UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey
Washington
1947

Preliminary Reports

on

IRON ORE DEPOSITS OF THE IRON MOUNTAIN DISTRICT
Washington County, Idaho

and

IRON ORE DEPOSITS IN THE CLEARWATER DISTRICT
Idaho County, Idaho

by

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OPEN FILE 47-14

Washington
1947

IRON ORE DEPOSITS OF THE IRON MOUNTAIN DISTRICT, Washington County, IDAHO

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IRON ORE DEPOSITS OF THE IRON MOUNTAIN DISTRICT

Washington County, Idaho

SUMMARY

The iron ore deposits of the Iron Mountain district are 33 miles by road from the Union Pacific railroad at Weiser, Idaho. An alternative route for movement of the ores to the railroad at Still Station, Oregon (6 miles) would require construction of a tram or some other means of conveyance across the Snake River.

Estimates summarized in the accompanying table are much lower than those listed in an earlier preliminary report. The drastic reduction in estimates is due in part to recasting of the "proved, probable, and possible" ores of the preliminary report into categories of "measured, indicated, and inferred" ores used in the present report, and in part to new data secured after preparation of the preliminary report. Because of the undeveloped state of the deposits, and the fact that all are of types characteristically erratic in form, estimates of "measured, indicated, and inferred" ores have little significance with regard to tonnage that would be blocked out by exploratory work.

It should be noted, in connection with all "totals", that the ores occur in five separate deposits, that some of the deposits are so small that it is doubtful that exploitation would be feasible even under the most favorable conditions, and that the ores are of three distinctly different types, probably not susceptible to the same metallurgical treatment.

Since it is unlikely that exploration would develop more than 1,000,000 tons in the district, because of the high cost per ton of mining and delivering the ore to the railroad, and because there is no existing market for the ore, no further exploration of the deposits appears to be justified at the present time.

It is possible that at some future time a group of deposits that may contain a "possible" 1,000,000 tons, and situated as these are, may be of commercial significance. For this reason the detailed descriptions of individual properties in this report are accompanied by tentative recommendations for future exploration.

Summary of Tonnage Estimates

	"Measured"	"Indicated"	"Inferred"	Totals
Campbell				
(magnetite (63% Fe)	12,000 tons	16,000 tons	30,000 tons	58,000 tons
Standard				
(specularite (55% Fe)	3,300 "	12,800 "	44,900 "	61,000 "
Mortimer				
(magnetite (61% Fe)	3,600 "	34,000 "	34,000 "	71,600 "
Abundance				
(red hematite (56% Fe)	----	----	45,000 "	45,000 "
Montana				
(magnetite (67% Fe)	----	2,000 "	2,000 "	4,000 "
(red hematite (53% Fe)	----	2,500	2,500 "	5,000 "
Totals	18,900 tons	67,300 tons	158,400 tons	244,600 tons

INTRODUCTION

The Iron Mountain district is located in southwestern Idaho, six miles east of the Snake River and twenty miles north of Weiser, Idaho. As here defined to include a group of closely related iron deposits, the district is approximately two and one-half miles in north-south dimension, with an average width of one mile. It includes parts of sections 11, 12, 13, 14, and 23, T. 14 N., R. 6 W. (B.M.).

The altitude of the iron deposits ranges from 5,400 feet to 6,500 feet; general topographic relations are indicated on the U. S. Geological Survey Pine Quadrangle (Oregon-Idaho). South-facing slopes are mantled chiefly by sage and grass; the remainder is forested, usually with a heavy growth of underbrush. Springs and small perennial streams provide an adequate water supply in all parts of the district.

Distance of the deposits from the Union Pacific Railroad at Weiser is approximately 33 miles, of which 13 miles is paved highway and 20 miles is graded dirt road. The greater part of the dirt road is impassable in wet weather, and it includes local grades exceeding 10 percent. The deposits are approximately 6 miles from Still Station, Oregon, on a branch of the Union Pacific Railroad on the west side of the Snake River. A dirt road, with very steep grades, connects the Iron Mountain district with the Snake via the valley of Dennett Creek. Movement of the iron ores to Still Station by way of the Dennett Creek road would require construction of a tram or other means of conveyance across the Snake River.

Field work in the Iron Mountain district occupied six weeks during July and August 1943. The writer was ably assisted by Earl F. Cook and Joseph R. Fribrock. James Gilluly, Charles F. Park, and P. J. Shenon visited the party in the field and made numerous helpful suggestions. The principal economic results of the study are summarized in this report.

HISTORY AND DEVELOPMENT

The greater part of the prospecting and development around Iron Mountain took place during the latter part of the last century, being encouraged in part by silver strikes in the Mineral district, which adjoins the Iron Mountain district on the west. Nearly all the adits in the district were driven in search for copper or gold- and silver-bearing sulphides, on the basis of a long-standing local theory to the effect that the iron deposits grade into massive sulphide ores at a shallow depth.

A small amount of iron ore, probably less than 1,000 tons, has been shipped for use in cement manufacture at Lime, Oregon, and as smelter flux at Mineral and Cuprum, Idaho. The ore was taken chiefly from open cuts on the crest and north slope of Iron Mountain; no shipments have been made in recent years.

Ownership

Ownership of the iron ore prospects is as follows: the Abundance red hematite, the Standard specular hematite, and the Montana red hematite and magnetite deposits by John Siegwein of Weiser, Idaho; the Mortimer magnetite deposit by Frank Mortimer and associates (the Iron Mountain Mining Company), of Weiser; and the Campbell magnetite deposit by J. W. Campbell and Clifton Barton, of Weiser.

Few claim corners were found in the course of the mapping, and for the most part, all identifying markings had been effaced by weathering. A claim map of the district is included in the Hodge report, cited below.

EARLIER GEOLOGIC STUDIES

The ores on Iron Mountain are described briefly by R. N. Bell 1/ in the Annual Reports of the Mining Industry of Idaho for 1917 and 1918

1/ Bell, Robert N. 19th Annual Report of Mining Industry in Idaho for 1917.
20th Annual Report of Mining Industry in Idaho for 1918.

as consisting of crystalline hematite carrying from 50 to 60 percent metallic iron, with estimated reserves up to several million tons.

A report by E. T. Hodge (1938) 2/ prepared for the U. S. Army

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2/ Hodge, E. T. Report on Available Raw Materials for a Pacific Coast Iron Industry. Vol. 5, Part I. U. S. Army, Office of Division Engineer, North Pacific Division, Portland, Oregon., 1938, pp. 28-45.

Engineers, includes a very generalized geologic map probably taken in part from Livingston's report on the Mineral district, claim maps and a number of analyses. He does not mention any occurrences of magnetite in the district, following Bell in describing the "Campbell magnetite" of the present report as belonging to the "hematite vein type" of ore. Under the heading "Amount and Quality of the Ore" Hodge states:

> "In estimating reserves of possibly commercial ore only thoroughly oxidized and leached portions of the veins can be considered as the sulphur content of all other material will be high. Not over 10 feet can be considered mineable ore and in places even that depth is too great.....For a reserve of 100,000 tons of oxidized (low sulphur) Bessemer ore, assuming an average vein width of 25 feet and a mineable depth of 10 feet, a total outcrop of 3,000 feet is necessary. It is extremely doubtful if the equivalent of such a block of ore could be obtained from the various small lenses....."

The area was visited briefly by John R. Cooper of the U. S. Geological Survey in November 1942, under conditions of snow cover which made detailed study of the deposits impossible. Cooper's report includes several analyses, a generalized map of part of the area, and a recommendation that the district be given further study.

THE ROCK SEQUENCE - EXPLANATION OF THE GENERAL MAP

The metamorphic group: The oldest rocks in the district are a group of metamorphics including (1) a basal hornfels, greenstone, quartzite member, (2) a middle member consisting of coarsely crystalline marble, and (3) an upper member similar to (1). Because both the basal and upper members vary widely from place to place in the district and are usually not separable on the basis of lithology, they are indicated on the general geologic map by the same symbol.

Dominant structural trends in the metamorphic rocks, as revealed by foliation and bedding and by their general outcrop pattern, are northerly and northeasterly.

Quartz diorite and associated rocks: The metamorphics were intruded by a Batholith made up principally of quartz diorite, but including border phases ranging from aplitic to gabbroic types, not distinguished as such on the general geologic map. A transitional zone of strong contact effects, chiefly silication in the marble and silicification and granitization in the hornfels, greenstone, quartzite members, are shown by combination of the symbols for quartz diorite and the respective altered rocks.

The magnetite and specular hematite ores of the district, and closely associated pyrite-magnetite-chalcopyrite veins, were formed by emanations from the batholithic body.

Andesite porphyry: After a period of erosion sufficiently long to permit deroofing of the batholith by erosion, the district was covered in part by flows of andesite porphyry. The relative age of the andesite and the quartz diorite are of some importance in connection with the iron ore deposits; critical relations are best seen in the southern part of the map area, where the quartz diorite is cut by an "andesite dike swarm", and where, in Chinamans Hat, andesite flows rest on an erosion surface which bevels the quartz diorite.

Sheared conglomerate: Following extrusion of the andesite a thrust plate composed largely of Paleozoic volcanic and sedimentary rocks advanced across part of the district from the west and northwest. The sheared conglomerate of the northwestern part of the map area represents a thick series of alluvial deposits spread out in front of the advancing thrust plate, and subsequently overridden and intensely sheared by continued forward movement of the plate. The rocks of the thrust plate proper have been removed by erosion from the Iron Mountain district, but are preserved in the adjoining Mineral district.

At some time after the formation of the overthrust the district was cut by a system of high-angle north-south faults, faulting being accompanied by westward tilting of individual blocks. The body of marble which includes the Campbell magnetite deposit, for example is cut off on the west by a fault belonging to this system.

Basalt: Flows of porphyritic and non-porphyritic basalt rest unconformably on all of the older rocks. Three erosional remnants of the flow sequence occur along the snake-Weiser River divide; the attitude of the flows in two of the remnants suggests post-basalt faulting and tilting. Numerous basalt dikes, only a few of which appear on the geologic map, occur in all parts of the district.

ORIGIN OF THE IRON DEPOSITS

General statement: There are three principal types of iron ore in the district, namely (1) ores made up chiefly of magnetite, (2) ores consisting of gray crystalline hematite, and (3) ores of hard earthy red hematite.

A fourth type of material, not considered here as an iron ore, includes small deposits of cellular limonite which lie as gossan cappings on pyrite-magnetite-chalcopyrite veins. The mode of origin of the several types of ore is discussed briefly below; detailed descriptions of the five separate iron deposits that occur in the district will be found in a **later** section.

Magnetite and specular hematite ores: The magnetite and specular hematite ores are irregular shaped bodies lying in the marble member of the metamorphic group at and near the quartz-diorite intrusive contact. The specularite ranges from finely to coarsely crystalline in texture; the magnetite is massive to finely crystalline. Common mineral associates are quartz and brown garnet and (with the specularite) red jasper. Minor associates include a variety of lime silicate minerals.

The ores can be examined only in natural exposures and shallow pits; locally both types contain cavities occupied by cellular limonite formed by leaching of soluble minerals, probably chiefly sulphides. The leached cavities make up less than 3% by volume of the deposits described below as iron ores.

These relations indicate that the magnetite and specular hematite ores are primary replacement deposits--the sulphur content may be expected to increase somewhat below the surficial zone of leaching, but ores of this type will not normally (see Sulphides below) grade downwards into sulphide deposits.

Red hematite: Locally the compact earthy red hematite ores approach the theoretical metallic iron content of pure hematite; in general the grade is lower by reason of included quartz and red carbonate veinlets and masses of jasperoid material. Minor mineral associates include epidote and soft greenish chloritic substances.

