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MINES AND MINERAL DEPOSITS

(EXCEPT FUELS)

BEAVERHEAD COUNTY, MONTANA

by

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Montana Bureau of Mines and Geology

Prepared in cooperation with U. S. Bureau of Mines

MONTANA COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY
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MINES AND MINERAL DEPOSITS (EXCEPT FUELS) BEAVERHEAD COUNTY, MONTANA

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ABSTRACT

The mineral resources of Beaverhead County are varied. Among the metals are gold, silver, lead, copper, zinc, manganese, thorium, tungsten, iron, molybdenum, and nickel. Of these metals, $13,907,155 worth of gold, silver, copper, lead, and zinc had been produced from the mines of Beaverhead County between 1902 and 1965, the period for which there are production figures. Manganese and thorium production have been small. The thoria reserves of the Lemhi Pass district of Montana and Idaho aggregate 100,000 tons in deposits containing 0.5 percent thoria. Production of tungsten from deposits on the north and east flanks of the Pioneer Mountains has been significant; in 1956, Montana ranked fourth in tungsten production. Some iron ore has been produced from the Carter Creek iron deposit for testing, and some from the Birch Creek (Utopia) mines was used in the past for flux. Molybdenum, in the mineral powellite, has been recovered from the tungsten ore. No nickel has been produced.

The nonmetallic resources of the county include talc, graphite, gypsum, silica, phosphate rock, sand and gravel, oil shale, sillimanite, corundum, and pegmatite minerals. Of these, only talc was being produced in 1969. Production of phosphate rock from mines in the northern part of the county stopped late in 1967. Production figures for these commodities are confidential.

In the county, at least four mining regions can be defined, the Pioneer Mountain mining region in the north-central part of the county, the Beaverhead Mountains mining region, which forms the western and southwestern boundary of the county, the Tendoy Mountains mining region, which is in the south-central part of the county, and the Ruby Mountains mining region, which occupies the east-central part of the county. Most of the precious and base metal has been produced from deposits localized in sedimentary rocks in the Pioneer Mountains mining region. In the Ruby Mountains mining region, talc has been the principal mineral commodity produced. Minor base metal production has come from deposits in the Beaverhead and Tendoy Mountains mining regions.

Appendices A, B, and C give production from individual mines under three categories: (a) all figures are publishable, (b) only total production is publishable, and (c) no production figures are publishable. Appendix D gives total production of manganese and thorium ore in the county for the period 1902-65.

INTRODUCTION

The purpose of this report is to bring under one cover all available information on mines and mineral production of Beaverhead County. The report summarizes published information and unpublished private reports and theses, supplemented by field examinations. The report also lists annual production totals from 1902 through 1965 by mine, district, and county.

The report is the result of cooperation between two agencies, the Montana Bureau of Mines and Geology and the Federal Bureau of Mines. As their contribution to this report, mineral production data for Beaverhead County on file at the Albany, Oregon, Office of Mineral Resources, Region 1, Bureau of Mines, were assembled by staff members of the U. S. Bureau of Mines under the direction of A. J. Kauffman, Jr., physical science administrator of the Albany office. Field examinations were made and the manuscript prepared by R. D. Geach of the Montana Bureau of Mines and Geology, who was ably assisted in the field by D. D. Freestone, A. W. Clarkson, Jr., and C. F. Redden in 1963, 1964, and 1965, respectively.

Production figures were obtained from the U. S. Bureau of Mines on a confidential basis, and permission to publish was obtained from the individual mine operators. If permission was not obtained, and if production could not be concealed in a larger dis-

trict, county, or state total, those particular production figures are not given.

The extraordinary industrial demand in recent years for silver and gold as well as other less glamorous metals and industrial minerals augurs well for the mining future of Beaverhead County. The county is the cradle of Montana's mining and smelting industry and contains a diversity of mineral resources. It is hoped that publication of reports of this kind, which contain reliable production statistics and geologic information on these resources, can stimulate interest in their development.

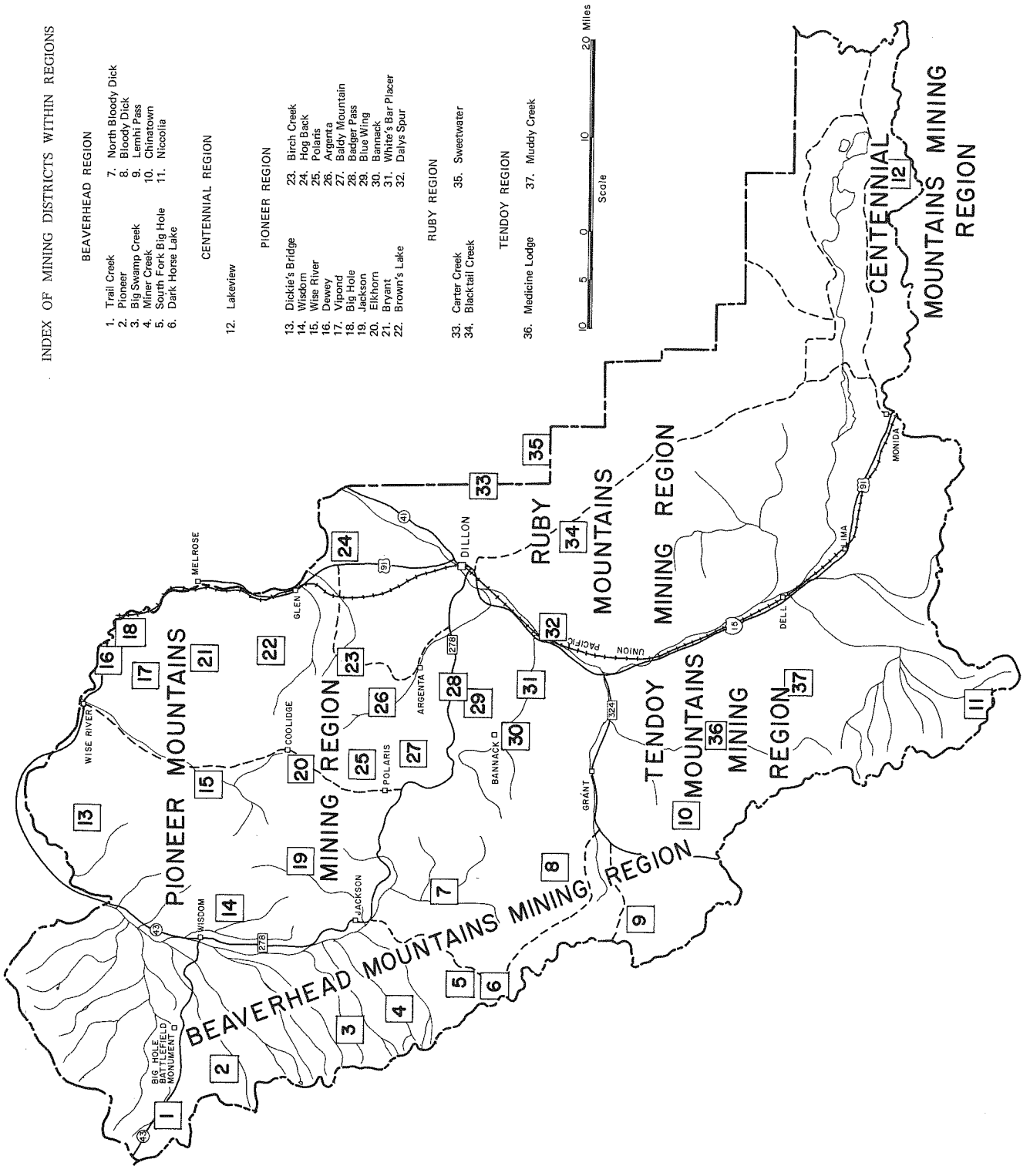


Figure 1.—Map of Beaverhead County showing major transportation routes, geographical features, and mining regions.

ACKNOWLEDGMENTS

Sincere appreciation is extended to all prospectors and mine operators in the county who assisted in the field examinations by providing maps and by guiding the writer to and through the various mining properties. To John and Bill Hand, Leonard Lively, Robert Fleming, Gunnar Johnson, Harland Tibbitts, Lee James, George Jawlowski, John Shafer, Harry Renz, George Elder, Rudy Nygren, Ben Davis, Jack Miller, and Spike Proffit, a debt of gratitude is hereby acknowledged.

ORGANIZATION OF THE REPORT

The material in this report is organized on the basis of mining regions; for example, the large mountainous area occupied by the Pioneer Mountains (Fig. 1) is designated the Pioneer Mountains mining region, and it includes all the mining districts that logically fall within the region. Thus, in the main body of the report, the name of the mining region is the principal heading, and under it are listed alphabetically the names of the mining districts that lie within the region; each mining district heading is followed by an alphabetical listing of the mines and mineral deposits within that district.

This format is adopted because the mountainous regions in the county are structural units, separate and distinct from each other. Thus, on this basis at least four mining regions in the county can be outlined — the Pioneer Mountains mining region, the Beaverhead Mountains mining region, the Ruby Mountains mining region, and the Tendoy Mountains mining region.

No description of phosphate resources in Beaverhead County is included in this report, as this resource is the subject of a comprehensive report already published (Popoff and Service, 1965).

GEOGRAPHY

Beaverhead County, the southwesternmost county in Montana, is also the largest, encompassing an area of 5,619 square miles. It is about 120 miles long and about 50 miles wide at the north and 75 miles wide at the south. It is also one of the older counties in the state, having been created on February 2, 1865.

The major transportation route through the county is U.S. Highway 91 (soon to be superseded by Interstate 15), which traverses the county from north to south through Dillon and is paralleled by a branch line of the Union Pacific Railroad from Corinne, Utah, to Butte (Fig. 1). More than 2,000 miles of other roads, paved and unpaved, provide access by car to almost any point in the county.

Geographical boundaries delineate the county on the south, west, and north. The Centennial Range on the south and the Beaverhead Range on the west form part of the Continental Divide. On the north, the Big Hole River separates the county from adjoining Deer Lodge, Silver Bow, and Madison Counties. The eastern boundary is man made and follows along legal subdivisions of land instead of any natural geographical feature.

The interior landscape of Beaverhead County is mountainous, but is described more accurately as a collection of short mountain ranges separated by linear valleys and broad basins. Altitudes range from 6,000 feet along the valley-basin floors to 11,000 feet or more at Mount Tweedy, in the center of the Pioneer Mountains. Some of the valleys, such as Lima Valley, are linear and are clearly the result of block faulting. The basins, however, are elliptical and their origin can be attributed to downwarping. A few valleys may be predominantly erosional.

The Pioneer Range, of subelliptical outline, extends northward from the central part of the county across the Big Hole River well into Deer Lodge and Silver Bow Counties; it is flanked to the east and west by the Big Hole, Melrose, and Beaverhead Basins. The north-trending (Chief) Tendoy Range (Lima Peaks) rises between Lima Valley and Horse Prairie Basin. The northeast-trending Ruby Range, including the Blacktail Mountains, stands between the Beaverhead and Sweetwater Basins, and the subparallel southwest end of the Snowcrest Range rises between the Sweetwater Basin and Centennial Valley.

Beaverhead County, as part of the mountainous region of western Montana, is within the Northern Rocky Mountains physiographic province. Some of the mountain units in the county seem to be of fault-block origin, however, and hence not unlike those in the Basin and Range physiographic province of the western United States. The region thus could logically be included (Thornbury, 1965, p. 385) in the Basin and Range province if it were not for the intervening Snake River lava plain.

The interior drainage of the county, eventually to the Missouri River, is by the Beaverhead River and the Big Hole River, principal tributaries to the

Table 1.—Average monthly and annual precipitation and snowfall, in inches, and temperature, °F.

Station	Altitude, ft.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Apex 2 NW	5400													
Precipitation		.33	.30	.55	.88	1.62	1.84	.87	.90	.73	.49	.34	.28	9.13
Argenta	6000													
Precipitation		.33	.33	.78	.70	1.90	1.98	.89	.81	.82	.69	.47	.33	10.03
Dell	6010													
Precipitation		.27	.12	.35	.55	1.53	1.64	.96	1.14	.49	.61	.23	.22	8.11
Dell 19 NW	7800													
Precipitation		.79	.00	.30	1.51	2.69	.80	.92	.38	.43	.98	.16	.41	9.37
Dillon WMCE	5228													
Precipitation		.44	.47	.71	1.12	1.81	2.14	1.16	.83	1.06	.76	.43	.41	11.34
Mean temperature		22.8	26.7	33.0	42.8	50.8	58.2	65.1	63.0	54.3	46.0	33.9	26.0	43.6
Jackson	6477													
Precipitation		.80	.73	1.08	1.05	1.78	2.21	.78	.81	.89	.77	.75	.68	12.32
Total snowfall		10.5	11.1	15.5	8.6	4.7	.8	.1	.4	1.4	4.7	7.9	9.4	75.1
Lakeview	6710													
Precipitation		1.35	1.29	1.76	1.45	2.83	2.98	1.19	1.37	1.27	1.57	1.53	1.37	19.96
Total snowfall		23.9	23.0	25.6	15.2	5.5	.3	.2	.1	2.4	8.0	16.6	21.3	142.1
Mean temperature		10.3	14.8	20.0	34.0	44.3	50.4	58.9	57.3	49.2	38.9	23.1	14.5	34.6
Lima	6265													
Precipitation		.28	.29	.50	1.03	1.61	1.96	1.01	.88	.94	.80	.33	.29	9.92
Total snowfall		5.5	4.2	7.6	5.3	2.6	.5	tr	.1	1.6	4.5	5.3	5.1	42.3
Mean temperature		16.3	18.7	27.2	38.5	47.1	54.8	63.0	61.2	52.3	42.3	28.3	19.8	39.1
Polaris	6700													
Precipitation		.88	.45	.99	.70	2.37	2.01	1.00	.59	.52	.53	.51	.57	11.12
Wisdom	6058													
Precipitation		.72	.66	.86	.94	1.79	2.01	1.01	.99	.96	.95	.76	.79	12.44
Mean temperature		12.9	16.7	23.6	36.2	45.4	52.7	59.7	56.4	48.0	38.8	25.6	17.1	36.1
Wise River	5600													
Precipitation		.44	.47	.48	.78	1.68	2.53	1.00	1.15	.91	.81	.53	.61	11.39

Jefferson River, which is the main tributary of the Missouri River. Red Rock Creek, the headwaters of the Beaverhead River, begins in the extreme southeast corner of the county at Upper Red Rock Lake, which is situated at the head of Centennial Valley. Centennial Valley, of westward trend, is a downthrown basin block (Honkala, 1960, p. 109) bounded on the south by the upthrown range block of the Centennial Mountains. The valley is nearly 50 miles long and as much as 15 miles across.

At Lima, the river turns generally north and flows through Lima Valley, then through a narrow gorge cut in volcanic rock, then enters the broad Beaverhead Basin a few miles south of Dillon. Principal tributaries to the Beaverhead River are Sheep, Horse, Grasshopper, and Rattlesnake Creeks, all entering from the west. Sage and Blacktail Creeks are the principal tributaries entering from the east and southeast.

The headwaters of the Big Hole River are near the western rim of the county at the south end of the Big Hole Basin. The river flows in a semicircular path, first northward, then eastward in a narrow canyon through the Pioneer Mountains, then southward to Melrose and then Reichle. At Reichle, the river again changes course and flows eastward, then northeastward to Twin Bridges in Madison County, where it joins the Beaverhead River to form the Jefferson River.

In the Big Hole Basin, three times as many tributaries enter the Big Hole River from the west as from the east (Perry, 1934, p. 3). Tributaries entering from the west drain a region of rugged, glacially eroded mountain peaks that form part of the Beaverhead Mountains. Stream gradients are steep, and flow is turbulent through narrow steep-walled canyons. Tributaries entering from the north, east, and south, drain a lower but still mountainous region characterized by less rugged topography and less relief. Mountain slopes are gentle and rounded and generally covered with thick growths of lodgepole pine and fir.

CLIMATE

The climate of Beaverhead County ranges from semiarid in the bottom land to subhumid in the mountainous regions. Summer temperatures may reach 100° and winter temperatures -40°.

In general, early winter snows stay on the ground in late November, but by May or early June of the next year the snow is melted. Except for some high peaks, which remain snow covered throughout most of the year, the ground throughout the county is virtually free of snow for the greater part of the year.

At lower altitudes mining is possible all year without difficulty from weather conditions. At higher altitudes, mine roads can be kept open except when temporarily blocked by severe winter storms. Most mountain roads maintained by the Forest Service are impassable during winter months but are accessible for travel from July through November.

Climatological data for the county are given in Table 1.

ECONOMIC STATISTICS

Most of the land in Beaverhead County is range and forest. The county is sparsely populated, having a population density (1960) of about 1.3 persons per square mile. In 1950 the county population was 6,671, and in 1960 it was 7,194.

About 30 percent of the area of the county is forest land administered as part of the Beaverhead National Forest; 81 percent of the forest is commercial, and the rest is noncommercial and reserved from timber use. Principal tree species of the Beaverhead National Forest is lodgepole pine, but Douglas fir and some spruce grow at lower altitudes in moist canyons, on protected north slopes, or at higher altitudes where moisture is sufficient.

The principal industry of Beaverhead County is agriculture; 52 percent of the area is farm land. In 1964 there were 269 farms in the county, and the average size was 6,835.8 acres. The greatest income is from the production of livestock; in 1964 the average value of farm products sold per farm was $35,940. The average value of land and buildings was $306,257 per farm or $44.98 per acre.

Table 2.—Labor force, Beaverhead County and Montana, 1940, 1950, and 1960.*

	Beaverhead County			Montana
Industry group	1940	1950	1960	1960
Agriculture	1,259	1,145	1,053	39,479
Forestry and fisheries	14	26	37	1,365
Mining	195	63	83	6,782
Contract construction	84	147	151	14,911
Manufacturing	45	53	60	23,439
Transportation and utilities	148	226	178	21,013
Trade	404	457	550	47,094
Services and finance	434	544	670	59,486
Public administration	68	93	89	12,590
Not reported	22	38	35	5,111
Armed services	0	3	0	---
Total	2,673	2,795	2,906	231,270

*Growth patterns in employment by county, 1940-50 and 1950-60, v. 7. Rocky Mountains, by Lowell D. Ashby, p. 7-1: U.S. Dept. Commerce, Office of Business Economics.

In 1960, the year of the latest available census, 36 percent of the labor force was engaged in agriculture, and 42 percent was engaged in retail trade, services, and finances. Only 3 percent of the labor was engaged in mining.

In 1959, the medium income of families in the county was $4,998 versus $5,403 for the state; 11.4 percent of families had incomes exceeding $10,000, and 24 percent of families had incomes less than $3,000.

SUMMARY OF MINING HISTORY AND PRODUCTION

Mining in Beaverhead County began on July 10, 1862, when placer gold was discovered in the gravels of a small tributary of the Big Hole River west of the town of Wisdom. The discovery was made by Mortimer H. Lott and eleven companions. Three weeks later the richer gold placers on Grasshopper Creek were discovered by John White and William Eads, and by the end of the year, the camp there, called Bannack, had a population of about 400. A year later (1863), however, the rich gold placers of Alder Gulch near Virginia City, in Madison County, were discovered, and the gold placers of Bannack were nearly deserted for the richer diggings.

In 1866, after completion of ditches to bring in additional water, placer mining at Bannack was revived; after the introduction of dredges in the 1890's it continued on a modest scale until 1916. It has been estimated (Lyden, 1948, p. 6) that $2,500,000 in placer gold has been taken from the gravels of Grasshopper Creek, making it Beaverhead County's most important placer discovery.

In 1864 the silver-bearing veins in the Argenta district, about 15 miles northeast of Bannack, were discovered. The discovery is reported (Sassman, 1941, p. 161) to have been made on June 25, 1864, by William Becken, Charles Ream, and J. A. Brown. Some of the richest ores were shipped as far as Swansea, Wales, for treatment, but because of transportation difficulties and excessive shipment charges it seemed necessary to treat the ores locally. Accordingly, four smelters were constructed along the banks of Rattlesnake Creek near the town of Argenta. One of these, however, proved to be a failure and was not in operation longer than a day.

Ores from the Argenta and Blue Wing districts and from outlying districts were successfully treated. In 1893, the last smelter in Argenta, owned by W. A. Clark, was shut after the repeal of the Sherman Silver Purchase Act. With the exception of the Mauldin mine, production from the district in the last 60 years or so has been sporadic, most of it by lessees successful at finding new pockets of ore and reworking old dumps.

In 1873, the Treasurehouse of Beaverhead County was discovered — the rich silver-lead ore that cropped out on Lion Mountain at the head of Trapper Creek in the heart of the Pioneer Mountains. The district was organized as the Bryant mining district (now called Hecla), and from the start became a good producer. It reached its peak under management of the Hecla Consolidated Mining Company, during which time 20 miles of underground workings were driven into the heart of Lion Mountain and a 40-ton lead smelter placed in operation at Glendale. The decline of the district set in about 1901, owing to dwindling ore reserves and the low price of silver brought about by repeal of the Sherman Silver Purchase Act. The district has produced nearly $20 million, principally in silver and lead. Mining in the district since 1904 has been small but fairly continuous. Production has been achieved mainly by lessors mining small pockets of ore, reworking company dumps, and shipping old mill tailings and smelter slag from the site of the old smelter at Glendale.

In 1913, Beaverhead County's greatest venture in mining began with the start of mining operations in the Elkhorn mining district near the south end of the Pioneer Mountains by the Boston-Montana Development Corporation. At least $5 million was spent by the company for underground mine development, living facilities, construction of a 750-ton-per-day concentrator, and building of a railroad 37 miles long between the mines and Divide. By 1925, about 200 men were employed and underground workings totaled 24,000 feet. In the late twenties, however, lack of ore resulted in financial difficulties and debts for the company and forced it into a reduced development program. In 1930, work by the company was suspended altogether in the district.

Gold mining in Beaverhead County was revived in 1933 when the price of gold was officially raised to $35 per ounce. Major placer operations were conducted along Grasshopper Creek, and some of the gold lode mines at Bannack were reactivated. The Ermont mine, about 2½ miles southwest of Argenta, became the chief producer in the county. Gold pro-

Table 3.—Production of gold, silver, copper, lead, and zinc from lode mines, Beaverhead County, 1902-65, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)	Total value
1902	4,043	1,178	146,142	145,203	807,485	-----	$141,203
1903	9,535	419	156,116	657,487	444,322	-----	150,923
1904	12,570	315	59,840	543,126	107,081	-----	97,460
1905	1,320	78	48,141	109,009	177,600	-----	56,042
1906	1,530	100	58,540	246,841	243,022	-----	102,772
1907	1,613	43	67,434	129,195	88,239	-----	75,906
1908	954	211	38,945	129,879	80,610	-----	45,536
1909	1,257	257	71,003	95,309	387,851	-----	71,293
1910	992	2,680	51,641	59,313	273,985	-----	102,886
1911	2,155	2,099	102,859	137,577	830,572	-----	152,488
1912	1,787	3,818	87,439	83,580	567,484	-----	172,029
1913	4,405	1,162	47,478	65,681	284,175	-----	75,373
1914	17,312	365	88,906	58,949	521,826	-----	84,892
1915	1,515	792	65,727	125,988	467,644	33,136	97,840
1916	2,660	238	90,613	226,132	785,308	-----	174,349
1917	11,730	1,734	139,301	266,634	1,515,521	15,918	355,381
1918	4,583	398	94,386	190,981	1,050,111	-----	224,347
1919	6,295	1,001	75,672	219,114	1,051,512	-----	201,939
1920	14,111	1,341	64,771	167,379	1,968,009	-----	286,565
1921	6,088	509	37,516	36,716	234,407	-----	63,322
1922	22,373	921	136,239	206,741	669,342	-----	220,000
1923	26,220	346	70,876	151,607	2,211,796	-----	242,376
1924	36,842	134	77,540	191,027	3,534,401	-----	362,503
1925	51,821	973	122,871	296,219	3,096,647	-----	416,856
1926	20,487	331	41,750	145,123	1,807,635	-----	197,823
1927	9,266	52	32,363	68,112	896,513	34,174	87,012
1928	1,432	81	45,887	54,813	599,802	108,772	77,830
1929	4,593	239	45,366	62,704	847,788	-----	93,563
1930	257	58	9,018	6,081	93,884	-----	10,153
1931	12,552	4,114	18,220	2,585	28,808	-----	91,631
1932	16,338	4,520	16,305	5,969	35,900	-----	99,479
1933	20,041	3,165	46,117	12,094	67,730	-----	84,841
1934	27,338	5,004	152,310	36,075	196,027	-----	283,504
1935	41,928	10,369	255,705	61,554	126,850	2,614	557,008
1936	24,989	3,715	291,827	90,424	166,978	-----	372,038
1937	41,855	8,821	144,150	71,000	519,000	13,000	460,292
1938	47,317	10,632	70,307	60,857	320,826	-----	438,293
1939	57,246	9,497	181,553	199,394	763,064	-----	512,232
1940	92,439	11,096	503,387	638,000	1,650,000	6,000	901,296
1941	43,971	7,120	119,846	63,000	507,000	2,000	370,907
1942	27,439	3,549	59,531	97,863	1,578,700	1,500,700	423,727
1943	17,135	806	74,160	144,500	1,395,800	1,012,500	313,766
1944	10,665	426	50,805	105,800	1,210,700	731,500	245,568
1945	7,937	811	53,865	79,000	709,500	323,800	175,608
1946	5,079	1,050	32,344	37,500	358,000	42,500	113,166
1947	11,599	2,236	83,147	45,800	619,000	42,600	257,417
1948	12,422	2,280	89,901	42,600	931,200	207,600	364,705
1949	9,754	1,291	59,284	24,500	1,240,500	102,500	312,375
1950	6,630	1,705	61,970	25,600	1,001,800	114,400	272,574
1951	3,876	595	24,318	30,000	718,000	136,000	199,060
1952	4,814	425	23,358	40,000	1,006,000	172,000	236,213
1953	3,569	687	26,728	38,000	1,022,000	108,000	205,443
1954	4,125	534	25,075	24,000	866,000	134,000	181,578
1955	3,437	297	17,135	24,000	852,000	74,000	170,905
1956	4,558	468	24,992	30,000	1,080,000	144,000	241,037
1957	5,332	1,133	14,536	12,000	758,000	88,000	175,025
1958	9,797	327	48,302	24,000	566,000	118,000	139,731
1959	3,438	216	14,601	28,000	356,000	118,000	83,881
1960	8,668	1,327	39,125	20,000	702,000	362,000	217,107
1961	5,344	1,226	52,592	14,700	328,000	86,000	139,614
1962	5,979	1,826	40,832	20,700	308,900	46,000	148,298
1963	7,036	938	46,668	18,000	373,600	69,600	146,421
1964	22,005	338	166,488	31,100	597,000	210,300	344,046
1965	7,528	358	42,849	22,000	588,700	138,000	187,707
Total	913,926	124,775	5,146,713	7,097,135	49,194,155	6,297,614	13,907,155

duction declined drastically after October 1942, however, when governmental order (L-208) prevented acquisition of mining supplies.

In recent years, nonmetallic minerals have played an increasingly important part in Beaverhead County's mining economy. The county contains proved reserves of phosphate rock, talc, oil shale, silica, limestone, graphite, sand and gravel, and gypsum. Talc and phosphate have been the principal nonmetallic commodities produced. Talc production began about 1941 from deposits situated along the west end of the Ruby Mountains about 11 miles southeast of Dillon. Large-scale phosphate rock production from mines in Beaverhead County began in 1952, when an elemental-phosphorus plant was constructed to reduce phosphate rock at Silverbow in Silver Bow County.

Table 3 shows recorded production of gold, silver, copper, lead, and zinc from Beaverhead County for the years 1902 to 1965, inclusive. Accurate production data are not available prior to 1902, but a fair estimate would be that probably as much again has been produced. Thus the total value of mineral production from Beaverhead County is estimated to be in the range of $25 million to $30 million.

ROCK UNITS

METAMORPHIC ROCKS

Metamorphic rocks crop out over large areas in the Ruby, Blacktail, and Snowcrest Mountains (Fig. 2). In the Tendoy Mountains, metamorphic rocks are exposed in narrow belts along north-trending thrust faults that follow along the flanks of the range. These metamorphic complexes are mainly gneiss and schist, but they include marble and quartzite units that are plainly of sedimentary origin. The complexes are regarded by most geologists as of pre-Belt age, but as pointed out by Ross (1963, p. 91), some are enough like the Belt Series that uncertainties as to correlation have arisen. This comment by Ross is interpreted to mean that some metamorphic rocks in southwestern Montana regarded as unquestionably pre-Belt might instead be metamorphosed Belt rocks.

The metamorphic rocks can be divided into three major units, the pre-Cherry Creek Group (Pony?) (Heinrich and Rabbitt, 1960, p. 16), the Cherry Creek Group, and intrusive Dillon granite gneiss.

Pre-Cherry Creek Group (Pony?). — Rocks of the pre-Cherry Creek Group (Pony?), some of which are garnet rich, are coarse-grained banded gneiss, consisting mainly of biotite granite and biotite gneiss, quartz-feldspar and hornblende-quartz-feldspar gneiss, hornblende gneiss, amphibolite, and epidote gneiss. Minor varieties are biotite schist and sillimanite garnet gneiss. Mappable units in the group are traceable for only short distances along strike. Rocks of the group show extremes of folding; they are intensely contorted over large areas and locally are ptygmatically folded. Stringers, pods, and lit-par-lit injections of thin granite layers, originating from Dillon granite gneiss, are present in most units of the group (Heinrich and Rabbitt, 1960, p. 16).

Cherry Creek Group. — Rocks of the Cherry Creek Group, which is as much as 4 miles thick, are distinctive layers that are made up of marble, silicated marble, quartzite, muscovite and biotite schist, amphibolite, and hornblende-rich gneiss and schist. Less common types are garnet gneiss, sillimanite schist and gneiss, pyroxene schist and gneiss, chlorite and corundum schist, and actinolite schist. Near Carter Creek, an iron formation consisting of finely banded and contorted hypersthene-magnetite schist is closely associated with banded quartz-hornblende gneiss. The marble and quartzite units are the most useful in mapping, as they crop out well, are easily recognized, and are more uniform and continuous than any of the other types. Although some of the marble units vary markedly in thickness within short distances, they are traceable for as much as 5 miles. The quartzite forms thin layers or short lenses of more nearly uniform thickness; the thickest unit is about 1,200 feet across and the longest is 2½ miles (Heinrich and Rabbitt, 1960, p. 19). Rocks of the Cherry Creek Group have not been found in the Blacktail Range even though Dillon granite gneiss and pre-Cherry Creek rocks are present.

Dillon Granite Gneiss. — The term Dillon granite gneiss was introduced by Heinrich (Heinrich and Rabbitt, 1960, p. 16) to replace the original selection, Blacktail granite gneiss (Heinrich, 1949, p. 2). Dillon granite gneiss crops out in the Ruby, Blacktail, and Snowcrest Ranges; similar granite gneiss also occurs in the Tendoy Range and in the Jeff Davis Peak area in southwestern

Beaverhead County. The type area for the unit is in the Blacktail Range. In the Ruby Mountains, Dillon granite gneiss forms a long tabular pluton ½ mile to 2 miles wide intruded along the contact between pre-Cherry Creek and Cherry Creek rocks. In outcrop, the granite gneiss ranges from gray to red. The texture ranges from an equigranular type with hardly discernible foliation to a strongly layered and evenly lineated gneissic variety. Commonly, the rock contains quartz, microcline, plagioclase, minor biotite, and accessory zircon, magnetite, allanite, and garnet. Most of the pegmatite, aplite, and quartz veins intruded into the granite gneiss parallel the trend of its foliation.

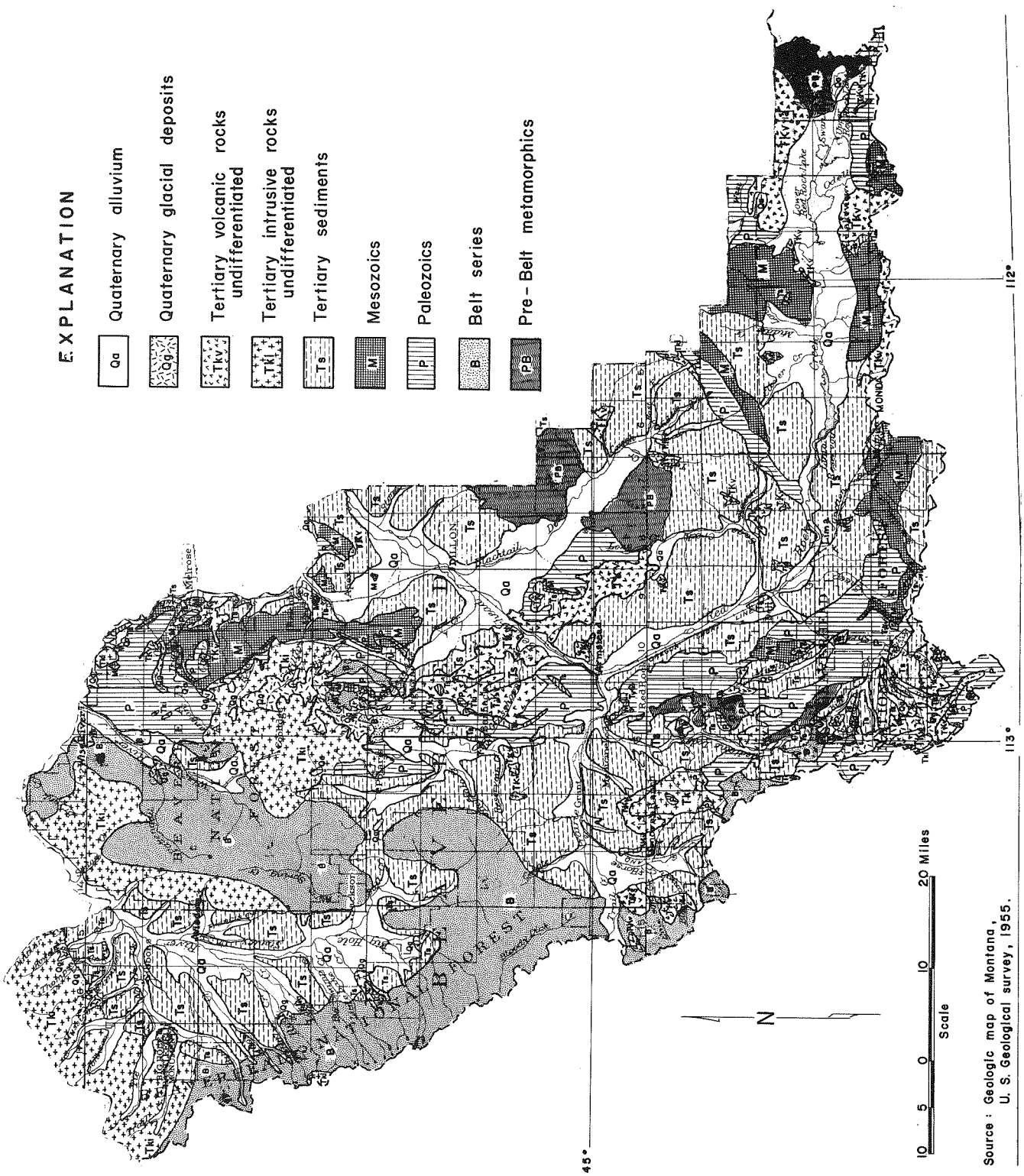


Figure 2.—Generalized geologic map of Beaverhead County.

SEDIMENTARY ROCKS

BELTIAN (PRECAMBRIAN)

In Montana, the oldest sequence of relatively unmetamorphosed sedimentary rocks is the Belt Series, which underlies the Flathead Quartzite (Middle Cambrian). In Beaverhead County, Belt strata and structure have been so little studied that correlations based on lithologic equivalence to groups in the Belt Series elsewhere in Montana are provisional. The greatest exposure of Belt strata is in the northwest third of the county (Fig. 2), where Paleozoic and Mesozoic strata are not present. Smaller isolated patches of Belt rocks are exposed in southwestern Beaverhead County and on the southeast flank of the Pioneer Mountains north of Argenta.

The three major groups of the Belt Series, from oldest to youngest, the Ravalli, Piegan, and Missoula, are represented in the county. In addition, coarse conglomerate assigned to the North Boulder Group is exposed in the north part of the Pioneer Range.

Ravalli Group. — Rocks of the Ravalli Group form part of the Beaverhead Mountains west of the Big Hole Valley, in a tract extending from Trail Creek on the north into T. 7 S., R. 16 W., on the south. No descriptions of these rocks in Beaverhead County have been published, but the Ravalli Group in the Philipsburg region, about 55 miles to the north, was described by Emmons and Calkins (1913, p. 59) as about 2,000 feet thick, of which the lower two-thirds is composed mainly of light-gray quartzite. The upper third contains dark-bluish and greenish shale interbedded with dark quartzitic sandstone and quartzite similar to that in the lower part.

Piegan Group. — On the state geologic map (Ross, Andrews, and Witkind, 1955), rocks questionably of the Piegan Group in Beaverhead County are shown in an area of about eight townships in the vicinity of Lemhi Pass. In the Lemhi Pass area, the country rock is predominantly micaceous quartzite locally containing thin beds of argillite. The base of the unit is not exposed, but on the assumption that the strata dip northward at angles ranging from about 20 to 50 degrees, a thickness of 10,000 feet could be present in a distance of 10 miles (Sharp and Cavender, 1962, p. 6). Elsewhere in Montana, the Piegan Group is composed of carbonate-rich rocks. The group is equivalent to the Wallace Formation, which is characterized by an assemblage of thin-bedded, fine-grained calcareous quartzite, impure limestone, and calcareous shale (Ross, 1963, p. 66).

Missoula Group. — Rocks of the Missoula Group are exposed in the western half of the Pioneer Mountains and as small isolated patches in southwestern Beaverhead County near the Idaho border. Most of the beds in this group are red to lavender coarse-grained massive quartzite. Myers (1952, p. 4) mapped strata about 10,000 feet thick near Argenta as Missoula Group and divided the rocks into two units — an upper light-colored quartzite and a lower red crossbedded arkosic quartzite. The lower red member is more than a mile thick at the southwest, but northward it thins rapidly within 8 miles to only about 2,000 feet. Farther east the member is predominantly reddish shale but contains some green and gray shale.

North Boulder Group. — Pebble conglomerate and coarse-grained crossbedded quartzose to arkosic wacke are exposed on the north face of Sheep Mountain in northern Beaverhead County and logically can be assigned to the North Boulder Group. On Sheep Mountain, the estimated thickness is 500 feet but the conglomerate lenses out abruptly. Most of the pebbles in the conglomerate are quartzite, but pebbles of chert and gneiss are present; they range in size from 5 to 12 mm (Obert, 1962, p. 15). Similar but coarser conglomerate was found in the vicinity of Sheep Mountain as well as along Pattengail Creek, a northeast-flowing tributary of Wise River.

CAMBRIAN

The middle and upper parts of the Cambrian System in southwestern Montana consist of six distinct units, Flathead Quartzite, Wolsey Shale, Meagher Limestone, Park Shale, Pilgrim Limestone, and Red Lion Formation, which is shaly limestone. For localities in northern Beaverhead County, however, the term Hasmark Formation, which is equivalent to the Meagher, Park, and Pilgrim Formations (Hansen, 1952, p. 12), is used.

Flathead Quartzite. — The Flathead Quartzite is of Middle Cambrian age. It is silica-cemented medium-grained moderately quartzose sandstone normally stained pink or brown (Sloss and Moritz, 1951, p. 2142). Crossbedding and ripple marks are common sedimentary structures. Near the base, the unit contains zones of rounded pebbles of pegmatitic quartz. In the upper half of the formation, green and maroon micaceous shale laminae are common. Myers (1952, p. 6) reported an unusually thick section of Flathead Quartzite northwest

of Argenta. In southwestern Beaverhead County, Sloss and Moritz (1951, p. 2142) reported thicknesses ranging from 75 to 125 feet.

Wolsey Shale. — Transitionally and conformably overlying the Flathead is the Wolsey Shale, which is characteristically fissile and finely micaceous shale, chiefly green but exhibiting some maroon, brown, and purple hues. Thin beds of sandstone are included, and near the top of the Wolsey, thin beds of limestone and dolomite appear and increase toward the arbitrary contact with the overlying Meagher Limestone. The thickness of Wolsey, as measured by Sloss and Moritz (1951, p. 2142), is 125 to 200 feet. The unit gradually thickens northward.

Meagher Limestone. — The Meagher Formation rests conformably and transitionally on the Wolsey Shale and is technically well known for the "black and gold" mottling of its limestone. The lower part of the Meagher consists of thin-bedded interlayered limestone and shale. The upper part is dark-gray to black massive limestone. A middle thin-bedded shale zone serves to separate the upper massive limestone from the lower shaly beds (Sloss and Moritz, 1951, p. 2143). In the western part of the state, which includes all of Beaverhead County, the Meagher Limestone is dolomitic (Hansen, 1952, p. 14). The maximum thickness of the Meagher is approximately 1,000 feet in the Gravelly, Snowcrest, and Ruby Ranges, but the unit is absent in the Argenta, Bannack, Armstead, and Lima areas, and areas farther west, as a result of pre-Pilgrim uplift, block faulting, and erosion (Myers, 1952, p. 6).

Park Shale. — The Park Shale conformably overlies the Meagher Limestone. It is gray to green fissile micaceous shale interbedded at some localities with gray to black dense limestone. The Park Shale can be confused with Wolsey Shale, but the formation is identifiable by its position between two thick carbonate formations. The thickness of the Park ranges from 100 to 150 feet in southwestern Montana. In the Hecla district, Karlstrom (1948, p. 23) described the Park Formation as a dark-green to greenish-gray quartzitic unit, attaining a maximum thickness of 85 feet. Elsewhere in northern Beaverhead County the Park Formation has not been recognized.

Pilgrim Limestone. — In southwestern Montana, the Pilgrim Formation is in transitional contact with the Park Shale if present or in disconformable contact with the Meagher Limestone where the Park Shale has been removed by erosion. The lower part of the Pilgrim contains yellowish mottled dense to fragmental limestone and some edgewise conglomerate. The upper part of the Pilgrim is massive light-gray mottled sugary dolomite containing some dark-gray to black beds. The thickness of uneroded Pilgrim in southwestern Montana is 100 to 300 feet.

Red Lion Formation. — Where present, the Red Lion rests conformably on the Pilgrim, but the Red Lion is missing in most of Beaverhead County, having been removed by pre-Middle Ordovician and pre-Middle Devonian erosion (Sloss and Moritz, 1951, p. 2146). In the Quartz Hill district in northern Beaverhead County, red and buff shale transitionally overlying Hasmark Dolomite were assigned by Guttormsen (1952, p. 44) to the Red Lion Formation. The shale is not exposed but is concealed by a soil formed from its debris. Shale chips in the soil are red to buff to yellow dolomitic fragments, some of which show dendritic growths of black manganese oxide.

ORDOVICIAN

Kinnikinic Quartzite. — The Kinnikinic Quartzite is the only formation of Ordovician age recognized in Beaverhead County. It consists of a few tens of feet of pink and yellow stained well-bedded silica-cemented sandstone that rests on purple Beltian quartzite. The unit crops out as small isolated patches in the Tendoy Range near the Idaho boundary (Sloss and Moritz, 1951, p. 2148).

DEVONIAN

Maywood Formation. — The base of the Devonian System in western Montana is the Maywood Formation, of Middle Devonian age. In southwestern Montana, however, exposures reveal only a few inches to a few feet of reddish dolomitic shale, which does not constitute a cartographic unit of any significance (Sloss and Moritz, 1951, p. 2149). In many localities, the unit is absent, and Jefferson Limestone, of Middle and Late Devonian age, rest unconformably on older rocks.

Jefferson Formation. — The Jefferson Formation is divided into two unnamed units, a lower limestone member and an upper dolomite member. The lower limestone member is limited to a small area and consists of a few feet to a few tens of feet of dark-brown dolomitic limestone containing light-gray and yellowish zones near the base. The upper dolomite, which ranges in thickness from about 150 to 600 feet in southwestern Montana, consists of dark-gray to brown and black dolomite, sugary in

appearance and giving off a fetid odor on fresh fracture. The unit is thin bedded to massive. Evaporite-solution-breccia zones, which contain fragments of dolomite in a matrix of lighter colored dolomite stained red at some localities, are present in the upper third of the unit (Sloss and Moritz, 1951, p. 2151). In the Snowcrest Range, gypsum beds (Potlatch evaporite?) at the top of the Jefferson Formation probably are correlative with the evaporite-solution-breccia zones.

Three Forks Shale. — The Three Forks Shale overlies the Jefferson Formation in conformable and transitional contact. The lower part of the formation consists of gray-green shale, shaly limestone, and silty and sandy limestone, but is not well exposed. The upper part of the formation contains the Sappington Sandstone member, which is characterized by yellow, buff, and orange sandy limestone and calcareous sandstone. At some localities the Sappington Sandstone is in contact with black fissile shale that is thought by some writers to be basal Mississippian. Sloss and Moritz (1951, p. 2153) reported a thickness of 221 feet for the Three Forks on the north face of Arrowhead Mountain in the Centennial Range.

MISSISSIPPIAN

Madison Group. — The base of the Mississippian System in southwestern Montana is the Madison Group, which is divisible into two formations, the Lodgepole Limestone and the Mission Canyon Limestone. Near its base, the Lodgepole Limestone consists of thin beds of black dense cherty limestone interbedded with shaly limestone and limy shale that grade to fossiliferous gray-brown to gray more massive limestone near the top.

The Mission Canyon Formation consists of massive cliff-forming limestone, the upper part of which is dolomitic, light gray buff or brown, and sugary. The thickness of the Madison Group in Beaverhead County exceeds 1,000 feet (Sloss and Moritz, 1951, p. 2157).

Big Snowy Group. — The Big Snowy Group is of Late Mississippian age, but its distribution in Beaverhead County is limited by nondeposition and by pre-Amsden erosion. The group is best exposed in the Tendoy, Blacktail, and Snowcrest Ranges, but the true thickness is unknown, owing to lack of suitable exposures. The group contains red dolomitic sandstone and siltstone, apparently representing the Kibbey Formation, overlain by a succession of thin-bedded black and gray fragmental limestone beds containing interbeds of black fissile shale corresponding to the Heath Formation. The base of the Big Snowy Group, the Kibbey Formation, contains commercial gypsum beds in the Tendoy Range west of Lima (Sloss and Moritz, 1951, p. 2158).

PENNSYLVANIAN

Amsden Formation. — The Amsden Formation is the base of the Pennsylvanian System, and where the Big Snowy Group is absent it rests unconformably on the Madison. The formation contains bright red to purplish shale, siltstone, and shaly dolomite. In the Blacktail Range, the formation attains a thickness of 110 feet (Sloss and Moritz, 1951, p. 2160).

Quadrant Formation. — The Quadrant Formation is transitional from and conformably overlies the Amsden. It is commonly termed the Quadrant Quartzite, although in cementation it ranges from sandstone to quartzite in southwestern Montana. The lower part of the formation consists principally of massive white, brown-weathering sandstone or white and pink vitreous quartzite. The upper part of the formation consists of thin-bedded brown to buff sandstone interbedded with light-gray to buff dolomite. An unusual thickness of 2,662 feet was reported by Sloss and Moritz (1951, p. 2165) for the Quadrant at the Big Sheep Creek locality in southern Beaverhead County. A thickness of several hundred feet, however, is more nearly typical for the formation throughout the county.

PERMIAN

Phosphoria Formation. — In southwestern Montana, the Phosphoria Formation, of Permian age, contains several different major rock types — chert, dolomite, sandstone and interbedded phosphorite, and dark mudstone (Cressman and Swanson, 1964, p. 284). The formation has been the object of much study because of its important phosphate, vanadium, uranium, and oil-shale reserves. Its thickness ranges from about 200 feet in northern Beaverhead County to about 800 feet in southern Beaverhead County. The formation was provisionally subdivided into five members, A, B, C, D, and E, in ascending order; the B and D members are the phosphatic shale units, the A member is the basal dolomite unit, the C member is a middle unit consisting of chert, dolomite, and sandstone, and the E member is the upper chert, carbonate, and sandstone unit. The phosphatic shale members (B and D) also contain bituminous shales. The U. S. Geological Survey subsequently adopted a complex nomenclature (McKelvey and others, 1956, p. 2834) under which

formational names are assigned to the different lithologic units. The phosphatic shales (the B and D members) and the chert beds in the C and E members were left in the Phosphoria Formation; the dolomitic limestone beds (the A and C members and part of the E member) became the Park City Formation; and the sandstone units (most of the E member and the sandstone unit in the C member) became the Shedhorn Sandstone.

The B (Meade Peak) and D (Retort) members are present throughout Beaverhead County, but the Retort member pinches out east of the Gravelly Range in Madison County and north of the Big Hole Canyon (Cressman and Swanson, 1964, p. 303).

TRIASSIC AND JURASSIC

The Triassic and Jurassic are represented in Beaverhead County by the Dinwoody, Woodside, and Thaynes Formations of Early Triassic age, and the Ellis Group and Morrison Formation of Jurassic age. Middle and Upper Triassic rocks are absent throughout the region either because of nondeposition or erosion.

Dinwoody Formation. — The Dinwoody Formation is the most widespread of the Triassic units in the county, occurring throughout the eastern half. Its thickness is about 500 feet along the eastern boundary of the county and increases to about 800 feet in the Tendoy Range. Overall, the formation is fossiliferous and consists of brown-weathering thin-bedded silty and argillaceous limestone, siltstone, sandstone, and gray-green to tan shale. The formation can conveniently be divided into a lower shale member and an upper limestone member.

Woodside Formation. — The Woodside Formation overlies the Dinwoody Formation in the southeastern part of the county and attains a maximum thickness of about 700 feet near Upper Red Rock Lake. It thins rapidly northward and is absent north of a line trending northeast through the center of the Ruby and Blacktail Mountains. It consists of nonmarine red siltstone and shale deposited in the wake of a regressing sea. The formation is not resistant to erosion, but its presence can be recognized by red soil above the brown-weathering Dinwoody Formation.

Thaynes Formation. — The Thaynes Formation overlies the Woodside and Dinwoody Formations. It is divisible into three units, a lower thin-bedded gray-weathering limestone member, a middle thin-bedded gray to tan sandstone member, and an upper thin-bedded gray to buff limestone member. The unit attains a maximum thickness of 800 feet near Monida but thins rapidly northward. It is absent beyond the north end of the Blacktail Mountains.

Ellis Group. — The Ellis Group, of late Middle and Late Jurassic age, comprises the Sawtooth, Rierdon, and Swift Formations, in ascending order. The Sawtooth Formation is made up of calcareous shale or argillaceous limestone that is light gray and brittle and weathers into elongate splintery or "pencil-shaped" fragments. The Rierdon Formation is composed of oolitic limestone, argillacous limestone, and sandy limestone. The Swift Formation is made up of green to greenish-gray calcareous and glauconitic sandstone and shale. The thickness of the Ellis Group in southern Beaverhead County is about 200 feet, but the group thins rapidly northward and is missing in the north half of the county (Moritz, 1951, p. 1806).

Morrison Formation. — The Morrison Formation is of Late Jurassic age and conformably overlies the Ellis Group. It consists of continental gray-green to red-brown shale interbedded with some sandstone and fresh-water limestone. In the Little Water Canyon section (sec. 9 and 10, T. 13 S., R. 10 W.) the top of the formation is marked by 2 inches of black carbonaceous shale that corresponds to carbonaceous shale and coal beds at the same horizon in other parts of Montana. The maximum thickness of the formation is nearly 400 feet near the Idaho border; it thins rapidly northward (Moritz, 1951, p. 1810).

CRETACEOUS

Kootenai Formation. — The base of the Cretaceous System is the Kootenai Formation, which rests on Triassic beds in northern Beaverhead County and on Jurassic beds in the southern part of the county. Near Bannack the formation is about 1,200 feet thick and can be subdivided in ascending order into a basal sandstone and conglomerate member 200 feet thick; an interbedded sandstone, shale, and limestone member 800 feet thick; and a fossiliferous (gastropod) massive gray limestone member 200 feet thick.

Colorado Group. — Succeeding the Kootenai is the Colorado Group. The group has not been as extensively studied in Beaverhead County as other units, therefore published information about it is scanty.

In the Hecla district, most of the unit is somewhat

quartzitic sandstone, but the basal part is black fissile shale (Karlstrom, 1948, p. 29). In the Ruby River valley, the Colorado Group (Klepper, 1950, p. 68) consists of more than 1,000 feet of gray, green, and black shale and interbedded sandstone. Near the top is a lignite bed 10 feet thick, which is overlain and underlain by black shale. Some light-colored tuff and impure bentonite and bentonitic shale, probably equivalent to the Aspen or Mowry Shale of the Frontier Formation, occur near the bottom of the group.

TERTIARY

Included in the Tertiary Period are the Paleocene, Eocene, Oligocene, Miocene, and Pliocene Epochs. Sediments deposited during these epochs are collectively called basin beds (Scholten and others, 1955) because they were laid down in intermontane basins that came into being during the Laramide orogeny at or near the end of Cretaceous time. These sediments include an assemblage of gravel, poorly consolidated beds of conglomerate and sandstone, clay, fresh-water limestone, and volcanic tuff. Within the sequences are numerous volcanic flows, most of which are basaltic in composition.

The following are the sequences, from oldest to youngest, in the Lima region (Scholten and others, 1955, p. 354):

Paleocene. — Beaverhead Formation: Pebble and boulder conglomerate; sparse sandy and silty matrix; mostly quartzite, locally limestone and chert pebbles; toward southeast thick salt-and-pepper sandstone near base; thick fresh-water limestone unit in McKnight Canyon, Tendoy Range; colors are red, orange, and gray; thickness approximately 9,700 feet.

Eocene. — Sage Creek Formation: Sandstone conglomerate, clay, tuff; basal basalt; colors gray and greenish; thickness 300 to 400 feet.

Oligocene. — Cook Ranch Formation: Clay, tuff, some sandstone and conglomerate; grades northward into tuff and acidic breccia; colors mostly white and light gray; thickness 125 to 1,000 feet.

Muddy Creek beds: Tuff, some shale, conglomerate, and fresh-water limestone; basal pebble conglomerate and sandstone in Muddy Hole Basin; some bituminous shale; colors mostly white, light gray, and buff, some pink, red, brown, and black; thickness 1,000 feet.

Miocene. — Blacktail Deer Formation: Clay, feldspathic sandstone, fine conglomerate; tuff; thick vuggy travertine limestone; basal pebble conglomerate and limestone breccia; interbedded basalt flows; grains, pebbles, and thin beds of chert; some lignite; colors light gray and tan, some weathering purplish; thickness 2,000 feet.

Medicine Lodge beds: Shale, bentonitic clay, sandstone, pebble conglomerate, fanglomerate; some lignite; thick vuggy fresh-water limestone at top; colors white, gray, yellow, violet brown, brown; thickness 5,000 feet.

Pliocene. — Stream gravel.

QUATERNARY

Quaternary deposits consist of terrace gravel, stream-bed alluvium, landslide deposits, and glacial drift. The terraces are developed on tilted and deformed Tertiary beds. Near the mountain fronts, the terraces are overlapped by coalescing alluvial fans made up of coarse detrital material carried down from the mountains.

Most of the glacial deposits are in the high mountainous areas. Early and middle Pleistocene glacial deposits are lacking in Beaverhead County but alpine glacial deposits of Late Pleistocene (Wisconsin age) occur in the Pioneer Mountains, in Nicholia and Meadow Creek Canyon west of Lima, and along the drainages from the Beaverhead Mountains flanking the Big Hole Basin. The Big Hole glaciers ranged from 9 to 12 miles in length and at their terminals were 1 to 2 miles across (Alden, 1953, p. 166). Well-developed terminal moraines can also be seen along Rattlesnake Creek north of Argenta and along Wise River 15 miles south of the town of Wise River. The Hecla Basin has been sculptured by alpine glaciers into a compound cirque; the maximum thickness of ice in the basin was at least 1,000 feet (Karlstrom, 1948, p. 14).

IGNEOUS ROCKS

The four principal types of igneous rocks in the county are Dillon granite gneiss, Tertiary plutonic rocks of granitic texture, rocks ranging in composition from aplite to peridotite and occurring as small intrusions such as sills, dikes, and chonoliths, and Tertiary volcanic rocks ranging in composition from basalt to rhyolite.

The Dillon granite gneiss has been described under the heading of Metamorphic Rocks.

GRANITIC PLUTONIC ROCKS

The greatest exposure of Tertiary plutonic rocks of granitic texture in Beaverhead County is in the Pioneer Mountains, where an intrusive mass of batholithic proportions forms the core of the mountains. The western flank of the mountains near the town of Wisdom is also bordered by a separate intrusive mass, elongate north-south, that is separated from the core by intervening Missoula Group metasediments. In the Elkhorn district, the rock was described by Winchell (1914, p. 169) as porphyritic biotite-hornblende-quartz monzonite whose porphyritic character is not noticeable in the field. The quartz monzonite composition of the mass is retained into the Hecla district (Karlstorm, 1948, p. 31), but the texture of the rock grades from coarse to fine crystalline as the contact with bordering sedimentary rocks is approached. In the Birch Creek district near Pear Lake, the country rock is biotite granite composed of orthoclase and small amounts of plagioclase, quartz, and biotite (Kirkemo, Anderson, and Creasey, 1965, p. 63). Coarse-grained biotite granite that is porphyritic in many places is exposed discontinuously at Browns Lake and along the walls of Rock Creek Canyon for about 1¼ miles west of the lake (Myers, 1952, p. 16). The west margin of the granite is in irregular contact with the major pluton of quartz monzonite.

At Argenta and Bannack, smaller plutonic masses are quartz monzonitic and granodioritic in composition and are localized near zones of complex faulting and folding of sedimentary rocks.

SILLS AND DIKES

APLITE

Associated with granitic plutonic rocks are aplitic rocks principally in the form of small dikes or chonoliths. In the Wisdom district the small vein deposits are associated with aplitic rocks. In the Elkhorn district several bands of aplite were exposed in underground workings as well as on the south slope of Comet Mountain. In the Browns Lake area, dikes and accordant sheets of aplite are locally abundant near the contact of the biotite granite pluton with quartzite (Myers, 1952, p. 16). At the Queen of the Hills mine on the west flank of Sheep Mountain, the gneiss and schist are cut by aplitic dikes (Winchell, 1914, p. 79), and aplite is mentioned as occurring on the west and north margins of the nickel-bearing ultramafic complex southeast of Dillon in the Ruby Mountains (Sinkler, 1942, p. 137).

PEGMATITE

Most of the pegmatite bodies in Beaverhead County are in the Ruby Mountains (Heinrich, 1948). They are small, lenticular, not more than 80 feet in length, and generally parallel the foliation of the metamorphic country rock. Some are zoned but most consist of irregular-grained intergrowths of feldspar, quartz, and mica.

Pegmatite bodies in the Hecla district were reported (Winchell, 1914, p. 41) to be associated with minor ore deposits.

MINETTE

A minette dike cutting dolomite at Hecla was described by Winchell (1914, p. 42) as composed of orthoclase and biotite, minor amounts of clinoenstatite, titanite, pyrite, and chlorite, and very little quartz. The rock resembles a black mica schist but shows no distinct lamination.

DIABASE

Diabase dikes in the Ruby Mountains transect metamorphic foliation nearly at right angles along major northwest-striking faults (Heinrich and Rabbitt, 1960, p. 31). The largest dike is 6 miles long and as much as 600 feet across, but many are only a few feet to several tens of feet wide and ten to several score feet long. Augite, labradorite, and magnetite are the principal minerals, and apatite, ilmenite, pyrite, and pyrrhotite are the minor minerals. Locally, the dikes are altered to mixtures of chlorite, serpentine, hornblende, carbonate, and magnetite.

ANDESITE

Intrusive andesite occurs chiefly in the Blue Wing and Argenta districts, where it forms sills and some dikes (Shenon, 1931, p. 52). Two types were described by Shenon, both grayish-green rock, one of which in hand specimen does not show marked porphyritic characteristics, whereas the other contains phenocrysts of augite in a dense groundmass. The distinctly porphyritic andesite is less altered than the dense variety. At the Ermont mine the andesite at the limestone contact is extensively altered and may be brown or almost white.

PERIDOTITE

Peridotite and other ultramafic bodies intrude metamorphic rocks in the Ruby Mountains and in the Jake Creek area in the Blacktail Mountains. The Timber Gulch bodies, consisting of enstatite-olivine rock, are rounded and flat-lying, and may be sill-like

intrusive bodies. The Wolf Creek pluton is bounded on the west and east by northwest-trending faults (Heinrich and Rabbitt, 1960, p. 30), and is composed of saxonite, harzburgite, peridotite, nickeliferous serpentine, and other related ultramafic rocks (Sinkler, 1942, p. 138). A dike about 1,000 feet long near the Crystal graphite mine contains chiefly enstatite and remnants of olivine, both altered to actinolite and serpentine.

EXTRUSIVE VOLCANIC ROCKS

Extrusive volcanic rocks in Beaverhead County occur principally in a northwest-trending belt lying between Argenta and Bannack and extending southeastward into the Blacktail Mountains. The flows are conspicuously exposed in the narrow gorge between Dillon and Clark Canyon dam. Two sequences of flows have been recognized (Lowell, 1965), a lower tuff and andesite agglomerate of early Tertiary age and an upper sequence of basalt, tuff, and rhyolite of late Tertiary age intruded by rhyolite and basalt dikes. The lower sequence rests with angular unconformity on the Beaverhead Formation and is intruded by andesite dikes.

Lavas and pyroclastic deposits also occur in patches in the southern part of the county. The largest remnants are in topographic basins and along lower mountain slopes, but some are along the tops of the mountains (Scholten and others, 1955, p. 370). In composition they range from basalt to rhyolite and in age from Eocene to Pleistocene.

In the Centennial Mountains, most of the volcanic rocks are rhyolite and welded tuff (Stearns and others, 1939, p. 20) that on the mountain crests generally dip 15° to 25° S. (Kirkham, 1927, p. 13). Beds of pumiceous ash crop out east of Monida along the Idaho border.

MINERAL DEPOSITS

BEAVERHEAD MOUNTAINS MINING REGION

The Beaverhead Mountains mining region, for the purpose of this report, is intended to include all the mines and mining districts that lie within the chain. This chain of mountains forms the western and southwestern boundary of the county. Thus it includes the Chinatown mining district, the Lemhi Pass district, the Monument district, and other mines in this chain that cannot be included with any of the districts.

CHINATOWN DISTRICT

The Chinatown district is in the southwestern part of Beaverhead County, near the Idaho boundary. The area is served by a main transportation route, Montana State Highway 324, which begins at Clark Canyon dam and traverses the entire length of Horse Prairie Valley up to Bannock Pass on the Idaho boundary, where it connects with a main transportation route in Idaho. At a point 24 miles southwest of the dam, a dirt road leading off from the highway goes up Jeff Davis Gulch a few miles to the site of the old mining camp of Chinatown.

For the purpose of this report, the district boundaries are drawn to include the drainages of Jeff Davis Gulch and Maiden Creek. Both are west-flowing tributaries of Horse Prairie Creek. Elevations within the district range from about 7,000 feet at Chinatown to 9,600 feet atop Jeff Davis Peak.

The district is on the west flank of a short but rugged mountain range that lies between Medicine Lodge and Horse Prairie Creeks. The uplift trends north-northwest and parallels the trend of the Tendoy Mountains, the next range to the east.

Granite gneiss is the major rock type cropping out within the range. The area of gneissic outcrops extends about 12 miles along the range trend and is about 5 miles across. Most of the gneiss is a coarse-grained light-gray to red-brown variety and has an average modal composition of 38 percent microcline, 25 percent quartz, 12 percent orthoclase, 11 percent plagioclase, and 12 percent combined hornblende and biotite (M'Gonigle, 1965, p. 11). In general, the foliation of the gneiss is nearly north-south and dips 30° to 60° eastward.

The northern end of the gneiss outcrop area is rimmed by a belt of Tertiary volcanic rocks that form low foothills flanking the more mountainous region underlain by the gneiss. The volcanic rocks are exposed on the west side of the range as far south as the Chinatown mining district. Southward beyond the district Belt and Paleozoic sedimentary rocks unconformably overlie the gneiss.

Most of the production from the district has come from gold placers along Jeff Davis Gulch. The placers are described in a subsequent section of the report. Lode production has come from one mine, the H & S (Hoffman and Steele), and consisted chiefly of oxidized silver-lead ore.

H & S

The H & S mine is in the center of sec. 9, T. 11 S., R. 13 W., at an altitude of approximately 7,400 feet on a low hill overlooking the site of the former mining camp of Chinatown. The properties consist of several unpatented claims held by Ben Davis of Dillon. The workings are easily accessible by means of several interconnecting mine roads leading off from the main dirt road up Jeff Davis Gulch.

The mine is situated along a northwest-trending contact between gneiss and intrusive volcanic rock. As exposed in the underground workings, the gray granite gneiss ranges from predominantly massive with hardly discernible foliation to well foliated. A few layers of biotite schist and coarsely cryststalline marble were also observed in the mine workings.

The intrusive volcanic rocks are feldspathic and range from light-gray and tan felsite to porphyry that contains altered phenocrysts of feldspar in a dark siliceous groundmass. In the lower mine workings, the volcanic rocks in contact with gneiss are brecciated, the breccia zones attaining widths of 100 feet. Most of the breccia fragments are felsite, but some are gneiss and calcite. Some of the breccia is recemented by chalcedonic silica and locally contains cubes of galena and sparse finely disseminated pyrite in the breccia matrix.

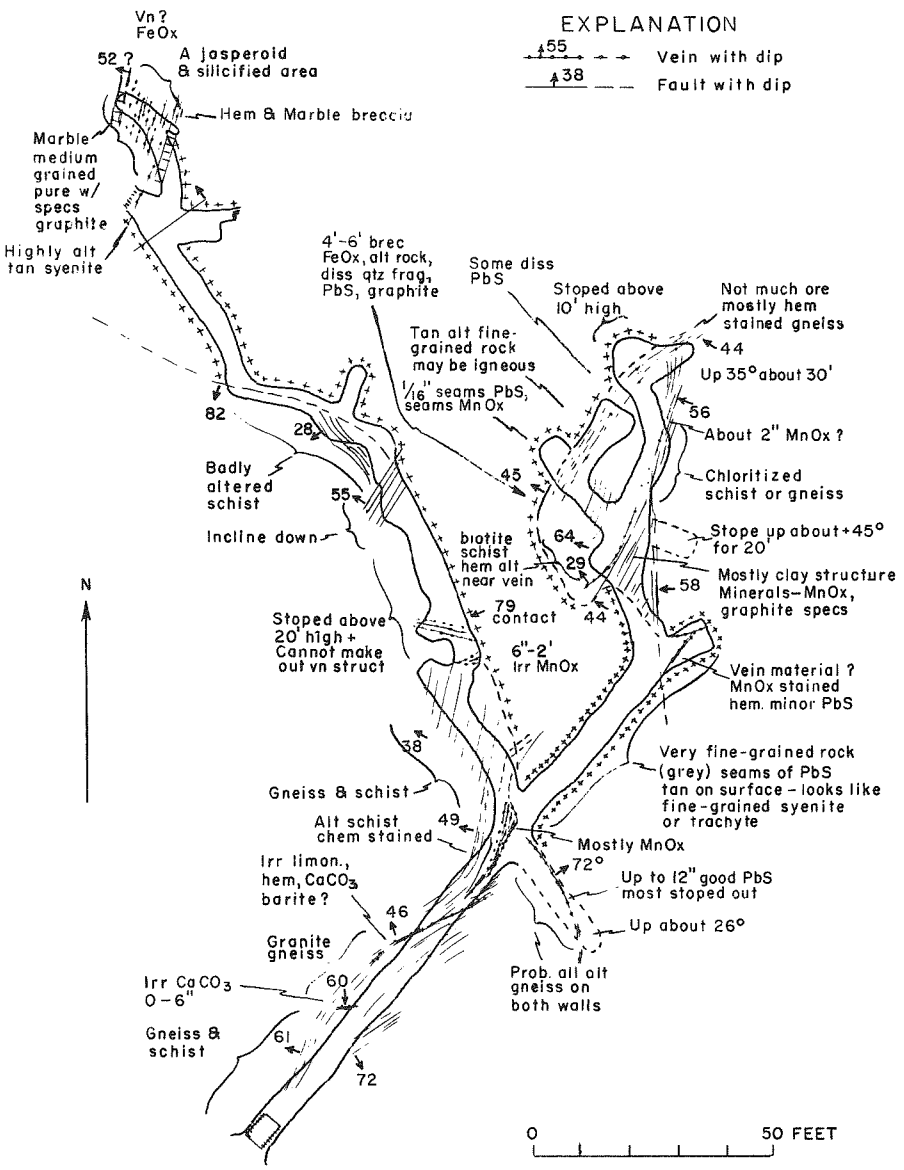


Figure 3.—Geologic plan of upper adit H & S mine, Chinatown district.

Most of the ore is oxidized and contains various amounts of oxidized lead minerals. A characteristic feature is the red earthy hematite generally associated with the ore and staining the country rock near the deposits. Grains of hematite are also disseminated in altered gneiss. Hematite in the ore probably results from oxidation of pyrite, whereas hematite in the gneiss most likely results from alteration of ferromagnesian minerals.

The different kinds of ore include earthy oxidized lead minerals and hematite breccia deposits at the contact between the gneiss and volcanic rock, volcanic rock breccias cemented by chalcedonic silica and galena, jasperoid replacements in coarse-grained calcite beds, and narrow veins in gneiss that contain abundant black manganese oxides and some galena.

The principal workings at the mine are two main adit levels, one about 162 feet above the other, and some surface cuts and shallow shafts. On the upper adit level (Fig. 3), the underground workings total about 500 feet and explore mineralized zones localized along both walls of an elongate northwest-trending plug or dike of light-gray felsite. At its narrowest point where it is exposed along the walls of a crosscut, the plug is about 25 feet thick, but it thickens abruptly on each side of the crosscut. The southwest contact of the plug with the gneiss has been explored over a length of 100 feet. Several small stopes are situated along the contact. Remnants of ore left on the walls of the stopes are predominantly black manganese oxides containing some galena. The largest stope is about 25 feet long, and ore has been stoped overhead and below the sill. From the end of these workings a crosscut about 45 feet long through felsite has exposed a bed of coarse-grained marble replaced by jasper in a zone 9 feet wide. Both the bed and the jasper zone trend N. 15° E. and dip 52° NW. A chip sample across the zone assayed no lead, 0.40 percent zinc, 0.90 ounce silver, and 0.005 ounce gold per ton. At the northeast end of the adit level, a 5-foot breccia zone consisting of altered country rock, jasper, and earthy hematite is exposed. The zone has been pocketed by small chimneylike stopes. A chip sample across the zone assayed 1.10 percent lead, 0.90 percent zinc, 0.60 ounce silver, and 0.001 ounce gold per ton.

The underground workings on the lower adit level aggregate about 1,365 feet and have been driven mostly along the southwest contact of the same plug of igneous rock that is exposed in the upper adit level (Fig. 4). The contact is brecciated and has been explored for more than 500 feet in a northwest direction. The plug has been penetrated by several crosscuts, one of which is 180 feet in length and still in felsite. Near the beginning of this 180-foot crosscut, a northwest-trending mineralized breccia zone impregnated with red hematite is exposed. A chip sample across the zone assayed no lead, 0.30 percent zinc, 0.10 ounce silver, and only a trace of gold per ton. At a distance of 360 feet northwest of the 180-foot crosscut, a short crosscut about 25 feet long has exposed disseminated galena in a breccia of tan felsite. The workings at the northwest end of the adit level exposed a northwest-trending breccia zone stained by earthy red iron oxides. A former lessee of the property reported that a sample taken here assayed about 4 percent lead. Only a small quantity of ore has been stoped from the lower adit level and it was mined from a stope about 10 feet high and 10 feet long in which ¼-inch stringers of galena cut the gneiss.

Total recorded production from the property is 1,293 tons, which yielded 728,908 pounds of lead, 14,977 pounds of zinc, 700 pounds of copper, 11,182 ounces of silver, and 42 ounces of gold.

MAIDEN CREEK COPPER

The Maiden Creek Copper mine is in sec. 23, T. 11 S., R. 13 W. The property is at an altitude of about 8,600 feet and can be reached by a jeep trail that leaves the road up Jeff Davis Gulch at a point about 1 mile east of Chinatown and goes up the ridge between Jeff Davis Gulch and Colorado Creek. The property consists of several unpatented claims located in 1962 by Chester A. Given of Arco, Idaho.

The principal workings consist of an adit on the Maiden Creek Copper claim No. 1. At the time of the writer's visit the adit had been driven about 25 feet to explore a 2-foot quartz vein that strikes N. 8° W. and dips 62° SW. The quartz is copper stained and contains some chalcopyrite. The country rock is well-foliated red granite gneiss; the foliation trends N. 80° W. and dips 16° NE.

The property has no record of production.

LEMHI PASS DISTRICT

The Lemhi Pass district is in the extreme southwestern part of Beaverhead County and is situated in the Beaverhead Mountains. The district is accessible by a graveled county road from Clark Canyon damsite (Armstead) in Montana to Tendoy, Idaho,

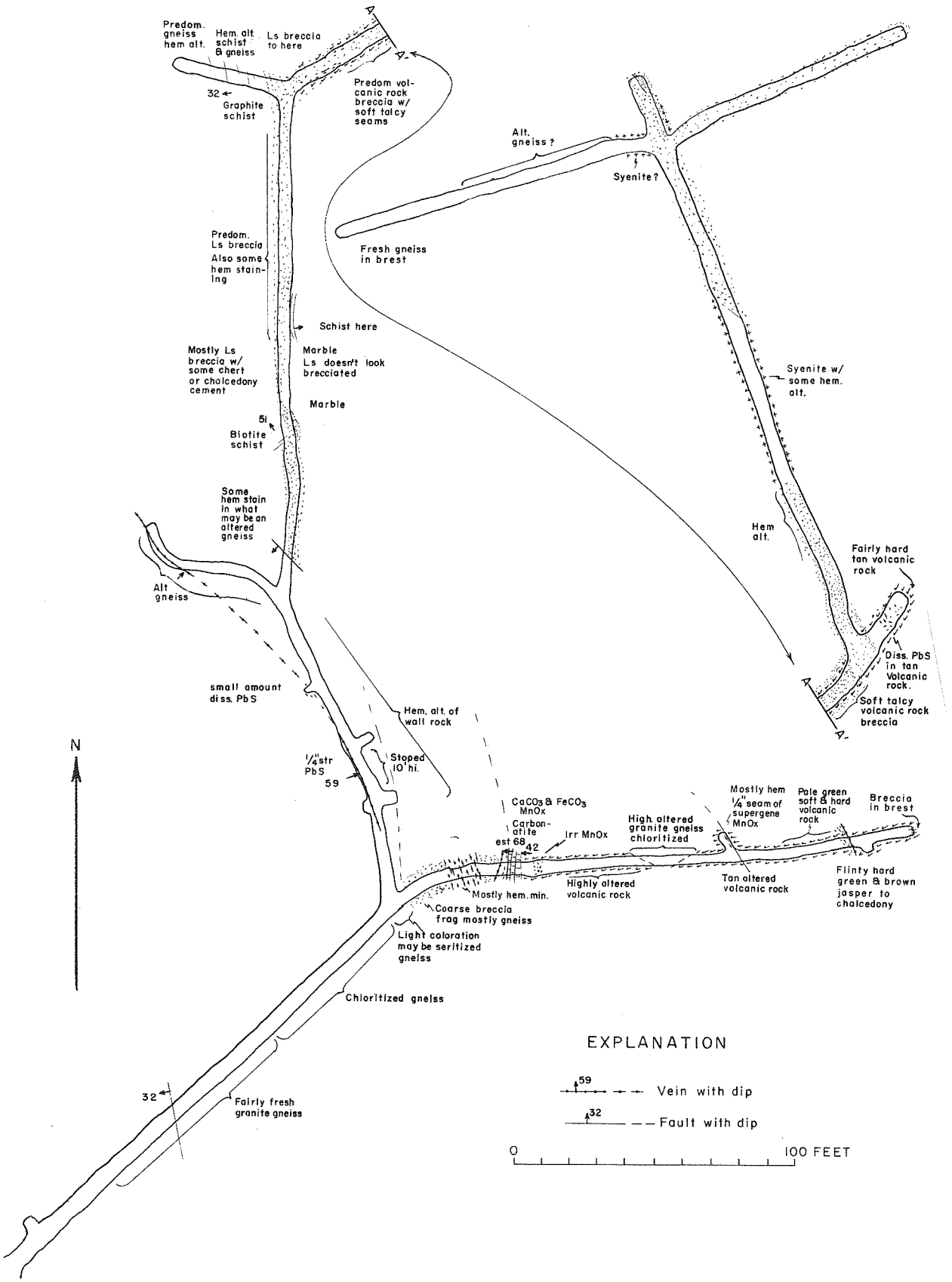


Figure 4.—Geologic plan of lower adit H & S mine, Chinatown district.

that follows the route traveled in the summer of 1805 by the Lewis and Clark Expedition.

The ore deposits of the district have been developed only for their thorium and rare-earth content. Because of small present demand for thorium, however, and because the distribution and quantities of rare-earth elements in the veins are not established throughout the district, development work on the deposits has been confined to surface cuts and very shallow underground workings.

The deposits of the district were described by Moen (1957), Trites and Tooker (1953), Sharp, Hetland, and Granger (1962), and Geach and Matson (1966). The last-cited report is out of print, but the discriptions of the deposits are reproduced in this report. In Montana, the district takes in the region drained by Trail Creek and its tributaries including North and South Frying Pan Creeks, Trapper Creek, and Bear Creek. Relief on the Montana side of the Continental Divide is moderate, not exceeding 2,000 feet within the district. The area is mountainous, but the topography is characterized by rounded spurs generally trending eastward from the main ridge of the divide and paralleling the main stream drainage. The north-facing slopes are well timbered with pine and fir, and park areas, common on south-facing slopes, are covered with bunch grass and sagebrush. Rock outcrops are scarce, and most of the land surface is obscured by vegetation and soil.

Rock Units. — The thorium rare-earth deposits in the Lemhi Pass district are contained in folded and faulted sedimentary rocks of the Belt Series (Precambrian). These rocks are intruded by small dikes and dioritic masses probably of late Mesozoic or early Tertiary age. Erosional remnants of Tertiary volcanic flows and tuffs, presumably correlatives of the Challis volcanics (Oligocene), blanket much of the area. Tertiary lake beds and Quaternary terrace gravels and alluvium cover and encroach upon all older rocks.

Precambrian sedimentary rocks of the Belt Series are the basement rocks of the area and are the predominant rock types exposed in the district. They consist of regionally metamorphosed and sericitized quartzite interlayered with some hard greenish argillite. Where exposed, the quartzite layers are thin bedded to massive, fine grained, and light gray to buff. Iron staining of the beds is common near mineralized zones.

On the Montana state geologic map, Belt strata of the district are tentatively assigned to the Piegan Group. Because of lithologic similarity to the Ravalli Group in the Philipsburg quadrange (Emmons and Calkins, 1913, p. 40), the Lemhi Pass rocks may instead be correlatives of the Ravalli Group (Sharp and Cavender, 1962, p. 6).

In the extreme southeastern part of the district, the predominant rock type is grayish-green argillite containing thin micaceous interbeds of quartzite (Sharp and Cavender, 1962, p. 7). A gradational change between the two units is not evident, owing to thick soil cover, hence a fault contact between the two rock types has been inferred.

The regional trend of the Belt strata is believed to be northwest, but rock attitudes differ greatly from place to place because of faulting, warping, and folding of the strata.

Intrusive igneous rocks make up a small fraction of the total rocks exposed in the area, and occur in the form of small dikes and sill-like masses, predominantly of diorite. One is on state land in sec. 28, T. 10 S., R. 15 W., M.P.M. (Fig. 5), on the south side of South Frying Pan Creek in an area covered by dense growth of lodgepole pine. Medium-grained diorite is exposed in a shallow bulldozer trench. The diorite is somewhat chloritized and the joints are filled with iron oxides, although some of the rock seems fresh and unaltered. Contacts with Belt strata are obscured, but the total area of exposure is thought to be no more than a few hundred square yards. A short distance to the east, a narrow lamprophyric dike, striking N. 60° W. and dipping 63° NE., is exposed in another bulldozer cut. The dike is seemingly a differentiated offshoot of the larger mass and has been altered to an unconsolidated brown-green material in which biotite is the principal mineral constituent. The dike is also associated with thorium and rare-earth mineralization.

Diorite dikes also crop out near the headwaters of both North and South Frying Pan Creeks (Sharp and Cavender, 1962, p. 9). The dike crossing the head of South Frying Pan Creek contains abundant epidote and has a porphyritic texture. Antigorite is present in the small dike at the head of North Frying Pan Creek. Sharp and Cohenour (1962, pl. 1) showed an igneous intrusive rock mass, presumably of dioritic composition, in sec. 27 and 34, T. 10 S., R. 15 W., M.P.M. The mass measures about ½ mile long in a northwest direction and ¼ mile wide. Its north, west, and south edges are in contact with volcanic rocks, but the east edge is in fault contact with Belt strata.

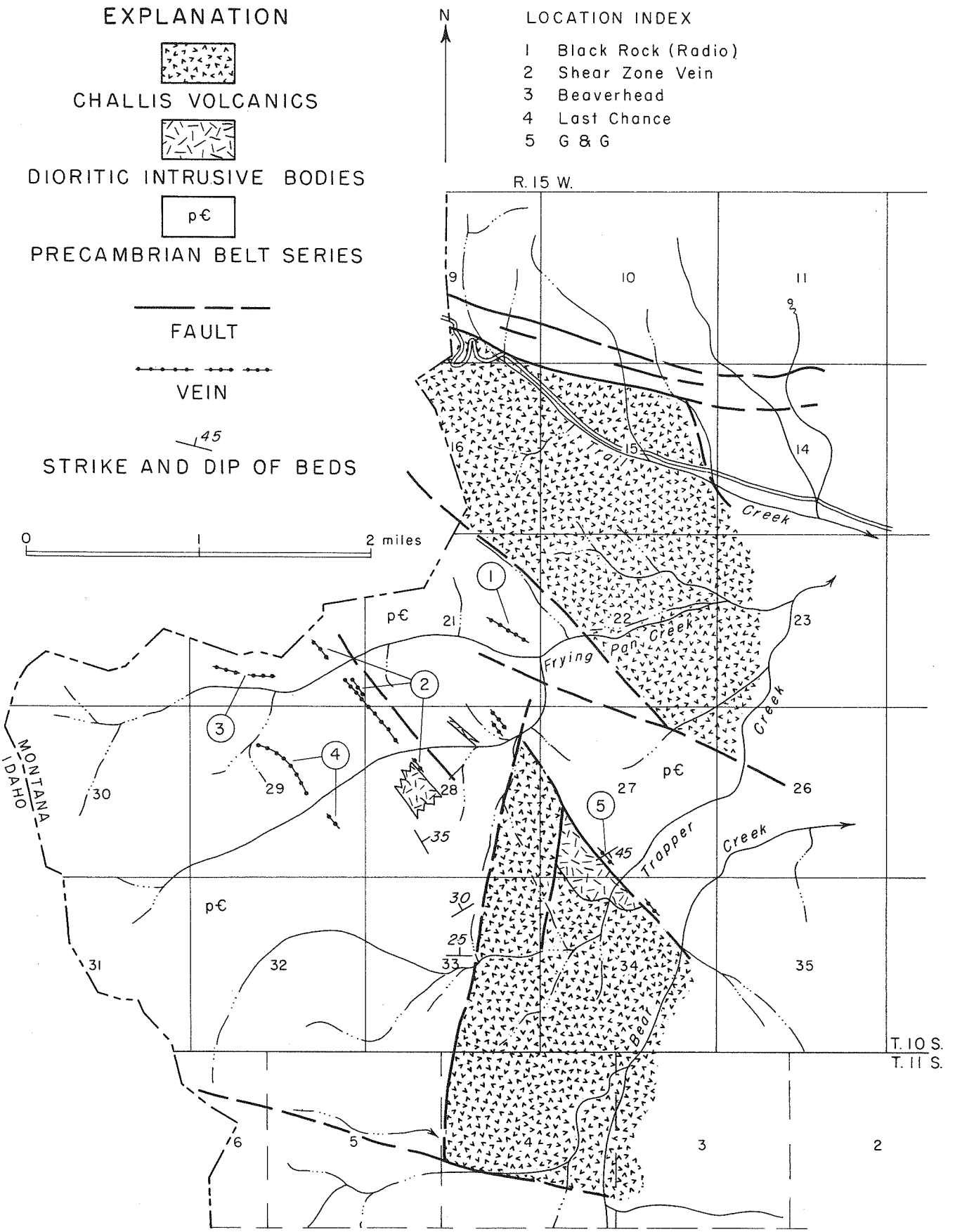


Figure 5.—Geologic map of Montana portion of Lemhi Pass district. (Sharp and Cohenour, 1962).

The age of these intrusive rocks cannot be established except within broad limits of time, as Paleozoic and Mesozoic strata are not present in the district. The intrusive rocks are younger than the Precambrian strata and older than the volcanic flows. Other dikes and sills cutting Belt strata in northeastern Idaho are truncated by an early Eocene erosion surface but show no evidence of being older than the granite of the Idaho batholith. On this basis, Umpleby (1913, p. 46) concluded that most dikes and sills in eastern Idaho are slightly younger than the granite of the Idaho batholith, but are related to a late Mesozoic or early Tertiary volcanic epoch of which the Idaho batholith is the dominant expression. The Lemhi Pass intrusions may be thus dated by inference as late Mesozoic or early Tertiary.

Tertiary volcanic rocks of the district comprise lavas of basaltic and rhyolitic composition and welded tuffs and tuffaceous material of rhyolitic composition. In distribution, the volcanic rocks are more abundant along slopes of the Continental Divide than along the crest and obviously are remnants of larger and more extensive masses that have undergone differential erosion. Contacts with Belt strata are very steep, which indicates fault contacts everywhere (Sharp, Hetland, and Granger, 1962, p. 13).

The cover of volcanic rocks is thin; basalt flows east of the pass may be 100 feet thick but seem to be only a few tens of feet thick. The basalt is dark gray and fine grained to porphyritic. Outcrops along Trail Creek contain about 20 percent olivine crystals, and plagioclase laths are locally abundant in the groundmass. Surface exposures are generally red brown from iron staining. At some outcrops, removal of olivine phenocrysts has given a pock-marked appearance to the rock (Sharp and Cavender, 1962, p. 10).

Rhyolite flows are less abundant than basalt flows and generally occur in patches higher on mountain slopes. The rhyolite flows are probably not more than several tens of feet thick, and outcrops conform generally to the configuration of the pre-volcanic land surface. The rhyolite is light gray and greenish gray and weathers to white, purple white, red brown, or light green. The groundmass is commonly fine grained and contains phenocrysts of quartz and sanidine. Some biotite, hornblende, and plagioclase may be present. A rhyolite flow southeast of the pass contains small amygdules filled with greenish silica (Sharp and Cavender, 1962, p. 11).

The largest area of pyroclastic material exposed on the Montana side of the divide is a narrow elongate mass extending at least 2 miles southeast along the divide crest. At its northern edge it is cut off by the Lemhi Pass fault zone. The pyroclastic rocks of the Lemhi Pass area (Sharp and Cavender, 1962, p. 11) are welded tuffs containing small crystal fragments of quartz, biotite, and sanidine, as well as evenly distributed fragments of dark-gray Belt country rock in a fine-grained groundmass. The tuff is gray to pink to green on fresh surfaces, and weathers white.

The lava flows of Lemhi County, Idaho, are dated by Umpleby (1913, p. 49) as later than Eocene, based on evidence that lava fills valleys carved by Eocene erosion and is interbedded with Miocene lake beds, although in some places lava underlies Miocene lake beds.

Structure and Faults. — The regional trend of the Belt strata is believed to be northwest parallel to Beltian geosynclinal deposition, although folding, warping, and faulting are locally complex, and rock attitudes differ greatly from place to place. Sharp and Cavender (1962, p. 17) reported that beds of the Belt Series in most of the area have a general northerly dip ranging from 20° to 50°. Anderson (1958, p. 48) mapped beds about 2.5 miles east of Tendoy, Idaho, that trend N. 60° W. and dip 45° SW., however, and farther northeastward the beds trend N. 30° to 60° W. but dip 25° to 70° NE. This change in dip may indicate a broad anticline of northwesterly trend as the principal geologic structure of the area.

The Lemhi Pass fault is the major lineament in the area (Fig. 5). It is a nonmineralized fault zone that strikes N. 70° W. and dips generally south at 60° or more. The width of the zone is 350 to 1,000 feet. On the Idaho side of the divide the zone has been traced for more than 6 miles; it passes underneath Tertiary lake beds along the east flank of Lemhi Valley. On the east side of the divide it seemingly becomes aligned with Trail Creek and may continue farther eastward beneath alluvium of Horse Prairie Valley. On higher slopes the fault zone is marked by hummocky terrane, ridge saddles, and flowing springs. Movement along the fault zone probably totals several hundred feet (Sharp and Cavender, 1962, p. 17).

A second fault system, which has a uniform strike of N. 35° W., is also represented in the district. A major member of the system branches south from the Lemhi Pass fault at about the center of sec. 9,

T. 19 N., R. 25 E., in Idaho, and continues on a uniform strike of S. 35° E. for at least 5 miles into Montana. Three thorium-bearing deposits are adjacent to this fault zone, the Wonder Lode and Wonder Lode 18, both in Idaho, and the Shear Zone vein in Montana. The Shear Zone vein, which has been delineated by prospect pits and trenches for more than a mile in length, is a mineralized shear zone, and within acceptable limits parallels the general trend of the system. Proximity of deposits along northwestward-trending regional faults suggests that faults of this trend may be genetically related to or have some important influence on the veins in the district.

A third fault system trends north to northeastward. This system is the last stage of regional faulting in the area and has the effect of cutting areas bounded by the two other fault systems into more or less triangular fault blocks.

Vein System. — The veins in the Lemhi Pass district can be divided into two sets of fissures based on physical differences. Mine openings and surface exploratory work are as yet insufficient to permit determination of the relative ages of these two sets. Veins of an east-west trend are classified as true tension fractures, whereas veins of a northwest trend are shear fractures.

The east-west set of veins is represented by the Last Chance-Shady Tree vein and the lenticular quartzose masses cropping out on the Beaverhead and Trapper No. 1 lode claim. The Last Chance-Shady Tree vein is a long, more or less continuously mineralized fracture. The walls of the vein are distinct and regular along most of its length, but in some places vein contacts with the country rock are irregular and indefinite, indicating some replacement or silicification of the wall rock. The width of the main vein is as much as 30 feet at its northwest extremity where the strike of the vein assumes more of an east-west trend. The quartzose masses on the Beaverhead and Trapper No. 1 claim are essentially west striking, but are lenticular, attaining widths of 100 feet (Sharp and Cavender, 1962, p. 35). Silicification or partial replacement of the wall rock is more extensive in comparison with the Last Chance-Shady Tree vein. The extreme widths of these veins, excluding the effects of replacement, suggest that maximum tensile stress on the country rock was concentrated primarily along a north-south direction perpendicular to the trend of the system.

The shear fracture veins represent a system in which the shearing stress acting on the country rock reached its maximum value. A representative of this system is the Shear Zone vein. Sharp, Hetland, and Granger (1962, p. 25) characterized this vein as "a series of shears, splits, and lenses along a near-vertical zone of at least 6,000 feet in length . . . Ore pods occur en echelon within a zone in which crushing and horizontal movement are reflected by offset pods and clay gouge seams. Although the width of the zone may be measured in tens of feet, the separate pods and ore stringers are usually not more than 2 feet in width."

Mineralogy. — The mineral assemblage in the veins of the district is unusual. The principal gangue minerals are quartz, specular hematite, barite, secondary iron oxides, and manganese-rich brown and black hydrous iron oxides. Thorium-bearing minerals that have been identified are thorite, monazite (?), and thorogummite. Rare-earth minerals have not been identified, but rare-earth elements have been detected by x-ray spectrographic analysis.

Quartz is the principal gangue mineral and is invariably fractured or brecciated. In vein segments of high thorium concentration, quartz is dark reddish brown, probably from included hematite and thorite, whereas in areas of lower thorium concentration, it is predominantly vitreous and milky white. Some quartz is also admixed with hydrous brown iron oxides, forming a brown to tan jasperoid. Thorium also seems to be concentrated to a lesser degree in jasperoid.

Specular hematite occurs not only in the veins but also along joints and cracks in the country rock. In the veins it is disseminated and occurs as microscopic grains distributed throughout the vein filling or as blebs readily visible to the eye. Thorium seems to have no affinity for the larger blebs but is closely associated with fine-grained specularite. In some Idaho deposits (Anderson, 1958, p. 53) there seem to be two generations of specularite — one fine grained and accompanied by thorium, the other coarse grained with or without thorium.

Barite is locally abundant in the Last Chance vein and also occurs in the Black Rock No. 1 (Radio) vein (Sharp and Cavender, 1962, p. 22). In the northwest extension of the Last Chance vein, barite is a major constituent of the vein. In a section of the vein that is vuggy and contains open cracks, barite occurs in masses weighing several tens of pounds. It is white to pinkish, massive, and somewhat stained by iron oxides. In the Black Rock No. 1 vein, barite is not especially abundant. Most of the barite

Table 4.—Thoria and rare-earth analyses

(X-ray spectrographic)

Location	Width, feet	Thoria (chemical)	Cerium group						Terbium group				Yttrium group					
			Lanthanum	Cerium	Praseodymium	Neodymium	Promethium	Samarium	Europium	Gadolinium	Terbium	Dysprosium	Holmium	Erbium	Thulium	Ytterbium	Lutetium	Yttrium
Trapper No. 4, [1] Shear Zone vein	1.5	3.66	--	--	--	D		D	--	D				--		E		D
Beaverhead[1]		0.66	D	D	D	C		C	D	D				--		E		D
Trapper No. 4, [1] Shear Zone vein	1.5	0.68	--	--	--	--		--	--	--				--		E		E
State land, [1] Shear Zone vein	1.5	2.25	--	--	--	--		--	--	--				--		D		C
Trapper No. 1[2]			D	C		C		C		C								D
Last Chance vein (south of South Frying Pan Creek)[1]		0.19	--	--	--	D		--	--	--				--		E		D
Last Chance vein[2]			D	C		C												D
Last Chance vein DDH 1-A[2]			E	D		D		D	D	D		E				F		E
Last Chance vein B[2]																F		E
Last Chance vein C[2]																F		E
Last Chance vein D[2]																F		E
Last Chance vein E[2]			E	D		D			D			E				F		D
Last Chance vein DDH 3-A[2]			E	D		D			E	D						E		E
Last Chance vein B[2]						E			E							E		E
Last Chance vein C[2]						E												E
Last Chance vein F[2]																		E
Last Chance vein G[2]																		E
Last Chance vein H[2]																		E
Last Chance vein J[2]				D		E			E	D								E
Black Rock No. 1 vein (State land)	6	0.82		--	--	D		--	--	--				--		D		D
	6	0.70		--	--	D		--	--	--				--		D		D

--, not detected
A, probably > 10%
B, probably 1 - 10%
C, probably .1 - 1%
D, probably .01 - .1%
E, probably .001 - .01%
F, probably .0001 - .001%
[1]Analysis provided by Atomic Energy Commission.
[2]Modified from Sharp and Cavender (1962, p. 31, 33).

in the veins is of microscopic size and cannot be distinguished by the unaided eye.

Thorite ($ThSiO_4$) is found as disseminated crystals in quartz and barite, and also as minute particles in irregular dark-red-brown streaks and masses along fractures in the veins. Both crystalline and metamict thorite have been identified (Sharp and Cavender, 1962, p. 23). Freshly broken crystals of thorite have a vitreous luster, but thorite weathers to a dull earthy appearance after exposure. The hydrated form of thorite is thorogummite, which is found in surface oxidized portions of the veins.

Monazite has not been definitely recognized as a mineral constituent in the veins. Sharp and Cavender (1962, p. 23) inferred its presence because they found minute mineral aggregates of a mineral having similar optical properties in association with thorite crystals and as isolated blebs in quartz.

Rare-earth elements in the veins have been detected by x-ray spectrographic analysis, but the mineralogical form, distribution, and quantities of the elements are not established throughout the district. Rare-earth mineralization is probably associated spatially with thorium mineralization. From the few x-ray spectrographic analyses available, it seems that yttrium is the dominant rare-earth element, followed by elements belonging to the cerium group and the terbium group respectively (Table 4).

BLACK ROCK NO. 1

The Black Rock No. 1 (formerly the Radio) vein zone is north of North Frying Pan Creek in sec. 21, T. 10 S., R. 15 W. Most of sec. 21 is owned by the State of Montana. The mining lease on sec. 21 is held by Harry Katseanes and Harvey Bell of Blackfoot, Idaho.

