UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Technical Letter
Saudi Arabian Mineral
Exploration SA24
Prepared September 15, 1964
Issued September 6, 1965

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 10 copies of:

TECHNICAL LETTER NUMBER 24
EVALUATION OF THE UM GERAD BARITE DEPOSITS NEAR RABIGH, KINGDOM OF SAUDI ARABIA

by

Donald A. Brobst*

Sincerely,

Glen F. Brown

Glen F. Brown, Chief
Saudi Arabian Mineral Exploration Project

* U. S. Geological Survey, Denver, Colorado

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Donald A. Brobst*

Introduction

The barite deposits of the Um Gerad district, about 20 km N.50°E. of Rabigh, Kingdom of Saudi Arabia, have been investigated by Mr. S. K. Twitchell in 1936, Mr. D. F. Schaffner in 1957-58, and Mr. W. N. Maclean in 1958. Reports on the work by Mr. Schaffner and Mr. Maclean are in the files of the Ministry of Petroleum and Mineral Resources and need not be recounted in detail here. Investigations were resumed in 1964 by Mr. Ahmed Shanti of the Ministry of Petroleum and Mineral Resources who has undertaken a detailed study of the deposits, including geologic mapping at a scale of 1:1000. In September 1964, the writer was asked to evaluate the economic potential of these barite deposits. The following discussion is based on the information available in the previous reports, conversations with many Ministry geologists, a field examination of the deposits in the company of Mr. Shanti, and laboratory work to determine the barium content of rocks in the Um Gerad district.

Geology

The geology of the Um Gerad district is complex, but the geology of the heart of the district, which lies in a low range of hills having a northerly trend, has been excellently mapped by Mr. Shanti at a scale of 1:1000. The rocks of the district include granite, granodiorite, quartz diorite, diorite and various altered facies cut by dikes of andesite, rhyolite, and aplite. These rocks

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are cut by fractures and faults, some of which are filled with barite.

The barite is restricted chiefly to a series of major fractures with a northerly trend and to other fractures oriented about 45° easterly and westerly to the major structural trend. Only minor amounts of barite occur in fractures and shear zones perpendicular to the major northerly structural trend. The barite veins dip steeply, generally 60° to vertical, and there is variation of dip across short distances along strike.

Most of the barite veins occur in fractured granitic rocks near the base of the hills. Some of the thicker barite veins can be traced outward from the base of the hills to their disappearance beneath the sand of the surrounding valleys. The inner core of the hills consists of dioritic and andesitic rocks that are much less fractured and contain only scattered thin veins and stringers of barite.

The exposed barite veins of the district are generally narrow, one-half meter or less, but locally widen to as much as 3 meters. The veins pinch and swell along strike, and mapping of shafts sunk in the wider parts of some veins indicates that the veins also pinch and swell down dip.

The barite is generally white to pink in crystalline masses that also contain scattered crystals of galena and chalcopyrite, the latter commonly altered to malachite. The barite also contains local pods of dark golden brown jasperoid and black oxides of manganese. The barite is suitable for drilling-mud with little beneficiation.

Interpretation and evaluation

The barite deposits of the Um Gerad district are controlled by the fracture pattern of the host rocks. The fractures are assumed to be part of the Red Sea Rift System. The visible fractures are small as indicated by numerous narrow barite veins.

Chances for finding barite bodies outside of the fracture system are indeed poor because leakage of barium-bearing solutions from the fractures into the surrounding wall rocks was negligible. The barium content of 13 samples of rocks adjacent to and away from barite veins was determined (table 1). Brecciated wall rock next to a barite vein contained less than 500 ppm barium. This value is much less than expected if the mineralizing solutions had deeply penetrated the wall rocks. Only the late andesite and aplite dikes contained 500 ppm barium or more, but these values are normally expected in unaltered rocks of these types. The less fractured diorite, granodiorite, and quartz diorite in the core of the hills away from the best barite veins also contained less than 500 ppm barium. These values also are in the normal range of barium content for unaltered rocks of these types.

The possible tonnage of barite in the studied parts of the Um Gerad district is small. Mr. Shanti has estimated about 100,000 tons of possible barite in veins not less than 0.5 meter in width projected to a depth of about 35 meters (100 feet). Much of this tonnage is estimated to be in veins having the minimum width of 0.5 meter which are widely distributed across many square kilometers. Under the present economic conditions, this is not a geologic situation that is favorable to profitable large scale development.

Recommendations

Further geologic examination of the Um Gerad district is warranted. The barite veins are structurally controlled and some of the wider veins exposed can be traced out to the edges of the sand covered valleys adjacent to the known deposits.

