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An Enzyme Leach B-Horizon Soil Geochemical Profile Over the Pipestone Ti-V Deposit (South, Disseminated and North Contact Zones), Pipestone Lake, Manitoba (NTS 63I/5 and 63I/12)

By
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OPEN FILE REPORT

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Soil profile in the vicinity of the Pipestone Lake Ti-V deposit.

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SUMMARY

The Pipestone Lake Ti-V-Fe deposit comprises disseminated to near-solid ilmenite and magnetite within a late Archean sill-like layered intrusion known as the Pipestone Lake Anorthosite Complex (PLAC). The deposit is described as comprising 730 000 000 tons of which 685 000 000 tons averages 70.74 m true width, 6325 m length with a grade of 8.37% ilmenite, 17.89% magnetite and 0.2% vanadium pentoxide. Included in the grade and tonnage is 243 000 000 tons in the Main Central Zone and the Disseminated Zone that grades 9.28% ilmenite, 23.6% magnetite and 0.28% vanadium pentoxide (Gossan Resources Limited, 1998). A magmatic origin for the Fe-Ti-V mineralization is indicated.

A single transect of 27 b-horizon soil samples was collected at 25 m sample spacings from hand-dug pits. These were analyzed using the enzyme leach procedure to document single and multisample, low- to moderate-contrast geochemical anomalies over the deposit. Indicator elements comprise the commodity element Ti, late, structurally controlled sulphide-bound metals (Ni, Cu, Pb, Ga, Zn), Nb (Nb-bearing rutile?), Cl, Cs and Ba introduced during late potassium metasomatism. Chlorine forms the widest anomalous response on the transect and encompasses both the South and Disseminated Zones. The highest contrast anomaly-forming metals include Cu and Cs.

The enzyme leach responses over the Disseminated Zone is a "composite" signature, with the magnitude of the anomaly related, in part, to the composition of the parent material. Neutron activation (INAA) and inductively coupled plasma-atomic emission spectrometry (ICP-AES) document high Ni, Co, Cr, Cu and Mg in one of the soil samples marked by an enzyme leach anomaly. The soil at this site is a chrome green residuum of the mafic-ultramafic host rocks to the mineralization. This suggests that at least a portion of the enzyme leach anomaly is controlled by metal stripping from a detrital component in the soil derived from the PLAC. Enzyme leach responses, however, are marked by multisample, higher contrast anomalies rather than a single sample spike in INAA and ICP-AES data.

An enzyme leach geochemical survey can assist in the exploration of repetitions and/or extensions of this style of mineralization particularly since host rocks have been overprinted with a late potassium metasomatic process and a suite of related sulphide-bound metals. The broad Cl anomaly may be the most useful of the indicator elements for exploration purposes.

INTRODUCTION

Surficial deposits, such as till, lacustrine sand, silt, clay and peat represent serious impediments to mineral exploration. Although the analysis of various size fractions of glacial till, and to some degree boulder tracing, has been successful in delineating gold- and base metal-enriched heavy metal dispersion fans, the explorationist is still required to search "up-ice" or within the areal influence of these dispersion trains for the source of the anomalies. In some instances, the till dispersion fans can attain considerable areal dimensions (cf. Kaszycki, 1989). The recent development of geochemical techniques based on sequential, phase-specific and partial digestions coupled with analytical technological advances that permit routine part per billion analysis has provided an opportunity to "see through" transported and other types of overburden. Anomalies defined in this manner generally occur directly over, or in the immediate vicinity of, the mineralized zone. The enzyme leach approach to geochemical prospecting represents a commercially available technique that has application to blind and/or buried mineralization. This analytical technique formed the basis for the orientation survey conducted over the Pipestone Lake Ti-V deposit.

GEOLOGICAL SETTING OF THE PIPESTONE LAKE ANORTHOSITE COMPLEX (PLAC) AND Ti-V-Fe MINERALIZATION

The Pipestone Lake Anorthosite Complex is located on the south shore of Pipestone Lake in the Cross Lake region of central Manitoba (Fig.1) and is within or proximal to the Cross Lake greenstone belt. The late Archean PLAC is a sill-like layered intrusion that is 17 km long, and averages 800 m in width and contains greenschist to lower amphibolite facies mineral assemblages.

It is flanked to the north by basalt and minor sedimentary rocks of the Pipestone Lake Group and to the south by tonalite gneiss of the Whiskey Jack Gneiss Complex (Fig. 2). Numerous east-trending shears are observed in the area.

The geological setting of the Ti-V-Fe mineralization within the Pipestone Lake Anorthosite Complex has been the focus of renewed interest since the publication of Manitoba Energy and Mines Open File Report OF92-1 (Cameron, 1992). This report concentrated primarily on the geological mapping of the PLAC and was subsequently followed up by studies of the characteristics of the Ti-V-Fe oxide mineralization in the western part of the PLAC (Peck et al., 1994a, b) and in the central and eastern portions of the PLAC (Jobin-Bevans et al., 1995, 1996). Recently, Peck et al. (1998) discuss new insights into the PLAC and contained Ti-V-Fe oxide mineralization.

The disseminated and massive oxide mineralization in the PLAC form four separate and distinct, laterally continuous layers and layered sequences. The South Zone is characterized by disseminated, near-solid to solid oxide ilmenite and magnetite mineralization within interlayered leucogabbro, gabbro, and melagabbro. The Main Central Zone comprises near-solid to solid oxide layers that interdigitate with oxide mineralization-bearing gabbro and melagabbro. It varies in thickness from <1 to >20 m. The Main Central Zone is overlain by the Disseminated Zone that comprises a homogeneous melagabbro layer with a consistent (>10%) content of

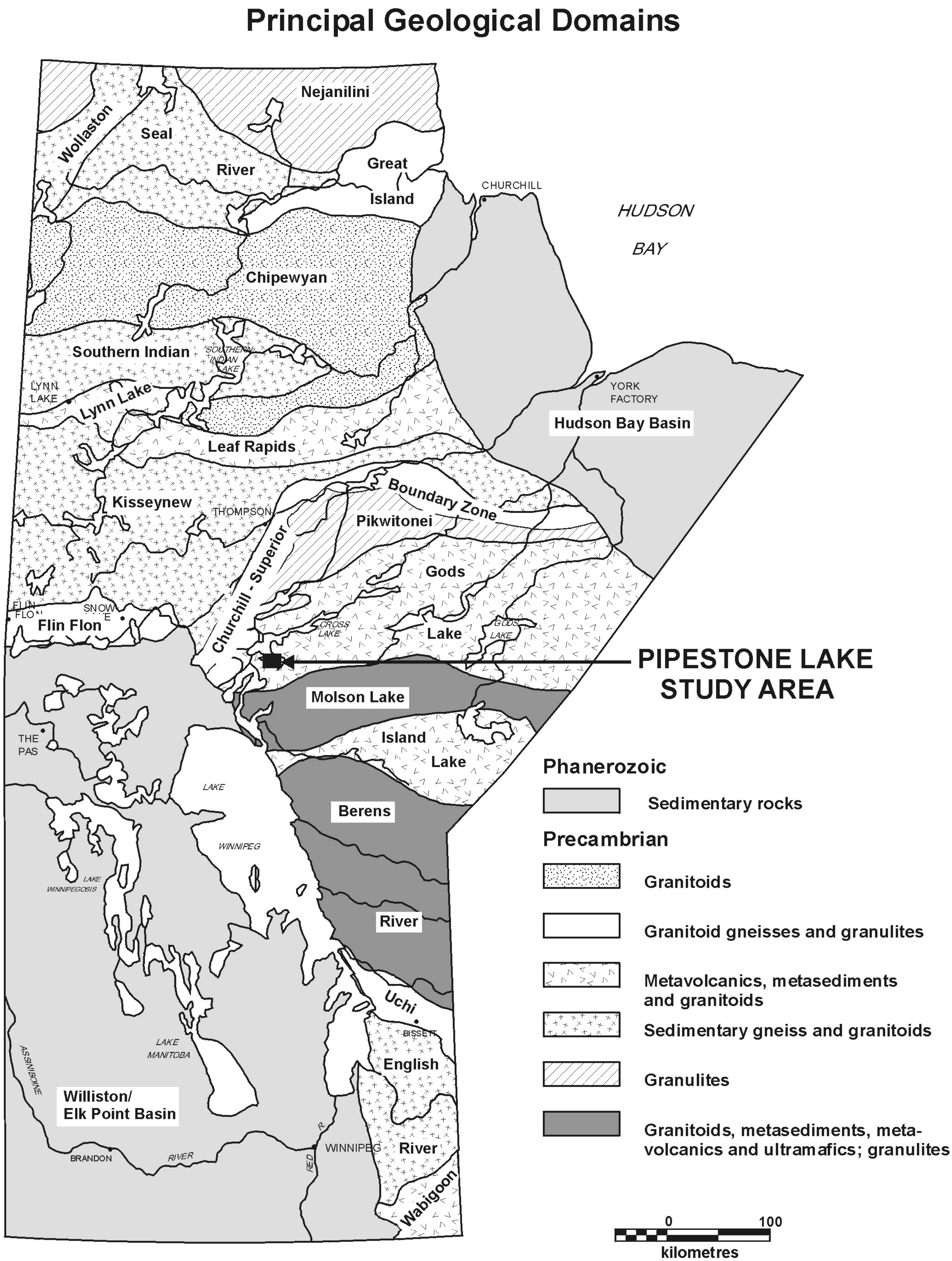

Figure 1: Location map for the Pipestone Lake Ti-V deposit enzyme leach survey.

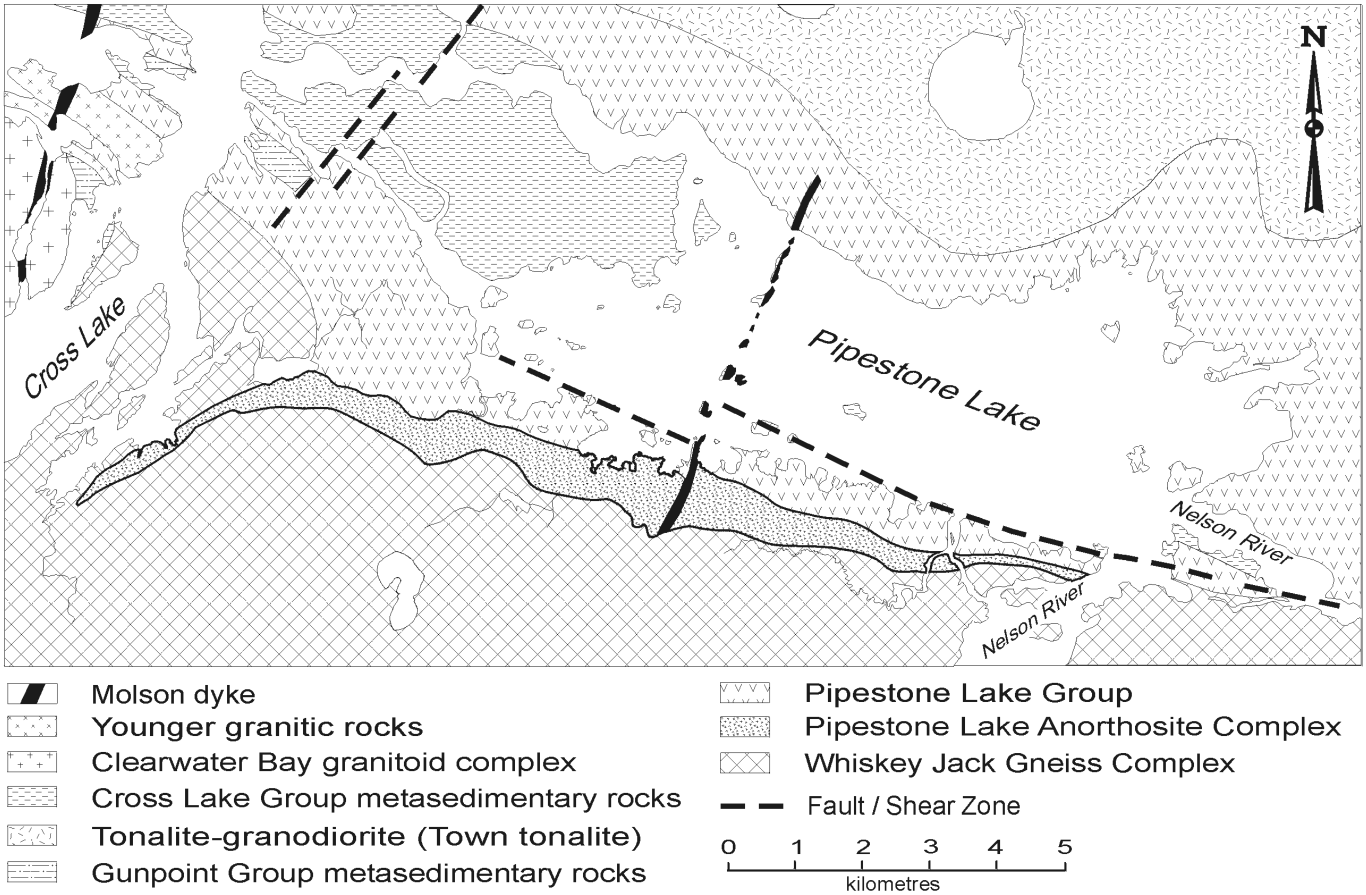

Figure 2: Local geology of the Pipestone Lake area (modified after Cameron, 1992).

ilmenite. The lower portion of the Disseminated Zone is magnetite-enriched. The most northerly of the oxide mineralized zones in the North Contact Zone comprises oxide-enriched garnetiferous sequences of melagabbro, gabbro, minor leucogabbro and pyroxenite. The North Central Zone is marked by more variable and higher ilmenite contents (10-20%) than the underlying Disseminated Zone. The Disseminated Zone contains late-stage, rare, near-solid to solid ilmenite veins.

Although the current genetic interpretation for the Fe-Ti-V oxide mineralization is magmatic (Peck et al., 1994a), recent field evidence documents solid ilmenite-magnetite stringers that may have been produced as a result of unspecified sedimentary processes (Jobin-Bevans et al., 1995).

For more detail regarding the geology and nature of the oxide mineralized zones in the PLAC, the reader is directed to the publications cited above. The preceeding geological description was derived from Jobin-Bevans et al. (1995).

SAMPLE COLLECTION AND PREPARATION

A total of 27 b-horizon soil samples and two duplicate pairs were collected from hand-dug pits on the sampling transect (Fig. 3). Line 31+50 was selected for sample collection since it crosscuts the South, Disseminated and North Contact Zones. Samples were collected from stations 25 m apart and consist of approximately 1 kg of damp inorganic silty clay, sand and silt b-horizon material that was stored in medium-sized ZIPLOC™ freezer bags. Parent material collected at site GR-23 is distinctly different from other samples collected along the transect. The sample comprises chrome green silt interpreted to represent weathered mafic-ultramafic rocks of the PLAC. B-horizon was encountered at an average depth of about 30 cm. Care was taken to exclude all organic material from the sample. Sampling was undertaken in late September and ambient air temperature was constant at approximately 15ºC. Sample preparation was undertaken in the laboratories of the Geological Services Branch. Samples were air dried on plastic, disposable plates and sieved to obtain the -60 mesh size fraction. The -60 mesh size fraction was forwarded to Activation Laboratories Ltd. (Ancaster, Ontario) for multi-element ICP-MS analysis subsequent to enzyme leach extraction. Samples from stations 1+50N, 6+25N, 6+50N, 6+75N and 7+00N on the sampling transect were unavailable due to wet swamp and disturbed ground.

SAMPLE ANALYSIS

Enzyme leach

The enzyme leach process is a phase-specific leach that preferentially attacks amorphous manganese oxide coatings on mineral grains, thereby liberating trace metals that are trapped in this material. Amorphous

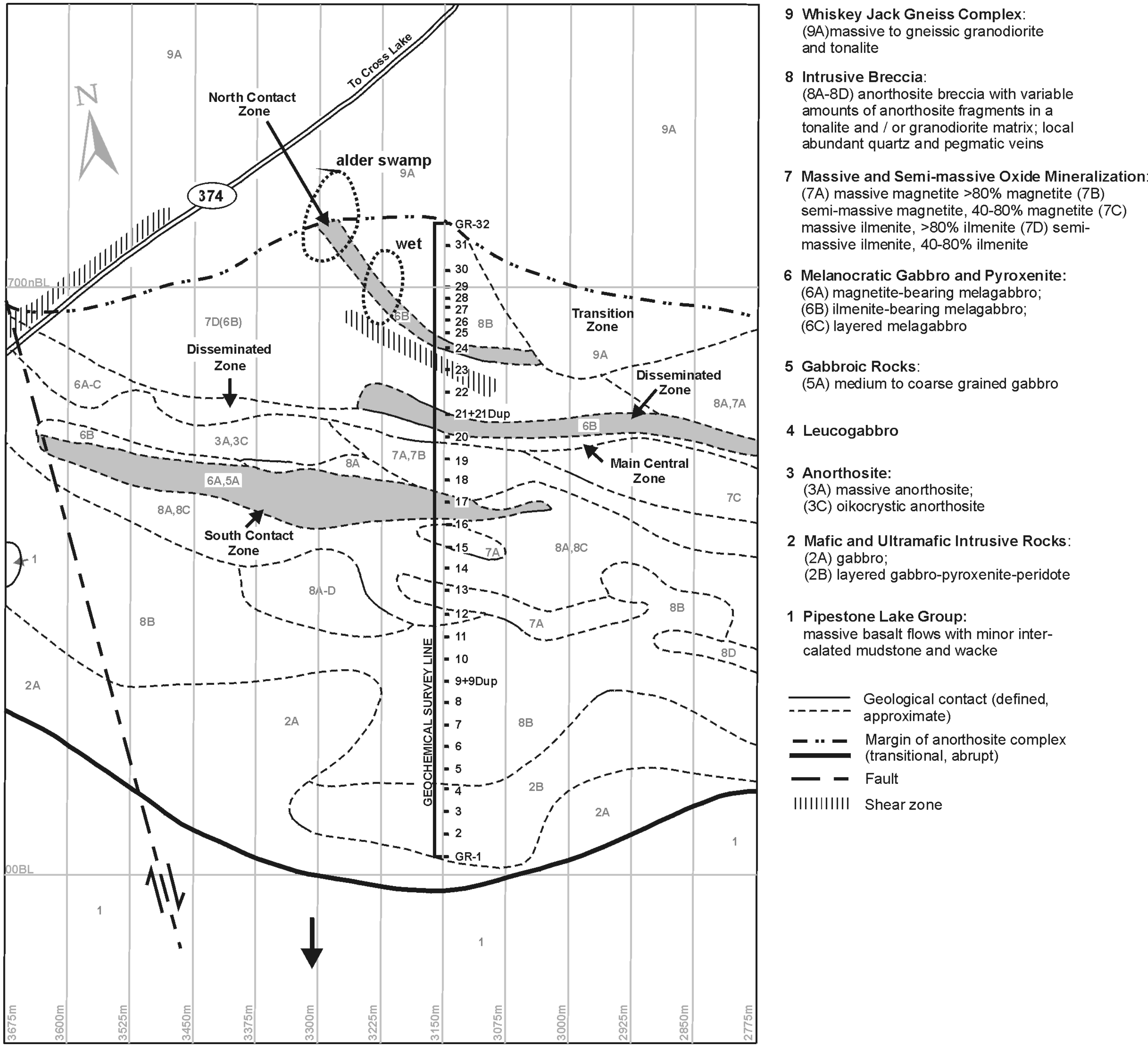

Figure 3: Detailed geology and the location of the enzyme leach b-horizon sampling transect, Pipestone Lake Ti-V deposit.

manganese oxide represents an efficient chemical sieve or trap for cations, anions and polar molecules because of its large surface area and the random distribution of surface charges. The trace elements that are trapped or complexed on the amorphous manganese oxides are interpreted to represent the chemical signatures of buried, oxidizing mineralization at depth, rather than signatures originating from a transported overburden source, such as till. It should be noted, however, that where b-horizon development takes place in till the geochemical signature within the b-horizon may be strongly affected by the weathering of till and the resulting subsequent downward movement of metals. This effect could produce a "transported" till geochemical signature in combination with the site specific mineralization-related geochemical signatures and a composite signature overall. The possible contribution of parent sediment composition to the overall enzyme leach signature is not well understood.

