PRELIMINARY REPORT

ON

IRON ORE DEPOSITS ADJACENT TO BELT CREEK

MEACHER COUNTY, MONTANA

by

G. E. Goodspeed and P. J. Fitzsimmons

Open-File Report #46-27

1943

CONTENTS

PRELIMINARY REPORT

ON

IRON ORE DEPOSITS ADJACENT TO BELT CREEK

MEAGHER COUNTY, MONTANA

by

G. E. Goodspeed

ABSTRACT

The principal iron deposits adjacent to Belt Creek lie within a radius of several miles from Neihart, Meagher County, Montana. The two principal deposits are the one at Iron Mines Park, 14 miles northwest of Neihart, and in the vicinity of Thunder Mountain about 8 miles west of Monarch, which is 13 miles north of Neihart. The iron ore occurs along or near the contact of the syenite with sedimentary rocks, or as detrital boulders derived from such a contact. The evidence indicates a replacement origin for the ore along only those parts of the contact where fractures permitted the penetration of iron rich solutions. It is estimated that there are 105,000 tons of detrital ore, averaging about 57 percent Fe, in the Iron Mines Park deposit. The deposits on the western slope of Thunder Mountain are estimated to contain 50,000 tons of inferred ore. There is no chemical data on grade.

INTRODUCTION

Belt Creek, heading in the northern slope of King's Hill in the central part of the Little Belt Mountains, flows over 50 miles northward into the Missouri 14 miles east of Great Falls. From a few miles south of Neihart to Monarch the canyon of Belt Creek has exposed the older pre-Cambrian crystalline rocks, and from Monarch to Riceville has exposed a section of the later sedimentary rocks.

The crystalline rocks have been briefly described by Weed 1/ and Pirsson 2/, but it is possible that some of their conclusions might be modified in the light of more recent knowledge of metamorphic rocks. No iron ore deposits have been reported in this series of metamorphic rocks, but one specimen collected from the west side of Belt Creek canyon about 1 mile north of Neihart contains a considerable amount of magnetite.

1/ Weed, W. H., Geology of the Little Belt Mountains, Montana, U. S. Geol. Survey Twentieth Annual Report, 1898-1899, Part III, pp. 251-460.
2/ Pirsson, L. V., Petrography of the Igneous Rocks of the Little Belt Mountains, Montana, U. S. Geol. Survey Twentieth Annual Report, Part III, pp. 463-581, 1900.

Part of this specimen appeared to be a dark purplish argillite, and one face of the specimen showed a few light gray and dark bands; on the other faces, presumably joint cracks were obscured by dark brown (iron and manganese) oxidation products. A sawed section of this specimen not only reveals the banded nature of the rock, but also that the dark bands consist of finely granular magnetite constituting perhaps 40 to 50 percent of the rock. The irregular penetration of the magnetite parallel to the bedding of the argillite, and the lateral spreading out of magnetite from minute cross-cutting veinlets, as well as long, thin, irregular relics of argillite in the magnetite suggest replacement as a mechanism of formation.

Examined under vertically reflected, polarized light, the iron ore is seen to consist of a very fine-grained aggregate of magnetite, hematite, and a highly anisotropic, blood-red mineral which appears to have much internal reflection, and may be lepidocrosite. A little later limonite is also present. Thin sections show that the argillite consists chiefly of kaolinitic material in irregularly rounded (0.02 millimeter) patches and elongated patches (0.06 millimeter) which are in rough alignment with what is presumably the original bedding. Interspersed with the kaolinitic material are numerous minute grains (less than 0.01 millimeter) of a mineral of high refringence and birefringence, which may be boehmite. A few grains of detrital quartz, some secondary silica, and some fine grains of magnetite are present in the argillite. There are also irregular penetrations of silica and a few very minute quartz veinlets with magnetite.

The magnetite in the thin section is seen to be in the form of irregular aggregates 1 by 0.5 millimeter, haphazardly arranged in bands of about 8 millimeters wide. It is associated with quartz and a little chlorite and epidote. Well-formed crystal faces border the magnetite aggregates, and there are projections of magnetite into the quartz aggregate. Some magnetite is finely disseminated in the argillite. It appears that there has been a distinct increase in grain size and a partial recrystallization accompanying the introduction of magnetite and quartz. Since the presence of magnetite was not revealed in this rock until the laboratory studies were made, there is no field data as to possible extent.

