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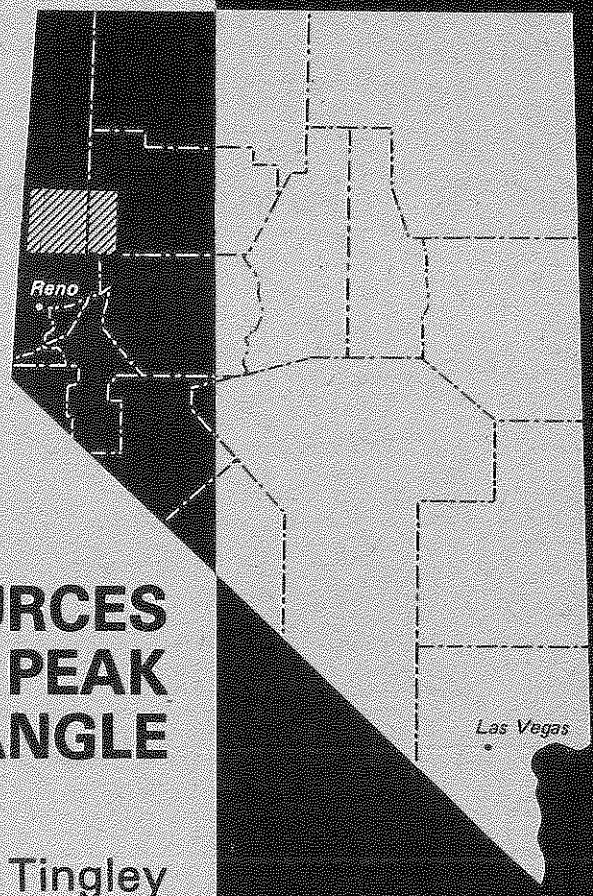

MINERAL RESOURCES OF THE KUMIVA PEAK 30′ BY 60′ QUADRANGLE

Joseph V. Tingley

A summary of the mineral resources of the Kumiva Peak 30′ by 60′ Quadrangle including mining history and geologic setting; descriptions of mines, prospects, and occurrences of metallic and nonmetallic minerals, oil and gas, and geothermal resources; and results of geochemical analyses. A 1:100,000-scale map showing locations of the occurrences is included.

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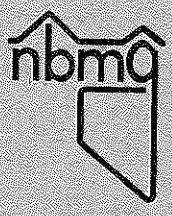

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MINERAL RESOURCES OF THE KUMIVA PEAK 30′ BY 60′ QUADRANGLE

INTRODUCTION

The Kumiva Peak 30′ by 60′ Quadrangle lies about 40 miles north of Reno in western Nevada. The southern boundary is the 40th parallel and the western boundary, the 120th meridian, lies about ¼ mile west of the Nevada-California state line. Portions of Washoe and Pershing Counties, the northern half of Pyramid Lake, and a large part of the Pyramid Lake Indian Reservation all lie within this quadrangle.

The John Fremont and Kit Carson party traveled through the central portion of this area in early January 1844. The Fremont party discovered and named Pyramid Lake and passed along its eastern shore on their way south. The earliest mining activity, gold and silver prospecting, began about 1870 in Cottonwood Canyon in the northern Fox Range, just north of the quadrangle boundary, but no production was recorded as a result of that early activity.

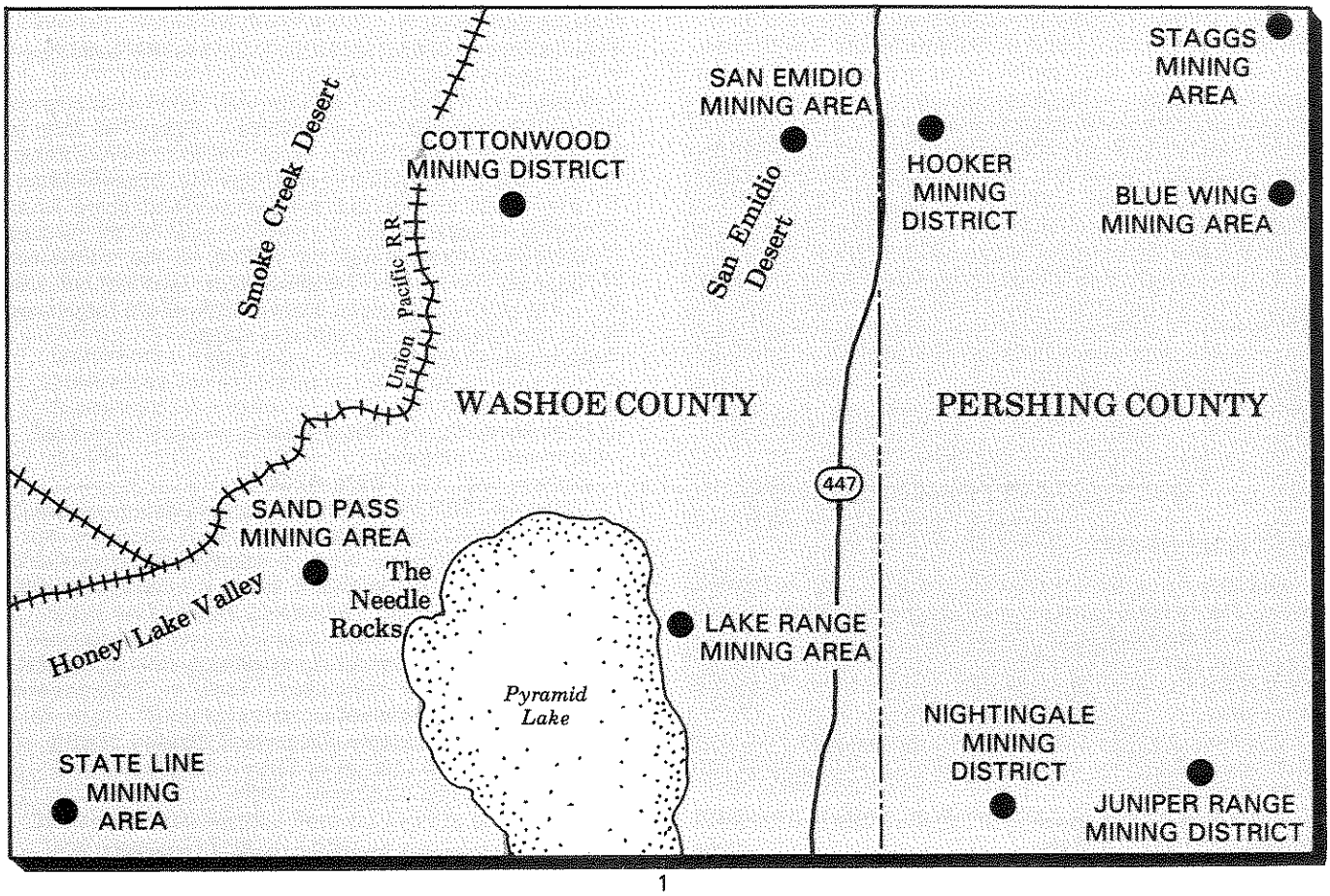
Tungsten-bearing skarn deposits were discovered in the Nightingale and Sahwave Mountains about the time of World War I and gypsum discoveries were made in the northern Selenite Range about the same time. Tungsten deposits in the Selenite Range were found in 1941. Production from mines in all three of the tungsten areas was intermittent through 1972, the year of last recorded production. Gypsum is still being produced from deposits along the northern border of the quadrangle.

