

Geology and Mineral Resources of a Portion of the Silver City Region Owyhee County, Idaho

R. R. Asher

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GEOLOGY AND MINERAL RESOURCES OF A PORTION OF
THE SILVER CITY REGION, OWYHEE COUNTY, IDAHO

by

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ABSTRACT

Reconnaissance mapping of 300 square miles north of Silver City in the Owyhee Mountains was done to determine the favorability of the area for mineralization. Approximately \$30,000,000 in silver-gold ore was mined from small mineralized areas near Silver City from 1865 to 1914.

The area is in the Columbia Intermontane physiographic province and not in the Basin and Range province. The Owyhee Range originated because of uplift and doming. Granitic rocks of Cretaceous age are overlain by volcanic rocks of Cenozoic age that are interbedded with clastic sedimentary formations. The volcanic rocks are not correlated with formally defined units that crop out elsewhere in Idaho because of difference in composition and stratigraphic position.

The area north of Silver City is structurally unfavorable for mineralization. Exploration should be conducted south of the mapped area within the zone of structural intersection that localized the veins near Silver City. High-grade silver ore probably remains on the lower levels of the De Lamar mine and possibilities exist for an open-pit silver mine on Florida Mountain.

Two fracture systems trend northeast and north-northwest; they intersect near Silver City. Mineralization was emplaced along faults in these systems during at least two periods of hydrothermal activity. The most intense mineralization is in the zone of intersection. A N75W fracture system controls mineralization near De Lamar. Antimony-silver veins are in the Silver City Granite; silver-gold veins are in pre-Pliocene igneous rocks. Other mineralization includes mercury, auriferous pyrite veins, and traces of copper.

INTRODUCTION

PURPOSE AND SCOPE

A growing demand for silver has materialized over the past several years, and the price of silver has risen accordingly. One of the functions of the Idaho Bureau of Mines and Geology is to evaluate potential sources of valuable minerals in Idaho. Because of the increasing need for silver, this project was undertaken to investigate the possibilities for ore occurrences in the Owyhee Mountains north of Silver City, Owyhee County, Idaho. Fifty to one hundred years ago, rich silver-gold ore was produced from mines near Silver City, De Lamar, and Flint; these former mine camps are now deserted. A study of the state geologic map and other published information indicates that the geologic setting throughout much of the Owyhee Mountains is similar to the setting in the old production areas, but no other important ore occurrences were discovered by the early miners. An attribute of the early prospector was that he missed little ore of value if it cropped out at surface. No mineralization of consequence was discovered in the country north of Silver City and De Lamar; the area must be essentially barren or the ore occurrences are not obvious by surface inspection. This project was designed to determine if the area to the north contains any significant mineralization. In order to solve the problem, I planned a project that called for the completion of a reconnaissance geologic map covering about 300 square miles and a geochemical survey of the same area. The geochemical phase of the program was not completed for reasons discussed below.

The completion date for the project was established as June, 1967, three years after the field work began in June, 1964. Because of the large area involved, the geologic section of this report must be considered a preliminary study.

Upon completion of the mapping in 1965 I realized that a two-man crew, one field assistant and myself, would face a formidable task in attempting to complete a full-scale soil sampling program in one summer. Stream sediment sampling, the one method that might have been feasible in so large an area, was not practical because of contamination. The land has been used by miners and stockmen for close to one hundred years; the numerous mine dumps, found near the heads of many streams and gullies, attest to the amount of activity that has taken place in the region. In addition, the amount of water in the streams is highly variable; many streams in the region are at flood stage in May and early June but are dry by mid-August. Conditions at the start of the program would have changed by the end of the field season.

Because of the problems involved in a full-scale geochemical program, I decided to limit the program to selected areas that appeared to have the greatest potential. In the spring of 1966 a number of orientation traverses were laid out and soil samples were collected across known ore-bearing structures in the old mining areas. Available equipment did not permit employment of elaborate or complex analytical techniques. For practical reasons, largely involving equipment, the analytical technique was limited to heavy metals analysis, a rapid, simple, and economical procedure. An interpretation of the results from the orientation samples indicated that heavy metals are not reliable ore guides in the district.

I do not wish to imply that geochemical prospecting is not a valid technique in the region. With more refined equipment and adequate time, it is likely that an element, such as arsenic, manganese, or mercury, would be found which would serve as a useful ore guide.

The purpose of this project was to investigate the possibility of extending the boundaries of a known mining district. There are a number of districts in the state that deserve the same attention; this report represents the initial effort in a program designed to accomplish this end. Based on experience gained during this investigation, the following recommendations are suggested for future projects:

1. In order to expedite the transmission of reports, the size of the area studied should be limited to one that can be completed in one to two field seasons.
2. Where regional mapping is required, one field season should be devoted to accomplishing it. A second season should be devoted to detailed study of smaller areas that have the greatest economic potential.
3. When feasible, based on availability of staff, the project should be done by a team. One man would complete the areal geology while another concentrated his efforts on detailed economic studies of selected areas.
4. Where geochemical prospecting methods are to be used, adequate labor for collection of samples and adequate facilities for analytical work are needed.

There is little doubt that further suggestions concerning projects of this kind could be made. I would welcome constructive recommendations on methods of approach that would improve the efficiency and value of these undertakings.

GEOGRAPHICAL FEATURES

Location

Silver City and the Owyhee Mountains are in Owyhee County, Idaho. Owyhee County occupies the southwest corner of the state; it is bounded on the west by Malheur County, Oregon, and on the south by Elko County, Nevada. Owyhee County's northern and eastern limits are defined by the Snake River.

The Silver City region, as used in this report, refers to an area with indefinite boundaries surrounding the abandoned mining camp of Silver City, Idaho. This investigation deals with the geology and mineral potential of a portion of the Silver City region; an area covering about 300 square miles (Fig. 1). Most of the ground examined lies north of Silver City and extends to the east and west margins of the Owyhee Mountains.

The south limit of the mapped area is marked by parallel 43°00' north latitude,

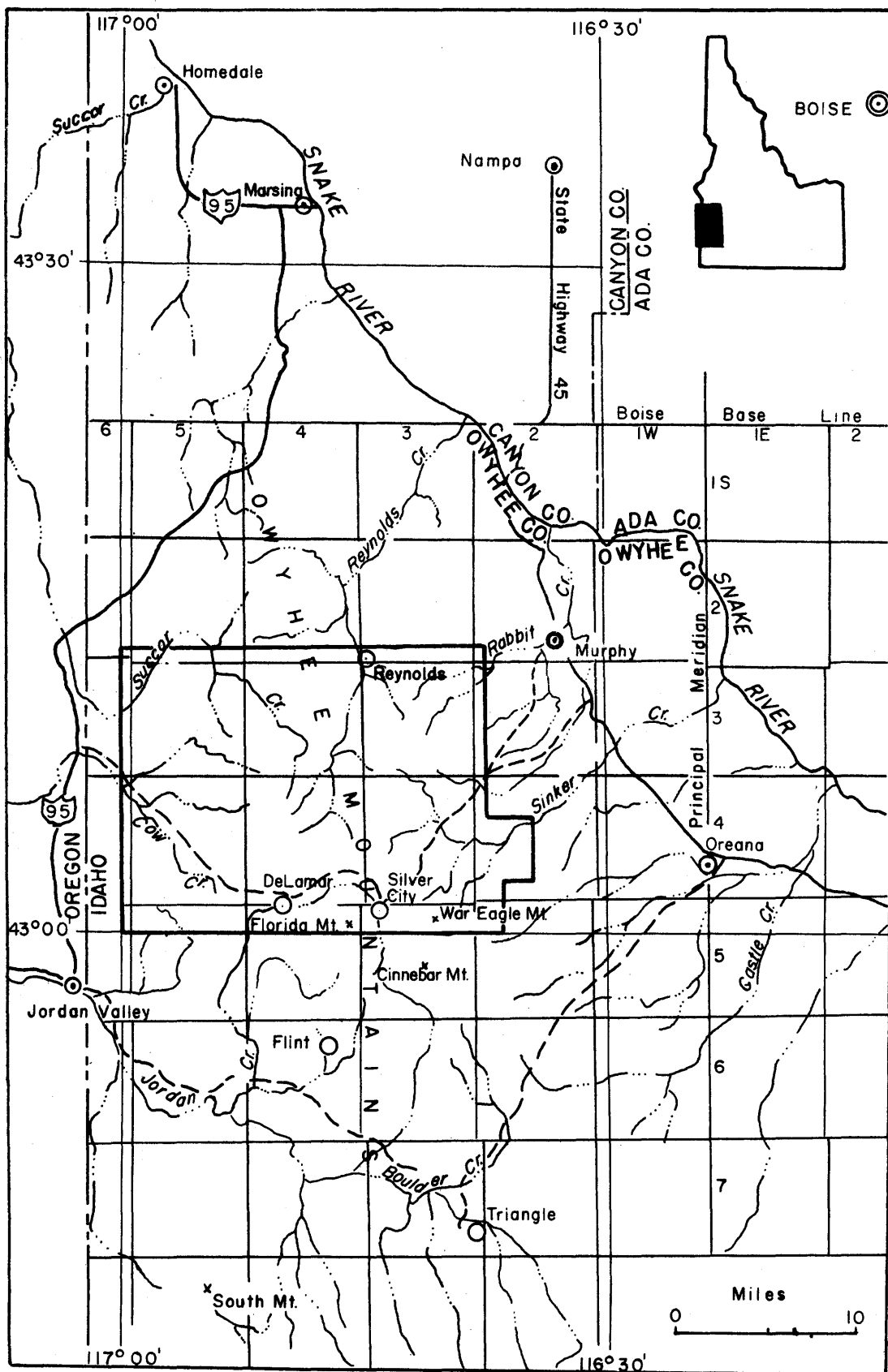


Figure 1, Location Map Of Northwestern Owyhee County, Idaho Showing Location Of Silver City Region.

This line of latitude passes about a mile south of Silver City. The west boundary, less than 2 miles from the Oregon border, and 14 miles west of Silver City, is marked by meridian 117°00' west longitude. The east boundary, about 8 miles east of Silver City, is marked by the east margin of the Owyhee Mountains where the mountains merge with the Snake River plains. The north limit of the map is about 14 miles north of Silver City; it passes about a mile north of the community of Reynolds.

All or parts of Townships 2, 3, 4 and 5 South and Ranges 2, 3, 4, 5 and 6 West, Boise base line and meridian, are included in the map area. The Carson, De Lamar and part of the French mining districts are within the area of study (Ross, 1941). Locally the region around Silver City is called the Silver City mining district.

Population and Cultural Features

Owyhee County is sparsely populated; the population of the county is centered along the Snake River or in the lower valleys of its major tributaries. Since the decline of mining activity in the Owyhee Mountains, emphasis has shifted to agriculture and, except for the community of Reynolds, there are no permanent residents in the Silver City region.

In 1934 the county seat was moved from Silver City to Murphy (Adams, 1960, p. 14) and no permanent residents reside in Silver City. A tavern, a small store, a restaurant, and a museum are maintained during the summer to accommodate the many tourists who visit this historic area.

Dewey and De Lamar, west of Silver City along Jordan Creek, are abandoned mining camps. One or two prospectors can usually be found living at De Lamar during the summer.

Reynolds is an agricultural community located in the Reynolds Creek basin, near the north boundary of the map area (Fig. 1). The land in the basin is suitable for the cultivation of hay for winter livestock feed. Approximately 3 square miles of the Reynolds basin is cultivated (McIntyre, 1966, p. 5). The Agricultural Research Service has an installation at Reynolds in connection with a hydrologic research program.

Occasionally problems between prospectors and landowners have developed in the region because of the mistaken belief that all of the land in the area is public domain and open to mining location. The status of the land and the ownership of the mineral rights should be established before a mining claim is located.

Access

Access to the Silver City region may be gained by leaving State Highway 45 at Murphy. A county-maintained dirt road, locally called the Silver City road, leads 26 miles to Silver City (Fig. 1). From Silver City the road continues west along Jordan Creek five miles to De Lamar; just west of De Lamar the road enters Cow Creek drainage and leads to U. S. Highway 95 at Sheaville, Oregon. It is

approximately 15 miles from De Lamar to Sheaville. About two and one-half miles west of De Lamar a road branches to the southwest and leads to Jordan Valley, Oregon, a distance of 12 miles.

A road that leads to Reynolds junctions with State Highway 45 on the southwest side of the bridge that crosses the Snake River (Fig. 1). Reynolds is also accessible from Murphy. From Reynolds a road leads south to Silver City, a distance of 12 miles. The road is not surfaced; it is partially maintained by the Agricultural Research Service. The main access routes to Silver City are not kept open during the winter. Without special vehicles, the region is inaccessible by automobile from late November until mid-April.

There are a number of trails and primitive roads within the mapped area. Access to points within the region is best attempted with a four-wheel drive vehicle.

The nearest railhead is at Melba, Idaho, in Canyon County, about 40 miles northeast of Silver City. There is also a railhead at Marsing, Idaho, on U. S. Highway 95, approximately 60 miles north of Silver City (Fig. 1).

Climate and Vegetation

On the basis of inches of average annual precipitation, three climatic zones occur in the region. An arid zone, receiving 5 to 10 inches of precipitation annually, occurs along the extreme east edge of the map area. West of the arid zone, a semiarid zone prevails from 3,600 feet to 6,000 feet of elevation; the semiarid zone receives from 10 to 20 inches rainfall. Those parts of the region that exceed 6,000 feet of elevation are subhumid; they receive more than 20 inches rainfall. The classification of climatic types follows Strahler (1951, p. 345). Data on average annual precipitation are from the U. S. Department of Agriculture (1949).

The summer months are hot and dry. Most of the precipitation falls as snow during the winter, but in the higher elevations late afternoon thundershowers may occur during the summer. Summer storms approach from the west and lose moisture over the mountains; consequently the desert to the east receives minor precipitation.

Annual snow surveys show that the maximum snow depth along the ridge separating Reynolds Creek and Jordan Creek averages 43 inches. The maximum accumulation is recorded in February or March (Nelson and Wilson, 1965, p. 122). At Silver City the annual snowfall is 129 inches (Piper and Laney, 1926, p. 9). Silver City is situated near the head of Jordan Creek on the north slope of a high ridge; it is in the shadow of War Eagle Mountain on the east and Florida Mountain on the west; hence snow accumulates to a greater depth at Silver City than it does along the relatively open Jordan Creek-Reynolds Creek divide.

The desert area receives the greatest amount of snow during January; averages are 5 inches in December, 7 inches in January, and 5 inches in February. The average annual snowfall for the desert area is about 2 inches (U. S. Department of Agriculture, 1949).

Vegetation in the region is typical of the southern Idaho desert and Basin and

Range province of northern Nevada. Low brush and grasses such as horsebrush (Tetradymia sp.), salt brush (Atriplex sp.), grayia (Grayia spinosa), winterfat (Eurotia lanata), Indian rice (Oryzopsis hymenoides), and squirrel tail (Sitanion hystrix) are typical vegetation (J. S. Burkhardt, College of Forestry, University of Idaho, personal communication, December, 1966).

The semiarid slopes of the Owyhee range are typified by a sagebrush-bunchgrass vegetation zone. Big sagebrush (Artemisia tridentata), rabbit brush (Chrysothamnus sp.), bluebunch wheatgrass (Agropyron spicatum), cheat grass (Bromus tectorum), and squirrel tail (Sitanion hystrix) are common (Burkhardt, personal communication, December, 1966).

Mountain brush and forest type vegetation grow in the higher elevations. Included in the mountain brush are juniper (Juniperus occidentalis), mountain mahogany (Cercocarpus ledifolius), bitter brush (Purshia tridentata), big sagebrush (Artemisia tridentata), bluebunch wheatgrass (Agropyron spicatum), Idaho fescue (Festuca idahoensis), and snowberry (Symphoricarpos rivularis). The forest type vegetation includes Douglas fir (Pseudotsuga taxifolia), subalpine fir (Abies), aspen (Populus tremuloides), snowbrush (Ceanothus velutinus) and mountain brome (Bromus marginatus) (Burkhardt, personal communication, December, 1966).

In general, forest or brush cover does not obscure outcrops or hamper geologic study. In the higher elevations thick stands of fir and mountain brush grow on the north slopes of the ridges; south slopes support vegetation but not to the same degree. Much of the fir and some of the juniper in the vicinity of Silver City and the surrounding area are second growth vegetation. Most of the original stands of timber were used in early mining operations.

The grasses in the region make good stock forage and the area is used extensively for spring and winter range. Sheep and cattle ranching are major industries in Owyhee County.

Physiography and Drainage

The Silver City region is in the central part of the Owyhee Mountains (Fig. 2). The Owyhee Mountains border the Snake River plains on the east. They are surrounded by an elevated, lava-covered plateau with interbedded Miocene sediments on the north, west and south. The mountain range trends west of north; the major portion of the range covers an area about 25 miles long and 10 miles wide. The elevated plateau that flanks the mountains stands above the Snake River plains; it is the Owyhee Upland subprovince of the Columbia Intermontane physiographic province (Thornbury, 1965, p. 463). The location of the Owyhee Mountains and Snake River plains (High Lava plains) is shown on Figure 2.

The elevation of the plateau is about 5,500 feet. The Owyhee Mountains average 6,500 feet, but locally peaks attain elevations exceeding 8,000 feet. The mountains rise from the east margin of the Snake River plains. From a distance, the range appears to rise abruptly from the relatively flat plains, and it appears to have a steep eastern slope. However, profiles drawn east-west, normal to the axis of the range, show an eastern slope of only six to eight degrees on the east side (Figs. 3 and 4).

From the margin of the plains, the east face of the range slopes upward for approximately 4 miles to the crest of the mountains. The margin of the plains is about 3,500 feet, the crest of the range is at approximately 6,000 feet, giving 2,500 feet of relief. From the crest, the range slopes gently westward and merges with the plateau at an elevation of 5,500 feet.

The range slopes gently westward, but within the map area there is considerable relief. War Eagle Mountain has an elevation of 8,051 feet; it is the highest point in the map area. Cinnabar Mountain to the south attains an elevation of 8,115 feet. High points such as Florida Mountain, Tennessee Mountain and Slack Mountain reach elevations exceeding 7,000 feet. Local relief from peaks to adjacent valley floors in the map area may exceed 2,500 feet. Total relief from the top of War Eagle Mountain to the Snake River plains is about 4,500 feet.

In general stream divides are well defined in the map area. The slopes of major stream valleys are steep but the streams are not sharply incised, the valleys are fairly broad and the major streams are graded. Thornbury (1954, p. 137) cites graded streams and maximum relief as being characteristic of maturity. Freeman and others (1945, p. 59) note that the Owyhee Mountains are in a mature stage of erosion, but the surrounding plateau is in a youthful stage.

Lithologic controls topographic forms in the map area. The granitic rocks are the least resistant to erosion, and the greatest amount of local relief is developed in areas underlain by granitic rocks. Steep slopes and rounded summits are typical in granitic terrain, but where weathering has progressed along joint planes, steep, castellated forms and pinnacles are common. Basalt or latite terrain is characterized by rolling, smooth topography. Nearly flat to gently-sloping summits with terraced slopes are indicative of basalt or latite bedrock. Rhyolitic rocks yield a rugged topography with steep slopes; cliffs and flat-topped mesas are not uncommon features. Where hydrothermal alteration has been active, as on Florida Mountain, long, smooth, rounded slopes are developed on the rhyolitic rocks. The characteristic topographic forms, together with the tone and texture of the rock types, are distinctive on air photos.

Along the east slope of the range a pediment surface has developed (Figs. 5 and 6). It is most conspicuous in those areas where the granitic rocks crop out near the base of the range. The granitic rocks occur as knobs and erosional remnants protruding through a surface that is veneered with alluvium. There is insufficient run-off to carry away the debris that results from breakdown of the bedrock; as the mountain front weathers back it is buried in the resulting waste. To the east, away from the mountain front, the pediment disappears under the alluvial cover mantling the Snake River plain.

Lindgren (1900, p. 77) notes that the Owyhee Range is a short desert range, that it trends north-south, and that it is similar to others of its kind further south. Presumably Lindgren compared it to the short, isolated ranges typical of the Basin and Range province. Lindgren also notes that the range is bordered on the west by the lava-covered plateau flanking the Owyhee River. Since Lindgren's

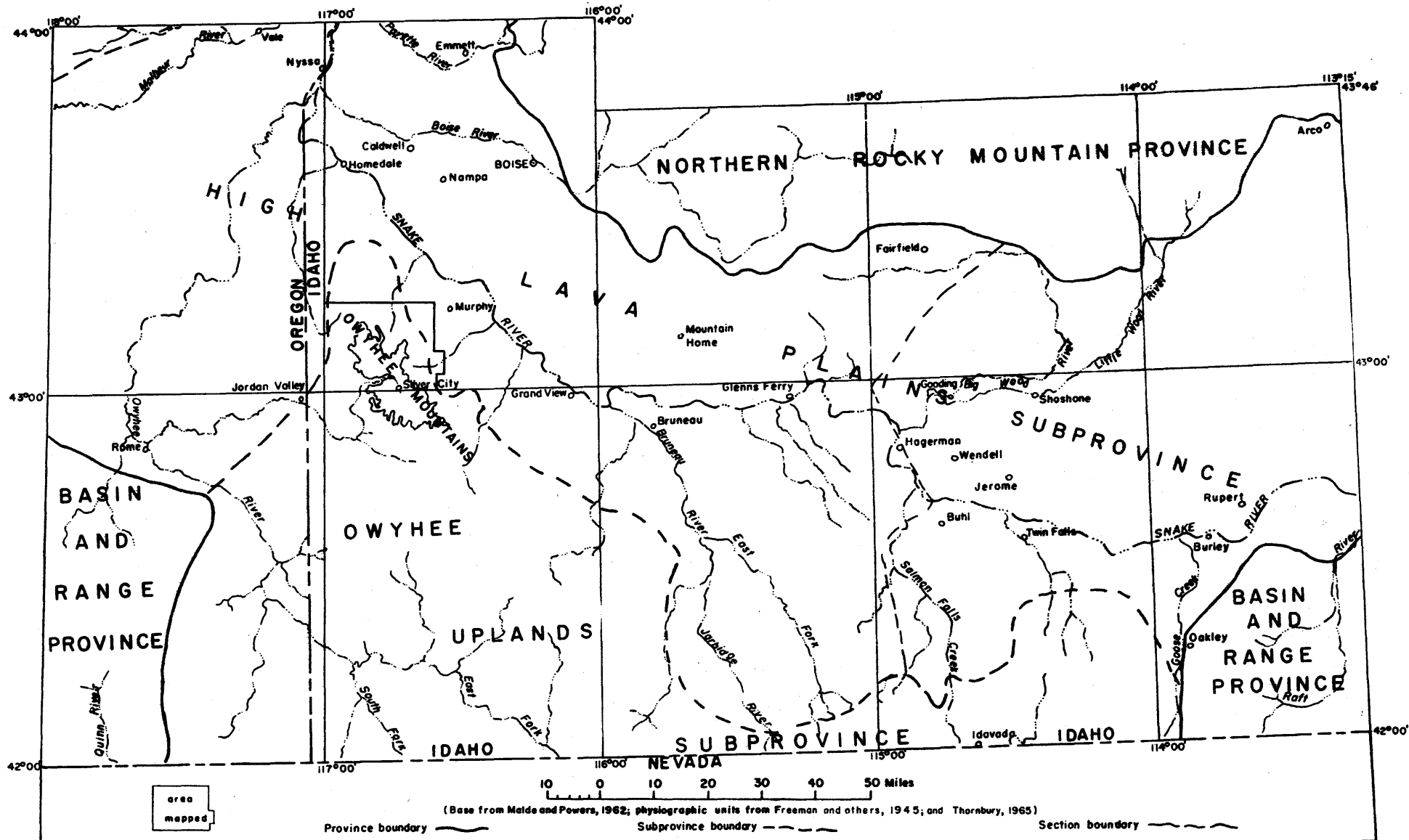


Figure 2, Location Map, Owyhee Uplands Physiographic Subprovince - Columbia Intermontane Province

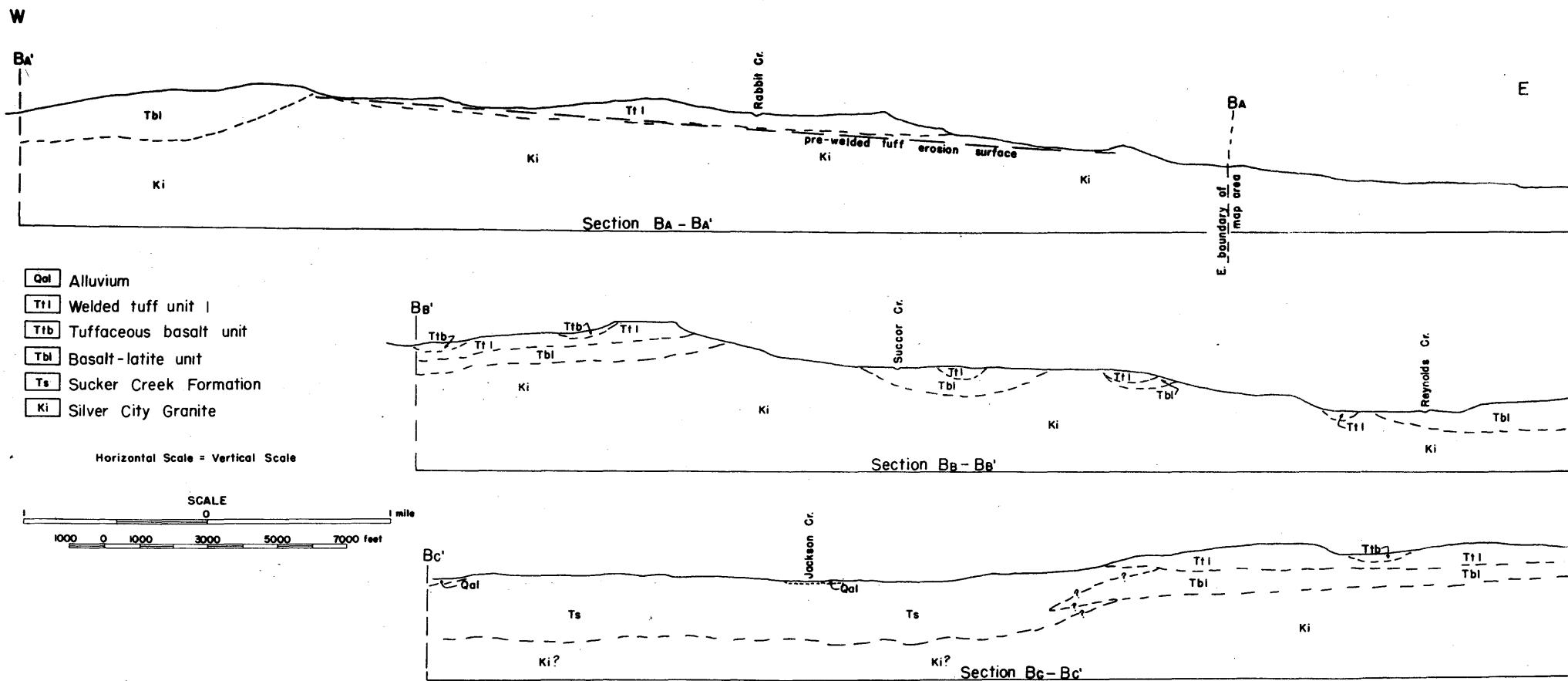


Figure 4— Cross Section B-B', Silver City region, Owyhee County, Idaho



Figure 5. Erosional remnants of Silver City
Granite protruding through alluvial cover.
Lower part of Diamond Basin road, sec. 30, T3S,
R2W, Silver City region, Owyhee County, Idaho.



Figure 6. East margin of Owyhee Range; pediment in
middle background near base of hills. Looking
southwest from Rabbit Creek near Reynolds - Murphy
road, sec. 6, T2S, R2W, Silver City region, Owyhee
County, Idaho.

time, authors (Fenneman, 1931; Anderson, 1941; Freeman and others, 1945; Thornbury, 1965) discussing the physiographic provinces of Idaho and surrounding areas have pondered the question of whether to include the Owyhee Range with the Columbia Intermontane province or the Basin and Range province.

Fenneman (1931, p. 246) includes the Owyhee Mountains and the surrounding plateau with his Payette section of the Columbia Plateau province. Fenneman divides the Snake River plains into three sections; the Payette section is the west-central part. Fenneman remarks on the similarity of the Owyhee Range and the "basin ranges"; he notes that it should be included with the Basin and Range province except for its isolated position.

Anderson (1941) suggests revisions of Fenneman's classification of the Columbia Plateau province in Idaho. He points out that the Owyhee Uplands have been warped and locally faulted upward, and because they stand as a distinct, elevated plateau above the general level of the Snake River plains, they should be separated from the sections of the Snake River plains and considered a separate physiographic unit. Anderson introduced the name Owyhee section (p. 213).

Freeman and others (1945) further revised Fenneman's classification of the Columbia Plateau province. They put forth the name Columbia Intermontane province because such a name better describes the diverse topographic features found in the province (1945, p. 54). The Owyhee Mountains and the upland plateau are included in the Owyhee Upland section (p. 44).

Thornbury (1965) in general follows the classification set forth by Freeman and others. Thornbury, however, breaks the province down into subprovinces which are further classified into sections. In this report I have followed Thornbury's classification and the Owyhee Uplands are considered a subprovince of the Columbia Intermontane province.

Most of the persons who have written on the physiography of Idaho note a similarity between the Owyhee Mountains and the ranges of the Basin and Range province. The Owyhee Mountains make up a small part of the Owyhee Uplands subprovince (Fig. 2), and except for the mountains, most authors feel that in origin they are more closely related to the Columbia Intermontane province (upwarping) than to the Basin and Range province (block-faulting). For this reason the upland is retained as a part of the Columbia Intermontane province. Figure 2 shows the position of the Owyhee Upland in relation to other physiographic units of southern Idaho and southeastern Oregon.

As in much of Idaho, the Snake River is the master stream in the region. The streams that drain the eastern slopes of the Owyhee Mountains flow directly into the Snake River (Fig. 1). The streams that drain the western slopes are tributary to the Owyhee River; these streams enter the Owyhee River in Oregon. This river flows north and enters the Snake River near Ontario, Oregon.

Sinker Creek, Reynolds Creek, and Rabbit Creek are the most important streams on the eastern slope. Jordan Creek drains the southwestern part of the area and flows through the Silver City mining area. Cow Creek and Succor Creek are important drainages on the western slope of the mountains. Cow Creek does not flow

into the Owyhee River; it feeds into Cow Creek Lakes, north of Jordan Valley and west of Sheaville, Oregon. These lakes have no surface outlet.

Most of the streams in the area have adjusted to variations in lithology, and at places there is marked fault control of stream patterns. As a result of these influences, abrupt changes in direction and sharp bends in stream courses are common.

Alpine glaciation has been effective at a few places. Small cirque-like basins occur in the upper reaches of Sinker Creek in the east-central part of the map area. North of Slack Mountain in sec. 8, T4S, R3W a mound of gravel and cobbles occupies a small circular basin. The mound is about 150 feet long by 50 feet wide and is probably a glacial deposit.

Piper and Laney (1926, p. 10) note that alpine glaciation has been effective to a limited extent in the area. A small cirque remains on the east face of Florida Mountain. The roughly circular, flat-bottomed basins that occupy the heads of Long Gulch, Sawpit Gulch, and Coffee Gulch are the result of glacial action, and glacial debris is being eroded from the basins. South of the map area, a cirque occurs near the head of the South Fork of Sinker Creek. The north slope of Cinabar Mountain is the result of ice plucking (Piper and Laney, 1926, p. 11). Piper and Laney also remark that the roundness of the summits of War Eagle and Florida Mountains is in part caused by the action of ice (p. 11). Locally, glaciation has played a role in developing the topography found in the area, but the effects are limited. The dominant erosive agent has been running water.

HISTORICAL BACKGROUND

Three periods of activity make up the mining history of the Silver City region. As the graph in Figure 7 shows, two of these episodes were important, the third was hardly significant. The first period covers 12 years; it extends from 1863, when the initial discovery was made, until 1875, when the Bank of California failed. The second period lasted from about 1889 until 1914. When the second period ended, Silver City ceased to be an important producing region. During the 1930's, however, a rise in the price of gold renewed interest in the district; dredges operated on Jordan Creek, old dumps were milled for their gold and silver content, and some of the old underground mines were worked by lessees. Except for some very recent activity there have been no developments of consequence since operations ceased in 1942. Sidney Mining Company of Kellogg, Idaho, staked about 50 claims between Florida and De Lamar Mountains in 1964. In the same year Continental Materials Corporation of Grand Junction, Colorado, acquired control of many of the old claims in the De Lamar area and staked a number of new claims. Both of these companies were engaged in diamond drill projects during the summer and fall of 1966.

In 1863 a party of 29 men, led by Michael Jordan, left the Boise Basin mine camps on a prospecting venture. Whether the party was lost when they discovered gold on what was later called Jordan Creek, or whether they intended to go there originally, is not certain; legend has it that they were searching for the mythical Blue Bucket mine that is supposed to be in central Oregon. At any rate, on May 18, 1863, gold was found at Discovery Bar on Jordan Creek, just above the present site of De Lamar (Wells, 1963, p. 26).

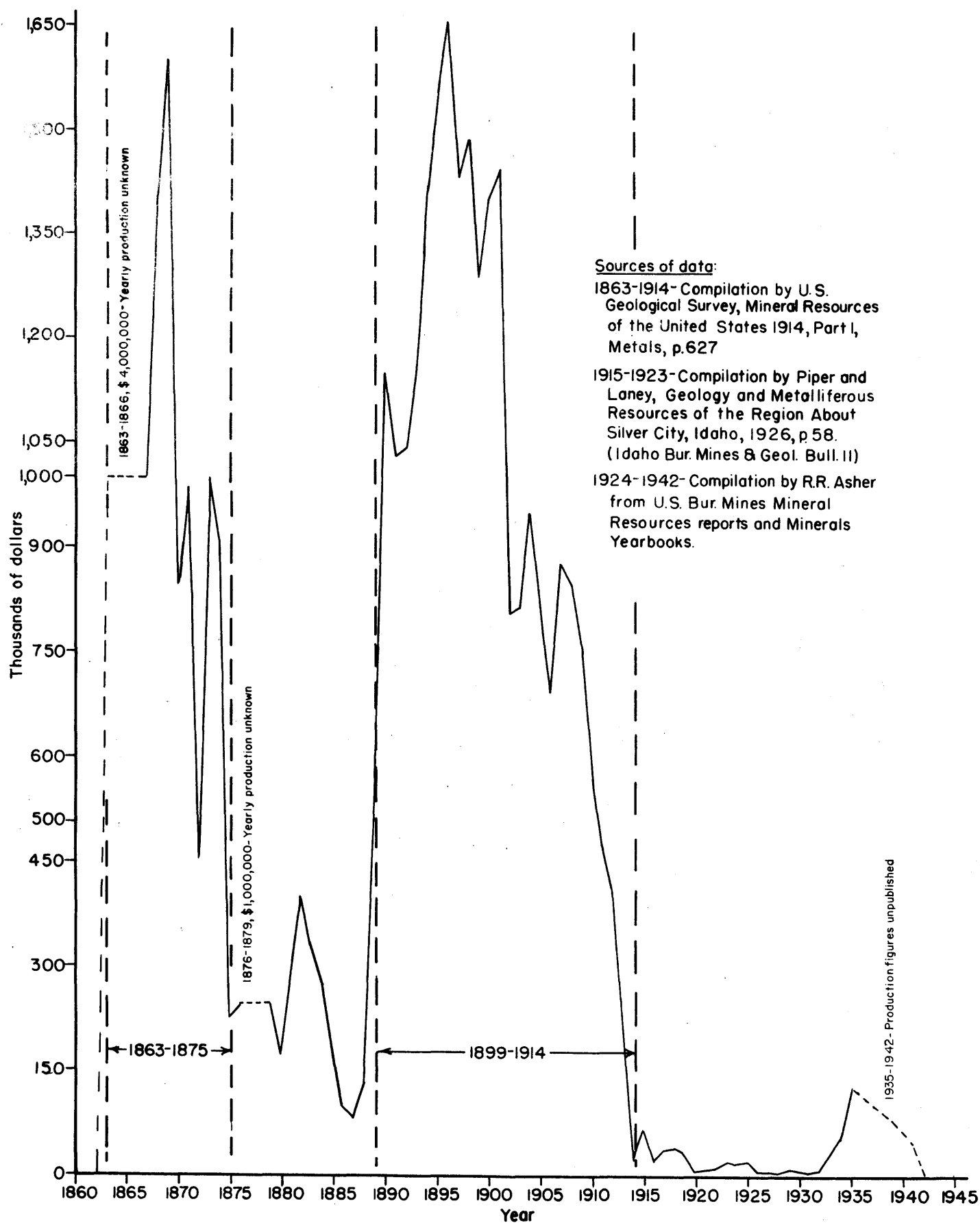


Figure 7, Annual Production in Dollars- Silver City Region, Owyhee County, Idaho.

As was typical of the times, a new discovery precipitated a rush and hundreds of prospectors flocked to the Owyhee country when news of the new diggings reached Boise Basin. Many were disappointed because the members of the original Jordan party had staked the best ground and each had taken up three claims, a total of 900 feet apiece. The placers extended along Jordan Creek from 4 to 10 miles and yielded \$15 to \$18 a day during the 3 to 4 months the water lasted in the summer of 1863 (Wells, 1963, p. 27).

If the placer deposits had been the sole attraction in the Silver City region, its history would have been short-lived. By the end of the 1864 season the placers were largely abandoned except by the Chinese, who continued to work them for a number of years (Wells, 1963, p. 27). On August 15, 1863, the Oro Fino ledge was staked by a group of prospectors who had traced some placer gravels near the head of Sinker Creek on the east side of War Eagle Mountain to their source (Wells, 1963, p. 27). The Oro Fino was a promising gold prospect and it was thought by the early miners that the lodes would be gold mines even though the Jordan Creek placers yielded a product that was about half gold and half silver. On the opposite side of War Eagle Mountain, near the present site of Silver City, the Morning Star vein was discovered on October 14, 1863 (Wells, 1963, p. 28). The discovery of the Oro Fino and the Morning Star heralded the beginning of the lode mining era on War Eagle Mountain, and the first important production from the district.

This first period of mining activity was marked by the discovery of a number of fabulously rich veins. Such mines as the Poorman, the Ida Elmore, the Golden Chariot, the Mahogany, the Minnesota and others were soon in production. By 1866, 12 mills totaling 132 stamps were in operation (Piper and Laney, 1926, p. 53). At first the operations of the mines and mills were individual enterprises, but later corporate ventures were started for the development of the veins on War Eagle Mountain.

Near the surface the mines were in truly bonanza ore. The Poorman produced shipments of silver chloride and ruby silver ores valued at \$4,000 per ton and milling ore yielding bullion worth \$300 per ton. In the upper levels of the Oro Fino the ore averaged \$150 per ton, the gold-silver ratio was about 1:1 (Piper and Laney, 1926, p. 53).

Independent activity, highly speculative management, low grade ore at depth and high mining costs eventually forced the mines on War Eagle Mountain to close. But before they closed several fortunes were made, and some violent events took place as men struggled bitterly for the control of the riches to be found there.

The earliest lode discoveries led to a frenzy of claim staking and adjoining claims were often staked on the same vein by different individuals. Each claim was then developed as a separate enterprise with no thought of a joint venture with a neighbor. Such practices resulted in much duplication of effort and inefficiency. Inevitably quarrels over ownership and trespass arose that led to more than one so-called "war".

The first of these conflicts is called the "Hays and Ray-Poorman war" of 1865

(Wells, 1963, p. 34). This episode in the history of the district involved the discovery of the rich Poorman vein. Hays and Ray owned eight claims on War Eagle Mountain, none of which were exceptionally rich at the point of discovery. Some other prospectors discovered a rich lode on ground covered by the Hays and Ray claims; they called the lode the Poorman and removed rich silver ore. Hays and Ray claimed ownership, but they could not trace their vein directly to the Poorman discovery. The Poorman group decided to remove as much ore as they could before Hays and Ray could take steps to prove their claim. Supposedly in six days the Poorman group removed over half a million dollars in gold and silver - mostly silver (Wells, 1963, p. 35). On September 24, 1865, when it was certain that the Poorman was on the extension of the Hays and Ray vein, the Poorman group met the Hays and Ray faction armed with six shooters and shotguns; the Hays and Ray forces retreated. The Poorman defenders then erected a log fort, but Hays and Ray did not attack. Expensive litigation followed and eventually a compromise solution was reached in which Hays and Ray received their just share of the Poorman discovery (Wells, 1963, p. 36).

The Owyhee War took place in 1868; the following discussion is taken from Wells (1963, p. 41-43). The Ida Elmore and Golden Chariot are adjacent claims on the same vein and the two properties were operated by rival organizations. To avoid interference a neutral ground was left between the two operations by mutual agreement, but each group thought they were entitled to the property of the other. The agreement worked until the Golden Chariot violated it, and broke into the Ida Elmore workings. Both camps then armed for conflict and occasional shooting followed for a month or so. The Golden Chariot forces finally went on the offensive. They advanced underground and captured the Ida Elmore shaft. Several casualties were sustained from the copious amount of firing that took place during this action. When D. H. Fogus, owner of the Idaho Elmore, lost control of the underground workings he issued a call for reinforcements and a number of toughs rallied to his support. If Fogus could transfer the war to the surface, where he could easily besiege the Golden Chariot, the situation would attain serious proportions.

Governor Ballard in Boise dispatched his personal representative to the area on March 26, 1868. Upon arrival the representative rounded up officials from both companies and read them a proclamation from Governor Ballard commanding them to cease hostilities and settle the conflict by due process of law. That same evening the matter was settled; formal deeds were drawn so that no court action was required. A short time later on April 1, a number of the Ida Elmore backers decided to lynch some of their Golden Chariot opponents. This situation became so tense that the Governor requested Federal troops who arrived from Fort Boise. The 95 soldiers, with brass cannon, occupied Silver City from April 4 to 8 and the Owyhee war ended.

The "wars" described above are included as examples of the reckless management that characterized the early day operations at Silver City. The attitude of independence and self-reliance in settling disagreements resulted in costly litigation in some instances, and caused long periods of non-production that strained the financial position of the property owners.

Another example of improper management is illustrated by the practices of More and Fogus. More and Fogus were two of the earliest lode mine operators in the region. These partners gained control of the Oro Fino and Morning Star mines shortly after the properties were discovered and operated them successfully. However, in 1866 More and Fogus had debts amounting to over \$200,000 that they could not meet. By speculating so heavily in new properties and neglecting to pay their help and other creditors they found themselves insolvent. The More and Fogus holdings were attached and sold. A miners' cooperative was eventually formed to work the Morning Star and Oro Fino so the miners could collect their back pay (Wells, 1963, p. 38-39).

The veins the early prospectors found on War Eagle Mountain were narrow but exceedingly rich. At depth values decreased signalling an end to the production of bonanza ore. The Oro Fino had \$150 ore at the surface and a gold-silver ratio of 1:1 but at 220 feet the ore averaged \$40-\$45 and the gold-silver ratio was 1:6. The Golden Chariot, on the same vein, averaged \$21 ore on the 6th and 7th levels (probably 700 feet) (Piper and Laney, 1926, p. 53). Other mine owners were experiencing the same disappointment with increasing depth. Mine consolidation, conservative management and more efficient operations were needed at this time but failed to materialize.