The veins are exposed in a 10-foot prospect shaft, probably dug about the turn of the century, and in bulldozer trenches (Fig. 6). A vein zone 2 feet wide exposed along the walls of the pit consists of two small stringers 4 inches wide separated by about 1 foot of wall rock stained with iron oxide. The zone

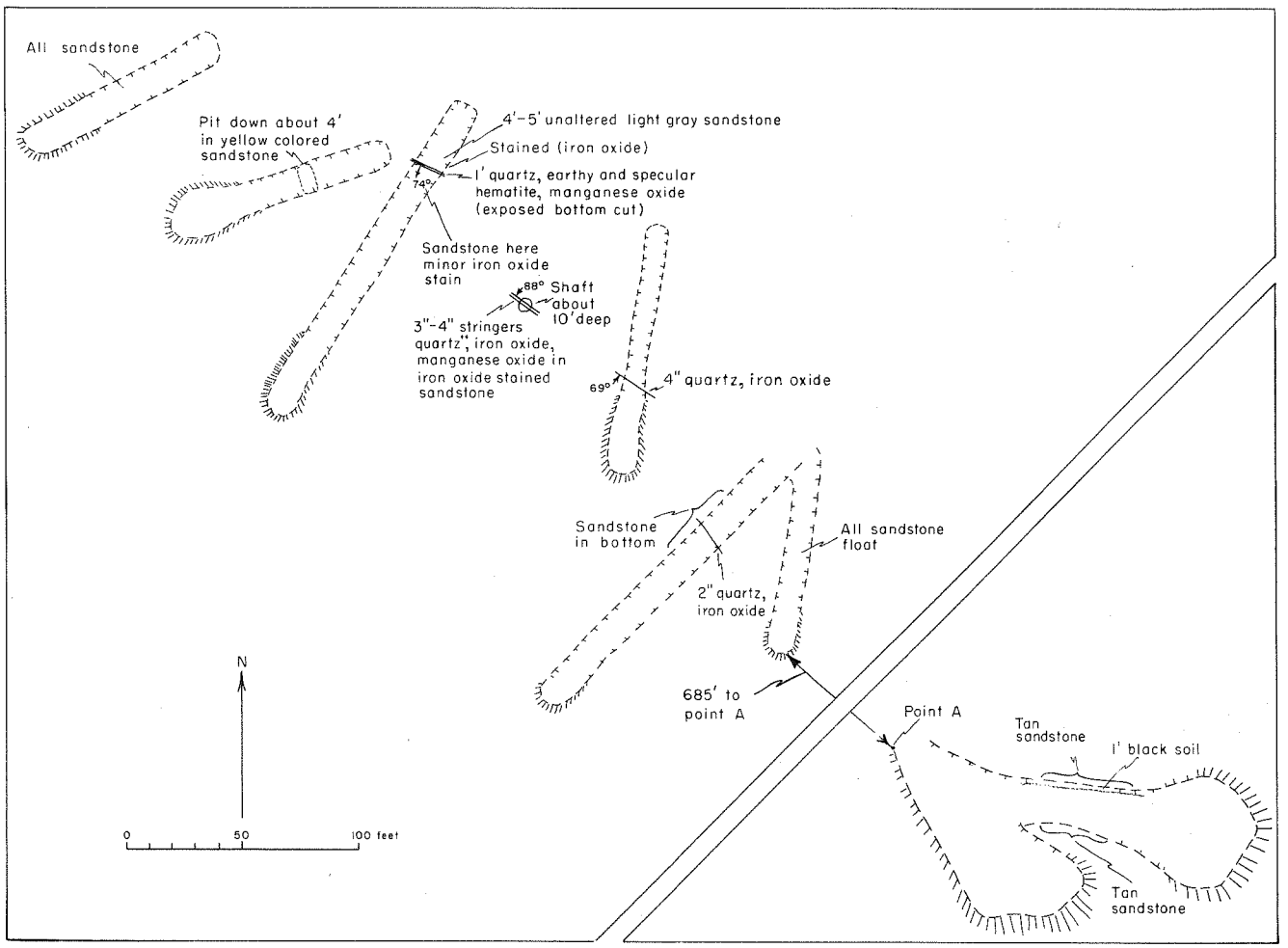


Figure 6.—Geologic map of state-owned ground, sec. 21, T. 10 S., R. 15 W.

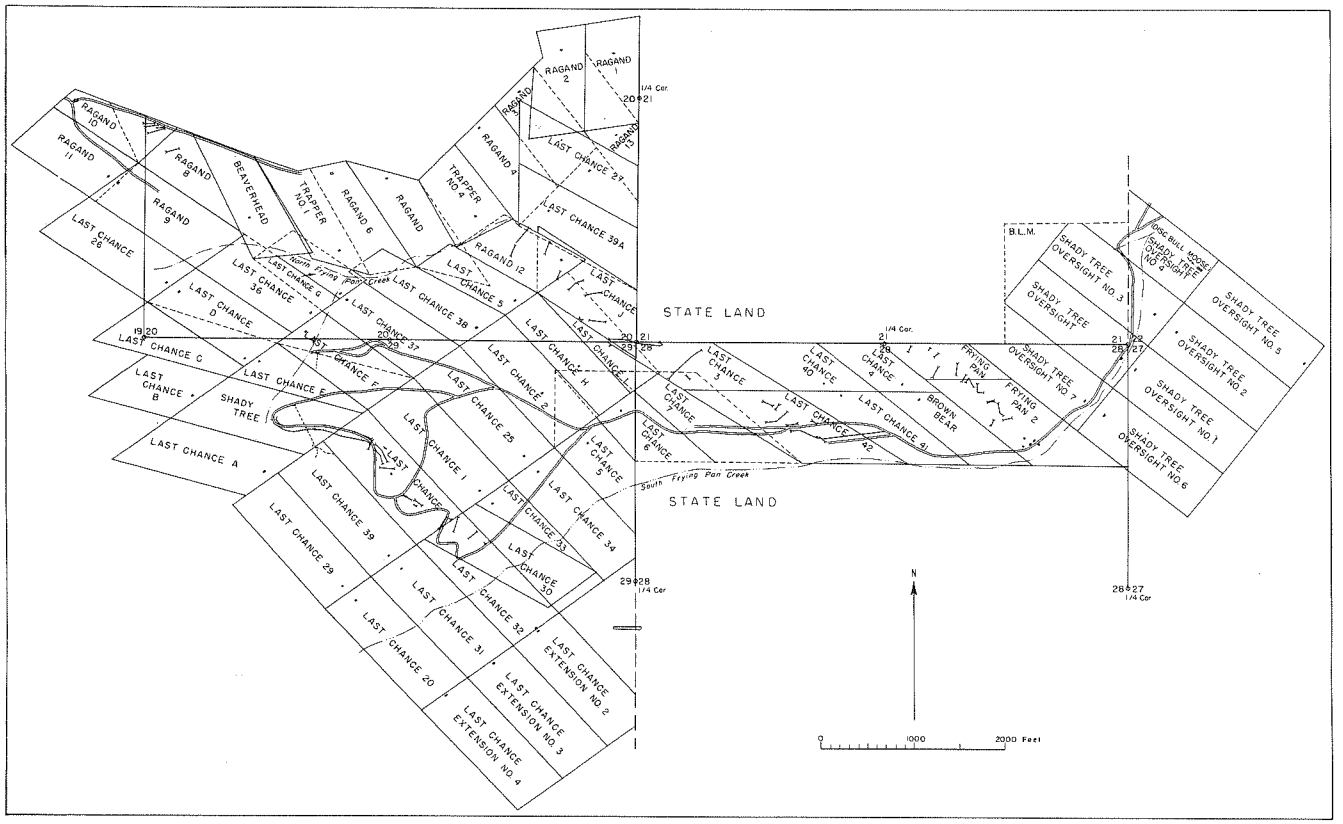


Figure 7.—Claim map of Sawyer Petroleum Company.

strikes N. 35° W. and dips 88° SW. The vein filling consists of dark quartz, hematite, jasperoid, brown-black manganese oxides, and minor pale-green smithsonite. The country rock is altered to tan friable sandstone locally stained with iron oxide near the zone. About 75 feet northwest of the prospect pit, a bulldozer cut has exposed a dark quartz vein about 1 foot wide trending N. 65° W. and dipping 74° SW. This vein is similar in mineralogy to the stringers exposed in the prospect pit. A sample across the vein assayed 0.78 percent ThO_2 and 2.90 percent Zn.

Sharp, Hetland, and Granger (1962, p. 25) traced the Black Rock No. 1 vein zone by radiometric surveys and reported that anomalies in the overburden indicate that the zone is at least 4 feet wide over a length of 2,000 feet.

The vein exposed in a bulldozer cut on the Shady Tree Oversight No. 4 (Bull Moose) claim in sec. 22, T. 10 S., R. 15 W., may possibly be a southeast continuation of the Black Bear No. 1 vein. The vein is 1 to 4 inches wide, trends N. 43° W., and is 60 feet long (Sharp and Cavender, 1962, p. 41).

BROWN BEAR AND FRYING PAN

The Brown Bear and Frying Pan claims are in sec. 28, T. 10 S., R. 15 W., about half a mile east of the Shear Zone vein. The properties, located in 1949 and 1950, were originally owned by R. A. Wellborn and Associates. In 1950, the Brown Bear property was leased to the Elkhorn Mining Company of Boulder, Montana, but both properties were acquired subsequently by Sawyer Petroleum Company of Los Angeles, the present owner.

No underground workings explore the veins, but veins are exposed by several bulldozer cuts on the claims (Fig. 7). Small quartz veins 6 to 8 inches wide are exposed within a zone 300 feet wide. They trend northwestward and dip steeply southwest. The country rock is fine-grained light-gray Belt quartzite that is bleached and stained with iron oxide along the vein zones. The veins occupy faults and are minutely fractured. The fractures are filled with hematite, thorium-bearing minerals, and limonite. Thorite is present as small blebs in quartz, but most of the thorium is in the limonite fracture filling.

Manganese-rich brown and black hydrous iron oxides are abundant in fractures parallel to the veins and in jasperoid (Sharp and Cavender, 1962, p. 39).

LAST CHANCE-SHADY TREE

The Last Chance-Shady Tree vein is in sec. 29, T. 10 S., R. 15 W. Lode claims were first staked on the vein by R. A. Wellborn, Grant, Montana. In July 1950 the properties were leased to the Elkhorn Mining Company of Boulder, Montana, and subsequently acquired by Sawyer Petroleum Company of Los Angeles.

The Last Chance-Shady Tree vein has been delineated over the divide between North Frying Pan Creek and South Frying Pan Creek for a horizontal distance of 2,000 feet (Fig. 7). The vein trends N. 70° W. and dips about 60° SW. at its southeast extremity. The northwest extremity of the vein, however, strikes N. 80° W. and dips about 63° SW.

Development on the vein consists of two adits about 2,000 feet apart and an 80-foot shaft sunk on the vein near the top of the divide. Numerous bulldozer cuts and trenches have further exposed the vein along its length.

The 7220 adit, started in 1960, is near South Frying Pan Creek and was driven northward (Fig. 8). The adit crosses the vein near the portal and then parallels the vein on the footwall side for about 200 feet, then recrosses the vein about 300 feet from the portal. The width of the vein exposed at these two places is 7 feet and 22 feet, respectively. The vein filling is composed of dark-red-brown fractured quartz, jasperoid, and brown iron oxides. The country rock is green argillite that is sericitized and stained with red iron oxides. Bedding is obscured, but the formation seemingly strikes N. 65° W. and dips 75° SW. The thoria assay is not known along this particular segment of the vein, but radiometric probes of drill holes into the vein indicate a thoria content exceeding 1 percent (Sawyer Petroleum Co., written communication).

The 80-foot shaft near the top of the divide is about 1,000 feet northwest of the portal of the 7220 adit. The shaft is sunk on the footwall of the vein. A short crosscut driven west from the bottom of the shaft is about 22 feet long and exposes the vein from footwall to hanging wall. The vein is 14 feet wide along the crosscut, and the thoria content is reported to be 0.62 percent (Sawyer Petroleum Co., written communication).

The northernmost workings on the Last Chance-Shady Tree vein are about 2,000 feet northwest of the 7220 adit portal and consist of an adit at an elevation of 7,400 feet and an open cut dug along the vein for about 300 feet. The 7400 adit (Fig. 9) is driven southward through a quartzite unit, which strikes about N. 70° W. and dips 35° NE. The main vein was intersected about 500 feet from the portal and at about 150 feet below the surface cut. The full width of the main vein as exposed is about 30 feet. The vein filling consists of dark-red-brown quartz, red-brown iron oxides, and some disseminated specularite. A conspicuous yellowish

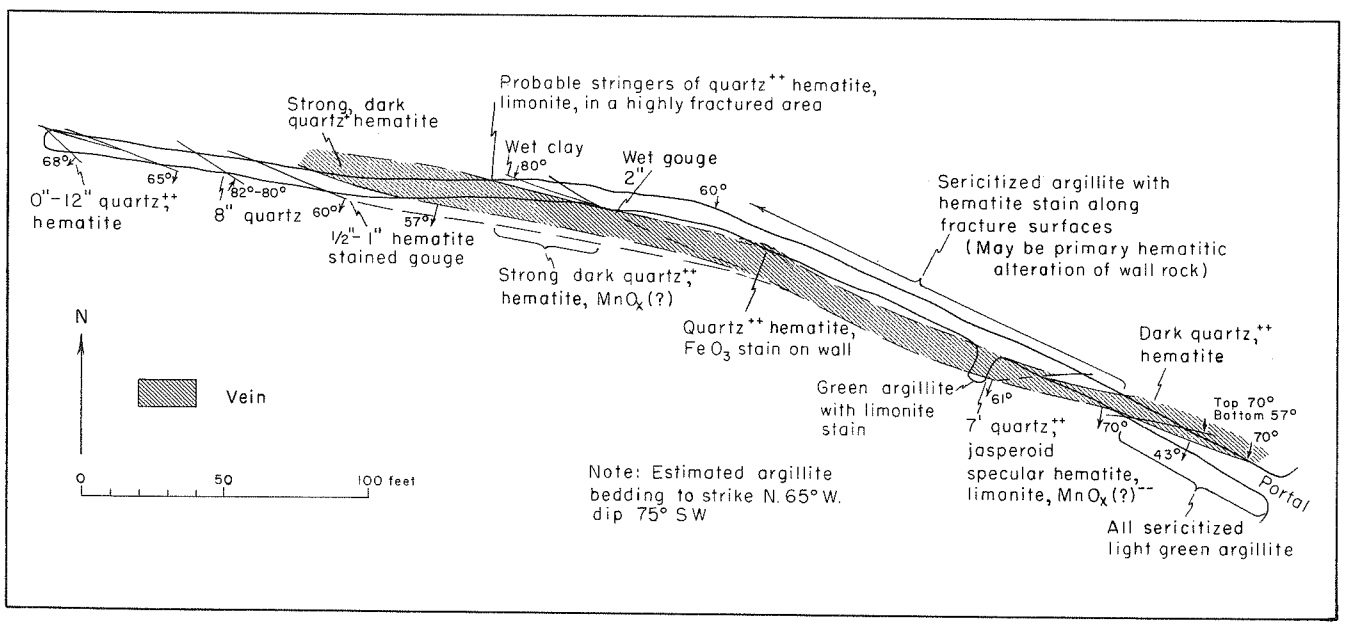


Figure 8.—Geologic plan map of 7220 adit, Last Chance-Shady Tree vein.

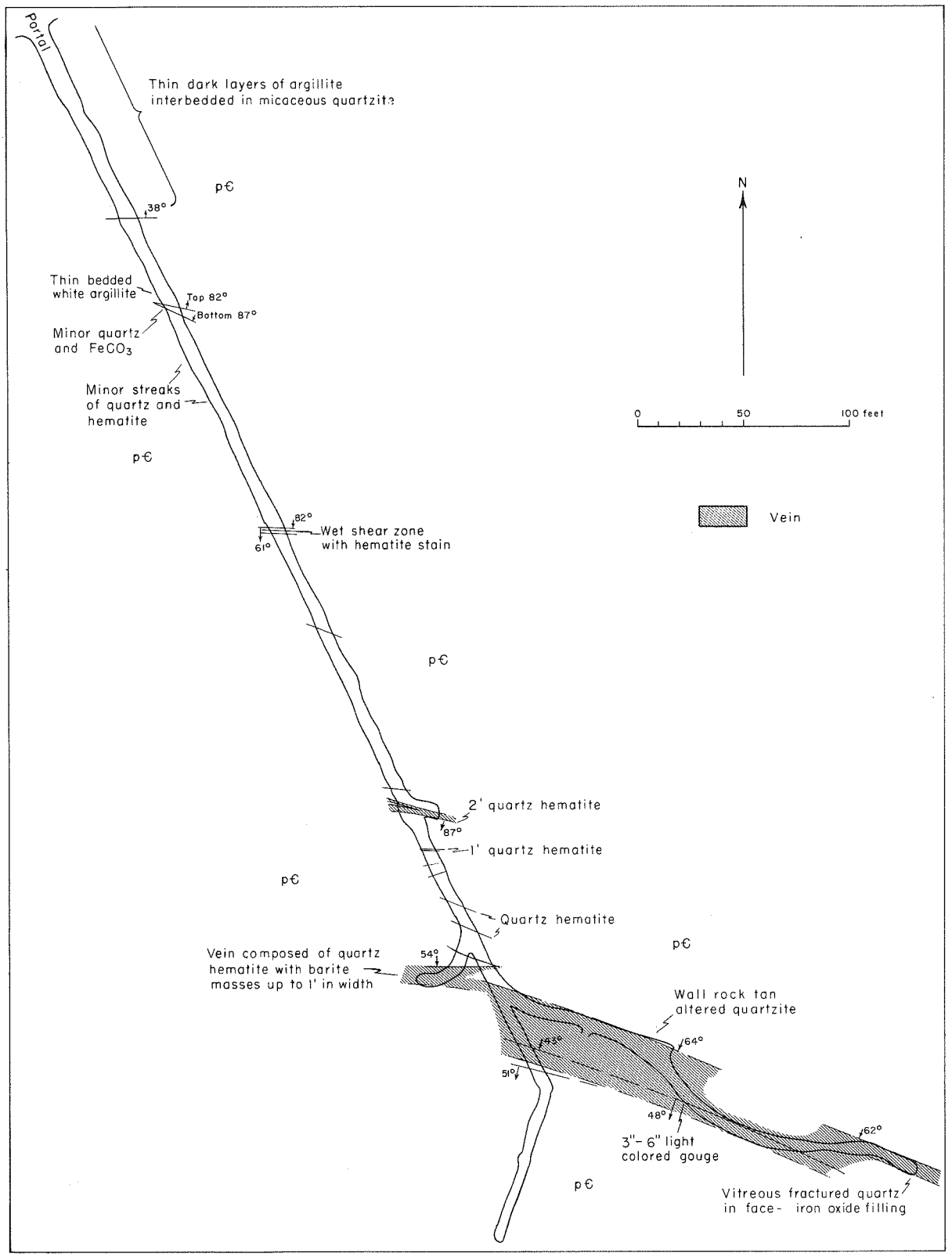


Figure 9.—Geologic plan map of 7400 adit, Last Chance-Shady Tree vein.

fault gouge as much as 6 inches wide cuts across the vein at a dip of 43° SW. with no evidence of dip-slip movement. The footwall section of the vein is developed by east and west drifts. The west drift is 30 feet long, and the vein at the face contains abundant white and pinkish barite stained by brown iron oxides. The east drift, about 150 feet long, follows a sinuous course more or less along the footwall of the vein. The face of the east drift contains fractured vitreous milky white quartz and fracture filling of red-brown iron oxides.

The thoria content of the vein exposed underground is reported (Sawyer Petroleum Co., written communication) to be 1.211 percent. Ore reserves in the Last Chance-Shady Tree vein are calculated by Sawyer Petroleum Company (written communication) to be 692,520 tons averaging 0.669 percent thoria, based on a cutoff grade of 0.25 percent thoria, over a length of about 2,000 feet and a projected depth of 250 feet below the vein outcrop.

SHEAR ZONE

The Shear Zone vein lies about ½ mile northeast of the Last Chance-Shady Tree vein. The vein zone has been delineated over a mile in length by prospect pits and trenches. No underground workings have been driven to explore the zone at depth.

The northwest extension of the zone lies near the Idaho border and is on the Trapper No. 4 claim, which is controlled by Nuclear Fuels and Rare Metals Company. Bulldozer cuts have exposed a quartz vein about 1½ feet wide over a length estimated to be 500 feet. A similar subsidiary vein lies 70 to 80 feet northeast and is exposed for about 50 feet. The vein filling is similar to that of the Last Chance-Shady Tree vein, but contains abundant dusty limonite. Thorite is present as blebs in fractured quartz. A sample taken at the main bulldozer cut assayed 2.11 percent ThO_2 and 1.50 percent Re_2O_3 (Sharp and Cavender, 1962, p. 65).

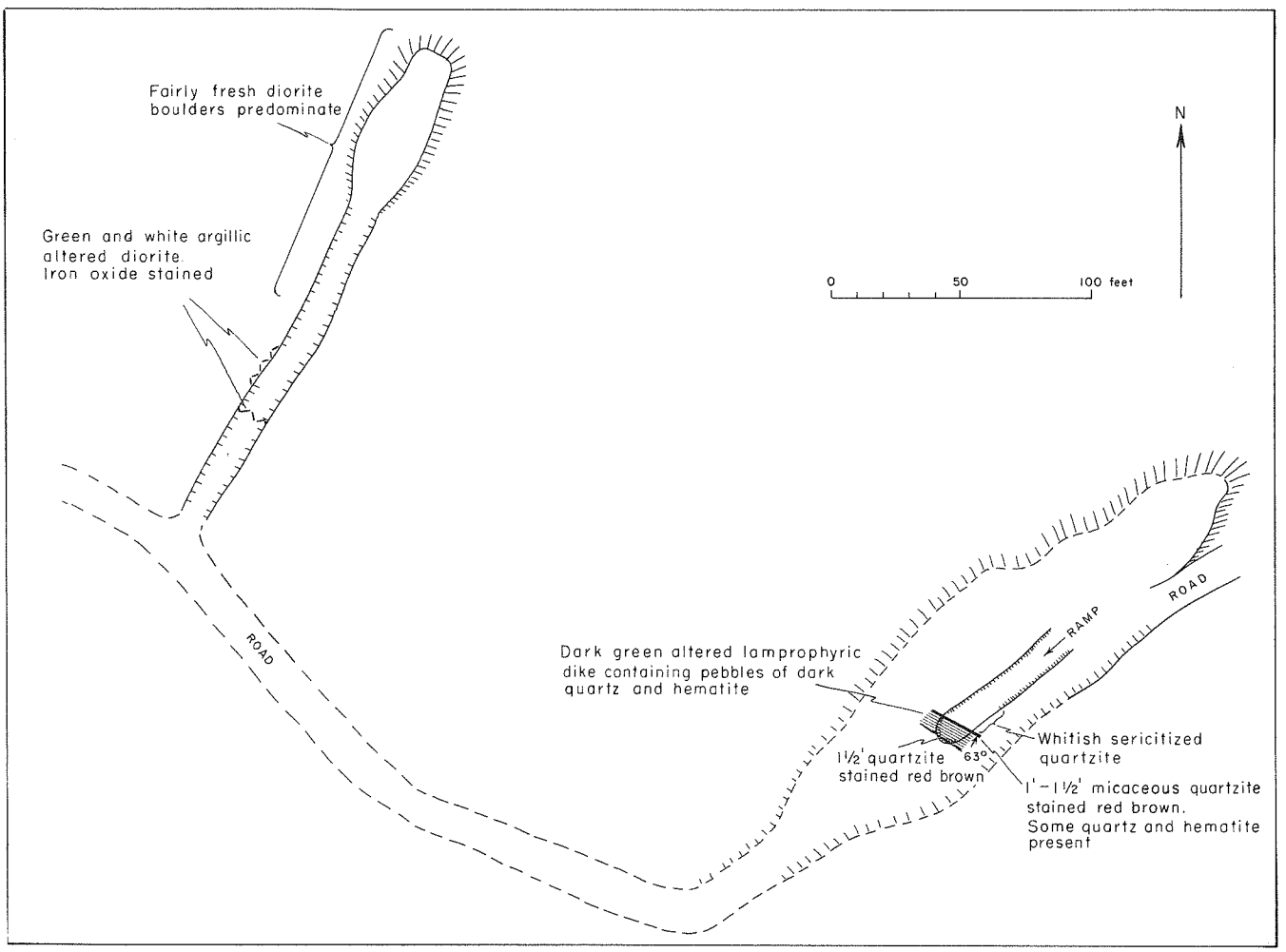


Figure 10.—Geologic map of state-owned ground in sec. 28, T. 10 S., R. 15 W.

The middle segment of the zone is on ground controlled by Sawyer Petroleum Company, and the southernmost extension of the zone in sec. 28, T. 10 S., R. 15 W., across South Frying Pan Creek, is on ground owned by the State of Montana. The state ground is under mining lease to Harry Katseanes and Harvey Bell of Blackfoot, Idaho.

Development work on state ground consists of two bulldozer trenches, in only one of which is a mineralized zone exposed (Fig. 10). The zone trends N. 60° W., dips 63° NE., and is exposed in the easternmost cut. A red-brown quartz vein about 1 foot wide heavily stained with red-brown iron oxides forms the hanging wall of the zone and rests against a crushed greenish-brown igneous dike 6 feet wide in which biotite is the prominent mineral constituent. The footwall section of the dike also contains fragments of dark quartz and hematite. The wall rock is bleached micaceous quartzite stained with iron oxide. A chip sample across the vein assayed 3.23 percent ThO_2, and a chip sample across 3 feet of the footwall section of the dike containing quartz fragments assayed 0.78 percent ThO_2. No thoria was detected by chemical assay of samples from other parts of the zone.

TRAPPER NO. 1 AND BEAVERHEAD

The Trapper No. 1 and Beaverhead (formerly Lucky Strike) claims are in sec. 20, T. 10 S., R. 15 W., at the Idaho border. These deposits consist of lenticular quartzose zones enclosed in gray micaceous Precambrian quartzite.

On Trapper No. 1 claim, the largest outcrop measures 60 feet wide and 100 feet long. A strong fault or shear zone is present along the hanging wall of the vein. The trend of the fault is almost due east and the dip is 50° to 70° S. Small outcrops west of the main mass, mapped by Sharp and Cavender (1962, p. 32), indicate a continuous silicified zone 600 to 700 feet long. The east end of the vein is offset to the south by north-striking faults dipping steeply to the east. The horizontal offset is about 100 feet.

On the Beaverhead (Lucky Strike) claim, the major quartzose body trends N. 70° E. but dips steeply to the north. The silicified zone is more than 100 feet wide in places and probably extends for more than 700 feet across the claim. The center of the deposit contains a horse of moderately altered Belt rock. Three sets of faults cut the quartzose lens,

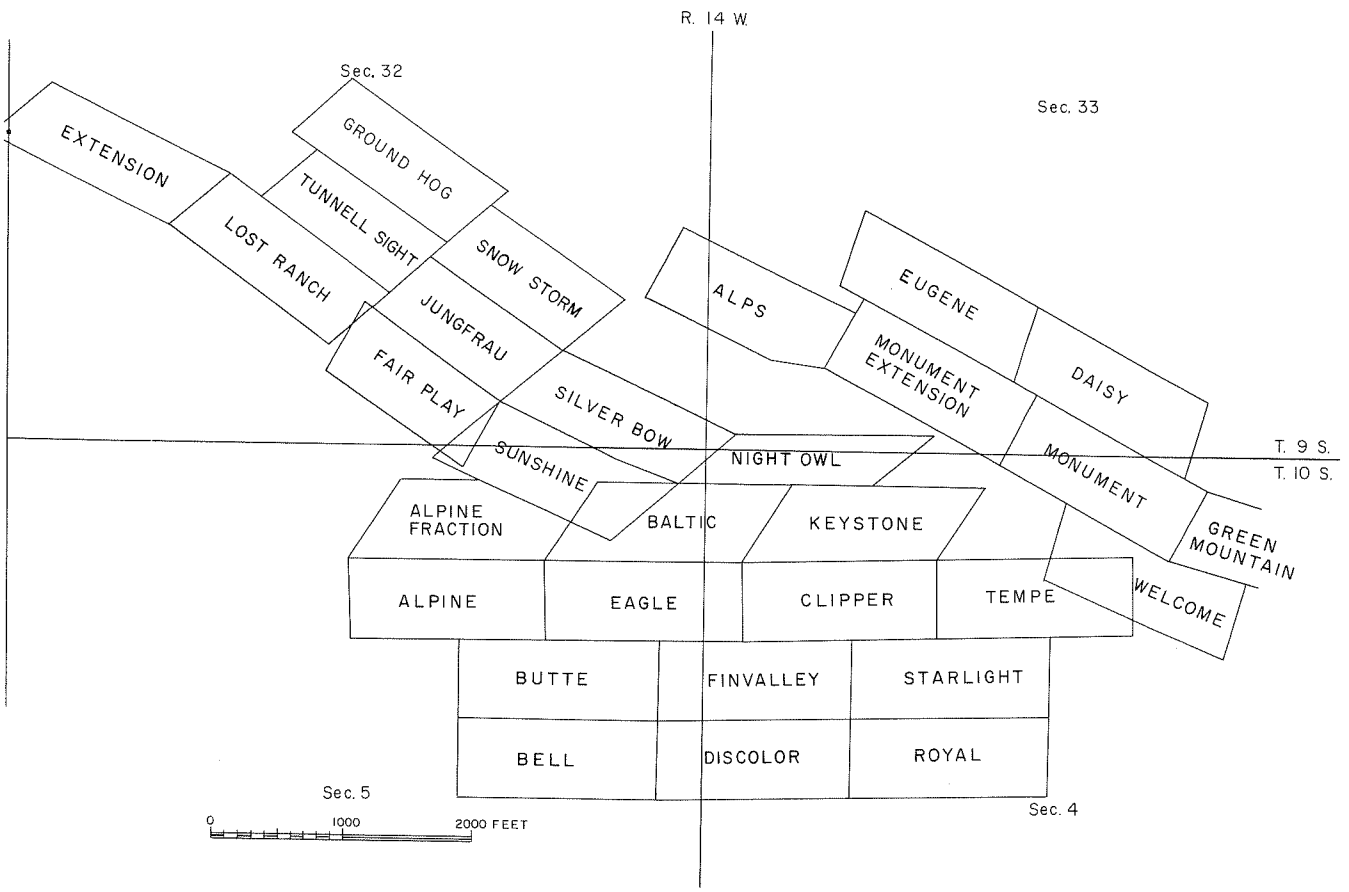


Figure 11.—Claim map of Monument (Beaverhead) district.

but horizontal displacements are nil or very small. One set trends N. 70° W., the second set trends N. 45° W., and the third set trends about N. 60° E.

The southernmost quartzose body on the Beaverhead claim is a lenticular mass trending N. 80° W. and dipping 55° southward. The silicified zone is 600 feet long and as much as 50 feet wide. It seems to have an en echelon relationship to the quartzose lens on the Trapper No. 1 claim.

These quartzose lenses are mineralogically similar to the Last Chance-Shady Tree vein. The quartz is locally dark or vitreous and milky white, but is invariably fractured. Silicification as replacement of the wall rock, however, is more extensive. The fractures in the quartz are filled with red-brown iron oxides. Thorite occurs as red-brown blebs and as minute crystals throughout the quartz, but most of the thorium is found in the red-brown fracture fillings (Sharp and Cavender, 1962, p. 36).

MONUMENT (BEAVERHEAD) DISTRICT

The Monument (Beaverhead) district is about 28 miles west of the Clark Canyon dam and can be reached via State Highway 324, which begins at the damsite and continues up Horse Prairie Valley, and thence by a graveled county road up Bloody Dick Creek. For the purpose of this report, the district is defined as the land included in sec. 31, 32, and 33, T. 9 S., R. 14 W., and part of the land in sec. 4, 5, and 6, T. 10 S., R. 14 W.

No satisfactory geologic map of the district has been published, but a claim map of the district is shown in Figure 11. On the state geologic map (Ross, Andrews, and Witkind, 1955), the bedrock of the district is shown as Missoula Group. The lode deposits of the district, however, are contained in metamorphic rocks, gneiss, and schist that crop out over an area of about 4 square miles. The overall trend of these rocks is about N. 85° W. and dips are chiefly to the southwest, although locally the rocks are so contorted that extreme differences from the general trend can be measured. The gneiss is composed of biotite, quartz, and feldspar, and the outcrops resist erosion. The schist is nonresistant to erosion and is concealed beneath a soil formed from the weathered debris. Along the northern and western edges of the outcrop, the gneiss and schist are in contact with white micaceous quartz sandstone of Beltian age, whereas along the southern and eastern edges they are in contact with Tertiary volcanic rocks.

The lodes in the district were probably discovered about the 1880's. The district has produced very little ore (Table 5), most of it from narrow quartz veins in gneiss.

BALTIC

The Baltic property is a patented mining claim in sec. 4 and 5, T. 10 S., R. 14 W. (Fig. 11), now owned by R. A. Wellborn of Grant.

Table 5.—Production of gold, silver, copper, and lead from lode mines, Monument (Beaverhead) district, 1902-65, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Total value
1902-06	no production					
1907	22	9	152	8,382	-----	$ 1,970
1908	14	5	69	4,110	-----	675
1909	9	2	55	3,149	-----	486
1910-11	no production					
1912	10	1/	22	1,389	-----	254
1913	no production					
1914	11	1	95	2,289	-----	369
1915	23	1/	586	221	5,381	590
1916	32	14	250	13,613	-----	3,799
1917	164	20	5,588	18,747	36,180	13,245
1918	174	46	2,500	44,470	-----	14,437
1919	no production					
1920	27	17	101	759	8,301	1,260
1921-27	no production					
1928	7	-----	763	1,853	-----	713
1929-65	no production					
Total	493	114	10,181	98,982	49,862	37,798

No zinc was reported in any year.
1/ Less than ½ ounce.

The workings on the claim consist of a surface cut that has exposed a 2-foot quartz vein that strikes S. 75° W. and dips 70° SE. The quartz is iron stained and contains some manganese oxides.

The only recorded production from the claim, in 1917 and 1918, totaled 60 tons and yielded 3,504 pounds of copper, 117 ounces of silver, and 2 ounces of gold.

JUNG FRAU

The Jung Frau property is a patented mining claim in sec. 32, T. 9 S., R. 14 W. (Fig. 11), owned by R. A. Wellborn of Grant.

The workings on the claim consist of a surface cut and two adits, one of which is caved at the portal. The workings are in gneiss and have been dug on a shear zone that trends N. 70° W. to N. 20° W. and dips 30° to 38° SW. The easternmost adit is about 35 feet long and is inclined, having been driven downdip on the shear zone, which here is about 5 feet wide and contains a few parallel quartz stringers as much as ½ inch wide in addition to crushed country rock. In the back of the adit a 1- to 3-inch barite vein containing minor tetrahedrite strikes S. 40° E. and abuts against the shear zone at an oblique angle. Absence of barite drag in the shear zone suggests that the vein was not faulted; instead, it probably originated as a tensional fracture formed by movement along the shear zone.

The dump of the caved adit, which is about 200 feet northwest of the open adit, yielded a few scattered pieces of barite containing minor tetrahedrite. On the west endline of the claim, the shear zone is exposed along the surface; it is 2 to 3 feet wide there and shows some iron stain. A few pieces of barite were observed on the dump but none was found in place.

The property has produced some ore, although none is recorded. Ore from the property was most likely mixed with ore from other claims and shipped under a different name.

MONUMENT

The Monument mine is in sec. 4, T. 10 S., R. 14 W. (Fig. 11). The property consists of Monument, Monument Extension, Green Mountain, Welcome, Daisy, Eugene, and Alps, all patented claims owned by the Monument Copper Mining Company.

The deposit consists of iron- and copper-stained quartzite that crops out on the Monument claim. The ledge is at least 900 feet long and attains a maximum width of 80 feet. Its overall trend is N. 85° W., and it is enclosed in dark biotite schist. The deposit was explored by a shaft said to be 350 feet deep, which was sunk at the south contact of the ledge with schist country rock. The work was done in the early 1900's and a small trial shipment of ore was made in 1908. The shipment consisted of 2 tons, containing 415 pounds of copper and 8 ounces of silver. In 1917, a shipment of 43 tons contained 3,208 pounds of copper and 76 ounces of silver. The property has been inactive since 1917. The collar of the shaft is caved, and a lower adit driven toward the shaft is caved at the portal.

ROYAL

The Royal claim is in sec. 4, T. 10 S., R. 14 W. (Fig. 11); it is a patented mining claim owned by R. A. Wellborn of Grant. The north sideline of the Royal is also the south sideline of the Starlight.

The workings on the claim consist of an adit 330 feet long driven N. 15° E. in green schist. The foliation of the schist trends about N. 45° W. and dips about 40° NE. Near the face of the adit, however, the foliation trends N. 12° W. and dips 44° NE. At 220 feet from the portal, the adit cuts a 4-inch white quartz vein that strikes N. 65° E. and dips 51° SE.

The property has no record of production.

STARLIGHT

The Starlight claim is in sec. 5, T. 10 S., R. 14 W. (Fig. 11); it is a patented claim now owned by R. A. Wellborn of Grant. Workings consist of three old adits and several surface trenches. Two of the adits are caved. A surface cut near the southwest corner of the claim exposes a 2-foot mineralized zone in gneiss. The zone strikes S. 70° W. and dips 79° SE.; it contains quartz stringers as much as 6 inches wide. Other minerals are jasper and sparse galena. The zone has been explored for about 200 feet by an adit now caved at the portal and by two surface trenches. No economic minerals were noted on the dumps from these workings.

The accessible adit, which is near the center of the claim, trends west and is about 120 feet long. A strongly mineralized zone about 3 feet wide is exposed; it contains stringers of manganese oxides as well as sparse galena and cerussite. At a distance of 95 feet from the portal the mineralized zone is terminated by a shear zone that strikes N. 80° W. and dips 34° SW. A short crosscut about 20 feet long and bearing to the south on the hanging-wall side of the zone has not exposed the faulted extension

of the mineralized zone, if it exists.

The property has no record of production.

SUNSHINE

The Sunshine claim is in sec. 32, T. 9 S., R. 14 W., and sec. 5, T. 10 S., R. 14 W. (Fig. 11). The property is a patented claim now owned by R. A. Wellborn of Grant but formerly owned by J. L. Templeman.

The deposit is a narrow quartz vein in gneiss and is exposed in an adit about 40 feet long. The vein strikes N. 65° W. and dips 72° SW., conformable to the trend of the country rock. The vein seems to be a short lens, which attains a maximum width of about 3 feet. The vein quartz is slightly stained by oxidation products of copper and iron. A few small blebs of chalcopyrite and a few small grains of a sulfide mineral tentatively identified as tetrahedrite were also noticed.

An old shaft, estimated to be 50 feet deep, has been sunk in line with the vein and about 150 feet west of the adit portal. The vein probably does not extend to the shaft, however, as no vein minerals were found on the dump at the shaft.

In 1914 and 1915, the mine produced 29 tons of ore, which yielded 2,289 pounds of copper, 1,480 pounds of lead, 528 ounces of silver, and 1 ounce of gold, the total recorded production.

OTHER MINES

Under this title are descriptions of isolated mines that because of their geographic location cannot be included within a mining district but are within the Beaverhead Montana mining region.

AJAX

The Ajax mine is situated at the head of Big Swamp Creek in a glacial amphitheater partly occupied by Ajax and Lena Lakes. The mine is about 22 miles southwest of Wisdom and is accessible only by small 4-wheel-drive jeeps during the summer months. The mine workings are at an altitude of about 9,000 feet.

The deposit was located in 1874 by W. S. Burnett, who named it the Carrie Leonard. The location seemingly was allowed to lapse, and in the early 80's it was relocated by Frank Brown, who named it the Ajax. The claims were subsequently acquired by Alva J. Noyes, the first settler in the Big Hole Valley. The trials and tribulations of owning the Ajax mine were described by Noyes in his book "Ajax", a story of early-day life in the Big Hole Valley.

A stamp mill was built at the property during the late 90's but proved unsatisfactory because so much of the gold was lost. In 1903, the Montana-Ajax Company, capitalized at $1 million, was organized to operate the properties. B. F. White was elected president, and Noyes, secretary. The old mill was torn down and in 1903 a new 10-stamp mill was erected in its place. Each stamp weighed 1,050 pounds; other equipment included two Wilfley tables. During the brief period of operation, the mill produced several bricks of gold, but the operation was not profitable. In 1905, the last brick poured was valued at $1,160 (Sassman, 1941, p. 286). The property consists of three patented claims, the Ajax, Ajax Extension, and Edna and Edith, now owned by H. E. Morse of Dillon, Montana.

The deposit consists of a quartz-filled fissure vein, exposed for several thousand feet along the south wall of the cirque and clearly visible from Ajax Lake. The vein strikes N. 68° E. and dips 34° SE. The width of the vein is 3 to 5 feet and the vein filling is principally quartz stained with iron oxide. Ore minerals are free-milling gold and galena. Copper-stained fragments of vein quartz were found on some of the dumps.

The country rock is gray to green medium-grained quartzite containing seams of magnetite. The formation strikes N. 15° E. and dips 15° SE.

The mine workings consist of four adits (Fig. 12); three upper adits driven on the vein and a lower fourth adit driven to crosscut the vein at depth. A rockslide has completely buried the lower adit, and only a small part of the dump is visible. The upper workings were not visited by the writer, but according to an old report, No. 1 adit is the highest and was driven for a distance of 131 feet on the vein. From the adit, two inclined raises were driven on the vein to surface. No. 2 adit, about 160 feet below No. 1, was driven on the vein for a distance of 222 feet. A raise on the vein connects to No. 1 adit. No. 3 adit is about 160 feet below No. 2, and extends about 250 feet from portal. It was driven on the vein for 136 feet, and from it two winzes were sunk to a depth of 12 feet. The portal of No. 4 adit is not visible, but an old mine map of the property indicates that it must have reached its objective.

In 1904, the ore being mined averaged about $7.19, the principal value being in gold. The total ore remaining in 1904, however, averaged only $4.27 per ton.

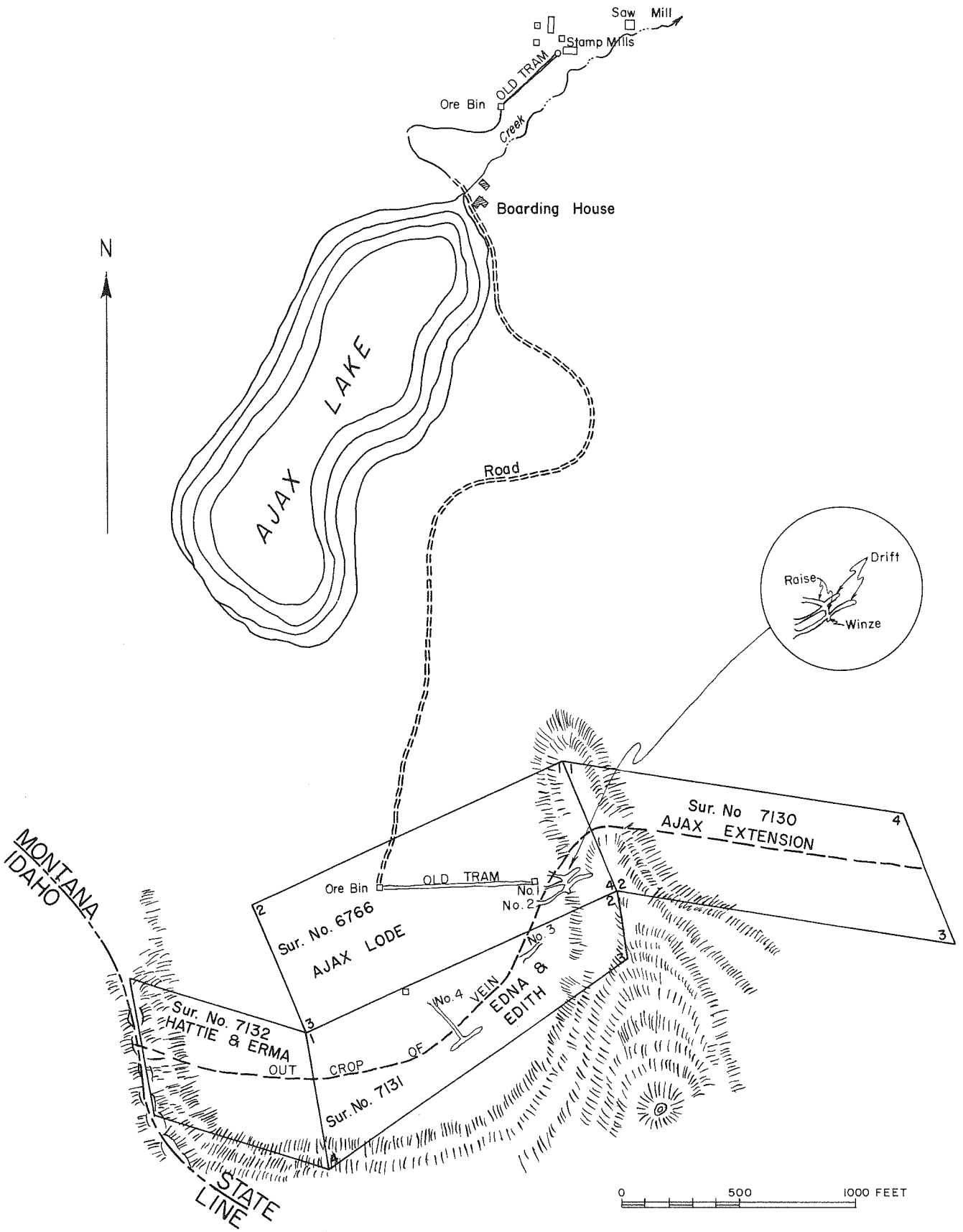


Figure 12.—Map of mine workings, Ajax mine.

Total recorded production from the Ajax, which is for the period 1902-40, is 1,643 tons of ore, which yielded 140,239 pounds of lead, 276 pounds of copper, 7,621 ounces of silver, and 979 ounces of gold. Of this amount, 1,200 tons of ore that yielded 120,000 pounds of lead, 7,200 ounces of silver, and 630 ounces of gold was mined in 1902.

DARK HORSE

The Dark Horse mine is situated at the head of Bloody Dick Creek in a glacial cirque developed just below the crestline of the Beaverhead Mountains. The mine is at an altitude of about 9,000 feet and can be reached by jeep road up Dark Horse Creek from a country road connecting Jackson and Horse Prairie.

The original locators are unknown, but in 1902 a Fred Stuart was one owner. In 1906, the properties were taken over by the Calumont-Montana Mining Company from Duluth. In the fall of 1906, 33 men were employed, and shipments averaged 12 tons of ore a week. In 1909 and later, an adit 2,935 feet long was driven on the Idaho side of the divide to open the mine at a depth of 800 feet below the crest of the divide. The present owner is Laura Cannon of Fallbrook, California.

The country rock in the vicinity of the mine is foliated gray micaceous Precambrian sandstone containing some thin shale beds; it resembles schist. The formation trends N. 62° W. and dips 35° SW.

The mine workings consist of a caved shaft, probably several hundred feet deep, and three short adits. Two adits about 200 feet north of the shaft explore a weak bedding-plane quartz vein 1 to 2 feet wide containing an occasional speck of bornite or chalcopyrite. The third adit, about 350 feet west of the shaft, was driven north across the trend of the bedding; in about 150 feet from the portal it cuts a green schist zone containing a few narrow stringers of iron-stained quartz. At the time of the visit the long adit on the Idaho side was not known to exist and so was not examined.

Total recorded production from the Dark Horse mine is 294 tons of ore, which yielded 85,739 pounds of copper, 1,611 ounces of silver, and 93 ounces of gold. The ore was produced between 1907 and 1939.

HAUSEMAN

The Hauseman mine is in unsurveyed sec. 22, T. 1 N., R. 16 W. It can be reached by following U. S. Forest Service Trail 371 up Plimpton Creek and crossing over to the next drainage east of the trail.

The property is an unpatented claim, and the deposit seemingly was located by John Hauseman, a recluse who lived in those parts for many years.

The granitic country rock near the mine is part of the great Idaho batholith, which crops out in that part of Beaverhead County.

The mine workings consist of an adit along the creek bottom, which is overgrown with brush. The adit trends N. 22° W., and the size of the dump indicates that it extended about 100 feet. A few small

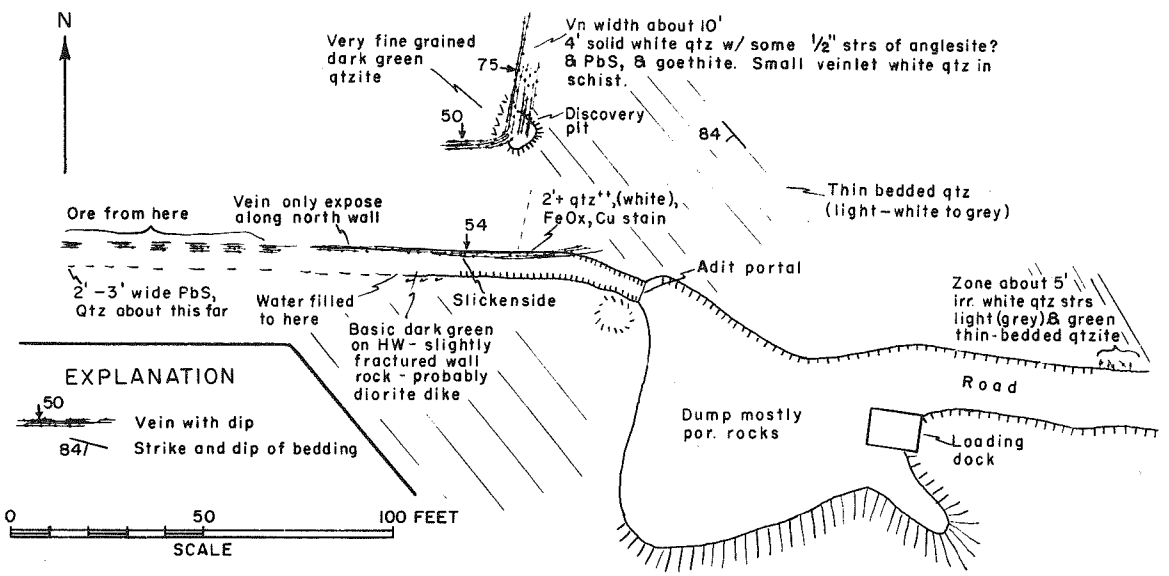


Figure 13.—Geologic sketch of Jackson mine.

pieces of vein material found on the dump consist of white massive quartz, some of which were coated with a thin layer of iron oxides. No sulfide could be seen in the white quartz.

The property has no history of production.

JACKSON

The Jackson mine is situated far up Miner Creek on the south flank of Freeman Peak at an altitude of about 9,000 feet. The mine is in unsurveyed sec. 27, T. 6 S., R. 17 W., about 15 miles southwest of the town of Jackson. The property consists of four unpatented lode claims held by Noel Jackson of Jackson. A road has been built to the property but it was not passable to vehicles at the time of the writer's visit.

Within the Miner Creek drainage, the country rock is medium-grained light-gray to gray quartzite containing thin beds of shale as much as 4 inches thick. In the mine vicinity, the quartzite in the unit has been metamorphosed to greenish fine-grained quartzite, and the thin beds of shale to hard dense hornfels. At the mine the unit strikes N. 40° W. and dips 84° SW.

The deposit consists of a narrow quartz vein along the footwall of a diorite dike (Fig. 13), which trends due west and can be traced by float for more than 2,000 feet west from the adit. The vein has been explored by an adit for a distance of about 150 feet (Noel Jackson, oral communication), but only the first 50 feet of the underground working is accessible. The rest of the adit is flooded to the top. The vein exposed in the adit is about 2 feet wide and consists of white vitreous quartz showing slight iron and copper stain. Some vein material containing galena was observed in the mine dump. According to Mr. Jackson, good grade galena ore was found in the section of adit that is now inaccessible, where the vein averaged 2 to 3 feet in width. Ore shipped in 1957 came from that segment of the vein and represented the entire vein.

Total production from the mine is 10 tons, averaging 11.7 percent lead, 0.5 percent zinc, 0.50 percent copper, 6.0 ounces silver, and 0.040 ounce gold.

JAHNKE

The Jahnke mine is at the head of Jahnke Creek about 20 miles south-southwest of Jackson; it is not accessible by vehicle. The upper workings are along the crest of the divide at an altitude of about 10,000 feet, and can be reached by following a trail from the Dark Horse mine for about 2 miles across the ridge between Dark Horse Creek and Jahnke Creek. The lower workings are alongside Jahnke Lake, which lies in a glacial cirque developed below the crest of the divide. A road was built up Jahnke Creek to the lower workings, but no vestiges of it now remain, and the only way is over a forest service trail up Jahnke Creek for a distance of about 4 miles.

The property consists of five patented claims, the Good Hope, Wabash, Mt. Vernon, Ranger, and Potomac. Three claims are situated edgewise and are located along the crest of the divide.

The deposit was discovered by Frank Benson, an early-day trapper in those parts who was reported to be the first white man to explore the rugged mountains in that part of the country. In 1898, the deposit was staked by W. P. August and John H. Jahnke. The first ore shipped to Salt Lake City netted $43 to $47 per ton. In 1907, the Montana Oreway Company, organized by a Chicago syndicate, acquired the properties and built 5 miles of road to the mine. At one time 22 men were employed, and underground workings driven into the side of the mountain totaled approximately 3,000 feet. Approximately $125,000 was spent in the venture (Sassman, 1941, p. 282). The properties are now owned by John L. Rankine.

The country rock in the mine vicinity is Precambrian gray micaceous and foliated quartzite, which strikes about N. 33° W. and dips about 26° SW. The quartzite is intruded by a sill as much as 100 feet wide, which crops out across the head of the cirque a few feet below the crest and is readily visible from Jahnke Lake, 1,000 feet below. Some large boulders of sill rock, which have tumbled off the walls of the cirque near the lake shore, are cut by white quartz veinlets as much as 3 inches across, which contain galena, hematite, and magnetite.

The dark-green sill rock is equigranular and is composed of quartz, feldspar, abundant ilmenite, and chlorite (Winchell, 1914, p. 77). In hand speciman it would be termed diorite. The sill is the prominent igneous rock feature in the district and can be traced for several miles along the crest of the divide.

The upper workings consist of two inclined shafts 50 and 150 feet deep and a 20-foot adit driven in the country rock on the footwall side of the sill (Fig. 14). The workings were driven on quartz veins 8 to 27 inches wide, which parallel the bedding. Seemingly no great tonnage of ore was shipped, and most of the ore mined is probably left on the dump. Walker (1963, p. 8) reported that samples from two

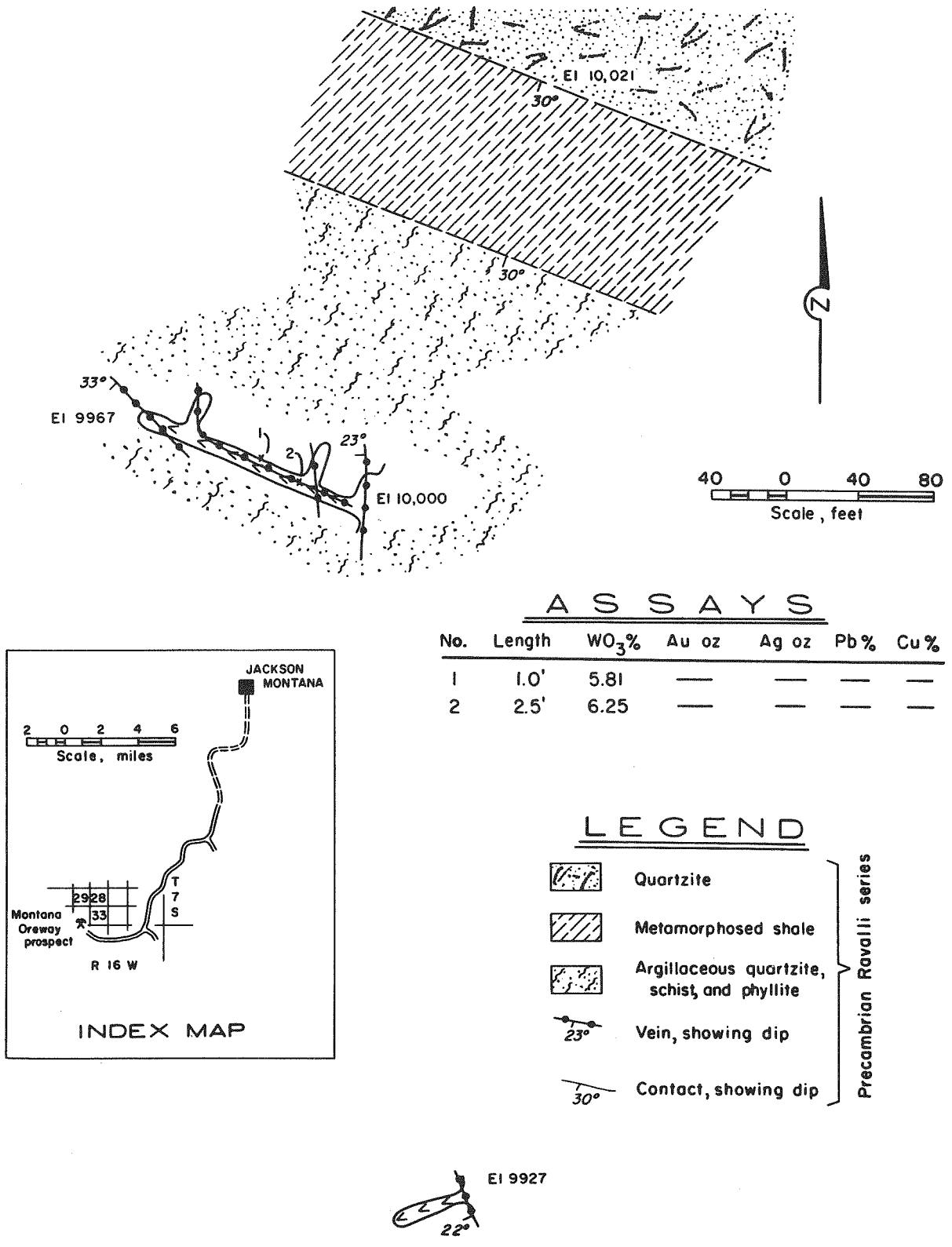


Figure 14.—Jahnke (Montana Oreway) mine. (Walker, 1963).

high-grade scheelite pods in the 150-foot shaft assayed 5.81 percent WO_3 across 1 foot and 6.25 percent WO_3 across 2.5 feet.

The 3,000-foot adit near Jahnke Lake is inaccessible but material on the dump, consisting of sheared and chloritized igneous rock, seems to indicate that the sill was intersected by the adit.

The only production recorded by the Montana Oreway Company was from a mine called the Straight Tip. This mine is assumed to be the Jahnke. Production for the Straight Tip mine was 106 tons of ore, which yielded 17,129 pounds of lead, 4,804 pounds of copper, 1,238 ounces of silver, and 16 ounces of gold.

JUMPER NO. 1

The Jumper No. 1 lode claim is on a ridge between two small drainages tributary to Ruby Creek about ⅓ mile north of the Moosehorn mine. A mine road extends from the Moosehorn mine to the deposit. The property consists of several unpatented claims held in 1963 by G. Elmo Shoup

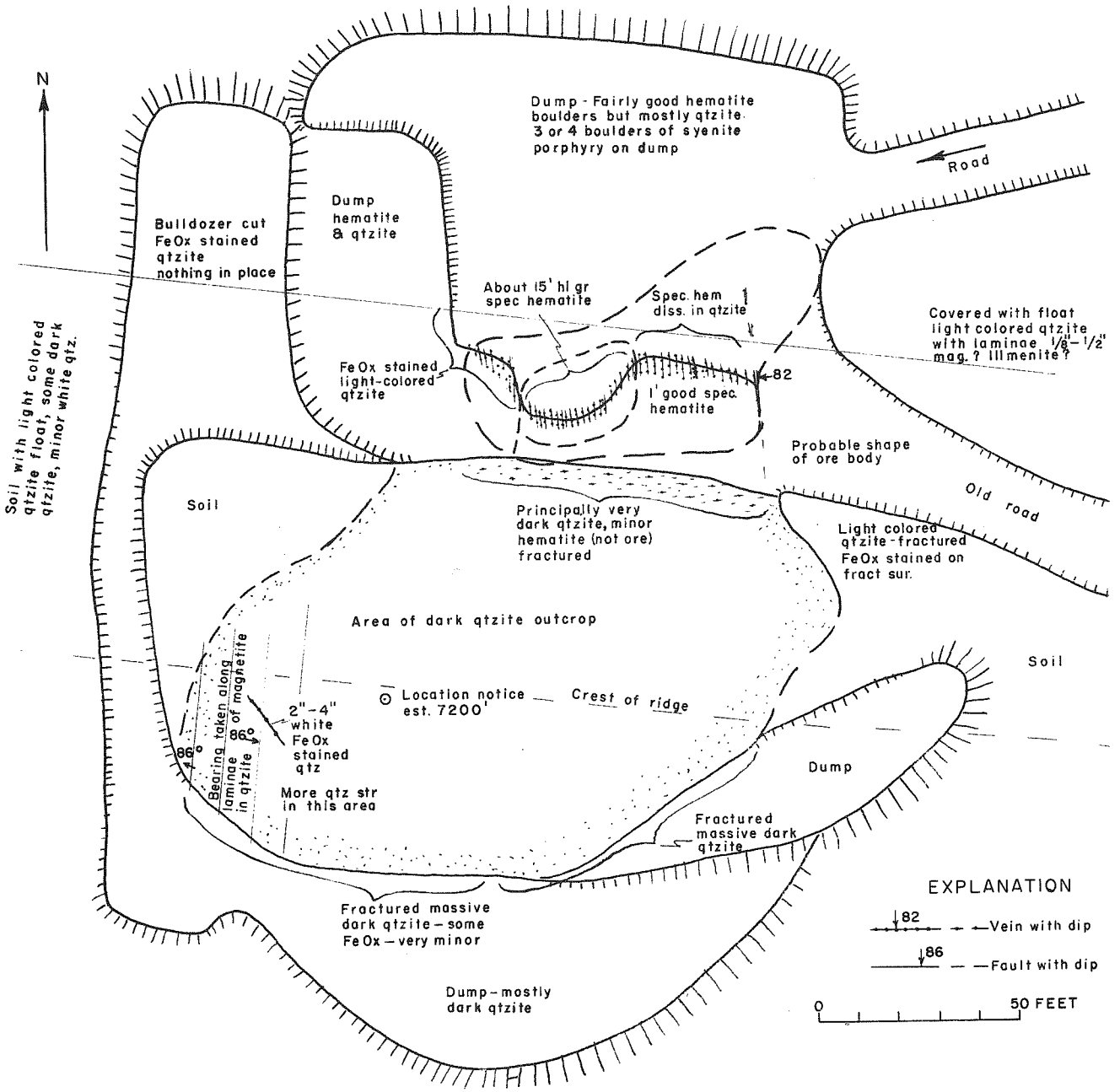


Figure 15.—Geologic sketch of Jumper No. 1 mine.

of Salmon, Idaho. The mine workings are at an altitude of 7,200 feet.

The deposit is a black hematite-bearing siliceous mass, subelliptical in outcrop, enclosed by light-gray Precambrian quartzite. The mass is seemingly a replacement of the quartzite by silica and hematite, and in outcrop measures 200 feet long in a northward direction and 120 feet across. The long axis of the mass coincides with the trend of the country rock.

The mine workings consist of an east-west open cut across the mass and penetrating about 30 feet below its top (Fig. 15). The cut has exposed a zone of nearly pure specular hematite as much as 15 feet across, surrounded on top and sides by the black hematite-bearing silica. The nearly pure hematite seemingly is an inner zone or core of the larger mass.

The only igneous rock found in the vicinity was float containing large phenocrysts of orthoclase in a greenish aphanitic groundmass. It is best termed syenite porphyry.

MOOSEHORN

The Moosehorn mine is in sec. 19, T. 3 S., R. 17 W., about 15 miles southwest of Wisdom. The mine can be reached by traveling the Ruby Creek road to Little Moosehorn Creek. At Little Moosehorn Creek a side road goes north for about 1 mile to the mine, which lies in the heavily vegetated foothills of the Beaverhead Range at an altitude of about 7,000 feet.

The property consists of several unpatented claims held by the Moosehorn Mining Company of Franklin, Idaho.

The country rock is light-gray medium-grained quartzite that strikes about due north and dips 30° W. The formation is concealed by residual quartzitic soil and dense forest cover. Many pieces of quartzite float show platy surfaces or laminae of specular hematite.

The deposit is a quartz-filled fissure vein that

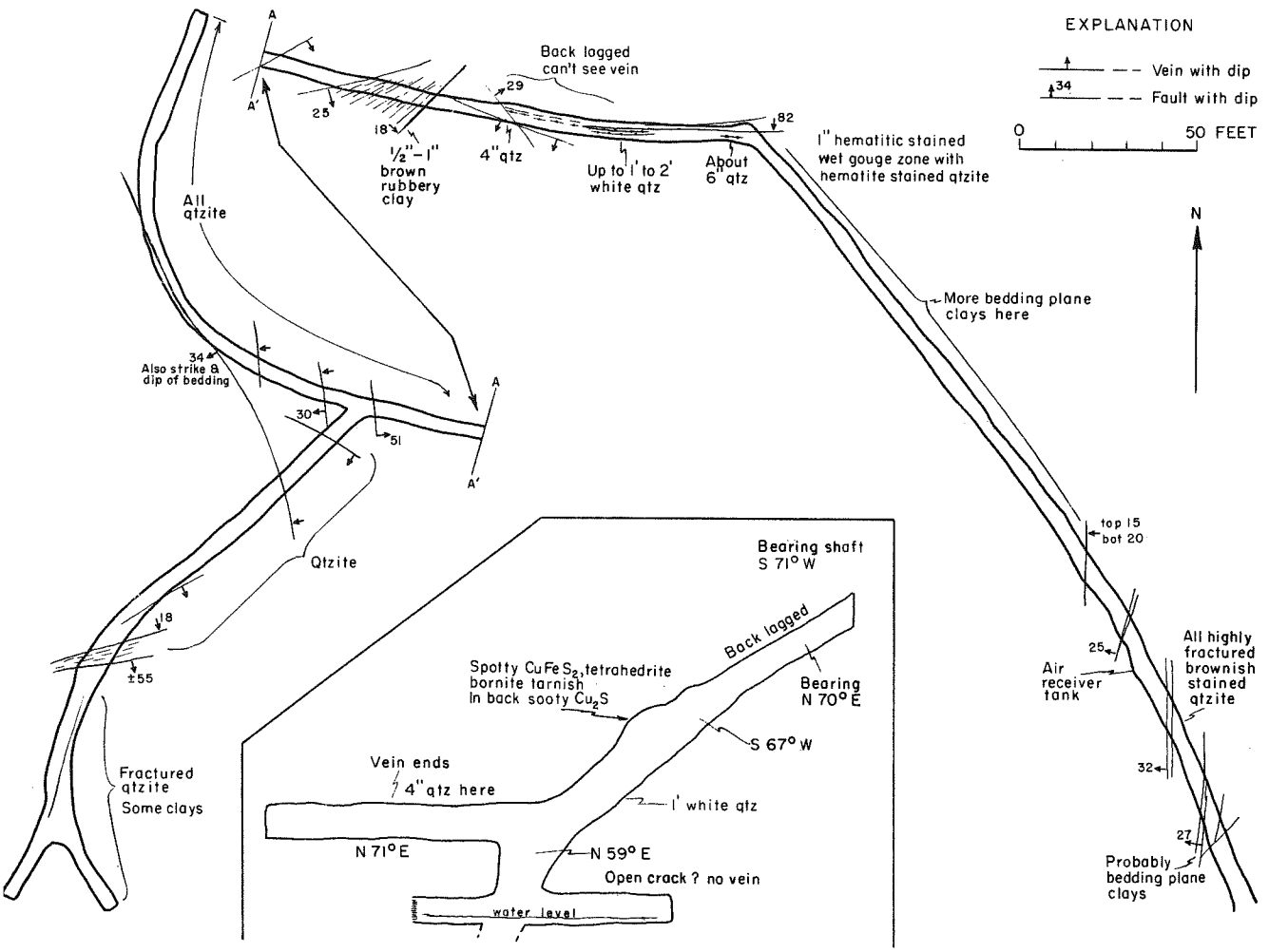


Figure 16.—Geologic plan map of adit of Moosehorn mine and profile of Moosehorn shaft.

strikes N. 83° W. across the bedding of the quartzite and dips 82° SW. The maximum observed width of the vein was 2½ feet. The mine workings consist of an inclined shaft and an adit about 100 feet downhill from the collar of the shaft (Fig. 16).

The shaft, inclined about 45°, has been sunk on the vein to a depth of about 70 feet. Two short levels, established at about 50 feet and 60 feet below the collar of the shaft, have been driven on the vein. The 50-foot level is about 35 feet long and extends west of the shaft. On the 60-foot level, one short drift extends 10 feet west and another extends 20 feet east from the shaft.

The best ore was about 35 feet below the shaft collar, where the vein is about 2½ feet wide and consists of quartz containing some sparsely disseminated chalcopyrite, tetrahedrite, and bornite. Most of the ore shipped from the property seemingly came from this part of the vein. On the 50-foot level the vein is 4 inches wide but pinches out completely about 15 feet from the shaft. It is composed of white quartz and contains no visible sulfides. On the 60-foot level, the only sign of a vein is an open fissure or crack containing no vein filling.

A crosscut adit, the portal of which is about 100 feet lower than the collar of the shaft and approximately 200 feet southeast of the shaft, was driven northward and intersected the vein underground about 220 feet northeast of the shaft. The vein exposed in the drift is about 1 foot wide and is composed of white quartz. A 1-inch reddish fault gouge parallels the vein on the footwall side. The drift was driven west on the vein for about 90 feet, where it encountered a fault zone about 3 feet wide, which trends northeast and dips about 20° SE. The fault zone was penetrated by the drift, and crosscuts were turned off north and south, but the faulted extension of the vein was not found. The north crosscut extends about 100 feet and the south crosscut about 160 feet.

The mine has produced some ore but production figures are confidential.

PIONEER

The Pioneer mine is in the NE¼ of unsurveyed sec. 19, T. 7 S., R. 16 W., and can be reached by following U. S. Forest Service Trail 42 for several miles, beginning near Van Houten Lake. The mine is in a small glacial cirque at an altitude of about 8,500 feet. The early history of the mine is not known, but seemingly it was located before the turn of the century. It has no recorded history of production. No work has been done recently.

The mine workings consist of an old adit, now caved at the portal and inaccessible. At the portal the adit trends north, and the size of the dump indicates that it was probably several hundred feet long. Material on the dump is all light-gray quartzite; no ore minerals were found. A few pieces of quartz float stained with iron oxide were found on the hillside above the adit.

RANGER

The Ranger mine is in unsurveyed sec. 26, T. 5 S., R. 17 W., and can be reached by a jeep road that turns off up Slag-a-Melt Creek from Big Swamp Creek. The mine is at an altitude of about 8,400 feet and above the extreme east flank of Squaw Mountain. The mine is several hundred feet above the head of Slag-a-Melt Creek on the mountain slope. A switchback road leads to the mine from the valley but was not passable in 1965.

The history of the mine is not known, and the last time it was worked was in the 1930's (John Shepard, oral communication).

The country rock is medium-grained unaltered granodiorite. The limits of the igneous rock are not known, but the granitic texture of the rock at its exposure in the mine area suggests that it could be a small stock or an outlier of the Idaho batholith.

The mine workings consist of a lower adit and an upper adit several hundred feet higher. Both adits are caved at the portal. The lower adit trends N. 25° W. and the upper adit N. 55° W. On the slope halfway between the two adits is an outcrop of a quartz vein stained by red-brown iron oxides. The vein is 3 to 4 feet wide and dips 55° SW. Material on the dumps consists of white and iron-stained quartz containing pyrite and some specks of galena, chalcopyrite, and molybdenite. Some of it has a blackish tone, which may be produced by disseminated MoS_2, and some has small paper-thin seams of molybdenite through it.

No ore has been produced from the property.

SAGINAW

The Saginaw mine is in the N½ sec. 16, T. 7 S., R. 15 W., about 10 miles south of Jackson. The mine can be reached by an old wagon road, which begins near the sign at the entrance of the Beaverhead National Forest on the county road between Jackson and Brenner.

The property was discovered in 1894 by Dunc Wadams (Sassman, 1941, p. 282), and leased by Wil-

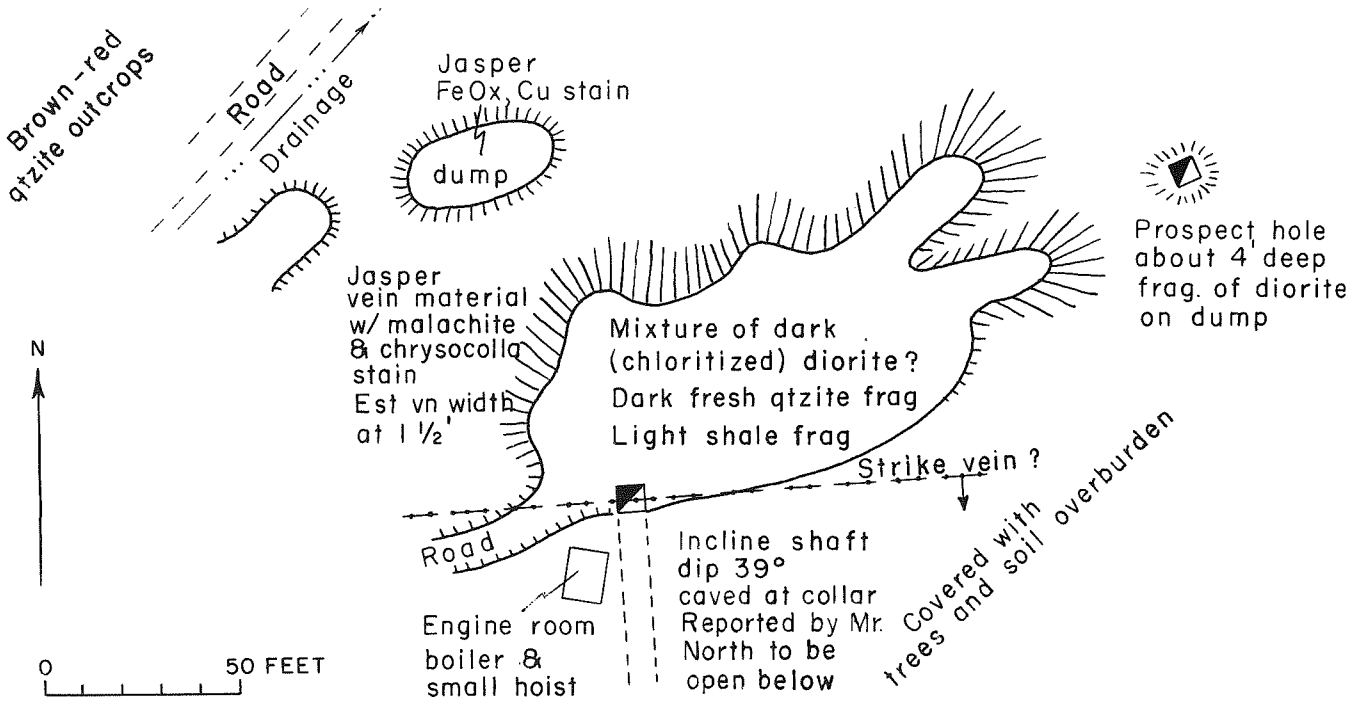


Figure 17.—Surface sketch of Saginaw mine.

liam Krdney and a Mr. Ballenger in 1900. In 1904, operations were suspended because the pumps were unable to handle the flow of mine water into the workings. In 1916, the mine was reopened by Krdney and George North. Ore was hauled in wagons over 27 miles of road to Brenner by way of Ore and Selway Creeks for shipment to Salt Lake City. In 1963 the property was owned by Elmer Holt, but it was later sold to Bennett Owen of Dillon, Montana.

The mine workings are along the median drainage of a small tributary to Ore Creek in an area covered with trees and residual soil. The country rock is reddish-brown quartzite, probably part of the Missoula Group(Precambrian), and forms conspicuous ridges on both sides of the drainage.

The mine workings (Fig. 17) consist of an incline 320 feet deep, sunk on a vein that trends east-west. The collar of the shaft is caved, but the shaft is reported by Mr. North to be open below. Drifts were turned off on both sides at 150 feet and at 300 feet below the collar.

Dump material consists of reddish quartzite, yellow shale, and chloritized diorite. The igneous rock may have come from a dike or from a sill intruded along a shale bed in the quartzite. Vein material on the dump consists of red and brown jasper, some of which is veined and stained by malachite, chrysocolla, and other secondary copper minerals. No sulfides were noticed on any of the pieces examined.

Total production from the Saginaw, all mined between 1914 and 1917, was 1,236 tons of ore, which yielded 206,282 pounds of copper and 445 ounces of silver.

PIONEER MOUNTAINS MINING REGION

The Pioneer Mountains mining region is in the mountainous area in the north-central part of the county. Most of the metal production of the county has come from this region. It includes the Argenta, Badger Pass, Baldy Mountain, Bannack, Birch Creek (Utopia), Blue Wing, Elkhorn, Hecla (Bryant), Polaris, Rock Creek and Lost Creek, Vipond Park-Quartz Hill, and Wisdom mining districts. Isolated mines in this range of mountains that cannot be logically included in these districts are described under the heading of Other Mines.

ARGENTA DISTRICT

The Argenta district, about 15 miles northwest of Dillon, occupies mountainous and rolling bench-land terrane on the southeast flank of the Pioneer Mountains. The district limits, for the purposes of this report, include the drainage basins of Ermont Gulch, Rattlesnake Creek and its tributaries, Cave Gulch, and Long John Gulch. Altitude ranges from about 6,000 feet near Argenta, the principal settle-

ment, to 9,000 feet or more near Minneopa and Estler Lakes in the northern part of the district. Most mines in the district are situated near Argenta at altitudes ranging from 6,000 to 7,000 feet.

The principal road through the district is a county-maintained graveled road that connects Argenta with an oiled highway 7 miles south. The road continues past Argenta along Rattlesnake Creek, and a branch road follows French Gulch and passes over the divide into the Birch Creek drainage system. Most mines and areas in the district can easily be reached by side roads leading from the main county road.

With the exception of an area underlain by quartz monzonite rocks of the Mount Torrey batholith in the northwestern part of the district, the bedrock is predominantly sedimentary rocks, ranging from Precambrian to Cretaceous in age, that occupy a regional belt of folding and thrust faulting several miles wide.

The overall geologic structural pattern in the district (Fig. 18) is dominated by the Humbolt Mountain anticline, which is a broad broken and faulted doubly plunging anticlinal fold of northeast to north trend. At the south end, the fold dies out near the Ermont mine; the fold axis can be traced northeastward from the Ermont mine to Clark Canyon and then farther north in arcuate fashion through Humbolt Mountain, beyond which the fold plunges steeply to the north in the vicinity of Birch Creek (Myers, 1952). The western limb of the fold is overridden by a zone of overthrusting 2 miles wide developed along a faulted block of Paleozoic and Mesozoic strata that are in turn overridden by Beltian (Precambrian) strata. In general, the trace of the zone of overthrusting coincides in trend with the trace of the axial plane of the Mount Humbolt anticline (Myers, 1952, p. 23). East of the Kelley thrust plane the crest of the fold is deeply eroded; Belt strata are exposed surrounded by Paleozoic and Mesozoic formations. The gently eastward dipping east limb of the fold is intruded by several small stocklike bodies ranging from quartz monzonite to granodiorite, which are aligned in a north-northeast direction with a south-trending apophysis of quartz monzonite from the Mount Torrey batholith in the vicinity of Birch Creek. The Argenta quartz monzonite stock is the southernmost of these bodies in the district and crops out over an area of nearly 1 square mile at the town of Argenta.

The more productive ore deposits of the district have been in Paleozoic carbonate rocks that crop out along the limbs of the fold. The Tuscarora-Governor Tilden, Legal Tender, and Hand (Mauldin) mines are situated along the east limb, the Ermont group near the nose of the fold, and the Shafer group in the overthrust zone on the west limb of the fold (Fig. 18). Most of the silver-lead production in the district has come from the mines situated along the east limb of the fold and chiefly from deposits in Devonian and Mississippian carbonate rocks. The Ermont and Shafer deposits are in Devonian carbonate rocks and are the most important gold producers in the district. Some gold as well as silver and lead has come from narrow veins in Belt shale and overlying Flathead Quartzite (Middle Cambrian) in the core of the fold.

District production of gold, silver, copper, lead, and zinc for the period 1902-65 is given in Table 6.

ARGENTA PYROPHYLLITE DEPOSIT

The Argenta pyrophyllite deposit is near the center of the W½ W½ sec. 29, T. 6 S., R. 10 W., about 300 feet north of Rattlesnake Creek at the town of Argenta and about 50 feet higher than the creek. The deposit has been described by Perry (1948, p. 11), and one pit dug in pyrophyllite was examined by the writer. The deposit is on a patented claim that is part of the Mauldin group.

The pit is only about 4 feet deep and about 5 feet in diameter. Pure micaceous pyrophyllite and some sandy impure material are exposed along the walls of the pit. The pyrophyllite mass is enclosed in quartz monzonite and could have been formed only by hydrothermal alteration of the quartz monzonite.

Perry (1948, p. 11) reported pyrophyllite exposed in two large pits 15 feet deep and elsewhere in an area measuring 200 to 400 feet across.

No pyrophyllite has been produced commercially from the deposits.

BADGER (NORTH ERMONT)

The Badger property consists of one unpatented claim in the SE¼ sec. 26, T. 6 S., R. 11 W., north of the Ermont No. 19 shaft. The property was located about 1932 by Hurly Leach and D. V. Erwin, and was relocated as the North Ermont by R. M. Fleming in 1962.

The deposit consists of a silicified replacement body in Jefferson Dolomite. It is developed by an inclined shaft at least 110 feet deep. Production from

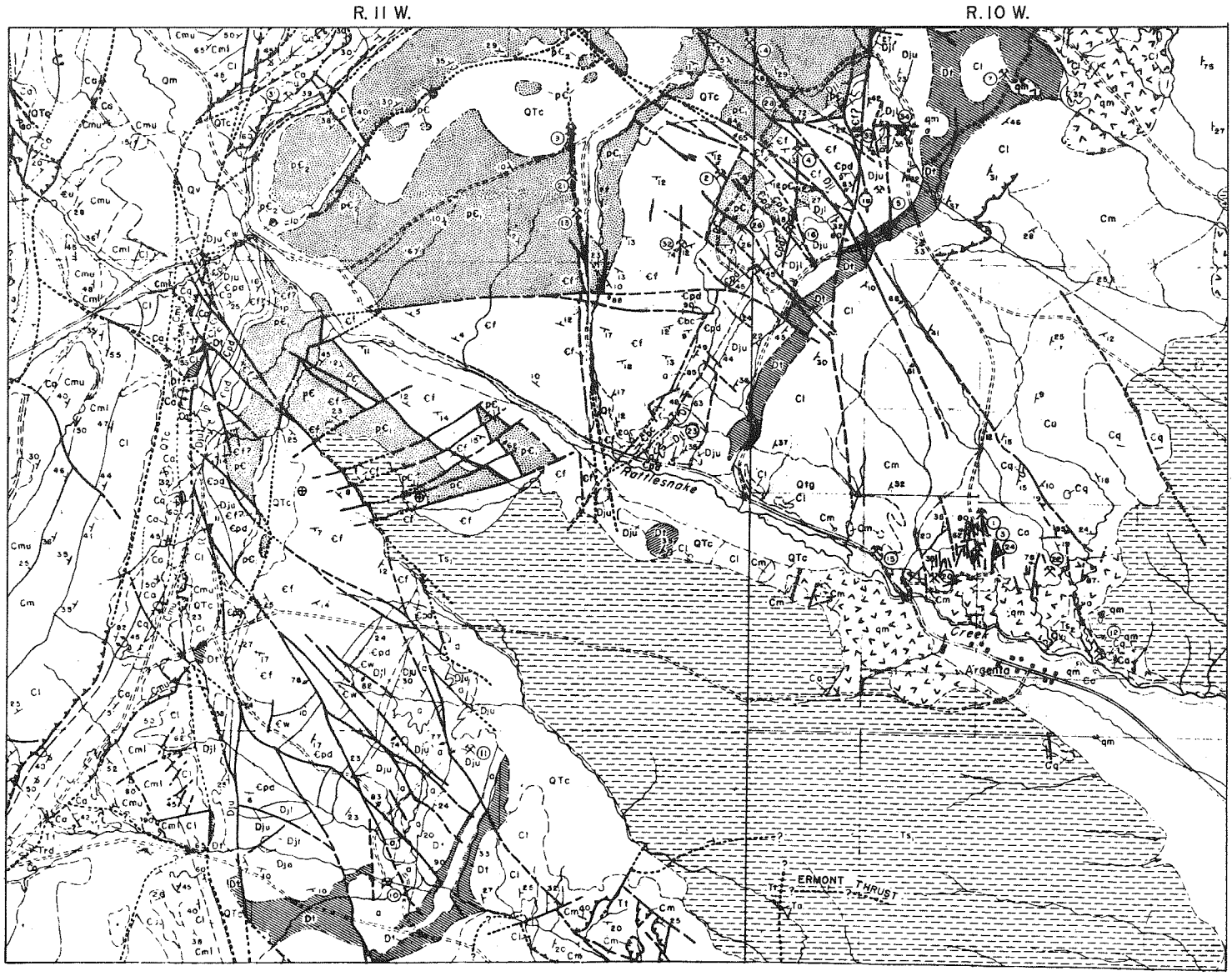


Figure 18.—Geologic map of the Argenta mining district showing location of mines. (Myers, 1952).

Table 6. — Production of gold, silver, copper, lead, and zinc from lode mines, Argenta district, 1902-65, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)	Total value
1902	548	300	7,803	100	173,344	-----	$ 14,256
1903-05	no production						
1906	161	8	2,779	371	26,864	-----	3,628
1907	250	12	3,000	-----	2,500	-----	2,363
1908	24	8	821	109	15,429	-----	1,253
1909	218	7	2,266	1,919	75,061	-----	4,799
1910	95	94	879	3,767	20,843	-----	3,808
1911	no production						
1912	35	1	1,037	9,769	-----	-----	2,263
1913	34	1	863	8,532	-----	-----	1,856
1914	81	5	1,127	14,279	-----	-----	2,629
1915	338	376	5,348	1,533	64,333	-----	13,771
1916	547	139	8,299	5,328	144,900	-----	19,645
1917	2,969	90	14,923	57,063	544,776	-----	76,595
1918	1,127	120	6,139	13,993	275,208	-----	31,621
1919	299	107	4,278	7,886	80,447	-----	12,735
1920	170	40	2,482	522	41,009	-----	6,920
1921	99	28	1,027	249	35,271	-----	3,229
1922	115	27	1,216	-----	49,777	-----	4,510
1923	123	36	1,575	221	49,750	-----	5,544
1924	128	23	1,011	517	47,956	-----	5,066
1925	1,742	344	8,846	9,495	507,294	-----	58,745
1926	1,208	139	5,641	36,245	347,874	-----	39,305
1927	356	19	1,549	13,010	99,839	34,174	11,445
1928	720	56	5,216	5,904	204,707	105,656	23,381
1929	52	3	553	603	20,823	-----	1,772
1930	36	1	382	1,046	11,742	-----	898
1931	82	78	509	348	11,987	-----	2,231
1932	1,064	663	1,174	1,762	13,500	-----	14,547
1933	3,837	1,615	4,343	5,188	41,838	-----	36,792
1934	1,171	901	7,131	2,325	87,892	-----	39,546
1935	14,014	5,163	30,254	2,048	52,225	-----	204,693
1936	11,206	3,044	17,592	1,522	68,348	-----	123,449
1937	32,663	8,374	25,426	9,000	274,000	13,000	330,857
1938	33,487	8,319	9,866	1,265	100,826	-----	302,305
1939	34,814	6,986	7,313	884	37,915	-----	251,348
1940	35,398	7,247	11,461	1,310	122,880	6,000	268,465
1941	35,755	6,384	15,152	1,600	228,000	-----	247,400
1942	13,060	3,300	13,244	6,000	440,600	-----	155,164
1943	3,264	110	8,536	13,900	538,600	74,000	60,114
1944	1,398	50	2,506	7,200	358,200	5,000	33,730
1945	1,560	151	3,285	6,600	249,000	6,400	30,662
1946	1,664	685	7,891	2,000	160,000	15,500	50,006
1947	3,751	2,020	20,885	11,600	418,200	100	152,270
1948	6,854	2,130	22,865	20,600	680,600	29,900	225,518
1949	7,664	1,228	30,901	15,500	1,024,500	55,900	242,803
1950	5,893	1,679	46,951	24,100	944,800	108,800	249,269
1951	3,601	582	19,369	26,000	708,000	135,400	191,319
1952	4,749	421	22,899	39,925	989,616	169,500	232,587
1953	3,499	685	22,933	37,297	1,012,065	105,636	200,163
1954	3,721	459	15,460	22,000	805,400	113,500	159,145
1955	3,352	290	14,311	22,900	832,300	71,700	164,476
1956	4,331	463	13,541	20,600	1,053,200	131,400	220,569
1957	4,818	1,131	10,432	10,500	720,300	72,600	163,612
1958	3,046	279	6,410	10,000	537,300	113,900	92,678
1959	2,913	193	9,848	27,600	352,800	115,600	78,007
1960	2,985	1,210	8,348	9,800	385,700	104,500	111,658
1961	2,660	1,124	7,166	7,200	322,800	73,000	89,768
1962	3,405	1,760	9,144	10,700	306,800	41,800	107,850
1963	3,204	914	9,870	9,600	362,500	64,100	94,094
1964	2,457	278	8,056	13,900	531,800	116,300	110,160
1965	2,981	341	8,027	8,900	575,700	126,000	133,670
Total	311,796	72,241	562,159	604,135	18,189,939	2,009,366	5,522,962

the deposit in 1933-36 and in 1941 consisted of 859 tons of ore containing 102 pounds of copper, 123 ounces of silver, and 330 ounces of gold.

CAPITOL

The Capitol mine is on the top of an east-trending ridge at the head of Cave Gulch in the NE¼ sec. 5, T. 6 S., R. 10 W., at an altitude of about 7,900 feet. The property is unpatented and is presently held by Lee James of Polaris and is under lease to Spokane National Mines.

The deposit consists of a north-striking network of closely spaced mineralized fractures ½ inch wide cutting white to red Belt quartzite stained with iron oxide. The fractures are chiefly filled by iron oxide minerals but quartz, galena, and cerussite are also present. The fracture zone has been mined by an open cut (Fig. 19) approximately 60 feet square to a depth of about 20 feet, and was filled with much broken mineralized rock. About 250 feet downhill from the open cut two adits, now caved at the portals, were driven southward to find the continuation of the fracture zone at depth. Although the dumps contain much quartzite country rock, none was found containing fractures and minerals resembling the material found in the open cut above. The continuation of the zone apparently was not found in the adits.

A selected grab sample of iron oxide material from the open cut assayed 5.40 percent lead, 0.8 percent zinc, 0.70 percent copper, 3.20 ounces silver, and 0.14 ounce gold. A similar sample but containing much visible galena assayed 6.90 percent lead, 0.4 percent zinc, 0.17 percent copper, 4.40 ounces silver, and 0.01 ounce gold.

Recorded production from the property in 1940-41, 1948-49, and 1952-53, consisted of 36 tons of ore containing 7,986 pounds of lead, 634 pounds of zinc, 311 pounds of copper, 267 ounces of silver, and 1 ounce of gold.

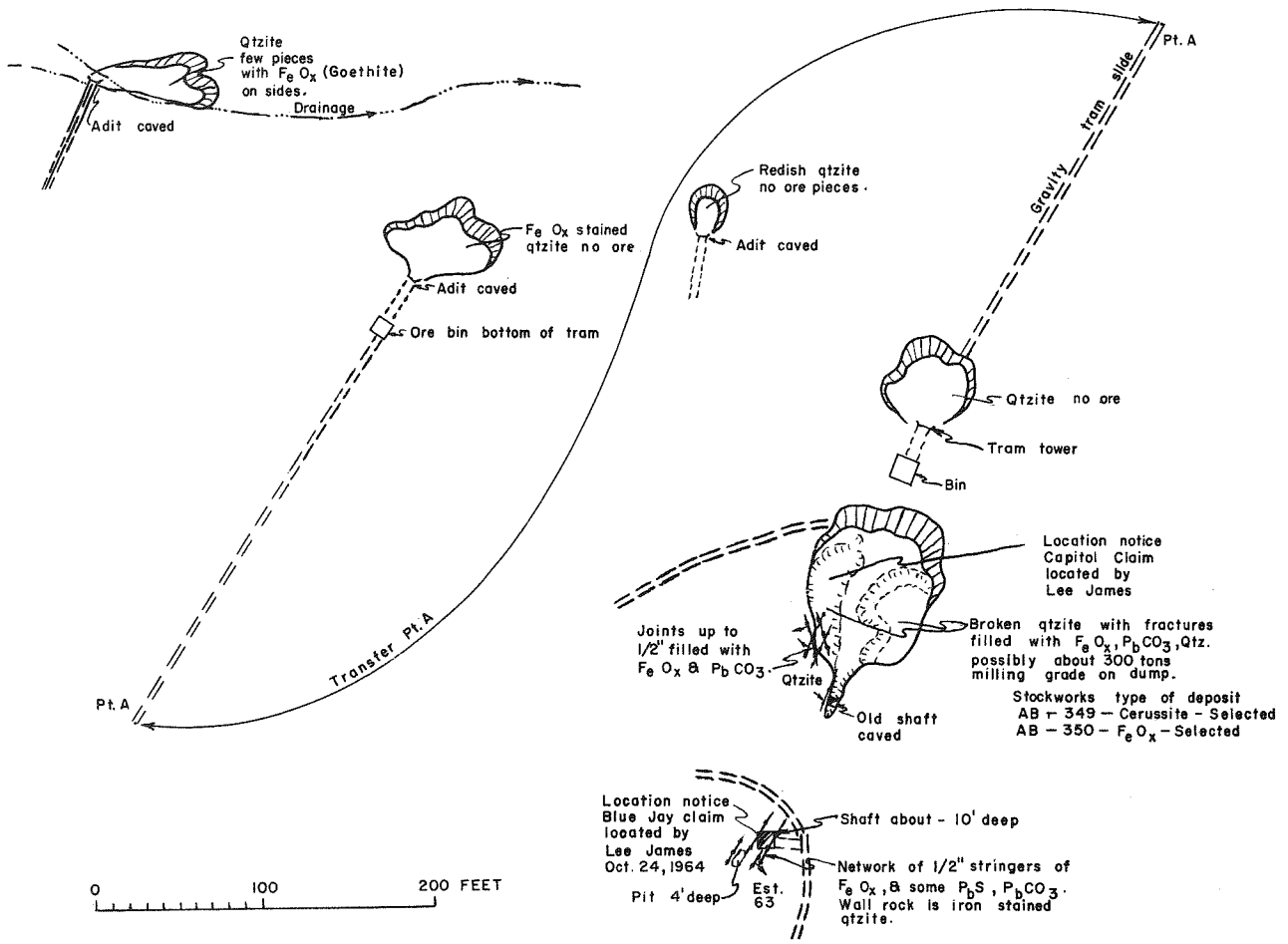


Figure 19.—Sketch of workings, Capitol mine, Argenta district.

CARBONATE

The Carbonate mine consists of one unpatented claim, now held by John Hand of Argenta, which adjoins the Rena to the south.

The property was located in 1890 by Phil M. Brown, who shipped about ten carloads of ore to local smelters. The property was later acquired by the St. Louis and Montana Mining Company and a shaft was sunk 75 feet near the endline of the Rena claim. W. H. McMannis and Alfred Graeter relocated the property and it was later acquired by A. H. and George French. Most of the ore mined is credited to Brown (Shenon, 1931, p. 71). Some ore was shipped from the property in 1942, 1949, and 1953.

The deposit is a steeply inclined north-trending vein that cuts Flathead Quartzite. A grayish-green andesite porphyry dike follows the hanging wall of the ore (Shenon, 1931, p. 71). The vein has been explored over the length of the claim by prospect pits and several shafts ranging in depth from 30 to 90 feet. All shafts are caved except the 90-foot shaft, and because of its unsafe condition it was not examined.

The principal primary ore mineral is galena but thin selvages of cerussite along a slickenside wall are present in some of the prospect pits. The dumps

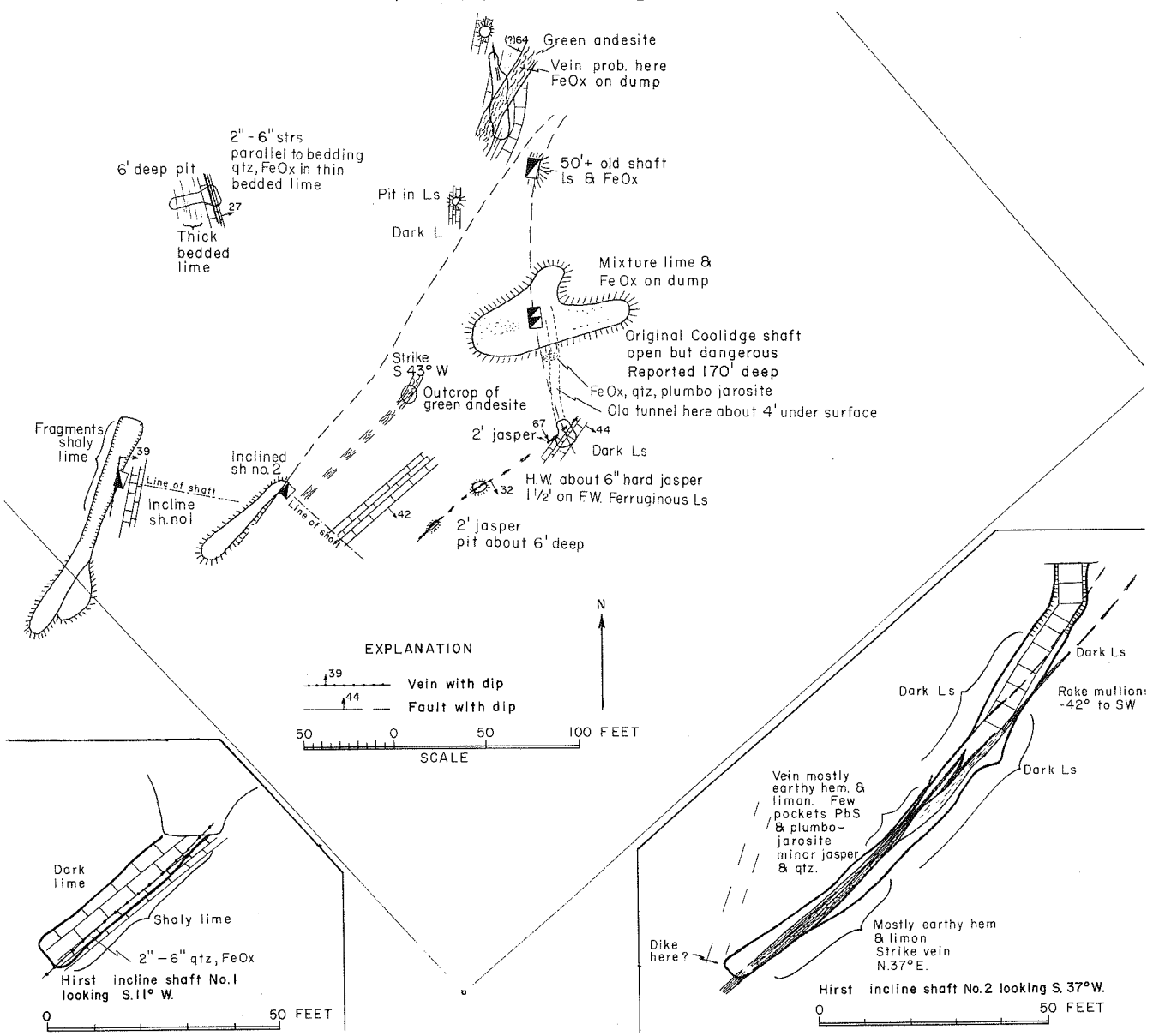


Figure 20.—Sketch of surface of Coolidge mine and profiles of Hirst No. 1 and 2 shafts, Argenta district.

contain much brecciated quartzite recemented by yellow jasper.

