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SILVER IN THE UNITED STATES

(Exclusive of Alaska and Hawaii)

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Introduction

The productive silver districts in the United States (exclusive of Alaska and Hawaii) are shown on the accompanying map. Only those districts known or believed to have contained 100,000 troy ounces or more silver are shown. Three size categories, based on production and estimated reserves, are distinguished and indicated by size of symbols: districts containing 100,000 to 5 million ounces, those containing 5 million to 50 million ounces, and those containing more than 50 million ounces. Symbols show the approximate centers of the districts.

Some of the more prominent districts are identified by name on the map, and all are numbered to correspond to the index. Because a name established through common usage may not be the legal name of the mining district, several names are given in the index for some localities. The index, arranged alphabetically by States, includes a brief description of major geologic features for most districts. Both published and unpublished data were used, and at least one reference is given for each locality if reports on it have been published.

Occurrence and mineralogy of silver

Silver is primarily an accompanier of other metals, notably lead, copper, and gold. In the deposits of these metals it usually occurs as a minor constituent, commonly of only byproduct importance. There are, however, all gradations to districts in which the chief values have been in silver. Though most of these have been mined out, one of the greatest, the Silver Belt in the Coeur d'Alene region in Idaho, is currently the major silver-producing district of the United States. Many districts commonly classed as silver districts nevertheless carry important values in other metals, such as gold in the Comstock and Tonopah districts in Nevada, and copper, lead, and antimony in the Silver Belt. In relatively few districts are virtually all the values in silver, and these have accounted for only a minor proportion of the total production (Merrill, 1930). Silver is usually a companion of zinc only where there is associated lead or copper. However, the small amount of zinc sulfide that occurs in some of the major lead deposits of southeast Missouri contains a significant amount of silver.

Byproduct silver in lead sulfide deposits occurs in "argentiferous galena" as minute inclusions of argentite (Ag_2S), tetrahedrite ($(Cu,Fe,Zn,Ag)_{12}Sb_4S_{13})$), tennantite ($(Cu,Fe,Zn,Ag)_{12}As_4S_{13}$)), or possibly other silver-bearing minerals. It may also occur in larger grains of tetrahedrite or tennantite, interstitial to the other ore-forming minerals. By increase of tetrahedrite relative to galena, the type of deposit grades to that of the Silver Belt. Byproduct silver in copper deposits is presumably an "impurity" in chalcopyrite, bornite, enargite, or chalcocite; but in deposits richer in silver, the silver occurs in tetrahedrite, tennantite, or stromeyerite (CuAgS).

Most gold mined in the United States contains some alloyed silver, the amount ranging from less than 10 percent to as much as 60 percent in exceptional cases. Gold from the Mother Lode Belt in California commonly contains 10 to 20 percent silver; that from the Homestake mine in South Dakota averages about 20 percent. The largest proportion of silver is contained in the gold from the epithermal precious metal deposits. Placer gold contains less silver than gold in the lode from which it was derived. The difference has commonly been explained as due to loss of silver during exposures in the zone of weathering, but it may be due to a primary difference between the gold in deep-seated portions of a lode and that in the apical portions from which the placer gold was derived (Mertie, 1940). One large dredging operation in California in recent years produced gold containing about 7 percent silver, but some placer gold is known from California containing only 2 to 3 percent silver.

In addition to the silver that is alloyed with native gold, many gold deposits contain appreciable amounts of silver minerals. Such deposits grade to predominantly silver deposits with increase in the proportion of silver-bearing minerals. In primary gold and silver deposits, these minerals include tetrahedrite, tennantite, argentite, hessite (Ag_2Te), polybasite ($Ag_{16}Sb_2S_{11}$), pyrargyrite (Ag_3SbS_3), proustite (Ag_3AsS_3), stephanite (Ag_5SbS_4), pearceite $Ag_{16}As_2S_{11}$), miargyrite ($AgSbS_2$), and other silver-bearing sulfides, including galena.

During oxidation of primary deposits, the silver is dissolved and reprecipitated as cerargyrite (AgCl), embolite (Ag(Cl,Br)), bromyrite (AgBr), iodyrite (AgI), native silver, argentite, argentite, stromeyerite, or one or more of the combinations of silver with antimony, arsenic, and sulfur that have been listed above as primary silver minerals.

Where silver is a byproduct of other metals, it may be recovered from ores that are extremely low grade in terms of silver. Whether it is recovered at all may depend upon the metallurgical technology used in processing the other metals. The lead ore of southeast Missouri contains so little silver that the cost of recovering if from the lead bullion is greater than the value of the silver. For some uses, however, silver-free lead is required, which necessitates separation of the silver from a substantial part of the large amount of lead produced from this district. The common ratio of one ounce of silver per ton of lead from southeast Missouri is equivalent to only 0.03 oz of silver per ton of crude ore. Similarly, the porphyry copper deposits contain a very low percentage of silver (0.02 to 0.11 oz recovered per ton ore), yet so great a tonnage of this material is mined and processed annually that this type of deposit is currently a major source of silver.

In the refining methods that are currently used on the metals from most western ores, silver is recovered at relatively little additional cost, hence it is an especially valuable byproduct or coproduct that may determine whether a deposit can be worked or not. Primary copper ores of various geologic types have yielded much silver from ores that, with a few minor exceptions, have been rather lean in this constituent. Most lead-bearing ores of the western states are richer in silver values, which in some deposits equal or exceed the combined values of the other products. Lead ore of the Tintic district, Utah, is especially argentiferous; much of it has averaged 30 to 40 oz of silver per ton (Lindgren and Loughlin, 1919). Such ore approaches, in tenor of silver, the higher grades of dominantly silver ores. Gold ores have produced less silver than lead and copper ores. They show a range from a negligible but recoverable trace of silver to ores in which silver predominates.

Whereas much of the ore mined principally for silver has been of the lowest average grade that could be economically worked, some districts, particularly during their youth, have yielded shipments of very rich ores. The Comstock district, Nevada, is especially famous for its bonanza ore; some shipments yielded perhaps 1,000 ounces of silver per ton of ore with nearly comparable values in gold. Tonnages of this grade were relatively small, however, and the average grade for even the richest mines of the Comstock Lode was less than 40 oz of silver per ton. Ore from the Sunshine mine and several adjacent properties that were worked as a milling unit in the Silver Belt of the Coeur d'Alene region, Idaho, averaged 49 oz of silver per ton (and 4 percent lead) for 51,000 tons of ore mined in 1946; and the Sunshine mine, in an earlier year, 1937, had yielded 47.5 oz of silver per ton from a quarter of a million tons of ore.

During oxidation of silver-bearing deposits near the surface, the silver is normally taken into solution by ground waters, carried downward, and reprecipitated in an enriched zone of secondary minerals. The richest zones are concentrated from near the outcrop to some distance below the groundwater table, with varying mineralogy at different levels. The grade of ore decreases unevenly at greater depth until the unenriched primary ores are reached. Gold and copper, if present, are enriched along with the silver, whereas the lead shows no pronounced change in tenor, though the primary sulfide is commonly oxidized to the carbonate above the water table. In the early days of western mining when transportation was primitive, such shallow oxidized deposits were particularly attractive because of the high values that could be concentrated in a relatively small weight of ore. Many deposits, too low grade to be profitable when the primary ore was reached, were worked out and abandoned. Others, although the amount of silver diminished with depth, proved workable as primary lead deposits in which the silver could be recovered as a byproduct or coproduct. This type of deposit has, over the years, yielded far more silver than the oxidized ores. The oxidized surficial zones of a few massive sulfide copper deposits, such as the Iron Mountain deposit in the West Shasta district, California, were worked principally for silver in their early history. Most copper deposits, however, were worked as enriched copper deposits in which the silver contributed much to the value of the ore. Part of the copper and silver in the porphyry copper deposits is derived from enrichment of extremely low grade disseminated primary material.

The grade of secondarily enriched silver ores shows wide fluctuations within any given deposit. Gouging of thin pay streaks by the hand-mining methods used in the early days of the West yielded fabulously rich ore for relatively small tonnages; but for many deposits, particularly those worked by small mining operations, no record of grade has been preserved. Assays of very rich ore that have been cited mean little in the absence of a tonnage to which the grade could be applied. Some of the richest ore for which there is record was mined from Treasure Hill in the White Pine district, Nevada. Here, one lot of 22 tons was valued at more than $5,000 per ton, equivalent to about 3800 oz of silver per ton. Very rich shipments are also recorded from the Yankee Girl mine in the Red Mountain district of Colorado, where one lot of 10 tons carried 3,270 oz of silver per ton, and another of 6 tons carried 5,300 oz per ton; several carloads of ore contained 1500 to 3000 oz per ton. The mine average was, of course, much lower, the ore from an 80-foot interval between 2 levels averaging 242 oz of silver per ton. Though there is lack of agreement as to the extent of enrichment in Red Mountain ores, it is probable that at least part of the richest ore was secondary. This ore was unusual in that copper was the other major metal. Other examples of enriched ore include that from the Granite-Bimetallic mine at Philipsburg, Montana, which carried 50 to 1,000 oz of silver per ton; the "Bridal Chamber" ore from the Lake Valley district, New Mexico, where several carloads ran more than 400 oz of silver per ton; the early chloride ore at Austin, Nevada, running 1,500 oz per ton; and the shipping ore from the California Rand mine at Randsburg, California, the first 49,000 tons of which averaged 106 oz of silver per ton.

Types of silver deposits

The association of silver with other metals is reflected in the wide variation in its geologic occurrence. Virtually all silver-bearing deposits, however, are near or in igneous rocks to which they must be genetically related. The argentiferous lead, most of the copper, and many of the gold and silver deposits are typically in or near stocks or small batholiths of intermediate to acidic composition, though in some areas the largest known intrusive bodies are sills and dikes of this composition. An important class of precious-metal deposits, in which gold values predominate in some and silver in others, occurs as shallow veins in Tertiary extrusive rocks of intermediate to acidic composition. Although intrusive rocks are generally not exposed with such deposits, indications are commonly present that an intrusive mass of comparable composition is buried at no great depth. Some silver-bearing copper deposits are associated with mafic igneous rocks, both intrusive and extrusive.

Silver-bearing deposits may lie within the igneous masses to which they are genetically related or in the adjacent older rocks. In some districts they appear in both, and furthermore may be of more than one type in either environment. There is a tendency for the copper deposits to occur in or immediately next to the intrusive igneous rocks, for the lead and lead-zinc deposits to occur in the adjacent sedimentary rocks, and for the gold and dominantly silver deposits to occur in Tertiary lava rocks. However, the exceptions are numerous and important. The physical and chemical conditions at the site of ore deposition are controlling factors which affect the metals differently, depending on their chemical properties. To judge from the wide range of conditions under which silver is deposited in some form or other, this metal may be somewhat less exacting in its requirements for deposition than the metals with which it is commonly associated. However, the relatively high value of silver, making feasible its recovery from deposits in which it occurs in very low concentration, may make such contrasts with other metals more apparent than real.

In the following account of silver-bearing deposits, only those types of base- and precious-metal deposits will be discussed which have yielded relatively large amounts of silver from individual districts. A complete account of silver-producing ores would encompass nearly every type of deposit that has produced gold, silver, copper, or lead in the United States but would tend to obscure the salient features of the geologic occurrence of silver.

Deposits in intrusive igneous rocks: Silver-bearing deposits that lie within the parent plutonic igneous mass may take several forms. Commonly such deposits are veins or lodes along fractures and faults, with variable replacement of the broken wall-rock material. Large silver production has come from copper deposits of this type at Butte, Montana, and Lordsburg, New Mexico; from such lead-zinc deposits as those in the Butte, Barker, and Cataract districts, Montana; and from silver deposits, all secondarily enriched, in the Reese River (Austin), Nevada, Blind Spring, California, and Philipsburg, Montana, districts. The Granite-Bimetallic mine at Philipsburg was a famous silver lode, but its rich secondary ores have been long exhausted. The Butte district is especially noteworthy in that although its silver output has been exceeded at different times by that from other districts, its total silver production exceeds that of any other district in the United States. This production has been obtained largely as a byproduct or coproduct from base-metal ores which are roughly segregated into an inner copper core and an outer zinc-lead zone in the quartz monzonite country rock. In the early days of the district, however, much silver was recovered from oxidized ores near the surface, particularly in the zinc-lead zone.

Gold-quartz veins have yielded much silver from associated silver minerals in the Nevada City district, California. A substantial amount has come from veins in the intrusive granodiorite, though perhaps more has come from similar veins in the adjacent country rock.

Another type of silver-bearing deposit that occurs within the parent igneous rock is exemplified by the porphyry copper deposits of the West. In these, the primary copper minerals, chalcopyrite and locally bornite, and associated pyrite are disseminated in small grains or in small indefinite and irregularly anastomosing veinlets through large blocks in igneous stocks or other irregular igneous bodies of intermediate to silicic composition. The primary material is commonly too low grade to be exploited, but with varying amounts of secondary enrichment in which chalcocite replaces part of the primary minerals, the mass becomes a low-grade copper ore that can be profitable if mined in large tonnages. The trace of silver present in the original ore is enriched along with the copper and is normally recovered in the refining of the copper. The silver content varies from one deposit to another, and in a few instances its value would not repay the cost of recovering it. In overall silver content the porphyry copper deposits rank individually somewhat below several other types of deposits, but at the present time some of them rank high among the silver-producing deposits. Those with important silver content include Bingham, Utah; Ely, Nevada; and Ajo, San Manuel, Miami, Ray, and Morenci, Arizona.

The deposits at Morenci might better be described as intermediate in type between the usual porphyry copper deposits and the lode type of deposits. The ore-bearing ground contains both low-grade lodes and disseminated ore minerals in the blocks between the lodes, but the deposits are workable only because of the secondary enrichment that has affected both. The Kelley copper mine at Butte exploits a block of ground in which the primary ore deposits show a similar structural setting.

An unusual type of silver-bearing deposit in an igneous stock was found in the San Francisco district, Utah. Here, in the Cactus copper mine, the ore, relatively low grade in both copper and silver, occurred in the interstices and replacing the fragments of a steeply plunging breccia pipe formed along a fault zone in quartz monzonite.

Deposits in igneous dikes of the same general magmatic derivation as the ore deposits will be discussed below, as they are more closely related to the veins and lodes in the invaded country rock.

Deposits in older rocks adjacent to intrusive rocks. Silver-bearing deposits that lie in the country rock near intrusive igneous masses to which they are genetically related constitute a large and varied group. The type of deposit is influenced by the lithologic character of the enclosing rock and by pre-existing structural features.

