MAP I-1310-B

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

# MINERAL DEPOSIT MAP OF THE SILVER CITY 1° x 2° QUADRANGLE, NEW MEXICO AND ARIZONA

By D. H. Richter and V. A. Lawrence

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RICHTER AND LAWRENCE—MINERAL DEPOSITS, SILVER CITY, N. MEX.–AZ. 1:250,000 MAP I-1310-B

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TO ACCOMPANY MAP I-1310-B

# MINERAL DEPOSIT MAP OF THE SILVER CITY 1°×2° QUADRANGLE, NEW MEXICO-ARIZONA

By D. H. Richter and V. A. Lawrence

This pamphlet, which accompanies map I-1310-B, is a descriptive compilation of more than 600 mineral deposits in the Silver City 1°× 2° quadrangle. It includes both metallic and nonmetallic deposits, but excludes such commodities as sand and gravel, rock, and most other low cost per unit volume construction materials. The compilation is generally restricted to deposits that have been described in the literature, although data for a few deposits are from unpublished sources.

Individual descriptions of deposits are grouped under the 10 regional areas shown on the accompanying map, plus an intervening general basin area, and are numerically keyed to each area on the map. The following information for each deposit, or group of deposits, is provided:

*Name*—Most commonly used name; other known names are shown in parentheses. No attempt is made to categorize name; name may refer to a mine, prospect, claim, claim group, or specific mine working, such as a shaft, adit, or tunnel. Leaders indicate deposits whose names are unknown.

*Location*—All locations are given by section, township, and range, generally to within a quarter section.

*Geology*—Brief description of deposit, including information on the age and nature of the host rocks, where known. Leaders indicate no information available.

*Ore minerals*—List of ore minerals known to occur in deposit with important ore minerals, if known or appropriate, underlined. Leaders indicate no information available.

*History and development*—Brief history of deposit and description of physical workings. Tonnage and grade figures are given, if data are available.

*Production*—Where data are available the quantity of metal or commodity produced is given. If only monetary values have been reported, they are shown in time-of-production dollars.

*References*—Principal sources of information for preceding data. References are keyed numerically to the reference list in back of pamphlet. Where no references are shown, information is from unpublished data gathered by the authors.

All weights and measures used in the descriptions are in the metric system. Conversion factors relating to gold and silver quantities and grades are as follows:

metric ton × 1.1 = short ton

kilogram × 32.15 = troy ounce

gram/metric ton (g/t) × 0.029 = troy ounce/short ton

GILA AND NORTHERN PELONCILLO MOUNTAINS AREA (includes Ash Peak and Lone Star mining districts)

HYDROTHERMAL DEPOSITS

## Porphyry Cu (Mo) Deposits

The porphyry copper and closely associated copper vein deposits in the Lone Star mining district are genetically related to a group of small, chiefly granodiorite plutons and silicic to intermediate hypabyssal rocks of Late Cretaceous to early Tertiary age (67-52 m.y.) emplaced along wide ENE-trending shear zones in Late Cretaceous (70 m.y.) andesite flows and breccias.

Copper minerals were discovered in the Lone Star district about 1886 and between then and the early 1940's exploration and mining activity was focused on the high grade copper vein deposits. With the exception of the San Juan mine (map no. 2), data on mining activity and production are virtually non-existent for the many small mines that operated during that period. The porphyry copper potential of the district was recognized in the late 1940's.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Dos Pobres (Phelps Dodge-Safford) | Sec. 27 T. 5 S., R. 26 E. | Sulfide veins and disseminations in fragmented quartz monzonite porphyry dikes (52 m.y.) and host andesite volcanics at apex of granodiorite pluton localized at intersection of ENE shear zone and NE-trending drag fold. Supergene enrichment minor | Primary minerals--chalcopyrite, bornite, molybdenite. Oxide and supergene minerals--chrysocolla, cuprite, native copper, chalcocite, covellite | Discovered in 1957 and being developed in 1980 for modified underground block caving. Deposit contains 363 million metric tons of 0.72% Cu with values in $MoS_2$, Au, and Ag | None | 109, 131, 155, 160, 190, 191, 209 |
| 2 | San Juan (Peacock Mine) | Sec. 35 T. 5 S., R. 26 E. | Secondary copper minerals in veins and disseminations in quartz monzonite porphyry pluton (58 m.y.) and its granodiorite porphyry border zone, breccia pipes, and host andesite volcanics. Pluton intrudes ENE shear zone. Supergene enrichment minor | Oxide and supergene minerals--chrysocolla, brochantite, malachite, azurite, cuprite, chalcocite | Discovered about 1886 and worked as underground mine probably between 1905 and 1920. Developed for surface in situ leaching in 1960's. Present (1980) leaching operations producing about 7 metric tons of Cu daily. Deposit contains 18 million metric tons of 0.5% Cu in oxide ore | Minimum of 340 metric tons of Cu produced prior to 1920. Estimated 10,000 metric tons Cu from leaching operations | 10, 35, 100, 160, 190, 191, 193 |
| 3 | Safford Kennecott | Sec. 5 T. 6 S., R. 27 E. | Sulfide veins and disseminations in swarm of silicic to intermediate dikes and andesite volcanics in ENE shear zone north of Lone Star granodiorite pluton (58 m.y.). Sericite from alteration halo dated at 53 m.y. Extensive oxidized zone but minor supergene enrichment. Ore body covered by as much as 240 m of middle Tertiary volcanic rocks | Primary minerals--chalcopyrite, bornite, molybdenite. Oxide and supergene minerals--chrysocolla, malachite, brochantite, chalcocite, covellite | Discovered in 1955 and subsequently developed for underground solution mining. Inactive in 1980. Deposit contains 1,800 million metric tons of 0.41% Cu in mixed oxide--sulfide ore with values in $MoS_2$, Au, and Ag | None | 2, 19, 33, 43, 130, 190 |
| 4 | Horseshoe | NW1/4sec. 17 T. 6 S., R. 27 E. | Secondary copper minerals in veins and disseminations in quartz monzonite porphyry and host andesite volcanics | Oxide minerals--chrysocolla, malachite, brochantite | Developed by 2 shafts and adit prior to 1920 for high grade oxidized ore in shear zones and along porphyry--volcanic contact. Inactive in 1980. Deposit contains estimated 70,000 metric tons of 1.0% Cu to depth of 15 m | None | |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 5 | Sanchez (Safford Inspiration) | NE1/4sec. 26 T. 6 S., R. 27 E. | Secondary copper minerals in veins and disseminations in quartz monzonite porphyry pluton and host andesite volcanics | Oxide minerals--chrysocolla, brochantite | Old shaft indicates considerable early underground development. In 1970's developed for leaching operation. Inactive in 1980. Deposit contains 72 million metric tons of 0.18% Cu in oxide ore | About 7 metric tons Cu | 100, 190, 191 |
| 6 | SOL | Secs. 23, 24, 25, 26 T. 7 S., R. 27 E. | Sulfide system in monzonite pluton and host andesite volcanics overlain by as much as 200 m of Quaternary and Tertiary lacustrine and alluvial deposits | Primary minerals--chalcopyrite(?) | Discovered in 1970's by geophysical and geochemical surveys. Extensively drilled. Inactive in 1980. Deposit contains 3-15% sulfides | None | 210 |
| | | | Cu Vein Deposits | | | | |
| | Same geologic environment as the porphyry copper deposits. Early activity in the Lone Star mining district was restricted chiefly to exploration and mining of these high grade oxidized veins that are localized in shear zones generally peripheral to the known porphyry deposits. Only a few of the many vein deposits in the district are described below. | | | | | | |
| 7 | Ben Hur | N1/2sec. 36 T. 5 S., R. 26 E. | Secondary copper minerals and quartz in 0.5 m-wide shear zone (N75°E, 85°S) along contact of brecciated felsic dike and Late Cretaceous andesite volcanics | Chrysocolla | Old shallow shaft and trenches. Inactive in 1980 | - - - - - - - - - | |
| 8 | Au | NE1/4sec. 8 T. 6 S., R. 27 E. | Secondary copper minerals and thin quartz stringers in shear zone (N65°E, vert) in Late Cretaceous andesite volcanics | Chrysocolla | Old shaft, >10 m deep, and trench. Inactive in 1980 | - - - - - - - - - | |
| 9 | group of 5 prospects | SE1/4sec. 8, SW1/4sec. 9, NW1/4sec. 16 NE1/4sec. 17 T. 6 S., R. 27 E. | Secondary copper and iron minerals and quartz in thin (<1 m) shear zones trending between N75°E and E-W in Late Cretaceous andesite volcanics | Chrysocolla | Old shafts, adits, and pits. Inactive in 1980 | - - - - - - - - - | |
| 10 | Lone Star | C sec. 7 T. 6 S., R. 27 E. | Secondary copper and iron minerals, quartz, and jarosite in shear zones in Late Cretaceous andesite volcanics | Chrysocolla | Old shafts and pits. Inactive in 1980 | Possibly as much as 15,000 metric tons Cu, 170 kg Ag, and 11 kg Au. Figures may include production from other mines in district | 100 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| | | | **Ag (Au) Vein Deposits** | | | | |
| | Veins restricted to sequence of amygdaloidal andesite and basaltic andesite of middle Tertiary age. Early (1900-1936) mining activity and production record virtually unknown. | | | | | | |
| 11 | Ash Peak (Shamrock and Commerce Shafts) | SE1/4sec. 3, NW1/4sec. 11 T. 8 S., R. 30 E. | Quartz- and calcite-filled fissure vein, as wide as 6 m, along 3 km length of major fault zone trending N60°W and dipping 80°S in middle Tertiary volcanic rocks. Vein locally brecciated | Argentite | Discovered about 1900. By 1919 had been developed by 2 shafts and more than 2000 m of underground workings. Apparently inactive 1920-1936. Reopened in 1936 with major production between 1936 and 1939, closed in 1940. Grade of 59,000 metric tons of ore (1938) was 377 g/t Ag, and 0.87 g/t Au. In 1979 mill under construction to treat 20,000 metric tons of old mill tailings reportedly averaging about 116 g/t Ag | Probably more than 97,000 kg Ag and 403 kg Au, with some Cu and Pb | 35, 100, 122, 135 |
| 12 | Compensation | N1/2sec. 3 T. 8 S., R. 30 E. | Quartz fissure vein as wide as 5 m north of and subparallel to vein of the Ash Peak mines | Argentite?, secondary copper minerals | Located 1975. In 1980 under development | None | |
| | | | **Mn Vein Deposits** | | | | |
| | With exception of Gila Hot Springs deposit (map no. 13), veins are spatially related to Ash Peak Ag (Au) veins and occur as fissure fillings in amygdaloidal andesite and basaltic andesite of middle Tertiary age and as fracture fillings in massive rhyolite flows (23 m.y.) that both overlie and are contemporaneous with the amygdaloidal flows. | | | | | | |
| 13 | Gila Hot Springs (Hult pyrolusite deposit) | N1/2sec. 26 T. 5 S., R. 29 E | Lenses of manganese oxides with calcite and barite in NNW trending fault zone in Gila Conglomerate | Wad, pyrolusite | Located in 1938. Developed by opencut and adit. Inactive in 1980 | A few tons of hand-sorted ore averaging 40% Mn produced in 1955 | 48, 191 |
| 14 | Thurston and Hardy (Godfrey) | NE1/4sec. 34 NW1/4sec. 35 T. 7 S., R. 30 E. | Brecciated fissure filling along two prominent fault zones trending N70°W and N55°W in amygdaloidal andesite | Psilomelane, pyrolusite | Mine active 1918-19, 1942, and 1952-55. Developed by opencuts trenches, and shafts. Inactive in 1980 | 1704 metric tons of 39-45% Mn | 28, 48, 93, 100, 190, 205 |
| 15 | Wilba (PBC, Black King) | NW1/4sec. 12 T. 8 S., R. 30 E | Fracture zone trending E-W in amygdaloidal andesite | Psilomelane, pyrolusite | Located in 1890's as Au, Ag prospect. Old shaft. Inactive in 1980 | 5.6 metric tons of 19.3% Mn | 48, 190 |
| 16 | Crow | SE1/4sec. 14 T. 8 S., R. 30 E. | Fracture zones trending N and N50°W in rhyolite | Psilomelane | Located in 1951. Opencuts. Inactive in 1980 | 77 metric tons of about 25% Mn | 48, 190 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 17 | A-1 | SW1/4sec. 13 T. 8 S., R. 30 E. | Fracture zone trending NW in rhyolite | Psilomelane, pyrolusite | Located in 1952. 4 m deep shaft and opencuts. Inactive in 1980 | 6.5 metric tons of 41% Mn | 48 |
| | Paradise, SPW | NE1/4sec. 23 T. 8 S., R. 30 E. | Fracture zone trending N in rhyolite | Psilomelane | Located in 1952. Opencuts. Inactive in 1980 | None | 48, 190 |
| 18 | Black Beauty | SE1/4sec. 11 T. 8 S., R. 30 E. | Fracture zone trending N in rhyolite | Psilomelane | Located in 1952. Opencut. Inactive in 1980 | 33 metric tons of 21.2% Mn | 48, 190 |
| | | | SEDIMENTARY DEPOSITS | | | | |
| | | | Au Placer Deposits | | | | |
| 19 | Dorothy B. (Neel) | N1/2sec. 28 T. 6 S., R. 28 E. | | | New mining and milling facility, designed for large scale operation, constructed in 1980 | Production before 1980 very minor | 203 |
| 20 | Gila River | Secs. 21, 22, and 28 T. 6 S., R. 28 E. | Gold associated with boulders and cobbles of massive hematite-magnetite and black sand in older alluvial deposits of the Gila and San Francisco Rivers deposited chiefly on Gila Conglomerate. Source of gold is probably the Clifton-Morenci area | Native gold | Many small deposits known since early 1900's and worked intermittently until 1970's | Production before 1980 very minor | 203 |
| 21 | Clifton-Morenci (Smuggler) | Chiefly in secs. 14 and 15 T. 5 S., R. 29 E. | | | Many small deposits known since 1900's and worked intermittently prior to 1970's | About $30,000 (1910-1949) mostly from deposits north of quadrangle | 203 |
| | | | VOLCANIC DEPOSITS | | | | |
| | | | Pumice and Cinder Deposits | | | | |
| 22 | Gila Valley Block Co. | SW1/4sec. 28 T. 6 S., R. 29 E. | Pyroclastic deposits of white rhyolite pumice and red basaltic andesite cinder of middle Tertiary age | - - - - - - - - - - - - - - | Quarry. Active in 1980 | Hundreds of metric tons | |

SUMMIT MOUNTAINS AND BLACK MOUNTAIN AREA (includes the Cap Rock, Duncan, and Steeple Rock mining districts)

HYDROTHERMAL DEPOSITS

Au-Ag Base Metal Vein Deposits

The precious and base metal ores of the Steeple Rock mining district are epithermal fissure fillings chiefly along brecciated NW- and WNW- trending faults that cut a variety of middle Tertiary volcanic rocks. Quartz and pyrite the dominant gangue, and the ore minerals form ore shoots in silicified breccia zones generally at fault intersections or at abrupt changes in the strike or dip of a fault. Gold and silver values decrease with depth in the mines concomitant with an increase in base metal values.

The presence of precious metals in the Steeple Rock district was known as early as 1860 and the Carlisle mine may have produced ore prior to 1880. Most of the known mines were active between 1880 and 1920, but records of mining activity and production for that period are very limited. In 1932 mining revived and since then the district has been intermittently productive up to the present (1980). Value of total production is probably about $6,800,000.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Twin Peaks | NW1/4sec. 8 T. 16 S., R. 21 W | Vein (N35°W, vert.) in breccia zone in andesite | Gold- and silver-bearing minerals, malachite | Shaft, 150 m deep | - - - - - - - - - | 56, 78 |
| 2 | Fraser Brothers | E1/2sec. 17 T. 16 S., R. 21 W. | Vein and silicified fault zone | Gold- and silver-bearing minerals | 4 shafts, as deep as 200 m, worked as late as 1958 | - - - - - - - - - | 56, 78 |
| 3 | Norman King (includes Bilali, Hoover Tunnel) | S1/2sec. 26 T. 16 S., R. 21 W. | Silicified breccia zone along the East Camp fault (N35°-50°W) | - - - - - - - - - - - - - | Shaft 150 m deep, with extensive drifts, last worked in 1940. Ore averaged 21.6 g/t Au and 1,475 g/t Ag (1919-1921) and 6.2 g/t Au and 365 g/t Ag (1936-1940). Largest mine in Bitter Creek area | More than $63,200. chiefly in Au and Ag | 56, 80 |
| 4 | Bank | NE1/4sec. 35 T. 16 S., R. 21 W. | Vein along fault southwest and subparallel to East Camp fault | - - - - - - - - - - - - - | Shaft. Workings being rehabilitated in 1979 | Some; amount unknown | 56 |
| 5 | Summit (includes Apex) | W1/2sec. 36 T. 16 S., R. 21 W. | Silicified breccia zone along East Camp fault | Chalcopyrite, sphalerite, galena | Tunnels and drifts. Rehabilitated in 1978 | Production in 1979, some earlier, amount unknown | 56, 81 |
| 6 | Laura | SW1/4sec. 2 T. 17 S., R. 21 W. | Quartz vein along Laura fault | - - - - - - - - - - - - - | Developed between 1914 and 1942 to depth of 214 m. Rehabilitated in 1978 | Production in 1979, some earlier, amount unknown. | 56, 81 |
| 7 | Carlisle | SW1/4sec. 1 T. 17 S., R. 21 W. | Wide breccia zone or pipe at pronounced bend in E-W trending Carlisle fault. Gold and silver values decrease, and base metal values increase with depth | Native gold, galena, sphalerite, chalcopyrite | Largest mine in district; operated as early as 1880 and intermittently up to 1946. Shaft and winze, 218 m deep with 3050 m of workings on 6 levels. Ore below 60 m averaged 45% Pb, 5.7% Zn, 1% Cu, and a trace of Au | Total about 93,000 kg Ag, 4,000 kg Au and 3,600 metric tons of Cu, Pb, Zn valued at about $5 million | 9, 56, 62, 81, 121 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 8 | Center, Pennsylvania | SE1/4sec 1, NE1/4sec 12 T. 17 S., R. 21 W. | Breccia zones at bends in Carlisle fault (N75°W) | Native gold, galena, sphalerite, chalcopyrite, argentite | Shafts and extensive underground workings to depths of 116 m. Mined intermittently from late 1800's to 1980 | About 200 kg Ag and 240 kg Au | 9, 56, 62, 81, 191 |
| 9 | Ontario | NW1/4sec. 7 T. 17 S., R. 20 W | Vein or breccia along east end of Carlisle fault (E-W, 70°S) | - - - - - - - - - - - - - | Inclined shaft 49 m deep. Some ore assayed as much as $200 per metric ton | Some; amount unknown | 57, 81 |
| 10 | Carnation | NE1/4sec. 6 T. 17 S., R. 20 W. | Vein (N55°W) subparallel to East Camp fault | - - - - - - - - - - - - - | Old shaft and pits. Drilled 1959 and 1960 | - - - - - - - - - - | 57, 81 |
| 11 | Goldenrod | C Sec 7 T. 17 S., R. 20 W. | Silicified and brecciated zone along Blue Goose fault | - - - - - - - - - - - - - | Shaft | - - - - - - - - - - | 56 |
| 12 | East Camp (includes McDonald Tunnel) | SE1/4sec. 8 T. 17 S., R. 20 W. | | | | | |
| | Davenport (includes Thanksgiving) | SE1/4sec. 8 T. 17 S., R. 20 W | Brecciated and vuggy zones along the East Camp fault (N70°W, Steep SW) | Native gold, argentite, native silver, cerargyrite, secondary copper minerals. Chalcopyrite, galena, sphalerite at depth | Worked in early 1900's from a number of shafts, tunnels, and extensive drifts. Ore mined over a length of 1,350 m along fault. Ore mined in 1943-1944 averaged 8% combined Pb, Zn, Cu, and 68.6 g/t Ag and 0.34 g/t Au | About 31,000 kg Ag and 930 kg Au valued at $1.4 million (1934-1942) | 9, 54, 60, 79 |
| | Golden Nugget | NW1/4sec. 8 T. 17 S., R. 20 W | | | | | |
| 13 | Bluebird | NW1/4sec. 9 T. 17 S., R. 20 W. | Vein (N60°W) northeast, and subparallel to, the East Camp fault | Secondary copper minerals | Shaft 100 m deep | - - - - - - - - - - | 56, 81 |
| 14 | New Year's Gift | SW1/4sec. 10 T. 17 S., R. 21 W. | Vein (N40°W) on northwest extension of Steeple Rock fault | - - - - - - - - - - - - - | Shaft 75 m deep | - - - - - - - - - - | 56, 81 |
| 15 | Smuggler | SE1/4sec. 11 T. 17 S., R. 21 W. | Quartz vein along Laura fault | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - - | 81 |
| 16 | Alabama | NW1/4sec. 14 T. 17 S., R. 21 W. | Silicified and brecciated zone along N-trending fault coextensive with rhyolite dike | - - - - - - - - - - - - - | Shaft 92 m deep and prospect pits | - - - - - - - - - - | 56, 81 |
| 17 | Jim Crow, Imperial | NE1/4sec. 23 T. 17 S., R. 21 W. | Silicified and brecciated zones along Steeple Rock fault which strikes N15°-20°W (Imperial) and N45°-60°W (Jim Crow) | - - - - - - - - - - - - - | Several shafts, as deep as 92 m. Mined prior to 1914 up to 1936. Average grade about 2.7 g/t Au and 272 g/t Ag | About $98,000 | 56, 81 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 18 | Mount Royal | SE1/4sec. 23 T. 17 S., R. 21 W. | Vein along Steeple Rock fault (N45°W) | - - - - - - - - - - - - - | Shaft 100 m deep. Last worked in 1939 | Some; amount unknown | 56 |
| | | | **Cu Vein Deposits** | | | | |
| | Deposits consist chiefly of copper-bearing minerals with quartz and pyrite in small veins and fracture fillings in middle Tertiary volcanic rocks at the northwest end of the zone of precious and base metal veins. | | | | | | |
| 19 | Yellowjacket | S1/2sec. 28 T. 15 S., R. 21 W. | Fracture fillings in basaltic andesite flows | Chrysocolla, pyrite, chalcopyrite | Adit | - - - - - - - - - | 78 |
| 20 | Commerce-Mayflower | Secs 8 and 9 T. 6 S., R. 32 E. | Veinlets along Commerce fault (N55°-60°W,75°W) | Chalcocite, chalcopyrite, native copper, chrysocolla | Numerous shallow shafts and surface workings | - - - - - - - - - | 78 |
| 21 | Copper Basin (Lotty-Independence) | NE1/4sec. 10 T. 6 S., R. 32 E. | Vein along fault (N35°W) | Chalcopyrite, malachite, azurite | Shaft and numerous surface workings | - - - - - - - - - | 78 |
| 22 | Wampoo | C sec. 15 T. 6 S., R. 32 E. | Secondary copper minerals along fault (N15°W,70°W) | Chrysocolla, azurite, malachite | Shaft, trench, and drill holes | - - - - - - - - - | 78 |
| | | | **Fluorite Vein Deposits** | | | | |
| | The fluorite veins in the Duncan mining district are epithermal deposits formed at shallow depth and occur chiefly as fracture fillings and small stockworks mostly along NW-trending faults that cut middle Tertiary volcanic rocks. Vein minerals consist chiefly of quartz, intimately mixed with fluorite, calcite locally coated with manganese oxides, and locally pyrite. Distribution of the fluorite veins peripheral to the precious and base metal vein deposits is suggestive of regional zonation in a large hydrothermal system. | | | | | | |
| 23 | Leta Lynn | NE1/4sec. 19 T. 16 S., R. 21 W. | Silicified fault breccia (N35°W, 80°W) as wide as 6 m | Fluorite, manganese oxides | Discovered in 1971. Shaft and shallow surface workings | 3 metric tons | 9, 78, 125 |
| 24 | Powell (Fork) | SW1/4sec. 20 T. 16 S., R. 21 W. | Stockwork, as wide as 4 m, in fault breccia of Bitter Creek fault (N80°-85°W) | Fluorite, manganese oxides | Trench, pits and drill holes. Mined 1942-1943 | 115 metric tons of 59% $CaF_2$ | 9, 78, 125, 162, 190, 201 |
| 25 | Black Willow | SE1/4sec. 22 T. 16 S., R. 21 W. | Fracture fillings and disseminations along silicified and brecciated fault (N60°W) | Fluorite, manganese oxides, native gold, argentite, | Shaft, 20 m deep, mined for gold and silver in 1920's. Numerous prospect pits are from more recent development for fluorite | Some production of Au and Ag | 9, 56, 78, 125, 190, 191 |
| 26 | Mohawk (Bitter Creek) | NW1/4sec. 26 T. 16 S., R. 21 W. | Silicified and brecciated zone at northwest end of East Camp fault (N15°W) | Fluorite | 4 shafts to 60 m deep with drifts. Last operated in 1972 | About 5,900 metric tons of 65-70% $CaF_2$ | 9, 56, 62, 80, 125, 163, 201 |
| 27 | Daniels Camp | NE1/4sec. 5 T. 7 S., R. 32 E. | Fracture fillings along faults (N12°E and N5°W) | Fluorite, manganese oxides | Shaft and prospect pits | Some; amount unknown | 9, 79, 127, 190, 191 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 28 | Fourth of July | N1/2sec. 4 T. 7 S., R. 32 E. | Fracture fillings along Fourth of July fault (N35°-65°W) | Fluorite, manganese oxides, bertrandite | Shaft and incline, 45 m deep. Mined intermittently 1936 to 1960(?) | About 2,900 metric tons of 64% $CaF_2$ | 79, 127, 132, 187, 190 |
| 29 | Forbis (Polly Ann) | S1/2sec. 4, N1/2sec. 9 T. 7 S., R. 32 E. | Vein along fault (N15°W) | Fluorite | Shaft, 57 m deep, with drifts | Some; amount unknown | 79, 127, 190, 207 |
| 30 | Luckie No. 1 and 2 | S1/2sec. 3, N1/2sec. 10 T. 7 S., R. 32 E. | Vein along brecciated rhyolite dike contact (N15°E) (Luckie No. 1), and vuggy vein along fault (N40°W) (Luckie No. 2) | Fluorite, chrysocolla, manganese oxides, bertrandite | Open pit, shafts. Worked intermittently since early 1900's. Inactive by 1960 | More than 2,000 metric tons of 65-70% $CaF_2$ | 79, 127, 132, 187, 190, 191 |
| 31 | Dean | NW1/4sec. 15 T. 7 S., R. 32 E. | | | | | |
| | Ontario and Stotts | NE1/4sec. 15 T. 7 S., R. 32 E. | Fracture fillings and small veins along faults (N10°W-N10°E) | Fluorite | Shafts, trenches, and pits | Some; amount unknown | 79, 127 |
| | Phillips | SE1/4sec. 15 T. 7 S., R. 32 E. | | | | | |
| 32 | | NE1/4sec. 30 T. 17 S., R. 21 W. | Fracture fillings (N70°-75°E) | Fluorite | Shaft and pit | - - - - - - - - - | 79 |
| 33 | Rattlesnake No. 1 and 2 | SE1/4sec 20, NE1/4sec. 29 T. 17 S., R. 21 W. | Small veins (N2°-15°W) | Fluorite | Shaft and trenches | - - - - - - - - - | 79 |
| 34 | Big Nine | SW1/4sec. 20 T. 18 S., R. 20 W | Veinlets in granite hanging wall along E-W fault. Tertiary volcanic rocks in footwall | Fluorite | Located 1944. Small Pits | None | 190, 201 |
| | | | Mn Vein Deposits | | | | |
| 35 | Black Cat | NW1/4sec. 33 T. 6 S., R. 32 E. | Vein, trending N, in middle Tertiary volcanic rocks | Psilomelane, fluorite | Shaft and opencuts, mined 1953-1955 | 78 metric tons of ore containing 43% Mn | 47, 190, 191 |
| 36 | Black Bob | SW1/4sec. 13 T. 19 S., R. 20 W. | Fracture fillings in altered and brecciated middle Tertiary volcanic rocks | Psilomelane | Developed by shaft, 21 m deep, and drift | About 10 metric tons containing 17-40% Mn | 47, 56, 190 |
| | Winnie | N1/2sec. 24 T. 19 S., R. 20 W. | | | Located in 1959. Shallow surface workings | About 10 metric tons containing 40% Mn | 47, 190 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 37 | Consolation No. 1 (Black Diamond) | SW1/4sec. 20 T. 19 S., R. 19 W. | Lenticular mass in fault zone (N40°W,80°NE) in middle Tertiary basaltic flows and breccias | Psilomelane | Probably located during WWI. Operated chiefly 1951-1957 from shaft, 30 m deep, and large opencut | Included with production from Consolation No. 2 (map no. 38) | 47, 56 |
| 38 | Cliff Roy | SW1/4sec. 33 T. 19 S., R. 19 W. | Veins along faults in middle Tertiary basaltic breccias and epiclastic deposits. Travertine in veins at Cliff Roy mine | Psilomelane | Deposits located during WWI. During WWII known as Owl or Fuller group but production unknown. Principal development 1951-1959. Deposits mined to depths of 25 m by shafts and open pits. Grade of 10,000 metric tons mined from Consolation No. 1 and 2 averaged 8-10% Mn | About 4,300 metric tons of concentrate and hand-picked ore containing about 33% Mn | 39, 47, 56, 190 |
| | Ward | NW1/4sec. 33 T. 19 S., R. 19 W. | | | | | |
| | Consolation No. 2 | SE1/4sec 32, SW1/4sec. 33 T. 19 S., R. 19 W. | | | | | |
| | | | Other Hydrothermal Deposits | | | | |
| 39 | Saddleback Mountain | Secs. 28 and 29 T. 16 S., R. 21 W. | Altered tuffaceous sandstone of middle Tertiary age containing up to 30% alunite | Alunite | No development | None; resource as much as $55 \times 10^6$ metric tons | 64, 78 |
| 40 | Goat Camp Canyon | Sec. 18 T. 17 S., R. 21 W. | Altered middle Tertiary andesite porphyry and rhyolite containing abundant kaolinite and locally alunite | Alunite | No development | None | 79 |

BIG BURRO AND LITTLE BURRO MOUNTAINS AREA (includes the Blackhawk, Bound Ranch, Gold Hill, Malone, Telegraph, Tyrone, and White Signal mining districts)

HYDROTHERMAL DEPOSITS

Porphyry Cu (Mo) Deposits

The porphyry copper deposit at Tyrone (map no. 1) is the major producing mine in the Burro Mountains. The deposit includes a number of older underground mines that exploited high grade oxidized copper ore along a series of broad northeast-trending fracture zones in a quartz monzonite stock of early Tertiary age (56.2 m.y.). Smaller disseminated deposits localized along fracture and fault zones, both within the quartz monzonite and in the peripheral Precambrian granite host rock, occur outside the main Tyrone workings but only the Liberty Bell-Copper Mountain deposit (map no. 2) is listed here as a porphyry copper deposit. The others (map nos. 10 and 12) are included with the Cu vein deposits that are described separately.

