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R. I. 3992

AUGUST 1946

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Deviation of Holes

UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

REPORT OF INVESTIGATIONS

CLARK FORK LEAD-ZINC DISTRICT, BONNER COUNTY, IDAHO

BY

S. H. LORAIN

R. I. 3992,
August 1946.

REPORT OF INVESTIGATIONS

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

CLARK FORK LEAD-ZINC DISTRICT, BONNER COUNTY, IDAHO[1]

By S. H. Lorain[2]

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INTRODUCTION

The veins of the Clark Fork district have been mined on a small scale since 1913. In May 1943, the district was examined by an engineer[3] of the Bureau of Mines with a view to possible exploration for larger ore deposits

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is made: "Reprinted from Bureau of Mines Report of Investigations 3992."

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

3/ Glenn C. Reed, Albany Division, Mining Branch, Bureau of Mines.

that might be of value to the war effort. The area adjacent to the Hope, Whitedelf, and Lawrence mines was re-examined[4] December 27, 1943. As a result, the Bureau of Mines started exploratory operations in the district during the summer of 1944 which was continued until the late spring of 1946. This report presents the data obtained from the investigation.

ACKNOWLEDGMENTS

In its program of exploration of mineral deposits, the Bureau of Mines has as its primary objective the more effective utilization of our mineral resources to the end that they make the greatest possible contribution to national security and economy. It is the policy of the Bureau to publish the facts developed by each exploratory project as soon as practicable after its conclusion. The Mining Branch, Lowell B. Moon, chief, conducts the preliminary examinations, performs the actual exploratory work, and prepares the final report. The Metallurgical Branch, R. G. Knickerbocker, chief, analyzes samples and performs beneficiation tests.

The exploratory work at Clark Fork was part of the activities of the Albany Division of the Mining Branch, S. H. Lorain, chief. Project work was under the immediate direction of Miro Mihelich, mining engineer, Albany Division, Mining Branch.

Chemical analyses were performed at Reno, Nev., under the direction of A. C. Rice, acting engineer in charge, Rare and Precious Metals Experiment Station, Bureau of Mines.

The author wishes to acknowledge the wholehearted and courteous cooperation extended by officials of the Hope Mining Co. and the Whitedelf Mining Co., on whose properties the work was done.

LOCATION AND ACCESSIBILITY

The producing mines of the Clark Fork district are in Lightning Creek Valley, 1 to 2 miles north of the town of Clark Fork, Idaho. Clark Fork (population 400) is near the eastern end of Pend Oreille lake. It is on U. S. Highway 10 (alternate) and on the main line of the Northern Pacific Railroad (fig. 1). The nearest large supply center is Spokane, Wash., 93 miles by rail or 100 miles by road southwest of Clark Fork. The mines are about 2 miles by nearly level, graveled road from the railroad station at Clark Fork. Freight rates to lead smelters at East Helena, Mont., or Kellogg, Idaho, are nearly identical. The rates on concentrates from Clark Fork to East Helena are as follows:

Per ton valuation	Rate, dollars per ton
$25	$3.47
30	3.64
40	4.02
60-80	4.72

4/ S. H. Lorain, chief, Albany Division, Mining Branch, Bureau of Mines.