War Eagle Mountain has steep eastern and western slopes. The veins trend near north and south, so it would seem that cross-cuts designed to intersect the veins at depth would have been the logical procedure. Such a plan of development would have avoided the expense of hoisting ore and waste and of pumping water. The early miners lacked capital and by necessity were interested in high grade ore. Driving long cross-cuts requires the excavation of much barren rock; thus the mines were developed from the surface by shafts.

In 1868 a company was organized to drive a low-level tunnel far down the slope of War Eagle Mountain. The tunnel would provide drainage and haulage in addition to performing important exploratory work on the continuity of the veins with depth. The idea was essentially similar to the Sutro Tunnel on the Comstock lode in Nevada (Lord, 1883, p. 233). The plan was sound but work was never commenced (Piper and Laney, 1926, p. 54).

Operating costs were high in the early days. Until 1869 freight was brought up the Columbia River by river steamer to Umatilla, Oregon, and then transported overland to the mines. Transportation costs averaged 7 1/2 cents per pound. In 1869 the Central Pacific Railroad reached Winnemucca, Nevada, and rates dropped to 4 1/2 cents per pound (Piper and Laney, 1926, p. 51).

The major source of financial backing for the War Eagle mines, the Bank of California, failed in 1875. This event marked the end of the first period of prosperity for the Silver City region. The mines were closed and most have never been reopened. In later years minor production from the mines is reported, but it was never sustained nor was it significant.

The mines on War Eagle Mountain are credited with a production of \$12,500,000

in the eleven years they operated (Piper and Laney, 1926, p. 53). By the end of 1869, six years after the first lodes were discovered, several of the mines had grossed over a million dollars and others over half a million dollars.

Speculative management, high costs and low grade ore at depth, coupled with the failure of the Bank of California, forced the closing of the mines. If the mines had been consolidated into one or two large corporate organizations with sound financial backing and if more planning had gone into development and mining, much more could have been gained from these deposits.

Some people were not convinced that the mines on War Eagle were doomed to idleness. The War Eagle Consolidated Mining Company was organized near the turn of the century to drive a low-level tunnel and explore the War Eagle veins system at depth. The company acquired eight patented claims that covered the Oro Fino-Golden Chariot ground and commenced work in 1899. The adit is called the Sinker Tunnel; it is at an elevation of about 5,450 feet, 2,030 feet below the collar of the Ida Elmore shaft on the east slope of War Eagle Mountain. The portal is about 800 feet below the lowest workings of the mines.

In 1902 a vein thought to be the Oro Fino-Golden Chariot was encountered 6,177 feet from the portal of the adit. A drift was turned southward, but the amount of exploratory work done is not known. According to Piper and Laney (1926, p. 146), no authentic information could be found as to conditions encountered. According to the State Mine Inspector's report for 1903 (Bell, 1904, p. 113):

"The Sinker Tunnel cuts the Chariot vein 2200 feet below the collar, it has produced some altered gold-bearing copper ore and rich native gold specimen ore."

According to Piper and Laney (1926, p. 147) where the adit penetrated the vein a raise was started, evidently to connect to the Golden Chariot shaft. Had an adequate survey been at hand the connection might have been made; as it was, the work consisted of blind groping for the old workings above. In 1905, when the raise had been driven 622 feet, the Mine Inspector declared the situation unduly hazardous; work was stopped and the project abandoned.

The dates given for the activity at the Sinker Tunnel by Piper and Laney are not in agreement with those given by the Mine Inspector. The report for 1904 (Bell, 1905, p. 112) states that operations in the Sinker Tunnel had been suspended for over two years, which would mean work was stopped in 1902. The report for 1905 (Bell, 1906, p. 99) says that the Sinker Tunnel Company planned to unwater the Golden Chariot workings. The project is not mentioned again until 1910 (Moore, 1911, p. 14) where it is said that preparations are underway to continue work in the Sinker Tunnel. Evidently no progress was made, because in the years immediately following, no mention is made of the project.

The U. S. Geological Survey mentions in 1905 (Heikes, 1905, p. 238) that operations in the tunnel were suspended until suitable pumps could be installed

at the surface. The report also states that where the vein was encountered, a drift was driven for 1,375 feet toward the Chariot shaft where a raise was started and abandoned after 600 feet.

Though there are discrepancies in the record, it seems clear that a vein was encountered somewhat over 6,000 feet from the portal, a drift was driven on the vein and a raise started in hopes of connecting to the old workings above.

The Mine Inspector notes that in 1919 slow progress was being made on the Sinker Tunnel Project (Bell, 1920, p. 88). The 1921 report notes that the Mahogany vein was being searched for in the Sinker Tunnel (Campbell, 1921, p. 83). The project received no further attention until 1931 when the Golden Chariot-War Eagle Mines Company acquired the principal properties on War Eagle Mountain and commenced work (Campbell, 1931, p. 191). The Sinker Tunnel and an old upper level were reopened, an extensive examination started, a small amount of development work done and operations suspended in August. In 1933 a small amount of drifting was done in the tunnel and a three compartment raise started to connect the old Mahogany shaft, but operations were suspended shortly after they got underway (Simons, 1933, p. 168). From that time until the present no work has been done in the Sinker Tunnel. It is caved and inaccessible at the present time.

Piper and Laney (1926, p. 147) remarked on the Sinker Tunnel project that began in 1919. According to them drifts were driven on two veins and a third was discovered by extension of the adit; the total exploratory work on the tunnel level aggregates 2,600 feet. Because workable ore was not developed the entire project collapsed in 1923.

At the present time Floyd Tegnell and Associates of Idaho Falls control many of the properties on War Eagle Mountain; they plan to open the Sinker Tunnel and explore the veins at depth (Floyd Tegnell, personal communication, August, 1966). It is hoped that this effort will be successful and productive.

There were hard times at Silver City for several years following 1875. The town that could boast a population of 4,000 in the early 1870's had shrunk to a mere 800 persons by 1880. Fairview, on the east side of War Eagle Mountain, had 2,500 in 1870; by 1880 Fairview was abandoned (Piper and Laney, 1926, p. 54).

Production during the period 1876-1888 ranged from a high of about \$380,000 in 1882 to a low of about \$80,000 in 1887 (Fig. 7). There was sporadic production from War Eagle Mountain as attempts were made to reopen some of the mines.

Important discoveries were being made on Florida and De Lamar Mountains during the seventies and eighties. The Silver Vault mine, south of De Lamar Mountain, was discovered in 1871 and contributed to the production record of the district. Piper and Laney (1926, p. 54) note that the old mint reports speak of production from the Seventy-nine ledge as early as 1881; it was later to become an important vein in the De Lamar mine. In the same year the Black Jack and Empire State were producing. These mines were later included in the Trade Dollar organization.

The 1883 mint report speaks of production from the Garfield, Webfoot, Crown Point, Idaho, St. Clair and Stoddard claims near De Lamar, and important production was being realized from the Silver Vault and Henrietta claims south of De Lamar (Piper and Laney, 1926, p. 54). In this seemingly dormant period, with production decreasing and the population drifting away, prospecting and development were going forward that ushered in a second period of prosperity which surpassed the first in duration and monetary contribution.

In 1889 the rich ore shoot of the Black Jack mine on Florida Mountain was discovered. The ore body at the De Lamar mine was encountered the same year. The Trade Dollar Company, on a southern extension of the Black Jack vein, encountered bonanza ore in 1892 (Piper and Laney, 1926, p. 54). By 1890 annual production exceeded a million dollars; it maintained this level for the next twelve years (Fig. 7).

The mines that started as individual enterprises were eventually acquired by well-financed, incorporated companies. The Black Jack and Trade Dollar were bitter rivals for a number of years but the companies were consolidated in 1903. Captain J. W. De Lamar was responsible for the development of the De Lamar mine; in 1901 he sold out to English interests who provided solid, conservative management for the enterprise. The Trade Dollar Consolidated Mining Company and the De Lamar Mines, Ltd. became the leading companies in the district.

In 1898 a branch line of the railroad reached Murphy from Nampa so the distance to railhead was reduced to 25 miles (Piper and Laney, 1926, p. 55). By 1906 the Trade Dollar Company had erected a hydroelectric plant at Swan Falls on the Snake River. Electric power was thus available for its own operations as well as the operations of its neighbors (Heikes, 1906, p. 263).

Although the De Lamar and Trade Dollar were the leading companies and contributing the bulk of the production, other properties within the district were not idle. Some of the older mines on War Eagle were worked from time to time and new discoveries were made at various places.

On War Eagle Mountain the Poorman was operated profitably by a London concern from 1895 until 1903 (Piper and Laney, 1926, p. 55). The Afterthought and the Never Sweat, southern extensions of known veins on War Eagle, were opened in 1903 and 1905 respectively. (Both of these properties are just south of the southern limit of the map area.) A number of old mines such as the Potosi and the Morning Star were under development from time to time and recorded small production.

Farther north the Rooster Comb mine (probably the present Monarcha) and the Berg mine (formerly the Sunnyside) were discovered in 1903 and 1906 respectively. These mines are on Whiskey Hill not far from Reynolds.

On the south side of Florida Mountain the Banner underwent considerable development for a number of years beginning in 1905. The vein is parallel to the Trade Dollar vein and the mineralization is similar. High hopes were held for

the Banner vein but it never became a large producer. The reports for the years 1905-1923 indicate mostly development and exploration with only occasional production. The Rich Gulch mine west of Florida Mountain and the Ontario on the west slope of Florida Mountain were extensively developed around 1912.

Much of the work mentioned above consisted of exploration by long and expensive cross-cuts followed by drifts on the veins. Most of these undertakings recorded only minor production. The Trade Dollar and De Lamar mines continued to dominate the district.

Owyhee County led the state in gold production from about 1903 until 1910. In 1906 the Trade Dollar was said to be the most extensively developed mine in the state with over 80,000 feet of lineal development (Heikes, 1906, p. 262).

The first hint of decreasing values at depth is heard from the Trade Dollar in 1907. The lowest level had been driven some 11,000 feet and had developed the vein to a maximum depth of 1,700 feet. The report for that year (Bell, 1908, p. 146) notes that the lowest level is not as productive as the middle levels, the shoots are smaller but the ore is still rich; it averages \$35.00. Milling costs averaged about \$3.00 per ton.

At De Lamar a low level tunnel tapped the vein at depth. At 950 feet below the outcrop values averaged only \$1.50 per ton and the tunnel was abandoned. Extensive exploration work was done between 1905 and 1907 while a new mill, designed to treat lower grade ore, was installed. Significantly the new mill, a cyanide plant, reduced milling costs from \$16.00 to \$2.00 per ton (Bell, 1913, p. 137).

In 1906 total operating costs for the Trade Dollar are given at \$20.36 per ton (Heikes, 1906, p. 262). The vein is narrow; the ore shoot ranges from 6 inches to 12 inches in width. Because of the narrow width, hand sorting was required and resulted in relatively high mining costs. In 1910, because of low grade ore at depth, the Trade Dollar closed on company account. Lessees gleaned occasional high-grade shipments from the mine and dumps until 1941, but the Trade Dollar as a major producer was finished.

De Lamar was experiencing similar problems. In spite of new milling procedures and lower treatment costs, ores at depth were proving unprofitable. In 1912 the Federal Government initiated a law suit to recover the cost of timber that had been cut for the operation. Steps were also taken to prevent further use of timber from Government land sections in the region (Bell, 1913, p. 139). This legal action caused the company, already faced with a marginal operation because of low-grade ore, to close the mine in November, 1913 (Gerry, 1913, p. 778). As in the Trade Dollar, occasional small lots of ore were shipped from time to time, and in 1938 a 200-ton flotation mill was erected to treat the De Lamar dumps for their gold and silver content. The mill ceased to operate in December, 1942 (Campbell, 1943, p. 182).

From 1914 until 1934 production from the region was very limited (Fig. 7). The ore produced was mined by various lessees operating the old mines and from new

properties that recorded small but sustained production for a few years. The Ida Bell on Reynolds Creek operated from 1933 until 1938. The Never Sweat on War Eagle Mountain recorded sporadic production for a number of years.

The Jordan Creek Placer Company operated a dredge near De Lamar from 1934 to 1938. De Lamar Placers, another dredging company, operated on Jordan Creek below De Lamar from 1938 to 1940. Production figures for these operations are not available, but in 1937 the gravel was yielding about 25 cents a yard (Campbell, 1937, p. 206). The dredging operations mark the final chapter in the production history of the district.

Piper and Laney (1926, p. 56) state that about \$23,000,000 in precious metals was produced by the Trade Dollar and De Lamar mines during the 25 years they operated. The Mine Inspector's report for 1910 (Moore, 1911, p. 14) states that production from the Trade Dollar was over \$20,000,000. In 1912 he placed the De Lamar production at \$10,000,000 (Bell, 1913, p. 136). Thus the total production for the period would be over \$30,000,000. The Mine Inspector's reports tend to be slightly optimistic; the figure given by Piper and Laney is probably more correct.

FIELD WORK

When the field work on this project began in the summer of 1964, no base maps for plotting geology were available, but the United States Geological Survey had completed photographing the region in September, 1963. Thus, vertical air photos with an average scale of 1:34,000 were available for recording field data.

In the spring of 1964, preliminary 7 1/2 minute topographic sheets, at a scale of 1:24,000, became available from the Geological Survey. The contour interval is 40 feet on some of these maps, and 20 feet on others (Fig. 8). Data were transferred from the photos to the maps visually with the aid of a stereoscope. Contacts are estimated to be correct within 50 feet.

Geologic data were compiled from foot traverses. Contacts, faults, mineralization or other features were plotted on the photos for later transfer to the maps. Traverses were laid out roughly on the photos, but were not strictly adhered to because most contacts had to be walked out and were likely to lead one away from a planned course of travel.

When the mining area near De Lamar was studied, data were plotted directly on the topographic sheets to take advantage of the larger scale. Some photographs of the De Lamar area were enlarged four times to facilitate the study.

In some instances small areas of mineralization were mapped by compass and tape traverses. A surveying altimeter was used for vertical control.

PREVIOUS GEOLOGIC INVESTIGATIONS

In terms of ore produced and contributions to the early history of the west, Silver City was an important mining district. In spite of its importance

the region has not been extensively investigated. Probably the earliest published report was by Browne (1868, p. 522-527) who visited Silver City in 1868, only five years after the initial discovery. In 1895 Eldridge (p. 271-272) made a brief examination of the district as part of a reconnaissance across central Idaho.

The first important investigation of the Silver City mining region was by Lindgren (1900, p. 77-189). He studied the geology of the mineralized areas in detail. The report contains a great deal of information gathered first hand from underground workings. In 1904 the Silver City Folio was published (Lindgren and Drake). The folio described the regional geology of the area embraced by the old (1899) 30-minute Silver City quadrangle sheet of the U. S. Geological Survey. This early areal report covers all of the area included in the present investigation and more.

Piper and Laney (1926) studied the geology of the mineralized areas at War Eagle Mountain, Florida Mountain and De Lamar. Detailed reports on many individual mines are included in the bulletin.

McIntyre (1966) made a thorough and detailed study of the Reynolds Creek drainage basin in the north-central part of the mapped area. McIntyre's report stresses the Cenozoic history of the basin; it does not deal at length with economic geology. Geology of the Reynolds Creek drainage shown on Figure 8 is taken from McIntyre's map.

Records of mine production and notes of interest on various mining properties can be found in the annual reports of the State Mine Inspector, and in the annual Mineral Resources reports of the U. S. Geological Survey and the U. S. Bureau of Mines.

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Many residents of Owyhee County, Idaho, and Jordan Valley, Oregon, extended courtesies to me during the project and these are sincerely appreciated. Special thanks is extended to N. M. Williams, Paul Freed and Tom Brunzell, residents of Murphy, Idaho, for their help, especially in learning the names and locations of many old mining projects. Everett Jones of Jordan Valley, Oregon, was kind enough to permit me to use his house in Silver City during the 1964 field season. His hospitality is gratefully acknowledged.

M. C. Brown, Sidney Mining Company; G. T. Brook, Continental Materials Corporation; Floyd Tegnall, Idaho Falls; and D. H. McIntyre, Washington State University, offered valuable suggestions and gave freely of information in their possession.

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REGIONAL GEOLOGIC SETTING

SILVER CITY REGION

The rocks in the mapped area can be broadly correlated with similar rocks found elsewhere in Idaho. The oldest rocks in the area of study are Cretaceous intrusive rocks that crop out along the crest and eastern flank of the Owyhee Range. Their composition ranges from granodiorite to granite; granodiorite is the most common rock type. Whether these rocks are an outlier of the larger Idaho batholith, that occurs further north and east, or whether they are in some manner connected to it under the intervening Snake River downwarp is unknown. Because they are similar in composition, the intrusive rocks of the Silver City region are thought to be related to the batholith and are assigned a Cretaceous age. Presumably the intrusive rocks in the Owyhee Mountains invaded Paleozoic or Mesozoic metasedimentary rocks.

During Miocene time, basalts, latites and rhyolites were erupted from vents and fissures. Intrusive dikes and domes of similar composition, some of which were feeders for the flows, were also emplaced during the Miocene. These events probably coincided in time with eruption of the basalts of the Columbia River group further north, and extrusion of Miocene silicic volcanic rocks at other places in southern Idaho. Upwarping, faulting and local doming affected the Miocene rocks, and metalliferous veins were localized in the resulting fissures.

On the west side of the Owyhee Mountains are the nonmarine clastic, tuffaceous sedimentary rocks of the Sucker Creek Formation of Miocene age. Sedimentary rocks that have been assigned to the Miocene also occur in the Reynolds basin in the north-central part of the map area. These sediments were evidently accumulating at the same time the volcanic rocks were being extruded, because the two are interbedded and interfinger in a complex manner. Most of the sediments are lacustrine and probably accumulated in small ponds and lakes. Miocene sediments were probably accumulating on the east side of the mountains, but cover by younger sediments and flows does not permit their identification in the map area.

Volcanic activity continued into Pliocene time. The extensive welded ash-flow tuffs in the map area are evidence of this activity. The flows may be part of the Idavada Volcanics, a unit of regional extent, named by Malde and Powers (1962, p. 1199) and assigned a Pliocene age, but they differ in composition and stratigraphic position from the bulk of the Idavada; hence a definite correlation is not made. Pliocene silicic volcanic rocks are widespread throughout Idaho south of the Snake River.

On the west side of the range, along the western boundary of the map area, there is a thin flow of basalt and volcanic breccia of Pliocene age. It is associated with a thick welded tuff unit. Rocks in the welded tuff unit form prominent cliffs near the western boundary of the area (Fig. 8C); they tower over the more easily erodable Sucker Creek sediments that extend to the west. The welded tuff unit is also exposed along part of the southern boundary of the area, south of De Lamar Ridge (Fig. 8B).

In Oregon the Jump Creek Rhyolite is recognized. It overlies the Sucker Creek

Formation and is Pliocene in age (Kittleman and others, 1965, p. 7). Although no direct correlation can be made, it is likely that the welded tuff unit in the Owyhee Mountains is related to the Jump Creek Rhyolite. Kittleman and others (1965, p. 8) postulate that the Jump Creek Rhyolite is related to the Idavada Volcanics.

Pliocene sediments of the Idaho Group occur along the eastern edge of the area. Sediments and lavas of this group are extensive further east and are exposed on the Snake River plain. The basalt unit of the Idaho Group, the Poison Creek Formation, and the Banbury Basalt, which overlies the Poison Creek Formation, are formations of the group that were recognized in the area studied.

Gravels occur above the level of Jordan Creek near De Lamar. They represent terrace gravels that probably accumulated during a time when Jordan Creek was ponded from damming by igneous rocks. The gravels contain rounded granitic pebbles and pebbles of Miocene rhyolite. Similar gravels are found west of De Lamar along Cow Creek and along the west side of Jordan Creek southwest of De Lamar. Unconsolidated alluvial material is common along stream valleys and in the desert along the eastern margin of the map area.

SURROUNDING AREA

The broad expanse of the Owyhee Upland extends south of the area mapped. The upland consists of a series of undifferentiated silicic volcanic rocks. Rhyolite, latite and silicic welded ash-flow tuffs make up the bulk of the upland with patches of younger basalt distributed irregularly over the surface. Regional relationships are not known over most of the upland, but local mapping in the vicinity of Grandview and Bruneau indicates two ages of rhyolitic rocks. According to Littleton and Crosthwaite (1957, p. 157) there are fine- and coarse-grained, biotite-rich rhyolitic rocks containing interconnected mineralized fault zones of Miocene age. Late Miocene to Early Pliocene silicic volcanic rocks, which are probably part of the Idavada Volcanics, overlie the mineralized rhyolite.

Late Cretaceous uplift of the Owyhee Upland included arching of the pre-Tertiary rocks, igneous intrusion and dynamic metamorphism. Faulting and volcanic extrusion occurred during the Miocene and Pliocene.

The relatively flat surface of the lava plateau, with its deeply incised canyons, is interrupted locally by isolated mountainous ridges that are linear in trend and roughly parallel to the Owyhee Range. The ridge that includes South Mountain, about 20 miles southwest of Silver City, is one such elevated area (Fig. 1). It is at South Mountain that the oldest rocks in the region are found. A series of garnetiferous quartz mica schists, quartzites and marbles are surrounded by a granodiorite intrusive. There are xenoliths of the metamorphosed sediments within the intrusive (Sorenson, 1927, p. 10). Dynamic metamorphism occurred before intrusion of the granodiorite (Sorenson, 1927, p. 29), probably during Late Cretaceous uplift and folding of the Owyhee Upland. Contact metamorphic effects and metasomatic ore bodies are found in the metasediments as a result of the intrusion.

Lindgren (1900, p. 76) mapped the South Mountain metasediments as probably Carboniferous and suggested that they are correlatable with the Seven Devils series that crop out further north; no basis for the correlation is given. The nearest exposures of similar rocks are at Huntington, Oregon; the rocks at Huntington are Triassic (G. A. Williams, College of Mines, University of Idaho, personal communication, January, 1967); hence the South Mountain metasedimentary rocks might be Mesozoic.

Piper and Laney (1926, p. 10, 11) noted a few scattered blocks of highly metamorphosed graphite and biotite schists near the periphery of a granodiorite intrusive body in the vicinity of Flint (Fig. 1). The exposures were too small to map, but they believed that these rocks could be correlated with the metasediments at South Mountain.

Lindgren (1900, p. 118) noted that two miles northwest of De Lamar a small area of pegmatitic granite is traversed by a belt 150 feet wide that is made up of quartz-biotite schist and normal quartzite. Lindgren states that the rocks in the belt represent contact metamorphosed sediments of unknown age. Tongues and stringers of granite penetrate the schist. I searched for the outcrop that Lindgren described but was unable to find it.

As mentioned previously granitic intrusive rocks are at South Mountain and at Flint. Granitic rocks also project through the lava cover on Boulder Creek and Castle Creek (Fig. 1). It should be noted that mineralization has been found in all of the exposures of granitic rocks south of Silver City.

The Snake River plain cuts across southern Idaho in a sweeping arc that is convex southward and about 50 miles wide. This broad basin borders the mapped area on the east and north (the High Lava plain of Fig. 2). The plain is an alluvial terraced area underlain by gravel, sand, silt, clay and ash of the Pliocene-Pleistocene Idaho Group, basalt flows of the Pleistocene to Recent Snake River eruptives and Recent terrace gravels and sands. Along the flanks of the basin, beds of the Payette Formation, which consist of nonmarine clastics and volcanics, generally more deformed than the younger sediments, crop out at places and presumably underlie the central part of the basin. Fossil remains indicate a Middle or Upper Miocene age for the Payette sediments (Newton and Corcoran, 1963, p. 4).

Structurally the Snake River plain is a great downwarp. Subsidence probably began near the close of the Laramide Revolution in Late Cretaceous or Early Tertiary time (Savage, 1958, p. 32). This event probably coincided with the development of the Owyhee Uplands to the south and intrusion of the Idaho batholith to the north. Erosion, deposition, faulting and volcanic activity have occurred several times in the Snake River downwarp and adjacent regions. These vents have led to the accumulation of a complex succession of volcanic and sedimentary rocks.

West of the mapped area and north of Jordan Valley, Oregon, sedimentary rocks of the Sucker Creek Formation of Miocene age crop out. The outcrops are in the western part of the High Lava plain (Fig. 2). The Sucker Creek Formation

is probably equivalent to the Payette Formation in Idaho. The Sucker Creek Formation contains interbedded rhyolites, tuffs, and basalts of Miocene age (Kittleman and others, 1965, p. 6). The Sucker Creek Formation is overlain by Miocene to Pliocene basalts, silicic volcanics and Pliocene sedimentary rocks that are broadly equivalent to the Idavada Volcanics and the Idaho Group (Kittleman and others, 1965).

The rocks of the Sucker Creek Formation were faulted, tilted and eroded near the end of the Miocene. North-trending basins were developed that were filled with debris during the Late Miocene through the Middle Pliocene. Explosive volcanism occurred frequently enough for the clastic sediments to contain a high proportion of pyroclastic material. Basin filling was followed by extrusion of basaltic lavas. Volcanism began in the Middle Pliocene and persisted through the Late Pliocene; some local flows may have been extruded in historic times (Kittleman and others, 1965, p. 27, 28).

South of Jordan Valley, Oregon, rhyolites of the Owyhee Upland extend westward to the margin of the Basin and Range province in Southeast Oregon. Regionally there is evidence for a minor orogeny near the close of the Miocene. Kirkham (1931, p. 202-203) found evidence in southern Idaho of a regional uplift at the end of the Miocene. Stearns and others (1938, p. 106) reached a similar conclusion. Further evidence is afforded by the angular unconformity between the Payette-Sucker Creek Formations of Miocene age and the younger formations of the Idaho Group.

PRE-TERTIARY ROCKS

SILVER CITY GRANITE

Piper and Laney (1926, p. 15) named the granitic intrusive rocks of the Silver City region, the Silver City Granite. That name is retained even though much of the intrusive is granodiorite.

Rock Type

After studying samples of the intrusive in thin section, Piper and Laney, (1926, p. 16) concluded that the most common rock type is granodiorite. Lindgren and Drake (1904, p. 2) thought that biotite granite was the most prevalent variety, but they noted that the rock contains much oligoclase and may be closely related to quartz monzonite. McIntyre (1966, p. 16) referred to the unit as granitic rock, quartz monzonite in part. My observations of hand specimens and thin sections indicate that granodiorite makes up the bulk of the Silver City Granite.

Age

Direct evidence for the age of the Silver City Granite is not available. Other geologists, including Lindgren (1900), Piper and Laney (1926), Sorenson (1927) and McIntyre (1966) have placed these rocks in the Cretaceous period. The age assignment is based on similarity to the Idaho batholith of Cretaceous age that crops out further north and east. Many geologists consider the Silver City Granite an outlier of the Idaho batholith or connected to it beneath the intervening Snake River plains. I find no evidence to support a suggestion that the Silver City Granite is some other age; hence the Silver City Granite is assigned to the Cretaceous period.

Outcrop Areas

The granitic rocks are found as large continuous masses at two places in the area studied. A mass of granitic rock extends from War Eagle Mountain north and west and covers approximately 36 square miles in the Sinker Creek drainage. The other exposure covers about 21 square miles; it is in the north-central part of the map area in the vicinity of Whiskey Mountain. The area occupies part of the divide between Reynolds Creek and Succor Creek (Fig. 8).

Small exposures of granitic rocks are numerous throughout the region except in the western third of the map area. The rocks crop out as irregular masses and elongate narrow ridges. These exposures probably represent topographic highs that were developed on the granitic surface before extrusion of the volcanic rocks in the area. The granitic highs were either not covered by the flows or they were only thinly covered and have since been exposed by erosion. At places faults form the contacts of the granitic rocks and bordering volcanics.

Jointing and Topographic Expression

Several intersecting joint sets are prevalent in the granitic intrusive rocks.

The poles to 150 joints plotted on an equal area projection yielded the contour diagram shown in Figure 9. The diagram shows a concentration of points in the north-west quadrant, indicating a dominant trend of N65E and a moderate southeast dip, about 45 degrees. Other trends are not as obvious, but a steeply dipping N10E trend is indicated as well as a steeply dipping N45W trend. Where the joints are more perfectly developed along one direction than another, a distinctive sheeting results; at places the jointing imparts a bedded appearance to the outcrops and the exposures resemble sedimentary units (Fig. 10). Where weathering progresses along a well-developed joint system, towers and pinnacles of granitic rock may result (Fig. 11), but more commonly summits are rounded and covered with granitic debris; slopes are generally steep.

Hand Specimen Descriptions

In hand specimen the typical granitic rock is medium- to coarse-grained with granular texture. Mineral grains range from 0.3 cm to 1.0 cm in size, and minerals are about equal in size in a given specimen. In some specimens there are larger than average euhedral orthoclase crystals, and the rock has a porphyritic texture. Minerals observable in hand specimen are quartz, orthoclase, plagioclase, biotite and muscovite. Plagioclase is dominant over orthoclase in most specimens examined, but in some they are about equal in amount. The bulk of the rock is granodiorite but at places it is quartz monzonite or granite. Thin sections support this conclusion.

Light gray to white is the dominant color of the granitic rocks; because of their distinctive color and weathering characteristics they stand out clearly on air photos.

Thin Section Description

Petrographic study shows the rock to be a biotite granodiorite; however, the rock has a range in composition and at places it is quartz monzonite or granite. Medium grain hypidiomorphic granular texture is characteristic. Quartz makes up an estimated 30 percent of the minerals in the rock; the quartz shows undulatory extinction and occurs in distinct grains or as poikilitic inclusions in the feldspars.

Orthoclase makes up about 30 percent of the total mineral grains and about 15 percent of the total feldspar. Orthoclase occurs as anhedral grains; myrmekitic intergrowths with quartz, and poikilitic inclusions of quartz in the orthoclase are common. Microcline occurs but it is not abundant. Oligoclase-andesine plagioclase (An27 to An33) makes up to 40 to 45 percent of the rock and about 65 percent of the total feldspar. Albite and carlsbad twins are common. The plagioclase grains are in subhedral forms; inclusions of quartz, potassium feldspar (perthite) and biotite are seen along some cleavage planes.

Biotite is an estimated 15 percent of the rock. It occurs as irregular grains and shreds and along cleavages in the feldspars. Muscovite is in most specimens but in the normal rock, biotite is the principal mica. Apatite, zircon, and magnetite

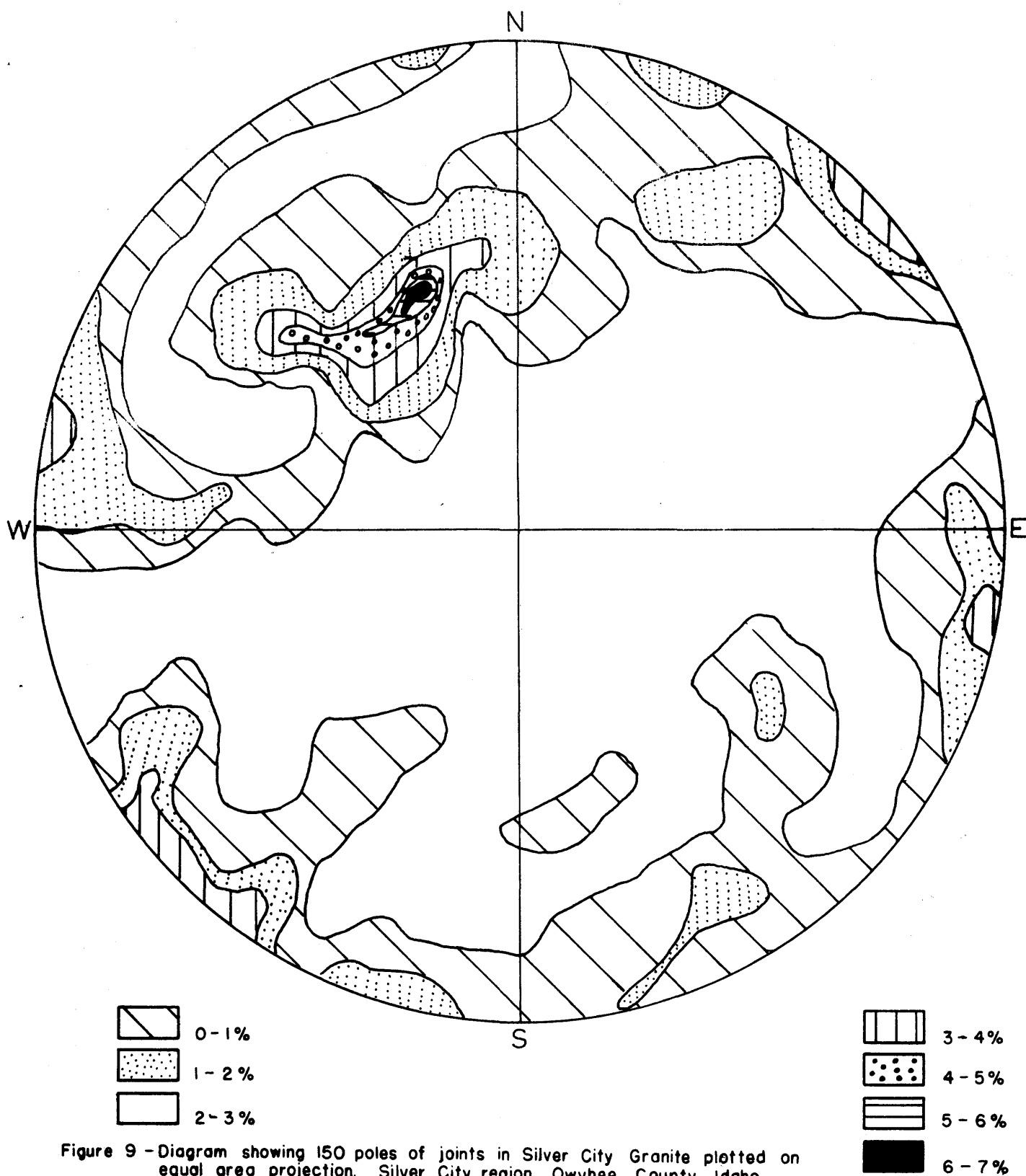


Figure 9 - Diagram showing 150 poles of joints in Silver City Granite plotted on equal area projection. Silver City region, Owyhee County, Idaho.



Figure 10. Dipping joints in granitic rocks; joints impart a bedded appearance to outcrops. T3S, R2W, Silver City region, Owyhee County, Idaho.

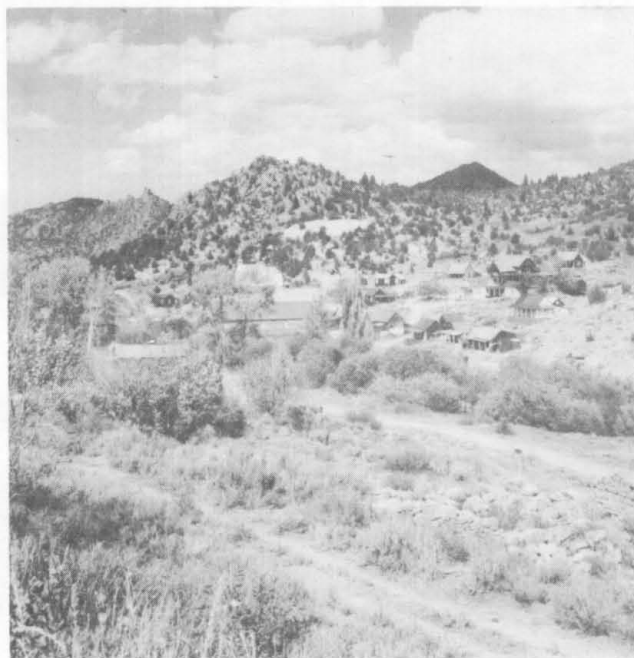


Figure 11. Topographic expression of granitic rocks; looking north from Silver City; Silver City region, Owyhee County, Idaho.

are accessory minerals. No amphibolites were identified.

The above description is taken as typical, but in some samples orthoclase and plagioclase are about equal and the rock is a quartz monzonite; muscovite may be as abundant as biotite in some specimens. Larsen and Schmidt (1958, p. 4) have found similar variations in the Idaho batholith north of the Snake River.

Compositional Varieties

In addition to the textural and compositional variations in the Silver City Granite, there are alaskite, pegmatite-aplite and schlieren zones in the intrusive body.

Near Slack Mountain, on the divide between Sinker Creek and Reynolds Creek (near sec. 18, T4S, R3W), a very fine-grained phase of the intrusive that displays saccharoidal texture crops out. In hand specimen the rock appears to be made up essentially of quartz and feldspar. Biotite is absent, but muscovite or sericite is plentiful and garnet is an abundant accessory. Compositionally the rock at Slack Mountain is a fine-grained muscovite granite or alaskite. According to Moorhouse (1959, p. 273), alaskite is quartz-alkali feldspar granite with virtually no ferromagnesian minerals. Texturally the rock resembles aplite, but the texture is slightly too coarse-grained to be called aplitic (R. R. Reid, personal communication, April, 1966). The texture is best described as granular.

Orthoclase, quartz, plagioclase and muscovite are the essential minerals in the alaskite. Quartz showing undulatory extinction makes up 30 to 35 percent of the rock; it occurs as interlocking anhedral grains and as intergrowths with feldspar. Potassium feldspar, mostly orthoclase, is present as about 40 percent of the total mineral grains and 70 percent of the total feldspar. Sericite and muscovite are abundant along cleavages. The orthoclase embays and surrounds the quartz grains; myrmekitic intergrowths of quartz and orthoclase are minor. Subhedral oligoclase (An₂₅) makes up about 15 percent of the rock and 30 percent of the total feldspar; at places it is intergrown with potassium feldspar. Oligoclase contains quartz inclusions and sericitic mica is along cleavage and twin planes. Muscovite is the dominant mica, no biotite was observed. The muscovite occurs in bands or zones that are aligned across the thin section; away from these zones muscovite is in small amounts as irregular shreds and patches associated with the feldspars.

Garnet is an abundant accessory; it occurs as granular aggregates interstitial to quartz and feldspar. Euhedral opaque grains of pyrite are a minor accessory as well as zircon and apatite.

At several places well-developed schlieren zones occur within the granitic rocks. These schistose rocks are on the north slope of Slack Mountain on some of the old mine dumps. The rocks are also associated with many of the prospects on Whiskey Mountain to the north. The long northeast-trending ridge of granodiorite exposed in the northeast corner of the map area shows a well-developed schlieren zone in sections 14 and 15, T3S, R3W. These foliated masses of rock

are characterized by bands of dark micaceous minerals separated by thin laminae of lighter quartz and feldspar. The contacts with the surrounding granitic rocks are gradational.

In two instances the schlieren zones are associated with mineralization but a genetic relation cannot be established. Where the schlieren zones were observed they are associated with faulting. The zones may represent pre-existing lines of weakness developed by stresses imposed on the magma before it was completely rigid; these lines of weakness may have localized faulting during a later stress period. There is little evidence that the schlieren zones bear a relationship to intrusive contacts, nor does their spatial distribution suggest such a relation. Piper and Laney (1926, p. 17) remark that primary gneissic or laminated texture is well exposed about a mile and a half north of Silver City along the Silver City-De Lamar stage road. The potash feldspar phenocrysts have been turned parallel to one another by movement of the magma during crystallization, according to Piper and Laney.

Light-colored pegmatite lenses, stringers and dikes occur at irregular intervals in the granitic rocks. Generally the individual pegmatite masses are highly irregular in attitude and of limited extent. The pegmatites appear to occur in distinct zones or swarms; in some areas they are particularly abundant, but in surrounding areas they are rare. There is some evidence that the pegmatite zones are aligned across the area, but mapping in greater detail would be necessary to substantiate this suggested alignment. Spatial relations of the pegmatites do not indicate that they are necessarily located near the margins of the intrusive mass.

The pegmatite bodies are granitic in composition. They are made up of massive quartz; coarse potassium feldspar, much of which is microcline and some of which is perthitic; and books of muscovite up to 4 inches across. Exotic minerals are rare in these pegmatites although garnets up to 1/2 inch across are a common accessory. Coarse to very coarse texture is predominant.

At some places the pegmatites are bordered by fine-grained, saccharoidal, light-colored aplitic rocks. In hand specimen, identifiable minerals are quartz, feldspar and muscovite. Small, pale pink garnets sprinkled through the aplitic bodies can be observed at some places. In appearance the aplites resemble the fine-grained alaskites described from Slack Mountain. As a rule the aplitic dikes are at the margins of coarser pegmatites; the dikes are 2 to 3 inches in width and their contacts are gradational with the surrounding granitic rock.

At many places coarse quartz float litters slopes and hillsides. This quartz is derived from pegmatite masses and has little connection with mineralization. Prospecting by following these float trains to their source is generally unproductive. As Lindgren (1900, p. 118) stated: "These quartzose pegmatites contain no valuable minerals and bear no relation to the metalliferous veins." At one place, however, antimony minerals are found in association with pegmatitic rocks.

The granitic rocks bordering the pegmatite or pegmatite-aplite zones show no unusual features nor alteration because of the pegmatite emplacements.

PORPHYRITIC DIORITE AND DACITE DIKES

Outcrop Areas

On War Eagle Mountain porphyritic diorite and dacite dikes are abundant in the Silver City Granite. Elsewhere in the region dikes of a similar nature are not plentiful. A diorite or dacite dike about 30 feet wide occurs in the granodiorite near the Sinker Creek bridge on the Silver City road. Core from drill holes near Florida Mountain contain highly altered material that has been tentatively identified as diorite or dacite. Along the North Fork of Sinker Creek a small diorite dike less than a foot in width was observed, and a narrow diorite dike is associated with a fault along the southwest boundary of the irregular granite mass in the northeast corner of the map area in section 1, T3S, R3W. Both of these dikes are too small to show on the geologic map.

Rock Descriptions and Age Relations

Piper and Laney (1926, p. 19-20) studied the dikes on War Eagle Mountain in detail. Their descriptions are summarized below.

The dikes are 25 to 50 feet thick but widen locally to as much as 200 feet. They strike N20-65E and dip 45-70SE. At some places the dikes follow sheeting planes in the granitic rocks. The diorite is older than the dacite, but Piper and Laney note that they represent the same general period of igneous activity. The dikes do not penetrate the rhyolite; their age relation to the basalt was not determined by Piper and Laney. Evidence from drill holes on Florida Mountain indicates the possibility that the dikes are younger than the basalt. Piper and Laney believe that the porphyritic diorite and dacite dikes are differentiates from the granodiorite magma; differentiates that are slightly more mafic than normal.

Specimens of unweathered porphyritic diorite are a mottled light greenish gray with a very few slightly rounded quartz phenocrysts 0.02 to 0.03 cm in diameter; the groundmass is crystalline and fine- to medium-grained. Andesine (An40) in mutually interlocking prisms is the dominant constituent; biotite forms a few foils and irregular shreds; and quartz is present as a few small scattered anhedral. Interstitial hornblende or other amphibole is doubtfully known from alteration products. Orthoclase is probably present but was not determinable. Magnetite is the most plentiful accessory, but apatite is also present.

The porphyritic dacite is typically a grayish green rock, of which as much as 25 percent is composed of phenocrysts. In order of abundance the phenocrysts are andesine, quartz, biotite, and hornblende(?). Andesine (An33) forms mutually interlocking prisms commonly less than 0.04 by 0.08 cm, although a few are as large as 0.2 by 0.25 cm; basal sections show zonal banding. Andesine makes up 15 to 20 percent of the rock. Quartz phenocrysts, which attain a maximum diameter of 0.04 cm amount to less than 5 percent of the rock, and are generally surrounded by a fringe of radiating microlites. The average index of the fringe is approximately that of oligoclase. Biotite is always present and may or may not be accompanied by amphibole, probably hornblende. Biotite and hornblende make up 2 to 3 percent

of the whole. A very few intratelluric crystals of sanidine are the only determinable potassic feldspars. The groundmass is microcrystalline, largely soda-lime feldspar and probably contains orthoclase and quartz.

