EXPLORATION

WESTERN CANADA

ASSESSMENT REPORT

COMBINED HELICOPTER-BORNE MAGNETIC AND ELECTROMAGNETIC SURVEY AND SOIL GEOCHEMICAL SURVEY

COAL PROPERTY

(Coal 1-168: YB53186-YB53564)
(Coal 169-196: YB53326-YB53353)

NTS 116 C/8

LAT. 64°26'N; LONG. 140°20'W

Period of Work

(June 9 and Aug 16-22, 1995)

May 23, 1996

K. R. Pride

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF MAPS

The survey data are presented in sets of numbered maps in the following format:

BLACK LINE MAPS: (Scale 1:20,000)

Map No.	Description
1-1	Base Map; screened topographic base map plus survey area boundary, and UTM grid.
1-2	TOTAL FIELD MAGNETIC CONTOURS; with base map and flight lines.
1-3	HEM OFFSET PROFILES; coaxial 935 Hz data with flight lines, base map and EM anomaly symbols.
1-4	HEM OFFSET PROFILES; coaxial 4,600 Hz data with flight lines, base map and EM anomaly symbols.
1-5	CLAIM MAP: (1:50,000)
1-6	GEOCHEM MAP: (1:20,000)

I. GEOPHYSICAL REPORT

1. INTRODUCTION

The Coal property was staked in May, 1995 to cover drainage basins highlighted by a 1978 RGS survey to be anomalous in Cu/Zn/Pb. This report describes a 248 line km airborne geophysical survey flown over the Coal Property for Cominco Exploration by Aerodat Inc. Principal geophysical sensors include a five frequency electromagnetic system and a high sensitivity cesium vapour magnetometers. Ancillary equipment consists of a colour video tracking camera, a Global Positioning System (GPS) for navigation, a radar altimeter and a base station magnetometer.

Block No.	Date Flown	No. of Flights	Line Direction	Area km^2	Line km.	NTS
1-Coal	June 9	2	15°	74	248	116 C/8

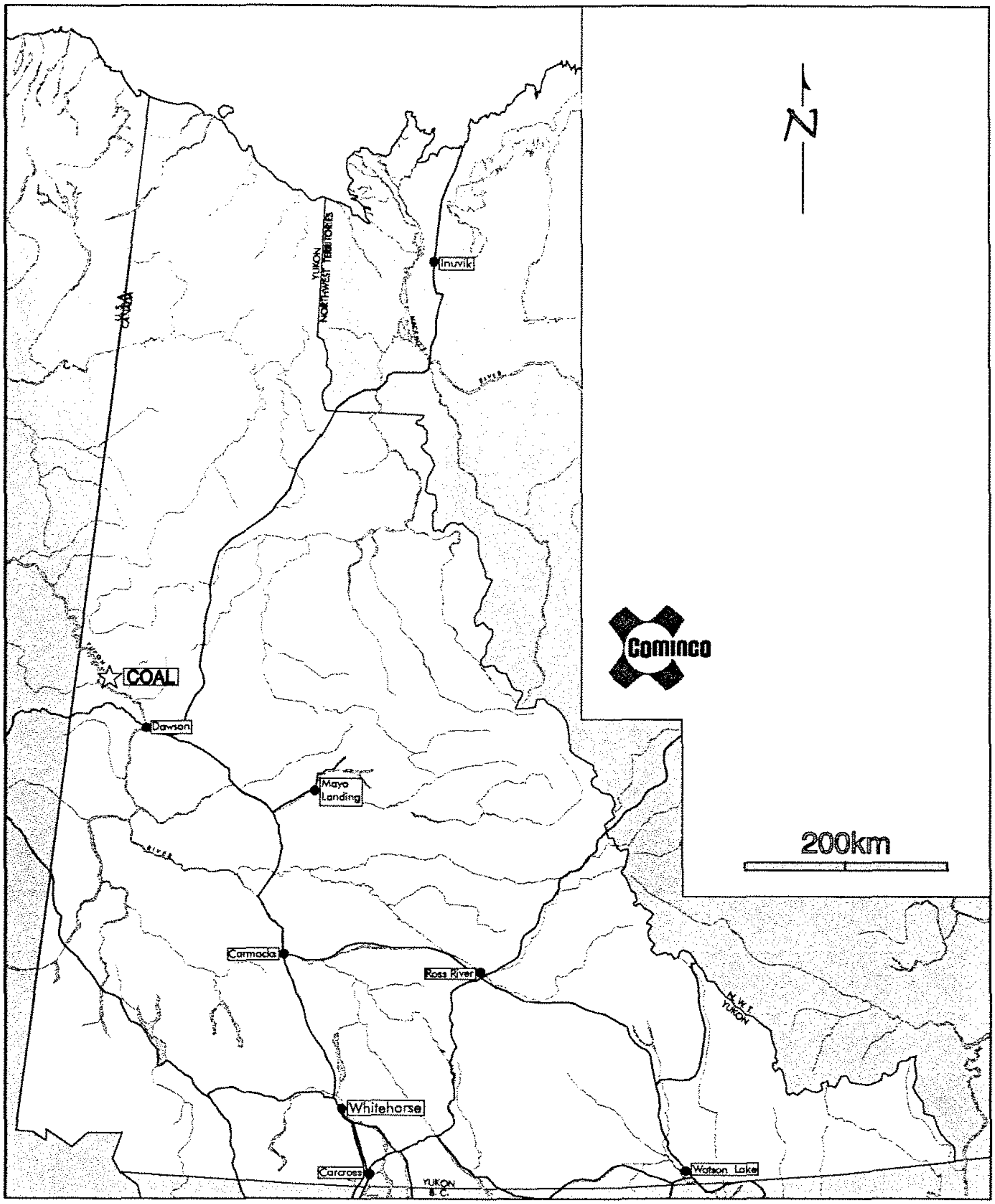
2. SURVEY AREA

The survey block is located approximately 60 km west-northwest of Dawson. Topography is shown on the 1:20,000 scale NTS map (plate:1-1 attached). Local relief is characterized by generally steep-sided stream valleys and rounded hill tops. Elevations range from about 600 m to over 1,250 m. The flight line direction is north-south.

3. SURVEY PROCEDURES

The survey of the Coal Property was completed on June 9, 1995. A total of 2 survey flights were required to complete the project as detailed in the previous table. Aircraft ground speed is maintained at approximately 60 knots (30 metres per second). The nominal EM sensor height is 30 metres (100 feet), consistent with the safety of the aircraft and crew. A global positioning system (GPS) consisting of Magnavox MX 9212 operated in differential mode guides aircraft navigation and flight line control. Field processing of the differential GPS data in the field utilizes a PC using software supplied by the manufacturer. One system is installed in the survey helicopter. This involved mounting the receiver antenna on the tail boom. A second system acts as the base station.

The published NTS maps provide the UTM coordinates of the survey area corners. These coordinates program the navigation system. A test flight confirms if area coverage is correct. Thereafter the navigation system guides the pilot along the survey traverse lines marked on the topographic map. The operator also enters manual fiducials over prominent topographic features. Survey lines showing excessive deviation are re-flown. The aircraft position is registered by the navigation system.



Drawn by:		Traced by: a. m. a.	
Revised by:	Date:	Revised by:	Date:

COAL PROPERTY
Location Map

Scale: As Shown | Date: Dec. 13.1995 | Figure 1

Drawn by:		Traced by:	
Revised by	Date	Revised by	Date

COAL PROPERTY LOCATION MAP

Scale: 1:250,000	Date: DEC. 13, 1995	Figure 2

The operator calibrates the geophysical systems at the start, middle (if required) and end of every survey flight. During calibration the aircraft is flown away from ground effects to record electromagnetic zero levels.

4. DELIVERABLES

The maps and report on the results of the survey is presented in two copies. The black line maps show topography, UTM grid coordinates and the survey boundary. A full list of all map types is at the beginning of this report. A summary follows:

BLACK LINE PLATES

1-1	Base Map
1-2	Total Field Magnetic Contours
1-3	HEM Offset Profiles - 935 Hz
1-4	HEM Offset Profiles - 4,600 Hz

5. AIRCRAFT AND EQUIPMENT

5.1 Aircraft

The survey aircraft was an Eurocopter AS350BA helicopter, piloted by K. Hyllestao, owned and operated by Peace Helicopters Ltd. of Peace River, Alberta. M. Barry of Aerodat acted as navigator and equipment operator. Aerodat performed the installation of the geophysical and ancillary equipment. The survey aircraft flies at a mean terrain clearance of 60 metres (200 feet).

5.2 Electromagnetic System

The electromagnetic system is an Aerodat five frequency configuration. This survey utilized the Hornet bird which has frequencies of 917 Hz and 4,507 Hz for the coaxial coil pairs and 867 Hz, 4,127 Hz and 32,330 Hz for the coplanar coil pairs. The transmitter-receiver separation is seven metres. Inphase and quadrature signals are measured simultaneously for the five frequencies with a time constant of 0.1 seconds. The HEM bird is towed 30 metres below the helicopter.

5.3 Magnetometer

A Scintrex H8 cesium, optically pumped magnetometer sensor, measures the earth's magnetic field. The sensitivity of this instrument is 0.001 nanoTesla at a sampling rate of 0.2 seconds. The sensor is towed in a bird 15 metres below the helicopter 45 metres above the ground.

5.4 Ancillary Systems

Base Station Magnetometer

An IFG-2 proton precession magnetometer is set up at the base of operations to record diurnal variations of the earth's magnetic field. The date, time and current total field magnetic value are automatically recorded every 10 minutes.

Radar Altimeter

A King KRA-10 radar altimeter records terrain clearance. The output from the instrument is a linear function of altitude.

Tracking Camera

A Panasonic colour video camera records the flight path on VHS video tape. The video tape also shows the flight number, 24 hour clock time and manual fiducial number.

Global Positioning System (GPS)

The GPS is a U.S. Department of Defense program that provides world-wide, 24 hour, all weather position determinations. GPS consists of three segments: 1) a constellation of 24 satellites, 2) ground stations that control the satellites, 3) a receiver.

Analog Recorder

An RMS dot matrix recorder displays the data during the survey. Data is recorded with positive- up and negative- down. The analog zero of the radar altimeter is 5 cm from the top of the analog record. A helicopter terrain clearance of 60 m should therefore be seen some 3 cm from the top of the analog record. Chart speed is 2 mm/second and the 24 hour clock is printed every 20 seconds. The total magnetic field value is printed every 30 seconds. The ranges from the radar navigation system are printed every minute.

Digital Recorder

A DGR-33 data system records the digital survey data on magnetic media.

6. DATA PROCESSING AND PRESENTATION

6.1 Base Map

The base map is taken from a photographic enlargement of the NTS topographic maps. A UTM reference grid (lines every kilometre) and the survey area boundary are added.

6.2 Flight Path Map

The GPS receiver takes in coded data from satellites in view and there after works out the range to each satellite. The coded data must therefore include the instantaneous position of the satellite relative to some earth-fixed coordinate system. Normally the receiver must see 4 satellites for a full positional determination; the position of the receiver is updated every second. The horizontal position accuracy is 25 m but the system may be degraded for civilian use and the autonomous accuracy is then 100 m. However, using two GPS receivers simultaneously, differential corrections can determine a position accuracy of 5 m. The flight path map is drawn using linear interpolation between x, y positions from the navigation system. These positions are updated every second (or about 1.5 m at a scale of 1:20,000). These positions are expressed as UTM eastings (x) and UTM northings (y). The flight path map is merged with the base map by matching UTM coordinates from the base maps and the flight path record. The match is confirmed by checking the position of prominent topographic features as recorded by the manual fiducial marks or as seen on the flight path video record.

6.3 Electromagnetic Data

The electromagnetic data are recorded digitally at a sample rate of 10 per second with a time constant of 0.1 seconds. A two stage digital filtering process rejects major sferic events and reduces system noise.

Local sferic activity can produce sharp, large amplitude events that cannot be removed by conventional filtering procedures. Smoothing or stacking will reduce their amplitude but leave a broader residual response that can be confused with geological phenomena. To avoid this possibility, a computer algorithm searches out and rejects the major sferic events. The signal to noise ratio is further enhanced by the application of a low pass digital filter. This filter has zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only variations with a wavelength less than about 0.25 seconds. This low effective time constant gives minimal profile distortion.

Following the filtering process, a base level correction is made using EM zero levels determined during high altitude calibration sequences. The correction applied is a linear function of time that ensures the corrected amplitude of the various inphase and quadrature components is zero when no conductive or permeable source is present. The filtered and levelled data is the basis for determination of apparent resistivity.

6.4 Total Field Magnetics

The aeromagnetic data are corrected for diurnal variations by adjustment with the recorded base station magnetic values. No corrections for regional variations are applied. The corrected profile data are interpolated on to a regular grid using an Akima spline technique. The grid provided the basis for threading the presented contours. The minimum contour interval is 2 nT with a grid cell size of 25 m.

7. ELECTROMAGNETIC ANOMALY SELECTION

Usually two sets of stacked colour coded profile maps of one coaxial and one coplanar inphase and quadrature responses are used to select conductive anomalies of interest. Selection of anomalies is based on conductivity as indicated by the inphase to quadrature ratios of the 935 Hz and/or 4,600 Hz coaxial data, anomaly shape, and anomaly profile characteristics relative to coaxial and corresponding coplanar responses (see discussion and figure in Appendix II). It is difficult to differentiate between responses associated with the edge effects of flat lying conductors and actual poor conductivity bedrock conductors on the edge of or overlain by flat lying conductors. Poor conductivity bedrock conductors having low dips will also exhibit responses that may be interpreted as surficial overburden conductors. In such cases, where the source of the conductive response appears to be ambiguous, the anomaly is still selected for plotting. In some situations the conductive response has line to line continuity and some magnetic association thus providing possible evidence that the response is related to an actual bedrock source.

The calculation of the depth to the conductive source and its conductivity is based on the 4,600 Hz data assuming a thin vertical sheet model. The amplitude of the inphase and quadrature responses are used for the calculations which are automatically determined by computer. These data are listed in appendix III and the depth and conductivity values are shown with each plotted anomaly. Further detailed discussion and illustration of the determination of these values is contained in Appendix II.

The selected anomalies are automatically categorized according to their conductivity and amplitude. The calculation of the conductivity of low amplitude anomalies can be very inaccurate. Therefore, anomalies having amplitudes below a certain level and/or low conductivity value are given a zero rating with the category increasing for increasing conductivity values that are statistically reliable.

Very conductive flat lying material is contributing to the electromagnetic responses in some of the areas. These areas are characterized by identically shaped coaxial and coplanar response profiles. This is a typical response shape usually seen over a flat lying conductor as illustrated in Appendix II, in the figure entitled "HEM Response Profile Shapes ....." profile I. These areas are best defined on resistivity map products. In the more conductive flat lying zones HEM intercepts at response peaks have been chosen to show the conductivity levels associated with these flat lying sources.

Flat ribbon type sources are characterized by a M shaped coaxial anomaly with a single peaked coplanar anomaly centred in the trough between the two coaxial peaks. This is illustrated in Appendix II in the same figure as previously mentioned (see profile shale E and G). The coaxial peak of these types of profiles are picked for plotting. They generally define the edge of the conductive source.

7.1 Interpretation

Two large areas of conductivity (labelled C and D) roughly trending N100°E are visible in the EM data. They each comprise several parallel zones of variable conductivity. Zone C is up to 800 m wide. It correlates with a magnetic low in the west and is located along a broad magnetic gradient in the east. The anomaly projects onto a steep north facing slope.

Zone D is broader than Zone C and it is situated over Coal Creek and its tributaries. Several broad and more defined magnetic highs correlate with it but the strongest mag.

peaks are offset from the EM peaks. Some of the strongest conductor intercepts can be interconnected but do not show a mag. correlation.

More interesting, though not top priority, are Zones A and B. Zone A is a 2+ kms long a mainly single conductor striking N70°E, correlatable with a mag. low. Zone B is a two-line conductor without a magnetic association located near the edge of a N-S ridge which may be fault bounded (E-W). This feature is, geophysically speaking, the only one of interest in this grid area. Portions of Zones C and D will have to be upgraded by means by geochem, or prospective geology.

