Geologic and Grade-Tonnage Information on Tertiary Epithermal Precious- and Base-Metal Vein Districts Associated with Volcanic Rocks

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Geologic and Grade-Tonnage Information on Tertiary Epithermal Precious- and Base-Metal Vein Districts Associated with Volcanic Rocks

By Dan L. Mosier, W. David Menzie, *and* Frank J. Kleinhampl

Abstract

Data on grades, tonnages, and geology of selected Tertiary epithermal precious- and base-metal vein districts associated with volcanic rocks were tabulated for ease of examination and comparison of characteristics between districts. There are 215 districts listed, with a cumulative tonnage of 709 million metric tons and average grades of 4.7 g/t Au, 224 g/t Ag, 0.16 percent Cu, 0.55 percent Pb, and 0.83 percent Zn, representing about 60 percent of world districts.

INTRODUCTION

This is a worldwide compilation of data on grades, tonnages, and geology of selected Tertiary epithermal precious- and base-metal vein districts associated with volcanic rocks. There are 215 districts tabulated in table 1, of which most are ore producers or past producers. The list contains a cumulative tonnage of 709 million metric tons of ore with average grades of 4.7 g/t Au, 224 g/t Ag, 0.16 percent Cu, 0.55 percent Pb, and 0.83 percent Zn; ore tonnage mean is about 3.3 million metric tons. This compilation is not complete--we believe it represents about 60 percent of the known districts in the world.

These data were collected for the purpose of constructing both descriptive and grade-tonnage models for different types of epithermal precious- and base-metal districts (Berger, 1983a, b, c; Mosier and Menzie, 1983a, b). In response to requests for making these data available, we have tabulated the information to allow ease of examination and comparison of characteristics between districts. More important, these data can be used to revise existing models or to develop new models.

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CHARACTERISTICS OF DISTRICTS

Generally, the districts are precious- and base-metal-rich veins, stockworks, and breccias that occur in through-going fracture systems within mainly intermediate to felsic subaerial volcanic rocks. For such deposits, mineralization is thought to have been emplaced at depths less than 1,000 m and at temperatures below 300 °C (Sillitoe, 1977). The principal ore minerals are electrum, tellurides, argentite, native gold and silver, base metal sulfides, and sulfosalts. The principal gangue minerals are quartz, chalcedony, opal, adularia, alunite, calcite, chlorite, pyrite, and arsenopyrite. Ore textures typically include drusy cavities, crustification, comb structures, colloform structures, and brecciation. The six types of hydrothermal alteration and their mineral assemblages commonly found in epithermal districts are (1) silicic (quartz-opal-chalcedony-sulfides), (2) potassium silicate (quartz-adularia-sericite), (3) argillic (quartz-kaolinite-dickite-illite-montmorillonite), (4) advanced argillic (dickite-pyrophyllite-kaolinite-alunite-sericite-quartz), (5) sericitic or phyllic (quartz-sericite-pyrite), and (6) propylitic (chlorite-albite-calcite-epidote-pyrite-sericite).

DEVELOPMENT OF GRADE-TONNAGE MODELS

Some of these data were used in making grade-tonnage models for mineral-resource assessments. The first grade-tonnage model for epithermal gold-silver deposits was constructed for the mineral resource assessment of the Walker Lake 2° quadrangle, Nevada-California, as part of the Conterminous United States Mineral Resource Assessment Program. The model contained 61 districts from Nevada (compiled by Menzie and Kleinhampl) and California (compiled by Mosier). For a subsequent mineral-resource assessment of Colombia, the data were expanded to include a total of 153 districts from Mexico (compiled by Menzie) and Asia, Canada, U.S., New Zealand, Middle East, and South and Central America (compiled by Mosier). With these data, the grade-tonnage models for the epithermal gold-silver-quartz-adularia type (Mosier and Menzie, 1983a) and the epithermal gold-quartz-alunite type (Mosier and Menzie, 1983b) districts were developed. Additional districts not considered in the grade-tonnage models and some districts considered to be of the hot springs type were included in table 1, making a total of 215 districts.

CRITERIA AND SELECTION OF DATA

The selection of districts is based on the availability of grades, tonnages, and geologic information, and the criteria that volcanic rocks are associated with epithermal ore veins. The information in table 1 was compiled on a district level, mainly because the data on deposit size and geology have been designated by districts in the literature or on maps. Before the data can be compiled for a grade-tonnage model, the type of ore deposit being studied should be defined in a geologic model in which the lithology, mineralogy, alteration, structure, depositional environment, tectonic setting, and geochemical signature of example deposits from around the world are described. Geologic descriptions of the districts were compared with descriptive models of Berger (1983a, b, c).

All of the districts in this compilation have mineralization of Tertiary age or younger. This is not to say that epithermal veins did not form thoughout the Phanerozoic, but, because of erosion, the ones commonly preserved are of Tertiary age or younger. Furthermore, the older deposits, if preserved, may be metamorphosed to the point that they no longer exhibit epithermal characteristics (Buchanan, 1981) and, therefore, they are difficult to identify and classify.

When an epithermal district contains deposits of other types (e.g., limestone replacement), our compilation is confined only to epithermal veins. Thus, our estimates of district grades and tonnages exclude the production, reserves, and geologic information of other deposit types.

Grade and tonnage data were collected from the literature. The tonnage for each district is the sum of past production and reserves, representing the total premined tonnage of the district. The grade is the average of either percent metal or grams per metric ton metal of the total tonnage. Although it is desirable that grade-tonnage data be stated at a uniform cutoff grade, these generally are not reported in the literature.

For districts with incomplete production records, tonnages and grades were estimated either by extrapolating known production figures or using average mining rates and reported assays. Because of the erratic nature of these veins, we did not estimate reserves. Some important districts, such as Ocampo, Mexico, could not be included because we were unable to find or estimate past production or reported reserves.

DESCRIPTION OF HEADINGS IN TABLE 1

The data in table 1 include the district name, country, latitude, longitude, tonnage, grades, discovery year, comments, basement rocks, host rocks, associated rocks, alteration, vein morphology, mineralization age, minerals, and references. Abbreviations used in table 1 are listed in tables 2, 3, and 4. The approximate location of each district is shown on the maps in figures 1-24.

District--District names are listed alphetically. Combination of two or more districts or subdistricts are separated by a hyphen. Synonyms are shown in parentheses (see table 5 for district name synonyms).

Country--Country, country-state, and country-province are expressed in four-letter codes (see table 3 for country abbreviations). For the country-state and country-province codes, the first two letters represent the country and the last two the state or province.

Latitude--Latitude is expressed in six-digit numbers followed by a letter representing the north or south direction. The first two digits are the degrees, the next two are the minutes, and the last two are the seconds.

Longitude--Longitude is expressed in seven-digit numbers followed by a letter representing the east or west direction. The first three digits are the degrees, the next two are the minutes, and the last two are the seconds.

Tonnage--The tonnage, in millions of metric tons, includes past production, reserves, and (or) resources. To convert from metric ton to short ton, multiply by 1.1023.

Au--Gold grade is in grams per metric ton. Unreported grades and grades less than 0.01 g/t are entered as dashes. To convert from grams per metric ton to ounces per short ton, multiply by 0.0292.

Ag--Silver grade is in grams per metric ton. Unreported grades and grades less than 0.1 g/t are entered as dashes. To convert from grams per metric ton to ounces per short ton, multiply by 0.0292.

Cu--Copper grade is in percent. Unreported grades and grades less than 0.1 parts per million are entered as dashes.

Pb--Lead grade is in percent. Unreported grades and grades less than 0.1 parts per million are entered as dashes.

Zn--Zinc grade is in percent. Unreported grades and grades less than 1.0 parts per million are entered as dashes.

Discovery year--The year that the gold-silver mineralization was discovered.

Comments--Additional information on grades and tonnages, such as grades of other commodities and dates of past production and reserves.

Basement rocks--Entry includes lithologic units (from oldest to youngest) that underlie host rocks. Only basement rocks that occur within or near a district are considered. For each district, vertical extent of basement rocks is based on available information rather than a depth limitation.

Host rocks--The major enclosing rocks of mineralized veins. Lithologic units are listed from oldest to youngest.

Associated rocks--All unmineralized rocks associated with the host rocks. Lithologic units are listed from oldest to youngest. The ages of these rocks in relation to the host rocks are either contemporaneous or younger.

Alteration--Types of alteration are listed.

Vein morphology--Entry includes the form, structure, size (either as maximum or average lengths), and orientation of the deposit. All units are metric.

Age--Only the absolute age of mineralization, when available, is entered.

Minerals--Ore minerals are listed first, followed by gangue minerals. They are not listed in order of abundance. Generally, the order begins with sulfides, sulfosalts, and native metals, followed by metallic carbonates, metallic silicates, and oxides, and ends with nonmetallic minerals. Minerals abbreviations are listed in table 2.

References--References cited in table 1. Starred references indentify sources of grade and tonnage data.

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TABLES 1-5; FIGURES 1-24

Table 1. Location, tonnage, grade, and geologic information for epithermal gold-silver districts

[Minerals and elements are spelled out on table 2; countries are spelled out on table 3; all other abbreviations are spelled out on table 4; district names and their synonyms are given on table 5]

District	Country	Latitude	Longitude	Tonnage ($x10^6$)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Discovery year	Comments	Basement rocks	Host rocks
Akabane	JAPN	373000N	1394200E	0.414	1.8	9.9	0.47	---	---		Prod. (to 1945) and reserves (1945)		Tertiary andesite tuff, rhyolite flows
Akaishi	JAPN	392130N	1404730E	2.158	0.2	1.1	0.39	---	---		Prod. (1914-1945) and reserves (1946)		Miocene rhyolite flows and tuffs
Akarimata	JAPN	400730N	1403330E	0.141	---	41.4	1.9	---	---		22% pyrite; prod. (1947-1970)		Miocene andesite flows
Angangueo	MXCO	194000N	1001500W	1.313	0.24	355.0	0.02	0.49	---		Prod. (1973-1976) and reserves (1973); prod. began 1907		Tertiary andesite flows, dacite tuff, shale
Ani	JAPN	395900N	1402530E	2.077	0.5	15.4	1.0	0.3	---		Prod. (1885-1980)		Miocene basalt flows, rhyolite tuff, marine sedimentary rocks
Animas	USCO	374730N	1073630W	8.5	3.4	99.0	0.45	2.0	0.3	1870s	Prod. (to 1959)	Precambrian metamorphic rocks; Paleozoic marine sedimentary rocks; Mesozoic carbonate and sedimentary rocks	Tertiary andesite and rhyodacite flows, tuffs, and breccias
Antelope Springs	USNV	373633N	1164407W	0.0003	11.7	4,389.0	0.09	4.0	---	1903	Prod. (1903-1932)		Tertiary tuff
Arapdagi-Alurcakoy	TRKY	380300N	0270500E	0.363	9.6	52.7	---	---	---		Reserves		Dacite breccia intrusion
Athens	USNV	383646N	1175002W	0.0058	19.5	21.3	---	---	---		Prod. (1915-1965)		Tertiary rhyolite and dacite flows
Aurora (Esmeralda)	USNV	381704N	1185329W	1.7	19.0	203.0	---	---	---	1860	As much as 15% pyrite; prod. (1860-1940)	Paleozoic metamorphic rocks; Mesozoic granitic rocks; Triassic and Jurassic felsic to intermediate flows, tuffs, and breccias, argillite, sandstone, conglomerate, limestone	13.5-14.5 m.y. andesite flows, quartz latite flows
Avino	MXCO	243100N	1041400W	25.0	0.5	100.0	0.7	0.7	---	1500s	Reserves (1977)		Tertiary andesite flows and tuffs, quartz monzonite, dacite porphyry, and syenite intrusions
Baboquivari	USAZ	314439N	1113248W	0.054	6.6	79.0	0.014	0.0009	---		Prod. (1895-1972)		Tertiary andesite flows
Bajo	JAPN	332731N	1313109E	0.132	5.9	76.6	---	---	---		Prod. (1925-1945) and reserves (1945)	Mesozoic granite and gneiss	Pliocene andesite flows
Bellehelen (Longstreet)	USNV	380246N	1162655W	0.0083	26.0	1,029.0	0.03	0.03	---	1904	Prod. (1906-1956)	Triassic limestone	Miocene rhyolite-rhyodacite tuffs, Triassic limestone
Benten	JAPN	392800N	1405000E	0.02	9.0	13.0	0.9	---	---		Prod. (1938-1942) and reserves (1945)	Mesozoic granitic intrusion	Miocene andesite tuff, rhyolite flows
Black Dome Mountain	CNBC	512000N	1222900W	0.28	12.0	110.0	---	---	---		Reserves (1980)	Andesite and dacite flows	Eocene to Pliocene andesite and rhyolite flows
Blue River	USOR	441237N	1222049W	0.0705	3.4	9.6	0.003	0.0007	---	1887	Prod. (1896-1941)		Miocene andesite tuffs and flows
Bodie	USCA	381246N	1190013W	0.757	58.0	41.0	0.007	0.17	---	1859	Prod. (1877-1941)	Paleozoic argillite, slate, hornfels, metasiltstone, quartzite, limestone, metaconglomerate; Triassic and Jurassic felsic to intermediate flows, tuffs, breccias, argillite, sandstone, limestone, conglomerate; Mesozoic granite and granodiorite	9.5-8 m.y. andesite and dacite flows, tuff breccia, and plugs
Bohemia	USOR	433405N	1223730W	0.107	11.0	10.8	0.086	0.24	0.096	1858	Prod. (1880-1952)		Oligocene and l. Miocene andesite and rhyolite tuffs and breccias
Bolanos	MXCO	215100N	1034600W	0.39	0.02	250.0	0.09	0.49	---		Prod. (1973-1976)		Oligocene(?) andesite flows and tuffs
Bonanza (Kerber Creek)	USCO	381900N	1060900W	0.508	1.0	237.0	1.2	2.6	0.23	1880	Prod. (1880-1930)	Precambrian metasedimentary and igneous rocks	37.6 m.y. andesite and latite flows, breccias, tuffs, and lahars
Bovard (Rand)	USNV	384644N	1182323W	0.0068	30.0	532.0	0.25	0.02	---	1906	Prod. (1910-1950)	Triassic dolomite, limestone and shale; Cretaceous quartz monzonite, granodiorite, and albite granite	Oligocene quartz latite flows and tuffs; Miocene rhyodacite tuff
Bruner (Phonolite)	USNV	390347N	1174553W	0.0907	17.0	78.0	---	0.003	---	1906	Prod. (1924-1949)	Metavolcanic rocks	Oligocene and Miocene rhyolite breccias and andesite flows
Buckhorn (Mill Canyon)	USNV	401102N	1162905W	0.204	6.2	48.0	0.0001	---	---	1908	Prod. (1910-1960)		16.3 m.y. basaltic andesite flows and shale
Bullfrog-Pioneer (Rhyolite)	USNV	365445N	1164830W	0.298	12.0	88.0	0.003	0.004	---	1904	Prod. (1907-1957)	Ordovician quartzite and mica schist; Silurian limestone, shale, and quartzite	12.8-11.4 m.y. rhyolite flows and tuffs
Cababi (Comobabi)	USAZ	320411N	1115153W	0.0064	14.7	355.0	1.2	2.3	0.01	1770s	Prod. (1864-1974)		L. Tertiary andesite flow
Calico	USCA	345730N	1165230W	0.41	1.2	1,234.0	---	0.15	---	1881	Estimated prod. (1882-1952)	Precambrian gneiss; Jurassic and Cretaceous metamorphic rocks	M. Miocene tuff, tuff-breccia, granite breccia and sandstone

Associated rocks	Alteration	Vein morphology	Age m.y.	Minerals	References
		3 fissure-filled veins		CPY,QTZ	Grant (1950)*
	Silicic, sericitic	Stockworks		CPY,QTZ,CALC,SER	Grant (1950)*, Yamada and others (1980)
Miocene rhyolite flows, diorite intrusion	Silicic	NE-trending fissure-filled vein		PYR,CPY,QTZ,MAG,SID	Yamada and others (1980)*, Shikazono (1985)
Tertiary porphyritic dacite, andesite, and diorite intrusions	Silicic, propylitic, argillic	NE-trending fissure-filled vein, dips 70°SE		PYR,Ag,SPH,GAL,CPY,APY,MARC,PYGR, PROU,RH,QTZ,CALC	Busch (1980)*
Neogene granite	Silicic, propylitic	8 groups of fissure-filled veins 7-120 cm wide, 200 m depth	11	CPY,PYR,Au,ARG,GAL,SPH,QTZ,AD,CHL, CALC,CLAY,HEM,CHM,SER,K-FELD	Grant (1950), Yamada and others (1980)*, Imai (1978), Shikazono (1985)
Tuffs, conglomerate		Radial and arcuate fissure-filled veins related to a caldera		GAL,CPY,PYR,SPH,Au,SPEC,QTZ,CALC, FL	Koschmann and Bergendahl (1968), Elevatorski (1982)*
	Silicic, propylitic,	N-trending faults, dip 30°W, veins average 2.4 m wide, 600 m long		CGR,ARG,Au,Ag,QTZ,KAOL,AL,SER,CHL, CALC,AD,Fe oxides	Cornwall (1972), Nolan (1936)*
	Silicic, propylitic(?)	6 parallel veins, strike N87°E, dip 50°-80°N, 138 m depth, variable length and width		PYR,Au,SPH,GAL,CPY,QTZ,PRHN,EP, CHL,BAR	Maden Tetkik (1970)*
Tertiary andesite		2 quartz veins		CGR,QTZ	Lincoln (1923), U.S. Bureau of Mines (1900-1984)*
Younger rhyolite and basalt flows and plugs	Silicic, argillic, potassium silicate, propylitic	Veins strike N45°E, dip 75°-85° SE and NW, stringers, ribs, stockworks, up to 9 m wide, 137 m depth, several tens of m long	10	Au,EL,Se,TET,GAL,SPH,CPY,PYR,NAUM, ARG,Ag,QTZ,AD,CALC,SER,KAOL	Nolan (1936), Koschmann and Bergendahl (1968), Buchanan (1981), Silberman and McKee (1972), Silberman and others (1976), Elevatorski (1982)*, Hill (1915)
	Silicic	Silicified fault breccia, NW-trending fissure-filled veins and disseminations, dip 50°-85°		ARG,CPY,BOR,GAL,Cu oxides,Cu-CARB, QTZ	White (1980)*, Busch (1980), Mining Magazine (1981b)
		Veins in fault zones		Au,Ag,CGR,ARG,CPY,GAL,Mn oxides,Fe oxides,QTZ	Elevatorski (1982), Keith and others (1983)*
		4 fissure-filled quartz veins		Au,ARG,PYR,STIB,PYGR,QTZ,CALC	Grant (1950)*
	Silicic, argillic	Quartz-adularia veins up to 180 m long with stringers 8-10 cm wide in a 5 m wide fissure zone, trend N15°-76°E, dip 75°SE-70°NW		Au,CPY,GAL,CGR,HEM,QTZ,AD	Nolan (1936)*, Kleinhampl and Ziony (1984), U.S. Bureau of Mines (1900-1984)*
		5 fissure-filled veins, trend E-W and N-S		CPY,PYR,Au,QTZ	Grant (1950)*, Yamada and others (1980)*
Younger olivine basalt dikes, flows and agglomerates	Silicic	3 steeply dipping quartz and carbonate fracture-filled veins, trend N, breccia zone 400 m long and 1-30 m wide		Au,PYR,QTZ,CARB,JAS	Church (1980), Church (1982)*, Worobec and Needham (1980)
Basalt flows, diorite dikes	Silicic	Veins up to 7.5 m wide, 548 m long, 46 m depth, trend N30°-45°W and N33°-70°E, dip 65°-85°SW and NE, silicified breccia zone		PYR,SPH,GAL,CPY,TET,CC,COV,CHR, MAL,CER,ANG,LIM,QTZ,CALC,AD,BAR	Brooks and Ramp (1968), Callaghan and Buddington (1938), Koschmann and Bergendahl (1968), U.S. Bureau of Mines (1900-1984)*, Oregon Department of Geology (1951)
Younger rhyolitic rocks	Silicic, potassium silicate, propylitic, argillic	3 sets of quartz veins in brecciated rock, 0.3-27 m wide, 366 m depth, 305 m wide mineralized zone	8-7.2	PYR,Au,ARG,PYGR,EL,STP,PROU,SPH, Ag,CGR,GAL,TET,CPY,HEM,CC,TL,LIM, STIB,STRM,REAL,BOR,ANG,EMB,AZ,PYL, CHR,QTZ,AD,CALC,BAR,OR,CHL,CHD,EP, KAOL,PLAG	Chesterman (1968), Ross (1961), Buchanan (1981), Kleinhampl and others (1975), Silberman and Chesterman (1972), Silberman and others (1972), Albers and Kleinhampl (1970), Rowan and Purdy (1980), Eakle and McLaughlin (1919)*, U.S. Bureau of Mines (1900-1984)*; O'Neil and others (1973)
Granodiorite porphyry, diorite plugs and dikes	Silicic, argillic, sericitic	Cavity fillings and wallrock replacements, veins trend N30°-90°W, dip 60°-80°S, up to 548 m long, 213 m depth, 3.6 m wide		Au,SPH,GAL,PYR,CPY,TET,HEM,STIB, SPEC,CC,QTZ,CALC,KAOL	Callaghan and Buddington (1938), Koschmann and Bergendahl (1968), U.S. Bureau of Mines (1900-1984)*, Oregon Department of Geology (1951)
		NNE- and N-trending veins		CPY,GAL	Clark and others (1979), Busch (1980)*
Younger rhyolite, dacite, and andesite	Propylitic, argillic, silicic	Quartz veins and quartz-rhodochrosite-fluorite-silver veins in fractures		PYR,GAL,SPH,CPY,BOR,EN,TEN,STRM, TET,HES,PETZ,SYL,ARG,EMB,EMP,Au, HEM,PYGR,COV,ANG,AZ,BRM,CGR,CER, CC,CHR,Cu,GYP,JAR,MAL,MNG,SID,BAR, CALC,RH,QTZ,FL,AD,ALT,AL,AN,AP, CHL,DIA,DOL,EP,KAOL,RD,ZUN	Koschmann and Bergendahl (1968), Burbank (1932)*, Lipman and others (1972), Varga and Smith (1984)
Pliocene rhyodacite, rhyolite, andesite	Silicic, propylitic, argillic, pyritic	Veins trend N40°W, dip steeply NE, 0.9-1.8 m wide, 168 m depth	23-22	CGY,ARG,EL,SPH,GAL,TET,CALV,WUF, PYR,PYGR,POLY,CPY,STP,Au,Ag,JAR, GYP,MAL,TNR,CER,CHR,Fe-MOLY,QTZ, AD,CALC,AL,SER,EP,KAOL,SID,HEM	Vanderburg (1937)*, Ekren and Byers (1978), Ross (1961), Ekren and others (1980), Rowan and Purdy (1980), Schrader (1947)
Oligocene and Miocene rhyolite tuffs, tuffaceous sedimentary rocks, andesite dikes	Silicic, argillic	Veins up to 8 m wide in faults, fissures, and breccia; chimney-like shoots 4.3 m x 2.4 m in cross-section; 274 m depth, N-trending veins dip 44°-76°W and 79°E		PYR,Au,Ag	Koschmann and Bergendahl (1968)*, Kral (1951), Elevatorski (1982), U.S. Bureau of Mines (1900-1984)*, Kleinhampl and Ziony (1984)
16-14 m.y. rhyolite and basalt flows and plugs	Silicic, argillic, potassium silicate	Breccia zones along faults, trend N5°W, dip 75°E, 198 m wide, 37 m depth; 30 m depth of oxidized zone	14.6	PYR,CPY,GAL,SPH,Au,MARC,TALC,KAOL, AD,MONT,CHL,QTZ	Roberts and others (1971), Wells and Silberman (1973), Wells and others (1971), Koschmann and Bergendahl (1968), World Mining (1979), Vanderburg (1940)*, U.S. Bureau of Mines (1900-1984)*, Buchanan (1981)
12.8-11.4 m.y. basalt, quartz latite flows and tuffs	Silicic, potassium silicate, argillic	Veins in fault zones, stringers, and veinlets in zones up to 30 m wide, up to 244 m depth, trend N-S to E-W, dip 18°-90°	9.5	PYR,EL,GAL,CPY,LIM,CGR,MAL,CHR,CC, Ag,Mn oxide,QTZ,CALC,AD,KAOL,AL, CHD	Koschmann and Bergendahl (1968), Ransome and others (1910), Kral (1951), Morton and Silberman (1977), Cornwall and Kleinhampl (1964), Nolan (1936)*, U.S. Bureau of Mines (1900-1984)*, Buchanan (1981)
Felsic dikes	Silicic, sericitic	Veins in fractures and faults		PYGR,GAL,SPH,CPY,QTZ,CALC,SID	Keith and others (1983)*, Elevatorski (1982)
Andesite, rhyolite intrusion	Silicic, baritization	Stockwork and veins in faults, trend NW, 15-1,371 m long, 0.6-15 m wide, dip 75°-85°W		EMB,CGR,TET,TEN,STRM,PROU,ARG,GAL, CPY,HEM,PYR,Mn oxides,PYGR,REAL, STIB,BOR,Au,Ag,CC,PYL,ANG,AZ,CHR, CHD,BAR	Weber (1967)*, Gardner (1954), Wright and others (1953), Weber (1976)

