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GEOCHEMICAL SAMPLING IN THE WADI SHUGEA-WADI HAWARA AREA SAUDI ARABIA

by

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 Also on open file in that office is a large amount of material, in the form of unpublished manuscripts, maps, field notes, drill logs, annotated aerial photographs, etc., that has resulted from other previous geologic work by Saudi Arabian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

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Introduction

The Wadi Shugea - Wadi Hawara area is about 130 kilometers northeast of Jiddah and about 35 kilometers northeast of Jabal Sumran. The area was investigated in the course of a reconnaissance mineral survey in the escarpment region of the Hijaz between 22 degrees and 24 degrees latitude during October and November, 1965. More samples were taken here than over most of the rest of the region because of the presence of ancient workings. Abdul Razak Bakr† assisted in the work.

The area is accessible by road up Wadi Sitarah from Buraykah and up Wadi Siyah from Khulays. Cleared vehicle tracks in Wadi Hawara and Wadi Marrakh lead to charcoal collecting and shipping points at Am Mahani and As Shugea. Beyond these points, four wheel drive vehicles can go no more than a short distance in the main wadis. It is possible, however, to drive up Wadi Shugea at least three kilometers. Local relief ranges up to 2000 feet and most wadis are quite bouldery. Most of the sampling was done by helicopter. One-half day was spent on the ground in Wadi Shugea.

R.G. Bogue (unpub. data, 1952) spent eight days in the area in 1952 and has described the rocks and several of the ancient workings and slag piles. Unfortunately, I was not able to identify the places named by Bogue except for Wadi Hawara and Wadi Sitarah. His Wadi Baharan may be Wadi Shugea or it may be the wadi parallel to it on the east. Bogue thought the prospects of finding copper of economic grade in this area unlikely. Assays of gold and silver from ancient workings in upper Wadi Hawara, presumably near Am Mahani, showed little value (table 1B). He suggested, however, that further investigation be made in the vicinity of ancient workings in a place called Maharis (not found) which showed possibilities of gold and silver (table 1B).

From the air, a zone of apparent alteration marked by red, pink, and white rocks was seen extending north-northeastward from Wadi Marrakh along Wadi Shugea into upper Wadi Hawara near Am Mahani (map). This zone, about 15 kilometers long and about 3 to 4 kilometers wide, was crossed several times in different places by helicopter. The Am Mahani area, Jabal Baharan and Wadi al Joeh were circled in an effort to locate ancient workings and slag piles. The presumed workings near Am Mahani were not located, but the slag pile in Wadi Shugea and two possible ancient pits along the crest of Jabal Baharan east and northeast of the mine symbol shown on the map were located. The helicopter was unable to land at the pits and time did not permit them to be visited on foot. Observations on rocks were made at places where the helicopter set down to collect wadi samples and at a few places on tops of ridges where the helicopter could land. The lower part of Wadi Shugea was visited by vehicle and an ancient working on the side of Jabal Baharan was located and sampled.

Geologic setting

The major geologic units are shown on the accompanying map with approximate boundaries. Details of the local geology have been given by Bogue, and the geology of the region to the west, involving some of the same units, has been recently mapped at a scale of 1:50,000 by Dr. K. Nebert of the Directorate General for Mineral Resources. Descriptions of the rocks are given below only for the area sampled.

The volcanic and sedimentary rocks are a thick folded sequence of sandstone, shale, and limestone interspersed with layers of tuff and tuffaceous wackes, conglomerate containing primarily volcanic material, and sheets, dikes, and masses of andesite, felsite, and locally basalt. A large part of the section is volcanic in origin. Most of these rocks are little metamorphosed but locally some are cleaved, recrystallized, and sheared producing greenschist, greenstone, marble, and hornfels. Some rocks contain disseminated pyrite and appear silicified. Scattered thin quartz veins appear to be later than the pyritization. Late hydrothermal alteration has taken place along fracture or shear zones.