This report compiled by
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July 21, 1995

II. GEOCHEMISTRY

1. SUMMARY

Between August 16 and 22, 1995, a geochemical survey was carried out on the Coal Property. Contour soil and silt sampling was designed to follow-up drainage basins anomalous in Cu/Zn/Pb which were outlined by a 1978 RGS survey and to investigate airborne mag and EM conductors outlined by the June 9, 1995 Aerodat geophysical survey. Geologically, the claims are underlain by the Nasina Assemblage which consists of Devon.-Mississippian black meta-pellites, quartzites and thin felsic meta-tuffs.

Geophysical anomaly, Zone A, a 2+ km long conductor striking N70E is offset from a mag anomaly of the same orientation. Down slope of the mag anomaly, prospecting located float boulders of barite-quartz-magnetite. Contour soil sampling up-slope of the float failed to detect anomalous Cu/Zn/Pb. Contour soil sampling across the strike of geophysical anomalies: Zones B, C and D failed to detect any Cu/Zn/Pb anomalies. Additional soil geochemistry and geological mapping is recommended along the strike length of the geophysical anomalies.

2. LOCATION

The Coal Property (NTS:116C-8) is located 10 km east of Forty Mile, between Coal Ck. and the Yukon River. Access is by helicopter or river boat from Dawson City, 60 km to the southeast. The property is heavily vegetated with moss-mat, buck-brush and black spruce which limits rock exposures to less than 1%.

3. TENURE

The Coal Property is 100% owned by Cominco Ltd. and comprises 196 mineral claims. The Coal 1-168 claims, having record numbers YB53186-YB53564, were recorded on May 15, 1995 and the Coal 169-196 claims, having record numbers YB53326-53353, were recorded on May 12, 1995. An R-block, owned by the Dawson Indian band, forms the western boundary of the Coal Property.

4. THE 1995 PROGRAM

The geochemical program was carried out between August 16 and 22, 1995. The first two days of work involved hiking into the central part of the property to cut an opening in the vegetation suitable for helicopter landing site. In total, 82 soil and silt samples were collected from 4 traverses designed to follow-up anomalous drainage basins highlighted by a 1978 RGS stream sediment survey. Extensive permafrost development on the north-facing slopes made sampling difficult. The geochemical sample locations and analytical data are presented in plate 1-6.

Soil samples were collected from the B-horizon using a long-narrow profile spade and placed in pre-numbered kraft paper sample bags and then shipped to Cominco's Exploration Laboratory at 1486 East Pender St., Vancouver, B. C. for analyses. The samples were dried and sieved to -80 mesh, then 0.50 grams of the -80 mesh fraction was digested in acid (3HNO3: 1HCL) and analyzed for Cu, Zn, Pb by Atomic Absorption. Barium was analyzed by loose pellet XRF.

5. CONCLUSIONS AND RECOMMENDATIONS

The 1978 RGS stream sediment Cu/Pb/Zn anomalies located at the confluence of three north-flowing streams with Coal Creek were followed up with contour soil and silt sampling in their headwaters. No anomalies were obtained and the source of the RGS anomalies still remains unknown.

Soil sampling across 4 airborne mag-EM geophysical features failed to obtain Cu/Zn/Pb anomalies which indicates that these anomalies are not sourced by basemetal sulphides.

Additional soil geochemistry and geological mapping is recommended along the strike length of the geophysical anomalies.

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APPENDIX I: STATEMENT OF EXPENDITURES

Aerodat Inc. Airborne EM and Mag Survey	$ 18,067.00
Helicopter (4 hrs at $ 750/hr)	3,000.00
Geochemical analyses	881.50
Salaries	1,600.00
Domicile	1,200.00
Report preparation	750.00
Total :	$ 25,498.50

APPENDIX II

GENERAL INTERPRETIVE CONSIDERATIONS

GENERAL INTERPRETIVE CONSIDERATIONS

Electromagnetic

The Aerodat electromagnetic system utilized two different transmitter-receiver coil geometries. The traditional coaxial coil configuration is operated at widely separated frequencies. The horizontal coplanar coil configuration is similarly operated at different frequencies where at least one pair is approximately aligned with one of the coaxial frequencies.

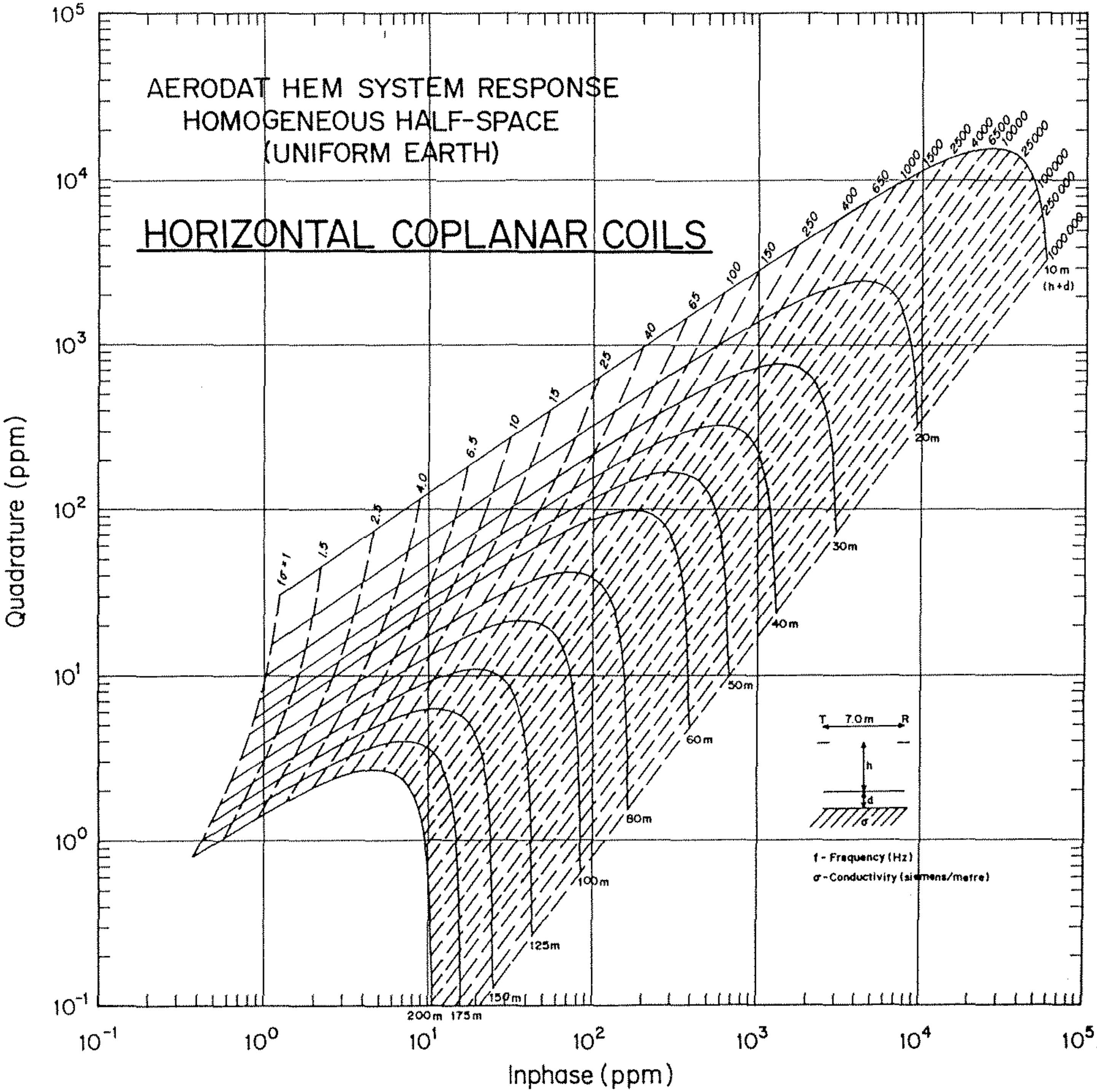
The electromagnetic response measured by the helicopter system is a function of the "electrical" and "geometrical" properties of the conductor. The "electrical" property of a conductor is determined largely by its electrical conductivity, magnetic susceptibility and its size and shape; the "geometrical" property of the response is largely a function of the conductor's shape and orientation with respect to the measuring transmitter and receiver.

Electrical Considerations

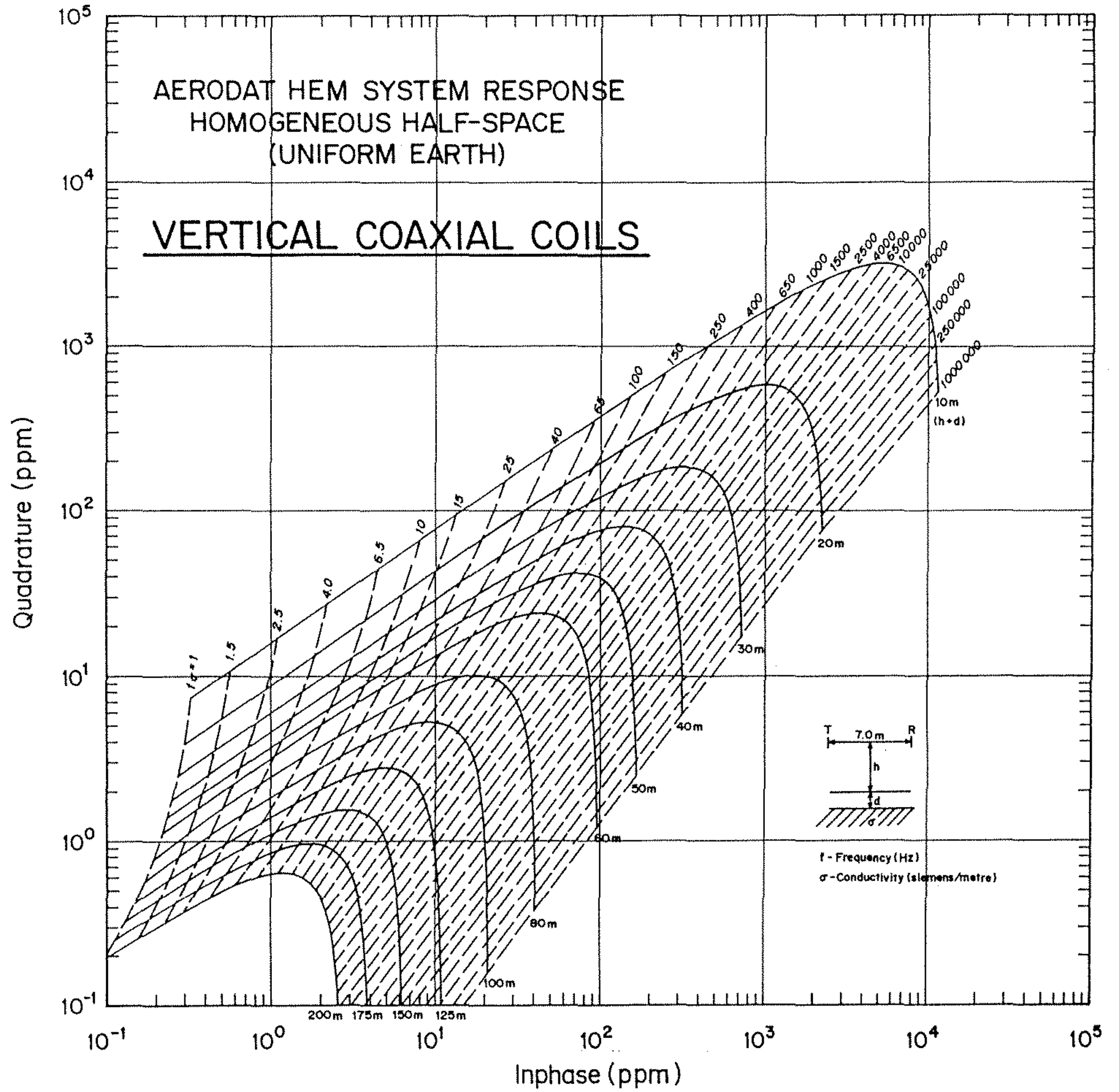
For a given conductive body the measure of its conductivity or conductance is closely related to the measured phase shift between the received and transmitted electromagnetic field. A small phase shift indicates a relatively high conductance, a large phase shift lower conductance. A small phase shift results in a large inphase to quadrature ratio and a large phase shift a low ratio. This relationship is shown quantitatively for a non-magnetic vertical half-plane and half space models on the accompanying phasor diagrams. Other physical models will show the same trend but different quantitative relationships.

The phasor diagram for the vertical half-plane model, as presented, is for the coaxial coil configuration with the amplitudes in parts per million (ppm) of the primary field as measured at the response peak over the conductor. To assist the interpretation of the survey results the computer is used to identify the apparent conductance and depth at selected anomalies. The results of this calculation are presented in anomaly listings included in the survey report and the conductance and inphase amplitude are presented in symbolized form on the map presentation.

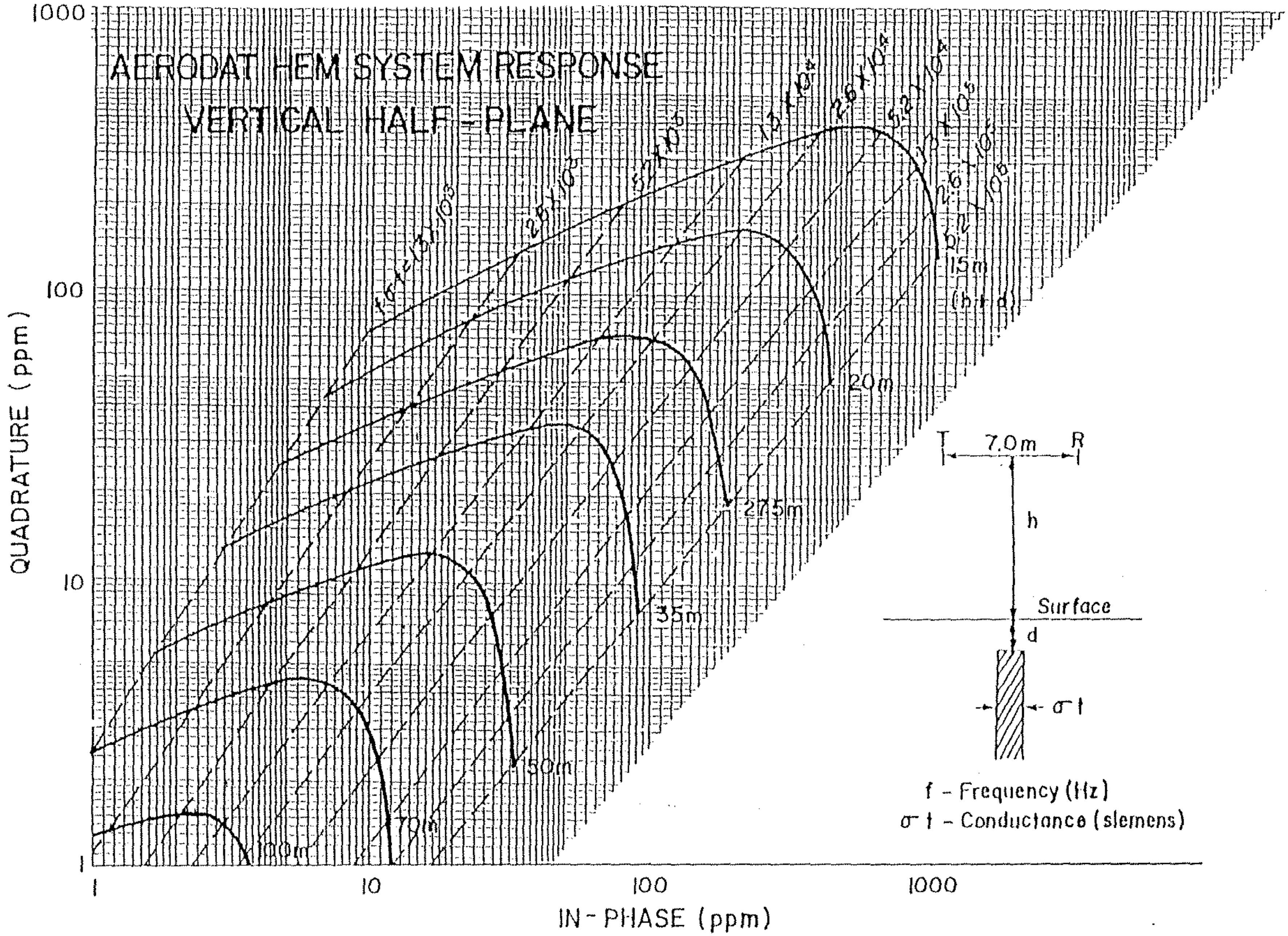
The conductance estimate is most reliable when anomaly amplitudes are large and background resistivities are high. Where the anomaly is of low amplitude and background resistivities are low, the conductance estimates are much less reliable. In such situations, the conductance estimate is often quite low regardless of the true nature of the conductor. This is due to the elevated background response levels in the quadrature channel. In an extreme case, the conductance estimate should be discounted and should not prejudice target selection.



