Bureau of Mines
Report of Investigations 4723

INVESTIGATION OF MANGANESE DEPOSITS IN THE PHILIPSBURG MINING DISTRICT GRANITE COUNTY, MONT.

BY S. H. LORAIN

United States Department of the Interior — October 1950

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UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary
BUREAU OF MINES
James Boyd, Director

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S. H. Lorain[1/]

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1/ Chief, Albany Branch, Mining Division, Bureau of Mines.

INTRODUCTION AND SUMMARY

Introduction

Shortly after the Strategic Minerals Act of 1939 was passed by Congress, the Bureau of Mines was authorized to begin a program of investigation of domestic sources of strategic minerals. Since World War I, the Philipsburg district had been virtually the only one in the United States that was producing manganese on a commercial scale. Consequently, the district was among the first to be investigated. During the summer of 1939, the Geological Survey mapped the geology and ore deposits of the district. In late July 1939 the writer examined the district for the Bureau of Mines. On the basis of this examination and of the work performed by the Geological Survey, the Bureau of Mines diamond-drilled at several properties in the district during the summer of 1940. This report reviews the mining history and geology of the district, and presents the factual data obtained by diamond drilling.

Summary

The Philipsburg district is about 45 miles, air-line, northwest of Butte, and about the same distance southeast of Missoula. Nearly all the manganese mines are within an area of about 1 square mile whose center is about 1 mile due east from Philipsburg. Some silver mines, however, are a mile or more east, southeast, or north, of the manganese-producing area. The Philipsburg district produced at least $35,000,000, chiefly in silver ore, before 1900. Since 1900 it has produced 539,000 tons of plus 35 percent manganese ore, 24,700 tons of zinc, 8,111 tons of lead, 80,000 ounces of gold, and 20,840,000 ounces of silver. Virtually all of the manganese ore has been produced since the beginning of World War I. Except during World War I, nearly all of the manganese production has been concentrated to a grade of about 70 percent MnO_2 and sold for use in the manufacture of dry batteries.

The manganese deposits in the Philipsburg district are in sedimentary rocks of Paleozoic age. These rocks have been folded into a symmetrical anticline whose axis strikes north-south, and which plunges north at about 25°. The east flank and the south end of the anticline terminate against granodiorite of the Philipsburg batholith. Numerous east-west tension fractures are in the sedimentary rocks and in the granodiorite throughout an area several thousand feet wide on each side of the sedimentary-granodiorite contact and about 8,000 feet long on the strike of the contact. The fractures contain numerous shoots of zinc-silver-lead ore in a gangue of quartz and rhodochrosite. Limestone members of the sedimentary formations adjacent to the fractures contain numerous irregular replacement-type ore bodies of manganese oxides and a few vein-type deposits. These deposits presumably

have been derived by oxidation of primary rhodochrosite ore bodies. Development at greater depth is expected to disclose bodies of rhodochrosite ore whose size and manner of occurrence is similar to the manganese oxide ore bodies that have been mined. A few small rhodochrosite deposits already have been mined in the lower levels of some mines.

In an effort to stimulate manganese production by indicating the position of additional ore reserves in the Philipsburg district, the Bureau of Mines completed 4,019 feet of diamond drilling from surface stations and 1,528 feet of diamond drilling from underground stations during the period June 1, 1940, to December 6, 1940. The locations of the holes, description of the formations intersected, and analyses of the samples obtained by drilling are given in this report.

ACKNOWLEDGMENTS

The writer wishes to acknowledge his indebtedness to Russell R. Trengove, project mining engineer of the Bureau, whose maps and records constitute the basis for this report.

J. T. Pardee and E. N. Goddard, geologists of the U. S. Geological Survey, provided assistance and advice that were of great value in the conduct of the investigation. Mine operators and prospectors of the district gave unlimited access to underground workings and mine records; they also were most generous with their time and personal efforts.

All chemical analyses of samples were made under the direction of the late E. S. Leaver, supervising engineer, Rare and Precious Metals Experiment Station, Federal Bureau of Mines, Reno, Nev.

LOCATION AND TRANSPORTATION

The Philipsburg mining district (known also as the Flint Creek mining district) is in Granite County, Mont., about 45 miles, air-line, northwest of Butte and about the same distance southeast of Missoula (fig. 1). The road distances to Butte and Missoula are 54 and 78 miles respectively. Both routes are on paved highway U. S. 10.

The town of Philipsburg (pop. 1,200) is served by a branch line of the Northern Pacific Railway. The branch joins the main line at Drummond, 25 miles north of Philipsburg. This road does not provide passenger service.

Nearly all of the manganese mines are within an area of about 1 square mile, whose center is about 1 mile due east from Philipsburg. Some silver mines, however, are a mile or more southeast, east, or north of the manganese-producing area. Access to the mines from Philipsburg is by winding mountain roads which climb from an altitude of 5,200 feet at Philipsburg to about 6,000 feet at the mines.

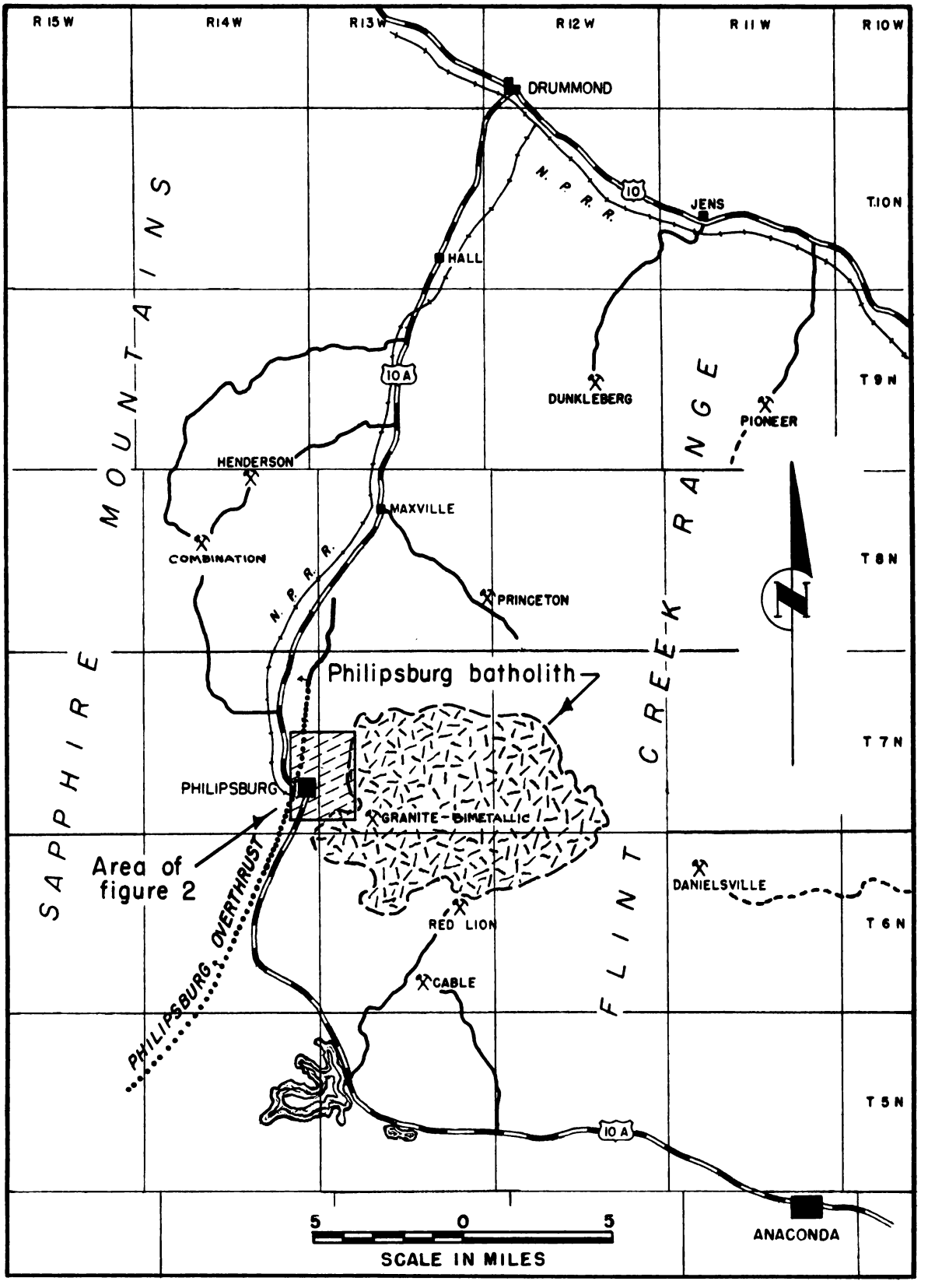


Figure 1. - Location of Philipsburg mining district, Granite County, Mont.

PROPERTY AND OWNERSHIP

Subsequent to examination of the district's known manganese-producing properties, the Bureau of Mines further investigated the following patented lode claims by diamond drilling:

Claim	Present ownership
Bowie	Earl Bellm, Philipsburg, Mont.
Chicago	Do.
Little Dandy	Do.
Casey	Contact Mines Corp., Philipsburg, Mont.
Cliff No. 2	Do.
Seal Rock	Do.
Horseshoe	C. Hickey, J. A. Harrah, and T. Hickey Estate, Philipsburg, Mont.
Horton	Do.
Myrtle	Do.
Saunders	Do.
W. C. Bryant	Do.
Scratch Awl	Owned in April 1940 by the Phillipsbugh Mining Co.

HISTORY AND PRODUCTION

The town of Philipsburg was founded in 1867, 3 years after a prospector named Horton discovered the Hope silver mine. Philipsburg was named in honor of Philip Diedesheimer, who came from the Comstock lode in Nevada to erect the Hope mill at the time the town was founded. The Trout, Algonquin, Poorman's Joy, and other mines were opened in quick succession. For many years thereafter the district was noted chiefly for its production of rich silver ores. The period of greatest prosperity was from 1881 to 1893, when the Granite and Bimetallic mines, about 3 miles southeast of Philipsburg, were at the peak of their production. Production records for the early years are not complete; nevertheless it may be estimated, conservatively, that the district produced at least $35,000,000 before 1900.

The first recorded production of manganese was made in 1900 from the Coyle mine. Very little manganese was produced, however, until about 1916, when the demand for it in the steel industry was stimulated by World War I. Manganese production then increased rapidly until 1918, when over 127,000 tons of manganese ore was produced. After the war the district was unable to compete with foreign sources of metallurgical manganese, but it was learned that the ore, after concentrating, was well suited for use in dry batteries. Since then a small but fairly consistent production of battery-grade manganese has been maintained. During World War II a considerable tonnage of ore, which consisted partly of pyrolusite and partly of rhodochrosite, was purchased by the Government and stock-piled.

Although past interest has centered first on silver production and then on manganese production, considerable amounts of zinc and lead and some

copper have been associated with the silver and manganese ores. During the period of high silver production, the zinc, lead, and copper-bearing minerals were wasted. Since World War I, however, considerable quantities of zinc and lead have been recovered; some mines were operated chiefly for their zinc-silver-lead ores.

The officially recorded production records of the Philipsburg district, as compiled by Needham,2/ are tabulated in table 1.

PHYSICAL FEATURES AND CLIMATE

Philipsburg is on the eastern edge of Flint Creek Valley, 5,200 feet above sea level. Flint Creek originates about 10 miles south of Philipsburg and flows almost due north 35 miles to join the Clark Fork River at Drummond; its valley, in the vicinity of Philipsburg, is about 3 miles wide and is nearly flat. Cattle raising is the chief industry.

The Flint Creek Range rises abruptly from the edge of Flint Creek Valley a few thousand feet east of Philipsburg. Within about 1 mile, the ridges attain an altitude of about 6,000 feet. About 8 miles east of Philipsburg the highest ridges of the range are nearly 9,000 feet above sea level. Most of the mountain slopes are covered with dense stands of lodgepole pine; some larger timber is in the more sheltered valley. The Flint Creek Range is within the Missoula National Forest.

Annual precipitation at Philipsburg is between 15 and 20 inches. About a third of this falls during May and June; the remainder is distributed fairly evenly throughout the year. Extremes of temperature range from 20° to 30° below zero to about 90° above zero. Below freezing temperatures may be expected at any time between late September and late May. Usually, the snowfall is not heavy; snow depths at Philipsburg or at the nearby mines seldom exceed 1 or 2 feet. Road maintenance because of snow is not difficult except at the highest and most distant operations.

DESCRIPTION OF DEPOSITS

General Geology

The regional geology has been described in considerable detail by Emmons and Calkins.3/ The geology of the manganese deposits was described briefly by Pardee4/in 1921 and was described in considerable detail by Goddard5/ in 1940. The following description of the general geology is based on these reports.

2/ Needham, C. E., supervising engineer, Metal Economics Division, Federal Bureau of Mines, Salt Lake City, Utah.

3/ Emmons, William Harvey, and Calkins, Frank Cathcart, Geology and Ore Deposits of the Philipsburg Quadrangle, Mont.: U. S. Geol. Survey Prof. Paper 78, 1913.

4/ Pardee, J. T., Deposits of Manganese in Montana, Utah, Oregon, and Washington. U. S. Geol. Surv. Bull. 725, 1921, pp. 146-174.

5/ Goddard, E. N., Manganese Deposits at Philipsburg, Granite County, Mont.: U. S. Geol. Surv. Bull. 922-G, 1940, pp. 157-204.

TABLE 1. - Production of gold, silver, copper, lead, zinc, and manganese in the Philipsburg mining district, 1904-1947, in terms of recovered metals

Year	Ore and old tailings (short tons) Au, Ag, Cu, Pb, Zn ore	Gold, ounces	Silver, ounces	Copper, pounds	Lead, pounds	Zinc, pounds	Total value, Au, Ag, Cu, Pb, Zn	Manganese crude ore and concentrates, 35 percent or more (long tons)
1900	-	-	-	-	-	-	-	137
1904	1/	1,462	1,290,570	-	-	-	$769,073	-
1905	1/	705	709,294	-	38,687	-	444,808	-
1906	7,849	1,012	306,896	7,197	171,072	-	237,670	-
1907	15,665	1,714	448,850	38,311	43,247	-	341,622	-
1908	14,430	1,159	436,154	63,003	54,526	-	265,718	-
1909	11,377	1,078	352,279	57,387	71,670	-	217,308	-
1910	4,396	599	305,733	15,894	26,321	-	180,664	-
1911	5,490	700	343,558	12,690	80,679	-	201,763	-
1912	7,106	1,128	407,603	31,004	83,186	-	282,846	-
1913	24,857	2,976	721,425	51,970	70,832	-	508,428	-
1914	13,784	1,949	697,626	52,101	123,910	-	437,844	-
1915	13,717	2,158	853,072	4,406	133,809	-	484,185	
1916	15,415	2,062	631,560	222,345	72,767	70,128	527,309	3,230
1917	16,810	1,923	427,623	201,064	41,652	-	450,593	59,327
1918	25,800	3,393	456,732	18,466	10,874	-	532,207	127,415
1919	19,595	2,026	546,347	40,803	18,137	-	662,354	21,343
1920	18,054	1,267	646,577	69,145	25,786	-	745,748	20,176
1921	12,611	751	508,150	8,631	388,875	363,740	560,463	11,101
1922	20,788	1,292	642,357	25,588	421,655	1,124,355	759,798	9,706
1923	6,783	541	274,082	173,939	28,223	-	263,479	20,540
1924	1,290	221	47,723	-	743	-	36,631	23,526
1925	5,545	729	110,002	3,388	176,796	203,149	122,715	28,681
1926	10,859	475	149,378	5,797	268,539	446,542	158,816	16,641
1927	55,572	816	224,744	14,464	172,736	336,893	178,632	22,392
1928	48,074	717	333,821	48,641	682,228	2,545,918	411,981	15,124
1929	53,498	1,014	542,092	105,478	897,554	5,214,628	729,178	12,770
1930	19,413	450	364,407	84,161	630,156	3,320,510	351,441	11,771
1931	69	8	4,479	138	20,660	-	2,242	8,204
1932	-	-	-	-	-	-	-	7,012
1933	4,990	78	46,157	16,641	117,433	613,381	49,319	8,071
1934	50,283	774	429,779	150,850	800,973	4,432,535	537,207	9,345
1935	78,850	2,489	984,672	346,518	1,975,100	9,492,250	1,320,272	7,783
1936	145,810	3,908	1,416,293	261,217	2,991,130	8,614,440	1,826,038	10,551
1937	162,882	5,303	1,580,287	283,000	3,021,000	9,281,000	2,223,704	8,814
1938	66,163	1,350	582,598	65,704	226,261	852,708	481,656	5,619
1939	104,470	5,071	681,752	129,154	436,809	1,326,404	743,185	7,767
1940	54,730	4,517	441,720	150,018	237,180	198,000	513,492	9,270
1941	64,324	5,207	480,375	301,600	228,000	87,600	579,000	9,080
1942	75,908	6,900	526,275	175,900	238,600	285,300	679,543	8,501
1943	43,212	3,195	245,447	119,300	279,000	6,000	323,447	7,768
1944	57,181	2,748	249,141	199,800	292,900	233,500	350,371	7,411
1945	52,963	2,449	208,260	178,000	493,500	101,000	311,897	7,180
1946	286	9	10,255	1,500	20,000	30,500	14,745	7,352
1947	37,673	1,615	173,716	133,900	110,500	218,800	284,244	5,526
Totals..	1,448,572	79,938	20,839,861	3,869,856	16,222,963	49,399,281	$21,103,636	2/539,134

1/ Data not available.

2/ A considerable additional tonnage of lower-grade ore was mined and delivered to Government stock piles during World War II.

