MR 114-7

# REPORT OF GEOPHYSICAL INVESTIGATION

# LUCKY DEVIL MINING CLAIMS

# CHICHAGOF ISLAND, ALASKA

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## INTRODUCTION

A reconnaissance geophysical investigation has been completed on the Lucky Devil mining claims, which are located on the west coast of Chichagof Island, Alaska, approximately 55 miles northwest of Sitka in the vicinity of Mt. Baker and Goulding Harbor. The location of the site is shown on Figure 1, Location Map.

The geophysical field explorations consisted of magnetic and self-potential ground surveys and were conducted between August 8 and August 22, 1962. The explorations were confined mainly to the region lying within the limits of the Lucky Devil claims, which extend southeasterly, from the summit of Mt. Baker to the head of Goulding Harbor.

Prior to the geophysical investigation, test pits and minor underground development had exposed the Lucky Devil lead on the northwest slope of Mt. Baker between approximate elevations 1500 and 1700 feet. Two other leads had been tested and mapped as converging on the Lucky Devil lead. These leads were designated the Angle Boy and Baker Peak leads; their approximate locations are shown on Figure 3, Exploration Plan. The claims had been examined, and the structural geology mapped, by a Mr. Dan Ryason. Representatives of the Bureau of Mines in Juneau, Alaska had also examined the property. As a result of the examinations, the projection of the Lucky Devil lead in a southeasterly direction, from the summit of Mt. Baker to the coast, had been predicted. Heavy vegetation and overburden cover, however, had prevented a visual tracing of the lead along the southern slopes of Mt. Baker.

Tracing the major lead (or the structure associated with the lead), from its position of comparitive inaccessibility on the peak, to a position at a lower level, was considered to be the major goal of this geophysical investigation.

The investigation was conducted, therefore, to follow the main structure down toward the coast to an elevation of 200 feet or less.

The magnetic method was selected as the fastest, most accurate method for tracing out the Lucky Devil structure. The instrument used for the magnetic field work was an Elsec Proton Magnetometer, Type 592, designed to measure the total magnetic field to an accuracy of ± 0.5 gamma. Self-potential measurements were also taken at various locations to provide supplementary information to the magnetic data. Self-potential measurements are made with a null-type potentiometer and copper-copper sulfate, non-polarizing electrodes which measure, at ground surface, electric potentials resulting from electrochemical interaction of minerals and solutions; these potentials may be as high as 1000 millivolts in the case of a strong anomaly.

PRELIMINARY TESTING

In order to establish a valid average value for the regional magnetic intensity over the country rock bordering the mineralized zone, 37 magnetic test stations were first occupied, at random locations, in the areas adjacent to the exposed leads. The average background count for the country rock was found to be 57,042 gammas, with a maximum-minimum count of 57,141 and 56,885 gammas, respectively.

Magnetic tests were then conducted across the exposed veins, and it was found that, while the veins were not especially magnetic, a magnetic anomaly was associated with the structure containing the veins (see Figures 5 and 6, Magnetic Test Profiles).

Self-potential (SP) tests were then made along the same traverses as the magnetic tests. The SP tests indicated that oxidation of the Angle Boy and Lucky Devil leads was occurring, and that an electric field, resulting from the oxidation, could be measured on the ground surface. A maximum potential variation of 100 millivolts was detected, resulting in an anomalous potential zone which was bounded on either side by the Angle Boy and Lucky Devil leads (see Figure 15, Stations 3+00 to 6+00). An SP test, taken across the Baker Peak lead was less conclusive, although a potential anomaly of about 50 millivolts was measured at Pit #2. The smaller potential, and the more limited horizontal size of this anomaly, may reflect a lesser volume of mineralization at the Baker Peak lead, as compared with the Angle Boy-Lucky Devil zone.

RESULTS

The method used to trace the extension of the Lucky Devil shear structure consisted of a series of magnetic traverses, spaced at various distances away from the known mineralization and oriented approximately at right angles to the strike of the structure. The locations of these traverses are shown on Figure 3, Magnetic and Self-Potential Exploration Plan. The individual traverses are given on Figures 7 through 13, Magnetic Profiles, on which are plotted the intensity of the total magnetic fields, the stationing and the bearings of the traverses.

The trend and width of the magnetic anomalies, as interpolated between adjacent traverses, are illustrated on Figure 4, Magnetic Anomaly Map. Those magnetic profiles, that we consider to best illustrate the trend, are also superimposed upon the map. A major anomaly extends from the test pits, along a strike of S40$^{\circ}$E, for a horizontal distance of about 3000 feet to elevation 900 $\pm$ feet. From this point there is a change in strike to about S12$^{\circ}$E, and the anomaly then continues along this latter bearing to elevation 200 feet, or lower. From the test pits to the strike change at elevation 900 feet, the anomaly is a broad, single zone averaging about 300 feet in width. At the strike change, the anomaly splits into four or more narrower, nearly parallel anomalies.

The broad, single anomaly parallels the strike of the primary, regional structures, shown on Figure 2, Regional Geology Map; the splits follow the strike of the secondary structural trends. Based upon the general shape, alignment, and trends of the magnetic anomalies, it is our opinion that these anomalies represent a southeasterly continuation of the shear zone associated with the Lucky Devil lead. The shear apparently extends as a broad, single zone to the strike change locality, where a structural disturbance has caused the warping and resultant tension fracturing as reflected by the strike change and anomaly splits.

The varying width of the anomalies probably reflects the influence of several geologic factors, such as the presence of magnetic minerals, the width of the shear zone, and the depth of the magnetic body. Magnetite may often occur as a "halo" around a sulfide deposit, or shear zone, thereby masking the true size of the zone. The shear zones may produce high magnetic intensities, even though highly magnetized minerals may not be concentrated in the zones. This would explain certain magnetic anomalies, found along some of the traverses, that contained little surface evidence of magnetite.

The results of the self-potential measurements are shown on Figures 16 through 19, Self-Potential Profiles. SP traverses were taken along portions of two magnetic traverses (LD-6 and LD-10) containing magnetic highs. In addition, a series of SP traverses were made in the vicinity of an isolated knoll located at a lower elevation near the head of Goulding Harbor (see Figure 3, Exploration Map; Figures 17, 18, 19, Self-Potential Profiles).