The known iron ore deposits in this region are located (1) at Iron Mines Park about 14 miles northwest of Neihart and (2) on the western slope of Thunder Mountain 4 miles in an airline southwest of Monarch. These deposits which are adjacent to contacts between igneous and sedimentary rocks, are predominantly of magnetite which appears to be somewhat similar to the magnetic ores of the Running Wolf district. The development work on them, however, is insufficient to form a basis for accurate tonnage estimates. The above two deposits will be described in some detail.

IRON MINES PARK

The Iron Mountain mine, consisting of some ten claims owned by Mr. Dewey F. Whittaker of Great Falls, Montana, is in Iron Mines Park, 14 miles northwest of Neihart (Fig. 1). It is in Meagher County just southwest of the Cascade County line. The town of Neihart is on a branch line of the Great Northern Railway. Iron Mines Park can be reached from Neihart by a good mountain road up Harley Creek to the southern border of Belt Park, then westward to the Park. The grades on some parts of the road are steep. Iron Mines Park is one of the high mountain parks, over 7,150 feet, of the Little Belt Mountains and has a gentle slope to the south into the drainage of Tenderfoot Creek. Geologically, this region, as shown by Weed 3/, consists of a sequence of sedimentary rocks designated by him as the Barker formation with intrusive masses of syenite.

An area about 1,900 by 900 feet in Iron Mines Park was mapped on a scale of 100 feet to the inch, with a contour interval of 10 feet (Plate I). Although most of the numerous trenches and old shafts plotted on the map showed boulders of magnetite ore on their dumps, no iron ore was seen in place and many of the pieces of ore had the appearance of detrital boulders. In two cuts about 500 feet south of the monument sign on the road, not shown on the map, detrital boulders of iron ore were to be seen extending downward for 2 or 3 feet just below the soil covering. Dip-needle readings taken along the road showed variations of only 2 degrees, and the same results prevailed even where taken along and across cuts showing iron ore on their dumps.

On some of the dumps pieces of igneous and sedimentary rock, as well as banded ore and sedimentary rock, suggest an origin for the ore similar to other deposits adjacent to the laccolithic intrusions of the Little Belt Mountains, namely, a replacement of sedimentary rock by hydrothermal solutions rich in iron and controlled by fracture systems which are present along certain portions of the contact. At Iron Mines Park, however, no ore was seen in place, and where the contact between the igneous and sedimentary rock is exposed, just to the north of the mapped area, no ore is present. Since the dip needle did not indicate any considerable mass of iron ore in the Park, no assumption as to primary deposits below the soil cover could be made. In other words, the presumably detrital ore in the Park may have been derived from some nearby primary deposit or from a primary deposit immediately below the soil cover of the Park. On the assumption that the iron ore was transported, a conservative estimate of the amount of detrital ore underlying the area to a depth of 10 feet would be 105,000 tons.

The only exposure of sedimentary rock in the area mapped crops out 125 feet north of the road (Plate 1). It is a greenish-gray, hard, compact, thin-bedded siltstone with closely spaced, intersecting joints stained with limonite at right angles to one another. The strike is north-south; the dip, 17° E. A thin section shows a fragmental texture with mineral grains in alignment. The dominant constituents are angular

