92 L/3 Box 8

REPORT ON COMBINED HELICOPTER-BORNE MAGNETIC AND ELECTROMAGNETIC SURVEY KYUQUOT BRITISH COLUMBIA

AERODAT

REPORT ON
COMBINED HELICOPTER-BORNE
MAGNETIC AND ELECTROMAGNETIC
SURVEY
KYUQUOT
BRITISH COLUMBIA

for

FALCONBRIDGE LIMITED

by

AERODAT LIMITED

October, 1985

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(Scale: 1:5,000)

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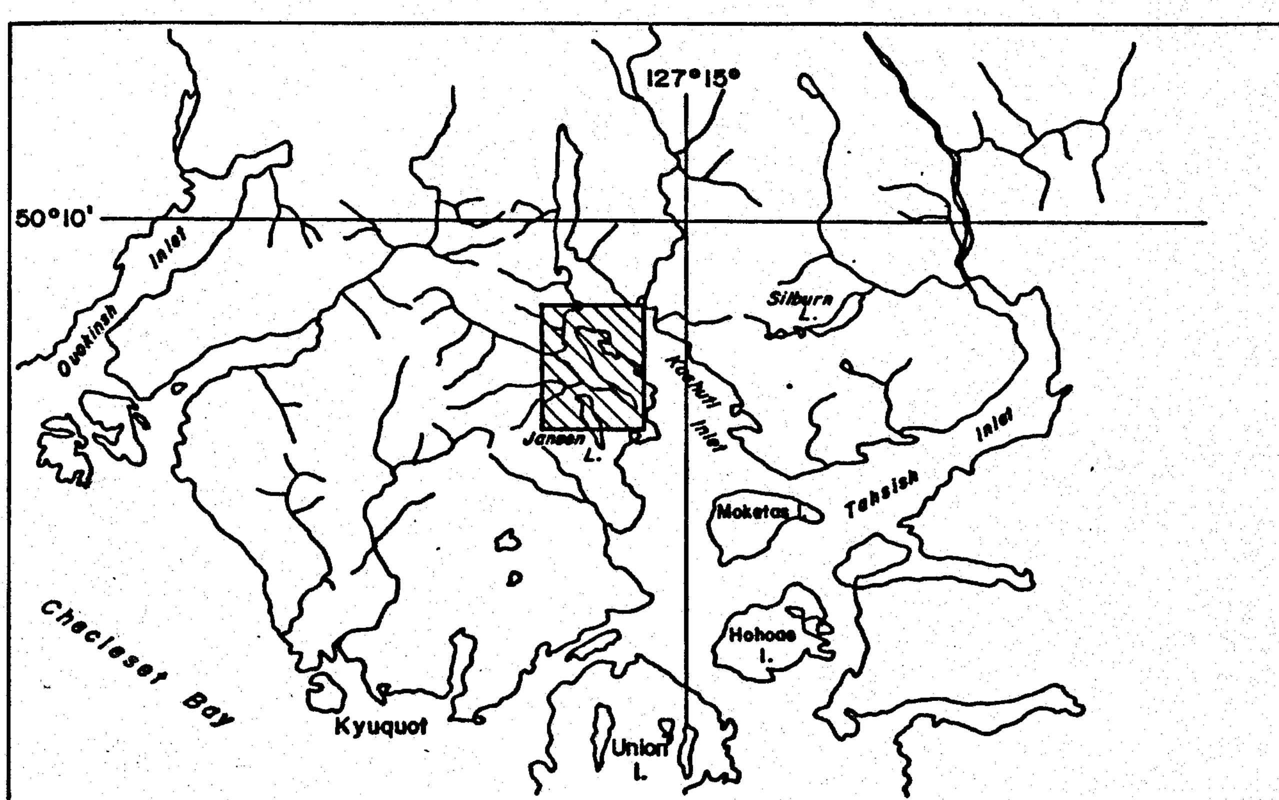
1. INTRODUCTION

This report describes an airborne geophysical survey carried out on behalf of Falconbridge Limited by Aerodat Limited. Equipment operated included a 3-frequency electromagnetic system, a magnetometer, a VLF-EM system, tracking camera and a radar positioning system.

The survey area, centered approximately at Latitude 50 degrees 03 minutes and Longitude 127 degrees 24 minutes, was flown on May 25, 1985. A total of 128 line kilometers of data were collected and is presented in this report.