AERODAT HEM SYSTEM RESPONSE
HOMOGENEOUS HALF-SPACE
(UNIFORM EARTH)
HORIZONTAL COPLANAR COILS
Quadrature (ppm)
Inphase (ppm)
10 m (h+d)
20m
30m
40m
50m
60m
80m
100m
125m
150m
175m
200m
T 7.0m R
h
d
σ
f - Frequency (Hz)
σ - Conductivity (siemens/metre)



AERODAT HEM SYSTEM RESPONSE
HOMOGENEOUS HALF-SPACE
(UNIFORM EARTH)
VERTICAL COAXIAL COILS
Quadrature (ppm)
Inphase (ppm)
10m (h+d)
20m
30m
40m
50m
60m
80m
100m
125m
150m
175m
200m
T
7.0m
R
h
d
σ
f - Frequency (Hz)
σ - Conductivity (siemens/metre)


AERODAT HEM SYSTEM RESPONSE
VERTICAL HALF-PLANE
QUADRATURE (ppm)
IN-PHASE (ppm)
1000
100
10
1
1
10
100
1000
15m
(h+d)
20m
27.5m
35m
50m
70m
100m
T
7.0m
R
h
Surface
d
σ t
f - Frequency (Hz)
σ t - Conductance (siemens)

The conductance and depth vales as presented are correct only as far as the model approximates the real geological situation. The actual geological source may be of limited length, have significant dip, may be strongly magnetic. Its conductivity and thickness may vary with depth and/or strike and adjacent bodies and overburden may have modified the response. In general the conductance estimate is less affected by these limitations than is the depth estimate, but both should be considered as relative rather than absolute guides to the anomaly's properties.

Conductance in mhos is the reciprocal of resistance in ohms and in the case of narrow slab-like bodies is the product of electrical conductivity and thickness.

The higher ranges of conductance, greater than 2-4 mhos, indicate that a significant fraction of the electrical conduction is electronic rather than electrolytic in nature. Materials that conduct electronically are limited to certain metallic sulphides and to graphite. High conductance anomalies, roughly 10 mhos or greater, are generally limited to massive sulphides or graphites.

Sulphide minerals, with the exception of such ore minerals as sphalerite, cinnabar and stibnite, are good conductors. Sulphides may occur in a disseminated manner that inhibits electrical conduction through the rock mass. In this case the apparent conductance can seriously underrate the quality of the conductor in geological terms. In a similar sense the relatively non-conducting sulphide minerals noted above may be present in significant concentrations in association with minor conductive sulphides, and the electromagnetic response will only relate to the minor associated mineralization. Indicated conductance is also of little direct significance for the identification of gold mineralization. Although gold is highly conductive, it would not be expected to exist in sufficient quantity to create a recognizable anomaly. Minor accessory sulphide mineralization may however provide a useful indirect indication.

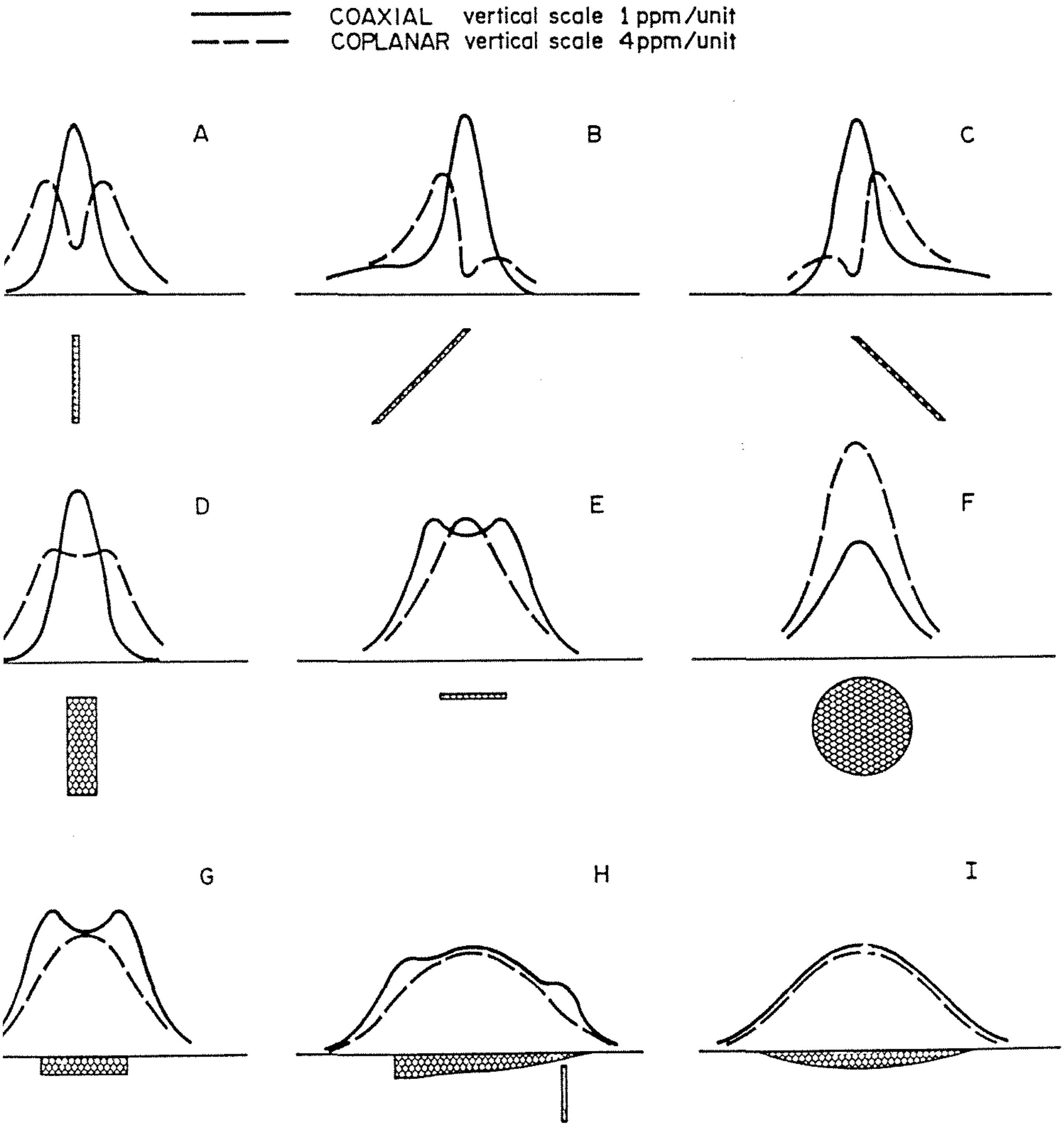
In summary, the estimated conductance of a conductor can provide a relatively positive identification of significant sulphide or graphite mineralization. A moderate to low conductance value does not rule out the possibility of significant economic mineralization.

Geometrical Considerations

Geometrical information about the geologic conductor can often be interpreted from the profile shape of the anomaly. The change in shape is primarily related to the change in inductive coupling among the transmitter, the target, and the receiver. The accompanying figure shows a selection of HEM response profile shapes from nine idealized targets. Response profiles are labelled A through I. These labels are used in the discussion which follows.

HEM RESPONSE PROFILE SHAPE AS AN INDICATOR OF CONDUCTOR GEOMETRY

COAXIAL vertical scale 1 ppm/unit
COPLANAR vertical scale 4 ppm/unit



In the case of a thin, steeply dipping, sheet-like conductor, the coaxial coil pair will yield a near symmetric peak over the conductor. On the other hand, the coplanar coil pair will pass through a null couple relationship and yield a minimum over the conductor, flanked by positive side lobes (Profile A). As the dip of the conductor decrease from vertical, the coaxial anomaly shape changes only slightly, but in the case of the coplanar coil pair the side lobe on the down dip side strengthens relative to that on the up dip side (Profiles B and C).

As the thickness of the conductor increases, induced current flow across the thickness of the conductor becomes relatively significant and complete null coupling with the coplanar coils is no longer possible (Profile D). As a result, the apparent minimum of the coplanar response over the conductor diminishes with increasing thickness, and in the limiting case of a fully 3 dimensional body or a horizontal layer or half-space, the minimum disappears completely.

A horizontal conducting layer such as a horizontal thin sheet or overburden will produce a response in the coaxial and coplanar coils that is a function of altitude (and conductivity if not uniform). The profile shape will be similar in both coil configurations with an amplitude ratio (coplanar:coaxial) of about 4:1* (Profiles E and G).

In the case of a spherical conductor, the induced currents are confined to the volume of the sphere, but not relatively restricted to any arbitrary plane as in the case of a sheet-like form. The response of the coplanar coil pair directly over the sphere may be up to 8* times greater than that of the coaxial pair (Profile F).

In summary, a steeply dipping, sheet-like conductor will display a decrease in the coplanar response coincident with the peak of the coaxial response. The relative strength of this coplanar null is related inversely to the thickness of the conductor. A pronounced null indicates a relatively thin conductor. The dip of such a conductor can be inferred from the relative amplitudes of the side-lobes.

Massive conductors that could be approximated by a conducting sphere will display a simple single peak profile form on both coaxial and coplanar coils, with a ratio between the coplanar to coaxial response amplitudes as high as 8*.

Overburden anomalies often produce broad poorly defined anomaly profiles (Profile I). In most cases, the response of the coplanar coils closely follows that of the coaxial coils with a relative amplitude ration of 4*.

Occasionally, if the edge of an overburden zone is sharply defined with some significant depth extent, an edge effect will occur in the coaxial coils. In the case of a horizontal conductive ring or ribbon, the coaxial response will consist of two peaks, one over each edge; whereas the coplanar coil will yield a single peak (Profile H).

* It should be noted at this point that Aerodat's definition of the measured ppm unit is related to the primary field sensed in the receiving coil without normalization to the maximum coupled (coaxial configuration). If such normalization were applied to the Aerodat units, the amplitude of the coplanar coil pair would be halved.

Magnetics

The Total Field Magnetic Map shows contours of the total magnetic field, uncorrected for regional variation. Whether an EM anomaly with a magnetic correlation is more likely to be caused by a sulphide deposit than one without depends on the type of mineralization. An apparent coincidence between an EM and a magnetic anomaly may be caused by a conductor which is also magnetic, or by a conductor which lies in close proximity to a magnetic body. The majority of conductors which are also magnetic are sulphides containing pyrrhotite and/or magnetite. Conductive and magnetic bodies in close association can be, and often are, graphite and magnetite. It is often very difficult to distinguish between these cases. If the conductor is also magnetic, it will usually produce an EM anomaly whose general pattern resembles that of the magnetics. Depending on the magnetic permeability of the conducting body, the amplitude of the inphase EM anomaly will be weakened, and if the conductivity is also weak, the inphase EM anomaly may even be reversed in sign.

The interpretation of contoured aeromagnetic data is a subject on its own involving an array of methods and attitudes. The interpretation of source characteristics for example from total field results is often based on some numerical modelling scheme. The vertical gradient data is more legible in some aspects however and useful inferences about source characteristics can often be read off the contoured VG map.

The zero contour lines in contoured VG data are often sited as a good approximation to the outline of the top of the magnetic source. This only applies to wide (relative to depth of burial) near vertical sources at high magnetic latitudes. It will give an incorrect interpretation in most other cases.

Theoretical profiles of total field and vertical gradient anomalies from tabular sources at a variety of magnetic inclinations are shown in the attached figure. Sources are 10, 50 and 200 m wide. The source-sensor separation is 50 m. The thin line is the total field profile. The thick line is the vertical gradient profile.

The following comments about source geometry apply to contoured vertical gradient data for magnetic inclinations of 70 to 80°.

Outline

Where the VG anomaly has a single sharp peak, the source may be a thin near-vertical tabular source. It may be represented as a magnetic axis or as a tabular source of measurable width - the choice is one of geological preference.

Where the VG anomaly has a broad, flat or inclined top, the source may be a thick tabular source. It may be represented as a thick body where the width is taken from the zero contour lines if the body dips to magnetic north. If the source appears to be dipping to the south (i.e. the VG anomaly is asymmetric), the zero contours are less reliable indicators of outline. The southern most zero contour line should be ignored and the outline taken from the northern zero contour line and the extent of the anomaly peak width.

Dip

A symmetrical vertical gradient response is produced by a body dipping to magnetic north. An asymmetrical response is produced by a body which is vertical or dipping to the south. For southern dips, the southern most zero contour line may be several hundred meters south of the source.

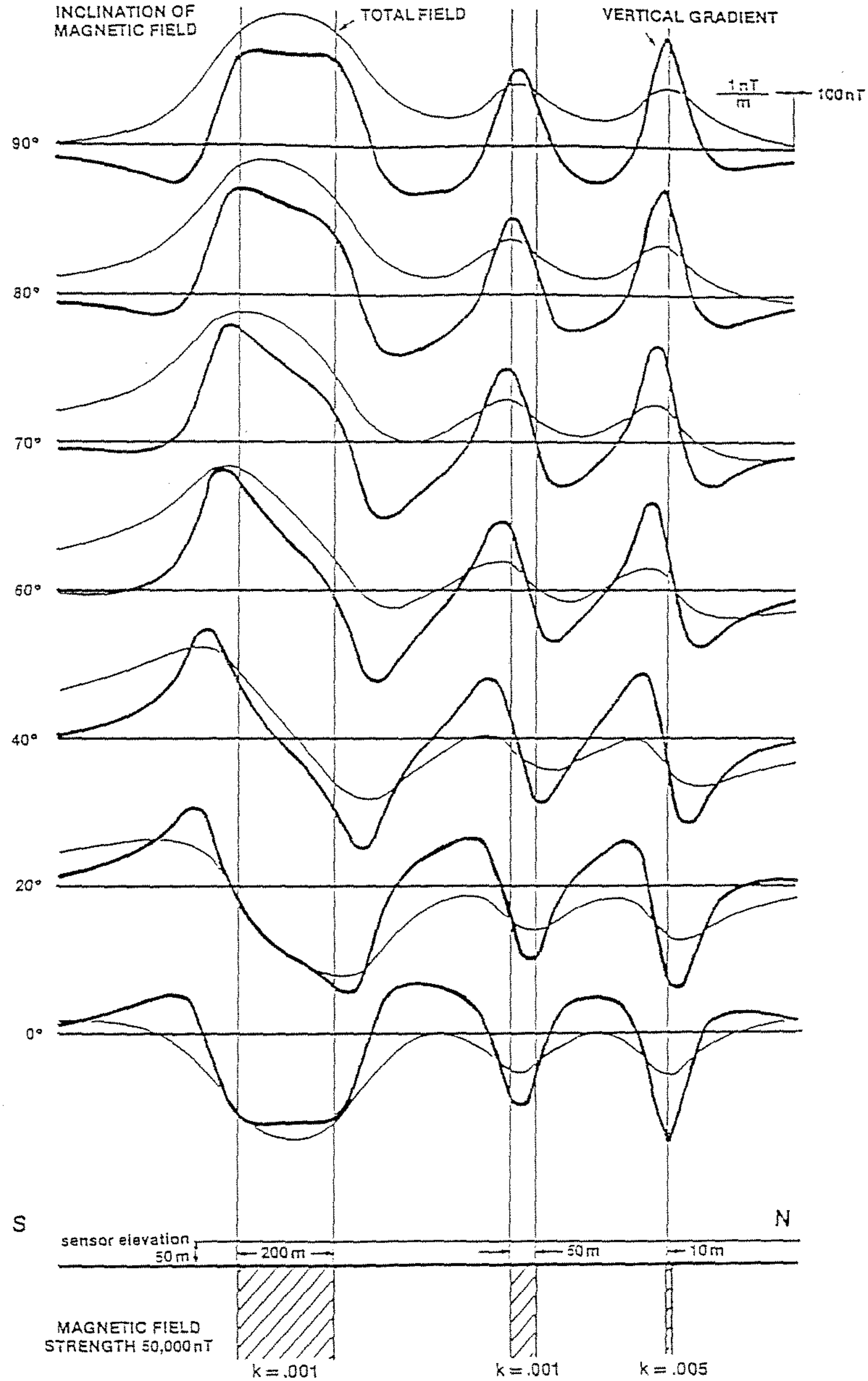
Depth of Burial

The source-sensor separation is about equal to half of the distance between the zero contour lines for thin near-vertical sources. The estimated depth of burial for such sources is this separation minus 50 m. If a variety of VG anomaly widths are seen in an area, use the narrowest width seen to estimate local depths.

