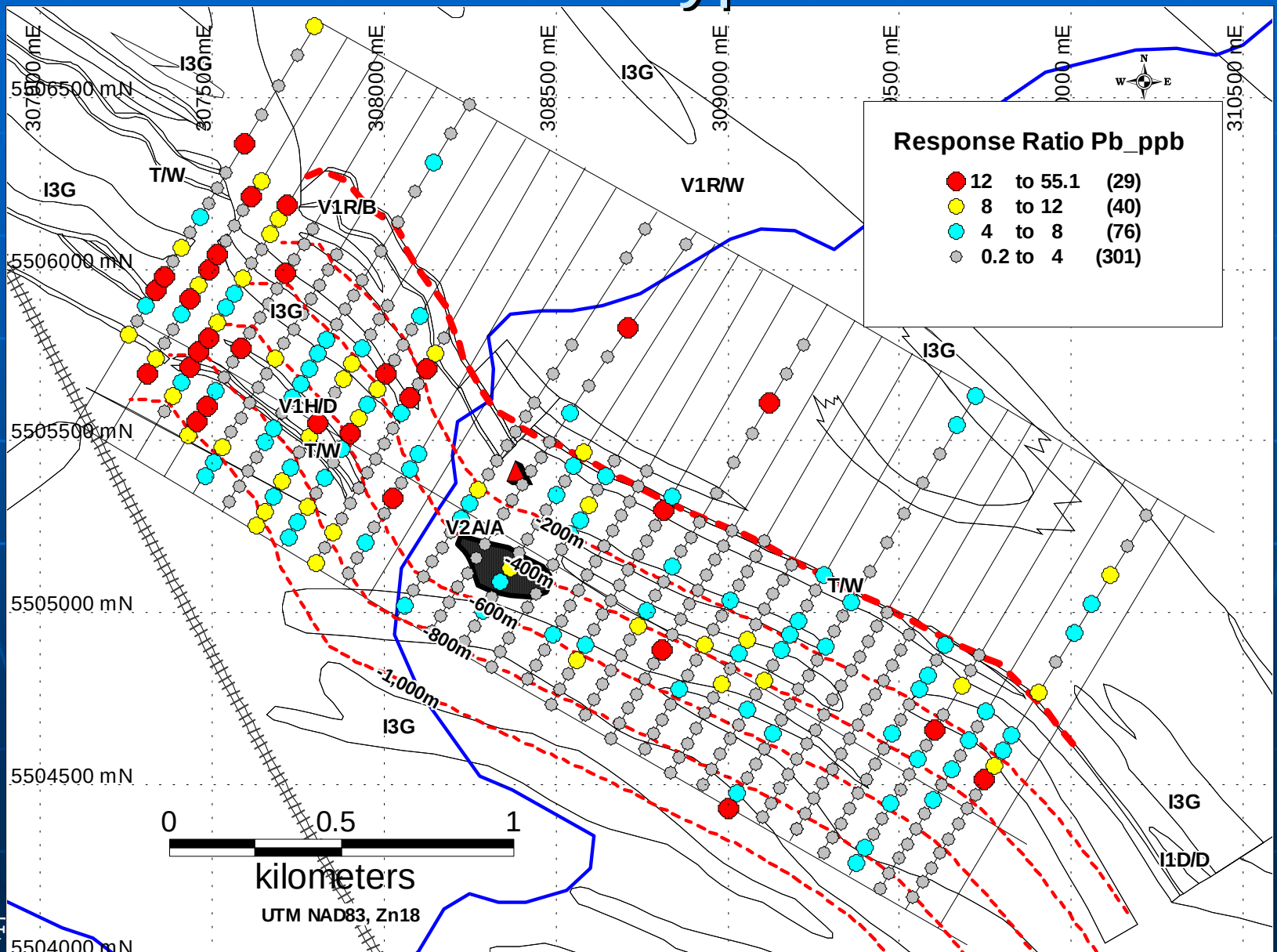
Response Ratio Maps

- 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)

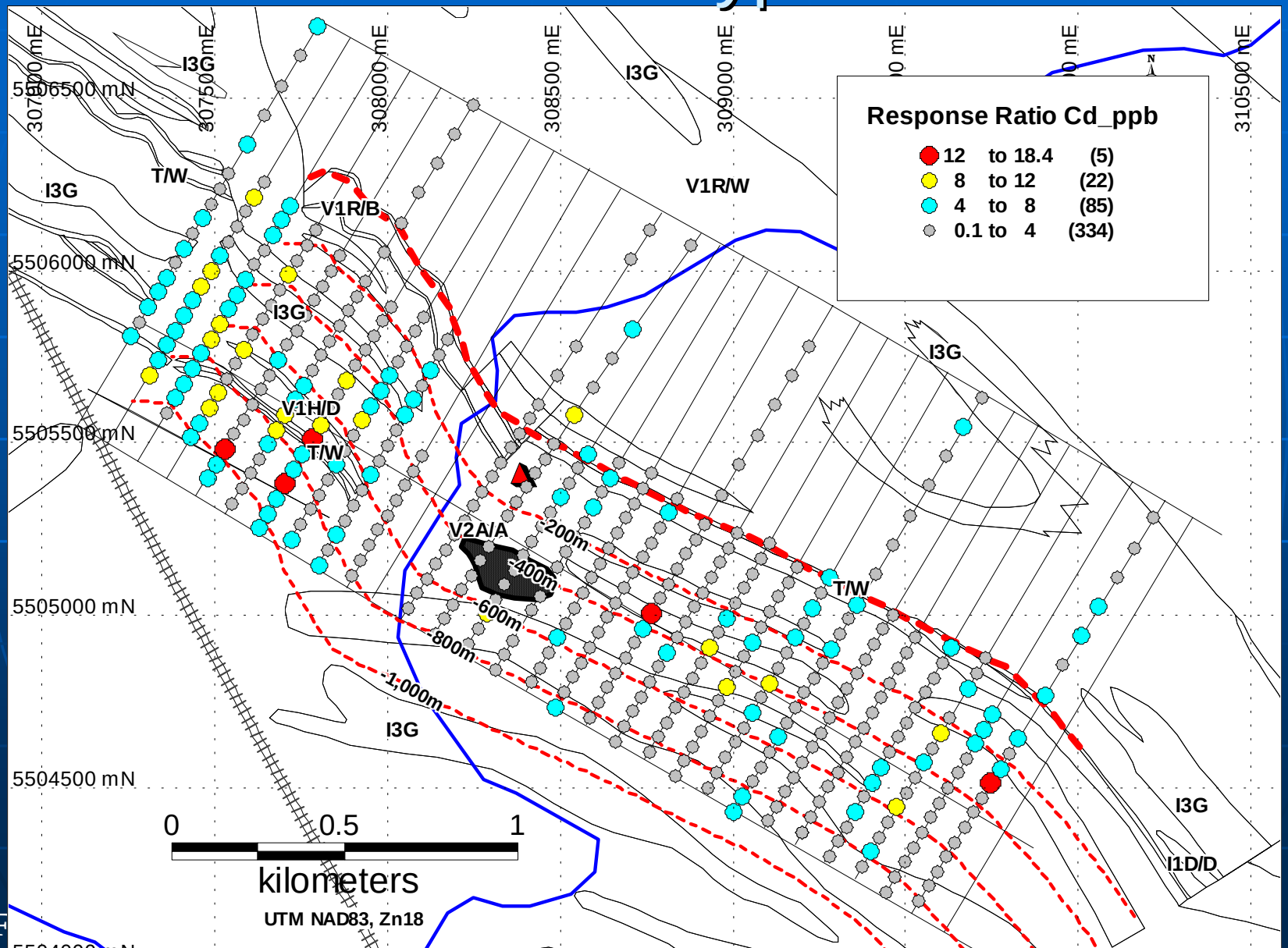
Zn_ppb Response Ratio Normalized for Soil Type