2. SURVEY AREA LOCATION

The survey area is depicted on the index map below (NTS Reference 92 L/3). It covers an area along the northwest coast of Vancouver Island, on the west shore at Kashutl Inlet. Flight line direction was north-south and line spacing was nominally 100 meters.



AIRCRAFT AND EQUIPMENT

3.1 Aircraft

The helicopter used for the survey was an Aerospatiale A-Star 350D owned and operated by Frontier Helicopters Limited. Installation of the geophysical and ancillary equipment was carried out by Aerodat. The survey aircraft was flown at a mean terrain clearance of 60 meters.

3.2 Equipment

3.2.1 Electromagnetic System

The electromagnetic system was an Aerodat 3-frequency system. Two vertical coaxial coil pairs were operated at 932 and 4600 Hz and a horizontal coplanar coil pair at 4186 Hz. The transmitter-receiver separation was 7 meters. Inphase and quadrature signals were measured simultaneously for the 3 frequencies with a time constant of 0.1 seconds. The electromagnetic bird was towed 30 meters below the helicopter.

3.2.2 VLF-EM System

The VLF-EM system was a Herz Totem 1A. This instrument measures the total field and quadrature component of the selected frequency. The sensor was towed in a bird 12 meters below the helicopter. The transmitting station used was NLK (Jim Creek, Washington, 24.8 kHz) for the entire survey.

3.2.3 Magnetometer

The magnetometer was a Geometrics G 803 proton precession type. The sensitivity of the instrument was 1 gamma at a 0.5 second sampling rate. The sensor was towed in a bird 12 meters below the helicopter.

3.2.4 Magnetic Base Station

An IFG proton precession magnetometer was operated at the base of operations to record diurnal variations of the earth's magnetic field.

The clock of the base station was synchronized with that of the airborne system to facilitate later correlation.

3.2.5 Radar Altimeter

A Hoffman HRA-100 radar altimeter was used to record terrain clearance. The output from the instrument is a linear function of altitude for maximum accuracy.

3.2.6 Tracking Camera

A Geocam tracking camera was used to record flight path on 35mm film. The camera was operated in frame mode and the fiducial numbers for cross-reference to the analog and digital data were imprinted on the margin of the film.

3.2.7 Analog Recorder

An RMS dot-matrix recorder was used to display the data during the survey. In addition to manual and time fiducials, the following data was recorded:

Channel	Input	Scale
0	Low Frequency Inphase	2 ppm/mm
1	Low Frequency Quadrature	2 ppm/mm
2	High Frequency Inphase	2 ppm/mm
3	High Frequency Quadrature	2 ppm/mm
4	Mid Frequency Inphase	4 ppm/mm
5	Mid Frequency Quadrature	4 ppm/mm
6	VLF-EM Total Field	2.5%/mm
7	VLF-EM Quadrature	2.5%/mm
13	Altimeter (500 ft. at top of chart).	10 ft./mm
14	Magnetometer	5 gamma/mm
15	Magnetometer	50 gamma/mm

3.2.8 Digital Recorder

A Perle DAC/NAV data system recorded the survey on magnetic tape. Information recorded was as follows:

Equipment	Interval
EM	0.1 seconds
VLF-EM	0.5 seconds
Magnetometer	0.5 seconds
Altimeter	0.5 seconds
MRS III	0.5 seconds

3.2.9 Radar Positioning System

A Motorola Mini-Ranger (MRS III) radar navigation system was utilized for both navigation and track recovery. Transponders located at fixed locations were interrogated several times per second and the ranges from these points to the helicopter measured to several meter accuracy. A navigational computer triangulates the position of the helicopter and provides the pilot with navigation information. The range/range data was recorded on magnetic tape for subsequent flight path determination.

4. DATA PRESENTATION

4.1 Base Map and Flight Path

Photo map bases at 1:10,000 scale were prepared by enlargement of aerial photographs of the areas. They were used with topographic maps at the same scale during the course of the survey for visual navigation, for final flight path recovery using the 35mm film and for final map presentation at a 1:5,000 scale.

4.2 Electromagnetic Profile Maps

The electromagnetic data was recorded digitally at a sample rate of 10/second with a time constant of 0.1 second. A two stage digital filtering process was carried out to reject major sferic events, and to reduce 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 a geological phenomenon. To avoid this possibility, a computer algorithm searches out and rejects the major sferic events.