A few hundred yards south of the Sinker Creek bridge on the Silver City road, in section 24, T4S, R3W, an altered diorite or dacite dike about 30 feet wide has been offset by a northeast-trending fault. The dike strikes N65W; it carries pyrite, and is traversed by a number of quartz-calcite-hematite veinlets. The rock contains biotite, muscovite, and small quartz phenocrysts in a dark greyish-green groundmass. A soft, white, chalky coating is developed on the weathered surface along with patches of a bluish-black coating.

Sidney Mining Company drilled a number of diamond drill holes west of Florida Mountain in 1966. Core from two of the holes contains diorite (?) that has been highly altered. Chloritized basalt occurs above and below the diorite (?). Consequently, there is weak evidence of a post-basalt age for the dikes.

TERTIARY IGNEOUS ROCKS

BASALT-LATITE UNIT

Name of Unit and Regional Correlations

No formal name is applied to the group of basalt and latite flows that overlie the Silver City Granite. On the state geologic map the rocks are designated Columbia River Basalt (Ross and Forrester, 1947). Ross and Forrester (1958, p. 15) state that the U. S. Geological Survey recognized Columbia River Basalt as a convenient blanket term to include basalts of Eocene, Miocene, and Pliocene(?) age that occur in the Columbia River drainage. Usage in Idaho restricts the term to a unit that consists mainly of flows of basaltic lava and kindred composition that extend interruptedly from the vicinity of South Mountain, Owyhee County, through western Idaho as far north as Kootenai County.

Lindgren, (1900, p. 100) discusses the Miocene flows of the Owyhee Range under a section entitled: Miocene Eruptions Not Connected with the Columbia Lava. Lindgren (p. 116) notes that the Columbia River lavas and the flows in the Owyhee Mountains were probably extruded contemporaneously, but I could not find a reference in which he applied the same name to the two units. Lindgren regards the basalts in the Owyhees to be an independent unit (p. 116).

Later writers (Buwalda, 1924 and Kirkham, 1931) imply that the units are equivalent in age and composition. Malde and Powers (1962, p. 1200) say that Lindgren correlated the flows in the Owyhees with the Columbia River Basalt. McIntyre (1966, p.13) objected to calling the flows in the Owyhee Mountains Columbia River Basalt because they are not flood basalts and they are not tholeiitic in composition.

In the Reynolds Creek Basin, McIntyre (1966, p. 52-146) describes the Reynolds Basin group which includes the basalt-latite unit. McIntyre named units informally from local geographic features. Included in the Reynolds Basin group is a series of volcanic rocks made up of three basalt flows, two latite flows and the rhyolite of the Silver City mining district. These extrusive units are in part contemporaneous with and interfinger with a sedimentary unit of Miocene age composed of sand, silt, diatomite and pyroclastic debris that crops out in the Reynolds Basin. A basalt-andesite unit older than the extrusive rocks of the Reynolds Basin group occurs in the northern part of the Reynolds Creek drainage outside the area mapped for this report.

Rock Types

The detailed work of McIntyre (1966) in the Reynolds Creek drainage basin has added to the value of this study. McIntyre developed the stratigraphic relations in the various basalt and latite flows and their relation to the interbedded sedimentary rocks. During the course of this study no attempt was made to differentiate the basalt and latite flows. Concerning the latites and basalts, McIntyre (1966, p. 81) points out: "Rocks from both units (upper and lower latite units) might easily be mistaken for basalt, both in the field and under the microscope".

Silica determinations by the fusion method show that the latites have a silica

content of 63 to 65 percent, which, according to McIntyre (1966, p. 87) is within the latite to quartz latite range. Turner and Verhoogen (1960, p. 57) classify rocks with a silica content of 52 to 66 percent as intermediate. It is doubtful if silica determination alone is definitive enough to classify these rocks. Williams and other (1955, p. 97) use the term trachyandesites (latites) to embrace all andesites with more than 10 percent modal or normative potash feldspar. They note that many trachyandesites are recognizable only by means of chemical analyses. Because McIntyre used the term latite and because potassium feldspar phenocrysts occur in the glassy groundmass of the rocks, the name latite is retained. It should be kept in mind, however, that the rocks might well be called andesites.

Age

McIntyre (1966) considered the Reynolds Basin group, of which the basalt-latite unit is a part, to be Upper Miocene or Lower Pliocene in age. Lindgren (1900, p. 116) thought the basalts in the Owyhee Mountains were Miocene. I have assigned the basalt-latite unit to the Upper Miocene or Lower Pliocene.

Lindgren and Drake (1904, p. 4) discuss two series of basalts in the Owyhee Mountain range: one older and one younger than the Miocene rhyolitic rocks. Much of the younger basalt shown by Lindgren and Drake is north of Reynolds outside the area mapped for this report. During the course of this study, evidence for an early and late sequence of Miocene basalt flows was not found. Except for the Pliocene basalt that occurs near the western boundary of the map area and the Banbury Basalt of the Idaho Group, the basalt in the region is older than the rhyolite and underlies it. McIntyre (1966, p. 11), who mapped the Reynolds Basin in detail, reached a similar conclusion.

The relation between the basalt-latite unit and the beds of the Sucker Creek Formation of Miocene age that occur extensively in the western part of the map area was not studied in detail. Several reconnaissance traverses were made across the part of the area underlain by the Sucker Creek Formation. There are interbedded basalt flows in the Sucker Creek Formation, and it is likely that the Miocene basalt and the sedimentary rocks of the Sucker Creek Formation are in part contemporaneous.

Outcrop Areas

The basalt-latite unit is exposed from north to south in the central part of the area investigated. Outcrops of the later rhyolite and earlier granitic rocks interrupt the continuity, and at places dikes and domes of rhyolite and quartz latite intrude the basalt. On the east flank of the Owyhee Mountains remnants of the basalt-latite unit rest on granitic rocks and are overlain by acidic welded tuffs of Pliocene age. These small exposures are of limited extent and only a few tens of feet thick; they are included with the more extensive basalt-latite unit although no direct evidence for correlation was found.

An irregular zone of red to blue clay and soil is near the south boundary of the mapped area, on the south side of De Lamar Mountain. The general appearance of the irregular zone suggests that the material was derived from basalt; a few rounded basalt cobbles are mixed with the clay several hundred yards south of the Henrietta shaft. No analyses were made of this material; it is thought to be altered basalt

because of its appearance and its stratigraphic position. The clay-soil zone is shown separately on the geologic map (Fig. 8B). The highly altered nature of the clay-soil zone is probably related to weathering, baking by the overlying Silver City rhyolite and hydrothermal alteration.

Outcrop Characteristics

The basalts in the unit form dark, rubbly slopes and ledges, or rounded slopes covered by a brown to a reddish-brown soil mantle. Columnar structure and horizontal jointing are rudely developed in some exposures, but jointing is not an outstanding feature.

The topography in areas where the basalt-latite unit crops out is generally rolling to rounded. Slopes are commonly steep, but not precipitous. Figure 12 is a view of the basaltic terrain in the northern part of the area.

Hand Specimen Description

The basalts range from porphyritic to dense fine-grained olivine basalts. In the porphyritic varieties clear feldspar laths are conspicuous in a dense felted groundmass containing olivine. The porphyritic varieties are grayish black on a fresh surface. The rocks weather grayish orange to dark yellowish brown. The fine-grained varieties are characterized by felted texture. They are greenish black on a fresh surface, and weather brownish gray.

The latites are dark glassy rocks to crystalline felsites. At places light gray pumicite tuff is associated with the lower contacts of the latite flows.

The felsitic latites are so fine-grained that little can be learned of their composition in hand specimen. Most are uniformly felsitic, medium dark gray to dark gray rocks. A mottled appearance characterizes some outcrops, but probably more characteristic is the tendency for weathering to produce flaggy debris that litters hillslopes below latite outcrops. The weathered surface is moderate brown to moderate reddish brown. Porphyritic varieties of the felsitic latites contain small, white feldspar phenocrysts, 1 to 2 mm across, in a dense groundmass. Outcrops displaying almond-shaped vesicles occur at a few places.

The glassy variety of the latite is black with a sub-vitric luster. It breaks with conchoidal fracture. Some of the glassy material is porphyritic; small feldspar laths 1 to 2 mm in maximum dimension are in the glass. A grayish brown color develops on the weathered surface of the glassy latite.

Thin Section Description

In thin section the basalts display intergranular to intersertal texture. Hyalophitic to pilotaxitic texture is observed in a few specimens. The feldspar minerals are labradorite or bytownite. In porphyritic rocks the large plagioclase laths range from An₅₀ to An₇₅; most are about An₆₀. In some sections the plagioclase laths have sharp boundaries, in others they are embayed and corroded by the

surrounding groundmass. Calcite may be developed along cleavage planes.

Pyroxene, probably augite, is abundant in some sections. Plagioclase sieves the pyroxene grains in coarse-grained specimens, in fine-grained specimens the pyroxene occurs as intergranular fragments interstitial to small feldspar laths. Chlorite developed from the pyroxene is common.

Olivine is an abundant to minor constituent. In most sections it is subordinate to pyroxene. It occurs as grains interstitial to pyroxene and plagioclase in specimens displaying intergranular texture. In porphyritic rocks, large, discrete grains of olivine rimmed by iddingsite can be observed. In many sections the olivine is altered to chlorite and opaque granules of iron oxide.

Dark brown to yellowish glass is interstitial to plagioclase and pyroxene in some specimens. The groundmass of the basalt is glassy to a fine-felted mass of feldspar and pyroxene grains with interstitial olivine. Alteration products and accessory minerals include chlorite, calcite, iddingsite, iron oxides and pyrite.

The latite shows hyalopilitic to pilotaxitic texture in thin section. Phenocrysts of sanidine, plagioclase, olivine and clinopyroxene in a partially to wholly devitrified groundmass are characteristic of the porphyritic varieties. Phenocrysts do not constitute more than 20 percent of the rock in most sections. The felsitic varieties are characterized by microlites, feldspar laths, pyroxene grains and dark brown glass. The groundmass ranges from glassy to microlitic.

The plagioclase phenocrysts in the latite are predominantly andesine (An₄₄), the range in composition is from An₄₀ to An₆₀. Many of the phenocrysts are complexly zoned and determination of An content by optical means is not possible. The predominance of andesine in these rocks is further evidence that the rocks are latites rather than andesites. According to Williams and others (1955, p. 94) the porphyritic plagioclase in most andesites is labradorite that is more calcic than An₅₅.

Iron oxides are a common accessory mineral in the latites. Olivine is generally rimmed by iddingsite. Some phenocrysts have sharp boundaries, others are corroded and embayed by the groundmass.

Thickness

The exposed thickness of the basalt is 1,600 feet on the south slope of Jordan Creek north of De Lamar. A well drilled near De Lamar penetrated 975 feet of basalt (Lindgren and Drake, 1904, p. 4). A total thickness in excess of 2,500 feet is probably represented. The thickness from place to place is variable because of the irregularities in the underlying surface over which the basalt flowed. McIntyre (1966, p. 53) estimates a maximum thickness of 3,100 feet on the east side of Reynolds Creek basin.

Source

In the northern part of the Reynolds Creek basin, north of the area shown on Figure 8, basaltic pyroclastic rocks are associated with a basalt-andesite flow complex



Figure 12. Basaltic terrain; Rooster Comb Peak in background. Looking north from Slack Mountain, Silver City region, Owyhee County, Idaho.



Figure 13. Irregular jointing in aphanitic Silver City rhyolite. South side of De Lamar Mountain, Silver City region, Owyhee County, Idaho.

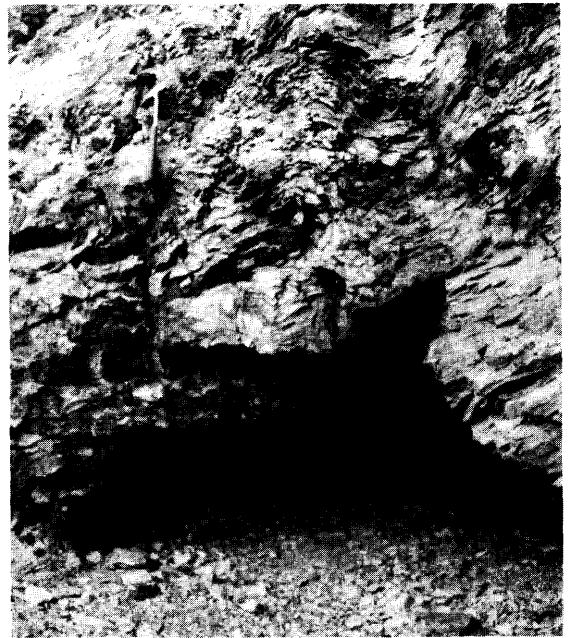


Figure 14. Jointing in aphanitic Silver City rhyolite. South side of De Lamar Mountain, Silver City region, Owyhee County, Idaho. Note small folds in the rocks.

(McIntyre, 1966, p. 42). Piper and Laney (1926, p. 21) discuss a similar series of mafic pyroclastic rocks 1,500 feet in thickness north of the Flint District, south of the area studied for this report. Both occurrences are at the base of the basaltic sequence. The presence of the mafic pyroclastic rocks indicates that some of the basalt in the region must have been erupted violently, but the bulk of material was probably extruded quietly from fissures.

In the Flint district, basaltic dikes 10 to 20 feet wide cut the granitic rocks. In some places the dikes can be traced to a direct connection with a basalt flow (Piper and Laney, 1926, p. 22). The lower levels of the Black Jack-Trade Dollar mine on Florida Mountain follow a basalt dike that merges upward with a flow (Lindgren, 1900, p. 137). These examples show that fissure activity accounted for at least part of the extrusions. The volcanic vents giving rise to pyroclastic material were located south and north of the area under consideration. An early explosive phase was followed by quiet fissure eruptions, but the sites of the fissures are mostly unknown.

It is interesting to speculate on the possibility that the diorite and dacite dikes on War Eagle Mountain were feeders for some of the flows that are intermediate in composition. No latite flows are found in proximity to the dike swarm in the region investigated, but War Eagle Mountain is at the south boundary of the map area. When this study is extended to the south, evidence for a connection between the two may be established.

SILVER CITY RHYOLITE

Name of Unit and Regional Correlations

The silicic volcanic rocks that overlie the basalt-latite unit are informally called the Silver City rhyolite. No formal name has been proposed by previous workers. Piper and Laney (1926) refer at one place (p. 28) to the rocks as the Silver City rhyolite, but they do not use the name in a formal sense. McIntyre (1966, p. 120) referred to the rocks included in the Silver City rhyolite as the rhyolites of the Silver City mining district.

Malde and Powers (1962, p. 1200) point out that mineralized Miocene rhyolitic rocks, similar to the Silver City rhyolite, have been recognized near the Bruneau River, Owyhee County, Idaho; near Goose Creek, Cassia County, Idaho; on the north side of the Mount Bennett Hills, Elmore County, Idaho; and in the Jarbidge Mountains, Elko County, Nevada. The Silver City rhyolite and these occurrences are probably related. Malde and Powers go on to say that these rocks resemble some rhyolitic rocks in the Challis Volcanics of south-central Idaho. Thus the Silver City rhyolite may correlate with similar rocks on a regional basis.

The rhyolites of the Silver City region were all called the Owyhee Rhyolite by Kirkham (1931); he did not differentiate the Miocene and Pliocene silicic volcanic rocks that occur in southwest Idaho. A similar procedure is followed on the state geologic map (Ross and Forrester, 1947), where these rocks are all grouped as Tertiary Silicic Volcanics.

In the area studied, the Silver City rhyolite is distinguished from younger rocks that are also rhyolitic in composition. Until more regional work is done and the correlations of the unit established I don't feel that a formal name for the unit is justified. Hence, the rocks are informally called the Silver City rhyolite.

Age

The Silver City rhyolite is probably Upper Miocene in age. North of Wagontown, near the Mercury prospect in sec. 25, T4S, R4W (Fig. 8B), a number of plant fossils are at the contact of the rhyolite and underlying basalt. The plant remains are cellular and are probably a variety of cattail. Cattails are not highly diagnostic because they were wide-spread throughout the Tertiary, but they were abundant in the Miocene (C. J. Smiley, College of Mines, University of Idaho, personal communication, December, 1966).

Previous workers have placed the Silver City rhyolite in the Upper Miocene or Lower Pliocene, Lindgren (1900, p. 116) thought that the rhyolites were extruded in the Miocene. Piper and Laney (1926, p. 25) date the rocks as probably Miocene. McIntyre (1966, p. 124-125) presents evidence for assigning the Silver City rhyolite to the Upper Miocene or Lower Pliocene. He observed fragments of Silver City rhyolite in an arkosic unit that occurs in the Reynolds basin. Because the arkosic unit is Upper Miocene or Lower Pliocene, McIntyre infers that the Silver City rhyolite has a similar age.

In the western part of the map area a contact between the Silver City rhyolite and Sucker Creek Formation was observed; the rhyolite is the uppermost unit. However, without further mapping beyond the area of study, the relation between the two units cannot be stated with certainty. The Silver City rhyolite occurs near the top of the Sucker Creek sequence; it is likely that some of the Sucker Creek beds are contemporaneous with or younger than the rhyolitic rocks, similar to the arrangement of the sedimentary and volcanic rocks in the Reynolds basin.

Rock Type and Map Units

Most of the Silver City rhyolite is composed of welded ash-flow tuffs, but there are some air-fall tuffs and rhyolite flows. McIntyre (1966, p. 121) makes the following statement:

"All specimens from this unit [the Silver City rhyolite] examined by the writer were of welded ash-flow tuff. Exposures of unusually porous welded crystal-vitric tuff are located in the bluffs across Jordan Creek southwest of De Lamar. Most exposures examined were of densely welded silicified crystal-vitric tuff. Some samples contain conspicuous pumice fragments."

I find that devitrification and silicification have been extreme at many places and the original texture obscured to a point where the mode of origin is uncertain.

Most of the unit is shown on the geologic map (Figs. 8B and 8C) as Silver City

rhyolite, undifferentiated. In the vicinity of De Lamar and Florida Mountains, an aphanitic member and a younger, overlying, massive porphyritic member were mapped separately to see if rock type exerted a control on the location of ore shoots (Fig. 8B). Hydrothermal alteration has masked the true character of the rocks at places and the two varieties are difficult to distinguish. The chief criterion for distinguishing between them is the presence or absence of abundant phenocrysts.

Outcrop Areas

In the region studied, outcrops of Silver City rhyolite are confined to the western slope of the Owyhee Mountains in the south-central part of the area. The unit rests on the basalt-latite unit except in the western part of the outcrop area where it is associated with beds of the Sucker Creek Formation.

One large mass of Silver City rhyolite occurs in the vicinity of Florida Mountain and Sawpit Peak. The Silver City rhyolite also forms the crest and southern slope of De Lamar Mountain and extends west where it flanks Jordan Creek as a prominent north-trending ridge. This mass of rhyolitic rock can be followed northward across Jordan Creek for about 4 1/2 miles north of the site of Wagontown (Fig. 8B).

Small isolated occurrences of Silver City rhyolite crop out at several places in the south central part of the area. The largest of these includes the rocks at Tennessee Mountain and Twin Peaks and near Slack Mountain.

Most of the aphanitic variety of rhyolite is on the south side of De Lamar Mountain where it lies in the hanging wall of the De Lamar fault (Fig. 8B), but some aphanitic rock extends from the east end of De Lamar Mountain along the north side to the vicinity of De Lamar. Faulting has influenced the distribution of this rock type and has given rise to an intricate outcrop pattern. The aphanitic variety probably occurs on Florida Mountain, but because of the intense alteration it was not identified. Where exposed in a normal relationship, the aphanitic rocks underlie the massive porphyritic rocks.

Piper and Laney (1926) do not differentiate varieties of the rhyolitic rocks in the mineralized areas they mapped because of the complications of alteration and faulting. They note (p. 26-27) well-banded porphyritic rocks, agglomerates or breccias, massive spherulitic flows, vitrophyre or porphyritic glass and local tuff beds. They note that the lower part of the sequence is composed of thin-banded, porphyritic rocks; these are probably the rocks I mapped as the aphanitic variety. Piper and Laney state that the thin-banded rocks are overlain by breccias and spherulitic flows with scattered lenticular masses of black vitrophyre capped by heavy flows of spherulitic rocks.

There are rhyolitic welded tuffs in the Silver City region that are younger than the Silver City rhyolite. Neither Lindgren (1900), Lindgren and Drake (1904) nor Piper and Laney (1926) separated the younger rhyolitic rocks from the older ones.

Jointing and Topographic Expression

The Silver City rhyolite makes massive outcrops; there is rudely developed jointing at some places, but it is highly irregular and not a striking feature. The aphanitic variety is typically laminated by numerous parting planes; at places the laminae are so closely spaced that the rock has a structure resembling shale. The laminae are irregular and attitudes change radically in short distances. Small folds 5 to 10 feet across are not unusual, the axial planes generally strike to the north (Figs. 13 and 14).

Diversity of topography characterizes areas where the Silver City rhyolite crops out. Most typical is the development of rugged cliffs, as along the east side of Jordan Creek southwest of De Lamar. At places joints transverse to the trend of the ridge, causes cliffs to develop across the strike of the ridge line; a step-like effect is the result. Near the crest of the ridge that comprises De Lamar Mountain, rugged crags are developed in silicified Silver City rhyolite.

The aphanitic variety of rhyolite forms gentler slopes than the more massive rocks, and a smoother, more rounded topography results. Where hydrothermal alteration has been intense, long smooth steep ridges with a heavy soil mantle and a few outcrops develop. Florida Mountain is a typical example of this type of topography (Fig. 15).

Hand Specimen Description

In hand specimen the Silver City rhyolite is typically a white to light grey rock with porphyritic to aphanitic texture. Porphyritic rocks are the most abundant. Where sericitization has been intense the porphyritic rocks have been softened and bleached to a point where they resemble fine-grained tuffs.

Porphyritic varieties show quartz, sanidine and rare biotite as megascopic phenocrysts in a white to grey, dense aphanitic groundmass. Phenocrysts are generally small and average 0.5 mm across. In altered rocks much of the feldspar exists as soft clay aggregates. On a weathered surface, the outcrop develops a pitted appearance, because cavities develop where phenocrysts have weathered out of the groundmass.

Flow banding and eutaxitic texture (Ross and Smith, 1961, p. 4) generally are not well developed. In many specimens the original texture has been obscured by alteration, devitrification, and recrystallization of the groundmass.

The lower aphanitic rocks are white to grey; at most places they show a very fine cleavage that gives the rocks a fissile character. A few specimens are massive aphanitic rocks with rare megascopic phenocrysts.

Lithophysae and spherulites are locally abundant in the upper massive unit. On the north point of Twin Peaks (Fig. 8B) lithophysae cavities up to an inch across occur in the rocks (Fig. 16). The cavities, which are lined with aggregates of secondary quartz crystals, are cone-shaped in cross section.



Figure 15. Florida Mountain, looking south from the north side of Jordan Creek. Note rounded form and sparse outcrops. Rock has been sericitized and silicified. Silver City region, Owyhee County, Idaho.

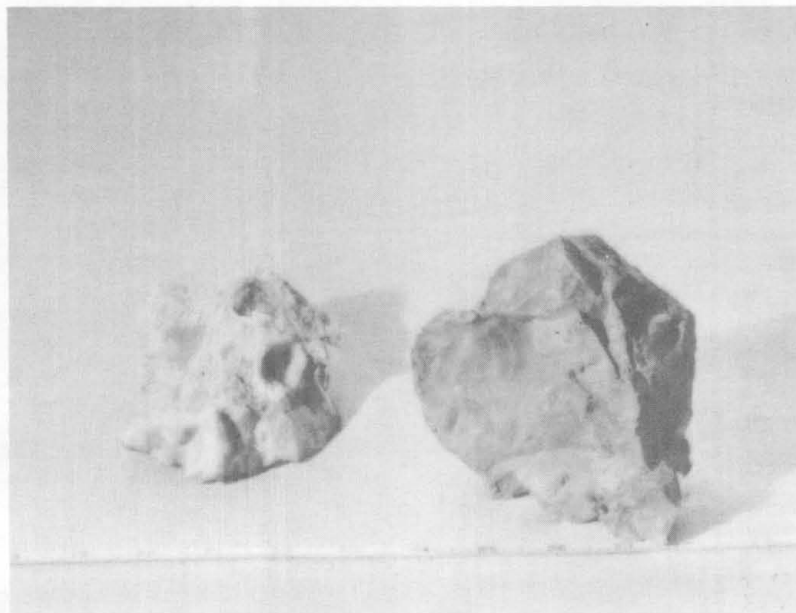


Figure 16. Lithophysal cavities in Silver City rhyolite, and jasper from near Slack Mountain. Specimen at left is from Twin Peaks, Silver City region, Owyhee County, Idaho. Scale in inches.



Figure 17. Nodules in Silver City rhyolite; specimens from the west end of De Lamar Mountain. Siliceous plates fill nodules and stand out in relief on specimen at right. Scale in inches. Silver City region, Owyhee County, Idaho.



Figure 15. Florida Mountain, looking south from the north side of Jordan Creek. Note rounded form and sparse outcrops. Rock has been sericitized and silicified. Silver City region, Owyhee County, Idaho.

At certain localities spherical nodules may make up 75 percent of an outcrop. Some of the nodules exceed 6 inches in diameter, but most are less than 2 inches. The nodules occur as individual spheres or aggregates of spheres (Fig. 17). Most of the spheres are hollow, the center may be traversed by thin plates of silica that appear to be pseudomorphic after calcite. The fillings in the spheres are similar in texture and structure to the gangue material that accompanies many of the metalliferous veins. Localities where spherical nodules are abundant include the narrow saddle at the west end of De Lamar Mountain east of the Golden Cycle Mine; and near the south end of the ridge that parallels the east side of Jordan Creek southwest of De Lamar. About 4 1/2 miles north of the site of Wagontown, in the vicinity of the prospects in sec. 25, T4S, R4W, there are nodules that are flat on the lower side (Fig. 8B).

Eutaxitic texture can be observed locally in the upper massive unit. A spongy appearance develops on weathering, and on a fresh surface the groundmass has a streaked appearance. This rock represents a crystal-rich, welded ash-flow tuff; the streaking is a reflection of the compacted shards.

North of Wagontown, in the vicinity of the mercury prospect (Fig. 8B), there is a highly siliceous variety of the Silver City rhyolite. The rock outcrops over an area covering several square miles. It ranges from a black, dense, flint-like rock to a white or pale red opaline variety. A number of pits have been excavated in the outcrops by rock collectors because the lighter colored rocks are suitable for cutting and polishing. Fragments of petrified wood are also abundant at the locality.

Near the contact with the underlying basalt-latite unit, numerous silicified plant remains and petrified wood are included in the dark flint-like rock. Sparse pyrite occurs with the silicified wood fragments. The total thickness of the siliceous unit is about 25 feet; it is overlain by massive porphyritic rhyolite. It appears that sediments and plant debris accumulated in a pond or swamp that was covered by a rhyolitic flow. Later silicification and pyritization then altered the buried sediments into the dense, siliceous rock that is exposed at the locality today.

On the flat west of the Henrietta shaft (sec. 6, T5S, R4W, Fig. 8B), petrified wood is abundant as float. South of the Silver Vault mine (sec. 8, T5S, R4W, Fig. 8B), petrified wood occurs in a highly siliceous aphanitic variety of the Silver City rhyolite. The petrified wood horizon is directly over the red soil zone that is thought to be weathered and altered basalt. Conditions in the area south of De Lamar Mountain were probably suitable for the accumulation of plant debris, similar to the conditions north of Wagontown, when the first rhyolitic flows were extruded.

A mass of Silver City rhyolite occurs near Slack Mountain. At the north end of the outcrop, near the contact with the basalt-latite unit, red jasper and chert crop out; much of it is intricately banded and streaked.

On the Florida Mountain pieces of natural charcoal occur on several of the old

mine dumps. These localities are well up in the rhyolite sequence above the basalt contact. Evidently there was sufficient time between the extrusion of rhyolitic flows for vegetation to become established.

On the east side of Florida Mountain, west of the granite-rhyolite contact (Fig. 8A), fragments of granitic rock can be seen in the highly altered porphyritic rhyolite as inclusions. The fragments I observed were 3 inches or smaller in diameter; Piper and Laney (1926, p. 26) observed fragments up to 1 foot in diameter in the vicinity.

Because the Silver City rhyolite is an important host rock for ore deposits, and because all other silicic volcanic rocks in the region are post-ore, a brief summary of the megascopic criteria for recognition of the Silver City rhyolite is presented below:

1. It is light colored; white to light grey is characteristic
2. Much of the unit is porphyritic, with visible quartz and sanidine phenocrysts. Phenocrysts are usually small; they average 1 mm in diameter.
3. Spherulites, lithophysae cavities and spherical nodules are locally abundant.
4. The rock is silicified throughout much of its outcrop area. Hence it is hard and resistant to erosion, except where altered by sericitization.

Thin Section Description

Most specimens of Silver City rhyolite that were examined in thin section show the effects of hydrothermal alteration. Silicification is pervasive and widespread; sericitization is locally important in those areas where metalliferous deposits are abundant.

The Silver City rhyolite is generally distinct megascopically from other silicic volcanic rocks in the region, but at places assignment of a particular outcrop requires thin section study. In this section study the phenocryst content is a reliable criterion to make the Silver City rhyolite a distinctive unit. The virtual absence of plagioclase in the Silver City rhyolite also distinguishes it from younger silicic volcanic rocks in the region. Correlation of varieties within the Silver City rhyolite, such as the highly altered rocks on Florida Mountain, the aphanitic variety and the porphyritic variety is more difficult, however. Correlation based on silica determination by refractive index of a fused bead was not attempted because of the pervasive silicification apparent in rocks of the Silver City rhyolite. Staining, as a means of identifying phenocrysts, was also discarded as a technique because of the possibility of introduced potassium accompanying sericitization.

The Silver City rhyolite generally contains 5 to 10 percent phenocrysts. Euhedral

to rounded quartz grains, slightly corroded and embayed by the groundmass, are the most abundant. Sanidine occurs as euhedral crystals or angular fragments; in many specimens sanidine is partially to wholly replaced by silica. Some sanidine crystals retain their characteristic euhedral outlines, but they are observed as a mosaic of quartz grains. Plagioclase is a rare constituent and biotite is sparse. Biotite flakes are commonly surrounded by a rim of iron oxide or they are completely altered to iron oxide. Zircon is the only abundant accessory.

The groundmass is typically devitrified to radiating aggregates of tridymite and minute sanidine phenocrysts. The groundmass of many specimens is composed of secondary silica and the original texture is obscure.

Some specimens from the lower aphanitic member show perlitic texture; alteration follows the circular fractures. Other specimens are tuffaceous with inclusions of foreign rock fragments in the groundmass. The rocks from Florida Mountain resemble tuffs, but thin section reveals a porphyritic nature; hence, they are included with the porphyritic rocks.

Thickness

More than 1,000 feet of Silver City rhyolite is exposed on Florida Mountain. On the south slope of De Lamar Mountain a drill hole inclined at 50 degrees from the horizontal went through 983 feet of Silver City rhyolite without penetrating it completely. The effects of faulting have exaggerated the thickness of the Silver City rhyolite and its true thickness is not known.

Source

Rhyolite dikes abound in the Silver City region and there are several rhyolitic domes. These intrusive bodies were possible sources for the rhyolitic rocks included in the Silver City rhyolite. Tennessee Mountain and Twin Peaks (Fig. 8B) were mapped as domes surrounded by flows of limited extent. The domes were probably local sources for some of the rhyolitic rocks of the region.

DOMES AND SILICIC DIKES

Numerous dikes intrude the Silver City Granite and the basalt-latite unit. The dikes are rhyolitic and resemble porphyritic Silver City rhyolite in appearance and composition. The domes were mapped as occurring in rhyolite or quartz latite.

Dikes

Rhyolite dikes are distributed throughout that part of the area underlain by basalt, latite, or granitic rocks. The dikes are much more abundant at some places than at others; they tend to occur in sub-parallel swarms.

On the west side of the range, north of De Lamar in secs. 27 and 28, T4S, R4W, dikes are particularly abundant. Exposures are poor to the south but dikes in the swarm appear to continue south across Jordan Creek to the vicinity of Jacobs Gulch. From Jacobs Gulch intermittent exposures indicate that the dikes

continue to and beyond the south boundary of the area (Fig. 8B).

The largest dike in the map area occurs north of Slack Mountain near the head of Reynolds Creek in secs. 12 and 13, T4S, R4W. The dike intrudes both granite and basalt.

Rooster Comb Peak is a well known landmark in the northern part of the map area (Fig. 8B, Fig. 12). The peak is a short linear ridge that stands above the surrounding granitic terrain because a resistant dike occurs at its crest. The resemblance to a rooster comb is enhanced by the fact that the dike flares out on the southwest side and columnar joints dip into the ridge at about 50 degrees.

A dike occurs at the south end of Tennessee Mountain; it is exposed in a road cut and along the south bank of Jordan Creek east of Dewey (Fig. 8B). The dike was not traced south, beyond Jordan Creek, but it probably underlies part of Florida Mountain. Dike material occurs on a dump near the Humboldt mine at the north end of Florida Mountain.

Dikes are localized in the granitic rocks on the east side of the range, but in general they are not as continuous nor as wide as those on the west side. A wide, faulted dike occurs near the Sinker Creek bridge on the Silver City road.

On the west side of the range the dikes show a prominent northwest strike, but some, including the largest dike in the map area, trend north to northeast. The dominant northwest trend is parallel to the major trend of the metalliferous veins in the region. Dips are steep to vertical.

On the east side of the Owyhee Range attitude of dikes are more variable than on the west side, but northeast and northwest trends predominate.

The dikes range from narrow stringers a foot or two in width to masses 200 feet in width. The northeast-trending dike north of Slack Mountain is about 200 feet wide. The dike at Rooster Comb Peak and those north of De Lamar are about 50 feet wide. Dikes 10 to 20 feet wide are the most common, and except for the faulted dike near the Sinker Creek bridge on the Silver City road, which is about 100 feet across, most of the dikes on the east side of the range are less than 20 feet wide.

On the west side of the mountains some of the dikes can be traced along strike by intermittent exposures for over two miles. The big dike north of Slack Mountain is exposed more-or-less continuously for over a mile and a half. At places faults offset the dikes up to 75 feet horizontally.

Dike zones or swarms can be followed for several miles. The one that begins north of De Lamar and trends up Jacobs Gulch attains a length of six miles in the map area; it extends beyond the southern limit an unknown distance.

Many dikes, particularly those on the west side of the mountains, stand out

in relief as compared to the surrounding rocks, and they form linear ridges. Rooster Comb Peak is a good example of such topographic expression (Fig. 12). The large dike north of Slack Mountain is another example. Many dikes are distinct on air photos because of their light color and linear trend.

On the east side of the range the dikes are not as distinct as on the west side. They tend to disintegrate from weathering as rapidly as the surrounding granitic rocks. At many places no distinct outcrop is visible and the presence of a dike must be inferred from float fragments.

The dikes of the region are coarsely porphyritic to fine-grained aphanitic rocks. Specimens from the dike on Rooster Comb Peak contain 25 to 30 percent phenocrysts. Megascopic phenocrysts include large sanidine crystals 2 mm by 0.5 mm and subequal amounts of quartz in grains about 0.5 mm across. Visible magnetite grains are scattered through the aphanitic groundmass. The rock weathers dark brown; it is white on a fresh surface.

Other dikes on the west side of the range contain about 25 percent phenocrysts. Quartz, sanidine and minor magnetite are obvious in hand specimens. The phenocrysts are small; they are 0.1 to 0.2 mm across. The groundmass is aphanitic; it is generally silicified. Quartz veinlets, a few millimeters wide, are common in the groundmass. Rock specimens from the dikes are light-colored; they weather light brown.

On the east slope of the mountains the dikes are finer grained than on the west side. Minute rounded quartz phenocrysts occur in a uniformly light-colored aphanitic groundmass. Phenocrysts constitute less than 5 percent of the rock.

The dikes in the swarm north of De Lamar are sheeted by closely spaced joints that strike northeast. Many of the dikes in this vicinity show glassy perlitic selvages along contacts.

A typical thin section of a porphyritic dike from the west side of the range contains 15 to 20 percent phenocrysts. Sanidine and quartz are present in subequal amounts; biotite is a rare constituent. Zircons are sparse as accessory minerals. The groundmass is typically made up of silicified, radiating masses of cristobalite. Locally sericitization is important. A specimen of the large dike north of Slack Mountain shows many sanidine crystals almost completely replaced by quartz. Commonly the phenocrysts have sharp outline and are not embayed or corroded by the groundmass.

Thin sections of dike specimens from the east side of the mountains show that the dikes contain 3 to 5 percent quartz and sanidine phenocrysts. The groundmass is made up of radiating fibrous microlites. Sanidine phenocrysts are embayed and corroded; they generally show a radiating fringe of microlitic material.

Volcanic Domes

Ten volcanic domes were noted in the area. Volcanic domes, according to

Billings (1954, p. 273), are steep-sided, bulbous bodies of lava that were so viscous at the time of extrusion that normal flows could not develop. Four of the domes were mapped in rhyolite, and for convenience will be called rhyolite domes; the other six domes were mapped in quartz latite and will be called quartz latite domes.

Three quartz latite domes occur in an east-west line along the southern boundary of the area mapped between De Lamar Mountain and Florida Mountain (Fig. 8B). Two quartz latite domes occur along the crest of the Owyhee Range. One of these is a bald peak in sec. 27, T4S, R3W (Fig. 18). The other dome is farther north; it forms Little Sugarloaf, a symmetrical cone-shaped peak in sec. 9, T4S, R3W (Fig. 8A), and Fig. 19). The sixth quartz latite dome occurs about 4 miles northwest of De Lamar. The distribution pattern of the quartz latite domes is roughly U-shaped; the open part of the U faces northwest (Fig. 8A and B).

The rhyolite domes are surrounded by basalt or by granitic rocks. The rhyolite domes are located at Tennessee Mountain (sec. 26, T4S, R4W; Fig. 8B), at Twin Peaks (sec. 7, T4S, R3W; Fig. 8A), and at a locality about 1 1/4 miles north of Wagontown (sec. 30, T4S, R4W; Fig. 8B).

The domes are generally rounded to oval in plan. Little Sugarloaf is markedly conical in section (Fig. 19); other domes in the area do not show as great a difference in diameter between the top and the base as does Little Sugarloaf. They slope steeply upward to broad, gently rounded summits (Fig. 20).

The quartz-latite dome at the head of Rich Gulch (Fig. 8B) is elongated in a north-south direction. The southern part is flat and planar. The north end rises abruptly and stands almost vertical, like a volcanic neck or spine (Fig. 21).

Most of the domes are 1,500 by 2,000 feet at the summit, and because of their steep slopes they do not greatly exceed these dimensions at the base. The large dome east of China Gulch (Fig. 8B) is 4,000 by 4,000 feet.

Most of the domes are exposed through a vertical distance of about 200 feet, but the quartz latite dome in sec. 10, T4S, R12W stands 500 feet above the surrounding terrain. The domes are surrounded by local flows that were probably extruded at the time of dome formation; the flows obscure relations with surrounding rocks.

The rhyolite domes are massive to jointed. The dome west of Dewey shows columnar jointing that dips at angles of about 45 degrees southwest toward the center of the dome. The columns resemble stacks of cordwood that have been tilted. The dome on Tennessee Mountain is sheeted by closely spaced joint planes that dip steeply toward the center of the dome and parallel the margins. The dome near the head of Rich Gulch is sheeted and jointed, the joints parallel the margins of the dome and dip steeply inward toward the center. A pile of loose, rectangular to slabby blocks several feet across occurs on the summit of the large quartz latite dome in sec. 10, T4S, R4W. Platy, curved joint surfaces can be observed on the

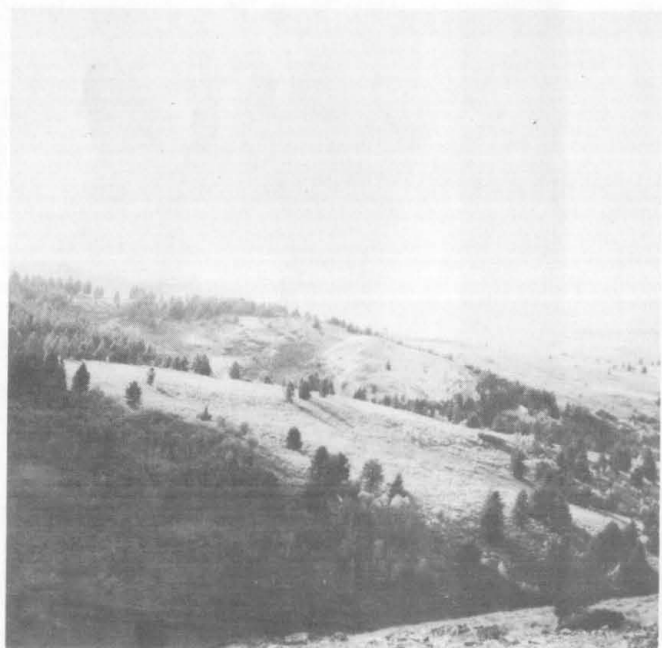


Figure 20. Dome in quartz latite between Florida and De Lamar Mountains. Light-colored outcrop, barren of vegetation, is dome; basalt in foreground. Note steep slopes and rounded summit of dome. Looking west from Rich Gulch, Silver City region, Owyhee County, Idaho.



Figure 21. Dome in quartz latite near head of Rich Gulch. Note flat upper part to south and vertical "neck" at north; view toward the west. Silver City region, Owyhee County, Idaho.



Figure 18. Dome in quartz latite near crest of Owyhee Range, in sec. 27, T4S, R3W, Silver City region, Owyhee County, Idaho. Looking east from Silver City road near New York Summit.

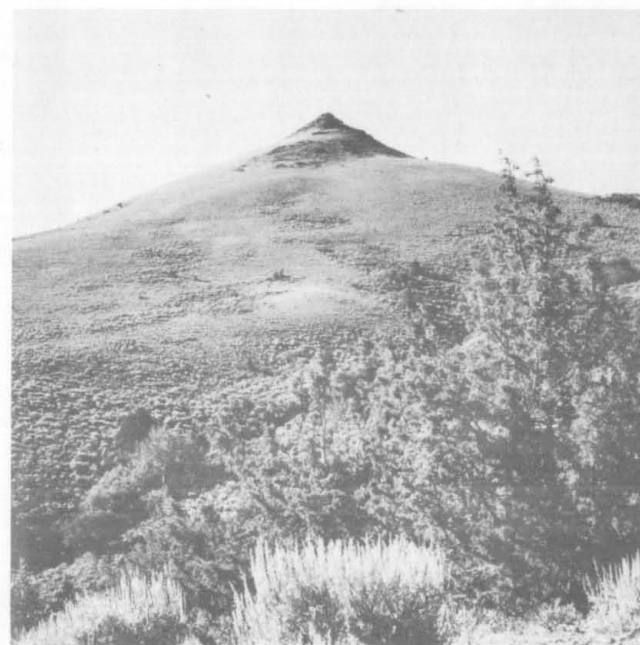


Figure 19. Little Sugarloaf dome in quartz latite in sec. 9, T4S, R3W, Silver City region, Owyhee County, Idaho. Looking west from Diamond Basin road.

sides of some of the domes. Local flows associated with the quartz latite domes are highly contorted and show intricate folding of flow bands.