Table 1. Location, tonnage, grade, and geologic information for epithermal gold-silver districts—Continued

District	Country	Latitude	Longitude	Tonnage ($x10^6$)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Discovery year	Comments	Basement rocks	Host rocks
Calistoga	USCA	383856N	1223640W	0.176	4.1	480.0	0.02	0.001	---	1872	Prod. (1875-1948)	Mesozoic graywacke, chert, shale, and greenstone	Pliocene andesite and rhyolite flows and tuffs
Casapalca	PERU	114056S	0761449W	17.0	---	161.0	0.3	1.8	3.5	1700s	Reserves (1977)	Paleozoic limestone and sedimentary rocks; Cretaceous limestone and sedimentary and volcanic rocks	Tertiary andesite
Chavin (San Juan de Castrovirreyna)	PERU	131130S	0753900W	0.315	---	125.0	0.8	8.0	12.5	1910	Reserves (1960)		Tertiary andesite flows and tuffs
Chinkuashih	TIWN	250500N	1215100E	5.017	3.1	9.5	0.09	---	---	1894	Prod. (1897-1945) and reserves (1978)		Miocene shale and sandstone; Pleistocene dacite intrusion
Chitose	JAPN	424420N	1411246E	1.66	13.9	62.0	0.004	---	---	1933	Prod. (1931-1957) and reserves (1982)	Shale and granitic rocks	U. Miocene dacite flows, breccia, agglomerate, breccia-tuff
Chloride (Apache)	USNM	332000N	1074230W	0.37	1.33	206.0	1.4	1.0	1.3	1879	Prod. (1931-1952)	Paleozoic limestone	Eocene andesite breccia, latite flows
Clifford	USNV	380817N	1162918W	0.0003	14.0	135.0	---	---	---		Reserves (1977)		Rhyolite tuffs and breccias
Coco Mina	NCRG	143500N	0844500W	1.7	26.0	---	---	---	3.4		Prod. (1976) and reserves (1977)	Jurassic limestone, schist, and conglomerate	Tertiary andestie-dacite breccia
Colqui	PERU	113303N	0762748W	5.63	1.4	132.0	0.2	1.7	4.9		Prod. (1976) and reserves (1977)	Carboniferous to Jurassic limestone; Jurassic and Cretaceous red beds, salt, gypsum	Tertiary volcanic rocks
Como	USNV	391007N	1192907W	0.143	2.5	58.0	0.002	---	---	1860s	Prod. (1900-1950)		Tertiary andesites
Comstock	USNV	391850N	1193916W	17.55	14.6	340.0	0.0002	0.0001	---	1859	Prod. (1859-1965)	Triassic metasedimentary and metavolcanic rocks; Jurassic granitic intrusions	22.6 m.y. rhyolite pyroclastics; 16.5-12.4 m.y. andesite-dacite flows, breccias, and pyroclastic rocks
Cornucopia	USNV	413144N	1161749W	0.028	4.0	305.0	0.001	---	0.0002	1873	Prod. (1875-1940)		Tertiary andesite porphyry
Creede	USCO	365100N	1065536W	3.9	1.2	714.0	0.1	4.0	1.7	1883-84	Prod. (1891-1976) and reserves (1976)	Precambrian metasediments and igneous rocks; Paleozoic and Mesozoic limestone and sedimentary rocks; Oligocene andesite	27.8-26.5 m.y. rhyolite and quartz latite flows, tuffs, and breccias, fluvial sedimentary rocks
Cripple Creek	USCO	384435N	1051024W	26.4	23.0	2.6	---	---	---	1891	Prod. (1891-1962) and reserves (1982)	Precambrian granite, gneiss, and schist; conglomerate, arkose, shale, mudstone, limestone, and volcanic rocks	Miocene latite-phonolite tuffs and breccias
Daira	JAPN	402305N	1401900E	0.47	---	56.5	0.4	2.3	5.4		6.1% pyrite; prod. (1910-1955)		Miocene rhyolite
Divide	USNV	380000N	1171344W	0.123	8.3	827.0	0.005	0.008	---	1901	Prod. (1910-1950)	Ordovician sedimentary rocks and limestone; Mesozoic granitic intrusion; 20.4 m.y. trachyte	15.5 m.y. rhyolite and andesite intrusions, and rhyolite tuff; 17 m.y. rhyolite breccia and welded tuff
Dolores	MXCO	290000N	1083000W	0.334	9.2	483.0	0.15	0.1	---		Prod. (1922-1936)	Schist, sandstone, andesite, dacite, agglomerate, and basalt	Tertiary diabase
Eagle Valley (Fay, Deer Lodge)	USNV	375529N	1140415W	0.065	7.0	79.0	0.0015	0.002	---	1896	Prod. (1903-1951)		Miocene(?) andesite-latite flows, tuffs, and breccias, rhyolite flows
East Gate	USNV	391234N	1174600W	0.008	12.7	151.0	---	0.11	---		Prod. (1935-1957)	Triassic and Jurassic volcaniclastic rocks and limestone; Triassic limestone and dolomite; Mesozoic quartz monzonite, quartz diorite dikes	Miocene and Pliocene rhyolite lithic tuff, rhyodacite tuff, and diatomaceous shale
El Dorado	ELSA	135100N	0884800W	0.868	7.2	32.4	---	---	---		Reserves (1980)		Tertiary(?) volcanic rocks
El Dorado Canyon	USNV	354152N	1145008W	0.52	5.6	133.0	0.0021	0.013	0.0007		Prod. (1910-1951)	Precambrian gneiss and schist	Precambrian gneiss and schist; Tertiary quartz monzonite, andesite and rhyolite tuffs, flows, and breccias
El Indio	CILE	294500S	0700000W	3.317	21.6	140.0	3.9	---	---		4% As, 0.5% Sb; prod. (1978-1981) and reserves (1982)	Jurassic and Cretaceous sedimentary rocks and gypsum	Miocene quartz dacite, rhyolite, andesite tuffs and agglomerate
El Rincon (Temascaltepec)	MXCO	191606N	1000830W	0.198	2.7	778.0	---	---	---		Prod. (1910-1915) and reserves (1917)	Mesozoic limestone and argillite	Andesite
El Tigre	MXCO	304000N	1091200W	1.234	8.6	1,337.0	0.25	1.0	1.5		Prod. (1903-1938)	Permian limestone; Cretaceous shale, sandstone, and granite	Oligocene(?) rhyolite flows and tuffs

Associated rocks	Alteration	Vein morphology	Age m.y.	Minerals	References
	Silicic	2 brecciated veins, steeply dipping, 4.5 m wide, 183 m depth		Au,CPY,PYR,ARG,POLY,GAL,CIN,QTZ,AD,CALC,CHD	Koschmann and Bergendahl (1968)*, Elevatorski (1982), U.S. Bureau of Mines (1900-1984)*, Clark (1970)
Tertiary sandstone, shale, and limestone	Silicic, sericitic, propylitic, pyritic	Vein and fissure system, 2,000 m depth, 5,000 m long, 1 m wide, trend N30°E, dip 70°NW; 6 types of veins		ARG,PROU,PYGR,OWY,PEAR,POLY,TET,REAL,ORP,STIB,GAL,SPH,CPY,BOUR,JAM,TEN,PYR,QTZ,CALC,BAR,RH,RD,SER,CHL	Dunham (1950), Goudarzi (1972a)*
Andesite sills, dikes, and plugs	Silicic, pyritic, propylitic	Veins in tension and shear fractures, 180 m depth, 800 m long, 1.2 m wide, trend N70°-80°W, dip 70°		SPH,GAL,CPY,Ag,PYR,CER,ANG,QTZ,CLAY,CALC,EP	Shaffer (1973a)*, De las Casas (1957)
	Silicic, argillic, propylitic, advanced argillic	Veins and pipes in N-trending normal faults; fissure-filling, breccia interstices and impregnation; dip 40°-70°E-W		PYR,EN,LUZ,WUR,TET,TEN,CIN,Au,LIM,CHR,MAL,FAM,CPY,SPH,BOUR,MARC,QTZ,MONT,NAC,CALC,BAR,AL,KAOL,SER,CHL,S,DIA	Ho and Lee (1963)*, Imai (1978)
	Silicic, argillic, potassium silicate, sericitic, propylitic, pyritic	7 vein groups, trend NNE and SSW, 270-1,200 m long, 0.8-1.5 m wide, 360 m depth, dip 80°SE; quartz veins and stockworks		PYR,SPH,GAL,CPY,EL,POLY,CGR,PYGR,PROU,STP,ARG,Au,MARC,TET-TEN,RH,CALC,BAR,QTZ,AD,SER,CHL	Hunahashi and Akiba (1970), Sato and others (1981), Takeo Sato (written commun., 1985)*
Eocene andesite dikes and sills, quartz latite flows, volcaniclastic sedimentary rocks; tuffs; Miocene rhyolite ash flow tuff, quartz latite flow	Silicic	Veins in shear zone 1.2-2.4 m wide, 2,345 m long, 305 m depth, trend N45°-70°W, dip 65°-85°SW, also trend NE and N-S		Au,Ag,LIM,MAL,AZ,BOR,GAL,SPH,CPY,COV,CC,BET,PYR,HEM,QTZ,CALC,AD,SER,BAR,RH	Elevatorski (1982), Anderson (1957), Howard (1967), U.S. Bureau of Mines (1900-1984)*, Freeman and Harrison (1984)*
	Silicic	Limonitic pipes and masses		Au,CGR,PYR,Ag,STP,PYGR,PROU,LIM,JAR,MARC,QTZ	Elevatorski (1982), Ferguson (1917), Lincoln (1923), U.S. Bureau of Mines (1900-1984)*
	Silicic, argillic	Cavity fillings in breccia		PYR,SPH,CPY,APY,Au,QTZ	Middleton and Campbell (1979)*
Diorite and andesite intrusions		Veins in ENE tension faults, 2,000 m long, 2.5 m wide		GAL,SPH,TET,TEN,PYGR,PROU,POLY,PEAR,ARG,Au,EL,CIN,PYR,APY,QTZ,RH,BAR,RD,MARC,SID,SER,KAOL	Buchanan (1981), Theune (1978)*
		Quartz veins trend E-W, varying dips		Au,Ag,CGR,TET,QTZ,CALC	Koschmann and Bergendahl (1968), Lincoln (1923), Stoddard and Carpenter (1950), U.S. Bureau of Mines (1900-1984)*
Quaternary andesite and olivine basalt	Silicic, propylitic, argillic, potassium silicate, sericitic	Veins in fault zone, 3,960 m long, 0.9-30 m wide, brecciated quartz veinlets	12.6	Au,ARG,STP,SPH,GAL,PYR,CPY,POLY,PYGR,Ag,COV,CC,ANG,CGR,EL,QTZ,CALC,WUF,GYP,LIM,KAOL	Bonham (1969)*, Buchanan (1981), Koschmann and Bergendahl (1968), Elevatorski (1982), Albers and Kleinhampl (1970), Thompson (1956), Cornwall and others (1967)
15 m.y. rhyolite ignimbrite	Propylitic, argillic, silicic	Quartz veins in fault zones	15	ARG,PYGR,TET,SPH,PYR,CPY,STP,GAL,BOR,Ag,QTZ,BAR,CALC	Buchanan (1981), Nolan (1933), Roberts and others (1971), Elevatorski (1982), Couch and Carpenter (1943)*, U.S. Bureau of Mines (1900-1984)*
Dacite flows and breccias	Potassium silicate, chloritic, silicic, argillic	Vein in N-trending faults, dips 55°-80°, 400 m depth, 9 km long, 4.5 km wide area; some disseminated ore in fluvial sediments	24.6	Au,Ag,TET,TEN,PYGR,PROU,PYR,STIB,SPH,GAL,CPY,HEM,ARG,CC,COV,BOR,QTZ,BAR,FL,CALC,SID,RH,CHL,CHD,AD,SER,SM,KAOL,AL,ANK,AMY,PYL,ALAB	Henderson (1926)*, Vanderwilt (1947)*, N. K. Foley (written commun., 1982), Stevens and Eaton (1975), Robinson and Norman (1984), U.S. Bureau of Mines (1900-1984)*, Buchanan (1981)
Phonolite, syenite, monchiquite, and vogesite dikes	Propylitic, silicic	Veins, sheeted zones, replacements in breccia and along fissures and irregular pipes in mineralized breccia, 914 m depth		CALV,SYL,PETZ,PYR,SPH,GAL,TET,CIN,STIB,MOLY,WOLF,COL,AC,CEL,ROS,HES,JAR,KREN,QTZ,CHD,FL,DOL-ANK,AD,CALC	Boyle (1979), Koschmann and Bergendahl (1968), U.S. Bureau of Mines (1900-1984)*, Elevatorski (1982)*
	Silicic, sericitic, chloritic	9 main, 7 small fracture-filled veins		SPH,GAL,CPY,PYR,QTZ,SER,CHL	Grant (1950), Yamada and others (1980)*
16.2 m.y. quartz porphyry latite flows	Sericitic, argillic, silicic, propylitic, potassium silicate	Quartz veins in fractures and faults, major vein is 122 m long, 6 m wide, oxidized zone 46 m depth	15.5-16.5	Au,Ag,ARG,GAL,SPH,CPY,CIN,PYR,COV,MOLY,POW,CGR,FMO,LIM,PYRM,QTZ,AD,SER,BAR,JAR	Willden and Speed (1974), Bonham and Garside (1974), Buchanan (1981), Albers and Stewart (1972), Silberman and others (1979), U.S. Bureau of Mines (1900-1984)*
Rhyolite	Silicic	Veins trend NNW, over 1,600 m long, 122 m depth, leached to 61-122 m depth		GAL,SPH,CPY	Gonzalez Reyna (1946)*, Farish (1907), Wisser (1966)
	Propylitic, silicic	Veins trend N30°E, dip 40°SE		PYR,Au,Hg,MOLB,TL,AUT,Mn oxides,CGR,Cu-CARB,QTZ,FL,AD,CARB	Nolan (1936)*, Tschanz and Pampeyan (1970)*
Pliocene andesite and basalt	Argillic, silicic	Quartz veins, trend N26°E, dip 66°SE and NW, 0.3-1.8 m wide, in fault zone		Au,Ag,HEM,MAG,GAL,QTZ,KAOL,SER	Willden and Speed (1974), U.S. Bureau of Mines (1900-1984)*
	Silicic	Quartz veins trend N		Au,PYR,QTZ	Levy (1970), Roberts and Irving (1957), Mining Journal (1980)*
	Silicic	Veins trend E-W, dip 70°-90°S		Au,Ag,SPH,GAL,CPY,CHR,PYR,TET,CPY,LIM,QTZ,CALC	Vanderberg (1937), Longwell and others (1965), U.S. Bureau of Mines (1900-1984)*
Granodiorite	Argillic, sericitic, silicic, propylitic	Veins occur in a 400 m x 100 m block oriented NE-SW between two major NW-dipping faults; massive sulfide veins over 10 m wide, 170 m long, 230 m dip length, dip 45°; quartz veins have 2 m width, 150 m strike length, 270 m depth, dip 65°NW		Au,Ag,EN,TET,TEN,CPY,BOR,CC,COV,DIG,GAL,PYR,SPH,QTZ,AL,SCD,JAR,S,LIM,CHC,MACK	Walthier and others (1982)*, Mining Magazine (1982b)
Basalt	Silicic	Veins		PYR,ARG,PYGR,PROU,STIB,SPH,CPY,BOR,MAG,LIM,MAL,QTZ,CALC,Na-FELD,SER,CHL,CHD	Cardenas and Perez (1947)*
Tertiary rhyolite flows and tuffs, shale, and limestone	Silicic, pyritic, argillic	4 veins in fissures, discontinuous lenses of high grade sulfides, low grade impregnations; veins trend N5°E and N10°W, dip 60°W; major vein is over 1,500 m long, 213 m down-dip, and 0.9 m wide; leached to 61 m depth		PYR,SPH,GAL,CPY,Au,TET,ARG,STRM,Ag,FRI,CGR,QTZ,CALC,KAOL	Mishler (1920)*, Buchanan (1981)

Table 1. Location, tonnage, grade, and geologic information for epithermal gold-silver districts—Continued

District	Country	Latitude	Longitude	Tonnage ($x10^6$)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Discovery year	Comments	Basement rocks	Host rocks
Ellendale	USNV	380531N	1164500W	0.017	23.0	185.0	0.18	0.04	---	1909	Prod. (1909-1950)	Precambrian phyllitic shale and siltstone; Paleozoic quartzite, shale, limestone, greenstone	Miocene rhyolite plugs and domes; Oligocene andesite; U. Cretaceous and Tertiary diorite; Paleozoic quartzite, shale, limestone
Eniwa	JAPN	424930N	1411545E	0.101	7.0	50.0	---	---	---		Prod. (1929-1943)		Miocene andesite and rhyolite tuffs and breccias
Eureka (Animas Fork, Gladstone)	USCO	375412N	1073635W	7.2	3.1	50.0	0.24	2.3	2.9	1873	Prod. (1902-1977)	Precambrian quartzite and slate; Devonian and Mississippian limestones; Permian sandstone and shale; Miocene conglomerate and rhyodacite tuff	Miocene rhyodacite, quartz latite flows, breccias, and tuffs
Fairview (Bell)	USNV	391233N	1180916W	1.865	4.4	161.0	---	---	---	1905	Prod. (1906-1950) and reserves (1982)	Crystalline schist, limestone, granite	Miocene andesite flows and tuffs
Farallon Negro-Alto de la Blenda	AGTN	273000S	663000W	1.3	7.4	139.0	---	---	---		14.5% Mn; reserves (1965)	Mica schist, quartzite, granite, monzonite; Eocene sandstone	Andesite, basalt, tuff, and agglomerate
Fuke	JAPN	320815N	1303517E	0.372	10.4	8.3	---	---	---		Prod. (1925-1945) and reserves (1943)		Pliocene augite andesite and rhyolite
Funauchi	JAPN	403130N	1402045E	0.651	0.04	22.0	0.3	2.2	6.3		Prod. (1935-1945) and reserves (1946)		Miocene andesite
Furokura	JAPN	401600N	1405630E	1.5	0.8	30.0	1.7	---	17.5		5.6% pyrite; prod. (1865-1963)		Miocene andesite flows and dikes, rhyodacite flows and dikes, green tuff, and shale
Gilbert (Desert)	USNV	380900N	1174200W	0.0048	33.0	107.0	0.16	0.19	---		Prod. (1924-1944)	Ordovician shale, siltstone, and limestone; Triassic and Jurassic quartz monzonite porphyry; l. Tertiary rhyolite tuff and breccia, shale, siltstone, sandstone, and limestone	15.1 m.y. andesite-dacite flows, rhyodacite intrusions; pre-Tertiary limestone and sedimentary rocks
Gold Circle (Midas)	USNV	411418N	1164720W	0.365	11.0	140.0	0.0001	0.002	---	1907	Prod. (1908-1951)	Paleozoic shaly limestone	Miocene rhyolite and andesite flows and breccias
Gold Hill	USNV	384538N	1170146W	0.027	12.0	65.0	---	---	---		Prod. (1931-1932)		Tertiary rhyolite
Gold Mountain (Kimberly)	USUT	382752N	1122716W	0.545	9.6	30.0	---	---	---	1889	Prod. (1892-1957)	Pre-Tertiary sedimentary rocks, quartz monzonite	Oligocene andesite, dacite, quartz latite breccias and tuffs, quartz latite flows
Golden Arrow	USNV	375847N	1163723W	0.0016	12.0	419.0	0.006	---	---		Prod. (1938-1945)		Tertiary andesite-dacite flow, rhyolite tuff
Goldfield	USNV	374316N	1171252W	14.36	10.5	3.7	0.046	0.0003	---	1902	Prod. (1903-1960) and reserves (1980)	Cambrian shale and quartzite; L. Cretaceous granite and alaskite; Tertiary volcanic ash, gravel, and diatomaceous earth	20.7-21.6 m.y. dacite and andesite flows
Guadalupe y Calvo	MXCO	260400N	1065800W	1.54	40.5	569.0	0.002	0.006	---		Estimated prod. (1836-1982)	Granite	Oligocene(?) andesites, minor rhyolite
Guanacevi	MXCO	255500N	1055500W	6.4	5.1	2,167.0	---	---	---		Estimated prod. (up to 1982)	Mesozoic metamorphic rocks	Tertiary andesite and conglomerate
Guanajuato	MXCO	210100N	1011500W	82.95	1.7	374.0	0.01	0.005	---	1548	Estimated prod. (1701-1979) and reserves (1978)	Triassic schist, shale, limestone, and basalt	Eocene and Oligocene conglomerate; 37 m.y. andesite and rhyolite flows, tuffs, and agglomerates
Hannapah	USNV	380726N	1165507W	0.0015	12.0	1,831.0	---	---	---	1902	Prod. (1908-1949)		U. Oligocene(?) rhyolite flows and pyroclastic rocks
Hart	USCA	351710N	1150550W	0.0075	6.2	3.3	---	---	---	1907	Prod. (1909-1941)		U. Tertiary rhyolite flows, tuffs, and breccias
Hata	JAPN	393500N	1402300E	0.102	3.8	45.5	0.6	4.1	6.5		Prod. (1932-1945) and reserves (1945)		Miocene rhyolite flow and tuff, black shale
Hayden Hill	USCA	405940N	1205237W	0.47	9.96	24.4	---	---	---	1869	Prod. (1874-1948) and reserves (1984)	Mesozoic granodiorite; Permian to Jurassic metavolcanic and minor metasedimentary rocks	Miocene rhyolite tuffs and breccias
High Grade	USCA	415756N	1201130W	0.0308	9.9	5.5	---	---	---	1870	Estimated prod. (1880-1952)	Mesozoic granodiorite; Permian to Jurassic metavolcanic and minor metasedimentary rocks	Miocene rhyolite breccia and andesite flow
Hillsboro (Las Animas)	USNM	325600N	1073000W	0.354	18.9	63.0	0.026	0.006	---	1877	Prod. (1877-1967)		Tertiary andesites and latites
Hiyama	JAPN	372100N	1401100E	0.024	8.7	8.7	0.52	---	---		Estimated prod. (1934-40), reserves (1939)		Tertiary tuff
Hog Heaven (Flathead)	USMT	475525N	1143452W	2.87	0.45	240.0	---	0.06	---	1928	Prod. (1928-1934) and reserves (1984)	Argillite	Porphyritic latite intrusion

