UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Technical Letter
Saudi Arabian Mineral
Exploration - 46
March 17, 1966

Dr. Fadil K. Kabbani
Deputy Minister for Mineral Resources
Directorate General for Mineral Resources
Ministry of Petroleum & Mineral Resources
Jiddah, Saudi Arabia

Dear Dr. Kabbani:

Transmitted herewith are 10 copies of:

TECHNICAL LETTER NUMBER 46
PRELIMINARY GEOLOGIC REPORT ON THE AT TA'IF AREA, SAUDI ARABIA, AND AN APPROACH TO THE SEARCH FOR TUNGSTEN.

by

Jameel Kouther*

Sincerely,

Glen F. Brown

Glen F. Brown, Chief
Saudi Arabian Mineral Exploration Project

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Jameel Kouther*

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* Directorate General for Mineral Resources, Jiddah, Saudi Arabia

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Abstract

High values in tungsten were recorded in wadi sands in the At Ta'if area after reconnaissance geologic and geochemical work. More intensive sampling of each wadi over the whole area was done to find out the actual extent of the anomaly and which rocks carry the tungsten. The tungsten appears to be derived from granite which intrudes amphibolite schist.

Tungsten anomalies are centered at Jabal Barad, Ar-Roddaf, and Lyah.

Graphs have been drawn to show how the tungsten value in a sample of wadi sand increases when the number of scheelite grains increase, and to show that the amount of scheelite decreases as the distance from the source increases.

The tungsten anomalies probably extend towards the less accessible scarp region to the west and south.

Introduction

In July 1964, Dr. Richard Goldsmith and the writer spent about two weeks in reconnaissance of the At Ta'if area, Saudi Arabia. Samples collected at that time were spectrographically analyzed by Mr. C. E. Thompson, U.S.G.S., for 27 elements, among which tungsten was found.

Field exploration for tungsten was resumed by the writer on July 13, 1965, and completed August 27, 1965. About 65 samples of wadi sand were collected for geochemical analysis and examination by ultra-violet light.* Many hand specimens were examined every day. The area is rough and not many spots can be reached by vehicles; even foot traverses are difficult in some places.

Geology

Rock types.

This area is underlain by amphibolite schist and plutonic rocks which are Precambrian in age (Brown and others 1962).

Amphibolite schist:-- The oldest rocks are amphibolite schist and some mig-

* Short wave length.

matites with which are intercalated subordinate fine-grained muscovite-biotite schist. The rocks are evidently a metamorphosed sequence of andesite, keratophyre, and tuffaceous graywacke in which pyroclastic materials dominated over detrital clastic debris. Where exposed in the At Ta'if area the unit is at the amphibolite facies of regional metamorphism, or is contact metamorphosed.

The layering of the metamorphosed rocks dips uniformally towards the southeast. The schist has been intruded by non-foliated pink granite, aplite, and pegmatite dikes as well as by andesite dikes.

Plutonic rocks:-- Plutonic rocks in the At Ta'if area are of different ages and include granite and granite gneiss associated with aplite and pegmatite dikes. Granodiorite is rare. These rocks have inclusions of all sizes of the amphibolite schist.

Andesite and felsite dikes:-- There are many andesite dikes intruded into both units; felsite dikes also cut some of the sequence. Relations among these rocks are quite complex but it seems probable that there are two ages of pegmatite and andesite.

Quartz veins:-- Quartz veins are of variable size, cutting all the rock units. They may be of different generations. Some of them have some mineralization of iron, copper or lead.

Structure.

The amphibolite schist unit is moderately folded and all the rocks are faulted. At Wadi Al-G'aaied a fault trends northwest. At Wadi 'Oradah a northeast-trending fault is superimposed on the contact zone between schist and granite gneiss. Near the junction of Wadi Al-G'aaied and Wadi Shugra the axial line of a small anticline trends northeast parallel to the contact zone between the amphibolite schist and plutonic rocks.

Mineralization.

Mineralization in the At Ta'if area mostly occurs at the contact zones between the amphibolite schist and granite gneiss. Copper, lead, zinc, tungsten, and possibly gold and silver are present. Pyritized zones were also observed.

Copper and zinc:-- Near Jebal Gasr, at Wadi Oradah, copper in the form of malachite, chrysocolla, and chalcopyrite is disseminated in a lens of andesite flanked by gossan about 500 m. in length and 3-11 m. in width. Three ancient stopes were found and a few pieces of slag. Ancient ruins are across the wadi from the stopes. Samples were taken to determine the amount of copper, zinc, and lead, but no important values have been recorded.

Near Lyah Farms in Wadi Lyah, the same type of mineralization is present as at Jebal Gasr. In addition, quartz veins up to one meter in width and exposed for about 200 meters along the strike contain sparse malachite and chalcopyrite.

Lead:-- A quartz vein at Jabal Barad about 60 meters in length and half to two meters in width, is shaped like the letter N, and contains pockets of galena.