The masses of rock described above are thought to be intrusive domal bodies because of their rounded oval shapes, limited outcrop area and the nature of the associated jointing. The inclined joints on the rhyolite dome near Dewey indicates that it was intruded under shallow cover, and that the joints developed normal to an inclined cooling surface. Steep inward dips on joints are common features of volcanic domes according to Williams (1932, p. 144). Associated surface flows of limited extent were generally not mapped separately, but they cover and effectively mask any structural deformation the intruded rocks may have suffered.

Megascopically, specimens from the rhyolite domes do not differ greatly in composition or appearance from specimens of rhyolite dikes. The white to light brown rocks are porphyritic, with 25 to 30 percent quartz and sanidine phenocrysts. Flows of local extent associated with the domes are flow banded and porphyritic. Silica veinlets cut some of the rocks and many are silicified.

Hand specimens of the quartz latite are greyish purple, porphyritic rocks that contain small quartz, sanidine and biotite grains. Phenocrysts are 0.1 to 0.2 mm. The rocks have a streaked or banded appearance. The domes probably broke through to the surface and short flows of highly viscous material were extruded; the banding is likely the result of flow. The banding is generally highly contorted. The rocks from the quartz latite domes are not as silicified as rocks from the rhyolite domes. Silicification, where present, is generally minor.

In thin section rocks from the rhyolite domes show quartz, sanidine, and minor biotite as phenocrysts. Phenocrysts in the quartz latite rocks are plagioclase, quartz, sanidine, and biotite.

Under the microscope specimens from the rhyolite domes resemble dikes in composition and texture. Quartz and sanidine phenocrysts are set in a highly devitrified groundmass consisting of microlites and radiating aggregates of cristobalite. All the specimens examined were silicified. The rhyolite domes were host rocks for vein material at some places and locally sericitization is important.

The quartz latites show quartz, sanidine, biotite and sparse oligoclase (An₂₇ to An₃₀) phenocrysts in a devitrified groundmass of radiating cristobalite aggregates. The biotite is partially altered to iron oxide. Phenocrysts are euhedral and show little embayment or corrosion by the groundmass. The cristobalite aggregates tend to line up across the section as continuous flow bands. A few zircons are present as accessory minerals.

The quartz latites and rhyolites are differentiated on the basis of phenocryst content in thin section. According to Moorhouse (1959, p. 202), quartz latites and rhyodacites are invariably porphyritic with phenocrysts of oligoclase-andesine plagioclase, sanidine, anorthoclase, rarely orthoclase and the ferromagnesian hornblende or biotite.

Evidence for the relative ages of the late intrusives is not well expressed.

North of Wagontown a quartz latite dome is surrounded on three sides by Silver City rhyolite and apparently intrudes it. If the source of the rhyolite domes were the same for the flows, the rhyolite flows and rhyolite domes would be relatively the same age and the quartz latite domes would be the younger. The large quartz latite dome in sec. 10, T4W, R4W (Fig. 8B) is intruded by a rhyolite dike. All of the dikes in the map area were not necessarily emplaced at one time, however, nor are the rhyolite dikes and rhyolite domes necessarily the same age. Hence, the presence of the dike cannot be used to postulate the relative ages of the domes.

The dikes and domes and some of the flows that occur in the region probably had a common source. The rhyolite domes at Tennessee Mountain and Twin Peaks are associated directly with flows of local extent. McIntyre (1966, p. 122) observed vitroclastic texture and pumice fragments up to one inch in diameter in the big dike north of Slack Mountain. McIntyre concluded that the dike rock is a welded tuff; the dike probably extended to the surface at the time of emplacement and acted as a feeder for nearby flows (McIntyre, 1966, p. 122).

On the east side of the mountains near the head of the North Fork of Sinker Creek in sec. 11, T4S, R3W, a dike can be followed to a direct connection with a glassy surface flow of limited extent; the dike evidently acted as a feeder for the flow. The dikes on the east side of the mountains differ in texture from those on the west side. The dikes on the east were probably sources for the Pliocene welded tuffs that occur on the eastern side of the mountains and are younger than the dikes on the west side.

TUFFACEOUS BASALT UNIT

Name of Unit and Regional Correlations

A thin basalt flow occurs near the west margin of the area studied. No formal name is assigned to the unit in this report. Previous workers (Lindgren and Drake, 1904) did not separate this flow from the main mass of basic eruptive rocks that occur in the area. The unit may be related to the Banbury Basalt (Malde and Powers, 1962, p. 1204), but the Banbury Basalt occurs much farther east and no attempt is made in this report to correlate the two.

Outcrop Areas

The tuffaceous basalt unit occurs in the northwestern and southwestern part of the region studied; its outcrop area is limited. Most of the unit is shown on Figure 8C, however, a part of it is shown on Figure 8B.

Age

The tuffaceous basalt unit is thought to be Pliocene in age. It is overlain by welded tuff of Pliocene age, but at some places, as along Coyote Creek in sec. 22, T3S, R5W (Fig. 8C), it is interbedded with the welded tuff, and it caps the Pliocene welded tuffs along the top of the ridge in sec. 8, T4S, R4W (Fig. 8B). Because of these relations it is assigned to the Pliocene. The basalt flow could

be entirely younger than the welded tuff, and the apparent interbedding may be the result of canyon filling by basalt flows following stream valleys cut in the older welded tuff. The relations were not studied in detail, but field observations suggest that interbedding is more likely.

Topographic Expression

Weathering and erosion of the unit produces an even, gently rolling topography. Steep-sided hills and mesas may remain above the general level of the flow as erosional remnants of slightly more resistant material.

Hand Specimen Description

The rocks range from bluish black porphyritic basalt to highly scoriaceous basalt. Specimens from the vicinity of Coyote Creek in sec. 22, T3S, R6W (Fig. 8C) are dark bluish black rocks that contain visible feldspar laths up to 0.2 mm long and blebs of olivine about 0.1 mm across. The rock weathers dark reddish brown. Specimens from the southwestern corner of the area are dense, fine-grained, dark grey to black rocks that break with conchoidal fracture. These rocks weather light brown. The basalt that caps the ridge in sec. 8, T4S, R4W (Fig. 8B), and the basalt that occurs in the basin in the vicinity of sec. 11, T4S, R5W (Fig. 8C) are dark to light reddish brown and highly vesicular to scoriaceous. The basalt that occurs in the southwest corner of the area is associated with layers of light brown tuffaceous silt and basaltic cinders in an agglomerated mass that contains basaltic fragments up to one-half an inch across.

Thin Section Description

One thin section of dense fine-grained basalt from the southwest corner of the map area was examined. The section shows intergranular to intersertal texture. Minerals observed were pyroxene grains, andesine or labradorite (An55 to An60), and olivine grains rimmed by iddingsite and magnetite. The groundmass is yellow glass.

Thickness

The maximum exposed thickness of the unit is about 300 feet. Along Coyote Creek the unit is about 200 feet thick. At this locality both the upper and lower contacts are exposed.

Source

The tuffaceous basalt unit was probably extruded from local vents. Along the west edge of the map area in sec. 36, T4S, R6W (Fig. 8C) a rounded peak that resembles a volcanic cone may represent a local vent. It is not likely that this unit is widespread or important regionally, although it may be related to the Banbury Basalt of Pliocene age that occurs further east on the Snake River plain.

WELDED TUFF UNIT ONE AND UNIT TWO

Names of Units and Regional Correlations

Two welded tuff units were differentiated in the Silver City region. For convenience these are designated welded tuff unit one and welded tuff unit two. Malde and Powers (1962, p. 1200-1201) called the silicic volcanic rocks of Pliocene age that occur along the eastern margin of the Snake River plain the Idavada Volcanics; it is a unit of regional extent. According to Malde and Powers, the Idavada Volcanics underlie the Poison Creek Formation and mark the base of the Pliocene in southwestern Idaho. The Poison Creek Formation is the basal formation of the Idaho Group of Pliocene age.

At places, as in the northeast corner of the area mapped (sec. 1, T3S, R3W, Fig. 8A) small lenses of welded tuff unit one overlie the Poison Creek Formation. Rocks included in welded tuff unit two overlie parts of the Poison Creek Formation in the southeast part of the area studied (Fig. 8A). McIntyre (1966, p. 156) observed that welded tuffs north of Reynolds overlie the Poison Creek Formation and are younger than that unit.

Some of the welded tuffs along the east margin of the area mapped are within the outcrop area of the Idavada Volcanics as defined by Malde and Powers. The stratigraphic position of the rocks, however, does not support a correlation.

McIntyre (1966, p. 152) referred to welded tuff unit one as the Black Mountain Unit; welded tuff unit two is not present in the area covered by his report.

Rock Type

The rocks included in the welded tuff units are rhyolitic in compositions. Quartz, sanidine and abundant plagioclase are the principal phenocrysts in welded tuff unit one. According to McIntyre (1966, p. 156) the unit has a silica content of 69 percent or higher. Welded tuff unit two is less porphyritic, but it contains phenocrysts of quartz, sanidine and minor plagioclase.

According to Malde and Powers (1962, p. 1201), silicic latites containing phenocrysts of andesine, clinopyroxene, hypersthene and magnetite are the dominant welded ash flows in the Idavada Volcanics. The glass in the groundmass is rhyolitic in composition. Phenocrysts of quartz or sanidine are rare and no hornblende or biotite is present. On petrographic evidence, the welded tuffs of the Silver City region should not be correlated with the Idavada Volcanics.

Age

The two welded tuff units were not observed in contact with each other, consequently their relative ages are not established. The units are assigned to the Pliocene because of their relation to the Poison Creek Formation of Pliocene age. In the southeast part of the map area the Banbury Basalt, also of Pliocene age (Malde and Powers, 1962, p. 1199), overlies welded tuff unit two. The welded tuff units overlie granitic rocks, the basalt-latite unit, the Silver City rhyolite and the tuffaceous basalt unit.

Outcrop Areas

Welded tuff unit one is the more widespread of the two units. A large irregular mass crops out along the eastern margin of the map area in a northeast-trending belt about 6 miles long and 4 miles wide (Fig. 8A). It overlies the basal-latitude unit on the west and granitic rocks on the east. The continuity of the outcrop area is interrupted by a northeast-trending granite ridge in the central part. The flow probably filled a pre-existing channel cut into the granitic terrain. Small exposures, a few square miles in area, rest on rocks of the basal-latitude unit west of the larger mass.

Further west, on the west side of Whisky Mountain, welded tuff unit one crops out and overlies the Sucker Creek Formation; it is also associated with the tuffaceous basalt unit (Fig. 8C). The welded tuff can be traced southward by intermittent outcrops to the area west of Jordan Creek where it crops out extensively (Fig. 8C).

Welded tuff unit one was mapped along the southern boundary of the map area south of De Lamar Mountain, where the unit overlies the aphanitic member of the Silver City rhyolite. The welded tuff continues beyond the south limit of the map area for an unknown distance.

Welded tuff unit two was not observed outside the Sinker Creek drainage. It crops out in the southeast part of the map area, along the eastern margin of the Owyhee Range (Fig. 8Z). The unit crops out almost continuously from the southern boundary of the map area to a point several miles north of the Sinker Creek bridge on the Silver City road. Throughout most of its outcrop area the unit overlies granitic rocks except in the southwest part of the outcrop area where it rests on Poison Creek Formation. The canyon of Sinker Creek is cut in welded tuff unit two. The flow filled a channel cut in the Poison Creek Formation and the Silver City Granite. East of War Eagle Mountain several small isolated masses of welded tuff unit two rest on Silver City Granite (Fig. 8A).

Jointing and Topographic Expression

Welded tuff unit one is broken by closely spaced, curved joints at some outcrops, especially in the northeastern part of the area. The joints are from 1/4 inch to 18 inches apart. Because of the joints, long talus slopes develop on hill-slopes. To the west the rocks are more massive and jointing is less obvious.

The rocks in welded tuff unit one are resistant to weathering. Cliffs and mesas with steep to vertical sides are typically developed with talus surrounding the lower part.

Outcrops of welded tuff unit two are usually broken by closely spaced joints. Joints vary in attitude and range from 1/4 inch to 18 inches apart. Flow lines and platy jointing are usually highly curved and contorted (Fig. 22).

The upper surface of welded tuff unit two is relatively level in the eastern part of the area along the lower part of Sinker Creek (Fig. 23). To the north and

south the topography developed on this unit consists of rounded hills with steep slopes. Vertical cliffs and mesas are not as typical in this unit as they are in unit one.

Hand Specimen Description

In hand specimen, welded tuff unit one is dark grey to purplish red. Lighter tones develop during weathering and surfaces become tan to red or light grey.

The rocks comprising welded tuff unit one in the northern part of the area are dense, hard, compacted ash-flow tuffs with little pore space. To the southwest, on the west side of Jordan Creek (Fig. 8C), the rocks are more porous and slightly compacted pumice fragments are obvious. Some specimens from west of Jordan Creek contain fragments of black glassy devitrified pyroclastic fragments up to 4 mm by 1.5 mm in a porphyritic red groundmass.

Specimens from welded tuff unit one contain visible plagioclase. Most specimens are porphyritic, although phenocrysts are less than 0.4 mm in length and generally constitute less than 10 percent of the rock. Many specimens are banded or streaked and show eutaxitic texture (Ross and Smith, 1961, p. 4). Specimens of welded tuff unit one from south of De Lamar Mountain are purple porphyritic rocks with spherulitic texture, rich in opaline silica.

Lithophysae are not common in specimens of welded tuff unit one, but in Diamond Basin, near sec. 35, T3S, R3W (Fig. 8A), outcrops of highly vesicular rocks contain lithophysal cavities up to 1 mm across.

Locally the base of welded tuff unit one is marked by perlitic glass and tuff. A layer of tuff about 35 feet thick overlain by a band of perlitic glass about 20 feet thick occurs north of the Matteson Mine at the base of the cliff in sec. 19, T3S, R2W (Fig. 8A).

Welded tuff unit two is generally dark, black and glassy but some specimens are light tan or pink. The weathered surface is dark grey to reddish brown.

Eutaxitic texture is well developed in rocks from most outcrops of welded tuff unit two. Pumice fragments can usually be identified. The rocks range from pumiceous non-welded tuff with abundant pore space to dense highly compacted varieties with virtually no pore space remaining in the compressed fragments. Many outcrops show a case-hardening on the surface because of a coating of opaline silica. Ross and Smith (1961, p. 20) ascribe this feature to the release of silica from the ash and its redeposition as opal or chalcedony by evaporation at the surface.

Welded tuff unit two is more glassy than is welded tuff unit one. Megascopic phenocrysts are sparse in welded tuff unit two although small quartz and sanidine crystals 0.2 to 0.3 mm across occur at some places.

Brecciation and contorted structure is a typical feature in welded tuff unit two.

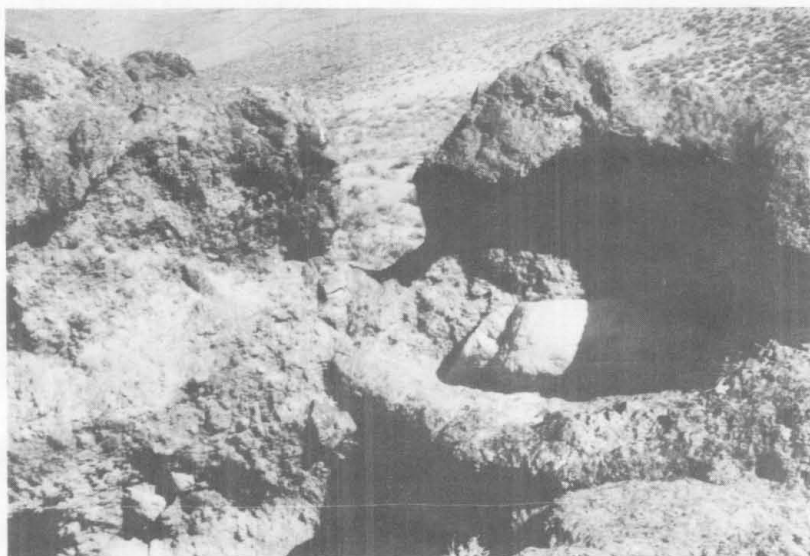


Figure 26, Granodiorite inclusion near base of welded tuff unit 2, south side of Sinker Creek, sec. 17, T4S, R2W, Silver City region, Owyhee County, Idaho. Boulder is about 1 by 2 feet.



Figure 24. Uncompressed pumice fragments in welded tuff unit 2; southwest corner of map area. Silver City region, Owyhee County, Idaho.



Figure 25. Pumice fragments in matrix of finer pyroclastic material; welded tuff unit 2, southwest corner of map area. Silver City region, Owyhee County, Idaho.



Figure 22. Outcrop of welded tuff unit 2. Note unit contorted flow bands and joints. Southeast corner of map area. Silver City region, Owyhee County, Idaho.



Figure 23. Sinker Creek Canyon cut in welded tuff unit 2. Note flat upper surface of flow and landslide scar in background. Looking south from sec. 17, T4S, R2W, Silver City region, Owyhee County, Idaho.

Near contacts, resistant breccias are developed that trend as near vertical cliffs in dike-like fashion sub-parallel to the contacts.

Nonwelded tuff, composed of pumice fragments up to 2 inches across in a matrix of fine glass shards, occurs on the south side of Sinker Creek in secs. 20 and 21, T4S, R2W (Figs. 24 and 25). The locality represents the distal end of a flow. Nonwelded tuff also occurs at the base of the glassy welded tuff exposed near the Silver City road in sec. 18, T4S, R2W (Fig. 8A).

Another important feature of welded tuff unit two is the abundance of granitic inclusions in the welded tuff unit near the base of the flow (Fig. 26). The inclusions generally are associated with dark, glassy highly brecciated zones of the flows.

A north-south traverse through 550 feet of welded tuff unit two up the slope of the hill in sec. 25, T4S, R3W (Fig. 8A) showed the following sequence of rocks from the base to the summit:

1. Granite contact
2. Dark perlitic glass 4 feet
3. Dark grey to black welded tuff with partially compacted
pumice fragments35 feet
4. Dark perlitic glass 3 feet
5. Banded dark grey to black welded tuff with partially
compact pumice fragments25 feet
6. Dark perlitic glass 1 foot
7. Dark porphyritic welded tuff containing one inclusion
of granitic rock, 3 inches across; partially compacted
pumice fragments about 0.25 inches15 feet
8. Thin, platy, fine-grained, devitrified welded tuff,
plates about 1/2 inch thick, light tan to purple 120 feet
9. Thin, platy and pink vesicular rocks; vesicles filled
with tridymite. 50 feet
10. Thin, platy, devitrified welded tuff, light to reddish
purple 300 feet

The sequence of glass and devitrified tuff indicates that unit two is a composite cooling unit composed of several welded-ash flows. The upper part is devitrified and contains vapor phase minerals. The rocks lower in the sequence are less compacted and less devitrified.

Thin Section Description

In thin section, specimens of welded tuff unit one are porphyritic. Oligoclase-andesine (An26 to An31) is characteristic of the unit. Quartz and sanidine generally are present, and sparse biotite occurs in some sections. Zircons and opaque minerals, probably hematite or magnetite, occur as accessory minerals. Phenocrysts do not constitute more than 10 percent of the rock.

Phenocrysts are set in a brown, glassy, devitrified groundmass. The groundmass generally appears as radiating aggregates and spherulites of cristobalite. Tridymite fills open spaces. In many sections devitrification has progressed to a point where identification as welded tuff is questionable. However, most specimens show the irregular, discontinuous banding and streaking, termed eutaxitic texture, that is characteristic of welded tuffs.

Rocks from separate localities were correlated on the basis of similar phenocryst content. All specimens of welded tuff unit one contain abundant phenocrysts of plagioclase. Rocks included in the unit from west of Jordan Creek, south of De Lamar Mountain, and in the northwestern part of the map area contain zircons; zircons are not found in specimens from the eastern part of the unit. Hence, there may be more than one flow included in unit one. A study in greater detail would be necessary to differentiate these rocks.

Welded tuff unit two shows sparse phenocrysts. Quartz and sanidine are dominant; plagioclase as minute phenocrysts occurs as a minor constituent. The phenocrysts are set in a devitrified glassy groundmass, but eutaxitic texture is evident. Contorted, devitrified shards and compacted pumice fragments, which range from those with very little pore space to partially compacted fragments with abundant pore space, are observed in thin section. Many of the pores are filled with tridymite.

Thickness

Welded tuff unit one is about 1,000 feet thick in the northeast part of the area. West of Jordan Creek about 600 feet is exposed above the tuffaceous basalt unit in the southwest corner of the map area. A single cooling unit 1,000 feet thick would be unlikely; hence it is probable that several flows are included in welded tuff unit one.

About 400 feet of welded tuff unit two is exposed in the canyon of lower Sinker Creek (Fig. 23). In the southeast part of the area studied, near the south boundary, 1,000 feet of welded tuff unit two are exposed (Fig. 8A). Such a thickness in a single flow unit is uncommon; it is likely that several flows are included in the unit.

Sources

Sources for the welded tuffs are not known. Numerous rhyolitic dikes occur in the region, but no conclusive evidence was found to definitely establish a connection between the extrusive rocks and the dikes.

A dike-like body of brecciated glass occurs near the Sinker Creek bridge on the Silver City road (Fig. 8A). This outcrop was mapped as part of welded tuff unit two; it may represent a local vent area for the flow that filled a pre-existing canyon along Sinker Creek. Many of the flows included in the welded tuff units on the east side of the range flowed down pre-existing channels cut in the granitic rocks and the Poison Creek Formation.

BANBURY BASALT

Name of Unit and Regional Correlation

The Banbury Basalt was defined by Malde and Powers (1962, p. 1204) as a formation of the Idaho Group of Pliocene age. The Banbury Basalt, as defined, overlies the Poison Creek Formation, and extends along the west margin of the Snake River plain. I have included the fine-grained olivine basalts, that occur along the east margin of the area, with the Banbury Basalt.

Outcrop Areas

The area covered by Banbury Basalt is limited. The Banbury Basalt occurs in the northeast part of the map area in secs. 34 and 36, T2S, R3W and in secs. 1 and 2, T3S, R3W (Fig. 8A). The rocks also crop out in the southeast part of the map area in secs. 28 and 29, T4S, R2W (Fig. 8A). The total area covered by the Banbury Basalt is less than three square miles.

The Banbury Basalt rests on the Poison Creek Formation in the northeast part of the area and on welded tuff unit two in the southeast part of the area. The maximum thickness of the unit is 350 feet.

Age

On the basis of stratigraphic position, the Banbury Basalt is assigned to the Pliocene.

Jointing and Topographic Form

Outcrops of Banbury Basalt display well-developed vertical columnar joints. Horizontal joints break the columns into blocks about a foot thick at most outcrops. The unit forms isolated mesas with abundant blocky talus at the base of the cliffs.

Hand Specimen Description

Specimens of Banbury Basalt range from dark bluish black, dense basalts with minor vesicles to dark highly vesicular basalts. Weathering causes the rocks to become dark reddish brown on the surface.

The outcrop in sec. 26, T2S, R3W is made up of grey, highly vesicular basalt and basaltic tuff. The tuff is not highly compacted and no bedding was observed. The tuffaceous material resembles fine, grey volcanic cinders.

Thin Section Description

One thin section of dark, aphanitic basalt from the southwest part of the area was examined. The section contains ophitic to hyalo-~~ophitic~~ texture. Pyroxene granules, andesine-labradorite plagioclase (An45 to An60), olivine rimmed by iddingsite, magnetite, and yellow glass were identified.

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TERTIARY SEDIMENTARY ROCKS

Sedimentary rocks of Miocene to Pliocene age occur in the area studied. The sediments were not mapped in detail because they have little influence on the localization of metallic ore deposits and time was not available for a detailed investigation.

Beds of the Sucker Creek Formation of Miocene age crop out extensively west of the Silver City region in Oregon; the outcrop area adjoins the area studied on the west (Fig. 8C). Kittleman and others (1965) studied the Sucker Creek Formation in detail in the region to the west. A small exposure of sedimentary rocks in the northwest part of the map area (sec. 10, 11, 14 and 15, T3S, R5W; 8C) resembles rocks in the Sucker Creek Formation to the west and are included with it.

Sedimentary rocks of Late Miocene or Early Pliocene age occur in the Reynolds basin and were included by McIntyre (1966) in the Reynolds Basin group. He recognized and informally named the Boston Ranch unit and an arkosic unit.

The Idaho Group (Malde and Powers, 1962) that extends from Lower Pliocene to Middle Pleistocene in age includes the Poison Creek Formation of Lower Pliocene age. The Poison Creek Formation crops out along the east margin of the area mapped. Exposures are not extensive because of the alluvial cover that flanks the base of the Owyhee Range.

SUCKER CREEK FORMATION

The following brief summary of the Sucker Creek Formation is taken from Kittleman and others (1965).

The Sucker Creek Formation consists of altered tuffs, volcanic sandstones, vitric tuffs, arkosic sandstones, granite-cobble conglomerate and carbonaceous volcanic shales. According to Kittleman and others (1965), p. 6, it has been correlated with the Payette Formation in western Idaho, but the correlation has never been substantiated. The total thickness of the formation is about 1,600 feet.

Near the base of the Sucker Creek Formation is at least one flow of olivine basalt. Other basalt flows are interbedded locally near the top, and a tabular rhyolitic body occurs near the middle of the formation at one place.

Kittleman and others (1965, p. 7) recognized the Leslie Gulch Ash-Flow Tuff Member near the top of the Sucker Creek Formation in an area adjacent to the Silver City region. The member is lenticular and about 1,000 feet thick. Locally it is gradational with sedimentary strata of the Sucker Creek Formation.

The Sucker Creek Formation is a yellowish-grey, severely altered volcanic sandstone derived from andesine-bearing crystal vitric ash. Included in the formation are beds of arkosic rocks that were derived from granitic rocks to the east. The formation is composed mainly of fluvial deposits; lacustrine deposits are subordinate (Kittleman and others, 1965, p. 6).

The Leslie Gulch Ash-Flow Tuff Member has sparse quartz and sanidine

phenocrysts in an altered vitroclastic matrix. It is always moderately indurated but rarely shows the effects of welding and compression. Locally the member is severely silicified and the vitroclastic texture obliterated (Kittleman and others, 1965, p. 7). The description of the Leslie Gulch Ash Flow-Tuff Member given by Kittleman and others is similar to a description of the Silver City rhyolite and the two units may be correlative.

The Sucker Creek Formation is assigned to the Upper Miocene based on identification of mammalian fossils (Kittleman and others, 1965, p. 7).

A small exposure of sedimentary rocks in the northeastern part of the area (secs. 10, 11, 14 and 15, T3S, R5W; Fig. 8C) resembles rocks in the Sucker Creek Formation and is included with it. The rocks crop out in a basin on Little Succor Creek; and are overlain by the tuffaceous basalt unit and welded tuff unit one. The rocks are massive tuffaceous silts and tuffs.

SEDIMENTS OF MIOCENE AGE IN THE REYNOLDS BASIN

Sediments of Upper Miocene or Lower Pliocene age occur in the Reynolds basin in the north-central part of the area (Fig. 8B). These rocks were not studied in detail; the following description is taken from McIntyre (1966).

A sequence of volcanic rocks and interbedded sediments of Upper Miocene to Lower Pliocene age was informally named the Reynolds Basin group by McIntyre (1966, p. 52). The volcanic rocks include the basalt-latite unit and the Silver City rhyolite. The sedimentary rocks are divided into the Boston Ranch unit and an arkosic unit. The sedimentary rocks and the volcanic rocks interfinger in a complex manner because deposition was taking place at the same time the volcanic flows were being extruded. On the west side of the basin, the Boston Ranch unit was deposited almost continuously but on the east side deposition was interrupted repeatedly by the extrusion of volcanic rocks.

McIntyre (1966, p. 125) describes the Boston Ranch unit as consisting of altered fine vitric tuff, diatomite, pumicite, pumice breccia and lignite. Locally detritus derived from granitic or basaltic terrain is an important constituent. The maximum measured thickness of the unit is 208 feet. Seismic data southwest of the Reynolds School (Fig. 8B) indicate a thickness of 460 feet.

The arkosic unit rests on the Boston Ranch unit in the eastern and northeastern part of Reynolds basin and consists of fluviatile deposits of arkosic sand, granitic gravel and clay. The unit is about 150 feet thick. The arkosic unit was derived from granitic rocks, basalts and rhyolites (McIntyre, 1966, p. 135).

POISON CREEK FORMATION

The Poison Creek Formation crops out beneath the alluvial cover at the eastern base of the Owyhee Mountains in the area studied. Its outcrop area is not extensive. The formation consists of beds of massive volcanic ash up to 50 feet in thickness, tuffaceous silt, arkosic sand that contains granitic cobbles, and conglomerate. The

beds are consolidated but not indurated.

According to Malde and Powers (1962, p. 1202), the Poison Creek Formation has an exposed thickness of 400 feet, 7 miles northwest of Murphy on the Reynolds Creek road. Much of the formation represents lacustrine deposits with subordinate fluvial deposits. The relation of The Poison Creek Formation to the welded tuffs of the area is discussed in the section of this report dealing with the welded tuff units. The formation is assigned to the Pliocene on the basis of the presence of Early Pliocene fossil mammals (Malde and Powers, 1962, p. 1202).

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QUATERNARY DEPOSITS

The rocks and rock materials of Quaternary age in the area include bench gravels, landslide deposits and alluvium. The alluvial gravels along Jordan Creek that were dredged for gold are shown separately on Figure 8 as placer gravels.

BENCH GRAVELS

In the area studied deposits of gravel occur above the present level of Jordan Creek. On the north side of De Lamar Mountain in sec. 5, T5S, R4W, near the Garfield Mine, a small deposit of gravel rests on a beveled surface cut on the basalt-latitude unit. The gravel consists of rounded granitic cobbles and pebbles. The deposit covers an area about 1,000 feet by 500 feet. Its position is about 400 feet above the present level of Jordan Creek. Near the cemetery, north of Wagontown in sec. 31, T4S, R4W, a similar patch of gravel crops out about 300 feet above the present level of Jordan Creek (Fig. 8B).

Long Ridge extends south from the Jordan Creek-Cow Creek divide west of Wagontown. The ridge parallels the south-flowing portion of Jordan Creek; the crest of the ridge is about 300 feet above Jordan Creek. The ridge is capped by rounded granitic gravel (Fig. 8C).

The gravels that cap Long Ridge can be traced to the northwest along Soda Creek, a tributary to Cow Creek that the Silver City-Sheaville road follows. The gravels extend northwest from the divide on Long Ridge at an elevation of 5,900 feet along the ridge above Soda Creek to an elevation of 4,900 feet (Fig. 8C). The top of the gravel deposits are about 400 feet above Soda Creek (Fig. 8C).

The gravel that occurs on Long Ridge and along Soda Creek consists of rounded granitic cobbles and pebbles; local residents report that the gravels contain detrital gold. In the area studied the gravels occur in a belt about 1 1/2 miles wide and 7 miles long. The distance the gravel deposit continues south down Long Ridge is unknown.

Jordan Creek probably flowed west at one time and followed the present course of Soda Creek; stream capture by a south-flowing stream diverted the drainage southward. The gravels represent material deposited along the former course of Jordan Creek.

It is possible that the drainage change was initiated through damming by a volcanic flow, such as the ridge of Silver City rhyolite that crosses Jordan Creek near Wagontown. If the flow caused the drainage change, the gravels probably should be considered Miocene or Pliocene in age.

LANDSLIDE DEPOSITS

One landslide was mapped in sec. 30, T4S, R2W on the East Fork of Sinker Creek (Fig. 8A). A block of welded tuff unit two has moved downward and rests on the underlying Silver City Granite (Fig. 8A). The topography on the surface of the block is hummocky and a prominent scar marks the site of the landslide (Fig. 23). South of the area studied, on the east slope of Cinnabar Mountain, a prominent landslide scar and slump block can also be observed.

RECENT ALLUVIUM

Alluvium mantles the desert area that extends east from the base of the Owyhee Range (Fig. 8A). Where the alluvial cover masks the underlying rocks, it is shown as Quaternary alluvium on Figure 8.

Alluvial gravels that were dredged along Jordan Creek, west and south of De Lamar, are a prominent feature and are shown separately on the map.

Alluvium mantles parts of the Reynolds basin and the western part of the area where the Sucker Creek Formation crops out. Because these areas were not mapped in detail, the alluvium was not mapped separately from the underlying rock formations. Although narrow strips of sand and gravel occur in the beds of the larger creeks and gullies of the region, these alluvial deposits are not shown on the map.

SUMMARY OF ROCK UNITS

Figure 27 shows the sequence of rocks in the area studied. Basic to intermediate volcanic rocks of Miocene age, the basalt-latite unit, rest on granitic intrusive rocks of Cretaceous age. The basic to intermediate rocks are followed by the Silver City rhyolite of Miocene age. It is a volcanic unit made up of acidic welded ash-flow tuffs and lava flows.

The volcanic rocks of Miocene age are interbedded with the Sucker Creek Formation of Miocene age on the west and sedimentary rocks of Miocene age in the Reynolds basin to the north. Deposition of sediments and eruption of volcanic rock materials proceeded contemporaneously.

The granitic rocks of the area are intruded by porphyritic diorite and dacite dikes. Some evidence indicates that these dikes also intrude the basalt-latite unit. The granitic rocks and the basalt-latite unit are also intruded by rhyolitic dikes, and volcanic domes of rhyolite and quartz latite. Some of the quartz latite domes appear to intrude the Silver City rhyolite. The dikes and domes of the region may represent feeders to the vents or fissures from which the volcanic flows of the region were extruded, but no conclusive evidence to support this hypothesis was observed in the field.

Two welded tuff units, called welded tuff unit one and welded tuff unit two, are in the region. A local basalt flow is associated with welded tuff unit one in the western part of the area as an interbed or as a younger valley fill.

The Poison Creek Formation of Pliocene age is interbedded with the welded tuff units and in part of its outcrop area it is overlain by welded tuff. The Banbury Basalt, a Pliocene formation, overlies the Poison Creek Formation and the welded tuff units.

Quaternary rocks include bench gravels that were deposited by a stream ancestral to Jordan Creek that flowed west through the Cow Creek drainage. Landslide deposits, recent stream gravels and alluvium are also included in the Quaternary system.

The Silver City Granite is assigned a Cretaceous age based on broad similarities to the Idaho batholith. Similarity in composition is the chief criterion for the correlation.

The lavas that formed the basalt-latite unit were probably extruded at about the same time as the lavas making up the Columbia River Basalt to the north, but it is not included with the Columbia River Basalt because the basalts in the Owyhee Range are not tholeiitic basalts. As originally defined by Lindgren (1900), the basalts in the Owyhee Range are a separate unit and that definition is retained in this report.

Rocks in the basalt-latite unit were erupted in a repetitive sequence. The sequence began with the extrusion of basalt; the basalt eruptions were followed by eruption of latite. The sequence was then repeated; a second basalt outpouring took place and was followed by a final eruption of latite. Extrusion of the Silver City rhyolite marked the final phase of eruptive activity that occurred in the area during the Miocene epoch.

The volcanic rocks of Miocene age in the area occur on the west side of the Owyhee Range. During the Miocene epoch, the range was being extended westward by constructional processes, but on the east side of the range the Silver City Granite was being eroded. As a result, a steeper slope developed on the east side of the range than on the west side.

In Pliocene time ash-flow tuffs were deposited in the east, west and north parts of the area mapped. The highlands in the south-central part of the area were not covered by the Pliocene volcanics. The flows border the east and west margins of the Owyhee Range; they also occur extensively to the north and south of the area mapped for this report. The result was a central highland of Cretaceous intrusive and Miocene volcanic rocks bordered by younger acidic volcanic rocks.

The welded tuffs interrupted the established drainage patterns and filled pre-existing stream valleys. On the east side of the range, the previously-developed erosion surface on the granitic rocks was partially buried and a second erosion surface developed. The two surfaces are expressed on east-west profiles drawn transverse to the trend of the range (Figs. 3 and 4).

On the west a local basalt flow is interbedded with welded tuff unit one. This flow may be related to the Banbury Basalt of Pliocene age that occurs further east; if so, it is probably a canyon fill and completely younger than the welded tuff unit.

The welded tuffs in the area are not included with the Idavada Volcanics. The Idavada Volcanics are a formation of regional extent; they are made up of silicic volcanic rocks, principally latites in composition, mostly welded tuffs, that underlie the Poison Creek Formation of the Idaho Group. In the area of this report, the welded tuffs overlie, at least in part, the Poison Creek Formation, and they are rhyolitic in composition.

CENOZOIC	TERTIARY	Pleistocene or Recent	Bench gravels, landslide deposits, alluvial deposits	Includes older gravels above present level of Jordan Creek and Recent alluvium.
		PLIOCENE	Banbury Basalt	Overlies and rests on Poison Creek Formation and welded tuff units.
			Unconformity	Poison Creek Formation
Upper Miocene or Lower Pliocene	Unit 1, and Welded Tuff Unit 2	Welded Tuff		
	Tuffaceous basalt Unit	Unconformity	Sucker Creek Sediments and sediments in Reynolds Creek basin	Series of welded ash-flow tuffs and lava flows; intruded by quartz latite domes
MESOZOIC	Cretaceous	Upper Miocene or Lower Pliocene	Silver City rhyolite	Inter- bedded with tuffaceous and arko- sic sedi- ments
			Unconformity	
			Unconformity	
			Silver City Granite	Ranges from granite to granodiorite in composition, mostly granodiorite; includes pegmatite and alaskite phases; schlieren zones; intruded by porphyritic diorite and dacite dikes, rhyolite dikes and domes, quartz latite domes.

Figure 27— Sequence of rocks in Silver City region, Owyhee County, Idaho; thickness of units not to scale.

STRUCTURAL GEOLOGY

INTRODUCTION

Faults and folds occur in the map area. Faults are relatively more important, not only because of their greater abundance, but also because faults control the locations of ore deposits in the region.

Folds occur in the northwest part of the area in the Reynolds Creek basin. The fold axes shown were mapped by McIntyre (1966, Fig. 61). Faults are distributed throughout the map area. They seem most abundant in the southern part of the region, particularly in the old mining areas; but this is, in part, because more detailed work has been done in the mineralized zones, and more faults have been recognized.

Joints are well developed in the Silver City Granite. Joint patterns were not studied in sufficient detail to determine their relation to the major structures of the area, however.

Lack of suitable marker horizons in the rocks of the Silver City region hinders the detection of faults. At some places faults are reflected in the topography or in the stream patterns; however, faults are not shown on the map unless strong evidence for their presence was observed. Gouge, breccias, offset dikes, veins and contacts are examples of the evidence used. Many of the veins, faults and dikes on War Eagle, Florida and De Lamar Mountains are taken from data presented by Piper and Laney (1926). When Piper and Laney investigated the area, many more mines and prospects were open than there are now, old mine maps were still obtainable and persons familiar with the underground features were available for interview. Consequently, some of the structural details mapped by Piper and Laney are shown on the geologic map and on Figure 28. Figure 28 is a map showing the major lineal features in the area mapped.

FAULTS AND FRACTURES

Fracture Patterns

The area studied shows several systems of fractures. Dikes and mineralization follow some of the major fracture trends. Study of Figure 28 shows three prominent linear trends in the Silver City region. The trends are northeast, north or northwest and N75W. High angle and low angle faults follow the N75W trend.

Fractures Trending Northeast

A zone of prominent northeast faults trends across the eastern part of the map area. The trend is represented on War Eagle Mountain by the traces of the porphyritic diorite and dacite dikes.

Northeast fractures cut the Silver City Granite, the basalt-latite unit and welded tuff units one and two. The fractures strike N24E to N50E; the average strike is

N34E. Most of the faults were mapped by indirect evidence; hence, reliable dips could not generally be measured. Most of the faults appear to dip 50 to 75 degrees; generally east. Most of the movement was normal, but Piper and Laney (1926, p. 39) note that nearly horizontal striations and grooves occur on the walls of some of the fault planes, and that longitudinal movement is an important component of displacement.

Faults of the northeast set are expressed by gouge zones, particularly in the granitic rocks. In the more brittle rhyolitic rocks, breccia zones with some silification may mark the trace of a fault. At some places offset contacts were used as indirect evidence for the presence of a fault.

Many of the rhyolite dikes on the east side of the Owyhee Range trend northeast and it is likely that northeast fractures and joints exerted a control on the localization of the dikes. Some of the dikes are offset by later north- to northwest-trending fractures. The porphyritic diorite and dacite dikes on War Eagle Mountain have an average strike of N50E; they were probably emplaced along fractures of the northeast set. The porphyritic dikes are offset by north to northwest fractures, and at places the dikes are mineralized where they are crossed by north-trending fractures. The vicinity of War Eagle Mountain represents a zone of structural intersection between two dominant fracture systems of the region.

Mineralization follows the northeast trend, but fractures of this system are not as important as northwest fractures as an ore control in the area studied. The silver-antimony mineralization that is exposed intermittently for over 4 miles, beginning in sec. 3, T4S, R3W and extending southwest, follows a northeast trend (Fig. 8A; Fig. 28). On the east edge of the mapped area in sec. 21, T4S, R2W (Fig. 8A) traces of copper are associated with a northeast fracture system localized in a small exposure of Silver City Granite. The fault exposed along the Silver City road, near the Sinker Creek bridge, that is marked by white gouge clay in sec. 24, T4S, R3W (Fig. 8A) has some minor veinlets of calcite and hematite associated with it. The lead-silver vein on Whiskey Mountain follows a northeast fracture; it strikes N35W and dips 65° SE (Fig. 8B).

The northeast faults are offset by faults of other orientations. They are the oldest fractures in the region, but they may in part be contemporaneous with the north to northwest fractures that are described below.

The Sommercamp fault on the south side of De Lamar Mountain (Fig. 28) trends N60E and is probably a fracture of the northeast system. However, it is a relatively flat structure; it dips 26° SE. There is a possibility that a block of ground near the south boundary of the area has been rotated on an east-west axis and consequently the fault dips at a low angle. This possibility is discussed at greater length in a following section of this report (see Summary and Interpretation of Structural Features). The Sommercamp fault offsets some of the veins in the De Lamar area.

Fractures Trending North to Northwest

Fractures of this set are most abundant in the western part of the map area,

west of the zone of the northeast fractures (Fig. 28). By projection, the north to northwest and northeast trending fractures would intersect in the vicinity of War Eagle and Florida Mountains; the areas of intense mineralization in the region.

The fractures that trend north to northwest cut the Silver City Granite, the basalt-latite unit, the Silver City rhyolite and welded tuff unit two. Fractures in this set strike north to N43W; the average strike is N23W. Dips range from vertical to 60° SW. The relative movement on the faults is not known.

The veins on War Eagle Mountain and Florida Mountain are mineralized fractures of the north to northwest set. Some of the veins in the De Lamar area are filled fractures of this system also.

A large number of the fractures included in this system have controlled the locations of dikes or veins. The dikes in the dike swarm north of De Lamar (Fig. 8B) were emplaced along fractures of the north-northwest set.

Dikes and faults of the northeast set, described in the preceding section, are offset by fractures of the north-northwest system and the north-northwest system is thought to be the younger of the two systems. Evidence of the relative age of the two fracture systems can be observed on War Eagle Mountain where north-northwest veins offset porphyritic diorite and dacite dikes that are included with the northeast system (Fig. 28). At De Lamar, however, the Hamilton-Wilson-No. 9 vein system (Fig. 29), which is thought to be a filled fracture of the north-northwest system, is offset by the Sommercamp fault, a northeast fault. Hence, the development of fractures in the two systems overlapped in time.

