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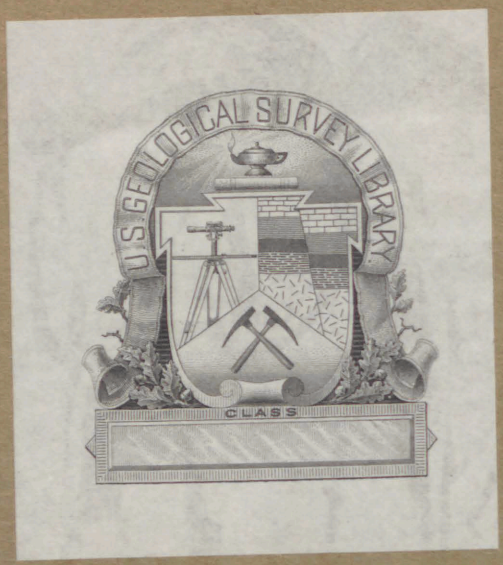
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MAGNETOMETER SURVEY IN THE JEBEL IDSAS AREA

SAUDI ARABIA

by

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U. S. Geological Survey

and

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1. Magnetometer survey in the Jebel Idsas area, Saudi Arabia, by W. E. Davis, R. V. Allen, and M. N. Akhrass. 8 p., 2 figs.

2. Preliminary report on the ancient mines and mineral occurrences in northeastern Hijaz quadrangle 205 and the southwest part of Wadi Ar Rimah quadrangle 206, Saudi Arabia, by C. L. Hummel, Abdullah Ankary, and Hashim Hakim. 45 p. (incl. 1 fig.), 6 tables, 1 pl.

3. Evaluation of a diamond drilling program at the Samrah Mine near Ad Dawadimi, Kingdom of Saudi Arabia, by T. H. Kiilsgaard. 77 p., 13 figs., 3 tables.

4. Report on the field trip in the northwestern Hijaz quadrangle, Saudi Arabia, during the period February 21 to March 28, 1965, by Robert F. Johnson and Virgil A. Trent. 3 p., 1 fig.

5. Summary of field trip March-April 1964 to the southern Tuwayq quadrangle, Saudi Arabia, by William C. Overstreet, Jesse W. Whitlow, and Abdullah O. Ankary. 7 p.

6. Summary of trip during May-June 1964 to the southern Tuwayq quadrangle, Saudi Arabia, by William C. Overstreet and Jesse W. Whitlow. 4 p.

7. Geologic log and chemical data, diamond drill hole 1, Samrah, Kingdom of Saudi Arabia, by Paul K. Theobald, Jr., Charles E. Thompson, and Henry D. Horn. 61 p., 15 figs., 5 tables.

8. Geology of Samrah and vicinity, Kingdom of Saudi Arabia, by Paul K. Theobald, Jr. 24 p., 2 figs.

9. Mineral investigations in the Bir Al Bayda-Al 'Ula area, Saudi Arabia, by Virgil A. Trent. 2 p.

10. A mineral reconnaissance of the Jabal Sahah quadrangle, Kingdom of Saudi Arabia, by Jesse W. Whitlow. 16 p., 3 figs.

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PREFACE

In 1963, in response to a request from the Ministry of Petroleum and Mineral Resources, the Saudi Arabian Government and the U. S. Geological Survey, U. S. Department of the Interior, with the approval of the U. S. Department of State, undertook a joint and cooperative effort to map and evaluate the mineral potential of central and western Saudi Arabia. The results of this program are being released in USGS open files in the United States and are also available in the Library of the Ministry of Petroleum and Mineral Resources. Also on open file in that office is a large amount of material, in the form of unpublished manuscripts, maps, field notes, drill logs, annotated aerial photographs, etc., that has resulted from other previous geologic work by Saudi Arabian government agencies. The Government of Saudi Arabia makes this information available to interested persons, and has set up a liberal mining code which is included in "Mineral Resources of Saudi Arabia, a Guide for Investment and Development," published in 1965 as Bulletin 1 of the Ministry of Petroleum and Mineral Resources, Directorate General of Mineral Resources, Jiddah, Saudi Arabia.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MAGNETOMETER SURVEY IN THE JEBEL IDSAS AREA, SAUDI ARABIA

by

W. E. Davis , R. V. Allen , and M. N. Akhrass

Abstract

A ground magnetometer investigation in the southern part of the Jebel Idsas magnetite area, Kingdom of Saudi Arabia, was done in compliance to requests by D. R. Mabey and F. Keller to delineate the source of the aeromagnetic total-intensity anomaly that was interpreted as being the expression of a commercial magnetite deposit.