Most of the amorphous manganese oxide is developed in the b-horizon, where studies in both arid and humid geological and climatic environments have established that mineral particles within this soil horizon are coated with this authigenic material. The a-soil horizon may not reflect geochemical anomalies identified in the b-horizon since the a-horizon may be fairly rapidly leached of its metallic components. Leached metals are carried downwards, perhaps as humic- or fulvic-acid compounds (humates/fulvates?), and trapped or sieved as they encounter the amorphous Mn-oxide coatings on mineral grains in the b-horizon. The chemical composition of the a-horizon can also be significantly impacted by the metal content of vegetation contributing litter to the forest floor. This litter will reflect metals obtained by vegetation during nutrient acquisition from soil horizons tapped by root systems. Accordingly, the a-horizon geochemical signature can reflect the ability of various species to acquire and store metals until such time as they are dropped to the forest floor, decompose and move downward in the soil profile. This source of metal may therefore reflect a transported metal signature representing a clastic component within an exotic till at depth rather than a buried mineralization signature.

In the vicinity of oxidizing mineralization, the diffusion of relatively volatile metal phases, or metal transport by gases such as Hg-vapour, CO_2, Rn, He, N, O_2, CO_4, Ar and S-compounds, undoubtedly occurs as a result of a number of processes. Metal transport may be effected by development of an electrochemical or self-potential cell, or possibly as components in soil gases derived from mantle de-gassing (cf. Gold and Soter, 1980; "geogas", Malmquist and Kristiansson, 1984; "earth-gas", Wang et al., 1997). The role of shallow groundwater as the transport medium for metals from source to surface is also being investigated (Stewart Hamilton, pers. comm.). Metals carried by one or more of these mechanisms will enrich the amorphous Mn-oxide in the b-horizon in metals.

The leachate from the b-horizon soil is analyzed by ICP-MS for multiple elements at detection limits in the parts per billion range. Clark (1992, 1993) provides theory and application of the enzyme leach method.

RESULTS

B-horizon soil sample descriptions and the analytical data derived from the enzyme leach/ICP-MS procedure, including field duplicate pairs, is presented in Appendices I and II, respectively. Analyses below the lower limit of detection (<LLD) were converted to half the value of the LLD for graphical and statistical procedures. All elements >LLD were plotted against a lithologic section through the Pipestone Ti-V deposit, thereby transecting the South Zone, the Disseminated Zone and the North Contact Zone. Enzyme leach response over the North Contact Zone could not be properly assessed due to the presence of wet and disturbed swamps that prevented sample collection. Appendix III includes profiles for all elements over the mineralized zones. Neutron activation and inductively coupled plasma-emission spectrometry analytical data for samples collected from transect L31+50 are presented in Appendix IV. Descriptive statistics for enzyme leach data are given in Table 1.

Field duplicate pairs

The enzyme leach/ICP-MS analytical data from two b-horizon soil duplicate pairs at stations 31+50, 2+25N and 31+50, 5+25N on the sampling transect are generally reproducible. The b-horizon at these two sites comprise light reddish brown clay at 2+25N and a brown silty clay that is mixed with less oxidized equivalents due to frost heaving at 5+25N. Duplicates at these two sites were collected 1 m apart. Manganese contents in the duplicate pairs exhibit the most variability whereas all other elements across the observed measured concentration range are reproducible. Manganese varies from 130 ppb to 458 ppb in the duplicate pair from 2+25N and from 275 ppb to 107 ppb at 5+25N. The elements <LLD in the field duplicate pairs are Be, Sc, Ge, Se, Ru, Pd, Cd, In, Sn, Te, Tm, Lu, Ta, W, Re, Os, Pt, Au, Hg, Tl and Bi.

Enzyme leach profiles

Figures 4 through 6 illustrate the elevated responses of elements with proximity to known mineralized zones. These anomalies are plotted for comparative purposes against a threshold value derived from a probability plot for each element.

A broad 6 sample, Cl anomaly encompasses the Disseminated Zone and remains elevated (10,197 to 15,213 ppb) up to the edge of the North Contact Zone (Table 2; Fig. 4). The commodity element Ti forms a single sample anomaly of 3301 ppb over the Disseminated Zone (Fig. 4) with a lesser response of 1459 ppb over the South Zone. If the threshold as determined for Ti using probability plots is accurate and represents the upper limit of background variation then the single sample response over the South Zone is invalid.

Single sample anomalous responses for Ni (128 ppb), and Cu (483 ppb) in Figure 4, Nb (16 ppb), Cs (15

Table 1: Descriptive statistics for elements greater than the lower limit of detection (LLD).

A value of one half the LLD was used for calculations where analyses were less than the LLD. All values in parts per billion. Bracketed figure represents the LLD for that element.

Element	Minimum	Maximum	Median	Arith. Mean	Standard Deviation
SQLi (10)	5	144	44	43	30
SQBe (20)	10	10			
SQCl (3000)	1500	15213	3273	5004	4315
SQSc (100)	50	50			
SQTi (100)	50	3301	383	516	612
V (5)	2.5	428	117	132	99
Mn (10)	69	2074	290	577	545
Co (1)	3	41	9	13	10
Ni (5)	2.5	128	31	36	24
Cu (5)	2.5	483	40	56	85
Zn (10)	13	91	23	28	18
Ga (1)	0.5	16	4	4	3
Ge (1)	0.5	2	0.5	0.6	0.3
As (5)	2.5	28	12	12	6
Se (30)	15	15			
Br (30)	15	593	68	110	126
Rb (1)	10	149	34	48	34
Sr (1)	71	498	216	248	98
Y (1)	1	72	32	33	19
Zr (1)	0.5	227	75	83	53
Nb (1)	0.5	16	3	3	3
Mo (1)	0.5	19	2	3	4
Ru (1)	0.5	0.5			
Pd (1)	0.5	3	0.5	0.9	0.6
Ag (0.2)	0.1	0.8	0.3	0.3	0.2
Cd (0.2)	0.1	0.7	0.1	0.2	0.1
In (0.2)	0.1	0.1			
Sn (1)	0.5	3	0.5	0.8	0.8
Sb (1)	0.5	6	2	2	1
Te (1)	0.5	2	0.5	0.6	0.3
I (10)	5	94	48	45	25
Cs (1)	0.5	15	0.5	1.5	3
Ba (1)	220	968	421	440	142
La (1)	2	129	65	59	33
Ce (1)	4	307	82	93	68
Pr (1)	0.5	40	21	17	10
Nd (1)	2	150	69	66	39
Sm (1)	0.5	36	15	16	9
Eu (1)	0.5	8	3	3	2
Gd (1)	0.5	43	14	16	10
Tb (1)	0.5	4	2	2	1
Dy (1)	0.5	19	7	8	5
Ho (1)	0.5	3	1	1	1
Er (1)	0.5	11	5	5	3
Tm (1)	0.5	2	0.5	0.7	0.3
Yb (1)	0.5	8	3	4	2
Lu (1)	0.5	2	0.5	0.6	0.3
Hf (1)	0.5	6	2	2	2
Ta (1)	0.1	1	0.5	0.5	0.1
W (1)	0.5	2	0.5	0.8	0.5
Re (0.1)	0.05	0.05			
Os (1)	0.5	0.5			
Pt (1)	0.5	0.5			
Au (0.1)	0.05	0.05			
SQHg (1)	0.5	0.5			
Tl (1)	0.5	1	0.5	0.5	0.2
Pb (1)	1	28	7	8	5
Bi (1)	0.5	0.5			
Th (1)	0.5	33	13	14	7
U (1)	0.5	9	3	4	2

PIPESTONE Ti-V ENZYME LEACH PROFILES

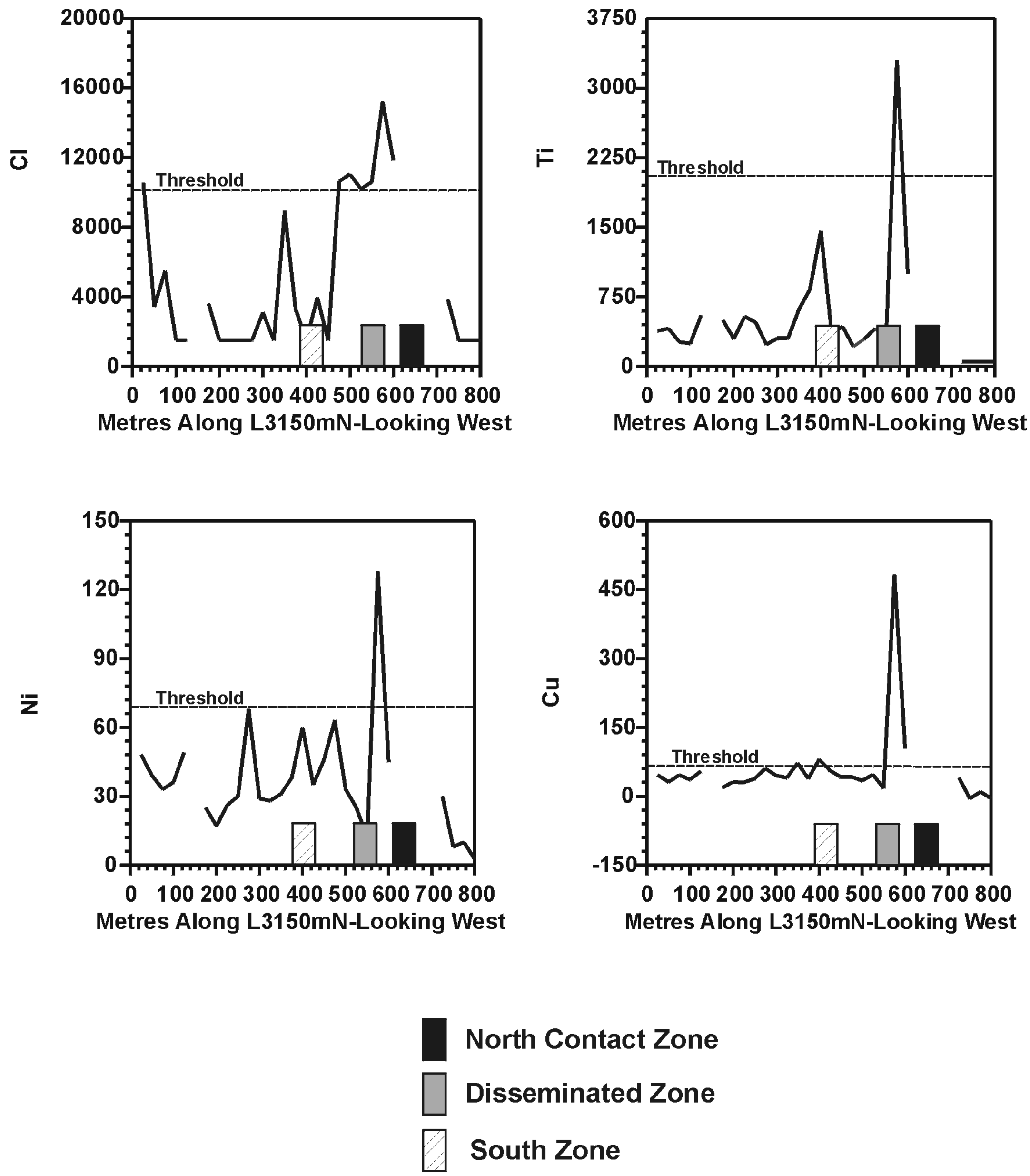

Figure 4: Enzyme leach profiles for Cl, Ti, Ni and Cu over the Pipestone Lake Ti-V deposit.

PIPESTONE Ti-V ENZYME LEACH PROFILES

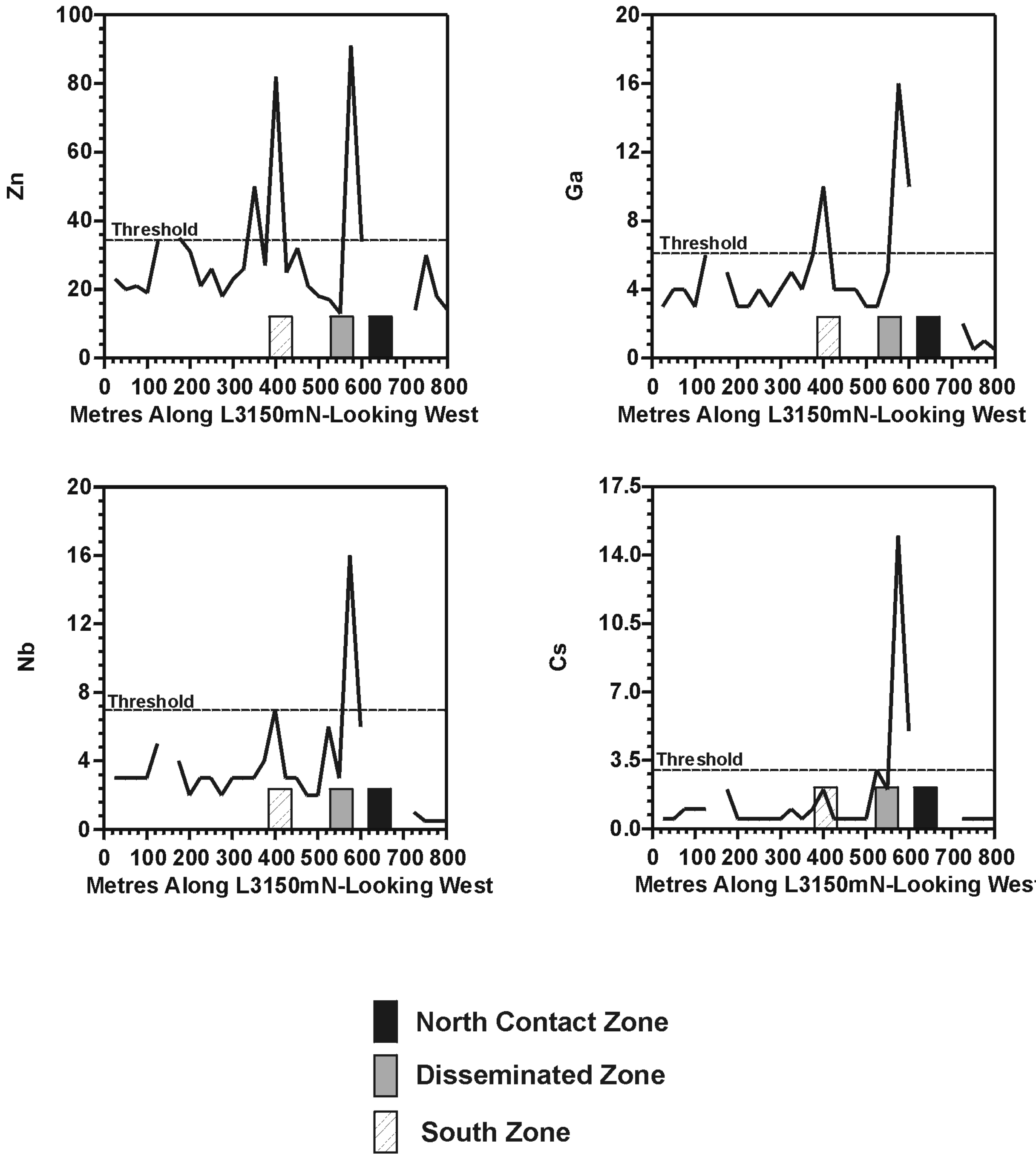

Figure 5: Enzyme leach profiles for Zn, Ga, Nb and Cs over the Pipestone Lake Ti-V deposit.