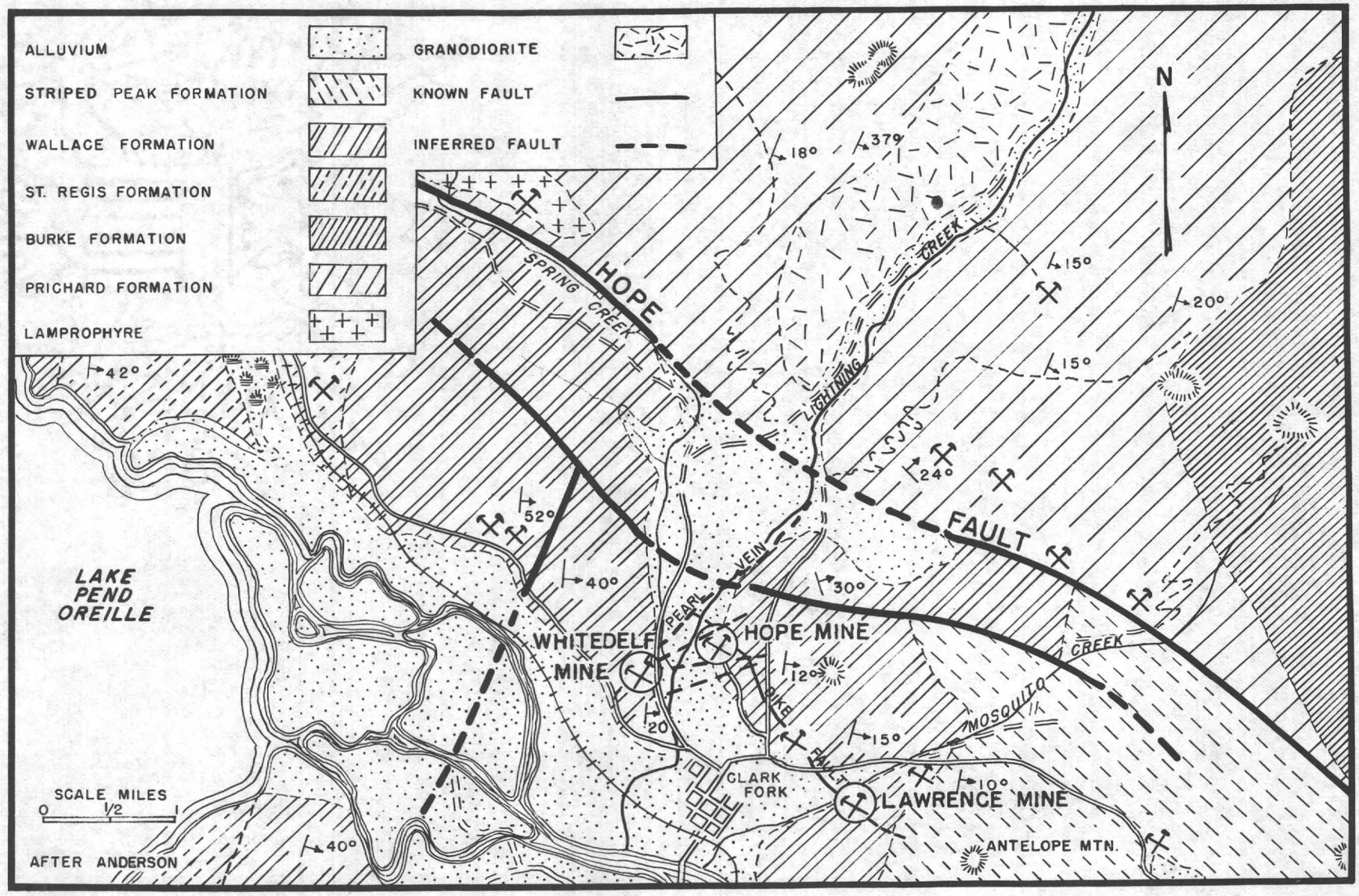


FIG.I GEOLOGY OF PART OF CLARK FORK DISTRICT

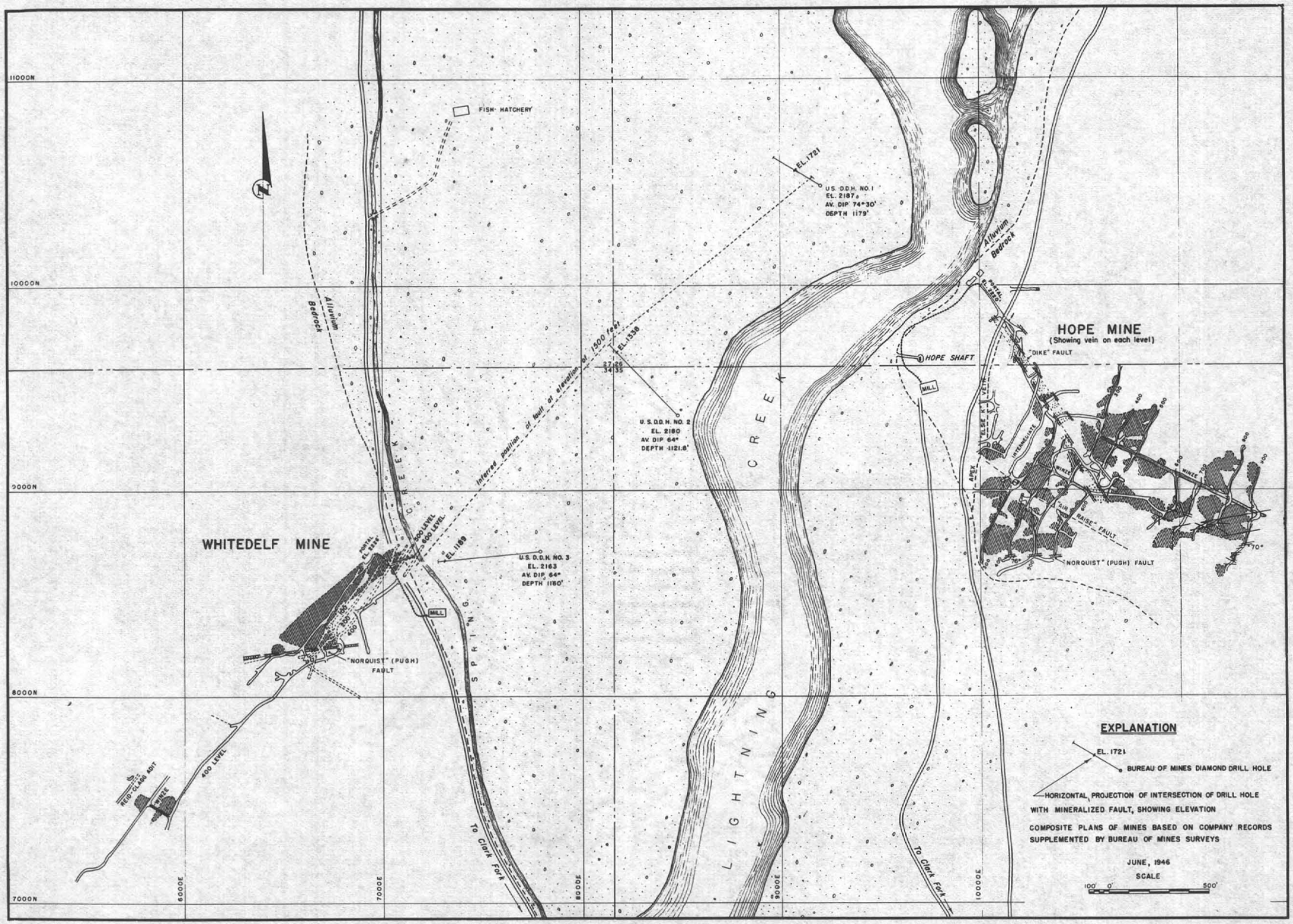


FIG. 2 PLAN SHOWING RELATION OF BUREAU OF MINES DRILL HOLES TO WHITEDELF AND HOPE MINES

HISTORY AND PRODUCTION

The first ore discoveries in the Clark Fork district probably were made shortly after the discovery of ore in the nearby Pend Oreille district in 1888. The first recorded shipments of ore were from the Lawrence mine, in 1913. The Hope vein (fig. 2), originally known as the Elsie K., was discovered in 1923. The Whitedelf vein is said to have been discovered in a road constructed in 1926. Although numerous other veins have been discovered within the district, the only noteworthy production has been derived from the three mines mentioned above. The recorded production from 1913 to 1942, inclusive, is tabulated below:5/

Year	Crude ore, tons	Concentrated, tons	Metal recovered				
			Gold, oz.	Silver, oz.	Copper, lb.	Lead, lb.	Zinc, lb.
1913.....	4,746	355	0.26	4,877	-	-	-
1914.....	324	81	.21	1,326	111	510,579	-
1915.....	457	110	.08	1,455	40	121,914	-
1916.....	454	73	-	943	74	163,308	-
1917.....	762	127	0.08	2,254	160	111,225	-
1918.....	772	128	-	2,195	159	197,271	-
1919.....	144	37	-	518	-	199,753	-
1920.....	-	-	-	-	-	56,514	-
1921.....	-	-	-	-	-	-	-
1922.....	94	-	-	1,458	-	145,167	-
1923.....	36	-	-	535	-	51,970	-
1924.....	-	-	-	-	-	-	-
1925.....	224	34	-	6,080	-	198,078	-
1926.....	1,322	46	0.95	45,760	1,051	1,003,067	-
1927.....	3,028	92	.20	116,661	246	2,179,146	-
1928.....	2,483	71	-	74,461	398	1,445,445	-
1929.....	11,797	660	2.70	88,522	805	1,791,854	-
1930.....	19,182	1,128	-	85,960	2,607	1,992,496	-
1931.....	21,516	1,380	-	89,550	2,629	2,125,320	-
1932.....	11,992	242	-	53,105	1,193	1,189,915	-
1933.....	6,455	414	0.60	24,219	762	642,848	-
1934.....	6,700	-	.50	22,348	450	665,495	-
1935.....	4,764	-	.80	12,713	226	394,546	-

5/ Compiled under the direction of George E. Woodward, supervising engineer, Salt Lake Section, Economics and Statistics Service, Bureau of Mines.

