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GEOLOGICAL SURVEY

Geochemical Signatures of Ores and Altered Rocks in the Gilbert District, Esmeralda County, Nevada

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ABSTRACT

Two types of ore have been produced from several small mines in the Gilbert district: Ag-Pb from a base-metal sulfide assemblage in limestone and skarn adjacent to a Mesozoic stock, and Ag-Au from silica-rich epithermal veins in Tertiary volcanic and pre-Tertiary wallrocks. The older base-metal deposits are characterized by generally high contents of Fe, Mn, Ag, As, Bi, Cu, Mo, Pb, Sb, Zn, and Te. Calc-silicate minerals such as garnet and actinolite, as well as massive vein quartz, accompany the base metals. Iron-oxide-rich jasperoid ledges in limestone are near-surface expressions of these ores. The Tertiary precious metal veins are rich in silica and are accompanied by generally high contents of Mn, Ba, Ag, As, Cu, Pb, Sr, Zn, and Te. A few of the vein samples contain more than 50 ppm bismuth, an unusually high value for epithermal precious-metal veins of the region. The multi-element suites should be useful in regional geochemical exploration, but the relatively high base-metal content of the precious-metal veins could cause confusion with base-metal deposits, unless there is information on the characteristic fine-grained siliceous alteration.

INTRODUCTION

The Gilbert district in northern Esmeralda County, Nevada, about 45 km west of Tonopah, was the site of base- and precious-metal mining from 1890 to the 1920's. Although production was relatively small (about $105,000; Albers and Stewart, 1972), the geology of the district compares favorably with that of other districts in the region that have had much higher production. Base-metal or Cu-Mo porphyry type systems associated with granitic stocks, and precious metal deposits associated with Tertiary volcanic rocks have been the target of industry exploration for the past decade.

The Gilbert district is in the Monte Cristo Range (fig. 1) which is unusual for the region in its arcuate shape and relatively low relief of about 500 m. The drainage in the area is not well developed. Vegetation is sparse. Access by jeep trails and a few graded dirt roads is good. There are no permanent inhabitants in the district, and no mines were in production in 1982.

This study was undertaken in 1982 as part of the Conterminous United States Mineral Appraisal Program (CUSMAP) in the Tonopah 1^{o} x 2^{o} AMS quadrangle to provide modern geochemical description of some known mineralized areas and historic mines. We collected 70 samples of rocks from outcrops, mine openings, prospect pits, and mine dumps. Similar reconnaissance rock-geochemical studies are underway at most known districts in the Tonopah quadrangle to provide geochemical criteria for characterizing mineral deposit types, a step toward mineral resource assessment of the quadrangle, and to aid in the interpretation of regional stream sediment geochemistry data. J. S. Zuker is interpreting the stream-sediment geochemistry of the Gilbert area as part of a M.Sc. program at Colorado School of Mines; data for that study have been released (Siems and others, 1984).

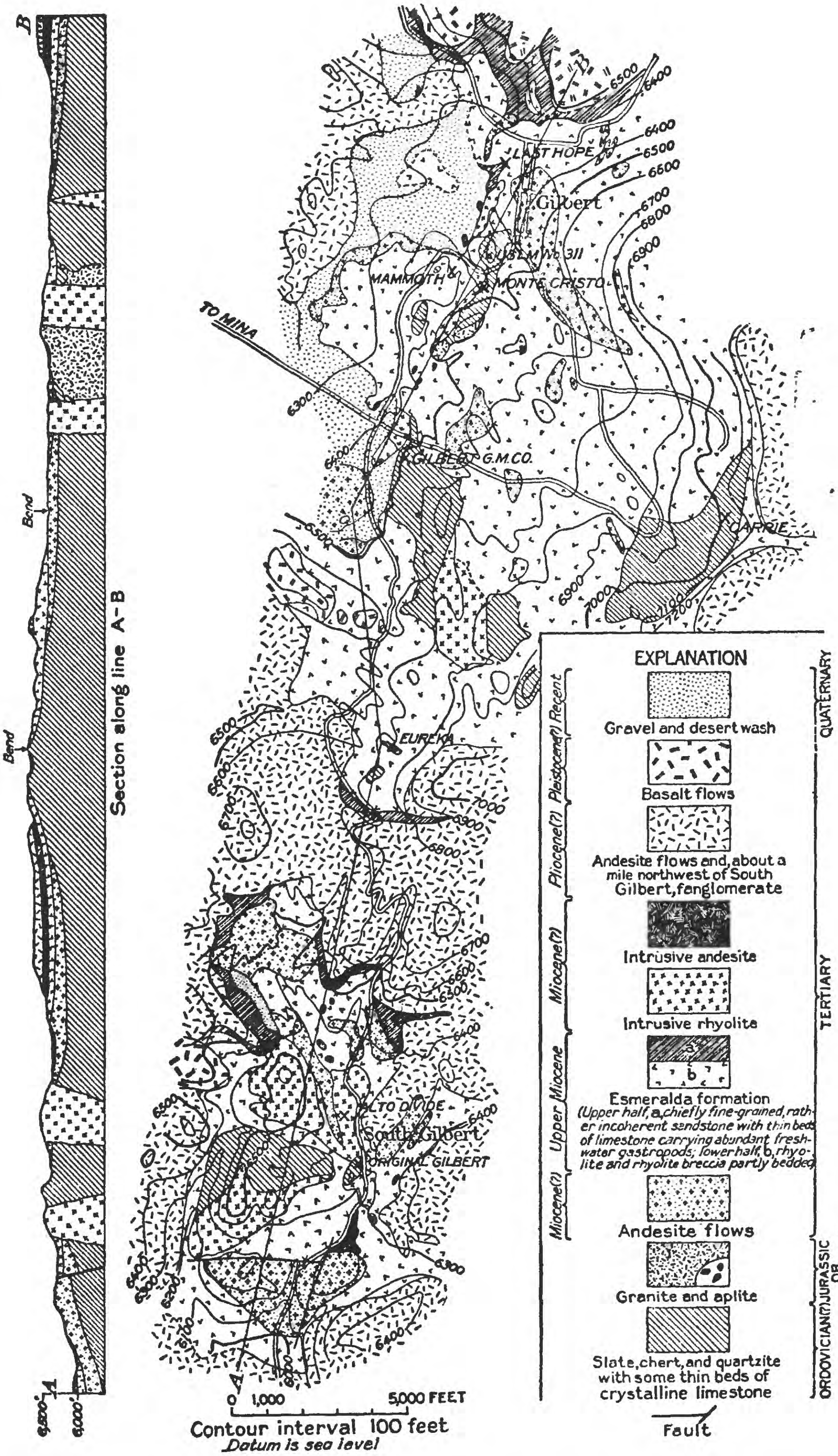

Figure 1.--Geologic map and cross section of the Gilbert district, Nevada, showing location of major mines and prospects (from Ferguson, 1928, fig. 10).

