CORRELATION OF MAP UNITS PLUTONIC ROCKS Age relations uncertain Kcp Ktl CRETACEOUS

DESCRIPTION OF MAP UNITS VOLCANIC ROCKS

Tv VOLCANIC FLOWS, TUFFS, AND LAHARS (TERTIARY) -- These deposits vary in the Disaster Peak and Relief Peak Formations of Slemmons (1966). undivided Stanislaus Group, and Valley Springs Formation Tavi ALTERED ROCKS (TERTIARY)--Hydrothermally and propylitically altered volcanic and intrusive rocks

> PLUTONIC ROCKS GRANODIORITE OF MOUNT EMMA AND ASSOCIATED DIKES (TERTIARY)

Kcp CATHEDRAL PEAK GRANODIORITE (CRETACEOUS) Kt1 GRANODIORITE OF TOPAZ LAKE (CRETACEOUS)

MzPp PLUTONIC ROCKS, UNDIVIDED (MESOZOIC AND PERMIAN?) -- Predominantly granitic to granodioritic in composition. As mapped, unit includes the granite of Eagle Creek (Late Cretaceous), granodiorite of Buckeye Creek (Mesozoic), granodiorite of Green Creek (Late Cretaceous), granodiorite of Long Canyon (Late Cretaceous), alaskite of Grace Meadow (Late Cretaceous), granite of Upper Twin Lakes (Late Cretaceous), granodiorite of Bond Pass (Late Cretaceous), granodiorite of Mono Dome (Cretaceous and Triassic), granite of Dorothy Lake (Early Cretaceous), granodiorite of Log Cabin Creek (Late Cretaceous), granite of Devils Gate (Late Cretaceous), gabbro of Mount Warren (Late Cretaceous), and quartz diorite of Odell Lake (Triassic or Permian). Shaded units, underlined above, are associated with gold mineralization

GRANODIORITE OF FREMONT LAKE (CRETACEOUS) Klh GRANODIORITE OF LAKE HARMET (CRETACEOUS)

GABBRO OF TWIN LAKES (MESOZOIC) METAMORPHIC ROCKS

JPzmu METASEDIMENTARY AND METAVOLCANIC ROCKS, UNDIVIDED (JURASSIC TO PALEOZOIC) -- Roof-pendant rocks. Locally; divided into: metasedimentary rocks, JPzms, and metavolcanic rocks, JPzmv Patterned units are associated with gold or tungsten

---- CONTACT

Arrows indicate relative movement; bar and ball on downthrown side ANTICLINE--Normal and overturned. Dashed where approximately

SYNCLINE--Dashed where approximately located APPROXIMATE BOUNDARY OF HOOVER WILDERNESS (NFO36) APPROXIMATE BOUNDARY OF ROADLESS AREA

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. 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 resource potential survey of the Hoover Wilderness and Cherry Creek A, Hoover Extension (East). Hoover Extension (West), and Leavitt Lake Roadless Areas in the Toiyabe, Stanislaus, and Inyo National Forests, Mono and Tuolumne Counties, California. Hoover Wilderness (NFO36) was established by Public Law 88-577, September 3, 1964. Cherry Creek A (5-662) Roadless Area was classified as a further planning area and Hoover Extension (East) (E4-662), Hoover Extension (West) (W4-662), and Leavitt Lake (4-666) Roadless Areas were classified as recommended wilderness areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