Massive pyritic ores of copper with some associated zinc, which replace siliceous wall rocks, have yielded large amounts of byproduct silver in a few districts of large ore production. At Jerome, Ariz., a great pyritic replacement pipe containing chalcopyrite and a little sphalerite occurred in schist immediately bordering a gabbro stock. This deposit, only recently mined out, averaged only 1 to 2 oz of silver per ton of ore. In the West Shasta district, California, flat lenticular pyritic bodies of similar composition replace a slightly metamorphosed soda rhyolite. Although much of the silver produced here has been a byproduct of primary ores, the surficial oxidized zone of one deposit was first worked for secondary silver ores in the early history of the camp.

Disseminated grains of secondary copper sulfide showing much the same relation to the enclosing country rock as those in the adjacent porphyry copper masses occur in schist immediately bordering the porphyry in the Miami and Ray copper districts, Arizona. These disseminated sulfides in schist have undergone the same secondary enrichment as those in the porphyry, and the ores in the two kinds of host rocks have been mined together without distinction. Part of the low-grade primary ore in depth at Ray consists of disseminated pyrite and chalcopyrite in a diabase sill which is intruded by the copper-bearing porphyry.

Pyrometasomatic deposits replacing limestone close to or immediately bordering on intrusive igneous masses have yielded predominantly copper or copper-zinc ores. As silver producers, such deposits are not usually large enough to compensate for the low silver content of copper ores, but a few have been large enough to contain appreciable quantities of silver; among these the currently producing Pima and adjacent mines in the Pima district, Arizona, are good examples. Districts that contain pyrometasomatic deposits commonly also contain other types of deposits with higher silver content. As the different types of deposits are not usually differentiated in the published statistics of silver production, the relative unimportance of the pyrometasomatic deposits is not usually apparent.

Replacement deposits in limestone adjacent to faults, fissures, igneous dikes, or other types of feeder channels at some distance from the main intrusive igneous rock form a major class of silver-producing deposits. They have various attitudes and shapes, lying either along or across the bedding of the limestone. Some copper deposits of this type contain silver, but the deposits of the Bisbee district, Arizona, are the only outstanding examples. Copper replacement ores in limestone have produced considerable silver also from the Globe district, Arizona, and, in recent years, from the Magma mine in the Pioneer district, Arizona. The lead-zinc replacement deposits in limestone, on the other hand, include many famous districts of major silver production, such as Leadville, Aspen, and Red Cliff, Colorado; Bingham, Park City, and Tintic, Utah; Eureka, Nevada; Philipsburg, Montana; and numerous others of only slightly lesser importance. There is some segregation of lead-zinc replacement bodies even in such dominantly copper camps as Bisbee; and some of the lead-zinc districts carry variable amounts of copper ore, more or less segregated in separate bodies. There are all gradations in silver content from districts which contain very little, such as Metaline, Washington, to others, such as Tintic, in which silver may equal or exceed the base metals in value. In a few districts, replacement deposits in limestone are dominantly silver ores, as at Tombstone, Arizona; Cortez, Nevada; Lake Valley and Kingston, New Mexico; and the Presidio mine at Shafter, Texas. In these silver districts the deposits have been variable to thoroughly oxidized; and although the Tombstone ores appear to have been secondarily enriched from primary lead-zinc deposits that were perhaps high in silver, the other deposits mentioned appear to have been dominantly silver ores even before enrichment. The bulk of the silver-bearing replacement deposits in limestone are in Paleozoic strata.

Replacement deposits in carbonate rocks commonly contain some gold along with the other metals, and in such deposits in the Black Hills of South Dakota, gold becomes the dominant product. Thus, the deposits in the Bald Mountain district, in which the ore minerals replace Cambrian dolomite and dolomitic quartzite, contain appreciable amounts of silver as a byproduct of the gold. Those of the Homestake mine (Whitewood district) replace a cummingtonite-chlorite schist which was derived from Precambrian dolomitic limestone; and although the silver content here amounts to only a few cents per ton, the large tonnage of ore treated in this leading gold mine of the United States has accounted for a relatively large production of silver.

Although silver-bearing deposits in carbonate rock usually form massive replacement deposits, in some instances they may be narrowly confined to crosscutting channels to form vein and lode deposits. Such are the silver (stromeyerite) veins which occur in dolomite and were worked in the early days in the Clark Mountain (Ivanpah) district, California. Lode deposits in many districts crosscut several types of rocks and commonly thicken where they cross limestone, thus forming gradations to the replacement deposits, as along some of the famous lead-silver lodes in the Park City district, Utah.

In more refractory rocks that are less reactive with the ore-forming solutions than limestone or dolomite, vein and lode deposits along faults or fractures are the usual forms taken by silver-bearing deposits in the country rock adjacent to the parent igneous intrusives. Commonly, replacement of the country rock has been equally as effective as open-space filling in emplacement of the ore, though the replaced rock is usually rather narrowly confined to the immediate vicinity of the feeding channels. Practically all kinds of country rocks have been mineralized at some place or other, and in many districts several kinds have been mineralized.

Lodes in quartzite have accounted for such famous silver producing deposits as those in the Coeur d'Alene region, Idaho. Here, the host rock is a fine-grained sericitic quartzite of Precambrian age. Lead-zinc deposits with substantial silver content account for much of the silver but, in the Silver Belt, tetrahedrite rich in silver becomes abundant relative to the associated lead mineral, and silver becomes the primary product. In consequence, the Coeur d'Alene region has led in the production of silver since development of the Silver Belt about 1930. Lodes in quartzite have also yielded much silver from lead-zinc deposits in the Park City region, Utah, and from the oxidized silver deposits that were worked in the early days at Pioche, Nevada.

Argillaceous rocks do not, in general, have the requisite physical strength to maintain permeable fractures for movement of ore-bearing solutions. At a few places, however, such rocks had been sufficiently hardened by metamorphism or by a small carbonate content to permit formation of important silver-bearing lodes. Lead-zinc lodes in argillite and calcareous argillite have accounted for much silver from the Warm Springs and Mineral Hill districts, Idaho. Tetrahedrite-galena lodes, rich in silver and occurring in a slate host rock, were at one time very productive of silver from both oxidized and primary ores in certain mines of the Bayhorse district, Idaho. The oxidized silver veins in the Candelaria district, Nevada, occur, in large part, in argillite which has been somewhat hardened by a varying content of calcium carbonate.

Schist forms the wall rock of lodes and veins that contain the zinc-lead-silver deposits at the Iron King mine in the Big Bug district, Arizona. Gneiss forms the wall rock of the silver-lead-zinc lodes in the Neihart district, Montana and, with subordinate inter-banded schist, of such similar lodes as those in the Wallapai district, Arizona, and Silver Plume district, Colorado, and of gold-silver lodes in the Central City district, Colorado.

Igneous rocks older than and genetically unrelated to the enclosed lodes are the host rock for some silver-bearing deposits. In the Magma copper mine of the Pioneer district, Arizona, the lode is confined within a thick diabase sill over much of its extent. In the Sugar Loaf-St. Kevin district, Colorado, the silver lodes, secondarily enriched, occur chiefly in a highly altered Precambrian granite, though the lodes are probably of early Tertiary age.

No single gold mining district along the 120-mile-long Mother Lode belt in California has been a major producer of silver, but the total silver content of the gold bullion from the belt has been appreciable. The gold veins and lodes in this belt, which lies west of the Sierra Nevada batholith, have cut various types of older rocks, including black slate, greenstone, various schists, and serpentine. In some of the lodes in greenstone and serpentine, replacement of the country rock near the quartz veins has been the dominant mode of ore emplacement.

Deposits in igneous dikes. An important class of silver-bearing deposits occurs in or along igneous dikes of the same general magmatic source as the plutonic mass to which the ores are related. These dikes cut the country rock into which the plutonic mass was intruded. Physical and chemical conditions within the dikes were similar to those prevailing at comparable locations in several types of noncalcareous country rock, hence, the mineralogical and structural features of these deposits are quite similar to those in the veins and lodes that cut the country rock. In nearly all dike deposits, it is clear that fault movement along and later than the dike has opened the ground to the ore solutions. Replacement of the broken igneous rock has been a large factor in emplacement of the ore. Those dike deposits that have produced much silver have been lead-zinc deposits that usually contain appreciable silver in the primary ore. Outstanding examples occur in the Tybo district, Nevada, the Central and Willow Creek districts, New Mexico, and the Tombstone district, Arizona. In the Willow Creek district the country rock is Precambrian diabase, but the deposit, now worked out, was along a shear zone in schistose material believed to have been derived from injected Precambrian granite or from hybrid material formed by partial assimilation of the diabase by the granite magma. In the Tombstone district, deposits occurred in and along the sheared Contention dike where it cuts shale and sandstone. Prior to 1886 these yielded more than $10,000,000, chiefly in silver and gold, though they also contained much lead. The ores were oxidized and secondarily enriched in silver.

Deposits in predominantly volcanic rocks. The most characteristic single geologic habitat of silver is in the vein and lode deposits in Tertiary lava rocks. Such deposits contain both silver and gold, and locally important quantities of base metals as well. Although a few silver districts contain only nominal amounts of the other metals, the most productive silver districts have contained appreciable gold, and there are all gradations to districts in which the chief value has been in gold. The deposits occur in volcanic rocks ranging in composition from andesite to rhyolite. The silver districts include such famous camps as Tonopah, Comstock (in part), Tuscarora, Rochester, Fairview, and Wonder, Nevada; Calico and Mojave, California; Silver City, DeLamar, and Yankee Fork, Idaho; and Mogollon, New Mexico. In some districts secondary enrichment has been effective in concentrating the silver values; in others, such as Tonopah, the production has come largely from primary deposits.

The base-metal lodes in the Tertiary volcanic rocks of the San Juan Mountains, Colorado, carry both silver and gold, which were mainly responsible for early exploitation of the deposits. Major silver-producing camps, still active, are Creede, where the ores are in rhyolite, and the Telluride-Sneffels district, where the host rock is chiefly andesitic breccia and flows. Five other districts in the San Juan region have each produced more than 5 million ounces of silver. In all of these San Juan districts, lead, zinc, and some copper have been important coproducts.

Similar deposits, except for such details as a unique tourmaline gangue, have yielded the large silver output from the Wickes district in Montana, where the major production (Alta mine) took place in the 1880's and 1890's. There, however, the lodes are in Upper Cretaceous quartz latites, closely adjacent to the Boulder Batholith of only slightly later age to which the deposits are genetically related. Such deposits are transitional to the lodes described above, which are in older rocks but obviously related in origin to an intrusive igneous mass.

In regions of Tertiary volcanism, some silver lodes are known which occur in much older rocks but which resemble in structure and mineralogical and chemical composition the precious metal lodes in Tertiary lavas. Such lodes are believed to be of the same origin as the more typical ones in the lavas. An example is the Randsburg district, California, where the deposits occur in Precambrian schist but are evidently related to Miocene volcanism, as evidenced in a volcanic pipe, dikes, and sills, ranging in composition from rhyolite to diabase, which intrude the country rocks. The gold-silver veins of the Marysville district, Montana, are in hornstone that was formed by contact metamorphism of limestone adjacent to a small intrusive stock of Laramide age; the veins, however, are probably not related genetically to this stock but to a later period of Tertiary mineralization which was preceded by intrusion of dikes and sills of dacite (Knopf, 1913).

Lodes may also occur along fault contacts between Tertiary volcanic rocks and older rocks, as in the San Francisco district, Utah, where the Hornsilver lode lies between Tertiary quartz latite flows and lower Paleozoic limestone. Similar relations exist along parts of the Comstock lode and in the adjacent Silver City district, Nevada, where the footwall rocks are Mesozoic metabasalt. Such deposits usually resemble those enclosed entirely within the Tertiary lavas.

An uncommon type of silver-bearing deposit is found in volcanic breccia pipes or chimneys of Tertiary age. In several such deposits in the Red Mountain district, Colorado, the ore filled the interstices and replaced the country rock in the breccia or in a cylindrical envelope zone along the contact with the volcanic rocks immediately surrounding the breccia. These deposits were particularly famous for their richness in silver and copper, but they also contained lead and some zinc. The highest grade ore consisted of stromeyerite and bornite, and was probably secondarily enriched in silver to some extent. The deposits lay on the periphery of a large caldera in the general vicinity of several small plugs of quartz latite porphyry.

Another deposit of apparently similar type has been worked at the Flathead mine, Hog Heaven district, Montana. Here, silver-lead ore replaced the igneous country rock in a stockwork formed by two or three intersecting systems of irregular fractures in a porphyritic latite intrusive mass of Tertiary age. The primary ore was dominantly galena and pyrite but contained the rare silver mineral matildite ($AgBiS_2$). However, the deposit owes its value chiefly to extensive secondary enrichment of the silver.

Silver is also associated with extrusive igneous rocks of pre-Tertiary age. The copper deposits of the Keweenaw Peninsula, Michigan, occur both in basalt flows of Precambrian age and in conglomerate closely associated with these flows. In the igneous rock the ore minerals fill the openings and replace fractured amygdaloid layers or occur along crosscutting and bedding veins. In the conglomerates they are disseminated in the matrix. The chief ore mineral is native copper, but a little native silver is present and has been recovered as a byproduct. Output of the latter is large because of the high production from these copper deposits. Although opinions as to origin have not been in unanimous agreement, most geologists propose that ascending hydrothermal solutions have either extracted the metals from the igneous rocks at lower levels and deposited them at higher levels, or have carried the metals up from the magmatic reservoir from which the mafic igneous rocks and allied types were derived.

Deposits on fault contacts between intrusive and igneous rocks. In many of the mining districts that contain silver deposits in Tertiary lava rocks, no intrusive igneous rocks are exposed to which the ores can be genetically related. In other districts, as in the San Juan Mountains of Colorado, small plutonic igneous masses intrusive into the lava rocks are exposed within the general region of ore deposition, but their distribution relative to the ore deposits is haphazard. In both types of mineralized areas, the silver-bearing lodes occur along tectonic faults of considerable lateral extent and appear to have been derived from a deep-seated source. Segregation of the mineralizing solutions from a deeply buried intrusive mass, which may or may not have delivered satellitic offshoots into the crustal zone, offers the best explanation for the origin of the ore.

