UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey
Washington
1945

DAYTON IRON DEPOSIT, LYON COUNTY, NEVADA

By Arthur P. Butler, Jr.

Abstract

The Dayton iron deposit, in Lyon County, Nev., was studied and explored in 1942 by the Federal Geological Survey and the Bureau of Mines. It is a contact-metamorphic deposit in partly metamorphosed and folded sedimentary beds of unknown geologic age, which are intruded by granitic rocks. Most of the ore is on and near the crest of a southward-plunging anticline. Magnetite is the main ore mineral, and is accompanied by pyrite, epidote, garnet, and unreplaced minerals of the original rocks. Hematite and limonite have been formed near the surface. Exploration has revealed two bodies of ore in the main part of the deposit. The larger is an irregular lenticular body near the crest of the anticline. The other, which lies farther north, is in steeply dipping rocks and is of unknown shape. Still farther north are scattered smaller bodies of ore.

The total reserves are estimated to be about 5,500,000 long tons of ore containing more than 40 percent of iron and averaging 47 percent, or 9,700,000 long tons of ore containing more than 30 percent of iron and averaging 43+ percent. Owing to the presence of pyrite, the sulfur content of the ore is about 4 percent.

Introduction

The Dayton iron deposit is in the western part of sec. 6, T. 17 N., R. 23 E., and 13⅔ miles east of Dayton, Nev. (fig. 1). It may be reached by going eastward for 12 miles from Dayton on U. S. Highway No. 50, and thence north by dirt road for 1½ miles. The deposit is about 10 miles west of the Hazen-Tonopah Junction branch of the Southern Pacific Railroad and 25 miles from the Virginia and Truckee Railway at Carson City.

Most of the deposit underlies a low knoll, but the ore extends several hundred feet north of the knoll (fig. 2). The knoll rises about 100 feet above a gravel-strewn and slightly dissected pediment that slopes southward from a range of hills, the base of which is about 1 mile to the north. The average altitude of the deposit is about 4,500 feet.

Although the deposit has been known since 1890, it has never been worked. Messrs. Robert C. Gillis, Pacific Palisades, Calif., and Mortimer Fleischhacker, 155 Sansome Street, San Francisco, Calif., jointly own patented claims on and adjacent to the deposit. The survey numbers of the claims are 2205, 2207, 2890, 2891, and 2892.

E. C. Harder visited the deposit in 1908 and described it. 1/ In the period extending from May to mid-December, 1942, the U. S. Bureau of Mines explored the deposit under the Federal program of investigating raw material resources for western steel production. The work, which was under the supervision of R. W. Geehan, resident engineer, is described in a recent report by the Bureau of Mines. 2/ It consisted of (1) trenching, (2) drilling of 11 holes, and (3) sampling of the trenches, drill cores, and previously existing workings, which include an inclined shaft and drift on the east side of the hill, a 160-foot shaft near the center of the hill, and a 320-foot adit on the west side of the hill (fig. 3).

A. E. Granger and A. F. Shride of the Geological Survey made a preliminary examination of the deposit in June 1942, and the writer spent from November 23 to December 20, 1942 in making an additional study of the structure and in logging drill cores.

Geology

Rocks.--The iron ores occur in a series of party metamorphosed and folded sedimentary beds of unknown geologic age, which are intruded by granitic rocks and aplite. They are exposed in trenches and as sparse natural outcrops on the hill and have been penetrated by drill holes through the alluvium north of the hill (fig. 3). Scattered shafts and pits north of the hill (fig. 2) reveal sedimentary

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1/ Harder, E.C., Iron ores near Dayton, Nev.: U. S. Geol. Survey Bull. 430, pp. 240-246, 1909.

2/ Dayton iron deposits, Lyon and Storey Counties, Nev.: U. S. Bur. Mines War Minerals Rept. 213, 19 pp., 1944.

rocks that resemble those that contain the ore and may be part of the same series, although they have not been correlated with those on the hill. Similar rocks crop out, also, north and east of the mapped area. A reconnaissance magnetometer survey made by the Bureau of Mines indicates the presence of iron-bearing rocks northwest of drill hole 10, but as these rocks do not crop out, their character and their relation to those near the hill is not known.

The sedimentary rocks can be roughly divided into three units (fig. 2). The lowest unit, which is at least 400 feet thick, consists mostly of interbedded limestone and chloritic rocks, but includes from 10 to 20 feet of chloritic quartzose rocks at the bottom. The proportion of limestone to noncalcareous rocks is not precisely known, and rocks of these two kinds probably interfinger. Limestone that crops out on the west end of the hill is relatively pure, medium-to coarse-grained, and little interbedded with other kinds of rock. Most of the rock in the central shaft is coarse-grained limestone, and drill hole 6 is almost continuously in limestone for 150 feet. Farther east, however, as shown by exposures in cut A and by cores from drill holes 1, 5, and 7, beds believed to be the stratigraphic equivalent of this limestone consist in some places of alternating beds of limestone and chloritic rocks and in other places of dominantly chloritic rocks.

The middle unit, about 200 feet thick, consists of chloritic rocks, chlorite-epidote rocks--in part probably feldspathic--and subordinate amounts of micaceous and quartz-mica rocks, which increase in abundance toward the top of the unit.

At some places the rocks of these two lower units are sufficiently replaced by magnetite to form ore.

