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Geological Sciences

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THE MAGNETITE DEPOSITS OF THE WICHITA MOUNTAINS, OKLAHOMA*

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Deposits of magnetite have been known in the Wichita mountains since the early part of the twentieth century. However, there have been no comprehensive studies made of them nor have they been described in the literature.

During the recent W. P. A. Mineral Survey of Oklahoma, under the direction of the Oklahoma Geological Survey, these ore bodies were examined and samples taken so that further study could be carried on in the laboratory. The results of these investigations are presented in this article.

Magnetite is present in all the gabbro and anorthosite outcrops of the Wichita region. It is only locally, however, that the mineral is concentrated in any abundance and these iron ores are in two general areas, one in Kiowa and one in Comanche counties. The individual deposits will be described in turn.

KIOWA COUNTY

SW¼ sec. 7, T. 4 N., R. 16 W. This deposit is in the form of a ledge 16-18 feet wide. The country rock is arkose (granite wash) and contains some malachite. Fragments of labradorite and other igneous minerals are found in the ore and it is clear that anorthosite underlies the Permian sediments. An old shaft a mile to the northwest, exposes a ledge of magnetite 17 feet wide.

SE SE SE sec. 18, T. 4 N., R. 16 W. Magnetite is exposed in an old prospect pit 6 feet deep. This magnetite is a natural lodestone and the country rock is altered anorthosite. There has been considerable hydrothermal alteration and the rock is loose and friable and is used for road surfacing. Quartz stringers and some malachite are also present.

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NW SW sec. 24, T. 4 N., R. 16 W. Magnetite fragments are abundant over an area of 5 acres, where it is associated with anorthosite.

NW¼ sec. 29, T. 4 N., R. 16 W. Magnetite crops out over an area of 2500 square yards on the side of a hill. The mineral is associated with anorthosite.

NW¼ sec. 33, T. 4 N., R. 16 W. The magnetite fragments are exposed over the area of 10 square feet. A shaft nearby shows the magnetite is associated with anorthosite.

NE¼ sec. 5, T. 3 N., R. 16 W. The magnetite covers 900 square yards.

COMANCHE COUNTY

SE¼ sec. 4, T. 3 N., R. 13 W. Magnetite is found in a fault zone at the contact of anorthosite and granophyre. Considerable magnetite also is disseminated throughout the anorthosite.

NW¼ sec. 21, T. 3 N., R. 14 W. A shaft, 100 feet deep, has been sunk at the contact of anorthosite and granophyre and an inspection of the material from this opening reveals magnetite, sphalerite and galena.

These are probably the most important deposits in the area, but other small ones undoubtedly occur. Many of the outcrops may be only a few square feet or yards in extent, therefore only detailed field mapping will furnish a comprehensive list. However, all the magnetite deposits have similar characteristics and origin, consequenutly the location of additional deposits should in no way alter the conclusions concerning them.

SUMMARY OF THE DEPOSITS

In all the exposures there is clear evidence that the magnetite is associated with anorthosite. In two of the deposits, the magnetite is located at the contact of anorthosite and granophyre and this indicates a structural control of the concentration. In the other outcrops the iron ore grades irregularly into the anorthosite. In every case there has been some hydrothermal alteration and later mineralization with the introduction of quartz and other minerals. Furthermore, all samples show some degree of weathering, the magnetite being partially altered to limonite and hematite and the ilmenite to leuxocene.