In a few scattered districts of Tertiary volcanism, structural weakening of the crust in the neighborhood of small intrusive igneous bodies has localized tectonic breaks along the borders of such masses. In these places a silver lode may lie along a fault contact between the lava rocks and the intrusive igneous mass to which it is, indirectly, related. An outstanding example is the Comstock Lode, in Nevada. Though most of the bonanza deposits in this district were in subsidiary breaks within the andesite hanging wall, some of the ore was along a great fault, including a part of its course where the footwall is a small intrusive stock of diorite, believed to be closely related to the ore in origin and time of emplacement. The ores otherwise resemble those in the Tertiary lava rocks.

Deposits of uncertain or disputed igneous affiliation. With minor exceptions, the lead-zinc deposits in the Mississippi Valley and west of the Blue Ridge in Tennessee and Virginia contain at most only nominal amounts of silver. In most of these mining districts no exposures or other indications of intrusive igneous activity are present. In the southeast Missouri and Southern Illinois-Kentucky districts, however, mafic igneous dikes, sills, and pipes are exposed; and explosion centers (diatremes) are a further indication of both mafic and silicic igneous intrusives. These features are not closely related in position to the ore deposits, and their genetic significance is questioned by some. The districts involved, however, are the ones that contain the most silver. In spite of a low silver content, the total amount of silver produced from the lead ores of southeast Missouri has been large owing to the huge tonnage of ore that has been mined. Although most of the silver has been obtained from galena averaging about 1 oz per ton, the silver is particularly enriched in the small amount of sphalerite in these deposits, ranging up to 25 oz per ton of zinc sulfide concentrates. The ore is disseminated or forms small replacement lenses in dolomite and is the lowest grade of lead ore mined in the United States. Galena concentrates from the fluorspar-zinc-lead deposits of the Southern Illinois-Kentucky district contain 5 to 15 oz silver per ton, though the production of silver has not been large owing to the subordinate percentage of galena in the ores. These deposits include bedded replacement deposits and veins in limestone.

A few deposits of apparently sedimentary origin contain appreciable silver, as, for example, the copper deposits in bedded siltstone and shale of the White Pine area, Ontonagon County, Michigan, and particularly the silver deposits in bedded sandstone of the Silver Reef district in Utah. In the latter district, the ore minerals are largely restricted to sandstone strata that contain abundant plant debris. Although a direct hydrothermal origin from igneous sources is not completely ruled out, the silver in these deposits was possibly derived in a short sedimentary cycle from typical deposits of igneous origin, from igneous tuffs, or perhaps from igneous exhalations that entered the drainage systems during deposition of the host rocks.

Placer deposits. Placer gold always yields by-product silver, although the total amount is not large in any individual placer basin. Placers on the west slope of the Sierra Nevada, however, have accounted for an appreciable amount of silver. The gold with its alloyed silver was derived both from the Mother Lode belt and from the East Belt, which is an indefinite, broad zone lying east of the Mother Lode and characterized by many small but rich "pockets" of gold.

Age of silver deposits

Silver is found in deposits ranging in age from Precambrian to late Tertiary. In the United States more deposits are of Laramide or Tertiary age than of earlier age, because of the prevalence of igneous intrusive activity during this span of geologic time. Earlier periods of silver deposition coincided with orogeny and igneous intrusion at the end of the Jurassic Period or during the Cretaceous Period in the West, and at the end of the Paleozoic Era in the Appalachian region. The latter region, however, has yielded very little silver. Precambrian silver deposits occur in important districts as Jerome and Big Bug, Arizona, Willow Creek, New Mexico, the Michigan copper districts, and probably the Coeur d'Alene region in Idaho (Long and others, 1960).

Distribution of silver deposits

Most of the deposits containing silver are within a few broadly defined structural units: The western slopes of the Sierra Nevada and their extension into the Klamath Mountain block of California and Oregon; the Basin and Range region of Nevada, western Utah, southeastern California, southern Arizona, southern New Mexico, and Western Texas; the Rocky Mountain Cordillera, extending from New Mexico to the Canadian border, with a notable absence of any deposits in Wyoming; and the Black Hills uplift in South Dakota. There are, however, scattered silver-bearing deposits outside these four areas, among which the copper deposits in the Keweenaw Peninsula of Michigan and the lead deposits of southeast Missouri have yielded important amounts of silver as a by-product. The main productive lead-zinc deposits of the Appalachian Cordillera contain only insignificant amounts of silver or none, but a few scattered deposits that have been relatively small producers have contained silver in ratios more characteristic of the Western States; there is also a little silver associated with eastern copper deposits.

Index

District or region	Lat. N.	Long. W.
ARIZONA		
1. Union Pass (Katherine mine). Veins in Precambrian granite and Tertiary rhyolite dikes. Wilson and others, 1934; Hewett and others, 1936.	35°17'	114°25'
2. Wallapai (Chloride Camp). Veins in Precambrian granite, gneiss, schist, and amphibolite. Dings, 1951; Thomas, 1949.	35°25'	114°11'
3. Wallapai (Cerbat Camp). Veins in Precambrian granite, gneiss, schist, and amphibolite. Dings, 1951; Thomas, 1949.	35°19'	114°08'
4. San Francisco (Oatman). Byproduct of gold. Veins in Tertiary andesite. Wilson and others, 1934.	35°01'	114°24'
5. Owens (McCracken mine). Veins in Precambrian quartz-mica schist. Bancroft, 1911.	34°28'	113°46'
6. Eureka (Bagdad area). Byproduct of base metals. Vein and replacement lenses along faults in Precambrian schists; by-product of copper in disseminated ore, partly enriched, in upper Cretaceous or Tertiary quartz monzonite. Anderson and others, 1956.	34°35'	113°13'
7. Jerome (Verde) (United Verde mine). Byproduct of copper. Replacement pipe in Precambrian schist adjacent to Precambrian gabbro stock. Anderson and Creasey, 1958.	34°45'	112°07'

ARIZONA (cont'd.)

8. Black Hills. Veins in Precambrian schist. Lindgren, 1926; Hewett and others, 1936.	34°40'	112°13'
9. Agua Fria. Byproduct of copper. Replacement lenses in Precambrian schist. Lindgren, 1926; Hewett and others, 1936.	34°26'	112°10'
10. Big Bug (Iron King mine). Byproduct of base metals. Replacement lenses in silicified Precambrian schist. Anderson and Creasey, 1958.	34°30'	112°15'
11. Walker. Veins in early Tertiary (?) granodiorite and Precambrian amphibolite schist. Lindgren, 1926; Hewett and others, 1936.	34°27'	112°23'
12. Hassayampa. Veins in Precambrian amphibolite schist and granite. Lindgren, 1926; Hewett and others, 1936.	34°25'	112°30'
13. Turkey Creek. Veins in Precambrian schist. Lindgren, 1926; Hewett and others, 1936.	34°22'	112°23'
14. Peck (Ocotillo). Veins in quartzite lenses in Precambrian schist. Lindgren, 1926; Hewett and others, 1936.	34°16'	112°19'
15. Pine Grove. Veins in Precambrian granodiorite, diorite, and schist. Lindgren, 1926; Hewett and others, 1936.	34°14'	112°21'
16. Tiger. Veins in Precambrian schist and lower Tertiary (?) granodiorite. Lindgren, 1926; Hewett and others, 1936.	34°11'	112°21'
17. Black Canyon. Veins in Precambrian schist. Wilson and others, 1934; Lindgren, 1926, Hewett and others, 1936.	34°13'	112°10'
18. Old Tip Top. Veins in Precambrian granite and pegmatite. Lindgren, 1926.	34°03'	112°14'
19. Vulture (Vulture mine). Byproduct of gold. Veins in Precambrian schist. Wilson and others, 1934; Hewett and others, 1936.	33°49'	112°50'
20. Osborn. Veins in Tertiary andesite and rhyolite. Tenney, 1928.	33°37'	112°52'
21. Kofa. Byproduct of gold. Lodes along brecciated fault zones in Tertiary andesite. Wilson and others, 1934; Hewett and others, 1936.	33°18'	113°58'
22. Silver. Veins along faults between Precambrian granite and lower Tertiary (?) andesitic breccia and tuff, or in Precambrian schist. Wilson, 1951a.	33°06'	114°36'
23. Castle Dome. Veins along fault zones in and along diorite porphyry dikes of Cretaceous (?) age and in Cretaceous shale. Wilson, 1951b.	33°02'	114°11'
24. Ajo (New Cornelia mine). Byproduct of copper. Disseminated ore in lower Tertiary (?) quartz monzonite. Gilluly, 1946.	32°22'	112°52'
25. Silver Bell. Contact metamorphic deposits in Carboniferous (?) limestone; byproduct of copper in disseminated deposits in Laramide(?) porphyry stock. Stewart, 1912; Richard and Courtright, 1954.	32°25'	111°31'
26. Superior (Pioneer) (Magma mine). Replacement veins along faults in quartz-monzonite porphyry, diabase, and quartzite; bedded replacement deposits in Devonian limestone. Short and others, 1943; Webster, 1958.	33°18'	111°06'
27. Globe. Byproduct of copper. Veins and replacement bodies along faults in Precambrian quartizite and limestone and Paleozoic limestone and diabase sills. Ransome, 1903; Tenney, 1935; Peterson, 1950.	33°25'	110°47'
27a. Miami. Byproduct of copper. Disseminated ore in Precambrian schist adjacent to granite porphyry intrusive, and in lower Tertiary(?) quartz monzonite porphyry and granite porphyry masses. Ransome, 1919; Tenney, 1935; Peterson and others, 1951.	33°24'	110°53'
28. Ray (Mineral Creek). In part, byproduct of copper in disseminated ore (secondarily enriched) in Precambrian schist and diabase and in adjacent Tertiary quartz monzonite porphyry stock; in part, with lead ore. Ransome, 1919.	33°10'	111°00'
29. Banner. Vein-replacement bodies in and bordering a sheared dike of rhyolite porphyry; replacement bodies in Pennsylvanian limestone along bedding and bordering igneous masses; byproduct of copper in contact metamorphic deposits in Carboniferous limestone. Kiersch, 1951; Ross, 1925a.	33°04'	110°48'

ARIZONA (cont'd.)

30. Aravaipa. Veins and replacement bodies on fault breccia in Pennsylvanian limestone; veins in intrusive rhyolite. Ross, 1925b, Wilson, 1950a.	32°59'	110°20'
31. Copper Mountain (Morenci). Byproduct of copper. Contact metamorphic deposits in Paleozoic limestone, and secondarily enriched disseminated ore in lower Tertiary porphyry. Lindgren, 1905.	33°04'	109°20'
32. Bunker Hill (Blue Bird mine). Vein in granodiorite stock of Laramide (?) age. Kuhn, 1951.	32°46'	110°28'
33. Old Hat (Mammoth). Replacement veins along shear zones in Tertiary(?), rhyolite, and in Precambrian (?) quartz monzonite; by-product of copper, disseminated ore in Precambrian quartz monzonite and Laramide (?) monzonite porphyry. Creasey, 1950; Schwartz, 1953.	32°42'	110°42'
34. Pima (San Xavier mine area) Byproduct of base metals. Replacement pipes along fissures and contact metamorphic deposits in Mississippian and Permian limestones. Wilson, 1950b; Huttl, 1958.	31°58'	111°05'
34a. Pima (Esperanza mine). Byproduct of copper. Disseminated ore in Tertiary quartz monzonite, intrusive andesite, and in intruded Cretaceous or Tertiary clastic rocks. Schmitt and others, 1959.	31°51'	111°08'
35. Oro Blanco (Montana mine). Replacement lode along shear zone between intrusive diorite and igneous-pebble conglomerate, or in latter. Fowler, 1938.	31°28'	111°14'
36. Patagonia (Duquesne) (including Mowry mine). Contact metamorphic and replacement deposits in Devonian and Pennsylvanian limestones adjacent to intrusive quartz monzonite. Schrader, 1915.	31°23'	110°42'
37. Harshaw (Trench and Flux mines). Veins along shear zones in intrusive igneous rocks and replacement bodies in Pennsylvanian(?) limestone. Schrader, 1915.	31°28'	110°44'
38. Tyndall. Veins in quartz diorite, quartz monzonite, and quartz latite porphyry. Schrader, 1915.	31°36'	110°52'
39. Helvetia. Byproduct of copper. Contact metamorphic deposits, in part along fault zones, in Pennsylvanian and Permian limestone. Creasey and Quick, 1955; Schrader, 1915.	31°52'	110°47'
40. Empire. Replacement bodies and pipes along fissures in Permian limestone, and at contacts with porphyry dikes and sills. Wilson, 1951c.	31°53'	110°36'
41. Cochise (Johnson Camp). Bedded replacement bodies, mantos, and chimneys at or near intersections of fissures in Cambrian limestone. Cooper, 1950.	32°06'	110°04'
42. Tombstone. Replacement bodies along faults and fissures, partly on tops of folds, in Pennsylvanian and Lower Cretaceous limestones, quartzites, and shales, and in sheared granodiorite dikes. Butler and others, 1938.	31°42'	110°04'
43. Turquoise. Replacement bodies along fractures and faults in Pennsylvanian limestone. Wilson, 1927; 1951d.	31°44'	109°49'
44. Bisbee (Warren). Replacement bodies along bedding or cross fractures, or adjacent to porphyry dikes and sills in Devonian and Mississippian limestones; byproduct of copper in disseminated ore (secondarily enriched in Upper Jurassic(?) granite porphyry stock. Hogue and Wilson, 1950.	31°27'	109°54'
45. Swisshelm. Replacement bodies in fractured Pennsylvanian limestone above a diorite porphyry sill. Galbraith and Loring, 1951.	31°42'	109°32'
46. California (Hilltop mine). Veins and contact deposits.	31°59'	109°14'
47. Ash Peak. Veins along diabase dike on fault in Tertiary andesite. Lines, 1940.	32°46'	109°15'

CALIFORNIA

1. Squaw Creek (Blue Ledge mine). Byproduct of copper. Replacement lenses along contact between Devonian or older quartz-hornblende schist and sericite schist. Shenon, 1933.	41°58'	123°06'
2. Dillon Creek (Klamath River, in part) (Siskon mine). Byproduct of gold from gossan of massive	41°35'	123°39'

CALIFORNIA (cont'd.)

pyritic replacement deposit in tuff. United States Bureau of Mines, 1953-57.		
3. Island Mountain (Island Mountain mine). Byproduct of copper. Replacement deposits along shear zones (thrust fault?) in Jurassic (?) shale and graywacke. Stinson, 1957.	40°02'	123°30'
4. French Gulch - Deadwood (Brown Bear, Washington, and Niagara Summit mines). Byproduct of lode and placer gold. Ferguson, 1914; Averill, 1933.	40°43'	122°43'
5. South Fork (Chicago mine). Veins along faults in granodiorite batholith of Lower Cretaceous (?) age. Tucker, 1922.	40°32'	122°35'
6. West Shasta (Flat Creek). Byproduct of copper. Bedded replacement bodies in Devonian soda rhyolite along axes of broad folds. Kinkel and others, 1956.	40°44'	122°30'
7. Bully Hill. Byproduct of copper. Replacement bodies in Triassic rhyolite along shear zones on anticlinal crest and flanks. Boyle, 1915; Graton, 1910; Albers and Robertson, 1961.	40°48'	122°13'
8. Cow Creek (Ingot) (Afterthought mine). Replacement bodies in fractured soda rhyolite and adjacent limy shale of Triassic age. Albers, 1953.	40°44'	122°04'
9. Lights Canyon (Engels, Superior mines). Byproduct of copper. Replacements of intrusion breccia along contacts of Upper Jurassic gabbro and quartz diorite with Carboniferous(?) andesite and keratophyre; veins and stockworks in Upper Jurassic quartz monzonite. Knopf, 1935; Anderson, 1931.	40°13'	120°45'
10. Genessee (Walker mine). Byproduct of copper. Replacement bodies in highly metamorphosed Carboniferous argillaceous rocks adjacent to contact of Upper Jurassic quartz diorite. Averill, 1937; Knopf, 1935.	39°58'	120°40'
11. Sierra City (Sierra Buttes mine). Byproduct of lode gold. Averill, 1942.	39°35'	120°39'
12. Washington (Graniteville) (Spanish, Gaston mines). Byproduct of lode and placer gold. MacBoyle, 1919; Logan, 1941.	39°24'	120°46'

CALIFORNIA (cont'd.)

