Bureau of Mines
Report of Investigations 4556

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MINING DIVISION

INVESTIGATION OF THE YOUNG AMERICA LEAD-ZINC DEPOSIT, STEVENS COUNTY, WASH.

BY ROBERT J. HUNDHAUSEN

United States Department of the Interior — November 1949

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* * * * * * * * * **Report of Investigations 4556**

A Century of Conservation

1849 1949

UNITED STATES DEPARTMENT OF THE INTERIOR
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James Boyd, Director

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November 1949

INVESTIGATION OF THE YOUNG AMERICA LEAD-ZINC DEPOSIT STEVENS COUNTY, WASH.

by

Robert J. Hundhausen[1]

CONTENTS

ILLUSTRATIONS

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

Report of Investigations 4556

ILLUSTRATIONS (Cont'd.)

INTRODUCTION AND SUMMARY

The Young America lead-silver-zinc mine in Stevens County, Wash., was investigated by the Bureau of Mines during parts of 1946, 1947, and 1948. Results of the investigation are described herein.

The mine is 1/4 mile northeast of Bossburg, Wash., the nearest railway station. An excellent paved highway (No. 22) connects Bossburg with Colville, Wash., 23 miles to the south.

The property was located in October 1885. It is credited with a production of 2,178 tons of shipping ore since 1901. The shipping ore averaged 7 percent lead, 7.7 percent zinc, and 16.1 ounces silver per ton. The property is under lease and option to Walter E. Morris and Perry Leighton of Colville, Wash.

The deposit crops out on a steep limestone bluff overlooking the Columbia River. The country rock is a highly metamorphosed, brecciated, marbleized limestone (Northport formation).

Two ore types have been recognized; for convenience these types will be referred to as "mine" ore and "dolomitic" ore. All past production has been obtained from the "mine" ore; it occurs as stringers and lenses of sphalerite, galena, and geocronite along an irregular, gently dipping zone of shearing. The "mine" ore has been developed along its strike for a distance of 300 feet and up its dip for a distance of 200 feet. It ranges in width from a few inches up to 10 feet. The "mine" ore contains small amounts of tin.

The "dolomitic" ore consists of sphalerite and galena disseminated along the foot wall and hangingwall contacts of an irregular zone of silicified, brecciated, weakly mineralized, dolomitic limestone. This zone is 30 feet to 150 feet thick; it dips gently to the southeast and trends N. 30° E. The "dolomitic" ore structure has been traced by outcrop indications and by Bureau of Mines diamond drilling for 900 feet along the strike.

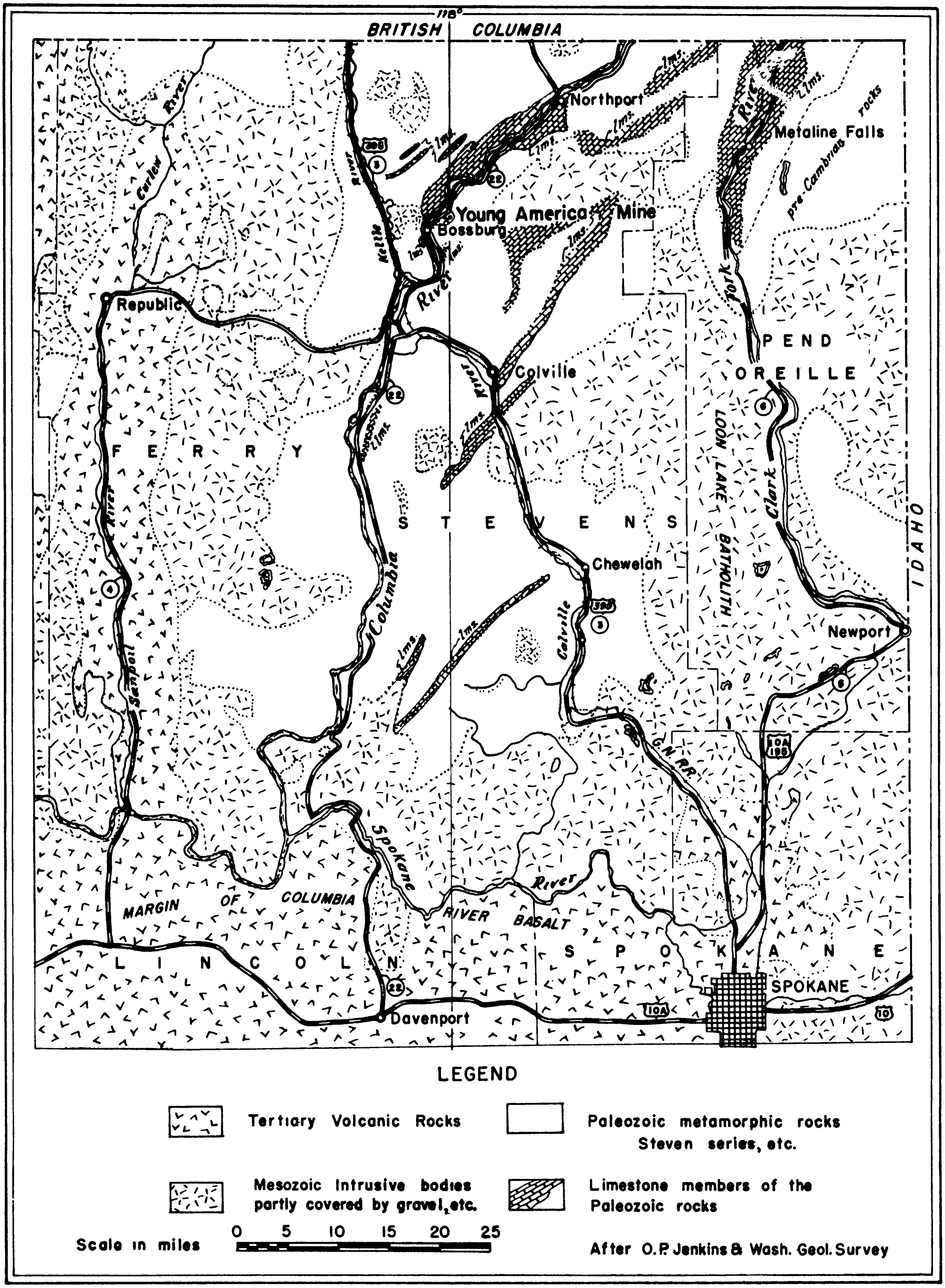

Figure I. - Location and general geology map, Young America mine.

In the course of the Bureau's investigation, topographic and geologic maps of the property were made; 15 diamond-drill holes whose aggregate length was 4,590 feet were completed, and microscopic, spectrographic, X-ray, and metallurgical tests were performed on the ore. The sulfide ore is amenable to selective lead-zinc flotation. A 30-ton flotation mill is on the property.

ACKNOWLEDGMENTS

The project was under the general supervision of S. H. Lorain.[2] The project field work was started in May 1946 under the direct supervision of S. W. Zoldok;[3] it was continued to December 1946, when the work was recessed for the winter. The project was resumed under the direct supervision of M. Mihelich[3] in April 1947 and continued to May 1947, when it was recessed for lack of funds. The writer completed the field investigations during the period April to July 1948.

Samples were submitted to the Bureau's Northwest Electrodevelopment Laboratory at Albany, Oreg., where M. Wright[4] supervised chemical analyses, R. N. Spencer[5] supervised ore-dressing tests, and A. J. Kauffman[6] performed petrographic studies on the ore.

The lessees of the mine, Walter E. Morris and Perry Leighton, of Colville, Wash., rendered valuable assistance and provided useful information.

LOCATION AND ACCESSIBILITY

The Young America mine is in sec. 28, T. 38 N., R. 38 E., on a bluff overlooking the Columbia River (now Roosevelt Lake). The mine is 1/4 mile northeast of the small town of Bossburg, Wash. Bossburg is a station on the Great Northern branch line which extends from Spokane, Wash. to Nelson, B. C. The town and mine are 110 miles by rail north of Spokane. An excellent paved State highway (No. 22) passes through Bossburg. A graveled road 1/4 mile long leads from the highway to the mine. Colville, Wash., the county seat, is 23 miles south of the mine via Highway 22 (fig. 1).

A 30-ton flotation mill is situated just below the mine. The ore is trucked from the mine to the mill. Zinc concentrates from the mill are shipped by rail to the Sullivan zinc plant at Kellogg, Idaho. The freight rate is $5.90 per ton. Lead concentrates are trucked to the Bunker Hill smelter at Kellogg. The trucking rate is $9 per ton.

