AIRBORNE MAGNETOMETER SURVEY

of the

GOLD STAR GROUP

NEAR TERRACE, B.C.

Latitude: 54°38' : Longitude: 128°30'

N.T.S. 103 I/9W & 10E

54°128° NE

103 I /9 W

by:

D.R. Cochrane, P. Eng.

April 20th, 1967

GEO-X SURVEYS Ltd.
VANCOUVER, CANADA

999

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SUMMARY and RECOMMENDATIONS:

Just over 30 line miles of coincident airborne magnetometer and photography was flown on seven lines across a claim group near Terrace B.C., owned by Gold Star Mines Ltd.

The survey was a reconaissance venture, with line spacing 2,000 feet except along Hankin Creek, where an intermediate line at low altitude was flown to detail the mineral showing area.

Due to the wide line spacing, across line magnetic correlation is necessarily tentative, except in the detailed area.

The original data indicates five interesting anomalies. Three anomalies are positive and have amplitudes of over +500 gammas above background. Two anomalies are negative, and the larger of the two is believed to be caused by topography.

A fourth degree trend surface, and fourth degree residual map was prepared from theoriginal data by General Engineering Company Ltd., on a Univac 1107 Computer, located in Richland, Washington.

The trend surface indicates a broad magnetically low zone in the northeast, probably indicating the Hankin Creek basin. The remainder of the area is, in general, a low amplitude trend surface zone.

The residual contour map outlined two additional magnetically anomalous areas differing significantly from an average background value.

Investigation as to the cause of the three positive and one small negative originaldata anomalies, and two residual data anomalies is recommended.

INTRODUCTION:

On April 4th, 1967, an airborne magnetometer survey was flown on the Gold Star claim group, near Terrace, B.C., by Geo-X Surveys Ltd. This report discusses and describes the field work, subsequent data processing and interpretation of the airborne magnetic survey.

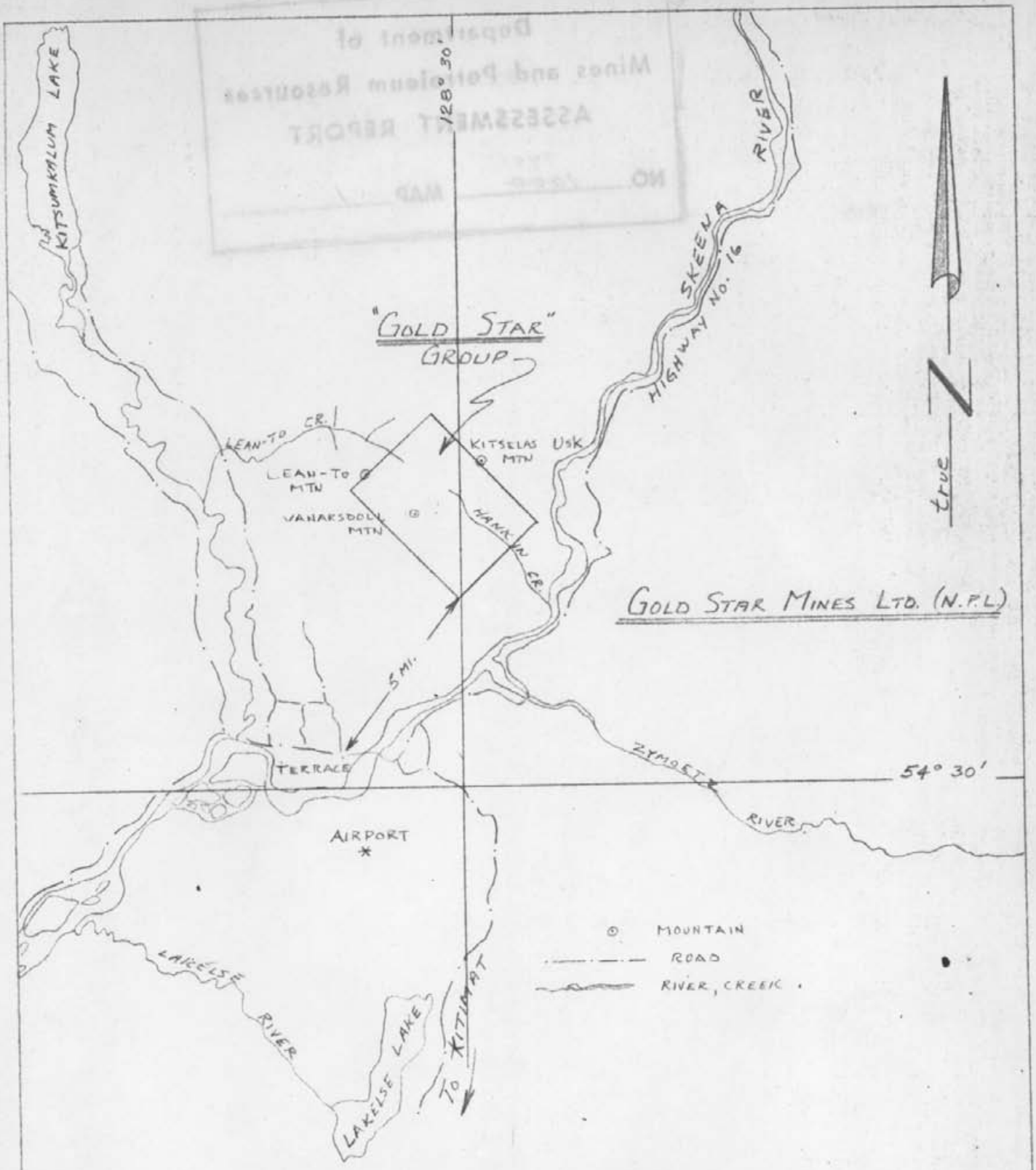
LOCATION:

The property is centered on Hankin (formerly called Phillips) Creek, a tributary of the Skeena River. It is ten air miles northeast of the town of Terrace, B.C. The claims lie east and south of Lean-To Mountain, and west and south of Kitselas Mountain (see figures 1 and 2).