Total recorded production is 64 tons of ore, which yielded 10,773 pounds of lead, 611 pounds of zinc, 592 ounces of silver, and 10 ounces of gold.

COOLIDGE

The Coolidge mine is in the SE¼ sec. 18, T. 6 S., R. 10 W., and consists of one patented claim, the St. Joseph, which is owned by John Hand of Argenta.

The property was located in the 1870's by Thomas E. Tuttle and was later acquired by E. S. Ball, who shipped some ore to the St. Louis and Montana smelter at Argenta. The Golden Era Company sank a 170-foot inclined shaft on the property but made no ore shipments. In 1898, 200 tons of dump material was shipped by Alfred Graeter (Shenon, 1931, p. 66).

Ore was also shipped from the property in 1935, 1936, 1940, 1948, 1960, 1961, and 1964. The last shipment was made by Mark Dayley.

Workings on the property consist of the 170-foot inclined shaft (Fig. 20), two other inclined shafts, 40 and 120 feet deep, and several old prospect pits. Most of the ore was mined from the 50-foot level in the 170-foot inclined shaft. The ore occurred on the footwall side of an andesite dike (John Hand, oral communication). The ore shoot was 10 feet high and 2 to 7 feet wide, raked 35° to the south, and extended about 100 feet beneath the surface (Shenon, 1931, p. 66).

The two shallow inclined shafts were sunk by Russell Hirst in 1961 and 1963, and are about 200 feet southwest of the 170-foot inclined shaft, but they explore different structures. The 40-foot shaft was sunk on a narrow bedding-plane vein 2 to 6 inches wide containing a filling of quartz stained with iron oxide. The 120-foot incline exposed a 2-foot bedding-plane vein containing earthy red and yellow iron oxides intermixed with some small residual pieces of galena and jasper.

The deposit is in the basal beds of the Jefferson Formation (Devonian) near the contact with underlying Flathead Quartzite. The Jefferson Formation in the vicinity of the mine trends northeast and dips 27° to 44° SE. A northeast-striking sill or dike of greenish andesite as much as 15 feet wide locally cuts across the strike of the bedding but generally seems to parallel the bedding.

Total recorded production from the property is 279 tons of ore, which yielded 17,713 pounds of lead, 882 pounds of zinc, 170 pounds of copper, 3,114 ounces of silver, and 23 ounces of gold.

COPPER BELL

The Copper Bell claim is patented and lies between the Jack Rabbit and Louis Philip claims in the NW¼ sec. 29, T. 6 S., R. 10 W., about ½ mile northwest of Argenta. In 1963 the property was recorded in the name of J. S. Cohen of Butte. The mine is situated on the north margin of the Argenta quartz monzonite stock. The workings are inaccessible, but according to Shenon (1931, p. 77) the deposit consists of a north-trending vein enclosed in quartz monzonite near the limestone contact. The vein strikes N. 5° E. and dips 80° SE., and was opened by a 112-foot shaft and prospected along its strike on the 45-, 60-, and 112-foot levels. The ore was entirely oxidized on the 60-foot level but was sulfides on the lower level. Cuprite, chrysocolla, malachite, copper pitch, and limonite occurred in the oxidized ore, which on surface assayed $20 in gold per ton.

Production is combined with that from the Jack Rabbit claim and the total is 959 tons of ore, which yielded 92,939 pounds of lead, 73,366 pounds of copper, 6,681 ounces of silver, and 9 ounces of gold.

DEXTER

The Dexter mine is about 2½ miles due north of Argenta and is in the NW¼ sec. 17, T. 6 S., R. 10 W. The property is situated along the contact of a small intrusion of granodiorite with limestone and shale. When visited, all underground workings were inaccessible, but according to Shenon (1931, p. 74), the mine was worked in the 1880's by William Dudley, who shipped some ore from the property, and later by the St. Louis and Montana Company. In 1929 the property was explored by the Continental Mines Company.

Several shafts have been sunk — one to a depth of 317 feet by the St. Louis and Montana Company. An adit 260 feet long connects with this shaft. The adit was driven through brecciated rocks cut by several well-defined faults. A crosscut from the adit was driven to intersect old stopes lying southwest of the adit.

The principal ore deposits were found in veins in shale not far from the contact with granodiorite. Ore minerals are partly oxidized galena, pyrite, and tetrahedrite.

Production is recorded for 1925, 1932, and 1936, but production figures are confidential.

ERMONT

The Ermont group consists of thirty-four unpatented claims, most of which are in sec. 35, T. 6 S., R. 11 W., about 1 mile north of the Jackson-Dillon highway. The mine is on one of Beaverhead County's principal gold deposits and was the largest single lode producer of gold in the county until operations ceased in 1942 because of World War II.

The deposit was found in 1926 by D. V. Erwin and W. J. Corbett, and in 1927 was bonded to the Standard Silver and Lead Company of Spokane, Washington (Shenon, 1931, p. 69). The claims were acquired by a partnership composed of R. B. Caswell, S. K. Caswell, J. R. Bowles, and F. P. Gram, and in 1936 the property was equipped with a 100-ton cyanide mill. In 1936 the partnership was succeeded by Ermont Mines, Inc.; R. B. Caswell was president and manager. About 70 men were employed until World War II, when operations ceased. In 1962 the properties were acquired by R. A. Wellborn of Grant, Montana, the present claimant.

Production was recorded from the properties in 1932-33, 1935-42, 1949-50, and 1963. Total production is 189,649 tons of ore, which yielded 4,789 pounds of copper, 6,999 ounces of silver, and 41,255 ounces of gold.

The ore bodies of the Ermont group are associated with a sill of andesite emplaced near the nose but along the east flank of the Humbolt Mountain anticline of north-south trend. The anticlinal structure lies in a thrust slice between two thrust planes; the slice has been broken by northwest-trending block faults (Fig. 18).

Sedimentary rocks in the mine area are the Jefferson and Three Forks Formations, which dip 23° to 30° eastward. The andesite intrusive bodies consist of two sills traceable by exposures in prospect pits and mine workings as well as float for several thousand feet to the north. The sills are united at their southern exposures.

The eastern andesite sill, about 80 feet thick, is emplaced in Three Forks Shale. Prospect pits and shallow shafts have failed to reveal commercial ore associated with it. The western sill is several hundred feet thick, intrudes Jefferson Dolomite, and is associated with the ore bodies of the Ermont group. The sill tends to follow bedding but contains marginal protrusions that cut across the bedding. The ore bodies associated with the sill are two types, (1) gold-bearing quartz and iron oxide disseminated in dolomite at the andesite contact, and (2) disseminations and veinlets along fracture zones in altered andesite (Kelly, 1941).

The dolomitic ore bodies occur in a gently eastward dipping (20° to 25°), remnant of strongly altered and mineralized dolomite virtually surrounded by andesite. The dolomite ranges from white through buff to brown as a result of impregnation by gold-bearing iron oxides, which are finely disseminated in the dolomite, form concentrations great enough to give a distinct mottled appearance to the ore, or produce rhythmic bands, which give rise to "zebra" ore (Kelly, 1941, p. 13). Some of the dolomite is silicified by gray quartz, chert, and jasper.

The principal mineralized zones occur on both sides of the dolomite remnant at the andesite contacts, forming two ore bodies. No. 1 ore body, averaging 14 feet thick, occurs on the footwall side or westward edge of the dolomite remnant and was worked by an open pit about 175 feet long, 100 feet wide, and in places 50 feet deep. No. 2 ore body, on the hanging-wall side of the remnant, averaged 8 feet in thickness and was mined by underground workings off an inclined shaft 600 feet long, which is now inaccessible. Both ore bodies may have averaged about 0.3 ounce gold per ton.

The fracture-zone ore body is at the east side of the andesite sill near the contact with the dolomite and about 3,200 feet northeast of the open pit. The deposit is in a northwest-trending fracture zone that cuts both the andesite and the dolomite. It was mined from five levels, 100 feet apart, off No. 19 shaft, which is now inaccessible. The continuation of the fracture zone in the dolomite crops out a few feet south of the shaft as a prominent but barren jasperoid ledge several feet wide. The zone contains ore only where it cuts the andesite. Most of the ore was disseminations and veinlets of gold-bearing quartz and iron oxide in altered andesite, although pyrite ore was found on the 500-foot level. The fracture zone extends along a strike length of about 1,000 feet and encloses a large horse of andesite. The apex of the horse was above the 300-foot level, and the mineralized zone on each side was mined to a maximum width of five sets (Mining World, Nov. 1940, p. 21).

FERDINAND

The Ferdinand mine is in the SE¼ sec. 29, T. 6 S., R. 10 W., and is just on the east outskirts of

Argenta, on the north side of Grasshopper Creek. The property is owned by Rudy Nygren of Argenta.

The lode was found in 1868 by Thomas Harrison, who shipped some ore to Swansea, Wales, for treatment. After smelters were constructed at Argenta, the Ferdinand ore was treated locally. When sulfide ore was reached, the property lay dormant for 20 years, until the St. Louis and Montana Mining Company was able to treat the ore by giving it a preliminary roast. The mine was then operated for two years and was subsequently acquired by Lafayette Scott. In 1909, the property was acquired by the Argenta-Dillon Mining Company (Shenon, 1931, p. 76). Production from the property was recorded in 1909, 1924-25, 1927-28, 1937, 1940, 1943, 1946, 1948-51, and 1953-57. Total recorded production is 3,060 tons, containing 436,392 pounds of lead, 265,934 pounds of zinc, 15,746 pounds of copper, 8,942 ounces of silver, and 17 ounces of gold.

The deposit occurs along a vertical mineralized shear zone, which strikes N. 30° W. and which is at the contact between quartz monzonite and Madison Limestone. The ore minerals are pyrite, galena, sphalerite, and chalcopyrite. The material mined was not solid ore but sulfide material alternating with bands of soft, altered and partly mineralized quartz monzonite as much as 12 feet wide (Shenon, 1931, p. 76).

The deposit has been developed by a shaft about 245 feet deep and levels at depths of 70 feet, 101 feet, and 134 feet. When visited, the mine was filled with water to the 70-foot level, which is open to surface. Mine maps of the property show the north drift on the 134-foot level to be the farthest advanced, extending about 280 feet northwest of the shaft.

FLUORITE NO. 1

The Fluorite No. 1 consists of an unpatented claim relocated by R. M. Fleming in 1964. The original claim was called Grand Deposit No. 17 and located by Gregory Salish (R. M. Fleming, oral communication). The property is situated in the SE¼ sec. 33, T. 6 S., R. 11 W., a few feet south of a dirt road.

The deposit is poorly exposed by a bulldozer cut. It contains dark-gray barite fragments, possibly occuring as lenses in a bed of red and purple shale 10 feet thick. Sparse specks of fluorite are distributed through the barite.

GALENA

The Galena shaft is about 2,000 feet southeast of the Dexter shaft. In 1929 the shaft had been sunk 60 feet on a vein striking S. 20° E. and dipping 70° S., which widened from a few inches on surface to about 2 feet near the bottom of the shaft. The country rock is garnetized limestone in contact with granodiorite along the hanging wall (Shenon, 1931, p. 74).

GLADSTONE

The Gladstone and Argenta claims lie in the SE¼ sec. 13, T. 6 S., R. 11 W., and are patented claims owned by H. E. Morse of Dillon and others.

The claims were located in the 1880's. The Argenta has produced 150 tons of ore, but the Gladstone produced little or no ore (Shenon, 1931, p. 75).

The deposit consists of a fissure vein that cuts Flathead Quartzite and trends N. 45° W. and dips 80° NE. Development work consists of a 200-foot shaft sunk on the Argenta claim and a 50-foot shaft on the Gladstone. A few drifts were driven off the Argenta shaft, and some ore was stoped to the grass roots. All workings and shafts are inaccessible. The principal value was in gold, but the ore carried some lead. A vein at the bottom of the Gladstone shaft is said to be 5 to 6 feet wide and to assay $12 per ton in gold (Shenon, 1931, p. 75).

Total production from the group, which is combined with that from the Midnight mine, is 3,324 tons of ore, which yielded 369,958 pounds of lead, 8,873 pounds of copper, 22,447 ounces of silver, and 1,180 ounces of gold. This ore was produced in 1902, 1908-10, 1915-16, 1918, 1921-26, 1928, 1931-40, 1942, and 1962-63.

GOLDEN ERA

The Golden Era mine is in the NW¼ sec. 13, T. 6 S., R. 11 W. The property consists of one patented claim and millsite recorded in the name of Joseph F. Imbs.

The deposit was discovered in 1880 by W. D. Booth and was later relocated by A. I. Watts. In 1884, G. W. French and Henry Laughlin purchased the property and shipped a small amount of ore. The mine was later developed by the St. Louis and Montana Mining Company, who shipped some first-class ore and milled about 1,000 tons of lower-grade material (Shenon, 1931, p. 72). In the fall and winter

of 1935, two shafts were sunk and additional trenching was done under the supervision of J. U. MacEwan (Johnston, 1936, p. 12).

The deposit consists of a mineralized shear zone that trends almost due north, dips 60° E., and cuts slightly dipping Precambrian green and red shale. The vein in the shear zone was 1 to 4 feet wide and contained a filling of galena and pyrite in quartz gangue (Shenon, 1931, p. 72).

The deposit was developed by three shafts (Fig. 21). The principal shaft (No. 1) reached a depth of 300 feet, and considerable ore was stoped from the vein in the vicinity of the shaft. No. 2 shaft, about 141 feet north of No. 1 shaft, was sunk on the vein to a depth of 65 feet. No. 3, about 200 feet south of No. 1 shaft, was sunk through old stopes to the water table at a depth of 118 feet, and a drift was driven north in gob for a distance of 100 feet. All shafts are now caved at the collars.

The property has no record of production for the period 1902-65.

GOLDFINCH

The claims of the Goldfinch group are about 2½ miles northwest of Argenta and are situated along Clark Canyon. The group comprises the Goldfinch, Jack, Dolphin, Harmon, Sunny Day, Southside, Golden Crown, Big Lode, Caledonia, Three Cheers, and All Nations. The properties are unpatented and are held by H. C. Russell of Seattle, Washington.

The deposit was found in the 1880's by A. V. Clark, who shipped several carloads of ore from the property. In 1890, G. W. and A. H. French purchased the properties and sank the Dolphin shaft to a depth of 100 feet. The total production to 1931 was 250 tons (Johnston, 1936, p. 10). In 1932 the properties were leased to the Clark Canyon Gold Mining Company. The Meadow Lark shaft, about 800 feet north of the Dolphin shaft, was sunk to a depth of 120 feet and considerable ore was mined. A 50-ton gravity concentrator was installed on the property, but it was dismantled in 1936. The Federal Mining and Smelting Company of Wallace, Idaho, a subsidiary of the American Smelting and Refining Company, deepened the Meadow Lark shaft to the 220-foot level in 1936 and shipped some ore in 1937. Most of the ore from the group was produced between 1932 and 1937. In recent years the properties have been inactive except for the necessary assessment work.

The deposit consists of ore lenses localized along a shear zone that trends north and dips 75° E. The zone cuts slightly dipping thin-bedded Precambrian shale and ranges in width from several feet to 50 feet. The width of the ore lenses ranges from 1 to 15 feet in the ballroom stope, and the lenses rake to the north at about 65° (R. M. Fleming, oral communication). A strongly altered porphyritic dike follows along the vein (Shenon, 1931, p. 73).

The deposit has been explored by several shafts spaced about 300 feet apart over a length of 2,500 feet. The deepest shaft was the Meadow Lark, which attained a depth of 220 feet. All shafts except the Gardner shaft are now caved. The Gardner shaft, sunk in 1937, is 90 feet deep and at the bottom has

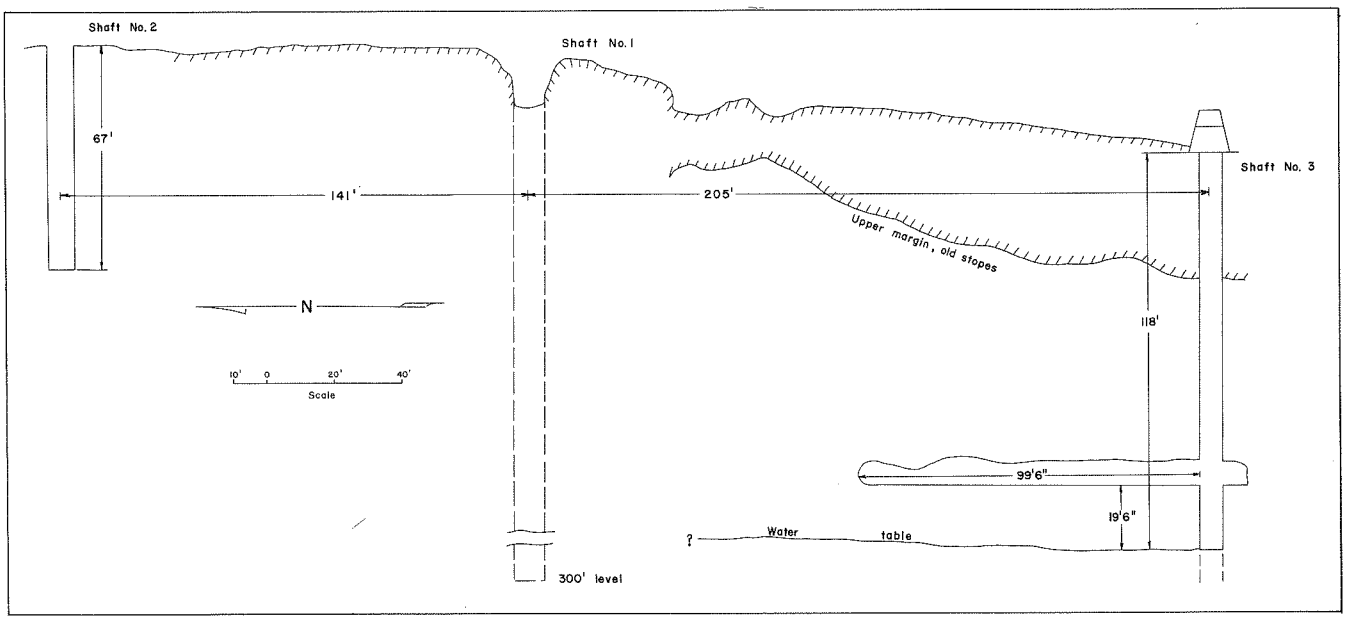


Figure 21.—Longitudinal section of the Golden Era mine, Argenta district. (Johnston, 1936).

exposed a 3-foot lens of quartz and pyrite in a black gouge zone about 5 feet wide. Figure 22 is an incomplete plan and longitudinal section of the underground workings.

Primary ore minerals in the deposit are auriferous pyrite and galena, and some sphalerite and arsenopyrite. The dumps have been carefully sorted; vein material on them consists principally of quartz and pyrite.

Production from the property between 1932 and 1937 was 3,811 tons, which averaged 0.66 ounce gold and 7.04 ounces silver; 963 tons of this ore averaged 5.8 percent lead.

Total production from the property is 6,604 tons, which yielded 318,689 pounds of lead, 5,502 pounds of copper, 171 pounds of zinc, 46,003 ounces of silver, and 3,871 ounces of gold. This ore was produced in 1902, 1906, 1908, 1910, 1925-26, 1932-42, 1948-50, and 1954.

GOLDSMITH

The Goldsmith property is situated a short distance west of Argenta. The property consists of one patented claim contiguous with the Iron Mountain claim and owned by The Anaconda Company and the J. S. Cohen estate.

The property was located in the late 1880's by Thomas Judge and Thomas Fox, who shipped some ore but then seemingly allowed the location to lapse. Mark Bray relocated the property and sold a one-half interest to a Mr. Smeed. His remaining one-half interest was purchased by W. A. Clark and subsequently was acquired by The Anaconda Company in 1928. Smeed's interest was acquired by J. E. Oppenheimer and later by J. S. Cohen.

Production from the property was recorded in 1926-27, 1930, 1937, 1942-43, 1949, 1954-59, 1964, and 1965, and amounted to 563 tons, which yielded

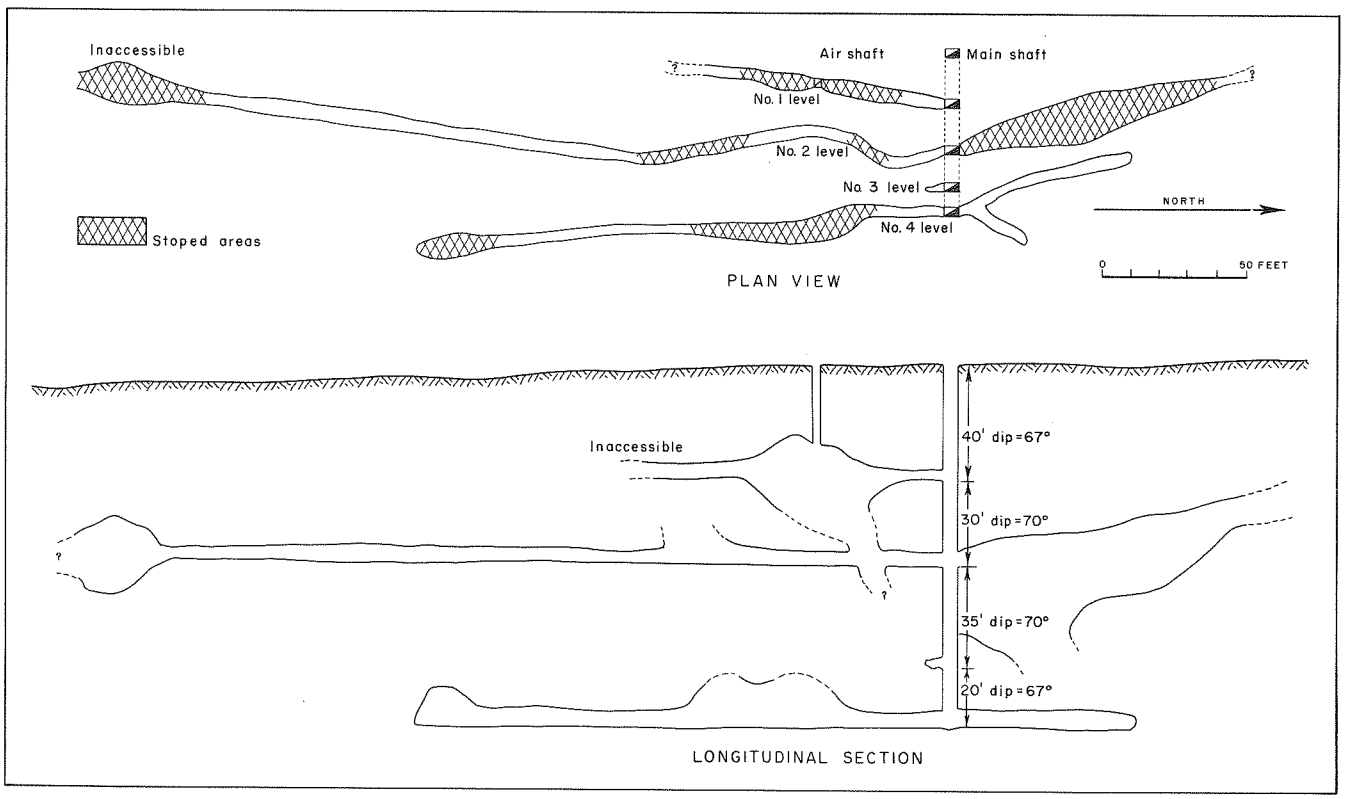


Figure 22.—Plan and longitudinal section of the Goldfinch mine, Argenta district.

172,309 pounds of lead, 28,900 pounds of zinc, 38,574 pounds of copper, 2,761 ounces of silver, and 56 ounces of gold.

In 1968 the property was being leased and operated by C. F. Wroble and H. T. Kruse of Anaconda, Montana.

The deposit is in limestone in the contact zone along the northwest margin of the Argenta quartz monzonite stock and is similar geologically to the deposits in the Hand mines. The old workings consist of three adits 120, 60, and 25 feet in length, and a shallow inclined shaft. The 60- and 25-foot adits intersected a well-defined fissure that strikes N. 80° W. and dips 70° NE. With the exception of the 120-foot adit, these workings are now inaccessible. Production from these workings was estimated by Shenon (1931, p. 67) to be about 300 tons of ore.

The 120-foot adit has been extended to 170 feet and intercepts a vein that trends N. 70° W. and dips

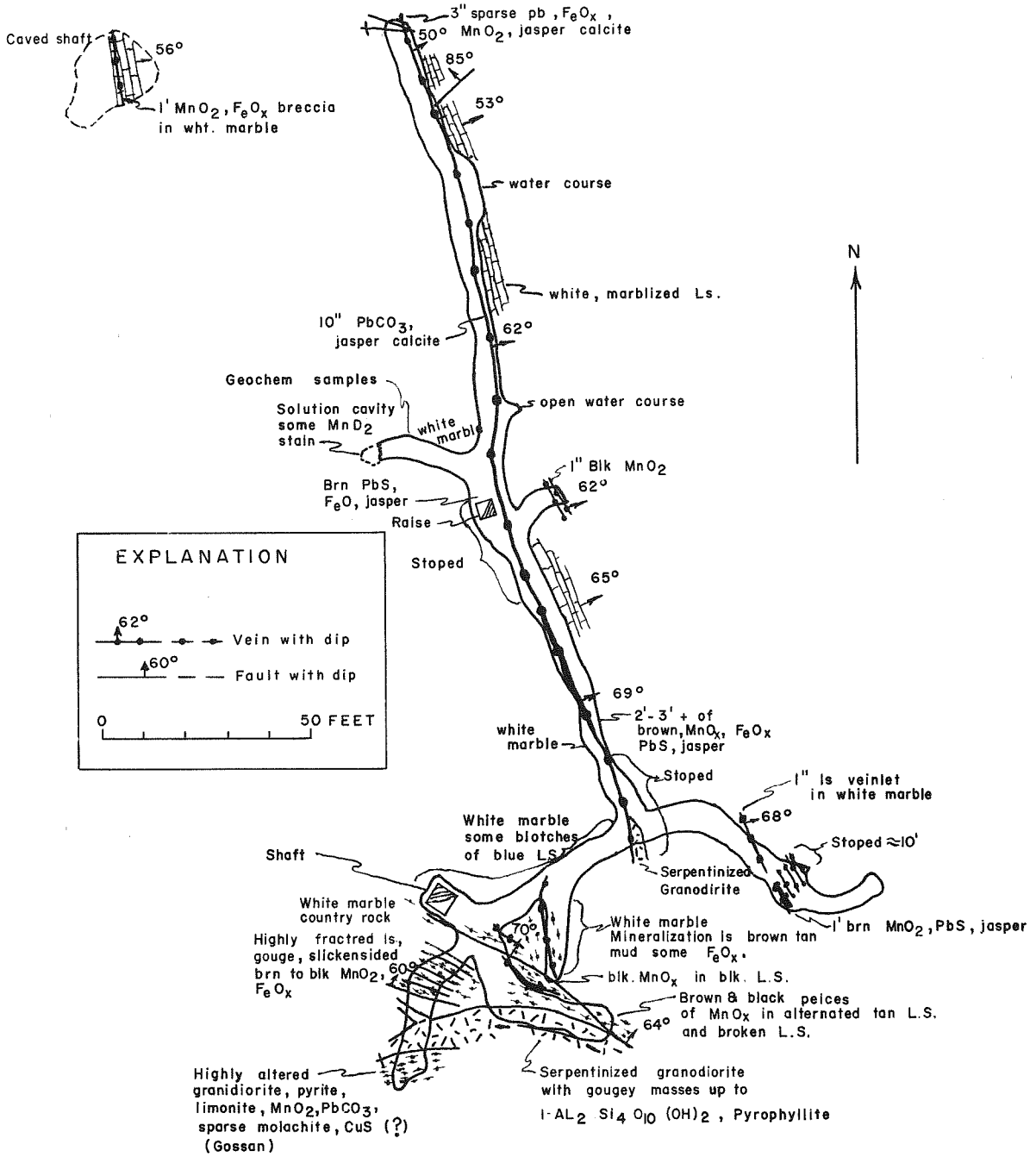


Figure 23.—Geologic sketch of underground workings of the Goldsmith mine, Argenta district.

45° NE. The vein has been developed for short distances on both sides of the adit. The vein filling is all oxidized and consists principally of mixtures of red-brown iron and manganese oxides and oxidized lead minerals. The wall rock is fine-grained white marble. Probably some ore has been shipped from the adit.

Recent production has come from a 35-foot shaft (Fig. 23), which was sunk in 1965, near the contact of limestone with quartz monzonite. It is situated about 600 feet east-southeast of the 170-foot adit and a few feet south of another old adit, now caved at the portal.

A 40-foot northeast-trending crosscut from the bottom of the shaft has cut a fissure vein that trends N. 20° W. and dips 69° NE. The vein has been developed for about 200 feet and stoped at places along its length. The width ranges from 3 inches to 3 feet. The ore consists of mixtures of manganese and iron oxides, oxidized lead minerals, sparse galena, and jasper. Some of the ore mined is reported to run high in silver. About 20 feet south of the shaft, a heavily mineralized but low-grade shear zone has been explored for a few feet. It trends about N. 80° W. and dips 64° N., and follows the contact between the limestone and quartz monzonite. The zone averages about 5 feet in width, and contains mixtures of manganese and iron oxides, fault gouge, and limestone fragments. Much of the fault gouge along the contact is accompanied by lenses of pyrophillite as much as 1 foot thick.

GOODVIEW

The Goodview mine is in the SW¼ sec. 18, T. 6 N., R. 10 W. The property consists of one unpatented claim held by John Hand of Argenta. It adjoins the Carbonate claim to the south.

The ore body occurs as a replacement of thin-bedded shaly limestone at its contact with underlying Flathead Quartzite (Fig. 24). The limestone strikes N. 20° E. and dips 35° SE. and seemingly rests conformably on the underlying quartzite. The deposit is at the intersection of favorable host limestone and a fissure that strikes N. 5° E. and dips 85° SE., which seemingly is the south extension of the Carbonate vein. A few feet into the quartzite the fissure is cut by a northeast-striking fault. The faulted extension of the fissure has not been found.

The ore shoot, measured along its plunge with the bedding, was about 40 feet long and as much as 10 feet wide. It has been mined out to a vertical depth of about 60 feet by a horizontal adit and an inclined drift driven under the ore body along the line of the upper adit. A lower adit, about 100 feet below the upper workings, was evidently started to intersect the limestone formation at depth, but this adit, driven about 50 feet entirely in shale, did not reach its objective. The ore mined was composed mainly of earthy oxidized lead minerals. Remnants of tan and brown jasper are left on the walls of the excavations.

Below the limestone unit is a zone several feet thick consisting of white and tan altered material, which contains grains of quartz and is impregnated with red earthy oxides of iron. Seemingly it is altered Flathead Quartzite, which shows some traces of bedding.

Total recorded production from the mine is 1,080 tons, which yielded 163,934 pounds of lead, 2,204 pounds of zinc, 742 pounds of copper, 7,403 ounces of silver, and 179 ounces of gold. Ore was produced in 1941-42, 1948, 1950, and 1954.

GRAYBIRD

The Graybird group consists of six unpatented claims in the NE¼ sec. 29, T. 6 S., R. 10 W., and lying north of the Ferdinand. The claims are held by Mrs. Carl Meine of Dillon, Montana.

The principal work on the claims is on the Graybird No. 1 claim, where a surface cut about 70 feet long has been dug along an irregular contact between an intensely kaolinized and sericitized granodiorite (?) dike and thin-bedded partly marmarized and chloritized limestone in the Amsden Formation. The contact strikes N. 20° W. and dips 67° NE. Vein matter exposed along the contact zone consists of a lens of red-brown jasper containing blebs of steel galena and lead carbonate. The lens was estimated to be about 15 feet long and as much as 4 feet wide.

In 1965, a prospect shaft then about 6 feet deep was sunk on the lens by Glen Shafer of Argenta, Montana, and some hand-cobbed ore was shipped. At the bottom of the pit the lens was cut off by the dike, which here dips to the west.

Production from the property was recorded in 1961 and 1965. Actual production figures, however, are confidential.

GROUNDHOG

The Groundhog group of claims is in the SW¼ sec. 18, T. 6 S., R. 10 W., and consists of two unpatented claims, the Groundhog and Fissure,

both now held by John Hand of Argenta.

The property was located in 1895 by A. H. French and G. W. French, who shipped a carload of ore that assayed $20 per ton in gold (Shenon, 1931, p. 71). In 1935 the property was held by the Groundhog Mining Syndicate (Gilbert, 1935, p. 4).

The deposit consists of a shear zone cutting flat-lying Flathead Quartzite near the contact with overlying limestone. The zone trends N. 30° W. and dips 80° NE. The quartzite in the zone has been crushed and altered for a width of 2 to 3 feet, and stained by red iron oxides probably formed by oxidation of auriferous pyrite.

Principal development work has been on the Groundhog claim. A drift has been driven on the zone for a distance of about 450 feet and ore stoped (overhead) along most of this length. A shaft 100 feet deep was sunk near the portal of the drift, and several levels were established from it, but it is now inaccessible.

From an assay map of the underground workings

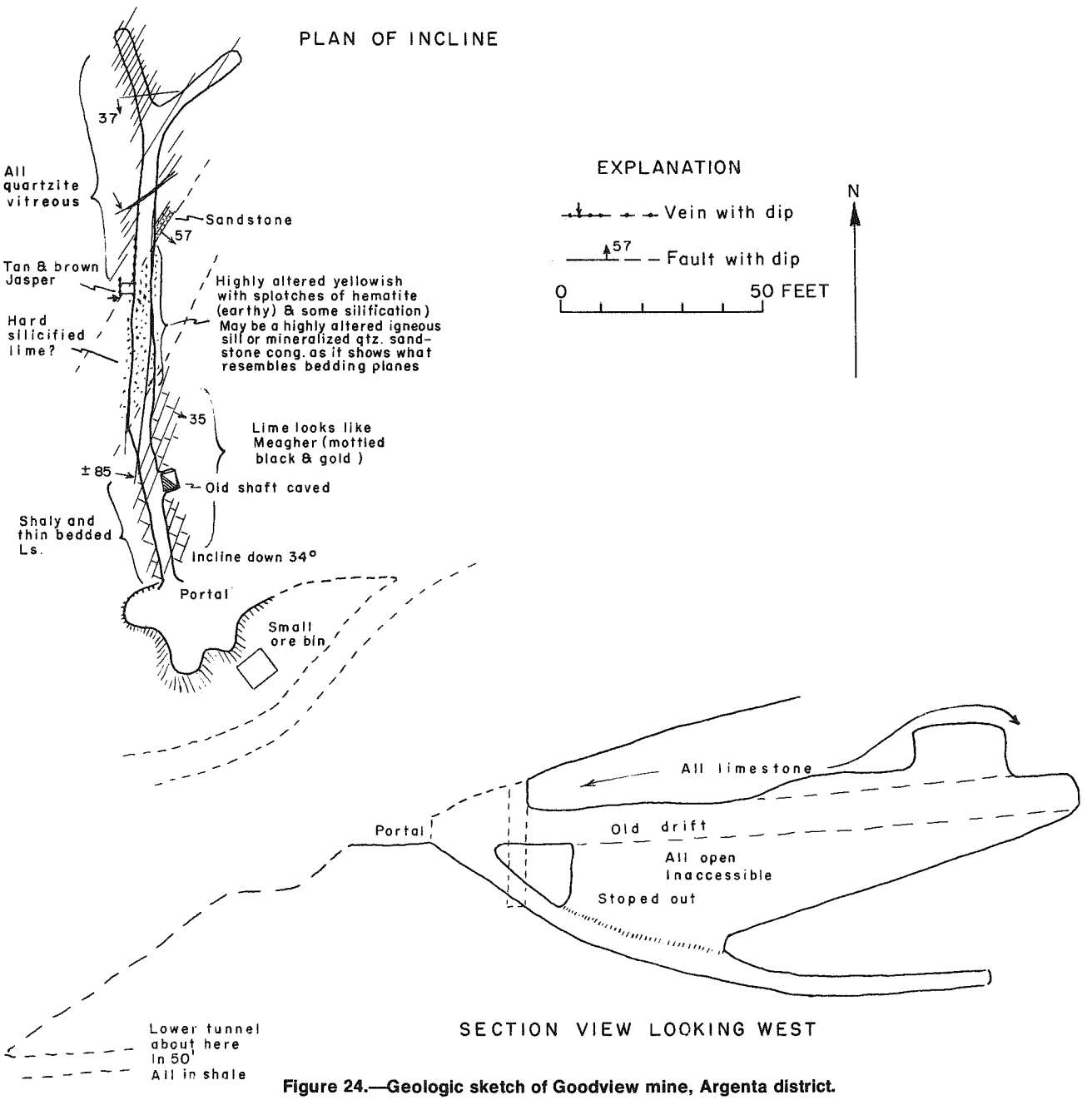


Figure 24.—Geologic sketch of Goodview mine, Argenta district.

(Fig. 25), provided by William Hand, gold values can be seen to range from a few cents to about $5 per ton near the face of the drift, and from about $15 to $25 per ton in the stoped area. Gold values in the 100-foot shaft range from a few cents to $3 or $4 per ton.

The only recorded production from the group is off the Fissure claim; one ton of ore containing 300 pounds of lead and 8 ounces of silver was shipped in 1957.

HAND (MAULDIN)

The Hand (Mauldin) mines are situated on the low bluff directly overlooking the town of Argenta. The property is a consolidation of several patented claims, formerly held under diverse ownership, and includes the Anaconda, Rittenhouse, Louis Phillip, Brownell, Iron Mountain, Little Iron Mountain, Daylight, Captain Jim, Three Times Winner, and Copper Blossom. The property is held by John and William Hand of Argenta.

The Brownell claim, located in 1865 by Harry Griffiths, was the second lode discovery in the Argenta district. Considerable ore was shipped to the St. Louis and Montana smelter at Argenta by E. S. Ball and others. About this time the Rittenhouse and Louis Phillip claims were located by James Mauldin. Mauldin and Ball became involved in a lawsuit over ownership of the properties, which was settled in favor of Mauldin. After the lawsuit Ball located the Anaconda property and sank a 30-foot shaft, which encountered an ore body.

The Brownell ore bodies were mined by means of a shaft 150 feet deep, and produced about 5,000 tons of ore by 1931 (Shenon, 1931, p. 64). The Mauldin property was formerly worked through four shafts and a long adit. One of the shafts, named after a Professor Eaton, who was probably the first mining geologist to visit the district, was sunk on a fissure striking N. 10° W. and dipping 80° SW. The Iron Mountain deposits were worked from two adits and two inclined shafts near the contact between quartz monzonite and limestone. The lower Iron Mountain adit was started near the level of Rattlesnake Creek

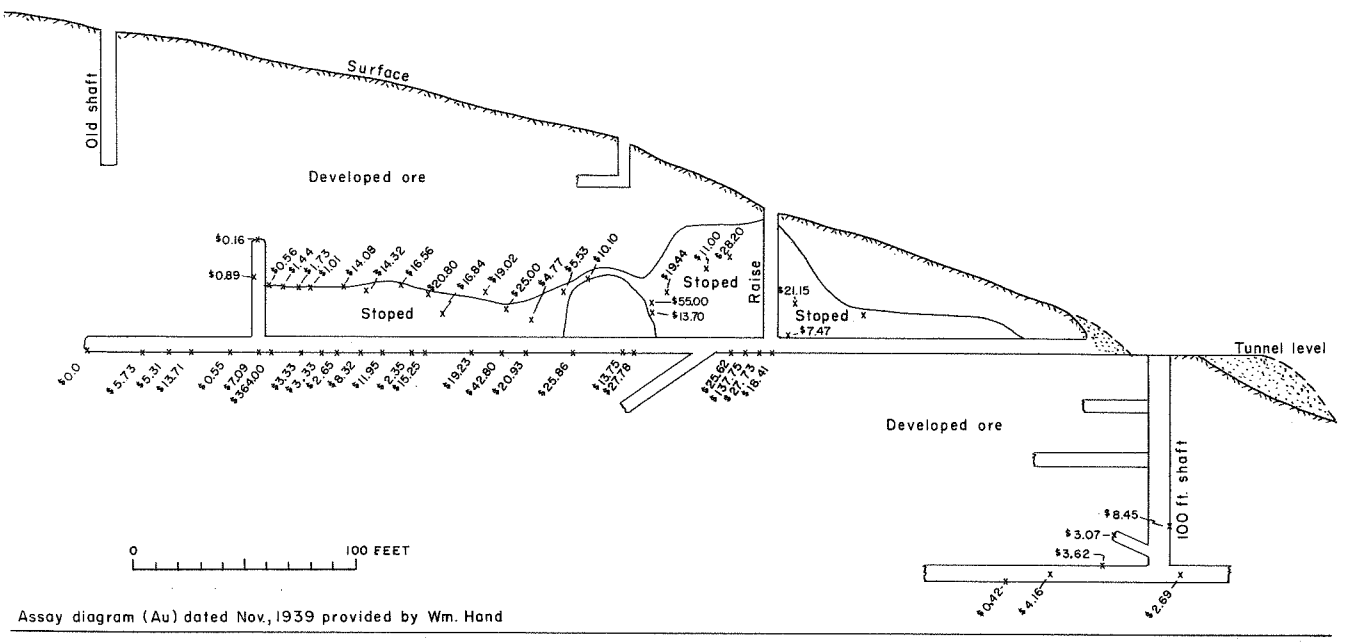


Figure 25.—Longitudinal section, Groundhog mine, Argenta district.

and was driven northward 700 feet in quartz monzonite to ore bodies localized at the contact of quartz monzonite with limestone. A copious flow of pure fresh water issues from the portal of the adit.

In 1942 the properties were leased by John Hand. The first ore shipments were made from surface cuts on the Louis Phillip claim. Underground operations began in 1943 through the old Eaton

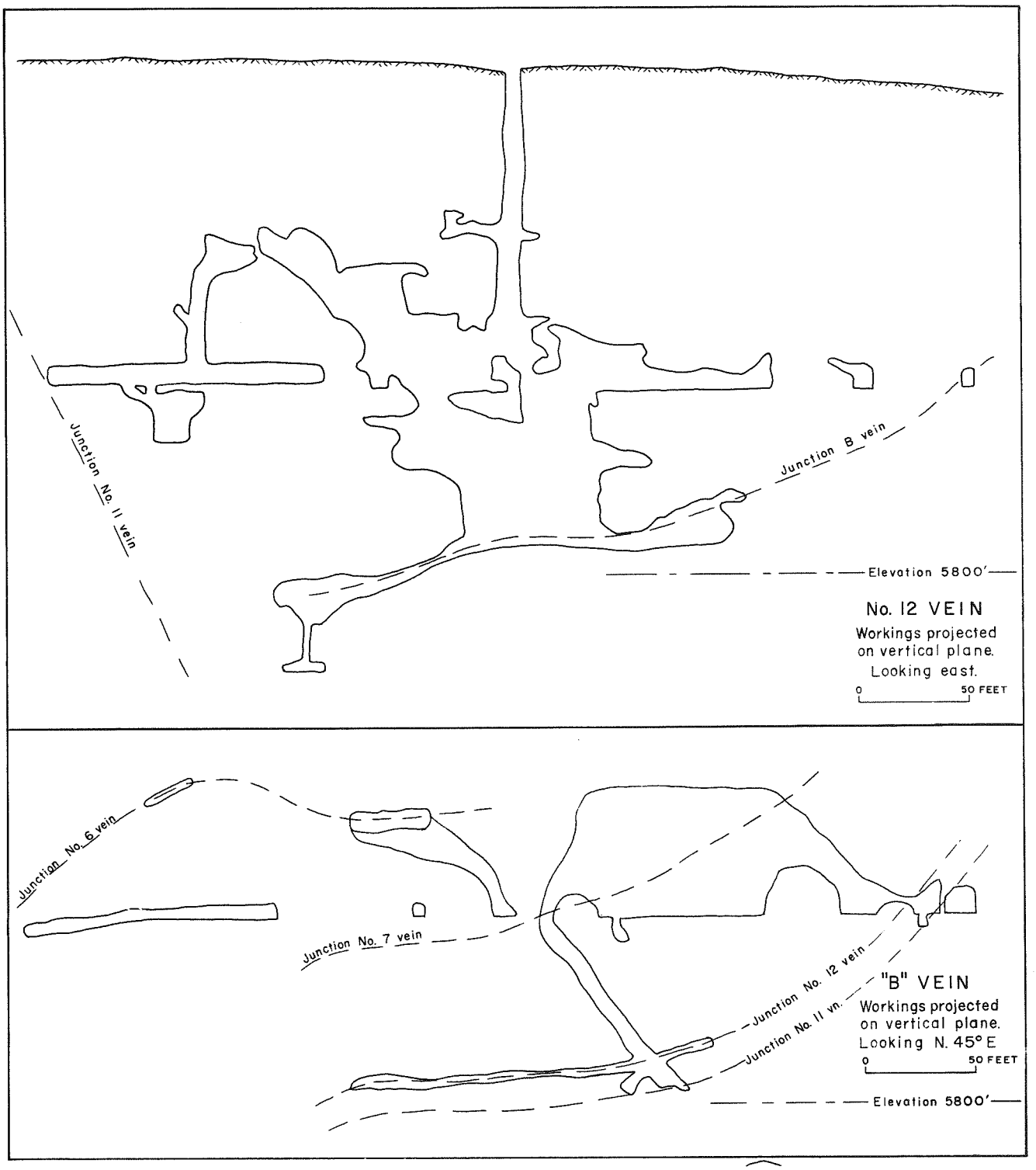


Figure 26.—Longitudinal sections, No. 12 and B veins, Hand (Mauldin) mine, Argenta district.

shaft. The 5885-level adit, the present principal means of entry, was driven in 1949 (Pl. 1). Present underground workings total several thousand feet and have exposed twenty or more veins. The mines have been in fairly continuous operation since 1942 and normally employ 4 or 5 men. Daily production is about 20 tons of ore per day.

The ore bodies of the Hand (Mauldin) mines are localized in the upper bed of Madison Limestone, which trends northeast and dips gently southeast. They are at or near the contact of the beds with the north side of the Argenta quartz monzonite stock. The deposits are in a strongly mineralized area measuring possibly 1,200 feet in east-west width across the north margin of the stock and more than 1,200 feet in length north from the contact. A north-trending altered quartz latite dike as much as 20 feet wide cuts the limestone beds near the central part of the area and has been traced by surface and underground exposures for at least 1,200 feet north of the contact. Some silica-cemented and recrystallized limestone breccia is exposed by underground workings in the eastern part of the area. If these structures have any relationship to the ore, it is not apparent (Pl. 1).

Intrusion of the stock has caused recrystallization of the limestone as the principal effect of contact metamorphism. Normal dark-blue or gray Madison Limestone has been transformed into white coarse-grained limestone or white fine-grained marble lacking appreciable garnet or epidote. Much of the white fine-grained marble is associated with unaltered limestone so as to give the rock a mottled appearance. A silicated noneffervescing white to tan "limestone", greasy to the touch and resembling talc in appearance, is locally associated with the deposits. A rock identified as garnet (Shenon, 1931, p. 55) is also associated with the deposits.

The ore bodies are of two kinds, fissure veins of great irregularity, which cut the limestone country rock, and replacement deposits at or near the quartz monzonite contact.

The fissure veins can be divided into two sets. One set trends north and dips nearly vertical but generally to the west. The other, interconnecting set trends northwest and dips southwest at 5° to 60°.

The north-trending series of fissures is the major system of veins and has produced most of the ore mined in recent years. Individual fissures are 20 to 100 feet apart; slickensides on the walls, and fault gouge developed along some of them, suggest that they were formed by north-south shearing stresses acting on the country rock. The ore in these veins occurs in several shoots, which are generally connected and rake south to the quartz monzonite contact (Fig. 26). Some ore shoots seem to be at the intersection with northwest structures. Individual shoots are irregular in length and height; stoping widths range from 1 to 7 feet. Ore shoots in No. 7 vein, which is on the hanging wall of the quartz latite dike, and in No. 11 and No. 12 veins (Fig. 26) have been mined to a height of about 60 feet above the 5885-adit level by stopes and to a depth of about 90 feet.

The interconnecting northwest-striking set of veins is best represented by the B vein. En echelon segments of the vein lie between several pairs of north-south veins (Pl. 1). The B vein has been mined to a height of about 60 feet above the 5885-adit level and explored to a depth of 70 feet below (Fig. 26). Production from the vein through 1965 was approximately 4,100 tons, averaging 8.5 percent lead, 1.38 percent zinc, 0.3 percent copper, 6.0 ounces silver, and 0.15 ounce gold (William Hand, written communication). In the eastern part of the mine, one of the northwest veins is localized along a series of small north- to northeast-plunging folds.

Replacement ore bodies at the contact between quartz monzonite and limestone are exposed in the Iron Mountain adit (Pl. 1), which is about 200 feet lower than the 5885-adit level. The adit is about 700 feet long and should be extended northeastward to cut the vein structures exposed on the 5885 level. The underground workings were not accessible during the writer's visit; the following description is based on Shenon's observations (1931, p. 68).

The ore shoots are tabular bodies along and paralleling the contact, which dips steeply to the north. They differ greatly in size. Originally they were mined by two inclined shafts, one of which was 300 feet long. Stopes, which reached to surface from the 100-foot level, were mined to a maximum width of 20 feet. The zone has been explored over a distance of 200 feet along its length. North-trending fissures localized ore in the vicinity of the Knapp stope and were intersected by one of the shafts. In 1958, the Iron Mountain adit was reopened by the Hands, and ore was mined from the contact zone.

The ore in the deposits consists principally of earthy, soft iron-rich oxidation products. The veins contain mixtures of dark brown, orange, yellow, and

Table 7.—Recorded production from Hand (Mauldin) mine, Argenta district.

Name of claim	Tons	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
Anaconda	133	11	559	1,233	61,612	-----
Brownell	558	14	1,330	4,054	138,797	-----
Iron Mountain	4,022	203	16,527	27,039	1,141,420	5,000
Mauldin	51,392	3,439	192,108	320,916	11,918,695	1,604,585
Louis Phillip	12	3	119	165	9,446	-----
Total	56,117	3,670	210,643	353,407	13,269,970	1,609,585

red iron oxides, jarosite, plumbojarosite, cerussite, anglesite, and small amounts of galena and smithsonite. Plumbojarosite is the principal ore mineral mined. Red-brown jasper containing blebs of galena occurs in some of the veins but the ore in general lacks silica. Brown manganese oxide minerals dispersed in the veins and throughout the wall rock are abundant in surface cuts at the north end of the mineralized area and in the western part of the underground mine area.

In the Iron Mountain workings the richer ore is massive brown cerussite and limonite and patches of dark-gray anglesite (Shenon, 1931, p. 69). Copper oxidation products are abundant as stains throughout the ore and along seams containing pyrite and chalcopyrite in the quartz monzonite within 200 feet of the contact. The distribution of these metals seems to indicate a rough zonation consisting of a manganese-bearing outer zone surrounding the central lead zone, copper being distributed at or near the contact between quartz monzonite and limestone.

The value of metal produced from the mines is several million dollars. Production figures are given in Table 7.

JACK RABBIT

The Jack Rabbit mine is on a patented claim recorded in the name of W. H. Graeter, and is in the NW¼ sec. 29, T. 6 S., R. 10 W., about half a mile northeast of Argenta. The property lies on the north margin of the Argenta quartz monzonite stock near the contact with limestone.

According to Shenon (1931, p. 76), the mine was discovered by J. P. Fletcher in the 1870's, and a 140-foot inclined shaft was sunk on a small outcrop of ore. From 1915 to 1919 the property was operated by the Conda Mining Company, who sank a 300-foot shaft and drove 200 feet of crosscuts on the 200- and 300-foot levels to the Jack Rabbit and Copper Bell veins. The company shipped about 16 carloads of ore.

The deposit is in the quartz monzonite. Ore shipped from the lower levels consisted principally of chalcocite and pyrite in a quartz gangue.

The property produced in 1912-14, 1917-18, 1926, and 1933, the last shipment being made by H. Latimer and K. MacPhail of Butte. Total production, which is combined with that from the Copper Bell claim, is 959 tons of ore containing 92,934 pounds of lead, 73,366 pounds of copper, 6,681 ounces of silver, and 9 ounces of gold.

LEGAL TENDER

The Legal Tender mine is in the SE¼ sec. 24, T. 6 N., R. 11 W. The property consists of one patented claim named the Old Legal Tender and is owned by Margaret Eddy Grimes and Gordon Relling.

The deposit was found in 1865 by A. M. Esler and is one of the earlier silver-lead discoveries in Montana. The property subsequently was purchased by G. M. Brown and later leased to Cornelius Bray, who mined ore valued at $10,000 from a small shoot. An issue of the Dillon Tribune (Sept. 26, 1890) reported diamond drilling at the Legal Tender and that in a 250-foot hole ore was found between porphyry and blue limestone. The property has no recorded history of production, but Shenon (1931, p. 63) estimated production at $150,000.

The deposit follows a bedding plane of the lower, gray dolomitic limestone member of the Jefferson Formation, which strikes N. 20° E. and dips 60° SE. The deposit was mined by a 100-foot inclined shaft, which is now caved. According to Shenon (1931, p. 63), underground stopes averaged about 4 feet in width but the deposit was probably narrower. The ore was granular lead carbonate, which assayed about 300 ounces of silver per ton. Residual patches of galena remain along the walls near the termination of the ore shoots.

MAYDAY

The Mayday mine is in the SW¼ sec. 7, T. 5 S., R. 10 W., on one unpatented claim held by John

Thuleson. The deposit was found by George and Dick Fleming in 1934.

The deposit is in a mineralized shear zone, which cuts brown and tan fissile shale of Precambrian age. The zone trends about N. 12° E.; dip ranges from 76° W. to 71° E. The bedding of the shale strikes N. 37° E. and dips 38° SE. The shear zone is 6 to 12 inches wide and is marked by gray to yellowish gouge. No ore could be seen by the writer in the gouge exposed in the shallow surface workings, but R. M. Fleming reported (oral communication) that quartz, pyrite, and some lead formed small lenses 1 to 6 inches wide in the gouge zone. The property has been tested over its entire length by shallow prospect pits, shafts, and trenches (Fig. 27). All shafts are inaccessible for inspection.

Total recorded production from the Mayday is 754 tons of ore, which yielded 51,684 pounds of lead, 1,256 pounds of zinc, 572 pounds of copper, 4,830 ounces of silver, and 539 ounces of gold. The ore was produced in 1935-37, 1939-42, 1947-50, and 1961.

McDONALD

The McDonald claim is between Clark Canyon and Stapleton Gulch and north of the road along Grasshopper Creek. The workings lie about 1,000 feet south of the Old Legal Tender claim. The property is mentioned by Shenon (1931, p. 63) as having produced some ore. The only production recorded is a small amount of ore shipped in 1934 by Donald McDonald of Argenta. Actual production figures are confidential.

Workings on the property consist of three adits. Two adits driven north and east across the bedding of gray and black limestone show no sign of ore. The lowest and most westerly adit was driven north and west across the bedding and ends in a gray limestone breccia zone about 100 feet from the portal. Two small inclined dogholes driven into the breccia zone from the south wall of the adit are now filled with muck. The ore probably came from a small pocket in the breccia zone, and presumably was mined from the dogholes.

MIDNIGHT

The Midnight mine is in the SE¼ sec. 13, T. 6 S., R. 11 W. The property consists of two patented claims, the Midnight and Midnight Extension, which border the Argenta-Gladstone claims to the south. The properties are recorded in the name of Monidah Trust Company.

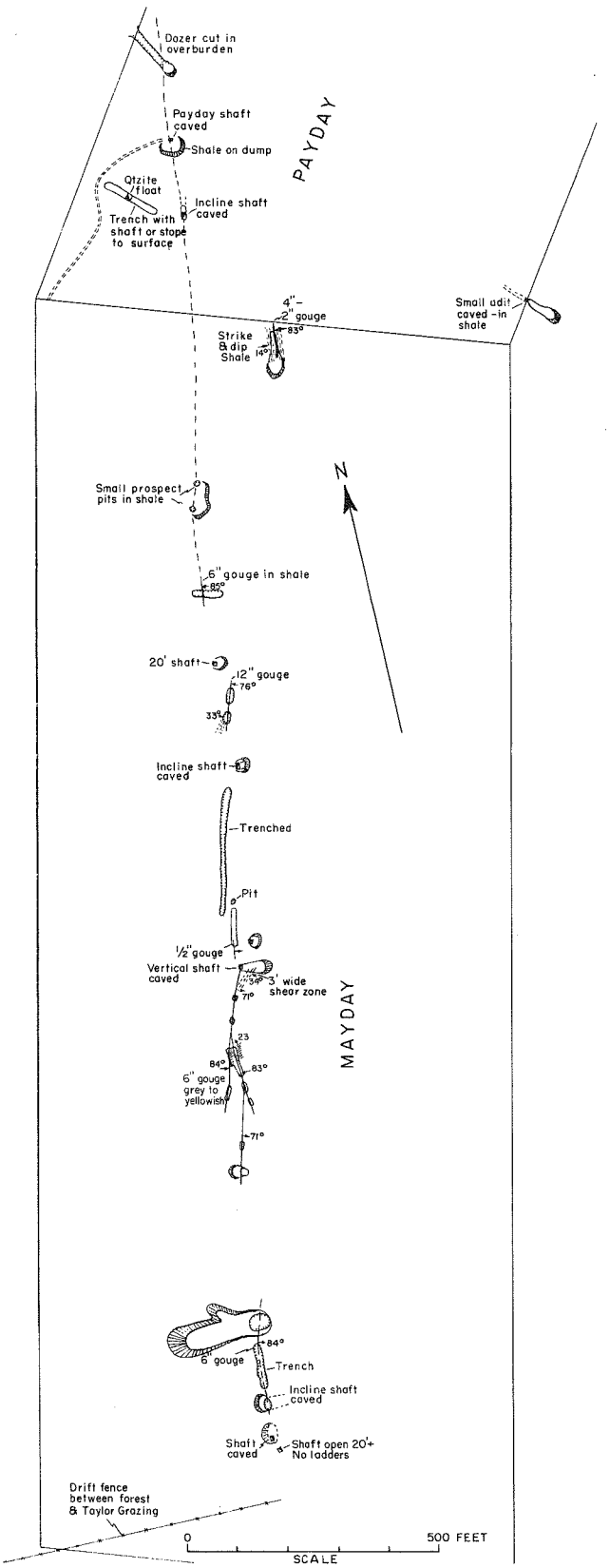


Figure 27.—Sketch of workings on the Mayday and Payday claims, Argenta district.

The deposit was discovered in the 1870's by Robert Wing, who sank a shaft 60 feet. The properties were later relocated by H. R. Paddock and Fred Randolph, who shipped some ore. A. V. Clark acquired the properties, and he also shipped ore. The properties were later purchased by Monidah Trust Company, the present owner (Shenon, 1931, p. 73).

The deposit is in a fissure vein that strikes N. 40° W. and dips 70° N. at the surface. The country rock is flat-lying shale of Precambrian age and Flathead Quartzite. The vein varies considerably in width and encloses some horses of shale. Primary ore minerals are galena and pyrite in a quartz gangue (Shenon, 1931, p. 73).

The principal workings consist of five shafts, ranging in depth from 60 to 265 feet. All shafts and underground workings are now inaccessible.

Recorded production from the Midnight mine is combined with that from the Gladstone; the total is 3,324 tons of ore containing 369,958 pounds of lead, 8,873 pounds of copper, 22,447 ounces of silver, and 1,180 ounces of gold.

PAYDAY

The Payday claim adjoins the Mayday to the north and, like it, was discovered by George and Dick Fleming in 1934. In 1964 the property was held by Jack Knight of Dillon.

The deposit is on the north extension of the Mayday shear zone. Workings on the zone (Fig. 27) are two shafts, now caved at the collar, and several bulldozer cuts. No economic minerals were noted either on the mine dumps at the shafts or in the bulldozer cuts. Nevertheless, the property has produced 90 tons of ore, which yielded 2,593 pounds of lead, 423 pounds of zinc, 22 pounds of copper, 303 ounces of silver, and 77 ounces of gold. The ore probably came from small lenses similar to those that were productive on the Mayday property. Production was recorded in 1936-37, 1939-40, 1947, 1949, and 1950.

RENA

The Rena mine is on a patented claim now owned by John Hand of Argenta. The mine is in the NW¼ sec. 18, T. 6 S., R. 10 W., and was found by Homer Lawrence and John Mills in 1884.

A shaft was sunk 70 feet, and ore shipped to Omaha. The property was later purchased by St. Louis and Montana Mining Company, who sank a shaft 300 feet. Only a small amount of ore was shipped. In 1922, A. H. French acquired the property (Shenon, 1931, p. 72). At present all workings are caved.

The well-defined vein cuts flat-dipping shale of Precambrian age. The vein strikes N. 40° W. and dips 60° S. The vein turned and dipped to the north near the bottom of the 300-foot shaft. The ore shoot was cut off on the south by a fault.

Primary ore minerals were silver-bearing galena and pyrite in a gangue of quartz; the ore also contained an appreciable amount of gold. The oxidized ore shipped by Lawrence and Mills is said to have averaged 5 ounces of gold per ton. Ore shipped by French assayed 20 percent lead and 2.0 ounces of gold per ton.

Total recorded production from the property, in 1940 and 1947-48, was 63 tons of ore, which yielded 5,641 pounds of lead, 2,394 pounds of zinc, 197 pounds of copper, 220 ounces of silver, and 68 ounces of gold.

ROSEMONT

The Rosemont property is in sec. 8, T. 6 S., R. 10 W., along the course of Good Friday Gulch. The mine workings are in Madison Limestone on the east margin of a small quartz monzonite stock that crops out between this mine and the Dexter mine to the southwest. The property produced ore in 1940 and 1942, and at that time was operated by R. M. Fleming of Argenta.

The mine workings on the east side of the gulch consist of two vertical shafts, now inaccessible. The dump contains white recrystallized limestone, but no economic minerals were observed. On the west side of the gulch, an adit has been driven on a shear zone about 3 inches wide that strikes N. 5° W. and dips 73° E. A winze follows the zone to a depth of about 30 feet. Two small drifts about 50 and 20 feet long have been driven along the zone from the bottom of the winze. No economic minerals were observed along the zone. The wall rock is coarse recrystallized limestone, which cleaves into specimens an inch or so across.

Production from the property, recorded in 1940-42, was 468 tons of ore, which yielded 99,904 pounds of lead, 354 pounds of copper, 1,679 ounces of silver, and 55 ounces of gold.

SILVER RULE

The Silver Rule property is in the NE¼ sec. 16, T. 6 S., R. 11 W., a short distance west of Kearns

Creek. The claim seemingly is unpatented.

In 1895 W. A. Clark bought the claims from Dan and Henry Laughlin for $20,000. A force of ten men was put to work on the building, prospecting, and development, but after 6 months work was stopped, the property stripped, and all machinery moved to the Tuscarora mine (Sassman, 1941, p. 185).

The mine workings consist of an adit, now inaccessible, which was driven N. 60° W. along a zone of dolomitization and silicification 2 to 3 feet wide that dips 20° NE. Country rock is limestone of Mississippian age. About 500 feet southwest of the portal of the adit, a lens of brown and red jasper, brecciated in places, crops out. The lens is about 50 feet wide and 300 feet long, and seems to be a replacement deposit parallel to the bedding of the limestone.

The property has no record of production.

SIR WALTER SCOTT AND AMARANTH

The Sir Walter Scott group of patented claims is situated just outside the town of Argenta and along the west margin of the Argenta stock. The properties have been described by Shenon (1931, p. 70) under the heading of Argenta Mining Company. The group comprises the Sir Walter Scott, Thistle, Robert Burns, Hunter, and Amaranth claims, owned by G. V. Elder of Argenta and others.

Production from the Sir Walter Scott, in 1931-32, amounted to 23 tons of ore, which contained 101 pounds of lead, 57 pounds of copper, 14 ounces of silver, and 7 ounces of gold. Recorded production from the Amaranth, in 1960, was 1 ton of ore, which contained 200 pounds of lead and 8 ounces of silver.

The ore body on the Sir Walter Scott claim was a small vertical pipe of oxidized ore localized at the contact between serpentine and white powdery silicated limestone, which is in contact with unaltered quartz monzonite. The deposit was developed by an adit about 60 feet long, from the end of which a winze was sunk on the ore body for a depth of about 55 feet. Another adit about 100 feet below the upper adit was started to intersect the ore body at depth but seemingly did not reach it, as the dump material is all quartz monzonite. The portal is now caved.

The ore was all oxidized, and most of it was limonite carrying considerable gold as well as bismutite.

The workings on the Amaranth claim consist of an inclined shaft about 60 feet deep sunk on a narrow north-trending near-vertical vein 2 to 6 inches wide enclosed in quartz monzonite. Most of the vein filling is iron-stained quartz, which contained some galena.

SPANISH

The Spanish mine is about 300 feet northeast of the Old Legal Tender mine. The property consists of one patented claim; a half interest is owned by The Anaconda Company and half by G. L. Dixon.

The mine workings are in the same gray dolomitic limestone as the Old Legal Tender mine. The principal working on the property is an old shaft, presumably vertical but now completely caved, sunk on a vertical fault that strikes N. 45° W. across the trend of the limestone beds. Two shallow small prospect pits about 25 feet and 50 feet southwest of the shaft seemingly were dug in search of an extension of the Old Legal Tender ore body. The mine dumps contain only dolomitic gray limestone; no economic minerals were observed on them. The property has no recorded production, although Shenon (1931, p. 64) reported a small production.

STARLIGHT

The Starlight claim, in the SW¼ sec. 24, T. 6 S., R. 11 W., was located by M. H. Christensen in 1957. The workings consist of a small inclined shaft sunk on a narrow north-trending mineralized zone cutting dark-gray Jefferson Dolomite. The shaft was not entered by the writer. Ore material consisted of small pieces of red and brown jasper and some oxidized lead minerals. Production was recorded in 1957 and consisted of 3 tons of ore containing 500 pounds of lead, 32 ounces of silver, and 1 ounce of gold.

STORM KING

The Storm King claim is in the SW¼ SE¼ sec. 13, T. 6 S., R. 11 W., and is about 1,200 feet northwest of the Sylvia mine. The deposit was found by Malcolm Fleming before World War II.

The deposit is in a vertical shear zone about 6 inches wide, which cuts Flathead Quartzite and strikes N. 9° E. The zone consists of crushed quartzite mineralized by red iron oxides. A small adit has been driven on the zone for about 15 feet. In the face of the adit, the zone is cut by a small cross fault that trends N. 50° E. and dips 75° NW. A chip sample taken from the breccia zone near the portal of the adit assayed 0.15 percent lead, no zinc, 0.52 ounce gold, and 0.25 ounce silver.

The Storm King produced ore in 1951 and 1959. The amount was small, but actual production figures are confidential.

SUNRISE

The Sunrise claim is in the SE¼ sec. 24, T. 6 S., R. 11 W., on the south side of Rattlesnake Creek and opposite the Legal Tender mine. The property was located in 1957 by E. C. Nelson.

The mine workings consist of an adit, now caved at the portal, and above it a bulldozer cut in which is exposed a 1-foot yellow gouge cutting limestone country rock. The zone trends S. 10° W. and dips 80° NW. The gouge contains some flinty gray quartz fragments and is slightly stained by black manganese oxides. A chip sample across the zone assayed 0.20 percent copper, 0.60 percent lead, 0.70 percent zinc, 0.60 ounce silver, and 0.010 ounce gold.

The property has no record of production.

SYLVIA

The Sylvia mine is in the SE¼ sec. 13, T. 6 S., R. 11 W., very near the boundary with section 24. The deposit was discovered in 1940 by Malcolm Fleming. The property consists of one unpatented claim now held by George Elder, George Fleming, and John Collins.

The deposit is a fissure vein 4 to 14 inches wide, which cuts flat-lying Flathead Quartzite. The vein strikes about N. 5° E. and dips 80° NW. The principal workings consist of an inclined shaft 90 feet deep and a drift 150 feet long, which runs south from the shaft. From the end of the drift a winze has been sunk 70 feet on the vein. Oxidized ore was stoped from the 90-foot level to surface; sulfides were found below the 90-foot level. Values were principally in lead and silver, but some gold in the oxidized zone was reported (R. M. Fleming, oral communication).

Most of the vein filling is banded yellowish-tan jasper containing small inclusions of vitreous quartz and earthy limonite and plumbojarosite. The primary ore mineral is galena.

In 1962 the Sylvia dumps were obtained by Rudy Nygren of Argenta.

Production was recorded in 1937, 1941-43, 1948-50, 1954, and 1963-64 and amounted to 545 tons of ore, which contained 229,047 pounds of lead, 5,393 pounds of zinc, 584 pounds of copper, 16,757 ounces of silver, and 516 ounces of gold.

TUSCARORA AND GOVERNOR TILDEN

The Tuscarora group of patented claims includes the Governor Tilden, Florida, Wooley, Fraction, Fraction Placer, Reform, Burleigh, and Spring. The properties lie in sec. 18, T. 6 S., R. 10 W., a short distance north of the Coolidge mine. Ownership of the claims is divided among The Anaconda Company, Emrys and Carolyn White, and G. W. Foger.

Most of the ore produced from the group has come from the Tuscarora and Governor Tilden mines.

The Tuscarora ore bodies were found in 1865 by Amede Bessette and Wash Stapleton; the Governor Tilden was found a short time later. The mines subsequently were acquired by W. G. Gallagher and LaFayette Scott, who mined ore from the properties in the 1870's. LaFayette Scott's interest was purchased by W. A. Clark, who owned and operated a smelter at Argenta. Several carloads of ore were mined by Clark to supply his smelter. In 1898 and 1899, the property was leased by Frank Benton, who shipped 195 tons from a pipelike ore shoot found on the Governor Tilden. From 1914 to 1921, A. H. French and W. G. Graeter shipped ore and also made concentrates from the dumps by jigging. Production from the properties was also recorded for the years 1922-23, 1926-27, 1936-37, 1946-49, 1952-54, and 1959. According to Shenon (1931, p. 60), the Tuscarora produced 5,000 to 7,000 tons of ore and the Governor Tilden 2,000 to 3,000 tons of ore. Production recorded from the Tuscarora and Governor Tilden in 1902, 1915-23, 1926-27, 1936-37, 1946-49, 1952-54, and 1959 totaled 4,068 tons of ore, which yielded 978,771 pounds of lead, 10,323 pounds of zinc, 25,283 pounds of copper, 45,855 ounces of silver, and 1,216 ounces of gold.

The ore bodies of the Governor Tilden and Tuscarora mines are contained in a faulted block of gray dolomitic limestone in the lower part of the Jefferson Formation (Devonian). On the west is Flathead Quartzite (Cambrian), and on the north, the east-trending Tuscarora fault brings lower limestone into contact with upper limestone of the Devonian (Myers, 1952, p. 33).

A north-trending vertical andesite dike about 1 foot wide is exposed along the north wall of one of the surface cuts on the Tuscarora claim. It is the only igneous rock noted in the mine area; it may be a continuation of the andesite dike at the Coolidge mine.

The ore bodies on the Tuscarora and Governor Tilden claims are pipes (mantos) localized at intersections of fractures parallel to the Tuscarora fault with one or more favorable beds a few feet thick. On the Governor Tilden claim several pipes coalesce to form a single large pipe (Fig. 28). The pipes on the Governor Tilden claim are terminated by north-trending vertical faults, the eastern faulted blocks being progressively raised. Several small ore shoots on the Governor Tilden claim are at the intersection of northwest-trending fractures with the favorable bedding zone (Myers, 1952, p. 33).

The pipes on the Tuscarora claim were mined principally by surface cuts as much as 150 feet long, although some ore is reported to have been taken out of an incline driven directly beneath the open cuts from the Florida shaft (Shenon, 1931, p. 60). The incline also connected with the Tuscarora shaft to the west and the Shesser Bros. and McKay shaft to the east. The Tuscarora shaft was reported (Shenon, 1931, p. 60) to be about 120 feet deep, the Florida 80 feet deep, and the Shesser Bros. and McKay shaft 130 feet deep. All shafts are now inaccessible for inspection.

On the Governor Tilden claim the pipes were mined by 300 feet of underground workings inclined along the bedding to a depth of about 150 feet and an additional 600 feet of drifts driven for exploration (Shenon, 1931, p. 60). In 1964 the workings that were not already caved were too dangerous to enter.

The ore mined from the properties was almost entirely oxidized and was said to be a "sand carbonate" that assayed as much as 60 percent lead and 60 ounces in silver (Shenon, 1931, p. 61). Locally, galena can be found in patches in association with red-brown jasper remnants left on the walls of some pipes.

According to Myers (1952, p. 34) some of the pipes give the appearance of solution cavities formed by circulation of meteoric waters. The uppermost part of some of the pipes is a gently undulating solution surface from which the ore contracted by shrinking during the oxidation process, and on which neither bedding planes nor fractures can be detected.

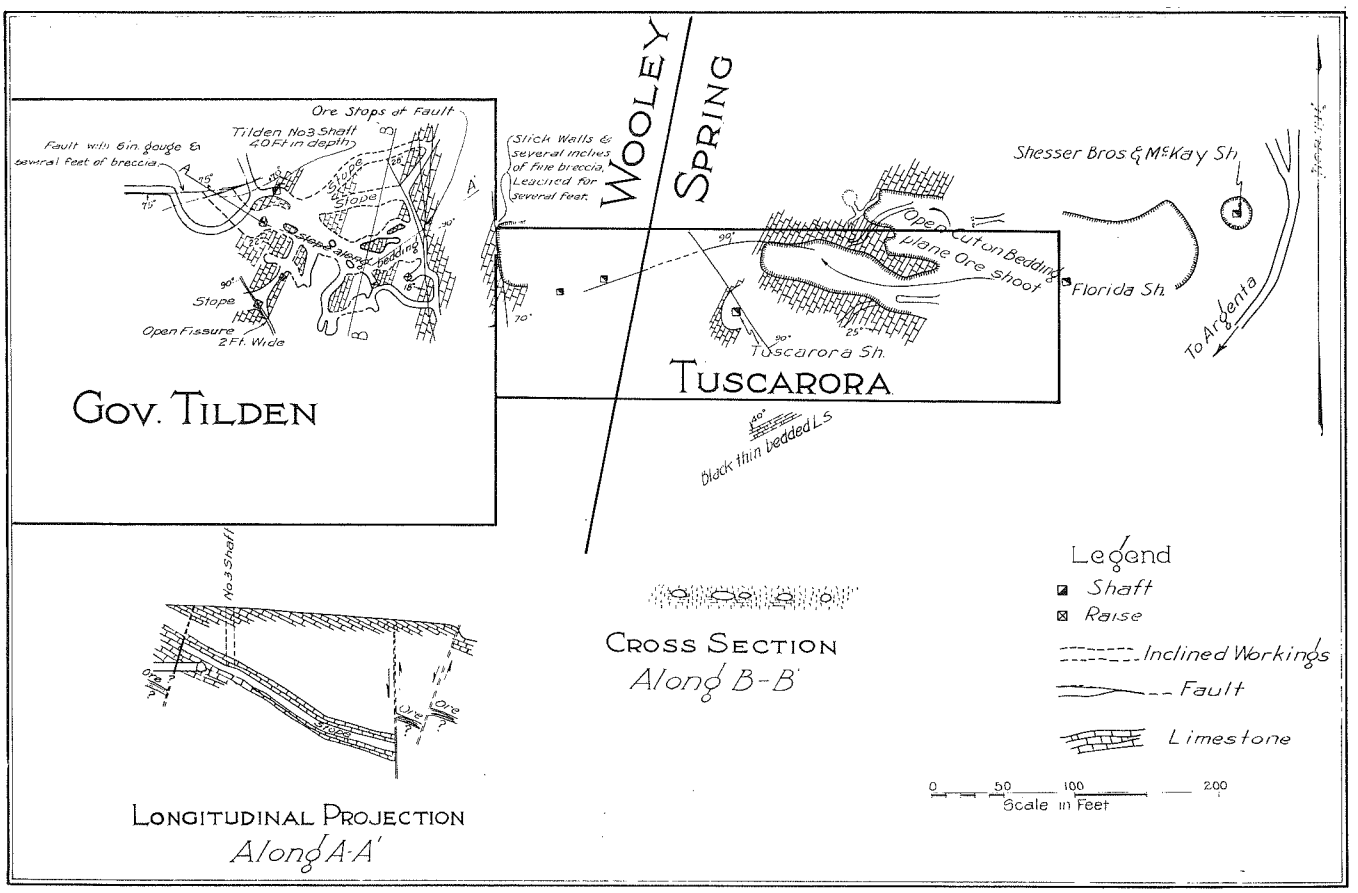


Figure 28.—Map of the Tuscarora and Governor Tilden mines, Argenta district. (Shenon, 1931).

VIRGINIA GULCH (STINSON)

The Virginia Gulch (Stinson) mine is in the NW¼ sec. 14, T. 6 S., R. 11 W., between Rattlesnake and French Creeks. The mine can be reached by a road leading off from the French and Thief Creeks road. The property is not patented. When visited in 1964 it was being developed by Alumont, Inc., of Salt Lake City, Utah.

The mine, which is about 1½ miles southwest of the Shafer group, is situated along a zone of northeast-trending and eastward overthrusting, in which Amsden Formation (Mississippian) overrides the Jefferson Formation (Devonian). The mine workings are entirely in the Jefferson, probably only a few feet below the projected thrust plane, which trends N. 10° E. to N. 55° E. and dips 28° to 39° NW.

The mine workings (Fig. 29) explore a cross fault that trends N. 80° E. and dips 40° to 70° N., cutting the dolomite below the thrust plane. The fault is exposed at only two points underground. At its first exposure, the fault zone is about 5 feet wide and

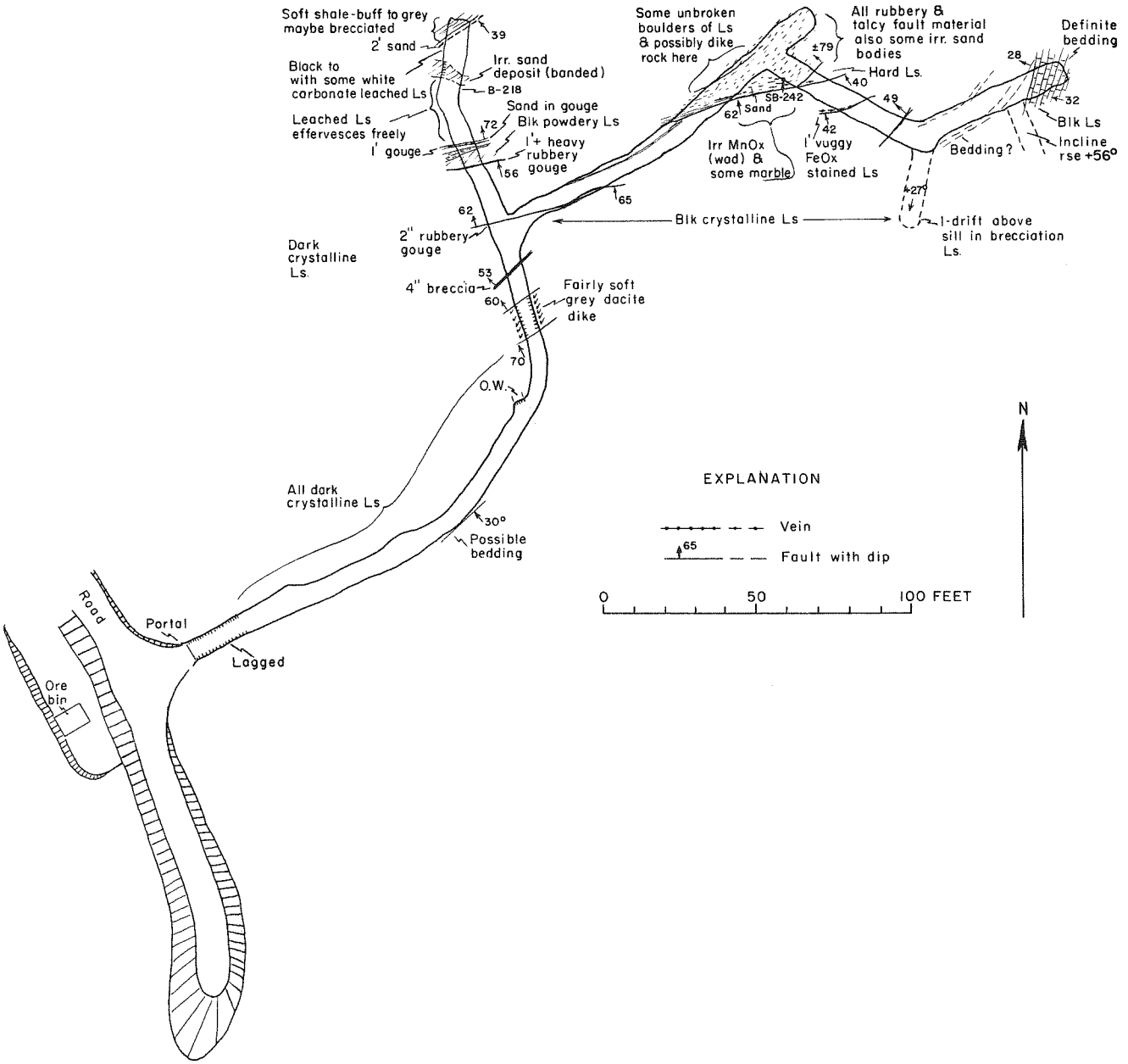


Figure 29.— Sketch of Virginia Gulch (Stinson) mine workings, Argenta district.

contains three strands of heavy black rubbery fault gouge as much as 1 foot across enclosed in black powdery limestone. At its second exposure, about 80 feet farther east, the zone contains a 1-foot gouge overlain by at least 25 feet of soft brecciated and crushed limestone, which is stained by black manganese oxides in an irregular zone along the footwall gouge. A chip sample of the black manganese oxide zone assayed 0.50 percent lead, 3.30 percent manganese, 0.45 ounce silver, and 0.001 ounce gold. Qualitative tests showed no nickel or cobalt. The only igneous rock exposed underground is a 10-foot dike of soft altered quartz latite, which strikes N. 55° E. and dips 65° NW.; the dike is crosscut about 46 feet south of the fault zone at the first-described exposure.

The only recorded production from the mine, in 1961 and 1963, cannot be revealed.

WOOLEY

The Wooley claim overlaps part of the Governor Tilden and Tuscarora claims. The property is recorded in the names of The Anaconda Company, Emrys and Carolyn White, and G. W. Foger.

The country rock is the lower light-gray dolomitic limestone of the Jefferson Formation, which trends N. 25° E. and dips 20° SE.

Workings (Fig. 30) on the claim consist of a 30-foot inclined shaft and several open cuts dug along

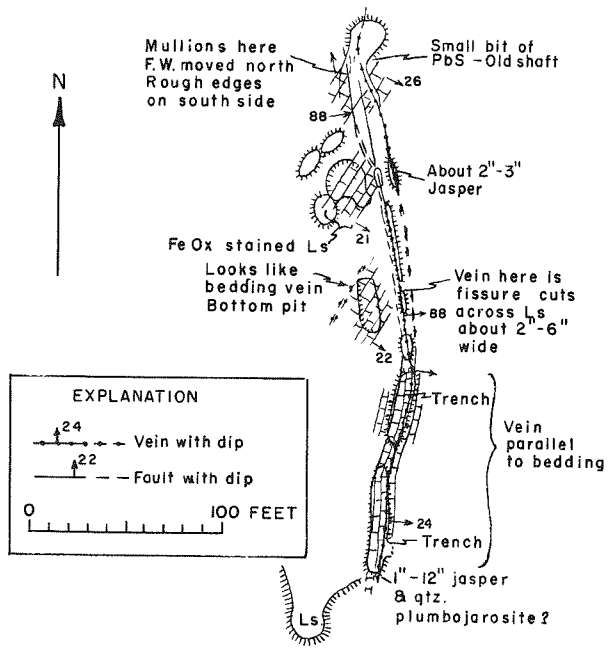


Figure 30.—Sketch of workings on Wooley claim, Argenta district.

the vein for a distance of about 250 feet south of the shaft. The shaft and several of the cuts explore a steeply dipping fissure vein 2 to 6 inches wide, which strikes N. 10° W. and cuts across the limestone. Most of the vein filling is red-brown jasper, but some patches of galena were noted on the walls near the shaft. The south extension of the vein parallels the limestone in strike and dip.

The only production recorded from the Wooley, in 1950, consisted of 13 tons of ore, containing 2,207 pounds of lead, 177 pounds of zinc, 139 ounces of silver, and 1 ounce of gold.

YELLOW BAND (SHAFER GROUP)

The Yellow Band (Shafer group) is 4½ miles north of Argenta in sec. 1, 2, and 11, T. 6 S., R. 11 W., and is accessible by a fair to good road from Argenta. The Discovery, Cross, Yellow Band, Park, French Creek, Prince Albert, and Kelley unpatented claims are held by John Shafer and Associates of Dillon. The Pine Tree, Pine Tree No. 2, Hillside, Silver Light, and Silver Light No. 2 unpatented claims, regarded as part of the same group, are held by Harry Renz, also of Dillon.

The deposit was discovered in May 1934 by Ernest Shafer and Floyd McClennan, who found boulders containing gold and silver strewing the hillside along French Creek. Early ore shipments consisted of float boulders.

In 1935 and 1936, the properties were leased to The Anaconda Copper Mining Company, and principal development work during this period was on the Park, Discovery, and Cross claims. Some ore was mined from a small surface pit on the Park claim and the rest from ore structures exposed underground. The lease was terminated by the company in 1936, and the properties reverted to the locators. Shortly thereafter a Canadian company did further work at the property and milled some ore at a small mill near Argenta (John Shafer, oral communication). During World War II, only scant development work was done on the properties but mining was resumed in 1946. In the fall of 1950, a group headed by A. J. Theis of Seattle, Washington, obtained a development lease and drove the Boaz adit on the Yellow Band claim (Pl. 2). The length of the adit is about 1,000 feet. The only mineralized rock cut in the adit was a barren quartz vein 200 feet from the portal. In 1956 a raise was put up about 300 feet from the portal and intercepted an ore shoot about 60 feet above the adit level. Approximately $250,000 was taken from the shoot, which was named the Boaz.

Most of the production since 1956 has come from the Boaz ore shoot, which is now almost mined out. Recent production from the group has been small.

The mine is in a zone of overthrusting and overturning of sedimentary rocks bordering the east flank of the Pioneer Mountains. The principal fault in the area is the Kelley thrust, which comes to the surface west of the mine. It trends northeast and dips about 45° W. and has carried Belt rocks over tightly folded Mesozoic and Paleozoic rocks (Myers, 1952, p. 22). Beneath the Kelley thrust is a zone of minor thrusting as much as 2 miles wide. The ore bodies of the Shafer group are localized along or below one of these thrusts.

On the Yellow Band claim, the Boaz gold-quartz ore shoot is localized below the thrust along the contact of Jefferson Dolomite with Three Forks Shale, which shows slickensides. The long dimension of the lens, trending about N. 25° E., is about 200 feet, and the width is about 50 feet. The average thickness is about 3 or 4 feet. Most of the quartz is brown and flinty, but some is white and crumbly.

Where exposed in underground workings, the Three Forks Shale is yellow to brown, plastic, and shows slickensides. Geologic mine maps indicate that some narrow lenticular sills of andesite occur within the unit. The Jefferson Formation, which is the host rock for the ore, consists of black sugary dolomite, locally powdery and almost everywhere interlaced by a network of small fractures filled with pure white calcite. The formation trends northeast parallel to the thrust trend, and its regional dip is 10° to 30° W. The dolomite is cut by northwest-trending near-vertical cross faults, probably initially developed as tear faults during the period of overthrusting.

The ore bodies of the Shafer group consist of flat-lying replacement lenses parallel to the bedding of the dolomite country rock and localized along crests of small domal or anticlinal structures. Some lenses lie along roughly the same general horizon. Individual lenses may be several hundred feet long and as much as 20 feet thick. The lenses grade laterally into quartz dolomite breccia and then dolomite breccia. All lenses are cut by near-vertical tear faults, which may have influenced ore deposition.

Economic minerals are native gold and sparse tetrahedrite in a gangue of quartz. Cinnabar and stibnite also have been found, as well as some quicksilver (John Shafer, oral communication).

The deposit has been mined by adits, and ore bodies close to surface on the Yellow Band and Park claims (Pl. 2) have been mined by small open cuts. The underground stopes aggregate several thousand feet but most are now caved and inaccessible.

Recorded production for the group is 28,715 tons of ore, which yielded 2,583 pounds of lead, 8,521 pounds of zinc, 10,740 pounds of copper, 77,515 ounces of silver, and 16,258 ounces of gold.

YELLOW BIRD (WEST ERMONT)

The Yellow Bird (West Ermont) is an unpatented claim in the NE¼ sec. 35, T. 6 S., R. 11 W. The property formerly was held by D. V. Erwin, who shipped some ore from it in 1926 and 1936. In 1963 the property was relocated as the West Ermont by R. M. Fleming.

A small inclined shaft, about 55 feet deep, and several prospect pits were dug on a 1- to 2-foot brecciated jasper vein in Jefferson Dolomite. The vein trends N. 35° W. and dips 65° SW. The ore produced from the property is reported to have contained some antimony (R. M. Fleming, oral communication).

Total recorded production from the property in 1926 and 1936 is 62 tons of ore, containing 4,233 pounds of lead, 45 pounds of copper, 804 ounces of silver, and 4 ounces of gold.

BADGER PASS DISTRICT

The Badger Pass district was named by Sahinen (1934) to designate the then unmapped area (Fig. 31) lying between the south boundary of the Argenta district as mapped by Shenon (1931) and the north boundary of Shenon's Bannack sheet. The district comprises 24 square miles made up of parts of T. 7 S., R. 11 W., and T. 7 S., R. 10 W. It is bisected by the Jackson-Dillon road. Most of the land surface within the district is a rolling terrane. The most rugged part is hogback ridges of Quadrant Quartzite that rise to an altitude of about 7,200 feet.

The Badger Pass report (Sahinen, 1934) was written because of interest aroused by the discovery in 1932 of ore carrying as much as 1.25 ounces of gold per ton. When the news broke, many mining claims were staked, and a flurry of digging and activity began. After the discovery work was done, however, interest in the area died about as suddenly as it began. The following year, interest in the prospects was revived after the Ermont mine, about a quarter of a mile north of the district, began producing, but very little came of it. No mining claims

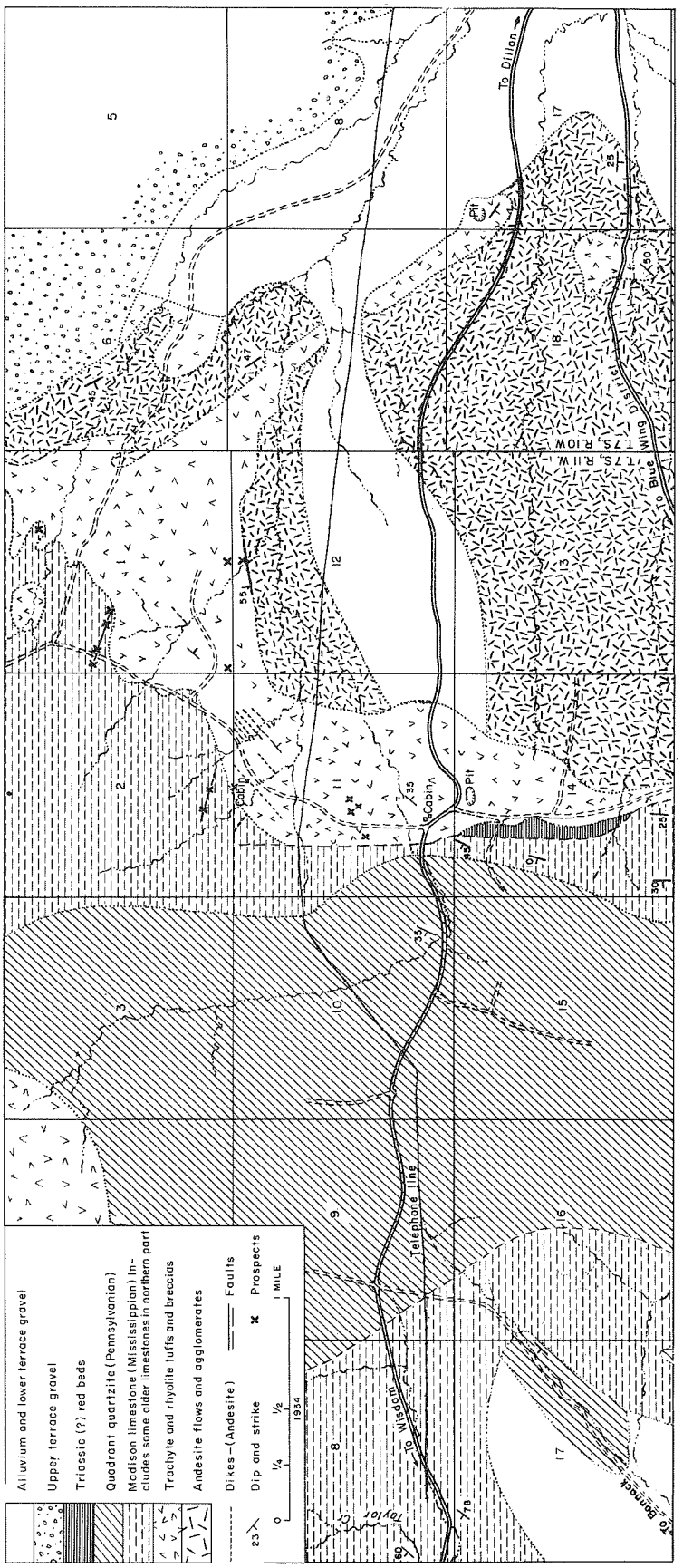


Figure 31.—Geologic map of the Badger Pass district. (Sahinen, 1934).

were ever patented and all the prospects seem to have been abandoned.

The amount of ore produced, if any, is not known. It is possible that a small amount may have come from some of the prospects, but names of individuals who might have mined it and names of the claims from which it might have come are not known.

The fracture zones in the district cut both limestone and volcanic rocks and commonly are marked by outcrops of quartz and chalcedony. In places the silicified zones are brecciated and recemented by later silica and are associated with altered andesite dikes. Limonite and some gold accompany the quartz, but gold values generally are low.

A deposit mentioned by Sahinen (1934, p. 9) is the Nelson prospect in the north-central part of sec. 12, T. 7 S., R. 11 W., where rhyolite and andesite in fault contact are hydrothermally altered and impregnated with disseminated pyrite and galena. Pyrite is also present in the fault gouge and in minute veinlets in rhyolite. Some gold and trace amounts of silver are present.

FLEMING'S "HALLOYSITE" PROSPECT

Fleming's "halloysite" clay prospect is in sec. 2, T. 7 S., R. 11 W., and is accessible by a dirt road turning off to the Ermont mine from the Dillon-Jackson road. The property is an unpatented claim held by Robert Fleming of Dillon. The deposit was described by Sahinen and others (1962, p. 12).

The halloysite is exposed in a shaft 25 feet deep and in a short drift at the bottom of the shaft. The halloysite, which was formed by hydrothermal alteration of light-colored volcanic rocks, ranges from white to pale orange and locally is stained by blue-black manganese oxides. The plasticity and strength of the green material are low. The P. C. E. exceeds Cone 12. The material can be used for ceramic products if blended with a bonding clay.

BALDY MOUNTAIN DISTRICT

The Baldy Mountain district is at the south end of the Pioneer Mountains and occupies an area between Taylor and Grasshopper Creeks, taking in the region drained by Scudder, Dyce, and Taylor Creeks. The district is about 27 miles west-northwest of Dillon, and can be reached by taking the old road west from Badger Pass and turning north on the Dyce Creek road. The principal landmark in the district is Baldy Mountain, which rises to an altitude of 10,570 feet. Most of the district is between 7,000 and 8,000 feet, and the terrane is rolling foothills flanking the more rugged interior of the Pioneer Mountains.

The bedrock of the district consists of Precambrian quartzite and Paleozoic limestone, shale, and quartzite that have been intruded by quartz monzonite of the Mount Torrey batholith (Fig. 32). Near the igneous contacts the limestone beds have been recrystallized and metamorphosed to form tactite zones, some of which contain tungsten. In the Scudder Creek area, massive carbonate units equivalent to the Hasmark Formation (Cambrian) have altered to buff dolomite and resemble the altered limestone formations in the Hecla district and on the north edge of the Mount Torrey batholith.

The general geologic structure of the district is not well known, as no satisfactory geologic map of the district has been published. The formations have been complexly folded and faulted, besides being locally metamorphosed.

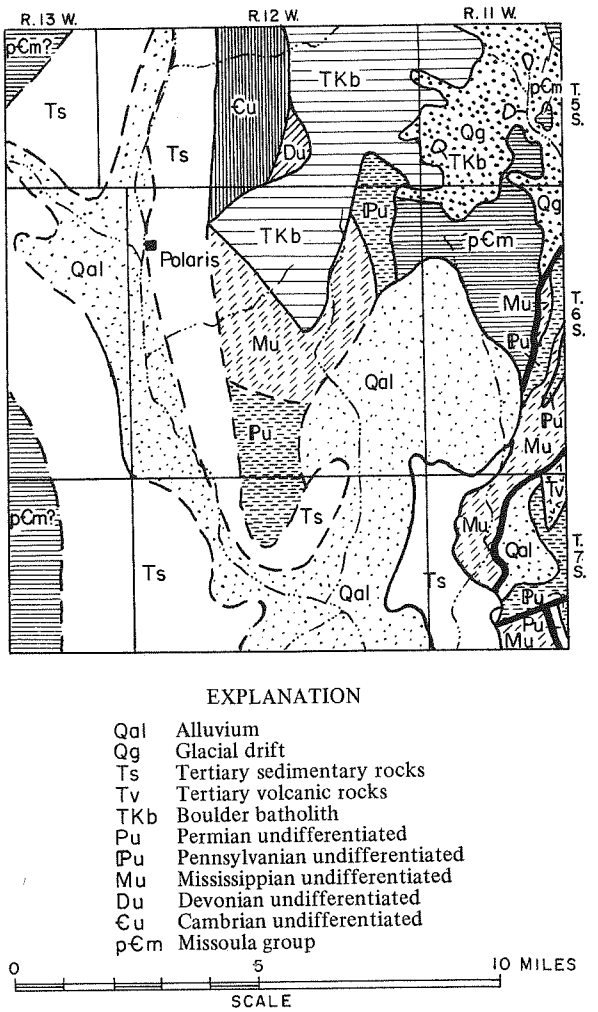


Figure 32.—Geologic map of the Baldy Mountain district.

