

DOZER PROSPECT (KM. 410)

CANYON GOLD PROPERTY

SUMMARY REPORT

Whitehorse Mining District

**N.T.S. 105 K- 3
Longitude 133° 07'
Latitude 62° 09'**

by

Allen Carlos

July 23 – August 10, 1999

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Summary

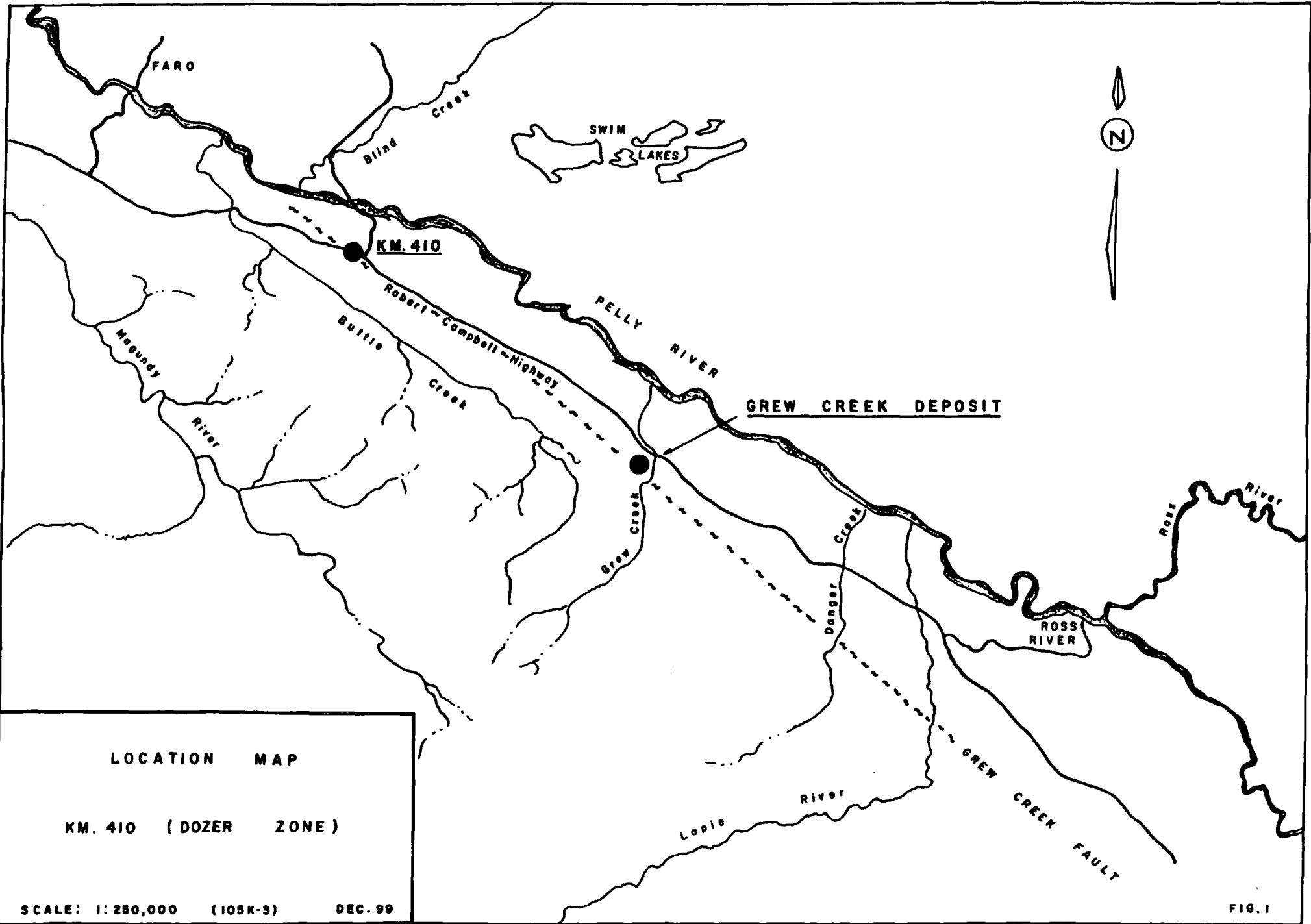
An airborne geophysical anomaly, located in an intriguing setting, was assessed in a "first pass" approach by the taking of 148 soil samples over a 3 km. baseline distance. Geochemically anomalous zones correlate with 2 distinct geophysical centers (21a and 21b, Fig.5a).

One particular element stood out in its behaviour (Ca). Why? This same question was asked several years ago while compiling soil geo-chem data Noranda had produced in a limited survey nearby the Grew Creek deposit, 11 miles along the Tintina Trench to the southeast. A striking aspect of this work was the strong Ca response near a high mercury center. Research has led to a specific report on Ca and its behaviour over a known sediment - hosted deposit in Nevada (Barry W. Smee in Journal of Geochemical Exploration 61, 1998). The referred to text is a 230 page issue devoted to "selective extractions in geochemistry." The specific article noted, plus the issue in general, has led me to believe that perhaps we are already "seeing through the overburden," and need only to tinker with the approach to make it more sensitive to our specific environment.

Introduction

Fourteen (14) Dozer claims were staked July 21, 1999 to cover an airborne geophysical feature located proximal to Permian limestone exposures (Cpal, Fig.2). Several years ago gold bearing jasperoid float was discovered nearby these limestones, immediately north of the Grew Creek Au deposit (Fig.2). Other common features of the float discovery area near Grew Creek and the current target are:

- a) Located immediately north of the Canyon graben (bounded by the Danger Creek and Grew Creek faults).
- b) Tertiary volcanic centers within the graben at both locations (Fig.2 and Fig.3).
- c) A strong north trending extensional fault.



SCALE: 1:250,000 (105K-3) DEC. 99

FIG. 1

Since 1983, a number of cursory attempts to assess the altered and geochemically anomalous Tertiary units to the south has occurred.

This report will deal predominantly with a geochemical soil survey, carried out on a grid basis, to cover the before mentioned airborne geophysical feature. Aerodat was contracted to perform the airborne survey in 1988.

Geology

The geology and structure at Km. 410 is very similar to that occurring at the Main Zone Au-Ag mineralization at Grew Creek, 11 miles to the southeast (Fig.2). The latter is well documented in Yukon Geology (Vol.3) by Christie, Duke and Rushton.

The Main Zone deposit, along the Tintina fault, is hosted by Eocene rhyolitic volcanics within the Canyon graben, bounded by the Danger and Grew Creek faults. North of Danger Creek fault occur allochthonous Permian limestones, propylitically altered basalts (not observed to be magnetic) and locally, quartzite (Fig.2 and Fig.3), all supposedly part of Yukon-Tanana terrane. Till cover undoubtedly conceals more recessive units. Tertiary igneous rocks are not restricted to the graben, as local exposure within Yukon-Tanana has been noted at 2 separate locations between Grew Creek and Km.410. This last observation is important in regard to the current survey area, as magnetic features along the grid (Fig.5b) most likely reflect Tertiary mafic igneous units. Fine and coarse grained intersections of these rocks (magnetic) were encountered in drilling of the Grew Creek deposit. As an added note, unique angular pieces of a coarse grained K-spar rich igneous rock were observed in the till while soil sampling at site 9+650W - 10+000N.

1999 Program (Methods)

Soil sampling was initiated following the cutting by chainsaw of a grid spread along a 3 km. baseline (Fig.3). A limited orientation survey (J.Helson, 1987), at the Grew Creek site, determined that deep soil samples should be

taken for "significant gold values." Following this advice, soil augers were used to a maximum 1 metre depth. A wedged bar was used in difficult conditions to attain at least 0.6 metre. Observational information at sampling sites was gathered and noted (attached). Soil profile generally is: Surface litter, humus, ash, a variable thickness rusty zone (at times missing), and finally a clay rich till which, on occasion, is somewhat silty. A number of sites were all silt, generally with permafrost at the base; most likely a windblown dust. At times we were able to get through the silt to underlying till.

Resultant samples (148) were air dried and sent to Bondar Clegg for their multi-element package of Au plus 35 (screened to -80 mesh). All analysis was by ICP except Au (30 g fire assay AA) and Hg (cold vapor AA). Elements relevant to this survey with only partial digestion are K-Mn-Ni-Ca-Sr-Fe-Sb and Ba. Supposedly total element extraction was achieved for Cu-Ag-Bi-Zn-As and Cd.

Several days were spent in detailed prospecting of the immediate and surrounding area.

Results and Discussion

To put our present soil survey into some context, I wish to quote 3 geologists (written texts) regarding soil sampling at Grew Creek and the general area.

- a) T. GARAGAN, 1985 - regarding mineralized outcrop near Main Zone deposit: "The soil samples taken over the silicified knoll contain gold and silver values ranging from 5 to 1100 ppb and 0.2 to 3.4 ppm respectively. Arsenic and mercury are only slightly anomalous with metal values up to 110 ppm arsenic and 85 ppb mercury. The samples with low metal values were taken in glaciated till adjacent to the silicified knoll, indicating a poor dispersion of metals in the till. Soil sampling only seems to work on the property when soil samples are collected from above weathered bedrock."
- b) J. Duke, 1988 - regarding Seds Zone mineralization: "It is clear from the weakness of the gold dispersion (and nonexistence of Ag-As and Hg dispersion) from outcropping mineralization at the 1988 trenches

that the value of soil geochemistry to define even outcropping mineralization is limited.”

- c) Alaine Plouffe (till geochemistry study): “Reproducibility of Au analysis with the silt and clay size fraction is very low.” Also: “Pathfinders such as Ag-As-Hg and Sb, analyzed in the clay size fraction of till, are not recommended for drift prospecting of epithermal gold in this area, since their glacial dispersal does not reflect the mineralization at Grew Creek.”

Unfortunately, a proper orientation survey to determine soil background values and those overlying the known Grew Creek deposit has not been done. There has also been an unusual limiting focus on only 4 elements: Au-Ag-As and Hg.

Studies by Plouffe and myself have determined that the heavy mineral fraction is useful in the exploration of till. However, this leads to a practical problem of sample size and processing. Again, in this approach, one would be only measuring a dispersal pattern. Is there a better way?

The current soil sampling program has determined that geochemically anomalous zones correlate with 2 geophysical centers (Fig.4a-c and Fig.5). Due to suspected deeper till at the northwesterly anomaly and lower values in Au, we will focus on the geochem feature centered at line 9+400W - 10+000N. Despite less than adequate sample spacings or coverage, the following pattern emerges at 9+400W:

- Distinct coincident values in Mn-K-Ba and Hg.
- Coincident to above but more subtle Cu and Zn.
- Fe values that show an increase locally, but not essentially coincident with the above elements.
- Subtle As appears generally to follow Fe.
- Locally extreme Ca responses.
- A distinct gold response immediately down-ice of the multi-element anomaly noted.

On the final point, regarding Au values in soil: A 23 or 26 ppb value (Fig.4a and Fig.6) is definitely anomalous. For example, a 211 sample soil survey

over and down-ice of the mineralized discovery outcrop at Grew Creek supports this last statement. At the Pogo area in Alaska - similar low level gold anomalies in soil are considered anomalous (N.Miner, Nov.1999). How does one interpret the above observations?

Casting about for an explanation regarding calcium behaviour, research led me to the Journal of Geochemical Exploration Vol.61 (1998). This 230 page issue is devoted to "selective extractions in geochemistry," and a specific article, by Barry W. Smee, deals with the behaviour of calcium. From its study, I believe that:

- 1.) The multi-element geochem anomaly at 9+400W is the surficial expression of vertical mobile element migration from oxidizing mineralization. If the cover is relatively thin - other factors may have played a part.
- 2.) Adjacent gold in soil values are the down-ice dispersion of that same mineralization. If any gold is reaching the surface by vertical element migration - a more sensitive analytical procedure than presently used would be required for its determination.

In order to quickly grasp the possibilities for the above statements, I briefly quote selected passages from the referred to publication:

- a.) "The objective of selective extraction is to isolate and quantify that portion of the element in a sample which is relatively loosely bound, indicating prior mobility, presumably from depth."
- b.) "Controversy abounds as to the dominant mechanisms of transport of the element from oxidizing mineralization at depth." Recently, gaseous diffusion/vapor transport has been considered.
- c.) "Selective extractions are proven deposit finders, as shown by case studies in Russia, China, South America and elsewhere."
- d.) "The selective leach signature in glacial-fluvial sand overlying mineralization provides convincing evidence for the upward migration of elements."
- e.) "Mobile element concentration may represent only a small fraction of the trace element content of the overburden: hence, geochemical contrast would be suppressed if total metal extraction were used."

One may ask: What do partial metal extractions have to do with our current exercise? Other than for Au and Hg, analysis for elements in this study was by ICP. Only partial digestion was achieved for the following elements relevant to this discussion (Mn-K-Ba and Fe). Of these, Mn-K and Ba show much better contrast than those elements which experienced total digestion (Ag-Cu-Zn and As). If the arguments regarding total versus partial extractions are correct (selected passage #e), then the above underlined observation is to be expected in an anomalous environment. Behaviour of Fe is ambiguous.

Regarding element migration, mercury would be the most likely to immediately overlie its source, by vaporization. Strong evidence for the vertical migration of mercury from underlying mineralization involves a past program, in the Clear Lake area of Yukon. Anomalous mercury in till was used as a successful guide in locating directly underlying sulphide zones (Rick Zurrán, pers. comm.). The coincident presence of other elements with mercury in surficial tills (9+400W) suggests that they also migrated vertically from the same underlying source (Fig.6). Conductive E.M. centers (airborne) appear to correlate well with overlying multi-element anomalies (Fig.4a-c and Fig.5). Might this support the idea of vertical metal migration from underlying sulphide mineralization? Finally, calcium peaks directly adjacent to and overlying the geo-chem anomaly at 9+400W (Fig.6, overlay). The behaviour of Ca in soil, overlying a known gold deposit in the example given by Smee, was similar; supporting a common process of vertical migration. The specific article regarding calcium is appended and highlighted.

Other than for mercury, two important conditions may have allowed for recognition of anomalous centers in the present study: A portion of the anomalous elements were subjected to partial (selective) digestion prior to analysis, enhancing their contrast in the soils. Secondly, sensitivity and accuracy of ICP analysis allows for their recognition. Even those elements not subject to partial digestion can be recognized (Cu-Zn-Ag and As), but subtly so.

To conclude this chapter, local observances in the grid area plus peripheral prospecting will be noted:

- 1.) At grid location 10+800W/9+950N, high soil geo-chem values for Cu-217 ppm, Co-60 ppm, Mn-1254 ppm and Sc-19 ppm were determined directly overlying the only exposure on the grid: A

limited area of (quartzite)? Fine grained pyrite is pervasive with local portions somewhat carbonaceous (Fig.3). Initial assay of this exposure was non-anomalous (V73421). A later analysis was similar (V73430). Obviously, soil geochemistry is reflecting something other than the underlying bedrock, perhaps up-ice mineralization.

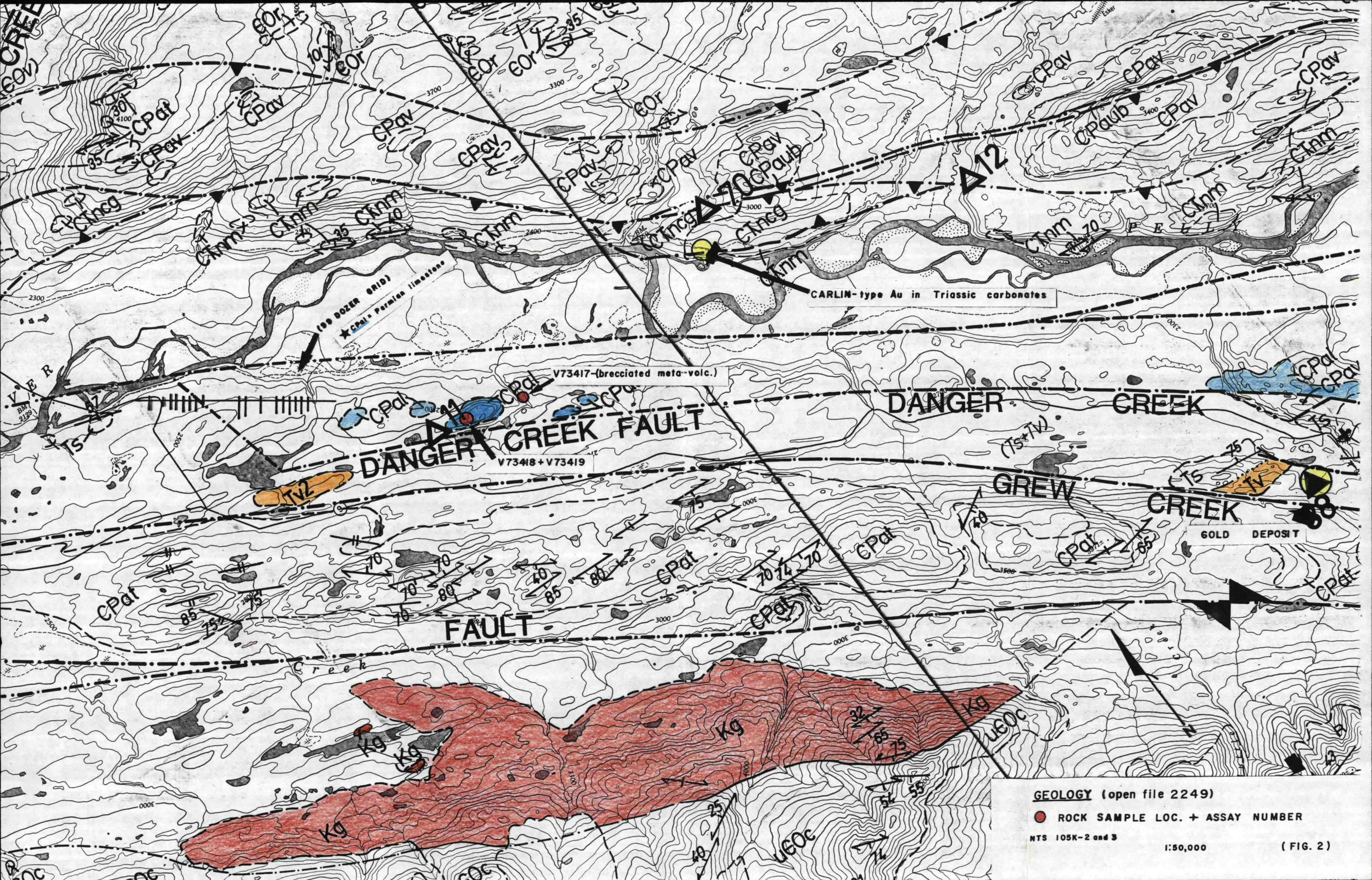
- 2.) An erratically mineralized limestone unit was discovered southeast of the grid: Sample number 73418 is silicified (sugary textured) and brecciated. It is anomalous in Au at 389 ppb and Bi at 13 ppm. A nearby sample is similar, but more limonitic. It is anomalous in mercury at 2153 ppb. This mineralization (Fig.2) is limited. However, it alerts one to nearby possibilities. The presence of bismuth in one sample suggests the presence of intrusive rocks. No airborne geophysical expression coincides with this mineralization.
- 3.) A green weathering, brecciated meta-volcanic, occasionally malachite stained, is located at sample site V73417 (Fig.2). The copper assay was 788 ppm; gold only 8 ppb. Again, no airborne geophysical feature can be related to this mineralization.
- 4.) In the grid area again, at 9+400W, a sampling observation should be mentioned: Black to dark gray clay rich till occurs at sample sites bordering the multi-element anomaly (Fig.6) on its southern boundary. Coloration appears due to carbonaceous material.

Conclusions

A soil sampling program has delineated geochemically anomalous zones correlating well with 2 distinct geophysical centers (Fig.5a, 21a and 21b). Results show anomalous calcium behaviour, noted previously in one other area of interest nearby. Research on the calcium subject led in turn to the study of "selective extractions." Briefly, I suspect the currently identified multi-element geochem centers are reflecting directly underlying zones of mineralization. Gold values most likely are down-ice dispersions from these sources. If so, this ability to "see through the overburden" has significant implications. No doubt, consultation with knowledgeable people will lead to

improving the approach. Measurement of Au-As and Sb to low detection limits, as suggested by Barry W. Smee, would be a positive start.

Following establishment of a tightened grid at the 9+400W target, a subsequent V.L.F. E.M. survey would most likely establish an underlying conductive zone. Only drilling will give us the answer!



★CPal - Permian limestone
 (99 002R 0119)

V73417 - (brecciated meta-volc.)

DANGER CREEK FAULT
 V73418 + V73419

CARLIN-type Au in Triassic carbonates

DANGER CREEK

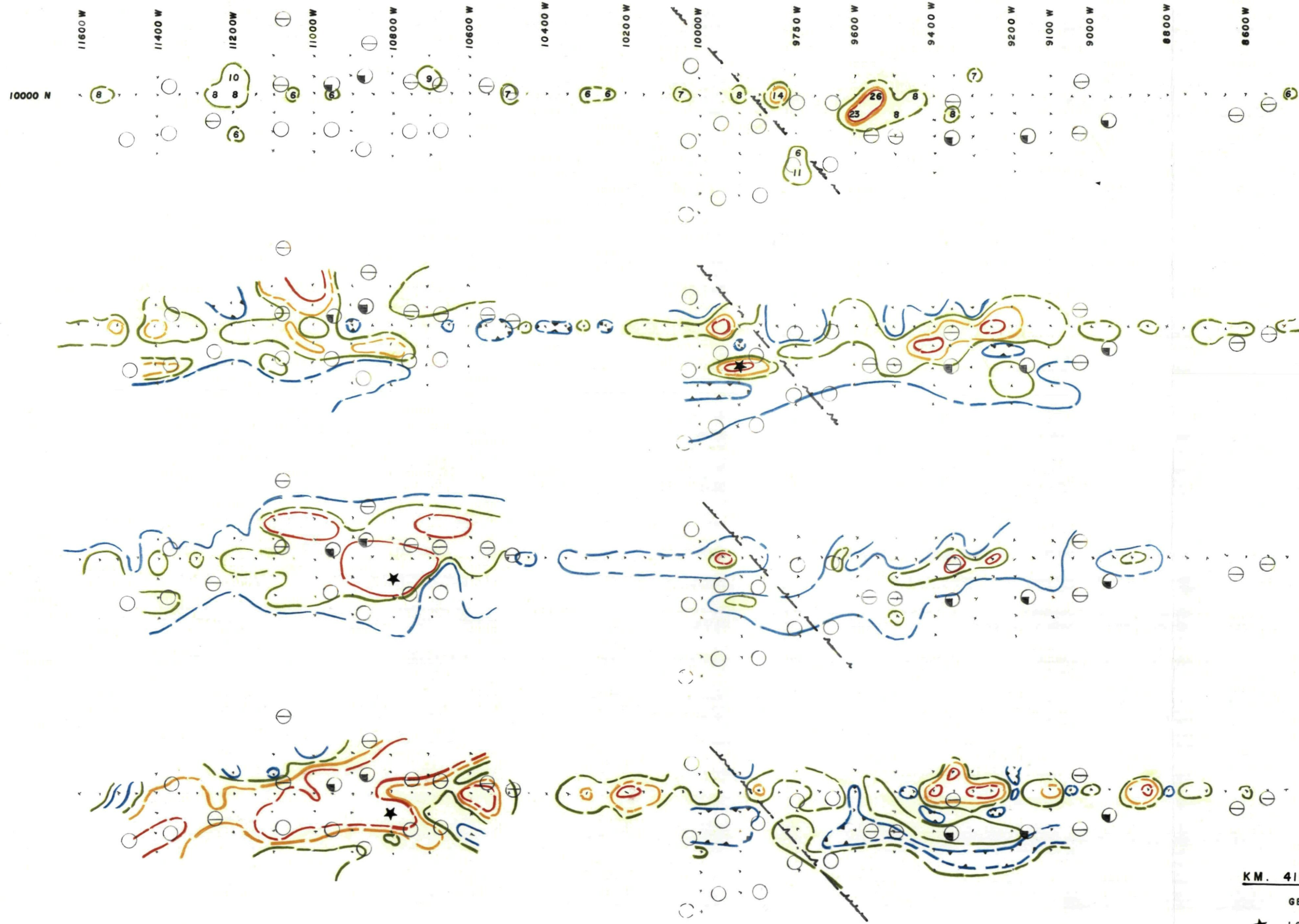
GREW CREEK

GOLD DEPOSIT

GEOLOGY (open file 2249)
 ● ROCK SAMPLE LOC. + ASSAY NUMBER
 NTS 105K-2 and 3
 1:50,000
 (FIG. 2)



KM. 410 (DOZER ZONE)
 GRID LOC. + SIMPLIFIED GEOLOGY (FIG. 3)
 SCALE: 1:10,000



Au (ppb)

- < 5 ppb
- 6 ppb or >
- 14 ppb or >
- 22 ppb or >

Hg (ppb)

- 80 ppb or >
- 110 ppb or >
- 140 ppb or >
- 170 - 198 ppb

Cu (ppm)

- 28 or >
- 34 or >
- 40 - 217 ppm

Mn (ppm)

- 360 or >
- 400 or >
- 450 or >
- 490 - 1254

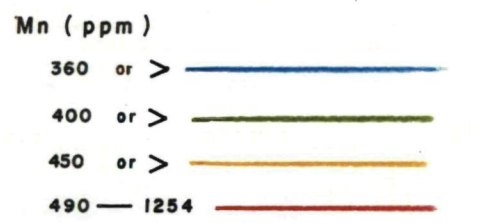
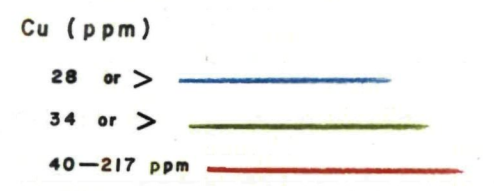
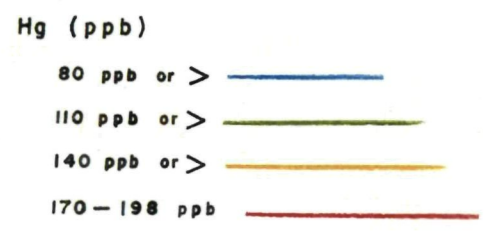
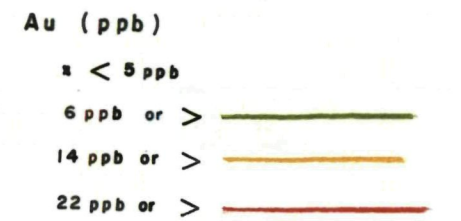
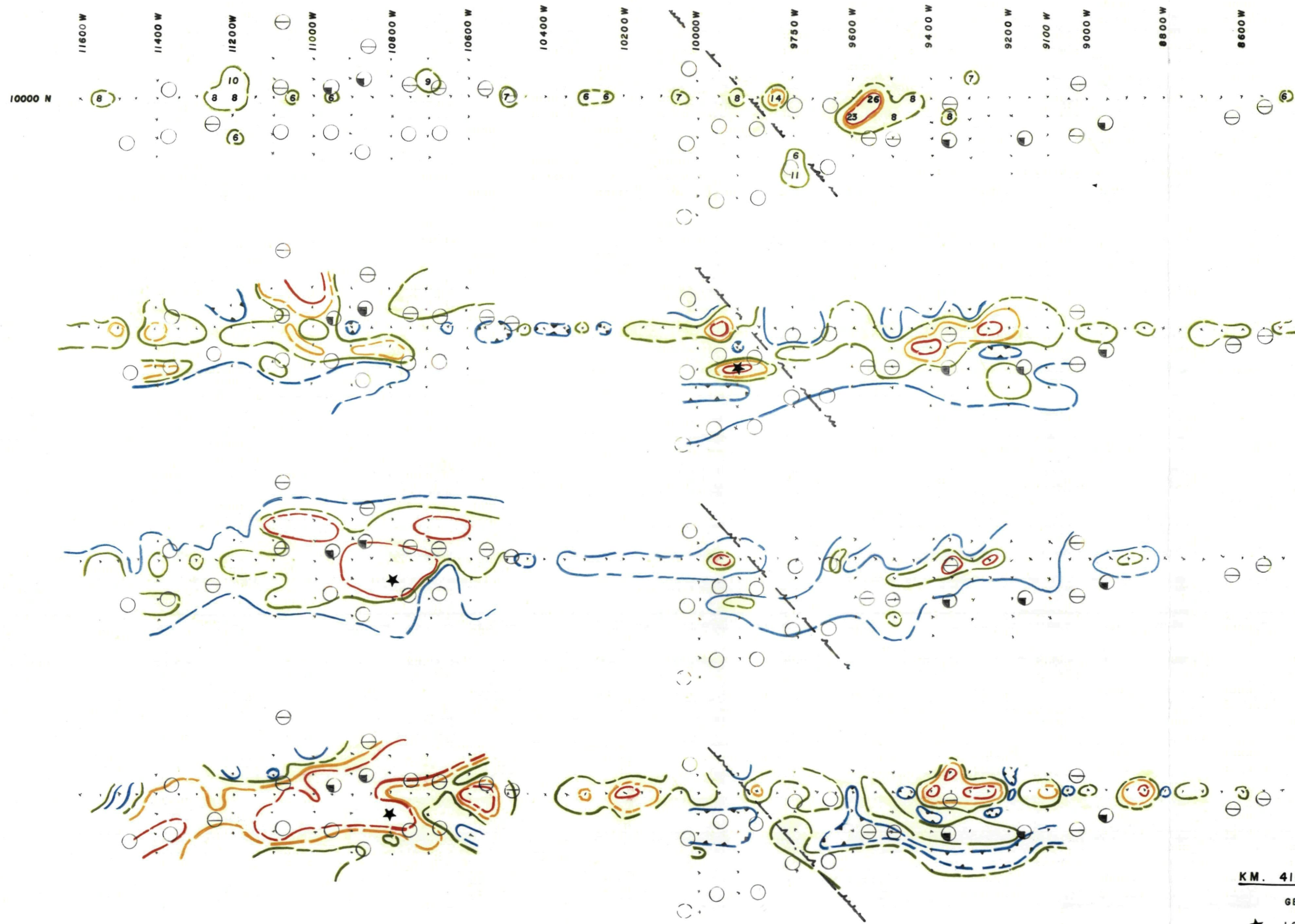
KM. 410 (DOZER ZONE)

