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GRAVITY SURVEYS IN THE HOPE AREA OF BRITISH COLUMBIA OVER ULTRABASIC ROCKS WITH NICKLE PYRRHOTITE ORE BODIES

JANUARY, 1970

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SUMMARY

Areas Assessed:

- Figure 1 - Hope Area - Index Map of S. W. British Columbia
- Figure 2 - Summit Area - Near a highly concentrated ore body - Pride of Emory
- Figure 3 - 3900 Elevation Area - Near an ore body of low concentration
- Figure 4 - Traverse on Mine Road - Giant Mascot Mine
- Figure 5 - Trail ore zone - Chinamens Tunnel Giant Mascot Mine
- Figure 6 - Swede Mineral Claims in the Hope area

The information presented in these gravity surveys is a check on the significant anomalies to be expected in the Hope Mining Area. The lithology includes rock types of ultrabasic composition and a Figure 1 rather high specific gravity contrast. The rocks of lowest gravity values are the diorites and the granodiorites.

Some economic ore bodies of varied character have been introduced in the surveys to show the density contrast of these bodies in reference to their host rocks. These are nickle pyrrhotite ore bodies of a one to three ore to gangue ratio. The mineralization consists of more than 70% Pyrrhotite and Pentlandite combined with small amounts of chalcopyrite mineralization.

The densities of some of the host rocks found in the Hope Area are as follows:

TABLE I

Rocks	Mean Density (c.g.s.)
1. Andesite	2.47
2. Dacite	2.51
3. Quartz diorite	2.81
4. Biotite Schist	3.15
5. Dunite	3.29

The density of the ore bodies depends on their concentration of mineral content, but in most cases would be greater than the density of the host rocks. A mean density could be postulated as 3.7 c.g.s. units for the average ore body in this district.

The areas depicted here were surveyed with a Worden gravity meter and the stations leveled with a transit and rod. All data has been corrected for diurnal variations, elevation control, Bouguer effect and terrain influence.

The variation of these gravity readings has been correlated with lithology changes to give a meaningful representation. For example, (Figure 4) shows a change in gravity on a mine road at the Giant Mascot property of 22 G.U. over a granite intrusive body. This depicts the average change in gravity value between areas occupied by ultrabasic rocks and those of dioritic character. The variation caused by the greater density of the ore bodies is a less critical change. This is clearly shown in (Figures 2, 3 and 5) over known ore occurrences on the Giant Mascot Property. These zones vary in the amount of change from 1.6 to 7 G.U. dependant on the character of the ore.

The information gained from the work done on the Giant Mascot Property was used in the interpretation of the surveys made later on the property of Kelso Exploration Limited. This property adjoins the producer and has gravity control over the Swede Claim Group, which is illustrated in (Figure 6).

GENERAL GEOLOGY

The Giant Mascot Mine is situated in a norite diorite ultrabasic complex, associated with granite, granodiorite and diorite intrussive masses. These are related to the Coast intrusives as generally depicted on the Index Map (Figure 1). These rocks generally intrude north trending regionally metamorphosed Paleozoic sediments.

The main structural feature is a northwesterly trending fault zone some ten miles due east of Hope. Subsidiary faults in the area strike both N45^{o} - 50^{o}W and N10^{o} - 30^{o}E. The northwest trending faults seem to control the presence of the peridotite intrusives, while the ore shoots seem to favor the locus of the northeasterly trending faults.

The lithology and mineralization of this area consists of the following ultrabasic feldspathic and metamorphic rocks with included mineralization:

TABLE II

Ultra Basic Rocks	Density
Peridotite	3.29
Pyroxenite	3.23
Hornblendite	3.23

Feldspathic Rocks	Density
Norite	2.98
Diorite	2.84
Metamorphic Rocks	**Density**
Schist	3.15
Hornfels	2.83
Quartzite	2.65
Mineralization (ore to gangue 1:3)	
45% Pyrrhotite	4.7
25% Pentlandite	4.6
10% Violorite	4.6
10% Pyrite	5.0
5% Chalcopyrite	5.0

The mineralization should give an overall average density of 3.66 c.g.s. units. A more disseminated ore would have a density range between 3.3 and 3.7 c.g.s. units.

