1995 SUMMARY REPORT

REGIONAL EXPLORATION PROGRAM

BABINE PORPHYRY BELT, CENTRAL B. C.

NTS: 93M/1, 2, 7 AMD 8

LATITUDE: 55° 15' LONGITUDE: 126° 15'

OMINECA MINING DIVISION

VOLUME I - REPORT

February, 1996

Teck Exploration Ltd.

R. Farmer

M. Smith

SUMMARY

The 1995 regional program in the Babine Porphyry Belt consisted of a fixed wing airborne high sensitivity magnetic and radiometric geophysical survey. The survey comprised 4200 line kilometres and covered portions of NTS mapsheets 93M/1, 2, 7 and 8. Although the survey was "completed" in November, slow progress and poor fall weather prevented the survey from being completed as proposed (5000 line km proposed, 4200 line km completed).

Ongoing supervision and ground followup of anomalies were a planned part of the program. Only a few days of ground followup were completed due to the late arrival of even partial data and early snowfall.

Results of the survey are good. Magnetic response correlates well with known geology and can be used as an effective tool for predicting regional lithology and structure. The radiometric data shows a strong, multielement anomaly over the well exposed Bell deposit. Similar, but weaker responses are present over other major prospects, which generally exhibit increased overburden and/or vegetation cover.

Field examination of three anomalous areas carried out in November indicate that well exposed, un-mineralized Topley intrusions can, at least locally, produce a response similar to that of partially covered, mineralized Babine intrusions, and that an on the ground source to the anomalies may not always be readily apparent. More detailed followup work, incorporating ground radiometrics, is necessary to resolve these problems.

RECOMMENDATIONS

1. Carry out detailed ground followup of the airborne survey with particular emphasis on examining both known deposits/prospects and new anomalies, geologically and with ground radiometric testing. Proper interpretation of the airborne radiometrics may depend on developing response signatures for different rock types, in particular, altered and unaltered Babine intrusions, and Topley intrusions.

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INTRODUCTION

During 1995 a fixed wing, airborne magnetic and radiometric survey was flown over the Babine Porphyry Belt. The purpose of the program was to apply the success of airborne radiometrics in identifying porphyry-style alteration/mineralization in other areas (Iron Mask Batholith, Mt. Milligan), to the search for new deposits in the Babine Belt. A total of 4200 line kilometres were completed of the 5000 line kilometres proposed, due to a late start, slow progress and bad weather.

Ground followup of airborne anomalies was undertaken, but was also severely limited due to the late completion of the survey and bad weather. Three anomalous areas were examined and results are described in the discussion section of this report.

Copies of the origional magnetic and radiometric maps, along with flight line data records, are included in the pockets, and a copy of a report by Aerodat Inc. is included in Appendix III.

This report describes the program and results. Interpretation of the airborne data, particularily the radiometric data, is dependant on field examination. Some interpretive comments will be presented in the Discussion section of this report relating to the Bell deposit and the areas examined in the field, however detailed interpretation cannot be made until field examination is complete.

LOCATION AND ACCESS

The Babine Porphyry Belt is located in west-central British Columbia near the north end of Babine Lake, approximately 70 kilometres northeast of the town of Smithers (figure 1). The airborne survey covers an area bounded by:

Latitude	Longitude
55° 05'	126° 33'
55° 29'	126° 42'
55° 25'	126° 00'
55° 00'	126° 00'

located on NTS mapsheets 93M/1,2,7,8 (figure 2).

Road access is gained by either travelling north from Topley to Granisle and thence by ferry to the east side of Babine lake or northeast from Smithers to Smithers Landing or to the north end of Babine lake. The southern half of the survey area is covered by a network of logging roads, whereas the north half is generally accessible only by helicopter.

FIGURE 1

LOCATION of the BABINE PORPHYRY BELT

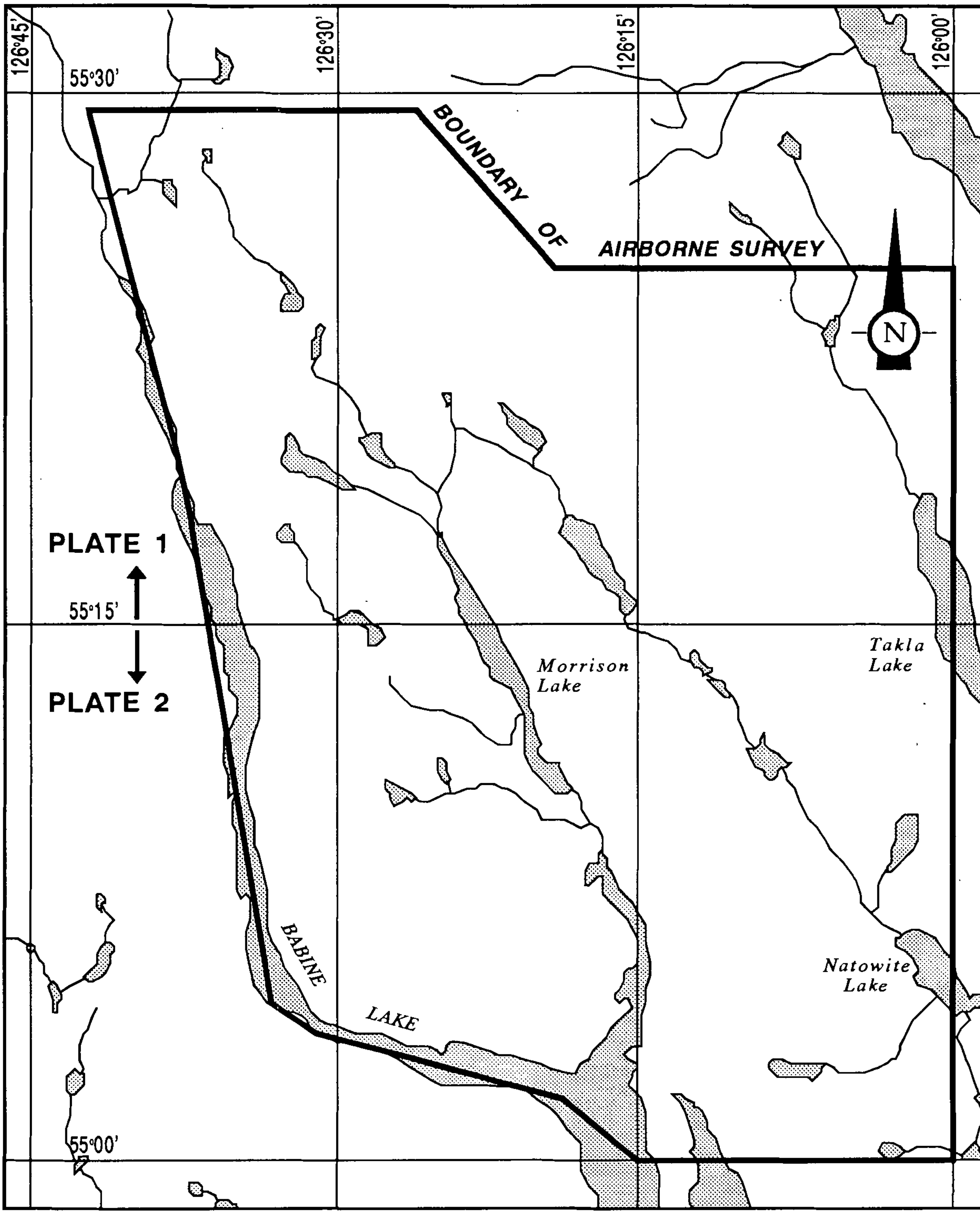

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Figure 2

BABINE PORPHYRY BELT

LOCATION of 1995 AIRBORNE SURVEY

EXPLORATION HISTORY

The area to the north of the Bell Mine was the focus of considerable exploration activity in the late 1960's and early 1970's. Ground exploration during this period was hampered by poor exposure and poor access, and exploration relied heavily on detection and follow-up work on geophysical anomalies (access has improved considerably since 1970 due to logging activities in the region). Work included airborne magnetics and VLF-EM coverage of most areas, ground IP coverage of many areas and drilling on a number of properties. Targets for more intensive exploration efforts included thumbprint magnetic anomalies (both high and low), areas known to be underlain by the Babine intrusions, areas along high-angle faults, and (preferably) areas where two or more of these conditions are present.

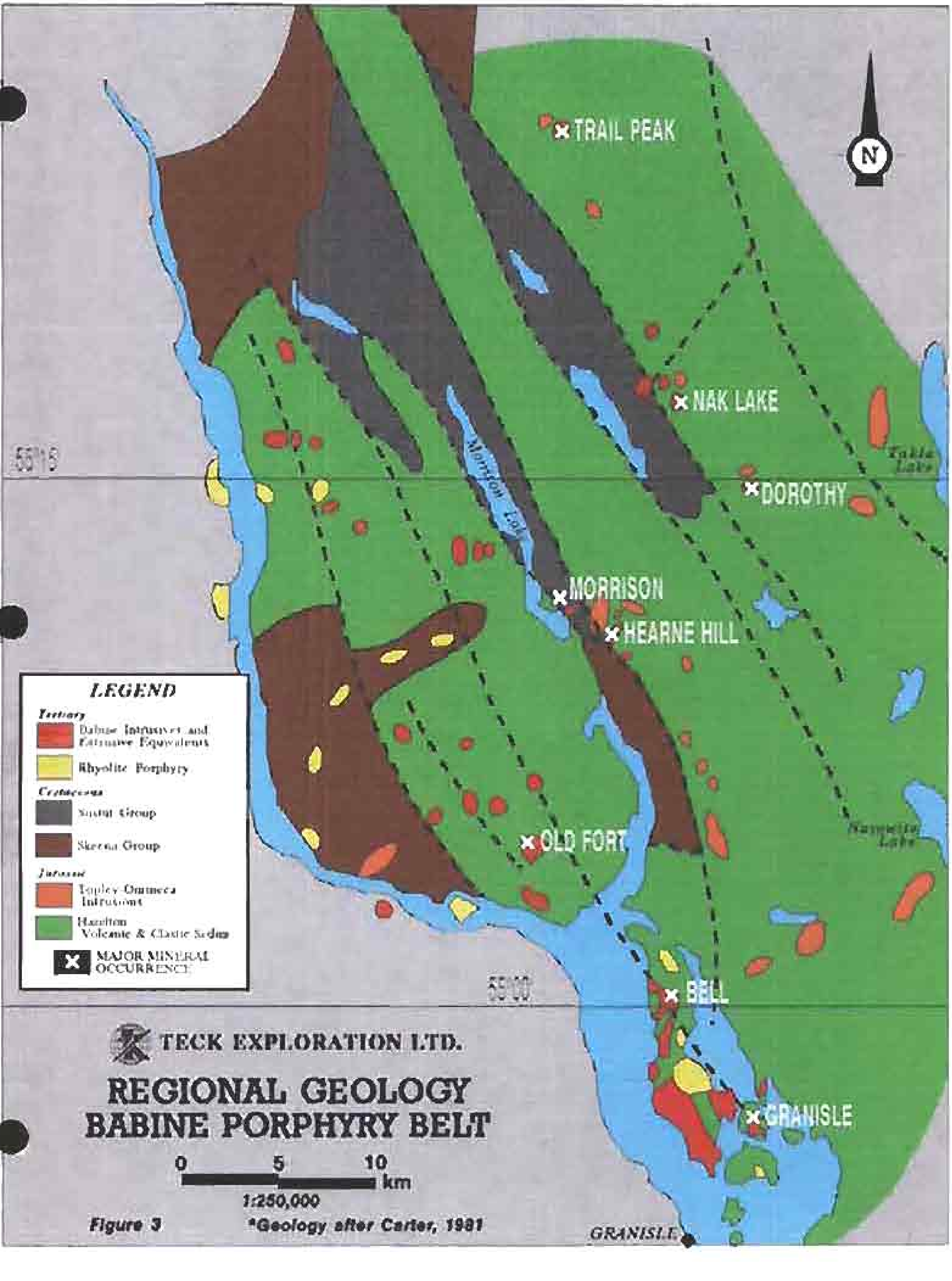
The area was relatively quiet until the early 1990's, when rising prices led to renewed interest in copper-gold porphyry targets, prompting Noranda and other operators to renew exploration of several previously identified targets. Many of these investigations (e.g., Assessment Reports 22191, 22111, 22143) involved relatively limited IP coverage and minor drilling (1-3 holes); follow-up work was generally not recommended. Several large exploration projects are presently underway, including Nak Lake and Hearne Hill.

