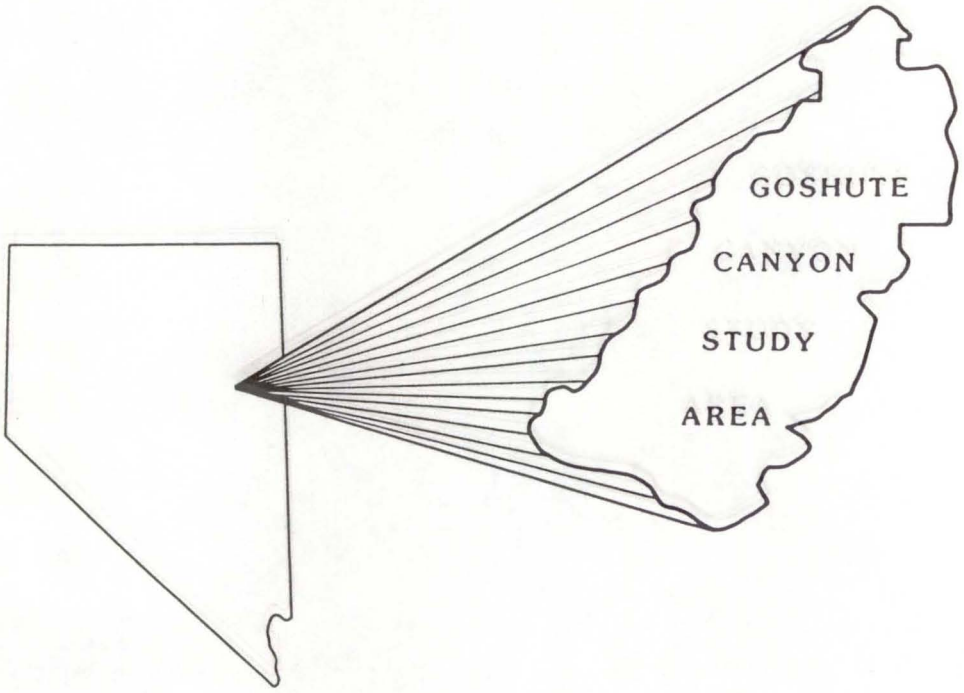
MLA 77-86

Mineral Land Assessment/1986
Open File Report

Mineral Resources of the Goshute Canyon Study Area, Elko and White Pine Counties, Nevada



BUREAU OF MINES
UNITED STATES DEPARTMENT OF THE INTERIOR

MINERAL RESOURCES OF THE GOSHUTE CANYON STUDY AREA, ELKO AND WHITE PINE COUNTIES, NEVADA

By
Fredrick L. Johnson

Western Field Operations Center
Spokane, Washington

UNITED STATES DEPARTMENT OF THE INTERIOR
Donald P. Hodel, Secretary

BUREAU OF MINES
Robert C. Horton, Director

PREFACE

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and U.S. Bureau of Mines to conduct mineral surveys on U.S. Bureau of Land Management administered land designated as Wilderness Study Areas ". . . to determine the mineral values, if any, that may be present . . . ." Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a Bureau of Mines mineral survey of a portion of the Goshute Canyon Wilderness Study Area (NV-040-015), Elko and White Pine Counties, Nevada.

This open-file report will be summarized in a joint report published by the U.S. Geological Survey. The data were gathered and interpreted by Bureau of Mines personnel from Western Field Operations Center, E. 360 Third Ave., Spokane, WA 99202. The report has been edited by members of the Branch of Mineral Land Assessment at the field center and reviewed at the Division of Mineral Land Assessment, Washington, DC.

CONTENTS

ILLUSTRATIONS

SUMMARY

In 1985, at the request of the U.S. Bureau of Land Management, the U.S. Bureau of Mines studied part of the 30,585-acre Goshute Canyon Wilderness Study Area (NV 040-015) in order to evaluate the mineral resources. The study area is located in Elko and White Pine Counties, NV, midway between Wells and Ely.

The Cherry Creek mining district, organized in 1872, extends into the south half of the study area. Production from the district, mainly gold, silver, copper, lead, and tungsten, is estimated at between $6 and $20 million; all from mines south of the study area. There is no recorded production from the study area.

The area is underlain by Paleozoic sedimentary rocks which trend northeast and dip northwest. At least 100 mining claims have been located in the area, the most recent by American Selco Inc., and 21 inactive workings were found. Most of the claims and workings are concentrated along three major bedding plane faults at the base of thick, incompetent shale beds. The faults have many of the characteristics of hot-spring type gold deposits; the rocks have been brecciated, silicified, and hydrothermally altered, and have anomalous concentrations of precious metals and pathfinder elements. Although no mineral resources were delineated during our investigation, additional exploration may disclose gold resources.

Extensive sand and gravel and stone occurrences in the study area are suitable for many construction purposes; however, adequate material is available closer to major markets in the region, and sand and gravel in the study area does not constitute an identified resource. Oil and gas leases extend into the north part of the WSA, but are not evaluated in this study.

INTRODUCTION

This report describes the USBM (U.S. Bureau of Mines) portion of a cooperative study with the USGS (U.S. Geological Survey) to evaluate mineral resources and potential of the Goshute Canyon study area at the request of the BLM (U.S. Bureau of Land Management). The USBM examines individual mines, prospects, claims, and mineralized zones, and evaluates identified mineral and energy resources. The USGS evaluates potential for undiscovered resources based on areal geological, geochemical, and geophysical surveys. Results of the investigations will be used to help determine the suitability of the Goshute Canyon study area for inclusion into the National Wilderness Preservation System. The immediate goal of this and other USBM mineral surveys is to provide data for the President, Congress, government agencies, and the public for land use decisions. The long-term objective is to ensure the Nation has an adequate and dependable supply of minerals at a reasonable cost.

Setting

The Goshute Canyon study area encompasses 22,225 acres of the 30,585-acre WSA (Wilderness Study Area) in eastern Nevada, about midway between Wells and Ely (fig. 1). It lies near the center of the Cherry Creek Range, and is bound on the east by Steptoe Valley (fig. 2). Elevations range from 10,276 ft (feet) [3,132 m (meters)], the highest point in the study area, to about 5,850 ft (1,780 m) in Steptoe Valley. Dirt roads provide access to all sides of the study area. The climate, and thus the vegetation in the Cherry Creek Range, is diverse. Grasses and sagebrush grow at lower elevations while higher elevations support aspen, juniper, white fir, and pinyon, bristlecone, and limber pines.

Previous Studies

The most comprehensive work done near the study area is by Adair (1961), who discusses rock formations, structural geology, and mineral deposits of the Cherry Creek mining district. Hose, Blake, and Smith (1976) elaborate on the geology and mineral resources of all of White Pine County. Several geologic cross-sections parallel to Log Cabin, Carry, and Goshute Creeks (Misch, 1960) are useful for identifying individual formations. Two Ph.D. theses, one on the bedrock geology of the northern Scheel Creek Range (Dechert, 1967), and another on the structure and stratigraphy of the northern Egan Range (Fritz, 1960), contain detailed descriptions of the same rock formations present in the study area.

In 1942, the U.S. Bureau of Mines conducted an exploration program in the Cherry Creek mining district which consisted of surveying, trenching, sampling, long-hole and core drilling, rehabilitation of mine workings, road building, drifting, and shaft sinking. Results from that program appear in War Minerals Report No. 216 (1944) and Report of Investigations No. 4631 (Holmes, 1950). Two older reports, one by Schrader (1931) and another by Hill (1916), contain sections which address the history, geology, and mineral deposits of the Cherry Creek mining district.

Present Study

All available information on geology, mining, and exploration in the area, including county mining claim records, was reviewed prior to field work.

Claimants were contacted for permission to examine properties and publish the results. In some cases, the claimant accompanied the author to the property. Field studies involved searches for all mines, prospects, and claims indicated by pre-field studies to be in the study area. Those found were examined, and where warranted, mapped and sampled. In addition, ground and air reconnaissance was performed in areas of obvious rock alteration.