A mineralogical study of the ore bearing bodies shows them to be ultrabasic masses high in sulphur content and intruded as a crystalline complex with a relatively high nickle sulphide mineralization. This silicate sulphide magmatic complex could have been formed by differentiation and relocation at depth. The higher grade ore might have been filter pressed and injected interstitially into the rock mineralization by later structural movements. At the same time the whole complex could have been moved while the minerals were in a semi consolidated condition.

ELEVATION CONTROL

An exact definition of the elevation of the gravity stations is necessary in order to correct the readings to an elevation datum. In order to make a minimum correction the lowest elevation for each individual area is used as a control datum. The elevations have been surveyed with a mean error of 0.1 feet and have been checked with a regional elevation control map. The elevations in this area vary from less than 2000 feet a.s.l. to over 4000 feet.

In order to keep the terrain correction to a minimum all gravity stations have been selected with the greatest of care to avoid sudden declevities, in the vicinity of the station point. This includes any voids, or ridges that are less than 50 feet from the station point. It is observed that in most cases mean terrain error is not greater than 0.215 gravity units per foot of elevation. Since the survey lines are relatively short it was found that more distant terrain corrections were not necessary.

SURVEY AND CALCULATIONS

The survey was made using a Worden gravity meter with a sensitivity of 0.5 gravity units. The scale constant of this instrument was very near unity and under ordinary use temperature variation is automatically compensated for. In order to avoid diurnal errors frequent readings were made at base stations with the time of reading.

Using the elevations from the level control the uncorrected gravity readings have been corrected using the combined elevation and Bouguer correction factor. The values used corresponded to the mean density of the host rocks in this area which was 2.8 c.g.s. units. The use of this factor eliminates the influence of changes in elevation from the center of the earth and also prevents the plates of material of the density given from influencing individual station values. In some cases it was also necessary to make terrain corrections to individual stations to eliminate the effect of nearby ridges or canyons.

Because of the experience and exemplary performance of the field personnel, many errors were avoided in these surveys, which otherwise might have been made. Therefore, the quality of a Gravity survey is reflected from performance much more than in magnetic or electromagnetic surveys. For this reason the instrument work should be done by well qualified surveyers or technicians rather than the usual survey crews employed for general geophysical work.

SUMMIT AREA

Figure 2

This profile shows an elevation and Bouguer chart oriented east and west. The elevation rises from 4200 feet a.s.l. to more than 4300 feet. The Bouguer values rise from near datum level to about 7 gravity units above datum and then drop suddenly to datum level again. In this case the lower level readings over the granite intrusive have been left out. The main rise in the Bouguer value is attributed to the presence of an ore body in this vicinity.

3900 FOOT ELEVATION AREA

Figure 3

This profile indicates an elevation change from less than 3870 feet a.s.l. to 3830 feet. At the same location the Bouguer chart shows a gradient, which is attributed to a lithologic change and is noted in this case with a broken line. A smoothed residual chart, however, shows a definite anomalous situation with a total rise of 1.6 gravity units above datum. This is coincident with the presence of a low grade ore body at this location.

MINE ROAD AREA

Figure 4

This area has an elevation change from 3000 feet a.s.l. to 3100 feet. There is a negative change on the Bouguer chart of 22 gravity units below datum. This is attributed in this case to a deep rooted granite intrusive whose difference in mass density gives a lower gravity value than that found over the ultrabasic host rocks. There is no known ore body covered in this area, and the survey was made to illustrate lithologic changes only.

TRAIL ORE BODY

Figure 5

The ore body is found underground at the 3550 foot level in Chinamens Tunnel on the Giant Mascot Property. The Bouguer chart shows a rise in gravity value to 7 gravity units above datum. This indicates a body of the same mass density as that depicted in the Summit Area (Fig. 2), and is again in contrast to an ultrabasic intrusive pyroxenite.

SWEDE CLAIMS 5 and 6

Figure 6

The Swede Claim Group comprises an area of preliminary control, which is in the process of being drilled for further assessment. It is believed to have the same lithology as that found at the Giant Mascot Mine.

The northwest to southeast profile shown in Figure 6 is oriented across the general structural strike of the postulated intrusive bodies. The elevation change for this area is very gradual and is at a lower elevation than the previously described sections.

The Bouguer chart shows a greater change from the mean minimum value to datum of 70 gravity units. This might be attributed to a very deep rooted intrusive such as would be expected when dealing with pipe-like structures.