Results of the investigation indicate that a zone of magnetite more than 1700 meters in length lies beneath southward protruding ridges and the adjoining margin of a wadi in the central part of the area; and that a small zone of less economic importance occurs beneath a low ridge to the east. Within these zones, the magnetite probably occurs as lenticular masses, stringers, and veins, which aggregate in substantial quantities that constitute the richer parts and are marked by magnetic anomalies.

The main zone is inferred to be the source of the total-intensity anomaly and is several hundred meters longer than is indicated by the wide-spaced aeromagnetic profiles. This zone averages about 75 meters in width. It may contain as much as 50 percent magnetite, however an estimate of the tonnage represented cannot be made reliably without more complete subsurface information.

A study of drilling sites in the area reveals that most of the holes are along the south edge of the main zone and were not properly located to test the richer parts as indicated by our magnetic data.

Drill hole N 40, which was abandoned in November owing to broken drilling equipment, is properly located to test the richest part of the main magnetite-bearing zone. We recommended that this hole be completed and that the resulting subsurface information be used as a guide in selecting additional drilling sites along the trend of the anomaly.

Introduction

A magnetometer survey was made in the southern part of the Jebel Idsas area, Kingdom of Saudi Arabia, to locate magnetite deposits and to supplement geologic mapping. The work was done primarily to define the source of a total intensity magnetic anomaly discovered in an aeromagnetic survey by the Hunting Survey Corporation in 1962. Mr. D. R. Mabey made an analysis of the anomaly and concluded that it is associated with a magnetite deposit of commercial size, whose top lies between depths 100 and 200 meters. This was confirmed by results of a brief ground survey conducted by Mr. F. Keller, who estimated that the deposit is about 75 meters wide and 900 meters long and that it may contain as much as 135,000,000 tons of magnetite. Both persons recognized that the data were not sufficient for delineating the anomalous source and recommended that a detailed survey be made.

The magnetometer survey was conducted by the authors during November 1964. It includes areal coverage obtained in ground magnetic investigations made by H. Tayem and W. MacLean in 1959 and by F. Keller and M. Akhrass in 1964. Results of this earlier geophysical work and of geologic mapping have been used to guide exploratory drilling programs, which have been conducted intermittently in the area since June 1961.

The surveyed area (Fig.1) is near lat. 23°18'N. long. 45°12'E. in the southern part of the Idsas mountains about 45 kilometers south of Al Amar. It occupies a narrow wadi and much of the lower slopes along the south and south-eastern flanks of the main mountain. The slopes are rugged and rise steeply to heights more than 300 meters above the wadi floor.

Small exposures of magnetite are scattered throughout a narrow arcuate belt that lies along the mountain slopes and extends northwestward from the east end of the area for a distance of more than 7.5 kilometers. The exposures have been studied briefly and evaluated by several geologists. More recently the area has been mapped geologically by V. P. Kahr. The magnetite occurs in the form of tabular bodies and lenses with subordinate amounts in stringers and veinlets. These masses are in the basic part of a flowrock complex whose overlying acidic phase is exposed in upper slopes to the north and northeast. The magnetite bodies are fractured and in places they have been intensely folded. Results of geologic mapping indicate that the hostrock is in an overthrust that moved generally from east to west. Presumably, the roots of magnetite masses in the area surveyed lie to the northeast beneath the thrustfault.

Field measurements

Torsion and fluxgate vertical force magnetometers with scale constants of 12 and 50 gammas per dial division, respectively, were used in making the measurements. Data were obtained at stations 25 meters apart along traverses spaced 100 meters perpendicular to a base line trending E-W through the middle of the area. Measurements were referenced to a base station, 3-0, which was occupied at intervals of three hours or less. The data were not corrected for diurnal variation which was found to be very small and insignificant compared to the magnitudes of anomalies observed in the area.