The first observations of the geology of the area were made in the late 1860's by geologists with the Fortieth Parallel Survey. Descriptions of mines and prospects within the quadrangle were made by Hill (1915), Lincoln (1923), Vanderburg (1936), Overton (1947), Bonham (1969), and Johnson (1977). Descriptions of the geology of the Washoe County portion of the quadrangle were included in the work by Bonham (1969); Johnson (1977) described the geology of the Pershing County part of the quadrangle.

During 1984–85, the Nevada Bureau of Mines and Geology conducted a mineral inventory of the Sonoma-Gerlach Resource Area for the Bureau of Land Management and, as part of that project, many mines and prospects in the Kumiva Peak 30′ by 60′ Quadrangle were examined and sampled. Field data were collected by Jack Quade, J. V. Tingley, R. B. Jones, and L. J. Garside. In 1986, T. L. T. Grose reported on several prospects in the southern part of the quadrangle and, in 1987, J. V. Tingley collected information on occurrences in the Nightingale Mountains.

Samples were selected from dumps and mineralized outcrops to examine trace element associations. Sample descriptions and results of geochemical analyses are in appendixes A and B. The samples are high grade and do not represent average ore grades. The U.S. Geological Survey Branch of Geochemistry performed the geochemical analyses as part of a cooperative agreement with the Nevada Bureau of Mines and Geology.

The information in this report draws from all known sources and is intended to be a compilation of data on mines, prospects, and mineral, geothermal, and oil and gas



occurrences within the Kumiva Peak 30′ by 60′ Quadrangle. When information from literature sources has been supplemented by field examination, the information presented has been adjusted to reflect the field observations. When information sources are cited, the first source listed has provided the primary information.

GEOLOGIC SETTING

The oldest rocks identified within the Kumiva Peak 30′ by 60′ Quadrangle are metasedimentary and metavolcanic rocks of Triassic and Jurassic age. In the Pershing County portion of the quadrangle these rocks are described by Johnson (1977, p. 19) as the Auld Lang Syne Group, a thick sequence of pelitic and sandy strata with interbeds and lenses of limestone and dolomite. To the west, in the Washoe County portion of the quadrangle, similar Triassic and Jurassic age rocks are included in the Nightingale sequence of Bonham (1969, p. 6). Outcrops of other Mesozoic metasedimentary and metavolcanic rocks are found on the west side of the Lake Range and in the Fort Sage Mountains near the southwestern corner of the quadrangle.

Fairly extensive outcrops of intrusive rocks of presumed Mesozoic age were mapped by T. L. T. Grose (written commun., 1988) in the Fox Range. These rocks include granodiorite to diorite, locally migmatitic, and gabbroic rocks.

Large outcrops of Cretaceous intrusive rocks dominate the Pershing County portion of the quadrangle. Granodiorite forms the core of both the Nightingale Mountains and the Selenite Range. The Sahwave Mountains, to the east, are composed of quartz monzonite (T. L. T. Grose, written commun., 1988). West of Pyramid Lake, intrusive rocks are confined to small patches of Cretaceous granodiorite in the Virginia Mountains and near State Line Peak in the Fort Sage Mountains.

Tertiary volcanic rocks comprise most of the outcrops in the Washoe County portion of the quadrangle. These rocks include: andesitic and basaltic flows and pyroclastic rocks in the Lake Range; tuffs, flows, and pyroclastic rocks in the Fox Range; andesite and basalt flows, silicic flows, domes, and pyroclastic rocks in the Virginia Mountains; and andesite and basalt flows and flow breccia in the mountains north of Honey Lake Valley along the Nevada-California border. Northwest-trending faults of the Walker Lane system pass through the southwest corner of the quadrangle, extending from State Line Peak to the Pyramid Lake basin. East of this point, faults that follow the boundaries of many of the ranges show north-south alignment then trend to the northeast in the eastern portions of the map area. A number of domes, pipes, and complex volcanic centers are present in the Virginia, Lake, and Nightingale mountain ranges (T. L. T. Grose, written commun., 1988).

METALLIC OCCURRENCES

BLUE WING MINING AREA

The Blue Wing mining area, Pershing County, is located along the northern part of the eastern boundary of the Kumiva Peak 30′ by 60′ Quadrangle. The mining properties in the district are clustered in the northeastern quarter of T29N, R26E on the northern edge of the Bluewing Mountains.

The first recorded mining activity in this area was prospecting for tungsten during World War I but no production was recorded until 1972. The only other recorded production is a few ounces of gold and silver. There is no current production from the area.

Prospects in this area explore narrow quartz veins that cut Jurassic and Triassic metasedimentary rocks. Gold placer deposits have been prospected north of Black Mountain Spring. There is also evidence of considerable prospecting, probably for gold, in the southern Bluewing Mountains and the northern Sahwave Mountains, north of Juniper Pass.