The White Signal-Saddle Mountain deposit (map no. 3) is a buried sulfide system that may represent a potentially significant porphyry copper or porphyry molybdenum deposit. Data concerning the deposit are mostly proprietary.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Tyrone (includes a number of older underground mines: Gettysburg, Copper Gulf, Rocket, Niagara, Mohawk, Sampson, McKinley, St. Louis, Boston, Virginia, Klondike, Valencia, Emerald) | Secs. 14 and 15, 22, 23, 24, 25, 26, and 27 T. 19 S., R. 15 W. | Deposit covers about 15 $km^2$ at the northeast end of Tyrone stock. Ore minerals occur as fracture-fillings, disseminations, and replacements in shattered and hydrothermally altered quartz monzonite and locally the peripheral Precambrian granite. High grade ores are localized along 4 broad NE-trending zones of intense shearing and shattering. A supergene-enriched blanket, 60 to 90 m thick, dipping 5° NE forms bulk of ore. The supergene zone grades downward into primary sulfides and is capped by an oxidized zone that is locally barren | Primary minerals--chalcopyrite, molybdenite, sphalerite. Supergene minerals--chalcocite. Oxide minerals--chrysocolla, malachite, azurite, cuprite, native copper, turquoise | Discovered about 1879 and many individual veins mined from extensive underground workings prior to 1920. Leaching operations intermittent between 1921 and 1950. No production between 1950 and 1969 when large scale open-pit mining started. Prior to open-pit mining, deposit contained about 360 million metric tons of 0.8% Cu, with values in $MoS_2$ and Au | Prior to 1979 about 806,400 metric tons of Cu plus significant amounts of $MoS_2$ and Au | 34, 70, 155, 189, 208, 211 |
| 2 | Liberty Bell-Copper Mountain | SE1/4sec. 21, N1/2sec 28 T. 19 S., R. 15 W. | Fracture-fillings and coatings in shattered and altered Tyrone stock in zone as wide as 30 m along Burro Chief fault (N50°-55°E, 40°-60°SE) where intersected by two shear-fracture zones of the Tyrone deposit | Chrysocolla, azurite, chalcocite | Worked in 1800's to depths of about 30 m from shafts and adits. Later mined by leaching. Drilling in 1961 to depths of 63 m indicated ore averaging 1-1.2% Cu | Considerable; amount unknown | 56, 66 |
| 3 | White Signal-Saddle Mountain | Probably sec. 23 and 24 T. 20 S., R. 15 W. | Buried sulfide system at intersection of NNW and ENE-trending fault systems. Apparently genetically related to early Tertiary rhyolite intrusions of Saddle Mountain-Three Sisters-Tullock Peak | Chalcopyrite(?), molybdenite(?) | Extensively drilled in late 1970's | None | |

## Cu Vein Deposits

The copper vein deposits along with the turquoise vein deposits described separately below (map nos. 16-18), are spatially related to the Tyrone porphyry copper deposit (map no. 1). The deposits consist of veins, fracture fillings, and local disseminations of primary and secondary copper minerals, with occasional pyrite and molybdenite, chiefly in prominent NE-trending shear zones in Precambrian granite peripheral to the early Tertiary (56.2 m.y.) Tyrone quartz monzonite stock.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 4 | Beaseley (includes National and Mayflower Shafts) | N1/2sec. 18 T. 19 S., R. 15 W. | Veins along Beaumont fault (N70°S) and subsidiary fractures in Precambrian granite | Chalcocite, azurite, molybdenite | 2 shafts, 48 and 34 m deep, sunk prior to 1911, and a shaft, 15 m deep, sunk in 1956. Ore shipped in 1956 averaged 9% Cu | Some; amount unknown | 56, 66, 144 |
| 5 | National Copper Company | SW1/4sec. 17, SE1/4sec. 18 T. 19 S., R. 15 W. | Fractured shear zone, trending NE in Precambrian granite. Probably NE extension of Austin-Amazon fault zone | Chalcopyrite, azurite, chrysocolla | Mined between 1910 and 1926; some surface exploration in 1950's. Shaft, 60 m deep, and adit, 110 m long with deep winze. Ore from adit averaged 2% Cu and 3.4 g/t Au | Some; amount unknown | 56, 144 |
| 6 | Ohio | SE1/4sec. 17 T. 19 S., R. 15 W. | Vein between faults (N20°-30°E, 45°E) in Precambrian granite | Copper carbonates, chrysocolla, fluorite | Mined about 1900 from shaft 104 m deep and extensive underground workings. In 1969-1970 leaching operations in open pit. Ore averaged as high as 8% Cu | Some; amount unknown | 56, 66 |
| | Little Rock | E1/2sec. 17, T. 19 S., R. 15 W. | Vein parallels quartz monzonite dike (E-W,50°S) in Precambrian granite; smaller veins (N70°E) | Chrysocolla, chalcocite, chalcopyrite | Mined about 1900 principally from an inclined and vertical shaft. Ore contained 4-5% Cu | Some; amount unknown | 56, 66 |
| 7 | Two-Best-in-Three | W1/2sec. 16 T. 19 S., R. 15 W. | Fractured shear zone (N70°E) parallel to quartz monzonite porphyry dike in Precambrian granite | Copper carbonates, chrysocolla | Mined in 1880's from adit, 115 m long, and underground workings. Ore contained as much as 15% Cu and a trace of gold | About 270 m tons Cu | 56, 66 |
| | Nellie Bly | SW1/4sec. 16 T. 19 S., R. 15 W. | Vein (E-W) in Precambrian granite | - - - - - - - - - - - - - | Old adit, 30 m long | Some; amount unknown | 56, 66 |
| 8 | Copper King | W1/2sec. 15 T. 19 S., R. 15 W. | Fracture zone (N55°E) in Precambrian granite | Chrysocolla, copper carbonates | Shaft, more than 125 m deep | - - - - - - - - - | 66 |
| 9 | Bolton and Alexander | SE1/4sec. 13, NE1/4sec. 24 T. 19 S., R. 16 W. | Fracture fillings in Precambrian granite parallel early Tertiary rhyolite and quartz monzonite porphyry dikes | Chalcopyrite, copper carbonates, chalcocite, molybdenite | Last worked in 1920's from shallow shafts and pits | Some; amount unknown | 56, 66, 144, 167 |
| | Tall Pine | SE1/4sec. 24 T. 19 S., R. 16 W. | Veins in Precambrian granite along NE-trending Austin-Amazon fault | Copper carbonates and sulfides | Pits | - - - - - - - - - | 56 |
| 10 | Tullock | NE1/4sec. 13 T. 19 S., R. 15 W. | Veins (N70°E) in early Tertiary quartz monzonite porphyry that is probably part of Tyrone stock | Copper carbonates | Three shallow shafts | - - - - - - - - - | 56 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| | Bostonian | NW1/4sec. 18 T. 19 S., R. 14 W.; NE1/4sec. 13 T. 19 S., R. 15 W. | Veins in highly altered early Tertiary quartz monzonite stock. Deposit has features characteristic of porphyry copper-type mineralization | Secondary copper minerals | Extensive, old underground workings to depth of 105 m | Some; amount unknown | 56 |
| 11 | Montezuma | NW1/4sec. 19 T. 19 S., R. 14 W. | Veins in early Tertiary quartz monzonite stock now largely covered by dump material from Tyrone pit | Secondary copper minerals | Old workings | - - - - - - - - - | 56 |
| 12 | Austin-Amazon (includes High Point Extension) | NE1/4sec. 35 T. 19 S., R. 17 W. | Veinlets and fracture fillings in wide (as wide as 30 m) shear zone along Austin-Amazon fault zone (N50°-55°E) in Precambrian granite. Deposit has features characteristic of porphyry copper-type mineralization | Chalcopyrite, chalcocite, bornite, molybdenite, azurite, malachite, cuprite, native copper, tenorite | Originally opened in 1800's probably for gold. Extensive underground development (750 m) and some mining 1914-1921. As many as 200 carloads of ore containing as much as 17% Cu mined. In 1956-1957, 1300 metric tons of 0.88% Cu and a few tons of higher grade ore were mined from surface workings | More than 22 metric tons Cu | 56, 73 |
| 13 | Boone, Oquaqua | SE1/4sec. 27 T. 19 S., R. 15 W. | Veins (E-W) in early Tertiary quartz monzonite stock | Chalcopyrite | Old shaft 90 m deep and drifts. Ore contained up to 5% Cu | Some; amount unknown | 121, 144 |
| 14 | Emma, Surprise | SW1/4sec. 25, NW1/4sec. 36 T. 19 S., R. 15 W. | Veins in Precambrian granite. Copper minerals also present in Tertiary conglomerate (see map no. 145) | Chrysocolla, malachite, azurite, cuprite, chalcocite | Old workings. In 1960 9 metric tons of 7.3% Cu mined | Probably more than 1 metric ton Cu | 56 |
| 15 | Indian Hill and unnamed prospects | C and SW1/4 sec. 4 T. 20 S., R. 15 W. | Veins and fractures in faults at NE end of Sprouse-Copeland fault zone in early Tertiary quartz monzonite stock | Chalcopyrite, azurite, malachite | Old shaft and more recent extensive surface exploration | - - - - - - - - - | 56 |
| | | | Turquoise Vein Deposits | | | | |
| 16 | Azure, New Azure | NW1/4sec. 15 T. 19 S., R. 15 W. | Fracture fillings in fracture-shear zone (N55°-60°E) in Precambrian granite near contact with early Tertiary quartz monzonite stock | Turquoise | Mined by Indians and probably Spanish prior to 1870. Rediscovered about 1880 and mined chiefly between 1890 and 1910 from both underground workings and large open pits | Probably several million dollars | 56, 121, 183, 211 |
| | Parker | C sec. 15 T. 19 S., R. 15 W. | Fracture fillings trending NE in both Precambrian granite and early Tertiary quartz monzonite stock | Turquoise | Mined by Indians and site of original turquoise discovery in 1875. Mined up to 1910 from two large open pits | Significant; amount unknown | 56, 66, 211 |
| | Porterfield (Maroney) | SW1/4sec. 15 T. 19 S., R. 15 W. | Fracture fillings in Precambrian granite | Turquoise | Old shafts and tunnel | Some; amount unknown | 56, 66 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 17 | Turquoise | NE1/4sec. 16 T. 19 S., R. 15 W. | Vein along fault (N65°E) in Precambrian granite | Turquoise, copper carbonates | - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 66 |
| 18 | Red Hill | NW1/4sec. 16 T. 20 S., R. 15. W. | Fracture fillings in zone (N30°W) in Precambrian quartz-biotite schist | Turquoise, radioactive minerals(?) | Operated as late as 1961 from open pit near old shaft and adit | Some; amount unknown | 56, 73 |

Au-Ag-Base Metal Vein Deposits

Two groups of precious and base metal vein deposits occur in the area. The northern group (map nos. 19-25) consists of a variety of small veins and mineralized breccia zones in Precambrian and Cretaceous rocks containing chiefly galena and silver minerals. The second and larger group of deposits (map nos. 26-46) occurs in a broad irregular belt peripheral to the Tyrone quartz monzonite stock. This belt, which includes a number of fluorite vein deposits, may represent the outer limits of a large zoned hydrothermal system centered roughly around the porphyry copper and copper vein deposits at Tyrone. The deposits are chiefly quartz veins, along NE-trending faults and shear zones in Precambrian rocks that contain pyrite, base metal sulfides, and locally bismuth minerals (map nos. 29, 30, 42). Most of the deposits were originally mined for gold (especially map nos. 29, 30, 35, 39, 40, 42); silver was the principal commodity from deposits of map nos. 31, 32, 36, 37, and 38.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | Telegraph | SW1/4sec. 32 T. 17 S., R. 17 W. | Vein along fault (N28°E,65°SE) cutting Precambrian granite and Cretaceous Beartooth Quartzite near major NW-trending fault | Silver minerals, fluorite, manganese oxides | Discovered 1881 and mined intermittently until 1903. Shaft and two adits, up to 60 m long | Some; amount unknown | 56 |
| 20 | Lead Mountain | SE1/4sec. 36 T. 17 S., R. 18 W. | Vein in shear zone (N30°-35°E, 58°-65°SE) in Precambrian granite | Galena, fluorite, chrysocolla, manganese oxides | Two caved adits | - - - - - - - - - | 56, 85 |
| 21 | Slate Creek | SW1/4sec. 36 T. 17 S., R. 18 W. | Mineralized breccia zone along fault (N62°E, 68°NW) in Cretaceous Beartooth Quartzite | Galena, sphalerite, chalcopyrite, bornite | Shaft and adit. Limited mining in 1960 | Some; amount unknown | 56, 85 |
| 22 | Foxtail Creek | SW1/4sec. 31 T. 17 S., R. 17 W. | Probably small veins near major faults (E-W) that juxtapose Tertiary volcanic rocks against Cretaceous rocks | Silver minerals(?) | Numerous shallow shafts | None | 49 |
| 23 | Hard Pan (German) | NW1/4sec. 15 T. 18 S., R. 17 W. | Vein along Tertiary andesite porphyry dike (E-W) in Precambrian granite and gneiss | Galena, sphalerite, chalcopyrite | Worked prior to 1900 and again in late 1930's and early 1940's. Developed by 3 adits and winze | Some; amount unknown | 56, 76, 85 |
| 24 | Jennie | NE1/4sec. 24 T. 18 S., R. 18 W. | Veinlets and coatings in fault breccia in Precambrian granite and diabase | Malachite, chrysocolla | Adit | None | 56, 75, 85 |
| 25 | - - - - - - - - | SW1/4sec. 17 T. 18 S., R. 17 W. | Vein (N-S) in Precambrian granite | Malachite, azurite | Two pits | None | 76 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 26 | Live Oak | NE1/4sec. 19 T. 19 S., R. 16 W. | Vein (NW-trending) in Precambrian granite | Galena, sphalerite, chalcopyrite | Two shallow shafts | - - - - - - - - - | 56, 76, 85 |
| 27 | Astrologer | SW1/4sec. 20 T. 19 S., R. 16 W. | Subparallel veins (NE-trending) in Precambrian granite | Chalcopyrite, galena, chalcocite | Mined for silver, gold, and lead probably around 1900. Two shafts and drifts | Some; amount unknown | 56, 76, 85 |
| 28 | Moody | N1/2sec. 8 T. 20 S., R. 16 W. | Veins (N60°E) in Precambrian diabase near Tertiary rhyolite dikes | Hematite, malachite, chalcopyrite | Two shafts, one sunk since 1950 | - - - - - - - - - | 56, 76 |
| 29 | Osmer Gold (Shamrock) | Sec. 22, 23 T. 19 S., R. 16 W. | Vein about 2,000 m long along Osmer fault (N60°E) in Precambrian granite. Fault zone intruded by early Tertiary rhyolite and quartz monzonite porphyry dikes | Gold, hematite, bismutite, copper minerals, galena | Mined intermittently from early 1880's to 1930's from at least 5 shafts as deep as 30 m and extensive drifts | Significant; amount unknown | 56 |
| 30 | Foster Zinc | NW1/4sec. 26 T. 19 S., R. 16 W. | Vein along Bismuth-Foster fault (N70°-55°E,75°NW) in Precambrian granite and intruded by early Tertiary rhyolite dike | Sphalerite, auriferous pyrite, iron oxides | Originally developed for precious metals prior to 1900. Sphalerite recognized in 1940 and mined in 1950. Shaft 24 m deep and drifts | About 12.6 metric tons Zn (1950) | 56, 66 |
| | Bismuth Lode | NE1/4sec. 27 T. 19 S., R. 15 W. | | Bismutite, native bismuth, secondary copper minerals, gold | Originally developed for gold. Bismuth mined in 1920's. Shaft 21 m deep and drifts | More than 1 metric ton Bi | 56, 66 |
| 31 | Beaumont | E1/4sec. 13 T. 19 S., R. 16 W. | Vein along Beaumont fault (N70°E, 60°S) in Precambrian granite. Fault is part of major NE-trending fault zone that includes the Osmer and Bismuth-Foster faults | Argentite, native silver, argentiferous galena, molybdenite | Mined in 1880's for silver. Developed by shaft 105 m deep and shallow surface workings | Some; amount unknown | 56, 167 |
| 32 | Full Moon | NW1/4sec. 2 T. 19 S., R. 15 W. | Veins along faults (N40°E,85°SE, and N25°E,65°SE) in Precambrian granite. Latter vein is northern extension of Casino vein-fault system | Galena, sphalerite | Developed in late 1800's; last mined in 1942. Two shafts and drifts. Some ore averaged up to 30% Pb and Zn, and 340 g/t Ag | Considerable; amount unknown | 56 |
| 33 | Contact Group (includes Contact and Copper Sulfide Shafts, Virtue Tunnel, and Contact Manganese) | W1/2sec. 2 T. 19 S., R. 15 W. | Fissure-filled subparallel veins, in part along faults that cut and juxtapose Precambrian granite, Colorado Formation, and Tertiary andesite. Veins from west to east are: Casino (N20°E), Wyman (N12°-15°E,75°SE), and Contact (N15°-20°E) | Galena, sphalerite, cerargyrite, chalcopyrite, pyrolusite, psilomelane, wad | Mined intermittently from 1880's to 1944. Developed to depths of more than 30 m from shafts and adits. 1900 metric tons of ore from Contact vein averaged 6-7% Pb and Zn, 68 g/t Ag and 8.5 g/t Au; 55 metric tons of ore from Casino Vein averaged 4.4% Pb, 4% Zn, 0.31% Cu, and 42 g/t Ag and 0.3 g/t Au. Mined in 1942, 1943, and 1953 for manganese | Considerable base and precious metal ore; amount unknown. 940 metric tons of 18-39% Mn | 47, 56, 164 |
| 34 | Afternoon | SE1/4sec. 2 T. 19 S., R. 15 W. | Vein along fault (N35°E) in Late Cretaceous-early Tertiary andesite | Sphalerite, galena, chalcopyrite | Probably mined in 1880's. Shaft at least 45 m deep with drifts. Ore on dump averaged 14% Zn, 12.6% Pb, 1.33% Cu, and 51 g/t Ag and 0.3 g/t Au | Some; amount unknown | 56, 71 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 35 | Silver King-Mystery | N1/2sec. 11 T. 19 S., R. 15 W. | Vein along fracture (N50°E) in Late Cretaceous-early Tertiary andesite | Gold, malachite | Probably mined in 1800's from shaft and adit | Some; amount unknown | 56, 70 |
| 36 | Silver Dollar | NE1/4sec. 33 T. 19 S., R. 16 W. | Vein on southwest extension of Spar Hill fault (N55°-60°E) in Precambrian granite | Silver, gold, galena | Worked in 1908 and again in 1946-1947 from shaft, 48 m deep and drifts on two levels. Ore (1946-47) averaged $9.50/ton, mostly in Ag | Some; amount unknown | 56 |
| 37 | Lone Pine | NW1/4sec. 3 T. 20 S., R. 16 W. | Vein (N20°E) in Precambrian granite | Galena, cerussite, bornite | Shaft, 24 m deep, sunk in 1950-1951 | - - - - - - - - - | 56 |
| 38 | John Malone, Lost Frenchman Tunnel | NE1/4sec. 16 T. 20 S., R. 16 W. | At John Malone, vein (N35°E,70°SE) in Precambrian granite at basic dike contact. Frenchman Tunnel intersects NE-trending vein | Argentite, secondary copper minerals | Worked prior to 1900. Shaft more than 24 m deep and adit 12 m long | Some; amount unknown | 56 |
| 39 | Barnett, Wild Irishman No. 5 | N1/2sec. 26 T. 20 S., R. 16 W. | Veins along southwest end of Sprouse-Copeland fault (N85°E) in Precambrian granite | Gold, chalcopyrite, tornbernite | Three shafts as much as 30 m deep. Some ore averaged 3% Cu and 409 g/t Au and 269 g/t Ag | Some; amount unknown | 56 |
| 40 | Russell, Uncle Jimmy Thwaits | C and E1/2 Sec 26 T. 20 S., R. 16 W. | At Russell, vein (N55°E) is along contact of early Tertiary rhyolite dike and Precambrian granite. Stringers in granite at Uncle Jimmy Thwaits deposit | Gold | Shaft and adit. Ore from Russell deposit in 1915-1916 contained 98 g/t Au; high grade ore from Uncle Jimmy Thwaits averaged as much as 92,000 g/t Au | - - - - - - - - - | 56 |
| 41 | Summit (Wes Williams) | NE1/4sec. 23 T. 20 S., R. 16 W. | Vein along contact of basic dike and Precambrian granite (N45°E,70°SE) | Galena, chalcopyrite, radioactive minerals(?) | Shaft 25 m deep, sunk in 1920-1922 for gold and copper | - - - - - - - - - | 56, 73 |
| 42 | Neglected | NE1/4sec. 25 T. 20 S., R. 16 W. | Vein (N87°E,75°S) along contact of early Tertiary rhyolite dike and Precambrian granite in Sprouse-Copeland fault zone | Chalcopyrite, bornite, gold, covellite, galena, sphalerite, bismutite | Discovered prior to 1900 and worked intermittently from 1900 to 1964. Developed by 3 shafts an adit and numerous pits to depths of 45 m | Some; amount unknown | 56, 73, 121 |
| 43 | Hop Williams (Pocahontas) | NE1/4sec. 19 T. 20 S., R. 15 W. | Quartz vein (N75°E, vert) along early Tertiary rhyolite dike in Precambrian granite | Secondary copper minerals, galena | Developed in 1916-1917 by shaft 29 m deep and adit 34 m long. Assays from drill hole averaged 1.5% Pb, 0.5% Cu, and traces of Au and Ag | - - - - - - - - - | 56 |
| 44 | Joy (includes Sprouse, Copeland) | E1/2sec. 8, SW1/4sec. 4 T. 20 S., R. 15 W. | Quartz lenses and fillings in wide shattered zone along complex Sprouse - Copeland fault (N35°-50°E,65°-85°SE) that juxtaposes early Tertiary quartz monzonite porphyry and Precambrian granite. Mineralized zone more than 1 km long | Chalcopyrite, tenorite, galena, sphalerite, molybdenite, malachite, azurite | Developed about 1900 for copper by shafts up to 36 m deep. Intermittant activity between 1930 and 1960, including extensive drilling | - - - - - - - - - | 56 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 45 | Malone Mines (includes Malone, Hillcrest, Patanka, Barranca, and many smaller deposits) | SW1/4sec. 20 NW1/4sec 29 T. 20 S., R. 16 W. | Quartz fissure fillings chiefly in footwall of Malone fault (N10°-20°W,70°E) in Precambrian granite near contact with overlying middle Tertiary volcanic rocks. Veins trend E-W with exception of Patanka, that trends NE-SW | Gold, chalcopyrite, galena, sphalerite | Discovered in 1884; major production prior to 1900. Interest in area revived in 1930, but inactive by 1961. Deposits worked by numerous shallow shafts (<30 m deep), drifts, and stopes. Vein and ore samples from Patanka in 1947 assayed 24-27 g/t Au and 646-894 g/t Ag, and from Barranca 1 g/t Au and 94 g/t Ag | About $250,000 in gold and a little silver prior to 1900 and $50,000 after 1925 | 56, 77 |
| 46 | Hogback Lode | S1/2sec. 31 T. 22 S., R. 15 W. | Vein with travertine and sulfides along fault (N35°W) in Precambrian granite | Chalcopyrite | Small pit | None | 68 |

Au (Cu-Bi-U) Vein Deposits

Numerous and generally small quartz-pyrite, or locally quartz-specularite, veins locally containing gold, copper, uranium and bismuth minerals occur throughout the White Signal mining district and are spatially and probably genetically related to the early Tertiary rhyolite intrusions of Three Sisters-Saddle Mountain. The veins are chiefly simple fillings in fractures and in brecciated fault zones in Precambrian granite or along early Tertiary rhyolite dike-granite contacts. Uranium minerals tend to be concentrated where veins, or faults, cut NW-trending Precambrian diabase dikes in granite. Exploitable deposits of gold, copper, and to a much lesser degree, uranium have only been found in the oxidized parts of the veins, generally less than 30 m deep. Primary minerals encountered in a few deeper mines and in drilling have been too low in grade to warrant mining.