Year	Crude ore, tons	Concentrates, tons	Metal recovered				
			Gold, oz.	Silver, oz.	Copper, lb.	Lead, lb.	Zinc, lb.
1936.....	10,250	-	2.80	37,162	-	1,168,358	-
1937.....	23,806	-	14.00	52,206	-	1,695,466	-
1938.....	12,591	626	4.00	47,320	-	1,346,668	-
1939.....	12,135	798	4.00	48,355	1,597	1,232,797	-
1940.....	12,759	821	3.00	63,279	2,400	1,195,176	-
1941.....	9,616	685	1.00	58,747	3,171	841,867	-
1942.....	12,077	630	2.00	47,737	1,914	812,620	70,000
Total....	190,486	8,538	37.18	989,746	19,993	23,478,863	70,000

Approximately 12 percent of the lead and 2.6 percent of the silver were produced by the Lawrence mine. The remainder of the lead was produced in nearly equal amounts by the Hope and Whitedelf mines. The Whitedelf, however, has produced nearly 67 percent of the total silver. Neither zinc nor copper were paid for prior to 1942, when the premium-payment plan was introduced in connection with the war effort; consequently, the production of these metals was not recorded. Nevertheless, it is estimated that output from the three mines has been approximately 1,600,000 pounds of zinc and 100,000 pounds of copper.

For the past several years the Lawrence and Whitedelf mines have been operated only intermittently and on a small scale by leasers. The Hope mine continued full-scale production until 1944, when the Bureau of Mines demonstrated that the Pearl (Whitedelf) mineralized fault extended into Hope ground. In 1944 the original Hope mine was abandoned, and a shaft (fig. 2) was started for the purpose of exploring and developing the northeasterly and deeper extensions of the Pearl vein.

PHYSICAL FEATURES AND CLIMATE

The town of Clark Fork is on the broad alluvial floor of Lightning Creek Valley (fig. 1) near its confluence with the valley of Clark Fork River. It is about 2,000 feet above sea level and 4 miles east of the eastern shore of Pend Oreille Lake. The mines discussed in this report are in or near Lightning Creek Valley. The Hope and Whitedelf mine plants are on the lower hillsides, very near the outer edges of the alluvial deposits, which in this locality are about 2,700 feet wide and 400 feet deep. The Lawrence mine workings are on the lower slopes of Antelope Mountain, a few hundred feet above the valley floor.

The heavily forested foothills of the Cabinet Range rise sharply from the sides of the river and creek valleys. Within 6 to 7 miles northeasterly from Clark Fork, the summits of the Cabinet Range attain an altitude of 7,000 feet or more.

The climate in the vicinity of Clark Fork is moderate throughout the year. Rainfall is sufficient to support a prosperous farming community in

the Clark Fork Valley and on the large delta near the mouth of the Clark Fork River. In the higher parts of the Cabinet Range, the winters are severe and snowfall is heavy. At the altitude of Clark Fork and the nearby mines snow seldom constitutes a serious problem; it occasionally accumulates to a depth of as much as 30 inches, but during some winters the fall is almost negligible. Normally, the ground is bare of snow from April to December, inclusive.

LABOR AND LIVING CONDITIONS

In normal times a fair supply of skilled mine labor is available in Spokane and in the Coeur d'Alene mining district, which, in turn, derives a considerable part of its labor from the Spokane area. A few skilled miners reside in Clark Fork and in nearby towns. In the past, wage rates in the Clark Fork district have been lower than in the Coeur d'Alene district. It is probable, however, that with deeper mining operations in the Clark Fork district the Coeur d'Alene scale will have to be met. In the spring of 1946, the Coeur d'Alene rate for underground workers ranged from $7.75 for stope muckers to $8.75 for timbermen. As this report is being written (June 1946), negotiations are under way for a substantial increase in these rates. An increase of 18-1/2 cents per hour would raise these rates to $9.23 and $10.23, respectively.

No housing or boarding accommodations are available at the mines of the Clark Fork district; the workers live in Clark Fork. Only very limited accommodations for transients or for a greater number of permanent workers are now available in the town. These accommodations could readily be increased, however, as soon as building materials become available.

PROPERTY AND OWNERSHIP

The Hope mine is owned by the Hope Silver-Lead Mines, Inc. Albert Nash, of Clark Fork, is president and manager. The company owns 360 acres of patented land in the S 1/2, sec. 26. T 56 N., R 2 E, and the N 1/2, sec. 35, T 56 N., R 2 E. It also holds 14 unpatented claims in sections 25 and 26. The company is capitalized for 3,000,000 shares, par value $0.25.

The Lawrence mine is owned by the Lawrence Consolidated Mining Co. Joseph Reed, of Clark Fork, is president and manager. This company holds 12 unpatented claims. It is capitalized for 1,500,000 shares, par value 1 cent.6/

The Whitedelf mine is owned by the Whitedelf Mining & Development Co. Compton I. White, of Clark Fork, is president. The company owns or leases 300 acres of patented land. It is capitalized for 2,000,000 shares, par value 10 cents.6/ According to reports, this company has recently acquired part of the holdings of the Lawrence Consolidated Mining Co.

6/ Campbell, Arthur, Inspector of Mines, Boise, Idaho: Forty-second Annual Report of the Mining Industry of Idaho, pp. 114-115.

MINE WORKINGS AND PLANT

Underground workings on the Hope mine property have a total length of about 11,000 feet. These workings have developed the Hope (Elsie K.) vein for a strike length of 1,300 feet and a dip length of 900 feet (fig. 2). A vertical 2-1/2-compartment shaft is now being sunk from the surface to a depth of 750 feet. It is planned to drive a crosscut from the bottom of this shaft to intersect the Pearl (Whitedelf) vein about 2,800 feet northeast of the Whitedelf mine. In June 1946, the shaft had been sunk to a depth of about 650 feet. The mine and nearby flotation plant are fully equipped for a production of 50 tons per day.

The Whitedelf mine is developed by approximately 5,000 feet of underground workings (fig. 2). These workings comprise a main adit level, which has developed the main ore shoot for a strike distance of about 700 feet, a shaft from the main adit level to the 400-foot level, and a winze to about 250 feet below the 400 level. The winze is now inaccessible. The mine is partly equipped. A 50-ton flotation mill is adjacent to the mine portal.