Traverse LDS-1, Figure 16, was conducted to provide additional information regarding the high magnetic anomaly occuring on LD-6, between stations 3+50 and 5+00. A maximum potential gradient of about 40 millivolts was detected at the same location as the magnetic high, suggesting an association of sulfide and magnetic mineralization along this zone.

Traverse LDS-2, Figure 16, covered a portion of magnetic profile LD-10, between Stations 6+00 and 12+00, which contained a high magnetic anomaly (see Figure 13). A comparison of the SP profile (LDS-2) with the magnetic profile (LD-10) reveals a similarity in the shape of the two profiles, with the SP profile showing a maximum variation of about 40 millivolts. Hear again, it is apparent that sulfide-magnetic mineralization may occur in the same zone, assuming, of course, that the SP potentials are caused primarily by the oxidation of sulfides.

It should be noted that, in the two cases described above, the maximum SP variations were about 40 millivolts, whereas those recorded at the test pit sites were 100 millivolts. While the difference in potentials are pronounced, the lower potentials may not necessarily signify a smaller volume of sulfides;

other conditions, such as the relationship of the groundwater level to an ore body, may greatly influence the oxidation of sulfide minerals. Sulfides may be present at LDS-1 and 2, but may not be oxidizing as rapidly as they apparently are at the test sites.

SP traverses LDS-3, 4, and 5 were conducted to furnish additional information about the mineralization in the area near the head of Goulding Harbor. An unfortunate accident had incapacitated the magnetometer during the final few days of the investigation; the above SP traverses would have been conducted by magnetometer, had this instrument been available. Numerous anomalies were detected in the area, some which may be correlated with the magnetic splits that approach the area from higher elevations. However, insufficient data is available to the significance of the SP data in detail, other than to state that the area exhibits a great variety of electrical ground potentials which may be primarily caused by sulfide mineralization, but which may also be caused by other geological and structural conditions, such as formational contacts, fault zones filled with wet clay gouges, etc.

## CONCLUSIONS

Based on our interpretation of the geophysical investigation, the following conclusions are presented:

(1) A magnetic anomaly (a zone of significantly high magnetic intensity) is apparently associated with the structure containing the Lucky Devil lead.

(2) The extension of the structure, from the point of testing on exposures of ore to elevation 200, or lower, was accomplished by projection of the magnetic anomalies between adjacent magnetic traverses.

(3) Based upon the shape and trend of the anomalies, the Lucky Devil structure probably extends from the summit of Mt. Baker along a bearing of S40$^{\circ}$E for a horizontal distance of about 3000 feet in the form of a single, broad zone displaying high magnetic intensity.

(4) Beyond this point, the structure apparently splits into several narrower zones and changes bearing to S12$^{O}$E downslope to elevation 200 feet or lower.

(5) The relationship between the magnetic anomalies and the sulfide mineralization is, as yet, not known; however, the SP results suggest that the sulfide and magnetic minerals may be intimately associated in the zones of magnetic highs. Further exploration will be necessary to confirm this possibility.

GEOLOGY

The regional geology has been described in several published Geological Survey Bulletins. The local geology has been detailed, in part, by these bulletins and by the report of Mr. Ryason. The areal geology will be discussed primarily with regard to the interpretation of the results of the geophysical investigation.

The Lucky Devil claims lie in a region of highly metamorphosed Mesozoic and Paleozoic rocks. In the vicinity of Mt. Baker, the major rock types are, in order of decreasing age: schist, limestone and greenstone (Figure 2, Regional Geology Map). The schist occurs only in the extreme southwestern corner of the area of investigation. The limestone occurs as a narrow belt, approximately 500 feet wide. In the northwest portion of the area, it can be easily traced but, at lower elevation to the southeast, heavy overburden masks its outcrops.

Greenstone is the dominant rock in the area of investigation; it contains all exposures of the leads and the magnetic anomalies. It is derived from basaltic flows and sediments and contains predominantly ferromagnesian minerals of primary and secondary origin. Local units, such as massive amphibolite, banded amphibolite, amygdaloidal greenstone and schistose greenstone, are found within the greenstone. The mineralogical variance between the several units may be related to some of the minor magnetic anomalies which were found during the magnetic investigation.

The minerals of greatest interest for the investigation were magnetite, pyrite and hornblende for their magnetic susceptibility, and for their association with chalcopyrite. Magnetite is a common accessory mineral in basaltic rocks, and is finely disseminated in varying degrees throughout the greenstone. It also occurs as thin films and smears along the joint planes and shear zones, becoming sufficiently concentrated, at certain localities, to produce very high magnetic intensities. Pyrite is the main sulfide found in the leads and also occurs as smears along joint planes, as thin, discontinuous bands roughly paralleling joints and shears, as erratic segregations in the shear zones, and as disseminations throughout the greenstone. Chalcopyrite, which invariably occurs with, or near, pyrite, is confined generally to the area of the major magnetic intensities. It is slightly disseminated throughout the greenstone near the sides of the anomalous zone, and occurs as segregated masses in the more, highly-sheared center. Malachite is exposed in the test pits on the Lucky Devil lead and is also encountered in the slide area near the peak of Mt. Baker, together with azurite.

The general structural trend is to the northwest. Numerous strong, continuous faults traverse the region, influencing the topography in some areas, and being masked by overburden in others. The faults, or shears, are steeply dipping, generally to the southwest, although subject to local change and are fairly linear with minor variations in strike. Numerous splits diverge from the faults, in many cases forming structures of equal magnitude to the main structure. Throughout southeastern Alaska the junctions of splits with the faults, as well as the above mentioned warped area, are considered favorable loci for ore deposition.

A northeast-trending, or cross-faulting, secondary system of faulting has developed locally. Though of considerably smaller magnitude than those of the primary system, the cross faults may cause noticeable offsetting of formations and possible offsetting of veins.

A highly-developed, complex joint system obscures much of the fault structure, particularly in the greenstone. Weathering of the joints produces large blocks, causing numerous rock falls and slides on the steeper slopes.