The volcanic and sedimentary rocks are intruded by plutonic rocks, primarily granodiorite, and quartz diorite. These rocks are part of an extensive mass of granodiorite, quartz diorite, and diorite forming a northeast-southwest trending belt in this region. Small masses of apparently younger red to pink granite or quartz

monzonite occur in the granodiorite. East of Wadi Shugea is a satellite mass of medium-grained granodiorite. The granodiorite and quartz diorite are locally crushed and partly epidotized and in one place at least has late enrichment in quartz. Although the granodiorite is younger than the sedimentary rocks and most of the fragmental volcanic rocks, andesite and felsite dikes cut the granodiorite. The contact of the main mass of the granodiorite with the sedimentary-volcanic rocks is relatively straight suggesting that it might be a fault.

Most of the altered rocks observed along Wadi Shugea are, where fresh, greenish gray and bluish gray siliceous or cherty-appearing rocks containing scattered pyrite cubes. Some of these rocks contain small feldspar crystals and resemble a porphyritic felsite. Others contain rounded quartz grains recalling a quartz porphyry. Where altered these rocks are stained red and pink, or are leached to a chalky white. The pyrite cubes are converted to hematite and limonite. The alteration appears to be most intense along certain planes of fracture or shear and some of these have thin seams of gossan.

The one ancient working visited was on the south side of a spur extending from Jabal Baharan toward Wadi Shugea (see mine symbol, fig. 1 on map). It consists of a series of ten pits extending for about 100 feet along the edge of an andesite dike cutting altered rocks. The dike is not noticeably altered. The pits are filled by rubble. Fractures in the andesite, particularly near the edges contain a little malachite and rarely chalcopyrite. Thin quartz veins in the area, mostly less than 5 cm thick, appear to be barren except for a little chlorite and a few hematite - limonite cubes after pyrite. Some quartz in the dump piles shows a little malachite stain.

Grab samples of some of the quartz and some of the malachite-coated rocks in the dumps were taken for assay. Samples were also taken of altered and unaltered pyritiferous felsite (or silicified rock) in the same area. Results of assays of these rocks show little of value (table 1A).

Table 1A Results of assays of samples near ancient workings, east side of Wadi Shugea

Sample number	Rock type	Ounces per ton		Percent
		Gold	Silver	copper
1922	Grab, vein quartz, tailings, ancient workings	.06	.64	trace
1923	Grab, assorted tailings, including quartz	.05	.61	0.2
1925	Leached felsite	trace	.60	0.1
1926	Pyritiferous felsite, upper layer 50' wide	trace	.60	0.15
1927	Pyritiferous felsite, lower layer, 25' wide	trace	.60	0.1

Assays by M. Bahijry, Laboratory of Directorate General for Mineral Resources, Jiddah

Table 1B Results of assays reported by Bogue, 1952 (unpub. data).

Sample number	Description	Ounces per ton	
		Gold	Silver
RGB-8	Composite of 14 quartz veins, ancient workings Wadi Hawara	0.07	0.33
RGB-9	Pillar, 12" sample, ancient workings Wadi Hawara	0.02	0.56
RGB-3	Surface exposure or vein, 8", Maharis	0.22	1.10
RGB-4	Pillars, 12" sample, ancient stope, Maharis	0.08	1.04
RGB-5	Pillar, 10" sample, ancient stope, Maharis	0.06	0.78

Analyst not reported.

Geochemical sampling

Samples of fresh wadi sand were collected at appropriate localities. Unfortunately Wadi Al Joeh and its tributaries were not sampled. The wadi sand was seived to -30 80 mesh and submitted for spectrographic analysis. A panned heavy mineral separate and a magnetite sample taken from the raw wadi sand were submitted at the same time, but the results of analysis of these samples have not been received as yet and are expected only to supplement the data presented here. Spectrographic analyses were made by Mr. Charles E. Thompson, U.S.G.S. and Mr. Mohammed Said, and Mr. K. Shabwan in the laboratory of the Directorate General for Mineral Resources, Jiddah. Twenty-seven elements were reported but only copper, molybdenum, and zinc have anomalous values worth noting. Histograms prepared for these three minerals made possible an estimate of anomalous and non-anomalous values (figure 2). Anomalous copper values were considered to be 100 ppm or more, anomalous molybdenum values to be 3 ppm or more, and anomalous zinc values to be 150 ppm or more. It is possible that when reports of analyses from elsewhere in the region are received, it will be found that 70, 50 or even 30 ppm copper is anomalous. However, in this area it appears that the 30 -50 -70 ppm interval represents background and that only the values a 100 ppm copper or over are anomalous. The non-anomalous copper values are plotted on the map to show the location of the samples.

