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REPORT OF AIRBORNE MAGNETOMETER SURVEY

QUEEN GROUP

By G. W. H. NORMAN, P. Eng.

For: GRANDUC MINES LIMITED (N.P.L.)

April 13 - May 3, 1960

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Figure 1. Airborne Magnetometer Survey of the Granduc
Mine Area, including the Adell, Seabee and Queen
Groups.

800 feet = 1 inch In folder

<p>Department of Mines and Petroleum Resources ASSESSMENT REPORT</p> <p>NO. <u>340</u> MAP.....</p>

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INTRODUCTION:

This report gives airborne magnetic data on and in the general vicinity of the Queen Group of claims in the Granduc mines area, Skeena Mining Division, of Northern British Columbia. Granduc mines area is 25 miles northwesterly from the town of Stewart at the head of the Portland Canal.

The survey was carried out by the Geophysical Division of Hunting Survey Corporation Ltd. Preliminary discussions regarding the operational methods and specifications regarding the equipment to be used were conducted for Granduc Mines Ltd. by Dr. A. A. Brant. Dr. Brant taught Geophysics at the University of Toronto for several years before becoming head of the Geophysical Department of Newmont Mining Corporation, which position he has held for the past 15 years. He has had wide experience in geophysical work and has supervised airborne geophysical surveys for the Newmont group in New Brunswick, Northwest Territories and in Manitoba.

Insufficient airborne geophysical work has been done in the mountains of British Columbia, particularly in

the rough type of terrain of the Coast Range, on which to base the cost per mile estimates. The project was discussed with several reputable companies and the proposals made by Hunting were accepted as being most likely to produce results. The charge for the work had to be arranged on a cost plus fixed fee basis, due to lack of data on which to base charges per line mile, which is customary in non-mountainous areas.

April was chosen as the best month to carry out the operation because it is a month which usually has more sunny clear days than other months. This desirable feature is to some extent offset by the amount of snow-covered ground present in April. Flight lines over snow-covered parts above timber line are very difficult to locate on a map and are impossible to locate in completely unfamiliar areas. In order to complete the job during the short period of fine weather the crew had to be doubled to keep the aircraft busy throughout the daylight flying hours.

LOCATION:

The accompanying map, figure 1, in folder, shows the claims of the Granduc property along and between the two arms of the Leduc glacier. It shows the claims of the Queen Group which consist of located claims:- Queen 1 to 6 inclusive, Queen 9, Queen 10, Queen 13, Queen 14, Queen 20, Queen 24, Orphan No. 1 Fraction, Orphan No. 2 Fraction, and the following Crown granted claims:-

Bent Fraction, Iola 4, Iola 6, Blend 3, Blend 4, Dal Fraction.

WORK PERFORMED:

Figure 1 shows, also, the location of the airborne magnetic lines and the variation in magnetic intensities measured in contour form. This work was done for the benefit of the Granduc Property and it is planned to submit reports and the map of the work to fulfill assessment work requirements for 22 located claims of the Granduc Property whose anniversary dates include the period in which the work was done. This report is submitted to fulfill the assessment requirements of the 12 located Queen claims of the Queen Group. The proper anniversary dates of the two Orphan Fractions do not include the period in which the airborne work was done and it is not intended that they are to be covered by this report.

The lines shown on the figure are numbered and were flown on the following days:-

April 13, 1960:	1E, 2W, 3W, 4W, 5E, 6W, 8W, 9N/W; 10N/E, 11N/E
" 14, "	12N
" 20 "	X1S
" 22 "	X2S
" 24 "	X3S
" 25 "	X4N, X5S, X6N, 53WN, 54E, 55E, 56W, 57AW, 57W
" 29 "	AE, BW, CE, DW
May 3, 1960	2AE, 1AW, 2BE, 3AW, 4AW, 5AW, 6AW, 7

The work done on April 13 and three-quarters of the work done on April 29 and on May 3 is specifically allotted for the benefit of the Queen Group.

