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PRECAMBRIAN BANDED IRON FORMATION AT COPPER MOUNTAIN

by

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PRECAMBRIAN IRON FORMATION AT COPPER MOUNTAIN, FREMONT COUNTY, WYOMING

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A B S T R A C T

Precambrian banded iron formation is exposed along the south-facing flanks of Copper Mountain, approximately 15 miles north of Shoshoni, in northeastern Fremont County, Wyoming. The Precambrian metamorphic complex consists of interlayered quartzofeldspathic gneisses, amphibolites, amphibole schists, peletic rocks, and iron formation into which granite, pegmatite, and mafic dikes and sills have been intruded. The complex has been metamorphosed to the kyanite-muscovite subfacies of the almandine-amphibolite facies. Sedimentary rocks of Paleozoic or Cenozoic age abut the Precambiran complex on all sides.

The mineralogical composition of the iron formation is very simple, consisting of magnetite, quartz, and any combination of blue-green hornblende, grunerite, and cummingtonite. Magnetite, in all degrees of alteration to hematite, occurs in thin laminae and fine clusters with angular, sharply embayed boundaries and as very fine inclusions in quartz and amphibole grains. Banding is developed by apparent increase in grain size of the magnetite at the expense of quartz and amphibole grains.

The iron formation, interlayered with amphibolite and quartz-mica schist, is exposed for a distance of about 6 miles over an approximate width of 1000 feet. The strike of the formation is N 80°E and the dip is 70° to the south.

Liberation and concentration tests indicate the presence of roughly 13½ million tons of concentrates containing 56% iron and 22% silica. The amount of very fine magnetite in quartz and amphibole grains and the amount of interstitial quartz in the magnetite-rich bands account for the high silica content of the concentrates.

Rail transportation comes within ten miles of the outcrop area, but the nearest markets for a blast furnace feed are over 240 miles away.

The distance to market, high silica content, low tonnage, and steep dip combine to indicate that this iron formation has a questionable economic potential.

PRECAMBRIAN BANDED IRON FORMATION AT COPPER MOUNTAIN

Fremont County, Wyoming

W. H. Duhling, Jr.

Precambrian banded iron formation is exposed along the south-facing flanks of Copper Mountain in northeastern Fremont County, Wyoming (Duhling, 1969). This report presents a short description of the mineralogy and concentration characteristics of this iron formation.

Copper Mountain is aptly named. Copper-stained outcrops are numerous and in the past at least two mines, the McGraw and the De Pass, produced copper. Another mine, the Gold Nugget, reportedly produced gold and silver. During the early 1940's the Stardust and Comet mines were opened in a zone of scheelite mineralization. Numerous test pits and adits in the mountain attest to attempts to win mineral wealth from the area.

Figure 1 shows the location of Copper Mountain and the area covered in this report. Copper Mountain is located in the eastern part of the Owl Creek Mountains, in what is sometimes called the Bridger Range, approximately seven miles east of the southern entrance to Wind River Canyon and approximately 15 miles north of Shoshoni, Wyo.

The Precambrian complex at Copper Mountain consists of two series of metasedimentary rocks which have been intruded by granite, pegmatites, and mafic dikes and sills. Overlying the Precambrian rocks are the Flathead Sandstone, Gros Ventre Shale, and Gallatin Limestone, all of Late Cambrian age, the Ordovician Bighorn Dolomite, and the Mississippian Madison Limestone. The Eocene Wind River formation covers portions of the lowlands south of the mountain front.