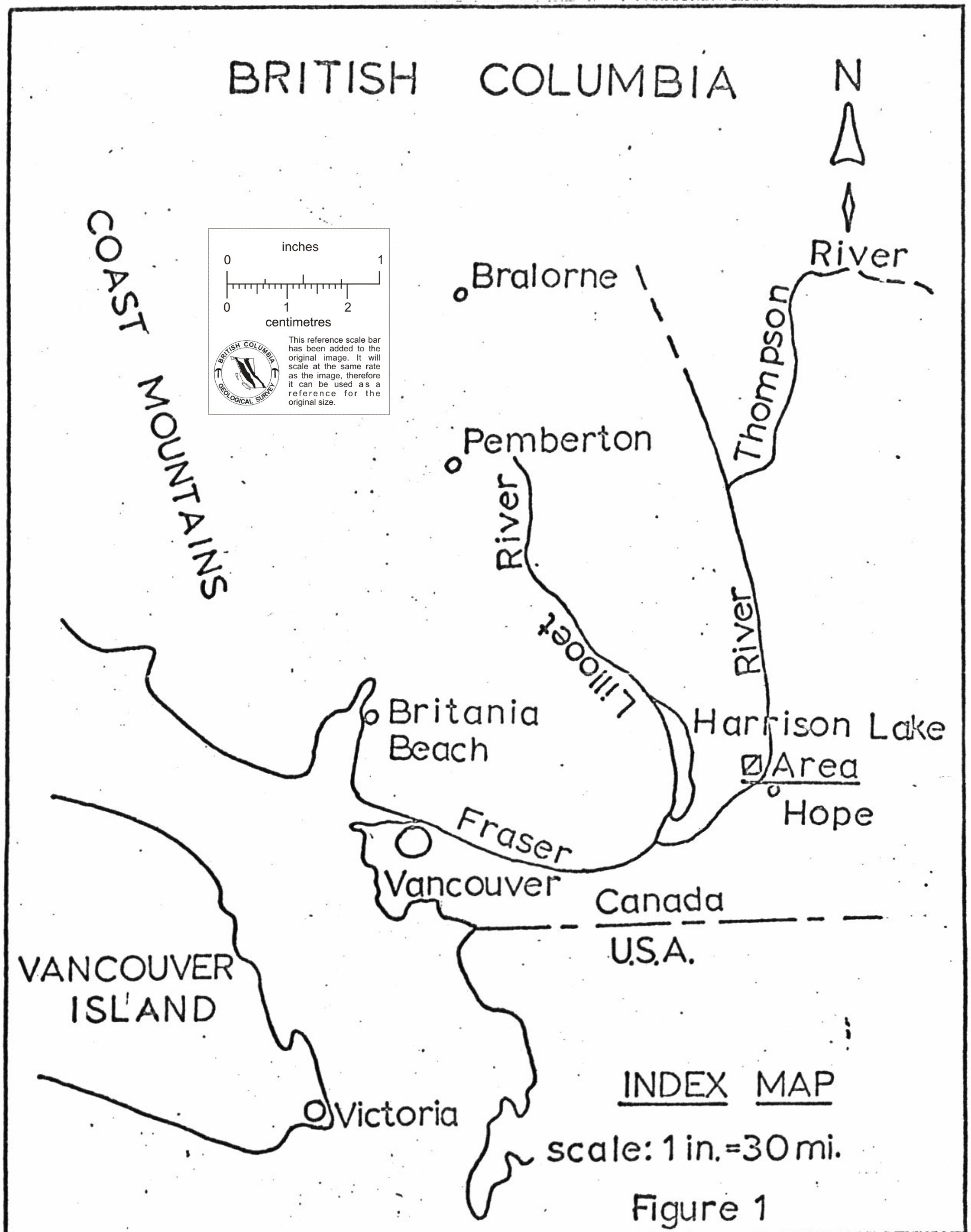
The dashed curve depicts the root mean square of the Bouguer curve. It makes a maximum residual value of 15 gravity units above datum near the inflexion point to the right of the minimum on the Bouguer curve.