At one point the red hematite is known to be underlain by massive sulphide deposits, and, largely on this basis, it has been considered to be a modern gossan capping. But it is wholly different in all respects from the cellular limonite gossans now in process of formation on sulphide veins in the district. Field relations to be described later indicate that the hematite was formed by thorough leaching of sulphides under conditions of climate, relief, and ground water relations different from those of the present time, on an ancient erosion surface which beveled the rocks of the metamorphic group. According to this view the compactness of the red hematite is the result of static pressure and contact metamorphic effects associated with the spreading of andesite porphyry flows over the old erosion surface, and regional deformation subsequent to burial by the andesites.

The implications of this "ancient gossan" theory differ markedly from those of the modern gossan theory, both with regard to the value of the red hematite as an iron ore, and in connection with its use as a guide to secondary enriched copper deposits.

Sulphide deposits: Veins and pod-like bodies made up chiefly of pyrite, with greater or less amounts of magnetite, and usually carrying some chalcopyrite, occur at a number of points in the district. These deposits are not discussed as such in the present report, but they were formed by emanations from the quartz diorite intrusive, and are, in this sense, genetically related to the magnetite and specular hematite ores. By relative increase in magnetite content, the pyrite-magnetite-chalcopyrite deposits grade into the primary replacement iron ores, all of which probably carry a small percentage of sulphides below the zone of leaching; the "iron deposits" and the "sulphide deposits" are, in other words, end members of the same series. There is reason to believe that the character of the host rock played an important part in determining the nature of any given replacement deposit--marble appears to have favored precipitation of the iron oxide molecule, and the hornfels, greenstone, quartzite, the sulphide molecule.

THE CAMPBELL MAGNETITE DEPOSIT

Geology: The Campbell deposit lies in a small block of marble which is underlain by hornfels on the east, and is probably in fault contact with the same rock on the west (see Campbell map). Numerous measurements of attitude of the foliation in the marble indicate that it strikes slightly west of north and dips 20-35° westward, parallel with the sedimentary contact of the marble and the underlying hornfels; this parallelism suggests that the foliation is probably close to the sedimentary bedding of the original limestone.

The marble is traversed by numerous stringers and irregular pod-like masses of brown garnet and other lime silicate minerals, not separately mapped. The solutions that formed these minerals and the replacement magnetite were probably derived from a quartz diorite intrusive body exposed at the forks of Barton Creek, 600 feet southeast of the deposit and 400 feet below its level (see general geologic map).

Three hundred feet south of the South ore body and 200 feet vertically below it on the southern hill slope, is a caved adit that may have been driven to pass beneath the magnetite croppings (see general geologic map). The adit follows the approximate trend of quartz-pyrite-magnetite-chalcopyrite-specularite veins which strike in a northerly and northeasterly direction in this area; the dump shows some sulphides, but no massive magnetite. The space relations suggest that the same solutions which formed predominantly sulphide veins in their passage through the hornfels produced irregularly ramifying magnetite replacement bodies, low in sulphides, on entering the overlying marble. This possibility may need to be considered in the interpretation of any future exploratory drill holes which pass downwards from marble and/or magnetite ores into hornfels and/or sulphide deposits.

A late basalt dike crosses the northeastern part of the map area, and may be locally in contact with the North ore body.

Description of Ore Occurrences: The South ore body crops out in a mass of magnetite boulders forming a continuous mantle over an area of approximately 10,000 square feet (see Campbell map). Only the upper portion of the boulder mass is in place; the single exposure of the base of the ore body shows massive magnetite underlain by relatively soft material composed of an intergrowth of magnetite and garnet, with a large proportion of limonite-filled cavities suggesting leaching of sulphides. This basal contact, a poorly developed sheeted structure in the magnetite, and the foliation of the overlying marble, dip westward 20-30 degrees. The South ore body is, therefore, believed to be a westward dipping lens; its thickness (exclusive of the subjacent magnetite-garnet material) is at least 20-30 feet.

The North ore body is best exposed in a short adit and an adjoining pit on the north slope of the Campbell spur (see map). The caved portal of the adit shows an 11-foot face of magnetite underlain by a thin magnetite-garnet zone, which is, in turn, underlain by hornfels. The magnetite is overlain by marble, the general relations suggesting a westward dipping tabular body 10-15 feet in thickness.

Sparse magnetite and magnetite-garnet float can be traced northwestward, diagonally down the hillslope, for about 150 feet. More or less continuous float can be followed from the adit southeastward part way around the nose of the spur, to a small caved pit that exposes magnetite in situ. The overall length of the float band is approximately 400 feet.

The elongation of both the North and South ore bodies along the surface trace of the marble-hornfels contact indicates that the basal portion of the marble was especially susceptible to replacement by the ore-bearing solutions, and suggests that the North and South bodies may actually be parts of a single tabular body, continuous along the contact (see map). The intervening space is mantled by soil and talus, so that no direct evidence is available. However, the magnetic contours on the map indicate that the North and South bodies are separate units, not connected at or near the surface. (The contours are based on dip needle readings, the needle being so counterbalanced as to read - 11-13 in areas of no exceptional magnetic disturbance).

No ore appears at the surface along the marble-hornfels contact west of the South ore body. High positive readings in this area, comparable with those over the exposed ore, indicate that the South ore body extends westward under a thin cover of marble for at least 100 feet beyond the ore outcrop area (see Campbell map). A train of large boulders made up in part of magnetite mantles the south slope of the Campbell spur near the west margin of the marble. The magnetite is so heavily contaminated by garnet, and shows so high a proportion of limonite-filled cavities suggesting leaching of sulphides that it is not considered here as an iron ore.

Tonnage Estimates: The 10,000 square feet of boulder masses "in sight" on and near the outcrop of the South ore body is believed to be equivalent to a blanket of solid magnetite of like area and ten feet in thickness. This block of 12,000 tons of "measured ore" probably includes 4,000 tons essentially in place, the remainder being boulders moved somewhat from the parent ledges. This estimate does not take into account a discontinuous mantle of magnetite boulders which extends downslope for 150-200 feet below the main boulder mass. The North body contains no "measured ore."

For purposes of a preliminary estimate of "indicated ore" the South body may be considered to be equivalent to a tabular body with a length of 100 feet (the minimum exposed length), a thickness of 20 feet, and a westward (downdip) extension of 30 feet...7,000 tons. Similarly, the North body may be credited with a length of 250 feet, (exposed or marked by float southeast of the adit), a thickness of 10 feet, and a downdip extension of 30 feet...9,000 tons.

On the basis the increased length suggested by the magnetic contour pattern, and a corresponding increase in downdip dimension, "inferred ore" in the South ore body is considered to be three times the "indicated ore" ... 21,000 tons. "Inferred ore" in the North ore body is estimated to be equal to "indicated" ore ... 9,000 tons.

It is possible that either or both the North and South ore bodies may extend downdip for several hundred feet to the fault on the west side of the marble outcrop, that they may merge in depth, or that other similar lenses may occur in the lower portion of the marble. Estimates of "possible ore," on this basis, would run into six figures, but there is no basis for "inferring" the existence of such additional bodies or extensions of the known bodies.

The magnetite ores to which these estimates apply show a small proportion of quartz veinlets, include some garnet intergrowths, and contain limonite-filled cavities suggesting that sulphides make up 1 to 3 percent of the material below the zone of weathering. The accompanying analyses are representative of the grade of the leached material.

Analyses of Campbell magnetite

	1	2
SiO_2	6.88	7.97
Al_2O_3	2.98	1.08
Fe_2O_3	88.92	----
Fe	62.15	63.25
TiO_2	0.70	0.01
P_2O_5	0.12	----
P	----	0.056
MnO	0.12	----
Mn	----	0.06
H_2O	0.80	----
Total	100.52	

(1) Sample by E. T. Hodge. 39 pounds chipped from boulders (and perhaps ore in place) across 40 feet on the east line of the Last Chance claim

(2) Sample by J. H. Mackin. 22 pounds chipped from boulders for distance of 70 feet along trail around base of South ore body.

Recommendations: The Campbell magnetite deposit appears to be the best of the several prospects in the Iron Mountain district, but it is not likely that exploratory drilling will block out more than a few hundred thousand tons at the maximum. Since a deposit of this size would have little significance as a source of ore for existing plants, no further study is recommended. Any future exploratory program should include (1) bulldozing the outcrop of the North ore body, and (2) three or more drill holes entering at equal intervals along the line A-A', with an inclination of 65° from the horizontal, and an easterly bearing normal to line A-A'. The relations that may be expected in one such hole are illustrated in section B-B'. All holes should be extended through the marble, and at least 10 feet into the underlying hornfels.

Summary of Tonnage Estimates

	"Measured"	"Indicated"	"Inferred"
North ore body	----	9,000 tons	9,000 tons
South ore body	12,000 tons	7,000 tons	21,000 tons
Totals	12,000 tons	16,000 tons	30,000 tons

Total in all categories..................58,000 tons (60-65% Fe)

THE STANDARD SPECULAR HEMATITE DEPOSIT

Geology: The geologic relations of the Standard hematite ore can be described in terms of the succession of rock types encountered in a traverse westward across the three peaks and two intervening saddles which form the crest of Iron Mountain (see Standard Hematite map and section A-A'):-

The east peak is made up of flows of andesite porphyry which rest unconformably upon, or are in fault contact with iron-bearing "contact rocks" and quartz diorite on the west. The "contact rocks" of the eastern saddle and middle peak are subdivided into numbered zones on the Standard map:-

The east saddle (zone 1) shows mixed float including spheroidal-weathering boulders of basalt, probably from a small dike; dense reddish marble with seams of red hematite; red jasper; garnet; and pegmatitic rock types differing notably from the main quartz diorite body to the west and probably representing dikes or apophyses from that body (see section A-A).

The eastern slope of the middle peak (zone 2) is made up largely of dense red marble, heavily garnetized and streaked with red hematite. Bedding or foliation in the marble strikes north-south, and essentially vertical.

The eastern part of the middle peak (zone 3) consists of a four to seven-foot zone of massive quartz containing pods or lenses of coarsely crystalline hematite, with individual warped foliae up to 3/4 inch in breadth. The hematite surrounds euhedral quartz crystals and penetrates cracks in massive quartz. The larger pods of hematite are up to three feet in width and a few tens of feet in length, the elongation of the tabular bodies paralleling the structure of the adjacent marble. The western half of the rib is made up of massive and coarsely crystalline brown garnet containing masses of crystalline calcite and some small veinlets of specularite.

The surface which slopes westward from the quartz-garnet rib to the quartz diorite contact in the western saddle is made up largely of reddish marble and jasper, generally poorly exposed (zone 4). Standing in relief above this surface are two ledges of massive hematite, trending parallel with the bedding or foliation of the marble wall rock. The relations of the two bodies are indicated on the Standard map; whether they represent separate lenses or are parts of a single lens displaced by a minor fault cannot be determined from present exposures. The northern of the two bodies forms a ridge traceable northward for 130-140 feet down the mountain slope. As seen in a 34-foot horizontal face prepared for sampling across the North body, the ore is in sharp contact with red jasper at both ends. The body contains some small quartz veinlets and very small jaspery portions, but is composed principally of finely crystalline specularite traversed by vertical bands (paralleling the walls) of coarsely crystalline specularite. Leached cavities probably amount to less than 1% by volume; a small copper-green stain appears at one point. The south ore body is much smaller in size, and appears to be inferior in grade.

A number of dip needle traverses across the ore exposures indicate that the specularite is essentially non-magnetic; an instrument much more sensitive than the dip needle will be required for any future geophysical work on the deposit.

The limits of the several rock types and ore described above are indicated by dashed lines on the Standard map. These limits can be determined with reasonable accuracy only along the crest line of the mountain; the steep slopes descending northward and southward from the crest are mantled by talus and creep material which makes it impossible to trace out the minor differences (zones) noted along the crest. Data on the geology of the slopes which bears directly on the probable subsurface extension of the North and South ore bodies are as follows:-

Quartz diorite crops out at C, and it is probable that the carbonate contact rocks and quartz diorite continue southward and southeastward under a cover of andesite talus in the vicinity of B. The draw at C contains a narrow train of hematite boulders, some of which are larger in size (up to six feet in diameter) than any hematite pods now exposed in the quartz-garnet-hematite rib at the head of the draw (zone 3). The suggestion is that some of the hematite boulders may have been derived from lenses of hematite in the contact rocks at and southeast of B, now covered by andesite talus. This possibility might be worth testing with an appropriate geophysical instrument if the Standard ores are ever seriously considered for exploitation.

