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Exploration - 96
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Dr. Fadil K. Kabbani
Deputy Minister for Mineral Resources
Directorate General for Mineral Resources
Ministry of Petroleum and Mineral Resources
Jiddah, Saudi Arabia

Dear Dr. Kabbani:

Transmitted herewith are 20 copies of:

TECHNICAL LETTER NUMBER 96
PRELIMINARY GEOPHYSICAL INVESTIGATION
OF THE
WADI YIBA COPPER PROSPECT
SAUDI ARABIA

by

Willard E. Davis* and Mohammed N. Akhrass**

Sincerely,

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for

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PRELIMINARY GEOPHYSICAL INVESTIGATION
OF THE
WADI YIBA COPPER PROSPECT
SAUDI ARABIA

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Willard E. Davis
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and

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Directorate General for Mineral Resources
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ABSTRACT

A brief electromagnetic investigation was made of a copper prospect near Wadi Yiba in the Al Qunfidhah quadrangle. Dip-angle and horizontal-coil measurements were made along traverses across sulphide-bearing dolomite zones in the east limb and nose of a syncline. Small anomalies occur over the dolomite and parts of the country rock. The anomalies are attributed to minor changes in conductivity of the chlorite and chlorite-quartz schist and possibly to sulphide mineralization in the dolomite zones. More work should be done to define anomalous trends and to determine their relationship to the dolomite units.

INTRODUCTION

Extensive copper mineralization was discovered in the rocks near Wadi Yiba (fig. 1) during geologic reconnaissance of the Ablah Formation in the Al Qunfidhah quadrangle. The mineral occurrence is similar to stratabound copper deposits in Africa. Such deposits in the Katanga-Rhodesia copper belt contain disseminated sulphide mineralization and are the source of important copper-producing mines.

In supplementing geologic study of the mineral discovery, a brief electromagnetic investigation was made to detect hidden zones containing sulphides. Field operations were conducted simultaneously with geologic mapping and accomplished by helicopter from a camp near Al Khamis about 31 km to the west. More work was planned, but operations had to be suspended because of inclement weather and unfavorable flying conditions. The investigation was made as part of a mineral exploration program undertaken by the U. S. Geological Survey in behalf of the Ministry of Petroleum and Mineral Resources of the Kingdom of Saudi Arabia. Field data were obtained by the authors during the period of April 9-16, 1967.

The area is near lat. 19°10'N., long. 41°50'E., about 13 km south of Qarn Hadil and 12 km west of Lakathah (fig. 1). It occupies the east part of a lowland between Wadis Yiba and Shai'al north of Wadi Nahimah (fig. 2) and is about 500 m above sea level. Narrow sharp crested ridges rise to heights of 15 m to 60 m in the eastern part and very prominent high ridges lie along the west side of the area.

The geology of the area was mapped by R. L. Earhart of the U. S. Geological Survey. The country rock consists of chlorite and chlorite-quartz schist which include zones of siliceous dolomite interbedded with quartz-chlorite schist (fig. 2). These rocks have been deformed into a north-plunging syncline and cut by several near-vertical faults. Disseminations of chalcocite and malachite with minor amounts of zinc mineralization occur in the dolomite zones near the nose and along the east limb of the syncline. Small amounts of copper carbonate and sulphides also occur in the bordering belts of chlorite-quartz schist. The dolomite units form the ridges in the eastern part and along the west side of area.

Reconnaissance dip-angle data were obtained along 12 traverses across the dolomite unit on the eastern limb and in the nose of the syncline (fig. 2). These data were supplemented by horizontal-coil measurements along six traverses in the more level parts of the area to define conductive zones indicated by dip-angle observations.

INSTRUMENTS AND FIELD PROCEDURE

The dip-angle measurements were made with vertical-coil equipment energized by a 500-watt generator and operated at a frequency of 1100 cps (Sharpe, Model SE-100). Measurements were made with the transmitter placed over mineralized outcrops, and subsequently, over the trace of conductive zones located by the receiver coil along traverses 100 to 300 m from the transmitter stations. Data were obtained at 10 m intervals along traverses crossing trends of the zones at right angles. Depth of penetration of the dip-angle measurements was about 50 to 150 m approximately half the distance between the transmitting and receiving coils.

Horizontal-coil data were obtained with an ABEM Gun operated at a frequency of 1760 cps and a coil separation of 90 m. In-phase (R) and out-of-phase (I) measurements were made at intervals of 10 m along traverses across the inferred conductive zones. The effective depth of penetration of these measurements was about 45 m. The instruments were calibrated near the camp.

DATA AND INTERPRETATION

Small dip-angles with magnitudes of less than 12° were observed in the geophysical reconnaissance. Data obtained over a low ridge in the northeast part of the area suggest that a weak conductive source lies near the fault zone on the west side of the dolomite unit (fig. 2). According to measurements made along adjacent traverses, this source does not seem to continue southward beneath wadi sediments into a higher and more prominent exposure of the unit. Measurements near the nose of the syncline suggest that a conductive zone lies along the south side of the dolomite unit and continues westward into the chlorite schist beyond the main ridge of the exposed dolomite (fig. 2).

Profiles of the horizontal-coil data along traverses A and B in the northeastern part of the area show small negative out-of-phase values and corresponding low-in-phase readings on the west side of the base line; and a more prominent negative anomaly over the western part of traverse B (fig. 3). The small negative variations appear to be anomalous and probably are caused by conductive material in the bordering fault zone and in the interbedded schist and quartz veins west of the dolomite unit. The prominent anomaly on traverse B occurs over similar rocks between 130 m and 230 m west of the base line. It coincides with a westward-trending fault zone that cuts the axis and west limb of the syncline. The anomaly seems to be associated with material in the fault zone.

Small negative in-phase and out-of-phase anomalies (fig. 3) were observed along traverses in the southeastern part of the area. Profiles of traverses C & D show an anomaly over the conductor trace indicated by dip-angle measurements; and small anomalous variations to the north that may be the expression of a weak conductor beneath the northern edge of the dolomite unit. Anomalies along traverses E & F are much broader than those east of the main outcrop ridge and may be associated with multiple conductive sources. The minimum shown in the profile along traverse E are inferred to mark thin conductors near the trace of the dip-angle anomaly source and near stations 90 S and 130 S. Irregularities in the anomaly

along traverse F indicate that the source is a broad zone comprised of thin multiple conductors beneath wadi sediments between stations 30 N and 110 S. The data suggest that the thickness of individual conductive sources in the nose of the syncline are generally less than 10 m. Ratios of the in-phase to out-of-phase values indicate the anomaly sources are of low conductivity.

CONCLUSION

The results of this brief investigation indicate that no deposits of massive sulphides occur in the parts of the area investigated. The observed anomalies are small and are probably caused mostly by minor changes in conductivity of the country rock. However, anomalies near the dolomite unit may represent deposits of disseminated sulphides. More geophysical work should be done to establish anomalous trends and to determine their relationship to the sulphide-bearing dolomite unit. Such information in the light of geologic data would be helpful in locating concentrations of disseminated sulphides.