High Angle Fractures Trending N75W

High angle faults that trend approximately N75W cross War Eagle Mountain; one occurs north of Dewey and one on Tennessee Mountain (Figs. 8A and 8B). Several faults of this set offset dikes north of De Lamar (Figs. 8B and 28). The surface traces of some of these fractures can be projected for 2 to 3 miles based mainly on alignment of saddles, stream deflections and other topographic evidence. Faults of this set are either not as abundant as the faults of other sets or their surface expression is such that they were not detected during the reconnaissance mapping.

The high angle N75W faults on War Eagle Mountain and north of Dewey were mapped by Piper and Laney (1926), where the faults cut granitic rocks. On Tennessee Mountain the faults are localized in Silver City rhyolite and north of De Lamar they offset northwest-trending dikes that are localized in the basalt-latite unit. On War Eagle Mountain they offset northwest-trending veins and fractures as well as northeast-trending fractures and dikes. One fault of this set in the southeast corner of the map area (Fig. 8A) cuts off welded tuff unit two.

Dips on the N75W high angle faults are not highly reliable; most of the faults were plotted from indirect evidence. On War Eagle Mountain, Piper and Laney

(1926, p. 39) indicate a dip of 70 to 75° SW for faults of this system. Movement was normal with a left-lateral longitudinal component. The fault on the north side of War Eagle Mountain in sec. 4, T5S, R3W that extends west to sec. 31, T4S, R3W (Fig. 8A) seems to offset a northwest fracture about 4,000 feet longitudinally, but veins and dikes on War Eagle Mountain that are offset by high angle N75W faults show a horizontal displacement of 200 to 300 feet.

Surface evidence of the high angle N75W faults is not well expressed. The fault that trends northwest from the southeast corner of the map area (Fig. 8A) was mapped on the basis of topographic saddles, one offset dike and the abrupt termination of welded tuff unit two along the trace of the fault. At other places, offset veins and dikes and information from underground workings collected by Piper and Laney (1926) indicate the presence of the N75W high angle faults.

Faults of the high angle N75W set are among the youngest major fractures in the region. They offset linear features included with the fracture systems already described. No dikes follow this trend and, except for the 77 vein of the De Lamar area (Fig. 29), structures that follow this trend are not mineralized. At one place in the southeast corner of the district (sec. 12, T5S, R3W, Fig. 8B) a fault of the N75W set is offset by a northeast fault.

Low Angle Faults Trending N75W

A zone of low angle faults occurs along part of the south edge of the map area. Three of the faults occur within the De Lamar mining area, one occurs near the south end of Florida Mountain and one near the south end of War Eagle Mountain (Figs. 8A and 8B). South of the map area, in the vicinity of War Eagle Mountain, several other low angle faults are recognized by Piper and Laney (1926).

The low angle N75W faults are important features, especially at De Lamar, because they exert a marked control on the distribution of ore. A correct interpretation of the relative movement and age of the faults is essential to planning an intelligent exploration program in the De Lamar area.

The attitudes of the faults are known from underground workings. They strike near N75W and dip 26 to 30° SW. The direction or amount of movement is not easily determined. There appears to have been some strike-slip movement, but cross-sections constructed from surface evidence and drill hole data indicate that dip-slip movement is the more important. According to Piper and Laney (1926, p. 45):

"The Chatauqua fault [Fig. 28] is indubitably normal, since it brings basalt in the foot wall into juxtaposition to rhyolite in the hanging (south) wall. Since the direction of displacement probably would be the same for each of the parallel slicings the south block may be regarded as the one which is relatively downthrown. The greater component of the displacement, however, is shove parallel to the strike of the fault plane. The combined shove along the De Lamar and Henrietta faults [Fig. 28] from a measurement based upon a somewhat uncertain correlation of an older displaced fracture, is 2,400 feet, the southern

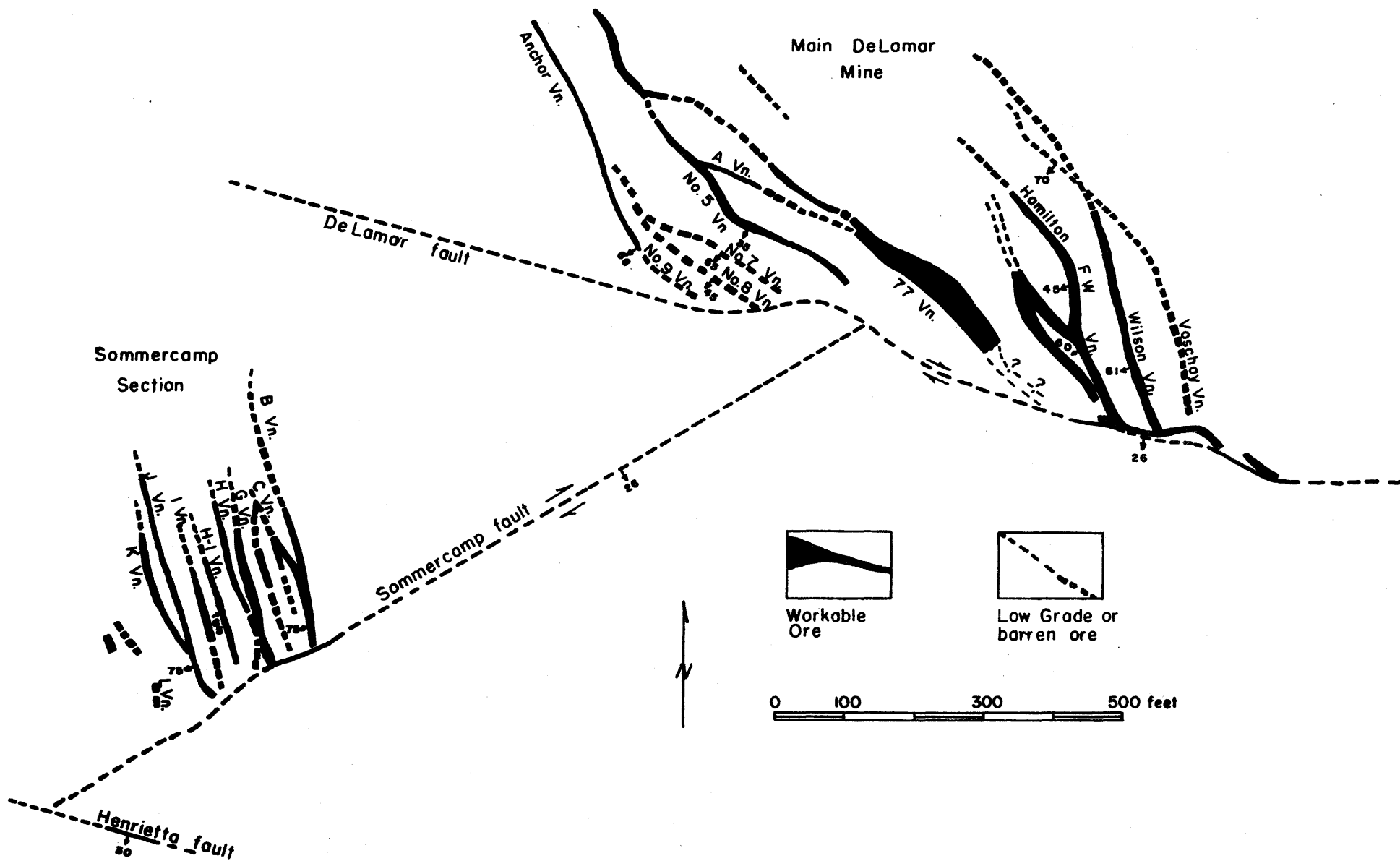
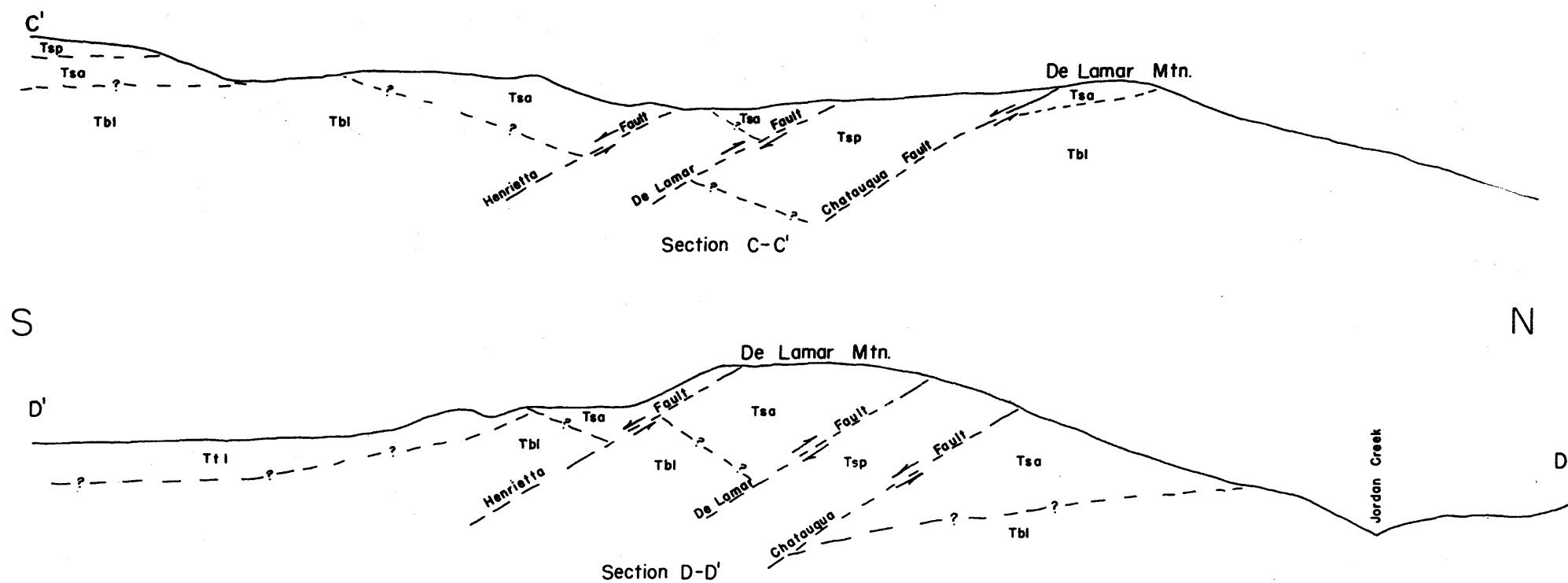


Figure 29 — Vein System of DeLamar Mine, 4th level, Silver City Region, Owyhee County, Idaho.
(From Piper and Laney, 1926, PL X).



- Tbl Basalt-latite unit
- Tsa Aphanitic member Silver City rhyolite
- Tsp Porphyritic member Silver City rhyolite
- Ttl Welded tuff unit I

Horizontal Scale = Vertical Scale

SCALE
0 500 1000 feet

Figure 30— North-South cross sections across low-angle faults, De Lamar Mountain, showing relative directions of movement, Silver City region, Owyhee County, Idaho

blocks having been displaced eastward. If the two faults are equal in magnitude, the shove along each would be 1,200 feet, although the figure is merely an approximate estimate."

I disagree with the interpretation given by Piper and Laney. Surface mapping and drill records indicate that dip-slip movement was probably the chief component of displacement with a relatively minor amount of left-lateral movement, probably 200 to 300 feet. The amount of lateral movement is estimated from offsets along the contacts of the aphanitic and porphyritic rocks near De Lamar. Cross sections indicate that reverse movement rather than normal movement occurred on the De Lamar fault; normal movement occurred on the Chatauqua and Henrietta faults (Fig. 30).

The low angle N75W faults are not well expressed on the surface because of deep soil cover that results from the weathering of the highly altered rhyolite. The Henrietta fault (Fig. 28) can be observed in the Sommercamp adit on the south side of De Lamar Mountain (Fig. 8B). A breccia zone marks the hanging wall, and heavy green clay that is impregnated with pyrite cubes marks the footwall. Because the fault has a flat dip, the adit is in the fault zone for about 300 feet. When the mines were in operation, the miners referred to the faults as "iron dikes"; the miners feared these structures because of the heavy ground conditions encountered in the fault zones.

Exposures in various mine workings and surface information along the length of De Lamar Mountain permit the projection of the low angle N75W faults along the length of the ridge. It is likely that these faults continue across the country from De Lamar to War Eagle Mountain where similar structures are exposed, but the evidence is not strong enough for such a projection.

The low angle N75W faults are probably the youngest significant structural features in the region. They appear to control the ore shoots that occur along the 77 vein, but the 77 fracture was probably in existence before the low angle faults originated.

There is a possibility that the low angle faults once dipped more steeply than they do now. A hypothesis is presented in the summary of structural features to explain the flat dip of these fractures.

FOLDS

Folds are not abundant in the region studied. The Reynolds basin is the only area within the region where folding attains significance.

The Reynolds basin is essentially a structural basin that is surrounded by structural and topographic highs. According to McIntyre (1966, p. 177) that part of the Reynolds basin shown on the geologic map (Figs. 8A and 8B) is synclinal. The axis of the fold trends north-south. Near the drainage divide on the south, near the head of Reynolds Creek, the fold dies out and the basalt is horizontal to gently south dipping.

On the east side of Whiskey Mountain a small area of gentle open folds occurs (Fig. 8B). The volcanic rocks in the locality thinly veneer the granitic rocks; the maximum thickness is about 500 feet. The folds are localized in the volcanic rocks (McIntyre, 1966, p. 178). McIntyre (p. 178) relates the open folds near Whiskey Mountain to east-west compression or to structural adjustments in the underlying granitic rocks.

SUMMARY AND INTERPRETATION OF STRUCTURAL FEATURES

Faults of the northeast system are the oldest fractures in the region. However, fractures that trend north-northwest are in part contemporaneous. The force that caused the fractures was probably directed northeast and inclined upward; hence the force exerted upward as well as horizontal pressure. The inclined force from the southwest pushing upward and to the northeast accounts for the longitudinal movement on the northeast fractures, localization of fractures in the east and west parts of the area, an area of no fracturing between the two fracture zones, and a zone of intersection at the point of maximum pressure. If the force hypothesized was responsible for the northeast and north-northwest fractures, the north-northwest fractures should be high angle reverse faults. As noted the sense of movement on these faults is not known.

During and following the time the northeast and north-northwest fractures developed, mineralization and dike emplacement were taking place. Piper and Laney (1926, p. 63) described the veins near Silver City as fissures filled with quartz, silicified and mineralized shear zones, and cemented breccias. In the silicified shear zones the vein filling is broken and recemented at places, which indicates that movement occurred during the time the vein matter was being deposited. In the breccia zones quartz and country rock alike are broken. Some of the veins show massive quartz along the walls of the fissure, thus mineralization in the Hamilton-Wilson-No. 9 vein system at De Lamar was probably emplaced along a northwest-trending fracture but late movement along the Sommercamp fault, a fracture of the early northeast set, offset the veins.

The most intense mineralization formed in the zone of greatest shattering, where the fracture zones intersect, hence the bulk of the mineralization in the region is localized near Silver City. If the north-northwest fractures are high-angle reverse faults, they were probably more open and provided better channels for circulating, mineralizing solutions than the northeast fissures that had a component of longitudinal movement. Hence, the north-northwest fractures were preferentially mineralized.

After the veins and dikes were in place, fractures that strike N75W developed and offset the earlier structures. The movement on the N75W faults was oblique dip-slip.

The 77 vein at De Lamar (Fig. 29) is probably a fracture of the N75W set that offset the northern segment of Hamilton-Wilson-No. 9 vein system. Figure 31 shows the steps in the evolution of the De Lamar vein system. The fracture that is now the 77 vein was probably mineralized after the low-angle N75W De Lamar

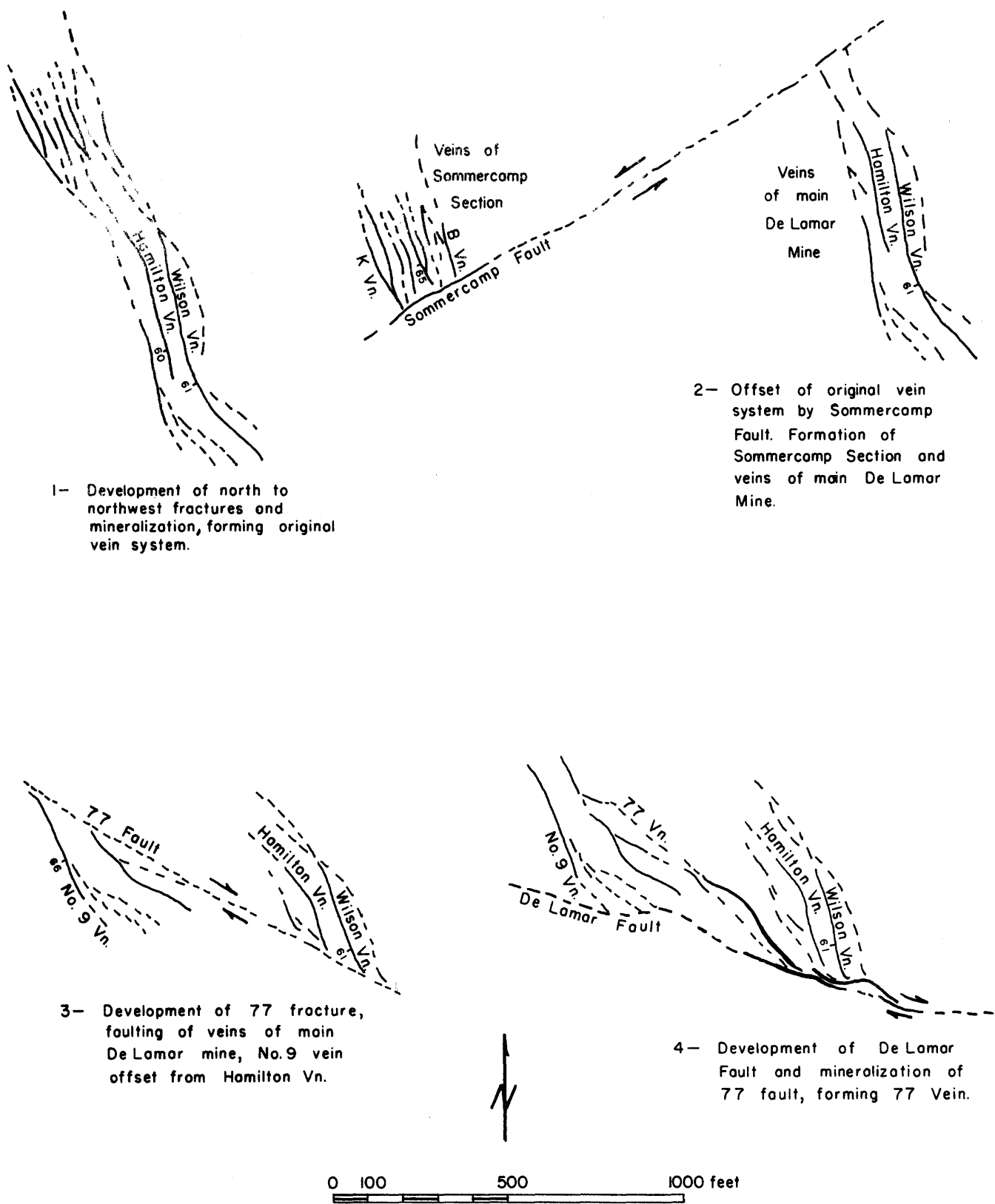


Figure 31 — Diagram showing structural evolution of De Lamar vein system, Silver City Region, Owyhee County, Idaho.

fault developed. The richest ore shoots on the 77 vein occur near its intersection with the footwall of the De Lamar fault, and the ore body rakes down the dip of the fault. The fault evidently controlled localization of the ore shoot.

The low angle N75W faults were probably the last major fault developments in the region. Sections constructed through De Lamar Mountain indicate that the Chatauqua and Henrietta faults are normal faults and the De Lamar fault is a reverse fault (Fig. 30). The block of ground between the Chatauqua and De Lamar faults was relatively down-dropped.

Many of the structures in the De Lamar area have a flatter dip than structures elsewhere in the region. The Sommercamp fault (Fig. 28) according to Piper and Laney (1926, Pl. X) dips 26° SE. The 77 vein, in the upper levels of the De Lamar mine, dips 36° SW. The low dip of the structures on De Lamar Mountain was probably caused by rotation of a block of ground along a near east-west axis. The northern boundary of the block is marked by the Chatauqua fault at De Lamar, and the boundary of the block trends southeast to the south slope of War Eagle Mountain. The rotation could have been caused by uplift or doming to the south; evidence for such an event is lacking, however, because mapping has not been extended to the south. The dips of the north trending veins of the Hamilton-Wilson-No. 9 vein system were not changed because rotation occurred along an east-west axis; consequently a north-south striking, west dipping structure would retain the same relative dip.

A final period of mineralization followed development of the N75W faults, at which time the 77 vein (Fig. 31) was mineralized. The footwall of the De Lamar fault acted as a barrier to the passage of mineralizing solutions, hence the ore body is wider near the fault and it rakes down the dip of the fault.

There is little chance that a vein similar to the 77 vein can be discovered in the hanging (south) wall of the De Lamar fault. The best exploration opportunity in the De Lamar area is the eastward projection of the 77 ore shoot along the footwall of the De Lamar fault.

According to McIntyre (1966, p. 168) folding in the Reynolds Creek basin affects all the rocks of Miocene age in the basin, but the older rocks are relatively more deformed than the younger rocks. This observation suggests that the rocks in the Reynolds basin were undergoing deformation more or less continuously throughout the Upper Miocene and possibly part of the Lower Pliocene. The time relation between these events and faulting in the region are not known. McIntyre suggests that a northeast-southwest couple or northwest-southeast couple was responsible for the folding. The inclined northeast directed force suggested as an origin for the northeast and north-northwest fault pattern could have been a component of the force suggested, but because pressure was decreasing northward rupture did not take place in the northern part of the region. Consequently the folding and earliest faulting may be contemporaneous.

Some geologists (Malde and Powers, 1962; Hill and others, 1961) think that

the western Snake River plain is a graben structure and that movement along boundary faults has been active since the beginning of the Tertiary period. A cross-section by Malde and Powers (1962, p. 1203) shows a vertical fault along the southwestern margin of the Snake River plains. The Owyhee Range represents the upthrown block on the southwest, the Snake River plains to the northeast represent the downthrown block. Malde (1959, p. 272) presents evidence for border faults along the northeastern margin of the western Snake River plains also. Gravity anomalies indicate that the western Snake River plain is a graben structure (Hill and others, 1961, p. 250). The picture presented implies basin and range structure, and the relative positions of the Owyhee Range and Snake River plains are related to block faulting.

The structural details in the area mapped for this report offer little support for a hypothesis that the Owyhee Mountains are a block faulted range. The following points are significant:

1. The structural pattern is more likely the result of doming and uplift than the result of block faulting.
2. There is no evidence that the range is a tilted fault block or a series of tilted fault blocks (Figs. 3 and 4).
3. A boundary fault separating the mountains and the plains was not found during the field work on this project. Such a fault could, of course, be farther east and its trace obscured by erosion and alluvial cover.

The Owyhee Mountains appear to rise abruptly from the eastern margin of the Snake River plains, and they give the impression that they are a westward-tilted fault block. The oversteeping of the eastern slope of the range is related to the erosion and not to block faulting. If the Snake River plain is a structural depression, base level would be lower on the east side of the range than on the west side; hence relief would be relatively greater on the east side of the range (Fig. 3).

ECONOMIC GEOLOGY

INTRODUCTION

For discussion purposes the ore deposits of the region are classified into seven types. The types include the precious metal veins in the old mining areas near Silver City and De Lamar; silver-gold mineralization north of the old mining areas; antimony-silver veins north-northwest of Silver City; the lead-silver veins at Whiskey Mountain, near Reynolds; mercury mineralization north of Wagontown; traces of copper in the area; and placer deposits.

The nonmetallic mineral resources of the area are of little significance. A few brief remarks near the end of this section summarize their potential.

PRECIOUS METAL VEINS IN THE VICINITY OF SILVER CITY AND DE LAMAR

The veins in the old mining areas are discussed by area of occurrence. Areas include War Eagle Mountain, Florida Mountain and De Lamar. A summary of the ore and gangue minerals and a brief discussion of the effects of hydrothermal alteration are also included.

Time was not available for a complete and detailed study of the veins in the old mining areas. Most of the mines are inaccessible and vein outcrops are sparse. Lindgren (1900) and Piper and Laney (1926) investigated the mineralized zones in detail at a time when significant features could be observed and studied to better advantage than they can now. To spend a large amount of time reinvestigating these areas would be to indulge in needless repetition of effort. I visited the old mining areas for familiarization and to add any supplemental information that could be learned. Some additional details were added to previous maps of the De Lamar area. For detailed descriptions of the veins, ores and individual mining properties, the reader is referred to Piper and Laney (1926) and Lindgren (1900). Much of the information on the old mining areas is summarized from these sources.

Ore and Gangue Minerals

Piper and Laney (1926) made chemical analyses of the ores from the area and studied polished ore sections with the reflecting microscope. The following list of minerals is summarized from Piper and Laney (1926, p. 73-86):

Argentite (Ag_2S) - important mineral in veins on Florida Mountain and at De Lamar; supergene and hypogene.

Cassiterite (SnO_2) - in Jordan Creek placer mines as water-worn pebbles; source unknown.

Cerargyrite (AgCl) - important in oxidized zones of most veins. Formed bonanza ore bodies at places, notably in the Poorman mine on War Eagle Mountain.

Chalcopyrite (CuFeS_2) - occurs on the lower levels of the mines on War Eagle and Florida Mountains.

Clausthalite (PbSe) - rare in district.

Electrum (natural alloy of gold and silver) - important in most mines; hypogene.

Galena (PbS) - occurs on lower levels of Black Jack-Trade Dollar mine on Florida Mountain; hypogene.

Gold (Au) - native gold free from silver is rare in the district. Native gold is important, however, especially on War Eagle Mountain and at De Lamar; hypogene.

Jamesonite ($4\text{PbS} \cdot \text{FeS} \cdot 3\text{Sb}_2\text{S}_3$) - in Black Jack-Trade Dollar mine on Florida Mountain, sparse at De Lamar; hypogene.

Marcasite (FeS_2) - sparingly present in most veins of district; hypogene.

Miargyrite ($\text{Ag}_2\text{S} \cdot \text{Sb}_2\text{S}_3$) - in most veins of district, notably abundant in Black Jack-Trade Dollar vein on Florida Mountain; hypogene.

Naumannite ((Ag, Pb) Se) - almost identical to argentite in physical characteristics, probably as abundant as argentite in district. Important in most mines; hypogene.

Owyheeite ($8\text{PbS} \cdot 2\text{Ag}_2\text{S} \cdot 5\text{Sb}_2\text{S}_3$) - rare, identified in ores from Poorman vein on War Eagle Mountain; hypogene.

Proustite ($3\text{Ag}_2\text{S} \cdot \text{As}_2\text{S}_3$) - in veins on Florida and War Eagle Mountains. Intimately associated with pyrargyrite and polybasite; hypogene.

Polybasite ($9\text{Ag}_2\text{S} \cdot \text{Sb}_2\text{S}_3$) - one of most abundant silver-bearing minerals in district; hypogene.

Pyrargyrite ($3\text{Ag}_2\text{S} \cdot \text{Sb}_2\text{S}_3$) - widely distributed in veins of district; hypogene.

Pyrite (FeS_2) - in all veins in district in varying amounts, not highly auriferous; hypogene.

Silver (Ag) - some supergene native silver, most is with gold in electrum.

Sphalerite (ZnS) - associated with other base metal minerals on lower levels of mines on Florida and War Eagle Mountains; hypogene.

The gangue minerals include:

Barite - sparingly present near De Lamar.

Calcite - sparse as true gangue mineral; occurs sparingly in the Poorman vein on War Eagle Mountain and the Banner vein on Florida Mountain. May be abundant in hydrothermally altered basalts.

Chlorites - widely distributed but nowhere abundant, most common in veins in basalts.

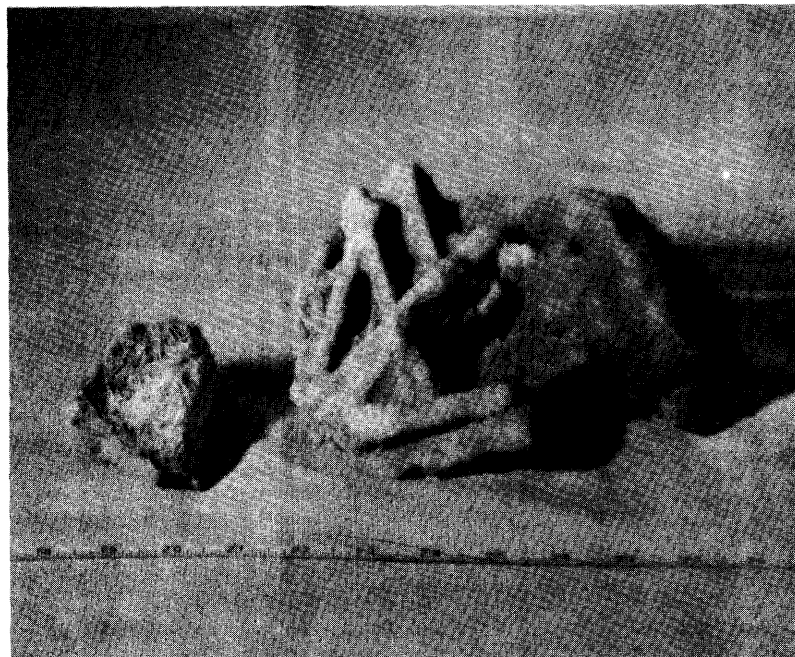


Figure 32. Cellular quartz associated with veins, Silver City region, Owyhee County, Idaho. Fine-textured specimen on left from vein north of Wagontown. Coarse specimen on right from vein on War Eagle Mountain. Scale in inches.

Epidote - occurs along walls of veins in more mafic rocks or as crystals in the usual quartz gangue. Most abundant on Florida and War Eagle Mountains.

Fluorite - rare.

Leverrierite (?) - a variety of clay. Grim (1953, p. 39-40) suggests that the term leverrierite be discarded. X-ray analyses show that the clay, formerly thought to be a distinct species, is a mixture of alternating plates of kaolin and muscovite. The gouge clay that accompanies the Black Jack vein of Florida Mountain has been termed leverrierite or beidellite (Piper and Laney, 1926, p. 83). (Grim also suggests (1953, p. 50) that the term beidellite be discarded as it is a mixture of several clay minerals). The clay accompanying the veins is commonly rich in silver; it occupies open spaces in the veins and is especially abundant in the Banner vein on Florida Mountain and in the Henrietta and De Lamar mines near De Lamar. The clay may be derived in part from alteration of the surrounding rocks.

Muscovite - not a true gangue mineral, accompanies veins in granitic rocks.

Quartz - dominant gangue mineral in the region. There are several varieties including chalcedonic quartz; massive, milk-white, common vein quartz; crystalline quartz, with comb structure; and a peculiar cellular variety of quartz.

Chalcedonic quartz is common in most of the veins enclosed by granodiorite or rhyolite.

Massive, milk-white quartz is the most abundant variety and is the gangue in most of the veins; it serves as an important host for gold- and silver-bearing minerals.

Crystalline quartz is with ore minerals in cavities, vugs, fissures and tiny open spaces in massive quartz.

Cellular quartz is variously referred to as cellular, lamellar or pseudomorphic quartz. This variety is characteristic of the veins at De Lamar; it is abundant in the veins on War Eagle Mountain and rare in the veins on Florida Mountain. The material is made up of thin plates from a fraction of an inch to two inches in length that intersect and join each other at various angles; hence the intersecting plates form a cellular mass (Fig. 32). Piper and Laney (1926, p. 85) note from microscopic study that a single plate is composed of a mosaic of tiny cryptocrystalline quartz grains arranged along the sides of a median line representing the center of the plate. The surfaces of the plates in some examples are coated by drusy quartz crystals.

Lindgren (1900, p. 128) and Piper and Laney (1926, p. 85) conclude that the cellular quartz is pseudomorphic after a previously formed gangue mineral. The previous mineral is thought to be calcite or possibly barite. Cellular calcite from the Banner vein, in outward appearance, is a replica of the cellular quartz. Lindgren (1933, p. 449) in his text on mineral deposits, describes cellular quartz from De Lamar as an illustration of an earlier gangue mineral being completely replaced by a new gangue mineral.

Sericite - abundant near most veins in region.

Valencianite - a variety of orthoclase found in veins (Winchell, 1951, p. 305). It is abundant locally in the veins on Florida and War Eagle Mountains; it is sparse at De Lamar.

Hydrothermal Alteration

Time was not available for a detailed study of the effects of hydrothermal alteration in the district. Consequently only a few general remarks are included. Near a vein the granitic rocks show biotite altered to chlorite. Feldspars are generally cloudy and altered to kaolin and sericite. Alteration of the granitic rocks is not intense, and along some veins on War Eagle Mountain one wall may be relatively fresh. Because alteration is not intense, it is not a particularly good prospecting guide.

The porphyritic diorite or dacite dikes on War Eagle Mountain may show the effects of hydrothermal alteration to a marked degree where they are cut by a vein. According to Piper and Laney (1926, p. 20) biotite and amphibole are almost completely destroyed and are represented by chlorite and iron oxides. Andesine is transformed into zoisite, mica, calcite and kaolin. Talc, secondary quartz and questionably sillimanite may be recognized in more intensely altered phases. Pyritization of the diorite and dacite has also taken place in contrast to the granitic rocks that are almost devoid of pyrite.

Hydrothermal alteration of the basalts may be intense in the vicinity of a mineralized vein, but alteration is erratic. Fresh rocks may be within a few feet of the vein and intensely altered rock several hundred feet away. Altered basalt is characterized by a dull earthy luster, greenish-grey color and loss of conchoidal fracture. Piper and Laney (1926, p. 23) note the development of chlorite, calcite and serpentine from pyroxene with a minor amount of magnetite. Flocculent kaolin is abundant in some specimens; but in others, where calcite is abundant, it is lacking. Hematite may be abundant locally and it imparts a deep red color to the altered rocks.

As a prospecting guide, especially when evaluating drill core, it should be borne in mind that highly altered basalt may mean that mineralization is nearby, but within a radius of several hundred feet, and that fresh rock may occur close to the vein.

Alteration in the Silver City rhyolite is pervasive and extensive. An almost complete silicification has affected the rocks through most of their outcrop area; consequently a completely unaltered specimen is rare. Because of the silicification many specimens appear deceptively fresh. Sericitization is also an important alteration feature in the Silver City rhyolite, and locally there is pyritization.

In thin section the Silver City rhyolite shows aureoles of secondary microgranular quartz surrounding phenocrysts with sericitization of the sanidine. Sericite is also distributed through the groundmass as flocculent films.

Piper and Laney (1926, p. 30) note that sericitization and silicification are contemporaneous in the Silver City rhyolite, but either may dominate locally. Near a vein silicification is generally developed to a greater degree with sericitization increasing in importance further from the vein.

Veins on War Eagle Mountain

The veins on War Eagle Mountain are considered in four groups or systems. The veins included in a group were selected on the basis of proximity and similar structural trend (Fig. 33). The vein systems discussed are the (1) Morning Star-Potosi, (2) Poorman, (3) General Connor-Stormy Hill, and the (4) Oro Fino-Golden Chariot. The Morning Star-Potosi is on Jordan Creek below the summit and west of War Eagle Mountain, but it is included with the veins on War Eagle Mountain.

The Morning Star mine was one of the earliest producers in the region. The mine has been idle for many years and little is known about the workings or the nature of the vein. According to Piper and Laney (1926, p. 149) the mine is developed by an inclined shaft 450 feet deep. Five levels were turned from the shaft and drifts follow the vein for a maximum of 400 feet.

The Morning Star vein is 12 to 30 inches wide; it strikes due north and dips steeply west. The country rock is Silver City Granite, but a diorite dike was encountered on the lower levels. The dike is bleached by hydrothermal alteration and contains pyrite cubes. The vein contains quartz showing comb structure. The ore minerals are contained in the quartz and consist chiefly of chalcopryite with small amounts of native gold and native silver (Piper and Laney, 1926, p. 150). Lindgren (1900, p. 156) reports silver sulphides as well. Ore shoots in the vein are irregular. Nothing is known of the other mining properties on the Morning Star vein.

The Poorman mine was a leading producer during early days in the Silver City region. The Poorman mine is developed by shafts, raises, winzes and adits to a total depth of 950 feet below the apex on surface (Fig. 34). The winze sunk from the Belle Peck adit (Fig. 34) encountered a vein that dips 45-50° E (Piper and Laney, 1926, p. 135). It is likely that the winze encountered the Owyhee vein (No. 14, Fig. 33), rather than the Poorman. The Owyhee vein, to the west, dips 50° E.

According to Piper and Laney (1926, p. 132) the Poorman vein is a silicified shear zone. The vein ranges from a single quartz filled fissure 4 to 5 inches wide to a zone 4 1/2 feet wide consisting of quartz stringers 1 1/2 inches to 3 inches wide. The vein strikes N02W to N04E and is about vertical. It can be traced for nearly a mile on the surface; it persists downward for 600 feet or more.

The country rock surrounding the Poorman vein is Silver City Granite. Hydrothermal alteration of the granitic rocks yield epidote, chlorite, sericite and kaolin (Piper and Laney, 1926, p. 135).

Massive quartz is the dominant gangue mineral in the Poorman vein; comb quartz is also common. Locally calcite accompanies the quartz (Piper and Laney, 1926, p. 135). Ore minerals include native gold and silver, cerargyrite, pyrrargyrite, proustite, polybasite, stephanite, owyheeite and argentite (naumannite?). In the lower levels, small quantities of pyrite, marcasite(?), galena, sphalerite and chalcopryite are reported (Piper and Laney, 1926, p. 135-136).

Piper and Laney (1926, p. 136), quoting Browne (1868, p. 523-524), report that

the silver ore above 250 feet was cerargyrite in large plates. Browne (from Piper and Laney, 1926, p. 136) also states that 100 feet below the surface an homogeneous solid mass of proustite that weighed 500 pounds was encountered. The mass was bounded by the planes and angles of a single crystal.

The Poorman mine was fabulously rich near the surface; some of the ore extracted averaged \$4,000 per ton. The gold to silver ratio averaged 1:37.5 by weight near the surface. On the intermediate levels the ratio was 1:5.6 and on the lowest level 1:1.1 (Piper and Laney, 1926, p. 136). The depth to which supergene enrichment affected the Poorman vein is not known. The upper levels were almost certainly in secondary ore.

Figure 34 shows one main ore shoot that rakes about 45 degrees north in the Poorman vein and a second much smaller ore shoot near the south end of the mine. The bonanza ore in the Poorman mine terminated at the Oso level (Fig. 34). The best ore was found where the main vein was intersected by a spur vein or barren fissure (Piper and Laney, 1926, p. 136).

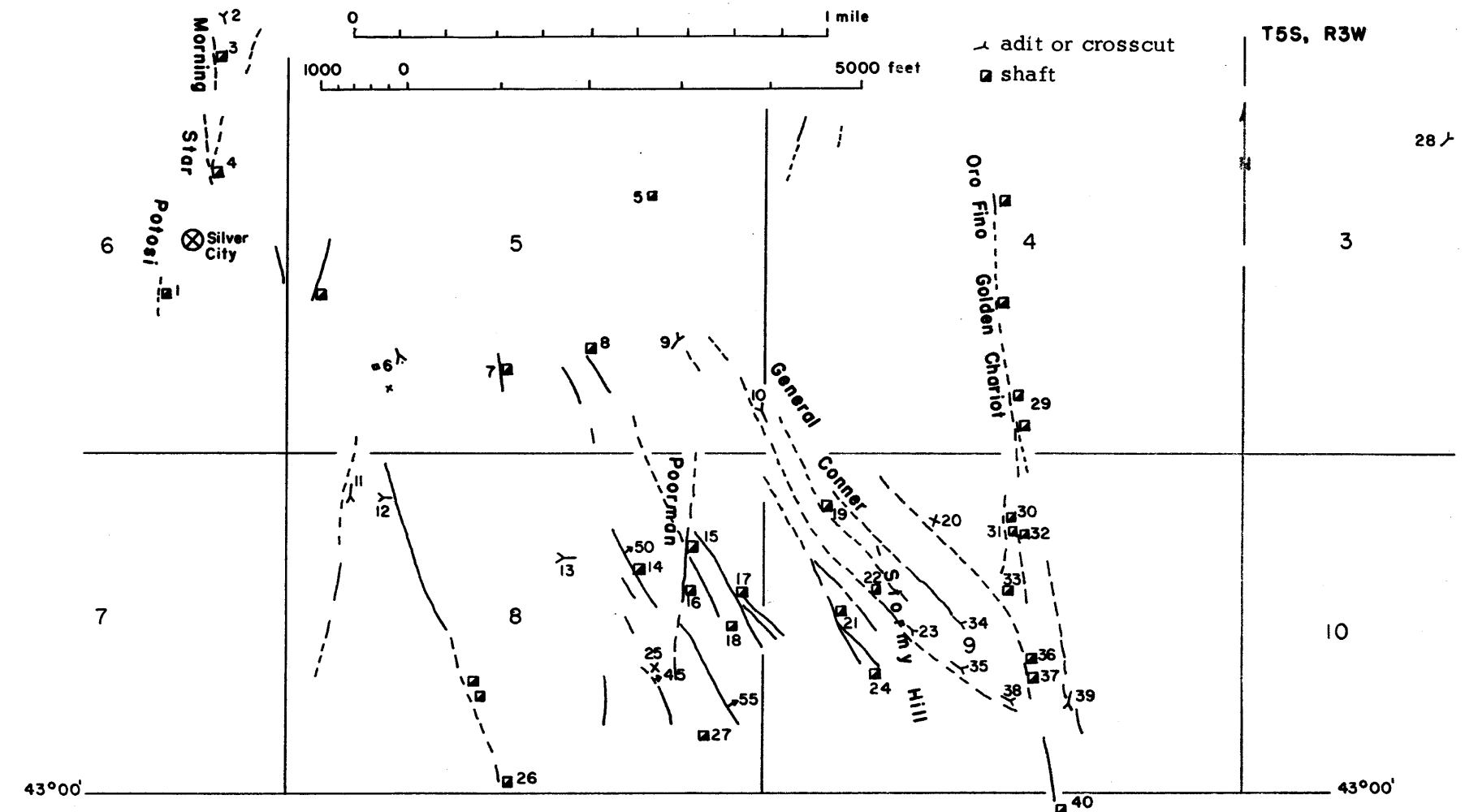
Little can be learned about the other veins in the Poorman system. They strike to the northwest and evidently cross the Poorman vein; these veins may be slightly offset by the Poorman shear zone (Fig. 33). The Owyhee vein evidently intersects the Poorman vein down dip, below Belle Peck level.

Lindgren (1900, p. 154-155 and p. 173) presents a brief discussion of the Illinois Central, the Empire and the Owyhee veins (Fig. 33). He notes that the Illinois Central is developed by a 600-foot shaft. The average value of the ore extracted was \$73 per ton. The ore shoot on the vein is 200 feet long near the surface; it narrows with depth.