Small caved adits at D are in quartz diorite, and the quartz diorite contact as drawn between C and E is controlled by float and scattered outcrops.

The caved adit at F trends in the direction of the northern ore body, and was evidently intended to cut it 50-60 feet below the outcrop. The size of the dump suggests that the adit was extended 75-100 feet beyond the caved portion, that is, it was driven close to or beneath the downward projection of the ore. The dump is composed of a hornfels-greenstone type of contact rock believed to be unfavorable for replacement by iron oxide ores; there is no evidence that ore was encountered in the adit.

A wide train of hematite boulder masses (to be described below) extends down the north slope of the mountain from the ledge croppings of the North ore body to and beyond a caved open cut near G. The quartz diorite contact is traceable by float mapping from E to the west side of the boulder train, and is exposed farther down the slope on the east side; in a road cut at J the quartz diorite grades into a strongly granitized quartzitic phase of the metamorphic group. Dumps of adits at G and H, in the boulder train area, show only quartz diorite; there is no evidence of ore in situ.

There is a local belief that the great blocks of ore at Cut G, some exceeding ten feet in diameter, are essentially in place and that they indicate a hematite ore body probably continuous with the North ore body at the crest of the mountain. If this were the case, that is, if the boulder train were taken to be outcrop of ore in place, a horizontal length of 700 feet, and a difference in level of 400 feet between the two ends of the body would provide a basis for large tonnage estimates; estimates of several million tons made by some earlier workers appear to be based on this view. But since the hematite replacement ores occur only in carbonate rock and do not occur in the quartz diorite so far as known, the geologic relations described above indicate that the boulder masses at Cut G are part of an ore talus from farther up the slope, probably from the North ore body.

The quartz diorite contact shown in section A-A' by closely spaced dashes is based on connecting a number of points along the surface trace of the contact on the north and south slopes of the ridge by straight lines passing through the plane of the section. An alternative (deeper) position of the contact is shown by widely spaced dashes to emphasize the uncertainty which attaches to its position. The position of adit F in the section is entirely hypothetical, being based on the assumption that the adit continues far enough in a straight line to intersect the plane of the section.

Description of Exposures - Tonnage Estimates: The North ore body is more or less continuously exposed for 140 feet, the exposed width decreasing from about 30 feet near the south end to 13 feet near the north end; the difference in level between the two ends is 50 feet. Two pits in the rib formed by the outcrop show a depth of at least 10 feet. Measured ore is considered to be equivalent to a block 140 feet (long) by 20 feet (wide) by 10 feet (deep)...3,000 tons. Indicated and inferred ore is arrived at by assuming that the body maintains its length and width to the level of the lower end of the exposure, that is, that it is equivalent to a triangular shaped tabular body with the base 140 feet, the vertical leg 50 feet, and the thickness 20 feet....9,000 tons, of which half is "indicated ore" and half "inferred ore."

The small southern ore body is exposed in a blasted face 12 feet high, is at least 20 feet in length in a north-south direction, and at least 10 feet in width. A block 12 feet by 20 feet by 10 feet is considered to be "measured ore"...300 tons. On the assumption that the extension in depth is equal to the exposed height, "indicated ore" is 300 tons. An estimate of "inferred ore" takes into account the possibility that there may be ore in place beneath a stockpile at the base of the blasted face, and that bouldery masses extending for a distance of 25 feet south (downslope) from the ledges may be in situ....400 tons.

The quality of the ore is indicated by the accompanying analyses. Number 1 was probably taken from the South ore body of the present report. Numbers 2 and 4 are representative of the North ore body. The float ore from the north slope of Iron Mountain (number 5) was probably derived from the North ore body. Number 3 is a grab sample of "low grade ore" probably taken across zone 3 and the portion of zone 4 east of the North ore body.

Analyses of Standard Hematite Ores

	1	2	3	4	5
SiO_2	33.92	----	----	12.30	16.92
Al_2O_3	2.59	----	----	1.24	4.26
Fe_2O_3	54.19	79.7	57.00	----	77.78
Equivalent Fe	37.90	58.8	39.9	58.36	54.37
MgO	0.40	----	----	----	----
CaO	3.23	----	----	----	----
Na_2O	0.40	----	----	----	----
TiO_2	0.92	----	----	0.02	0.48
P_2O_5	0.13	----	----	----	0.06
P	----	0.008	----	0.039	----
SO_3	0.02	----	----	----	0.06
MnO	0.11	----	----	----	0.02
Mn				.09	
H_2O	3.91	----	----	----	0.64
Insol.	----	20.4	42.1	----	----
Totals	99.82				100.22

1. Sample by E. T. Hodge .. "31 pounds on a 16-foot horizontal cut along an old pit, the westernmost opening on Iron Mountain"...
2. Sample by J. R. Cooper .. "Half a dozen chips taken at random across 40 feet of high grade ore lying immediately west of the low-grade ore .." U. S. Geological Survey.
3. Sample by J. R. Cooper .. "A grab sample of low-grade specularite ore which is about 100 feet wide. Since the specularite is not uniformly distributed throughout the 100 feet, the analysis is only suggestive of the average grade." .. U. S. Geological Survey
4. Sample by J. H. Mackin.. "32 pound chip sample across 34 foot face of North ore body, north edge of middle peak of Iron Mountain".. U. S. Geological Survey
5. Sample by E. T. Hodge..."49 pounds of chips from a large number of boulders of float ore on the north slope of Iron Mountain, just above the blacksmith shop on the Standard claim.

Recommendations

It is "possible" that ore bodies of moderate size may occur beneath the surface anywhere in the carbonate contact rocks of zone 4, and that the small pods which crop out in zone 3 may increase in size with depth, but there is no basis for "inferring" that these favorable relations obtain. In view of the very small total of estimated tonnages in all categories, and the fact that relations shown in section A-A' virtually eliminate the possibility of deep subsurface extension of any of the replacement ores, no exploration or further study is recommended.

If conditions not foreseeable at the present time call for exploration of the deposit, a drill hole, entering at I (see map and section A-A'), with an inclination from the horizontal of 40 degrees, and a westerly bearing in the line of section A-A', will yield a maximum of data at small cost. The hole should stop at an incline depth of 90 feet if it is in quartz diorite or hornfels-greenstone at that depth, but should be continued beyond the 90-foot point, as long as it remains in carbonate rocks, to 150 feet. If ore is encountered in mineable thickness in hole I, a second hole entering at II, with the same inclination, bearing and qualifications as I, but with a minimum slant depth of 200 feet, will provide data regarding zones 3 and 4 in addition to the extension of the ore encountered in hole I. The advantages of this program, which combines the core data in a single vertical plane, more than offset the disadvantage resulting from the divergence of section A-A' from a direction normal to the strike of the North ore body. If ore is encountered in both holes, a third, from a setup on the west side of the dump of adit F with an inclination of 40° and a bearing of S. 50 W., would be desirable.

Boulder ores: There are more or less continuous showings of hematite and hematite-quartz-jasper boulders through a soil and vegetal cover down the north slope of Iron Mountain to the 6,170 contour. The width of the hematite boulder train is 50-100 feet; sparsely distributed blocks of hematite appear east of the boulder train for an additional 100 feet. Surface showings are relatively poor from the 6,170 to the 6,050 contour, but the open cut at G, in this area, exposes large hematite boulders intermixed with soil and other rock types in a face at least 12 feet in height, along the full length of the cut (70 feet).

The available tonnage of boulder ore can be determined only by bulldozing or extensive test pitting. For purposes of a preliminary estimate, the boulder ore may be considered to be a discontinuous blanket covering one-half the slope distance from Cut G to the parent ledges near the crest (700 feet), with a thickness of 8 feet, and a width of 50 feet. Observations in several small caved pits along the slope suggest that the hematite boulders make up one-half of the blanket, the remainder being soil and rock types other than ore, including hematite boulders greatly contaminated by quartz and jasper. "Indicated ore" would then be equivalent to a block 350 feet by 50 feet by 8 feet/2....8,000 tons. The "inferred ore" estimate is based on the assumption of a continuous blanket 12 feet in thickness and 100 feet in width...700 feet by 100 feet by 12 feet/2...., 40,000 tons. These figures do not take into account boulder ores poorly exposed for 600 feet downslope from Cut C, or the scattered hematite boulders east of the main boulder train.

The quality of the boulder ore is probably similar to that of the North ore body, from which it was derived (see analyses numbers 2, 4, and 5).

No exploration is recommended. The practicability of mining the boulder ores and the "measured" tonnage available could be determined by bulldozer cuts to bedrock along three lines, at least one of which should be in the zone of poor showings between 6,050 feet and 6,170 feet.

Summary of tonnage estimates, Standard hematite ores

	"Measured"	"Indicated"	"Inferred"
North ore body (58 Fe)	3,000 tons	4,500 tons	4,500 tons
South ore body (38 Fe)	300 "	300 "	400 "
Boulder ores (54 Fe)	----	8,000 "	40,000 "
Total	3,300 tons	12,800 tons	44,900 tons

Total in all categories.....61,000 (55 Fe)

THE MORTIMER MAGNETITE DEPOSIT

Geology: The Mortimer deposit lies in a mass of marble surrounded on all sides by quartz diorite (see Mortimer Magnetite map). The contact is everywhere covered by a mantle of soil and talus; it is based on float mapping, and may not be accurate to within 20 feet or more on steep slopes.

Bedding or foliation in the marble, and a sheeted structure (relict bedding?) in the replacement ore, strike north and northeast and dip eastward 20-60 degrees.

Because a number of dip needle traverses across the area tend merely to confirm the extent of the ore based on float mapping, the magnetic readings are not included on the map.

Description of ore occurrences - Tonnage Estimates: Ore is seen in place at three points on the Mortimer property;- at a small caved pit (B on Mortimer detail) at the north end of a belt of magnetite float, and at a caved shaft (C) and two pits (D), near the south end of the float area. The shaft is approximately 15 feet square and 15 feet deep to a floor of caved material; the north, west, and south faces are in magnetite. The larger of the pits at D shows a curving face 12 feet in length measured around the curve and 9 feet in height at the deepest point, all in magnetite. The magnetite in the shaft and the pit extends to the surface, and the area between is littered with magnetite float except along the outcrop of a 30-35 foot basalt dike which passes between them. Excluding the basalt dike, a rectangular block 100 feet long by 20 feet wide by 15 feet deep will include both pits. This block is estimated to contain 3,600 tons "measured ore."

The belt of abundant magnetite float is indicated by a cross-hatched pattern on the map. The greater part of this area, as drawn, lies at the same level or above the three openings which show ore in place; that is, the lower boundary had been so placed as to exclude creep material below the outcrop. The average length and width of the float belt are 400 feet and 60 feet, respectively; the average altitude of the surface is 5,645 feet, and magnetite is exposed in the bottom of the shaft at 5,620 feet. "indicated ore" is estimated as one-half of a block 24,000 square feet in area by 25 feet in depth, the division by 2 being intended to allow for marble and garnet which appears from point to point in the float ...34,000 tons.

The portal of the adit at E is completely caved; the dump is made up largely of quartz diorite and contact rocks, with small amounts of magnetite. It is reported that the tunnel, or a crosscut from it, penetrated to a point directly below the caved shaft at C; that a raise 50 to 60 feet in height was extended to the surface at this point, and that a winze was sunk to a depth of 40 to 50 feet, the raise and the winze together forming a shaft about 100 feet deep (see section A-A'). The tunnel is said to have been in "soft rock," definitely not ore, for the greater part of its length; the winze and the raise are said to have been in very heavy black material that may have been magnetite. But there is no evidence (as ore on the dump at E) to support this view, and it is possible that the black material may have been (dike) basalt in part. It will be noted in section A-A' that a margin of the ore drawn on the basis of this very doubtful hearsay evidence, extends much deeper than would be inferred from the levels of the quartz diorite contacts on the hill sides. In view of these uncertainties, and the probable absence of ore along the tunnel line, inferred ore is considered to be equal to indicated ore....34,000 tons.