FIELD OPERATIONS

The field work was accomplished by a four-man crew which was flown to the site by plane and helicopter. Most of the supplies and equipment were transported to the summit of Mt. Baker by helicopter, where the field operations began.

The first few days in the field were confined to testing the magnetic and self-potential methods in the vicinity of the test pits. The remainder of the field time was devoted to geophysical explorations along the southern slope of Mt. Baker, and to moving camping equipment and supplies to various campsites, concurrent with the geophysical work.

A total of 13,150 feet of magnetic traverse was completed, consisting of 193 individual recordings, most of them spaced 100 feet apart. A total of 7450 feet of SP traverse was also completed.

Magnetic measurements were taken with a portable proton magnetometer, which includes a sensing head and a recording instrument. In normal field operations the sensing head is carried by a field assistant, who places the head on the station to be recorded. The instrument operator usually occupies the station previously occupied by the sensing head. The instrument and recording head were interconnected with a 100 foot cable which was used to establish the distance between stations.

The readings, which are taken in a few seconds, are usually repeated two or three times to assure that the correct data is being recorded. The two operators then advance for a distance of 100 feet along the traverse, and repeat the procedure. Where anomalous readings are detected, readings are taken at shorter intervals, in order to delineate the exact shape of the anomaly.

The self-potential measurements were made by recording the potential drop between two porous pots placed 50 feet apart. Two slightly different procedures were employed; in one method progress along the profile was made by "leap-frogging" one electrode past the other, whereas in the other case both electrodes were moved forward simultaneously. In each case a new electrode station is always referred electrically to a previously measured station.

The potential curves, plotted in this report, represent the potential of any station compared to any other station on the same profile. No absolute values of potential are given in this report because any reference potential is only an arbitrary one and it is the differences in potential which are significant.

SURVEYING

Most of the traverses were located in the field in the following manner by a variation of the resection method:

> A point was determined on a geophysical traverse in the field where certain known topographic features were visible, such as shoreline configurations of nearby lakes that could be located on the field map. Three such points were selected, as widely spaced as possible, and magnetic compass bearings were taken from the field point to these selected points. The compass declination was set at $30^{\circ}$ east of north.
>
> The compass bearings, when plotted on a map, usually formed a small triangle and the center of the triangle was designated as the field point. In our opinion, the field points surveyed in this manner are within 100 feet, or less, of their actual locations. Because of the rough terrain, and heavy vegetation, performing standard compass and tape surveys between the traverses was considered to be too difficult and time consuming for a reconnaissance investigation of this type, and would probably not have been more accurate.

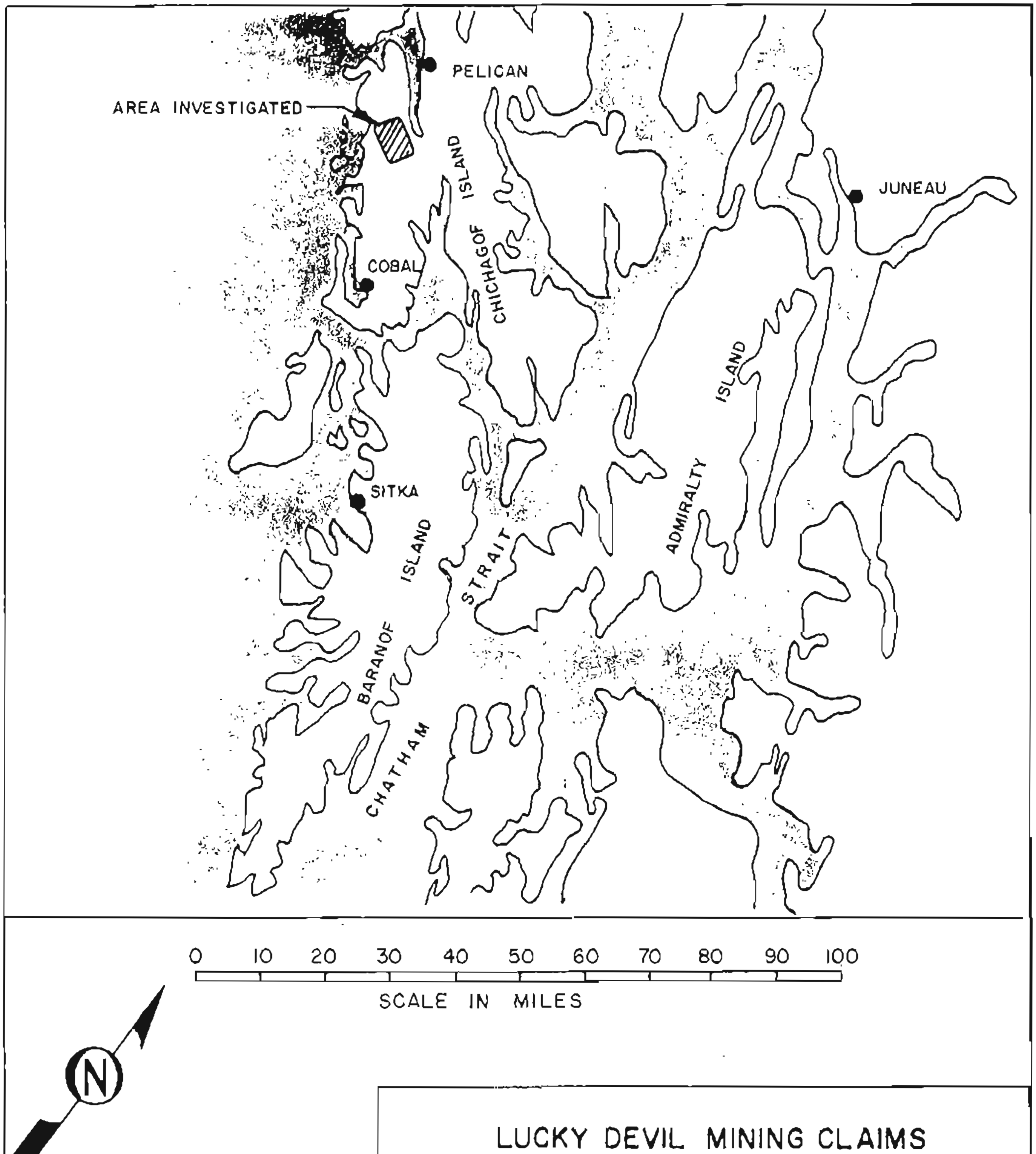
Bearings along each magnetic and SP traverse were established by compass during the course of the geophysical explorations. In the case of the magnetic traverses, the 100-foot connecting cable between the sensing head and the instrument box was used as a surveying chain. For the SP traverses, the distance between the pots was measured at 50 feet for each reading.