Associated rocks	Alteration	Vein morphology	Age m.y.	Minerals	References
Miocene and Pliocene andesite porphyry and dacite porphyry dikes and plugs, andesite flows, basalt	Silicic, sericitic, argillic, propylitic, pyritic	Irregular quartz veins in faults and fissures, trend N55°-65°E, dip 50°SE, and N55°W, 40°NE		Au,PYR,JAR,LIM,QTZ,FELD	Koschmann and Bergendahl (1968), U.S. Bureau of Mines (1900-1984)*, Kleinhampl and Ziony (1984)*
	Silicic, propylitic	Fissure-filled quartz veins; one vein trends N-S, 700 m long, 1 m wide; another vein trends N70°E, 150 m long, 1.5 m wide		Au,ARG,PYR,CALC,QTZ,CHL	Grant (1950), Yamada and others (1980)*
Miocene andesite-rhyodacite flows, breccias, and tuffs	Silicic, sericitic, propylitic	Veins in NE-trending faults, 900 m depth, 0.9-1.5 m wide		Au,Ag,TL,SPH,GAL,CPY,PYR,HEM,TET-TEN,PYGR,PROU,STRM,MOLY,HUB,BOUR,COV,CC,EN,BOR,BIS,QTZ,RD,RH,CALC,FL,BAR,AD,FRI,SER,ANH,GYP,DOL,CHL,EP,CHD,ILL	N. K. Foley (written commun., 1982)*, Burbank and Luedke (1969), U.S. Bureau of Mines (1900-1984)*, Elevatorski (1982)
Miocene rhyolite flows and plug, dacite tuff, andesite dikes	Silicic, sericitic, chloritic	Veins in fissures and in contact between dacite and rhyolite tuff, trend NW, dip 50°-75°SE		ARG,STP,CGR,PYGR,CPY,PYR,TET,GAL,SPH,Au,EL,EMB,BRM,POLY,Ag,STIB,CER,MAL,BOR,COV,QTZ,CALC,PYL,RH,HEM,LIM,AD,FL,CHL,CHD,SER,EP,AGN	Koschmann and Bergendahl (1968), Willden and Speed (1974), Mining Engineering (1982)*, U.S. Bureau of Mines (1900-1984)*
Monzonite, sandstone, and conglomerate		Veins trend N70°W, dip 70°NE, 2 km long, 1 m by 15 m wide		Au,POLY,ARG,GAL,TET-TEN,RD,PYL,MNG,other Mn minerals	Haude and Weber (1975)*
	Propylitic	9 veins mined, up to 600 m long, 0.2-1.0 m wide, 350 m depth		Au,ARG,CPY,PYR,GAL,SPH,EL,HEM,TL,QTZ,CALC,CHL,AD,KAOL,MONT	Grant (1950)*, Taguchi and Hirowatari (1981)
	Propylitic	4 veins trend N-S, two are 500 m long, 50 m wide		GAL,SPH,CPY,PYR,QTZ,CALC,BAR	Grant (1950)*, Yamada and others (1980)*
	Propylitic, silicic	4 vein groups in fissures, trend NNE, E-W, WNW, or N-S, dip steeply N, 300-1,500 m long, 10 cm-5 m wide		CPY,PYR,GAL,SPH,HEM,QTZ,CHL,AD,SER,CALC,CHD,BAR	Grant (1950), Kinoshita (1930), Yamada and others (1980)*
Tertiary olivine basalt		Veins	7.9		Silberman and others (1975), U.S. Bureau of Mines (1900-1984)*
12 m.y. rhyolite welded tuff	Silicic, propylitic, potassium silicate, pyritic	Veins in faults, trend N30°-60° W, dip 65°NE, 0.9-1.5 m wide; oxidized to 46 m depth	15	Au,PYR,STRM,ARG,TET,PROU,CPY,SPH,POLY,PYGR,APY,NAUM,Ag,CGR,LIM,HEM,Mn oxides,QTZ,CHL,SER,AD,CALC	Roberts and others (1971), Koschmann and Bergendahl (1968), Elevatorski (1982), Granger and others (1957), U.S. Bureau of Mines (1900-1984)*
	Silicic	Quartz veins		Au,PYR,ARG,QTZ,CALC	Koschmann and Bergendahl (1968), U.S. Bureau of Mines (1900-1984)*
Rhyolite tuffs	Silicic, propylitic, sericitic,	Quartz veins, 0.9-9 m wide		Au,Ag,MAG,PYR,ARG,TET,Ag-Se,Ag-Te,Fe oxides,Mn oxides,QTZ,CALC,BAR,AD,FL	Callaghan (1973)*, Nolan (1933), Butler and others (1920), Elevatorski (1982), U.S. Bureau of Mines (1900-1984)*
		Veins			Kleinhampl and Ziony (1984), U.S. Bureau of Mines (1900-1984)*
Andesite dikes, rhyolite flows, tuffs, and breccias	Silicic, argillic, propylitic, pyritic, advanced argillic	Quartz-alunite veins fill fractures, faults, and breccias in silicified and argillized zones	20.7	Au,PYR,BIS,GDF,FAM,MARC,TET-TEN,SYL,SPH,MOLY(?),ANG(?),LIM,JAR,AL,WUF(?),POW(?),KAOL,QTZ	Albers and Kleinhampl (1970), Albers and Stewart (1972)*, Ashley (1974, 1979), Engineering & Mining Journal (1980)
Basalt and rhyolite		Veins trend NW, up to 20 m wide		PYR,Au,Ag,GAL,SPH,CPY,ARG,QTZ,CHL,JAS	Weed (1902), Clark and others (1979), Buchanan (1981), Gonzalez Reyna (1946)*, Elevatorski (1982)*
Andesite dikes and flows		Veins trend NNW		ARG,STP,PYGR,PYR,EL,TET,BOR,GAL,SPH,CPY,TEN,MARC,PROU,FL,RH,AD,QTZ,CALC,BAR,RD	Clark and others (1979), Consejo de Recursos (1972)*, Buchanan (1981), Elevatorski (1982)*
	Propylitic, potassium silicate, phyllic, argillic	Veins and stockwork in NW-trending faults; area 22 km long, 9 km wide, 700 m deep		Au,Ag,TET,TEN,SPH,GAL,CPY,PYR,PO,CIN,HEM,NAUM,POLY,PYGR,AGU,ANT,EL,ARG,AC,STP,APY,MARC,MOLY,STIB,GUAN,RAUM,EMB,CGR,PSL,AMY,QTZ,CHD,VAL,SAP,CHL,ANK,CALC,DOL,RH,SID,BAR,CEL,GYP,LIM,FL	N. K. Foley (written commun., 1982)*, Buchanan (1981), Wandke and Martinez (1928), Busch (1980)*
	Silicic, argillic	Quartz veins		PYR,POLY,CGR,STP,ARG,Au,Ag,QTZ,JAS	Nolan (1936)*, Kral (1951), Lincoln (1923), U.S. Bureau of Mines (1900-1984)*
	Silicic	Quartz veins and breccias, 0.3-0.9 m thick		Au,PYR,QTZ,CHL	Elevatorski (1982)*, Clark (1970), U.S. Bureau of Mines (1900-1984)*
Miocene andesite	Propylitic	Fracture-filled veins in NW- and NE-trending fractures		Au,ARG,CPY,SPH,GAL,QTZ,BAR	Grant (1950)*, Yamada and others (1980)*
Pliocene basalt	Silicic, argillic	Veins in shear zones trend N68°W and N38°E, dip 60°-80°N, up to 244 m long, 244 m depth, 7.6 m wide; breccias and stockworks are in N-trending structures	8.3	Au,EL,STP,Ag,PYR,Fe oxides,PYL,AC,QTZ,AD,KAOL,Mn oxides	Koschmann and Bergendahl (1968), Hill (1915), Elevatorski (1982), Finn and Buchanan (1984), Buchanan (1981)*, Skillings' Mining Review (1984)*
Pliocene basalt	Silicic, potassium silicate	Quartz-adularia veins and replacement of the wallrock in fissures trending N60°W, dip 70°-75°S, up to 1.5 m wide, 152 m long, 46 m depth		Au,EL,PYR,Mn oxides,CHR,LIM,MAL,QTZ,AD	Koschmann and Bergendahl (1968), Elevatorski (1982)*, U.S. Bureau of Mines (1900-1984)*, Averill (1936), Hill (1915)
Quartz monzonite intrusions	Pyritic, argillic, silicic, chloritic, sericitic	0.6-2.4 m wide veins in shear zone		PYR,Au,Ag,CPY,BOR,MOLY,QTZ,KAOL,CALC	Howard (1967), Elevatorski (1982), Koschmann and Bergendahl (1968), U.S. Bureau of Mines (1900-1984)*
		Fracture-filled sulfide veins		CPY,PYR,QTZ	Grant (1950)*
Latite and trachyte tuffs and agglomerates, andesite flows and intrusions	Silicic, alunitic	N-trending orebody in irregular fractures; elliptical shape, 46 m x 122 m		PYR,GAL,MAT,EN,ARG,COV,MARC,Ag,ANG,MEL,MAL,CGR,BAR,QTZ,AL,KAOL,JAR,BEID	Shenon (1935)*, Engineering and Mining Journal (1984a)*

Table 1. Location, tonnage, grade, and geologic information for epithermal gold-silver districts—Continued

District	Country	Latitude	Longitude	Tonnage (x10^6)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Discovery year	Comments	Basement rocks	Host rocks
Hokuryu	JAPN	443230N	1424900E	0.61	5.7	20.3	---	---	---		Estimated prod. (1928-1942) and reserves (1942)	Cretaceous metamorphic rocks	Miocene rhyolite and andesite flows
Holy Cross	USNV	390800N	1184000W	0.0017	5.1	1,324.0	0.017	0.89	0.008	1911	Prod. (1934-1965)	Cretaceous granodiorite	U. Miocene and l. Pliocene rhyolite tuffs
Hosokura	JAPN	384830N	1405400E	14.4	0.2	36.7	---	1.5	4.1		9.7% pyrite; prod. (1848-1977)	Mesozoic granodiorite; Tertiary green tuff, shale, conglomerate, and pumice	Miocene rhyolite flows, tuff-breccias, andesite flows, tuffs
Hostotipaquilla	MXCO	210500N	1040500W	1.084	3.2	476.0	---	---	---	1824	Prod. (1922-1928)	Cretaceous sedimentary rocks	Miocene andesite flows and breccias; Pliocene rhyolite
Huayelon	AGTN	383200S	0703549W	0.012	---	235.0	---	17.0	3.0		Prod. (1927-1932) and reserves (1962)	Mesozoic lutite	Tertiary andesite porphyry
Innai	JAPN	390318N	1402153E	0.083	3.0	371.0	---	---	---		Estimated prod. (1931-1945) and reserves (1945)		Pliocene rhyolite and sedimentary rocks
Iwato	JAPN	311630N	1301900E	0.311	8.3	11.0	---	---	---		Prod. (1939-1974)	Mesozoic sandstone, claystone, diabase	Miocene andesite tuff
Jarbidge	USNV	415219N	1152547W	0.59	12.0	43.0	---	---	---	1909	Prod. (1910-1950)	Cambrian quartzite; Paleozoic limestone	16.8-15.4 m.y. rhyolite and rhyodacite flows and intrusions
Julcani	PERU	125800S	0744830W	4.0	0.45	600.0	0.2	1.5	---	1790	Prod. (1957-1972) and reserves (1973)	L. Paleozoic shale, phyllite, and sandstone; Permian red beds; Triassic and Jurassic limestone; L. Cretaceous sandstone and shale, L. Cretaceous limestone	10 m.y. rhyodacite and dacite pyroclastic rocks and flows
Jyokoku	JAPN	413945N	1400315E	2.76	---	55.0	---	0.5	1.3		0.1% Mn; prod. (1941-1974)		Miocene andesite breccia
Kasuga	JAPN	311600N	1301545E	1.96	3.6	1.4	---	---	---		Estimated prod. (1929-1943) and reserves (1945)	Mesozoic metasedimentary rocks	Pliocene andesite tuff, tuff breccia, and tuffaceous shale
Kata	PERU	151800S	710030W	0.1	---	75.0	---	7.0	6.0		Reserves (1956)	Paleozoic sandstone, shale and limestone; Jurassic and Cretaceous red beds, salt, and gypsum	Tertiary porphyritic andesite flows
Katherine	USAZ	351330N	1142713W	0.64	6.2	15.0	---	---	---	1865	Prod. (1868-1943)	Precambrian granitic rocks, gneiss, and schist	M. Tertiary rhyolite flows and rhyolite porphyry dikes
Kawaguchi	JAPN	392903N	1404245E	0.03	0.3	250.0	3.0	10.0	10.0		Prod. (1914-1956)		Miocene rhyolite
Kawasaki	JAPN	381300N	1403600E	0.074	0.17	29.0	3.12	---	---		Estimated prod. (1937-45), reserves (1945)	Mesozoic granitic rocks	Tertiary rhyolite
Kidogasawa	JAPN	364750N	1394200E	1.89	---	4.9	1.4	---	0.5		Prod. (1940-1974)		Miocene rhyolite tuff, tuff breccia
Kitami-Inaushi	JAPN	440130N	1431700E	0.59	---	38.0	0.8	1.5	2.5		9.1% pyrite; prod. (1934-1964)		Miocene shale and andesite tuff; Mesozoic rocks
Kitanoo	JAPN	435500N	1433415E	3.2	2.4	2.9	---	---	---		Estimated prod. (1924-1943) and reserves (1945)		Miocene rhyolite
Klondike (Klondyke)	USNV	375433N	1171158W	0.014	4.8	727.0	0.015	0.97	---	1899	Prod. (1908-1953)	M. and U. Cambrian limestone	M. and U. Cambrian limestone; Tertiary rhyolite and rhyodacite dikes; Cretaceous granitic intrusion
Kofa	USAZ	331623N	1135804W	0.612	5.4	12.0	0.0005	0.0002	---	1896	Prod. (1897-1957)		Miocene andesite porphyry
Konomai	JAPN	440900N	1432030E	12.4	5.9	106.0	0.14	---	---	1914	1.27-1.29% S; estimated prod. (1917-1975)	Jurassic metamorphic rocks	Miocene rhyolite and andesite
Koyama	JAPN	382822N	1400748E	0.39	8.4	6.1	1.0	---	---		2% pyrite; prod. (since 1932)		Miocene volcanic rocks
Kushikino-Arakawa	JAPN	314515N	1301800E	10.1	3.4	32.0	0.06	0.02	0.12	1660	0.05-0.14% Mn, 2.6-2.7% Fe, 0.16-0.28% S; estimated prod. (1914-1943) and reserves (1943)	L. Cretaceous sandstone and shale(?)	18.3-8.2 m.y. andesites, agglomerates
La Concordia	AGTN	240953S	0662650W	0.029	---	1,300.0	1.7	9.6	4.7		Prod. and reserves (no dates available)	Precambrian phyllite	Miocene and Pliocene dacite flows and breccias
La Estancia-Nueva Carolina	AGTN	324925S	0660834W	0.004	4.6	199.0	---	9.8	12.4		Reserves (1962)	Schist	Tertiary andesite intrusions; pre-Tertiary schist
La Libertad	MXCO	234900N	1054000W	0.17	0.8	400.0	---	---	---	1930s	Prod. (1930s) and reserves (1975)	Mesozoic diorite porphyry, granodiorite	L. Tertiary rhyolite and dacite
Lake City (Galena, Lake Fork)	USCO	380100N	1072000W	0.81	2.7	223.0	0.17	5.7	0.09	1871	Prod. (1875-1968)	Precambrian metavolcanic and metasedimentary rocks; Paleozoic and Mesozoic limestone, shale, sandstone; 35-30 m.y. alkali andesite, rhyodacite, and quartz latite flows, volcaniclastic mudflows, breccias, conglomerate, rhyodacite-andesite dikes	28.4-27.8 m.y. rhyolite, quartz latite flows and tuffs; 25.7 m.y. quartz monzonite; latite intrusions

Associated rocks	Alteration	Vein morphology	Age m.y.	Minerals	References
Rhyolite, andesite flows and tuffs, sandstone, conglomerate	Silicic, argillic	2 fracture-filled veins in NE- and E-trending fissures		Au,ARG,PYR,QTZ,CALC,BAR,KAOL	Grant (1950)*, Yamada and others (1980)
Dacite intrusions, flows, and basalt	Silicic, pyritic	Quartz veins		Au,Ag,GAL,SPH,CPY,Mn oxides,Fe oxides,QTZ	Willden and Speed (1974), U.S. Bureau of Mines (1900-1984)*
	Propylitic, sericitic, silicic, argillic,	Quartz veins, 700-2,200 m long, 1.1-1.6 m wide, 60-200 m depth, trend N, NE, and NW, dip 65°-80° W and 70°E; breccia zones and fissures		PYR,ARG,GAL,SPH,CPY,BOR,TET-TEN, PYGR,POLY,HEM,WUR,STIB,PO,HMM,ARG, SMTH,CER,JAM,PYRM,BAR,QTZ,CALC,FL, Fe-CHL,SER,KAOL,MONT,GYP,K-FELD	Urabe (1977), Tsuboya (1972), Yamada and others (1980)*, Grant (1950), Imai (1978), Shikanozo (1985)
Pleistocene basalt, rhyolite flows, rhyolite and dacite dikes		Quartz veins trend N45°W, dip 60°-70°SW, in faults		PYR,ARG,GAL,SPH,CPY,Sn,EL,Au,QTZ, CALC	Rivera and Vasquez (1963)
		9 veins, trend E-W, dip N, 1,440 m long, 1 m wide; breccia and banded structure in fractures		GAL,SPH,PYR,CPY,CALC,SID,QTZ	Angelelli and others (1970)*
	Propylitic	10 veins; main one is 1,200 m long; others 200 m long; 100-300 m depth		ARG,PYGR,STP,GAL,SPH,QTZ,CALC,RH, RD	Grant (1950)*, Shikanozo (1985)
Quaternary ash	Silicic, argillic, propylitic	Veins in N60°E fissures, 2,000 m long; some veins and pipes are brecciated	4.15	Au,ARG,CPY,PYR,CUB,HEM,GOE,QTZ, CALC,AL,KAOL	Yamada and others (1980)*, Grant (1950), Urashima and others (1981)
	Silicic, argillic, potassium silicate	Veins in fault zones, cavities, replacements of wallrock; W zone strikes NNW, dips steeply E; E zone strikes N; veins up to 914 m long, 0.3-9 m wide; oxide zone to depth of 244 m	14	Au,Ag,EL,ARG,CGR,NAUM,PYR,HEM, MARC,LIM,LEV,PSL,PYL,CPY,PYGR, PETZ,QTZ,AD,AP,BAR,CALC,CHD,CHL, EP,FL,HYA,KAOL,HAL,SER,TALC	Granger and others (1957), Nolan (1936), Roberts and others (1971), Koschmann and Bergendahl (1968), U.S. Bureau of Mines (1900-1984)*, R. R. Coats (oral commun., 1980)
Dacite and andesite dikes	Sericitic, argillic, pyritic, propylitic, advanced argillic	Veins in NW- and NE-trending fault zones, dip NE-SE, 450 m vertical extent; 5 x 3 km area	9.9-9.3	PYR,MARC,GAL,SPH,CPY,BISM,WOLF, TET,TEN,STRM,EN,SEM,ANR,ARM,BOUR, Au,APY,STIB,QTZ,BAR,SID,CALC,AP, ANK,KAOL,AL	Goudarzi (1973a), Foley (1984), Buchanan (1981)
Miocene andesite and quartz porphyry	Propylitic	Veins trend N30°-40°W		RH,SID,DOL	Yamada and others (1980)*, Shikanozo (1985)
	Silicic, argillic, propylitic, advanced argillic	Stockwork of quartz veins and stringers in silicified zone, 200 m long, 130 m wide, 100 m depth, NE- and E-trending fissures		EN,Au,CPY,PYR,EL,S,LUZ-FAM,BER, LIM,QTZ,CALC,AL,KAOL,DIA,DIC,CHL, ALB	Boyle (1979), Grant (1950)*, Yamada and others (1980), Tokunaga (1955)
Porphyry intrusion	Silicic, argillic	Veins 300 m long, 400 m depth, 1 m wide, trend N55°W, dip 90°; massive lenses 1 m wide with disseminations and veinlets		GAL,SPH,CPY,Ag,PYR,QTZ,RH	Shaffer (1973b)*
	Silicic, argillic	Veins and stringers in faults, 3 m wide		Au,EL,PYR,MARC,GAL,SPH,WUF,HEM, CPY,CC,PYL,PSL,GYP,LIM,CHR,QTZ, CALC,AD,FL,KAOL,ASB,CHL,SER	Lausen (1931), Buchanan (1981), Elevatorski (1982), Keith and others (1983)*
	Sericitic, argillic	Veins in N-trending faults			Yamada and others (1980)*
		Sulfide vein		CPY,PYR,ARG,QTZ	Grant (1950)*
Miocene sandstone, conglomerate, dacite	Silicic, sericitic, chloritic	Vein, 350 m long, 0.7 m wide		CPY,SPH,QTZ,SER,CHL	Yamada and others (1980)*
Pliocene basalt	Chloritic, sericitic, silicic, argillic	Veins trend N-S to E-W, E-trending fractures dominate; veins range from 200-900 m long, 0.6-1 m wide		CPY,SPH,GAL,PYR,QTZ,SER,HEM,CHL, MONT,CALC	Yamada and others (1980)*, Shikanozo (1985)
Shale, sandstone	Silicic, potassium silicate	Fissure-filled veins trend NE, ENE, and WNW; veins range from 50-200 m long, 0.3-1 m wide		Au,PYR,CIN,QTZ,AD	Grant (1950)*, Yamada and others (1980)
	Silicic		10.5	Au,Ag,GAL,CER,QTZ,SID,CALC,HEM,WAD	Albers and Stewart (1972), Lincoln (1923)*, U.S. Bureau of Mines (1900-1984)*
Rhyolite, olivine basalt	Silicic	Stringers, 3.7 m wide veins, breccias in wide shear zone		Au,PYR,GAL,CPY,QTZ,CALC,AD	Nolan (1936), Elevatorski (1982), Koschmann and Bergendahl (1968), Keith and others (1983)*
Rhyolite, basalt, sandstone, shale, tuffaceous sandstone	Silicic, argillic, potassium silicate	Fissure-filled quartz veins trend ENE and WNW; veins range from 250-2,100 m long, 3.3-200 m wide		Au,ARG,PROU,PYGR,PYR,CPY,SPH,MARC, QTZ,CALC,AD,KAOL,SER,SM	Yamada and others (1980)*, Grant (1950, 1951), Furukawa (1982)*, Shikanozo (1985)
Miocene rhyolite	Silicic, argillic, propylitic, sericitic	Veins in NW-trending faults; veins range from 40-150 m long, 2-40 m wide		PYR,Au,CPY,QTZ,SER,CHL,KAOL,MONT, SID	Yamada and others (1980)*, Shikanozo (1985)
Miocene andesite and tuff; Pliocene rhyolite and tuff; Pleistocene andesite	Silicic, sericitic, propylitic, argillic	NE- and NNE-trending fissure-filled anastomosing series of quartz veins; veins 2,500 m long, 5 m wide, and 900 m long, 1.7 m wide, 450 m depth	4	PYR,EL,Au,CPY,MARC,SPH,GAL,AC,STP, PYGR,POLY,NAUM,TET,ARG,QTZ,AD,CHL, CALC,MONT,SER,GYR,LAUM,CHM,SM-SAP, K-FELD	Yamada and others (1980), Izawa and others (1981), Motomura and others (1981), Grant (1950)*, Boyle (1979), Shikanozo (1985)
Miocene and Pliocene dacite tuff and agglomerate		Breccia trends N40°-70°W, dips 60°SW-90°; irregular; ore shoots 100 m long		GAL,SPH,TET,PYR,CPY,QTZ	Angelelli and others (1970)*
		Veins in fractures, trend E-W, dip 80°S, 300 m long, 0.3 m wide		GAL,SPH,PYR,QTZ	Angelelli and others (1970)*
U. Oligocene(?) andesite, red beds, and ash flows	Argillic	Veins trend NE-N, dip 70°W, 1.4-10 m wide, 170 m depth; oxide zone 40 m depth		ARG,Au,PYR,LIM,QTZ,CALC,CLAY	Clark and others (1979), Haptonstall (1980)*
26 m.y. quartz latite plug; 22.5 m.y. quartz latite plugs and dikes, granite porphyry dikes and plugs; 18.5 m.y. rhyolite porphyry intrusions	Sericitic, argillic, propylitic	Veins in ring, radial, and transverse faults on N, NE, and E margin of caldera; veins range from 0.5-1.5 m wide, 2,000 long, dip >60°	22.5	PYR,SPH,GAL,CPY,TET,TEN,APY,HEM, Au,EPL,MAG,EL,PEAR,POLY,PROU,PYGR, BOUR,BOUL,BIS,WUR,AIK,MAT,AC,JAM, SCH,STP,CLS,EN-LUZ,CST,MARC,MAW, Te,PETZ,HES,KREN,SYL,BOR,COV,PTC, COL,WEH,MEL,ALT,CALV,AGU,VOL,TLB, QTZ,RH,CALC,SER,ANK,DOL,CHD,FL, ANH,PXM,BAR,KAOL,DIC,AL,HINS	Slack (1980), Koschmann and Bergendahl (1968), U.S. Bureau of Mines (1900-1984)*