Table 8. — Production of gold, silver, copper, lead, and zinc from lode mines, Baldy Mountain district, 1902-65, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)	Total Value
1902-15	no production						
1916	7	-----	484	140	1,155	-----	$ 437
1917-20	no production						
1921	10	-----	570	85	986	-----	633
1922-34	no production						
1935	209	63	167	1,964	4,500	-----	2,670
1936	24	-----	414	-----	-----	-----	321
1937-38	no production						
1939	488	100	333	327	10,298	-----	4,244
1940	300	156	218	-----	-----	-----	5,615
1941	3	-----	90	-----	-----	-----	64
1942-46	no production						
1947	50	2	179	300	11,000	-----	1,879
1948	133	7	653	1,700	35,900	3,100	8,043
1949	70	3	231	300	12,900	3,600	2,857
1950-65	no production						
Undistributed	30	17	79	170	4,162	-----	716
Total	1,324	348	3,418	4,986	80,901	6,700	27,479

Mining began in the district during the 1860's when placer gold was discovered along Dyce Creek. In 1870, the Old Faithful lode was discovered by A. H. Odell, who treated the ore in an arrastra. In 1892, the Dillon Mining Company built a 25-stamp mill in the district to crush ore from the Dillon mine, and in addition the company worked the Old Faithful, Cable, Capitol, Alice, and New York properties. The ore bodies were small or low grade, and since the turn of the century very little mining has been done in the district.

In 1951 tungsten minerals were discovered in a tactite zone on the Little Hawk (Bartholdi?) claim, and in 1955 the Little Hawk Mining Company constructed a 150-ton mill to treat the ore (Pattee, 1960, p. 32). The deposit, however, proved to be too low grade, and operation soon ceased after producing a small amount of concentrates. At present, all the mill equipment has been dismantled and only a few of the mill buildings are standing.

Total recorded production from the district from 1902 to 1965 is only 1,324 tons of ore containing 348 ounces of gold, 3,418 ounces of silver, 4,986 pounds of copper, 80,901 pounds of lead, and 6,700 pounds of zinc; total value was $27,479 (Table 8).

AGNES

The Agnes unpatented claim is directly west of the Echo claim.

The deposit consists of tactite and partly altered limestone along a granodiorite dike (Pattee, 1960, p. 34). It has been explored by a few bulldozer cuts. No tungsten was detected by assay of a sample of the tactite. A mineral that fluoresces similar to scheelite occurs in the tactite, but it is too fine grained to allow qualitative tungsten tests to be made.

CABLE

The Cable mine is in sec. 24, T. 6 S., R. 12 W., and adjoins the Capitol claim to the southwest. The patented claim is owned by Mabel Erwin of Dillon.

The deposit is in an irregular fissure vein that strikes N. 25° W. and dips 30° to 54° NE. The country rock is buff calcareous sandstone, which trends north-south and dips about 26° west. The vein is explored by an adit about 170 feet long (Fig. 33). The vein ranges from 12 inches to 4 feet in width and contains a filling of red-brown iron oxides showing some copper stain. A chip sample of a copper-stained portion of the vein at a distance of 45 feet from the portal assayed 4.93 percent copper, 0.35 ounce silver, and 0.006 ounce gold per ton, and no lead or zinc. At a distance of 130 feet from the portal, the vein pinches out. It has not been stoped.

The property has no record of production.

CAPITOL

The Capitol patented claim is in sec. 24, T. 6 S., R. 12 W., and adjoins the Faithful claim to the south. The property is owned by Mabel Erwin of Dillon.

The deposit is a lens of brown to tan jasperoid localized at the contact of basalt that projects into

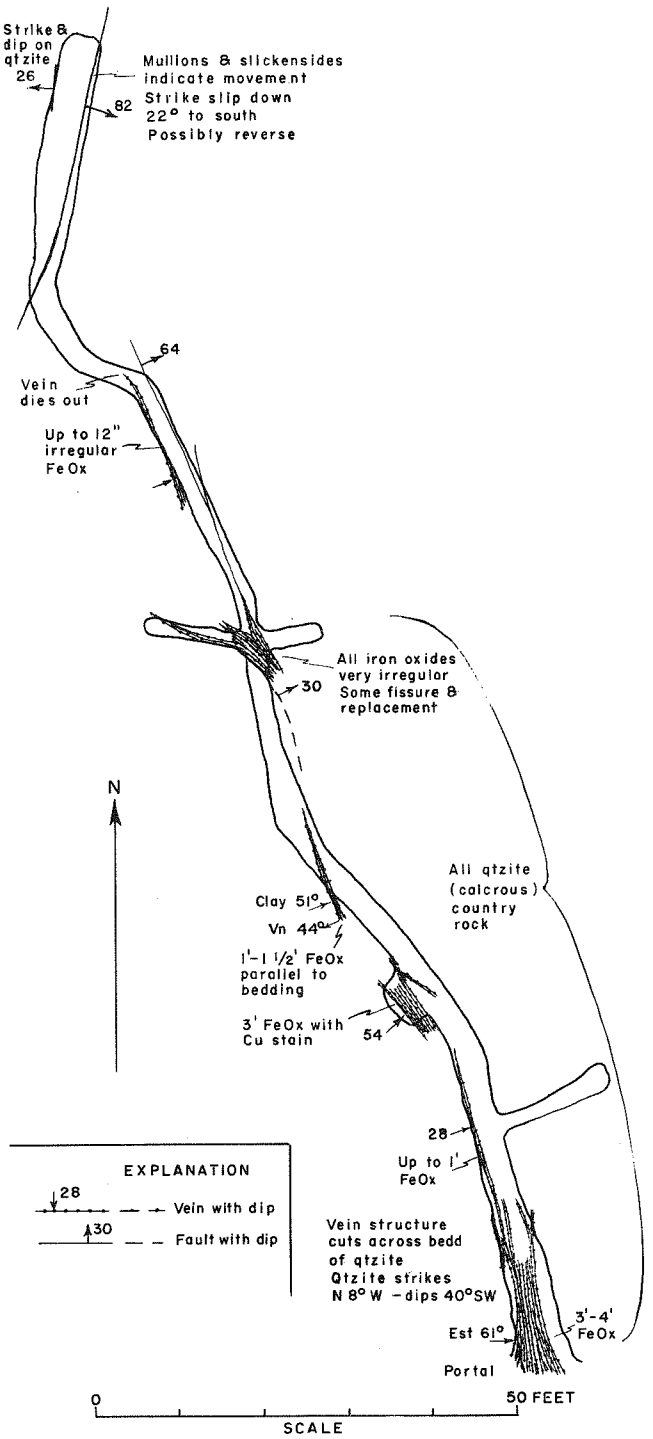


Figure 33.—Geologic plan of Cable mine adit.

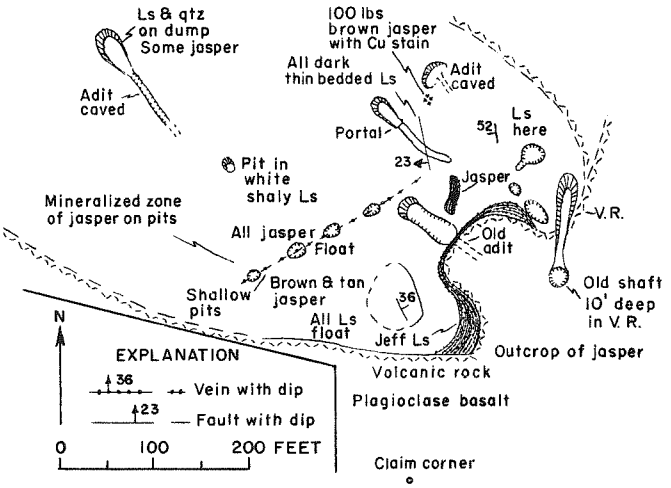


Figure 34.—Geologic sketch of surface of Capitol claim.

white thin-bedded limestone, which strikes N. 5° W. and dips 23° SW. (Fig. 34). The lens is about 200 feet long and 5 to 20 feet wide. About 50 feet northwest of the lens, a narrow mineralized zone of jasperoid, which strikes N. 60° W., has been explored by several shallow prospect pits and by adits farther down the slope of the hill, which were driven to intersect the zone at depth. Only one adit is open; it is about 70 feet long but was driven entirely in limestone. The dump at the lowermost adit, the portal of which is caved, contains some pieces of jasperoid. The only metallic mineral noted at the mine was minor copper stain on a few brown jasperoid fragments.

The property has no record of production.

DILLON

The Dillon mine is in the center of sec. 23, T. 6 S., R. 12 W. The patented claim is owned by J. Womack of Dillon. The mine workings are at an altitude of about 7,500 feet and are accessible by road up the East Fork of Dyce Creek for 1½ miles and then west on an old wagon road for about ½ mile.

The deposit is in a bedding-plane vein in the Hasmark Formation near its contact with an underlying quartzite unit, which may be part of the Flathead Formation or part of the Belt Series. The vein strikes north and dips about 30° W. It has been developed over a length of about 800 feet by a series of inclined shafts, prospect pits, and short adits (Fig. 35). Most of the underground workings are caved at the entrances, but in one short adit the vein is exposed. It is about 3 feet wide and contains iron oxides. Dumps at some of the other workings show pieces of copper-stained (malachite and tenorite) iron oxides. No sulfide material was noticed on any of the dumps; presumably the sulfide zone was not penetrated by the workings. A selected sample of oxide vein material from a shallow prospect pit 50 feet south of the old inclined shaft that has the largest dump assayed 28.68 percent copper, 0.05 percent lead, 0.90 percent zinc, 1.45 ounces silver, and 0.030

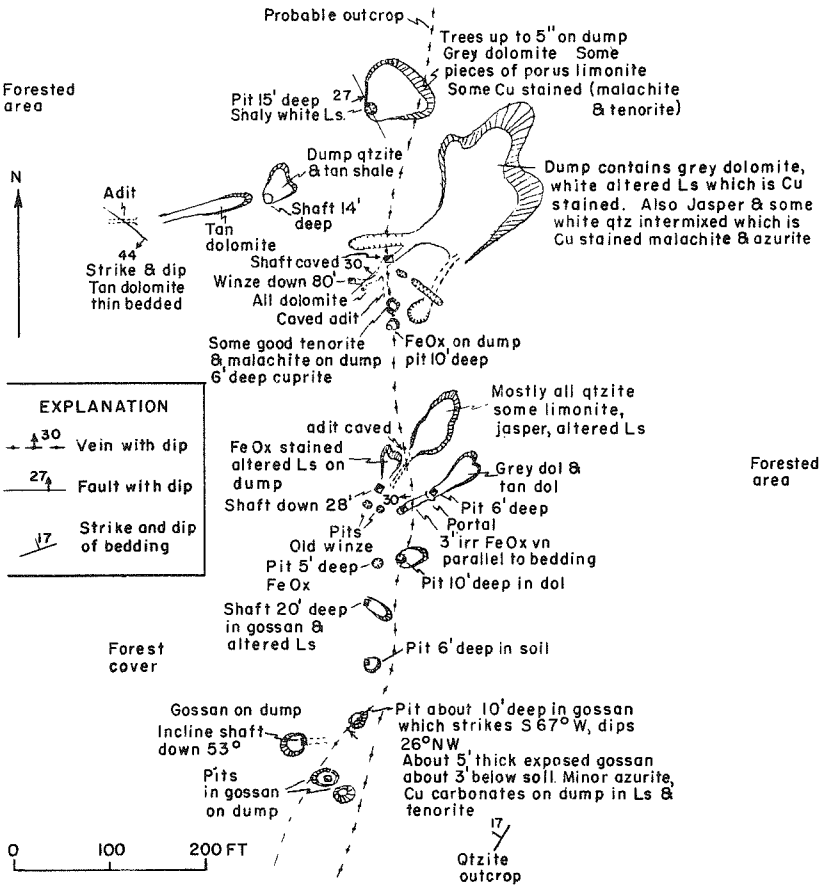


Figure 35.—Sketch of workings on Dillon mine, Baldy Mountain district.

ounce gold per ton. A sample of vein material from a prospect pit 6 feet deep and about 420 feet south of the main inclined shaft consisted of iron-stained honeycombed quartz and assayed 0.27 percent copper, 0.05 percent zinc, 0.65 ounce silver, and 0.40 ounce gold per ton, and no lead.

Total recorded production from the property (all in 1935) was 201 tons of ore, which contained 974 pounds of lead, 1,941 pounds of copper, 127 ounces of silver, and 62 ounces of gold.

DURHAM BULL

The Durham Bull patented claim is in the SE¼ sec. 25, T. 6 S., R. 12 W. It is owned by J. Womack of Dillon.

The mine workings consist of a winding adit (Fig. 36) about 150 feet long driven through buff dolomite and black limestone. The formations strike N. 10° E. and dip 39° NW. No vein material is exposed, but a few pieces of iron oxide were found on the dump. About 170 feet south-southwest of the portal is another old adit, now caved at the portal. The dump at this adit contains about 200 pounds of iron oxide material stained by copper oxidation products.

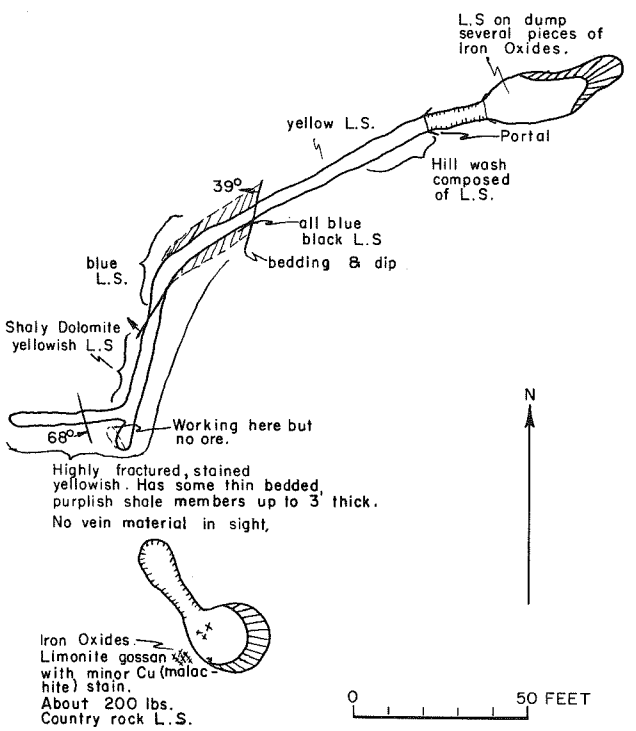


Figure 36.—Sketch of workings on Durham Bull claim, Baldy Mountain district.

A selected sample assayed 2.28 percent copper, no lead, 0.30 percent zinc, 1.55 ounces silver, and 0.38 ounce gold per ton.

The property has no record of production.

ECHO

The Echo is a patented claim owned by John H. Judge and others. It is in sec. 11, T. 6 S., R. 12 W., and overlaps slightly into sec. 14.

The deposit consists of tactite associated with a granodiorite dike in limestone (Pattee, 1960, p. 34). At the portal of a lower adit, now caved, the tactite strikes N. 76° E. and dips 58° NW. A chip sample across the tactite, here 3 feet wide, assayed 0.005 percent WO_3. No tungsten minerals occur in the two upper adits, but muscovite, magnetite, limonite, malachite, and azurite were reported (Pattee, 1960, p. 34).

ELSE

The Else patented claim is near the center of sec. 15, T. 6 S., R. 12 W. It is owned by William Beck and others.

The workings consist of a pit about 10 feet deep, sunk in diorite and on a copper-stained fracture zone about 2 feet wide, which strikes N. 4° E. and dips 63° E.

FAITHFUL

The Faithful group comprises the Faithful, Alice, Capitol, and Cable patented claims, owned by Mabel Erwin of Dillon, and the Sunrise and Old Favorite patented claims owned by Earl Tash and others. The group is in sec. 24, T. 6 S., R. 12 W., and can be reached by a road up Dyce Creek.

On the Faithful and Old Favorite claims the deposits are in a vein (?) that trends north-south and has been explored over a length of 1,200 feet by several adits and shallow shafts (Fig. 37). Nowhere does the vein (?) show on surface, and none of the underground workings are accessible, therefore its attitude cannot be determined. The June 12, 1886, issue of the Dillon Tribune reported that the main inclined shaft on the vein was 250 feet deep and from the bottom of the shaft 300 feet of levels had been driven on the vein, which ranged from 3 to 5 feet in width. The ore assayed $15 to $20 per ton in free-milling gold. The country rock is thin-bedded limestone, probably equivalent to the lower part of the Hasmark Formation, and strikes N. 9° W. and dips 21° SW. Specimens of vein material on the dumps consist of red-brown jasper, goethite,

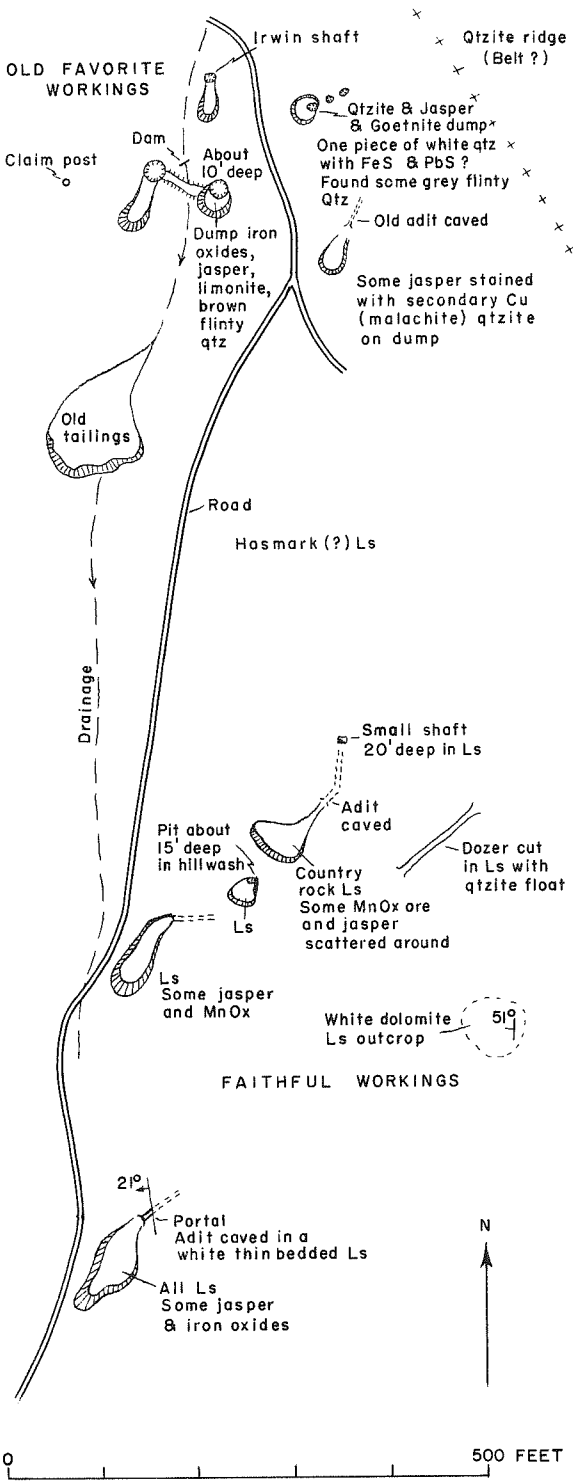


Figure 37.—Sketch of workings on Faithful and Old Favorite claims, Baldy Mountain district.

limonite, and manganese oxide minerals. One piece of white quartz containing small blebs of pyrite and galena was found on one dump. Most of the dump material is limestone, but there is some white fine-grained marble speckled with manganese oxides

and there are some red-brown quartzite fragments. The quartzite fragments indicate that the shafts penetrated quartzite underlying the limestone.

Total recorded production from the Faithful mine is 1,037 tons of ore, which contained 69,512 pounds of lead, 6,700 pounds of zinc, 2,582 pounds of copper, 1,576 ounces of silver, and 268 ounces of gold. This ore was produced in 1939-40 and 1947-49.

FIREHOLE

The Firehole patented claim is owned by Frank Marchesseau. It is in the NE¼ sec. 8, T. 6 S., R. 12 W., and can be reached by an unimproved road up Steel Creek.

The mine workings consist of an adit 300 feet long driven along a S. 20° W. line. The adit is all in buff sugary dolomite. No ore minerals were noted in the adit or on the dump.

The property has no record of production.

GRIZZLY BEAR

The Grizzly Bear prospect is in the center of the N½ sec. 22, T. 6 S., R. 12 W. The patented claim is owned by W. H. Beck and George Lemon.

Workings consist of two prospect pits about 50 feet apart and along a N. 22° W. line, and an adit about 100 feet lower and driven underneath the pits; it is now caved near the portal. Exploration at the contact between quartzite and buff dolomite revealed only a weakly mineralized zone. One piece of ore found on the dump consisted of quartz and a copper-stained sulfide mineral, presumably tetrahedrite. The specimen assayed 0.75 percent copper, 0.15 percent lead, 0.80 percent zinc, 21.10 ounces silver, and 0.005 ounce gold per ton.

The property has no record of production.

HAZEL

The Hazel prospect is in sec. 11, T. 6 S., R. 12 W., and can be reached by a road up the West Fork of Dyce Creek. The property includes eleven unpatented claims held in 1960 by W. E. Talent of Dillon.

The deposit was described by Pattee (1960) and consists of several tungsten-bearing tactite bodies localized at the contact between remnants of limestone with the enclosing granodiorite. The limestone remnants trend north-northwest except one at the southeast end of the property, which trends northeast. The tactite body localized on the northeast end of this remnant is exposed for a length of 215 feet, and its average width is 105 feet. It is explored by surface cuts and a short adit to depths of 3 to 33 feet. Assays of samples range from 0.11 percent to nil in WO_3 content (Pattee, 1960, p. 31). About 800 feet southwest, also at the southeast end of the property, a second tactite body is exposed for 104 feet along the strike; it is 2 to 8.5 feet wide. Samples taken here range from 0.084 percent to nil in WO_3 content.

The tungsten-bearing mineral is scheelite disseminated in the tactite. Crystals are as much as 15 mm in length but average 3 mm.

The property has no record of production.

LITTLE HAWK

The Little Hawk mine is on the top of Garrett Hill in the NE¼ sec. 15, T. 6 S., R. 12 W., at an altitude of about 7,900 feet. It can be reached by a road up the West Fork of Dyce Creek. The property consists of a patented claim, the Bartholdi, and six unpatented claims. In 1955, the Bartholdi claim was leased to the Little Hawk Mining Company of St. Louis, Missouri, and the six unpatented claims were held by the same company. A 150-ton mill was constructed in 1955, but produced only a small amount of tungsten concentrates.

The deposit consists of tungsten-bearing tactite zones in recrystallized limestone near a granodiorite contact (Pattee, 1960). The deposit on the Bartholdi claim is exposed by a scraped area 550 feet long by 140 feet wide (Fig. 38). At the northwest end of the scraped area, a tactite body 100 feet in length and possibly averaging 50 feet in width is exposed. The tactite is composed principally of garnet but contains some epidote and shows some copper stain at its southeast end. Assays of samples of the tactite range from 0.096 to 0.154 percent WO_3 (Pattee, 1960, p. 35).

At the southeast end of the scraped area, an inclined shaft about 30 feet deep was sunk on a copper-stained silicated zone in white limestone at the granodiorite contact. No copper stain shows at the bottom of the shaft, however.

The tungsten occurs as scheelite and powellite in crystals 1.2 mm in length disseminated in the tactite; most of the crystals range from 0.3 to 0.6 mm in length (Pattee, 1960, p. 33).

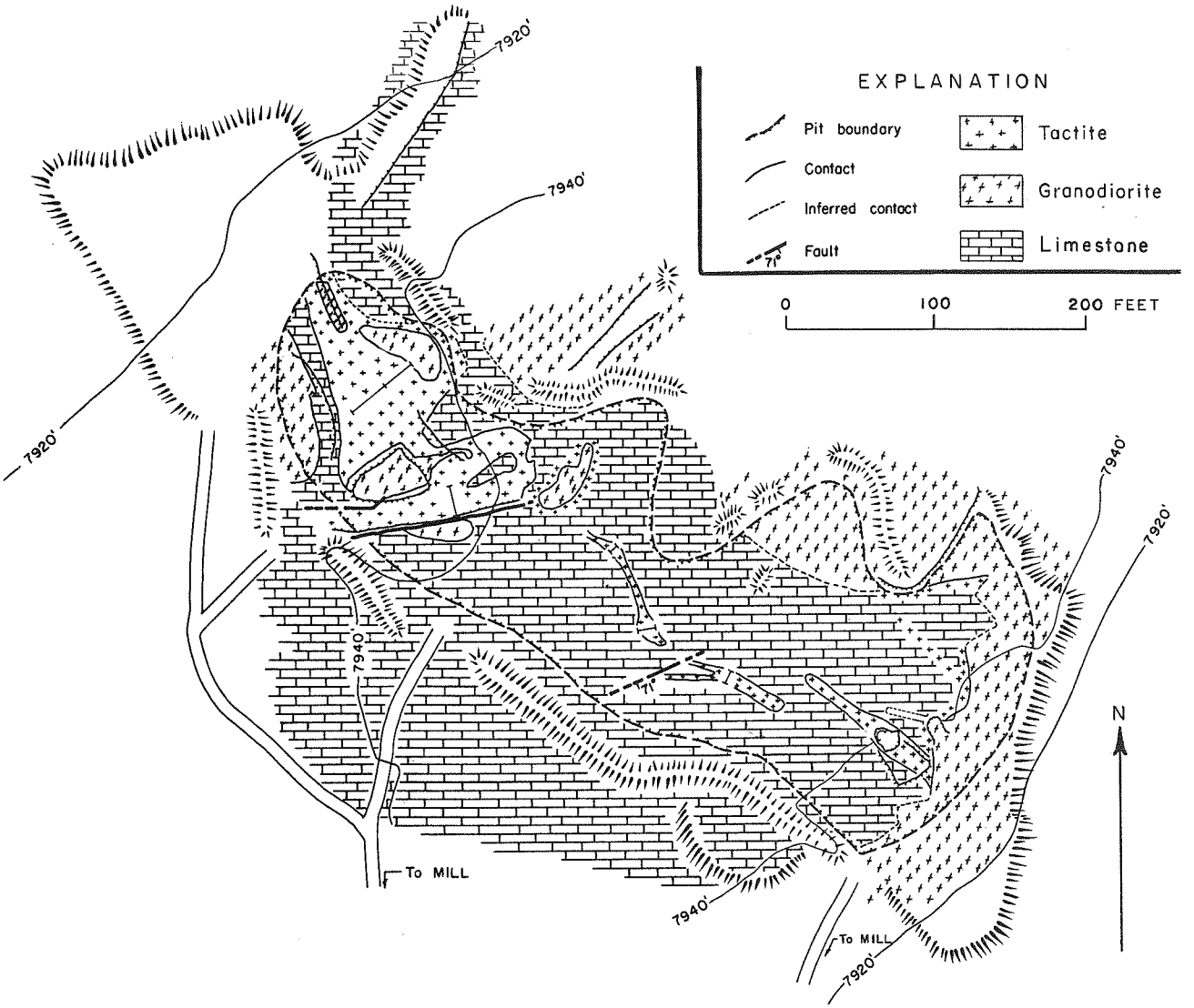


Figure 38.—Sketch of Little Hawk mine, Baldy Mountain district. (Pattee, 1960).

MAYFLOWER

The Mayflower property is on the south boundary of sec. 22, T. 6 S., R. 12 W. The patented claim is owned by W. H. Beck and George Lemon.

Workings on the property consist of two shallow prospect pits, seemingly on a structure that trends N. 12° W. The dumps contain shaly light-gray limestone fragments. No ore minerals were observed.

Total recorded production from the property, all in 1935, is small, but actual production figures are confidential.

MISS GRUNDY

The Miss Grundy patented claim is near the center of sec. 16, T. 6 S., R. 12 W. It is owned by W. H. Beck, George Lemon, and Paul Vandervort.

Workings consist of several short adits driven into a ledge of quartzite, which strikes N. 34° W. and dips 14° SW. All adits are now caved, but fragments on the dump indicate that the vein is not more than 4 inches wide and is mainly limonite. The dump at one pit contained a few pieces of pyrite-bearing quartz.

The property has no record of production.

NICK PREEN

The Nick Preen mines are in sec. 14, T. 6 S., R. 12 W., and can be reached by a road up the East Fork of Dyce Creek. The claims are not patented,

and present ownership is unknown.

The deposit is in a quartz vein localized between buff thin-bedded shaly limestone and massive fine-grained limestone. The beds strike S. 80° W. and dip 23° SE. The vein has been explored for a horizontal distance of 400 feet by several adits on the side of the hill (Fig. 39). All the adits are caved at their portals. Some dumps show no vein material; either the vein was not intersected underground or it is not continuous. At the lowermost adit, near the bank of the creek, a small stockpile of vein material consists of copper- and iron-stained quartz containing some galena and anglesite. A selected sample of the material assayed 0.15 percent copper, 3.65 percent lead, 0.10 percent zinc, 5.70 ounces silver, and 0.012 ounce gold per ton. The dump contains some pieces of white quartzite and granodiorite. At the uppermost adit, a stockpile of vein material consists of iron-stained white quartz in pieces of such size as to suggest that the vein was about 6 inches wide. A sample of this material assayed 0.85 percent copper, 0.88 percent lead, 3.60 ounces silver, 0.020 ounce gold per ton, and no zinc.

The property has no record of production.

OSTERLY

The Osterly prospect is an unpatented claim located by Pete Piazzola of Dillon; it is in sec. 14, T. 6 S., R. 12 W.

The workings consist of an adit about 20 feet long (Fig. 39) driven along a N. 40° E. line. The adit is in a white recrystallized limestone, which strikes N. 62° W. and dips 32° SW. No ore was observed underground, but a small ore pile by the adit contains fragments of recrystallized limestone stained by copper and showing some disseminated galena.

The prospect has no record of production.

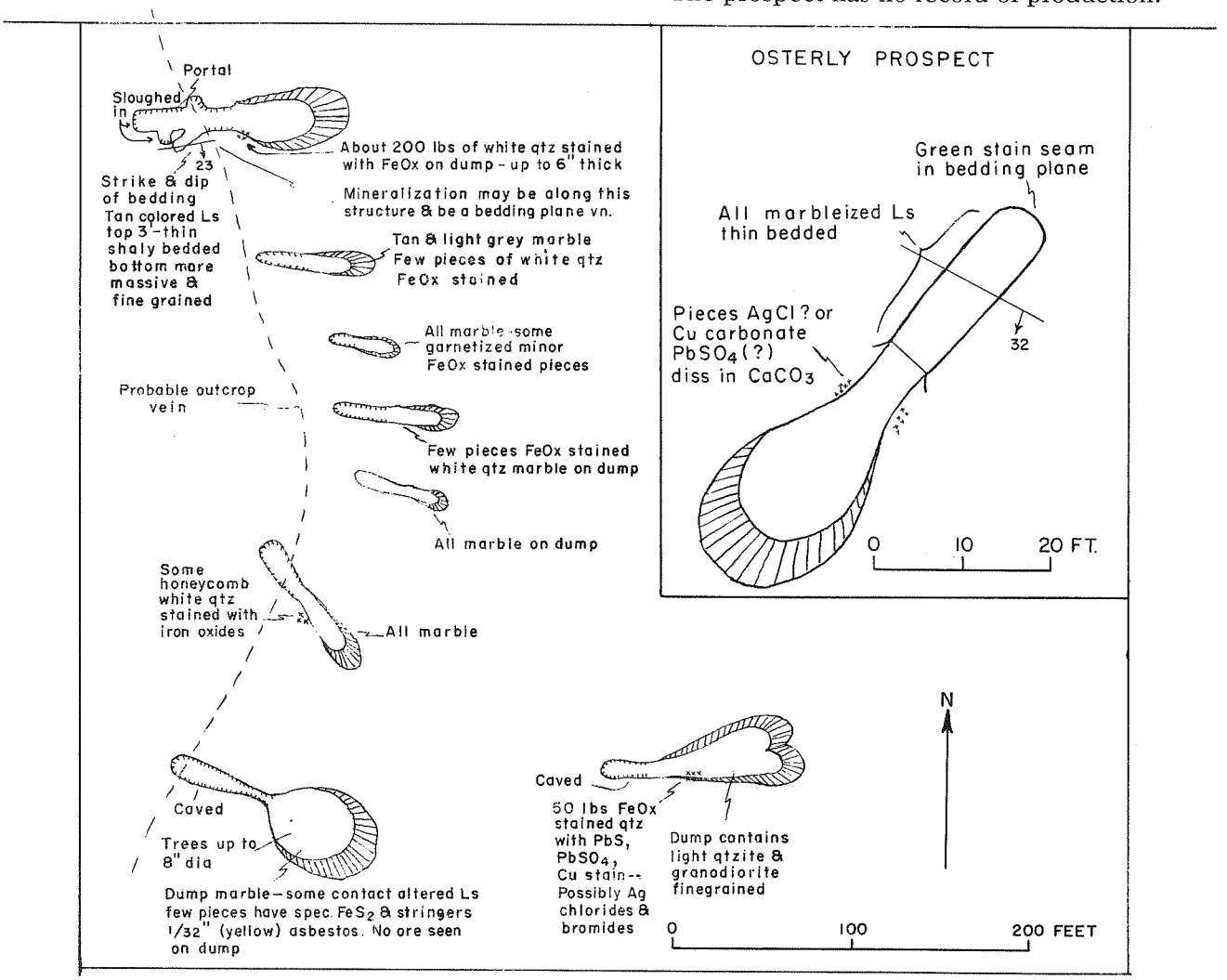


Figure 39.—Sketch of Nick Preen mine workings on Osterly prospect.

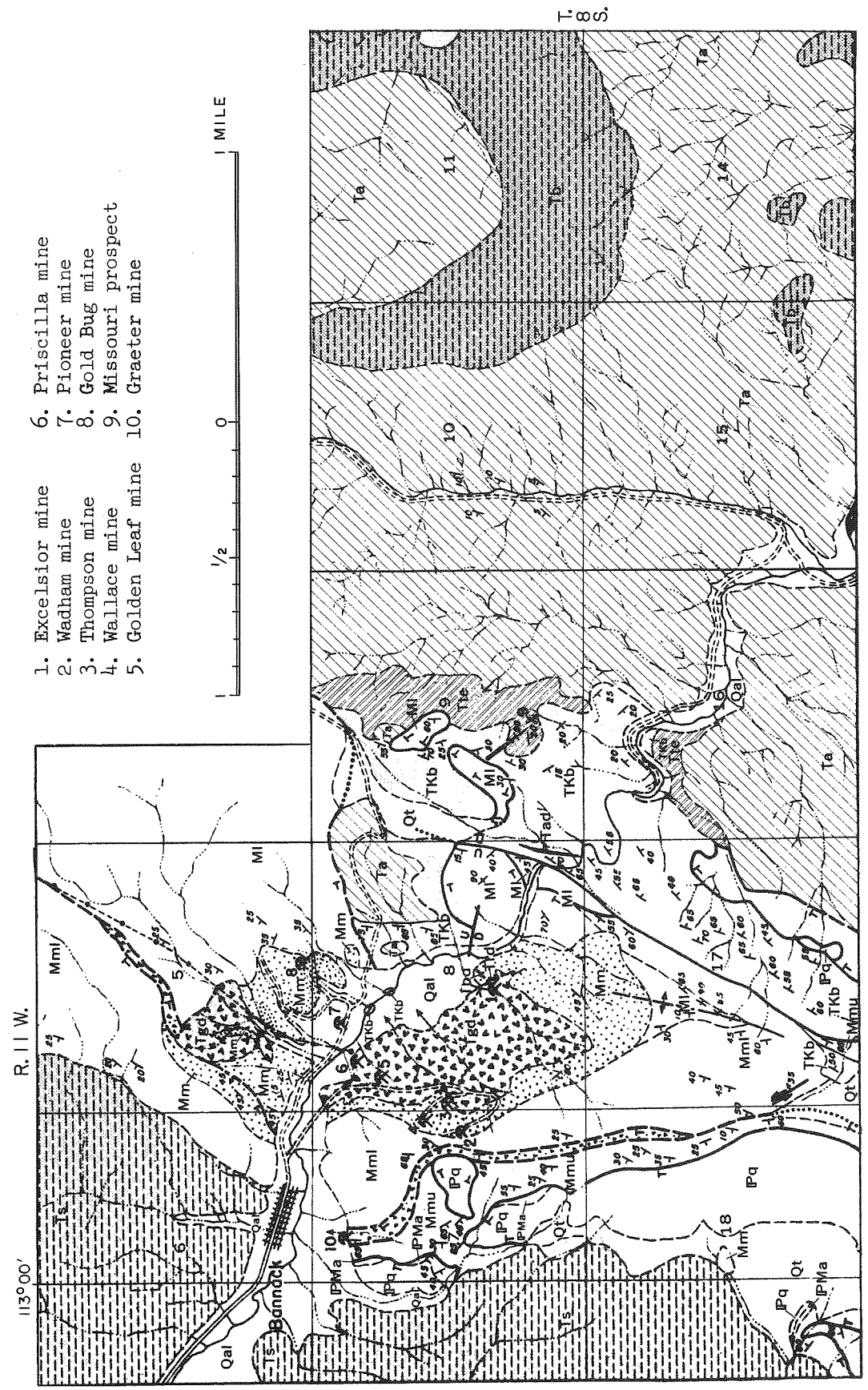
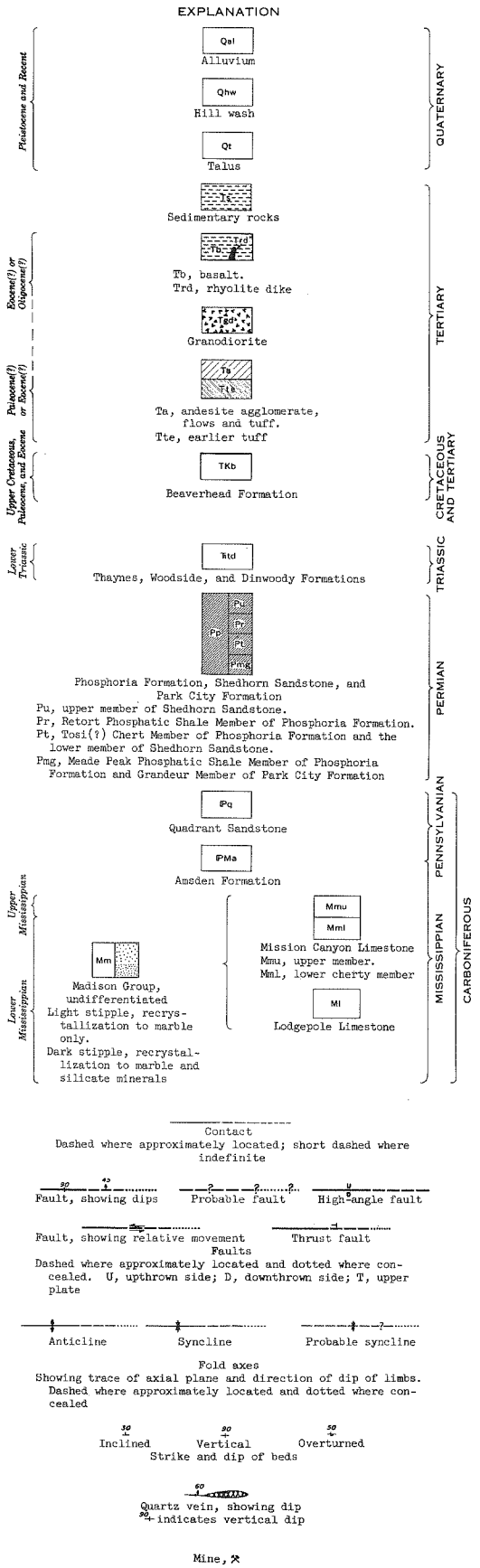


Figure 40.—Geologic map of the Bannack district. (Lowell, 1965).



PROSPECTS IN THE SW¼ SW¼ SEC. 9, T. 6 S., R. 12 W.

The prospects in the SW¼ SW¼ sec. 9, T. 6 S., R. 12 W., were explored by two adits on opposite sides of Driscoll Creek. The adits can be reached by an unimproved road up Driscoll Creek. The north adit trends N. 31° E. and is about 100 feet long. It follows the contact of white silicated limestone with granodiorite. The south adit trends S. 46° E. and is about 200 feet long. It begins in white silicated limestone and ends in granodiorite. No ore minerals were observed either in the adits or on the dumps.

The names of the adits or production from them, if any, are not known.

PROSPECTS IN SEC. 16 AND 17, T. 6 S., R. 12 W.

The prospects in sec. 16 and 17, T. 6 S., R. 12 W., were explored by five adits driven northward in buff dolomite. All adits are caved at the portals. Only a few pieces of iron-stained quartz were found on some of the dumps.

The name of the prospects and production record, if any, are not known.

SUNRISE

The Sunrise mine is in sec. 24, T. 6 S., R. 12 W., on a patented claim, the sidelines of which adjoin the Old Favorite and Faithful claims to the west. The property is owned by Earl Tash and others.

The mine workings consist of two adits. The upper adit trends N. 60° W.; it is caved at the portal. Dump material consists of flaggy limestone, iron-stained quartzite, and contact-metamorphosed limestone. A small ore bin by the dump contains about 5 tons of jasper and quartz in pieces as much as 6 inches across. A selected sample of this material assayed 0.17 percent copper, 0.50 ounce silver, and 0.57 ounce gold per ton, and no lead or zinc.

The lower adit, about 400 feet northwest and about 100 feet below the upper adit, is driven in about 42 feet along a N. 25° E. line. The adit begins in metamorphosed limestone, cuts a 2-foot chloritized diorite dike, then a bed of marble about 5 feet thick, and ends in fine-grained diorite, which is probably a larger dike, the full width of which is not exposed. Both igneous bodies strike N. 70° E. and dip steeply northwest. No ore is exposed in the adit, but a small pit near the portal contains a few pieces of copper-stained metamorphosed

limestone containing anglesite and some iron oxides.

The property has no record of production.

VIRGINIA

The Virginia unpatented claim is south of the Agnes claim.

The deposit consists of two faulted segments of tactite and tactite fragments in a shear zone in granodiorite (Pattee, 1960, p. 34). A disseminated mineral that fluoresces like scheelite or powellite occurs in the tactite, but it is too fine grained to allow qualitative tungsten tests to be made. A chip sample across the shear zone and another from the tactite segment assayed no tungsten.

WILD BAT

The Wild Bat prospect is in sec. 14, T. 6 S., R. 12 W., about 1,000 feet southwest of the Osterly prospect. The deposit is tactite along the contact between limestone and epidotized granodiorite. A small ore pile alongside a dozer cut contained copper-stained limestone and another contained iron-stained quartz. A sample of the copper-stained material assayed 0.75 percent copper, 0.05 ounce silver, 0.001 ounce gold per ton, and no lead, zinc, or tungsten. A sample from the pile of iron-stained quartz assayed 0.50 percent copper, 0.45 ounce silver, 0.006 ounce gold per ton, and no lead or zinc.

About 257 feet south of the cut, a vertical shaft 22 feet deep is entirely within granodiorite. Dump material consists of epidotized granodiorite, which contains some calcite stringers, and massive epidote and garnet rock. About 150 feet southeast of the shaft, the granodiorite has been intruded by two leucogranite dikes, which trend N. 45° W. They are not more than 100 feet long.

The property has no record of production.

BANNACK DISTRICT

The Bannack district is about 20 miles southwest of Dillon. The lode mines in this district are situated about 1 mile downstream from Bannack, along a narrow gorge through which flows Grasshopper Creek. Bannack is the principal settlement in the district, and though almost abandoned today, was the first territorial capital (1864) of Montana. The town can be reached by county roads that lead south from Badger Pass and north from Horse Prairie Valley.

The principal sedimentary rocks in the district are the white-weathering, cliff-forming massive limestone beds of the Madison Group. These rocks in general trend northward, dip to the west, and lie in a north-trending belt of overthrust faults, which extends from Idaho through Bannack, Argenta, and possibly even as far north as the Lewis and Clark lineament in west-central Montana.

Within the district the limestone beds have been intruded by igneous rocks of granodioritic composition. The largest of these intrusive bodies crops out about half a mile southeast of Bannack on the south side of Grasshopper Creek (Fig. 40). For the purpose of this report it will be called the Bannack granodiorite stock. It is about 1 mile long in a northerly direction and as much as a third of a mile across. About one-third of a mile north of Grasshopper Creek is a smaller granodiorite stock. Between the two stocks a tabular granodiorite dike crops out on the Blue Grass and Gold Bug claims. Undoubtedly, the two stocks connect at depth, and thus would be the upward extensions of a larger igneous mass that is still concealed.

The limestone around the stocks and within the aureole of contact metamorphism has been changed from blue-gray definitely sedimentary rock to white fine-grained marble or a light-gray coarsely crystalline variety. Locally, tactite made up of epidote containing bunches of garnet and coarse calcite has resulted; specularite and disseminated pyrite are common minerals in this kind of tactite.

The lode deposits of the district are clustered around the igneous bodies but are in the limestone, either localized near the change from white to bluish-white limestone or along the contact with granodiorite. No ore deposits have been found along the granodiorite contact where the adjacent rock is epidote-garnet tactite.

Characteristically, the Bannack lode deposits are replacement bodies composed of gold-bearing quartz and pyrite containing sparse but ubiquitous chalcopyrite in the unoxidized part. Small amounts of galena and sphalerite may also be present. The deposits were especially valued in the early days because the gold in the oxidized part was free milling and could be recovered simply by crushing the ores and treating them by amalgamation or cyanidation. The richer oxidized ore has been mined but low-grade oxidized ore still remains, and the primary sulfide ore has been barely touched.

Total recorded lode production from the Bannack mines is given in Table 9.

BEA ANN

The Bea Ann unpatented claim is in sec. 5, T. 8 S., R. 11 W., at an altitude of about 6,200 feet. It can be reached by a mountain road that leads off from the Gold Bug mine road. The location of the mine and the access road to it are shown on the Bannack topographic map.

The country rock at the mine is limestone of the Madison Group. The deposit consists of a chimney or cavern, developed in the limestone, which is filled with a rubble of earthy iron oxides, banded nodules of calcite and black psilomelane-type manganese oxides, and fragments of quartz and jasper. The chimney is about 20 feet across its smallest dimension, northwest-southeast; it dips 52° NW. (Fig. 41). The chimney has been opened up by a

Table 9. — Production of gold, silver, copper, lead, and zinc from lode mines, Bannack district, 1902-65, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)	Total value
1902	202	90	10	-----	-----	-----	$ 1,862
1903-06	no production						
1907	19	12	125	200	-----	-----	376
1908	no production						
1909	35	170	311	138	1,696	-----	3,773
1910	467	2,570	7,643	1,955	56,542	-----	59,994
1911	839	2,048	6,886	3,013	38,349	-----	48,094
1912	632	3,729	9,238	328	7,870	-----	83,175
1913	188	1,131	2,328	1,224	-----	-----	24,975
1914	214	281	4,142	865	5,061	-----	8,407
1915	153	384	2,579	2,066	8,482	-----	10,001
1916	no production						
1917	5,450	1,415	7,895	17,416	7,997	-----	41,198
1918	88	175	306	4,622	-----	-----	5,061
1919	1,949	841	836	12,716	-----	-----	20,693
1920	4,420	1,234	975	-----	-----	-----	26,576
1921	704	227	205	106	296	-----	4,920
1922	56	285	102	-----	-----	-----	5,994
1923	34	162	44	-----	-----	-----	3,382
1924	7	83	8	-----	-----	-----	1,710
1925	226	373	1,063	-----	-----	-----	8,454
1926	232	187	104	-----	----	-----	3,923
1927-28	no production						
1929	33	43	86	536	1,873	-----	1,142
1930	no production						
1931	12,383	4,008	9,968	490	-----	-----	85,784
1932	15,004	3,735	6,500	-----	-----	-----	79,034
1933	15,250	1,480	12,800	1,734	1,838	-----	35,242
1934	21,039	3,796	20,442	6,650	2,973	-----	146,545
1935	18,091	4,916	5,472	2,807	200	-----	176,228
1936	362	464	998	1,739	804	-----	17,210
1937	873	408	1,139	19,000	-----	-----	17,460
1938	10,334	2,150	6,008	3,296	2,043	-----	79,551
1939	4,995	1,338	1,108	29	-----	-----	47,585
1940	9,666	1,702	3,607	9,000	-----	-----	63,152
1941	230	191	353	1,100	200	-----	7,077
1942	45	57	90	1,800	-----	-----	2,277
1943	379	364	14	-----	-----	-----	12,750
1944	63	51	-----	-----	-----	-----	1,785
1945-51	no production						
1952	1	-----	10	-----	223	180	75
1953	2	-----	3	-----	800	400	154
1954	no production						
1955	16	3	39	100	900	300	348
1956-60	no production						
1961	6	5	339	-----	-----	-----	488
1962-65	no production						
Total	124,687	40,108	113,776	92,930	138,147	880	1,136,455

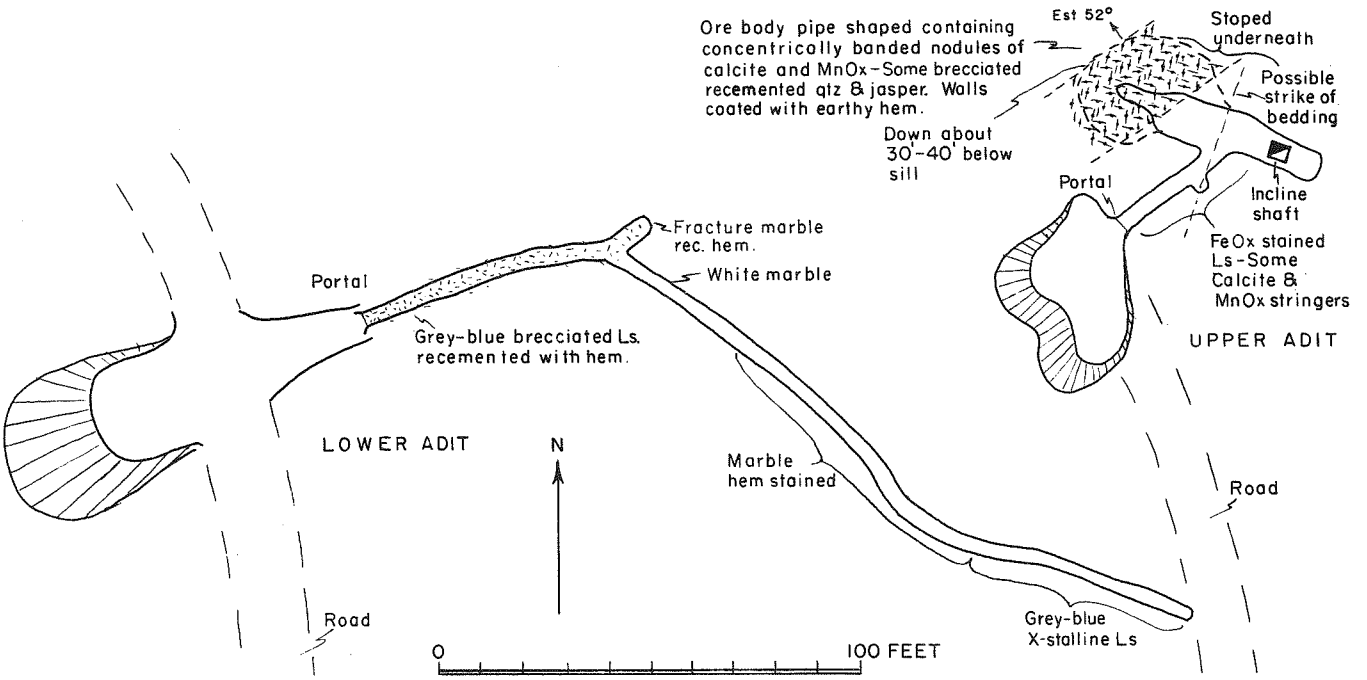


Figure 41.—Geologic sketch of Bea Ann claim.

short adit and excavated below the level of the adit to a depth of 30 or 40 feet. A lower adit, about 130 feet below the upper adit, is about 220 feet long and for the greater part of its length was driven southeastward, obviously on the assumption that the structure in the upper adit was a vein having a northeast trend.

The property has no record of production under the name of Bea Ann.

EXCELSIOR

The Excelsior mine is approximately in the center of the S½ sec. 8, T. 8 S., R. 11 W., and is nearly 1½ miles downstream from Bannack. The mine is at the end of a dirt road that begins at Bannack and is situated on the south bank of Grasshopper Creek. The mine is on a patented claim owned by Phillip and Fred Shenon and others.

The deposit is in a vein on the northeastern side of the Bannack granodiorite stock where apophyses from the stock have intruded Madison Limestone. The limestone along the contact has been recrystallized to white fine-grained marble, which locally is slightly garnetized.

The workings consist of an adit level that aggregates about 1,400 feet, a main shaft near the portal of the adit, now caved at the collar, and an old shaft on the vein, which has been exposed by workings on the adit level (Fig. 42). No workings below the adit level are accessible. The vein strikes S. 37° E. and dips steeply southwest. It is entirely within fine-grained white marble about 5 feet from the contact of the marble with a southeast-trending apophysis of granodiorite. On the adit level the vein is not more than 2 feet wide and it is about 30 feet long. Its northwest end merges with a north-trending fault, which caused a 10-foot left horizontal displacement of the marble-granodiorite contact. The old shaft that was sunk on the vein is open for about 60 feet above the adit level and for about 20 feet below; the rest is caved. Shenon (1931, p. 40) reported that the vein had been mined to a depth of about 300 feet and that it produced approximately $300,000.

The vein on the adit level is composed entirely of tan to brown earthy iron oxide minerals. A chip sample taken across it near the old shaft assayed 0.30 percent copper, 0.05 ounce silver, and 0.001 ounce gold per ton, and no lead or zinc. Auriferous pyrite is said to compose the vein below the oxidized zone.

Shenon (1931, p. 40) reported that the ore shoot in the lower part of the mine was offset to the southwest by a series of step faults.

The mine produced in 1902, and 1917-19, when it was operated by Western Mine Enterprise Company, Original Bannack Mining Company, and New York Montana Mines Company. Total production for these years was 660 tons of ore, which yielded

520 ounces of gold, 1,428 ounces of silver, and 27,536 pounds of copper.

The last work done at the mine was in 1963, when the margin of a granodiorite apophysis lying to the southwest (Fig. 42) was explored on the adit level by the Grand Deposit Mining Company of Reno, Nevada, under an $80,000 Office of Minerals Exploration contract. No ore was found, however.

GOLD BUG AND BLUE GRASS

The Gold Bug and Blue Grass claims are in sec. 5, T. 8 S., R. 11 W., about 1 mile east of Bannack. The claims can be reached from Bannack by way of a road along the north bank of Grasshopper Creek.

The Gold Bug claim overlies the Dakota discovery claim on which was started the first quartz lode

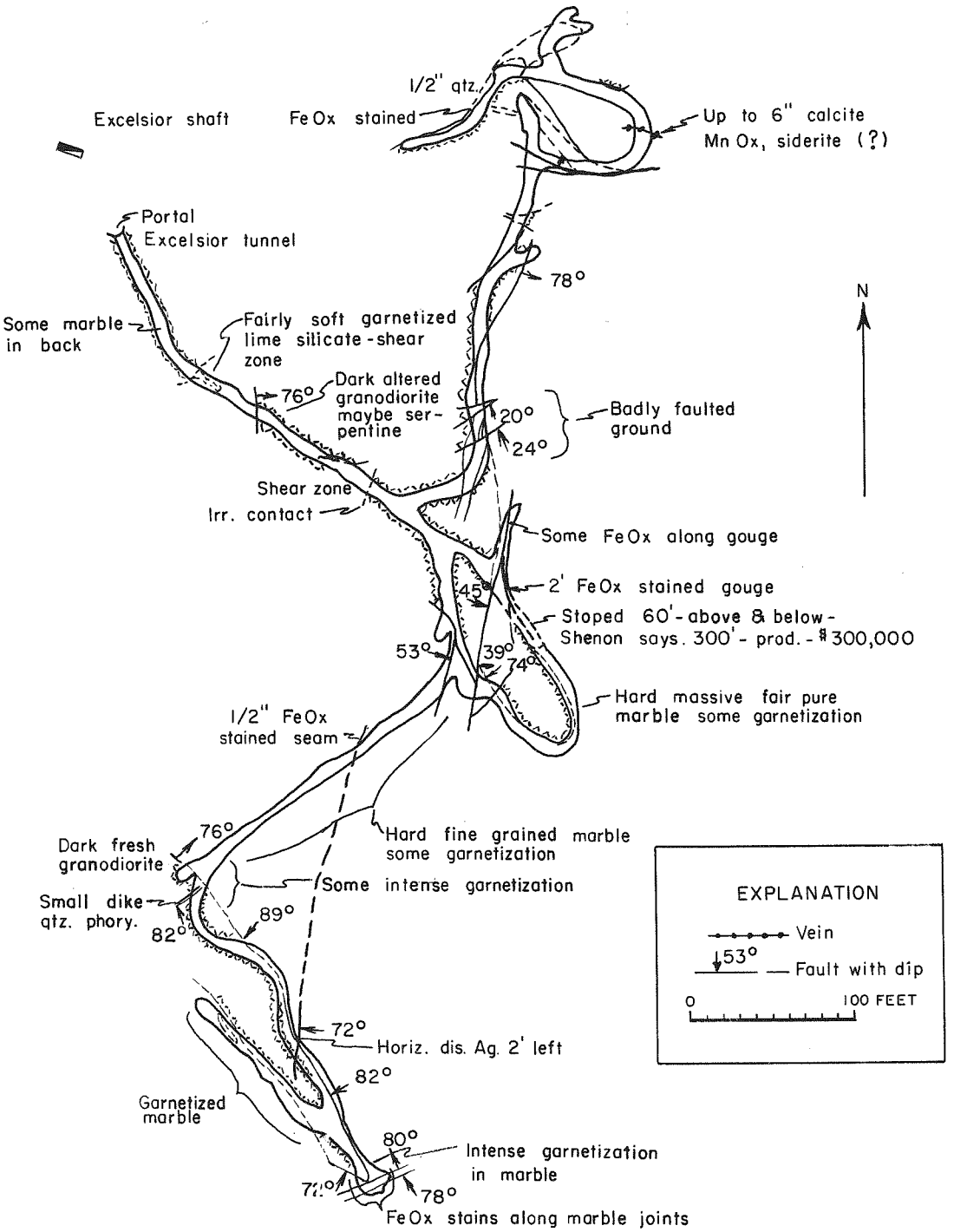


Figure 42.—Geologic sketch of Excelsior mine.

mine in Montana (Shenon, 1931, p. 27, 42). The original Dakota claims numbered twelve in all. Each claim was only 100 feet long, as the 1862 rules and regulations under which these claims were located allowed only 100 feet to a claim. When the Gold Bug and Blue Grass claims were patented, they took in the ground originally occupied by the Dakota claims.

The ore deposits are localized at the contact between white fine-grained marble and a granodiorite dike, which extends over the length of the two claims and has irregular walls. The overall trend of the dike seems to be about N. 80° W. Primary ore along the contact consists of gold-bearing pyrite and subordinate quartz. In the oxidized zone, the ore is composed of massive brown iron oxides and quartz that contains free gold and is locally copper stained. The deposits are replacement veins that average 2 or 3 feet in width and locally attain a width as great as 15 feet. The veins are not continuous along the contact; where the country rock is tactite made up of epidote, coarse garnet, and calcite, it is only sparsely mineralized and contains disseminated pyrite and specularite.

The Dakota No. 6 was the best developed of the early claims. It had a main shaft 310 feet deep, a tunnel 345 feet long, and a winze sunk 135 feet below the tunnel. The other claims were also developed by shafts, most of which were shallow. The Dakota No. 8 claim had two shafts, each about 80 feet deep. One of the shafts broke into a cave about 20 feet deep that extended for the entire length of the claim (100 feet). The floor of the cave was covered with quartz that contained free gold (Raymond, 1871, p. 264).

Underground workings on the Gold Bug claim that were accessible in 1964 are shown in Figure 43. On the Blue Grass claim, the ore along the contact between the granodiorite and limestone has been mined from an open cut that is 120 feet long and 20 feet wide.

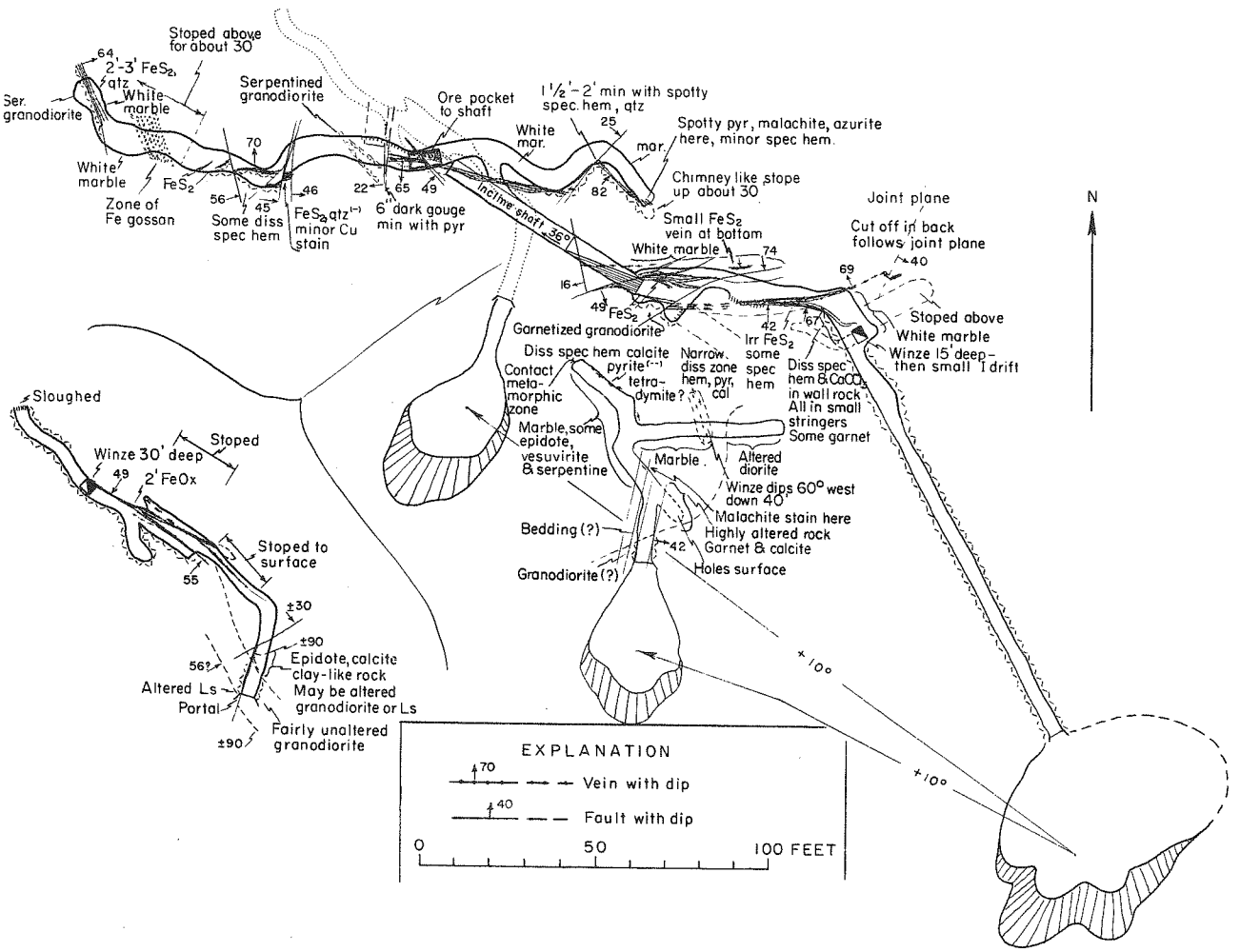


Figure 43.—Geologic sketch of accessible underground workings on the Gold Bug claim.

In the 1930's, the Thompson Gold Milling Company had underway an adit on the Pioneer claim to find the downward extension of the Blue Grass and Gold Bug ore bodies, which were reported to have been cut by a low-angle fault at a depth of approximately 100 feet below surface. The adit did reach the contact and was driven along the contact for a short distance, but no ore was found. The adit was still open for its entire length in 1964.

Production was recorded from the Gold Bug claim for the period between 1922 and 1941, and consisted of 2,353 tons of ore, which yielded 2,181 ounces of gold, 4,830 ounces of silver, 32,073 pounds of copper, and 7,437 pounds of lead.

GOLDEN LEAF (SLEEPING PRINCESS)

The Golden Leaf (Sleeping Princess) patented claims are in sec. 7 and 8, T. 8 S., R. 11 W., about three-fourths of a mile southeast of Bannack. They are on the south side of Grasshopper Creek and can be reached via a dirt road from Bannack.

In 1963 the claims were recorded in the name of New York Montana Mines Company. They are now under a lease and purchase agreement with Spokane National Mines, Inc. (H. J. Tibbetts, president, written communication). The claims are the Wadams, Wallace, French, Golden Leaf, Montana, Empire, Junction, and Springfield.

The original location was made in the late 1860's by Wilson Wadams (Wadham), who is said to have taken out $200,000 worth of ore through a shaft 75 feet deep (William Dunn, Sr., private report). The properties subsequently were acquired by Western Enterprise Mining Company, from whom they were purchased in 1905 by Bannack Consolidated Mining Company. Between 1909 and 1911, ore valued at $206,000 was taken out of the Wadams mine by Dunn Development Company under a lease from Bannack Consolidated Mining Company. In 1915 the properties were acquired by New York Montana Mines Company, who constructed a 250-ton mill on Grasshopper Creek. The mill was designed to be powered by water from Grasshopper Creek, but it was soon obvious that the water available was insufficient to power the mill even at half capacity. In 1929 the properties were leased by the I. B. Haviland Company, who constructed an electric powerline to Bannack from Dillon, a distance of 24 miles, and erected a 100-ton cyanidation plant. The company operated the plant for approximately 2 years on ore produced from remnants left in the old stopes, from dumps, and from a body of milling-grade ore discovered by the company at the south end of the Wadams claim. In 1933 the Thompson Gold Milling Company leased the properties and mined ore from them until Februrary 1938. In the latter part of 1938, the properties were leased to the Golden Messenger Corporation of Helena, who cyanided nearly 6,000 tons of gold ore the latter part of the year. In addition, lessees shipped directly to smelters nearly 700 tons of gold ore obtained chiefly from the Priscilla and Wallace claims. The lease on the property was surrendered by the company in 1939. In 1940, 1,120 tons of ore mined from the Priscilla was treated. In 1950 the properties were optioned by the Signal Mining Company of Kellogg, Idaho, who retimbered the Golden Leaf shaft. The last recorded production was in 1955, when L. N. Eberline shipped from the Wadams claim 16 tons of ore, which yielded 3 ounces of gold, 39 ounces of silver, 100 pounds of copper, 900 pounds of lead, and 300 pounds of zinc.

Total production from the group is estimated at $2,577,000 (Dunn report). Total recorded production is given in Table 10.

The ore bodies consist of a series of interconnected and irregular replacement bodies localized in white to bluish-white marmorized limestone of the Madison Group. The limestone is in contact with granodiorite on the western margin of the Bannack stock. In general, the ore occurs outside garnetized zones adjacent to the granodiorite, some of the best ore being found near granodiorite apophyses

Table 10. — Recorded production from Golden Leaf group, 1902-65.

Year	Property or company name under which ore was shipped	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
1909-1955	Wadams & Golden Leaf	2,921	10,472	29,455	7,001	100,781	300
1917	Bannack	5,042	1,184	6,991	138	-----	-----
1931-1939	Sleeping Princess group	87,092	18,256	57,328	3,516	2,043	-----
1939	Wallace	32	24	28	-----	-----	-----
1940	Priscilla	1,244	399	1,959	-----	-----	-----
1941	New York Montana group	154	106	282	717	-----	-----
Total		96,485	30,441	96,043	11,372	102,824	300

extending into the limestone (Fig. 44) (Shenon, 1931, p. 42). Some of the ore bodies are connected to the granodiorite by smooth waterworn passageways, which range from 40 feet in diameter to small pipes hardly large enough for a man to crawl through (Barrell, 1897). According to the Dunn report, many of the ore bodies were faulted, and the downward extension of the Wadams and Wallace ore bodies was cut off by a large fault. The same report also stated that work by the Thompson Gold Milling Company was directed toward the recovery of the faulted extension of the ore, and at the time of the report (1936) the work was within 100 feet of its objective. It is doubtful that the extensions of the Wadams and Wallace ore bodies were found.

Most of the ore produced from the deposits has been oxidized and was mined within 300 feet of surface. The oxidized ore is chiefly red-brown earthy iron oxides containing gold. Some of the ore was copper stained and some contained cerussite, anglesite, residual galena, and smithsonite. The gangue is quartz; sulfide ore exposed on the Pricilla and Dunn level is almost all pyrite but contains very minor and spotty chalcopyrite in intensely garnetized limestone (Shenon, 1931, p. 42).

The ore bodies have been mined from three adit levels, named from top to bottom the Wallace, Golden Leaf, and Priscilla; the Dunn level, apapproximately 150 feet below the Priscilla level, was established off the Priscilla winze. The levels are interconnected by raises and other workings. Ore mined from the upper workings was transferred to the Priscilla level, whence it was delivered to the Golden Leaf mill. The total length of underground workings in the group is probably about 2 miles.

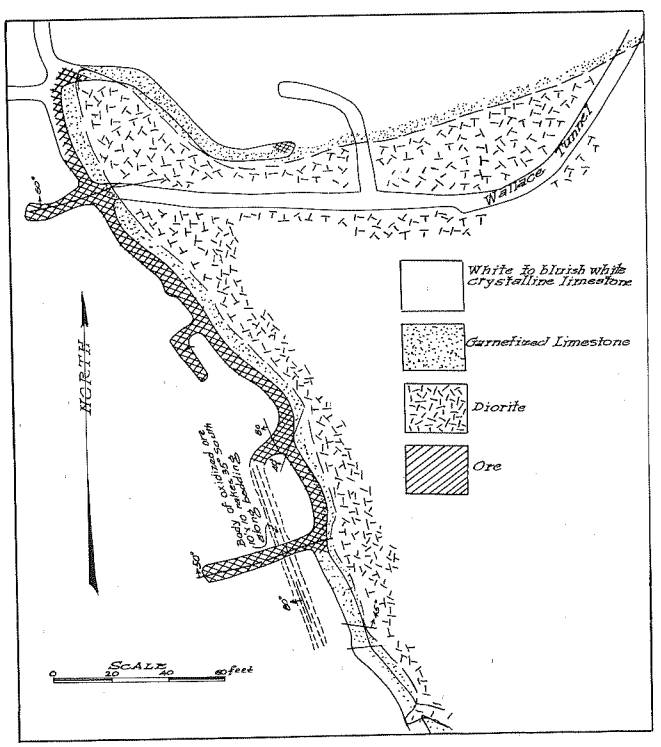


Figure 44.—Map showing ore localization on Wallace level of Golden Leaf (Sleeping Princess) group. (Shenon, 1931).

HENDRICKS (GRAETER)

The Hendricks (Graeter) mine is in the center of the N½ sec. 7, T. 8 S., R. 11 W., a quarter of a mile south of Bannack and on the south side of Grasshopper Creek. The property consists of two patented claims, the Hendricks and Suffield, and the unpatented Hendricks millsite claim. The properties are held by Spokane National Mines, Inc. (H. J. Tibbits, president, written communication).

The claims were among the earliest located in the district, but not much ore was produced from them until 1918 when the Bannack Gold Mining and Milling Company, operating under a lease and bond, installed a 5-stamp amalgamation mill on the properties and began mining (Shenon, 1931, p. 45). A small ball mill, classifier, and two cyanide tanks were added in 1919. In 1920 a new 10-stamp mill was constructed; it contained a ball mill, a classifier, two agitators, four thickeners, and six cyanide tanks and had a capacity of 50 tons per day. It was closed in 1921. In 1933 the properties were reactivated and produced continuously through 1941, during which period the amount of ore mined and treated in the mill was 16,601 tons averaging 0.19 ounce of gold per ton. In 1939 the mine was operated by the Bannack Apex Mining Company. From 1941 through 1965, no ore was produced from the mine, except in 1961, when 6 tons of ore yielded 5 ounces of gold and 339 ounces of silver.

Total recorded production for the mine is 23,594 tons of ore, which yielded 5,299 ounces of gold, 4,979 ounces of silver, 296 pounds of copper, and 251 pounds of lead.

The deposit is in Madison Limestone not far below the contact with the overlying Amsden Formation. According to Lowell's map (1965), the deposit is in a north-trending zone of overthrusting within the Madison Limestone. The fault zone was traced by Lowell for at least 2½ miles south of Bannack and 1½ miles northeast of Bannack.

The ore occurs along two bedding planes in limestone (Shenon, 1931, p. 43). Milling-grade ore formed six different shoots within a distance of 200 feet; the shoots were interconnected by lower grade

ore. The ore bodies raked 7° N. and dipped 20° to 65° W., depending on the attitude of the beds. Altered garnet occurs in the wall rock of one stope. No intrusive rocks are known in the mine area. The ore was entirely oxidized and consisted of gold-bearing red-brown iron oxides.

The mine workings consist of an adit level called the Graeter tunnel level (Fig. 45) and an open cut 300 feet long and 150 feet across. Ore exposed in the south wall of the cut consists of a nearly horizontal bedding-plane vein, as much as 8 feet thick, composed of yellow, red, and brown iron oxides. Some of the iron oxide material is stained by black manganese oxides. The vein is overlain by a 1-foot layer of calcareous black and white gouge. The country rock is recrystallized limestone stained brown. Ore from the cut was transferred to the Graeter level through raises connecting the Graeter level and the open cut. The underground workings off the Graeter level are shown in Figure 45.

LAURILENE NO. 1

The Laurilene No. 1 unpatented claim is in sec. 5, T. 8 S., R. 11 W. It is about 1,000 feet west of the Bea Ann claim and is at an altitude of about 5,950 feet. The location of the mine and the access road leading to it are shown on the Bannack topographic map.

The mine is in Madison Limestone on the southeast margin of a small pluton of granodiorite. Near the contact the limestone has been altered to soft greasy white to buff silicated limestone that resembles talc or serpentine. The only evidence of mineralization consists of a few narrow iron-stained quartz and jasper veinlets and some iron oxide staining in recrystallized dark-blue limestone. The geologic plan map of the mine is shown in Figure 46.

The mine has no record of production under the name of Laurilene No. 1.

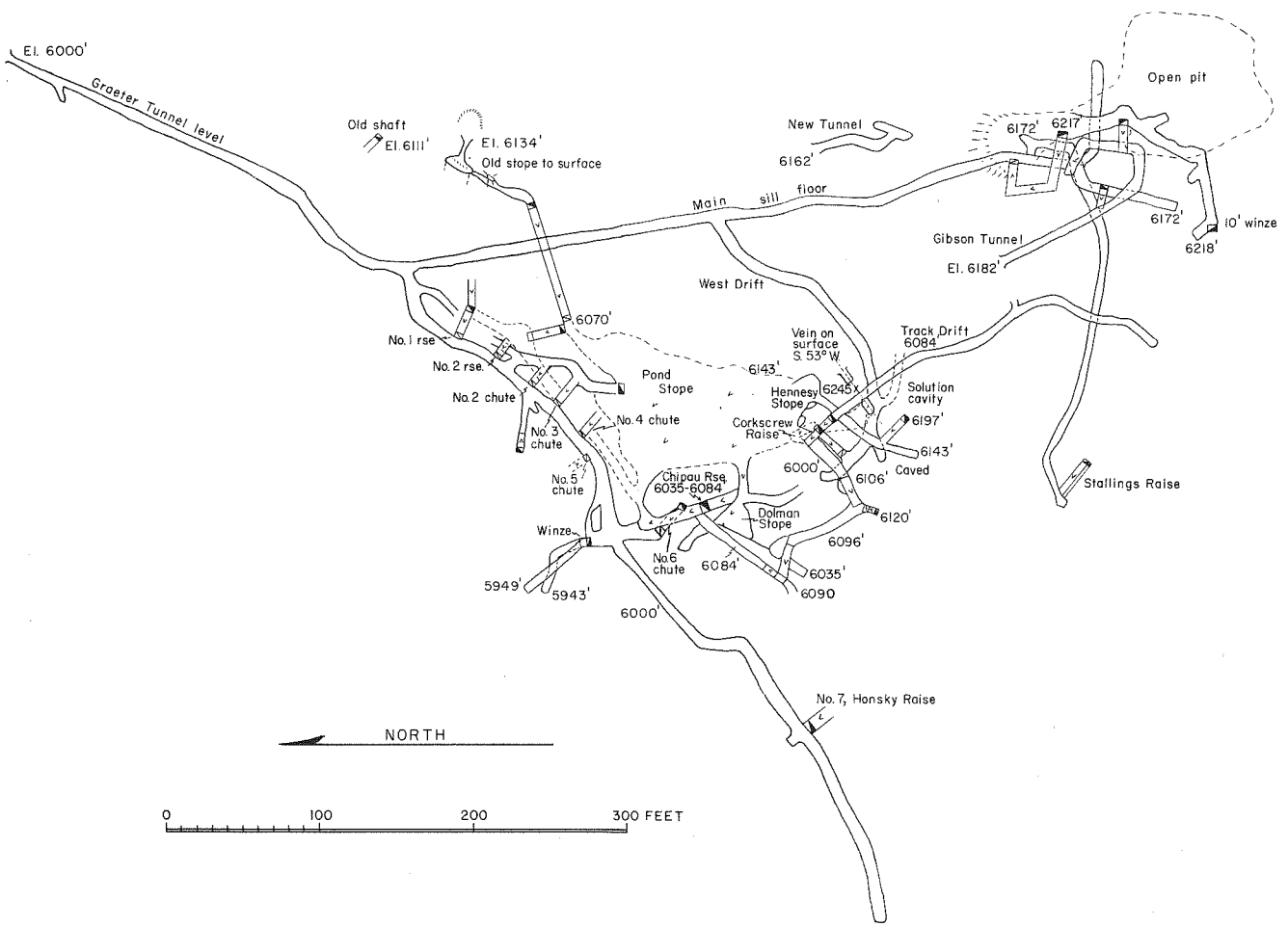


Figure 45.—Plan map of workings of Hendricks (Graeter) mine.

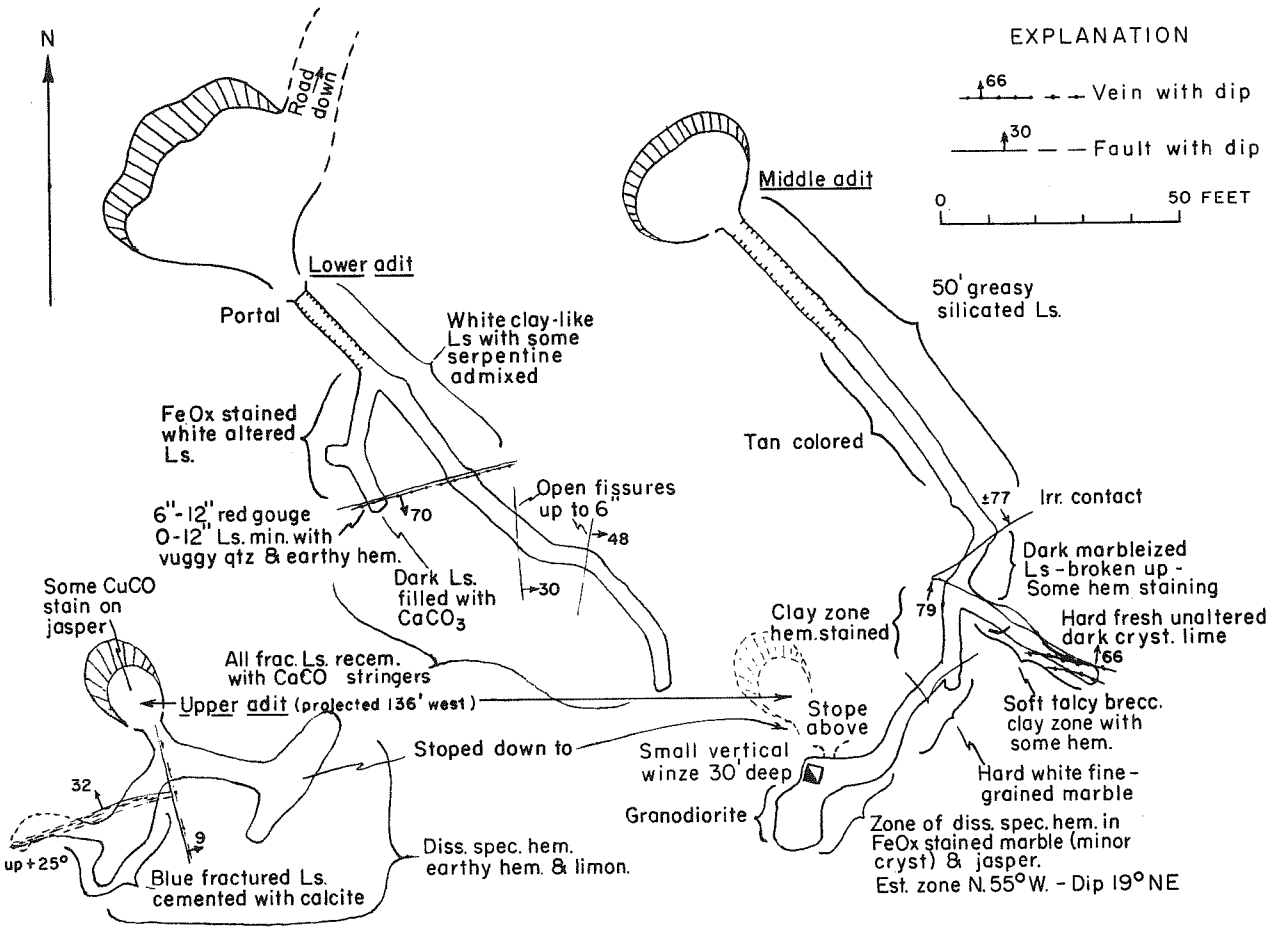


Figure 46.—Geologic sketch of Laurilene No. 1 claim.

BIRCH CREEK (UTOPIA) DISTRICT

The Birch Creek (Utopia) district is about 10 miles north of Argenta, and occupies a mountainous terrane on the southeast slope of the Pioneer Mountains. For the purpose of this report, the district is defined as all the region drained by Birch Creek and Willow Creek and their tributaries.

The principal road through the district is the Birch Creek-Thief Creek-French Creek road, which turns west off U. S. Highway 91 ten miles north of Dillon. Many of the mines in the district are accessible by mountain roads that lead off from the Birch Creek road.

Altitude ranges from 11,000+feet atop Torrey and Tweedy Peaks in the extreme western part of the district down to 6,100 feet at the site of the old town of Farlin on Birch Creek near the Indian Queen mine. At one time the town was the principal settlement in the district, but nothing remains of it today. A forest service sign has been erected at the site, which is near the slag pile from the old Farlin smelter.

The Birch Creek district is situated on the southeast end of the Mount Torrey batholith where quartz monzonite batholithic rock cuts across north-trending upturned sedimentary rocks. The batholithic rock crops out in the northern and western parts of the district, and the sedimentary rocks in the southern and eastern parts. The sedimentary rocks have been complexly folded and faulted; their overall geologic structural pattern is dominated by the Humbolt Mountain anticline.

The Humbolt Mountain anticline is a broad compound structural upwarp (Myers, 1952, p. 23), which is traceable from the Ermont mine in the Argenta district for about 12 miles northward into the Birch Creek district, where it is interrupted by batholithic rocks. South of Humbolt Mountain (sec. 29, T. 5 S., R. 10 W.), the fold plunges south; to the north it plunges steeply north to the quartz monzonite contact. The west limb of the fold is marked by a continuation from the Argenta district and even farther southward of a complex belt of overthrust faulting, which has carried Belt rocks over younger,

predominately carbonate rocks. This structural element, like the Humbolt Mountain anticline, is interrupted to the north in the vicinity of Birch Creek by batholithic rocks.

The east limb of the Mount Humbolt anticline includes a large south-trending apophysis of quartz monzonite, which is part of the batholith. The apophysis, which is in the north-central part of T. 5 S., R. 10 W., averages about 3 miles in width, and it extends south across Birch Creek for half a mile. Although it intrudes both Belt and Paleozoic sedimentary rocks, the main mass of the apophysis seems to have preferentially replaced rocks ranging in age from middle Cambrian through Mississippian, which are chiefly composed of carbonate. The apophysis is definitely in alignment with smaller intrusive masses of similar composition, which are exposed farther south well into the Argenta district and which also occur on the east limb of the Mount Humbolt anticline. These aligned intrusive masses most likely are upward extensions of a larger concealed granitic mass that is an integral part of the Mount Torrey batholith.

The Birch Creek district is in reality a one-mine district, nearly all of its recorded base-metal production having come from the Indian Queen mine. The deposit is on the eastern margin of the quartz monzonite apophysis where it is in contact with Mississippian limestone. The ores were contained in garnet-epidote tactite developed in the limestone. North of the Indian Queen mine, the deposits of the Greenstone and Glowworm prospects are in well-developed tactite zones in rocks of similar age. Production of base metals from these deposits has been small.

Garnet-epidote tactite zones are also developed in Paleozoic carbonate rocks around the nose of the apophysis. All these zones have been prospected for tungsten, but to date only low-grade tungsten ore has been found, despite the fact that host rocks favorable for tungsten mineralization are plentiful in the district.

Sedimentary rocks outside the aureole of contact metamorphism have been explored for base metals. They have no record of production, but their production, if any, would be insignificant.

No productive deposits are known in the batholithic rocks, although a few metalliferous deposits have been found. The Monaghan molybdenite prospect is the most significant.

Recorded base-metal production for the district is valued at only $244,004. Total ore mined was 23,186 tons, which yielded 1,771,824 pounds of

Table 11. — Production of gold, silver, copper, and lead from lode mines, Birch Creek district, 1902-65.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Total value
1902	465	5	2,400	90,390	-----	$ 10,301
1903	8,000	160	16,000	553,220	-----	58,275
1904	12,000	31	12,577	525,639	-----	60,164
1905	400	6	2,160	81,420	-----	14,129
1906	755	19	4,371	194,922	3,542	41,132
1907	471	1	2,449	103,207	-----	22,272
1908	341	74	1,249	107,172	-----	16,348
1909	199	3	420	28,765	-----	4,021
1910	35	-----	46	10,885	-----	1,411
1911	65	1	154	14,877	-----	1,960
1912	31	2	194	4,627	1,102	984
1913	48	1	224	13,858	-----	2,301
1914	15	-----	99	5,540	-----	796
1915	18	-----	75	3,768	-----	701
1916	54	1	210	5,291	-----	1,451
1917	140	2	726	14,692	820	4,714
1918	47	1	120	3,482	-----	990
1919	48	1	195	4,533	-----	1,074
1920-22	no production					
1923	8	-----	20	971	-----	161
1924	3	-----	2	1,965	-----	259
1925-48	no production					
1949	43	-----	53	2,600	-----	560
1950-65	no production					
Total	23,186	308	43,744	1,771,824	5,464	244,004

copper, 5,464 pounds of lead, 43,744 ounces of silver, and 308 ounces of gold. Annual production is given in Table 11.

BLACKMORE

The Blackmore prospect is approximately 1,500 feet northwest of Pear Lake dam and 16 miles northwest of Apex by the Birch Creek road (Pattee, 1960, p. 37).

A small prospect pit exposed three narrow quartz-molybdenite veins enclosed in quartz monzonite. The veins are less than 5 inches wide. No tungsten minerals were observed in the veins.

BUSTER

The Buster patented claim is in the N½ sec. 19, T. 5 S., R. 10 W., several hundred feet east of the Thief Creek-French Creek road.

The country rock is tan sandy dolomite, which closely resembles altered Cambrian limestone, particularly the Pilgrim Formation or the equivalent upper part of the Hasmark Formation.

The principal working on the claim is an adit, which trends S. 5° E. at the portal. The adit is now caved, but the size of its dump indicates that it was several hundred feet long. Most of the dump material is tan dolomite, some of which contains a boxwork of tiny silica stringers. Other material consists of dark-brown and tan jasper, some pieces containing limonite, galena, and anglesite. A selected sample of this material assayed 5.85 percent lead, 0.40 percent copper, 4.75 ounces silver, and 0.020 ounce gold per ton. Prospect pits have been dug in similar rock south of the adit and up on the divide between Armstrong and Sheep Creeks; most of the pits have sloughed. The property has no record of production.

COPPER CONTACT

The Copper Contact patented claim is owned by Myrl Erwin, C. W. Ellingwood, and G. E. Divel. It is half a mile south of the Greenstone mine. The deposit consists of sparsely disseminated fine-grained scheelite in tactite. The tactite zone, which averages 2½ feet in width, formed along the contact between quartz monzonite and Mission Canyon Limestone (Mississippian); it strikes N. 79° E. and dips 80° E. (Pattee, 1960, p. 22). It is exposed in a shallow prospect pit 4 feet long and 3 feet deep. No tungsten was detected by assay of a chip sample taken over a distance of 4 feet diagonally across the zone. Other workings on the property are caved. The property has no record of production.

FLORENCE AND LILLY

The Florence and Lilly claims are in sec. 22, 27, and 28, T. 5 S., R. 10 W. The claims are not patented but have been surveyed for patent. Their present status is unknown.

The principal workings observed seem to be on the Florence claim. They consist of an inclined shaft sunk on a mineralized zone along a bedding plane that strikes N. 11° E. and dips 48° SE., and a short adit that intersects the shaft a few feet below its collar. The shaft is filled with water 50 feet below its collar. Mineralized material on the dump is in pieces as much as 6 inches thick and consists of jasper, goethite, and limonite. The country rock is a gray yellowish-weathering limestone of the Jefferson Formation.

Production from the property, if any, is not known.

GLOWWORM AND GREENHORN

The Glowworm and Greenhorn properties are in sec. 2 and 11, T. 5 S., R. 10 W., and consist of several overlapping unpatented claims. The claims are on the north face of Greenstone Mountain and are accessible by way of Farlin Gulch on Birch Creek, or via Birch Creek, Willow Creek, and Barbour Gulch roads.

The deposit is in a tactite zone in the Amsden Formation at its contact with quartz monzonite of the Mount Torrey batholith (Fig. 47). The tactite zone has been traced for a slope distance of 2,230 feet and is estimated to be 30 to 140 feet wide. Chip samples taken over the length of the tactite zone assayed a trace to 0.17 percent WO_3 and less than 0.2 percent Mo.

The property was first explored in 1919 for its copper content. The underground workings consist of six adits and four shafts driven on copper-stained tactite outcrops. Five bulldozer trenches and several small pits were dug along the zone in 1952 and 1953 to explore for tungsten (Pattee, 1960, p. 16-19).

The property has no record of production under the names of Glowworm and Greenhorn.

GOLD NUGGET

The Gold Nugget unpatented claim is in sec. 15, T. 5 S., R. 10 W., on the south side of the Indian Queen claim. It was held in 1960 by Charles Hein of Dillon. The workings consist of an adit and lateral totaling 122 feet in length. At the face of the adit,

a 7 by 9 by 10-inch inclusion of hornfels contains scheelite, powellite, magnetite, and some chlorite. A grab sample assayed 0.026 percent WO_3 and 0.046 percent Mo (Pattee, 1960, p. 24).

GREENSTONE

The Greenstone mine is near the center of sec. 11, T. 5 S., R. 10 W., on a patented claim recorded

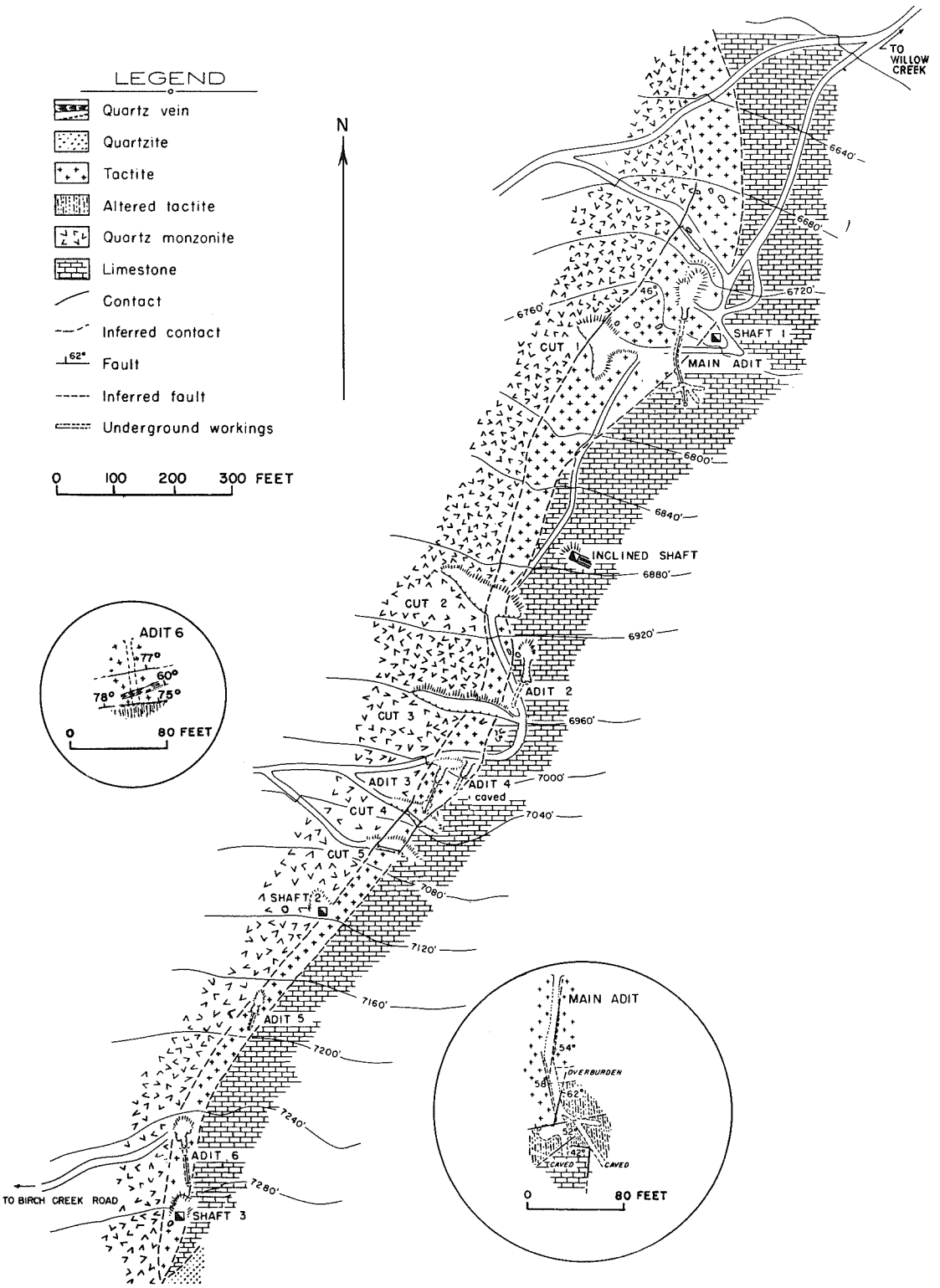


Figure 47.—Geologic sketch of Glowworm prospect and Greenhorn claim, Birch Creek district. (Pattee, 1960).

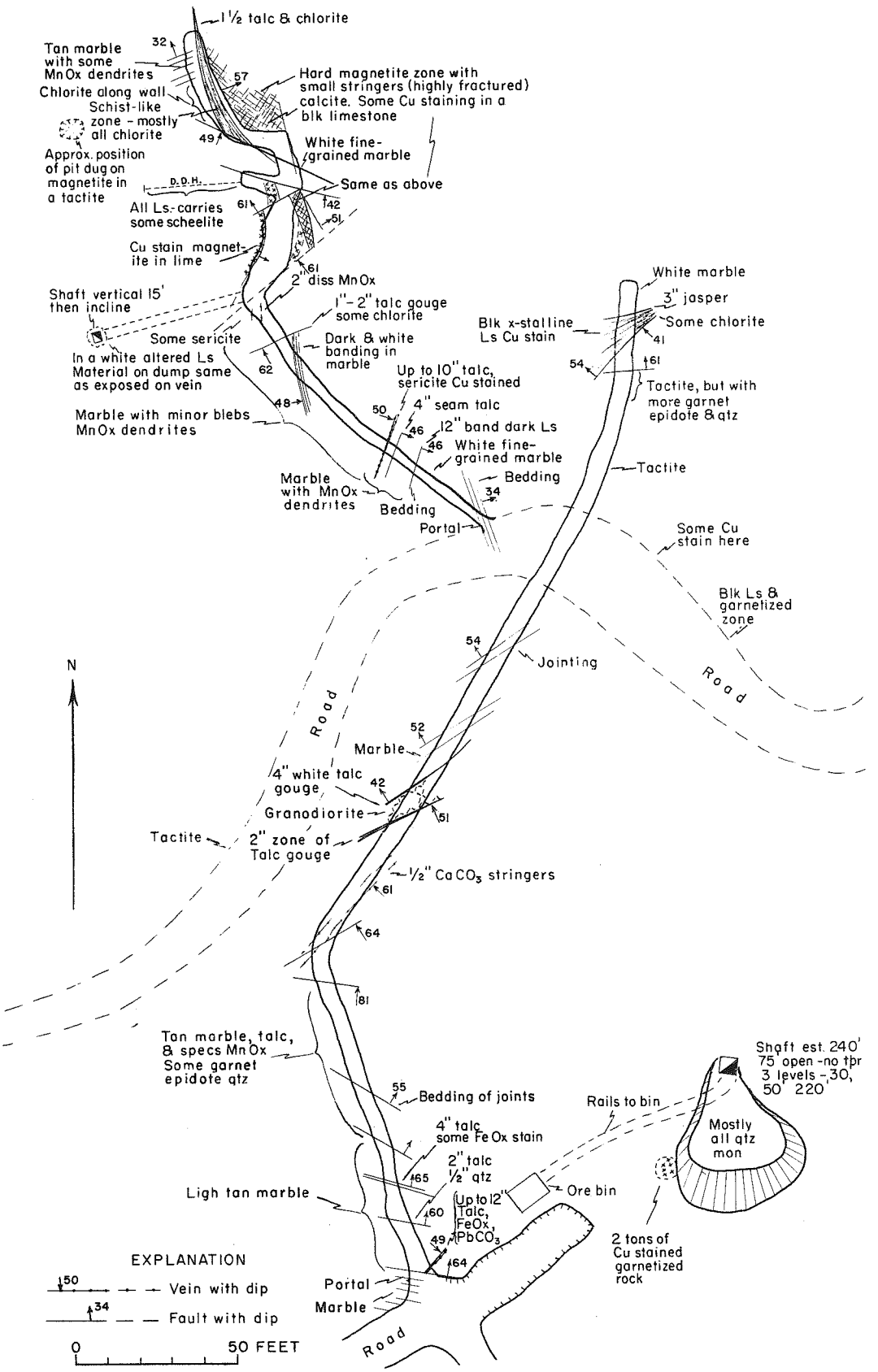


Figure 48.—Geologic sketch of workings at the Greenstone mine.

in the name of G. W. Farlin. It has been worked in recent years by Carl Kennedy of Dillon. The claim can be reached over either of two dirt roads that lead off from the Birch Creek road. The property has been described by Winchell (1914, p. 63) and Pattee (1960, p. 19-22).