DESCRIPTION OF THE MAGNETITE

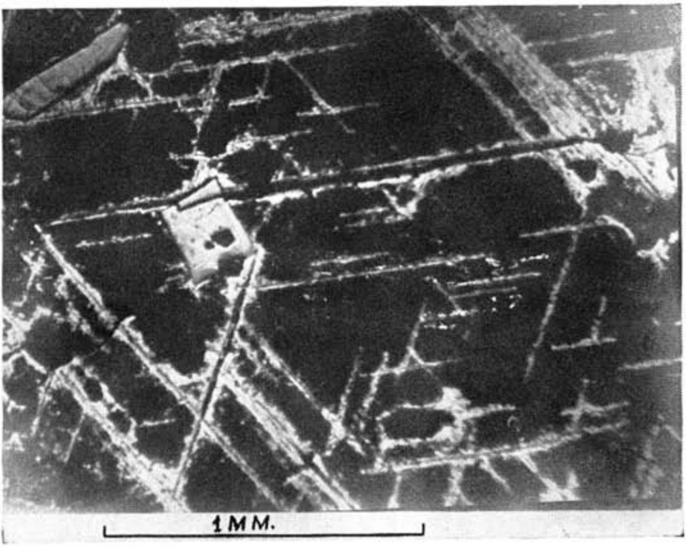
The magnetite is present as fine to coarse crystals, occasionally showing poor octahedral faces.

Two complete analyses of massive magnetite are given in Table I. The specimens analyzed were hand samples and selected because they

TABLE I. *The Chemical Composition of Massive Magnetite*

Chemical Composition	1 Percent	2 Percent
SiO_2	2.52	2.20
FeO	5.34	10.43
Fe_2O_3	71.68	61.95
Al_2O_3	8.61	7.53
MgO	1.47	2.83
TiO_2	10.93	16.05
P_2O_5	1.07	trace
MnO	trace	trace
Total	101.62	100.99
Total Fe	54.28	51.44

appeared to be comparatively free from associated minerals. Sample No. 1 was obtained from NW¼ sec. 24, T. 4 N., R. 16 W., and is Oklahoma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Geological Survey sample No. 4181.. Sample No. 2 was collected from the SW¼ sec. 7, T. 4 N., R. 16 W. and the Oklahoma Geological Survey number is 5736.

Three partial analyses were also made on hand samples from various deposits. In these cases the specimens were selected so as to be representative of the ore bodies. These results are given in Table 2.

TABLE II. *Partial Analyses of Three Samples of Magnetite.*

Chemical Composition	3 Percent	4 Percent	5 Percent
TiO_2	——	5.20	4.40
Fe	19.80	13.70	11.50
Insoluble residue	56.60	75.34	73.00

Insoluble residue was determined after treating with concentrated HCl, HNO_3, and H_2SO_4 and is mainly undecomposed silicates such as labradorite.

The location of these samples were as follows: No. 3. Sec. 21, T. 3 N., R. 14 W.; Oklahoma Geological Survey laboratory No. 5737. No. 4. S ½ SE NW sec. 33, T. 4 N., R. 16 W.; Oklahoma Geological Survey laboratory No. 5734. No. 5. NW SE NW sec. 4, T. 3 N., R. 13 W.; Oklahoma Geological Survey laboratory No. 5738. All chemical analyses were made by S. G. English and H. Sudduth, chemists for the Oklahoma Geological Survey.

A study of these analyses shows the following:

1. The magnetite is titaniferous.
2. There is insufficient ferrous iron to convert the titanium to ilmenite, therefore the latter mineral has been partly altered to leuxocene.
3. Likewise the insufficient ferrous iron indicates that the magnetite has been partially altered to hematite.
4. The magnesium and aluminum are present as silicates and spinel.
5. The iron and titanium contents are variable. In one sample no titanium is reported but this probably represents only a local phase.

MICROSCOPIC CHARACTER OF THE ORE

Polished specimens were made for microscopic studies, and one of these was etched by cold 50% HCl for two hours. The acid attacks the magnetite but not the ilmenite and thus brings them into relief, showing their intimate relationship. Plate 1 shows the typical structure of the titaniferous magnetite which appears as a dark background and the lighter material is ilmenite and spinel.

Ilmenite is present as minute crystals with rectangular outlines and also as irregular elongated fragments. In part, it is intimately intergrown along the octahedral planes of the magnetite crystals, which planes show as a triangular network in the polished specimens.