13. Alleghany. Byproduct of lode and placer gold. Ferguson and Gannett, 1932.	39°28'	120°50'
14. Slate Creek (LaPorte) Byproduct of placer gold. Pettee, 1880; Lindgren, 1911.	39°40'	120°57'
15. Yankee Hill. Replacement bodies near fault zone along schistosity in Carboniferous(?) metavolcanic rocks. Eric, 1948.	39°41'	121°26'
16. Oroville. Byproduct of placer gold. Clark, 1957; Logan, 1930a; Aubury, 1910.	39°27'	121°37'
17. Hammonton (Yuba River). Byproduct of placer gold. Clark, 1957; Logan, 1930b; Aubury, 1910.	39°12'	121°26'
18. Nevada City. Byproduct of lode and placer gold. Johnston, 1940; Lindgren, 1896.	39°15'	120°59'
19. Ophir. Byproduct of lode and placer gold. Logan, 1936.	38°52'	121°08'
20. Calistoga (Silverado, Palisade mines). Fissure veins in andesite. Averill, 1929.	38°38'	122°35'
21. Folsom. Byproduct of placer gold. Clark, 1957; Carlson, 1955; Aubury, 1910.	38°38'	121°13'
22. Placerville. Byproduct of lode and placer gold. Clark and Carlson, 1956.	38°43'	120°48'
23. Plymouth-Jackson. Byproduct of lode and placer gold. Knopf, 1929; Denton and Clark, 1954.	38°24'	120°49'
24. Ione (Newton mine). Byproduct of copper. Replacement deposit along schistosity fault in altered Jurassic volcanic rocks. Heyl and Eric, 1948.	38°21'	120°54'
25. Campo Seco (Penn mine). Byproduct of copper. Replacement bodies along schistosity in Jurassic metavolcanic rocks. Heyl and others, 1948.	38°14'	120°52'
26. Mokelumne Hill. Byproduct of lode and placer gold. Julihn and Horton, 1938.	38°17'	120°43'
27. Monitor. Braided fissure zones and impregnations in kaolinized andesite. Logan, 1922.	38°40'	119°42'
28. Mount Patterson (Silverado and Kentuck mines). Veins along fault between andesite and rhyolite. Sampson, 1940.	38°27'	119°17'
29. Masonic. Byproduct of lode gold. Sampson, 1940.	38°22'	119°07'

CALIFORNIA (cont'd.)

30.	Bodie. Byproduct of gold. Veins in andesite. Sampson, 1940.	38°13'	119°01'
31.	Angels Camp. Byproduct of lode and placer gold. Eric and others, 1955; Knopf, 1929; Julihn and Horton, 1938.	38°04'	120°32'
32.	West Belt (Quail Hill area). Replacement bodies along shear zones near or along borders of Upper Jurassic stocks of felsite and quartz porphyry. Heyl, 1948b.	37°57'	120°44'
33.	Copperopolis (Keystone-Union, North Keystone mines). Byproduct of copper. Replacement bodies along fault zone along schistosity of Jurassic(?) slates and metavolcanic schists. Heyl, 1948a.	37°59'	120°39'
34.	Carson Hill (Carson Hill mine). Byproduct of lode and placer gold. Eric and others, 1955; Knopf, 1929; Julihn and Horton, 1938.	38°01'	120°30'
35.	Columbia Basin. Byproduct of placer gold. Julihn and Horton, 1940.	38°02'	120°25'
36.	Sonora. Byproduct of lode and placer gold. Julihn and Horton, 1940, Eric and others, 1955.	37°59'	120°23'
37.	Soulsbyville-Tuolumne. Byproduct of lode gold. Julihn and Horton, 1940.	37°59'	120°15'
38.	Jamestown. Byproduct of lode and placer gold. Julihn and Horton, 1940; Knopf, 1929.	37°56'	120°26'
39.	Shawmut (Eagle-Shawmut mine). Byproduct of lode and placer gold. Julihn and Horton, 1940; Knopf, 1929.	37°52'	120°24'
40.	Groveland-Big Oak Flat. Byproduct of placer and lode gold. Julihn and Horton, 1940.	37°50'	120°15'
41.	Hunter Valley. Replacement bodies along shear zones in schistose felsite tuff and breccia of Carbonaceous to Jurassic ages. Eric and Cox, 1948.	37°34'	120°15'
42.	Hites Cove. Byproduct of lode and placer gold. Julihn and Horton, 1940; Bowen and Gray, 1957.	37°39'	119°52'
43.	Boot Jack. Veins in Upper Jurassic(?) granite. Julihn and Horton, 1940; Bowen and Gray, 1957.	37°25'	119°53'

CALIFORNIA (cont'd.)

44.	Mammoth Lakes. Byproduct of lode gold. Sampson, 1940.	37°37'	118°59'
45.	Chidago. Veins in granite, rhyolite, and limestone. Sampson, 1940.	37°42'	118°34'
46.	Blind Spring. Veins along parallel faults in Jurassic granitic stock. Ransome, 1940.	37°46'	118°29'
47.	Bishop Creek. Byproduct of tungsten and copper. Contact metamorphic deposits in Paleozoic marble. Bateman, 1956.	37°24'	118°43'
48.	Black Canyon. Replacement lenses in fissures in Paleozoic(?) limestone. Norman and Stewart, 1951.	37°20'	118°12'
49.	Cerro Gordo. Replacement bodies near axis of plunging anticline in Devonian limestone. Knopf, 1918a; Norman and Stewart, 1951.	36°32'	117°48'
50.	Lee (Santa Rosa). Parallel veins across bedding in tactitic Permian limestone and ore shoots along bedding fractures in Mississippian limestone. Hall and Mackevett, 1958.	36°25'	117°43'
51.	Darwin. Replacement bodies near and along faults in tactitic Pennsylvanian limestone adjacent to granodiorite stock. Hall and Mackevett, 1958.	36°17'	117°36'
52.	Modoc. Bedded replacement bodies along small faults in Carboniferous limestone. Hall and Mackevett, 1958; Norman and Stewart, 1951.	36°16'	117°28'
53.	Panamint. Veins in early Paleozoic(?) limestone, schist, and slate. Murphy, 1930.	36°06'	117°05'
54.	Carbonate (Queen of Sheba mine). Replacement bodies along bedding of Paleozoic(?) dolomitic limestone. Norman and Stewart, 1951.	36°00'	116°53'
55.	Resting Springs (Tecopa). Replacement bodies along fault intersections in Cambrian dolomite and limestone. Carlisle and others, 1954; Sampson, 1937.	35°50'	116°06'
56.	Slate Range. Replacement bodies along bedding fissures in steeply-dipping Paleozoic(?) limestone. Norman and Stewart, 1951.	35°49'	117°17'
57.	Cove. Byproduct of gold. Vein in shear zone along grano-	35°44'	118°26'

CALIFORNIA (cont'd.)

diorite-alaskite fault contact. Prout, 1940.

58. Amalie (Agua Caliente). Veins within quartz porphyry in granodiorite. Tucker and others, 1949. 35°17' 118°27'

59. Mojave. Veins along faults in Miocene dacite flows and plugs, and on contact between flows and underlying Upper Jurassic quartz monzonite. Tucker, 1935. 34°58' 118°14'

60. Randsburg. Intersecting vein systems in Precambrian biotite schist, amphibole schist, and quartzite, in footwall of flat fault. Wright and others, 1953; Hulin, 1925. 35°21' 117°38'

61. Grapevine (Waterman mine). Vein along steeply-dipping contact between rhyolite and overlying rhyolite tuff. Wright and others, 1953. 34°58' 117°02'

62. Calico. Veins along or near faults and disseminated deposits in shattered Miocene volcanic rocks and lake beds. Wright and others, 1953; Erwin and Gardner, 1940. 34°58' 116°52'

63. Clark Mountain (Ivanpah in part). Replacement bodies, in part localized by fractures near quartz monzonite sill, in Mississippian limestone and Devonian dolomite; veins in Devonian dolomite, locally on bedding. Wright and others, 1953; Hewett, 1956. 35°29' 115°34'

64. Cima (Death Valley mine). Veins in quartz monzonite of Laramide age. Hewett, 1956. 35°13' 115°28'

65. Buckeye (Bagdad Chase mine). Byproduct of lode gold. Wright and others, 1953. 34°38' 116°10'

66. Lava Beds. Veins in Upper Jurassic(?) monzonite porphyry. Tucker and Sampson, 1940. 34°40' 116°25'

67. Dale (Monte Negro). Byproduct of lode gold. Tucker and Sampson, 1945; Wright and others, 1953. 34°02' 115°41'

68. Eagle Mountain. Vein along quartzite-diorite contact. Tucker and Sampson, 1945. 33°53' 115°33'

69. Paymaster (Paymaster mine). Vein along fault(?) contact between diorite and granite. Sampson and Tucker, 1942. 33°12' 114°54'

CALIFORNIA (cont'd.)

70. Cargo Muchacho. Byproduct of lode gold. Henshaw, 1942. 32°53' 114°49'

71. Silverado (Santa Rosa). Veins in syenite and porphyry. Merrill, 1919; Fairbanks, 1893. 33°45' 117°37'

72. Santa Catalina Island. Lodes in Jurassic hornblende schist and in andesite. Tucker, 1927. 33°21' 118°22'

COLORADO

1. La Sal (Cashin mine). Veinlets in fissure zones along intersecting faults in Triassic or Jurassic sandstone. Emmons, 1906; Fischer, 1936. 38°19' 108°57'

2. Lone Cone (Dunton). Fissure veins in shale of Permian and Triassic ages. Bastin, 1923. 37°46' 108°06'

3. Rico (Pioneer). Replacement bodies along bedding and fractures in Pennsylvanian limestone; veins along fractures in sandstone and arkose; filling of breccia from solution of gypsum bed. Burbank and others, 1947; Ransome, 1901b; Cross and Spencer, 1900. 37°42' 108°01'

4. La Plata (California). Veins and veinlet systems along breccia zones in Pennsylvanian, Permian, and Jurassic sandstones and arkoses and in Laramide porphyry stocks; replacement bodies in Jurassic limestone. Eckel, 1949. 37°22' 108°04'

5. Animas (Silverton). Lode veins, partly along dikes, in Miocene (?) extrusive and intrusive igneous rocks. Burbank, 1933. 37°48' 107°36'

6. Eureka. Lode veins in Miocene andesite and latite. Burbank and others, 1947. 37°54' 107°36'

7. Poughkeepsie, Mineral Point, and Upper Uncompahgre. Veins and lodes along faults and filling of breccia chimneys in Miocene extrusive and intrusive igneous rocks. Kelley, 1946. 37°57' 107°37'

8. Red Mountain. Filling of volcanic breccia pipes with replacement or veining of adjacent volcanic rocks of Miocene age. Burbank, 1941. 37°54' 107°42'

9. Ophir (Iron Springs) (including Alta mine). Lode veins in Tertiary extrusive and intrusive igneous rocks, and in conglomerate and sandstone of Permian and Eocene age. Burbank and others, 1947. 37°52' 107°50'

COLORADO (cont'd.)