The boundary of this residual area from inspection of the general gravity control in this region shows an irregular area 0.2 kilo-feet by 0.16 kilo-feet. The supposition that the density difference is at least 0.5 c.g.s. units with a gravity residual value of 1.5 milligal indicates that the thickness dimension could be 1.5 kilo-feet. Thus by using a factor of 10 cubic feet to the ton, the residual tonnage involved would be approximately 4800 kilo-tons. If further evaluation by diamond drilling indicates that this residual body is an economic ore body with nickle pyrrhotite content as found at Giant Mascot Mines, this could represent a very interesting mining problem solved by the use of preliminary gravity control.

ACKNOWLEDGEMENTS

The writer wishes to thank Kelso Exploration Limited for permission to publish this report. The survey work was carried out by their own personnel under the supervision of Mr. Pat Connell. The engineering work was accomplished by Mr. Jeff Sluggett who did the instrument work and tied in the elevation control in the areas surveyed.

The areas chosen on Giant Mascot Property were also surveyed by the same crew under the direction of Mr. F. W. Holland, Resident Manager at this property. These have only been used to coordinate the survey work for Kelso Exploration Limited. The information for the General Geology was obtained from a report on Giant Mascot Mines Ltd., by Walter E. Clarke, Western Miner, June, 1969.


BRITISH COLUMBIA
N
COAST MOUNTAINS
inches
0
1
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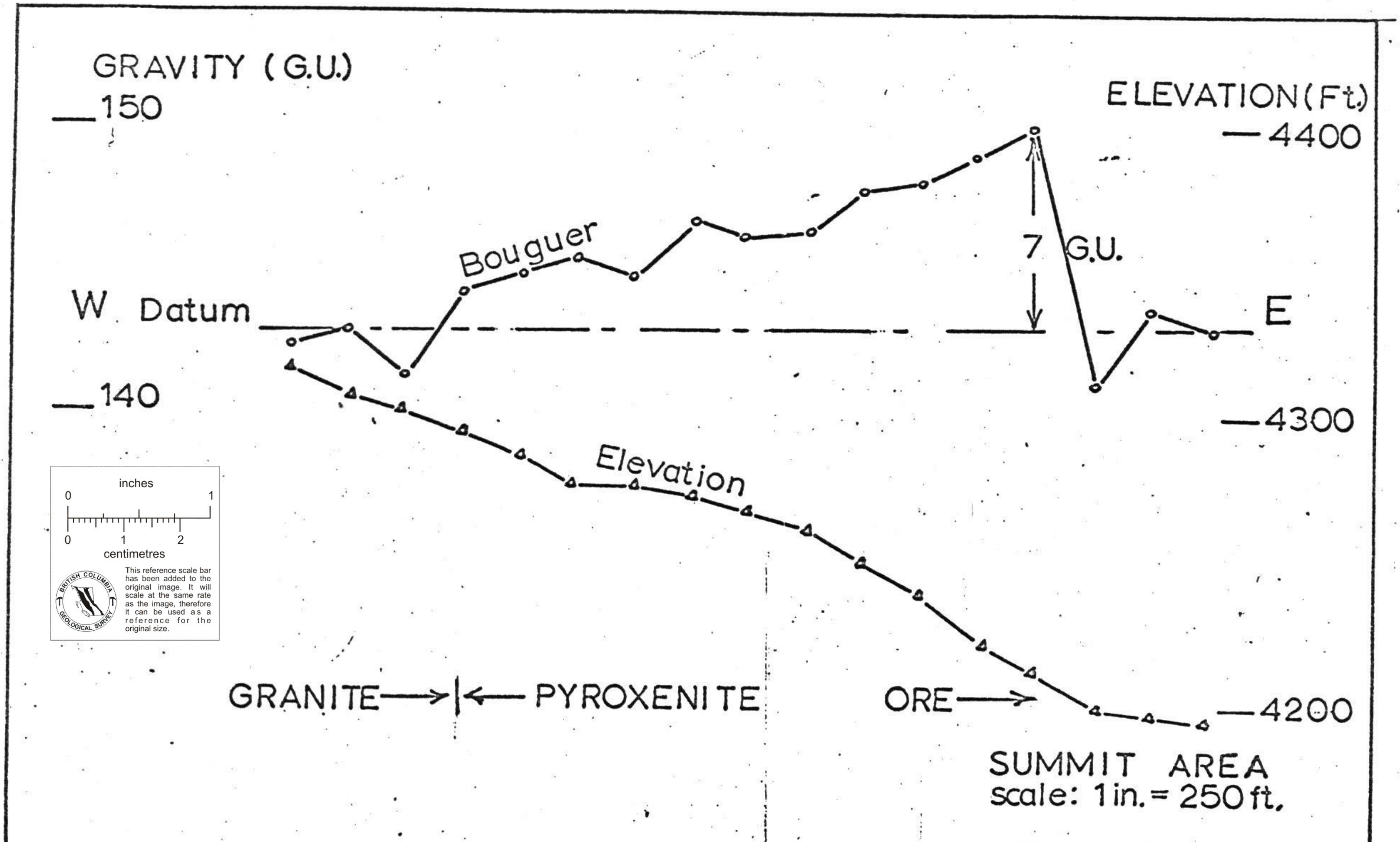
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
BRITISH COLUMBIA GEOLOGICAL SURVEY
Bralorne
Thompson
River
Pemberton
Lillooet
River
River
Britania
Beach
Harrison Lake
Area
Hope
Fraser
Vancouver
Canada
U.S.A.
VANCOUVER
ISLAND
INDEX MAP
scale: 1 in.=30 mi.
Victoria