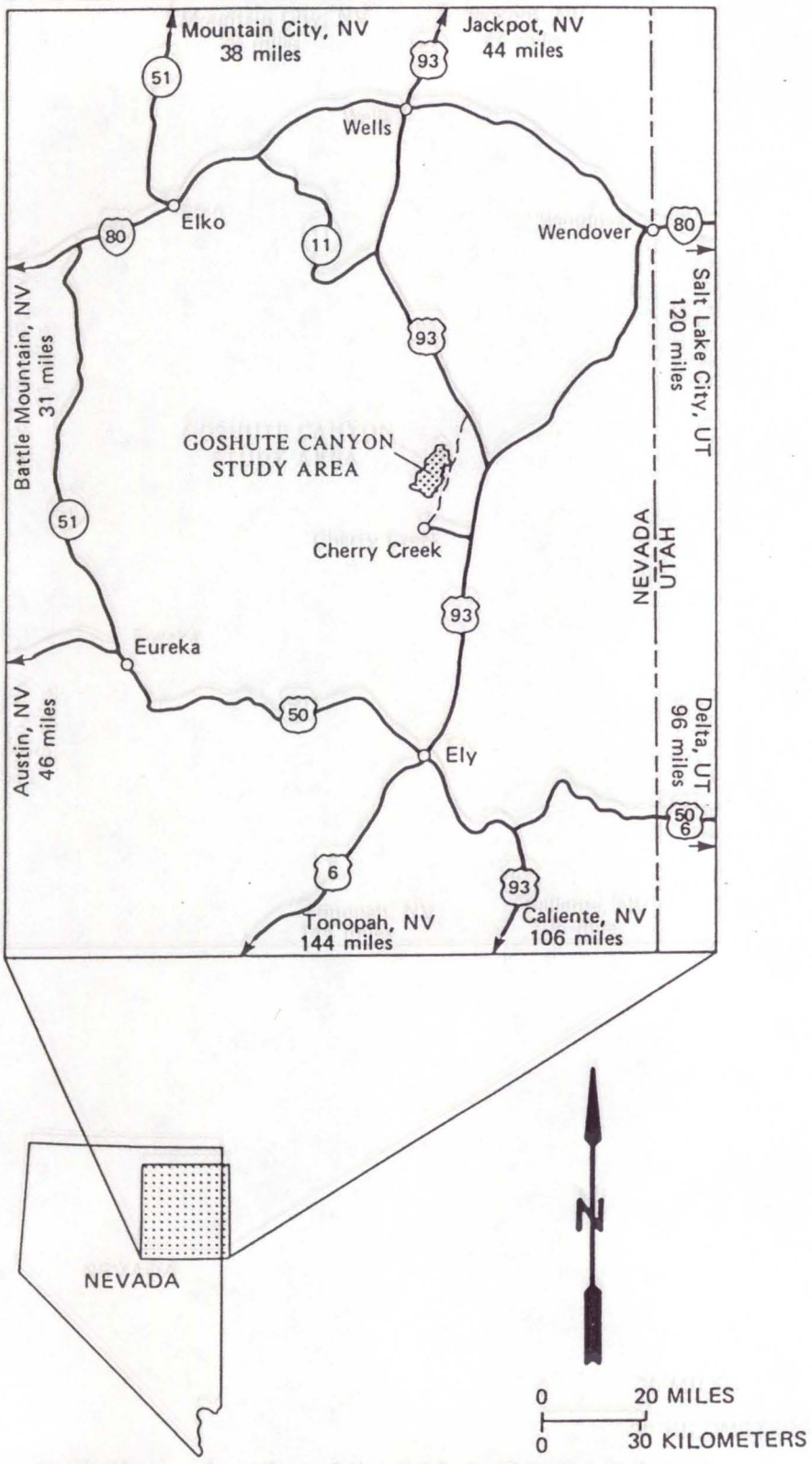


FIGURE 1. – Location of the Goshute Canyon study area, Elko and White Pine Counties, NV

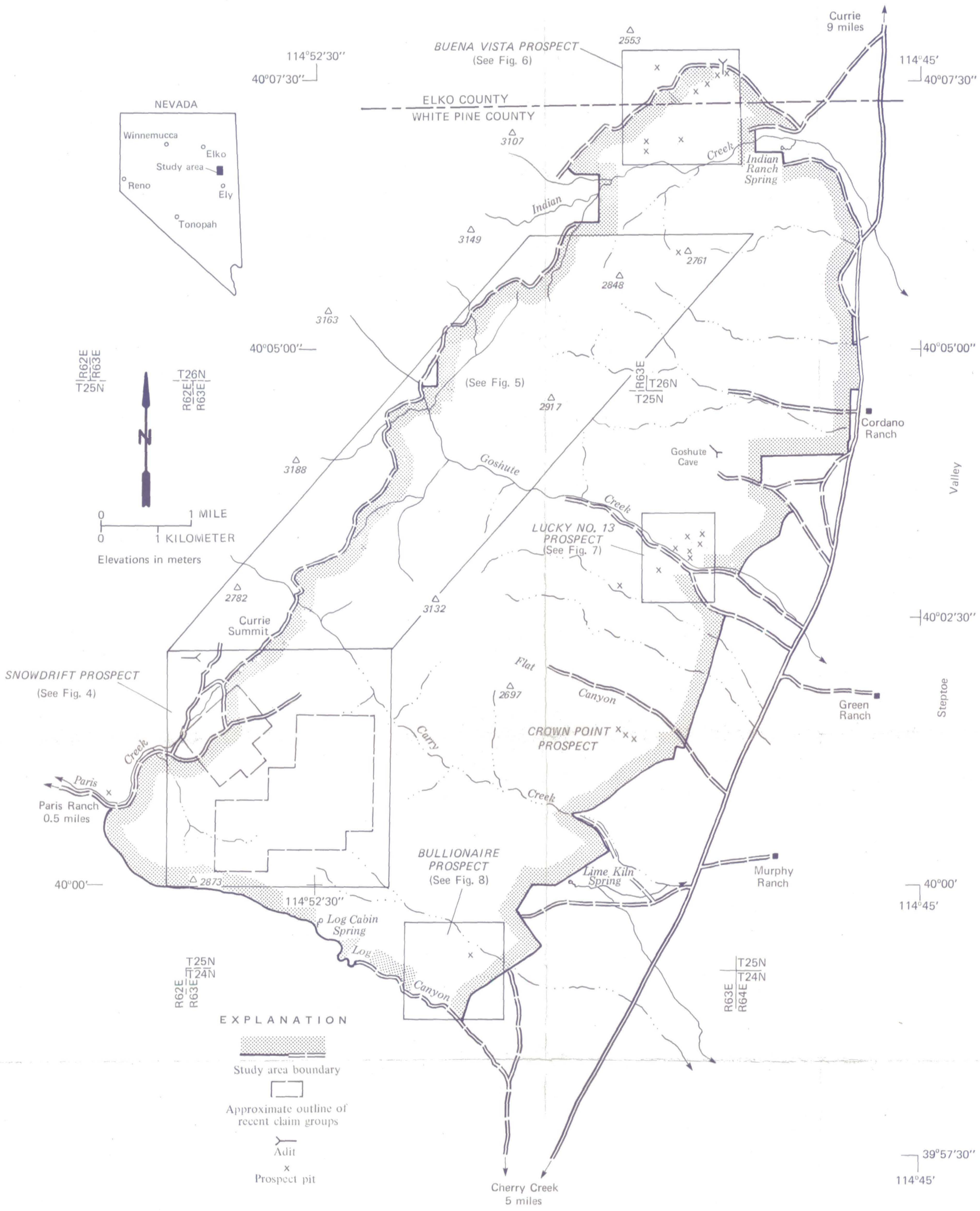


FIGURE 2. – Prospects, claims, and mineralized areas in and adjacent to the Goshute Canyon study area, Elko and White Pine Counties, NV

Field work was conducted during the summer of 1985 and 167 samples were taken. The samples were of four types: 1) chip - a regular series of rock chips taken in a continuous line across a mineralized zone or other exposure; 2) random chip - an unsystematic series of chips taken from an exposure of apparently homogeneous rock; 3) grab - rock pieces taken unsystematically from a dump or stockpile, or of float (loose rock lying on the ground); and 4) select - an intentionally biased selection of rock because of a unique or unusual property. All samples were crushed, pulverized, mixed and split, and checked for radioactive and fluorescent minerals. Each sample was analyzed for gold and silver content by fire-assay and ICP (inductively coupled plasma) methods. The detection limit by these methods is 0.007 ppm (parts per million) gold and 0.3 ppm silver. They were also analyzed for arsenic and mercury. The arsenic content was determined by ICP/atomic absorption methods. One of several special methods, determined by rock lithology and mercury concentration, was used for mercury analyses. The detection limit for arsenic and mercury by these methods is 2.0 ppm.

ACKNOWLEDGEMENTS

Our gratitude is extended to Mr. Don Witter, exploration geologist, for familiarizing us with the rock formations, alteration, and mineral deposits in the study area. We greatly appreciate pilot Jack Fulton, El Aero Services, Inc., for his expert flying ability and knowledge of the area.

GEOLOGIC SETTING

The Goshute Canyon study area is in the Basin and Range province of eastern Nevada. It lies within a steeply northwest-tilted block of Paleozoic sedimentary rocks bound on the east by a high-angle fault.

The sedimentary rocks strike northeast, consist of limestone, dolomite, shale, siltstone, sandstone, quartzite, and conglomerate, and represent the Cambrian through Mississippian periods (fig. 3). The oldest rock unit exposed in the study area is in the Cambrian Orr Formation. This unit is overlain by the Cambrian Dunderburg Shale and Windfall Formation. Rocks of the Ordovician period include the Pogonip Group, Eureka Quartzite, and Fish Haven Dolomite. These are followed by the Silurian Laketown Dolomite and the Devonian Sevy Dolomite, Simonson Dolomite, and Guilmette Formation. The youngest Paleozoic rock units exposed in the study area are the Mississippian Pilot Shale, Joana Limestone, and Chainman Shale.