The Cambrian and younger rocks and complexly faulted and will

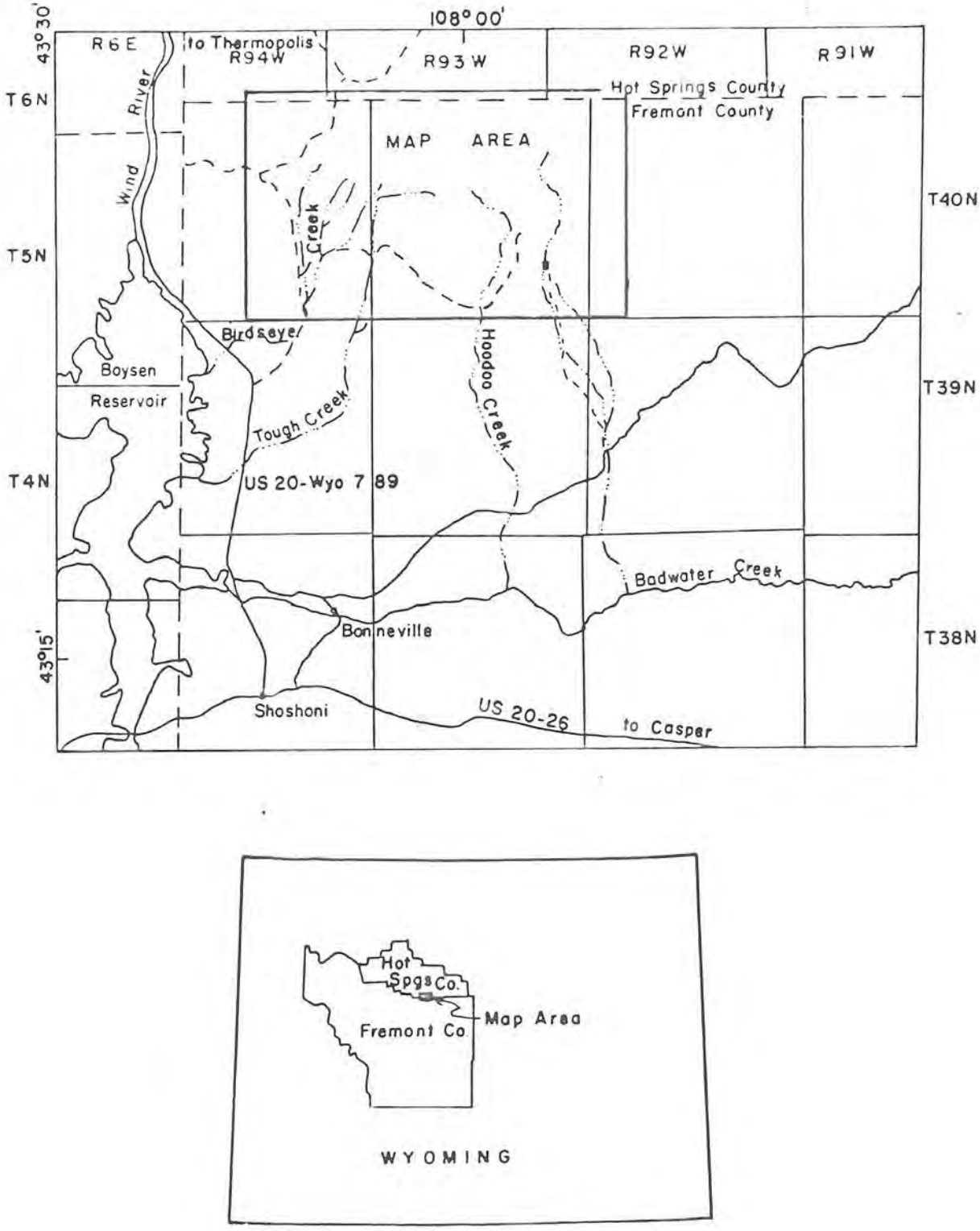


Figure 1. Index Map Showing Study Area

not be discussed here. Details of the faulting are shown by Tourtelot and Thompson. (1948)

The Precambrian metasedimentary rocks (Plate 1) have been divided into two series, an older and a younger, in a PhD dissertation by James L. Gliozzi (1967). In the eastern part of the map area, Gliozzi (1967, p. 16) has made the division on the basis of a slight discordance in the layering which he considers to represent an erosional disconformity. At the western end of the map area, the present study has made a similar division on the basis of a pronounced discordance which represents a period of folding and erosion.

The older series of metasedimentary rocks consists of quartzofeldspathic gneisses and interlayered mafic rocks and is better exposed in the eastern part of the map area. In the western part of the map area the older metasedimentary series is exposed in a narrow zone between exposures of younger metasediments and the Paleozioc sediments.

The younger metasedimentary series consists of about 5,000 feet of quartzites, quartzofeldspathic schists, pelitic schists, iron formation, amphibolite and amphibole schists, migmatitic rocks, and marble in general order, older to younger.

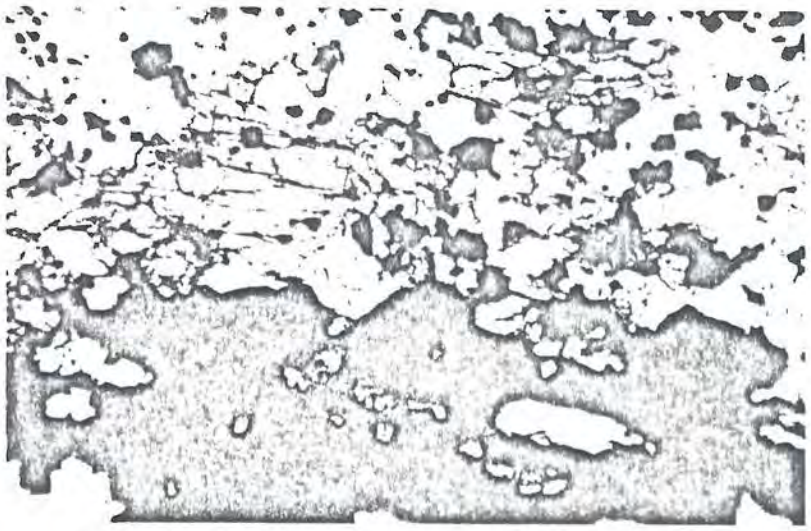
The mineral assemblage of the iron formation indicates that metamorphism reached the intermediate grade in the scheme proposed by James (1955). This is in general agreement with the kyanite-muscovite subfacies of the almandine-amphibolite facies proposed by Gliozzi (1967, p. 94) from a study of the pelitic rocks.

Banded iron formation is exposed discontinuously for a distance of approximately six miles from the valley of Birdseye Creek eastward to the head of the Bridger Creek drainage (Plate 1). Iron formation

is also exposed over a distance of approximately 2 miles along the mountain front just north of the trace of the Boysen fault (Plate 1). From studies made to date it is not entirely certain that these two zones of exposures consist of the same iron formation. The iron formation is exposed, interlayered with other rock types, in a zone that is as much as 2500 feet wide locally, but exposures of individual beds, or lenses, of iron formation more than 200 feet wide are rare. The interlayered rocks are predominently amphibolite sills in the main body of the iron formation although quartz-mica schist is conspicuous at the base of the iron formation.

In all exposures of the iron formation dips steeply to the south. Outcrops are slabby to slaty and weather to a yellowish brown or dark brown. In hand specimen the iron formation is composed of bands of iron oxide 1/8 to 1/2 inch thick alternating with bands of yellowish orange iron silicate and quartz which show the same range of thickness as the iron oxide bands.

Mineralogically, the iron formation is quite simple, containing principally iron oxides, quartz, and amphiboles. The iron oxide is primarily magnetite with minor amounts of hematite; most magnetite grains show alteration to hematite along grain boundaries and along {111} planes. Quartz is present in both magnetite-rich bands and in quartz-rich bands. The following amphiboles may be present in any combination: blue-green hornblende, grunerite, and cummingtonite. Point counts made on randomly selected thin sections indicate that the mineral composition is: magnetite, 43.4%; amphiboles, 36.6%; and quartz, 20.0%.