Figure 1



GRAVITY (G.U.)
150
140
ELEVATION (Ft.)
4400
4300
4200
Bouguer
7 G.U.
W Datum
E
Elevation
inches
0
1
0
1
2
centimetres
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BRITISH COLUMBIA GEOLOGICAL SURVEY
GRANITE
PYROXENITE
ORE
SUMMIT AREA
scale: 1 in. = 250 ft.

Figure 2

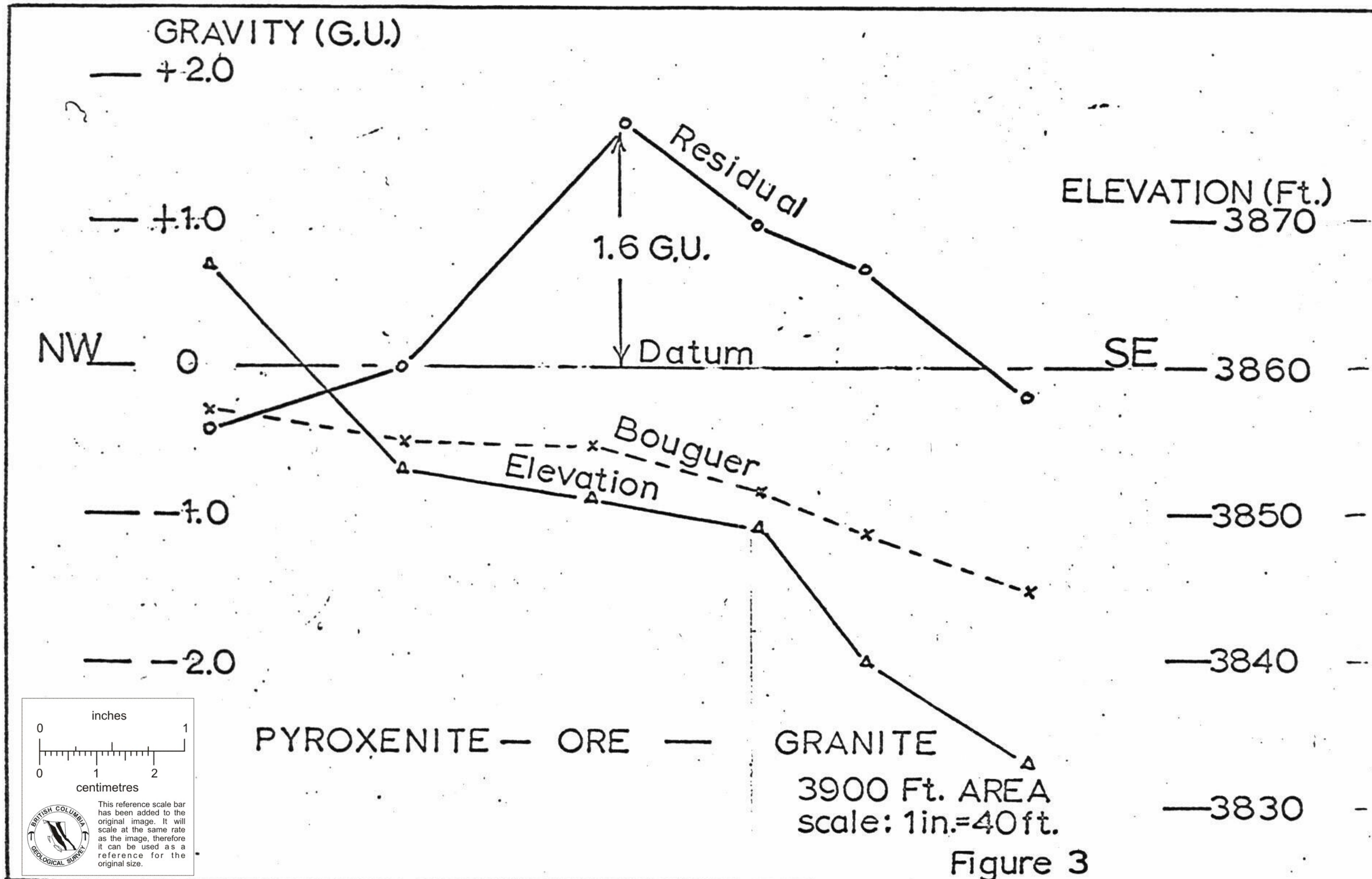
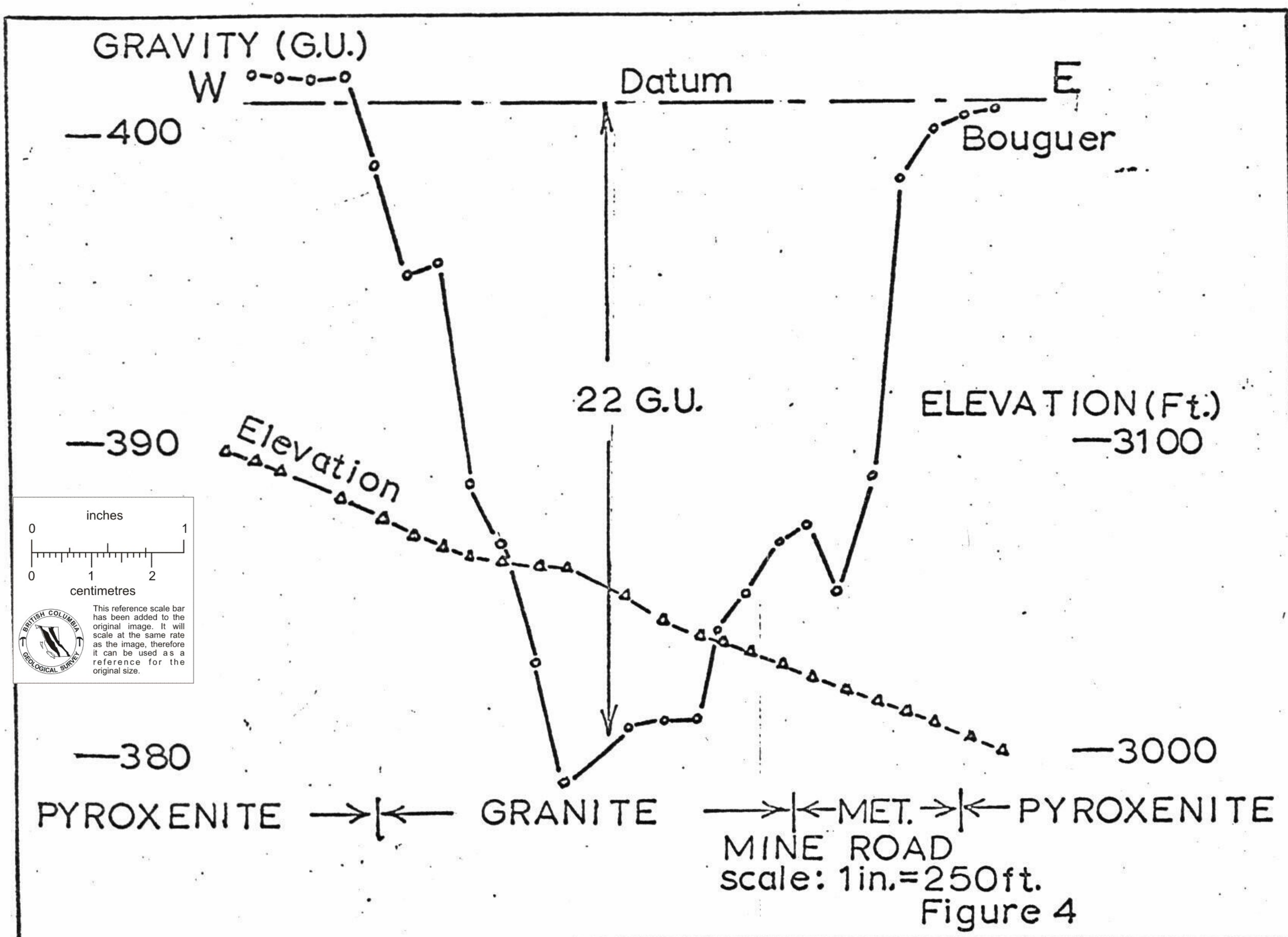