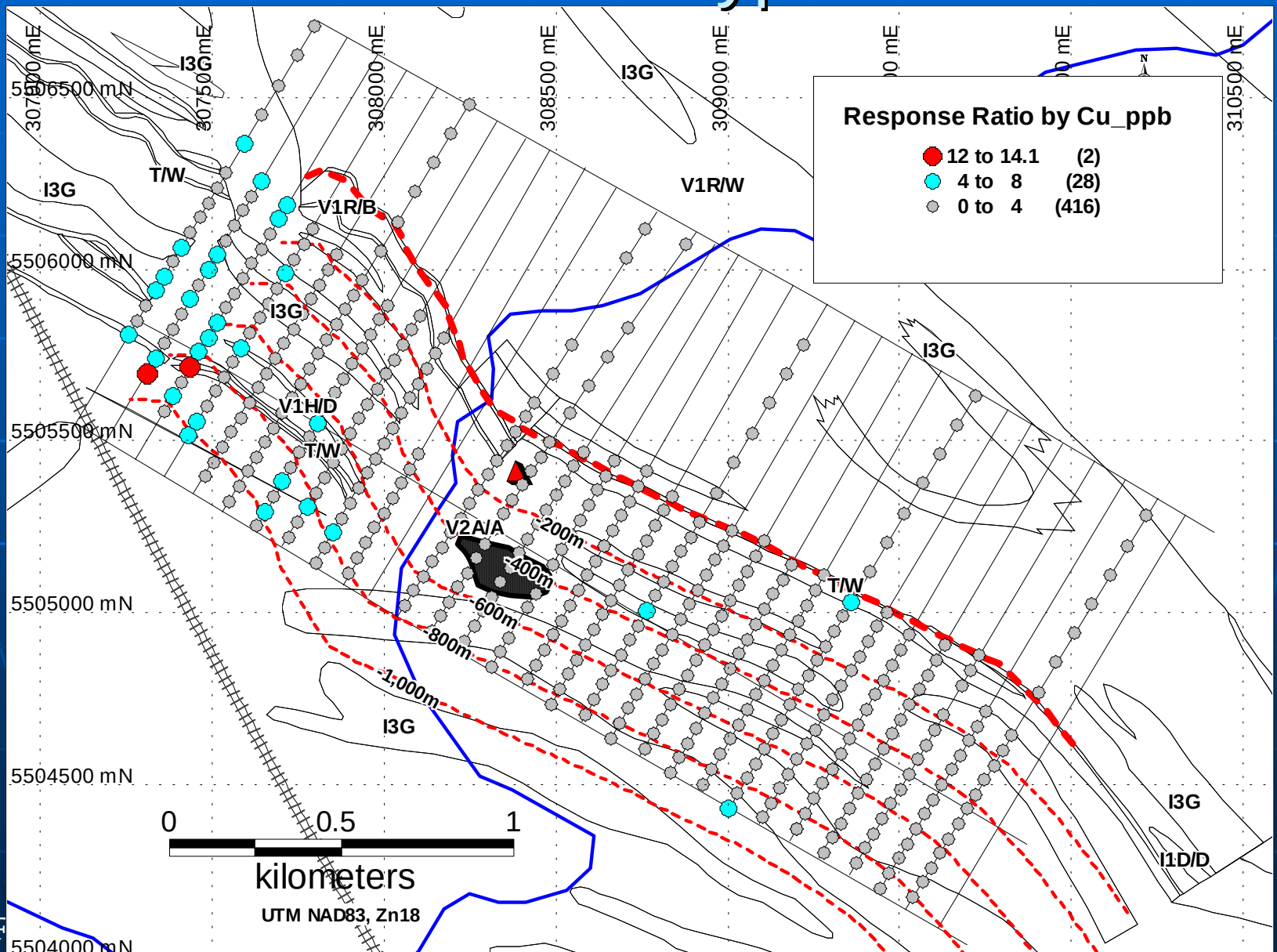
Pb_ppb Response Ratio Normalized for Soil Type



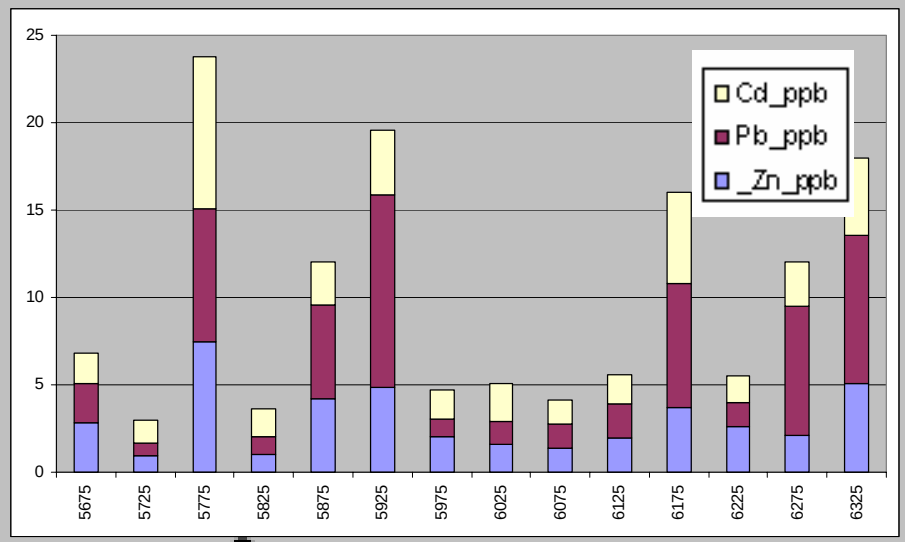
Cd_ppb Response Ratio Normalized for Soil Type