The workings are at an altitude of about 7,100 feet and consist of a vertical shaft said to be 240 feet deep (Carl Kennedy, oral communication) and two adits, the lower one about 120 feet southwest of the shaft and the upper one, driven many years ago, about 180 feet northwest of the shaft (Fig. 48).

The country rock is metamorphosed limestone of Mississippian age, which is in contact with quartz monzonite on the east margin of the Mount Torrey batholith. The contact is nearly accordant, although a tongue or apophysis of quartz monzonite juts into the limestone a short distance northwest of the upper adit. The overall trend of the contact is north-south, and the limestone dips 45° to 55° E. The limestone is identified on Myers' map (1952) of the area as part of the Amsden Formation. Quadrant Quartzite crops out a few hundred feet east of the contact.

Three kinds of metamorphosed limestone can be distinguished. Against the contact, the metamorphosed limestone is tan fine-grained marble containing manganese dendrites, some garnet and epidote, and sparse scheelite and powellite. Samples taken by Pattee (1960, p. 19-22) across the zone assayed only small amounts of WO_3. Next to the tan fine-grained marble is hard black crystalline limestone, which is bordered by white fine-grained marble. The contact between tan and black limestone is marked by fault gouge.

The hard black crystalline variety of limestone is the ore zone. In the upper adit, it attains a width of 10 feet and is exposed for a length of 70 feet. The ledge trends north-northwestward and dips 51° to 57° NE. It contains disseminated magnetite and is copper stained. A chip sample taken across the 10-foot width assayed 1.17 percent copper, 0.2 percent zinc, 14.5 percent iron, no lead, 0.50 ounce of silver, and 0.015 ounce of gold per ton. The lower adit, which was driven recently, exposes copper-stained black crystalline limestone, which trends N. 70° E. and dips 41° to 54° NW. On the east wall of the adit the black limestone is 3 feet wide; 3 inches of jasper occurs on the hanging wall. A chip sample taken across the limestone assayed 0.60 percent copper, 0.10 percent lead, 0.20 percent zinc, 1.05 ounces of silver, and 0.005 ounce of gold per ton.

The shaft at the property is open but not safe to enter. According to Carl Kennedy, three drifts were turned off the shaft at the 30-foot, 50-foot, and 220-foot levels. Some tungsten and copper zones were found underground. The dump at the shaft is mostly fragments of quartz monzonite. At the toe of the dump is about 2 tons of copper-stained garnetized rock.

Recorded production from the property is 1 ton of sorted tungsten ore containing 1.2 percent WO_3 (Pattee, 1960, p. 19), and 106 tons of copper ore, produced in 1908, 1909, and 1949, which yielded 6,684 pounds of copper, 153 ounces of silver, and 1 ounce of gold.

HAGGERTY

The Haggerty property is in sec. 15 and 22, T. 5 S., R. 10 W. (Pattee, 1960, p. 24). The property consists of two unpatented claims located on a ridge on the south side of Birch Creek and between Sheep Creek and Bridge Gulch. At the time of Pattee's report (1960), the claims were held by Dewey Haggerty of Butte, Montana.

The deposit consists of scheelite and powellite in unconsolidated Tertiary gravel and in a tactite zone developed along the contact between quartz monzonite of the Mount Torrey batholith and Mission Canyon Limestone. The gravel consists of pebbles and boulders of limestone loosely cemented by tungsten-bearing carbonate sand. Two adits have been driven in the gravel. A chip sample taken along a 35-foot section in one adit assayed 0.012 percent WO_3 and 0.009 percent Mo (Pattee, 1960, p. 26). The tactite zone cropping out on the ridge above the gravel bar has been developed over a length of about 1,200 feet by two adits, three shallow shafts, and several surface cuts. Chip samples taken across the zone assayed 0.014 to 0.022 WO_3 (Pattee, 1960, p. 26).

The property has no record of production.

INDIAN QUEEN

The Indian Queen mine is in the SE¼ sec. 15, T. 5 S., R. 10 W. The mine workings are alongside the main road up Birch Creek at the old mining camp of Farlin, about 9 miles west of U. S. Highway 91. Several patented claims in this area are under diverse ownership, but the Indian Queen mine is on the Indian Queen claim, which is owned by Myrl Erwin and The Anaconda Company.

Little is known about the history of the property. The mine was opened in 1867 (Stevens, 1906, p. 581), and until the early 1900's was worked intermittently by lessors, who produced only a small amount of ore. In 1903, the Western Mining Company produced 8,000 tons of ore containing 553,220 pounds of copper, 16,000 ounces of silver, and 160 ounces of gold. In 1904, the Indian Queen Mining and Smelting Company produced 12,000 tons of ore, which yielded 525,639 pounds of copper, 12,577 ounces of silver, and 31 ounces of gold. In 1905, production decreased drastically, to 400 tons of ore, and it gradually declined still more in the following years. In 1923, the last year of production, the ore produced amounted to only 8 tons, which yielded 971 pounds of copper and 20 ounces of silver. Total recorded production from the property from 1902 to 1923 is 22,907 tons of ore, which contained 1,729,404 pounds of copper, 42,219 ounces of silver, and 299 ounces of gold.

The mine workings are in a garnet-epidote tactite zone developed in Mission Canyon Limestone east of the contact with the Mount Torrey batholith (Fig. 49). The contact runs roughly north-south, and the limestone on the east side dips eastward. The mine workings, now inaccessible, consist of three adits driven northward into the side of the hill, two small shafts on top of the hill, and numerous prospect pits and trenches. The underground workings were said to consist of shafts 150 and 200 feet deep and an 820-foot tunnel, and a total of 1,600 feet of underground openings (Stevens, 1906, p. 581). Winchell (1914, p. 63) reported that the ore occurred in irregular shoots and bunches in a fault between the monzonite and limestone or in the limestone near

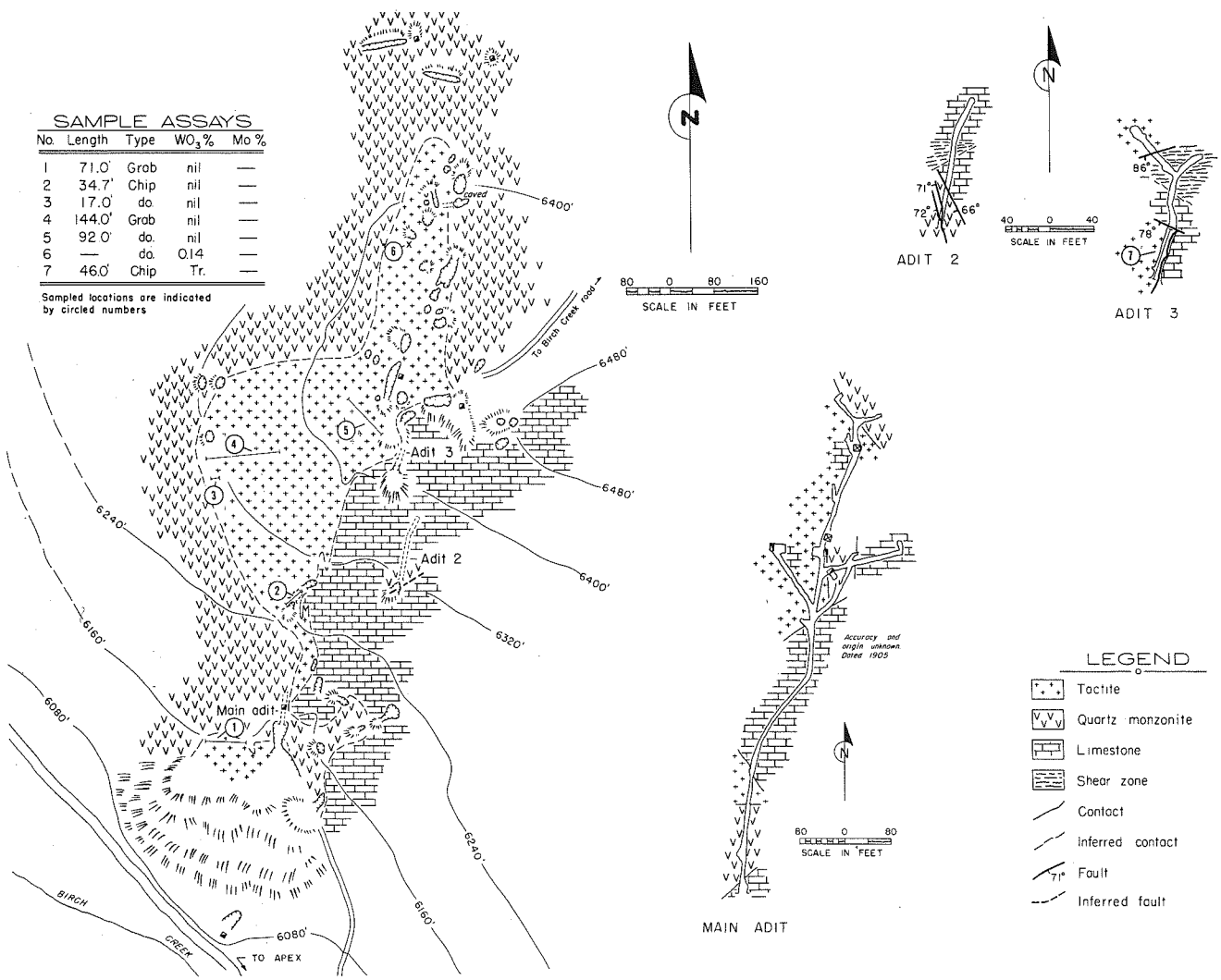


Figure 49.—Geologic sketch of Indian Queen mine. (Pattee, 1960).

the contact. Most of the ore mined was oxidized, containing native copper, malachite, azurite, chrysocolla, cuprite, and melaconite. Sulfide ore below the oxidized zone consisted of some rich massive chalcocite, chalcopyrite, and bornite. Very little copper ore was found scattered about on the mine dumps, and that was only copper-stained garnet rock.

The tactite zone was sampled by the U. S. Bureau of Mines (Pattee, 1960, p. 22) for its tungsten content. The only sample that contained enough tungstate to be reported was a grab sample taken from a small pit in tactite at the north end of the claim. It assayed 0.14 percent WO_3, and consisted of gray and banded rock containing scheelite, magnetite, and malachite.

JUMBO AND ORO FINO

The larger part of the Jumbo group of five patented claims is in sec. 16 and 21, T. 5 S., R. 10 W. The claims, called the Jumbo, Indian Squaw, Indian Chief, U. S. Treasurer, and Burch, are under different ownerships. The claims can be reached over an unimproved narrow mine road, which is shown on the topographic map of the area (Twin Adams Mountain sheet). The upper mine workings on the U. S. Treasurer claim were examined but the rest of the description is from Pattee (1960, p. 28).

Magnetite ore is believed to have been mined about the turn of the century for use as a flux in the Glendale smelter. Production is not known but the size of the stoped area in the upper workings indicates that as much as 500 tons may have been produced.

The magnetite zones are in metamorphosed Cambrian limestone near the contact with quartz monzonite of the Mount Torrey batholith. In the upper mine workings, an adit has been driven for about 70 feet on a magnetite zone in hard black siliceous limestone; the zone trends N. 42° W. and dips 32° NE. Magnetite occurs as bunches and disseminated in the black siliceous limestone; it shows some copper stain. A soft black powdery limestone overlies the hard black siliceous kind. A chip sample across 10 feet of one magnetite-rich area assayed 41.0 percent iron, 0.02 percent copper, 0.30 ounce silver, and 0.010 ounce gold per ton. Near the portal of the main adit, two more adits about 25 feet long have been driven easterly into similar hard black siliceous limestone; only a small amount of low-grade magnetite ore is exposed in these workings.

Tactite float and exposures extend over an area approximately 1,600 feet long and averaging 113 feet wide, which trends northwest (Pattee, 1960, p. 28). Scheelite and powellite are sparse in the tactite; samples taken by Pattee at various points along the tactite zone assayed a trace to 0.042 percent WO_3.

In the same area, a mine called the Oro Fino (DeMunck, 1956, p. 27) is said to have some iron deposits, low in gold content, near the contact of quartzite with quartz monzonite. This mine was not found.

MONAGHAN

The Monaghan prospect is in sec. 5, T. 5 S., R. 11 W., about 1 mile north of Pear Lake, which is accessible by means of the Birch Creek road.

The country rock is biotite granite containing orthoclase and smaller amounts of plagioclase, quartz, and biotite. Locally the granite is altered to a greisen of white mica and quartz containing a stockwork as much as 14 feet wide of quartz veins and blebs of white quartz. Molybdenite occurs in the quartz veins and blebs and in the greisen either in bunches or rosettes or as disseminated crystals. Pyrite and traces of chalcopyrite accompany the molybdenite. The largest and strongest quartz veins strike northeast. Channel samples collected from the deposit assayed between 0.08 and 0.12 percent MoS_2 and 0.02 percent copper (Kirkemo and others, 1965, p. 62).

ROCKY HUEEP

The Rocky Hueep tungsten prospect is in sec. 16, T. 5 S., R. 10 W., on public land administered by the U. S. Forest Service.

The deposit is in quartz monzonite of the Mount Torrey batholith about a quarter of a mile from the southern end of the exposure. Workings consist of three small pits, the dumps of which contain white to grayish-green scheelite-bearing quartz. An adit lower down the hill was driven in barren quartz monzonite to intersect the mineralized zone exposed in the pits, but it did not reach its target.

A grab sample of scheelite-bearing quartz on the dumps assayed 0.001 percent WO_3, and a sample of quartz float collected between the prospect pits assayed 0.121 percent WO_3 (Pattee, 1960, p. 30).

The property has no record of production.

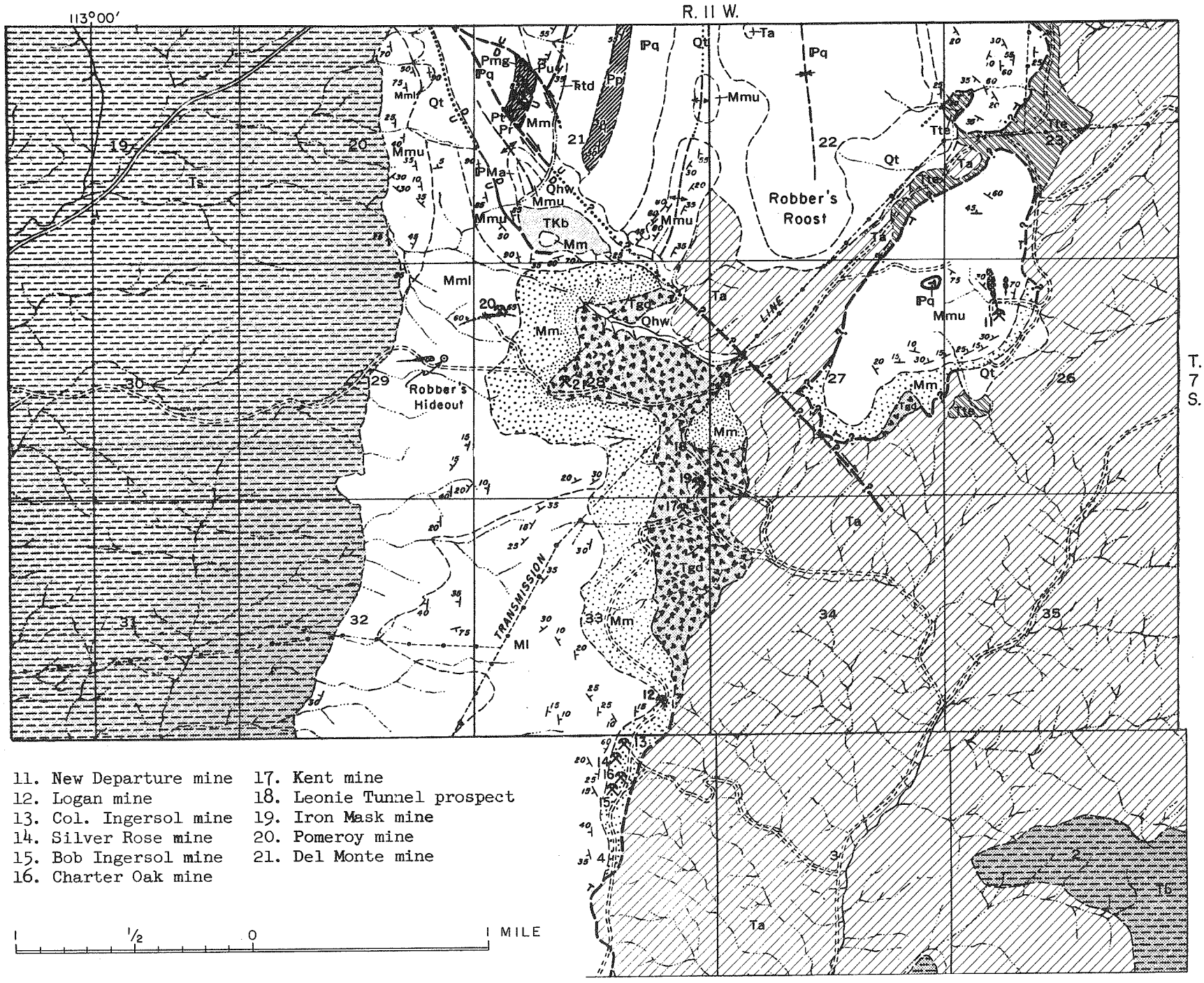


Figure 50.—Geologic map of the Blue Wing district. (Lowell, 1965). For explanation see page 77.

STANFIELD

The Stanfield prospect (Pattee, 1960, p. 24-28) is in sec. 22, T. 5 S., R. 10 W. In 1960 the property consisted of six unpatented claims held by Ray and Roy Stanfield of Dillon. The claims are located on the south end of the Mount Torrey batholith where quartz monzonite of the batholith is in contact with Mississippian limestone. The deposit consists of a garnet and epidote tactite zone intermittently exposed over a length of 1,850 feet and averaging 120 feet in width.

The oldest workings on the property are two adits that were driven about 1903 to explore for copper. In 1954 and 1955, the property was being developed for tungsten, and a 50- to 100-ton tungsten mill was installed. All material mined was used for mill tests. Workings excavated during this time consisted of several exploratory bulldozer cuts, dug at intervals across the outcrop, and a small open pit or large bulldozer cut dug near the west end of the outcrop. The pit is about 100 feet long and about 15 feet deep. Most of the tactite exposed in the pit is massive brown garnet containing disseminated specularite and quartz. Some quartz stringers about 2 inches wide show on the south wall of the pit.

Scheelite is present throughout the deposit as fine crystals as much as 12 mm long. Chip samples of tactite exposed in the surface cuts on the property assayed 0.02 to 0.21 percent WO_3. The 0.21 percent WO_3 sample was collected in the open pit.

The property has no record of production.

BLUE WING DISTRICT

The Blue Wing district is about 15 miles nearly due west of Dillon. The district is bordered on the north by the Badger Pass mining district and on the south by the Bannack mining district. It is in that belt of overthrust faulting that extends from Idaho through the mining districts of Bannack and Argenta and possibly as far northward as the Lewis and Clark lineament in west-central Montana. Most of the mines and prospects in the district can be reached by dirt roads passable by 2-wheel-drive vehicles.

As in the Bannack district, the principal sedimentary rock in the Blue Wing district is white-weathering cliff-forming massive limestone of the Madison Group. The general trend of the limestone beds is north, and dips to the west are moderate. A few small erosional remnants of Quadrant Quartzite overlie the limestone in the central part of the district, but farther north in the Badger Pass district, Quadrant Quartzite crops out in complexly folded generally north-trending and west-dipping hogbacks that are the striking topographical features of the area (Fig. 50).

In the sourthern part of the Blue Wing district, a low-angle fault puts limestone on the west in contact with andesite of Tertiary age. Farther north in the central part of the district, a granodiorite stock 2 miles long north-south and 1 mile across is between the limestone and the andesite. For the purpose of this report the stock will be identified as the Blue Wing granodiorite stock. The Madison Limestone in the contact-metamorphic aureole around the stock has been altered to either white fine-grained marble or coarse crystalline limestone. Complex silicate minerals, such as garnet and epidote, are sparse.

In the eastern part of the district, near the common corner of sec. 22, 23, 26, 27, T. 7 S., R. 11 W., a block of Madison Limestone about 1½ miles long and ½ mile wide is surrounded by igneous rocks, principally andesite. At the eastern edge of the block, particularly at the New Departure mine, the limestone beds rest on andesite; the contact is a low-angle fault. Along the southeast margin of the block the limestone has been recrystallized to fine-grained white marble at the contact with andesite.

Whereas the lode deposits of the Bannack district have been mined chiefly for gold, the lode deposits of the Blue Wing district are valued principally for their silver content. These deposits are irregular replacement bodies and fissure veins localized in recrystallized limestone at or near the contact with blue-gray limestone. In the district no deposits have been found along the contact with granodiorite. A few narrow veins localized entirely within granodiorite have been mined, but they cannot be regarded as important sources of ore.

Lode mine production from the district for the period 1902-65 is given in Table 12. The largest single producer in the district is the New Departure mine, which is being operated by Spokane National Mines, Inc.

ARTIC

The Artic claim is in sec. 20 and 21, T. 7 S., R. 11 W., about ¾ mile north of the old Bannack-Dillon stage road. The one patented mining claim is in the name of the George W. Farlin Trust.

Table 12. — Production of gold, silver, copper, lead, and zinc from lode mines, Blue Wing district, 1902-65, in terms of recoverable metals.

Year	Ore (oz.)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)	Total value
1902	89	1	10,645	-----	1,360	-----	$ 5,388
1903-04	no production						
1905	40	-----	7,200	-----	-----	-----	4,349
1906	17	-----	4,270	-----	2,890	-----	3,026
1907	607	5	36,898	166	29,939	-----	26,071
1908	63	1	6,368	1,055	9,360	-----	3,939
1909	105	9	18,016	6,717	21,413	-----	11,342
1910	52	2	12,485	3,748	12,155	-----	7,793
1911	9	1/	1,099	130	778	-----	638
1912	49	1	2,528	269	-----	-----	1,621
1913	56	1	1,995	122	-----	-----	1,250
1914	6	1/	1,332	146	-----	-----	761
1915	4	1/	533	57	-----	-----	283
1916	60	6	1,637	604	11,368	-----	2,137
1917	248	110	13,935	2,187	6,391	-----	14,911
1918	41	1	4,494	1,208	4,742	-----	5,159
1919	14	1	1,250	292	-----	-----	1,470
1920	13	-----	127	-----	1,457	-----	255
1921	25	-----	515	-----	-----	-----	521
1922	58	18	1,337	904	-----	-----	1,835
1923	17	1	2,632	156	-----	-----	2,206
1924	81	3	8,759	496	-----	-----	5,993
1925	62	3	8,880	1,042	-----	-----	6,366
1926	24	1	4,869	367	-----	-----	3,104
1927	13	1/	2,396	198	-----	-----	1,393
1928	42	1	5,013	281	4,910	3,116	3,465
1929	5	-----	1,282	115	-----	-----	703
1930	no production						
1931	36	1	5,824	546	1,883	-----	1,844
1932	107	4	4,826	556	-----	-----	1,477
1933	76	2	1,057	188	-----	-----	424
1934	758	21	17,936	2,725	9,297	-----	12,899
1935	578	14	13,230	723	2,275	2,614	10,284
1936	705	65	13,532	989	-----	-----	12,833
1937	336	16	6,870	1,000	-----	-----	5,995
1938	17	-----	263	-----	-----	-----	170
1939	1,974	65	30,631	96	1,042	-----	23,126
1940	1,187	48	14,168	584	1,900	-----	11,916
1941	273	16	5,895	2,000	9,300	2,000	5,668
1942	20	-----	540	-----	-----	-----	384
1943-48	no production						
1949	25	-----	748	100	3,500	2,300	1,535
1950	19	1	990	-----	-----	-----	931
1951-52	no production						
1953	60	2	3,765	603	8,735	1,564	4,975
1954	87	2	3,085	1,000	24,000	-----	6,445
1955	50	1	1,895	600	13,000	-----	3,911
1956	126	3	7,334	800	14,900	3,400	9,888
1957-61	no production						
1962	77	4	4,446	300	2,100	4,200	5,732
1963-64	no production						
1965	2,600	2	10,398	900	6,100	6,200	15,691
Undistributed	21,279	47	162,023	13,700	83,200	100,400	236,928
Total	32,190	479	469,951	47,670	287,995	125,794	489,035

1/ Less than ½ ounce.

Little is known about the history of the property other than an item in the May 23, 1885, issue of the Dillon Tribune, which reported that the mine was yielding high-grade ore, and one in the May 8, 1896, issue of the same newspaper, which reported the Artic shaft to be 160 feet deep. A drift 60 feet long was driven to the east off the shaft. One carload of ore containing 70 ounces silver per ton was said to be ready for shipment.

The mine working is the shaft mentioned previously, which is open but untimbered. No attempt was made to enter the shaft. The country rock is white recrystallized limestone. No ore minerals were noted on the dump. The property has no record of production.

CHARTER OAK

The Charter Oak mine is in sec. 4, T. 8 S., R. 11 W., and can be reached via a dirt road from Bannack. The mine is at an altitude of about 7,100 feet, and is on an unpatented claim held by L. B. Wilkinson of Burley, Idaho.

The country rock is gray-blue Madison Limestone, which has been thrust over Tertiary andesite (Lowell, 1965). The ore occurs as small and narrow replacement bodies localized near or along a north-trending fault, which dips 61° W. above the adit level but flattens to a dip of about 24° W. below the adit level (Fig. 51). The fault probably connects with the main overthrust fault under the limestone sheet. The ore consists of red-brown iron oxides stained by black manganese oxides and generally occurs in a calcite gangue. A chip sample across 2½ feet of oxidized material left at the end of a small stope assayed 2.0 percent lead, 8.0 percent zinc, 0.32 percent copper, 11.4 ounces of silver, and 0.020 ounce of gold per ton.

The main workings at the mine consist of an adit level aggregating about 500 feet of underground workings. Only a small amount of ore has been produced from these workings, as judged from the amount of stoping. Total production recorded from the property, between 1938 and 1964, was 506 tons of ore, which yielded 76,923 pounds of lead, 15,700 pounds of zinc, 3,409 pounds of copper, 14,845 ounces of silver, and 20 ounces of gold.

DEL MONTE GROUP

The Del Monte group of patented claims is in sec. 28, T. 7 S., R. 11 W., alongside the old Bannack-Dillon stage road (the location of the mine is erroneously shown on the Bannack topographic map).

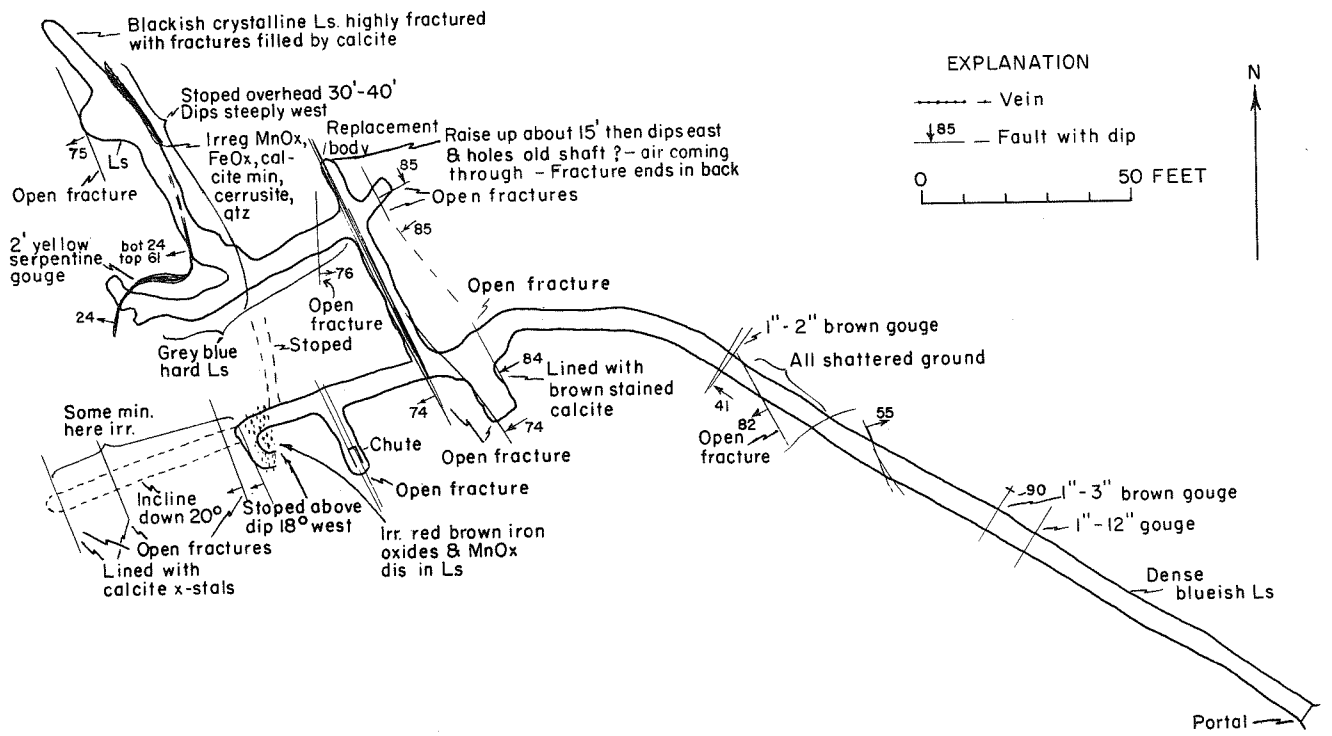


Figure 51.—Geologic sketch of underground workings at the Charter Oak mine.

The six claims are the Del Monte, Bonaparte, Maltby S., Isabella, Francis H., and Barehill, all owned by Sarah M. Anderson but formerly owned by the West Butte Mining Company (Shenon, 1931, p. 35).

The principal workings are on the Del Monte claim; a shaft is reported (Shenon, 1931, p. 35) to have reached a depth of 253 feet. The shaft was sunk in granodiorite near its contact with Madison Limestone. At present the timber in the shaft is gone, and the shaft is filled with water to about 50 feet below the collar. The only records of production from the property are from 1935 to 1941, when shipments totaled 394 tons of ore, which contained 206 pounds of lead, 228 pounds of copper, 7,397 ounces of silver, and 20 ounces of gold.

The following descriptions of the property are from Shenon (1931, p. 35):

"Very little was learned of the history and production. Some early-day shipments were made (Raymond, R. W., Mineral resources west of the Rocky Mountains for 1872, 1873, and 1874) but records of the returns are not available. Lessees who took out considerable ore in the late nineties are said to have netted a profit. One of the cars shipped averaged over 500 ounces in silver per ton. Since these lessees sank a shaft to a depth of over 250 feet, and handled considerable water, besides doing a good deal of drifting, it is estimated that they must have taken out at least $30,000 and probably not over $50,000. The West Butte Mining Company purchased the property from the Graves Estate of Bannack in 1922 and, after cleaning out and retimbering the Del Monte shaft, ran a number of prospect drifts, chiefly on the upper levels. Prospecting was abandoned after a year's work, and the property has since been idle.

"The underground workings (Wichman, F. M., letter of May 17, 1925), with the exception of a few tunnels and open cuts, are all driven from the Del Monte shaft, which reached a depth of 253 feet. At present the shaft is full of water below a depth of 50 feet.

"The ores in the Del Monte mine occur chiefly in well-defined veins in granodiorite which strike about N. 80° E., and dip at steep angles to the south. Veins in the limestone usually have a low silver content but some contain small deposits of high-grade antimony ore. According to F. M. Wichman, faulting has been extensive in the neighborhood of the Del Monte mine. The faults trend in all directions but the northerly and northeasterly ones are the most prominent.

"Two veins in the granodiorite have been mined, the Del Monte and the Bonaparte. The Bonaparte is the larger but is lower grade than the Del Monte vein, and is said to assay from 20 to 40 ounces in silver per ton. It is about 6 feet wide on the surface. The Del Monte vein ranges in width from 4 to 14 inches on the bottom level and averages 60 ounces of silver per ton. Some assays run as high as 450 ounces.

"Near the surface these veins are much oxidized and are filled with brownish to black porous material consisting largely of quartz with oxides of manganese and iron. Casts of the original minerals are plainly visible. The sulphides appear about 50 feet beneath the surface and in the lower levels no evidence of oxidation is visible. Sphalerite, galena, chalcopyrite, pyrite, polybasite, tetrahedrite, and pyrargyrite occur in a gangue of calcite, rhodochrosite and quartz."

On the Francis H. claim, a shaft estimated to be about 50 feet deep was sunk in recrystallized limestone. Material on the dump contains blebs of stibnite and tremolite needles in a siliceous gangue. Shenon (1931, p. 36) reported that the antimony on the claim occurs along vertical fissures, which strike N. 60° E.; it is associated with about 2 feet of reddish-brown gouge. The property has no record of production.

The workings on the Barehill claim consist of four shallow prospect pits. In one that is approximately 15 feet deep is exposed a 3-foot mineralized zone consisting of narrow seams and impregnations of black manganese oxides in recrystallized limestone. The overall trend of the zone seems to be N. 58° E., and the dip is 88° NW. A chip sample taken across the zone assayed 1.30 percent lead, 0.60 percent zinc, 0.65 percent manganese, 29.20 ounces of silver, and 0.030 ounce of gold. The property has no record of production.

HURON (COTTONTAIL)

The Huron mine was described by Shenon (1931, p. 37), who placed its location in sec. 28, T. 7 S., R. 11 W., just north of the Kent mine. The property comprised seven unpatented claims. At mine workings in this vicinity, a posted location notice signed by James F. Smith gives the name for the property as the Cottontail. The Cottontail and the Huron mines are believed to be the same.

According to Shenon (1931, p. 37) the Huron claim was located by a man named Batchelor, who shipped ore from the property as far as Swansea,

Wales, for treatment. Later the property was acquired by John Costello, who sold a half interest to Frank Sinnott in 1910. Costello's remaining half interest was acquired by Sinnott after Costello's death.

Under the name of Huron, ore was shipped from the property in 1902 by V. W. Grace, and in 1918-19, in 1925, and in 1936-37 by Sinnott. Under the name of Cottontail, ore was shipped from the property in 1917 by Sinnott and Tweedy, and in 1953 by C. M. Cass. Total recorded production from the property for these years is 129 tons of ore, which yielded 1,730 pounds of lead, 200 pounds of zinc, 1,869 pounds of copper, 7,334 ounces of silver, and 7 ounces of gold. Since 1966, the property has been under lease by Spokane National Mines, but seemingly no ore has been produced other than a few small test shipments to the company's mill at Bannack.

The deposit consists of two narrow fissure veins that cut white recrystallized limestone and blue-gray limestone of the Madison Group (Fig. 52). One vein strikes N. 80° E., the other N. 65° E., and both dip steeply south. Each vein has been developed over a length of about 500 feet by shallow shafts, trenches, and short adits, and neither seems to have been much more than 12 inches wide at most. One vein exposed at the face of a short adit is 2 to 3 inches wide. Vein material on the dumps contains iron- and copper-stained quartz, jasper, calcite, minor galena, and some brown-black manganese oxides. Shenon (1931, p. 37) reported that the ore contained cerargyrite and patches of residual sulfides in a gangue of quartz and calcite.

JEANETTE

The Jeanette is an unpatented claim in sec. 33, T. 7 S., R. 11 W., along the road near the Randall mine. The former name of the claim is not known, but it was relocated as the Jeanette by Charles R. Talman and Alvin Herr in 1964.

In a shallow prospect pit alongside the road, a dark-brown jasper vein about 1 foot wide is exposed. The vein strikes N. 67° W., and dips steeply. Country rock is buff and white recrystallized limestone. A chip sample of the vein assayed 7.35 percent lead, 0.40 percent zinc, 0.07 percent copper, 5.2 ounces of silver, and 0.001 ounce of gold per ton. A few hundred feet down the slope of the hill to the south-

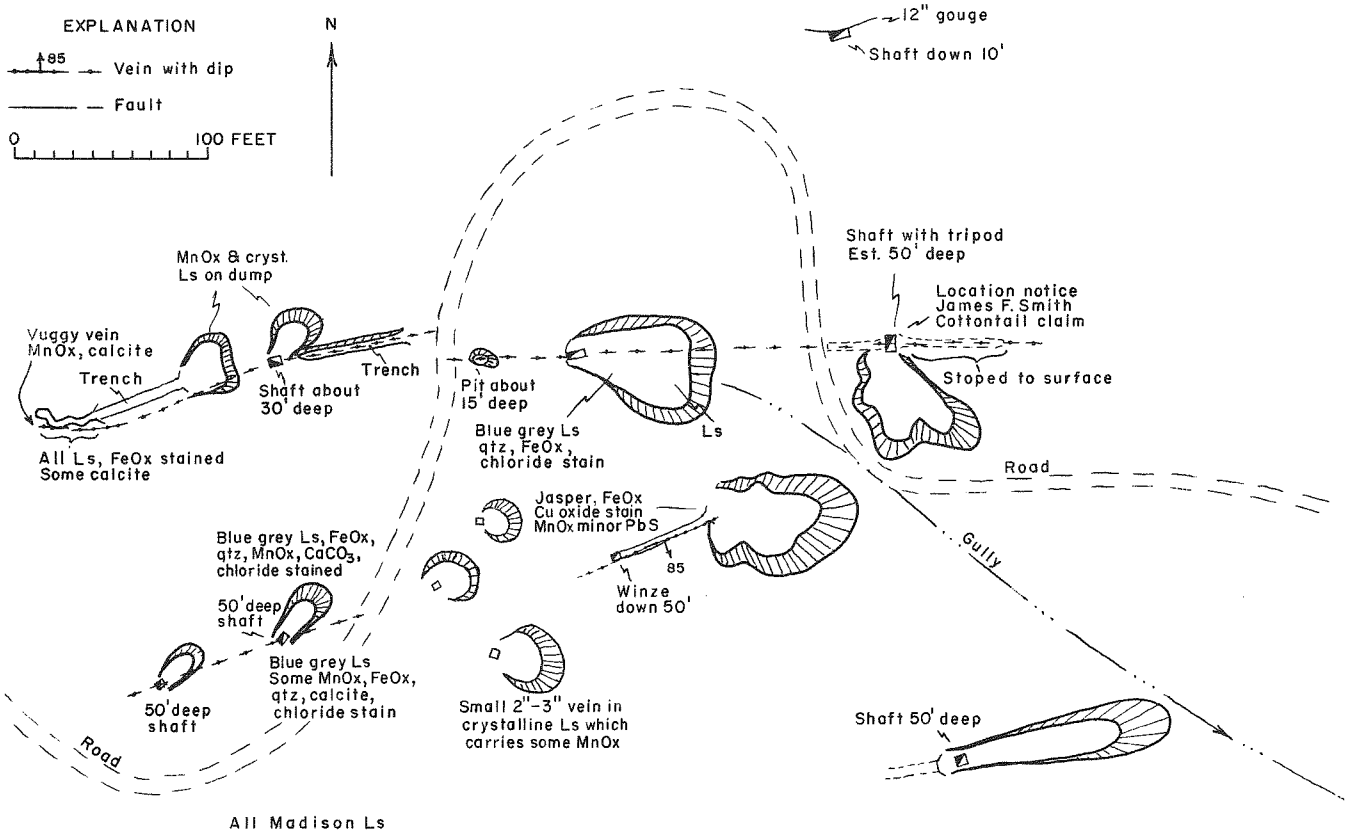


Figure 52.—Geologic sketch of workings on Huron (Cottontail) mine, Blue Wing district.

east, the workings consist of an adit, now caved at the portal, and several prospect pits. The adit seems to have been several hundred feet long and was driven westward. Northwest, the workings consist of several prospect pits, now sloughed in. Most of the material on the various dumps is manganiferous recrystallized limestone, but some pieces of quartz were seen. The property is not known to have produced.

KENT

The Kent mine is in sec. 28 and 33, T. 7 S., R. 11 W., about ½ mile south of the old Bannack-Dillon stage road. The property comprises four patented claims, the Jay Gould, Edith, E. M. Wilson, and Nettie, all owned by Phillip and Fred Shenon. The following historical description of the property is mainly condensed from Shenon (1931, p. 32).

The Kent veins were found in 1864 and were called the Blue Wing, Kent, and Bannack Chief. The veins were worked during the 1860's and 70's, and the ore was shipped by wagon train to Corinne, Utah, then by rail to San Francisco, and finally by freight ships to smelters in Swansea, Wales. In the 1880's the mine was worked by Col. Phillip Shenon, who ran an 850-foot adit from the Edith claim into the hill between the Blue Wing and Kent. The adit disclosed a body of lead-zinc sulfide ore near the contact of the intrusive rock with the limestone; the ore averaged 25 ounces of silver per ton. From 1907 through 1909, the property was operated by the Butte and Dillon Development Company, which produced 179 tons of ore worth about $15,000. In 1910, S. P. Burr produced 40 tons of ore worth nearly $10,000, and in 1917, another 20 tons of ore worth about $500. Small quantities were shipped in 1918, 1919, 1928, and the last in 1935. Total recorded production from the property, 1907 to 1935, is 276 tons of ore, which contained 72,261 pounds of lead, 3,116 pounds of zinc, 9,907 pounds of copper, 38,980 ounces of silver, and 9 ounces of gold. Figure 53 is a map of Blue Wing workings of the Kent mine.

The following geological description of the property is taken in its entirety from Shenon (1931, p. 33):

"The ores of the Kent mine occur as shoots along fissures in white crystalline limestone and as veins in granodiorite but the deposits in limestone alone have been worked. The fissures in limestone strike N. 80° E., and dip 70° N., and all the deposits in limestone occur a short distance from the granodiorite contact. The Kent and Whopper ore bodies were tabular deposits along well-defined fissures. The

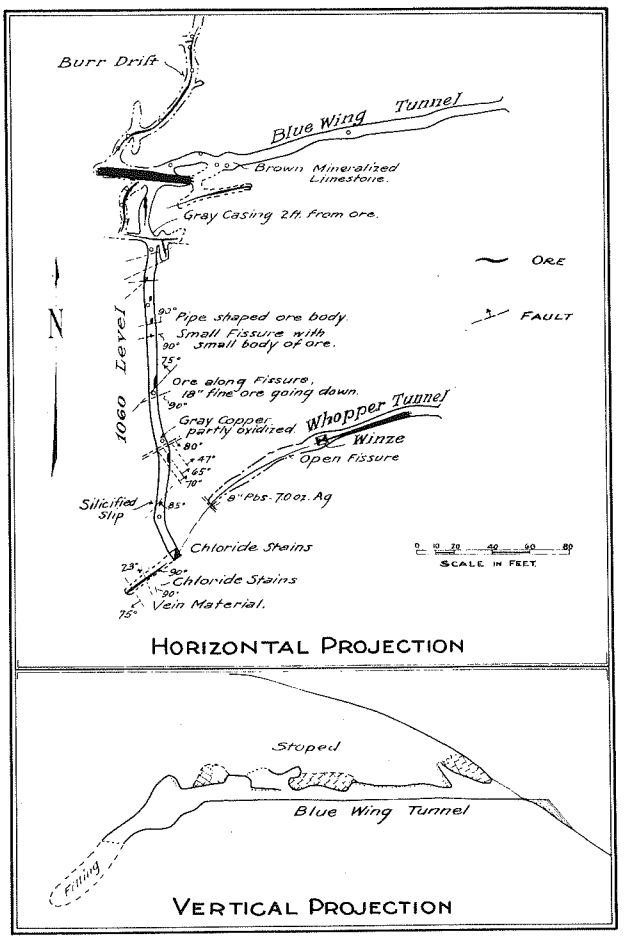


Figure 53.—Map of Blue Wing workings of Kent mine. (Shenon, 1931).

Kent ore body which raked to the west at an angle of about 20 degrees was the largest in the mine. The Whopper ore body was an irregular deposit along the Whopper fissure, and its downward extension has not yet been found. The Hayes and Ewing ore shoot was a pipelike deposit occurring at the intersection of the Blue Wing fissure with the contact of a white marble and a dense bluish-gray limestone. Above the tunnel a small seam of ore extended out along the fissure to the portal. The Burr ore shoot was a peculiar winding pipe extending away from the Hayes and Ewing ore body. The Kent and the Hayes and Ewing stopes average from 8 to 10 feet in width, but the Whopper was considerably narrower. The walls of the ore bodies are usually well defined although the ore is sometimes "frozen" to the walls. The limestone for several feet adjacent to the larger ore shoots is frequently altered to a chocolate-brown color and sometimes a gray claylike casing is found next to the ore.

"The veins in granodiorite have well-defined walls which are frequently slickensided. The ore

in the Shenon tunnel, known as the 'blind lead,' is exposed by crosscuts for a distance of 170 feet. It strikes east and dips about 30° to the south. The ore band is associated with 2 or 3 feet of gouge impregnated with pyrite on the footwall side. The ore itself is cut by slickensided fractures, the result of postmineral movement. The relationship between the veins in granodiorite and those in the limestone could not be ascertained because of the condition of the old workings.

"The chief gangue minerals of the ores in limestone are quartz and calcite and the ore minerals include galena, tetrahedrite, jamesonite, sphalerite, covellite, pyrite, jalpaite (?), cerargyrite, bindheimite, linarite, caledonite, cerussite, anglesite, malachite, azurite, chrysocolla, smithsonite, calamine, limonite, and manganese oxides. Much of the ore, particularly in the Kent vein, is soft porous material predominantly brown in color, but containing green and yellow 'splotches' of lead, copper, and silver minerals. The ore from the Blue Wing and Whopper veins is predominantly greenish and yellowish in color, usually well indurated, and sometimes waxy in appearance. Because the harder ore is sometimes 'frozen' to the walls, skillful mining is required to prevent heavy losses.

"The sulphide ore in the granodiorite is in a gangue of quartz and calcite. Galena, sphalerite, and pyrite are the commonest ore minerals and chalcopyrite was noted as inclusions in sphalerite. Pyrargyrite is visible locally and probably accounts for the high silver content shown in some of the assays. Both gangue and ore minerals have been brecciated and recemented but the galena is sometimes deformed without fracturing. The sulphide ore shows no oxidation, and secondary enrichment only locally. . .

. . . . . .

"The veins in the limestone which were readily seen at the surface have been mined at a handsome profit, nevertheless, little search has been made for new deposits. The most favorable place to prospect for high-grade ore is along the contact of the white marble and the bluish-gray limestone."

INGERSOLL

The Ingersoll mine is in sec. 4, T. 8 S., R. 11 W., about a third of a mile north of the Charter Oak mine and at an altitude of about 7,000 feet. The property comprises three patented claims, the Bob Ingersoll, the Colonel Ingersoll, and the Contact, all owned by Carl Kennedy of Seattle. A fourth patented claim, the Silver Rose, associated with the group is owned by Mrs. M. E. Mathews.

The country rock at the mine is a sheet of Madison Limestone that has been thrust over Tertiary andesite (Lowell, 1965). The mine is at the same or nearly the same stratigraphic horizon as the Charter Oak mine. The mine workings, now inaccessible, consist of several adits, caved at their portals, driven westward into the side of the hill, and farther up the slope two vertical shafts that are open but untimbered. The lower adit dump shows nonmineralized gray-blue limestone and some andesite and white recrystallized limestone, both of which contain some pyrite. Ore material from the lower dump is brown iron-stained quartz, pyrite, sphalerite, and some chalcopyrite. A selected sample of this material assayed 7.75 percent lead, 5.60 percent zinc, 0.30 percent copper, 8.7 ounces of silver, and 0.02 ounce of gold per ton. According to Shenon (1931, p. 38), the underground workings include a winze, 200 feet deep, that crossed the fault contact between the limestone and granodiorite and was extended into the granodiorite for some distance.

Total recorded production from the mine, which was operated at various short periods from 1918 to 1941, is 511 tons of ore, which contained 20,300 pounds of lead, 2,000 pounds of zinc, 3,185 pounds of copper, 10,922 ounces of silver, and 13 ounces of gold. The mine has not produced since 1941.

IRON MASK

The Iron Mask silver mine is in the SE¼ sec. 28, T. 7 S., R. 11 W., very near the corner common to sec. 27, 28, 33, and 34 (the location of the mine is erroneously shown on the Bannack topographic map). The property consists of one patented claim recorded in the name of Constance Crawford.

The country rock in the vicinity of the mine is granodiorite. The shaft is completely caved at the collar. Dump material is granodiorite; vein material on the dumps is quartz, which contains much pyrite and some manganese oxide.

The shaft is reported to be 200 feet deep, and the ore was in well-defined east-striking veins in granodiorite. Near the surface the vein material was quartz, calcite, and oxides of manganese and iron (Shenon, 1931, p. 38).

Production was recorded in 1934 and 1935, when ore was shipped by the Beaverhead Mining Company, and in 1942 when ore was shipped by the Blackhawk Mining Company, both of Dillon. Actual production figures are confidential.

NEW DEPARTURE

The New Departure mine is in sec. 26, T. 7 S., R. 11 W., about 17 miles due west of Dillon. The mine is readily accessible by means of a county road that follows along the old Bannack-Dillon stage road.

The New Departure group of patented lode claims comprises the Clift, Director, Guardian, Protector, Queen Sabbe, Shield, and Signal. In addition, the Chess group of unpatented claims has been staked adjacent to the patented claims. Since 1958 the properties have been operated by Spokane National Mines, Inc., under an option and purchase agreement.

The first mining location (Shenon, 1931, p. 36) on the New Departure ore bodies was made in 1871 by George Washington Stapleton, who mined ore through adits situated on the Queen Sabbe claim. In 1880, Stapleton's interest was purchased by Lawrence A. Brown and Joshua E. Clayton for $2,500. Seven years later, Brown purchased Clayton's interest for $3,500 and operated the mine continuously until his death in 1905. The property subsequently was purchased from Brown's heirs for $50,000 by the New Departure Mining Company. For two years the company shipped small amounts of ore, but the mine was operated by lessees until 1918, when it was sold to O. M. Best of Dillon. The mine was worked continuously from 1923 to 1928 by John Coppin of Dillon, who then sold it to J. L. Templeman of Butte. Excepting 1930, 1937, and 1938, some ore was shipped each year during the period 1923-41. In 1948, the properties were acquired by C. Gosta Miller of Dillon. In 1952, the Blue Dot Mining Company of Dillon began what is now called the Blue Dot adit to explore the area at greater depth. The adit was started 800 feet east of the previously mined area and had attained a length of about 700 feet when the project was stopped. In 1958 the properties were optioned by Spokane National Mines, Inc., and the Blue Dot adit was extended farther west under the known mineralized area. This resulted in the discovery of the 208 ore body, from which the company by 1965 extracted about 23,645 tons of ore, which yielded 69,300 pounds of lead, 13,600 pounds of copper, 90,500 pounds of zinc, 162,642 ounces of silver, and 34 ounces of gold.

Total recorded production from the property for the period 1902 to 1965 amounts to 27,137 tons of ore, from which 96,965 pounds of lead, 24,427 pounds of copper, 102,164 pounds of zinc, 340,447 ounces of silver, and 205 ounces of gold were recovered. Estimates of the total value of production from the mine range from $1,500,000 to $3,000,000.

The country rock at the mine is Madison Limestone occurring as a structural block that is about 1½ miles long in a northeast direction and more than ½ mile across. The block is nearly surrounded by andesite of Tertiary age. The limestone and andesite are in fault contact, a relationship that can be observed in the Blue Dot adit and which is also shown on Lowell's map (1965) of the area. The limestone along the south, southeast, and east margins of the block has been metamorphosed to white fine-grained marble, which contains some contact-metamorphic silicate minerals.

The New Departure ore bodies occur near the contact of white marble with andesite and are localized along fractures in black massive crystalline limestone which contains small white calcite veinlets. Most of the ore was produced from the Signal (208) and Stapleton ore zones (Pl. 3). These zones are subparallel, trend northwest, dip southwest, and are about 400 feet apart. Workings on the Stapleton ore zone are the earliest, and the greater part is inaccessible. Mine maps show that the zone was developed over a horizontal length of approximately 400 feet and a vertical range estimated at 200 feet. These workings have been penetrated by a long crosscut off the Homeside tunnel. A large ore body at the head of the incline at the end of Homeside crosscut was localized at the intersection of northeast- and northwest-trending fractures (Shenon, 1931, p. 36).

The Signal (208) ore zone has been mined over a horizontal length of about 800 feet and a vertical distance of at least 200 feet by workings off the Stinker incline, the Silver Springs level, and the Blue Dot level. The position of stopes along fractures in this zone indicates that the overall trend of ore in the fractures may be at low angles southward toward the limestone-andesite contact. Ore mined from the Blue Dot level was primary sulfides seemingly localized at the intersection of northwest-trending flat fractures with steeply dipping fractures. The ore seemed to be widest along rolls in the fractures, and it pinched out where the strike changed. In the Badger workings the ore terminated after flattening against the lower side of the flat slips (Shenon, 1931, p. 36). Coarse slickensides and striations are common on the fractures. The direction of most of the movement along them is vertical.

Most of the ore produced from the mine prior to the start of the Blue Dot adit was oxidized and

contained appreciable silver. Oxidized minerals (Shenon, 1931, p. 36) are cerargyrite, cerussite, bindheimite, smithsonite, anglesite, malachite, azurite, gypsum, and oxides of manganese and iron. Sulfide minerals include sphalerite, galena, argentiferous tetrahedrite, and probably some argentite. Sulfide minerals in the 208 ore body are finely divided, hence difficult to discern, and they occur in the black crystalline limestone as well as in streaks and patches along the fracture zones. In the upper levels some of the gangue was quartz. In the 208 ore body some siderite gangue was observed.

POMEROY

The Pomeroy mine is in sec. 28 and 29, T. 7 S., R. 11 W., a short distance north of the old Bannack-Dillon stage road. The mine has also been called the Brick Pomeroy, Silver Buckle, and Silver Belt. The property includes three patented claims, the Silver Buckle, Silver Belt, and Quebec.

The deposit was found in the 1860's and worked in the 1870's and 1880's. In 1908 and 1909 the property was worked by Amede Bessett, who produced 38 tons of ore, which yielded 3,904 pounds of lead, 491 pounds of copper, 3,476 ounces of silver, and 2 ounces of gold. This is the only production recorded for the property, which seems to have been idle from 1909 until 1966, when it was leased by Spokane National Mines, Inc. A small amount of exploration work was done by that company in 1966 and 1967, and a few small test lots of ore were hauled to the company's mill at Bannack. In 1968 the property was idle.

The deposit is in a fissure vein, which cuts Madison Limestone near the contact with granodiorite. The recrystallized limestone is white to bluish and strikes N. 15° W. and dips 18° SW. The vein strikes N. 75° E. to nearly due east and dips about 75° NW. It has been developed and mined by three or four small shafts estimated to be about 50 feet deep, trenches along the vein, and open stopes that reach surface. These workings extend along the vein for about 800 feet. The position of the workings suggest that the vein was offset by two north-trending faults, the west blocks being displaced south relative to the east blocks. Maximum horizontal displacement is about 50 feet.

The ore occurs in quartz lenses that are separated by red gouge as much as 2 feet wide. Value of the gouge is slight. A chip sample across 2 feet of gouge assayed 0.20 percent lead, 0.40 percent zinc, 1.25 ounces silver, and 0.003 ounce gold. A qualitative test for mercury showed none. The chief ore mineral was silver-bearing cerussite. Small amounts of pyrite, manganese oxides, and possibly chlorides of silver in siliceous gangue are present in specimens found in the mine dumps.

PROSPECT IN SW¼ SEC. 15, T. 7 S., R. 11 W.

The mine workings at this prospect consist of two adits, both driven in Quadrant Quartzite. The property is not patented and seems to have been abandoned. Nothing is known about its history or production, if any.

The lower adit trends N. 63° E., and from the size of the dump it is estimated to be at least 500 feet long. It is caved at the portal. Dump material consists of iron-stained quartzite. No ore minerals were observed.

The upper adit trends N. 89° E., and it too seems to be about 500 feet long. Dump material consists of buff and purplish sandstone. No ore minerals were observed.

RANDALL

The Randall patented claim is in sec. 33, T. 7 S., R. 11 W., south of the Kent group, and is owned by Muriel P. Tyro.

The deposit was found in the 1860's and produced silver-bearing ore containing considerable galena. The ore occurred in replacement deposits along east-striking fissures, in white crystalline limestone. The ore shoots terminate against massive bluish-gray limestone (Shenon, 1931, p. 37).

The only production recorded from the Randall was in 1939; a shipment of 26 tons of ore yielded 322 ounces of silver and 1 ounce of gold.

SILVER STAR (LONE STAR?)

The Silver Star property was described by Shenon (1931, p. 38). Its location in the SW¼ sec. 33, T. 7 S., R. 11 W., seems to be in error; its proper location is believed to be in the SE¼ sec. 33, T. 7 S., R. 11 W., which would make the property identical to the Lone Star mine shown on Shenon's map (1931). A location notice posted at the mine site in November 1964 is signed by H. L. Patterson and identifies the claim as the Skeets No. 1.

The country rock at the mine is white recrystallized Madison Limestone, which has been thrust over andesite of Tertiary age (Lowell, 1965). The workings are at an altitude of 7,000 feet and at approximately the same stratigraphic level as the

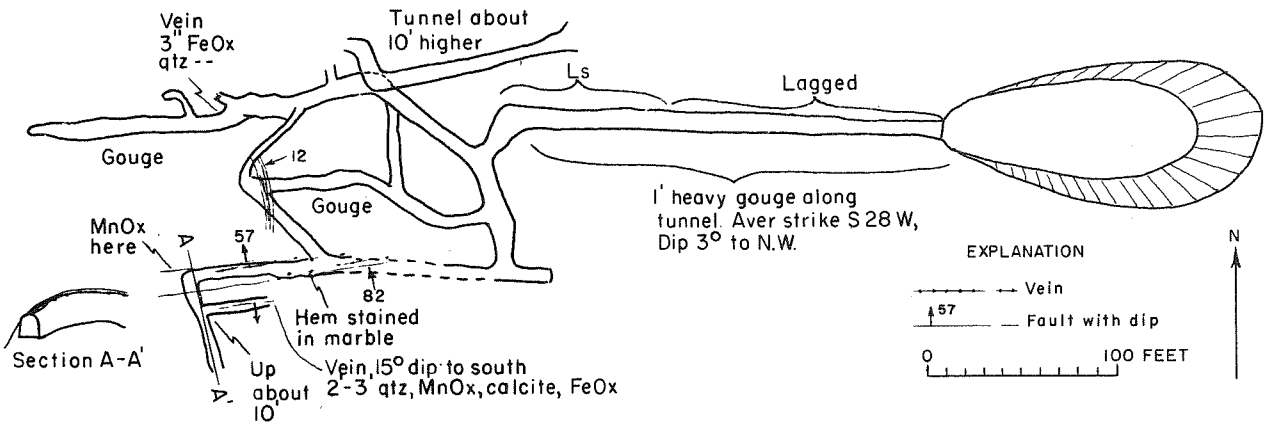


Figure 54.—Geologic sketch of underground workings of the Silver Star (Lone Star?, Skeets No. 1) mine.

workings of the Ingersoll and Charter Oak mines farther south.

The principal opening is an adit driven westward into the side of the hill (Fig. 54) along a fault zone, which is about 1 foot wide, strikes N. 28° E. and dips 3° NW. Ore minerals are associated with the fault at a distance of about 90 feet from the portal. Several side drifts have been turned off along the fault in search of ore. In a south-side drift, a narrow iron-stained mineralized zone containing quartz, manganese oxides, and calcite is exposed along a small arch in the fault zone. A chip sample from the zone assayed 0.02 percent lead, no zinc, 0.55 ounce of silver, and 0.005 ounce of gold per ton. The zone seems to be localized at the intersection of the flat-lying fault with small tear faults (in the overridden block) that strike about east-west and dip steeply north. A north-side drift penetrates a chimneylike quartz and iron-oxide zone, which seems to be about 3 feet across and is localized beneath the flat-dipping fault. A chip sample from the zone assayed 0.80 percent lead, 1.00 percent zinc, 0.15 percent copper, 4.85 ounces of silver, and 0.005 ounce of gold per ton. The property has no record of production under the names of Silver Star, Lone Star, or Skeets No. 1.

WHEAL ROSE

The Wheal Rose patented claim is near the center of sec. 27, T. 7 S., R. 11 W., and is owned by Frank and Joseph C. Ryburn and Carl Kennedy.

The mine workings on the Wheal Rose were not identified with certainty; the working believed to be on the Wheal Rose claim is a short adit that trends S. 57° E. The adit is open for 50 feet but is caved beyond this point. The adit has been driven in white and black limestone of the Madison Group. No mineralization was noted along the adit, but dump material contains pieces of brown-black iron and manganese oxides and some white quartz. A selected sample of this material assayed 0.55 percent lead, 1.30 percent zinc, 0.04 percent copper, 2.35 ounces of silver, and 0.010 ounce of gold per ton. The property has no record of production. According to Shenon (1931, p. 38) the property produced from fissures in Madison Limestone that strikes east; the ore minerals include cerargyrite and cerussite in a gangue of quartz and calcite.

ELKHORN DISTRICT

The Elkhorn district is centrally located within the Pioneer Mountains mining region, and lies athwart the divide between Wise River and Grasshopper Creek. A county road traverses the district from north to south, and mines and prospects in the district can usually be reached by mine roads or Forest Service roads leading off from the main county road.

Comet Mountain, the principal landmark in the area, rises to an altitude of about 10,200 feet. The west face slopes at an angle of about 45°, but the east face drops off vertically almost 1,000 feet into a U-shaped valley containing the headwaters of Wise River. Topography thus changes radically from east to west. East of Comet Mountain, the surface of the land has been carved into rugged serrated peaks and glaciated valleys by Pleistocene alpine glaciation. West of Comet Mountain, the topography is more moderate, and the landscape consists of uplands characterized by well-rounded hills, mature valleys, and mountain parks.

Below an altitude of 9,000 feet, the area is well timbered with lodgepole pine, which seems to favor a granite base soil. Fir and spruce, however, can

be found on protected slopes and in gullies where sufficient moisture is present.

The first discovery of ore in the district was made in 1872 by Preston Sheldon, who shipped from the Old Elkhorn claim a carload of ore assaying 300 ounces of silver to the ton. Mike Steel, in 1874, located the Storm claim and shipped two carloads of ore assaying 260 ounces of silver to the ton. In 1888 a 90-foot shaft was sunk on the Mono vein, and the Storm Mining Company was to sink the Storm shaft to a depth of 250 feet. Ore from the Simpson shipped by Frank Williams in 1895 ran $100 per ton.

Figure 55.—Claim map of Elkhorn mining district.

In 1906 Frank Felt bought several of the claims in the district and located a tunnel site on the Idanha vein. The northern group of the Felt claims was later bonded to W. R. Allen, a former lieutenant governor of the state and author of the book "Chequemegon". Allen organized the Boston and Montana Company in 1913. The program undertaken by the company included the construction of a narrow-gauge railroad, the Montana Southern, running from Divide to the mines, a distance of 35 miles, the building of a 42-mile high-tension electric line, erection of a 750-ton treatment plant, and underground development of the properties. The projects were finished in 1921, but it was soon learned that the veins were insufficiently developed to supply even a fraction of the daily mill tonnage requirements. In 1923 the company was placed under a stockholders receivership. Under the receivership the company debts were eventually liquidated, but the company was forced into a reduced underground development program. By 1930 the company stopped work in the district altogether, and in the 1940's most of the deeded properties were acquired by Beaverhead County in lieu of taxes. It is estimated that $5 million was spent by the company in the district. Figure 55 is a claim map of the district.

The most recent activity in the district took place in 1960-64 when some of the underground workings on the Comet group of claims, situated on the southwest side of Comet Mountain, were reopened.

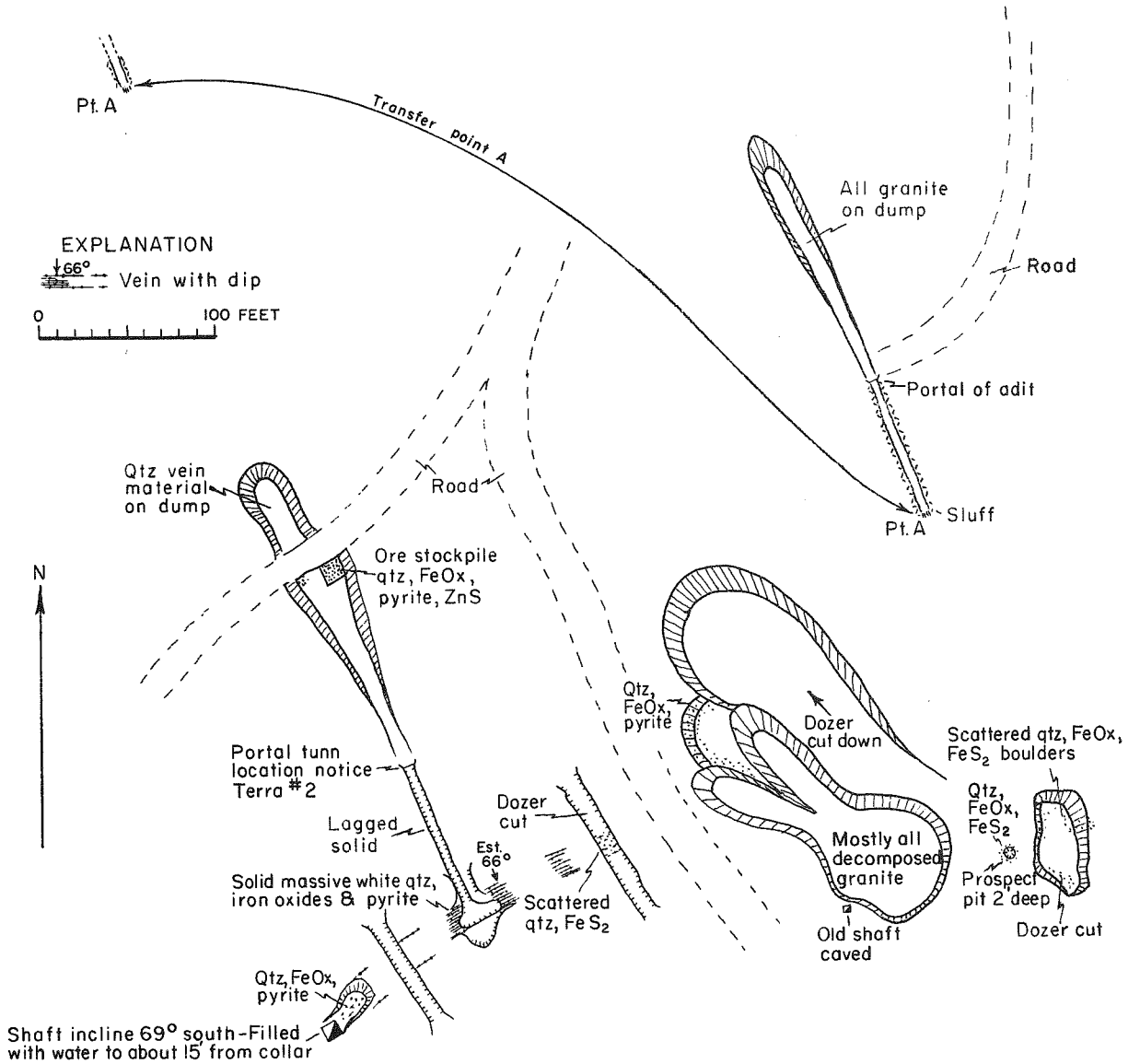


Figure 56.—Geologic sketch of workings on the Park claim.

Production amounted to 773 tons of ore, which yielded 4,000 pounds of copper, 1,700 pounds of lead, 300 pounds of zinc, 23,879 ounces of silver, and 20 ounces of gold.

The Elkhorn district is situated in the middle of the quartz monzonite intrusive mass, of batholithic proportions, that forms the core of the Pioneer Mountains. As described by Winchell (1914, p. 169), the rock is porphyritic biotite-hornblende-quartz monzonite, although its porphyritic character is not noticeable in the field. Typically, the rock is fresh, uniform in appearance, and disintegrates into a sandy granitic soil. A few irregular dikelike bodies of aplite cut the quartz monzonite, but complementary lamprophyric structures are unknown.

The principal geologic structure in the district is the Comet fault. This north-south zone of complex fracturing, possibly 300 feet wide, traverses the district along its eastern margin, skirting the base of Comet Mountain. Comet Mountain clearly is a fault scarp; its western slope closely parallels the dip of the fault plane, estimated to be about 45° W. The difference in altitude between the base and top of Comet Mountain indicates a vertical component of movement along the fault plane of at least 1,000 feet.

A second important fault, the Mono, lies 1,200 feet west of the Comet fault but is a fracture of less magnitude. It parallels the Comet fault in strike but dips oppositely, about 45° to the east. According to old Boston and Montana Company reports, vein structures are offset very little by the Mono fault.

The principal mineralized area in the Elkhorn district is west of the Comet fault in a tract measuring possibly 3,000 feet wide by 7,000 feet long. Veins within this tract can be classified as a set of fissure veins striking about N. 50° E., interconnected by a set of east-west fissure veins. Veins of the northeast set dip 65° to 80° SE., and include the Park, Lulu, Blue Jay, Atlas, Mono, White Seal Fraction, and Ram. Veins assigned to the east-west system dip steeply to the north or south and include the Elkhorn, Simpson, Central, Lost Cloud, Idanha, and Aspen.

The Park vein, where intersected a few feet below surface by a crosscut adit, is 15 feet wide (Fig. 56) and is the widest vein that I saw in the district. Old Boston and Montana Company reports indicate veins ranging from 5 to 50 feet in width where exposed underground, but these greater widths cannot now be verified, because underground workings in the district are virtually inaccessible.

Most vein quartz in the district is white and massive, but locally it is brecciated and recemented by darker quartz or by red-brown jasper. Quartz in the oxidized zone is generally iron stained and honeycombed from leaching of primary sulfide minerals. Granular pyrite is the commonest sulfide mineral and is associated with tetrahedrite, galena, sphalerite, chalcopyrite, and some molybdenite. Specimens of quartzose vein material containing sparse bladed wolframite also have been found on some dumps in the area.

Annual production figures for the district are given in Table 13.

BOBSLED AND O. C. J. CLAIMS

The Bobsled and O. C. J. patented claims are in sec. 2, T. 4 S., R. 12 W., and sec. 35, T. 3 S., R. 12 W., and are held by Carl Kennedy. The claims are situated on the east bank of Wise River 2 miles downstream from the old mining camp of Coolidge. The lower mine dump is near the level of Wise River and is visible from the Mono Creek-Coolidge road, on the opposite bank of the river.

The principal working is indicated by the large dump near the river level and consists of an adit, now caved at the portal, which trends S. 72° W. The dump is coarse-grained aplite (alaskite) and pieces of quartz containing pyrite and molybdenite. About 50 feet above this lower adit is another adit, also caved at the portal. Dump material includes several tons of massive white quartz, which contains molybdenite as thin plates and in thin seams veining the quartz. Because of thick overburden and soil development, the exact nature of the deposit could not be determined, but it is believed to be a vein that is probably genetically related to the alaskite country rock.

The property has no record of production under the name of Bobsled or O. C. J.

BOSTON AND MONTANA GROUP

The Boston and Montana group originally comprised about 68 claims, of which only the Copper Queen, Red Sky, St. Louis, Atlas, Simpson, Blue Eyed Annie, Mammoth, Mono, and Storm were patented.

Many shallow shafts, adits, and prospect pits explore the veins over their length, but the principal workings on the group are a 300-foot adit level and

Table 13. — Production of gold, silver, copper, lead, and zinc from lode mines, Elkhorn district, 1902-65, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)	Total value
1902-05	no production						
1906	20	6	133	7,273	-----	-----	$ 1,618
1907	no production						
1908	19	1	1,424	167	1,816	-----	869
1909	22	1	2,065	954	2,088	-----	1,302
1910-15	no production						
1916	25	3	900	75	1,972	-----	808
1917-18	no production						
1919	32	-----	170	514	2,172	-----	407
1920	88	3	1,935	4,333	11,574	-----	3,888
1921	4,680	40	6,868	11,786	11,117	-----	9,716
1922	20,827	560	90,357	169,001	303,545	-----	141,442
1923	6,210	133	22,531	42,458	226,866	-----	43,345
1924	no production						
1925	20,095	237	49,920	123,255	288,879	-----	82,182
1926-31	no production						
1932	49	71	21	238	-----	-----	1,489
1933	60	52	17	141	-----	-----	1,090
1934	13	10	14	-----	-----	-----	347
1935	109	8	1,426	2,723	-----	-----	1,531
1936	179	22	4,519	10,924	-----	-----	5,275
1937	8	1	234	-----	-----	-----	216
1938	no production						
1939	45	3	1,102	2,538	150	-----	1,124
1940-41	no production						
1942	57	4	519	1,900	1,000	-----	806
1943-47	no production						
1948	41	4	527	1,200	4,200	3,700	2,121
1949-52	no production						
1953	8	-----	27	100	400	400	151
1954-58	no production						
1959	13	5	5	-----	200	400	249
1960	44	1	2,478	-----	1,700	300	2,516
1961	173	7	7,154	900	-----	-----	7,129
1962	306	8	9,262	1,600	-----	-----	10,822
1963-65	no production						
Undistributed	250	4	4,985	1,500	-----	-----	6,996
Total	53,373	1,184	208,593	383,580	857,679	4,800	327,439

a 1,000-foot adit level, both driven westward from the side of Wise River canyon. Both adits are now caved at the portals.

According to Boston and Montana reports, about 24,000 feet of underground development was performed and consists of crosscuts, drifts, and raises. Work on the 300-foot level amounted to 10,000 feet; the rest was on the 1,000-foot level. The levels are connected by a large raise known as No. 1 Raise. Between the 300-foot and 1,000-foot levels, 400-foot and 800-foot levels were established from the raise. No raises or stopes from the 300-foot level connect to old workings or to surface.

Veins cut underground are the Idanha, Park, Blue Jay, Mono, and Elkhorn. The highest grade ore mined by the company came from the Blue Jay vein; the largest block of ore mined was a segment 700 feet long on the Idanha vein on the 300-foot adit level. The Idanha vein is supposed to contain a reserve of 100,000 tons of ore having a minimum metal content of 1.6 percent copper, 2.5 percent lead, 2.0 percent zinc, 7.0 ounces of silver, and 0.2 ounce of gold per ton.

From 1921 to 1925, ore production totaled possibly 26,000 tons; shipments amounted to 5,397 tons of concentrates averaging 3.2 percent copper, 7.0 percent lead, 7.7 percent zinc, 26.2 ounces of silver, and 0.13 ounce of gold per ton.

Total recorded production from the group, which was achieved in 1916, 1919-23, 1925, 1935-37, 1939,

1942, 1948, and 1953 is 52,385 tons of ore, which yielded 851,725 pounds of lead, 4,100 pounds of zinc, 370,799 pounds of copper, 180,843 ounces of silver, and 1,013 ounces of gold.

GUY

The Guy mine is on a patented claim owned by Frayne Fitzwater. The vein was discovered in 1891 and was reported to be 12 feet wide, of which 4 feet ran 100 ounces of silver to the ton. In 1907, the underground workings on the claim consisted of a 50-foot shaft, the bottom 25 feet inclined, and a 100-foot vertical shaft. Both shafts are now filled with water almost to the collars and inaccessible to inspection.

The property lies about 1 mile southeast of the Park claim and can be reached over a Forest Service road beginning at Elkhorn Hot Springs and wending its way along the base of Comet Mountain.

The two shafts lie at the bottom of a north-trending ravine tributary to the Wise River drainage system (Fig. 57). The vein, which strikes about N. 15° W., does not crop out but seemingly follows the line of the ravine.

Material on the dumps consists of fresh to altered iron-stained quartz monzonite and scattered pieces of vein material. The vein material is white brecciated quartz recemented by dark quartz. Most of the quartz is mineralized and contains granular pyrite, tetrahedrite, sphalerite, minor galena, and a few specks of molybdenite. A selected sample from a 5-ton stockpile near the 50-foot shaft assayed 10.25 percent copper, 4.40 percent zinc, 0.022 percent molybdenum, 10.25 ounces of silver, and 0.02 ounce of gold per ton.

MCCONNELL (WELLMAN) GROUP

The McConnell (Wellman) group is on the southwest flank of Comet Mountain between Wellman Creek and Dingley Creek. The group comprises eleven patented claims, the W. M. C., Northern Light, Virginia, Toledo, California, Oswego, Chicago, New York, I. X. L., Sadie, and Nevada. The claims are recorded in the name of Stanley Fitzwater and others.

The name Wellman is placed in parentheses after McConnell because mine workings shown in sec. 33, T. 4 S., R. 12 W., on the Polaris topographic map are identified as the Wellman mine. These workings are believed to be on the New York claim. They consist of two adits, one a short distance above the other, which seem to have been driven to intersect northeast-trending veins. Both adits are now caved at the portals. The country rock into which the adits were driven is quartz monzonite of the Mount Torrey batholith. Pieces of vein material on the dump of the lower adit consist of pyrite and minor galena, sphalerite, and chalcopyrite in a

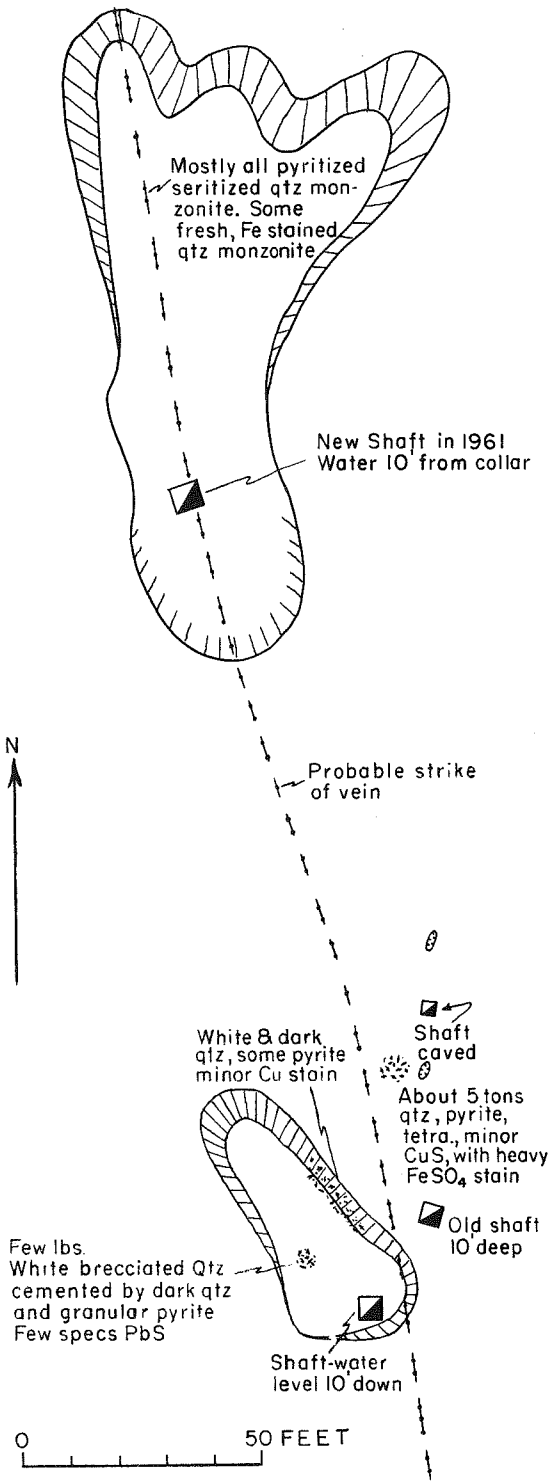


Figure 57.—Sketch of workings on the Guy claim.

gangue of white quartz. A sorted sample of this material assayed 1.05 percent copper, 5.30 percent lead, 2.70 percent zinc, 5.0 ounces of silver, and 0.020 ounce of gold per ton. The claim map of the district (Fig. 55) shows an adit on the New York claim to be about 800 feet long.

On the W. M. C. claim, which was not visited, the same map shows the underground workings to aggregate about 4,800 feet, the greater part of which is allocated to an adit 3,200 feet long. The rest is divided between two crosscuts off the adit. This adit was driven, according to an item in the July 24, 1891, issue of the Dillon Tribune, by two miners named Williams (Wellman?) and McConnell. The adit was being driven to cut two veins, and at the time of the report it was 700 feet long. A 1910 report by a mining engineer (not seen) is said to have described the veins cut in the adit as follows: at 1,634 feet from the portal, a vein 18 inches wide containing chalcopyrite, chalcocite, galena, and pyrite; another vein, 136 feet beyond the first, was reported to be 4 feet wide and to include 4 inches of tetrahedrite; and a third vein 10 feet wide, cut 214 feet beyond the second, contained copper, silver, and lead. The adit is also reported to have encountered a great fault (Comet?); the miners backed away and drove parallel to the fault for several hundred feet. Several crosscuts from the lateral were driven into the fault.

According to Winchell (1914, p. 169), who visited the properties either in 1910 or 1911, the veins within the group of claims are narrow and contained chalcopyrite, galena, sphalerite, and chalcocite films on pyrite; copper stained the vein material from the oxidized zone. The veins were cut by later mineralized faults. Some faults dip gently to the west whereas others strike about east and are near vertical.

The properties have no record of production.

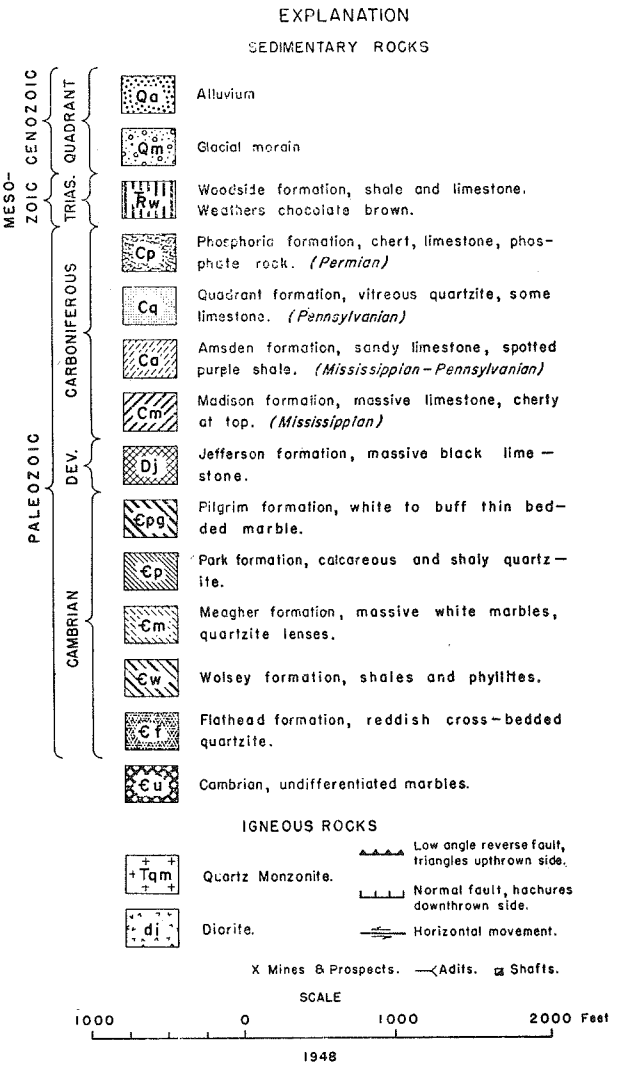
ORO GRANDE AND ECLIPSE

The Eclipse and Oro Grande are two patented claims end to end on the same vein. The Eclipse is owned by Jane C. Gaylord and others, and the Oro Grande by Roscoe Pilon. The properties lie about one claim length northeast of the Guy mine.

The vein, estimated to average 2 feet in width, strikes N. 40° E. It has been explored by three adits, some shallow shafts, and prospect pits over its length. All workings are inaccess'' le for examination.

Most of the dump material is altered quartz monzonite country rock. Vein material consists of white and dark quartz, pyrite, and tetrahedrite. Specimens containing sparse molybdenite associated with pyrite were also found on the dumps.

The property has no record of production.



HECLA (BRYANT) DISTRICT

The Hecla (Bryant) mining district is the treasure house of Beaverhead County, having produced ore valued at nearly $20 million. Most of the value was in silver and lead, but some was in copper, zinc, and gold.

The district lies in the Pioneer Mountains about 16 miles west of Melrose, and is accessible by dirt road from Melrose. The region is one of scenic and rugged glaciated terrane developed along the north margin of the Mount Torrey batholith and the bordering sedimentary rocks. The mining district occupies a glacial amphitheater drained by Trapper and Sappington Creeks. To the south, the district

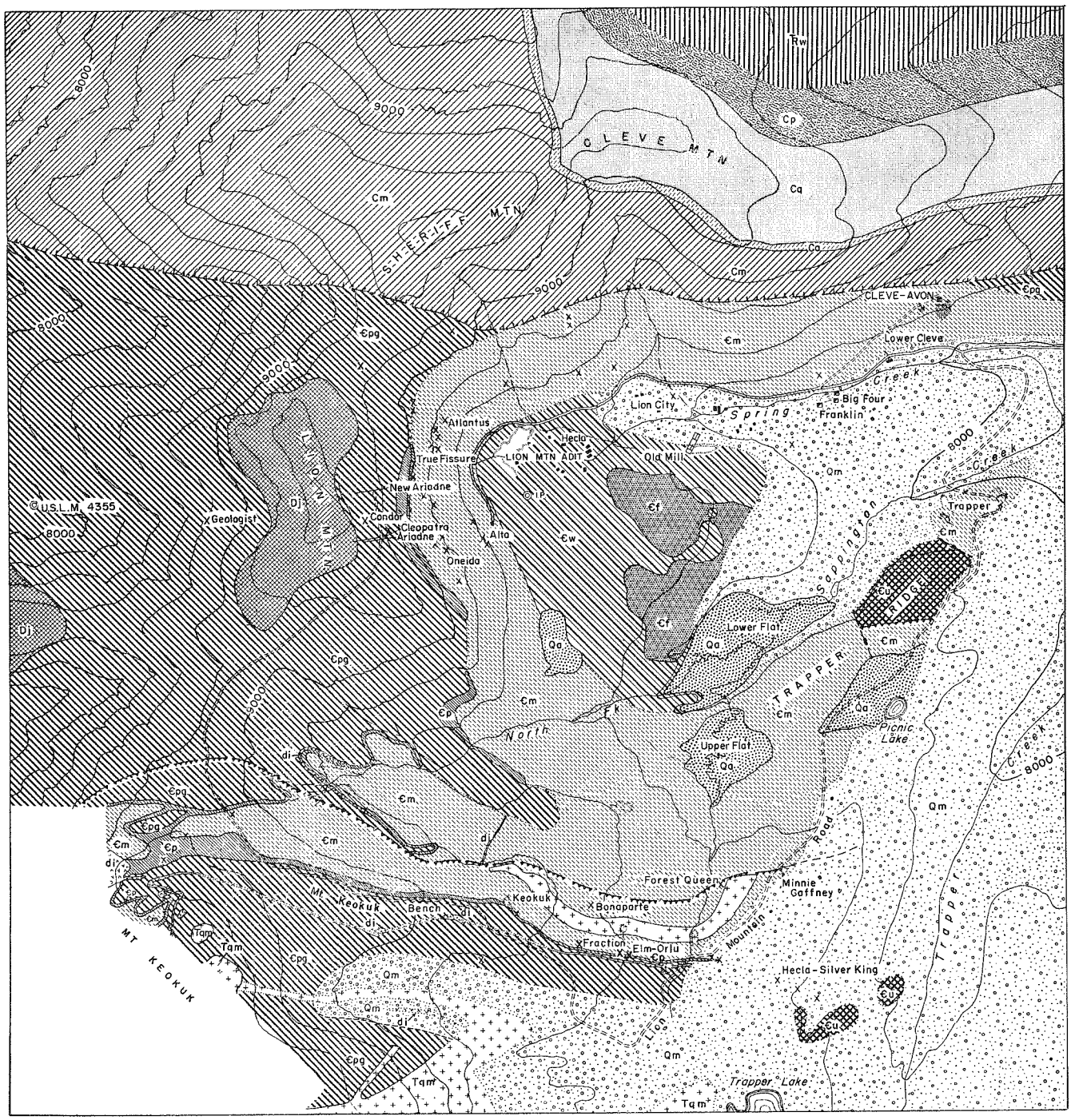


Figure 58.—Geologic map of Hecla district. (Karlstrom, 1948).

is bounded by the steep jagged face of Granite Mountain, which rises to an altitude of 10,633 feet; to the west by a high divide that separates Canyon Creek from Trapper and Sappington Creeks; and to the north and northwest by the steep but rounded slopes of Lion Mountain (9,644 feet), Sheriff Mountain (9,855 feet), and Cleve Mountain. Hecla basin, occupying the center of the district, is at an altitude of approximately 8,500 feet and is characterized by a rolling terrane mantled by grassy mountain parks, forested areas, and glacial debris.

Ore was discovered in the district in 1872, when William Spurr located the Forest Queen claim. In 1873 the Trapper lode was discovered, and then the Cleve-Avon and Franklin lodes, and the Alta, Atlantus, Mark Anthony, and Ariadne lodes, which crop out on the face of Lion Mountain. The district soon became a major producer. The first ore shipped in 1873 to Swansea, Wales, amounted to 10 tons of high-grade silver-lead ore averaging 35 percent lead, 140 ounces of silver, and 1 ounce of gold per ton (Winchell, 1914, p. 86).

Trapper City was the first settlement and was situated along the banks of Sappington Creek near the Trapper mine. The finding of larger ore bodies in Lion Mountain, however, caused a migration of miners over the hill to Spring Creek, where Lion City was founded. Lion City grew to a town housing 500 to 600 inhabitants. In 1874, a 40-ton lead smelter was constructed at Glendale, about 10 miles down the valley toward Melrose, to treat the increasing production from the district.

In 1877 the Hecla Consolidated Mining Company purchased the Cleopatra, and later bought most of the more productive properties in the district, as well as the smelter at Glendale. The Hecla, Trapper, Franklin, Cleve-Avon, Mark Anthony, Cleopatra, Ariadne, True Fissure lodes, and later the Atlantus lode, were all mined by the company. Under the management of Henry Knippenberg, between 1881 and 1901 the company produced ore having a gross metal value of $15 million and paid dividends aggregating $2¼ million.

In 1904 the Hecla Company ceased operations and the properties were acquired by Knippenberg at a sheriff's sale. From 1913 to 1915, under agreement with Knippenberg, the Penobscot Mining Company worked the Atlantus, True Fissure, Trapper, Cleve, and Franklin lodes and produced ore valued at $243,427. A 20-stamp concentrator was constructed by the company at Lion City. Between 1916 and 1922, shipments of ore and slag from the old smelter at Glendale realized $902,878. The properties were sold for $230,000 in 1923 to the Hecla Development Syndicate, which spent $152,000 for development work and for ore, slag, and mill tailings worth $447,664. After 1926, the district became a leasers' camp under supervision of G. B. Conway, former cashier of the old Hecla Company. In 1927 the United States Smelting, Refining, and Exploration Company under lease and option did development work at the Cleve-Avon but relinquished the option before getting into production. In 1928 the properties were acquired by Conway, who sold them on option to the Foundation Company of Utah. The company spent $80,000 in exploration work and shipped ore and slag valued at $78,376. In 1930 the properties reverted to Conway, and the district again became a leasers' camp. From 1930 to 1945, the year of Conway's death, shipments of ore, mill tailings, and slag were valued at $1,656,991. After Conway's death, L. D. Foreman of Dillon, who had previously leased in the district, acquired the option for the district. Leonard Lively of Melrose subsequently acquired the option, and in 1965 held title to the old Hecla Company properties.

Table 14 lists annual production for the district from 1902 through 1965.

The ore deposits of the district are localized in dolomitized carbonate strata of Paleozoic age, which have been folded into a subelliptical dome trending about N. 75° W. (Fig. 58). To the south the dome is bordered by quartz monzonite rocks of the Mount Torrey batholith, and to the north it abuts against the Great Fault. The Great Fault trends northwest approximately parallel to the axial trend of the dome and dips steeply to the north. Displacement along the fault is normal and has brought limestone of Mississippian age in fault contact with upper Cambrian beds. North of the Great Fault beyond the district limits, the structure of the area is a syncline overturned to the south and plunging southeast.

Hecla basin occupies the center of the dome. Sedimentary rocks exposed along the basin floor are metamorphosed Wolsey Shale and gray to red-brown Flathead Quartzite. Strata of Belt (Precambrian) age may also crop out along the basin floor but none have been recognized. Rimming the basin is dolomitized limestone of the Meagher and Pilgrim Formations (Cambrian), which forms conspicuous buff and white cliffs in the district. The beds dip radially at low angles from the domal center. Isolated remnants of gray-blue to black Jefferson Limestone cap Lion Mountain but younger strata are missing

Table 14. — Production of gold, silver, copper, lead, and zinc, from lode mines, Hecla (Bryant) district, 1873-1965.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)	Total value
1873*	10	1	1,400	300	7,000	-----	2,366
1874	101	5	28,280	3,000	70,000	-----	41,161
1875	1,812	90	200,000	77,000	1,466,000	-----	352,365
1876	2,000	90	200,000	70,000	1,500,000	-----	340,060
1877	2,069	100	150,000	60,000	1,500,000	-----	275,967
1878	5,426	150	250,000	100,000	2,500,000	-----	397,200
1879	11,067	200	350,000	150,000	3,200,000	-----	555,234
1880	11,067	200	350,000	150,000	3,200,000	-----	598,734
1881	8,831	300	534,197	215,067	4,843,646	-----	881,482
1882	16,470	307	547,754	229,708	4,984,697	-----	918,916
1883	24,564	403	662,836	308,519	5,203,919	-----	1,018,744
1884	17,148	248	656,849	339,928	4,589,280	-----	948,228
1885	19,240	713	686,845	177,567	5,528,653	-----	984,452
1886	19,717	800	398,707	64,786	4,102,040	-----	607,138
1887	21,284	442	474,719	123,642	4,663,148	-----	701,261
1888	28,349	1,211	716,860	208,605	6,884,857	-----	1,036,856
1889	24,463	1,099	579,431	228,380	6,138,258	-----	787,598
1890	20,698	692	480,904	159,981	4,298,176	-----	737,619
1891	30,122	666	485,209	89,674	4,030,947	-----	678,940
1892	20,149	344	364,397	157,516	3,304,040	-----	474,561
1893	12,003	211	226,240	94,095	1,973,851	-----	264,019
1894	18,067	343	616,809	362,897	2,941,912	-----	527,246
1895	15,964	340	347,342	239,631	1,175,523	-----	296,050
1896	10,525	548	365,223	315,702	1,331,645	-----	334,353
1897	5,914	406	215,431	184,836	1,090,175	-----	197,966
1898	7,361	518	367,979	121,039	1,582,450	-----	302,594
1899	3,477	219	242,738	155,719	838,894	-----	215,640
1900	2,357	150	134,089	183,165	579,106	-----	142,618
1901	1,944	305	236,168	108,426	1,025,562	-----	210,202
Sub Total	362,199	11,101	10,870,407	4,679,183	84,553,779	-----	14,829,570
1902	1,539	152	118,084	54,713	512,781	-----	$ 89,596
1903	1,515	159	140,116	104,267	444,322	-----	90,662
1904	300	27	21,227	17,487	103,980	-----	16,465
1905	540	-----	36,000	24,000	144,000	-----	32,256
1906	577	67	46,987	44,275	209,726	-----	53,368
1907	149	4	22,648	17,240	55,800	-----	21,427
1908	181	27	17,473	14,112	54,005	-----	13,953
1909	574	63	45,053	53,399	287,470	-----	44,039
1910	338	12	30,391	38,958	184,445	-----	29,733
1911	1,095	44	90,480	98,126	766,883	-----	95,646
1912	949	51	69,382	66,423	541,067	-----	79,023
1913	4,057	24	41,933	41,709	280,505	-----	44,626
1914	16,800	65	79,661	2,446	516,765	-----	65,884
1915	697	17	55,347	71,814	389,448	33,136	63,406
1916	1,343	65	77,733	115,625	605,527	-----	122,707
1917	1,918	71	80,891	104,791	908,830	15,918	176,518
1918	2,835	36	66,859	118,118	765,383	-----	151,121
1919	3,826	47	62,479	188,300	967,370	-----	157,250
1920	9,289	41	53,595	159,628	1,894,024	-----	240,151
1921	334	11	26,233	24,282	166,247	-----	37,063
1922	1,027	14	32,267	36,343	315,894	-----	54,830
1923	19,777	14	42,946	106,185	1,935,180	-----	186,574
1924	36,620	25	67,513	188,016	3,486,445	-----	349,303
1925	29,695	15	54,151	162,427	2,300,474	-----	261,090
1926	19,023	4	31,136	108,511	1,459,761	-----	151,491
1927	8,880	33	27,996	54,904	796,674	-----	73,935
1928	627	24	34,743	42,690	390,185	-----	49,593
1929	4,244	187	41,032	52,906	687,600	-----	78,376
1930	173	56	8,199	5,035	50,914	-----	7,501

*Winchell, A. N., Mining districts of Dillon quadrangle, Montana: U. S. Geol. Survey Bull. 574, p. 86.