Power for the mine and mill is furnished by the Washington Power Co. The mill water supply is obtained from the Columbia River, a few hundred feet from the mill.

2/ Chief, Albany Branch, Mining Division, Bureau of Mines.
3/ Mining engineer, Albany Branch, Mining Division, Bureau of Mines.
4/ Chemist, Albany Branch, Metallurgical Division, Bureau of Mines.
5/ Metallurgist, Albany Branch, Metallurgical Division, Bureau of Mines.
6/ Petrographer, Albany Branch, Metallurgical Division, Bureau of Mines.

HISTORY AND PRODUCTION

The Young America mine was located in October 1885. It is said to be the second oldest discovery in the Colville district; the Old Dominion mine is the oldest.

No information concerning production before 1901 is available. Much of the early mine development and stoping were done haphazardly by various lessees whose records are lost.

Measurement of the workings indicates that approximately 7,000 tons of rock have been removed from the mine. More than half of this tonnage remains on the dumps. Table 1 shows the metal production since 1901 as recorded by the Bureau of Mines. The table was compiled under the direction of C. E. Needham.7/

PROPERTY AND OWNERSHIP

Four lode-mining claims comprise the property. These are the Comet Silver, Mt. Vernon, Potomac, and Silver Star claims. They are not patented. The Cuprite Mining Co., of Yakima, Wash., owns the property. It is under lease and option to Walter E. Morris and Perry Leighton of Colville, Wash.

PHYSICAL FEATURES AND CLIMATE

The deposit crops out on the face of a precipitous limestone bluff overlooking the valley of the Columbia River. The deposit is at an altitude of 2,200 feet, 500 feet higher than the river.

The region has been subjected to long-continued erosion, both fluviatile and glacial. The principal rivers, consequently, are deeply entrenched in a series of parallel north-south trending valleys. The intervening mountains have been rounded and subdued by glaciation of the Continental ice sheet. Many of the main valleys and older tributaries are filled deeply with glacial debris.

A remnant of a prominent lateral moraine occupies a bend in the valley immediately south of the Young America mine. Also, large granite boulders (glacial erratics) are found on the limestone bluffs immediately above the mine area, 700 feet above the present river level.

The limestone bluffs generally are barren of soil; glacial striae may be observed in places. Mining timber is absent from the property, but elsewhere in the area it is plentiful. The lower gravel terraces generally are brush-covered.

7/ Supervising engineer, Metal Economics Division, Bureau of Mines, Salt Lake City, Utah.

TABLE 1. - Metal production of the Young America mine, Stevens County, Wash., 1901-1947, in terms of recovered metals

Year	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
1901-1904..........	-	-	-	-	-	-
1905..............	150	-	3,311	-	21,176	-
1906-1912..........	-	-	-	-	-	-
1913..............	8	1	402		6,000	-
1914-1916..........	-	-	-	-	-	-
1917..............	78	-	-	-	-	18,852
1918-1921..........	-	-	-	-	-	-
1922..............	25	1	1,561	-	13,607	-
1923..............	153	6	6,036	-	49,157	-
1924..............	19	1	917	-	8,390	-
1925-1927..........	-	-	-	-	-	-
1928..............	17	1	1,233	-	10,539	-
1929-1934..........	-	-	-	-	-	-
1935..............	4	-	12	-	111	-
1936..............	5	-	541	-	5,500	-
1937..............	-	-	-	-	-	-
1938..............	13	-	210	-	4,009	-
1939-1940..........	-	-	-	-	-	-
1941..............	70	-	347	400	2,650	8,600
1942-1944..........	-	-	-	-	-	-
1945..............	380	3	3,386	578	29,444	21,830
1946..............	359	6	6,375	850	56,200	80,000
1947..............	897	13	10,831	1,725	99,738	209,200
Total..........	2,178	32	35,162	3,553	306,521	338,482
Average/ton....		0.015	16.1	1.63	140.5	155.0

The climate of the area surrounding Colville, Wash., is characterized by an annual average of 164 clear days. Summers are pleasantly warm - temperature average 68.1° in July; winters are not extremely cold, but snow accumulates on the nearby mountains to a depth of 3 feet or more. At the mine, snow seldom accumulates to more than 1 foot. January temperature at Colville averages 22°.

MINE WORKINGS

The main (hanging wall) ore zone is developed along its strike for a maximum distance of 300 feet and up its dip for a distance of 200 feet. The stopebacks are supported by an occasional rock pillar of low-grade vein material. The No. 2 or main adit level (altitude 2,200 feet) has served as the principal haulageway for the removal of ore; it is 250 feet long. An underlying semi-parallel foot-wall vein 25 feet below the main ore zone has been stoped from the No. 4 level. This stope has a strike length of 100 feet and a dip length of 60 feet. Other adits, such as the Nos. 1, 3, 5, and 6, have been driven into the limestone bluff in an effort to find additional ore shoots, but little or no one has been found in them.

DESCRIPTION OF THE DEPOSIT

General Geology

Bancroft,[8] Weaver,[9] Patty,[10] and Jenkins[11] have reported on various features of the geology of Stevens County. The following summary is based upon their reports and upon evidence obtained during the Bureau's investigation.

The oldest rocks in Stevens County are Paleozoic metamorphic rocks such as quartzite, argillite, phyllite, schist, dolomite, and marbleized limestone. These formations, known as the Stevens series, have been intruded by the Loon Lake granitic batholith of Mesozoic age. This intrusion was accompanied, or followed, by deformation, metamorphism, and ore deposition within the Stevens series. Later, in the Tertiary age, widespread basic igneous activity took place. The result is a maze of basic dikes and sills that transect the entire series. Most of the basic intrusions are post-ore, but some antedate ore bodies of Tertiary age; for example, the gold ores of Republic, Wash.

The structural setting of the Stevens series is complicated. Generally, the formations trend northeast in pitching anticlinal and synclinal folds,

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8/ Bancroft, Howland, The Ore Deposits of Northeastern Washington: U. S. Geol. Surv. Bull. 550, 1914.

9/ Weaver, C. E., the Mineral Resources of Stevens County, Wash.: Wash. Geol. Survey Bull. 20, 1920.

10/ Patty, E. N., The Metal Mines of Washington: Wash. Geol. Survey Bull. 23, 1921.

11/ Jenkins, O. P., Lead Deposits of Pend Oreille and Stevens Counties, Wash.: Wash. Dept. Cons. Develop., Div. Geol., Bull. 31, 1924.