Table 1. Location, tonnage, grade, and geologic information for epithermal gold-silver districts—Continued

District	Country	Latitude	Longitude	Tonnage ($x10^6$)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Discovery year	Comments	Basement rocks	Host rocks
Las Caracahs	AGTN	284900S	0622400W	0.013	---	600.0	---	13.0	---		Reserves (no date)		Tertiary andesite and dacite
Los Mantiales	AGTN	420600N	0690000W	0.024	---	11.0	---	6.0	9.0		Reserves (1964)	Paleozoic slate, phyllite, limestone, latite, and igneous intrusions; Jurassic andesite, tuffs, and breccias; L. Cretaceous limestone and marl; U. Cretaceous red sandstone	Eocene andesite
Madrigal	PERU	153500S	0712200W	2.34	---	110.0	1.97	2.8	4.9		Prod. (1972-1977) and reserves (1977)	Jurassic and Cretaceous red beds, gypsum, and salt	Cretaceous and Tertiary pyroclastic rocks
Mamuro	JAPN	385250N	1401739E	0.126	3.8	44.0	---	---	---		Estimated prod. (1937-1942), reserves (1941)		Tertiary andesite
Masbate (Aroroy)	PLPN	122100N	1233200E	17.4	2.4	3.4	---	---	---	1500s	Estimated prod. (1914-1976) and reserves (1982)	Pre-Eocene sedimentary rocks	Eocene to Pliocene andesite flows
Masonic	USCA	382159N	1190717W	0.14	12.0	74.0	0.02	---	---		Estimated prod. (1907-1913)	Metamorphic and granitic rocks	12.8 m.y. andesite-dacite breccia, rhyodacite-rhyolite intrusions; metamorphic and granitic rocks
Mikawa	JAPN	374635N	1392720E	0.86	1.0	23.8	0.6	0.3	1.5		Prod. (1932-1961)	Carboniferous limestone; Cretaceous granite	Miocene rhyolite, tuff, andesite, shale, mudstone, conglomerate
Minamizawa	JAPN	380810N	1401150E	0.041	5.7	32.0	0.34	5.1	10.9	1600s	Estimated prod. (1938-1945), reserves (1945)		Miocene green tuff
Mizobe	JAPN	332658N	1305742E	0.221	3.0	11.1	---	---	---		Estimated prod. (1938-1943) and reserves (1942)	Paleozoic schist and phyllite; U. Cretaceous and L. Tertiary granitic rocks	Tertiary andesite
Mochikoshi	JAPN	345234N	1385144E	2.03	3.6	52.0	---	---	---		Estimated prod. (1928-1943) and reserves (1943)		Miocene andesite tuff, sandstone, shale; Pliocene dacite
Mogollon	USNM	332400N	1084800W	1.94	5.8	326.0	0.03	0.0005	---	1875	Estimated prod. (1879--1959)	Precambrian granite, gneiss, schist, and quartzite; Cretaceous conglomerate, sandstone, quartzite, shale, latite, and andesite; Eocene(?) sandstone and shale	25 m.y. andesite and rhyolite
Mohave (Mojave, Rosamond)	USCA	345900N	1181130W	1.814	10.3	41.0	---	---	---	1894	Estimated prod. (1894--1952)	Mesozoic quartz monzonite	Oligocene and Miocene rhyolite porphyry and quartz latite porphyry
Monitor-Mogul	USCA	384000N	1194216W	1.663	2.5	49.0	0.0007	0.004	0.005	1857	As much as 0.1% Mo; estimated prod. (1862-1968) and reserves (1981)	Cretaceous granite and quartz monzonite	4.9 m.y. rhyolite intrusion, andesite-dacite flows
Montana Mountain	CNYT	600125N	1343740W	0.109	7.5	233.0	---	---	---	1900	Reserves (1980)		Cretaceous andesite; 65 m.y. quartz monzonite
Motokura	JAPN	444100N	1422800E	0.15	0.2	99.4	1.0	12.4	8.6		16.4% pyrite; prod. (1958-1967)		Miocene andesite
Muka	JAPN	434800N	1433330E	0.026	8.4	42.6	---	---	---		Prod. (1933-1943)		Miocene rhyolite, rhyolite tuff, shale
Nagamatsu	JAPN	392131N	1404845E	1.43	0.06	31.5	0.83	---	---		Estimated prod. (1925--1945) and reserves (1945)		Miocene andesite, shale
Namariyama	JAPN	402615N	1405045E	0.35	0.9	23.5	1.4	1.1	5.7		Prod. (1952-1974)		Miocene quartz porphyry
Namiquipa	MXCO	291500N	1072400W	0.9	---	448.0	---	3.4	5.0		Estimated prod. (1922--1955)		Tertiary andesite flows
National	USNV	414746N	1173205W	0.079	69.6	183.0	0.002	0.008	---	1907	Prod. (1909-1962)	Triassic and Jurassic slate, siltstone, and quartzite	20.2 m.y. quartz latite flows; 18-14 m.y. rhyolite flows, tuffs, breccias and dikes; andesite, basalt, and dacite flows and tuffs
Nawaji	JAPN	344508N	1385840E	0.402	6.5	105.0	---	---	---		Estimated prod. (1925-1945), reserves (1943)		Miocene andesite, tuff, rhyolite
Nebazawa	JAPN	365206N	1391950E	0.167	2.9	206.0	---	---	---		Prod. (1942-1974)	Cretaceous sandstone and shale; metabasic rocks	Paleogene rhyolite welded tuff
Nikko (Tochigi)	JAPN	364640N	1394920E	1.15	0.1	6.6	1.14	---	---		Prod. (1908-1950)		Miocene rhyolite; Cretaceous quartz porphyry
Nogal	USNM	333138N	1054444W	0.043	11.0	44.0	---	7.1	0.4	1868	0.01% Mo; estimated prod. (1882-1959)	Permian shale, sandstone, mudstone, conglomerate, limestone, and gypsum; Triassic sandstone, shale, conglomerate, and limestone; Cretaceous sandstone, shale, and limestone	Miocene andesite flows and tuffs; monzonite porphyry
North Santiam River	USOR	445100W	1221500W	0.183	6.9	21.3	0.9	1.0	4.3	1896-1897	0.18% Mn; estimated prod. (1897-1947) and reserves (1951)	Eocene rhyolite and marine sandstone	17.6-15.9 m.y. andesite flow, tuff, and breccia, rhyolite flow and dikes; 11 m.y. quartz diorite
Numanoue	JAPN	441045N	1432600E	0.072	15.8	1,128.0	---	---	---		Prod. (1923-1959)		Miocene rhyolite

Associated rocks	Alteration	Vein morphology	Age m.y.	Minerals	References
		Veins trend N30°-60°W, dip 55°-80°NE, 35-40 m long, 50 m depth, 0.3-0.4 m wide		GAL,SPH,PYR,ANG,CER,LIM,QTZ,BAR	Angelelli and others (1970)*
Eocene tuff, basalt, granite-tonalite dikes; Quaternary basalt	Sericitic, propylitic	3 veins in 2 sets of fractures, trend N55°E, dip 76°W and N85°E, dip 90°; vein 500 m long, 2 m thick, lenticular shape		GAL,SPH,CPY,PYR,BOR,HEM,CC,MAL, LIM,QTZ,SER,CHL	Angelelli and others (1970)*, Miller and Singewald (1919)
		Veins		CPY,GAL,SPH	Goudarzi (1972b)*
	Propylitic	Fissure-filled vein		Au,ARG,QTZ,CALC,RH	Grant (1950)*
Tuffaceous agglomerates	Silicic, argillic	Quartz veins, 1 km long, 3-30 m wide, in NW-trending, steeply dipping faults, 213 m depth		PYR,Au,Ag,Mn oxide,Fe oxide,QTZ, CALC	Mitke (1939), Mining Magazine (1982a)*
	Propylitic, argillic, alunitic, silicic	Brecciated veins in NE-trending fractures and faults, up to 46 m depth, dip 70°-90°, 1.2-8 m thick veins		Au,GAL,ARG,BOR,CPY,PYR,FAM-EN,HEM, STIB,BIS,CIN,TL,S,Ag,SEL,LIM,MAL, CHR,MEL,JAR,SCD,GYP,CHD,OPAL,BAR, AL	Clark (1970), Eakle and McLaughlin (1919)*, Kleinhampl and others (1975), Rowan and Purdy (1980), R. F. Johnson (written commun., 1951)
Trachyte	Silicic, sericitic, chloritic	Fissure-filled veins trend WNW, 830 m long, 1.65 m wide, 300 m depth		Au,CPY,GAL,SPH,PYR,HEM,MARC,ARG, POLY,MAG,QTZ,CALC,KAOL,AD,SER,CHL, ANK-DOL,SID,BAR,K-FELD	Grant (1950), Nagasawa (1953), Yamada and others (1980)*, Imai (1978), Shikanozo (1985)
	Silicic	44 fissure-filled veins; main vein 80 m long, 0.5 m wide		PYR,CPY,GAL,SPH,QTZ	Yamada and others (1980)*, Grant (1950)
	Propylitic, argillic	7 fissure-filled veins		Au,ARG,PYR,STIB,QTZ,CALC,CLAY,AD	Grant (1950)*, Nishiwaki and others (1971)
Neogene volcanic rocks	Propylitic, silicic	Fissure-filled vein, 1,900 m long, 3 m wide, trend WNW		Au,ARG,PYR,SPH,QTZ,AD,CALC,LAUM	Grant (1950)*, Yamada and others (1980), Shikanozo (1985)
Miocene and Pliocene latite, basalt, basaltic andesite		Quartz veins and stringers in fault zones, 0.9-3.7 m wide veins	18-17	Au,Ag,PYR,CPY,BOR,CC,SPH,GAL,STRM, TET,ARG,LIM,AZ,MAL,CHR,CGR,CALC, QTZ,FL,AD,CHD,RH,CHL	Koschmann and Bergendahl (1968), Elston and others (1973), Ratte and others (1984), Elevatorski (1982)*, Ferguson (1927)*
	Silicic, advanced argillic	Steeply dipping quartz veins in brecciated and sheared zones; ore shoots are 61 m long, 12 m wide, 305 m depth; veins are 3-9 m wide		Au,ARG,CGR,PYGR,PROU,EL,PYR,CPY, MARC,SPH,QTZ,CALC,Mn oxide,GAL, Fe oxide,APY,KAOL,AL	Koschmann and Bergendahl (1968), Elevatorski (1982)*, Dibblee (1980), Clark (1970)
Pliocene andesite tuffs; 11-9.5 m.y. andesite flows, flow breccias, lahars, and intrusions	Silicic, argillic, propylitic, potassium silicate, advanced argillic	Disseminations, seams, veins, and tabular orebodies in fractures and shear zones	5	PYR,Au,ARG,EN,SPH,GAL,PCGR,POLY, STP,PYGR,TET,FAM,CIN,REAL,APY,CC, STRM,PYL,Ag,GDF,RH,HUB,KAOL,QTZ, AD,SER,HEM,BAR	Clark (1977), Elevatorski (1982)*, Silberman and others (1976), Morton and Silberman (1977), Rowan and Purdy (1980), D. A. John (written commun., 1984), Benedict and others (1981)
	Silicic, argillic, pyritic, propylitic	Vein, 1,000 m long, 0.3-2 m thick		PYR,APY,GAL,SPH,QTZ	Morin (1982)*
Miocene granitic rocks; Pliocene rhyolite; Pleistocene basaltic andesite	Propylitic	Veins in NE-trending fissures, range from 50-100 m long, 1-5.2 m wide		Au,CPY,GAL,SPH,PYR,QTZ,CHL	Yamada and others (1980)*
	Potassium silicate	3 fissure-filled veins trend N45°E, 100 m long, 1 m wide		Au,ARG,QTZ,CALC,AD	Grant (1950), Nishiwaki and others (1971), Yamada and others (1980)*
Miocene granodiorite; Tertiary granite	Propylitic	2 groups of NW-trending fissure-filled veins, 180 m long, 0.1 m wide		CPY,GAL,SPH,QTZ,BAR	Yamada and others (1980), Grant (1950)*
Miocene dolerite		N-NE-trending fissure-filled veins, 350 m long, 0.35 m wide		CPY,GAL,SPH,QTZ	Yamada and others (1980)*
Tertiary andesite tuff, rhyolite	Silicic	Steep dipping quartz veins, brecciated; oxidized zone 100 m depth		PYR,SPH,GAL,CPY,LIM,CER,ANG,WUF, Ag,CER,QTZ,FL,CHD,BAR	Shefelbine (1957)*
Miocene quartz latite flows, rhyolite flows and breccias	Propylitic, silicic, argillic, advanced argillic	Fissure veins, trend N25°W-N15°E, dip 50°-80°W, 0.6-1.5 m wide, up to 1,523 m long, up to 213 m depth; banded ore, massive, vuggy aggregates, and fills breccia matrices	15.6	Au,STIB,PYR,MARC,EL,PYGR,CIN,APY, CPY,SPH,GAL,BOR,STP,As,CGR,OR, REAL,LIM,POLY,MIG,PO,TET,NAUM,BER, HEM,GOE,AC,CGR,AD,CALC,SER,QTZ, KAOL,HAL,CHD	Willden (1964), Nolan (1933), Buchanan (1981), Roberts and others (1971), Koschmann and Bergendahl (1968), U.S. Bureau of Mines (1900-1984)*, Vikre (1985)
	Propylitic	12 fissure-filled veins		Au,ARG,CPY,PROU,GAL,QTZ,CALC	Grant (1950)*
Miocene rhyolite tuff, mudstone, conglomerate, rhyolite dikes	Silicic, sericitic, potassium silicate	8 fissure-filled veins, trend N70°-85°E, dip 70°-85°S, 50-1,800 m long, 70-300 m depth, 0.6-3 m wide	5.7-5.0	CPY,PYR,SPH,GAL,EL,ARG,PYGR,TET, STP,HEM,QTZ,AD,CALC,ALB,SER,CHL	Yamada and others (1980)*, Ochiai (1981), Nakano (1981)
	Chloritic, sericitic	2 groups of fissure-filled veins trend N to N5°E, 320 m long, 0.25 m wide, 300 m long and 0.25 m wide		CPY,PYR,QTZ,SER,CHL	Yamada and others (1980)*, Grant (1950)*
Tertiary diorite porphyry	Silicic, argillic	Breccia pipe, stringers and disseminations		Au,PYR,GAL,SPH,MOLY,LIM,TUR,CGR, QTZ,DOL,CALC,KAOL	Koschmann and Bergendahl (1968), Griswold (1959), Elevatorski (1982)*
13.4 m.y. granodiorite	Sericitic, silicic, argillic, propylitic	Veins trend NW, dip 40°SW to 45°NE, up to 122 m long, 5 cm to 4 m wide; in fracture zones	11	Au,CPY,SPH,GAL,PYR,SPEC,Bi,S,LIM, MAL,AZ,CHR,Mn oxide,CALC,SER,QTZ, ANK,AD,EP	Oregon Dept. of Geology (1951)*, Brooks and Ramp (1968), U.S. Bureau of Mines (1900-1984)*
	Silicic, potassium silicate	12 fissure-filled veins; one NE-trending vein is 400 m long, 1.5 m wide; one E-trending vein is 200 m long, 4.5 m wide		Au,ARG,PYR,PROU,QTZ,AD,CALC	Grant (1950), Yamada and others (1980)*

Table 1. Location, tonnage, grade, and geologic information for epithermal gold-silver districts—Continued

District	Country	Latitude	Longitude	Tonnage ($x10^6$)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Discovery year	Comments	Basement rocks	Host rocks
Oatman	USAZ	350130N	1142400W	3.69	16.5	9.7	0.0007	---	---	1863	Prod. (1870-1980)	Precambrian granite, gneiss, and schist; l. Miocene trachyte tuff, quartz latite flows, breccias, carbonaceous shale, and limestone; 22.6 m.y. granite	M. Miocene latitic andesite flows, tuffs, and flow breccias
Odomori	JAPN	385300N	1405500E	0.104	---	44.0	---	2.2	8.3		Estimated prod. (1937-1945), reserves (1945)		Tertiary andesite
Ogane	JAPN	424508N	1402230E	0.476	4.2	93.6	---	---	---		Estimated prod. (1930-1943) and reserves (1943)	Permian and Mesozoic limestone, chert, mudstone, basalt and sandstone; L. Cretaceous granitic rocks; l. and m. Miocene sandstone, mudstone, conglomerate, tuff; m. and u. Miocene granite to quartz diorite; Pliocene mudstone, sandstone, tuff	Pliocene andesite
Ohe (Oe)	JAPN	420830N	1400100E	1.92	1.3	56.9	0.1	0.9	2.5		16% Mn, 7.5% S; prod. (1890-1974)	Permian and Mesozoic limestone, chert, mudstone, basalt, sandstone	Miocene rhyolite; andesite pyroclastic rocks; quartz diorite
Ohguchi (Oguchi)	JAPN	320615N	1303730E	1.63	13.0	9.6	---	---	---		Prod. (1905-1974)		Tertiary rhyolite, andesite; quartz diorite
Ohito	JAPN	350106N	1385619E	1.25	3.0	9.2	---	---	---		Estimated prod. (1934-1945), reserves (1945)		Tertiary andesite, tuff, and shale
Oizumi	JAPN	382552N	1394516E	0.61	0.5	14.0	0.2	0.17	0.59		Estimated prod. (1940-1945), reserves (1946)		Tertiary andesite
Okinoura	JAPN	353300N	1344500E	0.41	6.1	6.1	0.69	---	---		Estimated prod. (1925-1941), reserves (1940)		Tertiary shale, sandstone, volcanic rocks
Okuzu	JAPN	400755N	1404305E	0.037	10.6	28.9	4.4	6.7	15.6		8.4% pyrite; prod. (1930-1965)		Miocene rhyolite
Olinghouse	USNV	394007N	1192443W	0.027	28.0	19.9	0.008	0.0017	---	1864	Prod. (1898-1966)	U. Triassic and Jurassic slate, phyllite, hornfels, and quartzite; Cretaceous granodiorite	L. Miocene rhyolite tuff; m. Miocene basaltic andesite; l. and m. Miocene granodiorite
Omodani	JAPN	355030N	1364430E	0.2	4.6	124.0	2.1	0.3	---		Prod. (1906-1919)	Paleozoic gneiss and metamorphic rocks	Cretaceous rhyolite
Ophir (Iron Springs)	USCO	375149N	1074943W	0.77	5.8	171.0	0.1	2.0	0.007	1877	Prod. (1877-1956)	Devonian and Mississippian limestones; Pennsylvanian sandstone, shale; Miocene conglomerate	Miocene rhyodacite, andesite, and quartz latite flows, breccias, and tuffs
Orient	USWA	485217N	1180947W	0.22	6.5	4.6	0.12	0.005	---	1897	Prod. (1904-1942)	Paleozoic schist, amphibolite, quartzite, gneiss, cherty argillite and limestone	U. Jurassic to Tertiary (?) latite flows
Osarizawa	JAPN	401100N	1404500E	31.0	0.2	8.1	---	---	---	708	Prod. (1905-1974)	Pre-Tertiary black phyllite and chert	Miocene rhyolite-dacite tuffs, andesite intrusions, mudstone
Otaez	MXCO	243400N	1055400W	5.1	5.0	500.0	0.04	0.4	---		Prod. (1973-1975) and reserves (1975)		Tertiary volcanic rocks
Pachuca-Real Del Monte	MXCO	201500N	0984500W	107.0	2.2	461.0	0.04	0.2	0.75	1522	3% Fe; estimated prod. (1552-1979)	L. Cretaceous limestone; U. Cretaceous sandstone, siltstone, shale, conglomerate; Eocene conglomerate, siltstone, clay, tuff, and lava flows	Oligocene rhyolite-dacite, and andesite flows, tuffs, and breccias; Miocene rhyolite, dacite, and andesite flows, tuffs, and breccias; volcanic sandstone and conglomerate
Pan de Azucar	AGTN	225600S	0665000W	0.037	---	1,100.0	---	12.0	7.5		Prod. (1958-1964) and reserves (1964)	Cambrian and Ordovician sedimentary rocks	Miocene and Pliocene dacite stocks
Patterson	USCA	382600N	1191519W	0.95	2.4	1,029.0	0.009	0.008	---	1860s	Estimated prod. (1880-1926) and reserves (1926)	Paleozoic argillite, slate, hornfels, metasiltstone, quartzite, limestone, metaconglomerate; Triassic and Jurassic felsic to intermediate flows, tuffs, breccias, argillite, sandstone, conglomerate, limestone; Mesozoic granite and granodiorite	Tertiary andesite tuffs, rhyolite porphyry
Peavine	USNV	393453N	1195405W	0.033	1.1	72.0	0.25	0.06	---	1863	Prod. (1872-1966)	Jurassic metavolcanic and metasedimentary rocks; Cretaceous granodiorite	38-18 m.y. welded ash flow tuffs, rhyolite plug, andesite to dacite flows, breccias, and intrusions
Provenir	PERU	101500S	0760200W	10.0	---	170.0	---	4.3	6.0		Reserves (1974)		Cretaceous and Tertiary andesite, diorite intrusions
Pyramid	USNV	405153N	1193716W	0.0028	0.4	30.4	4.0	---	---	1863	Estimated prod. (1881-1952)		22 m.y. latite tuffs
Quartzville	USOR	443400N	1222300W	0.019	14.0	6.0	---	---	---	1863	Estimated prod. (1863-1939)		M. Miocene andesite and rhyolite flows, tuffs, and breccias