GEO-CHEM SOIL CONTOURS

★ **LOCATION OF HIGHEST VALUE**

SCALE: 1: 10,000

(FIG. 4a)



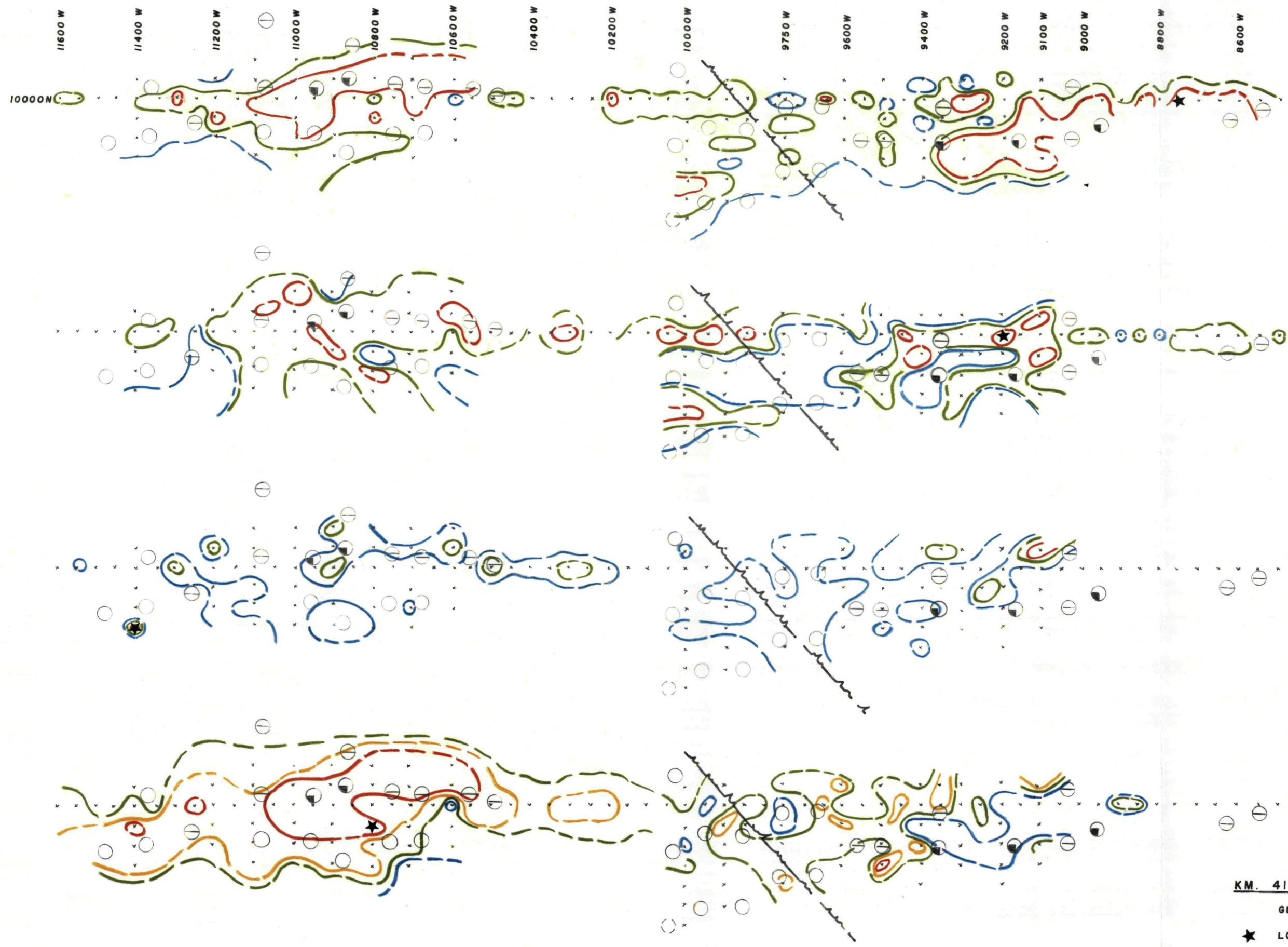
KM. 410 (DOZER ZONE)

GEO-CHEM SOIL CONTOURS

★ LOCATION OF HIGHEST VALUE

SCALE: 1: 10,000

(FIG. 4a)



K (%)

- 0.07% or > ———
- 0.10% or > ———
- 0.13% or > ———

Ba (ppm)

- 550 or > ———
- 600 or > ———
- 700-879 > ———

As (ppm)

- 13 or > ———
- 16 or > ———
- 19-21 > ———

Fe (%)

- 2.0% or > ———
- 2.2% or > ———
- 2.4% or > ———
- 2.8% or > ———

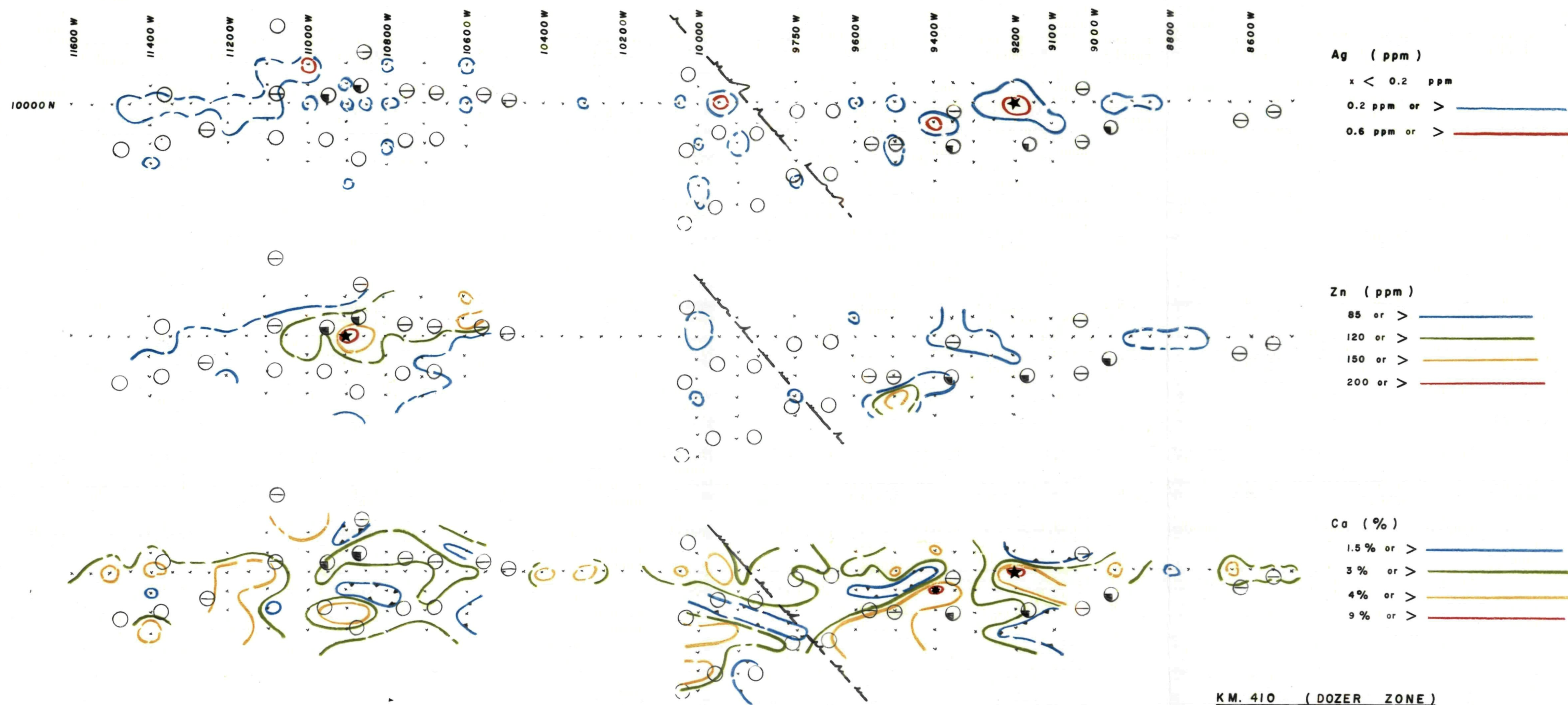
KM. 410 (DOZER ZONE)

GEO-CHEM SOIL CONTOURS

★ LOCATION OF HIGHEST VALUE

SCALE: 1:10,000

(FIG. 4b)



KM. 410 (DOZER ZONE)

- GEO-CHEM SOIL CONTOURS
- ★ LOCATION OF HIGHEST VALUE
 - * 2nd HIGHEST VALUE = 9.67%

SCALE: 1:10,000

(FIG. 4c)

EM Anomalies

Conductivity Thickness (mhos)

- 0 - 1
- 1 - 2
- ⊖ 2 - 4
- ⊙ 4 - 8
- 8 - 15
- 15 - 30
- > 30



EM Anomaly A. 4600 Hz
inphase amplitude 7 ppm.
Conductivity thickness
1-2 mhos (see code).

INTERPRETATION LEGEND

- Interpreted bedrock conductor axis
- Possible bedrock conductor axis
- Fault
- Conductive Zone
- Magnetic trend
- Contact

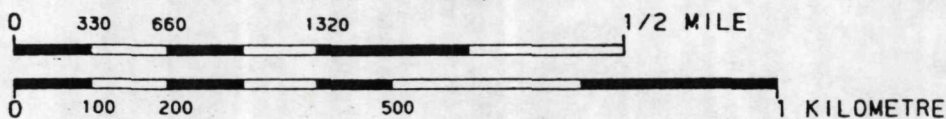
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INTERPRETATION

PELLY RIVER

YUKON TERRITORY

SCALE 1:10,000



AERODAT LIMITED

DATE: MARCH/APRIL 1988

NTS No: 105 K/3

MAP No: 3

J8815-6



AIRBORNE SURVEY INTERPRETATION
LEGEND (SEE APPENDIX I)
1999 GRID LOCATION
SCALE: 1:10,000 (FIG. 5a)





Vertical Gradient

Vertical Magnetic Gradient
calculated from the total field
magnetic intensity in nT/m.

Cesium high sensitivity
magnetometer.








Sensor elevation 45m

Map contours are multiples of
those listed below

	0.2 nT/m
	1 nT/m
	5 nT/m
	25 nT/m

EM Anomalies

Conductivity Thickness (mhos)

	0 - 1
	1 - 2
	2 - 4
	4 - 8
	8 - 15
	15 - 30
	> 30



EM Anomaly A. 4600 Hz
in phase amplitude 7 ppm.
Conductivity thickness
1-2 mhos (see code).

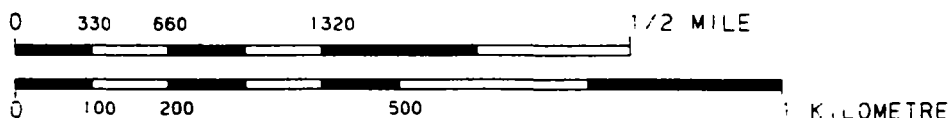
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CALCULATED VERTICAL MAGNETIC GRADIENT

PELLY RIVER

YUKON TERRITORY

SCALE 1:10,000



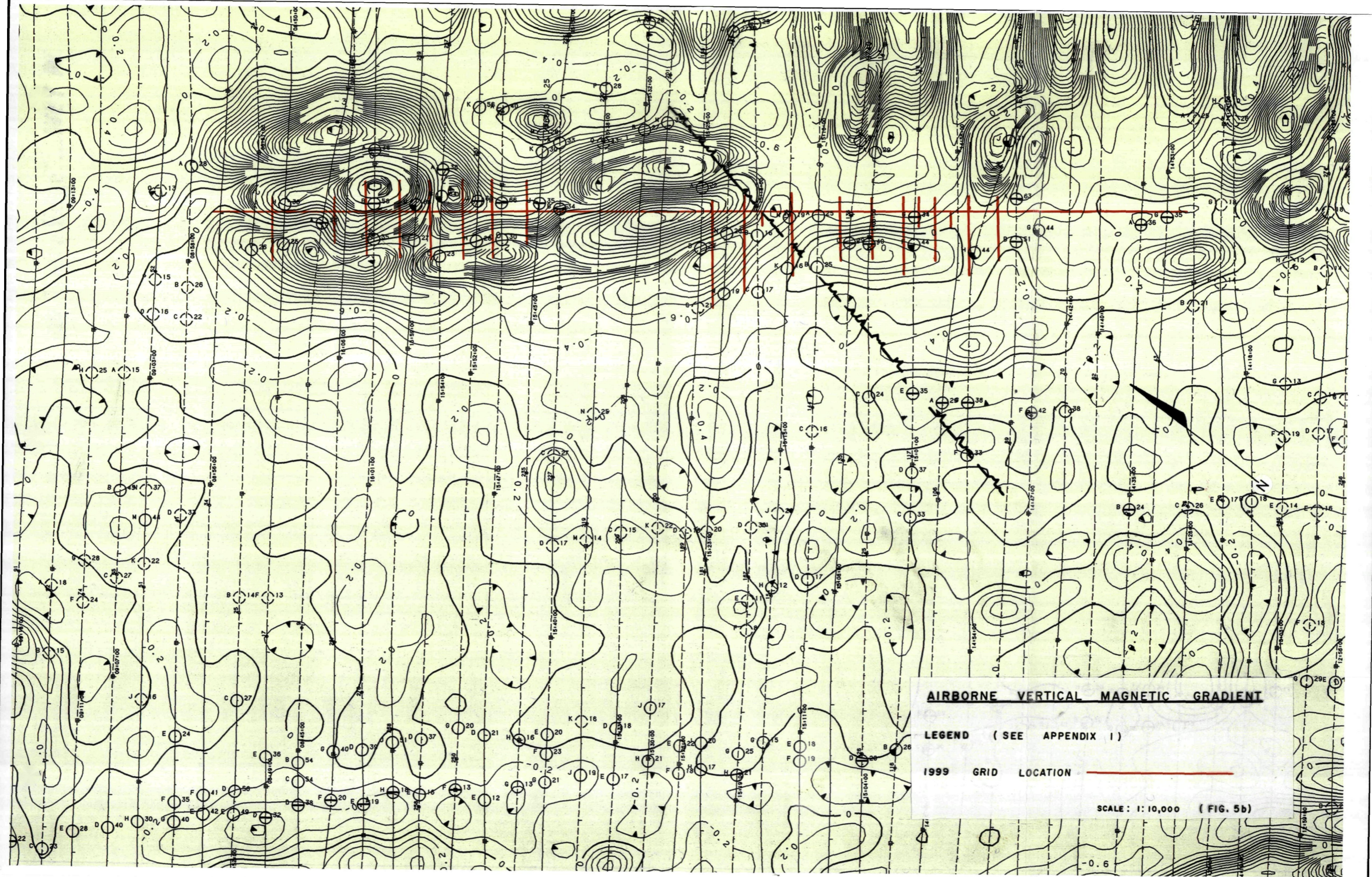
AERODAT LIMITED

DATE: MARCH/APRIL 1988

NTS No: 105 K/3


MAP No: 5

18815-6



AIRBORNE VERTICAL MAGNETIC GRADIENT

LEGEND (SEE APPENDIX I)

1999 GRID LOCATION 

SCALE: 1:10,000 (FIG. 5b)

Apparent Resistivity

Calculated from 4600 Hz coaxial EM response assuming a 200 m conductive layer.

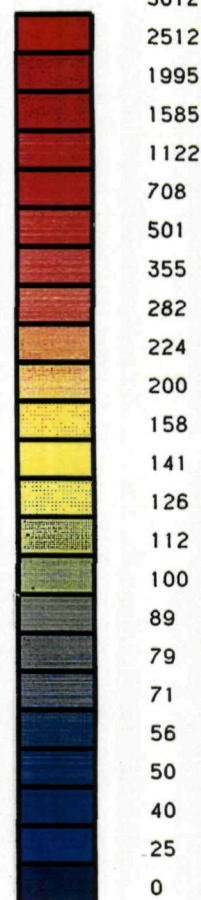
Contouring in ohm*m at logarithmic intervals.

Colours distributed on an equal area basis.

Sensor elevation 30m

Map contours are multiples of those listed below

- 0.1 log(ohm*m)
- 0.5 log(ohm*m)
- 2.5 log(ohm*m)



EM Anomalies

Conductivity Thickness (mos)

- 0 - 1
- 1 - 2
- ⊖ 2 - 4
- ⊙ 4 - 8
- 8 - 15
- 15 - 30
- > 30



EM Anomaly A, 4600 Hz inphase amplitude 7 ppm. Conductivity thickness 1-2 mos (see code).

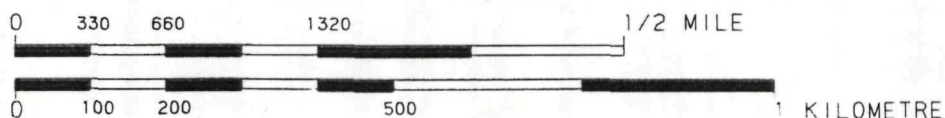
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APPARENT RESISTIVITY CONTOURS AND COLOURS

PELLY RIVER

YUKON TERRITORY

SCALE 1:10,000



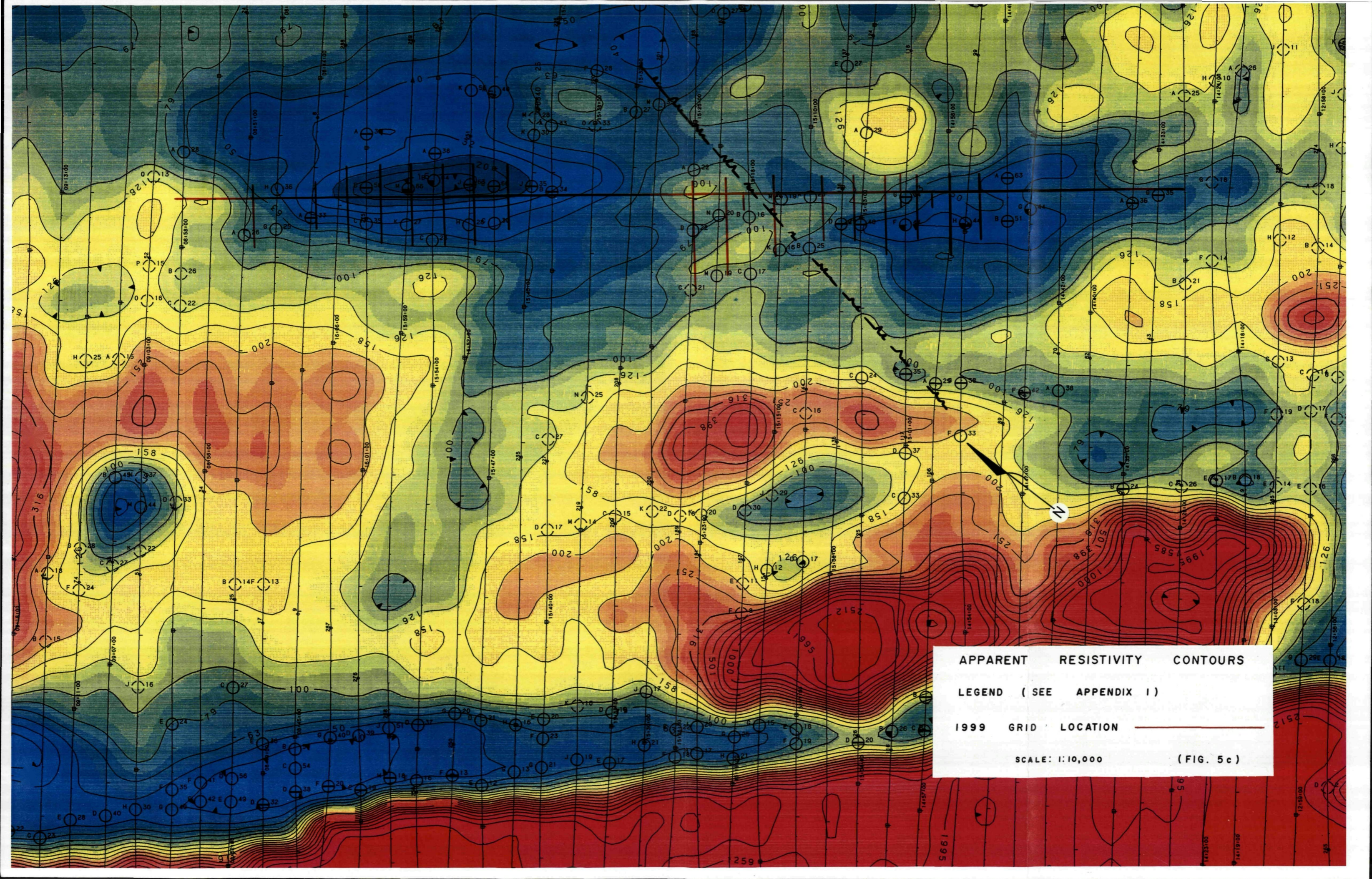
AERODAT LIMITED

DATE: MARCH/APRIL 1988

NTS No: 105 K/3

MAP No: 6

J8815-6



APPARENT RESISTIVITY CONTOURS
LEGEND (SEE APPENDIX I)
1999 GRID LOCATION
SCALE: 1:10,000 (FIG. 5c)

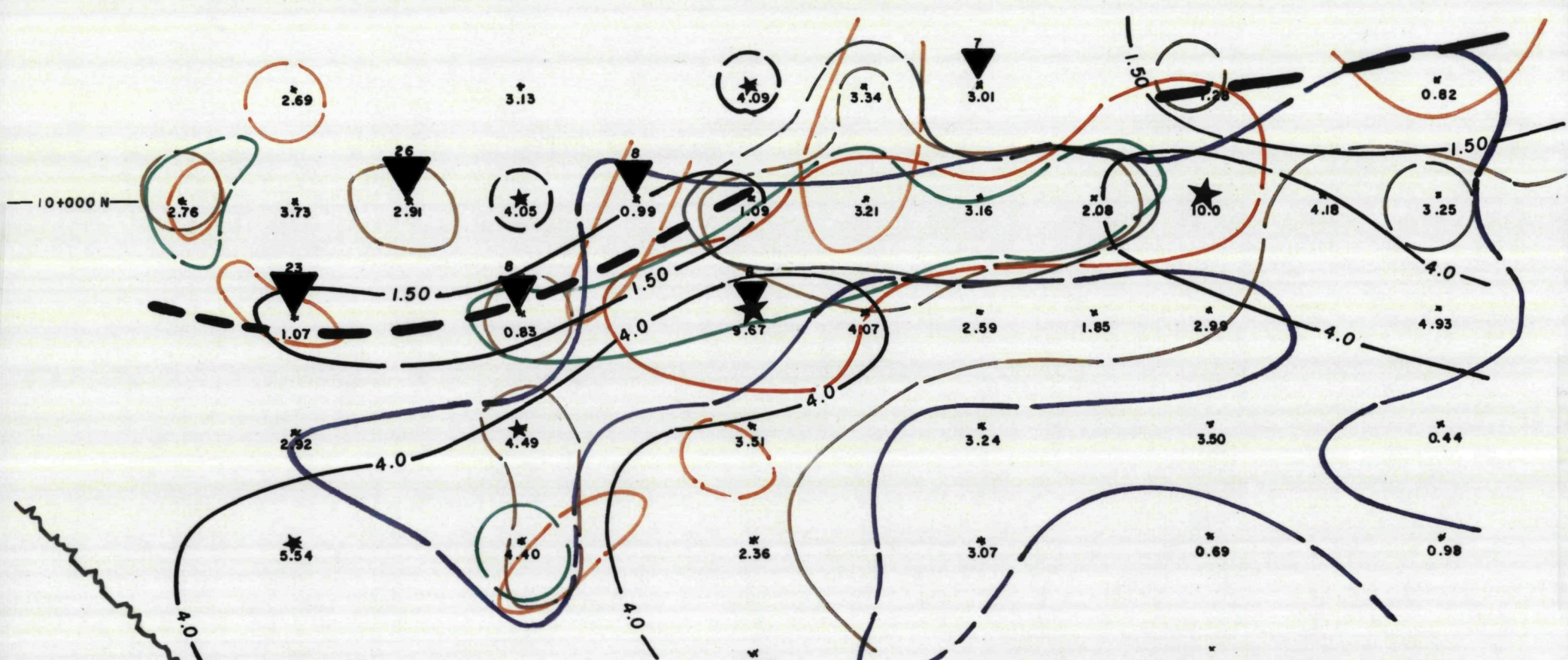
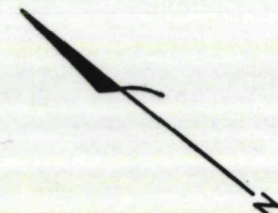
9600W

9400W

9200W

CONTOUR LEGEND

Ba — 600 ppm or >	Hg — 140 ppb or >
Cu — 34 ppm or >	Mn — 450 ppm or >
Fe — 2.4% or >	K — 0.1% or >



23 = Au soil in ppb

* REMAINING SITES ALL < 5 ppb

KM 410 EAST for TARGET Fig. 6 (DOZER ZONE)

SELECT CONTOUR OF KEY ELEMENTS
Ca VALUES IN %

LOCATION: 9400 W — 10+000 N

GENERAL TREND OF TROUGH
SCALE: 1:2500 FIG. 6

PEAK Ca % tiles ★ ★

APPENDIX I

ASSESSMENT OF AIRBORNE
GEOPHYSICAL FEATURES

Conductors XXIa and XXIb. These groups of mostly moderate quality conductors are located along the eastern sheet boundary. Group XXIa appears to be related to a well defined magnetic anomaly, or a unit. In contrast, group XXIb occurs in an area of virtually no magnetic activity. Short strike length and moderate quality of these conductors, as well as the termination by structural features and/or magnetic association of some conductors make them attractive exploration targets. Ground follow-up is recommended.

