Mineral Resources of the Inyo Mountains Wilderness Study Area, Inyo County, California

U.S. GEOLOGICAL SURVEY BULLETIN–1708-A

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STUDIES RELATED TO WILDERNESS

Bureau of Land Management Wilderness Study Area

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas to determine the mineral values, if any, that may be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral survey of the Inyo Mountains Wilderness Study Area (CDCA-122), California Desert Conservation Area, Inyo County, California.

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Mineral Resources of the Inyo Mountains Wilderness Study Area, Inyo County, California

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U.S. Geological Survey

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SUMMARY

Abstract

The Inyo Mountains Wilderness Study Area (CDCA-122) encompasses 57,400 acres on the east side of the Inyo Mountains. Fieldwork for this report was carried out between 1981 and 1984. Twelve mines and prospects of the 84 examined within the wilderness study area have identified resources. The identified resource with the most value is gold, followed by silver and talc. The principal metallic mineral having high resource potential in the study area is gold; silver, lead, zinc, and tungsten have moderate to low resource potential. The non-metallic mineral talc has a high resource potential at three localities on the border of the study area.

Character and Setting

The Inyo Mountains Wilderness Study Area is in the southern part of the Inyo Mountains east of Lone Pine, California (fig. 1) and includes a very rugged part of the Inyo Mountains. Relief is as much as 10,000 ft, with many deep and inaccessable canyons and numerous spectacular cliffs and rock exposures. The area is underlain by a sequence of intensely folded and faulted marine sedimentary rocks of Silurian through Triassic age. Limestone is the most abundant rock type in the lower part of the stratigraphic sequence; shale is more abundant near the top of the sequence. These rocks are intruded by a number of plutons and small granitic bodies of Jurassic age. Faulting, folding and metamorphism have greatly distorted the marine strata, especially in the proximity of the large plutons.

Mining activity has been intermittent in this part of the Inyo Mountains for more that 100 years. The famous Cerro Gordo silver, lead, and zinc mine is located about 3 mi south of the study area, and the Lone Pine District adjoins the west side. Prospecting began in the wilderness study area in 1866 and by 1900, 350 mine workings were excavated and 13 mills built. There were more than 1,000 mining claims located within the study area. It is among the most heavily prospected areas in the western United States.

Identified Resources

Fifty-four of the 84 mines and prospects within the wilderness study area have some significance. The 12 mines and claims with identified resources are shown on figure 2. The identified resource with the most value is gold, followed by silver and talc. About 4.4 million tons of gold-vein resources with 1.1 million oz of gold and 3.2 million oz of silver are identified at five localities; three localities have about 280,000 tons of identified silver-vein resources containing about 2 million oz of silver; 27 occurrences have about 1.2 million tons of poorly defined, smaller, or lower grade gold and silver vein material; the remaining 15 gold and silver occurrences are too poorly exposed to be classified as having resources. Four localities have about 640,000 tons of talc resources. At most of the 54 sites it is likely that additional resources would be disclosed by trenching and drilling.

Mineral Resource Potential

Gold has the greatest mineral resource potential in the Inyo Mountains Wilderness Study Area; silver, lead, zinc, and tungsten have lesser resource potential. Talc, a nonmetallic mineral, is present at and near the Snow Flake Talc mine, Florence Talc mine, Bonham Talc mine and Doris Dee Talc mine and has high resource potential in these areas (fig. 2).

The Inyo Mountains are part of a large province characterized by hydrothermal deposits of lead, zinc, and precious metals. Base and precious metals in the wilderness study area occur almost entirely in veins in granitic rocks or nearby sedimentary rocks. Most large deposits in this region, such as at the Cerro Gordo mine (fig.1), occur in carbonate rock as veins, stockworks, or bedded replacement bodies. Small but rich precious-metal-bearing veins can occur in all rock

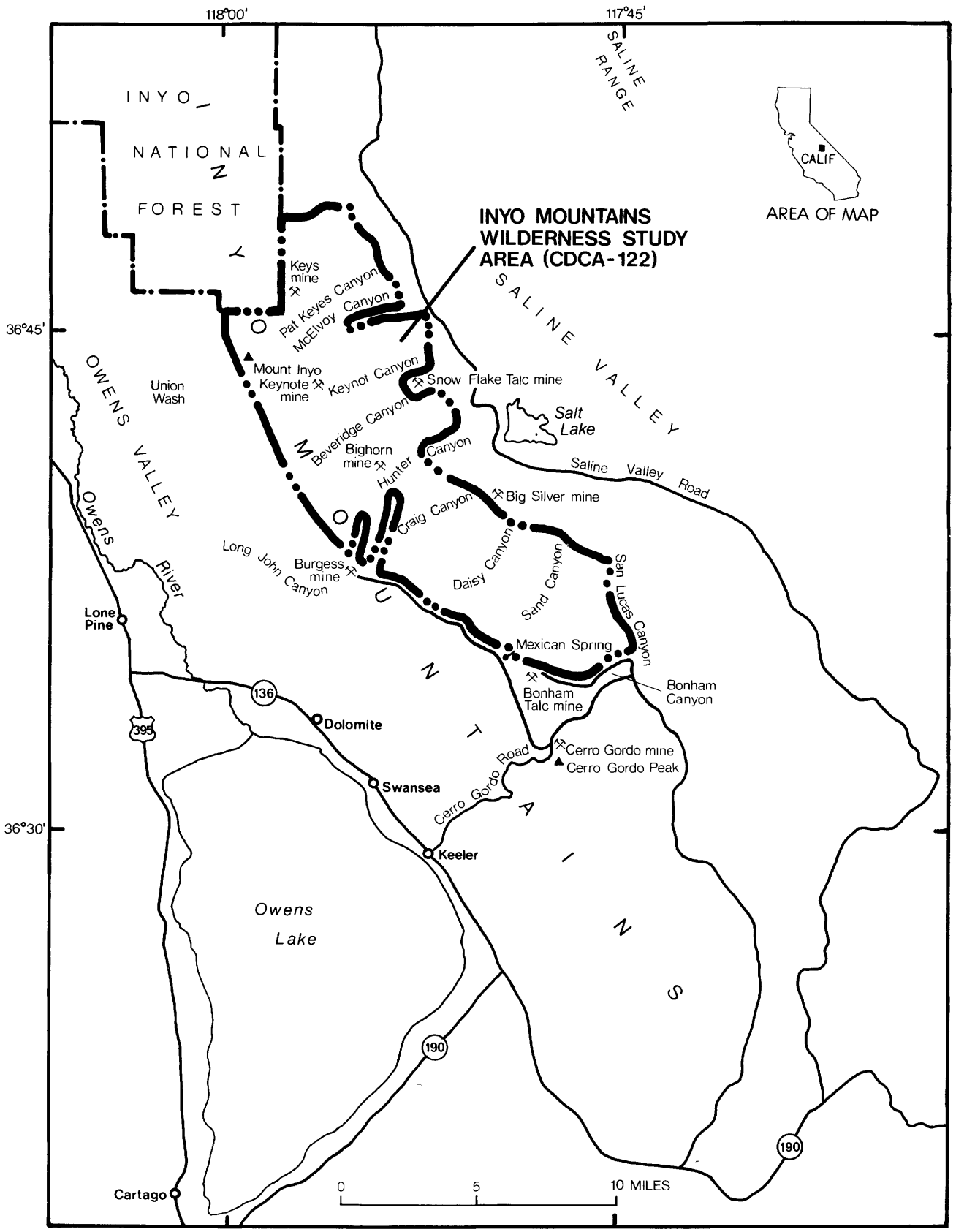

Figure 1. Index map showing location of the Inyo Mountains Wilderness Study Area, Inyo County, California

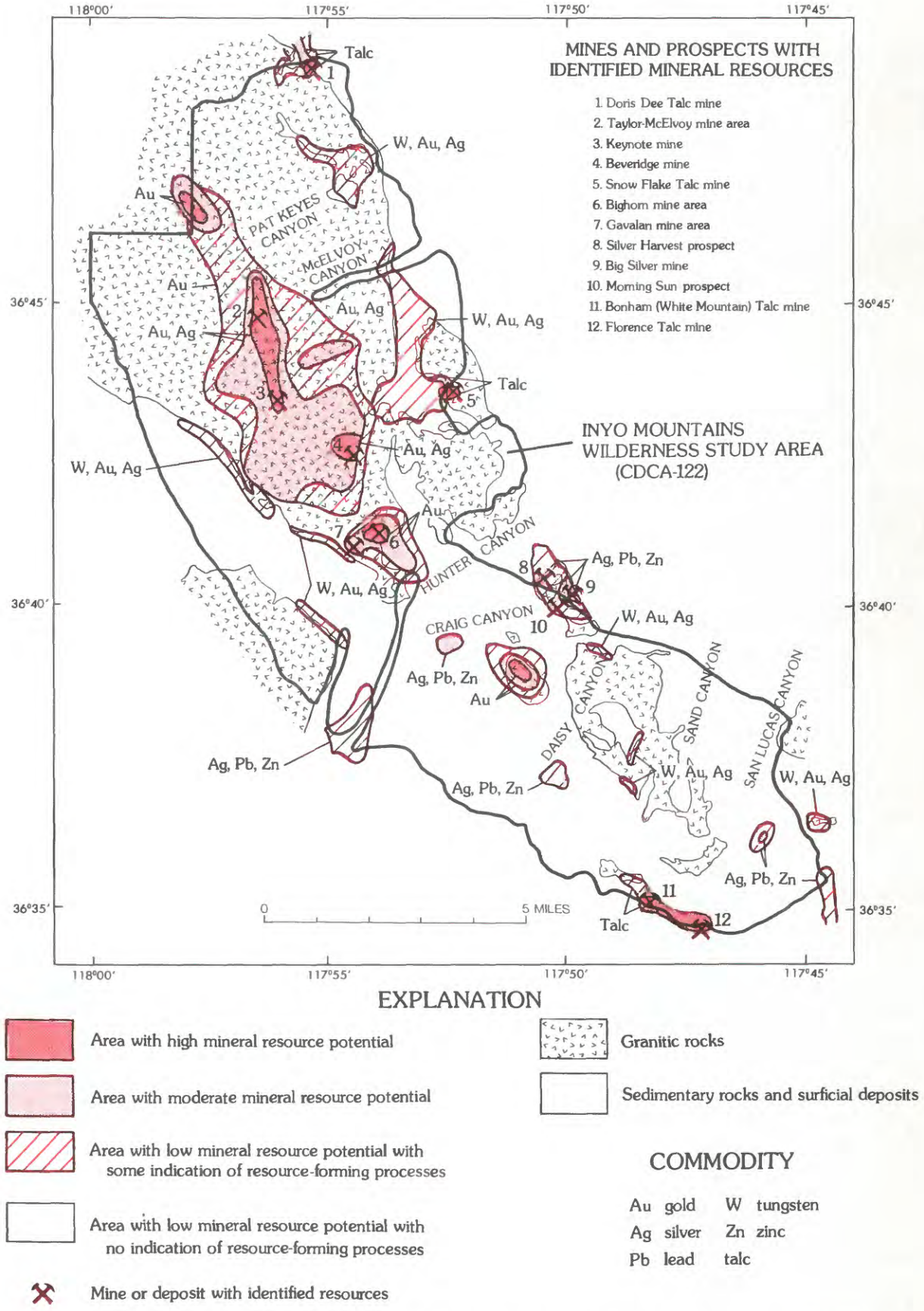

Figure 2. Map showing mineral resource potential of the Inyo Mountains Wilderness Study Area, Inyo County, California

types but generally are concentrated in or near the large granitic bodies.