Associated rocks	Alteration	Vein morphology	Age m.y.	Minerals	References
M. Miocene trachyte tuff and quartz latite; 18.2 m.y. latitic andesite and dacite flows and lithic tuff; 18.7 m.y. trachyte, quartz latite, and rhyolite tuffs and flows; 10.4 m.y. monzonite-tonalite-granodiorite; u. Miocene rhyolite dikes and olivine basalt	Silicic, illitic, alunitic, propylitic	Veins in NW-trending radial faults, dip 80°-85°NE; two major veins average 1.2 m wide and 274 m long, and 2.1 m wide and 122 m long		EL,Au,Ag,SEL,SPH,CPY,PYR,HEM,WUF, MARC,WOLF,CHR,LIM,CC,Mn oxides, GYP,KAOL,QTZ,FL,CALC,AD,CHL,CHD, SER,ILL,ASB	Durning and Buchanan (1984)*, Koschmann and Bergendahl (1968), Keith and others (1983)*
		14 veins		SPH,GAL,CPY,QTZ,CALC	Grant (1950)*
Pliocene basalt	Propylitic, silicic	12 veins		Au,ARG,PYR,CPY,SPH,QTZ,BAR	Grant (1950)*
Miocene basalt	Silicic, sericitic, argillic, propylitic	Veins in faults, trend N60°W and N60°E, dip 80°SW; one vein is 1,500 m long, 600 m down dip, 5 m wide		PYR,CPY,SPH,GAL,EL,PYGR,CIN,STIB, ARG,PO,FAH,APY,MAG,WOLF,PXM,MARC, SID,HEM,RH,QTZ,BAR,RD,TEP,CALC, CLAYS,CER,ANH,KAOL	Sato and others (1980), Yamada and others (1980)*, Shikanozo (1985)
Tertiary andesites; Pleistocene welded tuff	Propylitic	9 veins in NE-trending fissures, 650-1,500 m long, 0.7-3 m wide		Au,ARG,PYR,STIB,SPH,GAL,CPY,QTZ, CALC,AD,SM,KAOL	Grant (1950), Kishimoto and others (1966), Yamada and others (1980)*
	Propylitic	10 veins		Au,ARG,PYR,CPY,QTZ,CALC	Grant (1950)*
		3 veins		CPY,SPH,GAL,PYR,QTZ,CALC,BUS,RH, SID	Grant (1950)*, Shikanozo (1985)
		2 fissure-filled veins		CPY,PYR,QTZ,CALC	Grant (1950)*
Miocene andesite, dacite and basalt	Chloritic	Fissure-filled veins trend N15°-55°E, 200-375 m long, 0.3-0.5 m wide		PYR,CPY,GAL,SPH,CHL,QTZ,CALC	Yamada and others (1980)*, Grant (1950), Shikanozo (1985)
L. Pliocene andesite-rhyodacite flows, breccias, and intrusions	Potassium silicate, propylitic, silicic	Small pockets of high grade ore shoots in faults trend N45°E, dip steeply SE; stringers and veinlets form tabular stockworks in fault breccia and gouge		Au,CGR,CPY,PYR,PETZ,COL,Te,BOR, GAL,QTZ,CALC	Bonham (1969), Rose (1969), Koschmann and Bergendahl (1968), Johnson (1977), U.S. Bureau of Mines (1900-1984)*
	Silicic, propylitic	Vein trends N70°E, 450 m long, 1 m wide		CPY,GAL,SPH,QTZ,CHL,CALC	Yamada and others (1980)*
Quartz monzonite to diorite intrusions		Composite veins in fault fractures, trending N and NE; minor mineralization in underlying sedimentary rocks		Au,PYR,GAL,SPH,CPY,FRI,HEM,MAG, QTZ,ANK,CALC,BAR,Mn-Fe CARB,FL,ANH	Koschmann and Bergendahl (1968), Elevatorski (1982), U.S. Bureau of Mines (1900-1984)*
U. Jurassic to Tertiary (?) rhyolite, andesite, monzonite porphyry		Veins in fractures and breccia zones		Au,PYR,CPY,PO,GAL,SPH,BOR,TET, BOUL,QTZ,CARB	Koschmann and Bergendahl (1968), Elevatorski (1982)*, Moen (1976), Fulkerson and Kinston (1958)*
Miocene rhyolite flows, mudstone	Silicic, propylitic, sericitic	Veins in fault fractures, trend N30°-85°E, dip 55°-90°NW-SE, 300-1,130 m long, 0.5-1.2 m wide, 400 m depth; over 300 veins		CPY,PYR,HEM,GAL,SPH,Au,Ag,QTZ,CHL, CALC,BAR,RH	Grant (1950, 1951), Hori (1940), Yamada and others (1980)*
		Stockwork		Au,Ag,CPY,GAL	Busch (1980)*
Pliocene rhyolite-rhyodacite flows and tuffs, andesite-dacite flows, breccias and tuffs, olivine basalt, and olivine andesite	Propylitic, silicic, sericitic, argillic, potassium silicate	Veins in 3 fracture groups, trend N45°-90°W, dip 40°-90°S N0°-20°E, dip 70°-90°W, and N50°E, dip 60°S-60°N; veins average 200-400 m long and vertically, 2-4 m wide; pinch out upward and downward; deposited between 300-1,000 m depth		ARG,AC,PYR,POLY,STP,Ag,Au,STRN, SPH,GAL,CPY,MARC,MIG,EL,PROU,TET, PYGR,CC,COV,BOR,ALLO,ANG,AZ,CGR, CER,CHC,CHR,GOE,GYP,JAR,LIM,MAL, MNG,CALC,ALB,AD,FL,CHL,PRHN,EP, KAOL,QTZ,CHD,BAR,OPAL,RH,SER,SID, RD-BUS,K-FELD,ANH,DOL	Geyne and others (1963)*, Buchanan (1981), Dreier (1982), Geyne (1968)
	Silicic, argillic	Veins in fractures trend N70°W, dip 80°SW, 100 m long, 0.3-1 m wide		GAL,SPH,PYR,CPY,MARC,CER,LIM,MAL, AZ,QTZ,CHD,ANK	Angelelli and others (1970)*
		Quartz veins and breccias in fault contact between andesite and rhyolite and andesite and granite; high grade ore shoots and lenticular masses up to several tens of m long		PYR,ARG,CGR,CPY,GAL,Fe oxides,QTZ	Neale (1926)*, Elevatorski (1982), U.S. Bureau of Mines (1900-1984)*
Pliocene diamite, shale, sandstone, and basalt flows	Silicic, sericitic, pyritic, propylitic, argillic, potassium silicate	Stockwork in NW- and N-trending fracture zones; bleached area 21 km x 6 km, up to 65 m depth; mesothermal quartz veins are associated with Pre-Tertiary rocks		EN,ARG,GAL,SPH,CPY,PYR,CC,Au,Ag, Ag-SS,COV,BOR,CHC,ANG,CGR,MAL, CALC,TOUR,QTZ,CHD,SER,KAOL,GYP	Bonham (1969)*
		Veins and fissure-fillings, 1,000 m long, 1 m wide, trend N50°-70°E, dip 70°NW		GAL,SPH,CPY	Goudarzi (1973b)*
Oligocene and Miocene rhyolite flows, tuffs, and mud flow breccias, dacite flows, tuff breccias, ash flow tuffs, and stocks, basalt flows	Sericitic, pyritic, propylitic, advanced argillic	Veins, up to 152 m depth; siliceous cap 5-10 m thick; oxidized zone 30 m thick		EN,LUZ,TET,SPH,GAL,CPY,APY,BOR,CC, HEM,PYR,Au,Ag-halides,COV,HMM,CER, LIM,MAL,JAR,CHC,Mn oxides,AZ,Cu, BAR,GYP,QTZ,PYPH,DIA,KAOL,SER,AD, CALC	Wallace (1980), Bonham (1969)*, U.S. Bureau of Mines (1900-1984)*
Dacite porphyry dikes and plugs	Silicic	Veins trend N40°W, dip steeply NE-SW, up to 135 m long, 107 m depth, 10 cm-3.7 m wide; in shear zones 15 m wide; short ore shoots and massive sulfides		PYR,SPH,BOUR,TET,Au,GAL,CPY,CER, QTZ,SER,ANK,BAR	Oregon Dept. of Geology (1951)*, Brooks and Ramp (1968), Callaghan and Buddington (1938), U.S. Bureau of Mines (1900-1984)*

Table 1. Location, tonnage, grade, and geologic information for epithermal gold-silver districts—Continued

District	Country	Latitude	Longitude	Tonnage ($x10^6$)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Discovery year	Comments	Basement rocks	Host rocks
Ramsey	USNV	392754N	1192230W	0.028	6.4	1.2	---	---	---	1906	Prod. (1915-1941)		Miocene rhyodacites, andesites, and rhyolite tuffs
Rawhide (Regent)	USNV	390042N	1182349W	0.068	23.0	346.0	0.018	0.02	---	1906	Prod. (1908-1951)	U. Triassic limestone, marble, shale, slate, and other clastic rocks	Miocene rhyolite flows and tuffs, dacite intrusions, basalt and basaltic andesite flows, tuffaceous rhyolite dikes and sheets
Red Mountain	USCO	375500N	1074200W	0.185	5.1	165.0	1.04	2.4	0.82	1881	Prod. (1883-1956)	Precambrian quartzite and slate; Devonian-Mississippian limestones; Pennsylvanian shale and sandstone; Miocene conglomerate and rhyodacite tuff	Miocene rhyodacite-quartz latite ash-flow tuffs, flows, and breccias, quartz latite intrusions
Republic	USWA	484019N	1184500W	2.27	24.0	140.0	---	---	---	1896	Estimated prod. (1896-1970)	Permian greenstone, chert, graywacke, argillite, and limestone; Cretaceous granodiorite	49.8 m.y. rhyodacite and quartz latite flows and breccias
Rio Pallanga	PERU	110900N	0762800W	4.4	---	170.0	---	4.0	5.0		Reserves (1972)	L. Cretaceous limestone, sandstone, conglomerate, and shale; l. Tertiary red siltstone, marly limestone, and conglomerate	Tertiary tuff and tuff-breccia
Rosario	HNDR	141500N	870400W	7.0	2.7	540.0	---	---	---	1882	Estimated prod. (1882-1954)	Jurassic shale, siltstone, and sandstone; L. Cretaceous siltstone, sandstone, limestone, andesitic tuffs and breccias	Andesite tuffs and breccias; sandstone, siltstone, and shale; Cretaceous dacite dikes
Rosebud	USNV	404847N	1183933W	0.0072	10.3	424.0	0.043	0.015	---	1906	Estimated prod. (1908-1945)		Tertiary rhyolite flows, pyroclastic rocks and flow breccia
Round Mountain	USNV	384223N	1170446W	0.69	15.4	14.1	---	0.0005	---	1906	Prod. (1907-1955)	Paleozoic limestone, jasper, and slaty schist; Cretaceous granitic rocks	26-20 m.y. rhyolite ash-flow tuffs, lithic tuff, and volcanic breccia
Ryuo	JAPN	435845N	1433000E	0.031	8.9	35.6	---	---	---		Prod. (1935-1952)		Miocene rhyolite
Sado	JAPN	380215N	1381545E	15.0	5.1	153.0	0.04	---	---	1542	Prod. (1601-1974)	Mesozoic granite and metasedimentary rocks	L. Miocene rhyolite tuffs, dacite tuffs, and minor shale
Sai	JAPN	412115N	1405215E	0.111	0.3	90.8	2.3	---	2.2		Prod. (1911-1959)	Miocene tuffs and sedimentary rocks	Tertiary quartz porphyry
San Antone (Royston)	USNV	381826N	1171739W	0.0013	3.9	754.0	0.18	1.24	0.024	1863	Prod. (1925-1956)		Tertiary rhyolite tuff and porphyry
Sand Springs	USNV	391624N	1183111W	0.092	7.2	429.0	---	---	---	1905	Prod. (1923-1951)	Triassic and Jurassic metamorphic rocks	Miocene andesite-dacite, rhyolite tuffs, rhyodacite, andesite and rhyolite dikes; Jurassic basalt and andesite and rhyolite dikes; Cretaceous granodiorite
Sanei	JAPN	382307N	1401155E	0.093	14.0	2.7	0.74	---	---		Estimated prod. (1931-1945), reserves (1945)	Mesozoic granitic rocks	Miocene rhyolite tuff
Sanru	JAPN	442300N	1423830E	0.9	7.4	42.1	---	---	---		Prod. (1925-1974)		Miocene rhyolite tuff, tuff-breccia
Sayama	JAPN	395615N	1402630E	0.172	0.3	28.5	1.4	0.3	0.2		Prod. (1948-1972)		Miocene basalt flows, rhyolite tuff, marine sedimentary rocks
Searchlight	USNV	352816N	1145517W	0.614	0.43	0.59	0.06	0.14	---	1897	Prod. (1898-1954)	Precambrian granite gneiss	Miocene andesite porphyry, dacite flows and breccias, quartz monzonite intrusion, hornfelsized andesite
Seikoshi	JAPN	345403N	1384940E	1.18	10.3	337.0	---	---	---		Prod. (1935-1974)		Miocene dacite, rhyolite and diorite porphyry
Seven Troughs	USNV	402700N	1184700W	0.099	42.5	215.0	---	0.005	0.0003	1863	Prod. (1908-1955)	Jurassic(?) slate and shale; Mesozoic granodiorite	Miocene andesite and rhyolite flows and breccias
Sheep Tank	USAZ	332225N	1134500W	0.015	12.0	68.6	0.006	---	---	1909	Prod. (1929-1950)	Mesozoic schist and phyllite(?)	Tertiary andesite and rhyolite flows and breccias
Shizukari	JAPN	423600N	1402730E	4.62	2.2	18.0	---	---	---		Estimated prod. (1925-1943) and reserves (1943)		Miocene andesite and dacite
Silver Bow	USNV	375317N	1162907W	0.002	27.0	558.0	---	---	---	1904	Prod. (1908-1944)		17.8 m.y. rhyolite tuff
Silver City (DeLamar-Carson)	USID	430000N	1164500W	8.6	3.5	219.0	---	0.0001	---	1963	Prod. (1863-1951) and reserves (1977)	66-62 m.y. granodiorite	M. Miocene rhyolite tuffs, flows, and domes; quartz latite flow, flow breccia, and domes; basalt flows

Associated rocks	Alteration	Vein morphology	Age m.y.	Minerals	References
Miocene dacite intrusion	Silicic, propylitic, argillic, phyllic	12 m wide fracture zone trends E-W, dips N, up to 213 m depth	10	Au,PYR,ARG,CPY,CGR,Fe oxides,Ag,QTZ,CALC,AD,CHL,AL	Rose (1969), Buchanan (1981), Elevatorski (1982), Stoddard and Carpenter (1950), U.S. Bureau of Mines (1900-1984)*
Miocene latite, quartz latite, basalt flows and diorite intrusions	Argillic, silicic, potassium silicate	Network veinlets trend N30°W-N32°E, dip steeply W, NW, and E, up to 231 m depth; in fissures and faults; width average 0.6-1.2 m, up to 12 m wide	15.5-14.5	PYGR,PROU,TET,ARG,GAL,SPH,CPY,PO,STIB,PYR,MARC,APY,MOLY,NAUM,EP,TL,Au,EL,COV,Cu,Te,PYL,HEM,GYP,BAR,JAR,LIM,CGR,MAL,AZ,Ag,IOD,HAL,CALD,CALC,QTZ,CHD,AD,OPAL,AL,SER,KAOL,EP	Silberman and others (1975), Ross (1961), Schrader (1947), Buchanan (1981), Nolan (1933), Koschmann and Bergendahl (1968), Ekren and Byers (1978), Vanderburg (1937)*, U.S. Bureau of Mines (1900-1984)*
Miocene andesite-rhyodacite flows, breccias, and tuffs	Silicic, propylitic, argillic, advanced argillic, sericitic	Massive ore at intersections of fractures or breccia pipes; veins in NW-, N-, and NE-trending faults near NW border of Silverton caldera; 500 m depth		Au,Ag,TET-TEN,STM,ARG,SPH,GAL,CPY,PYR,APY,BOR,COV,EN,HEM,CC,ANH,QTZ,BAR,FL,CALC,RH,SER,ILL,SM,KAOL,DIC,ZUN,AL	N. K. Foley (written commun., 1982), Henderson (1926), Koschmann and Bergendahl (1968), U.S. Bureau of Mines (1900-1984)*
Oligocene latite flows and tuffs; Miocene volcanic conglomerate, quartz monzonite, diorite, rhyodacite, quartz latite porphyry, andesite, rhyolite, and basalt	Propylitic, argillic, silicic, sericitic	Veins in faults trend N, dip steeply, 609 m depth, 1.5-4.6 m wide veins		PYR,CPY,STP,NAUM,Ag,EL,Au,MARC,TET,PYGR-PROU,ARG,AGU,STIB,GAL,SPH,Au-SEL(?),TL,REAL,MAL,AZ,APY,QTZ,AD,CHD,FL,CALC,LAUM,CHL,EP,SER,BAR	Full and Grantham (1968)*, Muessig (1967), Nolan (1933), Buchanan (1981), Koschmann and Bergendahl (1968), Elevatorski (1982)
		Veins trend NNE, dip 90°, 1,500 m long, 5 m wide, 235 m depth; 3 S-pitching ore shoots separated by low-grade vein material		PYR,GAL,SPH,TET,CPY,STIB,REAL,ORP,QTZ,CLAY,CARB	Goudarzi (1973c)*
Cretaceous andesite and granodiorite dikes and plugs; U. Cretaceous and Tertiary volcanic flows and tuffs and sedimentary rocks	Sericitic, chloritic, silicic, argillic, pyritic	Quartz veins trend N70°W, 1.2 m thick, up to 1.83 km long, 55 km depth; banding, vugs, brecciation, replacement; 85 known veins		ARG,Au,Ag,PYGR,STP,EL,CPY,PYR,GAL,SPH,PROU,ANG,CER,SMTH,MAL,AZ,HEM,Mn oxides,QTZ,CALC,RD,DOL,FL,GYP,RH	Roberts and Irving (1957)*, Levy (1970)*, Carpenter (1954)*
	Argillic	Veins trend N70°E, dip vertical, up to 0.3 m wide; irregular and splits at some places into stringers; veins in shear zone		ARG,Au,PYR,QTZ,FL,KAOL,LIM,JAR	Johnson (1977), U.S. Bureau of Mines (1900-1984)*, Lincoln (1923)*
Miocene tuffaceous sedimentary rocks, rhyodacite ash	Silicic, sericitic, propylitic, argillic	Gold occurs as blebs in pyrite in disseminated ore; shallow veins and stockworks in NW-trending, nearly vertical faults; high grade vein ore at depth; 213 m depth of oxidized zone		Au,PYR,REAL,EL,GAL,MOLY,QTZ,AD,AL,FL,CALC	Koschmann and Bergendahl (1968), Mills (1984)*, U.S. Bureau of Mines (1900-1984)
Pliocene rhyolite and welded tuff	Potassium silicate	Veins in N50°-65°E-trending fractures, 600 m long, 3 m wide		Au,Ag,QTZ,AD	Yamada and others (1980)*
Miocene andesite, shale, sandstone, conglomerate, rhyolite and andesite dikes	Silicic, potassium silicate, propylitic, pyritic	6 veins in N75°-80°E-trending faults, dip 60°-80°N-S, 70-2,100 m long, 150-780 m depth, 0.1-10 m wide		Au,ARG,CPY,PYR,GAL,SPH,PYGR,PROU,STP,POLY,EL,Ag,STRM,JAL,APL,PEAR,TET,MARC,BOR,COV,HES,QTZ,CHD,BAR,RH,AD,CALC,SER,CHL,MONT,FL,RD	Grant (1950, 1951), Yamada and others (1980)*, Sakai and Oba (1970), Sato (written commun., 1985)*, Imai and Bunno (1978)
Miocene quartz diorite	Silicic, chloritic, sericitic	Veins in NW-trending fissures, 1,000 m long, 0.5 m wide		Au,CPY,SPH,GAL,QTZ,CHL,SER,CALC	Yamada and others (1980)*, Shikanozo (1985)
	Silicic, argillic	Veins		Ag,CGR,STP,CPY,GAL,SPH,QTZ,CLAY	Lincoln (1923), U.S. Bureau of Mines (1900-1984)*
	Silicic, argillic	Quartz veins, 137 m depth		Au,PYR,CGR,ARG,QTZ,CALC,CLAY	Willden and Speed (1974), U.S. Bureau of Mines (1900-1984)*
		Fissure-filled veins		CPY,PYR,QTZ	Grant (1950)*
Miocene sandstone	Propylitic, argillic, silicic, pyritic	Vein in N70°E-trending fissure, 2,000 m long, 4 m wide		Au,ARG,PYR,CPY,QTZ,AD,CALC,ANK	Grant (1950)*, Yamada and others (1980), Shikanozo (1985)
Neogene granite	Silicic, sericitic, chloritic	Vein in fault, trending N60°W, 250 m long, 0.14 m wide		Au,Ag,CPY,GAL,SPH,QTZ,SER,CHL	Yamada and others (1980)*
Tertiary volcanic breccia, rhyolite and lamprophyre dikes	Potassium silicate, argillic, propylitic, phyllic, pyritic, silicic	Veins, up to 15 m wide, up to 274 m depth, up to 305 m long, trend N57°-65°W, dip 60° or less S		GAL,SPH,CPY,Au,HEM,CER,WUF,CC,CUP,MAL,BRCH,LIM,LDH,CHR,VAN,MOT,HMM,QTZ,CHD,CALC,AD,SER,CHL	Koschmann and Bergendahl (1968), Callaghan (1939), Buchanan (1981), Nolan (1936), Proctor and Doraibabu (1977), U.S. Bureau of Mines (1900-1984)*
Miocene andesites, rhyolite tuffs; Pliocene dacites; Neogene volcanic rocks	Silicic, propylitic	4 veins in faults trending N30°E; major vein is 1,000 m long, 3.5 m wide		Au,ARG,CPY,PYR,EL,PEAR,QTZ,AD,CALC,SER,HMC,CHL,MONT	Grant (1950), Nishiwaki and others (1971), Yamada and others (1980)*
Miocene basalt dikes	Silicic, potassium silicate, argillic, propylitic, phyllic	Veins average 0.9 m wide in breccia zones or fissures, trend N0°-20°E, 245 m depth	13.7	Au,EL,Ag,STIB,PYR,ARG,CPY,GAL,SPH,PROU,STP,POLY,BOR(?),QTZ,AD,CALC,CHL	Nolan (1933), Buchanan (1981), Johnson (1977), Silberman and Roberts (1973), U.S. Bureau of Mines (1900-1984)*
Tertiary diorite porphyry intrusions, basalt flow, dacite flows and agglomerate	Silicic, propylitic, sericitic, carbonate	Quartz stringers and ore shoots in fault fractures and shear zones		Au,Ag,GAL,HEM,CPY,ANG,CER,LIM,PYL,CHL,BAR,QTZ,CALC,AD,SER	Elevatorski (1982), Wilson (1933), Keith and others (1983)*, Wilson and others (1934)
Miocene andesite and tuff	Potassium silicate, argillic	25 fissure-filled veins trending E-W, NNE, and NNW; veins range 300-1,000 m long, 3-12 m wide		Au,ARG,QTZ,CALC,RH,MONT,KAOL,RD	Grant (1950)*, Yamada and others (1980), Shikanozo (1985)
	Silicic, argillic			STP,PYR,Au,Ag,PYL,LIM,CGR,FL,MAL,QTZ,AD,KAOL	Cornwall (1972), Ekren and others (1971), U.S. Bureau of Mines (1900-1984)*, Lincoln (1923)
	Silicic, sericitic, argillic, propylitic	Veins in faults and fractures, trend N-NW and N75°-85°W, dip steeply; major vein system 1,220 m long, 762 m depth, 1 m wide; ore shoots up to 9 m x 61 m x 305 m; some veins are brecciated; crustification, vuggy, drusy, banded; disseminated Ag in secondary silica as veinlets	15.2-14.8	Au,Ag,EL,AC,PROU,PYGR,POLY,MIG,CGR,NAUM,PYR,CPY,GAL,SPH,JAM,APY,CLU,MARC,OWY,PYST,STP,STIB,STRM,TET,XAN,LIM,MAL,AZ,AD,QTZ,CALC,FL,BAR,SID,VIV,CHL,EP,GRA,LEV,MUSC,CHD,SER,VAL	Pansze (1975), Piper and Laney (1926)*, World Mining (1977)*, Lindgren (1900)*, U.S. Bureau of Mines (1900-1984)*

Table 1. Location, tonnage, grade, and geologic information for epithermal gold-silver districts—Continued