10. Sneffels and Telluride (Upper San Miguel). Lode veins, partly along dikes, in Miocene volcanic rocks. Burbank and others, 1947; Ransome, 1901a; Burbank, 1941. — 37°57' 107°46'

11. Uncompahgre (Ouray). Veins and replacement bodies along fissures and bedding and within breccias in quartzites, sandstones, limestones, and shales ranging from Pennsylvanian to Cretaceous in age. Burbank, 1940. — 38°03' 107°40'

12. Lake City (Galena, Lake). Veins in Miocene andesite, latite, and rhyolite, along fissures in caldera rift zone. Burbank and others, 1947; Irving and Bancroft, 1911. — 38°01' 107°22'

13. Creede. Veins along faults in Miocene rhyolite. Emmons and Larsen, 1923; Larsen, 1929. — 37°52' 106°56'

14. Summitville. Byproduct of gold. Replacement veins and pipes along fracture zones in Upper Tertiary quartz latite. Patton, 1917; Garrey, 1950. — 37°26' 106°36'

15. Kerber Creek (Bonanza). Veins in Oligocene(?) andesite and latite. Burbank, 1932. — 38°19' 106°08'

16. Monarch (Garfield). Replacement bodies, mostly adjacent to faults, in dominantly Ordovician limestone and dolomite. Dings and Robinson, 1957. — 38°32' 106°18'

17. White Pine (Tomichi). Replacement bodies within fault zones or along adjacent bedding in Ordovician and Mississippian limestone and dolomite. Dings and Robinson, 1957. — 38°32' 106°23'

18. Chalk Creek (Mary Murphy mine). Lodes in quartz monzonite of Tertiary age. Dings and Robinson, 1957. — 38°40' 106°21'

19. Gold Brick. Replacement veins along faults in Precambrian gneiss and schist. Crawford and Worcester, 1916. — 38°37' 106°35'

20. Quartz Creek. Replacement bodies adjacent to faults in Ordovician and Carboniferous limestones, veins in Precambrian gneissic granite. Dings and Robinson, 1957. — 38°40' 106°30'

21. Tincup. Bedded replacement bodies and veins in Mississippian and Ordovician limestone

and dolomite; fissure veins in Ordovician and Devonian quartzite and in quartz diorite porphyry (early(?) Tertiary). Dings and Robinson, 1957. — 38°43' 106°29'

22. Dorchester-Taylor Park. Veins and replacement bodies in Carboniferous dolomite and limestone. Vanderwilt, 1947. — 38°57' 106°40'

23. Elk Mountain (Keystone mine). Veins and breccia filling along faults in Cretaceous sandstone. Emmons and others, 1894. — 38°52' 107°03'

24. Rock Creek. Replacement bodies along bedding or cross fractures in limestone beds of Devonian to Cretaceous age. Vanderwilt, 1937. — 39°04' 107°06'

25. Roaring Fork (Aspen). Breccia filling and replacement bodies in shattered Carboniferous dolomite and limestone. Vanderwilt, 1935; Spurr, 1898; Knopf, 1926. — 39°11' 106°49'

26. Brush Creek. Impregnation of Jurassic sandstone below shale and just above thrust fault. Gabelman, 1950. — 39°35' 106°44'

27. Red Cliff (Gilman, Battle Mountain) (Eagle mine). Replacement pipes along intersecting joints or faults in Devonian and Mississippian limestones; replacement deposits in bedding breccia in Cambrian quartzite. Tweto and Lovering, 1947. — 39°32' 106°23'

28. Sugar Loaf-St. Kevin (Independent). Lodes within shear zones in Precambrian granite, schist and gneiss. Singewald, 1955. — 39°17' 106°23'

29. Leadville (California). Replacement bodies along fissures and chiefly below porphyry sills or shale, in Ordovician and Mississippian limestones. Emmons and others, 1927. — 39°14' 106°16'

30. Horseshoe-Sacramento (Hilltop mine). Replacement pipes at intersections of faults and fractures with favorable dolomite beds in Devonian and Mississippian strata. Behre, 1953; Singewald and Butler, 1941. — 39°13' 106°10'

31. Alma (Mosquito, Buckskin, Consolidated Montgomery). Veins along faults in or adjoining lower Tertiary quartzite; replacement bodies within shattered zones in Ordovician and Mississippian limestone. Singe- — 39°18' 106°06'

COLORADO (cont'd.)

wald and Butler, 1933, 1941.		
32. Upper Blue River. Replacement bodies adjacent to fractures cutting Devonian, Pennsylvanian and Permian limestone beds between unfavorable rock types. Singewald, 1951.	39°23'	106°04'
33. Kokomo (Tenmile. Replacement pipes along fractures in Pennsylvanian limestone beds between unfavorable rock types. Koschmann and Wells, 1946.	39°25'	106°12'
34. Breckenridge. Veins along faults in Eocene(?) monzonite porphyry and in Cretaceous quartz monzonite porphyry. Lovering, 1934.	39°29'	106°01'
35. Montezuma (Snake River). Veins partly along faults, in Precambrian gneiss and granite and in Eocene quartz monzonite. Lovering, 1935.	39°35'	105°51'
36. Green Mountain (Big Four mine). Byproduct of zinc. Fracture filling and replacement bodies in Cretaceous quartzite and shale adjacent to porphyry stock. McCulloch and Huleatt, 1946.	39°53'	106°20'
37. Argentine. Veins, partly along faults, in Precambrian granite, gneiss, and schist. Lovering, 1935.	39°39'	105°47'
38. Silver Plume-Georgetown (Griffith). Veins along faults and locally following porphyry dikes in Precambrian granite, pegmatite, gneiss, and schist. Lovering and Goddard, 1950.	39°42'	105°43'
39. Central City-Idaho Springs (including Trail Creek). Veins along faults and foliation in Precambrian gneiss, pegmatite, and schist (may follow porphyry dikes of Laramide age); byproduct of gold in pyritic stockwork in gneiss. Lovering and Goddard, 1950.	39°45'	105°32'
40. Lawson-Dumont (Montana). Veins in Precambrian gneiss, granite, and pegmatite. Lovering and Goddard, 1950.	39°46'	105°38'
41. Alice (Alice mine). Byproduct of gold and copper. Gossan and enriched sulfide zone of pyritic stockwork in quartz monzonite porphyry stock of Laramide age. Lovering and Goddard, 1950.	39°49'	105°39'

42. Caribou-Grand Island. Veins along faults in monzonite stock of Laramide age and in Precambrian schist, gneiss and granite. Lovering and Goddard, 1950.	39°59'	105°34'
43. Ward. Byproduct of lode gold. Lovering and Goddard, 1950.	40°04'	105°30'
44. Gold Hill (Sugar Loaf). Byproduct of gold. Veins and stockworks along faults in Precambrian granite. Lovering and Goddard, 1950.	40°03'	105°23'
45. Jamestown (Central). Veins along faults in Precambrian schist and granite; filling of breccia zones in lower Tertiary granodiorite. Lovering and Goddard, 1950.	40°08'	105°23'
46. Cripple Creek. Byproduct of gold. Radiating steep sheeted veins in Tertiary volcanic plug of latite-phonolite pyroclastic material. Loughlin and Koschmann, 1935.	38°44'	105°08'
47. Hardscrabble (Silver Cliff, Westcliff). Veins and stockworks in lower Tertiary rhyolite and tuff; veins in Precambrian granite and gneiss; interstitial filling of rubble in chimney in Precambrian gneiss, granite, and syenite. Emmons, 1896.	38°09'	105°27'
48. Rosita Hills. Veins along faults in lower Tertiary andesite and trachyte and Precambrian granite; interstitial filling of rubble in lower Tertiary volcanic neck in granite and gneiss. Emmons, 1896.	38°07'	105°20'

IDAHO

1. Port Hill (Idaho Continental mine). Replacement bodies along shear zones and fissures in Precambrian sericitic quartzite. Kirkham and Ellis, 1926.	48°56'	116°53'
2. Talache (Pend Oreille in part) (Armstead mine). Fissure veins in Precambrian argillite. Sampson, 1928.	48°08'	116°29'
3. Clark Fork. Replacement veins along shear zones in Precambrian argillite, quartzite, and limestone. Anderson, 1947a.	48°10'	116°10'
4. Lake View. Ore shoots in breccia along fault fissures in Precambrian quartzite and argillite. Sampson, 1928.	47°54'	116°27'
5. West Coeur d'Alene. Composite replacement veins along shear	47°30'	116°04'

zones in Precambrian sericitic quartzite. Ransome and Calkins, 1908; Umpleby and Jones, 1923; Shenon and McConnel, 1939.

6. East Coeur d'Alene. Composite replacement veins along shear zones in Precambrian sericitic quartzite. Ransome and Calkins, 1908; Umpleby and Jones, 1923. 47°31' 115°50'

7. Elk City. Byproduct of lode and placer gold. Shenon and Reed, 1934. 45°49' 115°24'

8. Florence. Byproduct of lode and placer gold. Reed, 1939. 45°31' 116°02'

9. Marshall Lake. Byproduct of lode and placer gold. Reed, 1937; Ross, 1941. 45°25' 115°52'

10. Warren. Byproduct of placer and lode gold. Reed, 1937. 45°16' 115°41'

11. Yellow Pine. Byproduct of antimony and gold. Replacement bodies along wide fault zone in Lower Cretaceous(?) quartz monzonite batholith. Cooper, 1951. 44°55' 115°20'

12. Seafoam. Replacement bodies in Cambrian(?) dolomitic limestone occurring as xenolith in Lower Cretaceous quartz monzonite batholith; replacement bodies in shear zones in the batholith. Treves and Melear, 1953. 44°35' 115°04'

13. Deadwood (Cascade). Replacement bodies in vertical shear zone in "granite." Campbell, 1930. 44°28' 115°35'

14. Mineral. Replacement veins along fractures in Permian(?) andesite and latite. Anderson and Wagner, 1952. 44°34' 117°05'

15. Pearl-Horseshoe Bend (West View). Stringers and seams along complex fissure zones in Cretaceous(?) granodiorite batholith. Anderson, 1934. 43°51' 116°19'

16. Quartzburg. Byproduct of gold. Fissure and replacement lodes along shear zone within Cretaceous(?) quartz monzonite batholith; placer gold. Anderson, 1947d. 43°57' 115°59'

17. Grimes Pass (Pioneerville) (Comeback mine). Replacement lodes along fissures or shear zones in Cretaceous(?) quartz monzonite batholith or in Miocene porphyry dikes. Anderson, 1947d. 44°01' 115°49'

IDAHO (cont'd.)

18. Banner. Fissure veins along a shear zone within Cretaceous (?) granodiorite batholith. Anderson and Rasor, 1923. 44°02' 115°32'

19. Atlanta (Middle Boise). Breccia filling of wide shear zones in quartz monzonite of Early Cretaceous(?) age. Anderson, 1939. 43°47' 115°06'

20. Rosetta (Little Smoky). Veins and replacement bodies along crushed zones in Pennsylvanian (?) limestone. Ross, 1930; Umpleby, 1914. 43°36' 114°42'

21. Vienna. Veins along crushed zone, with some replacement, in quartz monzonite of Cretaceous(?) age. Ross, 1927. 43°49' 114°50'

22. East Fork. Replacement veins and lodes along conjugate fractures in Mississippian argillite, and along shear zones in Cretaceous(?) quartz diorite stock. Ross, 1937. 44°00' 114°39'

23. Boulder Creek (Livingston mine). Replacement lodes along shear zones in Mississippian siliceous argillite and in shattered rhyolite porphyry dikes of Mesozoic or Tertiary age. Kiilsgaard, 1949. 44°08' 114°36'

24. Yankee Fork. Breccia veins, lodes, and stockworks in altered Oligocene andesite, latite, and tuff. Anderson, 1949. 44°23' 114°42'

25. Bayhorse. Replacement bodies in Cambrian and Ordovician dolomite; lodes in argillite. Ross, 1937. 44°21' 114°23'

26. Blue Wing. Veins in Precambrian quartzitic slates and schists. Callaghan and Lemmon, 1941. 44°32' 113°41'

27. Junction (Leadville mine). Replacement bodies adjacent to bedding fault in Paleozoic limestone. Umpleby, 1913. 44°42' 113°18'

28. Texas. Replacement bodies along fissures and bedding in Paleozoic limestone. Umpleby, 1913. 44°28' 113°18'

29. Nicholia (Viola mine). Replacement bodies along fractures in Upper Ordovician or Devonian limestone. Anderson and Wagner, 1944. 44°22' 112°59'

30. Birch Creek. Replacement 44°09' 112°50'

IDAHO (cont'd.)

bodies along bedding in limestones of Ordovician, Devonian, and Pennsylvanian age. Anderson and Wagner, 1944.

31. Dome (Wilbert mine). Replacement bodies along fracture zones in Ordovician quartzitic dolomite. Ross, 1933; Anderson, 1947b. 43°58' 113°01'

32. Alder Creek. Replacement veins in tactitic Mississippian limestone or along its contact with quartz diorite stock, Ross, 1930. 43°54' 113°41'

33. Lava Creek. Fissure veins and replacement bodies within brecciated zones in Miocene(?) andesite and latite and in Mississippian limestone. Anderson, 1929; Anderson, 1947c. 43°33' 113°37'

34. Muldoon (Little Wood River) (Muldoon mine). Replacement bodies along faults in Carboniferous limestone, slate, and quartzite, and along contact with quartz diorite sill. Anderson and Wagner, 1946. 43°37' 113°53'

35. Warm Springs. Replacement lodes along shear zones in Mississippian argillite. Umpleby and others, 1930; Killsgaard, 1950. 43°40' 114°17'

36. Mineral Hill (Wood River). Fissure veins in Carboniferous calcareous shale bordering a monzonitic batholith. Umpleby and others, 1930; Anderson and others, 1950. 43°29' 114°22'

37. DeLamar. Veins, breccia veins, and silicified shear zones in Miocene(?) rhyolite. Piper and Laney, 1926. 43°01' 116°49'

38. Silver City (Carson, in part). Veins, breccia veins, and silicified shear zones in Cretaceous(?) granodiorite and in Miocene(?) rhyolite and basalt. Piper and Laney, 1926. 43°01' 116°43'

39. Flint (Rising Star mine). Veins in Cretaceous(?) stock of granite to diorite. Piper and Laney, 1926. 42°55' 116°46'

40. South Mountain. Contact metamorphic deposits and replacement veins along vertical fractures in limestone. Sorenson, 1927. 42°45' 116°56'

ILLINOIS

1. Cave in Rock. Byproduct of lead and zinc. Lode veins and replacement bodies in fault blocks of Mississippian limestone. Oesterling, 1952; Currier and Hubbert, 1944. 37°30' 88°12'

MICHIGAN

1. Michigan copper. Byproduct of copper. Native copper and silver in conglomerate and amygdaloidal lodes; fissure veins in lava flows of Keweenawan age. Butler and Burbank, 1929. 47°15' 88°30'

2. White Pine. Byproduct of copper. Disseminated ore in Precambrian shale, siltstone, and sandstone. White and Wright, 1954; Butler and Burbank, 1929. 46°45' 89°35'

KENTUCKY

1. Western Kentucky. Byproduct of lead and zinc. Lode veins and replacement bodies in fault blocks of Mississippian limestone. Oesterling, 1952. 37°15' 88°12'

MISSOURI

1. Flat River-Bonne Terre. Byproduct of lead. Bedded replacement bodies in Cambrian dolomite near buried Precambrian ridges. Tarr, 1936. 37°52' 90°33'

2. Fredericktown. Byproduct of lead. Bedded replacement bodies in Cambrian sandy dolomite near buried Precambrian ridges. Winslow, 1894. 37°35' 90°18'

MONTANA

1. Troy (Grouse Mountain) (Snowstorm mine). Replacement lodes in Mesozoic(?) metadiorite dikes that intrude Precambrian argillite. Gibson, 1948. 48°27' 115°59'

2. Libby. Replacement lodes along shear zones in Precambrian argillite. Gibson, 1948. 48°13' 115°38'

3. Hog Heaven. Replacement bodies in stockwork in porphyritic latite intrusive mass of late Tertiary age. Shenon and Taylor, 1936. 47°56' 114°34'

4. Eagle (Jack Waite mine). Replacement veins along shears in Precambrian fine-grained quartzite and argillite. Hosterman, 1956. 47°40' 115°44'

5. Packer Creek (Last Chance, Silver Cable mine). Replacement veins along faults and fractures in Precambrian argillite and quartzite. Wallace and Hosterman, 1956. 47°28' 115°34'

6. Keystone (Iron Mountain) (Iron 47°16' 114°54'

MONTANA (cont'd.)