Magnetic features and exploratory drilling

Profiles of the vertical intensity magnetic data (Fig.2) show a prominent maximum on traverse 0 in the east part of the area and an extensive anomaly along traverses west of 300 W. Superimposed on these features and along the northern parts of most traverses are narrow magnetic highs and lows that occur over exposed veins of magnetite. General low magnetic relief is shown in the profiles of traverses east of 100 E.

The magnetic maximum on traverse 0 is known from previous geologic and magnetic mapping to be associated with a mass of magnetite that crops out on a low ridge to the east. Concealed extremities of the mass are indicated by small anomalies shown in profiles of traverses 100 E. and 100 W. A vertical hole, DH6, drilled near the center of the maximum cut "rich" veins of magnetite between depths 31 and 61 feet, 74 and 82 feet, and 120 and 132 feet. An inclined hole, DH5, drilled a short distance to the northwest indicates that the veins dip steeply and occur in a zone that is about 75 feet wide. The magnitude and shape of the anomaly on traverse 100 E. strongly suggest that northeastern end of the zone consists of small concentrations of magnetite, probably in widely spaced stringers.

The anomaly west of traverse 300 W. consists of a pronounced maximum and a general magnetic low on the north, which is expressed as a minimum in only a few profiles. The magnetic maximum is centered between stations 300 N and 400 N near the base of the hills along the north side of the main wadi. The magnetic low occurs over the hills and seems to be the reflection of a northward decrease in intensity of the magnetic field.

This major anomaly is inferred to be associated with a narrow zone of magnetite-bearing rock that extends westward from traverse 300 W to a point beyond traverse 2300 W. Results of drilling near exposures of magnetite along the trend of the anomaly indicate that the zone contains magnetite lenses and veins which in places may constitute fairly rich concentrations of ore. If the magnetite bodies are magnetized in the direction of the earth's field, the richer parts of the zone may be expected to lie beneath the northern flank of the magnetic maximum. The width of this zone varies and cannot be determined successfully by quantitative analysis because the negative part of the anomaly is not defined sufficiently. The negative part seems to be masked by effects caused by topography and by variable concentrations of magnetite in the rocks underlying the hills in the northern part of the area.

From the data we infer that the zone is about 75 meters wide near traverse 1500 W and that it increases in width to the east, though it probably consists of several lenses near traverses 1300 W, 1200 W and 1100 W. Farther to the east, the data suggest that the zone becomes more compact and may lie at greater depths as indicated by the smallee magnitudes of the maximum along traverses 700 W and 600 W, which are mostly in the wadi. The rich part of the zone continues west from traverse 1500 W without much change in width. Associated with the zone along traverses 1700 W, 1800 W, and 2100 W are widely separated lenses that lie in the upland to the north. The magnitude of the anomaly decreases westward from 1500 W and suggests that the source may become smaller and more deeply concealed. Throughout much of this part of the area, the larger maximum values were observed in the wadi, doubtlessly, the zone is concealed by a greater thickness of overburden in the bordering ridges. Beyond traverse 2100 W the anomaly is comparatively weak which indicates that the zone contains only minor amounts of magnetite. Near traverse 2200 W the magnetite probably is disseminated throughout the host rock, however, along traverse 2300 W it is inferred to occur in the form of thin lenses or stringers that are marked by small highs and lows in the profile.

Test holes have been drilled near outcrops of magnetite east of traverse 1500 W. The profiles show that most of these holes are near the crest of the magnetic maximum and may not have cut the richest part of the zone. Hole 4 is about ten meters east of the maximum shown on the profile of traverse 400 W. In this hole stringers of magnetite were cut between depths 130 and 137 feet 145 and 165 feet, and 170 and 185 feet with the richer concentrations occurring between depths 145 and 160 feet. The magnetic data indicate that the hole has been drilled near the east end of the zone where small concentrations of magnetite probably occur. Along traverses to the west the profiles suggest that the zone is larger and that it probably contains more magnetite.

Drill hole 3A (vertical) is approximately 11 meters west of the major maximum on traverse 900 W. The hole penetrated magnetite veins and lenses

between depths 30 and 37 feet, 110 and 123 feet, and 129 and 152 feet with the greatest concentration between depths 135 and 152 feet. From the shape of the anomaly we infer that the hole penetrated veins and lenses in the south edge of the zone.

