GEOCHEMICAL RECONNAISSANCE AT MERCUR, UTAH

by

G. W. Lenzi

UTAH GEOLOGICAL AND MINERALOGICAL SURVEY
affiliated with
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University of Utah, Salt Lake City, Utah

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CONTENTS

ILLUSTRATIONS

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ABSTRACT

A geochemical reconnaissance was conducted in the abandoned Camp Floyd (Mercur) mining district in the south Oquirrh Mountains of Utah to determine the average amount of gold and silver remaining in the district and to locate possible prospects. More than $25 million in metal value, mostly from gold mining, has been produced. Samples collected in and near the mined areas were assayed commercially for gold and silver. Gold content varied from nil to 0.16 ounces per ton, silver from nil to 4.2 ounces per ton. Samples were listed according to lithology as altered or fresh shales, altered or fresh limestones, and the average gold and silver content for each lithologic unit was computed. The highest average silver content by lithology, using 118 samples from the entire district, was 1.37 ounces per ton in fresh shales; the highest average gold content was 0.022 ounces per ton, also in fresh shales. In contrast, averages by lithology within each of three main areas (Mercur, West Mercur and Sunshine) indicate highest average gold content occurred in altered limestones.

Gold deposits appear to be stratigraphically controlled. Silver concentration was highest along faults; six samples from the Mercur area averaged 2.17 ounces per ton.

Splits of samples were analyzed by atomic-absorption spectrometry for silver and copper. Geochemical maps of the Mercur (Camp Floyd) vicinity were prepared and anomalously higher areas of gold, silver and copper content were located. Maps for silver content prepared for both analytical methods showed silver anomalies in the same locations, which indicates the usefulness of rapid atomic-absorption analysis. No correlation was found between arsenic or mercury content with gold and silver content in 13 samples analyzed for mercury and 18 samples analyzed for arsenic.

Halite, halloysite and fluorite were found in a small adit in the south part of the area.

ACKNOWLEDGEMENTS

The research reported here was originally done as a master's thesis, University of Utah, financed in part by the Utah Geological and Mineralogical Survey. W. P. Hewitt, UGMS director, made this study possible through his interest in the economic geology of Utah. Professors M. L. Jensen and William Parry helped in the preparation of the thesis and Kennecott Exploration, Inc., conducted the mercury analyses.

INTRODUCTION

Gold prospecting in the Basin and Range Province has been renewed since the discovery of the Carlin gold deposit near Carlin, Nevada in 1961. Among several low-grade gold deposits mineralogically similar to Carlin is the abandoned deposit at Mercur, Utah (Roberts, Radtke and Coats, 1971, p. 24). The similarity between the two districts prompted this study of the Camp Floyd (Mercur) mining district in which a brief geochemical reconnaissance was conducted by the author in known mineralized areas to determine the amount and location of remaining gold and silver and to develop additional geochemical guides to ore in the district.

The Camp Floyd (Mercur) mining district lies at the south end of the Oquirrh Mountains, about 55 miles southwest of Salt Lake City. Principal mining activity was at Mercur, which was abandoned in 1945. Other mining camps were at Sunshine, about 4 miles south of Mercur at the south end of the range, and at West Mercur, about 2 miles west of Mercur near the west part of the range.

The Mercur mining camp lies at an elevation of about 6,750 feet in a northwest-southeast strike valley near the crest of the low-lying south Oquirrh Mountains. Mercur Canyon, which drains the valley to the west, is steep and sinuous; it cuts the northwest-striking Ophir anticline and exposes Mississippian limestones and quartzites of the Deseret Limestone, Humbug Formation and the Great Blue Limestone.

The large dump of the Mercur Consolidated Mines Co., on the west approach to Mercur via Mercur Canyon, covers an area of about 4,000 square feet and is more than 100 feet high. To the west of the dump are smaller dumps of the Geyser-Marion mine and the remains of large thickeners used in the cyanide process for extracting gold from coarsely broken ore. To the south above Mercur several open cuts are exposed along the mountain with one large open stope exposing the contact of intrusive rhyolite with the limestone country rock. The limestone is altered to light violet

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and red near the intrusive, but is otherwise altered to light buff, silicified limestone or light gray to white silicified shales. Unaltered limestone in Mercur Canyon is blue gray. The Long Trail Shale Member of the Great Blue Limestone is a black calcareous shaley limestone seen on dumps and in outcrops to the east and southeast of Mercur. Weathered Long Trail Shale is light buff to tan.

About 4 miles to the southeast in a widely eroded area along the Long Trail Shale is the Sunshine area with two large and several smaller dumps. The dumps at Sunshine, considerably smaller than the large dump at Mercur, contain light buff altered limestones and black shales. To the west of the largest dump, the Overland mine lies adjacent to an outcrop of red jasperoid. About 1,000 feet southeast of the Overland mine dump there is an olive-green breccia with quartz and jarosite replacing the original breccia fragments. One adit close to a breccia outcrop contains halite, halloysite and fluorite.

West Mercur lies at the west edge of the Oquirrh Mountains where Great Blue Limestone and Long Trail Shale dip westerly beneath alluvium covering Rush Valley. The ore lies at the same horizon as at Mercur and Sunshine. Again light buff altered limestones and black shales are seen on the dumps.

History

The district was first organized in 1870 as a result of successful silver prospecting. Several silver claims were worked in rich but localized silver lodes with values up to $5,000 per ton (Gemmell, 1897, p. 403). Early attempts at placer gold mining failed because water was scarce and the gold was extremely fine-grained.

The Mercur lode, discovered in 1879 by Arie Pinedo, who thought he had discovered a rich cinnabar vein, was worked for a short time and then abandoned because of the poor tenor of the ore. In 1883, commercial gold assays were obtained in a bedded replacement deposit called the Gold Ledge; the gold, however, could not be panned. Attempts to amalgamate the ore in 1890 failed because potassium cyanide was used to clean mercury in the amalgamation process; about 1,500 tons were milled with a recovery of less than $5,000 (Gemmell, 1897, p. 403).

Gold ore from Mercur was successfully treated by the cyanide process in 1891, and by 1900 the town had a population of 2,351 (Butler and others, 1920, p. 383). Mining ceased, except by lessees, in 1913 when the Consolidated Mercur mines closed after $19,035,512 in metal value had been mined from the district.

Production resumed in 1931 when lessees began treating mill tailings. Some of the mines reopened and production continued until 1945 when the mines again were abandoned.

To date (1971) more than $25.5 million in metal values have come from the Camp Floyd (Mercur) district; presently there is no production and most of the workings have caved. During 1969, Newmont Exploration Ltd. became interested in the area and, for several months, drilled and sampled the strata near Mercur. Newmont left the district the same year.

Previous Geologic Studies

One of the earliest reports of the Camp Floyd (Mercur) district was an economic geology study in the vicinity of Mercur by Spurr (1895). Butler and others (1920, p. 382-395) compiled an excellent summary of the history, production and geology of the Camp Floyd (Mercur) district from previous geologic studies and mining reports. Later, Gilluly (1932) published a paper on the geology of the Stockton and Fairfield quadrangles, but he relied on Butler's report for descriptions of the economic geology. Bissell (1959) and others studied the south Oquirrh Mountains, but did not investigate further the economic geology of the Camp Floyd (Mercur) district.

Similarity with Carlin Deposit, Nevada

In 1962, a large deposit of low-grade gold ore was discovered in the Lynn district near Carlin, Nevada. Before this discovery a few mines and placer operations in the area produced a few hundred ounces of gold per year (Roberts, Montgomery and Lehner, 1967, p. 69). Following a recommendation by the U. S. Geological Survey that mineralization was favorable in the area, interest in the Lynn district was revived. Gold, too fine to be visible, was found in a window of the Roberts Mountain thrust. Drilling outlined a deposit containing 11 million tons of ore averaging 0.32 ounces of gold per ton (Hausen and Kerr, 1968, p. 913).