Skarn, or metasomatically altered and enriched carbonate rocks near large plutons, also could be expected in the area on the basis of the geologic environment. The signature elements tungsten, molybdenum, and bismuth as well as the heavy minerals scheelite and pyrite are present in anomalous amounts at a number of places in the Inyo Mountains and indicate the presence of skarns. Other types of deposits related to the contact-metamorphic effects of large granitic bodies would be expected as well; the most likely is talc, which is found at a number of places in the region.

Geochemical and mineralogical evidence and an inventory of mines and prospects indicate a zone of precious- and base-metal concentration along the upper flank of the Inyo Mountains between Pat Keyes and Daisy Canyons (fig. 2). This zone contains numerous mines and prospects and yielded silver, gold, bismuth, and lead anomalies in heavy-mineral concentrate samples and silver and barium anomalies from stream-sediment samples. The zone is judged to have high resource potential for gold in the vicinity of the Keys mine, between the Johny mine and the Keynote mine, and in the vicinity of the Bighorn, Beveridge and American Flag mines.

An area of high to moderate resource potential for silver, lead, and zinc is located near the Big Silver mine along the eastern edge of the wilderness study area. Three areas judged to have moderate to low potential for resources of these elements are in or near Craig Canyon, Daisy Canyon, and San Lucas Canyon (fig. 2).

There is high resource potential for talc along the granite-dolomite contact in the vicinity of the Snow Flake Talc mine on the eastern edge of the study area, the Doris Dee Talc mine on the north edge, and the Bonham Talc and Florence Talc mines on the southern edge of the wilderness study area.

INTRODUCTION

Area Description

The Inyo Mountains Wilderness Study Area (CDCA-122) covers 57,400 acres on the eastern side of the southern Inyo Mountains east of Lone Pine, in southeastern California (fig. 1). The terrain is rugged and the relief is great, rising from 1,150 ft above sea level at the floor of Saline Valley, to 11,107 ft above sea level at the summit of Mount Inyo. The climate is arid to semiarid; and vegetation is sparse with creosote bush, desert holly, and encelia in the valley bottom, Joshua tree, sage, and rabbit brush at middle elevations, and pinon pine, juniper, and mountain mahogany at higher elevations. Perennial vegetation along streams or near springs includes willow and wild rose. Lush grasses and many varieties of wildflowers also are present.

Access within the area is limited to foot trails built in the 1870's and not maintained since 1906. East of the area a graded dirt road runs along Saline Valley and unimproved roads branching from it lead to the mouths of several canyons and to the Snow Flake Talc mine and Big Silver mine. The southern part of the area can be reached from the west by a graded but steep road that runs from the town of Keeler to the Cerro Gordo mine near the ridge crest and down the east side of the range to the upper part of San Lucas Canyon and the Bonham Talc mine. An unimproved road that runs from the Cerro Gordo mine to the Burgess mine along the crest of the Inyo Mountains and down into the upper part of Hunter Canyon provides access along the southwestern part of the study area. A jeep trail from Swansea in Owens Valley also provides access to the Burgess mine.

Previous and Present Investigations

The Inyo Mountains Wilderness Study Area includes parts of the New York Butte, Ubehebe Peak, and Waucoba Wash 15-minute quadrangles. Unpublished geologic mapping by W. C. Smith in the New York Butte quadrangle served as the basis for most of the geologic mapping done in conjunction with this study. Published geologic maps of the Ubehebe Peak quadrangle (McAllister, 1956), and the Waucoba Wash quadrangle (Ross, 1967) provided information about small parts of the study area. A geologic map of the Inyo Mountains Wilderness Study Area has been compiled by Conrad and McKee (1985).

Early work in the Inyo Mountains includes that of Knopf (1914, 1918) and Kirk (in Knopf, 1918), who first described the stratigraphy and published reconnaissance geologic maps of parts of the range. Merriam (1963), in studies related to the Cerro Gordo mine, mapped south of the study area, but did some reconnaissance mapping within the wilderness study area.

The U.S. Geological Survey carried out field investigations in the wilderness study area during the summers of 1982 and 1983. The work included field checking of existing geologic maps, new mapping where necessary, geochemical sampling, and aeromagmatic and gravity surveys. Rock samples were collected from mines and areas of observed alteration in order to obtain information about mineral suites and trace-element signatures associated with mineralized systems. The analytical data from 66 stream-sediment and 66 panned heavy-mineral concentrate samples are given in Detra and others (1984).

The U.S. Bureau of Mines conducted a library search for information on mines and prospects within the wilderness study area. These data were supplemented by information from claim owners and Inyo County and U.S. Bureau of Land Management claim records. Field studies by U.S. Bureau of Mines personnel were carried out at various times between 1981 and 1983. One thousand five hundred eighty-one samples were taken from 84 mining properties to help appraise the mineral resources of the wilderness study area. Samples were analyzed by fire-assay, atomic-absorption, and inductively coupled argon-plasma spectrophotometric methods. Complete analytical data and detailed property maps are on file at the U.S. Bureau of Mines, Western Field Operations Center, Spokane, Washington 99202.

APPRAISAL OF IDENTIFIED RESOURCES

By Terry J. Close, U.S. Bureau of Mines

History and Production

Mining began in the vicinity of the Inyo Mountains Wilderness Study Area with the 1861 discovery of silver-gold deposits in the Lone Pine (Russ) mining district and the 1866 discovery of silver-lead deposits at Cerro Gordo (Knopf, 1918), just south of the study area.

The principal mines within the wilderness study area, the Keynote and the Bighorn, were discovered in the 1870's (Burchard, 1882; Tucker and Sampson, 1938). The Beveridge mining district, organized in 1877, encompasses these mines as well as those on the northeastern slope of the Inyo Mountains within 15 miles of the Cerro Gordo mine (fig. 1). The wilderness study area now encompasses most of this district. In the 1880's and 1890's small settlements grew up around arrastras and mills built in Craig, Hunter, McElvoy, and Pat Keyes Canyons. Most gold mining in the Beveridge district was done between 1878 and 1906. At first the ore was treated in small burro-driven arrastras located near water sources. The ore was hand sorted at the mines to a gold content of over 6 oz per ton before being transported by pack animals to the mills. Later, small steam-powered mills were built to process the hand sorted ore.

Between 1906 and 1930 mining was tried at a few localities in the district and small cyanide mills were erected at these localities. No production was recorded for any of these operations.

Mining activity increased in the 1930's when the price of gold rose to $35 per oz. Mills were built, but less than $4,000 worth of gold, silver, copper, lead, and zinc was produced. From 1940 to the late 1960's, activity consisted mainly of assessment work. Exploration activity again increased in the 1970's and 1980's, following the steep rise in gold prices. In 1979, Far West Exploration Incorporated acquired an interest in the Keynote mine and began development. In 1983, a cyanide leach plant was flown in by helicopter and began processing the mine dump. Operations terminated later that year.

Production records for the Beveridge district are incomplete; most mining occurred prior to 1905, before detailed records were kept. Most production reported for the district came from veins. About $420,000 in gold (29,000 oz) is reported to have been produced from the Keynote and nearby mines prior to 1906 (Burchard, 1881, 1882, 1883, 1885; Leech, 1890; and U.S. Bureau of Mines production records). Tucker (1926) reported that 1,600 oz of gold with some silver, copper, and lead was produced from the Bighorn mine prior to 1926. Hall (1903), reported that $2 million in gold was produced from the Beveridge district by 1903.

Examinations of mine workings in the wilderness study area suggest that precious metals were probably produced from 33 mines in addition to the Keynote and Bighorn. It is estimated that the 35 mines yielded at least 38,000 oz of gold and 39,000 oz of silver. Some copper, lead, and zinc was recovered, but their total value was small.

Talc mining began in Inyo County in 1912 and in the study area in the 1930s (Norman and Stewart, 1951). Between the 1930s and 1950s, Inyo County deposits were among the principal sources of steatite-grade talc in the United States (Page, 1951, p. 5). Four mines in or near the study area yielded about 50,000 tons of steatite talc. These mines are the Bonham Talc, Florence Talc, Snow Flake Talc, and Doris Dee Talc. In the 1960's the need for steatite talc decreased as cheaper, lower grade talc was adapted for most steatite uses. Intermittent talc mining has continued until the present (1984).

Claim records indicate that more than 1,000 mining claims were located in the study area between 1866 and 1984. Two hundred and four mining claims are currently held (1984).

Mineral Deposits

Three principal deposit types were examined by the Bureau of Mines: 1) fissure gold veins; 2) fissure and replacement silver veins; and 3) metasomatic talc lenses.

The gold-bearing veins are in a zone that extends from the American Flag mine 11 mi northwest to the Cougar mine and is as wide as 3 mi (pl. 1). The veins are in granodioritic rock and are principally drusy quartz with small amounts of gold, silver, pyrite, chalcopyrite, galena and sphalerite. Some veins are as thick as 8.5 ft and as long as 4,200 ft. A total of about 32,000 ft of quartz veins was identified.