Several bedding plane faults occurring at the base of thick, incompetent shale beds are exposed in the area. The most pronounced of these faults are at the base of the Dunderburg, Pilot, and Chainman Shales. Most mining claims that have been located in the study area appear to be along these three major bedding plane faults. In the Cherry Creek mining district, the bedding plane fault at the base of the Dunderburg Shale hosts silver, lead, and tungsten ores (Adair, 1961). Along this horizon, the Baltic mine produced moderate amounts of silver, the Lead

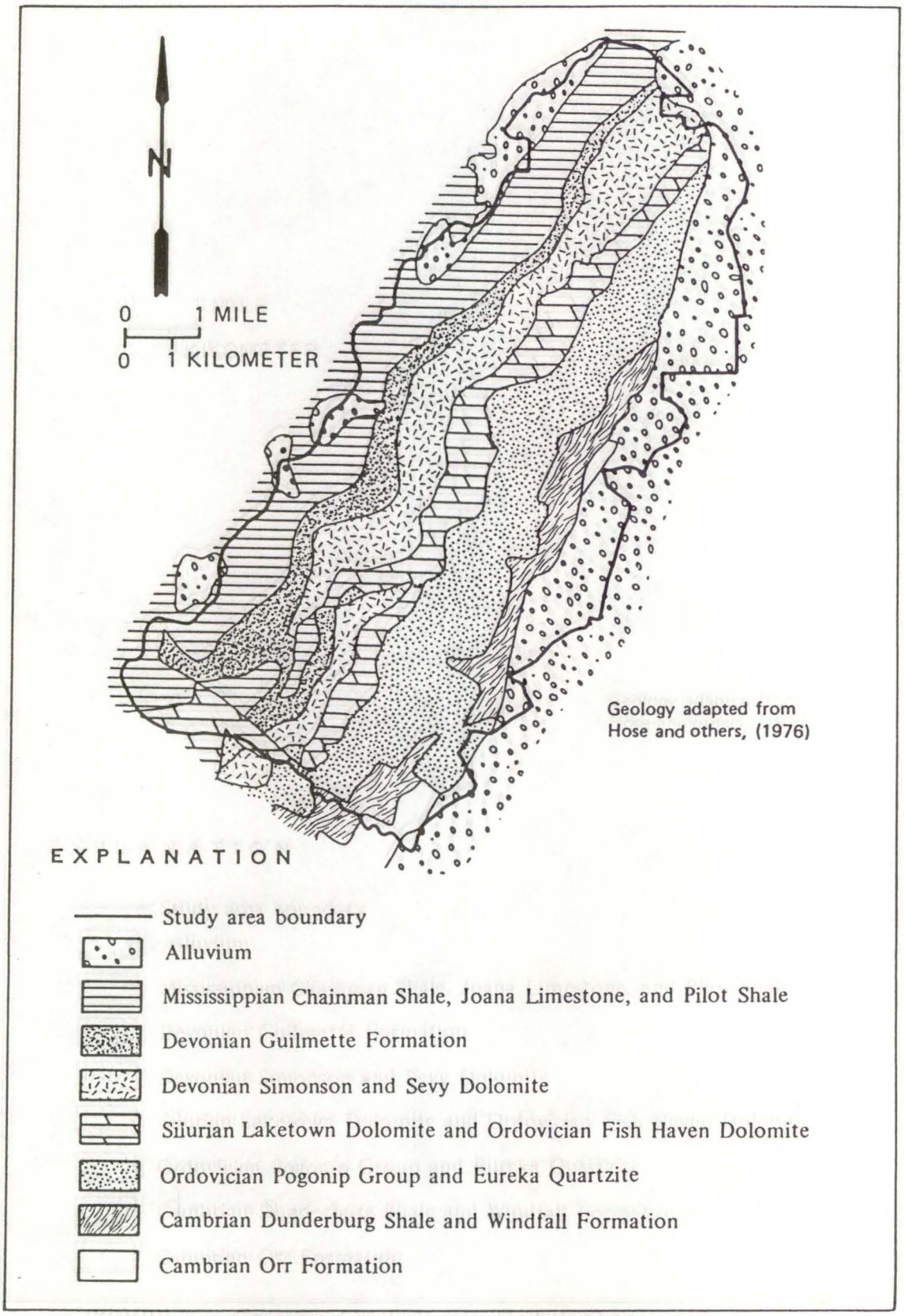


FIGURE 3. – Generalized geologic map, Goshute Canyon study area

mine produced moderate amounts of very high-grade lead ore, and the Shoestring-Happy mine produced tungsten (Adair, 1961). The Windfall mine, about 4 mi (miles) [6.4 km (kilometers)] south of Eureka, is producing gold from siliceous zones near the base of the Dunderburg Shale (Grove, 1979).

The Alligator Ridge mine, located 35 mi (56 km) southwest of the study area, is producing gold from siliceous zones at the base of the Pilot Shale. The deposit was discovered in 1976 and mining began in 1980. The original ore reserves were estimated at 5 million tons averaging 0.12 oz/ton (ounces per ton) gold (Klessig, 1984).

The Rain disseminated gold deposit, located 70 mi (110 km) northwest of the study area, is similar to the Alligator Ridge mine; gold occurs there in siliceous zones near the contact of the Mississippian shales with Devonian limestones (Knutsen and West, 1984). Although not producing, reserves are estimated at 8.3 million tons averaging 0.083 oz/ton gold (Lowe and others, 1985).

Siliceous zones, similar to those at the Alligator Ridge and Rain deposits, occur in the study area near the base of the Pilot Shale.

There are no known operating gold mines close to the study area associated with the base of the Chainman Shale. However, the rocks along this bedding plane fault have been brecciated and silicified as intensely as those at the base of the Pilot Shale. Many of the old workings found in the study area are along this fault.

MINING HISTORY

The Cherry Creek mining district, organized in 1872, extends from Egan Canyon south of Cherry Creek, north to Goshute Creek (Hill, 1916). The town of Cherry Creek was established in 1873 and by 1878, a 10-stamp mill was operating at the nearby Star mine (Hose and others, 1976). The district was most active between 1872 and 1883, producing principally gold and silver with lesser amounts of copper and lead. During this time, the population of Cherry Creek grew to about 6,000 (Hill, 1916). In 1884, mining activity began to decline and with the demonetization of silver in 1893, it practically ceased.

Estimates of total production for the district prior to 1916 range from $6 to $20 million (Hill, 1916). Base and precious metal production since then has been sporadic and relatively small. Tungsten was discovered in the district in 1915, but the principal tungsten production occurred from 1940 through 1958. Total tungsten production through 1958 is estimated at more than 30,000 short-ton units WO_3 [20 pounds (lb)] (Hose and others, 1976). All known production from the district was from mines south of the study area.

Exploration activity in the Goshute Canyon study area has been moderate. A search of White Pine County and BLM mining records revealed that no active mining claims and about 100 historical claims were located

in the study area. Many of the location descriptions for the historical claims, however, are vague and many more may have been located in the study area. During our reconnaissance, old claim corners and prospect pits were found in areas not previously known to be claimed. Oil and gas leases extend into the north part of the study area, but are not evaluated in this report.

American Selco, Inc. (Amselco) located 77 claims (Snowdrift prospect) during 1979 and 1980 in the southwest corner of the study area (fig. 2). They were exploring for hot-spring type, large tonnage, low-grade gold deposits, similar to the Alligator Ridge mine 35 mi (56 km) to the southwest. Exploration on these claims included geologic mapping, geochemical sampling, and drilling. During 1980, 17 holes totalling 3,415 ft (1,041 m) were drilled. Results from their exploration program were not encouraging and the claims were subsequently dropped.