GEOCHEMICAL STUDIES

Sample preparation and chemical analysis

All samples were crushed and then pulverized between ceramic plates to attain a grain size smaller than 100 mesh (0.15 mm). All samples were analyzed for 31 elements using a semiquantitative, direct-current arc emission spectrographic method (Grimes and Marranzino, 1968). Limits of determination are summarized in Table 1. Spectrographic results are obtained by visual comparison of spectra derived from the sample against spectra obtained from standards made of pure oxides and carbonates. Standard concentrations are geometrically spaced over any given order of magnitude of concentrations as follows: 100, 50, 20, 10, and so forth. Samples whose concentrations are estimated to fall between those values are assigned values of 70, 30, 15, and so forth. The precision of the method is approximately plus or minus one reporting interval at the 83 percent confidence level and plus or minus two reporting intervals at the 96 percent confidence level (Motooka and Grimes, 1976). Values determined for the major elements (iron, magnesium, calcium, and titanium) are reported in weight percent of the element; all other elements are reported in parts per million (micrograms per gram) (Table 1).

All samples were also analyzed by a wet chemical procedure for determination of elements of special interest or which have high limits of determination by emission spectrography (such as As, Sb, and Zn). The wet chemical methods are summarized in Table 2.

Upon completion of the analytical work results were entered into a computer-based file called RASS (Rock Analysis Storage System) that contains both the system data and descriptive geologic and geographic information for each sample. Parts of the RASS data were retrieved under a slightly different format and manipulated using routines of the STATPAC system (VanTrump and Miesch, 1976).

Results

Chemical data and locations for 70 samples are in Table 3. Data for 32 elements are reported in Table 3; samples were analyzed for Nb and Th by emission spectrography but no samples contained detectable amounts, 20 and 100 parts per million, respectively. Only a few samples contained detectable amounts of Au, Cd, Sn, and W; those samples are explained in the notes to Table 3. Some elements are reported twice (both spectrographic and atomic absorption values) because of the different ranges of determination of the methods. Sample localities are shown on Figure 2.

GEOLOGY AND MINERAL DEPOSITS

The Monte Cristo Range has been described by Ferguson and others (1953) and by Albers and Stewart (1972). Much of the following description of the geology of of the district is based on the the work of J. H. Stewart (written commun., 1984) who is mapping the Monte Cristo Range as part of the Tonopah CUSMAP project. Ferguson (1928) described the ore deposits and related geology of the Gilbert district; his descriptions of the deposits are the best available because he was able to study the mines while they were in production and obtain information from the mining staff.

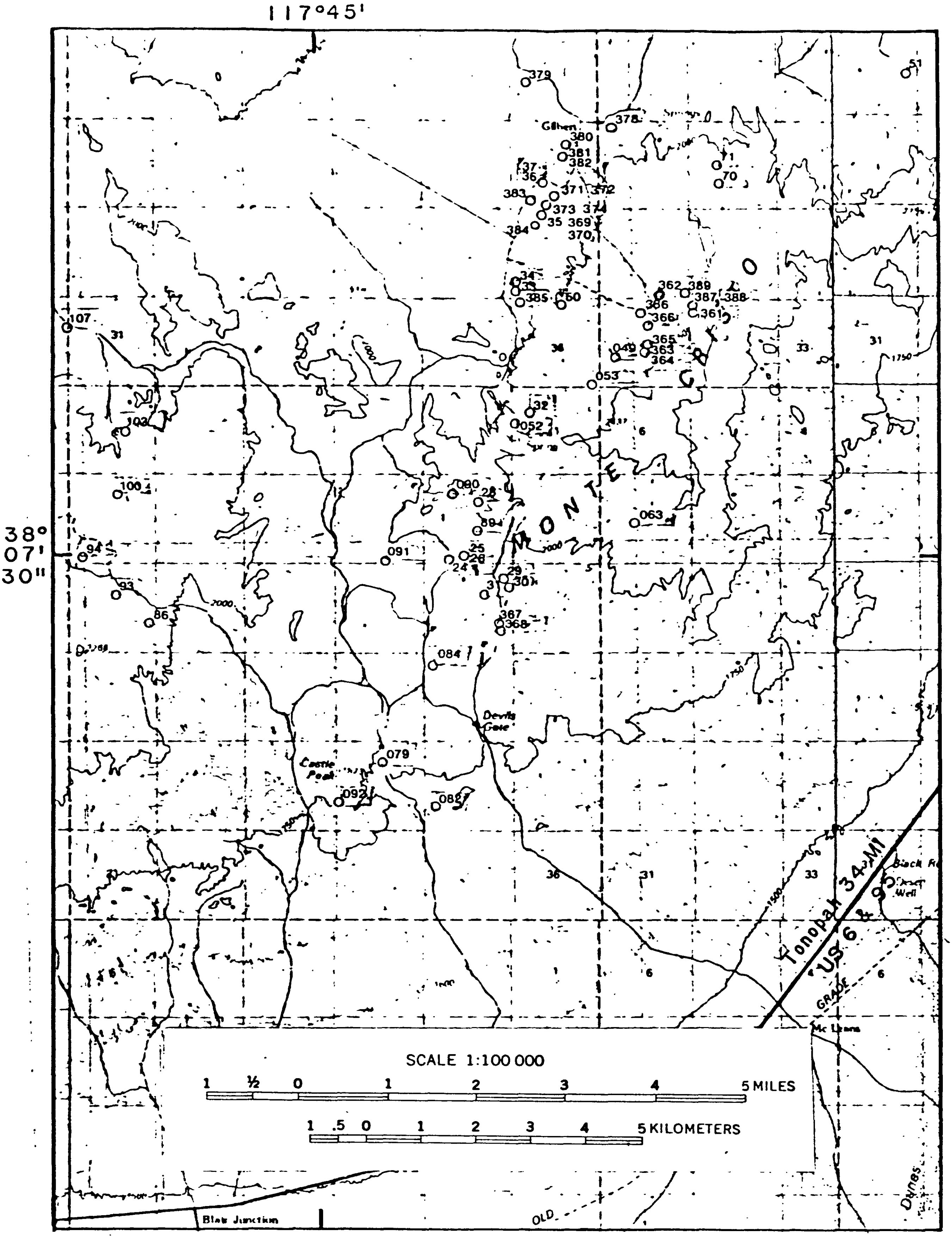

Figure 2.--Location of rock samples from the Gilbert district, Esmeralda, County, Nevada.