VLF Electromagnetics

The VLF-EM method employs the radiation from powerful military radio transmitters as the primary signals. The magnetic field associated with the primary field is locally horizontal and normal to a line pointing at the transmitter.

The Herz Totem uses three coils in the X, Y, Z configuration to measure the total field and vertical quadrature component from two VLF stations. These stations are designated Line and Ortho. The line station is ideally in a direction from the survey area at right angles to the flight line direction. Conductors normal to the flight line direction point at the line station and are therefore optimally coupled to VLF magnetic fields and in the best situation to gather secondary VLF currents. The ortho station is ideally 90 degrees in azimuth from the line station.


INCLINATION OF MAGNETIC FIELD
TOTAL FIELD
VERTICAL GRADIENT
1 nT / m
100 nT
90°
80°
70°
60°
40°
20°
0°
S
N
sensor elevation
50 m
200 m
50 m
10 m
MAGNETIC FIELD STRENGTH 50,000 nT
k = .001
k = .001
k = .005

The relatively high frequency of VLF (15-25) kHz provides high response factors for bodies of low conductance. Relatively "disconnected" sulphide ores have been found to produce measurable VLF signals. For the same reason, poor conductors such as sheared contacts, breccia zones, narrow faults, alteration zones and porous flow tops normally produce VLF anomalies. The method can therefore be used effectively for geological mapping. The only relative disadvantage of the method lies in its sensitivity to conductive overburden. In conductive ground to depth of exploration is severely limited.

The effect of strike direction is important in the sense of the relation of the conductor axis relative to the energizing electromagnetic field. A conductor aligned along a radius drawn from a transmitting station will be in a maximum coupled orientation and thereby produce a stronger response than a similar conductor at a different strike angle. Theoretically, it would be possible for a conductor, oriented tangentially to the transmitter to produce no signal. The most obvious effect of the strike angle consideration is that conductors favourably oriented with respect to the transmitter location and also near perpendicular to the flight direction are most clearly rendered and usually dominate the map presentation.

The total field anomaly is an indicator of the existence and position of a conductor. The response will be a maximum over the conductor, without any special filtering, and strongly favour the upper edge of the conductor even in the case of a relatively shallow dip.

Conversely a negative total field anomaly is often seen over local resistivity highs. This is because the VLF field produces electrical currents which flow towards (or away from) the transmitter. These currents are gathered into a conductor and are taken from resistive bodies. The VLF system sees the currents gathered into the conductor as a total field high. It sees the relative absence of secondary currents in the resistor as a total field low.

As noted, VLF anomaly trends show a strong bias towards the VLF transmitter. Structure which is normal to this direction may have no associated VLF anomaly but may be seen as a break or interruption in VLF anomalies. If these structures are of particular interest, maps of the ortho station data may be worthwhile.

Conductive overburden will obscure VLF responses from bedrock sources and may produce low amplitude, broad anomalies which reflect variations in the resistivity of thickness of the overburden.

Extreme topographic relief will produce VLF anomalies which may bear no relationship to variations in electrical conductivity. Deep gullies which are too narrow to have been surveyed at a uniform sensor height often show up as VLF total field lows. Sharp ridges show up as total field highs.

The vertical quadrature component over steeply dipping sheet-like conductor will be a cross-over type response with the cross-over closely associated with the upper edge of the conductor.

The response is a cross-over type due to the fact that it is the vertical rather than total field quadrature component that is measured. The response shape is due largely to geometrical rather than conductivity considerations and the distance between the maximum and minimum on either side of the cross-over is related to target depth. For a given target geometry, the larger this distance the greater the depth.

The vertical quadrature component is rarely presented. Experience has shown the total field to be more sensitive to bedrock conductors and less affected by variations in conductive overburden.

Apparent Resistivity/Conductivity Maps

Overburden and different types of bedrock may be modelled as a large area horizontal conductor of fixed thickness. A phasor diagram may be constructed, in the same fashion as for the vertical sheet, to convert the measured HEM in-phase and quadrature response to a depth and conductivity value for a horizontal layer. Traditionally if the thickness is large, an infinite half-space, the associated conductivity value is referred to as "apparent conductivity". We have generalized the use of the word "apparent" to include any model where the thickness of the layer is a fixed as opposed to a variable parameter. The units of apparent resisitivity are ohm-m and those of apparent conductivity are the inverse mhos/m or siemen/m. If the chosen model layer thickness is close to the true thickness of the conductor then the apparent conductivity will closely conform to the true value; however, if the thickness is inappropriate the apparent value may be considerably different from the true value.

The benefit of the apparent conductivity mapping is that it provides a simple robust method of converting the HEM in-phase and quadrature response to apparent change in ground conductivity.

A phasor diagram for several apparent resistivity models is presented. The general forms for the various thicknesses is very similar and also closely resembles the diagram for the vertical sheet. The diagrams also show the curves for apparent depth. As with the conductivity value the depth value is meaningful if the model thickness closely resembles the true conductive layer thickness. If the HEM response from a thin conducting layer is applied to a thick layer model the apparent conductivity and depth will be less than the true conductivity and depth.

APPENDIX III

ANOMALY LISTINGS

COAL PROPERTY

AREA 1 TANANA PROJECT

COAL PROPERTY

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS		
23	10300	A/	0	23.3	41.0	0.6	0	47	537226.1	7148724.0
23	10300	B/	1	25.9	33.2	1.0	0	44	537197.2	7148643.0
23	10300	C/	2	33.1	27.4	2.0	0	58	537174.2	7148529.0
23	10300	D/	1	32.3	33.1	1.5	0	49	537156.5	7148403.0
23	10300	E/	2	39.6	28.7	2.5	0	60	537106.2	7148060.5
23	10300	F/	4	176.4	52.6	12.4	0	45	537050.4	7147878.0
23	10300	G/	3	72.4	33.5	5.4	0	40	536973.7	7147666.5
23	10300	H/	3	47.5	17.5	6.4	0	44	536945.3	7147531.0
23	10300	J/	2	27.7	19.3	2.3	0	55	536909.6	7147228.0
23	10300	K/	2	30.6	24.1	2.0	0	43	536883.5	7147112.0
23	10300	M/	2	33.9	22.0	2.7	0	51	536444.4	7145655.0
23	10300	N/	0	9.1	31.0	0.1	0	41	535764.6	7142816.5
23	10290	A/	1	28.7	33.7	1.2	0	42	535534.1	7143278.0
23	10290	B/	1	14.6	16.4	1.0	2	41	535736.3	7143973.5
23	10290	C/	0	18.2	24.6	0.8	0	38	536078.7	7145038.5
23	10290	D/	0	22.3	45.4	0.5	0	29	536491.5	7147044.5
23	10290	E/	3	53.9	19.0	7.1	0	57	536782.5	7147898.5
23	10290	F/	1	28.3	33.6	1.1	0	36	536909.4	7148773.0
23	10280	A/	0	42.3	65.2	0.9	0	43	536686.4	7148842.0
23	10280	B/	0	37.8	76.0	0.6	0	37	536673.6	7148751.0
23	10280	C/	0	40.0	83.2	0.6	0	34	536652.1	7148687.5
23	10280	D/	0	41.9	87.0	0.6	0	38	536609.9	7148595.0
23	10280	E/	1	39.9	52.0	1.1	0	51	536492.8	7148311.0
23	10280	F/	3	58.4	25.6	5.5	0	57	536444.3	7148098.0
23	10280	G/	3	47.1	22.9	4.5	0	42	536419.8	7147928.0
23	10280	H/	3	35.0	12.4	6.2	0	50	536397.0	7147775.5
23	10280	J/	2	25.2	11.6	3.9	0	50	536359.9	7147593.0
23	10280	K/	0	13.4	25.2	0.4	0	35	536140.4	7146776.0
23	10280	M/	1	30.0	40.1	1.0	0	43	535330.1	7143387.5
23	10280	N/	0	8.6	29.4	0.1	0	44	535177.1	7142729.0
23	10270	A/	0	24.6	32.4	0.9	0	36	535084.4	7143550.5
23	10270	B/	0	22.9	46.4	0.5	0	32	535847.2	7146734.5
23	10270	C/	0	19.3	28.5	0.7	0	37	535917.8	7147168.0
23	10270	D/	2	48.9	27.3	3.8	0	42	536053.8	7147607.0
23	10270	E/	4	77.0	24.3	9.1	0	39	536096.6	7147754.0
23	10270	F/	4	91.4	31.7	8.4	0	39	536114.3	7147815.5
23	10270	G/	3	48.7	17.4	6.7	0	50	536169.6	7148036.0
23	10270	H/	2	21.9	14.1	2.4	0	60	536217.9	7148249.0
23	10260	A/	3	70.5	29.6	6.1	0	58	535844.4	7148163.5
23	10260	B/	3	68.3	39.5	4.0	0	50	535820.1	7148097.5

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

AREA 1 TANANA PROJECT

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS		
23	10260	C/	2	45.9	29.2	3.1	0	44	535779.4	7147944.5
23	10260	D/	2	28.8	15.1	3.4	0	47	535735.3	7147664.0
23	10250	A/	2	54.4	49.4	2.1	0	57	535174.5	7146633.5
23	10250	B/	1	35.0	44.8	1.1	0	49	535221.7	7146743.5
23	10250	C/	1	38.3	50.0	1.1	0	44	535311.8	7147008.0
23	10250	D/	0	28.8	45.2	0.8	0	39	535321.8	7147067.5
23	10250	E/	3	41.3	17.0	5.3	0	52	535477.5	7148042.5
23	10250	F/	3	40.1	16.8	5.2	0	63	535562.0	7148327.0
23	10240	A/	0	28.8	48.2	0.7	0	55	535389.3	7148700.0
23	10240	B/	0	36.9	87.9	0.5	0	47	535374.8	7148599.0
23	10240	C/	2	66.5	43.6	3.4	0	48	535331.1	7148375.5
23	10240	D/	3	42.5	21.7	4.0	0	46	535224.3	7148047.0
23	10240	E/	3	36.2	16.8	4.4	0	42	535174.1	7147930.5
23	10240	F/	2	31.5	24.5	2.1	3	36	535110.7	7147773.0
23	10240	G/	2	67.0	50.2	2.8	0	36	534258.6	7143884.5
23	10240	H/	1	58.4	57.4	1.9	0	31	534215.2	7143769.0
23	10230	A/	2	42.1	30.0	2.6	0	51	533921.8	7143979.5
23	10230	B/	1	30.3	28.1	1.6	0	44	533988.8	7144241.5
23	10230	C/	1	39.0	45.9	1.3	0	46	534114.3	7144852.5
23	10230	D/	1	59.3	58.9	1.9	0	44	534144.6	7144973.0
23	10230	E/	1	56.2	79.1	1.2	0	40	534155.3	7145050.0
23	10230	F/	1	49.3	72.1	1.1	0	35	534168.3	7145126.5
23	10230	G/	2	49.8	43.1	2.1	0	37	534853.5	7147883.5
23	10230	H/	3	61.3	30.9	4.6	0	36	534897.9	7148013.0
23	10230	J/	3	63.1	27.4	5.7	0	39	534952.1	7148184.5
23	10230	K/	3	72.6	30.3	6.2	0	44	534984.0	7148283.0
23	10230	M/	0	19.2	35.0	0.5	0	33	535097.6	7148805.0
23	10230	N/	0	22.8	34.2	0.8	0	38	535204.2	7149119.5
23	10230	O/	1	27.6	36.3	1.0	0	32	535215.3	7149210.5
23	10210	A/	1	29.6	30.9	1.4	0	45	533349.6	7143955.0
23	10210	B/	3	73.0	30.4	6.2	0	50	533339.0	7144224.5
23	10210	C/	3	62.5	30.0	4.9	0	43	533342.2	7144309.5
23	10210	D/	1	37.6	41.2	1.4	5	27	533447.3	7144741.5
23	10210	E/	0	24.9	34.4	0.9	0	35	533563.5	7144995.0
23	10210	F/	0	23.3	37.7	0.7	0	38	533624.8	7145141.0
23	10210	G/	1	26.7	34.9	1.0	0	47	533706.6	7145404.5
23	10210	H/	0	11.3	20.5	0.4	0	43	534059.4	7147361.0
23	10210	J/	2	41.9	31.5	2.4	0	44	534255.7	7147754.5
23	10210	K/	2	49.9	33.6	3.0	0	34	534285.8	7147830.0
23	10210	M/	1	43.5	43.2	1.7	0	32	534307.0	7147929.5
23	10210	N/	2	37.1	27.9	2.3	0	44	534330.2	7148134.5