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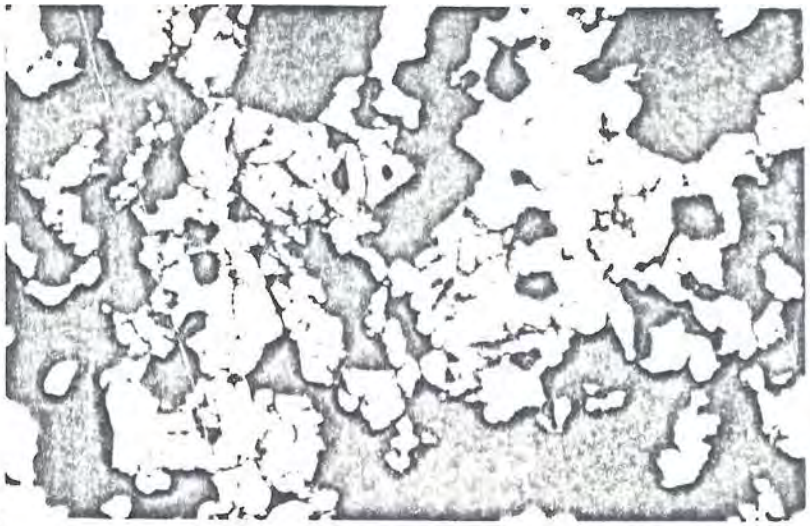

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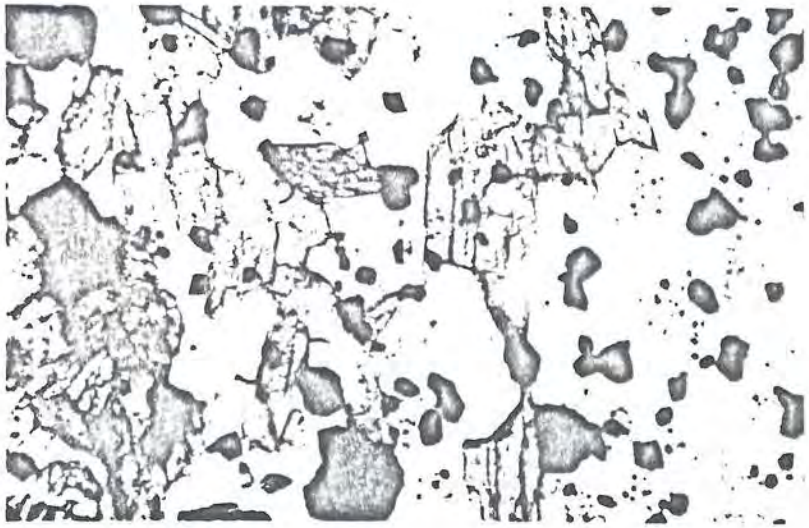

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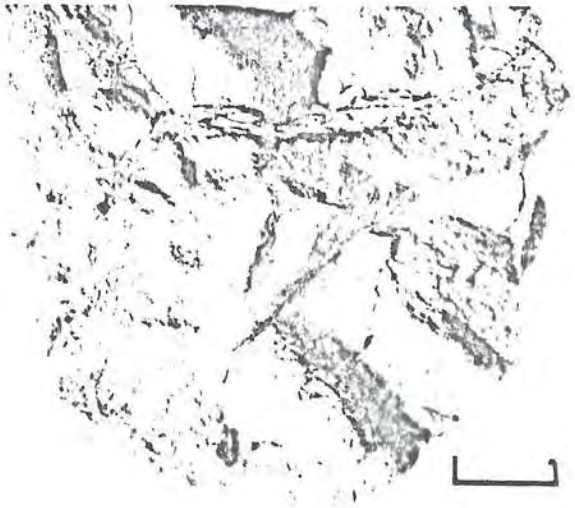

PLATE 2 WORM BURROWS IN FLATHEAD BASAL CONGLOMERATE AND THIN SECTIONS OF IRON FORMATION

Figure 1. Typical occurrence of amphibole minerals as selvage between magnitite-rich and quartz-rich bands in the iron formation. Thin section 67204. Plane light, magnification 155x.

Figure 2. Typical occurrence of amphibole minerals in magnetite-rich bands in the iron formation. Thin section 67204. Plane light, magnification 155x.

Figure 3. Typical occurrence of amphibole minerals in quartz-rich bands in the iron formation. Thin section 67191. Plane light, magnification 155x.

Figure 4. Worm trails preserved in silty material in conglomerate at base of Cambrian Flathead Sandstone. Scale: bar is one inch.

The magnetite-rich bands occur as mixtures of magnetite and quartz with subordinate amphibole. Magnetite forms short, thin stringers of rather loosely intergrown individual, almost euhedral, grains. The average grain size of the magnetite is 0.05 mm.

Quartz-rich bands contain predominently quartz and amphibole with subordinate magnetite. All quartz grains contain very fine inclusions of magnetite which are generally much less than 0.01 mm in diameter.

Amphiboles are abundant in the iron formation and were found in all thin sections examined. They are found in three relationships with the magnetite and quartz:

1. Interstitial to magnetite grains in magnetite-rich bands (Plate 2, figure 2)
2. Interstitial to quartz grains in quartz-rich bands (Plate 2, figure 3)
3. As a selvage between quartz-rich and magnetite-rich bands (Plate 2, figure 1)

Minor minerals in the iron formation include: goethite, limonite, pyrite, minnesotaite, biotite, stilpnomelane, and a garnet that has been identified by x-ray diffraction as andradite.

