Economic Report ER95-1

Multi-Media Geochemical Surveys at the Farley Lake Gold Deposits, Agassiz Metallotect, Lynn Lake Area; Part 1: Element Distribution in the Host Rocks to the Wendy Zone

by M.A.F. Fedikow

Manitoba
Energy and Mines
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Front cover: Oblique aerial photograph of the Farley Lake Gold deposit area.

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Winnipeg, 1995

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ABSTRACT

Seventy drill core chip samples from a single drill hole through the iron formation-hosted Wendy Au Zone were analysed by atomic absorption spectrometry subsequent to a partial HCL-HNO_3-H_2O dissolution. In addition to Au and Fe, the elements W, Ag, Co, Bi, Cu, Pb and Zn are highly to moderately enriched in the mineralized zone. Despite concentrations of greater than 1% As through the section containing the Au mineralization, As alone is not considered to be a diagnostic indicator for replacement type Au deposits like the Wendy Zone. Patterns formed by the variation in concentration of Cu, Pb and Zn are demonstrated to be more useful than simple high concentrations of these metals for recognizing rock geochemical anomalies in proximity to the Wendy Zone. Enrichment of Au, W, Ag, Co, Bi, Cu, Pb and Zn in the Wendy deposit and the spatial association of high As concentrations are useful indicators facilitating interpretation of subsequent peat bog and vegetation geochemical surveys in the area of the deposit.

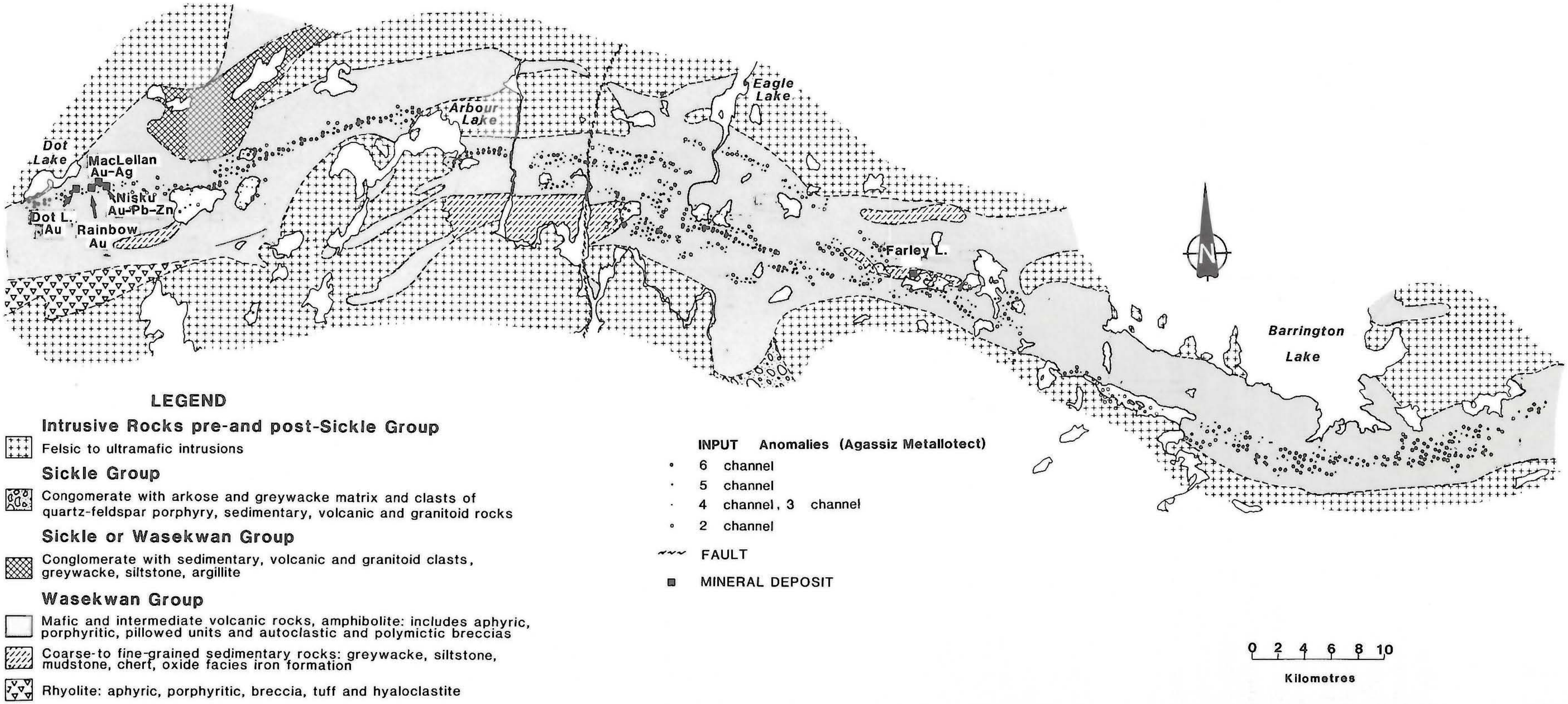


Figure 1: Individual airborne INPUT anomalies, simplified regional geology and gold deposits along the Agassiz Metallotect. Geophysical data from Questor (1976).

INTRODUCTION

Multi-media geochemical surveys in the area of the Farley Lake Au deposits, (Fedikow *et al*, 1984), included rock chip (drill core), till, peat bog and vegetation sampling programs. The multi-media approach to geochemical signature definition was adopted because of the lack of outcrop in the area, as well as the successful application of surficial geochemical methods at the MacLellan Au-Ag deposit, 40 km west of the Farley deposit within the Agassiz Metallotect (Fig. 1; Fedikow *et al*, 1989; Nielsen and Fedikow, 1987). Samples from the host rocks to the Wendy Zone, one of three mineralized zones in the deposit, were collected from diamond drill core; the analytical results form the basis of this report (Part 1). Part 2 will describe the geochemistry of five permafrozen peat bogs that, in the area of the deposit, were cored from surface to their base. A vegetation geochemical survey (Part 3) was undertaken subsequent to the peat bog survey; samples of black spruce (*Picea mariana*) needles and twigs were collected over three of five peat bogs. Till, peat bog and vegetation samples were collected early in the exploration of the deposit, and accordingly, are considered to be unaffected by anthropogenic contamination. A final assessment of the relative merits of the surficial geochemical program will be provided in Part 4. This will include an assessment of the results of the overburden geochemical surveys conducted at the deposit by Nielsen and Graham (1985) and by the staff of Manitoba Mineral Resources Ltd. (Brereton *et al*, 1988), the discoverer of the Farley Lake deposits.

This hierarchical study of element dispersion about the Wendy Zone in bedrock, till, peat bog and vegetation will assess these geochemical techniques for application to exploration for other occurrences of replacement Au mineralization along the Agassiz Metallotect.

GEOLOGICAL SETTING OF THE DEPOSIT

The Farley Lake gold deposits are situated in the northern belt of the early Proterozoic Lynn Lake greenstone belt in northwestern Manitoba (Fig. 1). The belt forms part of the Churchill Structural Province of the Canadian Shield, trends east, has an aggregate length of 130 km and is up to 60 km wide.

To date, most significant gold deposits and occurrences in the Lynn Lake greenstone belt are associated with two regional metallogenetic features: the Agassiz Metallotect in the northern belt and the Johnson Shear Zone in the southern belt (Fedikow *et al*, 1986, 1989, 1991). Gold deposits associated with the Agassiz Metallotect include the past-producing MacLellan Au-Ag deposit (1 174 000 t at 6.51 g/t Au and 18.89 g/t Ag), the Dot Lake Au deposits (7 zones totalling 1 248 000 t at 4.01 g/t Au), the Nisku Au-Ag-Zn-Pb deposit (187 000 t at 6.51 g/t Au, 1.3% Zn and 0.8% Pb), the Rainbow Au deposit (539 000 t at 8.57 g/t Au) and the Farley Lake Au deposits. Currently, gold is being produced from the Burnt Timber deposit (930 000 t at 3.3 g/t Au) located along the Johnson Shear in the southern belt. Other significant gold deposits include the Cartwright Lake deposit (655 000 t at 2.4 g/t Au) and the Last Hope deposit (805 000 t at 10.35 g/t Au). Although the Last Hope deposit is spatially separated from the Johnson Shear Zone it occurs in a highly deformed remnant of Lynn Lake greenstone belt rocks to the south of the main greenstone outcrop belt. The structures developed in the highly deformed host rocks to the Last Hope deposit are considered to represent splays from the main shear that characterizes the Johnson Shear (P. Pawliw, pers. comm. to D. Peck, 1994).

The Farley Lake Au deposit occurs within the Agassiz Metallotect (Fig. 1). The metallotect comprises picritic basalt and oxide-, sulphide-, and silicate facies iron formation interlayered with greywacke, siltstone and tuffaceous rocks. Minor quartz phyric felsic volcanic rocks are also present (Parbery and Fedikow, 1987). Due to the presence of abundant magnetite and near solid to solid sulphide in this stratigraphic succession the rocks have a distinctive geophysical signature that has been traced by airborne INPUT and gradiometer for 65 to 70 km.

This mineralized sequence has been variably and multiply deformed (cf. Gilbert *et al*, 1980; Gagnon, 1991) and coincides with an east-trending lineament of regional extent that is clearly visible on aerial photographs. This lineament, although not thoroughly examined, appears to represent a series of faults and shears that are spatially associated with zones of mineralization along the metallotect.

Lithologies in the general area of the Farley Lake gold deposit are represented by hematite-magnetite oxide facies iron formation and mafic to intermediate volcanic flows and fragmental rocks (Fig. 2; Gilbert, 1992). The iron formation occurs within a 500 m thick unit of chemical and detrital sedimentary rocks that are flanked to the north by picritic heterolithologic breccia, pillowed flows, pillow breccia and tuff and to the south by mafic to intermediate volcanic rocks (Fig. 3; Parbery, 1992).

The Farley Lake Au deposit has been subdivided into three zones, namely the pyrrhotite-rich Wendy Zone and South Zone, and the pyrite-rich East Zone. The Wendy and South Zones have reserves of 1.3 million tonnes grading 6.86 g/t Au and the East Zone contains 363 000 tonnes grading 4.80 g/t (Fedikow *et al*, 1989). The mineralized zones occur within an east striking, subvertically dipping oxide facies iron formation as lenses enclosed by an alteration envelope of chloritization, silicification and sulphidization. A simplified geological cross section that illustrates some of these characteristics for the Wendy Zone is given in Figure 4. The deposits and accompanying alteration zones are oblique to layering, strike east and dip 34°-45° south. Gold occurs in sulphidized oxide facies iron formation (Briggs and Taylor, 1987) that consists of interbedded near solid pyrrhotite and/or pyrite (up to 90%), magnetite and chert laminae. Gold occurs as individual particles of free gold in cavities in the silicate matrix and within and mantling pyrrhotite and magnetite grains. Gold and sulphide minerals also occur as mobilisate(?) within quartz veins in argillite, iron formation, mafic volcanic rocks and quartz diorite. Average gold particle size from the Wendy and East Zones is 4 microns (Brereton *et al*, 1988). The deposit is considered to represent an epigenetic deposit similar to those at Water Tank Hill in Western Australia (Phillips *et al*, 1984) and to the Carshaw and Malga Au deposits near Timmins, Ontario (Fyon *et al*, 1983). These deposits formed by the selective replacement of magnetite by gold-bearing iron sulphides. At Farley Lake, it is conceivable that the fracture system, along which mineralizing fluids accessed the oxide facies iron formation and subsequently precipitated gold, is a subsidiary splay or fault associated with the major east-west lineaments that overprint the metallotect.

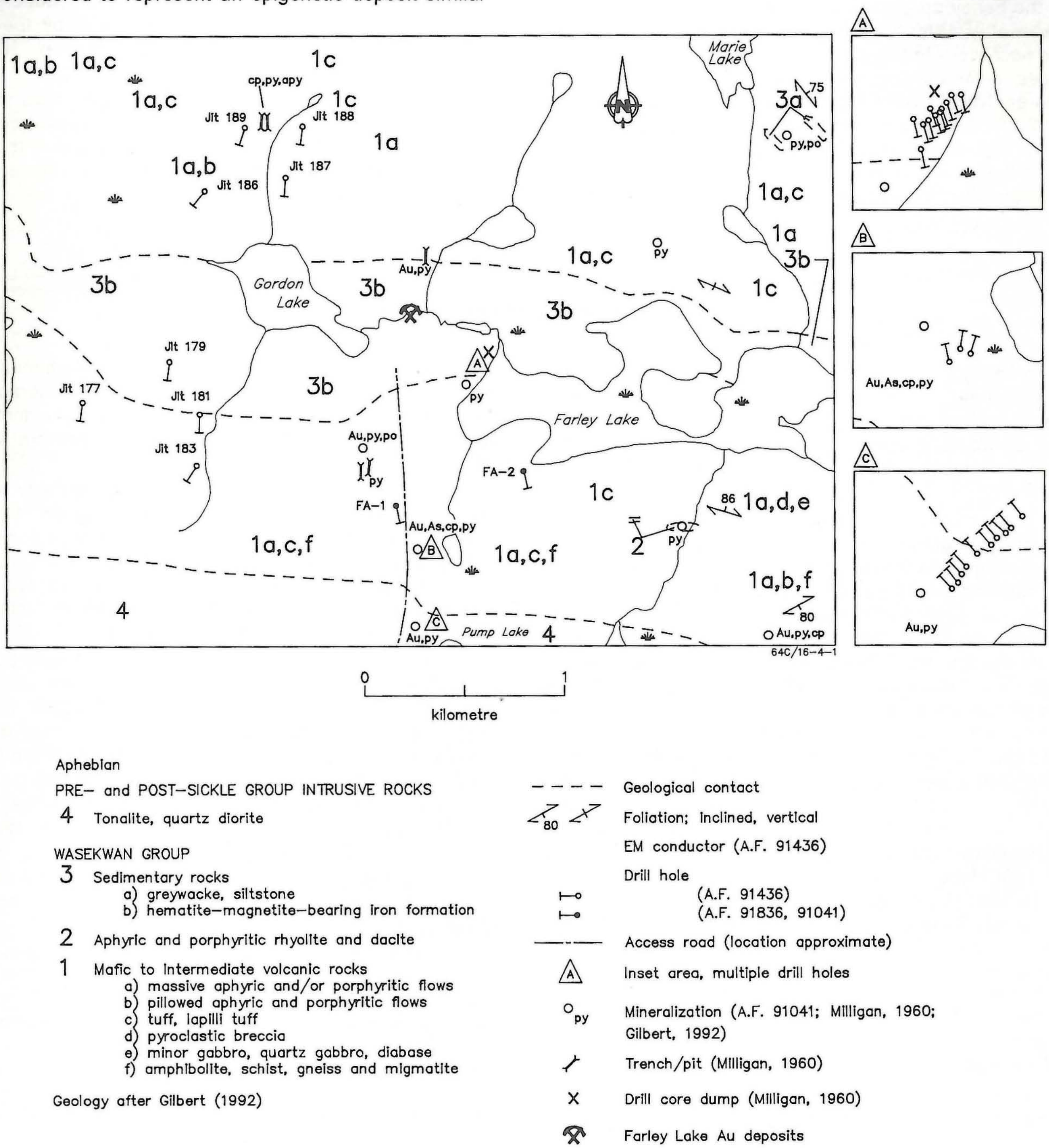
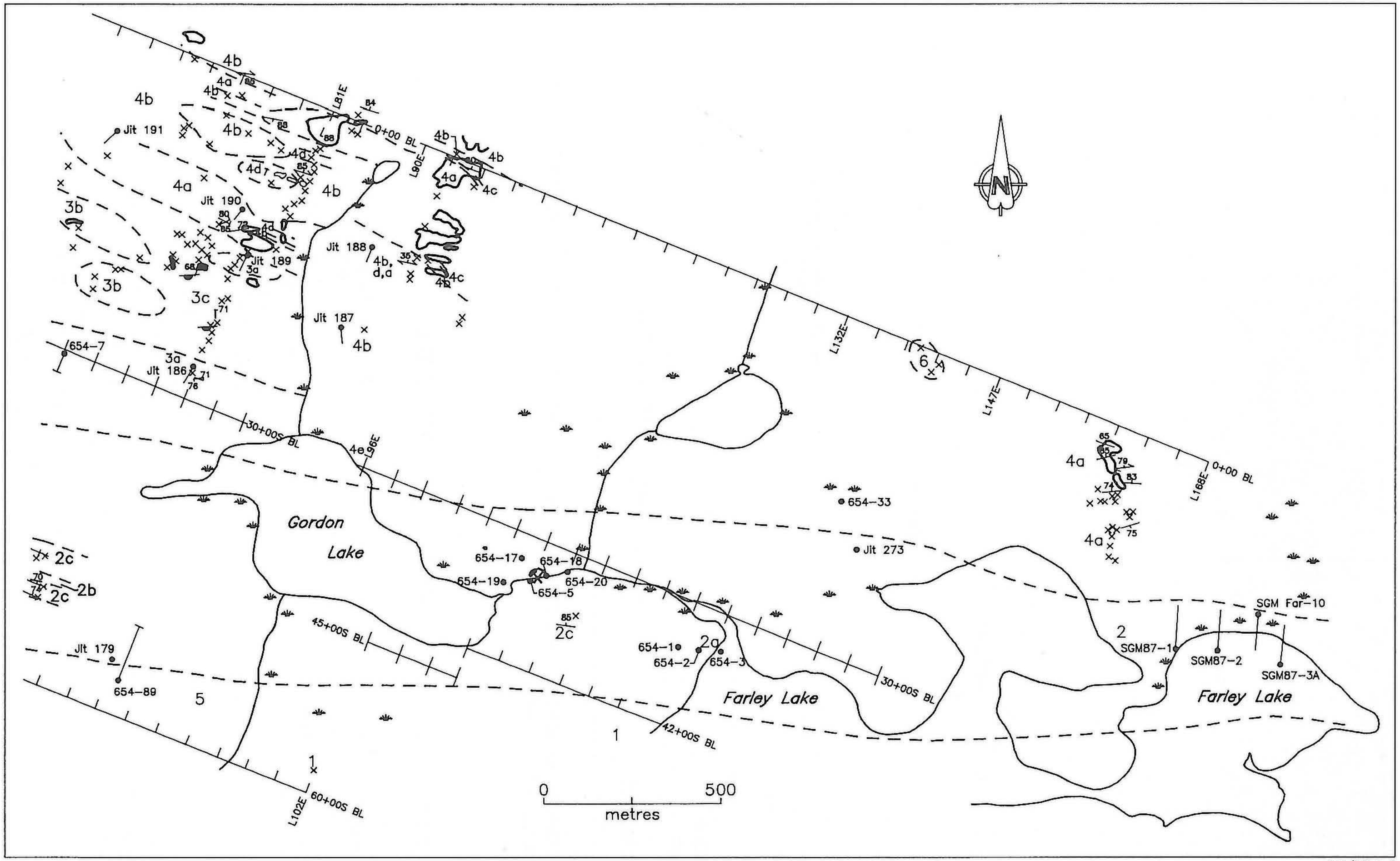