According to Lindgren (1900, p. 155) the Empire vein can be traced for 3,000 feet; it appears to extend across the Poorman vein. The Empire vein is developed at its south end by a 460-foot shaft. A crosscut from the Belle Peck adit on the Poorman vein connects with the bottom of the shaft. The Empire veins dip 60° E and range from a few inches to 3 feet in width. The gangue is massive quartz; the quartz contains pyrite, chalcopyrite, and some native gold. The main ore shoot follows an intersection of the main vein and a perpendicular cross seam. Where intersected by the crosscut from the Belle Peck adit, the Empire vein shows two seams of quartz, each 2 inches wide, separated by 5 inches of crushed granite (Lindgren, 1900, p. 155). Lindgren (p. 155) remarks that the Idlewild on a southern extension of the Empire vein (not shown on Fig. 33) has a gold-silver ratio of 1:85. He fails to mention the silver-bearing mineral in the vein.

The Owyhee vein is only briefly mentioned by Lindgren (1900, p. 173). He notes calcite in thin tabular form on siderite and quartz. Cellular quartz is abundant; sulphides are scarce.

Ore shoots in the veins of the Poorman system are controlled by fracture intersections; hence the intersections of the Poorman vein and the Empire or Illinois Central veins should be likely localities for the development of ore shoots. Theoretically



- | | | | |
|---|---------------------------------|---------------------------|--------------------------------|
| 1. Potosi mine. | 11. Deluge claim | 22. San Juan shaft. | 33. Minnesota shaft. |
| 2. Dubuque prospect. | 12. Village Blacksmith claim. | 23. San Juan tunnel. | 34. Dernier Resort claim. |
| 3. Morning Star shaft. | 13. Owyhee tunnel. | 24. Stormy Hill shaft. | 35. San Juan tunnel. |
| 4. Home claim. | 14. Owyhee shaft. | 25. Jackson claim. | 36. South Chariot shaft. |
| 5. Webfoot claim. | 15. Poorman north (Hope) shaft. | 26. Gold Bug shaft. | 37. Mahogany shaft. |
| 6. Addie Consolidated Mining Co. (Bishop Tunnel). | 16. Poorman south shaft. | 27. Silver Cord shaft. | 38. Red Jacket Gold Mining Co. |
| 7. Trook and Jennings claim. | 17. Illinois Central shaft. | 28. Sinker tunnel. | 39. Mountain Chief claim. |
| 8. Ruth claim. | 18. Empire shaft. | 29. Oro Fino shaft. | 40. Afterthought mine. |
| 9. Belle Peck adit (Poorman mine). | 19. General Connor claim. | 30. Ida Elmore shaft. | |
| 10. Oso adit (Poorman mine). | 20. Red Jacket shft (1885). | 31. Golden Chariot shaft. | |
| | 21. War Eagle shaft. | 32. Cumberland shaft. | |

Figure 33 — Veins and mines on War Eagle Mountain, T5S, R3W, Silver City Region, Owyhee County, Idaho.
(From Piper and Laney, 1926, Pl. II).

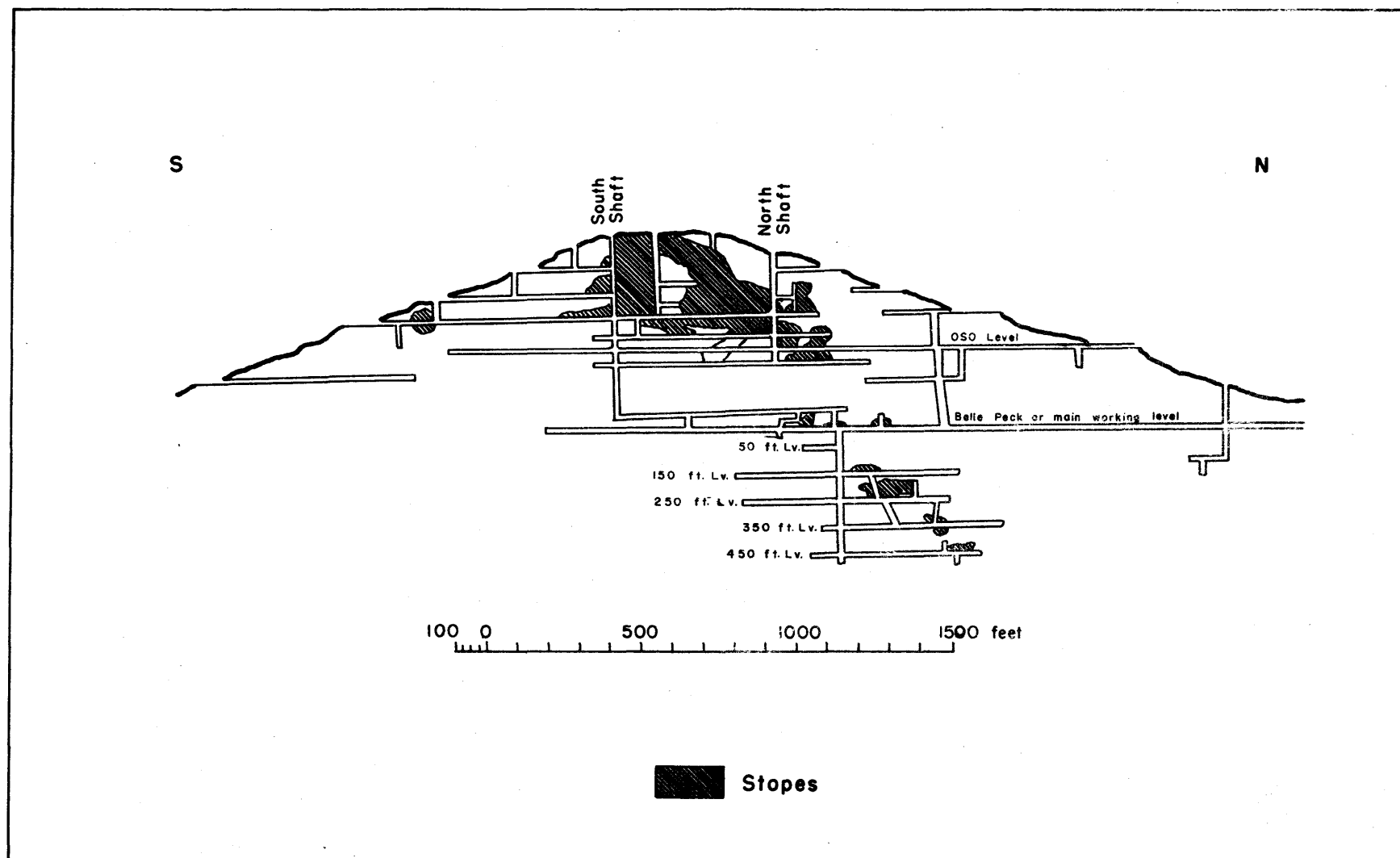


Figure 34 — North-South longitudinal section, Poorman mine workings, Silver City Region, Owyhee County, Idaho. (From Piper and Laney, 1926, p. 137).

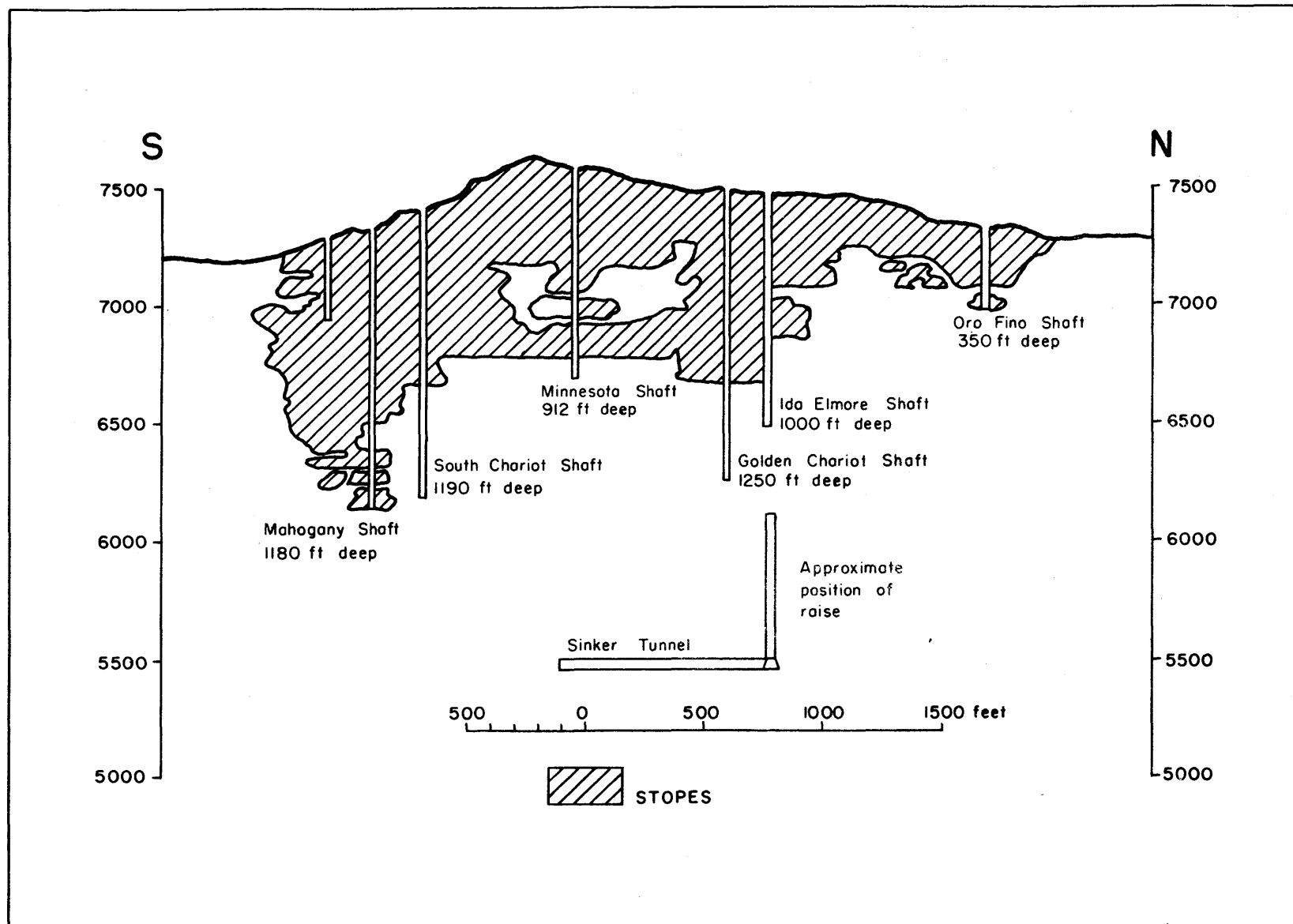


Figure 35— Longitudinal Section, Oro Fino-Golden Chariot Vein; Silver City Region, Owyhee County, Idaho (From Piper and Laney, 1926, p. 143)

the shoots would rake steeply northeast down the line of intersection of the veins; the Poorman is vertical and the other veins dip 60° E.

The veins included in the General Connor-Stormy Hill group are only briefly described in the literature of the district. The veins are narrow and none of them produced significant amounts of ore.

Lindgren (1900, p. 154) notes that the Stormy Hill vein is developed by the War Eagle shaft (No. 21, Fig. 33) to a depth of 700 feet. In 1873 the ore produced was valued at \$35 per ton. The south end of the vein is opened by the Stormy Hill shaft. The vein is wide and well defined. Cellular quartz is abundant. There is no information on the ore minerals or the character of the vein.

Piper and Laney (1926, p. 133) note that the veins of the General Connor-Stormy Hill system are filled fissures or shear zones; they are filled by massive, crystalline or cellular quartz. Locally the veins show calcite, sericite, epidote and chlorite.

The Oro Fino-Golden Chariot vein system is credited with a production of \$7,000,000 from a zone 3,600 feet long. The vein structure is still strong where intersected by the Sinker tunnel 2,500 feet below the apex (Piper and Laney, 1926, p. 66). The mines on the vein in the productive zone include the Oro Fino, the Ida Elmore, the Golden Chariot, the Minnesota, the South Chariot and the Mahogany (Piper and Laney, 1926, p. 139). The mines are opened by shafts that range from 350 feet to 1,250 feet in depth (Fig. 35).

The Oro Fino-Golden Chariot vein has an average strike of N04W, it dips 80° E. The vein can be traced intermittently from the Great Western Mines Company adit to the Afterthought mine, a distance of 1 1/2 miles (Piper and Laney, 1926, p. 132). The average width of the vein is 3 feet.

Gold exceeded silver in value in the Oro Fino-Golden Chariot vein, but only in the upper oxidized portion did it exceed silver by weight. At a depth of 220 feet the gold to silver ratio was 1:7.3 by weight. The relative amount of silver increased with depth (Piper and Laney, 1926, p. 139-140). Piper and Laney (1926, p. 140) estimate that the ores were enriched by supergene processes to a depth of about 300 feet. At depths below 300 feet the ore averaged \$20 to \$30 per ton.

Ore bodies in the veins are developed where the vein is intersected by secondary vein fissures (Piper and Laney, 1926, p. 141). The rake of the ore bodies is not definitely known; the section in Figure 35 indicates that they rake to the south.

Piper and Laney (1926, p. 63) note that the veins in the Oro Fino-Golden Chariot group are cemented breccias. The cementing material is cellular or massive quartz.

The Afterthought mine is on a southern extension of the Oro Fino-Golden Chariot vein. The mine is a few hundred feet south of the map area (Fig. 33). The Afterthought mine was developed by the De Lamar Mines Company about 1900 (Piper and Laney, 1926, p. 145). Aggregate development totals 2,000 feet. Five levels are

turned from a 450 foot shaft on a vein that dips 85° E (Piper and Laney, 1926, p. 145).

The Afterthought vein ranges from 4 inches to 6 feet in width; it averages 3 feet. The vein is a breccia or filled fissure. The first four levels of the mine develop an ore body that is 240 feet long on the second level. The ore averages 0.14 ounces of gold and 17.0 ounces of silver on the fourth level (Piper and Laney, 1926, p. 145). Wire silver and silver sulphides are the principal minerals (Piper and Laney, 1926, p. 145). The vein terminates to the south against heavy fault gouge that dips south at a low angle, 181 feet below the collar of the shaft (Piper and Laney, 1926, p. 145). No information is available on the nature of the vein and ore near the fault intersection.

In summary, the veins on War Eagle Mountain are mineralized shear zones, breccia zones and fissures enclosed in Silver City Granite and locally in diorite or dacite dikes. The veins are narrow and the richest ore was produced from the upper levels in the zone of oxidation and supergene enrichment. The Poorman vein and the Oro Fino-Golden Chariot vein were important producers, other veins on War Eagle Mountain are less important and are credited with minor production.

The ore occurs in shoots in the veins on War Eagle Mountain. Ore shoots are controlled by intersections of veins and subsidiary fractures. Silver exceeded gold in the veins by weight but not in value. The gold to silver ratio is variable in individual mines and between various veins. In the Poorman vein the relative amount of gold increased with depth. In the Oro Fino-Golden Chariot mine the reverse was true. Oxidation and supergene enrichment have had an important effect on the veins and have affected the relative concentration of silver and gold. The depth to which oxidation and enrichment was effective is not certainly known, but it is probably 250 to 300 feet.

The lower levels of the mines and those far down the slope of War Eagle Mountain, such as the Morning Star and the Sinker tunnel, show a marked increase in base metal content, especially chalcopyrite. The evidence indicates that the veins persist with depth, but mesothermal base metal minerals are present rather than epithermal silver minerals. Because the veins are narrow it is doubtful that they could be mined profitably at depth, unless significant amounts of gold accompany the copper, lead and zinc sulphides. The amount of gold on the lower levels of the mines is not known. Copper and gold are found where the Sinker tunnel intersects the Golden Chariot vein. The Morning Star carries copper and gold. The relative amount of gold increased with depth in the Poorman mine.

Veins on Florida Mountain

The Crown Point (No. 14, Fig. 36), the Miller and Walters (No. 24, Fig. 36), the Black Jack-Trade Dollar (No. 20, Fig. 36), the Alpine (No. 12, Fig. 36), the Empire State (No. 8, Fig. 36), the Tip Top (No. 10, Fig. 36) and the Banner (No. 16, Fig. 36) are the veins and mines on Florida Mountain. The Black Jack-Trade Dollar is the most extensively developed mine in the region and it was the only mine of real importance on Florida Mountain. The Alpine and Empire State veins branch from the Black Jack-Trade Dollar vein and were explored from the workings of the Black Jack-Trade Dollar

- Dewey
1. Dewey (Florida Mountain) tunnel and mill.
 2. Alta Vista Property.
 3. Humboldt tunnel.
 4. Seventy-nine claim (1881).
 5. Phillips and Sullivan No. 3 adit.
 6. Idaho tunnel (Trade Dollar mine, No. 12 adit).
 7. Black Jack Tunnel (Trade Dollar mine, No. 8 adit).
 8. Empire State tunnel.
 9. Ontario claim.
 10. Tip Top shaft.
 11. Lobe claim.
 12. Sierra Nevada tunnel.
 13. Lone Tree Prospect.
 14. Crown Point claim.
 15. Venus claim.
 16. Banner claim.
 17. Trade Dollar mine No. 4 adit.
 18. Erdman tunnel.
 19. Banner mill.
 20. Blaine tunnel (Trade Dollar mine No. 12 adit).
 21. Idawa Gold Mining & Milling Co. mill (Blaine mill).
 22. Idawa Gold Mining & Milling Co. (Silver City M. & M. Co.).
 23. Trade Dollar Extension property.
 24. Metallico (Miller and Walters) mine.

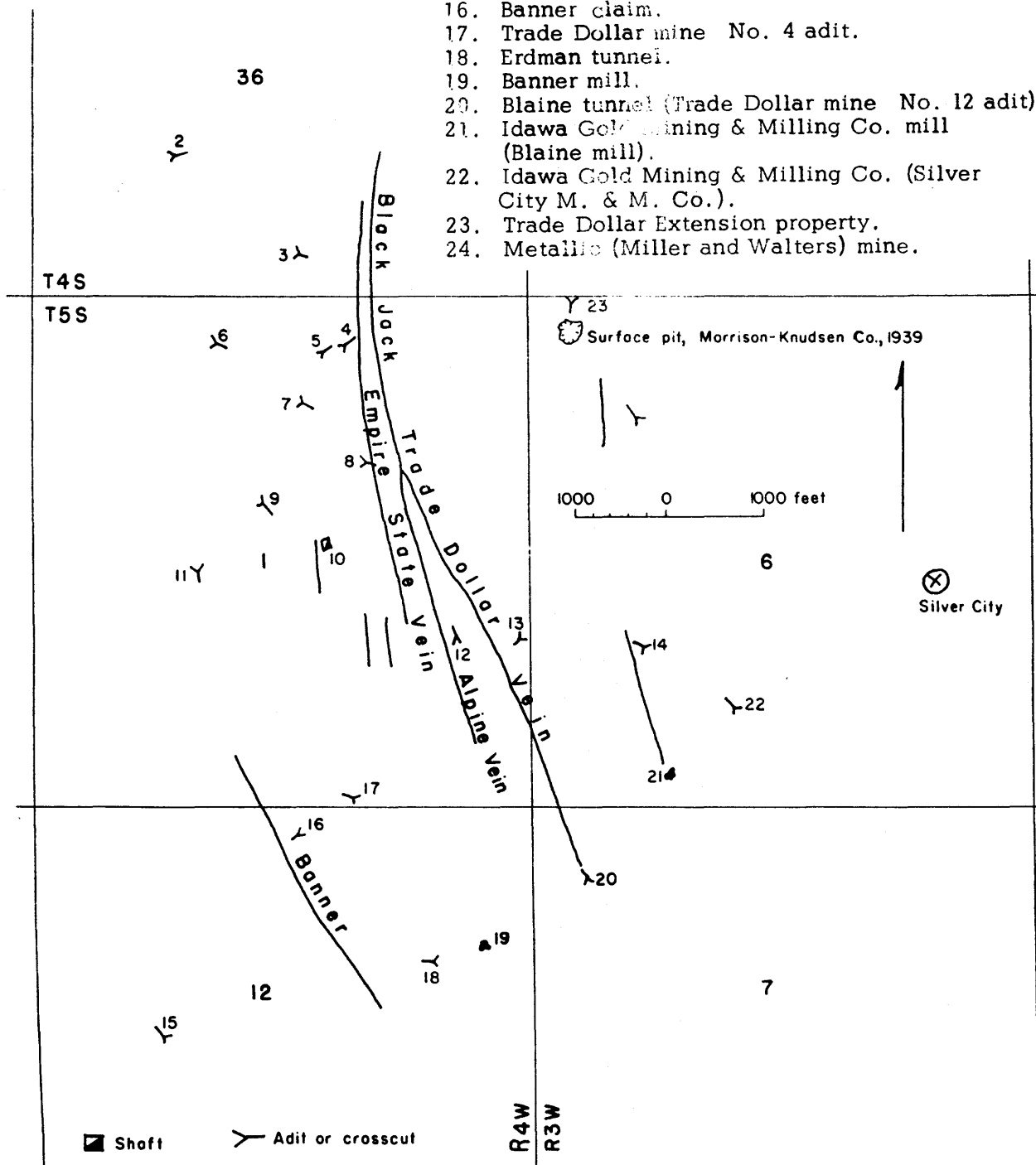


Figure 36 — Veins and mines on Florida Mountain, Silver City Region, Owyhee County, Idaho
(From Piper and Laney, 1926, Pl. II.)

mine. A large amount of development was done on the Banner vein but little ore was produced. Aside from the Black Jack-Trade Dollar mine, little could be learned about the mines on Florida Mountain.

The Black Jack-Trade Dollar is opened by adits and crosscuts to a depth of 1,700 feet below the apex (Fig. 37). The Dewey tunnel on the 1700 level of the mine, was driven to the Black Jack-Trade Dollar vein and follows the vein for 6,000 feet (No. 1, Fig. 36). Drifts were turned on the Alpine and Empire State veins from the 1700 level as well (Piper and Laney, 1926, p. 125).

The Blaine tunnel (1200 level), 550 feet above the Dewey tunnel, is driven on the Trade Dollar vein for 3,900 feet (No. 20, Fig. 36). The Idaho tunnel (No. 6, Fig. 36), a crosscut from the surface, intersects the vein 2,200 feet from the portal and a drift follows the vein to the south for 1,200 feet to join the Blaine tunnel on the 1200 level. On the 1200 level drifts follow the Alpine and Empire State veins. The 28 crosscut was driven 3,000 feet west from the 1200 level to intersect the Banner vein (Piper and Laney, 1926, p. 123).

On the 800 level of the Black Jack tunnel, a crosscut from the surface intersects the vein 900 feet from the portal where a drift extends to the south on the vein (Piper and Laney, 1926, p. 125). The mine is also opened by two higher adits that were used in the early history of the operation (Fig. 37).

The adit and crosscut levels are connected by raises, and intermediate levels were driven at 100-foot intervals. Drifts were driven north and south from a winze below the 1700 level (Fig. 37). Underground workings in the mine aggregate 60,000 feet (Piper and Laney, 1926, p. 125).

The Black Jack-Trade Dollar vein is enclosed by granitic rocks, basalt, and rhyolite (Fig. 37). Lindgren and Drake (1904, p. 4) note that there is little difference in the vein regardless of rock type. Piper and Laney (1926, p. 126) state, however, that the best ore is found in the granitic rocks. Figure 37 shows that the largest ore shoot, near the center of the mine, was localized in granitic rocks and the shoot rakes down the granite-basalt contact to the south.

In the lower levels of the Black Jack-Trade Dollar mine the vein follows a basalt dike in the granitic rocks. The dike merges with a basalt flow on the fifth level (Piper and Laney, 1926, p. 115).

The granitic rocks show slight chloritization of biotite, and kaolinization of feldspars by hydrothermal alteration. The basalt is chloritized; alteration may be slight next to the vein and intense several hundred feet away. The rhyolite is the porphyritic variety; it is the most altered of the rocks enclosing the vein. The rhyolite shows sericitization and silicification (Piper and Laney, 1926, p. 115-116).

The Black Jack-Trade Dollar vein strikes N15-30W and dips 75-80W; it is 1 1/2 miles long. The vein is narrow; it ranges from a seam to two feet in width (Lindgren and Drake, 1904, p. 5). Piper and Laney (1926, p. 117) note that the vein is

a filled fissure or mineralized breccia in the granitic rocks and basalt; it is a silicified shear zone in the rhyolite.

In the rhyolite the Black Jack-Trade Dollar vein is 3 to 16 feet wide; it averages 4 feet. The mineralized zone consists of stringers of quartz and valencianite; the stringers are separated by bands of intensely altered rhyolite. The walls of the vein in the rhyolite are definite to gradational (Piper and Laney, 1926, p. 117).

In the basalt the vein is a single filled fissure or vein breccia filled by quartz, valencianite or other minerals. The width of the fissure ranges from a seam to 6 inches. The breccia zone may be as much as 3 feet in width but not more than 12 inches of the whole is vein filling (Piper and Laney, 1926, p. 117).

In the granitic rocks the vein is tightly frozen to the walls; it ranges from a few inches to 2 1/2 feet in width. Where the vein follows the basalt dike it is separated from the dike by a thin seam of clay (Piper and Laney, 1926, p. 117).

Quartz is the predominant gangue mineral in the Black Jack-Trade Dollar vein. The quartz is crystalline to cellular; valencianite is locally abundant, especially near the southern end of the vein. At some places sericitic clay forms the entire vein filling, and it accompanies the quartz at other places. Minor epidote, chlorite, fluorite and vivianite are the gangue minerals (Piper and Laney, 1926, p. 118).

Ore minerals in the Black Jack-Trade Dollar include native gold and silver, cerargyrite, argentite, naumannite, proustite, polybasite, stephanite, pyrite, chalcopryrite, sphalerite, galena, jamesonite(?) and clausthalite (Piper and Laney, 1926, p. 118).

Native gold was mined near the surface in the Black Jack-Trade Dollar, but its importance decreased with depth where wire silver became relatively abundant. The silver and gold in the upper levels are probably supergene. The depth to which oxidation and enrichment were effective is unknown. The deeper levels of the Black Jack-Trade Dollar carried small but constant amounts of chalcopryrite, sphalerite, galena and pyrite along with naumannite, less argentite than in the higher levels, proustite, pyrargyrite, polybasite and cerargyrite (Piper and Laney, 1926, p. 118).

Lindgren (1900, p. 138) notes only argentite and chalcopryrite with some galena, sphalerite and pyrite in the Black Jack-Trade Dollar vein. The argentite is in finely divided grains. Lindgren adds (p. 138) that quartz and valencianite are the principal gangue minerals. The quartz occurs as crusts and projecting crystals.

Lindgren (1900, p. 142) gives the average grade of the Black Jack-Trade Dollar vein as 40 ounces of silver and 0.25 ounces of gold per ton. In contrast to many other mines in the district gold is a relatively minor constituent. For the total production Piper and Laney (1926, p. 118) fix the gold to silver ratio as 1:138.6.

Figure 37 shows the areas stoped during operation of the Black Jack-Trade Dollar mine. The figure indicates that there are four ore shoots that rake about 45 degrees south in the vein. One large shoot occurs near the center of the mine and there are three smaller ones. The shoots were strongest between the 10th and 12th levels.

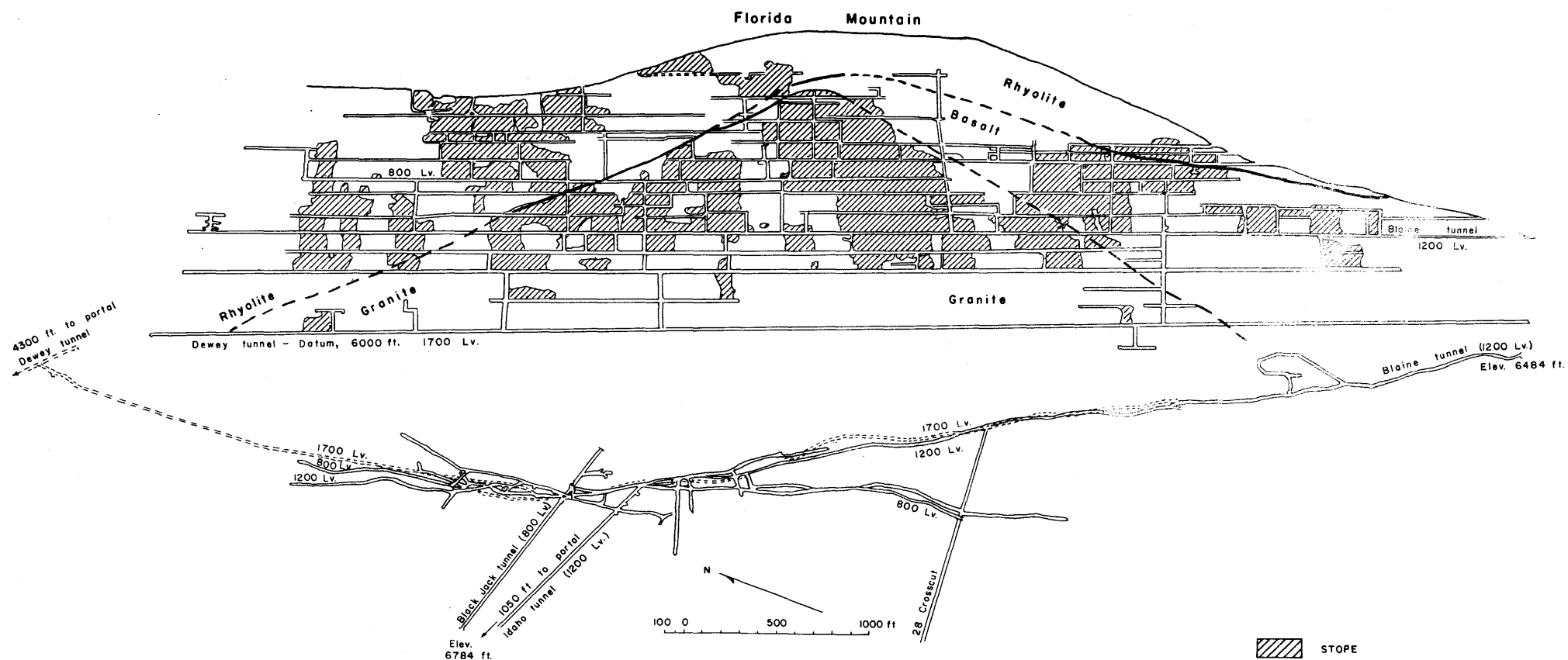


Figure 37 — Composite plan and longitudinal section, Black Jack-Trade Dollar Mine, Silver City Region, Owyhee County, Idaho. (From Piper and Laney, 1926, Pl. XIII — Rock contacts from Lindgren, 1900, Pl. XXV).

According to Piper and Laney (1926, p. 126) about two million square feet of vein area were stoped in the Black Jack-Trade Dollar mine. No post mineral fractures are known that disrupt the continuity of the vein (Piper and Laney, 1926, p. 116).

Little could be learned about the other veins and mines on Florida Mountain. The Alpine and Empire State veins were explored from the Black Jack-Trade Dollar workings, but the tenor of any ore developed or the nature of the veins are not known.

The Banner vein (No. 16, Fig. 36) is developed by five adits and a winze. The lowest adit is 600 feet below the apex on the surface; a 70-foot winze extends below the bottom level. The 28 crosscut was driven from the Black Jack-Trade Dollar to provide drainage for the Banner working (Piper and Laney, 1926, p. 128).

Bell (1908, p. 146) notes that the Banner vein is 15 to 20 feet wide and that the ore probably averages \$20 to \$30 per ton. In 1913 Bell (p. 144) states that the Banner vein is believed to be a wide fissure zone rather than a single vein like the Trade Dollar. At that time development was largely confined to one wall.

The Tip Top vein (No. 10, Fig. 36) is developed by a 280-foot shaft from which a short drift and crosscuts were turned. A 300-foot adit about 300 feet south of the shaft and at a higher elevation also penetrates the vein. The vein strikes N07E and dips 75°E.

According to Lindgren (1900, p. 146) the Tip Top vein contains a 4-foot streak of soft, white clay marked on the hanging wall by a 4-inch seam of black gouge and on the foot wall by a 2-inch seam of red clay that grades into porphyritic rhyolite. The vein matter is sericitic clay derived from the rhyolite by hydrothermal alteration. The 4 feet of clay carries gold; some high grade silver ore is in the black gouge on the hanging wall. The mine produced 8,000 tons of ore with an average value of \$16 per ton. According to Piper and Laney (1926, p. 129) the altered rhyolite that encloses the Tip Top vein carries a trace to 0.35 ounces of gold per ton at the surface over a wide area adjacent to the vein.

Piper and Laney (1926, p. 129) note that the Idawa (Silver City Mining and Milling Company, No. 21, Fig. 36) is opened by an adit, raises and drifts along two veins. Total development work is 2,000 feet.

In the spring of 1939, the Morrison-Knudsen Company, Inc. of Boise, Idaho, entertained the possibility of an open pit silver mine on Florida Mountain, and they entered into several lease-option agreements with owners of mining properties. The Banner group of claims, the Trade Dollar group of claims and the Trade Dollar Extension group of claims were under lease.

No mining was done on the Banner or Trade Dollar groups, but some testing and exploration by short shafts and trenches was completed. Based on incomplete information, samples were low grade; they ranged from \$0.02 to \$1.68 per ton and averaged \$0.40 per ton. No information is available on the locations or types of samples taken.

Material from the Trade Dollar Extension was mined and milled by Morrison-Knudsen during the fall of 1939. No data are available on the grade of material mined. The operation proved unprofitable and operations ceased in November, 1939. The above information was furnished by Morrison-Knudsen Company, Inc., Boise, Idaho.

Rich Gulch is on the west side of Florida Mountain (Fig. 8B). Near the south edge of the map area in sec. 2, T5S, R4W is the Rich Gulch mine. The Mine Inspector's report for 1912 (Bell, 1913, p. 142) notes that the vein is a fissure zone fully 50 feet wide that resembles the 77 vein at De Lamar. The zone has well-defined walls with ore well-defined along the margins. Values across the full width of the zone are not given.

The Ontario group of claims (No. 9, Fig. 36) is between Rich Gulch and the Black Jack-Trade Dollar mine. According to Bell (1913, p. 143), the vein contains small rich ore shoots accompanied by a large zone of highly altered rhyolite. The altered zone is said to be highly fissured and it carries low values through a considerable width. There are similar conditions on adjacent properties and there is much low grade ore in the fill in the upper levels of the Trade Dollar mine. Bell (1913, p. 143) suggests the possibility of large scale operations with high capacity mills.

In summary it can be said the Black Jack-Trade Dollar was the most important mine on Florida Mountain. The vein is narrow and the precious metal content decreases with depth; base metal content is notable on the lower levels. The Black Jack-Trade Dollar is probably depleted as far as precious metal content is concerned. The vein contains copper, lead and zinc minerals but the vein is too narrow to be mined economically for its base metal content.

The altered rhyolite and possibly the basalt on Florida Mountain carry low grade values in gold and silver, and there are several wide shear zones that carry low grade ore. One attempt at mass mining on Florida Mountain failed, but the possibilities are not fully exhausted. Wide shear zones occur in the Rich Gulch mine, in the Ontario and possibly in the Banner. A carefully designed exploration program might prove the feasibility of a large tonnage mining operation on the west side of Florida Mountain.

Veins on De Lamar Mountain

The mines on De Lamar Mountain are shown on Figure 38. The De Lamar mine (Nos. 17, 19, 20 and 24, Fig. 38) was the only mine of importance and the only mine on which information is extensive.

The De Lamar mine is developed by three adits from the north side of De Lamar Mountain. These are the No. 4 (Voschay) tunnel (No. 20, Fig. 38), the No. 8 (Wahl) tunnel (No. 19, Fig. 38) and the No. 16 tunnel (No. 17, Fig. 38). The No. 4 tunnel at an elevation of 6,244 feet, reaches the main lode in 625 feet; the No. 4 tunnel connects with the Sommercamp tunnel (No. 24, Fig. 38) that was driven from the south side of De Lamar Mountain (Fig. 39). The No. 8 tunnel, at an elevation of 6,041 feet, is driven 1,580 feet to the lode. The portal of the No. 16 tunnel is slightly south of the town of De Lamar and only a few feet above Jordan Creek; the elevation of the portal

1. Henrietta mill.
2. Garfield tunnel (Golden Cycle).
3. Golden Cycle.
4. Golden Cycle, south adit.
5. Belle Cora claim.
6. Webfoot adit.
7. Henrietta shaft.
8. Manifee tunnel.
9. Beck tunnel.
10. Lopley prospect.
11. Daisy claim.
12. Little Chief claim.
13. Silver Vault property.
14. Scadden prospect.
15. Chataqua adit.
16. De Lamar Mining Co. mill
17. De Lamar Mining Co. No 16 tunnel.
18. Alta property.
19. De Lamar Mining Co. No. 8 (Wahl) tunnel.
20. De Lamar Mining Co. No. 4 (Voschay) tunnel.
21. De Lamar Mining Co. No. 2 Sommercamp adit.
22. Hope vein crosscut.
23. M vein adit.
24. De Lamar Mining Co. No. 4 Sommercamp adit.
25. Cash prospect.
26. Stoddard adit.
27. Ohio adit.

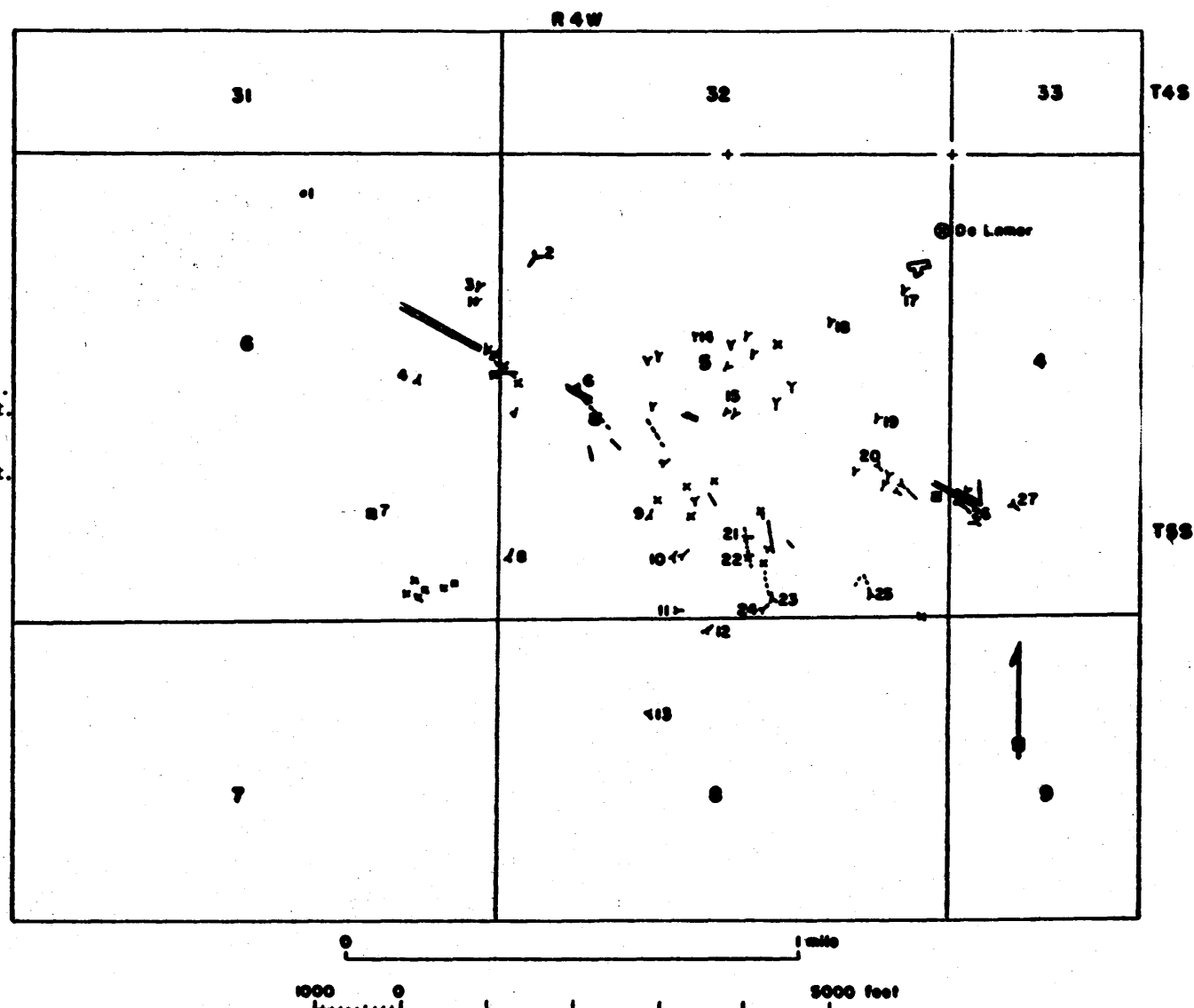


Figure 38 — Surface map showing locations of mines and veins near De Lamar, Silver City Region, Owyhee County, Idaho. (From Piper and Loney, 1926, Plate I, Quartz Reef from Lindgren, 1900, Plate XX).

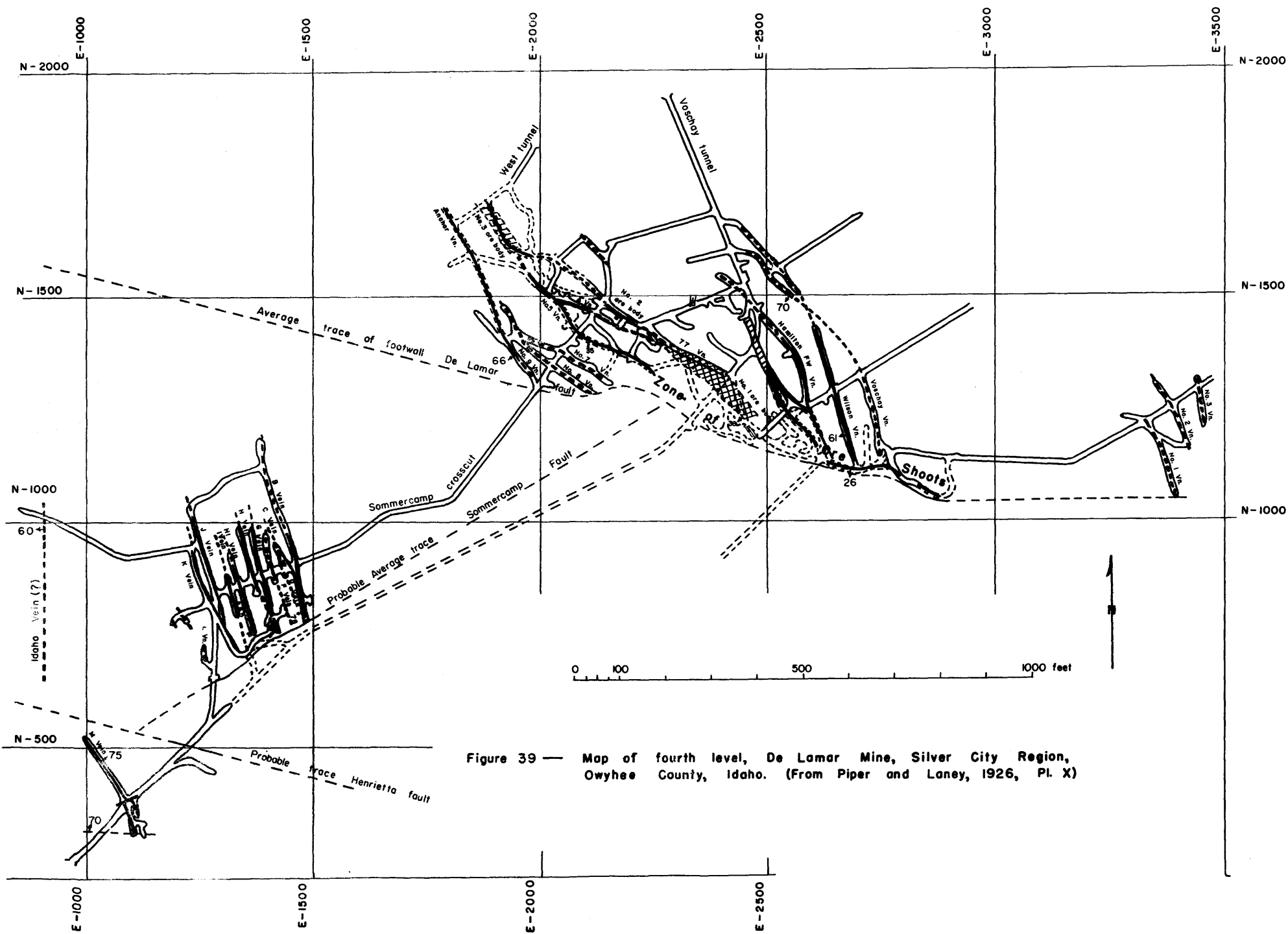


Figure 39 — Map of fourth level, De Lamar Mine, Silver City Region, Owyhee County, Idaho. (From Piper and Laney, 1926, Pl. X)

is 5,540 feet. The No. 16 drift turns east 3,240 feet from the portal and intersects the lode in 900 feet. The main adits are connected by inclined raises and winzes from which eight levels are turned at vertical intervals of 45 to 60 feet. There are about 115,000 feet of underground openings in the De Lamar mine, but some of this footage is the result of duplication of caved drifts (Piper and Laney, 1926, p. 95).