The solid magnetite in the several openings mentioned above shows an estimated 3 percent of cavities resulting from leaching of soluble materials, probably sulphides. Copper stain is common in some of the leached material. The ore in the openings, and especially in some parts of the float band, includes a considerable admixture of garnet and other lime silicate minerals, and may require beneficiation. The quality of the leached material is suggested by the accompanying analysis.

Analysis of Mortimer Magnetite

SiO_2	4.77
Al_2O_3	2.10
Fe	61.34
Mn	0.61
P	0.035
TiO_2	0.02

Sample by J. H. Mackin----23 pounds of chips from horizontal cut across faces of ore exposed in openings C and D (U. S. Geological Survey.)

Recommendations

The total tonnage estimates for ore in all categories is small, and the geologic relations are unfavorable for deep subsurface extension of the deposit; no further study is justified at the present time. Any exploratory program that may be undertaken in the future should include the following:- (1) Clearing of the caved portal at E to determine whether the remainder of the tunnel is in such condition as to permit examination; (2) clearing of strips across the float band to permit accurate measurement of the outcrop, and (3) a diamond drill hole entering on the slope a short distance east of the caved shaft (see section A-A') with an inclination of 45 degrees, and a westerly bearing in the line of section A-A'. The hole should be extended to the quartz-diorite contact (50-100 feet ?). Whether or not additional holes are needed and their location, must depend on the results of steps (1), (2), and (3).

Summary of tonnage estimates

	"Measured"	"Indicated"	"Inferred"
Mortimer Magnetite	3,600	34,000	34,000

Total in all categories - 71,600 (61% Fe)

THE ABUNDANCE RED HEMATITE DEPOSIT

Geology: The principal rock types of the Abundance claim area are (1) a thick series of andesite porphyry flows which rest unconformably on (2) the hornfels and marble members of the metamorphic group. Numerous measurements of attitude in the andesite porphyry indicate that the flows strike N. 60-70° E. and dip 20-30° northwestward. The outcrop pattern suggests that the unconformity between the flows and the older metamorphic rock is a somewhat irregular plane having the same attitude as the layering in the flows; it is, in other words, an erosion surface of low relief, covered by outpourings of andesite porphyry and later tilted northwestward.

Red hematite is seen at B on the dump of a short caved adit; at C in a small pit, possibly in float; at D and E as fragments in surficial soil; at exposures above and below the road at F, in a small pit at G, and in stockpiles adjacent to short caved adits at H, J, and K. All of these occurrences lie at or near the unconformable contact between the rocks of the metamorphic group and the overlying andesite flows. The only other known deposit of the red hematite type of ore in the Iron Mountain district (namely, on the Montana claim) lies at the same geologic horizon.

The base of the red hematite is exposed in the first right-hand crosscut in the main Abundance tunnel (portal at L---see section A-A') (1) where it is underlain by massive sulphides, with probable secondary copper enrichment in the sulphides just below the contact. A long caved adit at M passes beneath the hematite exposures at H, J, and K, and is said to have encountered sulphides.

For these reasons and because of the characteristic features of the hematite ore noted in an earlier section, which serve to distinguish it from the primary specularite ores on the one hand, and from the limonitic gossans now being formed by weathering of sulphides, on the other, the red hematite is believed to be an ancient gossan, produced by leaching of sulphide bodies in the rocks of the metamorphic group on a pre-andesite erosion surface, and subsequently buried by the andesite flows.

The fact that the red hematite can be observed to grade downwards into sulphides obviously raises a serious question as to whether the material should be considered an iron ore. It is important to emphasize, in this connection, that the compact nature of the material, and the absence of cavities formed by the leaching of sulphides, indicates that the high iron content and absence of sulphur in available analyses of the red hematite is not due to leaching of existing outcrops at the present surface. The hematite grades downwards into sulphides <u>from the pre-andesite surface</u>: the upper part of the ancient residual mantle is essentially a stratigraphic unit which may be expected to maintain the same quality as shown by the analyses as far down the dip as the mantle continues (section A-A').

The residual iron ore on the pre-andesite surface may have been reworked to a greater or less extent before burial by the andesite flows, and the red hematite is, therefore, not necessarily coextensive with the distribution of sulphide bodies in the metamorphic rock. This point is significant both with regard to the probable extent and continuity of the red hematite as an iron ore, and in connection with its possible utility as a guide to secondary enriched copper deposits.

Tonnage Estimates: Tonnage estimates in the case of the specular hematite and magnetite ores described earlier are based largely or wholly on ledge outcrops or the heavy float showings normally formed by these types of material. In sharp contrast, the red hematite rarely forms outcrops or float; the artificial excavation at F, for example, shows an 11-foot by 12-foot vertical face in solid hematite, but there are no fragments in the soil on adjoining slopes to suggest the presence of the ore. For this reason, in the present undeveloped state of the deposit, there is little basis for close estimates of the tonnage of red hematite available. The amount that might be classified as "measured" and "indicated" ore is insignificant.

For purposes of a preliminary estimate of "inferred ore," it may be assumed that the relatively closely spaced occurrences at E, F, G, H, J, and K, on the two sides of the Fourth of July Creek Valley, lie along the surface trace of a west-dipping tabular ore body. The vertical range of exposures of ore in place in the vicinity of the Abundance tunnel is 40 feet plus (from 5,360 in the underground workings to 5,405 in the face of ore above the road); the vertical range on the north valley side is 60 feet plus (pit H at 5,443 to pit K at 5,508). The tabular body may be assumed to have an average thickness of 30 feet and a downdip extension of 30 feet. The length along the "outcrop" is 500 feet. "Inferred ore" is then approximately 45,000 tons.

These figures do not take into account the possible extension of the ore along the 700-foot length of very sparse float showings between E and the pit at B.

The quality of the ore is suggested by the accompanying analyses:-

	1	2
SiO_2	——	27.87
Al_2O_3	——	1.56
Fe_2O_3	89.8	——
Fe	62.9	46.25
Mn	——	0.14
P	nil	0.116
TiO_2	——	0.01
Insol.	9.7	——

No. 1 Sample by J. R. Cooper--"compact earthy hematite gossan exposed at the end of the caved ground over the Abundance tunnel. From a uniform-looking vertical outcrop 10 feet high by 12 feet broad. The grade indicated is probably close to the average exposed, but this ore is known to pass over into massive iron sulphides at depths between 10 and perhaps 25 feet." (U. S. Geol. Sur.)

No. 2 Sample by J. H. Mackin---14 pound grab sample from stockpiles adjacent to pits H, J, and K. The grade is obviously lower than that of the red hematite exposed over the Abundance tunnel. (U. S. Geol. Sur.)

Recommendations

No exploration appears to be justified at the present time. In view of the uncertainty mentioned above regarding the continuity of the surface trace of the ore body, the first step in any future exploratory program should be the stripping of surface soil along the critical contact between the metamorphic rocks and the overlying andesite flows. Because this contact, as drawn on the steep soil-covered hillsides on the basis of poor float showings, may be in error by some tens of feet, the most practicable method of stripping will be to follow the ore (1) from pits J and K westward down the hillslope, and (2) from F eastward along the hillslope.

Summary of Tonnage Estimates

	"Measured"	"Indicated"	"Inferred"
Abundance Ore Body	----	----	45,000

Total in all categories 45,000 tons (56 Fe)

If the results of surface stripping are favorable, it is evident from section A- A' that a drill hole entering at or near the road, with an easterly bearing along the line of section A- A', and an inclination of 50°. from the horizontal, would provide valuable data on the downdip extension of the iron ore, and on the possibility of enriched copper deposits beneath it.

THE MONTANA DEPOSIT

Geology: The principal rock types on the Montana property include the marble and greenstone members of the metamorphic group, overlain unconformably by andesite porphyry flows in the western part of the map area. While the attitude of the andesites is not determinable locally, the flows and the unconformity at their base probably dip westward at a low angle. The "greenstone," as mapped, includes granular quartzitic phases probably representing recrystallized felsites or quartzose sedimentary rocks. Aplite occurs as float at several points, and aplite dikes cut the greenstone in the underground workings. Basalt float suggests the presence of one or more late basalt dikes, not separately mapped.

Three types of mineral deposits occur on the property, namely, (1) red hematite, (2) magnetite, and (3) sulphides:-

Red Hematite

Description of exposures: The red hematite is exposed in a vertical face 15 feet high by 14 feet across in a caved shaft at B. Adjoining ledges of red hematite and jasperoid material indicate a north-south dimension of 40 feet, and a width of outcrop of 20 feet.

The Montana adit, approximately 400 feet in length, was driven from the portal at C to a point directly beneath the caved shaft at B. The adit is principally in greenstone, which carries disseminated sulphides and some small pyritic stringers. According to John Siegwein, the owner, the shaft at B was sunk to a depth of 50-55 feet, and a crosscut was extended from the base in a westerly direction for 45 feet (see section A-A'). The shaft and crosscut were said to have been chiefly in marble, but "5 feet of red hematite" were encountered at or near the end of the crosscut. Later a raise was driven through greenstone from the Abundance tunnel to connect with the upper workings.

Like the Abundance red hematite, the Montana hematite is believed to be a lens or a tabular body dipping westward along the unconformity at the base of the andesite flows. Section A-A' indicates that this possibility has not been adequately tested by Siegwein's exploratory work.

Tonnage estimates: On the basis of the relations described above, "indicated ore" may be considered to be equivalent to a block 40 feet long, with a westerly downdip extension of 40 feet, and an average thickness of 15 feet ....2,500 tons.

Because the red hematite type of ore does not normally produce float, the absence of ore fragments on adjoining soil-covered slopes has little significance with regard to the possible continuation of the ore body beyond the limits of the present exposures. In the absence of direct evidence, an estimate of an additional 2,500 tons as "inferred ore" has little meaning; the tonnage available may be many times this figure.

Sulphides and Magnetite

A short adit at C penetrates a body of coarsely crystalline pyrite carrying some magnetite and a small percentage of chalcopyrite. The wall rock is a quartzose phase of the "greenstone" complex, and contains disseminated sulphides. The occurence is worthy of mention in this report because the caved portal shows a complete gradation from the massive sulphides into a cellular limonitic gossan, evidently due to leaching of the sulphides under existing conditions of relief and climate. This typical modern gossan is wholly unlike the primary specular hematite and magnetite ores believed by some earlier workers to pass downwards into massive sulphides, and it does not in any way resemble the compact red hematite ore regarded here as an ancient gossan, formed under conditions different from those of the present time.

The Montana magnetite is exposed in a bouldery mass at D, adjacent to the sulphide body. Brown garnet and small fragments of marble on the dump of a caved adit at the south end of the exposure suggest that the magnetite body may replace a pod of marble, not exposed at the surface. The relationship is thought to be analogous to that suggested in the case of the Campbell deposit, that is, selective replacement of marble by the iron oxide molecule, and of greenstone by the sulphide molecule.

Tonnage estimates: The length of the exposure is 50 feet measured along the contour, and the boulders mantle the surface for 30 to 40 feet below the highest croppings. There is no "measured ore." "Indicated ore" is considered to be equivalent to a block 50 feet (long) by 20 feet (thick) with an assumed depth of 20 feet....2,000 tons. On the basis of an assumed depth of 40 feet, "indicated ore" is 2,000 tons. Cavities due to the leaching of sulphides make up an estimated 5-7% of the magnetite boulder masses. It is, therefore, probable that excessive amounts of sulphur may be encountered below the leached material represented by the accompanying analysis.