The Philipsburg district is in and around an embayment on the west contact of the Philipsburg batholith (fig. 1). The batholith is granodiorite of early Tertiary age; its outcrop is about 10 miles long from east to west and about 6 miles wide from north to south. The rocks that have been intruded by the batholith constitute a thick sedimentary series whose age ranges from pre-Cambrian to upper Cretaceous.

A major fault, known as the Philipsburg Overthrust, crops out about 2-1/4 miles west of the batholith (fig. 1). This fault strikes nearly north-south and dips about 45° west. Pre-Cambrian sedimentaries west of the fault have overridden Paleozoic sedimentaries east of the fault. The Paleozoic sedimentaries between the fault and the batholith have been crumpled into synclines and anticlines whose axes strike north-south and plunge gently north.

Most of the Philipsburg mining district is in an anticline whose east flank and southern end are truncated by the batholith; part of the district is in the batholith within 1 mile east of the contact.

The Philipsburg anticline generally is symmetrical, except on the southern end of the east flank, where the beds appear to have been thinned and steepened by compression against the batholith. The top of the fold is rounded; the flanks dip 30° to 70°. Throughout most of the district the folds plunge north at about 20°; near the southern end, however, the plunge steepens slightly against the batholith.

The sedimentary rocks that comprise the Philipsburg anticline within the mining district are almost entirely of Paleozoic age; their age ranges from Cambrian to Carboniferous. Thin-bedded, impure quartzites of the pre-Cambrian Spokane formation crop out at the southern end of the district, but no ore deposits have been found in them (fig. 2).

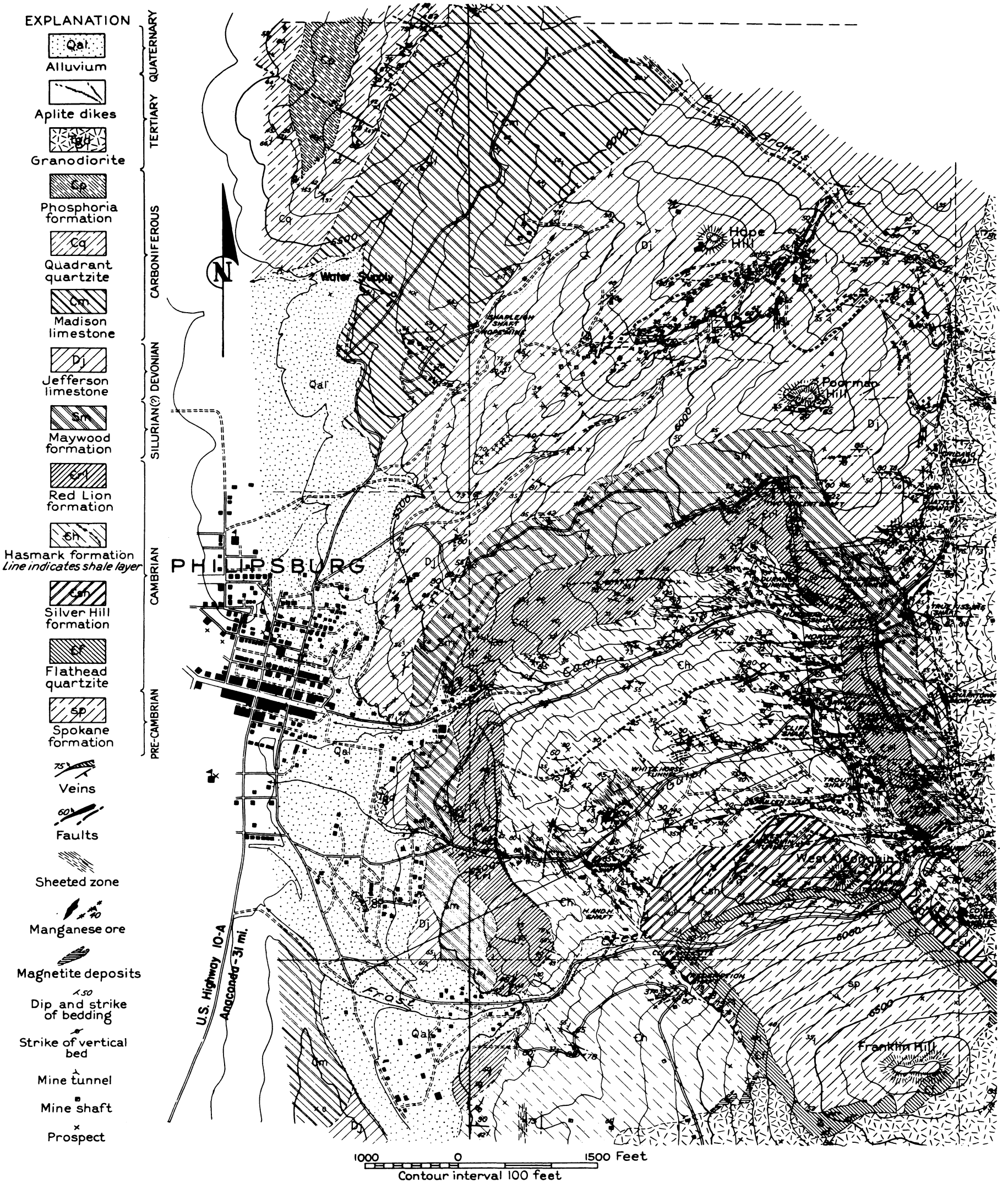
The Paleozoic formations are described briefly below. The descriptions are arranged successively, from lowest to highest.

1. Flathead quartzite: Cambrian - about 150 feet thick. Composed of fine-grained, impure quartzite and thin-bedded, dark, shaly quartzite. The base is composed of 25 feet of coarse-grained, white quartzite.

2. Silver Hill formation: Cambrian - about 300 feet thick. Chiefly thin-bedded, nearly pure limestone alternating with thinner, slightly wavy layers of brown, siliceous shale.

3. Hasmark formation: Cambrian - 800 to 1,000 feet thick. Medium- to fine-grained, dolomitic limestone locally metamorphosed to medium-grained white marble.

4. Red Lion formation: Cambrian - 225 to 300 feet thick. Chiefly thin-bedded, shaly limestone with wavy, discontinuous bands of yellowish shale.



Adapted From U.S. Geological Survey

Figure 2. - Geologic map of the western part of the Philipsburg district, Granite County, Mont.

5. Maywood formation: Silurian (?) - 200 to 500 feet thick. Fine-grained, moderately thin-bedded sandy limestone.

6. Jefferson limestone: Devonian - 1,000 to 1,300 feet thick. Massive, blue-gray limestone. Near the granodiorite contact it is altered to a white, medium-grained marble.

Ore Deposits

General

Most of the past production of manganese, zinc, and lead has been derived from ores that are in or associated closely with east-west tension fractures in the Hasmark limestone within 2,000 feet west of the granodiorite contact (fig. 2). East-west tension fractures and northwesterly striking faults between 2,000 feet and 4,000 feet to 5,000 feet west of the granodiorite contact are known to contain manganese or to be associated with manganese replacement deposits, but none of them have been developed much beyond the prospect stage.

Some manganese has been recovered also from deposits that are in or associated closely with bedding-plane faults between several of the sedimentary formations, or from deposits that constitute irregular replacements in the sedimentary formations adjacent to the granodiorite contact.

Most of the silver production of the district has been obtained from the Granite-Bimetallic lode and from the Hope mine. The Granite-Bimetallic lode is in an east-west fracture in granodiorite about a mile southeast of the granodiorite contact; numerous other east-west fractures in the granodiorite east of the contact have been prospected, but none have yielded important amounts of ore. The ores of the Hope mine are associated with east-west fractures in Jefferson limestone, but the ore bodies are chiefly replacements along bedding planes.

Zinc-lead-silver veins

Many of the east-west veins in the sedimentary rocks have been mined for zinc, silver, and lead. The width of the ore shoots ranges from a few inches to 5 or 6 feet; the length of the ore shoots ranges from about 50 feet to about 300 feet. The ore fractures in granodiorite usually are stronger than the ore fractures in the sedimentary rocks. The Granite-Bimetallic vein is the strongest vein in the district; its width, where it was mined, ranged from 4 feet to 8 feet throughout most of its length; in places it was as much as 20 feet wide. Stopes on the Granite-Bimetallic vein were almost continuous throughout a strike length of 4,500 feet and throughout a dip length of 1,500 feet; no lessening of width or length was apparent on the lowest levels. All of the east-west veins dip steeply; usually they dip between 70° south and vertical.

Manganese deposits

Rhodochrosite is an important primary constituent of virtually all ore deposits in the district. It is abundant in all vein deposits, where it is generally considered to be a gangue mineral and consequently is discarded; some veins of nearly pure rhodochrosite have been mined for manganese, however. Large amounts of rhodochrosite occur also as low-grade disseminations in limestone beds adjacent to faults between the sedimentary formations. Because the known disseminated rhodochrosite deposits seldom contain more than a small percentage of manganese, they have been mined only in a few places where relatively high-grade ore bodies have been found. However, inasmuch as all of the manganese oxide deposits of the district are believed to have been formed by oxidation in situ of primary rhodochrosite deposits, it is inferred that larger and richer rhodochrosite replacement deposits may be found by deeper exploration.

Nearly all of the past production of manganese has been obtained from deposits of manganese oxide, which occur as irregular replacements in Hasmark limestone adjacent to east-west fissures or as replacement deposits in Hasmark or Jefferson limestone adjacent to the granodiorite contact. Usually the largest ore bodies are near the intersection of east-west fissures with bedding-plane faults. Apparently their size depends on the degree of brecciation of the limestone. The southeastern part of the anticline, where the sedimentary rocks appear to have been crushed against the granodiorite, has been the most productive part of the district.

Manganese oxide deposits along limestone beds have been worked at the Headlight mine, where the manganese is in the Red Lion formation adjacent to the Red Lion-Maywood contact, and at the West Algonquin and Bernard mines, where the manganese is in limestone members of the Silver Hill formation. At the Headlight mine and at the West Algonquin and Bernard mines the manganese is in the vicinity of well-defined east-west fractures but is localized along favorable limestone beds.

The replacement deposits of manganese in Hasmark or Jefferson limestone generally are roughly pod-shaped. The dimensions of most deposits of this type that have been mined ranged from 50 to 250 feet long, by 30 to 100 feet thick, by 10 to 125 feet deep. Individual lenses seldom have produced as much as 50,000 to 100,000 tons each.

The tabular bodies of manganese ore in the Headlight mine have been developed throughout a strike length of about 800 feet and a dip length of about 1,000 feet. The thickness of the ore has ranged from about 3 feet to 8 feet. Approximately 25 to 30 percent of the developed area has contained ore whose thickness and grade have been great enough to permit commercial exploitation.

The tabular bodies of manganese that have been mined from the Silver Hill formation, chiefly by the West Algonquin and Bernard mines, have been persistent for as much as 50 to 250 feet along the strike; their dip length has not yet been determined definitely. Their thickness ranges up to about 50 feet, but usually is about 15 to 30 feet.

The Ore

Sulfide ores occur almost exclusively in vein deposits. Although the amounts and proportions of the various sulfides differ from place to place, the composition of nearly all veins, whether they are in granodiorite or in the sedimentary rocks, is similar. Most veins contain sphalerite, galena, and tennantite with some pyrite, chalcopyrite, polybasite, pyrargyrite, and proustite. Quartz is the most abundant gangue mineral, but rhodochrosite generally is present. In some veins, or parts of veins, rhodochrosite is notably abundant. Ankerite, calcite, and barite usually are present in small amounts. Oxidation of the sulfide ores is strong in the upper parts of the veins. The depth of oxidation differs markedly from place to place; nevertheless clean sulfides seldom can be mined from depths of less than 500 feet. The Granite-Bimetallic vein was impoverished by leaching to depths of 50 feet to over 300 feet; below the leached zone it was enriched by secondary silver minerals to depths of 400 to 1,000 feet.

Production records indicate that the average recoverable metal content of the ores mined from the veins in sedimentary rocks was about 5 percent zinc, 1 percent lead, and 13 ounces silver per ton. Most of these ores were wholly or partly oxidized; consequently, very few attempts were made to concentrate them. The average silver content of the ores from the Granite-Bimetallic vein is estimated to have been about 150 ounces per ton; the primary ores in the lower levels average about 12 to 16 ounces silver per ton.

It is the opinion of most geologists who have studied the district that rhodochrosite is the primary manganese ore of the district. Also, it is conceded generally that the rhodochrosite was deposited later than most of the sulfide minerals. Rhodochrosite not only occurs as vein fillings but as fine-grained replacements of limestone. Probably the replacement type ore bodies of manganese oxides were derived from replacement deposits of rhodochrosite. Although no large high-grade replacement deposits of rhodochrosite have been found, Pardee 6/ has estimated that the porosity of the manganese oxide bodies is approximately equal to the theoretical porosity that would result from the oxidation of rhodochrosite. The failure to find high-grade replacement deposits of rhodochrosite may be explained by the theory that they have been oxidized to the greatest depths mined, whereas smaller or lower-grade deposits have been less permeable.

The manganese oxide ores of the district are composed chiefly of pyrolusite. Nevertheless, considerable psilomelane and some braunite, manganite, and wad are present. Most of the manganese oxide ore mined from the Hasmark formation has contained between 30 and 40 percent manganese, 20 to 25 percent silica, 2.5 to 3.5 percent iron, and less than 1 percent lead. Most of this ore has been raised to battery grade by magnetic concentration. The concentrates contain about 47 percent manganese (70 percent MnO_2), 10 to 15 percent silica, 1.5 to 2.0 percent iron, and 0.15 to 0.2 percent lead.

6/ See footnote 4.

WORK BY THE BUREAU OF MINES

Diamond-drilling operations by the Bureau of Mines were started June 1, 1940, and were completed December 6, 1940. During this 6-month period 10 holes were drilled from surface stations and 12 from underground stations. The linear footage drilled is summarized below:

	AX hole	EX hole	Lost hole (AX)	Total
Surface stations	1,002	3,017	80	4,099
Underground stations ...	719	809	41	1,569
Total	1,721	3,826	121	5,668

The hole locations, cross sections through the holes, and assays of significant ore intersections are shown by figures 3, 4, 5, 6, and 7. Descriptive logs of the holes are given on succeeding pages. The descriptions of the rocks intersected by the holes are condensed from descriptions by geologists Goddard and Pardee.