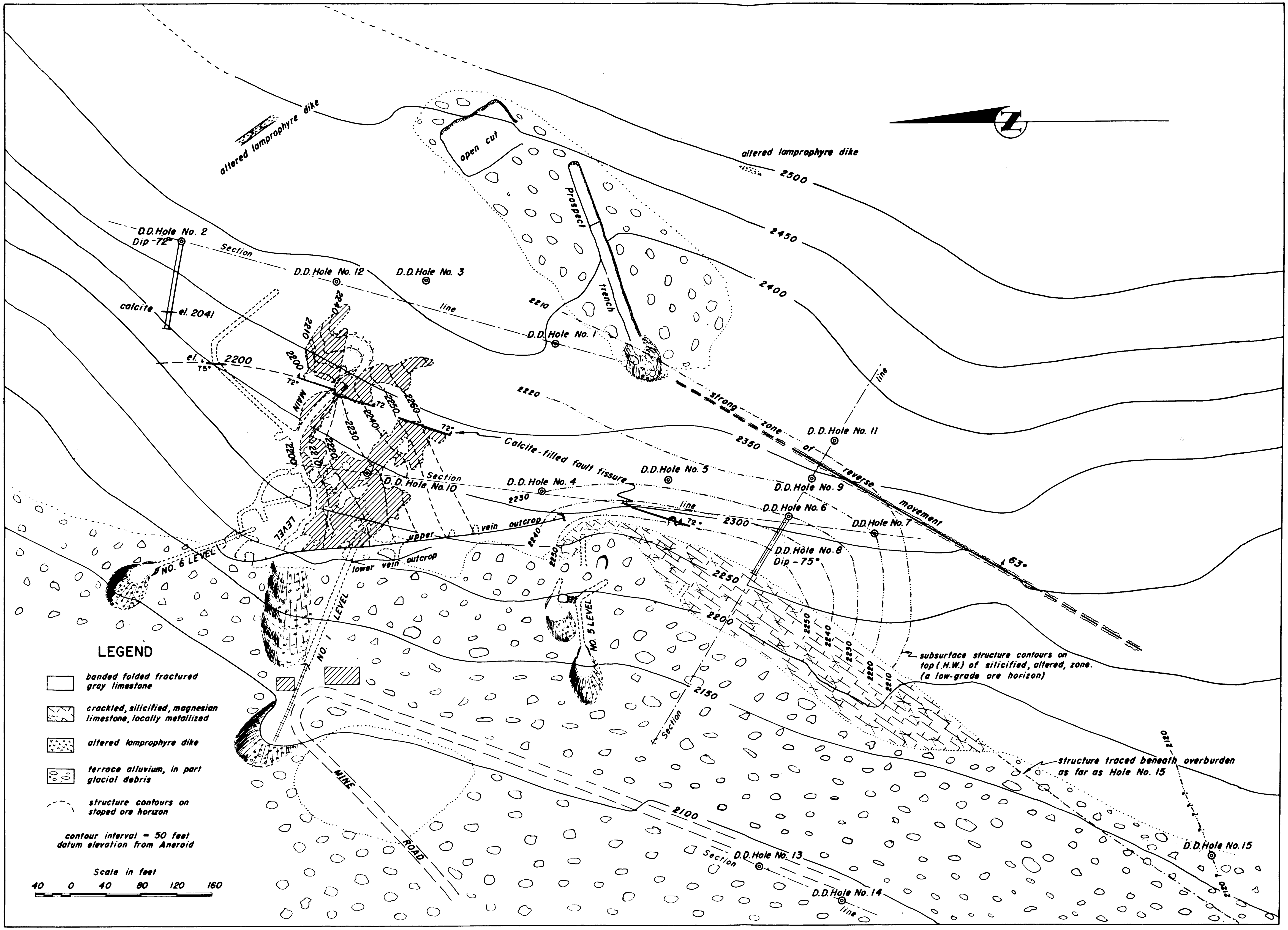


Figure 2. - Plan showing Young America mine and Bureau of Mines drill holes.

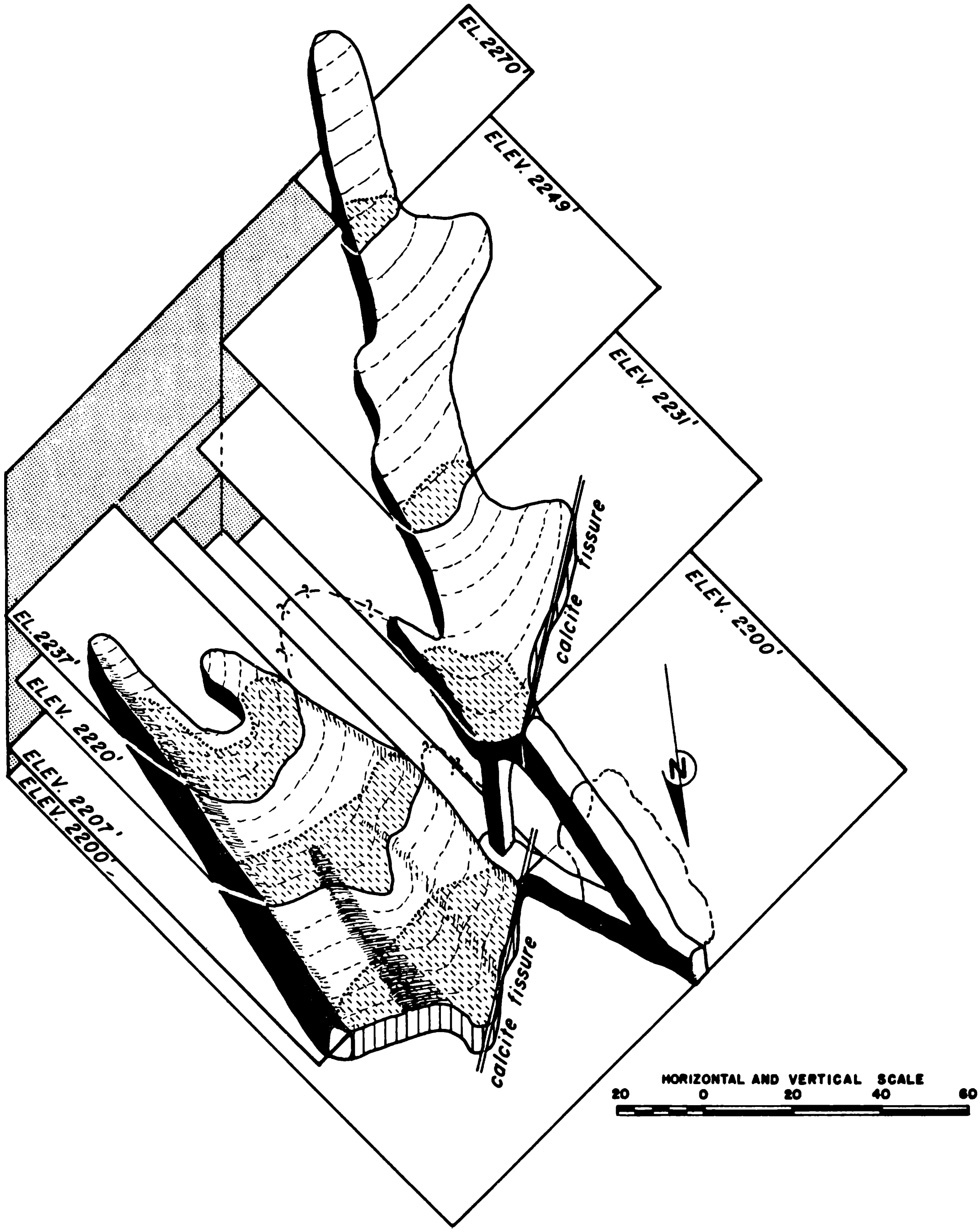


Figure 3. - Diagram showing two ore shoots, Young America mine.

many of which are overturned. The axis of the Loon Lake granitic intrusion trends north-south, discordantly cutting the sedimentary formations. Several elongate lobes of the intrusive, however, extend outward along bedding trends (fig. 1).

Major north-south fault structures are reflected and evidenced in the drainage systems of the San Poil, Kettle, Colville, Columbia, and Clark Fork Rivers. Strong, interlinking, secondary faults trend northeast, paralleling the axial planes of the folded rocks. Cross faults prevailingly trend northwest.

The Deposit

General Structure

The Young America lead-zinc deposit is in dolomitic limestone mapped by Weaver[12] as the Northport limestone. This limestone ordinarily is white, finely crystalline, and massive. It ranges in color from white to blue to gray to black. It may be banded or variegated. In the mine area, the limestone is highly metamorphosed, brecciated, and sheared.

The Northport limestone crops out on both sides of the Columbia River in a belt from Bossburg to Northport; it is exposed in isolated masses or hills. Deep glacial valley filling obscures structural relations between the rock outcrops. The writer believes, from evidence seen in aerial photographs as well as data obtained at the Young America mine, that this limestone belt is a complexly deformed graben, or faulted, crumpled geosyncline, several miles wide, bounded on each side by strong faults more or less parallel to the general course of the Columbia River.

The structure of the limestone ridge at the Young America mine is not known definitely, but the next limestone ridge immediately to the southeast is a tightly folded syncline. The axis of this syncline trends northeast. The axial plane dips steeply (60°) southeast. The limbs are highly contorted and closely appressed.

Faults

In the mine, minor folds pitch and trend northeast. The principal faults trend northeast, also, and dip steeply, usually southeast. This fault system apparently was developed contemporaneously with the folding; the fractures usually parallel axial planes. Fractures belonging to this fault system are both pre-ore and post-ore. A filled fault-fissure (known locally as the "calcite dike") belonging to this system displaces the ore body. The "calcite dike" strikes N. 20° E. and dips 72° southeast. The throw differs from place to place. In most places the east side is down a few feet; lateral movement, accompanied by drag folding is suggested in the displacement (fig. 2 and fig. 3). Drag ore breccia, cemented by calcite, was noted in this fault-fissure and in a similar fissure in drill hole 11.

12/ Work cited footnote 9.

Another fault zone nearly parallel to the "calcite dike" and 150 feet east of it strikes N. 35° E. and dips 65° southeasterly. A reverse movement was indicated by the slippage planes seen in the drill core. The total displacement along the fault is not known. The surface expression of this fault causes an abrupt flattening of the steep side-hill slope and a prominent depression. This fault appears to have been a factor in localizing the "dolomitic" ore. The altered dolomitic beds have been drag folded by movement along the fault. The trough of the drag fold may be the locus of the best "ore."