PIPESTONE Ti-V ENZYME LEACH PROFILES

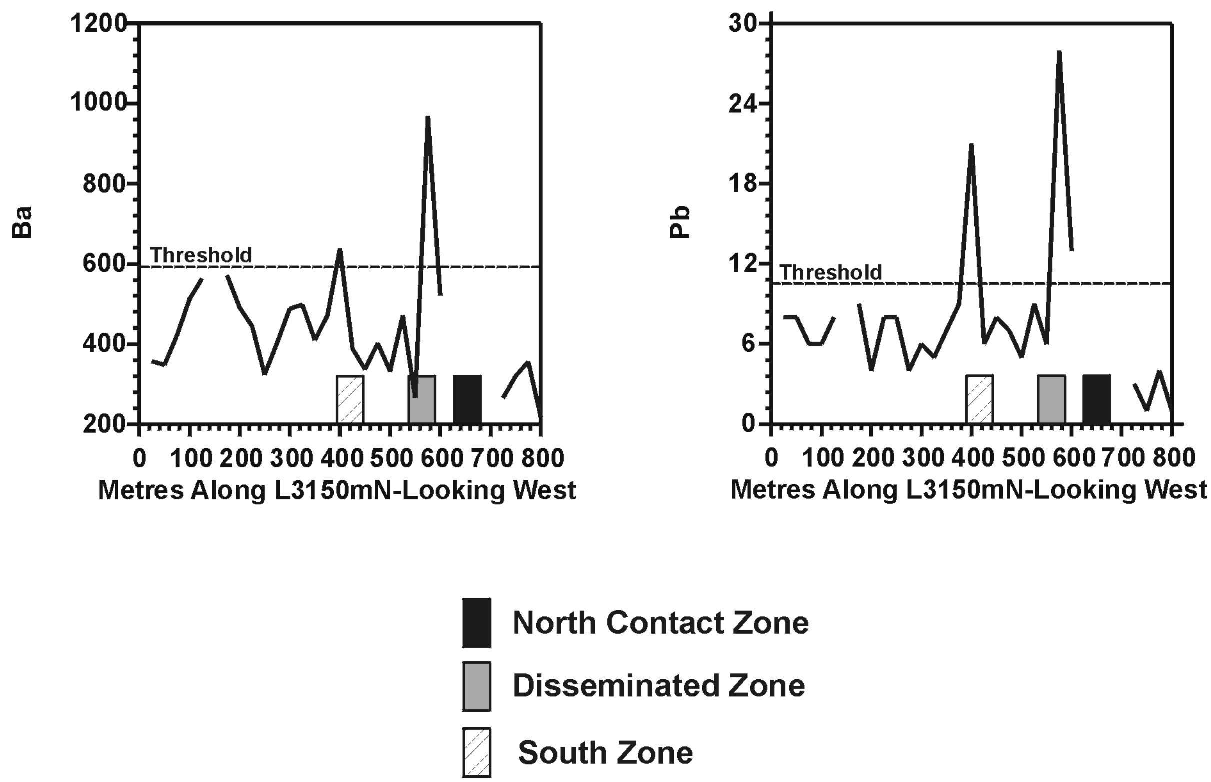

Figure 6: Enzyme leach profiles for Ba and Pb over the Pipestone Lake Ti-V deposit.

Table 2: Comparison of parent soil types and levels of concentration of indicator elements at these sites.

"NA" indicates that element was not anomalous at that site. All concentration levels in parts per billion.

Sample	Cl	Ti	Ba	Cu	Ni	Zn	Co	Pb	Ga	Nb	Cs
GR-16 (31+50, 4+00N) hematitic grey clay	NA	1459	638	80	NA	82	NA	21	NA	NA	NA
GR-23 (31+50, 5+75N) hematitic grey clay interlayered with Cr-green silt-fine sand	15213	3301	NA	483	128	91	41	28	16	16	15
GR-24 (31+50, 6+00N) light brown silt with hematitic blotches	11836	995	NA	104	NA	NA	NA	13	10	NA	NA

ppb and 5 ppb) in Figure 5, and Ba (968 ppb) (Fig. 6) are documented over the Disseminated Zone. Anomalies for Ga (16 ppb and 10 ppb) (Fig. 5) and Pb (28 ppb and 13 ppb) (Fig. 6) are also documented over this Zone. Distinctive anomalous responses are obtained for Zn (82 ppb and 50 ppb), Ga (10 ppb) (Fig. 5) and Pb (21 ppb) (Fig. 6) over the South Zone.

Anomaly:threshold ratios for indicator elements

Geochemical contrast for indicator elements is determined on the basis of anomaly:threshold ratios and summarized in Table 3. Ratios are rounded to the nearest unit. In general, the geochemical contrast for the indicator elements is in the range of 2-3. This is the case for the commodity element Ti, the sulphide-related suite as well as Cl, Nb and Ba. Cu and Cs are the exception with threshold ratios of 8 and 5, respectively.

INAA and ICP-AES profiles

Figures 7 and 8 summarize the anomalous responses for INAA and ICP-AES data over the mineralized zones. Cr (687 ppm), Ni (362 ppm) and Co (50 ppm) in the INAA data document a single sample "spike" over the Disseminated Zone. This same sample site is marked by a Cu (89 ppm), Ni (381 ppm) and Mg (4.02%) spike in ICP-AES data. These responses are controlled by the mineralogy of the soil sample collected at this site. The b-horizon is a chrome green, silt to fine sand and is derived in part from the weathering and erosion of the host rocks to the mineralized zone. The high Mg, Ni and Cr are reflecting the mafic-ultramafic host rocks whereas the Cu and Co represent a sulphide component in clastic material in the b-horizon.

DISCUSSION

Geochemical contribution of parent soil to enzyme leach anomalies

Individual b-horizon soil sample descriptions from sites along transect 31+50 are presented in Appendix I and document three distinctive types of material that characterize b-horizon soils over the sampling transect. These are variably oxidized clay, sand and silt. A unique soil composition is observed at site GR-23 where a hematitic silt is intermixed with a chrome green silt interpreted to represent a weathered or erosional remnant of the mafic-ultramafic rocks that host oxide mineralization at the PLAC. This chrome green silt was not observed in any of the other sample pits on the transect.

Interestingly, the highest contrast signatures, albeit single sample responses, for most of the elements interpreted to be indicative of the Disseminated Zone coincide with the sample of chrome green silt (site GR-23). Anomalous responses associated with this green silt are also observed in samples where a mafic-ultramafic detrital character is not present. Examples include hematitic grey clay at site GR-16 (31+50, 4+001N) and light brown silt with hematitic blotches at site GR-24 (31+50, 6+00N). The indicator elements and their concentration levels in each of the three samples described above are summarized in Table 2.

The geochemical response at site GR-23 suggests a significant contribution of some of the indicator elements to the overall enzyme leach signature at site GR-23 from the parent chrome-green silt. The signature at site GR-23, however, is interpreted to be composite with additional indicator element concentrations being added to the sample as they are transported via shallow groundwater or ascending metal-enriched vapours as well as from parent material. This is substantiated by the recognition of anomalous geochemical responses to zones of oxide mineralization that comprise similar elements (eg. Cl, Ti and Cu) at sites GR-16 and GR-24.The elements Cl-Ti-Cu are moderately correlated in a Spearman correlation matrix (Table 4).

Sulphide mineral associations

The observation of anomalous responses for the metals Ni, Cu, Pb, Ga and Zn over the Disseminated and South zones is surprising given the nature of the Pipestone Lake Ti-V deposit. The ilmenite-magnetite

Table 3: Anomaly:threshold ratios for indicator elements over the Pipestone Lake Ti-V deposit.

Elements are ranked from highest to lowest contrast. Ratios are rounded to the nearest unit.

Element	Anomaly (ppb)	Threshold (ppb)	Anomaly:threshold Ratio
Cu	483	65	8
Cs	15	3	5
Pb	28	10.6	3
Ga	16	6.2	3
Zn	91	35	3
Cl	15213	10080	2
Ti	3301	2070	2
Ni	128	69	2
Ba	968	600	2
Nb	16	7	2

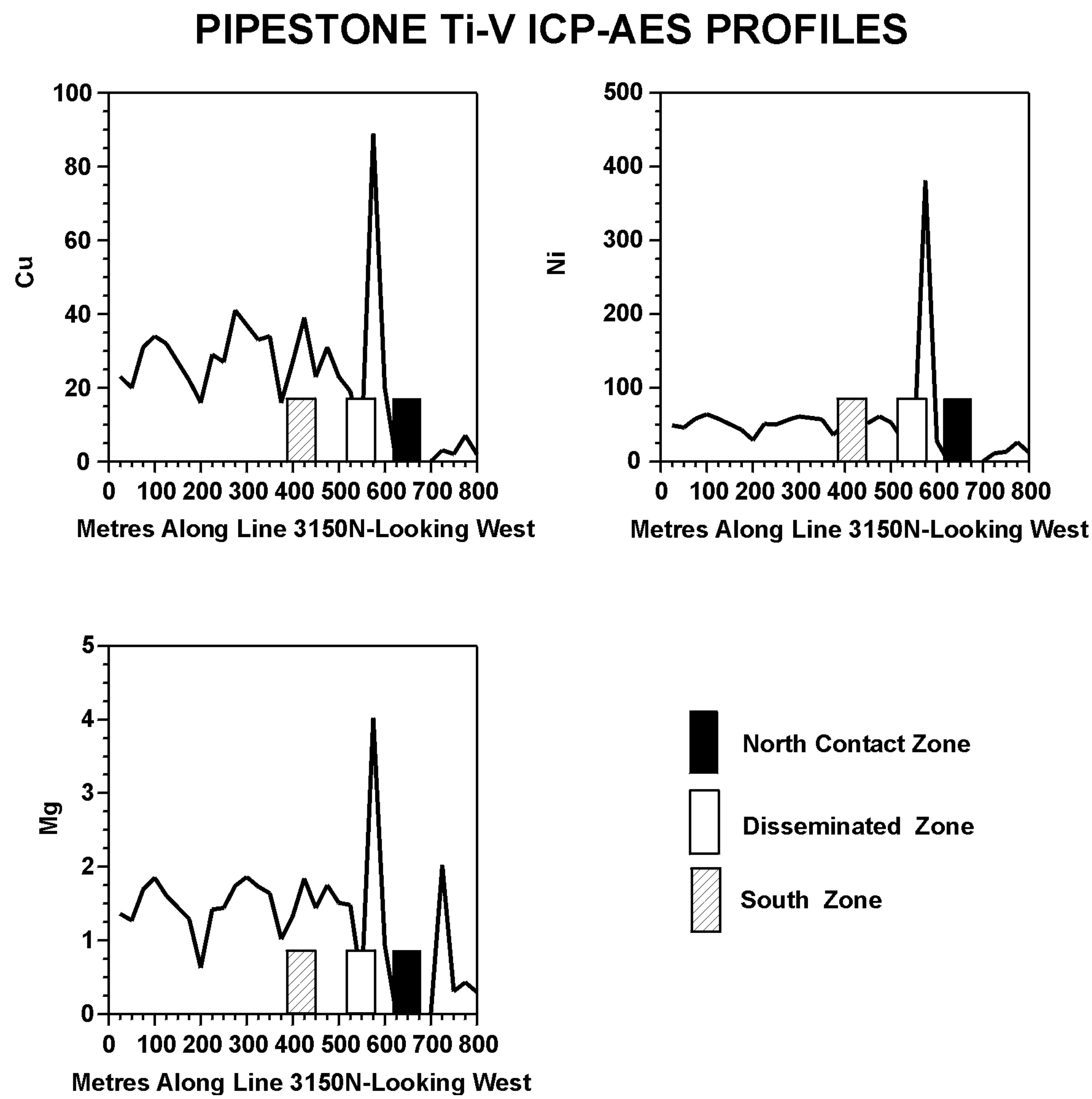

Figure 7: Neutron activation profiles for Co, Cr and Ni over the Pipestone Lake Ti-V deposit.

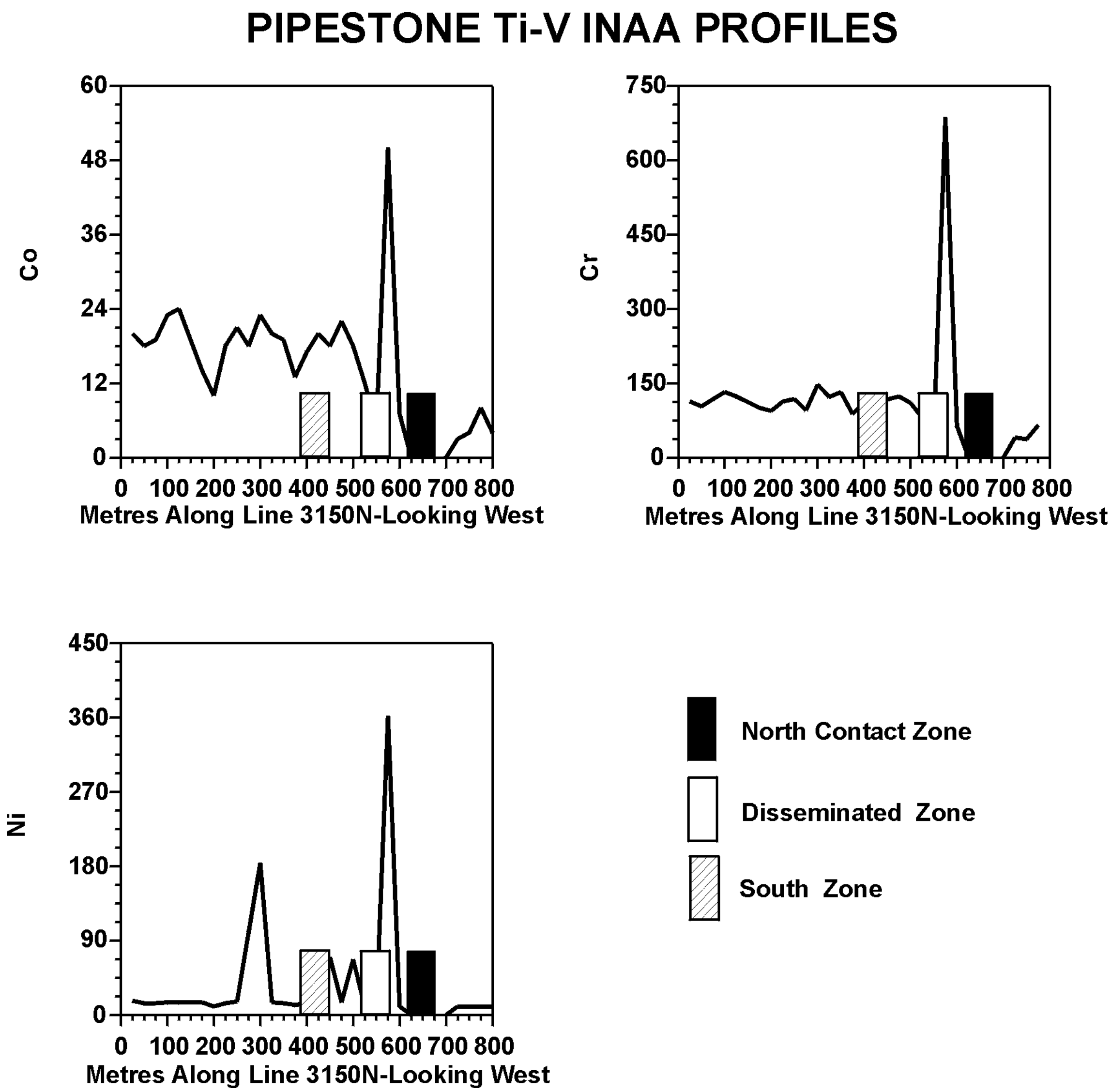

Figure 8: ICP-AES profiles for Cu, Ni and Mg over the Pipestone Lake Ti-V deposit.

Table 4: Spearman correlation coefficients for enzyme leach indicator elements, Mn and semi-quantitative Cl (SQCl).

Element	Spearman Correlation Coefficients	
	Mn	**SQCl**
SQTi	0.355	0.456
SQCl	-0.02	1
Ni	0.698	0.256
Cu	0.392	0.361
Zn	0.184	-0.035
Ga	0.205	0.296
Nb	0.335	0.281
Cs	0.089	0.312
Ba	0.256	0.019
Pb	0.465	0.33

oxide mineralogy of these disseminated to near-solid mineralized zones are not associated with sulphide mineralization. Subsequent to the recognition of the enzyme leach patterns for the elements Ni, Cu, Pb, Ga, Zn over this deposit, a re-examination of diamond drill logs revealed the presence of disseminated pyrite, pyrrhotite and chalcopyrite over core intervals of up to 18.5 m (e.g. DDH PL155, 162.5-223.3 ft.) in several lithologies of the PLAC. The sulphide mineralization is described as trace abundance and is associated with shear zones. An east-trending set of shear zones and north-trending brittle faults documented by Cameron (1992) and Jobin-Bevans et al. (1995) may provide pathways for hydrothermal fluid interaction with the Fe-oxide-rich PLAC and the subsequent formation of disseminated sulphides. These sulphur- and sulphide-bound metals are interpreted to be the cause for enzyme leach Cu, Pb, Ga, Zn (and in part the Ni) anomalies over predominantly oxide mineralization in the Disseminated and South Zones of the Pipestone Lake deposit.

Niobium, cesium, barium and chlorine anomalies

A single sample Nb response of 16 ppb and the two sample Cs responses of 15 ppb over the Disseminated Zone as well as a 5 ppb (threshold = 3.5 ppb) response in the area north of the Disseminated Zone are documented. Although specific examinations for minerals containing these elements has not been undertaken it is probable that the Nb response is attributed to the presence of Nb-bearing rutile (R. Gunter, pers. comm., 1999). The Cs and Ba signature is likely related to the metasomatic effects of the intrusion of a garnet-muscovite-tourmaline granite between 2653-2639 Ma in the Cross Lake greenstone belt (Mezger et al., 1990).