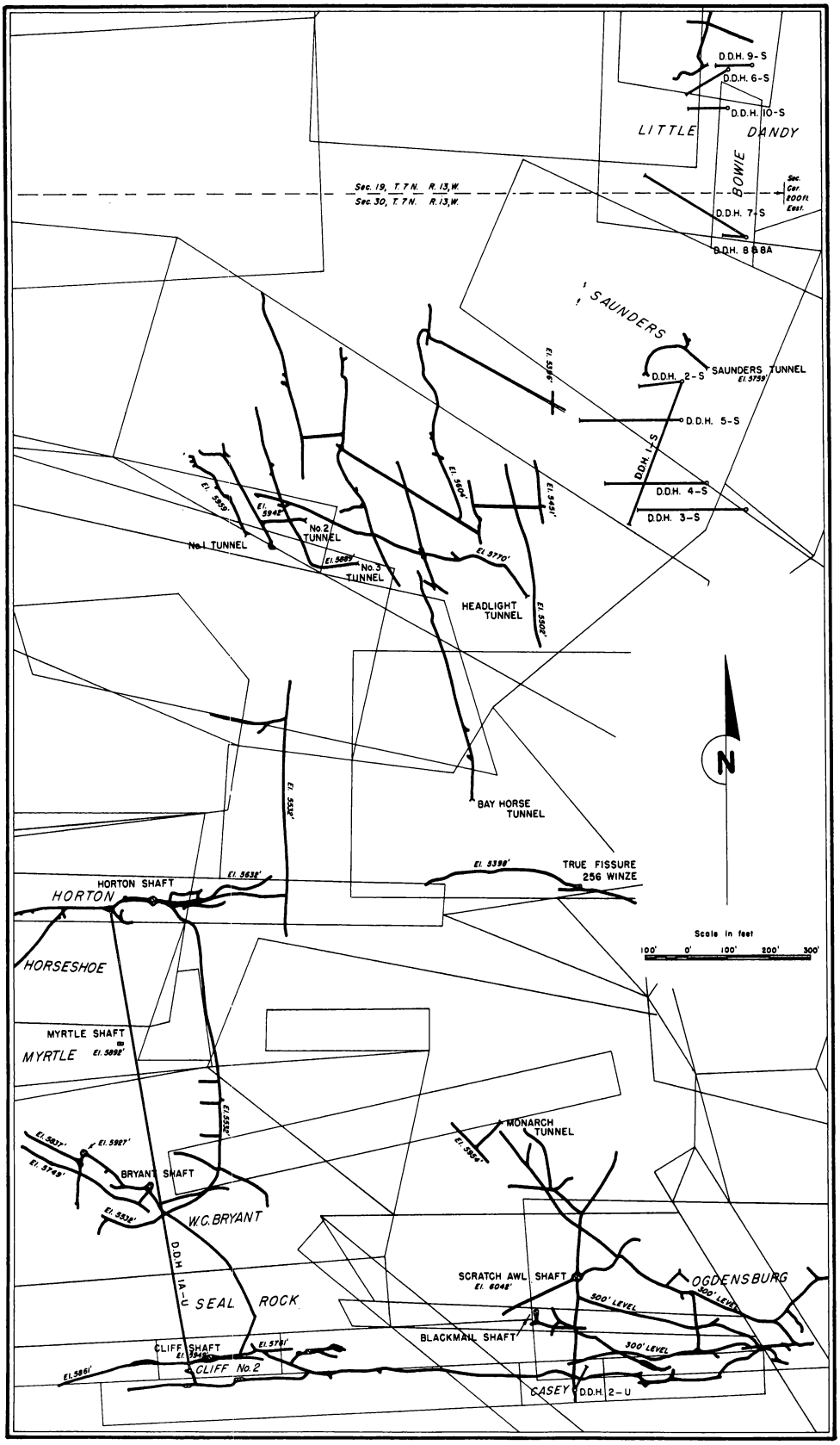
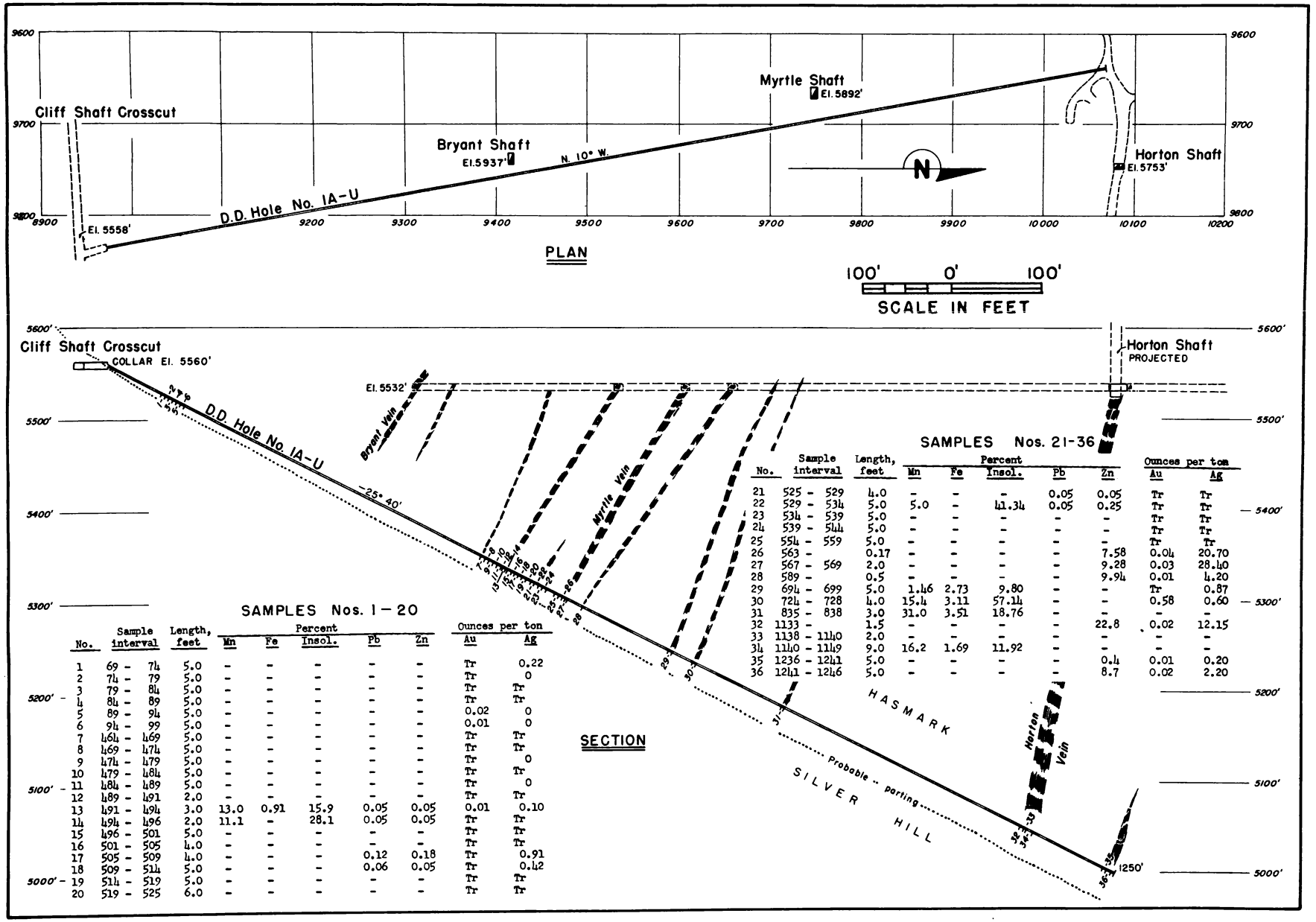


Figure 3. - Part of Philipsburg district, showing mine workings and drill-hole locations.



SAMPLES Nos. 1 – 20

No.	Sample interval	Length, feet	Percent Mn	Fe	Insol.	Pb	Zn	Ounces per ton Au	Ag
1	69 - 74	5.0	-	-	-	-	-	Tr	0.22
2	74 - 79	5.0	-	-	-	-	-	Tr	0
3	79 - 84	5.0	-	-	-	-	-	Tr	Tr
4	84 - 89	5.0	-	-	-	-	-	Tr	Tr
5	89 - 94	5.0	-	-	-	-	-	0.02	0
6	94 - 99	5.0	-	-	-	-	-	0.01	0
7	461 - 469	5.0	-	-	-	-	-	Tr	Tr
8	469 - 474	5.0	-	-	-	-	-	Tr	Tr
9	474 - 479	5.0	-	-	-	-	-	Tr	0
10	479 - 484	5.0	-	-	-	-	-	Tr	Tr
11	484 - 489	5.0	-	-	-	-	-	Tr	0
12	489 - 491	2.0	-	-	-	-	-	Tr	Tr
13	491 - 494	3.0	13.0	0.91	15.9	0.05	0.05	0.01	0.10
14	494 - 496	2.0	11.1	-	28.1	0.05	0.05	Tr	Tr
15	496 - 501	5.0	-	-	-	-	-	Tr	Tr
16	501 - 505	4.0	-	-	-	-	-	Tr	Tr
17	505 - 509	4.0	-	-	-	0.12	0.18	Tr	0.91
18	509 - 514	5.0	-	-	-	0.06	0.05	Tr	0.42
19	514 - 519	5.0	-	-	-	-	-	Tr	Tr
20	519 - 525	6.0	-	-	-	-	-	Tr	Tr

SAMPLES Nos. 21-36

No.	Sample interval	Length, feet	Percent Mn	Fe	Insol.	Pb	Zn	Ounces per ton Au	Ag
21	525 - 529	4.0	-	-	-	0.05	0.05	Tr	Tr
22	529 - 534	5.0	5.0	-	41.34	0.05	0.25	Tr	Tr
23	534 - 539	5.0	-	-	-	-	-	Tr	Tr
24	539 - 544	5.0	-	-	-	-	-	Tr	Tr
25	554 - 559	5.0	-	-	-	-	-	Tr	Tr
26	563 -	0.17	-	-	-	-	7.58	0.04	20.70
27	567 - 569	2.0	-	-	-	-	9.28	0.03	28.40
28	589 -	0.5	-	-	-	-	9.94	0.01	4.20
29	694 - 699	5.0	1.46	2.73	9.80	-	-	Tr	0.87
30	724 - 728	4.0	15.4	3.11	57.14	-	-	0.58	0.60
31	835 - 838	3.0	31.0	3.51	18.76	-	-	-	-
32	1133 -	1.5	-	-	-	-	22.8	0.02	12.15
33	1138 - 1140	2.0	-	-	-	-	-	-	-
34	1140 - 1149	9.0	16.2	1.69	11.92	-	-	-	-
35	1236 - 1241	5.0	-	-	-	-	0.4	0.01	0.20
36	1241 - 1246	5.0	-	-	-	-	8.7	0.02	2.20

Figure 4. - Plan and vertical section through drill hole 1 AU.

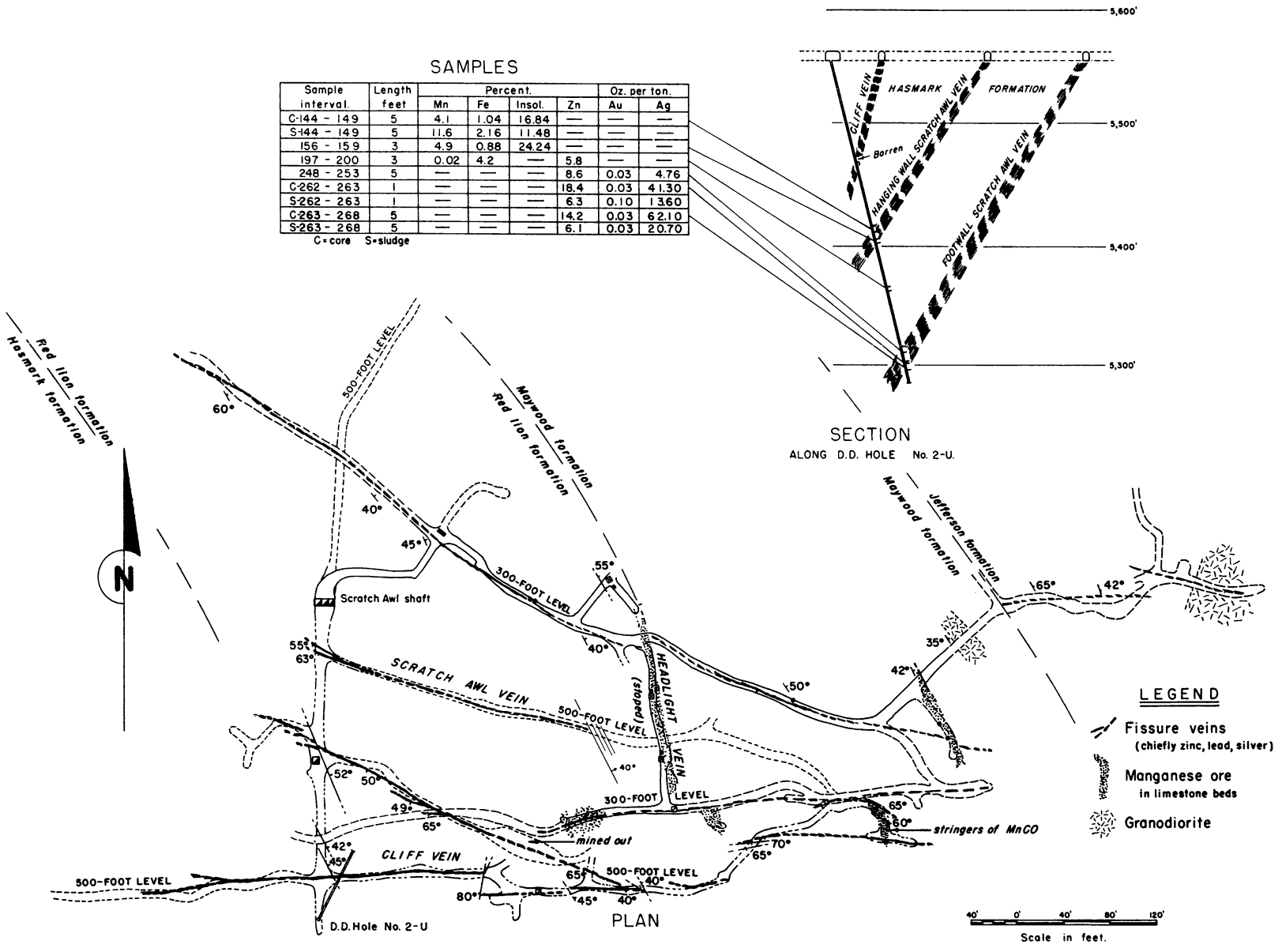
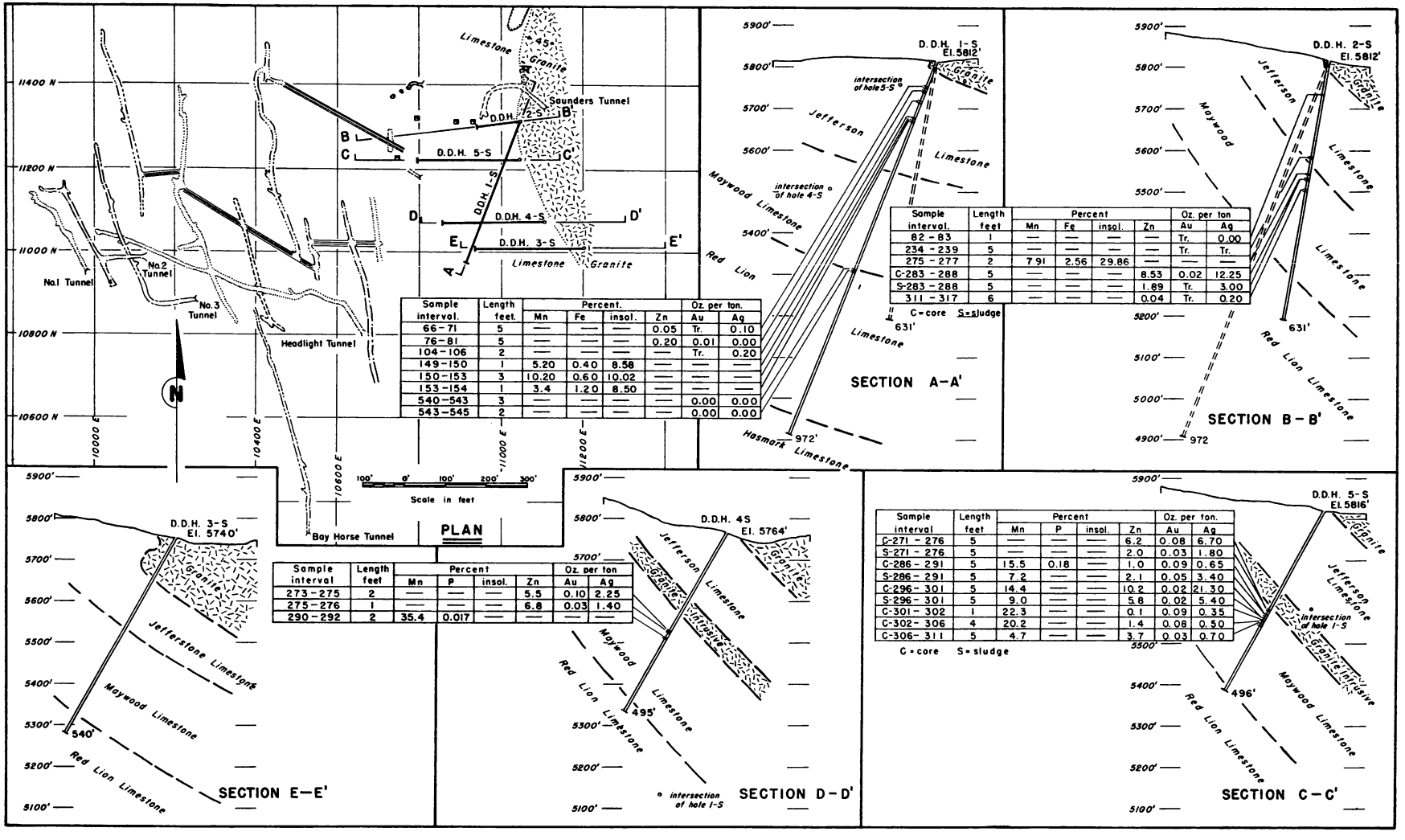


Figure 5. - Plan and vertical section through drill hole 2U, showing 300 and 500 levels, Scratch Awl mine.



