KEMUK MOUNTAIN IRON ORE PROSPECT

DILLINGHAM DISTRICT, ALASKA

HUMBLE OIL AND REFINING COMPANY
EXPLORATION DEPARTMENT
1959

TABLE OF CONTENTS

ILLUSTRATIONS

ABSTRACT

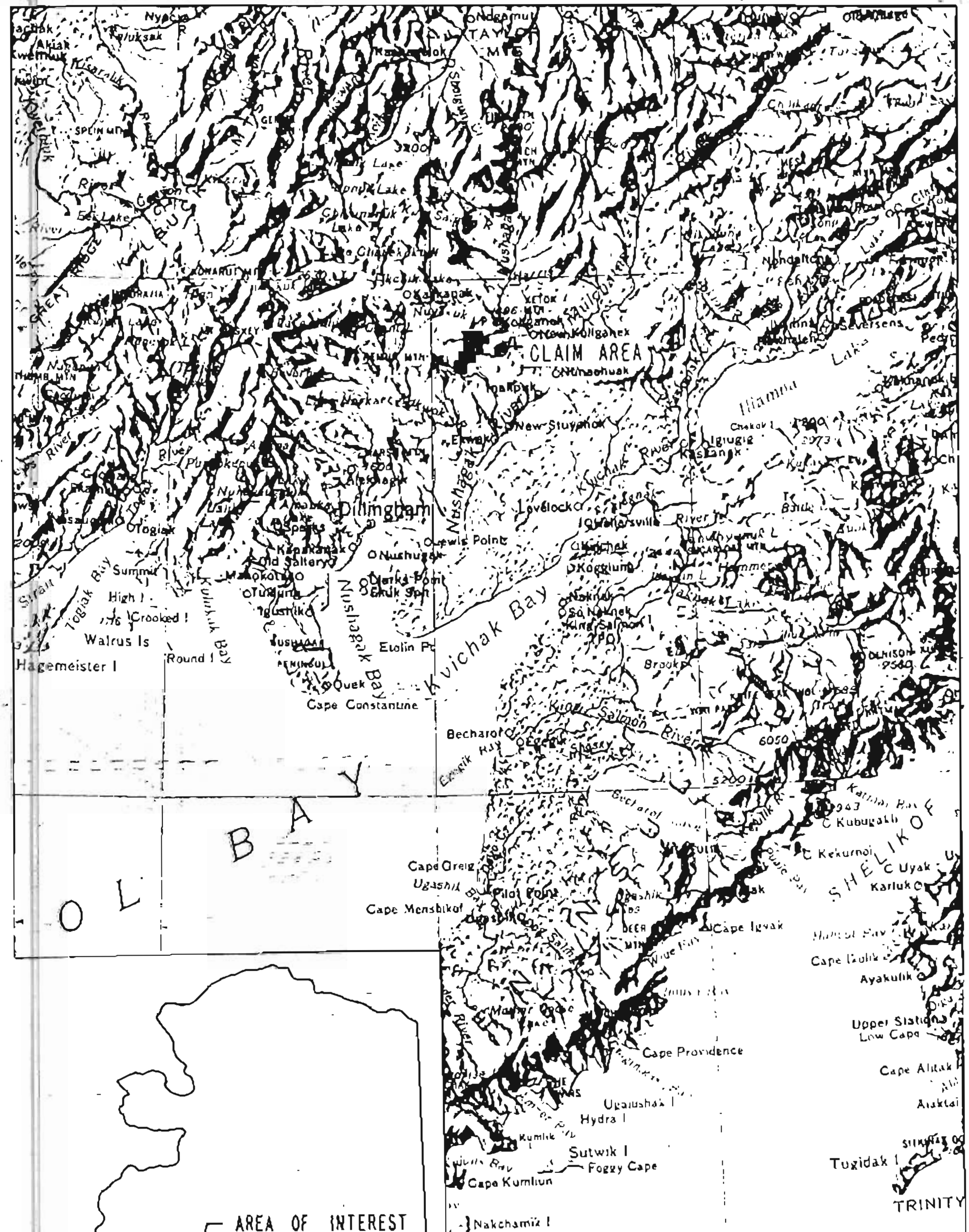
The Kemuk Mountain iron ore anomaly was discovered in 1957 by aerial magnetometer surveys conducted over the Nushagak Basin in southwestern Alaska. The related magnetic anomaly, with a maximum of 35,000 gammas relief, is caused by an ultrabasic igneous complex, not unlike several intrusive bodies discovered along the southeastern coast of Alaska, some of which are being developed.