REGIONAL GEOLOGY

The Babine porphyry belt extends from near the north end of Babine lake along a northerly trend to north of Trail Peak, a distance of approximately 80 km (Figure 3). The area is underlain by Mesozoic sedimentary and volcanic rocks including: the Lower to Middle Jurassic Hazelton Group (arc volcanic and volcaniclastic rocks); the Upper Jurassic to Lower Cretaceous Bowser Lake Group (siliciclastics); and the Cretaceous Skeena and Sustut Groups (fine to coarse clastic rocks).

The sedimentary-volcanic package is intruded by several generations of plutonic rocks, including Early Jurassic, Late Jurassic and Cretaceous rocks ranging from diorite to quartz monzonite, and by the Eocene Babine intrusions, which are the focus of this exploration program. The latter comprise mainly small stocks, dikes and plugs of quartz diorite, quartz monzonite, and biotite-feldspar porphyries of Eocene (49 to 51.5 Ma K-Ar) age. Extrusive equivalents, including hornblende-bearing rhyolite breccia and tuff, are present mainly in the southern part of the belt. The Babine intrusions are calc-alkaline in nature and appear to be related to a Cordillera-wide extensional episode, which is also manifested in the Babine area by numerous north-northwest-trending and east to northeast-trending high angle faults. The Babine intrusions host several significant porphyry copper-gold deposits, including the past-producing Bell and Granisle mines and the Morrison deposit.

The mineralized intrusions are typically polyphase; mineralization is closely associated with biotite-feldspar porphyry dikes. The larger of the known deposits,



REGIONAL GEOLOGY
BABINE PORPHYRY BELT

0 5 10 km
1:250,000

Figure 3 *Geology after Carter, 1981

including Bell, Granisle and Morrison, have concentrically zoned alteration halos, which grade from a central potassic zone with abundant secondary biotite, through a quartz-sericite-pyrite zone, to an outer zone of propylitic alteration. Pyritic halos are well developed and extend up to 300 metres or more from the deposits. Chalcopyrite and lesser bornite are the principal ore minerals, with chalcocite dominant in a supergene zone at Bell mine.

The Granisle Mine operated from 1966 to 1982, producing approximately 52 million tonnes of ore grading .41% copper and .12 g/tonne gold. Bell entered production in 1972, producing approximately 67 million tonnes of ore containing .47% copper and .35 g/tonne gold from geological reserves of 116 million tonnes grading 0.48% Cu and 0.35g/t Au. The Morrison deposit to the north is thought to contain at least 86 million tonnes of .42% copper and .3 g/tonne gold (Carson and Jambor, 1976).

1995 PROGRAM

The 1995 Babine Porphyry belt regional program consisted of a fixed wing, airborne magnetic and radiometric survey flown by Aerodat Inc. A total of 4200 line kilometres were completed covering portions of NTS mapsheets 93M/1, 2, 7 and 8 (figure 2). Lines were flown in an east-west direction (at an oblique angle to the structural grain in the area), spaced 400 metres apart. Details of survey parameters, including sampling methods and corrections applied, is provided in an Aerodat report (Appendix III).

A late start (Sept 26) and slow progress due to bad weather conditions in the fall prevented Aerodat from completing the full survey as proposed (5000 line kilometres). As a result, the proposed total expenditure of $150,000 was not attained(Appendix II).

The 1995 program also included field investigation of anomalous areas generated by the airborne survey. This portion of the program was also greatly hampered by the late arrival of data from Aerodat and the early arrival of snow. Due to prevailing bad weather conditions by the time partial data was recieved from Areodat, it was decided to send a large crew to the area to cover as many targets as possible in a short time, before weather prohibited further work. A total of 25 mandays, including travel time were spent examining three anomalous areas before excessive snow terminated the field season. Fieldwork included, geological examination of bedrock and float and prospecting for any signs of alteration or mineralization. These three areas are indicated on the overlay for the airborne maps (Plates A and B, in pocket), and results are described in the "Discussion" section of this report.

It should be noted that meaningful interpretation of the airborne data, particularily the radiometrics, is not possible without extensive on the ground examination. As a result interpretation will be limited to non-specific considerations and comments based on the field examinations accomplished and a description of the response associated with selected deposits/prospects.

DISCUSSION

This section will discuss results of the regional program described above, including comments on the airborne survey and results of the field checks.

A. Magnetics

The magnetic data is particularily useful in identifying regional lithology and structure as well as local geology such as magnetic intrusions. As such it is a valuable aid in interpretation of regional geological and structural trends.

A northwest dominant structural grain is evident from linear magnetic trends and from general boundaries between domains of similar magnetic response on the vertical gradient magnetic maps (Plates 1-2 and 2-2). North and northeast structural trends are locally evident. The survey area can be divided into two domains of similar magnetic response. The boundary between these domains has been mapped as a fault zone (eg, Richards 1980), and this can be readily seen on the magnetic maps (total field, Plates 1-1 and 2-1) as a linear trend extending from Newman Peninsula in the south, through Morrison Lake and off the northwest portion of the north survey sheet.

The first domain is located in the western portion of the survey area, generally between Morrison lake and the Northwest Arm of Babine Lake. This area is characterized by low, flat magnetic relief, suggestive of sediments as the dominant underlying stratigraphy, consistent with previous interpretations e.g., Carter (1973), Richards (1980). Areas of mapped Babine intrusive rocks stand out as magnetic highs against this low relief background, whereas extrusive equivalents generally do not. Numerous thumbprint magnetic anomalies in this domain may represent overburden covered Babine intrusions.

The eastern and northeastern portions of the survey area are magnetically distinct, and characterized by "noisy" response of moderate to high relief. It is possible to further divide this area into sub-domains of 1) broad areas of very high magnetic relief (ie along the east side of Hatchery Arm), and 2) "noisy" areas of generally lower magnetic relief. Sub-area 1 corresponds well with regions mapped as predominately andesitic volcanics and with topographically high ridge tops. Sub-area 2 corresponds to prominent valleys underlain by mixed volcanic/sedimentary assemblages. The airborne magnetics are useful in identifying gross lithologic trends as well as structural trends.

Magnetic response over porphyry copper deposits can be highly variable depending on degree of magnetite destruction due to alteration, or association of magnetite and copper mineralization with varying alteration assemblages. Overlaying the locations of major showings onto the vertical gradient magnetic maps indicates that all major showings are associated with magnetic highs (though often on flanks).

Showings/deposits such as Bell, North Newman, Morrison, Wolf and Trail Peak are generally associated with small, isolated magnetic highs, whereas Nak Lake and Hearne Hill are associated with relative lows adjacent to large-scale magnetic highs. In the case of Hearne Hill, overlying andesitic volcanics have a high magnetic signature resulting in a relative low for adjacent Babine intrusions/mineralization, and this is likely the case at Nak Lake.

B. Radiometrics

In reviewing the radiometric data it should be kept in mind that a proper assessment of anomalies cannot be carried out until extensive field checks of local geology and ground radiometric response are complete. As such only a preliminary assessment of the data will be presented here.

Until recently radiometrics was a relatively little used tool in exploration. Response is strongly affected by ground conditions; dry conditions giving the best results. Ground penetration is approximately 10-15 cm, thus deep overburden can mask underlying rock types. Relatively shallow overburden containing abundant local fragments can sometimes provide a reliable response, however. We have more confidence in the radiometric data for the southern half of the area, which was flown in drier conditions, than for the north half of the area, which may have been flown in conditions of wet or snow-covered ground. The amount and thickness of vegetation can also adversely affect radiometric response.

In previous studies airborne radiometrics has been shown to be a useful exploration tool. Recent work has shown that porphyry style alteration yields a predictible response characterized by elevated potassium counts, with corresponding low Th/K ratios (R. Shives, personnal comm.). This response may be related to strong potassic alteration, often a high temperature core alteration in porphyry systems.

A brief description of the radiometric response over some of the major deposits/prospects covered by the survey, utilizing the stacked profiles, follows. An attempt will be made here to examine known alteration/mineralization under varying overburden and vegetation conditions to examine the effect on response.