The oldest rocks in the Gilbert district are Ordovician strata of the Palmetto Formation (Ferguson and others, 1953), chiefly dark colored chert, shale, siltstone, and phyllite with minor limestone. Locally thick limestone units were included by Ferguson and others (1953) in the Palmetto Formation, but new information on conodonts in these units indicate Mississippian and Pennsylvanian ages (B. R. Wardlaw, written commun. to J. H. Stewart, 1984). Small stocks less than a kilometer in diameter intrude the Paleozoic rocks. The stocks and related dikes have granitic to monzonitic composition, porphyritic texture, and commonly are altered. An age of 194 m.y. was obtained by the K-Ar method on sericite from an altered stock in the western part of the district (Silberman and others, 1975). Tertiary volcanic rocks unconformably overlie the Paleozoic strata and Mesozoic intrusive rocks. The lowest Tertiary rocks consist of a sequence of upper Oligocene and Lower Miocene ash-flow tuffs. Overlying these tuffs are andesite flows, tuffs, and lacustrine sediments which are intruded by rhyolitic to dacitic rocks dated at about 20 m.y. using the K-Ar method (E. H. McKee, written commun., 1984). The next younger Tertiary rocks consist of a widespread andesite flow and breccia unit called the Gilbert Andesite. This unit is about 15 m.y. old on the basis of K-Ar dating (Silberman and others, 1975). Overlying this andesite in areas several kilometers east of Gilbert is a thick sequence of lacustrine sediments and tuffs that are intruded by rhyolite domes dated at about 7 m.y. by K-Ar methods (Silberman and others, 1975). These rhyolite domes form rugged hills and peaks on the east side of the Monte Cristo Range. Basalt flows and cinder cones occur southwest of Gilbert. Similar basalts on the northwest side of the Monte Cristo Range are about 0.7 m.y. old according to K-Ar dating (E. H. McKee, written commun., 1984).

The Gilbert district, also known as the Desert district, was first developed in 1890 with the opening of the Carrie mine (fig. 1). There was a boom in the area in 1924 when gold was discovered (Ferguson, 1928). The Carrie mine developed Ag-Pb ore from a 70 m deep inclined shaft and about 300 m of lateral drifts. The host rocks are recrystallized limestone of probable Mississippian age (J. H. Stewart, written commun., 1984). Most of the ore was in quartz veins adjacent to a granite or quartz monzonite stock (Ferguson, 1928). Primary ore minerals are pyrite, galena, tetrahedrite, chalcopyrite, and covellite; secondary iron, copper (and probably silver) minerals were abundant in the upper 15 m. Many of these minerals are present on dumps of the Carrie mine, along with fresh and altered pieces of granitic rock. There are many silicified "ledges" (or jasperoid) in limestone within 1 km of the Carrie mine; these zones often are rich in iron oxides. Ferguson (1928) termed the Carrie ores "deep seated," a reasonable description. The presence of garnet, actinolite, and other calc-silicate minerals on dumps near the Carrie mine support Ferguson's observations and his conclusion that the Ag-Pb ores were related to the intrusion of Mesozoic granitic rocks.

A second type of ore in the Gilbert district is vein-type precious metal deposits associated with abundant silica (Ferguson, 1928). The silica is present as finely banded chalcedony and coarse euhedral quartz. Coarse-grained calcite, commonly tan in color (from manganese?), rests on quartz and fills open spaces in veins. Ferguson mentions specimens of gypsum and anhydrite; the latter mineral or perhaps calcite may explain the tabular voids or casts observed in silica at many deposits. Gold occurs as native gold, and silver is present as pyrargyrite (Ag_3SbS_3), argentite (Ag_2S), and cerargyrite (AgCl). Most of the veins are in Tertiary volcanic rocks, but some at the southern end of the vein trend are in the Palmetto Formation or in Mississippian(?) limestone. Most deposits are near intrusive bodies of rhyolite. Adularia from veins in the Gilbert district was dated at 7.9 m.y. by K-Ar methods (Silberman and others, 1975), essentially the same age as obtained from the rhyolite intrusions.

At South Gilbert (fig. 1), the Original Gilbert prospect occurs in chert and phyllite of the Palmetto Formation. Ore mined from this prospect in the 1920's contained free gold with pyrite and sparse chalcopyrite; no silver minerals were observed. Other prospects in the South Gilbert area are in tuffaceous rocks at the base of the Tertiary section. Mineral deposits in the South Gilbert area are outwardly similar to the Tertiary deposits at Gilbert: they are localized along faults with small displacement, are associated with abundant silicification, and some are rich in iron oxides near the surface.

COMMENTS ON GEOCHEMICAL SUITES

The chemical composition of samples from the Gilbert district is quite variable (Table 3). The samples from the Carrie mine area have compositions that are distinct from samples from Tertiary veins at Gilbert, South Gilbert, and other deposits in the Palmetto Formation. The range in compositions is summarized in Table 4. Discussion here will focus on suites of elements that characterize the four geologic and geographic groups of samples: Carrie mine Ag-Pb deposits (N=9); main Gilbert area in Tertiary rocks (N=27); South Gilbert deposits in Tertiary rocks (N=15), and vein-type deposits of probable Tertiary age in Palmetto Formation (N=19). The reader must remember that all of these samples were picked as composites of chips or chunks that contain visible minerals of interest, particularly sulfides or oxides, in a deliberate attempt to magnify or "high-grade" the anomaly. None of the analyses is a reliable assay because all of the samples were selected as being "anomalous."

Carrie mine suite

The Carrie mine and adjacent prospects occur southeast of Gilbert (fig. 1) in an area of Mississippian(?) limestone adjacent to a granite stock. The Carrie mine produced Ag-Pb ore that was oxidized near the surface but rich in sulfides in its primary form. Silicified zones in limestone about 0.5 km southwest of the Carrie mine contain abundant earthy to vitreous iron oxides that presumably formed from sulfide minerals. Whether rich in sulfides or oxides today, the cluster of prospects near the Carrie mine all probably formed in the contact metamorphic aureole of the granitic intrusion in Mesozoic time (Ferguson, 1928). The nine samples from this area have generally high contents of Fe and Mn (but low Mg), along with high Ag, As, Cu, and Sb. Some samples are rich in Bi (10-30 ppm), Mo (10-200 ppm), Pb (to 700 ppm), Zn (to 5,000 ppm), and Te (to 9.3 ppm). Compared to the vein deposits of Tertiary age, the Carrie samples are distinctive for their higher contents of Cu, Mo (and probably Bi), and lower content of Ba, Sr, and Au.

Gilbert Au-Ag veins

Most of the productive deposits near the Gilbert townsite (fig. 1) are in Tertiary ash-flow tuffs, but the Eureka mine 5 km to the south of Gilbert in altered cherty rocks of the Palmetto Formation also is probably of Tertiary age. The deposits are in thoroughly silicified alteration zones; peripheral prospects show little silicification but wallrocks are propylitically altered. Sulfides and secondary iron oxides are relatively sparse in the Tertiary vein deposits. Samples from these deposits (N=27) tend to be rich in Mn and Ba, and some samples are rich in some of the following elements: Ag, As, Bi, Cu, Pb, Sb, Sr, Zn, and Te. Compositions are generally similar to that of samples from vein deposits in the South Gilbert area and to veins in the Palmetto Formation.