Figure 2: Local geological setting of the Farley Lake Au deposit (after Gilbert, 1992).



6 Diorite, gabbro

5 Granodiorite

4 Mafic to intermediate volcanic rocks
- a) tuff
- b) heterolithic breccia
- c) polymictic conglomerate
- d) flow breccia
- e) amphibole phyric basalt flows

3 Picritic volcanic rocks
- a) fragmental
- b) heterolithic breccia
- c) pillowed flows, pillow breccia

2 Chemical and detrital sedimentary rocks
- a) laminated siliceous sedimentary rocks
- b) hematite-quartz banded iron formation
- c) magnetite-quartz banded iron formation

1 Mafic to intermediate volcanic rocks, amygdaloidal mafic volcanic rocks

× O Outcrop

Drill hole

Geological contact, assumed

85 Bedding: inclined, vertical

79 Foliation, inclined

Pillowed flow, tops known

71 Fracture set: inclined, vertical

Farley Lake Au deposits

Geology by Parbery (1992)

Figure 3: Local geological setting of the Farley Lake Au deposit showing the location of picritic basalt (after Parbery, 1992).

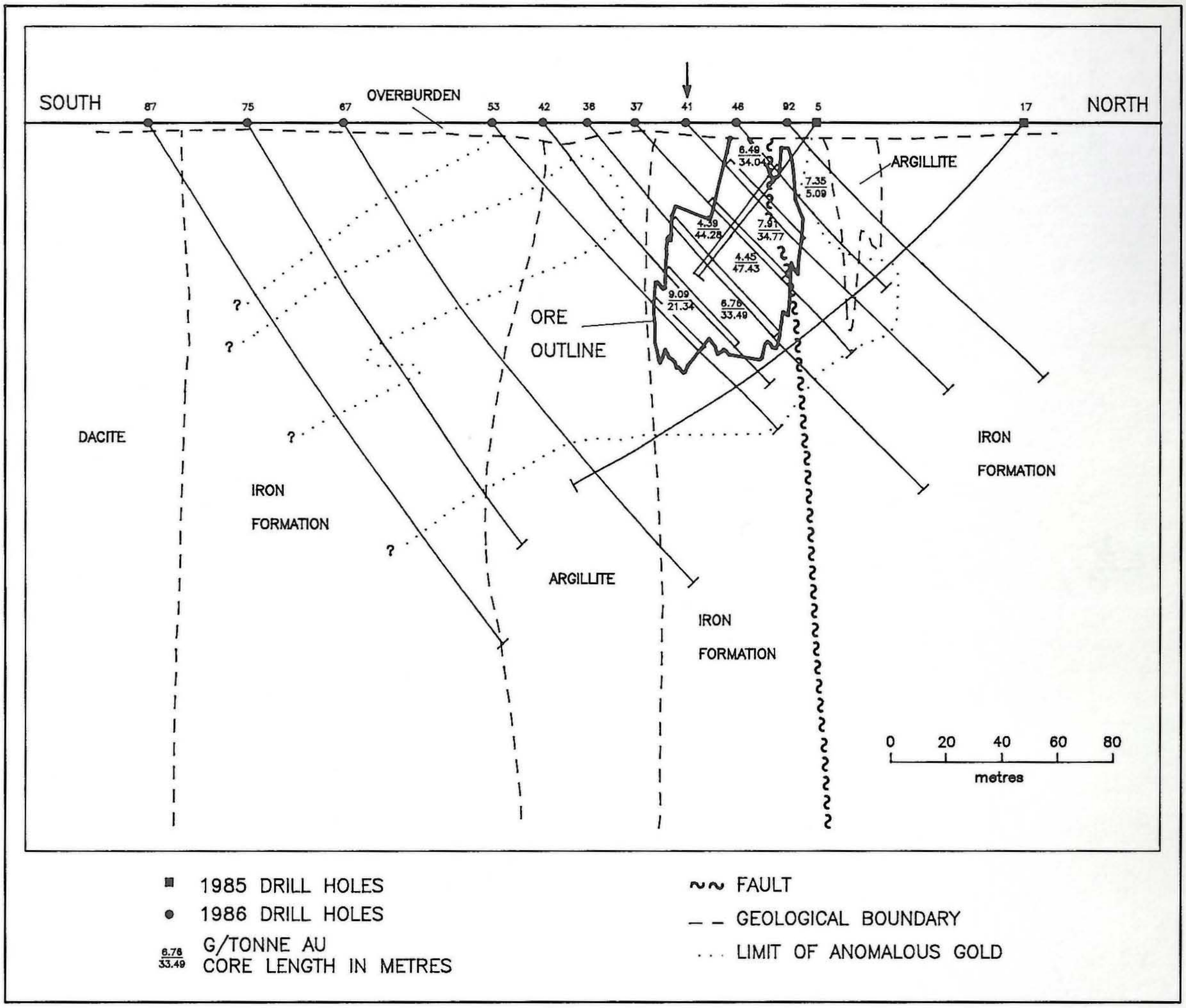


Figure 4: Simplified geological cross-section with diamond drill intersections of the Wendy Au Zone, Farley Lake Au deposits (after Manitoba Mineral Resources Ltd.). Arrow marks the location of DDH 654-41.

SAMPLE COLLECTION, PREPARATION AND ANALYSIS

Seventy rock chip samples were collected from diamond drill hole DDH 654-41, which intersected Au mineralization that was subsequently named the Wendy Zone. Individual samples represent five chips of drill core each 4-6 cm long that were bulked. Samples were collected approximately every five metres. Due to the thinly interlayered nature of the oxide, sulphide and silicate facies iron formations, no attempt was made to separate each of these lithologies. Obvious quartz veins and/or sulphide minerals were avoided with the exception of the immediate area of the mineralized zones where some samples contained pyrrhotite and/or pyrite. Rock chips were washed to remove dust and grit and then jaw crushed and pulverized to -200 mesh in a Cr-steel Tema mill. Powders were analysed by inductively coupled plasma-atomic absorption spectrometry (ICP-AAS) subsequent to a hot HCl-HNO_3-H_2O dissolution. Gold was determined on a 10 g sample by AAS after fire assay preconcentration. The analyses were done by Acme Laboratories (Vancouver). The dissolution is partial for the elements Mn, Fe, Ca, P, Cr, Mg, Ba, Ti, B, Al, Na, K and W. Laboratory internal standards included with the samples indicate a reproducibility of ±20% for elements above the lower limit of determination (LLD) for this analytical method. Cadmium was consistently below the LLD for this study, and as such, is not considered further. Three gold-enriched samples from the Wendy Zone were submitted to Activation Laboratories Ltd. (Ancaster) for multi-element neutron activation analysis.

RESULTS

Relative Abundances

Analytical data for the 70 samples collected from DDH 654-41 are presented in Appendix 1. Table 1 summarizes descriptive statistical information for these data.

The altered and mineralized iron formation that hosts the Wendy Zone is characterized by high As contents (2-10579 ppm) in proximity to the Au enriched (up to 28200 ppb) Wendy Zone. Arsenic and Au exhibit the highest coefficient of variation (cv=standard deviation/arithmetic mean x 100) in the sample population (As=6.41; Au=1.79), which reflects the relative enrichment between the general area of the Wendy mineralized zone and the rest of the iron formation. The median value of 17 ppm As reflects the low concentration of this element away from the mineralized zone in the iron formation. In addition to Au and As, there are lesser amounts of W (31-817 ppm) and Ba (8-292 ppm) and up to 20 ppm Bi and 4.7 ppm Ag recorded from the geochemical profile through the deposit.

Low concentrations of other elements determined in this study include those for Cu (3-89 ppm; median=16 ppm; cv=0.91), Pb (2-54 ppm; median=10 ppm; cv=0.69) and Zn (1-131 ppm; median=25 ppm; cv=0.68). Although the partial dissolution utilized for this study will not record all of the Cu, Pb and Zn in the iron formation, previous studies (Foster, 1973) indicate up to 75% of sulphide-bound metal can be taken into solution with partial (other than sulphide-selective) digestions. Accordingly, the low base metal values probably reflect a significant proportion of the metal in the iron formation. To some extent, this point is illustrated by the comparative plots for Ni and Cr subsequent to total and partial digestions (Fig. 5). Partial values were determined using the partial dissolution employed for this study; total Ni and Cr were determined by AAS after lithium metaborate fusion. Patterns of enrichment or depletion indicated by the total analysis are closely mimicked by the partial analysis. Examination of the descriptive statistical parameters for both partial and total contents of these elements in Table 1 illustrates the covariance of the two elements regardless of the digestion type.

Profiles

Variation in element concentration with distance along the core from DDH 654-41 and through the Wendy Zone was examined using simple x-y plots. Visual examination of Figures 6 through 10 indicates enrichment of Ag, W, Bi, Cu and to a lesser extent Pb, Zn and Co with Au and depletion of As and Ba in the Wendy Zone.

Figure 6 illustrates the apparent bilobate nature of the Wendy Zone with two distinctive Au zones between 20 to 34 m and 40 to 54 m down the hole. Silver, W, Bi, Cu and to a lesser extent Zn, Co and Ba are covariant. A third Au mineralized zone occurs between 70 and 75 m, but with lower Au concentrations. This third zone is marked by high Ag (Fig. 6), Bi (Fig. 7), Cu (Fig. 8) and possibly Zn (Fig. 9).

Geochemical contrast or flux is greatest for Au, Ag, W and Bi in the Wendy Zone; rapid variation in concentration within the third mineralized zone (70-75 m) is demonstrated by the results for Cu. High Cu contents (up to 79 ppm) extend approximately 5 m on either side of this Au zone, and as such, appear to be more widespread than Au, Ag or Bi.

Generally, the zones of enrichment or haloes are spatially restricted to the immediate area of the Au mineralized zones, and consequently, do not provide an exploration target significantly larger than the Au zone.

Inter-Element Associations

Associations between elements determined for this study were examined statistically and graphically using a Spearman correlation coefficient matrix, log-log x-y graphs with regression lines and 99% confidence limits, and Kernel population density estimator graphs. The Spearman correlation matrix is reproduced in Appendix 2. Log-log graphs and population density graphs are given in Figures 11 through 21. Kernel density estimator graphs (Silverman, 1986) are used to visually assist in the recognition of data populations on the log-log plots.

Within the Spearman correlation coefficient matrix there are two distinctive groupings of elements. A lithologic association is suggested by the group Al, K, Mg, Ca, Ni, Cr, Ti, Sr, Ba, La and V. The second group of highly correlated elements comprises Ag, Au, Bi, Co, Cu, Fe, Pb, W and Zn. This grouping includes all those elements that are enriched in the Wendy mineralized zones (Figs. 6 through 10) and is interpreted as a "mineralization" group.

Log-log plots of the data with regression lines and 99% confidence limits, as well as Kernel population density plots to help visualize the location of various groupings within the dataset, confirm the Spearman correlations.

Figure 11 illustrates a strong positive correlation between Au and Fe. A well defined trend in the log-log plot, an equally well defined ovoid population density, and a Spearman correlation (r) = +0.649 show a consistent positive relationship between the two elements. Additional positive correlations exist for Au and W (Fig. 12; r=0.612), Co (Fig. 13; r=0.610), Pb (Fig. 14; r=0.426), Cu (Fig. 15; r=0.320) and Bi (Fig. 16; r=0.734). The results for Bi need to be interpreted with caution since many Bi analyses are at the lower limit of determination.

Negative correlations in the dataset between Au and Sr (r=-0.726), Ca (r=-0.689), Ba (r=-0.566), As (r=-0.476) and Ni (r=-0.127) are depicted clearly by the log-log and population density plots (Fig. 17-21).

Principal Components Analysis

A principal components analysis was applied to log(10) transformed rock geochemical data from the Wendy Zone to assess the database for element groupings. The results are summarised in Table 2.

Two main components explaining 57% of the variance were identified in this analysis. Component 1 comprises Ba, La, V, Cr, Ti, Al, Ni, Na, Sr, Ca and K and probably represents the diversity of the silicate and oxide mineralogies of the iron formations sampled for this study. Component 2 is characterized by the ore- and ore-related elements Au, Ag, Bi, Zn and Pb as well as Ti, Al, Ni, Mg, Fe, P and Mn. The latter group of elements represent the alteration effects of chloritized, silicified and sulphidized iron formations at the deposit.