Black Mountain claims (1)
Other name: Black Mountain placers
Commodities: gold and silver
Location: secs. 1 and 12, T29N, R26E
UTM[1] 4473950N 329120E
Production: 7 ounces gold, 3 ounces silver, 1940–41
Development: considerable gravel moved over a ⅓-mile length of narrow canyon
Geology: Most of the gravels are composed of material weathered from Triassic and Jurassic metasedimentary rocks; placer gravels include some sulfide-bearing vein material.
Source of information: Johnson (1977, p. 56)
Field examination: J. Quade, 1984

Black Mountain lode prospect (2)
Commodity: gold
Location: sec. 1, T29N, R26E
UTM 4473490N 329190E
Production: none
History: evidence of hand work, bulldozer work
Development: prospect cuts
Geology: iron-stained brecciated quartz vein in Triassic and Jurassic metasedimentary rocks
Field examination: J. Quade, 1984

Bluewing prospect (3)
Commodities: gold and silver(?)
Location: sec. 25, T29N, R26E
UTM 4468350N 329000E
Production: none
Development: bulldozer roads, long, shallow cuts down several hill slopes
Geology: Cuts expose a brick-red, iron-oxide-stained zone in silicated metasedimentary rocks. The zone is laced with white quartz veins, up to 3 inches thick, and some manganese-oxide staining. Metasedimentary rocks include quartzite, shale, and some limestone. Limonite and hematite appear to be formed after magnetite. Large conical hill to the northwest appears to be an intrusive that has altered the metasedimentary rocks around it causing a large area of iron staining in the intruded rocks.
Field examination: J. V. Tingley, 1987

Springer prospect (4)
Other name: Spring Ore prospect
Commodity: tungsten
Location: sec. 12, T29N, R26E
UTM 4473980N 328600E
Production: 10 units WO_3 (est.)
History: The property was operated first during World War I and again in 1972 when 11 tons of 0.8% WO_3 was shipped.
Development: short adits, cuts
Geology: Scheelite occurs in coarse crystals in an east-trending weakly mineralized zone in Triassic and Jurassic metasedimentary rocks.
Sources of information: Stager and Tingley (1988, p. 158); Johnson (1977, p. 56)
Field examination: J. Quade, 1984

[1]Universal Transverse Mercator, zone 11 (meters)

COTTONWOOD MINING DISTRICT

The Cottonwood mining district, Washoe County, includes all of the Fox Range and extends from the Smoke Creek Desert on the west to the San Emidio Desert on the east and from Pyramid Lake on the south to beyond the quadrangle boundary into the northern Fox Range. The earliest mining in the district was in Cottonwood Canyon about 4 miles north of the northern border of the quadrangle. The southern part of the district is within the Pyramid Lake Indian Reservation.

According to Hill (1915, p. 183), the mines in Cottonwood Canyon were worked in the 1870's and, in 1882, there were 100 locations within the district. Hill reported that the Cottonwood Canyon mines had been closed since about 1900 but a five-stamp mill was in operation in 1912 at the Wild Horse mine northwest of Pah-rum Peak.

Although there has been intermittent activity in the district since the 1870's, the only recorded production is 1,500 pounds of lead produced in 1929 (Bonham, 1969, p. 56). Mines and prospects are in four widely separated areas in the portion of the Cottonwood district included within the Kumiva Peak 30' by 60' Quadrangle. On the west side of the Fox Range, precious-metal mineralization in quartz veins occurs at the Wild Horse mine in Wild Horse Canyon and at the Packard and Sano properties within Reservation lands near the south end of the district. Copper mineralization occurs at the Boundary prospect about 4 miles south of the Packard mine. In Rodeo Canyon, on the east side of the Fox Range, minor workings explore scheelite mineralization in skarn.

Boundary prospect (5)

Commodity: copper
Location: sec. 20, T29N, R21E
UTM 4471600N 275750E
Production: none
Development: one short adit
Geology: Iron-oxide staining and sulfide minerals occur in both disseminated and massive form in gabbroic and dioritic intrusives that are exposed in a small gully. The massive sulfide outcrop is exposed in the east bank of the gully and consists of a mixture of pyrite and pyrrhotite. Disseminated chalcopyrite with malachite staining occurs locally in altered and metamorphosed gabbro on both sides of the creek, upstream from the massive sulfide occurrence. Limestone and metasedimentary rocks of the Triassic and Jurassic Nightingale sequence have been intruded by gabbro and diorite which were later altered and metamorphosed. The mafic rocks have been intruded by granitic dikes and granodiorite. The older intrusive rocks have been covered by Tertiary volcanic rocks but are now partially exposed by erosion.
Source of information: Satkoski and Berg (1982, p. 8–10)

Garnet tungsten prospect (6)

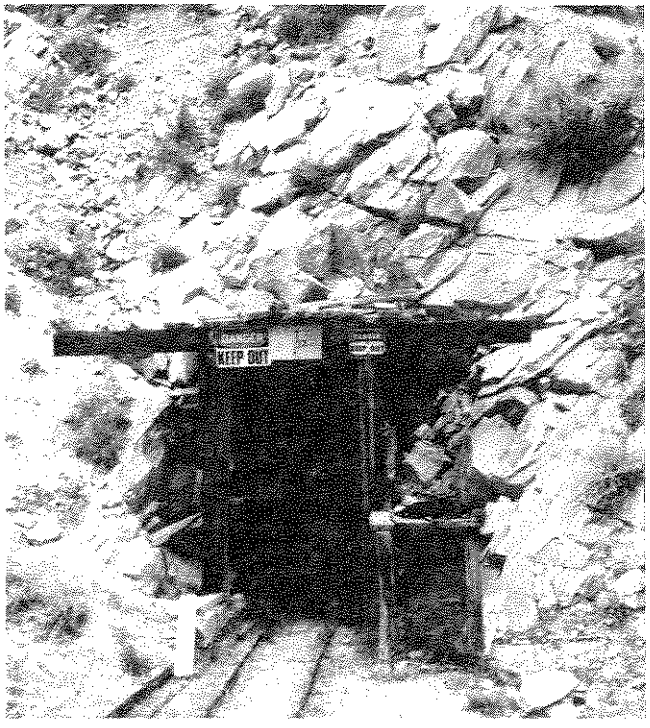
Other names: Garnet Ridge mine, Nash mine
Commodity: tungsten
Location: secs. 5 and 8, T29N, R22E
UTM 4475450N 284640E
Production: none recorded
Development: shallow inclined shaft, several trenches and pits
Geology: Scheelite occurs in thin skarn beds with garnet, epidote, quartz, diopside, and pyrite. The skarn is in silicated limestone beds, 3 to 4 feet thick, which are interbedded with hornfels and quartzite.
Sources of information: Bonham (1969, p. 58); Stager and Tingley (1988, p. 199)

Packard and Sano properties (7)

Other names: Packard mine, Sano mine, Powder Box adit
Commodities: silver, lead, and gold
Location: secs. 4 and 9, T28N, R21E
UTM 4465930N 276560E
Production: small
History: Properties were developed in the early 1920's.
Development: Workings consist of three adits at the Packard; three adits at the Sano; and the Powder Box adit, north of the Sano.
Geology: Mineralized structures at the Packard and Sano adits consist of easterly-striking, northerly-dipping veins and fault zones. Where exposed in underground workings, the veins are generally oxidized but contain galena, chalcopyrite, and sphalerite. Most of the veins have been offset by faulting.
Source of information: Satkoski and Berg (1982, p. 11–20); Lincoln (1923, p. 233)
Field examination: J. Quade, 1985