There are two sections in the De Lamar mine; these are the Sommercamp section and the main De Lamar mine or old mine section (Fig. 29). The main mine shows two vein systems; the Hamilton-Wilson-No. 9 vein system that strikes about N25W and dips 45 to 66° W on the fourth level and the 77 vein that strikes N62W and dips 35° W on the fourth level (Fig. 39). Dips steepen with depth on both vein systems. In both the Sommercamp section and the main mine the veins are interlinked and merge with each other in both the horizontal and vertical planes (Piper and Laney, 1926, p. 104).

In the eastern part of the main mine the veins are filled fissures with sharp walls, but where the veins are widest the walls are gradational into silicified rhyolite. The western part of the main mine was known as the "banded country" to the early miners. The name refers to the fact that the wider veins are silicified shear zones with several quartz stringers separated by bands of altered rhyolite (Piper and Laney, 1926, p. 105).

The Sommercamp section includes 10 interlinked veins that strike N18W and dip 65-80° W. The L vein is north of the Sommercamp fault (Fig. 39); it dips 70° E. Information as to whether the Sommercamp veins are filled fissures or shear zones is not available.

The veins of the De Lamar mine are in Silver City rhyolite, mostly of the porphyritic variety (Piper and Laney, 1926, p. 100). In the No. 16 adit one wall of the 77 vein is in what Piper and Laney refer to as tuff (1926, p. 100); the rock is probably what I mapped as the aphanitic variety of the Silver City rhyolite. No definite relation was established between rock type mineralization at De Lamar. The ore mined was within the relatively down-dropped block of porphyritic rhyolite in the footwall of the De Lamar fault; hence the nature of the vein in the aphanitic rocks is not known. The rhyolite is highly sericitized and silicified near the veins.

According to Lindgren and Drake (1904, p. 5) the De Lamar mine came into bonanza ore in 1890. In seven years the mine produced \$6,000,000; most of the values were in gold but silver exceeded gold by weight. Piper and Laney (1926, p. 95) calculate the gold to silver ratio as 1:15 for the total production of the mine, but the ratio was variable through the mine. It ranged from 1:25.6 in 1892-1893 to 1:1.7 in 1901-1902. Table 1 shows that in the 77 vein the gold content was about the same, approximately 0.50 ounce, on all the levels, but silver values decreased with depth. On the No. 9 vein values are more variable, but gold is more uniform than silver; silver values increase with depth.

The dominant gangue mineral at De Lamar is quartz of the cellular variety. In the main De Lamar mine the plates are commonly shattered and broken. A plastic white sericite or mixture of kaolin and sericite accompanies the quartz at places.

The sericitic material follows the vein walls or is within the quartz (Piper and Laney, 1926, p. 106).

The metallic minerals in the veins at De Lamar are rarely visible to the unaided eye. Piper and Laney (1926, p. 106) list the following minerals as supergene: native gold and silver, argentite (naumannite?), cerargyrite and marcasite (hypogene?); hypogene minerals include: native gold, electrum, argentite(?), naumannite, mlargyrite, pyrargyrite, proustite, jamesonite, polybasite, pyrite, and marcasite. Piper and Laney (1926, p. 106) note that the vein is oxidized above the fourth level of the De Lamar mine.

The following description of the more important veins in the De Lamar mine is summarized from Lindgren (1900, p. 126-127):

Voschay vein - known only above the fourth level, small in value and size.

The Wilson vein - contains one ore shoot above the fifth level. On the No. 3 level it is 9 feet wide and assays \$16 in gold and \$4 in silver per ton. (Silver was valued at about \$0.50 per ounce).

The Hamilton vein - contained one of the main ore shoots; relatively high in gold. It is known to the ninth level. The shoot contains 2 to 6 feet of \$12 to \$20 ore. Some stopes are 12 feet wide, and the vein is divided by one or more horses. At the "iron dike" (De Lamar fault) the vein contains argentite, ruby silver and bands with coarse native gold. Above the third level is a body of low grade quartz containing rich seams; seams of clay along the hanging wall are rich in silver.

The 77 vein - the principal vein in the mine. The vein is 60 feet wide at places; it contains much low-grade quartz and masses of altered rhyolite. One large ore shoot is on the hanging wall; the shoot extends from the first to the tenth level. There are smaller intermediate shoots near the center of the vein. Where it was mined, the hanging wall shoot contained from 4 to 30 feet of \$20 to \$50 ore. Between levels 4 and 7 there was a large tonnage of \$8 to \$20 ore in a footwall shoot. In 1897, the vein was being stoped above the fourth level; stopes were 20 feet wide, the ore was separated by horses of altered rhyolite. The ore was in streaks of quartz 1/2 to 4 inches wide separated by reddish clay.

No. 9 vein - contained a shoot of \$30 ore, 4 to 10 feet thick and 220 feet long. The shoot extends from level 4 to 40 feet below level 9.

Much of the rich silver ore taken from the De Lamar mine was extracted where the veins contact the De Lamar fault. Local bunches and seams of "silver talc" (sericitic clay containing very high silver values) 1 to 20 inches wide were encountered. The seams carried up to \$500 per ton in silver and very little gold (Piper and Laney, 1926, p. 108).

Accurate stope maps or longitudinal sections were not kept systematically when the De Lamar mine was in operation (Piper and Laney, 1926, p. 109). Consequently information on the distribution and shape of ore shoots is not available. The ore shoots mined were continuous within zones a few hundred feet wide in the footwall

TABLE 1. Approximate character of stopes and ore on the 77 and No. 9 veins, De Lamar mine, Silver City Region, Owyhee County, Idaho (From Piper and Laney, 1926, p. 107-108)

Level	Year or Period	Width	Ozs. Gold	Ozs. Silver
<u>77 vein</u>		Ft. - In.		
4	1893	12-0	0.50	18.0
4	1898-1900	3-2	0.57	1.3
4	1904	4-3	0.56	1.4
4	1907	4-2	0.50	0.4
5	1893	9-0	0.60	18.0
5	1898-1902	4-1	0.52	2.1
5	1908	1-6	0.99	3.9
6	1893-1894	24-0	0.41	50.5
6	1898-1902	3-7	0.51	1.7
7	1898-1902	4-7	0.45	2.8
8	1898-1901	6-8	0.38	2.8
8	1908	2-0	0.58	0.4
9	1900-1901	5-5	0.62	3.3
10	1900-1901	4-3	0.59	2.8
12	1899-1900	2-9	0.52	2.7
<u>No. 9 vein</u>				
4	1899-1904	3-4	0.74	1.7
6	1900-1904	3-6	0.56	1.5
6	1907	1-0	1.00	1.8
7	1895-1896	5-0	1.14	7.8
7	1900	3-0	0.53	1.6
7	1904	1-9	0.45	1.1
8	1895-1896	5-6	1.14	9.8
8	1899	2-9	0.55	1.3
9	1895-1896	3-0	1.10	8.0
10	1896	3-0	1.13	7.6

of the De Lamar and Sommercamp faults (Fig. 39). The zone of ore shoots rakes 20 to 30° E and follows the footwall of the De Lamar fault. The greatest width of the zone of ore shoots was on the fourth level; the width decreases above and below that level. Three ore bodies were found on the 77 vein, the most distant was 900 feet from the De Lamar fault. The Wilson, Hamilton, No. 5, and No. 9 veins show ore bodies 265, 415, 485 and 450 feet wide respectively, but in general the zone of ore shoots is from 200 to 400 feet wide in the main mine, and it averages 180 feet in the Sommercamp section (Piper and Laney, 1926, p. 109).

The relatively flat eastward rake of the zone of ore shoots was not recognized by the operators of the De Lamar mine. The De Lamar fault was not reached by developments below the 10th level, and prospecting below the 10th level was restricted to the 77 vein. The 77 vein was barren on the 16th level, but as Figure 40 shows, the workings did not reach the projected intersection of the 77 vein and the De Lamar fault. The 12th and 14th levels follow the 77 vein, but the workings are also west of the projected position of the eastward-raking ore shoot on the footwall of the De Lamar fault.

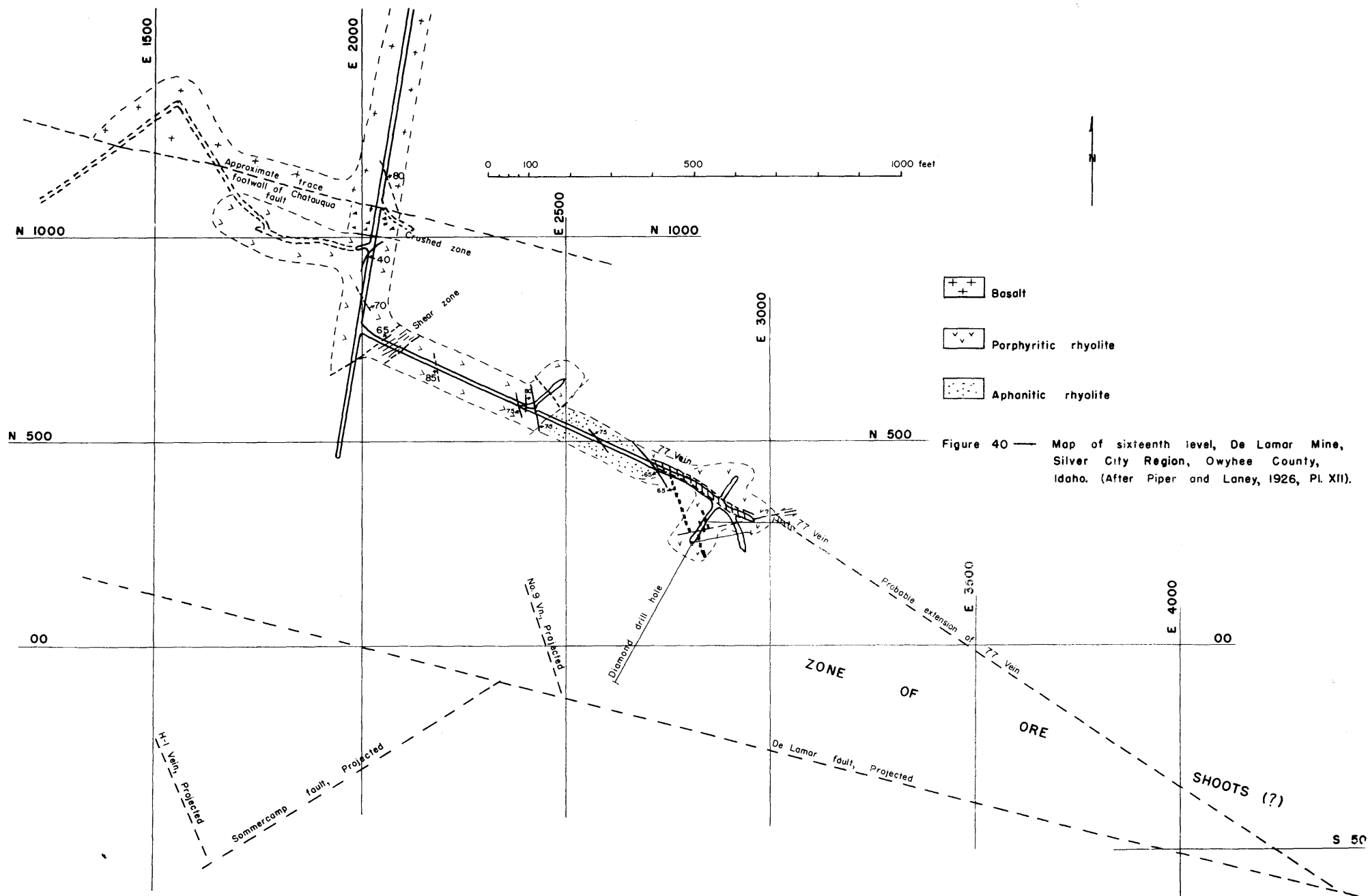
The Henrietta mine (No. 7, Fig. 38) is on the south side of De Lamar Mountain. The Henrietta was primarily a silver mine; the ore contained insignificant values in gold (Lindgren, 1900, p. 132).

The Henrietta mine was discovered about 1875, it is one of the oldest mines in the De Lamar area. Ore was extracted from four shafts, each about 100 feet deep (Lindgren, 1900, p. 132). No details are available on the early operations. In 1880 the present Henrietta shaft (No. 7, Fig. 38) was sunk to 150 feet and a mill built on Jordan Creek. In 1887 the shaft was sunk to 300 feet and a 75-foot winze was sunk from the lowest level. Very little ore was extracted, however. The shaft is vertical for 70 feet and then inclined slightly south; it leaves the vein 150 feet below the surface. Drifts follow the vein for a maximum of 200 feet (Lindgren, 1900, p. 132). In 1896 and 1897, 150 tons of ore were shipped from the Henrietta, the ore probably averaged \$100 per ton (Lindgren, 1900, p. 132).

The Henrietta vein has a general northwest strike and it is nearly vertical. West of the shaft (No. 7, Fig. 38) it terminates against a fault that dips 60°N (Lindgren, 1900, p. 132). The fault resembles an "iron dike" fault, but it is not likely that it is the Henrietta fault; in the No. 4 Sommercamp adit the Henrietta fault dips approximately 30° S.

The Henrietta vein is narrow; it is commonly a few inches wide, although it may reach two feet in width. The walls of the vein are not well defined.

The country rock surrounding the Henrietta vein is Silver City rhyolite. Mapping indicates that it is the aphanitic variety. Lindgren (1900, p. 132) notes that the country rock is laminated and shaly in appearance. Above (south and east of the mine) the rock becomes dark colored and massive; in the early days rich float mantled the surface. An adit was driven into the hill above the Henrietta, because of the presence of the rich float; the adit shows massive siliceous rhyolite containing thin seams of barite (Lindgren, 1900, p. 132).



Near the Henrietta vein the rhyolite is generally fresh, but in some places it is bleached and contains small pyrite cubes. The rhyolite itself may then be low grade ore (Lindgren, 1900, p. 132).

The ore extracted from the Henrietta mine contained sulpho-antimonides of silver that could not be reduced by roasting; hence a product was shipped. Because of transportation conditions at the time, the cut-off grade was about \$75 per ton (Lindgren, 1900, p. 132). Lindgren (p. 132) notes that there is considerable second class ore as reserves.

The Henrietta vein contains quartz in irregular lenticular bodies. The quartz is fine-grained; it may occur as a solid mass filling the vein, but more commonly it is as crusts a few inches wide tightly frozen to the walls. The quartz contains scattered grains of pyrargyrite, miargyrite, and rare pyrite; these minerals may also occur on the surface of the quartz as beautiful crystals. The space between the crusts of quartz may be filled by soft, white clay that contains rich silver sulphides distributed through it as tiny black specks. The clay is very soft and when a fissure was opened the clay would flow out of the vein. Some of the fissures from which the clay flowed were several feet long and up to 8 inches wide. An analysis by Lindgren (1900, p. 133) shows that the clay is a mixture of sericite and kaolin. At places several crusts of quartz are separated by soft gouge and at other places rounded masses of crusty quartz are covered by rich sulphides. The quartz never shows comb structure; it is a very fine-grained smooth mass that breaks with conchoidal fracture.

The grade of ore in the Henrietta mine is not precisely known. According to Lindgren (1900, p. 133), the vein carries \$3 to \$4 in gold per 100 ounces of silver per ton. Lindgren (1900, p. 133) notes a report that there is more gold at depth than near the surface.

Lindgren (1900, p. 133) attributes the peculiar texture and structure of the vein to the replacement of previous gangue and ore minerals by quartz. It is thought that barite may have been the previous mineral because barite is in the vicinity (Lindgren, 1900, p. 133).

The Silver Vault is a half-mile southeast of the Henrietta mine and 200 feet higher (No. 13, Fig. 38). It was discovered in 1870 and silver ore valued at \$30,000 was extracted. The vein and mineralization are similar to the Henrietta (Lindgren, 1900, p. 133).

The Lepley group of claims includes the Chatauqua adit, the Lepley prospect and the Beck tunnel (Nos. 15, 10, and 9 respectively, Fig. 38). The Lepley claims were intended to cover the westward extension of the De Lamar vein system. The claims are developed by the Chatauqua adit, which is 1,700 feet long (Lindgren, 1900, p. 130).

According to Lindgren (1900, p. 130) the Chatauqua adit is in fairly fresh, grey, banded rhyolite containing a few small quartz crystals; it is probably the aphanitic variety. The adit trends N56W for 1,500 feet where a raise reached the

surface. At the raise the adit turns to the west and enters a zone of greenish clay that contains pyrite. The zone is similar to the De Lamar fault zone. In the clay are two fault planes separated by 20 feet of comparatively fresh rhyolite. The fault planes dip 26° SW. A small band of typical laminated quartz is enclosed in the footwall of the clay zone. Lindgren notes (1900, p. 130) that veins parallel to or identical with the De Lamar vein occur in the drift but they lack the strong development of the De Lamar veins.

The Garfield, the Golden Cycle and the Belle Cora mine workings belong with the Garfield group of claims (Nos. 2, 3, and 5 respectively, Fig. 38). The claims are developed by the Garfield tunnel that is driven from the northeast side of De Lamar Mountain for 1,500 feet. The first 1,000 feet of drift is in basalt; the contact between the basalt and the overlying rhyolite dips 45° S (Lindgren, 1900, p. 131).

The Belle Cora adit is driven from the southwestern side of De Lamar Mountain N55E for 600 feet. The first 150 feet of drift is in talus. The remainder is in fresh grey rhyolite that is cut by joint planes dipping 45 to 60° SW. Some veins of soft sericitic clay, with pyrite, parallel the joints; the veins are a few inches to 2 feet in width. The largest vein is 10 feet wide, it begins 150 feet from the portal. The vein consists of altered rhyolite with abundant pyrite (Lindgren, 1900, p. 131).

The purpose of the Garfield and the Belle Cora tunnels was to develop a vein that appears at places along the summit of De Lamar Mountain as heavy outcroppings of laminated quartz. Lindgren (1900, p. 131) notes that the vein trends N62W (hence it parallels the 77 vein); the outcrops stand vertically for 150 feet and then dip to the southwest. On the Webfoot claim, the quartz is 15 feet wide, on the Belle Cora the aggregate width of the vein is 150 feet (Lindgren, 1900, p. 131). The quartz is very low grade, but it carries some gold and silver. As Lindgren states (1900, p. 131): "It is somewhat remarkable that no corresponding vein has been developed by either of the tunnels" (the Garfield or Belle Cora). Where the vein is not shown on the map (Fig. 38), croppings appear over a large extent of the surface. Most of the loose fragments consist of altered and pyritiferous rhyolite; some of it is silicified and shows vugs and streaks of quartz. There are also large masses of laminated quartz (Lindgren, p. 132).

The Stoddard adit (No. 27, Fig. 38) was evidently driven to explore the same quartz structure found in the Garfield and Belle Cora. No reports on the Stoddard are available.

In summary, it can be said that the De Lamar mine was the only mine that had a significant production record in the De Lamar area. Rich ore shoots on the veins are controlled by the De Lamar fault, but the shoots have not been adequately explored below the 10th level. Ore shoots on the veins are closely spaced and a zone of ore shoots parallels the footwall of the De Lamar fault. The zone rakes to the east. Ore reserves in the De Lamar mine are not exhausted. Analysis of available information and careful projection of the zone of ore shoots along the footwall of the De Lamar fault would lead to a highly potential exploration target that could yield a large ore body adaptable to high tonnage mining and milling techniques. Continental

Materials Corporation of Grand Junction, Colorado, has been engaged in an exploration program of the De Lamar area for the past several years and a diamond drill project is currently (1966) under way.

The Henrietta and Silver Vault veins may still contain some high-grade pockets of ore, but the veins are narrow. Consequently they are not highly attractive exploration targets.

Little information is available on the large quartz reef that outcrops along the summit of De Lamar Mountain. As Lindgren noted the croppings are very low grade and do not seem to persist in depth. It is possible that the vein has a low southern dip and the adits designed to explore it were in the footwall of the vein. Without a detailed sampling program, the potential of the vein or the large area of pyritized, silicified rhyolite that occurs between the quartz outcrops cannot be fully evaluated.

SILVER-GOLD MINERALIZATION NORTH OF THE OLD MINING AREAS

Introduction

A number of prospects and mineralized areas are outside of the old mining areas that are centered around Silver City and De Lamar. Most of the prospects are on the west side of the Owyhee Mountains, but one is on the east side.

Most of the prospects are in Silver City rhyolite, but some are in the Silver City Granite. Several of those in the rhyolite are nothing more than pyritized breccia zones with possible low values in gold. Descriptions and locations of each prospect or mineralized zone visited is included to make the record complete.

Because of limited facilities, extensive quantitative analyses of samples could not be made. I analyzed 50 samples on an atomic absorption unit and semi-quantitative results were obtained. Because of time limitations on the availability of the atomic absorption apparatus, the precise results that the unit is capable of yielding were not obtained.

Pyritized Breccia Zone Near Wagontown-Sec. 31, T4S, R4W

On the north side of the Sheaville-De Lamar road near the site of Wagontown (sec. 31, T4S, R4W, Fig. 8B), breccia zones occur in porphyritic Silver City rhyolite. The zones are composed of angular rhyolite fragments that are cemented by quartz with abundant pyrite. Material from the locality was examined with a binocular microscope, but no metallic minerals aside from pyrite, were noted. No analyses were made but the pyrite may be slightly auriferous.

The breccia zone is about 20 feet wide; it can be traced on the surface for about 150 feet. The zone is cut by vertical joints that strike N30W. A caved shaft and several pits are in the breccia zone.

There is a zone of similar material about 700 feet north of the breccia zone along the road (Fig. 8B). This zone can be traced by intermittent exposures for about 2,000 feet. Because of alluvial cover, contacts are not clear, but the zone is possibly one hundred feet wide. Several old adits penetrate the breccia.

One adit, at the west end of the zone, is open and accessible (Fig. 8B). Both walls of the adit show brecciated, silicified rhyolite. The breccia fragments are surrounded by a thin coating of soft, white clay. The clay contains disseminated, tiny, black blebs and specks that may be argentite. A narrow fault, which trends N50E and dips 50° W, is partially filled with a similar white clay. The clay in the fault is 6 to 8 inches in width. Detailed mapping and sampling of this zone might prove that there is mineable ore in the deposit.

Breccia Zones in Sec. 25, T4S, R5W

There are two pyritic breccia zones in the south half of sec. 23, T4S, R5W (Fig. 8C). The easternmost exposure is in highly siliceous, brecciated, cherty Silver City rhyolite. A large bulldozer pit exposes the mineralization in an area about 1,000 by 500 feet.

Loose rock fragments in the pit are crossed by veinlets and bands of white chalcocite quartz with thin seams of argentite or other silver minerals disseminated in the bands. The quartz veinlets are 2 to 3 inches in width. In some specimens discrete veinlets of argentite(?) are in the quartz bands. Pyrite is widespread throughout the exposure as veinlets and disseminations. No mineralization was found in place, hence the full limits of area of mineralization are not known. Loose silicified float occurs over much of the pit. The evidence indicates that there is a large zone of disseminated mineralization. Two selected samples gave silver values of 17 and 12 ounces per ton.

North of the bulldozer cut is a caved adit. The adit is about 50 feet lower in elevation than the cut. About midway between the pit and the adit is an old shaft. The dump at the adit shows basalt, which indicates that the rhyolite may not be much more than 50 feet thick. No mineralization was noted in the basalt on the dump.

Another caved adit is about 2,000 feet west of the bulldozer pit just described. Material on the dump indicates that the adit was driven in a pyritized breccia zone, although there are no indications of such a zone on the surface.

Veins in Secs. 19 and 30, T4S, R4W

North of Wagontown in Secs. 19 and 30, T4S, R4W (Fig. 8B) there are two veins that show cellular quartz. At the south end of the prospect three shafts have been sunk on the veins and there are several shallow prospect pits along their length. Further north there is a small mass of granitic rock that protrudes through the surrounding volcanic cover. One of the veins crops out in the granitic rock, and an adit is driven on the vein. Judging from the size of the dump the adit is 500 to 600 feet long. A second adit is driven in the Silver City rhyolite that crops out nearby (Fig. 8B).

Figure 41 is a sketch map of the south end of the vein occurrences in sec. 30. The dump at shaft A shows highly altered rhyolite with yellowish red limonite on the surface of the rock fragments. The rocks are sericitized.

Shaft B is inclined 60° W; it was sunk on the most northerly of the veins (Fig. 4).

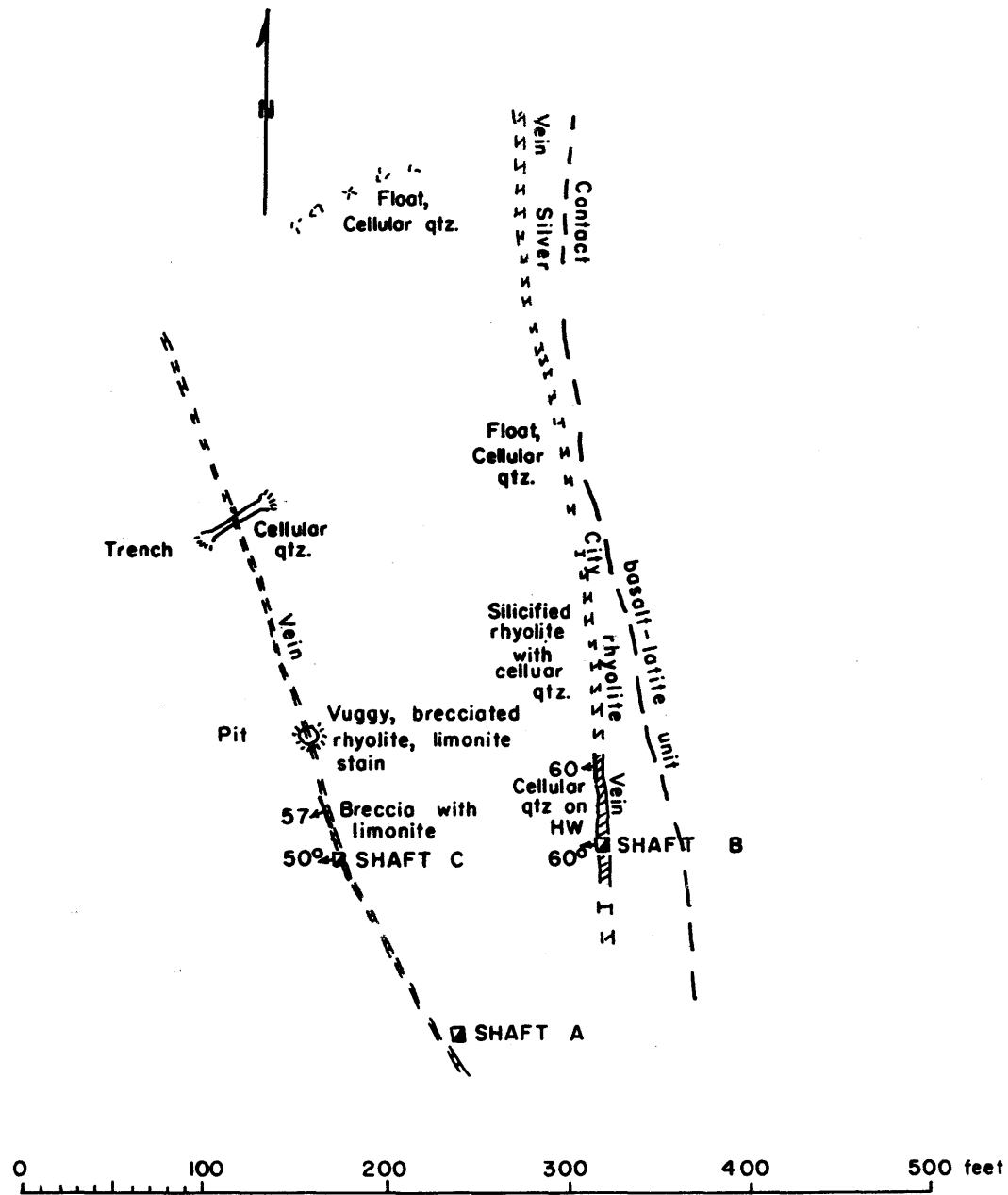


Figure 41 — Map showing veins in Sec 30, T4S, R4W, Silver City Region, Owyhee County, Idaho. (Compass and tape map).

The vein is about 6 feet wide, it shows white cellular quartz on the hanging wall and white siliceous rhyolite on the footwall. From float fragments and sparse outcrops of cellular quartz, the vein can be traced to the north for about 400 feet. The vein strikes north and dips 60° W.

Shaft C is about 150 feet west of shaft B on a different vein (Fig. 41). The shaft is inclined about 50° W down the dip of the vein. Pits and trenches expose the vein to the north from shaft C for about 350 feet; the vein probably extends to the south for 150 feet to shaft A. On the surface, the shaft C vein is expressed by a gossan zone of red limonite. Cellular quartz and brecciated quartz are also associated with the vein. The vein is about 4 feet wide; it strikes northwest and dips 50 to 60° W.

Rare float fragments indicate that the eastern vein, or vein at shaft B, continues to the north and that it is the same vein exposed in a small pod of granite in sec. 19 (Fig. 8B). A vein of white massive quartz about 50 feet wide is in the granitic rocks. Indications are that the vein is barren, however. The vein is not well expressed in the rhyolite flanking the granitic pod, but specimens from the dump of the old adit in the rhyolite show finely disseminated pyrite cubes in a mass of orthoclase or valencianite crystals.

That these veins have been explored is evident from the old shafts and adits in the vicinity. Nothing is known of their history. The veins have a considerable strike length and are worth further exploration.

In sec. 30, west of the veins just described, a short caved adit is near the summit of the peak (Fig. 8B). The dump at the adit shows brecciated rhyolite with much cellular quartz. The vein is not exposed on the surface.

Mineralization at Twin Peaks - Sec. 7, T4S, R4W

Eight short adits and prospect pits explore a zone of white siliceous, sericitic rhyolite on the south peak at Twin Peaks (Fig. 8B). The prospect pits are on the west side of the peak 150 to 200 feet below the summit; they are about 50 feet apart.

The rhyolite in the vicinity of the dumps is sericitized; many of the rocks have a white, chalky coating on their surface. The prospects are excavated in a volcanic dome of rhyolite. Disseminated pyrite is abundant in rock specimens from the dumps, and cellular quartz is common. The pyrite is generally associated with highly siliceous brecciated rhyolite. A semi-quantitative analysis of a specimen from one dump gave 17.0 ounces of silver per ton. The line of prospects trends about N40W across the slope of the peak. At one pit a poorly exposed, narrow fracture with cellular quartz strikes N45W and dips 30° W.

Near the head of Little Cow Creek, between the north and south peaks of Twin Peaks, an adit penetrates the north base of the south peak (Fig. 8B). Finely disseminated pyrite occurs in sericitized rhyolite on the dump. Analysis of a specimen

from the dump yielded less than 5 ounces of silver per ton.

Prospects On Tennessee Mountain - Sec. 26, T4S, R4W

Tennessee Mountain is north of Dewey and Florida Mountain (Fig. 8B). The veins on Florida Mountain trend directly toward Tennessee Mountain and it would seem that their continuation should be sought there. A number of pits, trenches and adits on Tennessee Mountain attest to the efforts of those seeking continuations of the Florida Mountain veins, but the seekers went unrewarded.

The rhyolite on Tennessee Mountain is severely altered, but mineralization is sparse. Several prospect pits and trenches expose narrow quartz-filled stringers, some of which carry disseminated pyrite.

On the east slope of Tennessee Mountain a crosscut and drift have been driven into the mountain for over 900 feet (Fig. 8B). The crosscut trends N55W for 750 feet from the portal; the drift trends N15E for 180 feet (Fig. 42). Approximately 550 feet from the portal a short drift follows a 2-foot gouge zone along a fault for 50 feet. The fault trends north and dips 55° E. The gouge contains silicified fragments of Silver City rhyolite. The footwall of the fault is sharp and well defined; the hanging wall is gradational with the rhyolite.

There is a narrow breccia zone approximately 665 feet from the portal of the adit. The zone is silicified and pyritized. A narrow fracture that trends N35W bounds the breccia zone on the northeast (Fig. 42).

A drift turns northeast 750 feet from the portal and follows a narrow seam of greenish clay that contains minor pyrite. The walls of the vein are in highly silicified rhyolite. The fracture strikes N15E and dips 75° W (Fig. 42).

No mineralization, other than pyrite, was observed on Tennessee Mountain. Assay data are not available, but the exploration work that has been done has disclosed only narrow seams with low values.

Veins on the East Fork of Reynolds Creek - Sec. 12, T4S, R4W

Near the head of the East Fork of Reynolds Creek, a small exposure of Silver City Granite protrudes through the surrounding basalt-latite unit (Fig. 8B). A vein of massive white quartz is enclosed by the granitic rocks. The vein strikes N20E and dips 75° SE. A vertical shaft is in the footwall of the vein near the southwest end. Black graphitic clay on the footwall shows vertical striae that represent slickensides. No metallic minerals were observed in the clay or in the vein.

A few hundred feet west of the vein a rhyolite dike, 200 feet wide, intrudes basalt and granitic rocks (Fig. 8B). An adit trends southwest in the dike along the southeast side, near the contact of the dike and the basalt. Sparse pyrite in sericitized rhyolite and chloritized basalt is on the dump.

At other places along the contact of the large dike in upper Reynolds Creek, are

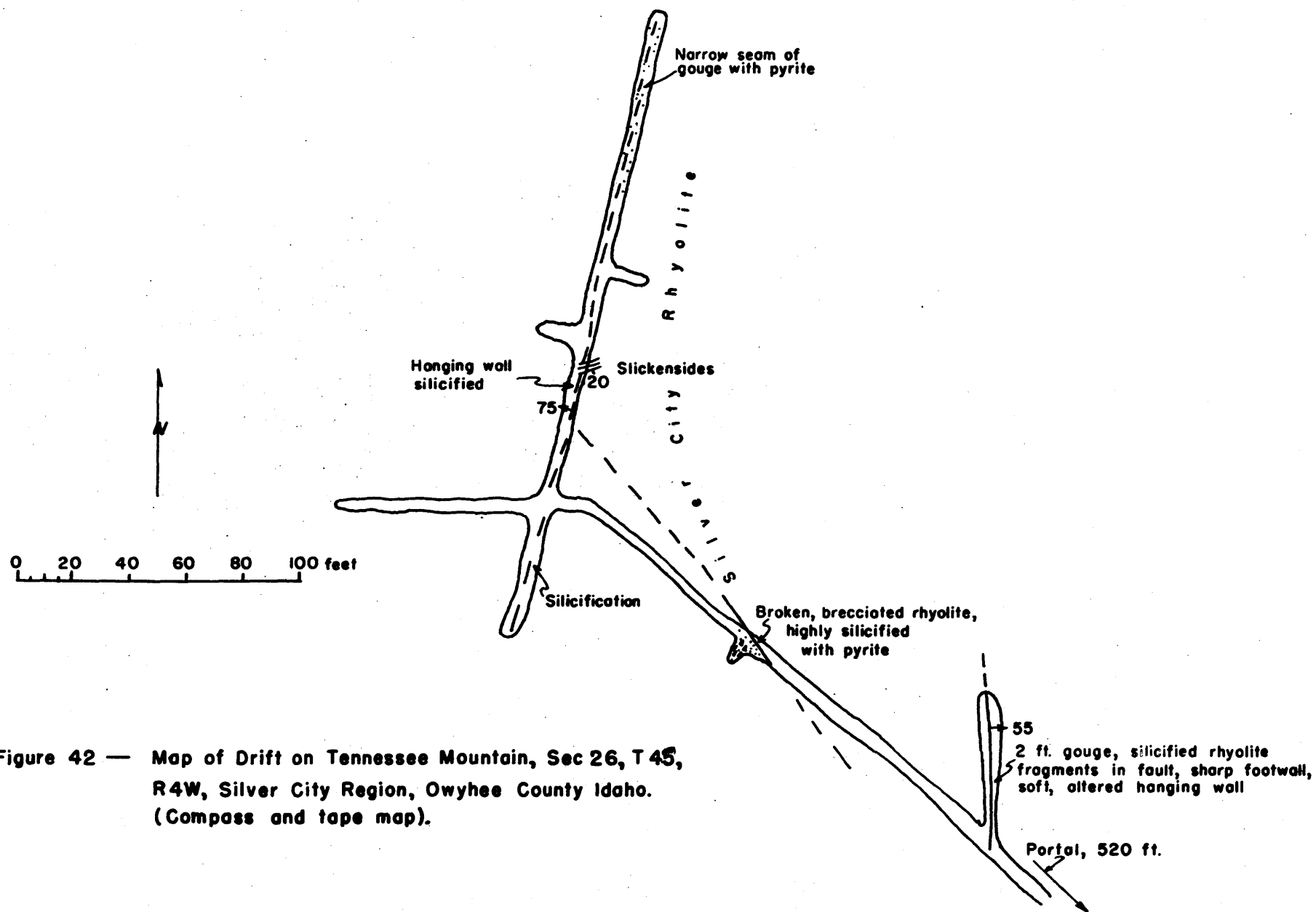


Figure 42 — Map of Drift on Tennessee Mountain, Sec 26, T45, R4W, Silver City Region, Owyhee County Idaho. (Compass and tape map).

minor fluorite and quartz veinlets. These occurrences are of local extent and contain no minerals of economic interest.

Matteson Mine - Sec. 30, T3S, R2W

Several old adits follow irregular narrow seams of quartz in granite at this locality in sec. 30, T3S, R2W (Fig. 8A). No metallic minerals were identified. Possibly the quartz stringers carry low values in gold.

Altered Granite - Sec. 28, T3S, R2W

A pod of granitic rock protrudes through the surrounding volcanic rocks in sec. 28, T3S, R2W (Fig. 8A). A red, highly siliceous material that resembles jasper litters the surface as float. The material was not found in place nor was it positively identified. No metallic minerals were found associated with the siliceous material.

ANTIMONY-SILVER VEINS

There is antimony-silver mineralization northeast of Silver City at the Black Horse mine, the Cosmopolitan mine, the Grey Eagle mine, the Nugent mine and at Slack Mountain.

Except for the Nugent mine the deposits are aligned on a N50E trend. The alignment suggests that the antimony veins follow a major structure and that their location is controlled by one of the early northeast fractures that cross the area. All of the known antimony mineralization is confined to granitic rocks.

Black Horse Mine, Sec. 3, T4S, R3W

The mineralization at the Black Horse prospect (Fig. 8A) is in highly silicified, coarse granodiorite. The rocks contain large cloudy feldspar crystals, partially altered to kaolin, and numerous small muscovite flakes in a highly siliceous groundmass.

Figure 43 is a sketch map of the locality. Several adits and pits expose quartz veins that contain stibnite as small irregular grains; bladed crystals are rare. There is a distinct vein in the northeast part of the locality that strikes N70E; it dips 25-35° S. The vein averages 2 feet in width.

Southwest of the vein is a mass of highly silicified, altered granodiorite (Fig. 43). The altered zone covers an area about 500 feet by 200 feet. The long axis of the zone extends to the southwest. A number of narrow siliceous veins trend northwest and dip 30-40° S within the zone of silicification. Sparse stibnite occurs in the veins and it is sparsely disseminated through the highly altered granodiorite that separates the veins.

A smaller mass of altered granodiorite occurs northeast of the large mass (Fig.

43). This mass contains one fairly continuous, narrow quartz-antimony vein that is enclosed by altered granodiorite. As in the other occurrences, small, sparse blebs of stibnite are disseminated through the mass. The vein strikes north and dips 20° E.

Cosmopolitan Mine, Sec. 8, T4S, R3W

Dilapidated mill and bunkhouse buildings mark the site of the Cosmopolitan mine. The mine is at the west base of the steep ridge surmounted by Little Sugarloaf (Fig. 8A). Two adits constitute the mine workings; in addition there are several pits and trenches north of the adits and at a higher elevation. Figure 44 is a sketch map of the locality.

The granitic rocks near the Cosmopolitan are fine-grained and display saccharoidal texture. The vein is not exposed at the surface, but stibnite is in rock fragments on the dumps of the two adits. The adits are aligned on a N50E trend, but the strike of the vein is unknown. Exploratory pits and trenches at higher elevations are northwest of the upper adit which indicates that the vein has a relatively flat dip to the southeast (Fig. 44).

Local residents report that the Cosmopolitan mine was originally developed for its gold content. Developments proved that the vein carries antimony with some silver, however.

About a thousand feet southwest of the Cosmopolitan mine buildings, a bulldozer cut exposes a quartz vein that carries excellent bladed stibnite specimens. The vein is exposed for only a few feet and it is less than a foot wide. Masses of bladed stibnite in a groundmass of quartz make up the entire width of the vein. This exposure strikes N50E and dips 25° SE. A semiquantitative analysis of a specimen from the bulldozer cut gave a value of 10 ounces of silver per ton.

Grey Eagle Mine, Sec. 17, T4S, R3W

Little is known about the Grey Eagle mine (Fig. 8A). An adit and shaft, both caved, are on the property. The workings are near a small stream and high water has washed away the dumps, destroying even this unsatisfactory method of evaluation. A few small pieces of material scattered over the surface show siliceous gangue with small grains of disseminated stibnite, which indicates that the Grey Eagle mine was also an antimony prospect.

Nugent Mine, Sec. 18, T4S, R3W

The Nugent mine is not on the trend of the other antimony prospects in the area (Fig. 8A). The mine is developed by an adit that trends west to northwest. Mineralization is sparse and the adit curves and bends in various directions for short distances; evidently the operators were exploring for continuations of vein structures (Fig. 45).