Mountain, Nancy Lee mines). Replacement veins parallel to foliation in Precambrian quartzite and argillite.

7. Curlew (Curlew mine). Fissure filling along fault contact between granite (or Pleistocene gravel?) and Precambrian(?) quartzite and limestone. Sahinen, 1957.	46°28'	114°10'
8. Garnet (First Chance). Veins in granodiorite stock of Laramide age, and along bedding in adjacent Precambrian and Cambrian quartzite and schistose shale. Pardee, 1918.	46°49'	113°21'
9. Dunkleberg. Veins near axis of anticline in rocks of Cretaceous age, and in dioritic and gabbroic sills; replacement bodies in limestone. Pardee, 1917; Popoff, 1953.	46°31'	113°05'
10. Henderson (Black Pine) (Combination mine = Black Pine mine). Fissure vein along bedding in Precambrian quartzite. Emmons and Calkins, 1913.	46°27'	113°22'
11. Boulder and South Boulder. Fissure veins in granite stock of early(?) Tertiary age, and in adjacent Precambrian, Carboniferous, and Mesozoic quartzites and impure limestones; replacement veins in limestone. Emmons and Calkins, 1913.	46°24'	113°08'
12. Philipsburg (Flint Creek). Replacement bodies in Cambrian, Silurian, and Devonian limestones and shales; veins in granodiorite. Emmons and Calkins, 1913.	46°20'	113°16'
13. Georgetown. Byproduct of gold. Replacement bodies and veins in Cambrian and Devonian limestone near granodiorite stocks. Emmons and Calkins, 1913.	46°12'	113°14'
14. Blue-eyed Nellie mine. Replacement bodies in Cambrian limestone. Emmons and Calkins, 1913.	46°12'	113°07'
15. Vipond. Ore shoots or pipes along fissures, and bedded replacement bodies, in Paleozoic limestone on top of low anticline. Taylor, 1942.	45°43'	112°54'
16. Bryant (Hecla). Replacement bodies along bedding in Cambrian dolomite on anticlinal crests near contact with quartz monzonite batholith. Karlstrom, 1948; Winchell, 1914.	45°36'	112°55'

MONTANA (cont'd.)

17. Polaris (Lost Cloud). Replacement bodies in Carboniferous limestone near contact with quartz monzonite batholith. Winchell, 1914.	45°23'	113°05'
18. Argenta. Replacement bodies along bedding and fissures in Cambrian, Devonian, and Mississippian limestones; fissure veins in Precambrian shale and in quartz monzonite of Laramide(?) age. Shenon, 1931.	45°18'	112°53'
19. Blue Wing. Replacement veins in Mississippian limestone and in granodiorite stock of Laramide(?) age. Shenon, 1931.	45°12'	112°57'
20. Virginia City (Alder Gulch). Byproduct of lode and placer gold. Tansley and others, 1933.	45°14'	111°58'
21. Norris. Byproduct of gold. Veins along intersections of fissures in quartz monzonite batholith of Laramide(?) age and in adjacent Precambrian gneiss and schist. Tansley and others, 1933.	45°33'	111°42'
22. Sheridan. Veins and replacement bodies along faults and bedding in Precambrian limestone and marble. Tansley and others, 1933.	45°28'	112°08'
23. Pony (Mineral Hill, South Boulder). Veins in Precambrian gneiss and schist, and in aplite and quartz monzonite of Laramide(?) batholith. Tansley and others, 1933.	45°39'	111°58'
24. Tidal Wave (Twin Bridges). Fissure veins in Precambrian gneiss and Lower Tertiary(?) quartz monzonite; replacement bodies along fissures and bedding in Paleozoic limestone. Tansley and others, 1933.	45°35'	112°10'
25. Rochester (Rabbit). Veins in Precambrian schist and gneiss; replacement bodies along fractures in Cambrian dolomitic limestone. Sahinen, 1939.	45°37'	112°29'
26. Melrose. Veins in Precambrian schist and argillite. Winchell, 1914; Sahinen, 1950.	45°42'	112°38'
27. Silver Star. Byproduct of gold. Contact metamorphic deposits in Paleozoic limestone; veins in Precambrian schist and gneiss. Sahinen, 1939.	45°41'	112°19'
28. Renova (Cedar Hollow). Byproduct of gold. Vein on fault nearly along bedding of Cambrian limestone. Tansley and others, 1933.	45°47'	112°06'

MONTANA (cont'd.)

29.	Whitehall (Cardwell). Veins in Precambrian calcareous shale, sandstone, and limestone, and in porphyry dikes. Winchell, 1914.	45°53'	112°01'
30.	Butte(Summit Valley). Replacement lodes and veins in quartz monzonite of early Tertiary(?) age. Sales, 1914; Perry, 1932.	46°01'	112°32'
31.	Oro Fino (Champion mine). Vein in quartz monzonite of Laramide(?) age. Pardee and Schrader, 1933.	46°14'	112°37'
32.	Zosell (Emery). Replacement veins along faults in Upper Cretaceous(?) andesite. Pardee and Schrader, 1933; Robertson, 1953.	46°22'	112°36'
33.	Elliston. Veins in andesite and quartz monzonite of Laramide age. Pardee and Schrader, 1933.	46°27'	112°24'
34.	Rimini (Vaughn). Lodes in sericitized quartz monzonite of Laramide(?) age. Pardee and Schrader, 1933.	46°28'	112°15'
35.	Cataract (Basin) and Boulder (Comet, Gray Eagle, Hope-Katie mines). Replacement veins in quartz monzonite and aplite of Laramide age. Pardee and Schrader, 1933.	46°17'	112°13'
36.	Wickes (Colorado). Veins in quartz latite and quartz monzonite of Laramide(?) age. Pardee and Schrader, 1933.	46°22'	112°07'
37.	Elkhorn (Elkhorn mine). Replacement bodies in Cambrian dolomite. Klepper and others, 1957.	46°16'	111°57'
38.	Radersburg (Cedar Plains). Veins in andesite and latite of early Tertiary(?) age and in rocks of Paleozoic and Mesozoic ages. Pardee and Schrader, 1933; Reed, 1951.	46°10'	111°42'
39.	Park (Indian Creek) (Iron Mask mine). Veins in Lower Tertiary(?) andesite. Stone, 1911; Reed, 1951.	46°20'	111°39'
40.	Beaver Creek (Winston). Veins in andesite and quartz monzonite of Laramide age. Pardee and Schrader, 1933; Reed, 1951.	46°25'	111°42'
41.	Warm Spring. Veins in quartz monzonite of Laramide age. Pardee and Schrader, 1933.	46°26'	111°53'
42.	Clancy (Lump Gulch). Lodes along fault zones in quartz monzonite and aplite of Laramide age. Pardee and Schrader, 1933.	46°28'	112°01'

43.	Helena. Byproduct of gold. Contact metamorphic deposits in Mississippian limestone; veins along crushed zones in Laramide quartz monzonite; and placers. Pardee and Schrader, 1933.	46°33'	112°04'
44.	Scratch Gravel. Contact metamorphic deposits in Precambrian limestone; veins in Precambrian shale, quartzite, and limestone, and in adjacent Laramide quartz monzonite stock. Pardee and Schrader, 1933.	46°40'	112°05'
45.	Marysville. Fissure veins in Precambrian hornstone bordering a quartz monzonite stock. Pardee and Schrader, 1933.	46°45'	112°19'
46.	Stemple-Gould. Byproduct of gold. Veins in contact metamorphosed Precambrian argillite. Pardee and Schrader, 1933.	46°53'	112°28'
47.	Heddleston (Mike Horse mine). Tabular breccia filling with some replacement in Precambrian argillite and quartzite and in igneous rocks. Pardee and Schrader, 1933.	47°02'	112°22'
48.	Dry Gulch (Golden Messenger, Old Amber mines). Byproduct of lode gold. Pardee and Schrader, 1933; Mertie and others, 1951.	46°44'	111°43'
49.	Castle Mountain. Replacement bodies along bedding and fractures in Mississippian and Cambrian limestone, partly along porphyry sills and dikes. Roby, 1950.	46°27'	110°41'
50.	Neihart. Sheeted replacement veins in Precambrian gneiss and quartzite. Schafer, 1935; Robertson, 1951.	46°57'	110°44'
51.	Barker (Hughesville) (Block P mine). Fissure vein in syenitic stock and at contact with Cambrian or Carboniferous limestone. Jackson and others, 1935; Weed, 1900; Spiroff, 1938.	47°05'	110°39'
52.	North Moccasin (Kendall). Byproduct of lode gold. Blixt, 1933.	47°17'	109°29'
53.	Warm Springs. Byproduct of lode gold. Robertson, 1950.	47°10'	109°13'
54.	Little Rockies. Byproduct of lode gold. Corry, 1933.	47°54'	108°36'
55.	New World (Cooke City). Contact metamorphic deposits, veins and replacement bodies in Cam-	45°02'	109°57'

MONTANA (cont'd.)

brian and Ordovician limestone and dolomite. Lovering, 1930; Reed, 1950.

NEVADA

1. Leadville (Leadville mine). Veins in diorite porphyry dike and in andesite of Tertiary age. Overton, 1947.	41°07'	119°25'
2. Sulphur. Veins and stringers in Tertiary rhyolite. Vanderburg, 1938a.	40°54'	118°39'
3. Rosebud. Replacement veins and stringers in Tertiary rhyolite. Vanderburg, 1936.	40°48'	118°36'
4. Antelope (Cedar). Replacement bodies in limestone; byproduct of copper in fissure in tourmalinized rhyolite. Vanderburg, 1936.	40°41'	118°32'
5. Seven Troughs. Veins along basalt dikes cutting Tertiary volcanic rocks. Vanderburg, 1936.	40°30'	118°38'
6. Trinity. Fissure veins in Cretaceous(?) granodiorite and in hornfelsed Jurassic slate. Vanderburg, 1936.	40°20'	118°30'
7. Arabia. Fissure veins in Cretaceous(?) granodiorite and in xenoliths of Jurassic hornfels. Knopf, 1918b; Vanderburg, 1936.	40°22'	118°24'
8. Relief (Antelope Springs). Vein in Triassic limestone. Vanderburg, 1936.	40°12'	118°10'
9. Rochester. Replacement veins and stringers in Triassic rhyolite. Vanderburg, 1936.	40°18'	118°11'
10. Kennedy. Vein in Triassic volcanic and sedimentary rocks. Vanderburg, 1936.	40°23'	117°42'
11. Indian. Vanderbury, 1936.	40°25'	118°09'
12. Buena Vista (Unionville). Veins in Triassic rhyolite and limestone. Lincoln, 1923; Vanderburg, 1936.	40°28'	118°09'
13. Rye Patch (Echo). Fissure veins in Triassic limestone. Vanderburg, 1936.	40°28'	118°12'
14. Star. Veins and bedding lenses in Triassic limestone. Vanderburg, 1936.	40°33'	118°06'
15. Humboldt (Imlay). Veins in shale, quartzite, and limestone. Vanderburg, 1936.	40°35'	118°13'
16. Sierra (Dun Glen, Chafey). Veins in silicified andesite near diabase dike, and fissure veins in limestone. Vanderburg, 1936.	40°43'	117°52'

17. Gold Run (Adelaide). Veins in limestone, quartzite, shale, and schist. Vanderburg, 1938a.	40°47'	117°31'
18. Winnemucca. Veins in Triassic calcareous slate. Vanderburg, 1938a.	41°03'	117°42'
19. Barrett Springs. Veins in shale. Vanderburg, 1938a.	41°08'	117°49'
20. Paradise Valley. Fissure veins in calcareous slate. Vanderburg, 1938a.	41°36'	117°27'
21. National. Veins in Tertiary volcanic rocks. Vanderburg, 1938a.	41°50'	117°34'
22. Gold Circle (Midas). Replacement and fissure veins and lodes in rhyolite and along shattered contact between rhyolite and andesite. Emmons, 1910; Granger and others, 1957.	41°14'	116°48'
23. Merrimac (Rip Van Winkle mine). Veins and bedding replacement bodies along faults bordering a graben in Mississippian shale and limestone. Granger and others, 1957.	41°07'	116°00'
24. Tuscarora. Stockworks and lodes in Tertiary rhyolite and andesite porphyry. Emmons, 1910; Nolan, 1936; Granger and others, 1957.	41°18'	116°15'
25. Good Hope. Lodes along shear zones in rhyolite flow breccia. Emmons, 1910; Granger and others, 1957.	41°28'	116°30'
26. Cornucopia. Lodes in Tertiary andesite. Granger and others, 1957.	41°34'	116°17'
27. Edgemont (Centennial). Fissure veins in Carboniferous(?) quartzite. Granger and others, 1957; Emmons, 1910.	41°41'	116°11'
28. Aura (Bull Run, Columbia). Lodes in limestone adjacent to granodiorite stock, and veins in the granodiorite. Granger and others, 1957; Emmons, 1910.	41°49'	116°05'
29. Mountain City (Cope, Van Duzer, Rio Tinto). Fissure veins in granite and metamorphosed limestone; byproduct of copper in secondarily enriched ore. Emmons, 1910; Matson, 1947.	41°50'	115°59'
30. Jarbidge. Fissure veins in Tertiary rhyolite. Schrader, 1912, 1923; Granger and others, 1957.	41°51'	115°25'

NEVADA (cont'd.)