1/ Less than ½ ounce.

Table 14.—Production of gold, silver, copper, lead, and zinc, from lode mines, Hecla (Bryant) district, 1873-1965 (continued).

Year	Ore (tons)	Gold (oz.)					
1931	46	11	1,919	1,201	14,938	-----	1,448
1932	67	11	3,752	3,302	22,400	-----	2,163
1933	5	1/	257	281	2,486	-----	202
1934	724	122	15,195	7,737	75,270	-----	17,479
1935	1,660	102	29,753	7,349	63,200	-----	28,077
1936	988	32	11,197	12,087	97,826	-----	15,411
1937	2,678	11	13,819	16,000	245,000	-----	27,465
1938	2,654	126	41,911	54,296	217,957	-----	46,851
1939	13,521	798	126,692	194,039	551,787	-----	160,041
1940	43,089	1,757	426,735	626,168	1,502,540	-----	510,835
1941	3,711	384	34,681	58,300	183,400	-----	55,435
1942	12,863	132	26,442	87,563	929,400	1,500,700	235,853
1943	12,454	324	46,904	127,500	828,200	938,500	224,742
1944	8,336	312	35,325	96,400	847,600	726,500	199,683
1945	6,346	660	49,185	72,400	460,500	317,400	143,954
1946	3,325	364	23,380	35,500	198,000	27,000	62,258
1947	2,448	168	13,273	22,800	164,700	42,500	51,540
1948	2,496	87	6,771	18,800	185,600	163,800	68,260
1949	524	42	3,202	4,900	36,100	32,700	15,092
1950-53	no production						
1954	280	73	6,161	1,000	22,600	18,500	13,520
1955	18	3	729	400	5,700	2,000	2,009
1956	70	1	1,836	8,400	9,100	7,600	7,737
1957	370	-----	1,195	300	11,800	400	2,905
1958	1,012	20	9,260	3,200	24,900	1,500	12,989
1959	287	17	4,256	-----	-----	-----	4,447
1960	1,890	102	20,480	-----	-----	-----	22,105
1961	1,338	62	15,229	5,000	-----	-----	17,749
1962	730	40	8,633	4,500	-----	-----	12,153
1963	339	9	3,790	1,800	5,900	3,100	6,710
1964	517	20	7,894	3,000	-----	-----	11,885
1965	171	4	1,904	1,000	-----	-----	2,956
Total	293,879	7,149	2,514,315	3,591,953	27,928,609	3,831,254	4,821,541
Grand Total	656,078	18,250	13,384,722	8,271,136	112,482,388	3,831,254	19,651,111

in the district south of the Great Fault, having been removed by prolonged erosion after domal uplift.

The geology and ore deposits of Hecla district have been described in an excellent report (Karlstrom, 1948), from which much of the following information was condensed.

From his study of the district, Karlstrom (1948) concluded that the Hecla basin is underlain by an igneous cupola. According to his thesis, the ore was deposited in the overlying sediments by ascending metalliferous solutions emanating from the magma during its cooling period. No igneous rocks are known to crop out anywhere along the basin floor, to provide direct evidence of such a cupola beneath the basin. Indirect evidence includes the fact that the structure of the district is domal, the rocks in the basin are thermally metamorphosed, and the ore deposits are arranged in a subcircular pattern about the basin, which may indicate that they had a common source. The Lion Mountain deposits are on the west side of the basin, the Keokuk-Elm Orlu deposits on the south, the Hecla-Silver King and Trapper deposits on the east, and the Cleve-Avon deposits on the north.

Because cupolas are regarded as favorable sites for localization of ore, especially if the magmas were "wet", the Montana Bureau of Mines and Geology in the summer of 1967 undertook a program, proposed by the author, to determine whether geochemical soil sampling would indicate the presence of a large mineralized area underlying the basin floor by detection of traces of residual metal in the soil. Although soil in the Hecla basin was expected to be contaminated by metals brought down from deposits situated along the rims of the basin, it was decided to analyze the soil samples for copper and molybdenum as well as lead and zinc. The detection of anomalous amounts of copper would not be conclusive, because of the quantity of copper in the ore bodies surrounding the basin, but the presence of anomalous amounts of copper and molybdenum together would be more encouraging because of

their common association in copper-molybdenum porphyry-type ore deposits. The geochemical survey results are included in an open-file report.

CLEVE-AVON GROUP

The Cleve-Avon group of claims is on the north edge of Hecla basin at the base of Cleve Mountain. In production the group ranks second only to the Lion Mountain group. They were worked continuously throughout the history of the old Hecla Company. The important producing claims were the Cleve, Avon, and Franklin, owned by Leonard Lively of Melrose.

The ore deposits of the group are contained in dolomitic limestone of the Meagher Formation, which has been folded into an anticlinal structure, plunging about 35° NE., terminated on the northeast by the Great Fault. The ore bodies are gently dipping replacement shoots localized at different favorable stratigraphic zones marked by blue limestone. The ore bodies spread out from ore-filled vertical fissures, which form two sets, one of which strikes northeast, the other northwest. The upper Cleve and main Cleve incline-Hull workings, though separated by the Avon workings, are on the northwest-striking set, whereas the Avon and Barbour workings, separated by the main Cleve incline-Hull workings, are on the northeast-striking set (Fig. 59).

The only igneous intrusive rock known in the Cleve-Avon deposit is a basalt dike. According to an old report by the Hecla Company, the dike was cut in the old Cleve incline 1,300 feet from surface as measured along the slope of the incline.

The ores mined were thoroughly oxidized and consisted principally of silver-bearing cerussite, iron, and manganese oxides, stained by copper oxidation products, in a gangue of quartz. Residual sulfides were dominantly galena and tetrahedrite. Sooty manganese oxide minerals are reported to be abundant in the Barbour workings, the lowest workings of the group.

The deposit was developed by the upper Cleve adit, 300 feet above the foot of Cleve Mountain, and the lower Cleve adit at the base of the mountain. From the lower Cleve adit the main Cleve incline was started and levels were established at 250 feet (No. 1 level), 350 feet (No. 2 level), and 375 feet (No. 3 level) below the adit level. The Barbour workings, the lowest workings in the group, had reached a depth of approximately 500 feet below surface when mining ceased. Most of the workings along the lower Cleve adit and along the main Cleve incline are still open but filled with water to about the No. 1 level.

HECLA-SILVER KING

The Hecla-Silver King group, owned by Leonard Lively of Melrose, comprises two patented claims on the moraine-covered south-facing slope bordering Trapper Creek. The properties were described by Karlstrom (1948, p. 78) as follows:

"The ore was taken from a sulfide vein near the intrusive contact in Pilgrim Limestone. According to Winchell (1914, p. 86) the vein, erroneously considered by him at this time to be in quartz monzonite, had not been extensively opened but appeared to contain a shoot of sulfide ore showing some oxidation along the hanging wall. The ore shoot pitched about 45° to 60° E. or SE.

"The mine workings of the Hecla have completely caved. All that remains is a dump showing much limonitic limestone, sphalerite, pyrite, galèna, and a little chalcopyrite, the oxidation products malachite, azurite, and limonite; and clumps of iron-stained quartz crystals. The ore was apparently taken from a much shattered light yellow siliceous limestone zone characterized by the presence of manganese dendrites. The Silver King dump shows white crystalline to yellow limonite-stained limestone with granular masses of pyrite crystals, light-colored translucent sphalerite, and massive galena associated with both quartz and limestone. In contrast to the Hecla dump material, there is no malachite or azurite, and much less limonite, which suggests that the ore was taken from a lower and unoxidized portion of the vein. Fragments of minette on both dumps indicates the association of a basic dike or sill with the ore, and strongly suggests a genetic relationship such as found in Lion Mountain."

The only recorded production from the group was in 1913, when 1 ton of ore yielded 175 pounds of lead, 15 pounds of copper, and 191 ounces of silver.

KEOKUK-ELM ORLU

The Keokuk-Elm Orlu group of claims, on the southwest rim of Hecla basin, can be reached by the Lion Mountain road. The properties are in the west-central part of unsurveyed sec. 11, T. 3 S., R. 11 W. The six patented claims, the Forest Queen, Keokuk, Minnie Gaffney, Bonaparte, Moffet &

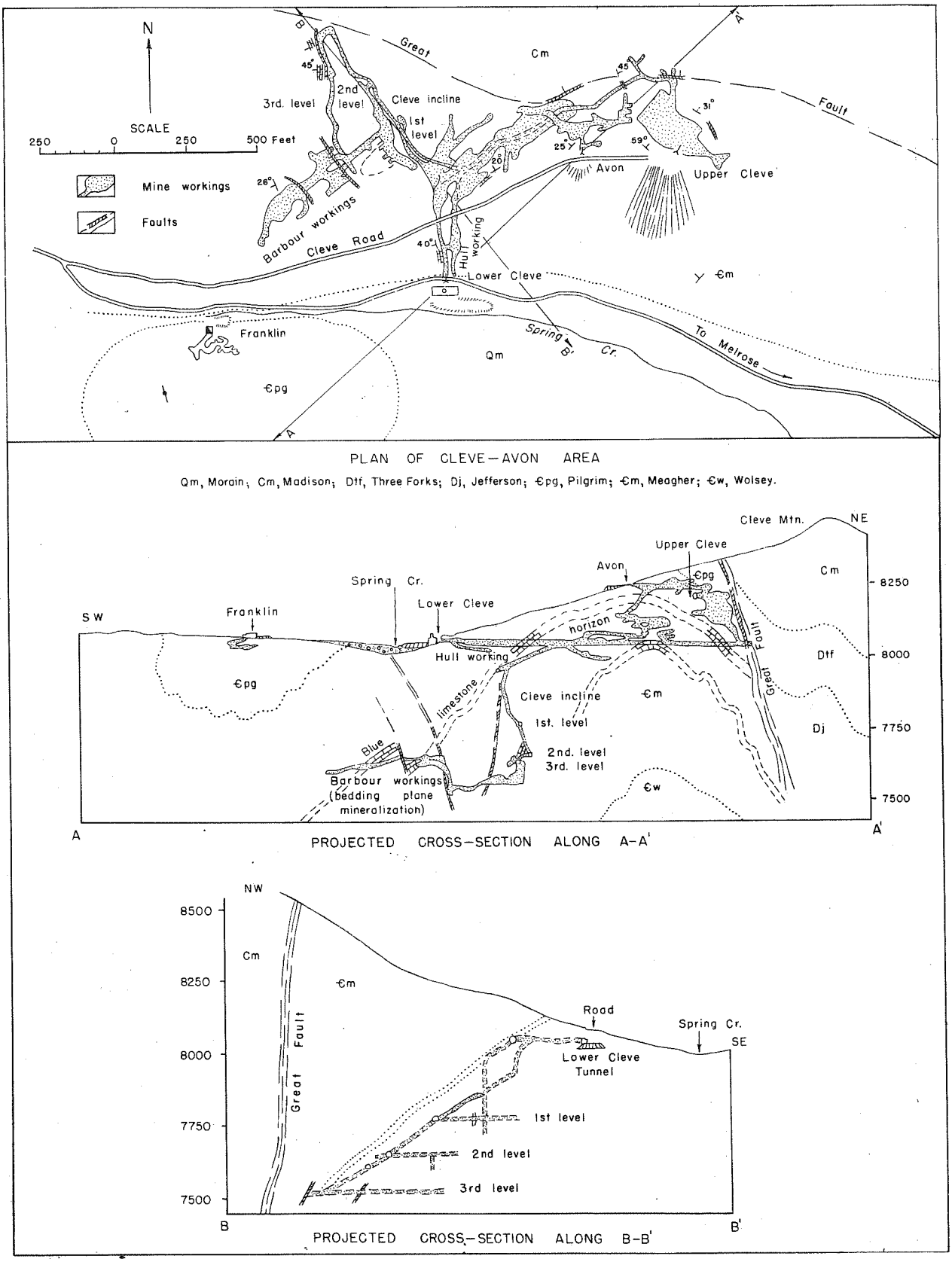


Figure 59.—Geologic plan and sections of the Cleve-Avon mine. (Karlstrom, 1948).

Maynard, and Elm Orlu are under diverse ownership. The Keokuk, Elm Orlu, Minnie Gaffney, and Moffet & Maynard claims are situated along a mineralized zone between the Park and Meagher Formations overlying a quartz monzonite sill more than 100 feet thick, which intruded into the upper half of the Meagher Formation (Fig. 60). The formations dip gently to the south and are curved in trend from N. 60° W. to S. 80° W. The mineralized solutions that produced the deposit were regarded by Karlstrom (1948, p. 76) as originating from the underlying quartz monzonite sill and making their way upward to collect beneath an impervious quartzite bed of the Park Formation.

On the Keokuk claim, which is the farthest west, the mine workings consist of two inclined shafts, which were sunk along the mineralized zone, and an adit about 700 feet south of the shafts, which was driven northward through the overlying Pilgrim Limestone to intersect the zone at depth. Quartzite, probably from the Park Formation, was found on the dump of the adit. All underground workings are inaccessible. The mine dumps contain copper-stained brecciated limestone fragments cemented by quartz and chalcedony (Karlstrom, 1948, p. 75).

The Fraction is an unpatented claim between the Keokuk and Elm Orlu mines. The workings consist of an old shaft sunk along the mineralized zone between the Park and Meagher Formations; it is filled with water nearly to the collar. The dumps contain copper-stained quartz and chalcedony cementing brecciated limestone.

The Elm Orlu mine is near the head of Sappington Creek. Workings consist of eight shallow inclined shafts sunk along the mineralized zone between the Park and Meagher Formations. The dumps contained white and mineralized yellow limestone and pieces of white quartz showing pyrite and sphalerite (Karlstrom, 1948, p. 75).

The Minnie Gaffney claim, which is the farthest east, was developed by a steeply inclined shaft, now caved. Dump material consists of quartz and silicified limestone fragments containing some galena and pyrite. The glacial mantle in the mine area obscures relationships, but the deposit is probably a continuation of the mineralized zone exposed on the Keokuk, Elm Orlu, and other claims (Karlstrom, 1948, p. 75).

The Bonaparte and Forest Queen claims are along the contact between the quartz monzonite sill and the underlying Meagher Limestone. Workings on the Bonaparte claim consist of two adits now caved at the portals. One adit was driven on a quartz vein trending N. 75° W. in Meagher Limestone, and the other was started in quartz monzonite but driven

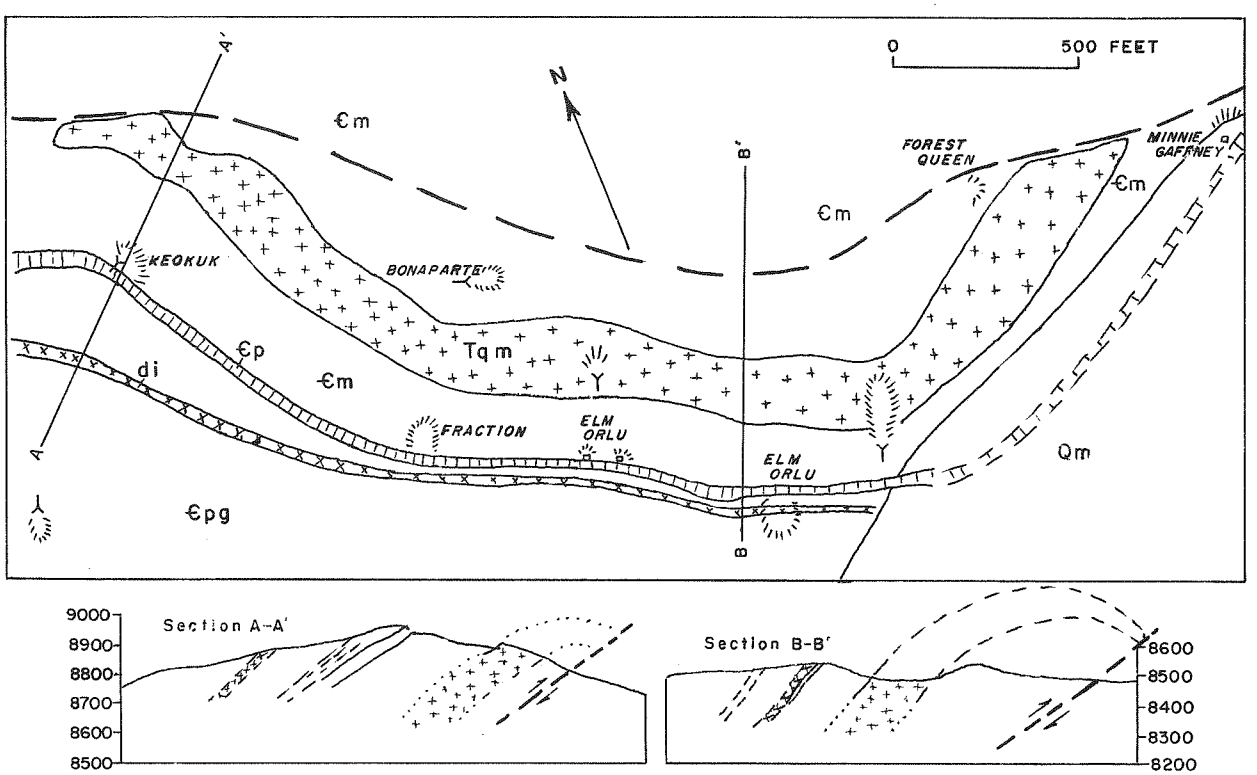


Figure 60.—Geologic plan of Keokuk-Elm Orlu group. (Karlstrom, 1948).

to intersect the mineralized zone at the Park-Meagher contact. The dumps contain a few pieces of vein material consisting of copper-stained quartz and pyrite (Karlstrom, 1948, p. 75).

The only recorded production from the group was in 1935, when the Bonaparte produced 50 tons of ore, which yielded 181 pounds of copper, 699 ounces of silver, and 1 ounce of gold.

LION MOUNTAIN

The Lion Mountain group comprises fourteen patented claims owned by Leonard Lively of Melrose. They are along the face of Lion Mountain and have been developed by 20 miles of underground workings, many of which are still accessible. The workings include inclines, drifts, and a main adit level more than 3,000 feet long, called the Lion Mountain tunnel, driven at the base of the mountain.

The ore is in gently dipping replacement bodies parallel to the bedding. Stratigraphically the ore bodies are localized along three zones: in the middle of the Meagher Limestone beneath an 80-foot section of blue limestone associated with white marble containing quartzite lenses; in the upper part of the Meagher Limestone just beneath the Park Formation; and in the middle of the Pilgrim Limestone in blue limestone. The main ore bodies are characterized (Karlstrom, 1948, p. 55) as irregular networks of winding tubular chimneys, pipes, or pods, localized along crests of minor fold structures in favorable ore zones.

The ore bodies trend westward and are cut or terminated by a series of narrow near-vertical northeast-trending basic dikes of two types, basalt and minette. Eleven such dikes are exposed in the Lion Mountain adit; all are accompanied by fault gouge. Two major faults along dikes are the Mountain Sheep and the Atlantus; the Atlantus fault-dike terminated the Atlantus ore body downdip. The dikes were regarded by Karlstrom (1948, p. 63) as premineral, their contacts serving as guiding channels for hypogene mineralizing solutions, which then migrated up dip along favorable stratigraphic zones to form the Lion Mountain ore bodies. The fact that the dikes cut or terminate the ore bodies, however, clearly indicates a postmineral origin; more likely the dikes were emplaced in the ore channels after the mineralizing solutions.

The ore bodies worked (Fig. 61) included the Cleopatra, Old and New Ariadne, and Condor, which were in the middle of the Pilgrim Formation and cropped out near the top of Lion Mountain; the True Fissure and Silver Quartz, which were in the upper part of the Meagher Formation beneath the Park Formation and cropped out about halfway down the mountain face; the Old and New Atlantus and Bluebird, which were in the middle part of the Meagher Formation and cropped out near the base of the mountain; and the Ramshorn, Silver King, and Johnny Cake, which were also in the middle part of the Meagher but about 35 feet below the others.

The Cleopatra was the great ore body at Hecla in terms of quantity of ore mined. Workings extended downdip for 3,000 feet from the outcrop. In places the ore was 300 feet wide and 20 to 30 feet thick; it was soft and easily mined. Quartz gangue contained iron oxides and lead and silver. Some first-class ore assayed 25 percent lead and as much as 45 ounces of silver per ton. In the lower workings the ore is composed mainly of iron oxides that contain small amounts of lead, silver, and gold.

The Old and New Atlantus ore bodies, near the base of the mountain, were the richest ones mined, containing abundant lead and copper as well as silver. Selected ore from the Old Atlantus assayed 100 ounces of silver per ton, and some even as much as 600 ounces silver per ton, besides 30 to 40 percent lead.

The major ore bodies of the group are not situated vertically above each other (Fig. 61); instead, they are offset in a step-wise fashion to the northeast. This pattern suggests that an area remains to be explored between the New Atlantus ore body and the Great Fault along a favorable zone in the lower part of the Meagher Formation.

TRAPPER

The Trapper mine is on the north slope and near the end of Trapper Ridge on the Sappington Creek side; it can be reached by the Lion Mountain road. The property consists of one patented claim owned by Leonard Lively of Melrose. Between 1877 and 1899 the mine produced 4,320 tons of ore, which contained 346 ounces of gold, 614,713 ounces of silver, 4,576,789 pounds of lead, and 312,003 pounds of copper, valued at $1,025,211.

The ore deposits occur in small fissures and as bedding vein replacements in the dolomitic upper part of the Meagher Formation beneath quartzite layers. The beds in the vicinity of the deposit seem to dip south to southeast, curving around the domal structure of the Hecla basin. The ore deposits seem to be localized along crests of large drag folds, which

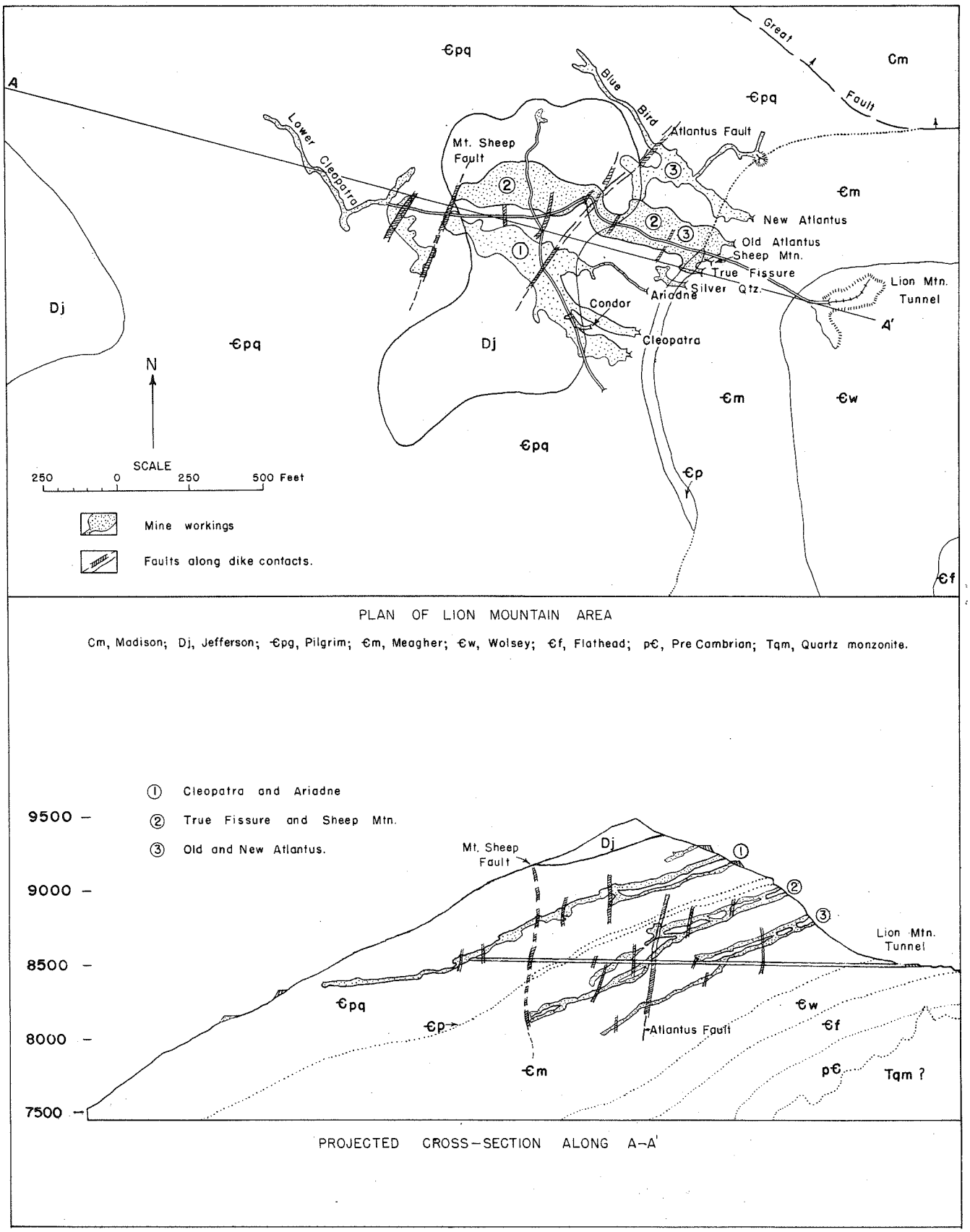


Figure 61.—Geologic plan and section of Lion Mountain group. (Karlstrom, 1948).

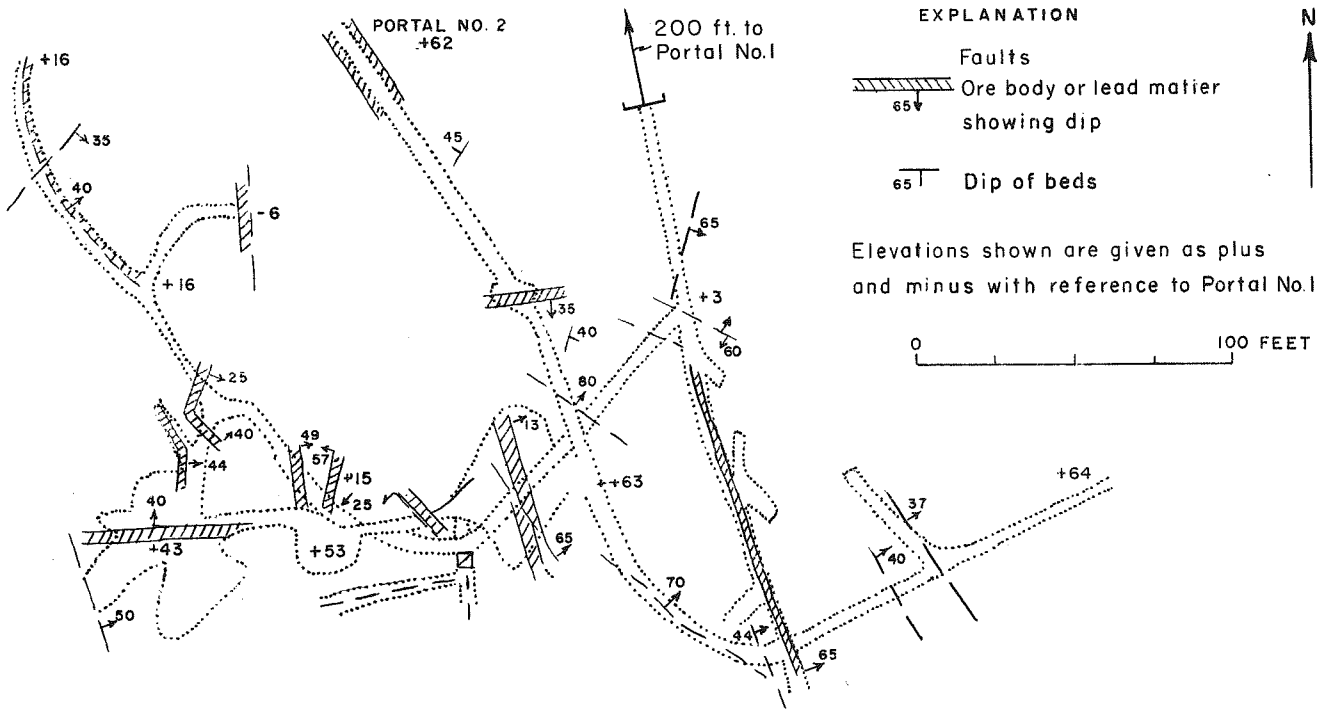


Figure 62.—Plan of Trapper mine workings showing geology. (Karlstrom, 1948).

were developed by a tear fault block of Cambrian dolomite just west of the mine area (Karlstrom, 1948, p. 82).

The deposit was developed by two adits and two shafts, 310 feet and 200 feet deep. All entrances to the underground workings are now caved. The lower adit was started near Sappington Creek, the other adit higher up the slope. A plan map of the underground work is given in Figure 62.

The dumps contain white quartz stained by manganese and iron oxides; some show copper staining. Some of the dolomite contains much siderite altered in part to limonite. Some ore fragments containing galena, sphalerite, and pyrite were also observed by Karlstrom (1948, p. 81), indicating that the zone of mixed sulfides and oxides was encountered in the workings.

POLARIS (LOST CLOUD) DISTRICT

The Polaris (Lost Cloud) district is on the west slope of Baldy Mountain. For the purposes of this report it is defined to include the region drained by Billings Creek. It is actually a one-mine district and takes its name from the Polaris mine, which is about 3 miles up Billings Creek east of Polaris Post Office.

Annual production figures for the district are given in Table 15.

POLARIS

The Polaris mine is in sec. 28, T. 5 S., R. 12 W., at an altitude of about 7,200 feet. The property can be reached by a good road that leads off from the Billings Creek road, which begins at Polaris. The property consists of several patented mining claims, which for several years have been under lease and option to Lee James of Polaris.

The deposit was discovered in 1883 and was first developed by shallow shafts and short adits. By 1886 approximately 20 men were employed at the mine, and the principal mining operations were conducted through an inclined shaft 200 feet deep. In 1891 the Polaris Mining and Milling Company purchased the mine and drove the lower Polaris adit, which was at a vertical distance of about 600 feet below the vein outcrop and which attained a length of 2,300 feet. In addition, drifts amounting to several hundred feet were driven on the adit level, and an inclined raise connected with the upper workings. Sassman (1941, p. 273) reported that the company mined silver ore valued at $250,000 during the period of operation. After operation by the company ceased, the property was subsequently acquired by

J. E. Morse at a sheriff's sale. In 1905 it was sold to the Silver Fissure Mining Company, who constructed a 100-ton smelter at the mine in 1906. The

Table 15. — Production of gold, silver, copper, lead, and zinc from lode mines, Polaris (Lost Cloud) district, 1902-65, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)	Total value
1902-07	no production						
1908	11	65	2,811	2,204	-----	-----	$ 3,122
1909	no production						
1910	2	-----	196	-----	-----	-----	112
1911	no production						
1912	51	8	4,309	628	-----	-----	2,919
1913	no production						
1914	19	3	2,363	198	-----	-----	1,390
1915	10	1	1,223	125	-----	-----	663
1916	no production						
1917	446	14	13,768	-----	-----	-----	11,641
1918	193	15	12,035	3,680	-----	-----	13,257
1919	56	4	3,400	1,236	-----	-----	4,111
1920	87	6	5,239	1,299	-----	-----	6,080
1921	no production						
1922	275	8	10,955	493	126	-----	11,199
1923	no production						
1924	3	1/	247	33	-----	-----	172
1925	1	1	11	-----	-----	-----	19
1926-33	no production						
1934	151	83	266	675	379	-----	3,137
1935	85	19	1,056	747	4,450	-----	1,679
1936	366	39	626	-----	-----	-----	1,849
1937-38	no production						
1939	8	-----	436	-----	-----	-----	296
1940	5	-----	180	44	80	-----	137
1941-51	no production						
1952	32	4	157	75	1,105	-----	478
1953-54	no production						
1955	1	-----	161	-----	100	-----	161
1956	26	1	2,274	200	1,700	900	2,541
1957	no production						
1958	7	-----	107	-----	-----	200	117
1959	29	-----	165	-----	-----	-----	149
1960	no production						
1961	920	17	17,230	700	2,200	10,000	18,111
1962	481	9	4,673	1,600	-----	-----	5,878
1963	450	6	12,324	2,400	-----	-----	16,713
1964	588	5	11,673	2,300	-----	-----	16,018
1965	581	4	12,138	2,300	1,000	1,000	16,950
Total	4,884	312	120,023	20,937	11,140	12,100	138,899

1/ Less than ½ ounce

smelter was in operation for less than a year because of an insufficient supply of ore.

Tributers worked the property until 1918, when it was leased to the Silver Fissure Silver Mining Company. Ore reserves at this time were reported at 69,600 tons containing 1,500,000 ounces of silver and 1,300 ounces of gold. The company erected a 50-ton mill employing chloridizing roasting and hyposulfite leaching of the ore. Small shipments were made in 1919 and in 1922, but operation by the company ceased soon thereafter. Production from the property was small and sporadic until 1959. Since 1959, Lee James of Polaris, the present owner, has maintained small but continuous production from a surface cut.

The deposit is in a mineralized fault zone at the contact between quartzite and altered fractured limestone. The fault zone, known as the Polaris fault, strikes N. 60° E. and dips 45° to 60° NW. An old map of the Polaris main adit level shows the fault zone 10 to 20 feet wide. In the surface cut, which is about 300 feet long, the fault zone is not mineralized; instead, the altered limestone country rock on the footwall side of the fault is fractured and sheared, and quartz-filled veins that trend nearly due east abut at acute angles against the main

Polaris fault. These veins resemble feather fractures caused by displacement along the fault prior to mineralization. The veins are not long, and they pinch within a few feet from the fault. Principal vein minerals are black sulfides of silver and copper in a gangue of quartz; some galena and sphalerite were found in the lower mine workings. The oxidized ore is in copper- and iron-stained quartz. The hanging-wall quartzite is not mineralized.

At one time the deposit was worked through a main shaft, which extended down to the 320-foot

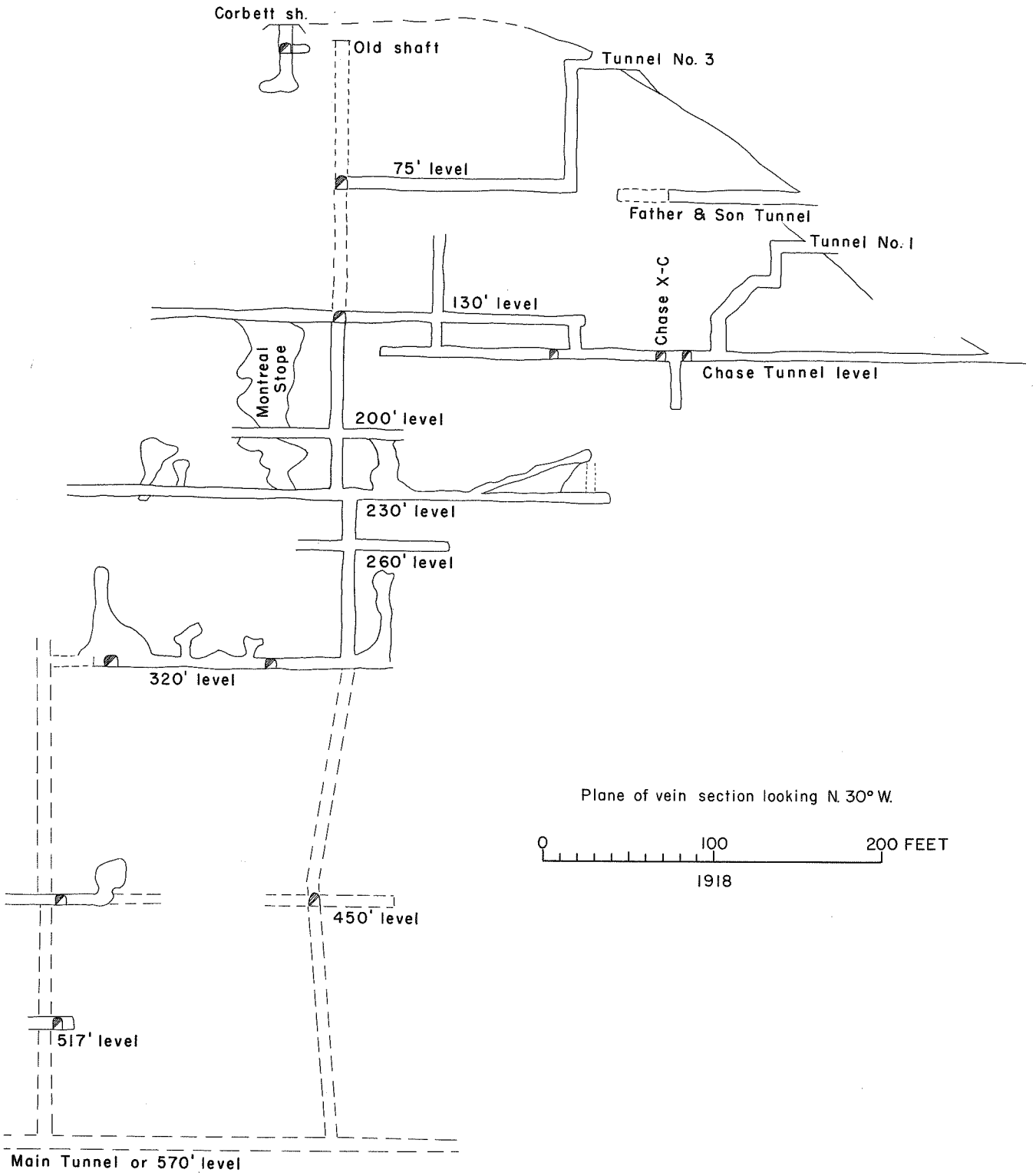


Figure 63.—Longitudinal section of Polaris vein, Polaris mine, Polaris (Lost Cloud) district.

level (Fig. 63), and much ore was mined from the upper levels. A vertical raise and an inclined raise were driven from the main Polaris adit to connect with the 320-foot level, but very little stoping was done below the 320 level. Most of the underground workings are inaccessible, and the main adit is caved at the portal. According to an old report on the property, the Polaris fault was mineralized for several hundred feet along its strike. Numerous lenses of high-grade silver ore were separated by lower grade segments containing 12 to 40 ounces of silver per ton. The rake of the ore was about 45° to the SW.

Total recorded production from the property is 4,243 tons, which yielded 231 ounces of gold, 116,506 ounces of silver, 19,357 pounds of copper, 5,126 pounds of lead, and 11,900 pounds of zinc. This ore was produced in 1908, 1912, 1914-15, 1917-20, 1922, 1924-25, 1934-35, 1939, 1955-56, and 1959-65.

PROSPECT IN THE SE¼ NE¼ SEC. 33, T. 5 S., R, 12 W.

The prospect is about 0.4 mile southeast of the Silver King mine. According to local report, the property was originally worked to provide fluxing material for the Polaris smelter.

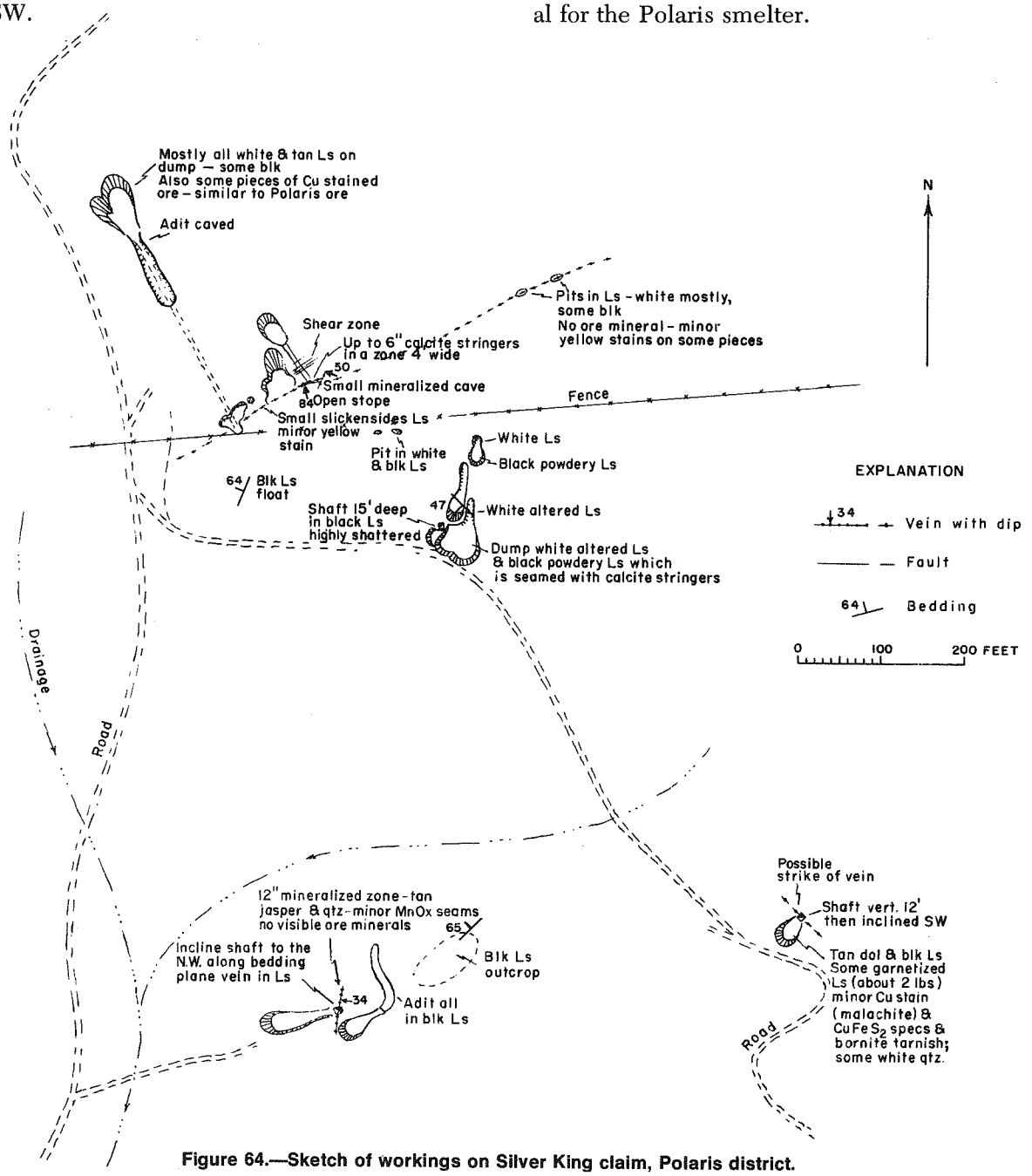


Figure 64.—Sketch of workings on Silver King claim, Polaris district.

The country rock is white recrystallized limestone. An adit, driven into the limestone along a N. 24° W. line, is now caved at the portal but seems to have been at least 150 feet long. Two pieces of magnetite were found on the dump.

SILVER KING

The Silver King mine is in sec. 28, T. 5 S., R. 12 W. It is at an altitude of about 7,600 feet and is a few hundred feet south of the Polaris mine, from which it is accessible by a jeep road, which continues south over the divide into the Farlin Creek drainage. The property consists of one patented claim, which is owned by E. P. Marchesseau.

The deposit consists of a narrow fissure vein that strikes N. 60° E. and dips 84° NW., subparallel to the main Polaris fault. The vein cuts white and tan limestone, which trends N. 22° E. and dips 64° NW. Within a strike length of 150 feet, several surface cuts and a short adit have been excavated (Fig. 64). Where exposed in the surface cuts, the vein is a narrow barren fracture accompanied by a thin selvage of yellow-stained silicified limestone showing slickensides. A sample of this material selected from the dump assayed 0.20 percent lead, 1.70 percent zinc, 20.3 ounces of silver, and 0.020 ounce of gold per ton. A 4-foot mineralized zone at the face of the short adit contains only stringers of calcite not more than 6 inches wide.

A lower adit, the portal of which is about 60 feet lower and about 250 feet downslope from the upper workings, was driven to intersect the structure at depth. It is now caved at the portal. Vein material on the dump consists of copper- and iron-stained quartz and resembles ore from the Polaris mine. A selected grab sample of this material assayed 0.40 percent copper, 0.80 percent lead, 1.30 percent zinc, 54.0 ounces of silver, and 0.020 ounce of gold per ton.

Total production from the property is 84 tons, which yielded 1,105 pounds of lead, 200 pounds of zinc, 75 pounds of copper, 797 ounces of silver, and 4 ounces of gold. Ore was produced in 1936, 1940, 1952, and 1958-59.

ROCK CREEK AND LOST CREEK DISTRICTS

The Rock Creek and Lost Creek districts are situated on the east flank of the Pioneer Mountains and for the purpose of this report are defined to include the region drained by the named creeks and their tributaries. The district is about 24 miles north of Dillon and is accessible by mountain roads that turn west off U. S. Highway 91 near Dell and extend part way up both creeks.

Topography from the mountain front toward the interior of the district is generally rugged. Altitude ranges from about 6,000 feet at the foothills to 10,473 feet atop Mount Tohepea, which is at the head of Rock Creek.

The district straddles the contact between quartz monzonite rocks of the Mount Torrey batholith and north-trending upturned sedimentary rocks. The batholithic rocks occupy the western part of the district and are bordered on the east by metamorphosed Paleozoic and Mesozoic sedimentary rocks (Fig. 65).

Total and annual production of copper, silver, and gold from the Ivanhoe claim is given in Table 16. No production of lead or zinc is recorded for the district. The mineral wealth of the district has come from tungsten-bearing tactite zones developed in the Amdsen Formation. Tungsten production figures (Pattee, 1960) are given in the description of the individual mines.

Table 16. — Production of gold, silver, and copper from Ivanhoe claim, Lost Creek district, 1902-65.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Total value
1902-27	no production				
1928	36	1/	152	4,085	$ 678
1929	51	1	495	8,544	1,789
1930-65	no production				
Total	87	1	647	12,629	2,467

1/ Less than ½ ounce.

ADAMS PEAK

The Adams Peak claims are in sec. 23, T. 4 S., R. 10 W., on the south slope of the west peak of Twin Adams Mountain. In 1960, nine unpatented claims were held by R. E. Meine, H. M. Meine, and D. F. Guidici (Pattee, 1960, p. 12).

Disseminated scheelite was found in tactite debris from two trenches but none is exposed in place. A grab sample of material from the north trench assayed a trace of WO_3. No WO_3 was detected in two other samples from the same trench nor in a sample from the second trench.

BROWNS LAKE (IVANHOE)

The Browns Lake (Ivanhoe) mine is in sec. 3 and 4, T. 4 S., R. 10 W., and is reached by traveling

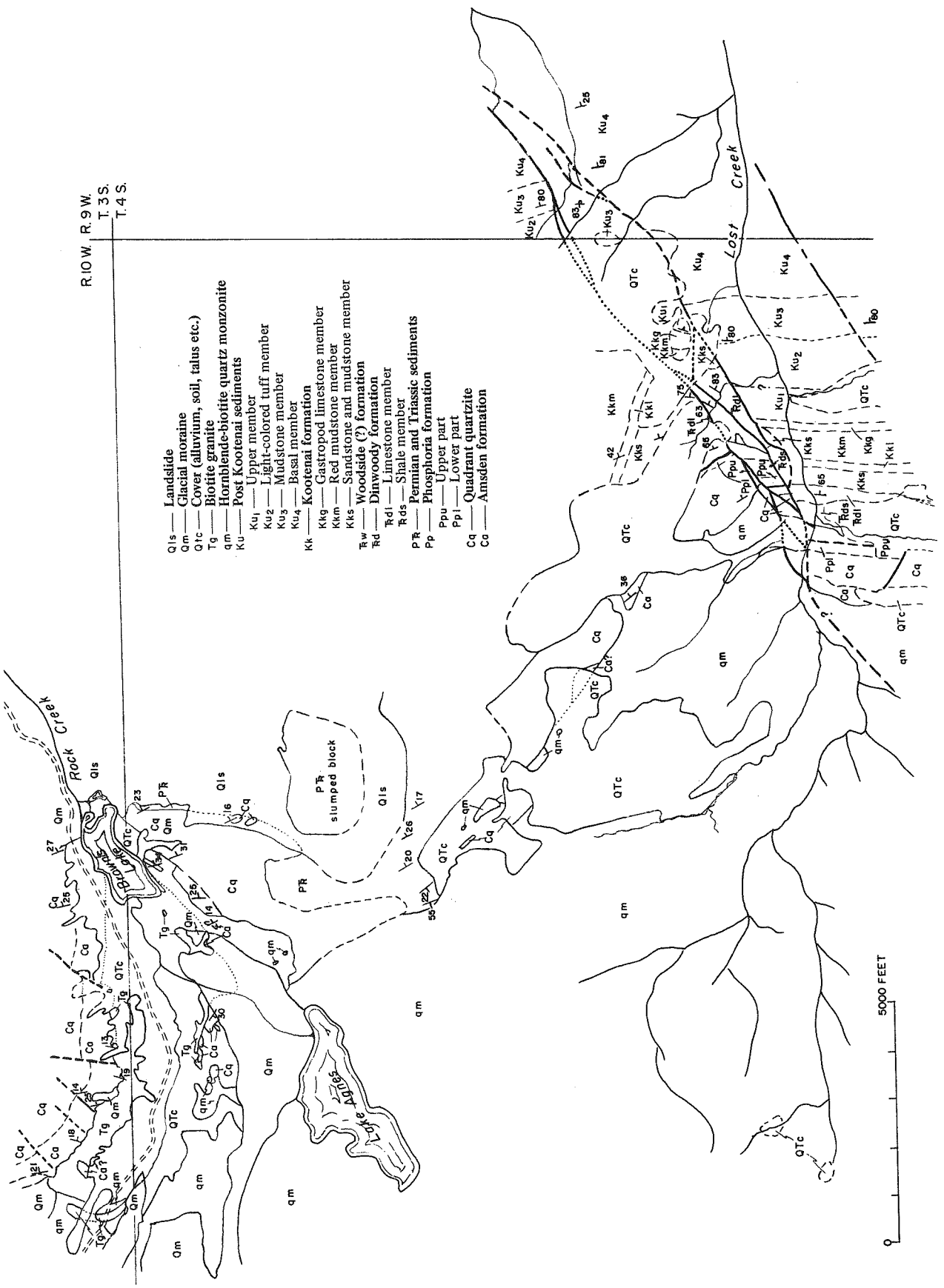


Figure 65.—Geologic sketch of Rock Creek and Lost Creek mining district. (Myers, 1952).

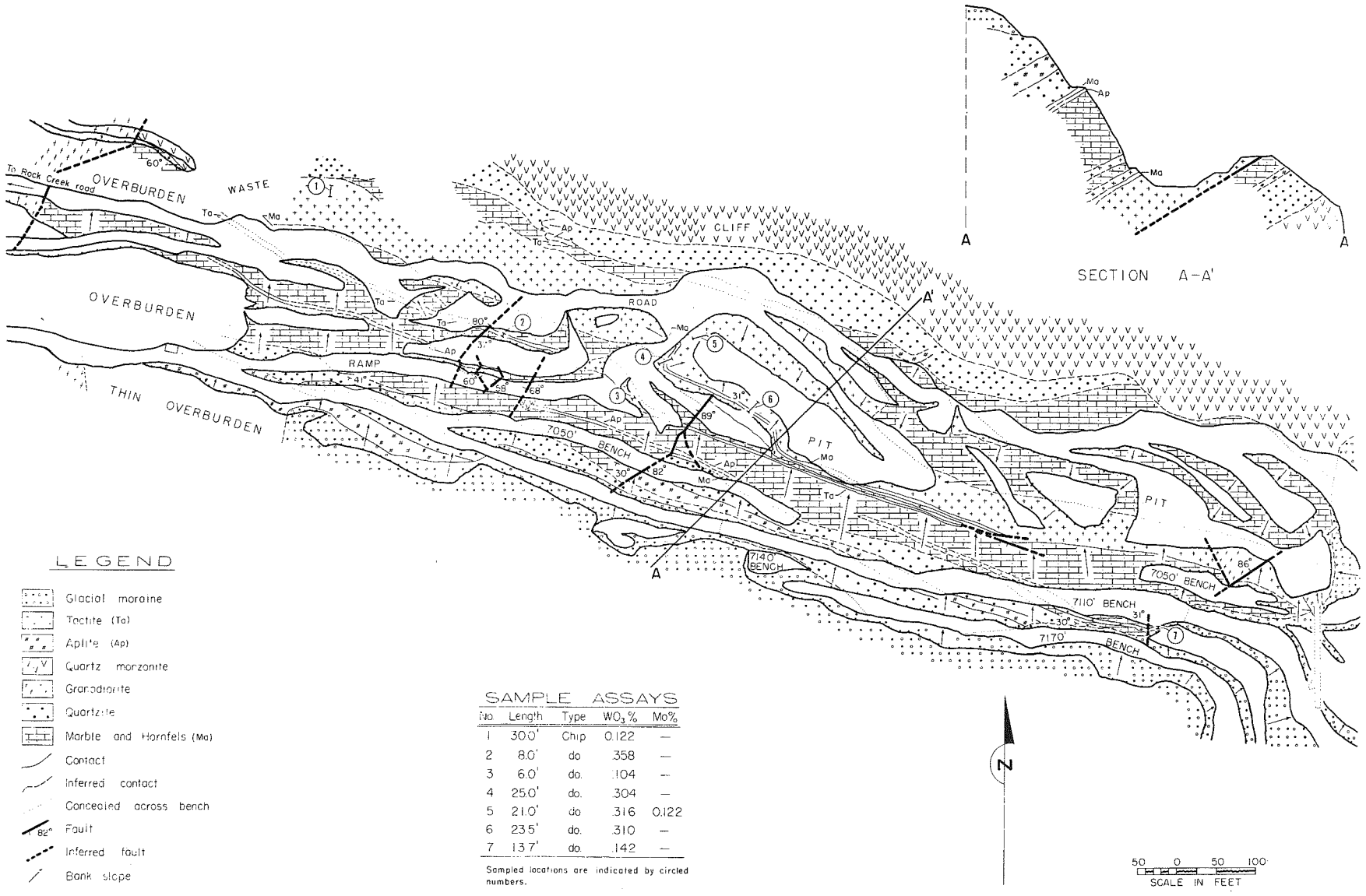


Figure 66.—Browns Lake (Ivanhoe) mine, Rock Creek district. (Pattee, 1960).

a road up Rock Creek for 9 miles from U. S. Highway 91. The mine is at an altitude of about 7,000 feet, and is along the steep south wall of the canyon occupied by Browns Lake and Rock Creek. The deposit is a tungsten-bearing tactite zone in the Amsden Formation at its contact with granitic rocks of the Mount Torrey batholith. The deposit has been described by Myers (1952), Waterhouse (1952), and Pattee (1960).

The first production recorded from the property came from the Ivanhoe claim, on which the tactite zone was developed for copper (Table 16). In 1942, R. C. McLaughlin examined some stockpiled ore from the Ivanhoe by ultraviolet light and detected fluorescent tungsten minerals (Waterhouse, 1952, p. 38). McLaughlin and his associates organized Fluorescent Mines, Inc., and staked seventeen mining claims, two on the south side of Rock Creek adjacent to the Ivanhoe, and fifteen on the north side, one of which was the Garnet. In 1944 a small tabling mill produced tungsten concentrate from about 30 tons of tactite mined from workings on the Garnet claim. Three hundred pounds of concentrate averaging 26 percent WO_3 were sold to the Wah Chang Trading Company in Salt Lake City, and another 300 pounds was stored in Dillon.

In 1952 the properties were taken over by American Alloy Metals, Inc., who drove an exploration adit on the Ivanhoe claim under a DMEA contract. In 1953 the deposit was operated by Minerals Engineering Company under a leasing arrangement with American Alloy Metals. Ownership of the properties was acquired by Minerals Engineering in 1954 through purchase of American Alloy's stock and assets. Tungsten ore was mined from the deposit by open-pit methods and treated at a 300-ton flotation mill owned by Minerals Engineering and situated at Glen. Low-grade concentrates from the mill were shipped to the tungsten refinery of the Salt Lake Tungsten Company (the refinery was owned jointly by Minerals Engineering and Sylvania Electric Products, Inc.), where high-purity synthetic scheelite was produced. High-grade concentrates were shipped to Salt Lake City and leached of impurities before delivery to the General Services Administration.

The Browns Lake deposit was Montana's leading producer of tungsten from 1954 through 1956, but production from the deposit was discontinued in 1958 after termination of the government domestic stockpiling program late in 1956. Production through 1957 was 625,107 tons of ore averaging 0.35 percent WO_3 (Pattee, 1960, p. 6).

The deposit consists of tactite in a block of Amsden Formation, which trends northwest and dips moderately to the southwest. The block is overlain and underlain by granitic rocks of the Mount Torrey batholith; it is terminated on the northwest end by quartz monzonite, and to the southeast it is covered by glacial moraine. It may be a roof pendant entirely surrounded by intrusive rocks.

The main ore body in the block strikes N. 50° W. to N. 57° W., and dips 30° to 37° SW. (Pattee, 1960, p. 7). It is approximately 117 feet thick, and besides the tactite, it contains a bed of marble and four or more beds of hornfels. The marble is barren, but a small amount of scheelite is present in the hornfels. The footwall of the zone is a fault parallel to the bedding. A 9-foot scheelite-bearing tactite bed is 16 feet above the main bed and is separated from it by barren marble. At the east end of the pit the two beds converge because of faulting. An isolated ore bed 13 feet thick and 90 feet above the main ore body can be traced westward for 420 feet from the glacial moraine. Figure 66 is a sketch of the mine.

Most of the scheelite is fine-grained particles, but crystals more than 6 mm in length occur. Sulfide minerals in the tactite are sparse chalcopyrite, bornite, and pyrite. Other minerals included are biotite, limonite, malachite, and magnetite (Pardee, 1960, p. 6).

LOST CREEK

The Lost Creek mine is in sec. 14 and 23, T. 4 S., R. 10 W. The mine workings are on the north slope of Twin Adams Mountain at an altitude of 6,800 to 7,900 feet. They are reached by traveling a road up Lost Creek for 9 miles from Glen. The property comprises 29 unpatented claims held by Minerals Engineering Company, Carl Guidici, and Henry Meine (Pattee, 1960, p. 6).

The tungsten resources were developed in 1951 by Minerals Engineering Company. In production, the mine ranks second to the Browns Lake mine, and from 1952 to August 1956, it produced 21,150 tons of tungsten ore averaging 0.18 percent WO_3 (Pattee, 1960, p. 12).

The deposit consists of a nearly north-trending tungsten-bearing tactite zone in the Amsden Formation at its contact with quartz monzonite of the Mount Torrey batholith (Fig. 67). The tactite zone has been traced for a slope distance of about 4,470 feet by float, adits, and surface pits and trenches. The two principal adits on the property are the "B"

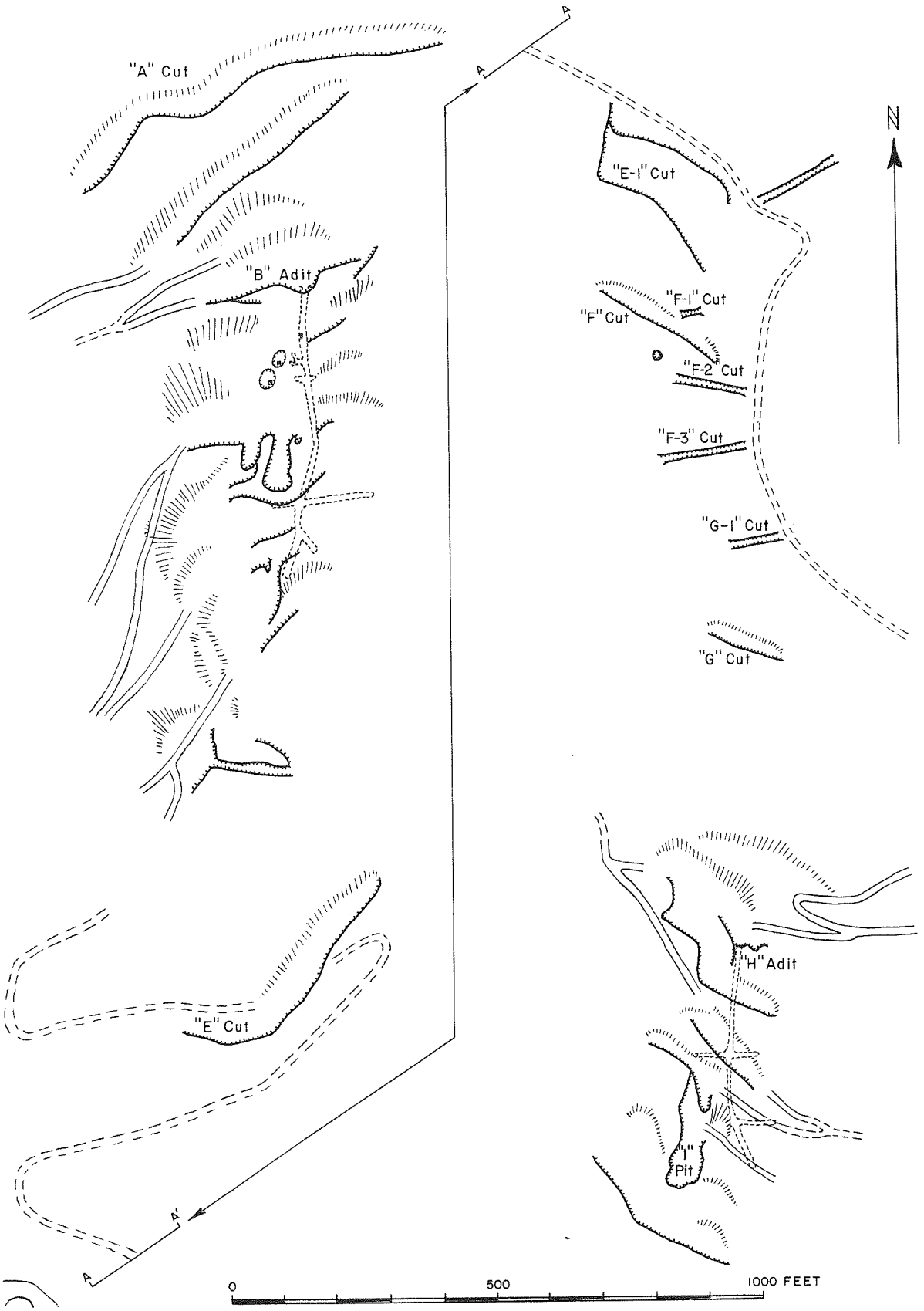


Figure 67.—Sketch of Lost Creek mine, Lost Creek district. (Pattee, 1960).

adit and the "H" adit. The portal of B adit is at an altitude of approximately 6,850 feet, and that of H adit is at approximately 7,750 feet. B adit is about 540 feet long and has been driven south along the tactite zone. The average width of the zone exposed by surface and underground workings is 87 feet. H adit is about 420 feet long and also has been driven south along the tactite zone. The underground workings and diamond drill holes indicate that the maximum horizontal width of the tactite is 157 feet. Scheelite ore has also been produced from tactite exposed in an "I" pit, which is a small pit about 400 feet south of the portal of H adit (Pattee, 1960, p. 12).

VIPOND PARK AND QUARTZ HILL DISTRICT

The Vipond Park and Quartz Hill districts occupy a mountainous region on the north end of the Pioneer Mountains. To eliminate verbiage they will be referred to as "the district". The district is bordered on the north by the Big Hole River and on the south by Vipond Park and Sheep Mountain; it includes the drainages of Adson Creek, Mammoth Gulch, Triangle Gulch, Quartz Hill Gulch, Sawmill Gulch, and Cattle Gulch (Fig. 68). The highest peak within the district is Sheep Mountain, which exceeds 9,400 feet. Most mines and prospects are at an altitude of 8,000 feet or lower.

The district is accessible by a county road south from Dewey, upgrade along Quartz Hill Gulch to the Quartz Hill mines, southward across Vipond Park, and then down into the Canyon Creek drainage and out of the district. Mines and prospects in the district can be reached by side roads leading off from the main county road or by forest trails.

Mining began in the district about 1867, and the first ore shipped consisted of rich float boulders. By the late 1880's, three pan-amalgamation mills had been constructed at Dewey to treat the ore from the mines. The Jay Hawk Mining Company owned one mill, the Lone Pine Mining and Milling Company another, and the third was owned by the Leggat family. Although other outlying mines in the district supplied ore to the mills, the principal production undoubtedly came from mines on Quartz Hill, of which the Lone Pine mine was the most important.

In 1891 the Jay Hawk and Lone Pine Mining and Milling Companies were consolidated into an English corporation, called the Jay Hawk and Lone Pine Consolidated Mining Company. A new mill was constructed at the Lone Pine mine and operated until 1895, when it was shut down because of depletion of the Lone Pine ore shoot and the low price of silver. In 1908 the Benton Mining and Milling Company mined ore from the Argyle vein; it was succeeded by the Argyle Silver Mining Company, which also acquired a three-fourths interest in the English company. Activity in the district was dormant until 1928, when the Quartz Hill Mining Company, the present owner, acquired the interests of the Argyle company, the remaining one-fourth interest in the English company, and other patented claims on Quartz Hill. The Lone Pine shaft was opened and the West Lone Pine ore shoot (Lorain, 1937) was discovered. The property began producing in 1933, under management of the Quartz Hill Mining Company, but after the early 1940's, production was continued by lessors. The mine produced continuously from 1933 to 1950. Some ore was produced in 1958, 1961, and 1962.

Total recorded production from the district for the period 1902-65 was 57,261 tons of ore, which contained 1,118 ounces of gold, 1,024,485 ounces of silver, 198,991 pounds of copper, 72,032 pounds of lead, and 500 pounds of zinc. Of this total, 47,618 tons containing 311 ounces of gold, 924,353 ounces of silver, and 163,803 pounds of copper came from the Lone Pine (Quartz Hill) mine, mostly from 1933 to 1962. Annual production figures for the district are given in Table 17.

The basement rocks of the district are iron-stained quartzite and shale of Beltian age, which are unconformably overlain by dolomite of the Hasmark (Meagher, Park, and Pilgrim equivalent) Formation. The Flathead and Wolsey Formations are missing in the district proper, either because of nondeposition or pre-Hasmark erosion, but Wolsey Shale has been mapped by Obert (1962, p. 20) in the vicinity of Sheep Mountain. Upper Paleozoic limestone and shale overlie the Hasmark Formation. Mesozoic formations are absent but crop out northeast of the district. The sedimentary formations have been warped into a series of narrow northwest-trending anticlines and synclines that plunge to the southeast at low angles.

No intrusive igneous rocks are known to occur in any of the mine workings except the Queen of the Hills mine. A few diorite sills as much as 3 feet thick intruded into siltstone of Beltian age are reported by Guttormsen (1952, p. 62) in the vicinity of Swamp and Adson Gulches, in the western part of the district. In addition, Obert's map (1962) shows a stock of coarse-grained granite intrusive into Belt

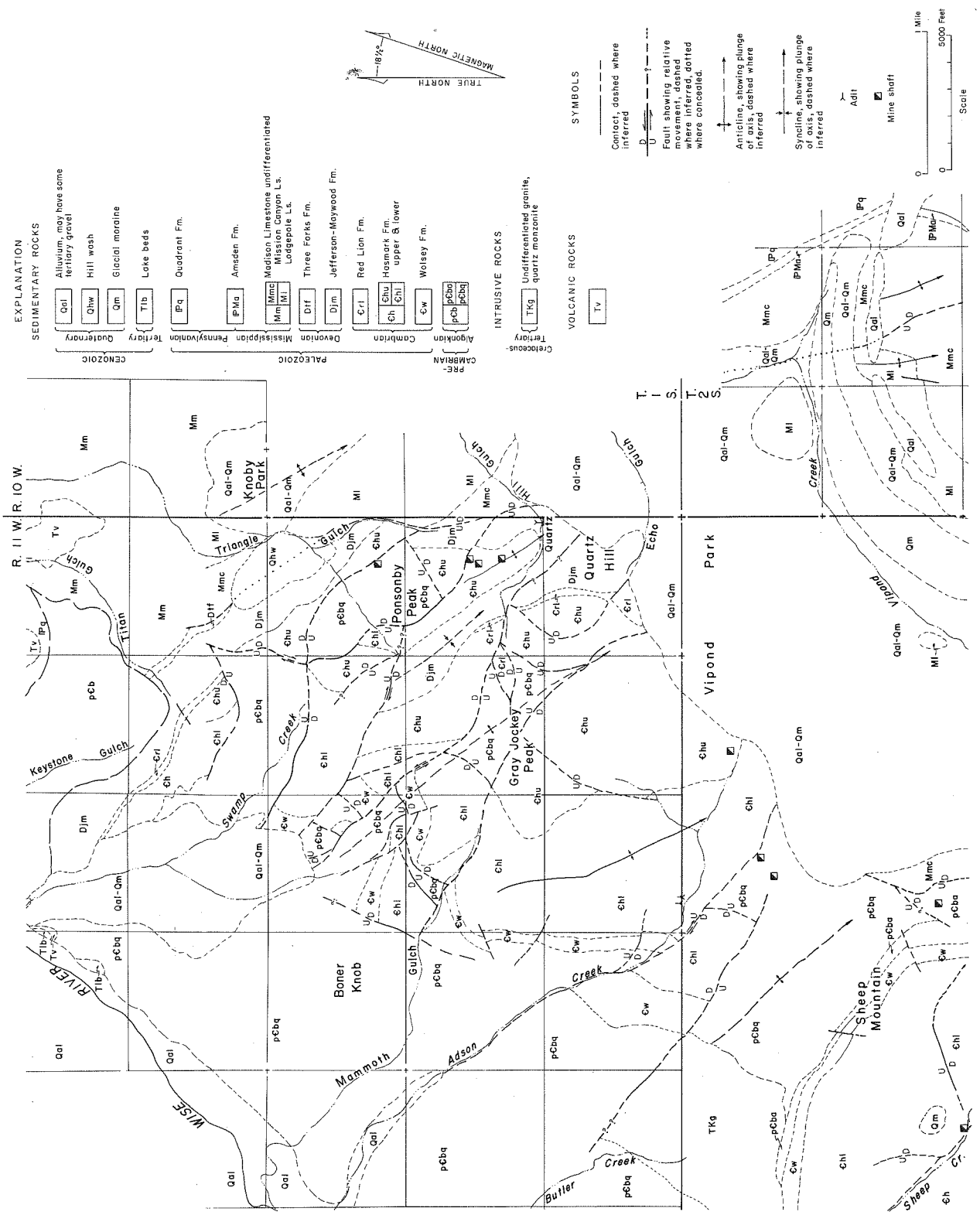


Figure 68.—Geologic map of the Vipond Park and Quartz Hill district. (Guttormsen, 1952; Obert, 1962).

Table 17. — Production of gold, silver, copper, lead, and zinc from lode mines, Quartz Hill and Vipond Park districts, 1902-65, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)	Total value
1902-04	no production						
1905	100	-----	2,781	3,589	28,000	-----	$ 3,556
1906	no production						
1907	95	-----	2,162	-----	-----	-----	1,427
1908	301	30	8,730	950	-----	-----	5,377
1909	93	1	2,758	253	-----	-----	1,484
1910	no production						
1911	14	-----	479	-----	-----	-----	255
1912-13	no production						
1914	9	10	39	88	-----	-----	226
1915	9	14	4	-----	-----	-----	288
1916	no production						
1917	18	1	699	691	3,027	-----	1,040
1918	78	4	1,933	1,408	4,778	-----	2,701
1919	43	-----	1,262	1,649	-----	-----	1,726
1920	17	-----	317	838	11,644	-----	1,435
1921	231	203	1,906	208	16,483	-----	6,868
1922	15	9	5	-----	-----	-----	190
1923-26	no production						
1927	17	-----	422	-----	-----	-----	239
1928-31	no production		-----	-----	-----	-----	55
1933	773	15	27,080	4,562	-----	-----	10,071
1934	3,047	55	84,973	14,900	3,000	-----	58,173
1935	6,959	78	172,242	40,217	-----	-----	129,876
1936	11,159	49	242,949	63,163	-----	-----	195,690
1937	5,121	4	95,839	21,875	-----	-----	76,918
1938	736	7	12,246	1,500	-----	-----	8,309
1939	922	184	12,801	-----	-----	-----	15,129
1940	2,597	110	46,531	-----	-----	-----	36,939
1941	3,774	116	62,932	-----	1,400	-----	48,892
1942	981	43	16,778	200	600	-----	13,500
1943	957	6	18,211	3,100	800	-----	13,623
1944	844	13	12,915	2,200	-----	-----	9,936
1945	31	-----	1,395	-----	-----	-----	992
1946	90	1	1,073	-----	-----	-----	902
1947	5,249	43	48,568	11,100	1,500	-----	48,006
1948	2,714	29	57,578	-----	-----	-----	53,126
1949	1,184	7	21,084	-----	-----	-----	19,327
1950	631	23	12,997	1,400	800	500	13,038
1951	257	12	4,728	4,000	-----	-----	5,667
1952-57	no production						
1958	5,686	28	31,712	10,000	-----	-----	32,311
1959	no production						
1960	10	-----	62	-----	-----	-----	56
1961-65	no production						
Undistributed	2,457	20	16,294	11,100	-----	-----	24,065
Total	57,221	1,118	1,024,485	198,991	72,032	500	841,413

rocks. The stock crops out at the base of Sheep Mountain in sec. 32, T. 2 S., R. 11 W. and unsurveyed sec. 5, T. 3 S., R. 11 W. The granite is composed of 46.3 percent perthite, 10.4 percent oligoclase, and 40.2 percent quartz. Accessory minerals are biotite, hornblende, apatite, muscovite, and epidote (Obert, 1962, p. 52).

Most of the ore deposits within the district are fissure veins in Hasmark Dolomite along the flanks and nose of the Quartz Hill anticline and on the south flank of the Gray Jockey Mountain anticline. At the Lone Pine mine, the principal producer in the district, the best deposits were bedding-plane replacements localized at the contact between the Hasmark Dolomite and overlying Red Lion Shale.

The ores contain small amounts of lead (galena) and zinc (sphalerite) but are valued only for their silver, most of which is contained in the primary mineral freibergite (silver-rich tetrahedrite). Supergene silver minerals include pyrargyrite, stephanite,

argentite, and dyscrasite, as well as native silver (Goudarzi, 1941, p. 34). Some of the rich silver ore can be recognized visually by the amount of copper stain on weathered surfaces. Gangue minerals are white crystalline cavernous quartz, brown or gray fine-grained quartz, barite, which occurs in tabular crystals an inch or so long in a fine-grained quartz matrix, and some disseminated pyrite.

AURORA

The Aurora mine, on patented ground in sec. 10, T. 1 S., R. 11 W., is about 3,300 feet northwest of the West Lone Pine mine.

The mine workings consist of two shafts, one 80 feet deep and the other about 50 feet deep, sunk on a near-vertical east-trending fissure vein that cuts Hasmark Dolomite. The vein is 5 to 6 feet wide

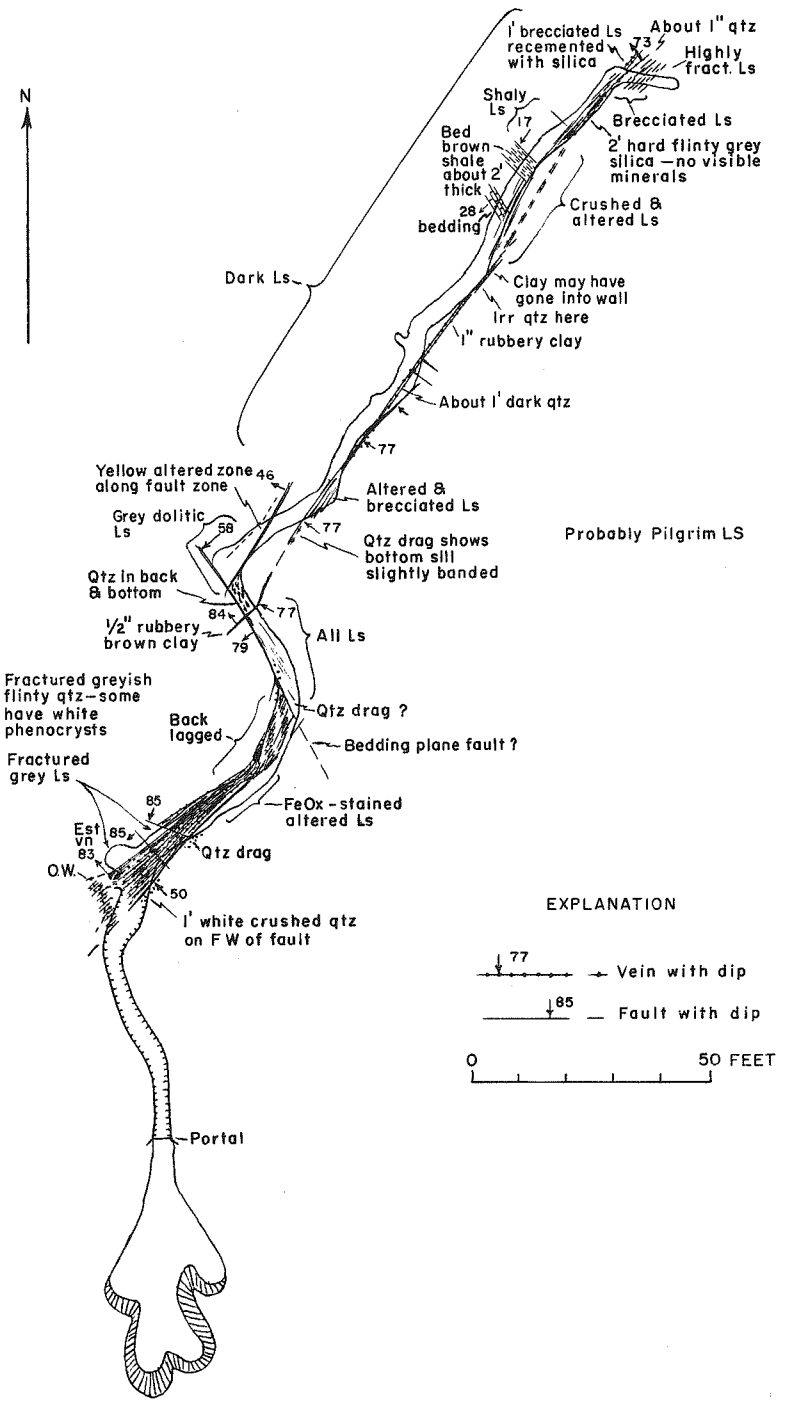


Figure 69.—Geologic sketch of Vega adit, Burgierosa group, Vipond Park district.

at a depth of 80 feet and was displaced by a small fault (Goudarzi, 1941, p. 44).

Vein minerals consist of barite associated with argentite and native silver in quartz.

Production was recorded from the property in 1933-36 and 1941 and totaled 663 tons of ore, which yielded 4 ounces of gold, 13,746 ounces of silver, and 1,914 pounds of copper.

BLUE BELL

The Blue Bell mine, erroneously identified as the Blue Belt mine on Forest Service and topographic maps, is very near the common boundary between unsurveyed sec. 8 and 17, T. 2 S., R. 11 W. The property, which is unpatented, can be reached either by trail up Sheep Creek, which drains into Wise River, or by trail down Sheep Creek via Queens Gulch.

The mine workings are along the bank of Sheep Creek and consist of two shallow shafts, both now filled with water to their collars. The country rock is thin-bedded limestone that weathers white and is part of the Hasmark Formation. The limestone beds strike N. 39° W. and dip 89° NE. The shafts probably explore bedding-plane veins not visible at surface. About 100 pounds of vein material piled on one of the dumps consists of honeycombed quartz stained by iron oxides.

In 1963 the shaft was pumped out but no ore was found.

The property has no record of production under the name Blue Bell.

BURGIEROSA

The Burgierosa group consists of thirteen unpatented claims held by George S. Gluck of Ramsay. The claims are in sec. 34 and 35, T. 1 S., R. 11 W., at an altitude of 7,200 to 8,400 feet. They are accessible by a forest road leading off from the Quartz Hill Gulch-Vipond Park road.

Four parallel nearly vertical fissure veins cut the Hasmark Formation and trend north northeast. From west to east they are the Madison, Jefferson, Burglind, and Vega. The principal work has been done on the Burglind and Vega veins. On the Burglind claim, the main working is an old shaft 17 feet deep, which was cleaned and retimbered; it shows a zone of mineralized quartz stringers and bunches of galena in the hanging wall of the zone (George S. Gluck, written communication). A sample taken by the owner from a small ore pile assayed 4.7 percent lead, 0.9 percent copper, and 25.0 ounces of silver per ton.

On the Vega and ajoining Polaris claims, the Vega vein has been traced by float, dozer cuts, shallow prospect shafts, and an adit over a distance of about 2,200 feet. On the Polaris claim, the vein is exposed in an old inclined shaft 60 to 70 feet deep, which was reopened and retimbered for 21 feet. At 11 feet from the collar, a quartz vein about 4 feet wide was exposed on the north side of the shaft; the vein on the south side of the shaft had been mined. A sample of the vein on the north side of the shaft assayed 3.4 ounces of silver per ton (George S. Gluck, written communication).

On the Vega claim, the vein is exposed by an adit (Fig. 69) driven during the summers of 1960, 1961, and 1962. Where the adit cuts the vein 60 feet from the portal, the vein is about 8 feet wide and contains gray fine-grained quartz and a few anhedral white quartz crystals but no visible sulfide minerals. The vein has been exposed by a drift for about 50 feet to the northeast, where it is terminated by a fault that strikes N. 30° W. and dips 79° SW.; drag along the fault indicates left lateral displacement. A crosscut driven along the fault into the hanging wall country rock for a distance of 20 feet has exposed a parallel vein or the faulted extension. This vein has been explored over a distance of 140 feet, but it is only about 1 foot wide. It is composed of gray fine-grained quartz, but certain parts are darker. Veins or vein segments may contain small amounts of finely disseminated silver-bearing minerals not visible to the naked eye.

The only known production from the group in the period 1902-65 was in 1950, when ore was shipped from the property by George S. Gluck and Frank Wegerstall. Actual production figures are confidential.

EAST AURORA

The East Aurora mine is east of the Aurora mine and is on patented ground.

The mine is near the Hasmark-Red Lion contact on the east flank of the Quartz Hill anticline. The mine workings (Fig. 70) consist of a vertical shaft 48 feet deep sunk in Hasmark Dolomite and an inclined shaft sunk along the strike of the Aurora vein toward the Hasmark-Red Lion contact. Ore was mined from the inclined shaft both vertically and horizontally. The vein is about 3 feet wide and

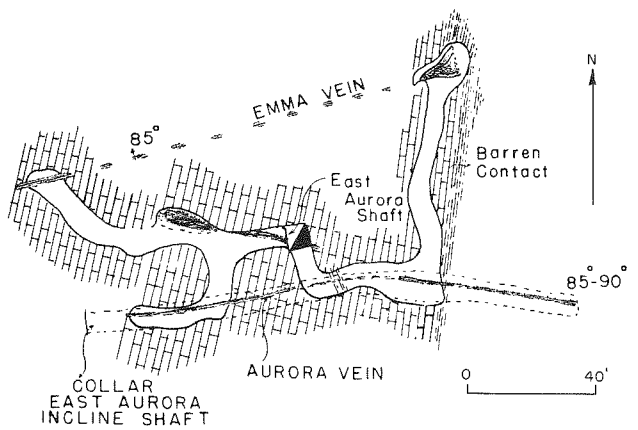


Figure 70.—Geologic sketch of East Aurora mine workings, Quartz Hill district. (Goudarzi, 1941).

selected ore samples assayed as much as $451 per ton, principally in silver (Goudarzi, 1941, p. 46).

The west extension of the Emma vein is about 50 feet north of the Aurora vein and was mined from underground workings driven off the 48-foot shaft. The vein abuts against the dolomite-shale contact and merges into a small replacement ore body. Both the veins trend northeasterly and are nearly vertical.

The property has no record of production under the name East Aurora.

FAITHFUL

The Faithful mine is in unsurveyed sec. 3, T. 2 S., R. 11 W., on the south side of Adson Creek. The property consists of a patented claim owned by Helen J. Browne. The mine is accessible by a Forest Service road that leads off the Quartz Hill Gulch-Vipond Park road.

The country rock is Belt sedimentary rock consisting principally of red-brown quartzite and cobble conglomerate beds that strike about N. 60° W. and dip 55° SW. The Belt rocks presumably are in fault contact with the Hasmark Formation along a northwest-trending fault; Adson Creek follows the fault trace.

The deposit consists of a quartz fissure vein (Fig. 71), which strikes N. 35° E. and dips 87° NW. The vein seems to be lenticular, as it is about 50 feet thick at the Faithful shaft and 8 to 12 feet thick at short distances northeast and southwest of the shaft, but there the outcrop of the vein is covered by overburden. The vein filling is massive to honeycombed white quartz stained by iron oxides. Some vein fragments show minor copper stain, and some small cubes of galena were found. Finely disseminated black tourmaline needles were noticed in gray vitreous quartz.

The deposit is developed by a vertical two-compartment shaft sunk in the footwall of the vein where the vein is the widest (Fig. 71). The shaft is inaccessible, as the manwav collar sets are broken. The depth is estimated to be at least 100 feet. A grab sample of the best pieces of ore around the shaft assayed 0.28 percent copper, 2.35 percent lead, 1.3 percent zinc, 6.30 ounces of silver, and 0.020 ounce of gold per ton. Total recorded production from the property is 268 tons of ore, which contained 3 ounces of gold, 1,569 ounces of silver, 507 pounds of copper, and 2,800 pounds of lead. This ore was produced in 1937, 1941-43, and 1959.

GOLD COIN

The Gold Coin mine is on the north face of Sheep Mountain at an altitude of about 8,800 feet. It can be reached by a forest road to the base of Sheep Mountain and then by a footpath up the north face of Sheep Mountain.

The country rock on the north face of Sheep Mountain (but not the mountain crest) is brown quartzite of Belt age, which strikes N. 60° W. and dips 55° SW. The quartzite forms a steep jagged face at the head of a south tributary to Adson Creek. Along this face the narrow footpath, hardly a foot wide in places, traverses a ledge of quartzite for a distance of about 1,500 feet. Along the ledge is exposed a

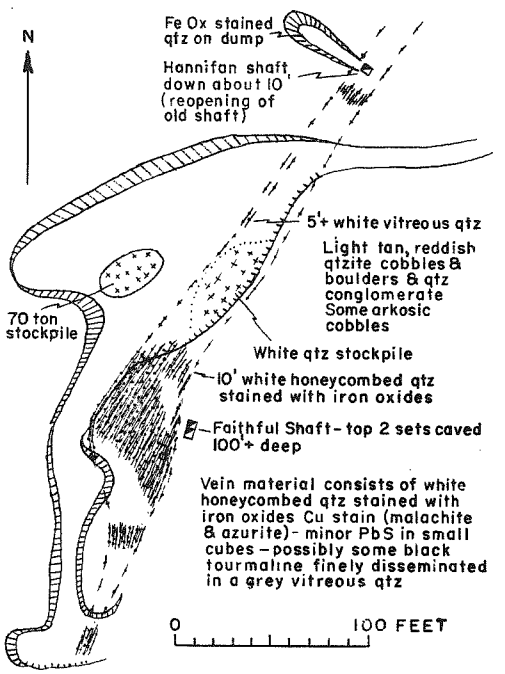


Figure 71.—Geologic sketch of workings on Faithful claim, Vipond Park district.

bed of gray-blue slate about 15 feet thick parallel to the overlying and underlying quartzite. The slaty bed is intensely fractured, the fracture cleavage trending nearly at right angles to the strike. At the south end of the path are the remains of two old adits, both of which are now caved. The only signs of mineralization were a few pieces of white quartz float containing some iron oxide stain.

Local stories about the property are that it was worked before the turn of the century and that high-grade gold ore was found in narrow quartz stringers in the gray-blue slate. Corry (1933, p. 28) reported that bonanza ore was found, which yielded 55 ounces of gold per ton.

The property has no record of production.

GRAY JOCKEY

The Gray Jockey mine is on a patented claim in sec. 2, T. 2 S., R. 11 W., at the head of Adson Creek. The mine workings are on the western margin of Vipond Park and only a short distance from the Quartz Hill Gulch-Vipond Park road. The property is held by Mabel Martin Jacob and others.

The deposit is in the upper part of the Hasmark Formation on the southwest flank of the Gray Jockey anticline and is a fissure vein, which strikes about N. 20° E. and dips 32° to 63° NW. The vein is exposed by a shallow open cut about 60 feet long and is 5 to 10 feet wide (Fig. 72). The vein filling consists of massive white quartz containing some disseminated tetrahedrite or freibergite. Weathered vein surfaces in places show some copper staining. About 100 feet northeast of the surface cut, along the trend of the vein, is an old shaft, now caved at the collar. From the size of the dump, the shaft is judged to be probably several hundred feet deep. Most of the dump material is gray oolitic limestone; there are some fragments of white quartz vein material. About 45 feet southwest of the surface cut, the vein has been explored by a small inclined shaft, only the upper 10 feet of which is accessible.

Production from the property was recorded in 1917-19, 1936-37, 1951, 1961-62, and 1965, and totaled 2,161 tons of ore, which yielded 18 ounces of gold, 22,789 ounces of silver, 18,094 pounds of copper, and 1,634 pounds of lead.

GREAT WESTERN

The Great Western vein is on patented ground owned by the Quartz Hill Mining Company and is about 1,500 feet northwest of the Lone Pine mine. The vein trends northeast through Hasmark

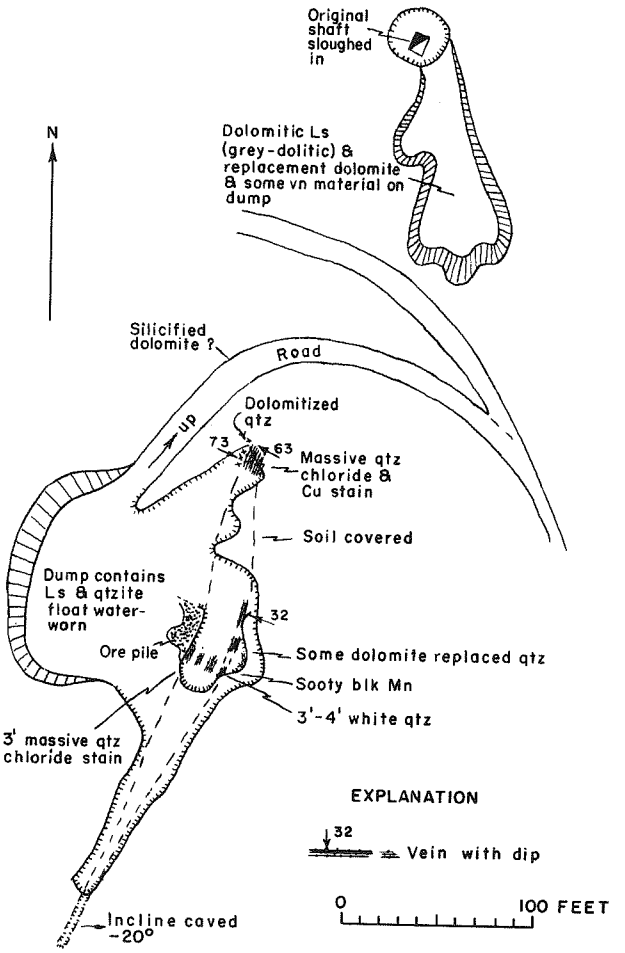


Figure 72.—Geologic sketch of Gray Jockey mine, Vipond Park district.

Dolomite and crops out on the crest of the Quartz Hill anticline.

The mine workings consist of a shaft 54 feet deep and about 200 feet of horizontal workings near the dolomite-shale contact (Fig. 73). A vertical high-grade replacement deposit in the shale was mined at the dolomite-shale contact, which trends north-south; some ore was produced from a fissure vein that cut across the dolomite-shale contact (Goudarzi, 1941, p. 43).

The mine has no record of production under the name Great Western.

IRONSTONE

The Ironstone prospect is in unsurveyed sec. 16, T. 2 S., R. 11 W., at an altitude of about 9,000 feet. It can be reached by a Forest Service trail that leads up to a mountain top about 1½ miles southeast of Sheep Mountain. The property was located by Art and Leonella Semsak in 1964.

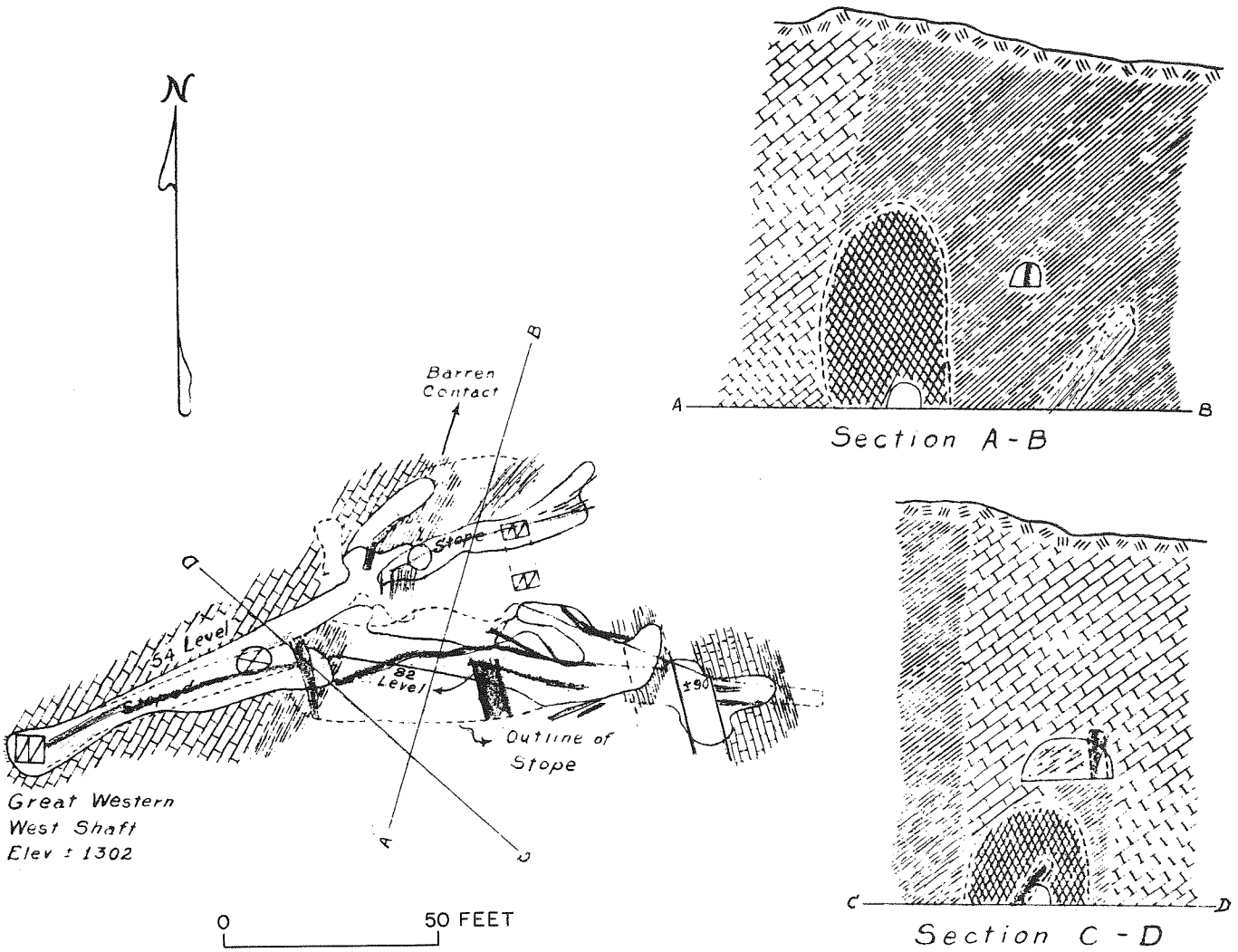


Figure 73.—Great Western mine, Quartz Hill district. (Goudarzi, 1941).

The country rock is gray limestone of the Hasmark Formation. Several pits are dug on the property. One pit is dug on a bedding-plane vein about 1 foot wide, which strikes N. 36° E. The vein filling is iron-stained white and vitreous quartz.

The property has no record of production.

KEYSTONE

The Keystone mine is in sec. 13, T. 1 S., R. 11 W., and can be reached by a road up Triangle Gulch. The property consists of several unpatented claims. The lower mine workings are at an altitude of about 6,500 feet, and the upper workings at about 7,450 feet.

The deposit is a bedding-plane vein in Jefferson Limestone. The vein strikes N. 77° W. and dips 47° NE. At the lower workings it is 2 to 3 feet wide and consists of white fine-grained quartz slightly iron stained. It has been explored by an inclined shaft probably less than 30 feet deep. Some of the vein material has been stoped along the shaft. An adit has been driven to intersect the vein about 50 feet below the shaft; its portal is caved.

The upper workings consist of several surface cuts on the vein and several short adits. The vein here contains fine-grained white and gray quartz; in one cut, euhedral crystals of barite were observed in a matrix of brown fine-grained quartz. Some of the vein material contains sparse blebs of a black sulfide mineral; copper stain on weathered surfaces suggests that it probably is tetrahedrite.

The property has no record of production between 1902 and 1965 under the name Keystone.

LEADVILLE

The Leadville mine is either in sec. 27 or 34, T. 1 S., R. 11 W., and can be reached by the Forest Service road leading off to the west from the Quartz Hill Gulch-Vipond Park road. The property consists of an old unpatented claim relocated as the Leadville in 1962 by Art Semsak and Julius Jackelini, both of Butte.