Silver-bearing veins, mainly in calcareous sedimentary rocks, are in a zone that extends from the Gold Standard mine southeast about 2 mi to the Morning Sun prospect (pl. 1). The veins are composed principally of breccia, gouge, drusy quartz, and calcite with tetrahedrite and galena and small amounts of sphalerite, stibnite and arsenopyrite. Veins of this type have been found as thick as 20 ft and as long as 1,800 ft. A total of about 7,700 ft of silver-bearing veins was identified.

Talc lenses occur on the north, east and south edges of the study area in metamorphosed carbonate rocks. The talc lenses can be as thick as 40 ft. About 5,200 ft of talc lenses was identified.

Fifty-four mines and prospects of the 84 examined within the wilderness study area are considered significant (Close, 1985); 12 with identified resources are shown on figure 2 and summarized in table 1. Identified gold resources have the greatest value, followed by silver and talc. About 4.4 million tons of inferred, marginal gold reserves averaging 0.24 oz of gold and 0.74 oz of silver per ton are identified at five localities; three localities have about 280,000 tons of subeconomic silver resources averaging 7.0 oz of silver per ton; 27 occurrences have about 1.2 million tons of poorly defined, smaller, or lower grade gold and silver deposits; 15 gold and silver occurrences are too poorly exposed to be classified as having resources; and four localities have about 640,000 tons of talc-bearing rock. It is likely that additional resources would be disclosed by trenching or drilling at most of the 54 sites which are summarized in table 2. There are large areas of limestone, dolomite and other stone. Sand, gravel and stone are not classified as resources because of their inaccessibility, and because

suitable deposits are closer to markets.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

By Edwin H. McKee, James E. Conrad, James E. Kilburn, J. Howard McCarthy, Jr., and Richard J. Blakely, U.S. Geological Survey

Geology

The Inyo Mountains Wilderness Study Area is underlain by a sequence of intensely folded and faulted marine sedimentary rocks of Silurian through Triassic age. These units are intruded by a number of Mesozoic plutons that are considered to be comagmatic with the Sierra Nevada batholith (Bateman and others, 1963; McKee and Nash, 1967; Ross, 1969).

A summary of the stratigraphy of the Inyo Mountains Wilderness Study Area is given in Conrad and McKee (1985). A composite section of more than 12,000 ft of strata is present in the southern part of the Inyo Mountains, but only a fraction of this total is present at any single place because faulting, folding, and metamorphism have greatly distorted these stratified rocks, especially adjacent to the large granitic plutons. The Devonian through Permian strata are about two thirds carbonate (limestone and dolomite) and one third siliceous rocks, including sandstone and shale. The limestone and dolomite in the lower part of the section are mostly medium- to thick-bedded units representing deposits formed in a shallow-water continental-shelf environment. Siliceous units interbedded with these carbonates are mostly clean, medium- to fine-grained quartz sandstones. The upper part of the Paleozoic section contains about equal amounts of carbonate and argillaceous strata. Most of the carbonates consist of thin-bedded limestone that is interbedded with shale and argillite. Abundant turbidite features are present in these rocks, which probably were deposited in basins on the continental shelf. Triassic rocks are mostly thin-bedded shale, with thick-bedded limestone present near the top of the sequence.

Mesozoic plutonic rocks underlie most of the northern part of the study area and smaller stocks intrude the Paleozoic and Triassic sedimentary rocks in the southern part of the area. Contacts with the surrounding country rock generally are steep and sharp, and contact-metamorphism extends as far as 2 mi from the contacts. The widespread signs of alteration, including hornfelsic texture, low grade metamorphic-mineral assemblages, and anomalous amounts of limonite that were observed in the sedimentary rocks throughout the area, suggest that plutonic rocks may underlie these strata at shallow depths throughout the region. Most of the plutonic rocks are quartz monzonite and granodiorite, but alaskite, monzonite, diorite, and gabbro also are present. The rocks are medium to coarse grained, porphyritic, and nonfoliated.

Quaternary deposits in the study area can be grouped into older and younger deposits. The older deposits are well bedded, partly consolidated sand and gravel that consist of small, discontinuous outcrops in canyon bottoms and perched remnants along the range-front, and on the uplifted sides of range-front faults. The younger Quaternary deposits consist of alluvial fans primarily along the edge of Saline Valley, unconsolidated alluvium along stream bottoms and in Saline Valley, and colluvium that consists of unconsolidated rock debris on gentle slopes and as talus on steeper slopes. The study area has several large and many small landslides along the steep eastern slopes of the Inyo Mountains. In addition to typical landslides there are several areas of 0.5 mi^2 or more in which the rocks are intensely broken and partially rotated but which retain their general order or stratigraphic positions—like a mildly disturbed jigsaw puzzle.

Paleozoic and Triassic strata in the study area are strongly folded and faulted. The intrusion of the large plutons further complicated the structure by creating widespread, pervasive hornfelsic texture, foliation, lineation, and recrystallization. Three major episodes of deformation can be recognized in this region. These deformational episodes are: (1) faulting and folding that took place prior to emplacement of granitic rocks; (2) deformation associated with emplacement of plutonic rocks; and (3) basin and range high-angle normal faulting that caused uplift of the Inyo Mountains.

Geochemical Studies

The reconnaissance geochemical study was based on analysis and evaluation of stream sediments, heavy-mineral concentrates from stream sediments, and rock samples. The stream-sediment and concentrate samples contain material derived from major rock units of the drainage basin. Sampled drainage basins range in area from less than one to several square miles. Analytical data and a description of the sampling and analytical techniques used are given in Detra and others (1984).

All samples were analyzed for 31 elements by a six-step semiquantitative emission spectrographic method (Grimes and Marranzino, 1968). These analyses identify drainages with anomalous concentrations of metal or metal-related elements. Anomalous values were determined by inspection of histograms, percentiles, and enrichment relative to crustal abundance. Most often these anomalies reflect known mining activity, but in some instances they indicate areas of undisclosed or previously unrecognized mineralization.

Metallic and nonmetallic elements present in anomalous amounts and minerals identified from stream-sediment samples indicate at least three types of mineralization occurred in the wilderness study area. Gold-bearing quartz veins are indicated in the upper flanks of the range between Hunter Canyon and Pat Keyes Canyon, and, locally, south of Craig Canyon (fig. 2; pl. 1). The trace element suite from stream-sediment samples (including panned concentrates) consists of gold, silver, bismuth, and lead. The anomalous area and mineral occurrence type is best delineated by the heavy-mineral concentrates that include gold, sphalerite, chalcopyrite, pyrite, arsenopyrite, and cinnabar. Granitic accessory minerals include apatite, zircon, sphene, and monozite.

Evidence for base-metal and silver mineraliza-

tion was found in Craig Canyon close to the contact between granitic rock and limestone. Anomalous elements include silver, lead, zinc, and copper. Sphalerite and pyrite and unidentified sulfide minerals are found in concentrate samples. A strong geochemical anomaly occurs in drainages below the Big Silver mine near the mouth of Craig Canyon. Stream sediments there contain anomalous silver, lead, zinc and arsenic, and optical studies of the concentrate samples reveal arsenopyrite, pyrite, hydrozincite, and malachite.

Geochemical anomalies with a different elemental signature occur in both stream sediment and heavy-mineral concentrates at a number of localities near the northeastern edge of the wilderness study area along the range front. Anomalies with a similar elemental and mineral composition occur locally in the upper reaches of McElvoy Canyon and in San Lucas Canyon on the southeastern edge of the wilderness study area. Anomalous elements from these localities are silver, molybdenum, barium, tungsten, lead, and zinc. Heavy minerals identified are scheelite, chalcopyrite, pyrite, sphalerite, barite, and powellite. The elemental and mineral signature is that of skarn deposits of the Bishop type (Rose and others, 1979).

Geophysical Studies

Much of the granitic rock of the Inyo Mountains has significantly higher magnetic susceptibilities than Proterozoic and Paleozoic sedimentary rocks of the region (Blakely and McKee, 1985; Blakely and Helferty, 1985). Aeromagnetic data can be used, therefore, to infer the presence of plutonic rocks at relatively shallow depth below the sedimentary rocks that they intrude. Base- and precious-metal deposits in the Inyo Mountains occur almost exclusively in veins within the granitic rocks or in adjacent sedimentary rocks. Hence, aeromagnetic data provide an important source of information concerning the mineral resource potential at relatively shallow depth within the Inyo Mountains Wilderness Study Area.

Four aeromagnetic surveys (U.S. Geological Survey, 1982a, 1982b, 1983a, 1983b) have been flown over the Inyo Mountains Wilderness Study Area and surrounding regions. Each survey was flown at a constant altitude appropriate for the terrain surveyed. Flightlines were directed east-west and spaced 1 mi apart for all surveys. Digital anomaly values are interpolated to a rectangular grid with grid intersections spaced 0.31 mi apart. The gridded data are then contoured at appropriate scales for comparison with geologic and topographic maps.

The aeromagnetic data indicate that most of the northwestern half of the wilderness study area is underlain by a single plutonic body that extends southeast at least several miles to a point about 1 mi south of the Burgess mine (fig. 1; pl. 1). The southeastern edge of this pluton is located approximately along Hunter Canyon. The magnetic anomaly implies that all of the areas considered to have mineral resource potential northwest of Hunter Canyon are underlain at shallow depth by granitic rocks and supports the hypothesis that base- and precious-metal and skarn deposits in this area are related to interactions between granitic intrusions and the older sedimentary rocks that they intrude. The anomaly suggests that most of the study area northwest of Hunter Canyon was geologically favorable for these types of mineralization at relatively shallow depth.

Several local positive anomalies are present within the area encompassed by the magnetic anomaly discussed above. Some of these are due to topographic relief in magnetic terrane. For example, the local anomaly over New York Butte is related to the 10,668-ft ridge of exposed granitic rock. Other local anomalies, however, are unrelated to topography and may indicate the presence of near-surface concentrations of magnetic minerals. A line of positive anomalies extends east-southeast from Mount Inyo to Hunter Canyon (fig. 1). The anomalies follow the zone of low to high resource potential for base- and precious-metal deposits and the subparallel zone of skarn deposits shown on plate 1; these areas include the Keynote and Bighorn mines. The anomalies may indicate the presence of iron sulfide or iron oxide concentrations related to these mineralized zones.