CLAIMS and OWNERSHIP:

The claims, in the Omineca Mining Division, were located by Mr. G.B. Rolph, as agent for Mr. C. Heppner, both of Terrace, B.C. At the present time, title to the claims is being transferred to Gold Star Mines Ltd., registered office at Suite 170, 444 Victoria Street, Prince George, B.C.

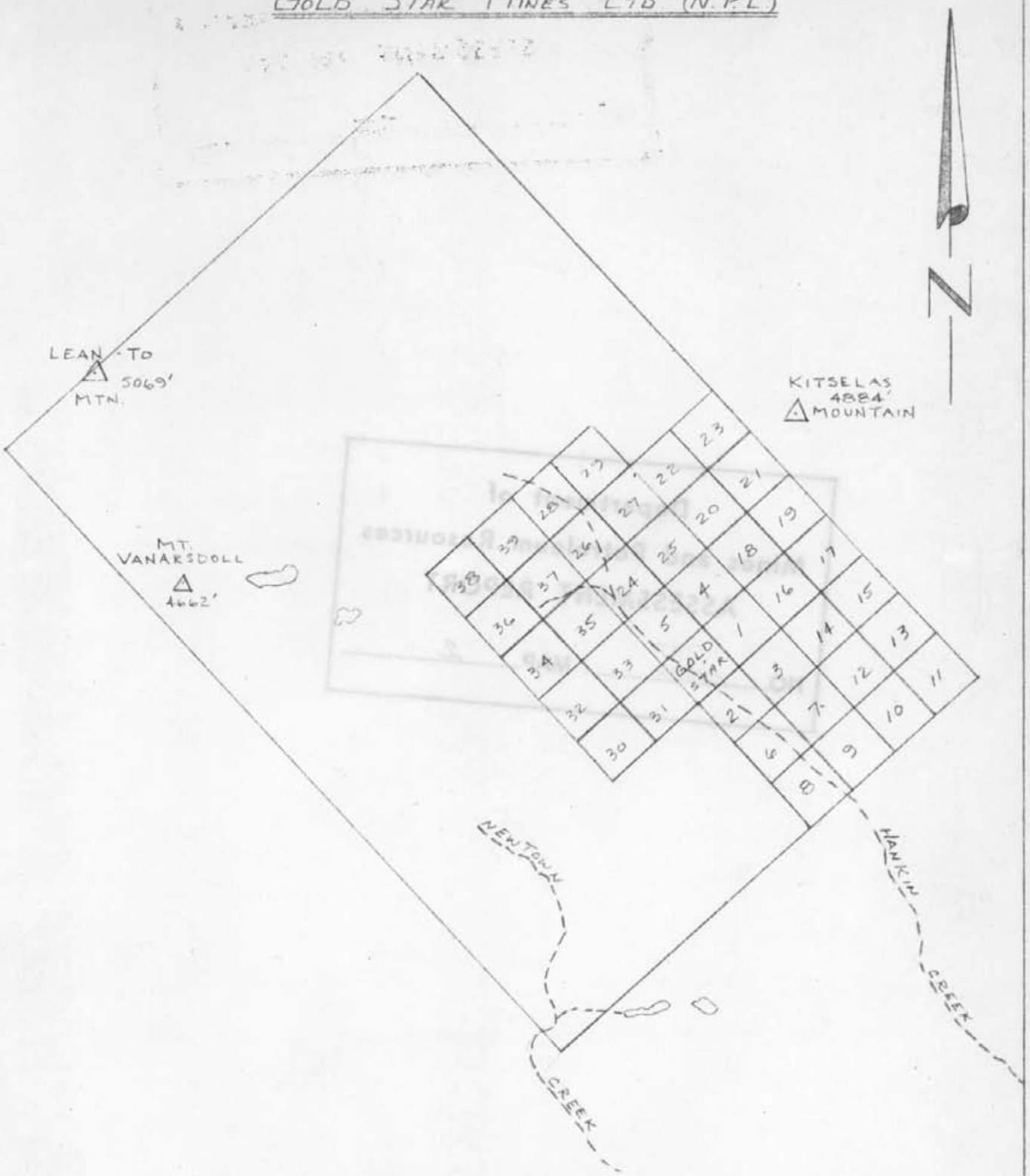
Claims and record numbers tabulated on [redacted] *page.5.*



GENERAL LOCATION OF GOLD STAR GROUP
NEAR TERRACE, B.C. OMINECA M.D.
SCALE: 1 INCH - 4 MILES
GEO-X SURVEYS LTD. APRIL 19, 1967
DRAWN BY: D.M.F.

FIGURE 1.

GOLD STAR MINES LTD (N.P.L)



CLAIM MAP OF GOLD STAR GROUP

NEAR TERRACE, B.C. OMINECA M.D.

GEO-X SURVEYS LTD. APRIL 13, 1967

SCALE 1.25 INCHES - 1 MILE

DRAWN BY: D.M.F.