APPENDIX II

A New Theory and Ca

by

Barry W. Smee

A new theory to explain the formation of soil geochemical responses over deeply covered gold mineralization in arid environments

Barry W. Smee *

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Received 10 June 1997; accepted 4 December 1997

Abstract

Mineral exploration is extending into geologically prospective areas which are overlain by surficial cover. Geochemical techniques using chemical reagents or analytical procedures that selectively dissolve certain minerals or attack specific ion-binding sites in soil have been suggested to enhance the detection of buried mineral deposits. Few of these techniques have been tested one against the other in a controlled environment, and no mechanism of transporting elements through overburden cover has been proposed that explains observed patterns. A geochemical orientation survey over two buried epithermal Au deposits at Marigold, Nevada was completed during 1994–95 in an attempt to determine the effectiveness of various analytical extractions, and develop a theory to explain observed geochemical responses. Soil samples were subjected to a variety of chemical attacks and analyses, including aqua regia, hydroxylamine hydrochloride, sodium acetate, enzyme leach, water-soluble anions, pH, soil conductivity, and 'low detection limit' Au, As and Sb. Results from the enzyme leach method showed that Fe is being dissolved in addition to Mn. Enzyme leach- and water-soluble anions were correlated with soil conductivity. Calcium and its substitute, Sr, were correlated with soil-Au (total), as has been found in other desert environments, and these are the only elements which produced positive responses to mineralization even where mineralization was covered by 100 m of alluvial valley fill. Double-peak responses to mineralization occurred regardless of the chemical extraction used. The proposed element migration model suggests that H^+ released during the oxidation of sulphide mineralization travels directly to the surface, or may react with carbonate in wall rocks, producing CO_2 . The CO_2 , in turn, migrates to the surface over time. In either situation, a disequilibrium in pH-sensitive compounds or elements such as $CaCO_3$, Fe and Mn oxides occurs at the soil surface in places of accumulation of H^+ or CO_2 . This disequilibrium corrects itself over time by the migration of these compounds or elements away from the stimuli and towards the ambient pH condition. Precipitation of these pH-sensitive components occurs at the positions where chemical stability is re-established—at the margins of the stimuli—thus producing double-peak patterns over the buried mineralization.

The use of Ca and Sr in closely spaced soil samples in alkaline environments, together with the measurement of Au, As and Sb to low detection limits, is recommended as an exploration method for buried or blind epithermal Au deposits. © 1998 Elsevier Science B.V. All rights reserved.

Keywords: gold; arid; calcium; strontium; selective leach; soil; Marigold

* E-mail: bwsmee@islandnet.com

1. Introduction

Mineral exploration is extending into geologically prospective areas which are overlain by thick cover. Geochemical methods have been used successfully where this cover has been locally dislocated from its source, such as down-ice dispersal in areas of glaciated terrain. A far more challenging problem for the geochemist is to develop and test transport theories and near-surface sampling techniques for use in areas overlain by cover of exotic origin, i.e. where the surficial cover is not related to the underlying bedrock. In the past decade, several geochemical techniques have been introduced which may detect mineralization through exotic cover. The United States Geological Survey (USGS) and others have developed instrumentation to detect hydrocarbons, sulphur gases, CO₂ and O₂ in soil which could be related to underlying mineralization (Lovell et al., 1983; McCarthy et al., 1986). These soil gas methods have been used with success by the oil exploration industry for some time, but the relationship of soil gas components to sulphide or precious metal deposits has not been widely accepted by mineral explorationists.

The use of chemical reagents or procedures which selectively dissolve certain minerals or attack specific ion binding sites in soil has been employed for more than 20 years to enhance the geochemical response from mineralization (Bradshaw et al., 1974; Chao, 1984). These techniques attempt to separate ionically transported components from the total geochemical signal defined by a hot concentrated mixed acid attack. Recent applications of this simple concept include: a physical collection of the ionic component with an electric field (CHIM) (Goldberg et al., 1990; Leinz and Hoover, 1993); the use of chemical extractions for various soil absorption sites (the 'enzyme leach' for Mn oxide, hydroxylamine hydrochloride for Fe₂O₃, and acetic acid for carbonates) (Smee, 1983; Clark, 1993; Hall et al., 1996); and the use of vegetation as an overall natural ion collector (Brooks et al., 1995).

All of these selective extraction methods assume that some form of upward migration of ions must be taking place. Chemical components related to mineralization must travel from the bedrock-overburden interface to the surface, where they are immobilized

or change the surface chemistry in some detectable fashion. The causes suggested for upward migration are numerous, including: diffusion down a concentration gradient (Smee, 1983); capillary action or wicking from the water table to the dry surface; osmotic action carrying ionic species (Gray and Lintern, 1994); vegetation roots carrying elements to the surface portions of the plant, and then back to the soil; and electrical fields transporting ions through the soil by cation exchange (Govett, 1972; Bolviken and Logn, 1975). Most likely, a combination of mechanisms occurs, depending upon overburden type and depth, and the style of mineralization.

An orientation program, over two buried Au deposits in Nevada, was undertaken by the author in 1994 to begin to evaluate various geochemical sampling and analytical techniques under controlled and comparative conditions. The orientation survey consisted of soil, vegetation and soil gas sampling as well as self potential (SP) geophysical and CHIM surveys. The soil samples comprised mineral horizon, pedogenic carbonate, and lag which were analyzed using various chemical extractions. Members of the USGS undertook the CHIM, SP and soil gas surveys. This research was funded by a number of mineral exploration companies who had a twelve-month proprietary use of the resulting information. Data in this paper were first presented in Smee (1997) where a theory for the formation of surface geochemical patterns over Au mineralization in semi-arid environments was proposed. This communication presents additional evidence supporting that theory.

2. The study area

2.1. Selection

Many of the world's active Au exploration areas occur in arid to semi-arid environments. One of the most prolific Au-producing areas is the Basin and Range geological province in the western United States, and Nevada in particular, which contains volcanic- and sediment-hosted epithermal Au bodies of multi-million ounce size. Most of the deposits found to-date in Nevada have had some surficial indication of hydrothermal alteration of the host rock

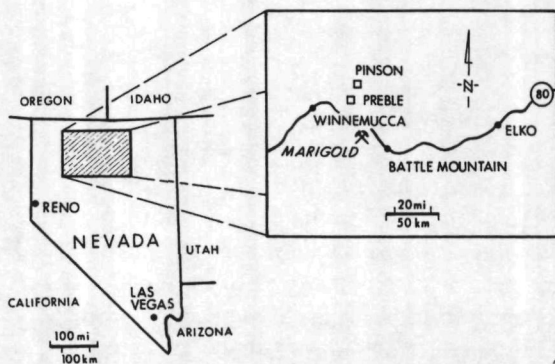


Fig. 1. Location map, Marigold Au deposits in western U.S.A.

or of Au mineralization directly. However, as the Ranges become thoroughly explored, the focus is shifting towards the alluvial-filled basins. A similar situation exists in Australia and the Middle East. Some type of reliable geochemical tool is needed to augment geological extrapolation and geophysical techniques in these areas covered by transported overburden. The search for an orientation target was therefore restricted to the alluvial-filled basins of Nevada.

Ideally, an orientation area for this study had to possess most of the following characteristics: the geology must be reasonably well known; the mineralogy of the buried mineralization must include sulphides, Au of a near economic grade and Au pathfinder elements such as As, Sb, Hg and Ba; the deposit must be at least partially oxidized; the pediment cover must comprise alluvial, fluvial or lacustrine material unrelated to the surrounding rocks; the depth of overburden cover must be between 15 and 120 m so as to form a valid but not impossible test; the present-day surface is undisturbed, or disturbance must be avoidable; and the three-dimensional extent of the mineralization must be outlined by drilling.

The two buried deposits near the Marigold Mine, operated by the Marigold Mining Company in northern Nevada, were eventually selected as the targets for this study.

2.2. Marigold mine area

2.2.1. Location, soil development and vegetation

The Marigold Mine area is located in Nevada, 30 km northwest of the town of Battle Mountain, and 4



Plate 1. Air photo of Marigold mine site showing locations of the 5 North and 8 North study areas, looking south.

km south of highway I-80 Valmy exit (Fig. 1). The 8 North and 5 North deposits lie beneath alluvial cover north and west of the Marigold 8 South pit. These mineralized zones do not outcrop, and are defined entirely by drilling (Plate 1). The Marigold deposits lie within the Basin and Range physiographic province of the northwestern United States, a region of generally north-trending mountain ranges separated by broad alluvial-filled valleys. The area is semi-arid with an annual rainfall of about 15 cm. Valley soils can best be described as aridsols. The tan-to-gray silt-to-sand matrix shows little horizon development, with the exception of a poorly developed pedogenic carbonate layer probably formed by evapotranspiration and deposition of Ca-rich compounds.

The valleys are sparsely vegetated. Mesquite, greasewood, bunchgrass, shadscale, and rarely, sagebrush, are the predominant vegetation types. Free-range cattle have harvested many of the grasses and shrubs.

2.2.2. Geological description

The geological description of the Marigold area is given in detail by Graney and McGibbon (1991) from which this summary is taken. Gold has been produced from the old Marigold Mine since the 1930s. A drill program was started by Cordex Exploration in 1986 on nearby mineralization, which led to the discovery of the 8 South, 8 North and 5 North mineral zones. The Marigold deposits, which line up approximately in a north-south direction, are hosted by clastic rocks of the Valmy and Antler sequences (Fig. 2). The Antler sequence of Permian age, host to the 8 North and 5 North deposits, is composed of coarse conglomerates and sandstone which grade upward into limey mudstone, shales, siltstone and sandstones. Mineralization is controlled by north-south-trending basin and range faulting and north-west-striking zones of fracturing.

The 8 North mineralized body is elongated in a north-south direction and is approximately 300 m by 170 m in dimension. Gold occurs with abundant

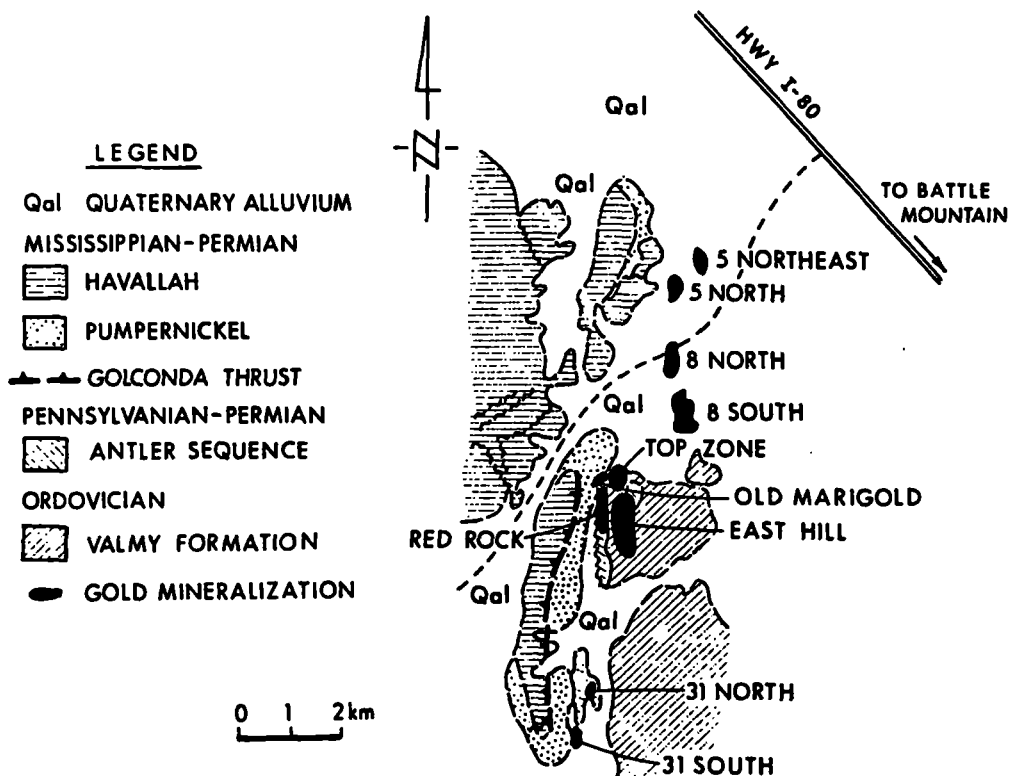


Fig. 2. Marigold Mine area, property geology and Au deposits (from Graney and McGibbon, 1991).

barite as well as As, Sb and Hg. The host clastic rocks are calcite-rich, with only minor silicification noticed in the drill cuttings. Overburden, consisting of alluvial and fluvial outwash of Tertiary age and interlayered lacustrine clay, covers the 8 North deposit to a depth of 100 m.

The 5 North zone is covered by between 20 m and 50 m of alluvium and is hosted by debris flows and siltstones, with minor limestone encountered in a few drill holes. The geochemical signature of 5 North includes As, Sb and Hg with the Au, but baritization is minor.

The deposits have been drilled on 30 m centres. Surficial disturbance is minimal on the 5 North deposit, but consists of rutted tire tracks and drill fluid run-off over portions of the 8 North deposit. Sample lines were positioned to avoid this disturbance. Abundant Fe-oxide staining in mineralized drill cuttings suggests that both deposits have undergone oxidation.

3. Methods

3.1. Soil sampling

Sample lines were chosen so as to overlie drill sections that showed subcropping mineralization of significant grade and minimal surface disturbance. Two east–west sample lines were oriented over each deposit: lines 1 and 2 over the 5 North, and lines 3 and 4 over the 8 North deposit. All sample spacings and distance measurements are in Imperial units so as to match the mine grid and geological maps. Fig. 3a and b show the position of mineralization relative to the sample stations on lines 1 and 2 over the 5 North deposit. The overburden is between 50 and 110 ft thick (ca. 15.5–33.5 m) over the mineralization on line 1. The orebody subcrops in the west, and then drops to the east where the majority of the economic grade is blind. Mineralization beneath line 2 subcrops beneath about 100 ft (30.5 m) of overburden, and then also drops to the east. Line 3 is positioned near the north end of the 8 North deposit, where the mineralization subcrops beneath about 300 ft (91.5 m) of overburden as shown in Fig. 3c. Line 4 was also positioned over subcropping mineralization with 280 to 300 ft (85.5–91.5 m) of cover (Fig.

3d). All lines over mineralization are 1900 ft (580 m) in length.

Sample lines were centred over the surface projection of the mineralization with 11 sample stations spaced 50 ft (15.2 m) apart over mineralization, 100 ft (30.5 m) apart for 300 ft (91.5 m) on either side of the 50-ft centres, and then 200 ft (61 m) apart for an additional 400 ft (122 m) on each side, for a total of 21 stations per line. The lines were tied into drill hole locations, and then chained between stations to ensure the accuracy of locations.

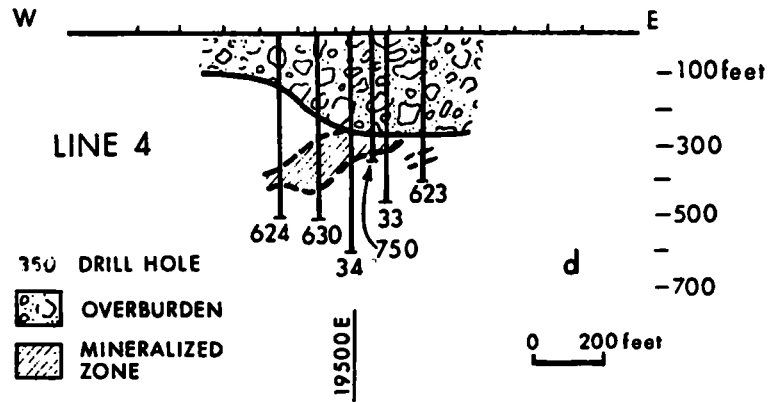
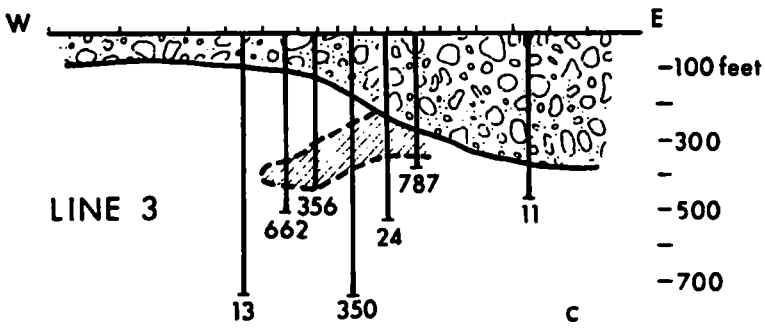
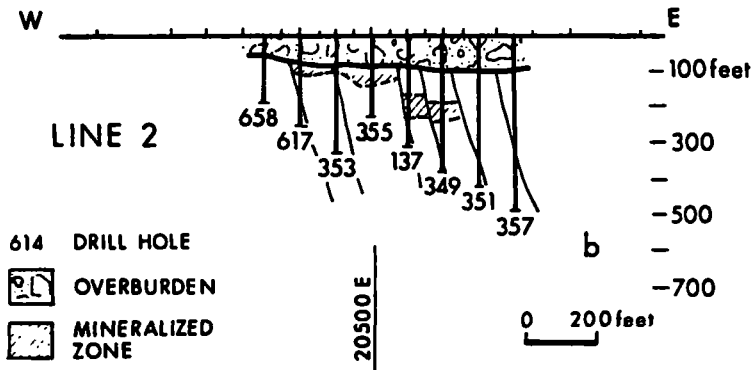
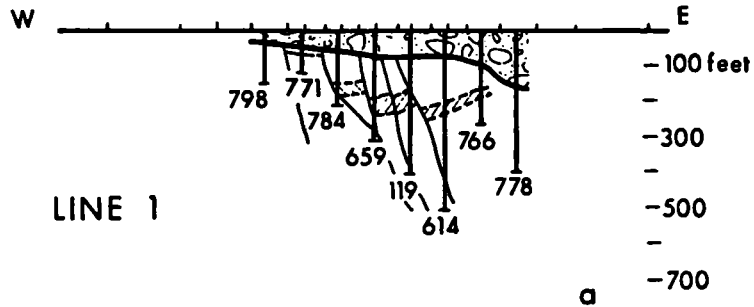
A pit was dug to a depth of approximately 60 cm at each sample site. A boulder layer was usually found below 50 cm, which prevented further hand sampling. A distinct colour and texture change was noticed at about 40 cm at most sites which usually coincided with a positive reaction to 10% HCl. This layer was thought to be the top of an immature pedogenic carbonate. Soil immediately above this layer was the medium selected for sampling. A woven olefin sandbag was filled with about 3 kg of material and allowed to dry in the air.



3.2. Analytical methods and quality control

A quality control program designed to estimate sampling and analytical errors and determine possible biases or shifts in background during analysis was implemented at the start of the sampling program. Twelve sites were selected at random at which duplicate soil samples were taken in the field. These field duplicates, together with the regular samples, generated a total of 96 samples for the survey. Prior to fieldwork, the samples were numbered sequentially from 1 to 96, and then randomized and merged with the line and station numbers. Once a sample was taken, the true position of the sample could not be determined without the sampling key.

Analysis of the mineral soils was performed at a number of commercial laboratories, each selected for their expertise or instrumentation. All mineral soils were hand screened to < 80 mesh (177 μm) and split into the required number of bags using a riffle splitter.

Different chemical attacks were tested in this study. A hot aqua regia extraction for the major and trace elements was used to produce a base concentration to which other extractions could be compared.



614 DRILL HOLE
 OVERBURDEN
 MINERALIZED ZONE



350 DRILL HOLE
 OVERBURDEN
 MINERALIZED ZONE

Table 1
Analytical methods used

Leach	Method
Total. Au	30-g fire assay, DIBK concentration, AAS to 1 ppb
Total or near-total. As, Sb	Aqua regia, hydride generation AAS to 0.1 ppm
AR (aqua regia)	ICP-ES
NaOAc/HOAc (sodium acetate)	ICP-ES for major elements and ICP-MS for selected trace elements ^a
HYDHCl (hydroxylamine hydrochloride)	ICP-ES for major elements and ICP-MS for selected trace elements ^a
Enzyme	Cations and anions by ICP-MS (Au not determined)
Water	Anions by ion chromatography (IC), Dionex

^a After Hall et al. (1996).

^b R. Leinz (pers. commun., 1994).

Soils in semi-arid desert environments are usually alkaline, with the near-surface acting as a depository for carbonates, sulphates and halides. The pedogenic carbonates, also known as caliche horizons, occur frequently in the Basin and Range Province. Therefore, a carbonate-specific extraction such as sodium acetate/acetic acid was used to establish the role of this important soil component in determining the phase distribution of elements over known mineralization. The enzyme leach method has been reported to be specific for the dissolution of amorphous manganese oxide and has been used in the alkaline semi-arid environments of Nevada (Clark, 1993). The active reagent in this chemical attack is hydrogen peroxide, which should react with iron and organic compounds in addition to manganese oxides. The alkaline pH characteristics of desert soils would be expected to inhibit the movement, redistribution, and adsorption of most cations onto stable Fe and Mn oxides. Both enzyme leach and hydroxylamine hydrochloride attacks were used to measure the amount of redistribution and element adsorption associated with Fe and Mn oxides in the desert environment.

Anions, particularly the halogens, have been reported to occur over, or adjacent to, Au mineralization when analyzed by the enzyme leach method (Clark, 1993). Results for anions released by the enzyme leach were compared to those by a water leach followed by an ion chromatographic (IC) detection method (using Dionex instrumentation) (Smee

et al., 1978). These, in turn, were compared to the soil conductivity, which would be expected to reflect the high salinization of desert soils. Soil paste pH measurements were obtained to determine the pH range of the desert soils, and the influence, if any, of the mineralization on surface soil pH. These methods are summarized in Table 1.

The quality control procedure examined possible shifts in analytical baseline first by plotting data in analytical order. Parameters which showed baseline shifts between analytical batches were not studied further. Field duplicate results reflect the sum of sampling, preparation and analytical errors. Table 2 shows the average percent differences between the twelve blind field duplicates for a number of parameters. The enzyme leach technique shows a difference of 10–52% for various elements considered to be of importance. The H₂O-soluble SO₄ by the IC method, and the fire assay Au (i.e. total Au) results show significant differences between duplicates, primarily because of the low concentrations in the soil. The aqua regia, sodium acetate and hydroxylamine hydrochloride extracted elements, determined by ICP-ES, have an average difference of less than 15%.

4. Results

4.1. Anions in mineral soil

Results for anions determined by both the enzyme leach method and water extraction have been re-

Fig. 3. Geological sections corresponding to soil sample lines, showing overburden thickness and mineralized zones: (a) 5 North deposit, sample line 1; (b) 5 North deposit, sample line 2; (c) 8 North deposit, sample line 3; (d) 8 North deposit, sample line 4.

Table 2
Average % differences between field duplicates (n = 12 duplicates) for selected parameters

Parameter	% difference	Parameter	% difference
Conductivity	23	Au (total)	58
Enz-Br	25	AR-Ca	13
Enz-Sb	11	NaOAc-Ca	12
Enz-As	52	HYDHCl-Ca	14
Enz-Sr	19	As (aqua regia)	11
Enz-Fe	20	AR-Sr	8
IC-SO ₄	33	NaOAc-Sr	6

Enz = enzyme leach; AR = aqua regia leach; HYDHCl = hydroxylamine hydrochloride leach; NaOAc = sodium acetate/acetic acid leach.

ported in Smee (1997). No single anion by either analytical method showed a consistent or interpretable response over the two deposits. However, the positive correlation between Cl⁻ determined by both methods and water soluble-SO₄²⁻ suggests that some of the soil samples are accumulating all anions, rather than one specific anion. This interpretation is supported by the positive correlation between all the major anions and soil conductivity. Profile plots for SO₄²⁻, conductivity and enzyme leach-Br (Fig. 4a, b) illustrate the similarity in responses over the 5 North deposit. It appears that a simple soil conductivity measurement could replace either the enzyme leach or water soluble anion analysis.

4.2. pH and conductivity in mineral soil

The measurement of pH is perhaps the most important variable a geochemist can use when attempting to understand the processes that control the distribution of cations in soil. H⁺ is extremely reactive and can mobilize other cations, such as Fe, Mn, Ca and Mg, which are highly sensitive to changes in pH. It is known that both the 5 North and 8 North bodies are oxidized, and would have released H⁺ to the surrounding environment during the breakdown of sulphides. H⁺ diffuses through the cover up to 10,000 times faster than many other cations (Farr et al., 1970). It is therefore prudent to measure H⁺ concentration in each sample.

The measurement of soil conductivity gives an indirect indication of the concentration of soluble anions and cations. A spatial relationship between

H⁺ and conductivity may occur where ions have been mobilized and reprecipitated in response to a change in pH (Govett and Chork, 1977; Smee, 1983).

The pH range in the B-horizon soils is 7.7 to 9.6, almost a 100-fold difference in H⁺ concentration. This large spread is surprising in that the surface soils appear to be highly alkaline and should be well buffered. The only explanation for this wide range of H⁺ concentration on a featureless gravel-covered pediment is an introduction of hydrogen from the substrate below the soil horizon. Although the H⁺ concentration range is large, no clear pattern related to mineralization exists on all lines. Similarly, soil conductivity is not a useful tool by itself, although clear responses above mineralization are seen on line 3. These profiles are not shown here because predictable and interpretable patterns on each line were not present.

4.3. Aqua regia, acetic acid / sodium acetate, hydroxylamine hydrochloride and enzyme leach extractions in mineral soil

Correlation coefficients between elements that had adequate analytical detection limits for the majority of sample sites were calculated and are shown in Table 3. The soil leaches—*aqua regia* (AR), acetic acid/sodium acetate (NaOAc) for carbonate-bound elements, and hydroxylamine hydrochloride (HYDHCl) for Fe- and Mn-bound elements—are listed as attacks 1, 2 and 3, respectively. Gold (total) displays a strong correlation with As, Sb, and Ba, which indicates that the mineralizing elements are responding together in the soils. Gold is also significantly correlated with Ca and Sr in all extractions, as is AR-Ba. *Aqua regia* does not dissolve barite, and therefore the Ba found in these soils must be in another form. These correlations are strong evidence that Ca plays a role in controlling the distribution of Au, As, Sb and Ba in the near-surface environment.