Most of the deposits were discovered between 1880 and the early 1900's and worked for gold; but data on activity and production for this early period are nonexistent. The recognition of uranium minerals in 1919 led to a radium boom that lasted until the late 1920's. Renewed interest in uranium for nuclear energy resulted in extensive exploration between the late 1940's and about 1955, but the results were discouraging. Drilling in late 1970's has apparently led to the discovery of a sulfide system at depth (see map no. 3).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 47 | Apache Trail | NE1/4sec. 2 T. 20 S., R. 15 W. | Vein along fault (N80°W,65°-70°N) locally associated with diabase dike, in granite | Secondary copper minerals, gold, hematite, bismuth minerals, torbernite | Located about 1890 and mined intermittently up to 1920's for copper. Developed by 60 m shaft with two levels and numerous surface workings. Ore (1915-1920) averaged 5% Cu and 170 g/t Ag | 9 metric tons of Cu and 30 kg Ag (1915-1920). Some Bi in 1920 | 56, 124 |
| 48 | Golden Eagle | NE1/4sec. 14 T. 20 S., R. 15 W. | Vein along intersection of two small faults, (N70°E and N10°-15°W) in granite | Gold, secondary copper minerals | Operated about 1905 for gold and copper. Shaft about 25 m deep | Some; amount unknown | 56, 74 |
| | - - - - - - - | NE1/4sec. 14 T. 20 S., R. 15 W. | Small veins | Gold | Located in 1880's, some work in 1930's. Shafts and surface pits. Ore averaged up to 400 g/t Au | Some; amount unknown | 56, 74 |
| 49 | Alhambra-Bluebell No. 2 | NE1/4sec. 31 T. 20 S., R. 15 W. | Fracture fillings in shattered diabase dike (N28°W) in granite | Torbernite | Two shallow shafts | - - - - - - - - - | 56 |
| | Floyd Collins | NE1/4sec. 21 NW1/4sec. 22 T. 20 S., R. 15 W. | Fracture and vug-fillings in faulted diabase dike (N20°W) | Torbernite, autunite | Mined in 1920's for uranium. Intermittently mined from 1954 to 1959. Developed by two inclined shafts, 24 m deep, with drifts and surface workings. Ore averaged 0.1-0.2% $U_3O_8$ | About 220 kg $U_3O_8$ | 56, 74, 192 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 50 | Merry Widow | C Sec. 22 T. 20 S., R. 15 W. | Fracture fillings where fault (E-W) cuts two diabase dikes; vein along fault | Gold, torbernite, autunite, bismite, bismutite, chalcopyrite, hematite | Located in 1880's for gold. Uranium discovered in 1919; mined until late 1920's for radium salts. Shaft 45 m deep with extensive workings on 4 levels | Gold production unknown; largest uranium producer in district, amount unknown | 54, 56, 60, 61, 124 |
| | Acme, Utah, California | SE1/4sec. 22 T. 20 S., R. 15 W. | Fracture fillings where faults cut NW-trending diabase dikes in granite | Torbernite, hydrous iron oxides | Numerous shallow shafts (< 12 m deep) and pits | - - - - - - - - - - | 56, 73 |
| 51 | Paymaster | NW1/4sec. 28 SW1/4sec. 21 T. 20 S., R. 15 W. | Two subparalled veins (N85°E and N80°E) along rhyolite and quartz monzonite porphyry dikes in granite | Gold, lead, silver and copper minerals, radioactive minerals | Mined in 1900's for gold. Two shafts and prospect pits | - - - - - - - - - - | 56 |
| 52 | Bisbee | SW1/4sec. 27 T. 20 S., R. 15 W. | Vein (N65°-85°E, Vert) in granite | Gold, radioactive minerals(?) | Mined between 1895 and 1910. Two shafts 27 m deep and adit 30 m long | - - - - - - - - - - | 56, 121 |
| 53 | Blue Jay, Banner | NW1/4sec. 26 T. 20 S., R. 15 W. | Veinlets along ENE-trending fault zone that is intruded by rhyolite and diabase dikes | Torbernite, autunite, pitchblende | Old shaft on Banner property, trenches and pits on Blue Jay | - - - - - - - - - - | 54, 56, 74, 124 |
| | Red Bird | SW1/4sec. 23 T. 20 S., R. 15 W. | Vein (S75°E,80°S) along contact of rhyolite dike and granite | Radioactive minerals(?) | Worked prior to 1905. Shaft 60 m deep | - - - - - - - - - - | 56 |
| 54 | Shamrock | SW1/4sec. 23 T. 20 S., R. 15 W. | Mineralized rock at intersection of diabase dikes (N40°W); NE-trending veins | Gold, copper and uranium minerals | Pits, trenches, and shafts | - - - - - - - - - - | 56, 74 |
| 55 | Combination | NE1/4sec. 23 T. 20 S., R. 15 W. | Series of parallel veins (N45°E) in granite | Gold, copper minerals, radioactive minerals? | Mined intermittently 1910 to 1950's. 3 shafts, one 30 m deep, and numerous surface workings. Some ore averaged 340-410 g/t Au (1910-1915) | 9,000 metric tons (1931-1943) of gold-silver ore | 56 |
| | Copper Glance | NE1/4sec. 23 T. 20 S., R. 15 W. | Vein (N45°E) in granite | Gold, chalcopyrite chalcocite, radioactive minerals(?) | Mined in early 1890's and in 1920's. Shaft 26 m deep and opencut | Some; amount unknown | 56,74 |
| 56 | Paddy Ford | SE1/4sec. 23 T. 20 S., R. 15 W. | Vein (N85°E) in granite associated with rhyolite and diabase dikes | Gold, copper minerals, secondary uranium minerals | Located in 1900's and worked intermittently up to early 1930's. Shaft 36 m deep with drifts. In 1914 ore averaged 16.8% Cu, 340 g/t Au and 270-340 g/t Ag | Some; amount unknown | 56, 74 |
| | Calamity | SE1/4sec. 23 T. 20 S., R. 15 W. | Vein (N75°E,85°S) in granite and diabase dike | Gold, secondary copper minerals, radioactive minerals(?) | Located about 1900 and worked intermittently up to 1917. Extensive exploration for uranium in 1955. Shaft 30 m deep, and surface workings | Some; amount unknown | 56 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 57 | Inez | SW1/4sec. 24 T. 20 S., R. 15 W. | Vein (N75°E) cutting diabase dike in granite at uranium prospect and vein (N5°W), along basic dike in granite at old workings | Torbernite, gold | Discovered in 1951 and mined in 1954 by adit and pits. About 236 metric tons of ore averaged 0.16% $U_3O_8$. Older workings, 150 m north, mined for gold | About 382 kg $U_3O_8$ | 56, 74 |
| | Hummer (Good Luck) | SW1/4sec. 24 T. 20 S., R. 15 W. | Vein along rhyolite dike (N70°E, vert) in granite | Gold | Located about 1900. Shaft about 30 m deep | - - - - - - - - - | 56, 74 |
| 58 | Eugenie | NE1/4sec. 26 T. 20 S., R. 15 W. | Vein (N55°E, vert) in granite near diabase dike | Gold, chalcocite, torbernite | Located about 1913 and mined intermittently up to 1925. Shaft 24 m deep, and drifts. Grade of ore in 1913-1914 averaged 29.6% Cu, 418 g/t Au and 476 g/t Ag | Two carloads of ore (1913-1914) and 225 kg torbernite (1920's) | 56, 74 |
| | Tunnel Site No. 1 | NE1/4sec. 26 T. 20 S., R. 15 W. | Veins along granite-rhyolite dike contact (N30°E) | Limonite, radioactive minerals(?) | Developed by adit 75 m long, with two winzes, and shallow shaft | None | 124 |
| 59 | Bouncing Bet | SE1/4sec. 24 T. 20 S., R. 15 W. | Subparallel veins and rhyolite dikes (N25°-30°E) in granite | Gold, malachite, radioactive minerals(?) | Known in 1890's. Mined about 1900. Shafts and surface workings | Some; amount unknown | 56 |
| 60 | Tullock | SW1/4sec. 25 T. 20 S., R. 15 W. | Veins (N70°W, N45°W, and N5°W) in granite. N45°W vein cuts diabase dikes and is radioactive | Gold, chalcocite, azurite, torbernite | Old shaft, 78 m deep, sunk prior to 1900 with drifts, on N70°W vein. Shaft, 9 m deep, sunk 1959 on N5°W vein. Ore averaged 9% Cu | About 2 metric tons of Cu mined in 1959 | 56, 74 |
| 61 | Gold Lake | S1/2sec. 20 T. 20 S., R. 14 W. | Numerous veinlets in granite and placer deposits (see map no. 167) | Gold | Lode deposits explored but not economical | None | 56 |
| 62 | Chapman | E1/2sec. 25 T. 20 S., R. 15 W. | Two veins (N62°E and N53°E) in early Tertiary rhyolite of Saddle Mountain | Turquoise, secondary copper minerals, radioactive minerals(?) | Turquoise mined from glory hole between two veins between 1890 and 1900 | Some; amount unknown | 56, 211 |
| 63 | New Years Gift | S1/2sec. 22 T. 20 S., R. 15 W. | Two parallel veins (E-W) in granite and diabase | Gold, copper minerals, bismutite, torbernite | Located in 1884 and worked intermittently until early 1930's. Two shafts, 37 and 25 m deep. Ore averaged 6% Cu and 510-680 g/t Au in 1913-1914 | $8,000 in Au prior to 1913. After 1913 8.4 kg Au, 1.9 metric tons Cu | 56 |
| 64 | - - - - - - - | C Sec 2 T. 20 S., R. 15 W. | Vein (N33°W) in granite | Hematite, magnetite | Shaft and pit | - - - - - - - - - | 74 |
| 65 | Black Tom | S1/2sec. 22 T. 20 S., R. 14 W. | Fracture fillings in granite | Manganese oxides | Pit | - - - - - - - - - | 74 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 66 | Monarch No. 2 | SE1/4sec. 19 T. 20 S., R. 15 W. | Vein along Tertiary rhyolite dike (N45°E) in granite. Probably NE extension of Moneymaker fluorite vein (map no. 116) | Autunite, limonite | Pit | None | 124 |
| | | | **Ag-Pb (Cu-Bi-U) Vein Deposits** | | | | |
| | Deposits similar and closely related to the quartz-pyrite Au (Cu-Bi-U) veins of the White Signal district, but contain lead and silver minerals rather than gold. They occur east of the area of quartz-pyrite veins in Precambrian granite and are generally small veins containing chiefly secondary silver minerals and galena. Most were worked between the 1880's and WWI; data on mining activity and production are lacking. | | | | | | |
| 67 | Edmonds | C Sec 34 T. 20 S., R. 15 W. | Vein (N85°W, vert) in granite | Galena, sphalerite(?) | Shaft sunk in late 1930's. Mined for silver | - - - - - - - - - | 56, 73 |
| 68 | Red Dodson | E1/2sec. 14 T. 20 S., R. 15 W. | Mineralized fault zone (N45°W) about 1,200 m long in granite | Cerargyrite, argentiferous galena, bismuthinite | Mined about 1910 from adit 10 m long and shaft 21 m deep. Ore averaged up to $300/ton Ag | About 27 metric tons ore (1910) | 56, 74 |
| 69 | Uncle Sam | NE1/4sec. 32 T. 20 S., R. 14 W. | Mineralized fault zone (N45°W) about 1,200 m long in granite | Cerargyrite, galena, argentite, wulfenite, radioactive minerals | Mined in early 1900's and reactivated briefly in 1940. Developed by a number of shafts, pits, and adits to depth of 30 m | One ore pocket produced $20,000 in Ag | 56, 74, 124 |
| 70 | Sellers | SW1/4sec. 30 T. 20 S., R. 14 W. | Vein in granite | Cerargyrite, copper minerals | Old workings | - - - - - - - - - | 56 |
| 71 | Tullock Silver and deposits to west | W1/2sec. 32 T. 20 S., R. 14 W. | Vein along fault (N30°-35°W) in granite | Cerargyrite, barite | Operated in 1885-1886 from 2 shafts and several pits. Ore from deposits to west averaged 2,380 g/t Ag | Some; amount unknown | 56 |
| 72 | Timmer | SE1/4sec. 15 T. 20 S., R. 14 W. | Veins (N87°E and N55°E) in granite | Cerargyrite, argentite | Worked in 1890's from 2 shafts more than 15 m deep | - - - - - - - - - | 56 |
| 73 | Blackman | NE1/4sec. 26 T. 20 S., R. 14 W. | Vein along fault (N85°E,85°S) in granite | Argentite, cerargyrite, galena, pyrite | Worked about 1910 from numerous pits and shallow shafts | - - - - - - - - - | 56, 74 |
| 74 | Jersey Lily | NW1/4sec. 34 T. 18 S., R. 15 W. | Fissure veins (N15°E) in granite | Cerargyrite, argentite, torbernite | Both deposits mined in 1907 and the Jersey Lily again in 1930. Shafts and adits. Ore in 1907 averaged as high as 24,000 g/t Ag; in 1930 1,700-2,040 g/t Ag | More than $40,000 in silver | 56 |
| | Snowflake | C Sec 34 T. 18 S., R. 15 W. | Vein along fault (N65°-70°E) in granite | | | | 56, 66 |
| 75 | Mose Trimmer | NE1/4sec. 21 T. 21 S., R. 14 W. | Barite-quartz vein (N60°-65°E, 75°-80°N) in granite | Argentiferous galena | Developed during WWI or before. Two shafts, one more than 60 m deep, and trenches | Some; amount unknown | 56, 71 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| | | | Au (Base Metal) Vein Deposits | | | | |
| | Chiefly low-grade and oxidized, gold-bearing quartz-pyrite veins in the Gold Hill district. Silver occurs in a few deposits (map nos. 82, 83, and 90) in the east and south parts of the district. The veins occur as simple fracture fillings in Precambrian granite.or commonly along Precambrian hornblende gneiss-granite contacts. Mineralization is probably Late Cretaceous or early Tertiary in age. Deposits were discovered in 1884 and many small mines were active up to about 1900 when the shallow oxidized ores were mined out. Data on production and activity during this period are virtually nonexistent. Minor intermittent activity between 1920 and 1960 resulted in production of at least 29 kg of gold. | | | | | |
| 76 | - - - - - - - - | NW1/4sec. 23 T. 21 S., R. 17 W. | Quartz vein (N25°-30°E,65°SE) in granite | Galena | Two old shafts and several pits | - - - - - - - - - | 69 |
| 77 | Minneapolis | C Sec 19 T. 21 S., R. 16 W. | Vein in granite | Gold | Extensive underground workings | Some; amount unknown | 56 |
| 78 | Yankey Girl | NE1/4sec. 20 T. 21 S., R. 16 W. | Quartz vein (N20°-25°W) in granite | Galena, sphalerite, chalcopyrite, covellite | Old adit | - - - - - - - - - | 69 |
| 79 | Monarch Canyon | NE1/4sec. 26 T. 21 S., R. 17 W. | Massive quartz vein (N80°-85°E) as thick as 24 m in granite | Galena | Old adit | - - - - - - - - - | 69 |
| 80 | Reservation (includes Gold Bullion) | NW1/4sec. 30 T. 21 S., R. 16 W. | Quartz vein (N45°-55°E, 60°-80°SE) in hornblende gneiss and migmatite | Gold, galena, sphalerite | Old adits and shafts along 600 m of vein. One of principal mines in Gold Hill area | Considerable; amount unknown | 56, 69 |
| 81 | Bruff | SE1/4sec. 30 T. 21 S., R. 16 W. | Quartz vein along fault (N70°-80°E) in granite | Gold | Shaft 60 m deep and pits. Last worked in 1940 | - - - - - - - - - | 56, 69 |
| 82 | Ruby Silver | W1/2sec. 29 T. 21 S., R. 16 W. | Veins in fault zone (N70°-80°E) in granite and hornblende gneiss | Galena, ruby silver | Old shaft 20 m deep and many pits | - - - - - - - - - | 56, 69 |
| 83 | Co-op (Goodluck) | E1/2sec. 29 T. 21 S., R. 16 W. | Veins at intersection of Co-op fault (N60°-75°E) and N-trending fault in granite | Native silver, galena, cerussite, sphalerite | Mined in 1920's from 2 inclined adits and numerous levels | More than $100,000 in Ag | 56, 69, 118 |
| 84 | - - - - - - - | NW1/4sec. 36 T. 21 S., R. 17 W. | Small quartz veins (N80°-85°E) in hornblende gneiss and granite | Galena, gold | Adit and shallow shaft | - - - - - - - - - | 69 |
| 85 | Gold Tunnel (Contention, Hoboken) | W1/2sec. 31 T. 21 S., R. 16 W. | Veins trending E and NE in hornblende gneiss | - - - - - - - - - - - - | Old adit and shafts | - - - - - - - - - | 56, 69 |
| | - - - - - - - | SE1/4sec. 36 T. 21 S., R. 17 W. | Quartz veins in hornblende gneiss. One vein along fault (N20°W) | Gold | Old adit | - - - - - - - - - | 69 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 86 | Mill | NE1/4sec. 1 T. 22 S., R. 17 W. | Quartz vein at contact of hornblende gneiss and migmatite near Gold Hill fault | Gold | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 69 |
| | Golden Chief | W1/2sec. 6 T. 22 S., R. 16 W. | Vein at contact of hornblende gneiss and migmatite | Gold | Original discovery in Gold Hill district in 1884. Adit with drifts | - - - - - - - - - | 56 |
| | Standard (includes California) | W1/2sec. 6 T. 22. S., R. 16 W. | Quartz vein trending WNW at contact of hornblende gneiss and migmatite | Gold | Largest mine in Gold Hill district. Mined out prior to 1900. Old adits | Considerable; amount unknown | 56, 69, 121 |
| 87 | Crescent (Homestead) | NW1/4sec. 6 T. 22 S., R. 16 W. | Quartz vein (N60°W,40°SW) in hornblende gneiss | Gold | Inclined shaft | - - - - - - - - - | 56, 69 |
| | Nancy Lee | NE1/4sec. 6 T. 22 S., R. 16 W. | Quartz vein trending NW in hornblende gneiss | Gold | Two vertical shafts | - - - - - - - - - | 56, 69 |
| 88 | Bluebird | NW1/4sec. 7 T. 22 S., R. 16 W. | Quartz veins (N40°-70°W) in hornblende gneiss | Galena, gold, scheelite, wolframite | Mined prior to 1900 from several shafts and pits. Rehabilitated in 1954 during exploration for tungsten | Several hundred tons Au ore | 24, 56, 69 |
| | - - - - - - - - | SE1/4sec. 1 T. 22 S., R. 17 W. | Brecciated quartz vein (N40°-50°W) at contact of hornblende gneiss and migmatite | Gold | Several old adits, as long as 21 m | - - - - - - - - - | 69 |
| 89 | - - - - - - - - | S1/2sec. 12, N1/2sec. 13 T. 22 S., R. 17 W. | Quartz vein (N-S) along fault in hornblende gneiss | Gold | Three old shafts | - - - - - - - - - | 69 |
| 90 | Climax | E1/2sec. 18 T. 22 S., R. 16 W. | Quartz veins (N30°-45°W, dip SW) in granite and hornblende gneiss | Argentiferous galena, gold | Old adit and shafts | - - - - - - - - - | 56, 69 |
| 91 | Never Fail (Connie Lynn) | SE1/4sec. 17 NE1/4sec. 20 T. 22 S., R. 16 W. | Quartz vein (N65°-75°W, 35°-40°SW) along fault contact between granite and hornblende gneiss | Galena, gold | Old deposit reopened in 1956-1959. Vein explored for 600 m by shafts as deep as 30 m and pits. Vein assayed 8-9% Pb and 120 g/t Au and 645 g/t Ag in 1956, but no ore shipped | - - - - - - - - - | 56, 69 |

## Ni-Co-Ag (U) Vein Deposits

Deposits are fissure veins along faults and fractures, trending N to NNE and NE to E, mainly in Precambrian quartz diorite gneiss and granite near the southeast margin of the Twin Peaks monzonite porphyry stock of Late Cretaceous age (72 m.y.). Lead-uranium isotope data indicate mineralization is Laramide in age, probably related to Twin Peaks stock. Ore minerals occur in gangue composed chiefly of carbonate minerals (calcite, dolomite, siderite, ankerite), and minor pyrite, barite, quartz and rhodochrosite. Deposits discovered in 1881 and extensively mined between then and 1893. Some activity in 1917, 1949-1960 and at present (1980). Total production of silver from all mines is estimated about 40,000 kg, valued between 1 and 1.5 million dollars.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 92 | Black Hawk (includes Black Hawk No. 1 and No. 2 Shafts and Hunecke Shaft) | E1/2sec. 21 T. 18 S., R. 16 W. | Fissure fillings along the Black Hawk vein, which consists of a series of imbricate subparallel fractures, (N70°E,60°-70°NW) in quartz diorite gneiss | Native silver, argentite, galena, chalcopyrite, sphalerite, niccolite, smaltite, nickel skutterudite, pitchblende | Mined 1881-1893 from 3 shafts to depth of 150 m and about 900 m of drifts from 8 levels. Reopened in 1917, and diamond drilled in 1952. Inactive in 1980 | About 14,000 kg Ag | 56, 58, 66, 121, 124 |
| | Copper Vein | | Vein (N50°E,80°-85°NW) about 60 m north of Black Hawk vein | Pitchblende | Trenches and shallow shafts | - - - - - - - - - - | 56 |
| 93 | Alhambra | SW1/4sec. 21 T. 18 S., R. 16 W. | Vein in porphyritic quartz diorite gneiss near E-trending monzonite porphyry dike | Native silver, argentite, niccolite, skutterudite, nickel skutterudite, pitchblende, sphalerite, galena, millerite | Original discovery. Mined 1881-1893 and 1957-1960 from 4 shafts to depth of 105 m | About 13,000 kg Ag (1881-1893) | 56, 58, 76, 94, 121, 124 |
| 94 | Rose | NE1/4sec. 29 T. 18 S., R. 16 W. | Two intersecting veins (N35°E and N85°E to N75°W) in granite, quartz diorite gneiss and monzonite porphyry | Native silver, argentite, cerargyrite, nickel and cobalt minerals, pyargyrite, proustite, pitchblende | Shaft 60 m deep and 2 adits. Closed in 1889 and reopened in 1979 | About 4,300 kg Ag | 56, 58, 76, 121, 124 |
| | Osmer Silver | SE1/4sec. 29 T. 18 S., R. 16 W. | Vein (N60°E,80°S) | Native silver, argentite, pitchblende | Shaft 12 m deep sunk 1950-1960. Inactive in 1980 | - - - - - - - - - - | 56, 76 |
| | Midnight | W1/2sec. 28 T. 18 S., R. 16 W. | Vein trending NE and dipping 80°SE in granite and quartz diorite gneiss | Native silver, nickel, cobalt, and uranium minerals | Shaft 24 m deep | - - - - - - - - - - | 56, 76 |
| 95 | Silver King (Hobson) | NE1/4sec. 21 T. 18 S., R. 16 W. | Vein (N50°-65°E,65°NW) in quartz diorite gneiss within few tens of meters of Twin Peaks monzonite porphyry stock | Argentite, native silver | Inclined shaft and 90-m-long adit | About 1,300 kg Ag | 56, 58, 121 |
| 96 | Good Hope | W1/2sec. 21 T. 18 S., R. 16 W. | Vein between Black Hawk and Alhambra mines (N65°-75°E) in quartz diorite gneiss and granite | Native silver, radioactive minerals | Shaft 37 m deep | - - - - - - - - - - | 56, 58, 121 |
| 97 | Missouri Girl | NE1/4sec. 21 T. 18 S., R. 16 W. | Vein in quartz diorite gneiss and granite | Native silver | Shaft 27 m deep | - - - - - - - - - - | 56, 66 |
| 98 | Eccles | SE1/4sec. 7 T. 19 S., R. 16 W. | Vein in hornblende gneiss and granite gneiss | - - - - - - - - - - - - - | Shaft > 30 m deep sunk in 1800's for silver | - - - - - - - - - - | 56 |

## Fluorite Vein Deposits

Three groups of fluorite vein deposits occur in the area. The northernmost group of deposits (map nos. 99-107) consists of small veins and breccia zones in Precambrian granite generally associated with early(?) Tertiary rhyolite dikes. The largest and most economically significant group of deposits (map nos. 108-120) is veins and breccia zones along faults chiefly in Precambrian granite peripheral to the Tyrone quartz monzonite stock. Many of the veins are associated with the early(?) Tertiary rhyolite or quartz monzonite porphyry dikes, and one deposit (map no. 110) is entirely within an early(?) Tertiary rhyolite dome complex. The third group of deposits (map nos. 121-131) is southeast of Gold Hill in the Bound Ranch district and consists of small veins and breccia zones generally along faults in Precambrian rocks. Manganese minerals, pyrite, galena, gold, scheelite, and uranium minerals are locally associated with the fluorite. Total production of the area has been about 175,000 metric tons of 60% $CaF_2$, most of which is from the Burro Chief (map no. 109) and Shrine (map no. 110) mines.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 99 | Purple Heart | SE1/4sec. 3 T. 18 S., R. 17 W. | Two subparallel breccia veins (N47°W,65°NE and N40°W,vert) in granite. Veins as much as 3 m wide and 750 m long | Fluorite, manganese oxides | Discovered 1947, worked intermittently until 1958 by 2 shafts, to depth of 32 m, and drifts | About 1275 metric tons of 80-85% $CaF_2$ | 51, 56, 85, 190, 201 |
| 100 | Blackmoor (Clover Leaf) | SW1/4sec. 3 T. 18 S., R. 17 W. | Vein, trending N and dipping vertically in granite | Fluorite | Pit 3 m deep | - - - - - - - - | 51, 56, 85, 190, 201 |
| 101 | Reed | N1/2sec. 2 T. 18 S., R. 17 W. | Vein (N60°W,75°SW) | Fluorite | Located 1951, worked 1953 and 1954 by two inclined shafts 15 m deep and opencuts | About 180 metric tons of 60-75% $CaF_2$ | 56, 125, 189, 201 |
| | Rambling Ruby | SW1/4sec. 36 T. 18 S., R. 17 W. | Vein (N15°W) in granite | Fluorite | Shallow pit | - - - - - - - - - | 56 |
| 102 | Great Eagle | SW1/4sec. 23 T. 18 S., R. 18 W. | Veins in brecciated shear zone (N30°-40°W) in granite. Ore zone as long as 240 m | Fluorite | Located in 1911, worked intermittently until 1945. Developed by shaft 33 m deep and adit and numerous surface workings. Exploration in mid 1970's included an adit and drilling | 13,800 metric tons of 53-92% $CaF_2$ | 56, 75, 85, 91, 125, 163, 201 |
| | Hope | SE1/4sec. 23 T. 18 S., R. 18 W. | Vein (N15°W,40°SW) in granite | Fluorite | Old prospect relocated in 1955. Developed by 7-m-long pit | 67 metric tons | 56, 85, 125, 190, 201 |
| | - - - - - - - - | NW1/4sec. 23 T. 18 S., R. 18 W. | Fault breccia in Tertiary rhyolite dike | Fluorite | Trench | - - - - - - - - - | 75 |
| 103 | Purple Rock | NE1/4sec. 22 T. 18 S., R. 18 W. | Veins along contact of Tertiary rhyolite dikes, trending NW, and granite | Fluorite, uranophane(?) | Extensive surface workings | - - - - - - - - - | 3, 56, 85, 190 |
| 104 | Blue Eagle | NE1/4sec. 21 T. 18 S., R. 18 W. | Veinlets in shattered zone (N20°W, steep SW) in granite | Fluorite | Located 1944. Shallow trench | None | 190, 191, 201 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 105 | Hummingbird | NE1/4sec. 32 T. 18 S., R. 17 W. | Three N-trending and intersecting veins in granite | Fluorite | Developed 1947-1953 by adit, with about 80 m of drifts and surface workings | About 560 metric tons | 76, 125, 190, 201 |
| 106 | Jackpot | C Sec 7 T. 18 S., R. 18 W. | Vein (N-trending) in granite | Fluorite, psilomelane | Shallow pits | None | 56, 190, 201 |
| 107 | Harper | NW1/4sec. 16 T. 18 S., R. 18 W. | Vein (NE-trending) in granite | Fluorite | Shallow pit | None | 190, 201 |
| 108 | California Gulch | NE1/4sec. 17 T. 19 S., R. 15 W. | Breccia zones and veins in granite | Fluorite, secondary copper minerals, hematite | Numerous shallow surface workings and an old adit | Some; amount unknown | 51, 56, 190, 191, 201 |
| 109 | Burro Chief | SE1/4sec. 15 T. 19 S., R. 15 W. | Breccia zone in foot wall of NNE-trending fault in granite, intruded by Late Cretaceous-early Tertiary quartz monzonite porphyry dikes. Ore zone 3-30 m wide and more than 120 m long | Fluorite, manganese oxides, secondary copper minerals, hematite | Mined intermittently from 1880 to 1950. Extensive underground workings on 4 levels from shaft 210 m deep | More than 90,000 metric tons averaging 60% $CaF_2$. Ore still present in lowermost levels | 51, 56, 66, 91, 175, 190, 201 |
| 110 | Shrine | NW1/4sec. 13 T. 19 S, R. 16 W. | Breccia zones along fault (N75°W, 46°-68°S) in Tertiary rhyolite porphyry dome flow complex. Ore shoots up to 3 m wide and 150 m long | Fluorite | Discovered in 1936 and mined intermittently until 1952. Inclined shaft 130 m deep and 7 levels | About 65,000 metric tons | 51, 53, 56, 163, 190 |
| 111 | Spar Hill (includes Pine Canyon) | S1/2sec. 27 T. 19 S., R. 16 W. | Breccia zone along fault (N60°E, 70°NW) in granite intruded by Tertiary rhyolite dikes | Fluorite | Discovered(?) in 1941 and worked 1942-1944. Developed by 15-m inclined shaft and 27-m-long drift, and surface workings | About 1100 metric tons | 51, 56, 163, 190, 201 |
| 112 | Long Lost Brother | NE1/4sec. 23 T. 19 S., R. 17 W. | Veins along two subparallel faults (N45°-65°E) in schist and granite | Fluorite, manganese oxides | Developed 1943-1945 by shaft 5 m deep and shallow surface workings | About 425 metric tons | 51, 56, 76, 85, 163, 190, 201 |
| 113 | Gardner | C Sec 26 T. 19 S., R. 16 W. | Veinlets (N60°E) in granite | Fluorite | - - - - - - - - - - - - - - - - - - | None | 51, 190, 201 |
| 114 | Ace High | E1/2sec. 28 T. 18 S., R. 15 W. | Vein (trending NW) in granite | Fluorite | Explored in 1948 by shallow pits | None | 51, 56, 190, 191, 201 |
| 115 | Oak Grove | E1/2sec. 36 T. 19 S., R. 15 W. | Vein (N70°E,60°N) in granite | Fluorite | Pit 3 m deep | - - - - - - - - - | 51, 201 |
| 116 | Moneymaker | SW1/4sec. 19 T. 20 S., R. 15 W. | Vein (N80°-85°E,70°-75°S) in brecciated contact zone between Tertiary rhyolite dike and granite | Fluorite, galena | Worked intermittently 1939-1952. Numerous shallow surface workings | 370 metric tons averaging 50% $CaF_2$ | 51, 56, 73, 163, 190, 201 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 117 | Rustler Canyon | SW1/4sec. 10 T. 20 S., R. 16 W. | Small veinlets in granite | Fluorite | - - - - - - - - - - - - - - - - - - | None | 51, 190, 201 |
| 118 | Accident | SE1/4sec. 22 T. 20 S., R. 16 W. | Small veinlets in granite | Fluorite | - - - - - - - - - - - - - - - - - - | None | 51, 190, 201 |
| 119 | Malpais Tanks | E1/2sec. 26 T. 20 S., R. 14 W. | Small vein in granite | Fluorite | - - - - - - - - - - - - - - - - - - | None | 51, 201 |
| 120 | Knight Peak | C Sec 29 T. 20 S., R. 16 W. | Small vein (N85°E,35°S) in Tertiary rhyolite | Fluorite | Shallow pits | - - - - - - - - - | 51, 190, 201 |
| 121 | Kelley | NE1/4sec. 20 T. 21 S., R. 16 W. | Fractures (N50°W) in granite | Fluorite | Shallow surface workings | None | 69 |
| 122 | Bluebird (Friday) | SW1/4sec. 14 NE1/4sec. 22 NW1/4sec. 23 T. 21 S., R. 16 W. | Breccia and sheeted zones along faults, (N65°E and N85W, dipping N) in granite. Ore zone 615 m long | Fluorite | Worked intermittently 1944-1949. Numerous surface workings and shallow stopes | About 2,700 metric tons averaging 50% $CaF_2$ | 56, 72, 91, 163, 190, 201 |
| 123 | Fence Line | NW1/4sec. 8 T. 22 S., R. 15 W. | Vein along fault (N5°W) in granite | Fluorite | Shallow shafts and numerous surface workings | About 110 metric tons | 56, 72, 190, 201 |
| | Grant County | NW1/4sec. 8 T. 22 S., R. 15 W. | Veins along two parallel faults (N15°W) in granite | Fluorite | Known before 1928. Shaft 20 m deep and surface workings | About 9 metric tons | 51, 56, 72, 91 |
| 124 | Double Strike (Rocky Trail and probably Valley Spar) | SE1/4sec. 4 T. 22 S., R. 15 W. | Breccia zones along faults (N5°-10°E and N20°W) | Fluorite, gold(?) | Valley Spar located in 1918 for gold. Fluorite mined in early 1940's. Two shafts and numerous surface workings | About 18 metric tons | 56, 72, 190, 201 |
| 125 | Windmill | NE1/4sec. 9 T. 22 S., R. 15 W. | Small breccia zones along fault (N60°W) in granite | Fluorite | Small trench and pit | - - - - - - - - - | 51, 56, 72, 190, 201 |
| 126 | Grandview or Grandrow (Bounds No.7) | SE1/4sec. 13 NE1/4sec. 24 T. 22 S., R. 16 W. | Breccia zones along fault (N25°E) and veins along fault (N85°W) in granite | Fluorite | Shaft and surface workings | About 5 metric tons | 56, 72, 190, 201 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 127 | - - - - - - - - | SE1/4sec. 13 T. 22 S., R. 16 W. | Fault (N70°E) in granite | Fluorite | Small pit | - - - - - - - - - | 72 |
| | American | SW1/4sec. 15 T. 22 S., R. 15 W. | Veins and breccias, as wide as 1 m, along faults (N25°E, N15°W and N10°E) in granite | Fluorite, gold(?) | Explored for gold in 1920's and 1930's. Relocated in 1943 for fluorite; minor production 1953. Developed by old shaft 30 m deep and surface workings | About 91 metric tons | 51, 56, 72, 190, 191, 201 |
| | - - - - - - - - - | NW1/4sec. 22 T. 22 S., R. 15 W. | Vein along fault (N10°E) in granite | Fluorite | Small pit | - - - - - - - - - | 72 |
| 128 | Bounds | SE1/4sec. 20 T. 22 S., R. 15 W. | Vein (N5°E) in granite | Fluorite, manganese oxides | Two shafts, 12 and 15 m deep, and short adits and pits | - - - - - - - - - | 51, 56, 183, 190, 191 |
| 129 | Langford | S1/2sec. 25 T. 22 S., R. 16 W. | Breccia zones along fault (N35°W) in granite | Fluorite, autunite | Small pits | - - - - - - - - - | 56, 68, 125, 190 |
| 130 | Continental | E1/2sec. 27 T. 22 S., R. 15 W. | Breccia zones along faults (N5°-15°E) in granite. Mineralization sporadic over length of 900 m | Fluorite | Shafts and numerous surface workings. Mined intermittently from before World War II to 1952 | 3 metric tons in 1952 | 51, 56, 67, 190, 191, 201 |
| | JAP (JPB?) Ranch | SW1/4sec. 26 T. 22 S., R. 15 W. | Veinlets (N20°E,70°-80°E) in granite | Fluorite | Small pits | - - - - - - - - - | 51, 56, 67, 190 |
| 131 | Hines (Werney) | NE1/4sec. 34 T. 21 S., R. 14 W. | Breccia zones along fractures (N85°E and N50°W) in Precambrian or Cambrian quartzite | Fluorite, autunite, scheelite | Located 1951. Shaft 15 m deep and surface workings | - - - - - - - - - | 51, 56, 124 |
| | | | Mn Vein Deposits | | | | |
| | Deposits are shallow epithermal fracture and fissure fillings chiefly in volcanic and volcaniclastic rocks of middle Tertiary age. Coarsely crystalline pink to black calcite and locally quartz are associated with the manganese oxides. The Cora Miller deposit (map no. 135) which was apparently mined for silver is included in this deposit type solely on the basis of the presence of manganese oxides and its association with middle Tertiary volcanic rocks. Most of the larger deposits were located originally during World War I and the remainder during or shortly after World War II, with peak activity between 1950 and 1957. All deposits inactive by 1960. | | | | | | |
| 132 | Black Tower | NW1/4sec. 22 T. 16 S., R. 17 W. | Fracture filling (N20°E,75°SE) in Tertiary rhyolite | Pyrolusite, psilomelane | Located in early 1950's and mined 1954-1957 from 22-m inclined shaft and 55-m-long adit | About 200 metric tons of 41% Mn | 47, 56, 190 |
| 133 | Hillside | SW1/4sec. 22 T. 16 S., R. 17 W. | Lenticular body in fracture, trending NW, in Tertiary volcanic rocks | Pyrolusite | Located in 1952 and mined from surface cut in 1952 and 1953 | 15 metric tons of 25% Mn | 47, 190 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 134 | Old Smokey (Lone Wolf) | Sec. 12 T. 17 S., R. 17 W. | Fractures in broad zone as wide as 60 m in Tertiary rhyolite | Manganese oxides | Discovered in early 1940's; some mining in 1955 | About 20 metric tons of 27.5% Mn | 47, 190 |
| 135 | Cora Miller | SW1/4sec. 6 T. 17 S., R. 16 W. | Vein filled fissure (N70°-75°E) in Tertiary ash-flow tuff | Silver(?), manganese oxides | Apparently worked for silver in 1880's and abandoned since. Inclined shaft 53 m deep and 3 adits | Probably considerable Ag ore | 56, 121 |
| 136 | Black Eagle (Black Jack) | SW1/4sec. 6 T. 18 S., R. 18 W. | Vein in major fault (N15°-25°W, 70°SW) with Precambrian granite foot wall and Tertiary volcanic-rock hanging wall | Psilomelane, pyrolusite, wad, fluorite | Located in 1942. Developed by open cut, 54 m long, and shaft | About 450 metric tons of 20-25% Mn | 47, 56, 85, 190 |
| 137 | Simpson | SW1/4sec. 14 T. 18 S., R. 18 W. | Vein in granite | Manganese oxides | - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 56, 85 |
| 138 | Burris | SE1/4sec. 5 T. 19 S., R. 14 W. | Irregular fractures and seams in Tertiary volcanic conglomerate | Pyrolusite, wad | Mined in 1954 | About 18 metric tons of 32.9% Mn | 47, 190 |
| | | | **U Vein Deposits** | | | | |
| | Chiefly small fracture fillings of secondary uranium minerals in Cretaceous Beartooth Quartzite and shale of the Colorado Formation and probably Tertiary volcanic rocks. Minor production recorded from deposit at map no. 141; the others are probably not economically significant. | | | | | | |
| 139 | Prince Albert No. 1 | Sec. 1 (?) T. 18 S., R. 17 W. | Fractures in Cretaceous Colorado Shale | - - - - - - - - - - - - - | Known in 1950's, some activity 1975-1976. Samples contain between 0.1 and 0.01% $U_3O_8$ | - - - - - - - - - | 16 |
| 140 | - - - - - - - - | NW1/4sec. 11 T. 18 S., R. 17 W. | Small vein in Cretaceous Beartooth Quartzite | Torbernite(?) | Discovered in 1955. Drilled in 1957-1958 | None | 56 |
| 141 | Oil Center Tool Co. | Sec. 21 (?) T. 18 S., R. 15 W. | Fractures in middle Tertiary volcanic rocks | - - - - - - - - - - - - - | Apparently the deposit that produced 35 metric tons of 0.04% $U_3O_8$ | 14 kg of $U_3O_8$ | 16 |
| 142 | - - - - - - - - | Sec 27,28,34 T. 18 S., R. 15 W. | Fractures in Precambrian granite and Cretaceous Beartooth Quartzite | Torbernite and other secondary uranium minerals | Explored in early 1950's by shallow trenches and drilling | - - - - - - - - - | 56 |
| | | | **Other Hydrothermal Deposits** | | | | |
| | Chiefly vein and replacement deposits not readily classified in types described above. | | | | | | |
| 143 | Smith Canyon Magnesite | N1/2sec. 17 T. 18 S., R. 18 W. | Veinlets and masses replacing dolomitic xenoliths(?) in Precambrian granite | Magnesite | Known in early 1920's. Explored by a few pits | None | 56 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 144 | Southern Star | NW1/4sec. 16 T. 19 S., R. 15 W. | Secondary copper and manganese minerals replacing(?) matrix of Tertiary conglomerate | Chrysocolla, crednerite | Explored in early 1900's by 3 adits. Rehabilitated 1959-60 to prepare for leaching | - - - - - - - - - | 56, 66 |
| 145 | north of Surprise shaft (map no. 14) | SW1/4sec. 25 T. 19 S., R. 15 W. | Secondary copper and manganese minerals replacing(?) matrix of Tertiary conglomerate. Zone 60 m long by 15 m wide and as thick as 6 m | Chrysocolla, crednerite, malachite | Trenches. Samples contain as much as 4.4% Cu | - - - - - - - - - | 56 |