CONCLUSIONS

This brief orientation survey provides a preliminary assessment of the usefulness of enzyme leach analytical methods in resolving a geochemical signature related to oxide mineralization as occurs within the Pipestone Ti-V deposits. Results indicate:

1. The South and Disseminated Zones have distinctive enzyme leach geochemical signatures that include Ti (commodity element), Ni, Cu, Pb, Ga and Zn (sulphide-related elements), Nb, Cs, Ba and Cl (alteration and mineralization elements).
2. The enzyme leach response for Ti, Ni and Cu is interpreted to be a "composite" signature reflecting both primary and secondary geochemical contributions from mafic-ultramafic host rocks of the PLAC and ascending metal-enriched vapours from mineralized zones.
3. In this study Cl forms an extensive halo characterized by a high contrast, six sample response that encompasses both the South and Disseminated Zones. All other indicator elements form one or two sample anomalies over the mineralized zones.
4. On the basis of anomaly:threshold ratios, indicator elements can be ranked from highest to lowest contrast as follows: Cu>Cs>Pb=Ga=Zn>Cl=Ti=Ni=Ba=Nb.
5. INAA and ICP-AES analyses document the presence of a single sample Mg, Ni, Cr, Co and Cu anomaly over the deposit. This response (site GR-23) is attributed to a mafic-ultramafic component and a sulphide mineral detrital assemblage in the b-horizon.
6. An enzyme leach geochemical survey is rapid and cost-effective and, on the basis of this orientation survey in the area of the Pipestone Lake Ti-V deposit, has the potential to reduce large areas of exploration interest to more localized zones suitable for diamond drill testing.
7. An enzyme leach geochemical survey in the PLAC can be particularly useful where Ti-V mineralization has post-depositional structurally-related sulphide mineralization or secondary (alteration) minerals associated with primary oxide mineralization. In the absence of post-depositional sulphides, the survey would have been less diagnostic.
8. The moderate contrast of enzyme leach indicator elements over this significant zone of oxide mineralization suggests that the magnitude of the geochemical response does not correlate to the volume and grade of the mineralized target but may be more profoundly affected by the style (oxide/sulphide) of the mineralization.

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Appendix 1: Enzyme leach field sample descriptions.

Sample	Grid Coordinates	Description
GR-1	L31+50, 0+25N	grey, visibly unoxidized "pebbly" clay with rootlets
GR-2	L31+50, 0+50N	grey, visibly unoxidized "pebbly" clay with rootlets
GR-3	L31+50, 0+75N	weakly limonitic grey clay, minor rootlets
GR-4	L31+50, 1+00N	"pebbly" weakly hematitic light brown clay
GR-5	L31+50, 1+25N	reddish brown "pebbly" clay
GR-6	L31+50, 1+50N	no sample possible, wet swamp
GR-7	L31+50, 1+75N	"pebbly" reddish brown clay
GR-8	L31+50, 2+00N	hematitic and limonitic fine sand
GR-9	L31+50, 2+25N	light reddish brown "pebbly" clay (DUPLICATE SITE)
GR-10	L31+50, 2+50N	light reddish brown "pebbly" clay, minor rootlets
GR-11	L31+50, 2+75N	light reddish brown "pebbly" clay, rootlets
GR-12	L31+50, 3+00N	chocolate brown, fine "pebbly" clay
GR-13	L31+50, 3+25N	brown "pebbly" clay, minor rootlets
GR-14	L31+50, 3+50N	reddish brown clay, minor rootlets
GR-15	L31+50, 3+75N	reddish brown "pebbly" clay;sample pit bottoms on outcrop
GR-16	L31+50, 4+00N	reddish grey, "pebbly" clay, rootlets
GR-17	L31+50, 4+25N	dark reddish brown "pebbly" clay
GR-18	L31+50, 4+50N	reddish greyish brown "pebbly" clay
GR-19	L31+50, 4+75N	dark reddish brown "pebbly" clay
GR-20	L31+50, 5+00N	dark reddish brown "pebbly" clay, minor rootlets
GR-21	L31+50, 5+25N	brown silty clay, frost mixing (DUPLICATE SITE)
GR-22	L31+50, 5+50N	hematitic-limonitic silt
GR-23	L31+50, 5+75N	hematitic silt interlayered with chrome green silt
GR-24	L31+50, 6+00N	hematitic blotches in light brown silt
GR-25	L31+50, 6+25N	no sample possible, wet swamp
GR-26	L31+50, 6+50N	no sample possible, wet swamp
GR-27	L31+50, 6+75N	no sample possible, wet swamp
GR-28	L31+50, 7+00N	no sample possible, wet swamp
GR-29	L31+50, 7+25N	limonitic-hematitic silt
GR-30	L31+50, 7+50N	limonitic fine sand, rounded granitoid pebbles
GR-31	L31+50, 7+75N	limonitic fine sand, rounded granitoid pebbles
GR-32	L31+50, 8+00N	limonitic fine sand, 10 cm leached zone capping sand

Appendix II: Enzyme leach/ICP-MS analytical data for sampling transect L31+50 and field duplicates. All data in parts per billion (ppb).

Sample	Distance	Grid Reference	S.Q.Li	S.Q.Be	S.Q.Cl	S.Q.Sc	S.Q.Ti	V	Mn	Co	Ni	Cu	Zn
LLD			10	20	3000	100	100	5	10	1	5	5	10
GR 1	25	L31+50, 0+25N	29	10	10546	50	383	90	2074	28	48	46	23
GR 2	50	L31+50, 0+50N	38	10	3423	50	408	65	1568	30	39	31	20
GR 3	75	L31+50, 0+75N	23	10	5483	50	262	157	272	8	33	46	21
GR 4	100	L31+50, 1+00N	46	10	1500	50	245	282	773	12	36	36	19
GR 5	125	L31+50, 1+25N	74	10	1500	50	550	150	1538	30	49	54	34
GR 6	150	L31+50, 1+50N	no sample-wet swamp										
GR 7	175	L31+50, 1+75N	144	10	3605	50	497	428	219	7	25	18	35
GR 8	200	L31+50, 2+00N	12	10	1500	50	297	29	374	12	17	31	31
GR 9	225	L31+50, 2+25N	33	10	1500	50	537	77	458	22	26	30	21
GR 10	250	L31+50, 2+50N	27	10	1500	50	475	103	707	18	30	38	26
GR 11	275	L31+50, 2+75N	47	10	1500	50	236	151	697	9	68	60	18
GR 12	300	L31+50, 3+00N	87	10	3085	50	301	253	205	6	29	45	23
GR 13	325	L31+50, 3+25N	44	10	1500	50	305	189	232	5	28	40	26
GR 14	350	L31+50, 3+50N	55	10	8939	50	617	146	215	6	31	72	50
GR 15	375	L31+50, 3+75N	44	10	3273	50	830	71	290	20	38	38	27
GR 16	400	L31+50, 4+00N	54	10	1500	50	1459	111	1080	28	60	80	82
GR 17	425	L31+50, 4+25N	79	10	3955	50	359	244	198	6	35	56	25
GR 18	450	L31+50, 4+50N	56	10	1500	50	431	93	1021	16	46	42	32
GR 19	475	L31+50, 4+75N	55	10	10630	50	213	172	393	10	63	42	21
GR 20	500	L31+50, 5+00N	17	10	11042	50	297	123	223	7	33	34	18
GR 21	525	L31+50, 5+25N	68	10	10197	50	408	119	275	8	25	47	17
GR 22	550	L31+50, 5+50N	10	10	10589	50	293	47	149	4	12	17	13
GR 23	575	L31+50, 5+75N	60	10	15213	50	3301	333	1593	41	128	483	91
GR 24	600	L31+50, 6+00N	29	10	11836	50	995	117	378	11	45	104	34
GR 25	625	L31+50, 6+25N	no sample-wet swamp										
GR 26	650	L31+50, 6+50N	no sample-wet swamp										
GR 27	675	L31+50, 6+75N	no sample-wet swamp										
GR 28	700	L31+50, 7+00N	no sample-wet swamp										
GR 29	725	L31+50, 7+25N	14	10	3827	50	50	58	1098	5	30	40	14
GR 30	750	L31+50, 7+50N	5	10	1500	50	50	2.5	69	3	8	-5	30
GR 31	775	L31+50, 7+75N	5	10	1500	50	50	13	272	9	10	9	18
GR 32	800	L31+50, 8+00N	5	10	1500	50	50	6	112	3	2.5	-5	14

Field Duplicates

Sample	Distance	Grid Reference	S.Q.Li	S.Q.Be	S.Q.Cl	S.Q.Sc	S.Q.Ti	V	Mn	Co	Ni	Cu	Zn
LLD			10	20	3000	100	100	5	10	1	5	5	10
GR 9-1	225	L31+50, 2+25N	36	10	1500	50	564	75	130	16	25	30	22
GR 9-2	225	L31+50, 2+25N	33	10	1500	50	537	77	458	22	26	30	21
GR 21-1	525	L31+50, 5+25N	68	10	10197	50	408	119	275	8	25	47	17
GR 21-2	525	L31+50, 5+25N	69	10	9960	50	488	117	107	4	31	59	13

Appendix II: Enzyme leach/ICP-MS analytical data for sampling transect L31+50 and field duplicates. All data in parts per billion (ppb). (Continued)

Sample	Distance	Grid Reference	Ga	Ge	As	Se	Br	Rb	Sr	Y	Zr	Nb	Mo
LLD			1	1	5	30	30	1	1	1	1	1	1
GR 1	25	L31+50, 0+25N	3	1	18	15	261	33	327	46	114	3	8
GR 2	50	L31+50, 0+50N	4	0.5	9	15	48	30	189	20	104	3	3
GR 3	75	L31+50, 0+75N	4	0.5	12	15	104	27	293	47	75	3	3
GR 4	100	L31+50, 1+00N	3	0.5	16	15	68	22	296	47	64	3	4
GR 5	125	L31+50, 1+25N	6	0.5	10	15	15	35	215	72	227	5	2
GR 6	150	L31+50, 1+50N	no sample-wet swamp										
GR 7	175	L31+50, 1+75N	5	0.5	14	15	15	50	378	14	53	4	19
GR 8	200	L31+50, 2+00N	3	0.5	6	15	57	83	200	15	23	2	1
GR 9-2	225	L31+50, 2+25N	3	0.5	8	15	43	87	203	27	141	3	0.5
GR 10	250	L31+50, 2+50N	4	0.5	12	15	312	34	190	29	104	3	2
GR 11	275	L31+50, 2+75N	3	0.5	14	15	593	18	498	32	58	2	6
GR 12	300	L31+50, 3+00N	4	0.5	17	15	152	28	308	41	55	3	3
GR 13	325	L31+50, 3+25N	5	1	14	15	121	36	199	38	63	3	2
GR 14	350	L31+50, 3+50N	4	0.5	12	15	192	26	206	48	111	3	0.5
GR 15	375	L31+50, 3+75N	6	0.5	9	15	33	67	220	42	134	4	0.5
GR 16	400	L31+50, 4+00N	10	0.5	18	15	81	107	322	65	166	7	7
GR 17	425	L31+50, 4+25N	4	0.5	22	15	171	22	248	50	57	3	3
GR 18	450	L31+50, 4+50N	4	0.5	14	15	133	44	216	49	148	3	2
GR 19	475	L31+50, 4+75N	4	0.5	17	15	116	17	336	58	90	2	2
GR 20	500	L31+50, 5+00N	3	0.5	11	15	281	10	173	38	81	2	3
GR 21-1	525	L31+50, 5+25N	3	0.5	11	15	126	27	366	20	63	6	3
GR 22	550	L31+50, 5+50N	5	0.5	6	15	15	23	124	13	45	3	0.5
GR 23	575	L31+50, 5+75N	16	2	28	15	15	149	261	36	140	16	7
GR 24	600	L31+50, 6+00N	10	0.5	18	15	15	61	173	31	75	6	0.5
GR 25	625	L31+50, 6+25N	no sample-wet swamp										
GR 26	650	L31+50, 6+50N	no sample-wet swamp										
GR 27	675	L31+50, 6+75N	no sample-wet swamp										
GR 28	700	L31+50, 7+00N	no sample-wet swamp										
GR 29	725	L31+50, 7+25N	2	0.5	11	15	15	19	212	7	21	1	0.5
GR 30	750	L31+50, 7+50N	0.5	0.5	2.5	15	15	30	71	1	0.5	0.5	0.5
GR 31	775	L31+50, 7+75N	1	0.5	2.5	15	15	84	155	3	6	0.5	0.5
GR 32	800	L31+50, 8+00N	0.5	0.5	2.5	15	15	99	85	1	0.5	0.5	0.5

Field Duplicates

Sample	Distance	Grid Reference	Ga	Ge	As	Se	Br	Rb	Sr	Y	Zr	Nb	Mo
LLD			1	1	5	30	30	1	1	1	1	1	1
GR 9-1	225	L31+50, 2+25N	5	0.5	6	15	49	84	333	31	134	3	0.5
GR 9-2	225	L31+50, 2+25N	3	0.5	8	15	43	87	203	27	141	3	0.5
GR 21-1	525	L31+50, 5+25N	3	0.5	11	15	126	27	366	20	63	6	3
GR 21-2	525	L31+50, 5+25N	3	0.5	14	15	122	34	408	26	57	2	2

Appendix II: Enzyme leach/ICP-MS analytical data for sampling transect L31+50 and field duplicates. All data in parts per billion (ppb). (Continued)

Sample	Distance	Grid Reference	Ru	Pd	Ag	Cd	In	Sn	Sb	Te	I	Cs	Ba
LLD			1	1	0.2	0.2	0.2	1	1	1	10	1	1
GR 1	25	L31+50, 0+25N	0.5	1	0.4	0.4	0.1	2	5	0.5	94	0.5	357
GR 2	50	L31+50, 0+50N	0.5	1	0.4	0.3	0.1	0.5	2	0.5	38	0.5	348
GR 3	75	L31+50, 0+75N	0.5	0.5	0.1	0.1	0.1	0.5	2	0.5	55	1	421
GR 4	100	L31+50, 1+00N	0.5	0.5	0.1	0.1	0.1	0.5	4	0.5	61	1	512
GR 5	125	L31+50, 1+25N	0.5	3	0.8	0.3	0.1	0.5	2	0.5	62	1	563
GR 6	150	L31+50, 1+50N	no sample-wet swamp										
GR 7	175	L31+50, 1+75N	0.5	0.5	0.3	0.1	0.1	0.5	3	0.5	49	2	571
GR 8	200	L31+50, 2+00N	0.5	0.5	0.1	0.3	0.1	0.5	2	0.5	26	0.5	492
GR 9-2	225	L31+50, 2+25N	0.5	1	0.5	0.1	0.1	0.5	2	0.5	32	0.5	444
GR 10	250	L31+50, 2+50N	0.5	1	0.4	0.1	0.1	2	2	0.5	48	0.5	324
GR 11	275	L31+50, 2+75N	0.5	0.5	0.3	0.1	0.1	0.5	2	0.5	85	0.5	404
GR 12	300	L31+50, 3+00N	0.5	0.5	0.1	0.1	0.1	0.5	2	0.5	40	0.5	488
GR 13	325	L31+50, 3+25N	0.5	0.5	0.3	0.1	0.1	0.5	2	0.5	57	1	498
GR 14	350	L31+50, 3+50N	0.5	1	0.4	0.2	0.1	0.5	2	0.5	61	0.5	410
GR 15	375	L31+50, 3+75N	0.5	2	0.5	0.1	0.1	0.5	1	0.5	36	1	471
GR 16	400	L31+50, 4+00N	0.5	2	0.6	0.4	0.1	3	2	0.5	60	2	638
GR 17	425	L31+50, 4+25N	0.5	0.5	0.1	0.1	0.1	0.5	6	0.5	72	0.5	388
GR 18	450	L31+50, 4+50N	0.5	2	0.6	0.7	0.1	0.5	1	0.5	48	0.5	337
GR 19	475	L31+50, 4+75N	0.5	1	0.3	0.1	0.1	0.5	2	0.5	58	0.5	402
GR 20	500	L31+50, 5+00N	0.5	0.5	0.3	0.2	0.1	0.5	2	1	54	0.5	333
GR 21-1	525	L31+50, 5+25N	0.5	0.5	0.4	0.1	0.1	1	2	0.5	86	3	471
GR 22	550	L31+50, 5+50N	0.5	0.5	0.1	0.1	0.1	0.5	1	2	19	2	267
GR 23	575	L31+50, 5+75N	0.5	0.5	0.5	0.2	0.1	3	2	0.5	5	15	968
GR 24	600	L31+50, 6+00N	0.5	0.5	0.4	0.1	0.1	2	2	0.5	44	5	521
GR 25	625	L31+50, 6+25N	no sample-wet swamp										
GR 26	650	L31+50, 6+50N	no sample-wet swamp										
GR 27	675	L31+50, 6+75N	no sample-wet swamp										
GR 28	700	L31+50, 7+00N	no sample-wet swamp										
GR 29	725	L31+50, 7+25N	0.5	0.5	0.1	0.1	0.1	0.5	0.5	0.5	5	0.5	266
GR 30	750	L31+50, 7+50N	0.5	0.5	0.1	0.4	0.1	0.5	0.5	0.5	5	0.5	320
GR 31	775	L31+50, 7+75N	0.5	0.5	0.1	0.4	0.1	0.5	0.5	0.5	5	0.5	356
GR 32	800	L31+50, 8+00N	0.5	0.5	0.1	0.2	0.1	0.5	0.5	0.5	5	0.5	220
Field Duplicates													
Sample	**Distance**	**Grid Reference**	**Ru**	**Pd**	**Ag**	**Cd**	**In**	**Sn**	**Sb**	**Te**	**I**	**Cs**	**Ba**
LLD			1	1	0.2	0.2	0.2	1	1	1	10	1	1
GR 9-2	225	L31+50, 2+25N	0.5	1	0.4	0.1	0.1	0.5	2	0.5	31	1	517
GR 9-2	225	L31+50, 2+25N	0.5	1	0.5	0.1	0.1	0.5	2	0.5	32	0.5	444
GR 21-1	525	L31+50, 5+25N	0.5	0.5	0.4	0.1	0.1	1	2	0.5	86	3	471
GR 21-2	525	L31+50, 5+25N	0.5	0.5	0.2	0.1	0.1	0.5	0.5	0.5	65	0.5	451