The gold at Carlin occurs as small, disseminated particles of gold-organic compounds and metallic gold (Roberts, Radtke and Coats, 1971, p. 26-27). Sulfides seldom occur, but pyrite, realgar, stibnite, cinnabar, sphalerite and galena are present with quartz and barite (McQuiston and Hernlund, 1965, p. 27). The largest gold particle reported by McQuiston and Hernlund

(1965, p. 27) was 7 by 2 microns. The gold occurs in silicified lower Paleozoic siltstones and calcareous shales of the Roberts Mountain Formation. The deposit appears to have local stratigraphic control and alteration of the host rock is not obvious.

Similarities between Carlin and Mercur were observed by Hewitt (1968b, p. 870) and Roberts, Radtke and Coats (1971, p. 24). Hewitt noted they both lack visible gold and both have realgar, cinnabar and carbon, associated with gold, as do many other gold deposits in Utah and Nevada.

STRATIGRAPHY

The ore bodies mined in the vicinity of Mercur occur in the Great Blue Limestone of Mississippian age (Bissell, 1959, p. 56). The Great Blue Limestone is divided into three members, the lower Great Blue Member, the Long Trail Shale and the upper Great Blue Member.

Lower Great Blue Member

The lower Great Blue Member consists of massive, nearly pure calcareous gray-blue limestone lying conformably on the Humbug Formation. The gray-blue limestone for which it is named probably results from the presence of a small amount of organic material; it weathers light pink to nearly white. According to Bissell (1959, p. 57), the lower member is about 500 feet thick and grades upward into the Long Trail Shale.

Long Trail Shale

The carbonaceous Long Trail Shale is black, weathering to a soft, light tan, poorly exposed shale; it is calcareous and nearly everywhere effervesces with acid. An excellent marker bed, this member is used to delineate structures. At Sunshine, a second shale occurs approximately 200 to 300 feet stratigraphically above the Long Trail Shale. Both shales are similar lithologically, but the upper unnamed shale is slightly thinner than the Long Trail Shale, which averages 90 feet thick (Bissell, 1959, p. 57).

Upper Great Blue Member

The upper Great Blue Member is also blue-gray; however, the upper limestone contains sporadic chert layers, some sandy limestones and thin black shales. The estimated thickness of the upper limestone is about 2,700 feet.

IGNEOUS ROCKS

Igneous rocks in the Camp Floyd (Mercur) district are the Eagle Hill Rhyolite and a granodiorite known as the Bird's-eye porphyry. Both are probably late Eocene or early Oligocene in age and are described in detail by Gilluly (1932, p. 49-60).

Eagle Hill Rhyolite

The Eagle Hill Rhyolite, originally called the Eagle Hill "porphyry" by Spurr (1895), is named for its exposure on Eagle Hill about one mile south of Mercur. Gilluly (1932, p. 58) classified the rock as a rhyolite or quartz latite. Variations in the appearance of the rhyolite are the result of changes in texture, mineral content and the degree of alteration. Generally it is light tan, almost white and very fine-grained. Quartz, feldspar and biotite phenocrysts make up 5 to 20 percent in an altered matrix of kaolinite and sericite. Phenocrysts of feldspar, mainly sanidine, are usually less than 1 mm long and doubly terminated quartz phenocrysts may be up to 5 mm. Pyrite inclusions are common and sericite, kaolinite and calcite occur locally as alteration products.

Granodiorite Intrusive

Gilluly (1932, p. 50) classified a sill exposed on Porphyry Hill, about 2 miles north of Mercur, as a granodiorite porphyry. It is gray with phenocrysts of plagioclase (Ab_{60}, An_{40}), biotite, hornblende, quartz and minor orthoclase. Phenocrysts range from 2 to 6 mm and are enclosed in a fine-grained matrix. Evidence of weathering and hydrothermal alteration is common.

The granodiorite porphyry was mapped as fourteen sill-like masses in the upper Great Blue Limestone, the thickest of which is up to 400 feet thick; most are less than 50 feet thick. Neither the rhyolite nor the granodiorite porphyry contain known gold or silver deposits, but both may have been sources of mineral-rich hydrothermal solutions.

ORE-BEARING HORIZONS

Gold and mercury deposits at Mercur are bedded replacement deposits in the lower limestone member of the Great Blue Limestone. The following descriptions of the ore-bearing horizons come from Butler and others (1920, p. 392-395) who compiled a generalized section of the gold deposits using information supplied by the Consolidated Mercur Mining Co. The lithology of the mineralized section by average thickness of beds is shown in figure 1. The names given to the beds do not necessarily represent their true lithology; for instance, a bed called a porphyry is not igneous, but is an altered sedimentary horizon (Butler and others, 1920, p. 392).

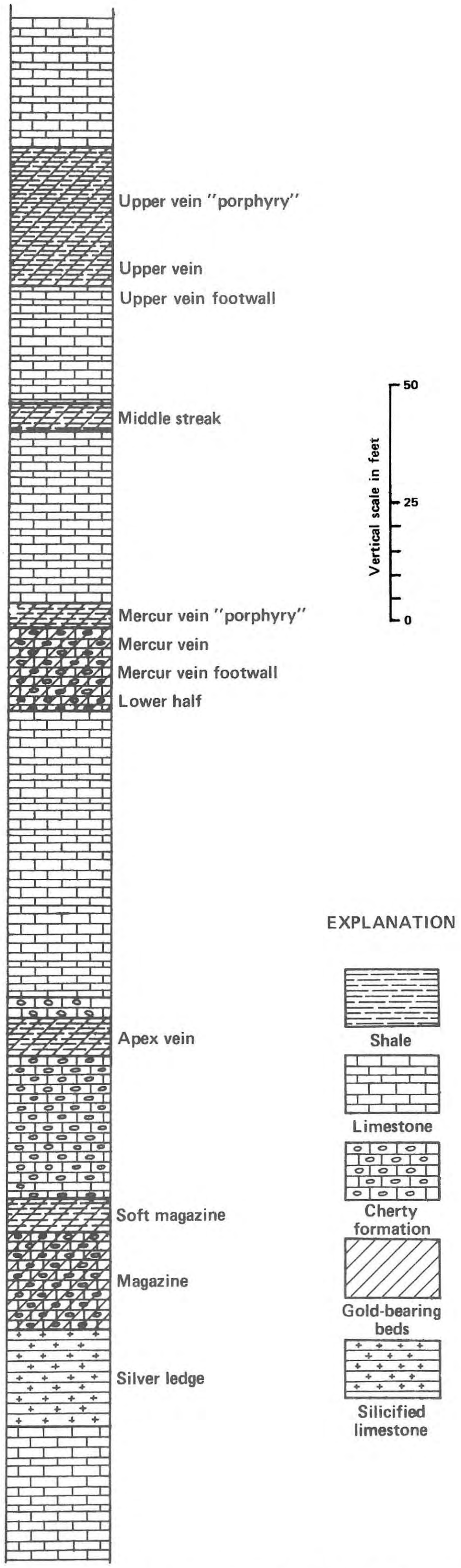

Figure 1. Generalized section of ore beds in the Camp Floyd (Mercur) district (after Butler and others, 1920, p. 392).

According to Butler, the base of the ore series is an unmineralized masssive blue limestone and some shaley beds which are part of the lower Great Blue Member. Overlying the limestone is a cherty, porous silicified limestone known as the silver ledge, which forms a ledge about 20 feet thick on the north wall of Mercur Canyon and which has contained some pockets of commercial ore, mostly silver with occasional gold.

Above the silver ledge, the Magazine vein, also a cherty or silicified limestone, is not as porous as the silver ledge. The upper part of the Magazine vein is called the Soft Magazine, a light shale where oxidized and black where unoxidized. Both the Magazine and Soft Magazine have produced gold. Together they are about 27 feet thick.

The Apex vein is a gold-carrying shaley limestone bed about 8 feet thick separated from the Soft Magazine by 20 feet of cherty altered limestone.

A barren, cherty limestone 4 feet thick overlies the Apex vein, followed by 60 feet of relatively unaltered limestone.