## HYDROTHERMAL AND MAGMATIC DEPOSITS

### W Vein and Pegmatite Deposits

Segregations, pods, and disseminations of scheelite occur chiefly in quartz veins and simple pegmatites generally associated with hornblende gneiss pendants enclosed in Precambrian granite of Burro Mountain. With the exception of deposits at map nos. 156 and 157 all occur in a NE-trending zone 13 km long by 6 km wide, east of Bullard Peak. The deposits were discovered in 1935 and in middle 1950's produced about 1.8 metric tons of 68% $WO_3$ and 865 metric tons of > 1% $WO_3$. Probably all deposits inactive since 1961.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 146 | Zelma | SW1/4sec. 33 NE1/4sec. 32 T. 18 S., R. 16 W. | Quartz vein (N30°W,15°NW) in granite (sec 33) and pegmatite segregations in mica schist and hornblende gneiss (sec 32) | Scheelite, bismuth minerals | Original discovery in 1935. Developed by 7.5-m-deep shaft and 60-m adit (sec 33), and numerous surface cuts (sec 32) | About 0.4 metric tons of 62% $WO_3$ and 180 metric tons of 2% $WO_3$ | 24, 56 |
| 147 | Morning Star | SW1/4sec. 28 T. 18 S., R. 16 W. | Scheelite in quartz-rich pegmatites in schist and along a fault (N55°E, 45°NW) in gabbro | Scheelite | Developed by 7-m-deep inclined shaft and numerous surface cuts | About 0.7 metric tons of 71% $WO_3$. | 56 |
| 148 | Greenrock | SE1/4sec. 29 NE1/4sec. 32 T. 18 S., R. 16 W. | Pegmatite dikes trending NW in hornblende gneiss | Scheelite | Developed by 2 shallow shafts and numerous surface cuts | About 4.5 metric tons of 2.7% $WO_3$ plus some high grade hand-sorted ore | 24, 56, 86 |
| 149 | Giant | SE1/4sec. 7 T. 19 S., R. 16 W. | Quartz fracture fillings in hornblende gneiss | Scheelite | Discovered in 1954 or 1955. Developed by 7.5-m-deep shaft and surface cuts | - - - - - - - - - | 56 |
| 150 | Evening Star | NE1/4sec. 26 T. 18 S., R. 16 W. | Quartz-rich pegmatite or vein (N25°E,75°NW) in granite and quartz diorite gneiss | Scheelite, bismuth minerals | Discovered in 1954. Explored by a few pits and diamond drill holes | None | 24, 56 |
| 151 | Rice-Graves (Moneatta No. 2) | NW1/4sec. 24 T. 19 S., R. 17 W. | Quartz-mica-epidote vein trending ENE in hornblende gneiss | Scheelite | Discovered in 1955. Developed by 12-m-deep shaft and numerous surface cuts | None | 24, 56, 76, 85 |
| 152 | Pacemaker (Reed Tungsten) | SE1/4sec. 35 T. 18 S., R. 16 W. | Quartz-rich pegmatites and quartz fracture fillings in granite | Scheelite, molybdenite | Discovered in 1954. Developed by 2 shafts (12-15 m deep) with 27 m of drifts and numerous surface cuts | About 0.7 metric tons of 62% $WO_3$ | 24, 56, 167 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 153 | Harper | NW1/4sec. 32 T. 18 S., R. 16 W. | Quartz vein (N5°-32°W) in hornblende gneiss | Scheelite | Explored by adit and shaft | - - - - - - - - - | 76, 85 |
| 154 | - - - - - - - - | NW1/4sec. 8 T. 19 S., R. 16 W. | Quartz-epidote vein in hornblende gneiss | Scheelite | Explored by adit and shaft | - - - - - - - - - | 76 |
| 155 | - - - - - - - - | NE1/4sec. 31 T. 18 S., R. 16 W. | Quartz vein trending N in hornblende gneiss | Scheelite | Trench | - - - - - - - - - | 76 |
| 156 | Alpha (Sunday, Great Republic 1 and 2) | NW1/4sec. 27 T. 22 S., R. 15 W. | Quartz veins (N80°-85°W) along contact of amphibolite with gneissic granite | Scheelite, chalcopyrite | Shafts as deep as 11 m and small pits | About 90 metric tons of 1.0% $WO_3$ | 24, 56, 68 |
| 157 | Hillside (Myers) | SE1/4sec. 26 T. 22 S., R. 16 W. | Quartz veins in granite | Scheelite, wolframite, gold(?), silver(?) | Prior to 1941 reportedly worked for gold and silver. Wolframite discovered in 1941. Three shafts 25 m deep and drifts | About 590 metric tons of hand-sorted ore | 24, 56, 68 |
| | | | RE-Pegmatite Deposits | | | | |
| | Chiefly zoned, simple pegmatites in Precambrian granite. There has been no recorded production. | | | | | | |
| 158 | - - - - - - - - | SE1/4sec. 17 T. 20 S., R. 15 W. | Quartz-muscovite-microcline pegmatite in granite | Euxenite | Shallow pits | None | 56, 73 |
| 159 | - - - - - - - - | NW1/4sec. 28 NW1/4sec. 29 T. 20 S., R. 15 W. | | | | | |
| 160 | - - - - - - - - | SW1/4sec. 30 T. 20 S., R. 14 W. | Two pegmatites in granite | - - - - - - - - - - - - - | Opencuts | None | 74 |
| 161 | White Rock | SE1/4sec. 13 T. 21 S., R. 17 W. | Two zoned pegmatites in granite | Euxenite, allanite, samarskite | Opencuts | None | 74 |
| 162 | South and North Pegmatites | NE1/4sec. 29 T. 21 S., R. 16 W. | Two zoned pegmatites aligned N40°W in granite | Euxenite, samarskite, cyrtolite | Opencuts | None | 12, 56, 69 |
| 163 | Whitetop Hill | W1/2sec. 27 T. 21 S., R. 16 W. | Three pipe-like zoned pegmatites in granite | Beryl, columbite-tantalite, rare-earth minerals | Small pits | None | 56, 72, 128 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| | | | **METAMORPHIC DEPOSITS** | | | | |
| 164 | Ricolite deposits | SW1/4sec. 9, NW1/4sec. 16 NE1/4sec. 17 T. 18 S., R. 18 W. | Xenoliths of thermally metamorphased dolomitic rocks in Precambrian granite | Talc-serpentinite | Quarried in limited quantity between 1880's and 1940's for ornamental stone | Some; amount unknown | 75, 85 |
| 165 | Magnetite deposits | SE1/4sec. 9 T. 18 S., R. 18 W. | Magnetite-rich bands in serpentinite in xenoliths of thermally metamorphosed rock in Precambrian granite. Magnetite locally constitutes 90% of rock | Magnetite | - - - - - - - - - - - - - - - - | None | 56, 65 |
| | | | **SEDIMENTARY DEPOSITS** | | | | |
| | | | **Au Placer Deposits** | | | | |
| 166 | Gold Gulch | S1/2sec. 21 T. 20 S., R. 16 W. | Holocene alluvial gravels on Tertiary Gila Conglomerate | Native gold | Operated before 1884 and intermittently up to 1950 | Some; amount unknown | 56, 94 |
| 167 | Gold Lake | S1/2sec. 20 T. 20 S., R. 14 W. | Holocene gravels below gold-bearing quartz veins in knob of Precambrian granite (see map no. 61) | Native gold, native bismuth, pyrope garnet | Mined intermittently between 1900 and 1932 | About 53 kg Au and 4.5 kg garnet in 1931-1932 | 56 |
| 168 | Foster | NE1/2sec. 31 T. 21 S., R. 16 W. | Holocene gravels in Gold Hill Canyon | Native gold | - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 69 |
| | | | **VOLCANIC DEPOSITS** | | | | |
| | | | **Perlite Deposits** | | | | |
| 169 | Wallace Ranch | N1/2sec. 30 SE1/4sec. 19 T. 16 S., R. 18 W. | Vitrophyre in middle Tertiary rhyolite | Perlite | Opened in 1958 and mined up to 1960 from 3 open pits. High-quality perlite | More than 180 metric tons | 56 |
| 170 | McDonald Ranch | NE1/4sec. 13 T. 22 S., R. 15 W.; NE1/4sec 19 sec 18 T. 22 S., R. 14 W. | Vitrophyre in middle Tertiary rhyolite | Perlite | Mined from a number of open pits in 1950 | About 2,700 metric tons | 7, 56, 71, 90 |
| 171 | Thompson Canyon (Brock) | Sec 18 T. 20 S., R. 16 W. | Vitrophyre in middle Tertiary rhyolite dome | Perlite | Undeveloped | None | 7, 56 |

CENTRAL MINING REGION AREA (includes the Central, Chloride Flat, Fierro-Hanover, Fierro Manganese, Fleming, Georgetown, Lone Mountain, Pinos Altos, Santa Rita, and Silver City mining districts)

## HYDROTHERMAL DEPOSITS

### Porphyry Cu (Mo) Deposits

Two major copper deposits in the Central mining region, the Santa Rita and Hanover Mountain deposits, classified here as porphyry copper deposits are complex porphyry-replacement deposits genetically related to two Laramide intrusives, the Santa Rita quartz monzonite porphyry stock (56-63 m.y.) and the Fierro-Hanover granodiorite stock (58-70 m.y.). Both deposits appear to be localized at the intersection of NE-trending fault zones with NW-trending fractures (Santa Rita) or N- and E-trending fractures (Hanover Mountain).

Data on early mining activity are incomplete. Both deposits were known to the Spanish; recorded production at Santa Rita began in 1801.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Santa Rita (Chino) (includes Flux, Keystone Shaft, and Wildcat) | Secs. 26, 27, 34, 35 T. 17 S., R. 12 W. | The ore bodies at Santa Rita are a complex of typical porphyry type veins and disseminated ores that have been secondarily enriched, and limestone replacement deposits exhibiting little or no enrichment, in and around the pervasively altered and intensely shattered Santa Rita stock. The supergene enriched zone, which provided much of the early-mined ore, occurred chiefly in the stock and peripheral Upper Cretaceous sedimentary rocks and quartz diorite sills where locally it is more than 200 m thick. The limestone replacement deposits which presently account for much of the ore mined, occur in Pennsylvanian Magdalena Group limestones along the north and northwest border of the stock | Supergene minerals--chalcocite, covellite, native copper, chrysocolla, cuprite, malachite, azurite. Primary minerals (replacement deposits)--chalcopyrite, magnetite. Primary minerals (porphyry)--chalcopyrite, bornite, molybdenite | Native copper mined by Indians prior to 1800. Underground mining of high grade oxidized ores and rich chalcocite ores in veins and masses occurred intermittently between 1801 and 1911. Since 1911, mine has produced continuously from large-scale open-pit operation; dump leaching, initiated in 1940's, accounts for about one third of copper produced. Average grade of 207 million metric tons of ore mined (1911-1962) was 0.93% Cu, with values in Mo, Ag and Au. Grade of primary ore below enriched zone probably averages about 0.1% Cu | Prior to 1977 about 3 million metric tons Cu, 15,000 metric tons $MoS_2$ and some Ag and Au | 34, 94, 105, 129, 166, 178, 189, 190 |
| 2 | Hanover Mountain (includes Gilchrist Tunnel, Hanover Tunnel, and part of Hanover Shaft) | SW1/4sec. 3, SE1/4sec. 4 T. 17 S., R. 12 W. | A zone of supergene-enriched copper minerals in the Cretaceous Colorado Formation in the hanging wall of the Barringer fault at the extreme north end of the Fierro-Hanover stock is associated with complex vein, disseminated, and replacement deposits | Supergene minerals--chalcocite. Primary minerals-cupriferous pyrite | High grade vein and replacement deposits mined intermittently between 1858 and 1910 from Hanover Shaft (see also U. V. Industries No. 3 Shaft, map no. 24). Supergene chalcocite blanket, which contains about 9.5 million metric tons of 0.6% copper, has not been mined | 450 metric tons Cu (1858-1861) | 65, 94, 102, 121, 165, 178 |

### Fe, Zn, Cu-Zn-Fe, and Zn-Pb Replacement Deposits

Massive sulfide and oxide replacement deposits in the Central mining region are spatially and genetically related to four Laramide stocks: the Fierro-Hanover granodiorite stock (58-70 m.y.), the Santa Rita quartz monzonite porphyry stock (56-63 m.y.), the Pinos Altos quartz monzonite stock (57-80 m.y.), and the Copper Flat quartz latite porphyry stock (Late Cretaceous-early Tertiary). Four types of deposits, each with a characteristic suite of ore minerals, are recognized: Fe replacement (magnetite), Zn replacement (sphalerite), Cu-Zn-Fe replacement (chalcopyrite, sphalerite, magnetite) and Zn-Pb replacement (sphalerite, galena). Gradations between types occur. The deposits also exhibit a crude zonation outward from the stock--the Fe and Zn replacement deposits being closest to the stock, the Cu-Zn-Fe replacement deposits in an intermediate position, and the Zn-Pb replacement deposits farthest from the stock. With the exception of some of the Zn-Pb replacement deposits all types occur in Paleozoic carbonate rocks and are generally associated with contact-metasomatic skarn minerals (chiefly garnet, epidote, ilvaite and salite).

Fe replacement deposits

Massive magnetite replacement deposits occur chiefly around the north lobe of the Fierro-Hanover stock and to a lesser extent around the Santa Rita and Copper Flat stocks. The deposits are controlled by both the chemical composition (magnesian limestones preferred) and permeability of the host carbonate rocks. Variable amounts of chalcopyrite and sphalerite may occur with the magnetite.

The deposits were probably mined as early as the 1800's, chiefly for flux, but production figures are very incomplete until 1899 when significant mining of iron ore began. Mining was continuous until 1931, and was intermittent and minor up to 1944. Total recorded production, including ore from the Cu-Zn-Fe replacement deposits, is about 5,000,000 metric tons averaging 53% Fe.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 3 | Republic, Union Hill | SE1/4sec. 9, NE1/4sec. 16 T. 17 S., R. 12 W. | Replacement of steeply dipping Ordovician and Silurian El Paso Limestone and Montoya and Fusselman Dolomites along west side of Fierro-Hanover stock. Ore bodies as long as 300 m and 6-24 m thick | Magnetite, hematite, chalcopyrite, sphalerite | Mined to depth of 100 m by extensive underground workings and opencuts | 2.3 million metric tons of about 42.4% Fe (1916-1931) | 4, 65, 102, 121, 142, 166 |
| 4 | Jim Fair (includes Nonpareil) | NW1/4sec. 10 T. 17 S., R. 12 W. | Replacement of Ordovician El Paso Limestone along east side of Fierro-Hanover stock. Ore bodies as thick as 12 m | Magnetite, limonite at Nonpareil | Mined to depth of about 100 m by extensive underground workings and opencuts | 0.72 million metric tons of about 54% Fe (1909-1924) | 4, 65, 102, 121, 142, 166 |
| | Eighty-six | NW1/4sec. 10 T. 17 S., R. 12 W. | | Magnetite | | 0.31 million metric tons of about 51% Fe (1909-1913) | 65, 103 |
| | Humboldt | SW1/4sec. 10 T. 17 S., R. 12 W. | Probably replacement of Ordovician El Paso Limestone | Magnetite | Mined principally by opencut | - - - - - - - - - | 65, 102 |
| 5 | Snowflake | S1/2sec. 10, N1/2sec. 15 T. 17 S., R. 12 W. | Replacement of Ordovician El Paso Limestone along east side of Fierro-Hanover stock. Ore bodies as thick as 9 m | Magnetite, chalcopyrite | Mined principally by opencut | 0.26 million metric tons of about 50% Fe (1913-1918) | 65, 102 |
| 6 | El Paso | N1/2sec. 22 T. 17 S., R. 12 W. | Replacement of Mississippian Lake Valley Limestone along east side of Fierro-Hanover stock | Magnetite, hematite | Mined by benches and opencuts | 0.09 million metric tons of about 56% Fe (1937-1945) | 65, 102, 166 |
| | Maggie Bell, Copper Bottom | NW1/4sec. 22 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Oswaldo Limestone along east side of Fierro-Hanover stock | Magnetite | Mined from opencuts in 1913 | About 1,000 metric tons | 65, 102 |
| | Queen | S1/2sec. 15 T. 17 S., R. 12 W. | Replacement of Paleozoic limestone along east side of Fierro-Hanover stock | Magnetite | - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 65 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 7 | Ironhead | SW1/4sec. 9 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Oswaldo Limestone in footwall of Barringer fault west of Fierro-Hanover stock. Ore bodies as thick as 30 m | Magnetite, sphalerite | Mined to depth of 90 m from Pearson and Barnes Shafts and from opencuts prior to 1946 | - - - - - - - - - | 65, 97, 102 |
| 8 | Robert E. Lee, Santa Fe No. 1 | N1/2sec. 21 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Oswaldo Limestone along southwest side of Fierro-Hanover stock | Magnetite | Mined in 1931 | 0.03 million metric tons of about 57% Fe | 65, 102 |
| | Lone Star, Copper Pillo | SE1/4sec. 16 T. 17 S., R. 12 W. | | | - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 65, 102 |
| 9 | Magnetite | SE1/4sec. 16 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Oswaldo Limestone along east side of Fierro-Hanover stock. Ore bodies less than 1 m thick | Magnetite, hematite | - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 102 |
| 10 | Cupola | E1/2sec. 21 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Oswaldo Limestone along south side of Fierro-Hanover stock. At Cupola Mine ore bodies as thick as 6 m | Magnetite, chalcopyrite | Mined from drift and opencuts | 0.03 million metric tons of about 58% Fe (1916-1930) | 65, 102 |
| | Philadelphia | W1/2sec. 22 T. 17 S., R. 12 W. | | | | | 142, 170 |
| 23 | Continental, Anson S | SW1/4sec. 9 T. 17 S., R. 12 W. | Ore bodies as thick as 37 m replacing Ordovician El Paso Limestone (Continental) and Ordovician Montoya Dolomite and Silurian Fusselman Dolomite (Anson S) in the footwall zone of Barringer fault along northwest side of Fierro-Hanover stock | Magnetite, limonite | Mined chiefly from shafts, as deep as 90 m. Workings within present U. V. Industries Continental pit | Production included with that of Union Hill and Republic mines | 65, 102, 190, 191, 194 |
| 11 | Nugent, Booth | S1/2sec. 22 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Oswaldo Limestone along north side of Santa Rita stock | Magnetite, hematite | Mined from shallow opencuts | 0.05 million metric tons of about 55% Fe (1943-1944) | 65, 102, 121 |
| 12 | Copper Flat | S1/2sec. 19 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Oswaldo Limestone along northwest side of Copper Flat stock | Hematite, magnetite, pyrolusite | Mined from open pit 65 m long and 20 m wide | 0.01 million metric tons (1931-1937) | 65, 102 |
| 13 | Hamlett | NW1/4sec. 2 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Magdalena Group limestones along fractures | Magnetite, hematite, manganese oxides | Explored by many shallow pits and trenches | - - - - - - - - - | 47, 65, 190 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| Zn replacement deposits | | | | | | | |
| | Massive sphalerite replacement deposits are concentrated around the south lobe of the Fierro-Hanover stock and the Copper Flat stock. The deposits are mostly in the upper part of the Mississippian Lake Valley Limestone beneath the "parting shale" of the Pennsylvanian Oswaldo Formation and are further structurally controlled by folds and granodiorite porphyry dikes. Magnetite and minor chalcopyrite and galena are generally associated with the sphalerite. Mining of the zinc deposits began in the 1890's but production records prior to about 1911 are incomplete. Principal mines operated with some interruption (mid-1930's), until 1971. | | | | | | |
| 14 | Empire Zinc mines at Hanover (includes U.S. Adit, U.S. Tunnel, Mason Tunnel, Strike Tunnel, and Republic (after 1920) | SW1/4sec. 16 N1/2sec. 21 T. 17 S., R. 12 W. | Blanket-like masses as thick as 40 m and upright tubular bodies as much as 300 m long, 36 m high, and 9 m in width, along granodiorite dikes, replacing Lake Valley Limestone around southwest margin of Fierro-Hanover stock | Sphalerite, smithsonite hydrozincite, galena, cerussite | Oxidized ores mined 1902-1918. Extensive underground workings and open pit. Mines closed in 1971. Sphalerite ore averaged 15% Zn | About 250,000 metric tons Zn, 1800 metric tons Pb | 4, 97, 179 |
| 15 | Pewabic | NW1/4sec. 22 T. 17 S., R. 12 W. | Ore bodies are horizontal pod-like forms as much as 12 m in diameter and 180 m long enclosed in Lake Valley Limestone and further controlled by vertical fissures and thrust faults at southeast margin of Fierro-Hanover stock | Sphalerite, magnetite, chalcopyrite, pyrrhotite | Extensive underground workings. Mine closed in 1953 | About 136,000 metric tons of Zn, valued at $20-25 million | 4, 65, 102, 117, 137, 170, 171 |
| 16 | Kearney | NW1/4sec. 27 T. 17 S., R. 12 W. | Ore bodies replace Lake Valley Limestone at southeast margin of Fierro-Hanover stock along two steeply-dipping faults and beneath thick diorite sill | Sphalerite, galena, chalcopyrite, magnetite | Magnetite mined probably in 1930's. Zinc mining started in 1943 and continued with brief interruptions until 1967. Main shaft 187 m deep. Grade of ore mined ranges from 5.3 to 15.7% Zn and 0.35 to 1.5% Pb | About 100,000 metric tons Zn and 3,000 metric tons Pb | 4, 181 |
| 17 | Oswaldo | SE1/4sec. 21 T. 17 S., R. 12 W. | Replacement of Lake Valley Limestone at southeast margin of Fierro-Hanover stock | Sphalerite | Developed as zinc producer in 1942 and continued in operation until 1971 | Production greater than 22,000 metric tons Zn | 4, 97 |
| 18 | Oswaldo No.2 | NE1/4sec. 27 T. 17 S., R. 12 W. | Ore body replaces Lake Valley Limestone along crest of assymetrical anticline and adjacent to granodiorite porphyry dike at north margin of Santa Rita stock | Sphalerite, galena | Probably operated at same time as Oswaldo mine | - - - - - - - - - | 97 |
| 19 | Republic | SE1/4sec. 21 T. 17 S., R. 12 W. | Replacement of Lake Valley Limestone at southeast margin of Fierro-Hanover stock | Sphalerite | In 1920 acquired by Empire Zinc Co. Probably major producer prior to 1920 | - - - - - - - - - | 4, 97 |
| | Thundercloud | SE1/4sec. 22 T. 17 S., R. 12 W. | | Sphalerite, galena, smithsonite, hydrozincite | Part of Empire Zinc Co. operations | - - - - - - - - - | 121 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 20 | Grant County | NE1/4sec. 22 T. 17 S., R. 12 W. | Ore bodies replace Pennsylvanian Syrena Formation near a granodiorite dike about 1.5 km east of Fierro-Hanover stock | Sphalerite | Mined 1928-1951. Grade of ore averaged 9.44% Zn | About 4,900 metric tons Zn | 97 |
| 21 | Princess | C sec. 28 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Oswaldo Limestone and Syrena Formation south of Fierro-Hanover stock | Sphalerite | Shaft | - - - - - - - - - | 97, 179 |
| 22 | Copper Flat | NE1/4sec. 30 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Oswaldo Limestone around the south and east margin of the Copper Flat stock | Sphalerite, magnetite | First prospected for copper about 1900 when 4 shafts were sunk. Zinc mining began 1942 and continued until 1947, when mine was closed | About 25,000 metric tons Zn | 137 |
| Cu-Zn-Fe replacement deposits | | | | | | | |
| | Massive mixed oxide-sulfide replacement deposits and some vein deposits associated with the Fierro-Hanover, Pinos Altos, and Santa Rita stocks. At the Fierro-Hanover stock the deposits occur in the footwall of the Barringer Fault, a major NE-trending structure that is slightly older than the stock. The deposits at Hanover Mountain (map no.24) were producing copper as early as 1858 and may have been worked much earlier by the Spanish. Some deposits mined for iron prior to 1930, but major production of copper and to a lesser extent iron and zinc did not begin until 1950's. | | | | | | |
| 23 | U.V. Industries Continental pit (includes the Continental, Modoc, Anson S, and Zuniga) | C sec. 9 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Magdalena Group and Mississippian Lake Valley Limestone in the footwall of the NE-trending Barringer Fault along the northwest side of the Fierro-Hanover stock. Also includes vein and supergene deposits in Cretaceous Colorado Formation in hanging wall of fault zone (see map no. 2) | Chalcopyrite, magnetite, sphalerite, chalcocite, molybdenite | Mined for iron from extensive underground workings prior to 1931. Between 1954 and 1968 considerable copper ore mined from Continental mine and leaching operations in Zuniga mine. In 1968 open-pit mining started. Deposit contains (1979) about 15-20 million metric tons of 0.88% Cu and values in Ag | About 0.22 million metric tons Cu and some Fe | 191, 194 |
| 24 | U.V. Industries #3 Shaft (includes part of Hanover Mountain, Hugo, and Gibhart Prospects) | NE1/4sec. 9 T. 17 S., R. 12 W. | | | Hanover Shaft produced copper as early as 1858, with intermittent production up to 1980. U.V. Industries underground operations began in 1968. Deposit contains (1979) about 17 million metric tons of 1.96% Cu | Probably more than 0.3 million metric tons of Cu | 191, 194 |
| 25 | Emma (includes Davidson Tunnel, Dewey Tunnel, and Bluebell Tunnel) | W1/2sec. 3 T. 17 S., R. 12 W. | Replacement of Mississippian Lake Valley Limestone in footwall of Barringer Fault zone | Chalcopyrite, magnetite | - - - - - - - - - - - - - - - - - - | Some, amount unknown | 179 |
| 26 | Lady Katherine | NW1/4sec. 36 T. 16 S., R. 14 W. | Veins in Pennsylvanian Magdalena Group limestones intruded by diorite porphyry in zone of complex NNE and NE faulting 1.6 km west of Pinos Altos stock | Chalcopyrite, sphalerite, bismuthinite | Trench and adit | Some; amount unknown | |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 27 | Exxon | SE1/4sec. 25 T. 16 S., R. 14 W; W1/2sec. 30 T. 16 S., R. 13 W. | Replacement of Pennsylvanian Magdalena Group and Mississippian Lake Valley Limestone along northwest margin of Pinos Altos stock. Deposits covered with as much as 510 m of postmineral volcanic and sedimentary rocks | Chalcopyrite, sphalerite, magnetite, hematite, galena, stromeyerite, tetrahedrite-tennantite | Discovered in 1973 by deep drilling through Cretaceous and Tertiary cover. Exploration and development continue to present (1980) | None | 49, 126 |
| 28 | Treasure Vault | SW1/4sec. 27 T. 17 S., R. 12 W. | Replacement of Pennsylvanian Magdalena Group limestones along northwest margin of Santa Rita stock | Chalcopyrite, magnetite, sphalerite | - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 97 |