The signal to noise ratio was further enhanced by the application of a low pass digital filter. It 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 permits maximum profile shape resolution.

Following the filtering processes, a base level correction was made. The correction applied is a linear function of time that ensures that 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 were then presented in profile map form.

The in phase and quadrature responses of the coaxial 4600 Hz, and coplanar 4186 Hz configurations were plotted with electromagnetic anomaly information on the base map.

4.3 Total Field Magnetic Contours

The aeromagnetic data was corrected for diurnal variations by subtraction of the digitally recorded base station magnetic profile. No correction for regional variation was applied.

The corrected profile data were interpolated onto a regular grid at a 25 m interval using a cubic spline technique. The grid provided the basis for threading the presented contours at a 10 gamma interval.

The aeromagnetic data has been presented with electromagnetic anomaly information on the base map.

4.4 VLF-EM Total Field Contours

The VLF-EM signal was compiled in map form using data from NLK.

4.5 Computed Vertical Magnetic Gradient Contours

The vertical magnetic gradient was calculated from the gridded total field magnetic data. Contoured at a 1 gamma/m interval, the gradient data were presented on a mylar overlay of the base map.

5. INTERPRETATION

KYUQUOT

ELECTROMAGNETICS

The survey detected no bedrock conductors. Bedrock response was registered, in the form of negative inphase anomalies, over some of the stronger magnetic zones but nowhere could one attribute the EM responses, both inphase and quadrature, from either coil configuration and any of the three frequencies, to bedrock conductivity. High conductivity was registered over salt water and low conductivity (quadrature response) was recorded over Jansen Lake. Accordingly, an EM interpretation map was not prepared.

MAGNETICS

The general magnetic trend appears to be east-northeasterly although several isolated magnetic highs (and lows) tend to assume a north-south orientation. The former trend is thought to reflect the geologic 'grain' of the area whereas the latter is more likely to be a structural overprint. Magnetic highs do not correlate with topography - they favour both the peaks and valleys - but topographic trends tend to follow magnetic trends.

The magnetic anomalies appear to be mafic dikes - somewhat segmented by north-south structures - that are roughly 200 to 300 meters in width and dip (steeply) to the southwest.

VLF - TOTAL FIELD

There is a general correlation between the Total Field response and the narrow salt water inlet (Easy Inlet as well as topographic highs). The former appears as a true conductor but the latter correlations seem to be artificial highs, judging from the lack of correlative quadrature cross-overs. The explanation for this is not clear but is probably due to a phenomenon similar to that encountered in some ground surveys where measured VLF fields follow the ground profile. There is certainly no corroborating evidence, either magnetic, electromagnetic or structural, to suggest that the topographic highs are more conductive than the surrounding land mass.

In fact, there may be a negative correlation between VLF and magnetic highs but this is by no means consistent over the survey.

6. RECOMMENDATIONS

No bedrock conductors were detected over the land portions of this block and there is no evidence that any such conductors exist beneath the water covered areas (i.e. within the limits of penetration) of the equipment used.

Judging from what little information one can glean from the topographic map - in the form of claim staking - interest seems to be focused in areas where magnetic anomalies are intersected by possible fault structures. These are general lineaments along magnetic breaks or lows. Other than that, and lacking any geologic data, the writer cannot recommend any specific areas for follow-up.

All the conductive anomalies detected in this survey can be attributed to salt water. Slight perturbations, of both inphase and quadrature (see medium frequency coplanar), occur over what appears to be a fresh water lake in the south-central portion of the survey block. Otherwise, the only anomalous data apparent are the excursions of the inphase over several (but not all) of the magnetic highs.

Bedrock resistivities are high and there is little or no surficial conductivity (i.e. no conductive overburden - probably little or no overburden of any kind).

STATEMENT OF QUALIFICATIONS

GEORGE PODOLSKY

1. I reside at 172 Dunwoody Drive, OAKVILLE, Ontario.

2. I hold a B.Sc. in Engineering Physics from Queen's University (1954).

3. I am a professional geophysicist, have been an active member of the Society of Exploration Geophysicists since 1960, and have worked in the minerals industry since 1954.

4. I have examined all the data obtained by Aerodat in the course of their survey and this report is based on that examination.