Although only slope distances were measured, the variation between the slope and horizontal distances is slight because the traverses roughly followed contours, in most cases.

GEO - RECON, INC.

By Boyd O. Bush
BOYD O. BUSH

By Robert F. Kenly
ROBERT F. KENLY

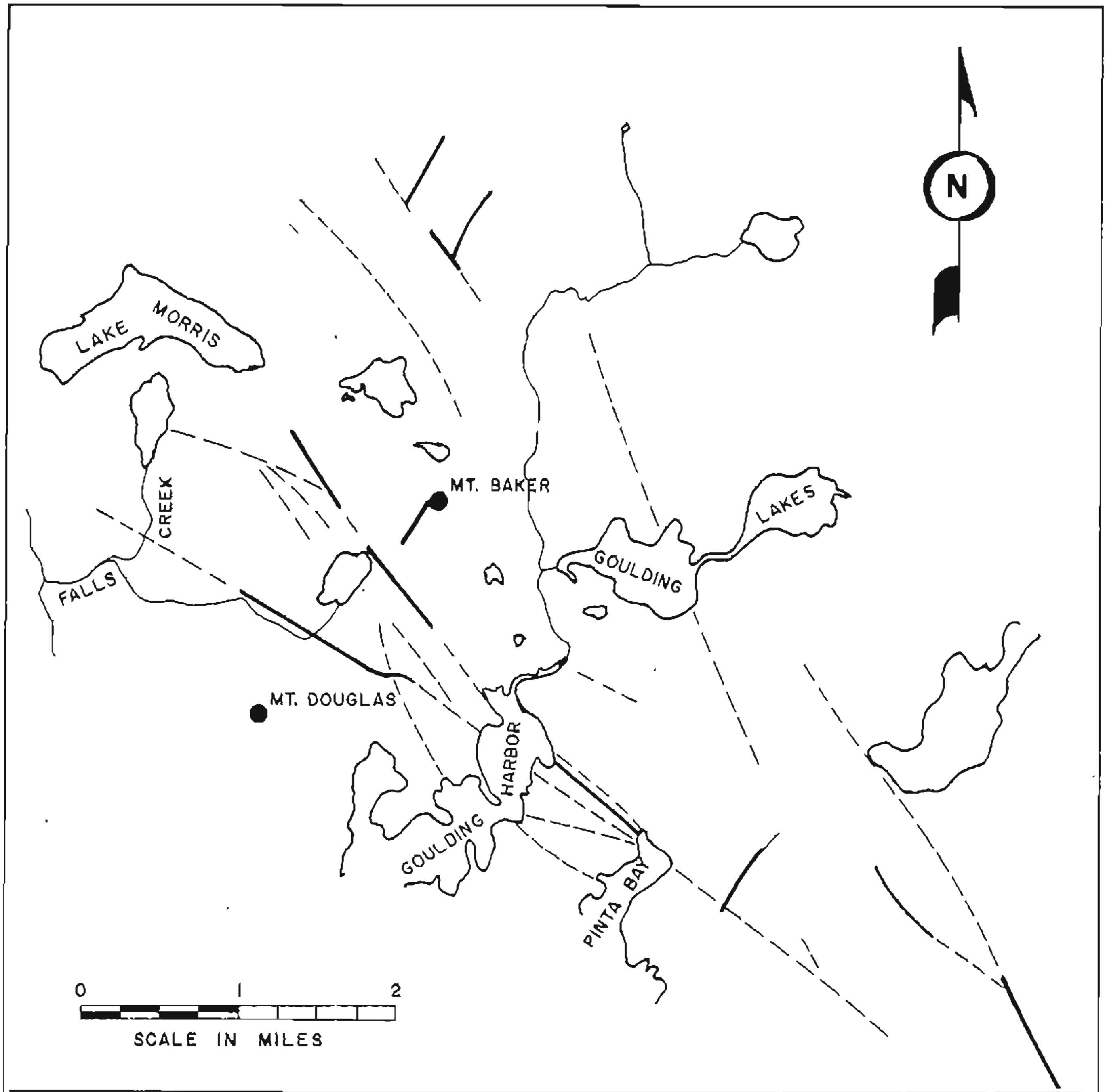



LUCKY DEVIL MINING CLAIMS

CHICHAGOF ISLAND, ALASKA
GEOPHYSICAL INVESTIGATION

# LOCATION MAP

GEO RECON INC — AUGUST, 1962 — G - 80 — FIG. 1




## LEGEND

SCHIST

LIMESTONE

GREENSTONE

MAGNETIC ANOMALY