FIGURE 3.

Claim Name:	Record No.(s)	Recording Date
Gold Star	33393	Sept.27, 1965
Gold Star 1-7 incl.	33394-33400	Sept.27, 1965
Gold Star 8-19 incl.	39993-40004	June 7, 1966
Gold Star 20-29 incl.	42627-42636	Aug. 2, 1966
Gold Star 30-37 incl.	44413-44420	Sept.2, 1966
Gold Star 38 and 39	44497,44498	Sept.14, 1966

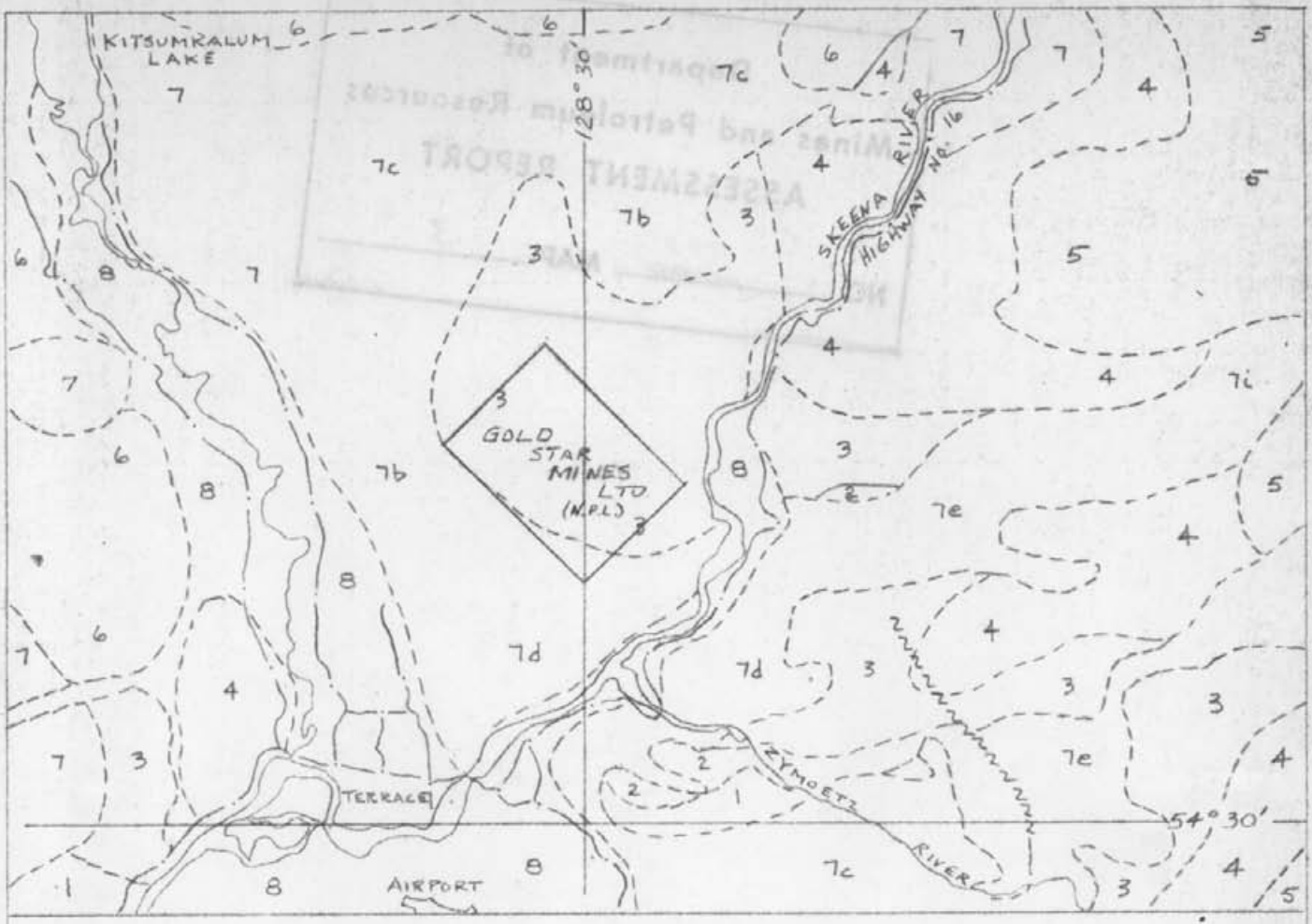
TOPOGRAPHY:

The Terrace area is within the confines of the Coast Range. It is characterized by high mountain peaks and deeply incised stream valleys. Kitselas Mountain, elevation 4884', and Lean-To Mountain, elevation 5065', are the highest peaks in the area surveyed, and the mouth of Hankin Creek (elevation 900') was the lowest point. The creek has a moderate gradient, falling 2,000 feet in just over three miles. But the valley flanks are steep, with a difference in elevation of over 2,000 feet in less than one mile. Below the tree line, between 3 and 4 thousand feet, the claims are covered with extensive stands of hemlock, spruce, balsam and red cedar.

GENERAL GEOLOGY:

The claim group is underlain by a Triassic (?) sedimentary and volcanic sequence including conglomerates, sandstones, andesites and chert.(1) This sequence has been complexly folded along axes striking mainly north, north-east It is enclosed and intruded by Upper Cretaceous coast granodiorite intrusives. The volcanic-granodiorite intrusive lies near the west boundary of the claim group, and extends from Lean-To mountain to near the mouth of the Hankin Creek. (see figure 2)

(1) numbers in parenthesss refer to references at back of report.