Appendix II: Enzyme leach/ICP-MS analytical data for sampling transect L31+50 and field duplicates. All data in parts per billion (ppb). (Continued)

Sample	Distance	Grid Reference	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
LLD			1	1	1	1	1	1	1	1	1	1	1
GR 1	25	L31+50, 0+25N	66	124	21	77	20	5	24	3	11	2	7
GR 2	50	L31+50, 0+50N	34	97	10	37	9	2	8	1	5	1	3
GR 3	75	L31+50, 0+75N	69	74	22	92	24	5	22	2	11	2	7
GR 4	100	L31+50, 1+00N	96	105	30	106	25	5	24	3	10	2	7
GR 5	125	L31+50, 1+25N	129	307	40	150	36	8	43	4	19	3	11
GR 6	150	L31+50, 1+50N	no sample-wet swamp										
GR 7	175	L31+50, 1+75N	31	64	8	31	7	2	7	0.5	3	0.5	2
GR 8	200	L31+50, 2+00N	32	66	7	27	6	2	6	0.5	3	0.5	2
GR 9-2	225	L31+50, 2+25N	50	113	17	61	14	3	14	3	7	1	5
GR 10	250	L31+50, 2+50N	44	82	14	53	14	3	13	1	6	1	4
GR 11	275	L31+50, 2+75N	62	64	15	58	13	3	13	1	6	1	4
GR 12	300	L31+50, 3+00N	71	50	23	87	21	4	20	2	9	2	5
GR 13	325	L31+50, 3+25N	68	45	21	82	21	4	18	2	9	2	6
GR 14	350	L31+50, 3+50N	63	86	24	96	24	4	23	2	11	2	7
GR 15	375	L31+50, 3+75N	69	121	22	89	21	4	22	2	11	2	7
GR 16	400	L31+50, 4+00N	129	269	36	133	29	7	31	4	17	3	10
GR 17	425	L31+50, 4+25N	81	55	25	98	24	4	22	2	11	2	6
GR 18	450	L31+50, 4+50N	67	140	21	78	19	4	21	2	10	2	7
GR 19	475	L31+50, 4+75N	100	104	32	128	33	6	32	3	15	3	10
GR 20	500	L31+50, 5+00N	66	87	21	81	18	4	17	2	10	2	6
GR 21-1	525	L31+50, 5+25N	47	75	12	42	9	2	10	1	5	0.5	3
GR 22	550	L31+50, 5+50N	29	54	7	29	7	2	7	0.5	4	0.5	2
GR 23	575	L31+50, 5+75N	95	177	21	69	15	3	14	2	7	1	4
GR 24	600	L31+50, 6+00N	78	95	18	64	14	3	13	1	7	1	4
GR 25	625	L31+50, 6+25N	no sample-wet swamp										
GR 26	650	L31+50, 6+50N	no sample-wet swamp										
GR 27	675	L31+50, 6+75N	no sample-wet swamp										
GR 28	700	L31+50, 7+00N	no sample-wet swamp										
GR 29	725	L31+50, 7+25N	15	21	3	13	3	0.5	3	0.5	1	0.5	0.5
GR 30	750	L31+50, 7+50N	2	4	0.5	3	0.5	0.5	0.5	0.5	0.5	0.5	0.5
GR 31	775	L31+50, 7+75N	7	17	2	6	1	0.5	2	0.5	1	0.5	0.5
GR 32	800	L31+50, 8+00N	2	4	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Field Duplicates

Sample	Distance	Grid Reference	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
LLD			1	1	1	1	1	1	1	1	1	1	1
GR 9-1	225	L31+50, 2+25N	65	146	21	75	16	3	17	3	9	2	5
GR 9-2	225	L31+50, 2+25N	50	113	17	61	14	3	14	3	7	1	5
GR 21-1	525	L31+50, 5+25N	47	75	12	42	9	2	10	1	5	0.5	3
GR 21-2	525	L31+50, 5+25N	52	62	12	48	10	2	10	1	5	1	3

Appendix II: Enzyme leach/ICP-MS analytical data for sampling transect L31+50 and field duplicates. All data in parts per billion (ppb). (Continued)

Sample	Distance	Grid Reference	Tm	Yb	Lu	Hf	Ta	W	Re	Os	Pt	Au	S.Q.Hg
LLD			1	1	1	1	1	1	0.1	1	1	0.1	1
GR 1	25	L31+50, 0+25N	1	5	1	3	0.5	1	0.05	0.5	0.5	0.05	0.5
GR 2	50	L31+50, 0+50N	0.5	3	0.5	3	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 3	75	L31+50, 0+75N	1	5	0.5	2	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 4	100	L31+50, 1+00N	0.5	5	0.5	2	0.5	1	0.05	0.5	0.5	0.05	0.5
GR 5	125	L31+50, 1+25N	1	7	1	6	0.5	1	0.05	0.5	0.5	0.05	0.5
GR 6	150	L31+50, 1+50N	no sample-wet swamp										
GR 7	175	L31+50, 1+75N	0.5	1	0.5	1	0.5	1	0.05	0.5	0.5	0.05	0.5
GR 8	200	L31+50, 2+00N	0.5	0.5	0.5	0.5	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 9-2	225	L31+50, 2+25N	0.5	3	0.5	5	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 10	250	L31+50, 2+50N	0.5	3	0.5	3	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 11	275	L31+50, 2+75N	0.5	3	0.5	1	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 12	300	L31+50, 3+00N	0.5	4	0.5	1	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 13	325	L31+50, 3+25N	0.5	4	0.5	2	0.5	1	0.05	0.5	0.5	0.05	0.5
GR 14	350	L31+50, 3+50N	1	6	0.5	2	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 15	375	L31+50, 3+75N	1	5	0.5	5	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 16	400	L31+50, 4+00N	2	8	2	5	0.5	1	0.05	0.5	0.5	0.05	0.5
GR 17	425	L31+50, 4+25N	0.5	5	0.5	1	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 18	450	L31+50, 4+50N	1	6	0.5	4	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 19	475	L31+50, 4+75N	1	6	0.5	2	0.5	1	0.05	0.5	0.5	0.05	0.5
GR 20	500	L31+50, 5+00N	0.5	5	0.5	3	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 21-1	525	L31+50, 5+25N	0.5	2	0.5	2	0.5	2	0.05	0.5	0.5	0.05	0.5
GR 22	550	L31+50, 5+50N	0.5	2	0.5	2	0.5	1	0.05	0.5	0.5	0.05	0.5
GR 23	575	L31+50, 5+75N	0.5	3	0.5	4	1	2	0.05	0.5	0.5	0.05	0.5
GR 24	600	L31+50, 6+00N	0.5	3	0.5	2	0.5	2	0.05	0.5	0.5	0.05	0.5
GR 25	625	L31+50, 6+25N	no sample-wet swamp										
GR 26	650	L31+50, 6+50N	no sample-wet swamp										
GR 27	675	L31+50, 6+75N	no sample-wet swamp										
GR 28	700	L31+50, 7+00N	no sample-wet swamp										
GR 29	725	L31+50, 7+25N	0.5	0.5	0.5	0.5	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 30	750	L31+50, 7+50N	0.5	0.5	0.5	0.5	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 31	775	L31+50, 7+75N	0.5	0.5	0.5	0.5	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 32	800	L31+50, 8+00N	0.5	0.5	0.5	0.5	0.5	0.5	0.05	0.5	0.5	0.05	0.5

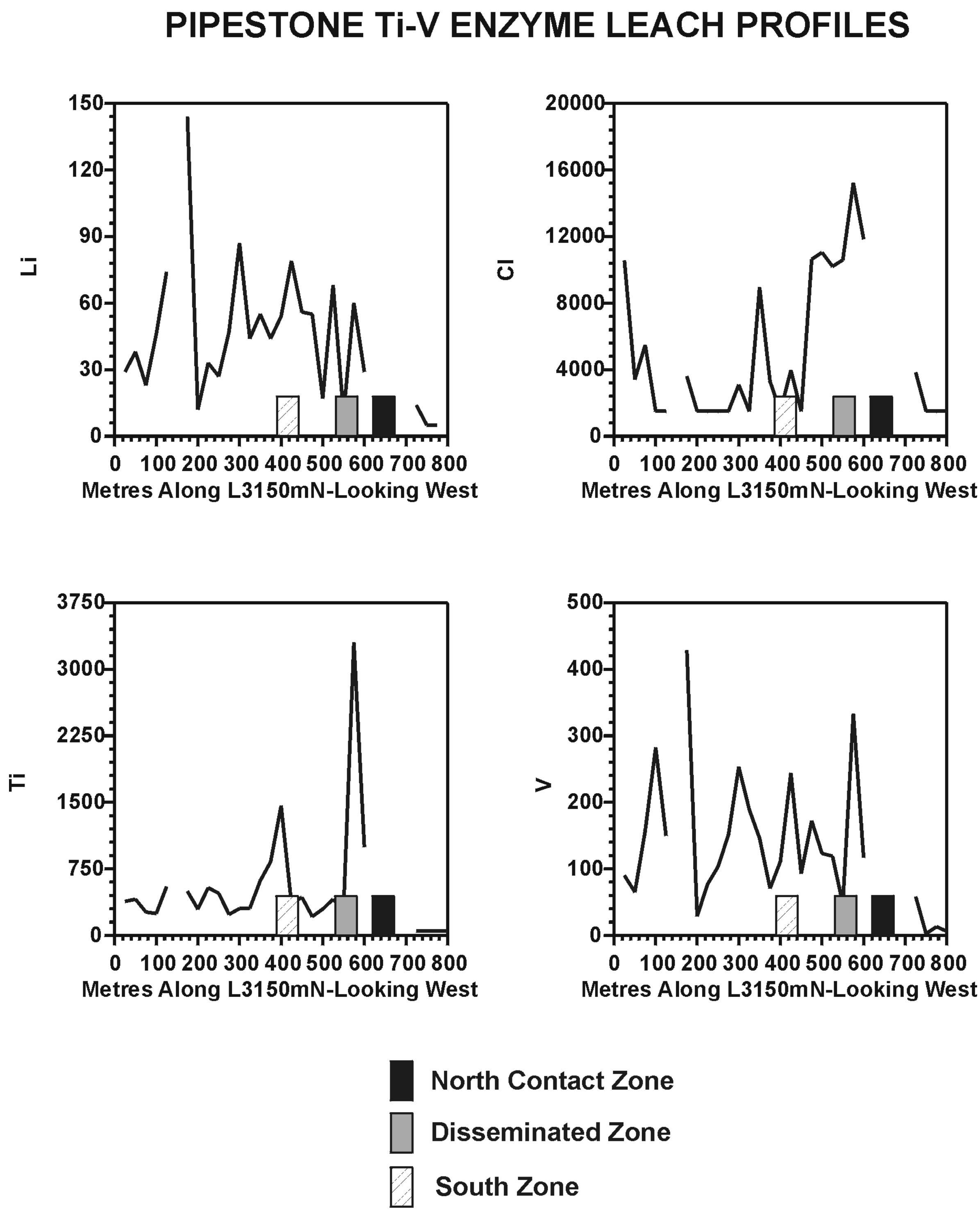
Field Duplicates

Sample	Distance	Grid Reference	Tm	Yb	Lu	Hf	Ta	W	Re	Os	Pt	Au	S.Q.Hg
LLD			1	1	1	1	1	1	0.1	1	1	0.1	1
GR 9-1	225	L31+50, 2+25N	0.5	4	0.5	4	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 9-2	225	L31+50, 2+25N	0.5	3	0.5	5	0.5	0.5	0.05	0.5	0.5	0.05	0.5
GR 21-1	525	L31+50, 5+25N	0.5	2	0.5	2	0.5	2	0.05	0.5	0.5	0.05	0.5
GR 21-2	525	L31+50, 5+25N	0.5	2	0.5	1	0.5	1	0.05	0.5	0.5	0.05	0.5

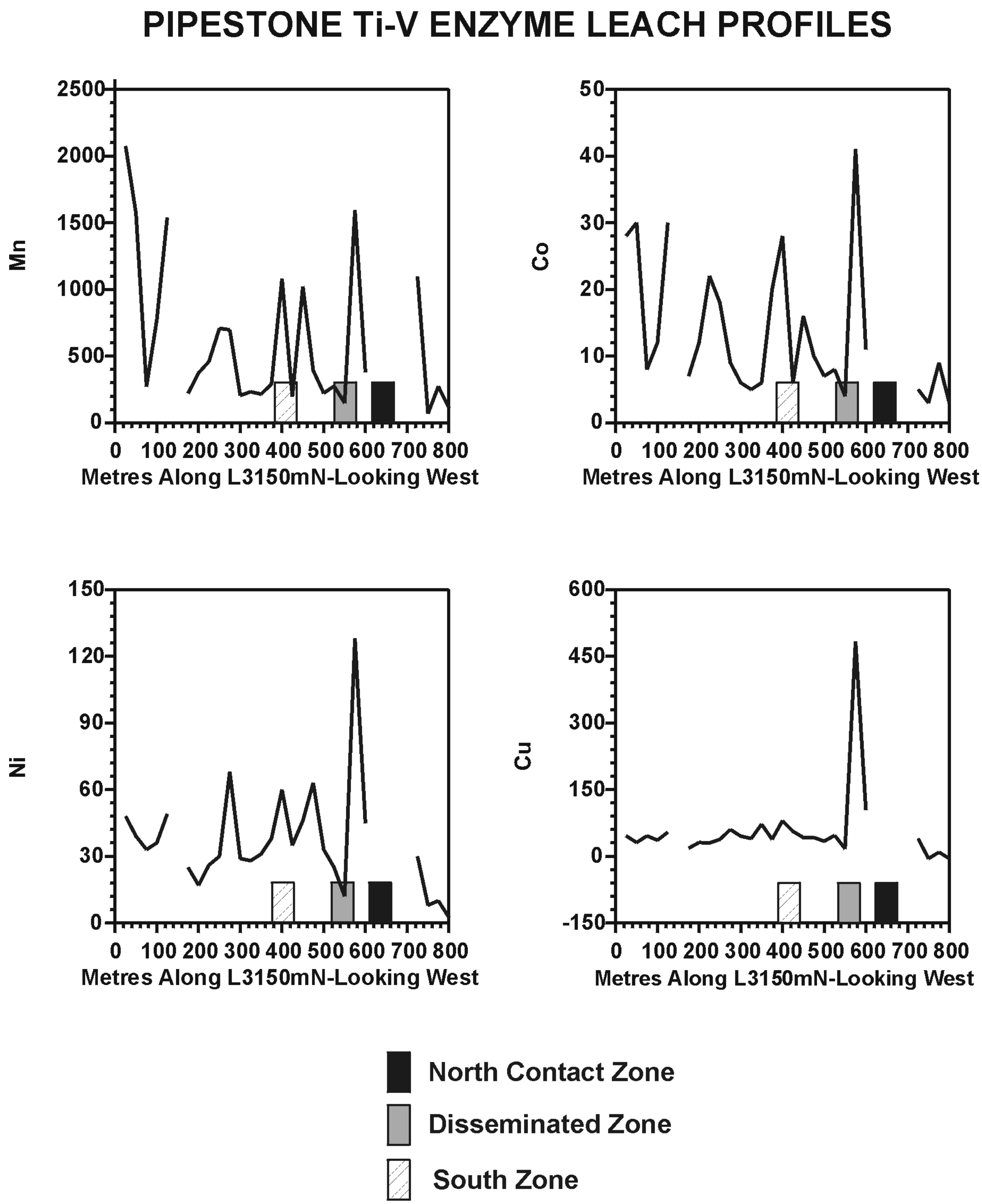
Appendix II: Enzyme leach/ICP-MS analytical data for sampling transect L31+50 and field duplicates. All data in parts per billion (ppb). (Continued)

Sample	Distance	Grid Reference	Tl	Pb	Bi	Th	U
LLD			1	1	1	1	1
GR 1	25	L31+50, 0+25N	0.5	8	0.5	17	7
GR 2	50	L31+50, 0+50N	0.5	8	0.5	11	4
GR 3	75	L31+50, 0+75N	0.5	6	0.5	9	3
GR 4	100	L31+50, 1+00N	0.5	6	0.5	10	8
GR 5	125	L31+50, 1+25N	0.5	8	0.5	33	7
GR 6	150	L31+50, 1+50N	no sample-wet swamp				
GR 7	175	L31+50, 1+75N	0.5	9	0.5	12	3
GR 8	200	L31+50, 2+00N	0.5	4	0.5	8	3
GR 9-2	225	L31+50, 2+25N	0.5	8	0.5	19	4
GR 10	250	L31+50, 2+50N	0.5	8	0.5	14	3
GR 11	275	L31+50, 2+75N	0.5	4	0.5	12	2
GR 12	300	L31+50, 3+00N	0.5	6	0.5	10	2
GR 13	325	L31+50, 3+25N	0.5	5	0.5	9	2
GR 14	350	L31+50, 3+50N	0.5	7	0.5	15	4
GR 15	375	L31+50, 3+75N	0.5	9	0.5	25	5
GR 16	400	L31+50, 4+00N	0.5	21	0.5	21	9
GR 17	425	L31+50, 4+25N	0.5	6	0.5	8	2
GR 18	450	L31+50, 4+50N	0.5	8	0.5	19	4
GR 19	475	L31+50, 4+75N	0.5	7	0.5	14	2
GR 20	500	L31+50, 5+00N	0.5	5	0.5	11	2
GR 21-1	525	L31+50, 5+25N	0.5	9	0.5	15	3
GR 22	550	L31+50, 5+50N	0.5	6	0.5	19	8
GR 23	575	L31+50, 5+75N	0.5	28	0.5	19	6
GR 24	600	L31+50, 6+00N	0.5	13	0.5	21	3
GR 25	625	L31+50, 6+25N	no sample-wet swamp				
GR 26	650	L31+50, 6+50N	no sample-wet swamp				
GR 27	675	L31+50, 6+75N	no sample-wet swamp				
GR 28	700	L31+50, 7+00N	no sample-wet swamp				
GR 29	725	L31+50, 7+25N	0.5	3	0.5	4	0.5
GR 30	750	L31+50, 7+50N	0.5	1	0.5	0.5	0.5
GR 31	775	L31+50, 7+75N	0.5	4	0.5	5	0.5
GR 32	800	L31+50, 8+00N	0.5	1	0.5	0.5	0.5
Field Duplicates							
Sample	**Distance**	**Grid Reference**	**Tl**	**Pb**	**Bi**	**Th**	**U**
LLD			1	1	1	1	1
GR 9-1	225	L31+50, 2+25N	0.5	8	0.5	19	5
GR 9-2	225	L31+50, 2+25N	0.5	8	0.5	19	4
GR 21-1	525	L31+50, 5+25N	0.5	9	0.5	15	3
GR 21-2	525	L31+50, 5+25N	0.5	7	0.5	13	2