The Lawrence mine has been developed by 5,000 to 6,000 feet of underground workings, but most of them are now inaccessible. One adit several hundred feet long is being worked intermittently by leasers.

DESCRIPTION OF THE DEPOSITS

General Geology

The general geology of the region has been described by Anderson,7/ and the following is based on his report.

The area is underlain by sedimentary rocks of the Belt series (Pre-Cambrian). This series comprises, from top to bottom, the Striped Peak, Wallace, St. Regis, Burke, and Prichard. An intrusive body of granodiorite is exposed 2-1/2 miles northeast of the Hope mine (fig. 1). The veins described in this report are in the upper and middle parts of the Wallace formation, which Anderson estimates to be over 6,000 feet thick. The Wallace formation is composed of grayish calcareous shales and quarzites interbedded with greenish or bluish shales and argillites. These beds strike N. 15° E. to N. 40° E. and dip 10 to 20 degrees southeasterly. Numerous large lamprophyre dikes traverse the Clark Fork district. One of these dikes follows the "Dike Fault" (fig. 2) through the workings of the Hope mine. Similar dikes, on the strike extension of the dike in the Hope mine, are near the Lawrence mine. Anderson considers these dikes to be definitely premineral.

Faults. - The Hope fault (fig. 1) is 2 miles northeast of the Hope vein. The horizontal displacement along the Hope fault is estimated to be

7/ Anderson, Alfred L., Geology and Ore Deposits of the Clark Fork District, Idaho: Bull. 12, Idaho Bureau of Mines and Geology, University of Idaho, 1930, 130 pp.

many thousands of feet - it may be as much as 10 miles. This fault has been traced for more than 20 miles, from Heron, Mont., to Hope, Idaho. It was probably formed by the same regional movements that formed the great Osborn fault of the Coeur d'Alene mining district.

The course of the Hope fault deviates southward near the Clark Fork district (fig. 1). Numerous strong faults and fractures, which may have been caused by local adjustments to the deviation of the Hope fault, traverse the Clark Fork district. Because of the heavy overburden, only a few of the local faults have been mapped in detail. Most of the local faults that have been mapped are exposed in the various mine workings. The local faults of particular interest to this report are the Pugh (or Norquist), the Dike, the Pearl, and the Elsie K.

The Pugh, or Norquist, fault is exposed on several levels of the Hope mine and on nearly every level of the Whitedelf mine. It is a strong, gouge-filled fissure which strikes S. 85° W. and dips about 75 degrees to the southeast. The principal ore shoots in both the Whitedelf and Hope mines terminate southwesterly against this fault. One good ore shoot in the Whitedelf mine, however, was on this fault a short distance west of its intersection with the main ore shoot. The Pugh fault appears to merge with the Dike fault just beyond the lowest and most southeasterly workings of the Hope mine. The Pugh fault displaces the Pearl fault about 175 feet westward on the south side.

The Dike fault is essentially a shear zone. Where exposed in the Hope mine, it may be as much as 50 feet wide. A strong and very persistent lamprophyre dike occupies part of the shear zone. This fault is well-exposed in the Hope mine; it was intersected by Bureau of Mines drill hole 1 about 1,400 feet northwest of its most northwesterly exposure in the Hope mine. Inferred extensions of this fault may be observed for a distance of about 2 miles southeasterly. The Dike fault strikes N. 40° W. and dips 60 degrees to the southwest. It is weakly mineralized at some places in the Hope mine but does not contain ore at any place where it has been exposed. The Elsie K. vein is displaced about 200 feet to the southeast on the north side of the Dike fault.

The Elsie K. vein occupies parts of a weak but very persistent fault that strikes about N. 40° E. and has an average dip of 15 degrees to the southeast. This fault is nearly parallel to the bedding but is slightly steeper. It tends to follow certain bedding planes for some distance and then cuts obliquely downward to a lower bed. In some places the ore shows a definite tendency to pinch in the steeper parts of the fault; therefore, it may be assumed that movement on the fault was reverse rather than normal. This fault is continuous between the Pugh fault and the Dike fault. It has not been found southwest of the Pugh fault nor for more than about 400 or 500 feet northeast of the Dike fault.

The Pearl fault is a strong shear zone that ranges in width from a few feet to 30 or more feet. Where exposed in the northeasterly workings of the Whitedelf mine, the Pearl fault consists of a central crushed section 3

to 4 feet wide, with 10 to 30 feet of strongly fractured and brecciated wall rock. Its average strike is about N. 40° E.; in the Whitedelf mine it dips 65 degrees to the southeast. This fault has been followed by mine workings 1,500 feet southwest from the Pugh fault and has been followed by mine workings or indicated by diamond-drill intersections for 3,400 feet northeast from the Pugh fault. Its further continuation for a mile or more to the northeast may be suspected from topographic features. The Pearl fault contains a couple of small ore shoots southwest of the Pugh fault, but it is not generally well-mineralized southwest of the Pugh fault. Northeast of the Pugh fault it is strongly mineralized wherever it has been intersected. It has been proved to contain at least one rich ore shoot - the Whitedelf ore shoot.

Ore Shoots

The productive ore shoots of the Clark Fork district are of two types. Flatly dipping veins in weak faults similar to the Elsie K. are the most numerous. The ore shoots worked by the Hope and Lawrence mines were of this type. On the other hand, the ore shoots worked by the Whitedelf mine are on steeply dipping veins in the strong Pearl fault. The main Whitedelf ore shoot has been stronger and more productive than any other ore shoot in the district.

Seven or eight parallel veins have been discovered on the Lawrence property. These occupy small, flat-dipping faults distributed over a vertical range of about 1,000 feet. The aggregate production from these veins has been considerable, but their actual extent has not been recorded in detail. The Elsie K. vein is similar to the veins on the Lawrence property. Its outcrop is slightly lower than the lowest vein outcrop on the Lawrence property. Ore shoots on the Elsie K. vein have been almost continuous for a strike length of about 1,000 feet in the upper levels to 400 feet in the lower levels, for a dip length of about 900 feet. The ore usually occurs as vein fillings or replacements consisting of nearly massive sulfides. The width of these deposits ranged from a few inches to several feet. The veins pinch and swell locally in both strike and dip. The recurrence of ore shoots along the strike is fairly regular but is generally unpredictable in detail. There is some suggestion that the ore shoots are stronger and more productive near the transverse faults. Along the dip, the veins tend to pinch to a narrow gouge seam where the fault steepens to cross the bedding and to widen where the fault conforms exactly with the bedding.