Only one significant magnetic anomaly occurs within the study area southeast of Hunter Canyon. An oval-shaped anomaly 4 mi in diameter is centered at lat $36^{\circ}37'$ N. and long $117^{\circ}48.5'$ W. and overlies outcrops of Mesozoic granitic and Paleozoic sedimentary rocks in this area. The anomaly probably is caused by the continuation of exposed granitic rocks to shallow depth below the sedimentary rocks. Several areas in addition to the Bonham Talc mine that are judged to have mineral resource potential lie along the southwestern, western, and northwestern margins of this anomaly (fig. 1; pl. 1). It is possible that similar mineral resource potential exists at shallow depth along the other margins of the anomaly, especially in the vicinity of Sand Canyon.

The absence of significant magnetic anomalies southeast of Hunter Canyon suggests that the intrusive rocks exposed at the surface in this area are either very small in volume or relatively nonmagnetic, and that magnetic phases of buried plutons do not exist in this region. The area of the Big Silver mine, for example, is not associated with a magnetic anomaly; intrusive rocks that crop out in this area must be very limited in size or nonmagnetic relative to other plutons in the study area.

Conclusions

Geologic studies, geochemical sampling, examinations of mines and prospects, and review of mine production and ore types indicate that the Inyo Mountains lie within a province characterized by hydrothermal deposits containing lead, zinc, silver, and local gold-quartz veins. Throughout this province ores contain significantly higher ratios of silver to gold than most places in the western United States, and copper, although present, is not abundant. A prime example of a large mine with ore minerals and element types and ratios typical of this province is the Cerro Gordo mine (fig. 1), which lies just south of the Inyo Mountain Wilderness Study Area.

Studies within the wilderness study area indicate that base- and precious-metal deposits containing lead,

zinc, and copper are in or near large granitic bodies. Gold is in small quartz veins in granitic rock and limestone, and is associated with pyrite, galena, sphalerite, and chalcopyrite (Knopf, 1918). Lead, zinc, and silver are found in veins, stockworks and bedded replacement bodies in carbonate rock associated with a quartz-calcite gangue; ore minerals are argentite, native silver, galena, and sphalerite (Goodwin, 1957). Based on the trace elements in the geochemical samples and the mineral suites in heavy-mineral concentrate samples, the conceptual model for mineralization appears to be related to low- to moderate-temperature hydrothermal events. The geologic environment is conducive to this type of mineralizing phenomenon. The plutonic rocks may have provided the mineralizing fluids that formed veins within the granites and replacement bodies and veins in the surrounding reactive carbonate rocks.

A second type of mineral deposit that might be expected in the area on the basis of the geologic environment is skarn, specifically skarns with the Bishop-type trace element signature (Rose and others, 1979, table 4.1). These skarns are characterized by the presence of tungsten, molybdenum and bismuth, as well as the typical heavy minerals scheelite and pyrite. All of these are present in anomalous amounts at a number of places in the southern Inyo Mountains and indicate the presence of Bishop-type skarns. Although sizable skarns were not found during this study, the presence of the signature elements and heavy minerals suggest their presence.

Geochemical and mineralogical evidence and assessment of mines and prospects indicate base- and precious- metal mineralization occurred along the upper flank of the Inyo Mountains between Pat Keyes and Daisy Canyons (fig. 2; pl. 1). This area contains numerous mines and prospects and yielded anomalous amounts of silver, gold, bismuth, and lead in some heavy-mineral concentrates, and silver and barium anomalies from stream-sediment samples. The area is judged to have high resource potential, certainty level D (see Appendix 1 and figure 3 for definition of certainty levels), for gold in the vicinity of the Keys and Cougar mines, between the Johny mine and the Keynote mine (certainty level C), and in the vicinity of the Bighorn, Beveridge, and the American Flag mines (certainty levels C and D, respectively). Moderate and low resource potential for gold (certainty level C) is peripheral to these areas. The deposits in these areas are in veins that cut granitic rocks and may be controlled by small faults and shear zones.

An area of high to moderate resource potential (certainty level D) for silver, lead, and zinc is indicated at and near the Big Silver mine near the base of the Inyo Mountains along the eastern edge of the wilderness study area. Four areas judged to have moderate to low potential for resources (certainty level C) of these elements are in Craig Canyon and in the vicinity of the American prospect (moderate), and in Daisy Canyon and San Lucas Canyon (low) (fig. 2; pl. 1). Mineralization at all these localities was of hydrothermal origin and formed veins or stockworks in or near granitic rocks.

Evidence that skarns exist at many places along the contact between plutonic rocks and calcareous units is indicated by anomalous molybdenum, tungsten, and bismuth in stream-sediment samples, and the presence of scheelite and pyrite in heavy-mineral concentrates. Although no sizable skarns were found during this study, the contact zones surrounding the large plutons in the northern part of the wilderness study area are judged to have low potential (certainty level C) for resources of tungsten and possibly gold and silver in small skarn deposits. Elsewhere at scattered localities in the southern part of the study area geochemically anomalous stream-sediment and heavy-mineral concentrate samples suggest low resource potential (certainty level C) for precious metals and for tungsten (fig. 2; pl. 1).

Talc, which formed at the contact between granitic rock and dolomite, is present and has been mined at the Snow Flake Talc mine on the eastern edge of the study area, at the Doris Dee Talc mine on the northern edge, and at the Bonham Talc and Florence Talc mines on the southern edge of the study area. There is high potential (certainty level D) for additional resources of talc from these mines and from nearby pods and bodies of talc.

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APPENDIX 1. Definition of levels of mineral resource potential and certainty of assessment

Mineral resource potential is defined as the likelihood of the presence of the mineral resources in a defined area; it is not a measure of the amount of resources or their profitability.

Mineral resources are concentrations of naturally occurring solid, liquid, or gaseous materials in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

Low mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment where the existence of resources is permissive. This level of potential embraces areas of dispersed mineralized rock as well as areas having few or no indications of mineralization. Assignment of low potential requires specific positive knowledge; it is not to be used as a catchall for areas where adequate data are lacking.

Moderate mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a reasonable chance for resource accumulation, and where an application of genetic and (or) occurrence models indicates favorable ground.

High mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resources, where interpretations of data indicate a high likelihood for resource accumulation, where data support occurrence and (or) genetic models indicating presence of resources, and where evidence indicates that mineral concentration has taken place. Assignment of high resource potential requires positive knowledge that resource-forming processes have been active in at least part of the area; it does not require that occurrences or deposits be identified.

Unknown mineral resource potential is assigned to areas where the level of knowledge is so inadequate that classification of the area as high, moderate, or low would be misleading. The phrase "no mineral resource potential" applies only to a specific resource type in a well defined area. This phrase should not be used if there is the slightest possibility of resource occurrence; it is not appropriate as the summary rating for any area.

Expressions of the certainty of the mineral resource assessment incorporate a consideration of (1) the adequacy of the geologic, geochemical, geophysical, and resource data base available at the time of the assessment, (2) the adequacy of the occurrence or genetic model used as the basis for a specific evaluation, and (3) an evaluation of the likelihood that the expected mineral endowment of the area is, or could be, economically extractable.

Levels of certainty of assessments are denoted by letters, A-D (fig. 3).

A. The available data are not adequate to determine the level of mineral resource potential. Level A is used with an assignment of unknown mineral resource potential.

B. The available data are adequate to suggest the geologic environment and the level of mineral resource potential, but either evidence is insufficient to establish precisely the likelihood of resource occurrence, or occurrence and (or) genetic models are not known well enough for predictive resource assessment.

C. The available data give a good indication of the geologic environment and the level of mineral resource potential, but additional evidence is needed to establish precisely the likelihood of resource occurrence, the activity of resource-forming processes, or available occurrence and (or) genetic models are minimal for predictive applications.

D. The available data clearly define the geologic environment and the level of mineral resource potential, and indicate the activity of resource-forming processes. Key evidence to interpret the presence or absence of specified types of resources is available, and occurrence and (or) genetic models are adequate for predictive resource assessment.

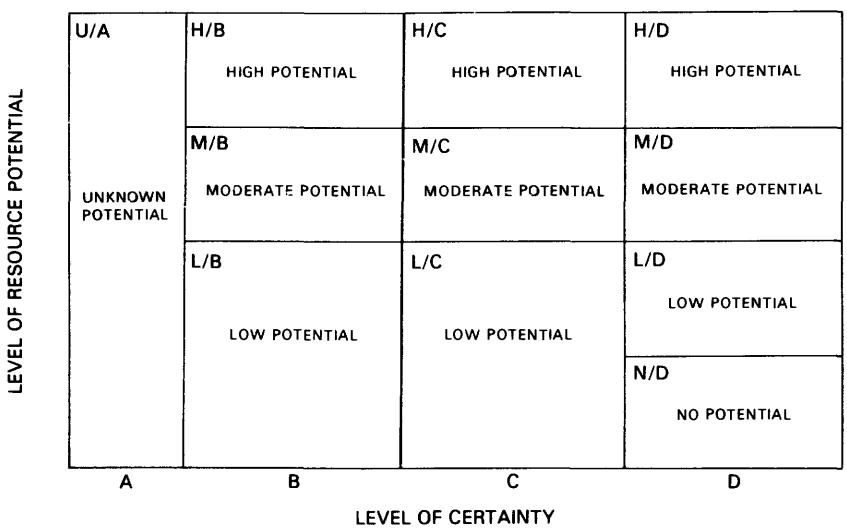

Figure 3. Major elements of mineral resource potential/certainty classification

Table 1. Identified mineral resources in the Inyo Mountains Wilderness Study Area

Map number (fig. 2; pl. 1)	Name	Deposit type	Quantity (tons)	Resource Classification[1]	Commodity	Grade [2]
1	Doris Dee Talc mine	Lens	20,000	Inferred marginal reserve	Talc	Steatite or near steatite
2	Taylor-McElvoy mine area	Fissure vein	370,000	do.	Gold Silver	.24 .23
3	Keynote mine	do.	2,500,000	do.	Gold	.17
	Do.	do.	100,000[3]	do.	Gold Silver Copper	.43 .56 .21
	Do.	Dump material	47,000	Indicated marginal reserve	Gold Silver	.21 .53
4	Beveridge mine	Fissure vein	200,000	Inferred marginal reserve	Gold Silver	.3 [4] 1.1
5	Snow Flake Talc mine	Lens	340,000	do.	Talc	Steatite or near steatite
6	Bighorn mine area	Fissure vein	1,200,000	do.	Gold Silver Copper	.39 [3] 2.4 .4
7	Gavalan mine area	do.	33,000	do.	Gold	.42
8	Silver Harvest claims	Fissure and replacement veins	180,000	Inferred subeconomic resources	Silver	2.6
9	Big Silver mine	do.	57,000	do.	Silver	9.5 [5]
10	Morning Sun claims	Fissure and replacement veins	44,000	Inferred subeconomic resources	Silver Copper Lead Zinc	22.0 .32 .27 .76
11	Bonham (White Mountian) Talc mine	Lens	32,000	Inferred marginal reserve	Talc	Steatite or near steatite
12	Florence Talc mine	do.	250,000	Inferred marginal reserve	Talc	Do.