Sample interval.	Length feet.	Percent. Mn	Fe	insol.	Zn	Oz. per ton. Au	Ag
66 - 71	5	—	—	—	0.05	Tr.	0.10
76 - 81	5	—	—	—	0.20	0.01	0.00
104 - 106	2	—	—	—	—	Tr.	0.20
149 - 150	1	5.20	0.40	8.58	—	—	—
150 - 153	3	10.20	0.60	10.02	—	—	—
153 - 154	1	3.4	1.20	8.50	—	—	—
540 - 543	3	—	—	—	—	0.00	0.00
543 - 545	2	—	—	—	—	0.00	0.00

Sample interval.	Length feet	Percent Mn	Fe	insol.	Zn	Oz. per ton Au	Ag
82 - 83	1	—	—	—	—	Tr.	0.00
234 - 239	5	—	—	—	—	Tr.	Tr.
275 - 277	2	7.91	2.56	29.86	—	—	—
C-283 - 288	5	—	—	—	8.53	0.02	12.25
S-283 - 288	5	—	—	—	1.89	Tr.	3.00
311 - 317	6	—	—	—	0.04	Tr.	0.20

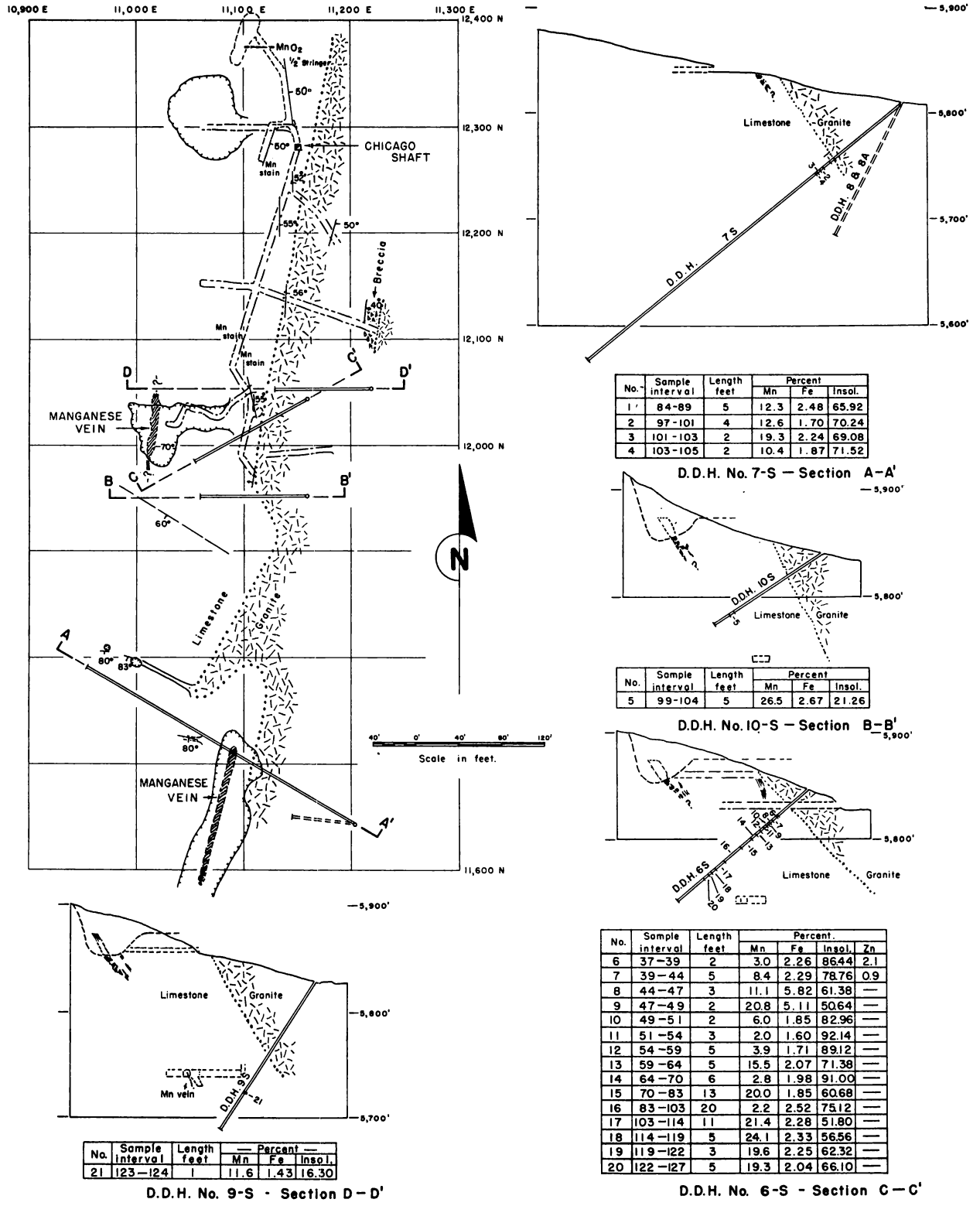
C = core S = sludge

Sample interval	Length feet	Percent Mn	P	insol.	Zn	Oz. per ton Au	Ag
273 - 275	2	—	—	—	5.5	0.10	2.25
275 - 276	1	—	—	—	6.8	0.03	1.40
290 - 292	2	35.4	0.017	—	—	—	—

Sample interval	Length feet	Percent Mn	P	insol.	Zn	Oz. per ton. Au	Ag
C-271 - 276	5	—	—	—	6.2	0.08	6.70
S-271 - 276	5	—	—	—	2.0	0.03	1.80
C-286 - 291	5	15.5	0.18	—	1.0	0.09	0.65
S-286 - 291	5	7.2	—	—	2.1	0.05	3.40
C-296 - 301	5	14.4	—	—	10.2	0.02	21.30
S-296 - 301	5	9.0	—	—	5.8	0.02	5.40
C-301 - 302	1	22.3	—	—	0.1	0.09	0.35
C-302 - 306	4	20.2	—	—	1.4	0.08	0.50
C-306 - 311	5	4.7	—	—	3.7	0.03	0.70

C = core S = sludge

Figure 6. - Plan and vertical sections through drill holes 1S, 2S, 3S, 4S, and 5S.



No.	Sample interval	Length feet	Percent Mn	Fe	Insol.
1	84-89	5	12.3	2.48	65.92
2	97-101	4	12.6	1.70	70.24
3	101-103	2	19.3	2.24	69.08
4	103-105	2	10.4	1.87	71.52

D.D.H. No. 7-S — Section A–A'

No.	Sample interval	Length feet	Percent Mn	Fe	Insol.
5	99-104	5	26.5	2.67	21.26

D.D.H. No. 10-S — Section B–B'

No.	Sample interval	Length feet	Percent. Mn	Fe	Insol.	Zn
6	37-39	2	3.0	2.26	86.44	2.1
7	39-44	5	8.4	2.29	78.76	0.9
8	44-47	3	11.1	5.82	61.38	—
9	47-49	2	20.8	5.11	50.64	—
10	49-51	2	6.0	1.85	82.96	—
11	51-54	3	2.0	1.60	92.14	—
12	54-59	5	3.9	1.71	89.12	—
13	59-64	5	15.5	2.07	71.38	—
14	64-70	6	2.8	1.98	91.00	—
15	70-83	13	20.0	1.85	60.68	—
16	83-103	20	2.2	2.52	75.12	—
17	103-114	11	21.4	2.28	51.80	—
18	114-119	5	24.1	2.33	56.56	—
19	119-122	3	19.6	2.25	62.32	—
20	122-127	5	19.3	2.04	66.10	—

D.D.H. No. 6-S - Section C–C'

No.	Sample interval	Length feet	— Percent — Mn	Fe	Insol.
21	123–124	1	11.6	1.43	16.30

D.D.H. No. 9-S - Section D–D'

Figure 7. - Plan and vertical sections through drill holes 6S, 7S, 9S, and 10S.

DESCRIPTIVE LOG

Hole 1A-U

Co-ordinates: 8972N, 9835E
Elevation at collar: 5,560 feet
Dip: 25° - 40'

Depth: 1,250 feet
Bearing: N. 10° W.

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description: Footage From-	Footage To-	
0	5	Ax	5		0.0	0	5	No core. Casing.
5	9	"	4	3'10"	95.8	5	25'6"	White Hasmark marble. Many iron-stained fractures.
9	14	"	5	1'6"	30.0			
14	18-1/2	"	4 1/2	2'11"	64.8			
18-1/2	23-1/2	"	5	3'8"	73.3			
23-1/2	28-1/2	"	5	0'10"	16.7	25.6"	28'6"	Fine-grained quartz with limonite and manganese oxide strains in veins.
28-1/2	34	"	5-1/2	0'11"	16.7	28'6"	54	White to yellowish Hasmark marble with yellow-stained fractures.
34	39	"	5	1'9"	35.0			
39	44	"	5	1'1"	21.7			
44	49	"	5	1'4"	26.7			
49	54	"	5	2'0"	40.0			
54	59	"	5	3'11"	78.3	54	70'7"	White Hasmark with few fractures. Between 48 and 69 feet two fairly prominent sets of fractures intersecting at 60 degrees.
59	64	"	5	3'6"	70.0			
64	69	"	5	4'8"	93.3			
69	74	"	5	4'8"	93.3			Medium-grained white Hasmark
74	79	"	5	4'6"	90.0	70'7"	153	marble. In places smlall cavities with limonite.
79	84	"	5	4'9"	95.0			
84	89	"	5	4'7"	91.6			
89	94	"	5	3'1"	61.6			
94	99	"	5	4'10"	96.6			
99	104	"	5	2'9"	55.0			
104	109	"	5	3'3"	65.0			
109	114	"	5	2'6"	50.0			
114	119	"	5	3'0"	65.0			
119	124	"	5	4'9"	95.0			
124	129	"	5	4'10"	96.0			
129	134	"	5	4'0"	80.0			
134	139	"	5	4'7"	91.6			

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Hole 1A-U (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
139	144	Ax	5	4'6"	90.0			Medium-grained white Hasmark marble. In places small cavities with limonite
144	149	"	5	4'8"	93.3			
149	154	"	5	4'8"	93.3			
154	159	"	5	3'11"	78.3			Medium White Hasmark. Few small cavities. Locally fractured. Scattered specks of pyrite.
159	164	"	5	2'5"	48.3	153	229'6"	
164	169	"	5	4'8"	93.3			
169	174	"	5	4'8"	93.3			
174	179	"	5	3'8"	73.3			
179	184	"	5	3'9"	75.0			
184	189	"	5	3'0"	60.0			
189	194	"	5	4'9"	95.0			
194	199	"	5	4'5"	88.3			
199	204	"	5	3'9"	75.0			
204	209	"	5	4'7"	91.6			
209	214	"	5	3'8"	73.3			
214	219	"	5	3'8"	73.3			
219	224	"	5	4'8"	93.3			
224	229	"	5	4'10"	96.6			
229	232	"	3	1'11"	63.9	229'6"	296'	White Hasmark marble with few cavities and fractures. At 252' 2" a 4-inch streak stained brown.
232	237	"	5	4'3"	85.0			
237	242	"	5	3'7"	71.7			
242	247	"	5	4'7"	91.6			
247	252	"	5	3'3"	65.0			
252	257	"	5	4'7"	91.6			
257	262	"	5	4'9"	95.0			
262	267	"	5	4'9"	95.00			
267	272-1/2	"	5-1/2	4'7"	83.3			
272-1/2	278	"	5-1/2	4'6"	81.8			
278	283	"	5	4'3"	85.0			
283	288	"	5	3'9"	93.3			
288	293-1/2	"	5-1/2	4'11"	87.9			

Hole 1A-U (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
293-1/2	299	Ax	5-1/2	4'3"	77.3	296	309	White Hasmark marble.
299	304	"	5	3'4"	80.0			
304	309	"	5	4'5"	88.3			
309	314	"	5	2'6"	50.0	309	314	Medium-grained, gray, Hasmark marble.
314	319	"	5	2'2"	43.3	314	341	White Hasmark, locally fractured.
319	324	"	5	2'8"	53.3			
324	329	"	5	2'1"	41.6			
329	334	"	5	2'10"	56.6			
334	339	"	5	3'2"	63.3			
339	344	"	5	2'6"	50.0	341	341'8"	Vein about 80 degrees to core, quartz-filled breccia.
344	349	"	5	2'1"	41.6			
349	354	"	5	4'8"	93.3	341'8"	379	White Hasmark marble locally fractured
354	359	"	5	4'11"	98.3			
359	364	"	5	4'8"	93.3			
364	369	"	5	4'10"	96.6			
369	374	"	5	1'3"	25.0			
374	379	"	5	4'9"	95.0			
379	384	"	5	4'5"	88.3	379	420'6"	White Hasmark-local small cavities.
384	389	"	5	4'6"	90.0			
389	394	"	5	3'8"	73.3			
394	399	"	5	2'11"	58.3			
399	404	"	5	2'6"	50.0			
404	409	"	5	4'7"	91.6			
409	414	"	5	3'6"	70.0			
414	419	"	5	4'3"	85.0			
419	424	"	5	4'8"	93.3	420'6"	499	Yellowish Hasmark, medium fine-grained. Fractured in places. At 448' 8", 1 inch of silicified breccia with disseminated pyrite.
424	429	"	5	4'2"	83.3			
429	434	"	5	4'11"	98.3			
434	439	"	5	4'5"	88.3			
439	444	"	5	4'9"	95.0			
444	449	"	5	4'7"	91.6			
						449	449'6"	Gray, fine-grained Hasmark. Dark-gray streaks. Scattered fine pyrite, some cavities.

Hole 1A-U (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
449	454	Ax	5	4'9"	95.0	499'6"	450	Yellowish Hasmark. One inch with solution cavities coated brown.
						450	456'6"	Yellowish Hasmark-a few fractures. The most prominent ones at 45 degrees and parallel to core. At 452'6" at 1 inch zone of brown seams parallel to core.
454	459	"	5	4'2"	83.3	456'6"	460	Yellowish Hasmark, medium texture. First 2 inches locally cavernous, brown-stained, and partly gone to sand.
459	464	"	5	2'0"	40.0	460	464	Yellow to white Hasmark, somewhat fractured and friable.
464	469	"	5	3'0"	60.0	464	469	Yellow, medium-grained Hasmark. At 465' 6" cavities partly filled with limonite.
469	474	"	5	4'4"	86.7	469	474	Yellow Hasmark. Numerous cavities more or less filled with limonite. A few fractures 45 degrees to core, some parallel.
474	479	"	5	3'6"	70.0	474	479	Grayish Hasmark, fractures parallel to core. Last 2 feet considerably broken.
479	484	"	5	3'0	60.0	479	484	Grayish Hasmark, many seams and fractures, lines with MnO2 films.
484	489	"	5	2'0"	40.0	484	489	Grayish Hasmark, much broken, ocassional fine grains of pyrite. Recovered core shows no Mn stain.
489	491	"	2	0'6"	25.00	489	490'7"	Yellowish Hasmark marble, fractured locally, porous with limonite stain.

Hole 1A-U (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
491	494	Ax	3	1'1"	36.1	490'7"	494'2"	First 6 inches mostly fine-grained quartz, replacing limestone; some pyrite; next 10 inches largely pink $MnCo_3$ with fine-grained dark patches (sulfides). Last 3 inches brownish, fine-grained Hasmark.
494	496	"	2	1'11"	95.8	494'2"	496	Hasmark breccia cemented with vein quartz and white to pale-pink carbonate (some $MnCo_3$). Rock is locally cavernous.
496	501	"	5	1'5"	28.3	496	500'7"	White Hasmark with indistinct gray bands (bedding) 45 degrees to core. Locally brecciated and cemented with quartz.
501	505	"	4	3'5"	85.4	500'7"	504'7"	Hasmark fractured and crossed by dark seams containing fine pyrite parallel to core. Last inch shows some pink carbonate.
505	509	"	4	2'8"	66.7	504'7"	509	Vein quartz banded parallel to core with dark seams showing pyrite ZnS & PbS at 506 feet, the sulfides fairly abundant. Last 2 inches gray gouge.
509	514	"	5	2'4"	46.7	509	514	Similar to last except more or less broken and showing smaller amounts of sulfides.
514	519	"	5	2'9"	55.00	514	519	Mostly quartz with some disseminated fine sulfides.
519	521	"	2	1'1"	54.2	519	525	Light-gray quartz and carbonate; some pale pink, some bands parallel to core showing fine sulfides.
521	525	"	4	3'2"	79.2			

Hole 1A-U (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
525	529	Ax	4	1'3"	31.2	525	529	Bands turn to 45 degrees to core. Sulfides are mostly pyrites.
529	534	"	5	2'1"	41.7	529	530	Broken core chiefly white and pink carbonate. Banding disappears.
534	539	"	5	1'0"	20.0	530	539	First 2 inches brownish marble. Next 6 inches white carbonate rather heavy in fine pyrite and ZnS. To 539 feet white Hasmark slightly stained yellow and fractured in places.
539	544	"	5	1'3"	25.0	539	544	White Hasmark locally fractured and stained yellow (limonite?).
544	549	"	5	3'8"	73.3	544	624	Medium-grained light-yellowish Hasmark.
549	554	"	5	1'0"	20.0			Marble core is mostly broken to pieces 2 inches or less in length.
554	559	"	5	1'4"	26.7			At about 563'-2" of quartz with fine sulfides.
559	564	"	5	1'4"	26.7			At about 567'-569' quartz with fine sphalerite.
564	569	"	5	3'0"	60.0			At about 573'-1" quartz and fine sulfides.
569	574	"	5	1'4"	26.7			At about 582'-584' Numerous fractures with iron stain and 1 seam pyrite.
574	579	"	5	1'4"	26.7			At about 588'6"-589' quite locally rich in sphalerite.
579	584	"	5	3'0"	60.0			At about 614'-619' fractured, friable, and slightly iron stained.
584	589	"	5	1'5"	28.3			
589	594	"	5	2'3"	45.0			
594	599	"	5	3'0"	60.0			
599	604	"	5	2'4"	46.7			
604	609	"	5	2'3"	45.0			
609	614	"	5	3'10"	76.7			
614	619	"	5	1'2"	23.3			
619	624	"	5	1'10"	36.7			

Hole 1A-U (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description: Footage From-	Petrographic description: Footage To-	Petrographic description
624	629	Ax	5	5'0"	100.0	624	634	Medium-grained gray marble crossed by several thin seams showing buff core. At 629' - 4" shows some black (MnO_2) and some pink ($MnCo_3$)
629	634	"	5	4'0"	80.0			
634	639	Ex	5	3'9"	75.0	634	719'6"	Mostly buff medium grained marble, some in gray. All more or less broken. At 639'-2" gouge with limonite. 683'6"-684' some qtz and trace of oxide. 694'6"-695'6" Much brown iron oxide. 694'6"-695' Fairly rich in MnO_2. 695'-697' Some quartz and MnO_2.
639	644	"	5	1'6"	30.0			
644	649	"	5	2'0"	40.0			
649	654	"	5	1'3"	25.0			
654	659	"	5	1'9"	35.0			
659	664	"	5	1'9"	35.0			
664	669	"	5	0'9"	15.0			
669	674	"	5	3'3"	65.0			
674	679	"	5	2'10"	56.7			
679	684	"	5	1'6"	30.0			
684	689	"	5	1'0"	20.0			
689	694	"	5	2'1"	41.7			
694	699	"	5	1'8"	33.3			
699	704	"	5	1'2"	23.3			
704	709	"	5	2'2"	43.3			
709	714	"	5	2'7"	51.6			
714	719	"	5	2'10"	56.7			
719	724	"	5	1'0"	20.0	719'6"	826'	Light buff Hasmark marble core. Much broken. At 724 feet, 2 inches of MnO_2 followed by 3 inches of marble heavily stained with limonite. Rock is locally cavernous and generally somewhat iron-stained.
724	728	"	4	0'6"	12.5			
728	732	"	4	0'11"	22.9			
732	734	"	2	0'9"	37.5			
734	739	"	5	1'0"	20.0			
739	742	"	3	0'9"	25.0			
742	747	"	5	0'9"	15.0			
747	750	Ax	3	0'9"	25.0			
750	755	"	5	1'6"	30.0			
755	760	"	5		0			