A total of about 71 miles of flight line is shown on the map. The actual number of miles flown in this map area was considerably greater because of check work done and preliminary flight lines that were not used.

The figure shows 35 lines which were flown at an average distance of 500 feet apart in the mine area and 800 to 1,000 feet or more apart elsewhere. Due to the rather hazardous nature of some flight lines along the edges of steep cirques precisely parallel lines were not always possible.

The "bird" (instrument suspended below aircraft to measure changes in the earth's magnetic field) was flown approximately 200 feet above the ground at the end of a 100-foot cable. At times, due to sudden changes in slopes, the distance from the ground was greater.

In order to get the project started a series of trial runs were made, which are not recorded on the figure. Trial runs had to be made from time to time to check the instrument.

EQUIPMENT USED:

The aircraft selected for the airborne survey was a Hiller 12E, owned and operated by Okanagan Helicopters. This machine proved to be a very satisfactory choice because

of its power enabling a steep gradient of climb and eliminating the need for 360 degree turns at intervals to get altitude. If such turns had been required, the time and cost would have been greater and plotting of the lines would be much more difficult.

The magnetic equipment was first installed in the aircraft by Hunting personnel in Vancouver and was removed at Stewart at the close of the project. The equipment consisted of a Gulf flux gate airborne magnetometer, which weighed about 50 pounds. It was suspended by a cable 100 feet long, (reduced later to 75 feet), below the aircraft. The seat on the left side of the pilot was removed for installation of the various instruments of the control panel of the magnetometer.

The recording table for the charts was installed in front of the seat to the right of the pilot. This gave a continuous record showing the variation in intensity of the earth's magnetic field during flight. In order to locate the flight lines accurately on a map a continuous strip camera was installed on the right luggage carrier, which took a succession of downward directed exposures normal to the aircraft. The film magazines for the camera contained 500 exposures. The distance between successive exposures during flight was about 200 feet, depending on the speed of the aircraft at the time.

The self-recorder automatically registers the location of every tenth exposure on the magnetic chart with a sharp short mark across the otherwise smooth profile. These reference marks are called fiducials and can be properly cross referenced, by means of a counter above the recorder, with the respective exposures in the corresponding reels. They provide the necessary correlation between the magnetic charts and the continuous strip films, giving a record for positioning the flight line on a map.

It had been planned to install a self-recording altimeter to give the distance between the magnetometer and the ground at any required time. It was found that the aircraft was already loaded to weight capacity without this device. In addition, there was no space left in the aircraft in which to install it. The available space for the observer was very small and after two hours of flying it was unpleasantly cramped. For general flying the altimeter is probably unnecessary. Its greatest use would have been for the sides of valleys indented by large side gulleys.

PERSONNEL:

The personnel for the airborne operation were based in buildings at the Granduc Airstrip and consisted of:

Hunting Survey Corporation Ltd:

R. Bird	Electronic expert, and operator
Peter Miles	Photographer and Data Processer
E. Sawyer	Navigator

Okanagan Helicopters:

Mike McDonagh	Pilot
Bud Tillotson	Pilot
Jack Rich	Mechanic

Omineca Air Service:

Richard Schreiber Pilot (Based at Stewart)

Newmont Exploration Ltd., Danbury, Connecticut:

Dr. Arthur Brant	Part time Consultant
Dr. Burlin Johnson	Geophysical Field Supervisor

Newmont Mining Corporation of Canada Limited:

G. W. H. Norman	Geologist
K. G. Sanders	Geologist
Leopold Meindl	Helper

Cook

Dr, Brant drew up the specifications for the project and arranged the necessary contacts and details of work with the commercial geophysical firm employed. Dr. Burlin Johnson acted as geophysical supervisor on the ground. His qualifications are as follows:

B. S.	Mathematics	Cornell University
M. S.	Geophysics	New Mexico School of Mines
Ph. D.	Geophysics	University of Utah

Three years field experience with airborne magnetic data in Venezuela with an exploration group of Standard Oil of California. He has had one year with Newmont, solving magnetic and electro-magnetic problems. His duties were to interpret the magnetic charts during the operation, so that any important gaps that might be found could be closed while the equipment was available.