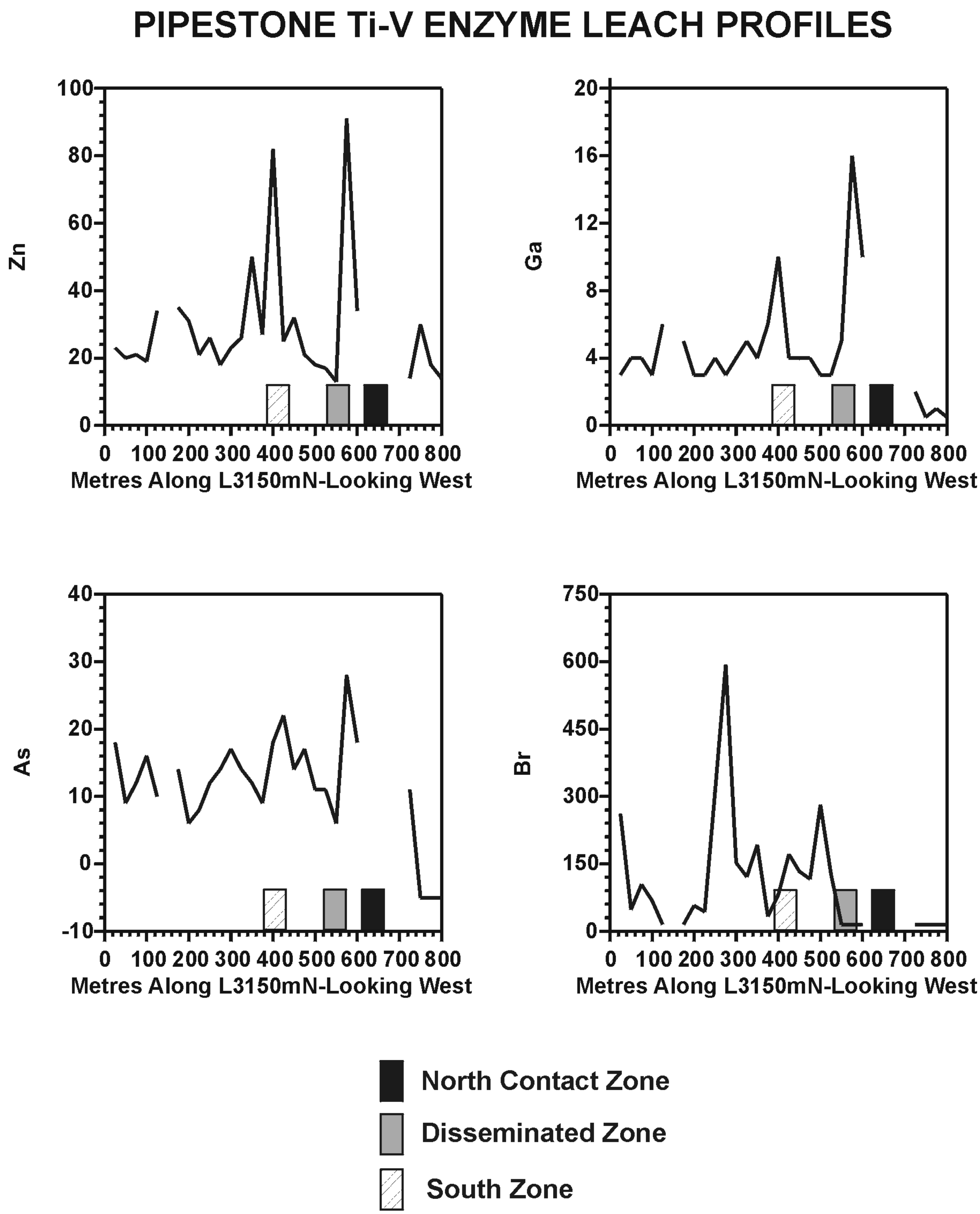
Appendix III: Enzyme leach element profiles over the Pipestone Lake Ti-V deposit.



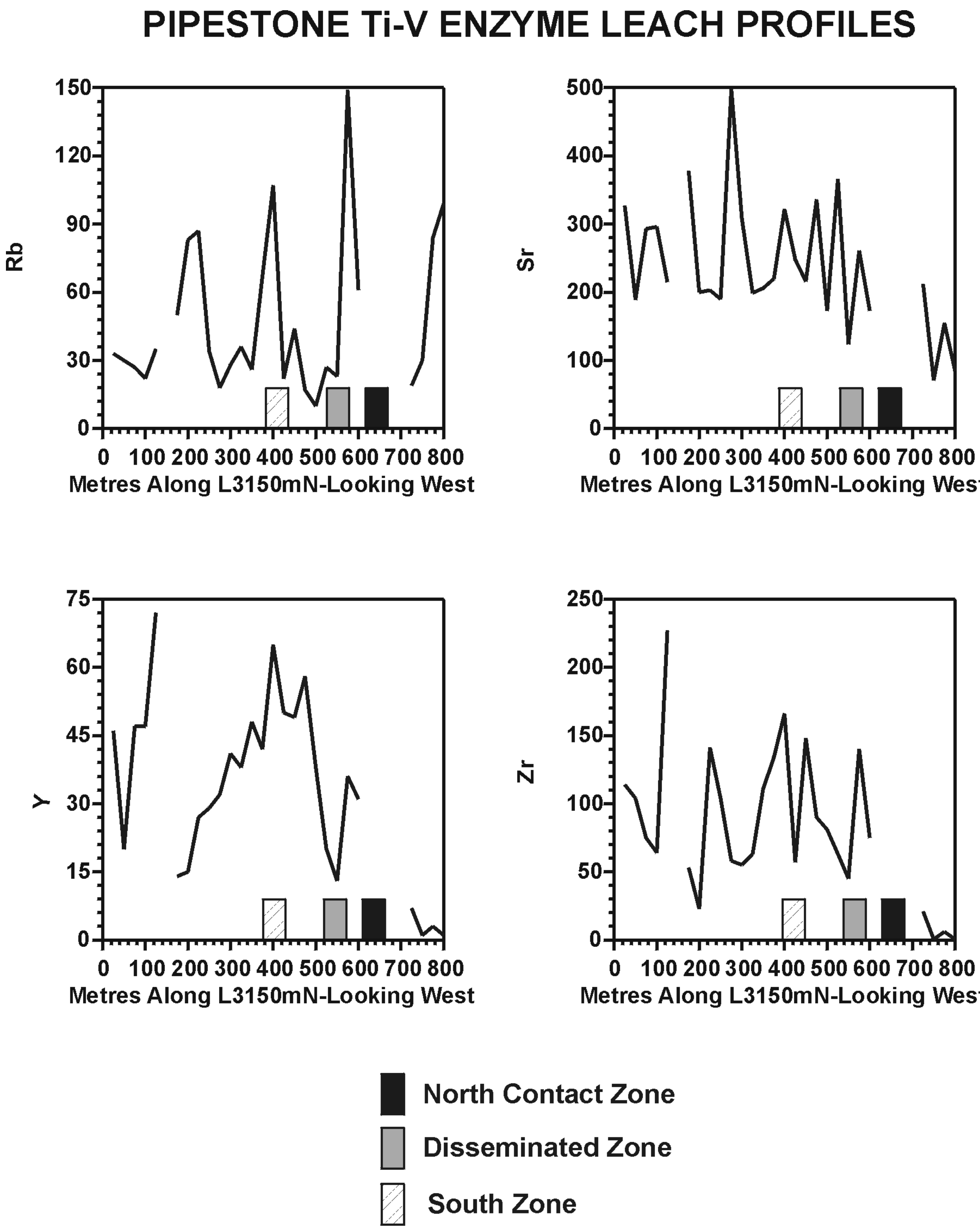
Appendix III: Enzyme leach element profiles over the Pipestone Lake Ti-V deposit. (continued)



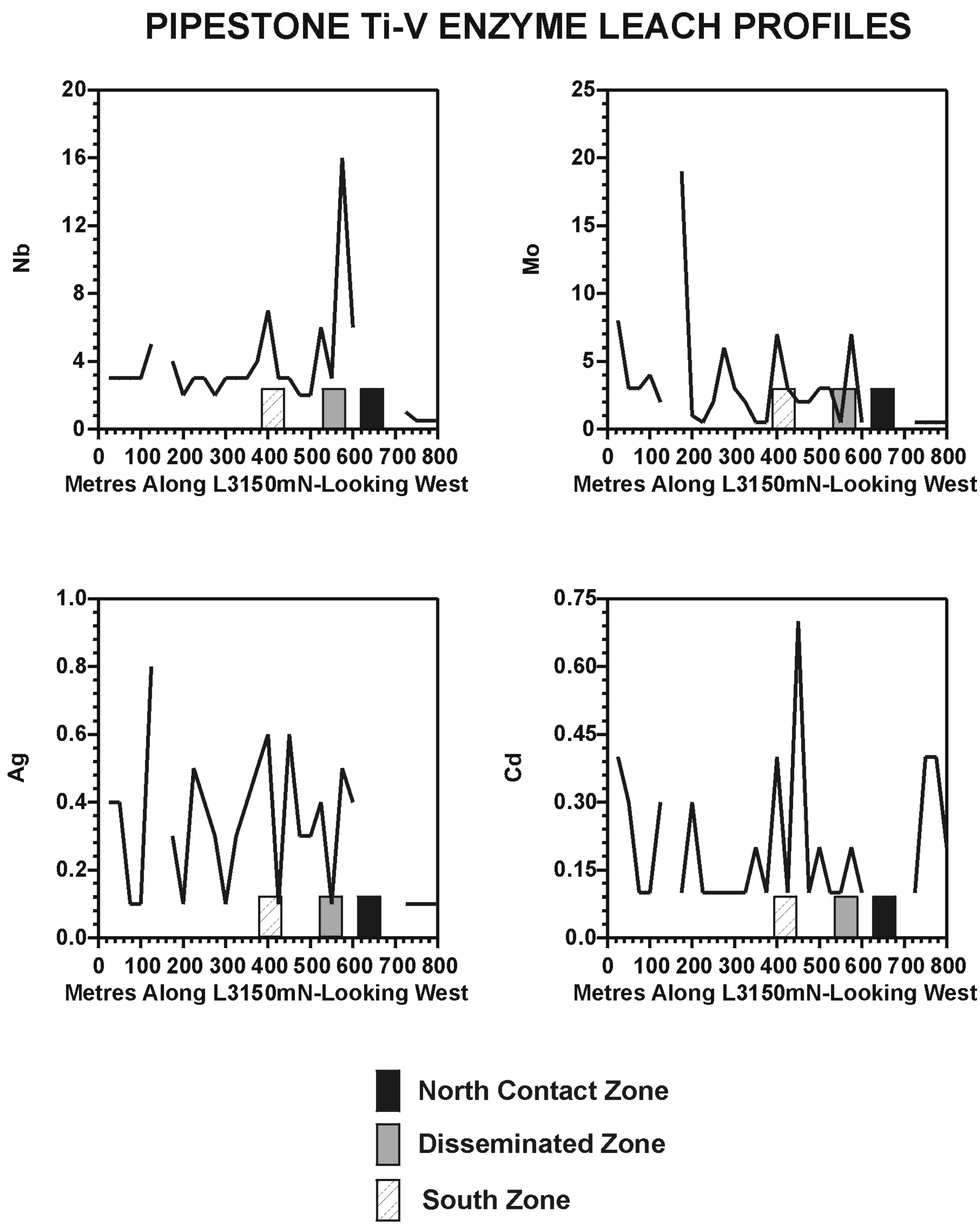
Appendix III: Enzyme leach element profiles over the Pipestone Lake Ti-V deposit. (continued)



Appendix III: Enzyme leach element profiles over the Pipestone Lake Ti-V deposit. (continued)

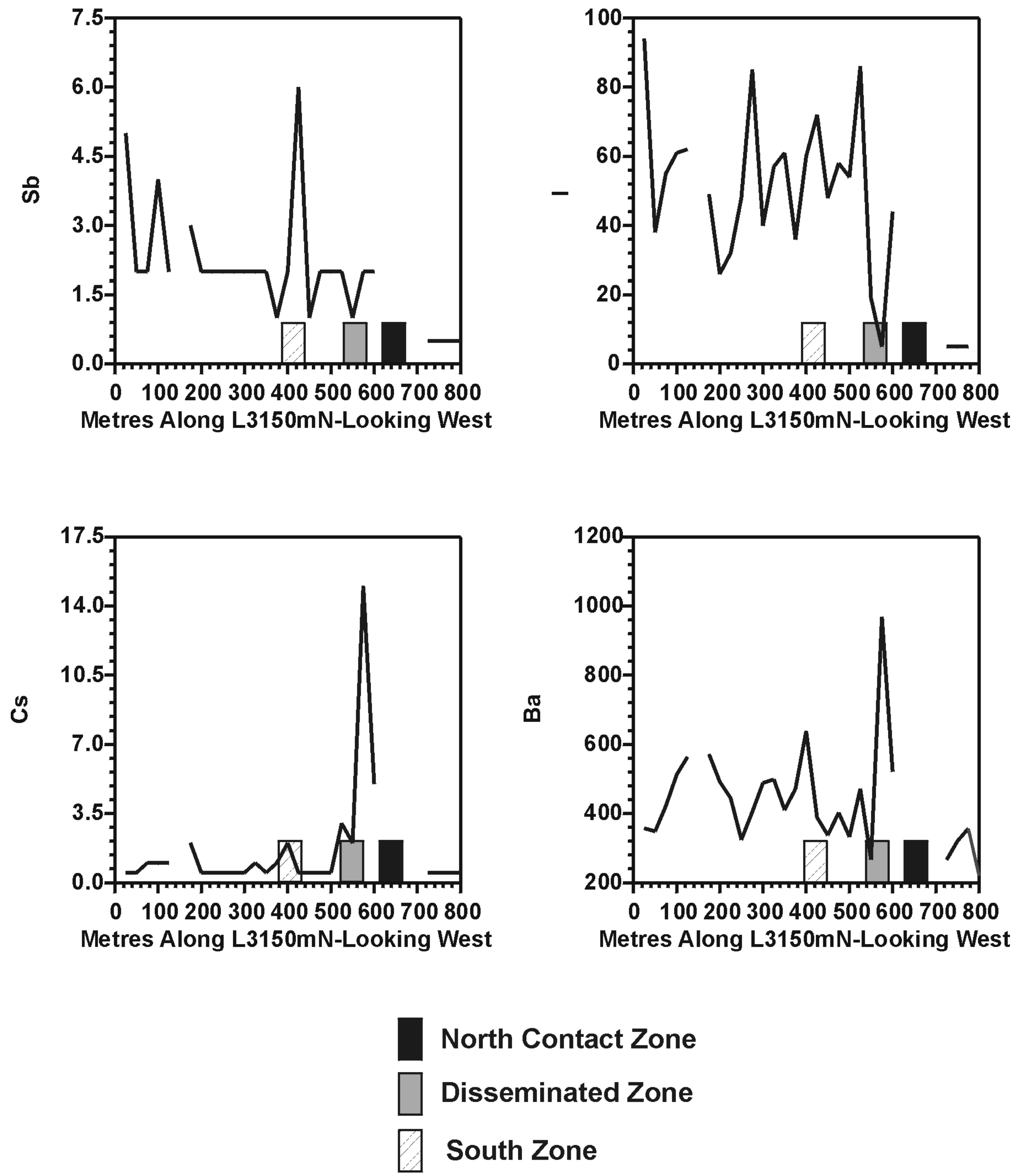


Appendix III: Enzyme leach element profiles over the Pipestone Lake Ti-V deposit. (continued)