Recommendations

No exploration of the Montana hematite is recommended. The first step in any future exploratory program should be the stripping of soil from the possible northward and southward extension of the ore body.

Because of its small size and probable high sulphur content, it is unlikely that the Montana magnetite deposit justifies exploration now or at any time in the future.

Summary of Tonnage Estimates

	"Measured"	"Indicated"	"Inferred"
Montana hematite (53 Fe)	----	2,500 tons	2,500 tons
Montana magnetite (67 Fe)	----	2,000 tons	2,000 tons

Total in all categories....9,000 tons

Analyses of Montana Ores

	Montana hematite 1	Montana magnetite 2
SiO_2	20.27	3.51
Al_2O_3	1.20	0.31
Fe	53.67	66.95
Mn	.03	0.09
P	.044	0.031
TiO_2	.19	0.01

(1) Sample by J. H. Mackin....composit of 10-pound chip sample across 14 feet of ore in south face of caved shaft at B, and 10-pound chip sample along 20-foot outcrop of jasper and hematite and jasperoid material south of the shaft. The siliceous character of the surface ledges may be a weathering effect; if so, the sample will show an iron content somewhat lower than the average grade of the body.

(2) Sample by J. H. Mackin....15 pounds of chips from 40-foot bouldery outcrop at D. Cavities due to leaching of soluble minerals make up from 5 to 7% of the material sampled.

IRON ORE DEPOSITS OF THE CLEARWATER DISTRICT
IDAHO COUNTY, IDAHO

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U. S. Geological Survey
Spokane Regional Office

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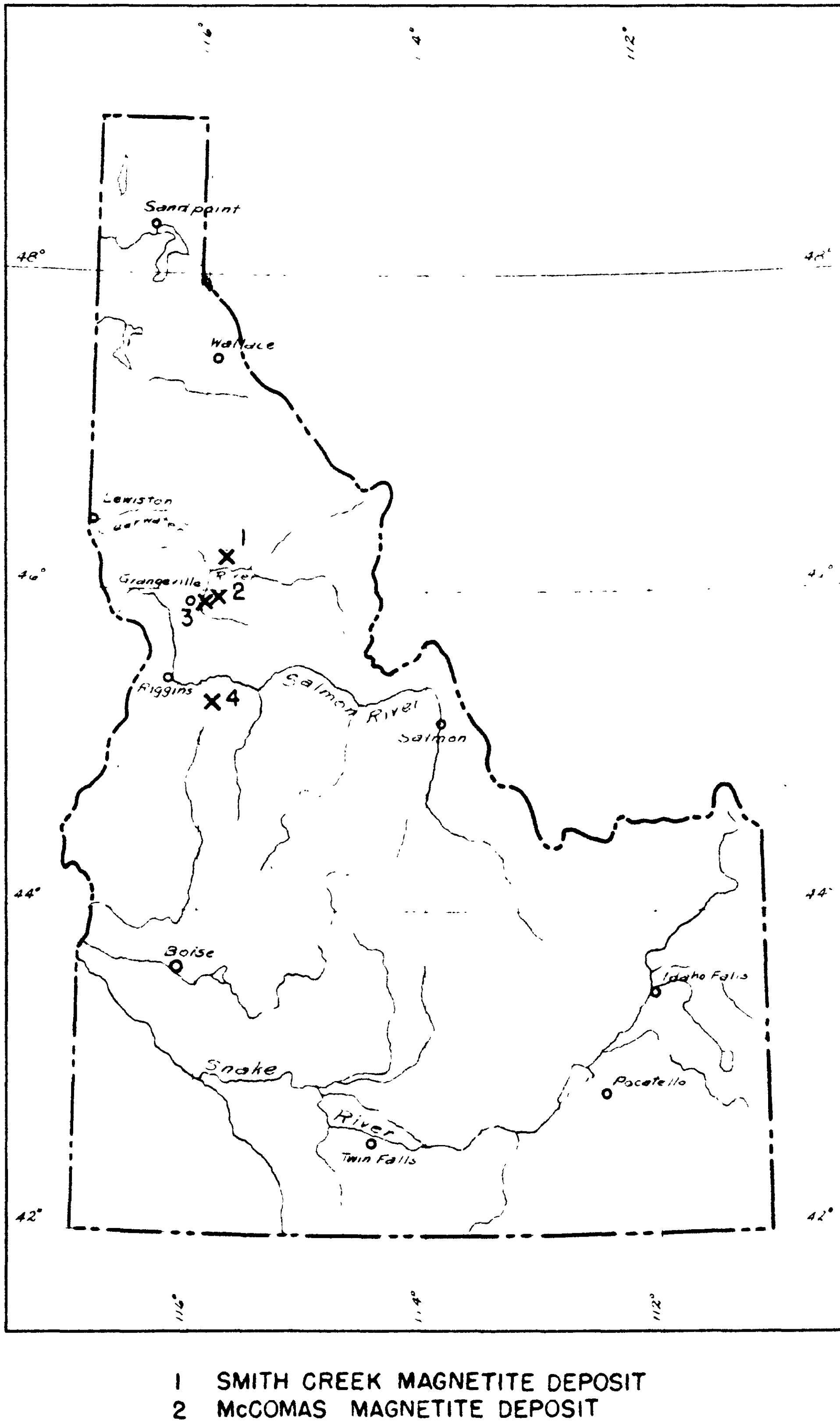
ILLUSTRATIONS



1 SMITH CREEK MAGNETITE DEPOSIT
2 McCOMAS MAGNETITE DEPOSIT
3 MEADOW CREEK MAGNETITE DEPOSIT
4 WAR EAGLE MAGNETITE DEPOSIT

INDEX MAP SHOWING LOCATION OF MAGNETITE DEPOSITS IN AND NEAR CLEARWATER MINING DISTRICT

IDAHO COUNTY, IDAHO

SCALE 50 0 50 100 MILES

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey
Washington
1947

IRON ORE DEPOSITS IN THE CLEARWATER DISTRICT IDAHO COUNTY, IDAHO

By

J. Hoover Mackin

GENERAL STATEMENT

The Clearwater iron deposits are relatively small pods of high-grade magnetite, generally lying parallel with the northerly trending foliation of metamorphic rocks (schist, banded granitic gneisses, and quartzite) probably representing altered and granitized sediments of the Belt series.

The district is forested and brushy, and is so heavily mantled by residual soil that exposures of ore or rock in place are rare. The usual question that confronts the investigator is whether two or more occurrences of ore seen in test pits or marked by float are separate small pods or parts of one continuous body; in most cases tonnage estimates will vary greatly depending on the decision with regard to this point. Geologic evidence, as such, contributes little to the solution of the problem, for there are no evident geologic controls for the localization, size, or continuity of the magnetite pods in the gneissic country rock.

Evalulation of the Clearwater deposits must therefore depend largely or wholly on geophysical mapping, and it was at once apparent that the crude type of dip needle with which the 1943 party was equipped was not suited to the task. It was therefore decided that the limited time available (about 20 days in the latter part of August) could be used to best advantage in a rapid examination of all known prospects and preparation of reconnaissance maps of as many as practicable, with the thought that the data so obtained would serve as a basis for planning future studies, if such studies seemed justified.

An examination of Iron Mountain (north of Elk City) under the guidance of Mr. W. H. Hill of Grangeville suggested that reports of a "mountain of iron ore" in that vicinity are probably based on a number of lenses of amphibolite in gneiss. Several other reported occurrences could not be found, because while many persons had heard of them no one was willing or able to guide us to them. The War Eagle prospect was mapped, and the Rupe and Callard prospects were studied sufficiently to indicate that, as now exposed, these bodies have no promise of providing even "inferred" tonnage in five figures. The McComas prospect was examined and would have been mapped had time and weather conditions permitted. The north half of the Strom-Anderson claims (Smith Creek deposit) was mapped; ore occurrences in the south half of the claim area are so small and widely scattered that mapping did not appear to be justified, particularly because reconnaissance dip-needle readings failed to indicate any continuity between the several exposures. The Meadow Creek deposit was mapped but a magnetic high that extends northward beyond the surface showings of ore was not traced to its end.

The Smith Creek deposit appears to be the largest of the group (indicated plus inferred ore--51,000 tons) probably at least in part because it is the only deposit that has been developed to any extent. The McComas prospect may provide tonnage of the same order of magnitude. In other words, these prospects are very small, and all of the others are much smaller. It should be emphasized that the data are incomplete, that float showings on known prospects are scanty, and that the discovery of the prospects examined in 1943 was in most cases accidental and based on compass deflections. There is at least a possibility that geophysical exploration and drilling may locate one or more elongate bodies of high-grade magnetite extending to considerable depth, and comparable (in methods of mining required, certainly not in size) with the steep-dipping tabular bodies that occur in the Adirondacks.

THE SMITH CREEK MAGNETITE DEPOSIT

Idaho County, Idaho

Summary

The Strom-Anderson claims on Smith Creek include nine occurrences of high-grade magnetite in a northerly trending belt about one mile in length. Exposures in test pits and mine workings, and a dip needle survey of part of the claim area, indicate that most of the occurrences are small separate lenses rather than parts of one or more continuous ore bodies.

Approximately 600 tons of ore were produced during 1942 and 1943 for use as a flux and low-heat admix by a cement plant at Orofino, Idaho.

There is no "measured ore" on the property. The total of "indicated" and "inferred ore" is 51,000 tons, of which 50,000 tons (12,000 "indicated" and 38,000 "inferred") may lie in one body. Because of the small tonnage defined by available evidence, and especially because of its remoteness from existing plants, the Smith Creek deposit has little significance as a source of iron ore at the present time. No further study is recommended.

Introduction

The Smith Creek deposit (also known as the Strom-Anderson and Woodrat Mountain deposit) has been developed to a greater extent than any of the other occurrences of magnetite in the Clearwater District, and, probably for this reason, contains the largest showings of ore in the District. A report by Hodge (1938) includes analyses of the ore, a claim map, and a map showing two small adits that are not accessible at the present time. 1/ Hodge concludes that "with the small amount of development work done, no definite statement of the commercial possibilities can be made." A party employed by the Northern Pacific Railway Company made a dip needle survey of the property during the fall of 1942, probably to determine whether scattered croppings of ore are parts of one or more continuous ore bodies. The results of this study are not known to the writer.

The present report is based on field studies during the latter part of August, 1943. The time available for the work proved to be insufficient to permit mapping of all of the area included in the Strom-Anderson claims, but the more important exposures of ore are shown on the accompanying map and it is believed that further study, in the present state of development of the property will not significantly change the conclusions summarized above.

1/ Hodge, E. T., Report on Available Raw Materials for a Pacific Coast Iron Industry. Vol. 5, Part I, U. S. Army, Office of Division Engineer, North Pacific Division, Portland, Oregon, 1938, pp. 48-53.

Location

The deposit is located in Sec. 29 T. 33 N., R. 6 E., (B.M.), on the west side of the valley of Smith Creek, a tributary of the Middle Fork of the Clearwater River. Neither claim corners nor section corners were certainly identified while the mapping was in progress.

The principal workings are approximately 19 miles from the Northern Pacific Railroad at Kooskia, Idaho, of which distance 17 miles is a paved highway along the Middle Fork Valley, and the remaining two miles is a steep woods road, impassable in wet weather. A projected timber access road will, if constructed, provide for all-weather truck haulagle to Kooskia by a somewhat shorter route.

Ownership and Production

The deposit is included in a group of 11 unpatented claims held by Arthur Anderson and Walter Strom of Kamiah, Idaho, and Charles Anderson of Woodland, Idaho. Iron ore was first discovered in the area by Arthur Anderson in 1932; since that time, on the basis of very sparse float showings and by use of a dip needle, Anderson has located nine separate occurrences of ore in a northerly-trending belt about one mile in length. These have been explored to a limited extent by shallow pits and several adits; the two largest were worked in 1942-43 to supply magnetite for use as a flux and low heat admix at the cement plant of the Washington-Idaho Lime Products Company at Orofino, Idaho. In 1943 Mr. Alvin Throop of Kamiah was producing the ore on a royalty basis, with a five year lease. The delivered price of the ore varies with the iron content, and is said to range from seven to ten dollars per ton.