31. Contact (Salmon River). Fissure veins, replacement bodies, and contact metamorphic deposits in Paleozoic limestone; veins in granodiorite near dikes of syenite and lamprophyre. Schrader, 1912, 1935; Granger and others, 1957.	41°47'	114°45'
32. Delano (Cleveland and Delano mines). Replacement bodies along bedding in brecciated Paleozoic dolomite(?). Granger and others, 1957.	41°40'	114°15'
33. Spruce Mountain. Replacement bodies along bedding, fractures, and faults in Mississippian limestone, partly at contact with porphyry dikes. Granger and others, 1957; Schrader, 1931.	40°34'	114°50'
34. Cherry Creek (Egan Canyon). Veins in Cambrian quartzite and in Cretaceous(?) quartz monzonite. Schrader, 1931.	39°54'	114°55'
35. Hunter. Replacement bodies in breccia along fault contact of Devonian dolomitic limestone with porphyry dikes. Hill, 1916.	39°37'	115°00'
36. Aurum. Replacement bodies along faults and bedding in Cambrian limestone. Hill, 1916.	39°37'	114°32'
37. Piermont. Veins in brecciated limestone at contact with porphyry and in slate. Lincoln, 1923.	39°30'	114°35'
38. Osceola. Lodes along fracture zones in Cambrian sedimentary rocks. Lincoln, 1923.	39°04'	114°23'
39. Taylor. Breccia filling and replacement bodies in brecciated Ordovician(?) limestone. Lincoln, 1923.	39°05'	114°40'
40. Ward. Veins and replacement bodies along contact of quartz monzonite porphyry dikes with Pennsylvanian limestone. Hill, 1916.	39°05'	114°53'
41. Ely (Robinson). Replacement bodies along veins and bedding, and contact metamorphic deposits in Devonian and Carboniferous limestones; byproduct of "porphyry" copper, disseminated in Jurassic(?) monzonite porphyry stocks. Spencer, 1917.	39°15'	114°59'
42. White Pine (Hamilton). Replacement bodies along veins and bedding in Ordovician dolomite; saddle reefs in Devonian limestone below shale. Hague, 1870.	39°15'	115°30'

NEVADA (cont'd.)

43. Newark. Vein in limestone. Lincoln, 1923.	39°32'	115°46'
44. Eureka. Replacement bodies along fissures, partly along bedding, in Cambrian limestone. Sharp, 1948.	39°30'	116°08'
45. Mount Hope (Mt. Hope mine). Replacement bodies along bedding and faults in Pennsylvanian limestone roof pendant in alaskite stock. Matson, 1946.	39°47'	116°10'
46. Diamond. Fissure veins in silicified limestone. Vanderburg, 1938b.	39°52'	115°53'
47. Union. Replacement bodies in limestone. Vanderburg, 1938b.	40°03'	116°03'
48. Mineral Hill. Replacement bodies cutting across bedding in Paleozoic limestone. Vanderburg, 1938b.	40°09'	116°06'
49. Railroad (Bullion). Replacement bodies in near-vertical chimneys at fracture intersections in Ordovician limestone; some contact metamorphic deposits. Granger and others, 1957.	40°31'	116°00'
50. Safford. Veins in andesite. Vanderburg, 1938b.	40°34'	116°20'
51. Buckhorn. Veins along fault in kaolinized brecciated basalt and scoria. Vanderburg, 1938b.	40°12'	116°28'
52. Cortez. Replacement bodies in Ordovician(?) limestone, partly within sheeted zones parallel to porphyry dikes. Emmons, 1910; Vanderburg, 1938b.	40°09'	116°35'
53. Bullion. Fissure veins and sheeted lodes in Carboniferous limestone, quartzite, and shale and in andesite and granodiorite. Vanderburg, 1939; Emmons, 1910.	40°22'	116°44'
54. Hilltop. Veins in brecciated quartzite. Vanderburg, 1939.	40°26'	116°48'
55. Lewis. Veins in granodiorite and in Carboniferous quartzite, limestone, and slate, in part with replacement. Vanderburg, 1939.	40°27'	116°52'
56. Battle Mountain. Veins and replacement bodies along faults in Carboniferous hornfels, conglomerate, and quartzite. Roberts, 1951.	40°33'	117°07'
57. Reese River (Austin). Veins in lower Tertiary(?) quartz monzonite and Paleozoic schistose	39°28'	117°04'

NEVADA (cont'd.)

quartzite. Vanderburg, 1939; Hill, 1915.		
58. Kingston. Veins in limestone. Vanderburg, 1939.	39°11'	117°08'
59. Jackson. Fissure veins in andesite. Kral, 1951.	39°08'	117°36'
60. Mammoth (Ellsworth). Veins in Tertiary rhyolite dikes cutting Triassic(?) metavolcanic rocks. Kral, 1951.	38°58'	117°45'
61. Bruner (Phonolite). Veins in brecciated Tertiary rhyolite and andesite. Kral, 1951.	39°05'	117°48'
62. Lodi (Illinois mine). Veins in Triassic limestone and limy shale at contact with intrusive granodiorite. Kral, 1951.	39°00'	117°53'
63. Quartz Mountain (San Rafael mine). Veins in Triassic limestone along contact with intrusive granodiorite porphyry. Kral, 1951.	39°03'	117°58'
64. Broken Hills. Veins and stockworks in andesite. Vanderburg, 1937.	39°03'	118°02'
65. Wonder. Veins in Tertiary rhyolite. Vanderburg, 1940.	39°27'	118°02'
66. Chalk Mountain (Chalk Mtn. mine). Replacement bodies along fissures and bedding planes in dolomitic limestone. Vanderburg, 1940.	39°20'	118°07'
67. Fairview. Fissure veins in Tertiary andesite. Vanderburg, 1940.	39°13'	118°10'
68. Sand Springs. Veins in schist, limestone, and andesite. Vanderburg, 1940.	39°19'	118°25'
69. Rawhide (Regent). Veins in rhyolite, dacite, and andesite. Vanderburg, 1937.	39°02'	118°25'
70. Holy Cross. Narrow veins in rhyolite and andesite. Vanderburg, 1940.	39°05'	118°37'
71. Talapoosa. Lodes along shear zones in Tertiary rhyolite. Stoddard and Carpenter, 1950.	39°28'	119°15'
72. Peavine. Veins and replacement bodies in schist, in Cretaceous quartz monzonite, and in Tertiary andesite. Overton, 1947.	39°35'	119°56'
73. Galena (Commonwealth mine). Veins in metamorphosed tuff and hornfels. Overton, 1947.	39°21'	119°46'

74. Flowery. Stringer network in andesite. Stoddard and Carpenter, 1950.	39°19'	119°36'
75. Comstock. Lodes and veins in Upper Tertiary igneous rocks ranging from diorite to andesite. Becker, 1882; Bastin, 1922; Gianella, 1936.	39°18'	119°38'
76. Silver City. Veins in Tertiary andesite and rhyolite. Stoddard and Carpenter, 1950; Gianella, 1936.	39°14'	119°37'
77. Como (Palmyra, Indian Springs). Veins in Tertiary volcanic rocks, chiefly andesite. Stoddard and Carpenter, 1950.	39°10'	119°28'
78. Yerington. Byproduct of copper. Disseminated deposits in quartz monzonite; contact metamorphic deposits in bordering limestone. Stoddard and Carpenter, 1950.	38°59'	119°10'
79. Wilson (Pine Grove, Rockland, Cambridge). Stringers and lenses along crushed zones in quartz monzonite. Stoddard and Carpenter, 1950; Hill, 1915.	38°40'	119°07'
80. Aurora (Esmeralda). Veins along fissures in Tertiary latite and andesite. Vanderburg, 1937.	38°17'	118°52'
81. Hawthorne. Vein along or near contact of granodiorite with Mesozoic limestone. Hill, 1915; Vanderburg, 1937.	38°28'	118°40'
82. Rand (Bovard). Breccia veins in Tertiary rhyolite and replacement veins in latite. Vanderburg, 1937.	38°48'	118°24'
83. Garfield. Veins in limestone and volcanic rocks. Vanderburg, 1937.	38°28'	118°20'
84. Santa Fe (Luning). Contact metamorphic deposits and replacement bodies in Triassic(?) limestones; veins in altered quartz monzonite. Vanderburg, 1937; Hill, 1915; Clark, 1922.	38°32'	118°06'
85. Silver Star (Gold Range, Mina, Douglas). Veins in Triassic conglomerates and Tertiary volcanic rocks. Vanderburg, 1937; Hill, 1915; Kerr, 1936.	38°20'	118°11'
86. Marietta (Black Mountain). Replacement lodes in Triassic(?) andesite tuff, quartzite, conglomerate, and limestone. Vanderburg, 1937; Hill, 1915.	38°17'	118°22'

NEVADA (cont'd.)

87. Buena Vista (Oneota). Veins in extrusive and intrusive igneous rocks and in adjacent hornfels and marble. Vanderburg, 1937. 37°55' 118°19'

88. Candelaria (Columbus). Veins in Ordovician(?) argillites and felsites. Knopf, 1922; Page,1959; Vanderburg, 1937. 38°09' 118°05'

89. Bell (Simon, Cedar Mountains) (Simon mine). Replacement bodies in Triassic limestone along sides of alaskite porphyry dike. Vanderburg, 1937; Knopf, 1921a. 38°34' 117°52'

90. Union (Grantsville, Berlin). Replacement bodies in Triassic limestone; veins in Permian(?) meta-andesite, Triassic slate, conglomerate and limestone, and Tertiary andesite. Kral, 1951; Ferguson and Muller, 1949. 38°53' 117°35'

91. Twin River (Millett). Vein in slate. Kral, 1951. 38°55' 117°16'

92. Jefferson Canyon. Veins in Tertiary rhyolite and along contact with Ordovician slate. Lincoln, 1923. 38°44' 117°01'

93. Round Mountain. Byproduct of gold. Fissure veins in Tertiary rhyolite. Kral, 1951. 38°41' 117°04'

94. Belmont. Veins and lenses in Ordovician limestone and shale near contact with granite intrusive. Kral, 1951. 38°37' 116°56'

95. Manhattan. Byproduct of gold. Veins, lodes, and stockworks in Paleozoic schists and limestones and in Tertiary volcanic rocks. Kral, 1951; Ferguson, 1924. 38°33' 117°03'

96. San Antone. Veins in Permian volcanic rocks and in Ordovician limestone. Kral, 1951. 38°15' 117°14'

97. Tonopah. Replacement veins in Tertiary andesite and rhyolite. Kral, 1951; Hewett and others, 1936; Nolan, 1935b. 38°05' 117°14'

98. Divide (Gold Mountain). Veins along shear zones in upper Tertiary pyroclastic rocks. Knopf, 1921b; Hewett and others, 1936. 38°01' 117°12'

99. Lone Mountain. Replacement bodies in Cambrian limestone along contact with porphyry dike or with granite intrusive. Ball, 1907. 37°57' 117°25'

NEVADA (cont'd.)

100. Klondyke. Veins in Cambrian sedimentary rocks. Lincoln, 1923, Spurr, 1906. 37°54' 117°13'

101. Silver Peak (Red Mountain). Veins in Paleozoic sedimentary rocks. Lincoln, 1923. 37°46' 117°36'

102. Montezuma. Veins and replacement bodies in Cambrian limestone near contact with quartz monzonite. Lincoln, 1923. 37°43' 117°23'

103. Goldfield. Byproduct of gold. Replacement bodies in Tertiary dacite and other volcanic rocks. Lincoln, 1923; Ransome, 1909a; Searles, 1948. 37°42' 117°15'

104. Lida. Veins and replacement bodies in Cambrian limestones. Lincoln, 1923. 37°27' 117°33'

105. Hornsilver. Veins in Paleozoic sediments near borders of granite intrusives. Ransome, 1909b; Hewett and others,1936. 37°22' 117°18'

106. Bullfrog. Veins and lodes along faults in Tertiary rhyolite. Kral, 1951. 36°53' 116°53'

107. Silverbow. Veins in rhyolite. Kral, 1951; Hewett and others, 1936. 37°53' 116°28'

108. Reveille. Veins and stringers in brecciated Paleozoic limestone. Kral, 1951. 38°01' 116°09'

109. Bellehelen. Fissure veins in rhyolite. Kral, 1951. 38°05' 116°28'

110. Tybo. Replacement bodies along a fault in quartz latite porphyry dikes that intrude Cambrian and Ordovician limestones. Ferguson, 1933; Kral, 1951. 38°22' 116°24'

111. Morey. Veins in quartz latite. Kral, 1951. 38°40' 116°15'

112. Tempiute. Veins in lower Paleozoic limestone. Hewett and others, 1936. 37°39' 115°37'

113. Groom (Groom mine).Replacement bodies along bedding and fissures in Cambrian limestone. Humphrey, 1945. 37°20' 115°46'

114. Bristol (Jackrabbit). Replacement bodies along intersections of fissures in Cambrian limestone. Westgate and Knopf, 1932. 38°05' 114°36'

115. Pioche. Replacement vein and bedded deposits along fissures in Cambrian limestone; veins 37°56' 114°29'

NEVADA (cont'd.)

in quartzite. Westgate and Knopf, 1932.		
116. Comet. Bedded replacement bodies in Cambrian limestone; veins in quartzite. Westgate and Knopf, 1932.	37°53'	114°37'
117. Ferguson (Delamar). Disseminated ore and veinlets in shattered Paleozoic quartzite. Hewett and others, 1936.	37°24'	114°49'
118. Yellow Pine (Goodsprings). Replacement bodies along fractures or folds in Mississippian dolomite. Albritton and others, 1954; Hewett, 1931a.	35°52'	115°31'
119. Eldorado. Fissure veins in Precambrian gneiss and schist and in quartz monzonite. Lincoln, 1923.	35°40'	114°50'
120. Searchlight. Breccia veins in metamorphosed lower Tertiary(?) andesite porphyry, in older volcanic rocks, and in Precambrian gneiss. Callaghan, 1939.	35°27'	114°55'

NEW HAMPSHIRE

1. Milan. Replacement lenses along schistosity in siliceous schist. Emmons, 1909.	44°34'	71°15'

NEW MEXICO

1. Cochiti. Veins and replacement bodies along fractures in monzonite. Anderson, 1957.	35°52'	106°27'
2. Willow Creek (Pecos) (Pecos mine). Replacement lenses in shear zone in Precambrian micaceous diorite. Krieger, 1932; Harley, 1940.	35°46'	105°40'
3. New Placers. Replacement pipe at intersection of fractured zone with Pennsylvanian limestone bed; byproduct of copper-gold in contact metamorphic deposits. Lindgren and others, 1910.	35°15'	106°12'
4. Magdalena. Replacement bodies in Mississippian limestone, mostly along crests of low folds. Loughlin and Koschmann, 1942.	34°05'	107°12'
5. Socorro Peak. Narrow veins in rhyolite and trachyte and associated tuffs and breccias. Anderson, 1957.	34°04'	106°58'
6. Black Range. Fissure veins in Tertiary andesite. Harley, 1934.	33°27'	107°43'
7. Apache (Chloride). Replacement veins in Tertiary andesite and	33°20'	107°45'

Pennsylvanian limestone. Harley, 1934.		
8. Hermosa (Palomas). Irregular replacement bodies along a faulted gentle anticline in Pennsylvanian limestone. Harley, 1934.	33°10'	107°43'
9. Kingston. Replacement bodies along fractures on axes of anticlines in Silurian limestone. Harley, 1934.	32°55'	107°43'
10. Lake Valley. Replacement bodies in Mississippian limestone. Harley, 1934; Jicha, 1954.	32°44'	107°34'
11. Cook's Peak. Replacement bodies on broad anticlinal arches in Silurian limestone. Anderson, 1957; Jicha, 1954.	32°33'	107°43'
12. Swartz (Carpenter). Replacement bodies along bedding, shear zones, and fractures in Ordovician limestone. Anderson, 1957.	32°52'	107°48'
13. Georgetown. Replacement bodies in Silurian limestone below Devonian shale near granite porphyry dikes. Paige, 1916.	32°51'	108°01'
14. Central (Hanover). Replacement veins on faulted contact between porphyry dikes and Carboniferous limestone, or in the dikes; contact metamorphic deposits; byproduct of copper in "porphyry" copper deposits of Laramide age. Anderson, 1957; Lasky, 1936; Schmitt, 1935.	32°47'	108°06'
15. Pinos Altos. Replacement bodies along fractures in Pennsylvanian limestone; veins across contact between granodiorite and diorite porphyry of Late Cretaceous(?) age. Anderson, 1957; Paige, 1911.	32°52'	108°14'
16. Chloride Flat. Stringers and pockets along joints and bedding in Silurian limestone associated with porphyry dikes. Anderson, 1957.	32°47'	108°18'
17. Fleming. Irregular pockets in Cretaceous quartzite. Anderson, 1957.	32°46'	108°25'
18. Burro Mountains (Tyrone). Byproduct of copper. Disseminated ore, secondarily enriched, in highly fractured quartz monzonite porphyry and in adjacent Precambrian granite. Anderson, 1957.	32°39'	108°28'
19. Black Hawk. Veins associated	32°42'	108°33'

NEW MEXICO (cont'd.)

with dikes of diorite porphyry in Precambrian gneiss. Anderson, 1957.