The Newmont staff laid out the lines in accordance with geological requirements and their prior knowledge of the ground. They were fully employed during the operation in assisting the Hunting personnel in identifying control points from continuous strip film negatives to permit identifying the flight lines on the Government air photos of the district and in plotting these lines on a map for building up the information for contouring the variations in magnetic intensity.

Omineca Air Service provided the required transportation of men and supplies between the operation and Stewart.

PERIOD OF OPERATION:

Installation of equipment was done in Vancouver by April 1st and the crew and equipment reached the Granduc mine April 8th. The first series of lines were flown over the Granduc ore body on April 13th. On April 14th the airborne magnetometer

was dropped during flight by mistake, from 300 feet elevation above ground. It landed on snow, but was damaged beyond field repair. A new unit arrived from Toronto on April 17, but work could not commence until April 20, due to weather. From April 20 to May 3 one or more flying hours were utilized every day except on the 21st, due to trouble with the electronic circuits, on 26th and 27th due to wind and on 30th due to a major magnetic storm.

During the 12 days in which flights were made the actual mileage of flight lines logged on the maps totalled 1,700, or 140 miles per day. A considerable mileage flown was over snow covered terrain. The strip photography gave no clues as to the location of such lines and, as they could not be plotted, they proved of no value. The total effective mileage was reduced therefore to 1,200 to 1,300 miles.

METHOD EMPLOYED:

The first problem to solve was the best method of locating the flight lines. It was decided to prepare plans of the areas to be flown on $\frac{1}{2}$ -mile scale showing drainage features, ice and snow boundaries and the centre and wing points of the aerial photos used on preparation of the map. Straight lines could not be flown because of the rough terrain. Contour flying was decided as the only feasible method to employ.

The lines to be flown were laid down on the plan and could be followed by the navigator of the aircraft quite well below timber line. Above timber line the ground was mostly snow-covered in April and many lines were impossible to fly as

drawn on the map. This caused some repetition of flight lines or lines which could not be located at all on the map. In the snow-covered areas there were a few places which could be recognized because of snow slides.

Directly the lines were flown, the strip film was developed. The film was then scrutinized to find exposures with recognizable features that could be also identified on the aerial photographs of the area. This proved a most laborious, time consuming job, but the identifications when made properly were 100 percent positive and served to tie down the flight lines very accurately. Most of the maps used were $\frac{1}{2}$ -mile to the inch, except near the mine, where an 800-scale map could be employed.

The air magnetometer was set first with a sensitivity of 600 gammas per full scale. The charts are 9.9 inches wide and divided into 60 divisions. Each division, therefore, had a value of 10 gammas. The extreme variations in the Granduc area as measured from the air appeared to be 3,000 gammas. The sensitivity was reduced to 1,200 gammas full scale, or 20 gammas per division. This gave less breaks in the continuity of the profiles, due to automatic datum shifts which keep the recording pen from leaving the chart.

The magnetometer charts were scrutinized in the field by Dr. Johnson, who plotted the changes in magnetic intensity numerically after each flight line had been laid down on the map. Finally, plans showing located flight lines, the magnetic charts and the daily flight records were sent to Dr. A. A. Brant's office, where the contoured magnetic maps were prepared.

RESULTS AND INTERPRETATION:

The general results of the survey in the vicinity of Granduc Mountain are shown on the accompanying figure.