The deposit is a narrow fissure vein, striking about N. 15° E., that seemingly is a southwest extension of the Tuxedo vein. The mine workings (Fig. 74) consist of two shallow shafts, now inaccessible, spaced about 65 feet apart. Between the shafts, a shallow prospect pit about 4 feet deep has exposed a vein about 1 foot wide; vein material is iron-stained quartz containing disseminated galena. A selected grab sample from a small stockpile near the pit assayed 9.30 percent lead, 3.40 percent zinc, 9.45 ounces of silver, and 0.002 ounce of gold per ton. The country rock is light-gray muddy limestone, probably in the upper part of the Hasmark; it strikes N. 45° W. and dips 10° SW.

The property has no record of production under the name of Leadville for the period 1902-65.

LOG CABIN

In unsurveyed sec. 3, T. 2 S., R. 11 W., about 4,000 feet due west of the Gray Jockey mine, are some old mine workings. The site was relocated as the Log Cabin lode in 1954 by Art Semsak of Butte.

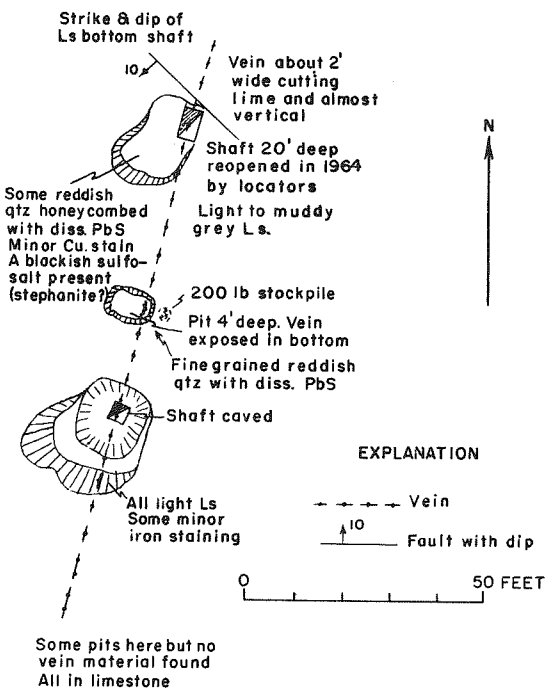


Figure 74.—Sketch of Leadville mine workings, Vipond Park district.

A fissure vein cutting gray limestone strikes about N. 5° E. and dips about 85° W. The vein is exposed for a length of about 500 feet in an adit (Fig. 75), the portal of which is a short distance above the bed of Adson Creek. Underground the vein is lenticular, ranging in width from 3 inches to about 6 feet. It is accompanied in places by brown rubbery fault gouge 2 inches thick and by 2 to 4 feet of crushed gray limestone. Horizontal mullions on the footwall side of the vein indicate that the east wall moved south relative to the west wall. The vein filling is iron-stained fine-grained gray quartz, which shows minor copper stain. At the face of the adit, the vein is 4 feet wide and consists of iron-stained white-gray quartz containing anhedral crystals of barite and a small amount of disseminated galena. The vein has been stoped extensively.

The property has no record of production under the name Log Cabin.

LONE PINE

The Lone Pine mine is on patented ground owned by the Quartz Hill Mining Company. It is at an altitude of about 7,000 feet, and is on the Quartz Hill Gulch road about 4 miles south of Dewey.

The ore deposits consist of bedding-plane replacements localized at the nose of the Quartz Hill anticline (Fig. 76). The ore bodies are in Hasmark Dolomite at the contact with overlying Red Lion Shale. The deposits are at terminations of southeast-trending fissure veins, which cut the Hasmark Dolomite and abut against the shale at oblique angles; the fissures barely penetrate the shale. The mineralizing solutions rising through the fissures were dammed by the impervious shale and spread upward beneath it to form the bedding-plane replacement deposits. Two such deposits have been found, the Lone Pine and West Lone Pine ore bodies. The Lone Pine ore body is localized on the east flank but near the nose of the Quartz Hill anticline and at the termination of a footwall branch of the southeast-trending Argyle vein at the Hasmark-Red Lion contact. The West Lone Pine ore body, found later, is localized near the axial plane of the Quartz Hill anticline at its nose and at the termination of a hanging-wall branch of the Argyle vein at the Hasmark-Red Lion contact. The best ore was found in the bedding-plane deposits; very little commercial ore was found in the fissure veins over a distance of 100 feet from the dolomite-shale contact

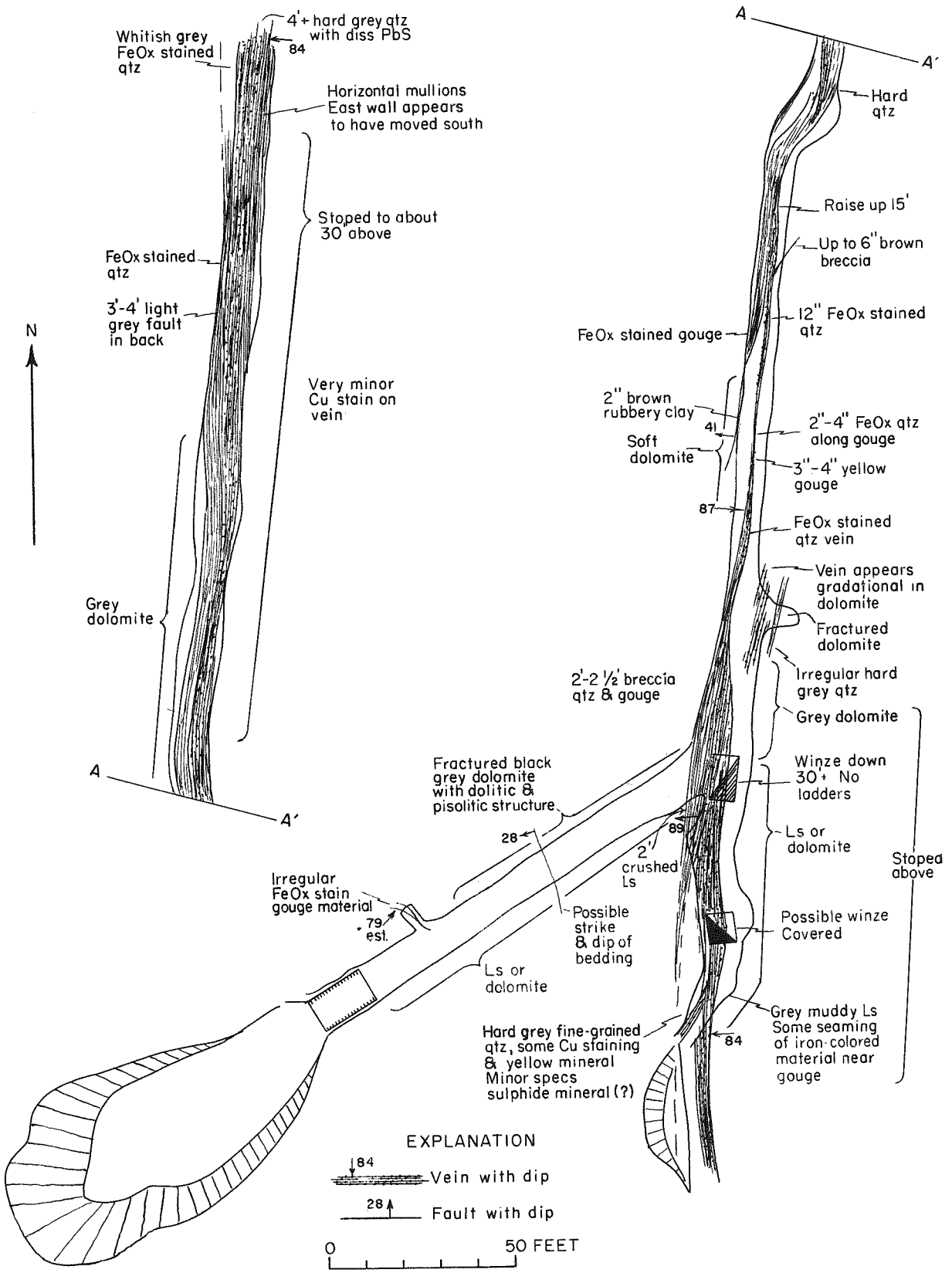


Figure 75.—Geologic sketch of adit on the Log Cabin mine, Vipond Park district.

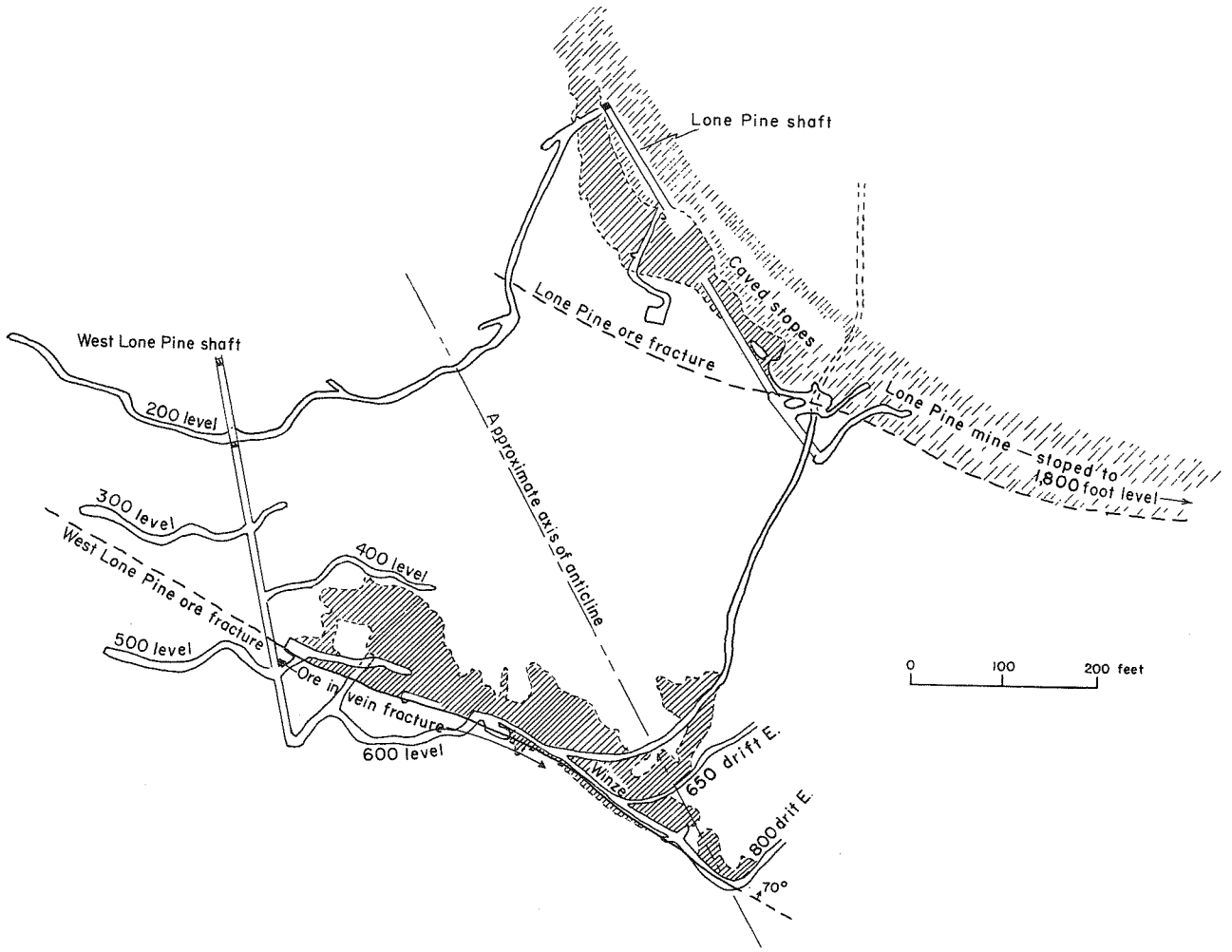


Figure 76.—Isometric drawing of the Lone Pine ore body (Lorain, 1937, Fig. 2).

even though the veins were strong (Taylor, 1942, p. 216).

The Lone Pine ore body cropped out and was mined by means of an inclined shaft. In 1928 the Lone Pine shaft was reopened and a drift on the 200-foot level driven from it along the dolomite-shale contact exposed the top of the West Lone Pine ore body. This ore body was mined by a series of winzes to the 850-foot level; these were later connected to surface by a shaft. Both shafts are now caved at the collar, making the underground workings inaccessible.

Total recorded production from the mine is 47,618 tons of ore, containing 311 ounces of gold, 924,353 ounces of silver, and 163,803 pounds of copper. Most of the ore was produced from the West Lone Pine ore body between 1933 and 1962.

MONTE CRISTO

The Monte Cristo mine is in the SE¼ sec. 24, T. 1 S., R. 11 W., and is accessible by a road that turns off from the Vipond Park-Quartz Hill Gulch road near the Lone Pine mine and continues to Triangle Gulch. The property is unpatented and was relocated by Phil Scalabrin of Butte in 1962.

The country rock is gray limestone of the Hasmark Formation, which crops out on the northeast limb of the Quartz Hill anticline. The limestone trends northwest and dips northeast, but the exact dip is not measurable, owing to poor exposures. The ground surface in the mine area is covered with pink quartzite float.

The deposit is a quartz vein that strikes N. 46° W. and is nearly vertical. It has been developed by a shaft estimated to be more than 200 feet deep. The shaft is inaccessible, its collar sets having fallen down the shaft. The vein has been stoped to surface alongside the shaft.

Vein material on the dumps is iron-stained

cavernous white and gray quartz containing some visible specks of black sulfides. Some of the fragments are copper stained, indicating that the predominant sulfide mineral probably is tetrahedrite.

Total recorded production from the property is 1,131 tons of ore, which contained 5 ounces of gold, 19,872 ounces of silver, 3,626 pounds of copper, and 28,000 pounds of lead. This ore was produced in 1905, 1907, 1934, 1936-40, 1943-44, and 1949-51.

PETTINGILL (RUSHWHITE)

The Pettingill (Rushwhite) mine is about 3,000 feet north of the West Lone Pine and on the east flank of the Quartz Hill anticline. The mine workings consist of an adit (Fig. 77) that was driven westward in Red Lion Shale to the contact with Hasmark Dolomite and then northward along the contact where a replacement ore body was found. Associated with the replacement ore body are narrow quartz veins, some of which strike north-south and some east-west. The ore contained tetrahedrite and some silver sulfides in a gangue of quartz (Goudarzi, 1941, p. 48).

The property has no record of production under the name of Pettingill or Rushwhite.

QUEEN OF THE HILLS

The Queen of the Hills mine is in unsurveyed sec. 10, T. 2 S., R. 11 W., and can be reached by a Forest Service road leading off from the Quartz Hill-Vipond Park road. It is at an altitude of about 8,400 feet.

The deposit consists of a quartz vein enclosed in foliated granitic rock. Fragments of aplitic float probably indicate the presence of aplite dikes in the mine area. The vein strikes N. 42° E. and dips 87° NW. The upper workings consist of an old shaft, sunk on the vein, and stopes to surface on each side of the shaft for a distance of about 100 feet; all these workings are now caved at surface. An unmined segment of vein, exposed at the endline of one old stope, is 1½ feet wide and consists of white quartz stained by iron oxides. The lower workings, about 200 feet below the old shaft, consist of an adit driven in a N. 52° W. direction to intersect the vein at depth. The adit is caved about 75 feet in from the portal.

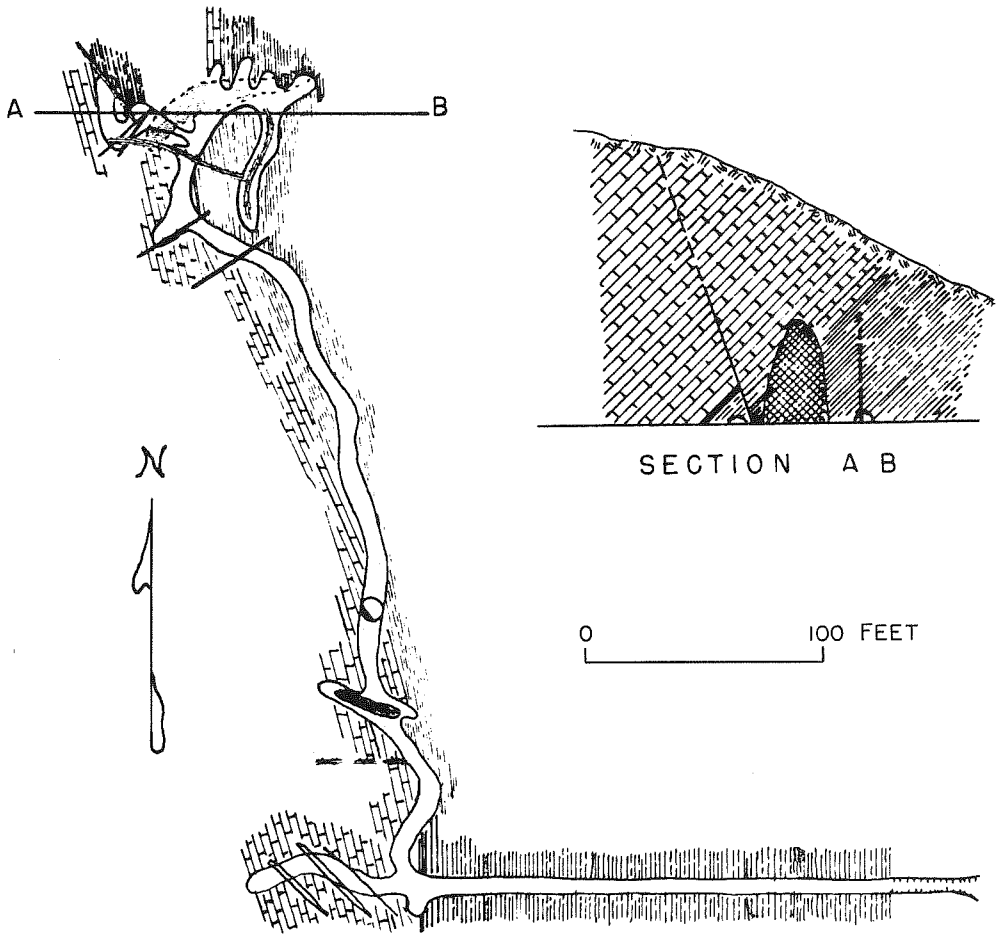


Figure 77.—Geologic sketch of Pettingill (Rushwhite) tunnel, Quartz Hill district. (Goudarzi, 1941).

The vein was intersected by the adit, as there is about a ton of iron-stained quartz vein material on the dump. A selected sample assayed 0.33 percent copper, 6.80 percent lead, 0.30 percent zinc, 0.430 ounce of silver, and 0.30 ounce of gold per ton. The vein was also reported by Winchell (1914, p. 79) to contain native silver, argentite, cerussite, galena, pyrite, and chalcopyrite.

The property has no record of production under the name of Queen of the Hills.

SHEEP MOUNTAIN PROSPECTS

The Sheep Mountain prospects are situated on the top of Sheep Mountain in unsurveyed sec. 9, T. 2 S., R. 11 W., at an altitude above 9,400 feet. They can be reached by a forest trail up the north side of the mountain.

The mountain is capped by light-gray limestone of the Hasmark Formation, which strikes N. 28° W. and dips 27° SW. and overlies Belt rocks.

On the northwest slope of the mountain, near the top, there are several old prospect pits. One is an inclined shaft, probably not more than 15 feet deep, which is caved at the collar. About 1 ton of vein material is piled on the dump and consists of iron-stained white quartz containing some cubical galena. A selected sample from the pile assayed 5.95 percent lead, 0.05 percent zinc, 0.03 percent copper, 1.85 ounces of silver, and 0.005 ounce of gold per ton.

On the southwest slope are the remains of two old adits, both now caved at the portal. Dump material consists of limestone and rusty to tan shale. No ore minerals were noticed.

The prospects are not known to have produced.

SHEEP MOUNTAIN TUNGSTEN PROSPECT

The Sheep Mountain Tungsten prospect (Pattee, 1960, p. 36) is in unsurveyed sec. 15 and 16, T. 2 S., R. 11 W., and is accessible by road up Cannivan Gulch for a distance of 2 miles and then southwest by foot trail a distance of 0.7 mile. (The topographic map of the Vipond Park quadrangle does not show such a road and trail.) The property consists of two unpatented mining claims and is at an altitude of 8,650 feet.

The country rock is quartz monzonite and Cambrian limestone. The quartz monzonite (Pattee, 1960, p. 37) seems to be a stock ¼ to ½ mile wide and about 1 mile long. The deposit is in a white quartz fissure vein in the quartz monzonite. The vein trends northeast and dips 79° SE. and has been exposed across a width of 9 feet. It contains scheelite, wolframite, and powellite, as well as some copper stain. The deposit has been explored by two shallow shafts and several prospect pits. A select grab sample from a dump at one of the shafts assayed 2.68 percent WO_3 (Pattee, 1960, p. 37).

No record of production can be found for the property.

TITANUS

The Titanus mine is about 600 feet due north of the Aurora mine and is on patented ground.

The deposit is a nearly vertical fissure vein as much as 10 feet wide, which trends east-west and cuts Hasmark Dolomite. The quartz gangue contains silver sulfides and some native silver. The vein has been explored by means of a 40-foot shaft and 100 feet of underground workings (Goudarzi, 1941, p. 48).

The property has no record of production under the name Titanus.

TUXEDO

The Tuxedo mine is in either sec. 34 or 35, T. 1 S., R. 11 W., and can be reached by a Forest Service road leading off the Quartz Hill Gulch-Vipond Park road. The Tuxedo is a patented mining claim owned by Lillian M. Pond.

The deposit is on the southwest flank of the northwest-trending Gray Jockey Peak anticline and is in a nearly vertical narrow fissure vein that strikes about N. 35° E., transverse to the general trend of the anticline. The country rock, which dips about 30° to the southwest, is Hasmark Dolomite containing yellow to tan shale estimated to be about 20 feet thick. Both the dolomite and shale are cut by the vein.

The principal workings on the claim consist of a main shaft 80 feet deep (Fig. 78) and two drifts from it. At 40 feet below the collar a drift has been extended northeast for about 100 feet. Near the shaft the vein cuts the shale interbed and consists of 12 to 18 inches of shale gouge in which white quartz lenses as much as 6 inches thick contain blebs of galena. A chip sample of the vein here assayed 0.90 percent lead, 1.20 percent zinc, 8.00 ounces of silver, and 0.020 ounce of gold per ton. The vein along the rest of the drift is concealed by back lagging. The country rock along the sides of the drift is blue to black limestone containing fractures filled with

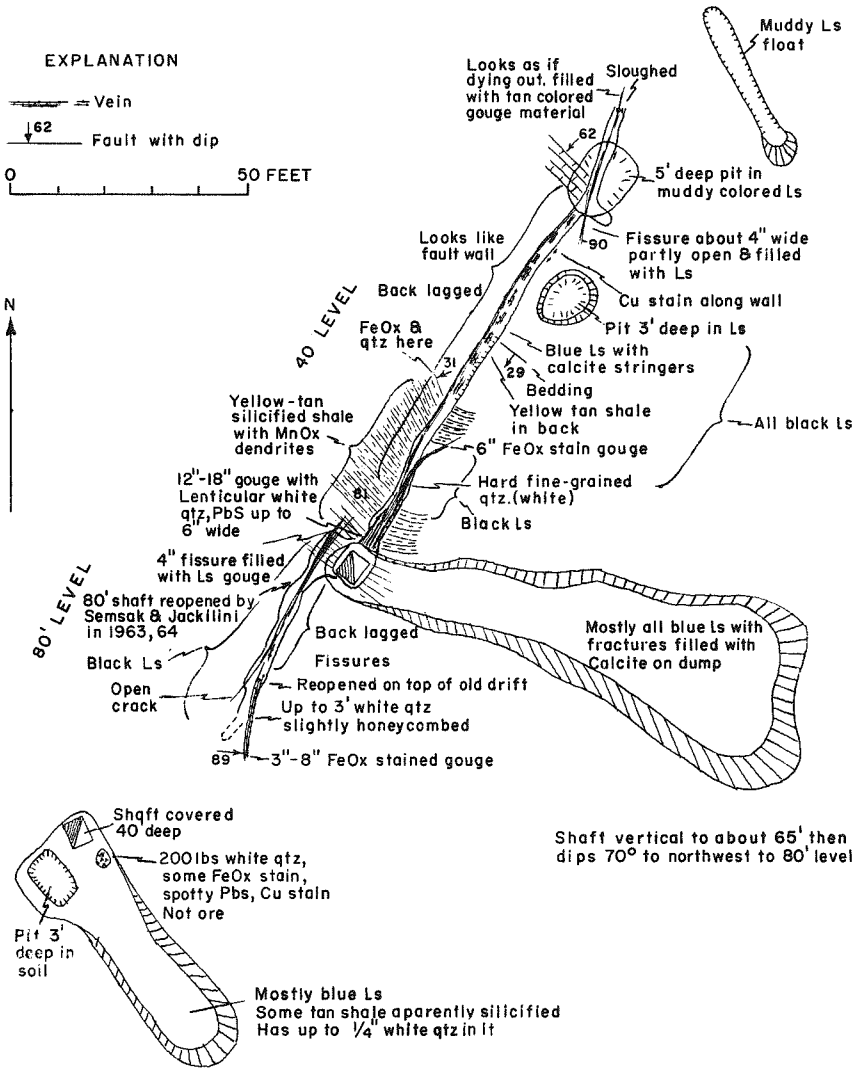


Figure 78.—Geologic sketch of workings on the Tuxedo claim, Vipond Park district.

white calcite. At the bottom of the shaft a drift has been extended about 50 feet to the southwest. It ends in a 3-foot vein of honeycombed quartz slightly stained by iron oxides.

About 80 feet southwest of the main shaft is another shaft about 40 feet deep, which is now inaccessible.

The property has no record of production under the name Tuxedo for the period 1902-65.

WISDOM DISTRICT

For the purpose of this report, the Wisdom district is defined as the mountainous region along the east side of the Big Hole Valley. It includes the drainages of Doolittle, McVay, Steel, Sand, and Sheep Creeks and Fox Gulch.

The terrain is hilly and the altitude ranges from about 7,500 to 9,000 feet. Lodgepole pine forest covers the greater part of the area. Access is difficult, as most of the roads into the district were constructed long ago for horse and wagon and are now so overgrown with trees and brush that they are hardly accessible to vehicles.

Bedrock in most of the district is granite (quartz monzonite), but rocks of the Missoula Group (Precambrian) crop out along the eastern margin toward the Wise River drainage. An aplite and pegmatite facies occurs throughout the quartz monzonite but lamprophyres are unknown. Numerous small and narrow quartz-pyrite veins cut the granite; many of them are associated with aplite. Gold and silver are found in some of these veins but the values are irregularly distributed and individual ore shoots are small.

Table 18. — Production of gold, silver, copper, and lead from lode mines, Wisdom district, 1902-65, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Total value
1902	1,200	630	7,200	-----	120,000	$19,800
1903	no production					
1904	270	257	26,036	-----	3,101	20,831
1905	200	72	-----	-----	5,600	1,752
1906-08	no production					
1909	2	1	59	15	123	47
1910	3	2	1	-----	-----	35
1911	no production					
1912	16	26	199	147	4,929	901
1913-15	no production					
1916	44	7	499	1,445	12,070	1,666
1917	64	10	606	2,594	7,500	2,055
1918-30	no production					
1931	5	16	-----	-----	-----	324
1932	39	27	21	16	-----	570
1933-36	no production					
1937	107	-----	792	125	-----	628
1938	89	30	13	500	-----	1,107
1939	118	23	124	1,196	-----	1,013
1940	159	76	386	894	7,269	3,398
1941	50	23	2	-----	-----	806
1942-46	no production					
1947	1	2	-----	-----	-----	70
1948-59	no production					
1960	4	3	26	-----	-----	129
1961-65	no production					
Total	2,371	1,205	35,964	6,932	160,592	55,132

Mining began in the district about 1869 when Mike Steel, Edward Boyle, and Barney McDonald discovered placer gold in Steel Creek (Sassman, 1941, p. 288). Remains of the early placer operation are clearly visible along Steel Creek where the valley floor meets outcropping granite bedrock along the mountain slope. Tailings from the old operations consist of cobbles of quartzite, granite, and aplite. The deposit resembles an ancient river channel.

Placer production has been very small — probably not more than a few thousand dollars. Annual lode production figures for the district are given in Table 18.

CLARA (MONTY CLINTON)

The Clara mine is in sec. 7, T. 3 S., R. 14 W., very near the east boundary. It is at an altitude of about 7,400 feet in the low foothills bordering the east side of the Big Hole Valley. The mine is readily accessible by a jeep road leading off from a turnoff at the Wilke ranch.

The property is unpatented and was formerly held by Monty Clinton of Wisdom. Mr. Clinton's interest was purchased in 1949 by Al Fischer of Butte, who is the present locator.

The deposit is in a narrow fissure vein cutting quartz monzonite. The vein trends northeast and dips west (Al Fischer, oral communication). Mine workings (Fig. 79) consist of a northeast-trending adit, caved at the portal but estimated to be several hundred feet long, and a 95-foot vertical shaft, which was sunk in 1960. Water has filled the shaft to within 30 feet of the collar. The shaft is about 70 feet up the hill from the portal of the adit and about 20 feet north of the adit line. According to Mr. Fischer, the vein was intersected in the shaft and in a 60-foot crosscut driven northwest from the bottom of the shaft. The vein was reported by Mr. Fischer to be 1 to 1½ feet wide and to contain sulfides and oxides of iron in a gangue of white and vitreous quartz. Its gold content is said to be 1 to 3 ounces per ton.

The only recorded production for a Clara mine for the period 1902-65 was in 1960, when 4 tons of ore yielded 3 ounces of gold and 26 ounces of silver.

MARTIN

The Martin mine is in unsurveyed sec. 19, T. 3 S., R. 13 W., at an altitude of about 8,000 feet. It can be reached by following an old wagon road

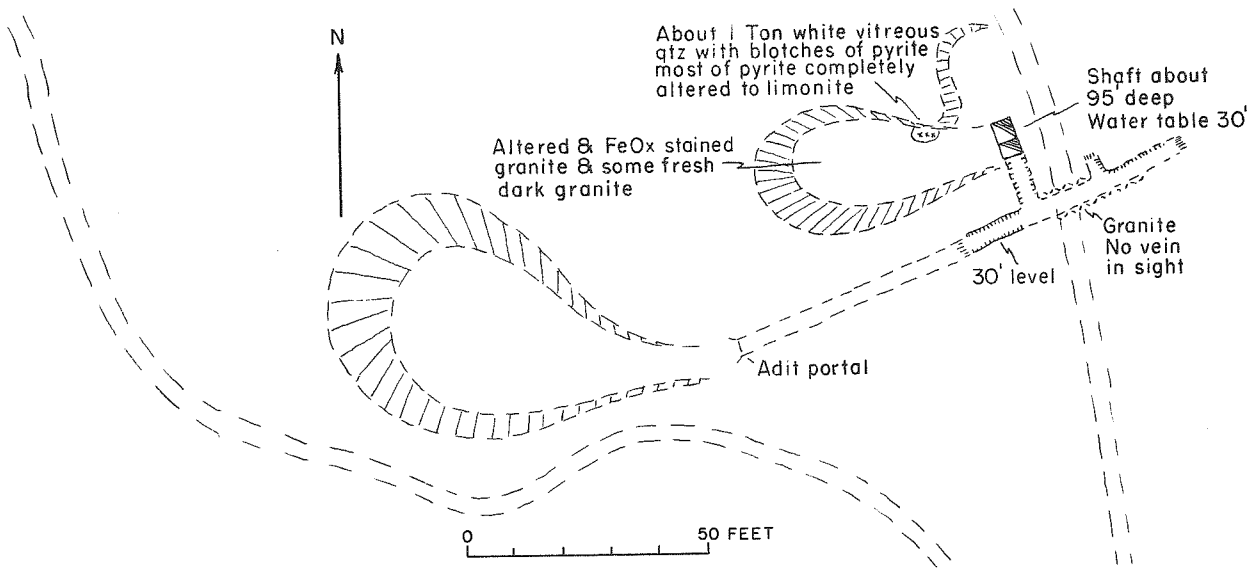


Figure 79.—Sketch of workings on the Clara (Monty Clinton) mine, Wisdom district.

for about 4 miles from Steel Creek divide. The property is unpatented and has been relocated at various times. It is now held by Al Fischer of Butte.

Little is known about the mine's early history. According to Sassman (1941, p. 288), a miner by the name of Ed Brown discovered a lode about 1869, but the sum later spent in its development resulted in no particular success.

The deposit is in a fissure vein cutting quartz monzonite, and the ore minerals are pyrite and subordinate galena and tetrahedrite in a gangue of iron-stained quartz. The vein strikes N. 49° E. and seemingly is nearly vertical. All mine workings are inaccessible, but fragments of vein material on the mine dumps suggest that the width of the vein is probably between ½ foot and 1½ feet. The mine workings (Fig. 80) consist of a shaft, now caved at the collar but estimated to be about 100 feet deep, and two adits, both caved at the portals, 220 feet west of the shaft and about 50 feet lower than the collar of the shaft. About four or five tons of hand-sorted ore is stockpiled beside one of the lower adits. A selected sample from the ore stockpile assayed 1.33 percent copper, 2.39 percent lead, 0.560 ounce of gold, and 70.80 ounces of silver per ton.

The only recorded production from the Martin mine for the period 1902-65 was in 1904, when 70 tons of ore yielded 17 ounces of gold, 26,036 ounces of silver, and 3,101 pounds of lead.

MAYNARD

The Maynard mine is in the NW¼ sec. 2, T. 3 S., R. 14 W., at an altitude of about 7,600 feet. An abandoned wagon road that is blocked by windfalls leads to an arrastre housed in a log building beside Steel Creek. The arrastre is about 200 feet below the mine workings. The grinding boulders with the eyebolts are still in the arrastre. The property is an unpatented claim that was relocated in 1956 as the Shady Rest Lode claim.

The mine workings consist of two adits, one about 200 feet above the other. The lower adit, now caved at the portal, was driven N. 43° E. in quartz monzonite. Dump material consists of quartz monzonite and some quartz stained with iron oxide. A selected sample of this material assayed 0.130 ounce of gold and 0.25 ounce of silver per ton.

The upper adit was driven along a vein that strikes N. 51° E. and dips 63° NW. The portal of the adit is caved, but the vein exposed above it is 3 to 4 inches wide and consists of quartz stained with iron oxide. The granitic rock adjacent to the vein has been chloritized and kaolinized for 2 to 3 feet. A chip sample of the vein above the portal assayed 0.090 ounce of gold and 0.20 ounce of silver per ton. One small piece of vein material contained pyrite and galena.

The property has no record of production. It is certain, however, that some ore was produced from it, probably before 1902, when records of production were started.

PROSPECT IN SEC. 3, T. 3 S., R. 14 W.

Along Steel Creek there is a prospect believed to be about in sec. 3, T 3 S., R. 14 W. As no location

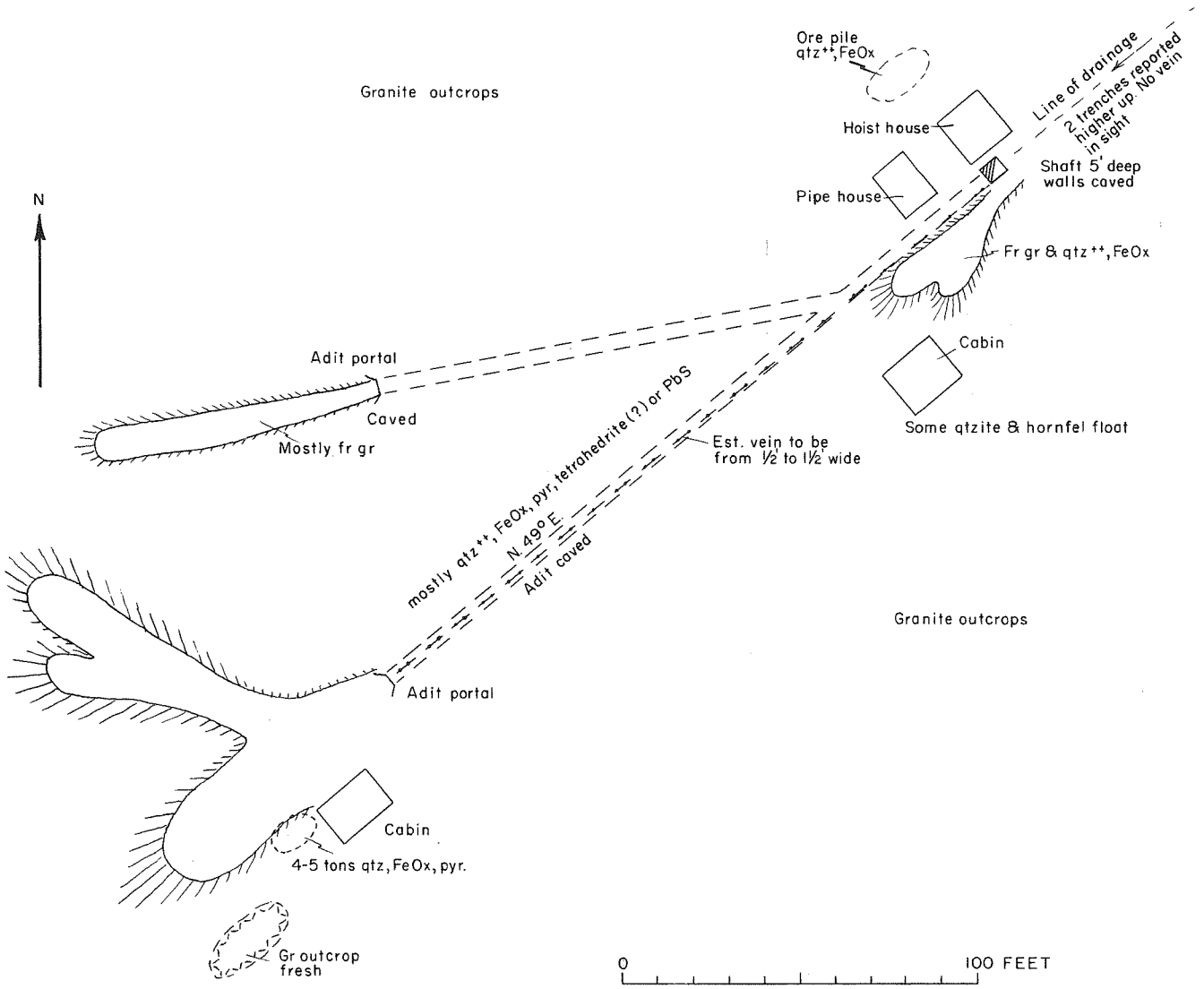


Figure 80.—Sketch of Martin mine, Wisdom district.

notice was found in the vicinity of the workings, the deposit is thought to be unclaimed at present.

The mine workings consist of two short adits, one about 25 feet above the other, driven on a small narrow vein in quartz monzonite. The upper adit is driven 69 feet along the vein, which here trends N. 62° E. and dips 69° NW. and ranges in width from 1 to 3 inches. The lower adit is caved at the portal but is estimated to be 150 feet long. About 1 ton of hand-sorted vein material is stockpiled on the dump of the lower adit. The ore minerals are pyrite and minor sphalerite in a gangue of iron-stained quartz. A grab sample from this pile assayed 1.620 ounces of gold and 2.10 ounces of silver per ton. As the name of the prospect is not known, there is no way of learning whether any ore was shipped from it. The appearance of the property indicates that no ore was shipped.

OTHER MINES

Under this subheading are descriptions of isolated mines that because of their geographical distribution cannot logically be included in any specific mining district, but all are within the Pioneer Mountains mining region.

ATLAS

The Atlas mine is near the head of Clifford Creek and can be reached by foot over an old wagon road 2 miles up Clifford Creek, which is a northwest-flowing tributary to Sheep Creek, which flows into Wise River.

The workings at the mine consist of an adit, now caved at the portal, which was driven S. 82° E. into black limestone. The dump contains about 150 tons of black limestone and some vein material consisting of copper-stained quartz.

The mine has no record of production under the name of Atlas.

BERLIN CLAIM

The Berlin claim is in sec. 10, T. 2 S., R. 9 W., and can be reached by a dirt road that turns off from the Glendale-Melrose road and goes north along the west side of the Melrose Valley for a short distance. The claim was patented in 1890 by Patrick Toole and Leopold F. Schmidt as administrator for the estate of Peter Wagner. Mr. Schmidt later achieved prominence in the Pacific Northwest as the founder of the Olympia Brewing Company of Tumwater, Washington. A half interest in the claim is recorded in the name of the Olympia Tumwater Foundation.

The principal workings (Fig. 81) on the claim consist of an old shaft, now completely caved, and an adit. The portal of the adit is about 200 feet southeast of the shaft and about 100 feet lower than the collar. The January 24, 1885, issue of the Dillon Tribune reported the shaft to have attained a depth of 85 feet, and at a depth of 55 feet to have cut through a vein 4 feet wide and 10 feet of vein matter. The vein is exposed in a small prospect pit about 55 feet northwest of the shaft; there it is about 5 feet wide, strikes N. 75° W. and dips 67° NE. The vein rock is crystalline quartz and goethite showing very minor copper stain. A chip sample across the vein assayed 0.05 percent lead, no zinc, 1.75 ounces of silver, and 0.005 ounce of gold per ton. The vein is said to have yielded some fine specimens of gold ore and in addition contained finely crystalline galena scattered throughout the quartz (Winchell, 1914, p. 95). On surface the vein is enclosed in metamorphosed quartzite, of early Cretaceous age, which is in contact with the northern edge of a small pluton of quartz monzonite.

The adit trends N. 68° W., and for most of its length (250 feet) is driven along a sheared shiny black carbonaceous shale bed, which strikes N. 66° W. and dips 68° to 77° SW. The bed lies between

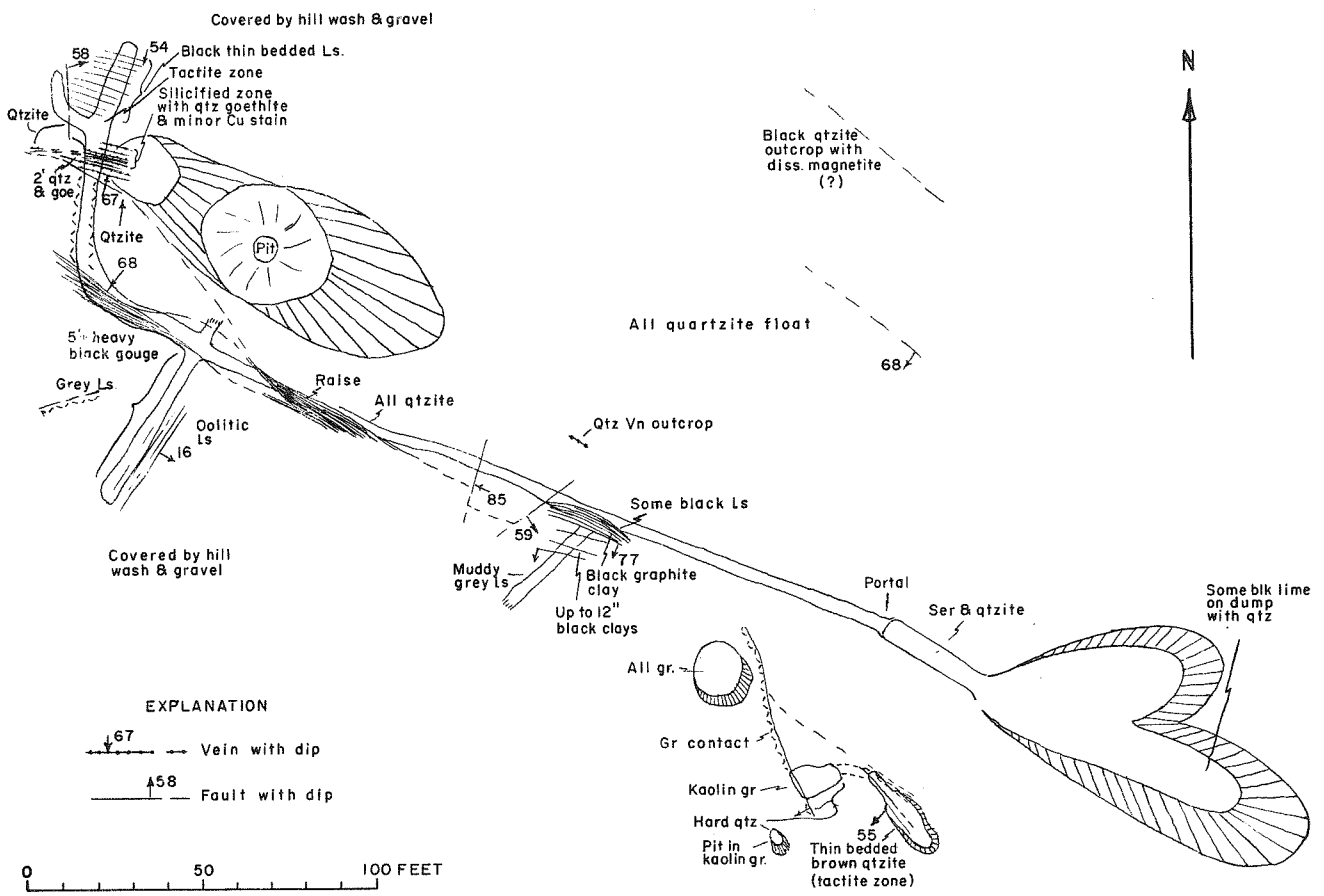


Figure 81.—Sketch of Berlin claim, Pioneer Mountains mining region.

quartzite on the north and gray oolitic limestone on the south. The shale pinches and swells and attains a thickness of at least 5 feet. It is cut by a multitude of tiny shears, which exhibit shiny black slickensides. At the end of the adit, a 70-foot crosscut was driven north to intersect the vein, but the vein has not been exposed, even though the crosscut passes directly beneath and beyond the projection of the vein as it lies on surface. Either the vein was faulted above the level of the adit or it pinches out and does not continue down to the adit level.

The property has no record of production.

CALVERT (RED BUTTON) TUNGSTEN

The Calvert (Red Button) Tungsten mine is in sec. 12, T. 1 N., R. 13 W. The mine can be reached on a right-hand fork from the Bryant Creek road, which turns off from Montana Highway 43 about 7 miles west of Wise River.

The deposit is described by Walker (1963, p. 4), from which the following description is taken. In addition, King (1966) described a beryl specimen, which was found by him on surface a few feet back from the top edge of the high wall of the pit. A few other specimens have been found subsequently. The occurrence is unusual because beryl is not one of the beryllium minerals commonly associated with tactites.

The deposit was found by W. I. Ferguson and George Henderson. In 1956, Minerals Engineering Company of Grand Junction, Colorado, began production of tungsten ore from the deposit and continued until August 1957, when the government tungsten-purchasing program was terminated. The ore was mined by open pit (Fig. 82) and was trucked to the company mill near Glen. About 102,800 tons of ore averaging 1.13 percent WO_3 was mined. In 1959, operations resumed. The pit was enlarged to

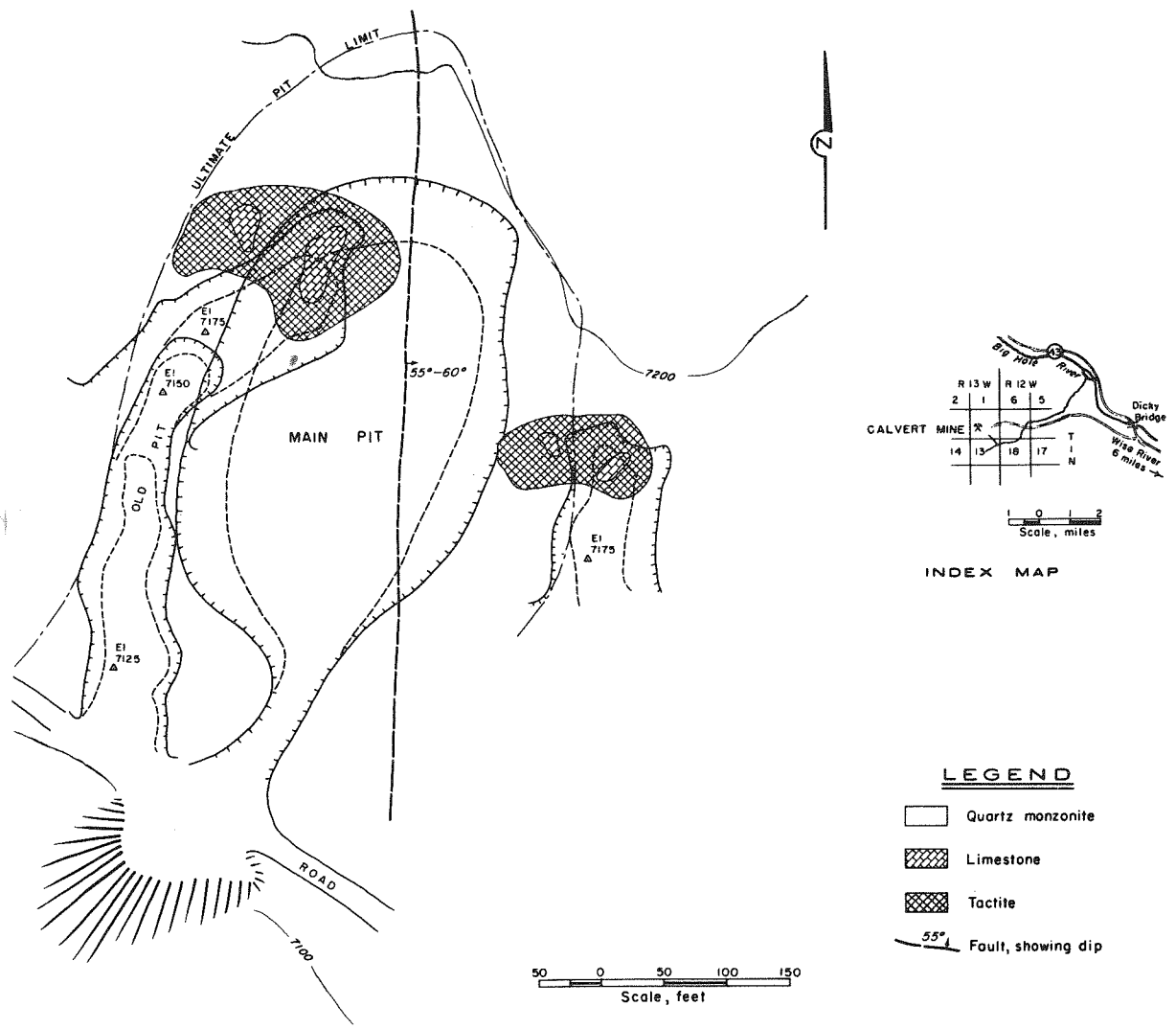


Figure 82.—Calvert mine. (Walker, 1963).

250 by 300 feet across and deepened to 85 feet when mining again was stopped. The amount of ore mined during this period was about 10,000 tons; WO_3 grade ranged from 0.66 to 1.47 percent. In 1966, Minerals Engineering Company did additional core drilling, and in 1967 started an adit below the level of the pit. The adit, if completed would have been directly under the ore bodies in the pit. The plan to mine the ore through the adit by a modified caving system was abandoned because bad ground conditions were encountered during the driving of the adit. The ore is being mined, as before, by open-pit method.

The deposit is a tungsten-bearing garnet-epidote tactite body at the contact between quartz monzonite and buff and white sandy limestone, which is probably the lower part of the Hasmark. The main ore body is about 200 feet in diameter and seems to plunge 45° to the south. About 150 feet east of the main ore body is a smaller ore body.

Tungsten occurs in the mineral scheelite, which is sporadically disseminated in the tactite. Scheelite crystals are about 2 mm across.

CHURCHILL

The Churchill mine is in sec. 5, T. 1 S., R. 10 W., approximately 1 mile west of Dewey and about 400 feet south of Montana Highway 43. The property is in the estate of W. O. Churchill, who made his home at the mine.

The country rock is Madison Limestone, which has been intruded by a small pluton of granodiorite. The east margin of the granodiorite has been explored by a small shaft 53 feet deep. At a depth of 25 feet, the shaft penetrated an irregular iron oxide replacement body that seems to be about 7 feet thick (Fig. 83). A chip sample of this material assayed 0.20 percent lead, no zinc, 0.001 ounce of gold, and 0.20 ounce of silver per ton. Beneath the iron oxide body is an apophysis of fresh granodiorite. Beneath that is marble, stained with iron oxide, and containing two narrow veins of iron oxide.

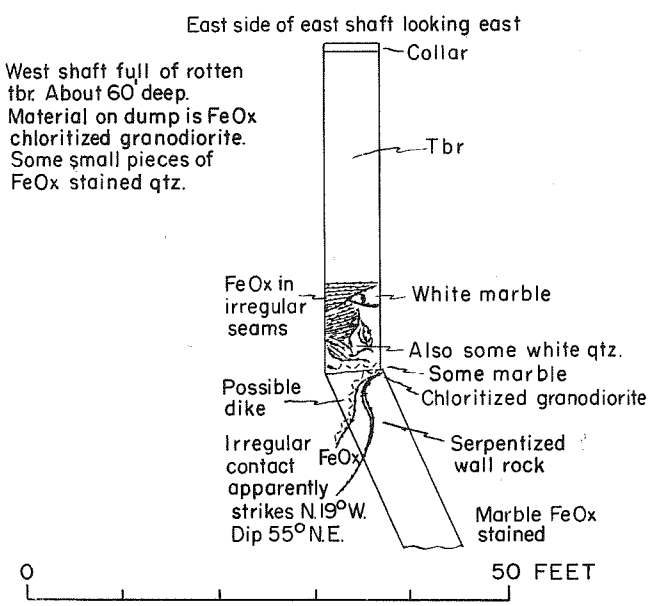


Figure 83.—Geologic vertical section of Churchill shaft.

About 100 feet west another small vertical shaft was sunk entirely in granodiorite. Because the timber is rotten, this shaft was not examined. The country rock in the dump is all granodiorite; the few pieces of vein material consist of iron-stained quartz. A selected sample of this material assayed 0.10 percent lead, 0.05 percent zinc, 0.20 ounce of silver per ton, and no gold.

The property has no record of production under the name of Churchill mine.

FOOLHEN TUNGSTEN PROSPECT

The Foolhen Tungsten prospect is about 2 miles southeast of the Calvert mine. The prospect was described by Walker (1963, p. 7), as being in sec. 19 and 20, T. 1 N., R. 12 W., on the crest of a sharp ridge between Bryant Creek and Alder Creek.

The deposit consists of tactite lenses and pods that range from 80 feet long by 25 feet wide to streaks a few feet long and a few inches wide. The tactite lenses are in medium-grained gray dolomite marble. Scheelite in grains as much as ⅛ inch across is irregularly disseminated through the tactite.

The tactite is exposed in a 1,000-foot bulldozer trench and two short side cuts. A sample from tactite zones exposed in the northwest end of the trench assayed 0.43 percent WO_3. Other samples assayed 0.01 to 0.23 percent WO_3.

The deposit has not produced.

IBEX

The Ibex mine is in unsurveyed sec. 8, T. 3 S., R. 13 W., on the south side of Schwinegar Lake. It can be reached by the Wise River road and a jeep road that goes up Bobcat Creek and thence up Lacy Creek to the lake. The mine is at an altitude of about 8,400 feet.

The country rock at the mine site is quartz monzonite and aplite. The mine workings consist of two adits, one about 100 feet above the other. The lower adit, now caved at the portal, trends S. 3° E. Dump material is quartz monzonite, which is slightly

chloritized, and aplite. Vein material, in pieces as large as 6 inches across, is white quartz in which a few finely divided dark minerals can be seen.

The upper adit is open and is about 140 feet long (Fig. 84). It trends south. It is driven in quartz monzonite, which is cut by a series of quartz stringers 2 to 8 inches wide. Two sets of stringers can be distinguished, a northeast-trending set, which dips 50° to 55° NW., and a west-trending set, which dips about 60° S. The quartz contains some iron oxides that were probably derived from oxidation of pyrite.

The property has no record of production.

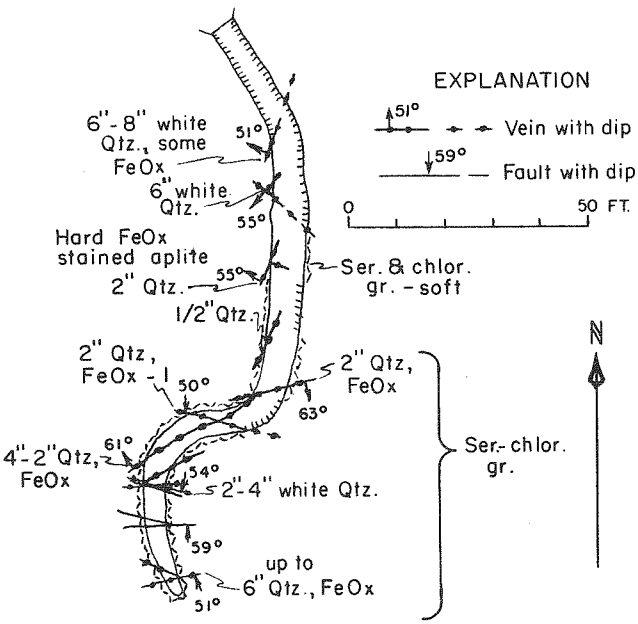


Figure 84.— Geologic sketch of upper adit of Ibex mine.

JOE MAURICE

The Joe Maurice mine is on Gold Creek about 4 miles above its junction with Wise River and about 1 mile due east of Maurice Mountain. It is at an altitude of about 9,000 feet, and can be reached by foot trail up Gold Creek. This area is not surveyed, but if it were, the mine would be in sec. 1, T. 3 S., R. 12 W.

The lower workings consist of an adit, now caved but estimated to be about 75 feet long, driven along a N. 7° E. line. Most of the material on the dump is white marble containing tremolite, but there are pieces of basalt and dark silicified limestone. Fragments of silicified limestone as large as 6 inches across contain layers of magnetite. The limestone country rock strikes N. 6° W. and dips 59° NE. About 100 feet northwest of the adit is a shaft, the top 20 feet of which is open. Material on this dump is marble. Another caved adit is about 100 feet northwest of the shaft. The dump contains iron-stained dolomite. One copper-stained piece was found.

The mine has no record of production.

NORTH STAR

The North Star and South Star properties were not visited; the following information was obtained from the files of the Montana Bureau of Mines and Geology. The patented mining claims, owned in 1963 by Harry and Robert LeBeau, are in sec. 9 and 10, T. 1 N., R. 12 W., about 1½ miles west of Dickey Bridge, which is on the Big Hole River.

The North Star mine was formerly owned by J. L. Templeman; it produced in 1931-32 and 1937-41.

The deposit consists of a flat-lying gold vein 1½ to 2 feet thick in quartzite beneath a shale bed. According to the state geologic map, the country rock is Missoula Group (Precambrian). The deposit has been developed by about 1,000 feet of drifts and crosscuts.

Total recorded production for the property is 424 tons of ore, which yielded 164 ounces of gold, 813 ounces of silver, and 141 pounds of copper.

SODAK MANGANESE DEPOSIT

The Sodak Manganese deposit is on state-owned land in sec. 16, T. 5 S., R. 8 W., about 3 miles east of U. S. Highway 91. The name Sodak is an acronym for South Dakota Uranium and Milling Company, which leased the tract in 1957. The deposit is in a tilted fault block of Quadrant Quartzite, which forms a conspicuous landmark known locally as the Hogback.

Black psilomelane-type manganese oxide fills narrow fractures in the quartzite near its contact with the overlying Phosphoria Formation and on the west side of a 15-foot dike, which cuts across the units. The formations trend N. 45° E. and dip 29° NW.; the dike trends N. 15° E. and dips 88° NW. The dike, probably andesite originally, is now altered to dark-red clayey material speckled with white dots of a mineral that is probably kaolin. A 1-foot white gouge zone cuts across the dike.

The zone of black manganese oxide on the hanging wall of the dike is exposed in a fairly large cut (Fig. 85). Manganese-bearing quartzite is exposed 350 feet farther southwest, where two benches have been cut across the exposures, which are 70 to 130 feet across. On the basis of visual inspection, none

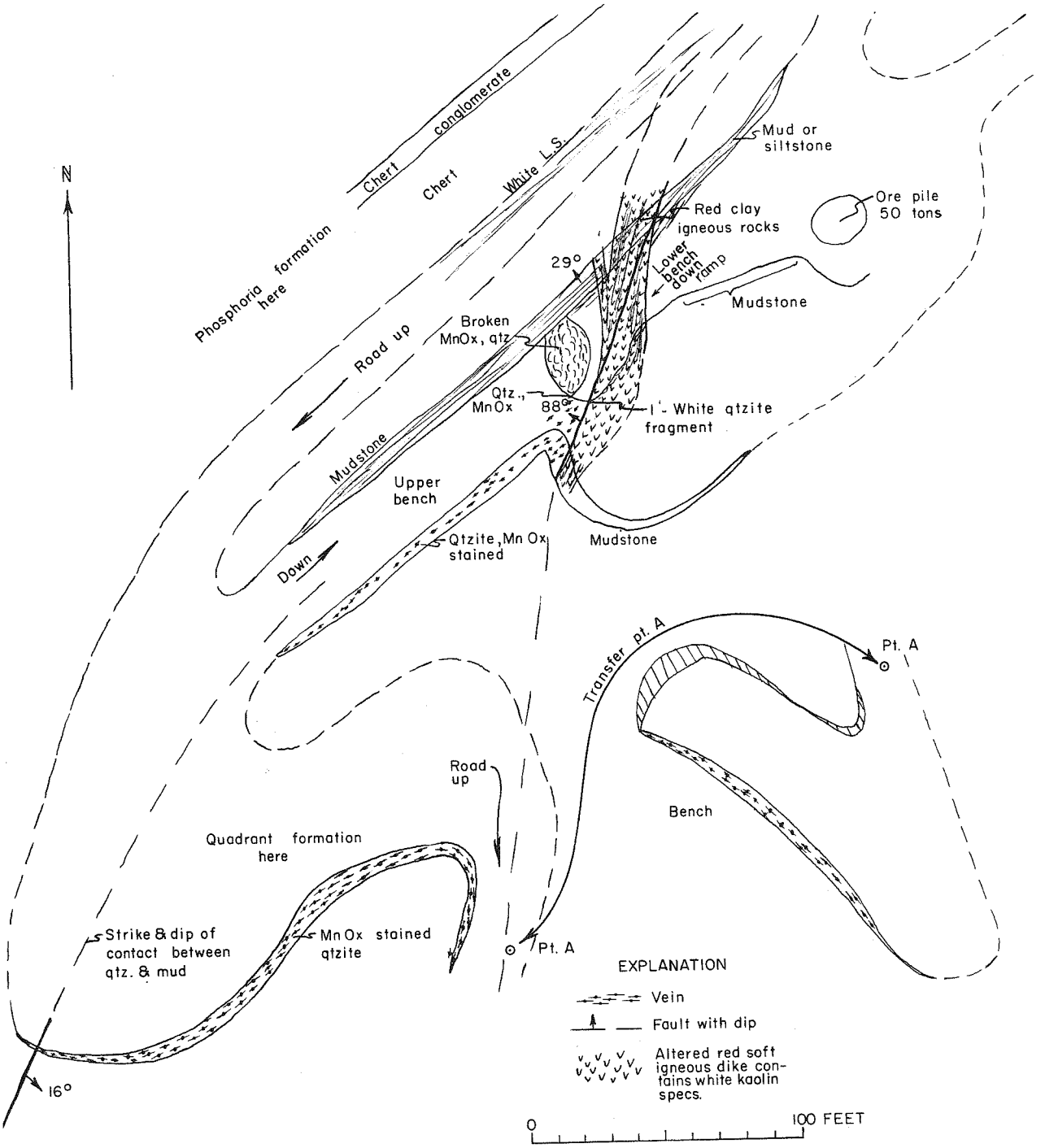


Figure 85.—Sketch of Sodak Manganese deposit.

of the manganese-bearing quartzite is thought to be direct-shipping ore.

The deposit does not have any record of production, although it has been reported (Mining World, March 1958) that manganese ore from this deposit was being processed in the Minerals Engineering Company tungsten mill at Glen.

STAR AND STAR EXTENSION

The Star and Star Extension mine is in the SE¼ sec. 36, T. 1 N., R. 12 W., about 4 miles west of the town of Wise River. The deposit was not visited; the only information on it is in Montana Bureau of Mines and Geology Memoir 20, **Directory of Montana Mining Properties,** page 8, which described

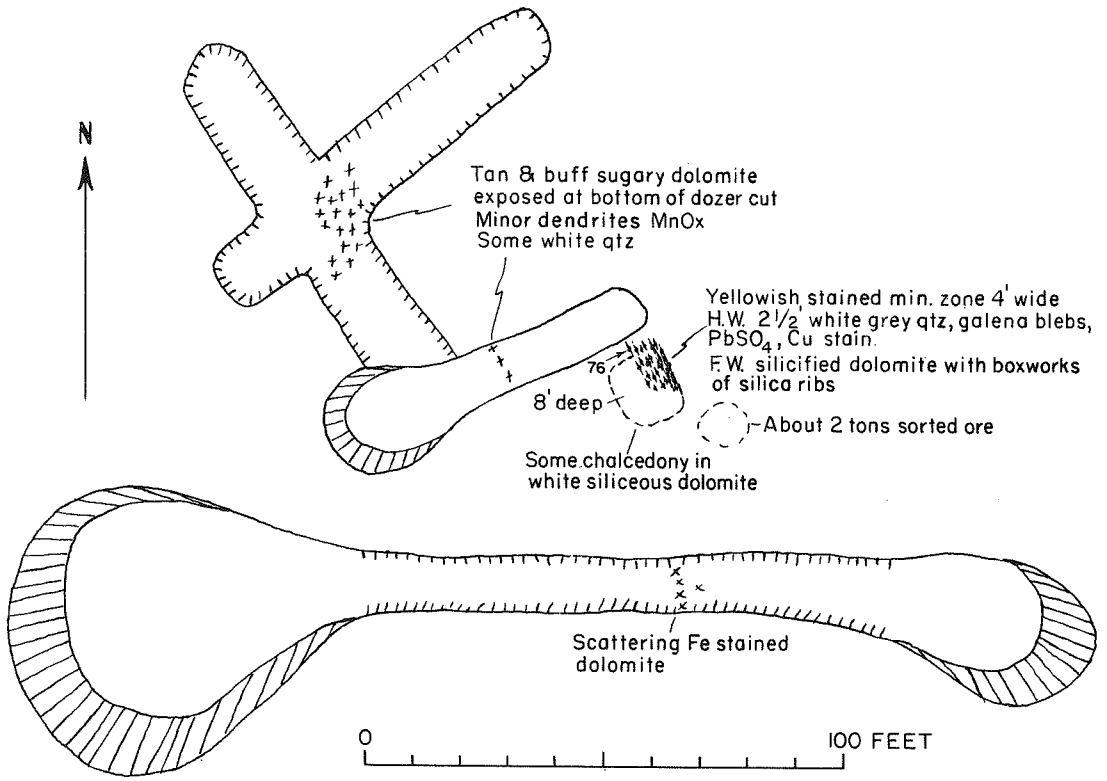


Figure 86.—Sketch of White Cap claim.

the operation as consisting of an open cut, shaft, and tunnel. Production was recorded during the period 1932 through 1959; it totaled 664 tons of ore, which yielded 552 ounces of gold, 780 ounces of silver, 579 pounds of copper, 200 pounds of lead, and 400 pounds of zinc.

According to the state geologic map, the country rock is Missoula Group (Precambrian).

WHITE CAP

The White Cap mine is in the SW¼ sec. 12, T. 1 N., R. 13 W., about ¾ mile due west of the Calvert open-pit tungsten mine, from which it can be reached by a mountain road. The unpatented claim was located in 1956 by George Henderson of Anaconda, Montana.

The country rock is buff sugary dolomite, which is believed to be part of the Hasmark Formation. A prospect pit, 8 feet deep, has been sunk on a 4-foot mineralized zone in the dolomite (Fig. 86). The zone has the characteristic of a vein and strikes N. 30° W. and dips 76° NE. The 2½-foot hanging wall part of the zone is mineralized by white to gray quartz, blebs of galena, and anglesite, and is copper stained. A chip sample across it assayed 0.08 percent copper, 0.25 percent lead, 0.014 percent WO_3, 0.002 ounce of gold, and 0.60 ounce of silver per ton. The footwall of the zone consists of a boxwork of silica ribs in dolomite. A chip sample of this material assayed 0.05 percent copper, 0.20 percent lead, 0.014 percent WO_3, 0.005 ounce of gold, and 0.60 ounce of silver per ton.

Bulldozer trenches have been dug around the discovery pit but no ore was discerned in any of them.

Total recorded production from the property is 10 tons of ore produced in 1960; it yielded 62 ounces of silver.

RUBY MOUNTAINS MINING REGION

The Ruby Mountains mining region is defined, for the purpose of this report, as including the Ruby Mountains and Blacktail Mountains. This region is underlain by gneiss and schist (Precambrian), but younger Paleozoic and Mesozoic rocks and Tertiary volcanic rocks crop out at the north end of the Blacktail Mountains (Fig. 87). It contains the mineral resources typical of a metamorphic province. Among these resources are talc, graphite, sillimanite, corundum, iron, manganese, and pegmatite minerals. Nickel also is known to occur, but the deposit has not been sufficiently explored to pass judgment on it;

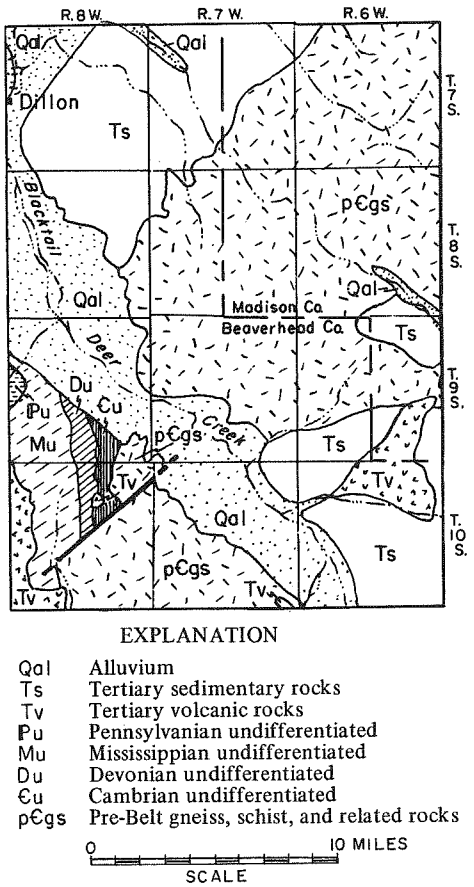


Figure 87.—Geologic map of the Ruby Mountains mining region.

the low nickel content of surface exposures is discouraging. Some base and precious metals have been produced from deposits in the Blacktail Mountains.

Table 19 gives annual production of gold, silver, and copper for these mines.

ASBESTOS

The asbestos in the region was described by Heinrich and Rabbitt (1960, p. 33). The deposits are small but widespread. Asbestos occurs along contacts of diabase dikes with carbonate rock and along contacts of marble with hornblende gneiss. Most of the asbestos is the chrysotile variety, but veins of anthophyllite asbestos are also present. The deposits are too small to be of any commercial significance.

BIRDS NEST GRAPHITE

The Birds Nest Graphite deposit is about 4,200 feet northeast of the Crystal Graphite mine, at an altitude of about 7,500 feet. The deposit was described by Perry (1948, p. 17) and Heinrich (1948, p. 35).

Table 19.— Production of gold, silver, and copper from lode mines, Blacktail district, 1902-65, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Total value
1902-22	no production				
1923	13	1/	5	1,616	$ 243
1924-33	no production				
1934	384	5	6,121	988	4,209
1935	183	2	2,098	-----	1,578
1936	no production				
1937	69	7	31	4,000	753
1938-65	no production				
Total	649	14	8,255	6,604	$6,783

1/ Less than ½ ounce.

The country rock comprises Precambrian gneiss, schist, and marble. The marble is the eastward continuation of the large belt that crops out on the Groundhog claim at the Crystal Graphite mine. A body of aplite-pegmatite 15 to 35 feet thick follows in general the bedding of the marble; it strikes N. 65° E. and is vertical. Graphite occupies veins as much as 3 inches wide and is also disseminated in the aplite-pegmatite; the marble contains no graphite.

The deposit has been developed by three adits, the longest of which is 270 feet. Some of the larger veins have been stoped. Production from the deposit (Perry, 1948, p. 17) was 50 tons, which was mined in 1902. Figure 88 is a plan of the lower mine workings.

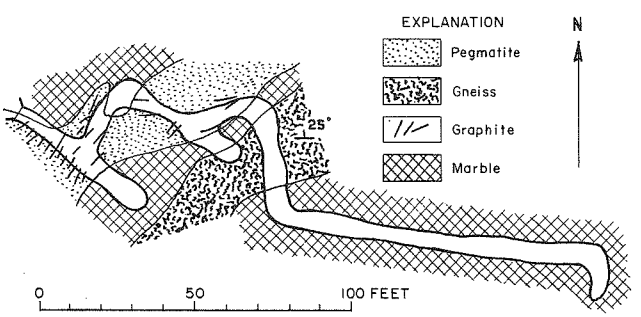


Figure 88.—Lower mine workings of the Birds Nest Graphite deposit. (Perry, 1948).

CAMP CREEK CORUNDUM

The Camp Creek corundum deposit was found in 1949 by Heinrich (1950). It is in the NE¼ sec. 36, T. 8 S., R. 8 W., at an altitude of about 7,000 feet (Fig. 89).

Corundum-bearing rocks occur in a lens of Cherry Creek marble, which is 280 feet long and 100 feet thick at its widest part; the marble lens

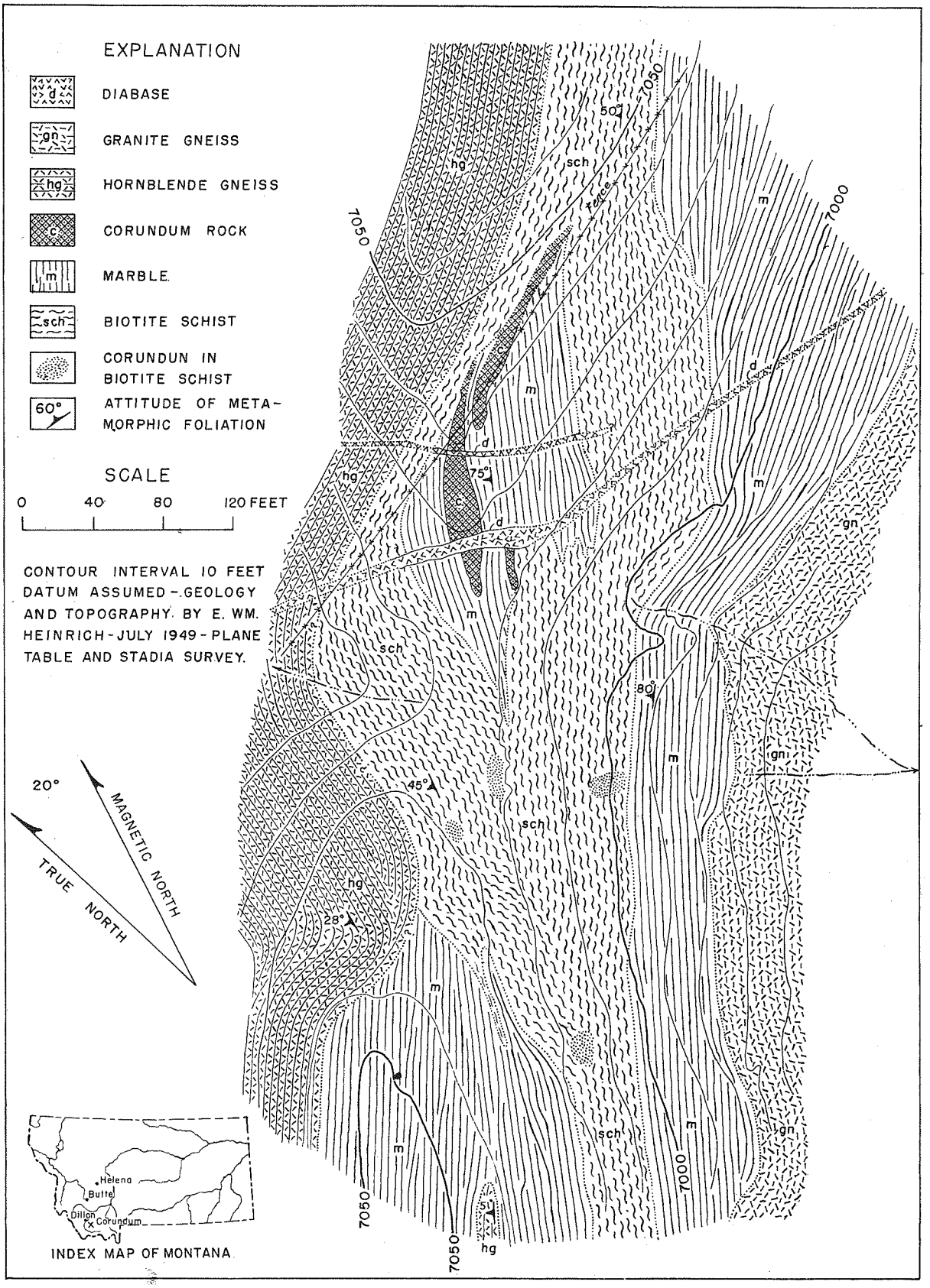


Figure 89.—Geologic map of the Camp Creek corundum deposit, NE¼ sec. 36, T. 8 S., R. 8 W. (Heinrich, 1950, pl. 2).

is enclosed by biotite schist. Three lenticular masses of corundum-bearing rocks lie within the lens of marble near its upper contact with the biotite schist. These three masses range from 20 to 130 feet in length and 4 to 20 feet in thickness. Two narrow vertical diabase dikes cut across the corundum lenses and the biotite schist.

Most of the corundum forms blue-gray barrel-shaped crystals as large as 1 inch in diameter but averaging about ¼ inch. Some narrow veinlike masses consist of small to large anhedral grains. The crystals and grains of corundum are set in a fine-grained matrix of sericite, chlorite, margarite, calcite, and rare grains of magnetite. Heinrich (1950, p. 14) estimated the corundum content of the deposits as ranging from 5 to 35 percent.

In a few places large corundum crystals oriented within biotite-rich layers are disseminated in the biotite schist.

No corundum has been produced from the deposit.

CARTER CREEK IRON

The larger part of the Carter Creek iron deposit is in Madison County, but it extends across the line into Beaverhead County. The deposit has been described by DeMunck (1956) and Heinrich and Rabbitt (1960), and has been mapped in detail by James and Wier (1961). In addition, results of beneficiation and smelting tests on Carter Creek ore have been reported (Holmes and others, 1962).

Heinrich's description of the deposit is as follows:

"Iron. — The main band of iron formation occurs on the southwest side of the Sweetwater fault in secs. 3, 9, and 10, T. 8 S., R. 7 W. The band is locally as much as 1,000 feet wide and has been traced for about 2 miles. The layer strikes northeasterly and is steeply dipping, usually to the northwest. It is bordered on the northwest side (from northeast to southwest) first by sillimanite schist and then hornblende gneiss and on its southeast side first by marble and then by hornblende gneiss.

"The strongly magnetic rock is fine grained and minutely blended with banding commonly crumpled. The chief constituents are quartz, magnetite, and hypersthene. Some varieties are hypersthene-free; others contain grunerite, riebeckite, and apatite as locally significant species.

"Estimates of the mineral composition based on measurements in thin sections are:

	Quartzose bands, %	Magnetite bands, %
Magnetite	2 - 10	25 - 65
Iron silicates	1 - 5	3 - 10
Quartz	85 - 97	25 - 72

"This deposit has been known to geologists since 1948, but efforts to interest iron companies in exploring it were fruitless, until 1956 when the deposit was "discovered" by mining engineers. In the summers of 1957 and 1958 the deposit was being explored by diamond drilling by the Minerals Engineering Company of Grand Junction, Colorado. It is reported that the initial exploration blocked out 52 million tons of ore and that estimates of reserves would be of the order of 280 million tons, which could yield 100 million tons of concentrate grading 63 to 65 percent iron."

No ore has been produced from the deposit except small amounts mined and shipped for beneficiation testing.

COPPER

The Ruby Mountains have been prospected for copper but the deposits found have been small and uneconomical to work. No production has been recorded, but it is possible that small amounts of carefully hand sorted ore may have been shipped by some enterprising souls. Because of lack of time these deposits were not visited; their general characteristics, however, were described by Heinrich and Rabbitt (1960, p. 32).

Chalcopyrite is the chief primary mineral and occurs as disseminated grains either in small replacement bodies of white quartz and calcite or in hornblende rocks partly altered to actinolitic serpentine. At the southeastern end of the Elk Creek fault, six deposits of the first kind are localized in diabase, in pre-Cherry Creek rocks, and in ultramafic rocks of the Wolf Creek pluton. These deposits are spatially and structurally related to the emplacement of the diabase dike along the fault. Accessory pyrite and pyrrhotite occur with chalcopyrite.

Most deposits of the second kind are in Madison County, but two are in Beaverhead County at the front of the Ruby Mountains 1½ to 2½ miles northeast of the mouth of Axes Creek.

On the Log Cabin claim on Hoffman Creek, Winchell (1914, p. 104) noted a deposit consisting of chalcopyrite and pyrrhotite in a gangue of calcite and quartz localized in a fault zone in limestone.

CRYSTAL GRAPHITE

The Crystal Graphite mine is in sec. 29, 30, and 31, T. 8 S., R. 7 W., about 15 miles by road southeast of Dillon. It can be reached by traveling the main county road up Blacktail Deer Creek then turning off on a dirt road up Van Camp Canyon. The mine workings are at an altitude of about 7,500 feet, nearly on top of the ridge between Van Camp Canyon and Timber Gulch.

The deposit has been discussed by Bastin (1912), Winchell (1914), Hum (1943), Perry (1948), Heinrich (1948), Heinrich and Rabbitt (1960), Armstrong and Full (1950), and Ford (1954).

The deposit was discovered in 1899 by Mr. Robbins, but when the graphite proved not to be lead, it was forgotten. Pearl I. Smith became owner of the deposit and in 1901 organized the Crystal Graphite Company. In 1902 the first shipment of graphite, about 50 tons, was made from the Birds Nest claim, which is about 1 mile east of the Groundhog claim. In 1903 the properties were leased to the Copper Cliff Mining Company of Chicago, which operated at the deposit for about a year. From 1904 until 1917 little work was done at the mine. From 1917 to 1920, when graphite prices ranged from 14 to 28 cents a pound, high-quality lump graphite mined principally from the deposit on the Groundhog claim was shipped to eastern markets. Approximately 2,200 tons of graphite is said to have been produced from the deposit between 1902 and 1920, of which two-thirds was produced during the war years (Hum, 1943, p. 30). In 1938 the Groundhog claim was patented, the patent being granted to Ralph I. Smith, the present owner and son of Pearl Smith, who died in 1937. Some development work was done at the property by lessees in 1941, 1943, and 1944, when a 1,050-foot adit 200 feet below the main workings was driven. In 1944 a small flotation mill on the property produced about 150 tons of concentrate, valued at $120 to $200 a ton, from run-of-mine ore and old dumps. The property since has been inactive.

The graphite deposits are localized in Cherry Creek metamorphic rocks, whose foliation in general trends northeast and dips northwest (Heinrich, 1948, p. 33). The principal rock types at the mine are biotite gneiss, hornblende gneiss, and marble; less abundant types are gray quartzite and biotite-garnet-sillimanite schist. These rocks have been intruded by pegmatite and aplite dikes and vertical north-trending diabase dikes. The largest pegmatite dike is 800 feet long and 100 feet wide, and crops out near the nose of a belt of marble 150 to 200 feet thick. The marble layer strikes N. 50° E. and dips 40° to 45° NW. and has been folded into a tight isoclinal fold.

Graphite occurs in veins in gneiss and pegmatite, as disseminations and irregular small masses in pegmatite, and as disseminations mainly in biotite gneiss. The veins pinch and swell, within a few inches forming bunches and pockets of graphite as much as 6 feet thick, and are generally 10 to 20 feet in vertical and horizontal dimensions. The veins can be grouped into mineralized zones 100 to 150 feet across that are believed to be continuous from upper to lower levels. Disseminated graphite is more abundant in the wall rock adjacent to the vein. In the gneiss the graphite is fine grained, being interlayered with the minerals of the gneiss and parallel to the gneissic structure. The graphite in the pegmatite is coarse grained and may occur in blades, rosettes, or irregular masses an inch or two across (Perry, 1948, p. 15).

The deposit has been explored by about 3,500 feet of underground workings through a vertical range of about 350 feet (Fig. 90). Most of the graphite, however, has been produced from stopes on the Smith and Dubie adit levels, and the Hoy level, all of which explore the upper 150-foot part of the deposit. The lowest working is the Antelope level, which is about 200 feet below the Hoy level and consists of an adit driven northward for about 1,050 feet. No graphite is present directly beneath the upper workings, but graphite is present in the end of the adit, which is north of the upper workings (Perry, 1949, p. 17).

Graphite produced from the mine has been a high-grade product, similar in quality to Ceylon graphite, but slightly softer and containing thin iron-oxide films between some of the graphite plates (Bastin, 1912, p. 438). The overall grade of the mill feed is said to have been 8 to 12 percent carbon, and that of the concentrates, 85 to 90 percent carbon (Perry, 1948, p. 17).

DILLON (WOLF CREEK) NICKEL

The Dillon (Wolf Creek) nickel deposit is in sec. 6, T. 9 S., R. 6 W.; sec. 1, 2, and 11, T. 9 S., R. 7 W.; sec. 31, T. 8 S., R. 6 W., and sec. 36, T. 9 S., R. 7 W. The general area of the deposit is accessible by a dirt road that begins at the mouth of Elk Gulch. The position of the road is shown on the Elk Gulch topographic quadrangle map.

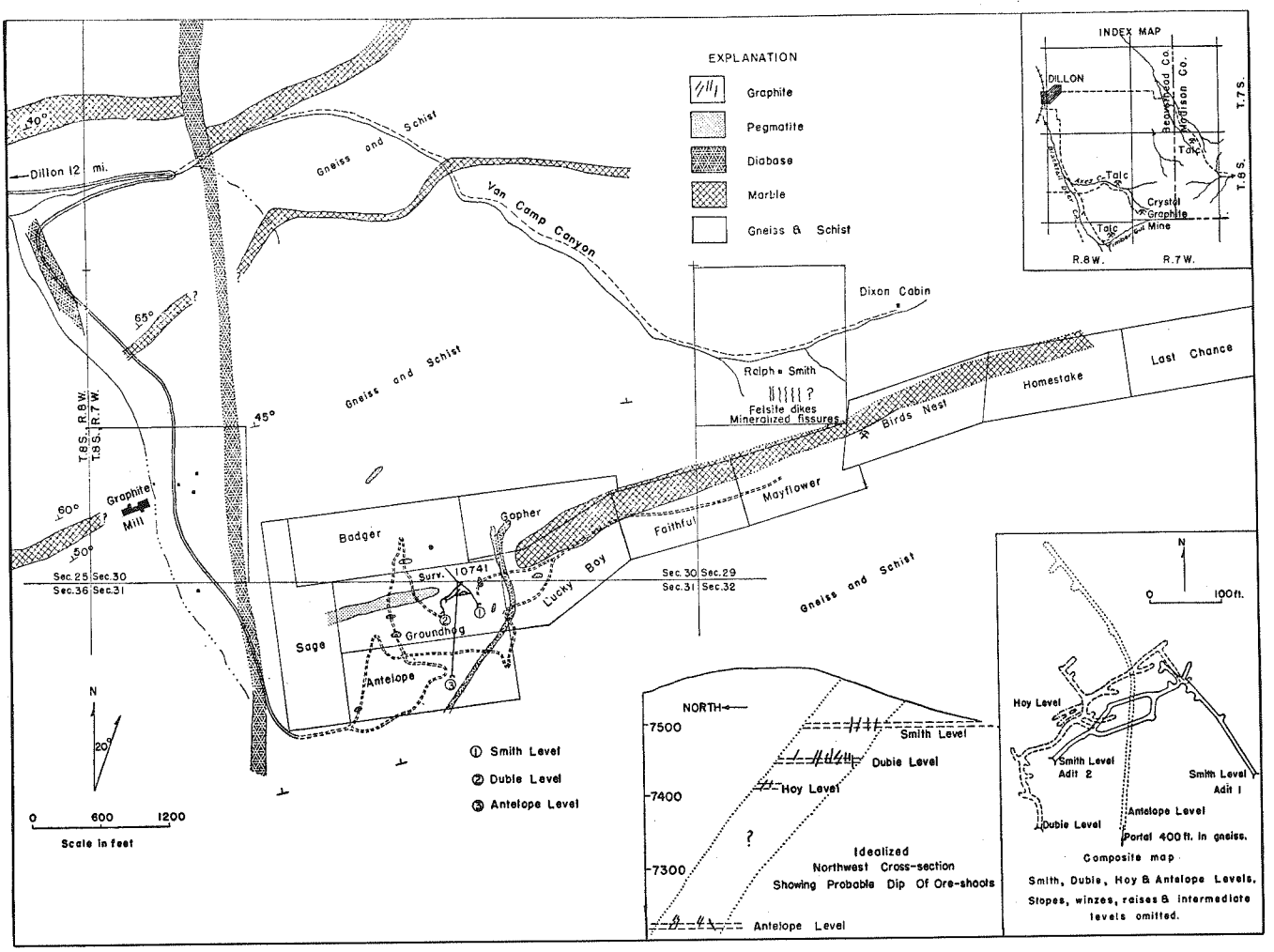


Figure 90.—Map of Crystal Graphite mine. (Perry, 1948).

The deposit has been studied by Sinkler (1942) and briefly described by Heinrich and Rabbitt (1960). It is a nickel-bearing ultramafic complex that extends through intermittent outcrops in a northeast direction for 2½ miles and in a northwest direction for an average distance of ½ mile (Fig. 91). The intrusion is bounded on the southwest end by the northwest-trending Elk Creek fault and on the northeast end by the Sweetgrass fault, which also trends northwest.

Nickel was discovered at the deposit by C. N. Roberts in July 1938 (Sinkler, 1942, p. 137), but the only work done has been the digging of a few shallow prospect pits and bulldozer cuts. The lack of interest in the deposit is probably due to the slight amount and spotty distribution of nickel in the surface rocks.

The ultramafic complex is composed principally of olivine and enstatite in different proportions. The most abundant nickel mineral is annabergite (hydrous nickel arsenate), which according to Sinkler (1942) is associated only with ultramafic rock composed of three-fourths enstatite and one-fourth olivine. The annabergite occurs as thin coatings and crusts on fracture surfaces. The amount of annabergite in the deposit is not large. Heinrich and Rabbitt (1960, p. 32) reported nickel minerals throughout the complex but in relative abundance only in a small prospect pit in the SE¼ NE¼ sec. 1, T. 9 S., R. 7 W.

Sinkler (1942) suggested that the annabergite was formed by passage of arsenical hypogene solutions, which extracted nickel from nickel-bearing olivine and enstatite. Heinrich and Rabbitt (1960, p. 32) suggested that the annabergite is of supergene origin, the nickel being derived by breakdown of nickel-bearing enstatite.

MANGANESE DEPOSIT IN CENTER SEC. 23, T. 8 S., R. 8 W.

The manganese deposit in the center of sec. 23, T. 8 S., R. 8 W., is alongside the main road up Axes

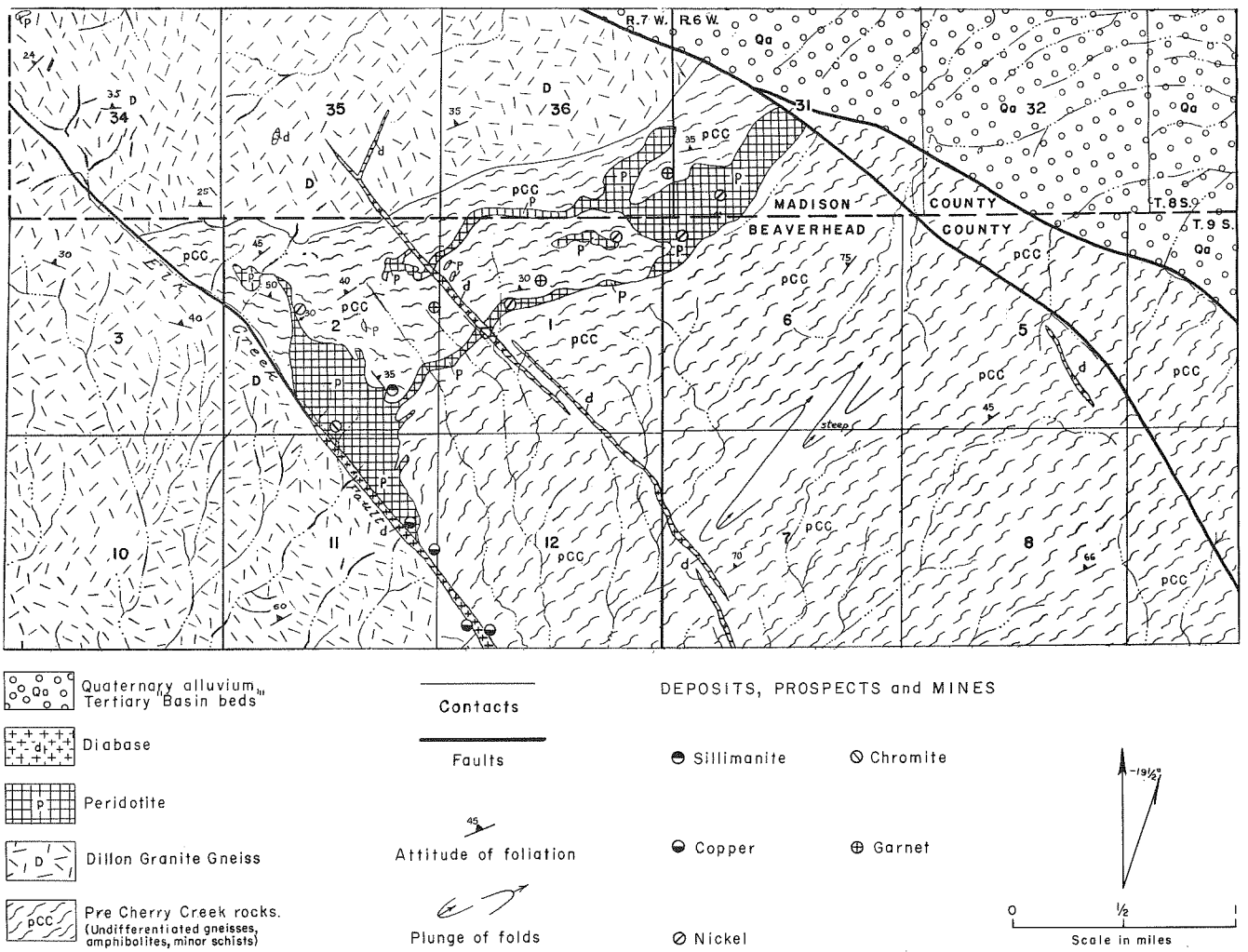


Figure 91.—Geologic map of Dillon (Wolf Creek) nickel deposit. (Heinrich, in Heinrich and Rabbitt, 1960).

Canyon and is about a quarter of a mile west of the Smith-Dillon talc mine. The position of the mine shaft at the deposit is shown on the Ashbough Canyon topographic quadrangle map.

The deposit consists of psilomelane-type manganese minerals and calcite concentrated in narrow layers in Cherry Creek marble (Portal marble, Heinrich, 1949, fig. 4). The manganese zone is narrow, probably not more than 6 feet, and the full width has been explored by an inclined shaft sunk on the outcrop. The shaft was not examined but it may be at least 100 feet deep. Material scattered on the dump consists of banded black manganese oxides and calcite. A few pieces of rhodonite and red-brown jasper were also found. The zone trends N. 55° E. and dips 60° NW.

Production from the deposit is not known, but a small amount of selected manganese ore may have been shipped from the deposit during the time when the government manganese stockpiling program was in effect.

MANGANESE DEPOSIT IN NW¼ NW¼ SEC. 24, T. 8 S., R. 8 W.

A manganese deposit in the NW¼ NW¼ sec. 24, T. 8 S., R. 8 W., can be reached via a dirt road that leads off from the main Axes Canyon road near the Smith-Dillon mine. The deposit is along the foothills of the Ruby Range at an altitude of about 6,300 feet.

The manganese is in a thick bed of Cherry Creek marble (Portal marble, Heinrich, 1949, fig. 4), which is the same marble unit in which the talc deposits at the Smith-Dillon mine occur. The overall trend of the marble is northeastward, and the dip is northwest.

Manganese occurs in black psilomelane-type minerals. These minerals and calcite were deposited in rhythmic layers and incrustations filling narrow solution cavities (gash veins) in the marble. Manganese minerals are also disseminated in the marble, which consequently weathers light brown, chocolate, or even black, depending on the manganese content.