Four channel samples were taken from the iron formation (Plate 1). One sample was taken at Hoodoo Creek in the area mapped by Gliozzi (1967), the second sample was taken at Swede Canyon, the third sample from Tough Creek, and the fourth sample was taken from the area south of Birdseye Peak which was mapped by Millgate (Millgate and Gliozzi, 1966).

These samples were used in liberation and concentration tests designed to aid in determining the economic potential of the iron formation. The samples were treated as outlined in figure 2. Liberation samples were ground in 4 x 6 inch laboratory ball mills and a portion of the pulp was concentrated by means of a Davis tube magnetic concentrator

SAMPLE PREPARATION

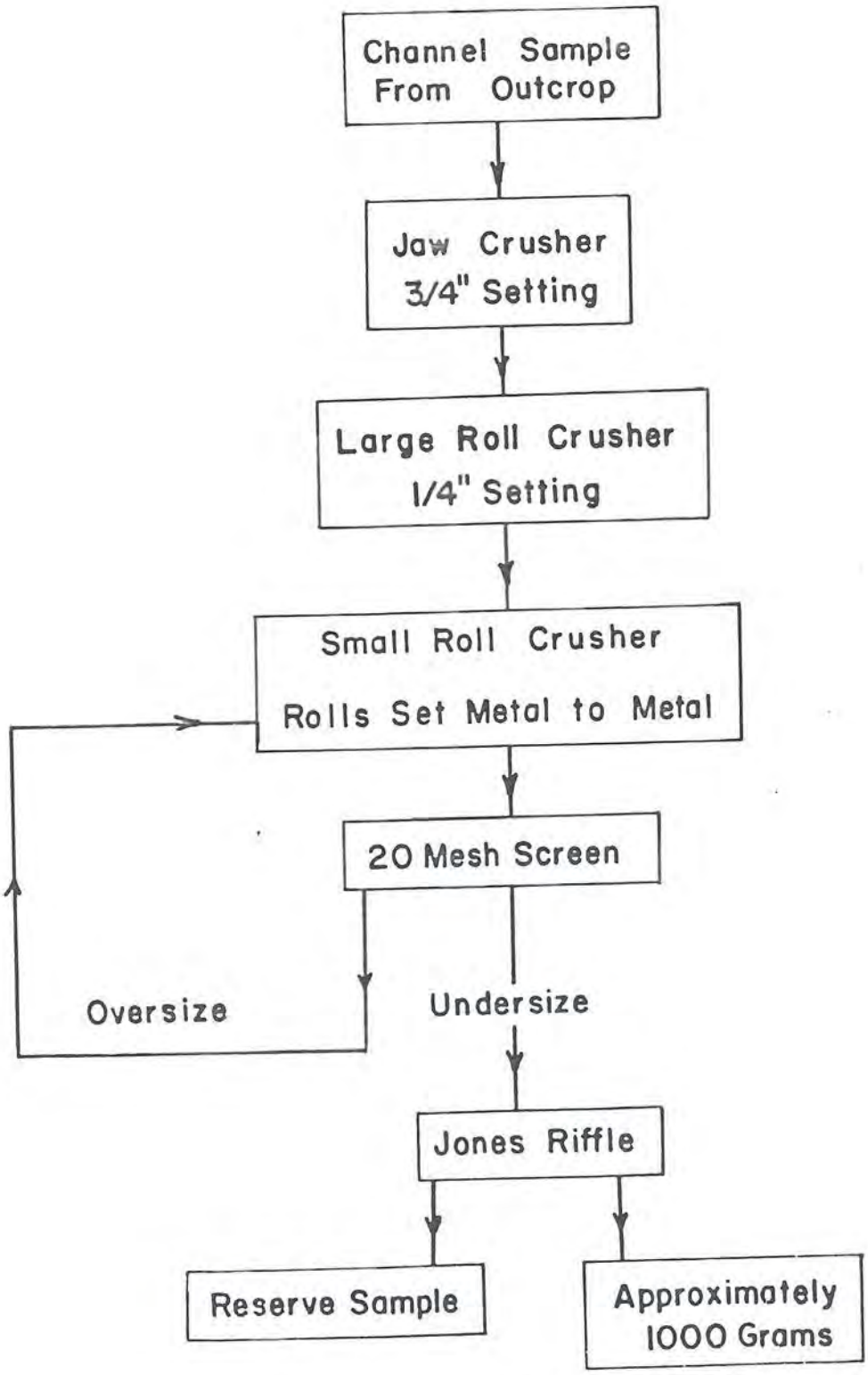

Figure 2 Sample Preparation Flow Chart

with a field strength of 6200 gauss measured 3/8 inch above the center of the pole piece gap. The concentrates were analyzed for iron and silica by x-ray emission spectroscopy. X-ray count data were converted to weight percentages by means of a computer program for regression analysis. Standards for x-ray analysis were made from selected concentrates which were analyzed colormetrically following the procedures of Shapiro and Brannock (1962).

Weighted averages for iron and silica analyses for both crude and for the best concentrate from each sample are listed in Table 1 for each of the sample areas. The best concentrate was made from sample H-1 from Hoodoo Creek which contained 65.0% iron and 6.5% silica at a grind of 87% passing 270 mesh and a weight recovery of 17.5 %; the crude analysis for this sample was 31.6% iron and 47.4% silica. Complete test results for each sample are given in Appendix A.