The ore in the main ore shoot of the Whitedelf mine usually occurs as a vein of massive sulfides along the footwall of the central or crushed section of the Pearl fault. In places the vein splits into small, closely spaced stringers; at other places the sulfides may be distributed throughout the fault. According to Anderson,8/ the ore shoot on the main level was 3 inches to 29 inches wide for 500 feet from the portal southwesterly to the Pugh fault; in places it widened to 8 feet of massive sulfides. This ore shoot has been mined continuously from the surface downward for 700 feet.

8/ See footnote 7.

A Bureau of Mines diamond-drill hole has demonstrated the existence of good ore 500 feet below the lowest level.

The Ore

The ore consists essentially of galena, tetrahedrite, sphalerite, and iron sulfides in a gangue of siderite, quartz, and altered wall rock. Alteration of the wall rocks consists chiefly of sericitization. Recent investigations by Anderson9/ indicate that many of the minerals that have been loosely classified as tetrahedrite are actually lead sulfantimonites and sulpharsenites, copper-lead sulfantimonites, and silver-lead sulfantimonites. Anderson has also recognized ruby silver. He lists boulangerite, geocronite, meneghinite, semseyite, jordanite, guitermanite, bournonite, freieslebenite, and pyrargyrite. Anderson postulates two separate periods of ore deposition. These periods were separated by a lowering of the rock temperatures and renewed fracturing of some of the original ore fissures. Deposition during the first period was characteristic of mesothermal temperatures; the sequence was similar to the mineralogic sequence in the Coeur d'Alene mining district; i.e., sericite, siderite, quartz, pyrite, arsenopyrite, sphalerite, and galena. During the second period there was further deposition of quartz, followed by the above-named series of sulfantimonites and sulfarsenites. These minerals are characteristic of relatively low temperature deposition. Minerals of the second period are most abundant in the Whitedelf mine, less abundant in the Hope mine, and are relatively rare in the Lawrence mine. They appear to increase with depth in the Whitedelf mine.

The ratio of silver to lead in the ores that have been produced from the three mines of the district is as follows:

Mine	Ounces Ag	Percent Pb.
Whitedelf.....	1	0.85
Hope.....	1	1.56
Lawrence.....	1	5.44

No accurate records of the zinc content of the ores are available. During 1942, when the Hope mine was paid a premium for the zinc content of its ores, it was indicated that the concentrates contained 1 pound of zinc to 9 pounds of lead. Analysis of the mill heads indicates, however, that the actual ratio may have been more nearly 1 pound of zinc to 6 pounds of lead.

WORK BY THE BUREAU OF MINES

The data obtained from preliminary examinations by Bureau of Mines engineers indicated that the Pearl fault is not only the strongest known ore-bearing fissure in the Clark Fork district but is an ore fissure of

9/ Anderson, Alfred. L., Lead-Silver Mineralization in the Clark Fork District, Bonner County, Idaho: Econ. Geol., vol. XLI, No. 2 (March-April 1946), pp. 105-123.

exceptional strength and persistence by any standards. It had been proved to be ore-bearing from its intersection with the Pugh fault northeasterly to where its outcrop was masked by the thick alluvial deposits of Lightning Creek Valley. Therefore, a decision was made to test its continuity for 2,800 feet northeast from its last exposure at the Whitedelf mine to its intersection with the Dike fault. Inasmuch as the vein apex in the area explored is covered by about 400 feet of alluvium, it was practicable to drill only a few holes for the purpose of proving the continuity and mineralization of the fault. It was believed, and this belief has since been confirmed, that such proof would result in deep level exploration by private enterprise. Accordingly, the Bureau of Mines drilled three holes at the positions shown on figure 2. Each hole intersected a strong mineralized fault at or very near the projected position of the Pearl fault. In order to check the findings from each hole, additional intersections with the fault were obtained by deflecting from the original hole below bedrock. Two deflections were drilled from hole 1, and one deflection each was drilled from holes 2 and 3. The total length of all holes and deflections was 4,686 feet. Some footage was lost by reason of caving ground.

A longitudinal section and cross sections through the holes are shown on figures 3, 4, 5, and 6. The assays obtained from the mimeralized sections of the holes are shown on figures 4, 5, and 6.