GRAVITY (G.U.)
+2.0
+1.0
0
-1.0
-2.0
NW
SE
Residual
1.6 G.U.
Datum
Bouguer
Elevation
ELEVATION (Ft.)
3870
3860
3850
3840
3830
PYROXENITE — ORE — GRANITE
3900 Ft. AREA
scale: 1in.=40ft.
inches
0
1
0
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

Figure 3



GRAVITY (G.U.)
W
Datum
E
Bouguer
—400
—390
—380
22 G.U.
Elevation
ELEVATION (Ft.)
—3100
—3000
PYROXENITE →|← GRANITE →|←MET.→|← PYROXENITE
MINE ROAD
scale: 1in.=250ft.
inches
centimetres
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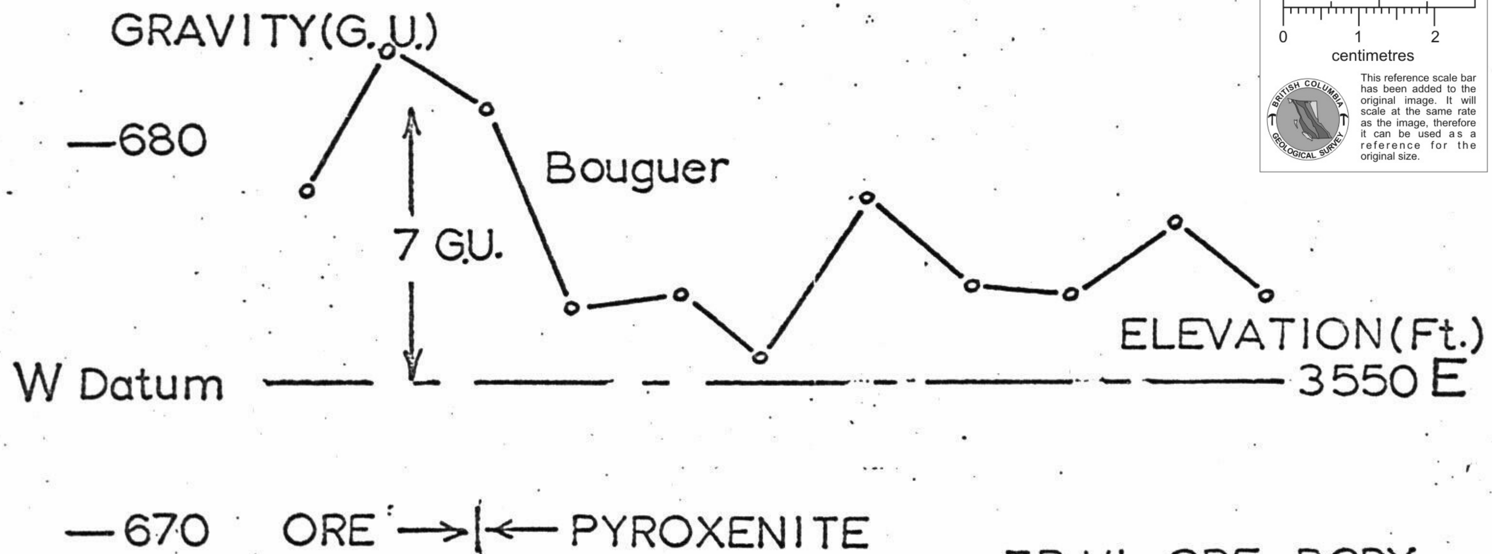
BRITISH COLUMBIA GEOLOGICAL SURVEY

Figure 4



TRAIL ORE BODY
scale: 1in. = 250 ft.