3/ Op. cit.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP

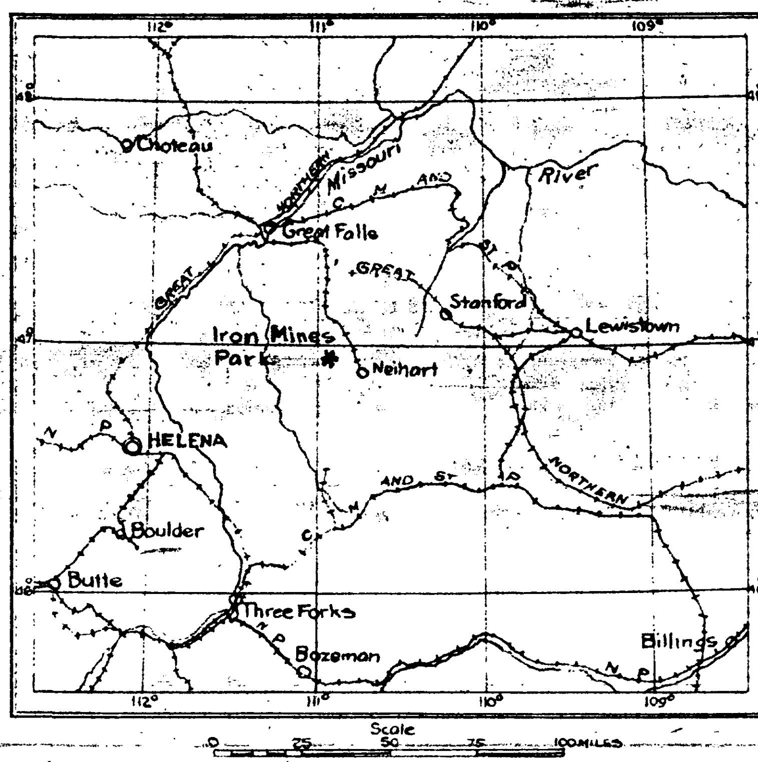

Figure 1 Index map of north central Montana showing location of Iron Mines Park.

to subangular detrital quartz (0.02 to 0.05 millimeter), numerous grains of epidote, some kaolinitic and limonitic material, and some authigenic quartz. A few veinlets of epidote and kaolinitic, limonitic and chloritic material are also present.

Just north of the area mapped, adjacent to the igneous rock, are a few scattered outcrops of indurated shale or argillite with no indication of bedding. This argillite is compact, hard, purplish-gray, and has numerous tight irregular joint cracks. Under the microscope may be seen a few rounded quartz grains and several angular to subangular quartz grains (up to 0.05 millimeter) in a matrix of very finely divided kaolinitic material stained a light brown by iron oxide. A few grains of pyrite (0.17 by 0.08 millimeters) from which some of the limonitic material may have been derived are associated with a little chlorite and secondary silica. There are numerous intersecting quartz veinlets (from 0.01 to 0.05 millimeters in width) which locally contain small grains of epidote and a few minute shreds of biotite. Quartz has also irregularly pervaded the finely divided matrix.

The igneous rock in contact with the argillite is a gray, aphanitic, porphyritic rock with small phenocrysts of feldspar, hornblende and biotite. Under the microscope some of the plagioclase phenocrysts are 2 by 1.5 millimeters in size, but most of them and the orthoclase are 0.75 by 0.5 millimeters. The plagioclase is probably oligoclase-andesine. Some of the brown biotite is in clear euhedral crystals, 1 by 0.25 millimeters in cross-section, and some is cloudy and opaque. There are a few clear crystals of green hornblende outline that consist of an aggregate of platy biotite. There are also aggregates of biotite and hornblende 0.8 by 0.4 millimeters with grains of magnetite in the central part, indicating derivation from an earlier mafic mineral like olivine. In one thin section one phenocryst of quartz 0.24 by 0.36 millimeters and one grain of garnet and one of corundum 0.24 millimeter were noted. Apatite and magnetite are the minor accessories. The phenocrysts, both large and small, constitute about 30 percent of the rock. The groundmass consists chiefly of interlocking anhedral orthoclase, 0.01 to 0.02 millimeters in size, with numerous minute flakes of biotite and a little quartz. This rock is remarkably fresh and unaltered; most of the feldspars are clear, a few of the larger phenocrysts show a slight amount of kaolinization. Due to the very fine groundmass, aphanitic in the hand specimen, this rock should be classified as a trachyte, even though the mode of occurrence is intrusive. It is, of course, a chilled phase of syenite.

About 200 feet north of the contact with the sedimentary rock, the igneous rock is light gray and porphyritic. It contains numerous, small (1 millimeter) phenocrysts of feldspar, euhedral brown biotite, and altered hornblende in a gray aphanitic groundmass. In thin section the phenocrysts are: plagioclase (1.7 millimeter), some zoned with calcic centers; oligoclase (one andesine), orthoclase (0.85 millimeter), brown biotite (0.45 millimeter) partially altered to chlorite; green hornblende (0.50 millimeter) also partially altered to chlorite; and rounded quartz grains (0.34 millimeter), one of which shows corrosion (0.80 millimeter). The groundmass under low magnification has a "salt and pepper" appearance due to the square-shaped orthoclase (0.05 millimeter), with allotriomorphic feldspar and a little quartz. The minor accessories are apatite, magnetite, sphene, an isotropic mineral of high refringence which may be garnet, and some grains with very high refringence and low birefringence which may be corundum. In addition to the chloritic alteration previously mentioned, some of the feldspars are partially kaolinized and sericitized, although the central parts of many of them are clear.