Wild Horse mine (8)

Other name: Wild Horse Canyon mine
Commodities: gold and silver
Location: sec. 2, T29N, R21E
UTM 4476000N 279750E
Production: small
History: The vein was located in about 1902. A 5-stamp mill was in operation on the property in 1912.
Development: six adits (mostly caved), caved shallow shafts, prospect pits
Geology: The mine workings explore two sets of mineralized faults which cut a granodiorite stock intruding Mesozoic metasedimentary rocks and hornblende gabbro. One set of faults trends about N60°W and dips 15° to 30°SW, the other trends N60°E to N80°E and dips from vertical to 60°NE. The mineralized fault zones are 2 to 20 feet thick and consist of fractured, sheared, and sericitized granodiorite. Quartz veins and stringers up to 2 feet thick occur in



Portal of the Wild Horse mine, Cottonwood district. *J. Quade photo.*

the fault zones. Pyrite and small amounts of arsenopyrite occur as disseminations and pods in both the altered granodiorite of the mineralized zones and in the main vein quartz. The vein material is described by Hill (1915) as consisting largely of altered porphyry cut by little stringers of dark, iron-oxide-stained quartz. The rich ore occurs in narrow siliceous streaks and contains flaky gold; some flakes are 1/16 inch across.

Sources of information: Bonham (1969, p. 58–59); Hill (1915, p. 184)

Field examination: R. B. Jones and J. Quade, 1985

HOOKER MINING DISTRICT

The Hooker mining district, Pershing County, includes all of the southern Selenite Range and extends eastward from the Pershing County line to the edge of Kumiva Valley.

Tungsten deposits were discovered in the Selenite Range in 1941 and, between 1944 and 1968, about 7,000 units of WO_3 was produced from the district (Stager and Tingley, 1988, p. 161). The tungsten deposits occur in skarn that is developed in metasedimentary rock adjacent to the contact with granodiorite. The zone of skarn development extends for about one mile along the western flank of the Selenite Range; the Stormy Day mine is at the south end, the Jeakins mine is on the north end.

Several uranium prospects have been explored in the area south of Mount Limbo but no economic deposits have been found. The occurrences are all within granodiorite; uranium mineralization is reported to occur with quartz veins and aplite and pegmatite dikes that cut the granodiorite.

Black Granite group (9)

Other name: Willow group
Commodity: uranium
Location: sec. 4, T28N, R24E
UTM 4465450N 305600E
Production: none
Development: 90-foot trench
Geology: Very slight radioactivity is associated with pegmatite and rhyolite dikes in granite.
Remarks: Rumsey (1986) described altered rhyolite tuff and granodiorite along a N85°E-striking, 45°N-dipping contact zone at what may be the same property.
Sources of information: Garside (1973, p. 95); Rumsey (1986, p. 9)

Gold prospect 1 (10)

Commodity: gold
Location: sec. 27, T30N, R24E
UTM 4478120N 310280E
Production: none
Development: prospect pits
Geology: A quartz vein cutting highly weathered granodiorite strikes N60°E, is nearly vertical, and occupies a small shear zone. Prospect uphill from this one is on offset part of the same vein.
Field examination: J. Quade, 1985

Jeakins mine (11)

Other names: Thrabert mine, Windy Hill mine, Windy Day mine
Commodity: tungsten
Location: sec. 6, T30N, R24E
UTM 4484600N 305600E
Production: 45 units WO_3
History: The deposit was discovered in 1941 but the only recorded production was in 1968.
Development: two crosscut adits, several open pits and cuts
Geology: Scheelite occurs in a narrow skarn zone, 2 to 5 feet wide, along about 200 feet of contact between calcareous metasedimentary rocks and granodiorite.
Sources of information: Stager and Tingley (1988, p. 161); Johnson (1977, p. 58)
Field examination: R. B. Jones, 1984

Limbo group (12)

Other name: Kimbo group
Commodities: uranium, silver, and gold
Location: sec. 9, T28N, R24E
UTM 4463950N 305750E
Production: none
Development: one 18-foot adit, shallow pits
Geology: A 4-foot-thick, iron-oxide-stained quartz vein which strikes N30°W and dips 60°NE is exposed for 200 feet along strike in granodiorite.
Remarks: Garside (1973, p. 95) reports anomalous radioactivity associated with pegmatite dikes in this same general area.
Sources of information: Garside (1973, p. 95); Rumsey (1986, p. 10, no. 14)

Pinto prospect (13)

Commodities: silver and uranium
Location: sec. 38, T29N, R24E
UTM 4475500N 305300E
Production: none
Development: one prospect pit
Geology: A 5-foot limonite-stained quartz vein and float are along a range-front fault that parallels a contact between granodiorite and volcanic rocks. The fault strikes N10°E, dips 65°NW, and can be traced for 6 miles along strike.
Source of information: Rumsey (1986, p. 9, no. 1)

Silver-gold-uranium prospect 1 (14)

Commodities: silver, gold, and uranium
Location: sec. 9, T28N, R24E
UTM 4465200N 305800E
Production: none
Development: two 30-foot trenches
Geology: A ½-foot-thick, iron-oxide-stained quartz vein cuts altered granodiorite.
Source of information: Rumsey (1986, p. 9, no. 6)

Silver-uranium occurrence 1 (15)

Commodities: silver and uranium
Location: sec. 9, T28N, R24E
UTM 4464050N 305700E
Production: none
Development: none
Geology: Two 1-foot-thick aplite dikes enclose 4-inch-thick veins of iron-oxide-stained quartz. The dikes are 5 feet apart, are exposed for 50 feet along strike, trend northward, and dip 10°E in granodiorite.
Source of information: Rumsey (1986, p. 10, no. 13)

Silver-uranium prospect 1 (16)

Commodities: silver and uranium
Location: sec. 10, T28N, R24E
UTM 4464750N 306250E
Production: none
Development: about 1 acre of ridge top bulldozed
Geology: A 1,600-foot-wide zone of leached and iron-oxide-stained quartz veins trends northeasterly in granodiorite.
Source of information: Rumsey (1986, p. 10, no. 9)

Silver-uranium prospect 2 (17)
Commodities: silver and uranium
Location: sec. 15, T29N, R24E
UTM 4472850N 306700E
Production: none
Development: one prospect pit
Geology: A 6-foot-thick, iron-oxide-stained smoky quartz vein with an attitude of N45°W, 35°NE is exposed for 7 feet along strike in granodiorite.
Source of information: Rumsey (1986, p. 9, no. 2)