Table 1

Descriptive statistical summary for geochemical data from DDH 654-41, Wendy Zone. Data from analysis of 70 drill core samples subsequent to partial $HC1\text{-}HN0_3\text{-}H_20$ dissolution. NiT and CrT represent total Ni and Cr. All analyses in ppm unless otherwise indicated.

Element	Range In Concentration	Arithmetic Mean	Standard Deviation	Skewness	Kurtosis	Coefficient of Variation	Median
Ag	0.1-4.7	0.8	0.9	1.88	3.41	1.21	0.4
Al(%)	0.20-4.25	1.98	0.59	0.75	2.75	0.30	1.91
As	2-10579	197	1261	8.15	64.67	6.41	17
Au(ppb)	1-28200	3240	5792	2.05	4.17	1.79	163
B	2-10	5	2	0.72	-0.51	0.53	4
Ba	8-292	94	64	0.87	0.37	0.68	88
Bi	2-20	4	4	2.25	4.13	1.08	2
Ca(%)	0.20-4.51	0.84	0.75	2.31	7.02	0.89	0.59
Co	8-44	17	6	1.75	4.63	0.38	15
CrP*	7-131	66	24	0.32	0.05	0.37	65
CrT*	1-134	72	27	0.05	-0.05	0.38	72
Cu	3-79	24	22	1.17	0.43	0.91	16
Fe(%)	1.80-29.51	18.70	5.42	-0.67	0.34	0.29	20
K(%)	0.12-2.16	0.87	0.43	0.92	0.96	0.49	0.83
La	2-14	7	3	0.38	0.16	0.39	7
Mg(%)	0.12-2.20	1.05	0.32	0.70	2.12	0.31	1.02
Mn	132-1048	548	174	0.62	0.19	0.32	523
Mo	1-4	2	1	1.31	1.08	0.48	1
Na(%)	0.01-0.25	0.06	0.06	1.45	1.22	1.09	0.02
NiP*	1-49	12	8	1.88	6.44	0.64	11
NiT*	1-87	19	17	1.15	2.56	0.88	18
P(%)	0.01-0.22	0.11	0.04	0.46	0.79	0.34	0.11
Pb	2-54	11	8	3.69	16.22	0.69	10
Sb	2-4	2	0.4	4.01	15.50	0.18	2
Sr	7-170	31	31	2.30	5.99	0.98	19
Th	1-7	3	1	1.42	7.79	0.24	3
Ti(%)	0.01-0.21	0.10	0.03	0.89	1.71	0.35	0.09
U	5-9	5	0.6	4.60	22.22	0.12	5
V	4-133	40	16	3.10	16.52	0.39	37
W	31-817	168	151	2.33	6.50	0.90	115
Zn	1-131	29	20	2.19	8.28	0.68	25

* NiP - Ni determined subsequent to partial digestion
NiT - Ni determined subsequent to total digestion
CrP - Cr determined subsequent to partial digestion
CrT - Cr determined subsequent to total digestion

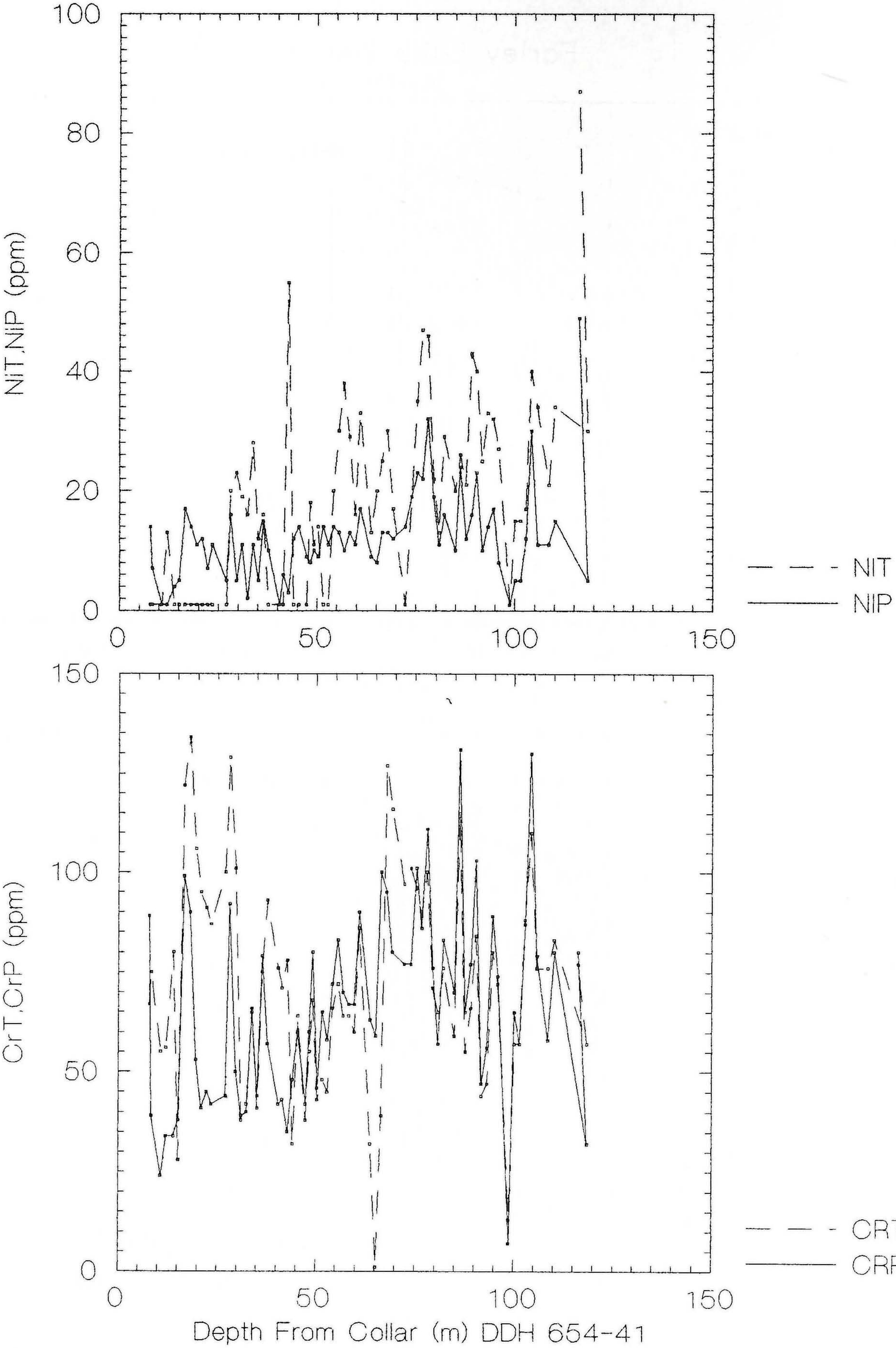


Figure 5: Comparison between total and partial Cr and Ni analyses. Abbreviations: CrT - total Cr, CrP - partial Cr, NiT - total Ni, N.P - partial N.

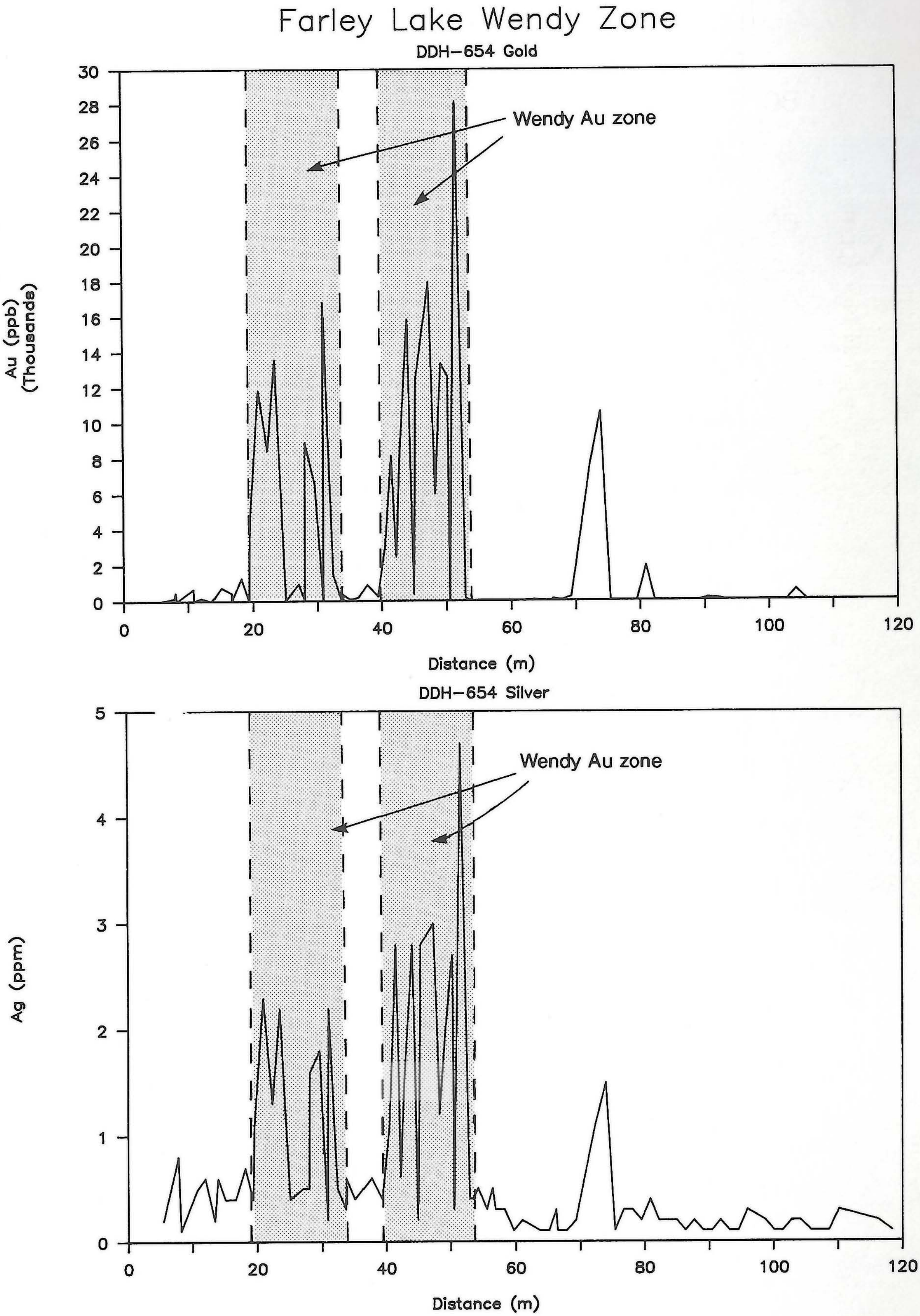
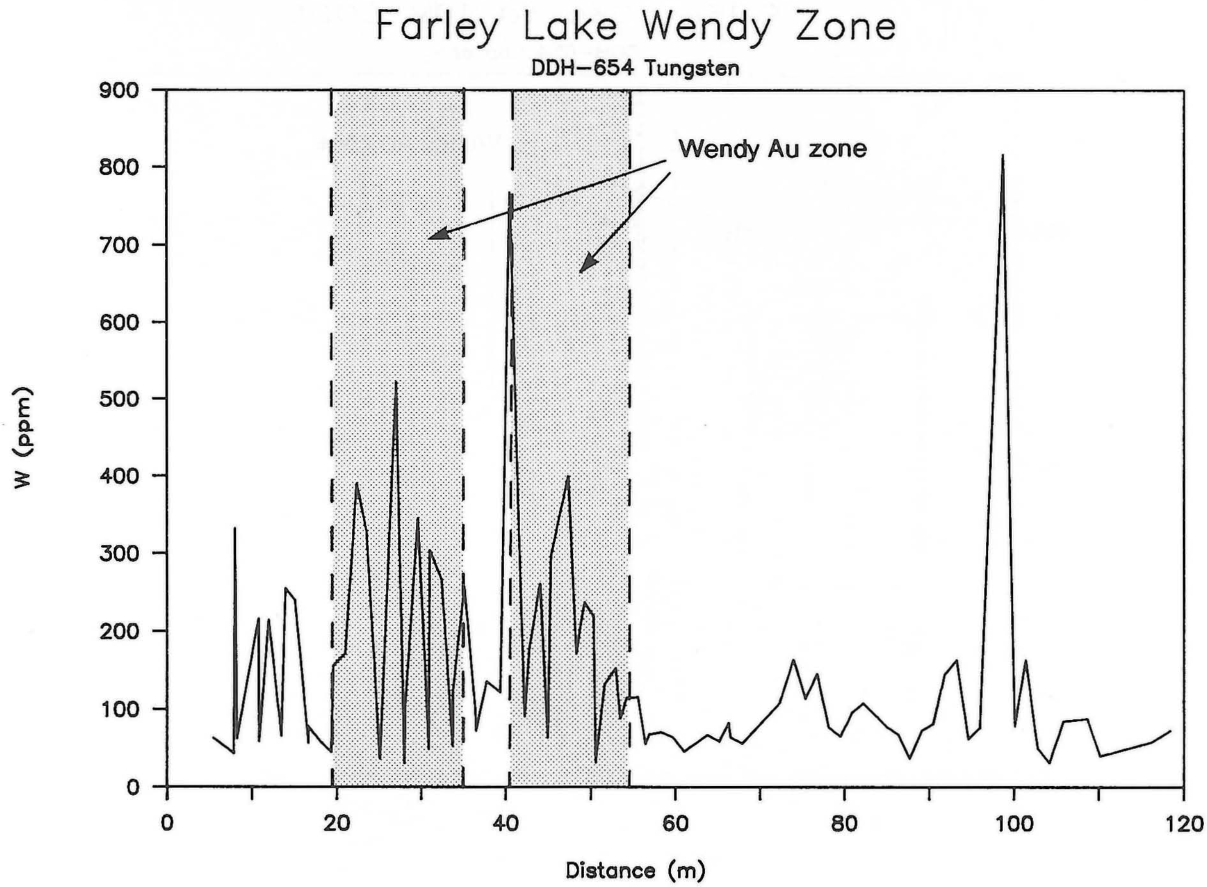


Figure 6: Variation in concentration of Au and Ag through the Wendy Zone.