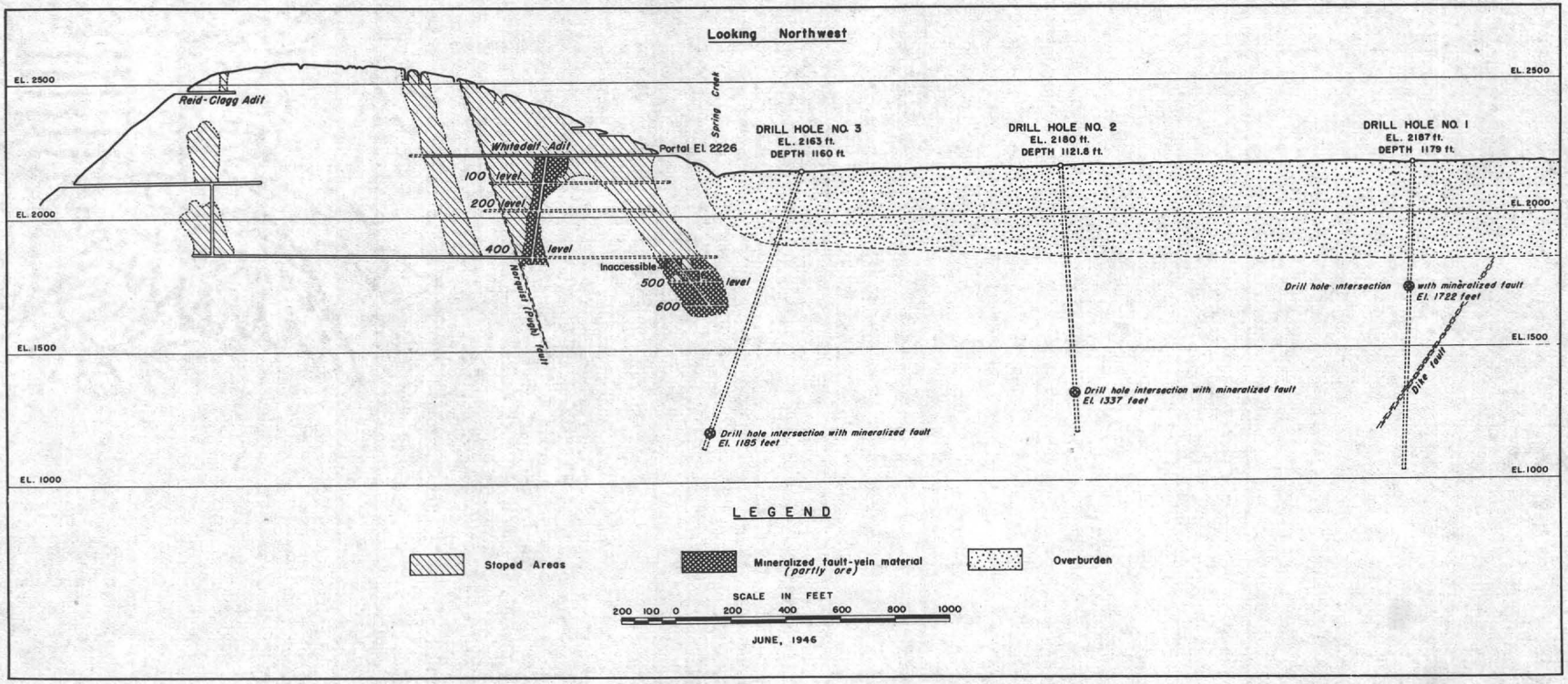
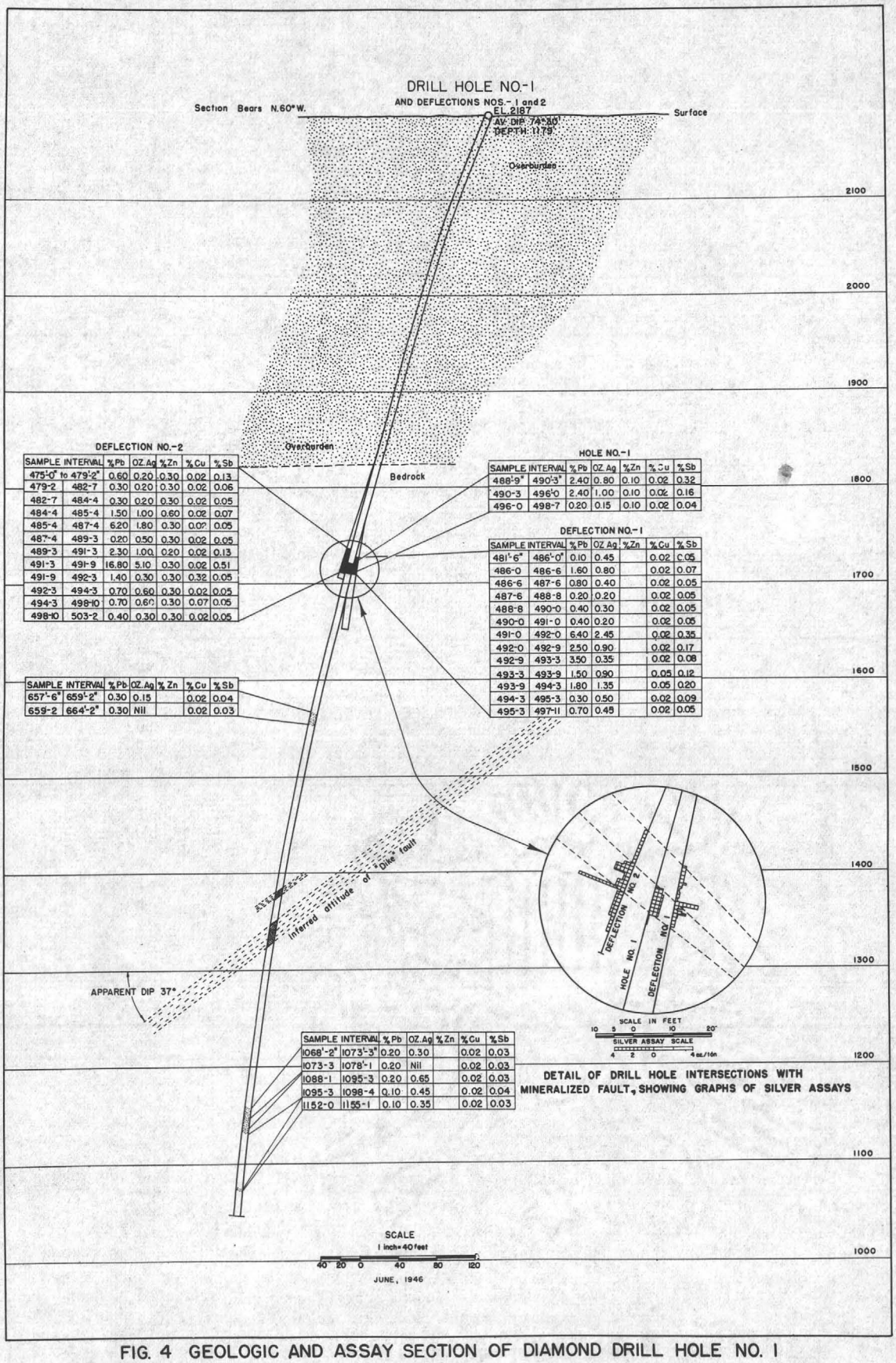


FIG. 3 LONGITUDINAL PROJECTION ON VERTICAL PLANE THROUGH PEARL FAULT



DEFLECTION NO.-2

SAMPLE INTERVAL		%Pb	OZ.Ag	%Zn	%Cu	%Sb
475'-0" to 479'-2"		0.60	0.20	0.30	0.02	0.13
479-2	482-7	0.30	0.20	0.30	0.02	0.06
482-7	484-4	0.30	0.20	0.30	0.02	0.05
484-4	485-4	1.50	1.00	0.60	0.02	0.07
485-4	487-4	6.20	1.80	0.30	0.02	0.05
487-4	489-3	0.20	0.50	0.30	0.02	0.05
489-3	491-3	2.30	1.00	0.20	0.02	0.13
491-3	491-9	16.80	5.10	0.30	0.02	0.51
491-9	492-3	1.40	0.30	0.30	0.32	0.05
492-3	494-3	0.70	0.60	0.30	0.02	0.05
494-3	498-10	0.70	0.60	0.30	0.07	0.05
498-10	503-2	0.40	0.30	0.30	0.02	0.05

HOLE NO.-1

SAMPLE INTERVAL		%Pb	OZ.Ag	%Zn	%Cu	%Sb
488'-9"	490'-3"	2.40	0.80	0.10	0.02	0.32
490-3	496-0	2.40	1.00	0.10	0.02	0.16
496-0	498-7	0.20	0.15	0.10	0.02	0.04