Hole 1A-U (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
760	765	Ax	5	1'7"	31.6			Light buff Hasmark marble core. Much broken. At 724 feet, 2 inches of MnO_2 followed by 3 inches of marble heavily stained with limonite. Rock is locally cavernous and generally somewhat iron-stained.
765	770	"	5	3'8"	73.3			
770	775	Ex	5	3'0"	60.0			
775	780	"	5	2'3"	45.0			
780	785	"	5	0'8"	13.3			
785	790	"	5	0'9"	15.0			
790	795	"	5	0'10"	16.7			
795	800	"	5	1'3"	25.0			
800	805	"	5	0'11"	18.3			
805	810	"	5	0'7"	11.6			
810	811	"	1	0'4"	33.0			
811	816	"	5	1'10"	36.7			
816	821	"	5	1'1"	21.7			
821	826	"	5	1'10"	36.7			
826	827-1/2	"	1-1/2	1'0"	66.7	826	831'7"	Core broken and largely wanting, shows some Fe and Mn stains.
827-1/2	831-1/2	"	4					
831-1/2	835	"	3-1/2	2'0"	57.1	831'7"	835	Largely quartz cavernous, some brown MnO_2.
835	840	"	5	1'10"	36.7	835	836	Rich in MnO_2.
840	845	"	5	1'1"	21.7	835	920	Light buff Hasmark, core much broken. A little Mn Stain in places.
845	850	"	5	1'2"	23.3			
850	850	"	5	4'0"	80.0			
855	860	"	5	0'10"	16.7			
860	865	"	5	2'11"	58.3			
865	870	"	5	2'4"	46.7			
870	875	"						
875	880	"	5	2'4"	46.7			
880	885	"	5	0'8"	13.3			
885	890	"	5	0'10"	16.7			
890	895	"	5	2'6"	50.0			
895	900	"	5	3'1"	61.7			
900	905	"	5	0'10"	16.7			
905	910	"	5	2'0"	40.0			
910	915	"	5	1'5"	28.3			
915	920	"	5	2'9"	55.0			

Hole 1A-U (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
920	925	Ex	5	2'0"	40.0	920	1030	Light buff, medium fine-grained marble (Hasmark). Locally cavernous. A little Mn stain in places. Core mostly to sections of 1 inch and smaller.
925	930	"	5	0'11"	18.3			
930	935	"	5	2'8"	53.3			
935	940	"	5	2'0"	40.0			
940	945	"	5	2'9"	55.0			
945	950	"	5	0'10"	16.7			
950	955	"	5	0'4"	6.7			
955	960	"	5	1'3"	25.0			
960	965	"	5	1'5"	28.3			
965	970	"	5	1'10"	36.7			
970	975	"	5	1'4"	26.7			
975	980	"	5	1'0"	20.0			
980	985	"	5	2'4"	46.7			
985	990	"	5	2'0"	40.0			
990	994	"	4	1'2"	29.2			
994	999	"	5	4'0"	80.0			
999	1004	"	5	2'8"	53.3			
1004	1009	"	5	1'8"	33.3			
1009	1014	"	5	2'1"	41.7			
1014	1019	"	5	1'0"	20.0			
1019	1024	"	5	2'1"	41.7			
1024	1025	"	1	0'9"	75.0			
1025	1030	"	5	1'3"	25.0			
1030	1034	"	4	2'6"	62.5	1030	1075	Nearly white to light buff marble. Many fractures thinly coated with MnO_2. A few specks of pyrite. Locally fractured parallel to core.
1034	1039	"	5	3'0"	60.0			
1039	1044	"	5	4'8"	93.3			
1044	1049	"	5	4'2"	83.3			
1049	1054	"	5	4'1"	81.7			
1054	1059	"	5	2'1"	41.7			
1059	1050	"	1	0'0"	0.0			
1060	1065	"	5	3'1"	61.7			
1065	1070	"	5	3'4"	66.7			
1070	1075	"	5	3'0"	60.0			

Hole 1A-U (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description Footage From-	Footage To-	
1075	1080	Ex	5	0'10"	16.7	1075	1132	Pale buff marble. Many fractures 45 degrees to core dusted with MnO_2. Core broken 2 inches or less.
1080	1083	"	3	0'10"	27.8			
1083	1088	"	5	2'8"	53.3			
1088	1093	"	5	2'1"	41.7			
1093	1098	"	5	2'3"	45.0			
1098	1103	"	5	1'11"	38.3			
1103	1108	"	5	3'0"	60.0			
1108	1113	"	5	3'0"	60.0			
1113	1118	"	5	2'9"	55.0			
1118	1123	"	5	1'5"	28.3			
1123	1128	"	5	1'10"	36.7			
1128	1133	"	5	1'10"	36.7			
1133	1138	"	5	1'2"	23.3	1132	1138	Chiefly fine-grained quartz with considerable ZnS partly oxidized. PbS in one place. Small amounts of fine, hard, pale-pink mineral.
1138	1140	"	2	0'6"	25.0	1138	1147	4/5 of core missing. Remainder small fragments showing quartz and pale-pink mineral and small amounts of sulfides.
1140	1143	"	3	0'6"	16.7			
1143	1147	"	4	0'4"	8.3			
1147	1152	"	5	1'5"	28.3	1147	1151	About 3/4 of core missing. Remainder is quartz with some of the pink mineral.
						1151	1152	Medium-grained, white to pale-buff marble - core broken.
1152	1157	"	5	3'2"	63.3	1152	1195	Medium-grained marble-in general lightly stained brown with Mn and Fe oxides. Many fractures at different angles carry Mn 02 films. Core mostly broken to 1 in. h or less. Only about 1/4 inch seam of Mn 02 at 45 degrees to core.
1157	1162	"	5	0'11"	18.3			
1162	1168	"	6	1'4"	22.2			
1168	1173	"	5	1'7"	31.6			
1173	1178	"	5	1'5"	28.3			
1178	1183	"	5	0'10"	16.7			
1183	1189	"	6	0'10"	13.9			
1189	1195	"	6	1'10"	30.6			

Hole 1A-U (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
1195	1201	Ex	6	1'11"	31.9	1195	1206	Core about 1/2 recovered. Pale buff marble (Hasmark) much broken.
1201	1206	"	5	1'4"	26.7			
1206	1212	"	6	2'0"	33.3	1206	1236	Pale-buff to yellowish-brown Hasmark marble, medium-grained. A few fractures at different angles carry thin films of MnO_2. Core broken and much of it missing.
1212	1218	"	6	1'5"	23.6			
1218	1224	"	6	3'5"	56.9			
1224	1230	"	6	1'5"	23.6			
1230	1236	"	6	1'10"	30.5			
1236	1241	"	5	1'8"	33.3	1236	1241	Similar rock as above - at 1,236 feet, 1 inch or more of cavernous quartz with MnO_2.
1241	1246	"	5	0'10"	16.7	1241	1246	Core broken and largely missing; Remainder is cavernous quartz with considerable pyrite - ZnS and some PbS (Assay for Zn and Ag).
1246	1250	"	4	0'10"	20.8	1246	1250	Pale buff to white Hasmark Marble, numerous fractures with thin coats of MnO_2. Core broken and largely missing.

Hole 2-U

Co-ordinates: 8918N, 10,772E
Hole No: 2-U
Dip: 78 degrees

Depth: 278 feet
Bearing: N.

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Petrographic description: Footage To-	Petrographic description
0	5	Ax	5	1'3"	25.0	0	56	Light-gray to pale-yellow coarsley-grained Hasmark marble. A few fractures 45 degrees to core. Just about 5 feet a 6-inch or larger zone of friable rock showing considerable Fe oxides and a little MnO_2.
5	10	"	5	4'0"	80.0			
10	15	"	5	4'1"	81.7			
15	20	"	5	3'5"	68.3			
20	25	"	5	2'1"	41.7			
25	30	"	5	2'10"	56.7			
30	32	"	2	1'3"	62.5			
32	36	"	4	1'9"	43.8			
36	41	"	5	2'2"	43.3			
41	46	"	5	3'1"	61.7			
46	51	"	5	2'10"	56.7			
51	56	"	5	2'11"	58.3			
56	61	"	5	2'11"	58.3	56	90	Light-gray fine-grained Hasmark with indistinct graylaminae 45 degrees to core (bedding).
61	66	"	5	4'1"	81.7			
66	71	"	5	3'0"	60.0			
71	75	"	4	2'0"	50.0			
75	80	"	5	3'0"	60.0			
80	85	"	5	1'3"	25.0			
85	90	"	5	1'0"	20.0			
90	95	"	5	1'10"	36.7	90	95	Friable Hasmark brown with dust of Fe and Mn oxides.
95	100	"	5	1'7"	31.6	95	119	Light buff to bluish-gray marble. Local fractures with films of MnO_2. Core much broken.
100	104	"	4	3'0"	75.0			
104	109	"	5	2'2"	43.3			
109	112	"	3	2'6"	83.3			
112	116	"	4					
116	119	"	3	2'6"	83.3			

Hole 2-U (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery percent	Petrographic description Footage From-	Footage To-	
119	124	Ex	5	1'9"	35.0	119	144	(Begin 7/8 inch core.) Light-gray to white marble. A few fractures with films of MnO_2.
124	129	"	5	3'2"	63.3			
129	134	"	5	2'8"	53.3			
134	139	"	5	4'1"	81.7			
139	144	"	5	2'1"	41.7			
144	149	"	5	2'6"	50.0	144	149	Core broken. Recovered fragments are chiefly a cavernous marble stained and filled with MnO_2.
149	154	"	5	1'3"	25.0	149	154	Small amount of core recovered consists of marble fragments irregularly streaked with MnO_2. One fragment of hard MnO_2 (psilomelane).
154	156	"	2	1'2"	58.4	154	197	Marble with numerous fractures, most of them at 45 degrees to core and coated with films of MnO_2. Core mostly broken to pieces less than 1 inch.
156	159	"	3	1'6"	50.0			
159	162	"	3	1'4"	44.4			
162	165	"	3	2'3"	75.0			
165	167-1/2	"	2-1/2	1'10"	73.3			
167-1/2	170	"	2-1/2	1'9"	70.0			
170	175	"	5	2'0"	40.0			
175	180	"	5	2'0"	40.0			
180	185	"	5	0'10"	16.7			
185	187	"	2	0'10"	41.7			
187	189	"	2	0'10"	41.7			
189	194	"	5	0'10"	16.7			
194	197	"	3	1'0"	33.3			
197	200	"	3	1'0"	33.3	197	200	Fine-grained quartz. Cavernous; considerable ZnS and some PbS. (Assay for Zn and Ag.)

Hole 2-U (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Petrographic description: Footage To-	Petrographic description
200	204	Ex	4	1'0"	25.0	200	220	Marble cut by numerous fractures. Mostly 45 degrees to core and coated with brown films of Fe and Mn oxides. Core is mostly broken to pieces 2 inches or less.
204	208	"	4	2'9"	68.8			
208	213	"	5	2'4"	46.7			
213	218	"	5	2'9"	55.0			
218	223	"	5	3'4"	66.7			
223	228	"	5	1'4"	26.7	220	243	Light-gray fine-grained Hasmark. Occasional fractures with MnO_2 films. Locally, rock shows a greenish cast (chlorite?).
228	233	"	5	4'0"	80.0			
233	238	"	5	0'10"	16.7			
238	243	"	5	2'6"	50.0			
243	248	"	5	1'8"	33.3	243	248	Marble. Brownish with dust of MnO_2 (wad). Some fractures with MnO_2 films.
248	253	"	5	1'5"	28.3	248	253	Mostly quartz with some fine-grained sulfides. Core broken to small fragments (assay for Zn, Ag).
253	258	"	5	1'3"	25.0	253	258	Small amount of core recovered. Consists of fragments brown with MnO_2 dust.
258	262	"	4	1'0"	25.0	258	262	Small part of core recovered. Consists of fragments of gray marble cut by fractures with MnO_2 films.
262	263	"	1	0'9"	75.0	262	263	Fine-grained quartz with disseminated fine sulfides (assay Zn, Ag).
263	268	"	5	0'10"	16.7	263	268	Small amount of core recovered, consists of quartz fragments containing fine disseminated sulfides (assay Zn, Ag).

Hole 2-U (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description Footage From-	Footage To-	
268	273	Ex	5	0'10"	16.7	268	273	Small amount of core recovered in pieces less than 1 inch. Gray to greenish-gray marble.
273	278	"	5	1'2"	23.3	273	278	Like last above except less broken.

Hole 1-S

Co-ordinates: 11,318N, 11,047E
Elevation at collar: 5,812 feet
Dip: 68° - 30'

Depth: 972 feet
Bearing: S 22° W.

0	28-1/2	Nx	28-1/2			0	28'6"	No core - disintegrated granite.
28-1/2	30	Ax	1-1/2	1'6"	100	28'6"	71	White Jefferson marble mostly somewhat coarser than the Hasmark-fractured in places. Fractures iron-stained.
30-1/2	35	"	5	1'6"	30			
35	40	"	5	4'9	95.0			
40	45	"	5	4'8"	93.3			
45	51	"	6	5'3"	87.5			
51	56	"	5	4'5"	93.3			
56	61	"	5	4'5"	88.3			
61	66	"	5	4'4"	86.7			
66	71	"	5	5'1"	100.0			
71	76	"	5	2'5"	48.3	71	74	White Jefferson - several seams of MnO_2 1/8 to 1/2 inch thick, 30 to 35 degrees to core.
76	81	"	5	3'5"	68.3	74	110	White Jefferson-locally brecciated and cemented with limonite. At 96 feet a 4 inch streak of breccia with quartz and limonite.
81	86	"	5	2'8"	53.3			
86	91	"	5	5'0"	100.0			
91	96	"	5	4'7"	91.7	110	111	Coarse gray Jefferson.
96	101	"	5	5'1"	100.0			
101	106	"	5	5'1"	100.0			
106	111	"	5	4'7"	91.7			

Hole 1-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
111	116	Ax	5	4'7"	91.7	111	141	Coarse white Jefferson-local occurances of limonite-stained fractures. At 128'6" a streak of porous limonitic material.
116	121	"	5	1'8"	33.3			
121	126	"	5	3'10"	76.7			
126	131	"	5	4'7"	91.7			
131	136	"	5	4'9"	95.0			
136	141	"	5	4'8"	93.3			
141	147	"	6	0'5"	6.9	141	147	Cavity-4 inch core with MnO_2 spots.
147	154	"	7	4'10"	69.0	147	149	Brecciated Jefferson with spots of MnO_2.
						149	151'6"	Chocolate-brown marble.
						151'6"	153	Soft brown MnO_2 (wad) appears to lie parallel to bedding and 45 degrees to core.
						153	154	Dark-brown marble.
154	156	Ex	2	1'4"	66.7	154	156	Begin 7/8 inch core. White and brown Jefferson marble.
156	158	"	2	2'3"	100.0	156	161	White Jefferson. Locally brecciated; some brown wad.
161	166	"	5	4'10"	96.7	161	166	White Jefferson, coarse-grained, wad-stained fractures.
166	171	"	5	4'6"	90.0	166	171	Medium-grained white Jefferson marble.
171	176	"	5	0'7"	11.7	171	176	Gray Jefferson - 6 inches of core.
176	183	"	7	4'6"	64.3	176	186	Gray to white Jefferson, locally friable and limonite-stained.
183	185-1/2	"	2-1/2	1'10"	73.3			
185-1/2	186	"	0-1/2	0'6"	100.0			
186	187	"	1	0'11"	91.7	186	187	Gouge

Hole 1-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
187	192	Ex	5	1'2"	23.2	187	201	Medium-grained white Jefferson marble. Local fractures with limonite stains.
192	195	"	3	2'6"	83.3			
195	199	"	4	1'10"	45.8			
199	200	"	1	1'5"	100.0			
200	201	"	1	0'10"	83.3			
201	206	"	5	3'8"	73.3	201	211	Fine-grained gray Jefferson marble with dark-gray bands (biotite?, etc.). Locally friable.
206	211	"	6	4'11"	98.3			
211	216	"	5	3'8"	73.3	211	239	Medium-grained white Jefferson- ocassional dark bands (biotite?, etc.). Locally friable.
216	221	"	5	1'11"	38.3			
221	226	"	6	0'9"	15.0			
226	231	"	5	4'2"	83.3			
231	236	"	5	1'8"	33.3			
236	241	"	5	3'3"	65.0			
241	246	"	5	1'3"	25.0	239	271'4"	Aplite and granite.
246	251	"	5	2'10"	56.7			
251	255	"	4	1'5"	35.4			
255	260	"	5	1'11"	38.3			
260	266	"	6	0'11"	15.3			
266	271	"	5	2'8"	53.3			
271	275	"	4	3'7"	89.6	271'4"	285	Gray Jefferson - locally sheared and gougy. Boundary of Maywood.
275	280	"	5	2'3"	45.0			
280	285	"	5	4'0"	80.0			
285	290	"	5	2'3"	45.0	285	290	Banded limey shale - Maywood.
290	295	"	5	1'7"	31.7	290	295	Fine-grained, sandy, Maywood limestone.
295	300	"	5	4'5"	88.3	295	297	Yellowish marble.
300	302	"	2	1'2"	58.3	297	311	Alternating sandy limestone and white marble.
302	306	"	4	1'1"	29.2			
306	311	"	5	1'1"	23.3			
311	317	"	6	2'8"	44.4	311	313	Granite gouge - disseminated pyrite.