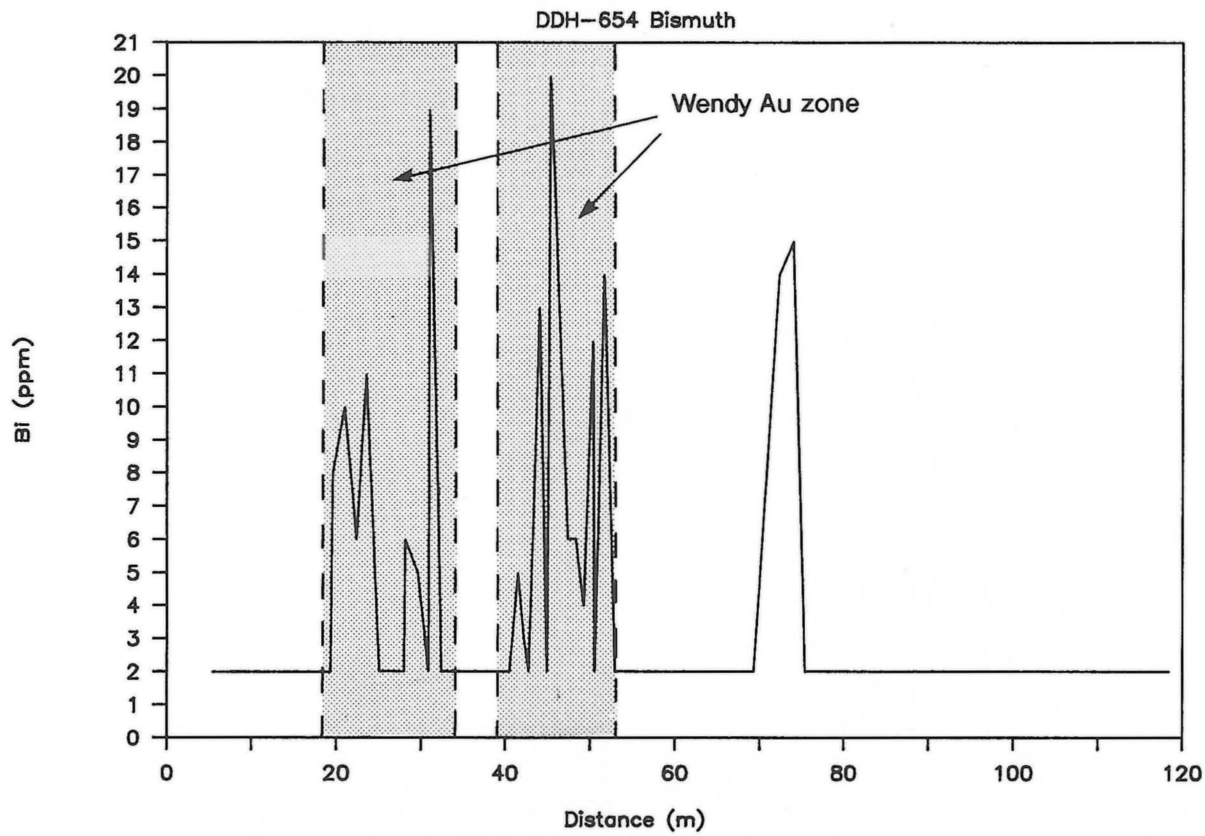


Figure 7: Variation in concentration of W and Bi through the Wendy Zone.

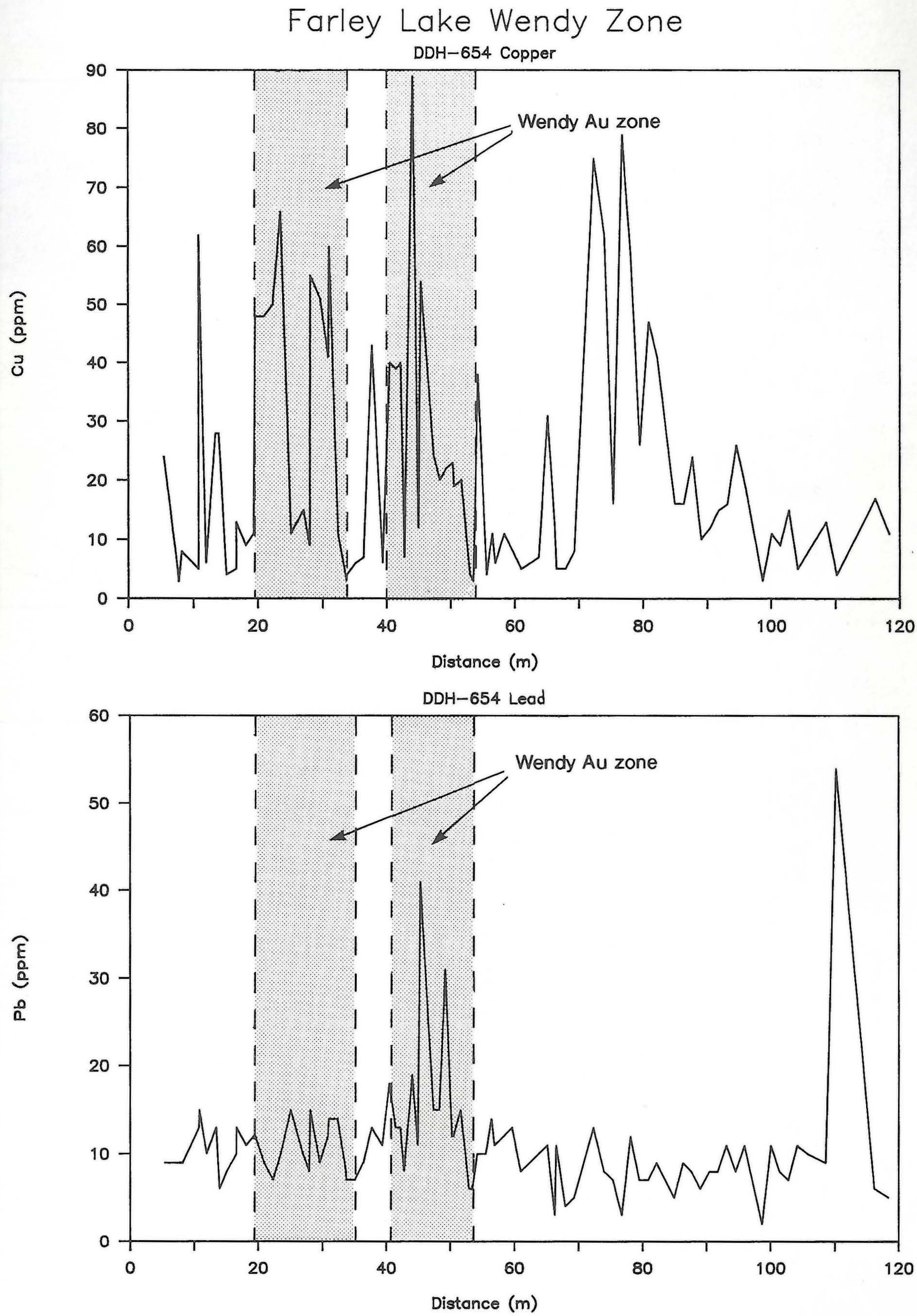


Figure 8: Variation in concentration of Cu and Pu through the Wendy Zone.

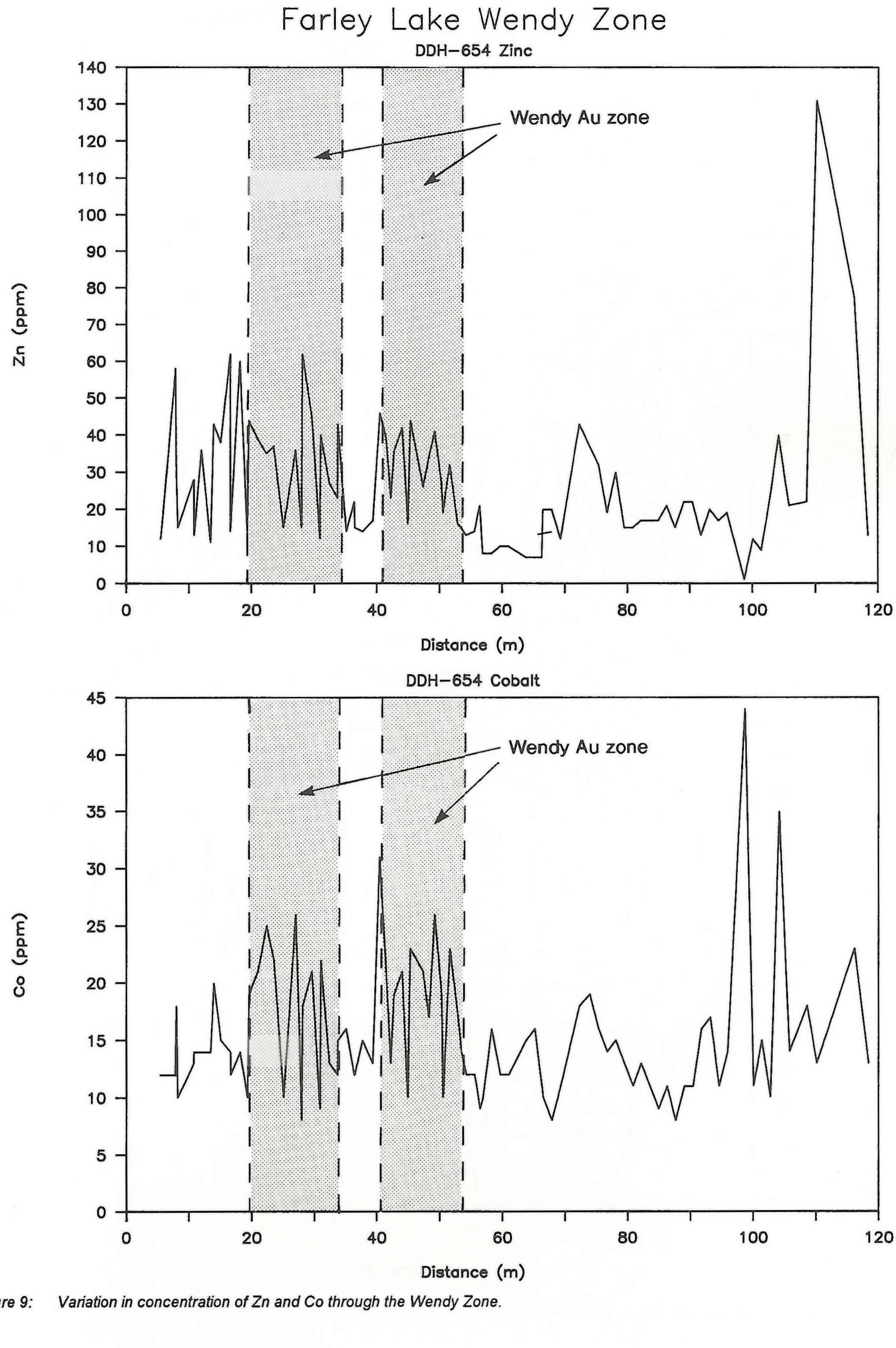


Figure 9: Variation in concentration of Zn and Co through the Wendy Zone.

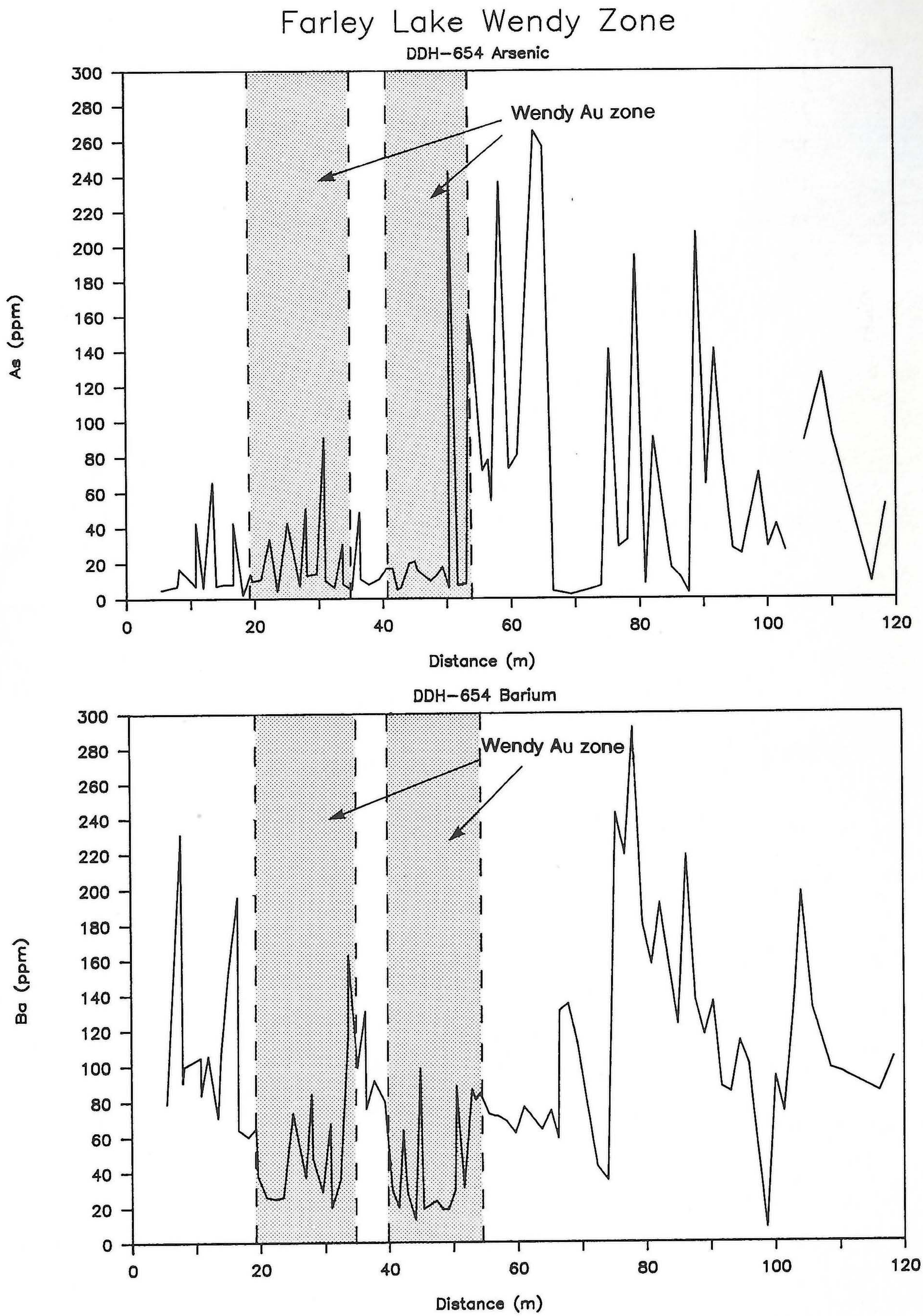


Figure 10: Variation in concentration of As and Ba through the Wendy Zone.

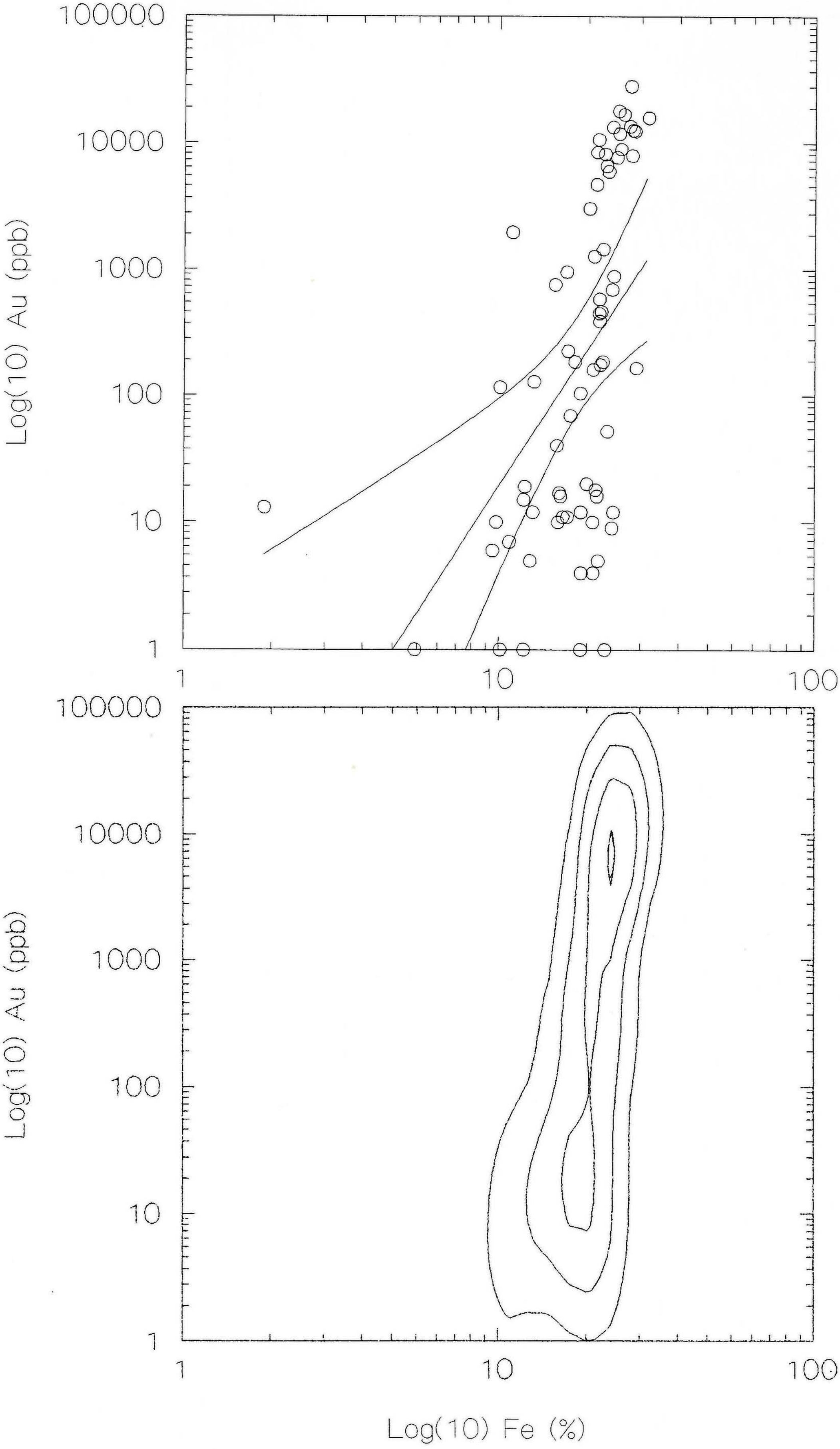


Figure 11: Log-log and Kernel population density plots for Au and Fe.