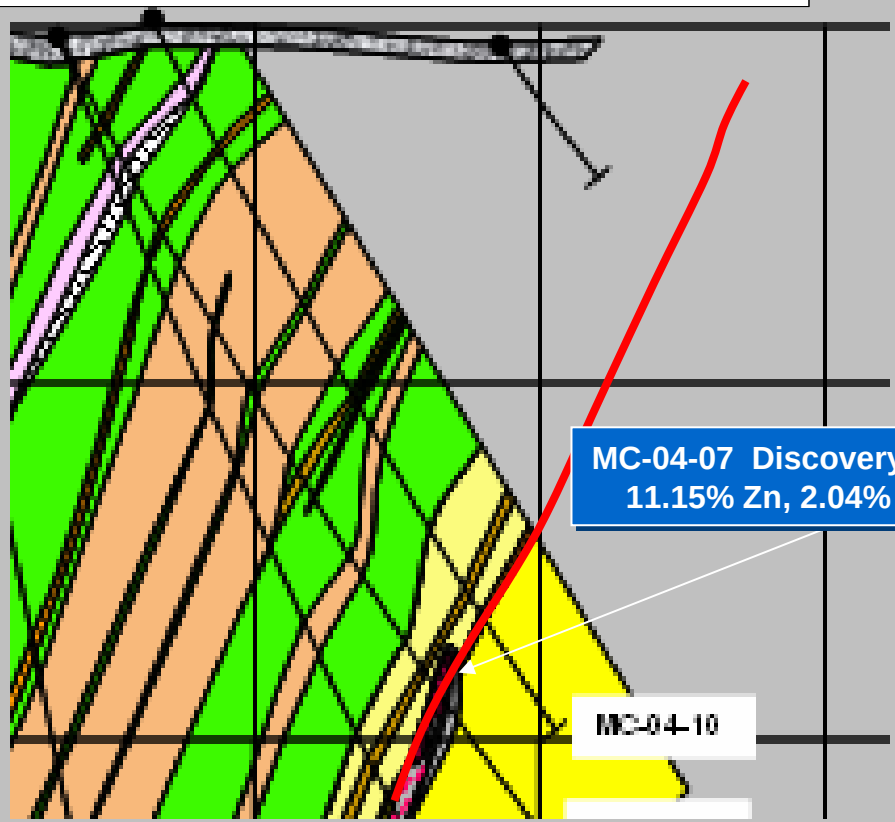


Cu_ppb Response Ratio Normalized for Soil Type

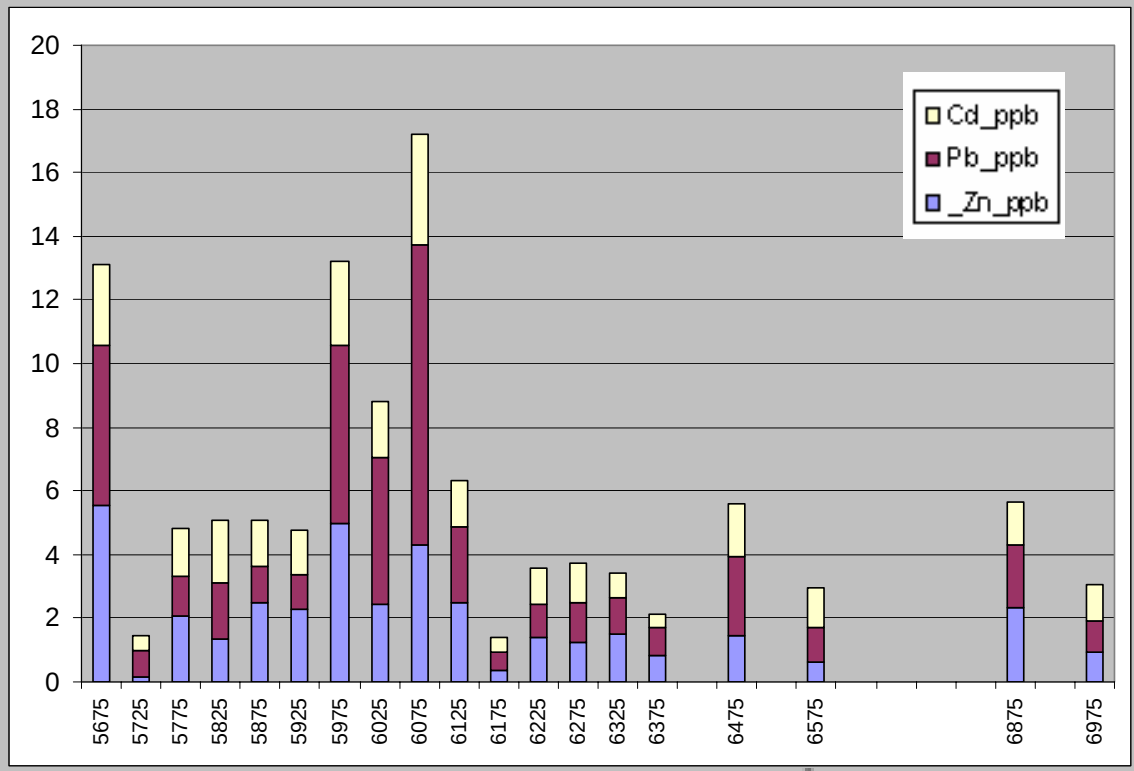


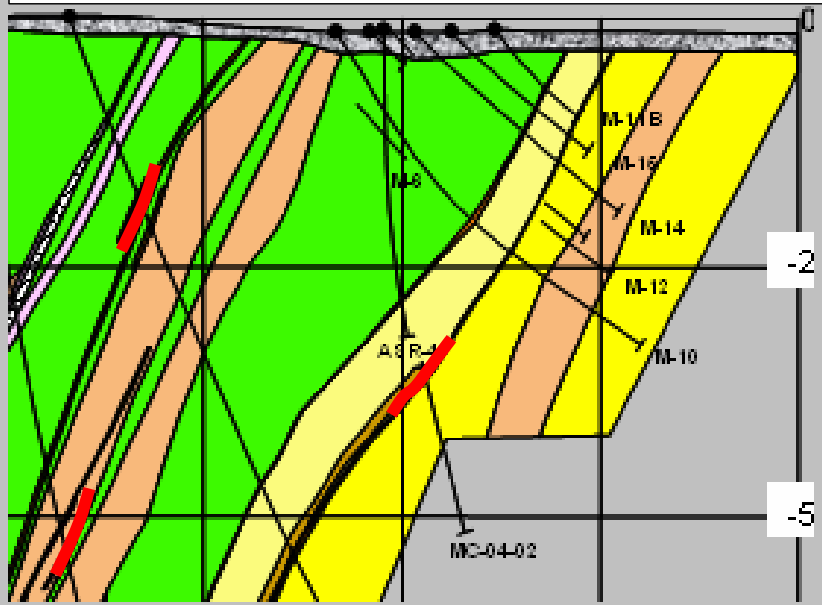
Section 75+00E 13375E



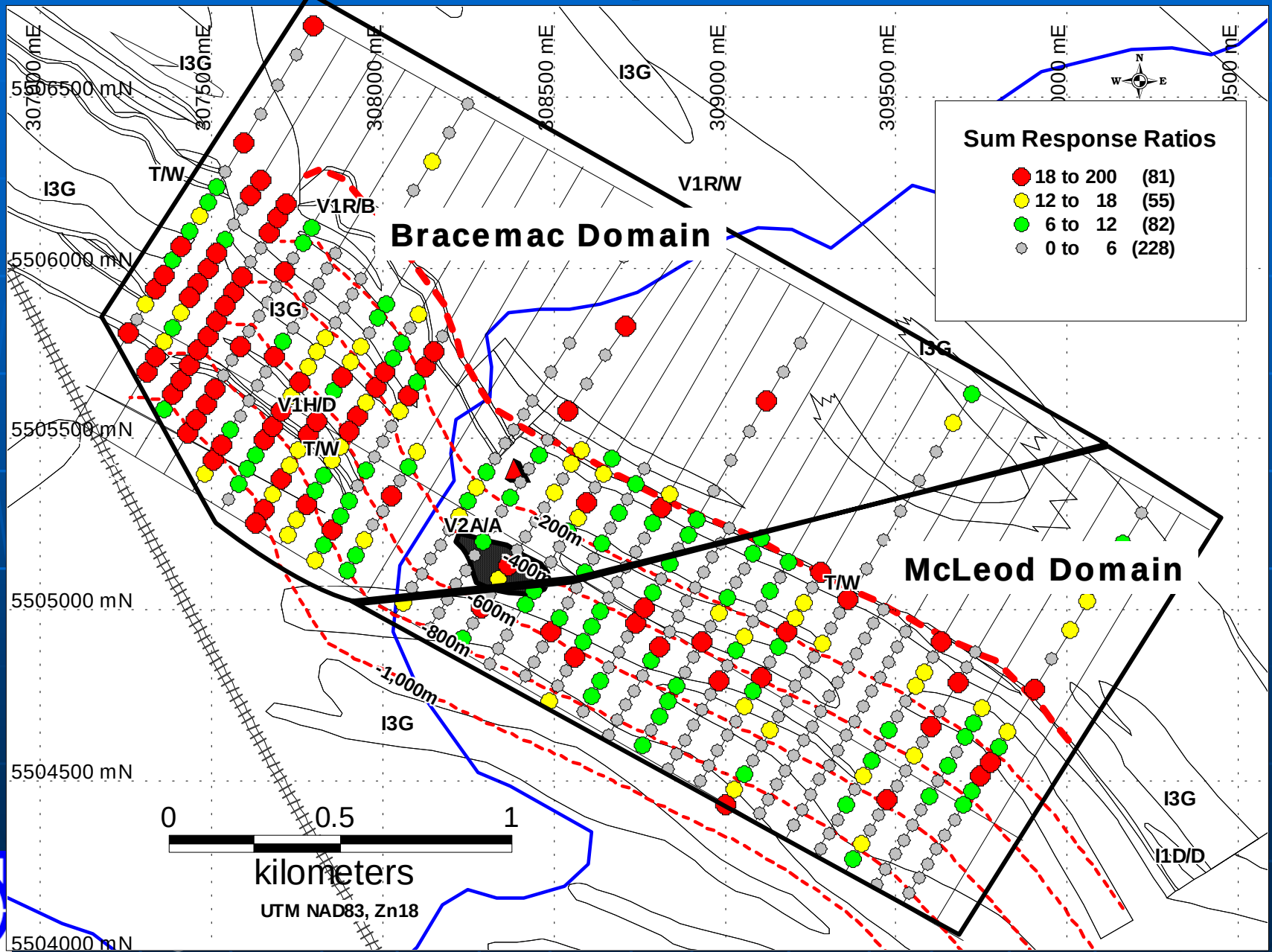


Section 73+00E 13175E

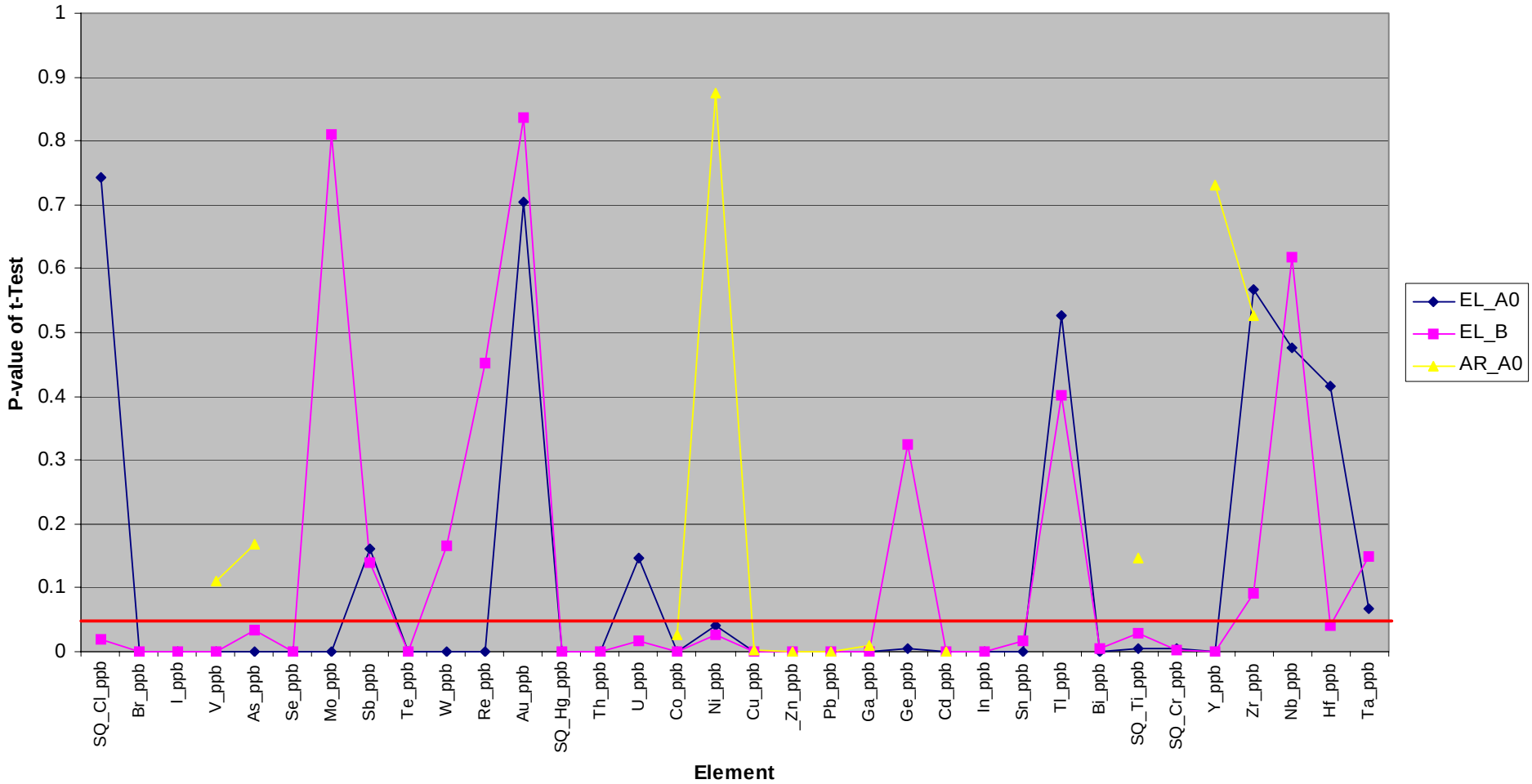




Sum of Response Ratios



P-values of t-Tests for Domains



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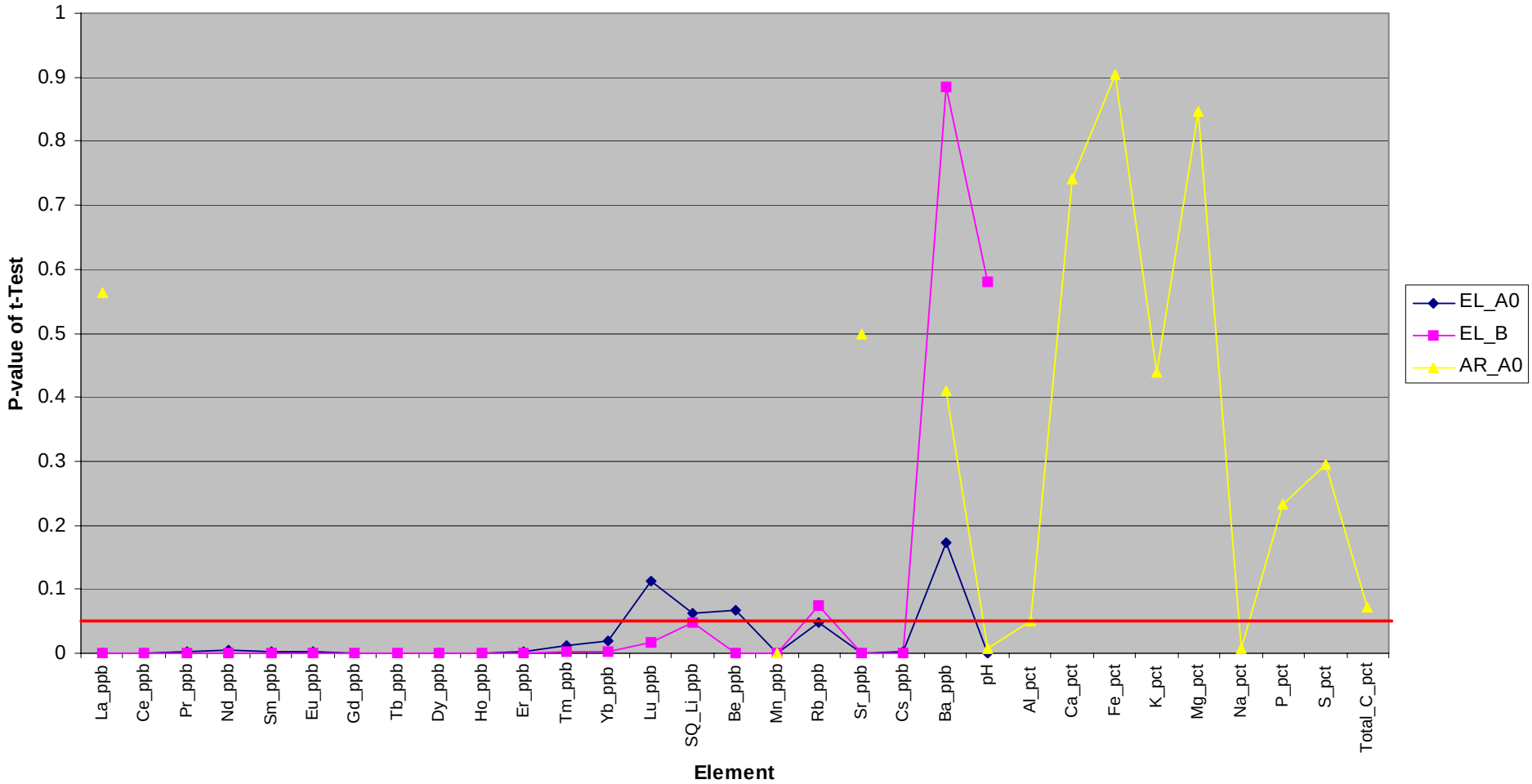


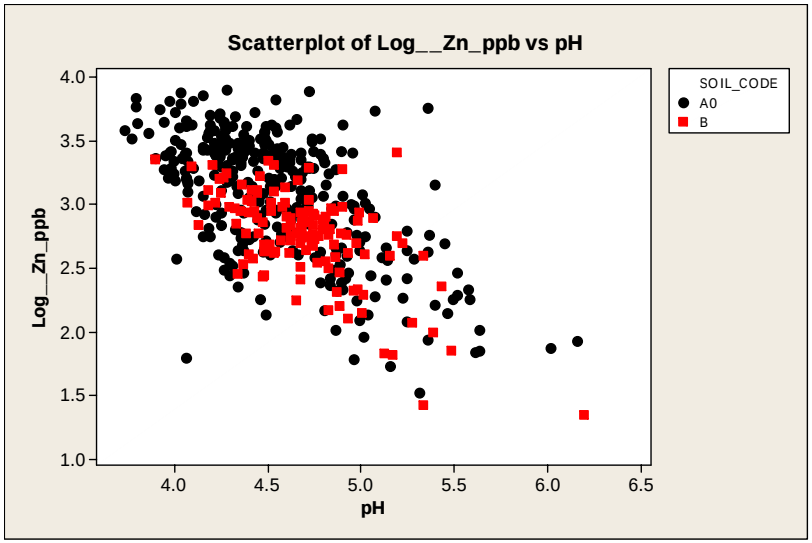
Conclusions of Response Ratio Method

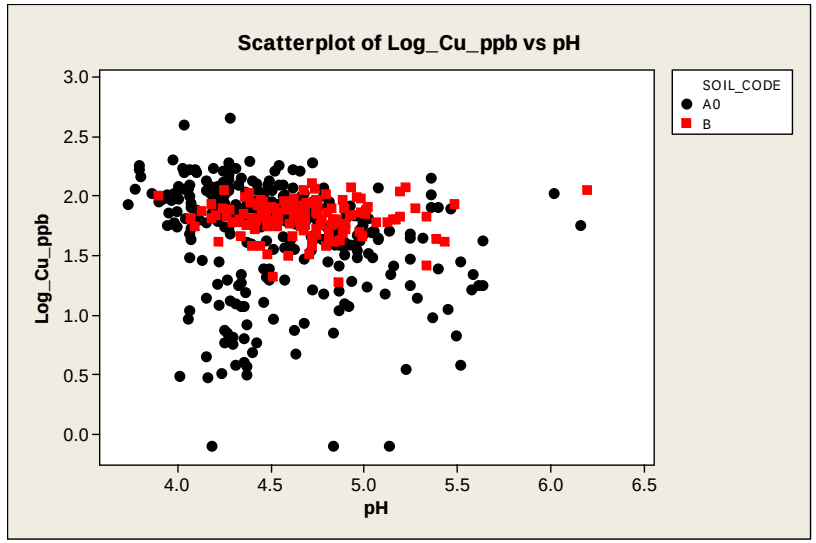
- Main feature of data is presence of 2 domains defined in part by pH.