The poor concentrate grades are a result of two factors. The principal factor is the intimate interlocking of magnetite and quartz grains in the magnetite-rich bands coupled with the fine average grain size, 0.05 mm, of the magnetite. More complete liberation of the iron and reduction of the silica content will require much finer grinding than was used in this study. The second factor which contributed to the poor concentrate grade is that the samples were not stage crushed. This allowed a considerable amount of material, 10% in one sample, to enter the liberation mills at a much coarser size than 20 mesh. This coarser material was not effectively ground in the liberation mill. This procedure was used in order to evaluate the iron formation from the standpoint of a smaller operation that could not afford to utilize

TABLE I

AVERAGE CONCENTRATE GRADE BY AREA

SAMPLE LOCATION	INTERVAL SAMPLED	NUMBER OF SAMPLES	CRUDE		CONCENTRATE	
			%Fe	% SiO_2	%Fe	% SiO_2
HOODOO CREEK	184.5'	19	30.7	52.0	54.7	25.1
SWEDE CANYON	116.0'	10	30.1	54.4	58.7	19.3
TOUGH CREEK	32.3'	2	31.9	54.4	58.7	21.3
BIRDSEYE PEAK	12.0'	1	25.2	56.0	56.4	19.6

the sophisticated crushing and grinding equipment found in commercial taconite plants.

Two samples, one from Hoodoo Creek and one from Swede Canyon, have been retested using stage crushing followed by liberation and concentration tests. The results of retesting are compared to the original tests in Table 2. Conditions for both sets of tests were the same except for the crushing procedure and the ball charge in the liberation mill for the retest; the retest charge consisted of 3490 grams of 3/4 inch balls compared to the 3540 grams of mixed 3/4 inch and 1/2 inch balls in the original tests. Table 2 shows that the concentrate increased in iron content while decreasing in silica content and weight recovery in the Davis tube; these are the expected results. Because of the difference in the ball charge used in the two tests, no comment can be made about the grinding time required to produce the increased amount of concentrate passing 270 mesh.

What do the economic factors indicate for the iron formation at Copper Mountain: A rough estimate indicates that mining to a depth of 200 feet over a width of 1000 feet for a distance of 6 miles would yield 13 1/2 million tons of concentrates averaging 56.5% iron and 22.6% silica. Of the 1000 foot mining width, over 800 feet is in waste rock.

If produced as blast furnace feed, what about markets and transportation? Transportation is good because the Chicago and Northwestern tracks pass through Shoshoni, Wyoming, 15 miles south of Copper Mountain and the Burlington Northern tracks pass through Bonneville, 12 miles to the south and then curve north to pass through Wind River Canyon, 7 miles to the west. The nearest blast furnaces are at Pueblo, Colorado,

TABLE 2

IMPROVEMENT IN CONCENTRATE GRADE
RESULTING FROM STAGE CRUSHING

SAMPLE	TIME MIN.	% PASSING 270 MESH	DAVIS TUBE % WT. REC.	CRUDE		CONCENTRATE	
				% Fe	% SiO_2	% Fe	% SiO_2
H-17-1	12	89.0	19.0	28.4	53.2	50.1	28.7
H-17-2	30	97.6	12.5			67.4	11.4
S-9-1	15	72.2	44.8	32.0	41.0	63.7	9.0
S-9-2	30	97.0	43.0			69.5	6.9

approximately 390 miles by rail, or at Provo, Utah, which is about 250 miles by rail if there were a connection between the C&NW railhead at Lander, Wyoming and U. S. Steel's tracks at Atlantic City, Wyoming.

I think it is safe to conclude that the quality and quantity of the concentrates plus the long rail haul to market would combine to leave the iron formation at Copper Mountain in the category of an interesting mineral occurrence until more detailed work can be done in the area to determine the extent and structure of the iron formation. Certainly the ore picture would have to be much darker before this could be considered as a source of blast furnace feed. Perhaps concentrates made from this iron formation could be utilized as a source of high density aggregate or some other such use.

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APPENDIX A

BENEFICIATION TESTS

Sample Number	Grind Time	% Minus 270 Mesh	% Minus 325 Mesh	%* Recovery	% Fe	% SiO_2	Total Oxides
H-1	0	27.7	21.1		31.6	47.4	91.0
	6	68.2	49.7	25.8	59.5	11.7	93.9
	12	45.8	31.4	43.0	50.9	21.9	92.2
	15	86.8	40.0	17.5	65.0	6.5	96.3
H-2	0	16.0	12.5		32.6	47.4	92.4
	6	58.8	18.6	41.0	42.6	27.6	86.4
	12	77.8	48.1	27.5	54.6	19.0	94.4
	15	82.4	21.9	21.8	60.3	15.9	99.2
H-3	0	8.8	7.4		32.5	51.1	96.0
	6	51.2	41.1	53.0	38.7	36.7	90.1
	12	77.6	31.9	40.0	50.8	33.4	103.6
	15	87.4	61.9	35.3	54.8	27.5	103.2
H-4	0	9.5	6.7		35.2	49.0	96.6
	6	54.8	46.1	39.5	40.8	35.9	92.2
	12	80.5	62.5	20.3	54.0	29.8	104.4
	18	88.5	62.4	18.0	54.1	27.6	102.3
H-5	0	8.9	7.4		37.5	39.7	91.5
	6	46.1	34.2	41.8	43.9	29.9	90.5
	12	61.1	31.0	24.1	55.4	25.8	102.3
	18	89.0	62.1	17.0	59.0	23.3	104.8
H-6	0	17.0	13.6		34.5	49.7	95.3
	6	62.1	30.4	16.3	45.2	28.0	90.4
	12	78.6	54.3	12.8	59.7	22.1	104.5
	15	84.2	27.2	10.8	61.6	18.0	103.1
H-7	0	12.5	10.1		29.5	48.2	88.9
	6	63.9	51.6	27.8	41.4	33.5	90.7
	12	73.9	26.1	21.5	52.5	28.4	100.9
	15	83.8	58.9	19.9	53.8	23.7	98.0

* % Recovery = % Weight Recovery in the Davis Tube

APPENDIX A (Cont.)