A mineral resource potential survey of Hoover Wilderness and surrounding Cherry Creek A, Hoover Extension (East and West), and Leavitt Lake Roadless Areas was conducted by the U.S. Geological Survey and U.S. Bureau of Mines. Studies included geologic mapping and geochemical and geophysical surveys by the U.S. Geological Survey, and a search of mining and production records and examination of known mines and prospects by the U.S. Bureau of Mines. On the basis of these studies, the mineral resource potential of the wilderness and adjacent roadless areas is ranked from I, favorable to IV, unfavorable, depending on the number of resource attributes in any area (table 1). Known gold deposits, some mined as early as 1871, are located in the southern half of the wilderness and adjoining roadless area in the Lundy Bureau of Mines records, although believed to be incomplete, indicate total production of at least 42,500 troy oz of gold and 18,000 oz of silver, mainly from the May Lundy mine (60)1. There is reasonable expectation that gold is present in extensions of some of the productive vein deposits, such as the Tamarack (12), Dunderberg (17, 20), Totland (28-31), May Lundy (60), and Jackson (59) mines (table 2). Any production from a single mine probably will be limited, owing to the small size of local high-grade ore shoots in veins along shear surfaces or in lens-shaped bodies in metasedimentary rocks that extend only to shallow depths. Small tungsten deposits are known in Cherry Creek A Roadless Area and in the southern tip of the Hoover Wilderness, but production in the wilderness itself has been small. There is only a low or limited favorability for extensions of tungsten deposits in the study area, mainly from a group of six claims in the Cherry Creek A Roadless Area (area 5-662, table 2). A buried disseminated copper and molybdenum occurrence may be present in a volcanic porphyry system near Mount Emma in the Hoover Extension (West) Roadless Area (Tooker and others, 1981). Additional detailed geologic studies and subsurface exploration will be necessary to confirm the presence of any ore body. The potential for conventional types of base-metal and uranium occurrences in and near the wilderness and roadless areas is considered low. There are no known sources of geothermal energy or of fossil fuels in the area, and so the energy potential must be considered low. Any future mineral production in the study area will be limited by difficult access and by special requirements for mining and milling that are necessary to protect the

INTRODUCTION The study area lies along and mainly east of the crest of the Sierra Nevada in Mono and Tuolumne Counties, Calif. (fig. 1). The areas are located mostly in the Toiyabe National Forest, but small parts extend also into the Stanislaus and Inyo National Forests. The Hoover Wilderness is about 31 mi (50 km) in length and ranges from 1.2 to 18.6 mi in width, enclosing approximately 159,000 acres. The roadless areas comprise approximately an additional 110,600 acres. The Hoover Wilderness and adjacent roadless areas are bounded on the west by the Emigrant Wilderness and Yosemite National Park and on the north and east are adjacent to Little Walker caldera, Bridgeport Valley, and Mono Lake basin. Elevations range from greater than 12,000 ft along the crest of the Sierra Nevada to 7,100 ft near Twin Lakes. The region is spectacularly scenic and is characterized by marked relief that has been enhanced by glacial erosion. Access to the wilderness and roadless areas is by two paved highways that cross the Sierra Nevada, at Sonora Pass on the north and Tioga Pass on the south, and by a number of spur roads from the

GEOLOGY By E. W. Tooker, G. F. Brem, J. F. Seitz, and W. J. Keith The Hoover Wilderness and adjacent roadless areas are dominated by two main geologic terranes, a batholithic complex containing roof pendants of metamorphosed sedimentary and volcanic rocks and a younger volcanic sequence that overlies and partly conceals the batholithic complex (Keith and Seitz. 1981). The areally extensive batholithic rocks consist of numerous plutons, ranging in age from Permian(?) to Tertiary and in composition from quartz diorite to granodiorite and granite. Two small gabbro plutons are also present. The granitic plutons were intruded into a sequence of tightly folded metavolcanic and metasedimentary rocks of Paleozoic and Mesozoic age. Steeply dipping northwest-trending veins in and near contacts between the plutonic and metasedimentary rocks contain gold in the central and southern parts of the wilderness. The large composite pluton comprised of the Cathedral Peak Granodiorite, lying mainly along the west side of the wilderness, is sparsely altered and pyritized along extensive joint systems. Local skarn zones are closely associated with calcareous metasedimentary rocks close to plutonic contacts. Miocene or younger volcanic rocks include flows, breccias, and lahars that have been intruded by dikes and sills and a small granodiorite pluton (Slemmons, 1966). These rocks are the remnants of a stratovolcano overlying the ring fracture system of Little Walker caldera (Brem, unpub. Inferred cross and shear faults occur within or separate plutonic and metamorphic roof-pendant rocks. Steeply dipping northeast-trending cross faults, or zones that cut across the structure of the metasedimentary rocks, abrupt changes in the fold structures of roof-pendant rocks, (3) contacts between plutons, (4) linear zones of accelerated erosion and glacial scour, (5) local hot-spring activity, and (6) subtle changes in aeromagnetic patterns. Smaller northwest-trending shear faults in roof pendants generally are subparallel to lithologic contacts. The shear faults locally separate or cut out metamorphic units and in some places occur along contacts with Movement along the Lundy Canyon fault is uncertain, but the offset of strata in the pendant appears to be right lateral. The inferred Twin Lakes fault coincides with a tongue of the Cathedral Peak Granodiorite that separates two sequences of metasedimentary rocks exposed on opposing canyon walls above Twin Lakes. The inferred prebatholith(?) Buckeye Creek fault separates Little Walker caldera and associated vouncer rocks from the plutonic-metamorphic terrane to the south. A warm spring also issues from follows the break in batholithic terranes across the Sierra Nevada divide into the Cherry Creek drainage. The main mass of the Cathedral Peak pluton lies to the south, and a generally older plutonic terrane containing locally altered roof pendants lies to the north.