District	Country	Latitude	Longitude	Tonnage ($x10^6$)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Discovery year	Comments	Basement rocks	Host rocks
Silver City	USNV	391542N	1193823W	0.611	9.7	387.0	---	---	---	1849	Less than 0.3% pyrite; prod. (1871-1940)	Triassic limestone, shale, schist, and metavolcanic rocks; U. Jurassic quartz monzonite	Miocene andesite and rhyolite breccia and tuff
Silver Peak	USNV	374300N	1174700W	2.39	4.6	162.0	0.0001	0.13	0.25	1864	Prod. (1909-1956) and reserves (1948)	Cambrian shale and limestone; Jurassic granitic rocks	22.8-11.1 m.y. andesite flows, rhyolite flows, breccias, and tuffs, sandstone and conglomerate; 5.9 m.y. latite flows
Sneffels	USCO	375901N	1074538W	3.24	14.4	223.0	0.45	2.2	2.1	1873	Prod. (1882-1978)	Devonian and Mississippian limestones; Pennsylvanian sandstone and shale; Miocene conglomerate	Miocene rhyodacite, andesite, and quartz latite flows, breccias, and tuffs
Stateline	USUT	380000N	1140130W	0.0117	6.6	24.0	---	---	---	1896	Prod. (1907-1915)		Oligocene latite-rhyolite flows, rhyolite tuff
Stedman	USCA	343735N	1161000W	0.754	12.0	51.0	1.8	---	---	1903	Estimated prod. (1904-1952)		Tertiary rhyodacite breccia sills and pipes
Steeple Rock	USNM	325817N	1085606W	0.382	6.5	264.0	0.39	1.5	1.25	1880	Prod. (1882-1981)		38-28 m.y. dacite, rhyolite, and andesite tuffs and flow breccias
Syowa	JAPN	435345N	1433500E	0.025	16.8	7.8	---	---	---		Prod. (1882-1981)		Miocene rhyolite
Taio	JAPN	330816N	1305429E	9.56	3.3	15.7	---	---	---	1897	Estimated prod. (1925-1942) and reserves (1943)	Paleozoic schist and phyllite, biotite granite	Pliocene andesite agglomerate and tuff
Taisei	JAPN	420106N	1403107E	0.66	2.4	148.0	---	---	---		Estimated prod. (1934-1942), reserves (1942)		Tertiary andesite, shale and sandstone
Takahata	JAPN	372200N	1401200E	0.414	7.4	7.0	0.6	---	---		Prod. (1936-1970)	Cretaceous granitic intrusion	Miocene rhyolite tuff, andesite, trachyte
Takatama	JAPN	373025N	1401750E	5.9	3.3	31.2	---	---	---	1600s	Estimated prod. (1925-1945) and reserves (1944)	Cretaceous granitic intrusion	Miocene rhyolite tuff and brecciated tuff
Takeno	JAPN	353646N	1344349E	1.14	2.7	57.8	---	---	---		Estimated prod. (1925-1945) and reserves (1946)	Jurassic granite	Miocene rhyolite tuff, andesite, conglomerate
Talapoosa	USNV	392712N	1191501W	0.008	51.4	470.0	---	0.019	---		Prod. (1924-1949)		Miocene dacite flows
Tatsumata	JAPN	400830N	1403400E	1.423	---	44.9	1.1	0.3	1.8		13% pyrite; prod. (1914-1973)		Miocene diorite
Tavua (Vatukoula)	FIJI	173000S	1775108E	5.026	18.0	4.0	---	---	---	1932	Prod. (1935-1961) and reserves (1967)		U. Miocene and l. Pliocene basalt flows and dikes
Tayoltita (San Dimas)	MXCO	240600N	1055600W	7.54	11.0	703.0	0.05	0.3	0.5	1757	Prod. (1757-1982)	Mesozoic clastic rocks	U. Cretaceous to Eocene rhyolite flows and tuffs, andesite flows, tuffs, and lahars
Teine	JAPN	430530N	1411215E	4.64	2.3	39.6	0.16	---	---	1892	Estimated prod. (1931-1945) and reserves (1945)		Miocene andesite flow and tuff-breccia
Telluride (Upper San Miguel)	USCO	375623N	1074725W	23.2	5.5	93.0	0.31	1.42	1.42	1875	Prod. (1875-1972) and reserves (1972)	Permian sandstone and shale; Mesozoic sandstone and shale; Cretaceous sandstone; Miocene conglomerate, rhyodacite tuffs, breccias, and flows	Miocene andesite, rhyodacite, quartz latite flows, breccias, and tuffs
Todoroki	JAPN	430030N	1405530E	0.8	7.1	217.0	---	---	---		Prod. (1903-1974)		Miocene rhyolite
Toi	JAPN	345419N	1384750E	1.113	15.6	194.0	0.04	0.07	---	1550	5.2% Fe, 1.01% S; estimated prod. (1925-1945) and reserves (1945)		Miocene andesite flows, breccias, and tuffs
Tokusei	JAPN	435642N	1424506E	0.829	2.2	30.4	---	---	---		Estimated prod. (1932-1942), reserves (1943)		Tertiary andesite, shale, and sandstone
Tolicha	USNV	371847N	1164734W	0.0007	30.0	58.0	0.74	0.12	---	1905	Prod. (1909-1940)		Miocene rhyolite
Tomii	JAPN	364110N	1394925E	0.098	0.4	3.8	1.3	---	---		Prod. (1956-1965)		Cretaceous quartz porphyry; Miocene trachyte
Tonopah	USNV	380350N	1171500W	7.8	7.4	698.0	0.0001	0.0001	---	1900	Prod. (1902-1957)	Ordovician sedimentary rocks and limestone; Mesozoic granodiorite	20.4 m.y. trachyte flows and breccias, andesite breccia
Topia	MXCO	251300N	1063400W	1.3	0.12	400.0	---	2.6	4.2		Prod. (1951-1976), reserves (1976)	46 m.y. granodiorite	Eocene andesite
Toyoha	JAPN	425845N	1410230E	7.55	0.3	121.0	---	3.0	7.4	1890s	15% S, 18.5% Mn; prod. (1914-1974)	Permian and Mesozoic limestone, chert, mudstone, basalt, and sandstone; Miocene rhyolite and andesite flows, tuffs, and sedimentary rocks	Miocene sandstone, mudstone, conglomerate, andesite flows, tuffs, and breccias, tuffaceous sandstone, and agglomerate
Tozawa	JAPN	385200N	1404900E	0.736	1.7	20.4	0.98	---	---		Estimated prod. (1940-1945), reserves (1945)		Tertiary andesite
Tuscarora	USNV	411808N	1161308W	0.405	5.8	82.0	0.005	0.07	---	1871	Prod. (1875-1955)	Ordovician quartzite and chert	U. Eocene andesite flows and rhyolite tuffs; andesite-dacite intrusions

Associated rocks	Alteration	Vein morphology	Age m.y.	Minerals	References
Pliocene and Pleistocene lavas, breccias, and agglomerates	Silicic	6,700 m long vein system in fissures and faults, up to 6 m wide, average 3 m wide; S extension of the Comstock Lode district		PYR,Au,EL,ARG,CPY,GAL,QTZ,CALC,CHL	Koschmann and Bergendahl (1968)*, Elevatorski (1982), Couch and Carpenter (1943)*
	Silicic, argillic, propylitic	Veins in NE-trending fault zones, 305 m long, 160 m depth, 1.5 m wide	5	Au,GAL,SPH,CPY,Ag,AC,PROU,PYGR,POLY,STP,TET,STRM,PYR,MARC,QTZ,CALC,CLAYS,BAR,SID,MCAL,AD,Mn oxides,Fe oxides	Lincoln (1923), Keith (1977), Earnest (1984), U.S. Bureau of Mines (1900-1984)*, Engineering and Mining Journal (1984b)*
Miocene rhyolite-quartz latite ash-flow tuffs		Veins in faults 1.2 m wide		PYR,EN,CPY,TEN,STRM,BOR,SPH,GAL,Au,TET,PEAR,CC,COV,QTZ,BAR,SER,ANK,RH,RD,CALC,FL,AD,CLAYS	Koschmann and Bergendahl (1968), Elevatorski (1982), Henderson (1926)*, U.S. Bureau of Mines (1900-1984)*
		Ore shoots in veins trend N-S, dip E		PYR,Au,EL,MOLY,TL,QTZ,CHD,CALC,AD,FL	Nolan (1936)*, Lausen (1931), Buchanan (1981)
	Silicic, propylitic, argillic	Veins and brecciated ore, 2.4-6 m wide, several tens of m long, 137 m depth		Au,Ag,HEM,CHR,MAL,QTZ	Elevatorski (1982)*, Koschmann and Bergendahl (1968), Polovina (1980)
	Silicic, argillic, chloritic, sericitic	Quartz veins in fault fractures and breccia zones, trend N35°-75°W, dip vertical, 200 m depth, 1.5-2.4 m wide; ore shoots occur as pods, irregular masses, and pockets		PYR,SPH,CPY,GAL,Au,ARG,Ag,CER,MAL,QTZ,CALC,AD	Richter and Lawrence (1983), Koschmann and Bergendahl (1968), Elevatorski (1982)*
Pliocene basalt	Silicic, propylitic	Vein trend N80°W, 2 m wide		Au,QTZ,AD	Yamada and others (1980)*
	Propylitic	5 large and 16 small fissure-filled veins; main veins are 800-2,400 m long, 450 m depth, 1-10 m wide; trend N40°E-N80°W, dip 70°-75°N-NE		Au,ARG,PYGR,PYR,CPY,SPH,EL,GAL,POLY,PYL,QTZ,CALC,AD,RH,CHD	Grant (1950)*, Matsukuma (1953)
	Propylitic	Vein		Au,ARG,PYR,CPY,QTZ,CALC	Grant (1950)*
	Silicic, argillic, propylitic	Fissure-filled veins and stockwork, trend N50°-60°W, 250 m long, 220 m wide		Au,PYR,CPY,QTZ,KAOL,CHL,CLAYS,HEM	Yamada and others (1980)*, Grant (1950)*, Shikanozo (1985)
Miocene tuffaceous shale	Silicic, propylitic, potassium silicate, argillic	Fissure-filled veins trend N50°W-N50°E, dip 50°-70°E-W, 340-400 m long, 0.28-0.56 m wide, 180 m depth		Au,ARG,PYR,CPY,EN,CIN,STIB,CER,SPH,GAL,QTZ,AD,CALC,SM,KAOL,WAIR,K-FELD	Grant (1950)*, Yamada and others (1980), Shikanozo (1985)
	Silicic, argillic, chloritic, sericitic	8 fissure-filled veins trend N10°-30°W, dip steeply E-W, 100-300 m depth	17.9-18.2	Au,ARG,PYR,EL,Ag,ALT,Te,CPY,TET-TEN,HES,PETZ,GAL,SPH,MARC,QTZ,AD,CALC,DOL,CHL,SER,KAOL	Grant (1950)*, Soeda and Watanabe (1981)
	Silicic, argillic, propylitic	Quartz veins in fractures and shear zones, 2.4-7.6 m wide, trend E-W, dip S	10.5	Au,PYR,CPY,ARG,CGR,Ag,QTZ,CALC,AD	Hill (1910), Rose (1969), Lincoln (1923), Elevatorski (1982), U.S. Bureau of Mines (1900-1984)*, Garside and Silberman (1973)
Miocene rhyolite and andesite	Silicic	Veins in fault and fold, trend N30°W, 1,100 m long, 1.2 m wide		PYR,CPY,GAL,SPH,MAG,IN,RH,CALC,SER	Yamada and others (1980)*, Shikanozo (1985)
L. Pliocene andesite agglomerate and pyroclastic rocks	Silicic, argillic	Veins in steep-dipping fractures, dip 24°-65°E, 1,800 m long, 309 m depth		PYR,PO,APY,COL,SYL,PETZ,GAL,SPH,HES,KREN,EMP,MEL,QTZ,DOL,CALC	Cohen (1962), Denholm (1967)*, Laznicka (1973)*
U. Cretaceous to Eocene quartz diorite-granodiorite	Silicic, propylitic	Veins in NE-, E-, and NW-trending faults, 1,300 m depth, 0.1-25 m width, 2,000 long	40	PYR,SPH,CPY,GAL,JAL,AC,PEAR,POLY,EL,MAG,Ag,ARG,PYGR,Au,STRM,CC,COV,QTZ,CHL,AD,RD,JOH,ALB,CALC,ZEOL,RH	Smith and others (1982)*, Buchanan (1981)
Miocene black shale	Silicic, propylitic	Fissure-filled veins in 3 groups trend N80°E-N82°W, dip over 65°, 80-1,010 m long, 0.7-2.7 m wide, 300 m depth		ARG,Au,PYR,CPY,SYL,Te,MARC,BIS,LUZ,STIB,ORP,REAL,SPH,GAL,PETZ,RIC,PYGR,TET,EN,CC,BOR,EMP,KLAP,TEL,TEIN,QTZ,CALC,RH,BAR,CHL	Yamada and others (1980), Grant (1950, 1951)*, Imai (1978)
Miocene rhyolite-quartz latite ash-flow tuffs		Quartz veins with disseminated and thin plates of gold	17	ARG,GAL,SPH,PYR,CPY,SPEC,Au,TL,TET,TEN,PROU,PEAR,Ag,QTZ,CALC,BAR,FL,EP,CHL,RD,CLAYS,AD,RH,SER,ANK	Koschmann and Bergendahl (1968), Elevatorski (1982), U.S. Bureau of Mines (1900-1984)*
Miocene andesite and dolerite dikes	Silicic, potassium silicate, propylitic, argillic	15 veins trend E-W to N35°E, 250-980 m long, 3-4.5 m wide		Au,ARG,QTZ,CALC,RH,AD,KAOL,MONT,CHL-SAP,IN	Grant (1950), Yamada and others (1980)*, Yoneda and Watanabe (1981), Shikanozo (1985)
Miocene rhyolite tuff; Pliocene dacite, diorite porphyry	Silicic, propylitic, sericitic	11 main fissure-filled veins, trend N20°W, dip 65°W; main vein is 2,000 m long, 1 m wide; others range 100-1,100 m long, 0.4-1.5 m wide; 30-300 m depth		Au,ARG,PYGR,STP,PYR,CPY,GAL,SPH,HEM,MARC,Ag,Cu,QTZ,AD,CALC,CHL,AP,IN,ZEOL,STIL,SER,LAUM,GYR	Grant (1950)*, Yamada and others (1980), Kato (1932), Shikanozo (1985)
	Propylitic	6 fissure-filled veins		Au,ARG,PYR,QTZ,CALC	Grant (1950)*
	Silicic, argillic(?)	Veins		Au,Ag,LIM,KAOL,SER	U.S. Bureau of Mines (1900-1984)*, Nolan (1936)*
	Silicic, argillic, propylitic	Veins in dome trend N20°E; other veins trend N30°E-N80°W, 80-450 m long, 0.4-0.7 m wide		Au,CPY,QTZ,KAOL,CHL	Yamada and others (1980)*
Miocene volcanic breccias, flows, and tuffs, rhyolite sills; 16-17 m.y. rhyodacite-rhyolite flow	Silicic, potassium silicate, propylitic, pyritic, argillic	Veins in faults and fractures, fault zone trend N, 305-457 m depth	19.1	EL,ARG,POLY,PYGR,SPH,GAL,CPY,PYR,NAUM,APY,Au,Ag,CER,EMB,IOD,WUF,LIM,CIN,COV,SEL,GYP,JAR,BAR,QTZ,AD,AL,CHL,SER,RH,ALB,RD,MONT,CALC	Nolan (1936), Bonham and Garside (1974), Silberman and others (1979), Bonham and others (1972), U.S. Bureau of Mines (1900-1984)*, Kleinhampl and Ziony (1984), Cornwall and others (1967)
		Veins trend NE and NNW		GAL,SPH,CPY	Clark and others (1979)*, Busch (1980)*
Miocene dacite flows and agglomerate	Silicic, propylitic, sericitic	Veins in fissures trend E-W and NW; main ones are 2,000 m long, 300-600 m depth, 1.5-3 m wide, dip 60°N-NE		POLY,PEAR,PYGR,PROU,MIG,STP,FRI,ROC,DIAP,MAT,JAM,BOUL,STIB,AC,PYR,HEM,MAG,PO,SPH,GAL,Ag,ARG,MARC,CPY,TET,APY,EL,TEN,BOR,CC,COV,GOE,SZ,CASS,STAN,BER,CAN,WUR,EN,WOLF,QTZ,CALC,MONT,KAOL,CHL,ALAB,AD,RH,DOL,ANK,BAR,SID,CARY,MCAL,IN,RD,PXM,CHM,BUS,TEP,SM	Shikazono (1975), Tokunaga (1970), Yamada and others (1980)*, Toyoha Mines Co., Ltd. (written commun., 1983), Shikanozo (1985), El Shatoury and others (1978)
	Propylitic	10 fissure-filled veins		Au,CPY,QTZ	Grant (1950)*
	Silicic, propylitic, potassium silicate	Stockworks in fractures, 228 m depth	38	Au,Ag,ARG,STP,BOR,CPY,SPH,GAL,PROU,PYGR,PYR,EN,APY,CER,LIM,CGR,CALC,QTZ,AD,CHL,SER	Nolan (1936), Roberts and others (1971), Silberman and others (1979), Koschmann and Bergendahl (1968), U.S. Bureau of Mines (1900-1984)*

Table 1. Location, tonnage, grade, and geologic information for epithermal gold-silver districts—Continued

District	Country	Latitude	Longitude	Tonnage ($x10^6$)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Discovery year	Comments	Basement rocks	Host rocks
Unga	USAK	551600N	1604000W	0.605	5.1	171.0	0.4	1.2	1.0		Estimated prod. (1894-1906)		Miocene dacite and andesite
Uruachic	MXCO	275400N	1082600W	0.033	32.0	1,357.0	0.15	1.6	0.2		Prod. (1928-1941)	Paleozoic and Mesozoic limestone and quartzite	Tertiary andesite-rhyolite flows and breccias
Waihi	NZLD	372200S	1755400E	47.0	7.0	34.4	---	---	---	1878	Prod. (1883-1951) and reserves (1981)	Permian to Jurassic argillite, graywacke, conglomerate	Miocene dacite and andesite flows and tuffs
Washiaimori	JAPN	391330N	1405200E	1.0	---	24.0	2.9	---	---		5.9% pyrite; prod. (1905-1970)		Miocene rhyolite and andesite
Weaver (Virginia, Mocking Bird)	USAZ	353200N	1142800W	0.069	8.0	8.0	0.0007	0.002	---	1904	Prod. (1907-1955)	Precambrian granite, gneiss, and schist	M. Tertiary andesite
Wedekind	USNV	393347N	1194500W	0.002	7.8	1,954.0	---	---	---	1896	Prod. (1900-1938)	Mesozoic granodiorite	Miocene andesite-dacite flows
Winters	USCA	412133N	1205622W	0.017	20.9	14.7	---	---	---	1890	Estimated prod. (1902-1942) and reserves (1920)	Diorite	Tertiary andesite; Pleistocene basalts
Wonder	USNV	392631N	1180338W	0.38	6.2	549.0	0.0008	0.0005	---	1906	Prod. (1907-1965)	Triassic and Jurassic limestones and volcaniclastic rocks	U. Oligocene and l. Miocene rhyolite-rhyodacite flows and tuffs
Yahagi	JAPN	435145N	1432630E	0.0102	5.6	288.0	3.5	---	---		Prod. (1937-1954)		Miocene rhyolite
Yankee Fork	USID	442500N	1144500W	8.542	2.3	42.0	0.0001	0.0002	---	1875	Prod. (1875-1957) and reserves (1985)	Pennsylvanian quartzite and shale; Permian(?) andesite and rhyolite flows and tuffs; U. Jurassic and Cretaceous quartz monzonite	Oligocene andesite-latite flows, rhyolite flows
Yatani	JAPN	374630N	1400100E	1.27	1.3	50.0	0.1	2.3	4.6		11.6% pyrite; prod. (1870-1974)	Tertiary granodiorite; Miocene clastic sedimentary rocks and tuffs	Miocene dacite tuff-breccia, sandstone and shale
Yoquivo	MXCO	270000N	1073000W	0.136	12.0	1,234.0	---	---	---		Estimated prod. (no dates)		Tertiary andesite breccias, flows, and tuffs
Yugashima	JAPN	345250N	1385450E	0.1	24.0	204.0	---	---	---		Estimated prod. (1937-1945) and reserves (1946)		Miocene dacite
Zeh Abad	IRAN	363000N	0494000E	0.22	3.0	110.0	0.3	5.0	10.0		Reserves (1974)		Eocene andesite and rhyolite

Associated rocks	Alteration	Vein morphology	Age m.y.	Minerals	References
Oligocene to Pliocene sedimentary rocks		Veins in fractures, 1.5-12 m wide, several tens of m long		Au,PYR,GAL,SPH,CPY,Cu,QTZ,CALC, FELD	World Mining (1982)*, Koschmann and Bergendahl (1968), Elevatorski (1982)*
		Veins		Au,GAL,SPH,CPY	Gonzales Reyna (1946)*, Wisser (1966)
Pliocene rhyolites	Propylitic, silicic, argillic	Quartz veins and vein breccia in a conjugate system of fissures, trend N-NE, dip steeply NW, 183-244 m depth, up to 2.2 km long, up to 30 m wide		PYR,SPH,GAL,CPY,PYGR,AC,STIB,AS, MOLY,Au,HES,EL,APY,AGU,MARC,BOR, CC,COV,QTZ,CALC,RH,KAOL,AD,CHL,OR, CHR,MAL,MCAL	Williams (1974), Main (1979), Mining Magazine (1981a)*, Boyle (1979), Laznicka (1973)*
Miocene granites; Pleistocene volcanic rocks	Silicic, chloritic, sericitic	Veins in N-S, E-W fissures, up to 900 m long, 0.4 m wide		PYR,CPY,QTZ	Yamada and others (1980)*
Tertiary porphyry dikes	Silicic, sericitic, propylitic	Veins trend N70°E, dip 20°-30° NW, 609 m long, up to 1.5 m wide, average 0.76 m wide		Au,Ag,HEM,PYR,GAL,CPY,QTZ,AD,CALC	Koschmann and Bergendahl (1968), Keith and others (1983)*
	Silicic, propylitic	Stockworks in NW- and N-trending fractures, lenses and stringers in fracture zones; oxidized ore extends down to 64 m depth, sulfide ore down to 122 m depth		Au,GAL,ARG,SPH,CGR,CER,ANG,Fe oxides,QTZ,ILL,CHD	Bonham (1969)*, U.S. Bureau of Mines (1900-1984)*
		Veins 0.9-3 m wide, trend E-W, dip 55°S, 46 m long, 61 m depth; brecciated		Au,PYR,QTZ,CALC,AD,GYP	Neale (1926), Averill (1936), Elevatorski (1982)*, Weed (1920)*, U.S. Bureau of Mines (1900-1984)*, Hill (1915), Clark (1970)
Andesite and basalt flows and intrusions	Silicic, potassium silicate, pyrite	Veins trend N25°W, dip 75°E, up to 12 m wide, 609 m depth; oxidized down to 396 m depth; tabular siliceous veins in fissures and shear zones	21.6	Au,ARG,EMB,IODB,IOD,EL,BRM,CPY, GAL,SPH,LIM,PSL,CGR,QTZ,AD,OR,FL, KAOL,SER	Willden and Speed (1974)*, Buchanan (1981), Koschmann and Bergendahl (1968), Silberman and Roberts (1973)
Miocene rhyolite; Pliocene welded tuff	Silicic, potassium silicate, propylitic	Veins in E-trending fractures, 400-500 m long, 0.3-0.5 m wide		Au,CPY,QTZ,AD,CALC,CHL	Yamada and others (1980)*
Oligocene tuff and shale; l. Miocene intrusions of granophyre, dacite porphyry, quartz monzonite porphyry, monzonite, granite, and rhyolite porphyry	Silicic, chloritic, sericitic, pyritic	Veins, breccias, stockworks, and chimneys in fractures and shear zones; veins trend N15°-80°E, dip 18°-85°NW, and N10°-80°W, 50°-65°NE; veins up to 762 m long, 457 m depth, 5.5 m wide; rich pockets near the surface; banding and crustification		PYR,CPY,SPH,TET,APY,EN,GAL,STP, MIG,PYGR,ARG,AGU,Au,EL,CGR,Ag,AZ, MAL,CC,COV,SMTH,PYL,QTZ,AD,CALC, OPAL,ALB,BAR,DOL	Anderson (1949)*, Umpleby (1913), Mining Journal (1984)*, U.S. Bureau of Mines (1900-1984)*
Miocene rhyolite and andesite intrusions	Argillic, propylitic, sericitic	Veins in E-W shear zone, trend N70°W-N55°E, 170-1,700 m long, 1.4-4 m wide; veins show breccia, cockade, or crustified banding structures		SPH,GAL,CPY,PO,MARC,STAN,APY,EL, ARG,CASS,QTZ,AD,RH,CHL,MUSC,RD, MONT,SER,CALC,PRHN	Hattori (1975), Urabe (1977), Yamada and others (1980)*, Shikanozo (1985)
Tertiary feldspar porphyries, latite, rhyolite	Silicic, propylitic, argillic	Veins in fault fissures, trend N5°-40°E, dip 60°-75°E, 305 m long, 305 m depth, 5 m wide		PYR,CPY,GAL,SPH,ARG,COV,BOR,STRM, STP,MAL,CHR,Au,Ag,QTZ,AD,CHD,CALC	Hall and Trenton (1926), Buchanan (1981), Elevatorski (1982)
Miocene andesites and rhyolite tuffs; Pliocene dacite	Propylitic, potassium silicate	Veins in faults, 510 m long, 2 m wide		Au,ARG,PYR,CPY,QTZ,CALC,AD	Grant (1950)*, Yamada and others (1980)
	Silicic, potassium silicate	Stockwork and breccia zone, 300 m long, 1 m wide		GAL,SPH,PYR,CPY,QTZ,AD,CALC	Wright (1964)*, Schmidt (1974)*, Laznicka (1973)