Zn-Pb replacement deposits

Massive sphalerite and galena replacement deposits generally containing silver and minor gold occur in outermost mineralized aureole around the Fierro-Hanover and Pinos Altos stocks. Some deposits (map no's. 31 and 35) are associated with skarn minerals; most others occur in carbonate beds that were altered only by chloritization or silicification. The Blackhawk and Hobo mines are at the northern extremity of a major NE fault system, southwest of the Fierro-Hanover stock. Data on mining activity and production incomplete; no mines operating since about 1953.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 29 | Cleveland (includes Atlas No. 1 and 2) | NW1/4sec. 1 T. 17 S., R. 14 W; SW1/4sec. 36 T. 16 S., R. 14 W. | Irregular to flat-lying replacement bodies, as much as 60 m long, 15 m wide, and 4 m thick in Pennsylvanian Magdalena Group limestones intruded by diorite porphyry in zone of complex NNE-NE faulting west of Pinos Altos stock | Sphalerite, galena, chalcopyrite. Bismuth minerals at Houston-Thomas mine | Prior to 1913 shallow oxide ore mined. From 1915 to 1947, 121,000 metric tons of sulfide ore contained 9-15% Zn, 1-2% Pb, 0.2-1% Cu, and 68-137 g/t Ag. Mine closed by 1952 | 14,250 metric tons Zn, 153 metric tons Pb, 37 metric tons Cu, 1147 kg Ag and 28 kg Au | 23, 82, 121, 178 |
| 30 | Houston-Thomas | SE1/4sec. 35 SW1/4sec. 36 T. 16 S., R. 14 W. | | | About 6,500 metric tons of oxide ore mined up to 1943. From 1943 to 1947 3,400 metric tons of sulfide ore containing 6-10% Zn, 1-3% Pb, 0.1-0.5% Cu, and 103-206 g/t Ag | 287 metric tons Zn, 79 metric tons Pb, 11 metric tons Cu and 527 kg Ag | 4, 126, 178 |
| 31 | Shingle Canyon (includes Maggie Shaft and Barringer Incline) | SE1/4sec. 34 SW1/4sec. 35 T. 16 S., R. 12 W. | Replacement of limy mudstone and limestone-pebble conglomerate in Permian Abo Formation in footwall of Barringer fault, northeast of Fierro-Hanover stock | Sphalerite, galena, chalcopyrite | Extensive underground workings | Considerable; amount unknown | 97 |
| 32 | Mountain Home and North Star | SE1/4sec. 17 T. 17 S., R. 12 W. | Replacement of limy beds at the base of the Pennsylvanian Syrena Formation where cut by NE-trending fractures about 1.5 km west of Fierro-Hanover stock | Smithsonite, cerussite. Primary ore contained sphalerite, galena, tungsten minerals | Oxide ores mined from a number of shafts and adits between 1909 and 1917. Inactive in 1980 | About 4,500 metric tons | 24, 97, 168 |
| 33 | Three Brothers | NW1/4sec. 31 T. 17 S., R. 12 W. | Replacement bodies and fissure fillings in the Pennsylvanian Syrena Formation along a NE-trending fault system | Sphalerite, galena, oxide minerals | Mined to depth of 48 m mostly in 1920's and 1930's. Average grade of about 150 metric tons of sulfide ore: 24% Zn, 13.5% Pb, 0.3% Cu, 0.7 g/t Au and 68 g/t Ag | About 45 metric tons of oxide and sulfide ore | 97, 113 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 34 | Blackhawk (Combination) | NE1/4sec. 29 T. 17 S., R. 12 W. | Vertical replacement bodies in the Mississippian Lake Valley Limestone and Pennsylvanian Oswaldo Formation at fault intersections in the hanging wall of the Mirror fault about 2 km southwest of the Fierro-Hanover stock | Sphalerite, galena, chalcopyrite | Major production started in 1919 and continued intermittently until 1953. Blackhawk mine developed to depth of at least 200 m. Average grade of ore until 1930: 12% Zn, 2.5% Pb, 0.5% Cu, 68 g/t Ag | 11,250 metric tons Zn and 2,250 metric tons Pb (1938-1946) | 4, 97, 168, 171 |
| 35 | Hobo | SE1/4sec. 29 T. 17 S., R. 12 W. | Replacement bodies in the Pennsylvanian Oswaldo Formation along the north end of the Hobo fault | | | | 97 |

## Ag (Pb-Mn) Vein and Replacement Deposits

Oxidized deposits of silver, generally associated with lead and manganese minerals, have been mined in a number of districts in the Central mining region. In the Georgetown, Lone Mountain and Chloride Flat mining districts the deposits are localized among fractures, joints, and bedding plains chiefly in the Silurian Fusselman Dolomite immediately below the Devonian Percha Shale; the carbonate rocks are silicified but otherwise show no evidence of calc-silicate skarn development. The deposits at Fleming Camp occur as irregular pockets in Cretaceous Beartooth Quartzite and Precambrian granite.

Data on mining activity and production are practically nonexistent. The deposits were discovered in the 1870's and most were mined out by 1893.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 36 | Georgetown (includes Naiad Queen, Commercial Cramer, MacGregor, McNulty, and Satisfaction) | SW1/4sec. 6, N1/2sec. 7 T. 17 S., R. 11 W. | Irregular oxidized bodies in Fusselman Dolomite, some localized near contacts with granodiorite porphyry dikes | Cerargyrite, native silver, argentite, cerussite. Primary ore probably argentiferous galena | Discovered in 1866, with major production between 1873-1893. Underground workings generally less than 60 m deep; at Naiad Queen, workings to depth of 180 m | About 120,000 kg Ag valued at $3.5 million | 4, 118, 121 |
| 37 | Lone Mountain Mines (includes Monarch, Home Ticket, New York, and Eighty-four) | N1/2sec. 27 T. 18 S., R. 13 W. | Veins up to 2 m thick, following vertical cross-cutting fractures throughout the Fusselman Dolomite | Cerargyrite, native silver, argentite, galena | Discovered in 1871; virtually mined out by 1884. Numerous shallow shafts probably no deeper than 30 m. Ore averaged 1,372-2,401 g/t Ag in Monarch mine | Considerable; amount unknown | 121, 157 |
| 38 | - - - - - - | C sec. 35 T. 18 S., R. 13 W. | Fractures in Mississippian Lake Valley Limestone | Cerargyrite(?), Mn oxides | Discovered in 1920. Worked intermittently by shafts and open pits until late 1940's | Some; amount unknown | 157 |
| 39 | Chloride Flat Mines (includes Baltic, Bell, Providencia, Seventy-six, Silver Cross, and Bremen) | E1/2sec. 32, SW1/4sec. 33 T. 17 S., R. 14 W.; E1/2sec. 5, W1/2sec. 4 T. 18 S., R. 14 W. | Supergene enriched replacement bodies 15-75 m long and 9-18 m wide in Fusselman Dolomite along a N-trending fracture zone 600 m long | Cerargyrite, argentite, native silver, embolite, pyrolusite, limonite, hematite. Primary ore probably argentiferous galena and mesitite (ferroan-manganoan magnesite) | Discovered in 1871 with major production between 1873-1893 and some production until 1937. Manganiferous iron ore mined in 1916 and in the early 1940's | About 124,000 kg Ag valued at $3.3 million and 3,300 metric tons containing 12-17% Mn and 34-38% Fe | 102, 121 |
| 40 | Fleming Camp (Old Man) | S1/2sec. 27, N1/2sec. 34 T. 17 S., R. 15 W. | Irregular oxidized bodies in Cretaceous Beartooth Quartzite | Cerargyrite, native silver, and argentite | Discovered in 1882, mined until about 1893. Mine developed to depth of 90 m by inclined shaft, but ore mostly above 25 m | About 9,300 kg Ag valued at $300,000 | 121 |
| 41 | Pauline | N1/2sec. 27 T. 17 S., R. 15 W. | Quartz fissure vein in Precambrian granite | - - - - - - - - - - - - - | Mined prior to 1910 | - - - - - - - - - | 121 |

## Mn (Fe) Replacement Deposits

Similar to above Ag (Pb-Mn) vein and replacement deposits but generally lack silver and lead minerals. At Boston Hill, deposits occur in Ordovician and Silurian dolomites; other deposits occur in Mississippian and Pennsylvanian limestones.
Most deposits worked during WWI, WWII, and the 1950's; only the deposits at Boston Hill are presently being mined.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 42 | Boston Hill mines (includes Comanche, Raven, North Pit, Silver Pick, Second Value, and Fierro No. 1) | N/1/2sec. 9, SE1/4sec. 4 T. 18 S., R. 14 W. | Supergene enriched replacement bodies along fractures, in brecciated rocks and in permeable beds in Ordovician Montoya and El Paso Dolomites (Boston Hill) and Silurian Fusselman Dolomite (Boston Hill east) cut by NE-trending faults along west side of Silver City stock. Ore bodies occur only above the water table which is generally less than 60 m deep | Hematite, limonite, pyrolusite. Primary ore contains hematite, magnetite, mesitite (ferroan-manganoan magnesite) and minor base-metal sulfides | Explored in late 1800's for silver, with some production as early as 1883. Principal production began in 1916 and has continued with some interruptions to present (1980). Ore has been mined from hundreds of open pits, trenches, and shallow underground workings in a 2 1/2 $km^2$ area. Since 1937 all mining has been from open pits | Approximately 2 million metric tons containing 30-40% Fe and 10-13% Mn | 44, 47, 102 |
| 43 | Boston Hill East mines (includes Silver Spot, Legal Tender, Iron Spike, Adonis, California, Atlas, and Luck Manganese) | W1/2sec. 10, SW1/4sec. 3 T. 18 S., R. 14 W. | | | | | 27, 44, 47, 102, 177 |
| 44 | Lost Treasure, Gold Quartz (Fierro Manganese) | S1/2sec. 35 T. 16 S., R. 12 W. | Replacement bodies and lenticular fissure fillings in Pennsylvanian Magdalena Group limestones along two subparallel faults striking N55°-60°E | Pyrolusite, wad, iron oxides | Mined during WWI, WWII, and the early 1950's from open-cuts and underground to depths of 24 m | About 600 metric tons containing 19-26% Mn | 47, 92, 190 |
| 45 | Old Claim | NE1/4sec 35, NW1/4sec. 36 T. 16 S., R. 12 W. | Irregular replacement (?) bodies along fault (vein) striking N50°E in Pennsylvanian Magdalena Group limestones near junction of Barringer and Mimbres fault zones | Manganese oxides, iron oxides, galena, sphalerite | Mined from open-cuts during 1950's | 72 metric tons containing 21.4% Mn | 47, 190 |
| 46 | - - - - - - | NE1/4sec. 17 T. 17 S., R. 12 W. | Replacement bodies in Pennsylvanian Oswaldo Formation | Manganese oxides | - - - - - - - - - - - - - - - - - - | None | 97 |
| 47 | Bear Mountain Group (Nineteen Sixteen Mine) | NE1/4sec. 13 T. 17 S., R. 15 W.; NW1/4sec. 18 T. 17 S., R. 14 W. | Irregular replacement bodies in Pennsylvanian Oswaldo Formation in fracture zone (N25°E) | Pyrolusite, wad, iron oxides | Mined during WWI, WWII and intermittently from 1953-1959 from 2 shafts, 20 m deep, and several opencuts | About 1,850 metric tons of 30% Mn | 27, 47, 92, 190, 191 |
| 48 | Tom Lyons (Includes Corliss, El Campo, Sweet Home, Hilltop, and Joe No. 1 and No. 2) | S1/2sec. 20 T. 18 S., R. 13 W. | Irregular replacement bodies as much as 2 m wide and 20 m long, in Mississippian Lake Valley Limestone along N-trending fracture zones | Pyrolusite, wad, iron oxides | Probably developed for silver in 1880's. Mined for manganese during WWI, probably during WWII and intermittently from 1950-1955 | About 900 metric tons of 29-40% Mn | 47, 190 |
| 49 | Causland (Mineral Mountain Group) | NW1/4sec 29, NE1/4sec. 30 T. 18 S., R. 13 W. | Irregular replacement bodies in area of highly fractured Mississippian Lake Valley Limestone | Pyrolusite, hematite | Mined from opencuts and shallow shafts during WWI and WWII | About 200 metric tons of 35% Fe and 15% Mn | 47, 190, 199 |

## Zn-Pb (Cu-Ag-Au) Vein and Replacement Deposits

Vein fissure fillings and, locally at depth, massive sulfide replacements along a series of subparallel and branching NE-trending faults in a zone 7 km long and 2 km wide (Bayard zone) that terminates 1-2 km southwest of the south end of the Fierro-Hanover stock. The ore consists of mixtures of gold and silver-bearing sphalerite, galena, and pyrite, with occasional chalcopyrite in a gangue of quartz and calcite. All deposits show some degree of oxidation and most early mining was devoted to supergene carbonate and sulfide ores. Gold placer deposits, derived from weathering of supergene ores, were common and generally present downslope below veins. Two periods of hypogene mineralization are recognized: early quartz-pyrite veins and later mixed sulfide veins and replacements. The latter appear to be genetically related to a series of granodiorite porphyry dikes of Late Cretaceous to early Tertiary age, probably representing a late stage of the Fierro-Hanover intrusive activity, that were implaced along the fault system prior to main period of mineralization. Deposits tend to be richer in gold and leaner in base metals at southwest end of zone (map nos. 56-59).

Data on early mining activity and production incomplete. The San Jose mine was producing prior to 1869 and most of the deposits were known by the 1870's and worked intermittently until about 1905. Major recorded production was from 1940 to 1953, when most mines closed. The Groundhog is the only mine active in 1980.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 50 | Ground Hog (includes San Jose, Denver, Lucky Bill, and C.G. Bell) | N1/2 and W1/2sec. 5 T. 18 S., R. 12 W. | Vein along NE-trending Ground Hog-Ivanhoe fault and dike system with ore localized at junctions of subsidiary faults, along reopened walls of dikes, and in intensely fractured rocks. Below 360 m ore occurs as replacement bodies in upper Paleozoic strata generally in favorable limestone beds at the intersection of faults and hornblende granodiorite porphyry dikes. Oxidation and supergene enrichment to depths of 120 m | Cerussite, chalcocite, azurite, malachite, chrysocolla, smithsonite, endlichite (Lucky Bill mine), wulfenite. Primary ore--chalcopyrite, galena, sphalerite | Worked sporadically up to 1928 and almost continuously since then. More than 11,000 m of underground workings by 1933 and by 1980 mine reached depth of 700 m. Average grade of ore up to 1933: 14% Zn, 9.5% Pb, 5.0% Cu and 343 g/t Ag | 21,600 metric tons Pb, 15,200 metric tons Zn, 7,100 metric tons Cu, 55,800 kg Ag and 12.7 kg Au, valued at about $6.8 million (1906-1932). Production since 1932 included in totals of Central mining region | 45, 97, 111, 113, 115, 117, 150, 167, 169, 179 |
| 51 | Bull-Frog (Owl) | SE1/4sec. 31 T. 17 S., R. 12 W. | Veins along Owl-Hobo fault and in Cretaceous quartz diorite sill in hanging wall of fault, associated with granodiorite porphyry dike | Sphalerite, galena, wulfenite | Mined prior to 1905, idle 1905-1940, and then major producer between 1940 and 1947. Inactive in 1980. Extensive underground workings. Main vein ore contained 1-5% Zn, 0.5-6% Pb and a trace to 20.6 g/t Ag | 45,000 metric tons Zn and 6,600 metric tons Pb valued at about $15 million (1943-1947) | 4, 30, 97, 113, 121, 167 |
| 52 | Ivanhoe, Ninety | W1/2sec. 33 T. 17 S., R. 12 W. | Veins along splayed northeast end of Groundhog-Ivanhoe fault and dike system. Veins chiefly between granodiorite porphyry dike (hanging wall) and Cretaceous Colorado Formation and quartz diorite sill (footwall) | Cerussite, chalcocite. Primary ore--galena, sphalerite, chalcopyrite | Rich supergene ores mined prior to 1904, some mining of sulfide ores to depth of 115 m up to 1907. Idle (?) since 1907 | Considerable; amount unknown | 113, 117, 121, 179 |
| | Copper Glance | SE1/4sec. 32 T. 17 S., R. 12 W. | Veins along southwest end of Lovers Lane fault. Vein (N70°E, 80°SE) forms contact between Cretaceous quartz diorite sill (hanging wall) and Cretaceous Colorado Formation (footwall) | Probably similar to that at Ivanhoe | Mined to depth of 105 m. Underground workings connect with Ivanhoe mine. Mined prior to 1905 | Considerable; amount unknown | 113 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 53 | Slate, Lion No. 2, and Lion (Rapp No. 2) | S1/2sec. 31 T. 17 S., R. 12 W.; NW1/4sec. 6 T. 18 S., R. 12 W.; NE1/4sec. 1 T. 18 S., R. 13 W. | Veins along the Slate fault, a foot wall spur of the Owl-Hobo fault, that trends ENE and dips 70°SE cutting Colorado Formation and the Cretaceous quartz diorite sill | Cerussite, smithsonite hydrozincite, wulfenite, cuprodescloizite, endlichite. Primary ore--galena, sphalerite | Mined prior to 1930 chiefly for carbonate ores to depths of about 30 m | Probably not more than a few thousand metric tons of carbonate ore | 113 |
| 54 | Betty Jo, Silver King | NE1/4sec. 1 T. 18 S., R. 13 W. | Veins along and between two splays of the NNE-trending Apollo fault chiefly in the Cretaceous quartz diorite sill | Cerussite. Primary ore--Galena, sphalerite, chalcopyrite | Mined prior to 1930 chiefly for gold and silver-bearing lead carbonate ores to depths of about 60 m. 116 metric tons of sulfide ore (Betty Jo) averaged: 16.2% Pb, 7.9% Zn, 0.6% Cu, 148 g/t Ag, and 0.7 g/t Au. 486 metric tons of carbonate ore (Silver King) averaged 15% Pb, 68 g/t Ag and 7 g/t Au | Probably not more than a few thousand metric tons | 113 |
| 55 | Vigil | NE1/4sec. 31 T. 17 S., R. 12 W. | Vein along the south end of NE-trending Mirror fault between Colorado Formation and the Cretaceous quartz diorite sill | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 113 |
| 56 | Lost Mine, Gold Spot (Corn Shaft, Spanish Tunnel) | W1/2sec. 6 T. 18 S., R. 12 W. | Veins along splays at the southwest end of the Owl-Hobo fault, chiefly between Colorado Formation and Cretaceous quartz diorite sill | Native gold, galena, wulfenite | Abundant old workings, apparently known to early Spanish. Supergene ores mined to depths of 30 m. Gold averages about 2.7 g/t | Probably less than $15,000 | 113 |
| 57 | St. Helena, Eighty-eight | W1/2sec. 1 T. 18 S., R. 13 W. | Veins along the NNW-trending St. Helena vein system in Cretaceous quartz diorite sill | Auriferous pyrite, galena | Discovered in 1887 and mined intermittently until 1935 to depths of 60 m. Some ore yielded as much as 274 g/t Au; average about 17 g/t | - - - - - - - - - | 113 |
| 58 | Peerless No. 2 | SW1/4sec. 36 T. 17 S., R. 13 W. | Veins along north end of St. Helena vein system in Cretaceous quartz diorite sill | Auriferous pyrite, sphalerite, galena, chalcopyrite, smithsonite | Developed in late 1800's, probably for gold. Major production 1937-1945 | 2,500 metric tons Zn, 1,900 metric tons Pb, 35 metric tons Cu, 1,395 kg Ag and 19 kg Au (1937-1945) | 4, 113, 176 |
| 59 | Texas | NW1/4sec. 2 T. 18 S., R. 13 W. | Vein trending ENE in Cretaceous quartz diorite sill | Auriferous (?) pyrite, galena, sphalerite | Shaft 120 m deep | Some Ag and Au | 113 |
| 60 | Manhattan, Pleasant View | NW1/4sec. 1 T. 18 S., R. 13 W. | Vein along fault striking N30°E in quartz diorite. Vein 1-2 m wide | Sphalerite, galena, cerussite, pyrolusite, wad | Claims patented in 1903 and mined for zinc and lead until WWII, when developed for manganese | About 135 metric tons containing 16-21% Mn. Zn-Pb production unknown | 47, 190 |

## Au-Ag (Base Metal) Vein Deposits

Deposits restricted to the Pinos Altos mining district where they occur as fissure-fillings along a NNE-trending fracture system that cuts the quartz monzonite Pinos Altos stock of Late Cretaceous to early Tertiary age (57-80 m.y.) and its country rock of complex intrusive diorite porphyries and andesite breccias of probable late Cretaceous age. The veins are typically banded with alternating ore and gangue, chiefly quartz, pyrite, calcite, rhodochrosite, and locally barite.

Data on mining activity and production are incomplete. The deposits were discovered in 1860 shortly after placer gold was found in the area. Peak mining occurred between 1867 and 1908; by 1910 virtually all activity had ceased. Total production was about $2,000,000, chiefly in gold and silver.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 61 | Pacific (Hearst, Thayer and Gillette Shafts, and Manhattan Adit) | SE1/4sec. 1 T. 17 S., R. 14 W. | Vein (N25°-46°E, steep NW) in diorite porphyry to north and andesite breccias to south. Vein about 1200 m long | Chalcopyrite, galena, sphalerite, argentite | First deposit mined in area. Developed to depths of 180 m with extensive workings on 9 levels. Ore ranged from $22 to $10 per ton in Au and Ag; on lower levels as much as 2.5% Cu | More than $1,000,000 by 1905 | 98, 121, 145 |
| 62 | Tampico | S1/2sec. 1 T. 17 S., R. 14 W. | Vein about 100 m west of Pacific vein in andesite breccias | Sphalerite, chalcopyrite | Shaft 90 m deep | - - - - - - - - - | 121, 145 |
| 63 | Aztec, Asiatic | E1/2sec. 1 T. 17 S., R. 14 W. | Northern extension of Pacific vein (N15°-20°E,61°W) in diorite porphyry | Sphalerite, chalcopyrite, galena | Shaft more than 90 m deep | - - - - - - - - - | 145 |
| 64 | Mountain Key | NE1/4sec. 1 T. 17 S., R. 14 W.; NW1/4sec. 6 T. 17 S., R. 13 W. | Vein trending NE and dipping 50°NW, in hornblende quartz monzonite porphyry | | Developed to depth of 225 m on 7 levels. Grade of ore in 1905 approximately 27-48 g/t Au, 377 g/t Ag, and 3.5% Cu | $500,000 by 1905 | 94, 121, 145 |
| | Little Key | NE1/4sec. 1 T. 17 S., R. 14 W. | Vein parallel to, and 30 m west of, the Mountain Key vein in hornblende quartz monzonite porphyry | Native gold, galena, sphalerite, chalcopyrite | Shaft 60 m deep. Ore averaged $25/ton in Au, Ag, Cu, and Zn | Some; amount unknown | 145 |
| | Ohio | NE1/4sec. 1 T. 17 S., R. 14 W. | Vein (N44°E) south of Mountain Key vein in andesite breccia | | Tunnels, adits, and surface workings. Ore averaged 8.6 g/t Au, 238 g/t Ag, 8% Zn, 1.5% Cu | Some, amount unknown | 145 |
| 65 | Mina Grande, Mogul, and Kept Woman | C sec. 6 T. 17 S., R. 13 W. | Vein (N13°-15°E,70°W) in hornblende quartz monzonite porphyry | Chalcopyrite, sphalerite, galena | 3 shafts, deepest 150 m with about 500 m of underground workings. Ore averaged about $10/ton | Some, amount unknown | 121, 145 |
| 66 | Gopher (Golden Giant) | E1/2sec. 6 T. 17 S., R. 13 W. | Vein (N30°E,70°W) in hornblende quartz monzonite porphyry | - - - - - - - - - - - - - | Shaft 155 m deep with 5 levels. Ore averaged about 34 g/t Au and locally as much as 100 g/t Ag | Some; amount unknown | 145 |
| 67 | Black Diamond | SE1/4sec. 32 T. 16 S., R. 13 W. | Vein trending NNE in hornblende quartz monzonite porphyry and andesite breccia | - - - - - - - - - - - - - | Adits | - - - - - - - - | 98 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 68 | Deep Down-Atlantic | SW1/4sec. 33 T. 16 S., R. 13 W. | Vein (N6°E,60°E) in andesite breccia | Sphalerite, galena, chalcopyrite | Shaft 210 m deep. Some ore averaged 8.6 g/t Au, 26-240 g/t Ag, 15% Zn and 2% Cu | Some; amount unknown | 121, 145 |
| 69 | Silver Cell | SE1/4sec. 7, SW1/4sec. 8 T. 17 S., R. 13 W. | Vein trending N and dipping 75°E in diorite porphyry | Native silver, cerargyrite, argentite | Discovered 1891. Developed by inclined shaft 120 m deep and 300 m of workings | About $100,000 by 1903 | 94, 121, 145 |
| 70 | Mammoth | NE1/4sec. 31 T. 16 S., R. 13 W. | Veins (N45°-55°E) in hornblende quartz monzonite porphyry | - - - - - - - - - - - - - | Shaft 75 m deep | More than $30,000 | 145 |
| 71 | Langston | NE1/4sec. 12 T. 17 S., R. 14 W. | Vein trending N and dipping 61°W in andesite breccia | Sphalerite, chalcopyrite | Developed to depth of about 50 m | Some; amount unknown | 4, 145 |
| | Arizona | NE1/4sec. 12 T. 17 S., R. 14 W. | Vein (N12°E, dips W) about 120 m east of Langston vein in andesite breccia | Sphalerite, galena, chalcopyrite | Shaft 75 m deep. Ore averaged $15-$16 per ton | More than $40,000 | 145 |
| 72 | Gila | SE1/4sec. 30 T. 16 S., R. 13 W. | Veins in hornblende quartz monzonite porphyry | Secondary copper minerals, chalcopyrite, galena, sphalerite | Old shafts. Reopened and worked intermittently from 1936-1955 | Some; amount unknown | 193 |
| 73 | Portland | Sec. 6 T. 17 S., R. 13 W. | Vein trending NE in hornblende quartz monzonite porphyry | Sphalerite, galena, chalcopyrite, molybdenite | - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 167 |
| | | | **Fluorite Vein Deposits** | | | | |
| 74 | Cottonwood Canyon | Sec. 7 T. 17 S., R. 15 W. | Fissure-filled vein (N75°W,80°S) in Paleozoic limestone | Fluorite | Explored by opencut and 15-m-long adit | About 9 metric tons of 52% $CaF_2$ | 91, 183, 190, 191, 201 |
| 75 | San Cristobel | W1/2sec. 21 T. 17 S., R. 15 W. | Veins as long as 750 m in Precambrian granite and pegmatite | Fluorite | Property located in 1951; produced in 1953. Developed by opencuts and 2 shafts, 9 m deep | 110 metric tons | 190, 201 |
| 76 | Ash Spring Canyon | N1/2sec. 23 T. 17 S., R. 15 W. | Fracture-filling and breccia coatings in fault (N65°E) in Paleozoic limestone | Fluorite | Deposit known prior to 1944. Developed by 50-m adit, raise, and numerous pits and opencuts | About 90 metric tons | 163, 190, 191, 201 |
| | | | **Other Hydrothermal Deposits** | | | | |
| | Includes a number of vein deposits in Fierro-Hanover grandiorite stock (58-70 m.y.) and other deposits and hydrothermally altered areas in the Central mining region that are not readily classified in the deposit types listed above. | | | | | | |
| 77 | Honey Comb | SW1/4sec. 10 T. 17 S., R. 12 W. | Pegmatite-like quartz-pyrite veins in granodiorite | Chalcopyrite, sphalerite, molybdenite | Explored by shaft 36 m deep | - - - - - - - - - | 121 |
| | Tourmaline | SW1/4sec. 10 T. 17 S., R. 12 W. | E-trending quartz-pyrite veins in granodiorite | Chalcopyrite | Explored by shaft 70 m deep | - - - - - - - - - | 121 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 78 | Mabel | SW1/4sec. 15 T. 17 S., R. 12 W. | Sheeted zone in granodiorite | Sphalerite | Explored by shaft 40 m deep | - - - - - - - - - | 97, 121 |
| 79 | Three Brothers | C sec. 26 T. 16 S., R. 12 W. | Quartz veins in breccia zone at intersection of two NE-trending faults in Paleozoic limestones in hanging wall of NW-trending Mimbres fault | Galena, sphalerite | Developed by shaft | Probably some; amount unknown | 136 |
| 80 | Woodlawn (Juniper Hill-Walnut Creek area) | S1/2sec. 25 T. 16 S., R. 15 W. | Small pods and segregations of sulfide minerals in Mississippian Lake Valley Limestone intruded by Late Cretaceous or early Tertiary quartz monzonite. Anomalous Ag, Pb, Zn and Mo in stream sediments | Galena, argentite(?) | Explored by a number of old adits and trenches | - - - - - - - - - | 49, 197 |
| 81 | Bear Creek area | SE1/4sec. 13 T. 16 S., R. 15 W. | Argillic alteration and pyrite in mid-Tertiary quartz latite, Bear Creek stock, and intrusive breccia | Chalcopyrite(?) | Geochemical and geophysical surveys. No underground workings | None | 188 |
| 82 | Bear Creek-Juniper Hill Meerschaum deposits | S1/2sec. 14 T. 16 S., R. 15 W. | Fracture fillings and balls in Ordovician El Paso Dolomite in hanging wall of N-trending major fault | Sepiolite | Mined prior to WWI from shallow workings | About 1,000 metric tons (includes production from Sapillo Creek deposits outside of quadrangle) | 15, 148, 180 |
| 83 | Eighty Mountain area | S1/2sec. 9, N1/2sec. 16 T. 17 S., R. 14 W. | Hematitic alteration along contact zone (fault?) between Pennsylvanian Oswaldo Formation and Cretaceous Beartooth Quartzite. Anomalous Be and W in stream sediments suggests some skarn-type mineralization possibly related to Tertiary Eighty Mountain stock | Hematite, scheelite(?) | Numerous shallow shafts and pits | None | 49, 197 |
| | | | SEDIMENTARY DEPOSITS | | | | |
| | | | Fe Deposits | | | | |
| | Oolitic hematite beds occur locally at or near the base of the Cambrian Bliss Formation, which outcrops extensively in the Silver City Range and Pinos Altos Mountains in the Central mining region. | | | | | | |
| 84 | Sycamore Canyon | N1/2sec. 13 T. 16 S., R. 15 W.; W1/2sec. 18 T. 16 S., R. 14 W. | Sandy oolitic hematite occurs in at least 4 separate beds, as much as 1.2 m thick, in the basal part of the Bliss Formation | Hematite | Not developed | None | 65, 102, 103 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 85 | Ash Spring Canyon | N1/2,E1/2 Sec. 23 T. 17 S., R. 15 W. | 0.6-m-thick bed of oolitic hematite near base of Bliss Formation | Hematite | Not developed | None | 65, 102, 103 |



Au Placer Deposits

Placer gold deposits have been worked in the Pinos Altos and Central mining districts. At Pinos Altos placer gold was discovered in 1860 near the Mountain Key mine (map no. 64), and was mined intermittently in a 2-km-square area up to about 1905 (references 114, 146). In the Central mining district placer gold was present in almost every stream draining area of veins--the most productive ground being downslope from the Copper Glance vein (map no. 52) and the Owl-Dutch Uncle-Tin Box-Lost Mine vein system (between map nos. 51 and 52) (reference 113).