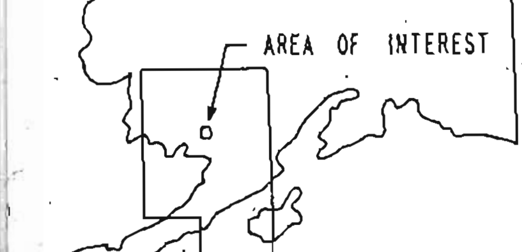
In 1958, 815 joint lode and placer claims were staked over the anomaly by Humble and ground magnetometer surveys were completed. During the summer months of 1958 and 1959 fourteen of a total of sixteen core tests that were drilled encountered the intrusive. The intrusive is overlain by glacial fill material to depths varying from 90 feet to 460 feet. Magnetite was discovered in percentages of two to 35 percent with the greatest concentration in a phase of the intrusive which is classified as magnetite pyroxenite. The magnetite content averages 14.5 to 16.5 percent in the western part of the magnetite pyroxenite mass, and 10.5 to 12 percent in the eastern part. Traces of native copper, chalcopyrite, and sphalerite were noted; however, extensive electromagnetic surveys completed in 1959 failed to detect anomalies which might suggest significant deposits of copper or other base sulfides.

INTRODUCTION

The Humble claims are located about 55 airline miles northeast of Dillingham, Alaska, at approximately 59° 45' north latitude and 158° 15' west longitude (Plate I). The area is part of a lowland plain of unconsolidated fluvial-glacial sediments deposited as outwash from the Quaternary glaciation of the Tikchik and Wood River Mountains to the west. The ultrabasic intrusive which is the prime concern of this report is buried beneath 90 to 460 feet of these sediments. The nearest outcrops to the claim area are the granitic prominence which forms Kemuk Mountain and scattered patches of Permian (?) greenstone along the west bank of the Nushagak River about 12 miles east of the claim area. The investigated intrusive is a complex of the following genetically related rock types: pyroxenite, magnetite pyroxenite, gabbro, and andesite. Economic interest centers on the magnetite pyroxenite.

The presence of a magnetite deposit was suggested by an airborne magnetometer survey conducted for Humble by the Aero Service Corporation of Philadelphia, Pennsylvania, in 1957. A camp site was maintained in the area during the summers of 1958 and 1959, and an exploration program was conducted to evaluate the prospect. Equipment and supplies were brought into the area, both to Dillingham and Naknek (King Salmon), by ships and by airplanes. Transportation into the claim area for personnel and smaller equipment and supplies was provided by float plane and helicopter. The Nushagak River, which is navigable for river barges to Koliganek, an Indian Village ten miles from the claim area, was used for heavy equipment and bulky supplies such as gasoline. Since no roads exist, transportation from the river to the claim area was by helicopter. The numerous lakes in the area provide landing for float planes.





LOCATION MAP
OF THE HUMBLE CLAIM AREA
SCALE 1:250,000

The surface of the prospect area is typical tundra, underlain by gravels, and suitable roads could be readily constructed. Good mill sites are available adjacent to abundant water supplies.

CLAIM GROUP

In November 1958, the area was covered by 815 joint lode and placer claims. All of the lode and placer claims are 18.18 acres each in area; each type of claim pre-empts a total of 14,816.7 acres. The claim block is shown on Plate VI in the pocket.