BENEFICIATION TESTS

Sample Number	Grind Time	% Minus 270 Mesh	% Minus 325 Mesh	%* Recovery	% Fe	% SiO_2	Total Oxides
H-8	0	19.7	16.3		27.5	53.4	91.4
	6	63.4	32.6	31.0	37.4	38.5	90.1
	12	83.2	70.3	13.8	43.7	32.3	92.6
	15	72.1	30.9	15.9	45.5	30.9	93.7
H-9	0	17.2	13.2		22.5	55.8	86.9
	6	64.5	50.3	24.0	40.6	38.2	94.3
	9	61.7	20.7	20.5	45.3	32.3	94.9
	12	80.9	57.4	17.6	50.7	31.2	101.2
H-10	0	12.3	10.4		31.2	51.9	95.0
	6	53.7	23.8	35.4	39.7	39.3	94.1
	12	79.6	68.2	23.4	44.0	33.6	94.5
	15	76.0	31.1	26.0	48.0	33.6	99.9
H-11	0	16.7	13.5		34.9	51.5	99.7
	6	64.5	61.0	54.4	42.9	36.0	95.1
	12	80.5	35.1	50.5	50.6	34.3	104.2
	15	89.6	66.9	49.8	53.4	33.3	107.0
H-12	0	19.7	16.4		26.8	56.4	93.4
	6	69.4	28.6	22.7	40.0	39.0	94.2
	9	83.4	63.9	18.8	44.7	33.2	94.9
	12	61.3	25.8	21.4	43.7	36.9	97.2
H-13	0	15.0	12.1		26.1	58.1	94.1
	6	65.3	50.3	32.4	40.6	39.8	95.7
	12	84.3	44.2	27.6	51.1	40.8	111.3
	15	84.4	59.5	25.4	53.2	34.7	108.2
H-14	0	9.8	7.8		30.1	54.1	95.7
	6	77.7	65.2	29.5	38.5	41.0	94.2
	9	75.3	34.8	22.5	41.3	36.6	93.6
	12	92.2	82.6	19.0	42.6	32.6	91.4
H-15	0	8.4	6.4		29.1	53.2	93.4
	6	62.6	49.7	25.3	43.1	35.7	95.2
	12	84.0	58.2	20.1	55.0	27.7	103.7
	15	78.3	59.0	17.5	56.8	24.8	103.2

APPENDIX A (Cont.)

BENEFICIATION TESTS

Sample Number	Grind Time	% Minus 270 Mesh	% Minus 325 Mesh	%* Recovery	% Fe	% SiO_2	Total Oxides
H-16	0	14.7	12.3		28.7	51.0	90.6
	6	79.4	53.0	25.5	49.7	38.1	106.7
	9	88.6	76.3	21.5	54.3	29.0	104.0
	12	92.9	33.0	19.8	55.9	24.2	101.3
H-17	0	12.3	9.5		28.4	53.2	92.4
	6	67.6	55.8	23.5	42.7	35.4	94.4
	9	81.9	35.6	18.3	45.0	33.6	95.7
	12	89.0	67.7	19.0	50.1	28.7	97.9
H-18	0	8.7	6.6		34.5	53.4	101.5
	6	40.0	12.6	41.9	37.0	29.6	80.7
	12	51.1	31.4	23.6	61.4	21.9	106.7
	18	66.6	15.8	22.4	61.2	17.7	102.2
H-19	0	9.8	7.5		32.8	53.5	98.8
	6	47.0	35.2	46.5	50.0	28.7	97.8
	12	66.6	23.4	34.3	57.5	18.4	97.8
	15	73.0	48.3	31.9	60.0	14.0	96.9
S-1	0	3.5	2.7		33.0	56.6	102.2
	6	9.8	5.2	61.6	38.0	41.2	93.7
	12	54.3	34.5	46.1	44.3	33.6	94.8
	18	27.7	13.4	41.2	54.2	29.2	104.1
S-2	0	9.3	6.0		31.0	56.8	99.6
	6	52.0	36.6	61.1	43.7	31.1	91.4
	12	63.8	19.2	47.2	57.4	20.5	99.8
	18	69.3	40.5	43.5	62.4	14.3	100.5
S-3	0	9.3	7.4		34.4	56.9	104.5
	6	42.4	12.8	56.1	46.9	35.6	100.4
	12	45.7	25.4	47.0	51.3	28.0	98.8
	18	73.4	17.6	39.8	61.7	18.8	104.0
S-4	0	6.1	4.3		31.0	58.8	101.6
	6	24.6	14.4	50.2	39.8	39.5	94.5
	12	16.8	10.5	40.7	48.6	38.3	105.4
	18	39.3	20.3	32.3	53.2	33.4	106.9

APPENDIX A (Cont.)