DRAGOON MOUNTAINS AND RED BIRD HILLS AREA (includes the Dragoon and Cochise mining districts)

HYDROTHERMAL DEPOSITS

Au-Ag (Base Metal) Vein Deposits

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Red Bird (Gold Coin) | S1/2sec. 11, N1/2sec. 14 T. 15 S., R. 23 E. | Mineralized fault breccia in Cretaceous Bisbee Group | Gold- and silver-bearing minerals | Shaft | About 68 metric tons of ore (1930-1932) | 20, 99 |
| 2 | Golden Rule (includes Old Terrible, Golden Eagle, Santa Lucia) | C sec. 23 T. 16 S., R. 23 E. | Vuggy quartz-calcite fissure veins in Cambrian Abrigo Limestone cut by Tertiary silicic intrusives | Cerussite, anglesite, galena, secondary zinc minerals | Located in late 1870's. Developed by shaft and underground workings. Mined intermittently 1883-1957 | 260.4 kg Au, 145 metric tons Pb (1883-1929) valued at $225,000 | 20, 35, 99, 134, 202, 206 |

METAMORPHIC DEPOSITS

Marble Deposits

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 3 | Ligier | SE1/4sec 10, N1/2sec. 27, N1/2sec. 35 T. 16 S., R. 23 E. | Metamorphosed upper Paleozoic limestone | - - - - - - - - - - - - - | Quarries | Some dimension stone and crushed marble | 14, 20, 99 |

## PINALENO MOUNTAINS AREA

### HYDROTHERMAL DEPOSITS

#### Mn Vein Deposits

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Junction and Shamrock (Graham) | SW1/4sec. 13 T. 11 S., R. 26 E. | Thin seams and veinlets trending NW, in Precambrian granite | Psilomelane | Located in 1951 and 1953. Developed by shallow shafts and opencuts | None | 48, 190 |
| 2 | Black Rock (Vickers) | N1/2sec. 31 T. 11 S., R. 27 E. | Brecciated shear zones (N20°W,75°E, and N50°W, steep SW) as wide as 2 m in Precambrian granite | Psilomelane, pyrolusite | Located during WWI and relocated 1938 and 1952. Developed by a number of shafts as deep as 15 m and opencuts. Assay across 1.5 m contained 15.4% Mn | Small amount of ore produced during WWI | 48, 190 |

#### U Vein Deposits

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 3 | Stoney Peak | Sec. 21 T. 10 S., R. 25 E. | Fractures in Precambrian granite | Autunite, uranophane, fluorite | Shallow pits. Samples contained 0.14 and 0.27% $U_3O_8$ | Possibly a few hundred tons of ore | 154 |
| 4 | Golondrina | SE1/4sec. 13. T. 11 S., R. 25 E. | Quartz-filled cavities and fractures in Tertiary volcanic breccia | Radioactive pyromorphite, secondary copper minerals | Shallow pits. Samples contained as much as 0.26% $eU_3O_8$ | None | 154 |
| 5 | Best | SE1/4sec. 16 T. 10 S., R. 25 E. | Radioactive NW-trending shears in Precambrian granite near contact with middle Tertiary granitic pluton | Radioactive minerals | Shallow pits. Drilled in 1979 | None | 184 |

#### Other Hydrothermal Deposits

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 6 | - - - - - - - - | SE1/4sec.20, NE1/4sec. 29 T. 9 S., R. 24. E. | Small quartz veins and Mn-stained fractures in Precambrian granite gneiss | - - - - - - - - - - - - | Numerous shallow shafts and adits probably explored for gold | - - - - - - - - - | 184 |
| 7 | - - - - - - - - | SW1/4sec. 20 T. 11 S., R. 25 E. | Altered middle Tertiary volcanic rocks | Secondary copper minerals | Shaft 10 m deep | - - - - - - - - - | 184 |

### MAGMATIC DEPOSITS

#### Be Pegmatite Deposits

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 8 | Twilight, Grey | Sec. 10 T. 9 S., R. 23 E. | Pegmatite in Precambrian schist | Beryl | Adit and opencuts. Sample assayed 0.27% BeO | None | 127, 132 |

DOS CABEZAS AND CHIRICAHUA MOUNTAINS AREA (includes the California, Dos Cabezas, and Teviston mining districts)

HYDROTHERMAL DEPOSITS

Au-Ag-Base Metal Vein and Replacement Deposits

The base and precious metal vein and replacement deposits (map nos. 1-13, 19-37) and some related tungsten vein deposits (map nos. 17, 18) of the Dos Cabezas and Chiricahua Mountains are relatively small, scattered occurrences in a terrane of complexly folded and faulted Precambrian granite and schist, Paleozoic to Mesozoic sedimentary rocks, and late Mesozoic or early Cenozoic volcanic rocks intruded by small granite plutons of both Laramide (56-62 m.y.) and middle Tertiary (28-34 m.y.) age. Some of the deposits are genetically related to Laramide plutonic activity; others appear to be associated with the younger, middle Tertiary plutonic event, but the data are equivocal. The gold, silver, and base metal deposits consist chiefly of sulfide-bearing quartz veins along faults and shear zones and spotty, small replacement deposits in upper Paleozoic limestone. Skarn minerals occur in deposits at map nos. 1, 4, and 8. Many deposits were known prior to 1870 but mining did not start until about 1878 and by 1950 most of the mines were idle. Data on grades, tonnage, and early mining activity are largely unavailable.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Silver Camp | NW1/4sec. 12 T. 14 S., R. 26 E. | Small replacement deposits in contact metasomatized Paleozoic limestone and quartz veins in quartz monzonite stock (62 m.y.). Limestone occurs as fault block within Cretaceous or Tertiary volcanic rocks | Secondary copper minerals, chalcocite, chalcopyrite | First claims in Dos Cabezas mining district (1860's) with production in late 1880's from as much as 1000 m of underground workings. Some activity in 1930's | About 450 metric tons of ore | 29, 99 |
| 2 | Casey Copper | NE1/4sec. 13 T. 14 S., R. 26 E. | Small replacement deposits in Paleozoic limestone in fault block within Cretaceous or Tertiary volcanic rocks | Chalcopyrite | Shallow surface workings | - - - - - - - - - | 29 |
| 3 | Elma (Central) | C sec. 9 T. 14 S., R. 27 E. | Pipe-like body with massive sulfides, along shear zone cutting Paleozoic limestone and Cretaceous or Tertiary volcanic rocks | Chalcopyrite | Shaft and underground workings mined intermittently from late 1910's to late 1960's | About 7200 metric tons of ore | 20, 99 |
| 4 | Mascot (includes Central Copper, Iron Tower, Mascot No. 1, Consolidated Tunnel, Bachelder group) | S1/2sec. 16, NE1/4sec. 21 T. 14 S., R. 27 E. | Veins, replacement deposits, and disseminations in fault blocks of contact-metasomatized Paleozoic limestone in Cretaceous or Tertiary volcanic rocks intruded by Laramide granite plutons | Chalcopyrite, bornite, galena, beryllium minerals | Extensive underground workings mined intermittently from early 1910's to mid-1950's | 1575 metric tons Cu and 40 kg Au (1908-1928). About 54,000 metric tons of ore mined 1910-1955 | 20, 35, 99, 127, 135 |
| 5 | Silver Strike (Devonian) | S1/2sec. 28, N1/2sec. 33 T. 14 S., R. 28 E. | Fissure vein (N62°E,80°SE) and associated quartz masses, containing spotty sulfides and scheelite, cutting Paleozoic and Cretaceous sedimentary rocks near Cretaceous or Tertiary granite plutons | Argentiferous galena, chalcopyrite, sphalerite, scheelite | Located about 1890 and mined until 1919 from shaft 24 m deep and more than 200 m of underground workings. Explored for tungsten in 1942 | A few hundred metric tons of Pb-Ag ore | 25, 29, 99 |
| 6 | Clair | SE1/4sec. 36 T. 15 S., R. 29 E. | Mineralized shear zone in upper Paleozoic limestone intruded by Tertiary dikes | Galena, chalcopyrite | Adit. Mined 1909-1910 | Less than 100 metric tons of ore | 99 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 7 | King of Lead | NE1/4sec 18, NW1/4sec. 17 T. 16 S., R. 30 E. | Mineralized faults and disseminations in Permian limestone intruded by Tertiary dikes | Galena, sphalerite, secondary copper and lead minerals | Adit. Mined intermittently 1923-1940 | About 320 metric tons of ore | 29, 99 |
| 8 | Hilltop Extension | SE1/4sec. 28 T. 16 S., R. 30 E. | Quartz veins and replacement deposits in silicified Paleozoic limestone cut by Cretaceous or Tertiary intrusions | Galena, sphalerite, chalcopyrite, secondary copper minerals | Adit. Mined intermittently 1923-1940 | About 360 metric tons of ore | 99 |
| 9 | Willie Rose | W1/2sec. 26 T. 15 S., R. 30 E. | Small replacement deposits in Permian limestone along contact with Cretaceous granite pluton | Chalcocite, bornite, sphalerite, secondary copper minerals | Shaft. Mined intermittently 1913-1953 | About 135 metric tons of ore | 99 |
| 10 | Rabbit Group | C sec. 14 T. 15 S., R. 30 E. | Spotty copper oxide minerals in Permian limestone and Cretaceous quartzite cut by Tertiary dikes | Secondary copper minerals | Shaft and surface workings. Worked in late 1800's | Some; amount unknown | 99 |
| 11 | Ajax | N1/2sec. 30 T. 16. S., R. 31 E. | Veins and disseminations in Late Cretaceous to Tertiary volcanic conglomerates cut by Tertiary silicic porphyry dikes | Primary and secondary base metal minerals | Shaft and adit. Mined intermittently 1909-1918 | About 90 metric tons of ore | 99 |
| 12 | Blue Mountain | S1/2sec. 20 T. 16 S., R. 31 E. | Small replacement deposits in folded layer of Mississippian limestone | Secondary lead and copper minerals | Shallow shafts and adits | About 45 metric tons of ore | 99 |
| 13 | Harris Mountain (includes the Blue Ribbon, Rimski, Harris, and Malachite groups) | SE1/4sec 29, SW1/4sec. 28 T. 16 S., R. 31 E. | Small replacement deposits and vein (N70°E) in folded Mississippian and Pennsylvanian limestones | Chalcopyrite, galena, sphalerite, malachite, azurite | Numerous shafts and adits. Mined intermittently 1913-1949 | About 90 metric tons of ore | 29, 99 |
| | | | W Vein Deposits | | | | |
| | Chiefly scheelite-bearing quartz veins in Precambrian rocks and Paleozoic limestone. Deposits 17 and 18 apparently related to Au-Ag-base metal vein and replacement deposits but classified here under W vein deposits because of their scheelite content; other deposits may have different genesis. | | | | | | |
| 14 | Comstock Lode (Cohen) | E1/2sec. 22 T. 13 S., R. 26 E. | Quartz vein and veinlets, trending east and dipping south in the quartz diorite-monzonite Cowboy pluton (59 m.y.) | Scheelite | Discovered in 1944 and explored sporadically up to 1956. Shafts, adits, and surface workings | - - - - - - - - - | 20, 25, 99 |
| 15 | Rough | Sec. 36 T. 13 S., R. 27 E. | Narrow streaks and disseminations in Precambrian amphibole schist | Scheelite | Discovered in early 1940's and explored by a few surface workings. Select ore on dump assayed 1.3% $WO_3$ | - - - - - - - - - | 25 |
| 16 | Ram | E1/2sec. 21 T. 14 S., R. 28 E. | Quartz lenses along foliation in Precambrian schist cut by felsite dikes | Scheelite | Discovered in 1956 and explored by shallow surface workings. Sample across 1 m assayed 0.79% $WO_3$ | - - - - - - - - - | 99 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 17 | Austin | NE1/4sec. 30 T. 14 S., R. 28 E. | Quartz vein (E-W) and veinlets along fault separating Paleozoic limestones on south, from Precambrian schists. Mineralization concentrated at limestone-quartz vein contact | Scheelite, galena, sphalerite, chalcopyrite | Located in 1900 for gold, and developed by shaft 26 m deep and adit 67 m long. Scheelite discovered in 1943. Samples from contact zone assayed 0.95-3.24% $WO_3$ over widths of 5-60 cm | - - - - - - - - - | 20, 25 |
| 18 | Silver Bell (Ella Shaft) | NW1/4sec. 29 T. 14 S., R. 28 E. | Quartz vein (N72°-82°E, vert) in contact metasomatized limestone | Scheelite | Located in 1910 or 1911 for gold and explored by shaft 50 m deep and adit. Sample across 1 m assayed 0.09% $WO_3$ | - - - - - - - - - | 20, 25 |
| 5 | Epidote Vein (part of Devonian group) | SW1/4sec. 28 T. 14 S., R. 28 E. | Epidote vein (N20°E,20°-30°W) in Precambrian schist with mineralized zone 10 to 45 cm thick | Scheelite | Explored by 10-m inclined shaft and trench. Mine-run ore averaged 1.3% $WO_3$ | - - - - - - - - - | 25 |
| | | | Au (Ag-Base Metal) Vein Deposits | | | | |
| | Chiefly small quartz-filled fissure veins containing lenses and spotty concentrations of auriferous pyrite and base metal sulfides and locally native gold. Deposits are concentrated along the complex Apache Pass fault zone, northeast of the town of Dos Cabezas, where they occur chiefly in metamorphosed Cretaceous sedimentary rocks and Precambrian granite and schist. Prospected in 1860's, but mining did not begin until about 1878 and by 1950 most mines were idle. Data on grade, tonnage, and early mining activity are largely nonexistent. | | | | | | |
| 19 | Golden Eagle | NW1/4sec. 20 T. 13 S., R. 26 E. | Irregular quartz veins in Precambrian schist with spotty oxidized base metal sulfides | Secondary base-metal minerals | Adit. Mined 1937-1939 | About 117 metric tons of ore | 99 |
| 20 | Cowboy | NW1/4sec. 29 T. 13 S., R. 26 E. | Irregular quartz veins in Precambrian schist | Base metal sulfides | Shallow surface workings, mined intermittently 1931-1940 | About 63 metric tons of ore | 99 |
| 21 | Speaks | S1/2sec. 29, N1/2sec. 32 T. 13 S., R. 26 E. | Irregular quartz veins in Precambrian schist with spotty mineralization | Secondary base metal minerals and base metal sulfides | Shallow surface workings. Mined 1933-1934 | About 45 metric tons of ore | 99 |
| 22 | Mineral Park (Gold Slope, Maria) | NE1/4sec. 7 T. 14 S., R. 27 E. | Quartz veins in propylitized Cretaceous or Tertiary volcanic rocks | Native gold, pyrite, chalcopyrite, secondary copper minerals | Numerous shallow workings developed in 1880's, with some production until 1935 | A few hundred metric tons of ore | 20, 29, 99 |
| 23 | Gold Farm | SE1/4sec. 5 T. 14 S., R. 27 E. | Quartz veins (N90°W and N10°E) in Precambrian granite near Tertiary dike | Pyrite, galena | Shallow workings | - - - - - - - - - | 20, 29 |
| 24 | Buckeye Apache | SE1/4sec. 4 T. 14 S., R. 27 E. | Quartz veins in Precambrian granite | Pyrite, galena | Adit. Mined intermittently from late 1800's to late 1940's | About 3600 metric tons of ore | 20, 29, 99 |
| 25 | Sunrise | C sec. 3 T. 14 S., R. 27 E. | Quartz vein in Precambrian granite | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 20 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 26 | Dos Cabezas Queen | NE1/4sec 19, SE1/4sec. 18 T. 14 S., R. 27 E. | Quartz-calcite fissure vein in metamorphosed Cretaceous shale | Pyrite, base metal sulfides | Adit. Some mining in early 1900's | Some; amount unknown | 99 |
| 27 | Honey Dew group | C sec. 20 T.14 S., R. 27 E. | Quartz veins and veinlets along fault zone in metamorphosed Cretaceous shale | Base metal sulfides | Numerous shallow shafts and adits. Mined intermittently from late 1880's to 1941 | About 500 metric tons of ore | 99 |
| 28 | Dives | SW1/4sec. 21 T. 14 S., R. 27 E. | Quartz vein (N68°-87°W,vert) along fault separating metamorphosed Cretaceous shale from Precambrian granite | Galena, pyrite, sphalerite, chalcopyrite | Inclined shaft 30 m deep, 2 adits and more than 1,000 m of underground workings. Mined intermittently 1882-1940 | About 9,000 metric tons of ore valued at more than $45,000 | 20, 35, 99, 206 |
| | Gold Ridge (Casey) | SE1/4sec 20, SW1/4sec. 21 T. 14 S., R. 27 E. | Quartz veins along fault separating Cretaceous shale and Paleozoic limestone from Precambrian granite | Galena, pyrite, chalcopyrite | Located in 1878. Numerous shafts and adits mined intermittently between 1880's and 1936 | More than 900 metric tons of ore | 20, 35, 99, 206 |
| | Ewell Spring | SW1/4sec. 21 T. 14 S., R. 27 E. | Quartz vein along fault in Cretaceous slate | Pyrite, galena, base-metal sulfides | Adit. Gold ore mined in 1880's and in 1935 | More than 45 metric tons of ore | 29, 99 |
| 29 | Philadelphia | SE1/4sec. 21 T. 14 S., R. 27 E. | Irregular quartz vein along fault in Precambrian granite, associated with diabase dike | Base-metal sulfides | Adit. Gold ore mined in 1880's and in 1935 | More than 45 metric tons of ore | 99 |
| | Arizona Klondike | SW1/4sec. 22 T. 14 S., R. 27 E. | Irregular quartz vein along fault in Cretaceous metamorphic rocks and manganese replacement bodies in limy beds | Pyrite, base-metal sulfides, wad, pyrolusite | Shaft and surface workings. Intermittently mined for gold 1884-1933 | A few hundred metric tons of ore | 20, 48, 99, 190 |
| 30 | Gold Prince | S1/2sec. 22, N1/2sec. 27 T. 14 S., R. 27 E. | Lenticular quartz bodies (N70°W, 65°S) along major fault in Cretaceous metamorphic rocks | Galena, pyrite, | Located in 1878 as Murphy mine. 5 adits and more than 1000 m of underground workings. Major gold producer in Dos Cabezas district, mined intermittently from early 1880's to 1950 | More than 9,000 metric tons of ore | 20, 99, 206 |
| 31 | LeRoy group (includes Black Hawk, Climax, Comet, Oneida, Gold Queen, Jack Dempsey, Standard, Lost Hope, War Eagle) | SW1/4sec 27, NE1/4sec 33, NW1/4sec. 34 T. 14 S., R. 27 E. | Quartz veins trending NE and dipping 65°SE with sulfide masses and disseminations along faults and shears in Precambrian granite intruded by diabase dikes | Pyrite, galena, sphalerite, chalcopyrite | Two inclined shafts, 100 m deep, and 700 m of underground workings. Mined intermittently 1880's to 1950 | As much as 5,000 metric tons of ore containing about 470 metric tons of Pb, 62 kg Au and 9,300 kg Ag | 20, 35, 99, 135, 206 |
| 32 | Howard group (includes Adriatic, Double Springs, Atlantic, Pacific) | SW1/4sec. 23 T. 14 S., R. 27 E. | Lensing quartz stringers with sulfides in shear zones in Cretaceous metamorphic rocks | Base-metal sulfides | Shallow workings. Mined intermittently from late 1880's to 1932 | A few hundred metric tons of ore | 29, 99 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| | First Chance | NW1/4sec. 26 T. 14 S., R. 27 E. | Quartz vein along fault in metamorphosed Cretaceous limy shale | Pyrite, base-metal sulfides | Shallow surface workings. Mined intermittently from 1880's to 1937 | A few hundred metric tons of ore | 20, 99 |
| 33 | Howell | W1/2sec. 11 T. 14 S., R. 27 E. | Vein in Precambrian granite | Pyrite, galena | - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 20, 29 |
| 34 | Cottonwood | SE1/4sec. 6 T. 15 S., R. 28 E. | Quartz veins in Precambrian granite | Native gold(?), galena | Shaft. Mined intermittently from 1880's to 1934 | About 450 metric tons of ore | 20, 29, 99 |
| 35 | Hillside | NE1/4sec. 35 T. 14 S., R. 28 E. | Quartz veins in Precambrian schist | Base-metal sulfides(?) | Adit and shaft. Mined in 1908 | About 70 metric tons of ore | 99 |
| 36 | Apache Pass (includes Gold Belle, Helen Dome, and Quillan groups, and Lula, Gold Nugget, New Year) | SE1/4sec. 4, NE1/4sec. 9, N1/2sec. 10, NE1/4sec. 11 T. 15 S., R. 28 E. | Irregular quartz veins in Precambrian granite | Base-metal sulfides | Numerous scattered shafts, adits, and surface workings. Intermittent production since 1870's | About 540 metric tons of ore | 29, 99 |
| 37 | - - - - - | N1/2sec. 2 T. 16 S., R. 29 E. | Quartz vein in shear zone ($N5^{o}W,65^{o}NE$) in Late Cretaceous or early Tertiary granite | Pyrite, secondary copper minerals | Shafts | - - - - - - - - - | 29 |
| | | | U Vein Deposits | | | | |
| 38 | Uranium Hill | NW1/4sec. 32 T. 14 S., R. 28 E. | Radioactive quartz-fluorite veins in Precambrian granite | Unknown radioactive minerals | Surface workings and diamond drill holes. Core samples assayed 0.3 and 1.09% $U_3O_8$ | None | 20, 100 |
| 39 | Valley View | SE1/4sec. 22 T. 13 S., R. 26 E. | Radioactive quartz vein in Precambrian granite | Base-metal sulfides | Surface workings. Sample assayed 0.04-1.09% $U_3O_8$ | None | 100 |
| | | | Other Hydrothermal Deposits | | | | |
| 40 | Spike-E Hills | Sec. 17 T. 13 S., R. 25 E. | Pyritized Precambrian schist exposed in Spike-E Hills. A porphyry copper deposit may be present in extension of sulfide system beneath basin-fill sediments | Chalcopyrite(?) | Extensively drilled in 1970's. No data available on mineralogy, grade, or tonnage | Resource estimated at 228,000 metric tons of Cu | 100, 101 |
| 41 | - - - - - | Secs. 32, 33, 34 T. 14 S., R. 29 E. | Weakly pyritized Precambrian granite covered by basin-fill gravel deposits. Geophysical studies suggest extensive sulfide system at depth | - - - - - - - - - - - - - | Drilled in 1970's, no data available | - - - - - - - - - | 32 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 42 | Pat Hills | Sec. 33<br>T. 16 S.,<br>R. 27 E. | Pyritized middle Tertiary andesitic flows intruded by quartz monzonite pluton (29.2 m.y.) | - - - - - - - - - - - - - | Some drilling in 1970's | None | 29 |
| | | | **HYDROTHERMAL AND MAGMATIC DEPOSITS** | | | | |
| | | | **Be Pegmatites** | | | | |
| 43 | Beryl Hill, Live Oak | Sec. 23<br>T. 14 S.,<br>R. 28 E. | Quartz pegmatite masses in Precambrian granite dikes in Precambrian gneiss and fracture coatings along gneiss-granite contact | Beryl | Surface workings developed in late 1950's | Some; amount unknown | 99, 127, 132 |
| | | | **METAMORPHIC DEPOSITS** | | | | |
| | | | **Marble** | | | | |
| | Occurrences of marble are known at a number of scattered localities in the Chiricahua Mountains (references 14 and 143), but only the deposit listed below has had any known production | | | | | | |
| 44 | Paronazzo, Pentelicus | E1/2sec. 20<br>T. 15 S.,<br>R. 29 E. | Metamorphosed Pennsylvanian Horquilla Limestone | Marble | Quarries operated in early 1900's | Some; amount unknown | 14, 99, 143 |
| | | | **SEDIMENTARY DEPOSITS** | | | | |
| | | | **Au Placer Deposits** | | | | |
| 45 | Gold Gulch (Teviston, Inspiration) | E1/2sec. 35,<br>W1/2sec. 36<br>T. 13 S.,<br>R. 26 E. | Shallow alluvium and gravel in mountain basin on north flank of the Dos Cabezas | Native gold | Chiefly a dry placer that has operated intermittently from early 1900's to 1947, with more than 15,000 $m^3$ of gravel treated | About 15.5 kg Au (1934-1947) | 99, 203 |
| 46 | Dos Cabezas | Chiefly in Secs. 27, 28, 29, 32, 33<br>T. 14 S.,<br>R. 27 E. | Alluvium in small streams draining area of Au (Ag-base metal) vein deposits along southwest flank of Dos Cabezas | Native gold | Discovered in 1901 and operated chiefly as dry placers until about 1947 | About 4.03 kg Au (1906-1914, 1934-1936) | 203 |

CENTRAL PELONCILLO MOUNTAINS AREA (includes Steins Pass and San Simon mining districts)

HYDROTHERMAL DEPOSITS

Ag (Au) Vein Deposits

Deposits are restricted to the Volcano vein (more than 3,000 m long), the Beck vein (900 m long), and a few shorter veins that occur along intensely silicified and brecciated fault zones in volcanic rocks of middle Tertiary age (31-34 m.y.). Faults may be on ring fractures related to cauldron subsidence. Quartz, the dominant gangue, and the ore minerals occur as open-space filling generally cementing brecciated fragments of wall rock.

Data on mining activity and production are very incomplete. Area known by 1875, major production ended by 1905. Intermittent activity up to 1980. Total production probably less than $500,000.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Volcano | W1/2sec. 17 T. 23 S., R. 21 W. | Volcano vein (N35°W,60°-75°E), as much as 15 m wide with rhyolite tuff footwall and andesite hanging wall | Cerargyrite. Below about 30 m, unoxidized ore contained pyrite and argentite(?) | In production by 1883. Developed by 100-m inclined shaft (1922) and irregular stopes off 3 levels. Mine being rehabilitated in 1980. Grade of ore in 1942-1943 was 514.5 g/t Ag and 1.4 g/t Au | Largest producer in Steins Pass district, with several hundred thousand dollars produced before 1905. More than 4,000 metric tons mined 1909-1947 | 121 |
| | Wyman | SE1/4sec. 17 T. 23 S., R. 21 W. | On Volcano vein south of Volcano mine | - - - - - - - - - - - - - | Probably worked in 1880's. Shaft | - - - - - - - - - | 38 |
| 2 | Coyle | SE1/4sec. 17 T. 23 S., R. 21 W. | West splay of Volcano vein (N-S,70°E) in ash-flow tuff (foot wall) and andesite (hanging wall) | - - - - - - - - - - - - - | Worked before 1893. Number of shafts | - - - - - - - - - | 38 |
| | Sixty-six | NE1/4sec. 20 T. 23 S., R. 21 W. | | | Worked intermittently up to 1940 | 391 kg Ag and 1.6 kg Au (1934-1935) | 38 |
| | El Oro (Federal) | SW1/4sec 16, NW1/4sec. 21 T. 23 S., R. 21 W. | East of Volcano vein, striking N5°W, chiefly in andesite | Native gold, argentite(?), vanadinite(?) | Some development by 1905. Extensive diamond drilling in 1980 | - - - - - - - - - | 121 |
| 3 | Saddle and Silver | N1/2sec. 17, S1/2sec. 8 T. 23 S., R. 21 W. | On Volcano vein, 750 m north of Volcano mine, in rhyolite sill (hanging wall) and andesite (footwall) | - - - - - - - - - - - - - | Developed by adit and 2 shafts | - - - - - - - - - | 38 |
| 4 | Beck (National, Hattie Lee) | C sec. 31 T. 23 S., R. 21 W. | Vein as much as 900 m long, trending WNW and dipping 50°-60°N in middle Tertiary volcanic rocks | Cerargyrite, argentite, sphalerite, galena, chalcopyrite, bornite, chalcocite | Intermittently worked from 90-m inclined shaft until 1936. Under development for cyanide leaching in 1980 | Considerable; amount unknown | 38, 121 |
| 5 | Ester | NW1/4sec. 6 T. 24 S., R. 21 W. | Vein (N67°E,80°SE) in middle Tertiary andesite and dacite flows | Secondary copper and iron minerals | Staked in 1956. Explored by trenches, adit, and shaft. Inactive 1980 | None | 38 |

## Au-Ag-Base Metal Vein and Replacement Deposits

Principal deposits are base-metal contact-metasomatic deposits replacing Paleozoic and Mesozoic limestone proximal to middle Tertiary (31.6 m.y.) granite porphyry dikes and sills and younger (26-27 m.y.) felsic intrusives. Garnet, epidote, and wollastonite are the chief skarn minerals. The less important vein deposits occur as fissure fillings, generally along faults, in Paleozoic limestone and Cenozoic volcanic rocks away from the middle Tertiary hypabyssal intrusives.
Data on mining activity and production are incomplete. Principal activity was prior to 1920, with intermittent production up to 1967 (map no. 16).