EXPLORATION PROGRAM

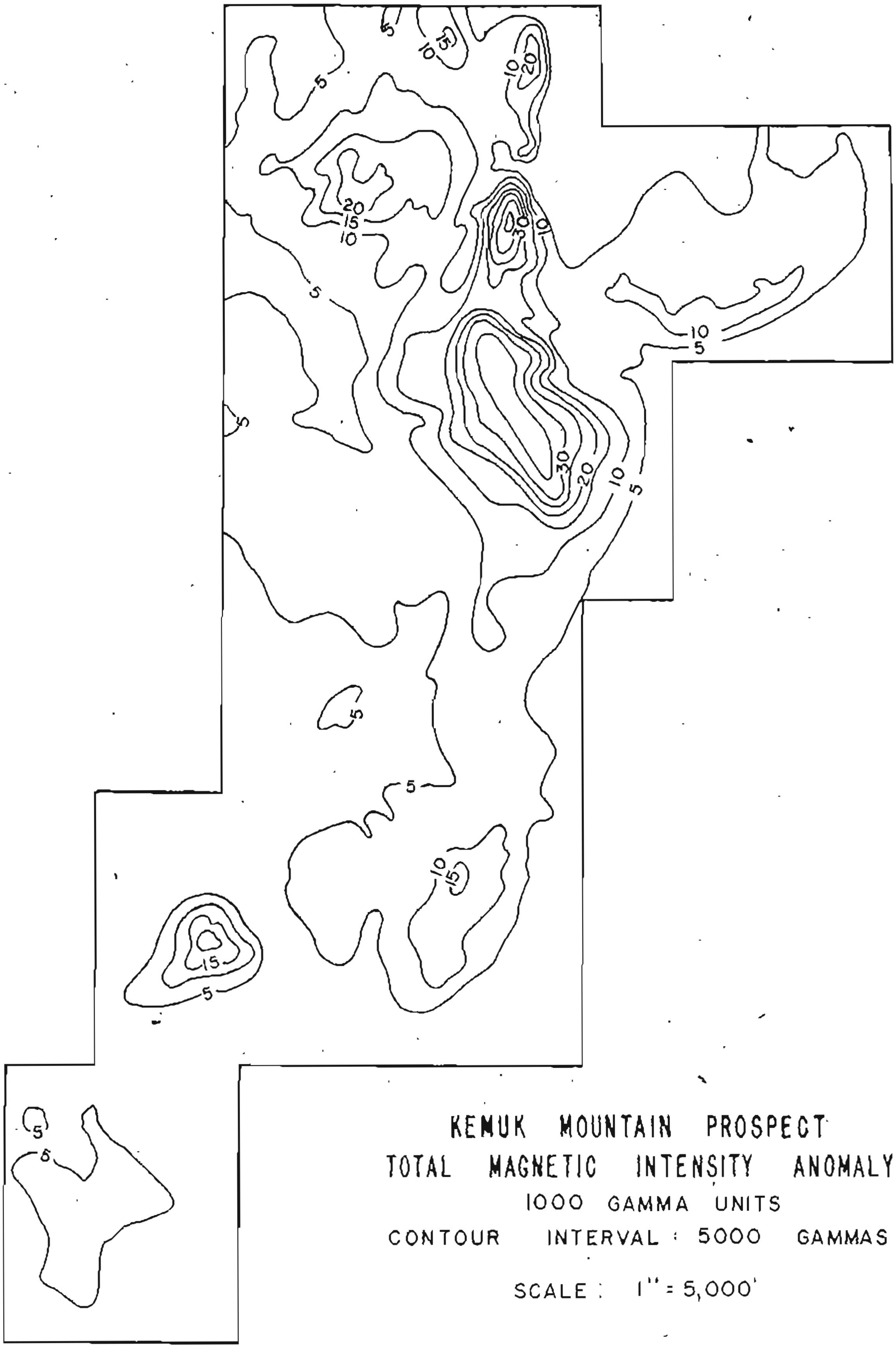
History and Methods

The area covered by the airborne magnetic anomaly was detailed with the ground magnetometer by Humble in 1958. During August and September of 1958, under supervision of the Longyear Company, Minneapolis, Minnesota, the anomaly was prospected by core drilling a total of 2,931 feet in four holes. The drilling encountered magnetite pyroxenite, associated in places with traces of native copper, chalcopyrite, sphalerite, and pyrite.

Following this work, results were reviewed with the aid of Longyear and Hunting Technical and Exploration Services, Ltd., of Toronto, Canada. It was concluded that additional geophysics and core testing were justified in order to determine the size and grade of the magnetite deposit, and the possibilities for the occurrence of commercial copper, etc.

In 1959, accordingly, eleven additional tests were cored under Longyear supervision and a detailed electromagnetic survey was conducted by Hunting. The core tests included two to depths of 2,000 feet and accounted

PLATE II



KEMUK MOUNTAIN PROSPECT

TOTAL MAGNETIC INTENSITY ANOMALY

1000 GAMMA UNITS

CONTOUR INTERVAL : 5000 GAMMAS

SCALE : 1" = 5,000'

for a total of 9,145 feet. The Longyear Company used one core drill rig in the 1958 program, a Longyear Junior Straitline model, and added a second rig in the 1959 program, a Longyear Model 44 unit.