GEOCHEMISTRY

By M. A. Chaffee The geochemical survey of the Hoover Wilderness and adjoining roadless areas, compiled by Chaffee, Banister, and others (1980), Chaffee, Hill, and others (1980), and Chaffee and others (1983a-k), is summarized in Chaffee and others (19821). The geochemical interpretations are based on analyses of 74 rock samples, 182 minus-0.01-in. stream-sediment samples, and 180 nonmagnetic heavy-mineral concentrate samples. (Geochemical data for additional sample from Leavitt Lake Roadless Area are tabulated in a separate report on Carson-Iceberg and Leavitt Lake Roadless Areas (Chaffee, unpub. data, 1982)). The three types of samples yield different types of data. Rock samples provide background information on the distribution and abundance of elements in primarily unaltered rock units. Stream-sediment samples, collected in firstorder (unbranched) and second-order (below function of two first-order) streams, provide information on the composite mineral suite present in a given drainage basin. Concentrate samples typically contain a number of minerals that provide information about elements commonly associated with metallic elements (Ag, As, Au, B, Ba, B1, Cd, Cu, Fe, Mo, Pb, Sb, W, and (or) Zn) that may be related to potential mineralization. The most significant anomalies in terms of mineral deposits are those found between Buckeye Creek and the Saddlebag Lake-Warren Fork area near the south end of the study area. These anomalies seem to be localized within Paleozoic and Mesozoic metasedimentary and metavolcanic roof pendants in the Sierra Nevada batholith. Small to extensive areas of pervasive hydrothermal alteration are present in many of these metamorphosed units. The strongest anomalies in the Hoover Wilderness are centered in Lundy Canyon and are characterized by the occurrence of anomalous elements in more than one sample type, relatively high numbers of anomalous elements present, and relatively high concentrations of these elements. Many of the streamsediment and concentrate anomalies in the southern part of the area are the result of contamination from past mining activity. Irrespective of this, the overall characteristics suggest that as yet undiscovered mineral deposits Cu, Pb, Zn, Cd, As, Sb, Bi, and W may be present within the metamorphic rocks. A number of areas contain overlapping geochemical anomalies for group 1 (probably mineralization related) and group 2 (possibly mineralization related) elements for both stream-sediment and concentrate samples. The sources of most of these anomalies have not been identified, and their significance is not known. Two anomalous areas are particularly signif icant: (1) areas in Lundy Canyon where known precious-metal mineralization occurs, and (2) the area immediately northwest of Mount Emma, where anomalous metallic elements coincide with areas of altered rock (Tooker and others, Low-level anomalies are present in other areas, but are more restricted in areal extent. The most important of these are in the vicinity of Cherry Creek, upper West Walker River, Molybdenite Creek, and Leavitt Lake. The source of the Mount Emma anomalies, as well as those in other parts of the detailed investigation. Low-level anomalies in the Leavitt Lake Roadless Area are present for the elements Bi, Cu, and Sb in samples of stream sediment and for the elements Au, Ba, Fe, and Pb in samples of nonmagnetic heavy-mineral concentrate. The most significant anomalies in both sample types were found in the upper part of the McKay Creek drainage basin, but the source of the be caused by contamination from past mining activity. Further detailed investigation may help to determine the sources of the anomalies.

By Donald Plouff Geophysical studies of the Hoover Wilderness and adjoining roadless areas

include a Bouguer gravity anomaly map and a residual magnetic intensity map (Plouff, 1982). Gravity anomalies reflect lateral changes in the density of the underlying rocks. Magnetic intensities are useful for indicating continuations of geologic trends related to existing mineral prospects and geochemical anomalies. The gravity anomaly map (Plouff, 1982) shows the northeast edge of a major region to the southwest of the wilderness that is dominated by nearly linear northwest-trending contours. These mostly reflect a regional zone of northeastward thickening of the crust and the effect of a root beneath the Sierra Nevada. Unfortunately the large regional gravity gradient obscures anomalies associated with near-surface density distributions that might be The source of a prominent gravity low at Twin Lakes is unknown, but the anomaly may reflect the density contrast between underlying plutonic rocks and metamorphic rocks to the north and south. A north-northwest-trending elongated gravity high in the southern part of the area overlies a belt of metamorphic rocks in roof pendants that are surrounded by less dense plutonic rocks. The prominent gravity low located near the northeast corner of the map area reflects the low density of the tuffs and sedimentary deposits that fill Little Walker caldera (Noble and others, 1974). ¹Numbers in parentheses refer to map locations.