The concept that Fe and Mn oxides in soil are acting only as a scavenging substrate is simplistic. Smee (1983) showed that where overburden is thick or of foreign provenance, such as in areas overlain by glaciolacustrine sediment, direct indicators of base-metal mineralization such as Cu or Zn did not reach the surface. However, Fe and Mn did show redistribution in the soil in response to underlying

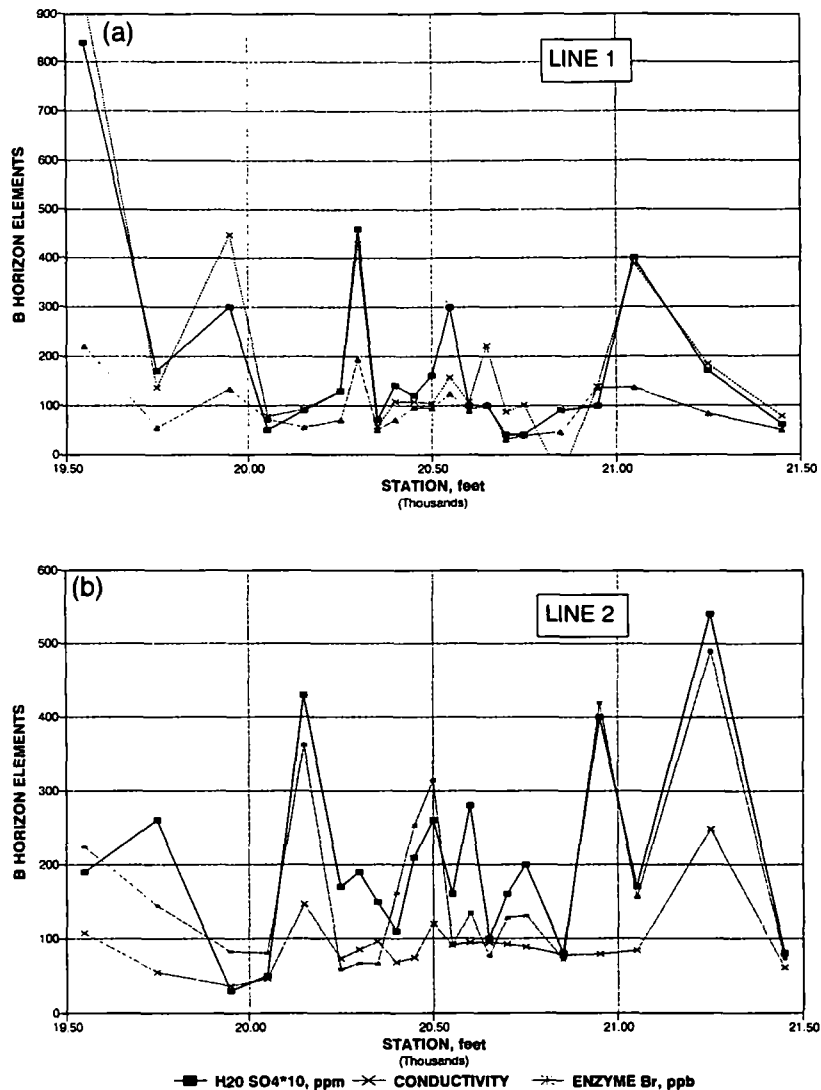


Fig. 4. Comparison of water-soluble SO_4^{2-} , soil conductivity, and enzyme leach Br on lines 1 (a) and 2 (b) over the 5 North deposit.

mineralization, but only when the selective-extraction soluble Fe or Mn was ratioed against the total. The pH-sensitive elements such as Fe, Mn, Ca, and Mg can be direct indicators of buried mineralization, depending on the soil pH-Eh conditions. In this study, a negative correlation exists between all types of extractions of Ca (positively correlated with Au) and, specifically, the HYDHCl-Rb. The HYDHCl-Rb is, in turn, positively correlated with HYDHCl-Fe. Therefore an argument can be made that a selective extraction for Fe and Mn in arid or alkaline

environments could actually suppress responses from Au mineralization, and selectively eliminate the anomalous areas.

Gold and As over the 5 North deposit (Fig. 5a, c) show weak positive responses over mineralization, with Au on line 1 reaching a peak value of 8 ppb, and on line 2, 26 ppb. Arsenic reaches 21 ppm on line 2, but does not respond to mineralization on line 1. Lines 3 and 4 over the 8 North deposit do not show any responses in the mineralizing elements (Fig. 5b, d).

Table 3
Aqua regia, sodium acetate, and hydroxylamine hydrochloride leach correlations

	Au	As	Sb	H ⁺	COND	Ca1	Ca2	Ca3	Fe1	Fe3	Mn1	Mn2	Sr1	Sr2	Sr3	Rb1	Rb2	Rb3	Ba1	Ba2
As	0.61																			
Sb	0.62	0.63																		
H ⁺	0.03	0.04	0.00																	
COND	0.13	0.29	0.26	-0.47																
Ca1	0.55	0.32	0.43	-0.15	0.37															
Ca2	0.54	0.32	0.44	-0.16	0.38	1.00														
Ca3	0.56	0.33	0.44	-0.15	0.36	1.00	1.00													
Fe1	0.43	0.37	0.64	0.14	0.00	0.25	0.26	0.25												
Fe3	0.18	0.25	0.25	0.23	-0.25	-0.37	-0.38	-0.36	0.35											
Mn1	0.05	0.09	0.04	0.23	-0.21	-0.05	-0.09	-0.05	0.05	0.36										
Mn3	0.05	0.14	0.03	0.19	-0.16	-0.07	-0.10	-0.06	-0.08	0.37	0.97									
Sr1	0.57	0.30	0.45	-0.12	0.35	0.94	0.95	0.94	0.38	-0.28	-0.15	-0.19								
Sr2	0.52	0.32	0.46	-0.15	0.41	0.95	0.96	0.95	0.36	-0.32	-0.18	-0.21	0.98							
Sr3	0.56	0.34	0.46	-0.13	0.37	0.95	0.96	0.95	0.37	-0.28	-0.15	-0.17	0.99	0.99						
Rb1	-0.13	-0.21	0.06	0.08	-0.17	-0.13	-0.12	-0.14	0.35	0.10	-0.24	-0.34	0.00	-0.02	-0.02	0.14				
Rb2	-0.03	-0.17	-0.09	0.15	-0.28	-0.02	-0.02	-0.03	0.12	-0.20	0.03	-0.03	-0.02	-0.02	-0.02	0.14				
Rb3	-0.33	-0.26	-0.23	0.16	-0.50	-0.59	-0.59	-0.58	0.04	0.50	0.34	0.30	-0.59	-0.62	-0.59	0.20	0.12			
Ba1	0.66	0.72	0.58	0.02	0.27	0.51	0.51	0.52	0.38	0.23	0.22	0.25	0.52	0.53	0.55	-0.18	-0.17	-0.31		
Ba2	0.52	0.64	0.51	-0.05	0.34	0.46	0.47	0.47	0.38	0.14	0.11	0.14	0.48	0.52	0.52	-0.16	-0.15	-0.36	0.95	
Ba3	0.59	0.68	0.52	0.00	0.26	0.45	0.45	0.47	0.35	0.24	0.25	0.29	0.46	0.48	0.50	-0.21	-0.15	-0.28	0.98	0.97

1 = aqua regia.

2 = sodium acetate/acetic acid.

3 = hydroxylamine hydrochloride.

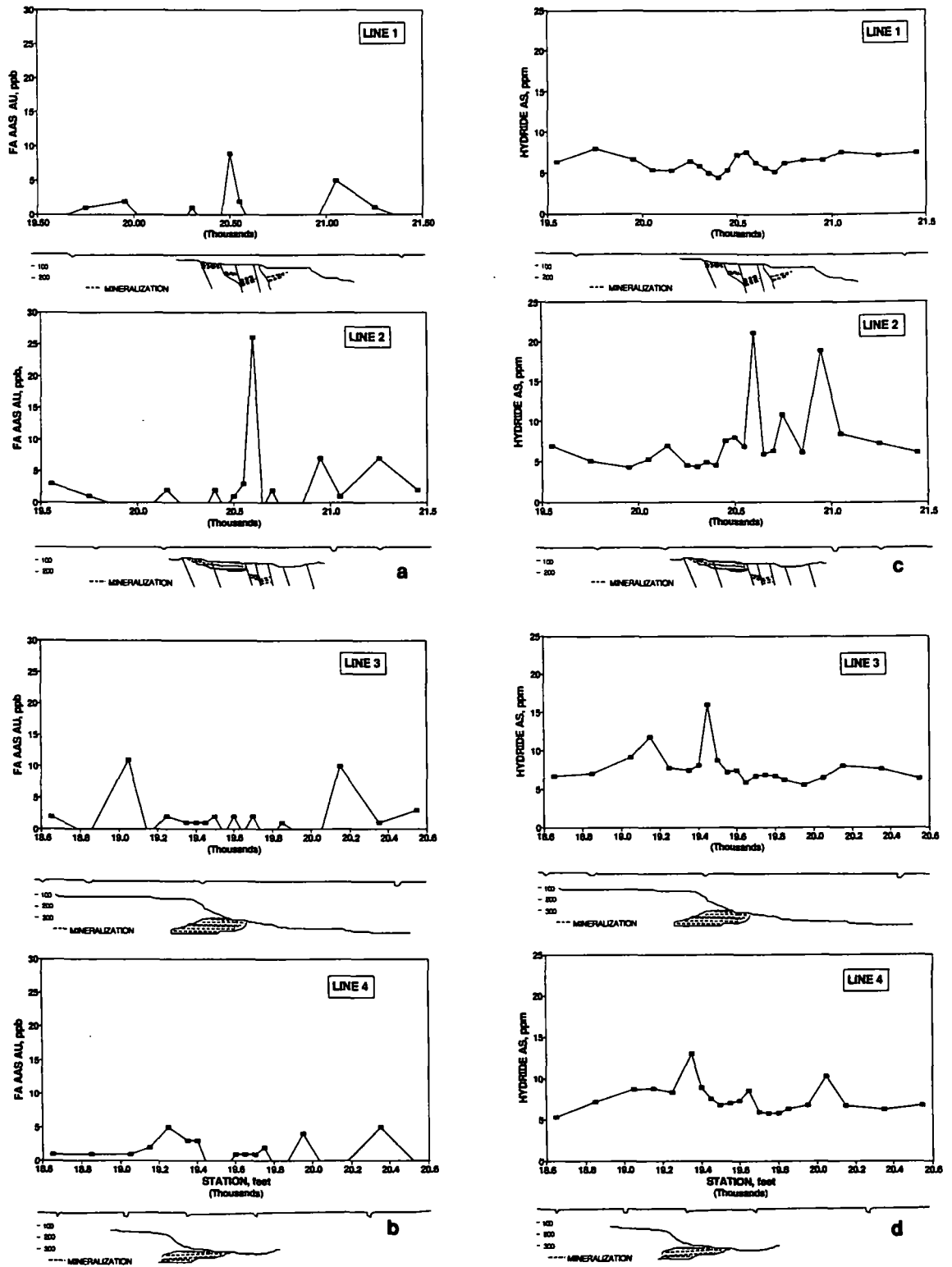


Fig. 5. Au and As profiles over lines 1 to 4: (a) 5 North deposit, Au; (b) 8 North deposit, Au; (c) 5 North deposit, As; (d) 8 North deposit, As.

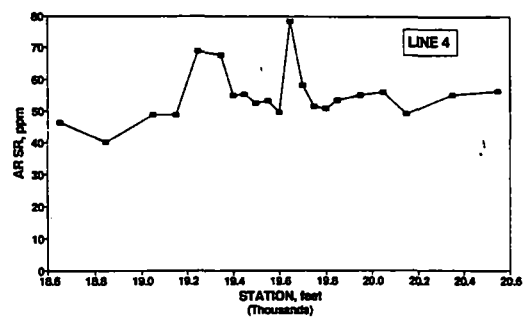
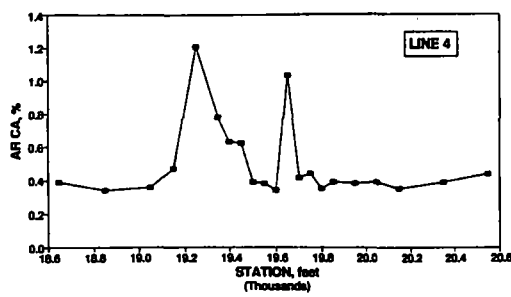
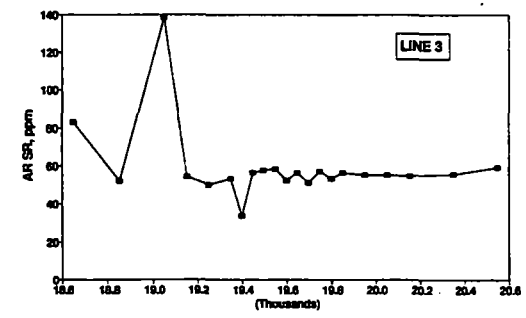
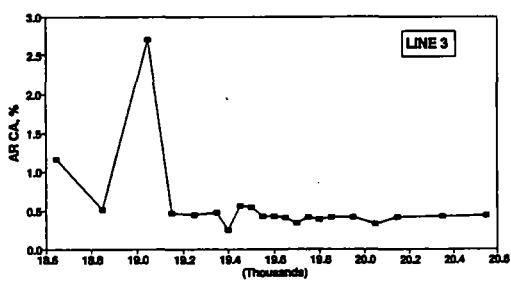
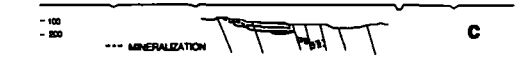
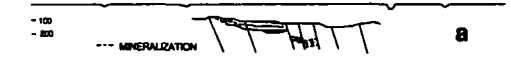
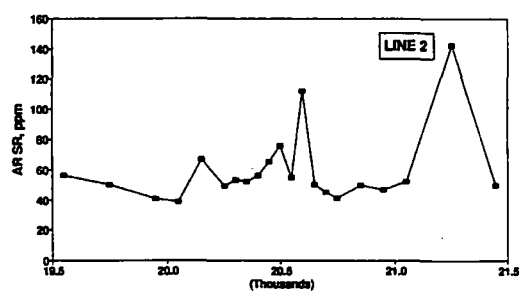
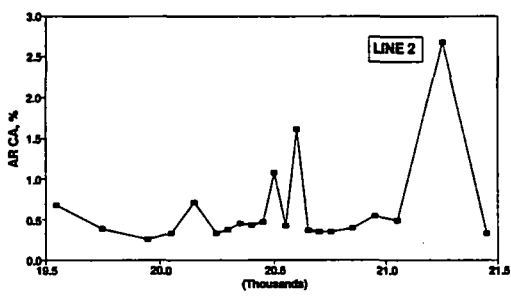
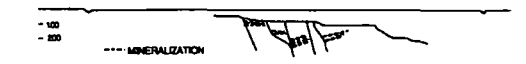
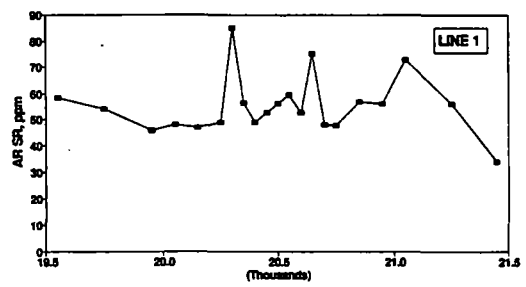
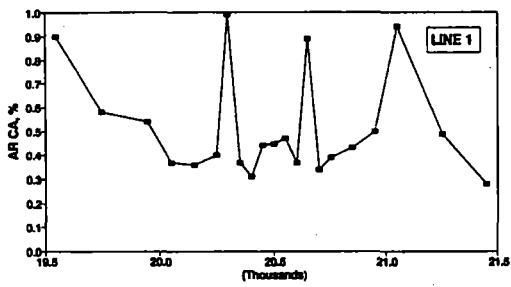


Fig. 6. Aqua regia (AR) soluble Ca and Sr over lines 1 to 4: (a) 5 North deposit, Ca; (b) 8 North deposit, Ca; (c) 5 North deposit, Sr; (d) 8 North deposit, Sr.

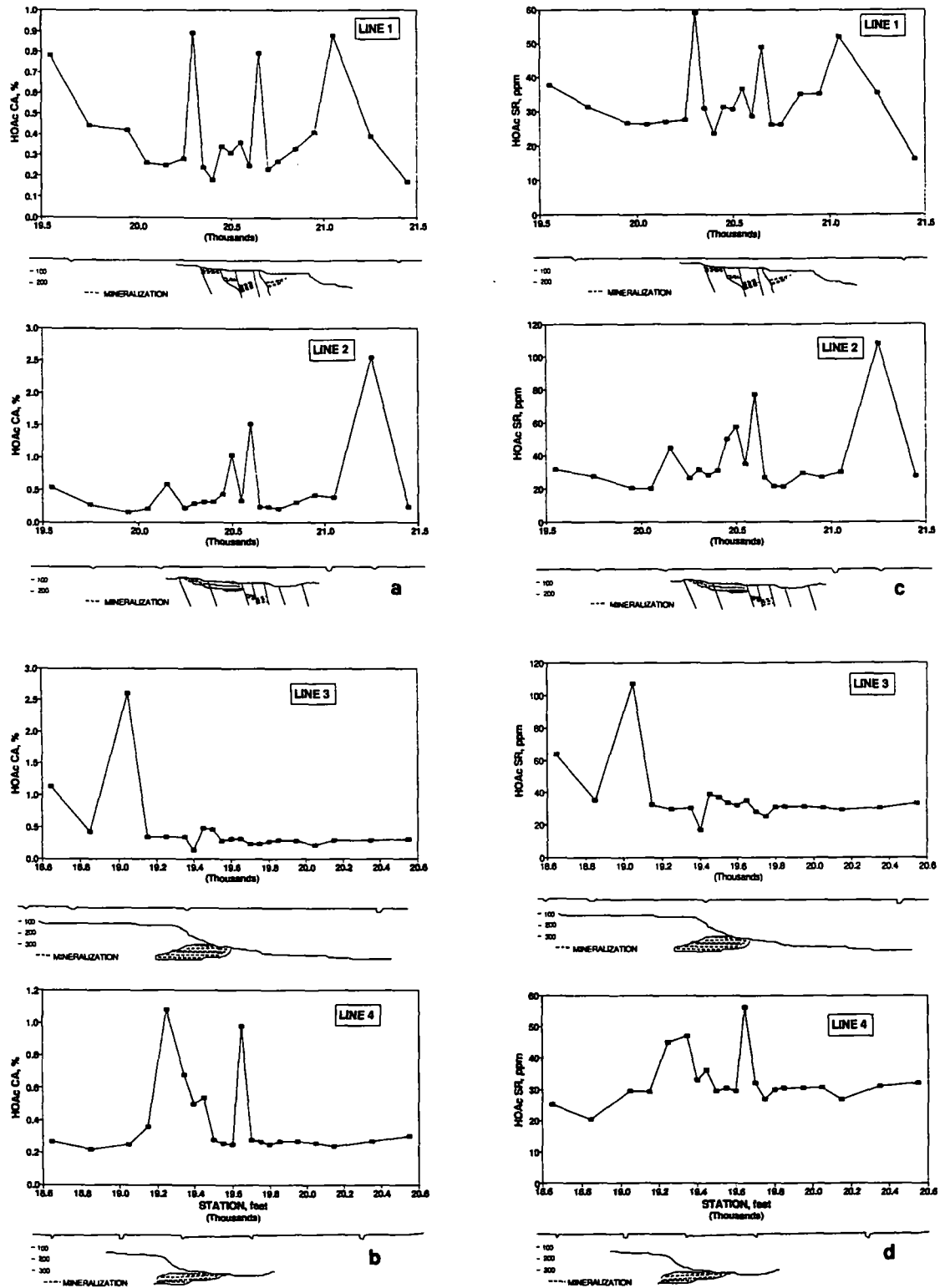
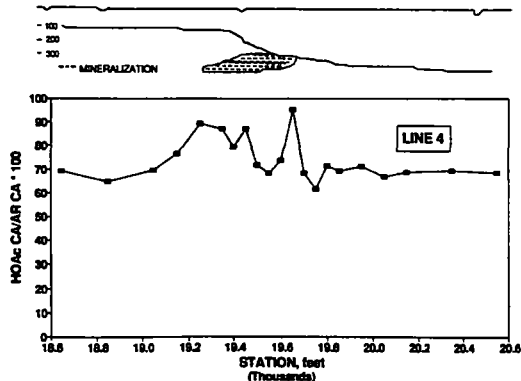
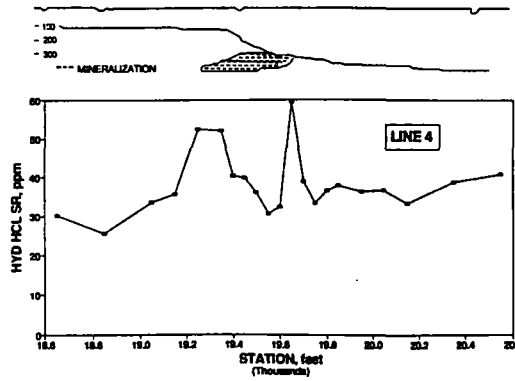
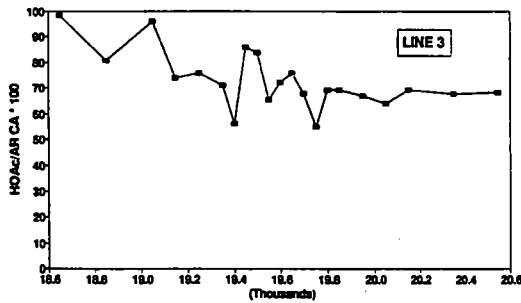
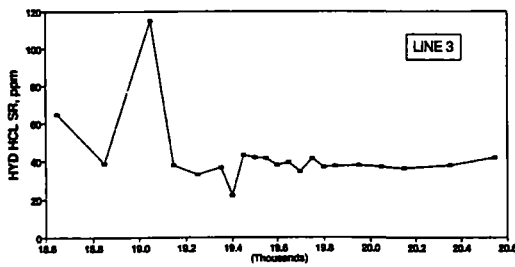
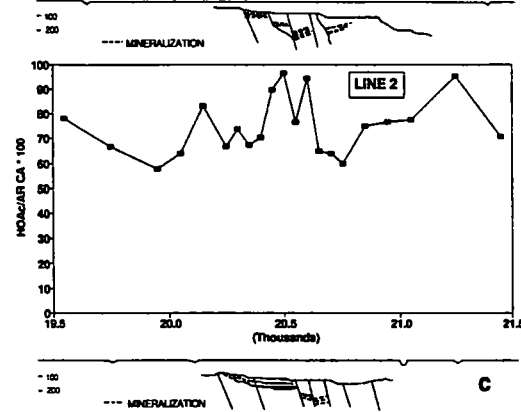
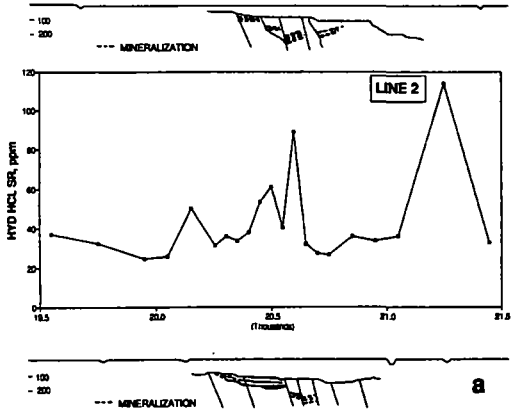
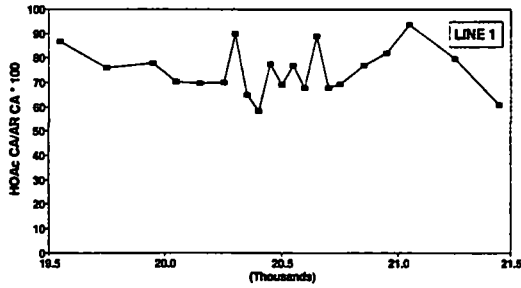
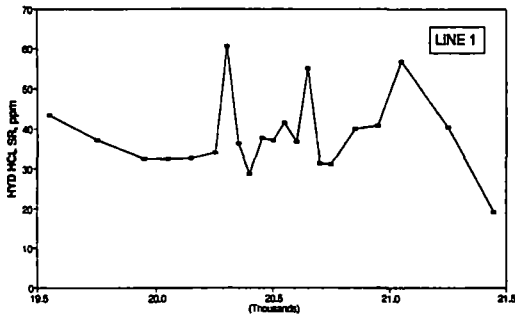


Fig. 7. Sodium acetate/acetic acid (NaOAc/HOAc) soluble Ca and Sr over lines 1 to 4: (a) 5 North deposit, Ca; (b) 8 North deposit, Ca; (c) 5 North deposit, Sr; (d) 8 North deposit, Sr.



The elements which produce a consistent response to mineralization over both deposits, regardless of chemical extraction used, are Ca and its substitute, Sr. AR–Ca on all but line 3 (Fig. 6a, b) shows a clear double-peak response over or on the margins of mineralization. Similar patterns are produced by Sr (Fig. 6c, d). HOAc–Ca and -Sr (Fig. 7a, d) produce identical patterns, as does HYDHCl–Sr (Fig. 8a, b). The ratios of the weak extraction HOAc–Ca to AR–Ca show positive residuals above the mineralization on all lines, regardless of depth of burial, which indicates that 'extra' Ca has been mobilized into these areas (Fig. 8c, d).

Enzyme leach is claimed to be specific for dissolving amorphous Mn oxide and to be self-limiting so that other compounds will not go into solution over time (Clark, 1993). These claims were to be tested in this study, as it is difficult to understand how a chemical attack, which produces weak H_2O_2 , could dissolve Mn compounds and not Fe compounds. The ranges of Mn and Fe concentrations reported by the enzyme leach are shown in Table 4. The maximum Fe concentration ranges between 18 and 40 times higher than the maximum Mn concentration on any one line. The ratio of the maximum to minimum concentrations, an indicator of the homogeneity of the element distribution, is 4 to 6 times greater for Fe than for Mn. These data suggest that the enzyme leach technique dissolves sesquioxides, with the overwhelming influence being Fe. The significant range of concentrations also suggests that a normalizing method incorporating both Fe and Mn concentrations should be considered before attempting to interpret enzyme leach data.

Interelement correlations for the enzyme leach data were calculated for each of the deposits prior to plotting of profiles. Tables 5 and 6 present these correlations for selected enzyme leach elements plus H^+ and soil conductivity for 5 North and 8 North, respectively. These data show that Fe is controlling the distribution of Ti, Ni, Cu, Zn, Rb, Zr and Pb. Enzyme leach Mn is positively correlated with H^+ , Ni, As and Mo on the 5 North area, and with V, Co and Ni on 8 North. H^+ appears play a role in the

Table 4

Comparison of minimum and maximum concentrations of Mn and Fe dissolved by the enzyme leach (values in ppb)

Line	Mn			Fe		
	min	max	max/min	min	max	max/min
1	391	5420	13.9	1919	101665	52.9
2	446	3623	8.1	2092	79572	38.0
3	260	2622	10.1	2198	106818	48.6
4	317	3922	12.4	1322	101517	76.8

availability of Mn and Fe, which may indicate that the enzyme leach analysis is sensitive to conditions where the pH may change, such as breaks in slope, seepages, changing groundwater conditions, and rock type differences as well as from oxidizing sulphide mineralization.

Profile plots for the enzyme leach elements directly related to mineralization, As and Sb, do not show a response to mineralization on any line, and nor do Fe and its correlated elements Cu, Pb, Zn and Ni. The enzyme leach method does not report Ca, and therefore the possible redistribution of this pH-sensitive element in response to a changing H^+ concentration cannot be observed. However, Sr frequently substitutes for Ca and can be used as an indicator of Ca distribution. Enzyme leach–Sr is strongly negatively correlated with the Fe-related enzyme leach elements; therefore, a ratio of Sr to one of these elements may give some indication of locations where Ca has been mobilized by changing surface conditions.