1. Bell (Figure 4)

At Bell, excellent exposure resulting from the pit can be expected to produce a stronger response than an undeveloped or hidden prospect. The response over the Bell deposit is characterized by very strong, positive anomalies for K, Th and U, and a strong negative Th/K anomaly. Thorium tends to map the pre-alteration chemistry (R. Shives, personnal comm.), and as such increased K related to alteration produces a negative Th/K anomaly. The increase in Th over the deposit likely represents the Babine intrusions

Morrison Lake
Babine Lake
BABE
DOROTHY
WOLF
MAST
MORRISON
HEARNE HILL
JAKE
BAB
MINERAL OCCUR.
ANOMALY 3
ANOMALY 2
ANOMALY 1
FORT
MINERAL OCCUR.
OFF
SNOOPY
JASH
BIG JOE
MINERALIZATION
FIREWEED (vein)
NORTH NEWMAN
BELL MINE
MAC
GEOLOGICAL SURVEY BRANCH
ASSESSMENT REPORT
25,376
LEGEND
RADIOMETRIC/MAGNETIC ANOMALIES EXAMINED ON THE GROUND
BABINE INTRUSION and EXTRUSIVE EQUIVALENTS
MINFILE LOCALITY
OTHER MINERAL LOCALITY
FAULT
TECK EXPLORATION LTD.
KAMLOOPS, BRITISH COLUMBIA
BABINE PORPHYRY BELT
OVERLAY SHOWING
MAJOR MINERAL OCCURRENCES
AND STRUCTURE
South Sheet
Plate A
126°30'

relative to surrounding volcano-sedimentary rocks. This radiometric anomaly is associated with the flank of a weak, positive magnetic anomaly. Magnetite has been largely converted to hematite within the altered zone, whereas unaltered Babine intrusions contain disseminated magnetite.

2. North Newman (Figure 5)

The weaker, more poorly exposed North Newman prospect can also be recognized as a similar anomaly to the Bell response. The anomaly is much weaker, but an increase in K, Th and to a lesser extent U is recognizable. A negative anomaly in the Th/K ratio is also present. This radiometric response is associated with a small, positive magnetic anomaly. The response is recognizable on two lines but, is strongest on line 10110. Although the radiometric response is much weaker than at Bell, a more poorly exposed, weaker mineralizing system such as North Newman can still be recognized as an anomalous response.

3. Morrison (Figure 6)

Morrison, is a strong mineralizing system which is essentially not exposed (except as exposed in trenches). Mineralized/altered float in overburden should be sufficient to produce an anomalous response (in this case altered float plus whatever exposure is present in trenches), however thicker vegetation may also be a factor here. Morrison is represented by a moderately strong positive response in Th and U and a weak K anomaly. The Th/K ratio does not show an anomalous response. A weak magnetic high is associated with Morrison. While an anomalous response can be recognized over the Morrison deposit, the weak K response and lack of a Th/K ratio anomaly likely represents a response that would not be selected as anomalous if it were not known that mineralization is present.

4. Wolf (Figure 7)

The Wolf prospect is located on the west side of Morrison lake and consists of a weak zone of alteration/mineralization, apparently fairly well exposed in outcrop. The radiometric response shows a broad zone containing several peaks displaying high K, Th and U. The Th/K ratio also indicates a broad area with moderate negative response. A strong magnetic high is coincident with the radiometric anomaly. Considering the known alteration/mineralization is weak this is a good response and if in an unknown area would warrant a ground examination.

The above examination of several selected deposits/prospects indicates an excellent response over well exposed, strong systems (Bell). Weaker systems still produce a good response if they are reasonably well exposed. Overburden cover and/or

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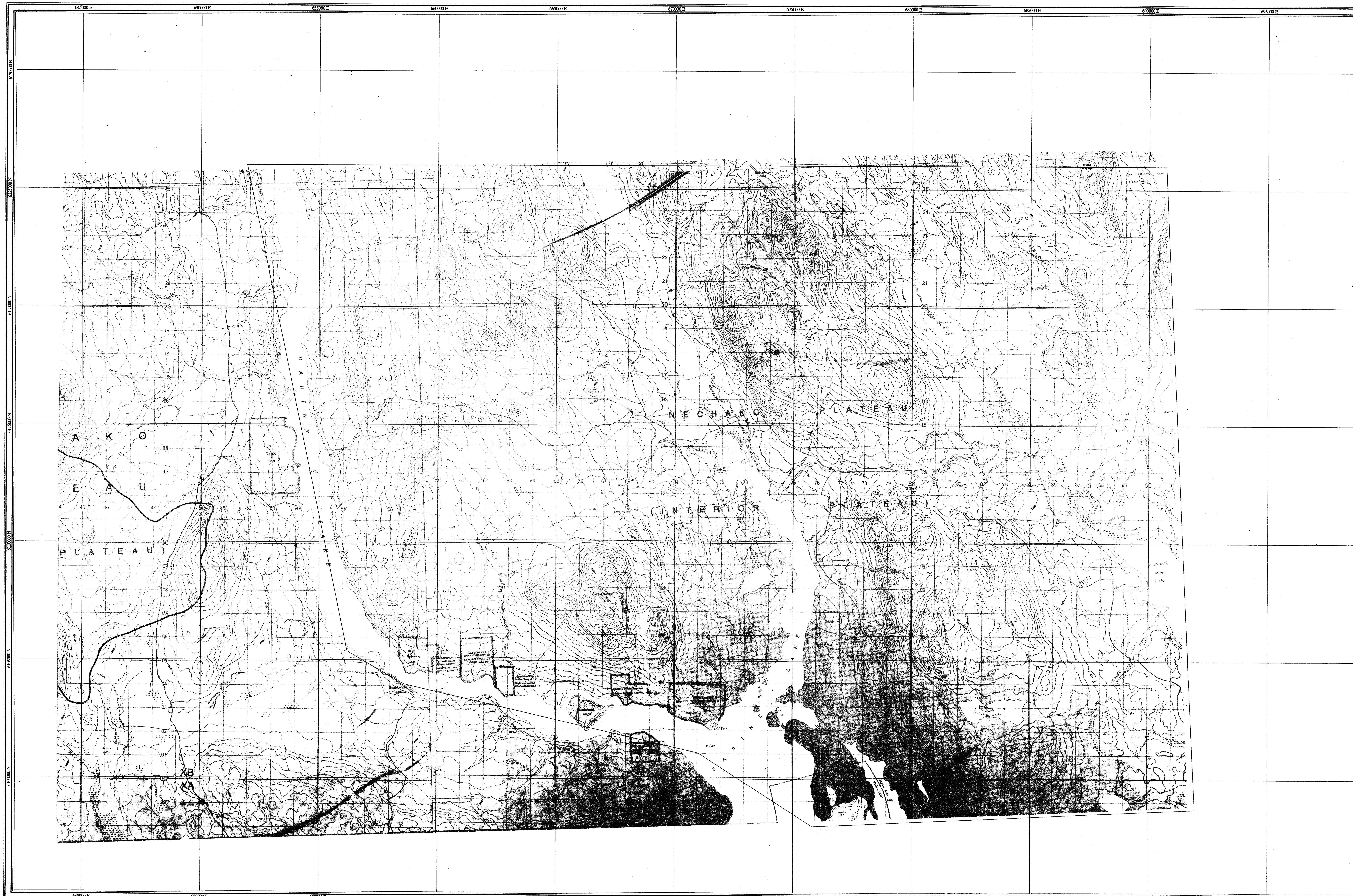
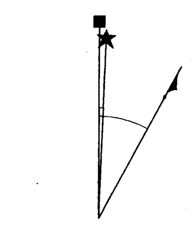
BABINE PORPHYRY BELT

OVERLAY SHOWING MAJOR MINERAL OCCURRENCES AND STRUCTURE

North Sheet **Plate B**

DATE DRAWN: FEB. 23, 1998	SCALE: 1:50,000
COMPILED BY: M.Smith, R.Farmer	JOB No: 1389
DRAWN BY: S.A.	NTS: 93M/1,8





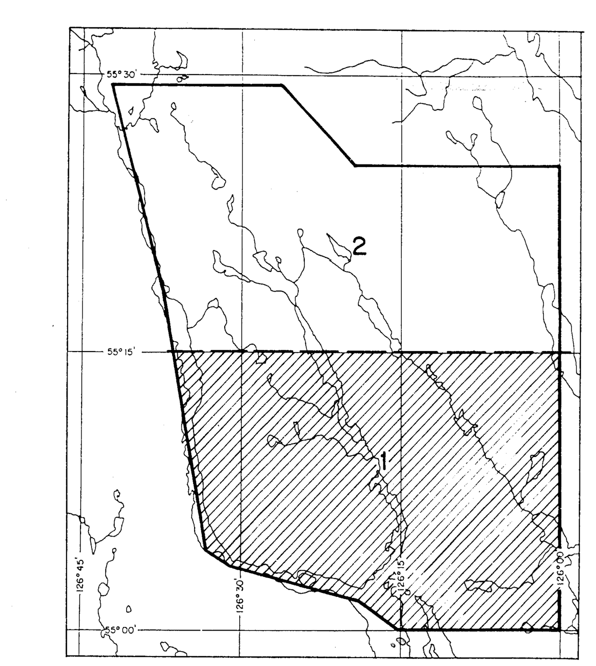
Square: Grid North
Star: True North
Arrow: Magnetic North

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

Grid North - True North : 2.2°
Grid North - Magnetic North : 28.4°
Annual change : -0.06°

25,376

GEOLOGICAL SURVEY BRANCH
ASSESSMENT REPORT



TECK EXPLORATION LTD.

BASE MAP

BABINE LAKE

BRITISH COLUMBIA

SCALE 1:50 000

1000 0 500 1000 2500 5000 metres

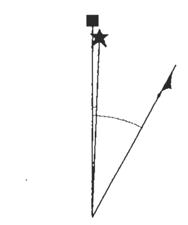
aerodat

AERODAT INC.

Date Flown : SEPTEMBER 1995

NTS : 93 M/7 Plate C

Project : J95118 [redacted]



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 : 2.2°
Grid North - Magnetic North : 28.4°
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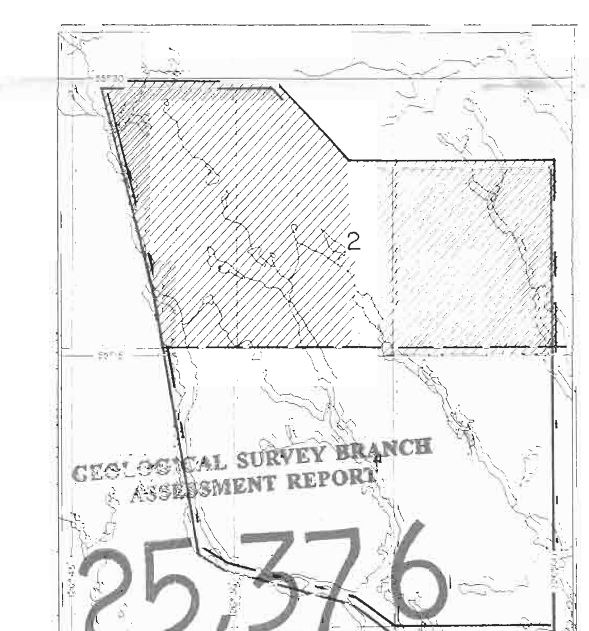

TECK EXPLORATION LTD.