South Gilbert veins in Tertiary rocks

In the South Gilbert area, mines and prospects occur in both chert and phyllite of the Palmetto Formation and in lacustrine tuffaceous rocks of the Tertiary section. Features observed at prospects seem to be very similar in both Tertiary and pre-Tertiary rocks. Samples of altered and mineralized Tertiary rocks from the South Gilbert area (N=19) tend to be enriched in Fe (chiefly secondary oxides), Mn, As, Ba, Sb and Sr. Some samples are rich in Ag, Mo, Pb, and Zn. Compared with similar samples of Tertiary rocks from Gilbert, the South Gilbert Tertiary samples tend to have more Ti, As, and Au, but most elements are in the same range.

Vein deposits in Palmetto Formation

Limestone, chert, and phyllite of the Palmetto Formation host vein-type prospects at many localities in the Gilbert district. Outside of the Carrie mine area, the prospects seem generally similar to nearby prospects in Tertiary rocks, thus a Tertiary age for the vein formation is assumed. The composition of 15 samples from Tertiary type veins is generally very similar to that of mineralized Tertiary rocks. The elements As, B, Sb, and Y are possibly higher, and Ca, Mn, and Bi lower, in the Palmetto samples. Apparent differences between the groups are probably as much a matter of what was sampled as to real differences in composition of the veins.

Relations between variables

Factor analysis is useful for simplifying relations between variables in complex multivariate datasets (Davis, 1973). Several factor analyses were made, but here only a very simple four-factor model will be explained (13 factors are required to convey 90 percent of the variance). Four extreme compositions were identified: sample 371 (quartz-carbonate vein material with high Mn and Ag); sample 389 (calc-silicate material with abundant iron oxides and high base-metal content); sample 103 (gossan in Palmetto Formation, rich in iron oxides and base-metals); and sample 378 (chloritic-altered Tertiary tuff from an unproductive prospect). Four groups of associated elements were defined using R-mode factor analysis: (1) a group consisting of Fe, Ti, Mg, B, Sc, V, Zr, and As, and negative loading for Ba--apparently representing the alteration suite in Tertiary rocks; (2) the Carrie-mine Ag-Pb ore suite characterized by positive loadings of Ag, As, Bi, Cu, Mo, Pb, Sb, and Zn, and negative loadings (depletions) for Mg and Sr; (3) a large suite of elements enriched in gossan developed from Tertiary veins in several rock types: Fe, Ca, Mn, B, Be, Co, Cr, Cu, La, Ni, Y, Zn, Cd, and Sb (plus weaker positive loading of As and Mo) and negative loading of Ba; and (4) a suite of elements in barren Tertiary rocks: Mg, Ti, La, and Zr with negative loading of Au, Te, and Sb (the latter three elements probably being the gold mineralization suite). These groups or associations of elements are in good agreement with observed geologic environments and element behavior in primary and secondary environments.

Precious metal distribution in these rocks is perhaps best revealed by comparing analytical values and geologic descriptions of samples. Gold content of the 27 samples with detectable gold (Table 3) ranges up to 14.4 ppm with a geometric mean of 0.55 ppm; these high values mean that the technique of picking chips of rock with fine-grained silica or iron-oxide minerals is effective for "high grading" gold. Gold values greater than 1 ppm (0.03 oz/ton) occur in many rock types, but most of the high values are in silicified rocks or jasperoid. Gold has weak or negative association with other metals (including Ag); the strongest association is with Sb (r=.13, which is not very strong). Silver content ranges up to 2,000 ppm. Highest Ag values are in sulfidic samples rich in Cu-Pb-As-Sb, but many values of 100 ppm or more are in jasperoid. The trace elements Te and Tl, often used in precious metal exploration, show no systematic relation to Ag or Au, to deposit type, or to rock type; note that not all samples were analyzed for these elements (Table 3). Tellurium and Tl are strongly associated (r=.85 for 15 samples), behavior that may reflect stability or enrichment in oxidizing environments.

Classification of samples

Discriminant function analysis (Dixon, 1965; Davis, 1973) is useful for examining relations between groups of samples (such as from various ore types), and for classifying poorly understood samples in terms of known ore types. The discriminant function analysis (DFA) computes which variables are most effective at distinguishing between groups by use of the F statistic, a measure of the equality of group means. A DFA test comparing grouped data for Tertiary vein-type samples from Gilbert and from Palmetto host rocks indicated that four elements were sufficent to distinguish between the groups based on the higher content of Mn and Bi in the Gilbert set and higher B and Y in the Palmetto set.

The Carrie mine area set of nine samples is chemically distinct from the Gilbert Tertiary vein samples according to DFA. Discrimination between the two groups is possible by six elements that are significantly different at the 95 percent level of confidence: Mn, Bi, and Mo are higher in the Carrie set and Ba, Sr, and Co are higher in the Gilbert set. Other elements are not significantly different between the two groups, a relationship that is not apparent from simple inspection of the data. Using these six elements the discriminant function could properly classify 33 of 36 samples (according to prior geologic features); the three samples that were "misclassified" do have some unusual attributes upon closer scrutiny. Sample 364 in the Carrie group is mostly silica (jasperoid) with relatively little iron oxide, which explains why it is chemically more like the Gilbert group. Samples 384 and 386 in the Gilbert group were classified as Carrie type; chemically this makes sense because of the high Mo in both samples and the high Bi in number 384. This classification also raises an interesting geologic question because samples 384 and 386 come from Tertiary rocks close to the contact with pre-Tertiary rocks. Despite strong geologic and geochronologic evidence that the Carrie and Gilbert deposits must have formed at different times in quite different environments, there is some evidence for chemical gradation between the two deposit types, as might be explained by the chemical influence of pre-Tertiary rocks (source rocks?) on both deposit types. By focusing attention on bismuth as generally diagnostic of the Carrie contact metamorphic environment, DFA also recognized the unusual Gilbert samples enriched in Bi--subsequent consideration of this anomalous behavior lead us to realize that these are among the few samples from "epithermal" precious metal deposits in the Tonopah quadrangle that are rich in bismuth.

CONCLUSIONS

Samples from the Carrie mine area contain a suite of elements that is fairly distinctive and typical of contact metasomatic environments. The elements As, Bi, Cu, and Mo are particularly diagnostic, although in this case they are not the ore elements. These elements were found to be characteristic of Cu-W skarns in the Cedar Mountains (Nash and others, 1985). The Tertiary precious-metal vein deposits can be distinguished from the base-metal ores, but the content of many base-metals is high enough to cause problems during interpretation. The suite of elements Pb-Zn-Bi-Mo-As-Sb that occurs in many of the Gilbert Tertiary vein samples is most characteristic of base-metal rich deposits such as at Simon (Nash and others, 1985) or Tybo (Nash and Siems, unpub. data) and which have been mined in the past for their content of silver, especially if supergene enriched. At Gilbert and elsewhere in the Tonopah quadrangle, enrichments in As and Sb are not diagnostic of precious metal deposits because similar or greater enrichments in these elements occurs in other types of deposits. Our reconnaisance studies throughout the Tonopah quadrangle have found As and Sb to be enriched in virtually all deposit types, from epithermal mercury deposits to skarn deposits. Also, As and Sb are enriched in several large jasperoid zones that have been drilled and so far proven to be submarginal in precious metals. Routine geochemical surveys can easily detect many anomalous metals in many environments in the Tonopah area, but other geologic information is needed to refine geochemical targets. For example, information on alteration characteristics and on vein-filling minerals--abundant chalcedonic quartz, adularia, barite, and Mn-calcite--should permit more reliable distinction of the precious-metal veins relative to base-metal deposits.