- Eastern (McLeod) domain generally much lower in average values for many elements and western (Bracemac) domain which has anomalous background in Zn, Pb, Cd, Sn, In and lower pH.
- Data tested for proximity to rail line but no correlation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

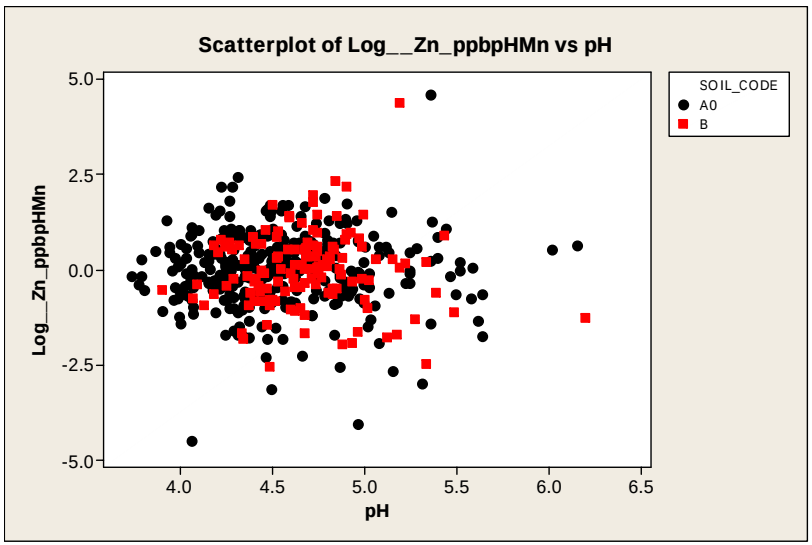
Normalization (Sequential Regression) Method

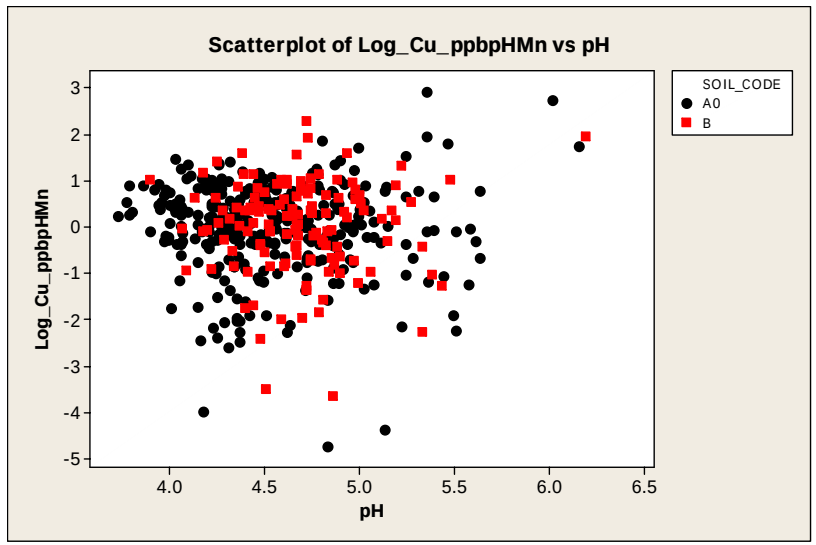
- Second stage of interpretation consisted of normalization to remove surficial effects.
- As part of this exercise 60 randomly selected A-horizon samples were submitted for aqua regia digestion/ICP-ES analysis to test whether major components could be controlling the abundance of Enzyme Leach elements.
- 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