PROSPECTS, CLAIMS, AND MINERALIZED AREAS

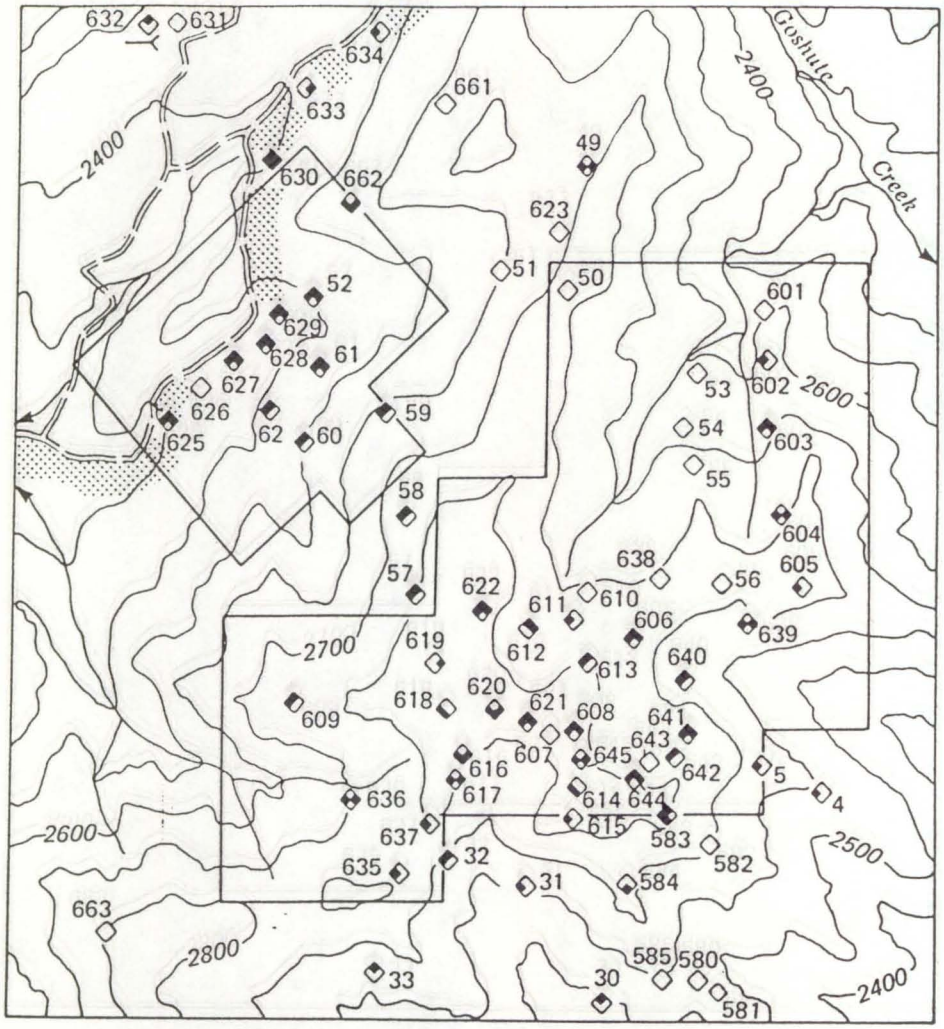
Three major bedding plane faults have features similar to those found at past and present producing mines. The faults occur at the base of the Chainman, Pilot, and Dunderburg Shales, and locally contain limonite- and hematite-stained, silicified, brecciated, limestone and siltstone. The Snowdrift, Buena Vista, Lucky No. 13, and Bullionaire prospects are along these three faults and are discussed in the following sections. Complete descriptions and analyses for all samples taken during this study appear in the appendix.

Several minor bedding plane faults in the Ordovician Pogonip Group also contain lenses of limonite-stained, silicified, brecciated limestone and shale. Four samples (nos. 502, 503, 506, and 507) taken from these silicified areas (two south and two north of Carry Creek) contained from 0.019 to 0.520 ppm gold and from 39 to 240 ppm arsenic. These concentrations are significant; however, the silicified zones are poorly exposed, not continuous, and pinch and swell sporadically along strike.

Snowdrift Prospect

Amselco's exploration program was concentrated near the bottom of the Pilot Shale and top of the Guilmette Formation in an area where high angle faults have duplicated the stratigraphic section. Zones of limonite- and hematite-stained, silicified fault breccia crop out locally along the contact of these formations and also along the Chainman Shale-Joana Limestone contact. Although these contacts are very similar, Amselco personnel believe that the Pilot Shale is a better host for gold mineralization than the Chainman Shale. This may be due to a higher clay content and corresponding lower permeability in the Chainman Shale. Both contacts were sampled during our study.

Seventy-three samples were taken in the Snowdrift prospect area. Their locations and general metal content are shown on Figure 4. Concentrations were as much as 0.352 ppm gold, 10.13 ppm silver, 4,700 ppm arsenic, and 9 ppm mercury. Complete descriptions and analyses of these samples appear in Appendix A-2.



EXPLANATION

Study area boundary

Adit

Approximate outline of claim block

Sample locality

Denotes gold (≥0.007 ppm)

Denotes silver (≥0.3 ppm)

Denotes anomalous arsenic (≥50 ppm)

Denotes mercury (≥2 ppm)

N

0 2000 FEET

0 600 METERS

Contour interval 100 meters

FIGURE 4.– Sample locations, Snowdrift prospect

The Chainman Shale-Joana Limestone and Pilot Shale-Guilmette Formation contacts were also sampled north of the Snowdrift prospect. Sixteen samples were taken along the Chainman Shale-Joana Limestone contact and twenty-two samples were taken along the Pilot Shale-Guilmette Formation contact. Their locations and general metal content are shown in Figure 5. Concentrations for all thirty-eight samples were as much as 0.649 ppm gold, 1.741 ppm silver, 4,000 ppm arsenic, and 2.0 ppm mercury. Complete descriptions and analyses for these samples appear in Appendix A-3.

Buena Vista Prospect

The Buena Vista prospect area is underlain by Mississippian Chainman Shale and Joana Limestone. The bedding plane fault at the base of the Chainman Shale in this area is relatively well exposed, and eight prospect pits and one 6-ft- (2 m) long adit were found along it. The workings generally expose zones of jasperoid, hematitic-limonitic gossan, and silicified fault breccia. Although the zones may be as much as 10 ft (3 m) thick in places, they generally are less than 3 ft (1 m) thick and not continuous.

Twenty samples were taken in the area and their locations are shown on Figure 6. For the 18 samples taken along the fault, concentrations were as much as 0.058 ppm gold, 2.018 ppm silver, and 170 ppm arsenic. One sample (no. 650) taken from a zone of silicified, brecciated sandstone in the Chainman Shale near the head of Dry Canyon contained 0.034 ppm gold. Complete descriptions and analyses for these samples appear in Appendix A-4.

Lucky No. 13 Prospect

This area is underlain by Cambrian Dunderburg Shale and Orr Formation. The Dunderburg Shale consists of black, fossiliferous shale, and is separated from the massive bedded, medium blue-gray limestone and dolomite of the Orr Formation, by a major bedding plane fault. Zones of dark, limonite-stained, silicified limestone and shale breccia outcrop along the contact. The bedding plane fault is covered by alluvium north and south of the area sampled. Seven old prospect pits were found.

Seventeen samples were taken and their locations and general metal content are shown on Figure 7. Concentrations were as much as 0.073 ppm gold, 3.871 ppm silver, 1,350 ppm arsenic, and 20 ppm mercury. Complete descriptions and analyses for these samples appear in Appendix A-5.

Bullionaire Prospect

The Bullionaire prospect is similar to the Lucky No. 13 prospect in that the area of interest is the bedding plane fault at the base of the Dunderburg Shale. Here the silicified zone is limonite-stained and contains angular, light-colored clasts of silicified limestone and shale. It pinches out about 700 ft (200 m) north of a prospect pit, extends south of the study area, and is as much as 100 ft (30 m) thick.

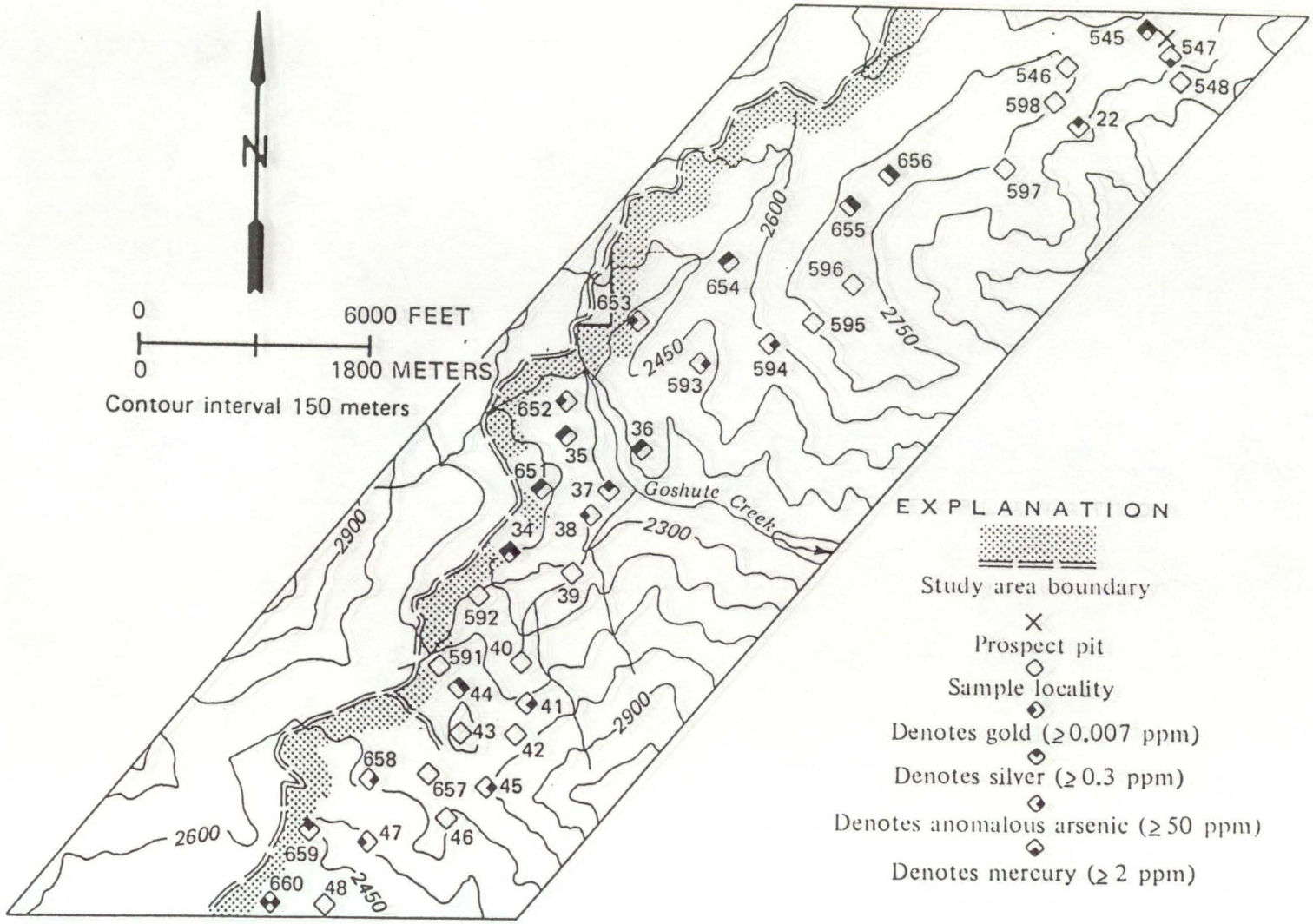


FIGURE 5.– Sample locations along the Chainman Shale–Joana Limestone, and Pilot Shale–Guilmette Formation contacts