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 6 | Mineral Mountain | S1/2sec. 17, N1/2sec. 20 T. 24 S., R. 21 W. | Small veins trending ENE in Cretaceous or Tertiary volcanic rocks | Galena, malachite, smithsonite | Mines closed by 1904. Developed by main shaft 60 m deep and numerous other shafts and surface workings. Ore contained as much as 686 g/t Ag | Some; amount unknown | 38, 55, 121 |
| 7 | Red Snake | SW1/4sec. 16 T. 24 S., R. 21 W. | Probably on ENE veins, east of Mineral Mountain veins | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - - | 38 |
| | Silver King | S1/2sec. 16 T. 24 S., R. 21 W. | | | | | |
| 8 | Charles | NE1/4sec. 21 T. 24 S., R. 21 W. | Vein along fault (N45°E, vert.) in Cretaceous or Tertiary volcanic rocks | Galena, chalcopyrite | Worked intermittently from 1927 to 1956; inactive, 1980. Developed by 30-m-deep shaft | Some; amount unknown | 55 |
| 9 | Lizzie Paul | S1/2sec. 20 T. 24 S., R. 21 W. | Fractures (N55°E,85°SE) in altered volcanic rocks | Chrysocolla, chalcocite | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - - | 121 |
| 10 | Duke | SE1/4sec. 33 T. 24 S., R. 21 W.; NE1/4sec. 4 T. 25 S., R. 21 W. | Minor replacement deposits in the Pennsylvanian Horquilla Limestone | Chalcopyrite, sphalerite, galena | Numerous prospects and shafts. Inactive in 1980 | - - - - - - - - - - | 55 |
| 11 | Silver Bell | NE1/4sec. 5 T. 25 S., R. 21 W. | Veins(?) in Cretaceous Bisbee Group cut by Tertiary rhyolite intrusive rocks | - - - - - - - - - - - - - | Shaft and prospect pits. Inactive in 1980 | - - - - - - - - - - | 38 |
| 12 | North Star | SE1/4sec. 27 T. 24 S., R. 21 W. | Vein in Cretaceous or Tertiary volcanic rocks | - - - - - - - - - - - - - | Adit. Inactive in 1980 | - - - - - - - - - - | 55 |
| 13 | Carbonate Hill (McGhee) | SE1/4sec. 34 T. 24 S., R. 21 W. | Replacement of Cretaceous Carbonate Hill Limestone along middle Tertiary felsic dike in complex north-trending fault zone | Galena, sphalerite | Discovered in 1894 and operated intermittently until 1956. Developed by 150-m-deep shaft and extensive underground workings. Grade of ore about 6% Pb, 5% Zn, and 68.6 g/t Ag | Total estimated at more than 5,440 metric tons Pb, 4,540 metric tons Zn, and 6,200 kg Ag for total value exceeding $1.5 million | 5, 55 |
| | Carbonate Hill Extension | NW1/4sec. 3 T. 25 S., R. 21 W. | Replacement of Pennsylvanian Horquilla Limestone along a middle Tertiary granite porphyry sill | Galena, sphalerite | 30 m adit and drifts | Some; probably included with Carbonate Hill mine | 55 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 14 | Silver Hill | NW1/4sec. 3 T. 25 S., R. 21 W. | Replacement of Pennsylvanian Horquilla Limestone in masses up to 2 x 7 m along fissures near contact of middle Tertiary granite porphyry sill | Galena, sphalerite, chalcopyrite | Discovered in 1877 and operated intermittently until 1953. Developed by 60-m inclined shaft and 4 levels. Grade of ore mined 1949-1952 averaged 11.5% Pb, 5.2% Zn and 114 g/t Ag | Probably several thousand tons | 55 |
| | Happy Promise No. 2 | NW1/4sec. 3 T. 25 S., R. 21 W. | Replacement deposits in Pennsylvanian Horquilla Limestone | - - - - - - - - - - - - - | Adit | - - - - - - - - - | 38 |
| 15 | Johnny Bull | SW1/4sec. 3 T. 25 S., R. 21 W. | Replacement deposits in Pennsylvanian Horquilla Limestone adjacent to NW-trending Johnny Bull fault | Chalcopyrite, bornite, galena | Operated intermittently, chiefly for copper, from before 1905 to 1920. Developed by 2 inclined shafts to depth of 45 m | Considerable; amount unknown | 55, 121 |
| | Stella Maris No. 1 | W1/2sec. 3 T. 25 S., R. 21 W. | | | 20-m-deep shaft | Some; amount unknown | 55, 121 |
| 16 | Crystal | NW1/4sec. 19 T. 25 S., R. 20 W. | Vein (N20°E, vert) in Mississippian Escabrosa Limestone within a few tens of meters of a granite porphyry intrusive | Galena, sphalerite, chalcopyrite | Operated intermittently 1950-1967, inactive 1980. Developed by 15-m deep shaft and 60-m-long adit | Probably less than 900 metric tons ore | 17, 55 |
| 17 | Granite Gap (Veseley, Montgomery) | SE1/4sec. 34 T. 25 S., R. 21 W.; N1/2sec. 3 T. 26 S., R. 21 W. | Irregular masses and stringers of oxidized ore minerals in highly fractured Pennsylvanian Horquilla Limestone and Mississippian Escabrosa Limestone near dikes of granite porphyry | Cerussite, galena, secondary copper and zinc minerals. Unoxidized ore probably galena and tetrahedrite | Discovered about 1880. Extensively mined between 1897 and 1915 with intermittent production until 1926. Developed by many shafts and extensive underground workings | About $1.2 million in silver and lead | 5, 38, 55, 121 |
| 18 | - - - - - - - | SE1/4sec. 35 T. 25 S., R. 21 W. | Mineralized fault zone separating granite and Ordovician El Paso Limestone | Secondary copper minerals, galena, sphalerite | Small pit | None | 55 |
| 19 | Sunrise (Hilltop Group) | NE1/4sec. 35 T. 25 S., R. 21 W. | Veins and replacement deposits in Ordovician El Paso Limestone near Granite Gap fault | Scheelite, galena | Shafts and extensive surface workings. Originally worked for lead and silver. Scheelite found in 1941. Inactive by 1956 | 270 metric tons of 0.5% $WO_3$ | 24, 55 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| | | | **W Replacement Deposits** | | | | |
| | Scheelite occurs sparingly in contact-metasomatic skarn zones in Paleozoic limestones along the Preacher Mountain fault zone. Skarn minerals are chiefly andradite garnet, tremolite, quartz, and calcite; no sulfide minerals are present. | | | | | | |
| 20 | Ward (Baker-Standard Tungsten) | NE1/4sec. 26 T. 25 S., R. 21 W. | Skarn in Pennsylvanian Horquilla Limestone along fault | Scheelite | Mined from 15-m-deep shaft and small pits in 1954 and 1955. Ore averaged 0.1-0.2% $WO_3$. Older workings produced ore up to 3-4% $WO_3$ | Probably a few hundred metric tons of ore | 24, 55 |
| | Buck Deer | SW1/4sec 23, NW1/4sec. 26 T. 25 S., R. 21 W. | Skarn in Pennsylvanian Horquilla Limestone | Scheelite | Pits and trenches. Ore reported to contain 1.2% $WO_3$ | None | 24 |
| 21 | Blue Hill | SE1/4sec. 23 T. 25 S., R. 21 W. | Skarn along fracture zones in Pennsylvanian Horquilla Limestone | Scheelite | Pits and trenches | - - - - - - - - - - | 55 |
| 22 | Scheelite | NW1/4sec. 27 T. 25 S., R. 21 W. | Skarn in pendant of limestone-cobble conglomerate in Tertiary granite | Scheelite | Located in 1952. Adit 7 m long and open cut | - - - - - - - - - - | 24, 55 |
| | | | **Fluorite Vein Deposits** | | | | |
| 23 | - - - - - | N1/2sec. 21 T. 25 S., R. 21 W. | Fissure-filling veins along NW-trending brecciated fault in Permian Earp Formation | Fluorite | Small pits | None | 55 |
| | | | **Mn Vein Deposits** | | | | |
| 24 | Black Face (Princess Pat) | S1/2sec. 7 T. 23 S., R. 21 W. | Fracture-fillings in middle Tertiary volcanic flows | Psilomelane | Active during WWII. Shallow trenches | 9-18 metric tons of ore | 47, 190 |

PYRAMID MOUNTAINS AREA (includes Lordsburg and Animas mining districts)

HYDROTHERMAL DEPOSITS

Cu-Ag-Au (Pb-Zn) Vein Deposits

The base and precious metal deposits of the Lordsburg mining district occur as fissure-fillings along NE- and E-trending sets of fracture and fault zones that transect the contact zone of a porphyritic granodiorite pluton (56-59 m.y.) intrusive into a sequence of propylitized andesite flows and breccias of Late Cretaceous age. The vein deposits, which are genetically related to the emplacement of the pluton, consist principally of quartz and pyrite with lesser amounts of base metal sulfides, chiefly chalcopyrite; tourmaline is a characteristic gangue mineral. In the Pyramid sub-district (map nos. 13,14,15) the vein deposits are restricted to the Late Cretaceous andesite and contained higher Ag values due largely to supergene enrichment.
The district was first prospected about 1870, and the greatest activity began about 1880. The numerous mines operated under various ownership until 1975, when all mining in district ceased; mines in Pyramid sub-district closed in 1931.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Eighty-five (includes Superior, Dundee, and Jim Crow) | S1/2sec. 12, NW1/4sec. 13 T. 23 S., R. 19 W. | Emerald vein (N33°-65°E,SE) longest and most productive in district. Vein more than 1,500 m long cuts both granodiorite and andesite | Chalcopyrite, sphalerite, galena | Located in 1885, major production 1904-1931, closed in 1931. Mined from Henry Clay mine 1959-1975. Extensively developed and mined to depth of 675 m by 2 shafts and 16 levels (1931). Average grade of ore (1904-1931) 2.8% Cu, 42.2 g/t Ag, 3.8 g/t Au | | 18, 95, 114, 121 |
| 2 | Bonney (Banner) | SE1/4sec 14, NE1/4sec. 23 T. 23 S., R. 19 W. | Bonney vein, probably second largest producer in district, strikes N50°E and dips steeply NW. Vein is more than 750 m long and is in andesite about 300 m from grandiorite contact | | Located in 1881 or 1882. Major producer 1905-1948. Extensively developed to depth of 450 m by 4 shafts (1936). Average grade of ore from Bonney and Misers Chest mines (1935-1954): 3.3% Cu, 106 g/t Ag, 3.1 g/t Au | Production not available for individual mines due to lack of early data and combining of production figures since about 1953. Total production for the 8 principal mines (chiefly map nos. 1-4): Au 8,060 kg, Ag 225,122 kg, Cu 104,200 m tons, Pb 3,060 m tons, Zn 740 m tons; total value greater than $60 million | 4, 18, 50, 114, 190 |
| | Misers Chest (Lena) | C sec. 14 T. 23 S., R. 19 W. | The Misers Chest vein, about 350 m SE of Bonney vein, trends NE and dips steeply NW. Vein is more than 600 m long entirely in andesite | Chalcopyrite, sphalerite, galena | Located in 1879. Intermittent production until 1975; major producer after 1945, when acquired by Banner Mine. Shaft with 8 levels (1951) | | 18, 114, 121 |
| | Nellie Gray | SE1/4sec. 14 T. 23 S., R. 19 W. | Small vein trending ENE in granodiorite | | Acquired by Banner Mine after 1936 | | 50, 114 |
| | Last Chance | SW1/4sec. 13 T. 23 S., R. 19 W. | Small vein trending E in andesite | | Part of Banner Mine | | 13 |
| 3 | Anita | E1/2sec. 11 T. 23 S., R. 19 W. | Linked vein system along granodiorite-andesite contact trending E, but changing to NE toward east end | Chalcopyrite, sphalerite, galena | Intermittent production 1927-1931. Acquired by Banner Mine 1941, production until 1961. Extensive development to depth of 240 m (1931). Ave. grade of ore (1930?) 2.6% Cu, 343 g/t Ag, 2.7 g/t Au | | 4, 18, 114 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 4 | Atwood | W1/2sec. 7 T. 23 S., R. 18 W. | Atwood vein consists of two closely spaced E-trending veins in andesite | Chalcopyrite, sphalerite, galena | Extensive workings to depth of 195 m (1931). Major producer (with Henry Clay mine) 1943-1970. | | 18, 88, 114, 121 |
| | Henry Clay | E1/2sec. 12 T. 23 S., R. 19 W. | Junction of E-trending Atwood vein and NE-trending Emerald vein in andesite | | Located 1878. Minor producer up to 1931, major producer 1955-1970. Extensive workings on 5 levels to depth of 240 m (1962) | | 18, 114 |
| 5 | Ada Etta (Mikesell Group) | NE1/4sec 10, NW1/4sec. 11 T. 23 S., R. 19 W. | On NE veins linking 2 strands of the E-trending Lee Peak vein along granodiorite-andesite contact | | | | 114 |
| | Clementine | SW1/4sec. 11 T. 23 S., R. 19 W. | On small veins at west end of Anita vein in granodiorite | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | Some; amount unknown | 18 |
| 6 | Goodsight (Bonnie Jean) | N1/2sec. 12 T. 23 S., R. 19 W. | On east end of E-trending Lee Peak vein in andesite | | | | 18, 114 |
| | Hobson | C sec. 12 T. 23 S., R. 19 W. | On short NE-trending vein off the Atwood vein in andesite | | | | 114 |
| 7 | Waldo | E1/2sec. 7 T. 23 S., R. 18 W. | On Waldo vein, a major E-trending vein in andesite | Chalcopyrite, sphalerite | Main shaft 150 m deep; more than 700 m of underground workings | Significant; amount unknown. | 18, 114 |
| | General Jerry Boyle | C sec. 7 T. 23 S., R. 18 W. | | | | | 114 |
| 8 | Century | SW1/4sec. 12 T. 23 S., R. 19 W. | On short ENE-trending veins between Emerald and Atwood veins at contact of granodiorite and andesite | Cerussite, wulfenite, limonite | Oxidized ore mined prior to 1905 | Some; amount unknown | 121 |
| | Battleship | | Near junction of Emerald and Atwood veins in andesite | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | Production 1933-1939; amount unknown | 4, 114 |
| 9 | Cobra Negra | W1/2sec. 14 T. 23 S., R. 19 W. | On vein trending NE, just north of SW end of Emerald vein in andesite | Malachite | Oxidized ore mined prior to 1931. Developed by 2 shafts, 80 and 45 m deep (1910) | Some; amount unknown | 114, 121 |
| 10 | Francis Kay (Atlantic, Aberdeen Camp) | NW1/4sec. 24 T. 23 S., R. 19 W. | On short E-trending vein in andesite | - - - - - - - - - - - - - | Atlantic mine caved in 1905 | - - - - - - - - - | 95, 121 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| | Owl (Part of Aberdeen Camp) | C sec. 24 T. 23 S., R. 19 W. | On short E-trending vein, 350 m south of Francis Kay vein, in andesite | Chalcopyrite, galena, sphalerite | Shaft and mill in operation prior to 1905 | - - - - - - - - - | 114, 121 |
| | Ruth | E1/2sec. 24 T. 23 S., R. 19 W. | On short ENE-trending vein in andesite | - - - - - - - - - - - - - | In operation 1942 | Production significant; amount unknown | 4, 18 |
| 11 | Gamco (Rosa) | S1/2sec. 24 T. 23 S., R. 19 W. | On short E-trending vein in andesite | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 18 |
| | Green King (White Cloud) | SW1/4sec. 19 T. 23 S., R. 18 W. | - - - - - - - - - - - - - - - - - | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | Some; amount unknown | 18, 114 |
| | Bluebird | NW1/4sec. 30 T. 23. S, R. 18 W. | - - - - - - - - - - - - - - - - - | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 95 |
| | Homestake-Needmore | SW1/4sec. 19 T. 23 S., R. 18 W. | On NE-trending vein in andesite | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 18 |
| | Big Three | NE1/4sec. 25 T. 23 S., R. 19 W. | On NE-trending vein, probably continuation of Homestake-Needmore vein in andesite | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 18 |
| 12 | Horn Silver (Eldorado) | C sec. 13 T. 23 S., R. 19 W. | Veins in andesite | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 18, 95 |
| | Copper Reef | NE1/4sec. 13 T. 23 S., R. 19 W. | | | | | 18 |
| 13 | Leitendorf (Viola, Venus) | C sec. 1 T. 24 S., R. 19 W. | Vein system (N40°E) in andesite. Supergene enriched | Cerargyrite, argentite, native silver, chalcopyrite, galena | Discovered in 1880. Intermittently mined until 1931. Extensive underground workings to depth of 90 m. Average grade for some ore: 411 g/t Ag, 1.03 g/t Au, 0.75% Cu, 2.0% Pb | Probably more than $1 million, chiefly in Ag | 114, 121 |
| | Last Chance | E1/2sec. 1 T. 24 S., R. 19 W. | Vein (N60°E) about 300 m SE of Leitendorf vein, in andesite. Supergene enriched | | | | 18, 114, 121 |
| 14 | Nellie Bly, Robert E. Lee | NE1/4sec. 2, NW1/4sec. 1 T. 24 S., R. 19 W. | Vein trending NE and dipping SE in andesite | Chalcopyrite, bornite(?) | Workings developed to depth of more than 60 m | Greater than $130,000 in Ag and Cu | 18, 114, 121 |
| | Susie | SE1/4sec. 2 T. 24 S., R. 19 W. | Vein trending ENE in andesite | - - - - - - - - - - - - - | - - - - - - - - - - - - - - - - - - - | - - - - - - - - - | 18 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 15 | Silver Bell | SE1/4sec. 2 T. 24 S., R. 19 W. | - - - - - - - - - - - - - - - - - - | - - - - - - - - - - - - - | Developed by shaft | - - - - - - - - - | 18 |
| | | | **Fluorite Vein Deposits** | | | | |
| | Map nos. 16-18 occur as fluorite-quartz fissure-fillings in both porphyritic granodiorite (56-59 m.y.) and host propylitized andesite flows of early Tertiary age. Map no. 19 is a fluorite-quartz-calcite fissure-filling in volcanic flows of middle Tertiary age. All deposits are probably middle Tertiary in age. | | | | | | |
| 16 | Lone Star | S1/2sec. 25 T. 23 S., R. 19 W. | Veins trending E, as wide as 1 m, in granodiorite | Fluorite | Developed by 2 shafts as deep as 5 m and pits. Active during WWII. Inactive since 1946 | A few metric tons | 163, 190 |
| 17 | Fluorite group (Kneyer) | SE1/4sec 34, SW1/4sec. 35 T. 23 S., R. 19 W.; N1/2sec. 2, NE1/4sec. 3 T. 24 S., R. 19 W. | Short discontinuous veins as wide as 1 m trending NW (sec. 2) and NE (sec. 34) in andesite | Fluorite | Developed by 2 shafts, as deep as 20 m, many pits and 25 m of drifts. Active intermittently during WWII | About 364 metric tons of 60% $CaF_2$ | 50, 163, 190 |
| 18 | Campbell | W1/2sec. 2 T. 24 S., R. 19 W. | Vein in andesite | Fluorite | Developed by shaft | - - - - - - - - - | 114 |
| 19 | Animas | SE1/4sec. 15 T. 25 S., R. 19 W. | Vein ($N21^{o}W,80^{o}SW$) as wide as 3 m, in pyroxene andesite | Fluorite | Developed on 3 levels by shaft 90 m deep. Mining ceased in 1943 | 8,300 metric tons of beneficiated ore | 50, 125, 163, 190, 201 |
| | | | **Other Hydrothermal Deposits** | | | | |
| 20 | Silver Tree | NE1/4sec. 7 T. 25 S., R. 18 W. | Veins in volcanic rocks of middle Tertiary age | Galena (Silver Tree), stibnite (Allen) | Developed by a number of prospect pits. History unknown. Inactive in 1980 | - - - - - - - | 41 |
| | Allen | SW1/4sec. 7 T. 25 S., R. 18 W. | | | | | |
| | | | **VOLCANIC DEPOSITS** | | | | |
| | | | **Perlite Deposits** | | | | |
| 21 | Pyramid Mountains | SW1/4sec. 1, NE1/4sec 11, SW1/4sec. 12 T. 24 S., R. 19 W. | Perlite glass in layered silicic volcanic rocks of middle Tertiary age | - - - - - - - - - - - - - | Deposits probably developed in early 1950's. Active quarrying in 1953 and 1954. Inactive in 1980 | Some; amount unknown | 50, 90 |

VICTORIO MOUNTAINS AREA (Victorio mining district)

HYDROTHERMAL DEPOSITS

Pb-Ag (Cu-Zn-Au) Vein Deposits

The oxidized lead-silver ores of the Victorio mining district occur in replacement veins as wide as 7 m in Fusselman Dolomite of Silurian age. Most productive veins strike N30°-65°E and dip steeply NW parallel to NE trending faults that show both pre- and post-ore movement; smaller, less productive, veins strike N-S and dip steeply east. Ores are thoroughly oxidized to depth of mining, probably about 100 m deep. Mineralization apparently related to intrusion of rhyolite and quartz latite porphyry dikes, sills and plugs of middle Tertiary age (25 m.y.).

Information on mining activity incomplete during period of 1800-1904 when most of the rich oxidized ore bodies were mined out. District has had minor and intermittent production since 1904, with last known activity in 1966.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Chance, Jesse | NW1/4sec. 33 T. 24 S., R. 12 E. | Closely spaced veins (N50°E, steeply NW) in dolomite | Cerussite, anglesite, smithsonite, galena | Largest and most productive mines in district with 3 shafts and development on 3 levels to depth of about 100 m along 300 m of strike length. Grade for 19,515 tons mined 1904-1929 averaged 12.25% Pb, 257 g/t Ag and 4.8 g/t Au | 18,087 kg Ag, 7,942 metric tons Pb, 377 kg Au, 26 metric tons Zn, and 14 metric tons Cu; total value $1.72 million (1880-1957) | 63, 94, 121 |
| | Burke | NW1/4sec. 33 T. 24 S., R. 12 E. | Vein (N50°-60°E) in dolomite | Cerussite, anglesite, smithsonite | Adit with 100 m of workings | | 63, 121 |
| | Rambler, Excess, Helen, Rover | NE1/4sec. 32 T. 24 S., R. 12 E. | At intersection of NE- and N-trending veins in dolomite | Cerussite, anglesite, smithsonite. At Excess mine disseminated pyrite and chalcopyrite occurs in rhyolite dike | 3 shafts and extensive underground workings to depth of 100 m | | 63, 121 |
| | Parole | NW1/4sec. 33 T. 24 S., R. 12. E. | Vein (N50°-55°E) in dolomite | - - - - - - - - - - - - - | Shaft and many pits and trenches | | 63 |
| 2 | Virginia | NE1/4sec. 33 T. 24 S., R. 12. E. | Vein | Oxidized lead minerals | - - - - - - - - - - - - - - - - - - | Lead ore shipped prior to 1905 | 121 |
| 3 | - - - - - | NW1/4sec. 28 T. 24 S., R. 12 E. | Small veins | Lead and copper minerals | Numerous small prospect pits | - - - - - - - - - | 63 |

## W-Be Vein and Replacement Deposits

Tungsten and beryllium minerals occur in quartz veins and numerous small tactite lenses consisting principally of grossularite, tremolite, pyroxene, idocrase, and phlogopite. The deposits cut and replace El Paso Limestone and Montoya Dolomite of Ordovician age. The veins and tactite lenses are spatially and genetically related to many small rhyolite and quartz latite porphyry intrusives of middle Tertiary age (25 m.y.).

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 4 | Irish Rose (Morlock-Eloi) | SW1/4sec. 29 T. 24 S., R. 12 E. | Quartz vein, 150 m long and as much as 1 m wide, trends N and dips 50°-70° E in El Paso Limestone | Wolframite, beryl | Mine active prior to 1905 and during WWII. Developed by inclined shaft 48 m deep. Inactive in 1980. Average grade of vein: 0.1% $WO_3$, 0.06% BeO | Estimated 1,000 metric tons of 1% $WO_3$ | 63, 87 |
| | Ogre-Bogle claim group (Tedford's) | SW1/4sec 29, SE1/4sec. 30 T. 24 S., R. 12 E. | Tactite in Montoya Dolomite | Helvite, scheelite, galena, sphalerite | Shallow pits. Inactive in 1980 | None | 24, 196 |
| 5 | Tungsten Hill Shaft | C sec. 29 T. 24 S., R. 12 E. | Tactite zone, 6 x 60 m, in vertical beds of El Paso Limestone | Helvite, scheelite | Shaft 30 m deep. Inactive in 1980 | - - - - - - - - - | 63, 87, 196 |

BASIN AREAS

SEDIMENTARY DEPOSITS

U Deposits

Minor occurrences of secondary uranium minerals coating fractures and bedding planes in Pliocene lacustrine beds on the north flank of Dry Mountain. Area has been extensively prospected by pits, trenches, and probably drill holes.

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Flat Tire | Sec. 22,27 T. 8 S., R. 28 E. | Secondary uranium minerals coating fractures and bedding planes in clay, tuff, and opalite beds | Carnotite-type minerals, uranophane | Probably prospected in 1950's. Select samples contained as much as 1.38% $eU_3O_8$ (Flat Tire group); other deposits, 0.01-0.08% $eU_3O_8$ | 3.6 metric tons of 0.02% $eU_3O_8$ produced from Flat Tire group | 154 |
| | Last Chance | S1/2sec. 21 T. 8 S., R. 28 E. | | | | | |
| | Pluto | SW1/4sec. 22 T. 8 S., R. 28 E. | | | | | |
| | Canuk | SE1/4sec. 23 T. 8 S., R. 28 E. | | | | | |
| | Royal John | S1/2sec. 22 T. 8 S., R. 28 E. | | | | | |

Brine Deposits

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | Safford Well | Sec. 22 T. 7 S., R. 25 E. | Water containing 120,000 ppm dissolved solids (Na and Cl) from depth of 375 m in Pliocene lacustrine beds | - - - - - - - - - - - - - | Water well | None | 153 |
| 3 | Willcox playa | Sec. 4 T. 15 S., R. 24 E. | Water containing 106,000 ppm dissolved solids (Na, Cl, $SO_4$), from depth of 2 m in Willcox playa | - - - - - - - - - - - - - | Auger hole | None | 153 |

Zeolite Deposits

Zeolite minerals are common throughout the quadrangle, occurring chiefly as alteration products of silicic pyroclastic ash-flow and ash-fall deposits of middle and late Tertiary age. The Bowie deposit of Pliocene age is the only presently known economically significant deposit.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4 | Bowie | Chiefly sec. 11,12,13 T11S,R28E; sec. 17,18, 21,27,28,34 T. 11 S., R. 29 E.; sec. 2,3 T. 12 S., R. 29 E. | Altered lacustrine volcanic ash bed of Pliocene age, 10-20 cm thick, presently restricted to about 12 $km^2$ in San Simon Valley | Chabazite, analcime, clinoptilolite, erionite | Discovered in 1870's and rediscovered in late 1950's. Mining started from a number of pits in 1961 and has continued intermittently to 1980. Pit-run ore generally contains more than 90% zeolites | About 10,000 metric tons valued at about $30 million | 46, 173, 174 |

| MAP NO. | NAME | LOCATION | GEOLOGY | ORE MINERALS | HISTORY AND DEVELOPMENT | PRODUCTION | REFERENCES |
|---|---|---|---|---|---|---|---|
| | | | Diatomite deposits | | | | |
| 5 | Dry Mountain | Sec. 22,26-28,33-35 T. 8 S., R. 28 E. | Diatomaceous material within Pliocene lacustrine beds on north and northeast flanks of Dry Mountain | - - - - - - - - - - - - | Shallow prospect pits and trenches | None | 152 |

## REFERENCES CITED


1. Aldrich, M. J., 1974, Structural development of the Hanover-Fierro pluton, southwestern New Mexico: Geological Society of America Bulletin, v. 85, p. 963-968.
2. Anderson, C. A., 1969, Copper, *in* Mineral and water resources of Arizona: U.S. 90th Congress, 2d Session, Senate Committee on Interior and Insular Affairs, p. 117-156.
3. Anderson, E. C., 1955, Occurrences of uranium ores in New Mexico: New Mexico Bureau of Mines and Mineral Resources Circular 29, 27 p.
4. _____1957, The metal resources of New Mexico and their economic features through 1954: New Mexico Bureau of Mines and Mineral Resources Bulletin 39, 183 p.
5. Armstrong, A. K., Silberman, M. L., Todd, V. R., Hoggatt, W. C., and Carten, R. B., 1978, Geology of central Peloncillo Mountains, Hidalgo County, New Mexico: New Mexico Bureau of Mines and Mineral Resources Circular 158, 19 p.
6. Ballman, D. L., 1956, The geology of the southwest 1/4 of the Red Rock quadrangle, New Mexico: Illinois University, M.S. thesis, 29 p.
7. _____1960, Geology of the Knight Peak area, Grant County, New Mexico: New Mexico Institute of Mining Technology, State Bureau of Mines and Mineral Resources Bulletin 70, 39 p.
8. Belt, C. B., Jr., 1960, Intrusion and ore deposition in New Mexico: Economic Geology, v. 55, p. 1244-1271.
9. Biggerstaff, B. P., 1974, Geology and ore deposits of the Steeple Rock-Twin Peaks area, Grant County, New Mexico: El Paso, Univesity of Texas, M.S. thesis, 102 p.
10. Blake, D. W., 1971, Geology, alteration, and mineralization of the San Juan mine area, Graham County, Arizona: Tucson, Univesity of Arizona, M.S. thesis, 85 p.
11. Bornhorst, T. J., Erb, E. E., and Elston, W. E., 1976, Reconnaissance geologic map of the Mogollon-Datil volcanic province and preliminary tectonic map of Mogollon-Datil volcanic province: New Mexico Geological Society Special Publication No. 5, scale 1:350,000.
12. Boyd, F. S., Jr., and Wolfe, H. D., 1953, Recent investigations of radioactive occurrences in Sierra, Dona Ana, and Hidalgo Counties, New Mexico: New Mexico Geological Survey Guidebook, 4th Field Conference, p. 141-142.
13. Bromfield, C. S., and Wrucke, C. T., 1961, Reconnaissance geologic map of the Cedar Mountains, Grant and Luna Counties, New Mexico: U.S. Geological Survey Mineral Investigations Field Studies Map MF-159, scale 1:62,500.
14. Burchard, E. F., 1914, Stone-Arizona, *in* Part 2 of Mineral Resources of the United States [1913]: U.S. Geological Survey, p. 1338-1346.
15. Bush, F. V., 1915, Meerschaum deposits of New Mexico: Engineering and Mining Journal, v. 99, p. 941-943.
16. Butler, A. P., Jr., Finch, W. I., and Twenhofel, W. S., 1962, Epigenetic uranium deposits in the United States, exclusive of Alaska and Hawaii: U.S. Geological Survey Mineral Investigations Resource Map MR-21, scale 1:3,168,000.
17. Cargo, D. N., 1959, Mineral deposits of the Granite Gap area, Hidalgo County, New Mexico: Albuquerque, New Mexico University, M.S. thesis, 70 p.
18. Clark, K. F., 1970, Zoning, paragenesis, and temperature formation in the Lordsburg district: New Mexico Geological Society Guidebook, 21st Field Conference, p. 107-113.
19. Cook, Annan, and Robinson, R. F., 1962, Geology of Kennecott Copper Corporation's Safford copper deposit: New Mexico Geological Society Guidebook, 13th Field Conference, p. 143-148.
20. Cooper, J. R., 1960, Reconnaissance map of the Willcox, Fisher Hills, Cochise and Dos Cabezas quadrangles, Cochise and Graham Counties, Arizona: U.S. Geological Survey Mineral Investigations Field Studies Map MF-231, scale 1:62,500.
21. _____1962, Bismuth in the United States, exclusive of Alaska and Hawaii: U.S. Geological Survey Mineral Investigations Resource Map MR-22, scale 1:3,168,000.
22. Corbitt, L. L., Nials, F. L., and Varnell, R. J., 1977, Structure of Brockman Hills, southwestern New Mexico: The American Association of Petroleum Geologists Bulletin 61, no. 4, p. 601-615.
23. Cunningham, J. E., 1974, Geologic map and sections of Silver City quadrangle, New Mexico: New Mexico Bureau of Mines and Mineral Resources Geologic Map 30, scale 1:24,000.
24. Dale, V. B., and McKinney, W. A., 1959, Tungsten deposits of New Mexico: U.S. Bureau of Mines Report of Investigations 5517, 72 p.
25. Dale, V. B., Stewart, L. A., and McKinney, W. A., 1960, Tungsten deposits of Cochise, Pima, and Santa Cruz Counties, Arizona: U.S. Bureau of Mines Report of Investigations RI-5650, 132 p.
26. Darton, N. H., 1916, Geology and underground water of Luna County, New Mexico: U.S. Geological Survey Bulletin 618, 188 p.
27. Dorr, J. V. N., 1965, Manganese, *in* Mineral and water resources of New Mexico: U.S. 89th Congress, 1st Session, Senate Committee on Interior and Insular Affairs, p. 183-195.
28. _____1969, Manganese, *in* Mineral and water resources of Arizona: U.S. 90th Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, p. 211-225.
29. Drewes, Harald, U.S. Geological Survey unpublished data, 1977-1980.
30. Duriez, L. H., and Newman, J. V.,Jr., 1948, Geology and mining practice Society of America Bulletin, v. 29, no. 502, p. 559-561.
31. Dutton, C. E., and Carr, M. S., 1947, Iron ore deposits of the Western United States: U.S. Geological Survey Mineral Investigations Preliminary Report 3-212.
32. Eastern Arizona Courier and Graham County Guardian, 1978, Kennecott Safford ore body called massive by geologist: Safford, Arizona, v. 83, no. 1, p. 1.
33. Eaton, G. P., 1970, Altered (pyritized) rocks in San Simon Valley, southeastern Arizona, *in* Geological Survey Research 1970: U.S. Geological Survey Professional Paper 700-A, p. A37.
34. Ellis, R. W., 1929, New Mexico mineral deposits except fuels: New Mexico University Bulletin 167, Geological Series, v. 4, no. 2, 148 p.
35. Elsing, M. J., and Heineman, R. E. S., 1936, Arizona metal production: Arizona Bureau of Mines Economic Series 19, Bulletin 140, 112 p.
36. Elston, W. E., 1957, Geology and mineral resources of the Dwyer quadrangle, Grant, Luna, and Sierra Counties, New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 38, 86 p.
37. _____1960, Reconnaissance geologic map of Virden thirty minute quadrangle: New Mexico Bureau of Mines and Mineral Resources Geologic Map 15, scale 1:125,000.
38. _____1963, Geology and mineral resources of Hidalgo County, New Mexico: New Mexico Bureau of Mines and Mineral Resources Open-File Report, 781 p.