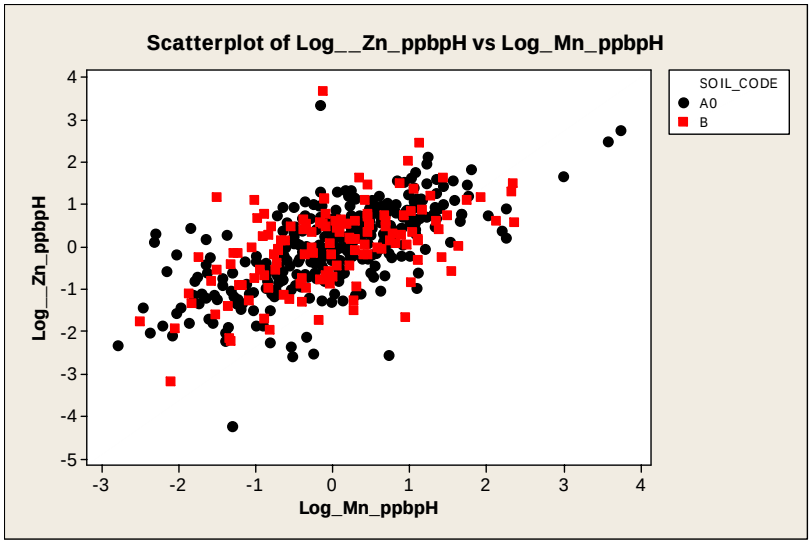


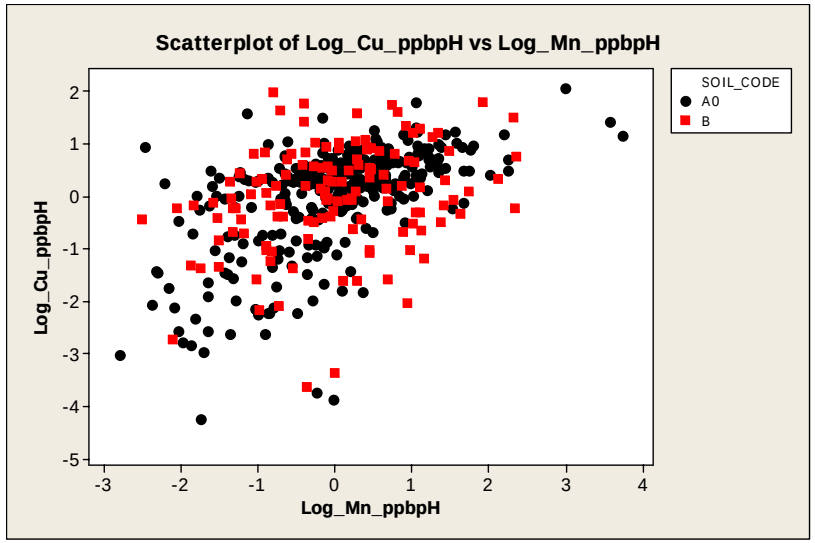


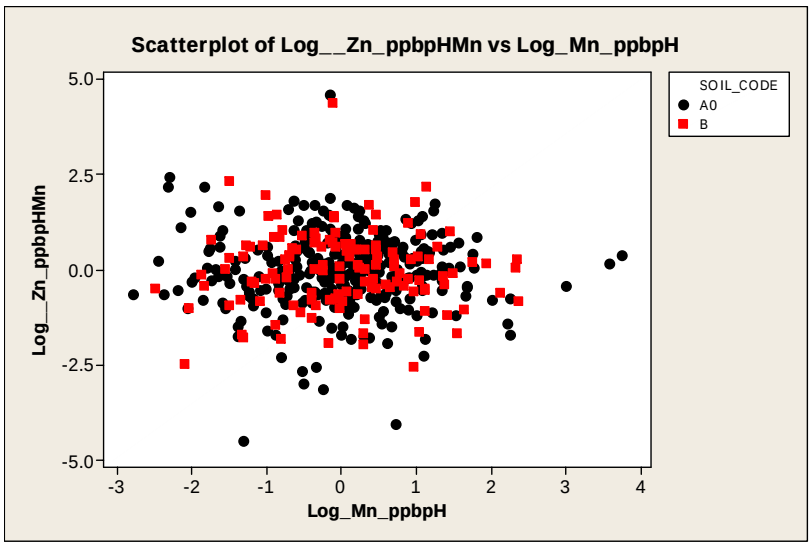


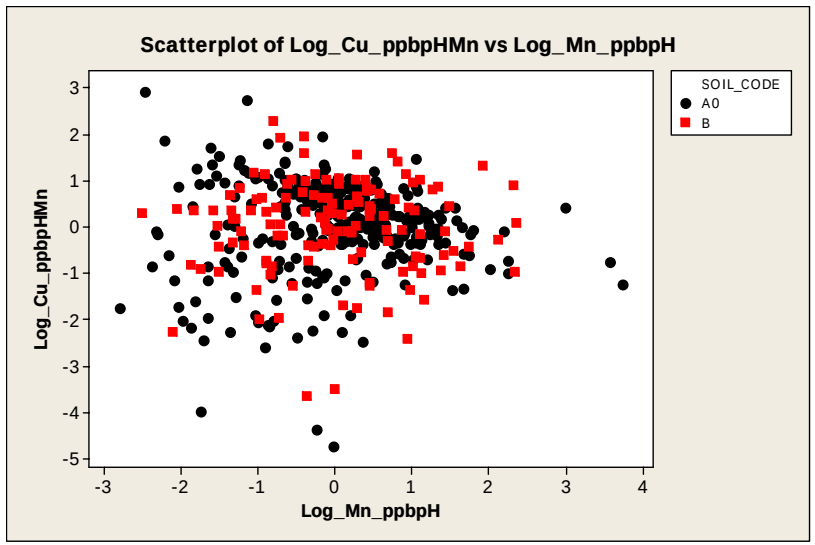


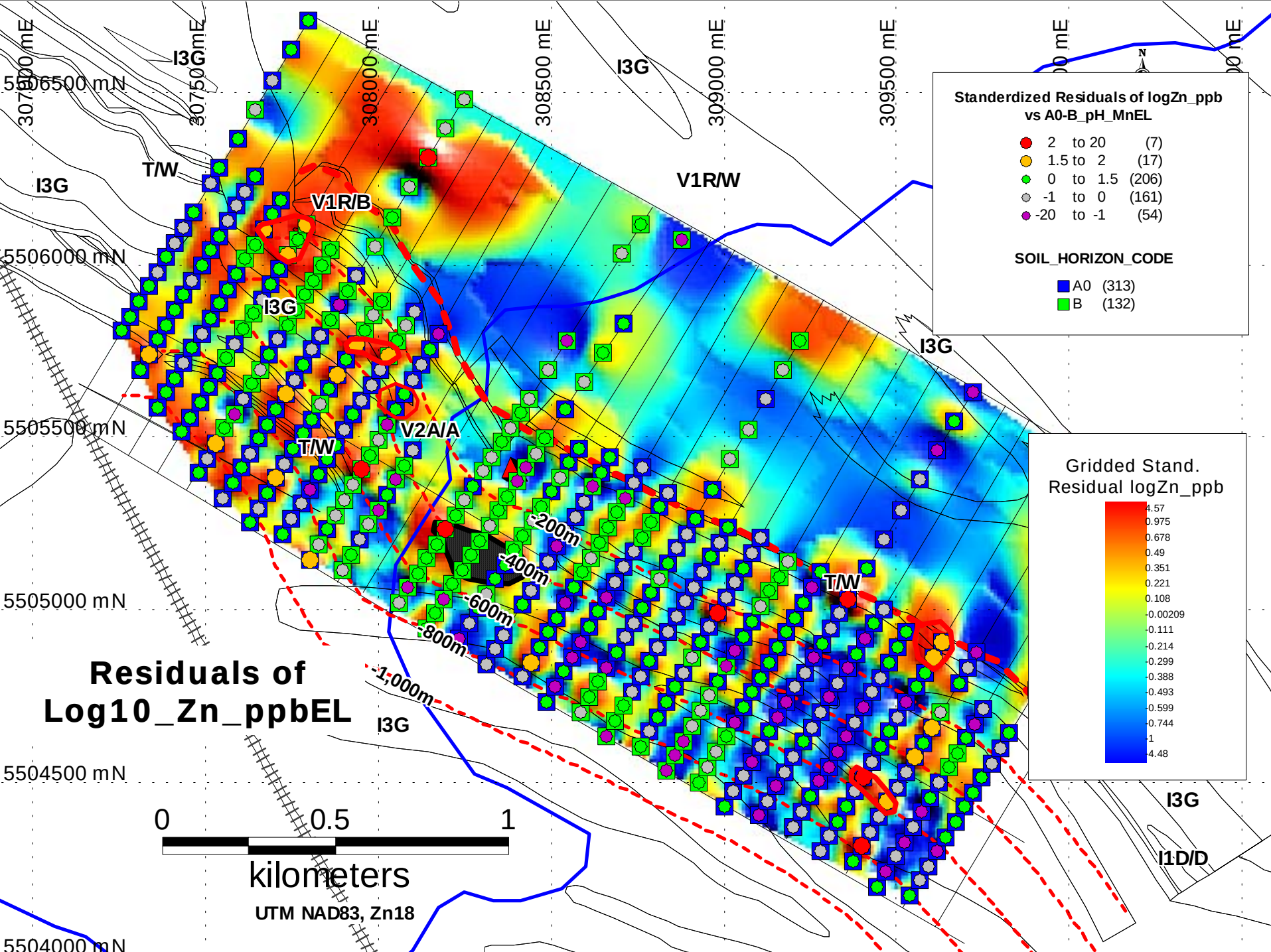
Regression of Selected Elements on Mn_EL