Cores were assayed and subjected to tests for magnetite concentration by H. T. Caddy Laboratories, Virginia, Minnesota. The cores were split; one half was used by Caddy and the other half is stored at Humble's Friendswood Sample Warehouse in the Houston area. Results of the drilling and testing are briefly summarized in Table I and are discussed under Geology. Detailed descriptions of the cores, accompanied by analytical data are in Humble's files.

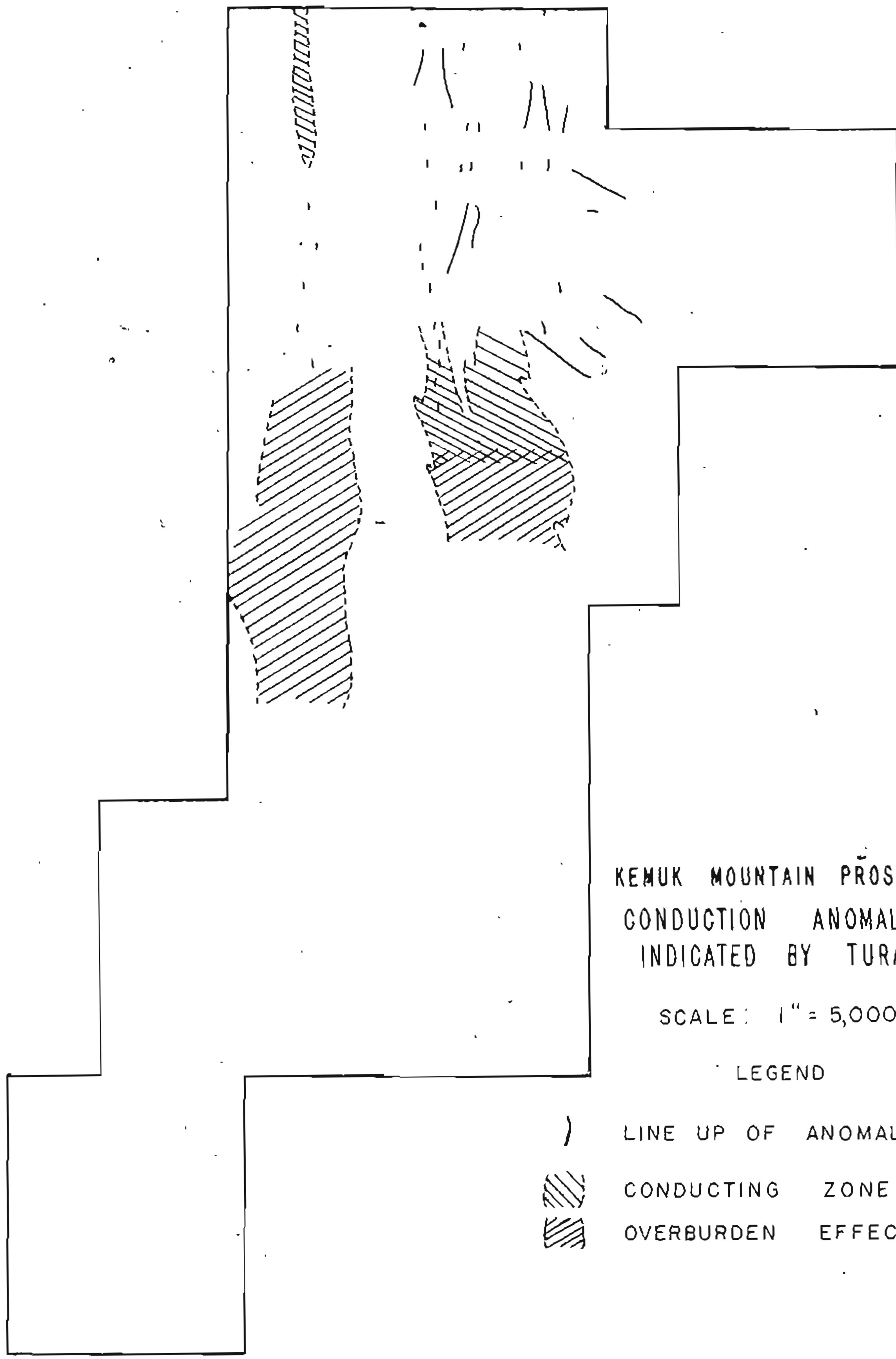
The Hunting geophysical surveys included both the Afmag and Turam electromagnetic types. Afmag, which measures the influence of the atmospheric magnetic field on natural conductors, failed to give results because of the weak magnetic fields of northern latitudes and was discontinued after a short trial. Failure of this method severely limited the thoroughness of the geophysical survey since Afmag is particularly useful for reconnaissance and for depth penetration, whereas Turam is of a detailed nature and intercepts only relatively shallow conductors. The stronger parts of the magnetic anomaly were covered by Turam surveys, utilizing charged loops and grounded cables to induce magnetic fields. The significance of the electromagnetic surveys is discussed in the following section on the results of the exploration program.