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Table 1.--Limits of determination for the spectrographic analysis of rocks from the Gilbert district, Nevada

Elements	Lower determination limit	Upper determination limit
	Percent	
Iron (Fe)	0.05	20
Magnesium (Mg)	.02	10
Calcium (Ca)	.05	20
Titanium (Ti)	.002	1
	Parts per million	
Manganese (Mn)	10	5,000
Silver (Ag)	0.5	5,000
Arsenic (As)	200	10,000
Gold (Au)	10	500
Boron (B)	10	2,000
Barium (Ba)	20	5,000
Beryllium (Be)	1	1,000
Bismuth (Bi)	10	1,000
Cadmium (Cd)	20	500
Cobalt (Co)	5	2,000
Chromium (Cr)	10	5,000
Copper (Cu)	5	20,000
Lanthanum (La)	20	1,000
Molybdenum (Mo)	5	2,000
Niobium (Nb)	20	2,000
Nickel (Ni)	5	5,000
Lead (Pb)	10	20,000
Antimony (Sb)	100	10,000
Scandium (Sc)	5	100
Tin (Sn)	10	1,000
Strontium (Sr)	100	5,000
Vanadium (V)	10	10,000
Tungsten (W)	50	10,000
Yttrium (Y)	10	2,000
Zinc (Zn)	200	10,000
Zirconium (Zr)	10	1,000
Thorium (Th)	100	2,000

Table 2.--Description of chemical methods used for analysis of rock samples from the Gilbert district, Nevada

Element determined	Analytical method	Determination limit (ppm)[1]	Reference
Au	Atomic absorption	0.05	Thompson and others, 1968
As	--do--	5.0	Modification of Viets, 1978
Bi	--do--	1.0	--do--
Cd	--do--	0.1	--do--
Sb	--do--	2.0	--do--
Zn	--do--	5.0	--do--
Te	--do--	0.2	Modification of Hubert and Lakin, 1972
Tl	--do--	0.2	--do--

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[1] The determination limit is dependent upon sample weight. Stated limits imply use of optimum sample weight; higher limits of determination result from use of smaller sample weights.

Explanatory notes for Table 3

Sample numbers: the first three characters are abbreviations:

first character, T--Tonopah project

second character, sampler: N, Nash
Z, Zuker

third character, media: D, dump sample
H, drill hole cuttings
R, rock outcrop, rock in place

Additional analytical data for elements not in Table 3

Element	sample	concentration
Au-s (ppm)	390	15 ppm
Cd-s (ppm)	361	300
	363	20
	389	500
Sn-s (ppm)	384	30
	385	50
	103	300
W-s (ppm)	386	L(50)
	387	70
	27	L(50)
	28	L(50)

S determined by emission spectrography
AA determined by atomic absorption
-- not detected

TABLE 3.--ANALYTICAL DATA FOR ROCK SAMPLES FROM THE GILBERT DISTRICT, ESMERALDA COUNTY, NEVADA
[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.]

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	Ag-ppm s	As-ppm s	B-ppm s	Ba-ppm s	Be-ppm s
TND00361	38 9 51	117 40 30	1.50	.10	.20	.100	500	1,500.0	5,000	200	1,000	1.0
TNR00362	38 9 56	117 40 54	20.00	.05	.20	.070	1,500	20.0	1,500	30	500	1.0
TNR00363	38 9 32	117 40 58	7.00	.07	1.50	.200	300	2.0	1,500	150	700	1.5
TNR00364	38 9 31	117 40 57	.10	.03	.50	.030	150	1.0	N	15	300	1.0
TND00365	38 9 33	117 40 55	20.00	.05	5.00	.015	>5,000	.7	200	20	70	2.0
TNR00366	38 9 48	117 40 58	1.00	.50	.07	.200	100	1.5	N	150	1,000	2.0
TND00367	38 6 48	117 42 46	2.00	.10	.05	.100	30	7.0	1,000	20	2,000	1.0
TND00368	38 6 42	117 42 46	.50	.10	<.05	.070	20	5.0	<200	20	1,000	<1.0
TND00369	38 11 0	117 42 8	2.00	.30	<.05	.500	50	5.0	<200	70	1,500	1.0
TND00370	38 11 0	117 42 8	.15	.03	.20	.050	5,000	15.0	N	20	1,000	7.0
TND00371	38 11 1	117 42 3	.20	.02	2.00	.005	1,000	20.0	N	10	1,000	1.0
TND00373	38 10 57	117 42 9	15.00	.50	.50	.300	300	15.0	700	300	2,000	3.0
TND00378	38 11 40	117 41 20	5.00	1.00	2.00	.300	1,000	N	N	20	2,000	1.0
TND00379	38 12 10	117 42 25	2.00	.50	20.00	.200	2,000	1.5	N	<10	500	1.0
TND00380	38 11 31	117 41 53	1.50	.15	.20	.200	30	3.0	N	20	700	1.5
TND00381	38 11 27	117 41 57	.30	.02	7.00	.050	1,000	100.0	N	10	300	3.0
TNR00382	38 11 27	117 41 57	1.00	.07	.50	.150	300	100.0	N	10	500	2.0
TND00383	38 11 1	117 42 21	2.00	.30	.10	.200	1,000	2.0	N	30	500	7.0
TND00384	38 10 51	117 42 15	5.00	.15	.07	.200	70	50.0	500	50	1,000	1.0
TND00385	38 10 9	117 42 28	15.00	.20	<.05	.200	30	100.0	5,000	50	1,000	1.0
TNR00386	38 9 55	117 41 5	.50	.10	.30	.200	200	10.0	<200	30	2,000	1.0
TND00387	38 9 54	117 40 30	15.00	2.00	20.00	.100	>5,000	N	N	30	50	1.0
TNR00388	38 9 56	117 40 28	7.00	.07	3.00	.050	150	20.0	300	20	300	5.0
TND00389	38 10 0	117 40 29	3.00	<.02	.07	.050	150	2,000.0	1,000	20	100	1.0
TND00390	38 10 49	117 41 32	2.00	.70	2.00	.200	1,000	20.0	200	20	1,000	2.0
TND00391	38 11 1	117 41 22	7.00	1.50	.70	.500	2,000	10.0	700	50	1,000	2.0
TND00392	38 11 16	117 41 26	1.00	.30	.20	.200	70	10.0	300	30	700	1.5
TZR00049	38 9 28	117 41 18	3.00	.20	.50	.150	500	N	N	30	700	5.0
TZR00050	38 10 0	117 41 57	1.50	.30	.70	.100	700	N	N	50	200	7.0
TZR00051	38 12 16	117 37 39	15.00	.70	1.00	.200	500	N	N	300	500	2.0
TZR00052	38 8 50	117 42 33	10.00	.15	.50	.050	300	10.0	1,000	30	500	5.0
TZR00053	38 9 13	117 41 35	1.00	.03	.10	.020	30	2.0	<200	10	500	N
TZR00063	38 7 51	117 41 5	2.00	.07	.15	.150	150	5.0	200	15	2,000	5.0
TZR00070	38 11 12	117 40 2	5.00	5.00	20.00	.150	2,000	N	N	10	700	1.5
TZR00071	38 11 22	117 40 2	3.00	.50	1.50	.300	300	N	N	50	1,000	3.0
TZR00079	38 5 31	117 44 13	1.50	.10	.05	.070	15	1.0	500	50	500	N
TZR00082	38 5 5	117 43 34	5.00	1.50	3.00	.500	700	.5	N	50	1,500	2.0
TZR00084	38 6 27	117 43 35	3.00	.70	.05	.300	200	.5	N	200	700	1.5
TZR00086	38 6 52	117 47 4	2.00	.15	.15	.150	30	1.0	N	100	500	1.0
TZR00089	38 7 47	117 43 1	10.00	.30	.50	.200	300	2.0	500	70	1,000	2.0
TZR00090	38 8 8	117 43 19	5.00	.50	.30	.300	200	3.0	300	50	1,500	2.0
TZR00091	38 7 29	117 44 10	1.50	.70	1.50	.200	700	N	N	50	200	3.0
TZR00092	38 5 8	117 44 45	3.00	.20	.07	.100	100	100.0	1,000	50	500	2.0
TZR00093	38 7 8	117 47 30	2.00	.15	.10	.150	50	<.5	N	100	1,000	<1.0
TZR00094	38 7 31	117 47 55	7.00	.50	.30	.150	100	20.0	<200	150	1,000	1.5