1/ U.S.Bureau of Mines and U.S. Geological Survey, 1980
2/ Gold and silver are reported in oz/ton and the base metals in percent.
3/ A part of the resource located in the principal workings.
4/ Also contains erratic lead values.
5/ Also contains erratic lead, zinc, copper, gold, and arsenic values.

Table 2. Summary of significant mines and prospects in and adjacent to the Inyo Mountains Wilderness Study Area (WSA) (BLM No. CDCA-122)

Name	Map No. (Plate 1)	Summary	Workings and production	Resource/sample data
Doris Dee Talc mine	1	Three irregular talc lenses that contain some hard siliceous-calcareous pods, crop out along two northwest trending fault zones that transect dolomitic marble. The largest lens is 30 ft thick and 100 ft long. The three lenses total 240 ft in length and average 27.5 ft thick.	Three adits totaling 380 ft, an 80-ft-long open cut, and a hoist and slusher. About 320 tons of talc were mined.	Based on 19 samples, about 20,000 tons of talc ore inferred that can be mined in conjunction with nearby deposits at a cost that is about equal to the value of the product. Thus, the Doris Dee depost is classified a marginal reserve. Additional talc is likely to occur at the mine.
Taylor-McElvoy mine area	2	Eight nearly parallel veins, 200- to 300-ft apart, are along a fracture zone in quartz monzonite. The zone can be traced 3,600 ft along its N. 20° to 40° W. trend. The veins are 0.2 to 3.3 ft thick and average 1.7 ft thick. They are mainly drusy quartz with gold, malachite, limonite, hematite boxwork, pyrite, and chalcopyrite.	Along the veins are 12 adits totaling about about 2,200 ft, and nine benches totaling 1,300 ft. A dismantled stamp mill, arrastre, and steam engine are on McElvoy Creek below the workings. It is estimated that 800 tons of ore containing at least 200 oz of gold and 200 oz of silver were mined.	The eight veins are inferred to contain 370,000 tons of resources averaging 0.24 oz/ton gold and 0.23 oz/ton silver, based on 73 chip samples. The deposit is classified a marginal reserve, assuming it is mined in conjuction with other deposits in the WSA and can be treated using typical mining and milling methods. Additional gold-silver resources are likely.
Keynote (Keynot) mine	3	Three nearly parallel veins, about 350 ft apart, and a subparallel vein are in quartz monzonite. The four veins identified have lengths totaling about 9,700 ft. The parallel veins are 0.3 to 5.0 ft thick, strike N. 40° to 70° W., and dip 25° to 55° SW. Near the surface they are primarily leached drusy quartz with gold. At depth gold is associated with chalcopyrite, pyrite, and galena. Most of the near surface veins have been mined and the workings backfilled. The subparallel vein is 0.5 to 4.0 ft thick, strikes N. 50° to 70° W., dips 25° to 35° SE., and has slightly more galena.	The principal working has 8,000 ft of levels, sublevels, and raises. In addition, there are another 27 smaller underground workings totaling about 2,100 ft, and numerous small pits and cuts. A 250-ton/day cyanide mill is near the principal workings. Laskey's stamp mill, where most Keynote ore was processed, is 3 mi south. Production records and workings sizes indicate that between 1878 and 1906 about 5,000 tons of handsorted, gold-bearing quartz were transported to the mill where about 29,000 oz of gold were recovered.	The four veins contain about 2.5 million tons of inferred resources averaging 0.17 oz/ton gold, based on 189 chip samples. A 100,000-ton part of the vein located in the principal workings average 0.43 oz/ton gold, 0.56 oz/ton silver, and 0.21% copper. The dump has about 47,000 tons of material that average 0.21 oz/ton gold and 0.53 oz/ton silver. The deposit is classified a marginal reserve, assuming it is mined in conjunction with other deposits in the WSA and can be treated using typical mining and milling methods. Additional vein material is likely.
Beveridge mine	4	A 1- to 8-ft-thick drusy quartz vein in quartz monzonite, with an average thickness of 2.1 ft, strikes N. 30° E., dips 35° NW., and is 1,500 ft long. The vein contains pyrite, limonite, malachite, chalcopyrite, and gold.	Along the vein are 11 underground workings totaling 700 ft, four benches totaling 400 ft, several small pits, a wireline tram, and a Huntington mill. Estimated production is 1,000 tons of ore containing at least 300 oz of gold and 1,000 oz of silver.	About 200,000 tons of inferred resources average 0.3 oz/ton gold and 1.1 oz/ton silver, based on 33 chip samples. The deposit is classified a marginal reserve, assuming it is mined in conjunction with other deposits in the WSA and can be treated using typical mining and milling methods. Additional vein material is likely.
Snowflake Talc mine	5	Four irregular, curvilinear talc lenses follow fractured contact zones between dolomitic limestone and quartz diorite. The lenses total about 2,000 ft in length, average 5 ft thick, and are composed of green-to-white, blocky talc that grades outward into impure talc-schist stringers. Pods of hard, calcareous-siliceous rock are included in the talc.	There are two groups of workings 1,300 ft apart. At the east group are a 370-ft tunnel with stopes, a 100-ft caved adit, a number of small pits and cuts, and an ore bin. At the west group are an 80-ft adit, three large pits, several small pits and cuts, and a dismantled slusher. It is estimated that 5,000 tons of steatite talc were hand cobbed and shipped.	The four talc lenses are inferred to contain about 340,000 tons. Assuming the deposits would be mined in conjunction with nearby deposits, the Snowflake deposit is classified a marginal reserve. Additional talc is likely.
Bighorn mine area	6	Three subparallel, drusy quartz veins in quartz monzonite are 0.1 to 8.5 ft thick, as long as 3,500 ft, strike N. 80° E. and dip 25° to 85° NW. The veins total about 4,000 ft in length and average 2.4 ft thick. A northwest-trending, gently dipping, poorly exposed vein crosscuts the three subparallel veins. The copper-stained veins have limonite, hematite boxwork, pyrite, chalcopyrite, galena, and gold.	In an area that measures 2,000 ft by 6,000 ft are 15 underground workings, eight benches, many small pits, a water line, and a small, dismantled cyanide mill. The principal mill (Hunter Arrastras) is 1.5 mi south. The underground workings total 3,000 ft and the benches 2,000 ft. Tucker (1926, p. 466) reported that $40,000 in gold, with some silver, copper, and lead, was produced. About 4,000 tons of ore containing at least 1,600 oz of gold and 9,600 oz of silver are estimated to have been mined.	There are 1.2 million tons of inferred resources in the three subparallel veins averaging 0.39 oz/ton gold, 2.4 oz/ton silver, and 0.4% copper, based on 77 chip samples. The deposit is classified a marginal reserve, assuming it is mined in conjunction with other deposits in the WSA and can be treated using typical mining and milling methods. Additional vein material and resources are probable.