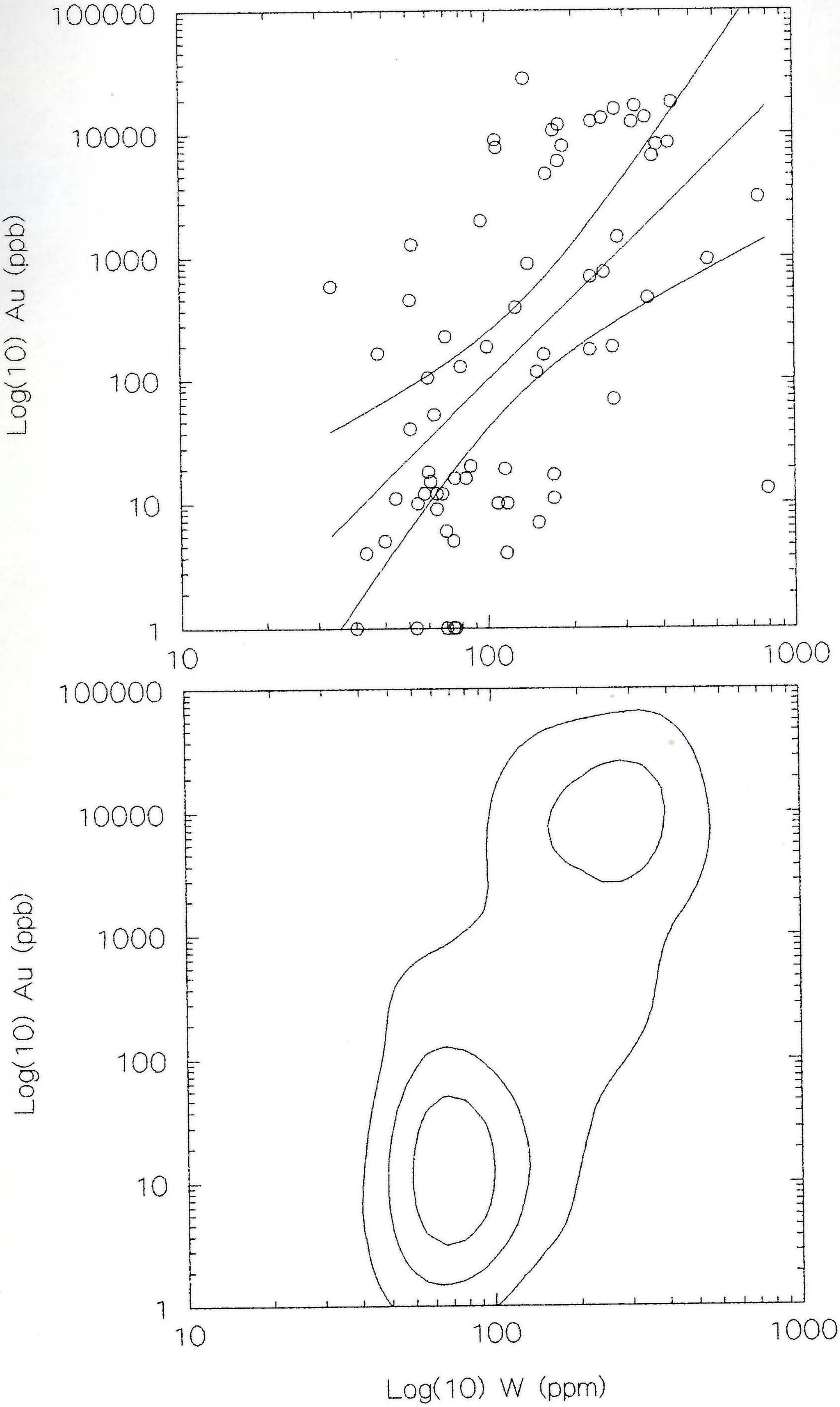


Figure 12: Log-log and Kernel population density plots for Au and W.

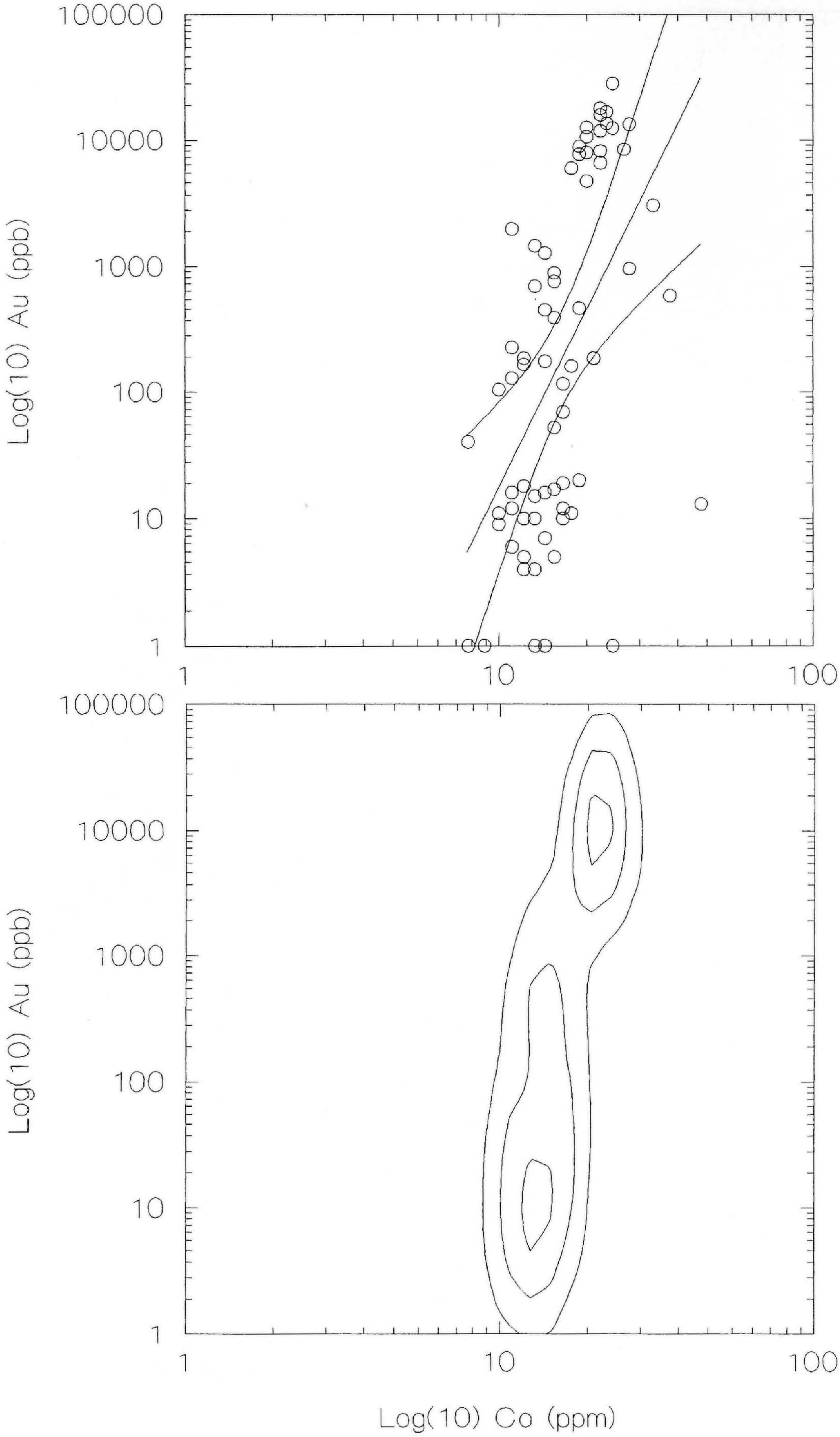


Figure 13: Log-log and Kernel population density plots for Au and Co.

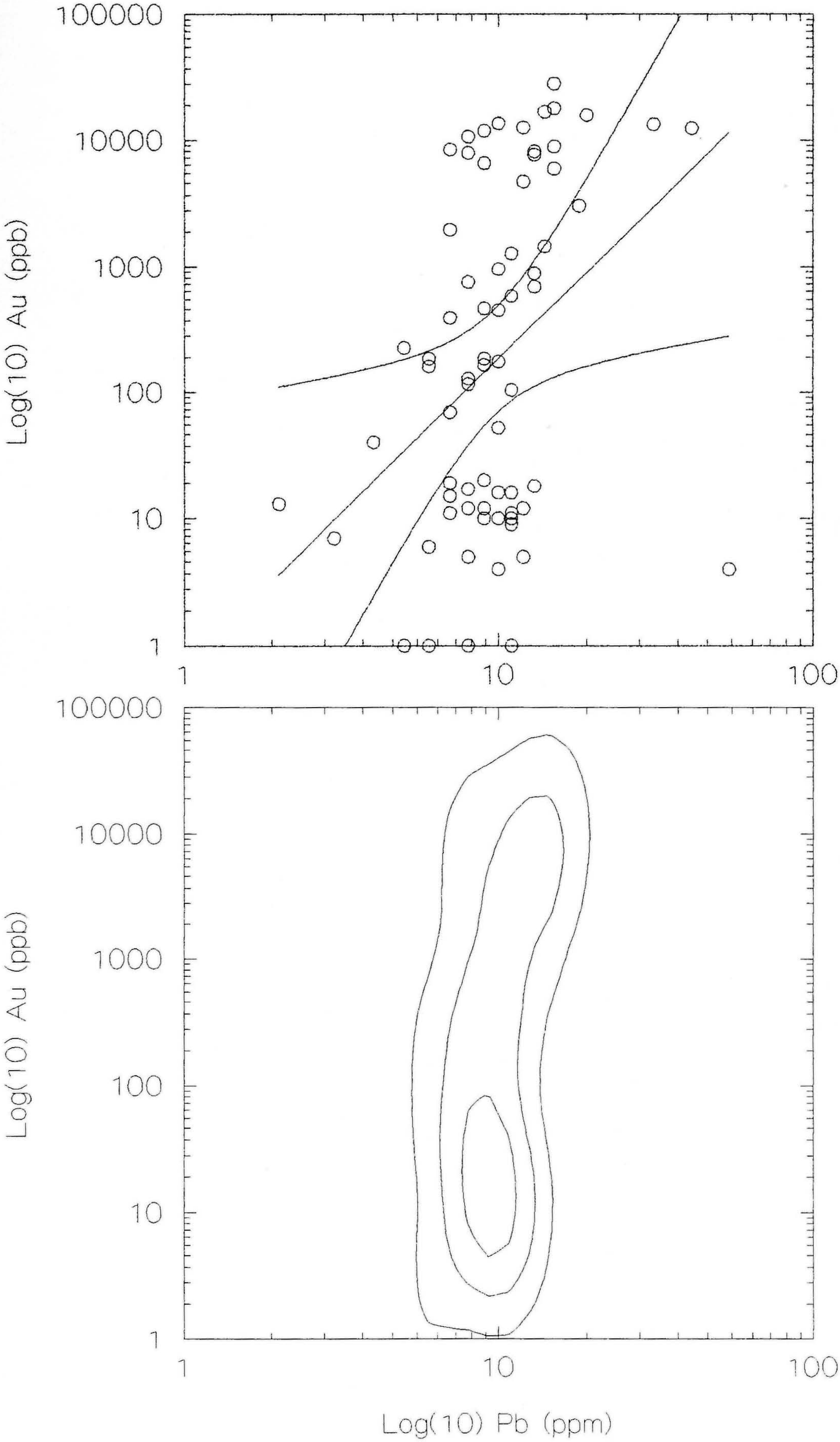


Figure 14: Log-log and Kernel population density plots for Au and Pb.

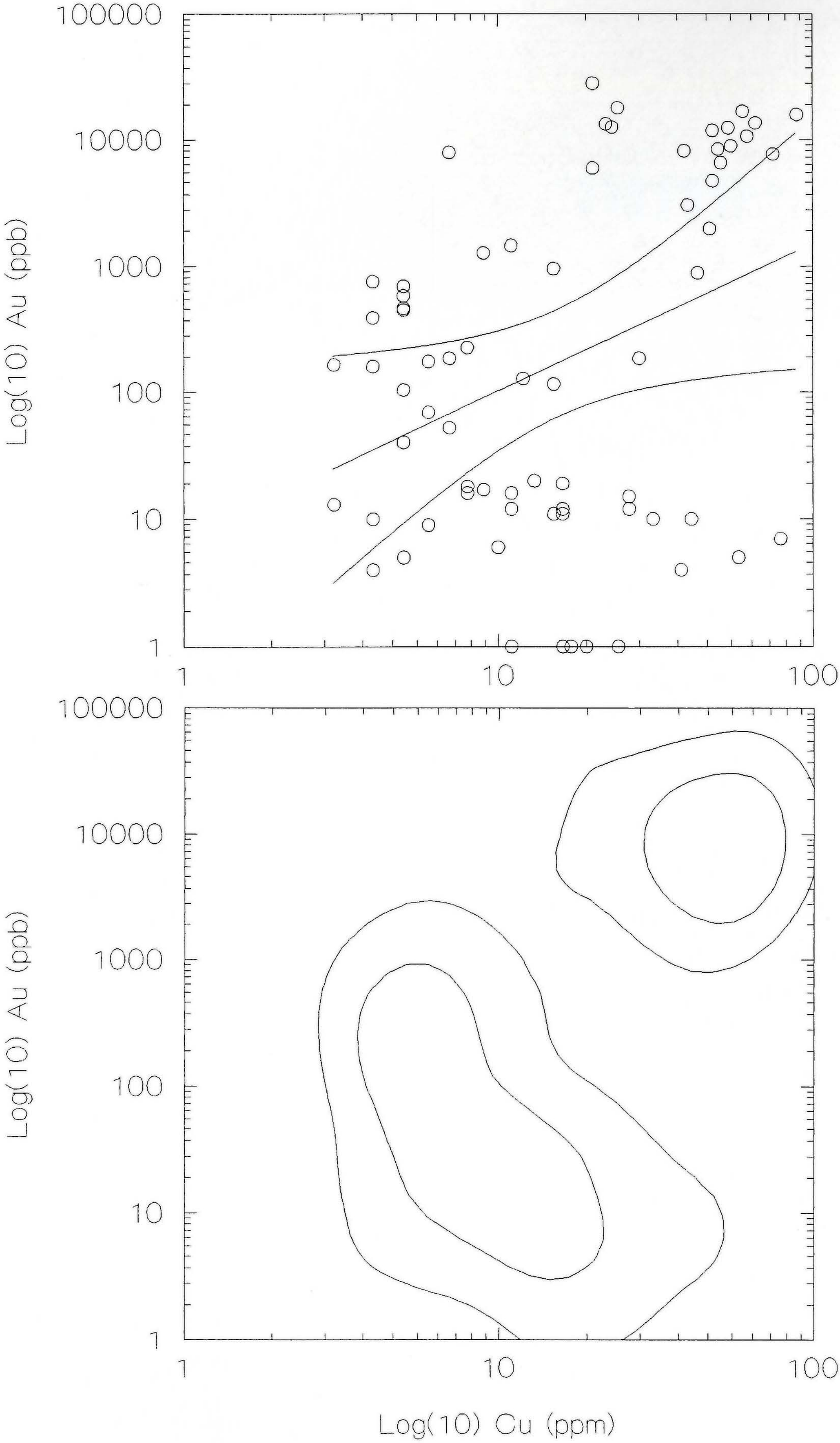


Figure 15: Log-log and Kernel population density plots for Au and Cu.