Numerous small joints and fractures belonging to the northeast fault system often cut the massive sulfide ore. The ore usually will break to these cleavage fractures rather than to an irregular surface. Minor crenulations in the ore suggest that mineralization was controlled partly by this system of northeast fractures.

Cross faults have northwest strikes. Rock breccia cemented by silica is developed most often on the cross faults. Fault intersections especially are shattered and brecciated. The ore shoots in the mine are elongated up and down the dip in a northwest direction, partly through the influence of the northwest cross faults.

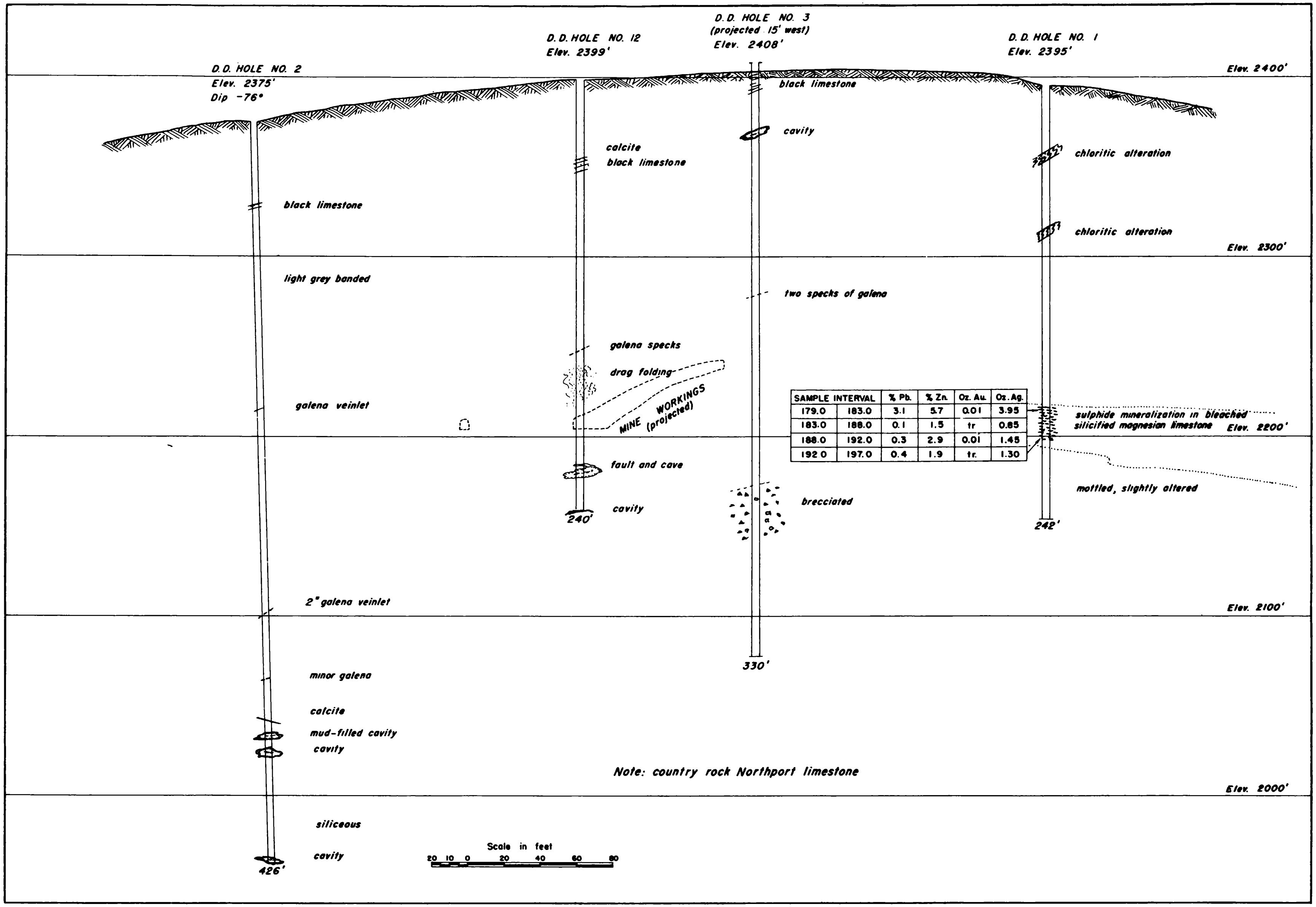
Ore shoots

"Mine ore." - The ore shoots in the mine consist of replacement stringers, veins, and lenses along an irregular, gently dipping zone of movement. The ore is not confined within sharply defined walls. In some places the zone consists of a series of narrow bands of ore separated by unreplaced limestone. It ranges in width from a thin stringer to a massive lens nearly 5 feet thick.

The numerous flexures within the ore horizon are shown by the structure contours in figure 2. In the steeper parts of the vein the ore tends to pinch; in the flatter parts the ore generally is thicker. Small lenses of ore often exhibit a wavy modified "S" shape in sectional view. Furthermore, a sectional view of the mine workings exhibits the same "S"-shaped fracture pattern. The flexures creating ore shoots become more curvaceous and complex toward the northeast end of the mine.

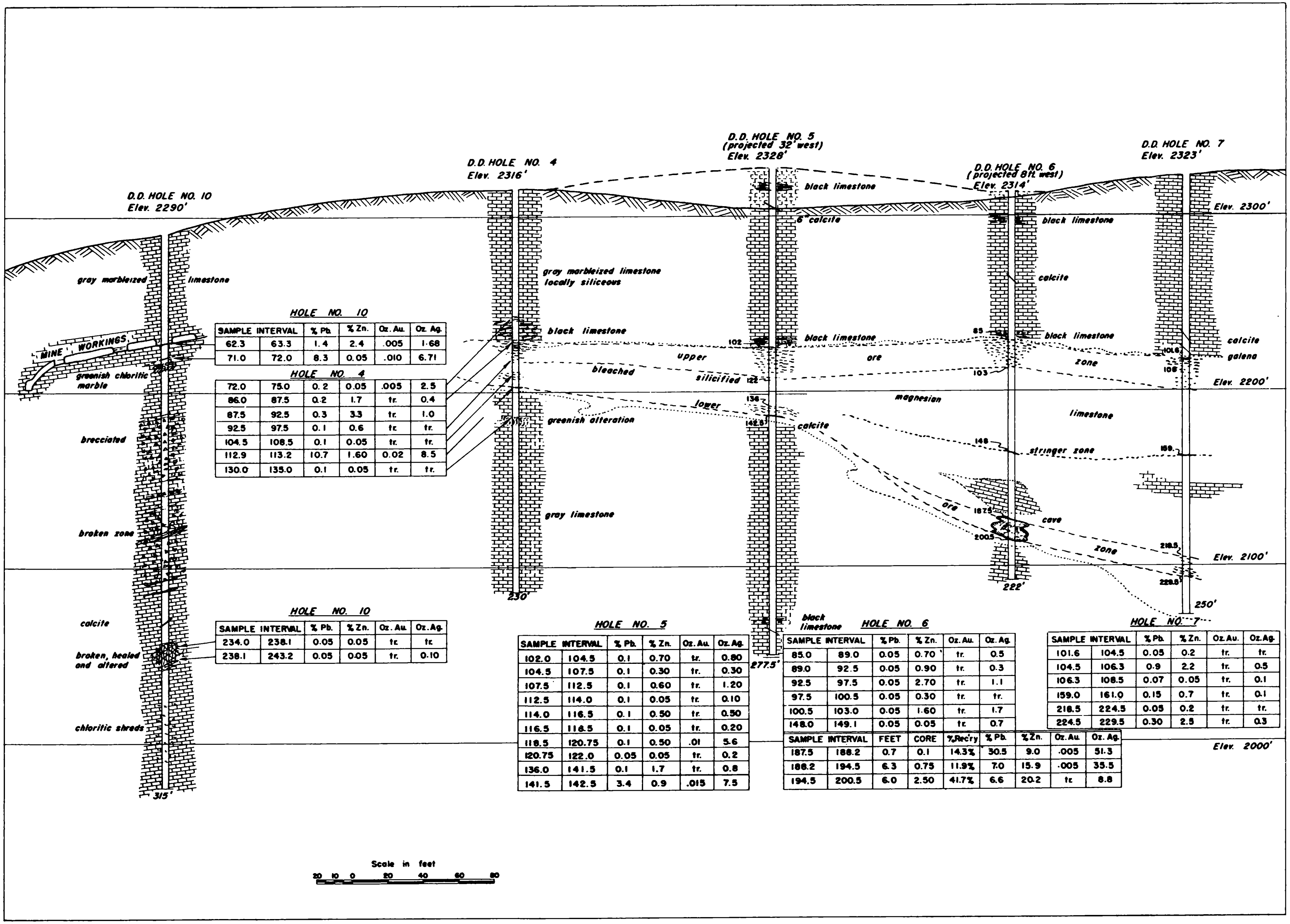
At least 3 distinct ore shoots have been mined from the No. 2 level. Two of these are shown in figure 3. The ore shoots narrow and finally pinch out when followed up the dip. Locally, the ore may narrow or widen abruptly in the vicinity of minor faults.