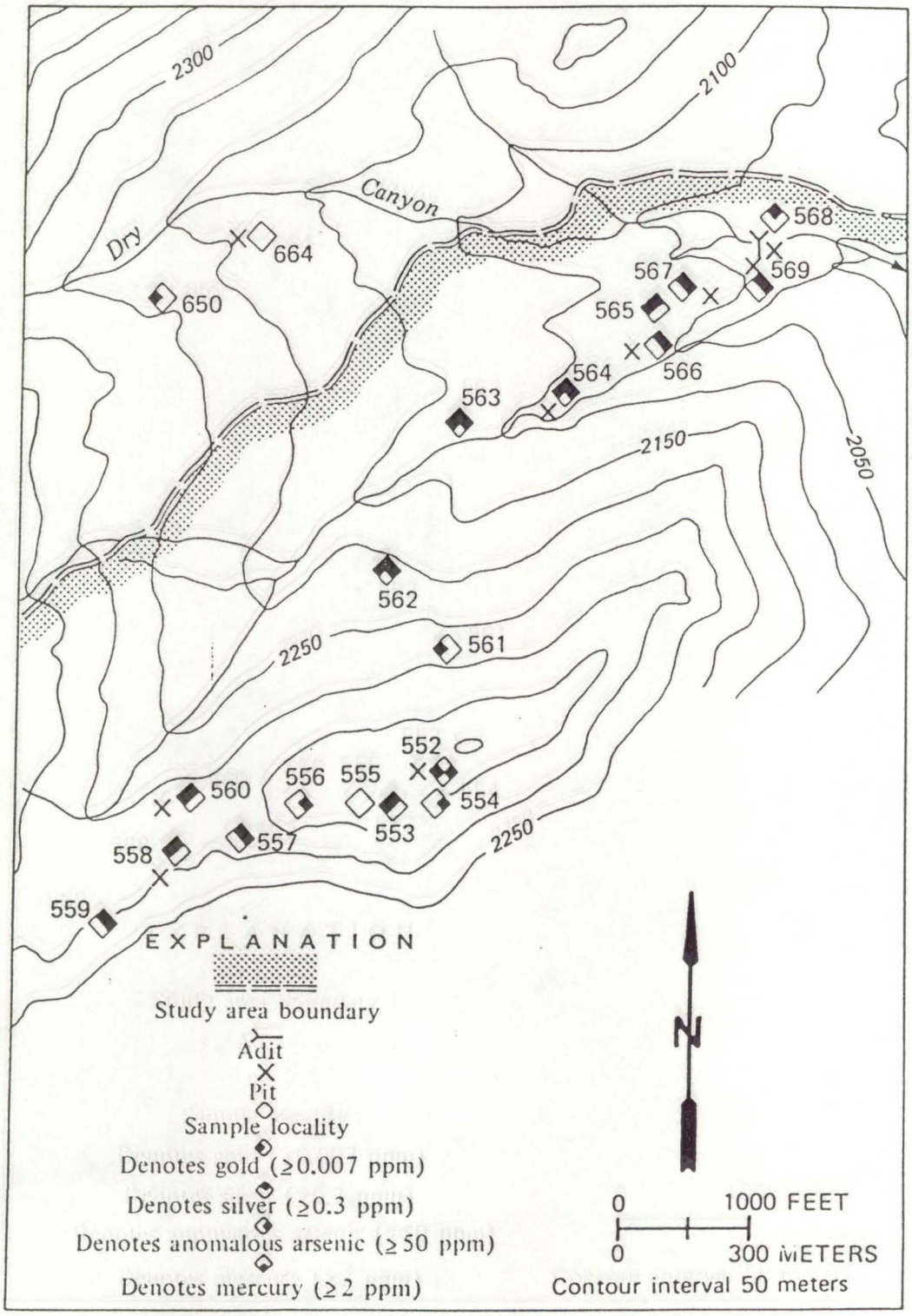


FIGURE 6.– Sample locations, Buena Vista prospect

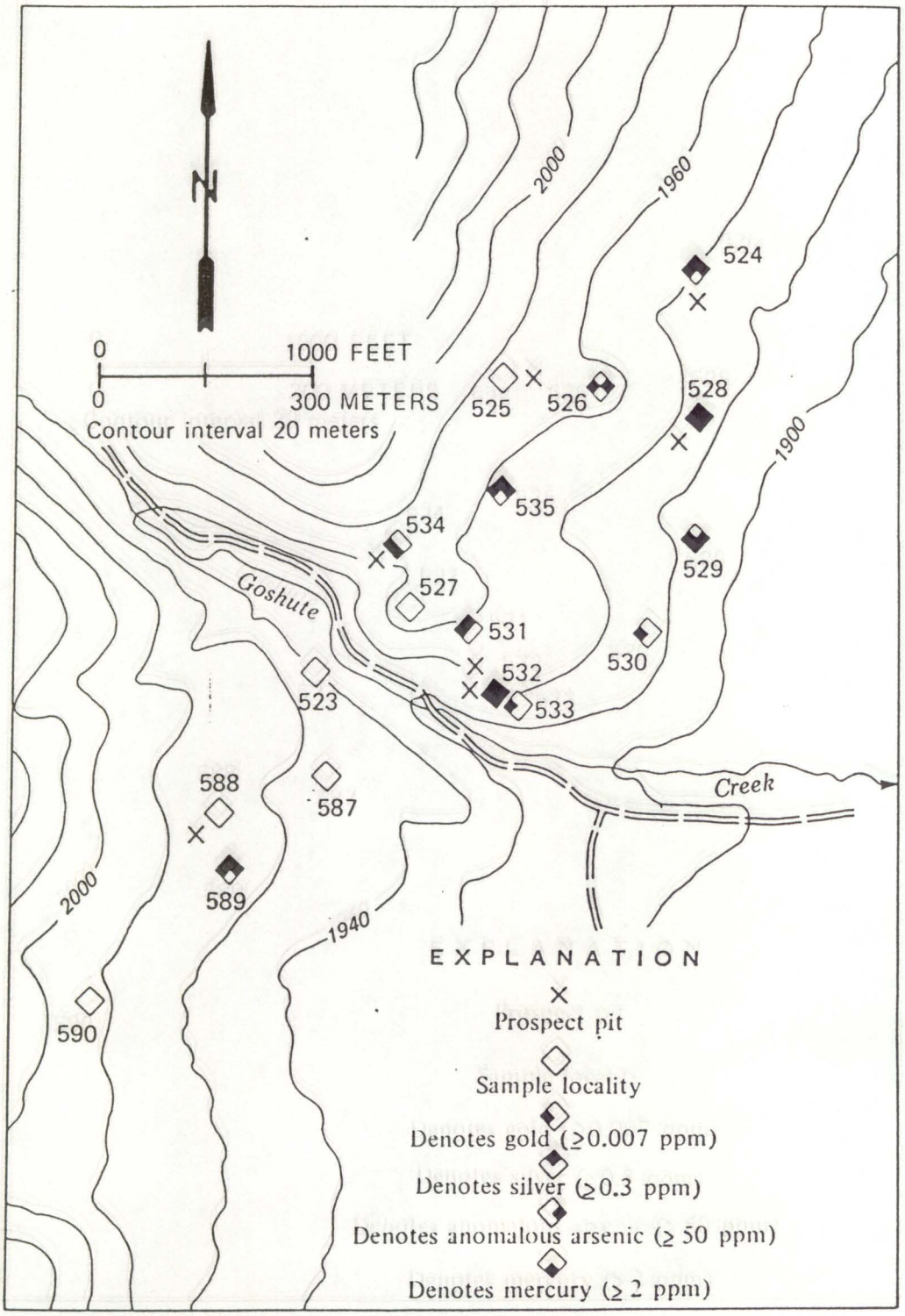


FIGURE 7.– Sample locations, Lucky No. 13 prospect

Ten samples taken from the major fault zone and one (no. 578) from a small unrelated silicified zone are shown on Figure 8. Of those from the major zone, concentrations were as much as 0.074 ppm gold, 1.287 ppm silver, and 110 ppm arsenic. Complete descriptions and analyses for these samples appear in Appendix A-6.