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AREA 1 TANANA PROJECT

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						CONDUCTOR		BIRD		
				AMPLITUDE (PPM)		CTP	DEPTH	HEIGHT		
FLIGHT	LINE	ANOMALY	CATEGORY	INPHASE	QUAD.	MHOS	MTRS	MTRS		
------	----	-------	--------	-------	-----	----	----	----		
23	10210	O/	3	78.8	42.7	4.5	0	43	534342.8	7148272.0
23	10210	P/	3	82.1	31.0	7.3	0	52	534349.5	7148384.5
23	10210	Q/	2	29.4	17.3	3.0	0	60	534358.8	7148560.5
23	10210	R/	2	49.8	32.2	3.1	0	50	534523.6	7149104.5
23	10210	S/	2	42.5	26.3	3.1	0	50	534589.4	7149366.0
23	10200	A/	2	49.8	34.0	2.9	0	49	534248.4	7149233.5
23	10200	B/	1	40.3	36.5	1.9	0	47	534146.3	7148646.5
23	10200	C/	3	50.9	21.7	5.4	0	43	534104.1	7148426.0
23	10200	D/	3	34.4	14.8	4.7	0	44	534078.2	7148320.0
23	10200	E/	2	36.7	19.7	3.6	0	50	533993.7	7148056.0
23	10200	F/	2	91.0	66.3	3.2	0	33	533138.5	7144535.0
23	10200	G/	2	85.5	54.5	3.8	0	33	533116.9	7144453.0
23	10200	H/	2	53.4	45.3	2.2	0	41	533052.0	7144190.0
23	10190	A/	2	62.1	39.2	3.5	0	38	532740.0	7144351.0
23	10190	B/	3	63.8	36.0	4.0	0	41	532761.3	7144438.0
23	10190	C/	3	60.6	27.7	5.2	0	45	532809.1	7144627.0
23	10190	D/	3	46.7	17.5	6.3	0	42	533756.6	7148452.0
23	10190	E/	3	55.2	28.3	4.4	0	43	533771.9	7148524.5
23	10190	F/	1	37.8	35.0	1.8	0	39	533803.5	7148668.5
23	10190	G/	2	49.9	39.6	2.4	0	46	533959.0	7149272.5
23	10190	H/	2	58.1	42.5	2.8	0	45	533994.2	7149393.0
23	10180	A/	1	29.0	24.2	1.9	0	40	533668.0	7149254.5
23	10180	B/	1	24.6	23.6	1.4	0	41	533446.8	7148407.0
23	10180	C/	0	23.3	37.8	0.7	0	36	532733.1	7144993.5
23	10180	D/	3	95.2	50.9	4.9	0	32	532543.3	7144596.0
23	10180	E/	2	108.0	76.7	3.5	0	36	532486.8	7144461.5
23	10180	F/	1	35.1	30.3	1.9	0	39	532428.9	7144312.0
23	10180	G/	0	13.8	21.4	0.6	0	55	532245.6	7143616.5
23	10170	A/	1	16.4	15.0	1.3	0	60	531985.6	7143601.5
23	10170	B/	3	74.4	35.5	5.3	0	47	532205.2	7144643.5
23	10170	C/	2	46.7	30.8	3.0	0	39	532256.8	7144874.0
23	10170	D/	2	24.5	14.8	2.7	0	45	532719.0	7146780.0
23	10170	E/	3	69.8	31.0	5.7	0	42	533207.7	7148688.0
23	10170	F/	3	57.6	29.4	4.5	0	49	533233.6	7148816.0
23	10160	A/	3	69.8	28.2	6.4	0	52	532930.5	7148810.5
23	10160	B/	3	64.4	29.5	5.3	0	48	532919.4	7148714.5
23	10160	C/	3	65.8	35.5	4.3	0	38	532871.4	7148336.5
23	10160	D/	2	47.5	33.0	2.8	0	39	532599.9	7147292.5
23	10160	E/	2	71.6	48.6	3.3	0	45	532552.7	7147096.0
23	10160	F/	2	59.0	41.0	3.0	0	42	532496.3	7146963.0

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS		
23	10160	G/	2	43.0	34.5	2.2	3	31	532427.8	7146807.0
23	10160	H/	1	33.2	39.0	1.2	9	22	532428.4	7146718.0
23	10160	J/	2	21.8	16.0	2.0	12	33	532412.3	7146655.5
23	10160	K/	2	68.3	57.5	2.5	0	41	532034.4	7144990.5
23	10160	M/	3	99.6	44.9	6.2	0	38	531957.9	7144778.5
23	10160	N/	3	91.4	41.2	6.0	0	39	531929.0	7144698.5
23	10160	O/	1	21.0	21.8	1.2	4	36	531880.3	7144503.5
23	10160	P/	1	29.7	25.5	1.8	1	37	531690.2	7143633.0
23	10150	A/	2	23.6	14.5	2.6	0	48	531366.3	7143559.0
23	10150	B/	2	77.5	67.5	2.5	0	35	531600.3	7144725.0
23	10150	C/	2	75.5	47.0	3.7	0	39	531628.6	7144816.0
23	10150	D/	2	48.1	36.2	2.5	0	37	531706.8	7145056.0
23	10150	E/	1	40.4	40.9	1.6	0	54	531816.0	7145414.5
23	10150	F/	1	34.6	43.4	1.1	0	31	531843.2	7145503.0
23	10150	G/	0	12.0	25.9	0.3	0	36	531907.6	7145896.5
23	10150	H/	1	23.8	28.8	1.0	0	43	532017.5	7146522.5
23	10150	J/	2	113.6	91.0	3.1	0	37	532161.5	7147010.0
23	10150	K/	3	58.6	26.9	5.1	4	32	532296.3	7147554.0
23	10150	M/	3	92.8	47.0	5.2	0	37	532531.6	7148456.5
23	10150	N/	3	80.7	35.9	5.9	0	49	532555.8	7148637.0
23	10150	O/	3	77.5	27.4	7.9	0	45	532594.9	7148854.0
23	10140	A/	2	27.9	19.6	2.3	0	65	532353.6	7149078.5
23	10140	B/	2	38.6	27.8	2.5	0	57	532306.9	7148958.5
23	10140	C/	2	47.2	27.4	3.5	0	55	532286.3	7148888.5
23	10140	D/	3	63.9	25.5	6.3	0	53	532261.6	7148731.5
23	10140	E/	3	66.2	30.0	5.4	0	43	532246.4	7148501.0
23	10140	F/	3	63.4	27.4	5.7	0	39	532238.6	7148404.0
23	10140	G/	2	44.6	27.2	3.3	0	42	532028.3	7147519.5
23	10140	H/	2	44.9	34.1	2.4	0	41	531929.2	7147225.5
23	10140	J/	2	45.4	39.9	2.0	1	31	531876.9	7147101.5
23	10140	K/	2	35.7	25.2	2.5	0	44	531832.3	7146953.5
23	10140	M/	2	35.0	28.5	2.0	0	39	531778.5	7146672.5
23	10140	N/	2	45.8	37.7	2.2	0	39	531436.5	7145161.0
23	10140	O/	2	71.0	57.0	2.6	0	38	531390.8	7145003.0
23	10140	P/	2	54.0	49.3	2.0	0	34	531361.5	7144898.0
23	10140	Q/	1	19.1	17.3	1.4	0	48	531000.7	7143516.0
23	10130	A/	2	22.0	15.1	2.2	0	50	530670.6	7143424.0
23	10130	B/	2	59.8	43.6	2.8	0	39	531143.4	7145241.0
23	10130	C/	2	61.3	46.3	2.7	2	29	531155.4	7145407.0
23	10130	D/	2	70.2	63.1	2.3	0	36	531571.6	7146954.0
23	10130	E/	1	95.1	120.3	1.6	0	33	531602.7	7147084.5
23	10130	F/	1	127.7	171.8	1.7	0	32	531628.8	7147183.5

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AREA 1 TANANA PROJECT

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FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS		
23	10130	G/	2	112.4	81.0	3.5	0	38	531676.2	7147366.5
23	10130	H/	2	117.5	110.6	2.5	0	38	531698.4	7147467.5
23	10130	J/	2	131.7	96.5	3.6	0	46	531728.3	7147575.5
23	10130	K/	3	111.8	52.7	6.0	0	48	531781.5	7147769.0
23	10130	M/	3	55.3	27.0	4.7	0	36	531851.3	7148205.0
23	10130	N/	3	62.2	32.4	4.4	0	36	531901.9	7148476.5
23	10130	O/	4	77.9	27.3	8.0	0	50	531957.4	7148673.5
23	10130	P/	3	77.4	30.8	6.7	0	49	531999.8	7148811.0
23	10130	Q/	2	55.6	32.8	3.6	0	49	532028.6	7148910.5
23	10130	R/	2	43.4	27.2	3.1	0	50	532056.9	7149009.5
23	10130	S/	2	34.1	19.9	3.2	0	57	532101.4	7149157.0
22	10120	A/	0	20.5	43.7	0.4	0	31	532070.6	7150040.5
22	10120	B/	1	39.8	53.1	1.1	0	37	531930.3	7149777.5
22	10120	C/	1	43.0	44.9	1.6	0	47	531880.8	7149685.0
22	10120	D/	2	41.2	31.4	2.4	0	54	531805.0	7149223.5
22	10120	E/	2	40.3	30.5	2.4	0	39	531471.3	7147775.0
22	10120	F/	2	36.0	24.2	2.7	0	42	531374.3	7147375.5
22	10120	G/	3	45.0	22.8	4.2	0	48	531196.6	7146810.5
22	10120	H/	3	73.3	38.9	4.6	0	44	530861.7	7145452.5
22	10120	J/	2	39.8	25.1	3.0	0	50	530792.8	7145156.0
22	10120	K/	1	26.0	28.1	1.3	0	47	530383.8	7143348.0
22	10110	A/	0	9.7	13.9	0.6	0	51	530079.9	7143348.0
22	10110	B/	0	14.2	18.4	0.8	0	46	530139.4	7143608.5
22	10110	C/	1	19.5	20.9	1.1	4	36	530249.5	7144084.5
22	10110	D/	2	77.1	72.0	2.2	0	47	530494.1	7145078.0
22	10110	E/	2	86.4	66.6	3.0	0	49	530510.0	7145146.5
22	10110	F/	2	76.0	45.9	3.9	0	40	530584.5	7145560.0
22	10110	G/	0	17.4	23.8	0.8	2	34	530758.9	7146125.5
22	10110	H/	0	7.4	19.0	0.2	0	43	530797.2	7146274.0
22	10110	J/	2	52.0	44.8	2.2	0	50	530904.7	7146826.5
22	10110	K/	2	50.3	42.7	2.2	0	57	530921.9	7146926.0
22	10110	M/	3	48.6	24.2	4.4	0	37	530981.7	7147186.0
22	10110	N/	2	78.0	57.2	3.1	0	48	531041.9	7147358.0
22	10110	O/	2	101.0	78.2	3.1	0	48	531077.2	7147441.5
22	10110	P/	2	68.3	56.6	2.5	0	33	531126.6	7147571.0
22	10110	Q/	2	49.1	40.5	2.3	0	37	531203.6	7147963.0
22	10110	R/	2	52.2	36.7	2.8	0	38	531219.9	7148060.0
22	10110	S/	3	65.4	28.7	5.6	0	42	531352.7	7148677.0
22	10110	T/	2	26.9	16.6	2.7	0	58	531442.9	7148969.5
22	10100	A/	1	40.8	47.6	1.3	0	39	531385.8	7149880.5
22	10100	B/	1	31.4	33.9	1.4	0	43	531350.3	7149754.5
22	10100	C/	0	24.7	37.2	0.8	0	43	531325.1	7149672.5

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

AREA 1 TANANA PROJECT

COAL PROPERTY

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS		
22	10100	D/	0	28.8	45.8	0.8	0	38	531279.1	7149553.0
22	10100	E/	3	92.7	36.2	7.3	0	48	531175.6	7149264.0
22	10100	F/	4	167.0	52.7	11.3	0	34	531143.1	7149119.5
22	10100	G/	2	65.7	47.3	3.0	0	39	531090.5	7148820.5
22	10100	H/	3	69.2	39.6	4.1	0	35	531074.7	7148728.5
22	10100	J/	3	66.1	29.9	5.4	0	37	531061.7	7148649.0
22	10100	K/	3	55.8	25.6	5.1	0	40	530781.8	7147618.0
22	10100	M/	3	58.9	21.9	6.8	0	39	530735.9	7147309.5
22	10100	N/	3	53.9	20.9	6.3	0	37	530705.1	7147165.0
22	10100	O/	2	38.0	26.9	2.5	3	34	530653.0	7146976.5
22	10100	P/	0	8.6	18.4	0.3	2	34	530380.9	7145791.0
22	10100	Q/	2	91.8	76.4	2.7	0	39	530303.6	7145543.5
22	10100	R/	3	72.8	39.1	4.5	0	38	530237.7	7145322.5
22	10100	S/	3	82.0	45.2	4.5	0	35	530163.2	7145110.5
22	10100	T/	1	41.3	39.0	1.8	0	41	530138.6	7144937.0
22	10100	U/	0	15.7	24.7	0.6	4	31	530092.3	7144668.5
22	10100	V/	0	12.1	19.0	0.5	7	32	529982.3	7144258.0
22	10100	W/	0	17.3	21.7	0.9	0	47	529774.7	7143563.0
22	10100	X/	0	5.3	15.2	0.1	0	43	529721.4	7143317.0
22	10090	A/	1	59.4	87.9	1.1	0	33	529899.9	7145151.0
22	10090	B/	1	49.4	53.8	1.6	0	50	529937.0	7145363.0
22	10090	C/	2	83.7	85.7	2.0	0	58	529959.9	7145497.0
22	10090	D/	1	22.4	19.6	1.6	0	53	530391.9	7147109.5
22	10090	E/	2	52.2	36.5	2.9	0	41	530448.6	7147376.0
22	10090	F/	0	27.2	40.3	0.8	0	42	530586.8	7148199.0
22	10090	G/	3	79.6	28.7	7.7	0	41	530788.5	7148723.0
22	10090	H/	3	92.3	34.5	7.7	0	43	530824.6	7148864.5
22	10090	J/	3	100.2	41.3	6.9	0	43	530835.3	7148923.5
22	10090	K/	4	140.2	40.3	12.2	0	46	530864.4	7149271.5
22	10090	M/	1	21.7	25.2	1.1	2	35	530960.4	7149654.0
22	10090	N/	2	74.2	73.4	2.1	0	51	531121.3	7150265.5
22	10080	A/	2	40.1	30.9	2.3	0	54	530815.4	7150249.0
22	10080	B/	2	44.8	36.3	2.2	0	35	530805.8	7150132.0
22	10080	C/	5	104.1	21.5	17.2	0	52	530600.5	7149360.0
22	10080	D/	2	25.9	17.0	2.5	0	53	530508.4	7149157.5
22	10080	E/	0	9.3	24.3	0.2	0	45	530073.9	7147557.5
22	10080	F/	2	38.3	33.0	2.0	0	63	530003.4	7147331.0
22	10080	G/	2	50.2	30.0	3.5	0	51	529977.4	7147138.0
22	10080	H/	2	44.8	24.1	3.8	0	43	529972.4	7147037.0
22	10080	J/	2	33.7	24.5	2.3	0	46	529697.3	7145635.0
22	10080	K/	1	23.2	18.3	1.8	6	37	529589.8	7145115.0
22	10070	A/	0	16.4	26.8	0.6	0	41	529251.1	7145119.0

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AREA 1 TANANA PROJECT

COAL PROPERTY

FLIGHT	LINE	ANOMALY	CATEGORY	AMPLITUDE (PPM) INPHASE	QUAD.	CONDUCTOR CTP MHOS	DEPTH MTRS	BIRD HEIGHT MTRS		
22	10070	B/	3	57.9	27.8	4.8	0	69	529381.4	7145630.0
22	10070	C/	3	59.4	23.8	6.2	0	46	529410.5	7145716.0
22	10070	D/	0	20.4	27.0	0.9	4	31	529841.8	7147536.0
22	10070	E/	1	44.4	53.5	1.3	0	45	530121.6	7148671.5
22	10070	F/	2	62.6	40.5	3.4	0	35	530122.5	7148762.5
22	10070	G/	3	43.6	17.2	5.7	5	35	530165.1	7148970.5
22	10070	H/	2	32.7	18.8	3.2	0	48	530225.9	7149197.0
22	10070	J/	5	80.6	17.0	15.6	0	50	530303.6	7149457.5
22	10070	K/	5	83.6	16.6	17.1	0	55	530336.4	7149576.5
22	10070	M/	4	82.5	18.3	14.7	0	50	530373.0	7149714.0
22	10070	N/	2	25.1	17.9	2.2	0	44	530422.1	7149885.5
22	10060	A/	1	18.6	16.9	1.4	3	41	530232.0	7150469.5
22	10060	B/	3	83.8	39.0	5.6	0	42	530083.7	7149765.5
22	10060	C/	3	64.9	22.3	7.7	0	55	530034.6	7149544.5
22	10060	D/	3	46.8	22.6	4.5	0	54	529978.6	7149295.0
22	10060	E/	2	24.2	13.6	3.0	0	52	529879.1	7148798.5
22	10060	F/	0	15.6	25.2	0.6	0	37	529577.6	7147733.5
22	10060	G/	3	36.9	17.9	4.1	0	60	529046.3	7145443.0
22	10060	H/	0	23.3	35.5	0.8	0	43	528455.7	7142973.5
22	10050	A/	0	8.9	15.9	0.4	0	51	528047.3	7142828.0
22	10050	B/	1	20.2	16.5	1.7	0	51	528107.4	7143028.5
22	10050	C/	0	16.4	21.9	0.8	2	36	528494.7	7144613.0
22	10050	D/	0	20.8	28.6	0.8	0	34	528519.6	7144711.5
22	10050	E/	0	19.9	35.7	0.6	0	36	528603.9	7144978.5
22	10050	F/	2	74.3	54.7	3.0	0	52	528715.1	7145342.0
22	10050	G/	2	63.1	40.8	3.4	0	51	528727.7	7145406.0
22	10050	H/	1	122.3	212.9	1.2	0	42	529242.4	7147658.5
22	10050	J/	2	43.1	24.1	3.6	0	49	529609.8	7149185.5
22	10050	K/	3	47.3	22.8	4.5	0	49	529625.6	7149286.5
22	10050	M/	3	63.6	25.5	6.3	0	47	529658.6	7149423.0
22	10050	N/	3	77.9	34.8	5.8	0	45	529679.9	7149491.0
22	10050	O/	0	11.0	21.9	0.4	0	36	529890.4	7150114.5
22	10050	P/	0	21.5	30.9	0.8	2	31	529942.1	7150423.0
22	10040	A/	0	9.3	18.2	0.3	0	37	529614.2	7150225.0
22	10040	B/	3	28.6	11.6	4.8	0	47	529273.0	7148927.5
22	10040	C/	0	22.4	40.4	0.6	2	26	528987.4	7147761.5
22	10040	D/	0	18.6	50.9	0.3	1	22	528970.9	7147655.5
22	10040	E/	2	35.8	24.3	2.6	0	45	528328.8	7145119.0
22	10040	F/	1	28.8	29.5	1.4	0	51	527840.4	7142953.0
22	10030	A/	0	11.6	21.0	0.4	1	35	527744.2	7144121.5
22	10030	B/	0	19.0	41.2	0.4	0	34	528213.3	7145858.0