Another lens of ore, 25 feet vertically below the hangingwall ore zone, has been mined from the No. 4 level. Apparently this is a branch fracture diverging from the main fracture zone. Both fractures converge up the dip and pinch out. Down the dip the ore fractures diverge; finally, both bend abruptly downward and pinch down to thin stringers.



SAMPLE INTERVAL		% Pb.	% Zn.	Oz. Au.	Oz. Ag.
179.0	183.0	3.1	5.7	0.01	3.95
183.0	188.0	0.1	1.5	tr	0.85
188.0	192.0	0.3	2.9	0.01	1.45
192.0	197.0	0.4	1.9	tr.	1.30

Figure 4. - Geologic and assay section of diamond drill holes 1, 2, 3, and 12.



HOLE NO. 10

SAMPLE INTERVAL		% Pb.	% Zn.	Oz. Au.	Oz. Ag.
62.3	63.3	1.4	2.4	.005	1.68
71.0	72.0	8.3	0.05	.010	6.71

HOLE NO. 4

72.0	75.0	0.2	0.05	.005	2.5
86.0	87.5	0.2	1.7	tr.	0.4
87.5	92.5	0.3	3.3	tr.	1.0
92.5	97.5	0.1	0.6	tr.	tr.
104.5	108.5	0.1	0.05	tr.	tr.
112.9	113.2	10.7	1.60	0.02	8.5
130.0	135.0	0.1	0.05	tr.	tr.

HOLE NO. 10

SAMPLE INTERVAL		% Pb.	% Zn.	Oz. Au.	Oz. Ag.
234.0	238.1	0.05	0.05	tr.	tr.
238.1	243.2	0.05	0.05	tr.	0.10

HOLE NO. 5

SAMPLE INTERVAL		% Pb.	% Zn.	Oz. Au.	Oz. Ag.
102.0	104.5	0.1	0.70	tr.	0.80
104.5	107.5	0.1	0.30	tr.	0.30
107.5	112.5	0.1	0.60	tr.	1.20
112.5	114.0	0.1	0.05	tr.	0.10
114.0	116.5	0.1	0.50	tr.	0.50
116.5	118.5	0.1	0.05	tr.	0.20
118.5	120.75	0.1	0.50	.01	5.6
120.75	122.0	0.05	0.05	tr.	0.2
136.0	141.5	0.1	1.7	tr.	0.8
141.5	142.5	3.4	0.9	.015	7.5

HOLE NO. 6

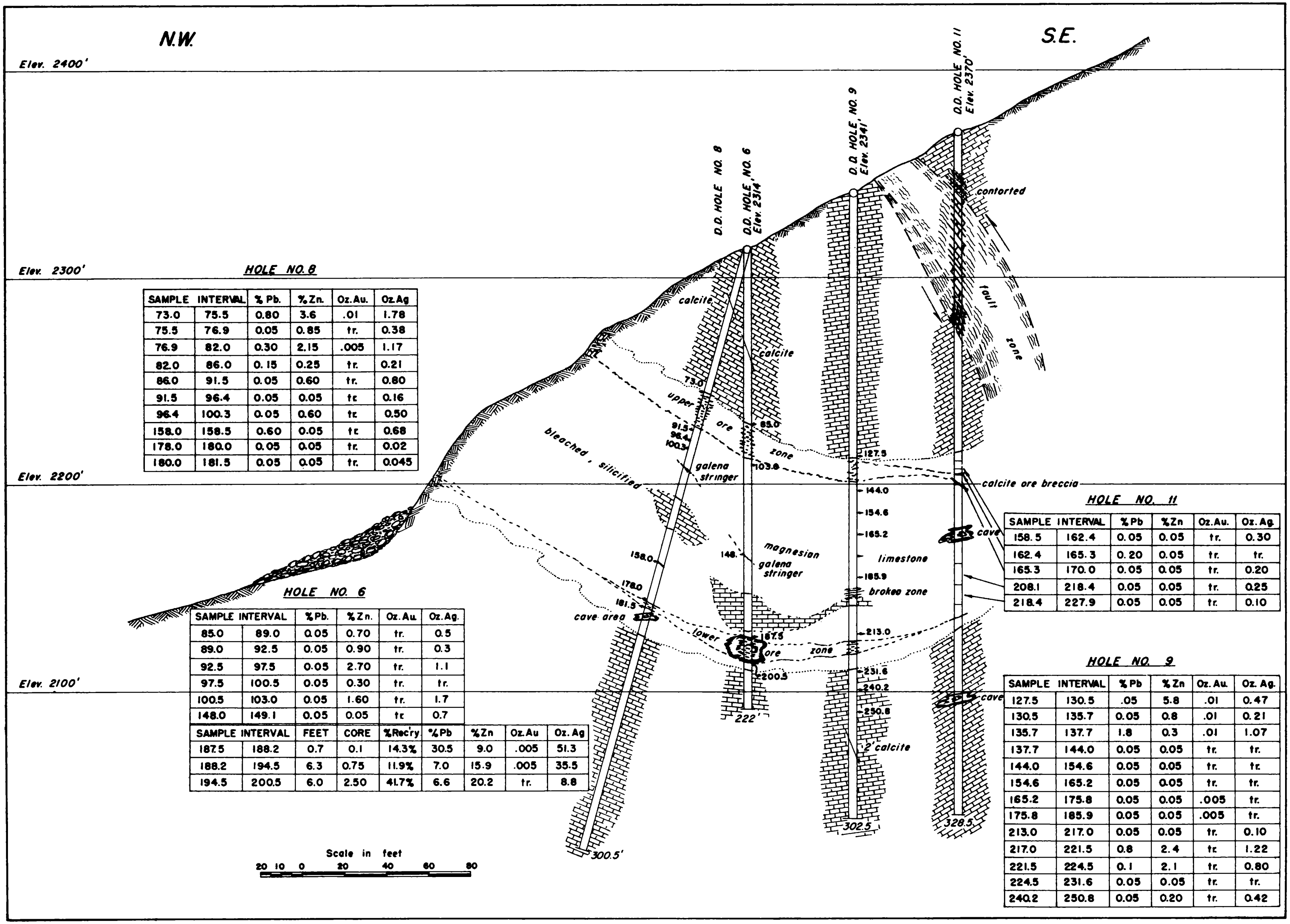
SAMPLE INTERVAL		% Pb.	% Zn.	Oz. Au.	Oz. Ag.
85.0	89.0	0.05	0.70	tr.	0.5
89.0	92.5	0.05	0.90	tr.	0.3
92.5	97.5	0.05	2.70	tr.	1.1
97.5	100.5	0.05	0.30	tr.	tr.
100.5	103.0	0.05	1.60	tr.	1.7
148.0	149.1	0.05	0.05	tr.	0.7

SAMPLE INTERVAL		FEET	CORE	% Rec'ry	% Pb.	% Zn.	Oz. Au.	Oz. Ag.
187.5	188.2	0.7	0.1	14.3%	30.5	9.0	.005	51.3
188.2	194.5	6.3	0.75	11.9%	7.0	15.9	.005	35.5
194.5	200.5	6.0	2.50	41.7%	6.6	20.2	tr.	8.8

HOLE NO. 7

SAMPLE INTERVAL		% Pb.	% Zn.	Oz. Au.	Oz. Ag.
101.6	104.5	0.05	0.2	tr.	tr.
104.5	106.3	0.9	2.2	tr.	0.5
106.3	108.5	0.07	0.05	tr.	0.1
159.0	161.0	0.15	0.7	tr.	0.1
218.5	224.5	0.05	0.2	tr.	tr.
224.5	229.5	0.30	2.5	tr.	0.3

Figure 5. - Geologic and assay section of diamond drill holes 10, 4, 5, 6, and 7.