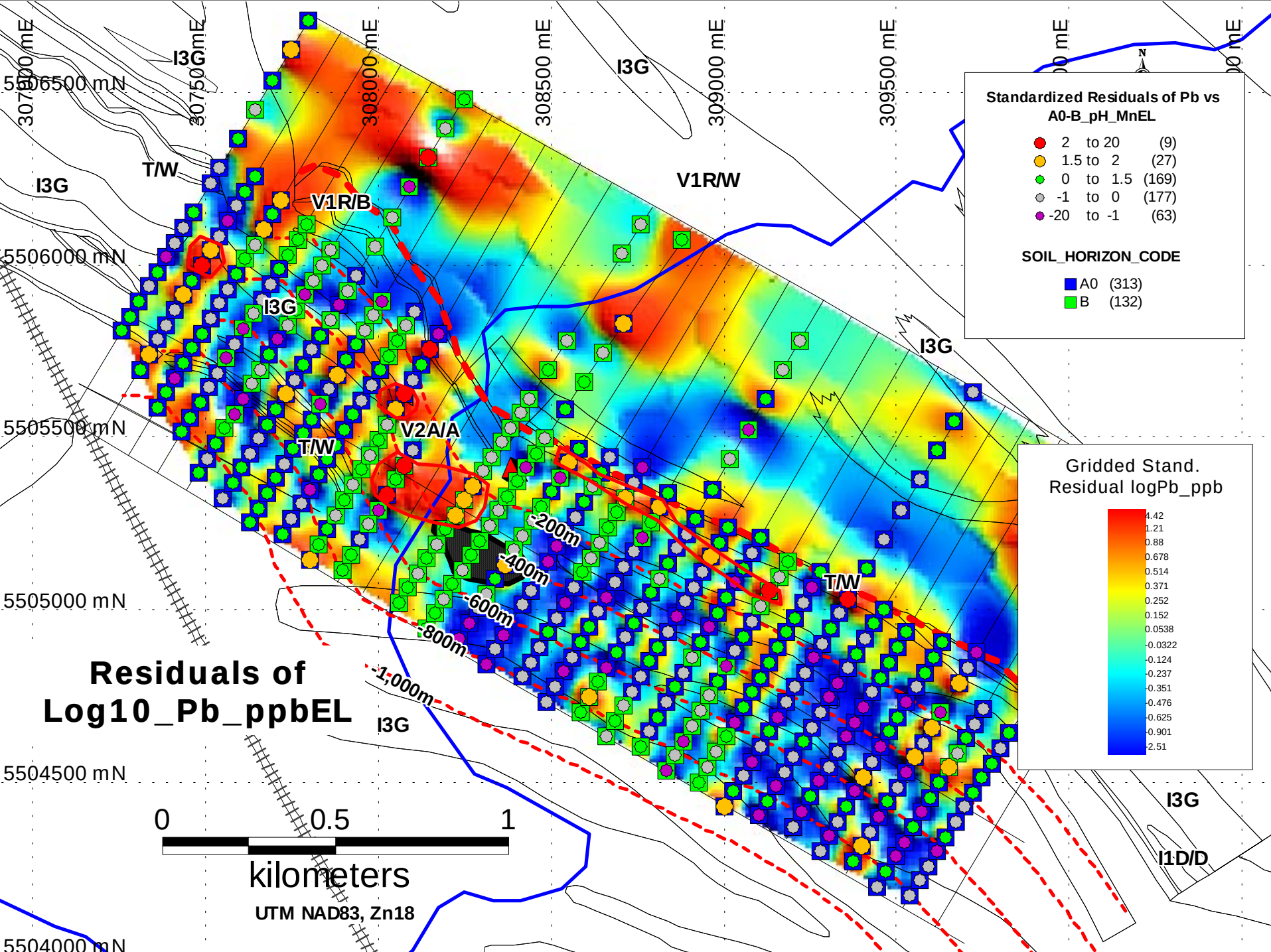


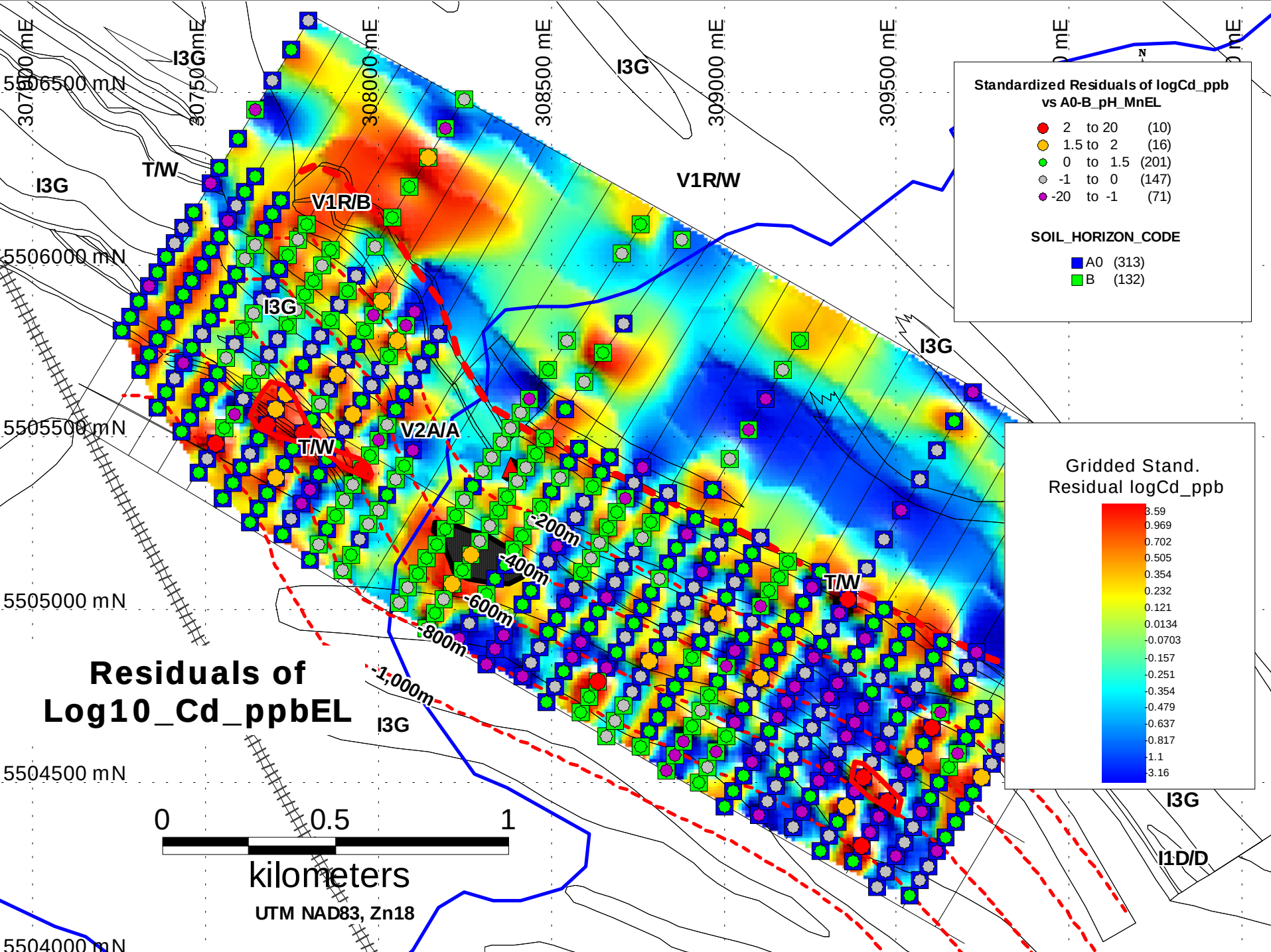


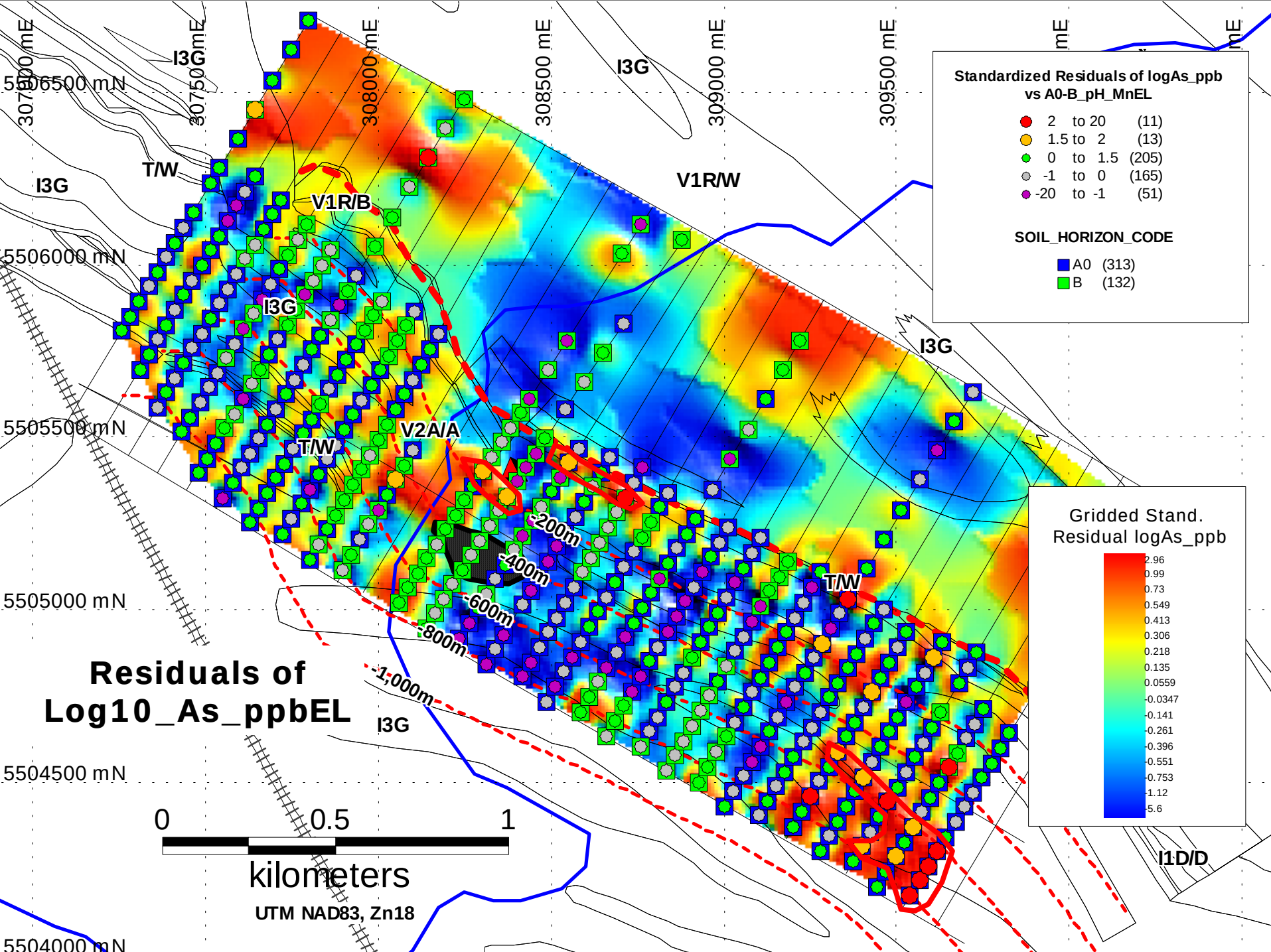


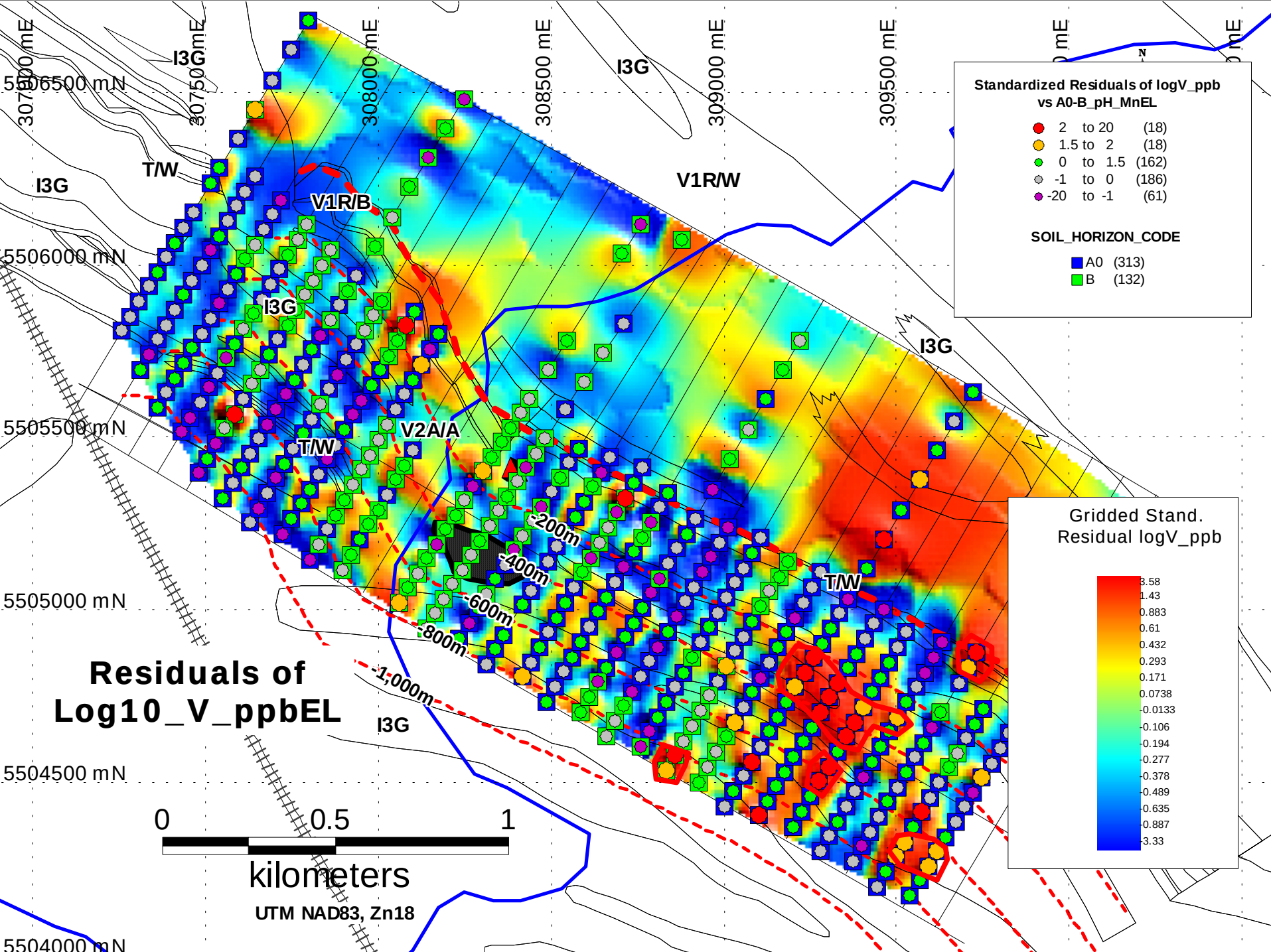


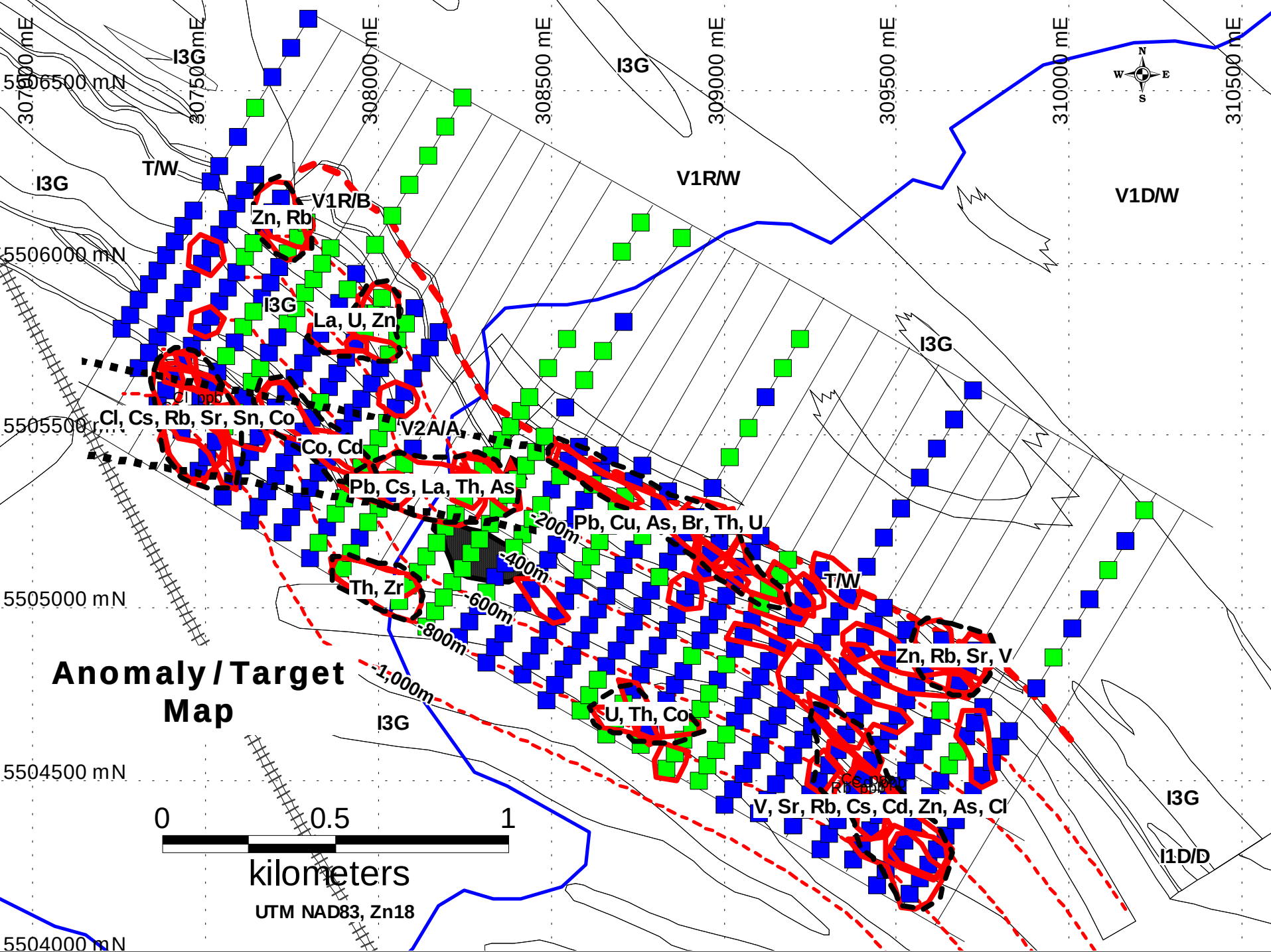

Standerdized Residuals of logZn_ppb
vs A0-B_pH_MnEL
2 to 20 (7)
1.5 to 2 (17)
0 to 1.5 (206)
-1 to 0 (161)
-20 to -1 (54)
SOIL_HORIZON_CODE
A0 (313)
B (132)
Gridded Stand.
Residual logZn_ppb
4.57
0.975
0.678
0.49
0.351
0.221
0.108
-0.00209
-0.111
-0.214
-0.299
-0.388
-0.493
-0.599
-0.744
-1
-4.48
Residuals of
Log10_Zn_ppbEL
I3G
T/W
V1R/B
V1R/W
V2A/A
-200m
-400m
-600m
-800m
-1,000m
I1D/D
307500 mE
308000 mE
308500 mE
309000 mE
309500 mE
5506500 mN
5506000 mN
5505500 mN
5505000 mN
5504500 mN
5504000 mN
0
0.5
1
kilometers
UTM NAD83, Zn18
N