The Smith Creek ore is prized because of its physical characteristics (ease in crushing, etc.) and high iron content, but, because of difficulty in securing labor, inadequacy of mining equipment and methods, frequent breakdown of the single truck available for haulage, and a short season limited to the dry summer months because of the condition of the woods road mentioned above, production from the deposit has not met the demand (reported as about 1,000 tons per year), and the Orofino plant makes up for the deficiency by importing ore from Utah by rail. The following records of purchases of Smith Creek ore were furnished by the Washington-Idaho Lime Products Company:-

	Tons	%Fe, calculated as Fe_2O_3	%Fe
July and August, 1942.	192.64	92.5	64.7
September and October, 1942. . .	178.3	84.95	59.5
July and August, 1943.	240.02	86.51	60.5

Part of the production (from the "North Pit") is vein run material; the remainder (from the "South Pit")is handcobbed.

Analyses of Smith Creek Iron Ore - Idaho County

Constituents	1	2	3	4
SiO_2	3.68	13.46	6.91	8.10
Al_2O_3	1.20	1.68	1.02	0.46
Fe_2O_3	----	52.55	----	----
FeO	----	23.10	----	----
Fe	64.40	54.8*	63.81	60.36
Mn	1.94	1.61	0.73	0.81
H_2O	1.00	-----	----	----
P	0.01	-----	0.005	0.023
TiO_2	----	-----	0.03	0.11
S	----	0.015	----	----
Undetermined	----	7.5	----	----
Total		99.915		
Moisture	2.10	0.44		

*Equivalent Fe

(1) A sample of magnetite sent by Mr. Strom to Pickens, Mather and Company.

(2) A twenty-five pound channel sample taken across a 6½ foot vein of pyroxenite by the U. S. Engineers (U.S.E.D. #255B).

Analyses (1) and (2) are from "Report and Available Raw Materials for a Pacific Coast Iron Industry", by Edwin T. Hodge. (Vol. V, Part I, page 52, Portland, Ore. 1938)

(3) Sample by J. H. Mackin....9 pound chip sample across 3.5 feet ore in place at head of trench at North Pit. U.S. Geol. Survey.

(4) Sample by J. H. Mackin....11 pound grab sample from handcobbed ore at South Pit. U. S. Geol. Survey.

Description of Exposures

The North Pit. The north workings consist of a mining trench 4 to 8 feet deep along the trend of the ore body. Ore is loosened from a face at the head of the trench by use of explosives and carried in a wheelbarrow to a truck loading chute.

The approximate length of the trench is 130 feet; because the southern portion has been partly filled with rubble as mining progressed northward, ore is exposed in the floor only in the northern part. Bulldozer stripping of residual soil makes it possible to trace the ore to a point 30 feet north of the head of the trench, where it lenses out. The over-all length of the body, indicated by the filled trench and ore now exposed, is therefore approximately 160 feet; the average width of the body is four feet. The ore removed to date is equivalent to a block 130 feet long, 4 feet wide, and 5 feet deep, or approximately 300 tons.

The country rock is a quartz-mica gneiss containing augen made up of an aggregate of quartz, kyanite and garnet. The gneissic foliation strikes slightly west of north and dips 80° eastward. The ore body is tabular in form, and lies generally parallel with the gneissic foliation, which wraps around pinches and swells in the margins. In the northern part of the trench two offshoots of the main body, four inches and eighteen inches in thickness, diverge 20 to 40 degrees from its trend.

The ore is an aggregate of granular magnetite containing flakes of a brown mica, probably phlogophite; the mica plates are so oriented as to give the ore a poorly developed schistosity parallel to the foliation of the wall rock. The contact of ore and gneiss is usually sharply defined, but there is locally a thin selvage made up chiefly of coarsely crystalline phlogophite with random orientation.

The South Pit. The South Pit consists of a bulldozer cut 160 feet long, 15 to 25 feet wide, and up to 25 feet in depth. The north half of the cut is partly in the "ore zone"; the south half was probably excavated in search for the continuation of the ore, but shows only weathered gneiss. Mining operations involve (1) loosening and caving off of the face of the "ore zone" on the west side of the cut by use of bars and picks, (2) handpicking of hard lumps consisting chiefly of magnetite from the caved material, (3) moving of the handcobbed material by horse-drawn scraper to a small crusher, and (4) delivery of the crushed ore by bucket conveyor to a truck loading bin.

At the time of the examination the lower part of the working face and the adjacent floor of the cut were covered by caved material. The portion of the "ore zone" exposed in the upper part of the face consists of blocks of magnetite formed by weathering and creep segmentation of irregular stringers and lenses which lie in a weathered, schistose matrix. Individual lenses and the ore zone as a whole are elongated parallel to the northerly trending foliation of the gneissic country rock; there are no well defined walls. The ore zone is exposed for about 30 feet along the west face of the cut, which is roughly parallel to the strike; the general relations suggest that the true width of the zone may be eight to twelve feet, and the estimated proportions of ore to matrix is such that this width is equivalent to five to seven feet of solid ore. In any large scale operation some type of beneficiation would be required to separate the ore from the schistose partings. The workmen state that mining has followed the ore zone along the strike for approximately 50 feet. On this basis, the amount of ore removed to date is equal to a block 50 feet long, 6 feet wide, and with an average vertical dimension of 10 feet, that is, approximately 350 tons.

The ore varies from dense massive magnetite to granular magnetite with a small percentage of brown mica; the mica of the matrix is locally coarsely crystalline and contains magnetite and blade-like crystals of an altered amphibole, probably actinolite. The waste heaps include fragments made up chiefly of aggregates of crystalline siderite showing single cleavage faces an inch or more in width. Crushed pieces of siderite yield greater or less amounts of granular magnetite, indicating that the magnetite is enclosed within the siderite aggregate structure. Also seen on the waste dumps, but not in place, are blocks of a magnetite-rich amphibolite made up in part of actinolite and minerals of the serpentine group.

Other exposures. The thick mantle of residual soil and the dense underbrush that characterize the greater part of the claim area are unfavorable for float mapping. Shallow and partly caved pits at B, C, and F contain small showings of ore, but none provide opportunity for measurement of the bodies. A few tons of magnetite are stockpiled adjacent to the portal of the caved adit at D (see map); Hodge states that this adit cuts two lenses of ore, 12 inches and 2½ feet in thickness. Three other widely separated prospect pits and adits, similar to these, occur in the southern part of the Strom-Anderson claims, not included on the map.

Dip Needle Survey

The contours on the accompanying overlay map indicate the intensity of the magnetic attraction measured in the plane of the magentic meridian. The needle used was counterbalanced to read -12 to -14 in areas of no exceptional magnetic distrubance in this vicinity.

It will be noted that an area of strong positive readings corresponds roughly with the ore outcrop in the North Pit. Strong negative readings just north of, and in alignment with the positive area tend to indicate that the subsurface extension of the ore body continues only a short distance northward beyond the north end of its surface outcrop.

Magnetic evidence bearing on the southward extension of the ore body is much less definite. The strong positive readings (plus 5 and up) continue for about 100 feet south of the south end of the exposure. Somewhat lower readings (0 and plus 1) define a broad magnetic ridge which continues southward for an additional 300 feet, curving eastward at the south end. A poorly defined zone of positive and negative anomalies continues the southerly trend for an additional 1200 feet; two small showings of ore in test pits (B and C) in this zone are not strongly reflected in the magnetic contour pattern. Beyond the end of the zone magnetically contoured numerous "reconnaissance" dip needle readings failed to register any exceptional magnetic disturbance.

This long magnetic ridge certainly defines a belt of gneiss which contains a higher proportion of magnetic materials than the gneiss on either side, but the contour pattern provides no basis for prediction as to depth of overburden, the manner of aggregation of the magnetite (whether disseminated in the gneiss or in well defined ore bodies), or as to the width or continuity of such bodies. In other words, the dip needle survey serves merely to indicate the location and general trend of an area of some promise; specific data as to subsurface relations can be obtained only by stripping of the surface soil and/or drilling. Available evidence suggests, as the most likely of several alternative possibilities, that the North Pit ore body may be continuous for about 400 feet southward from the North Pit exposures, and that the remainder of the belt may be underlain by scattered small lenses roughly aligned parallel with the northerly trend of the gneissic foliation.

The South Pit corresponds with a second sharply localized area of strong positive readings, surrounded on all sides by an area of little magnetic disturbance. There is no evidence of a connection between the South Pit body and the showings of ore at D or F; the relations suggest three separate lenses, those at D and F being smaller or more deeply buried than the South Pit body.

Origin of Ore

Schistosity within the ore, shearing around individual pods, and the general parallelism of the ore bodies to the gneissic foliation suggests that emplacement of the ore (by whatever processes) predates part or all of the period of dynamic metamorphism and metasomatism that produced the banded gneisses of the area. Present textures and mineralogic relationships have therefore only an indirect bearing on the manner of formation of the original iron-rich bodies.

Hodge refers to the deposit as being of the "magmatic segregation" type, and states that "the origin....from an ultra-basic rock is obvious". Closely linked with this interpretation is his identification of the ore as "peridotite" (see description of sample for analysis

#2, page 4). While it is possible that the ore bodies are metamorphosed ultrabasic dike-like injections, the occurrence of siderite counts heavily against this view. They may be metamorphosed veins or replacement deposits, or they may have been formed by metamorphic segregation in original iron rich sediments. The evidence in hand does not justify any positive conclusion as to origin.

Tonnage Estimates

Measured ore. Because it is not possible to measure depth in any of the exposures, there is no "measured ore" on the property.

Indicated ore. The length of the North Pit ore body may be considered to be 160 feet (exposed or represented by a filled trench), plus 100 feet (defined by the + 5 magnetic contour south of the end of the trench), or 260 feet. The average width is 4 feet (the width of the exposed portion) and the depth may be taken as 90 feet (1/3 the length). On the basis of 8 cubic feet per ton, the body contains 11,700 tons of "indicated ore".

The length of the South Pit ore body may be considered to be 75 feet, the width 6 feet and the depth 25 feet. The "indicated ore" is then 1400 tons.

The total "indicated ore" for the property is 13,000 tons, with a metallic iron content of 60-65%.

Inferred ore. On the basis of the low magnetic ridge (0 and + 1 readings) extending southward from the exposure in the North Pit, the total over-all length of the North Pit ore body may be inferred to be 500 feet, the width 4 feet and the depth 200 feet. This block of 50,000 tons includes about 12,000 tons listed above as "indicated ore"; the "inferred ore" is therefore 38,000 tons (60% Fe).

In so far as evidence now available is concerned, other bodies of magnetite in the mapped area and in the southern portion of the claims (indicated by showings in test pits and/or dip needle readings) are so small in size that it is doubtful whether the material could be mined profitably under the most favorable circumstances. Therefore, no estimate of tonnage represented by these deposits has been made.

Conclusions and Recommendations

Available evidence indicates that the total of indicated and inferred ore on the Strom-Anderson claims is 51,000 tons, of which 50,000

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may occur in one deposit (the North Pit ore body). Exploration required to block out this tonnage includes stripping of residual soil by bulldozer and a number of inclined drill holes located east of the body to intersect it at various depths.

It is possible that stripping of residual soil from a belt of small positive and negative anomalies extending southward from the North Pit ore body may uncover additional bodies of commercial ore not included in the above estimates.

Mining will necessarily be by underground methods. In view of this fact, a 17 to 19 mile truck haul to the nearest railroad, and a rail haul of some hundreds of miles to the nearest existing plant, the Smith Creek deposit has little significance as a source of ore for the manufacture of iron and steel at the present time. For this reason, no further exploration by the U. S. Geological Survey or the Bureau of Mines is recommended.