G.S.C. MAP 1136A

LEGEND:

2	White crystalline limestone
3	Limestone-boulder conglomerate, greywacke, banded volcanic sandstone, chert.
4	Andesite, breccia, tuff, greywacke, argillite.
6	Greywacke, conglomerate, argillite; minor tuff.
7	Undifferentiated: granodiorite, diorite, quartz diorite, quartz monzonite, adamellite, granite, gabbro. Border Facies: 7b, hornblende diorite, quartz diorite, migmatite. Inner Facies: 7c: white granodiorite; 7d, green granodiorite; 7e: pink granodiorite.
8	Sand, gravel, clay, alluvium

GENERAL GEOLOGY OF GOLD STAR GROUP

NEAR TERRACE, B.C. OMINECA M.D.

GEO-X SURVEYS LTD. APRIL 19, 1967

SCALE: 1 INCH - 4 MILES DRAWN BY: D.M.F FIGURE 2

PREVIOUS WORK:

Considerable prospecting and development work has been done in the area, since the early 1900's. One property, the Cordillera Mine, was discovered by float tracing on the east side of Kitselas Mountain, in 1914. A small mill was erected in 1920 and a small quantity of gold, copper and silver was produced (3, 1915; pg. K 141). The present Gold Star group covers two old properties on the south slope of Kitselas Mountain in the Hankin (Phillips) creek valley. Both properties, the Nugget Group and Copper King Group are described in early Minister of Mines Reports.

Mineralization is described as "quartz carrying bornite, chalcopyrite and iron pyrites" (3,1915). Most of the showings are described as having a volcanic (andesite and breccia) host rock, and close to small plugs or dykes of granodiorite.(2, p.52-53).

FIELD PROCEEDURE:

The airborne magnetometer used by Geo-X Surveys consists of a fluxgate element within an oil-dampened gimbol. This "sensing head" is attached to an aluminum boom and fastened to the aircraft. The head is connected to an amplifier, oscillator, AC/DC converter and a Bausch & Lomb chart recorder. Continuous chart recordings are made of the vertical component of the magnetic field when in flight. Ground control was maintained by an automatic camera which photographed the flight path at 4-second intervals.

Field Proceedure - con't

Lines 1 to 6 were flown at a bearing of S45°E; line 7 up Hankin Creek, was flown at N45°W. Line 1 commenced at the peak of Lean-To Mountain, and continued to a small lake, two miles north of the confluence of the Zymoetz and Skeena Rivers. Each additional line commenced approximately 2000 feet east of Lean-To Mountain peak, and was flown towards the Skeena River. A flight elevation of approximately 800 feet was maintained by the pilot, on the majority of the lines. In order to record detail along Hankin Creek (line 7) an altitude of 500 feet above ground was maintained.

DATA PROCESSING and FLIGHT DATA:

The airphotos were assembled and a mosaic prepared, showing the flight paths. Photo data were compared with the navigator's information as point of end (POE) and point of beginning (POB) of each line. With the known aircraft velocity, and ground control, the length of, and distance between, the flight lines can be calculated.

An "X" "Y" co-ordinate system was set up with the POB of line 1 as X= 0+00, Y= 0+00.

Flight line co-ordinates and information are tabulated:

Line No.	POB (feet) X	POB (feet) Y	POE (feet) X	POE (feet) Y	Average altitude above ground
L	0	0	0	-25,500	900'
2	+2000	-2000	+2000	-23,750	800
3	+4650	-6750	+4570	-24,318	800
4	+6360	-6750	+7100	-26,500	900
7	+7080	-13000	+7500	-26,250	500
5	+8550	-4000	+8000	-27,500	800
6	+10000	-2250	+10000	-30,500	800

Data Processing and Flight Data - con't

The chart record of each line is examined at specific X-Y positions and the amplitude of the magnetic field is tabulated at that point. The Y interval on lines 3,4, 5 and 7 was 125 feet, and on lines 1, 2 and 6 was 250 feet.

The XY co-ordinate and magnetic information is then computer processed by General Engineering Company of Canada, by a direct line to the Univac Computer in Seattle, Washington. Three maps are printed by the Computer: (a) a plot of original data; (b) a trend surface map; and (c) an original data minus trend surface, or residual plot.

A detailed bibliography on computer programming of geophysical data and trend surface maps is given in the reference section.

ORIGINAL DATA RESULTS:

The aeromagnetic plan of the original magnetic data is shown at 1000 feet to the inch in the map pocket.

In general, the broad magnetic trends are southwest-northeast, to eastwest; however, correlation between lines 1,2,3 and 5 and 6 must necessarily be considered tentative because of the wide line spacing (2,000').

Five anomalies, A to E, are located on the plan, and are superimposed on the accompanying topographic map.

Original Data Results - con't

Anomaly A, is a south-west trending magnetic high zone. The maximum vertical component value is +970 gammas above background.

Anomaly B, close to A, is an easterly trending magnetically positive area, nearly 2,000 feet long and 400 feet wide. The maximum vertical component value is +770 gammas above background.

Anomaly C, actually consists of two small positive zones, with maximum magnetic values of +700 gammas.

The above three zones are positive anomalies, often indicative of zones of ferromagnetic minerals, such as magnetite or pyrrhotite.