Minor amounts of diallage, biotite and hornblende were noticed in the polished specimens. These are partially altered to chlorite. A few quartz grains and stringers were also detected and likewise a little malachite and azurite.

The intimate relationship of the ilmenite and magnetite prevents them from being separated by electromagnetic or other mechanical methods.

ORIGIN OF THE DEPOSITS

The characteristics of the Wichita magnetites are so similar to those of other magnetite deposits in various parts of the United States that there can be little question concerning their origin. The titaniferous magnetite is a direct crystallization product from the pre-Cambrian magma that produced the anorthosite and gabbro. In other words, the magnetite is a magmatic segregation deposit. The following points all indicate this origin:

1. The presence of titaniferous magnetite in the gabbros, anorthosites, grano-grabbros, quartz gabbros, granophyres and dike rocks of the area.
2. The gradation of the magnetite deposits into gabbros and anorthosites that contain considerable magnetite.
3. The absence of magnetite deposits in other types of rocks.

The magnetite locally crystallized in considerable abundance and segregated from the other minerals which also were crystallizing from the magma.

There has been later hydrothermal action which introduced quartz, small amounts of chalcopyrite and also altered the femic minerals to chlorite and the feldspar to kaolin and calcite.

In some cases the segregated ore apparently was later moved into fault lines and along the contacts of different types of igneous rocks.

Surface weathering has altered the chalcopyrite to malachite and azurite; the magnetite partly to hematite and limonite; and the ilmenite to leuxocene.

ECONOMIC POSSIBILITIES OF THE ORE

The quantity of magnetite in most of the deposits cannot be determined from the outcrops, and the irregular character of the contacts would make core drilling an expensive procedure. In a few exposures the amount of ore can be crudely estimated from the surface conditions and must run into the thousands of tons. In sec. 7, T. 4 N., R. 16 W., according to Veeder[3], the ore is in a ledge one half mile long covered by granite wash and dipping to the north.

There seems to be little question but that sufficient ore could be found for commercial purposes, providing that the character of the mineral was such that it could be treated economically in the furnaces. Unfortunately, at the present time, the iron industry has a distinct prejudice against titaniferous iron ores and usually refuses to handle them if the titanium content is more than 2 or 3%. The ores of the Wichitas have a variable titanium content but the average of the five analyses, is 7.31% TiO_2 and consequently at the present time are not considered to have economic possibilities.

Singewald[1] has experimented on the separation of ilmenite from magnetite by electromagnetic methods in ores from various localities and in all cases has reduced the titanium content considerably but not sufficiently to warrant their mining. The intimate intermixture of the two minerals and especially the presence of ilmenite along the octahedral lines of magnetite, prevents a complete separation. Furthermore, the magnetite probably contains some titanium isomorphously.

The prejudice against titaniferous iron ores is based on the belief that such material requires an undue amount of fuel to reduce them and also that there is an infusible titanium compound formed which accumulates and chokes the furnace. This makes the process expensive and also requires more skilled labor to manipulate the furnaces. Since large quantities of the hematite ore, free from titanium, are available, the titaniferous ones are discriminated against.

Experiments by Stanfield[2] and others with the electric furnace have given promising results and it is possible that future years may bring a change in the status of these ores. Their low phosphorus and sulphur content are points in their favor and also a certain amount of titanium is beneficial in the making of special alloys such as tool steels.

There are several titaniferous-magnetite deposits known in the United States, and some of these have large bodies of ore and also are located advantageously with respect to coke, industrial centers, etc. In all probability these will be developed before the less favorably located ones, such as those of the Wichita region.

MAGNETITE SANDS OF THE WICHITAS

The sands of the Wichita area contain considerable magnetite which, of course, has been derived from the magnetites described in this article and therefore are titaniferous. In places the magnetite is rather abundant in the sands. It is present in the Permian arkose (granite wash) on the flanks of the mountains and also in the Tertiary and recent sediments in the central part of the region. Such deposits have no commercial possibilities.

REFERENCES

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