Excellent specimens of massive to delicately bladed stibnite are on the dump, but in the adit stibnite is sparse and in small pockets. The pockets of stibnite do

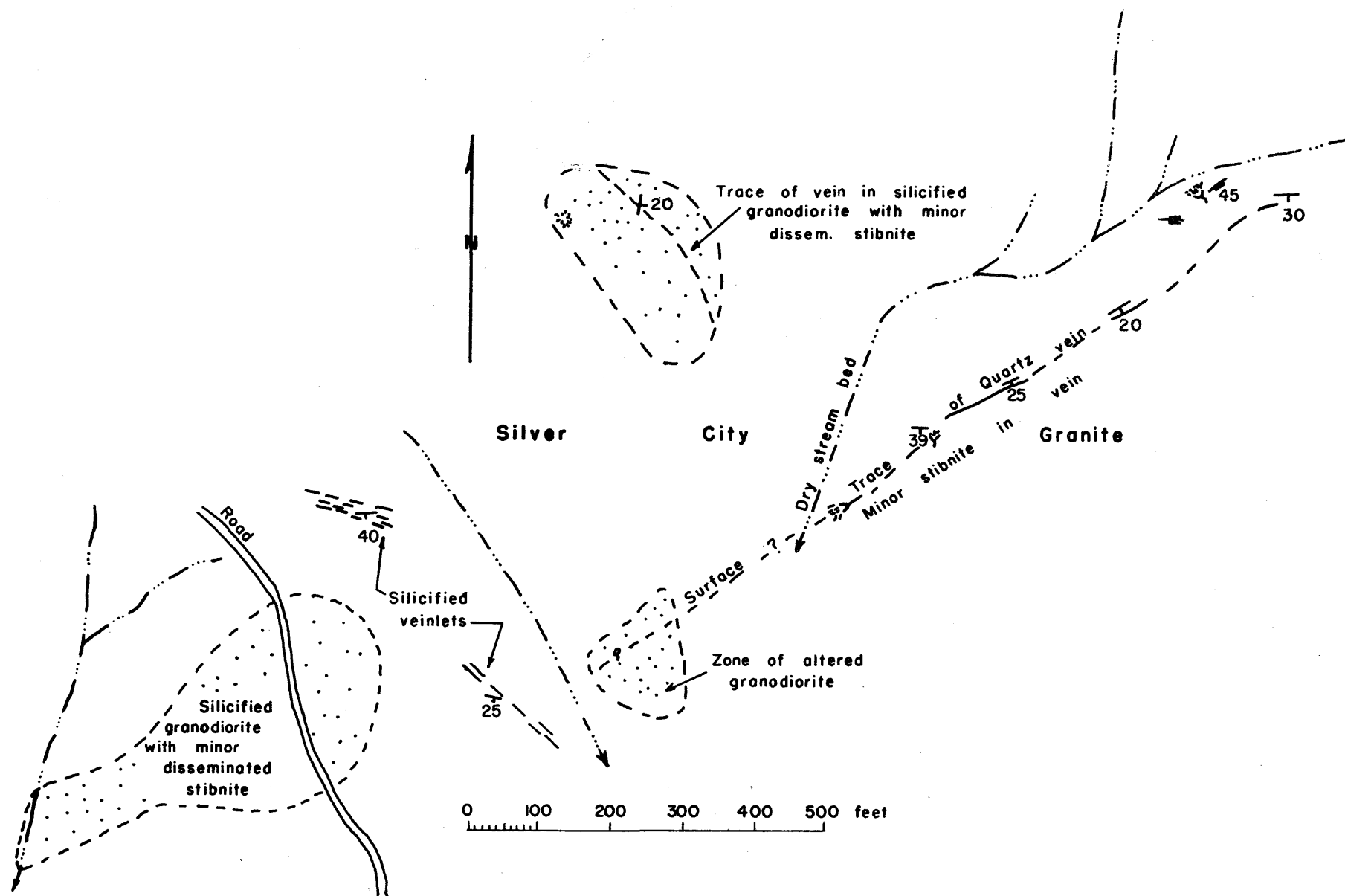


Figure 43 — Map of Black Horse antimony occurrence, Sec 3, T4S, R3W, Silver City Region, Owyhee County, Idaho. (Compass and tape map).

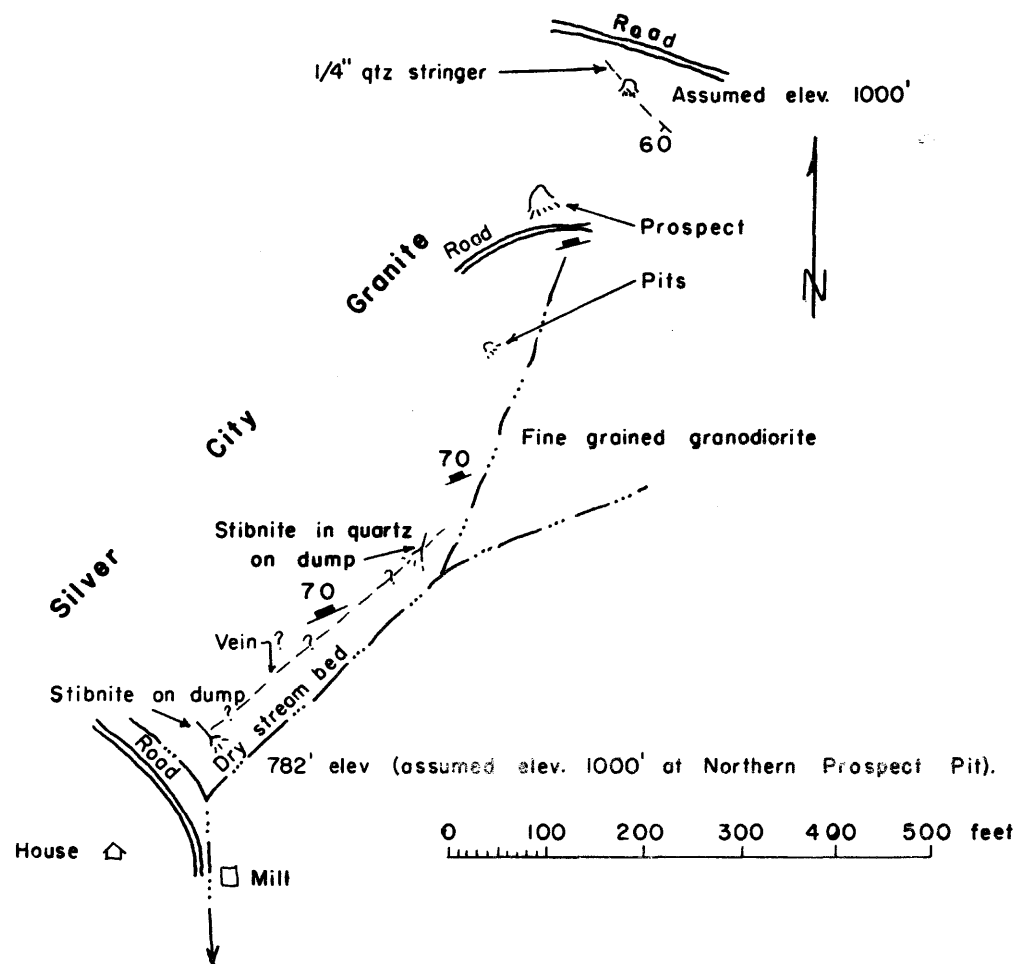


Figure 44 — Map of surface, Cosmopolitan Mine, Sec 8, T4S, R3W, Silver City Region, Owyhee County, Idaho. (Compass and tape map).

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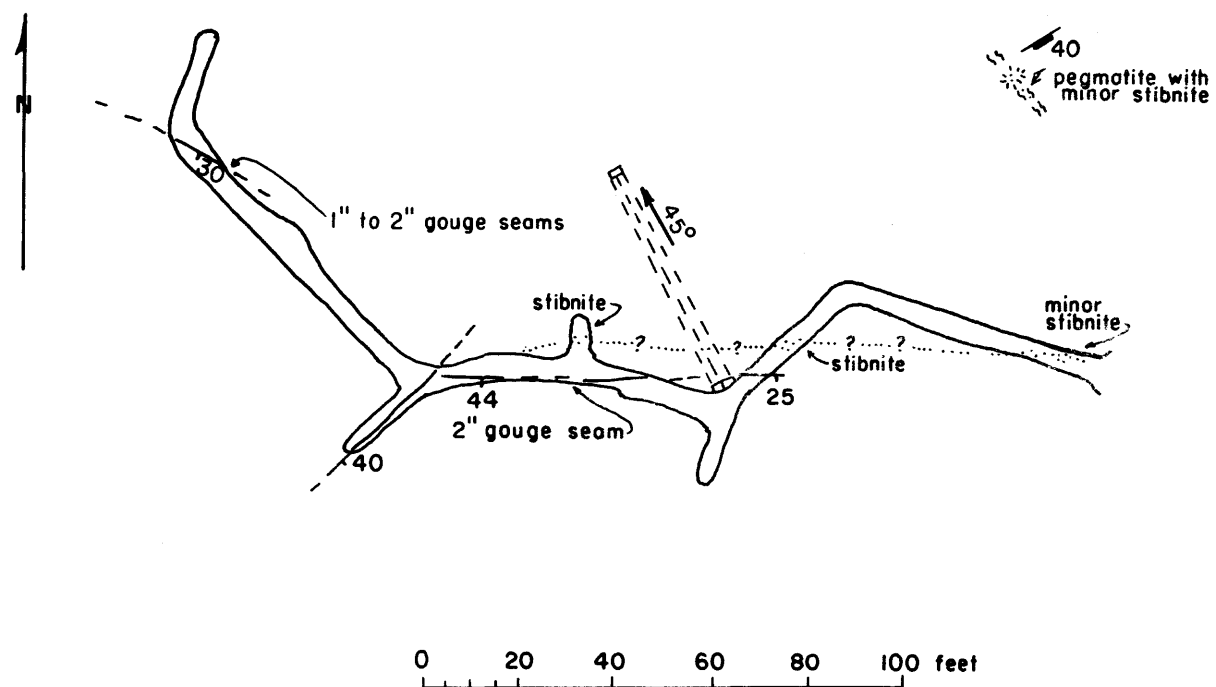


Figure 45 — Map of drift, Nugent antimony mine, Sec 18 T4S R3W, Silver City Region, Owyhee County, Idaho. (Compass and tape map).

not follow an identifiable, continuous vein structure. The western part of the adit trends north and crosses a narrow, barren, clay-filled seam about 2 inches wide (Fig. 45).

An irregular pegmatite dike occurs about 50 feet north of the portal of the adit. A small pit in the pegmatite shows minor stibnite (Fig. 45).

Prospects on Slack Mountain, Sec. 18, T4S, R3W

There are a number of pits, adits and shafts near the summit and on the north-western slope of Slack Mountain (Fig. 8A). Some of the excavations are in alaskite or pegmatite and some are in Silver City rhyolite (Fig. 46). Much of the work in the alaskite or pegmatite exposes no mineralization or vein structures.

A definite mineralized structure was not found on Slack Mountain, although cellular quartz occurs at some places as float or along narrow fractures. Specimens from the dumps of some of the workings show sparse, finely disseminated pyrite and rare stibnite in fine grains visible under a binocular microscope. The material on some of the dumps shows a yellowish-green stain that is characteristic of other antimony mine dumps in the area. The lowest and northernmost adit on Slack Mountain trends N55E with little deviation for over 100 feet. No vein is evident; several schlieren zones, quartz stringers and tight fractures, 1 to 2 inches wide, are exposed in the adit.

Two small masses of Silver City rhyolite are on Slack Mountain (Fig. 8A). Adits, shafts and pits have been excavated in the rhyolite (Fig. 46). The rhyolite is sericitized, silicified and slightly pyritized.

The dumps of the openings in the rhyolite show finely disseminated pyrite, some of which is in cubic crystals. No vein structure was noted on the surface but the adits evidently follow a structure containing abundant pyrite. Some crystalline quartz is in vugs and cavities in the rhyolite (Fig. 46).

LEAD - SILVER VEINS ON WHISKEY MOUNTAIN

The Monarca mine, the Berg mine, and the Ida Belle mine are aligned on a N30E trend in secs. 29, 20, 21 and 10, T3S, R4W on Whiskey Mountain (Fig. 8B). The Monarca and Berg mines are near the head of Succor Creek close to the Succor Creek-Reynolds Creek divide. The Ida Belle is on the Reynolds Creek side of the divide near the crest of the ridge.

Massive pyrite with galena, sphalerite and minor chalcopryrite are the metallic minerals in the veins. The ore also carries values in silver; the silver-bearing mineral was not identified. The alignment of the mines suggests that they are on the same structure; but, as in parts of the area, the vein is not well expressed at the surface.

The veins on Whiskey Mountain were discovered near the turn of the century

and mines were operated intermittently for brief periods. The mines have contributed an insignificant percentage to the total production record of the region.

The country rock is Silver City Granite. Schlieren zones in the granitic rocks are abundant, particularly near the Berg mine. The Silver City Granite is coarse-grained in the vicinity, and pegmatite dikes and irregular pegmatite stringers are common. No mineralization is in the basalt that intervenes between exposures of Silver City Granite (Fig. 8B).

Monarca Mine, Secs. 20 and 29, T3S, R4W

Several adits open the vein at the Monarca in sec. 20, T3S, R4W, (Fig. 8B). To the south in sec. 29, a number of pits and trenches have been excavated in unsuccessful attempts to locate a southern extension of the vein. The pits expose schlieren zones in the granitic rocks and coarse, weathered, but not hydrothermally altered, granodiorite.

The vein is exposed at one locality on the Monarca in an adit near the southeast corner of sec. 20, T3S, R4W. The entrance to the portal is a trench about 50 feet long that follows the vein. The adit is inaccessible from the end of the trench. The hanging wall of the vein strikes N31E and dips 72° E. The hanging wall is marked by black gouge that separates the vein from highly sheared, schistose granitic rocks. The footwall of the vein is sharp and it dips 60° E. The granitic rock on the footwall is fine-grained; it shows abundant muscovite and limonite. The vein structure in the trench is about 10 feet wide; the vein material breaks clean from the walls, hence the vein filling cannot be observed in place. The dump shows massive sulphides in a quartz gangue. The quartz is sparse; the bulk of the vein is evidently massive sulphides. The sulphide minerals include galena, sphalerite, pyrite and minor chalcopyrite. Pyrite is the most abundant mineral. A semi-quantitative analysis of an ore specimen shows that it contains about 9 ounces of silver per ton.

The dumps of the caved adits to the northeast show abundant pyrite, some galena and minor chalcopyrite disseminated in highly siliceous granite.

Berg Mine, Sec. 21, T3S, R4W

A shaft is the main development at the Berg mine. The shaft is inaccessible and bulldozer work has removed much of the dump. A few small specimens found on the surface indicate that the mineralization is similar to that at the Monarca.

A line of prospect pits and trenches continues northeast from the shaft (Fig. 8B). None of the pits expose the vein. Some pyrite is on the dump of a caved adit about 1500 feet northeast of the shaft.

The granitic rocks in the vicinity of the Berg mine range from schistose schlieren to medium-grained granodiorite. The granitic rocks are weathered but not hydrothermally altered.

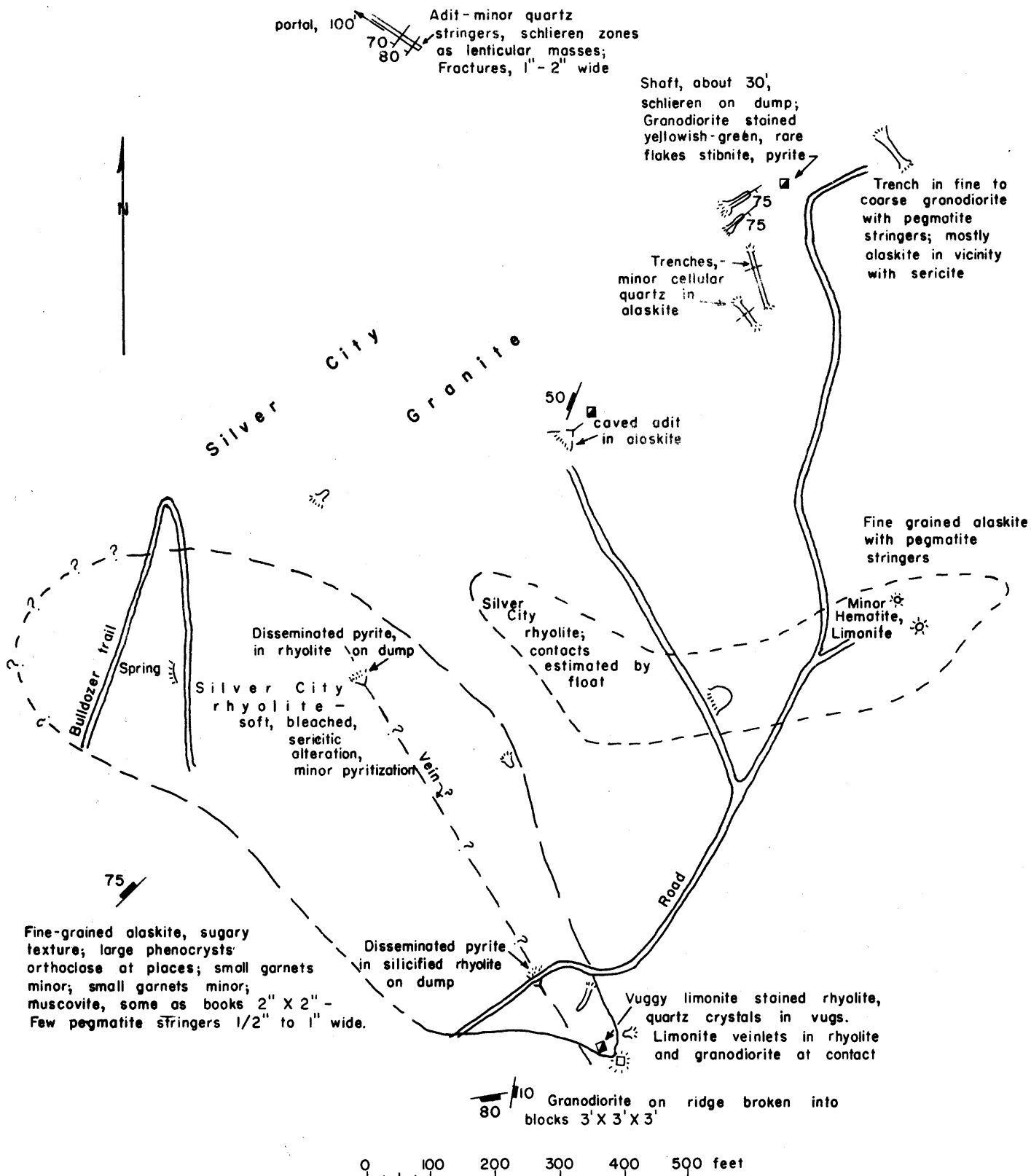


Figure 46 — Surface map showing prospects on Slack Mountain, Sec 18, T4S, R3W, Silver City Region, Owyhee County, Idaho. (Compass and tape map).

Ida Belle Mine, Sec. 10, T4W, R3W

An adit and an inclined shaft, both inaccessible, mark the site of the Ida Belle. Little was learned about this mine or the nature of the mineralization. The dumps show disseminated pyrite in siliceous Silver City Granite.

MERCURY PROSPECT, SEC. 20, T4S, R5W

Cinnabar is localized in highly siliceous, massive, cherty Silver City rhyolite about one and a half miles north of Wagontown (Fig. 8B). Prospecting by pits and trenches reveals that the cinnabar is localized as thin coatings along the faces of joint planes in the siliceous rocks.

Cinnabar and minor pyrite are exposed by prospect pits in an area about 500 feet by 500 feet. The full extent of the deposit is not known. The layer of cherty siliceous rocks overlies the basalt-latite unit that is not mineralized. The surrounding area to the north and east shows porphyritic to nodular rhyolite that is also barren of cinnabar. The areal extent of the deposit may be extensive, but the thickness of the mineralized zone is limited; it is probably about 30 feet. The average grade of the deposit is unknown.

COPPER MINERALIZATION AND ALTERED ZONES

Aside from the chalcopyrite on the deeper levels of the mines on War Eagle and Florida Mountains and the chalcopyrite on Whiskey Mountain, only traces of copper occur in the area.

In sec. 21, T4S, R4W, a small mass of Silver City Granite protrudes through the surrounding alluvial cover (Fig. 8A). A fault parallels the northwest contact of the granitic mass. There are small blebs of copper carbonate in the fault zone, but so sparse as to almost avoid detection. Several smaller faults or fracture zones cross the granitic outcrop and these also show traces of copper. The entire mass of granitic rock has an altered appearance, but mineralization is very sparse. Semi-quantitative analyses of specimens from the fault zone indicate 0.02 to 0.03 percent copper.

The small masses of granitic rocks exposed along Rabbit Creek in the northeast corner of the map area (Fig. 8A) are slightly sericitized. Analyses indicate traces of copper only, and no metallic minerals were identified.

A strong northwest-trending fault marks the eastern contact of the long granitic ridge in Sand Canyon (Secs. 14, 11 and 2, T3S, R3W; Fig. 8A). The fault zone shows gouge clay in a zone 6 to 8 feet wide. The rocks adjacent to the fault have a bleached, altered appearance. Many schlieren zones are in the granitic rocks in the vicinity of the fault. No mineralization was observed in the vicinity, but careful prospecting might reveal a mineralized structure.

Near the Sinker Creek bridge on the Silver City road in sec. 24, T4S, R3W a northeast fault trends up a narrow tributary to Sinker Creek (Fig. 8A). A diorite dike is in the Silver City Granite in the lower part of the draw and it has been offset by the fault. The dike contains sparse pyrite. A few veinlets and stringers of calcite and hematite are in the granitic rocks near the fault.

PLACER DEPOSITS

Most of the valuable placer deposits were depleted shortly after the initial discovery in the region, although dredges operated on Jordan Creek during the 1930's. Consequently placer deposits are now of little importance.

Below the old De Lamar mill, at De Lamar on Jordan Creek, quicksilver can be panned from the stream bed. The quicksilver is material that was lost or discarded during early milling operations. Several attempts have been made to recover the quicksilver on a commercial basis through the use of sluices. Reportedly the quicksilver contains too many impurities to yield an economic product.

The bench gravels along Jordan and Cow Creeks are known to contain detrital gold. The economic possibilities of the deposits were not investigated, but distance to a source of water would be a factor to consider in mining these gravels.

NONMETALLIC RESOURCES

Nonmetallic resources are of little consequence in the area studied. Some lignite reportedly occurs in the Sucker Creek Formation and in the sedimentary rocks in the Reynolds Creek group.

Limited deposits of pumice and pumicite are on the east side of the area, but these are of little economic interest because they are not readily accessible to markets. The silicic volcanic rocks would be attractive as decorative facing stone but accessibility to market areas again limits the economic potential.

SUMMARY - ECONOMIC GEOLOGY

Pre-Ore and Post-Ore Rocks

The Silver City Granite, the basalt-latite unit, the Silver City rhyolite, diorite, dacite and rhyolite dikes and volcanic domes of rhyolite are potential hosts for ore deposits. The other igneous rocks in the region are post-mineral in age. Aside from placer deposits, sedimentary units in the region can be disregarded in exploration programs.

The basalt-latite unit is known to be mineralized on Florida Mountain, but not elsewhere. Much of the unit is in structurally unfavorable areas, and other evidence indicates that it is not as favorable a host for ore deposits as the rhyolitic rocks or the granitic rocks. The basalt-latite unit should not be entirely disregarded, however, especially in structurally favorable areas such as between Florida and De Lamar Mountains. Sidney Mining Company of Kellogg, Idaho, is engaged in a drilling program in the area between Florida and De Lamar Mountains at the present time (1966).

Structural Control

As discussed in the section of structural geology, the intensely mineralized area near Silver City is in the zone of intersection of two regional fault trends. At the

intersection, a relatively greater number of fractures developed; hence the zone was the most favorable area in the region for the formation of ore deposits. The veins are fissure fillings and the locations of ore shoots are controlled by fracture intersections.

North of the Silver City area fracturing is less intense; hence veins are less abundant and mineralization is less important. There are several potential areas in the Silver City rhyolite, but the bulk of the mineralization consists of pyrite deposited in breccia zones.

Mineral deposits can be expected to follow northeast or north-northwest trends in the region. The trends are localized into two broadly defined belts with a structurally unfavorable zone between (Fig. 28).

Relative Age of Mineralization

Four major types of ore deposits are in the area. These are the precious metal deposits, the antimony-silver deposits, the lead-silver deposits and mercury mineralization.

The antimony-silver veins and the lead-silver veins are localized in Silver City Granite; so far as is known, these types of ore deposits do not occur in the volcanic rocks. It is significant that the trace of the vein that projects from the Monarca mine to the Berg mine and to the Ida Belle mine is not found in the basalt that crosses the line of projection. It is also significant that the lead-silver and antimony-silver veins follow northeast trends, a direction followed by the earliest faults in the region. Although evidence is not conclusive, it is likely that the lead-silver and antimony-silver deposits are earlier than the silver mineralization in the Silver City area; ore deposition may have occurred prior to extrusion of the Miocene volcanic rocks.

The precious metal veins in the Silver City region are not notably uniform in mineral content. The Black Jack-Trade Dollar vein and the Henrietta and Silver Vault veins are primarily silver veins with very low values in gold. The veins on War Eagle Mountain and the veins in the De Lamar vein system are silver-gold veins with high though variable amounts of gold. The mineralogy of all the veins in the vicinity of Silver City and De Lamar is similar; although relative percentages of the minerals may vary. The evidence indicates that the silver veins are probably all the same age; however, more than one period of mineralization may be represented. According to the structural interpretation of the De Lamar vein system, the 77 vein was mineralized later than the surrounding veins. The other veins in the area were probably affected by this later period of mineralization also.

The mercury mineralization in the area is probably late. Its relation to the other vein types could not be established from the available evidence.

Mineral Zoning

The mines on War Eagle Mountain and the Black Jack-Trade Dollar mine on Florida Mountain encountered increasing amounts of chalcopyrite, galena and

sphalerite as depth increased. The Morning Star mine in Silver City, at approximately 6,000 feet elevation, contains copper and gold. This elevation is roughly a limiting depth to economic silver mineralization in the vicinity of War Eagle and Florida Mountains.

A vertical zoning situation is indicated, and although the stronger veins may persist, base metals will form an increasingly prominent part of the vein material, and silver values will decrease as the veins are explored at greater depths. All the base metal deposits in the area are localized in the granitic rocks; the base metal content of the Silver City veins may be related to an earlier period of metallization, but zoning in response to temperature and pressure conditions during the period of silver deposition is more likely. No specimens are available for study of the age relations between the various minerals.

The cellular quartz in the area is thought to represent complete replacement of an earlier formed vein mineral. Evidence of associated ore minerals, if any were present, has been completely obliterated.

Potential of the Area

The discussion of the mines and veins in the area suggests several specific exploration targets. The De Lamar ore bodies have not been mined out, and large tonnages of high-grade silver ore could be discovered. The possibility of an open pit silver mine on Florida Mountain is not to be disregarded.

Exploration for new deposits will likely be most successful south of Silver City within the zone of structural intersection. This area has not been studied geologically, but plans are underway for a project in the area. Granitic outcrops below 6,000 feet elevation may be expected to carry base metals or antimony with silver value.

SUMMARY - HISTORICAL GEOLOGY

CRETACEOUS PERIOD

The geologic record begins with the Cretaceous period in the area studied. The succession of events that led to the development of the Owyhee Range began during this period of geologic time and coincides with the Laramide revolution.

The Silver City Granite was emplaced in the Cretaceous, and doming and uplift of the Owyhee Range began. The huge structural depression in the western Snake River plains, the Snake River downwarp, began subsiding at the same time; consequently a basin in which huge volumes of sediments could accumulate came into existence.

TERTIARY PERIOD

Early Tertiary

Deformation and uplift of the Owyhee Range continued through the Early Tertiary as the Snake River plains continued to subside. Material eroded from the slowly rising Owyhee Range was deposited in the Snake River downwarp on the east and in a local basin on the west through the Early Tertiary epochs and into the Early Miocene Epoch. Development of the Reynolds basin, a structural depression on the north, probably began in the Early Miocene and deformation of the rocks in the basin continued through the Miocene.

Doming and uplift of the Owyhee Range in the early Tertiary caused the development of early northeast faults and established lines of weakness in the rocks that were followed by later faults. A period of mineralization, with antimony veins and base metal veins filling early northeast fissures took place sometime prior to Late Miocene. Porphyritic diorite and dacite dikes were intruded locally along early-formed faults near the center of uplift on War Eagle Mountain.

Late Miocene

Erosion and deposition continued, seemingly without interruption, until late in the Miocene Epoch, when the Silver City Granite was exposed at the surface. A mature, rugged topography had developed on the granitic rocks in the Owyhee Range by the time the basalt-latite was extruded.

On the western side of the Owyhee Range, lava flows of the basalt-latite unit moved down stream valleys and overlapped ridges until all but the higher granitic peaks were buried. The flows extended into depositional basins on the west and north and locally interrupted sedimentation. Intermittent volcanic activity and sedimentation gave rise to a complex of interbedded sediments and flows.

Extrusion of the Silver City rhyolite followed extrusion of the basalt-latite unit. The Silver City rhyolite was accompanied by the emplacement of volcanic domes and rhyolite and quartz latite dikes. The locations of many of the dikes were controlled by fault lines, developed by uplift of the Owyhee Range. Uplift and deformation was a slowly continuing process that extended through the Miocene.

North-northwest faults developed in response to stresses accompanying local doming in the vicinity of Silver City, and movement continued along earlier formed northeast faults. The north-northwest faults were filled by quartz and silver-bearing minerals in the vicinity of Silver City and De Lamar.

Outpourings of lava subjected the western side of the Owyhee Range to a constructional process during the Miocene epoch and a lava plateau developed on the western side of the uplift. The eastern side was undergoing erosion during the Miocene epoch and deposition was taking place in the slowly subsiding Snake River down-warp. As a consequence, relief on the east side of the range is greater than it is on the west side.

Near the end of the Miocene Epoch, faults that trend N75W developed and offset the veins at De Lamar. A second period of silver mineralization filled some of these late fissures and enriched some of the earlier formed veins. Late rotational movements, initiated by hypothesized local doming to the south, rotated some of the N75W faults to relatively flat positions.

Pliocene

The east side of the Owyhee Range had developed a steep eastern face by Pliocene time because of long-continued erosion. Volcanic activity that began in the Miocene continued into the Pliocene; welded tuff units and local basalt flows enveloped the flanks of the range in the Pliocene epoch. The higher parts of the range were not covered by the Pliocene volcanic rocks.

On the east side of the range, sedimentary materials of the Poison Creek Formation were interbedded with welded tuff units and basalt flows. Deposition and volcanic activity were in part contemporaneous on the east. No Pliocene sedimentary rocks are on the west side of the range in the area studied.

Deformation in the range decreased in intensity following the Miocene Epoch. Some crustal adjustments took place but the major period of uplift had ceased by the beginning of the Pliocene Epoch.

The welded tuffs along the eastern flank of the range covered the granitic rocks and protected them from further erosion. A new erosion surface then developed on the surface of the welded tuffs.

At one time Jordan Creek flowed to the west down the drainage now occupied by Cow Creek. During the Pliocene Epoch, or possibly in the Quaternary Period, Jordan Creek was captured by a northward-eroding stream and diverted to the south. As a result of the drainage change, bench gravels occupy ridges above the present levels of Jordan and Cow Creeks.

QUATERNARY PERIOD

Erosion has caused the eastern slope of the Owyhee Range to recede to the west. The region has experienced an arid climate since the Miocene Epoch. Insufficient run-off has allowed the development of local pediments and alluvial landforms along the mountain front.

Alpine glaciation was locally important in the higher parts of the range. The glaciers probably existed during the Pleistocene Epoch.

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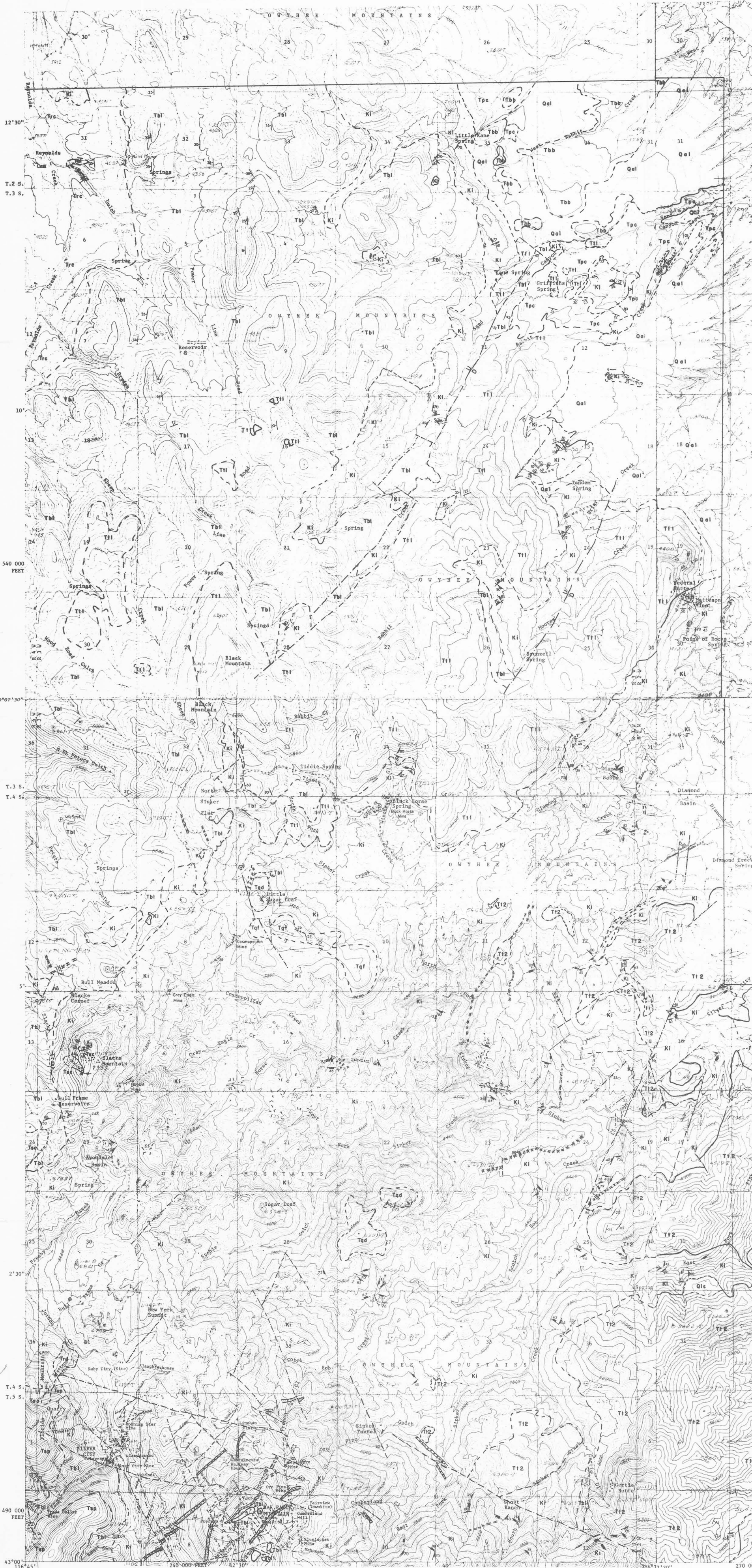
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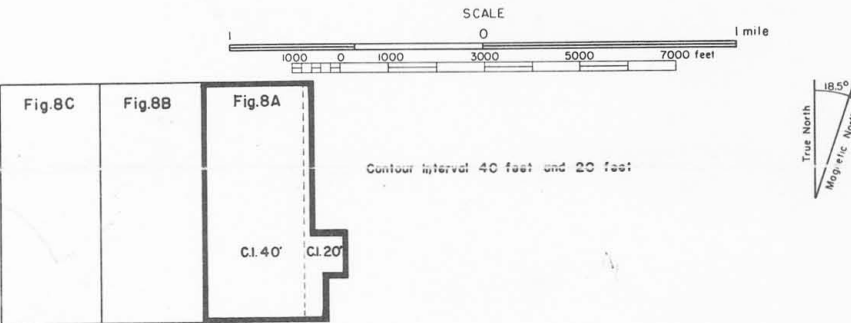


Pamphlet 138

Idaho Bureau of Mines and Geology
R. R. Reid, Director

Figure 8A, Geologic Map, Silver City Region, Owyhee County, Idaho

Geology by R.R. Asher, 1967 (Base from U.S. Geological Survey, geology in Reynolds Creek basin from McIntyre, 1966, with revisions; some dikes, veins and faults on War Eagle and Florida Mountains from Piper and Loney, 1926)



CENOZOIC				Sedimentary Rocks	
CENOZOIC	Tertiary	Quaternary	Pleistocene or Recent	Qal	alluvium
				Qls	landslide deposit
				Tpc	Poison Creek Formation
CENOZOIC	Tertiary	Miocene	Pliocene	Trc	Reynolds Basin group

CENOZOIC				Igneous Rocks	
CENOZOIC	Tertiary	Upper Miocene or Lower Pliocene	Pliocene	Tbb	Banbury Basalt
				Tt1	welded tuff unit; Tt2 welded tuff unit
				Tqd	quartz latite dome; Taf associated flow
CENOZOIC	Tertiary	Miocene	Pliocene	Trd	rhyolite dome
				Tsc	Silver City rhyolite; Tsp porphyritic member
				Tbl	basalt-latite unit
MESO. Cret.	Cret.			Ki	Silver City Granite, mostly granodiorite

.....

 rhyolite dike

=====

 porphyritic diorite or dacite dike

=====

 pegmatite

 contact

 fault

.....

 mineralization

.....

 vein

.....

 breccia

.....

 shear zone

.....

 attitude of joint

.....

 attitude of bedding or layering

■

 shaft

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 prospect

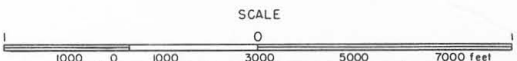
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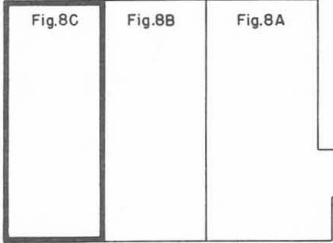
- ***** rhyolite dike
- ==== porphyritic diorite or dacite dike
- ==== pegmatite
- contact
- fault
- mineralization
- vein
- breccia
- shear zone
- attitude of joint
- attitude of bedding or layering
- shaft
- prospect
- adit

Figure 8C, Geologic Map, Silver City F
Owyhee County, Idaho

Geology by R.R. Asher, 1967 (Base from U.S. Geological Survey,)



Contour interval 20 feet



Sedimentary Rocks

CENOZOIC	Tertiary/Quaternary	Pleistocene or Recent	Qal alluvium
			Qbg bench gravels
	Pliocene		
		Miocene	Ts Sucker Creek Formation

Igneous Rocks

CENOZOIC	Tertiary	Pliocene	Tt1 welded tuff unit
			Tt2 tuffaceous basalt unit
	Upper Miocene or Lower Pliocene		Tsc Silver City rhyolite
			Tsp porphyritic member
MESO. Cret.			Tbl basalt-latite unit

- contact
--- fault
--- mineralization
--- vein
--- breccia
x prospect

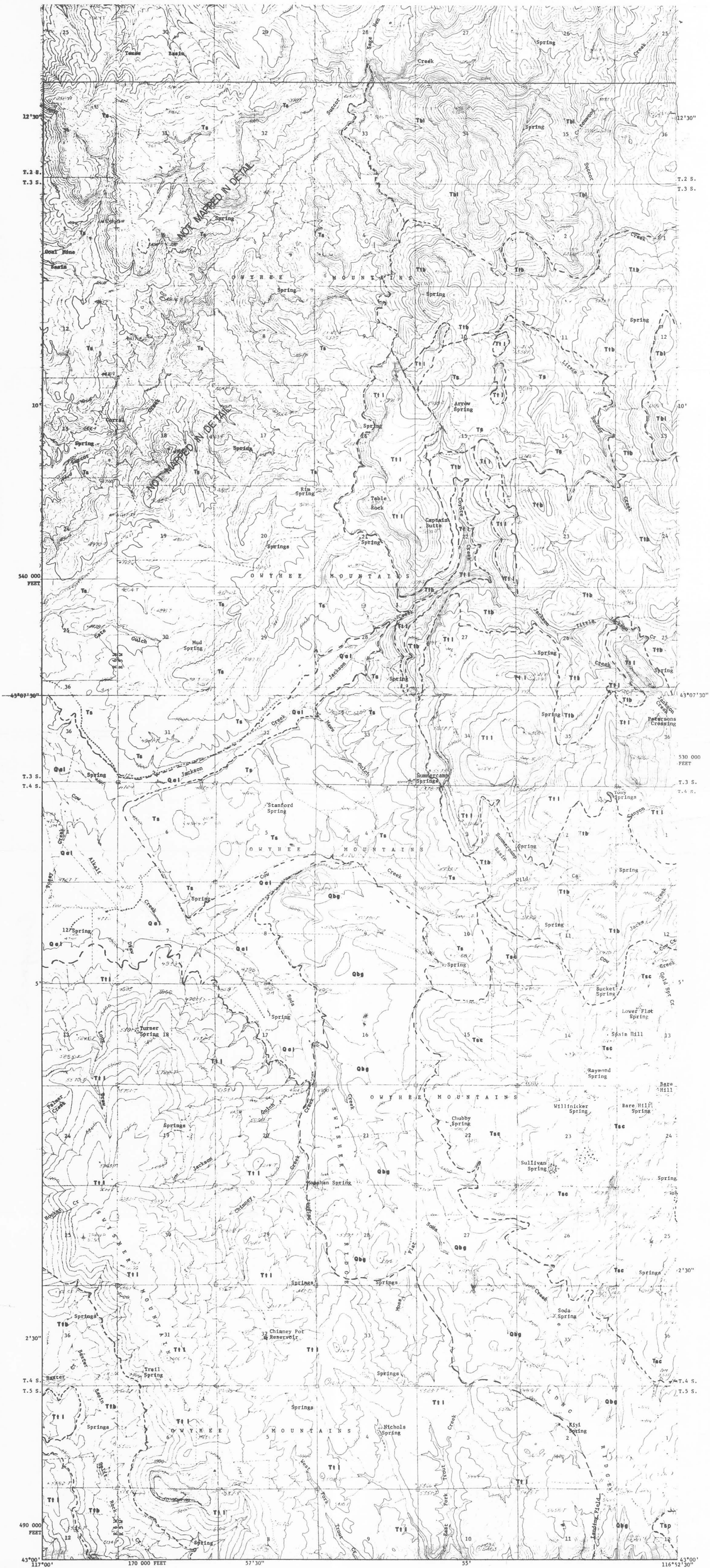


Figure 28— Diagram of Linear Features
Showing Major Structural
Trends, Silver City Region,
Owyhee County, Idaho

- Fault
--- Vein
--- Rhyolite dike
--- Porphyritic diorite or dacite dike
- ① Veins in Sommercamp section, De Lamar mine
 - ② No 9 Vein system (diagrammatic), De Lamar mine
 - ③ 77 Vein (diagrammatic), De Lamar mine
 - ④ Hamilton-Wilson Vein system (diagrammatic), De Lamar mine
 - ⑤ Banner Vein, Florida Mountain
 - ⑥ Black-Jack Trade Dollar Vein, Florida Mountain
 - ⑦ Poorman Vein system, War Eagle Mountain
 - ⑧ General Conner-Stormy Hill Vein system, War Eagle Mountain
 - ⑨ Oro Fino-Golden Chariot Vein system, War Eagle Mountain

SCALE
0 1000 2000 3000 4000 feet

N