BASE MAP

BABINE LAKE
BRITISH COLUMBIA

SCALE 1:50 000

1000 0 500 1000 2500 5000 metres

aerodat
AERODAT INC.

Date Flown : SEPTEMBER 1995

NTS : 93 M/7 Plate D

Project : J95118 [redacted]

thick vegetation however, seems to adversely affect the quality of the response, even for strong systems (Morrison).

C. Field Examinations

Due to late arrival of any data from Aerodat and the early arrival of winter only a few days of field examinations could be carried out. This included three days of recon before the survey (Sept. 9-11) to look at areas of known mineralization (Bell, Hearne Hill), and assess access, logistics and exposure in the south half of the survey area. After receipt of magnetic and K data for the south half targets were selected and, three anomalies were examined geologically in the field. The anomalies examined are shown on the overlay sheet (plate A, in pocket).

Anomaly 1 is located near the east boundary of the survey area on the south sheet, south of Natowite Lake. This anomalous area exhibits a moderate strength magnetic anomaly, on the flank of which are strong potassium, thorium and Th/K ratio anomalies. When examined on the ground a well exposed, fresh Topley intrusion was discovered. The intrusion is medium to coarse grained, contains abundant primary K-spar and locally contained disseminated magnetite or hematite. It is of considerable concern that an unaltered Topley intrusion produces a similar magnetic and radiometric response to altered and mineralized Babine intrusions. Additional ground work (geology and ground radiometric surveying) is required to determine if a method can be identified to discriminate one response from the other.

Anomaly 2 is located within an area of extensive clear-cut logging, northwest of Natowite Lake. The anomaly is characterized by an unusual "horseshoe shaped" magnetic anomaly (vertical gradient). Overlying the magnetic anomaly are northeast trending linear potassium and Th/K ratio anomalies. Traverses across the area failed to locate any outcrop. Float consists of a variety of rock types within glacial till. However, none of the observed float would explain the magnetic or potassium anomalies. Disseminated chalcopyrite hosted by mafic volcanics was discovered in fill around a culvert on one of the logging roads, but the borrow pit was not located. This is an interesting anomaly requiring further followup on the ground.

Anomaly 3 is located west of Morrison lake, near the Northwest Arm of Babine Lake. The anomalous area is characterized by a north trending series of weak magnetic anomalies, with a stronger isolated anomaly to the west, near the lake. Broad, strong potassium and Th/K ratio responses cover the area of magnetic anomalies. Road access is good into the anomalous area and it has been extensively clear-cut logged. Traverses across the area identified clastic sedimentary rocks in outcrop and float. Intrusive rocks were not observed and no explanation for the anomaly was determined.

Babine intrusions and/or alteration/mineralization seem to be associated with positive anomalies for K, U, and Th; a negative Th/K ratio anomaly and a related magnetic anomaly (high, low or flank). Some possible confusion may result from; 1. Tertiary felsic volcanics, which have a similar radiometric response, particularily for K and Th/K and; 2. Topley intrusions, which can have a similar radiometric and magnetic response. Tertiary felsic volcanics can be distinguished by subdued magnetic response. Topley intrusions can be distinguised from well exposed porphyry systems (eg Bell) by the magnitude of the radiometric response, however when overburden or vegetative cover are introduced the responses are similar. Ground checking may be the only way to resolve this problem, and may eventually uncover a method of distinguishing the responses.

More extensive followup will be required in 1996, utilizing ground radiometric testing to screen potentially significant airborne anomalies and to classify the response of various rock and alteration types.

CONCLUSIONS

The 1995 regional exploration program in the Babine Porphyry Belt included a fixed wing, airborne high sensitivity magnetic and radiometric geophysical survey totalling 4200 line kilometres. Monitoring and supervision of the survey as well as limited ground followup of anomalies also formed part of the program.

Results demonstrate that the high sensitivity magnetic data can be effectively used to map regional lithologic and structural trends.

Although further ground followup is required before a reliable interpretation of the radiometric data can be made, preliminary interpretation demonstrates a clean and distinctive anomalous response over the well exposed Bell porphyry copper system. Weaker mineralized systems or those with partial overburden or vegetative cover possess a similar, but weaker radiometric response.

Limited ground followup has indicated that at present this weaker response cannot always be distinguished from other, non-mineralized intrusive responses (ie well exposed Topley intrusions). Further followup, utilizing ground radiometric surveying, may provide a means of distinguishing the responses.

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APPENDIX I

Statement of Qualifications

I, Randy Farmer, do hereby certify that:

1) I am a geologist and have practised my profession for more than 15 years.

2) I graduated from Lakehead University in Thunder Bay, Ontario with an Honours Bachelor of Science degree, (Geology), in 1980.

3) I conducted the ground followup program, reviewed the airborne data and authored the report contained herein.

4) All data contained within this report and conclusions drawn from it are true and accurate to the best of my knowledge.

5) I hold no personal interest, direct or indirect, in the Babine regional program or its results, which is the subject of this report.

6) I am a Professional Geoscientist registered in the Province of British Columbia (Registration No. 20192).

Randy Farmer, P. Geo.
Senior Project Geologist
September, 1995

STATEMENT OF QUALIFICATIONS

I, Moira Smith, do hereby certify that:

1) I am a geologist and have practised my profession for the past 11 years.

2) I graduated from Pomona College, Claremont, California with a Bachelor of Arts degree in Geology (1983), Western Washington University in Bellingham, Washington, with a Master of Science degree in Geology (1986), and University of Arizona, Tucson, Arizona with a Doctor of Philosophy degree in Geology (1990).

3) I am a Professional Geoscientist registered with the Association of Professional Engineers and Geoscientists of British Columbia.

4) All data contained within this report and conclusions drawn from it are true and accurate to the best of my knowledge.

Moira Smith
Project Geologist
February, 1996

APPENDIX II

Cost Statement

COST STATEMENT

1. Airborne Survey (Aerodat Inc)

Sept. 26 - Nov. 5, 1995

4200 line km, incl. report, calibration, etc. $112,000.00

1 extra copy colour maps $840.00

Subtotal:...$112,840.00

2. Geology, (incl. Supervision, field followup, etc.)

A. Labour

M. Smith, Senior Geologist, Sept. 10 - Sept. 13, 1995
4 Days @ $285.00/day $1140.00

R. Farmer, Senior Project Geologist, Nov. 2 - Nov. 11,1995
10 days @ $200.00/day...$2000.00

G. Evans, Senior Project Geologist, Nov. 2 - Nov. 5, 1995
5 days @ $200.00/day..$1000.00

P.Watt, Prospector, Nov. 2 - Nov. 5, 1995
5 days @ $160.00/day..$800.00

J. Liard, Prospector, Nov. 2 - Nov. 5, 1995
5 days @ $160.00/day..$800.00

Subtotal:...$5740.00

B. Accomodation

Rooms, Nov. 2 - Nov. 11, 1995 ....$853.41
Sept. 10 - Sept. 13, 1995 (3 nights)...................................$180.00

Meals, Nov. 2 - Nov. 11,1995..$415.79
Sept. 10 - Sept. 13, 1995 ....$120.00

Subtotal:...$1569.20

3. Transportation

A. Truck Rental (incl. fuel, maintaince, etc.)
i) Sept. 10 - 13, 1995
4 days @ $90.00/day.......................................$360.00

ii) Nov. 2 - 11, 1995 (two trucks)
4 days @ $90.00/day.......................................$360.00
10 days @ $50.00/day.......................................$500.00

B. Helicopter (Northern Mtn. Helicopters)
Nov. 4-5, 1995, 4.5hrs @ $704.80/hr (incl. Fuel)..........................$3171.60

Subtotal:.......................................$4391.60

4. Maps, Copying and Drafting

Map purchase and print copies.......................................**$800.00**

5. Report (Data review and writing)

R. Farmer, Feb. 11 - 26, 1996
11 days @ $200.00/day.......................................**$2200.00**

TOTAL ELIGIBLE COST OF 1995 PROGRAM $127,540.80

APPENDIX III

AERODAT REPORT

REPORT

ON HIGH SENSITIVITY MAGNETIC AND RADIOMETRIC FIXED WING AIRBORNE GEOPHYSICAL SURVEY

BABINE LAKE
SMITHERS, B.C.

FOR

MR. FRED DALEY
VICE PRESIDENT, EXPLORATION - WESTERN CANADA
TECK EXPLORATION LTD.
#350 - 272 VICTORIA STREET
KAMLOOPS, B.C.
CANADA V2L 2A2

BY

AERODAT INC.
3883 NASHUA DRIVE
MISSISSAUGA, ONTARIO
CANADA L4V 1R3

December 29, 1995

J95118

Sandra A. Takata
Geophysicist

TABLE OF CONTENTS

MAPS

The results of the survey are presented in a series of black line maps at a scale of 1:50,000.

Map types are as follows:

Black Line Maps (Scale 1:50,000)

1. Topographic base

2. Total field magnetics map with superimposed flight path

3. Calculated vertical gradient map with superimposed flight path

Colour Maps (Scale 1:50,000)

1) Total field magnetics - colours, contours, flight path and topography

2) Calculated vertical gradient - colours, contours, flight path and topography

3) Radiometrics - colours and contours of Potassium, Uranium and Thorium (as separate maps) with flight path and topography

4) Radiometric ratio maps of U/Th and Th/K with contours, flight path and topography

Shadow and Ternary Maps (Scale 1:50,000)

1) Magnetics shadow map

2) Ternary map

REPORT ON A HIGH SENSITIVITY MAGNETIC AND RADIOMETRIC FIXED WING AIRBORNE GEOPHYSICAL SURVEY BABINE LAKE, SMITHERS, B.C.

1. INTRODUCTION

This report describes an airborne geophysical survey carried out on behalf of Teck Exploration Ltd. by Aerodat Inc. Equipment operated included a high sensitivity cesium vapour magnetometer, a spectrometer, a video tracking camera, an altimeter and an electronic positioning system.

The area and flight lines were flown east-west at a nominal spacing of 400 m. Coverage and quality were considered to be within the specifications described in the contract.

Tie lines were flown north-south azimuth and with a line spacing of 5000 m.