Anomaly D is a northerly trending negative zone, maximum amplitude - 1900 gammas below background. It is 2,000 feet long and has a maximum width of 700 feet.

Anomaly E is a broad arch of very low magnetic values. It extends south east of the point of beginning of lines 3, 4 and 5. This large magnetically negative area is centered in the headwater basin of Hankin Creek, and may be considered a topographic effect.

TREND SURFACE ANALYSIS:

Because of the quantative nature of airborne magnetic data, the information is particularly amenable to mathematical and computer processing. In addition, magnetic data is often complex and difficult to correlate in original (raw) form. Trend surface analysis is an established method of approximating results and producing best fit contours, and extraneous values caused by yaw of the aircraft and vibrations are filtered out in the process.

The theory of the method will not be reviewed in detail here. The reader is referred to the articles tabulated at the back of the report on computer trend analysis and other pertinent papers.

Trend surface maps may be considered, in general, as indications of regional trends because of the nature of approximation theory. Figure 6, the fourth degree trend surface plan, shows a broad southeast pointing arch of negative values which diminish in intensity to the southeast, to what may be called a rather uniform magnetic zone. The aforementioned negative trend surface anomaly is centered at the headwaters of Hankin Creek, within the large basin. The trend surface then has outlined a topographic anomaly.

RESIDUAL DATA ANALYSIS:

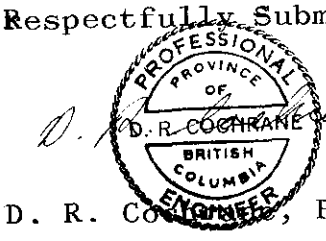
Trend surfaces are mathematically computed surfaces that best fit a given set of data, and which simulate the large scale "regional" aspect. The difference between the computed value of the trend surface and the actual, or original data at a particular point, represents the residual or what may be thought of as the local aspect. Removal of the regional trend (trend surface) from original data, has the effect of amplifying the local component. This local element is, of course, in our instance, of utmost importance, and represents "anomalies" or local areas differing significantly from the normal (background) magnetic datum. Figure 7, in map pocket, is contoured at an absolute value of 10, of the fourth degree residuals.

The map shows a strong northwest to southeast trend over the majority of the area surveyed, and a local cross trend at the southeast end of the map sheet. The most distinct residual anomaly is centered 4000 feet north of anomaly E, in the saddle near the start of line 5 (marked anomaly F). Original data anomalies are distributed on the southeast margin of a 260 to 330 residual trend, commencing from the residual anomaly. Another, more complex anomaly is indicated by the computer, at the end of line 1, around the small lakes. (marked anomaly G).

Original data anomalies A and B lie on a distinct change of residual trend, which may have some geological significance.

The two aforementioned residual anomalies, (F and G) should be investigated on the ground.

Respectfully Submitted,



D. R. Cochrane, P.Eng.

Vancouver, B.C.
April 20th, 1967

REFERENCES

(1) Geological Survey of Canada, Map 1136 A, Sheet 103 I (east$\frac{1}{2}$) Terrace, B.C. Geology by S. Duffell and J.G. Souther, 1953, 1954 and 1955

(2) Canada Department of Mines and Resources, Geological Survey, Memoir 205, Mineral Resources of the Terrace Area, Coast District, B.C., by E.D. Kindle, 1937.

(3) Reports of the Minister of Mines, B.C.

COMPUTER REFERENCES

Computers in the Mineral Industry, Stanford University Publications, Geological Sciences, Vol. IX, 1964. G.A. Parks, Editor.

(a) Application of Trend Analysis to Geochemical Data, J.J. Connor and A.T. Miesch; p. 110

(b) Application of Trend Surface Analysis to the White Pine Copper Deposit, S.C. Nording, et al; p.186.

(c) Comparison Analysis of Trend Maps, R.L. Miller; p.669

(d) Use of Trend-Surface Residuals in Interpreting Geological Structures; D.F. Merriam; p.686.

(e) Simplified Computer Contouring of Exploration Data D.R. Ojakangas: p.757

Allen, P. and Krumbein, W.C.; 1962, Secondary Trend Components in the Top Ashdorum Pebble Bed;

Jour. Geo., Vol. 70, No. 5, p.507-538

Chayes, et al, 1963, Geological Contours and Trend Surfaces: Jour. Pet., Vol. 4, No.2, p. 307-312

Krumbein, W.C., 1959, Trend Surface Analysis of Contour-Type Maps with Irregular Control Point Spacing: Jour. Geoph. Res., Vol. 64, No.7, p.823

Computers and Computer Applications in Mining and Exploration, 1965, College of Mines, Arizona, Synposium at Tuscon, March 15-19, Edited by Dotson and Peters.

APPENDIX I

Operator's Flight Report for Gold Star Mines Ltd. (NPL)

Property: Gold Star Group

Location: Approximately 10 miles northeast of Terrace, Omineca M.D.

Pilot: U. Legard; O.K. Helicopters Ltd. (Hiller 12E)

Operator: D.M. Fritz: Geo-X Surveys Ltd.

Navigator: D. Cochrane, P. Eng.: Geo-X Surveys Ltd.

Date: April 4th, 1967

Flight Time: Takeoff: 11:45 AM - Land: 1:15 PM - $1\frac{1}{2}$ hours.

Weather: Sunny and clear, winds light

Air Speed: 60 mph

Elevation: 800 foot elevation maintained where ever topography allowed, 500 feet on line 7.

Line Spacing: Approximately 2,000 feet.