HOLE NO. 8

SAMPLE	INTERVAL	% Pb.	% Zn.	Oz. Au.	Oz. Ag
73.0	75.5	0.80	3.6	.01	1.78
75.5	76.9	0.05	0.85	tr.	0.38
76.9	82.0	0.30	2.15	.005	1.17
82.0	86.0	0.15	0.25	tr.	0.21
86.0	91.5	0.05	0.60	tr.	0.80
91.5	96.4	0.05	0.05	tr.	0.16
96.4	100.3	0.05	0.60	tr.	0.50
158.0	158.5	0.60	0.05	tr.	0.68
178.0	180.0	0.05	0.05	tr.	0.02
180.0	181.5	0.05	0.05	tr.	0.045

HOLE NO. 6

SAMPLE	INTERVAL	% Pb.	% Zn.	Oz. Au.	Oz. Ag.
85.0	89.0	0.05	0.70	tr.	0.5
89.0	92.5	0.05	0.90	tr.	0.3
92.5	97.5	0.05	2.70	tr.	1.1
97.5	100.5	0.05	0.30	tr.	tr.
100.5	103.0	0.05	1.60	tr.	1.7
148.0	149.1	0.05	0.05	tr.	0.7

SAMPLE	INTERVAL	FEET	CORE	% Rec'ry	% Pb	% Zn	Oz. Au	Oz. Ag
187.5	188.2	0.7	0.1	14.3%	30.5	9.0	.005	51.3
188.2	194.5	6.3	0.75	11.9%	7.0	15.9	.005	35.5
194.5	200.5	6.0	2.50	41.7%	6.6	20.2	tr.	8.8

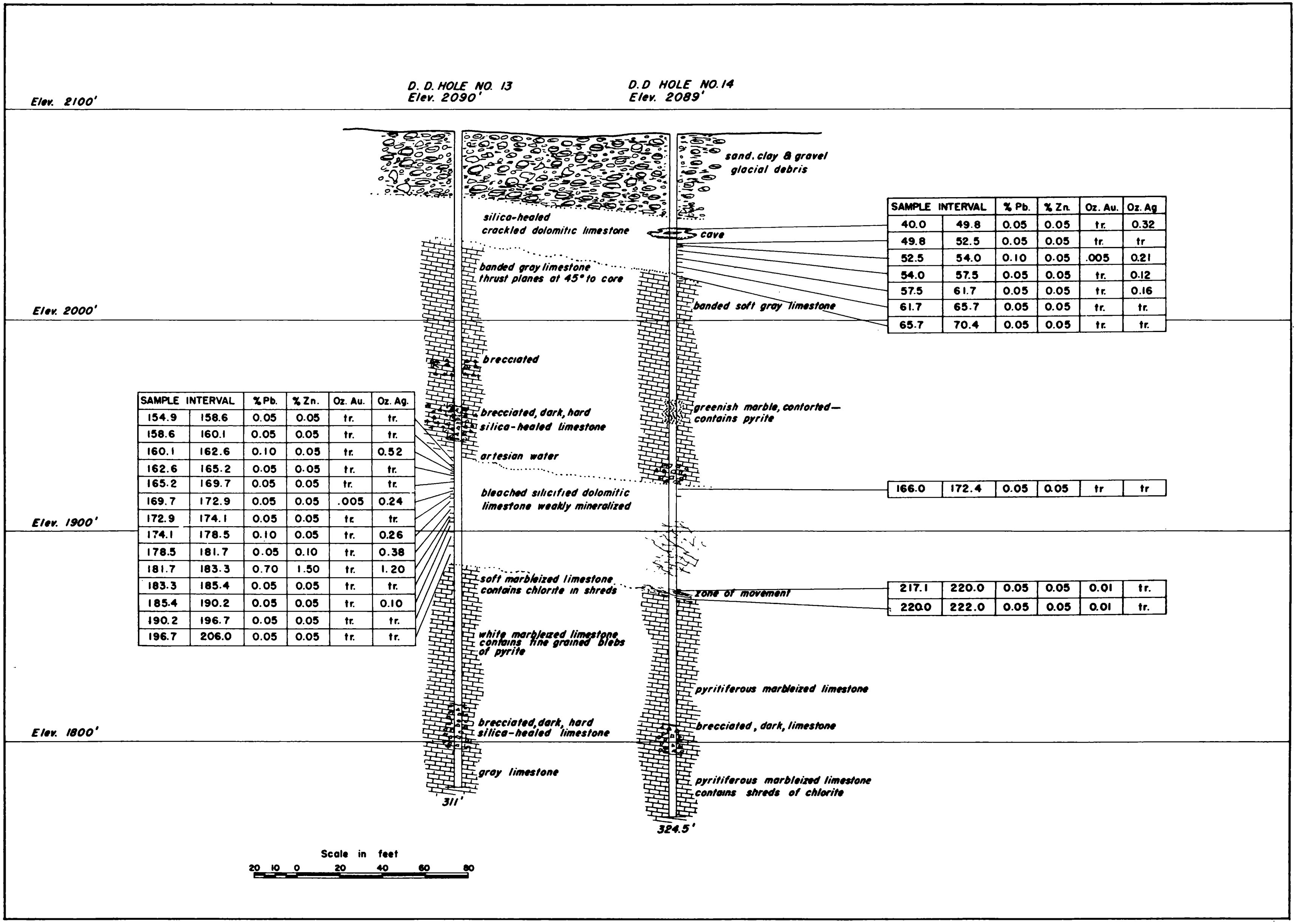
HOLE NO. 11

SAMPLE	INTERVAL	% Pb	% Zn	Oz. Au.	Oz. Ag.
158.5	162.4	0.05	0.05	tr.	0.30
162.4	165.3	0.20	0.05	tr.	tr.
165.3	170.0	0.05	0.05	tr.	0.20
208.1	218.4	0.05	0.05	tr.	0.25
218.4	227.9	0.05	0.05	tr.	0.10

HOLE NO. 9

SAMPLE	INTERVAL	% Pb	% Zn	Oz. Au.	Oz. Ag.
127.5	130.5	.05	5.8	.01	0.47
130.5	135.7	0.05	0.8	.01	0.21
135.7	137.7	1.8	0.3	.01	1.07
137.7	144.0	0.05	0.05	tr.	tr.
144.0	154.6	0.05	0.05	tr.	tr.
154.6	165.2	0.05	0.05	tr.	tr.
165.2	175.8	0.05	0.05	.005	tr.
175.8	185.9	0.05	0.05	.005	tr.
213.0	217.0	0.05	0.05	tr.	0.10
217.0	221.5	0.8	2.4	tr.	1.22
221.5	224.5	0.1	2.1	tr.	0.80
224.5	231.6	0.05	0.05	tr.	tr.
240.2	250.8	0.05	0.20	tr.	0.42

Figure 6. - Geologic and assay section of diamond drill holes 6, 8, 9, and 11.