The tonnage "in sight" on the property is sufficient to supply magnetite for use as a flux and low-heat admix by the cement plant at Orofino, or other similar small market, for many years. The steep grades and bad condition of the woods road leading to the deposit ~~is~~ are the chief difficulties faced by the operators, and it seems reasonable that a small share of the cost of a projected timber access road, which would eliminate this difficulty, should be charged against the ore deposits.

The McComas Magnetite Prospect

Idaho County, Idaho

Introduction

The McComas prospect was visited on August 31, 1943, in company with Messrs. J. B. McComas and W. H. Hill, of Grangeville, Idaho. Weather conditions and other circumstances made it impracticable to return to the deposit for further study during the 1943 season; the present memorandum is intended to place on record the incomplete data now in hand.

Location

The McComas prospect is located in the E$\frac{1}{2}$, Sec. 13, T. 30 N., R. 4 E., near the east line of the section, on the west side of the valley of the North Fork of North Meadow Creek. The occurrences of ore are approximately 1$\frac{1}{4}$ miles by trail eastward from the Green Creek Lookout road; the trail starts at a point 2.7 miles north of the junction of the Green Creek Lookout road and the Lightning Creek-McComas Ranch road. The area is timbered and brushy, and it is not advisable to seek the deposit without the services of a guide (J. B. McComas).

Ownership and Development

Owen Morgan and Tig Newman located the deposit and did the first exploratory work about 1900. G. P. McComas and George Frazer in 1916-1918, and Frank McComas and Lum Edwards in 1930, opened up several prospect pits and drove two adits to cross-cut the ore. Two unpatented claims, Iron Cap Nos. 1 and 2 are now held by J. B. McComas.

Description

The country rock is banded gneiss and gneissic granite, with foliation trending north-south. Float consisting of dense massive magnetite occurs at several points in residual soil in a northerly trending belt about 300 feet in length; for a distance of about 100 feet in the southern part of the belt sparse float showings are more or less continuous. The massive magnetite is nowhere seen in place.

A second type of ore is exposed in an east-west trench 11-12' long and up to 9' deep near the middle of the belt. The material is an open-textured aggregate of granular magnetite, so loosely joined that a light hammer blow causes it to crumble to a magnetite sand; pore space probably varies from 10% to 30% by volume. The ore is characterized by a strongly developed linear schistosity which pitches at a low angle to the north. The body evidently strikes north-south and is at least 11 feet in width, as there are no well defined walls at the ends of the partly caved trench. The granular ore does not yield float, and, while it is clearly associated with the dense magnetite, their mutual relations cannot be observed in available exposures.

The two adits are so placed as to pass under the north end of the belt of float, 50-75' vertically below the "outcrop". On the basis of the size of the dumps, they may be 75-100' long; both are now completely caved at the portals. According to J. B. McComas, whose father and brother did the early work, one or both adits passed "for a long distance" through loose sandy magnetite. Repeated caving, probably due in part to inexperience of the prospectors in methods of driving in bad ground, is said to have caused the project to be abandoned. The dumps are made up principally of gneissic granite; the relative absence of magnetite may be due to the washing away of the loose material since the adits were driven.

Origin of the Ore

As seen in the trench mentioned above, the granular ore is black in color, with dark brown earthy limonitic material in the interstices; it is wholly unlike the cellular gossan that normally caps magnetite-sulphide veins elsewhere in western Idaho, and there is no other evidence (as copper staining) of the former presence of sulphides. Occurrence of granular magnetite in siderite in another Clearwater deposit (the Smith Creek magnetite), in association with dense massive magnetite and under similar geologic conditions, suggests that the original interstitial material in the McComas ore may have been siderite. It may be noted in this connection that the granular ore effervesces freely when treated with hot dilute hydrochloric acid. The identity of the mineral removed by leaching bears directly on the value of the ore in depth, but can be finally determined only by drilling.

Whatever the origin of the ore, it is clear that its emplacement predates the stage of metamorphism that developed the linear schistocity.

Conclusions

Available evidence does not justify tonnage estimates. The deposit is known to be 11' wide at one point, and to extend to a depth of 50-75' in the vicinity of the adits. If it be assumed to maintain a width of 10' through a horizontal distance of 300' (the length of the belt of sparse float showings), and to a depth of 100' (1/3 the length), the body includes approximately 30,000 tons. Mapping, preferably with some type of magnetometer other than the dip needle, may be expected to provide a basis for determining the continuity and actual length of the body.

War Eagle Magnetite Prospect

Idaho County, Idaho

Summary

Tonnage estimates for the War Eagle prospect are:-measured ore, none; indicated ore, none; inferred ore, 10,000 tons. Because of its small size and inaccessibility, no further study of the deposit is recommended.

Location

The War Eagle prospect is located in the NW$\frac{1}{4}$, Sec. 24, T. 23 N, R. 5 E., B. M., in Idaho County, Idaho. Unpatented claims War Eagle Nos. 1, 2, and 3 are held by Mr. W. W. Prather of Warren, Idaho. In the absence of Mr. Prather from the district, the deposit was examined on August 15, 1943, without the service of a guide. Claim corners were not seen.

Accessibility

The property can be reached from Grangeville, Idaho, via Riggins, Burgdorf, and the War Eagle Lookout road. The workings are 350 feet west of the lookout station (see map).

The deposit is situated at an elevation of 8150 feet (barometric). The last five miles of the lookout road have an average grade of over 10%, and are passable only during dry weather. The nearest railroad is a branch line of the Union Pacific at McCall, Idaho (elevation 5,030) 40 miles away, the greater part of the distance being over graveled or dirt roads.

Description

The workings consist of a trench 45 feet long, 5 feet wide, and 4 to 7 feet deep, a shaft 15 feet deep to the water level, and several other small caved pits as indicated on the accompanying plane table map.

Openings B and C were partly caved at the time of the examination, and none of the ore seen was definitely in place. In the north-south segment of trench B rubble consisting entirely of ore underlies about 4 feet of soil made up of weathered gneissic granite;

the rubble may overlie a body of ore in place or it may be debris derived by creep from an ore body farther up the hill slope.

The ore consists chiefly of an aggregate of granular magnetite; interstices between the magnetite grains are occupied by cellular limonite indicating weathering removal of associated minerals, probably sulphides in part. The limonitic material and voids make up an estimated 5 to 25% of the ore by volume, probably averaging 15%. Other impurities include small quartz seamlets. It is estimated, on the basis of analyses of similar ores elsewhere in the district, that the metallic iron content would be 60-65%.

There is no magnetite on spoil heaps adjacent to the pit at A or the trench at D, and none appears on the dump below the shaft, which is lagged to the water line. Magnetite makes up a considerable part of the waste along trench B and pit C for a total distance of about 60 feet. As indicated above, this dimension is not the true width of the body, for much of the loose material may have been derived from a relatively narrow outcrop in the eastern part of trench B. A dotted line on the map shows the approximate limits of sparse float showings of magnetite, chiefly in the form of weathered fragments less than two inches in diameter. The dashed line defines an area of strong positive dip needle readings.

About 1500 feet farther north, along the eastern edge of a saddle north of the lookout station, there are several caved pits and trenches in cellular limonite and iron stained gneiss. (not shown on map). A few small blocks of magnetite associated with massive brown garnet are the only apparent reason for local reference to this occurrence as an iron prospect.

Tonnage Estimates

Ore in sight on spoil heaps adjacent to openings B and C is estimated at 20-25 tons; there is no "measured" or "indicated ore" on the property. On the basis of the relations described above and shown on the map, it may be assumed that the ore body is a north-south trending lens with an average width of 10 feet, an average length of 175 feet, (length of area of float showings) and an average depth of 60 feet (1/3 the length); "inferred ore" is then approximately 10,000 tons.

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Conclusions

The War Eagle prospect has no economic signficance, and no further study is reocmmended.

THE MEADOW CREEK MAGNETITE PROSPECT

Idaho County, Idaho

SUMMARY

The Meadow Creek prospect includes two small areas of magnetite float and ore in place in shallow pits at the north and south ends of the prospect, about 400 feet apart. A dip needle survey indicates that these showings of ore are separate lenses of limited size; there is no evidence that the northern and southern exposures are connected by a continuous ore body 400 or more feet in length. The total of indicated and inferred ore is estimated at 12,000 tons. No further study or exploration of the deposit appears justified at this time.

INTRODUCTION

Location and Ownership

The Meadow Creek deposit is situated in the SE¼, Sec. 20, T. 30 N., R. 4 E., Boise Meridian (unsurveyed). The ore lies on the Sylvia Ellen Lode Claim, an unpatented claim held by A. E. Throop and C. N. Bryan of Kamiah, Idaho.

Development and History

Magnetite float occurs at several points along the crest of a timbered ridge trending N. 20-30 E. along the center line of the Sylvia Ellen claim. Development consists of seven shallow pits and trenches along the ridge crest and adits at the northern and southern ends of the deposit that were driven to cross-cut the ore at depths of 70 and 40 feet, respectively, below the outcrop. Both of the adits and some of the surface diggings are said to be the work of Jim Dunn, who located the deposit 10 to 15 years ago, and was seeking gold or sulphide ore under the "iron capping". Several of the pits were dug and/or deepened and cleaned out by the present owners in 1942.

In 1942-43 Throop was under contract to deliver to the cement plant of the Washington-Idaho Lime Products Company at Orofino, Idaho, a small tonnage of magnetite produced by him from the Smith Creek deposit, Idaho County, Idaho, on a lease and royalty arrangement with Arthur Anderson and Walter Strom, owners of the Smith Creek deposit. Throop and Bryan plan to develop the Meadow Creek deposit as a source of magnetite for the Orofino plant.

Accessibility

The deposit is situated approximately 24 miles from the rail head at Stites, Idaho. Of this distance, approximately 13 miles is a surfaced highway (Idaho Number 13), 8 miles is an unsurfaced woods road terminating at the McComas Ranch, and the three remaining miles is trail along the Meadow Creek valley to the deposit. A main timber access road under construction during 1943 will, when completed, provide for good truck haulage from McComas Ranch to Highway 13. U. S. Forest Service officials in Grangeville, Idaho, state that a timber feeder road will be extended up Meadow Creek valley from McComas Ranch to within about a mile of the deposit, but that the date of this extension will depend on the progress of logging operations and may be delayed for some years. In other words, if the Meadow Creek ore must be made available at once, approximately three miles of road construction will be required. The road will have low grades except for the last half mile, where the grades will be moderate to steep (downhill for outgoing trucks), will require little rock excavation, and can be made, for the most part, by use of a bulldozer.

Acknowledgements

The deposit was visited by the writer on August 21 in company with a guide furnished by Mr. Throop. Field Assistant Joseph R. Fribrock aided in the mapping and dip needle studies on August 29 and 30. The corners of the Sylvia Ellen claim were not found; location of the deposit relative to section corners (in the SE$\frac{1}{4}$, Sec. 20, T. 30 N., R. 4 E., Boise Meridian, (unsurveyed)) is based on a verbal communication from Mr. Walter Hovey Hill, of Grangeville, Idaho. Hill was occupied during the latter part of August in surveying a projected road from the McComas Ranch to the deposit for Throop and Bryan, but spent part of one day on the ground with the party.