39. _____1965, Mining districts of Hidalgo County, New Mexico: New Mexico Geological Society Guidebook, 16th Field Conference, p. 210-214.
40. _____1965, Volcanic rocks of the Mimbres and upper Gila drainages, New Mexico: New Mexico Geological Society Guidebook, 16th Field Conference, p. 167-174.
41. Elston, W. E., Erb, E. E., and Deal, E. G., 1979, Tertiary geology of Hidalgo County, New Mexico: New Mexico Geology, v. 1, no. 1, p. 1.
42. Engineering and Mining Journal, 1981, Turquoise in southwestern New Mexico: Engineering and Mining Journal, v. 51, no. 25, p. 719.
43. _____1975, Kennecott investigates solution mining potential of deep copper deposit: Engineering and Mining Journal, v. 176, no. 9, p. 37.
44. Entwistle, L. P., 1944, Manganiferous iron ore deposits near Silver City, New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 19, 70 p.
45. _____1975, Geology and mineralization at the Ground Hog mine, New Mexico, *in* Base metal and precious metal districts of New Mexico and Arizona: New Mexico and Arizona Geological Society Symposium, May 21-24, 1975.
46. Eyde, T. H., 1978, Bowie zeolite, an Arizona industrial mineral, *in* Field notes: Arizona Bureau of Geology and Mineral Technology: v. 8, no. 4, p. 1-5.
47. Farnham, L. L., 1961, Manganese deposits of New Mexico: U.S. Bureau of Mines Information Circular 8030, 176 p.
48. Farnham, L. L., Stewart, L. A., and DeLong, C. W., 1961, Manganese deposits of eastern Arizona: U.S. Bureau of Mines Information of Circular 7990, 178 p.
49. Finnell, T. L., U.S. Geological Survey unpublished data, 1976-1980.
50. Flege, R. F., 1959, Geology of Lordsburg quadrangle, Hidalgo County, New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 62, 36 p.
51. Gillerman, Elliot, 1952, Fluorspar deposits of Burro Mountains and vicinity, New Mexico: U.S. Geological Survey Bulletin 973-F, p. 261-289.
52. _____1953, Search for and geology of uranium in sandstone type deposits, White Signal-Black Hawk districts, New Mexico, *in* Search for and geology of radioactive deposits, semiannual progress report: U.S. Geological Survey TEI-330, p. 111-113, issued by U.S. Atomic Energy Commission Technical Information Service, Oak Ridge, Tennessee.
53. _____1953, Fluorite deposits of Burro Mountains and vicinity: New Mexico Geological Society Guidebook, 4th Field Conference, p. 137-138.
54. _____1953, White Signal uranium deposits: New Mexico Geological Society Guidebook, 4th Field Conference, p. 133-137.
55. _____1958, Geology of the central Peloncillo Mountains, Hidalgo County, New Mexico and Cochise County, Arizona: New Mexico Bureau of Mines and Mineral Resources Bulletin 57, 152 p.
56. _____1964, Mineral deposits of western Grant County, New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 83, 213, p.
57. _____1970, Mineral deposits and structural pattern of the Big Burro Mountains, New Mexico: New Mexico Geological Society Guidebook, 21st Field Conference, p. 115-121.
58. Guillerman, Elliot, and Whitebread, D. H., 1956, Uranium-bearing nickel, cobalt, native silver deposits, Black Hawk district, Grant County, New Mexico: U.S. Geological Survey Bulletin 1009-K, p. 283-313
59. Graf, D. L., and Kerr, P. F., 1950, Trace-element studies, Santa Rita, New Mexico: Geological Society of America Bulletin, v. 61, p. 1023-1052.
60. Granger, H. C., and Bauer, H. L., Jr., 1951, Results of diamond drilling, Merry Widow claim, White Signal district, Grant County, New Mexico: U.S. Geological Survey TEM-146A, 11 p., issued by U.S. Atomic Energy Commission Technical Information Service, Oak Ridge, Tenn.
61. _____1952, Uranium occurrences on Merry Widow claim, White Signal district, Grant County, New Mexico: U.S. Geological Survey Circular 189, 16 p.
62. Griggs, R. L., and Wagner, H. C., 1966, Geology and ore deposits of the Steeple Rock mining district, Grant County, New Mexico: U.S. Geological Survey Bulletin 1222-E, 29 p.
63. Griswold, G. B., 1961, Mineral deposits of Luna County, New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 72, 157 p.
64. Hall, R. B., 1978, World nonbauxite aluminum resources—alunite: U.S. Geological Survey Professional Paper 1076-A, 35 p.
65. Harrer, C. M., and Kelly, F. J., 1963, Reconnaissance of iron resources in New Mexico: U.S. Bureau of Mines Information Circular 8190, 112 p.
66. Hedlund, D. C., 1978, Geologic map of the Wind Mountain quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1031, scale 1:24,000
67. _____1978, Geologic map of the Soldiers Farewell Hill quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1033, scale: 1:24,000.
68. _____1978, Geologic map of the Ninety-six Ranch quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1034, scale 1:24,000.
69. _____1978, Geologic map of the Gold Hill quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1035, scale 1:24,000.
70. _____1978, Geologic map of the Tyrone quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1037, scale 1:24,000.
71. _____1978, Geologic map of the Werney Hill quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1038, scale 1:24,000.
72. _____1978, Geologic map of the C-Bar Ranch quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1039, scale 1:24,000.
73. _____1978, Geologic map of the Burro Peak quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1040, scale 1:24,000.
74. _____1978, Geologic map of the White Signal quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1041, scale 1:24,000.
75. _____1980, Geologic map of the Redrock NW quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1263, scale 1:24,000.
76. _____1980, Geologic map of the Redrock NE quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1264, scale 1:24,000.
77. _____1980, Geologic map of the Redrock SE quadrangle, Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1265, scale 1:24,000.
78. _____U.S. Geological Survey unpublished data in the York Valley NE quadrangle, Grant County, New Mexico, and Greenlee County, Arizona, 1979-1980.
79. _____U.S. Geological Survey unpublished data in the York Valley SE quadrangle, Grant and Hidalgo Counties, New Mexico, and Greenlee County, Arizona, 1979-1980.
80. _____U.S. Geological Survey unpublished data in the Steeple Rock NW quadrangle, Grant County, New Mexico, 1979-1980.

81. _____U.S. Geological Survey unpublished data in the Steeple Rock SW quadrangle, Grant and Hidalgo Counties, New Mexico, 1979-1980.
82. Hernon, R. M., compiler, 1949, Geology and ore depsits of Silver City region, New Mexico: West Texas Geological Society and Southwestern New Mexico Section, AIME Guidebook, Field Trip 3, 45 p.
83. _____1953, Summary of smaller mining districts in Silver City region: New Mexico Geological Society Guidebook, 4th Conference, p. 138-142.
84. Hewett, D. F., and Fleischer, Michael, 1960, Deposits of manganese oxides: Economic Geology, v. 55, no. 1, p. 1-55.
85. Hewitt, C. H., 1959, Geology and mineral deposits of the northern Big Burro Mountains-Redrock area, Grant County, New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 60, 151 p.
86. Heyl, A. V., and Bozion, C. N., 1962, Oxidized zinc deposits of the United States: U.S. Geological Survey Bulletin 1135-A, 49 p.
87. Holser, W. T., 1953, Beryllium minerals in the Victorio Mountains, Luna County, New Mexico: American Mineralogist, v. 38, p. 599-611.
88. Huntington, M. G., 1947, Atwood Copper group, Lordsburg district, Hidalgo County, New Mexico: U.S. Bureau of Mines Report of Investigations 4029, 9 p.
89. Jahns, R. H., Kottlowski, F. E., and Kuellmer, F. J., 1955, Volcanic rocks of south-central New Mexico: New Mexico Geological Society, 6th Field Conference Guidebook, p. 92-95.
90. Jaster, M. C., 1956, Perlite resources of the United States: U.S. Geological Survey Bulletin 1027-I, p. 375-404.
91. Johnston, W. D., Jr., Fluorspar in New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 4, 128 p.
92. Jones, E. L., Jr., 1919, Deposits of manganese ore in New Mexico: U.S. Geological Survey Bulletin 710, p. 37-60.
93. Jones, E. L., Jr., and Ransome, F. L., 1920, Deposits of manganese ore in Arizona: U.S. Geological Survey Bulletin 710-D, p. 93-184.
94. Jones, F. A., 1904, New Mexico Mines and Minerals: Santa Fe, New Mexico Printing Company, 349 p.
95. _____1907, The Lordsburg mining region, New Mexico: Engineering and Mining Journal, v. 84, p. 444-445.
96. Jones, W. R., 1956, The Central mining district, Grant County: U.S. Geological Survey Open-File Report.
97. Jones, W. R., and Hernon, R. M., 1973, Ore deposits and rock alteration of the Santa Rita quadrangle, Grant County, New Mexico: U.S. Department of Commerce, National Technical Information Service PB 214, 371, 102 p.
98. Jones, W. R., Moore, S. L., Pratt, W. P., 1970, Geologic map of the Fort Bayard quadrangle, Grant County, New Mexico: U.S. Geological Survey Geologic Quadrangle Map GQ-865, scale 1:24,000.
99. Keith, S. B., 1973, Index of mining properties in Cochise County, Arizona: Arizona Bureau of Mines Bulletin 187, 98 p.
100. Keith, S. B., Arizona Bureau of Geology and Mineral Technology unpublished data, 1978-1979.
101. Keith, S. B., and Wilt, J. C., 1978, Supplemental road log no. 3, Tucson to Lordsburg via Interstate 10, *in* Land of Cochise: New Mexico Geological Society, 29th Field Conference, Guidebook, p. 112-114.
102. Kelley, V. C., 1949, Geology and economics of New Mexico iron-ore deposits: New Mexico University Publications in Geology Series, no. 2, 246 p.
103. _____1951, Oolitic iron deposits of New Mexico: American Association of Petroleum Geologists Bulletin, v. 35, no. 10, p. 2199-2228.
104. _____1952, Molybdenum—Occurrence, properties, utilization: New Mexico Miner, v. 14, no. 9, p. 8-13.
105. Kennecott Copper Corporation annual reports, 1963-1977.
106. King, R. U., 1969, Molybdenum and rhenium, *in* Mineral and water resources of Arizona: U.S. 90th Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, p. 230-238.
107. Kolessar, Joseph, 1970, Geology and copper deposits of the Tyrone district: New Mexico Geological Society Guidebook, 21st Field Conference, p. 127-132.
108. Krohn, D. H., 1976, Gravity survey of the Mogollon Plateau volcanic province, southwestern New Mexico, *in* Cenozoic volcanism in southwestern New Mexico: New Mexico Geological Society Special Publication 5, p. 113-116.
109. Langton, J. M., and Williams, S. A., (in press), Structural, petrologic, and mineralogic controls for the Dos Pobres ore body, Safford Valley, Graham County, Arizona, *in* Titley, S., ed., Advances in geology of the porphyry copper deposits, southewestern North America: Tucson, Univesity of Arizona Press.
110. Larsh, P. A., 1913, Lucky Bill lead-vanadium mine: Engineering and Mining Journal, v. 96, p. 1105.
111. Lasky, S. G., 1930, Geology and ore deposits of the Groundhog mine, Central district, Grant County, New Mexico: New Mexico Bureau of Mines and Mineral Resources Circular 2, 14 p.
112. _____1953, The Lordsburg district, New Mexico, *in* Copper resources of the world: Washington, D.C., International Geological Congress, 16th, 1933, p. 337-341.
113. _____1936, Geology and ore deposits of the Bayard area, Central mining district, New Mexico: U.S. Geological Survey Bulletin 870, 144 p.
114. _____1939, Geology and ore deposits of the Lordsburg mining district, Hidalgo County, New Mexico: U.S. Geological Survey Bulletin 885, 62 p.
115. _____1942, Groundhog Mine, Central district, New Mexico, *in* Newhouse, W. H., ed., Ore deposits as related to structural features: Princeton University Press, p. 244.
116. _____1947, Geology and ore deposits of the Little Hatchet Mountains, Hidalgo and Grant Counties, New Mexico: U.S. Geological Survey Professional Paper 208, 101 p.
117. Lasky, S. G., and Hoagland, A. D., 1948, Central mining district, New Mexico, *in* Symposium on geology, paragenesis, and reserves of ores of lead and zinc: London, International Geological Congress, 18th, 1948, p. 86-97.
118. Lasky, S. G., and Wootton, T. P., 1933, The metal resources of New Mexico and their economic features: New Mexico Bureau of Mines and Mineral Resources Bulletin 7, 178 p.
119. Leroy, P. G., 1951, Geology of the southern margin of the Santa Rita copper pit: New York, Columbia University, M.A. thesis.
120. _____1954, Correlation of copper mineralization with hydrothermal alteration in the Santa Rita porphyry copper deposit, New Mexico: Geological Society of America Bulletin, v. 65, p. 739-767.
121. Lindgren, Waldemar, Graton, L. C., and Gordon, C. H., 1910, The ore deposits of New Mexico: U.S. Geological Survey Professional Paper 68, 361 p.
122. Lines, H. L., 1940, Mining and milling methods and costs at the Ash Peak mine of the Veta Mines Incorporated, Duncan, Arizona: U.S. Bureau of Mines Information Circular IC-7119, 26 p.
123. Lovering, T. G., 1952, Geology of the western portion of the Santa Rita quadrangle, Grant County, New Mexico: U.S. Geological Survey Open-File Report 163, 44 p.
124. _____1956, Radioactive deposits in New Mexico: U.S. Geological Survey Bulletin 1009-L, p. 315-390.

125. McAnulty, W. N., 1978, Fluorspar in New Mexico: New Mexico Bureau of Mines and Mineral Resources, Memoir 34, 64 p.
126. McKnight, J. F., and Fellows, M. L., 1978, Silicate mineral assemblages and their relationship to sulfide mineralization, Pinos Altos mineral deposit: Arizona Geological Society Digest, v. 11, p. 1-8.
127. Meeves, H. C., 1966, Nonpegmatitic beryllium occurrences in Arizona, Colorado, New Mexico, Utah, and four adjacent states: U.S. Burea of Mines Report of Investigations RI-6828, 68 p.
128. Meeves. H. C., Harrer, C. M., Salsbury, M. H., Konselman, A. S., and Shannon, S. S., Jr., 1966, Reconnaissance of beryllium-bearing pegmatite deposits in six western states, Arizona, Colorado, New Mexico, South Dakota, Utah, Wyoming: U.S. Bureau of Mines Information Circular 8298, 34 p.
129. Mining Engineering, 1966, The Development of Chino: Mining Engineering v. 18, no. 1, p. 54-60.
130. Mining World, 1960, Kennecott sinks shaft to develop Safford copper deposits: Mining World v. 22, no. 10, p. 29.
131. _____1961, Phelps Dodge pays $3,500,000 for 299 Arizona copper claims: Mining World v. 23, no. 2, p. 19.
132. Moore, R. T., 1969, Beryllium, *in* Mineral and Water Resources of Arizona: U.S. 90th Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, p. 102-113.
133. _____1969, Gold, *in* Mineral and Water Resources of Arizona: U.S. 90th Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, p. 156-167.
134. _____1969, Lead and zinc *in* Mineral and Water Resources of Arizona: U.S. 90th Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, p. 182-205.
135. Moore, R. T., and Roseveare, G. H., 1969, Silver, *in* Mineral and Water Resources of Arizona: U.S. 90th Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, p. 251-270.
136. Moore, S. L., U.S. Geological Survey unpublished data, 1956.
137. Mullen, D. H., and Storms, W. R., 1948, Copper Flat zinc deposits, Central mining district, Grant County, New Mexico: U.S. Bureau of Mines Report of Investigations 4228, 8 p.
138. Neilsen, R. L., 1968, Hypogene texture and mineral zoning in a copper-bearing granodiorite porphyry stock, Santa Rita, New Mexico: Economic Geology, v. 63, p. 37-50.
139. _____1970, Mineralization and alteration in calcareous rocks near the Santa Rita stock, New Mexico: New Mexico Geological Society Guidebook, 21st Field Conference, p. 133-139.
140. Northrop, S. A., 1959, Minerals of New Mexico (revised ed.): Albuquerque, University of New Mexico Press, 665 p.
141. O'Sullivan, R. B., 1953, Geology and mineralogy of the Fierro-Hanover district, Grant County, New Mexico: New Mexico University, M.S. thesis, 76 p.
142. Paige, Sidney, 1908, The Hanover iron-ore deposits, New Mexico, *in* Iron and Manganese: U.S. Geological Survey Bulletin 380-E, p. 199-214.
143. _____1909, Marble prospects in the Chiricahua Mountains, Arizona, *in* Building Stones: U.S. Geological Survey Bulletin 380-I, p. 299-311.
144. _____1911, Metalliferous ore deposits near the Burro Mountains, Grant County, New Mexico, *in* Copper: U.S. Geological Survey Bulletin 470-C, p. 131-150.
145. _____1911, The ore deposits near Pinos Altos, New Mexico, *in* Gold and Silver: U.S. Geological Survey Bulletin 470-B, p. 109-125.
146. _____1912, The geologic and structural relations at Santa Rita (Chino), New Mexico: Economic Geology, v. 7, p. 547-559.
147. _____1912, The origin of turquoise in the Burro Mountains, New Mexico: Economic Geology, v. 7, p. 383-392.
148. _____1916, Description of the Silver City quadrangle, New Mexico: U.S. Geological Survey Geologic Atlas, Silver City Folio 199, 19 p.
149. _____1922, Copper deposits of the Tyrone district, New Mexico: U.S. Geological Survey Professional Paper 122, 53 p.
150. _____1932, The region around Santa Rita and Hanover, New Mexico: 16th International Geological Congress U.S., 1933, Guidebook 14, Excursion C-1, p. 23-40.
151. _____1935, Santa Rita and Tyrone, New Mexico, *in* Copper resources of the world: Washington, D.C., 16th International Congress, p. 327-335.
152. Peirce, H. W., 1969a, Diatomite, *in* Mineral and Water Resources of Arizona: U.S. 90th Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, p. 337-342.
153. _____1969b, Salines, *in* Mineral and Water Resources of Arizona: U.S. 90th Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, p. 417-424.
154. Peirce, H. W., Keith, S. B., and Wilt, J. C., 1970, Coal, oil, natural gas, helium and uranium in Arizona: Arizona Bureau of Mines Bulletin 182, p. 103-146.
155. Phelps Dodge Corporation Annual Reports, 1969-1977.
156. Powers, R. S., 1976, Geology of the Summit Mountains and vicinity, Grant County, New Mexico, and Greenlee County, Arizona: University of Houston, M.S. thesis, 107 p.
157. Pratt, W. P., 1967, Geology of the Hurley West quadrangle, Grant County, New Mexico: U.S. Geological Survey Bulletin 1241E, 91 p.
158. Raup, R. B., Jr., 1953, Reconnaissance for uranium in the United States, southwestern district (Tyrone district), *in* Geologic investigations of radioactive deposits, semiannual progress report, June 1 to November 30: U.S. Geological Survey TEI-390, p. 209-212.
159. _____1954, Reconnaissance for uranium in the United States, southwestern district (Tyrone district), *in* Geologic investigations of radioactive deposits, semiannual progress report, December 1 to May 31: U.S. Geological Survey TEI 440, p. 180-182.
160. Robinson, R. F., and Cook, Annan, 1966, The Safford copper deposit, Lone Star mining district, Graham County, Arizona, *in* Titley, S. R., and Hicks, C. L., eds., Geology of the porphyry copper deposits, southwestern North America: Tucson, University of Arizona Press, p. 251-266.
161. Rose, A. W., and Baltosser, W. W., 1966, The porphyry copper deposit at Santa Rita, New Mexico, *in* Titley, S. E., and Hicks, C. L., eds., Geology of the porphyry copper deposits, southwestern North America: Tucson, University of Arizona Press, p. 205-221.
162. Roseveare, G. H., 1969, Antimony and other minor metals, *in* Minerals and Water Resources of Arizona: U.S. 90th Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, p. 93-102.
163. Rothrock, H. E., Johnson, C. H., and Hahn, A. D., 1946, Fluorspar resources of New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 21, 245 p.
164. Russell, P. L., 1946, Exploration of Contact manganese mine, Grant County, New Mexico: U.S. Bureau of Mines Report of Investigations 3969, 5 p.
165. _____1947, Gila fluorspar district, Grant County, New Mexico: U.S. Bureau of Mines Report of Investigations 4020, 5 p.
166. _____1947, Exploration of Fluorite Ridge fluorspar district, Luna County, New Mexico: U.S. Bureau of Mines Report of Investigations 3987, 7 p.
167. Schilling, J. H., 1964, Molybdenum resources of New Mexico: New Mexico Bureau of Mines Bulletin 76, 74 p.
168. Schmitt, H. A., 1935, The Central mining district, New Mexico: American Institute of Mining and Metallurgical Engineers Transactions, v. 115, p. 187-208.

169. _____1939a, Outcrops of ore shoots: Economic Geology, v. 34, p. 654-673.
170. _____1939b, The Pewabic mine: Geological Society of America Bulletin 50, p. 777-818.
171. _____1942, Certain ore deposits in the Southwest, central mining district, New Mexico, *in* Newhouse, W. H., ed., Ore deposits as related to structural features: Princeton University Press, p. 73-79.
172. Sheffer, H. W., 1963, An investigation of some germanium occurrences in southwestern New Mexico: Socorro, New Mexico Institute of Mining and Technology, M.S. thesis, 68 p.
173. Sheppard, R. A., 1969, Zeolites, *in* Mineral and Water resources of Arizona: U.S. 90th Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, p. 464-467.
174. Sheppard, R. A., Gude, A. J., 3d, and Edson, G. M., 1978, Bowie zeolite deposit, Cochise and Graham Counties, Arizona, *in* Sand, L. B., and Mumpton, F. A., eds., Natural zeolites—Occurrence, properties, and use: Oxford and New York, Pergamon Press, p. 319-328.
175. Somers, R. E., 1916, Geology of the Burro Mountains copper district, New Mexico: American Institute of Mining Engineers Transactions, v. 52, p. 604-644.
176. Soule, J. H., 1947, Peerless lead-zinc mine, Grant County, New Mexico: U.S. Bureau of Mines Report of Investigations 4044, 8 p.
177. _____1948a, Silver Spot manganese-iron-zinc deposits, Grant County, New Mexico: U.S. Bureau of Mines Report of Investigations 4217, 5 p.
178. _____1948b, West Pinos Altos Zn-Pb deposits, Grant County, New Mexico: U.S. Bureau of Mines Report of Investigations 4237, 8 p.
179. Spencer, A. C., and Paige, Sidney, 1935, Geology of the Santa Rita mining area, New Mexico: U.S. Geological Survey Bulletin 859, 78 p.
180. Sterrett, D. B., 1907, Meerschaum in New Mexico, *in* Hayes, C. W., and Lindgren, Waldermar, eds., Contributions to Economic Geology: U.S. Geological Survey Bulletin 340, p. 466-473.
181. Storms, W. R., and Faust, J. W., 1949, Mining methods and costs at the Kearney zinc-lead mine: U.S. Bureau of Mines Information Circular 7507, 11 p.
182. Strongin, O., 1953, Reconnaissance of the geology and ore deposits of the Apache Hills and Sierra Rica, New Mexico: Columbia University, M.A. thesis, 38 p.
183. Talmage, S. B., and Wootton, T. P., 1937, The non-metallic mineral resources of New Mexico and their economic features (exclusive of fuels): New Mexico Bureau of Mines and Mineral Resources Bulletin 12, 159 p.
184. Thorman, C. H., U.S. Geological Survey unpublished data, 1977-1979.
185. Thorman, C. H., and Drewes, Harald, 1978, Geologic map of the Gary and Lordsburg quadrangles, Hidalgo County, New Mexico: U.S. Geological Survey Miscellaneous Investigations Series Map I-1151, scale 1:24,000.
186. Tourtelot, E. B., and Meier, A. L., 1976, Lithium in the Gila conglomerate, southwestern New Mexico *in* Vine, J. D., ed., Lithium resources and requirements by the year 2000: U.S. Geological Survey Professional Paper 1005, p. 123-127.
187. Trace, R. D., 1947, The Fourth of July and Luckie No. 1 and No. 2 fluorspar veins, Greenlee County, Arizona: U.S. Geological Survey Mineral Investigations Preliminary Strategic Map Report 3-207, 6 p.
188. Turner, D. L., 1978, Geology and economic geology of the Juniper Hill-Sycamore Creek area, Reading Mountain quadrangle, Grant County, New Mexico: Golden, Colorado School of Mines, M.S. thesis, 152 p.
189. U.S. Bureau of Mines, Minerals Yearbooks 1969 and 1970.
190. _____Mineral Inventory Location System, U.S. Bureau of Mines computer data bank, 1978a.
191. _____Minerals Availability System, U.S. Bureau of Mines computer data bank, 1979.
192. U.S. Department of Energy written commun., 1978.
193. U.S. Geological Survey unpublished DMEA reports.
194. U.V. Industries Annual Report, 1974.
195. Van Alstine, R. E., and Moore, R. T., 1969, Fluorspar, *in* Mineral and Water Resources of Arizona: U.S. 90th Congress, 2nd Session, Senate Committee on Interior and Insular Affairs, p. 348-357.
196. Warner, L. A., Holser, W. T., Wilmarth, V. R., and Cameron, E. N., 1959, Occurrence of nonpegmatite beryllium in the United States: U.S. Geological Survey Professional Paper 318, 198 p.
197. Watts, K. C., U.S. Geological Survey unpublished data, 1977-1979.
198. Weber, R. H., and Kottlowski, F. E., 1960, Gypsum resources of New Mexico: New Mexico Institute of Mining Technology, State Bureau of Mines and Mineral Resources Bulletin 68, 68 p.
199. Wells, E. H., 1918, Manganese in New Mexico: Socorro, New Mexico School of Mines, Bulletin 2, 85 p.
200. Wells, E. H ., and Wootton, T. P., 1940, Gold mining and gold deposits in New Mexico (revised ed.): New Mexico Bureau of Mines and Mineral Resources Circular 5, 25 p.
201. Williams, F. E., 1966, Fluorspar deposits of New Mexico: U.S. Bureau of Mines Information Circular 8307, 143 p.
202. Wilson, E. D., 1951, Dragoon Mountains, *in* part 2 *of* Arizona zinc and lead deposits: Arizona Bureau of Mines Bulletin 158, p. 10-29.
203. _____1961, Arizona gold placers, *in* part 1 *of* Gold placers and placering in Arizona: Arizona Bureau of Mines Bulletin 168, p. 1-86.
204. _____1962, a resume of the geology of Arizona: Arizona Bureau of Mines Bulletin 171, 140 p.
205. Wilson, E. D., and Butler, G. M., 1930, Manganese ore deposits in Arizona: Tucson, University of Arizona Bulletin 127, 104 p.
206. Wilson, E. D., Cunningham, J. B., and Butler, G. M., 1934, Arizona lode gold mines and gold mining: Arizona Bureau of Mines Bulletin 137, 261 p.
207. Wilson, E. D., and Roseveare, G. H., 1949, Arizona nonmetallics: A summary of past production and present operations, 2nd ed., (revised): Arizona Bureau of Mines Mineral Technology Series 42, Bulletin no. 155, 60 p.
208. World Mining, 1970, Phelps Dodge unveils Tyrone; Newest southwest copper mine: World Mining, v. 6, no. 1, p. 18-23.
209. _____1974, Phelps Dodge accelerates Safford underground development: World Mining, v. 27, no. 5, p. 76.
210. Wynn, J. C., and Zonge, K. L., 1975, EM coupling, its intrinsic value, its removal, and the cultural coupling problem: Geophysics, v. 40, no. 5, p. 831-850.
211. Zalinski, E. R., 1907, Turquoise in the Burro Mountains, New Mexico: Economic Geology, v. 2, no. 5, p. 464-492.