Table 2. Abbreviations for minerals and elements presented on table 1

Abbreviation	Mineral or element	Abbreviation	Mineral or element	Abbreviation	Mineral or element	Abbreviation	Mineral or element
AC	Acanthite	CHL	Chlorite	JOH	Johannsenite	RD	Rhodonite
AD	Adularia	CHM	Chamosite	K	Potassium	REAL	Realgar
Ag	Silver	CHR	Chrysocolla	KAOL	Kaolinite	RH	Rhodochrosite
AGN	Aragonite	CIN	Cinnabar	KLAP	Klaprothite	RIC	Rickardite
AGU	Aguilarite	CLAY	Clay	KREN	Krennerite	ROC	Rocartite
AIK	Aikinite	CLS	Colusite	LAUM	Laumannite	ROS	Roscoelite
AL	Alunite	CLU	Clausthalite	LDH	Leadhillite	S	Sulfur
ALAB	Alabandite	COL	Coloradoite	LEV	Leverrierite	SAP	Saponite
ALB	Albite	COV	Covellite	LIM	Limonite	SCD	Scorodite
ALLO	Allophane	CPY	Chalcopyrite	LUZ	Luzonite	SCH	Schirmerite
ALT	Altaite	CST	Chalcostibite	MACK	Mackayite	Se	Selenium
AMY	Amethyst	Cu	Copper	MAG	Magnetite	SEL	Selenide
AN	Anatose	CUB	Cubanite	MAL	Malachite	SEM	Semseyite
ANG	Anglesite	CUP	Cuprite	MARC	Marcasite	SER	Sericite
ANH	Anhydrite	DIA	Diaspore	MAT	Matildite	SM	Smectite
ANK	Ankerite	DIAP	Diaphorite	MAW	Mawsonite	SMTH	Smithsonite
ANR	Andorite	DIC	Dickite	MCAL	Manganocalcite	Sn	Tin
ANT	Anthite	DIG	Digenite	MEL	Melonite	SPEC	Specularite
AP	Apatite	DOL	Dolomite	MELT	Melanterite	SPH	Sphalerite
APL	Arsenopolybasite	EL	Electrum	MIG	Miargyrite	SS	Sulfosalt
APY	Arsenopyrite	EMB	Embolite	Mn	Manganese	STAN	Stannite
ARG	Argentite	EMP	Empressite	MNG	Manganite	STIB	Stibnite
ARM	Aramayoite	EN	Enargite	MOLB	Molybdite	STIL	Stilbite
As	Arsenic	EP	Epidote	MOLY	Molybdenite	STP	Stephanite
ASB	Asbestos	EPL	Emplectite	MONT	Montmorillonite	STRM	Stromeyerite
Au	Gold	FAH	Fahlore	MOT	Mottramite	STRN	Sternbergite
AUT	Autunite	FAM	Famatinite	MUSC	Muscovite	SYL	Sylvanite
AZ	Azurite	Fe	Iron	Na	Sodium	SZ	Szmikite
BAR	Barite	FELD	Feldspar	NAC	Nacrite	Te	Tellurium
BEID	Beidellite	FL	Fluorite	NAUM	Naumannite	TEIN	Teineite
BER	Berthierite	FMO	Ferrimolybdite	OPAL	Opal	TEL	Tellurite
BET	Betekhtinite	FRI	Freibergite	OR	Orthoclase	TEN	Tennantite
BIOT	Biotite	GAL	Galena	ORP	Orpiment	TEP	Tephroite
Bi	Bismuth	GDF	Goldfieldite	OWY	Owyheeite	TET	Tetrahedrite
BIS	Bismuthinite	GOE	Goethite	Pb	Lead	TL	Telluride
BOR	Bornite	GRA	Graphite	PCGR	Pyracerargyrite	TLB	Telluro-bismuthite
BOUL	Boulangerite	GUAN	Guanajuatite	PEAR	Pearceite		
BOUR	Bournonite	GYR	Gyrolite	PETZ	Petzite	TNR	Tenorite
BRCH	Brochantite	GYP	Gypsum	PLAG	Plagioclase	TOUR	Tourmaline
BRM	Bromyrite	HAL	Halloysite	PO	Pyrrhotite	TUR	Turquoise
BUS	Bustamite	HEM	Hematite	POLY	Polybasite	VAL	Valencianite
CALC	Calcite	HES	Hessite	POW	Powellite	VAN	Vanadinite
CALD	Caledonite	HINS	Hinsdalite	PRHN	Prehnite	VIV	Vivianite
CALV	Calaverite	HMC	Hydromica	PROU	Proustite	VOL	Volynskite
CAN	Canfieldite	HMM	Hemimorphite	PSL	Psilomelane	WAD	Wad
CARB	Carbonates	HUB	Huebnerite	PTC	Pitchblende	WAIR	Wairakite
CARY	Caryopilite	HYA	Hyalite	PXM	Pyroxmangite	WEH	Wehrlite
CASS	Cassiterite	ILL	Illite	PYGR	Pyrargyrite	WOLF	Wolframite
CC	Chalcocite	IOD	Iodyrite	PYST	Pyrostilpnite	WUF	Wulfenite
CEL	Celestite	IODB	Iodobromite	PYL	Pyrolusite	WUR	Wurtzite
CER	Cerussite	IN	Inesite	PYPH	Pyrophyllite	XAN	Xanthoconite
CGR	Cerargyrite	JAL	Jalpaite	PYR	Pyrite	XON	Xonotlite
CH	Chert	JAM	Jamesonite	PYRM	Pyromorphite	ZEOL	Zeolite
CHC	Chalcanthite	JAR	Jarosite	QTZ	Quartz	Zn	Zinc
CHD	Chalcedony	JAS	Jasper	RAUM	Raumonite	ZUN	Zunyite

Table 3. Names of countries for the abbreviations used in table 1

AGTN	Argentina
CILE	Chile
CNBC	Canada, British Columbia
CNYT	Canada, Yukon Territory
ELSA	El Salvador
FIJI	Fiji
HNDR	Honduras
IRAN	Iran
JAPN	Japan
MXCO	Mexico
NCRG	Nicaragua
NZLD	New Zealand
PERU	Peru
PLPN	Philippine
TIWN	Taiwan
TRKY	Turkey
USAK	U.S. Alaska
USAZ	U.S. Arizona
USCA	U.S. California
USCO	U.S. Colorado
USID	U.S. Idaho
USMT	U.S. Montana
USNM	U.S. New Mexico
USNV	U.S. Nevada
USOR	U.S. Oregon
USUT	U.S. Utah
USWA	U.S. Washington

Table 4. Miscellaneous abbreviations used in table 1

cm	centimeter
E	east
g	gram
km	kilometer
L.	Lower
l.	lower
m	meter
M.	Middle
m.	middle
m.y.	million year
N	north
prod.	production
S	south
t	metric ton
U.	Upper
u.	upper
W	west

Table 5. Synonyms of gold-silver district names

[Synonyms of district names are listed in alphabetical order for convenience in identifying the districts in table 1 that may be known by other names or are included with other districts]

Synonym of district name	Country	District name (table 1)
Alto de la Blenda	AGTN	Farallon Negro
Alpamara	PERU	Rio Pallanga
Alurcakoy	TRKY	Arapdagi
Apache	USNM	Chloride
Animas Fork	USCO	Eureka
Arakawa	JAPN	Kushikino
Aroroy	PLPN	Masbate
Bell Mountain	USNV	Fairview
Buckskin	USNV	National
Cailloma	PERU	Madrigal
Camp Bird	USCO	Sneffels
Carson	USID	Silver City
Clinton	CNBC	Black Dome Mountain
Comobabi	USAZ	Cababi
Deer Lodge	USNV	Eagle Valley
De Lamar	USID	Silver City
Desert	USNV	Gilbert
El Rosario	HNDR	Rosario
Esmeralda	USNV	Aurora
Eureka	USWA	Republic
Fay	USNV	Eagle Valley
Flathead	USMT	Hog Heaven
Flint	USID	Silver City
French	USID	Silver City
Gladstone	USCO	Eureka
Galena	USCO	Lake City
Gold Mountain	USNV	Divide
Gold Road	USAZ	Oatman
Gold Springs	USUT	Stateline
Huanuco	PERU	Provenir
Indian Springs	USNV	Como
Iron Springs	USCO	Ophir
Kerber Creek	USCO	Bonanza
Kimberly	USUT	Gold Mountain
Klondyke	USNV	Klondike
Lake Fork	USCO	Lake City
Oe	JAPN	Ohe
Oguchi	JAPN	Ohguchi
Otani	JAPN	Mikawa
Palmyra	USNV	Como
Phonolite	USNV	Bruner
Pioneer	USNV	Bullfrog
Rand	USNV	Bovard
Real Del Monte	MXCO	Pachuca
Red Mountain	USNV	Silver Peak
Regent	USNV	Rawhide
Rhyolite	USNV	Bullfrog
Rosamond	USCA	Mohave
Royston	USNV	San Antone
San Dimas	MXCO	Tayoltita
San Francisco	USAZ	Katherine and Oatman
San Juan de Castrovirreyna	PERU	Chavin
Shikaku	JAPN	Furokura
South Silverton	USCO	Animas
Temascaltepec	MXCO	El Rincon
Tochigi	JAPN	Nikko
Union Pass	USAZ	Katherine
Upper San Miguel	USCO	Telluride
Vatukoula	FNLD	Tavua
Ventanas	MXCO	La Libertad
Virginia	USAZ	Weaver
Virginia City	USNV	Comstock
Vivian	USAZ	Oatman
White Horse	USNV	Olinghouse

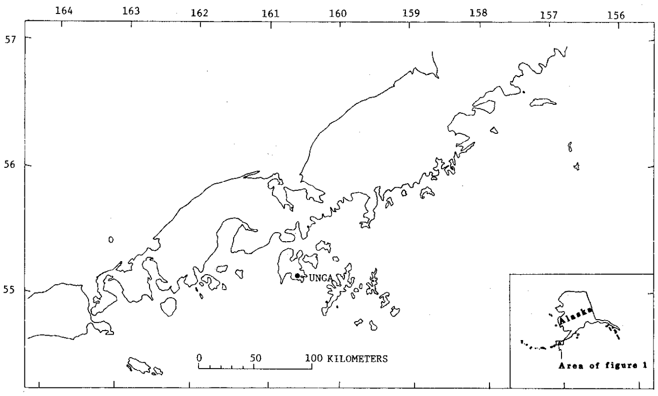

Figure 1. Gold-silver districts of Alaska, U.S.A.

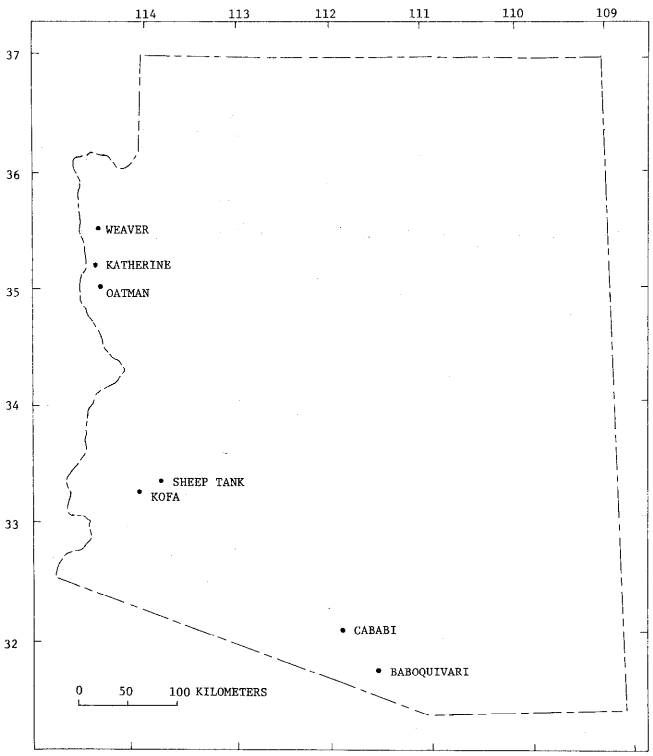

Figure 2. Gold-silver districts of Arizona, U.S.A.

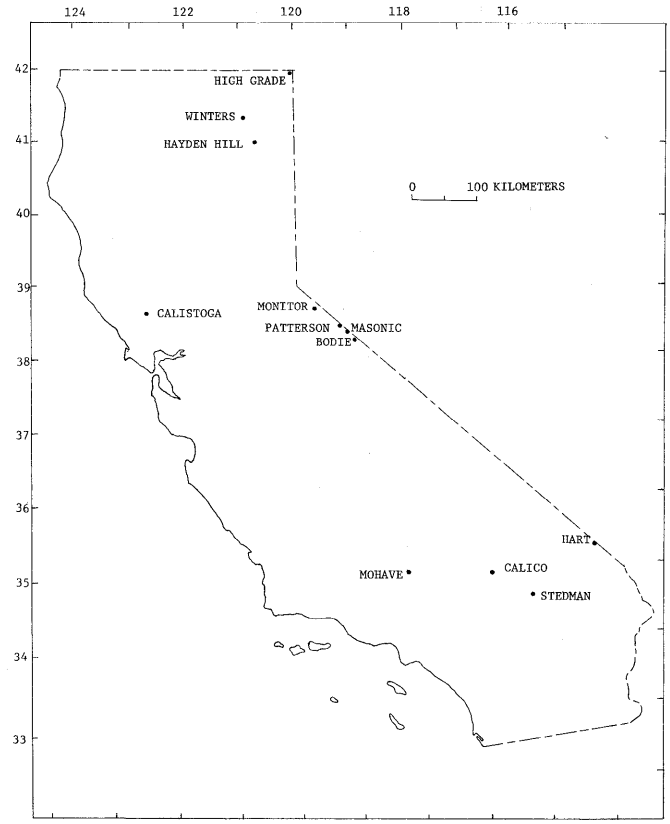

Figure 3. Gold-silver districts of California, U.S.A.

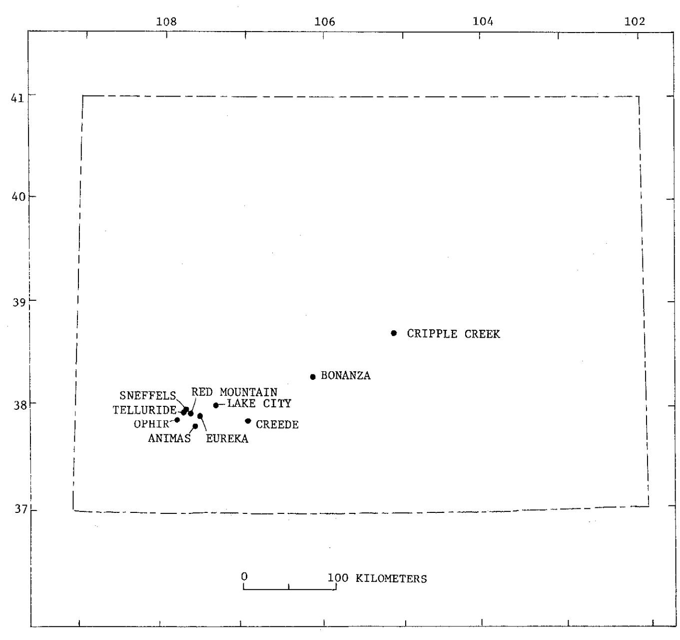

Figure 4. Gold-silver districts of Colorado, U.S.A.

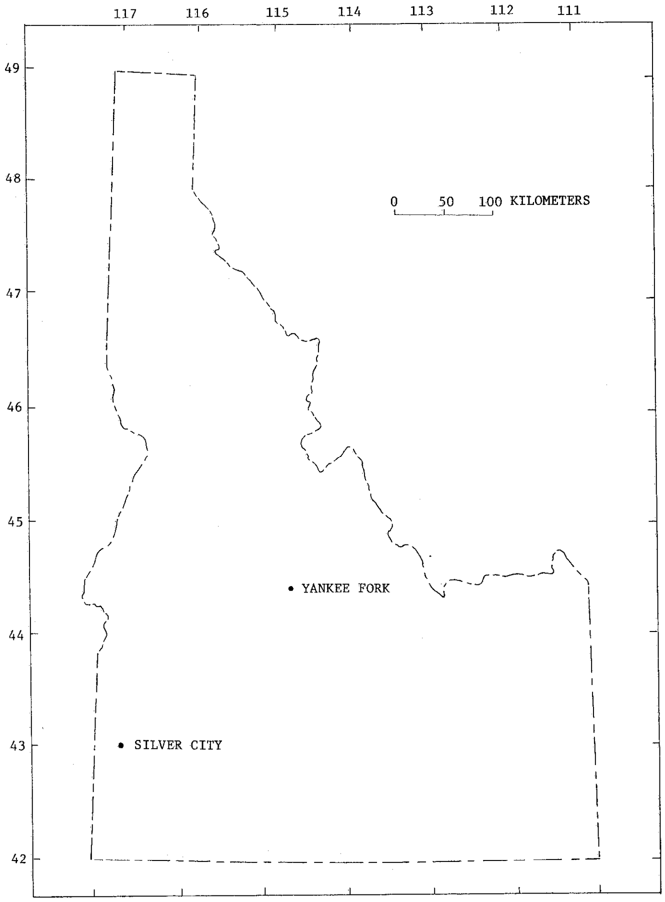

Figure 5. Gold-silver districts of Idaho, U.S.A.

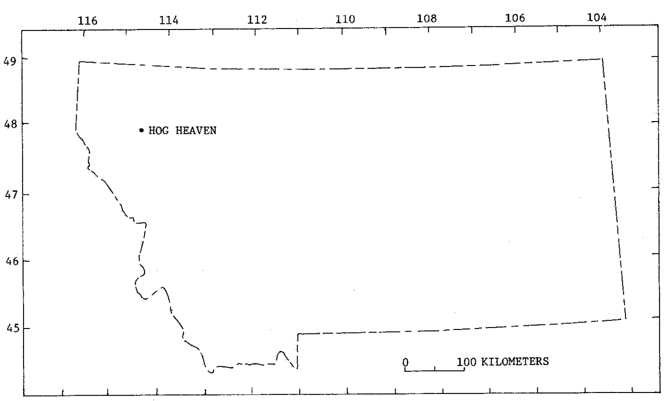

Figure 6. Gold-silver districts of Montana, U.S.A.

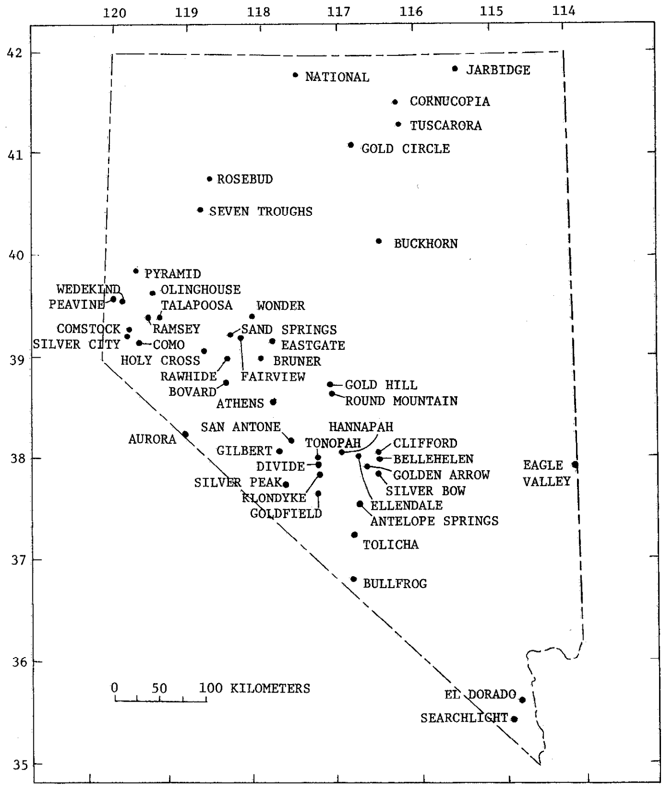

Figure 7. Gold-silver districts of Nevada, U.S.A.

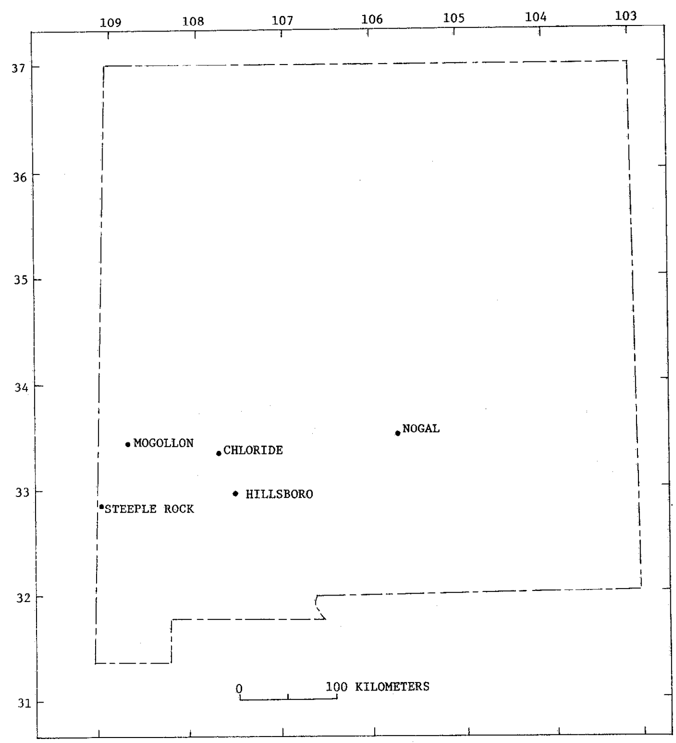

Figure 8. Gold-silver districts of New Mexico, U.S.A.

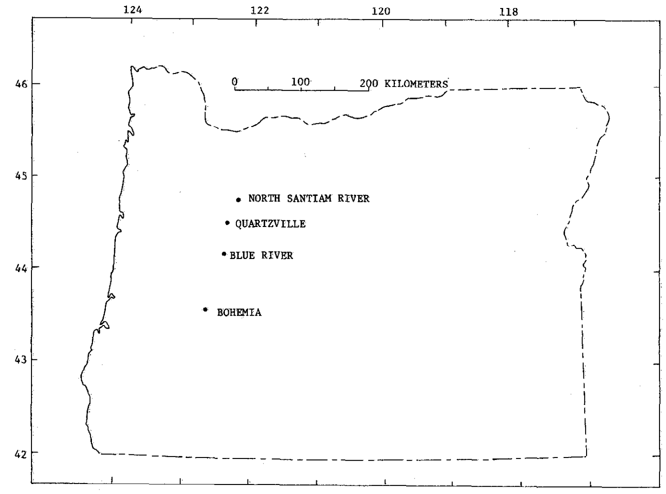

Figure 9. Gold-silver districts of Oregon, U.S.A.

