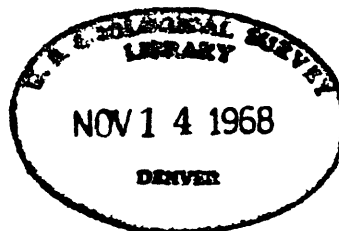


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Saudi Arabia Investigation Report
(IR) SA-43



MINERAL RECONNAISSANCE IN THE
SOUTHERN PART OF THE WADI AZLAM
QUADRANGLE, SAUDI ARABIA

by

Robert F. Johnson and Virgil A. Trent

U. S. Geological Survey *68-150*
OPEN FILE REPORT

This report is preliminary and has
not been edited or reviewed for
conformity with Geological Survey
standards or nomenclature.

1968

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 Also on open file in that office is a large amount of material, in the form of unpublished manuscripts, maps, field notes, drill logs, annotated aerial photographs, etc., that has resulted from other previous geologic work by Saudi Arabian government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.

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INTRODUCTION

During a mineral reconnaissance of the Bi'r al Bayda' quadrangle (Johnson and Trent, 1966) a few days were spent in the adjoining part of the Wadi Azlam quadrangle to determine the extent of known mineralized area and to examine anomalous features that had been observed in a study of aerial photographs. The area examined is indicated by the sample localities shown on the accompanying map. Subsequently a trip was made to Wadi Al Farra'ah in the eastern part of the Wadi Azlam quadrangle to examine an area that showed both an aeromagnetic anomaly and an aeroradioactivity anomaly on maps made of the Hunting Airborne Surveys in 1962.

No potentially economic mineral deposits were seen or indicated in the area examined. Some geochemically anomalous wadi sediment samples were obtained near Wadi Hayyan at the south edge of the map. Small amounts of secondary copper minerals and small bodies of magnetite occur in gabbroic rocks in the same area. The ground survey in the Wadi Al Farra'ah area did not disclose any radioactivity and only disseminated magnetite.

GEOLOGY

Granitic rocks predominate in the southern part of the Wadi Azlam quadrangle. Diorite and gabbro occur in a ring structure near Wadi Hayyan at the south edge of the map. Pendants of amphibolite occur in the granitic rock and one area within the granitic terrane is underlain by hornblende gneiss. Slightly metamorphosed mafic volcanic rocks crop out in the southeast corner of the quadrangle.

The granite bodies range in composition from alaskite to hornblende granite. Hornblende granite and hornblende-biotite granite predominate. Small intrusions of

biotite granite occur along the fault from which sample 4294 was taken. The hornblende-bearing granites are surrounded by areas of more mafic rock that are shown as "dg" on the map and are composed of granodiorite and monzonite. These rocks seem to have formed by reaction of the granite magma with the enclosing rocks rather than being separate intrusions. Evidence for granitization is shown by the well-banded hornblende gneiss shown as "sc" that grades into granite at its western end. Planar structures can be traced from the gneiss well into the granite; the planar structures are tightly folded. The red granite that intrudes the metavolcanic rocks in the southeast corner of the quadrangle shows only slight contact effects and is characterized by an abundance of internal slickensided slip surfaces. Some talus boulders are completely bounded by such surfaces.

The rocks are cut by large westerly trending faults that, to the west, intersect the major wrench faults described in the Bi'r Al Bayda' quadrangle. The fault that passes through sample locality 4294 is marked by large masses of quartz-epidote rock probably of hydrothermal origin, but no sulfides other than pyrite were seen.

In the Wadi Al Farra'ah area, slightly metamorphosed mafic volcanic rocks are unconformably overlain by coarse conglomerate and rhyolite flows and breccia. These in turn are overlain by reddish and pale green thin-bedded shale. Unconformably overlying the shale is basalt of Tertiary or Quaternary age. The shales, rhyolitic rocks, and conglomerate are folded, in contrast to nearby gently tilted sandstone of Cambrian age; thus, even though the contact with the sandstone was not seen, the shales and rhyolite are thought to be older and to belong to the uppermost Precambrian rocks, possibly the Shammur rhyolite of Brown and others (1963).

MINERAL DEPOSITS

Samples of screened wadi sediments in the size range between 30 and 80 mesh Tyler screens were collected for trace-element analysis. The results of the analyses for copper, zinc, and molybdenum are shown on the accompanying map. No copper analysis showed more than 50 ppm (parts per million) of copper which is about 5 times background. The anomalous copper values are found along the west-trending faults at the south edge of the area.

Only one sample contained anomalous amounts of zinc; 300 ppm or about 10 times background. Other samples from the same body of diorite and gabbro in the Bi'r Al Bayda' quadrangle contain similar amounts of zinc.