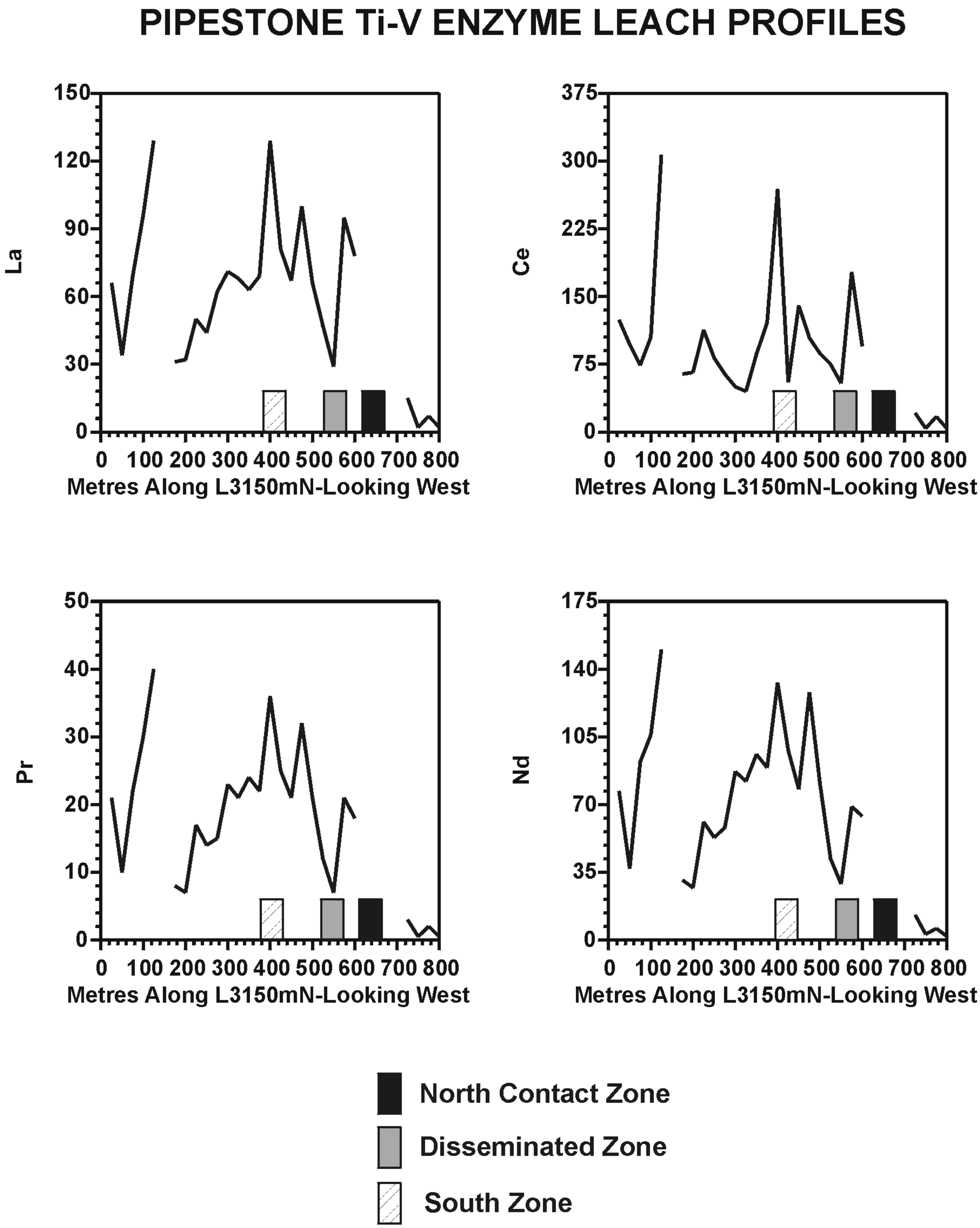


Appendix III: Enzyme leach element profiles over the Pipestone Lake Ti-V deposit. (continued)

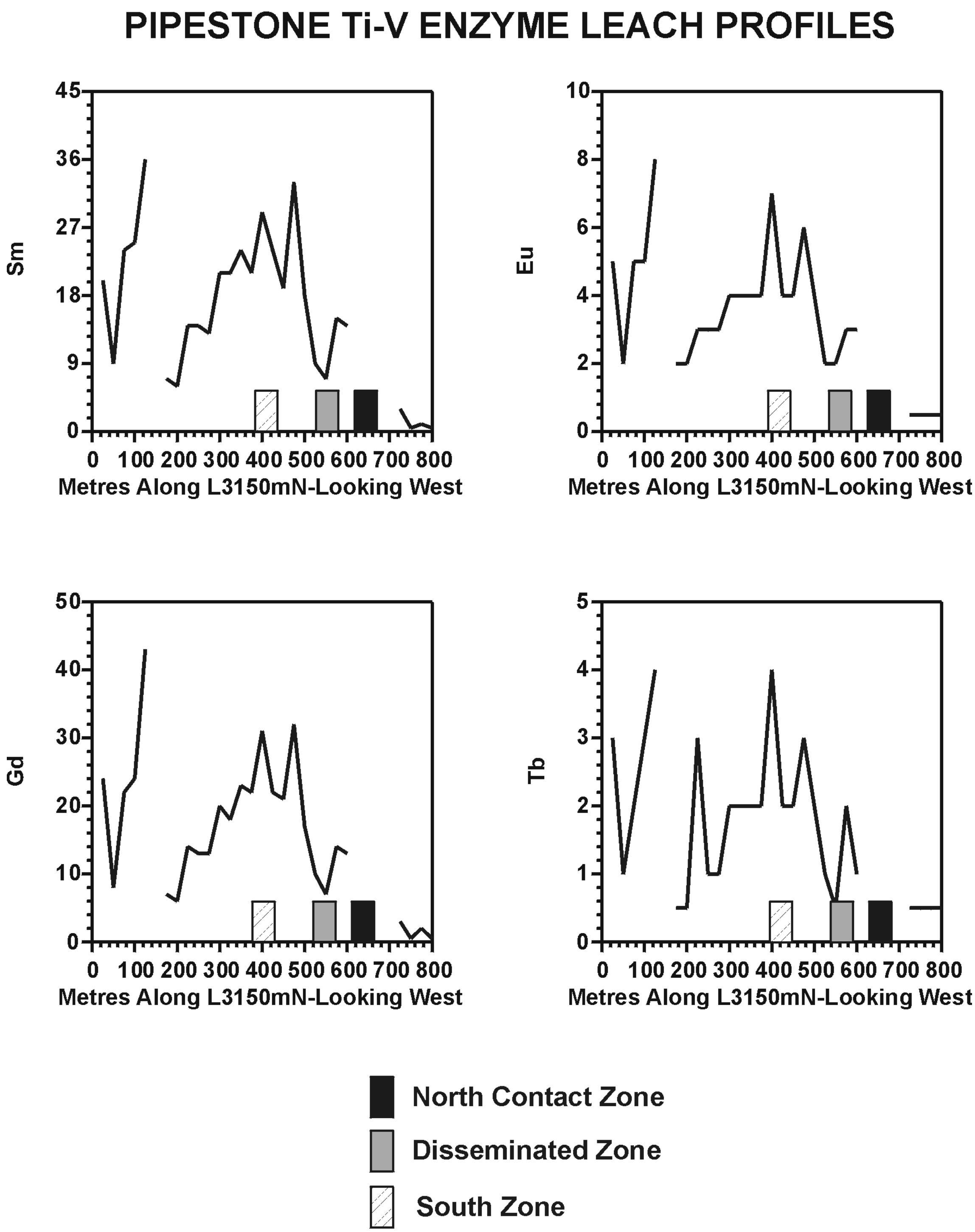
PIPESTONE Ti-V ENZYME LEACH PROFILES



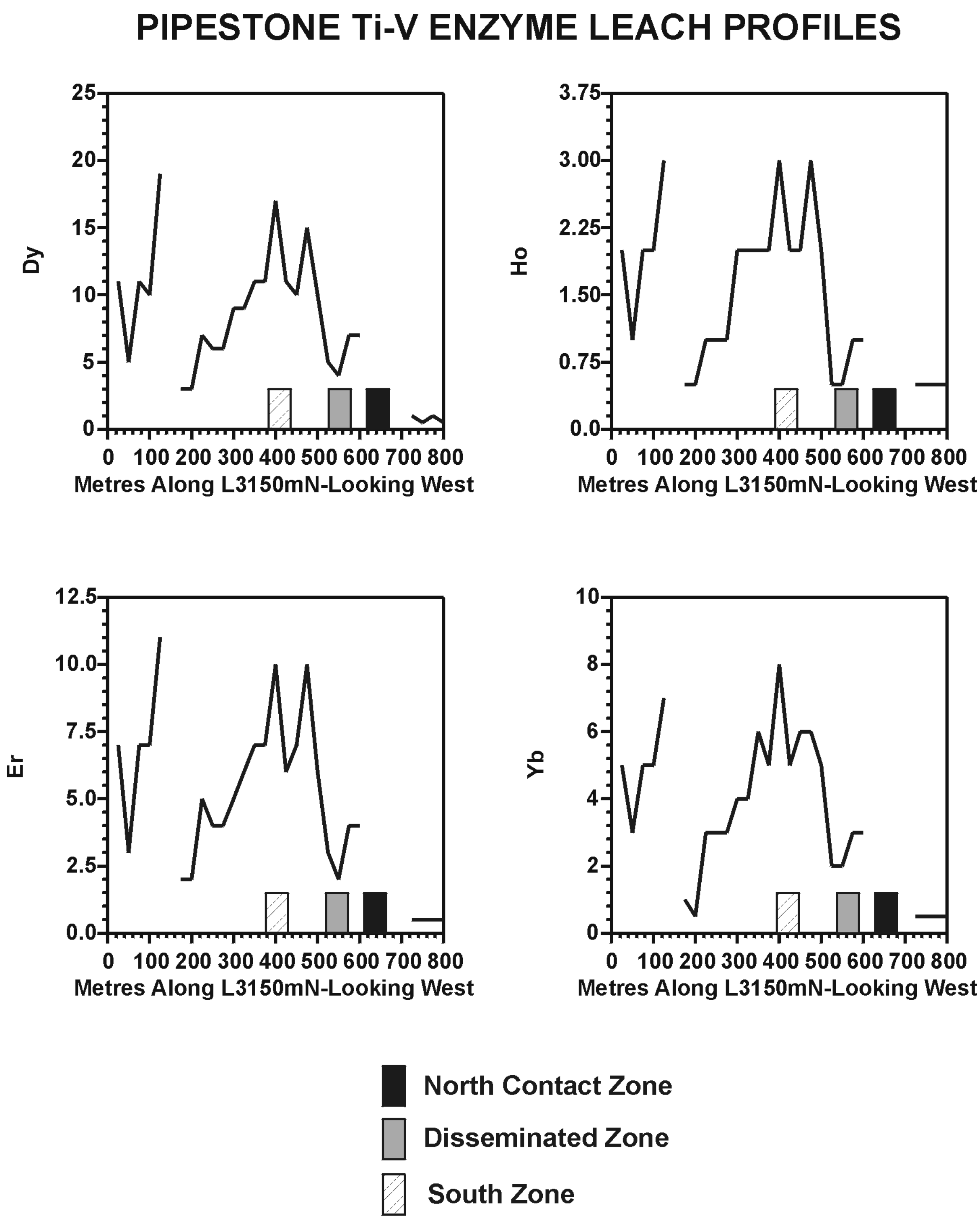
Appendix III: Enzyme leach element profiles over the Pipestone Lake Ti-V deposit. (continued)



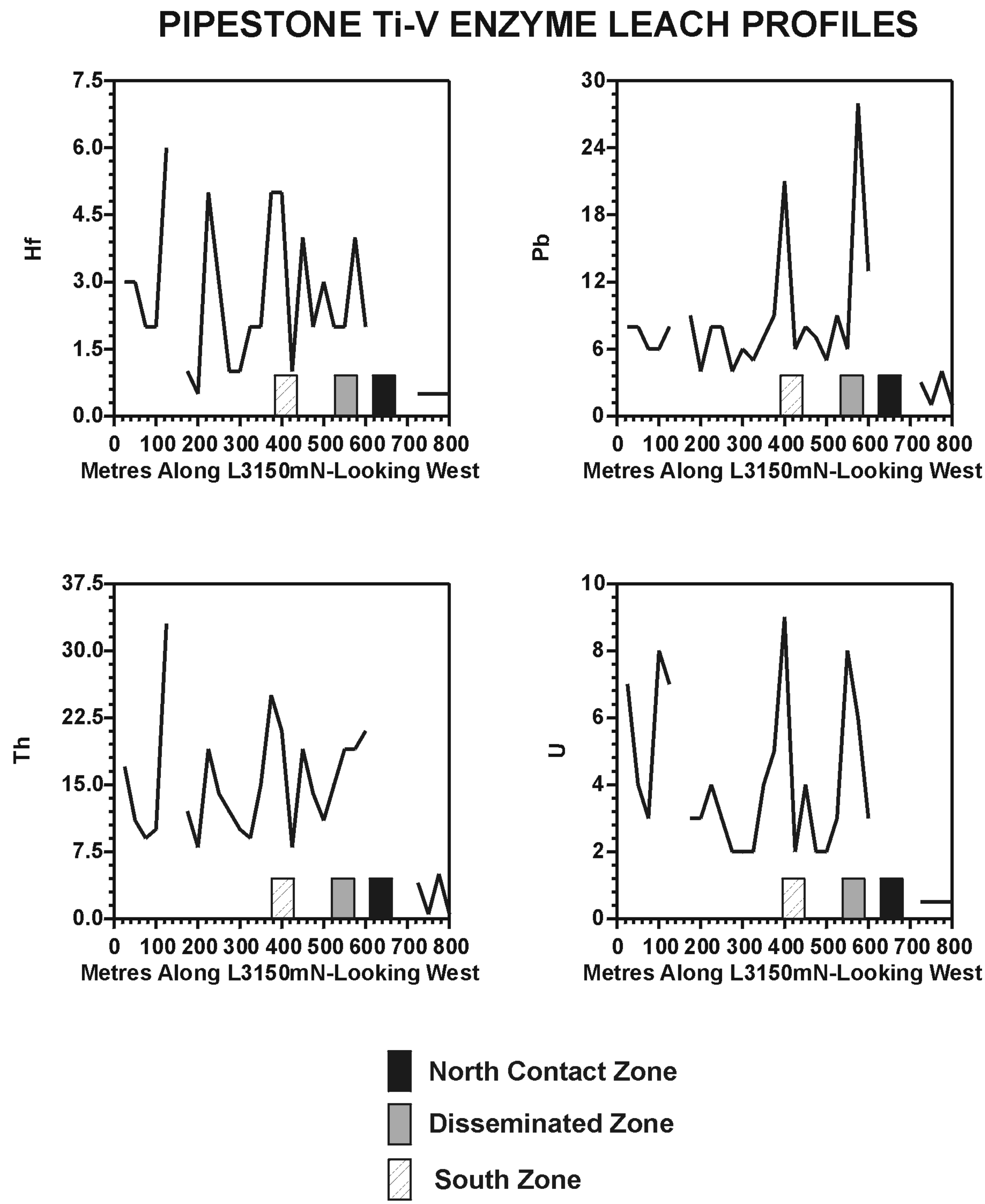
Appendix III: Enzyme leach element profiles over the Pipestone Lake Ti-V deposit. (continued)



Appendix III: Enzyme leach element profiles over the Pipestone Lake Ti-V deposit. (continued)



Appendix III: Enzyme leach element profiles over the Pipestone Lake Ti-V deposit. (continued)



Appendix IV: Neutron activation and inductively coupled plasma-atomic emission spectrometry analytical data for sampling transect L31+50. Hg data by flow injection (FIMS).