The Sr, Rb and Sr/Rb ratio profiles are shown in Fig. 9. Line 1 shows what may be a regional enzyme leach–Sr depletion as the 5 North mineralization is approached. Over the mineralization, several single-station increases in Sr concentration occur. The ratio of Sr/Rb in Fig. 9c clearly shows sharp peaks over mineralization on lines 1 and 2. Line 3 is located over the north end of the deeply buried 8 North deposit. A small increase in Sr occurs to the east of the mineralization, and a sharp depletion to the west of the body (Fig. 9b). An elevated response occurs at the west end of the line. The ratio Sr/Rb reveals a

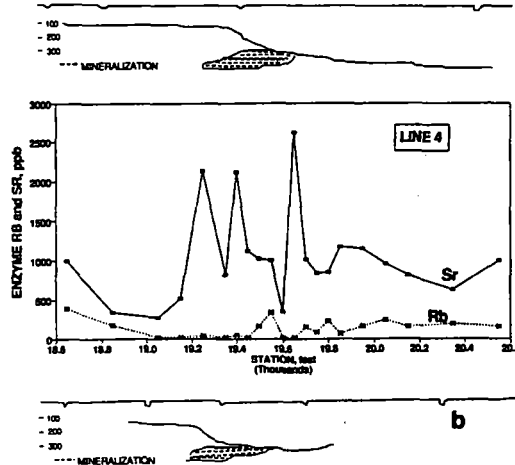
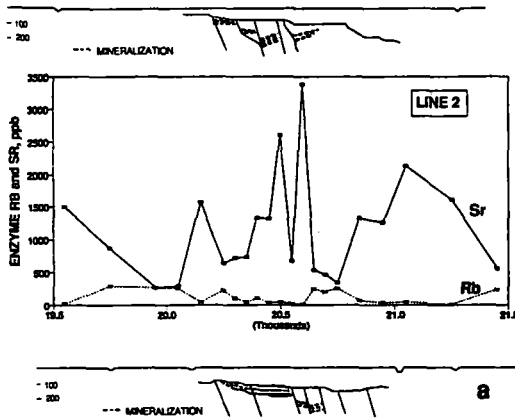
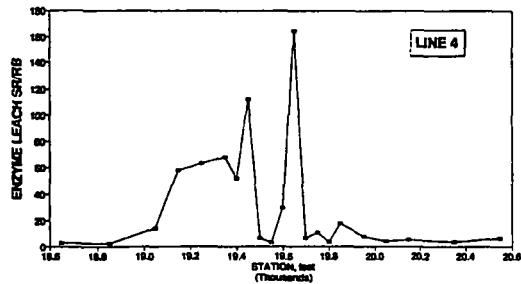
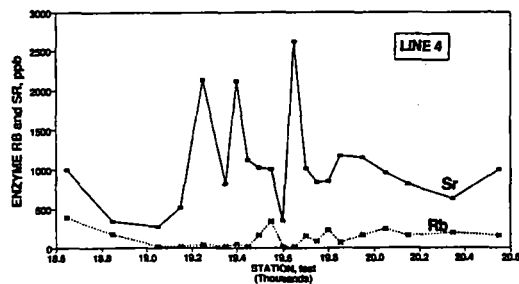
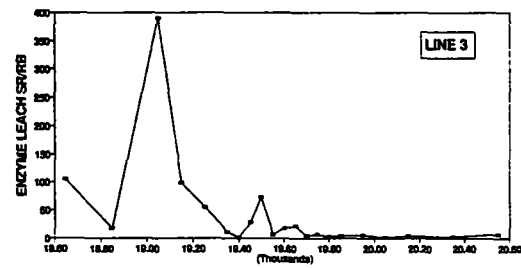
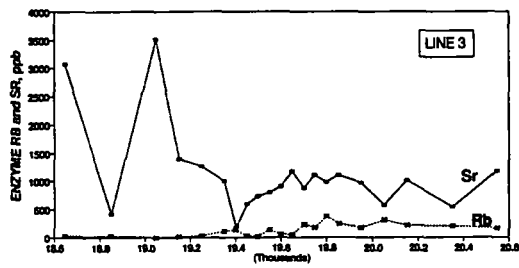
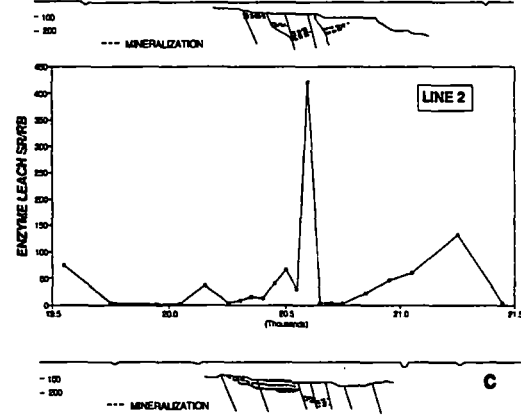
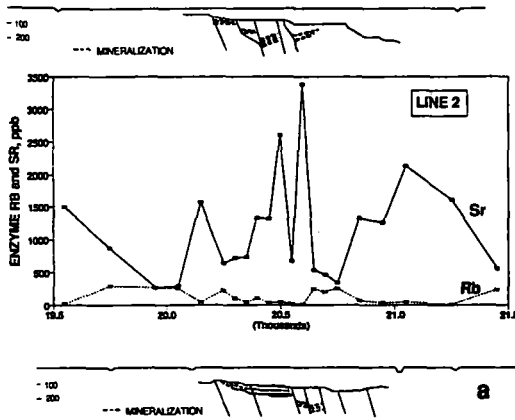
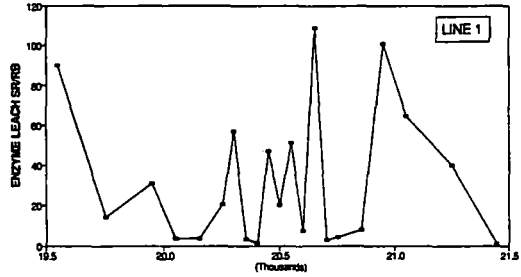
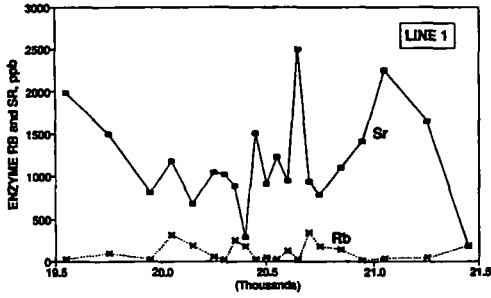
Fig. 8. Hydroxylamine hydrochloride (HYDHCl) soluble Sr, and ratio of NaOAc/HOAc-soluble Ca/AR-soluble Ca over lines 1 to 4: (a) 5 North deposit, HYDHCl–Sr; (b) 8 North deposit, HYDHCl–Sr; (c) 5 North deposit, HOAc/AR–Ca; (d) 8 North deposit, HOAc/AR–Ca.

Table 5
Enzyme leach correlations, S North deposit

	H ⁺	COND	Cl	Ti	V	Mn	Co	Ni	Cu	Zn	As	Br	Rb	Sr	Zr	Mo	Sb	Bi	Ba	Pb	B	
COND	-0.31																					
Cl	-0.11	0.68																				
Ti	0.22	-0.17	-0.18																			
V	0.37	0.08	-0.02	0.56																		
Mn	0.54	-0.22	-0.06	0.09	0.42																	
Co	0.44	0.01	0.00	0.62	0.81	0.70																
Ni	0.36	0.14	0.04	0.73	0.83	0.48	0.91															
Cu	0.17	0.41	0.15	0.74	0.71	0.14	0.71	0.85														
Zn	0.21	-0.20	-0.20	0.99	0.56	0.12	0.63	0.73	0.73													
As	0.41	0.09	0.02	0.02	0.54	0.67	0.56	0.46	0.32	0.05												
Br	0.00	0.86	0.83	-0.03	0.25	0.02	0.25	0.34	0.50	-0.06	0.22											
Rb	0.20	-0.24	-0.23	0.99	0.52	0.09	0.59	0.70	0.68	0.99	0.00	-0.10										
Sr	0.06	0.21	0.26	-0.56	0.03	0.09	-0.16	-0.19	-0.26	-0.59	0.19	0.22	-0.58									
Zr	0.19	-0.16	-0.20	0.99	0.55	0.07	0.61	0.74	0.74	0.99	0.02	-0.03	0.99	-0.58								
Mo	0.32	0.33	0.27	0.05	0.36	0.61	0.57	0.50	0.43	0.07	0.68	0.52	0.01	-0.06	0.05							
Sb	0.09	0.07	-0.04	-0.07	0.54	0.22	0.36	0.26	0.14	-0.08	0.25	0.07	-0.08	0.30	-0.07	0.11						
I	0.36	0.40	0.26	-0.22	0.41	0.41	0.37	0.29	0.24	-0.22	0.69	0.49	-0.27	0.42	-0.22	0.60	0.36					
Ba	0.10	0.42	0.26	0.31	0.75	0.20	0.59	0.66	0.69	0.29	0.34	0.53	0.25	0.19	0.30	0.32	0.52	0.41				
Pb	0.26	-0.19	-0.20	0.99	0.57	0.16	0.65	0.75	0.75	0.99	0.09	-0.03	0.98	-0.58	0.98	0.11	-0.06	-0.18	0.32			
B	-0.19	0.59	0.23	-0.01	0.16	-0.18	0.05	0.17	0.34	-0.05	0.09	0.46	-0.03	0.09	0.01	0.19	0.19	0.26	0.29	-0.03		
Fe	0.22	-0.19	-0.21	1.00	0.54	0.09	0.61	0.72	0.73	0.99	0.02	-0.05	0.99	-0.60	0.99	0.05	-0.09	-0.23	0.29	0.99	-0.02	

Table 6
Enzyme leach correlations, 8 North deposit

	H ⁺	COND	Cl	Ti	V	Mn	Co	Ni	Cu	Zn	As	Br	Rb	Sr	Zr	Mo	Sb	Bi	Ba	Pb	B
COND	-0.62																				
Cl	-0.38	0.71																			
Ti	0.51	-0.51	-0.33																		
V	0.50	-0.41	-0.29	0.81																	
Mn	0.47	-0.47	-0.30	0.45	0.58																
Co	0.46	-0.36	-0.21	0.76	0.79	0.80															
Ni	0.45	-0.38	-0.23	0.84	0.85	0.68	0.94														
Cu	0.39	-0.34	-0.17	0.94	0.87	0.43	0.80	0.89													
Zn	0.55	-0.52	-0.32	0.99	0.83	0.49	0.79	0.86	0.94												
As	0.16	0.00	0.09	0.36	0.60	0.48	0.53	0.51	0.49	0.39											
Br	-0.32	0.64	0.80	-0.54	-0.35	-0.32	-0.31	-0.33	-0.35	-0.52	0.13										
Rb	0.54	-0.52	-0.35	0.99	0.81	0.50	0.79	0.85	0.92	0.99	0.37	-0.56									
Sr	0.05	-0.22	-0.15	-0.27	-0.22	-0.01	-0.21	-0.22	-0.28	-0.27	-0.10	0.09	-0.26								
Zr	0.49	-0.49	-0.33	0.99	0.82	0.45	0.78	0.85	0.95	0.99	0.35	-0.55	0.99	-0.29							
Mo	-0.26	0.56	0.53	-0.37	-0.07	0.20	0.13	0.01	-0.16	-0.33	0.24	0.24	-0.25	-0.34							
Sb	0.08	-0.15	-0.13	0.14	0.28	0.34	0.45	0.41	0.20	0.15	0.21	-0.03	0.19	0.04	0.15	0.11					
I	-0.10	0.50	0.60	-0.46	-0.14	-0.17	-0.24	-0.26	-0.28	-0.43	0.16	0.16	0.76	-0.46	0.16	-0.45	0.55	-0.01			
Ba	-0.02	0.10	0.13	0.09	0.11	-0.05	0.15	0.13	0.17	0.08	0.07	0.17	0.08	0.12	0.09	0.10	0.24	0.05			
Pb	0.52	-0.50	-0.31	0.99	0.81	0.49	0.79	0.86	0.95	0.99	0.39	-0.53	0.99	-0.29	0.99	-0.32	0.17	-0.45	0.08		
B	-0.28	0.53	0.44	-0.30	-0.07	-0.33	-0.29	-0.28	-0.18	-0.30	0.07	0.42	-0.29	0.02	-0.29	0.32	-0.01	0.43	-0.02	-0.30	
Fe	0.53	-0.50	-0.32	1.00	0.81	0.47	0.78	0.85	0.93	0.99	0.36	-0.54	1.00	-0.28	0.99	-0.35	0.16	-0.45	0.07	0.99	-0.31



weak peak over the ore zone, which is dwarfed by the response on the west end of the line (Fig. 9d). However, line 4, located over the central portion of the mineralization, shows strong multi-peak Sr increases near the margins of the ore zone. The ratio clearly shows the location of the buried mineralization, with rabbit-ear anomalies over the margins, and the subcropping mineralization located in the trough between the peaks. No other elements produced consistent responses to mineralization using the enzyme leach technique.

5. Discussion

The results from the Marigold orientation suggest that a transport mechanism is influencing the distribution of Ca and, in turn, Sr over mineralization. This mechanism probably involves several steps, and affects nearly all elements to some degree. In addition, Au forms a detectable anomaly and appears to be influenced by Ca over the 5 North deposit, but not over the 8 North deposit. The former is overlain by about 100 ft (30.5 m) of alluvium and the latter by over 300 ft (91.5 m). The typical response to mineralization appears to be double-peak or rabbit-ear-shaped anomalies, with peaks over the margins of mineralization. This was seen in all extractions. The peaks are sharply defined and of limited lateral extent over the margins of the 5 North deposit, but broader over the margins of 8 North. The ratio of HOAc (carbonate specific)-soluble Ca to AR-Ca shows clear residual anomalies over the deposit margins. This indicates that two forms of Ca exist in the soil, one of which is easily dissolved and occurs near mineralization. The soil conditions are alkaline, with a pH above 8.0 in almost all locations.

Transport processes that cannot possibly be involved should first be discarded. Clastic transport from mineralization through to surface can be ruled out as a factor. Electrogeochemical transport, as described by Govett (1972) and Bolviken and Logn (1975), is not a plausible explanation as there are no electrical conductors, no conducting grain-to-grain

contact traversing a large Eh field and therefore, no self potential (SP) anomaly (D. Hoover, pers. commun., 1994). Without an established electrical field (battery), no net movement of ions can occur in response to the battery. If there were natural electrical fields over the Basin and Range precious metal deposits, the best exploration technique would be SP, looking for negative electrical potentials. The movement of ions, and their adsorption by Fe or Mn at surface, assumes that the target ions are mobile under the environmental conditions in and above the deposit. The alkaline nature of the desert environment limits the movement of many cations, including Fe and Mn. The stability diagrams for Fe and Mn at Standard Temperature and Pressure (STP) and at pH above 8, as shown by Garrels and Christ (1965), preclude the ionic movement of either of these elements in the Marigold environment. The formation of anomalies in Fe or Mn is unlikely. In fact, results in this study suggest that analyzing the sesquioxide component of soil may mask valid geochemical responses.

Recent work by Lintern and Butt (1993) has shown that the sampling of a pedogenic carbonate horizon and its analysis for Au has been successful in detecting Au mineralization through 40 m of overburden in South Australia. However, the origin of the Au anomalies is not clear. They point out that the formation of calcrete is the result of interaction of Ca^{2+} with bicarbonate (HCO_3^-). In turn, HCO_3^- is formed by the reaction of water and CO_2 gas; the latter could originate from the atmosphere, from microbial and root action, or from CO_2 released by the oxidation of sulphides. This correlation of Au and Ca also indicates that Au may be transported as an anion, perhaps in a bicarbonate complex. Gray and Lintern (1994) suggest that the Au distribution in carbonate soils may be partially controlled by evapotranspirative processes and be aided by biologically generated ligands. If this does occur, there may be a depth of burial limit beyond the influence of surface plants which will prevent the movement of Au to the surface.

Work over the Marigold deposit has shown that,

Fig. 9. Enzyme-leach soluble Rb and Sr and Sr/Rb ratios over lines 1 to 4: (a) 5 North deposit, Rb and Sr; (b) 8 North deposit, Rb and Sr; (c) 5 North deposit, Sr/Rb ratios; (d) 8 North deposit, Sr/Rb ratios.

in areas of thick recent alluvial fill, Ca anomalies can form over mineralization with or without Au, depending on the depth of overburden. This is strong evidence that the transport mechanism does not depend on the presence of Au at all, but some other factor related to the mineralization. The large variation in H^+ concentration observed in the Marigold soils may offer a clue to the formation of Ca anomalies.

Smee (1983) proposed a mechanism for the formation of soil anomalies through glaciolacustrine clay overburden over massive-sulphide deposits in the Canadian Shield. Laboratory experiments using radioisotope doping showed that ion migration through lacustrine clay was taking place by a process of cation exchange on soil-particle surfaces. The exchanged and released cation was H^+ . The resulting change in pH in the soil mobilized ambient Fe, Mn, Ca and Mg, which were then redistributed and precipitated in the clay column. Precipitation of the sesquioxides scavenged other ambient cations that produced pseudo-anomalies of a variety of elements. Thus, surficial responses in elements not associated with mineralization were possible. The pseudo-anomalous elements appeared as though they travelled through the overburden, but they had simply been redistributed into the sesquioxide phase, with a minimum of transport.

Confirmatory field studies in a glaciolacustrine-covered area in Northern Quebec showed patterns in soil similar to those found in the laboratory, with additional complexities. Measurement of soil pH showed that H^+ was diffusing through the glaciolacustrine clay from a subcropping massive sulphide to the surface, and that the pH-sensitive elements, particularly Fe and Mn, were subsequently redistributed in response to the pH shift. The soil pH was between 5.5 and 7.0, which crosses the stability field of Fe, depending on the Eh (Fig. 10). The Eh was influenced by degrading organic matter and was less oxidizing than initially expected. It was concluded that, in the pH regime found in the temperate forest of the southern Canadian Shield, Fe and Mn redistribution in response to diffusing H^+ from an oxidizing sulphide body can produce significant surficial anomalies. The ratio of weak leach extracted-Fe to total-Fe, when corrected for organic carbon concentrations, produced rabbit-ear patterns through more

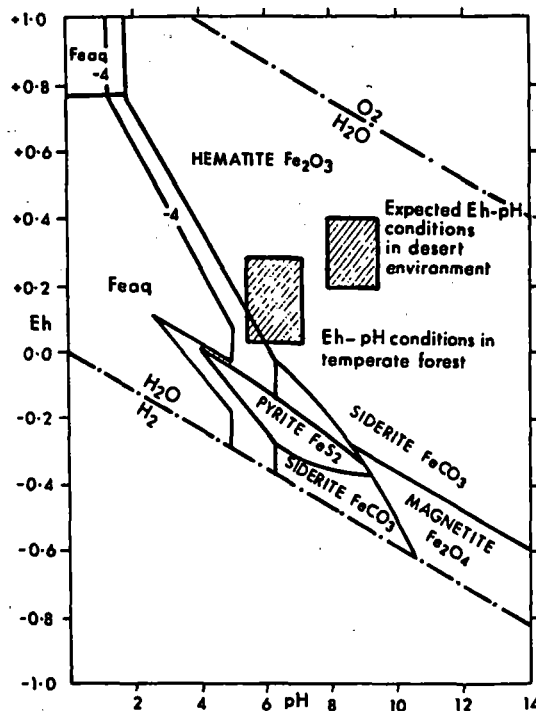


Fig. 10. Eh-pH diagram for Fe at STP conditions showing conditions found in boggy soil in temperate forest in Canada (Smee, 1983) and extrapolated conditions based on pH measurements at Marigold.

than 20 m of glaciolacustrine varved clay over a massive sulphide Cu/Zn body.

The pH-Eh conditions usually found in arid terrain will be different from those of the temperate forest. Fig. 10 shows the Eh-pH conditions reported in Smee (1983) and the pH and estimated Eh conditions in this study, plotted on an Eh-pH diagram for Fe at STP conditions (Garrels and Christ, 1965). A small addition of H^+ in the temperate forest will move the Fe field from hematite to Fe^{2+} . This provides the mechanism to redistribute Fe in the near-surface soils as previously described. The alkaline conditions found in the desert environment will not permit Fe to move at all. However, $CaCO_3$ should react to a H^+ stimulus and, as did hematite, move across its stability field and produce Ca^{2+} , CO_2 and HCO_3^- .

Support for the redistribution of pH-sensitive major elements in soil in response to a natural Eh-pH stimulus can be found in the petroleum exploration

literature. Donovan (1974) clearly showed a change in Ca content and mineralogy in rocks and soils above the Cement Oklahoma oilfield. Fe was removed from surface rocks above the oil reservoir, and added to rocks on the margins. The suggested mechanism for these features was a change in Eh and pH created by vertical migration of hydrocar-

bons from the petroleum reservoir to the surface, a distance of more than 1000 m. Drilling has shown this remobilization of major elements extends to at least 800 m depth. Analysis of soil samples over the Bell Creek oilfield in Montana included a partial extraction for Fe and Mn, using the chelating agent DTPA (diethylenetriaminepentaacetic acid) and

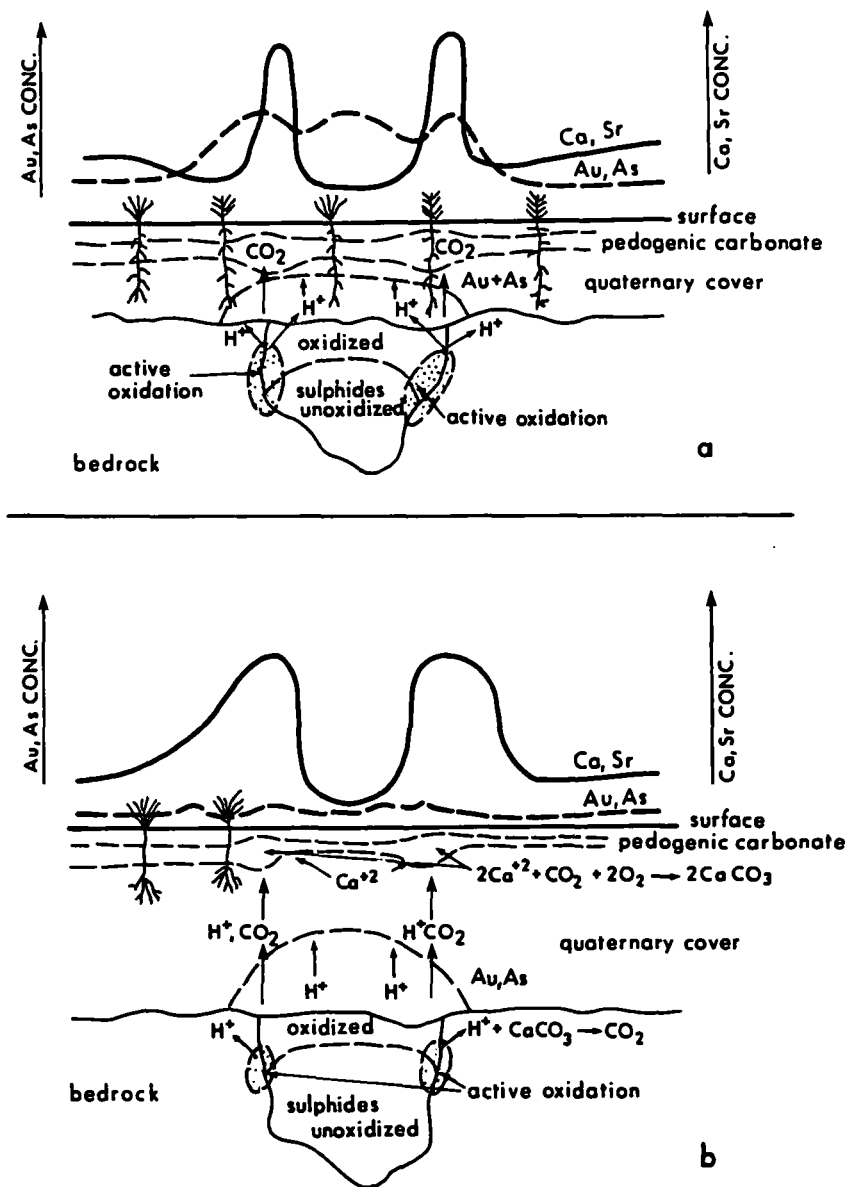


Fig. 11. Conceptual model for the formation of Ca, Sr and ore-forming element patterns in desert soils: (a) shallow overburden; (b) deep overburden.

atomic absorption (Roeming and Donovan, 1985). This work showed a higher concentration of this weakly bound Fe and Mn in soil over the oilfield, but the highest concentrations occurred on the margins of the field, thus forming an aureole pattern. In contrast, total Fe was lowest in concentration over the oilfield. A ratio of chelatable-Fe to total-Fe, calculated by this author, shows a 3:1 increase in the ratio on the margins of the oilfield. The depth of burial of the reservoir is about 1370 m.

The proposed model, which attempts to explain all these observations, is shown in Fig. 11. In this model, a mineral deposit contains at least some sulphides and is undergoing oxidation. Over time, an oxide cap forms at the top of the body, which slows the rate of oxidation, directly affecting the bedrock-overburden interface. Therefore the greatest rate of oxidation should be taking place at the margins of the mineralization. The breakdown of sulphides during oxidation will release H^+ and ionic species of the elements constituting the mineralization. Both H^+ and the other elements will diffuse around the deposit and form a concentration front within the overburden. The release of H^+ can result in two subsequent actions: it can react with surrounding limy rocks, either in the wallrock or overburden, and produce CO_2 ; or it can set up an ion exchange-based diffusion front in the overburden, and diffuse upwards toward the surface.

The occurrence of CO_2 in soil gas above and on the margins of ore deposits is well documented, particularly in arid environments (Lovell et al., 1983; McCarthy et al., 1986). The mechanism for the formation of CO_2 in these references is as explained previously. Both CO_2 and H^+ diffuse to the surface along the path of least resistance, which for both gaseous and ionic diffusion, should be straight up, above their source, as found in the petroleum studies.

The gradual build up over time of H^+ at the soil-alluvium interface should cause a reaction with ambient $CaCO_3$ in the soil, and cause the redistribution of Ca. The addition of extra CO_2 from below will, in turn, react with near-surface moisture, forming HCO_3^- . This should then react with ambient soil Ca^{2+} to re-form $CaCO_3$. Given sufficient time, an excess of nearly pure $CaCO_3$ should form first above, and then on the margins of mineralization. This $CaCO_3$ will be easily dissolved by HOAc, producing

a positive Ca anomaly when ratioed against AR–Ca. Strontium will mimic Ca.

A change in response pattern should be caused by different overburden thicknesses, or possibly regolith type. Fig. 11a shows a hypothetical distribution of Ca, Sr, Au and As where bedrock cover is relatively thin. Gold and As may travel directly to the surface or may be taken up by plants to be subsequently redeposited on the surface (Lintern and Butt, 1993). This superimposition of transport processes could result in a one-, two- or three-peak anomaly pattern as suggested by Govett (1976). The Ca and Sr anomalies should form sharp peaks on either side of the mineral body; the short transport distance above mineralization will not permit any significant lateral dispersion.

The schematic diagram in Fig. 11b, where a thicker overburden prevents the direct migration of the ore-forming elements to the surface, shows that only Ca and Sr should produce a response to mineralization. Plant roots do not penetrate to the aureole of elements released by oxidation, and thus no detectable Au or As is found in the surface soils. Broad double peaks should be found for Ca and Sr.

6. Conclusions

These geochemical orientation results over the two buried Marigold Au deposits suggest that an element transport mechanism is active through overburden whose thickness approaches 100 m. The soils over the Marigold study area are alkaline, the pH ranging from 7.7 to 9.5. This represents nearly a 100-fold difference in H^+ concentration, a surprising fact given the flat topography, high buffering capacity and thick outwash sequence which comprise the alluvial fill. A mechanism that could produce these sharp variations in surface H^+ concentration is an introduction of H^+ from the subsurface by oxidation of mineralization. However, pH alone does not explain the patterns seen over mineralization. Some other mechanism, perhaps dependent on pH, is influencing the near-surface soil chemistry.