Samples with anomalous molybdenum are more scattered but the anomalies are low, 3 to 5 ppm as compared with a background of less than 2 ppm. An exception is a sample of magnetite sand, number 4297, collected from a wadi west of the head of Wadi Jarasah. This sample contained 110 ppm of molybdenum as compared with a background of 10 ppm for molybdenum in magnetite in this area. The magnetite came from a wadi draining a body of hornblende granite.

The concentration of other elements that occur in unusual amounts in the wadi sediment samples can commonly be explained in terms of the nature of the rocks in the vicinity. For example, the sample located 3 kilometers north of rock sample 4294 contains 1,500 ppm of barium or about 5 times background. Many pegmatites crop out in the area and the barium may well be in the feldspar lattice rather than due to hydrothermal activity. A sample located 5 kilometers east of sample 4294 contains 200 ppm of lanthanum, about 10 times background. This could be of geologic significance as there is biotite granite in the source area of the sediment and other high-lanthanum samples in the Bi'r Al Bayda' quadrangle were associated with biotite granite; the lanthanum content could be of use in determining the sequence of intrusions.

The two rock samples shown on the map in the Wadi Hayyan area are of interest in that one, 10,383, composed of quartz-carbonate vein material, contains 1,000 ppm of copper and 10 ppm of molybdenum. This indicates that metals have been concentrated in veins in the area and helps substantiate our recommendation for more detailed work. The other sample, 4294, is of iron-stained granite along a fault and contains anomalous amounts (2 to 5 times background) of barium, lanthanum, niobium, lead, yttrium, and zirconium.

All of the above analytical data, except for sample 4297, was furnished by Charles E. Thompson, chemist, U. S. Geological Survey. Sample 4297 was analyzed by L. Al Dugaither, chemist, Directorate General, Ministry of Petroleum and Mineral Resources.

No mineral deposits of economic interest were seen in the Wadi Farra'ah basin.

The aeromagnetic anomaly is not large and may be due to a small fine-grained granitic intrusive that contains as much as 10 percent magnetite. The adjacent rocks are rhyolite flows and breccia that contain very little magnetite. We made four traverses on foot with a geiger counter across the area covered by the aeroradioactivity anomaly shown on the Hunting Survey maps but did not detect any anomalous radiation.

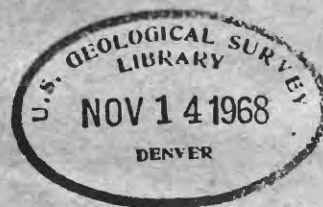
We recommend further work in the Wadi Hayyan area particularly that part underlain by the diorite and gabbro and along the major faults. A magnetometer survey of the ring structure is also recommended. We do not anticipate any major ore discoveries in this area but the concentration of magnetite bodies and the presence of anomalous trace amounts of several elements warrants further study.

REFERENCES

- Brown, G. F., Jackson, R. O., Bogue, R. G., and Elberg, E. L., Jr., 1963, Geology of the northwestern Hijaz quadrangle: U. S. Geol. Survey Misc. Geol. Inv. Map I-204 A.
- Johnson, R. F., and Trent, V. A., 1968, Mineral reconnaissance of the Bi'r Al Bayda' quadrangle, Northwest Hijaz: U. S. Geol. Survey open file rept. SA-37, 13 p.

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		Explanation
Quaternary	Qal	Alluvium and wadi fill
Quaternary and Tertiary	Tb	Basalt flows
Precambrian	sr	Shammar rhyolite. Rhyolite flows and breccia, red and pale-green thin-bedded shale. Unmetamorphosed but commonly dipping at moderate angles
	gb	Gabbro and associated diorite
	gr	Hornblende granite, hornblende-biotite granite, biotite granite, alaskite. Reddish to pale gray. Appears to be largely syntectonic.
	dg	Granodiorite and monzonite. Dark colored rocks on margins of granite intrusions.
	gd	Slightly metamorphosed andesitic volcanic rocks.
	am	Amphibolite, commonly occurs as pendants in granite
	sc	Hornblende gneiss. Well banded gneiss of unknown origin
	---	Contact. Dashed where approximately located, dotted where concealed
	- - - -	Fault. Dashed where approximately located dotted where concealed
	●	Sample with 20 ppm (parts per million) or less of copper in wadi sediments
	○	Sample with 30 or 50 ppm of copper in wadi sediments
	△	Sample with 300 ppm of zinc in wadi sediments
	□	Sample with 3 to 7 ppm molybdenum in wadi sediments
	X	Rock sample
10385		Sample number



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