ICP-AES

Element	Metres	Grid Reference	Hg	Mo	Cu	Pb	Zn	Ag	Ni	Mn	Sr	Cd	Bi	V	Ca	P	Mg	Ti	Al	K	Y	Be	S
Units			PPB	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	%	%	%	%	%	%	PPM	PPM	%
GR-1	25	L31+50, 0+25N	54	-2	23	21	80	0.6	49	606	148	-0.5	-5	102	1.15	0.037	1.36	0.39	8	2.7	22	2	0.03
GR-2	50	L31+50, 0+50N	40	-2	20	21	72	0.7	46	547	163	-0.5	-5	96	1.06	0.028	1.27	0.39	8.05	2.64	14	2	0.02
GR-3	75	L31+50, 0+75N	25	-2	31	24	95	0.7	58	555	158	-0.5	-5	121	1.14	0.033	1.69	0.41	9.37	2.9	20	2	0.02
GR-4	100	L31+50, 1+00N	26	-2	34	25	103	0.8	64	710	172	-0.5	-5	125	1.21	0.03	1.85	0.42	9.91	2.99	24	2	0.02
GR-5	125	L31+50, 1+25N	23	-2	32	23	102	0.6	58	711	149	-0.5	-5	117	1.12	0.031	1.61	0.39	9.03	2.71	20	2	0.02
GR-6	150	L31+50, 1+50N	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GR-7	175	L31+50, 1+75N	15	-2	22	20	74	0.7	43	384	180	-0.5	-5	92	2.63	0.017	1.29	0.34	7.97	2.47	17	2	0.03
GR-8	200	L31+50, 2+00N	14	-2	16	13	46	0.5	29	253	200	-0.5	-5	54	1.31	0.012	0.63	0.23	5.48	1.47	7	-2	0.02
GR-9-1	225	L31+50, 2+25N	17	-2	29	22	73	0.6	51	360	153	-0.5	-5	104	0.78	0.02	1.42	0.39	9	2.52	14	2	0.02
GR-9-2	225	L31+50, 2+25N	35	-2	19	21	65	0.6	44	412	167	-0.5	-5	93	0.95	0.017	1.21	0.38	8.35	2.73	10	2	0.02
RE GR-9-2	225	L31+50, 2+25N	NA	-2	19	21	68	0.6	44	427	176	-0.5	-5	94	0.97	0.018	1.25	0.38	8.4	2.68	11	2	0.03
GR-10	250	L31+50, 2+50N	36	-2	27	21	75	0.5	50	474	154	-0.5	-5	102	1.16	0.024	1.44	0.39	8.55	2.58	19	2	0.02
GR-11	275	L31+50, 2+75N	45	-2	41	18	81	0.5	56	538	165	-0.5	-5	103	4.51	0.048	1.74	0.35	8.01	2.14	40	2	0.05
GR-12	300	L31+50, 3+00N	29	-2	37	24	98	0.6	61	560	162	-0.5	-5	125	1.08	0.038	1.86	0.4	9.69	2.96	24	2	0.02
GR-13	325	L31+50, 3+25N	26	-2	33	24	98	0.7	59	668	161	-0.5	-5	118	1.25	0.032	1.73	0.4	9.53	2.87	22	2	0.03
GR-14	350	L31+50, 3+50N	26	-2	34	20	90	0.6	57	508	153	-0.5	-5	121	1	0.03	1.64	0.41	9.65	2.77	17	2	0.02
GR-15	375	L31+50, 3+75N	15	-2	16	19	57	0.5	36	377	187	-0.5	-5	82	1.08	0.02	1.02	0.34	7.41	2.42	13	-2	0.02
GR-16	400	L31+50, 4+00N	38	-2	27	21	76	0.5	52	491	160	-0.5	-5	103	0.98	0.027	1.33	0.39	8.55	2.64	22	2	0.02
GR-17	425	L31+50, 4+25N	38	-2	39	22	102	0.6	59	482	154	-0.5	-5	119	1.37	0.033	1.84	0.4	9.82	2.75	28	2	0.02
GR-18	450	L31+50, 4+50N	32	-2	23	22	83	0.6	52	569	161	-0.5	-5	105	1.13	0.035	1.44	0.39	8.65	2.81	20	2	0.02
GR-19	475	L31+50, 4+75N	28	-2	31	23	93	0.5	61	578	159	-0.5	-5	120	1.21	0.026	1.75	0.41	9.54	2.74	25	2	0.02
GR-20	500	L31+50, 5+00N	31	-2	23	21	77	0.6	53	516	151	-0.5	-5	107	1.44	0.024	1.51	0.37	8.81	2.23	20	2	0.03
GR-21-1	525	L31+50, 5+25N	18	-2	19	13	38	0.5	30	326	200	-0.5	-5	57	3.46	0.035	1.48	0.25	5.8	1.59	13	-2	0.04
GR-21-2	525	L31+50, 5+25N	19	-2	22	14	40	0.4	32	332	200	-0.5	-5	58	6.22	0.036	1.64	0.25	5.74	1.66	13	-2	0.06
GR-22	550	L31+50, 5+50N	5	-2	6	13	16	0.6	15	196	221	-0.5	-5	35	1.42	0.046	0.41	0.19	4.97	1.72	10	-2	0.02
GR-23	575	L31+50, 5+75N	39	-2	89	6	56	0.4	381	947	133	-0.5	-5	109	4.63	0.047	4.02	0.5	4.35	0.98	13	-2	0.04
GR-24	600	L31+50, 6+00N	10	-2	20	12	28	0.5	27	287	228	-0.5	-5	50	2.34	0.052	0.94	0.23	5.47	1.65	12	-2	0.02
GR-25	625	L31+50, 6+25N	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GR-26	650	L31+50, 6+50N	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GR-27	675	L31+50, 6+75N	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GR-28	700	L31+50, 7+00N	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GR-29	725	L31+50, 7+25N	15	-2	3	8	11	0.4	11	220	200	-0.5	-5	24	8.15	0.037	2.02	0.13	3.75	1.36	8	-2	0.07
GR-30	750	L31+50, 7+50N	3	-2	2	12	12	0.6	13	190	225	-0.5	-5	36	1.31	0.035	0.31	0.17	4.8	1.4	7	-2	0.02
GR-31	775	L31+50, 7+75N	6	-2	7	13	22	0.5	26	212	204	-0.5	-5	43	1.24	0.035	0.43	0.19	4.98	1.38	7	-2	0.01
GR-32	800	L31+50, 8+00N	3	-2	2	13	12	0.4	12	154	211	-0.5	-5	30	1.16	0.042	0.3	0.15	4.72	1.46	6	-2	0.02
Field Duplicate Pairs																							
GR-9-1	225	L31+50, 2+25N	17	-2	29	22	73	0.6	51	360	153	-0.5	-5	104	0.78	0.02	1.42	0.39	9	2.52	14	2	0.02
GR-9-2	225	L31+50, 2+25N	35	-2	19	21	65	0.6	44	412	167	-0.5	-5	93	0.95	0.017	1.21	0.38	8.35	2.73	10	2	0.02
GR-21-1	525	L31+50, 5+25N	18	-2	19	13	38	0.5	30	326	200	-0.5	-5	57	3.46	0.035	1.48	0.25	5.8	1.59	13	-2	0.04
GR-21-2	525	L31+50, 5+25N	19	-2	22	14	40	0.4	32	332	200	-0.5	-5	58	6.22	0.036	1.64	0.25	5.74	1.66	13	-2	0.06
Analytical Duplicates																							
GR-9-2	225	L31+50, 2+25N	35	-2	19	21	65	0.6	44	412	167	-0.5	-5	93	0.95	0.017	1.21	0.38	8.35	2.73	10	2	0.02
RE GR-9-2	225	L31+50, 2+25N	NA	-2	19	21	68	0.6	44	427	176	-0.5	-5	94	0.97	0.018	1.25	0.38	8.4	2.68	11	2	0.03

Appendix IV: Neutron activation and inductively coupled plasma-atomic emission spectrometry analytical data for sampling transect L31+50. Hg data by flow injection (FIMS). (Continued)

INAA

Element	Metres	Grid Reference	Au	Ag	As	Ba	Br	Ca	Co	Cr	Cs	Fe	Hf	Hg	Ir	Mo	Na	Ni	Rb	Sb	Sc	Se
Units			PPB	PPM	PPM	PPM	PPM	%	PPM	PPM	PPM	%	PPM	PPM	PPB	PPM	%	PPM	PPM	PPM	PPM	PPM
Detection Limit			2	5	0.5	50	0.5	1	1	5	1	0.01	1	1	5	1	0.01	20	15	0.1	0.1	3
GR-1	25	L31+50, 0+25N	4	-5	5.3	640	8.3	2	20	113	9	5.2	5	-1	-5	-1	1.14	-33	182	0.4	16.5	-3
GR-2	50	L31+50, 0+50N	-2	-5	5.3	680	4.2	-1	18	103	7	4.77	6	-1	-5	-1	1.27	-27	201	0.5	15.1	-3
GR-3	75	L31+50, 0+75N	5	-5	7.1	670	5.6	-1	19	118	9	5.82	5	-1	-5	-1	1.06	-28	175	0.4	17	-3
GR-4	100	L31+50, 1+00N	-2	-5	6.9	700	4.4	-1	23	132	9	6.32	5	-1	-5	2	1.14	-29	196	0.5	17.6	-3
GR-5	125	L31+50, 1+25N	2	-5	9.3	680	4.8	-1	24	123	9	6.07	5	-1	-5	-1	1.05	-29	182	0.4	16.4	3
GR-7	175	L31+50, 1+50N	-2	-5	6.9	650	2.5	3	14	100	6	4.53	6	-1	-5	2	1.31	-25	172	0.4	13.1	-3
GR-8	200	L31+50, 1+75N	-2	-5	4.5	620	3.4	-1	10	94	2	2.95	8	-1	-5	-1	1.75	-20	52	0.3	8	-3
GR-9-1	225	L31+50, 2+25N	-2	-5	7.5	660	3.9	2	18	113	8	5.42	6	-1	-5	-1	1.07	-28	184	0.5	15	-3
GR-9-2	225	L31+50, 2+25N	-2	-5	6.5	730	3.4	-1	16	106	7	4.51	6	-1	-5	-1	1.27	-26	162	0.3	13.2	-3
GR-10	250	L31+50, 2+50N	4	-5	8.2	760	6.5	1	21	118	9	5.54	6	-1	-5	1	1.14	-31	180	0.4	17	-3
GR-11	275	L31+50, 2+75N	-2	-5	9.5	550	9.7	4	18	95	7	5.5	5	-1	-5	-1	1.09	100	154	0.6	14.6	-3
GR-12	300	L31+50, 3+00N	-2	-5	8.7	860	5.1	-1	23	147	11	6.89	6	-1	-5	-1	1.15	184	216	0.4	18.9	-3
GR-13	325	L31+50, 3+25N	-2	-5	8.2	680	5.7	-1	20	122	8	5.75	6	-1	-5	-1	1.02	-29	179	0.4	16.4	-3
GR-14	350	L31+50, 3+50N	-2	-5	8.9	720	5.4	-1	19	132	9	6.03	6	-1	-5	-1	1.07	-28	183	0.4	17.6	-3
GR-15	375	L31+50, 3+75N	-2	-5	2.5	770	2.1	-1	13	88	5	3.65	6	-1	-5	-1	1.41	-24	146	0.2	11.7	-3
GR-16	400	L31+50, 4+00N	-2	-5	4.7	770	2.2	2	17	109	7	4.65	5	-1	-5	1	1.05	-27	194	-0.1	16.5	-3
GR-17	425	L31+50, 4+25N	-2	-5	8.3	710	8.3	-1	20	128	10	6.32	6	-1	-5	-1	0.97	-28	180	0.6	17.6	-3
GR-18	450	L31+50, 4+50N	2	-5	6.2	750	5.6	-1	18	117	8	5.4	6	-1	-5	3	1.21	70	190	0.4	16.9	-3
GR-19	475	L31+50, 4+75N	-2	-5	7.7	680	7.3	2	22	123	9	5.92	5	-1	-5	-1	0.99	-29	182	0.4	16.8	-3
GR-20	500	L31+50, 5+00N	-2	-5	8.6	720	9.5	2	18	110	8	5.3	6	-1	-5	-1	0.98	67	152	0.4	15.6	-3
GR-21-1	525	L31+50, 5+25N	-2	-5	4.9	610	6.7	4	12	80	3	3.09	6	-1	-5	2	1.49	-20	76	0.2	9.9	-3
GR-21-2	525	L31+50, 5+25N	-2	-5	4.8	600	6.5	6	12	77	3	3.15	6	-1	-5	-1	1.43	-20	91	0.2	9.7	-3
GR-22	550	L31+50, 5+50N	-2	-5	2.8	510	2.4	-1	5	48	1	1.51	9	-1	-5	1	1.79	-20	57	0.3	5.7	-3
GR-23	575	L31+50, 5+75N	-2	-5	5.4	300	3	4	50	687	2	7.76	6	-1	-5	-1	1.11	362	53	-0.1	17.4	-3
GR-24	600	L31+50, 6+00N	-2	-5	4.4	470	4.3	2	7	63	2	2.24	7	-1	-5	-1	1.76	-20	71	-0.1	7.3	-3
GR-25	625	L31+50,6+25N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GR-26	650	L31+50, 6+50N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GR-27	675	L31+50, 6+75N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GR-28	700	L31+50, 7+00N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GR-29	725	L31+50,7+25N	-2	-5	3.7	400	3.4	8	3	40	1	1.36	7	-1	-5	-1	1.42	-20	49	0.2	4.1	-3
GR-30	750	L31+50, 7+50N	-2	-5	2.2	430	1.4	2	4	37	-1	1.39	6	-1	-5	-1	1.61	-20	43	0.1	3.7	-3
GR-31	775	L31+50, 7+75N	-2	-5	2.9	410	-0.5	1	8	65	1	2.27	7	-1	-5	-1	1.65	-20	48	-0.1	5.6	-3
GR-32	800	L31+50, 8+00N	-2	-5	1.7	400	1.6	-1	4	29	-1	1.12	4	-1	-5	-1	1.59	-20	57	-0.1	3.3	-3
Field Duplicate Pairs																						
GR-9-1	225	L31+50, 2+00N	-2	-5	7.5	660	3.9	2	18	113	8	5.42	6	-1	-5	-1	1.07	-28	184	0.5	15	-3
GR-9-2	225	L31+50, 2+25N	-2	-5	6.5	730	3.4	-1	16	106	7	4.51	6	-1	-5	-1	1.27	-26	162	0.3	13.2	-3
GR-21-1	525	L31+50, 5+25N	-2	-5	4.9	610	6.7	4	12	80	3	3.09	6	-1	-5	2	1.49	-20	76	0.2	9.9	-3
GR-21-2	525	L31+50, 5+25N	-2	-5	4.8	600	6.5	6	12	77	3	3.15	6	-1	-5	-1	1.43	-20	91	0.2	9.7	-3

Appendix IV: Neutron activation and inductively coupled plasma-atomic emission spectrometry analytical data for sampling transect L31+50. Hg data by flow injection (FIMS). (Continued)

INAA

Element	Metres	Grid Reference	Sn	Sr	Ta	Th	U	W	Zn	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu
Units			%	%	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
Detection Limit			0.01	0.05	0.5	0.2	0.5	1	50	0.5	3	5	0.1	0.2	0.5	0.2	0.05
GR-1	25	L31+50, 0+25N	-0.01	-0.05	-0.5	21.2	3.2	-1	147	72.2	172	60	8.6	2	1.1	3	0.5
GR-2	50	L31+50, 0+50N	-0.01	-0.05	1.3	18	2.1	-1	146	48.3	145	36	5.6	1.3	-0.5	2.4	0.38
GR-3	75	L31+50, 0+75N	-0.01	-0.05	1.4	23.4	3.1	-1	132	59.7	122	45	7.1	1.9	-0.5	2.5	0.48
GR-4	100	L31+50, 1+00N	-0.01	-0.05	-0.5	25	4.7	-1	129	71	149	52	8.7	2	-0.5	3	0.5
GR-5	125	L31+50, 1+25N	-0.01	-0.05	1	23.6	2.5	-1	156	61.7	142	46	7.2	1.8	0.6	2.3	0.48
GR-7	175	L31+50, 1+50N	-0.01	-0.05	-0.5	17.7	1.9	-1	118	51.3	98	41	6.2	1.4	-0.5	2.2	0.41
GR-8	200	L31+50, 1+75N	-0.01	-0.05	-0.5	7.6	0.7	-1	67	24	37	14	2.9	0.7	-0.5	1.3	0.22
GR-9-1	225	L31+50, 2+25N	-0.01	-0.05	1.2	21.2	2.9	-1	107	59.9	138	44	5.6	1.4	-0.5	1.8	0.33
GR-9-2	225	L31+50, 2+25N	-0.01	-0.05	1.4	20.4	2.6	-1	105	47.6	115	32	4.3	1.2	-0.5	1.8	0.31
GR-10	250	L31+50, 2+50N	-0.01	-0.05	1.1	23.5	2.2	-1	144	70.1	174	56	8.8	2.1	1	3.1	0.52
GR-11	275	L31+50, 2+75N	-0.01	-0.05	0.8	21.3	2.7	-1	121	113	138	85	12.5	2.9	1	3.6	0.65
GR-12	300	L31+50, 3+00N	-0.01	-0.05	2	27.5	3.3	-1	109	75.7	151	60	9.6	2.1	-0.5	3	0.6
GR-13	325	L31+50, 3+25N	-0.01	-0.05	1.8	22.8	-0.5	-1	92	63.2	117	46	7.4	1.8	-0.5	2.5	0.44
GR-14	350	L31+50, 3+50N	-0.01	-0.05	-0.5	25.5	3.3	-1	153	57.7	137	44	6.9	1.5	-0.5	2.3	0.47
GR-15	375	L31+50, 3+75N	-0.01	-0.05	1.3	16	2.1	2	75	43.9	101	33	5.3	1.3	-0.5	2	0.37
GR-16	400	L31+50, 4+00N	-0.01	-0.05	1.4	22.7	2.5	-1	115	66.9	189	54	8.1	2	1	2.7	0.5
GR-17	425	L31+50, 4+25N	-0.01	-0.05	-0.5	25.4	3.2	-1	145	83.9	107	68	9.9	2.3	-0.5	3.1	0.56
GR-18	450	L31+50, 4+50N	-0.01	-0.05	-0.5	25.5	2.7	-1	107	63.4	184	54	8.2	1.7	-0.5	2.7	0.5
GR-19	475	L31+50, 4+75N	-0.01	-0.05	1.6	24.6	3.1	-1	123	72	137	59	8.9	2	-0.5	2.8	0.54
GR-20	500	L31+50, 5+00N	-0.01	-0.05	0.6	24.6	3.4	3	121	55.4	127	49	7.7	1.8	-0.5	2.7	0.44
GR-21-1	525	L31+50, 5+25N	-0.01	-0.05	-0.5	10.2	0.8	-1	-50	32.8	57	28	4.2	1	0.6	1.6	0.27
GR-21-2	525	L31+50, 5+25N	-0.01	-0.05	-0.5	11.8	0.8	-1	-50	35.2	63	28	4.3	1	0.6	1.5	0.26
GR-22	550	L31+50, 5+50N	-0.01	-0.05	-0.5	5.6	1.2	-1	-50	18.8	42	18	3	0.9	-0.5	1.6	0.27
GR-23	575	L31+50, 5+75N	-0.01	-0.05	1.1	6	-0.5	-1	82	21.8	50	21	4.2	1.2	-0.5	1.7	0.27
GR-24	600	L31+50, 6+00N	-0.01	-0.05	1.4	7.3	-0.5	-1	-50	24.5	46	22	3.6	1.1	-0.5	1.5	0.29
GR-25	625	L31+50,6+25N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GR-26	650	L31+50, 6+50N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GR-27	675	L31+50, 6+75N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GR-28	700	L31+50, 7+00N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GR-29	725	L31+50,7+25N	-0.01	-0.05	-0.5	4.2	-0.5	-1	-50	15.5	35	15	2.4	0.7	-0.5	1.2	0.21
GR-30	750	L31+50, 7+50N	-0.01	-0.05	-0.5	4.5	0.9	-1	-50	11.7	24	7	1.7	0.6	-0.5	0.8	0.15
GR-31	775	L31+50, 7+75N	-0.01	-0.05	-0.5	6.5	1.1	-1	-50	15.3	35	10	2.1	0.6	-0.5	1.1	0.21
GR-32	800	L31+50, 8+00N	-0.01	-0.05	-0.5	3.2	-0.5	-1	-50	9.6	20	7	1.5	0.5	-0.5	0.7	0.13
Field Duplicate Pairs																	
GR-9-1	225	L31+50, 2+00N	-0.01	-0.05	1.2	21.2	2.9	-1	107	59.9	138	44	5.6	1.4	-0.5	1.8	0.33
GR-9-2	225	L31+50, 2+25N	-0.01	-0.05	1.4	20.4	2.6	-1	105	47.6	115	32	4.3	1.2	-0.5	1.8	0.31
GR-21-1	525	L31+50, 5+25N	-0.01	-0.05	-0.5	10.2	0.8	-1	-50	32.8	57	28	4.2	1	0.6	1.6	0.27
GR-21-2	525	L31+50, 5+25N	-0.01	-0.05	-0.5	11.8	0.8	-1	-50	35.2	63	28	4.3	1	0.6	1.5	0.26