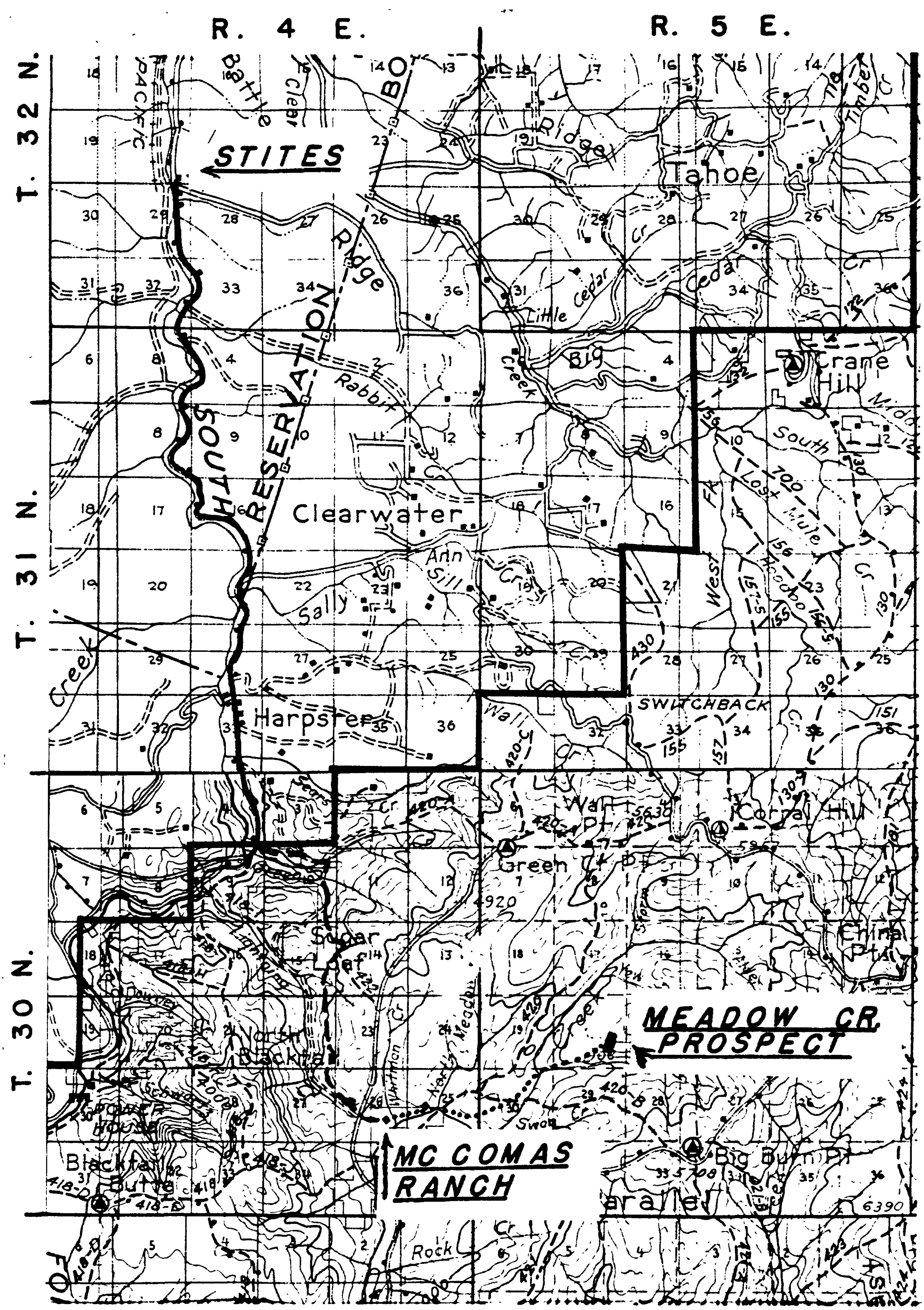
Geologic Relations

General Geology

The Sylvia Ellen claim area is criss-crossed by windfalls and mantled by underbrush and thick weathered soil and natural exposures of rock or ore in place are rare. The float includes gneissic granitoid rocks, banded granitic augen gneisses, and mica schists; where exposed in the adits the foliation of these metamorphic rock types is essentially vertical and ranges from N-S to N 20 E., thus paralleling the regional northerly trend of foliation in this portion of west central Idaho.

The ore consists of massive magnetite, dense to coarsely granular in texture. Cavities formed by leaching of associated minerals comprise about two percent of the ore by volume, and are occupied in part by cellular, gossan-like limonite suggesting removal of sulphides.

16a



HIGHWAY 13 NEW FOREST ROAD TRAIL

It is therefore evident that analyses of samples taken from shallow surface exposures will not be representative (particularly in sulphur content) of material that may occur below the surficial zone of leaching.

Available evidence does not provide an adequate basis for discussion of the origin of the deposit. The ore bodies appear to be small lenses or pods elongated parallel with the gneissic foliation. Occurrence of massive to coarsely crystalline brown garnet and other lime silicate minerals in float in the vicinity of the deposit suggests, as the most likely of several alternative possibilities, that the ore was formed by hydrothermal replacement of lenses of marble in the metamorphic sequence.

Analyses of Meadow Creek iron ore:

	(1) %	(2) %
Fe	64.25	59.74
SiO_2	2.31	6.66
Al_2O_3	0.31	1.44
CaO and MgO as MgO	2.65	
TiO_2	0.12	0.03
MnO_2	2.24	
Mn		1.11
P_2O5	0.016	
(P --- 0.007)		.014
SO_3	trace	
CO_2	4.95	
Combined H_2O	1.42	

(1) Analysis of "Meadow Creek iron ore" - supplied by Mr. Walter Hovey Hill, Grangeville, Idaho, from Electro Metallurgical Co., Spokane, Washington, 7/12/43.

(2) Sample by J. H. Mackin - 22 pound chip sample taken across 7' vertical face of ore in place in pit B. U. S. Geol. Surv. 1943.

Description of exposures

The dotted lines on the geologic map indicate the approximate extent of areas with numerous to scattered fragments of ore in surficial soil. The fragments are in all cases believed to be of local origin, but, because of the tendency for lateral spreading of the resistant magnetite float as the surface is lowered by erosion, the extent of the float areas has no direct bearing on the dimensions of the solid magnetite bodies from which the surficial fragments were derived.

No ore was found in either of the adits.

Magnetite float at A, on the map, is thicker and more continuous than at any other point on the Sylvia Ellen claim, but there are no diggings to reveal ore in place in this immediate vicinity.

The shallow and partly caved pit at B shows, in the north face, a width of six to seven feet of magnetite in place between vertical walls of weathered gneiss. Ore is exposed also in the extreme western end of the trench at C; the remainder of the trench is in gneiss.

A four to five foot pit at D, and a trench at E show only weathered gneiss, with a few fragments of ore in the surficial soil. In general, fragments of ore along this portion of the ridge crest are so widely scattered that a good share of them may have been transported by human agency; if there are bodies of solid ore at the base of the weathered soil they must be very small in size (maximum dimension a few feet).

Of the four aligned pits at F, the westernmost shows ore in place at the east face, the two middle pits show both magnetite and gneiss, fragmented by weathering but probably in place, and the eastern pit shows gneiss. The relationships suggest a number of pods of magnetite lying in gneiss in a zone about 30 feet in width, or a body of magnetite about 30 feet in width, with numerous partings of gneiss; the proportion of rock to ore in the 30 foot zone is not known.

Scattered fragments of ore in surficial soil at G probably represent material derived by creep from a pod of ore whose position, farther up the hill slope, is suggested by dip needle readings (see map).

Dip Needle Survey

The dip needle readings on the accompanying map indicate the vertical component of magnetic attraction measured in the plane of the magnetic meridian. The needle used was counterbalanced to read approximately - 13 in areas of no exceptional magnetic disturbance in this vicinity; the significance of the readings is therefore relative rather than absolute. All of the readings plotted on the map lie along surveyed lines; a large number of additional reconnaissance observations, taken south, east and west of the map area, fall uniformly within a range of -11 to -14, and are not potted because the time required for the brushing out of survey lines required to locate them accurately did not seem justified.

The magnetic contours reveal three areas where groups of exceptionally strong positive readings are associated in a systematic manner with groups of exceptionally strong negative readings. At F the positive and negative readings clearly define a unit field of magnetic force of the type which exists about a bar magnet; the fact that the positive and negative readings are grouped at the geographic south and north ends, respectively, of an area of magnetic float and croppings in test pits indicates that the solid magnetic body operates as a bar magnet. The body is probably a lense oriented in a generally north-south direction; its north and south ends (poles) are defined very approximately by the groups of strong negative and positive readings.

The area of magnetic disturbance at A-B-C provides a more complex pattern, with two groups of positive and negative readings, so oriented with respect to each other as to suggest the presence of two separate magnetic bodies. These may be (1) either two separate lenses, or (2) a single original lense cut by a fault of sufficient movement to separate the segments; in either case each of the two bodies (like that at F) operates as a bar magnet so polarized as to give strong positive and strong negative readings at the south and north ends, respectively.

These three paired groups of positive and negative readings are believed, then, to define three separate magnetic systems, each controlled by a small unit body of magnetite at or near the surface. The long narrow magnetic high (positive) at G may have a similar associated magnetic low beyond the north edge of the map; no readings were taken in this vicinity. It may, on the other hand, represent the geographic south pole of a pencil-shaped magnetic body pitching steeply to the north. These four areas of strong magnetic disturbance (at F, ABC, and G) include all known areas of croppings and float showings of ore on the Sylvia Ellen claim.

It will be noted that the four unit areas described above are aligned along a broad magnetic ridge which parallels the trend of foliation in the gneissic country rock. This broad ridge may correspond with (1) a belt of gneiss characterized by a somewhat greater abundance of disseminate magnetite grains than the gneiss to the east and the west, or it may register (2) the occurrence of a large number of very small magnetite pods (dimensions a few inches or feet) lying along the gneissic foliation, or (3) a smaller number of larger pods of dimensions comparable with those of the four bodies mentioned above, but buried to such depth that their individual patterns blend in the surface readings. The low magnetic ridge certainly does not indicate the existence of a continuous subsurface magnetite body connecting the areas of float and outcrop at the north and south ends of the Sylvia Ellen prospect.

Tonnage Estimates

Measured ore

Because exposures of ore in place are limited to a few shallow pits which do not permit even two dimensional measurements, there is no "measured ore" on the Sylvia Ellen claim.

(Pl. 8)

Indicated ore

On the basis of distribution of magnetite float, the width of ore seen in place in pits, and the extent of the areas of strong magnetic disturbance associated with these surface showings, it may be assumed that the Sylvia Ellen claim includes four lenses of magnetite, with average lengths of 60 feet, average widths of 10 feet, and average depths of 20 feet (1/3 the average length). The ore consists largely of magnetite, probably averages 60-65% metallic iron, and may be assumed to run about 8 cubic feet per ton. The calculation is then: - 4 x (60' x 10' x 20'/8), or 6000 tons.

Inferred ore

Because of uncertainty which attaches to interpretation of the broad magnetic ridge, there is little basis for estimating "inferred ore". The fact that four bodies of magnetite occur at or near the surface, and that these bodies are probably distributed at random in a north-south trending belt of gneiss, makes it reasonable to assume that an equal number of bodies of similar size may occur at a moderate depth beneath the surface. On the basis of this assumption, "inferred ore" may be considered to be equal to "indicated ore", (6000 tons).

Conclusions

Because of small tonnage of ore, a 23 mile truck haul to the rail head at Stites, and a rail haul of some hundreds of miles to existing plants, the Sylvia Ellen deposit has little importance as a source of iron ore. It is possible that further geophysical exploration with some instrument other than a dip needle, and/or bulldozing of the outcrop, and/or drilling may provide a basis for estimates much larger than those justified by evidence now in hand. But even if the present estimates were increased ten-fold, the conclusion stated above would not be changed. For this reason no further study of the deposit by the Geological Survey or the Bureau of Mines is recommended.

The requirements of the cement plant at Orofino are said to approximate 1,000 tons per year. Mr. Throop states (Sept. 1943) that if the geologic relations suggest that there is a good possibility of developing reserves sufficient to supply this demand over a period of years, it might be practicable for him to rough out a cat road to the deposit, and to bulldoze the outcrop. While many factors other than the size of the deposit are involved (as the difference between shipping costs to Orofino from the Meadow Creek (Sylvia Ellen) deposit and Throop's present leasehold on Smith Creek, the royalty paid for Smith Creek ore, and the security of the Orofino market) it does seem that a small investment by Throop and Bryan for exporation is justified.

(Ed-8)