Above the unaltered limestone the gold-bearing Mercur vein, 20 to 25 feet thick, contains original nodular cherty masses in the limestone. In many places the Mercur vein is altered to a silicified mass similar in appearance to the silver ledge and Magazine vein. A thin persistent shaley bed called the Mercur vein footwall divides the vein in two (figure 1); the lower part is 6 feet thick and that above the shale is 12 feet thick. The uppermost part of the Mercur vein, the Mercur vein porphyry, is a soft, altered, gray, shaley unit about 4 feet thick.

Above the Mercur vein porphyry is about 36 feet of limestone followed by shaley fossiliferous, gold-bearing beds known as the middle streak. The beds are gray to black with a thickness of 6 feet. Above the middle streak 20 feet of limestone are followed by 5 feet of shaley and siliceous limestone called the Upper vein footwall. Above the Upper vein footwall are gold-bearing shaley and siliceous beds about 8 feet thick called the Upper vein, followed by 20 feet of altered gold-bearing shales known as the Upper vein porphyry. Overlying this is the massive blue limestone.

STRUCTURE

With the exception of the Ophir anticline to the west of Mercur, obvious structural features are lacking in the Camp Floyd (Mercur) district. Proctor (1959, p. 224) noted that most of the ore in the district is stratigraphically controlled. Three groups of fissures recognized in mines are (in order of significance): northeast trending, north-south and northwest trending fissures. Northeast trending faults are poorly exposed at road cuts and open stopes above the Geyser-Marion mine area. They show displacement, but the amount and direction are not obvious. With the exception of road cuts and open stopes, faults and fissures are covered by vegetation.

ALTERATION

Many limestone beds are silicified to jasperoid. Although shales appear less altered, they contain sericite because of the addition of silica and potassium. Barite, as at Carlin, and secondary calcite are common alteration products associated with ore.

Jasperoid

Jasperoid occurs erratically in the vicinity of Mercur (Gilluly, 1932, p. 97), generally in isolated outcrops, outcrops connected by thin zones of altered rock or as prominent thick ledges, brown to slightly reddish brown. Fresh jasperoid is light to dark gray and sometimes black with a dense fine-grained texture often resembling quartzite or chert. Larger masses commonly are brecciated.

In addition to quartz, other minerals observed in the jasperoid include barite and stibnite (also in Carlin ores), muscovite, tourmaline, apatite, zircon, chalcopyrite, epidote, chlorite, carbon and probably hematite (Gilluly, 1932, p. 99).

The jasperoid probably formed from a series of colloidal silica and minor mineral injections along fissures and bedding surfaces of the original limestone (Gilluly, 1932, p. 100).

Alteration of Shales

The shales and shaley limestones in the ore sections often are altered to soft, light gray beds called porphyry shales. The author analyzed a sample of porphyry shale by X-ray diffraction and found it contained mostly quartz, sericite and kaolinite. Most of the ore-bearing shales also contain barite, pyrite, realgar with orpiment, plus cinnabar and secondary calcite.

OCCURRENCE OF GOLD

Gold is not visible in the ores of the Camp Floyd (Mercur) district as in the Carlin district. Ore, however, is not distinguished by color or minerals present; assays must be taken to separate ore from gangue. Minute gold particles were observed by Kennard (1935, p. 8) using an optical microscope; it was in metallic form and ranged from -200 mesh to -1,600 mesh. The combined weight of 127 particles was 0.01 milligram. Kennard reported them to be amorphous (more likely anhedral), flaky and irregular in shape with a recognizable yellow color. Some particles were coated by an unidentified substance.

At Mercur, gold associates notably with carbon in the ore so the gold is concentrated in carbon-rich portions (Butler and others, 1920, p. 394). A recent study by Radtke and Scheiner (1970) of the Carlin gold deposit, Nevada, shows that activated carbon components in carbonaceous limestones probably help precipitate gold from solutions forming gold organic compounds. That the same mechanism of gold deposition is responsible for the Mercur deposits is likely.

SAMPLING OF CAMP FLOYD DISTRICT

Samples were taken from areas previously mined or prospected, usually around prospect trenches, open cuts or adits, which provided good access to fresh and altered outcrops. Prospects generally are confined to three areas: Mercur, Sunshine and West Mercur. A few samples were collected between the three main mineralized areas.

Many of the entries to the mines have caved and are now inaccessible so waste dumps and material in and around loading chutes were sampled.

Samples weighing from 2 to 5 pounds of finely broken material were taken to Salt Lake City for analysis of gold and silver content by commercial assayers (see appendix).

Results

Gold content ranged from nil to 0.16 ounces per ton and silver content ranged from nil to 4.2 ounces per ton (tables 1 and 2). Samples were tabulated according to lithology, alteration and presence of faults from data obtained in the field. An arbitrary value of 0.001 ounces per ton was substituted for each nil or trace content of gold and silver giving all samples a numerical value and none was rejected. Tables 3, 4 and 5 tabulate silver content according to location of the samples (Mercur, West Mercur and Sunshine); samples not collected from one of the three main areas were included in the nearest area. Tables 6, 7 and 8 give the gold content of samples according to location (Mercur, West Mercur and Sunshine).

Figures 2 and 3 are histograms showing skewed distributions of gold and silver content for samples in the Mercur area. The average gold content in fresh shales and altered limestones is influenced by the solitary high assays of 0.14 and 0.16 ounces per ton.

Table 1. Average silver content in ounces per ton from samples in the Camp Floyd district by lithology.

	Shale		Limestone		Sum
	Altered	Fresh	Altered	Fresh	
Average content	1.13	1.37	1.06	1.07	
Number reported as nil	1	0	1	2	4
Number reported as trace	13	4	12	5	34
Number containing 0.02 to 5.00 ounces/ton	29	16	18	17	80
Total number of samples	43	20	31	24	118

Table 2. Average gold content in ounces per ton from samples in the Camp Floyd district by lithology.

	Shale		Limestone		Sum
	Altered	Fresh	Altered	Fresh	
Average content	0.010	0.022	0.012	0.004	
Number reported as nil	12	1	4	11	28
Number reported as trace	11	4	13	8	36
Number containing 0.005 to 0.20 ounces/ton	20	15	14	5	54
Total number of samples	43	20	31	24	118

Table 3. Average silver content in ounces per ton from the Mercur area by lithology.

	Shale		Limestone		Sum
	Altered	Fresh	Altered	Fresh	
Average content	1.60	1.82	1.72	1.38	
Number reported as nil	1	0	1	2	4
Number reported as trace	0	0	1	0	1
Number containing 0.02 to 5.00 ounces/ton	25	13	16	14	68
Total number of samples	26	13	18	16	73

Table 4. Average silver content in ounces per ton from the West Mercur area by lithology.

	Shale		Limestone		Sum
	Altered	Fresh	Altered	Fresh	
Average content	1.27	1.20	0.53	0.72	
Number reported as nil	0	0	0	0	0
Number reported as trace	2	1	2	2	7
Number containing 0.02 to 5.00 ounces/ton	4	2	1	3	10
Total number of samples	6	3	3	5	17

Table 5. Average silver content in ounces per ton from the Sunshine area by lithology.

	Shale		Limestone		Sum
	Altered	Fresh	Altered	Fresh	
Average content	0.001	0.03	0.03	0.001	
Number reported as nil	0	0	0	0	0
Number reported as trace	11	3	9	3	26
Number containing 0.02 to 5.00 ounces/ton	0	1	1	0	2
Total number of samples	11	4	10	3	28

Table 6. Average gold content in ounces per ton from the Mercur area by lithology.

	Shale		Limestone		Sum
	Altered	Fresh	Altered	Fresh	
Average content	0.014	0.030	0.037	0.004	
Number reported as nil	9	1	4	11	25
Number reported as trace	1	0	4	1	6
Number containing 0.005 to 0.20 ounces/ton	16	12	10	4	42
Total number of samples	26	13	18	16	73

Table 7. Average gold content in ounces per ton from the West Mercur area by lithology.

	Shale		Limestone		Sum
	Altered	Fresh	Altered	Fresh	
Average content	0.002	0.010	0.027	0.005	
Number reported as nil	3	0	0	0	3
Number reported as trace	2	1	2	4	9
Number containing 0.005 to 0.20 ounces/ton	1	2	1	1	5
Total number of samples	6	3	3	5	17

Table 8. Average gold content in ounces per ton from the Sunshine area by lithology.