TABLE 3.--ANALYTICAL DATA FOR ROCK SAMPLES FROM THE GILBERT DISTRICT, ESMERALDA COUNTY, NEVADA--Continued

Sample	Bi-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sr-ppm s	V-p s
TND00361	10	10	70	15,000	20	50	15	>20,000	10,000	5.0	<100	7
TNR00362	15	30	70	1,000	30	200	10	700	N	5.0	100	10
TNR00363	N	7	100	200	30	50	100	70	100	7.0	100	15
TNR00364	N	N	10	15	20	N	5	30	N	<5.0	<100	2
TND00365	10	30	20	700	<20	200	50	30	N	5.0	100	5
TNR00366	<10	N	10	20	50	70	5	30	N	5.0	<100	7
TND00367	N	5	20	70	30	15	20	15	150	5.0	300	15
TND00368	N	N	15	100	30	N	7	10	N	5.0	200	20
TND00369	15	7	50	50	30	N	30	70	N	10.0	<100	20
TND00370	N	50	15	700	20	N	200	30	N	<5.0	<100	1
TND00371	N	30	<10	50	20	N	20	20	<100	<5.0	100	1
TND00373	N	15	70	1,000	30	7	70	50	N	15.0	200	20
TND00378	N	7	<10	15	100	10	<5	50	N	10.0	500	5
TND00379	N	10	10	10	20	N	15	10	N	5.0	2,000	5
TND00380	N	N	50	7	30	5	5	20	N	5.0	500	5
TND00381	N	N	<10	15	<20	N	5	15	N	<5.0	200	1
TNR00382	N	N	<10	5	<20	N	5	15	<100	5.0	100	3
TND00383	N	20	15	15	50	N	20	15	<100	5.0	<100	7
TND00384	500	N	50	200	20	150	5	7,000	200	7.0	300	10
TND00385	1,000	10	20	700	50	30	7	5,000	2,000	7.0	<100	7
TNR00386	N	<5	50	30	30	100	10	30	N	<5.0	100	20
TND00387	N	20	70	70	20	20	30	10	N	7.0	<100	7
TNR00388	N	N	20	500	30	15	30	100	150	5.0	<100	30
TND00389	30	N	50	10,000	20	10	10	>20,000	10,000	5.0	<100	3
TND00390	N	10	150	100	<20	7	150	500	<100	10.0	200	15
TND00391	N	50	50	70	20	N	20	200	<100	15.0	200	30
TND00392	N	7	20	15	20	N	5	20	<100	7.0	100	15
TZR00049	N	7	<10	10	50	N	<5	50	N	7.0	200	5
TZR00050	N	7	10	7	50	N	5	50	N	5.0	100	15
TZR00051	N	20	30	20	20	10	30	N	N	7.0	200	20
TZR00052	N	10	50	500	20	20	50	150	200	5.0	100	20
TZR00053	N	N	30	15	<20	N	5	<10	100	<5.0	<100	3
TZR00063	N	7	20	150	<20	N	10	<10	<100	5.0	300	10
TZR00070	N	15	50	30	30	N	20	30	N	10.0	500	7
TZR00071	N	15	100	50	70	5	15	20	N	10.0	700	15
TZR00079	N	N	20	100	<20	N	5	N	100	5.0	<100	20
TZR00082	N	20	100	200	100	N	50	50	N	15.0	1,000	15
TZR00084	N	15	150	100	50	N	50	10	N	10.0	100	15
TZR00086	N	7	30	150	<20	N	30	<10	N	7.0	100	30
TZR00089	N	10	30	50	50	20	10	50	<100	7.0	200	10
TZR00090	N	15	70	50	70	5	20	20	N	7.0	500	20
TZR00091	N	7	30	70	50	N	10	150	N	5.0	300	3
TZR00092	N	10	15	70	50	300	10	70	1,000	5.0	200	20
TZR00093	N	5	30	100	<20	15	15	<10	N	7.0	<100	30
TZR00094	N	N	100	200	20	50	20	30	N	10.0	200	30