Crown Point Prospect

The Crown Point prospect consists of three bulldozer trenches about one-half mi (0.8 km) south of Flat Canyon (fig. 2). The trenches were as long as 85 ft (26 m) and up to 8 ft (2.4 m) deep, but exposed no outcrops. Silicified fault breccia, selected from the alluvium in and near the workings, contained as much as 0.111 ppm gold and 430 ppm arsenic; no silver or mercury were detected. A random chip sample (no. 648) of silicified shale was taken from an outcrop above the workings. The sample contained 0.024 ppm gold, 0.520 ppm silver, but no detectable arsenic or mercury. The silicified zone was along a bedding plane, was discontinuous, and averaged less than 2 ft (0.6 m) thick. This zone is probably not the source of the silicified fault breccia sampled around the workings. Complete descriptions and analyses for these samples (nos. 646-649) appear in Appendix A-1.

Goshute Cave Prospect

Goshute Cave, a natural limestone cavern over 1,000 ft (300 m) long, is located about 2 mi (3.2 km) north from the mouth of Goshute Creek (fig. 2). All bat guano in the cave was claimed by Keith Hinose in 1951. Probably less than 100 cubic yards of guano-bearing dust was present at the time of our study.

APPRAISAL OF MINERAL DEPOSITS

Although no resources were identified in the Goshute Canyon study area, major bedding plane faults at the base of the Chainman, Pilot, and Dunderburg Shales exhibit many of the characteristics of hot-spring type, large tonnage, low-grade gold deposits (Roberts and others, 1971, and Silberman, 1982). Analyses for samples taken along these faults compare favorably with sample results from initial sampling at other Nevada disseminated gold deposits. For example, at the Alligator Ridge deposit, the original sampling consisted of seventeen rock chip samples taken from jasperoid outcrops. Although the highest gold assay was only 0.45 ppm, it was high enough, combined with the favorable geology, to convince Amselco personnel that additional exploration was warranted (Klessig, 1984). The development of low-cost gold recovery methods, combined with historically relatively high gold prices (about $400/oz) and depressed prices for other metals, has created considerable interest in deposits of this type. Most new domestic mine operations have been on deposits of this type, and many of them have been in Nevada.

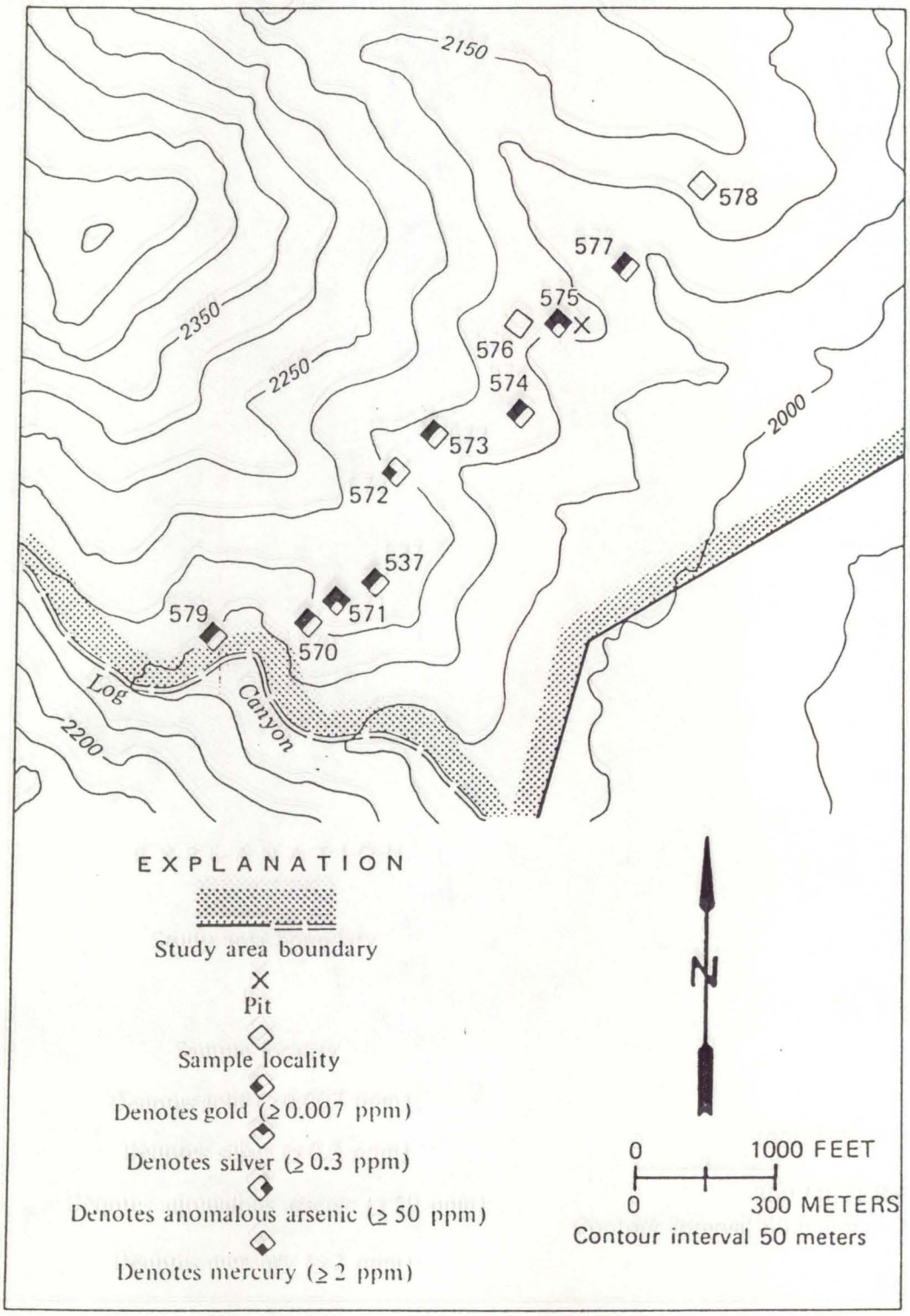


FIGURE 8.– Sample locations, Bullionaire prospect

Extensive sand and gravel and stone occurrences in the study area are suitable for many construction purposes. However, transportation cost to current markets, a major part of total production costs for these high bulk - low unit value commodities, would far exceed the value and, therefore, do not constitute an identified resource. Adequate material is available closer to major markets in the region.

RECOMMENDATIONS FOR FURTHER WORK

Additional sampling could be done along the major bedding plane faults near the bottom of the Chainman, Pilot, and Dunderburg Shales. The minor bedding plane faults in the Ordovician Pogonip Group, although much less extensive, could also be sampled in more detail.

REFERENCES

Adair, D. H., 1961, Geology of the Cherry Creek district, Nevada: Masters thesis, University of Utah, 122 p.

Dechert, C. P., 1967, Bedrock geology of the northern Schell Creek Range, White Pine County, Nevada: Ph.D. thesis, University of Washington, 266 p.

Fritz, W. H., 1960, Structure and stratigraphy of the northern Egan Range, White Pine County, Nevada: Ph.D. thesis, University of Washington, 117 p.

Grove, R. G., 1979, A study of the fine-grained disseminated gold ore at the Windfall Mine, Eureka County, Nevada: Masters thesis, University of California, 98 p.

Hill, J. M., 1916, Notes on some mining districts in eastern Nevada: U.S. Geological Survey Bulletin 648, 214 p.

Holmes, G. H., Jr., 1950, Investigation of Cherry Creek tungsten district, White Pine County, Nevada: U.S. Bureau of Mines Report of Investigations 4631, 7 p.

Hose, R. K., Blake, M. C., Jr., and Smith, R. M., 1976, Geology and mineral resources of White Pine County, Nevada: Nevada Bureau of Mines and Geology Bulletin 85, 97 p.

Klessig, P. J., 1984, History and geology of the Alligator Ridge Gold Mine, White Pine County, Nevada, in Gold and silver deposits of the Basin and Range province, western USA: Arizona Geological Society Digest, v. 15, p. 77-88.

Knutsen, G. C., and West, P. W., 1984, Geology of the Rain disseminated gold deposit, Elko County, Nevada, in Gold and silver deposits of the Basin and Range province, western USA: Arizona Geological Society Digest, v. 15, p. 73-76.

Lowe, N. T., Raney, R. G., and Norberg, J. R., 1985, Principal deposits of strategic and critical minerals in Nevada: U.S. Bureau of Mines Information Circular No. 9035, 202 p.

Misch, Peter, 1960, Regional structural reconnaissance in central-northeast Nevada and some adjacent areas: Observations and Interpretations in Guidebook to the geology of east-central Nevada: Intermountain Association of Petroleum Geologists and Eastern Nevada Geological Society, Eleventh Annual Field Conference, Salt Lake City, Utah, p. 17-42.

Roberts, R. J., Radtke, A. S., and Coats, R. R., 1971, Gold-bearing deposits in north-central Nevada and southwestern Idaho, with a section on Periods of plutonism in north-central Nevada, by M. L. Silberman and E. H. McKee: Economic Geology, v. 66, p. 14-33.

Schrader, F. C., 1931, Spruce Mountain district, Elko County, and Cherry Creek (Egan Canyon) district, White Pine County: Nevada Bureau of Mines Bulletin 14, 39 p.