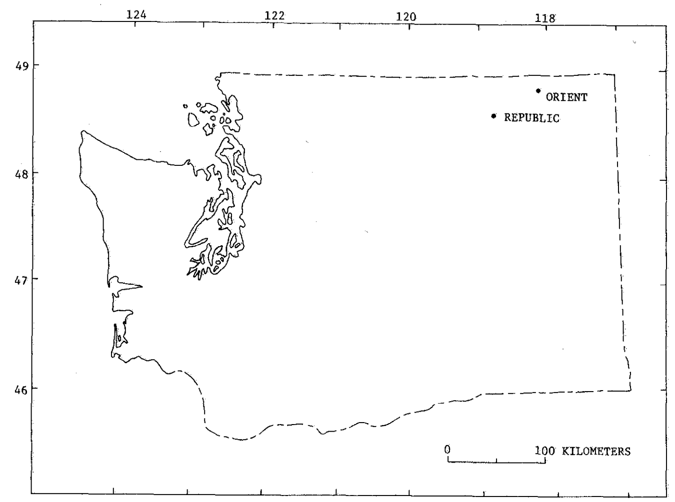

Figure 11. Gold-silver districts of Washington, U.S.A.

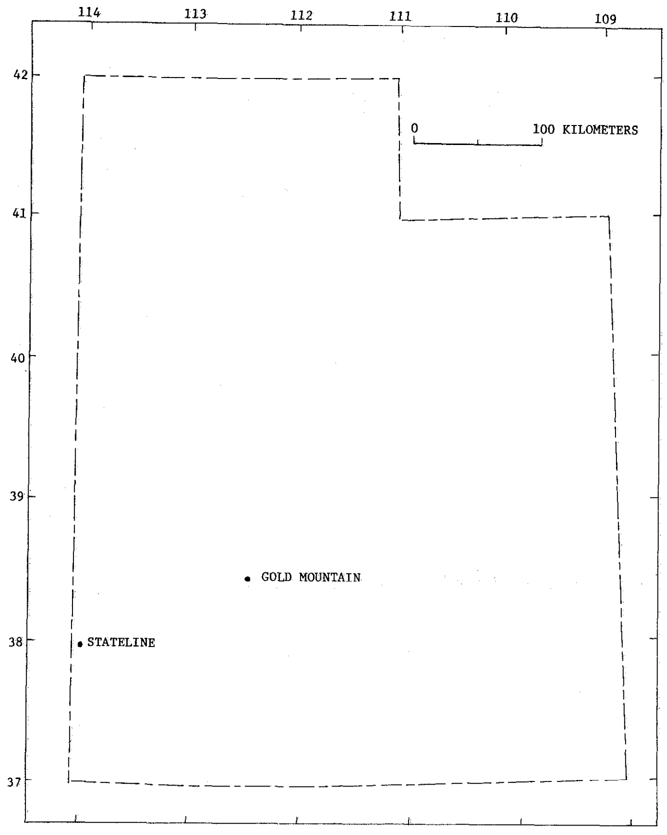

Figure 10. Gold-silver districts of Utah, U.S.A.

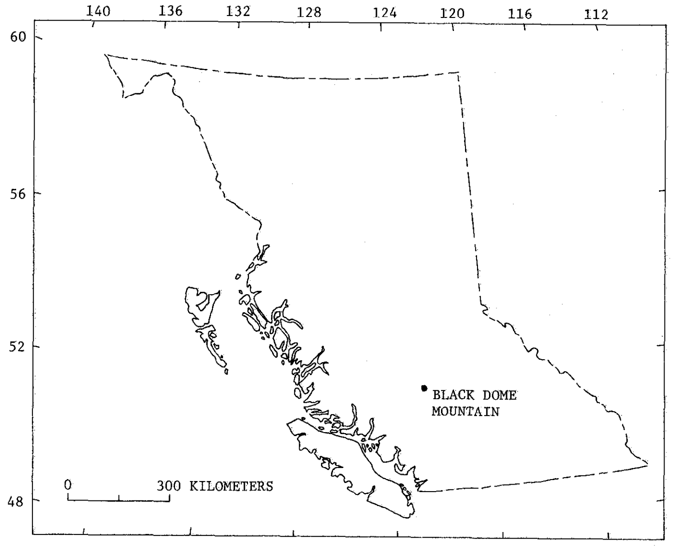

Figure 12. Gold-silver districts of British Columbia, Canada.

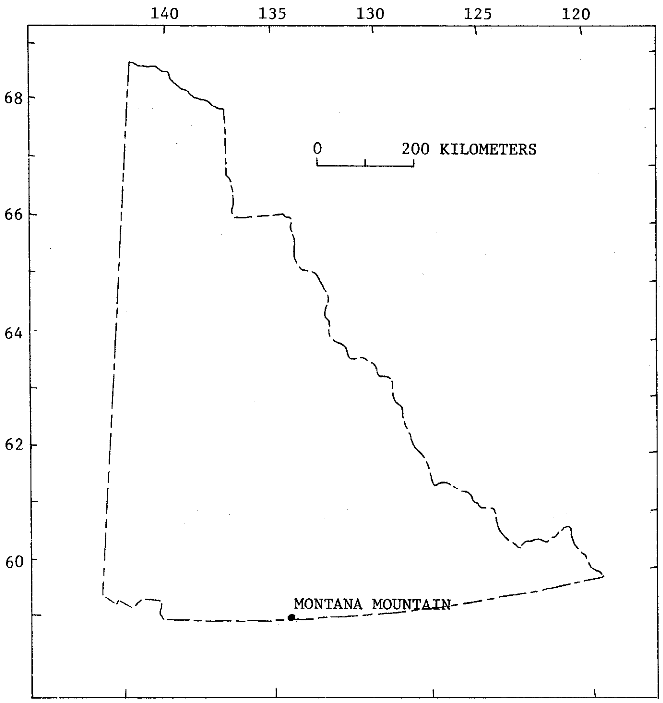

Figure 13. Gold-silver districts of Yukon Territory, Canada

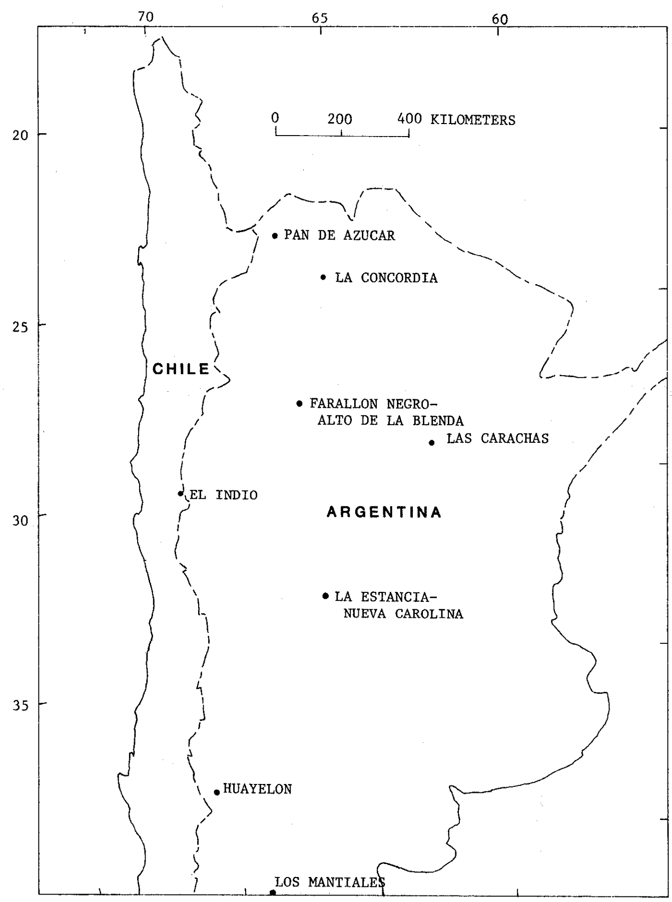

Figure 14. Gold-silver districts of Chile and Argentina.

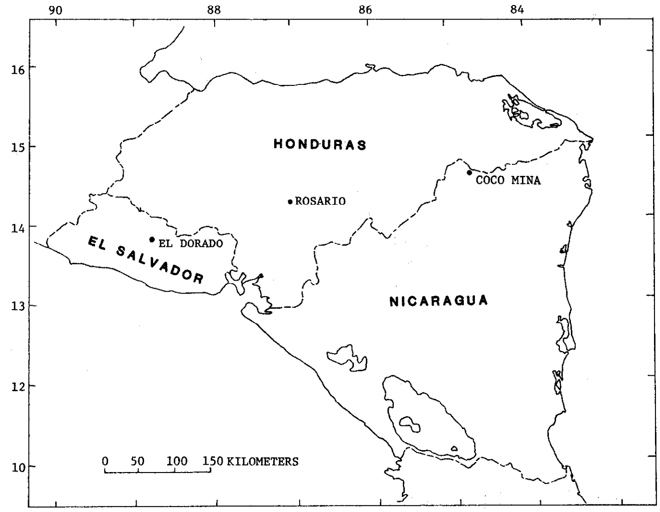

Figure 15. Gold-silver districts of El Salvador, Honduras, and Nicaragua.

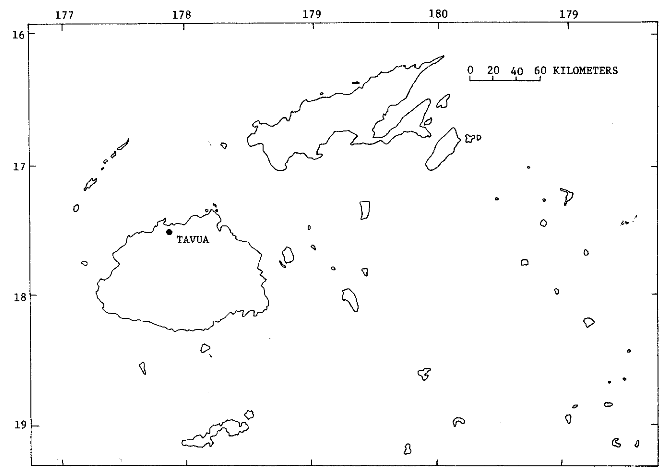

Figure 16. Gold-silver districts of Fiji.

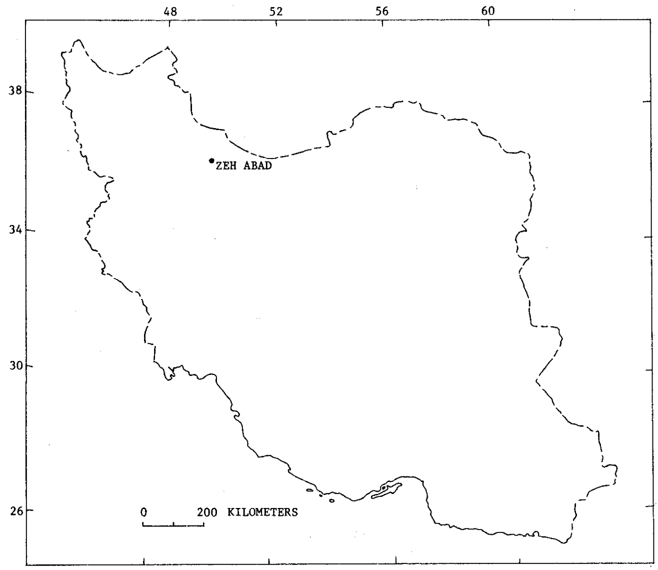

Figure 17. Gold-silver districts of Iran.

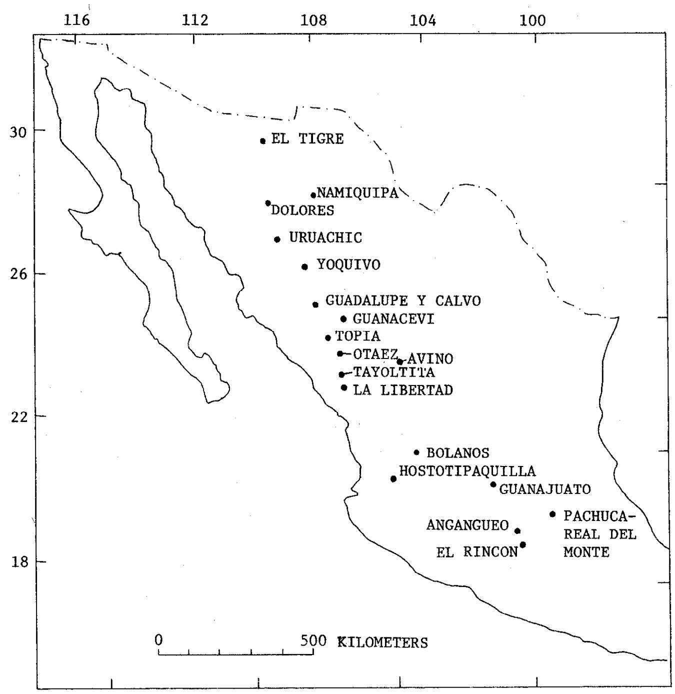

Figure 19. Gold-silver districts of Mexico.

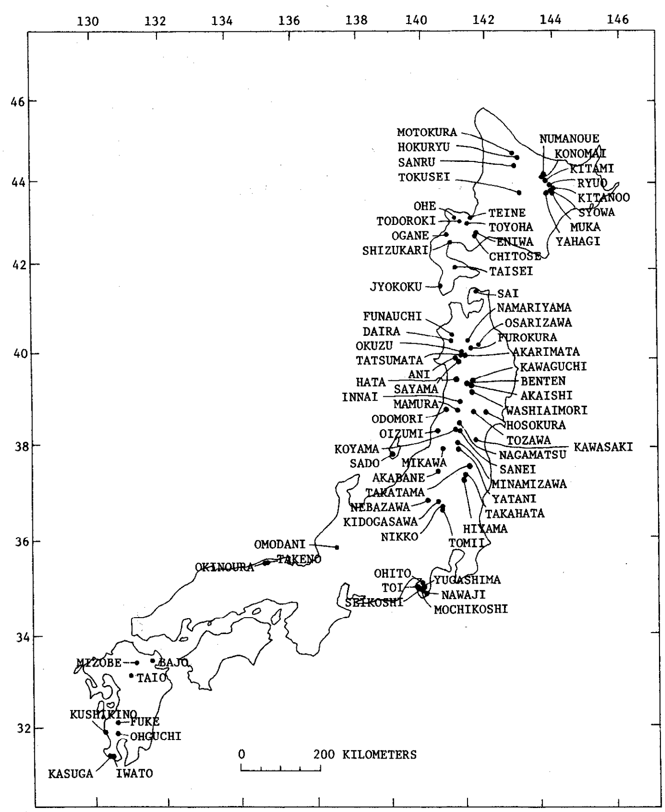

Figure 18. Gold-silver districts of Japan.

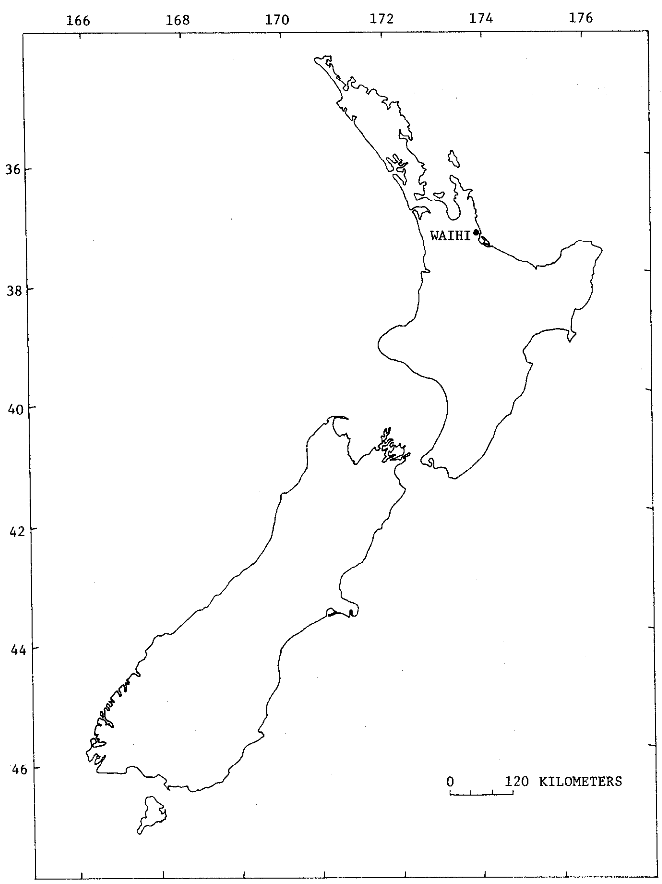

Figure 20. Gold-silver districts of New Zealand.

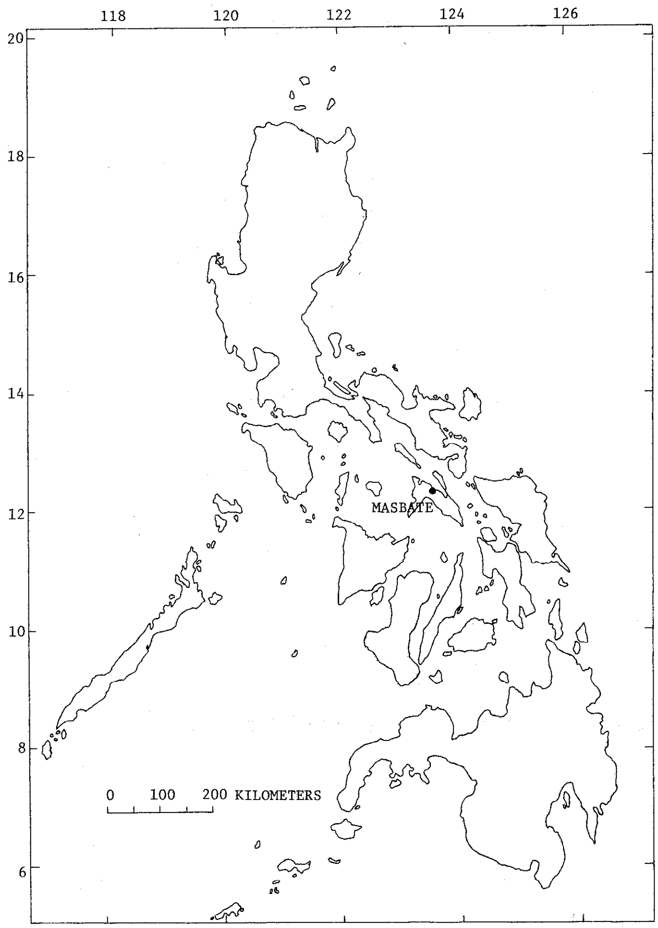

Figure 21. Gold-silver districts of Philippines.

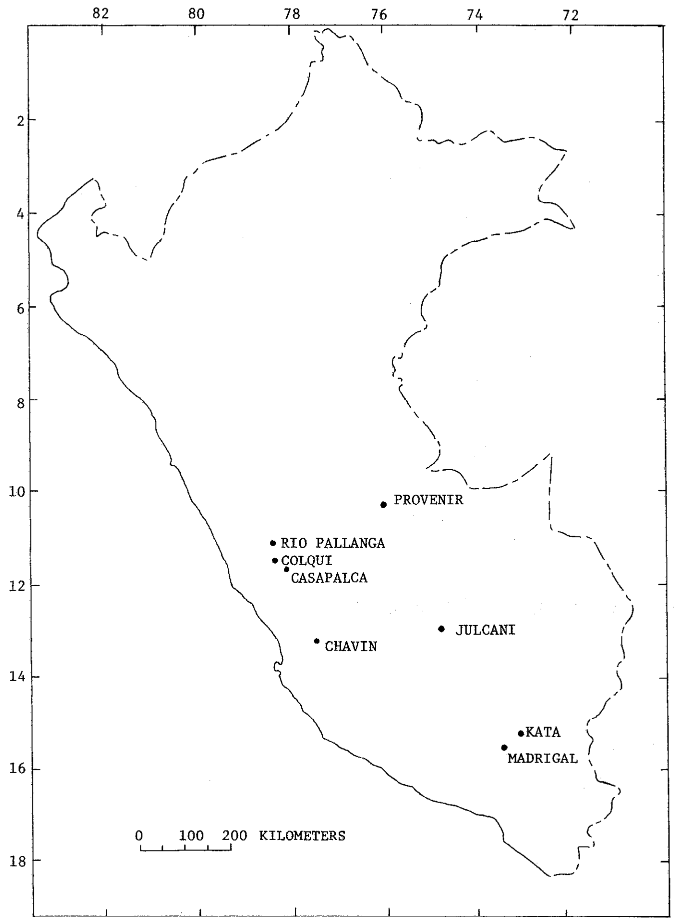

Figure 22. Gold-silver districts of Peru.

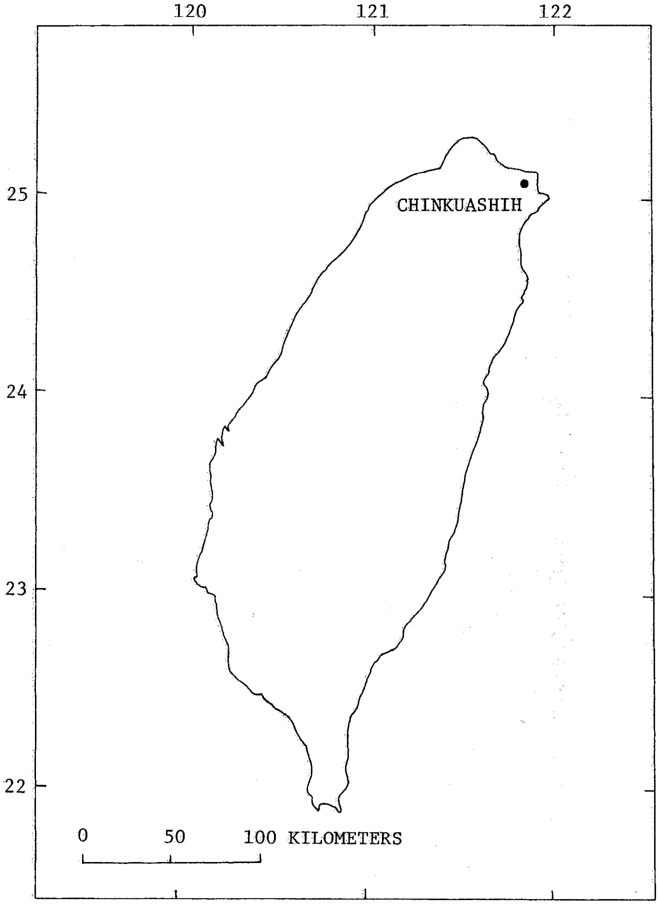

Figure 23. Gold-silver districts of Taiwan.

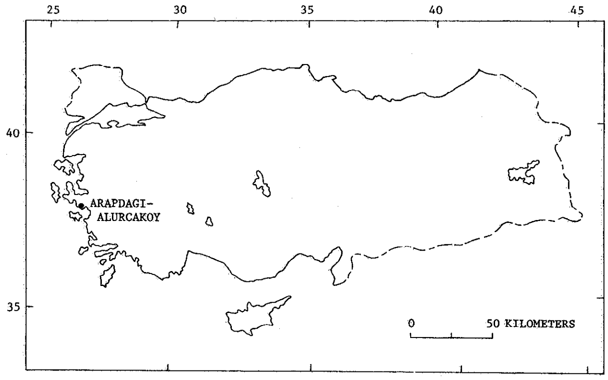

Figure 24. Gold-silver districts of Turkey.