	Shale		Limestone		Sum
	Altered	Fresh	Altered	Fresh	
Average content	0.004	0.003	0.004	0.001	
Number reported as nil	0	0	0	0	0
Number reported as trace	8	3	7	3	21
Number containing 0.005 to 0.20 ounces/ton	3	1	3	0	7
Total number of samples	11	4	10	3	28

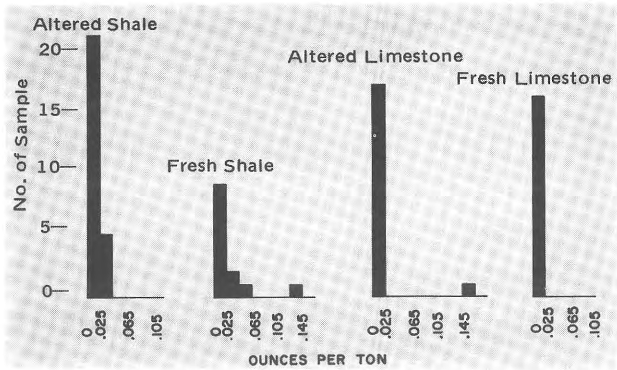

Figure 2. Distribution of gold content in samples from Mercur.

Fresh shales in the Mercur area (figure 3) appear to have a near normal distribution while all others are definitely skewed.

The highest average silver content according to lithology is not confined to the same lithologic unit from area to area. The highest average silver content at Mercur occurred in fresh shales, at West Mercur in altered shales and at Sunshine in altered limestones. In all three localities the highest average gold content occurred in altered limestones. Gold deposition apparently was stratigraphically controlled or certain lithologies caused preferential deposition of gold from hydrothermal solutions, perhaps the result of carbon content in the shales. Or gold may have deposited syngenetically within certain strata which could occur if the jasperoid and chert associated with gold ores in the Magazine and Mercur vein also are syngenetic; it appears, however, that the jasperoid replaced the limestones.

Since higher average silver contents are not confined to one lithologic type, the silver deposit is probably not stratigraphically controlled but may be located along small faults and fissures and may have been deposited later than the gold ores. Six samples collected along faults show the highest average silver content in the Mercur area was 2.17 ounces per ton, which is higher than any average silver content according to lithology. Gold content of samples along faults is rather low, 0.013 ounces per ton. Apparently silver is concentrated in faults and fractures in the Mercur area.

ATOMIC-ABSORPTION ANALYSES

Sample splits not used in the commercial assay plus some drill cuttings donated to the Sample Library of the Utah Geological and Mineralogical Survey by Newmont Exploration Ltd. were analyzed by atomic-absorption spectrometry for copper and silver. A total of 146 samples was analyzed, 79 collected by the author and 67 from samples of 14 drill-hole cuttings

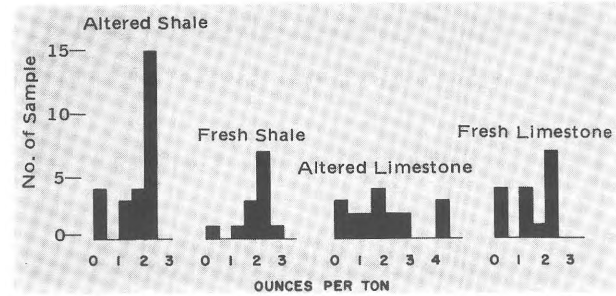

Figure 3. Distribution of silver content in samples from Mercur.

donated by Newmont. Samples from the 14 drill holes were taken at 50-foot intervals to detect vertical zoning of mineralization, but none was observed.

The samples used in the atomic-absorption analysis were prepared by a method similar to that described by Ward and others (1969, p. 9). The contents of the analyzed samples were plotted on a map of the Mercur area by sample location (figure 4) and geochemically contoured using a simple mechanical contour method. Areas of high mineralization were thus delineated (figures 5 and 8). Samples analyzed by fire assay also were plotted (figures 6 and 7).

Areas of higher concentration show a significant increase in metal content over the metal content in the surrounding area away from the mines and prospects. If the low metal content in samples away from the mined areas is considered as background, then the areas of high concentration can be considered anomalies. The high gold anomaly to the east of Sunrise Hill (figure 5) has a gold content more than 10 times the amount in samples from the area north of Mercur where several samples were collected. The silver anomaly northwest of Mercur contains samples with more than four times the amount of silver in samples from the unpatterned area. Copper anomalies are not as significant nor as reliable as the others because the difference in copper content between the highest and lowest area is only 2 parts per million (ppm).

Value of Atomic-Absorption Analyses

The mean of the analyses for silver by atomic-absorption was 0.754 ppm and the mean for the fire assay analyses was 1.7 ounces per ton. Since 1.7 troy ounces per ton equals 59 ppm, only a part of the silver in the samples was detected by atomic-absorption.

Using boiling nitric acid does not dissolve all the silver in the sample which accounts for the lower amount of silver detected by atomic-absorption; the boiling nitric acid method, however, was useful in detecting a silver anomaly. If the geochemical contour maps for silver in ppm (figure 5) and silver in ounces per ton by fire assay (figure 6) are compared, the area

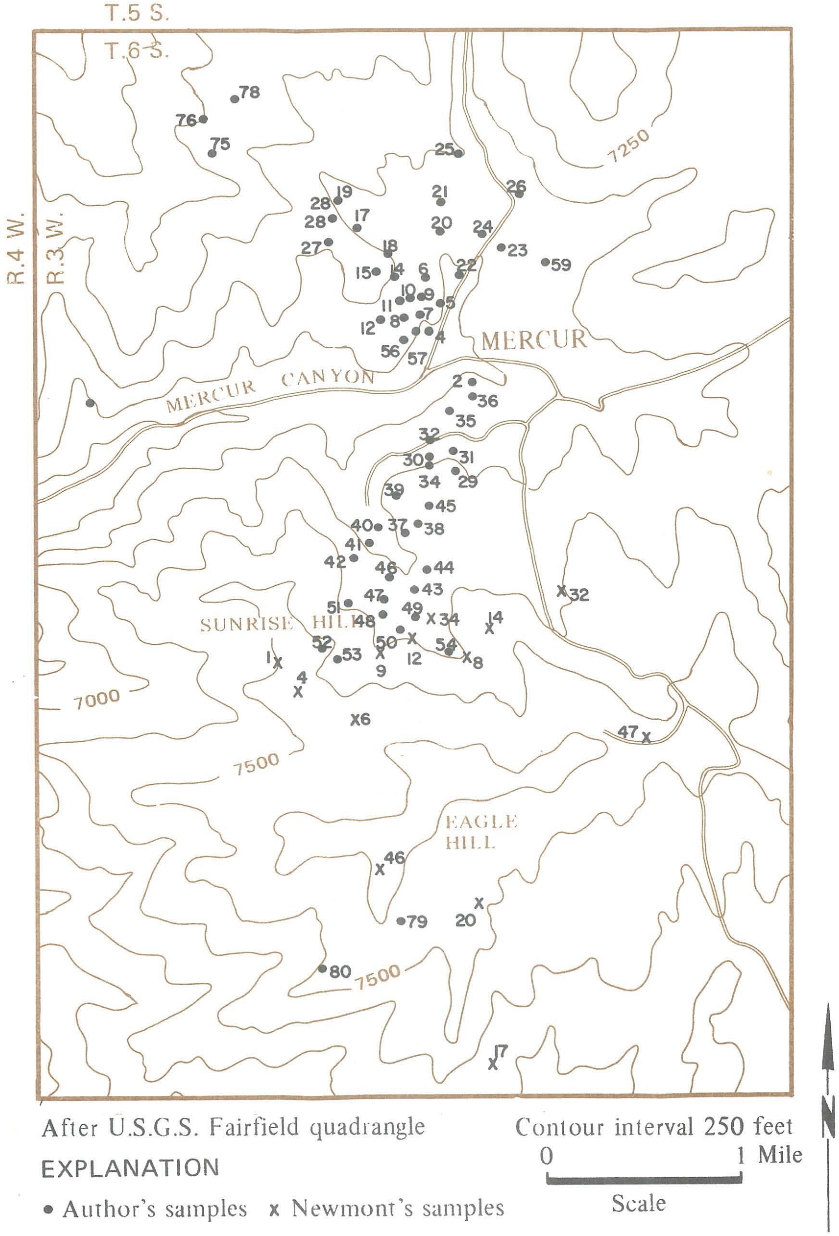

Figure 4. Sample locations by number at Mercur, Utah.