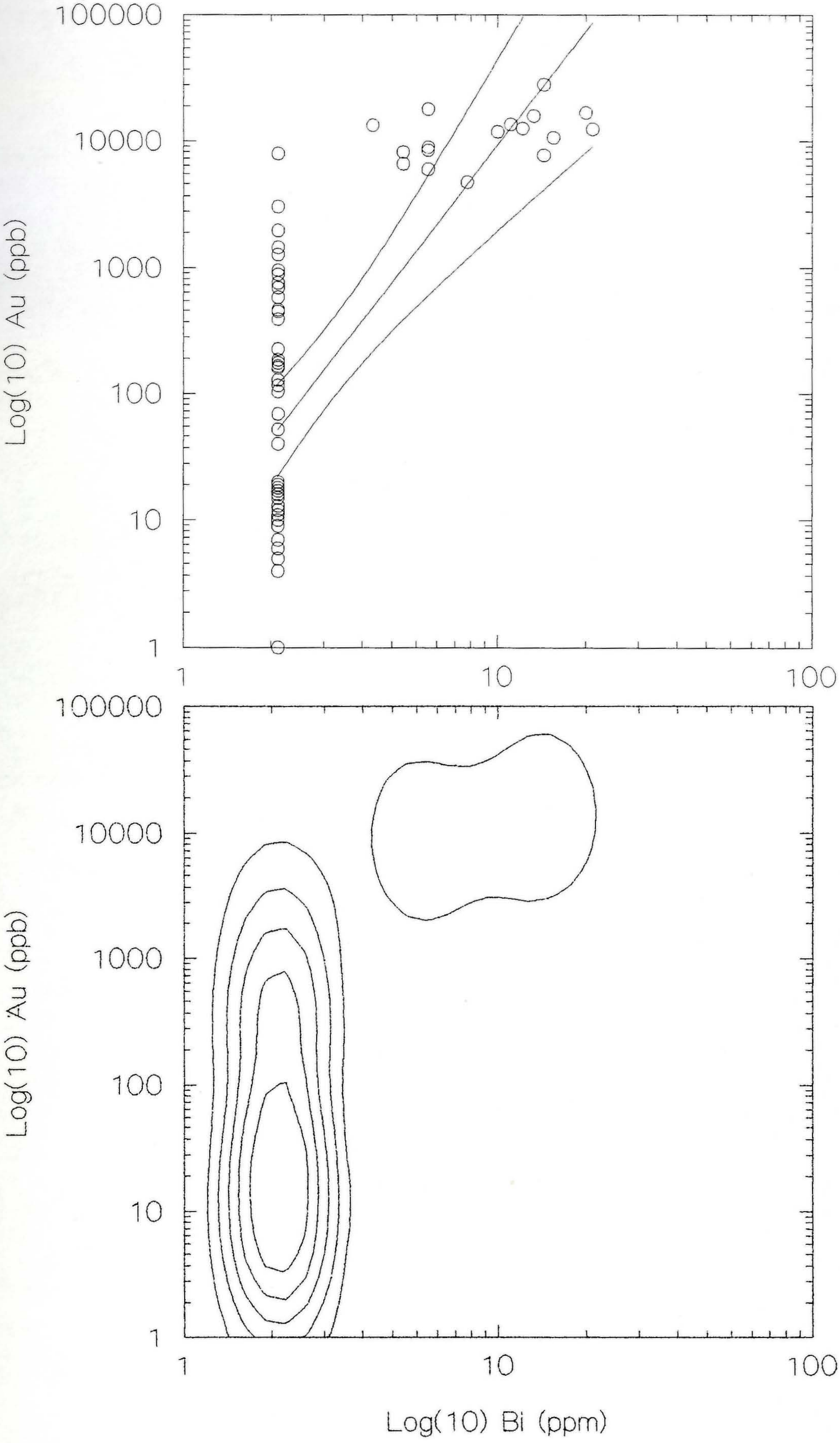


Figure 16: Log-log and Kernel population density plots for Au and Bi.

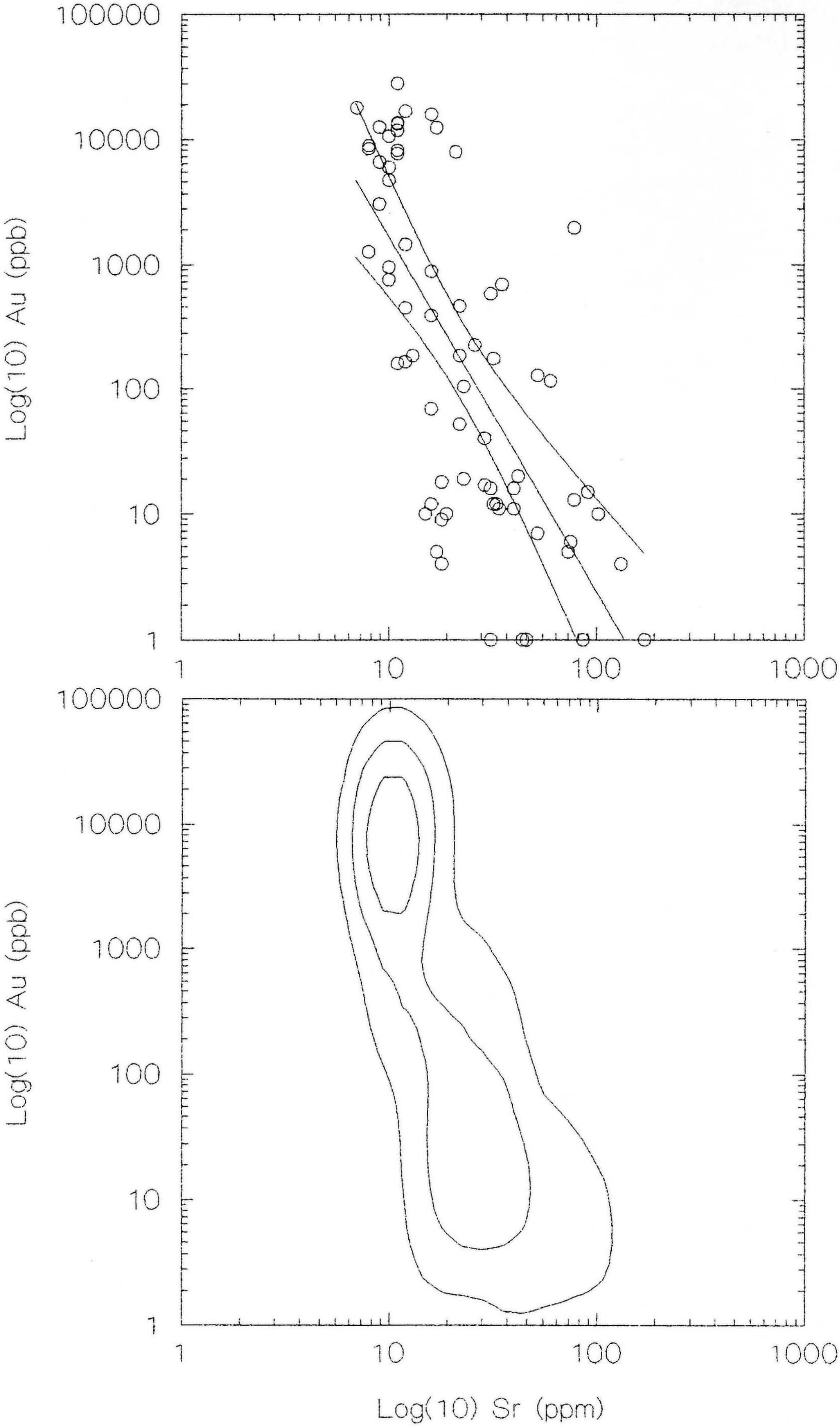


Figure 17: Log-log and Kernel population density plots for Au and Sr.

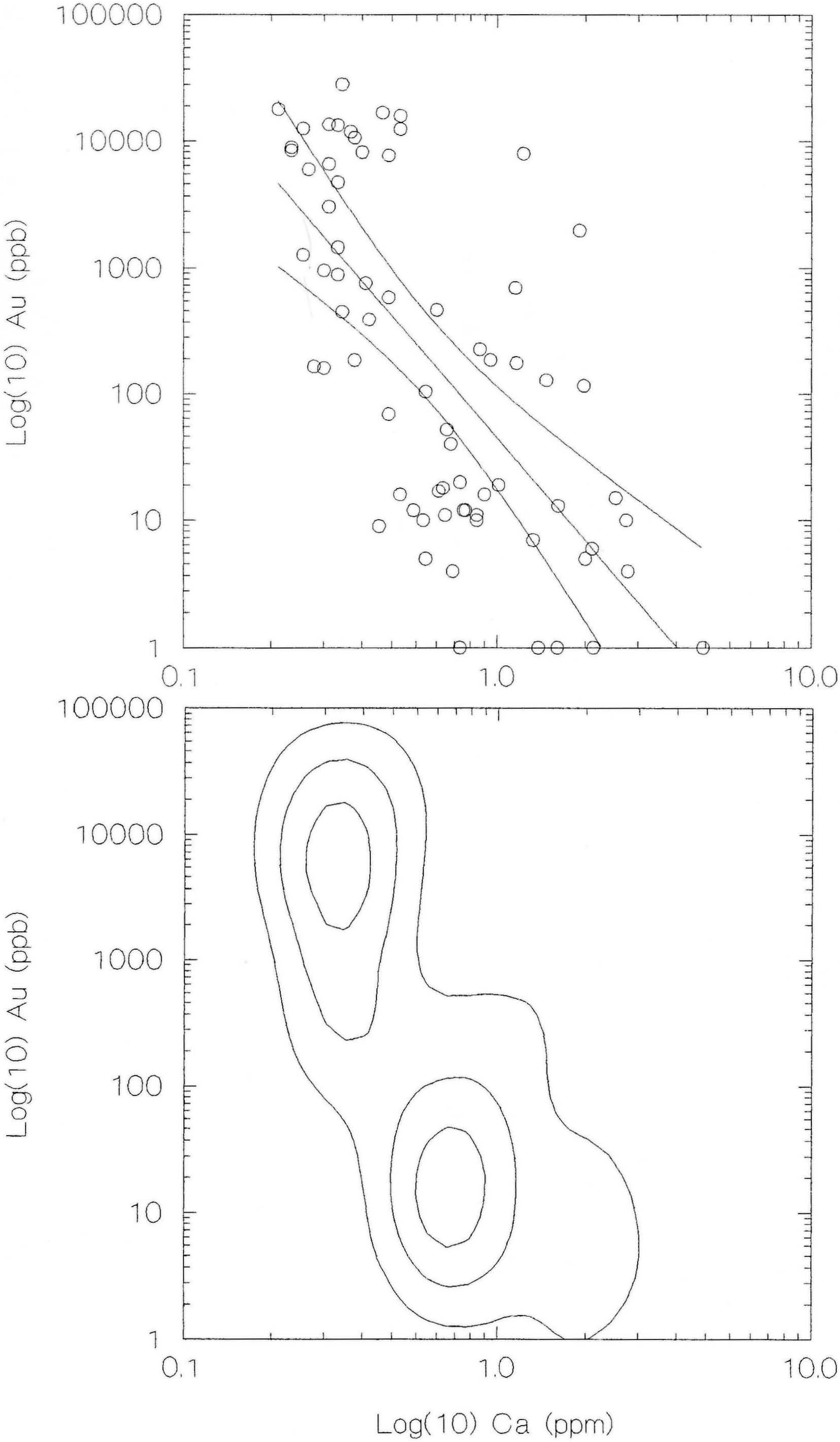


Figure 18: Log-log and Kernel population density plots for Au and Ca.

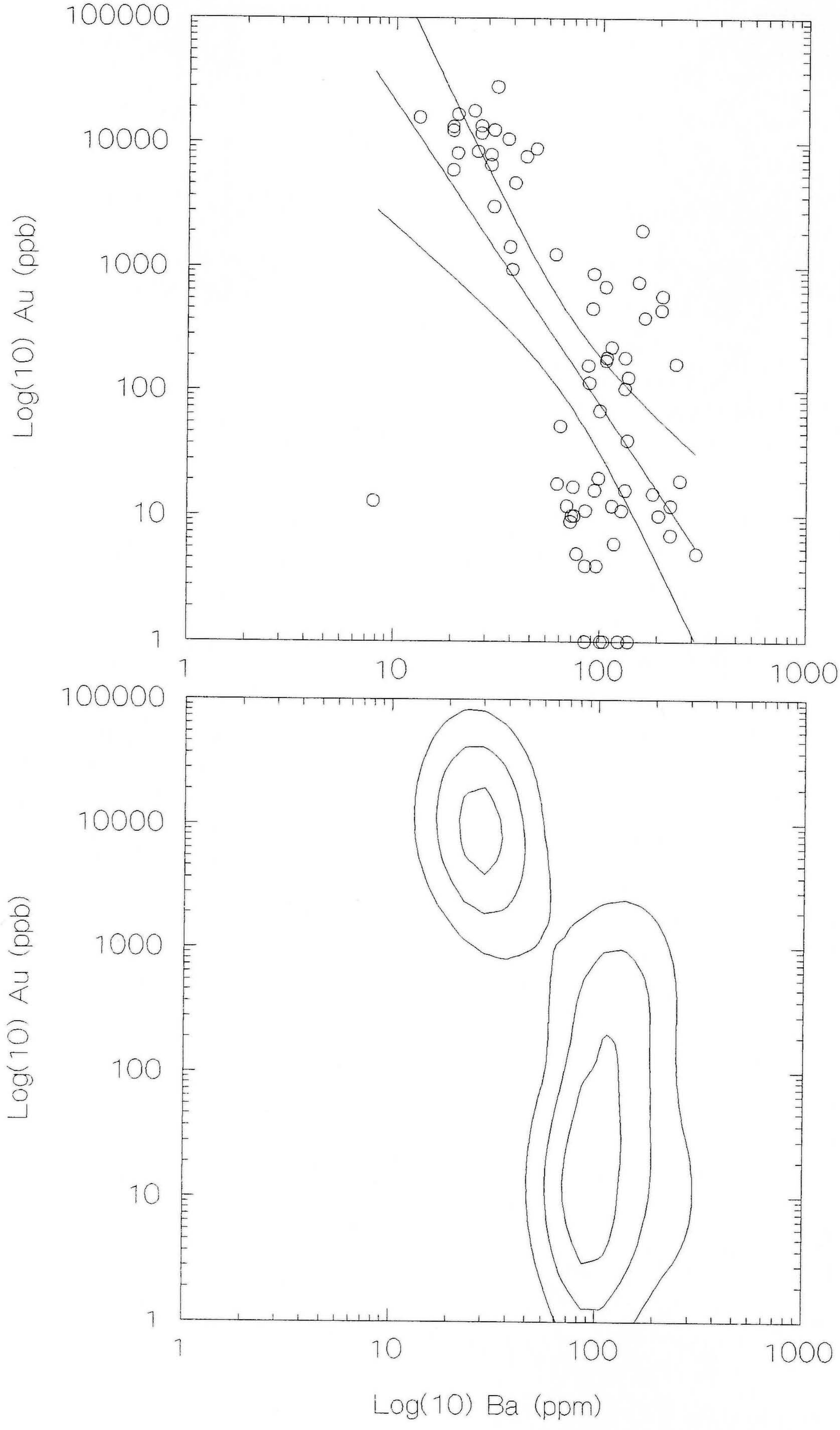


Figure 19: Log-log and Kernel population density plots for Au and Ba.