Gavalan mine area	7	Poorly exposed, irregular, quartz veins as thick as 13 ft are along a zone of east-trending, steeply dipping fractures in quartz monzonite. The veins contain malachite and limonite boxwork after pyrite and galena. The principal vein averages 2.9 ft thick and is 520 ft long.	Over a distance of 1,700 ft along the zone are seven pits, and three adits totaling 150 ft. Crawford (1894, p. 137) reported that a vein 5 ft thick, 100 ft wide, and 200 ft long (8,000 tons of ore) had been mined. It is estimated that this ore contained at least 3,400 oz of gold.	The principal vein contains about 33,000 tons of inferred resources averaging 0.42 oz/ton gold, based on nine chip samples. The deposit is classified a marginal reserve, assuming it is mined in conjunction with other daposits in the WSA and can be treated using typical mining and milling methods.
Silver Harvest prospect	8	Along a contact zone between quartz monzonite and argillaceous limestone is an 8- to 91-ft thick fracture zone that trends northeast and dips steeply. The zone is visible for 1,800 ft along strike and for 800 ft downdip; but, because of cliffs, is accessible for only about 460 ft. The accessible part of the zone averages 20 ft thick, and is leached and oxidized breccia and gouge with quartz and tetrahedrite.	Two adits totaling 40 ft and a pit.	The accessible portion of the zone is inferred to contain 180,000 tons of material that average 2.6 oz/ton silver, based on six chip samples. Assuming the zone would be mined in conjuction with nearby deposits, it is classified a subeconomic resource. Additional silver-bearing material is probably present in the inaccessible parts of the zone.
Big Silver mine	9	A 0.7- to 12.0-ft-thick vein trends east to northeast, dips steeply, and is broken by faults and dikes into segments which total 700 ft long and average 2.8 ft thick. The vein is mainly leached and oxidized breccia, gouge, and quartz with limonite, malachite, tetrahedrite, and sphalerite. It is in the contact zone between quartz monzonite and calcareous metasediments.	Six adits totaling 2,800 ft, and three wireline trams are along the vein segments. It is estimated that 800 tons of ore containing at least 7,600 oz of silver have been mined.	About 57,000 tons of vein material average 9.5 oz/ton silver, based on 23 chip samples. The deposit could be mined in conjunction with the Morning Sun and Silver Harvest deposits at a cost equal to about 1.8 times the value of production. It, therefore, is classified a subeconomic resource. It is probable that additional silver vein resources are present.
Morning Sun prospect	10	The prospect is on an extension of the Big Silver mine deposits, A 0.9- to 2.1-ft-thick vein strikes N. 60° to 80° E. and dips 85° NW. It averages 1.3 ft thick and crops out intermittently for 900 ft along a faulted contact zone between quartz monzonite and calcareous metasedimentary beds. The zone trends north and dips east. Vein material is leached and oxidized, and consists of drusy quartz with limonite, malachite, tetrahedrite, and sphalerite.	A 115-ft adit, one small pit, and a 1,550 ft wireline tram.	The vein contains about 44,000 tons of resources averaging 22 oz/ton silver, 0.32% copper, 0.27% lead, and 0.76% zinc, based on six samples. The vein could be mined in conjunction with nearby deposits and thus is classified as a subeconomic resource. Additional vein material is likely.
Bonham (White Mountain) Talc mine	11	The portion of the deposit inside the WSA consists of talc lenses 1.0 to 5.0 ft thick and as long as 500 ft along a 400- to 600-ft-thick zone of bedding plane fractures in dolomitic limestone. The best talc occurs where the fractures are crosscut by northwest trending fault zones.	Over a distance of 1,600 ft are two benches totaling 400 ft, one open and four caved adits totaling 250 ft and a number of small pits and trenches. About 35,000 tons of steatite-grade talc were produced between the 1930's and 1984.	Based on 25 samples, about 32,000 tons of talc are inferred in two lenses. These have a total length of 750 ft and an average thickness of 2.4 ft. This deposit could be mined in conjunction with nearby deposts at a cost that is about aqual to the value of production. The deposits can thus be classified marginal reserves. Additional talc resources are likely.
Florence Talc mine	12	Four talc lenses occur along a 400- to 500-ft-wide zone of fracturing which strikes N. 60° to 80° W. and dips 15° to 30° NE in dolomitic limestona. The fracture zone is crosscut by N. 10° to 20° W. striking, 50° to 70° SW. dipping fault zones. The lenses identified total 2,250 ft in length and average 3.3 ft thick. The largest talc bodies are where fractures and fault zones intersect. The talc is gradational and contains pods of silicified calcareous rock.	Eleven adits totaling 500 ft, five benches totaling 1,500 ft, and several small pits are scattered for 4,700 ft along the zone of fracturing. About 8,000 tons of talc were shipped (Norman and Stewart, 1951, p. 121).	Based on 47 samples, the lenses are inferred to contain 250,000 tons of marginal talc reserves that can be produced at a cost that is nearly equal to the value of production. Addtional resources would probably be disclosed by subsurface exploration.
Keys mine	13	A 0.1- to 2.3-ft-thick vein strikes N. 30° to 50° W. and dips 15° to 65° NW. in quartz monzonite. It is mainly leached, oxidized, drusy quartz with limonite, malachite, pyrite, chalcopyrite, and galena. The 1.2-ft-thick vein crops out intermittently for 1,200 ft along dip and 150 ft along strike on a ridgetop.	Along the vein are 11 underground workings totaling 800 ft, three benches totaling 450 ft, and number of small pits and open cuts. A small cyanide mill was located near an adit portal. The principal mill (Pat Keys arrastras) is 1.5 mi south. It is estimated that 5,000 tons of ore containing at least 1,200 oz of gold and 3,000 oz of silver were mined.	The vein is inferred to contain 18,000 tons of material averaging 0.25 oz/ton gold and 0.61 oz/ton silver, based on 27 chip samples. Subsurface work could disclose a small amount of additional gold-silver vein-bearing material.

Table 2. Summary of significant mines and prospects in and adjacent to the Inyo Mountains Wilderness Study Area (WSA) (BLM No. CDCA-122)—Continued

Name	Map No. (Plate 1)	Summary	Workings and production	Resource/sample data
Cougar mine	14	The principal vein consists of drusy quartz in quartz monzonite. The vein strikes N. 30° to 60° W., dips 15° to 25° SW. and contains limonite, malachite, and pyrite. The vein averages 0.3 ft thick and is exposed intermittently for 300 ft. A parallel vein of similar composition may occur about 100 ft above the principal vein.	Along the principal vein are four adits totaling 325 ft, and a 90-ft bench. A prospect pit is on the second vein. It is estimated that 50 tons of ore containing at least 20 oz of gold were mined.	The principal vein contains about 1,100 tons of material averaging 0.44 oz/ton gold, based on 14 chip samples. The vein is too narrow to be a resource; however, additional gold-bearing veins may occur.
Johny mine	15	A 0.4-ft-thick quartz vein monzonite is exposed for 200 ft. The vein is malachite- and limonite-stained, strikes northerly, and dips 25° to 45° W.	A 75-ft bench with a 6-ft underhand stope, from which 100 tons of ore containing at least 80 oz of gold are estimated to have been mined.	About 670 tons of vein material averaging 0.8 oz/ton gold are inferred, which is too small to be a resource. Three chip samples over also had 1.8 oz/ton silver. Subsurface work would probably disclose gold resources.
Prospect No. 12	16	No mineralized structure is exposed. Working alignments and material on dumps suggest a 0.5-ft-thick quartz vein trends northwest in quartz monzonite.	Over a distance of 100 ft along trend are three benches totaling 90 ft.	Grab samples of vein material as thick as 0.5 ft from each of the dumps assayed 1.44, 0.20 and 0.05 oz/ton gold. Gold resources may be present at depth.
Gold Bug mine	17	A 0.5- to 3.5-ft-thick quartz vein with limonite, malachite, pyrite, and chalcopyrite strikes N. 5° to 25° W. and dips 20° to 50° SW. in monzonite. The vein can be traced for 200 ft and averages 1.8 ft thick. The mine is near McElvoy Creek.	Three underground workings totaling 100 ft, a 100-ft bench, and three small pits. About 100 tons of ore containing at least 10 oz of gold are estimated to have been mined.	The vein is inferred to contain about 3,000 tons of material averaging 0.13 oz/ton gold, based on nine chip samples. It is too small to be considered a resource. Gold resources would probably be disclosed by subsurface exploration.
Rock Roof mine	18	A poorly exposed 1.1- to 4.0-ft-thick zone of limonite- and malachite-stained gauge and quartz follows a contact between granite and greenstone that strikes N. 58° E. and dips 32° NW.	A 40-ft caved adit and 100-ft bench. It is estimated that 50 tons of ore containing at least 20 oz of gold were mined.	One of two chip samples across the zone assayed 0.03 oz/ton gold; the second sample contained no significant metal values. Two grab samples of quartz from dumps had trace and 1.33 oz/ton gold, 0.1 and 0.6 oz/ton silver, 0.34% over lead. Gold-silver-copper-lead resources may be present.
Blueledge mine	19	A horizontal, dursy quartz vein 1.2 ft thick and 80 ft long in quartz monzonite contains limonite, malachite, and pyrite.	On the vein are two adits totaling 90 ft, and a 95-ft bench. It is estimated that 100 tons of ore containing at least 40 oz of gold and 20 oz of silver were mined.	The vein is inferred to contain 320 tons of material averaging 0.43 oz/ton gold and 0.21 oz/ton silver, based on five chip samples. This occurrence is too small to be classified a resource. Additional vein material is probable, and gold-silver resources are likely.
No. 18 mine	20	A 0.3- to 1.1-ft-thick vein strikes east and dips 30° to 35° S. in quartz monzonite. The vein averages 0.6 ft thick, is 60 ft long, and is mainly drusy quartz with malachite, limonite, and pyrite.	A 55-ft adit with stope, and a 65-ft bench. It is estimated that 100 tons of ore containing at least 10 oz of gold were mined.	The vein has about 90 tons of material averaging 0.11 oz/ton gold and 0.25 oz/ton silver, based on six chip samples. The occurrence is too small to be considered a resource. Gold resources probably are present at depth.
Crystal mine	21	A drusy quartz vein with pyrite strikes N. 80° W. and dips 30° to 40° SW. in quartz monzonite. The vein is 1 ft thick and 80 ft long.	A 40-ft adit, and 30-ft bench with an underhand stope. An estimated 30 tons of ore containing at least 5 oz of gold were mined.	The vein is inferred to contain 340 tons of material averaging 0.18 oz/ton gold, based on five chip samples. It is too small to be considered a resource. However, subsurface work could disclose gold resources.
Laura mine	22	Two parallel veins, 150 ft apart, trend north and dip 25° to 45° W. in unaltered diorite. The lower vein is 0.8 ft thick and 980 ft long; the upper is 1.4 ft thick and 600 ft long. Both veins are composed of limonitic quartz with pyrite and chalcopyrite.	Two adits totaling 40 ft, three benches totaling 160 ft, and one pit. It is estimated that 300 tons of ore containing at least 30 oz of gold were mined.	The two veins are inferred to total 57,000 tons of material averaging 0.08 oz/ton gold and 0.24 oz/ton silver, based on 16 chip samples. These occurrences are too small to be considered resources. Subsurface exploration would probably disclose gold-silver resources.