The area consisted of approximately 4200 km

2. SURVEY AREA AND SPECIFICATIONS

The survey area is shown in figure 1. The survey boundary is

675818.88	6097991.50
671020.81	6101095.00
658582.81	6103983.00
656190.38	6105376.00
651000.00	6130602.00
644976.19	6151388.50
661971.38	6152035.50
669409.81	6144175.00
689863.88	6145203.00
691939.38	6098708.00

The UTM grid is based on the North American 1927 datum (Clarke 1866 spheroid with WGS 84 to local datum shifts of 7 m (dx), -139 m (dy) and -181 m (dz)), with the central meridian at 129° west.

Specifications

Traverse line spacing :	400 metres
Traverse line direction :	east-west
Tie lines :	5000 m
Nominal survey ground speed :	260 km/h
Sampling rate:	0.1 seconds

1. The distance between adjacent flight lines will not exceed 1.25 times the line spacing for a distance of more than 1 kilometre along any flight line.

2. The nominal mag sensor height will be 100 $\pm$ 10 metres and will be consistent with safety of aircraft and crew.

3. The magnetic noise levels (high frequency) is such that the fourth difference divided by 16 is generally less than $\pm$ 0.1 nT. The fourth difference is defined by

   The fourth difference is defined by:

   $$FD_t = X_{t+2} - 4x_{t+1} + 6x_t - 4x_{t-1} + X_{t-2}$$

   where X_t is the t^{th} total field sample.

3. AIRCRAFT AND EQUIPMENT

3.1 Aircraft

A Cessna 404 Titan aircraft - Canadian registration C-FPVB - owned and operated by Aerodat Inc. - was used for the survey. Installation of the geophysical and ancillary equipment was carried out by Aerodat.

Model:	Cessna 404 Titan
Year:	1979
Airframe:	8774
Engine:	Teledyne Continental GITSO 520
Time to Overhaul:	350
Propeller:	1260
Fuel Capacity:	1300 litres
Range:	648 km
Endurance:	10.5
Electrical System:	28V
Radio equipment:	Standard Communication and Navigation with HF and GPS

3.2 Radiometric System

An Exploranium GR-820 gamma-ray spectrometer coupled to Exploranium GPX 1024/256 and GPX 1024 sensors was used to record seven channels of radiometric data. The sensors have eight 4" x 4" x 16" crystals (4 pi geometry) plus one 4" x 4" x 16" upward looking crystal. The total downward looking crystal volume is therefore 2048 cubic inches. Gain stabilization is maintained on each crystal separately by following the K photopeak.

Channels recorded and their energy windows were as follows:

Channel	Window
Total Count	0.40 to 2.81 MeV
Potassium	1.37 to 1.57 MeV
Uranium	1.66 to 1.86 MeV
Thorium	2.41 to 2.81 MeV
Uranium up	1.66 to 1.86 MeV
Cosmic	3.0 MeV and above

All channels of radiometric data were recorded at a 1 second update rate (counts per second - cps). Digital recording resolution is 1 cps.

3.3 VLF System

A Herz Totem IIA VLF system was used to measure VLF fields from two transmitters NLK, Seattle, Wa. (24.0 kHz) and NAA, Cutler, Maine (24.0 kHz). NLK were designated as the line station and the ortho station for flights 1 and 2. NSS, Annapolis (21.4 kHz) and NAA (24.0 kHz) for flights 3, 4, 5 and 6. The unit records the total field and vertical quadrature components at both frequencies. The sensor was mounted in the tail stinger.

3.4 Ancillary Systems

Base Station Magnetometer

A base station magnetometer was set up at the base of operations to record diurnal variations of the earth's magnetic field. The sensor was a Scintrex cesium vapour optically pumped magnetometer. The clock of the base station was synchronized with that of the airborne system to facilitate later correlation. Digital recording resolution was 0.001 nT. The update rate was 0.2 seconds.

The base station magnetometer included a PC and printer. A printer plot of the base station readings was generated in real time. Vertical sensitivities are 1 and

10 nT per centimetre. Printer speed is about 5 minutes per cm. The plot is annotated for date, time and total field amplitude.

Radar Altimeter

A TRT AHV8 radar altimeter was used to record terrain clearance. The working range is 1 to 1,500 metres with an accuracy of ± 1.5 metres.

Barometric Altimeter

A Rosemount 1241M 3 B1 barometric altimeter recorded elevation above sea level in feet. This unit is factory calibrated based on a standard atmosphere of about 1 millibar per 10 metres. As normal daily pressure variations are on the order of ± 10 millibars, the absolute accuracy of the barometric elevation is about ± 100 m. The relative accuracy is better.

Tracking Camera

A Panasonic colour video camera was used to record flight path on VHS video tape (NTSC format). The camera was operated in continuous mode. The flight number, 24 hour clock time (to 0.1 second), and manual fiducial number are encoded on the video tape.

Analog Recorder

A RMS dot matrix recorder was used to display the data during the survey. Record contents are as follows:

Label	Contents	Scale
GEOPHYSICAL SENSOR DATA		
UMGF	Total Magnetic Field, Uncompensated, Fine	1 nT/mm
MAGF	Total Magnetic Field, Compensated, Fine	1 nT/mm
UMGC	Total Magnetic Field, Uncompensated, Coarse	10 nT/mm
MAGC	Total Magnetic Field, Compensated, Coarse	10 nT/mm
MAGN	Fourth Difference	.02 nT/mm
TCDN	Total Count	50 cps/mm
K-40	Potassium	5 cps/mm
URDN	Uranium	2.5 cps/mm
TH	Thorium	2.5 cps/mm
URUP	Uranium (Upward Looking Crystal)	2.5 cps/mm
COSM	Cosmic	5 cps/mm

ANCILLARY DATA

RALT	Radar Altimeter	10 ft/mm
BALT	Barometric Elevation	50 ft/mm
GALT	GPS Elevation	50 ft/mm
OAT	Outside air temperature	
VMTF	Vector Magnetic Total Field	

The zero of the radar altimeter is 5 cm (5 large divisions) from the top of the analog chart. The full analog range for the radar altimeter is therefore 500 feet. A flying height of 100 m (328 feet) gives an analog trace which is almost two large divisions (1.72 cm) below the top of the analog record.

The chart speed is 2 mm/second. The 24 hour clock time is printed every 20 seconds. The total magnetic field value is printed every 30 seconds.

The start of any survey line is identified by two closely spaced manual fiducials. The end of any survey line is identified by three closely spaced manual fiducials. Manual fiducials are numbered in order. Every tenth manual fiducial is indicated by its number, printed at the bottom of the record.

Calibration sequences are located at the start and end of each flight and at intermediate times when needed.

Digital Recorder

An RMS data acquisition system recorded the digital survey data on magnetic media. Contents and update rates were as follows:

DATA TYPE	SAMPLING	RESOLUTION
Magnetometer	0.1 s	0.001 nT
Radiometrics	1.0 s	1 cps
Position (2 channels)	1.0 s	0.1 m
Altimeters (3 channels)	0.2 s	0.3 m
Manual Fiducial		
Clock Time		

3.5 Magnetometer

Scintrex optically pumped/monitored, cesium vapour, high sensitivity H-8 magnetometer mounted in a tail stinger.

The following is a summary of the magnetometer performance:

Sensitivity	0.005 nT
Resolution	0.01 nT
Noise level	0.1 nT
Range	20,000 - 100,000 nT
Sampling interval	0.1 second

3.6 Analog Recorder

An RMS GR-33 dot matrix recorder with resolution of 0.01 inches was used. The channels were labelled along with times and representative values.

3.7 Flight Path Tracking

Colour video camera was used to record the aircraft's overland flight path. The time as recorded on the digital and analog record and x, y position is displayed on the video image for precise correlation of video image with geophysical response.

3.8 Electronic Navigation (Airborne and Ground)

A Magnavox MX9212 GPS Receiver Global Positioning System (GPS) operated in differential mode was used for the navigation and the flight path recovery. Positional accuracy achieved with this system was in the order of 5 metres.

3.9 Magnetic Base Station

A GEM GSM-19F magnetometer with an absolute accuracy of 0.1 nT was used.

4. DATA PROCESSING AND PRESENTATION

4.1 Base Map

The base maps for the black line presentation were taken from a photographic enlargement of the local 1:50,000 scale NTS map sheets.

Base maps are constructed assuming the scale of the topographic maps is correct to within the accuracy required - normally better than 0.5 %. When registering the airborne results to the base maps, a larger scale error may be detected and the bases are redone. The scale of the airborne results as given by GPS latitude and longitude is assumed to be exact.

4.2 Flight Path and Registration

The flight path was derived from the Novatel electronic positioning system. The raw flight path record, expressed as WGS 84 latitude/longitude, is differentially corrected using the base station GPS data. The corrected flight path is translated into x and y coordinates in the local UTM system in metres.

The local reference ellipsoid and UTM protocol are described above - see section 2.

The flight path is drawn using linear interpolation between x,y positions from the navigation system. Processing includes speed checks to identify spikes and offsets which are removed. Positions are updated and expressed as UTM eastings (x) and UTM northings (y) in the local UTM system in metres.

The 24 hour clock time is shown as a small square, plotted every minute. Large tick marks are shown every 10 seconds. Small tick marks are plotted every 2 seconds.

The flight path is generally accurate to 5 m with respect to the topographic map.

Registration

Despite advances in absolute positioning systems such as GPS, the registration of the flight path to the local topographic maps is ultimately based on a reasonable fit between points picked from the video tape or calculated topography and local topographic maps. In countries with reliable topographic maps, the theoretical registration (based on an assumed datum and translation from WGS 84 coordinates) and the registration based on a best fit with local topographic features are commonly identical.

Where the local topographic maps, particularly the datum on which they are based, are more uncertain, differences in these two types of registration can occur.

The topographic maps and map datum have been found to be reliable and registration based on calculated topography is in good agreement with the registration based on the theoretical datum.

4.3 Magnetic Data

The aeromagnetic data were analyzed for diurnal variations by adjustment with the recorded base station magnetic values. This was followed by tie line levelling and manual adjustments applied to the profile data. The corrected profile data were interpolated on to a square grid using an Akima spline technique. The grid cell size was 100 m. A 5 x 5 Hanning grid filter was passed over the grid. The final grid provided the basis for threading the presented contours. The minimum contour interval is 5 nT.

Hanning profile and grid filters are used extensively in processing airborne geophysical data. These are cosine shaped low pass or smoothing filters which reduce noise with minimal signal distortion.

4.4 Vertical Magnetic Gradient

The vertical magnetic gradient was calculated from the gridded total field magnetic data. The calculation use Fourier Transforms to calculate the vertical gradient. The filtered data is further subject to a 3 x 3 Hanning grid filter. The results are contoured using a minimum contour interval of 0.05 nT/m. The grid cell size is the same as that used in processing the total field data.