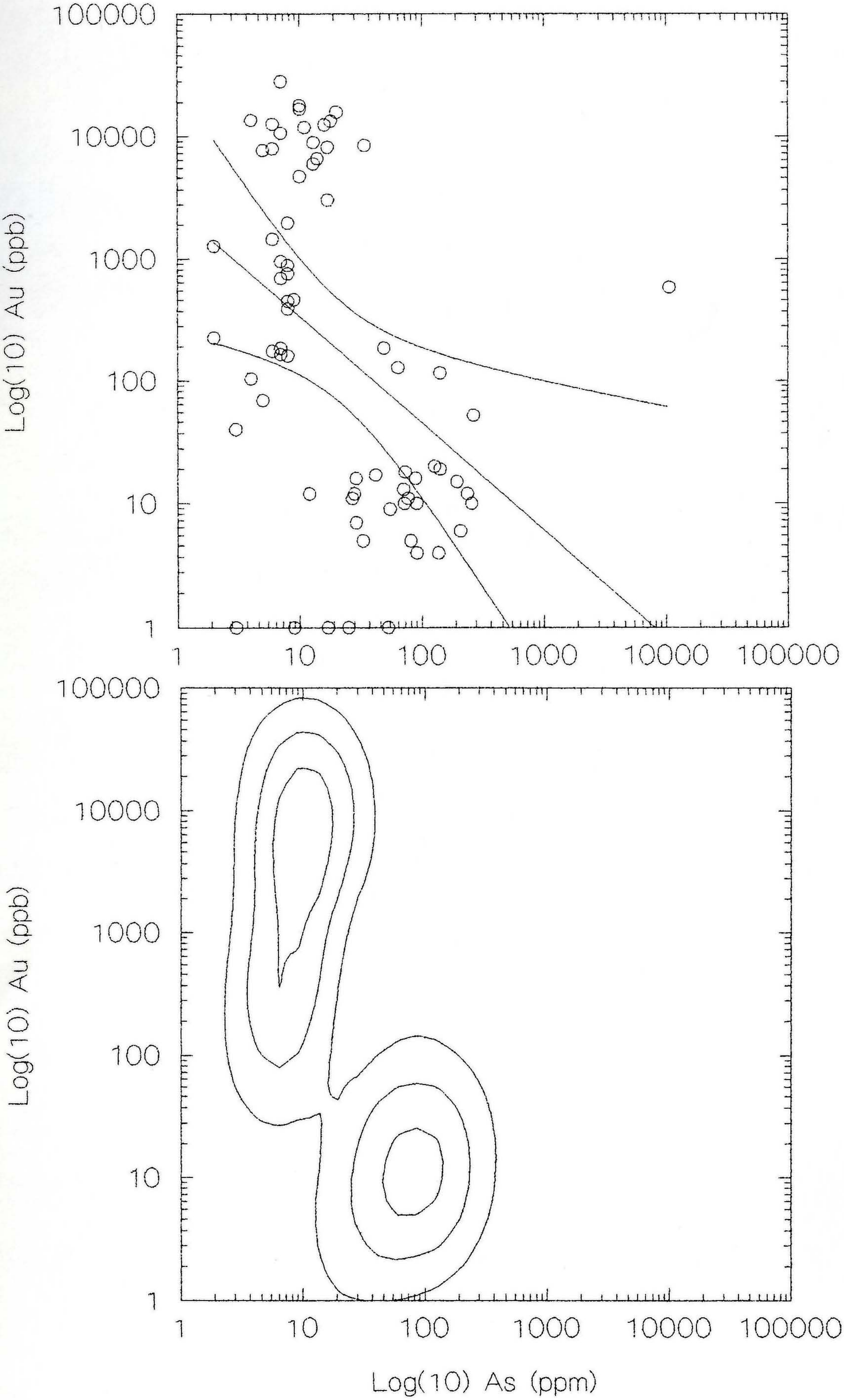


Figure 20: Log-log and Kernel population density plots for Au and As.

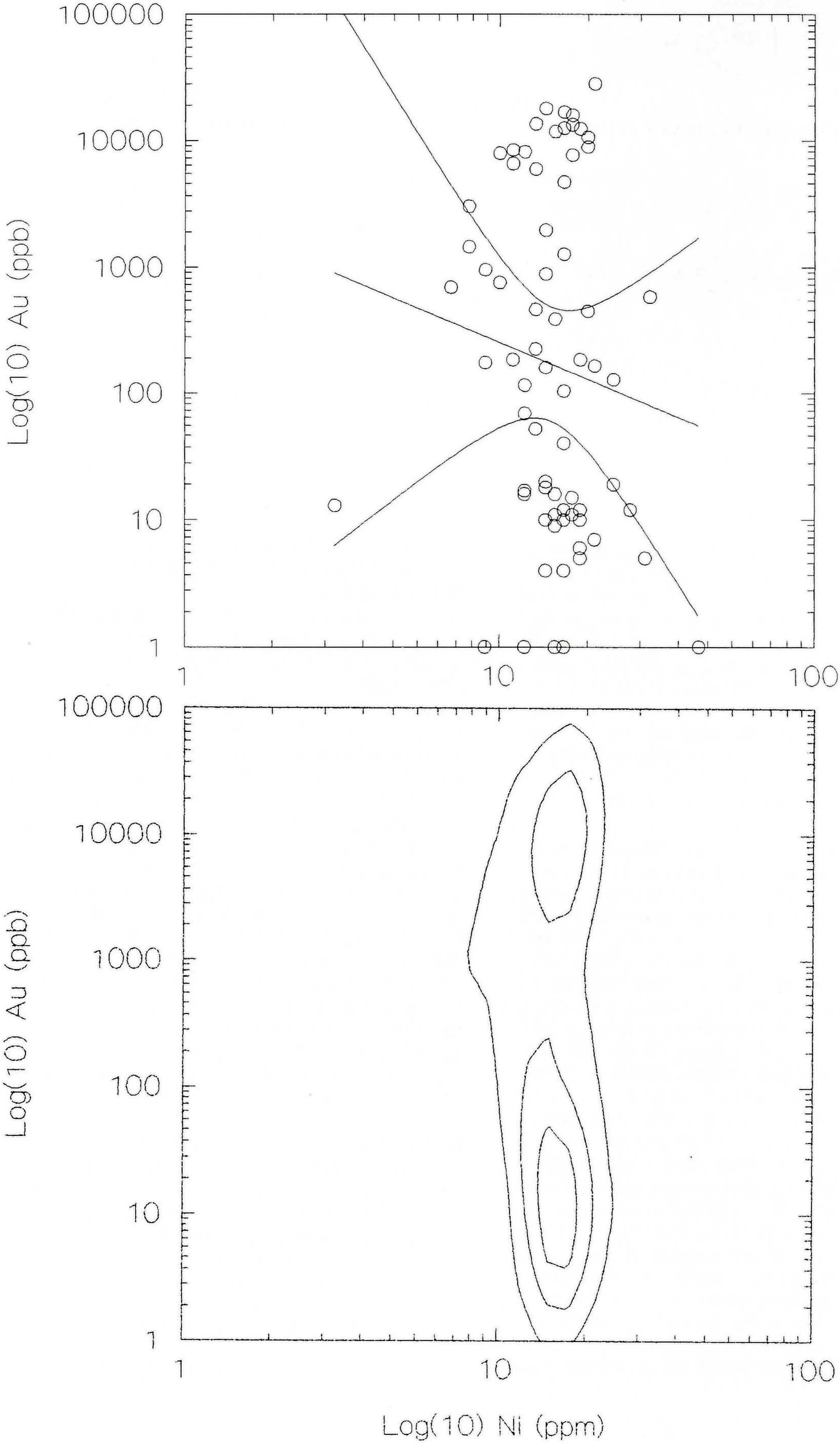


Figure 21: Log-log and Kernel population density plots for Au and Ni.

Table 2
Summary of principal components analysis of log $_{(10)}$ - transformed rock geochemical data, DDH 654-41, Wendy Zone

Component With High Element Loadings	Variance Explained by Components Variance/ Percent
1. Ba, La, V, Cr, Ti, Al, Ni, Na, Sr, Ca, K	7.860 / 31.4
2. Ag, Au, Ti, Al, Ni, Bi, Mg, Fe, Zn, Pb, P, Mn	6.515 / 26.1
3. V, Cr, Ni, Cu	2.172 / 8.7
4 Co, Ni, Sr, Ca, Cu, As	1.862 / 1.4
5. Cr, B	1.414 / 5.7
6. Co, Na, As	1.163 / 4.7
Total (%) Variance = 78.0	

DISCUSSION

Rock geochemical data derived from the partial digestion and analysis of rock chip samples collected through the section hosting the Wendy Zone permit an assessment of chemical elements enriched in the mineralized zone and their interrelationships. Gold, W, Ag, Co, Bi, Cu, Pb, Zn and Fe characterize the Wendy Zone and provide a suite of elements with potential for application to subsequent geochemical exploration surveys in the general area of the deposit. It is noteworthy that the same elements identified as the "enriched suite" are evident in neutron activation and inductively coupled plasma atomic absorption spectrometry multi-element analyses of three Au-enriched samples from the Wendy Zone (Appendix 3).

The omission of As from the list of enriched elements may be problematic in that it was successfully used to define an As dispersion fan by Brereton *et al* (1988) in the general area of the deposit. Arsenic is not positively correlated with any elements that are enriched in the deposit (r=-0.476 with Au) and, in fact, is depleted throughout the mineralized zone. The abundance of As in some of the samples collected for this study (maximum=10579 ppm) may indicate a separate, but spatially associated, mineralizing process genetically unrelated to the formation of the Wendy Zone. Overburden geochemical studies by Nielsen and Fedikow (1987) document well developed Au and As dispersal trains in till down-ice from the MacLellan Au-Ag deposit. Fedikow (1989, 1993) determined the presence of extensive Au and As rock geochemical haloes centred on the MacLellan Main Zone. Gagnon (1991) documents multiple Au-bearing structures in the MacLellan Main Zone including auriferous arsenopyrite veins. Despite the obvious importance of As at the MacLellan Main Zone, the spatial and temporal(?) role of arsenopyrite at the Wendy Zone is uncertain. Its inclusion as a useful indicator element in any geochemical survey designed to locate repetitions of Wendy Zone replacement-type Au deposits is warranted. Broad As dispersal fans in till with less extensive Au, W, Ag, Co, Bi, Cu, Pb and Zn anomalies would help to reduce large areas for potential exploration to more localized areas and perhaps to focus subsequent geophysical surveys and diamond drilling programs.

Of some interest is the determination of W as an enriched element in the mineralized zone and its high positive correlation with Au. Parbery and Fedikow (1987) documented a W (scheelite)-Ag-Cu occurrence near Nickel Lake during a regional assessment of the residual exploration potential of the Agassiz Metallotect. The recognition of a second association between W and precious metals at the Wendy Zone suggests that W may be a useful geochemical indicator for gold exploration.

Despite low median values for Cu, Pb and Zn throughout the host iron formation at the Wendy Zone, data from this study indicate that the patterns of variation of element concentration may be key to the recognition of anomalies in sampling materials, and not simply very high values of one or more elements. Copper, Pb and Zn anomalies about the mineralized zone are low contrast, but their rapid fluctuations in concentration with proximity to Au-enriched zones are diagnostic.

The high correlations between Fe, Au and the remainder of the enriched element suite suggests a temporal link to the proposed pyrrhotite-sulphidization process (Briggs and Taylor, 1987) for the Wendy Zone. The dumping of Au and the enriched element suite subsequent(?) to the conversion of magnetite to iron sulphides during sulphidization explains the close spatial association of these elements in the deposit.

One consequence of this brief rock geochemical study is that the applicability of peat bog and vegetation geochemical surveys to exploration for Wendy Zone replacement-type Au deposits may now be assessed on the basis of identification of the enriched suite of elements as indicator elements in samples of peat bog and various tissues of black spruce (*Picea mariana*) growing in the bogs. This hypothesis will be tested in Parts 2, 3 and 4 of this series.