DEFLECTION NO.-1

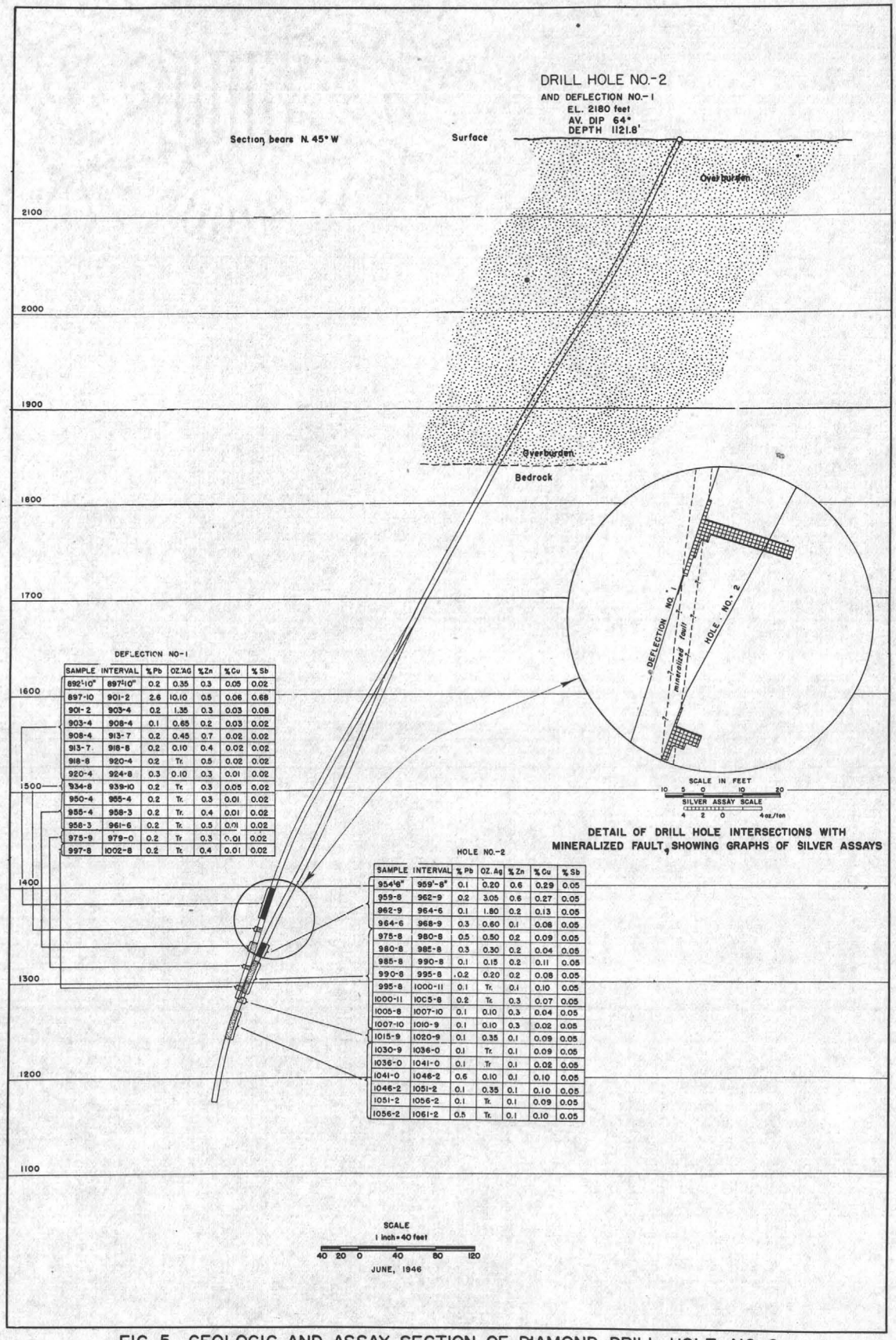
SAMPLE INTERVAL		%Pb	OZ.Ag	%Zn	%Cu	%Sb
481'-6"	486'-0"	0.10	0.45		0.02	0.05
486-0	486-6	1.60	0.80		0.02	0.07
486-6	487-6	0.80	0.40		0.02	0.05
487-6	488-8	0.20	0.20		0.02	0.05
488-8	490-0	0.40	0.30		0.02	0.05
490-0	491-0	0.40	0.20		0.02	0.05
491-0	492-0	6.40	2.45		0.02	0.35
492-0	492-9	2.50	0.90		0.02	0.17
492-9	493-3	3.50	0.35		0.02	0.08
493-3	493-9	1.50	0.90		0.05	0.12
493-9	494-3	1.80	1.35		0.05	0.20
494-3	495-3	0.30	0.50		0.02	0.09
495-3	497-11	0.70	0.45		0.02	0.05

SAMPLE INTERVAL		%Pb	OZ.Ag	%Zn	%Cu	%Sb
657'-6"	659'-2"	0.30	0.15		0.02	0.04
659-2	664'-2"	0.30	Nil		0.02	0.03

SAMPLE INTERVAL		%Pb	OZ.Ag	%Zn	%Cu	%Sb
1068'-2"	1073'-3"	0.20	0.30		0.02	0.03
1073-3	1078'-1	0.20	Nil		0.02	0.03
1088-1	1095-3	0.20	0.65		0.02	0.03
1095-3	1098-4	0.10	0.45		0.02	0.04
1152-0	1155-1	0.10	0.35		0.02	0.03