4.5 Radiometric Data

The four channels of radiometric data are subject to a number of corrections and filters. They are:

- low pass profile filter (9 point Hanning)
- back ground removal (cosmic + atmospheric)
- terrain clearance correction
- compton scattering correction
- calibration to ground concentrations
- low pass grid filter (7 x 7 point Hanning)

The radiometric data were levelled using traditional inspection methods. The results were later proven to be consistent with background removal using over-water background levels. Minor adjustments were made after review of preliminary contour maps.

The Compton stripping factors used were

alpha	-	0.3174 (Th into U)
beta	-	0.4865 (Th into K)
gamma	-	0.8318 (U into K)
a	-	0.0596 (U into Th)
b	-	0.0012 (K into Th)
g	-	0.0121 (K into U)

where alpha, beta and gamma are the forward stripping coefficients and a, b, g are the backward stripping coefficients. These coefficients are taken from the test pad calibration done in Breckinridge.

The altitude attenuation coefficients used were 0.00668255 (TC), 0.00812397 (K), 0.00791066 (U) and 0.006744612 (Th). The units are m^{-1}.

Radiometric data were corrected to a mean terrain clearance of 100 m. The terrain clearance correction was limited to 200 m. For terrain clearances more than 200 m, the 200 m correction was used. This prevents extreme amplification of low amplitude signals from high altitudes.

The corrected data were interpolated onto a 100 m grid using an Akima spline technique. The grids provided the basis for threading the presented contours. The minimum contour intervals are 0.1% (K) and 0.5 ppm (U and Th).

Ternary Map

Ternary radiometric maps were developed as a means of presenting three element radiometric ratios after the introduction of high resolution large format colour plotters. Ternary maps are produced by using different colours to represent the potassium, uranium and thorium ground concentration (Broome et al, 1987). Colour assignments are commonly red for potassium, blue for uranium and yellow for thorium.

The general principle is to examine the K, U, and Th values at each grid cell. These values may be expressed as a vector in K-U-Th space. The vector may be described by its amplitude and direction. Surfaces of constant amplitude are 1/8 sections of sphere or a distorted triangle if viewed from above its centre. If this surface is filled with an orderly array of colour with primary colours (red, blue and yellow) at the corners, any grid cell sample may be assigned a colour based on the relative values of K, U and Th. A map showing all these colour assignments should act as a surface radioelement geochemical map which might be used to characterise and separate different geological units.

In practice, a number of processing steps are needed to condition the data before colour assignment. The most important is histogram equalization - a process which amplifies small variations near the mean but which limits using the ternary map as a quantitative interpretation tool. The basic processing steps (Broome et al, 1987) are as follows (grids of K, U and Th in ground concentration are assumed although this is not critical and grids in counts per second will yield equivalent results).

1. Normalize data at each grid cell as follows;

$$K' = K/sum$$
$$U' = U/sum$$
$$Th' = Th/(4 \times sum)$$

where sum = K + U + Th/4

The factor 4 is used as K in %, U in ppm eU and Th in ppm eTh are commonly seen in the ratio 1:1:4.

2. The normalized radiometric grids are nonlinearly quantized using histogram equalization. The number of quantization levels is determined by the colour plotter and its ability to produce different colour intensities (for the same colour hue). A ternary map results when the three primary colour intensities at each grid cell are mixed to give a unique colour hue.

3. In low count rate areas, the ternary map would show erratic colour variations. To avoid this, the overall colour intensities are reduced for low overall amplitudes. The range of amplitudes are divided into five levels using histogram equalization applied to grid sum values. The colour intensities in the final ternary map are then varied according to these levels.

The final ternary map is therefore a combination of colour hue (representing relative radioelement concentration) and colour intensity (representing overall response amplitudes). The double application of histogram equalization makes translation of any colour hue/intensity into specific radioelement ratios difficult. Ternary maps are used to suggest differences in relative radioelement concentrations although these differences cannot be quantified.

Reference

Broome, J., Carson, J.M., Grant, J.A, and Ford, K.L., 1987, A modified ternary radioelement mapping technique and its application to the south coast of Newfoundland, Geol. Surv. of Canada, paper 87-14.

Respectfully submitted,

Sandra A. Takata
Aerodat Inc.
December 27, 1995

J95118

APPENDIX I

PERSONNEL

OFFICE

Processing	B. King
	G. McDonald
Report	S. Takata

APPENDIX II

GENERAL INTERPRETIVE CONSIDERATIONS

GENERAL INTERPRETIVE CONSIDERATIONS

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.

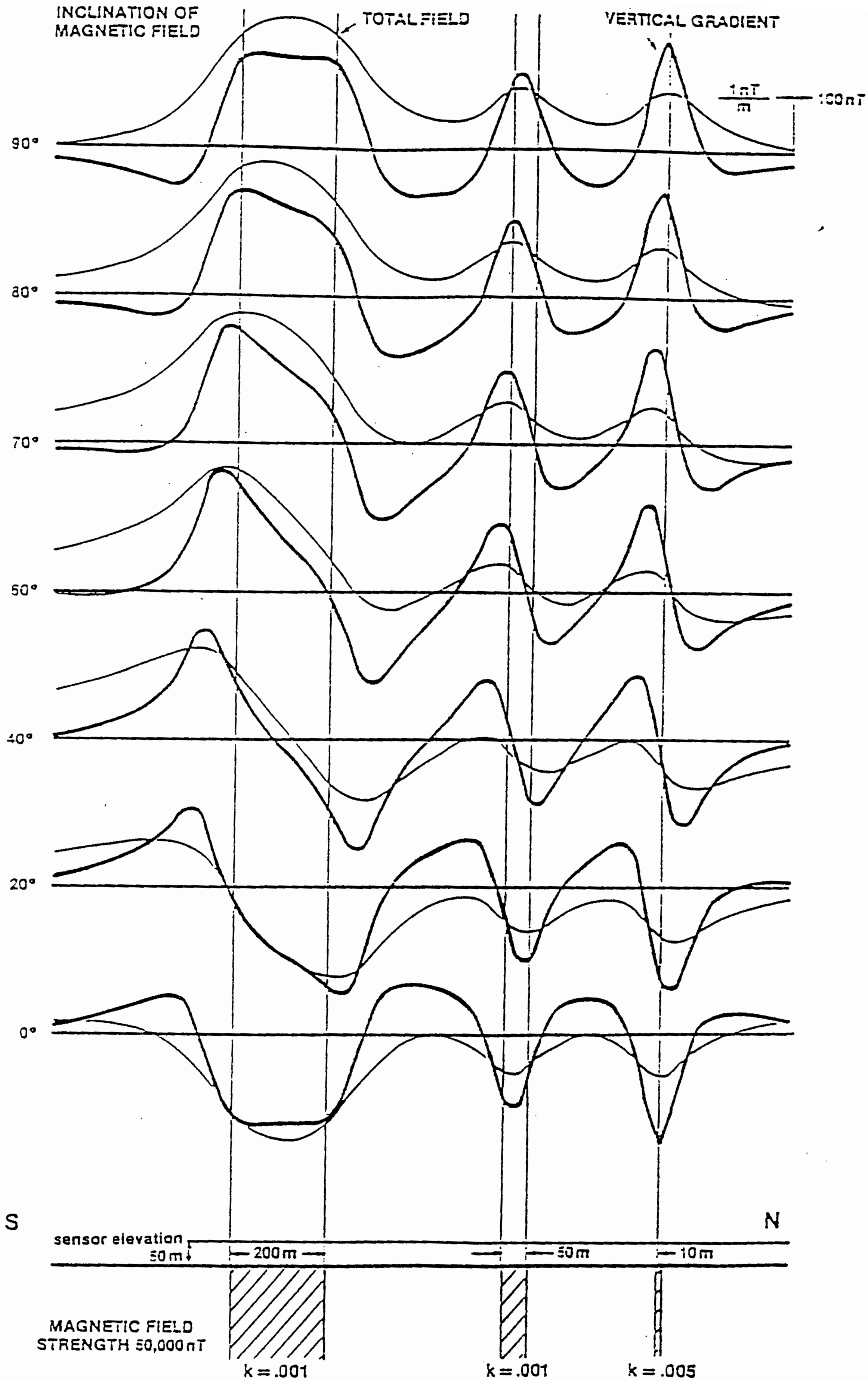
Theoretical profiles of total field and vertical gradient anomalies from tabular sources at a variety of magnetic inclinations are shown in the attached figure. Sources are 10, 50 and 200 m wide. The source-sensor separation is 50 m. The thin line is the total field profile. The thick line is the vertical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


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

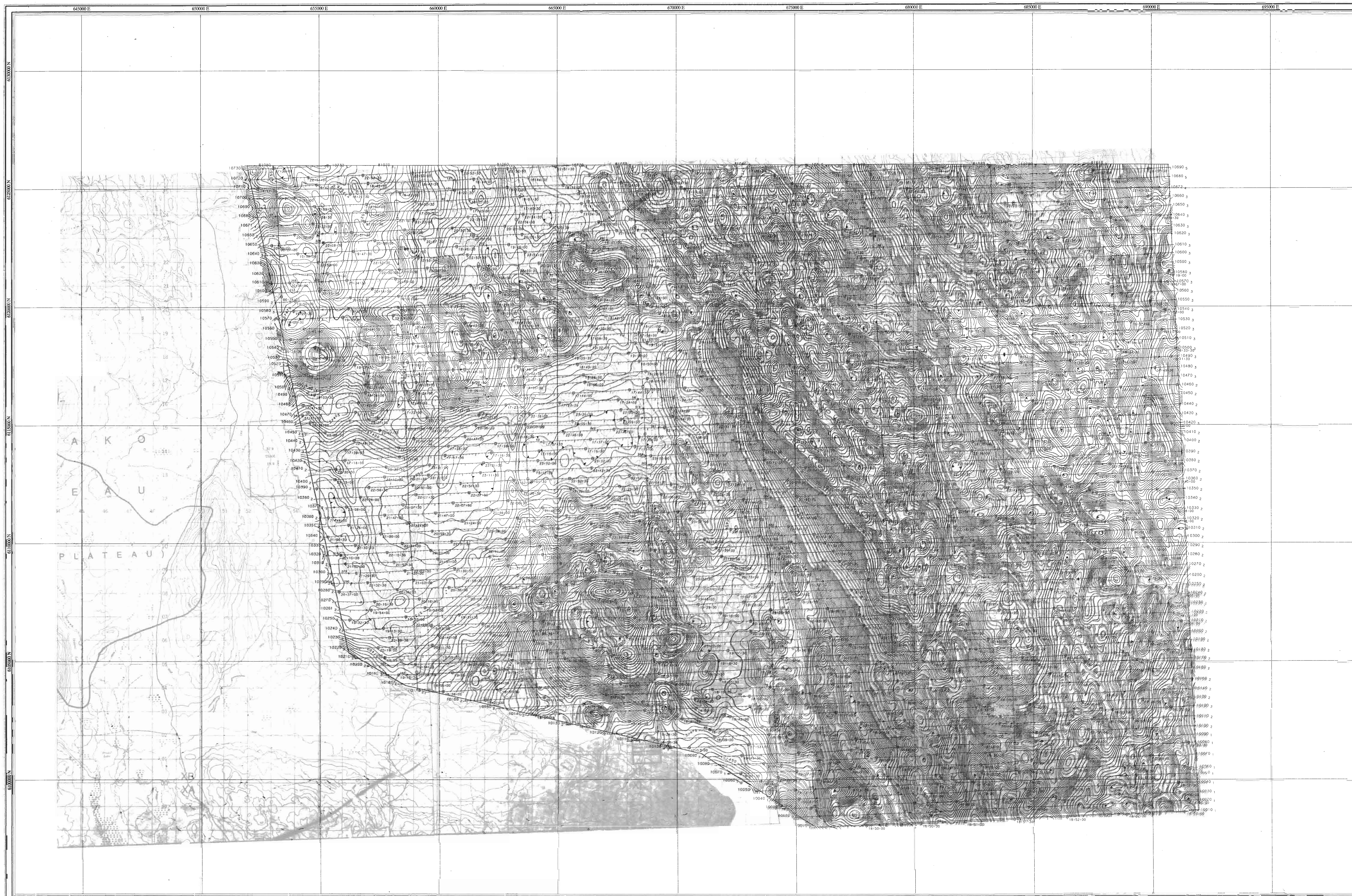
line should be ignored and the outline taken from the northern zero contour line and the extent of the anomaly peak width.