Preliminary tests had shown that the Granduc ore contained magnetite and pyrrhotite and was magnetic. This was confirmed on the ground with a magnetometer during 1959, but it was believed in 1959 that the general magnetic level of the area was rather low and uniform. The airborne operation showed that the Granduc ore body could be detected from the air. But the disappointing result of the 1960 air operation was the discovery that the general magnetic level of the region was very variable. The variability is due to the presence or introduction of magnetite in very irregular amounts from place to place. It occurs in seemingly quite abnormal amounts in the fresh granite along the eastern margin of the Coast Range, in many of the dikes issuing from this mass and in many of the small associated diorite intrusives.

The airborne operation provided a multiplicity of targets for inspection on the ground and is not sufficiently selective for use as a simple prospecting tool. It requires a very careful and a costly follow-up and cannot be considered a cheap, reliable method.

January 17, 1961


.....
G. W. H. Norman

Mr. G.W.H. Norman

IS REGISTERED AS A

PROFESSIONAL ENGINEER

(P. ENG.)

and is thereby authorized to engage in the practice of the Profession of Engineering in British Columbia during the current year.

UNDER THE TERMS OF THE
ENGINEERING PROFESSION ACT
OF THE PROVINCE OF B.C.

No. 3695

ASSOCIATION OF

PROFESSIONAL ENGINEERS OF B. C.

D. J. [Signature]

REGISTRAR

1000000000

DOMINION OF CANADA:
 PROVINCE OF BRITISH COLUMBIA.
 TO WIT:

In the Matter of costs, salaries and related expenses incurred for the airborne magnetometer survey of the Granduc Mine area and Unuk River watershed, carried out during the period April 1, 1960 to May 3, 1960 for Granduc Mines Limited

GOVERNMENT AGENT
 RECEIVED
 JAN 20 1961

I, G. W. H. Norman, P. Eng.,
 of 604, 744 West Hastings Street, Vancouver 1

in the Province of British Columbia, do solemnly declare that the costs, salaries and related expenses for the magnetometer survey were as follows:

<u>Hunting Survey Corporation charges:</u>		
Air photographs, base map preparation and prints thereof	\$ 3,404.61	
Complete charge for field work and interpretation	<u>14,902.44</u>	\$18,307.05
<u>Newmont Exploration Ltd. charges:</u>		
Preliminary planning, field supervision and final interpretation - includes related expenses		8,251.68
<u>Okanagan Helicopters charges:</u>		
April 1960 - 64 hours 15 min. @ \$90/hr.	5,782.50	
May 1960 - 9 hours 35 min. @ \$108/hr.	<u>1,034.37</u>	6,816.87
<u>Quincea Air Service charges:</u>		
119 hours @ \$30/hr.		3,570.00
<u>Newmont Mining Corporation of Canada Ltd. charges:</u>		
G. W. H. Norman - Project Engineer	1,500.00	
K. G. Sanders - Geologist	750.00	
L. Meindl - Assistant	350.00	
Plus 20% re overhead and transportation, etc.	<u>520.00</u>	3,120.00
<u>Camp operation - April and May 1960:</u>		
Food for 10 men for 30 days @ \$3.00/man-day	900.00	
Cook's salary and expenses	<u>500.00</u>	<u>1,400.00</u>
Total cost of survey		<u>\$41,465.60</u>
Useful miles flown		1,250
Cost per useful mile flown: \$41,465.60 ÷ 1,250		\$33.17

And I make this solemn declaration conscientiously believing it to be true, and knowing that it is of the same force and effect as if made under oath and by virtue of the "Canada Evidence Act."

DECLARED before me at the city
 of Vancouver, in the
 Province of British Columbia, this 17th
 day of January 1961, A.D.

G. W. H. Norman

Charles J. Bennett
 Commissioner, etc.
 Deputising Recorder

In the Matter of

Costs, salaries and related expenses
incurred for the airborne magnet-
ometer survey of the Granduc Mine
Area and the Unuk River watershed
carried out during the period
April 1 to May 3, 1960 for
Granduc Mines Limited (N.P.L.)

Statutory Declaration

(CANADA EVIDENCE ACT)