KNOWN FAULT

INFERRED FAULT

GEOLOGY FROM USGS BULLETIN 1058-E

LUCKY DEVIL MINING CLAIMS
CHICHAGOF ISLAND, ALASKA
GEOPHYSICAL INVESTIGATION

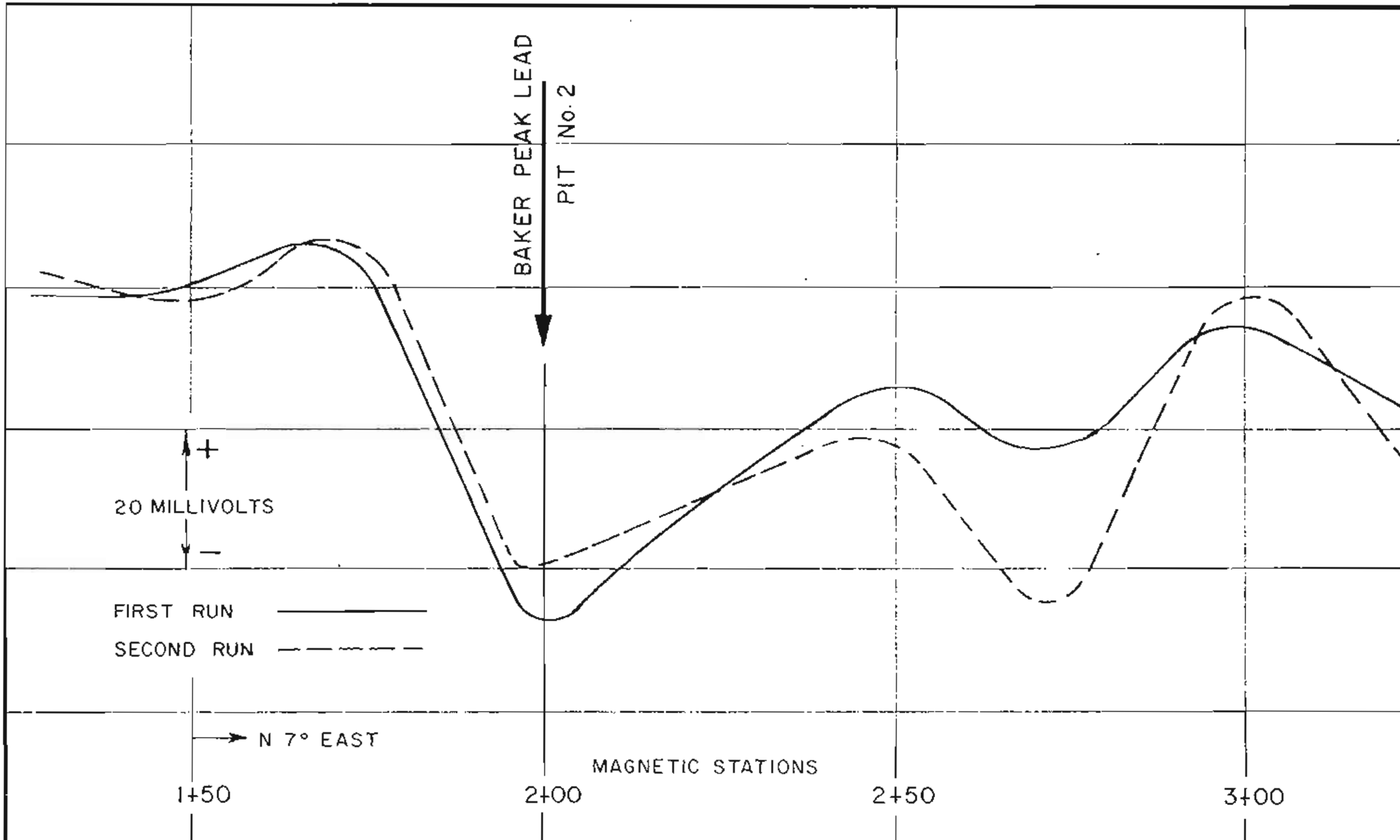
# REGIONAL GEOLOGY MAP

GEO RECON INC

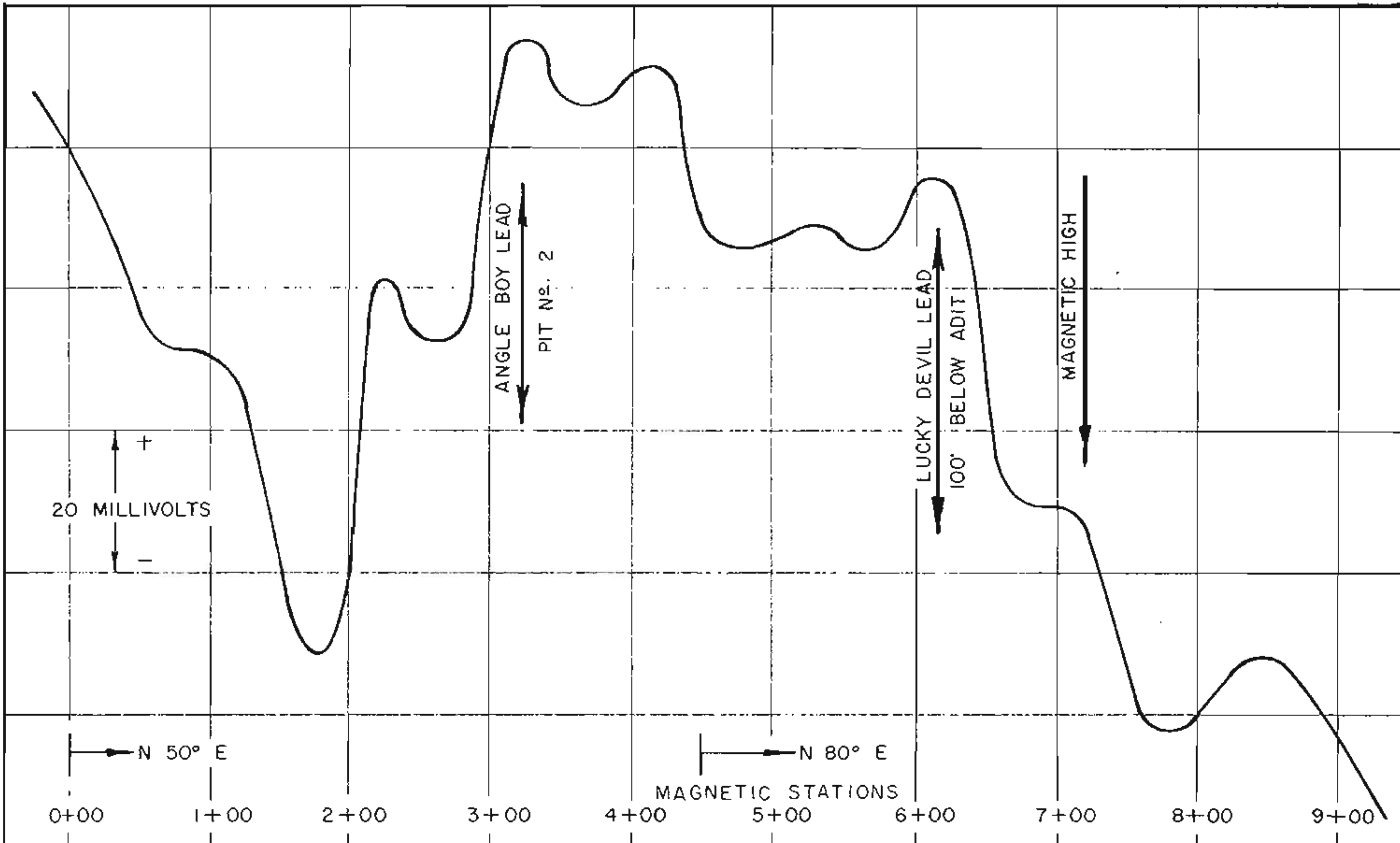
AUGUST, 1962
G-80

SEATTLE

FIG. 2




| | | | |
|---|---|---|---|
| LUCKY DEVIL MINING CLAIMS<br>CHICHAGOF ISLAND, ALASKA<br>GEOPHYSICAL INVESTIGATION | SELF POTENTIAL PROFILE<br>TEST PROFILE Nº. 1 | GEO RECON INC<br>AUGUST, 1962<br>G — 80 | FIG. 14 |