The top unit of the sequence consists of relatively pure, finegrained quartzite of undertermined thickness.

Granitic rocks intruded into the sedimentary rocks are exposed here and there in the area mapped and crop out extensively in the surrounding area. The iron-bearing sedimentary rocks of the mapped area may be a pendant in the granite, but the distribution of the two kinds of rock is not sufficiently well determined to make this certain. Both the granite and sedimentary rocks are cut by aplite dikes.

A part of the deposit and much of the surrounding area are mantled with partly indurated conglomerate of unknown age and by still younger alluvium and slope wash.

Structure.--In the area where the iron ore crops out, the principal structure is an asymmetric and possibly complex anticline, which trends and plunges 20° to 30° southward (fig. 2, and sec. A-A' in fig. 4). East of the axis of the anticline the beds strike northward and dip 70°-90° E. but locally are overturned to the west. West of the axis the beds strike about west and dip 10°-60° S. Drill cores from holes 9 and 10, which passed through the alluvium and whose relation to the axis of the anticline is not clear, show dips ranging from 35° to 70°.

A well defined fault, striking north-northwest and dipping 50°-55° NE., is exposed in the west adit (fig. 3 and sec. A-A', fig. 4). This fault brings iron-bearing limestone on the east into contact with granite on the west. Granite and

gouge were found in the upper part of drill hole 4 in a position that makes it seem probable that this hole intersected the same fault (sec. C-C', fig. 4). Three other faults, all probably small, are exposed in cuts A and B. No other offsets of rock and ore that seem to indicate faulting were revealed during the mapping, but owing to the lack of exposures, complete determination of the number and magnitude of the faults and their relation to the ore has not been possible.

Iron ore

Character.--As pointed out by Harder, 3/ the Dayton deposit is of contact-metamorphic origin. The ore is composed of magnetite and related minerals, which have partly, and in places almost wholly, replaced beds in the lower two units of the sedimentary rocks. The pyrite content of the ore ranges from 1 to 10 percent but is usually between 5 and 6 percent. The gangue includes quartz, chlorite, calcite, mica, epidote, garnet, and probably feldspar. The ore is oxidized to a depth of as much as 125 feet. In the oxidized zone, hematite and limonite accompany the magnetite, the pyrite has been leached, and gypsum has been deposited locally in fractures.

Localization.--Most of the ore is in the chloritic rocks, but some beds of limestone have been sufficiently replaced to form ore. Micaceous and quartz-mica rocks are generally almost barren. Most of the ore is in the steeply dipping beds on the east limb of the anticline and near the crest of the fold, but some ore extends westward along the flatter part of the southwest limb, at least 600 feet from the crest. Because of the change from dominant limestone to chlorite rock across the fold from west to east, it is not clear how far the degree to which the rocks are replaced depends upon their composition and how far it depends upon structure.

Size and distribution of the ore bodies.--Most of the ore in the area underlies the hill, but one ore body extends at least 800 feet north of the crest of the hill, and small isolated bodies lie still farther north. The ore consists of irregular lenses, and in places a number of these probably join to form fairly continuous podlike bodies. The actual size, shape, and distribution of the ore bodies is uncertain because of the scarcity of outcrops and because they have not been fully explored (fig. 3).

The main ore body (fig. 3) is exposed in the central shaft (figs. 3 and 4) and is penetrated by drill holes 1, 5, 6, and 7, parts of which are in substantially continuous ore. Little ore is exposed at the surface above drill hole 5, and the top of the ore body is probably more or less irregular (sec. A-A', fig. 4). In the vicinity of drill hole 6 and west of the shaft the ore interfingers with limestone and partly replaced rock, and the ore body thins out westward. Drill hole 11 penetrates only a few thin layers of magnetite and must be north of the edge of the main ore body. The ore body is about 800 feet long, 40 to 180 feet thick, and 200 to 370 feet wide. Its inferred limits are shown on the maps (figs. 2 and 3). These limits include a few scattered masses of waste rock as much as 5

3/ Harder, E.C., op. cit., p. 27.

feet thick, and of partly replaced rock as much as 15 feet thick, distributed about as shown in sections A-A' and B-B' of figure 4. On the scale of the maps and sections it has not always been practicable to distinguish barren rock from partly replaced rock, nor partly replaced rock from the better quality ore.

Drill holes 8, 9, and 10 probably mark the position of another ore body, or group of bodies, called the "north flat body" (fig. 3), which may or may not be continuous with the body beneath the hill. The holes each contain several layers of good ore, from 10 to 40 feet thick, separated by layers of low-grade ore and iron-bearing rock ranging from 5 to 15 feet thick and to a lesser extent by barren rock. A layer of ore intersected between depths of 85 and 125 feet in drill hole 8 is probably continuous with an outcrop west of cut C (fig. 3). This ore piches out south of the hole. Ore intersected higher in the hole is so near the barren part of cut C that it may represent only a local concentration. On the basis of anomalies obtained in a magnetometer survey by the Bureau of Mines, it is estimated that ore in the eastern part of this ore body, as represented by drill hole 8, extends 250 feet north of the hole. Granite, which crops out 70 feet west of drill hole 9 and is exposed in a shaft 300 feet north-northwest of drill hole 10 probably bounds the north flat ore body on the west.