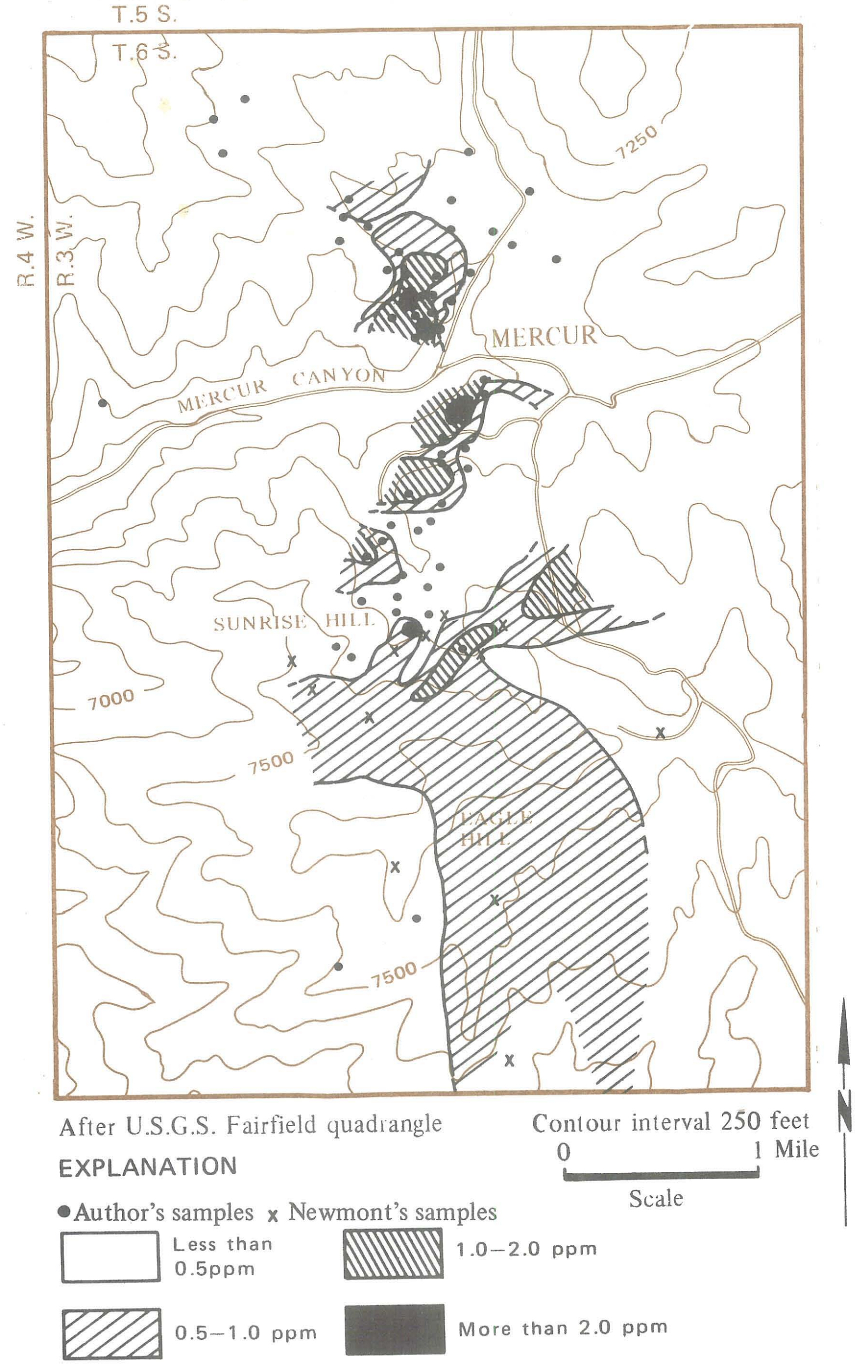

Figure 5. Silver content at Mercur, Utah as determined by atomic-absorption (in parts per million).

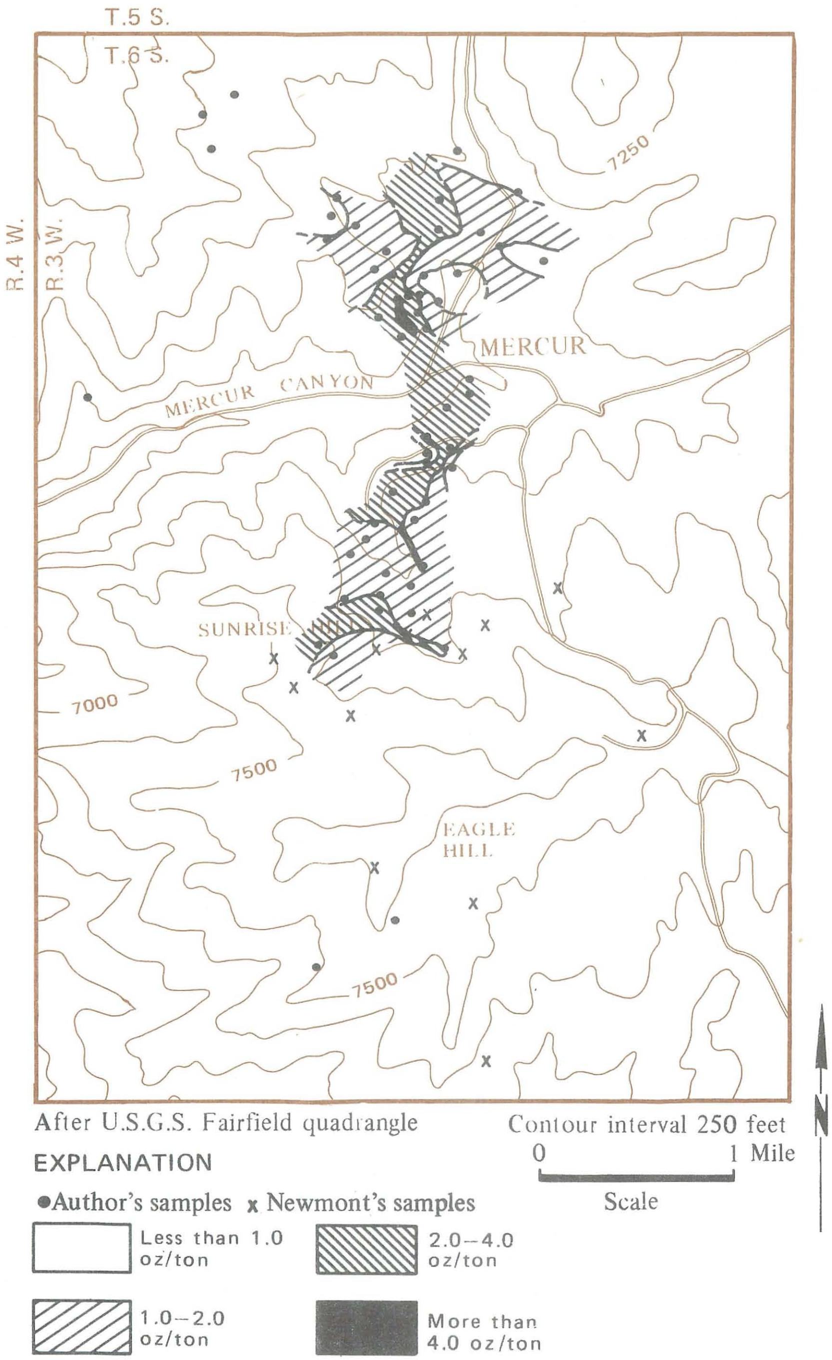

Figure 6. Silver content at Mercur, Utah (in ounces per ton).