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AREA 1 TANANA PROJECT

COAL PROPERTY

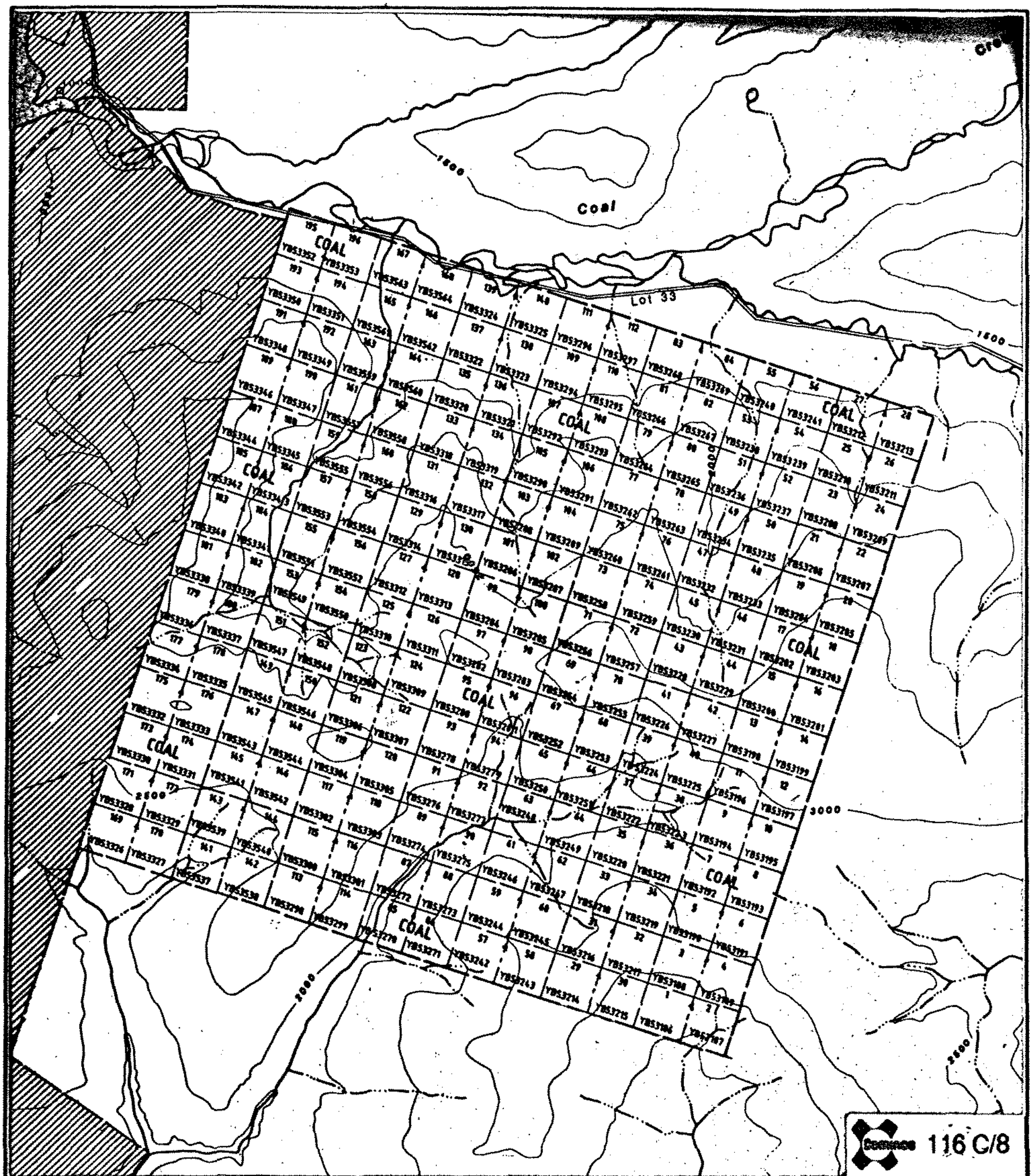
				AMPLITUDE (PPM)		CONDUCTOR CTP	DEPTH	BIRD HEIGHT		
FLIGHT	LINE	ANOMALY	CATEGORY	INPHASE	QUAD.	MHOS	MTRS	MTRS		
22	10030	C/	0	6.6	15.6	0.2	0	77	528349.9	7146364.0
22	10030	D/	1	19.3	14.6	1.8	0	64	528407.7	7146826.0
22	10030	E/	0	14.3	40.1	0.2	0	34	528738.8	7148044.5
22	10030	F/	3	64.5	21.9	7.8	0	48	529037.1	7149387.5
22	10030	G/	3	82.3	34.5	6.4	0	46	529084.6	7149515.0
22	10030	H/	1	22.7	24.9	1.2	0	46	529257.4	7150096.5
22	10030	J/	1	48.0	45.7	1.9	0	35	529293.4	7150430.0
22	10020	A/	0	25.0	33.0	0.9	0	39	529093.4	7150825.0
22	10020	B/	1	31.2	32.4	1.4	0	37	529048.2	7150494.5
22	10020	C/	0	15.7	22.9	0.7	0	38	529030.1	7150389.5
22	10020	D/	0	17.7	21.1	0.9	0	55	528947.3	7149992.5
22	10020	E/	3	33.2	14.8	4.5	0	45	528800.9	7149491.0
22	10020	F/	0	7.0	17.0	0.2	2	33	528485.8	7148061.0
22	10020	G/	2	27.0	16.8	2.7	0	72	527777.6	7145325.5
22	10020	H/	1	44.4	43.5	1.7	0	49	527730.6	7145183.5
22	10010	A/	0	11.9	27.0	0.3	0	36	527134.4	7144119.0
22	10010	B/	0	8.7	14.6	0.4	0	69	527441.1	7145190.5
22	10010	C/	0	9.1	39.4	0.1	0	36	527796.0	7146411.0
22	10010	D/	0	13.9	15.5	0.9	0	46	528267.4	7148528.0
22	10010	E/	1	17.2	16.0	1.3	1	44	528523.6	7149759.5
22	10010	F/	1	31.4	33.6	1.4	0	46	528620.8	7150131.0
22	10010	G/	2	85.1	59.2	3.4	0	35	528722.6	7150529.5

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

APPENDIX IV GEOCHEMICAL DATA

Coal

Labno	Fieldno	Cu	Pb	Zn
S9526807	307359	18	12	77
S9526808	307360	25	19	84
S9526809	307361	26	17	86
S9526810	307362	11	<4	25
S9526811	307363	35	8	51
S9526812	307364	35	14	134
S9526813	307365	34	25	182
S9526814	307366	26	16	79
S9526815	307367	37	8	73
S9526816	307368	45	53	134
S9526817	307369	33	35	68
S9526818	307370	39	49	96
S9526819	307371	31	19	193
S9526820	307372	48	25	158
S9526821	307373	32	14	125
S9526625	280091	18	5	45
S9526626	280092	24	8	55
S9526627	280093	39	<4	81
S9526628	280094	17	<4	30
S9526629	280095	54	571	429
S9526630	280096	52	57	179
S9526631	280097	38	13	153
S9526632	280098	67	13	142
S9526633	280099	40	10	132
S9526634	280100	41	10	164
S9526635	280101	39	16	116
S9526636	280102	25	13	152
S9526637	280103	39	17	161
S9526638	280104	25	25	138
S9526639	280105	32	18	112
S9526640	280106	22	10	109
S9526641	280107	59	12	200
S9526642	280108	34	10	91
S9526643	280109	23	14	73
S9526644	280110	29	52	108
S9526645	280111	40	12	96
S9526646	280112	24	48	121
S9526647	280113	34	47	192
S9526648	280114	26	27	125
S9526649	280115	49	44	150
S9526650	280116	84	13	151
S9526651	280117	38	17	104
S9526652	280118	39	8	94
S9526653	280119	91	7	73
S9526654	280120	47	12	103
S9526655	280121	57	22	123
S9526656	280122	54	<4	71
S9526657	280123	48	12	93
S9526658	280124	38	32	177
S9526659	280125	86	12	85
S9526660	280126	40	9	112
S9526661	280127	28	15	84
S9526662	280128	78	16	184
S9526663	280129	55	<4	154
S9526664	280130	46	8	106
S9526988	307117	17	11	68
S9526989	307118	41	15	54
S9526990	307119	31	21	48
S9526991	307120	22	17	71
S9526992	307121	13	20	77
S9526993	307122	11	26	58
S9526994	307123	20	19	75
S9526995	307124	146	49	243
S9526996	307125	46	29	84
S9526997	307126	33	28	93
S9526998	307127	16	11	65
S9526999	307128	58	27	153
S9526973	307102	15	14	38
S9526974	307103	24	13	56
S9526975	307104	12	11	37
S9526976	307105	15	8	41
S9526977	307106	15	148	73
S9526978	307107	9	11	29
S9526979	307108	11	9	27
S9526980	307109	13	12	36
S9526981	307110	11	11	19
S9526982	307111	11	10	35
S9526983	307112	7	11	31
S9526984	307113	16	12	45
S9526985	307114	8	8	33
S9526986	307115	12	7	44
S9526987	307116	31	19	64



Drawn by:		Traced by:	
Revised by	Date	Revised by	Date

COAL PROPERTY
CLAIM MAP

093480

Scale: 1:50,000 | Date: DEC. 13, 1995 | Plate: 1-5

NCI 112A CL

MAP NO: 116C/8

ASSESSMENT REPORT: X

PROSPECTUS:

CONFIDENTIAL: X

OPEN FILE:

DOCUMENT NO: 093480

MINING DISTRICT: Dawson

TYPE OF WORK: GP,GC

REPORT FILED UNDER: Cominco Ltd.

DATE PERFORMED: June 9, Aug 16-22, 1995

DATE FILED: June 17, 1996

LATITUDE: 64 26

AREA: Coal River

LONGITUDE: 140 20

VALUE: $24500

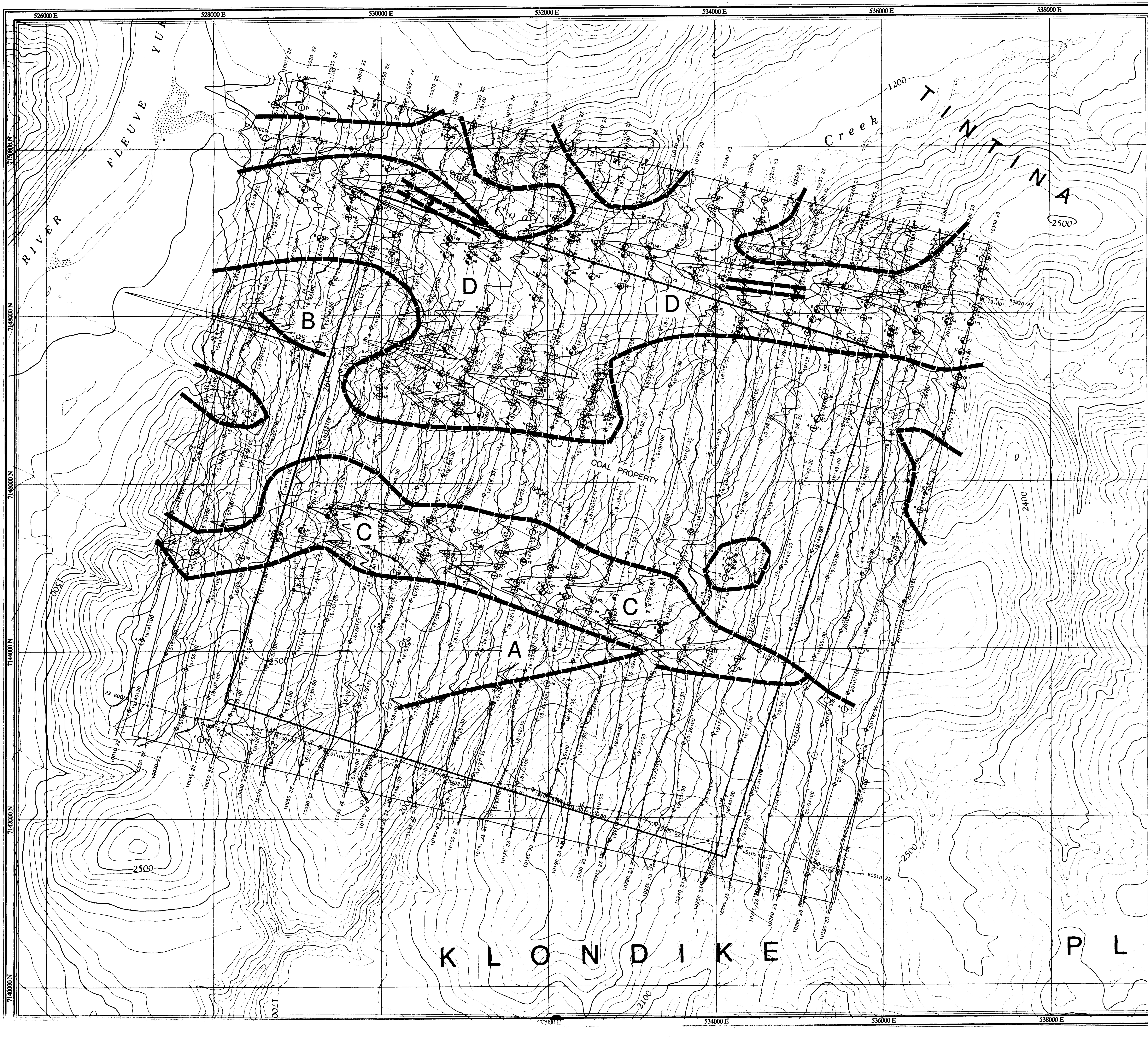
CLAIM NAME AND #: Coal 1-196

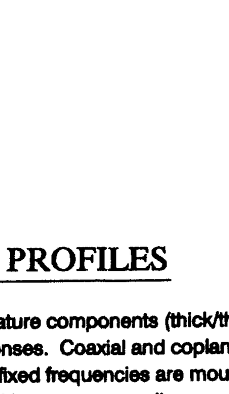
WORK DONE BY: K.R. Pride

WORK DONE FOR: Cominco Ltd.

Claims in Good Standing	

Remarks: Helicopter magnetic and electromagnetic survey and geochemistry.





Square: Grid North
Star: True North
Arrow: Magnetic North

Angles presented are approximate mean deviations for centre of NTS sheet.
Use diagram for reference only.