Stormy Day mine (18)
Other names: Old Thrasher mine, Milky Way mine
Commodity: tungsten
Location: secs. 29 and 30, T30N, R24E
UTM 4478620N 305670E
Production: 6,819 units WO_3, 1944–56
History: The deposit was discovered in 1941 and was intermittently operated until 1957.
Development: 2,000 feet of crosscuts and drifts on four levels, interconnecting stopes
Geology: Scheelite occurs in skarn along a limestone-granodiorite contact; the skarn consists of a coarse-grained aggregate of garnet, epidote, pyroxene, and quartz, with pyrite, chalcopyrite, molybdenite, and scheelite. Orebodies mined occurred along a strike length of 750 feet, were 1 to 15 feet wide, and extended down dip for 225 feet.
Sources of information: Stager and Tingley (1988, p. 161); Johnson, M. G. (1977, p. 58–60) Johnson, A. C. (1958, p. 1–9).
Field examination: J. Quade, 1985

Uranium occurrence 1 (19)
Commodity: uranium
Location: sec. 8, T30N, R24E
UTM 4483000N 305500E
Production: none
Development: none
Geology: Locally anomalous radioactivity occurs in small pods associated with a leucogranite dike which cuts granodiorite.
Source of information: Neff (1982, app. C, p. 2, no. 10)

Uranium occurrence 2 (20)
Commodity: uranium
Location: sec. 35, T30N, R24E
UTM 4475600N 311500E
Production: none
Development: none
Geology: Zones of anomalous radioactivity are associated with a felsic dike which cuts quartz monzonite. The dike has aplitic and pegmatitic phases and is partially deuterically altered; it strikes N65°E and is vertical. No uranium minerals were identified.
Source of information: Neff (1982, app. C, p. 2, no. 11)

Uranium prospect 1 (21)
Commodity: uranium
Location: sec. 15, T28N, R24E
UTM 4462750N 306100E
Production: none
Development: minor trenches, topsoil bulldozed from a 40- by 100-foot area
Geology: Three 2-foot-thick aplite dikes 400 feet apart strike north to N30°W and dip vertically in altered granodiorite.
Source of information: Rumsey (1986, p. 10, no. 16)

Uranium prospect 2 (22)
Commodity: uranium
Location: sec. 34, T29N, R24E
UTM 4467200N 307200E
Production: none
Development: two 150-foot-long by 2-foot-deep trenches and one prospect pit
Geology: Iron-oxide-stained contact between granodiorite and rhyolite trends generally easterly.
Source of information: Rumsey (1986, p. 9, no. 3)

JUNIPER RANGE MINING DISTRICT

The Juniper Range mining district is in the southern Sahwave Mountains, southwestern Pershing County, in the southeast corner of the quadrangle. The two major mining properties in the district, the Star mine and the Blue Wing mine, are on the south end of the range along the road that passes from Sage Hen Valley into Granite Springs Valley. The district was named after the stand of western juniper found on the slopes of what is now known as Juniper Mountain in the northern part of the range (Carlson, 1974, p. 147).

Copper discoveries were made in the Juniper Range district in February 1908. The original copper discovery was probably at the site of the Star mine in the southwestern part of the district. Copper mining activity had ceased by 1912 (Johnson, 1977, p. 63). In 1917 tungsten was discovered in the vicinity of the Star mine and, later, tungsten was also discovered at the Blue Wing mine 3 miles to the east. Tungsten was mined from these two deposits intermittently from World War I to about 1972. The district has a recorded production of about 12,000 units of WO_3 (Stager and Tingley, 1988, p. 165–166) but some additional production may have been credited to the Nightingale district, six miles to the west.

Copper and tungsten mineralization within the Juniper Range district is confined to small outcrop areas of Jurassic and Triassic metasedimentary rocks. Copper mineralization is associated with quartz veins that cut granodiorite; tungsten mineralization occurs in skarn formed at the granodiorite-metasedimentary rock contact. Several small prospects in the northeast part of the district appear to be associated with aplite and pegmatite dikes that cut the Sahwave Range granodiorite.

Blue Wing mine (23)
Other names: Roop and Allen mine, Blue Jay mine, Wild Bill claim, Cloudy Day mine
Commodity: tungsten
Location: sec. 21, T25N, R26E
UTM 4431220N 323640E
Production: 557 units WO_3
History: first mined in 1943
Development: several shallow pits and trenches, shallow shaft, two adits
Geology: Scheelite occurs disseminated in skarn that has been formed in three parallel ribs of limestone enclosed as pendants in granodiorite. The pendants are each about 3 feet wide, strike N10°E, and dip 45°NW. Pods of skarn are of irregular width; some are up to 20 feet thick. Skarn is massive and composed of garnet, diopside, and clots of bluish-white quartz. White quartz veins with cockscomb structure lace the skarn. Scheelite is present as fairly large crystals and displays a powdery, yellow fluorescence. The pendants are shallow and, where exposed in cuts at the south end of the property, appear to be floating in the granite. Faint lineations which correspond to sedimentary bedding can be traced into the granite.

Granite near the contact shows concentrations of shiny black biotite.
Sources of information: Stager and Tingley (1988, p. 165); Johnson (1977, p. 63–64)
Field examination: J. Quade, 1984; J. V. Tingley, 1987

Copper occurrence 1 (24)
Commodity: copper
Location: sec. 9, T25N, R26E
UTM 4434700N 323400E
Production: none
Development: none
Geology: gossan, malachite stringers in aplite, and vein float containing malachite and azurite, mineralization associated with granite-aplite contact
Source of information: Southern Pacific Co. (1964, p. 14)

Dewdrop #2 prospect (25)
Commodity: tungsten
Location: sec. 25, T25N, R25E
UTM 4431160N 318720E
Production: none
Development: open cut, 40 feet long by 10 feet wide; several small pits
Geology: Cut exposes banded marbleized limestone and garnet skarn; bands strike N40°W and dip 45°SW. Three skarn bands exposed in cut are separated by pale-green chloritic material. Skarn is laced with bluish-white quartz veins 2 to 3 inches thick. Skarn bands are mainly red-brown garnet, epidote, clots of quartz, and some calcite. Epidote crystals are up to 2 inches long, formed on fracture surfaces, and are very thin. Chloritic hornfels is copper stained. Granite outcrops occur on west, north, and south sides of cut; metasedimentary rocks probably represent a shallow pendant in granite.
Remarks: Dewdrop #2 location notice dated 1976
Field examination: J. V. Tingley, 1987

Silver occurrence 1 (26)
Commodity: silver
Location: sec. 3, T25N, R26E
UTM 4434700N 323400E
Production: none
Development: none
Geology: Nearly horizontal shear zone in granite contains disseminated pyrite, limonite, and hematite.
Source of information: Southern Pacific Co. (1964, p. 29)