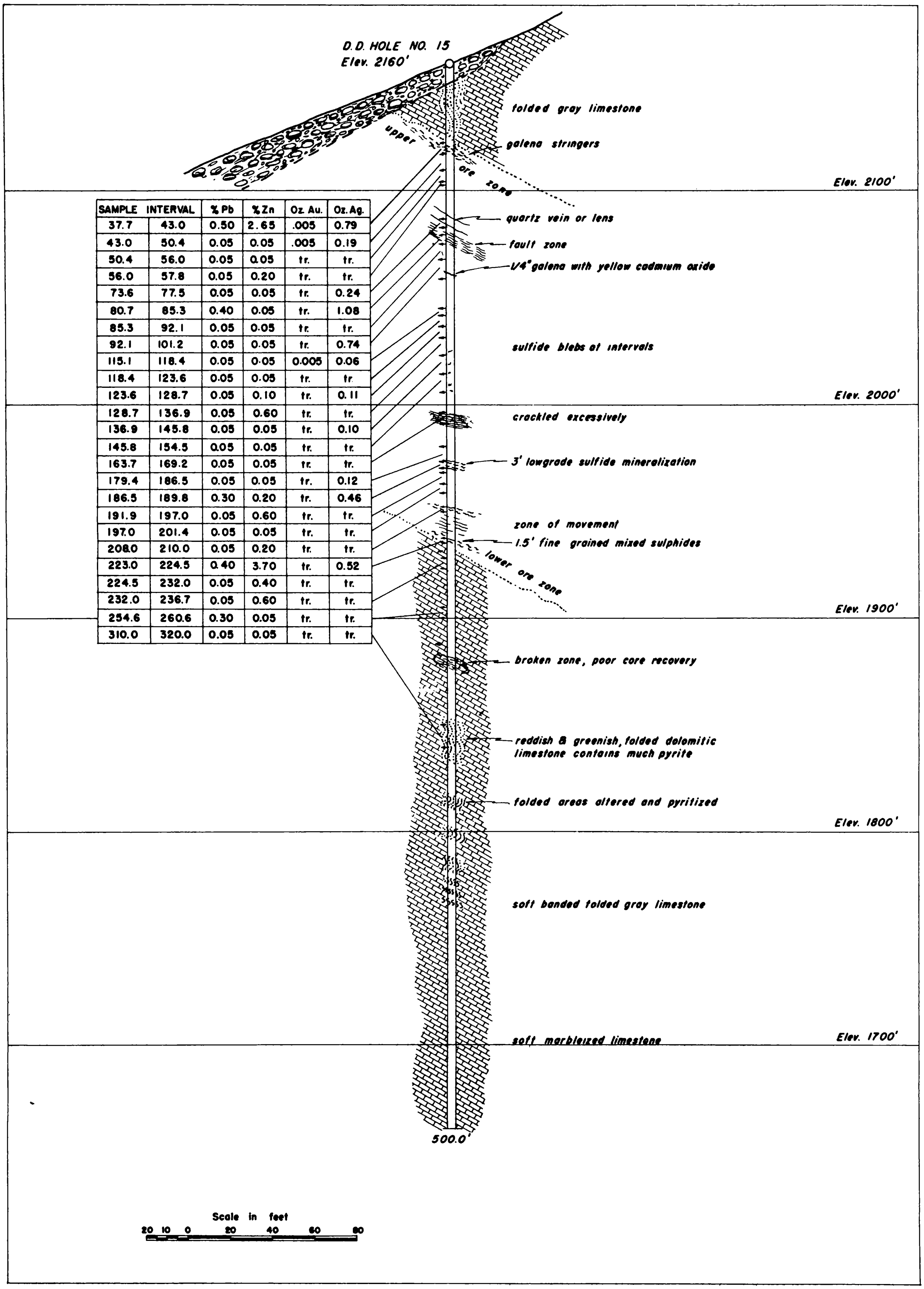
SAMPLE	INTERVAL	% Pb.	% Zn.	Oz. Au.	Oz. Ag.
154.9	158.6	0.05	0.05	tr.	tr.
158.6	160.1	0.05	0.05	tr.	tr.
160.1	162.6	0.10	0.05	tr.	0.52
162.6	165.2	0.05	0.05	tr.	tr.
165.2	169.7	0.05	0.05	tr.	tr.
169.7	172.9	0.05	0.05	.005	0.24
172.9	174.1	0.05	0.05	tr.	tr.
174.1	178.5	0.10	0.05	tr.	0.26
178.5	181.7	0.05	0.10	tr.	0.38
181.7	183.3	0.70	1.50	tr.	1.20
183.3	185.4	0.05	0.05	tr.	tr.
185.4	190.2	0.05	0.05	tr.	0.10
190.2	196.7	0.05	0.05	tr.	tr.
196.7	206.0	0.05	0.05	tr.	tr.

SAMPLE	INTERVAL	% Pb.	% Zn.	Oz. Au.	Oz. Ag.
40.0	49.8	0.05	0.05	tr.	0.32
49.8	52.5	0.05	0.05	tr.	tr
52.5	54.0	0.10	0.05	.005	0.21
54.0	57.5	0.05	0.05	tr.	0.12
57.5	61.7	0.05	0.05	tr.	0.16
61.7	65.7	0.05	0.05	tr.	tr.
65.7	70.4	0.05	0.05	tr.	tr.

166.0	172.4	0.05	0.05	tr	tr

217.1	220.0	0.05	0.05	0.01	tr.
220.0	222.0	0.05	0.05	0.01	tr.

Figure 7. - Geologic and assay section of diamond drill holes 13 and 14.



SAMPLE	INTERVAL	% Pb	% Zn	Oz. Au.	Oz. Ag.
37.7	43.0	0.50	2.65	.005	0.79
43.0	50.4	0.05	0.05	.005	0.19
50.4	56.0	0.05	0.05	tr.	tr.
56.0	57.8	0.05	0.20	tr.	tr.
73.6	77.5	0.05	0.05	tr.	0.24
80.7	85.3	0.40	0.05	tr.	1.08
85.3	92.1	0.05	0.05	tr.	tr.
92.1	101.2	0.05	0.05	tr.	0.74
115.1	118.4	0.05	0.05	0.005	0.06
118.4	123.6	0.05	0.05	tr.	tr.
123.6	128.7	0.05	0.10	tr.	0.11
128.7	136.9	0.05	0.60	tr.	tr.
136.9	145.8	0.05	0.05	tr.	0.10
145.8	154.5	0.05	0.05	tr.	tr.
163.7	169.2	0.05	0.05	tr.	tr.
179.4	186.5	0.05	0.05	tr.	0.12
186.5	189.8	0.30	0.20	tr.	0.46
191.9	197.0	0.05	0.60	tr.	tr.
197.0	201.4	0.05	0.05	tr.	tr.
208.0	210.0	0.05	0.20	tr.	tr.
223.0	224.5	0.40	3.70	tr.	0.52
224.5	232.0	0.05	0.40	tr.	tr.
232.0	236.7	0.05	0.60	tr.	tr.
254.6	260.6	0.30	0.05	tr.	tr.
310.0	320.0	0.05	0.05	tr.	tr.

Figure 8. - Geologic and assay section of diamond drill hole 15.

"Dolomitic ore." - Southwest of the mine, a wide zone of bleached, dolomitic limestone is exposed in the face of the river bluff (fig. 2). This dolomite has been replaced partly by silica; it also contains weakly disseminated sulfides of lead and zinc ("dolomitic" ore).

The silicified dolomite zone trends N. 30° E. and dips gently to the southeast. The structure has been traced by outcrop indications and by Bureau of Mines core drilling throughout a distance of 900 feet from northeast to southwest and throughout a distance of 200 feet from east to west. It ranges from 30 feet to 150 feet in thickness. The zone is in the foot wall of the easterly dipping northeast fault that was described in the section on faults.

The mineralization and structure of the dolomite zone are known only from Bureau of Mines drill-hole data. The dolomite boundaries are irregular; they may or may not conform to bedding planes in the limestone.

The sulfide ore minerals apparently are more concentrated near the hangingwall and foot-wall contacts of the dolomite. All of the Bureau's 9 drill holes disclosed weak sulfide mineralization on entering the altered silicified dolomite from the hanging wall. The average width of this zone of mineralization was 15 feet. The hanging-wall "dolomitic" ore horizon is indicated on figure 2 by diagrammatic structure contours. Sulfides in minor amounts, however, are disseminated at intervals throughout the altered zone.

As shown by the section through holes 6, 8, 9, and 11 (fig. 6), the altered dolomitic beds apparently have been drag-folded by movement along a steeply dipping fault. This fault strikes N. 35° E. and dips 65° southeasterly. It may be significant that the better-grade ore was found in the trough of the drag fold near the footwall contact (hole 6). The features of the footwall ore horizon are shown on the sections in figures 5 and 6. The average width of the footwall ore horizon, as disclosed in holes 5, 6, 7, and 9, is 5.6 feet.

The silicified dolomite zone was widest in hole 15, the farthest hole to the southwest. Geologic and assay sections for each of the holes are shown in figures 4 to 8, inclusive.

Dikes

The limestone is cut by an intrusive basic dike exposed in a small open pit 200 feet east of the mine workings. Bancroft[13] states: "The dike trends N. 21° W., dips approximately 60° W., and is about 4 feet wide. Some gold and copper are reported to have been found along the contact of this dike and the limestones * * * . Pyrite is a prominent constituent of the dike. The rock is evidently a very much altered lamprophyre." Another dike outcrop

13/ Work cited in footnote 8.

was found by the writer 550 feet due south of the open pit. No work has been done on this exposure. It is not known definitely whether these dikes at the Young America are post-ore or pre-ore. They serve, however, to indicate zones of alteration and weakness within the limestone.

Alteration

A close relationship exists between ore deposition and alteration. The limestone contains less ore mineralization where it is less altered, even though it may be highly brecciated or fractured. In general, the ore minerals are associated closely with a high-silica gangue.

The silica content of the silicified dolomite varies inversely as the lime (CaO) and magnesia (MgO) contents. This suggests that the double salt, dolomite, was replaced selectively. Lime, magnesia, and silica assays of the silicified dolomite from holes 9 and 15 are reproduced in table 2.