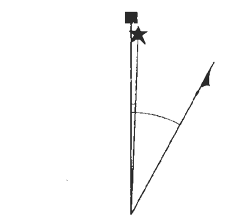
Dip

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.





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 : 2.2°
Grid North - Magnetic North : 28.4°
Annual change : -0.06°

TOTAL FIELD MAGNETICS

Total field magnetic intensity contour data, measured by a cesium high sensitivity magnetometer at an average sensor elevation of 100m, and corrected for diurnal variation.

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

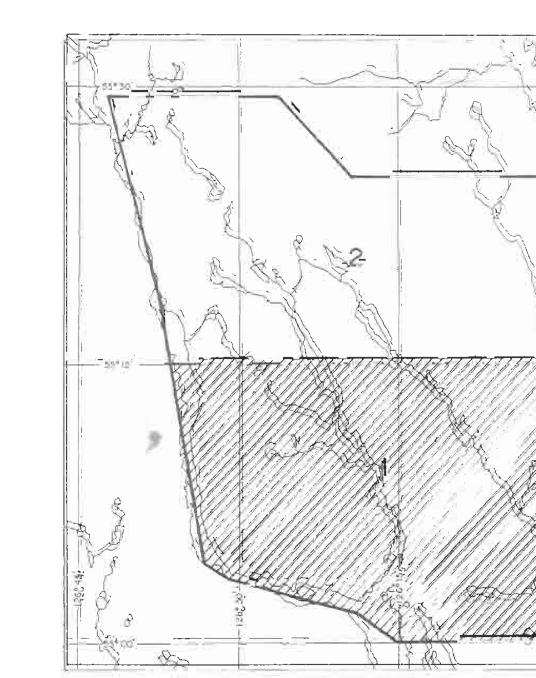
5 nT
25 nT
100 nT
500 nT
2500 nT

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 90 - 270°, with an average line spacing of 400m.

Average aircraft-terrain clearance of 100 m. was monitored by radar and barometric altimeters.



TECK EXPLORATION LTD.

TOTAL FIELD MAGNETICS

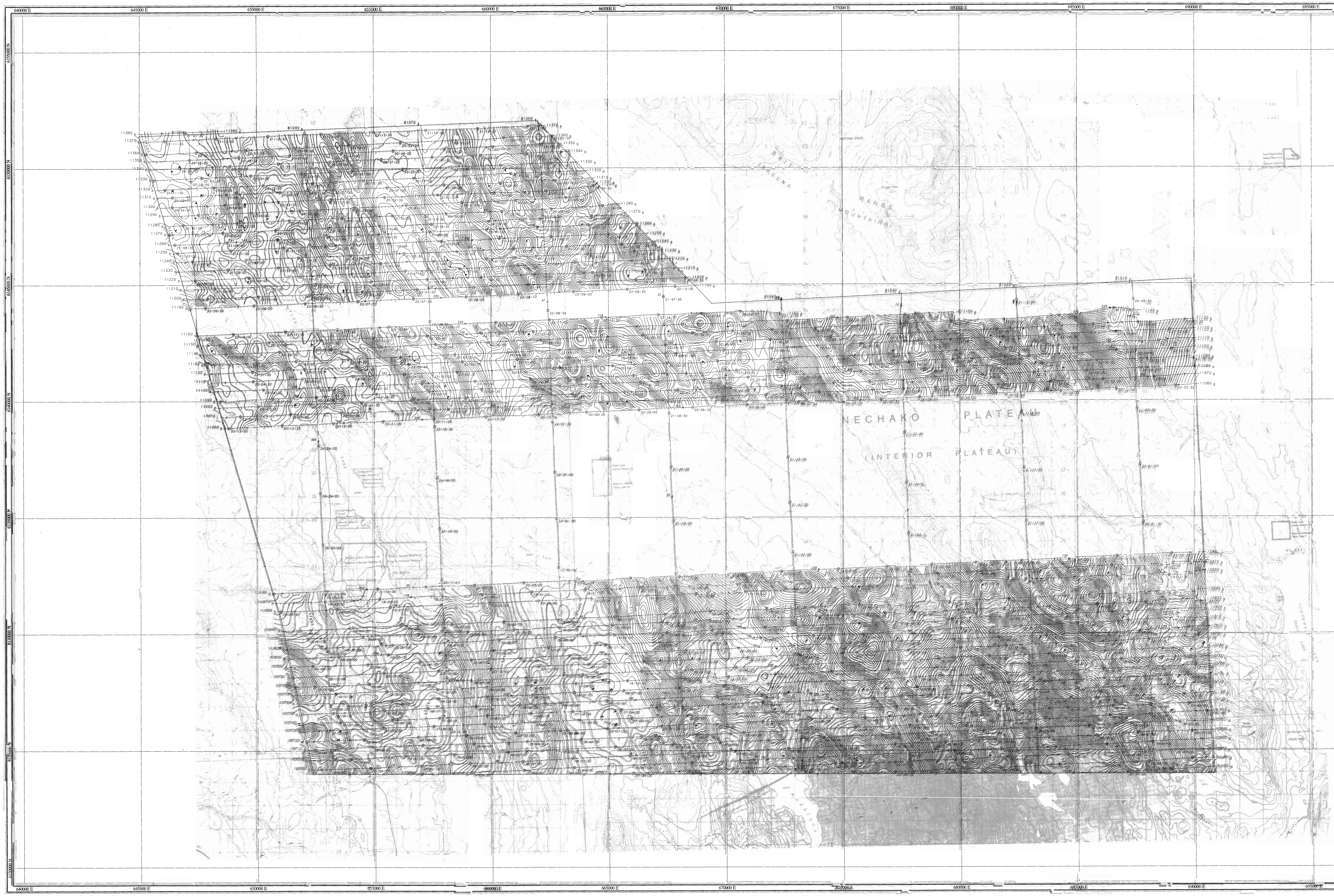
BABINE LAKE
BRITISH COLUMBIA

SCALE 1:50 000

1000 0 500 1000 2500 5000 metres

AERODAT INC.

Date Flown : SEPTEMBER 1995
NTS : 93 M/7 Plate E
Project : J95118 Map Ref.: 1-2



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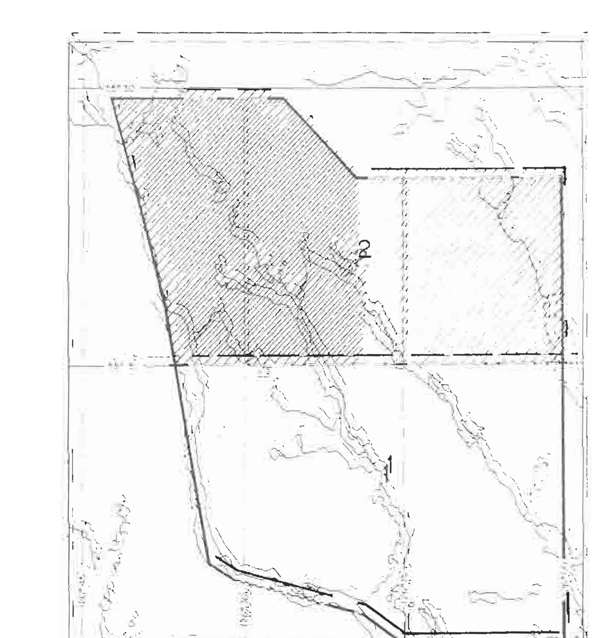
GEOLOGICAL SURVEY BRANCH
ASSESSMENT REPORT

25,376



TECK EXPLORATION LTD.