Star mine (27)
Other names: Anderson claims, Blue Star mine
Commodities: tungsten and copper
Location: sec. 25, T25N, R25E
UTM 4431150N 318800E
Production: 11,337 units WO_3
History: Property was first located as a copper prospect in February 1908, and tungsten was discovered about 1917. It was acquired by Rare Metals Corp. in 1944 and ore was hauled to the Toulon mill.
Development: open pit, cuts, trenches, and several shafts
Geology: In the mine area irregular masses of calcareous metasedimentary rocks are surrounded and intruded by granodiorite. The calcareous rocks consist principally of calc-silicate hornfels that strikes easterly and contains layers and lenses of skarn a few inches to 30 feet thick. The skarn is composed of garnet and epidote with varying amounts of quartz and limonite. Scheelite occurs as disseminated crystals that generally range in size from 1/16 to ¼ inch in diameter. Much of the scheelite is stained by green copper-oxide minerals. The copper deposits exploited in the 1908–12 period were quartz fissure veins hosted in granodiorite. The veins contained copper oxides, bornite, chalcocite, and tetrahedrite along with minor amounts of gold and silver. Uranium mineralization is reported present in a roof pendant zone about 300 to 400 feet west of the main open pit.
Sources of information: Stager and Tingley (1988, p. 166); Johnson (1977, p. 63–64)
Field examination: J. Quade, 1984

Three X prospects (28)
Commodity: uranium(?)
Location: sec. 33, T27N, R26E
UTM 4447500N 324500E
Production: none
Development: two trenches, about 150 feet long, across the slope and three short trenches that cut down the slope across the long trenches at right angles to them
Geology: Area of granitic outcrop, granite is cut by pinkish aplite dikes. Dikes exposed in cuts trend N80°E and are slightly iron-oxide stained. No obvious mineralization.
Field examination: J. V. Tingley, 1987

Tungsten prospect 1 (29)
Commodities: tungsten and copper(?)
County: Pershing
Location: sec. 13, T25N, R25E
UTM 4434600N 319460E
Production: none
Development: prospect pit
Geology: A 600-foot-long gneissic roof pendant in Cretaceous granitic rock trends east. Limy metasedimentary rocks and skarn are probably scheelite-bearing.
Remarks: The pit is on the south margin of the pendant.
Field examination: T. L. T. Grose, 1986

Tungsten prospect 2 (30)
Commodities: tungsten and copper(?)
Location: sec. 20, T25N, R26E
UTM 4431960N 322760E
Production: none
Development: prospect pit
Geology: Host rocks are gneiss and schist in a roof pendant in Cretaceous granite. The granite is cut by aplite and pegmatite dikes. Pendant is ⅔ mile wide by 1½ miles long and trends north-northwest.
Remarks: The prospect is on the north end of the roof pendant.
Field examination: T. L. T. Grose, 1986

Tungsten prospect 3 (31)
Commodity: tungsten
Location: sec. 14, T25N, R25E
UTM 4433600N 318040E
Production: none
Development: several prospect pits
Geology: Scheelite-bearing skarn in metacarbonate rocks in contact with Cretaceous granite; pendant trends northeast and dips 60°NW.
Field examination: T. L. T. Grose, 1986

Uranium occurrence 1 (32)
Commodity: uranium

Location: sec. 1, T27N, R26E
UTM 4456600N 328600E
Production: none
Development: none
Geology: Anomalous radioactivity occurs along iron-stained fractures in a kaolinized pegmatite dike which cuts granodiorite.
Source of information: Neff (1982, app. C, p. 2, no. 9)

Uranium occurrence 2 (33)
Commodity: uranium
Location: sec. 34, T26N, R26E
UTM 4438600N 325380E
Production: none
Development: none
Geology: Uranium mineralization occurs along limonite-stained joint surfaces in altered quartz monzonite immediately adjacent to a swarm of aplite-pegmatite dikes. No uranium minerals were identified.
Source of information: Neff (1982, app. C, p. 2, no. 8)

LAKE RANGE MINING AREA

The Lake Range lies between Pyramid Lake and Winnemucca Lake and extends from the southern border of the quadrangle north to the San Emidio Desert. Mineral deposits include small copper and gold occurrences on the west side of the Lake Range and a calcium carbonate occurrence on the east side of the range. All of these occurrences are within the Pyramid Lake Indian Reservation.

The only recorded mineral production for this area was from the Lakeview mine located south of Big Basin, east of Artillery Bay on Pyramid Lake. In 1929 a carload of hand-picked ore from this property was sent to the smelter in Selby, California. Mine workings explore quartz veins which follow a shear zone in altered volcanic rocks. The Pyramid Lake copper deposit, near Blizzard Camp Point, was discovered in 1979–81 by geologists with the U.S. Bureau of Mines during a mineral survey of the Pyramid Lake Indian Reservation. Copper mineralization is associated with diabase and quartz monzonite intrusive rocks. The deposit has not been explored and there has been no production from it.

At a third locality, a gold prospect on the northeast edge of the Pyramid Lake basin, traces of gold occur with copper-oxide minerals in a quartz vein cutting volcanic rocks.

Gold prospect 1 (34)
Commodities: gold, silver, lead, and zinc
Location: sec. 28, T27N, R22E
UTM 4451000N 286200E
Production: none
Development: 6-foot adit
Geology: A quartz vein in a 3- to 8-foot-wide shear zone in Tertiary andesitic pyroclastic rocks. The zone of veining is along a north-trending fault zone which forms the west margin of the Lake Range. The veins form a stockwork which is up to 100 feet wide and can be traced along strike for about 1,500 feet. Wall rocks are silicified near the shear zone and are malachite stained. The vein is oxidized, brecciated, and cemented with drusy quartz. Vein strikes N10°W and dips 72°W.
Remarks: Four samples taken by USBM contained 0.8 to 3.05 ppm gold and anomalous silver, lead, zinc, and copper.
Source of information: Satkoski and Berg (1982, p. D-5, nos. 26–29)
Field examination: L. J. Garside, 1988

Lakeview mine (35)
Other name: Big Basin prospect
Commodities: silver, gold, lead, and zinc
Location: sec. 14, T25N, R22E
UTM 4435000N 289000E
Production: 90 tons hand-sorted ore
History: The mine was first developed in the 1920's; the last work was reported to have been in 1931.
Development: three adits, a shallow shaft, and several prospect pits
Geology: Stringers of vein quartz occur in a N25° to 35°E-trending fault zone in silicified, bleached volcanic rocks of Miocene age. The vein is 5 to 6 feet wide and occurs within an altered zone several hundred feet long; abundant iron oxides occur within the vein. No sulfides are visible.
Sources of information: Satkoski and Berg (1982, p. 34–37); Bonham (1969, p. 98)