The regional structural setting of the Um Gerad district should be obtained. This can be done by further geologic mapping of the region at a scale of 1:50,000. It has not yet been established whether the known barite veins constitute the heart of a barite district or the fringes of one that lies centered in the structures in the partly covered surrounding area. It is presumed here that the valleys in the region are structurally controlled and that more intense fracturing is part of the reason for the development of these valleys. If this is so, then it is possible that more barite veins might be present in those structures, especially at their intersections. This particular aspect of the geology of the district has been discussed with Mr. Shanti.

If further regional mapping suggests that favorable structures have been located, it is recommended that these structures be studied by gravity measurements to determine whether they contain barite. The country rocks of the area have a sufficiently different specific gravity from the barite so that large barite veins might be outlined successfully by gravity measurements. Such favorable targets might then be prospected by trenches, shafts, or drilling.

It is strongly recommended that Mr. Shanti prepare a short report for publication outlining the principal features of the Um Gerad barite deposits. The report should include a generalized geologic map of the area that can be informative when reduced to page size. Mr. Shanti has plenty of information to do this now. The report should be submitted to one of the geological journals that have wide international circulation, such as the Bulletin of the Society of Economic Geologists published in the U.S.A. Such a report might well attract interest in these deposits by a barite producer who might be interested in doing further work in the area.

Table 1

Barium content of rocks in the Um Gerad barite district

Sample No.		Barium in ppm
1	Basic country rock	*(500
2	Andesite dike	1000
3	Felsite	500
4	Coarse facies of felsite	(500
5	Phorphyritic syenite (?)	(500
6	Brecciated wall rock adjacent to 30 cm barite vein	(500
7	Aplitic granite	500
8	Coarse blue quartz phase of aplite	(500
9	Quartz diorite	(500
10	Jasperoid	(500
11	Sheared, silicified granodiorite	(500
12	Little altered gneissic granodiorite	(500
13	Fresh granodiorite	(500

Analyses by wet chemical methods by D. A. Brobst, September 9, 1964.
All locations keyed to points on Mr. Shanti's map.

Samples 1 to 3 at locality 1
Samples 4 to 6 near DDH-1
Samples 7 to 9 near Station 23
Samples 10 to 12 near shaft at vein with large jasperoid pocket
Sample 13 near last shaft.

*(= less than

Possible deposits of bedded barite in Saudi Arabia

In the search for commercially valuable deposits of barite in Saudi Arabia, the possibility of finding bedded barite in sedimentary rocks should be checked.

Large bedded barite deposits containing many hundreds of thousands of tons of ore suitable for drilling mud have been discovered and mined in the United States and Canada in the past 20 years. The beds of barite commonly are various shades of gray to black, very fine grained and very similar in appearance to the enclosing rocks. Chert, pyrite, and manganese oxides are common associates. The heavy weight of the barite and the fetid odor of hydrogen sulfide commonly released when these beds are struck by a hammer are the best clues to the presence of barite. The barite-rich zone in the large deposit at Magnet Cove, Arkansas is about 60 feet thick and the individual beds contain 50 to 95 percent $BaSO_4$. The necessary beneficiation of bedded barite varies by deposit from grinding only to processing by flotation. Rock containing 30 percent barite is considered the minimum grade for beneficiation by flotation methods.

Sequences of siliceous shales appear to be the best host rocks, although some deposits do occur in carbonate rocks. Many of the deposits are in sedimentary rocks of the geosynclinal facies. Few deposits are known in the shallow water platform facies. Sedimentary units with evaporite rocks are not considered favorable for the discovery of barite deposits. Most of the deposits in North America are in rocks of Middle to Late Paleozoic age, but this age relationship is perhaps a coincidence that the proper geologic host environment prevalied at that time.

The geologic quadrangle maps of Saudi Arabia were examined and from them was compiled the following list of formations, from oldest to youngest age, that might be examined for bedded barite deposits.

1. A Precambrian unit described as sedimentary rocks interbedded with and overlying Shammar Rhyolite that contains some cherty dolomitic limestone appears worth an examination (Sheet 204-A).

2. The Cambrian-Ordovician Ram and Umm Sahm Sandstone, undivided is described as containing chert and manganese in the vicinity of Harrah al'Uwayrid. This area is definitely worth a check (Sheet 204-A).

3. The Devonian Jauf Formation contains micaceous shale and tan siltstone. This unit might have barite, but appears to be a long chance (Sheet 206-A).

4. The Cretaceous Aruma Formation consists of limestone and dolomite with some siliceous beds. The presence of siliceous beds makes this unit worth a check (Sheet 202-A).

5. The Cretaceous Tuwaiq Mountain Limestone containing cream and gray limestone and brown shale is a possibility (Sheet 206-A).

6. The Paleocene and Eocene Umm er Radhuma Formation contains limestone dolomite, black chert zones and thin siliceous beds. This unit definitely should be examined. The suite of rocks is very favorable, even though the unit is very young (Sheets 201 and 202).