Red Dog mine	23	An irregular, branching vein strikes N. 20° to 40° W., dips 10° to 40° SW., and is exposed intermittently for over 2,500 ft in quartz monzonite. The 0.5- to 10.0-ft-thick quartz malachite, pyrite, and gold.	Scattered for 1,500 ft along the vein are six underground workings totaling 500 ft, three benches totaling 150 ft, and a number of small pits and open cuts. It is estimated that 600 tons of ore containing at least 50 oz gold were mined.	Three segments of the vein, totaling 480 ft and averaging 2.2 ft thick, are inferred to contain 6,800 tons of material averaging 0.09 oz/ton gold and 0.12 oz/ton silver, based on 26 chip samples. It is an occurrence too small and low grade to be considered a resource. Additional vein material and gold resources are likely.
Sweitzer mine	24	A 1.7- to 3.2-ft-thick, 930-ft-long branching vein strikes N. 10° to 25° E. and dips 50° to 80° NE. in quartz diorite. The vein material is mainly quartz with limonite, malachite, azurite, and tetrahedrite. Silver-bearing vein segments total 115 ft in length and average 1.7 ft thick.	A 450-ft adit with stope to the surface, and several small pits and open cuts. It is estimated that 100 tons of ore containing at least 800 oz of silver were mined.	Identified are about 540 tons of vein material averaging 8.3 oz/ton silver, based on seven chip samples. The occurrence is too small to be considered a resource. It is probable that silver resources are present at depth.
Cinnamon mine	25	A 1.9-ft-thick, 40-ft-long vein of gouge, and quartz with pyrite and malachite is in diorite. The vein strikes east and dips 10° to 35° S.	A partially caved adit (with stope) is open for 65 ft. It is estimated that 60 tons of ore containing at least 16 oz of gold and 50 oz of silver were mined.	The vein is inferred to contain 120 tons of material averaging 0.26 oz/ton gold and 0.87 oz/ton silver, based on two chip samples. It is an occurrence too small and low grade to be considered a resource. Gold-silver resources may be present at depth.
Keynote No. 30 prospect	26	No mineralized structure is exposed. Working alignments and dump material indicate a 1.0-ft-thick vein strikes N. 80° W. and dips 55° SW. in quartz monzonite. The vein is mainly drusy quartz with limonite, pyrite, malachite, chalcopyrite, and gold.	Over a distance of 190 ft along the vein are a 100-ft bench and 90-ft caved adit. Eighty feet south is an arrastre. It is estimated that 600 tons of ore containing at least 200 oz of gold were mined.	Five grab samples contained 0.06 to 0.802 oz/ton gold, as much as 0.7 oz/ton silver, and 0.39% copper. Subsurface exploration would probably disclose gold resources.
Panament View mine	27	A vein 1.5 to 2.0 ft thick composed of drusy quartz with pyrite, galena, and malachite, strikes N. 30° W. and dips 20° to 30° SW. in quartz diorite. It averages 1.8 ft thick and is developed for 80 ft.	One 80-ft bench and four underground workings totaling 100 ft. It is estimated that 120 tons of ore containing at least 10 oz of gold and 200 oz of silver were mined.	The vein is inferred to contain 480 tons of material averaging 0.12 oz/ton gold, 1.8 oz/ton silver, 0.09% copper, and 0.89% lead, based on two chip samples. The occurrence is too small to be considered a resource. Additional vein material and gold-silver resources may be present at depth.
Bluebird prospect	28	A 2.2- to 3.0-ft-thick vein in quartz monzonite strikes N. 65° to 75° W., dips 30° to 65° SW., averages 2.7 ft thick, and is 770 ft long. The vein is composed of drusy quartz with pyrite and malachite.	Four adits totaling 230 ft, and one prospect pit.	The vein is inferred to contain 67,000 tons of material averaging 0.02 oz/ton gold, based on three chip samples. It is an occurrence too low grade to be classified a resource. Grab samples contained as much as 0.234 oz/ton gold and 3.5% copper. Gold resources may be present at depth.
Prospect No. 29	29	No mineralized structure is exposed. Dump material and working alignments indicate a northwest-trending, northeast-dipping, limonitic, pyritic quartz vein at least 0.5 ft thick in quartz monzonite.	Two pits 70 ft apart.	Two grab samples were taken. One of stockpiled quartz assayed 0.092 oz/ton gold. The other of quartz and wallrock had 0.036 oz/ton gold.
Mano Del Hombre mine	30	A 0.7- to 4.7-ft-thick vein strikes northerly and dips 10° to 30° W. in quartz monzonite. The vein is mainly drusy quartz with limonite, pyrite, malachite, chalcopyrite, and gold. The exposure averages 1.4 ft thick and is 290 ft long.	A 90-ft bench, 40-ft adit, and one pit. It is estimated that 100 tons of ore with at least 30 oz of gold were mined.	The vein is inferred to contain 4,900 tons of material averaging 0.29 oz/ton gold, based on five chip samples. It is an occurrence too small to be considered a resource. Gold resources are likely to be disclosed by subsurface exploration.
No. 32 mine	31	A vein of limonitic drusy quartz, with pyrite and malachite in monzonite, strikes N. 40° to 50° W., dips 25° to 35° NE., and is 0.3- to 1.5-ft thick. It averages 0.8 ft thick and is 220 ft long.	Two declines totaling 190 ft, and three prospect pits. It is estimated that 200 tons of ore containing 40 oz of gold were mined.	The vein is inferred to contain 1,600 tons of material averaging 0.2 oz/ton gold, based on three chip samples. It is an occurrence too small to be considered a resource. Gold resources are likely at depth.

Table 2. Summary of significant mines and prospects in and adjacent to the Inyo Mountains Wilderness Study Area (WSA) (BLM No. CDCA-122)—Continued

Name	Map No. (Plate 1)	Summary	Workings and production	Resource/sample data
Chambers mine	32	Two veins in quartz monzonite strike N. 30° to 40° W. and dip 20° to 30° SW. The better exposed vein is 0.1 to 3.0 ft thick, 1,000 ft long, and is composed of drusy quartz with malachite, limonite, pyrite, galena, and chalcopyrite. The second vein, 200 below, is indicated by dump material to be of similar composition.	Over a distance of 1,200 ft are 12 pits and trenches, four benches totaling 260 ft, five adits totaling 1,000 ft, and an arrastre. It is estimated that 300 tons of ore with at least 48 oz of gold and 87 oz of siver were mined.	Inferred in three vein segments totaling 530 ft in length and averaging 0.8 ft thick are 4,000 tons of material averaging 0.16 oz/ton gold and 0.29 oz/ton silver, based on nine chip samples. The vein segments are too small and low grade to be considered resources. However, subsurface exploration would probably disclose gold-silver resources.
No. 35 mine	33	Two parallel veins 100 ft apart, strike N. 40° W. and dip 10° to 20° SW. in quartz monzonite. The 0.4- to 4.0-ft-thick veins are composed of drusy quartz with limonite, malachite, pyrite, and chalcopyrite. The upper vein averages 0.7 ft thick and is developed for 650 ft.	Two benches totaling 155 ft, two adits totaling 85 ft, two declines totaling 75 ft, and several small pits and cuts. It is estimated that 200 tons of ore containing at least 20 oz of gold and 300 oz of silver were mined.	The upper vein is inferred to contain about 12,000 tons of material averaging 0.13 oz/ton gold, 1.3 oz/ton silver, and 0.23% copper, based on seven chip samples. It is an occurrence too small to be considered a resource. The lower vein averages a trace gold, 0.03 oz/ton silver, and 0.02% copper. Gold-silver resources may be present in these veins.
Silver Ridge No. 1 prospect	34	A limonitic vein is in a quartz monzonite intrusion in limestone. The 0.7- to 3.5-ft-thick vein strikes east, dips 60° to 85° NE., and is mainly quartz and calcite, with galena, tetrahedrite, and argentite. It is traceable for 240 ft and averages 2.2 ft thick.	Four small pits.	The vein is inferred to contain 5,300 tons averaging 1.7 oz/ton silver, 2.5% lead, and 0.13% copper, based on three chip samples. It is too small to be considered a resource. Additional vein material and silver-copper-lead resources are likely.
Prospect No. 40	35	A poorly exposed, 3.0-ft-thick quartz vein is in dolomite intruded by quartz diorite. It follows bedding which strikes N. 50° E. and dips 65° NW. The vein is exposed for 10 ft and contains malachite and tetrahedrite.	One small pit.	A chip sample across the vein had 0.052 oz/ton gold, 20.0 oz/ton silver, 0.11% copper, 0.055% lead, and 0.027% zinc. Exploration would probably disclose silver-gold resources.
Prospect No. 44	36	A 0.7-ft-thick quartz vein strikes N. 50° W. and dips 30° NE. in quartz diorite. The limonitic, pyritic vein is exposed in only one place but can be traced for at least 90 ft.	One 30-ft decline and two small pits.	A chip sample across the vein assayed 0.154 oz/ton gold and 1.3 oz/ton silver. Gold-silver resources might be disclosed by exploration.
Mano Del Hombre Segundo mine	37	A 0.5- to 3.0-ft thick vein strikes N. 60° E. and dips 10° to 60° NW. in quartz monzonite. The vein is mainly drusy quartz with pyrite and limonite. Only a 280-ft-long portion of the vein, averaging 2.1 ft thick, contains precious metals.	Two pits, a 125-ft bench, and three adits totaling 380 ft are along 400 ft of the vein. It is estimated that 350 tons were mined containing at least 20 oz of gold and 200 oz of silver.	The vein is inferred to contain 6,900 tons of material that averages 0.06 oz/ton gold and 0.54 oz/ton silver, based on six chip samples. This is too small and low grade to be considered a resource. Gold-silver resources may be present.
Highland Chief mine	38	A drusy quartz vein with limonite and pyrite is in quartz monzonite. The vein strikes N. 70° W., dips 60° NE., and is 0.7 to 3.0 ft thick.	There are two adits totaling 120 ft, 180 ft apart. A pit lies between them.	Two chip samples were taken. One assayed 0.02 oz/ton gold and the other contained no significant metal values. Gold resources could occur at depth.
Prospect No. 49	39	In quartz monzonite, a poorly exposed, 2.1-ft-thick vein strikes N. 20° to 40° E. and dips 10° to 20° SE. The vein contains pyrite and limonite.	One small pit.	A chip sample across the vein assayed 0.13 oz/ton gold. Gold resources could be disclosed by exploration.
Beveridge Canyon MN No. 12 mine	40	A 0.5- to 3.5-ft-thick drusy quartz vein in quartz monzonite strikes N. 30° to 50° W., dips 15° to 35° NE., and is 1,600 ft long. The vein contains pyrite, malachite, chalcopyrite, and gold.	Six adits totaling 650 ft, a 180-ft bench, an ore bin, and a wireline tram to Laskey's mill, 0.3 mi away. Production estimate totals about 1,000 tons of ore containing at least 200 oz of gold.	Of the 28 chip samples taken, 12 contined gold. Two had more than 0.1 oz/ton. The parts of the vein with gold are too scattered to estimate size and grade. Gold resources may be present.