Hole 1-S (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description Footage From-	Footage To-	
317	322	Ex	5	3'6"	70.0	313	323'6"	Sandy limestone - Maywood. At 316'2" of brecciated, cemented by calcite.
322	327	"	5	1'7"	31.7	323'6"	339	Medium-grained marble with black bands (biotite).
327	332	"	5	5'3"	100			
332	337	"	5	2'4"	46.6			
337	339	"	2	0'11"	45.8			
339	343	"	4	2'4"	58.3	339	535	Typical Maywood, fine-grained, study limestone. Locally steaked with biotite and ocassional layers of marble at 429 feet.
343	346	"	3	1'3"	41.7			
346	351	"	5	2'9"	55.0			
351	356	"	5	5'1"	100.0			
356	361	"	5	5'0"	100.0			
361	365	"	4	3'2"	79.2			
365	370	"	5	3'4"	66.6			
370	375	"	5	5'3"	100.0			
375	380	"	5	5'	100.0			
380	385	"	5	5'	100.0			
385	390	"	5	5'	100.0			
390	395	"	5	3'7"	71.7			
395	400	"	5	2'3"	45.0			
400	405	"	5	2'10"	56.7			
405	410	"	5	4'0"	80.0			
410	415-1/2	"	5	3'8"	73.3			
415	419-1/2	"	4-1/2	1'6"	33.3			
419-1/2	424-1/2	"	5	4'4"	86.6			
424-1/2	426-1/2	"	2	2'	100.0			
426-1/2	429	"	2-1/2	1'7"	63.3			
429	434	"	5	4'5"	88.3			
434	439	"	5	2'6"	50.0			
439	444	"	5	5'	100.0			
444	449	"	5	4'10"	96.6			
449	454	"	5	2'	40.0			
454	458	"	5	1'4"	33.3			

Hole 1-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
458	463	Ex	5	2'8"	53.3			Typical Maywood, fine-grained, study limestone. Locally steaked with biotite and ocassional layers of marble at 429 feet.
463	465	"	2	1'7"	31.7			
465	470	"	5	2'9"	55.5			
470	474	"	4	1'3"	31.2			
474	479	"	5	4'11"	98.3			
474	479	"	5	4'9"	95.0			
479	484	"	5	4'9"	95.0			
484	489	"	5	2'3"	45.0			
489	494	"	5	4'6"	90.0			
494	499	"	5	1'7"	31.7			
499	504	"	5	4'10"	96.7			
504	509	"	5	3'5"	68.3			
509	513	"	4	3'9"	93.7			
513	518	"	5	2'6"	50.0			
518	522	"	4	1'5"	35.4			
522	527	"	5	1'4"	26.7			
527	530	"	3	1'10"	61.1			
530	535	"	5	5'	100.0			
535	540	"	5	4'10"	96.7	535	540	Dense greenish rock with some thin bands of garnet.
540	545	"	5	5'	100.0	540	543'6"	Chiefly gouge with fragments of marble and garnet rock. This may represent the Headlight bed veins. The position is evidently below the oxidized zone, and therefore no black stain (MnO_2) would be formed. No pink ($MnCO_3$) was seen, but it might be present and concealed by the gouge or too pale in color to be recognized.

Hole 1-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
545	550	Ex	5	5'	100.0	543'6"	582'6"	Fine-grained gray to white marble with bands of greenish material and some garnet.
550	552	"	2	1'7"	79.2			
552	557	"	5	4'11"	98.3			
557	562	"	5	5'	100.0			
562	566	"	4	3'8"	91.7			
566	571	"	5	5'	100.0			
571	576	"	5	5'	100.0			
576	580	"	4	3'5"	85.4			
580	585	"	5	4'2"	83.3			
585	590	"	5	4'5"	88.3	582'6"	680	A visual inspection of these cores indicates them to be chiefly light to blue-gray marble, fine-grained, and ocassional thin bands of dark-gray, some of them wavy, that apparently represent bedding and started at 35 to 50 degrees to the core. This may be Red Lion, but the classification is not certain.
590	596	"	6	5'10"	97.2			
596	601	"	5	4'3"	85.0			
601	606	"	5	5'	100.0			
606	611	"	5	4'7"	91.7			
611	616	"	5	3'10"	71.7			
616	620	"	4	3'7"	89.6			
620	625	"	5	5'	100.0			
625	630	"	5	2'9"	55.0			
630	635	"	5	4'10"	96.7			
635	640	"	5	4'11"	98.3			
640	646	"	6	5'5"	90.3			
646	652	"	6	5'1"	84.7			
652	657	"	5	3'10"	76.7			
657	660	"	3	1'9"	76.7			
660	665	"	5	1'8"	33.3			
665	670	"	5	4'	80.0			
670	675	"	5	3'6"	70.0			
675	678	"	3	2'11"	97.2			
678	687	"	9	1'4"	14.8	680	690	Light-gray, fine-grained marble; core much broken.
687	692	"	5	1'11"	38.3			
692	697	"	5	4'7"	91.7	690	703	Marble as above, wavy dark bands at 60 degrees to core represents bedding.
697	703	"	6	5'1"	84.7			

Hole 1-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
703	708	Ex	5	5'	100.0	703	708	First 2 inches lead-gray, fine, siliceous rock. Remainder, fine gray marble with brownish-gray bands.
708	713	"	5	5'	100.0	708	718	Fine-to rather coarse-grained marble with brownish-gray bands (siliceous) at about 60 degrees to core.
713	718	"	5	5'	100.0			
718	723	"	5	5'	100.0	718	728	Similar to above - at 723'8" a seam of gouge containing fine pyrite. At 725'8" small fractures at right angles-banding cemented with fine pyrite. Another at 727 feet.
723	728	"	5	5'	100.0			
728	734	"	6	5'6"	91.7	728	731	Light-gray fine marble with a slight olive-green cast. At 730 feet a thin seam of pyrite.
734	739	"	5	4'10"	96.7	731	739	Medium-gray marble with dark wavy bands, locally brecciated.
739	745	"	6	5'3"	87.5	739	750	Similar marble with gray to greenish bands and occasional fractures.
745	750	"	5	4'10"	96.7			
750	755	"	5	2'3"	45.0	750	776	Similar marble, with greenish-gray bands.
755	760	"	5	5'	100.0			
760	765	"	5	5'	100.0			
765	770	"	5	5'	100.0			
770	776	"	6	5'3"	87.5			
776	781	"	5	5'	100.0	776	816	Similar marble with gray to greenish-gray bands about 60° to core. Locally crossed by fractures and thin greenish-gray seams.
781	786	"	5	3'10"	76.7			
786	791	"	5	5'	100.0			
791	796	"	5	5'	100.0			
796	801	"	5	4'7"	91.7			

Hole 1-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
801	806	Ex	5	4'11"	98.3			Similar marble with gray to greenish-gray bands about 60° to core. Locally crossed by fractures and thin greenish-gray seams.
806	812	"	6	5'4"	88.8			
812	816	"	4	4'	100.0			
816	821	"	5	5'	100.0	816	873'6"	Light-gray, fine- to medium-grained marble with brownish siliceous laminae, mostly less than 1/2 inch thick, that in places composes as much as 50% of the core. In places these alternate with thin gray laminae. Locally, grains of brown silicious mineral (garnet) form 50% of mass.
821	827	"	6	5'4"	88.8			
827	832	"	5	5'	100.0			
832	837	"	5	5'	100.0			
837	842	"	5	5'	100.0			
842	847	"	5	5'	100.0			
847	852	"	5	5'	100.0			
852	857	"	5	5'	100.0			
857	862	"	5	5'	100.0			
862	867	"	5	5'	100.0			
867	871	"	4	2'6"	62.5			
871	876	"	5	5'	100.0			
876	881	"	5	5'	100.0	873'6"	887	Bluish-gray marble with darker-gray rather indistinct laminae. Locally crossed by seams of greenish-gray (chlorite?)
881	887	"	6	4'10"	80.5			
887	892	"	5	5'	100.0	887	902	Similar marble, locally broken and gougy.
892	897	"	5	2'3"	45.0			
897	902	"	5	1'3"	25.0			
902	907	"	5	1'11"	38.3	902	907	Rather abrupt change to pale buff marble showing a few MnO_2, dendrites (top of Hasmark.)
902	912	"	5	3'8"	73.3	907	912	Buff to grayish-blue marble more or less fractured.
912	915	"	3	2'9"	91.6	912	914	Broken and gougy, with considerable disseminated pyrite.

Hole 1-S (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description Footage From-	Footage To-	
915	921	Ex	6	2'7"	43.0	914	933	Bluish-gray to buff marble with some gray bands at 70 degrees to core. Locally fractured. At 921'3" shows scattered pyrite grains. At 923 feet, 2-inch broken zone with a little pyrite.
921	923	"	2	1'5"	70.9			
923	928	"	5	3'11"	78.3			
928	933	"	5	4'10"	96.7			
933	939	"	6	5'4"	88.9	933	972	Mostly buff to pale gray or white marble, locally fractured and gougy. At 953 feet a seam of quartz nearly parallel to core.
939	945	"	6	5'4"	88.9			
945	951	"	6	4'7"	76.4			
951	957	"	6	4'	66.7			
957	963	"	6	5'1"	84.7			
963	966	"	3	1'	33.3			
966	972	"	6	4'4"	72.2			

Hole 2-S

Co-ordinates: 11,318N, 11,047E
Elevation at collar: 5,812 feet
Dip: 80 degrees

Depth: 631 feet
Bearing: S 84° W.

0	21		21	0	0	0	21	No core. Used 2-1/4 inch bit through decomposed granite for AX casing.
21	26	Ax	5	2'1"	41.7	21	41	Medium coarse-grained, grayish-white marble (Jefferson). Locally broken and stained with iron oxides. Indistinct grayish bands that probably represent the bedding show in places. These and some seams of yellow limonite stand about 80 degrees to the core axis. Occasional fractures with films of MnO_2. Broken zones with iron stain at 34-1/2 and 37 feet.
26	31	"	5	3'2"	63.3			
31	36	"	5	3'0"	60.0			
36	41	"	5	3'2"	63.3			

Hole 2-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
41	45	Ax	4	3'4"	83.4	41	68	Grayish-white marble with occasional fractures coated with limonite stains. Broken zones showing a little iron stain at 54'9" and from 62 to 63 feet.
45	51	"	6	5'0"	83.3			
51	57	"	6	3'8"	61.1			
57	63	"	6	3'6"	58.3			
63	68	"	5	4'9"	95.0			
68	73	"	5	4'9"	95.0	68	97	Light-gray to buff marble, more or less broken. In places, grayish banding about 70 degrees to the core axis. At 74 to 76 feet, rock is friable and seamed with limonite. At 68'6", 3 inches broken and gougy with a little MnO_2. At 82'2", to 82'8", quartz with much limonite. At 90' to 97', broken somewhat gougy zone.
73	77	"	4	3'8"	91.6			
77	82	"	5	4'7"	91.6			
82	87	"	5	3'10"	76.7			
87	92	"	5	4'8"	93.3			
92	97	"	5	3'4"	66.7			
97	102	"	5	3'0"	60.0	97	159	Light-gray to pale-buff marble, locally fractured and stained with limonite. Friable in places. At 132'to 135', breccia with considerable limonite and recrystallized calcite. Gougy at 135'; 137'6" to 139', brecciated with limonite and a little MnO_2. 157' to 159' breccia with limonite.
102	107	"	5	4'4"	86.7			
107	113	"	6	4'11"	81.9			
113	118	"	5	2'10"	56.7			
118	123	"	5	4'0"	80.0			
123	128	"	5	2'9"	55.0			
128	133	"	5	2'11"	58.3			
133	138	"	5	4'0"	80.0			
138	144	"	6	4'1"	68.0			
144	150	"	6	3'11"	65.3			
150	156	"	6	2'11"	34.7			
156	157-1/2	"	1-1/2	1'5"	94.5			
157-1/2	163	"	5-1/2	4'9"	86.4	159	166	White to grayish marble, banded at 70 degrees to core axis.
163	168	"	5	4'6"	90.0			

Hole 2-S (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Footage To-	
168	174	Ax	6	5'1"	84.7	166	219	Pale-buff and light-gray marble. Numerous limonite-coated fractures and seams.
174	176	"	2	1'8"	83.3			
176	181	"	5	4'11"	98.3			
181	185	Ex	4	3'7"	89.6			
185	180	"	4	2'8"	66.7			
189	194	"	5	5'	100.0			
194	199	"	5	3'11"	78.3			
199	204	"	5	4'6"	90.0			
204	209	"	5	4'1"	81.7			
209	214	"	5	4'5"	88.3			
214	219	"	5	4'9"	95.0			
219	222	"	3	1'11"	63.9	219	229	Buff friable marble, much broken - only fragmental recovery of core.
222	226	"	4	1'3"	31.3			
226	229	"	3	0'8"	22.2			
229	234	"	5	1'8"	33.3	229	268	Core much broken. Recovered fragments mostly light-gray, fine-grained marble, locally peppered with pyrite.
234	239	"	5	2'8"	53.3			
239	243	"	4	1'9"	43.8			
243	248	"	5	1'7"	31.6			
248	253	"	5	4'8"	93.3			
253	254	"	1	1'0"	100.0			
254	259	"	5	4'2"	83.3			
259	264	"	5	2'6"	50.0			
264	269	"	5	3'0"	60.0			
269	274	"	5	1'1"	21.7	268	288	Core badly broken. Fragments recovered show more or less quartz, limonite, and MnO_2. 282' to 288' breccia with quartz - locally shows ZnS.
274	278	"	4	2'1"	53.1			
278	283	"	5	1'9"	35.0			
283	288	"	5	1'1"	21.7			
288	293	"	5	1'2"	23.3	288	311	Core much broken. Recovered fragments are mostly medium-gray marble sparingly peppered with fine pyrite.
293	295	"	2	0'7"	29.2			
295	300	"	5	0'7"	11.6			
300	305	"	5	1'3"	25.0			
305	311	"	6	2'4"	38.9			

Hole 2-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
311	317	Ex	6	0'8"	11.1	311	317	Mostly quartz with disseminated fine sulfides.
317	319	Ax	2	2'0"	100.0	317	330	Mostly gray, fine-grained marble, indistinctly banded about 80 degrees to core axis - last 5 feet, buff, fine-grained, sandy limestone.
319	324	Ex	5	4'2"	83.3			
324	330	"	6	3'6"	58.3			
330	335	Ax	5	5'0"	100.0	330	383	Gray, fine-grained limestone. Dark-gray bands - occasional fractures 45 degrees to 50 degrees to core axis. Bedding stands from right angles to 75 degrees to core.
335	337	Ex	2	2'0"	100.0			
337	342	"	5	5'0"	100.0			
342	347	"	5	5'0"	100.0			
347	352	"	5	5'0"	100.0			
352	358	"	6	5'1"	84.6			
358	363	"	5	5'0"	100.0			
363	368	"	5	2'10"	56.7			
368	372	"	4	3'7"	89.6			
372	374	"	2	2'0"	100.0			
374	379	"	5	5'0"	100.0			
379	383	"	4	4'0"	100.0			
383	388	"	5	3'10"	76.7	383	421	Similar to last except crossed by several broken, gougy zones. Occasional fractures line, with soft greenish mineral (chlorite).
388	391	"	3	2'8"	88.9			
391	396	"	5	4'10"	96.7			
396	401	"	5	4'1"	81.7			
401	406	"	5	2'5"	48.3			
406	411	"	5	5'0"	100.0			
411	414	"	3	3'0"	100.0			
414	416	"	2	2'0"	100.0			
416	421	"	5	5'0"	100.0			
421	426	"	5	5'0"	100.0	421	433	Similar to last - core much broken from 432'-433'.
426	431	"	5	5'0"	100.0			
431	433	"	2	2'0"	100.0			

Hole 2-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
433	438	Ex	5	4'5"	88.3	433	442	Dark-gray, banded fine-grained, sandy limestone.
438	439	"	1	1'0"	100.0			
439	444	"	5	4'3"	85.0			
444	447	"	3	3'0"	100.0	442	458	Similar to last. Between 455 and 457 feet, core is peppered with specks of a black silicate mineral.
447	451	"	4	3'5"	85.4			
451	456	"	5	5'0"	100.0			
456	458	"	2	2'0"	100.0			
458	460	"	2	1'10"	91.7	458	498	Mostly gray, fine-grained limestone - in places light- to dark-gray and very siliceous. Occasional bands of pale greenish and yellowish-gray, apparently due to fine-grained silicates. At 477-478 feet many small laths of a dark silicate (andalusite). Last 4 feet is a light-gray fine-grained marble.
460	465	"	5	5'0"	100.0			
465	470	"	5	3'2"	63.3			
470	475	"	5	5'0"	100.0			
475	480	"	5	4'10"	96.7			
480	485	"	5	3'10"	76.7			
485	490-1/2	"	5-1/2	5'2"	93.9			
490-1/2	496	"	5-1/2	5'1"	92.4			
496	497-1/2	"	1-1/2	0'10"	55.5			
497-1/2	502-1/2	"	5	5'0"	100.0	498	557	Mostly light-gray, fine-grained limestone with darker bands (bedding) standing mostly at 75 degrees to core. Broken zones at 518, 526, and 539 feet.
502-1/2	507-1/2	"	5	5'0"	100.0			
507-1/2	512-1/2	"	5	5'0"	100.0			
512-1/2	518	"	5-1/2	5'6"	100.0			
518	523	"	5	3'9"	75.0			
523	523-1/2	"	0-1/2	0'1"	16.7			
523-1/2	526	"	2-1/2	0'7"	23.3			
526	530	"	4	3'5"	85.4			
530	534	"	4	0'	0			
534	539	"	5	1'2"	23.3			
539	542	"	3	0'6"	16.7			
542	547	"	5	5'0"	100.0			
547	552	"	5	4'10"	96.7			
552	557	"	5	4'10"	96.7			

Hole 2-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
557	560	Ex	3	1'9"	58.3	557	567	Light- to dark-gray, fine-grained limestone, locally friable and broken.
560	562	"	2	1'8"	83.3			
562	567	"	5	2'7"	51.6			
567	571	"	5	2'4"	46.7	567	591'6"	Light-gray, medium-grained limestone with distinct gray bands. Rather soft and friable. Core much broken at 590 feet.
571	576	"	5	4'6"	90.0			
576	581	"	5	4'9"	95.0			
581	586	"	5	4'8"	93.3			
586	591	"	5	4'11"	98.3			
591	596	"	5	3'10"	76.7	591'6"	596'6"	Light-gray, medium-grained marble, somewhat porous.
596	599	"	3	1'4"	44.4	596'6"	621	Light-gray, fine-grained marble with thin bands of brownish gray - 70 degrees to core. At 609 feet, 2 feet plus of dark-gray quartz; 609 to 610 feet, no core; 610 to 611 feet, dark-gray quartz, vuggy and badly broken, shows a little fine pyrite.
599	604	"	5	5'0"	100.0			
604	609	"	5	3'7"	71.6			
609	610	"	1	0'0"	0			
610	611	"	1	0'4"	33.3			
611	616	"	5	4'9"	95.0			
616	621	"	5	4'3"	85.0			
621	626	"	5	4'8"	93.0	621	626	Light-gray to white, medium-grained marble - banding not pronounced.
626	631	"	5	4'10"	96.7	626	631	Light-gray, fine-grained marble with darker bands that are locally wavy. Bands (parallel bedding) stand mostly at 70 degrees to core.
						631		Bottom.