The magnetic intensity map (Plouff, 1982) shows great diversity in the magnetization of the underlying rocks along the eastern flank of the Sierra Nevada. Although the map is complicated by topographic effects, there is a good correlation between magnetic intensity and geology. Metasedimentary rocks and sedimentary deposits have little or no magnetization. Most plutonic rocks have low to moderate magnetization, although several plutons yield relatively high values. The level of magnetization in metavolcanic rocks is variable, particularly in relation to that of surrounding rocks. Tertiary volcanic rocks have widely varying magnetizations, including reversed remanent magnetization that produces magnetic lows. Interpretation of the geophysical maps reveals anomaly patterns in five areas that may warrant further study (fig. 2): (1) A prominent gravity high and a somewhat discontinuous belt of magnetic lows trend north-northwest through Saddlebag Lake near the southeast corner of the map area. The anomaly primarily reflects high density and lower magnetization of the underlying belt of metasedimentary rocks in roof pendants than in surrounding plutonic rocks (2) The May Lundy (60) and adjacent mines in the Homer mining district occur along the broad east flank of a north-trending gravity high. Farther southeast, the Log Cabin mine (65) occurs in a magnetic low that forms part of a ring of polarization lows along the north flank of a magnetic high and an associated gravity high to the south. (3) The Tamarack area, southeast of Twin Lakes on the east side of the study area, occurs in metasedimentary rock within gradients along the south edges of east- and northeast-trending magnetic and gravity lows, respectively. (4) The mines in the Cherry Creek area occur along a prominent magnetic gradient. The gradient in part follows the trend of the metaconglomerate of Cooney Lake and its contact with plutonic rocks to the northwest. (5) A moderate gravity high and strong magnetic high are centered near Mount Emma in the northern part of the study area. The magnitude of the

> MINES AND MINING DISTRICTS By N. T. Zilka and A. M. Lescykowski

geophysical anomalies suggests that igneous rocks associated with the Mount

Emma eruptive center may extend a few miles beneath the surface.

Prospecting and mining in and adjoining the Hoover Wilderness began during the late 1850's in the Jordan mining district, east of Lundy Canyon, and in the Mono mining district, south of Tioga Pass (DeDecker, 1966). Total production from area mines is difficult to determine because complete production records do not exist; however, U.S. Bureau of Mines records2 show more than 41,000 tons of ore were mined yielding 42,500 oz of gold, and 18,000 oz of silver. Other reports indicate that the total production exceeded 128,000 tons of ore worth \$2,900,000 at the time of production (gold at \$20.67/oz). Most of this production was from the May Lundy mine. Tungsten ore also occurs in Hoover Wilderness and adjoining roadless areas. Tungsten production, however, has been small. Current interest by the mineral industry is centered on precious-metal deposits in or near the southern part of Hoover Wilderness. Exploration to determine the extent and grade of gold resources at the May Lundy mine (60) is being conducted by Minerals Management, Inc. Small-scale gold mining is continuing at the Totland mine (28-31) and in several other localities.