DETAIL OF DRILL HOLE INTERSECTIONS WITH MINERALIZED FAULT, SHOWING GRAPHS OF SILVER ASSAYS

FIG. 4 GEOLOGIC AND ASSAY SECTION OF DIAMOND DRILL HOLE NO. 1



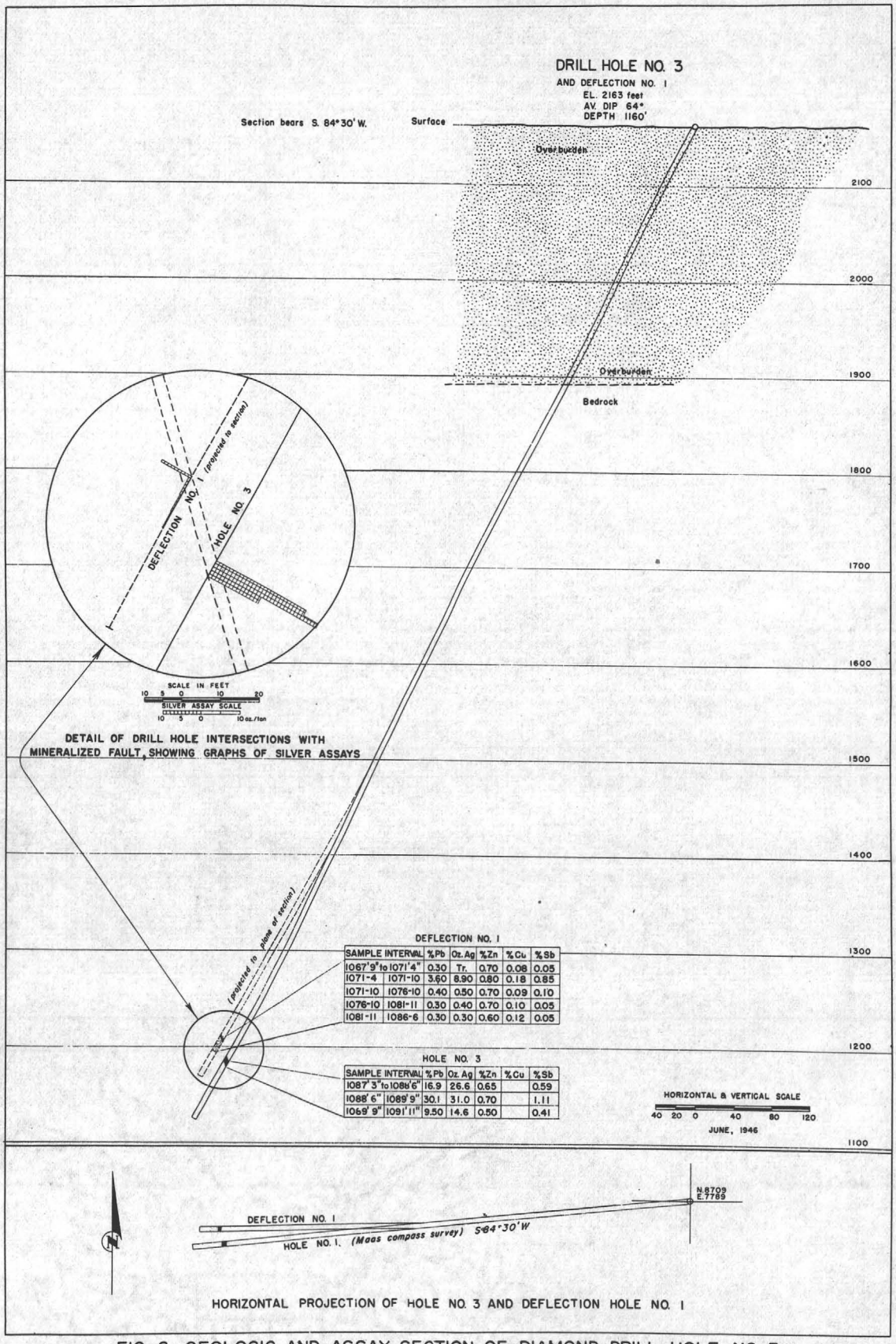
DEFLECTION NO-1

SAMPLE	INTERVAL	% Pb	OZ. AG	% Zn	% Cu	% Sb
892'-10"	897'-10"	0.2	0.35	0.3	0.05	0.02
897-10	901-2	2.6	10.10	0.5	0.06	0.68
901-2	903-4	0.2	1.35	0.3	0.03	0.08
903-4	908-4	0.1	0.65	0.2	0.03	0.02
908-4	913-7	0.2	0.45	0.7	0.02	0.02
913-7	918-8	0.2	0.10	0.4	0.02	0.02
918-8	920-4	0.2	Tr.	0.5	0.02	0.02
920-4	924-8	0.3	0.10	0.3	0.01	0.02
934-8	939-10	0.2	Tr.	0.3	0.05	0.02
950-4	955-4	0.2	Tr.	0.3	0.01	0.02
955-4	958-3	0.2	Tr.	0.4	0.01	0.02
958-3	961-6	0.2	Tr.	0.5	0.01	0.02
975-9	979-0	0.2	Tr	0.3	0.01	0.02
997-8	1002-8	0.2	Tr.	0.4	0.01	0.02

HOLE NO.-2

SAMPLE	INTERVAL	% Pb	OZ. Ag	% Zn	% Cu	% Sb
954'-8"	959'-8"	0.1	0.20	0.6	0.29	0.05
959-8	962-9	0.2	3.05	0.6	0.27	0.05
962-9	964-6	0.1	1.80	0.2	0.13	0.05
964-6	968-9	0.3	0.60	0.1	0.08	0.05
975-8	980-8	0.5	0.50	0.2	0.09	0.05
980-8	985-8	0.3	0.30	0.2	0.04	0.05
985-8	990-8	0.1	0.15	0.2	0.11	0.05
990-8	995-8	.0.2	0.20	0.2	0.08	0.05
995-8	1000-11	0.1	Tr.	0.1	0.10	0.05
1000-11	10C5-8	0.2	Tr.	0.3	0.07	0.05
1005-8	1007-10	0.1	0.10	0.3	0.04	0.05
1007-10	1010-9	0.1	0.10	0.3	0.02	0.05
1015-9	1020-9	0.1	0.35	0.1	0.09	0.05
1030-9	1036-0	0.1	Tr.	0.1	0.09	0.05
1036-0	1041-0	0.1	Tr	0.1	0.02	0.05
1041-0	1046-2	0.6	0.10	0.1	0.10	0.05
1046-2	1051-2	0.1	0.35	0.1	0.10	0.05
1051-2	1056-2	0.1	Tr.	0.1	0.09	0.05
1056-2	1061-2	0.5	Tr.	0.1	0.10	0.05

FIG. 5 GEOLOGIC AND ASSAY SECTION OF DIAMOND DRILL HOLE NO. 2



DEFLECTION NO. 1

SAMPLE INTERVAL		%Pb	Oz. Ag	%Zn	%Cu	%Sb
1067'9" to 1071'4"		0.30	Tr.	0.70	0.08	0.05
1071-4	1071-10	3.60	8.90	0.80	0.18	0.85
1071-10	1076-10	0.40	0.50	0.70	0.09	0.10
1076-10	1081-11	0.30	0.40	0.70	0.10	0.05
1081-11	1086-6	0.30	0.30	0.60	0.12	0.05

HOLE NO. 3

SAMPLE INTERVAL		%Pb	Oz. Ag	%Zn	%Cu	%Sb
1087' 3" to 1088'6"		16.9	26.6	0.65		0.59
1088' 6"	1089' 9"	30.1	31.0	0.70		1.11
1069' 9"	1091' 11"	9.50	14.6	0.50		0.41

FIG. 6 GEOLOGIC AND ASSAY SECTION OF DIAMOND DRILL HOLE NO. 3