Pyramid Lake copper deposit (36)
Other name: Blizzard Camp
Commodity: copper
Location: sec. 22, T26N, R22E
UTM 4443200N 287000E
Production: none
History: The prospect was discovered during stream-sediment survey of the Pyramid Lake Indian Reservation by USBM geologists.
Development: none
Geology: Chalcopyrite, pyrite, malachite, and occasional bornite occur in veins and shear zones in nonfoliated and foliated diorite porphyry of probable mid-Cretaceous age. The diorite has been metamorphosed by intrusion of a mid-Cretaceous quartz monzonite. Molybdenite associated with chalcopyrite was found in one vein; hessite, a silver telluride mineral, was identified in one sample of chalcocite. Scapolite, epidote, garnet, magnetite, K-feldspar, tourmaline, and calcite with occasional quartz are associated with the sulfides in the veins and shear zones. In two areas, sulfides are disseminated and are associated with biotite, K-feldspar, and magnetite in foliated diorite porphyry.
Source of information: Satkoski and Berg (1982, p. 21–33)

NIGHTINGALE MINING DISTRICT

The Nightingale mining district, Pershing County, encompasses all of the Nightingale Range. Most of the mining activity within this district has been on the southeast side of the range, centered around the Nightingale tungsten mine. A small part of the district lies south of the quadrangle boundary in Washoe County; properties in this part of the district are not discussed in this report.

The first mineral deposits prospected in this district, the tungsten occurrences at the Nightingale mine, were probably discovered early in 1917. Geologists with the U.S. Geological Survey visited the district in July 1917 and reported that tungsten prospecting was underway and that a small amount of ore had been shipped (Hess and Larson, 1921, p. 282–285). After this initial small production, the district was idle until 1929 when the Nightingale mine was purchased by the Tungsten Production Co. Reorganized in 1933 as Gold Silver Tungsten Co., this group built a mill on the property and mined and milled tungsten ores intermittently until 1939. Later, the tungsten mines in the district were intensively worked during the periods of high tungsten prices during World War II and the Korean War. Ore mined during these periods from the mines on the east side of the Nightingale Range was hauled to a mill at Toulon

for treatment, ore from the M.G.L. mine on the west side of the district was treated at a mill at the mouth of Cowles Canyon, west of the mine (Johnson, 1977, p. 75). The last tungsten production from the district was recorded in 1977 (Stager and Tingley, 1988, p. 198).

Tungsten deposits in this district are in skarn formed at and near the contact of granodiorite and limestone. The contact is irregular in detail although it is generally concordant with bedding in the metasedimentary rocks. Tungsten is in scheelite; the ore-bearing skarn is a dark-green and brown thinly layered rock composed mostly of quartz, epidote, and garnet, with substantial amounts of calcite and pyroxene. Locally the skarn also contains pyrrhotite, molybdenite, chalcopyrite, arsenopyrite, and pyrite; small amounts of galena and sphalerite occur at the Alpine mine (Johnson, 1977, p. 76).

Three uranium prospects are located on the east side of the Nightingale Range, just north of the Nightingale mine, and others are in the northern part of the range. At these prospects, uranium occurs as small pods of uranophane, autunite, and possibly uraninite in shear zones in metasedimentary rocks and as unidentified uranium minerals associated with fracture zones and pegmatite dikes in granodiorite.

AAA uranium prospect (37)
Commodity: uranium
Location: sec. 19, T26N, R25E
UTM 4442000N 311300E
Production: none
Development: two bulldozer cuts and four drill holes
Geology: Uranium occurs in a skarn, formed in a roof pendant of Auld Lang Syne sedimentary rocks enclosed in granodiorite. Minor scheelite is present.
Source of information: Smouse (1982, app. C, p. 3, no. 19)

Alpine mine (38)
Other name: Meyer mine
Commodities: tungsten, silver, lead, molybdenum, and zinc
Location: sec. 13, T25N, R24E
UTM 4433675N 308820E
Production: 26,000 units WO_3 (est.)
History: located in 1921, first production in 1943, idle since 1945
Development: Workings consist of an open pit and about 1,000 feet of underground workings consisting of an adit beneath the pit with openings into the pit, and a winze from the adit with drifts from the winze.
Geology: Scheelite-bearing skarn beds occur in a salient of limestone and hornfels that extends into granodiorite. Scheelite-bearing skarn extends out along the limestone beds for 100 to 200 feet from the contact. The skarn is cut off at a depth of about 100 feet by granodiorite. Both scheelite and powellite occur in the skarn; lead and silver sulfides occur in quartz veins which cut the skarn zone.
Sources of information: Stager and Tingley (1988, p. 180); Johnson (1977, p. 75–76)
Field examination: J. Quade, 1984

Big Question uranium occurrence (39)
Other name: Altonella No. 78 occurrence
Commodity: uranium and tungsten(?)
Location: sec. 3, T26N, R24E
UTM 4447250N 306200E
Production: none
Development: none
Geology: Anomalous radioactivity occurs in a kaolinized pegmatite which cuts the contact zone between Auld Lang Syne sedimentary rocks and granodiorite of the Nightingale batholith.
Remarks: Prospect was probably for scheelite originally.
Source of information: Smouse (1982, app. C, p. 2, no. 6)

Cay-U claims (40)
Commodity: uranium
Location: sec. 12, T26N, R24E
UTM 4445500N 308900E
Production: none
Development: none
Geology: Uranium minerals are reported to be present in metamorphic rocks which occur as roof pendants in a granitic intrusive. The geology is similar to the nearby Four Jacks prospect.
Source of information: Garside (1979, p. 16)

Four Jacks prospect (41)
Other names: Penny prospect, Dart prospect
Commodities: gold and uranium
Location: sec. 10, T26N, R24E
UTM 4445000N 306000E
Production: none
History: early period of mining for gold, later exploration for uranium
Development: many roads, trenches, and drill sites
Geology: Argillite, slate, and hornfels of the Auld Lang Syne Group occur as roof pendants in granodiorite. The contact zone is intruded by dikes and sills of granodiorite and pegmatite. The dikes are bleached and altered. Uranium minerals present are uranophane, autunite, and possibly uraninite. Uranium minerals are concentrated at the contact between pegmatite and hornfels.
Source of information: Smouse (1982, app. C, p. 2, no. 4)
Field examination: J. Quade, 1985