Hole 3-S

Co-ordinates: 11,012N, 11,202E
Elevation at collar: 5,740 feet
Dip: 60 degrees-0

Depth: 540 feet
Bearing: Due West

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Petrographic description: Footage To-	Petrographic description
0	110	Ax	110	0	0	0	115	No core. Decomposed granite.
110	115	"	5	0	0			
115	120	"	5	3'9"	75.0	115	128	Mostly white, coarsely crystalline marble (Jefferson). Friable, porous, and slightly iron-stained in places.
120	124	"	4	2'10"	70.8			
124	130	Ex	6	4'9"	79.2	128	130	Light-gray marble - a small cluster of pyrite grains at about 128'8".
130	135	Ax	5	2'6"	50.0	130	142	Pale-gray to buff marble (Jefferson). Core much broken at 130 feet plus.
135	140	"	5	2'6"	50.0			
140	145	Ex	5	5'0"	100.0			
145	150	"	5	1'0"	20.0	142	195	Light-gray to buff, medium fine-grained marble. Locally fractured, porous, and friable.
150	155	"	5	4'11"	98.3			
155	160	"	5	2'8"	53.3			
160	165	"	5	4'0"	80.0			
165	170	"	5	2'7"	51.6			
170	175	"	5	2'9"	55.0			
175	180	"	5	1'2"	23.3			
180	185	"	5	3'3"	65.0			
185	190	"	5	3'1"	61.7			
190	195	"	5	4'11"	98.3			
195	200	"	5	3'3"	65.0	195	244	Light-gray granite (intrusive).
200	205	"	5	2'2"	43.3	244	245	Yellowish, fine-grained marble.
205	210	"	5	4'9"	95.0			
210	215	"	5	1'3"	25.0			
215	220	"	5	1'11"	38.3			
220	225	"	5	1'3"	25.0			
225	230	"	5	1'8"	33.3			
230	235	"	5	2'8"	53.3			
235	240	"	5	2'1"	41.7			
240	245	"	5	1'10"	36.7			

Hole 3-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
245	246	Ex	1	0'9"	75.0	245	246	Fine, thin-bedded, gray marble. Core split into thin segments on bedding planes at right angles to core. A little fine pyrite.
246	251	"	5	1'7"	31.6	246	251	Yellowish, medium-grained marble-friable. Core broken.
251	256	"	5	3'6"	70.0	251	280	Light-gray, fine-grained marble. Bedding seams and fractures at different angles carry thin films of chlorite.
256	259	"	3	2'2"	72.2			
259	264	"	5	3'1"	61.7			
264	270	"	6	5'0"	83.3			
270	275	"	5	2'7"	51.6			
275	280	"	5	2'6"	50.0			
280	285	"	5	2'5"	48.3	280	285	Light-gray granite like 195'-244' section above. Dark minerals largely altered to chlorite. Fractures parallel to core. Coated with chlorite.
285	290	"	5	1'9"	35.0	285	318	Medium-grained, gray marble. Locally core is much broken and partly missing. A 1-inch, black, shaly band with gouge at 307 feet. Black shale (hornstone) at 316'6".
290	295	"	5	2'8"	53.3			
295	300	"	5	0'10"	16.7			
300	305	"	5	1'11"	38.3			
305	308	"	3	1'10"	61.1			
308	313	"	5	5'0"	100.0			
313	318	"	5	4'10"	96.7			
318	323	"	5	3'1"	61.7	318	338	Core badly broken. Occasional pyrite grains. At 322'-28' much chlorite and a litlle pink carbonate.
323	328	"	5	1'0"	20.0			
328	333	"	5	2'1"	41.7			
333	338	"	5	1'7"	31.6			
338	343	"	5	5'0"	100.0	338	350	Fine gray marble. Bedding planes and local fractures coated with chlorite.
343	348	"	5	3'4"	66.7			
348	353	"	5	5'0"	100.0	350	350'6"	Irregular veinlets of pink carbonate.

Hole 3-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
353	358	Ex	5	5'0"	100.0	350'6"	388	Gray, fine, limey hornstone. Local fractures with gouge and chlorite. Irregular spots of white carbonate here and there.
358	363	"	5	5'0"	100.0			
363	368	"	5	4'0"	80.0			
368	373	"	5	2'11"	58.3			
373	378	"	5	2'9"	55.0			
378	383	"	5	4'0"	80.0			
383	388	"	5	4'3"	85.0			
388	393	"	5	4'11"	98.3	388	483	Dark-gray, fine, limey hornstone banded at right angles to core. Local bands of black hornstone. Core borken and gougy in places.
393	398	"	5	2'8"	53.3			
398	403	"	5	3'5"	68.3			
403	408	"	5	5'0"	100.0			
408	410	"	2	1'7"	79.1			
410	415	"	5	4'4"	86.7			
415	420	"	5	3'1"	61.7			
420	425	"	5	5'0"	100.0			
425	430	"	5	4'10"	96.7			
430	435	"	5	4'10"	96.7			
435	440	"	5	4'10"	96.7			
440	445	"	5	1'10"	36.7			
445	449	"	4	3'4"	83.3			
449	454	"	5	2'2"	43.3			
454	459	"	5	1'11"	38.3			
459	464	"	5	3'9"	75.0			
464	469	"	5	3'8"	73.3			
469	472	"	3	1'4"	44.4			
472	477	"	5	4'8"	93.3			
477	480	"	3	0'8"	22.2			
480	483	"	3	2'10"	94.4			
483	486	"	3	2'0"	66.7	483	511	Light-gray, fine, silicious, calcareous hornstone; scattered specks of pyrite. At 506'-511', much brown garnet.
486	491	"	5	2'5"	48.3			
491	496	"	5	4'11"	98.3			
496	501	"	5	1'1"	21.7			
501	506	"	5	4'10"	96.7			
506	511	"	5	2'0"	40.0			

Hole 3-S (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Footage To-	Petrographic description
511	516	Ex	5	4'7"	91.6	511	525	Light-gray, fine-grained marble with irregular darker bands and mottlings.
516	521	"	5	3'10"	76.7			
521	525	"	4	2'3"	56.2			
525	530	"	5	1'6"	30.0	525	540	Gray, fine-grained marble with darker bands at right angle to core. Locally peppered with dark spots.
530	535	"	5	1'6"	30.0			
535	540	"	5	5'0"	100.0			

Hole 4-S

Co-ordinates: 11,073N, 11,105E
Elevation at collar: 5,764 feet
Dip: 60 degrees

Depth: 495 feet
Bearing: Due West

0	9	Ax	9	0	0	0	33	No core up to 9 feet Topsoil. Remainder light-gray, coarse-grained marble. Jefferson - shows light stain of Fe oxide. 31 to 33 feet, several fractures at 30 degrees to core - thinly coated with MnO_2.
9	14	"	5	2'0"	40.0			
14	18	"	4	2'0"	50.0			
18	23	"	5	3'3"	65.0			
23	28	"	5	3'0"	60.0			
28	33	"	5	3'0"	60.0			
33	38	"	5	4'6"	90.0	33	43	Coarse-grained Jefferson. Some of it broken and friable and lightly dusted with brown MnO_2 (wad). Last 5 feet partly brecciated and filled in places with wad and Fe oxides.
43	48	"	5	0'5"	8.3	43	48	Last 6 inches gray, coarse-grained Jefferson. Remainder is missing.
48	49	"	1	0'11"	91.6	48	63	Light-gray Jefferson. A few seams of Fe oxides right angle to core. At about 61 or 62 feet, 1/4-inch seam of MnO_2. Broken and gougy just about 63 feet.
49	53	"	4	3'10"	95.8			
53	58	"	5	3'2"	63.3			
58	63	"	5	3'6"	70.0			

Hole 4-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
63	68	Ax	5	3'11"	78.3	63	100	Light-gray to pale buff Jefferson. Locally fractured right angle to core. Light stains and specks of MnO_2. Locally cavernous and friable. Broken and gougy, zones above 93 feet and at 77 feet.
68	73	"	5	4'3"	86.0			
73	78	"	5	2'7"	51.6			
78	83	"	5	2'8"	53.3			
83	88	"	5	4'9"	95.0			
88	93	"	5	5'0"	100.0			
93	98	"	5	4'8"	93.3			
98	100	"	2	1'11"	95.8			
100	105	"	5	4'10"	96.7	100	110	(End of larger core.) Rock same as last. 103 to 105 feet friable, light-yellow, specks of Fe oxides. Core much broken.
105	110	"	5	3'5"	68.3			
110	115	Ex	5	5'0"	100.0	110	140	Light bluish-gray to yellowish-gray marble. Locally cavernous. A few fractures lined with Mn and Fe oxides.
115	120	"	5	5'0"	100.0			
120	125	"	5	5'0"	100.0			
125	130	"	5	5'0"	100.0			
130	135	"	5	3'4"	66.7			
135	140	"	5	2'11"	58.3			
140	145	"	5	5'0"	100.0	140	145	Light-gray, medium-grained marble. At 141 feet a few inches broken, friable, and stained with Fe oxides.
145	150	"	5	4'11"	98.3	145	174'6"	Light-gray, fine-grained marble locally peppered with dark-gray specks.
150	155	"	5	5'0"	100.0			
155	160	"	5	4'10"	96.7			
160	165	"	5	5'0"	100.0			
165	170	"	5	4'0"	80.0			
170	175	"	5	1'11"	38.3			
175	180	"	5	2'7"	51.6	174'6"	180'6"	Light yellowish-gray, fine-grained marble. Locally fractured parallel to core and somewhat friable.

Hole 4-S (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Footage To-	
180	185	Ex	5	1'7"	31.6	180'6"	184	Core mostly missing (contact zone?).
185	190	"	5	0'11"	18.3	184	212	Light-gray, medium-grained granite and aplite. Broken zone 199 to 210 feet.
190	195	"	5	1'11"	38.3			
195	200	"	5	2'0"	40.0			
200	205	"	5	1'8"	33.3			
205	210	"	5	1'4"	26.7			
210	215	"	5	2'3"	45.0			
215	220	"	5	3'1"	61.7	212	220	Pale yellowish-gray, fine-grained marble. Locally somewhat cavernous.
220	225	"	5	2'4"	46.7	220	235	Bluish to brownish-gray, fine-grained marble.
225	230	"	5	2'5"	48.3			
230	235	"	5	0'10"	16.7			
235	240	"	5	0'9"	15.0	235	240	Mostly broken and gougy. Largely missing.
240	245	"	5	1'0"	20.0	240	245	Yellowish medium-grained marble, core partly missing.
245	250	"	5	0'11"	18.3	245	250'6"	Light-gray granite. Core broken and largely missing.
250	255	"	5	2'8"	53.3	250'6"	265	Gray to dark-gray, fine-grained, impure limestone-soft in places.
255	260	"	5	2'8"	53.3			
260	265	"	5	2'10"	56.7			
265	270	"	5	1'5"	28.3	265	275	Siliceous fine-grained limestone. Greenish to brownish gray. At 266 to 267 feet, quartz showing fine disseminated sulfides (assay Ag Zn). At 273 to 275 feet, dark-gray quartz with fine, disseminated pyrite and some ZnS. (assay Ag Zn).
270	275	"	5	1'3"	25.0			
275	280	"	5	0'11"	18.3	275	276	Fine-grained quartz with disseminated pyrite and ZnS?

Hole 4-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
280	285	Ex	5	1'0"	20.0	276	285	Gray, siliceous limestone.
285	290	"	5	0'7"	11.6	285	290	Same as last. A 1-inch streak of hard, pink mineral (test for Mn?).
290	292	"	2	0'3"	5.0	290	292	Core missing except a few fragments, including one of the pink mineral.
292	297	"	5	2'2"	43.3	292	340	Fine-grained gray limestone, locally banded with dark gray at 60 degrees to core.
297	300	"	3	2'5"	80.6			
300	305	"	5	3'10"	76.7			
305	310	"	5	2'2"	43.3			
310	315	"	5	4'9"	95.0			
315	320	"	5	2'3"	45.0			
320	325	"	5	3'8"	73.3			
325	330	"	5	4'5"	88.3			
330	335	"	5	5'0"	100.0			
335	340	"	5	2'6"	50.0			
340	345	"	5	5'0"	100.0	340	365	Fine-grained, dark-gray, siliceous limestone. Locally peppered with dark specks.
345	350	"	5	4'10"	96.7			
350	355	"	5	3'3"	65.0			
355	360	"	5	5'0"	100.0			
360	365	"	5	5'0"	100.0			
365	370	"	5	3'0"	60.0	365	380	Like above except now nearly lead-gray. Shows some brownish-gray bands.
370	375	"	5	3'2"	63.3			
375	380	"	5	4'4"	86.7			
380	384	"	4	3'9"	93.8	380	389	Medium-gray fine limestone. Broken and somewhat gouged at 382 to 383 feet. Broken zone about 386 feet, fragment of quartz showing a little pyrite recovered.
384	389	"	5	1'6"	30.0			
389	394	"	5	0'9"	15.0	389	394	Broken and mostly missing. Some pieces contain irregular veinlets of white and very pale-pink carbonates.

Hole 4-S (Cont'd.)

Footage		Core size	Core drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
394	399	Ex	5	4'8"	93.3	394	426	Gray, fine-grained limestone. Closely spaced dark-greenish and brownish-gray laminae right angle to core.
399	404	"	5	5'0"	100.0			
404	409	"	5	5'0"	100.0			
409	414	"	5	4'6"	90.0			
414	419	"	5	4'8"	93.3			
419	425	"	6	5'0"	83.3			
425	430	"	5	4'7"	91.6	426	472	Fine-grained limestone. Mostly greenish-gray. Local patches of brown garnet.
430	435	"	5	4'9"	95.0			
435	440	"	5	5'0"	100.0			
440	445	"	5	2'10"	56.7			
445	450	"	5	4'9"	95.0			
450	452	"	2	1'2"	58.4			
452	457	"	5	4'10"	96.7			
457	462	"	5	4'10"	96.7			
462	467	"	5	5'0"	100.0			
467	472	"	5	3'11"	78.3			
472	477	"	5	2'0"	40.0	472	482	Light-buff medium-grained limestone. Local fractures 45 degrees to core. Shows a little iron stain.
477	482	"	5	1'2"	23.3			
482	485	"	3	0'7"	19.4	482	485	Small amount of core recovery. Consists of small fragments of dark-gray siliceous rock. Locally iron-stained.
485	487	"	2	1'3"	62.5	485	487	Pale yellow, rather soft, fine-grained limestone. Core much broken.
487	492	"	5	2'1"	41.7	487	495	Gray to greenish-gray, fine-grained limestone showing irregular cross laminae of darker gray.