BENEFICIATION TESTS

Sample Number	Grind Time	% Minus 250 Mesh	% Minus 325 Mesh	%* Recovery	% Fe	% SiO_2	Total Oxides
S-5	0	9.4	7.6		34.4	52.1	99.6
	6	50.4	26.8	54.3	44.2	30.1	91.1
	12	56.1	37.4	38.0	57.3	18.2	97.3
	18	75.9	14.2	35.0	61.6	11.4	96.5
S-6	0	12.0	9.2		29.6	43.6	84.5
	6	59.6	38.8	58.8	49.3	30.6	98.7
	12	62.2	17.0	48.2	53.8	21.4	95.7
	18	69.4	39.3	44.2	62.1	15.7	101.5
S-7	0	9.4	7.6		33.6	58.1	104.5
	6	55.9	21.7	69.5	43.2	31.7	91.4
	12	84.8	59.2	62.5	54.7	24.6	100.1
	15	85.3	61.2	56.3	57.4	22.4	101.7
S-8	0	11.2	8.3		32.2	41.0	85.5
	6	49.4	14.5	63.8	47.1	30.3	95.3
	12	58.8	35.6	47.6	59.1	15.7	97.3
	18	75.0	15.5	44.2	63.1	9.6	96.7
S-9	0	17.7	14.0		32.0	56.9	101.1
	6	58.8	45.3	50.1	53.4	21.2	94.9
	12	59.2	35.0	46.2	60.8	13.4	97.4
	15	72.2	44.3	44.8	63.7	9.0	97.0
S-10	0	8.3	6.1		31.5	56.9	100.4
	6	33.5	10.4	51.5	45.4	35.6	98.3
	12	46.0	24.4	39.3	55.1	26.2	102.3
	18	64.7	18.0	31.7	55.5	14.3	90.9
T-1	0	7.3	5.8		30.7	57.8	100.2
	6	33.5	22.3	38.4	47.3	47.8	113.1
	12	64.5	24.9	18.5	56.1	28.3	105.8
	18	65.5	34.5	16.4	59.6	23.7	106.0
T-2	0	9.1	6.8		32.8	51.9	97.3
	6	52.2	17.1	62.5	46.3	37.0	100.9
	12	60.6	28.0	53.3	54.5	27.3	102.6
	18	85.3	19.8	48.5	58.1	19.6	99.8

APPENDIX A (Cont.)

BENEFICIATION TESTS

Sample Number	Grind Time	% Minus 250 Mesh	% Minus 325 Mesh	%* Recovery	% Fe	% SiO_2	Total Oxides
M-1	0	4.1	3.2		6.7	45.9	55.2
	6	51.5	---	31.5	19.9	34.3	61.8
	12	34.0	---	15.8	29.1	30.8	71.0
	18	35.0	---	11.7	34.8	25.9	74.0
M-2	0	7.8	5.9		25.2	56.0	90.8
	6	51.5	---	43.6	39.2	40.3	94.4
	12	75.5	---	27.2	47.8	34.8	100.8
	18	91.0	---	21.5	56.4	19.6	97.5
M-3	0	8.2	6.4		8.9	43.7	56.0
	6	43.5	---	37.0	21.3	33.6	63.0
	12	69.0	---	24.9	26.3	30.4	66.7
	18	73.0	---	14.0	36.1	25.0	74.9

APPENDIX B

ANALYSES OF STANDARD SAMPLES FOR ANALYSIS OF IRON BY X-RAY SPECTROSCOPY

Sample Number	Grind Time	Fe	SiO_2	Al_2O_3	TiO_2	CaO	MgO	Total Oxides
H-4	0	33.61	44.22	2.48	0.127	0.90	2.00	96.14
S-9	0	33.55	49.40	0.51	0.065	0.68	1.65	98.64
H-9	6	40.60	39.68	1.11	0.110	0.10	1.35	98.42
S-6	0	34.96	46.62	0.40	0.060	0.40	1.40	97.16
H-1	15	66.84	3.79	1.18	0.180	0.00	1.15	98.61
M-3	12	23.75	36.64	3.32	0.711	18.65	12.38	104.50
M-1	0	6.58	49.90	6.52	0.428	10.55	15.02	91.50
M-2	0	24.06	57.23	1.95	0.199	4.53	2.10	99.24
H-15	0	30.39	48.76	2.99	0.119	0.00	1.85	95.69
S-6	6	49.45	27.92	0.27	0.077	0.00	1.46	98.02
S-9	12	61.70	10.74	2.17	0.089	0.00	1.15	99.36
H-15	15	53.13	19.33	1.87	0.149	0.00	1.40	96.12
H-7	12	51.58	21.98	1.88	0.110	0.00	1.29	96.49
H-17	9	46.86	28.05	1.84	0.127	0.00	1.26	95.99
H-8	15	44.39	30.82	1.90	0.175	0.50	1.60	96.30
M-1	18	34.13	28.05	2.63	1.065	5.44	11.41	95.73
M-1	6	18.49	41.56	3.17	0.947	6.36	16.08	93.65

APPENDIX C

ANALYSES OF STANDARD SAMPLES FOR ANALYSIS OF SILICA BY X-RAY SPECTROSCOPY

Sample	Grind	SiO_2
S-10	18	12.64
H-1	15	5.81
H-5	C	27.31
H-19	12	31.11
S-4	12	36.67
T-1	6	34.64
H-11	6	31.63
M-3	18	26.36
H-14	12	31.13
H-13	6	39.16
H-6	6	29.75
S-6	C	47.00
H-1	C	47.66
M-3	C	43.84
S-4	C	57.67
H-9	C	58.01
H-3	C	49.62

APPENDIX D

REGRESSION EQUATIONS USED TO DETERMINE ANALYSES FROM X-RAY SPECTROMETERY COUNT DATA

Iron

No dilution: $y = 34.32 + .0001196x$

1:1 dilution: $y = 13.53 + .001521x$

1:2 dilution: $y = 8.83 + .0001815x$

Silica

No dilution: $y = 19.56 + .00007655x$

1:1 dilution: $y = 6.85 + .0001153x$

1:2 dilution: $y = 1.08 + .0001986x$

Where y is the analysis sought and x is the average counts per minute from X-ray spectroscopy.

APPENDIX E

SAMPLE LOCALITIES AND DESCRIPTIONS, COPPER MOUNTAIN, NORTHEASTERN FREMONT COUNTY, WYOMING

H series: sampled on ridge east of east branch of Hoodoo Creek; mapped by James Gliozzi, PhD thesis, University of Wyoming, 1967.