5. I am an independent consultant and have no direct or indirect interest in Falconbridge Limited or in any properties lying within the surveyed area.

George Podolsky

APPENDIX I

GENERAL INTERPRETIVE CONSIDERATIONS

Electromagnetic

The Aerodat three frequency system utilizes two different transmitter-receiver coil geometries. The traditional coaxial coil configuration is operated at two widely separated frequencies and the horizontal coplanar coil pair is operated at a frequency 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 model on the accompanying phasor diagram. 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 table form in Appendix II and the conductance and inphase amplitude are presented in symbolized form on the map presentation.

The conductance and depth values 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.

Most overburden will have an indicated conductance of less than 2 mhos; however, more conductive clays may have an apparent conductance of say 2 to 4 mhos. Also in the low conductance range will be electrolytic conductors in faults and shears.

The higher ranges of conductance, greater than 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 sulphide or graphite bearing rocks.

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 consideration in association with minor conductive sulphides, and the electromagnetic response 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, but minor accessory sulphide mineralization could 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; however, 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.

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. As the dip of the conductor decreased 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.

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. 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 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*.

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.

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. In most cases, the response of the coplanar coils closely follows that of the coaxial coils with a relative amplitude ratio 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.

* 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.

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 elliptically polarized in the vicinity of electrical conductors. The Herz Totem uses three coils in the X, Y, Z configuration to measure the total field and vertical quadrature component of the polarization ellipse.

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 measureable 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 the depth of exploration is severly 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 response is an indicator of the existence and position of a conductivity anomaly. 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.

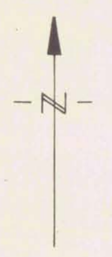
The vertical quadrature component over steeply dipping sheet-like conductor will be a cross-over type response with the cross-over closely associated with the upper edge of the conductor.

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 amplitude of the quadrature response, as opposed to shape is function of target conductance and depth as well as the conductivity of the overburden and host rock. As the primary field travels down to the conductor through conductive material it is both attenuated and phase shifted in a negative sense. The secondary field produced by this altered field at the target also has an associated phase shift. This phase shift is positive and is larger for relatively poor conductors. This secondary field is attenuated and phase shifted in a negative sense during return travel to the surface. The net effect of these 3 phase shifts determine the phase of the secondary field sensed at the receiver.

A relatively poor conductor in resistive ground will yield a net positive phase shift. A relatively good conductor in more conductive ground will yield a net negative phase shift. A combination is possible whereby the net phase shift is zero and the response is purely in-phase with no quadrature component.

A net positive phase shift combined with the geometrical cross-over shape will lead to a positive quadrature response on the side of approach and a negative on the side of departure. A net negative phase shift would produce the reverse. A further sign reversal occurs with a 180 degree change in instrument orientation as occurs on reciprocal line headings. During digital processing of the quadrature data for map presentation this is corrected for by normalizing the sign to one of the flight line headings.

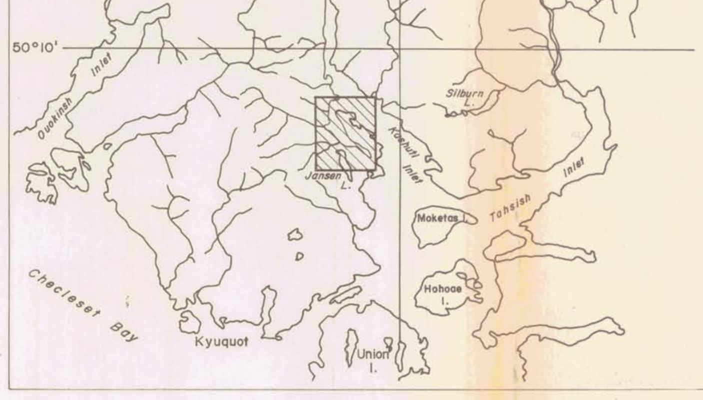


VERTICAL MAGNETIC GRADIENT

(CALCULATED FROM TOTAL FIELD MAGNETIC MAP)

CONTOUR INTERVAL:

25 gammas/metre
5 gammas/metre
1 gammas/metre



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VERTICAL MAGNETIC GRADIENT CONTOURS