There is no repeatable and clear pattern over mineralization for anions extracted by either water or enzyme leach. However, a simple soil conductivity

measurement produces patterns similar to anions in soil samples, is much less expensive and is field-portable. The enzyme leach technique dissolves up to 40 times more Fe than Mn. Enzyme-leachable Fe controls the distribution of most other cations, and as a result, is of little use to exploration in the alkaline environment of the desert.

Gold is strongly correlated with Ca. Calcium and its accompanying element, Sr, are the only elements that show a consistent, interpretable response to mineralization, regardless of depth of burial or chemical extraction used. The positive Ca residuals when AR-soluble Ca is ratioed to the weak-extraction Ca show that Ca has been mobilized or added to the soil by some mechanism. Double-peak or rabbit-ear anomalies are produced on the edges of mineralization, the 'hole' in the middle being the target. The double-peak responses are close together where overburden is less than 100 ft (30.5 m) thick, or the mineralization only partially subcrops, and are farther apart where the overburden is more than 200 ft (61 m) thick.

Calcium appears to be the controlling ion in this study; Fe and Mn are negatively correlated with the Ca-related elements. The conclusion therefore is that Fe-related leach techniques may actually mask responses related to Au mineralization in desert environments.

Those who invoke an electrogeochemical transport mechanism to explain surface anomalies should first detect the presence of a natural battery using a self-potential survey. At the Marigold test site, Au, As and Sb (at low levels) display anomalies related to mineralization through less than 100 ft (30.5 m) of overburden. The 'true' background for Au is less than 1 ppb, and is less than 0.1 ppm for As and Sb. Therefore it is imperative to use analytical methods that can produce these low levels of detection for all soil sampling surveys in the Basin and Range Province.

Conclusions reached in this study are restricted to the pH–Eh environment found at the Marigold site, i.e. alkaline and oxidizing. It is likely that the controlling element, Ca, would be replaced by Fe in more acidic environments, as was found in the Canadian Shield by the author. It is imperative to understand the geochemical landscape in order to interpret data from selective extraction surveys.

Acknowledgements

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APPENDIX III

ANALYTICAL CERTIFICATES



Intertek Testing Services

Bondar Clegg

Geo emical Lab Report

REPORT: V99-00968.0 (COMPLETE)

REFERENCE:

CLIENT: MR. A. CARLOS

SUBMITTED BY: A. CARLOS

PROJECT: NONE GIVEN

DATE RECEIVED: 27-AUG-99 DATE PRINTED: 2-SEP-99

DATE APPROVED	ELEMENT	NUMBER OF ANALYSES	LOWER DETECTION	EXTRACTION	METHOD
990831	1 Au30 Gold	148	5 PPB	Fire Assay of 30g	30g Fire Assay - AA
990831	2 Au Wt1 Test Weight	148	0.01 GM	FIRE ASSAY	FIRE ASSAY-AA
990831	3 Ag Silver	148	0.2 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	4 Cu Copper	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	5 Pb Lead	148	2 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	6 Zn Zinc	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	7 Mo Molybdenum	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	8 Ni Nickel	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	9 Co Cobalt	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	10 Cd Cadmium	148	0.2 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	11 Bi Bismuth	148	5 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	12 As Arsenic	148	5 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	13 Sb Antimony	148	5 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	14 Hg Mercury	148	0.010 PPM	HCL:HNO3 (3:1)	COLD VAPOR AA
990831	15 Fe Iron	148	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	16 Mn Manganese	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	17 Te Tellurium	148	10 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	18 Ba Barium	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	19 Cr Chromium	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	20 V Vanadium	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	21 Sn Tin	148	20 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	22 W Tungsten	148	20 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	23 La Lanthanum	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	24 Al Aluminum	148	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	25 Mg Magnesium	148	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	26 Ca Calcium	148	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	27 Na Sodium	148	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	28 K Potassium	148	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	29 Sr Strontium	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	30 Y Yttrium	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	31 Ga Gallium	148	2 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	32 Li Lithium	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	33 Nb Niobium	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	34 Sc Scandium	148	5 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	35 Ta Tantalum	148	10 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990831	36 Ti Titanium	148	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA

DATE APPROVED	ELEMENT	NUMBER OF ANALYSES	LOWER DETECTION	EXTRACTION	METHOD
990831	37 Zr Zirconium	148	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA

SAMPLE TYPES	NUMBER	SIZE FRACTIONS	NUMBER	SAMPLE PREPARATIONS	NUMBER
S SOIL	148	1 -80	148	DRY, SIEVE -80	148

REMARKS: PLEASE NOTE: SAMPLE 10+900W 9+800W WAS LABELLED ON THE BAG AS 10+900W 9+800W

REPORT COPIES TO: MR. A. CARLOS

INVOICE TO: MR. A. CARLOS

 This report must not be reproduced except in full. The data presented in this report is specific to those samples identified under "Sample Number" and is applicable only to the samples as received expressed on a dry basis unless otherwise indicated



Intertek Testing Services

Bondar Clegg

Geometrical Lab Report

CLIENT: MR. A. CARLOS
REPORT: V99-00968.0 (COMPLETE)

DATE RECEIVED: 27-AUG-99 DATE PRINTED: 2-SEP-99 PAGE 1 OF 10

PROJECT: NONE GIVEN

SAMPLE NUMBER	ELEMENT UNITS	Au	30	Au	Wt1	Ag	Cu	Pb	Zn	Mo	Ni	Co	Cd	Bi	As	Sb	Hg	Fe	Mn	Te	Ba	Cr	V	Sn	W	La	Al	Mg	Ca	Na	K	Sr	Y	Ga	Li	Nb	Sc	Ta	Ti	Zr
		PPB	GM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PCT	PCT	PCT	PCT	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM	
BL 8+500W		6	32.97	<.2	25	10	71	2	31	7	0.9	<5	11	<5	0.121	1.77	392	<10	601	21	32	<20	<20	13	0.81	0.85	3.24	0.02	0.10	102	8	<2	8	2	<5	<10	0.02	3		
BL 8+550W		<5	32.93	<.2	24	9	77	2	29	7	0.9	<5	10	<5	0.105	1.65	379	<10	575	19	32	<20	<20	12	0.77	0.80	3.43	0.02	0.11	95	8	<2	8	2	<5	<10	0.02	3		
BL 8+600W		<5	31.36	<.2	27	10	78	2	35	8	0.9	<5	10	<5	0.114	1.81	420	<10	684	22	38	<20	<20	13	0.97	0.88	3.19	0.02	0.16	97	9	<2	9	3	<5	<10	0.02	4		
BL 8+650W		<5	30.57	0.2	27	10	68	2	31	7	0.8	<5	9	<5	0.110	1.73	369	<10	734	22	39	<20	<20	13	1.00	0.84	4.47	0.02	0.15	120	9	<2	9	2	<5	<10	0.02	3		
BL 8+700W		<5	31.46	<.2	27	10	85	2	31	7	0.9	<5	9	<5	0.117	1.78	411	<10	649	21	38	<20	<20	13	0.96	0.85	2.76	0.02	0.16	90	8	<2	9	2	<5	<10	0.02	6		
BL 8+750W		<5	31.28	<.2	27	10	86	2	31	8	0.9	<5	10	<5	0.106	1.81	417	<10	663	21	39	<20	<20	13	0.97	0.87	2.83	0.02	0.17	92	8	<2	9	2	<5	<10	0.02	6		
BL 8+800W		<5	30.50	2.2	11	15	88	3	24	6	2.4	<5	44	<5	0.100	1.65	281	<10	500	19	29	<20	<20	13	0.74	0.63	1.06	0.02	0.11	70	8	<2	8	2	<5	<10	0.02	2		
BL 8+850W		<5	31.23	0.4	33	13	104	3	38	10	1.1	<5	16	<5	0.124	2.20	498	<10	615	23	38	<20	<20	16	0.97	0.87	2.44	0.02	0.15	88	9	<2	11	3	<5	<10	0.02	5		
BL 8+900W		<5	32.17	0.2	34	15	97	3	36	10	0.7	<5	16	<5	0.091	2.35	468	<10	535	20	30	<20	<20	14	0.82	1.08	3.42	0.02	0.09	109	9	<2	11	2	<5	<10	0.02	4		
BL 8+950W		<5	30.45	0.3	29	10	66	2	31	7	0.7	<5	9	<5	0.116	1.72	374	<10	624	21	38	<20	<20	12	0.98	0.93	4.78	0.02	0.15	128	8	<2	9	2	<5	<10	0.02	3		
BL 9+000W		<5	32.18	<.2	27	10	75	2	33	8	0.8	<5	10	<5	0.113	1.89	420	<10	679	19	35	<20	<20	13	0.90	0.82	3.44	0.02	0.13	100	8	<2	8	2	<5	<10	0.02	4		
BL 9+050W		<5	30.98	<.2	25	9	58	2	27	6	0.5	<5	10	<5	0.105	1.68	322	<10	556	19	32	<20	<20	13	0.84	0.67	3.42	0.02	0.10	86	8	<2	8	2	<5	<10	0.02	2		
BL 9+100W		<5	31.32	<.2	29	10	82	2	33	9	0.9	<5	12	<5	0.120	1.95	456	<10	663	21	37	<20	<20	15	0.93	0.82	3.25	0.02	0.12	96	9	<2	9	2	<5	<10	0.03	4		
9+100W 9+850N		<5	31.24	<.2	30	11	70	2	35	8	0.2	<5	10	<5	0.098	2.12	434	<10	632	26	45	<20	<20	17	1.25	0.55	0.98	0.02	0.15	38	13	<2	10	3	<5	<10	0.02	2		
9+100W 9+900N		<5	30.24	<.2	25	11	70	2	30	7	<.2	<5	11	<5	0.072	2.20	235	<10	468	25	39	<20	<20	19	1.17	0.52	0.44	0.02	0.12	24	13	<2	10	3	<5	<10	0.02	2		
9+100W 9+950N		<5	30.79	0.3	30	9	71	2	31	7	0.7	<5	10	<5	0.109	1.77	389	<10	750	23	39	<20	<20	13	1.03	0.87	4.93	0.02	0.16	126	9	<2	10	2	<5	<10	0.02	2		
9+100W 10+050N		<5	30.73	<.2	30	19	99	2	30	10	0.4	<5	19	<5	0.120	2.71	373	<10	740	22	33	<20	<20	18	1.00	0.63	0.82	0.02	0.09	54	10	<2	11	3	<5	<10	0.02	2		
BL 9+150W		<5	32.83	0.2	30	10	69	2	31	7	0.6	<5	10	<5	0.118	1.82	416	<10	693	21	36	<20	<20	14	0.92	0.82	4.18	0.02	0.13	107	9	<2	9	2	<5	<10	0.02	3		
BL 9+200W		<5	30.95	0.8	30	9	48	2	21	5	1.0	<5	13	<5	0.141	1.31	232	<10	879	16	25	<20	<20	8	0.69	0.92	10.00	0.02	0.09	243	6	<2	7	2	<5	<10	0.02	1		
9+200W 9+800N		<5	31.29	<.2	24	12	79	2	27	8	0.9	<5	12	<5	0.074	1.99	429	<10	531	16	23	<20	<20	12	0.68	1.14	3.97	0.01	0.07	108	8	<2	12	2	<5	<10	0.02	4		
9+200W 9+850N		<5	33.01	<.2	25	12	96	1	28	6	0.2	<5	12	<5	0.116	2.00	264	<10	431	23	38	<20	<20	14	1.09	0.55	0.69	0.02	0.12	26	13	2	8	3	<5	<10	0.02	2		
9+200W 9+900N		<5	31.20	<.2	25	9	78	1	30	7	0.8	<5	10	<5	0.114	1.78	404	<10	657	23	36	<20	<20	13	0.96	0.85	3.50	0.02	0.15	95	8	<2	9	3	<5	<10	0.02	4		
9+200W 9+950N		<5	32.69	<.2	27	13	86	2	28	8	0.6	<5	15	<5	0.077	2.07	385	<10	489	22	29	<20	<20	13	0.79	1.05	2.99	0.01	0.09	89	8	<2	10	2	<5	<10	0.02	4		
9+200W 10+050N		<5	31.86	0.2	33	11	81	2	33	8	1.2	<5	10	<5	0.138	2.04	350	<10	499	27	38	<20	<20	14	1.03	0.57	1.28	0.01	0.10	42	9	<2	9	3	<5	<10	0.01	1		
BL 9+250W		<5	31.06	0.5	41	11	89	2	42	9	0.5	<5	11	<5	0.176	2.31	499	<10	639	30	42	<20	<20	15	1.14	0.74	2.08	0.02	0.13	59	10	<2	10	3	<5	<10	0.02	3		
9+250W 9+950N		<5	31.02	<.2	22	14	83	2	26	7	0.3	<5	16	<5	0.055	2.20	318	<10	504	21	28	<20	<20	15	0.83	0.86	1.85	0.02	0.07	66	8	<2	9	2	<5	<10	0.02	2		
BL 9+300W		<5	30.44	0.2	34	11	95	2	37	9	0.8	<5	10	<5	0.146	2.18	498	<10	663	26	41	<20	<20	14	1.07	0.87	3.16	0.02	0.15	83	9	<2	10	3	<5	<10	0.02	5		
9+300W 9+850N		<5	31.12	<.2	24	11	75	2	26	6	0.3	<5	10	<5	0.088	2.05	353	<10	609	29	40	<20	<20	11	1.36	1.16	3.07	0.07	0.16	90	7	2	22	3	<5	<10	0.04	2		
9+300W 9+900N		<5	31.40	<.2	26	10	73	2	30	7	0.5	<5	10	<5	0.097	1.90	419	<10	628	22	35	<20	<20	13	0.97	0.84	3.24	0.02	0.14	87	9	<2	9	2	<5	<10	0.02	2		
9+300W 9+950N		<5	32.48	<.2	22	9	74	2	29	7	0.4	<5	10	<5	0.094	1.74	399	<10	476	23	28	<20	<20	12	0.72	0.80	2.59	0.01	0.09	79	8	<2	8	2	<5	<10	0.02	6		



Intertek Testing Services

Bondar Clegg

Geochemical Lab Report

CLIENT: MR. A. CARLOS

PROJECT: NONE GIVEN

REPORT: V99-00968.0 (COMPLETE)

DATE RECEIVED: 27-AUG-99

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PAGE 2 OF 10

SAMPLE NUMBER	ELEMENT UNITS	Au30	Au	Wt1	Ag	Cu	Pb	Zn	Mo	Ni	Co	Cd	Bi	As	Sb	Hg	Fe	Mn	Te	Ba	Cr	V	Sn	W	La	Al	Mg	Ca	Na	K	Sr	Y	Ga	Li	Nb	Sc	Ta	Ti	Zr
		PPB	GM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PCT	PCT	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM		
9+300W 10+050N		7	32.83	<.2	18	13	67	2	26	8	<.2	<5	15	<5	0.047	2.09	369	<10	538	15	23	<20	<20	14	0.70	1.15	3.01	0.01	0.05	84	9	<2	9	2	<5	<10	0.02	2	
BL 9+350W		<5	31.45	<.2	43	10	87	2	39	13	0.7	<5	12	<5	0.152	2.45	454	<10	616	27	40	<20	<20	13	1.04	0.90	3.21	0.02	0.11	90	8	<2	10	3	<5	<10	0.03	4	
9+350W 9+950N		8	30.75	0.2	29	10	72	1	32	7	0.4	<5	10	<5	0.119	1.89	363	<10	541	23	34	<20	<20	12	0.95	0.77	4.07	0.03	0.10	95	8	<2	9	3	<5	<10	0.02	3	
9+350W 10+050N		<5	31.25	<.2	33	15	102	3	34	10	0.7	<5	16	<5	0.102	2.48	491	<10	425	22	30	<20	<20	14	0.82	1.04	3.34	0.02	0.10	98	9	<2	10	2	<5	<10	0.02	3	
BL 9+400W		<5	32.16	<.2	34	12	86	2	40	8	<.2	<5	12	<5	0.126	2.24	492	<10	590	28	41	<20	<20	16	1.16	0.61	1.09	0.02	0.11	38	11	<2	9	3	<5	<10	0.02	4	
9+400W 9+800N		<5	31.09	<.2	23	13	77	2	27	8	0.3	<5	15	<5	0.069	2.23	398	<10	569	19	26	<20	<20	15	0.79	1.12	3.58	0.01	0.07	100	9	<2	10	2	<5	<10	0.02	2	
9+400W 9+850N		<5	30.23	<.2	21	10	73	2	25	6	0.5	<5	10	<5	0.081	1.94	350	<10	502	22	32	<20	<20	13	0.89	0.73	2.36	0.02	0.09	77	7	<2	8	3	<5	<10	0.02	2	
9+400W 9+900N		<5	32.28	<.2	28	16	102	3	32	9	1.0	<5	15	<5	0.087	2.44	421	<10	509	20	27	<20	<20	15	0.79	1.10	3.51	0.01	0.09	101	9	<2	10	2	<5	<10	0.02	6	
9+400W 9+950N		<5	31.78	0.7	34	8	41	1	24	4	0.6	<5	9	<5	0.192	1.40	202	<10	758	17	23	<20	<20	9	0.66	0.83	9.67	0.01	0.07	230	8	<2	6	2	<5	<10	0.01	<1	
9+400W 10+050N		<5	30.98	<.2	22	12	71	2	25	7	0.5	<5	13	<5	0.058	2.05	379	<10	493	14	23	<20	<20	13	0.68	1.26	4.09	0.02	0.07	116	8	<2	9	1	<5	<10	0.02	5	
BL 9+450W		8	30.92	<.2	27	13	77	2	35	9	<.2	<5	14	<5	0.109	2.42	301	<10	706	21	32	<20	<20	19	0.91	0.80	0.99	0.02	0.08	40	11	<2	10	2	<5	<10	0.02	2	
BL 9+500W		<5	30.98	0.3	27	12	76	2	28	8	1.7	<5	14	<5	0.062	2.01	390	<10	503	17	24	<20	<20	13	0.70	1.12	4.05	0.01	0.07	109	7	<2	9	2	<5	<10	0.02	4	
9+500W 9+850N		<5	31.78	0.2	39	16	156	5	39	10	0.9	<5	14	<5	0.074	2.85	453	<10	608	24	39	<20	<20	17	1.11	1.50	4.40	0.01	0.12	120	10	<2	14	3	<5	<10	0.02	7	
9+500W 9+900N		<5	30.73	0.3	30	10	67	2	32	7	0.5	<5	12	<5	0.119	2.03	340	<10	604	23	33	<20	<20	13	0.92	0.84	4.49	0.02	0.10	112	8	<2	9	2	<5	<10	0.02	3	
9+500W 9+950N		8	30.72	<.2	34	12	75	2	40	8	<.2	<5	12	<5	0.124	2.35	402	<10	563	29	40	<20	<20	16	1.09	0.64	0.83	0.02	0.10	41	11	<2	10	3	<5	<10	0.02	2	
9+500W 10+050N		<5	31.27	<.2	27	12	81	2	29	8	0.5	<5	13	<5	0.079	2.21	393	<10	530	20	27	<20	<20	14	0.72	0.98	3.13	0.01	0.08	91	8	<2	9	2	<5	<10	0.02	2	
BL 9+550W		26	30.98	<.2	29	11	76	1	36	8	0.6	<5	12	<5	0.129	2.16	436	<10	584	23	35	<20	<20	14	0.96	0.77	2.91	0.02	0.12	78	9	<2	9	2	<5	<10	0.03	4	
BL 9+600W		<5	30.24	0.2	24	8	66	1	28	6	0.6	<5	10	<5	0.111	1.77	354	<10	526	20	30	<20	<20	12	0.78	0.74	3.73	0.02	0.09	102	8	<2	7	2	<5	<10	0.02	4	
9+600W 9+850N		<5	30.50	<.2	20	13	60	1	23	6	0.3	<5	10	<5	0.062	1.99	421	<10	528	16	22	<20	<20	12	0.76	0.82	5.54	0.02	0.06	159	7	<2	10	2	<5	<10	0.02	1	
9+600W 9+900N		<5	30.60	<.2	31	11	69	2	30	6	<.2	<5	13	<5	0.102	2.25	296	<10	598	25	36	<20	<20	17	1.15	0.65	2.92	0.03	0.08	70	12	<2	10	2	<5	<10	0.02	2	
9+600W 9+950N		23	30.78	<.2	31	13	93	2	38	9	<.2	<5	14	<5	0.097	2.46	358	<10	466	26	35	<20	<20	18	0.93	0.74	1.07	0.02	0.09	46	12	<2	9	2	<5	<10	0.02	2	
9+600W 10+050N		<5	30.95	<.2	33	12	86	2	36	9	0.5	<5	14	<5	0.114	2.44	396	<10	622	24	31	<20	<20	16	0.90	0.77	2.69	0.01	0.08	81	9	<2	10	2	<5	<10	0.02	3	
BL 9+650W		<5	30.24	<.2	38	11	74	2	33	8	0.2	<5	11	<5	0.125	2.47	424	<10	461	25	39	<20	<20	15	1.16	0.87	2.76	0.02	0.13	81	10	<2	12	3	<5	<10	0.03	3	
BL 9+700W		<5	32.13	<.2	24	11	74	2	27	8	0.3	<5	14	<5	0.057	2.17	421	<10	513	15	23	<20	<20	15	0.69	1.17	3.12	0.01	0.07	96	8	<2	9	2	<5	<10	0.02	3	
BL 9+750W		<5	30.15	<.2	19	10	61	2	24	6	<.2	<5	11	<5	0.029	1.86	275	<10	396	14	20	<20	<20	13	0.63	1.21	2.69	0.01	0.06	80	7	<2	9	2	<5	<10	0.02	3	
9+750W 9+800N		11	31.24	0.2	28	14	78	2	34	8	0.5	<5	15	<5	0.080	2.51	353	<10	595	22	31	<20	<20	17	0.90	1.12	2.84	0.02	0.08	97	10	<2	12	2	<5	<10	0.02	2	
9+750W 9+850N		6	31.84	<.2	30	13	83	2	36	8	0.4	<5	15	<5	0.087	2.25	405	<10	493	23	33	<20	<20	16	0.83	0.55	0.58	0.01	0.10	34	10	<2	8	2	<5	<10	0.02	4	
9+750W 9+900N		<5	31.24	<.2	28	13	95	3	32	9	0.6	<5	14	<5	0.084	2.32	432	<10	427	21	28	<20	<20	13	0.74	0.97	2.98	0.02	0.09	102	8	<2	9	2	<5	<10	0.02	5	
9+750W 9+950N		<5	30.69	<.2	25	10	95	2	30	7	0.6	<5	10	<5	0.115	1.93	395	<10	540	23	34	<20	<20	14	0.89	0.85	3.68	0.02	0.12	108	8	<2	9	3	<5	<10	0.03	4	
9+750W 10+050N		<5	31.95	<.2	23	13	71	2	28	7	0.4	<5	14	<5	0.066	2.22	420	<10	584	20	29	<20	<20	14	0.85	0.95	3.03	0.02	0.09	101	8	<2	10	2	<5	<10	0.02	2	



Intertek Testing Services

Bondar Clegg

Geochemical Lab Report

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SAMPLE NUMBER	ELEMENT UNITS	Au30	Au	Wt1	Ag	Cu	Pb	Zn	Mo	Ni	Co	Cd	Bi	As	Sb	Hg	Fe	Mn	Te	Ba	Cr	V	Sn	W	La	Al	Mg	Ca	Na	K	Sr	Y	Ga	Li	Nb	Sc	Ta	Ti	Zr
		PPB	GM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PCT	PCT	PCT	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM	
BL 9+800W		14	32.44	<.2	22	12	72	2	28	8	0.3	<.5	13	<.5	0.064	2.21	358	<10	616	17	27	<20	<20	16	0.77	1.04	3.73	0.01	0.07	110	8	<2	10	2	<.5	<10	0.02	2	
BL 9+850W		<.5	31.41	<.2	31	12	91	2	33	8	0.5	<.5	14	<.5	0.108	2.38	452	<10	703	22	36	<20	<20	17	1.03	1.02	3.59	0.02	0.12	107	10	<2	11	3	<.5	<10	0.03	3	
9+850W 9+950N		<.5	30.89	<.2	23	12	80	2	26	7	0.5	<.5	14	<.5	0.081	2.12	360	<10	540	15	25	<20	<20	14	0.73	1.19	3.99	0.02	0.08	124	8	<2	10	2	<.5	<10	0.02	4	
BL 9+900W		8	32.33	<.2	29	10	75	2	33	7	0.4	<.5	11	<.5	0.101	2.11	395	<10	686	22	37	<20	<20	15	0.95	0.74	2.17	0.02	0.10	72	10	<2	9	2	<.5	<10	0.02	2	
9+900W 9+750N		<.5	30.47	<.2	22	9	66	1	28	7	<.2	<.5	10	<.5	0.072	2.04	266	<10	498	24	37	<20	<20	15	1.07	0.35	0.25	0.01	0.07	17	7	<2	8	3	<.5	<10	0.02	3	
9+900W 9+800N		<.5	32.77	<.2	25	9	64	1	28	7	<.2	<.5	10	<.5	0.088	1.96	340	<10	604	23	34	<20	<20	13	1.03	0.65	2.24	0.02	0.10	65	8	<2	9	3	<.5	<10	0.02	<1	
9+900W 9+850N		<.5	32.55	<.2	24	12	79	2	27	8	0.4	<.5	13	<.5	0.072	2.16	390	<10	516	16	24	<20	<20	13	0.72	1.25	4.01	0.01	0.07	125	8	<2	10	2	<.5	<10	0.02	5	
9+900W 9+900N		<.5	31.28	0.4	35	11	67	2	35	8	<.2	<.5	11	<.5	0.198	2.26	342	<10	462	29	42	<20	<20	16	1.17	0.66	0.82	0.02	0.12	36	12	<2	10	3	<.5	<10	0.03	2	
9+900W 9+950N		<.5	31.50	<.2	23	14	80	2	29	8	0.2	<.5	15	<.5	0.049	2.42	354	<10	594	18	28	<20	<20	17	0.85	1.12	3.50	0.01	0.08	112	9	<2	11	2	<.5	<10	0.02	3	
9+900W 10+050N		<.5	30.50	<.2	29	9	68	2	32	7	0.3	<.5	11	<.5	0.123	2.07	328	<10	606	21	38	<20	<20	14	0.97	0.71	2.83	0.02	0.10	87	10	<2	9	3	<.5	<10	0.02	2	
BL 9+950W		<.5	31.94	0.6	45	10	66	1	32	6	0.8	<.5	8	<.5	0.174	1.84	398	<10	781	21	33	<20	<20	12	0.95	0.82	6.93	0.03	0.10	157	8	<2	9	2	<.5	<10	0.02	2	
BL 10+000W		<.5	31.26	<.2	31	10	95	2	34	8	0.8	<.5	11	<.5	0.121	2.21	448	<10	693	23	39	<20	<20	14	0.95	0.89	3.18	0.02	0.12	107	9	<2	10	3	<.5	<10	0.02	5	
10+000W 9+700N		<.5	30.27	<.2	23	9	44	1	21	5	<.2	<.5	8	<.5	0.057	1.62	277	<10	470	17	32	<20	<20	10	0.91	0.43	1.63	0.03	0.09	47	6	<2	7	2	<.5	<10	0.02	2	
10+000W 9+750N		<.5	15.19	0.2	24	9	65	1	28	6	0.5	<.5	9	<.5	0.109	1.82	353	<10	578	21	31	<20	<20	12	0.87	0.84	4.90	0.02	0.11	124	8	<2	8	2	<.5	<10	0.03	3	
10+000W 9+800N		<.5	30.09	0.3	26	8	64	1	30	7	0.3	<.5	8	<.5	0.102	1.92	346	<10	714	23	37	<20	<20	12	1.08	0.86	3.50	0.03	0.14	103	9	<2	10	2	<.5	<10	0.03	3	
10+000W 9+850N		<.5	32.22	<.2	25	13	90	2	30	8	0.5	<.5	14	<.5	0.076	2.34	411	<10	625	19	28	<20	<20	15	0.77	1.28	4.40	0.02	0.08	148	9	<2	10	2	<.5	<10	0.02	5	
10+000W 9+900N		<.5	30.78	0.2	26	10	62	1	28	6	0.2	<.5	10	<.5	0.105	1.95	307	<10	501	21	33	<20	<20	13	0.90	0.68	2.89	0.02	0.09	82	9	<2	9	2	<.5	<10	0.02	2	
10+000W 9+950N		<.5	31.79	<.2	21	9	63	2	28	7	<.2	<.5	10	<.5	0.081	2.17	320	<10	437	25	38	<20	<20	16	1.08	0.52	0.46	0.02	0.09	24	10	<2	9	3	<.5	<10	0.03	2	
10+000W 10+050N		<.5	30.47	<.2	26	14	91	2	30	8	0.6	<.5	15	<.5	0.077	2.33	415	<10	520	18	27	<20	<20	15	0.76	1.25	3.90	0.02	0.08	130	8	<2	10	2	<.5	<10	0.02	4	
BL 10+050W		7	30.47	0.2	30	8	80	1	33	7	0.6	<.5	11	<.5	0.122	2.13	387	<10	709	23	38	<20	<20	15	0.93	0.86	4.04	0.02	0.11	120	9	<2	9	3	<.5	<10	0.02	3	
BL 10+100W		<.5	31.98	<.2	31	10	93	2	33	8	0.9	<.5	11	<.5	0.131	2.16	414	<10	689	24	43	<20	<20	14	0.92	0.96	3.81	0.02	0.12	138	9	<2	9	3	<.5	<10	0.03	5	
BL 10+150W		<.5	30.53	<.2	32	11	77	2	36	7	0.3	<.5	12	<.5	0.132	2.30	474	<10	606	24	41	<20	<20	16	1.02	0.82	2.10	0.02	0.12	74	13	<2	9	3	<.5	<10	0.02	2	
BL 10+200W		<.5	15.50	<.2	31	15	97	2	36	9	0.6	<.5	14	<.5	0.087	2.74	608	<10	559	26	41	<20	<20	16	1.11	1.09	2.18	0.03	0.13	90	11	<2	11	3	<.5	<10	0.03	2	
BL 10+250W		6	31.18	<.2	28	14	92	2	32	8	0.5	<.5	16	<.5	0.066	2.48	446	<10	561	20	29	<20	<20	15	0.77	1.16	3.63	0.02	0.09	118	9	<2	9	2	<.5	<10	0.02	3	
BL 10+300W		6	30.77	0.2	29	15	73	2	32	9	0.2	<.5	17	<.5	0.086	2.53	460	<10	725	20	29	<20	<20	16	0.85	1.28	4.48	0.02	0.08	137	9	<2	10	2	<.5	<10	0.02	2	
BL 10+350W		<.5	30.66	<.2	28	14	79	2	32	8	0.2	<.5	14	<.5	0.078	2.40	401	<10	609	20	31	<20	<20	17	0.91	1.15	3.18	0.02	0.09	103	9	<2	11	2	<.5	<10	0.02	3	
BL 10+400W		<.5	31.31	<.2	25	13	78	2	27	8	0.4	<.5	15	<.5	0.072	2.23	364	<10	585	18	27	<20	<20	16	0.79	1.22	4.15	0.02	0.09	128	8	<2	10	2	<.5	<10	0.02	3	
BL 10+450W		<.5	30.37	<.2	32	15	86	2	34	9	<.2	<.5	13	<.5	0.110	2.62	369	<10	603	25	38	<20	<20	19	1.10	1.02	2.09	0.02	0.12	76	11	<2	12	3	<.5	<10	0.02	2	
BL 10+500W		7	31.85	<.2	21	16	84	2	30	9	<.2	<.5	17	<.5	0.072	2.65	428	<10	633	21	31	<20	<20	19	0.92	1.23	2.82	0.02	0.10	96	10	<2	12	2	<.5	<10	0.02	3	
BL 10+550W		<.5	30.56	<.2	35	13	69	2	38	9	0.5	<.5	11	<.5	0.063	2.48	1001	<10	860	20	32	<20	<20	15	0.98	0.64	2.67	0.02	0.08	114	9	<2	11	3	<.5	<10	0.02	3	