Sample locations are in NE¼NW¼NW¼ sec. 23, T. 40 N., R. 93 W., and in W½SW¼ sec. 14, T. 40 N., R. 93 W. This area is on the Guffy Peak 7½ minute quandrangle.

Sample	Interval	Description
H-1	0-3½'	Slaty, poorly banded iron formation; magnetite-rich bands are widely spaced; difficult to sample because of slaty nature of exposure.
	3½-6'	Covered.
H-2	6-16 3/4'	Moderately well banded magnetite-silicate iron formation.
H-3	17-25'	Slaty, moderately banded mganetite-silicate iron formation with massive magnetite-rich bands.
	25-825'	Covered.
H-4	825-835'	Slaty magnetite-silicate iron formation; magnetite-rich bands fine-grained at the base becoming coarser grained at the top of the section.
H-5	835-850'	Less slaty than above, more massive magnetite-silicate iron formation; magnetite finely banded.
H-6	850-860'	Slaty to blocky to very finely banded magnetite-silicate iron formation; lower 5' partially oxidized.
H-7	860-869'	Moderately banded, blocky magnetite-chert iron formation.
	869-870'	Amphibolite.
H-8	870-875'	Poorly banded to massive magnetite-chert iron formation.

APPENDIX E (Cont.)

SAMPLE LOCALITIES AND DESCRIPTIONS, COPPER MOUNTAIN, NORTHEASTERN FREMONT COUNTY, WYOMING

Sample	Interval	Description
H-9	875-880'	Poorly exposed, slightly magnetic, very fine grained quartzite. Over sampled to obtain sufficient material for testing.
	880-885'	Covered.
H-10	885-890'	Poorly exposed, moderately magnetic, moderately banded magnetic quartzite.
H-11	890-895'	Very fine grained, slaty magnetite-silicate iron formation; poor exposure.
H-12	895-900'	Partially oxidized, very fine grained magnetite in ½" bands in magnetic quartzite.
H-13	900-911'	Massive banded iron formation; very fine grained magnetite in bands up to 3" thick separated by bands of magnetite-rich quartzite up to 1½" thick; magnetite banding becomes thinner and approaches slaty at the top of the section.
	911-1086'	Amphibolite.
H-14	1086-1097'	Poorly exposed magnetite-silicate iron formation.
	1097-1123'	Amphibolite.
H-15	1123-1139'	Slaty magnetite-silicate iron formation locally showing considerable oxidation; poor exposure.
H-16	1139-1153'	Thin banded magnetite-silicate iron formation; very fine grained magnetite-rich bands up to ½" thick; lower 7 feet sampled in test pit.
	1153-1179'	Amphibolite.
H-17	1179-1203'	Irregularly banded magnetite-silicate iron formation; magnetite content increases toward top of section.
H-18	1203-1217'	Well banded magnetite-silicate iron formation; banding very slightly wavy.
	1217-1275'	Amphibolite.

APPENDIX E (Cont.)

SAMPLE LOCALITIES AND DESCRIPTIONS, COPPER MOUNTAIN, NORTHEASTERN FREMONT COUNTY, WYOMING

Sample	Interval	Description
	1275-1277'	Iron formation; not sampled.
	1277-1333'	Amphibolite.
H-19	1333-1350'	Well banded magnetite-silicate iron formation.

End of Section

S-series: samples taken on ridge west of Swede Canyon (local name). Mapped by W. H. Duhling, Jr., MS thesis, University of Wyoming, 1969.

Sample location is in NE¼SW¼NE¼ sec. 20, T. 40 N., R. 93 W. This area is located on the Birdseye Pass 7½ minute quadrangle.

Sample	Interval	Description
S-1 to S-4	0-52'	Slaty magnetite-silicate iron formation; very fine grained magnetite occurs in bands up to ¼" thick alternating with quartz or iron silicate-quartz bands of about the same thickness. Metadiabase sill at 38-40, not sampled.
	52-62'	Covered.
	62-82'	Amphibolite.
S-5 to S-10	82-136'	Slaty iron formation very similar to above sections; some minor folding and some oxidation.
	136-196'	Covered.
	196'	Amphibolite.

End of Section

T-series: samples taken on the east bank of Tough Creek. Mapped by W. H. Duhling, Jr., MS thesis, University of Wyoming 1969.

Sample location is in SW¼SW¼SW¼ sec. 19, T. 40 N., R. 93 W. This area is located on the Birdseye Pass 7½ minute quadrangle.

APPENDIX E (Cont.)

SAMPLE LOCALITIES AND DESCRIPTIONS, COPPER MOUNTAIN, NORTHEASTERN FREMONT COUNTY, WYOMING

Sample	Interval	Description
T-1	0-15'	Slabby to slaty magnetite-chert-silicate iron formation.
	15-73'	Covered.
T-2	73-94'	Thinly banded slaty to massive siliceous magnetite-silicate iron formation.

End of Section

M-series: Samples taken on east bank of dry wash north of Birdseye Pass road. Mapped by M. L. Millgate, Wyoming Geological Survey, 1965.

Sample location is in NE¼SE¼NW¼ sec. 15, T. 40 N., R. 94 W. This area is located on the Birdseye Pass 7½ minute quadrangle.

Sample	Interval	Description
M-1	0-28'	Very fine grained magnetic greenschist.
	28-153'	Amphibolite with minor quartzite.
M-2	153-165'	Very fine grained, slaty magnetite-chert iron formation.
	165-304'	Amphibolite.
M-3	304-307'	Very fine grained magnetic greenschist.

End of Section