The fact that this rock, somewhat removed from the contact, shows more deuteric alteration than the rock at the contact indicates that the chilled border of the intrusive mass hindered the escape of the fugitive constituents released during the closing phases of the crystallization of the syenitic magma. Therefore, iron ore deposits would be expected only where a fracture system would permit the penetration of iron-rich, hydrothermal solutions. Furthermore, since the deuteric alteration in this adjacent igneous rock indicates no iron-rich solutions, these solutions may have come as the final stage of crystallization of a basic magma from some deeper seated mass. The syenitic magma (of which the trachyte is a chilled phase) may well have been a product of differentiation of a more basic magma as is indicated by the aggregates of hornblende and biotite after olivine in the chilled phase.

As is to be expected, the pieces of iron ore on the dumps of the trenches at Iron Mines Park show the effect of weathering in the amount of later limonite present. Some specimens show malachite with a little azurite along joint cracks. Porous textures, indicative of the former presence of sulphides, are common. From the dump of one cut in the western part of the Park there was obtained a specimen of banded sedimentary rock and magnetite which resembled somewhat the banded ore from the Le Roi claim in the Running Wolf district. Some of the specimens are finely granular magnetite, and several of them appear to be a mixture of granular magnetite and platy specular hematite.

A polished section of the granular magnetite shows a considerable amount of limonite which pervades the mass and surrounds individual grains of magnetite. Some specular hematite is also present, as well as vein-like carbonate stained with limonite. A section of the hematitic ore shows sheaf-like aggregates of specular hematite with interstitial, very fine-grained magnetite and hematite, a little lepidocrocite and later limonite. Some of the platy hematite is associated with carbonate which is commonly stained with limonite. Another section is seen to consist chiefly of very fine-grained magnetite with some granular hematite, lepidocrocite, and later limonite, and a few sheaves of platy specular hematite.

These ores differ from most of those of the Running Wolf district in that they have a higher percentage of hematite. The primary mechanism of origin is probably similar to the Running Wolf ores, namely a replacement of sedimentary layers adjacent to a laccolithic intrusion, although, as stated before, no actual relations were observed in the field.

WESTERN AND NORTHERN SLOPE OF THUNDER MOUNTAIN

The Thunder Mountain iron ore deposits are on the western and northern slope of the mountain of the same name, at an elevation of 6,050 feet, near the head of Iron Creek. They are 4 miles by trail south from Belt Creek and the branch line of the Great Northern Railway, at a point approximately 4 miles west of the town of Monarch. This deposit is called the Frank Marion Group of Iron Ore Claims and is owned by Aren Shell, of Lewistown, Montana, and C. W. Brazee and James A. Brazee, of Monarch.

Thunder Mountain, as shown by Weed 4/, is an intrusive mass of igneous rock with an exposure of about 4 miles in diameter. It is a laccolithic or perhaps chonolithic intrusion into sequence of sedimentary rocks designated by Weed as the Barker formation or the overlying sedimentary sequence designated by him as the Monarch formation. Although steep dips prevail at the contact with the igneous rock, the sedimentary strata a few hundred yards from the contact have gentle dips.

The igneous rock forming Thunder Mountain has been described by Lindgren 5/ as a hornblende dacite, and by Pirsson 6/ as a granite porphyry. Specimens from the northern slope are light gray and granular, with numerous phenocrysts of plagioclase and orthoclase 5 by 3 millimeters in size, a few small, rounded quartz phenocrysts, and altered hornblende and idiomorphic biotite in an aphanitic groundmass. There are a few rectangular patches (3 millimeters in length) of aggregates of mafic minerals. Thin sections show oligoclase (1.5 by 1.5 by 0.5 millimeters) and orthoclase of about the same size. In one section rounded quartz grains range in size from 0.25 to 1.25 millimeters. Some of these are corroded and some, where not corroded, are surrounded by a ragged rim of quartz 0.04 millimeter thick, extending into the groundmass and having the same optical orientation as the phenocryst. The groundmass in thin section consists of allotriomorphic feldspar and quartz (0.04 millimeter) with a mesostasis, of very low birefringence, which may be an altered glass or a form of silica. Under low magnification this groundmass has a "salt and pepper" appearance. In sections from another specimen which does not show as many quartz phenocrysts, the groundmass is peculiarly spotted by irregular patches (0.08 to 0.16 millimeters) which have a micropoikilitic structure of quartz including microlites of feldspar and crystallites of mafics 0.02 millimeter in size. Some of the irregular, sponge-like patches of quartz appear to be transitional into phenocrysts. A mesostasis which is turbid and isotropic may be an altered glass. The mafics are green hornblende and brown biotite. The biotite is unaltered, while some of the hornblende is partially altered to chlorite. The minor accessories are magnetite, apatite, and sphene. Some of the smaller feldspar phenocrysts are partially altered to kaolinitic material and sericite. Since this rock has a very fine groundmass, the term porphyritic rhyolite might be more

---

4/ Op. cit., pp. 364-367.
5/ Lindgren, W., Tenth Census, Vol. XV, p. 720, pp. 506-510.
6/ Op. cit.

applicable than granite prophyry. The chemical composition as given by by Pirsson indicates a granitic magma of rather low silica (67.44 percent) content.