Scale: 3,000 gamma, full scale deflection

Sensitivity: 2% of full scale deflection.

Line No.	Direction Flown:	No. Photos	Chart Length	Mileage
1	S 40°E	62	25.0"	4.83
2	S 40°E	55	20,8	4.12
3	S 40°E	43	21.2	3.33
4	S 40°E	51	17.1	3.74
1A	N 40°W	51	19.6	4.16
5	S 40°E	58	23.8	4.45
6	S 40°E	67	29.4	5.35
7	N 40°W	36	13.1	2.51
			Total Mileage:	32.49

APPENDIX II

Personnel:

Date:	Personnel:	Work Done:	Employer
Apr.2/'67	D.Fritz,D.Cochrane	Mobilization	Geo-X Surveys
Apr.3/'67	" "	"	"
April 4/'67	" "	Airborne Survey	"
April 5 & 6	", "	Demobilization	"
Apr.7/'67	D. Fritz	Data preparation	"
Apr.10-13	D.Fritz, D.Cochrane	Data Preparation	"
Apr.14-20	C.W.Baker	Computer	GECO
Apr.14-20	D.Fritz, D.Cochrane	Report & Data Preparation	Geo-X Surveys

APPENDIX III

Airborne Instrument Specifications:

Sensitivity: Four scales give full scale reading of ±150, ±500; ±1500; ±5000 gammas.

Readings ±2% of the full scale

Frequency Response: DC to 0.5 cycles per second

Chart Recorder: Bausch & Lomb VOM6 - self-balancing potentiometer type.

Camera: Robot recorder 24: 35mm with large film magazine; regulated by timing device.

Readout: Monitor meter on amplifier unit, and graphic chart recorder.

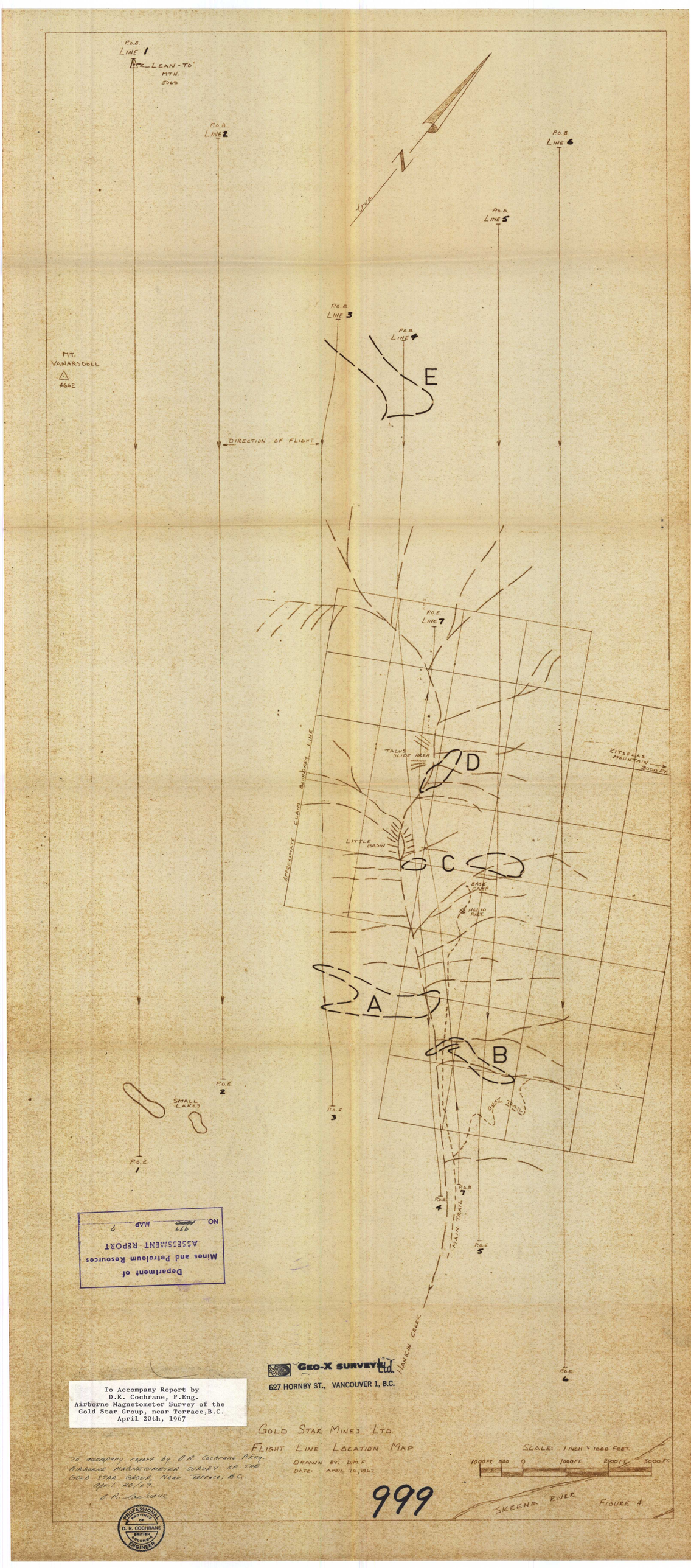
Power Supply: Vibrator converter that is operated by the aircraft battery, or portable power pack.

Sensing Head: Fluxgate element in oil dampened gimbal assembly.