KYUQUOT

BRITISH COLUMBIA

SCALE 1/5,000

0 330 660 1/4 mile

0 100 250 1/2 Kilometre

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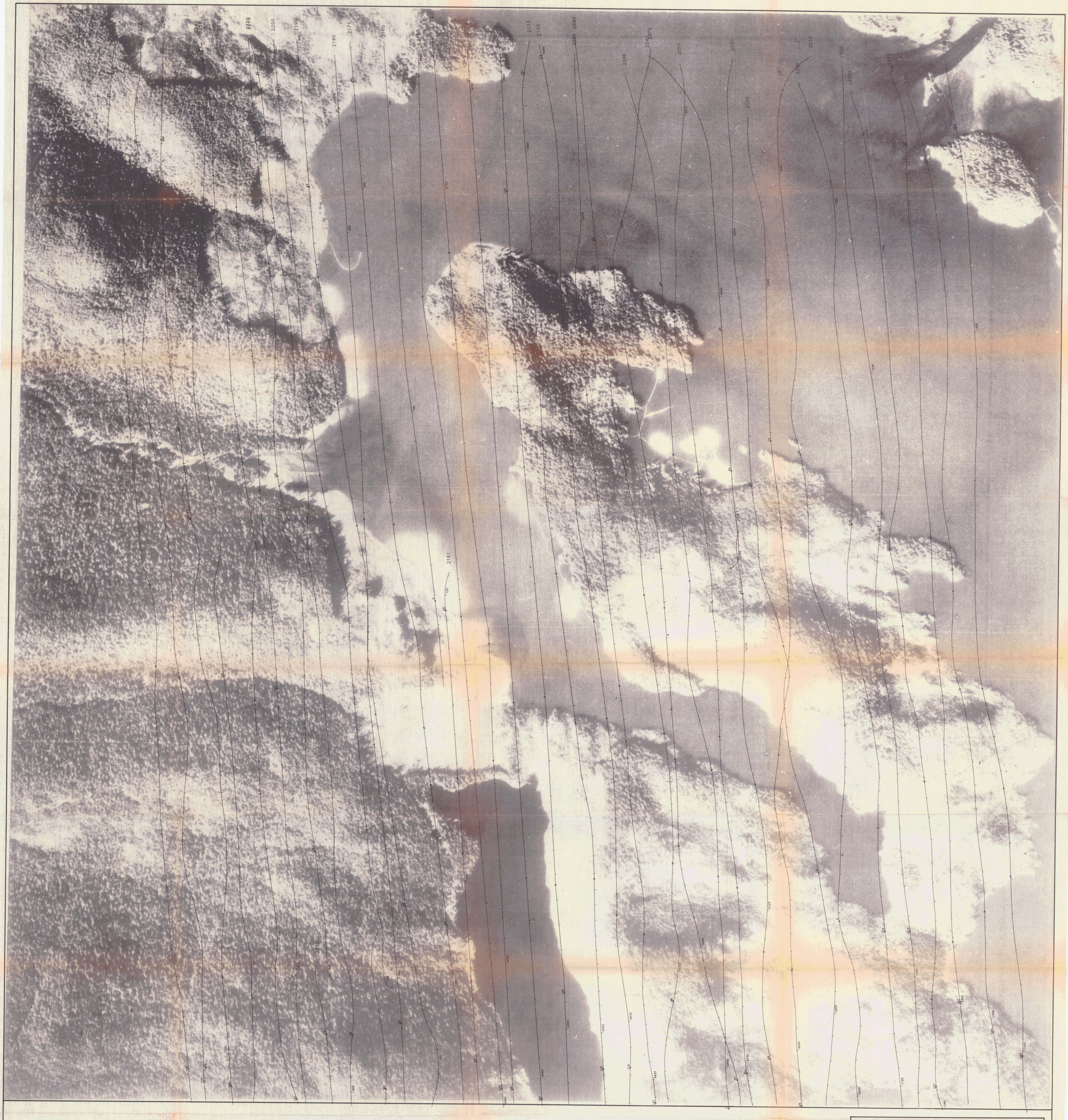
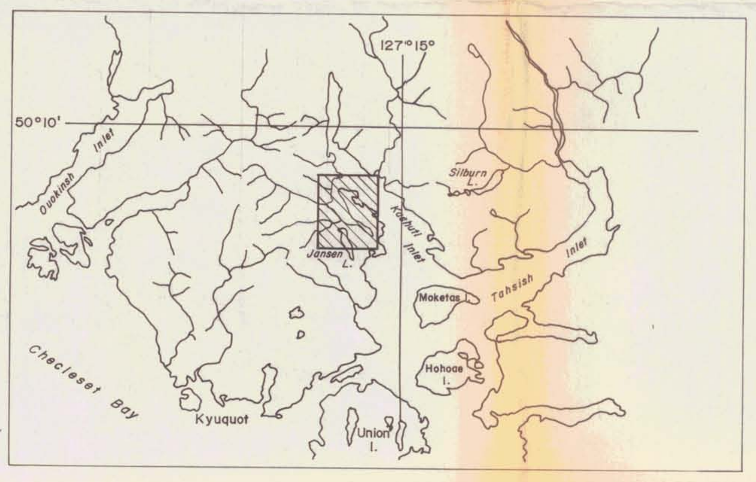
DATE:	May 1985
N.T.S. No:	92 L
MAP No:	3