The deposit has been explored by an adit (Fig. 92), which was driven S. 45° E. for about 300 feet, and two shallow prospect shafts and a short adit that are dug on manganese outcrops above the portal of the long adit; the long adit seems to have been driven within the last few years. Exposed underground is a series of manganese-bearing veins in marble; they make up a mineralized zone 220 feet across. For the last few feet, the adit is in serpentine. Near the portal of the adit, the veins strike N. 22° W., but near the end of the adit they strike N. 40° E.; the system of veins thus diverges to the north. The largest veins are extremely irregular, as would be expected of solution cavities, and attain widths of 5 feet. Most are incompletely filled and are characterized by narrow crevices, the walls of which are lined with manganese minerals or white calcite. The veins were formed by solution enlargement of joints(?) and deposition of calcite and psilomelane-

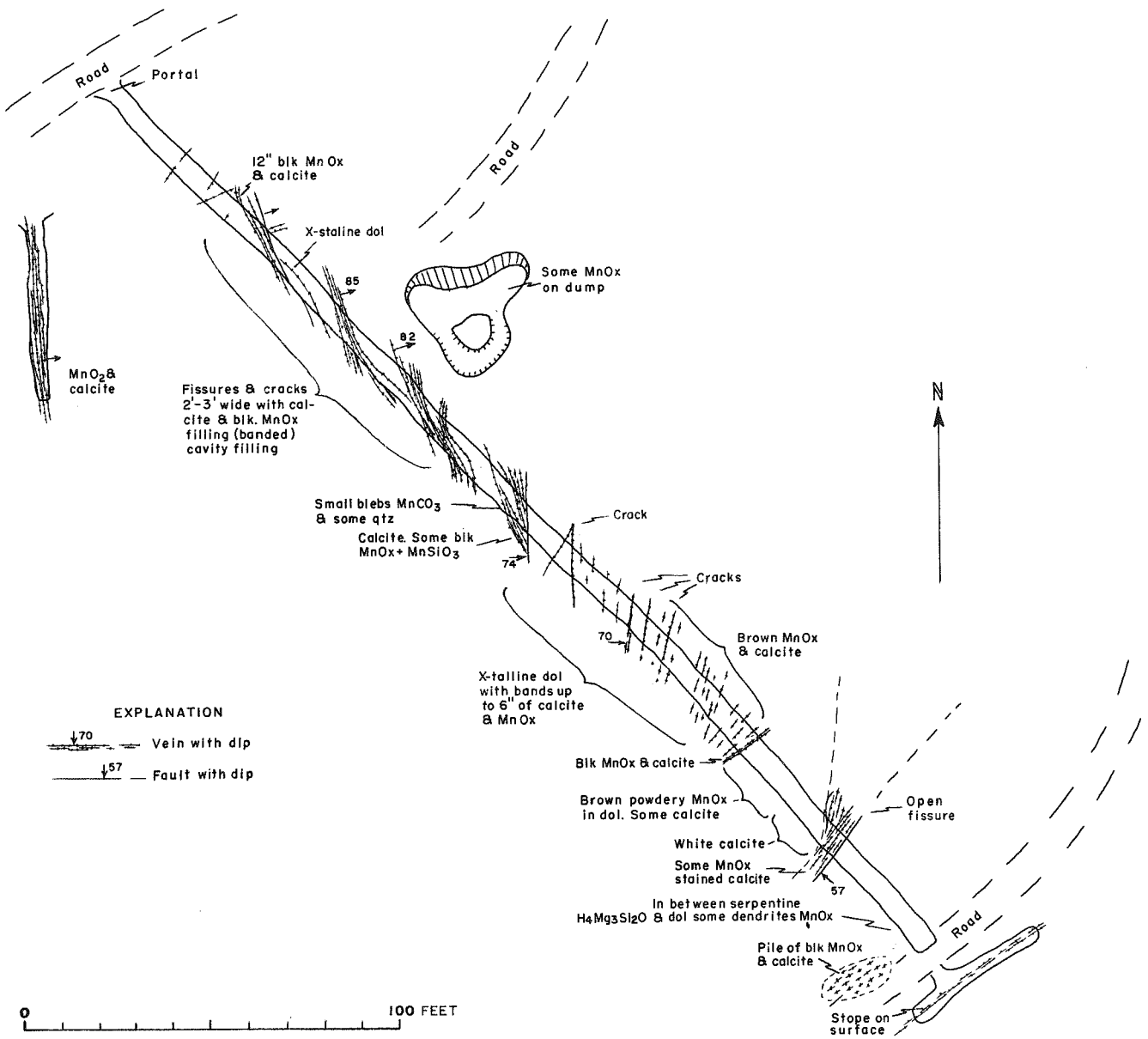


Figure 92.—Geologic sketch of adit on manganese deposit in NW¼ NW¼ sec. 24, T. 8 S., R. 8 W.

type manganese minerals derived from weathering of manganiferous marble.

Production from the deposit is not known; some manganese ore may have been shipped from the deposit during the years when the government manganese stockpiling program was active.

NEVADA

The Nevada mine is near the center of sec. 21, T. 9 S., R. 8 W., on the west side of the valley of Blacktail Deer Creek. The mine workings, in bedrock, are at the foot of the steep east front of the Blacktail Range just above the alluvium. They can be reached by a dirt road that leads off from the main Blacktail county road. The property is held by Jess Roberts of Dillon.

The main workings consist of a 240-foot adit, which trends S. 30° W. and which has been driven for its entire length in tan to gray argillaceous dolomite. The upper workings are 10 feet above the adit and consist of several short drifts that follow an irregular flat-dipping slightly copper stained black shale bed or fault zone. The bed or zone is about 1 foot to 2 feet thick, and overall seems to trend north and dip to the west at a low angle. It is overlain by what seems to be altered quartzite. The quartzite locally shows appreciable copper stain just above the black gougy material.

A chip sample of the copper-stained material above the black gouge assayed 0.93 percent copper, 0.20 percent zinc, 0.35 ounce of silver, and 0.004 ounce of gold per ton. At the southwest end of the upper workings, a stope 25 feet long, 30 feet high, and as wide as the drift, has been excavated in the quartzite.

Total recorded production for a mine called the "Nevada" in the Blacktail district is 567 tons of ore, which yielded 988 pounds of copper, 8,219 ounces of silver, and 7 ounces of gold. This ore was produced in 1934 and 1935, by C. N. Roberts and son of Dillon.

PEGMATITE MINERAL DEPOSITS

The pegmatite mineral deposits in the Ruby Mountains mining region were described by Heinrich (1948) and Heinrich and Rabbitt (1960).

The Proffitt pegmatite is approximately 1 mile east-southeast of the Smith-Dillon talc mine, and is on the northwest side of Proffitt Gulch. The pegmatite body is an east-trending irregular lens in biotite schist. It is about 80 feet long and 20 feet thick. It is not zoned, but consists of an aggregate of white to green feldspar, white quartz, muscovite in books, black tourmaline crystals, and irregular patches of dark-green, fine-grained sericite. Light-red muscovite books are 2 inches across. Some A-structure mars the mica, but the chief defects are irregular cracks and the small size of the books.

Small pegmatite bodies in the vicinity of Axes Canyon lie between the Smith-Dillon talc mine and the Crystal Graphite mine. Some cut a quartzite layer and consist of quartz-rich pods containing a trace of feldspar, large black tourmaline crystals, flakes of muscovite, and masses of dark-green sericite. Other pegmatite bodies occur in gneiss. The largest is a pod about 50 feet long and 10 feet thick. It contains a core of 2-inch white microcline crystals, and a wall zone of medium-grained quartz, white microcline, pale-green sodic plagioclase, and biotite. Rose quartz occurs in several small dikes near the Timber Gulch (Crescent) talc mine.

Heinrich (1948, p. 13) reported that good-quality, pale-ruby muscovite specimens from which pieces 3 by 4 inches might be trimmed were said to occur in a deposit 11 miles east of Dillon. The location of this deposit is not known.

No pegmatite minerals have been produced from these deposits. Seemingly they are too low grade, too small, and too far from markets.

SILLIMANITE

The sillimanite deposits of the Ruby Mountains mining region were described by Heinrich (1949). The Arthur Christensen deposit, which is just across the line in Madison County, was also described by Bracken (1949).

Sillimanite has been found in metamorphosed and unmetamorphosed pegmatite, in biotite schist and gneiss, and as large pods on the margins of pegmatite dikes. In metamorphosed pegmatite bodies, sillimanite is an accessory constituent and forms well-shaped crystals clustered in or near ellipsoidal quartz pods. In unmetamorphosed pegmatite bodies, sillimanite occurs throughout as randomly oriented needles and clusters of needles as large as 1 inch, or as films along narrow curving fractures that cut the pegmatite bodies at varying angles. Massive sillimanite pods on the margins of pegmatite dikes that intrude biotite schist are almost pure sillimanite, the chief impurity being biotite. Smaller pods occur entirely within biotite schist but not more than 25 feet from the pegmatite dikes. Most of the sillimanite in the region is in schistose and gneissic rocks that have been intruded by pegmatite bodies.

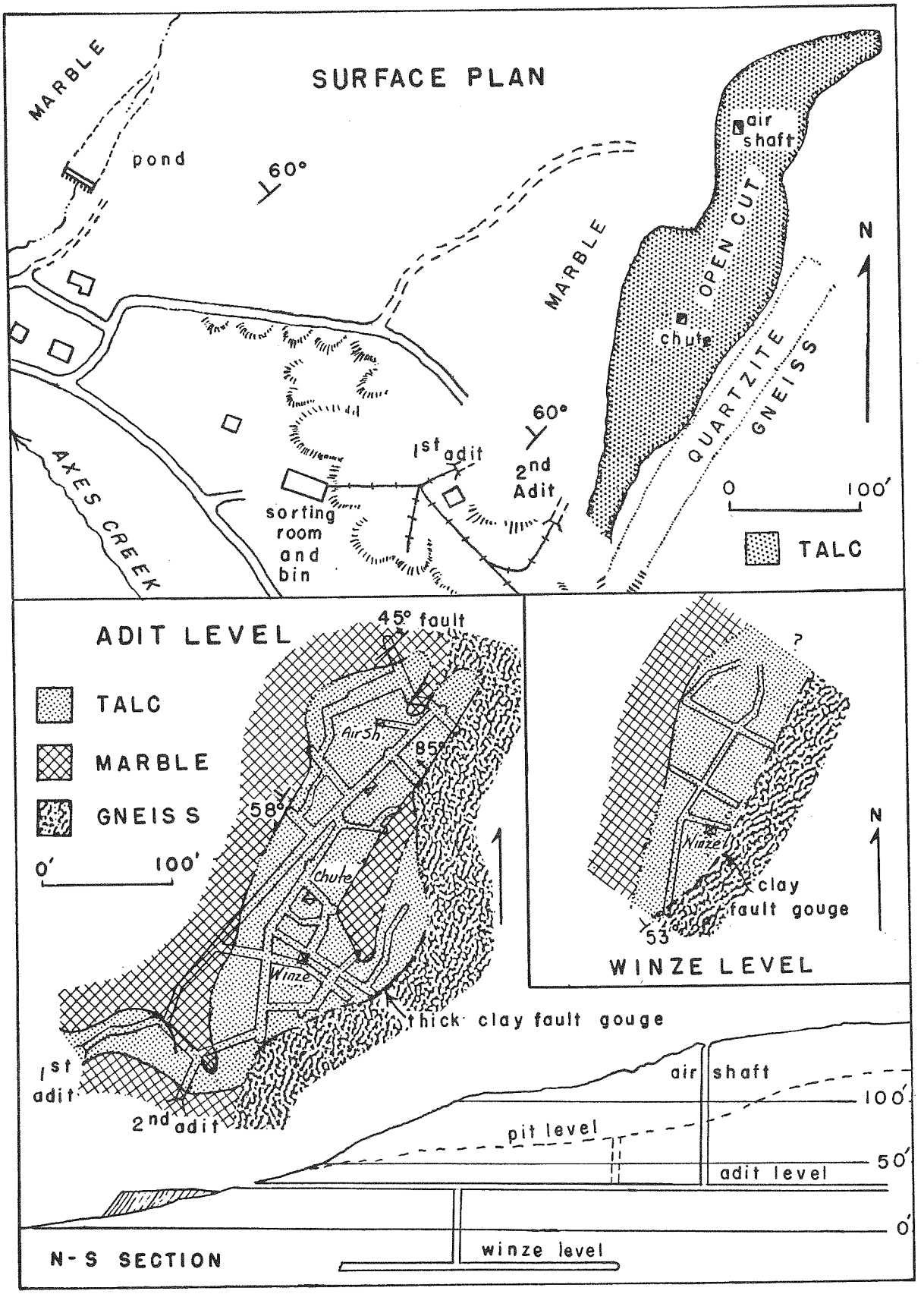


Figure 93.—Map of Smith-Dillon talc mine, southeast of Dillon. (Perry, 1948).

None of the deposits have been exploited, but they are a potential source of sillimanite.

SILVER QUEEN

The Silver Queen mine is in the NW¼ sec. 17, T. 10 S., R. 7 W., on the south side of Jake Canyon in the Blacktail Range. The mine can be reached via Jake Canyon road, which leaves the Blacktail county road at a point approximately 20 miles southeast of Dillon.

The property consists of six unpatented claims, which were located in 1904 by Columbus Newton Roberts. The claims are now held by Jess Roberts, Frank Actis, and Frank White, and are under lease to Silver Queen Exploration Company of Denver, Colorado.

The deposit is said to be in a mineralized fault zone in Precambrian metamorphic rocks and to contain silver and copper. The fault zone trends east-west and is said to be at least 30 feet wide. When visited in 1965, none of the underground workings were accessible, and the fault zone was not seen. The principal underground working is an adit, now caved near its portal, which trends southeast and at a distance of 750 feet is reported to have intersected the fault zone. It seems to have been driven for most of its length in quartzite. On the hill above the adit, dumps at several prospect pits in the gneiss show pieces of iron-stained quartz. A shipment of approximately 150 tons of float boulders containing native silver was said to have been picked off surface.

In 1965 work was in progress to start another adit to intersect the fault zone below the upper older workings.

The property has no record of production under the name of Silver Queen.

SMITH-DILLON TALC

The Smith-Dillon talc mine is in sec. 23, T. 8 S., R. 8 W., at an altitude of about 6,000 feet, and can be reached by traveling the main county road up Blacktail Deer Creek for about 7 miles and thence up the Axes Canyon road for about 3 miles. The deposit was described by Perry (1948).

Production began in 1942 and has continued without interruption to the present. Production figures are confidential. Prior to 1966 the operator was Tri-State Minerals Company, a subsidiary of Southern California Minerals Company. Since 1966 the property has been operated by Minerals, Pigments, and Metals Division of Chas. Pfizer and Company, Inc.

The talc deposits are localized in Cherry Creek metamorphic rocks; the marble units are the host rocks. The marble unit containing the Smith-Dillon deposit has been mapped by Heinrich (1949, fig. 4) as the Portal marble. It trends northeastward and dips about 60° NW. The talc body delineated by the workings is about 400 feet long, 60 to 100 feet wide, and more than 200 feet in vertical extent. The deposit is elongate parallel to the strike of the marble. The southeast wall of the deposit is gneiss, and the contact is marked by thick clay gouge and crushed zones.

The deposit was originally developed by underground workings (Fig. 93), which consist of about 1,500 feet of adits and drifts on a main haulage level 30 feet above the creek and about 400 feet of drifts on a winze level 60 feet below the main haulage level. Most of the talc has been produced by open-pit methods, however. Talc is hauled by truck from the mine to a mill at Barrett's siding, where it is processed into marketable form. The talc from the deposit is of steatite grade, which is the purest form of the commercial varieties.

TALC DEPOSIT ON STATE LAND (SEC. 13, T. 8 S., R. 8 W.)

A talc deposit on state land in sec. 13, T. 8 S., R. 8 W., was leased in 1964 to Wallace Banning and Lester Jones, both of Dillon. The deposit is at an altitude of about 6,400 feet along the foothills of the Ruby Range, and can be reached by traveling for about 2½ miles on a dirt road that leads off, near the Smith-Dillon talc mine, from the main dirt road up Axes Canyon.

The deposit is localized in the same belt of marble (Portal marble, Heinrich, 1949, fig. 4) as the Smith-Dillon talc deposit, and is about 1 mile northeast of that deposit. Talc on the state tract crops out near the bottom and on both sides of a northwest-trending gully. In 1964 talc was being mined from the east side of the gully. A small cut into the side of the hill exposed a zone about 40 feet wide composed of alternating layers of talc and marble (Fig. 94), the widest layer of talc being about 10 feet. The talc is of the steatite variety. In general, the layers strike N. 45° E. and dip 37° NW. The full width of the zone is not exposed, but surface exposures and float indicate that the full width is at least 100 feet. This body of talc is at the end of an east-trending granite pegmatite dike about 40 feet wide. The close spatial relationship of the dike

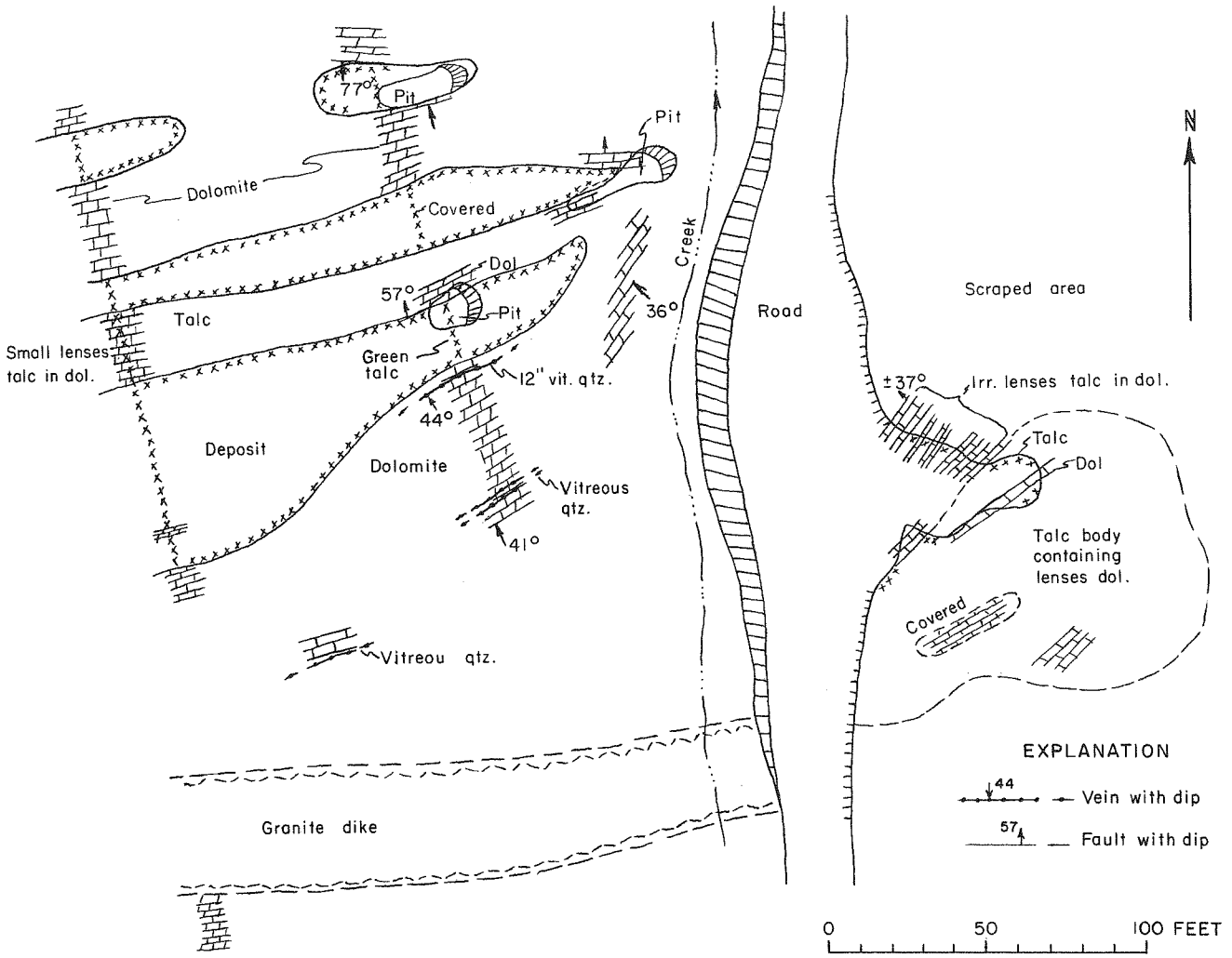


Figure 94.—Sketch of talc deposit on state land (sec. 13, T. 8 S., R. 8 W.).

and the talc deposit indicates that the talc was formed by reaction of the marble with siliceous aqueous solutions emanating from the dike.

The talc bodies on the west side of the gully have not been mined. At least three separate talc bodies seem to be indicated by the outcrop pattern. The largest seems to be at least 100 feet wide and 200 feet long, and all seem to taper at the ends. All the talc is of the steatite variety and gray green.

After preliminary hand sorting, the talc produced from the deposit was hauled by truck to Sheridan, where it was sold to American Chemet Corporation, mainly for use as filler in paint.

Production figures are confidential.

TENDOY MOUNTAINS MINING REGION

The Tendoy Mountains are in south-central Beaverhead County and flank the west side of the north-trending Lima Valley, from which the mountain front rises abruptly and regularly and has the characteristics of a fault scarp. According to Pardee (1950, p. 377), displacement along the fault may be as much as 3,000 feet, as a result of movements beginning in Pliocene or earlier. The mountains are made of Late Paleozoic sedimentary rocks, older metamorphic rocks, and some Mesozoic strata.

Mineral production from the region has been small. Base metals have been produced in the Medicine Lodge-Cabin Creek district.

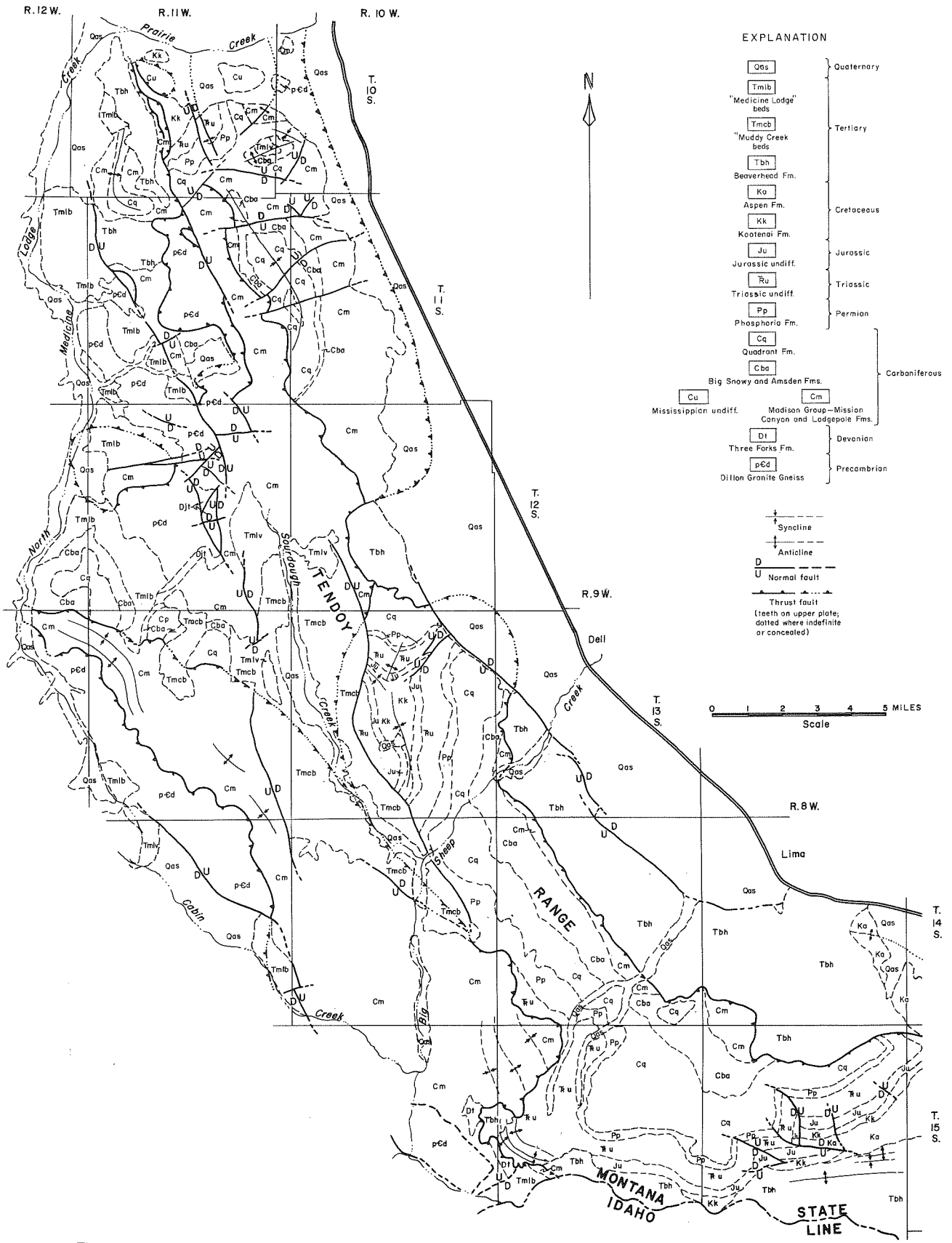


Figure 95.—Geologic sketch of Tendoy Mountains mining region. (Scholten, Keenmon, and Kupsch, 1955).

Table 20. — Annual production of metals from the Medicine Lodge-Cabin Creek district, 1902-65, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)	Total value
1902-38	no production						
1939	361	---	1,013	285	161,872	---	$ 8,326
1940	38	---	101	---	15,331	---	839
1941	83	---	208	---	32,300	---	1,989
1942	129	---	225	200	34,400	---	2,489
1943-46	no production						
1947	40	---	84	---	11,600	---	1,746
1948	49	---	106	100	11,200	5,200	2,815
1949	9	1	---	700	---	---	173
1950-59	no production						
1960	62	---	65	100	8,200	4,200	1,592
1961-65	no production						
Undistributed	21	---	50	---	8,790	4,743	2,065
Total	7921	1	1,852	1,385	283,693	14,143	$22,034

MEDICINE LODGE — CABIN CREEK DISTRICT

The Medicine Lodge-Cabin Creek district is in southwestern Beaverhead County, about 30 miles southwest of Dillon. The district contains two major streams, Medicine Lodge and Cabin Creeks. Medicine Lodge Creek is a north-flowing tributary to Horse Prairie Creek and drains a long linear north-trending valley, which is bounded on the east by the north end of the Tendoy Mountain Range and on the west by an unnamed short but rugged mountain range that is an offshoot from the main Beaverhead Range. The headwaters of Medicine Lodge and Cabin Creeks are separated by a low divide in the vicinity of Sourdough Peak. Cabin Creek flows southeast, and with other streams the same size drains an area known as the Big Sheep Creek basin (Scholten, Keenmon, and Kupsch, 1955). Big Sheep Creek basin is subelliptical and measures approximately 10 miles east-west and 15 miles long. It is bordered on the west and south by the Beaverhead Range and on the east by the southern part of the Tendoy Range.

The mineral wealth produced from the district has been very small. The total recorded value of base metals for the period 1902-65 was only $22,034. Production from 792 tons of ore was 283,693 pounds of lead, 14,143 pounds of zinc, 1,385 pounds of copper, 1,852 ounces of silver, and 1 ounce of gold. Of this amount, 596 tons was produced from the Sweeney mine. Annual production figures are given in Table 20.

In addition to the base metals in the district, deposits containing thorium, rare earths, fluorite, graphite, or asbestos are known, but all of them are subcommercial. None has a record of production. The mineral deposits mentioned are in the Tendoy Range; no deposits are known in the range bordering the district on the west.

Tertiary deposits on the west side of Medicine Lodge Creek contain coal of lignite rank. At the Peterson Brothers mine on Medicine Lodge Creek, a small tonnage of coal mined from underground workings in a 6½-foot bed was used for domestic fuel. The entrances to the mine workings are now caved.

ANDERSON ASBESTOS

The Anderson asbestos prospect is in sec. 16 and 21, T. 12 S., R. 11 W. The site was not revisited; it was described by Sahinen and Crowley (1959, p. 5).

The asbestos is chrysotile in seams about ½ inch thick in serpentinized Cherry Creek marble. No asbestos has been produced from the few widely scattered discovery pits.

DEER CREEK THORIUM AND FLUORITE

The Deer Creek thorium and fluorite prospects are in T. 11 S., R. 11 W., at the north end of the Tendoy Mountains. The general area of the prospects can be reached from the Medicine Lodge Creek road by mountain roads up Johnson Gulch or Deer Creek. The prospects were first described by Trites and Tooker (1953). No production has been reported.

The exploration work consists of shallow pits and trenches dug on radioactive exposures. Most of the work was probably done in the mid-fifties, during the height of the uranium boom.

The deposits are in a klippe of gneiss and schist that rests on Mississippian limestone. Thorium, probably contained in the mineral monazite, occurs in pegmatite dikes that cut the gneiss and schist. The largest dike on the Lookout No. 1 claim is 75 feet long and 12 feet wide (Trites and Tooker, 1953, p. 186). The dike comprises about 50 percent microcline, 33 percent plagioclase, 15 percent quartz, 2 percent magnetite, and a trace of monazite. The equivalent uranium content is extremely low, a few hundredths of a percent.

On the Poison Lake claim, in sec. 26, T. 11 S., R. 11 W., narrow fluorite veins in altered Mississippian limestone and aplite dikes show abnormal radioactivity. Overall, the veins trend northeast and are in an area more than 600 feet long and 200 feet wide. Most veins are less than 10 feet long and 3 inches to 1 foot thick, but one vein is 100 feet long and 75 feet wide. The narrow veins contain 30 to 65 percent fluorite, 10 to 50 percent quartz, 20 to 40 percent limonite, and 5 to 30 percent calcite (Trites and Tooker, 1953, p. 188).

Radioactivity is also abnormal in quartz veins and narrow biotite diorite and granite pegmatites in metamorphosed shale on the Gray Goose claims, in sec. 21 and 23, T. 11 S., R. 11 W. Radioactivity is strongest in the biotite diorite pegmatite dikes, which contain monazite and allanite (Trites and Tooker, 1953, p. 188).

On Lookout No. 3 claim, in sec. 9, T. 11 S., R. 11 W., a small lenticular carbonate vein in gneissic hornblende diorite is abnormally radioactive. The vein contains flesh-colored calcite, pyrite, and chalcopyrite along small fractures. A sample of the material assayed 0.24 percent thoria and 2.71 percent rare earths (Trites and Tooker, 1953, p. 188).

IOLA

The Iola prospect is in sec. 9, T. 15 S., R. 10 W., about 18 miles southwest of Dell. It was described by Trites and Tooker (1953, p. 190).

The deposit consists of abnormally radioactive quartz veins containing small amounts of base metals. The veins trend northwest, dip southwest, are 50 to 150 feet long and 3 to 12 feet wide, and are in a contact zone between Mississipian limestone and medium-grained red granite. The contact zone trends northwest and is 1,000 feet long and 100 feet wide. The limestone in the zone is altered to medium-grained white marble, which contains graphite.

The mine workings comprise a 150-foot adit, a 42-foot shaft, a short drift at the bottom of the shaft, and a prospect pit. Pieces of vein material on the dump at the shaft are quartz showing some limonite and copper stain. A grab sample contained 0.037 percent equivalent uranium and 0.050 percent uranium (Trites and Tooker, 1953, p. 190).

The property has no record of production under the name Iola.

KATE CREEK GRAPHITE

The Kate Creek graphite deposits are in sec. 22 and 27, T. 12 S., R. 11 W., along the upper course of McBride Creek. They were described by Perry (1948, p. 18).

Graphite is associated with a north-trending fault zone along the contact of white crystalline Mississippian limestone with gneiss and schist. The fault extends for several miles and seems to be vertical. Graphite occurs in the fault gouge, in fault breccia, and in the crushed gneiss, but not in solid limestone, although graphite-bearing rock has come from breccia zones in limestone.

The deposit has been explored by several adits, all of which are now caved, and several pits dug along the fault for perhaps a mile. The last work was done in 1918 by the National Carbon Company of New York City. No graphite is known to have been shipped from the deposit.

SWEENEY (BONANZA II)

The Sweeney mine is in sec. 1, T. 13 S., R. 12 W., about 27 miles south-southwest of Clark Canyon dam and can be reached by county dirt road up Medicine Lodge Creek. The unpatented claims are held by Peter Sweeney.

The deposit, in Mississippian limestone near its contact with granite gneiss, is developed by three adits (Fig. 96). The main vein strikes N. 80° E. and dips 53° to 80° SE where exposed in an upper adit level. It is developed for a length of 160 feet and has been stoped above and below the adit level. The width of the vein ranges from 3 feet to at least 10 feet. Remnants of vein material left on the walls of the workings consist of coarse crystalline calcite and vuggy hydrous iron oxides. Small remnants of cerussite and possibly a zinc carbonate mineral were noted along the walls near the stoped-out areas. The attitude of the stopes indicates that the lead and zinc minerals probably formed ore shoots having a southwest rake of approximately 45 degrees.

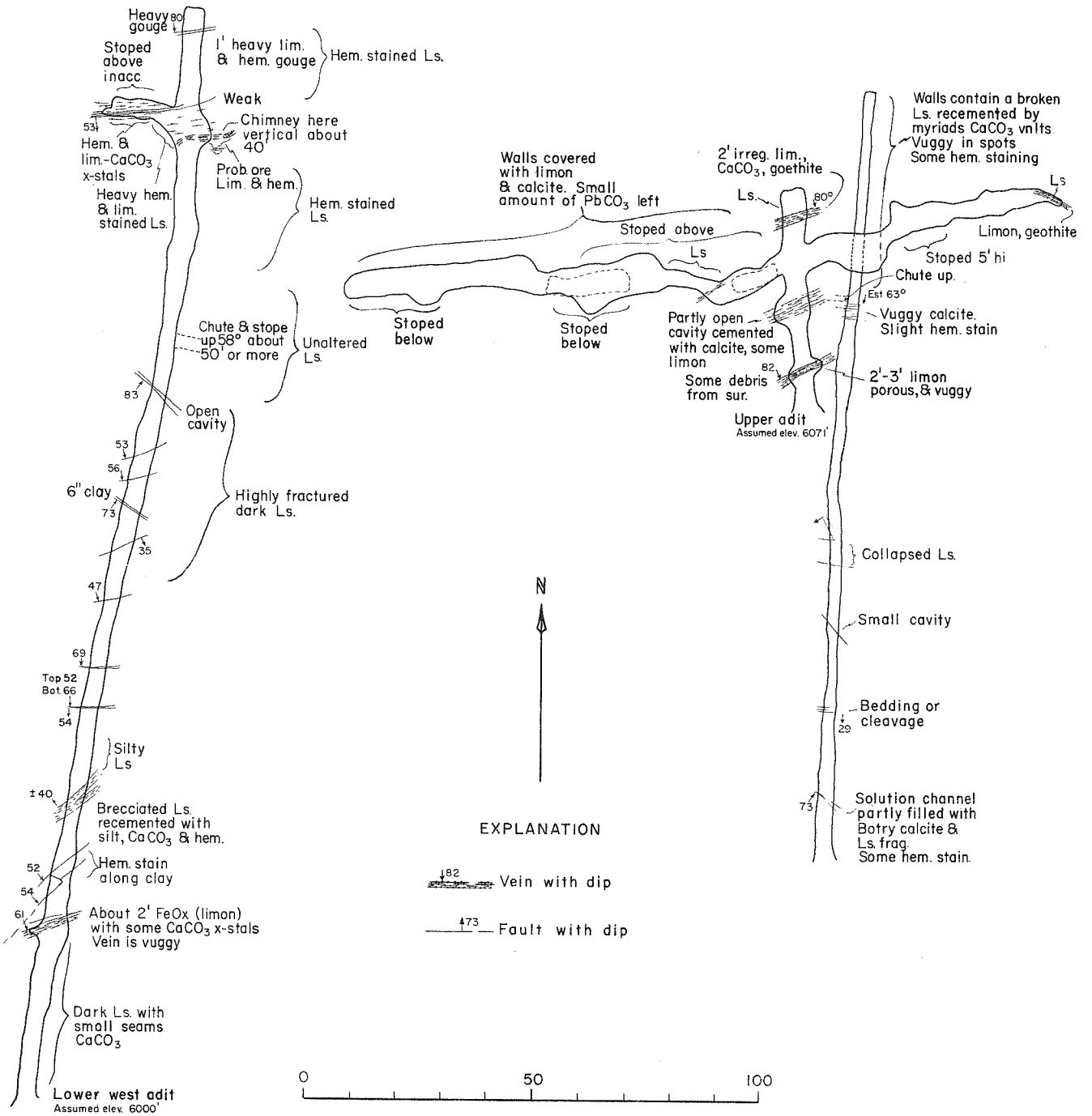


Figure 96.—Sketch of Sweeney mine workings.

At 64 feet directly below the upper adit, a second adit has been driven northward a distance of 164 feet. It cuts two open fractures, which strike N. 55° W. and dip nearly vertical. The fractures are partly filled with limestone fragments and are lined with calcite crystals. At a distance of 115 feet from the portal, a 4-foot zone of limestone breccia cemented by red-stained calcite is exposed; it is the downward extension of the main vein exposed in the upper adit. A chimneylike raise has been driven on the zone and connects with the upper adit.

The third adit is about 180 feet west of the lower adit and at approximately the same altitude. It is about 240 feet long and seemingly was driven to intersect the downward projections of the ore shoots mined from the upper adit level. The vein is cut at a distance of 215 feet from the portal. The

Table 21. — Annual production of gold and silver from placer mines, 1902-65.

Year	Material treated (cubic yd.)	Gold (fine oz.)	Silver (fine oz.)	Total value
1902	7,600	4,378	----	$ 82,514
1903	NA	1,183	----	19,826
1904	----	144	36	2,749
1905	----	35	4	732
1906	----	8	21	176
1907	----	216	22	4,483
1908	----	117	9	2,430
1909	----	328	55	6,807
1910	----	82	8	1,697
1911	----	70	5	1,458
1912	----	140	15	2,897
1913	----	132	11	2,736
1914	----	101	12	2,087
1915	----	33	6	687
1916	----	36	3	742
1917	----	28	2	577
1918	----	202	52	4,222
1919	----	36	2	750
1920	----	24	1	499
1921	----	50	6	1,043
1922	----	76	5	1,577
1923	----	20	1	428
1924	----	58	7	1,201
1925	----	48	4	1,002
1926	----	37	5	762
1927	----	21	2	442
1928	----	10	2	217
1929	----	2	----	41
1930	----	9	----	185
1931	----	9	----	188
1932	----	100	7	2,063
1933	----	65	3	1,342
1934	----	120	14	4,210
1935	----	81	7	2,840
1936	----	79	4	2,754
1937	----	33	----	1,155
1938	339,672	1,522	99	53,334
1939	1,148,050	2,073	165	72,667
1940	619,340	2,085	149	73,081
1941	270,005	3,838	315	134,554
1942	131,880	1,258	173	44,153
1943	1,040	327	45	11,477
1944	1,100	188	45	6,612
1945	----	----	----	----
1946	70,040	189	26	6,636
1947	60,060	311	43	10,924
1948	90,200	197	31	6,923
1949	51,020	246	32	8,639
1950-51	----	----	----	----
1952	----	1	----	35
1953	65	1	----	35
1954-58	----	----	----	----
1959	9,000	139	9	4,973
1960-62	----	----	----	----
1963	W	W	W	W
1964	W	W	W	W
1965	----	----	----	----
Undistributed	8,700	79	9	2,777
Total	2,807,772	20,565	1,472	$596,339

NA, not available.
W, withheld to avoid disclosing individual company confidential data; included in undistributed.

mineralized zone is about 6 feet wide and contains hydrous iron oxides, calcite, and iron-stained limestone. A small amount of ore has been stoped.

Total recorded production that can be reported from the Sweeney mine is 596 tons of ore, which contained 1,499 ounces of silver, 385 pounds of copper, 233,293 pounds of lead, and 6,443 pounds of zinc.

PLACER DEPOSITS

From 1902 to 65 the placer mines of Beaverhead County produced 20,565 ounces of gold and 1,472 ounces of silver, valued at $596,239. Annual production is given in Table 21.

Production prior to 1902 was not recorded. The most important placers in the county were along Grasshopper Creek. From these diggings, it has been estimated (Winchell, 1914, p. 19) that $3 million in gold was recovered during the 1860's. The total placer wealth recovered would therefore aggregate about $3½ million. District production from 1902 to 65 is given in Table 22.

GRASSHOPPER CREEK DRAINAGE

Placer mining has been conducted along Grasshopper Creek and its tributaries, Dyce and May Creeks.

The gold placers of Grasshopper Creek near the townsite of Bannack (Fig. 97, locality 1) were discovered in 1862 by John White and William Eads, and are the most important placer discovery in Beaverhead County.

The deposits are of two kinds, Late Pleistocene gold-bearing terrace deposits about 100 feet above creek level and Recent gravel bars in the creek bed (Lyden, 1948, p. 6). The bench gravels were worked by hydraulic mining, particularly in the vicinity of Bannack, and the gravel bars in the creek bed by methods ranging from primitive sluicing to dredging. How much ground is left that could be worked at a profit is not known. The remains of former placer operations are clearly visible around Bannack and at several places farther downstream, but there is much ground between Bannack and the mouth of Grasshopper Creek which shows no evidence of having been worked. Most of the ground undoubtedly has been tested, however, and probably proved to be unprofitable.

The Dyce Creek placers (Fig. 97, locality 2) are on a small southward-flowing tributary of Grasshopper Creek about 10 miles north of Bannack and are in the Baldy Mountain mining district. According to the Dillon Tribune, September 3, 1886, a prospect pit had been dug into the gravels of the creek about 1868 but struck a false bedrock. In 1886 Fisher and Foster sank 3 feet through the false bedrock and struck gravel 4 feet thick. The pay streak is said to have been about 25 feet wide and ranged from a few colors to as much as 60 cents a pan. One nugget was valued at $1.50.

Remnants of the old placer diggings are still visible and extend along the west and east forks of Dyce

Table 22. — Production of gold and silver from placer mines, by district, 1902-65.

District	Material treated (cubic yd.)	Gold (fine oz.)	Silver (fine oz.)	Total value
Argenta	1,600	107	11	$ 2,443
Baldy Mountain	200	120	10	2,564
Bannack	2,264,492	15,531	887	438,215
Beaverhead	-----	W	W	W
Big Hole (Wisdom)	2,340	264	46	6,666
Blacktail	W	W	W	W
Blue Wing	-----	W	-----	W
Bryant	-----	W	W	W
Chinatown	-----	14	-----	396
Horse Prairie (Colorado)	526,340	3,493	494	122,628
Lakeview	----	W	----	W
Pioneer	-----	16	----	359
Polaris	-----	W	W	W
Saginaw	-----	W	----	W
West Fork of Madison River	W	W	----	W
Undistributed	12,800	1,020	24	22,968
Total	2,807,772	20,565	1,472	$596,239

W, withheld to avoid disclosing individual company confidential data; included under undistributed.

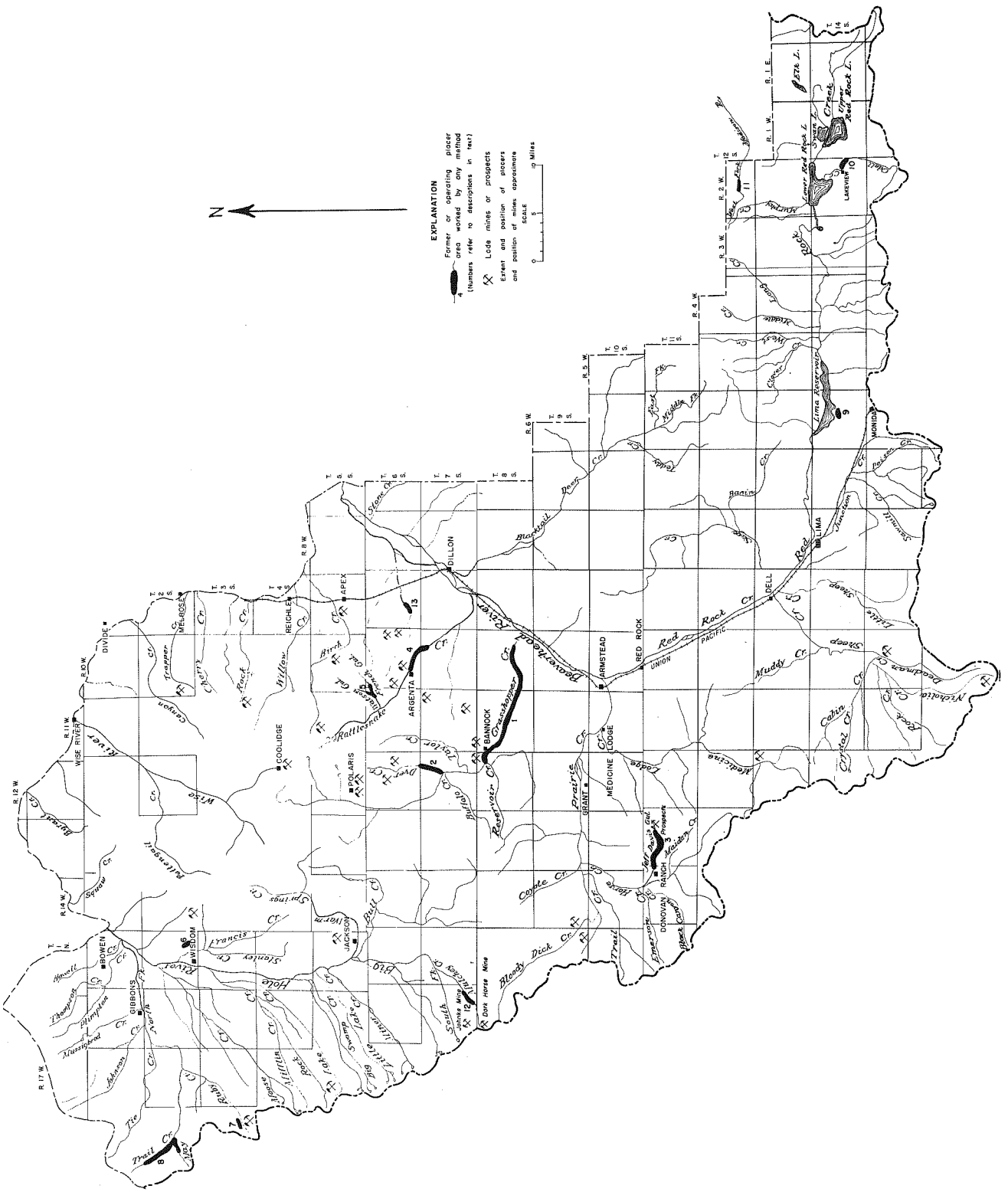


Figure 97.—Map of Beaverhead County placers. (Lyden, 1948).

Creek. Most available ground seemingly has been worked, principally by hand methods. The gulches are too narrow to contain much dredgable ground. Tailings from the diggings consist of cobbles of limestone, quartzite, and diorite. The greatest production recorded was in 1908 when it exceeded 100 ounces of gold (Lyden, 1948, p. 8). The source of the gold is probably the contact lode deposits of the Baldy Mountain district.

HORSE PRAIRIE CREEK DRAINAGE

The main placers along the Horse Prairie drainage system are those in Jeff Davis Gulch (Fig. 97, locality 3) in the Chinatown (Colorado) district. They are on the west flank of a north-trending range bordering Horse Prairie Valley and are about 6 miles north of Bannock Pass on the Idaho border.

Placer gold was found at this locality about July 4, 1863, and the first bar was named Solomon's Bar, presumably for S. Robison, one of the original locators (Sassman, 1941, p. 120). A mining district was organized in 1863 and was called the Prospect mining district.

In 1867 the Gold Hill-Montana Territory Mining Company and Yearian Brothers worked the gulches by hydraulic methods. The bar belonging to the brothers was 1½ miles long and ¼ mile wide, and was said to have paid $20 per day per man (Dillon Tribune, Dec. 25, 1897). In 1872 part of the placer ground was leased to some Chinese and the diggings became known as the China Diggings. The nearby settlement took the name of Chinatown and the district eventually was called the Chinatown mining district. In 1895 the Horse Prairie Gold Dredging Company was organized and constructed a dredge to work the gulches. The dredge was used successfully until 1904, when it was worn out after working a mile of gulch (Sassman, 1941, p. 120).

In 1939 a dryland dredge owned by W. C. McLeod worked the upper part of the gulch just below the confluence of Jeff Davis and Colorado Gulches. In 1941 and 1942, Associated Placers, Inc., a Missoula concern, worked a dryland dredge from the highway to the Brenner property (Lyden, 1948, p. 9).

The origin of the placer gold is not known. The gold was in the gravel of the stream bed as well as along the banks of the gulches. Spoil piles contain cobbles of banded coarse-grained gneiss, reddish Dillon granite gneiss, quartzite, and light-colored felsitic volcanic rocks. The placer operations have been conducted upstream to intrusive volcanic rocks, which cut across the confluence of Jeff Davis and Colorado Gulches. The source of some of the gold may have been the volcanic rocks, from which it was released and concentrated in the placers.

Total recorded production of placer gold from the district is given in Table 22.

RATTLESNAKE CREEK DRAINAGE

Rattlesnake Creek and its tributaries drain the southwest end of the Pioneer Mountains. It is a southeast-flowing tributary to the Beaverhead, and it is the principal source of potable water for the town of Dillon.

Placer operations have been conducted along the creek bed near Argenta and about 6 miles northwest of Argenta in French and Watson Gulches, which contain southwest-flowing tributaries to Rattlesnake Creek.

The gravels of Rattlesnake Creek near Argenta (Fig. 97, locality 4) were worked during the early 1870's (Winchell, 1914, p. 66). Remnants of a hydraulic operation are visible along the north bank of the creek just upstream from the Ferdinand mine. The source of the gold is probably the contact lode deposits north of Argenta (Lyden, 1948, p. 8). Amount of the production from these placers is not known.

The French and Watson Gulch placers (Fig. 97, locality 5) are about 6 miles northwest of Argenta. The French Gulch placers were probably found about the same time as the Rattlesnake Creek placers. The Watson Gulch placers were discovered in 1890 by Charles Watson. The largest nugget, about 40 ounces, found in Beaverhead County was discovered in the Watson Gulch placers in 1894 (Dillon Tribune, Sept. 14, 1894).

Both gulches were worked by sluicing (Lyden, 1948, p. 8), and the greatest production recorded was in 1941 when gold produced from both gulches totaled 9 ounces. The source of the placer gold in French Gulch was probably the quartz lodes of the Shafer group, which produce free-milling gold.

Production figures are given in Table 22 for the Argenta district.

STEEL CREEK

The placers about 4 miles east of Wisdom along Steel Creek, a west-flowing tributary of the Big Hole

River (Fig. 97, locality 6), were found in 1869 by Mike Steel, Edward Boyle, and Barney McDonald (Sassman, 1941, p. 288). According to the Dillon Tribune (Sept. 6, 1895), the pay was as much as $14 per day to the man. Remains of the early placer operations are still visible along a high terrace where the gravel meets outcropping residual granite boulders and bedrock of the mountain front. The deposit seemingly was worked by hydraulic mining. The spoil piles contain cobbles of quartzite, granitic rock, and aplite. The deposit resembles an ancient river channel.

TRAIL CREEK DRAINAGE

The Trail Creek drainage system (Fig. 97) includes the tributaries, Joseph, May, Stevenson, South Fork Trail, Gory, and Ruby Creeks. The second gold discovery in Montana, and the first in Beaverhead County, was made on a small tributary of the Big Hole River, probably Ruby Creek (Fig. 97, locality 7), west of the town of Wisdom (Sassman, 1941, p. 42). The date of discovery was July 10, 1862. In 1863, however, the camp was virtually deserted after news of the discovery of the richer diggings at Bannack was received.

In 1885 placer gold was found on Trail Creek (Fig. 97, locality 8), and in 1886 the Salt Lake and Big Hole Mining and Placer Company completed a 7-mile ditch to operate placers near the Big Hole Battleground. In 1894, about two men were working the placers, and in 1910, May Furlong O'Rourcke had title to twelve placer claims. Although interest in the area languished, in 1940 a dragline was in operation (Sassman, 1941, p. 42).

In 1951 the Trail Creek placers were explored over a length of 6 miles for their black sand content by the U. S. Bureau of Mines (Holt, 1964, p. 26). About 25 churn drill holes were put down to bedrock at depths ranging from 9 to 33 feet. The black sand is almost confined to the coarse gravel resting on bedrock clay rather than the overlying alluvium. Only a small amount of gold was encountered during the drilling program. The black sand fraction recovered ranged from 4.1 to 15.1 pounds per cubic yard, and contained 18.1 to 57.5 percent ilmenite, 8.4 to 46.8 percent magnetite, 1.3 to 7.6 percent monazite, and a trace to 1.3 percent zircon (Holt, 1964, p. 29).

Table 22 gives production from placers in the Big Hole (Wisdom) district.

OTHER PLACER AREAS

Lyden (1948, p. 10) reported a small production of gold in 1923 from the Paul property on the shore of Lima Reservoir in about sec. 14, 15, 22, and 23, T. 14 S., R. 6 W. (Fig. 97, locality 9).

Placer gold in the amount of 9.43 ounces was produced from Odell Creek near Lakeview (Fig. 97, locality 10) in 1935 (Lyden, 1948, p. 10).

In the upper reaches of the West Fork Madison River (Fig. 97, locality 11), a dryland dredge produced 20 ounces of placer gold in 1941, from gold-bearing gravel derived from auriferous glacial deposits (Lyden, 1948, p. 10).

The gravels of Mulchey Creek (Fig. 97, locality 12) have been worked, but production of gold was very small. The source of the gold was probably the lodes on which were located the Dark Horse claims (Lyden, 1948, p. 10).

In Frying Pan Basin about 6 miles northwest of Dillon (Fig. 97, locality 13), placer gold was produced in 1933 (Lyden, 1948, p. 10).

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APPENDICES, PRODUCTION FIGURES FOR 1902-65

APPENDIX A, Metal mines for which all production figures can be published

Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals.

AJAX DISTRICT

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
NOEL JACKSON						
1957	10	-----	58	-----	2,200	-----

ARGENTA DISTRICT

AMARANTH						
1960	1	-----	8	-----	200	-----
ANACONDA						
1925	50	3	134	343	14,356	-----
1926	75	7	376	829	42,198	-----
1927	8	1	49	61	5,058	-----
Total	133	11	559	1,233	61,612	-----
ANNIE						
1943	1,421	11	2,145	5,059	129,290	-----
1953	62	3	360	297	14,265	2,436
Total	1,483	14	2,505	5,356	143,555	2,436
BANKRUPT						
1941	34	9	114	-----	-----	-----
BRIGHT SMILE						
1931	5	2	2	-----	-----	-----
BROWNELL						
1925	30	1	190	350	19,400	-----
1927	16	-----	75	105	10,702	-----
1928	53	1	329	502	34,282	-----
1929	14	-----	57	230	6,038	-----
1930	18	-----	52	174	6,374	-----
1942	335	9	496	1,507	51,302	-----
1947	92	3	131	1,186	10,699	-----
Total	558	14	1,330	4,054	138,797	-----
COPPER PLATE						
1936	3	-----	7	399	-----	-----
FERDINAND FURNACE						
1954	6	-----	85	200	1,900	100
IRON MOUNTAIN						
1926	594	40	1,078	3,970	187,238	-----
1927	45	3	245	193	24,419	-----
1928	118	13	2,347	1,173	53,693	-----
1929	38	3	496	373	14,785	-----
1930	16	1	321	107	5,368	-----
1931	11	3	115	30	3,194	-----
1934	5	1	152	47	2,888	-----
1937	429	40	6,972	2,967	50,617	-----
1938	100	6	665	702	15,975	-----
1939	123	8	958	564	20,677	-----
1940	89	7	305	320	32,358	-----
1942	312	17	675	1,607	110,658	-----
1943	498	18	648	2,463	199,415	-----
1944	864	25	879	6,619	254,100	5,000
1945	686	16	537	5,430	144,102	-----
1947	58	1	98	323	13,072	-----
1948	36	1	36	151	8,861	-----
Total	4,022	203	16,527	27,039	1,141,420	5,000

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
JACK RABBIT & COPPER BELL						
1912	32	1	950	9,050	-----	-----
1913	34	1	863	8,532	-----	-----
1914	80	1	907	14,165	-----	-----
1917	146	2	2,840	29,752	-----	-----
1918	35	-----	611	6,545	-----	-----
1926	14	-----	172	4,445	-----	-----
1933	2	1	3	-----	-----	-----
1941	500	1	177	644	61,311	-----
1942	22	-----	40	233	11,128	-----
1943	94	2	118	-----	20,500	-----
Total	959	9	6,681	73,366	92,939	-----
KNAPP						
1912	3	-----	87	719	-----	-----
1940	5	2	37	-----	1,838	-----
Total	8	2	124	719	1,838	-----
LOOKOUT						
1939	13	11	158	7	1,442	-----
LUCKY STRIKE						
1955	40	-----	159	-----	10,500	2,000
1957	5	-----	25	-----	1,000	200
Total	45	-----	184	-----	11,500	2,200
MILLIONAIRE						
1949	109	-----	826	147	43,273	2,000
1950	13	-----	189	-----	6,143	420
Total	122	-----	1,015	147	49,416	2,420
MOHAWK						
1954	26	5	63	-----	1,600	200
MONTANA MERC.						
1910	5	11	60	33	-----	-----
OLD PAYMASTER						
1926	4	-----	150	13	1,665	-----
SIR WALTER SCOTT						
1931	17	6	11	57	101	-----
1932	6	1	3	-----	-----	-----
Total	23	7	14	57	101	-----
STANLEY						
1932	6	9	4	29	-----	-----
1933	2	2	1	10	-----	-----
Total	8	11	5	39	-----	-----
STORM						
1937	34	1	803	198	-----	-----
STRINGER						
1934	4	1	26	34	45	-----
1935	12	-----	80	84	604	-----
Total	16	1	106	118	649	-----
SUNNYSIDE						
1941	4	-----	42	-----	849	-----
TILDON						
1902	400	165	6,538	-----	136,000	-----
1915	285	286	4,031	912	49,215	-----
1916	321	120	4,498	1,813	65,112	-----
1917	283	56	3,540	1,471	57,938	-----
1918	381	77	3,602	2,487	135,882	-----
1919	271	100	3,935	7,859	72,275	-----
1920	61	8	974	-----	12,161	-----
1921	31	4	357	-----	5,218	-----
1923	24	5	299	-----	6,814	-----
1926	17	1	191	60	4,688	-----
Total	2,074	822	27,965	14,602	545,303	-----
TUSCARORA						
1916	25	4	252	99	6,534	-----
1919	22	4	309	-----	6,539	-----
1920	21	4	319	-----	5,759	-----
1921	19	3	297	-----	15,457	-----
1922	94	16	1,088	-----	47,415	-----
1923	41	11	754	48	18,420	-----
1926	138	12	1,386	4,158	52,837	-----
1927	24	-----	30	3,509	1,630	-----
1936	279	82	1,079	215	12,822	-----
1937	742	119	6,055	1,635	102,389	-----
1946	84	13	678	94	14,663	1,555
1947	40	6	316	139	8,197	-----
1948	60	7	538	167	10,410	986
1949	32	3	250	81	5,157	570
1952	96	11	686	264	21,065	2,800
1953	152	78	2,259	172	54,374	1,912
1954	84	13	1,218	100	37,000	1,600
1959	41	8	376	-----	12,800	900
Total	1,994	394	17,890	10,681	433,468	10,323
WOOLEY						
1950	13	1	139	-----	2,207	177
COOLIDGE						
1935	96	7	1,454	170	8,109	-----
1936	130	11	820	-----	-----	-----
1940	12	1	166	-----	1,886	-----
1948	5	1	40	-----	718	82
1960	7	1	267	-----	3,100	100
1961	17	1	220	-----	2,800	600
1964	12	1	147	-----	1,100	100
Total	279	23	3,114	170	17,713	882
FISHER						
1957	1	-----	8	-----	300	-----
GOODVIEW & RELIANCE						
1941	126	20	1,210	81	23,600	-----
1942	779	117	5,204	363	118,888	-----
1948	102	29	592	298	16,010	1,214
1950	23	6	99	-----	2,036	190
1954	50	7	298	-----	3,400	800
Total	1,080	179	7,403	742	163,934	2,204
HILLSIDE						
1936	351	3	3,160	-----	-----	-----
1937	30	-----	246	-----	-----	-----
Total	381	3	3,406	-----	-----	-----
ARGENTA SLAG DUMP						
1917	2,540	32	8,543	25,840	486,838	-----
BANNER MINE						
1902	40	75	-----	-----	-----	-----
CLARA MINE						
1902	5	1	100	100	6,600	-----
NAME UNKNOWN (Darrenhauer & Brooks)						
1916	9	1	186	92	2,629	-----
DEL MONTE						
1918	22	1	611	-----	-----	-----
DOLPHIN-GOLD FINCH						
1902	60	57	600	-----	140	-----
1906	161	8	2,779	371	26,864	-----
1908	6	4	60	-----	-----	-----
1910	1	3	14	-----	-----	-----
1925	89	3	867	991	48,104	-----
1926	31	4	196	-----	5,694	-----
1932	95	135	991	60	13,301	-----
1933	98	183	1,463	137	25,236	-----
1934	636	645	5,483	1,132	61,423	-----
1935	2,069	1,029	13,667	1,641	37,632	-----
1936	734	247	2,291	72	3,956	-----
1937	488	377	4,277	103	16,729	-----
1938	467	242	1,611	76	6,431	-----
1939	40	6	331	21	5,426	-----
1940	280	203	2,764	164	16,408	-----
1941	1,256	685	7,884	634	41,053	-----
1942	13	15	195	-----	-----	-----
1948	10	10	88	-----	1,901	171
1949	30	5	48	-----	-----	-----
1950	2	2	14	-----	391	-----
1954	38	8	380	100	8,000	-----
Total	6,604	3,871	46,003	5,502	318,689	171
GOLDSMITH						
1926	73	1	452	22,334	5,109	-----
1927	25	-----	18	7,772	-----	-----
1930	2	-----	9	765	-----	-----
1937	10	-----	42	1,770	-----	-----
1942	8	-----	21	1,560	-----	-----

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
1943	3	-----	6	653	-----	-----
1949	53	3	58	220	11,400	-----
1954	34	4	277	-----	17,500	1,400
1955	147	24	914	500	80,500	1,600
1956	31	4	121	300	8,600	500
1957	19	3	228	300	9,200	1,700
1958	11	-----	16	1,800	-----	-----
1959	5	1	28	-----	1,700	100
1964	44	3	143	100	8,600	3,200
1965	98	13	428	500	29,700	20,400
Total	563	56	2,761	38,574	172,309	28,900
GRAETER GROCERY						
1914	1	4	220	114	-----	-----
GREEN & SPAFFORD						
1910	16	-----	39	2,319	-----	-----
HARD LUCK						
1910	4	-----	8	754	-----	-----
HENRY						
1961	152	25	733	200	-----	-----
1962	612	154	3,236	800	-----	-----
Total	764	179	3,969	1,000	-----	-----
HOYER						
1910	22	38	335	188	6,560	-----
HUMBOLT GROUP						
1938	6	3	16	-----	-----	-----
LAKEVIEW						
1935	6	3	51	-----	-----	-----
LUCKY DAY						
1918	3	-----	30	17	1,763	-----
McMANNIS						
1926	69	1	340	6	19,814	-----
McKAY						
1910	1	-----	4	-----	776	-----
MAULDIN						
1923	1	-----	24	8	490	-----
1924	84	4	644	422	36,061	-----
1926	56	8	483	233	12,373	-----
1927	46	2	176	180	12,817	-----
1941	12	1	48	-----	3,744	-----
1942	211	18	765	232	37,893	-----
1943	518	37	2,178	1,153	85,831	-----
1944	524	23	1,627	581	104,100	-----
1945	874	135	2,748	1,170	104,898	6,400
1946	763	138	6,178	1,648	138,035	6,696
1947	1,601	231	14,131	8,797	346,249	-----
1948	2,419	243	10,933	18,314	582,494	4,890
1949	3,111	239	16,117	13,827	787,000	45,600
1950	3,640	167	19,540	21,676	805,233	100,435
1951	2,294	71	9,248	24,601	615,270	120,887
1952	4,066	136	12,285	38,375	915,341	149,212
1953	2,785	118	13,460	35,599	915,566	88,465
1954	2,744	54	7,100	21,600	721,600	108,000
1955	2,625	52	10,439	22,100	717,500	65,300
1956	4,013	398	11,570	20,100	1,016,100	126,700
1957	2,744	482	4,743	9,700	695,500	66,400
1958	2,222	85	4,154	7,700	537,000	113,900
1959	2,377	30	7,198	27,600	333,600	114,200
1960	2,474	79	7,185	9,200	378,200	100,800
1961	1,580	53	3,735	5,700	308,100	65,800
1962	1,269	145	4,050	3,700	306,800	41,800
1963	153	92	7,244	5,500	354,100	63,700
1964	1,986	84	6,623	12,800	511,300	112,400
1965	2,820	314	7,482	8,400	535,500	103,000
Total	51,392	3,439	192,108	320,916	11,918,695	1,604,585
MELVYN						
1909	8	1	137	-----	7,576	-----
MIDGE						
1953	3	-----	30	-----	651	60
PHILLIPS						
1923	12	3	119	165	9,446	-----
PILON						
1918	2	-----	27	23	1,133	-----
1919	6	3	34	27	1,633	-----
1920	88	28	1,189	522	23,089	-----
1921	26	8	203	249	11,596	-----
1936	21	1	381	290	4,904	-----
Total	143	40	1,834	1,111	42,355	-----
RENA						
1940	15	1	1	-----	-----	-----
1947	19	23	93	58	2,367	100
1948	29	44	126	139	3,274	2,294
Total	63	68	220	197	5,641	2,394
ROSEMONT GROUP						
1940	89	13	390	97	25,464	-----
1941	327	38	1,226	169	69,028	-----
1942	52	4	63	88	5,412	-----
Total	468	55	1,679	354	99,904	-----
SLAG DUMP						
1918	658	5	983	4,619	130,910	-----
SNOW STORM						
1924	3	4	1	-----	-----	-----
1936	4	-----	37	-----	-----	-----
Total	7	4	38	-----	-----	-----
SORENSON						
1910	7	-----	72	190	3,648	-----
STARLIGHT						
1957	3	1	32	-----	500	-----
SUMMER DAY						
1907	250	12	3,000	-----	2,500	-----
UNGENNAN						
1926	11	-----	28	27	8,963	-----
VARIOUS						
1927	59	11	35	69	275	-----
1938	1	1	2	-----	-----	-----
Total	60	12	37	69	275	-----
YELLOW BIRD						
1926	22	2	377	45	4,233	-----
1936	40	2	427	-----	-----	-----
Total	62	4	804	45	4,233	-----

BALDY MOUNTAIN DISTRICT

DILLON						
1935	201	62	127	1,941	974	-----
JACKO						
1939	4	-----	38	45	586	-----
ORIOLE						
1936	24	-----	414	-----	-----	-----
SUMMIT						
1941	3	-----	90	-----	-----	-----
FAITHFUL & OLD FAITHFUL						
1939	484	100	295	282	9,712	-----
1940	300	156	218	-----	-----	-----
1947	50	2	179	300	11,000	-----
1948	133	7	653	1,700	35,900	3,100
1949	70	3	231	300	12,900	3,600
Total	1,037	268	1,576	2,582	69,512	6,700
SULPHIDE						
1916	7	-----	484	140	1,155	-----
1921	10	-----	570	85	986	-----
Total	17	-----	1,054	225	2,141	-----

BANNACK DISTRICT

DUNN						
1936	1	8	30	-----	-----	-----
HENDRICKS-GRAETER						
1917	58	106	114	-----	-----	-----
1919	1,809	626	263	-----	-----	-----
1920	4,420	1,234	975	-----	-----	-----

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
1921	700	210	121	-----	-----	-----
1933	15	15	16	47	-----	-----
1934	43	25	39	-----	-----	-----
1935	3,500	1,054	663	-----	-----	-----
1936	83	104	42	249	251	-----
1937	215	61	20	-----	-----	-----
1938	546	109	277	-----	-----	-----
1939	3,975	566	492	-----	-----	-----
1940	8,218	1,168	1,614	-----	-----	-----
1941	6	16	4	-----	-----	-----
1961	6	5	339	-----	-----	-----
Total	23,594	5,299	4,979	296	251	-----
METAL						
1922	55	274	101	-----	-----	-----
PRISCILLA						
1940	1,244	399	1,959	-----	-----	-----
PURSUED DEER						
1918	46	36	76	4,611	-----	-----
VENETIUM						
1917	35	30	103	-----	7,997	-----
WALLACE						
1939	32	24	28	-----	-----	-----
BANNACK						
1917	5,042	1,184	6,991	138	-----	-----
CUMBERLAND						
1921	1	-----	79	106	296	-----
DUTAH						
1907	19	12	125	200	-----	-----
EXCELSIOR						
1902	202	90	10	-----	-----	-----
1917	295	91	681	14,820	-----	-----
1918	33	133	182	-----	-----	-----
1919	130	206	555	12,716	-----	-----
Total	660	520	1,428	27,536	-----	-----
FIRST NATIONAL BANK OF DILLON						
1911	11	2	63	-----	4,433	-----
GOLD BUG						
1922	1	11	1	-----	-----	-----
1923	34	162	44	-----	-----	-----
1924	7	83	8	-----	-----	-----
1925	1	8	-----	-----	-----	-----
1926	34	24	34	-----	-----	-----
1929	33	43	86	536	1,873	-----
1933	41	37	118	1,207	1,838	-----
1934	811	708	1,669	6,650	2,973	-----
1935	550	437	1,333	2,807	-----	-----
1936	253	199	739	1,490	553	-----
1937	364	239	684	19,000	-----	-----
1939	38	34	40	-----	-----	-----
1940	121	133	16	-----	-----	-----
1941	65	63	58	383	200	-----
Total	2,353	2,181	4,830	32,073	7,437	-----
GROVES						
1921	3	17	5	-----	-----	-----
LIBBY						
1911	7	-----	984	211	2,614	-----
LITTLE ROBERT						
1912	1	-----	47	19	271	-----
NEW YORK MONTANA GROUP						
1941	154	106	282	717	-----	-----
PAYMASTER						
1926	125	62	15	-----	-----	-----
SNOWDROP						
1918	1	-----	41	11	-----	-----
STALLINGS						
1915	153	384	2,579	2,066	8,482	-----
SULPHIDE GROUP						
1912	15	2	1,298	309	1,650	-----
TAYLOR						
1910	5	-----	286	83	669	-----
UNDERWOOD						
1911	1	11	1	-----	-----	-----
1918	8	6	7	-----	-----	-----
Total	9	17	8	-----	-----	-----
WADAMS & GOLD LEAF OR GOLDEN LEAF						
1909	35	170	311	138	1,696	-----
1910	462	2,570	7,357	1,872	55,873	-----
1911	820	2,035	5,838	2,802	31,302	-----
1912	616	3,727	7,893	-----	5,949	-----
1913	188	1,131	2,328	1,224	-----	-----
1914	214	281	4,142	865	5,061	-----
1925	225	365	1,063	-----	-----	-----
1926	73	101	55	-----	-----	-----
1937	272	89	429	-----	-----	-----
1955	16	3	39	100	900	300
Total	2,921	10,472	29,455	7,001	100,781	300
WEST SHORE						
1917	20	4	6	2,458	-----	-----
NAME UNKNOWN, OWNERS UNKNOWN						
1919	10	9	18	-----	-----	-----

BEAVERHEAD DISTRICT

BALTIC						
1917	30	1	60	1,755	-----	-----
1918	30	1	57	1,749	-----	-----
Total	60	2	117	3,504	-----	-----
BEST						
1917	1	-----	95	8	-----	-----
BILLETTE						
1917	2	1	32	-----	767	-----
BROWN BULL						
1917	55	2	4,883	1,371	33,986	-----
DARK HORSE & CALUMET						
1907	22	9	152	8,382	-----	-----
1908	9	4	61	3,695	-----	-----
1909	9	2	55	3,149	-----	-----
1915	2	-----	72	210	-----	-----
1916	32	14	250	13,613	-----	-----
1917	30	15	235	12,273	-----	-----
1918	112	45	743	42,721	-----	-----
Total	216	89	1,568	84,043	-----	-----
GRAVES						
1917	2	-----	174	-----	831	-----
KELLEY GROUP						
1912	10	1/	22	1,389	-----	-----
LITTLE ROSEBUD						
1908	3	1	-----	-----	-----	-----
MONUMENT C						
1908	2	-----	8	415	-----	-----
1917	43	1	76	3,208	-----	-----
Total	45	1	84	3,623	-----	-----
OWL						
1928	7	-----	763	1,853	-----	-----
PADDOCK						
1917	1	-----	33	132	596	-----
PAIGE						
1915	3	-----	81	11	3,901	-----
RICHARDSON						
1920	27	17	101	759	8,301	-----
SUNSHINE						
1914	11	1	95	2,289	-----	-----
1915	18	-----	433	-----	1,480	-----
Total	29	1	528	2,289	1,480	-----
TUNNEL SITE						
1918	32	-----	1,700	-----	-----	-----

1/ Less than ½ oz.

BIRCH CREEK (UTOPIA) DISTRICT

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
GREENSTONE						
1908	26	-----	29	965	-----	-----
1909	37	1	71	3,119	-----	-----
1949	43	-----	53	2,600	-----	-----
Total	106	1	153	6,684	-----	-----
BARNOSKY						
1924	3	-----	2	1,965	-----	-----
BRIGGS						
1906	9	3	52	41	3,542	-----
CHIEF & IDA						
1916	6	-----	63	1,349	-----	-----
1917	7	-----	36	1,817	-----	-----
Total	13	-----	99	3,166	-----	-----
INDIAN QUEEN						
1902	465	5	2,400	90,390	-----	-----
1903	8,000	160	16,000	553,220	-----	-----
1904	12,000	31	12,577	525,639	-----	-----
1905	400	6	2,160	81,420	-----	-----
1906	285	6	1,710	85,918	-----	-----
1906	395	8	2,135	101,606	-----	-----
1907	400	-----	2,000	80,000	-----	-----
1908	315	74	1,220	106,207	-----	-----
1909	162	2	349	25,646	-----	-----
1910	35	-----	46	10,885	-----	-----
1911	65	1	154	14,877	-----	-----
1912	25	-----	32	4,627	-----	-----
1913	48	1	224	13,858	-----	-----
1914	15	-----	99	5,540	-----	-----
1915	18	-----	75	3,768	-----	-----
1916	48	1	147	3,942	-----	-----
1917	133	2	690	12,875	820	-----
1918	47	1	120	3,482	-----	-----
1919	43	1	61	4,533	-----	-----
1923	8	-----	20	971	-----	-----
Total	22,907	299	42,219	1,729,404	820	-----
RICHARDS						
1906	27	1	130	4,402	-----	-----
1907	71	1	449	23,207	-----	-----
Total	98	2	579	27,609	-----	-----
SILVER KING						
1912	6	2	162	-----	1,102	-----
SLAGGETT						
1906	39	1	344	2,955	-----	-----
UTOPIA						
1919	5	-----	134	-----	-----	-----

BLACKTAIL DISTRICT

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
BLUE BIRD						
1923	13	-----	5	1,616	-----	-----
NEVADA						
1934	384	5	6,121	988	-----	-----
1935	183	2	2,098	-----	-----	-----
Total	567	7	8,219	988	-----	-----

BLUE WING DISTRICT

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
RANDALL						
1939	26	1	322	-----	-----	-----
SILVER JOHNNY						
1936	10	-----	277	-----	-----	-----
SILVER ROSE						
1935	74	1	1,550	58	2,069	2,614
SINGLE JACK						
1941	13	-----	234	-----	-----	-----
HAUPTMAN						
1916	14	5	22	146	901	-----
HURON						
1902	9	1	1,045	-----	1,360	-----
1918	18	-----	2,206	488	-----	-----
1919	13	1	1,092	249	-----	-----
1925	4	1	314	57	-----	-----
1936	4	-----	198	-----	-----	-----
1937	62	4	1,606	814	-----	-----
Total	110	7	6,461	1,608	1,360	-----
KENT						
1907	91	5	7,735	-----	27,300	-----
1908	23	-----	1,993	572	8,375	-----
1909	65	2	13,643	4,404	19,521	-----
1910	40	1	11,211	3,602	12,155	-----
1917	20	1	664	260	-----	-----
1918	6	-----	1,021	354	-----	-----
1919	1	-----	158	43	-----	-----
1928	22	-----	1,171	281	4,910	3,116
1935	8	-----	1,384	391	-----	-----
Total	276	9	38,980	9,907	72,261	3,116
LIMAN & BECK						
1922	13	15	34	904	-----	-----
McMANNIS MINE						
1916	34	1	165	138	9,996	-----
MOTHER LODE						
1934	4	-----	56	13	-----	-----
NEW DEPARTURE						
1902	80	-----	9,600	-----	-----	-----
1905	40	-----	7,200	-----	-----	-----
1906	17	-----	4,270	-----	2,890	-----
1907	516	-----	29,163	166	2,639	-----
1908	40	1	4,375	483	985	-----
1909	40	7	4,373	2,313	1,892	-----
1910	12	1	1,274	146	-----	-----
1911	9	-----	1,099	130	778	-----
1912	49	1	2,528	269	-----	-----
1913	56	1	1,995	122	-----	-----
1914	6	-----	1,332	146	-----	-----
1915	4	-----	533	57	-----	-----
1916	7	-----	829	103	-----	-----
1917	201	109	12,572	1,513	2,358	-----
1923	17	1	2,632	156	-----	-----
1924	81	3	8,759	496	-----	-----
1925	58	2	8,566	985	-----	-----
1926	24	1	4,869	367	-----	-----
1927	13	-----	2,396	198	-----	-----
1928	20	1	3,842	-----	-----	-----
1929	5	-----	1,282	115	-----	-----
1931	36	1	5,824	546	1,883	-----
1932	107	4	4,826	556	-----	-----
1933	76	2	1,057	188	-----	-----
1934	167	3	6,661	545	1,176	-----
1935	207	3	4,180	191	-----	-----
1956	30	1	1,733	-----	-----	-----
1939	1,221	17	19,035	96	1,042	-----
1941	189	5	4,758	-----	3,080	-----
1953	19	-----	1,224	40	542	1,364
1956	31	1	5,715	400	3,900	3,400
1957	6	-----	879	-----	600	300
1961	31	2	3,978	200	1,800	2,400
1962	77	4	4,446	300	2,100	4,200
1963	2,813	5	16,146	1,400	5,200	2,400
1964	18,232	27	136,098	11,300	58,000	81,900
1965	2,600	2	10,398	900	6,100	6,200
Total	27,137	205	340,447	24,427	96,965	102,164
PAYETTE						
1917	12	-----	48	207	3,604	-----
SILVER RULE						
1920	13	-----	127	-----	1,457	-----
SILVER SNOW						
1940	7	-----	446	40	-----	-----
1941	10	-----	193	-----	-----	-----
Total	17	-----	639	40	-----	-----
SMITH MINE						
1917	2	-----	6	-----	429	-----

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
SUNSHINE						
1936	40	3	448	249	-----	-----
WADE MINE						
1916	5	-----	621	217	471	-----

BRYANT DISTRICT

ATLANTIS-HECLA						
1902	1,539	152	118,084	54,713	512,781	-----
1903	1,515	159	140,116	104,267	444,322	-----
1904	300	27	21,227	17,487	103,980	-----
1905	540	-----	36,000	24,000	144,000	-----
1906	510	40	45,417	43,032	209,726	-----
1907	149	4	22,648	17,240	55,800	-----
1908	181	27	17,473	14,112	54,005	-----
1909	474	48	33,232	48,777	258,063	-----
1910	328	11	29,807	38,900	180,160	-----
1911	1,095	44	90,480	98,126	766,883	-----
1912	949	51	69,382	66,423	541,067	-----
1913	4,056	24	41,742	41,694	280,330	-----
1914	16,800	65	79,661	2,446	516,765	-----
1915	697	17	55,347	71,814	389,448	33,136
1916	1,184	59	76,603	102,083	574,004	-----
1917	1,657	60	77,610	102,947	824,455	15,918
(slag)	61	-----	137	-----	6,425	-----
1918	1,123	28	65,241	100,908	748,886	-----
(slag)	1,481					
1919	765	36	61,860	106,397	962,028	-----
(slag)	2,773					
1920	507	39	53,536	146,837	1,893,692	-----
(slag)	8,742					
1921	311	11	26,165	24,282	166,230	-----
(slag)	22					
1922	362	14	32,267	36,343	315,894	-----
(slag)	665					
1923	211	14	42,946	106,185	1,935,180	-----
(slag)	19,566					
1924	126	25	67,421	187,955	3,486,445	-----
(slag)	36,493					
1925	152	5	50,845	158,999	2,280,602	-----
(slag)	29,308					
1926	110	4	31,136	108,511	1,459,761	-----
(slag)	18,913					
1927	256	33	27,996	54,904	796,674	-----
(slag)	8,624					
1928	627	24	34,743	42,690	390,185	-----
1929	872	187	41,032	52,906	687,600	-----
(slag)	3,372					
1930	173	56	8,199	5,035	50,914	-----
1931	46	11	1,919	1,201	14,938	-----
1932	67	11	3,752	3,302	22,400	-----
1933	5	-----	257	281	2,486	-----
1934	724	122	15,195	7,737	75,270	-----
1935	1,339	94	28,324	7,122	63,200	-----
(slag)	222					
1936	578	32	11,197	12,087	97,826	-----
(slag)	410					
1937	221	11	13,819	16,000	245,000	-----
(slag)	2,457					
1938	248	126	41,911	54,296	217,957	-----
(slag)	2,406					
1939	-----	-----	-----	-----	-----	-----
(slag)	13,521	798	126,692	194,039	551,787	-----
1940	5	1,757	426,735	626,168	1,502,540	-----
(slag)	43,084					
1941	3,646	383	34,352	57,000	182,141	-----
1942	11,543	86	13,846	70,138	878,683	1,500,700
(slag)	1,320	46	12,596	17,425	50,717	-----
1943	12,454	324	46,904	127,500	828,200	938,500
1944	8,336	312	35,325	96,400	847,600	726,500
1945	6,346	660	49,185	72,400	460,500	317,400
1946	-----	-----	-----	-----	-----	-----
(slag)	3,325	364	23,380	35,500	198,000	27,000
1947	490	168	13,273	22,800	164,700	42,500
(slag)	1,958					
1948	190	87	6,771	18,800	185,600	163,800
(slag)	2,306					
1949	90	42	3,202	4,900	36,100	32,700
(slag)	434					
1954	280	73	6,161	1,000	22,600	18,500
1955	18	3	729	400	5,700	2,000
1956	70	1	1,836	8,400	9,100	7,600
1957	370	-----	1,195	300	11,800	400
1958	1,012	20	9,260	3,200	24,900	1,500
1959	287	17	4,256	-----	-----	-----
1960	1,890	102	20,480	-----	-----	-----
1961	1,338	62	15,229	5,000	-----	-----
1962	730	40	8,633	4,500	-----	-----
1963	339	9	3,790	1,800	5,900	3,100
1964	517	20	7,894	3,000	-----	-----
1965	171	4	1,904	1,000	-----	-----
Total	292,382	7,049	2,488,355	3,453,709	27,741,950	3,831,254
TRIANGLE						
1935	2	-----	25	41	-----	-----
AVANCA						
1916	70	3	921	94	26,594	-----
1917	178	10	2,816	598	75,042	-----
Total	248	13	3,737	692	101,636	-----
BIG FOUR						
1918	3	-----	84	218	775	-----
CHRISTENSEN MINE						
1906	49	25	132	1,243	-----	-----
CLIPPER-COLUMBIA						
1909	83	6	11,657	4,622	28,177	-----
1916	70	1	49	13,448	-----	-----
1918	141	1	97	15,349	-----	-----
1919	251	9	322	81,903	-----	-----
1920	38	1	26	12,791	-----	-----
Total	583	18	12,151	128,113	28,177	-----
COPPER BOTTOM						
1917	8	-----	4	1,233	-----	-----
CORDELL MINE						
1916	19	2	160	-----	4,929	-----
CURTIS MINE						
1920	2	1	33	-----	332	-----
DUTCH MINE						
1918	40	2	484	178	13,372	-----
FOREMAN MINE						
1925	235	10	3,306	3,428	19,872	-----
GOLD DUST						
1918	21	4	556	-----	-----	-----
HORN SILVER						
1918	17	1	295	-----	-----	-----
JACKSON MINE						
1917	12	1	15	-----	2,908	-----
LIVELY MINE						
1921	1	-----	68	-----	17	-----
MOUNTAIN VIEW						
1919	37	2	297	-----	5,342	-----
NAPOLEN-NAPOLEON BONAPARTE						
1935	50	1	699	181	-----	-----
RUBY						
1918	4	-----	5	1,465	-----	-----
SILVER BELT						
1906	18	2	1,438	-----	-----	-----
1909	17	9	164	-----	1,230	-----
1910	10	1	584	58	4,285	-----
Total	45	12	2,186	58	5,515	-----
SILVER FOX						
1924	1	-----	92	61	-----	-----
SILVER KING						
1913	1	-----	191	15	175	-----
SUPERIOR						
1918	5	-----	97	-----	2,350	-----
VERMONT						
1917	2	-----	309	13	-----	-----

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
ELKHORN DISTRICT						
INGERSOLL & BRICK POMEROY						
1908	19	1	1,424	167	1,816	-----
1909	19	1	2,052	324	2,088	-----
Total	38	2	3,476	491	3,904	-----
MONTANA APEX						
1909	3	-----	13	630	-----	-----
RED ROCK						
1906	20	6	133	7,273	-----	-----
LOST CREEK DISTRICT						
IVANHOE						
1928	36	-----	152	4,085	-----	-----
1929	51	1	495	8,544	-----	-----
Total	87	1	647	12,629	-----	-----
MEDICINE LODGE DISTRICT						
BLUE BIRD						
1949	4	-----	-----	236	-----	-----
SWEETWATER						
1949	5	1	-----	464	-----	-----
VIVIAN						
1948	10	-----	40	26	2,414	261
NOGO DISTRICT						
MILLIONAIRE						
1911	49	4	1,281	49	24,238	-----
1912	14	-----	530	-----	12,516	-----
1913	22	4	135	236	3,670	-----
1916	22	3	418	28	8,316	-----
1921	5	-----	192	-----	4,007	-----
Total	112	11	2,556	313	52,747	-----
POLARIS DISTRICT						
BLUE EYED ANNIE						
1965	62	-----	210	100	-----	-----
GOOD ENOUGH						
1936	92	18	353	-----	-----	-----
HOMESTAKE						
1940	2	-----	74	44	80	-----
BAKER & SMITH MINE						
1934	16	10	20	159	379	-----
BONNIE DEAN						
1934	15	5	5	188	-----	-----
1935	9	1	45	82	4,450	-----
Total	24	6	50	270	4,450	-----
COCHRAN						
1919	7	-----	488	78	-----	-----
DAKOTA						
1910	2	-----	196	-----	-----	-----
DILLON						
1936	260	21	10	-----	-----	-----
JENNINGS MINE						
1912	5	-----	221	-----	-----	-----
POLARIS						
1908	11	65	2,811	2,204	-----	-----
1912	29	8	3,208	594	-----	-----
1914	19	3	2,363	198	-----	-----
1915	10	1	1,223	125	-----	-----
1917	446	14	13,768	-----	-----	-----
1918	193	15	12,035	3,680	-----	-----
1919	49	4	2,912	1,158	-----	-----
1920	87	6	5,239	1,299	-----	-----
1922	275	8	10,955	493	126	-----
1924	3	-----	247	33	-----	-----
1925	1	1	11	-----	-----	-----
1934	114	64	233	173	-----	-----
1935	12	-----	801	-----	-----	-----
1939	8	-----	436	-----	-----	-----
1955	1	-----	161	-----	100	-----
1956	26	1	2,274	200	1,700	900
1959	1	-----	1	-----	-----	-----
1960	490	9	10,129	700	1,800	9,600
1961	430	8	7,101	-----	400	400
1962	481	9	4,673	1,600	-----	-----
1963	450	6	12,324	2,400	-----	-----
1964	588	5	11,673	2,300	-----	-----
1965	519	4	11,928	2,200	1,000	1,000
Total	4,243	231	116,506	19,357	5,126	11,900
TEDDY						
1912	17	-----	880	34	-----	-----
SAGINAW DISTRICT						
SAGINAW						
1914	157	-----	48	33,098	-----	-----
1915	263	-----	32	46,404	-----	-----
1916	526	-----	183	83,983	-----	-----
1917	290	-----	182	42,797	-----	-----
Total	1,236	-----	445	206,282	-----	-----
VIPOND PARK AND QUARTZ HILL						
AURORA						
1933	10	-----	635	90	-----	-----
1934	190	2	5,080	651	-----	-----
1935	173	1	3,321	664	-----	-----
1936	138	-----	2,330	509	-----	-----
1941	152	1	2,380	-----	-----	-----
Total	663	4	13,746	1,914	-----	-----
MELDON & ALDER GULCH						
1935	6	-----	29	-----	-----	-----
QUARTZ HILL (LONE PINE MINE)						
1908	289	3	8,730	950	-----	-----
1909	68	1	2,259	56	-----	-----
1921	31	1	1,524	-----	-----	-----
1927	17	-----	422	-----	-----	-----
1933	756	15	26,204	4,430	-----	-----
1934	2,806	39	78,834	14,054	-----	-----
1935	6,737	69	168,669	39,537	-----	-----
1936	10,847	31	238,387	60,810	-----	-----
1937	4,665	-----	89,407	20,467	-----	-----
1938	699	-----	12,111	1,500	-----	-----
1939	712	7	12,510	-----	-----	-----
1940	2,411	21	45,748	-----	-----	-----
1941	2,669	18	54,479	-----	-----	-----
1942	928	9	16,206	-----	-----	-----
1943	895	6	16,445	3,100	-----	-----
1944	833	5	12,817	2,200	-----	-----
1945	31	-----	1,395	-----	-----	-----
1946	90	1	1,073	-----	-----	-----
1947	2,027	20	26,548	5,899	-----	-----
1948	2,713	28	57,578	-----	-----	-----
1949	918	6	16,843	-----	-----	-----
1950	149	1	1,482	-----	-----	-----
1958	5,686	28	31,712	10,000	-----	-----
1961	25	-----	150	-----	-----	-----
1962	616	2	2,820	800	-----	-----
Total	47,618	311	924,353	163,803	-----	-----
SILVER QUEEN						
1937	11	-----	195	-----	-----	-----
WHITE CAP						
1960	10	-----	62	-----	-----	-----
BIG SNOW						
1915	4	5	3	-----	-----	-----
BUTTE & VIPOND						
1914	9	10	39	88	-----	-----
DeCELLES or MARTIN						
1921	200	202	382	208	16,483	-----
1922	15	9	5	-----	-----	-----
Total	215	211	387	208	16,483	-----

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
EMMA						
1950	166	1	6,930	-----	-----	-----
1951	5	-----	138	-----	-----	-----
Total	171	1	7,068	-----	-----	-----
EVANS						
1909	25	-----	499	197	-----	-----
FERGUSON & LEFFLER						
1908	12	27	-----	-----	-----	-----
1911	14	-----	479	-----	-----	-----
1918	27	-----	537	275	4,778	-----
Total	53	27	1,016	275	4,778	-----
HANSEN						
1917	3	1	45	26	1,393	-----
KEYSTONE						
1958	19	-----	179	-----	-----	-----
NANCY ANN						
1933	7	-----	241	42	-----	-----
1934	11	-----	273	2	569	-----
Total	18	-----	514	44	569	-----
ROBINSON						
1920	17	-----	317	838	11,644	-----
S. W. A. C.						
1937	12	-----	144	-----	-----	-----
TILLIE						
1915	5	9	1	-----	-----	-----
1918	2	4	1	20	-----	-----
Total	7	13	2	20	-----	-----

WISDOM (BIG HOLE) DISTRICT

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
AJAX						
1902	1,200	630	7,200	-----	120,000	-----
1904	200	240	-----	-----	-----	-----
1905	200	72	-----	-----	5,600	-----
1912	16	26	199	147	4,929	-----
1916	17	4	171	129	5,624	-----
1940	10	7	51	-----	4,086	-----
Total	1,643	979	7,621	276	140,239	-----
CLARA						
1960	4	3	26	-----	-----	-----
(UNKNOWN — OPERATED BY MONTE CLINTON)						
1932	1	2	12	-----	-----	-----
SLEEPING FAWN						
1932	1	1	3	-----	-----	-----
HALL						
1910	3	2	1	-----	-----	-----
MARTIN						
1904	70	17	26,036	-----	3,101	-----
TACOMA						
1909	2	1	59	15	123	-----

UNORGANIZED DISTRICT

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
CLIMAX						
1903	20	100	-----	-----	-----	-----
MONTANA MERCANTILE CO.						
1911	84	2	2,480	21,382	324	-----
ORR						
1919	14	-----	100	493	-----	-----
JAKE CREEK						
1923	38	-----	1,123	-----	-----	-----

APPENDIX B, METAL MINES FOR WHICH ONLY TOTAL PRODUCTION FIGURES CAN BE PUBLISHED

Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals.

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lb.)	Lead (lb.)	Zinc (lb.)
ARGENTA DISTRICT						
ARGENTA (GLADSTONE)	674	355	3,285	5,054	102,954	-----
BADGER	859	330	123	102	-----	-----
CAPITOL	36	1	267	311	7,986	634
CARBONATE	64	10	592	-----	10,773	611
CATHERINE L.	35	-----	565	88	4,814	32
CROSS	925	386	2,111	2,100	400	1,100
EIGHT BALL	555	392	1,377	104	-----	360
ERMONT	189,649	41,255	6,999	4,789	-----	-----
FERDINAND GROUP	3,060	17	8,942	15,746	436,392	265,934
GLADSTONE-MIDNIGHT	3,324	1,180	22,447	8,873	369,958	-----
GROUNDHOG GROUP-GOODREEN	2,209	632	6,144	618	65,884	1,336
JACK OR JACK GROUP	1,126	551	15,813	1,620	159,410	8,606
LAST CHANCE	35	-----	331	83	11,158	2,836
MAY DAY	754	539	4,830	572	51,684	1,256
ORO FINO	43	128	16	350	-----	-----
PARK	95	34	403	-----	-----	65
PAY DAY	90	77	303	22	2,593	423
PINE TREE	76	66	65	-----	1,253	227
SHAFER GROUP	26,855	15,593	70,967	7,640	930	7,129
SILVER HORN	134	59	1,972	85	6,580	-----
SYLVIA	545	516	16,757	584	229,047	5,393
BANNACK DISTRICT						
GOLD CROWN	183	116	90	779	-----	-----
PIONEER	432	384	103	1,800	-----	-----
SLEEPING PRINCESS GROUP	87,092	18,256	57,328	3,516	2,043	-----
BLUE WING DISTRICT						
BLUE WING	2,427	160	38,037	331	-----	-----
CHARTER OAK	506	20	14,845	3,409	76,923	15,700
DEL MONTE	394	20	7,397	228	206	-----
INGERSOLL	511	13	10,922	3,185	20,300	2,000
CHINATOWN DISTRICT						
HAMILTON	323	7	3,082	-----	203,342	-----
ELKHORN DISTRICT						
COMET	773	20	23,879	4,000	1,700	300
OLD ELKHORN-ELKHORN	52,385	1,013	180,843	370,799	851,725	4,100
STAR & STAR EXTENSION	150	143	64	379	200	400
HORSE PRAIRIE CREEK DISTRICT						
H & S	970	35	8,100	700	525,566	14,977
MEDICINE LODGE DISTRICT						
S. S. & R.	596	-----	1,499	385	233,293	6,443
POLARIS DISTRICT						
SILVER KING	84	4	797	75	1,105	200
SMELTER DISTRICT						
GLENDALE SMELTER	3,902	13	9,204	12,800	335,200	276,900
VIPOND DISTRICT						
FAITHFUL	268	3	1,569	507	2,800	-----
GRAY JOCKEY	2,161	18	22,789	18,094	1,634	-----
MONTE CRISTO	1,131	5	19,872	3,626	28,000	-----
STAR & STAR EXTENSION	514	409	716	200	-----	-----
WISDOM (BIG HOLE) DISTRICT						
NORTH STAR	424	164	813	141	-----	-----

APPENDIX C, METAL MINES FOR WHICH NO PRODUCTION FIGURES CAN BE PUBLISHED

ARGENTA DISTRICT

All Nations
Anita
Bean Money
Bear Hill
Bernice
Blue Moon
Brown Bear
Butte-Argenta
Daylight
Care
Name unknown (Collins & Burdick)
Connie
Consolidated
Cushing
Decker Special
Dexter
East End
Elliott
Fairview
Faithful
Florida
Geel
Gold Nuggett
Governor Tilden
Storm King
Summit & Silver King
Sunrise
Sylvia SK No. 1
Taylor
Trader Horn
Trout Creek No. 3
Graybird
Greenstreak
Grill
Hardly Able
Hard Scramble
Hay Seed
Interstate Mill
James
Leap Year
Lehson
Little Bear
Lupine
M & M
McCullough
McDonald
Magnolia
Malicote
Mertie No. 1 & 2, etc.
North Star
Paradise
Powers & Miller
Queen Ann
Skyline
Snowline
Underwood
Vance & Pond
Vermont
Virginia Gulch
Watson Creek Group
White Quartz
White Rock

BANNACK DISTRICT

Amazon
Bannack Apex
Barnes
Bretherton
Davis
Gold Coin
Kendall
Paddock
Rimrock
Name Unknown (owners Thompson, Thompson, and Stallings)
Garnet & Garnet Fraction
Vanadanite

BALDY MOUNTAIN DISTRICT

Goldconda
Mayflower
Vanadinite

BLACKTAIL DISTRICT

Hard Luck
Monument
West Shore

BLUE WING DISTRICT

Cable
Contact
Cottontail
Federal Star
Interstate
Iron Mask
Morris
Ruth
J. H. Temby

BRYANT DISTRICT

Allen
Rattlesnake
Wake Up Jim

CHINATOWN DISTRICT

Sprinkle
Templeton

DELL DISTRICT

West Shore

DILLON DISTRICT

Amazon Copper
Three Aces Claim

ELKHORN DISTRICT

Up Two

MEDICINE LODGE DISTRICT

Bonanza
Owl

POLARIS DISTRICT

Little Bell

VIPOND DISTRICT

Alice
Dewey Tailings
Emery
G & W
Harrison
John B
Long
Mammoth
Moosehorn
New Anaconda
School
Silver Fawn
Silver Hill
Slide Rock

WISDOM (BIG HOLE DISTRICT)

Dark Horse
Diadem
Goldridge
New Discovery
Peterson
Scheurer
Straight Tip

APPENDIX D, TOTAL PRODUCTION OF MANGANESE AND THORIUM ORE

Year	Short tons	Value	Operator	Mine name
	Low-grade manganese to stockpile (government)			
1902-52	None			
1953	440	$10,878		
1954	265	5,728		
1955	261	6,404		
1956	118	2,164		
1957	111	4,671		
1958	94	6,463		
1959-65	None			
Total	1,289	$36,308		
	Manganese ore, 35 percent Mn or more			
1880-1916	None			
1917	20	$ 828		
1918	39	1,035		
1919-65	None			
Total	59	$ 1,863		
		Thorium		
1959	10	$ 2,000	Sawyer Petroleum Co.	Horse Prairie
1960-61	None			
1962	25	6,760	Sawyer Petroleum Co.	Horse Prairie
1963-65	None			