Results

Magnetic Survey

The magnetic anomaly over the investigated intrusive is one of the world's most intense. As measured by both aerial and ground surveys it ranges over 35,000 gammas above regional values. Laboratory tests indicate that a

PLATE III



KEMUK MOUNTAIN PROSPECT
CONDUCTION ANOMALIES
INDICATED BY TURAM

SCALE: 1" = 5,000'

LEGEND

LINE UP OF ANOMALIES

CONDUCTING ZONE

OVERBURDEN EFFECTS

major portion of the total magnetism is remanent magnetism rather than induced. The strong remanent contribution may help explain the high intensity of the magnetic anomaly, but the possibility of richer ore at depth or laterally cannot be ruled out (see Plate II).

Electromagnetic Survey

Eighteen conduction anomalies were detected by Turam on the claim block. None of these were classed higher than "weak" or "doubtful", and none were interpreted as being caused by base sulfides (see Plate III). Hunting attributed the anomalies to: bodies of magnetite, fault zones, deposits of magnetiferous sands beneath the overburden, and the effects of increase in thickness of the overburden.

Assay Results

In Table I the iron assays from both the 1958 and 1959 drilling are grouped and averaged for significant drill hole intercepts. Percentages in parentheses are not actual assays but are calculated from the assayed average total iron content of the intercept. The table shows the early pyroxenite phase of the intrusive (see Plate VI) to average only five to six percent total iron with 1 to 1.5 percent magnetic iron or 2 to 2.5 percent magnetite. The most magnetiferous phase of the igneous complex is a later, sheet-like mass of magnetite pyroxenite, which is richer in magnetite in the western part than in the eastern part. Short intercepts of relatively pure magnetite pyroxenite in the western portion of the sheet average 18 to 20 percent total iron with 13.5 to 15 percent magnetic iron or 19 to 21 percent magnetite. In mineable thicknesses of 50 feet or more, the dilution from later gabbro and andesite dikes in places lowers the averages to 15 to 17 percent total iron with 10.5 to 12 percent magnetic iron, or 14.5 to 16.5 percent magnetite. In contrast, the eastern portion of the sheet averages 10.5 to 12 percent magnetite. The richest drill hole intercept, at 1373 to 1380 feet in H-9, averages 35.4 percent magnetite.

Assays for copper are all less than 0.2 percent. Test concentrates with at least 65 percent iron average 2 to 3 percent silica, 0.005 to 0.016 percent phosphorus oxide, and 2 to 3 percent titania.

Geology and Petrogenesis

The investigated intrusive is a composite of lithologic units which have apparently been derived from a single ultrabasic magma source. Pyroxenite is the first intrusive phase and forms the bulk of the igneous complex. It is succeeded by magnetite pyroxenite, gabbro, and andesite. The magnetite pyroxenite, which may reflect the habit of intrusion of the whole igneous complex, was probably injected into the earlier pyroxenite as a nearly horizontal, sheet-like mass. Post-intrusion regional tectonism has uplifted and tilted the mass. It now dips steeply to the east or southeast, and what had been its bottom is now its western margin. Across the main magnetic high, the sheet is at least 4,000 feet thick and extends to undetermined depths. It underlies an area of at least four square miles. Gabbro intrudes both the pyroxenite and the magnetite pyroxenite as steeply dipping dikes which are as thick as 500 feet. Dikes of andesite are of random attitude and are only a few feet to a few inches in thickness.

The magnetite pyroxenite is an iron-rich differentiate of the original pyroxenite magma. Its total iron content is three to four times that of the pyroxenite. A sequence of rock types transitional from magnetite pyroxenite to gabbro reflect a change in the differentiation trend of the magma from iron-enrichment to silica-enrichment. The magnetite pyroxenite is the only rock type meriting consideration as an iron ore.