J 8520-2





Horizontal control .... MRS III

Average bird height .... 30 metres

Line spacing .... 100 metres

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AIRBORNE ELECTROMAGNETIC SURVEY

KYUQUOT

BRITISH COLUMBIA

SCALE 1/5,000

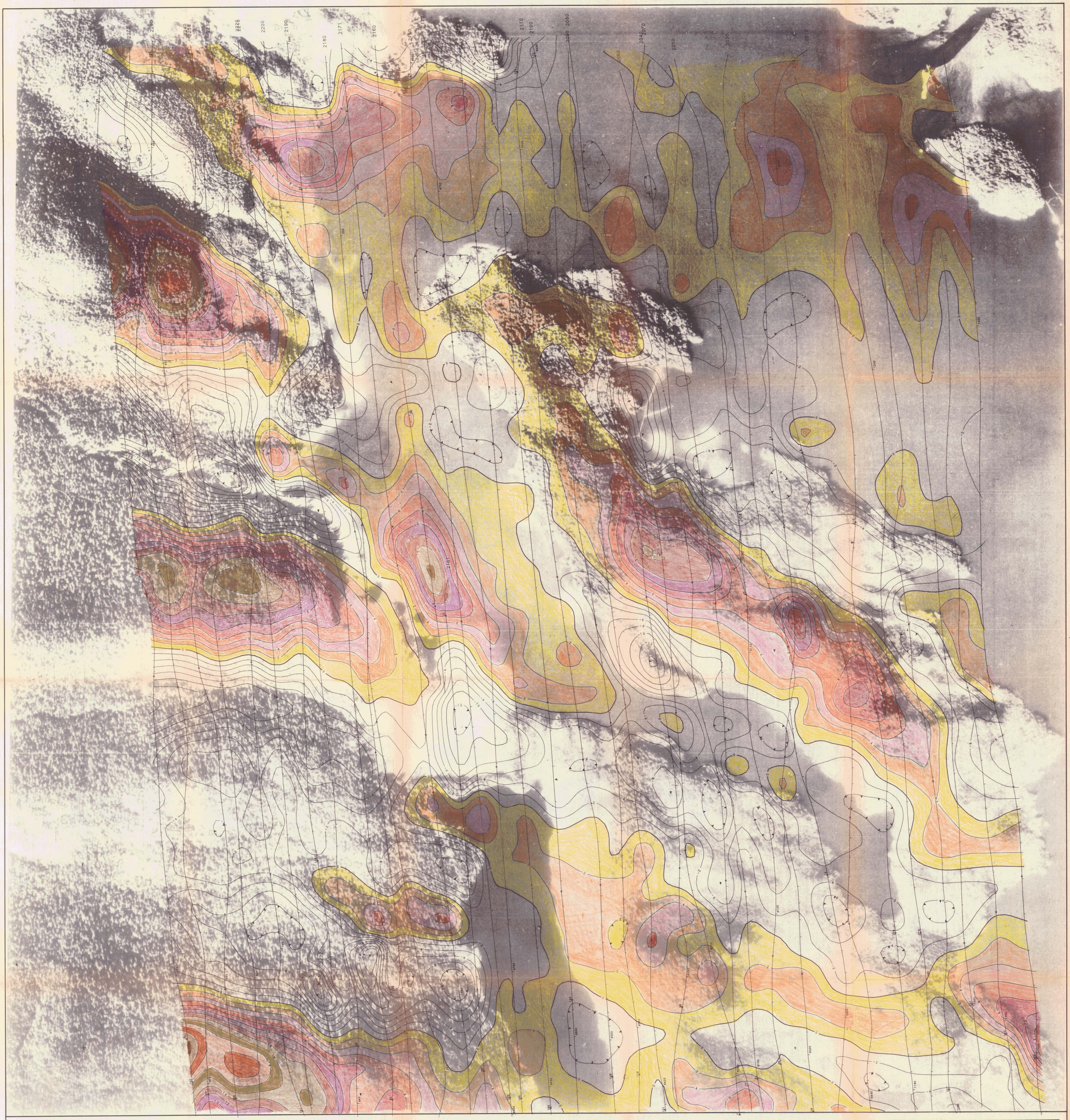
0 330 660 1/4 mile

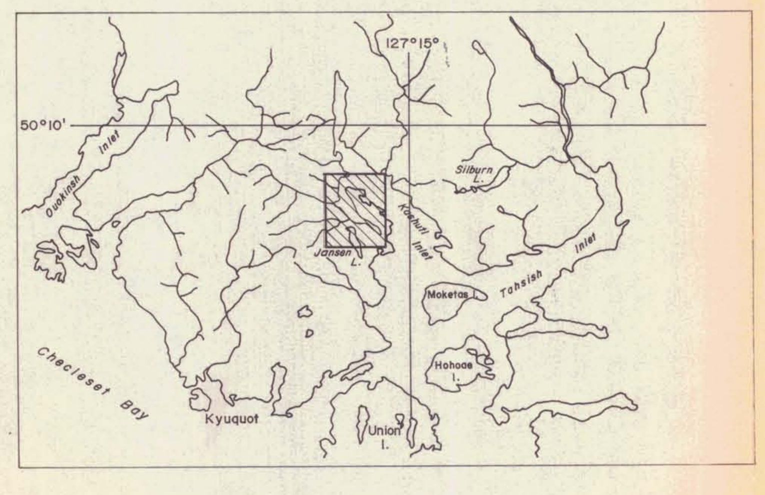
0 100 250 1/2 Kilometre

AERODAT LIMITED

DATE:	May 1985
N.T.S. No:	92 L
MAP No:	4

J 8520-2





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VLF-EM TOTAL FIELD CONTOURS

VLF STATION: NLK (Washington) 24.8 kHz.
SENSOR ELEVATION: 48 m.
CONTOUR INTERVAL:
50 %
10 %
2 %