Grid North - True North : 0.7°
Grid North - Magnetic North : 29.4°
Annual change : 0.17°

EM PROFILES

Inphase and quadrature components (thick/thin) of measured EM responses. Coaxial and coplanar coil pairs operating at fixed frequencies are mounted in a towed bird, with an average coil separation of 6.5m, and an average sensor elevation of 30m.

Profiles are presented as offsets from flight lines, using the vertical scales listed below:

COAXIAL
4600 Hz - 2 ppm/mm

FLIGHT PATH

Navigation and flight path recovery was conducted using a Global Positioning System (GPS) satellite navigation system.

Lines were flown at an azimuth of 15 - 195°, with an average line spacing of 300m.

Average helicopter-terrain clearance of 60m was monitored by radar and barometric altimeters.

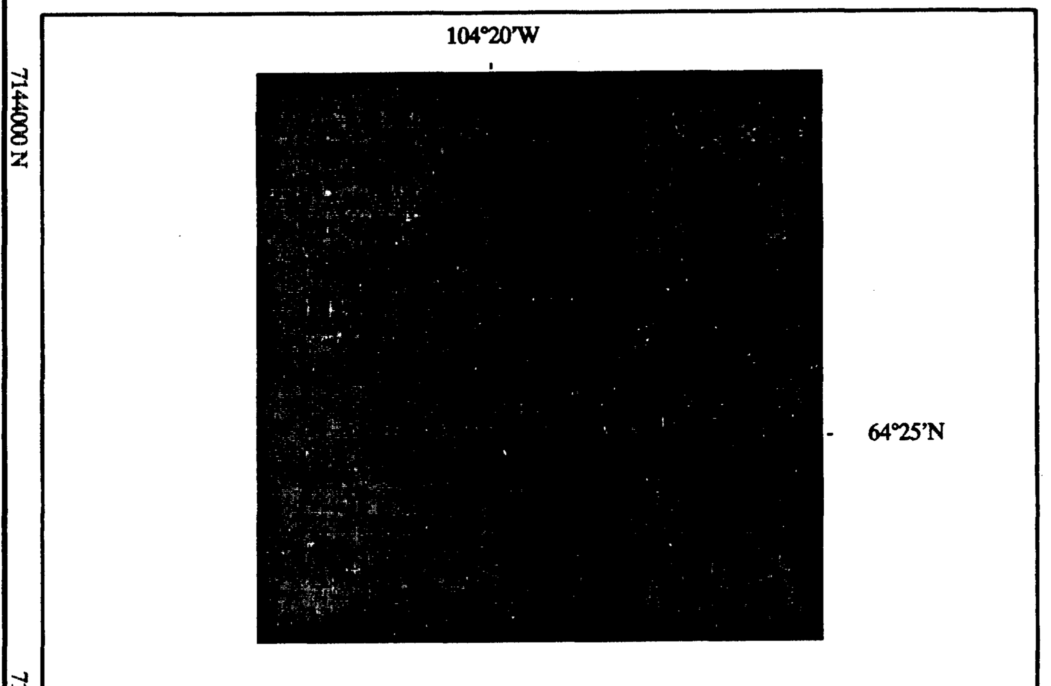
EM ANOMALIES

EM anomalies selected by computer algorithm and manually confirmed. Selection is based on the response correlation to theoretical sources such as a steeply dipping conductor.

Calculation of conductance is based on the response of the 4600 Hz coaxial data, and forms the basis for anomaly classification.

Letter codes are used to identify individual anomalies on a line, and the inphase amplitude of the 4600 Hz response is annotated opposite.

- 0 - 1 mhos
- 1 - 2 mhos
- 2 - 4 mhos
- 4 - 8 mhos
- 8 - 16 mhos
- 16 - 32 mhos
- > 32 mhos



COMINCO EXPLORATION

EM PROFILES

4600 Hz COAXIAL

COAL PROPERTY

YUKON

093480
#1

SCALE 1:20 000

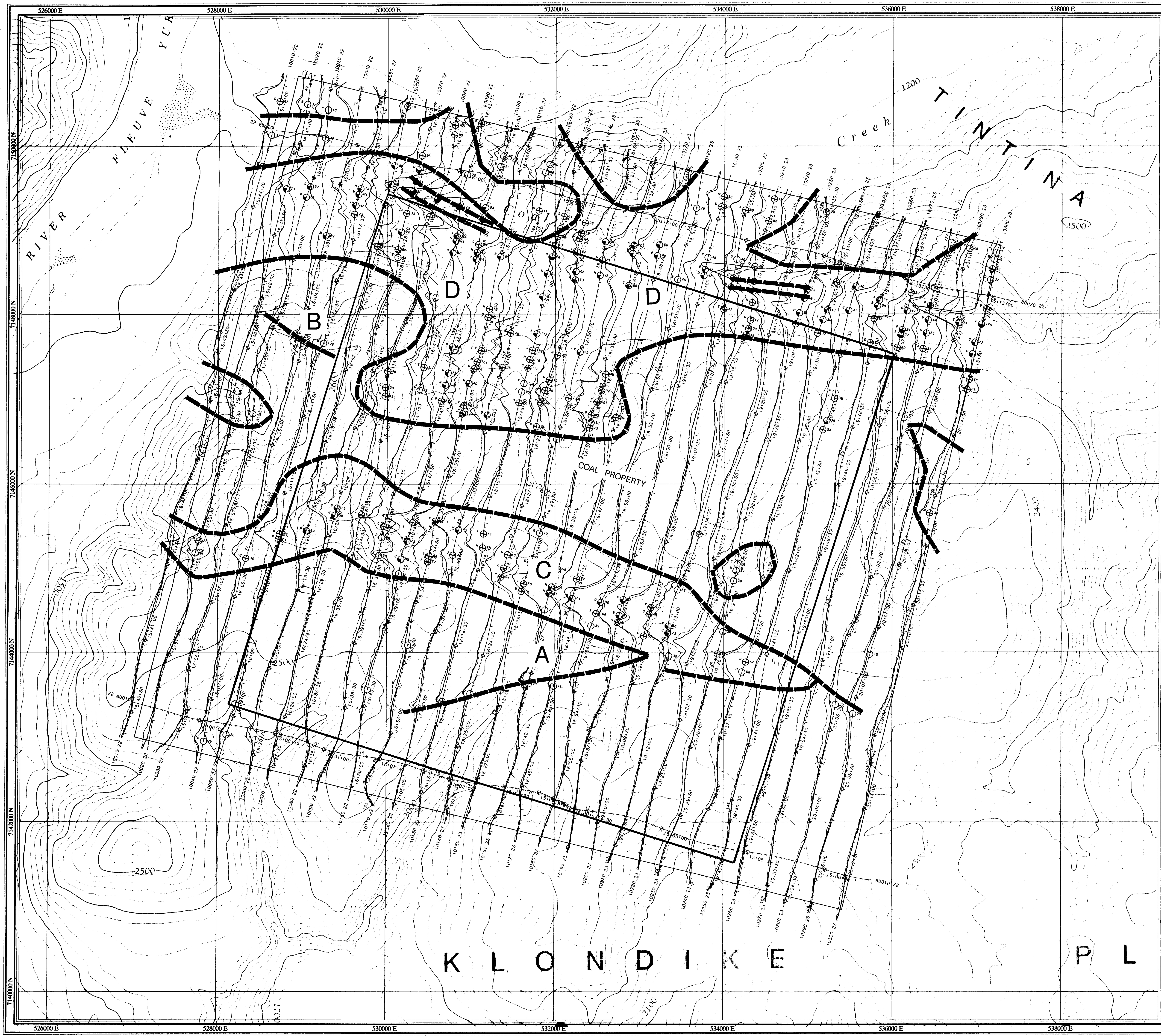
500 0 200 400 1000 2000 metres

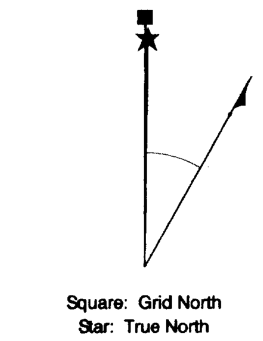
AERODAT INC.

Date Flown : JUNE 1995

NTS : 116 C/8

Project : J9518 Map Ref : 1 - 4





EM PROFILES

Inphase and quadrature components (thick/thin) of measured EM responses. Coaxial and coplanar coil pairs operating at fixed frequencies are mounted in a towed bird, with an average coil separation of 6.5m, and an average sensor elevation of 30m.

Profiles are presented as offsets from flight lines, using the vertical scales listed below:

COAXIAL
935 Hz - 2 ppm/mm

Square: Grid North
Star: True North
Arrow: Magnetic North

Angles presented are approximate mean deviations for centre of NTS sheet. Use diagram for reference only.

Grid North - True North : 0.7°
Grid North - Magnetic North : 29.4°
Annual change : 0.17°

FLIGHT PATH

Navigation and flight path recovery was conducted using a Global Positioning System (GPS) satellite navigation system.

Lines were flown at an azimuth of 15 - 195°, with an average line spacing of 300m.

Average helicopter-terrain clearance of 60m was monitored by radar and barometric altimeters.

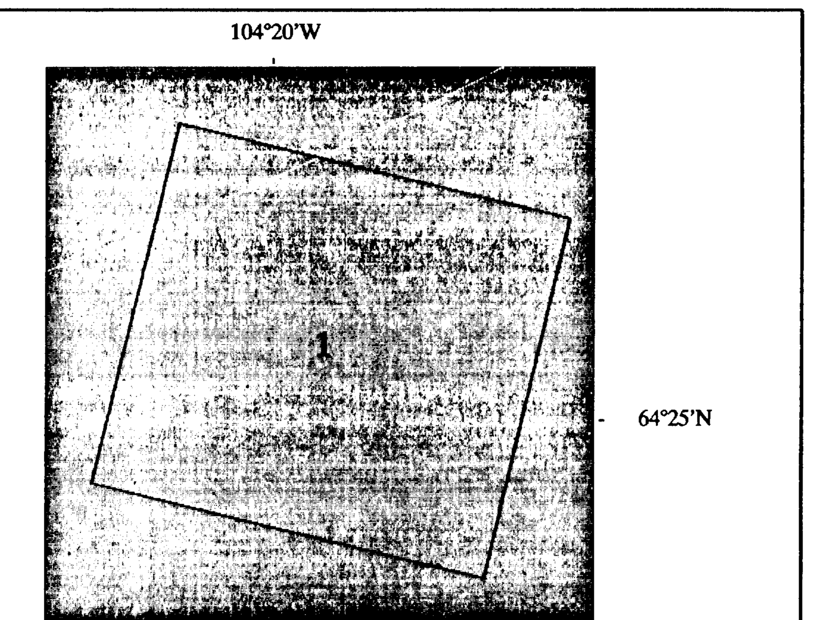
EM ANOMALIES

EM anomalies selected by computer algorithm and manually confirmed. Selection is based on the response correlation to theoretical sources such as a steeply dipping conductor.

Calculation of conductance is based on the response of the 4600 Hz coaxial data, and forms the basis for anomaly classification.

Letter codes are used to identify individual anomalies on a line, and the inphase amplitude of the 4600 Hz response is annotated opposite.

0 - 1 mhos
1 - 2 mhos
2 - 4 mhos
4 - 8 mhos
8 - 16 mhos
16 - 32 mhos
> 32 mhos



COMINCO EXPLORATION

EM PROFILES
935 Hz COAXIAL
COAL PROPERTY
YUKON

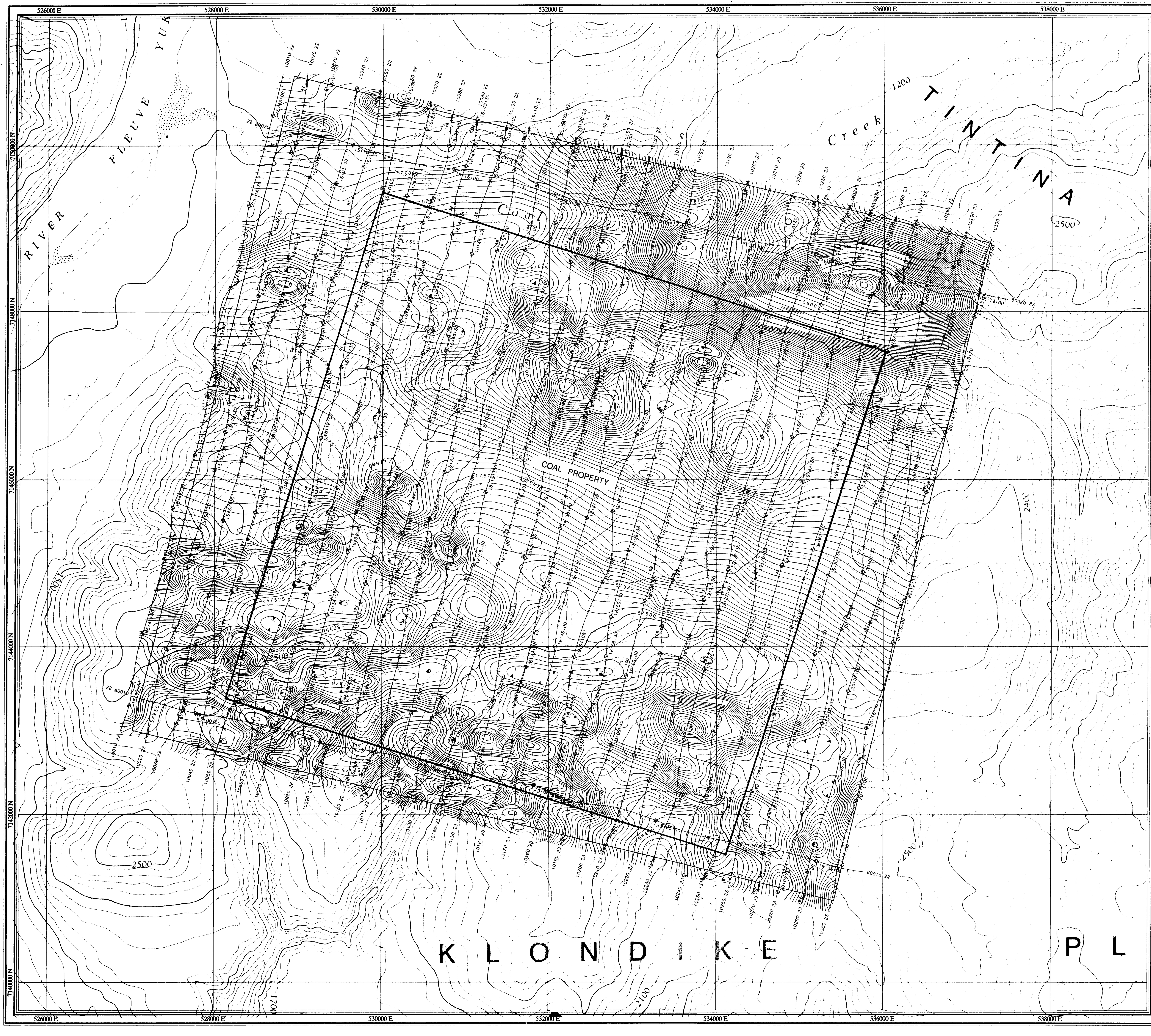
093480
#2

SCALE 1:20 000

500 0 200 400 1000 2000 metres

AERODAT INC.

Date Flown : JUNE 1995
NTS : 116 C/8
Project : J9518 Map Ref : 1 - 3

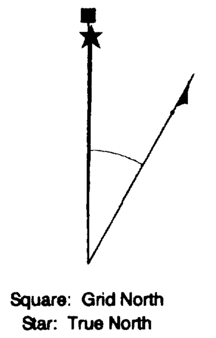


TOTAL FIELD MAGNETICS

Total field magnetic intensity contour data, measured by a cesium high sensitivity magnetometer at an average sensor elevation of 45m, and corrected for diurnal variation.