Although lithologic character does not furnish a satisfactory basis for correlation between drill holes 9 and 10, and although the structural relations are not clear, the better ore in the holes is believed to form a part of the "north flat body" that extends for about 200 feet down the dip, for 50 feet north of drill hole 10, and for 100 feet south of drill hole 9. This ore is tentatively outlined on figures 2 and 3. The average thickness of the better quality ore in this area is about 80 feet and that of higher-grade and lower-grade ore together about 170 feet.

Some bodies rich in hematite, containing as much as 60 percent of iron, crop out locally on the hill and make up most of the natural exposures (fig. 3). Most of these are small and many of them appear to be isolated, but some are continuous with the main ore body.

Two small, lenticular bodies of hematite, partly explored by shafts and pits, lie about 1,300 feet north of the hill (fig. 2). They are in steeply dipping metamorphic rocks resembling those of the middle unit in the hill, but their stratigraphic and structural relations with the main part of the deposit have not been determined. These hematite lenses are from 10 to 20 feet thick. The length of the east body is about 500 feet; that of the west body is not known but is probably much less. Still farther north, about 4,500 feet from the hill, are three bodies of hematite in limestone near a contact with granite.

Magnetometer measurements made by the Bureau of Mines indicate that iron-bearing rock extends at least 600 feet northwest of drill hole 10, and at least 250 feet north of drill hole 8 (fig. 3). The results of the work indicate that future exploration in these places would be worth while. Present knowledge, however, does not justify a quantitative appraisal of the amount, distribution, and grade of ore that might thus be found.

Reserves

Tonnage estimates are based on assays furnished by the Bureau of Mines, interpreted in the light of information obtained in the geologic mapping and by inspection of drill cores.

The ore bodies contain layers and lenses of barren and partly replaced rock. In general, they contain not more than one or two bands of barren rock, about 5 feet thick, and not more than one or two bands, from 5 to 15 feet thick, of ore below the cut-off grade. These lean layers are included in determining the average grade and tonnage on the assumption that they would not be separated in mining the large tonnages required for iron ore.

The ore reserves are calculated for cut-off grades of 40 and 30 percent of iron, and the ore is assumed to contain 9 cubic feet to the long ton. The lower cut-off grade is put at 30 percent because the grade decreases markedly below 30 percent and because much rock containing from 30 to 40 percent of iron lies between layers of ore containing more than 40 percent of iron, which it might be difficult to mine separately. Some of the ore contains more than 50 percent of iron, but ore of such high grade is so intermixed with ore of lower grade and forms so few bodies of minable size that a separate estimate of tonnage is not warranted.

This method of defining quality of ore on the basis of cut-off grade differs from that used by the Bureau of Mines, which is here called the "average grade" method. As used in this report, ore containing more than 40 percent of iron is approximately comparable to the Bureau of Mines' 45-percent average grade, and ore containing more than 30 percent of iron is comparable to the Bureau's 40-percent average grade. This difference in defining the limits of grade probably contributes to small differences in tonnage estimates of the Bureau of Mines and those of the Geological Survey, which are noted in the latter part of the paper.

Analyses of composite samples, which have been furnished by the Bureau of Mines, show the approximate composition of the ore in various parts of the ore bodies. The location of the samples and the data are summarized in the following table.

Table 1.--Analyses of composite samples, Dayton iron deposit

Sample Number	Location	Fe	Insol.	SiO_2	CaO	S	Al_2O_3	Cu	Pb	Zn	P	MgO	Mn
Ne 7.1	West Adit	46.6	10.2	6.8	13.8	2.05	2.0	0.05	0.25		0.009	1.45	0.1
Ne 7.2	East Incline	56.0	9.7	7.6	0.4	1.7	2.05	0.02	0.075		0.01	0.2	
Ne 7.3	Hole 5	49.0	19.3	13.1	2.5	3.45	3.85	0.025	0.025	0.35	0.011	2.25	0.05
Ne 7.4	Hole 7	52.2	10.4	6.8	5.1	4.95	2.55	0.025	0.025	0.35	0.012	1.3	0.05
Ne 7.5	Hole 8	49.9	18.8	11.6	4.4	3.80	4.15	0.025	0.025	0.35	0.011	2.8	0.05
Ne 7.6	Hole 9 upper	43.2	8.4	5.2	16.6	3.35	1.8	0.025	0.025	0.15	0.019	1.15	0.1
Ne 7.7	Hole 9 lower	51.2	13.7	8.5	5.6	3.70	2.85	0.025	0.025	0.25	0.014	1.9	0.05
Ne 7.8	Hole 10	54.9	12.0	7.3	4.3	3.90	2.4	0.037	0.025	0.20	0.006	1.8	0.05

The above analyses have been combined by the Bureau of Mines into a calculated composite analysis, which indicates the approximate average composition of the Dayton ore. This composite analysis is shown in table 2.

Table 2.--Calculated composite analysis

Fe	51.8 percent
Insol.	13.3 "
SiO_2	8.5 "
CaO	5.2 "
MgO	1.8 "
Al_2O_3	2.8 "
S	3.93 "
P	0.01 "
Cu	0.03 "
Pb	0.025 "
Zn	0.26 "
Mn	0.05 "

In connection with the composition as given in the above tables it should be noted that the iron content shown by most of the individual composite analyses and by the calculated composite analysis is somewhat larger than the average iron content for ore at a cut-off grade of 40 percent iron as calculated in making the tonnage estimates. This is probably due partly to unavoidable differences in weighting of the individual samples in making up the composite as contrasted to the weighting of the samples in calculating the average grade for a hole, and partly to the inclusion of rock in the calculated grade that was not included in the composite samples.