As previously noted, the western or lower portion of the sheet of magnetite pyroxenite is more magnetiferous than the eastern portion. The magnetite is primarily late-magmatic as it occurs in the interstices between the pyroxene crystals. Magnetite-rich zones such as at 1,375 feet in drill hole H-9 are probably lens-like and represent injections of the late, iron-rich residue of the magma along shears in the semi-rigid crystal network. Gravity settling of this residue through the crystal mesh may partly explain the concentration of magnetite toward the base of the intrusive sheet.

Both the magnetic and the electromagnetic data depict a set of northwest trending parallel faults. Where intersected by drill holes, the faults are steeply dipping (70° to 75°) with essentially horizontal, right-lateral displacement. There is no appreciable concentration of copper minerals along the faults.

An interpretation of the geology of the intrusive is presented graphically in cross-section view (Plates IV and V) and in plan view (Plate VI), drawn from a combination of the magnetic, electromagnetic and drilling data. The size and intrusive habit of the magnetite pyroxenite mass are based on the configuration of the magnetic anomaly and on the distribution of hydrous silicates and magnetite in the intrusive. The attitudes of primary structures and of dikes of gabbro and andesite were measured in a few intercepts of oriented core. The position and attitude of the faults are based on the magnetic and electromagnetic data. The dip and relative displacement of the faults were measured in core samples from the fault zones.

Table I.

HOLE NO.	DRILLING INTERVAL (FEET)	FEET SAMPLED	PERCENT TOTAL IRON	PERCENT MAGNETIC IRON	PERCENT OF TOTAL IRON AS MAGNETIC IRON	PERCENT MAGNETITE	LITHOLOGY OR CHARACTER OF INTERVAL
H2	375 - 400	25	6.89	2.28	33	3.2	Pyroxenite
H2	375 - 487	112	11.80	7.30	62	10.1	Pyroxenite and magnetite pyroxenite
H3	390 -1002	612	15.23	10.16	67	14.1	Magnetite pyroxenite (Total hole below overburden)
H4	315 - 468	153	13.37	6.95	52	9.6	Magnetite pyroxenite (Amphibole - rich)
H6	583 - 687	104	10.22	(5.6)*	(55)	(7.8)	Pyroxenite & magnetite pyroxenite
H7	151 -2000	1849	15.56	(10.6)	(68)	(14.7)	Magnetite pyroxenite (Total hole below overburden)
H8	222 - 402	180	16.36	(11.5)	(70)	(15.9)	Magnetite pyroxenite
H8	402 - 500	98	12.57	(6.3)	(50)	(8.7)	Gabbro
H8	550 - 576.5	26.5	19.37	(13.9)	(72)	(19.4)	Magnetite pyroxenite
H8	222 - 576.5	354.5	15.76	(10.2)	(65)	(14.2)	Total hole below overburden
H9	230 - 454.5	224.5	11.64	(6.1)	(52)	(8.4)	Gabbro
H9	454.5-1751	1296.5	15.90	(9.9)	(62)	(13.7)	Magnetite pyroxenite (with amphibole-rich zones)
H9	1373 -1380	7	29.65	25.43	86	35.4	Magnetite pyroxenite (Magnetite-rich zone)
H9	1751 -1949	198	13.45	(7.0)	(52)	(9.7)	Gabbro with some pyroxenite
H9	1949 -2000	51	16.15	10.19	63	14.2	Magnetite pyroxenite
H9	230 -2000	1770	14.17	(8.4)	(59)	(11.6)	Total hole below overburden
H10	201 - 532	331	14.24	(7.9)	(55)	(10.9)	Magnetite pyroxenite (Amphibole-rich)
H11	159 - 500	341	5.21	(1.8)	(35)	(2.5)	Pyroxenite (Total hole below overburden)
H12	254 - 600	346	12.20	(6.1)	(50)	(8.5)	Gabbro (Total hole below overburden)
H13	350 - 668	318	7.59	(4.0)	(53)	(5.6)	Pyroxenite and magnetite pyroxenite (Total hole below overburden)
H14	91 - 500	409	6.32	(2.2)	(35)	(3.1)	Pyroxenite (Total hole below overburden)
H15	470 - 637	167	5.38	(1.4)	(25)	(2.0)	Pyroxenite (Total hole below overburden)
H17	460 - 530	70	11.99	5.01	42	7.0	Magnetite pyroxenite (Amphibole rich)

Table I: Assayed and calculated iron content of significant drill-hole intercepts.

*Percentages in parentheses are not directly assay determined but are calculated