Standardized Residuals of Pb vs A0-B_pH_MnEL
2 to 20 (9)
1.5 to 2 (27)
0 to 1.5 (169)
-1 to 0 (177)
-20 to -1 (63)
SOIL_HORIZON_CODE
A0 (313)
B (132)
Gridded Stand. Residual logPb_ppb
4.42
1.21
0.88
0.678
0.514
0.371
0.252
0.152
0.0538
-0.0322
-0.124
-0.237
-0.351
-0.476
-0.625
-0.901
-2.51
Residuals of Log10_Pb_ppbEL
I3G
T/W
V1R/B
V1R/W
V2A/A
-200m
-400m
-600m
-800m
-1,000m
I1D/D
0
0.5
1
kilometers
UTM NAD83, Zn18
5506500 mN
5506000 mN
5505500 mN
5505000 mN
5504500 mN
5504000 mN
307500 mE
308000 mE
308500 mE
309000 mE
309500 mE


Standardized Residuals of logCd_ppb
vs A0-B_pH_MnEL
2 to 20 (10)
1.5 to 2 (16)
0 to 1.5 (201)
-1 to 0 (147)
-20 to -1 (71)
SOIL_HORIZON_CODE
A0 (313)
B (132)
Gridded Stand.
Residual logCd_ppb
3.59
0.969
0.702
0.505
0.354
0.232
0.121
0.0134
-0.0703
-0.157
-0.251
-0.354
-0.479
-0.637
-0.817
-1.1
-3.16
Residuals of
Log10_Cd_ppbEL
I3G
T/W
V1R/B
V1R/W
V2A/A
-200m
-400m
-600m
-800m
-1,000m
5506500 mN
5506000 mN
5505500 mN
5505000 mN
5504500 mN
5504000 mN
307500 mE
308000 mE
308500 mE
309000 mE
309500 mE
0
0.5
1
kilometers
UTM NAD83, Zn18
I1D/D


Standardized Residuals of logAs_ppb
vs A0-B_pH_MnEL
2 to 20 (11)
1.5 to 2 (13)
0 to 1.5 (205)
-1 to 0 (165)
-20 to -1 (51)
SOIL_HORIZON_CODE
A0 (313)
B (132)
Gridded Stand.
Residual logAs_ppb
2.96
0.99
0.73
0.549
0.413
0.306
0.218
0.135
0.0559
-0.0347
-0.141
-0.261
-0.396
-0.551
-0.753
-1.12
-5.6
Residuals of
Log10_As_ppbEL
I3G
T/W
V1R/B
V1R/W
V2A/A
-200m
-400m
-600m
-800m
-1,000m
I1D/D
307500 mE
308000 mE
308500 mE
309000 mE
309500 mE
5506500 mN
5506000 mN
5505500 mN
5505000 mN
5504500 mN
5504000 mN
0
0.5
1
kilometers
UTM NAD83, Zn18


Standardized Residuals of logV_ppb vs A0-B_pH_MnEL
2 to 20 (18)
1.5 to 2 (18)
0 to 1.5 (162)
-1 to 0 (186)
-20 to -1 (61)
SOIL_HORIZON_CODE
A0 (313)
B (132)
Gridded Stand. Residual logV_ppb
3.58
1.43
0.883
0.61
0.432
0.293
0.171
0.0738
-0.0133
-0.106
-0.194
-0.277
-0.378
-0.489
-0.635
-0.887
-3.33
Residuals of Log10_V_ppbEL
I3G
T/W
V1R/B
V1R/W
V2A/A
-200m
-400m
-600m
-800m
-1,000m
307500 mE
308000 mE
308500 mE
309000 mE
309500 mE
5506500 mN
5506000 mN
5505500 mN
5505000 mN
5504500 mN
5504000 mN
0
0.5
1
kilometers
UTM NAD83, Zn18
N

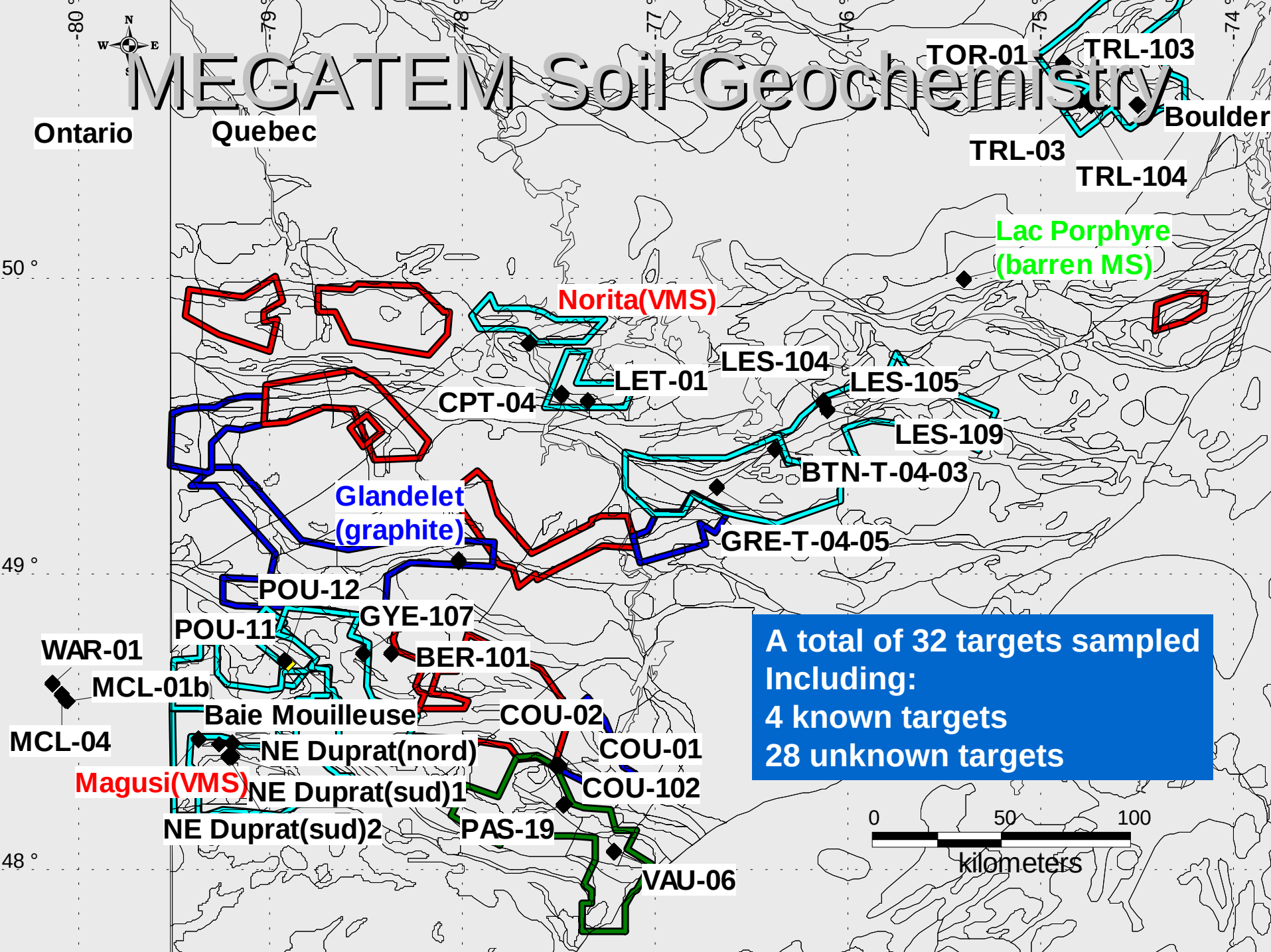

Anomaly / Target Map
I3G
T/W
V1R/W
V1D/W
V1R/B
Zn, Rb
La, U, Zn
Cl, Cs, Rb, Sr, Sn, Co
V2A/A
Co, Cd
Pb, Cs, La, Th, As
Pb, Cu, As, Br, Th, U
Th, Zr
U, Th, Co
Zn, Rb, Sr, V
V, Sr, Rb, Cs, Cd, Zn, As, Cl
I1D/D
-200m
-400m
-600m
-800m
-1,000m
307500 mE
308000 mE
308500 mE
309000 mE
309500 mE
310000 mE
310500 mE
5506500 mN
5506000 mN
5505500 mN
5505000 mN
5504500 mN
5504000 mN
0
0.5
1
kilometers
UTM NAD83, Zn18
N
S
W
E

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).


MEGATEM Soil Geochemistry
Ontario
Quebec
TOR-01
TRL-103
Boulder
TRL-03
TRL-104
Lac Porphyre
(barren MS)
Norita(VMS)
LES-104
LET-01
CPT-04
LES-105
LES-109
BTN-T-04-03
Glandelet
(graphite)
GRE-T-04-05
POU-12
GYE-107
POU-11
BER-101
WAR-01
MCL-01b
MCL-04
Baie Mouilleuse
COU-02
NE Duprat(nord)
COU-01
Magusi(VMS)
NE Duprat(sud)1
COU-102
NE Duprat(sud)2
PAS-19
VAU-06
A total of 32 targets sampled
Including:
4 known targets
28 unknown targets
0
50
100
kilometers
50 °
49 °
48 °
-80
-79
-78
-77
-76
-75
-74

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