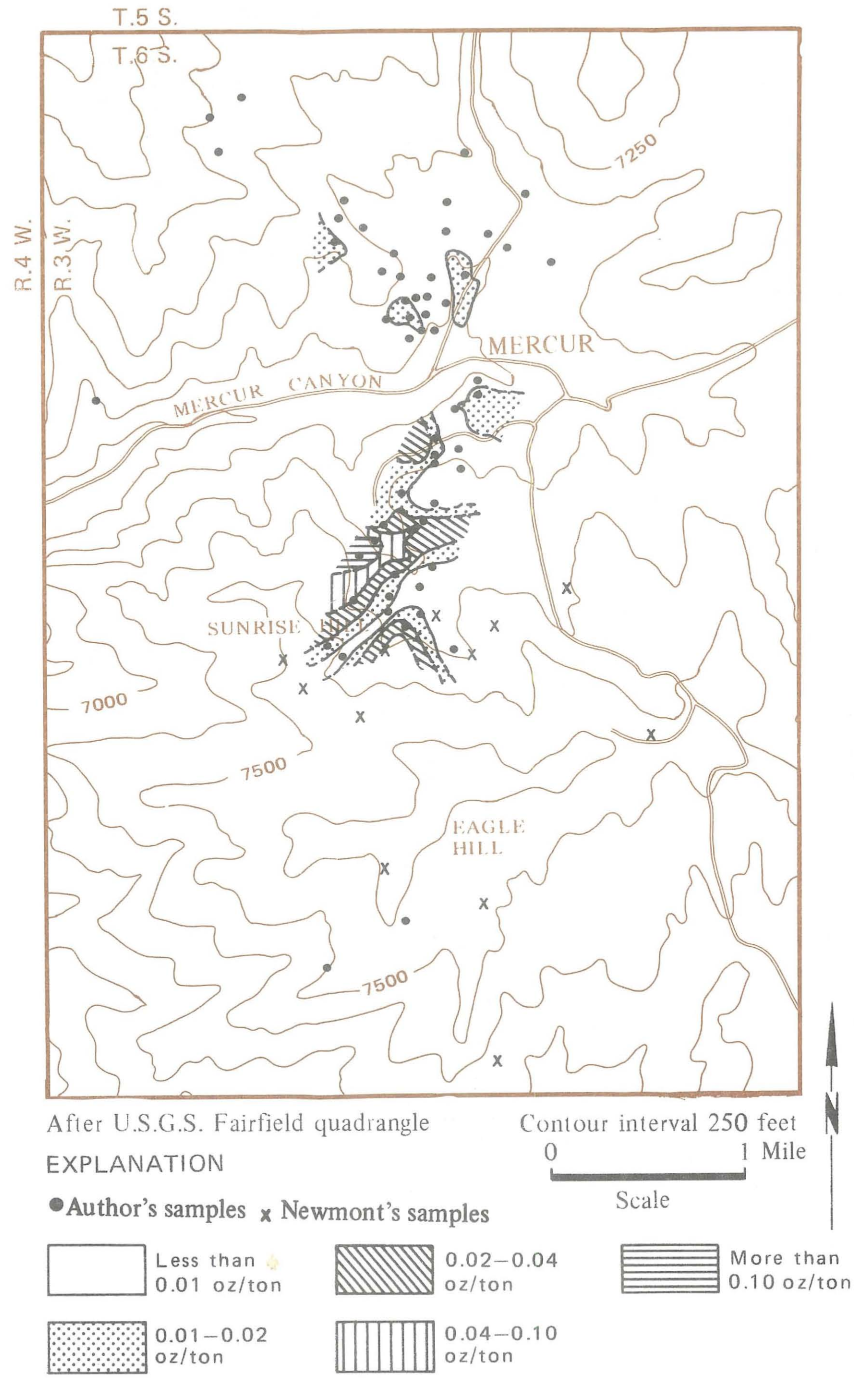

Figure 7. Gold content at Mercur, Utah (in ounces per ton).

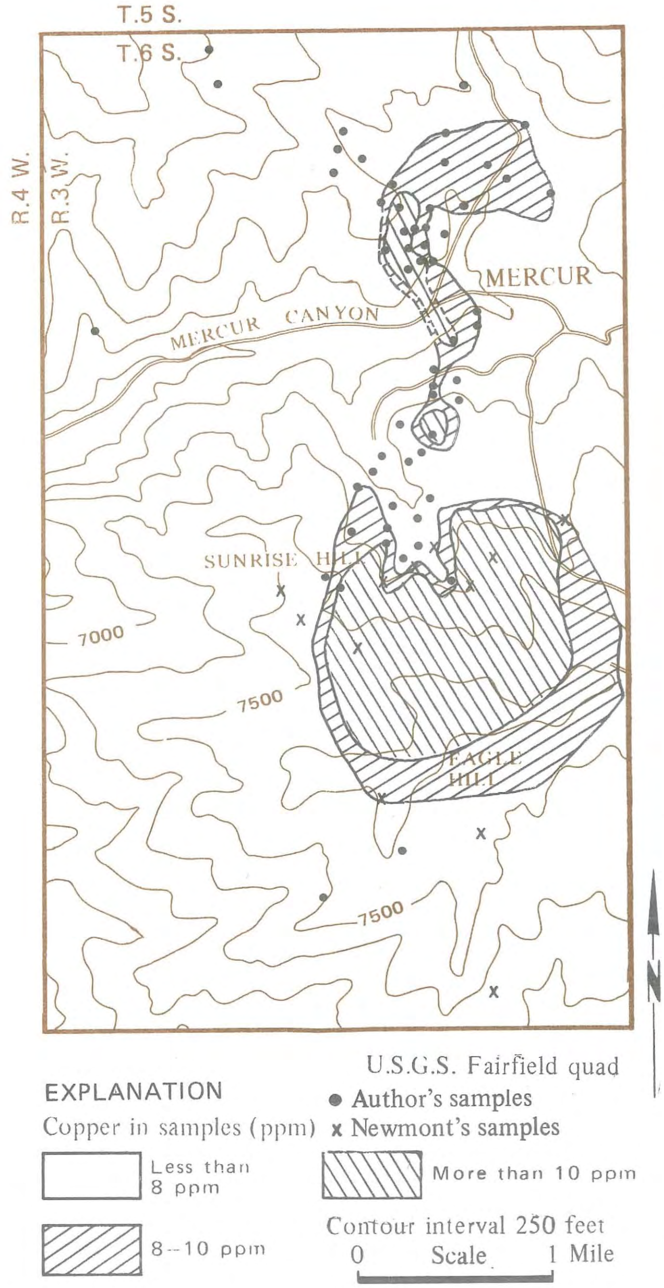

Figure 8. Copper content at Mercur, Utah (in parts per million).

of high concentration of silver to the north of Mercur is in the same location on both maps. The easier and more economical method of atomic-absorption is useful in detecting anomalies of silver; samples from anomalous highly concentrated areas, however, should be analyzed by fire assay before the area can be properly evaluated.

High gold content was found in dumps of the Sacramento mine on the east side of Sunrise Hill (figure 7). The material of the dumps comes from old mine workings near the contact of limestones and shales with rhyolite.

The copper content is highest around Eagle Hill (figure 8) to the south of Mercur and also to the north of Mercur where silver content is also high.

ARSENIC CONTENT

Eighteen samples analyzed to correlate arsenic content with gold and silver content (table 9) indicated no correlation between arsenic content and gold and silver content. More samples are needed to establish such a correlation.

MERCURY CONTENT

It is well known that mercury is associated with gold ore at Mercur and that mercury may be a guide to high-grade gold ore. Thirteen samples were analyzed for mercury at Kennecott Exploration, Inc., Salt Lake City. The samples are listed (table 10) with mercury content in parts per million and gold and silver content in ounces per ton. Sample 1 is from West Mercur; samples 14, 24, 31, 34, 35, 42, 51 and 75 are from the Mercur area; samples 79 and 80 were collected near and at the Violet Ray claims (figure 9) north of Sunshine; and samples 86 and 95 are from the Sunshine area. Mercury content correlates little with silver content, but sample 42 has the highest mercury and gold content of any of the samples analyzed. More samples should be analyzed for mercury before a definite correlation between gold and mercury content can be determined.