20. Mogollon. Veins along faults in Tertiary volcanic rocks. Anderson, 1957. 33°23' 108°49'

21. Steeple Rock. Lode veins in Tertiary extrusive and intrusive rocks. Lindgren and others, 1910; Anderson, 1957. 32°51' 108°58'

22. San Simon. Replacement bodies near granite porphyry dikes in Precambrian(?) limestone. Anderson, 1957. 32°09' 109°00'

23. Lordsburg. Veins along faults in granodiorite stock of Laramide age. Lasky, 1938. 32°18' 108°46'

24. Hachita (Eureka). Veins and replacement bodies commonly along igneous dikes and sills in Cretaceous limestone. Lasky, 1947. 31°55' 108°26'

25. Victorio. Replacement bodies in Ordovician and Silurian limestones. Anderson, 1957. 32°10' 108°06'

26. Organ. Replacement bodies along fracture zones or adjacent to porphyry sheets in Ordovician and Silurian dolomite; contact metamorphic deposits in Carboniferous limestone; veins in lower Tertiary(?) quartz monzonite. Dunham, 1935. 32°26' 106°36'

NEW YORK

1. Balmat- Edwards. Byproduct of lead-zinc. Replacement bodies along channels of microbreccias in Precambrian limestone. Brown, 1936, 1947. 44°18' 75°20'

NORTH CAROLINA

1. Ore Knob. Fissure veins in granite gneiss. Ballard and Clayton, 1948; Ross, 1935. 36°24' 81°18'

2. Silver Hill. Replacement bodies and disseminated ore in volcanic rocks. Pardee and Park, 1948. 35°43' 80°14'

3. Union Copper. Massive sulfide and gold-quartz lodes in belt of silicified chlorite-sericite schist. Pardee and Park, 1948. 35°31' 80°22'

OREGON

1. Riddle. Byproduct of copper. Replacement bodies along schistosity in highly foliated Jurassic schist. Shenon, 1933. 42°52' 123°23'

2. Bohemia. Veins and replacement 43°35' 122°38'

bodies along breccia zones in extrusive and intrusive volcanic rocks of Miocene(?) age. Callaghan and Buddington, 1938.

3. Ashwood (Trout Creek) (Oregon King mine). Lode along brecciated zones in Miocene(?) andesite. Parks and Swartley, 1916. 44°44' 120°40'

4. Granite. Byproduct of gold. Veins along brecciated shear zones in Permian(?) argillite and in Laramide(?) granodiorite batholith. Pardee and Hewett, 1914; Hewett, 1931b; Koch, 1959. 44°52' 118°23'

5. Bourne. Byproduct of gold. Veins in Paleozoic argillite. Swartley, 1914; Hewett, 1931b. 44°50' 118°12'

6. Greenhorn - Geiser. Byproduct of gold. Veins in Carboniferous argillite, Triassic greenstone, and Laramide(?) quartz diorite and serpentine. Swartley, 1914; Lindgren, 1901. 44°42' 118°25'

7. Rock Creek. Byproduct of gold. Veins in Paleozoic argillite and Mesozoic granodiorite. Swartley, 1914; Hewett, 1931b. 44°52' 118°05'

8. Cornucopia. Byproduct of gold. Veins in granodiorite, schist, and greenstone. Swartley, 1914; Goodspeed, 1939. 45°01' 117°12'

PENNSYLVANIA

1. Cornwall. Byproduct of copper. Contact metasomatic bodies in Cambrian limestone near diabase dike. Callahan and Newhouse, 1929; Spencer, 1908. 40°16' 76°24'

SOUTH DAKOTA

1. Bald Mountain (Bald Mountain mine). Byproduct of gold. Bedded replacement bodies along fractures in Cambrian dolomitic quartzite and sandy dolomite. Connolly, 1927; Connolly and O'Harra, 1929. 44°20' 103°50'

2. Whitewood (Lead) (Homestake, Belle Eldridge mines). Byproduct of gold; lenticular replacement bodies in highly altered Precambrian dolomite. Byproduct of lead-zinc; bedded replacement bodies along joint zones in Cambrian dolomite above porphyry sill or basal quartzite. Paige, 1924; Schwartz, 1937; Davis, 1948; Connolly and O'Harra, 1929. 44°22' 103°45'

3. Galena (Bear Butte). Bedded replacement bodies along fractures in Cambrian dolomitic quartzite 44°20' 103°38'

SOUTH DAKOTA (cont'd.).

and sandy dolomite. Connolly and O'Harra, 1929.

TENNESSEE

1. Ducktown. Byproduct of copper. Replacement bodies in Cambrian(?) schist and graywacke. Emmons, 1932; Ross, 1935. 35°02' 84°23'

TEXAS

1. Allamoore. Veins in Precambrian sandstone and in crushed Precambrian limestone, phyllite, and volcanic rocks along thrust fault. King and Flawn, 1953. 31°10' 104°55'

2. Van Horn Mountain. Disseminated ore in Permian sandstone adjacent to bedding plane thrust fault. Sellards and Baker, 1934. 30°55' 104°55'

3. Shafter. Replacement bodies along fracture zones and thrust faults in Permian limestone. Ross, 1943. 29°48' 104°20'

UTAH

1. Ashbrook (Vipont mine). Bedding replacement lenses and stockworks along small linear crenulations in Carboniferous(?) and Cambrian(?) limestone. Peterson, 1942. 41°59' 113°51'

2. Lucin. Replacement bodies adjacent to fissures in Carboniferous limestone. Butler and others, 1920. 41°15' 114°00'

3. Gold Hill (Clifton). Replacement bodies along fractures in Cambrian and Carboniferous limestones and dolomites; veins along faults in Tertiary quartz monzonite. Nolan, 1935a. 40°10' 113°50'

4. Rush Valley (Stockton). Bedded replacement bodies along fissures in Pennsylvanian limestone beds between quartzite beds. Gilluly, 1932. 40°28' 112°20'

5. Bingham (West Mountain). Bedded replacement bodies along faults in Pennsylvanian limestone beds between quartzite beds; byproduct of copper in "porphyry" copper deposits in Tertiary quartz monzonite. Hunt and Peacock, 1948; Boutwell, 1905. 40°31' 112°09'

6. Ophir. Bedded replacement bodies, pipes, and veins along fissures in Cambrian, Devonian, and Mississippian limestone, dolomite, and hornfels. Gilluly, 1932. 40°22' 112°15'

7. Camp Floyd (Mercur). Bedded replacement bodies and replacement veins in Mississippian limestone. Gilluly, 1932. 40°19' 112°13'

8. Little Cottonwood and Big Cottonwood. Bedded replacement bodies, pipes, and fault breccia filling along crosscutting fissures in Cambrian, Devonian, and Mississippian limestones and dolomites; veins in Precambrian and Cambrian quartzite and shale. Calkins and Butler, 1943. 40°36' 111°38'

9. Park City. Bedded replacement and lode deposits along fissures in Pennsylvanian, Permian, and Triassic limestone; lode deposits in Pennsylvanian quartzite and in Upper Cretaceous(?) diorite porphyry. Boutwell, 1912, 1933. 40°37' 111°31'

10. American Fork. Bedded replacement bodies in Cambrian limestone; fissure veins in Precambrian and Cambrian quartzite. Calkins and Butler, 1943. 40°32' 111°37'

11. Carbonate (Dyer mine). Byproduct of copper. Replacement bodies in Mississippian(?) limestone. Butler and others, 1920. 40°44' 109°34'

12. Tintic. Replacement bodies along fractures in Cambrian, Ordovician, and Mississippian limestone and dolomite; veins in Tertiary igneous rocks. Lindgren and Loughlin, 1919; Billingsley and Crane, 1933. 39°57' 112°05'

13. West Tintic. Replacement bodies along fissures in Paleozoic dolomite and limestone. Butler and others, 1920; Stringham, 1942. 39°51' 112°25'

14. Dugway. Veins with local replacement along faults in Cambrian and Mississippian quartzite, limestone, and dolomite. Butler and others, 1920. 39°59' 113°12'

15. Fish Spring. Replacement bodies along fissures and along wall of porphyry dike in Ordovician(?) and Silurian(?) limestone. Butler and others, 1920. 39°51' 113°27'

16. Stateline. Veins in Tertiary rhyolite and interbedded tuff. Butler and others, 1920. 38°05' 114°00'

17. San Francisco and Preuss (Horn Silver, Cactus mines). Replacement veins along faults in Tertiary quartz latite or at its contact with Cambrian(?) limestone; breccia pipe filling along fault in Tertiary quartz monzonite. Butler and others, 1920. 38°28' 113°17'

UTAH (cont'd.)

18. Rocky (Old Hickory mine). Byproduct of copper. Contact metamorphic deposits in Triassic limestone. Butler, 1913.	38°27'	113°04'
19. Star. Replacement bodies, including pipes, along fissures in Silurian(?), Mississippian(?), and Triassic limestone. Butler and others, 1920.	38°22'	113°08'
20. Bradshaw (Cave mine). Replacement bodies adjacent to fissures and along bedding in Carboniferous limestone. Butler and others, 1920.	38°18'	112°55'
21. Gold Mountain. Fissure veins along faults in middle(?) Tertiary dacite. Butler and others, 1920.	38°30'	112°24'
22. Ohio and Mount Baldy. Bedded replacement bodies in Jurassic limestone; veins along faults in Jurassic quartzite and Tertiary dacite. Butler and others, 1920.	38°24'	112°18'
23. Silver Reed (Harrisburg, Leeds). Disseminated deposits in Triassic sandstone associated with plant remains. Procter, 1953.	37°15'	113°22'
24. Tutsagubet. Replacement bodies along and adjacent to fissures in Pennsylvanian limestone. Butler and others, 1920.	37°04'	113°48'

VERMONT

1. Vermont copper. Byproduct of copper. Massive and disseminated replacement bodies in Ordovician(?) schists. Buerger, 1935; McKinstry and Mikkola, 1954.	43°55'	72°19'

VIRGINIA

1. Valzinco-Mineral. Veins along fissures and faults in Precambrian and Cambrian schists. Grosh, 1949.	38°06'	77°51'
2. Virgilina. Byproduct of copper. Fissure veins in lower Paleozoic gneisses and in Triassic sandstones and igneous rocks. Laney, 1917.	36°32'	78°40'
3. Austinville-Ivanhoe. Byproduct of zinc-lead. Ore along limb of anticline in brecciated Cambrian dolomite. Currier, 1935; Watson, 1905.	36°51'	80°57'

WASHINGTON

1. Oroville - Nighthawk. Fissure veins in marginal areas of granodiorite of Laramide age. Patty, 1921.	48°57'	119°40'
2. Ruby - Conconully. Veins near and along border of granite batholith of Laramide(?) age, and in adjacent schists. Patty, 1921.	48°30'	119°44'
3. Chelan Lake (Holden mine). Byproduct of copper. Pyritic replacement bodies along shear zone in amphibolite schist. Youngberg and Wilson, 1952.	48°12'	120°47'
4. Wenatchee (Lovitt mine). Byproduct of gold. Fissure veins in Eocene sandstone, shale, and conglomerate. Lovitt and Skerl, 1958.	47°18'	120°16'
5. Nespelem (Moses). Replacement lode along shear zone in granite batholith of Laramide(?) age. Patty, 1921.	48°09'	119°01'
6. Republic. Fissure veins, breccia ores, and disseminated deposits in Tertiary latite and andesite flows. Umpleby, 1910; Bancroft, 1914; Wright, 1947.	48°38'	118°43'
7. Deertrail (Cedar Canyon). Veins in fissures or shear zones along bedding in Cambrian(?) argillite and limestone. Weaver, 1920.	48°02'	118°05'
8. Springdale (Cleveland mine). Replacement veins along bedding fractures in dolomitic limestone and argillite of Paleozoic age. Jenkins, 1924.	48°07'	118°01'
9. Chewelah. Byproduct of copper. Veins along shear zones in Paleozoic(?) schist and argillite. Howard, 1925; Weaver, 1920.	48°19'	117°40'
10. Colville (Old Dominion mine). Replacement bodies along low-dipping fractures in Cambrian (?) limestone. Weaver, 1920; Howard, 1925; Jenkins, 1924.	48°33'	117°47'
11. Bossburg (Clugston Creek). Replacement bodies along fractures and bedding in Cambrian (?) limestone and argillite. Jenkins, 1924; Weaver, 1920.	48°44'	117°58'
12. Northport. Replacement bodies along bedding and within shear zones in Cambrian(?) dolomite. Weaver, 1920; Jenkins, 1924.	48°52'	117°43'
13. Metaline. Byproduct of zinc-lead. Replacement bodies in Cambrian dolomite and brecciated dolomitic limestone. Park and Cannon, 1943.	48°52'	117°22'

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