On the assumption that the smaller amount of iron in the calculated grade of the ore would be approximately compensated for by increases in silica, lime, alumina, and magnesia, an adjusted average composition can be computed from the preceding calculated composite analysis. The adjusted composition for ore of the calculated average grade at the cut-off of 40 percent of iron is given in table 3.

Table 3.--Adjusted calculated composite analysis, Dayton iron deposit

Fe	47 per cent
SiO_2	10.7 "
CaO	6.6 "
MgO	2.3 "
Al_2O_3	3.5 "
S	3.93 "
P	0.01 "
Cu	0.03 "
Pb	0.025 "
Zn	0.26 "
Mn	0.05 "

From the above data it is apparent that the ore is low in phosphorous, but that sulfur is sufficient to require special treatment of the ore before it could used. 4/ The silica content is partly compensated for by the amount of lime.

In the estimate of tonnages for the main ore body, the term "measurable ore" is applied to the ore between the central shaft and the east limit of the ore body above the level of drill hole 5 and lying within 100 feet of section A-A', fig. 3, and to ore above drill hole 7 and within 100 feet of the vertical plane through this hole. At a cut-off grade of 40 percent of iron this ore body contains 2,000,000 tons of measurable ore. The remainder of the ore in this body is mostly indicated ore, and includes the ore that extends 100 feet below the lines of drill holes 5 and 7 and to a depth of 400 feet in the vicinity of drill hole 1. Indicated ore at a cut-off grade of 40 percent of iron is estimated to be about 1,700,000 tons. The total for both classes of ore is about 3,700,000 tons and corresponds with the Bureau of Mines' estimate of indicated ore of + 45-percent average grade. The iron content of the ore ranges from 40 to 60 percent and averages about 48 percent.

At a cut-off grade of 30 percent the main ore body contains 2,400,000 tons of measurable ore, and 3,000,000 tons of indicated ore. Both classes have an average iron content of 44 percent.

The inferred ore in the main body, at a cut-off grade of 40 percent, consists of ore that is believed to be present north of and below drill hole 5, down to a depth of 100 feet below the hole. It is estimated that such ore amounts to about 400,000 tons. At a cut-off of 30 percent the estimated amount of inferred ore is 1,700,000 tons. The much larger tonnage for the lower cut-off is due to the fact that ore intersected in the lowest part of hole 7 (fig. 4, section B-B') is assumed to extend west beneath the central shaft (fig. 4, section A-A'), and that the lower grade ore is inferred to extend more than 100 feet west of section C-C'. The deepest ore intersected by hole 7 is not included in inferred ore of the higher grade because the higher-grade layers of ore in the lower part of this ore body appear to interfinger with lower-grade ore toward the west. Although some of the ore in the western part of the body might be classed as indicated ore, it is here classed as inferred ore of the lower grade because this part of the ore body is less well explored across its thickness and less thoroughly sampled than the eastern part.

Indicated ore in the north flat ore body is estimated on the assumption that this body is composed of three blocks, adjacent to drill holes 8, 9, and 10 (fig. 3). Most of the ore within a distance of 50 feet from drill hole 8 is classed as indicated, but the ore crossed near the middle of the hole, believed to connect with the outcrop near the western end of the hole, is classed as indicated ore between the level of the hole and the surface. It is estimated that the three blocks together contain 500,000 tons of ore above the 40 percent cut-off grade. The iron content in ore of this grade ranges from 40 to 62 percent and averages 45 percent. With a 30 percent cut-off grade the indicated ore is estimated at about 1,100,000 tons, averaging 42 percent of iron. The small difference in average iron content between the higher- and lower-grade ore is due to the fact

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4/ U. S. Bur. Mines, op. cit. (W. M. Rept. 213), pp. 12-13.

that much of the ore with a 30-percent cut-off contains more than 40 percent of iron. This higher grade ore, though interbedded with a sufficient thickness of lower-grade material to be excluded from ore with a 40 percent cut-off, serves to increase the average grade of the additional ore included in the estimates at the lower cut-off.

Although a satisfactory correlation between drill holes 9 and 10 cannot be made, the ore may extend between them. The ore lying between the holes at a distance of more than 50 feet from either one--which occupies a space about 225 feet long--and the ore that lies from 50 to 100 feet south of hole 9 is considered as inferred ore. Ore is also estimated to extend 100 feet below, 250 feet north, and 100 feet south of hole 8 (fig. 3). Within these limits ore lying outside the defined limits of indicated ore is classed as inferred. It is estimated that the areas of inferred ore in the north flat body would contain 900,000 tons of ore containing more than 40 percent of iron and 1,500,000 tons containing more than 30 percent of iron.

Estimates of tonnage and grade are summarized in the following table.

Table 4.--Reserves of ore in the Dayton iron deposit, showing tonnage and grade of ore available at cut-off grades of 40 and 30 percent.