APPENDIX IV

The cost per line mile includes the actual flight data, airphoto preparation, normal data processing and report preparation. Computer time and computer data processing is additional.

Total line miles: 32.49 @ $93.00/line mile	$ 3,021.57
Computer Data Processing	302.00
	$ 3,323.57



Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
MAP ?
NO. 999

GEO-X SURVEYS Ltd.
627 HORNBY ST., VANCOUVER 1, B.C.

To Accompany Report by
D.R. Cochrane, P.Eng.
Airborne Magnetometer Survey of the
Gold Star Group, near Terrace, B.C.
April 20th, 1967

GOLD STAR MINES LTD.
FLIGHT LINE LOCATION MAP
DRAWN BY: D.M.F.
DATE: APRIL 20, 1967

FIGURE 4.

To accompany report by D.R. Cochrane P.Eng.
AIRBORNE MAGNETOMETER SURVEY OF THE
GOLD STAR GROUP, Near Terrace, B.C.
April 20/67
D.R. Cochrane

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D. R. COCHRANE

999

JOB NO. A-67-1 AIRBORNE MAGNETOMETER DATA APRIL 14/67

CONTOURED FOURTH DEGREE SURFACE

PLOTTING LIMITS
MAXIMUM X = 10000.000000 MINIMUM X = .000000
MAXIMUM Y = .000000 MINIMUM Y = -30500.000000

X-SCALE IS HORIZONTAL
X-VALUE = .00 +101.0101 X (SCALE VALUE)

Y-SCALE IS VERTICAL

CONTOUR INTERVAL = 125.00
REFERENCE CONTOUR (.....) = .00

GOLD STAR MINES FOURTH DEGREE TREND SURFACE

FIGURE 6

GEO-X SURVEYS Ltd.
627 HORNBY ST., VANCOUVER 1, B.C.

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D.R. COCHRANE

999

JOB NO. A-67-1 AIRBORNE MAGNETOMETER DATA APRIL 14/67

PLOT OF ORIGINAL DATA (Z-COORDINATES)

PLOTTING LIMITS
MAXIMUM X = 7500.000000 MINIMUM X = .000000
MAXIMUM Y = .000000 MINIMUM Y = -30500.000000

X-SCALE IS HORIZONTAL
X-VALUE = .00 + 75.0000 X (SCALE VALUE)

Y-SCALE IS VERTICAL

JOB NO. A-67-1 AIRBORNE MAGNETOMETER DATA APRIL 14/67

PLOT OF ORIGINAL DATA (Z-COORDINATES)

PLOTTING LIMITS
MAXIMUM X = 10500.000000 MINIMUM X = 7500.000000
MAXIMUM Y = .000000 MINIMUM Y = -30500.000000

X-SCALE IS HORIZONTAL
X-VALUE = 7500.00 + 75.0000 X (SCALE VALUE)