Hole 3 (vertical) lies between traverses 900 W and 1000 W and beneath the south gradient of the anomaly. This hole cut only a few thin veins of magnetite and some limonite. As revealed by the magnetic data, the hole was drilled south of the magnetite-bearing zone.

Holes 2A and 2B (vertical) are near the main anomaly maximum between traverses 1100W and 1200W. The combined log of these holes reveals that within a section of small veins and disseminated magnetite between depths 89 and 186 feet, massive magnetite was encountered between depths 105 and 123 feet; and rich concentrations were found at greater depths between 221 and 237 feet. Hole 14 (inclined 45° to the west), about 40 meters west of hole 2B, found disseminated magnetite below 160 feet with fairly massive concentrations of 60% to 80% magnetite between 175 and 189 feet and between 243 and 249 feet. The hole bottomed at 283 feet in host rock containing an estimated 30% magnetite. This hole and holes 2A and 2B apparently penetrated the southern part of the inferred zone. The profiles in this part of the area show several major magnetic variations which suggest that the zone consists of widely spaced veins and lenses that are exposed or lie at shallow depths in the hills. To determine the amount of magnetite by drilling in this locality would require several holes in difficult terrain.

Hole N 40 (inclined 45° bearing N23°E) was started near station 325N, traverse 1500W, to penetrate the source of a major anomaly discovered in an airborne magnetometer survey and ground-checked by Keller and Akhrass. The drill cut stringers of magnetite at a vertical depth of 235 meters, but drilling ceased soon thereafter because of mechanical failure. The magnetite stringers encountered are in the south edge of the zone, as inferred from the corresponding data of Keller and the authors. According to geophysical information, this hole is properly situated to test the richest part of the magnetite-bearing zone.

Results and recommendations

Results of the magnetometer survey indicate that a zone of magnetite lies beneath the southward protruding ridges and adjoining margin of the wadi west of traverse 300 W; and that a small isolated zone of less economic importance occurs beneath a low ridge in the east part of the area. Geologic data and the results of exploratory drilling suggest that most of the magnetite within these zones probably occurs as lenticular masses, stringers, and veins. These concentrations may be inferred to aggregate in substantial quantities that constitute the richer parts of the zones, which are marked by the magnetic anomalies.

A study of the vertical intensity magnetic data indicates that the magnetite-rich part of the main zone lies between traverses 400 W and 2100 W. This zone constitutes the source of the total intensity anomaly and is several hundred meters longer than is indicated by the wide-spaced aeromagnetic profiles. In estimating the amount of magnetite in the source, Keller assumed that the zone is about 75 meters wide and it contains "50 percent disseminated magnetite accompanied by massive magnetite." This assumption is based on a block model and a susceptibility contrast indicated by the shape and magnitude of regular parts of the anomaly as shown by profiles along traverses 1400 W and 1500 W, which can be readily interpreted. The assumption may be reasonable; however, owing to the change in shape of the anomaly elsewhere and the probable dispersed nature of magnetite concentrations in the host rock, an estimate of the tonnage represented cannot be made reliably without more complete subsurface information.

The results of exploratory drilling in the area have been discouraging because no large deposits of magnetite have been discovered; and the aggregate quantity found is not great and probably could not be mined very efficiently. Examination of the magnetic data, however, indicates that results of past drilling should not be considered as a reliable basis for estimating the amount of magnetite present, because the drilling has not been done in the most favorable locations to cut the more massive concentrations of magnetite. Additional and more reliable information may be expected from drill hole N 40 which will penetrate

the richer part of the main zone. We recommend that additional drilling be done in the area to evaluate the source of the main magnetic anomaly. Drill hole N 40 should be completed and the resulting subsurface information should be used as a guide in selecting additional drilling sites along the trend of the anomaly.

Most of the exposed magnetite lenses and veins dip steeply, generally to the south, though the direction of dip is highly diversified. The magnetic data also suggest that the near-surface bodies dip steeply. Near traverse 1500 W, the subsurface source of the anomaly seems to be nearly vertical, but elsewhere the absence of a pronounced magnetic minimum on the north side of the maximum suggests that the major subsurface source dips northward beneath the upland and may conform with the thrust. The steep dips observed in the outcrops suggest that these masses may lie in the upturned front of the thrust. Subsequent drilling should be done to determine the dip and economic significance of the deeper parts of the anomalous source.

POCKET CONTAINS 3 ITEMS.