EXPLANATION OF CRITERIA FOR, AND AREAS OF,

Mineral resource potential in the wilderness and roadless areas is ranked

into four classes, from I, favorable, to IV, unfavorable. Ranking is based on the following criteria: I, Favorable -- Areas with a combination of resource attributes such as the presence of several productive deposits, the possibility for developing extensions of those deposits, outcrop exposures of ore minerals, fresh and altered host rocks and associated structures commonly occurring with ore deposits elsewhere, and strong geochemical and geophysical anomalies. II, moderately favorable or untested--Areas with a few small deposits or mineralized prospects and a minimal combination of geologic, geochemical, and geophysical attributes sufficient for proposing a new ore occurrence. III, low or limited favorability -- Areas with few if any prospects and only minor indications of favorable geologic attributes, or with geologic structures that preclude extension of surface deposits to sufficient depth for development. IV, unfavorable -- Those remaining geologic terranes containing none of the resource attributes that would provoke suspicion that an On the basis of this study, and one by the U.S. Bureau of Mines (Zilka and Leszcykowski, 1982), mineral resource potential is considered to be favorable (I) in one area, moderately favorable or untested (II) in three areas, of low or limited (III) favorability in eight areas, and unfavorable (IV) in the remaining areas. Each of these areas and the specific criteria for their ranking are summarized in table 1. The Lundy Canyon area, located partly within the southern tip of the wilderness, is ranked as having good (I) mineral resource potential for gold deposits. The area, which encompasses most of the pluton comprised of the granodiorite of Mono Dome, contains geochemical anomalies of Al, A2, B1, and B2 types. A large number of mines are present in this area, including the May Lundy (60), which produced most of the gold from within the wilderness. An inferred northeast-trending fault in Lundy Canyon that cuts the Mono Dome unit, divides the unit into areas apparently favorable (south) and unfavorable (north) to mineralization. Actually, the part of what is herein mapped as the granodiorite of Mono Dome north of the Lundy Canyon fault is Triassic in age and may be correlative with the Wheeler Crest Quartz Monzonite which is present further to the south in the Mount Morrison quadrangle (R. Kistler, Two areas are considered to have moderately favorable or untested (II) resource potential for gold. The Virginia Pass area, located in the southern part of the wilderness, has geochemical anomalies of the Al, Bl, B2, and C types, and several mines. The Green Creek area is east of the Virginia Lakes area and is partly in the wilderness and partly in the Hoover Extension (East) Roadless Area. The area includes most of the pluton comprised of the granodiorite of Green Creek, as well as the Monument Ridge area that has geochemical anomalies of the Al and Bl types. An area of moderately favorable or untested (II) potential for copper and molybdenum occurs near Mount Emma in the northern part of the study area. The region encompasses the pluton comprised of the granodiorite of Mount Emma, hydrothermally and propylitically altered volcanic and intrusive rocks, and Tertiary volcanic rocks. Geochemical anomalies of the A2, B1, B2, and C types are also present. Further investigations are needed before the copper-molybdenum potential of this area is substantiated. The Mount Emma unit was originally mapped by Brem (unpub. data, 1982) in an area shown by Keith and Seitz (1981) as underlain by Three areas have a low or limited (III) favorability for tungsten resources. The Cherry Creek area is the most significant of the three and is roughly coincident with a roof pendant of metasedimentary rocks. Six scheelite claims in the area have estimated resources of 480,000 tons (table 2). The Bonnie Lake area is located just northeast of the Cherry Creek area, and contains geochemical anomalies of the Al and A2 types. The third tungsten area is the Hess mine area, in the southern tip of Hoover Wilderness. The area encompasses a narrow strip of metasedimentary rocks and is considered to have a limited tungsten resource (table 2). Four areas have low or limited (III) favorability for gold. These are the Tioga Pass area, just outside of the southern tip of the wilderness, the Tamarack area in Hoover Extension (East) Roadless Area, the Upper Twin Lake area that coincides with geochemical anomalies of the Al and Bl types, and the Leavitt Lake area in the Leavitt Lake Roadless Area, which coincides with an area of Al, Bl, and C type geochemical anomalies. Lastly, the Walker Mountain area has low or limited (III) favorability for copper and molybdenum. The area coincides with geochemical anomalies of the A2 and C types. The remaining areas in the wilderness and adjoining roadless areas are considered to have unfavorable (IV) mineral resource potential.

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Table 1.--Summary classification of mineralized areas in Hoover Wilderness and adjoining roadless areas and comparison of the favorable attributes on which the classification is based

Assessment Report MLA 49-82, 13 p.

²Production units used: ton, short ton(s); oz troy ounce(s)

Resource attributes Productive mines ---- X of deposits ----Mineralized outcrops or prospect sites --- X host rock ---- X ional structures --- X Wallrock alteration --a. Stream sediments - X b. Nonmagnetic heavy-mineral concentrates ---- X Geophysical anomalies: a. Aeromagnetic ---b. Gravity ---- X