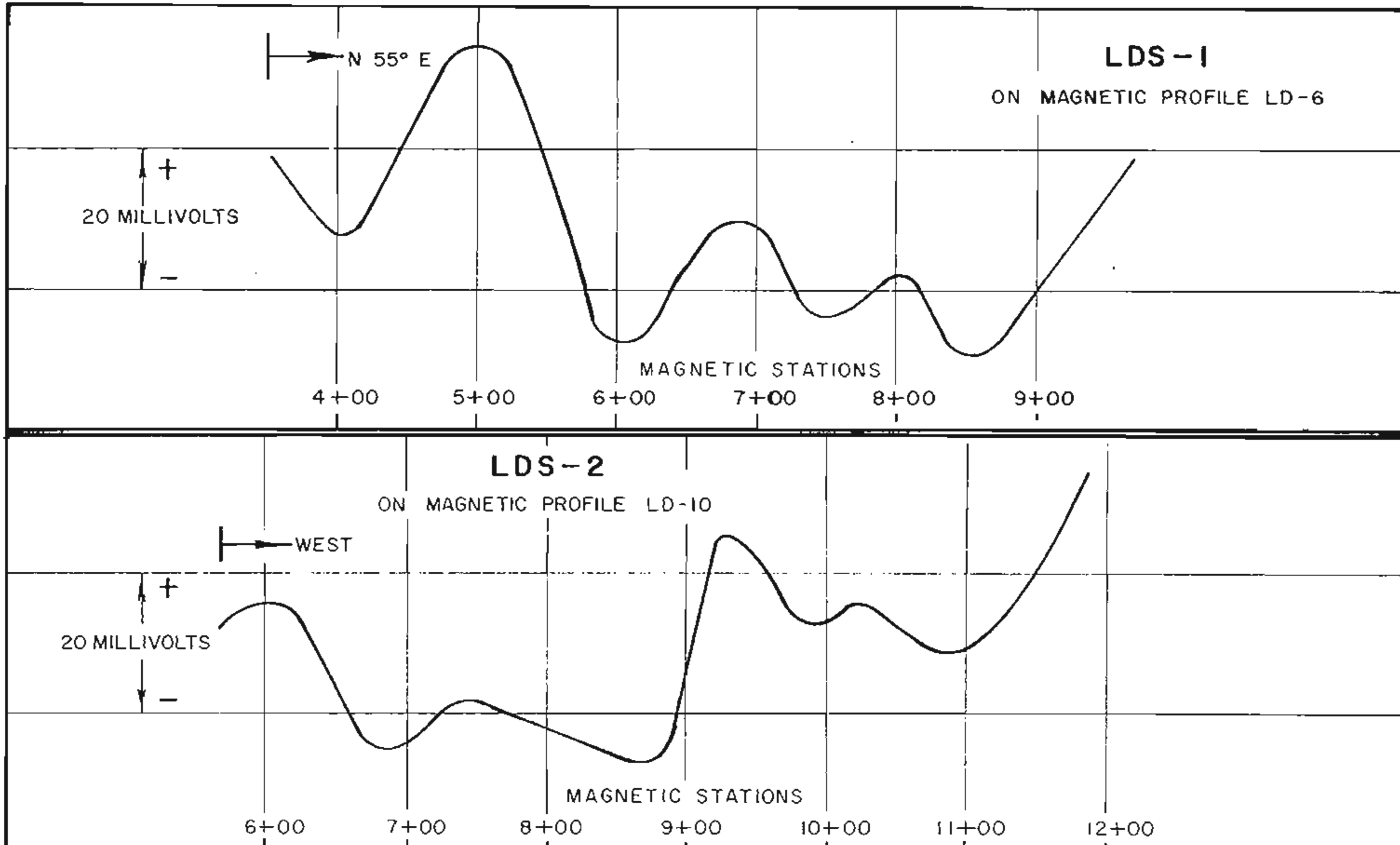

LUCKY DEVIL MINING CLAIMS
CHICHAGOF ISLAND, ALASKA
GEOPHYSICAL INVESTIGATION

# SELF POTENTIAL PROFILE

TEST PROFILE №. 2

GEO RECON INC — AUGUST, 1962 — G-80

FIG. 15

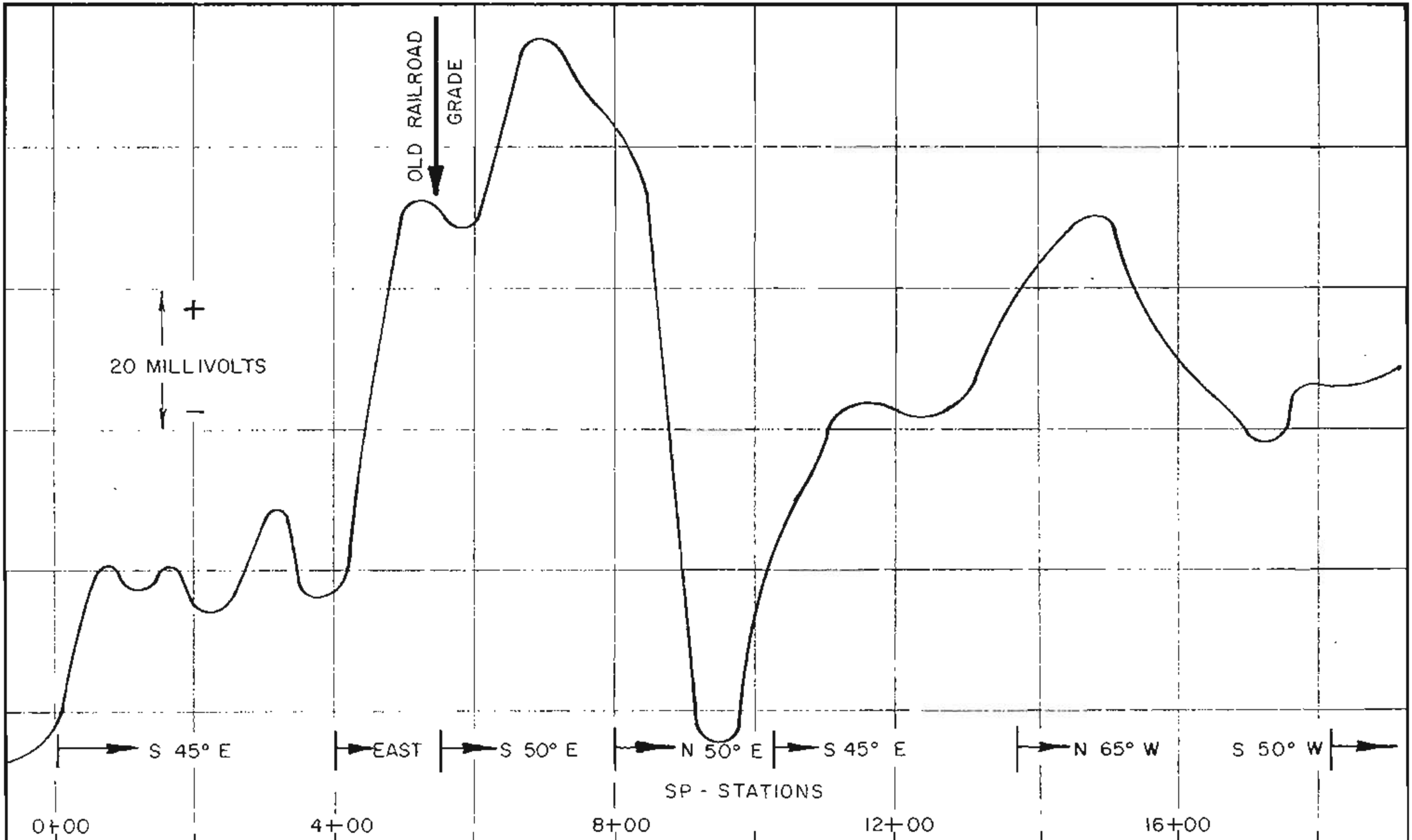



LUCKY DEVIL MINING CLAIMS
CHICHAGOF ISLAND, ALASKA
GEOPHYSICAL INVESTIGATION