Map contours are in nanoTeslas, and are multiples of those listed below:

- 5 nT
- 25 nT
- 100 nT
- 500 nT
- 2000 nT



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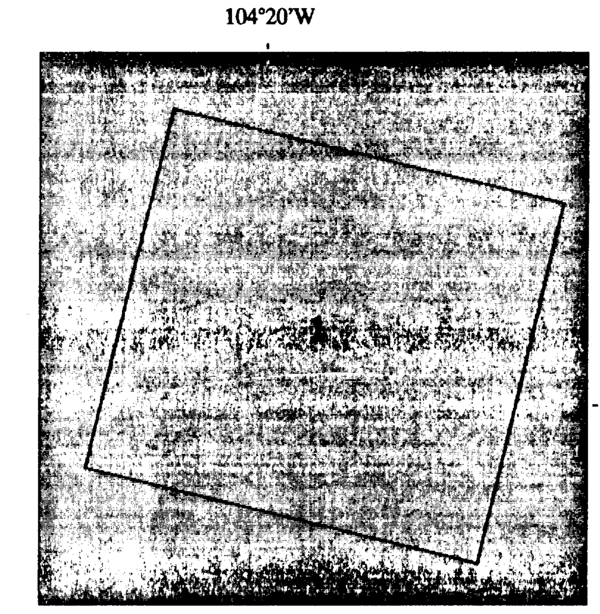

COMINCO EXPLORATION

TOTAL FIELD MAGNETICS

COAL PROPERTY
YUKON

093480
#3

SCALE 1:20 000

500 0 200 400 1000 2000 metres

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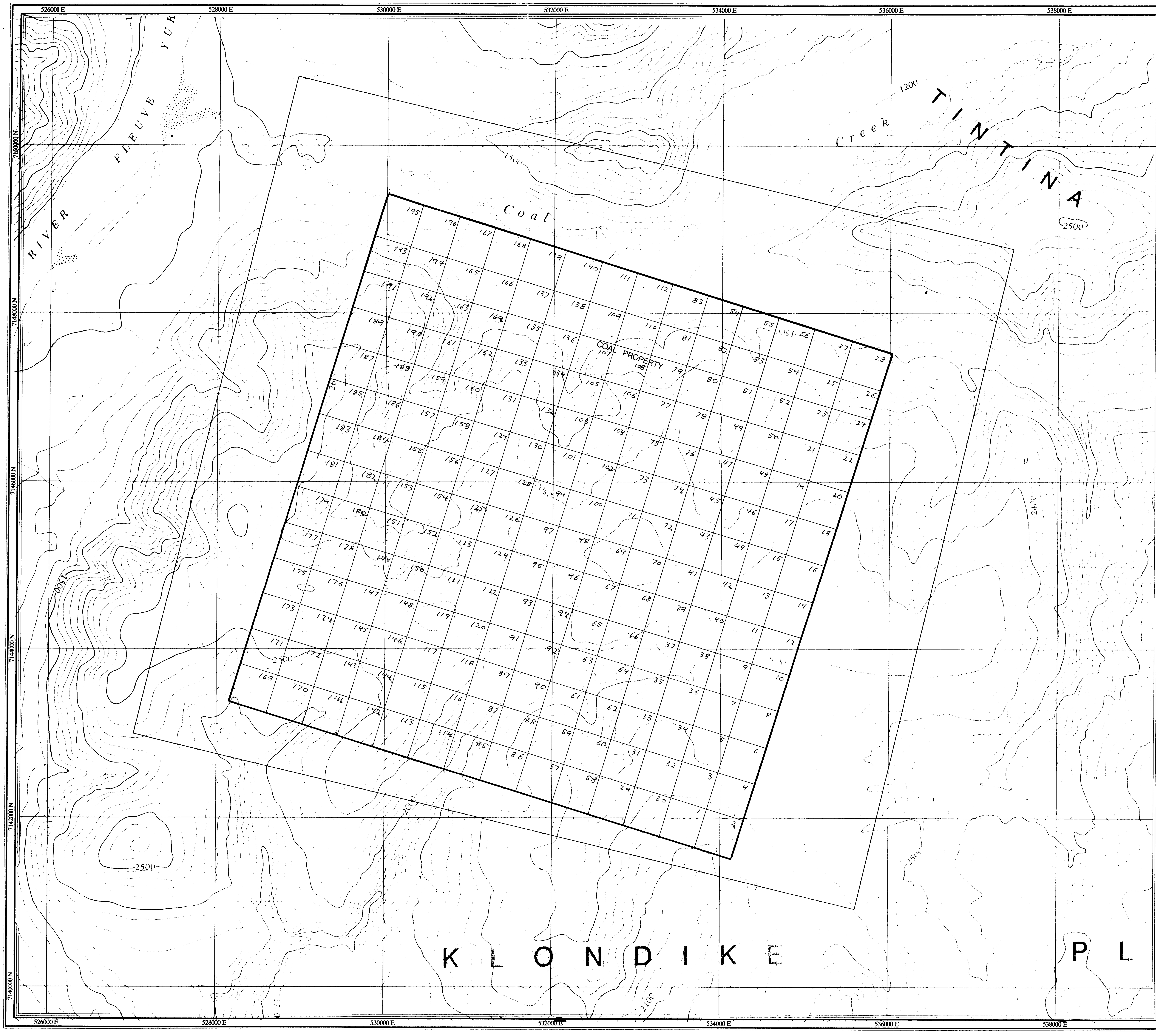
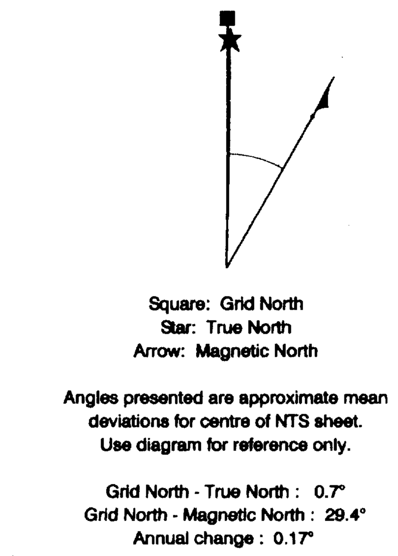
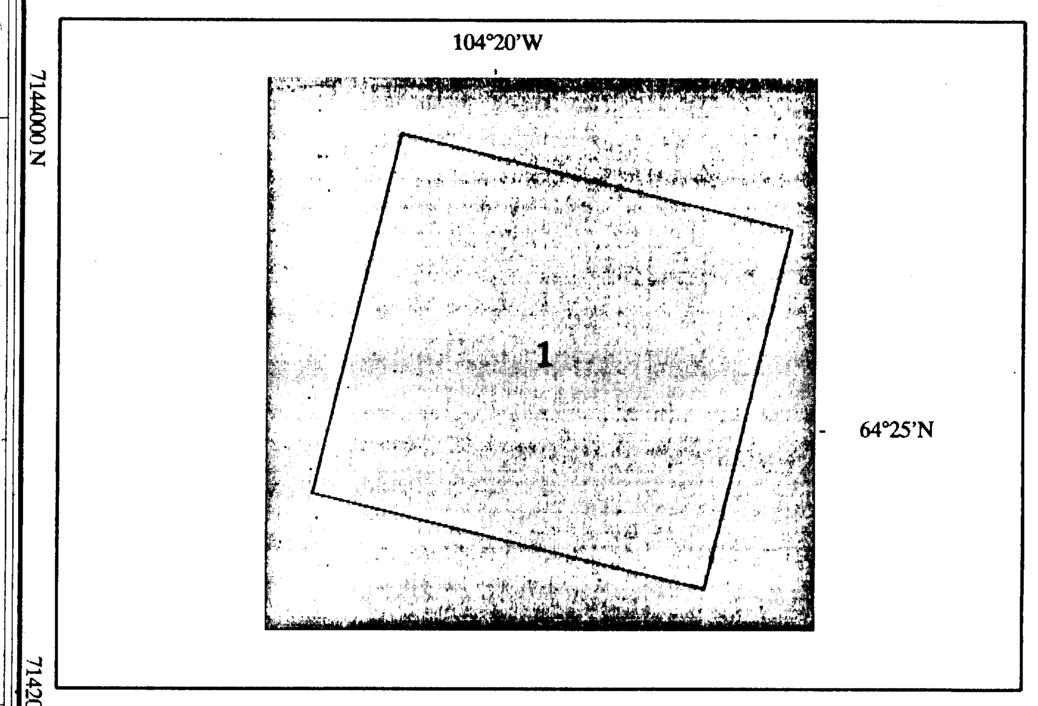
Project : J9518	Map Ref : 1 - 2







COMINCO EXPLORATION

BASE MAP

COAL PROPERTY

YUKON

093480
#4

SCALE 1:20 000

500 0 200 400 1000 2000 metres

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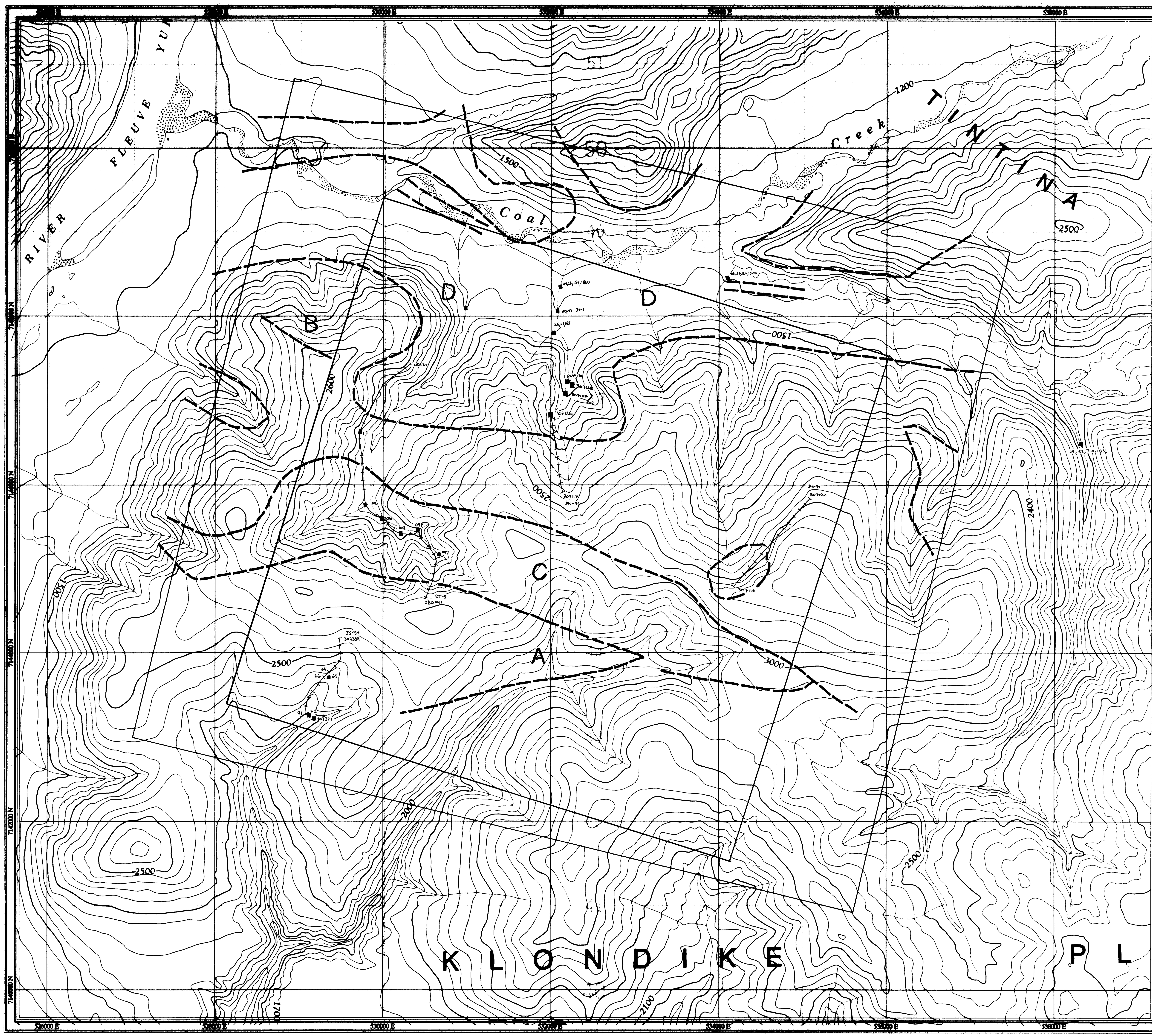
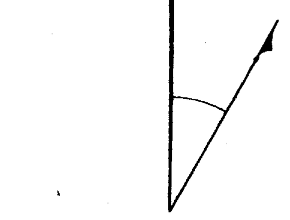
NTS : 116 C/8

Project : J9518 Map Ref : 1 - 1





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Grid North - True North : 0.7°
Grid North - Magnetic North : 29.4°
Annual change : 0.17°

Coal

Labno	Fieldno	Cu	Pb	Zn
S9526807	307359	18	12	77
S9526808	307360	25	19	84
S9526809	307361	26	17	86
S9526810	307362	11	<4	25
S9526811	307363	35	8	51
S9526812	307364	35	14	134
S9526813	307365	34	25	182
S9526814	307366	26	16	79
S9526815	307367	37	8	73
S9526816	307368	45	53	134
S9526817	307369	33	35	68
S9526818	307370	39	49	96
S9526819	307371	31	19	193
S9526820	307372	48	25	158
S9526821	307373	32	14	125
S9526625	280091	18	5	45
S9526626	280092	24	8	55
S9526627	280093	39	<4	81
S9526628	280094	17	<4	30
S9526629	280095	54	571	429
S9526630	280096	52	57	179
S9526631	280097	38	13	153
S9526632	280098	67	13	142
S9526633	280099	40	10	132
S9526634	280100	41	10	164
S9526635	280101	39	16	116
S9526636	280102	25	13	152
S9526637	280103	39	17	161
S9526638	280104	25	25	138
S9526639	280105	32	18	112
S9526640	280106	22	10	109
S9526641	280107	59	12	200
S9526642	280108	34	10	91
S9526643	280109	23	14	73
S9526644	280110	29	52	108
S9526645	280111	40	12	96
S9526646	280112	24	48	121
S9526647	280113	34	47	192
S9526648	280114	26	27	125
S9526649	280115	49	44	150
S9526650	280116	84	13	151
S9526651	280117	38	17	104
S9526652	280118	39	8	94
S9526653	280119	91	7	73
S9526654	280120	47	12	103
S9526655	280121	57	22	123
S9526656	280122	54	<4	71
S9526657	280123	48	12	93
S9526658	280124	38	32	177
S9526659	280125	86	12	85
S9526660	280126	40	9	112
S9526661	280127	28	15	84
S9526662	280128	78	16	184
S9526663	280129	55	<4	154
S9526664	280130	46	8	106
S9526988	307117	17	11	68
S9526989	307118	41	15	54
S9526990	307119	31	21	48
S9526991	307120	22	17	71
S9526992	307121	13	20	77
S9526993	307122	11	26	58
S9526994	307123	20	19	75
S9526995	307124	146	49	243
S9526996	307125	46	29	84
S9526997	307126	33	28	93
S9526998	307127	16	11	65
S9526999	307128	58	27	153
S9526973	307102	15	14	38
S9526974	307103	24	13	56
S9526975	307104	12	11	37
S9526976	307105	15	8	41
S9526977	307106	15	148	73
S9526978	307107	9	11	29
S9526979	307108	11	9	27
S9526980	307109	13	12	36
S9526981	307110	11	11	19
S9526982	307111	11	10	35
S9526983	307112	7	11	31
S9526984	307113	16	12	45
S9526985	307114	8	8	33
S9526986	307115	12	7	44
S9526987	307116	31	19	64

307116 Soil Sample Traverse (Field Number)

□ 307127 Silt Sample (Field Number)

△ DH-1 Heavy Mineral Sample (Field Number)

COMINCO EXPLORATION

COAL PROPERTY GEOCHEMISTRY

YUKON

093480
#5

SCALE 1:20 000

500 0 200 400 1000 2000 metres

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Project : J9518 Map Ref : 1-6