TABLE 2. - Assay logs, core

Hole 9

Interval	Pb	Zn	Au	Ag	SiO_2	MgO	CaO
127.5 - 130.5	*0.05	5.80	0.01	0.47	6.4	17.5	25.2
130.5 - 135.7	* .05	.80	.01	.21	5.2	19.9	28.7
135.7 - 137.7	1.80	.30	.01	1.07	9.4	18.2	27.6
137.7 - 144.0	* .05	* .05	Tr	Tr	4.4	20.5	29.5
144.0 - 154.6	* .05	* .05	Tr	Tr	6.5	20.2	28.8
154.6 - 165.2	* .05	* .05	Tr	Tr	9.7	19.5	28.2
165.2 - 175.8	* .05	* .05	.005	Tr	6.2	20.5	31.2
175.8 - 185.9	* .05	* .05	.005	Tr	6.7	20.5	31.6
213.0 - 217.0	* .05	* .05	Tr	.10	11.5	18.9	27.4
217.0 - 221.5	.80	2.40	Tr	1.22	9.0	18.1	26.5
221.5 - 224.5	.10	2.10	Tr	.80	42.9	9.5	14.3
224.5 - 231.6	* .05	* .05	Tr	Tr	7.8	18.6	29.0
240.2 - 250.8	* .05	.20	Tr	0.42	6.8	13.9	35.2

Hole 15

Interval	Pb	Zn	Au	Ag	SiO_2	MgO	CaO
37.7 - 43.0	0.50	2.65	0.005	0.79	14.6	15.8	23.4
43.0 - 50.4	* .05	* .05	.005	.19	18.3	12.3	27.4
50.4 - 56.0	* .05	* .05	Tr	Tr	16.7	14.9	25.5
56.0 - 57.8	* .05	.20	Tr	Tr	34.4	8.2	22.4
73.6 - 77.5	* .05	* .05	Tr	.24	81.8	1.7	2.6
80.7 - 85.3	.40	* .05	Tr	1.08	6.5	19.0	27.9
85.3 - 92.1	* .05	* .05	Tr	Tr	8.1	18.1	28.1
92.1 - 101.2	* .05	* .05	Tr	.74	8.3	18.4	27.4
115.1 - 118.4	* .05	* .05	.005	.06	20.1	14.8	24.1
118.4 - 123.6	* .05	* .05	Tr	Tr	11.6	16.3	27.6
123.6 - 128.7	* .05	.10	Tr	.11	18.2	15.9	24.3

TABLE 2. - Assay logs, core (Cont'd.)

Hole 15 (Cont'd.)

Interval	Pb	Zn	Au	Ag	SiO_2	MgO	CaO
128.7 - 136.9	* .05	.60	Tr	Tr	3.9	19.8	29.3
136.9 - 145.8	* .05	* .05	Tr	.10	5.9	19.0	28.2
145.8 - 154.5	* .05	* .05	Tr	Tr	4.0	19.5	29.0
163.7 - 169.2	* .05	* .05	Tr	Tr	5.3	19.1	29.0
179.4 - 186.5	* .05	* .05	Tr	.12	2.9	20.0	29.4
186.5 - 189.8	.30	.20	Tr	.46	12.6	17.7	26.2
191.9 - 197.0	* .05	.60	Tr	Tr	10.9	17.8	26.9
197.0 - 201.4	* .05	* .05	Tr	Tr	7.4	18.2	28.6
208.0 - 210.0	* .05	.20	Tr	Tr	2.3	17.8	29.5
223.0 - 224.5	.40	3.70	Tr	.52	7.6	16.6	26.0
224.5 - 232.0	* .05	.40	Tr	Tr	6.7	17.7	28.6
232.0 - 236.7	* .05	.60	Tr	Tr	7.8	17.8	29.3

*Indicates less than.

THE ORE

Both oxidized and primary ores are found at the Young America mine. The oxidized ore occurs usually within a few feet of the surface but also underground adjacent to water courses, etc. The best ore found in the Bureau drill holes (hole 6) was strongly oxidized. No other oxidized ore was found in the drill cores. The oxide ore is composed of smithsonite ($ZnCO_3$) and cerrusite ($PbCO_3$) in a gangue of siderite, calcite, limonite, and quartz.

Reports by Evans[14] and Kauffman[15] furnished much of the following mineralogical data about the "mine" ore:

The primary ore is a fine-grained, intimate mixture of sphalerite and galena with variable amounts of geocronite, a lead-antimony mineral. Pyrite, magnetite, chalcopyrite, and cassiterite are present in small quantities. The principal gangue mineral is quartz.

Galena ranges in size from minus 48 to plus 560 mesh. Sphalerite is intergrown with galena; it has the same range in particle size. The galena apparently is argentiferous. In addition, a few sporadic inclusions of tetrahedrite or tennantite are in the galena. Pyrargerite was identified in the ore.

Microscopic, spectrographic, and X-ray data established the presence of geocronite ($5\ PbS.\ Sb_2S_3$) in the ore. The geocronite replaces sphalerite. Its relative importance as a lead-ore mineral cannot be stated definitely. The geocronite was the predominant lead mineral in some of the specimens

14/ Evans, L. G., petrographer, Bureau of Mines, Salt Lake City, Utah.
15/ See footnote 7.

examined, but in others galena predominated, each to the exclusion of the other. The most easterly stope in the mine apparently contains the largest percentage of geocronite.

An appreciable quantity of tin was noted in the spectrographic analyses. The tin content, as shown by quantitative chemical analyses of 8 samples of the ore, ranged from 0.01 to 0.13 percent. The average of the 8 samples was 0.07 percent tin. The tin-bearing mineral is presumed to be cassiterite but was not identified definitely.

WORK BY THE BUREAU OF MINES

Topographic and geologic maps of the mine area were prepared by the Bureau of Mines. Two small prospect trenches were excavated, and 1/2 mile of road was built to the drill sites. Fifteen diamond drill holes aggregating 4,590.5 feet in length were completed. The geologic data and assay data for these holes are shown in figures 4 to 8, inclusive.

Microscopic, spectrographic, and metallurgical tests were conducted on the ore. The results of these tests are summarized in the following section.

METALLURGICAL TESTS

A 350-pound sample of representative ore was taken for the metallurgical tests.

The chemical and spectrographic analyses for the metallurgical test sample (head 76) are presented below:

Chemical analysis

Ounce/ton		Percent			
Au	Ag	Pb	Cu	Zn	Fe
0.011	10.6	5.1	0.09	10.9	1.2

Spectrographic analysis

Si	Al	Fe	Mg	Ca	Mn	Ti	Zr	Pb	Sn	Cr	Mo	W	V	Cu	Ag	Au	Be	Li	Zn
X	D	C	B	B	C	E	F	B	D	E	E	*D	E	D	D	F	F	F	A

Cd	Co	Ni	Pt	As	Sb	Bi
D	E	E	F	C	D	E

Legend:
A - over 10 percent
B - 1 to 10 percent
C - 1 to 0.1 percent
D - 0.1 to 0.01 percent
E - 0.01 to 0.001 percent
F - under 0.001 percent
X - unknown quantity

* Less than.

The ore was found to be amenable to selective lead-zinc flotation, as shown by the metallurgical data and description in the following typical test:

TABLE 3. - Metallurgical test, Young America mine, Stevens County, Wash.

Conditions and reagents

Grind: 100 percent minus 100 mesh.

Point of addition	Conditions: Time Min.	Percent Solids	pH	Reagents pounds per ton: $NaCO_3$	Na_2SO_3	$ZnSO_4$	Z-3	Aerofloat 15	Cresylic acid	Lime	Sodium Aerofloat	NaCN	$CuSO_4$
Lead conditioning	5	28	7.6..	to	2.5	1.5	0.07						
Lead flotation (rougher)	5	26	7.6					0.024	0.047				
Lead cleaner flotation	4		7.6		1.0	.8	.04						
Lead recleaner flotation	4		7.6			.5	.02	.02	.02			0.1	
Zinc conditioning	3		8.5........	....	....	....	....	....	....	to	0.24		1.5
Zinc flotation rougher	6		8.5										
Zinc cleaner flotation	5		8.5										

Metallurgical data

Product	Weight, percent	Assay, percent: Ag	Pb	Zn	Percent recovery: Ag	Pb	Zn
Lead concentrate	9.35	95.25	45.5	22.7	74.6	86.9	19.4
Zinc concentrate	15.85	7.70	1.8	51.0	17.3	5.9	74.0
Tailing	74.80	1.31	.5	.9	8.1	7.2	6.6
Calculated head	100.00	11.94	4.92	10.91	100.0	100.0	100.0