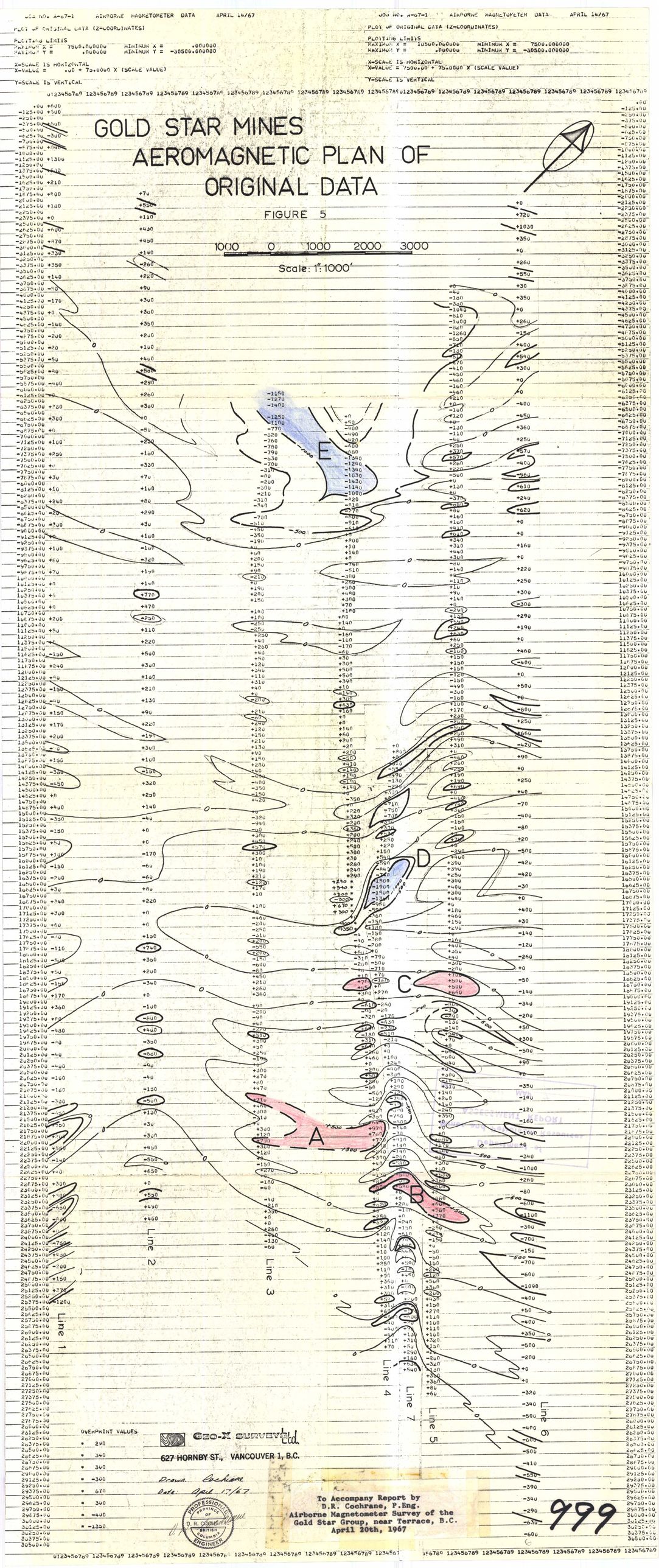
Y-SCALE IS VERTICAL

GOLD STAR MINES
AEROMAGNETIC PLAN OF ORIGINAL DATA

FIGURE 5

1000 0 1000 2000 3000

Scale: 1" = 1000'



OVERPRINT VALUES

* 290
* 340
* 300
* -300
* 670
* 300
* -490
* -1330

GEO-X SURVEYS Ltd.
627 HORNBY ST., VANCOUVER 1, B.C.

Drawn: Cochrane
Date: April 17/67

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D. R. COCHRANE

To Accompany Report by
D.R. Cochrane, P.Eng.
Airborne Magnetometer Survey of the
Gold Star Group, near Terrace, B.C.
April 20th, 1967

999

JOB NO. A-67-1 AIRBORNE MAGNETOMETER DATA APRIL 18/67

CONTOURED FOURTH DEGREE SURFACE

PLOTTING LIMITS
MAXIMUM X = 10000.000000 MINIMUM X = .000000
MAXIMUM Y = .000000 MINIMUM Y = -30500.000000

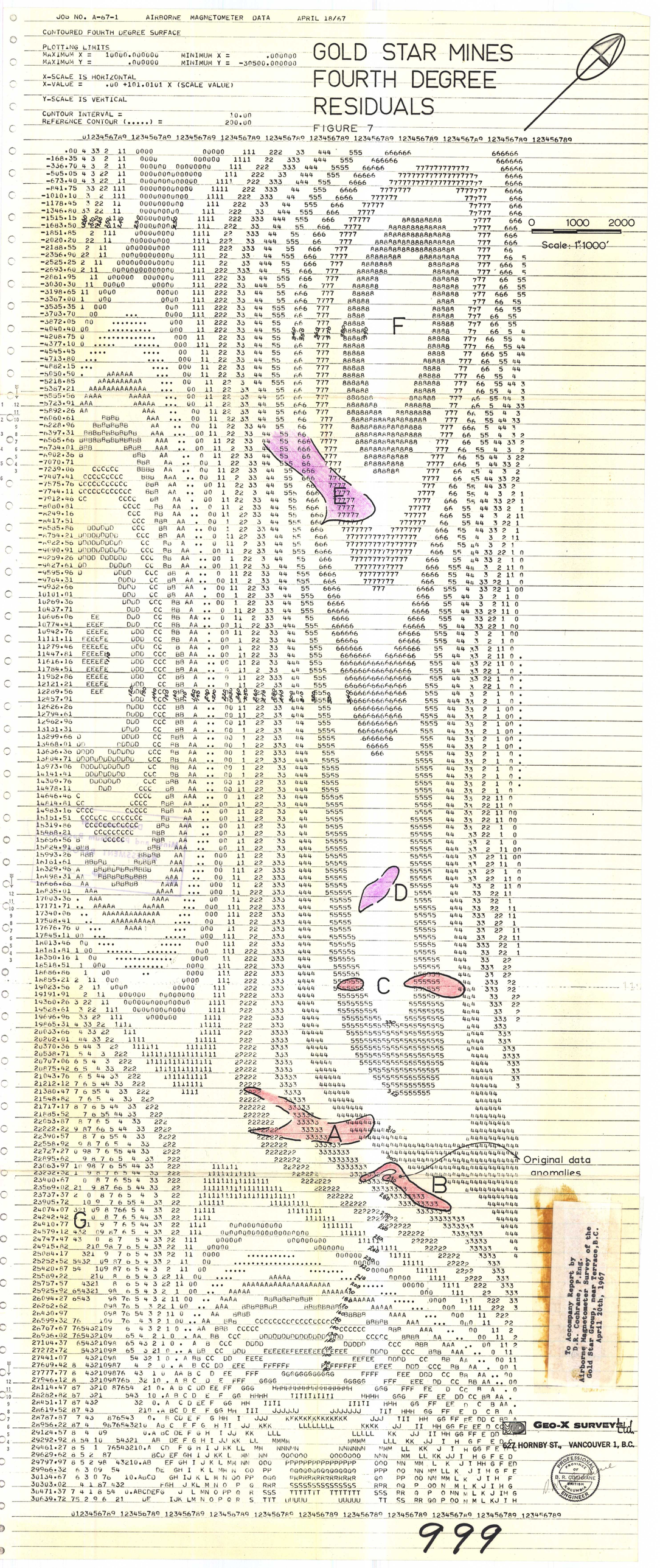
X-SCALE IS HORIZONTAL
X-VALUE = .00 +101.0101 X (SCALE VALUE)

Y-SCALE IS VERTICAL

CONTOUR INTERVAL = 10.00
REFERENCE CONTOUR (.....) = 200.00

GOLD STAR MINES
FOURTH DEGREE RESIDUALS

FIGURE 7



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