Tungsten:-- Scheelite was identified in wadi sand samples at many localities, the three most prominent of which are described below. The locations of all scheelite bearing samples are shown on figure 1.

The most important locality, at Jabal Barad southwest of At Ta'if covers about 85 square km. Tungsten has been identified from all sand samples in this area. Values range from 20-1600 ppm (parts per million). The second tungsten locality is at Ar-Roddaf about 11 km. south of At Ta'if. Samples collected there in 1964 have tungsten values ranging from 300-1600 parts per million. The third locality is Wadi Sunhan near Lyah Farms. Two samples are rich in scheelite. Sampling done in 1965 defines the limits of these high values (fig. 1).

A few hand specimens contain little clots which show golden yellow fluorescence under ultra-violet light. These clots are dull yellow in ordinary light and are probably powellite. Other specimens have a little scheelite with bright blue fluorescence and a waxy white color in ordinary light. Scheelite and powellite are locally disseminated in the younger pegmatite and in feldspathic masses in the granite, as well as being scattered in the granite itself. Some mineralized quartz veins contain scattered grains of scheelite and powellite. From this mode of occurrence it is inferred that the scheelite and powellite were deposited in the final stages of the crystallization of the granite and in the post-magmatic stages of formation of pegmatite and quartz veins.

Pyritized shear zones:-- Some cubic oxidesed pyrite is scattered in altered sericite schist at Wadi Shugra, Wadi 'Oradah and Wadi Al-Gaaied. The zones of alteration are intense but not large. Sericite and chlorite are the most prominent products of alteration.

Geochemical and heavy-mineral exploration for tungsten

Method of collecting and preparing samples.

Wadi sand:-- The sediments at the opening of each wadi were sampled with a shovel to about 1/4 meter depth and the locations plotted on the map. Locations were selected where the distributive province of the wadi drained only a small area and where the sample was not contaminated by great piles of mud or wind blown material.

Panning:-- The samples were washed in a gold pan in water, until the mud and light minerals were washed out leaving behind heavy minerals. The residue was then placed in an evnelope having the sample number and left until completely dry.

Removal of magnetite:-- A horseshoe magnet covered with a sheet of paper was passed over the dry heavy-mineral concentrate for three to five times to separate the magnetite from the other heavy minerals.

Ultra-violet examination:-- The concentrates were checked for the presence of tungsten and molybdenum in the form of the minerals scheelite and powellite, by examining every sample under ultra-violet light* in a dark room. Scheelite usually shows a bright bluish white fluorescence, whereas powellite shows a creamy to golden yellow fluorescence. If the sample had any fluorescence, then the number of scheelite or powellite grains were counted. The counting was repeated from three to five times, because the scheelite grains sometimes are very small. The presence of big grains was noted.

Rock samples:-- Many hand specimens were collected from rocks on the sides of the mountains adjacent to a particular wadi, and were numbered in sequence. Every night these specimens were examined by ultra-violet lamp and those with no

* Short wave length

fluorescence were discarded. The fluorescent samples were saved for further mineralogical and chemical examination, but at the time of this writing no further study of them has been made.

Chemical Analysis: The heavy-mineral concentrate and the magnetite, in separate containers, were sent to the laboratory for spectrographic analysis by Mr. C. E. Thompson and wet chemical analysis by J. W. Goldsmith and L. Al-Dugaither for tungsten. The range of tungsten value was from 20-1600 ppm.

Some reconnaissance samples collected earlier were spectrographically analysed for 27 elements, but no anomalous metals were reported.

Relation of scheelite grain counts to chemical analysis for tungsten.

The number of scheelite grains were plotted against the chemical data expressed by parts per million tungsten (graph No.1). An inclined line drawn along these points show that whenever the number of scheelite grains increases the amount of tungsten in the sample of wadi sand also increases. A few points lie out of the line. This may be due to the presence of other tungsten minerals which were not been counted owing to their non-fluorescent character. Normal spread of analytical values may account for part of this variation, but the likelihood remains that possible huebnerite accompanies scheelite in some samples.

Relation of scheelite concentration with the distance from the junction of Shaieb with the Wadi.

As it might be expected it has been proved that the number of scheelite grains decreases from the possible source (graph No.2).

Conclusion.

Results of the investigation disclosed anomalous amounts of tungsten in the forms of scheelite, powellite and possible huebnerite in wadi sands from Jabal Barad which covers about 85 sq.km. southwest of At Ta'if. The highest values reach 1600 ppm. Locally the tungsten minerals were identified in small veins, but no mineable deposits were found during this study. However, because the anomalous values cover such a wide area, Jabal Barad should have further detailed geologic mapping to

appraise the possibility of mineable tungsten deposits. For the same reason the other two areas - Ar-Roddaf and Lyah - should also be further investigaged in detail.

The copper, lead, and zinc are not in large quantities nor of high grade. Any possibility for their development in the At Ta'if area would depend on the discoveries of mineable tungsten.

The scarp region adjacent to the above mentioned areas should be examined and worked by helicopter, because of its rugged character.

References cited

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