HALITE OCCURRENCE AT SUNSHINE

Halite occurs with halloysite and fluorite in a 30-foot adit on the west wall of Sunshine Canyon 1,000 feet southwest of the Overland mine dump in the NE ¼ sec. 29, T. 6 S., R. 3 W. The halite is loose, white and poorly crystalline associated with white to pink halloysite and a minor amount of reddish violet fluorite. The halite and halloysite are well exposed over a width of 6 feet on the south wall of the adit and in the north portion of the face (figure 10).

The entrance of the adit is driven in a light green to light olive breccia composed of angular fragments of gray and tan altered limestone. The entire breccia is hard and difficult to break. Breccia also occurs at various outcrops above the adit. One breccia sample from the outcrops above the adit contains both quartz and jarosite in the breccia fragments as well as in the brown cementing material as identified by X-ray diffraction. No other minerals were detected. Beyond the

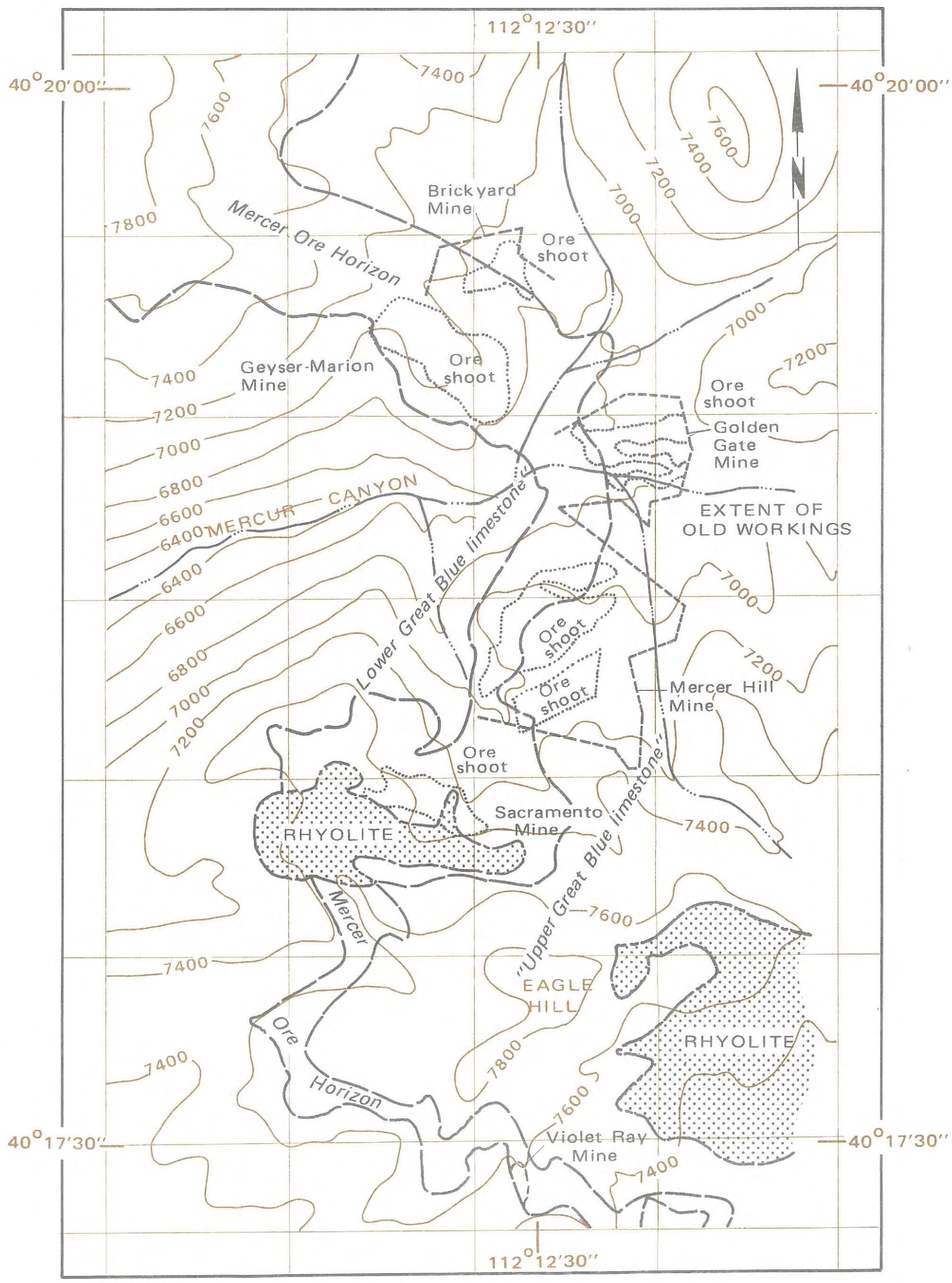

Figure 9. Gold mining area at Mercur, Utah.

Table 9. Attempted correlation of arsenic content with gold and silver content of some Mercur samples (unpublished records, Utah Geological and Mineralogical Survey, D. L. Barber, analyst).

Sample No.	Ounces per ton		ppm
	Gold	Silver	Arsenic
5	0.005	0.4	300
6	Nil	0.6	3,000
11	0.015	4.2	200
14	Nil	2.2	300
38	0.04	1.6	500
39	0.04	2.0	200
41	0.14	1.9	300
42	0.16	1.7	800
47	0.015	2.0	200
50	0.04	2.0	640
51	0.04	2.0	570
52	0.06	2.0	210
53	0.05	1.8	120
57	Nil	4.0	100
64	0.01	2.2	400
66	0.08	1.6	500
101	Trace	Trace	200
106	0.01	0.02	600

breccia are 8 feet of shales, altered shales and altered limestone followed by halloysite and halite.

The westerly third of the south wall near the back of the adit has exposures of bedded Great Blue Limestone that strike N. 20° E. and dip 20° to the southeast. Red iron oxides fill some of the bedding planes and fractures that cut the limestone. At the face of the adit, the bedded limestone is abruptly folded from a horizontal to a vertical structure that runs from the top to the bottom of the face (figure 11). Bedding can still be seen where the strata have been folded. Beds, once several inches thick, have thinned to less than one inch thick. Prospectors who dug the adit apparently followed the fold into the mountain hoping to find mineralization, but gold and silver were not found in the assays.

The thinning is not readily explained, but it may represent the nose of a tight fold or drag folding along

Table 10. Mercury, gold and silver content of samples from the Camp Floyd (Mercur) mining district.

Sample No.	Ounces per ton		ppm Mercury
	Gold	Silver	
1	Nil	2.0	1.32
14	Nil	2.2	5.83
24	Nil	1.8	1.78
31	Nil	2.0	3.44
34	Nil	2.0	0.84
35	Nil	2.0	7.00
42	0.16	1.7	352.00
51	0.04	2.0	2.28
75	Trace	Trace	1.64
79	Trace	0.5	0.56
80	Trace	0.2	9.60
86	Trace	Trace	9.71
95	0.01	Trace	8.71

a small fault not exposed at the surface above the adit. A similar occurrence of thinning in altered limestones was observed by Hewitt (1968a, p. 228-260) above stopes in the Santa Eulalia district, Mexico. Samples from the adit and from outcrops above gave only traces of gold and silver by fire assay.

CONCLUSIONS AND RECOMMENDATIONS

There is a mineralogical similarity between Carlin and Camp Floyd (Mercur), both in gold occurrence and associated gangue minerals; gold content of surface samples at Camp Floyd (Mercur), however, is much lower than at Carlin. Tabulation of gold and silver contents in samples by locality shows that gold mineralization is concentrated along faults and fissures. Additional study of structural features is merited to verify the high silver concentration along faults and fissures and perhaps lead to new silver prospects.

Areas of anomalously high gold and copper content were located (figures 7 and 8). The gold anomaly to the east of Sunrise Hill may be a guide to gold content higher than that found on the surface.