Silberman, M. L., 1982, Hot-spring type, large tonnage, low-grade gold deposits in Erickson, R. L., Characteristics of mineral occurrences: U.S. Geological Survey Open-File Report 82-795, p. 131-143.

U.S. Bureau of Mines, 1944, Cherry Creek tungsten district, White Pine County, Nevada: War Minerals Report 216, 18 p.

APPENDIX A-1.--Descriptions and analyses for miscellaneous samples

Sample No.	Sample Type	Sample Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
502	Random chip	Limonite-stained, silicified, brecciated limestone in fault zone trending N. 35° E. and dipping 30° NW.	0.119	<0.3	120	<2
503	do	Angular, silicified clasts in a light brown matrix of silica	.019	<.3	39	<2
506	do	Slightly limonite-stained, brecciated, silicified gray limestone	.520	.620	240	<2
507	do	do	.182	.770	140	<2
646	Select	Jasperoid float in trench 25 ft wide, 85 ft long, and 8 ft deep	.018	<.3	44	<2
647	do	Slightly limonite-stained, silicified breccia in alluvium	.111	<.3	430	<2
648	Random chip	Dark gray, silicified limestone striking north and dipping 24° W.	.024	.520	<2	<2
649	Select	Jasperoid float from pit	.032	<.3	190	<2

APPENDIX A-2.--Sample descriptions and analyses, Snowdrift prospect

Sample No.	Sample Type	Sample Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
4	Random chip	Partially silicified, light gray, brecciated dolomite	0.091	<0.3	23.1	<2
5	do	Brecciated limestone	.058	<.3	24.7	<2
30	do	Partially silicified, light gray limestone	<.007	.590	<2.0	<2
31	Grab	Hematitic-limonitic gossan	.069	<.3	28.7	<2
32	Random chip	Hematite- and limonite-stained, dark gray, silicified, brecciated limestone	.049	.530	9.1	<2
33	do	Limonite-stained, gray limestone	<.007	.370	<2.0	<2
49	do	Hematite-stained, silicified limestone	.035	<.3	160	<2
50	do	Hematite- and limonite-stained, silicified limestone breccia and jasperoid	<.007	<.3	14.3	<2
51	do	do	<.007	<.3	12.8	<2
52	do	Hematitic and limonitic, silicified limestone	.182	6.187	92	<2
53	do	Brecciated dolomite	<.007	<.3	10.0	<2
54	Grab	Dark gray, silicified limestone breccia	<.007	<.3	10.0	<2
55	Random chip	Limonite- and hematite-stained jasperoid and partially silicified, brecciated limestone	<.007	<.3	10.0	<2

APPENDIX A-2.--Sample descriptions and analyses, Snowdrift prospect--Continued

Sample No.	Sample Type	Sample Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
56	Grab	Gossan containing angular fragments of gray limestone	<0.007	<0.3	23.4	<2
57	Random chip	Hematite-stained jasperoid	.025	.450	38	<2
58	do	Hematite- and limonite-stained jasperoid	.132	1.409	15.8	<2
59	do	do	.100	1.023	12.8	<2
60	do	do	.028	1.566	29.1	<2
61	do	Hematite- and limonite-stained, silicified limestone breccia	.178	3.096	53	<2
62	do	do	.058	2.385	21.6	<2
580	do	Light gray dolomite	<.007	<.3	7.8	<2
581	do	Silicified dolomite breccia	<.007	<.3	7.0	<2
582	do	Calcite vein	<.007	<.3	<2.0	<2
583	do	Slightly brecciated, silicified limestone	.088	.861	34	2
584	do	Porphyritic rhyolite dike	<.007	<.3	<2.0	2
585	do	Light gray, silicified dolomite	<.007	<.3	<2.0	<2
601	do	Limonite-stained, brecciated limestone and calcite	<.007	<.3	20.1	<2

APPENDIX A-2.--Sample descriptions and analyses, Snowdrift prospect--Continued

Sample No.	Sample Type	Sample Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
602	Random chip	Slightly limonite-stained, multicolored, silicified fault breccia	0.089	<0.3	23.4	<2
603	do	do	.100	.350	190	<2
604	do	do	.048	<.3	66	<2
605	do	do	.028	<.3	39	<2
606	do	do	.352	2.131	54	<2
607	do	Dark gray limestone	<.007	<.3	<2.0	<2
608	do	Slightly limonite- and hematite-stained, silicified, brecciated shale	.049	.570	52	<2
609	do	Slightly limonite- and hematite-stained fault breccia	.055	.957	20.1	<2
610	do	Massive white calcite	<.007	<.3	3.0	<2
611	do	Dark gray, silicified fault breccia	.090	<.3	32	<2
612	do	Silicified, gray limestone breccia	<.007	.350	170	<2
613	do	Multicolored, silicified fault breccia	.081	.450	25.6	<2
614	do	Dark gray silicified fault breccia	.050	<.3	41	2
615	do	Dark gray limestone	.059	<.3	19.8	<2

APPENDIX A-2.--Sample descriptions and analyses, Snowdrift prospect--Continued

Sample No.	Type	Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
616	Random chip	Thin, platey, calcareous siltstone	0.079	<0.3	800	9
617	do	Limonite-stained jasperoid	.045	<.3	350	<2
618	do	Slightly limonite- and hematite-stained, silicified fault breccia	.042	<.3	7.0	2
619	do	Green and gray silicified fault breccia	<.007	<.3	57	<2
620	do	Hematite- and limonite-stained, acid leached, silicified intrusive rock (dike)	.029	<.3	4700	2
621	do	Slightly hematite-stained, gray, silicified fault breccia	.024	1.032	50	<2
622	do	Dark colored, silicified fault breccia	.047	.540	110	<2
623	do	do	<.007	<.3	20.1	<2
625	Grab	Slightly limonite-stained, gray, silicified fault breccia	.107	.700	58	<2
626	do	do	<.007	<.3	11.2	<2
627	do	do	.045	3.379	55	<2
628	Random chip	do	.196	4.602	94	<2
629	Grab	do	.228	10.13	61	<2

APPENDIX A-2.--Sample descriptions and analyses, Snowdrift prospect--Continued

Sample No.	Sample Type	Sample Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
630	Grab-------	Dark gray, silicified fault breccia----------	0.045	0.680	83	2
631	Random chip	Beige, partially silicified sandstone showing Liesegang banding----------	<.007	<.3	4.0	<2
632	do---------	Carbonaceous shale----------	<.007	.380	3.0	<2
633	Grab-------	Slightly limonite-stained, dark gray, silicified, brecciated shale----------	<.007	<.3	74	<2
634	do---------	do----------	.023	<.3	37	<2
635	Random chip	Hematite-stained, dark gray jasperoid----------	.116	<.3	17.9	<2
636	do---------	do----------	.109	<.3	54	<2
637	do---------	do----------	.059	<.3	47	<2
638	Grab-------	Silicified fault breccia----------	<.007	<.3	27.7	2
639	Random chip	Tan, silicified fault breccia----------	.139	<.3	79	<2
640	do---------	Gray and purple, silicified fault breccia----------	.083	1.073	31	<2
641	do---------	do----------	.145	2.957	51	<2
642	do---------	do----------	.138	3.858	47	<2
643	do---------	Dark gray, brecciated limestone----------	<.007	<.3	5.0	<2

APPENDIX A-2.--Sample descriptions and analyses, Snowdrift prospect--Continued

Sample No.	Type	Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
644	Random chip	Dark gray and purple, silicified fault breccia------	0.206	3.601	73	<2
645	Grab-------	Multicolored siltstone and limestone----------	.021	<.3	650	<2
661	do---------	Partially silicified, brecciated limestone----------	<.007	<.3	11	<2
662	Random chip	Limonite-stained, partially silicified, brecciated, dark gray limestone----------	.051	<.3	720	2
663	Grab-------	Slightly limonite-stained, silicified, quartzite breccia----------	<.007	<.3	43	<2

APPENDIX A-3.--Sample descriptions and analyses, Chainman Shale - Joana Limestone, and Pilot Shale - Guilmette Formation contacts

Sample No.	Sample Type	Sample Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
22	Random chip	Dark gray, dolomitic limestone and sandstone--------	<0.007	0.430	<2.0	<2
34	do---------	Silicified, black fault breccia at top of Joana limestone----------	.649	1.250	56	<2
35	do---------	Light gray, silicified Joana Limestone----------	.017	.350	<2.0	<2
36	do---------	Jasperoid at Pilot Shale - Guilmette Formation contact----------	.029	1.226	27.0	<2
37	do---------	Gray limestone from top of Guilmette Formation------	<.007	.380	<2.0	<2
38	do---------	Slightly hematite-stained, silicified breccia at Pilot Shale - Guilmette Formation contact----------	.017	<.3	18.9	<2
39	do---------	Light gray, silicified limestone from top of Guilmette Formation----------	<.007	<.3	<2.0	<2
40	do---------	Porphyritic rhyolite dike----------	<.007	<.3	<2.0	<2
41	do---------	Silicified breccia from Pilot Shale - Guilmette Formation contact----------	<.007	<.3	65	<2
42	do---------	Jasperoid at Pilot Shale - Guilmette Formation contact----------	<.007	<.3	34.0	<2
43	do---------	Hematite-stained jasperoid at Chainman Shale - Joana Limestone contact----------	<.007	<.3	12.0	<2