Horseshoe mine	41	Gold-bearing veins occur along northwest-trending, southwest-dipping fractures in quartz monzonite. Vein exposures are as thick as 3.0 ft; as long as 800 ft; and are composed of oxidized, limonitic, copper-stained, drusy quartz with pyrite and chalcopyrite. The veins occur in a zone that is 500 ft wide. Eight vein exposures average 1.3 ft thick and have a total length of 2,600 ft.	Over a distance of 2,200 ft along the zone are 29 adits totaling 1,200 ft, 11 benches totaling 2,100 ft, a number of small pits and cuts, and a dismantled two-stamp mill. Production is estimated to have totaled 2,000 tons of ore containing at least 200 oz of gold.	About 81,000 tons of vein material average 0.08 oz/ton gold, based on 67 chip samples. Sixty of the 67 chip samples were from across veins and had gold. Grab samples assayed as much as 2.67 oz/ton gold, 4.6 oz/ton silver, and 1.51% copper. The mineral occurrences are too low grade to be considered resources. Sampling suggests higher grade vein material and gold resources probably would be disclosed by subsurface exploration.
Beveridge Canyon MN prospect	42	Two veins in quartz monzonite, and a placer, are present. The principal vein, mainly gouge and quartz with limonite, malachite, and pyrite, is 1,700 ft long and 0.3 to 3.0 ft thick, strikes N. 20° to 80° E., and dips 10° to 35° NW. The other vein, mainly quartz with limonitic arsenopyrite and pyrite, is 3 to 10 ft thick and 250 ft long, strikes N. 15° to 20° W., and dips 75° to 85° NE. The placer is composed of angular, partially-indurated alluvium in a gulch 4,400 ft long.	Lode workings include five adits totaling 200 ft, and five small pits. A few pits and trenches comprise the placer workings.	A 400-ft-long, 2.6 ft-thick part of the principal vein contains 17,000 tons of vein material inferred to average 0.04 oz/ton gold, based on three chip samples. This is too small and low grade to be considered a resource. Chip samples taken by the owner averaged 0.6 oz/ton gold. Samples from the second vein contained no significant metal values. Gold concentrations in the placer, as much as 4.5×10^{-4} oz/yd^3, are too low grade and irregular to warrant resource estimation. The identified veins and placer are too low grade to be considered resources. However, additional vein material containing gold resources is probable.
Beveridge Canyon MN No. 28 prospect	43	The claim was located after completion of the Bureau of Mines field work. The claimant reports a 1.5-ft-thick quartz vein along the northwest trending, vertical contact zone between a dike and metasedimentary rock.	None.	The owner reports an assay of 1.46 oz/ton gold.
Beveridge Canyon MN No. 26 prospect	44	The claim was located after completion of the Bureau of Mines field work. The owner reports a sulfide-bearing quartz vein about 1.0 ft thick that trends northwest and dips 15° to 20° W. is in quartz monzonite.	None.	None.
Prospect No. 62	45	A vein strikes N. 5° to 10° W. and dips 40° to 50° NE. in quartz monzonite. The 400-ft-long, 0.9- to 3.8-ft-thick vein exposure is composed of drusy quartz with malachite, limonite, galena, and chalcopyrite. Only a 250-ft-long, 1.9-ft-thick portion contains significant metal values.	Four pits.	The gold-bearing portion of the vein is inferred to contain about 5,000 tons of material averaging 0.09 oz/ton gold and 0.84 oz/ton silver, based on three chip samples. The occurrence is too small and low grade to be considered a resource. The vein contains high grade portions and possibly, at depth, has gold resources.
Hunter arrastres	46	These arrastres were built in 1877 and treated ore from the Bighorn mine until the 1930's. They are near Hunter Spring.	Three 12-ft-diameter arrastres, driven by a 12-horsepower steam engine. All are partially dismantled. Five tons of ore were treated per day. Tucker and Sampson (1938, p. 383) reported that $8,000 to $10,000 in gold (about 640 oz) was recovered.	About 1,000 tons of tailings remain at the site. A grab sample assayed 0.17 oz/ton gold, 1.4 oz/ton silver, 0.26% copper, and 0.19% lead. The amount of tailings is too small and low grade to be considered a resource.
Gold Standard mine	47	A poorly exposed vein system occurs along the northwest-trending, southwest-dipping, fractured contact zone between quartz monzonite and argillaceous limestone. Veins are 0.2 to 4.0 ft thick and are mainly drusy quartz with limonite, galena, pyrite, and tetrahedrite. The principal vein averages 1.7 ft thick and is 2,500 ft long.	Along the vein system are several small pits and open cuts, two benches totaling 150 ft, and four adits totaling 500 ft. It is estimated that 200 tons of ore were mined containing at least 600 oz of gold, 12,000 oz of silver, and 4,000 lb copper.	The vein system is estimated to contain 440,000 tons of material averaging 1.7 oz/ton silver, 0.01 oz/ton gold, and 0.28% copper, based on 11 chip samples. It is too low grade to be considered a resource. Additional silver-, gold-, and copper-bearing material might be disclosed by subsurface exploration.

Table 2. Summary of significant mines and prospects in and adjacent to the Inyo Mountains Wilderness Study Area (WSA) (BLM No. CDCA-122)—Continued

Name	Map No. (Plate 1)	Summary	Workings and production	Resource/sample data
Joy and Vega prospect	48	Poorly exposed, jumbled, 0.1- to 1.0-ft-thick quartz-calcite veins containing malachite, pyrite, and chalcopyrite occur in a quartz monzonite slump block.	Two adits totaling 55 ft, and a number of pits and trenches are in a 1.5-acre area. About 2,000 ft north is a dismantled mill.	Ten samples were taken. Grab samples of vein material from the dumps contained as much as 0.199 oz/ton gold, 1.4 oz/ton silver, and 0.24% copper. Six vein chip samples had minor gold, silver, and copper. Gold resources may be present.
Prospect No. 72	49	A sheared and limonite-stained contact zone between an andesite dike and limestone is exposed in a road cut. The zone is 2.6 ft thick, strikes N. 25° W., dips 84° NE., and contains quartz and malachite.	Road cut.	A chip sample across the exposure contained trace gold, 0.6 oz/ton silver, and 0.61% copper. Subsurface exploration could disclose gold-silver-copper resources.
Burgess mine area	50	Poorly exposed, irregular, and randomly oriented quartz veins and skarn zones are in limestone and volcanic rocks, which have been metamorphosed by the intrusion of quartz monzonite and andesitic dikes. The veins are composed of quartz and calcite with limonite, manganese oxide, and sparse galena, tetrahedrite, sphalerite, cerussite, malachite, smithsonite, and azurite. The skarn zones are composed of garnet, epidote, actinolite, diopside, and sparse sphalerite. The skarns are leached and oxidized and occur mainly in volcanic rocks, although they may be found in the limestone.	In an area that measures 6,400 by 6,200 ft are 64 pits, 12 trenches, and 28 underground workings totaling about 4,000 ft. In 1910, 46 tons of ore containing 22 oz of gold and 11 oz of silver were shipped.	A total of 115 samples were taken. The grab samples contained as much as 0.64 oz/ton gold, 16.9 oz/ton silver, 1.28% copper, 4.1% lead, and 3.1% zinc. Chip samples with significant values were from widely scattered, isolated occurrences. Of the 74 chip samples taken, 20 had significant gold, 61 silver, 43 copper, 40 lead, and 41 zinc. The principal commodity in most chip samples was silver. Silver-lead-zinc-gold resources may be present.
American Flag mine	51	Three vein segments of drusy quartz strike N. 50° to 70° W. and dip 15° to 45° SW. The veins cut syenitic and granitic rocks and are traceable for 500 ft along strike and 400 ft downdip. The veins are 0.4 to 5.0 ft thick, as long as 116 ft, and contain limonite, malachite, pyrite, chalcopyrite, galena, sphalerite, and gold.	There are six underground workings totaling 720 ft, three benches totaling 100 ft, and several small pits. Production is estimated to have been 400 tons of ore containing at least 200 oz of gold and 500 oz of silver. Most ore was treated at the Craig Canyon mill 3 mi north of the mine.	About 790 tons averaging 0.49 oz/ton gold, 1.31 oz/ton silver and 1.4% copper are inferred in the three vein segments, based on 27 samples. These vein segments average 1.1 ft thick. The veins identified are too small to be considered resources. However, additional vein material is probable and gold-silver-copper resources are likely.
Prospect No. 77	52	No mineralized structure is exposed. Dump material and working alignments suggest a quartz vein trends northwest in granitic rock near its contact with calcareous sedimentary beds. Quartz on the dumps contains malachite, chalcopyrite, galena, and tetrahedrite.	Over a distance of 80 ft are two small pits and a 40-ft caved adit.	Two samples of quartz from dumps contained 0.635 and 7.1 oz/ton silver, 2.98% and 1.9% and 1.006 oz/ton gold, 10.53 copper, and 6.26% and 1.95% lead. Silver-gold-copper-lead resources could be disclosed by subsurface exploration.
Auguste mine	53	A fracture zone with irregular veins follows limestone beds intruded by quartz monzonite and andesitic dikes. The zone strikes N. 10° to 30° W. and dips 10° to 30° SW. Most veins (to the south of the WSA) are 0.2 to 3.0 ft thick, as long as 1,030 ft, and composed of quartz-calcite with limonite- and malachite- stained tetrahedrite, galena, and sphalerite. In the WSA, a 3-ft thick limonitic quartz vein is exposed for 650 ft.	Inside the WSA there are two small pits. Outside are three underground workings totaling 1,700 ft, and several small prospect pits. Production from the underground workings outside the WSA is estimated to have been 1,000 tons of ore containing 20,000 oz of silver and 10 tons of lead.	The vein in the WSA is inferred to contain 53,000 tons of material averaging 0.02 oz/ton gold and 0.1% copper, based on three samples. It is an occurrence too small and low grade to be classified a resource. However, in the WSA only the surface is accessible and chip samples contained gold and copper; a dump sample had silver, lead, and zinc. Identified in extensive workings outside and downdip from the WSA, are about 78,000 tons that average about 0.07 oz/ton gold, 12.7 oz/ton silver, 1.3% copper, 1.0% lead, and 0.8% zinc. Similar material may occur at depth in the WSA.
American prospect	54	A 1.5- to 4.2-ft-thick vein of leached and oxidized quartz and calcite is in limestone and argillite. The vein contains galena, sphalerite, limonite, and malachite. It strikes N. 5° E., dips 50° to 77° NW., and can be traced for 1,700 ft.	Two adits totaling 140 ft, and six prospect pits.	About 390,000 tons of vein material averaging 0.07 oz/ton silver, 0.2% copper, 0.8% lead, and 0.3% zinc are inferred, based on 25 chip samples. The occurrence is too low grade to be classified a resource. However, resources may occur at depth, and additional work is warranted.