Hole 5-S

Co-ordinates: 11,227N, 11,045E.
Elevation at collar: 5,816 feet
Dip: 60 degrees

Depth: 496 feet
Bearing: Due west

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Petrographic description: Footage To-	Petrographic description
5	10	Ax	5	1'6"	30.0	0	65	Core consists of pale-yellow to white, coarse-grained, Jefferson marble. Split on numerous cross laminae (bedding), showing a little Fe oxides. Locally much fractured and reddish brown to small fragments.
10	16	"	6	2'4"	38.9			
16	21	"	5	1'7"	31.6			
21	26	"	5	2'2"	43.3			
26	31	"	5	3'6"	70.0			
31	36	"	5	2'3"	45.0			
36	41	"	5	4'2"	83.3			
41	46	"	5	4'3"	85.0			
46	51	"	5	2'6"	50.0			
51	56	"	5	1'10"	36.7			
56	61	"	5	4'8"	93.3			
61	66	"	5	3'4"	66.7			
66	71	"	5	5'0"	100.0	65	116	Like above, except less broken. Local fractures at 30 degrees to core coated with MnO_2.
71	76	"	5	1'9"	35.0			
76	81	"	5	2'5"	48.3			
81	86	"	5	2'1"	41.7			
86	91	"	5	2'2"	43.3			
91	96	"	5	2'9"	55.0			
96	101	"	5	3'3"	65.0			
101	106	"	5	5'0"	100.0			
106	110-1/2	"	4-1/2	3'7"	79.6			
110-1/2	111	"	0-1/2	0	0			
111	116	"	5	5'0"	100.0			
116	121	"	5	4'8"	93.3	116	156	Mostly light-gray, coarse-grained marble. Locally yellowed by iron stains. Below 152 feet several fractures right angle and 30 degrees to core, that carry MnO_2 films.
121	126	"	5	4'8"	93.3			
126	131	"	5	2'10"	56.7			
131	136	"	5	4'8"	93.3			
136	141	"	5	4'9"	95.0			
141	146	"	5	4'9"	95.0			
146	151	"	5	4'9"	95.0			
151	156	"	5	4'1"	81.7			

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Footage To-	
156	161	Ax	5	4'6"	90.0	156	169	Pale buff, fine-grained limestone. In places core much broken.
161	166	"	5	4'0"	80.0			
166	171	"	5	4'8"	93.3			
171	176	"	5	5'0"	100.0	169	181	Gray, medium-grained limestone. Many indistinct cross laminae of darker gray.
176	181	"	5	4'10"	96.7			
181	186	"	5	5'0"	100.0	181	220	Mostly pale-yellow, medium-grained limestone. In places rock is friable and broken; some gouge at 215 feet.
186	190	"	4	1'0"	25.0			
190	195	"	5	5'0"	100.0			
195	200	"	5	4'6"	90.0			
200	205	"	5	4'4"	86.7			
205	210	"	5	3'5"	68.3			
210	215	"	5	2'10"	56.7			
215	220	"	5	1'11"	38.3			
220	225	"	5	4'11"	98.3	220	240	Medium- to fine-grained gray limestone with darker laminae right angle to core. Locally much fractured and shows a greenish-gray mineral (chlorite).
225	230	"	5	3'6"	70.0			
230	235	"	5	1'5"	28.3			
235	240	"	5	2'4"	46.7			
240	245	Ex	5	2'9"	55.0	240	253	(Begin 7/8 inch core.) Like above. Some gouge at end.
245	247	"	2	1'2"	58.4			
247	251	"	4	1'0"	25.0			
251	256	"	5	2'1"	41.7			
256	261	"	5	2'6"	50.0	253	261	Light-gray, medium-grained aplite and granite: Dark minerals relatively scarce.
261	266	"	5	2'8"	53.3	261	271	Gray to greenish-gray, fine-grained limestone. Some gouge at beginning. Core much broken.
266	271	"	5	1'6"	30.0			
271	276	"	5	1'6"	30.0	271	276	Fine-grained gray quartz, locally cavernous. Shows some fine sulfides (assay Zn Ag).

Hole 5-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
276	281	Ex	5	2'3"	45.0	276	281	Fine-grained siliceous limestone. Fractures coated with chlorite.
281	286	"	5	2'0"	40.0	281	286	Like above, core much broken.
286	291	"	5	1'11"	38.3	286	291	Same as last, some fragments contain pink $MnCO_3$ and a little ZnS. 286-288 feet heavy zinc. (Trengove) (assay Zn Ag Mn).
291	296	"	5	0'9"	15.0	291	296	Small amount of core recovered in small fragments consisting of quartz with some ZnS (assay Zn Ag).
296	301	"	5	1'6"	30.0	296	301	Fine, dark-gray quartz with a little disseminated fine sulfides and some $MnCO_3$ (assay Zn, Ag, Mn).
301	302	"	1	0'10"	83.3	301	311	Like above except less sulfides and $MnCO_3$ (assay Zn, Ag, Mn).
302	306	"	4	0'10"	20.8			
306	311	"	5	0'8"	13.3			
311	315	"	4	1'7"	39.6	311	317	
315	317	"	2	1'11"	95.8			
317	320	"	3	2'3"	75.0	317	353	Gray, fine-grained limestone with thin cross laminae of darker gray. A few fractures 30 degrees to core. In places, dark-brownish siliceous bands, and near the lower end some areas peppered with dark specks.
320	325	"	5	1'2"	23.3			
325	331	"	6	2'3"	37.5			
331	336	"	5	1'9"	35.0			
336	340	"	4	1'8"	41.7			
340	341	"	1	1'0"	100.0			
341	343	"	2	1'3"	63.2			
343	348	"	5	0'11"	18.3			
348	353	"	5	1'7"	31.6			
353	358	"	5	3'8"	73.3	353	388	Typical Maywood with local fracturing.
358	363	"	5	3'1"	61.7			
363	368	"	5	5'0"	100.0			
368	373	"	5	4'1"	81.7			

Hole 5-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
373	378	Ex	5	4'7"	91.6			Typical Maywood with local fracturing.
378	383	"	5	0'9"	15.0			
383	388	"	5	3'4"	66.7			
388	391	"	3	1'1"	36.1	388	391	Only 13 inches of core. Fractured and gougy. Last 3 inches mostly gouge.
391	396	"	5	4'2"	83.3	391	409	Same as above - last 6 weeks gougy.
396	401	"	5	5'0"	100.0			
401	406	"	5	3'8"	73.3			
406	409	"	3	1'7"	52.8			
409	411	"	2	1'1"	54.2	409	429	Same - at 411 feet is 1 inch of gouge and at 415 feet is 6 inches of gougy material.
411	416	"	5	1'9"	35.0			
416	421	"	5	1'9"	35.0			
421	426	"	5	1'5"	28.3			
426	431	"	5	4'6"	90.0	429	431	Fine-grained, dark-gray Maywood with abundant black tabular crystals. Maybe biotite. 6 inches fractured, somewhat gougy.
431	435	"	4	2'5"	60.4	431		6 inches fractured, somewhat gougy.
435	440	"	5	3'1"	61.7	431	464	Typical Maywood, dark greenish-gray in places.
440	445	"	5	4'11"	98.3			
445	449	"	4	2'5"	60.4			
449	454	"	5	4'0"	80.0			
454	455	"	1	0'10"	83.3			
455	460	"	5	2'1"	41.7			
460	464	"	4	2'1"	52.1			
464	469	"	5	2'9"	55.0	464		6 inches fractured and gougy.
469	474	"	5	2'6"	50.0	464	474	Typical Maywood - gougy material at 468 feet.

Hole 5-S (Cont'd.)

Footage From-	Footage To-	Core size	Distant drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Petrographic description: Footage To-	Petrographic description
474	479	Ex	5	2'11"	58.3	474		2 inches gougy material.
						474	479	2 feet of core - fine-grained, reddish-brown shale or shaley limestone - may contain some garnet.
479	484	"	5	3'4"	66.7	479	484	Same - contains a few thin seams of thulite and disseminated pyrite in places.
484	485	"	1	0'0"	0	484	485	No core - hole cut into Headlight winze. Went through muck pile and into footwall of Headlight bed.
485	487	"	2	0'4"	12.5	485	487	Only 3 inches of core - porous, siliceous, black manganese ore. Soft pyrolusite mixed with quartz.
487	491	"	4	0'10"	20.8	487	496	White to gray, medium-grained marble with chlorite seams at 80 degrees. First two inches yellow and friable.
491	496	"	5	1'8"	33.3			

Hole 6-S

Co-ordinates: 12,044N., 11,160E.
Elevation at collar: 5,848 feet
Dip: 41 degrees, 30 minutes

Depth: 160 feet
Bearing: S. 60° W.

0	37	Ax	37			0	37	Decomposed granite.
37	39	Ex	2	1'8"	83.3	37	39	Dark-gray limestone with MnO_2 and Zn.
39	40	"	1	0'1"	8.3	39	51	MnO_2.
40	44	"	4	0'10"	20.8			
44	47	"	3	0'11"	30.5			
47	49	"	2	0'8"	33.3			
49	51	"	2	0'3"	12.5			

Hole 6-S (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Petrographic description: Footage To-	Petrographic description
51	54	Ex	3	1'1"	36.1	51	59	MnO_2 and quartz.
54	59	"	5	0'3"	5.0			
59	64	"	5	0'5"	8.3	59	64	MnO_2.
64	70	"	6	1'6"	25.0	64	70	MnO_2 and quartz.
70	75	"	5	0'2"	3.3	70	83	MnO_2.
75	80	"	5					
80	83	"	3					
83	103	"	20	1'4"	0.7	83	103	MnO_2 and quartz.
103	109	"	6	0'1"	0.1	103	109	MnO_2.
109	114	"	5	0'10"	16.7	109	114	MnO_2 and 2 inches limestone.
114	119	"	5	1'2"	23.3	114	119	MnO_2 with scattering pyrite crystals.
119	122	"	3	0'2"	5.6	119	122	MnO_2 and quartz.
122	127	"	5	0'7"	11.6	122	127	MnO_2 and quartz.
127	133	"	6	0'3"	4.2	127	160	Typical buff Jefferson limestone.
133	138	"	5	0'2"	3.3			
138	141	"	3					
141	146	"	5	0'4	6.7			
146	151	"	5	1'3"	25.0			
151	156	"	5	2'10"	56.7			
156	160	"	4	1/4"	26.7			

Hole 7-S

Co-ordinates: 11,643N., 12,203E.
Elevation at collar: 5,810 feet
Dip: 40 degrees

Depth: 380 feet
Bearing: N. 60° W.

0	84	1/	84			0	84	Granite.
84	86	Ex	2	1'7"	79.1	84	89	MnO_2, quartz and limestone.
86	90	"	4	3'0"	75.0	89	90	Buff Jefferson limestone.
90	94	"	4	1'10"	45.8	90	94	Granite and limestone.
94	97	"	3	0'9"	25.0	94	97	Buff limestone.

1/ Core size: 0 to 57 feet, Ax; 57 to 84 feet, Ex.

Hole 7-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
97	101	Ex	4	0'10"	20.8	97	105	MnO_2.
101	103	"	2	0'9"	37.5			
103	105	"	2	0'11"	45.8			
105	110	"	5	2'10"	56.7	105	110	Mn-stained limestone.
110	115	"	5	1'2"	23.3	110	111	Fine-grained gray limestone.
						111	115	Mn-stained limestone and quartz.
115	120	"	5	1'8"	33.3	115	245	Fine-grained buff limestone.
120	125	"	5	1'7"	31.6			
125	130	"	5	1'3"	25.0			
130	135	"	5	0'7"	11.6			
135	140	"	5	0'5"	8.3			
140	145	"	5	1'8"	33.3			
145	150	"	5	1'8"	20.0			
150	155	"	5	1'11"	38.3			
155	160	"	5	4'6"	90.0			
160	165	"	5	3'1"	61.7			
165	170	"	5	0'7"	11.6			
170	175	"	5	1'1"	21.7			
175	180	"	5	1'7"	31.6			
180	185	"	5	2'1"	41.7			
185	190	"	5	2'4"	46.7			
190	195	"	5	1'11"	38.3			
195	200	"	5	0'7"	11.6			
200	205	"	5	0'11"	18.3			
205	210	"	5	0'9"	15.0			
210	215	"	5	1'0"	20.0			
215	220	"	5	1'7"	31.6			
220	225	"	5	2'10"	56.7			
225	230	"	5	2'9"	55.0			
230	235	"	5	2'9"	55.0			
235	240	"	5	1'2"	23.3			
240	245	"	5	1'9"	35.0			

Hole 7-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
245	250	Ex	5	4'8"	93.3	245	257	Fine-grained gray limestone with cavities 245 to 248.
250	252	"	2	0'7"	29.2			
252	257	"	5	4'7"	91.6			
257	258	"	1	0'7"	58.3	257	263	Buff, sugary limestone.
258	263	"	5	1'6"	30.0			
263	268	"	5	1'8"	33.3	263	268	Coarsely crystalline buff limestone.
268	274	"	6	4'0"	66.7	268	280	Coarsely crystalline gray limestone.
274	280	"	6	3'0"	50.0			
280	285	"	5	3'6"	70.0	280	337	Fine-grained bluish-gray limestone.
285	290	"	5	1'4"	26.7			
290	295	"	5	4'6"	90.0			
295	300	"	5	4'7"	91.6			
300	305	"	5	4'7"	91.6			
305	310	"	5	4'0"	80.0			
310	315	"	5	4'7"	91.6			
315	320	"	5	4'5"	88.3			
320	323	"	3	1'5"	47.2			
323	328	"	5	3'0"	60.0			
328	332	"	4	1'6"	37.5			
332	337	"	5	1'5"	28.3			
337	342	"	5	0'9"	15.0	337	342	Buff limestone - gougy.
342	347	"	5	0'8"	13.3	342	347	Fine-grained bluish-gray limestone.
347	352	"	5	2'4"	46.7	347	357	Buff limestone.
352	357	"	5	1'1"	21.7			
357	360	"	3	0'4"	11.1	357	364	Gray limestone with quartz.
360	364	"	4	0'5"	10.4			
364	368	"	4	0'6"	12.5	364	380	Bluish-gray fine-grained limestone.
368	372	"	4	0'4"	8.3			
372	377	"	5	0'6"	8.3			
377	380	"	3	0'3"	8.3			

Hole 8A-S

Co-ordinates: 11,643N., 12,203E.
Elevation at collar: 5,810 feet
Dip: 62 degrees

Depth: 140 feet
Bearing: N 80° W.

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Footage To-	
0	82	Ax	82			0	82	Granite.
82	85	Ex	3	2'0"	66.7	82	96	Buff limestone.
85	90	"	5	2'0"	40.0			
90	96	"	6	3'10"	63.9			
96	101	"	5	2'7"	51.6	96	101	Buff limestone - occasional fractures lined with soft greenish mineral - chlorite.
101	106	"	5	1'6"	30.0	101	106	Coarsely crystalline buff limestone - some muscovite.
106	111	"	5	3'6"	70.0	106	121	Buff limestone.
111	116	"	5	2'5"	48.3			
116	121	"	5	1'8"	33.3			
121	126	"	5	0'9"	15.0	121	126	Buff limestone - some muscovite and considerable gouge.
126	131	"	5	0'8"	13.3	126	140	Finely crystalline buff limestone.
131	135	"	4	0'10"	20.8			
135	140	"	5	1'3"	25.0			

Hole 9-S

Co-ordinates: 12,054N., 11,219E.
Elevation at collar: 5,830 feet
Dip: 58 degrees

Depth: 165 feet
Bearing: Due west

0	79	1/	79			0	81	Granite.
79	81	Ex	2					
81	86	"	5	1'7"	31.6	81	92	Buff limestone - some MnO_2 stain.
86	92	"	6	2'6"	41.6			
92	97	"	5	1'3"	25.0	92	97	Buff limestone - bedding planes at 45 degrees to core.
97	102	"	5	1'5"	28.3	97	102	Same as above but with MnO_2 stain.

1/ Core size: 0 to 57 feet, Ax; 57 to 79 feet, Ex.

Hole 9-S (Cont'd.)

Footage From-	Footage To-	Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description: Footage From-	Footage To-	Petrographic description
102	107	Ex	5	1'10"	36.7	102	107	Light-brown limestone - thin seam (1/2 inch) MnO_2 at 102 feet.
107	109	"	2	0'10"	41.6	107	109	Buff to bluish-gray limestone.
109	114	"	5	4'0"	80.0	109	111	Bluish-gray limestone.
						111	114	MnO_2-stained limestone.
114	119	"	5	1'0"	20.0	114	125	MnO_2-stained limestone - brecciated - a few MnO_2 stringers between 118 and 124.
119	124	"	5	1'11"	38.3			
124	130	"	6	2'9"	45.8	125	165	Buff limestone.
130	135	"	5	3'1"	61.7			
135	140	"	5	3'0"	60.0			
140	145	"	5	2'3"	45.0			
145	150	"	5	0'7"	11.6			
150	155	"	5	0'9"	15.0			
155	160	"	5	0'11"	18.3			
160	165	"	5	0'9"	15.0			

Hole 10-S

Co-ordinates: 11,951N, 11,159E.
Elevation at collar: 5,841 feet
Dip: 33 degrees

Depth: 120 feet
Bearing: Due west

0	31	Ex	31			0	48	Granite.
31	38	"	7	1'4"	19.0			
38	48	"	10	1'7"	15.8			
48	53	"	5	0'9"	15.0	48	53	Gray limestone - little MnO_2 stain.
53	58	"	5	1'0"	20.0	53	58	Gray to buff, medium-grained limestone - gougy.
58	63	"	5	1'2"	23.3	58	63	Gray limestone.
63	70	"	7	1'11"	27.4	63	84	Buff limestone - badly broken.
70	75	"	5	1'3"	25.0			
75	79	"	4	0'10"	20.8			
79	84	"	5	1'9"	35.0			

Hole 10-S (Cont'd.)

Footage		Core size	Distance drilled, feet	Core obtained, feet	Core recovery, percent	Petrographic description		
						Footage		
From-	To-					From-	To-	
84	88	Ex	4	1'11"	47.9	84	88	Medium to coarse-grained light-gray limestone.
88	95	"	7	2'3"	32.1	88	89	Buff limestone - fractures 45 degress to core.
95	100	"	5	3'3"	65.0	89	99	Buff limestone - medium-grained.
100	105	"	5	1'11"	38.3	99	104	MnO_2 and quartz.
						104	105	MnO_2 stained limestone - fractures 45 degrees to core.
105	110	"	5	0'9"	15.0	105	120	Coarse-grained buff limestone.
110	115	"	5	2'0"	40.0			
115	120	"	5	2'0"	40.0			