TABLE 3.--ANALYTICAL DATA FOR ROCK SAMPLES FROM THE GILBERT DISTRICT, ESMERALDA COUNTY, NEVADA--Continued

Sample	Y-ppm s	Zn-ppm s	Zr-ppm s	Au-ppm aa	Te-ppm aa	As-ppm aa	Zn-ppm aa	Cd-ppm aa	Bi-ppm aa	Sb-ppm aa	Tl-ppm aa
TND00361	20	2,000	30	1.66	2.2	--	--	--	--	--	.8
TNR00362	15	1,000	50	.15	1.4	--	--	16.0	--	28	1.3
TNR00363	30	700	100	.15	.2	--	--	--	<2	--	2.6
TNR00364	<10	N	20	.20	.2	<5	50	.7	N	5	.2
TND00365	20	300	N	.10	.2	--	--	.5	--	34	1.6
TNR00366	<10	N	100	.08	N	10	30	.5	N	3	3.4
TND00367	10	N	70	2.91	N	--	25	.5	N	--	10.0
TND00368	10	N	70	10.43	<.2	<5	10	.5	N	3	.6
TND00369	10	N	200	.13	.3	95	25	.5	--	13	2.2
TND00370	20	700	20	2.36	1.0	N	--	3.3	N	8	1.2
TND00371	N	N	N	6.61	.6	10	120	.7	N	1	1.0
TND00373	15	500	100	.14	.3	--	--	.7	N	10	2.2
TND00378	15	N	1,000	.11	N	N	160	.4	N	N	.6
TND00379	10	N	70	.92	.2	110	35	.5	N	2	1.6
TND00380	<10	N	100	1.01	N	N	40	.3	N	2	2.4
TND00381	<10	N	10	.74	<.2	N	25	N	N	20	1.6
TNR00382	<10	N	100	.31	N	30	50	.4	N	57	2.8
TND00383	10	N	100	.14	N	85	160	.3	N	9	2.6
TND00384	<10	N	100	1.54	9.0	--	75	.5	--	--	2.2
TND00385	20	N	70	.37	75.0	--	35	.9	--	--	6.6
TNR00386	30	N	200	.05	1.1	85	130	.4	<2	20	1.2
TND00387	10	200	30	.05	N	25	--	.3	N	N	N
TNR00388	30	<200	70	.29	9.3	--	250	1.8	N	98	.2
TND00389	10	5,000	20	1.17	3.2	--	--	--	--	--	.4
TND00390	15	N	70	4.20	N	--	200	.7	N	15	1.6
TND00391	20	N	100	2.15	N	--	220	.4	N	N	2.6
TND00392	<10	N	50	14.38	N	--	55	.5	N	3	.6
TZR00049	20	N	300	--	--	--	--	--	--	--	--
TZR00050	20	N	300	--	--	--	--	--	--	--	--
TZR00051	20	<200	70	--	--	--	--	--	--	--	--
TZR00052	50	700	30	--	--	--	--	--	--	--	--
TZR00053	<10	N	10	--	--	--	--	--	--	--	--
TZR00063	10	N	70	--	--	--	--	--	--	--	--
TZR00070	20	N	50	--	--	--	--	--	--	--	--
TZR00071	20	N	200	--	--	--	--	--	--	--	--
TZR00079	15	N	20	--	--	--	--	--	--	--	--
TZR00082	20	N	200	--	--	--	--	--	--	--	--
TZR00084	30	N	300	--	--	--	--	--	--	--	--
TZR00086	15	N	50	--	--	--	--	--	--	--	--
TZR00089	15	N	100	--	--	--	--	--	--	--	--
TZR00090	15	N	200	--	--	--	--	--	--	--	--
TZR00091	30	N	100	--	--	--	--	--	--	--	--
TZR00092	20	N	100	--	--	--	--	--	--	--	--
TZR00093	10	N	30	--	--	--	--	--	--	--	--
TZR00094	20	N	50	--	--	--	--	--	--	--	--

TABLE 3.--ANALYTICAL DATA FOR ROCK SAMPLES FROM THE GILBERT DISTRICT, ESMERALDA COUNTY, NEVADA--Continued

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	Ag-ppm s	As-ppm s	B-ppm s	Ba-ppm s	Be-ppm s
TZR00100	38 8 8	117 47 28	5.00	.07	.07	.100	50	<.5	500	50	500	N
TZR00103	38 8 44	117 47 23	10.00	1.50	2.00	.100	2,000	10.0	2,000	200	150	7.0
TZR00106	38 8 26	117 49 55	5.00	2.00	2.00	.500	1,000	N	N	50	1,500	3.0
TZR00107	38 9 45	117 48 7	5.00	2.00	7.00	.070	1,000	N	500	150	1,000	3.0
TZR00173	38 8 16	117 47 46	1.00	.15	1.00	.100	700	1.5	300	30	>5,000	N
TN24,MBF	38 7 29	117 43 18	7.00	2.00	7.00	1.000	700	.5	N	50	2,000	2.0
TN25	38 7 29	117 43 11	7.00	.30	.50	.300	50	.7	200	70	1,000	3.0
TN26	38 7 29	117 43 11	3.00	1.50	1.50	.200	700	.5	300	50	1,000	5.0
TN27	38 7 46	117 43 2	5.00	1.50	2.00	.300	500	1.5	300	50	2,000	5.0
TN28	38 8 8	117 43 14	5.00	1.50	2.00	.300	500	1.5	300	50	2,000	5.0
TN29A	38 7 16	117 42 44	15.00	.50	.20	.050	30	1.0	3,000	70	1,500	1.0
TN29B	38 7 16	117 42 44	5.00	.07	.20	.050	20	2.0	1,500	50	700	<0
TN29C	38 7 16	117 42 44	10.00	1.00	.30	.100	70	.5	2,000	70	1,000	2.0
TN29D	38 7 16	117 42 44	2.00	.50	.70	.100	50	1.0	200	50	1,500	3.0
TN30A	38 7 10	117 42 36	5.00	1.00	.70	.200	500	.7	<0	70	1,500	3.0
TN31A	38 7 6	117 42 53	3.00	1.00	.50	.150	500	.7	N	50	1,000	5.0
TN31B	38 7 6	117 42 53	2.00	1.00	.70	.150	700	.5	N	30	1,000	5.0
TN32B	38 8 50	117 42 33	7.00	5.00	10.00	.100	5,000	7.0	500	50	>5,000	5.0
TN32C	38 8 50	117 42 33	15.00	.20	.70	.070	5,000	5.0	1,500	30	700	7.0
TN33	38 10 11	117 42 31	7.00	.50	.10	.500	50	10.0	200	70	1,500	1.5
TN34A	38 10 14	117 42 28	7.00	1.50	.70	.500	2,000	5.0	500	50	1,000	5.0
TN35A	38 11 0	117 42 8	5.00	.50	.50	.500	3,000	5.0	300	70	5,000	3.0
TN36A	38 11 9	117 42 11	2.00	2.00	20.00	.050	3,000	2.0	N	15	500	3.0
TN36B	38 11 9	117 42 11	5.00	1.50	1.50	.200	1,000	10.0	<0	50	1,000	2.0
TN37	38 11 11	117 42 13	5.00	2.00	15.00	.200	2,000	3.0	N	30	1,000	3.0