APPENDIX A-3.--Sample descriptions and analyses, Chainman Shale - Joana Limestone, and Pilot Shale - Guilmette Formation contacts--Continued

Sample No.	Sample Type	Sample Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
44	Random chip	Hematite-stained jasperoid at Chainman Shale - Joana Limestone contact	<0.007	0.380	51	<2
45	Grab	Hematitic, gray, silicified breccia from Pilot Shale - Guilmette Formation contact	<.007	<.3	68	<2
46	do	Hematite-stained jasperoid from Pilot Shale - Guilmette Formation contact	<.007	<.3	5.0	<2
47	Random chip	Silicified dark gray breccia and jasperoid at top of Guilmette Formation	.018	<.3	28.7	<2
48	do	Hematitic, silicified limestone from Pilot Shale - Guilmette Formation contact	<.007	<.3	12.0	<2
545	Grab	Hematitic-limonitic gossan from pit in the Guilmette Formation	.032	.370	4000	<2
546	Random chip	Gray limestone at Pilot Shale - Joana Limestone contact	<.007	<.3	24.8	<2
547	do	Partially silicified, brecciated, light colored limestone in Guilmette Formation	<.007	<.3	29.1	2
548	do	do	<.007	<.3	<2.0	<2
591	do	Mulicolored, silicified fault breccia at Chainman Shale - Joana Limestone contact	<.007	<.3	24.8	<2

APPENDIX A-3.--Sample descriptions and analyses, Chainman Shale - Joana Limestone, and Pilot Shale - Guilmette Formation contacts--Continued

Sample No.	Sample Type	Sample Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
592	Random chip	Slightly limonite- and hematite-stained, silicified fault breccia at Chainman Shale - Joana Limestone contact	<0.007	<0.3	25.9	<2
593	Grab	Multicolored, silicified fault breccia from Pilot Shale - Guilmette Formation contact	<.007	<.3	650	<2
594	do	Beige, sugary, brecciated limestone from Guilmette Formation	<.007	<.3	58	<2
595	Random chip	Dark green and purple, silicified fault breccia at Pilot Shale - Guilmette Formation contact	<.007	<.3	40	<2
596	Grab	do	<.007	<.3	15.7	<2
597	Random chip	Hematite- and limonite-stained, partially silicified limestone at Pilot Shale - Guilmette Formation contact	<.007	<.3	<2.0	<2
598	Grab	Calcite, limestone, and silicified breccia at Pilot Shale - Guilmette Formation contact	<.007	<.3	<2.0	<2
651	do	Dark gray, fissile, argillaceous limestone (Chainman Shale)	.080	1.741	11.0	<2
652	do	Moderately silicified, dark gray limestone at Chainman Shale - Joana Limestone contact	.028	<.3	7.0	<2

APPENDIX A-3.--Sample descriptions and analyses, Chainman Shale - Joana Limestone, and Pilot Shale - Guilmette Formation contacts--Continued

Sample No.	Sample Type	Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
653	Grab-------	Dark gray, moderately silicified limestone breccia at Chainman Shale - Joana Limestone contact---------	0.031	<0.3	5.0	<2
654	do---------	do----------	.029	.490	29.8	<2
655	do---------	Limonite- and hematite-stained, partially silicified limestone breccia at Chainman Shale - Joana Limestone contact----------	<.007	1.003	460	<2
656	do---------	Slightly brecciated and silicified, dark gray limestone at Chainman Shale - Joana Limestone contact	<.007	.470	310	<2
657	do---------	Limonite- and hematite-stained, silicified fault breccia in Joana Limestone----------	<.007	<.3	37	<2
658	do---------	do----------	<.007	<.3	190	<2
659	do---------	Limonite- and hematite-stained, silicified fault breccia at Chainman Shale - Joana Limestone contact	<.007	.350	39	<2
660	do---------	do----------	.019	<.3	58	<2

APPENDIX A-4.--Sample descriptions and analyses, Buena Vista prospect

Sample No.	Type	Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
552	Random chip	Hematitic-limonitic gossan	0.043	<0.3	55	<2
553	do	Multicolored, platey, calcareous siltstone	.020	.510	<2.0	<2
554	do	Hematitic-limonitic gossan and jasperoid	<.007	<.3	160	<2
555	do	Hydrothermally altered intrusive rock (dike)	<.007	<.3	<2.0	<2
556	do	Hematitic-limonitic gossan	<.007	<.3	68	<2
557	do	do	<.007	.370	140	<2
558	do	Hematitic-limonitic gossan from small pit	.017	.530	39	<2
559	do	Hematitic-limonitic gossan and jasperoid	<.007	.874	140	<2
560	do	Hematitic-limonitic, acid leached, brecciated shale from small pit	.018	.350	<2.0	<2
561	do	Limonitic-hematitic gossan	.018	<.3	8.3	<2
562	do	do	.017	1.736	110	<2
563	do	do	.017	.430	130	<2
564	do	Limonitic-hematitic gossan from small pit	.058	.500	89	<2
565	do	Gray to beige silicified shale from small pit	.020	2.018	4.0	<2
566	do	Limonitic-hematitic gossan	<.007	1.662	100	<2

APPENDIX A-4.--Sample descriptions and analyses, Buena Vista prospect--Continued

Sample No.	Type	Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
567	Random chip	Limonitic gossan and jasperoid from small pit-------	<0.007	1.584	68	<2
568	do---------	Brecciated, limonitic-hematitic gossan from 6-ft-long adit----------	<.007	.730	<2.0	<2
569	do---------	Silicified, hematitic-limonitic gossan----------	<.007	1.568	170	<2
650	Grab-------	Brecciated, silicified sandstone----------	.034	<.3	19.8	<2
664	do---------	Limonite- and hematite-stained, silicified fault breccia from small pit----------	<.007	<.3	3.0	<2

APPENDIX A-5.--Sample descriptions and analyses, Lucky No. 13 prospect

Sample No.	Sample Type	Sample Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
523	Random chip	Black, brecciated, silicified limestone from bedding plane fault trending N. 40° E. and dipping 30° NW.--	<0.007	<0.3	<2.0	<2
524	do---------	Green and gray, silicified, brecciated limestone. Small pit just south of this sample----------	.029	.480	110	<2
525	Grab-------	Acid leached, limonite-stained limestone from dump of small pit----------	<.007	<.3	10.5	<2
526	Random chip	Silicified, brecciated limestone----------	.041	<.3	200	<2
527	do---------	do----------	<.007	<.3	6.0	<2
528	Grab-------	Silicified fault breccia from small open cut--------	.027	.500	170	2
529	Random chip	Silicified, brecciated limestone----------	.019	<.3	1350	20
530	Grab-------	Acid leached limestone exhibiting Liesegang banding	.017	<.3	17.2	<2
531	Random chip	Heavily limonite-stained, acid leached, silicified fault breccia----------	.030	.790	<2.0	<2
532	do---------	Dark gray, silicified, brecciated limestone from small open cut----------	.073	.440	52	2
533	do---------	Very light gray, fine grained limestone from small open cut----------	.022	<.3	<2.0	<2
534	Grab-------	Limonite-stained, acid-leached, limestone or shale from small pit. Some Liesegang banding exhibited---	.021	<.3	<2.0	2.8

APPENDIX A-5.--Sample descriptions and analyses, Lucky No. 13 prospect--Continued

Sample No.	Type	Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
535	Random chip	Gray, silicified, brecciated limestone----------	0.023	0.580	71	<2
587	Grab-------	Limonite-stained, partially silicified shale--------	<.007	<.3	7.0	<2
588	do---------	Light-green, sheared shale from small pit----------	<.007	<.3	<2.0	<2
589	Random chip	Silicified fault breccia----------	.035	3.871	50	<2
590	do---------	Gray, silicified fault breccia. Angular clasts are dark gray----------	<.007	<.3	40	<2

APPENDIX A-6.--Sample descriptions and analyses, Bullionaire prospect

Sample No.	Sample Type	Sample Description	Gold (ppm)	Silver (ppm)	Arsenic (ppm)	Mercury (ppm)
537	Random chip	Limonite-stained, acid-leached, silicified, brecciated limestone and shale	0.022	0.580	40	<2
570	do	do	.041	1.217	20.5	<2
571	do	Limonite-stained, silicified fault breccia. Silicified, angular white clasts in a matrix of brown silica	.051	.780	110	<2
572	do	Hematite- and limonite-stained Dunderburg shale. Contains numerous trilobites	.007	<.3	<2.0	<2
573	do	Gray, silicified fault breccia	.052	1.287	<2.0	<2
574	do	do	.025	.850	17.2	<2
575	do	Limonite- and hematite-stained, silicified fault breccia	.017	1.267	53	<2
576	Grab	Hydrothermally altered intrusive rock (dike) from small pit	<.007	<.3	<2.0	<2
577	Random chip	Silicified fault breccia	.074	.480	21.6	<2
578	do	Slightly limonite- and hematite-stained, silicified limestone	<.007	<.3	21.6	<2
579	do	Silicified fault breccia	.024	.930	9.4	<2