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VLF-EM TOTAL FIELD CONTOURS

KYUQUOT
BRITISH COLUMBIA

SCALE 1/5,000

0 330 660 1/4 mile
0 100 250 1/2 Kilometre

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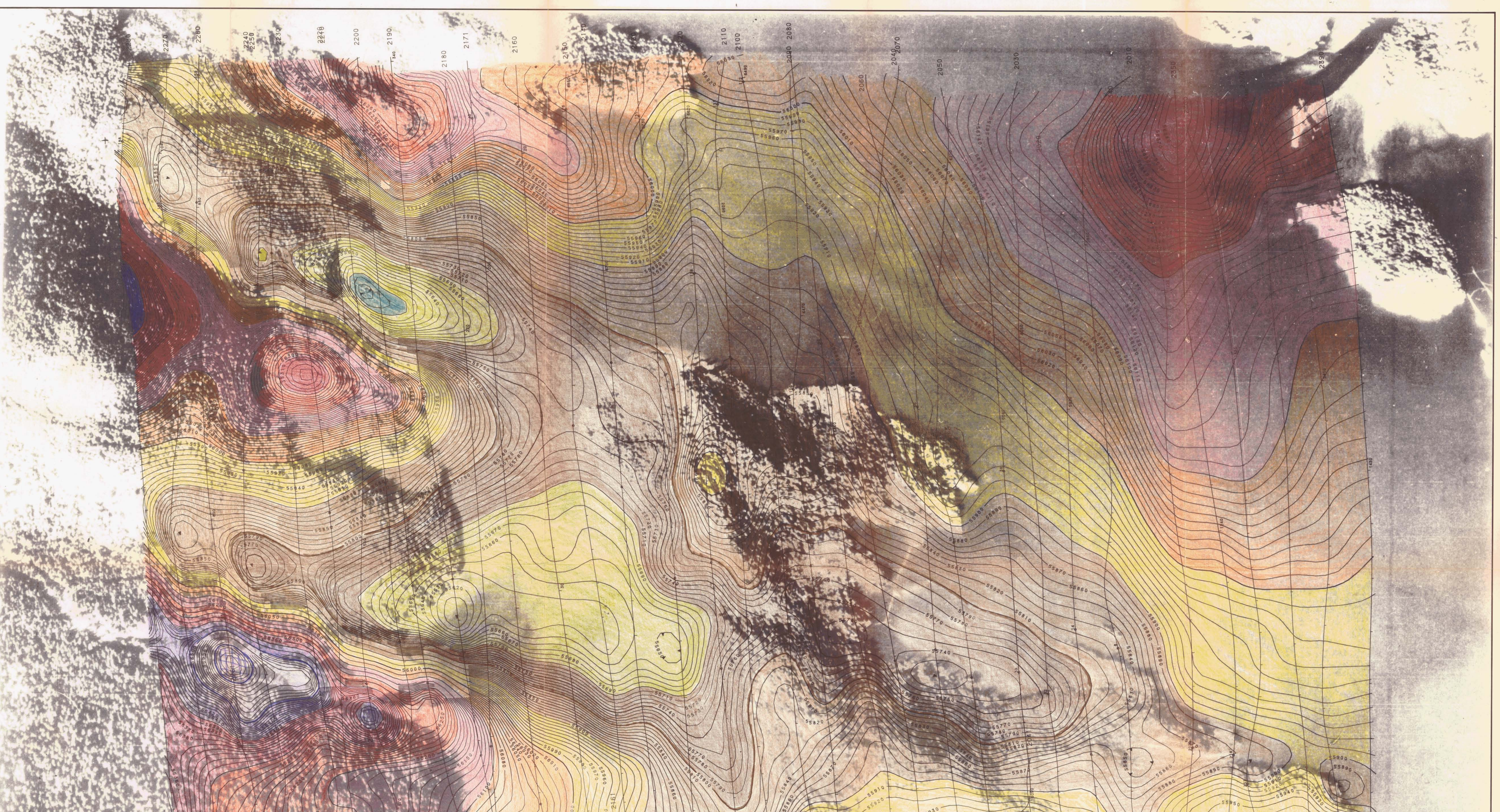
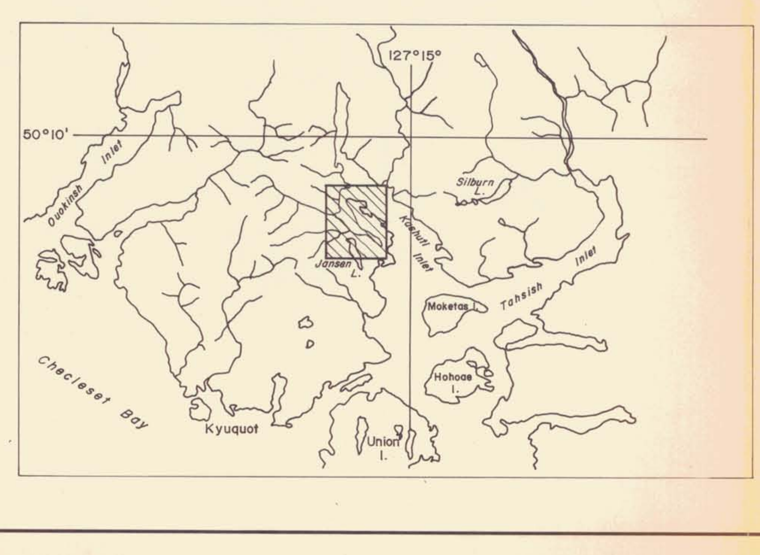
DATE: May 1985
N.T.S. No: 92L
MAP No: 2

J 8520-





N

TOTAL FIELD MAGNETIC CONTOURS

SENSOR ELEVATION: 48 m.

CONTOUR INTERVAL: 10 gammas

250 gammas
50 gammas
10 gammas

FALCONBRIDGE LIMITED

TOTAL FIELD MAGNETIC MAP

KYUQUOT

BRITISH COLUMBIA

SCALE 1/5,000

0 330 660 1/4 mile

0 100 250 1/2 Kilometre

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DATE:	May 1985
N.T.S. No:	92 L
MAP No:	1

J 8520-2