SELF POTENTIAL PROFILE
LDS-1 & LDS-2

GEO-RECON INC.
AUGUST, 1962
G-80

FIG. 16

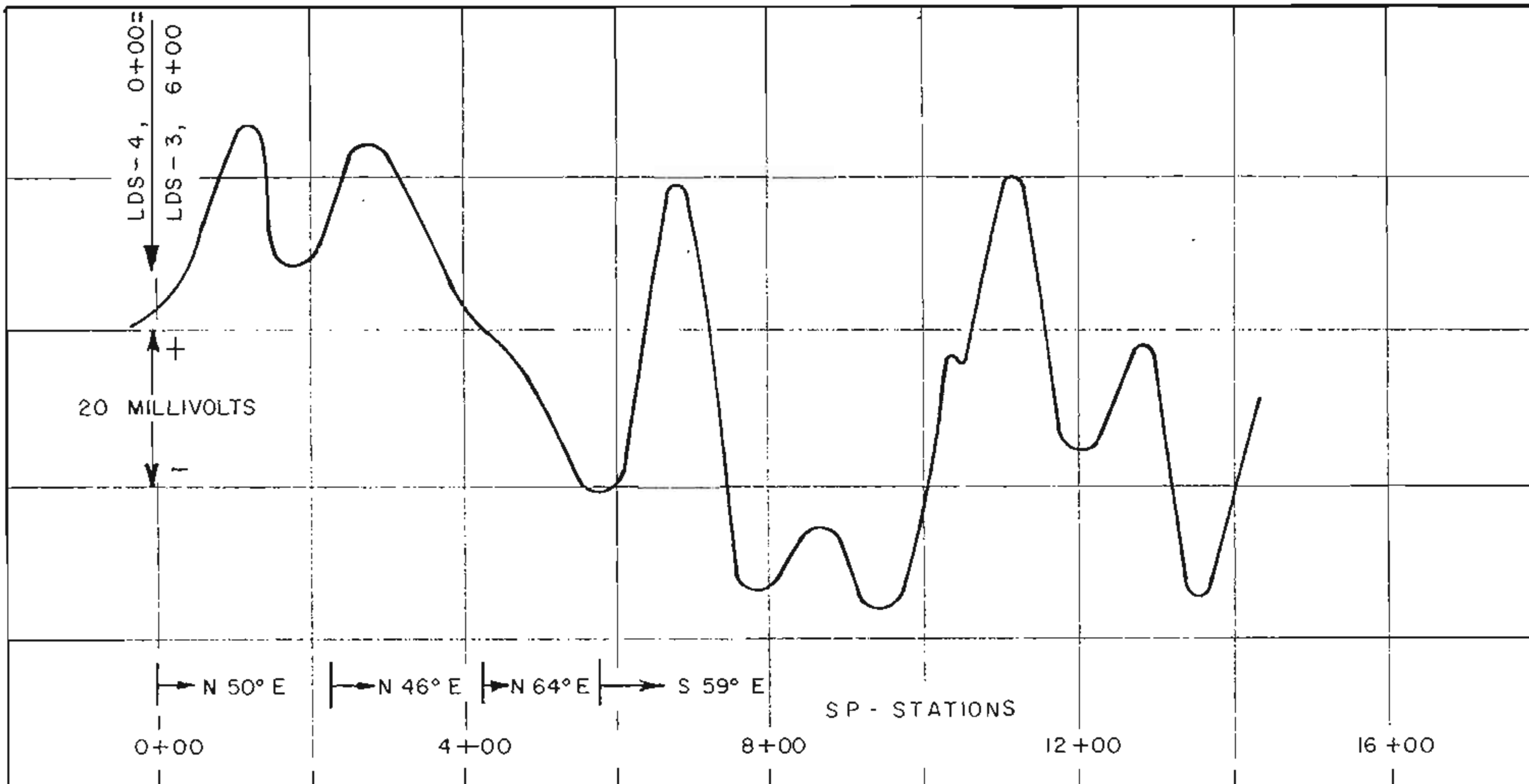



LUCKY DEVIL MINING CLAIMS
CHICHAGOF ISLAND, ALASKA
GEOPHYSICAL INVESTIGATION

SELF POTENTIAL PROFILE
LDS-3

GEO-RECON INC
AUGUST, 1962
SEATTLE
G-80

FIG. 17

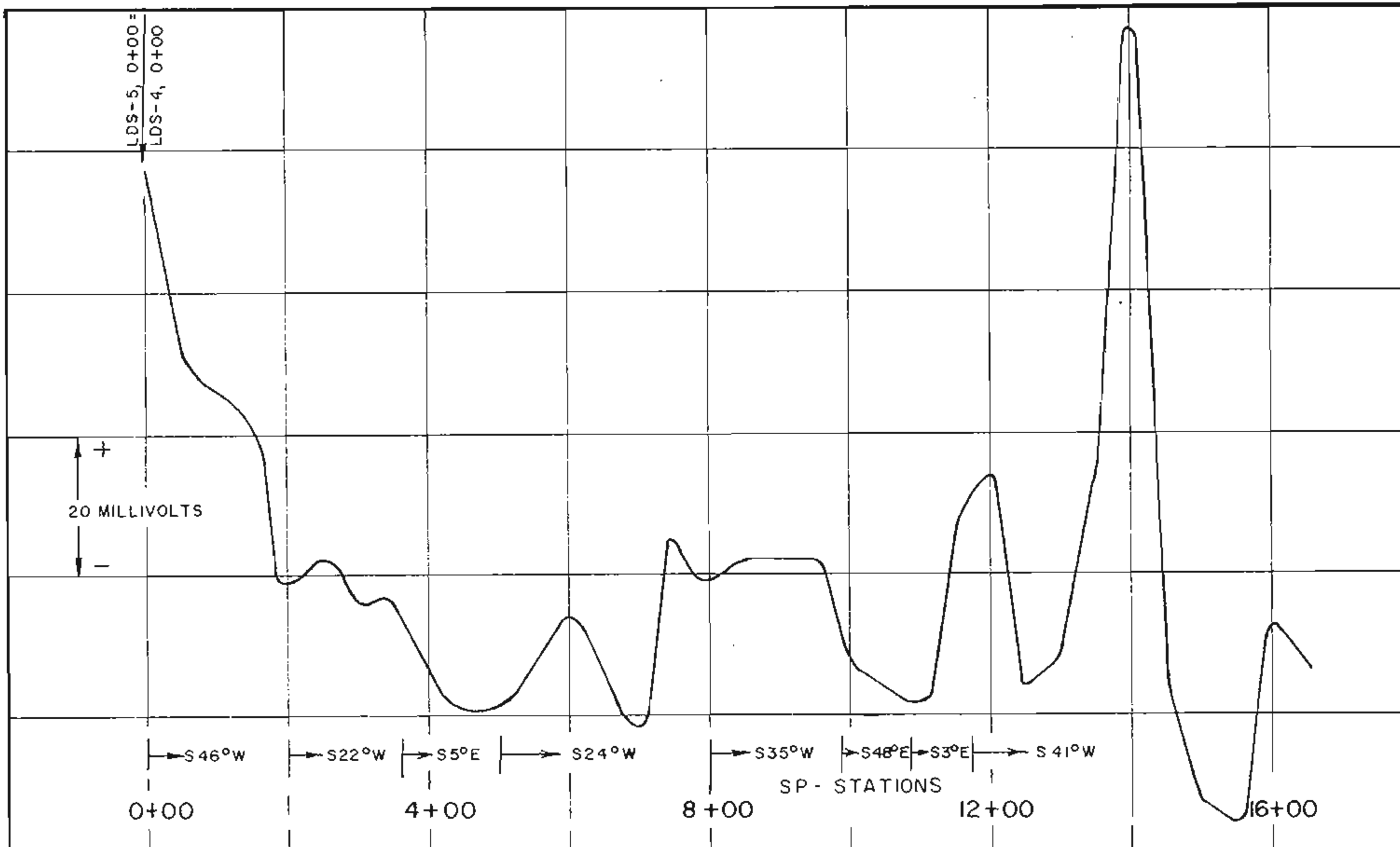



LUCKY DEVIL MINING CLAIMS
CHICHAGOF ISLAND, ALASKA
GEOPHYSICAL INVESTIGATION

**SELF POTENTIAL PROFILE**
LDS — 4

GEO RECON INC
AUGUST, 1962
G — 80

**FIG. 18**




LUCKY DEVIL MINING CLAIMS
CHICHAGOF ISLAND, ALASKA
GEOPHYSICAL INVESTIGATION

SELF POTENTIAL PROFILE
LDS—5

GEO-RECON INC
AUGUST, 1962
G—80

FIG. 19