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SAMPLE NUMBER	ELEMENT UNITS	Au30	Au	Wt1	Ag	Cu	Pb	Zn	Mo	Ni	Co	Cd	Bi	As	Sb	Hg	Fe	Mn	Te	Ba	Cr	V	Sn	W	La	Al	Mg	Ca	Na	K	Sr	Y	Ga	Li	Nb	Sc	Ta	Ti	Zr
		PPB	GM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PCT	PCT	PCT	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM	
BL 10+600W		<5	15.14	0.3	46	9	57	1	45	9	0.7	<5	8	<5	0.108	1.90	863	<10	590	17	24	<20	<20	10	0.72	0.95	3.53	0.01	0.07	163	8	<2	8	2	<5	<10	0.01	2	
10+600W 9+900N		<5	31.87	<.2	30	10	75	2	32	7	0.9	<5	10	<5	0.097	2.05	331	<10	431	26	38	<20	<20	15	1.01	0.55	1.06	0.02	0.12	52	9	<2	9	3	<5	<10	0.02	2	
10+600W 9+950N		<5	31.51	<.2	30	10	79	2	34	8	0.4	<5	11	<5	0.102	2.19	381	<10	578	25	39	<20	<20	16	1.08	0.65	1.69	0.02	0.12	64	10	<2	10	3	<5	<10	0.02	2	
10+600W 10+050N		<5	30.38	<.2	39	17	162	5	42	11	0.6	<5	17	<5	0.085	3.56	243	<10	775	31	50	<20	<20	22	1.33	0.74	0.81	0.01	0.16	62	12	<2	15	4	<5	<10	0.02	6	
10+600W 10+100N		<5	30.19	0.3	40	15	150	4	40	9	1.0	<5	13	<5	0.126	2.94	504	<10	675	27	43	<20	<20	17	1.23	1.41	3.43	0.03	0.14	127	11	<2	16	3	<5	<10	0.02	8	
BL 10+650W		<5	31.06	<.2	26	13	94	2	32	8	0.6	<5	12	<5	0.080	2.29	397	<10	645	21	33	<20	<20	17	0.93	1.14	3.78	0.02	0.11	135	9	<2	12	3	<5	<10	0.02	5	
BL 10+700W		<5	30.54	<.2	43	13	126	3	42	9	0.8	<5	11	<5	0.105	2.58	440	<10	693	26	42	<20	<20	18	1.18	1.20	2.03	0.01	0.14	105	10	<2	14	4	<5	<10	0.02	5	
10+700W 9+850N		<5	31.65	<.2	23	9	63	1	31	7	0.3	<5	11	<5	0.099	1.95	430	<10	607	21	35	<20	<20	15	0.95	0.72	3.97	0.02	0.11	100	10	<2	9	3	<5	<10	0.02	2	
10+700W 9+900N		<5	30.40	<.2	27	11	110	2	31	8	0.9	<5	14	<5	0.083	2.22	539	<10	590	23	36	<20	<20	17	1.00	0.78	2.80	0.02	0.10	97	9	<2	11	3	<5	<10	0.02	2	
10+700W 9+950N		<5	30.65	<.2	26	12	82	2	31	8	0.5	<5	12	<5	0.089	2.22	391	<10	593	22	36	<20	<20	16	1.05	0.98	3.35	0.02	0.11	114	9	<2	11	3	<5	<10	0.03	2	
10+700W 10+050N		9	30.25	<.2	36	15	129	3	39	10	0.8	<5	13	<5	0.119	2.98	528	<10	671	27	40	<20	<20	19	1.20	1.31	3.47	0.02	0.15	130	10	<2	15	2	<5	<10	0.03	9	
10+700W 10+100N		<5	30.12	<.2	42	14	139	3	44	10	1.4	<5	11	<5	0.111	2.88	594	<10	731	28	45	<20	<20	19	1.32	0.93	2.12	0.02	0.15	98	10	2	15	3	<5	<10	0.02	5	
BL 10+750W		<5	30.24	<.2	42	12	121	2	43	9	1.2	<5	9	<5	0.104	2.35	441	<10	601	25	38	<20	<20	16	1.13	0.89	1.81	0.01	0.12	78	9	<2	13	3	<5	<10	0.01	6	
BL 10+800W		<5	31.30	0.2	44	9	87	2	45	11	0.8	<5	7	<5	0.096	1.94	456	<10	624	21	32	<20	<20	12	1.00	0.62	2.46	0.02	0.10	95	8	<2	11	3	<5	<10	0.01	5	
10+800W 9+850N		<5	31.05	<.2	30	12	89	2	34	9	0.5	<5	13	<5	0.109	2.46	411	<10	632	22	35	<20	<20	18	1.01	0.98	2.99	0.02	0.12	107	9	<2	12	2	<5	<10	0.02	4	
10+800W 9+900N		<5	30.69	0.2	32	13	83	2	35	8	0.6	<5	12	<5	0.076	2.26	376	<10	779	21	32	<20	<20	16	0.96	0.85	2.02	0.02	0.07	110	9	<2	11	2	<5	<10	0.02	2	
10+800W 9+950N		<5	31.31	<.2	217	13	120	2	80	60	<.2	<5	11	<5	0.163	3.64	1254	<10	431	41	45	<20	<20	16	2.04	0.69	0.33	0.03	0.14	41	9	<2	18	2	19	<10	0.03	7	
10+800W 10+050N		<5	32.16	<.2	38	14	139	3	38	9	0.8	<5	13	<5	0.110	2.83	495	<10	680	25	42	<20	<20	18	1.17	1.28	3.88	0.02	0.15	135	10	<2	15	2	<5	<10	0.03	8	
10+800W 10+100N		<5	31.03	0.2	39	14	142	3	39	9	1.1	<5	13	<5	0.109	2.86	509	<10	599	25	37	<20	<20	16	1.10	1.29	3.99	0.02	0.13	122	10	<2	15	2	<5	<10	0.02	8	
BL 10+850W		<5	30.06	0.2	44	14	157	3	42	9	1.1	<5	12	<5	0.095	2.80	499	<10	648	25	40	<20	<20	17	1.15	1.20	2.63	0.02	0.12	95	10	<2	14	3	<5	<10	0.02	3	
BL 10+900W		<5	30.11	0.2	41	16	239	3	43	13	1.9	<5	17	<5	0.073	3.20	1010	<10	672	28	45	<20	<20	18	1.24	0.99	1.60	0.02	0.12	76	11	<2	16	3	<5	<10	0.02	2	
10+900W 9+800N		<5	32.00	0.2	26	16	82	2	31	8	0.5	<5	12	<5	0.092	2.19	428	<10	560	21	31	<20	<20	14	0.89	1.03	3.70	0.02	0.10	112	9	<2	10	3	<5	<10	0.02	2	
10+900W 9+850N		<5	30.80	<.2	28	15	130	3	34	9	0.8	<5	15	<5	0.066	2.57	369	<10	548	21	32	<20	<20	16	0.93	0.96	2.32	0.01	0.09	85	9	<2	13	2	<5	<10	0.02	2	
10+900W 9+900N		<5	30.05	<.2	28	14	108	2	31	8	0.9	<5	14	<5	0.060	2.57	433	<10	586	21	27	<20	<20	15	0.85	1.42	4.39	0.01	0.10	157	9	<2	12	2	<5	<10	0.02	3	
10+900W 9+950N		<5	30.46	<.2	40	13	109	2	43	10	0.4	<5	11	<5	0.137	2.91	562	<10	740	29	44	<20	<20	19	1.31	0.82	1.09	0.01	0.13	62	10	2	15	3	<5	<10	0.01	3	
10+900W 10+050N		<5	30.57	0.2	39	13	134	3	43	10	0.9	<5	12	<5	0.109	2.88	561	<10	687	26	40	<20	<20	18	1.16	1.14	3.33	0.02	0.14	109	11	<2	14	3	<5	<10	0.02	5	
10+900W 10+100N		<5	31.35	<.2	32	11	80	2	44	10	<.2	<5	16	<5	0.098	2.52	431	<10	507	32	39	<20	<20	20	1.05	0.63	0.49	0.02	0.11	32	16	<2	9	2	5	<10	0.02	6	
BL 10+950W		6	30.25	<.2	37	14	108	3	41	10	0.8	<5	14	<5	0.112	2.93	695	<10	720	26	39	<20	<20	19	1.15	1.32	3.49	0.02	0.14	122	11	<2	15	3	<5	<10	0.02	4	
BL 11+000W		<5	32.20	0.3	38	15	140	3	42	10	0.9	<5	12	<5	0.069	2.81	464	<10	679	26	41	<20	<20	17	1.16	1.06	2.32	0.01	0.13	92	10	<2	15	3	<5	<10	0.02	2	
11+000W 9+850N		<5	15.38	<.2	14	6	10	3	11	2	<.2	<5	<5	<5	0.044	1.04	23	<10	146	5	9	<20	<20	3	0.25	0.24	2.37	0.03	0.01	104	2	<2	1	<1	<5	<10	0.01	1	



Intertek Testing Services

Bondar Clegg

Geometrical Lab Report

CLIENT: MR. A. CARLOS
REPORT: V99-00968.0 (COMPLETE)

DATE RECEIVED: 27-AUG-99 DATE PRINTED: 2-SEP-99 PAGE 5 OF 10 PROJECT: NONE GIVEN

SAMPLE NUMBER	ELEMENT UNITS	Au30 PPB	Au Wt1 GM	Ag PPM	Cu PPM	Pb PPM	Zn PPM	Mo PPM	Ni PPM	Co PPM	Cd PPM	Bi PPM	As PPM	Sb PPM	Hg PPM	Fe PCT	Mn PPM	Te PPM	Ba PPM	Cr PPM	V PPM	Sn PPM	W PPM	La PPM	Al PCT	Mg PCT	Ca PCT	Na PCT	K PCT	Sr PPM	Y PPM	Ga PPM	Li PPM	Nb PPM	Sc PPM	Ta PPM	Ti PCT	Zr PPM
11+000W 9+900N	<5	30.06	0.2	36	12	101	2	36	10	0.8	<5	11	<5	0.082	2.60	456	<10	599	25	35	<20	<20	16	1.11	1.28	3.99	0.01	0.13	132	10	<2	16	2	<5	<10	0.02	6	
11+000W 9+950N	<5	31.59	<.2	36	13	121	2	39	10	0.8	<5	12	<5	0.141	2.84	551	<10	652	26	38	<20	<20	18	1.14	1.14	2.40	0.02	0.13	99	10	<2	15	2	<5	<10	0.02	6	
11+000W 10+050N	<5	32.95	<.2	38	13	122	3	38	9	0.8	<5	10	<5	0.149	2.87	508	<10	669	28	39	<20	<20	18	1.17	1.11	2.10	0.02	0.13	92	10	<2	16	2	<5	<10	0.02	8	
11+000W 10+100N	<5	30.86	0.6	54	10	81	2	53	8	0.3	<5	11	<5	0.182	2.23	352	<10	816	32	36	<20	<20	14	1.01	0.94	5.13	0.01	0.09	121	10	<2	10	3	<5	<10	0.01	2	
BL 11+050W	6	32.22	<.2	39	13	133	3	44	11	0.8	<5	12	<5	0.145	2.90	583	<10	590	29	41	<20	<20	16	1.22	1.21	2.24	0.02	0.14	86	10	<2	16	2	<5	<10	0.02	8	
BL 11+100W	<5	31.24	0.3	35	12	103	2	39	9	0.6	<5	12	<5	0.119	2.63	466	<10	627	23	35	<20	<20	14	1.06	1.36	5.02	0.03	0.14	170	9	<2	15	2	<5	<10	0.02	5	
11+100W 9+850N	<5	30.81	<.2	20	14	107	2	28	9	0.7	<5	14	<5	0.041	2.64	383	<10	675	20	30	<20	<20	15	0.94	1.04	3.13	0.02	0.07	108	8	<2	15	2	<5	<10	0.01	2	
11+100W 9+900N	<5	30.12	<.2	37	13	113	2	38	10	0.7	<5	11	<5	0.114	2.77	545	<10	642	28	39	<20	<20	16	1.19	1.02	1.23	0.02	0.11	63	10	<2	15	3	<5	<10	0.01	4	
11+100W 9+950N	<5	32.07	<.2	32	15	117	3	36	10	0.8	<5	15	<5	0.092	2.77	517	<10	617	23	34	<20	<20	17	1.03	1.25	3.40	0.01	0.11	102	9	<2	13	2	<5	<10	0.02	3	
11+100W 10+050N	<5	31.49	0.2	29	10	86	2	37	8	0.3	<5	11	<5	0.102	2.31	356	<10	700	26	36	<20	<20	14	1.05	0.73	3.15	0.01	0.08	86	8	<2	10	2	<5	<10	0.01	2	
11+100W 10+100N	<5	30.77	0.3	43	9	81	2	51	9	0.4	<5	12	<5	0.151	2.33	388	<10	604	34	36	<20	<20	13	0.94	1.02	3.68	0.02	0.08	93	9	<2	10	2	<5	<10	0.02	2	
BL 11+150W	<5	30.71	0.3	35	12	101	2	37	9	0.7	<5	11	<5	0.123	2.59	477	<10	611	24	34	<20	<20	14	1.04	1.28	4.56	0.03	0.11	158	9	<2	15	2	<5	<10	0.02	5	
BL 11+200W	8	32.44	0.3	38	11	95	2	40	9	0.7	<5	11	<5	0.130	2.58	490	<10	686	25	35	<20	<20	15	1.04	1.13	4.54	0.02	0.12	144	9	<2	13	2	<5	<10	0.02	4	
11+200W 9+900N	6	31.37	<.2	25	14	82	2	28	8	0.4	<5	14	<5	0.063	2.31	434	<10	472	16	23	<20	<20	13	0.72	1.30	4.73	0.01	0.06	134	8	<2	10	2	<5	<10	0.02	4	
11+200W 9+950N	<5	31.42	0.3	33	14	119	3	38	9	0.7	<5	13	<5	0.097	2.58	458	<10	485	24	35	<20	<20	14	1.05	1.21	4.10	0.02	0.13	129	9	<2	13	2	<5	<10	0.02	3	
11+200W 10+050N	10	31.75	<.2	30	14	82	2	40	9	<.2	<5	17	<5	0.070	2.69	346	<10	563	26	32	<20	<20	19	0.95	0.84	2.07	0.02	0.07	69	11	<2	11	2	<5	<10	0.02	3	
BL 11+250W	8	30.80	0.2	33	14	112	3	37	9	0.8	<5	13	<5	0.097	2.96	439	<10	531	23	31	<20	<20	14	0.87	1.26	3.97	0.03	0.11	129	9	<2	11	2	<5	<10	0.02	5	
BL 11+300W	<5	32.64	0.3	35	13	110	3	37	10	0.7	<5	16	<5	0.122	2.66	472	<10	588	24	35	<20	<20	15	1.00	1.16	3.95	0.02	0.13	131	9	<2	12	2	<5	<10	0.02	4	
BL 11+350W	<5	30.23	0.2	31	11	82	2	45	9	0.6	<5	11	<5	0.124	2.17	459	<10	603	28	35	<20	<20	14	0.96	1.12	3.89	0.03	0.12	122	9	<2	10	3	<5	<10	0.02	3	
BL 11+400W	<5	30.47	0.5	37	10	77	2	49	9	0.5	<5	11	<5	0.154	2.22	453	<10	648	32	36	<20	<20	14	1.01	1.05	4.33	0.03	0.10	120	10	<2	10	2	<5	<10	0.02	3	
11+400W 9+850N	<5	31.68	0.3	32	19	86	2	32	9	0.3	<5	21	<5	0.068	2.75	454	<10	547	18	25	<20	<20	14	0.83	1.39	5.38	0.02	0.06	146	9	<2	11	2	<5	<10	0.02	2	
11+400W 9+900N	<5	30.09	<.2	35	11	113	3	39	10	0.9	<5	10	<5	0.144	2.59	564	<10	586	25	35	<20	<20	15	1.02	1.04	1.92	0.02	0.11	82	9	<2	13	2	<5	<10	0.02	6	
11+400W 9+950N	<5	30.72	<.2	31	12	103	2	42	10	0.3	<5	12	<5	0.099	2.82	481	<10	593	29	38	<20	<20	18	1.17	0.82	1.47	0.02	0.08	63	10	<2	13	2	<5	<10	0.02	3	
11+400W 10+050N	<5	31.22	<.2	30	9	78	1	46	8	0.7	<5	10	<5	0.128	2.14	411	<10	488	30	33	<20	<20	13	0.86	1.07	3.34	0.02	0.09	113	8	<2	9	2	<5	<10	0.03	4	
BL 11+450W	<5	31.53	<.2	24	9	67	2	42	8	1.3	<5	11	<5	0.102	1.97	394	<10	473	29	33	<20	<20	13	0.83	1.00	3.10	0.03	0.09	104	8	<2	8	2	<5	<10	0.03	3	
BL 11+500W	<5	31.50	0.3	34	8	58	1	45	9	1.0	<5	10	<5	0.141	2.04	351	<10	582	32	34	<20	<20	12	0.91	0.89	4.25	0.02	0.08	112	8	<2	8	2	<5	<10	0.03	2	
BL 11+550W	8	30.62	<.2	35	10	82	2	62	10	1.3	<5	13	<5	0.124	2.33	443	<10	525	42	39	<20	<20	15	1.03	1.16	3.35	0.02	0.10	102	9	<2	10	3	<5	<10	0.03	3	
BL 11+600W	<5	31.99	<.2	32	11	84	2	62	10	1.4	<5	12	<5	0.124	2.27	449	<10	520	43	37	<20	<20	15	0.94	1.20	2.76	0.02	0.11	96	8	<2	10	2	<5	<10	0.03	6	



Intertek Testing Services

Bondar Clegg

Geometrical Lab Report

CLIENT: MR. A. CARLOS

PROJECT: NONE GIVEN

REPORT: V99-00967.0 (COMPLETE)

DATE RECEIVED: 27-AUG-99

DATE PRINTED: 31-AUG-99

PAGE 1 OF 2

SAMPLE NUMBER	ELEMENT UNITS	Al ₂ O ₃	Ag	Cu	Pb	Zn	Mo	Ni	Co	Cd	Bi	As	Sb	Hg	Fe	Mn	Te	Ba	Cr	V	Sn	W	La	Al	Mg	Ca	Na	K	Sr	Y	Ga	Li	Nb	Sc	Ta	Ti	Zr
		PPB	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PCT	PCT	PCT	PCT	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM
73417		8	<.2	788	5	82	3	13	17	<.2	<5	<5	<5	0.399	5.57	989	<10	1044	59	97	<20	<20	11	2.19	1.47	1.21	0.07	0.07	28	8	6	25	6	12	<10	0.02	1
73418		389	1.5	52	254	20	5	12	4	<.2	13	6	<5	0.104	1.41	56	10	60	153	11	<20	<20	3	0.26	<.01	0.05	<.01	0.01	27	<1	<2	2	<1	<5	<10	<.01	2
73419		29	0.8	14	8	51	7	36	10	0.2	<5	29	31	2.153	1.24	89	<10	25	217	11	<20	<20	2	0.08	0.23	0.83	0.02	0.06	9	3	<2	2	<1	<5	<10	<.01	2
73421		<5	<.2	11	7	1	7	9	1	<.2	<5	5	<5	0.074	0.43	20	<10	38	213	6	<20	<20	<1	0.08	<.01	0.01	<.01	0.05	2	<1	<2	1	<1	<5	<10	<.01	<1



Intertek Testing Services
Bondar Clegg

**Ge 'hemical
Lab
Report**

CLIENT: MR. A. CARLOS
REPORT: V99-01456.0 (COMPLETE)

DATE RECEIVED: 09-NOV-99 DATE PRINTED: 15-NOV-99 PAGE 1 OF 2

PROJECT: NONE GIVEN

SAMPLE NUMBER	ELEMENT	Au30	Ag	Cu	Pb	Zn	Mo	Ni	Co	Cd	Bi	As	Sb	Hg	Fe	Mn	Te	Ba	Cr	V	Sn	W	La	Al	Mg	Ca	Na	K	Sr	Y	Ga	Li	Nb	Sc	Ta	Ti	Zr
	UNITS	PPB	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PCT	PCT	PCT	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM

V73430		<5	<.2	14	<2	3	1	12	3	<.2	<5	16	<5	0.033	0.52	36	<10	66	189	2	<20	<20	<1	0.05	<.01	0.02	<.01	0.03	5	<1	<2	<1	<1	<5	<10	<.01	2
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APPENDIX IV

SOIL SAMPLING OBSERVATIONS

BASELINE	Notes by A. Carlos
11+600W	gray silty clay - surface oxide - up cat escarpment to South for non - contaminated sample from dozer cut - 1 metre +
11+550W	gray silty clay - had to bar down - 0.8 metre - surface oxide
11+500W	gray-silty clay - surface oxide - had to bar down - 0.75 metre
11+450W	gray silty clay - surface oxide - had to bar down - 0.9 metre
11+400W	gray silty clay - surface oxide - somewhat rusty at sample depth - 0.75 metre
11+350W	gray silty clay - had to bar down - 0.75 metre
11+300W	dark gray silty clay - pebbles at bottom - 0.9 metre
11+250W	0.85 metre - light gray silty clay - pebbly at bottom - surface oxide
11+200W	light gray silty clay - pebbly at bottom - 0.85 metre - surface oxide
11+150W	light gray silty clay - more pebbly at depth - 1 metre + - surface oxide below ash - approx. 1'
11+100W	gray clay - good rusty section below ash - sample has fair rusty fleck's - 1 metre +
11+050W	gray clay - minor rounded pebbles at base - 1 metre - no ash
11+000W	gray brown clay - small rusty flecks - 1 metre - no ash
10+950W	gray brown clay - small rusty fleck's - 1 metre - no ash
10+900W	gray brown clay - more rust - some charcoal - 1 metre no ash

10+850W	gray brown clay - small rusty flecks - 1 metre + - a thin hematite section higher up - no ash
10+800W	gray brown clay - dark rusty sericitic bands at base - 1 metre - no ash
10+750W	gray brown clay - rust particulars at depth - sample has some humic material - 1 metre - no ash
10+700W	gray brown clay - fine dark rusty material at depth - beginning to feel gritty - 1 metre - no ash
10+650W	pass from dark rusty bands into yellow brown gritty clay - minor yellow to red rust at depth - minor ash at surface - 1 metre +
10+600W	ash surface - hole is quite pebbly - dark rusty humus rich silty clay at bottom - 1 metre
10+550W	ash 1ft. down - sample has good amount of orange-red fine clay - 1 metre - frost at base
10+500W	yellow brown fine silty clay - no ash - gritty at base - 1 metre +
10+450W	yellow brown silty clay - ash at surface - hole pebbly & tough throughout - minor orange-red blotches - 0.9 metre
10+400W	light gray-brown sample - surface ash - begins with silt-clay, pebbly at depth - 0.8 metre
10+350W	light brown sandy clay - no ash - 0.75 metre
10+300W	light brown clay silt - surface oxide below ash - minor orange-red oxide in sample - 0.75 metre
10+250W	dark brown-gray sandy material - minor rusty zone below surface ash - 1 metre

10+200W	gray-brown sandy gravel - some rust below surface ash - 1 metre
10+150W	brown sandy gravel - minor rust below surface ash - mostly barred down - 0.75 metre
10+100W	sandy light brown sample - minor oxide below surface ash - tough to auger 0.85 metre
10+050W	light brown silty -sandy - minor oxide below surface ash - 0.85 metre
10+000W	light brown silty-sandy - minor rust below surface ash - 0.85 metre
9+950W	light brown silty material - minor oxide below surface ash - orange-red splotches and <i>hematite</i> in sample - 0.85 metre
9+900W	light brown silty-sandy - oxide below surface ash - 0.85 metre
9+850W	light brown silty-sandy - surface ash & oxide - 0.9 metre
9+800W	silty - sandy material - surface ash & oxide - no pebbles throughout - 1 metre + - ice at bottom
9+750W	light brown silty material - surface ash & oxide - no pebbles - appears to be a lake bed or river sediment - 1 metre +
9+700W	surface ash + longer oxide interval - light brown silty clay - no pebbles - 0.9 metre - ice at bottom
9+650W	surface ash + oxide - had to bar down - large + small pebbles - till - 0.85 metre - one larger rock of K-spar rich intrusive
9+600W	surface ash to oxide - barred down 0.75 metre - light brown silty till
9+550W	surface ash to oxide - barred down 0.75 metre - light brown till
9+500W	surface ash & oxide - light brown silty clay - frozen bottom - 1 m.