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Appendix 1
Rock geochemical data for core samples from DDH 654-41, Wendy Zone.
Analyses based upon an HCl-HNO_3-H_2O dissolution

MINERAL OCCURRENCE	SAMPLE NUMBER	Sample Depth (ft)	Avg. Depth (ft)	Avg. Depth (m)	Cr (ppm)	Mg (%)	Ba (ppm)	Ti (%)	B (ppm)	Al (%)	Na (%)	K (%)	W (ppm)	Au* (ppb)	Total Ni (ppm)	Total Cr (ppm)	Partial Ni (ppm)	Partial Cr (ppm)
Farley Lake Wendy Zone	1271	25.3 - 25.9	25.6	7.8	58	1.79	231	0.21	2	4.25	0.02	2.16	44	165	0	67	14	89
	1272	24.0 - 28.5	26.3	8.0	28	0.70	91	0.08	2	1.44	0.01	0.74	333	465	0	75	7	39
	1274	33.0 - 37.4	35.2	10.7	16	0.65	105	0.06	2	1.18	0.01	0.85	217	695	0	55	0	24
	1275	37.4 - 41.0	39.2	12.0	24	0.67	106	0.08	2	1.42	0.01	0.77	216	175	13	56	1	34
	1726	44.3 - 47.0	45.7	13.9	22	0.97	107	0.08	2	1.67	0.02	0.54	256	185	0	80	4	34
	1727	47.0 - 52.0	49.5	15.1	28	0.65	152	0.09	2	1.61	0.01	0.70	240	760	0	28	5	38
	1728	52.0 - 57.0	54.5	16.6	66	1.22	196	0.17	2	2.98	0.02	1.77	56	450	0	122	17	99
	1729	57.0 - 62.0	59.5	18.1	66	1.14	60	0.16	2	2.86	0.02	1.92	57	1280	0	134	14	90
	1730	62.0 - 66.4	64.2	19.6	36	0.95	38	0.10	8	1.87	0.02	1.18	156	4730	0	106	11	53
	1731	66.4 - 71.0	68.7	20.9	26	1.03	26	0.08	7	1.85	0.01	0.84	172	11860	0	95	12	41
	1732	71.0 - 75.5	73.3	22.3	29	0.88	25	0.07	4	1.40	0.01	0.89	391	8450	0	91	7	45
	1733	75.5 - 78.7	77.1	23.5	25	1.22	26	0.06	2	1.75	0.02	0.71	329	13600	0	87	11	42
	1734	87.8 - 89.3	88.6	27.0	31	0.68	37	0.09	3	1.60	0.01	0.86	523	960	0	100	5	44
	1735	89.3 - 95.0	92.2	28.1	63	1.48	48	0.16	2	2.75	0.02	1.96	107	8930	20	129	16	92
	1736	95.0 - 99.5	97.3	29.6	39	1.05	29	0.10	6	1.92	0.01	0.89	346	6590	23	101	5	50
	1737	99.5 - 104.0	101.8	31.0	27	1.05	20	0.08	7	1.62	0.01	0.97	305	16860	19	38	11	39
	1738	104.0 - 108.5	106.3	32.4	27	0.64	36	0.07	9	1.24	0.01	0.65	267	1460	16	42	2	40
	1739	108.5 - 113.0	110.8	33.8	42	0.87	163	0.11	3	1.88	0.02	1.02	124	390	28	66	11	65
	1740	113.0 - 117.2	115.1	35.1	35	0.68	99	0.09	2	1.63	0.02	0.60	258	69	12	41	5	44
	1741	117.2 - 121.5	119.3	36.4	57	1.01	131	0.13	4	2.39	0.02	0.78	100	185	16	75	15	79
	1742	121.5 - 126.0	123.8	37.7	41	0.90	92	0.10	7	1.84	0.03	0.69	136	890	0	93	10	57
	1744	131.5 - 134.0	132.8	40.5	29	0.98	30	0.09	7	1.89	0.02	0.76	769	3050	0	76	1	42
	1745	134.0 - 138.3	136.1	41.5	30	1.00	20	0.07	4	1.62	0.02	0.60	358	8180	0	71	6	43
	1746	138.3 - 142.5	140.4	42.8	22	1.12	29	0.06	10	1.21	0.02	0.40	177	7940	55	78	3	35
	1747	142.5 - 146.8	144.6	44.1	35	1.07	13	0.06	5	1.38	0.02	0.45	262	15860	0	32	12	48
	1748	146.8 - 151.0	148.9	45.4	43	1.82	19	0.06	2	2.03	0.02	0.31	298	12440	0	64	14	60
	1750	154.0 - 157.0	155.5	47.4	34	1.30	24	0.03	2	1.62	0.01	0.21	401	17980	0	38	9	42
	35901	157.0 - 160.0	158.5	48.3	42	1.40	19	0.06	4	2.05	0.02	0.29	171	5980	18	55	8	60
	35902	160.0 - 163.0	161.5	49.2	60	1.55	19	0.07	3	2.30	0.02	0.20	238	13380	11	68	10	80
	35903	163.0 - 167.3	165.1	50.3	36	1.12	30	0.07	2	1.52	0.02	0.74	220	12620	14	43	9	46
	35904	167.3 - 171.6	169.4	51.6	48	1.25	31	0.09	3	1.83	0.03	1.06	133	28200	0	48	14	65
	35905	171.6 - 175.8	173.7	52.9	41	1.12	87	0.10	8	2.16	0.04	0.72	153	160	0	45	11	58
	35906	175.8 - 180.1	178.0	54.2	44	1.22	85	0.09	6	1.95	0.04	0.68	115	4	20	66	14	72
	35907	180.1 - 184.5	182.3	55.6	56	1.26	73	0.11	5	2.03	0.04	0.65	116	10	30	72	13	83
	35908	184.5 - 189.0	186.8	56.9	46	1.04	72	0.09	4	1.97	0.11	0.87	68	9	38	64	10	70
	35909	189.0 - 193.5	191.3	58.3	41	1.25	69	0.09	8	1.98	0.14	0.91	71	12	29	64	13	67
	35910	193.5 - 198.0	195.8	59.7	44	1.14	62	0.07	8	1.72	0.14	0.96	64	18	16	60	11	67
	35911	198.0 - 202.5	200.3	61.0	57	1.36	77	0.09	7	2.31	0.17	1.23	46	5	33	86	17	90
	35913	207.0 - 211.5	209.3	63.8	40	1.02	64	0.07	10	1.69	0.14	0.99	67	52	13	32	9	63
	35914	211.5 - 216.0	213.8	65.2	40	0.99	75	0.08	9	1.43	0.10	0.93	59	10	20	0	8	59
	35915	216.0 - 220.5	218.3	66.5	68	1.08	131	0.15	5	2.42	0.10	1.17	64	104	25	39	13	100
	35916	220.5 - 225.0	222.8	67.9	63	0.93	135	0.14	3	2.02	0.09	1.18	56	40	30	127	13	95
	35917	225.0 - 229.5	227.3	69.3	57	0.75	113	0.11	5	1.42	0.07	1.01	73	225	17	116	12	80

MINERAL OCCURRENCE	SAMPLE NUMBER	Sample Depth (ft)	Avg. Depth (ft)	Avg. Depth (m)	Cr (ppm)	Mg (%)	Ba (ppm)	Ti (%)	B (ppm)	Al (%)	Na (%)	K (%)	W (ppm)	Au* (ppb)	Total Ni (ppm)	Total Cr (ppm)	Partial Ni (ppm)	Partial Cr (ppm)
	35919	234.0 - 240.5	237.3	72.3	52	1.50	43	0.11	3	2.15	0.02	1.60	108	7700	0	97	14	77
	35920	240.5 - 245.0	242.8	74.0	53	1.32	35	0.11	9	1.88	0.03	1.27	165	10660	19	101	19	77
	35921	245.0 - 249.5	247.3	75.4	67	1.36	243	0.12	4	2.93	0.03	0.80	114	19	35	96	23	101
	35922	249.5 - 254.0	251.8	76.7	64	0.85	219	0.09	3	2.25	0.02	0.47	146	7	47	89	22	86
	35923	254.0 - 258.5	256.3	78.1	74	1.17	292	0.13	2	2.63	0.03	0.64	77	5	46	100	32	111
	35924	258.5 - 263.0	260.8	79.5	49	0.84	180	0.08	5	2.16	0.02	0.44	65	15	22	71	19	76
	35925	263.0 - 267.5	265.3	80.8	42	0.80	157	0.09	4	2.02	0.01	0.47	96	1980	13	65	11	57
	35926	267.5 - 272.0	269.8	82.2	59	0.82	192	0.09	5	2.04	0.02	0.48	108	10	29	76	16	83
	35928	276.5 - 281.0	278.8	85.0	49	0.80	123	0.08	5	2.17	0.01	0.37	78	1	20	59	10	70
	35929	281.0 - 285.5	283.3	86.3	96	1.15	219	0.15	3	3.13	0.02	0.73	68	12	26	115	24	131
	35930	285.5 - 290.0	287.8	87.7	48	1.05	137	0.10	10	2.30	0.02	0.54	37	1	21	55	12	65
	35931	290.0 - 294.5	292.3	89.1	52	0.83	117	0.09	5	2.25	0.02	0.46	73	6	43	66	16	77
	35932	294.5 - 299.0	296.8	90.4	74	1.06	136	0.15	4	2.72	0.03	0.85	82	128	40	84	23	103
	35933	299.0 - 303.5	301.3	91.8	34	0.70	88	0.07	5	1.36	0.08	0.76	145	116	25	44	10	47
	35934	303.5 - 308.0	305.8	93.2	39	0.96	85	0.09	7	2.44	0.11	0.82	164	11	33	47	14	56
	35935	308.0 - 312.5	310.3	94.6	58	0.89	114	0.11	6	2.07	0.12	1.08	62	12	32	80	17	89
	35936	312.5 - 317.0	314.8	95.9	46	0.85	101	0.09	4	1.70	0.13	1.11	77	1	27	72	8	74
	35938	321.5 - 326.0	323.8	98.7	6	0.12	8	0.01	2	0.20	0.02	0.12	817	13	0	13	1	7
	35939	326.0 - 330.5	328.3	100.1	42	0.80	94	0.09	3	1.60	0.15	1.11	78	16	15	57	5	65
	35940	330.5 - 335.0	332.8	101.4	38	0.74	74	0.07	5	1.41	0.13	0.84	164	17	15	57	5	57
	35941	335.0 - 339.5	337.3	102.8	64	0.94	127	0.11	5	1.87	0.16	1.14	50	11	17	88	12	87
	35942	339.5 - 344.0	341.8	104.2	88	1.42	198	0.17	3	3.21	0.24	1.84	31	585	40	110	30	130
	35943	345.0 - 349.5	347.3	105.8	53	0.95	132	0.11	6	1.97	0.16	1.20	85	16	34	76	11	79
	35945	354.0 - 358.5	356.3	108.6	37	1.00	98	0.09	4	1.76	0.23	1.28	88	20	21	76	11	58
	35946	358.5 - 364.5	361.5	110.2	46	1.41	96	0.09	2	2.70	0.25	1.52	40	4	34	83	15	80
	35948	379.0 - 383.5	381.3	116.2	59	2.20	85	0.09	2	2.53	0.09	0.30	58	1	87	77	49	80
	35947	386.0 - 391.0	388.5	118.4	19	0.63	104	0.08	2	1.40	0.13	0.92	73	1	30	57	5	32

* Analysis based on 10g sample.

Appendix 2
Spearman correlation coefficient matrix

	AG	AL	AS	AU	B
AG	1.000				
AL	-0.198	1.000			
AS	-0.474	0.139	1.000		
AU	0.788	-0.271	-0.476	1.000	
B	-0.197	-0.080	0.261	-0.110	1.000
BA	-0.595	0.451	0.104	-0.566	-0.150
BI	0.734	-0.137	-0.247	0.734	-0.053
CA	-0.611	0.056	0.338	-0.689	0.029
CD					
CO	0.592	-0.267	-0.052	0.610	-0.148
CRT	0.038	0.436	-0.102	0.041	-0.103
FE	0.678	-0.216	-0.259	0.649	-0.051
K	-0.176	0.177	-0.008	-0.005	0.039
MG	0.292	0.588	0.030	0.196	-0.041
MN	0.224	-0.082	0.134	0.154	0.310
MO	0.063	-0.284	0.150	0.198	0.371
NA	-0.611	0.195	0.486	-0.533	0.230
NIT	-0.577	0.382	0.452	-0.627	0.207
P	0.291	-0.376	-0.132	0.261	-0.003
PB	0.449	0.002	-0.005	0.426	-0.007
SB	-0.093	0.108	0.004	-0.006	0.090
SR	-0.702	0.133	0.386	-0.726	-0.004
TH	-0.406	0.434	0.210	-0.291	-0.065
TI	-0.278	0.681	-0.087	-0.230	-0.019
U	0.187	0.054	-0.172	0.045	-0.235
V	-0.413	0.821	0.204	-0.436	-0.112
W	0.614	-0.564	-0.237	0.612	-0.101
ZN	0.612	0.242	-0.380	0.547	-0.380

	BA	BI	CA		CO
BA	1.000				
BI	-0.674	1.000			
CA	0.500	-0.533	1.000		
CD					
CO	-0.637	0.577	-0.448		1.000
CRT	0.218	0.020	-0.060		-0.003
FE	-0.553	0.599	-0.654		0.375
K	0.170	-0.027	-0.242		-0.165
MG	-0.207	0.403	-0.283		0.231
MN	-0.330	0.149	-0.133		0.296
MO	-0.424	0.253	-0.169		0.284
NA	0.202	-0.353	0.273		-0.269
NIT	0.431	-0.403	0.548		-0.394
P	-0.299	0.186	-0.101		0.215
PB	-0.472	0.446	-0.430		0.303
SB	0.159	-0.155	0.086		-0.038
SR	0.585	-0.598	0.928		-0.472
TH	0.468	-0.259	0.368		-0.262
TI	0.605	-0.284	-0.026		-0.387
U	-0.076	-0.004	-0.137		0.121
V	0.536	-0.274	0.188		-0.419
W	-0.594	0.477	-0.370		0.652
ZN	-0.171	0.465	-0.374		0.482

	CRT	FE	K	MG	MN
CRT	1.000				
FE	-0.087	1.000			
K	0.374	0.202	1.000		
MG	0.261	0.383	0.151	1.000	
MN	0.014	0.454	0.279	0.369	1.000
MO	-0.108	0.066	0.005	-0.040	0.187
NA	0.051	-0.162	0.436	0.213	0.242
NIT	0.157	-0.411	0.055	0.104	-0.008
P	-0.171	0.466	-0.002	-0.082	0.434
PB	-0.138	0.599	0.121	0.417	0.452
SB	-0.009	-0.125	0.012	-0.034	-0.010
SR	-0.075	-0.649	-0.162	-0.318	-0.187
TH	0.256	-0.169	0.208	0.203	-0.002
TI	0.574	-0.244	0.563	0.242	-0.109
U	0.084	0.055	-0.054	0.126	0.102
V	0.473	-0.263	0.318	0.458	-0.151
W	-0.231	0.266	-0.467	-0.240	-0.007
ZN	0.386	0.340	0.133	0.402	0.248

	MO	NA	NIT	P	PB
MO	1.000				
NA	0.002	1.000			
NIT	-0.277	0.497	1.000		
P	0.067	-0.121	-0.159	1.000	
PB	0.126	-0.021	-0.269	0.282	1.000
SB	-0.067	0.048	-0.006	-0.030	0.055
SR	-0.258	0.363	0.571	-0.113	-0.415
TH	-0.179	0.300	0.390	-0.140	-0.126
TI	-0.219	0.270	0.304	-0.403	-0.166
U	-0.047	-0.117	0.034	0.085	-0.082
V	-0.250	0.458	0.509	-0.369	-0.094
W	0.262	-0.621	-0.512	0.156	0.178
ZN	0.043	-0.417	-0.258	0.213	0.320

	SB	SR	TH	TI	U
SB	1.000				
SR	0.114	1.000			
TH	0.210	0.425	1.000		
TI	0.134	0.032	0.325	1.000	
U	-0.092	-0.155	-0.161	0.038	1.000
V	0.028	0.262	0.571	0.716	0.009
W	-0.133	-0.456	-0.482	-0.565	0.036
ZN	-0.027	-0.406	0.042	0.149	0.258

	V	W	ZN
V	1.000		
W	-0.736	1.000	
ZN	0.064	0.239	1.000

NUMBER OF OBSERVATIONS: 70

Appendix 3

Multi-element analyses of three gold-enriched core samples, DDH 654-41, Wendy Zone, Farley Lake. Analyses by neutron activation (Au to Zn) and inductively coupled plasma-atomic absorptiom spectrometry (Cu to Y). The elements Br, Hf, Hg, Ir, Mo, Rb, Se, Sn, U, Cd and Be were below the lower limits of determination. Analyses in ppm unless otherwise indicated.

Element	01733	01748	01750
Au (ppb)	14200	13800	15200
As	<0.5	15	2.9
Ba	280	<50	100
Co	34	33	26
Cr	45	82	54
Cs	30	15	6
Fe (%)	27.0	31.2	22.4
Sb	0.9	1.1	0.5
Sc	4.9	6.3	4.8
Ta	1.4	2.3	1.2
Th	1.7	2.0	1.6
W	400	410	420
Zn	78	83	51
Cu	59	54	22
Pb	<5	21	6
Ag	1.6	2.7	5.8
Ni	18	32	19
Mn	488	735	479
Sr	11	19	9
Bi	11	13	10
V	23	28	24
Ca (%)	0.30	0.52	0.20
P (%)	0.115	0.183	0.082
Mg (%)	1.18	1.85	1.23
Ti (%)	0.07	0.09	0.07
Al (%)	1.75	2.04	1.61
K (%)	0.62	0.25	0.16
Y	8	11	6