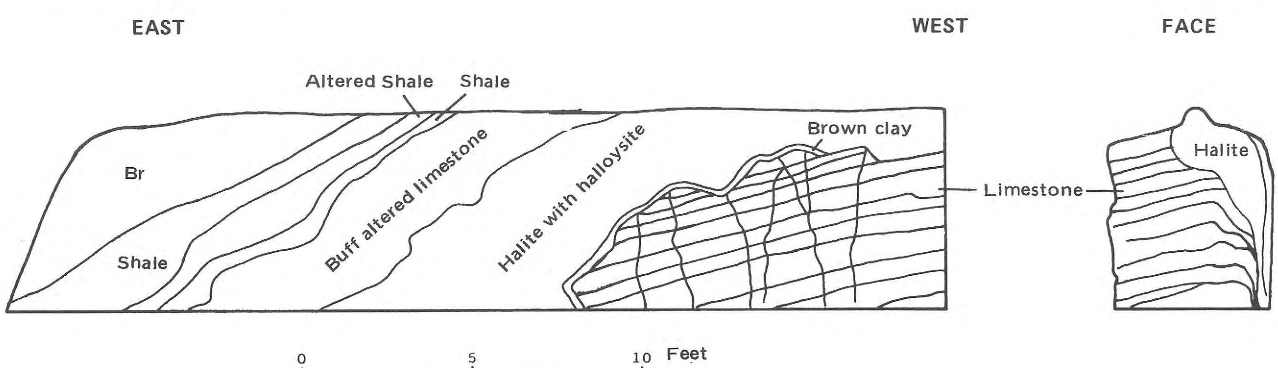

Figure 10. South wall of adit near Sunshine.

Figure 11. Folded and thinned altered limestone on face of adit near Sunshine.

The atomic-absorption method described by Ward and others (1969) proved valuable in locating the high silver anomaly in the same area as was located by fire assay analysis, further proving the existence of the anomaly. The amount of silver detected in the samples by atomic-absorption was only a portion of that detected by fire assay.

The attempted correlation between arsenic and mercury content with either gold or silver content in samples was not successful for the small number of samples used. Additional study of mercury and arsenic content in samples over a broad area is needed to test the usefulness of mercury or arsenic content as guides to ore in the district. Use of other elements as guides, especially antimony, also is suggested.

Further study of the distribution of other elements may lead to new means of exploration and to conclusions about the genesis of the deposits at Mercur. Antimony, arsenic and mercury, noted in the literature as occurring with gold, are suggested for future study. Geochemical sampling over a larger area around and including Mercur may show the importance of the associated elements as guides to ore. The importance of carbon in the gold deposits is mentioned in this paper. Recent studies by Radtke and Scheiner (1970, p. 87-102) showed organic carbon compounds associated with gold at Carlin; further investigation may indicate additional similarities between the two gold deposits and show the importance of carbon as a gold extracting agent from hydrothermal solutions. Carbon isotope studies also could contribute information about the genesis of the deposits.

The origin of halite at Sunshine is yet unsolved. Study of the halite with thinning of limestones may shed new light on ore genesis and the structural setting of the Camp Floyd (Mercur) district. Detailed geological mapping is proposed to find additional faults and joints which may contain high silver concentrations. Structural problems observed by the author include a possible chevron fold in the upper Great Blue Member southwest of the Sunshine mine.

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APPENDIX

Gold and Silver Analyses of Samples from Camp Floyd (Mercur) District

September 30, 1968
Black and Deason Assayers, Salt Lake City

Sample No.	Ounces per ton	
	Gold	Silver
GL 1	Nil	1.8
GL 1	Nil	2.0
GL 2 muck from old ore bin at bottom	0.04	2.0
GL 2-A	0.01	2.2
GL 2-B	0.01	1.8
GL 4	0.01	2.0
GL 4	0.01	0.4
GL 5 yellow	0.005	0.4
GL 6	Nil	0.6
GL 6-A	Nil	1.2
GL 7	0.01	2.0
GL 8	0.015	4.0
GL 9	Nil	2.0
GL 10	0.01	2.2
GL 11	0.015	4.2
GL 12	0.005	2.8
GL 14	Nil	2.2
GL 15	Nil	1.2
GL 16	Nil	1.4
GL 17	Nil	1.4
GL 18	0.015	2.0
GL 18-A	0.01	0.4
GL 19	Nil	1.0
GL 20	0.005	2.2
GL 21	0.01	2.6
GL 22	0.015	0.4
GL 23	Nil	2.0
GL 24	Nil	1.8
GL 25	Nil	0.4
GL 26	Nil	1.0
GL 27	0.015	1.6
GL 28	0.005	Nil
GL 29	Nil	Nil
GL 29-A	Nil	Nil
GL 30	0.02	Nil
GL 31	Nil	2.0

October 1, 1968
Black and Deason Assayers, Salt Lake City

Sample No.	Ounces per ton	
	Gold	Silver
GL 32	0.02	2.0
GL 33	0.01	1.2
GL 34	Nil	2.0
GL 35	Nil	2.0
GL 36	0.015	1.0
GL 37	0.04	2.0
GL 38	0.04	1.6
GL 38-A	0.02	1.6
GL 39	0.015	2.2
GL 39-A	0.04	2.0
GL 40	0.02	2.0
GL 41	0.14	1.9
GL 42	0.16	1.7
GL 43	0.006	1.6
GL 43-A	0.005	2.0
GL 44	0.005	2.0
GL 45	Nil	2.0
GL 46	0.015	1.4
GL 47	0.015	2.0
GL 48	0.01	2.2
GL 49	0.015	1.8
GL 50	0.04	2.0
GL 51	0.04	2.0
GL 52	0.015	2.0
GL 52-A	0.06	2.0
GL 53	0.05	1.8
GL 54	Nil	2.0
GL 55	Nil	2.0
GL 56	Nil	2.6
GL 57	Nil	4.0
GL 58	Nil	2.0
GL 59	Nil	2.4
GL 60	Nil	1.4
GL 61	0.02	2.0
GL 62	0.02	2.0
GL 63	0.01	1.6
GL 64	0.01	2.2
GL 65	Nil	1.6
GL 66	0.08	1.6
No number	0.01	1.6

October 23, 1968
Black and Deason Assayers, Salt Lake City

Sample No.	Ounces per ton		Value of gold per ton
	Gold	Silver	
GL 67	Trace	Trace	
GL 68	Trace	Trace	
GL 69	Trace	1.2	
GL 70	Trace	0.4	
GL 71	Trace	Trace	
GL 72	Trace	Trace	
GL 73	Trace	Trace	
GL 74	Trace	Trace	
GL 75	Trace	Trace	

August 12, 1968
Crimson and Nichols Assayers, Salt Lake City

Sample No.	Ounces per ton		Value of Gold per ton
	Gold	Silver	
GL 76	0.01	0.35	$ .35
GL 78	Trace	Trace	
GL 79	Trace	0.50	
GL 80	Trace	0.20	
GL 82	0.01	0.30	.35
GL 83	Trace	Trace	
GL 84	Trace	0.10	
GL,M.CO	Trace	0.30	

September 30, 1969
Crimson and Nichols Assayers, Salt Lake City

Sample No.	Ounces per ton		Value of Gold per ton
	Gold	Silver	
GL 85	Trace	Trace	
GL 86	Trace	Trace	
GL 87	0.01	Trace	$ .35
GL 88	0.01	Trace	.70
GL 89	Trace	Trace	
GL 90	Trace	Trace	
GL 91	Trace	Trace	
GL 92	Trace	Trace	
GL 93	0.01	Trace	.35
GL 94	Trace	Trace	
GL 95	0.01	Trace	.35
GL 96	0.01	Trace	.35
GL 97	Trace	Trace	
GL 98	Trace	Trace	
GL 100	Trace	Trace	
GL 101	Trace	Trace	
GL 102	0.01	Trace	.35
GL 105	Trace	Trace	
GL 106	0.01	Trace	.35
No number	Trace	Trace	
GL 108	Trace	Trace	
GL 109	Trace	Trace	
GL 110	Trace	Trace	
GL 111	Trace	Trace	
GL 113	Trace	Trace	

UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

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