9+450W	no ash - prominent surface oxide - augered down - <u>dark brown gritty clay for sample</u> - rusts spots throughout - 0.85 metre - ice
9+400W	surface ash + oxide - augered 0.8 metre - <u>dark brown gritty clay</u> - grit of quartz fragments - strange powdery white spots throughout sample
9+350W	surface ash + oxide - used bar - 0.85 metre - <u>dark brown gritty clay</u> - soft white powder spots - qtz. - collected several rusty fragments at bottom
9+300W	surface ash + oxide - used bar - 0.85 metre - <u>dark brown gritty clay</u> - rusty spots flecked throughout sample
9+250W	surface ash + oxide - bar - 0.85 metre - <u>dark brown gritty clay</u>
9+200W	surface ash + oxide - had to bar down - 0.8 metre - many pebbles - sample of gritty clay
9+150W	bar to 0.85 metre - ash & oxide zone - gritty brown clay - rust flecks through sample
9+100W	surface ash + oxide - bar to 0.75 metre - rust flecks through sample - gritty brown clay
9+050W	surface ash + oxide - bar to 0.70 metre - gritty brown clay
9+000W	surface ash + oxide - bar to 0.85 metre - gritty brown clay
8+950W	surface ash + oxide - bar to 0.85 metre - gritty brown clay
8+900W	surface ash + oxide - approx. 1 ft. of silt - than typical till - pebbly - augered to 0.9 metre - rust flecks through sample
8+850W	surface ash to oxide - 1½' of silt - barred to 0.9 metre - gritty brown clay - on slope to creek

8+800W	10' east to creek - <u>this is a creek sample</u> - augered 0.9 metre - minor humus in gritty material
8+750W	surface ash but no underlying oxide zone - gritty brown clay - bar & final auger - 0.9 metre
8+700W	surface ash - no oxide zone - bar and final auger - 0.85metre - gritty brown clay
8+650W	surface ash + oxide - bar & final auger 1 metre + - gritty brown clay
8+600W	surface ash + oxide - bar & auger 1 metre - gritty brown clay
8+550W	surface ash + oxide - bar & auger 1 metre - gritty brown clay
8+500W	surface ash + oxide - bar & auger 0.8 metre - gritty brown clay

CROSSLINES	Notes by Luke and Shane Carlos
Line 9+100W	
9+850N	ash layer - medium brown till - bar to 0.75 metres
9+900N	ash + oxide layer - medium brown till - bar to 0.75 metres
9+950N	ash + oxide layer - medium brown grainy till - rusty quartz fragments
10+050N	1 metre sand plus clay - ice at base
Line 9+200W	
9+800N	ash + oxide layer - tan silt - 1 metre
9+850N	ash + oxide layer - bar to 0.6 metre - large quartz fragments
9+900N	ash + minor oxide layer - light brown to dark gray clay rich till - quartz pebbles - 1 metre
9+950N	ash + minor oxide - fine grainy silt to silt at base - 1 metre
10+050N	bar plus auger - 0.75 metres - ash to medium brown till
Line 9+250W	
9+950N	ash to silt to very grainy silt - medium brown - 0.8 metre
Line 9+300W	
9+850N	ash to oxide - tan silt to grayish to black clay till - 0.65 metre
9+900N	ash to oxide - on to dark gray clay rich till - bar plus auger to 0.8 metre

9+950N	ash to oxide - tan silt streaked with orange oxide to sand to grayish clay till - 1 metre +
10+050N	ash plus oxide layer - tan silt mixed with red oxide to tan silt - 1 metre +
Line 9+350W	
9+950N	ash to oxide zone - light gray gritty soil - auger + bar to 0.8 metre
10+050N	ash to rusty silt to sandy grit - 1 metre +
Line 9+400W	
9+800N	ash to silt with orange + red oxides to gray silt - 1 metre +
9+850N	ash to oxide zone - gritty till - more clay rich at base - 0.8 metre
9+900N	ash to silt with rusty streaks - to black clay to gritty brown clay
9+950N	ash to oxide zone - larger till fragments make it tough to auger - rusty till - 1 metre
10+050N	ash to oxide zone - fine sand the rest of it - 1 metre +
Line 9+500W	
9+850N	fine silt to dark gray clay at bottom - 1 metre +
9+900N	ash to minor section of tan silt - brown till difficult to auger - bar to 0.75 metre
9+950N	surface oxides to fine gritty dark gray soil - 0.9 metre
10+050N	surface ash to oxide - very fine silt to gray grit at bottom - 1 metre +

Line 9+600W	
9+850N	surface ash to oxide - light brown till - bar + auger to 0.75 metre
9+900N	surface ash to minor oxide - brown till - bar + auger to 0.75 metre
9+950N	surface ash to silt - gritty clay rich till at base - 0.8 metre
10+050N	surface ash to silt - gritty brown till at base - 0.9 metre
Line 9+750W	
9+800N	surface ash to oxide - remainder rusty silt to gravelly silt - 0.85 metre
9+850N	surface ash to fine oxide to a gravelly orange oxide zone - base of brown, fine gritty till - mainly barred to 0.75 metre
9+900N	surface ash to oxide - gets more gritty at base - 1 metre +
9+950N	surface ash to oxide - gravelly brown clay (crumbly) with rust fragments which are not visible at base - 0.8 metre
10+050N	surface ash to silt to a gritty brown till - 0.9 metre
Line 9+850W	
9+950N	surface ash to oxide - gritty gray fine till at base - 1 metre +
Line 9+900W	
9+750N	surface ash to oxide - coarse brown till - bar to 0.7 metre
9+800N	surface ash to oxide - brown till - bar to 0.75 metre
9+850N	surface ash to oxide - fine silt to base - 1 metre +
9+900N	surface ash to oxide - light brown gritty till - auger & bar to 0.8 metre

9+950N	surface ash to a dark orange oxide zone - gray brown silt to frost at base - 0.9 metre
10+050N	ash to a gritty gray - brown till - 0.75 metre with bar & auger
Line 10+000W	
9+700N	ash to gritty till - bar to 0.75 metre
9+750N	surface ash to oxide - very gritty gray clay - 0.95 metre
9+800N	ash to gritty gray till - 0.7 metre
9+850N	surface ash to thick oxide zone - tan silt to gray at base - 1 metre +
9+900N	ash to brown coarse till - 0.8 metre
9+950N	surface ash to oxide - gritty brown till - bar & auger to 0.7 metre
10+050N	ash to light brown silt - gritty till at base - 1 metre +
Line 10+600W	
9+900N	gritty gray brown till - bar to 0.6 metres
9+950N	gritty gray brown till - bar to 0.65 metres
10+050N	dark gray clay - permafrost - 0.75 metre
10+100N	surface ash to oxide - tan silt to a gray clay rich silt with rust particles - 1 metre +
Line 10+700W	
9+850N	surface ash to a gritty oxide zone to a gritty tan till - 0.9 metres
9+900N	surface ash to a brown till - 0.9 metres

9+950N	surface ash to gritty till with patchy oxide - base a dark brown till - 1 metre +
10+050N	surface ash to gray silt - 1 metre +
10+100N	surface ash to gray clay ending in humus to permafrost - 0.8 metre - clay was sampled above humus
Line 10+800W	
9+850N	surface ash to gray silt to gritty gray with rusty quartz - 0.85 metre
9+900N	surface ash to very dark rust oxide zone - base of gritty tan silt with black clay - 1 metre +
9+950N	surface ash to a light brown clay silt - base of tan gritty till with rust particles - 1 metre + - above outcrop
10+050N	no ash layer - dark gray clay - 1 metre +
10+100N	surface ash to purple-black oxide zone - clay rich silt to humus - sample taken above humus - 1 metre +
Line 10+900W	
9+800N	surface ash to brown silt to a gray gritty clay - 0.7 metre
9+850N	no ash to brown gray clay rich silt to permafrost - 0.85 metre
9+900N	no ash to brown clay rich silt to a red brown clay silt rich in humus - 0.85 metre
9+950N	no ash - gray clay to permafrost - 0.6 metre
10+050N	no ash - a red black humus surface layer to a brown clay with bright orange rusty bits - purple black humus mixed with clay at base - 1 metre

10+100N	ash to a gritty red orange oxide zone to gritty tan - base a gritty material with a greenish tinge - 0.85 metre
Line 11+000W	
9+850N	humus - ash to humus permafrost - 0.5 metre - a humus sample
9+900N	humus to dark gray clay to permafrost - 0.85 metre
9+950N	ash to gray clay silt with purple tinge - 0.9 metre
10+050N	ash layer to gritty fine material to a silty clay - 1 metre +
10+100N	surface ash to gritty orange red oxide zone - gritty tan brown at base - 0.9 metre
Line 11+100W	
9+850N	surface ash to silt to permafrost - 0.7 metre
9+900N	surface ash to silty clay with streaks of iron oxide - base of gray silty clay - 0.7 metre
9+950N	dark gray clay to permafrost - 0.85 metre
10+050N	surface ash to an orange oxide zone - light brown till at base - 0.8 metre
10+100N	surface ash to oxide - base of light brown till - 0.9 metre
Line 11+200W	
9+900N	surface ash to oxide zone - gray silt - 1 metre
9+950N	surface ash to a gritty orange oxide zone - gritty gray clay at base - 1 metre

10+050N	surface ash to gritty red orange oxide zone - gritty silt at base - 0.9 metre
Line 11+400W	
9+850N	surface ash to a golden tan silt - clay rich silt at base - 1 metre +
9+900N	surface ash to oxide - tan clay rich silt at base - 1 metre +
9+950N	surface ash to oxide - clay rich till - bar & auger to 0.85 metre
10+050N	surface ash to oxide to brown till - 0.9 metre

LITTLE SALMON LAKE AREA

PROSPECTING PROGRAM

SUMMARY REPORT (1999)

N.T.S. 105L

by

Allen M. Carlos

Discussions

Fig. I and II essentially show this past summer activities. I will only discuss those areas that I believe warrant further attention.

Fig. I shows the location of gov't. geo-chem sites 3166, 3167 and 3168. They are all anomalous in Au and indicators relative to other sites in the area. Rock sample 21917 is of limonite stained and silicified qtz. sericite schist. Upon cutting, quartz vein stockwork is very evident. Analysis determined 27 ppb Au and anomalous Ag-Pb. At position T on Fig. I is a very rusty small drainage. Gov't. geochemistry together with rock sample 21917 indicates the area needs attention. However, it will involve grid geophysics and geochemistry. At this moment I couldn't sell a project like this!

Sample site V73424-6 is indicated on Fig. II. The degree of silicification, pyritization and surface leaching is attention grabbing. Gov't. silt sample 1077 reflects the highest Hg and Sb value in the general area. Sample no. 44- of weathered gravely material derived from highly silicified and leached sediments - is anomalous in Hg-Cu and Sb, but not Au. This correlates well with identical higher values in gov't. sample no. 1077. However, I am not yet satisfied. Next summer, the panning of some pits down-drainage should settle whether there are any precious metals around. It is possible that the intense surface leaching at the discovery site may have removed any Au. Another possibility may be that Au-Ag mineralization may occur proximal to the above area of intense alteration.

Prospecting Notes

June 7 - Dig II - Took 4x4 to point E.

F = Chlorite schist - strong folding - very gossanous -
GPS at N-6899062
E-519483

June 8 - A + J: Float - foliated biotite felds.

Porphyry - a portion of it mineralized with
pyrrhotite and minor $CuFeS_2$.

A + K: Float - rusty surface - tough to break -
pyrrhotite + minor $CuFeS_2$ - non magnetic.

A + N: Chlorite schist - qtz. along foliation.

A + L: A limbo, chlorite rich material -
epidote present in bands of nefery quartz
along foliation. It is slightly magnetic - likely
the cause of a subtle grav. mag. anomaly.

A + rock sample 21916: 2 float boulders -
well mineralized - pyrrhotite and $CuFeS_2$.

A + G: A foliated biotite felds. porphyry -
pyrrhotite with minor $CuFeS_2$.

June 9 - Walk up trail to tower site at M. Prospects
along branch of slope to west-northwest: Quartzite

plus quartz, albite schist. A concentration of more felsic (pink) rocks occurs just downstream from tower site. Perhaps it is the horizon hosting sulphides along the highway (discussed by M. Colpron-98).

June 11 - On highway - GPS E = 512828. A diopside horn with qtz. masses. D_1 about 30' thick - trending N60°W. No albite by U.V. light. Immediately to west occurs a foliated intrusion - likely cause of horn formation. Spent some time in creek - a year ago a albite occurrence was supposedly discovered in this vicinity.

June 11
At O: (Fig I) - Sericite and biotite rich schists along creek. At O occurs a very unique exposure. It is either a vuggy weathering dolomite or perhaps intense carbonate alteration of an unknown rock type.

At P: A good exposure of pyrrhotite rich hornfels with $CaFeS_2$. Followed creek to highway - where hornfels with minor chloropyrite occur thru-out.

June 23 Fig I - I drove to sample # 21915. Despite the steep slope - only takes to see - quartzite and micaite schists. At 21915: A punky-brown weathering, thinly foliated schist - breaking it across. Section exposes a good amount of laminar horworks. Saw a little remnant Chalcopyrite. No R-limestone. S is another limestone exposure (viciously silicified), but no other alteration or mineralization from the granitic intrusion. Followed edge of intrusion to h-way.

June 25 (Fig I) - From highway at west end of ditto Salmon lake to Northwest end camp, no outcrop in this low section.

June 26 - West to location V. Gert. Geo-chem together with magnetics pulled me in here. Poor exposure. At V: metal predominant. What to be a been weathering (Cassiterite type)? It responds positively to a hard held magnet and is the likely cause of the coincident Gert. mag. expression. Much gneiss sign along creek!

June 27 - North of camp to U - the location of a

Small gvt. mag. exposure. GPS N-6902648
E-495800

Located outcrop of a mafic rich unit with
pyrite and magnetite. It has a gneissic character.

Gvt. Geo-chem. Mt. Sample No. 163167 is anomalous
in Au+, no out North to prospect creek. Rock

Sample No. 21917 - GPS N-6903700
E-494000

- An outcrop of limonite stained, pervasively
silicified Qtz. matrix schist. It appears to have
a Qtz. network. Inverse to T - GPS - N6902660
E-4904070

Deep willows here - no GDI help! A more
intermittent drainage is very limonite stained.
On to camp. No exposure.

June 27 - Back to creek between T and U -
marked on Fig. I. Hoping to find exposure to
explain rusty drainage noted yesterday. Tough
hike and no outcrop!

Aug. 26 - See Fig II

Cutting some new ledges up
hill to B - Start seeing blocks of quartzite on float -

On to A - outcrop of Quartzite - fine matrix.
Mention A and B3 no outcrop - but float is
Mainly Quartzite to Quartz vein material.

August 27 - Westerly to GNS Station N-6902363
E-521243

Very interesting, poorly exposed area of silicified
One pelphite's local bediment.

Soil sample no. 43 - from dry limonite gully.

Soil sample no. 44 - rusty - poorly weathered silicified
Section - to west of #43. Checked down slope for
some distance - then to southeast.

Aug. 28 Northwesterly - discovered very large - massive
Quartz float - limonite stained along numerous fractures -
Rock sample no. V73423. Drove to northwest and
back to discovery of 27th; Numerous rough Qtz. float,

Aug. 29 - V73424 - porous - rusted out very siliceous
bediment - may have been a Qtz. schist or crystallite.

V73425 - Vein Quartz - vuggy - reaction
about rubble of gully.

V73426 - Distinct carbonate colored igneous

rich - much pyrite - Fractures + Disseminated. Located
approx 200' west of caliche rock samples.

Area is intensely silicified and surface
covered of sulphides. The only sulphides noted
were in the altered igneous rock no. V33426.

August 20 - From Mining area of yesterday - made
loop to west and south to prospect a subtle
part. very anomalous. Also - some claims were staked
here years ago. Noted much vein qtz. Slight -
Nothing visually interesting enough to assay.

August 21 - Drove to south and left to small
pond at A. Again - angular quartz, Slight is
dominant - no outcrop.

Aug. 22 - Loop to C to check a sharp topographic
high just east of the small pond. Outcrop is
of a isolated greenstone. Found an old survey
tripod atop this hill - geological survey?

Sept. 1 - Down Creek to north - then back
to creek - no exposure.

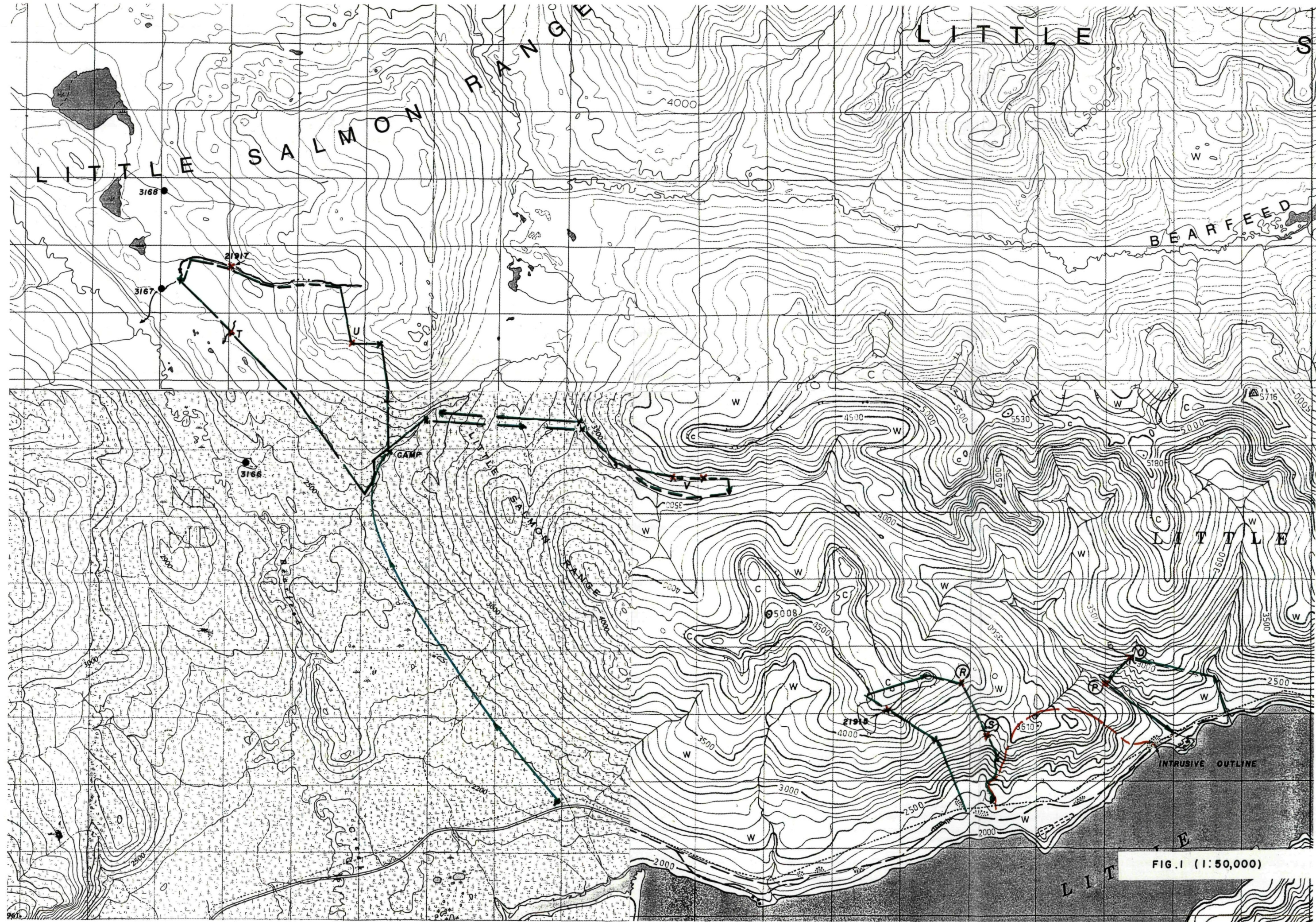


FIG. 1 (1:50,000)



FIG. 2 (1:50,000)



Intertek Testing Services

Bondar Clegg

Geochemical Lab Report

REPORT: V99-01066.0 (COMPLETE)

REFERENCE:

CLIENT: MR. A. CARLOS
PROJECT: NONE GIVEN

SUBMITTED BY: A. CARLOS
DATE RECEIVED: 15-SEP-99 DATE PRINTED: 20-SEP-99

DATE APPROVED	ELEMENT	NUMBER OF ANALYSES	LOWER DETECTION	EXTRACTION	METHOD
990917	1 Au30 Gold	6	5 PPB	Fire Assay of 30g	30g Fire Assay - AA
990917	2 Ag Silver	6	0.2 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	3 Cu Copper	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	4 Pb Lead	6	2 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	5 Zn Zinc	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	6 Mo Molybdenum	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	7 Ni Nickel	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	8 Co Cobalt	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	9 Cd Cadmium	6	0.2 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	10 Bi Bismuth	6	5 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	11 As Arsenic	6	5 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	12 Sb Antimony	6	5 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	13 Hg Mercury	6	0.010 PPM	HCL:HNO3 (3:1)	COLD VAPOR AA
990917	14 Fe Iron	6	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	15 Mn Manganese	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	16 Te Tellurium	6	10 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	17 Ba Barium	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	18 Cr Chromium	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	19 V Vanadium	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	20 Sn Tin	6	20 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	21 W Tungsten	6	20 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	22 La Lanthanum	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	23 Al Aluminum	6	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	24 Mg Magnesium	6	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	25 Ca Calcium	6	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	26 Na Sodium	6	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	27 K Potassium	6	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	28 Sr Strontium	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	29 Y Yttrium	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	30 Ga Gallium	6	2 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	31 Li Lithium	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	32 Nb Niobium	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	33 Sc Scandium	6	5 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	34 Ta Tantalum	6	10 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	35 Ti Titanium	6	0.01 PCT	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA
990917	36 Zr Zirconium	6	1 PPM	HCL:HNO3 (3:1)	INDUC. COUP. PLASMA

SAMPLE TYPES	NUMBER	SIZE FRACTIONS	NUMBER	SAMPLE PREPARATIONS	NUMBER
T STREAM SED, SILT	2	1 -80	2	CRUSH/SPLIT & PULV.	4
R ROCK	4	2 -150	4	DRY, SIEVE -80	2

REPORT COPIES TO: MR. A. CARLOS

INVOICE TO: MR. A. CARLOS

 This report must not be reproduced except in full. The data presented in this report is specific to those samples identified under "Sample Number" and is applicable only to the samples as received expressed on a dry basis unless otherwise indicated



Intertek Testing Services

Bondar Clegg

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DATE RECEIVED: 15-SEP-99

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PAGE 1 OF 2

SAMPLE NUMBER	ELEMENT UNITS	Al ₂ O ₃	Ag	Cu	Pb	Zn	Mo	Ni	Co	Cd	Bi	As	Sb	Hg	Fe	Mn	Te	Ba	Cr	V	Sn	W	La	Al	Mg	Ca	Na	K	Sr	Y	Ga	Li	Nb	Sc	Ta	Ti	Zr
		PPB	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PCT	PCT	PCT	PCT	PPM	PPM	PPM	PPM	PPM	PPM	PCT	PPM	
43		<5	<.2	32	11	38	<1	17	8	0.3	<5	<5	<5	0.508	1.26	229	<10	67	9	9	<20	<20	15	0.33	0.12	0.08	<.01	0.03	5	9	<2	2	<1	<5	<10	<.01	1
44		<5	<.2	80	19	59	<1	40	20	0.8	<5	<5	19	1.098	1.45	456	<10	82	10	6	<20	<20	9	0.18	0.04	0.02	<.01	0.01	5	17	<2	1	<1	<5	<10	<.01	<1
73423		<5	<.2	5	11	37	1	9	<1	<.2	<5	<5	<5	0.015	0.54	34	<10	7	312	2	<20	<20	<1	0.02	0.01	<.01	<.01	<.01	1	<1	<2	<1	<1	<5	<10	<.01	1
73424		<5	<.2	28	6	15	2	10	3	<.2	<5	<5	<5	0.269	1.00	32	<10	352	213	8	<20	<20	8	0.30	0.03	<.01	<.01	0.09	2	3	<2	1	<1	<5	<10	<.01	6
73425		<5	<.2	8	3	9	2	11	2	<.2	<5	<5	<5	0.120	0.56	41	<10	94	372	5	<20	<20	3	0.09	0.02	<.01	<.01	0.03	1	1	<2	<1	<1	<5	<10	<.01	3
73426		<5	0.4	3	<2	25	<1	1133	40	<.2	<5	<5	17	0.255	7.53	1094	<10	62	1295	39	<20	<20	<1	0.61	6.46	9.00	<.01	<.01	872	2	<2	13	<1	12	<10	<.01	<1



CERTIFICATE OF ANALYSIS

iPL 99G0548

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INTERNATIONAL PLASMA LABORATORY LTD.

Client : Northern Analytical Laboratories
 Project: WO#05674

1 Samples
 1=PuTp

[054809:43:14:99070699]

Out: Jul 06, 1999
 In : Jul 02, 1999

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Sample Name	Ag ppm	Cu ppm	Pb ppm	Zn ppm	As ppm	Sb ppm	Hg ppm	Mo ppm	Tl ppm	Bi ppm	Cd ppm	Co ppm	Ni ppm	Ba ppm	W ppm	Cr ppm	V ppm	Mn ppm	La ppm	Sr ppm	Zr ppm	Sc ppm	Ti %	Al %	Ca %	Fe %	Mg %	K %	Na %	P %
21917	1.1	6	144	123	21	<	<	<	<	<	5.7	8	14	43	<	100	14	232	12	16	4	4	<	0.39	2.10	1.80	0.20	0.06	0.04	0.04

Min Limit	0.1	1	2	1	5	5	3	1	10	2	0.1	1	1	2	5	1	2	1	2	1	1	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Max Reported*	99.9	20000	20000	20000	9999	999	9999	999	999	9999	99.9	9999	9999	9999	999	9999	9999	9999	9999	9999	9999	9999	1.00	9.99	9.99	9.99	9.99	9.99	5.00	5.00

30/06/99

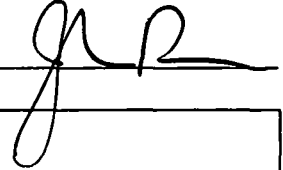
Certificate of Analysis

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Al Carlos

WO# 05674

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Sample #	Au ppb
21917	27

24/06/99

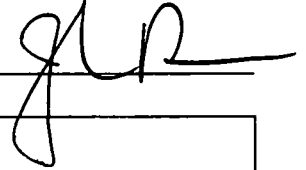
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Sample #	Au ppb	Ag ppm	Cu ppm	Pb ppm	Zn ppm
r 21915	11	0.5	175	36	365
r 21916	<5	0.4	461	5	34