It is noteworthy that a mass of magma 4 miles across, like the Thunder Mountain body should show little or no contact metamorphic effect. The sedimentary rocks only a short distance away from the igneous mass are entirely unmetamorphosed.

Near the head of Iron Creek adjacent to the iron ore deposits the compact, finely-bedded, greenish shales are somewhat altered, showing iron stains in numerous cross-cutting joint cracks. Under the microscope a section of this shale shows a very fine (0.02 millimeter) aggregate of interlocking, kaolin minerals, some of which have a rude alignment. This fine aggregate is spotted with chloritic patches 0.06 millimeter in diameter, and exhibits an irregular penetration of limonite with a few small grains of magnetite parallel to the bedding. Limonitic material is also to be seen spreading laterally from minute cross-cutting veinlets.

The best exposure, on the western slope of Thunder Mountain, examined in July 1943, is near the head of Iron Creek about 75 feet west of the creek and 25 feet above it at an elevation of 6,050 feet. Siliceous limestone lies to the north of this occurrence and igneous rock to the south. In this vicinity on the east side of the Creek the limestone strikes N. 77° W. and dips 57° N. The ore is exposed over a horizontal width of 20 feet, and most of the exposure, which has a maximum vertical height of 25 feet, is characterized by a marked sheeting which probably represents original bedding in the sedimentary rock now replaced by iron ore. Although the ore is massive for thicknesses of over 2 feet, it contains numerous thin layers of shale, and toward the north side of the exposure one is 8 inches thick. The sheeting or bedding has an east-west strike and dips 70° N. The ore is locally very porous and contains considerable limonite suggestive of the former presence of sulphides. A polished section shows a fine granular mixture of magnetite, hematite, and limonite.

Several prospect pits above this exposure and farther to the east along the northern slope of Thunder Mountain show on their dumps iron ore which has characteristics indicating a replacement of sedimentary rock. In cut No. 6 the thinly-bedded shale has a strike of N. 70° W. and dips 40° N.; where the shale is partly replaced by iron ore, its dip is slightly steeper (44° N.), and where wholly replaced its dip is from 44° to 48° N.

Development work was insufficient to warrant any estimate of measured or indicated ore for the deposit at the head of Iron Creek, but an estimate of inferred ore, on the assumption of an ore body 20 feet thick, 200 feet deep, and with a strike of 100 feet, would give a figure of 50,000 tons.

Here, as in the Running Wolf district, it would not be safe to assume that the iron ore occurs without interruption along the contact. The lack of contact metamorphic effects, the slight amount of deuteric alteration in the igneous rock, and the evidence indicative of a replacement mode of formation suggests the localization of the ore along only those parts of the contact where fractures permitted the penetration of iron-rich solutions.

RESERVES

Analyses by the Bureau of Mines of two chip samples from Iron Mines Park are as follows:

Location	Sample No.	% Fe	% Insol.	% S	% P
Open cut 100' long N. W. cor. of Park	21	59.05	8.24	0.003	0.022
Open cut 75' long S. W. cor. of Park	22	55.66	14.00	0.005	0.024
Average		57.35	11.24	0.004	0.023

As previously stated in this report a conservative estimate of the reserves of Iron Mines Park, based on the amount of ore exposed by the trenches and on the assumption that the ore is chiefly of detrital origin, is 105,000 tons to a depth of 10 feet.

For the deposits on the western slope of Thunder Mountain an estimate of inferred ore is 50,000 tons.

CONCLUSIONS AND RECOMMENDATIONS

A magnetometer survey of the Iron Mines Park area should be made before any new trenching or drilling program is undertaken to determine the ore reserves more accurately.

If warranted by exploratory work, open pit mining methods could be used for this type of ore body, provided there was a market for the ore.

As mentioned in the introduction to this report, a specimen collected from the west side of Belt Creek Canyon, about 1 mile north of Neihart, contains a considerable amount of magnetite. If a change in economic factors creates a market for this ore, additional field investigations might be warranted.