Figure 5

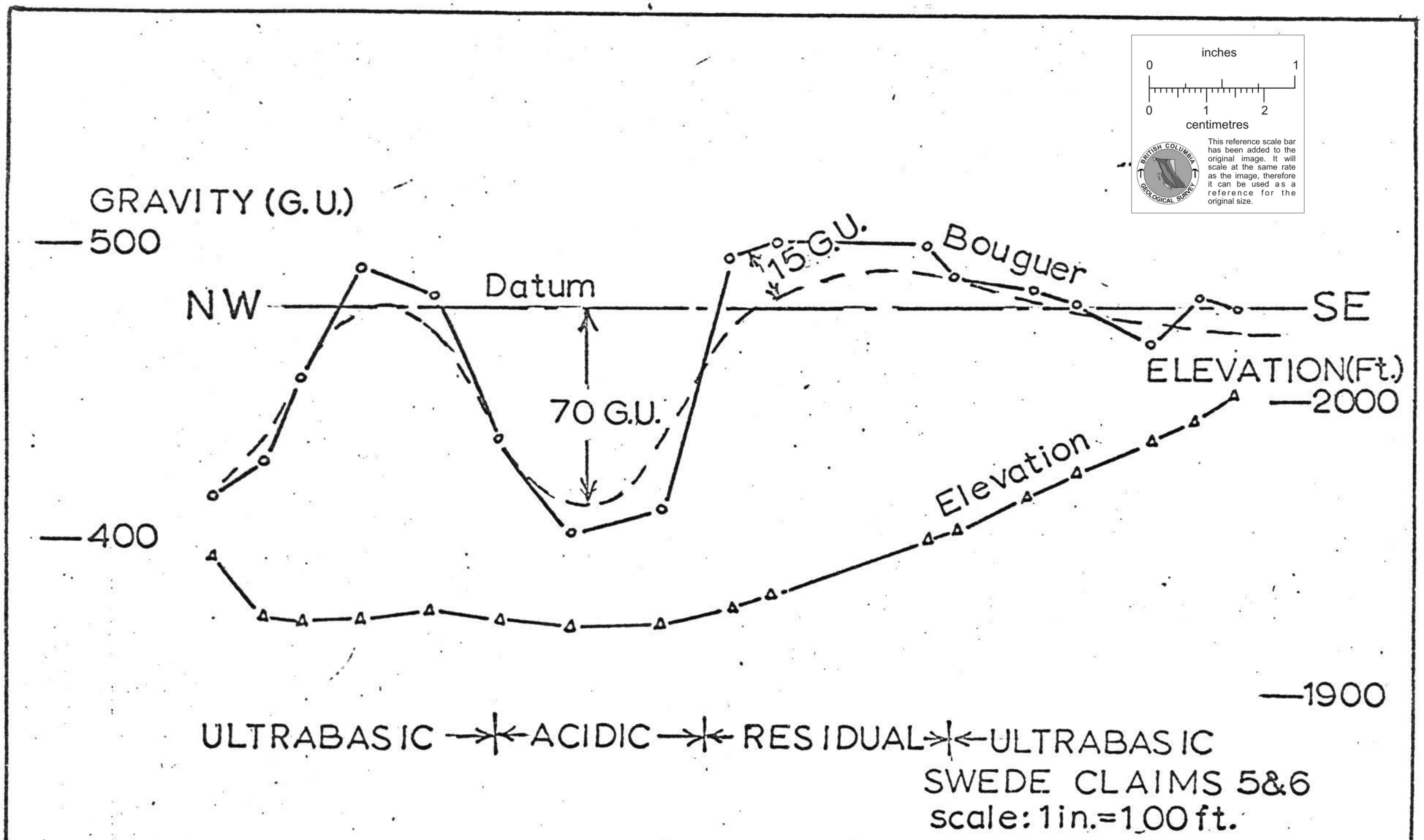

inches
0
1
0
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
BRITISH COLUMBIA
GEOLOGICAL SURVEY
GRAVITY (G.U.)
500
400
NW
SE
Datum
Bouguer
15 G.U.
70 G.U.
ELEVATION(Ft.)
2000
1900
Elevation
ULTRABASIC
ACIDIC
RESIDUAL
ULTRABASIC
SWEDE CLAIMS 5&6
scale: 1in.=100ft.

Figure 6