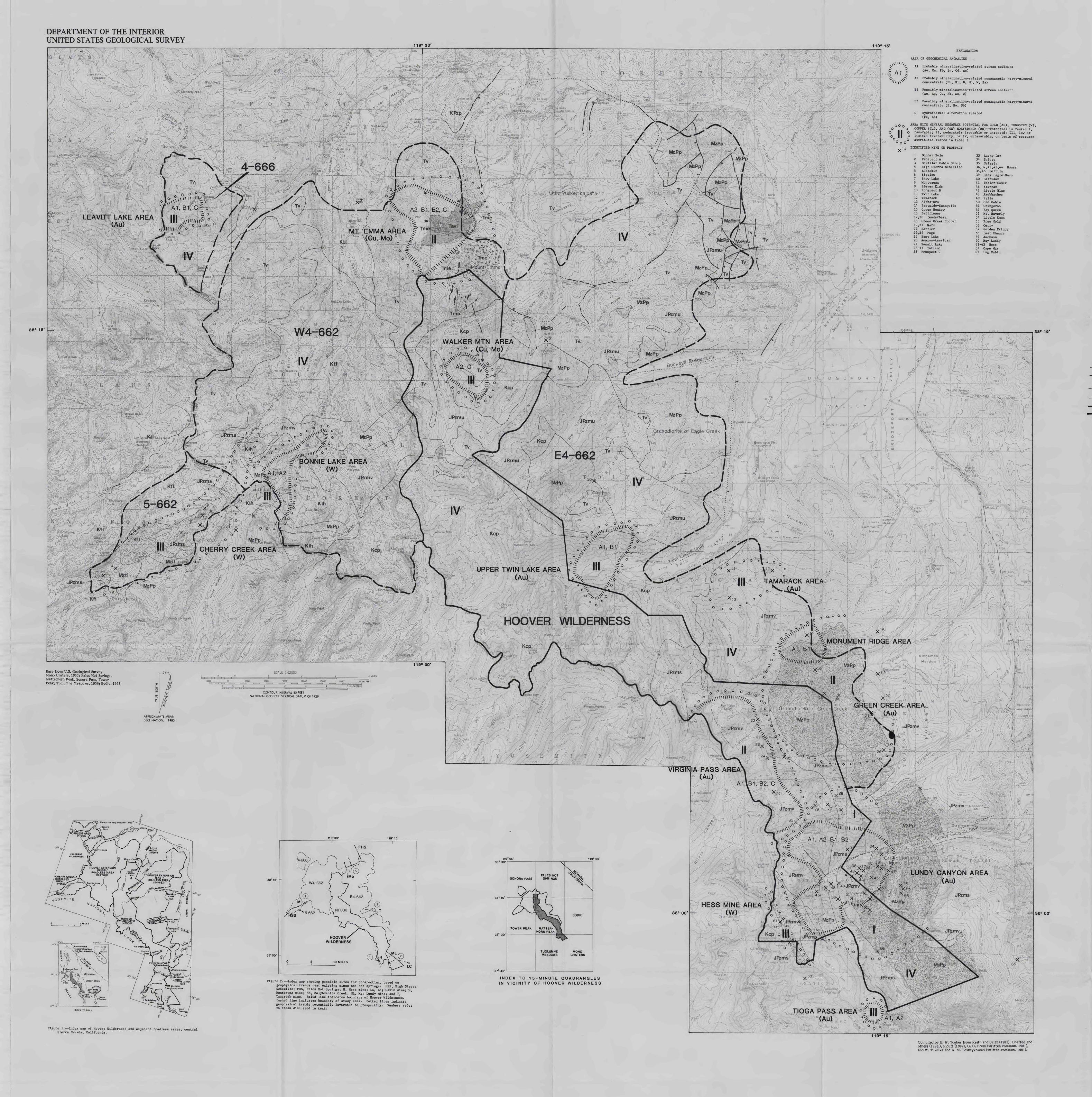
> Table 2.--Location, type of occurrence, and estimated resource potential in the Hoover Wilderness and Estimated reference number occurrence resource Snow Lake, Montezuma tungsten-bearing material and Eleven Kids High-grade pockets, gold 3.5 million tons. submarginal goldbearing materials Small reserves, gold 351,436 tons, reserves of ore material containing gold; 50,000 tons,

> > U.S. Geological Survey ²U.S. Bureau of Mines

Explanatory pamphlet accompanies map Interior-Geological Survey, Reston, Va.-1983 For sale by Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225

recoverable tailings

Contact Limited, tungsten



MINERAL RESOURCE POTENTIAL MAP OF THE HOOVER WILDERNESS AND ADJACENT ROADLESS AREAS, CENTRAL SIERRA NEVADA, CALIFORNIA

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