TABLE 3.--ANALYTICAL DATA FOR ROCK SAMPLES FROM THE GILBERT DISTRICT, ESMERALDA COUNTY, NEVADA--Continued

Sample	Bi-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sr-ppm s	V-ppm s
TZR00100	N	N	15	15	<20	5	5	15	<100	5.0	<100	50
TZR00103	N	500	150	>20,000	200	20	1,000	70	3,000	5.0	100	100
TZR00106	N	20	50	70	70	<5	30	30	N	10.0	700	150
TZR00107	N	20	700	50	20	7	300	20	N	7.0	200	70
TZR00173	N	7	10	20	20	N	7	N	700	<5.0	200	30
TN24,MBF	N	20	100	30	70	15	70	100	N	15.0	200	100
TN25	N	7	15	30	20	20	5	50	N	.5	200	70
TN26	N	20	100	50	50	10	50	70	N	10.0	300	100
TN27	N	15	50	30	100	20	30	70	N	10.0	300	100
TN28	N	15	70	30	100	20	20	50	N	10.0	200	150
TN29A	N	15	30	70	70	20	10	50	300	5.0	300	200
TN29B	N	7	10	50	20	15	5	50	300	5.0	300	150
TN29C	N	10	15	50	100	20	10	70	200	7.0	200	200
TN29D	N	10	15	20	70	15	5	100	N	5.0	200	50
TN30A	N	10	30	30	100	5	<0	100	N	10.0	200	200
TN31A	N	10	15	20	70	20	7	100	N	7.0	200	50
TN31B	N	10	15	7	70	20	5	70	N	7.0	150	50
TN32B	N	30	50	200	100	20	100	200	200	7.0	300	200
TN32C	N	30	100	300	100	50	100	300	500	7.0	300	150
TN33	20	15	100	100	70	30	15	500	200	10.0	150	200
TN34A	N	50	700	70	20	30	100	30	N	30.0	300	200
TN35A	10	30	150	150	70	20	100	200	N	10.0	200	150
TN36A	N	15	10	10	<0	10	<0	10	N	5.0	300	20
TN36B	N	15	30	30	50	15	7	50	N	10.0	500	100
TN37	N	10	50	20	50	5	7	30	N	10.0	200	100

TABLE 3.--ANALYTICAL DATA FOR ROCK SAMPLES FROM THE GILBERT DISTRICT, ESMERALDA COUNTY, NEVADA--Continued

Sample	Y-ppm s	Zn-ppm s	Zr-ppm s	Au-ppm aa	Te-ppm aa	As-ppm aa	Zn-ppm aa	Cd-ppm aa	Bi-ppm aa	Sb-ppm aa	Tl-ppm aa
TZR00100	15	N	50	--	--	--	--	--	--	--	--
TZR00103	200	1,000	50	--	--	--	--	--	--	--	--
TZR00106	20	N	200	--	--	--	--	--	--	--	--
TZR00107	20	N	50	--	--	--	--	--	--	--	--
TZR00173	10	N	70	--	--	--	--	--	--	--	--
TN24,MBF	30	N	200	N	--	--	--	--	--	--	--
TN25	15	N	100	N	--	--	--	--	--	--	--
TN26	15	N	100	N	--	--	--	--	--	--	--
TN27	15	N	100	N	--	--	--	--	--	--	--
TN28	20	N	200	N	--	--	--	--	--	--	--
TN29A	15	N	70	N	--	--	--	--	--	--	--
TN29B	<0	N	20	N	--	--	--	--	--	--	--
TN29C	30	N	150	N	--	--	--	--	--	--	--
TN29D	20	N	100	N	--	--	--	--	--	--	--
TN30A	30	N	150	N	--	--	--	--	--	--	--
TN31A	20	N	100	N	--	--	--	--	--	--	--
TN31B	20	N	100	N	--	--	--	--	--	--	--
TN32B	50	300	70	N	--	--	--	--	--	--	--
TN32C	50	500	30	N	--	--	--	--	--	--	--
TN33	20	N	200	N	--	--	--	--	--	--	--
TN34A	30	500	70	N	--	--	--	--	--	--	--
TN35A	30	300	150	N	--	--	--	--	--	--	--
TN36A	20	N	70	N	--	--	--	--	--	--	--
TN36B	20	N	150	N	--	--	--	--	--	--	--
TN37	20	N	100	N	--	--	--	--	--	--	--

Table 4.--Statistical summary of analytical results for rock samples from the Gilbert district, Nevada

,Explanation: S (as in S-Fe), determined by emission spectrography; AA (as in AA-As) determined by atomic absorption. Valid means analytical data are not qualified (L, N, G). L, less than limit of determination (Tables 1 and 2); N, not detected; G, greater than upper limit of determination. Major elements reported as weight percent, all other elements reported in parts per million; ***, not calculated.

Column	Minimum	Maximum	Geometric mean	Geometric deviation	Valid	L	N	G
S-Fe%	.10	20.	3.2	3.1	70	0	0	0
S-Mg%	.02	5.	.34	4.8	69	1	0	0
S-Ca%	.05	20.	.67	5.2	67	3	0	0
S-Ti%	.005	1.	.14	2.5	70	0	0	0
S-Mn	15.	5000.	302.	4.8	68	0	0	2
S-Ag	.5	2000.	4.8	6.5	58	2	10	0
S-As	200.	5000.	615.	2.5	36	7	27	0
S-Au	15.	15.	15.	***	1	0	69	0
S-B	10.	300.	44.	2.3	69	1	0	0
S-Ba	50.	5000.	774.	2.3	68	0	0	2
S-Be	1.	7.	2.3	1.9	63	3	4	0
S-Bi	10.	1000.	34.	5.8	9	1	60	0
S-Cd	20.	500.	144.	5.6	3	1	66	0
S-Co	5.	500.	14.	2.1	56	1	13	0
S-Cr	10.	700.	38.	2.6	65	5	0	0
S-Cu	5.	15000.	64.	4.8	69	0	0	1
S-La	20.	200.	41.	1.9	59	11	0	0
S-Mo	5.	300.	20.	2.8	47	1	22	0
S-Nb	20.	20.	20.	***	11	7	52	0
S-Ni	5.	1000.	18.	3.3	66	4	0	0
S-Pb	10.	7000.	56.	3.8	61	4	3	2
S-Sb	100.	10000.	435.	4.3	19	9	42	0
S-Sc	.5	30.	6.9	1.7	63	7	0	0
S-Sn	30.	300.	77.	3.4	3	0	67	0
S-Sr	100.	2000.	227.	1.9	56	14	0	0
S-V	10.	300.	95.	2.3	70	0	0	0
S-W	70.	70.	70.	***	1	2	67	0
S-Y	10.	200.	19.	1.7	60	9	1	0
S-Zn	200.	5000.	648.	2.3	14	2	54	0
S-Zr	10.	1000.	80.	2.3	68	0	2	0
AA-Au	.05	14.4	.55	5.3	27	0	20	0
AA-Te	.2	75.	1.1	5.7	15	2	10	0
AA-As	10.	110.	39.	2.7	8	2	4	0
AA-Zn	10.	250.	62.	2.5	19	0	0	0
AA-Cd	.3	16.	.65	2.4	23	0	1	0
AA-Bi	***	***	***	***	0	2	18	0
AA-Sb	1.	98.	9.0	3.5	18	0	3	0
AA-Tl	.2	10.	1.4	2.5	26	0	1	0