	Ore containing more than 40 percent of iron		Ore containing more than 30 percent of iron 1/	
	Long tons	Average iron content (percent)	Long tons	Average iron content (percent)
Main ore body:				
Measurable	2,000,000	48	2,400,000	44
Indicated	1,700,000	48	3,000,000	44
Inferred	400,000	48	1,700,000	44
Total, Main ore body	4,100,000	48	7,100,000	44
North flat ore body:				
Measurable	none		none	
Indicated	500,000	45	1,100,000	42+
Inferred	900,000	45	1,500,000	42+
Total, North flat ore body	1,400,000	45	2,600,000	42+
Grand Total	5,500,000	47	9,700,000	43+

1/ Note: The figures for ore containing more than 30 percent of iron include the higher grade ore.

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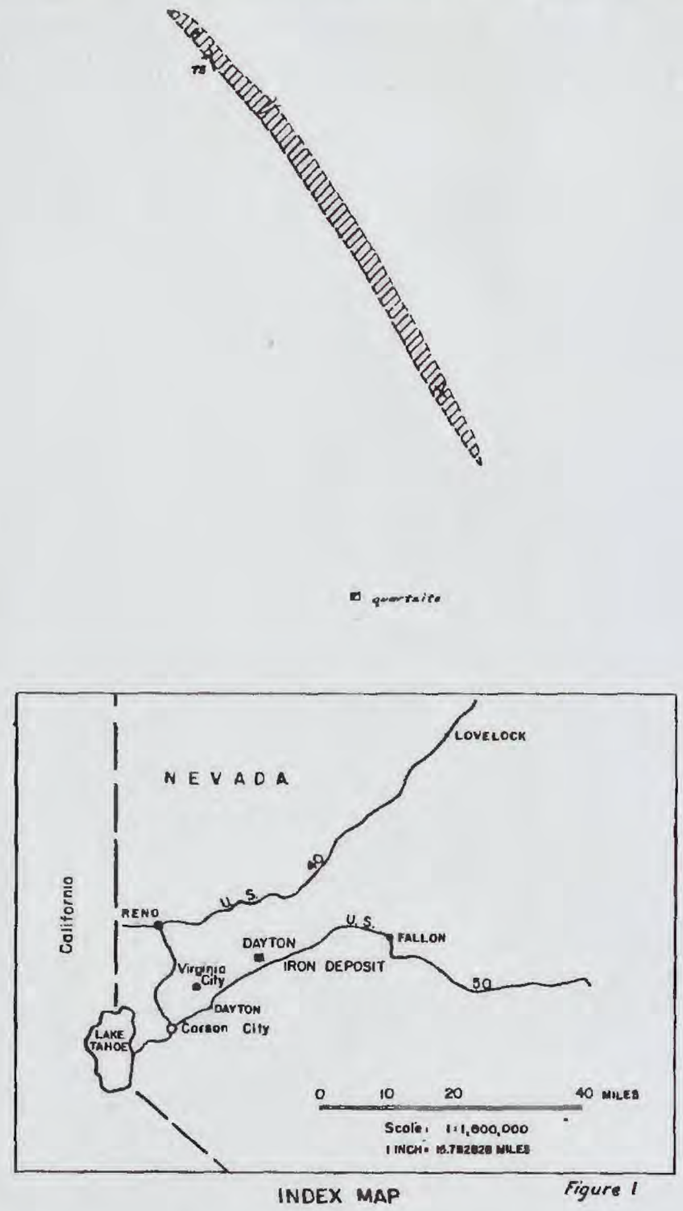
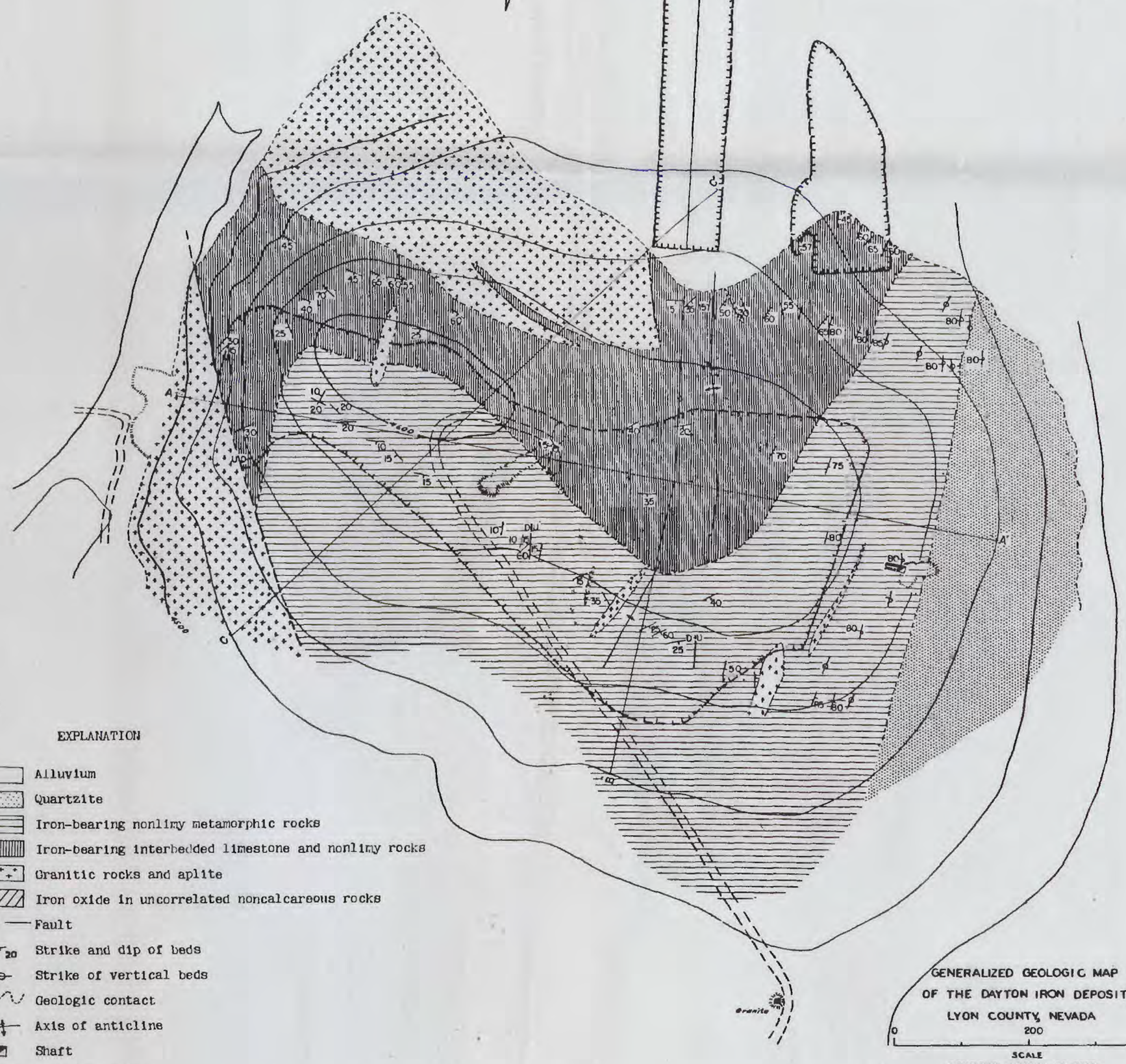
STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP



INDEX MAP

Figure 1



GENERALIZED GEOLOGIC MAP
OF THE DAYTON IRON DEPOSIT
LYON COUNTY, NEVADA

0 200 400 FEET
SCALE
CONTOUR INTERVAL 20 FEET

MAPPED BY A. P. BUTLER, JR.,
A. E. GRANGER, AND A. F. SHRIDE
January 1943

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GEOLOGICAL SURVEY
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FIGURE 2

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STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP

N

Mag

D.D.H. 10

INFERRED ORE

INFERRED ORE

INFERRED ORE

INFERRED ORE

D.D.H. 8

D.D.H. 9

D.D.H. 11

D.D.H. 3

D.D.H. 6

D.D.H. 1

D.D.H. 5

D.D.H. 4

D.D.H. 2

D.D.H. 7

EXPLANATION

- Iron oxides; some layers rich enough in iron to be ore have been omitted as too thin to map
- Granitic rocks and aplite
- Other rocks, distinguished in fig. 2, in part iron-bearing
- Fault
- Shaft
- Inclined shaft
- Adit
- Pit
- Vertical drill hole
- Inclined drill hole; all holes inclined at 45°
- Estimated limit of indicated ore containing more than 40 percent of iron
- Road
- Trench
- Bulldozer cut