TOTAL FIELD MAGNETICS

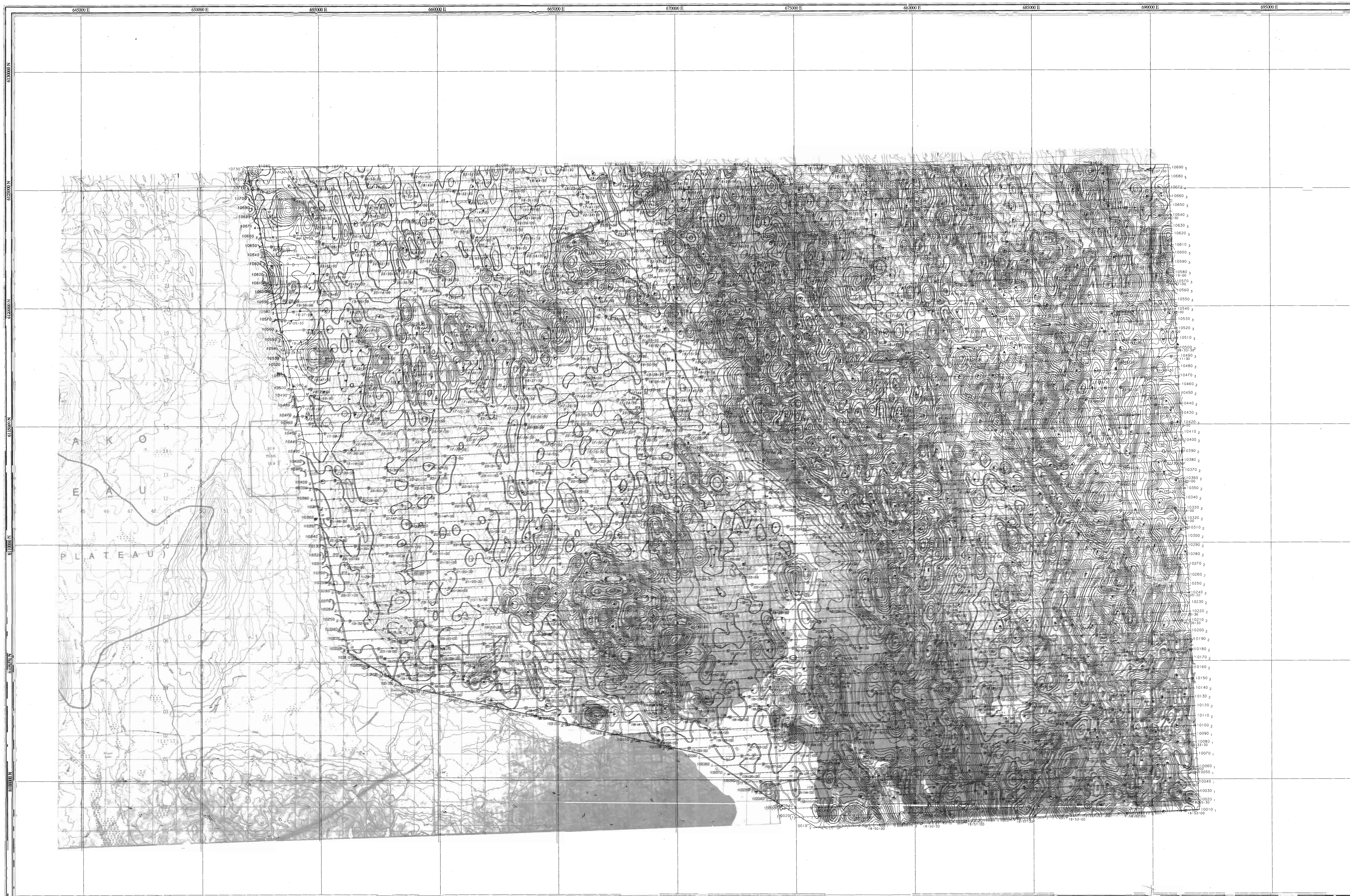
BABINE LAKE
BRITISH COLUMBIA

SCALE 1:50 000

1000 0 500 1000 2500 5000 metres

aerodat
AERODAT INC.

Date Flown : SEPTEMBER 1995
NTS : 93 M/7 Plate F
Project : J95118 [redacted]



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 : 2.2°
Grid North - Magnetic North : 28.4°
Annual change : -0.06°

VERTICAL GRADIENT

Vertical magnetic gradient contour data, calculated from the gridded total field magnetics data

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

0.05 nT/m
0.25 nT/m
1.0 nT/m
5 nT/m
25 nT/m

FLIGHT PATH

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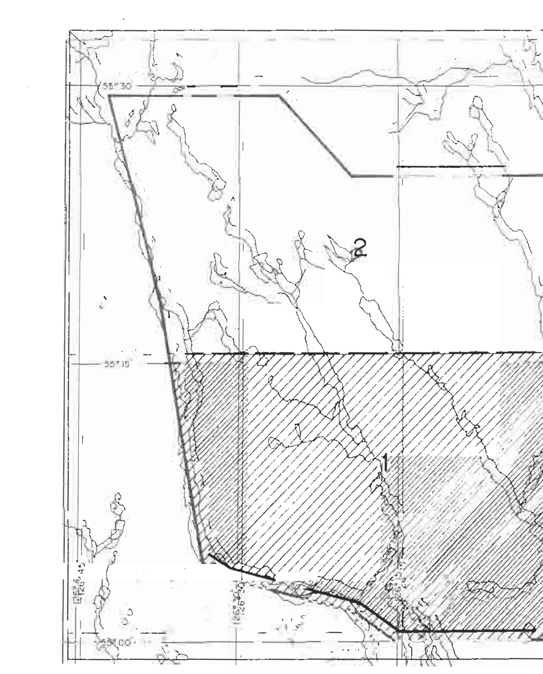
Average aircroft-terrain clearance of 100m. was monitored by radar and barometric altimeters.



TECK EXPLORATION LTD.

VERTICAL MAGNETIC GRADIENT

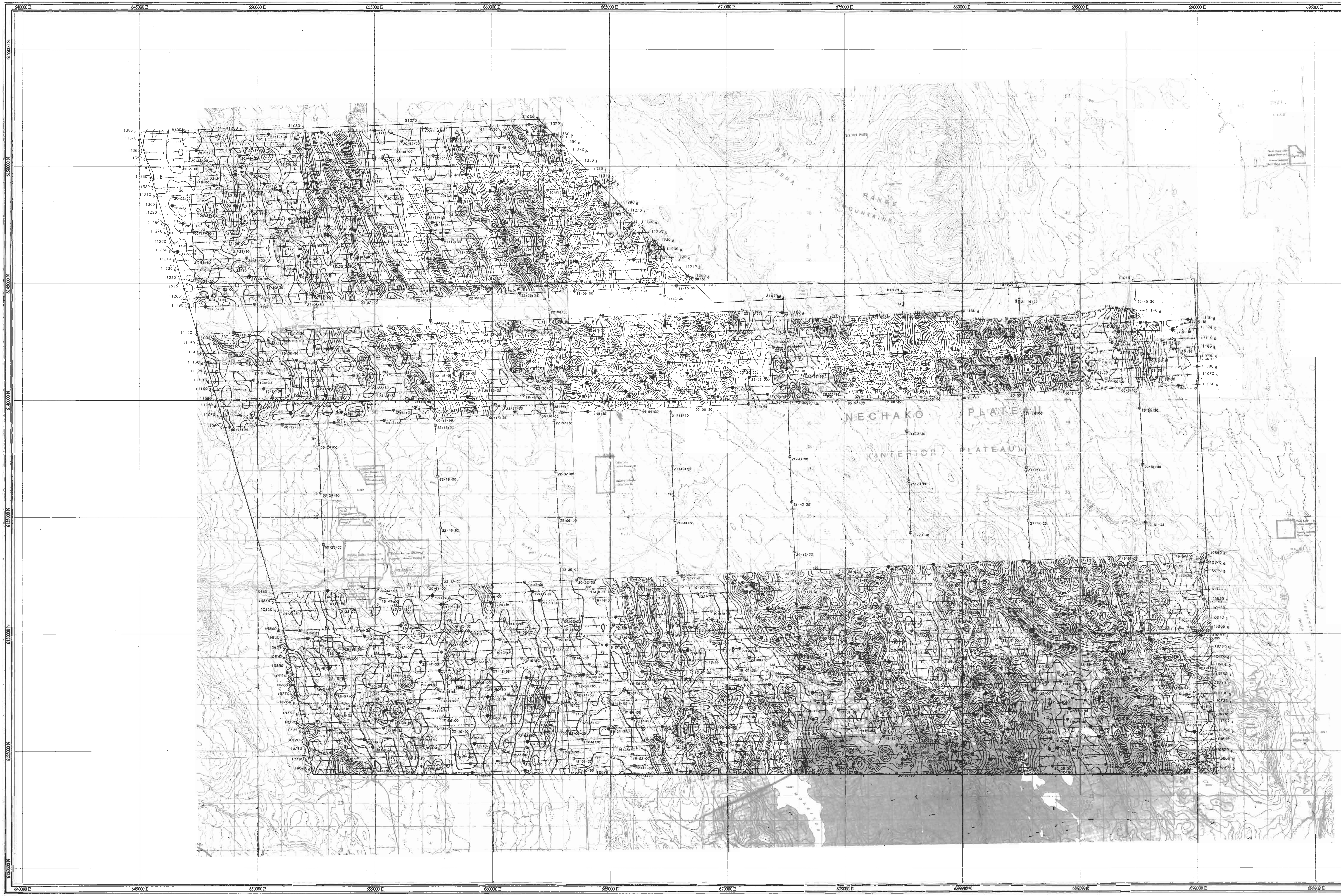
[illegible] LAKE
BRITISH COLUMBIA

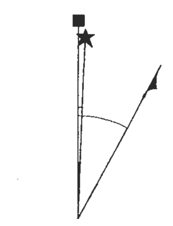
SCALE 1:50 000

1000 0 500 1000 2500 5000 metres

aerodat
AERODAT INC.

Date Flown : SEPTEMBER 1995
NTS : 93 M/7 Plate G
Project : J95118 [redacted]





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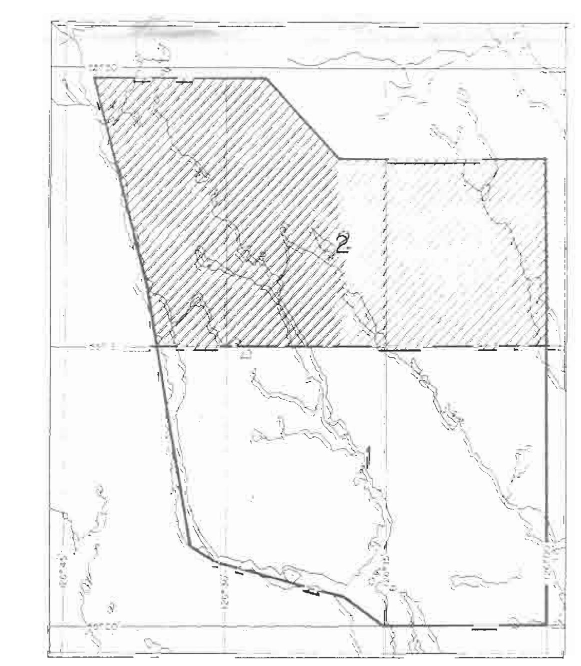
ASSESSMENT REPORT

25,376



TECK EXPLORATION LTD.

VERTICAL MAGNETIC GRADIENT

BABINE LAKE
BRITISH COLUMBIA

SCALE 1:50 000

1000 0 500 1000 2500 5000 metres

aerodat
AERODAT INC.

Date Flown : SEPTEMBER 1995
NTS : 93 M/7 Plate H
Project : J95118 [redacted]