The anomalous values coincide with the area of apparent alteration, except for the anomalous values in zinc and molybdenum near Bi'r AlMehejun, and indicate a positive, if low, combined anomaly in copper, zinc, and molybdenum in this area. It is possible that the trend of the anomalous area might be found to be in a more easterly direction if sampling were done in upper Wadi Thera and in Wadi al Joeh and its tributaries. However, no evidence was seen from the air of mineralization or alteration in these areas. Too, more detailed sampling might show that the anomalies for the different minerals have different patterns.

The anomalies do not appear to be particularly high, but this may be a function of the sampling technique. It should be noted that the sample showing the highest values was from a watercourse lying below a slag pile. One ppm of silver appeared in this sample. All other samples were less than 1 ppm silver. The sample taken in the watercourse to the south of this should not have been contaminated by this slag

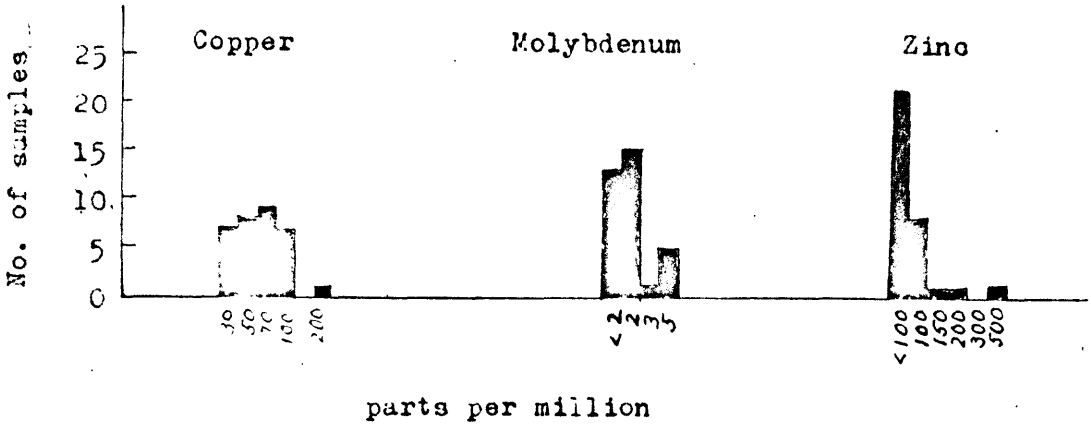

Figure 2. Histogram showing results of spectrographic analysis of Wadi sands in the Wadi Shugea - Wadi Hawara area, Saudi Arabia

pile. According to the local people the ancient workings in Wadi Shugea are along Jabal Baharan and it may be that unobserved tailings account for the anomalous values in the area northeast of the slag pile. However, the sample below the one ancient series of pits visited showed only an anomalous value in copper. It is surprising that the northern of the three samples at Am Mahani taken from a wadi draining an area of apparently considerably altered rocks showed no anomalous values.

Conclusion

The geochemical sampling identifies an area of anomalous values in copper, zinc, and molybdenum located in Wadi Shugea and the head of Wadi Hawara. The anomalous area coincides with a zone of partly altered rocks and with an area of ancient workings. A secondary anomaly, or part of the same one is identified in the Bi'r Al Mehejun area. The anomalies are not high, nor do assay values of samples from the area show significant values in gold and silver. However, I recommend that 1:50,000 mapping be carried out by the Directorate extending the mapping of Dr. Nebert around Jabal Sumran into this area. Such mapping coupled with further sampling and field examination of ancient or newly identified mineralized spots by the geologists mapping the area would make possible a more concrete assessment of the mineral potential of the area. I do not feel that work more detailed than 1:50,000 is warranted at this time.