ORE AT THE SURFACE AS INDICATED BY OUTCROPS AND EXPLORATION
DAYTON IRON DEPOSIT, LYON COUNTY NEVADA

0 200 400 FEET
SCALE
CONTOUR INTERVAL 20 FEET

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GEOLOGICAL SURVEY

Figure 3

38350

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UNITED STATES DEPARTMENT OF THE INTERIOR
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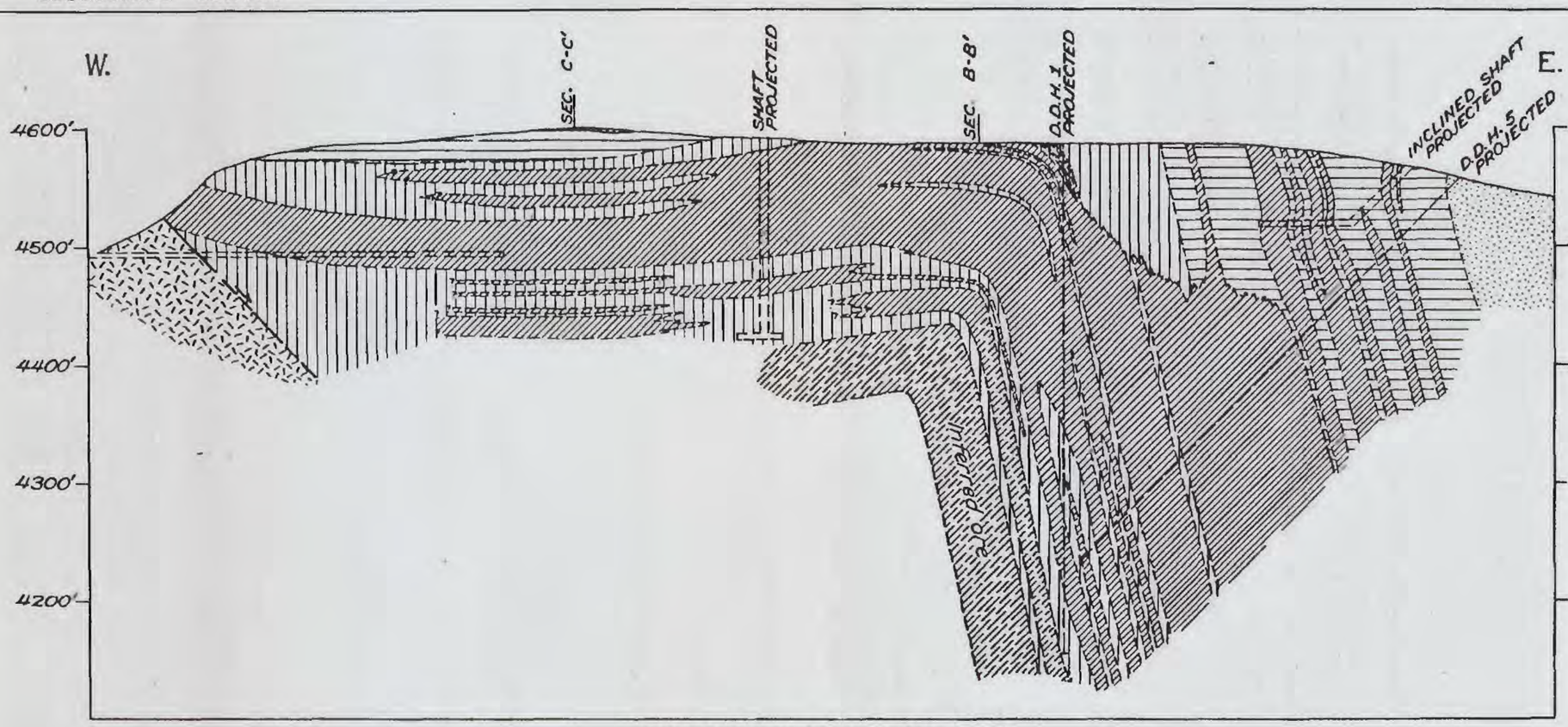
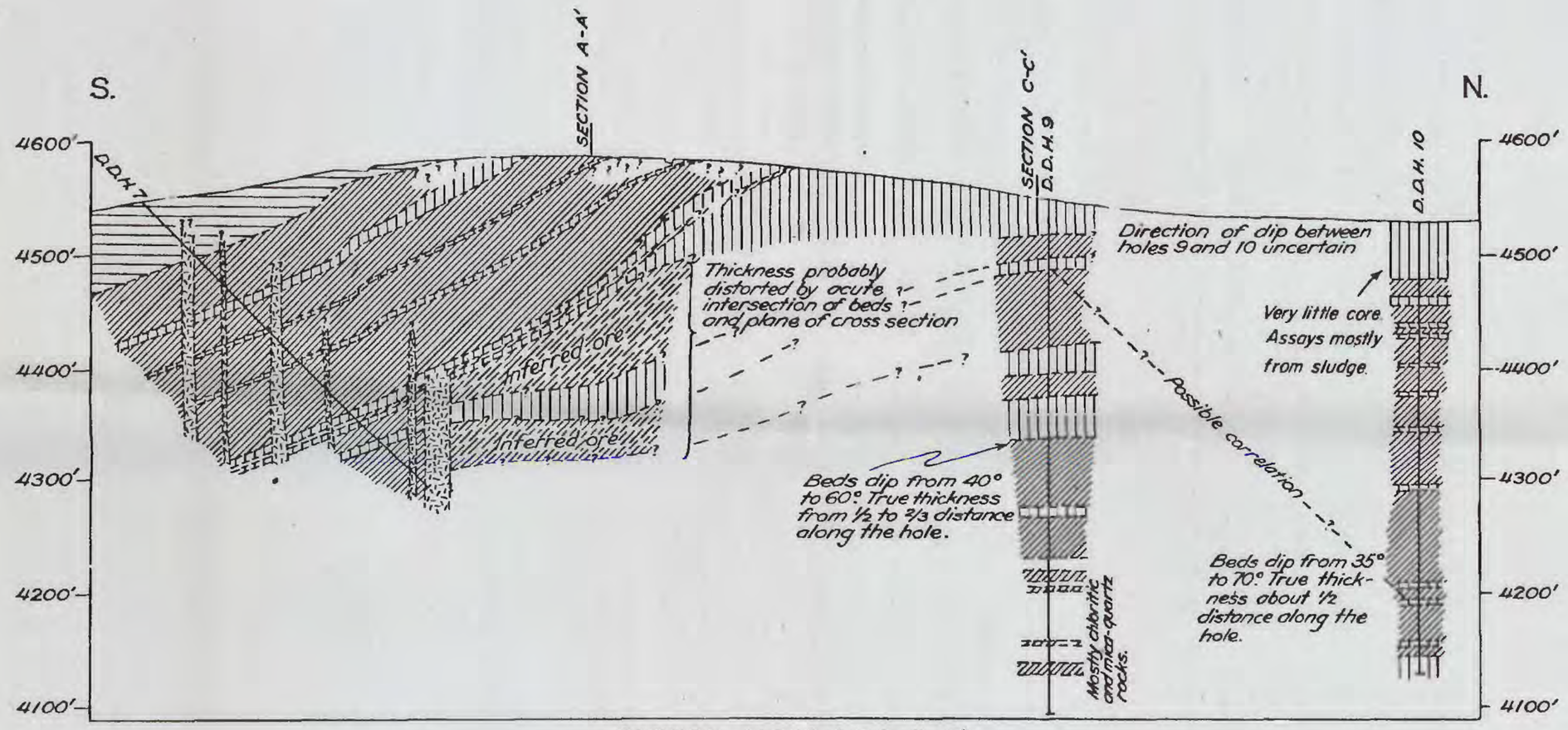
STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP



SECTION ALONG LINE A-A'



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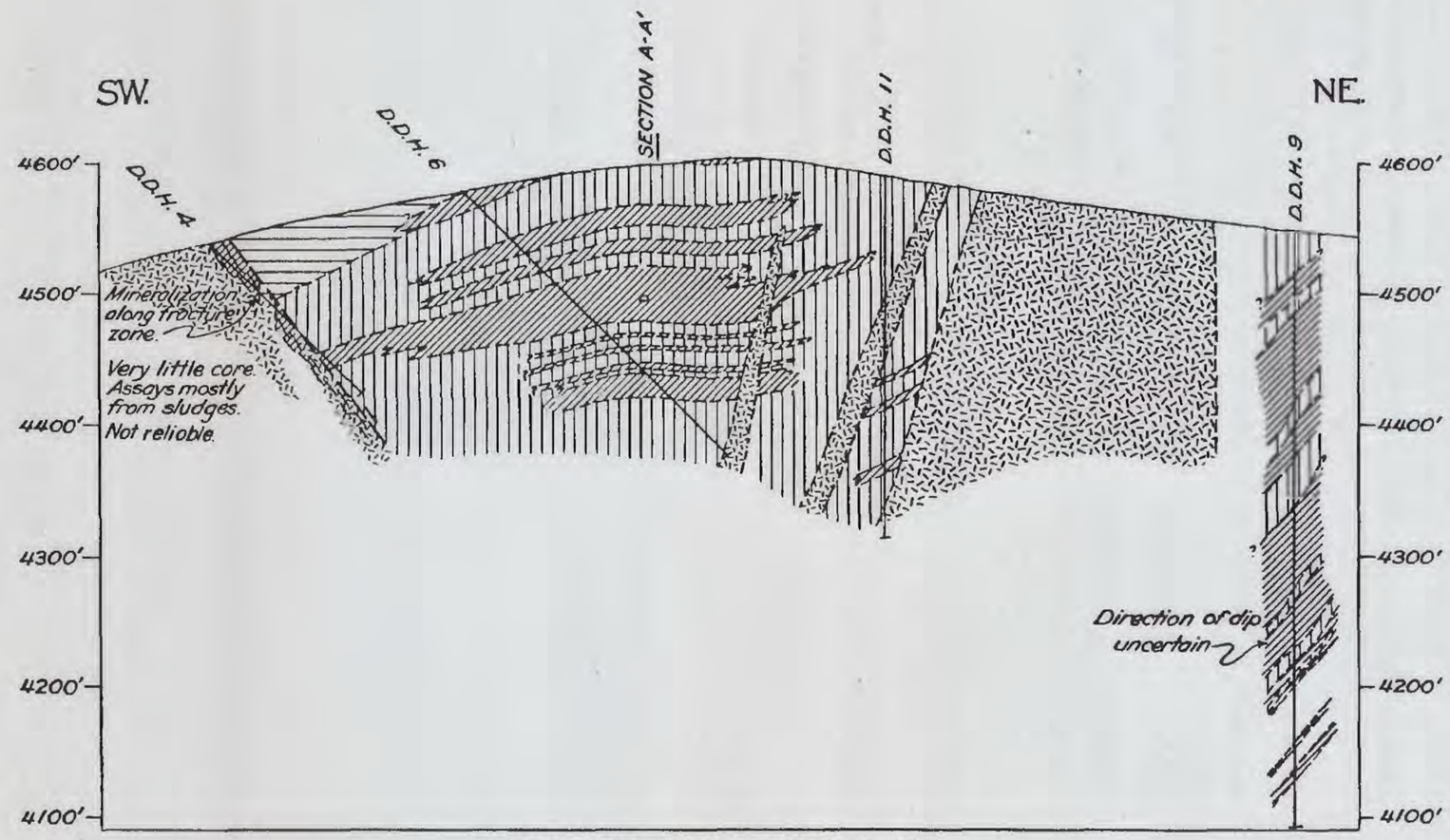

SECTION ALONG LINE C-C'

EXPLANATION

- Quartzite
- Iron-bearing non-limy rocks
- Iron bearing, interbedded limestone and non-limy rocks
  (IRON CONTENT MOSTLY LESS THAN 40%)
- Granitic rocks and aplite
- Iron ore containing more than 40% Fe and averaging 45-47%. Mostly included in reserves
- Inferred ore

0 200 400 FEET
Scale: [redacted]

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FIGURE 4

39350

STRUCTURE SECTIONS
MAINLY SHOWING DISTRIBUTION OF ORE
DAYTON IRON DEPOSIT
LYON COUNTY, NEVADA
1942