Highgrade prospect (42)
Commodities: tungsten, silver, copper, lead, and zinc
Location: sec. 25, T25N, R24E
UTM 4430200N 310100E
Production: none
Development: bulldozer cuts and drill pads
Geology: Scheelite occurs in a narrow skarn zone near a granodiorite contact.
Field examination: J. Quade, 1984

Hunt and Grunt mine (43)
Commodity: tungsten
Location: sec. 23, T25N, R24E
UTM 4433040N 307300E
Production: small
History: last work in 1940's(?)
Development: a steeply inclined, 80-foot, untimbered shaft with headframe still in place
Geology: The shaft is sunk on a marbleized limestone-granite contact, with granite to the east and marble and hornfels to the west. Bedding in the metasedimentary rocks at the shaft is contorted. The beds strike about N40° to 50°E and dip 45° to 50°NW. A lense of marble is exposed at the shaft collar and is overlain to the west by hornfels. Fine-grained, banded garnet-epidote-diopside skarn with clots of white quartz was found on the shaft dump. Sparse scheelite is present; scheelite is small to medium grained and fluoresces blue-white.

Remarks: Cabin on site and wooden headframe appear to date from the 1940's; no work appears to have been done since that time. The area was restaked in 1982.
Field examination: J. V. Tingley, 1987

M.G.L. mine (44)
Other names: Buster mine, Cowles mine, Western Soldier prospect, Wizzard group, Cameron claims
Commodities: tungsten and molybdenum
Location: sec. 15, T25N, R24E
UTM 4433860N 306840E
Production: 32,300 units WO_3 through 1961
History: discovered in 1917, first production in 1918, mill built in 1941, most production 1943–45
Development: three adits with 3,300 feet of drifts, raises, and crosscuts
Geology: The mine is in a contact zone, about 300 feet wide and 750 feet long, between a thick sequence of argillaceous and calcareous rocks and an intrusive body of granodiorite. The sedimentary rocks strike northwest and dip steeply southwest. The contact is nearly conformable but the contact zone is intricately injected by granodiorite, resulting in mixed rocks. The central part of the contact zone consists of a band of limestone about 80 feet wide that has been altered to skarn. At depths of a few hundred feet, the granodiorite cuts across the favorable limestone bed. At the surface, the best orebody consisted of highly quartzose skarn, 5 to 20 feet thick, consisting of 70 to 90 percent quartz and 10 to 30 percent epidote, pyroxene, hornblende, and garnet with small quantities of sulfides and scheelite.
Source of information: Stager and Tingley (1988, p. 183); Johnson (1977, p. 75–76)
Field examination: J. Quade, 1985

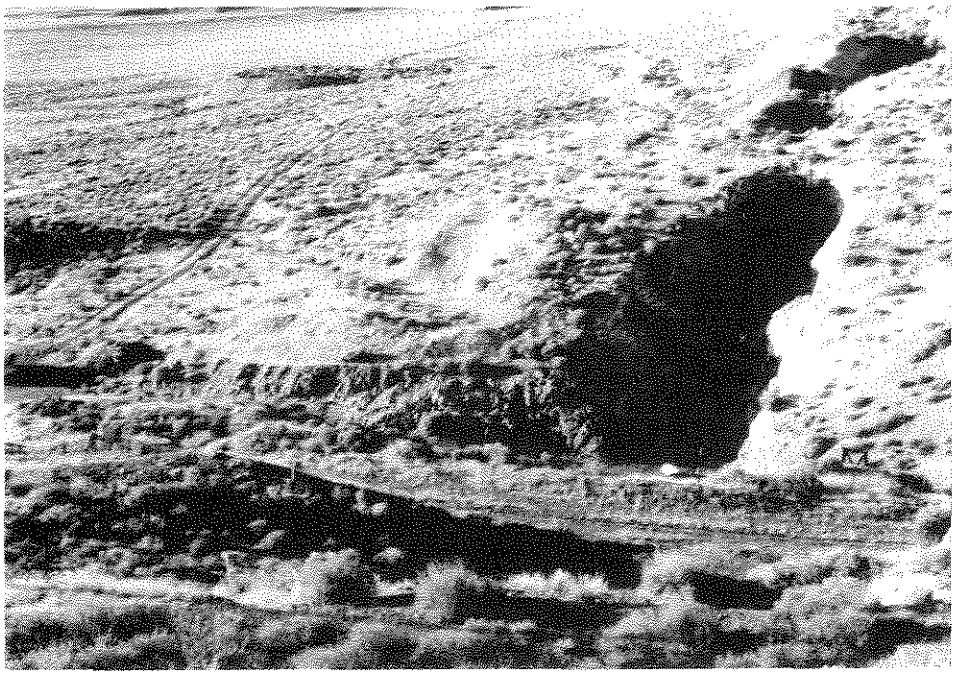
Maher mine (45)
Other names: Margrave mine, May claim, Joe claims
Commodity: tungsten
Location: secs. 15 and 22, T27N, R24E
UTM 4452600N 306000E
Production: 351 units WO_3
History: discovered in the early 1940's, most recorded production 1954–56, some in 1977
Development: two adits, several shallow trenches and cuts, and two pits
Geology: Scheelite-bearing skarn occurs at the contact between limestone and granodiorite. The skarn body is about 300 feet long and averages about 3 feet wide. The sedimentary rocks strike N30°W and dip 30°SW.
Source of information: Stager and Tingley (1988, p. 198)

Mammoth prospect (46)
Other names: Don claim, Scheelite Extension claim
Commodity: tungsten
Location: sec. 24, T25N, R24E
UTM 4432500N 309785E
Production: small
History: explored in 1942
Development: three shallow shafts, seven short adits, shallow pits, and trenches
Geology: In the claim area, thin limestone beds have been cut by granodiorite and partly altered to skarn. The skarn contains abundant garnet crystals in quartzose lenticular layers; sparse scheelite is present although some crystals nearly an inch in diameter are found. Minor copper minerals and some molybdenite are also present in the skarn.
Source of information: Stager and Tingley (1988, p. 182)
Field examination: J. Quade, 1984

Marvelous prospect (47)
Commodity: tungsten
Location: sec. 31, T25N, R25E
UTM 4430000N 312000E
Production: none
Development: small prospect pits
Geology: narrow skarn zone along a granodiorite contact
Field examination: J. Quade, 1984

Remains of a hand windlass, Marvelous prospect, Nightingale district. J. Quade photo.

Nightingale mine (48)
Commodities: tungsten and molybdenum
Location: sec. 25, T25N, R24E
UTM 4430980N 309970E
Production: 40,044 units WO_3
History: It was discovered in 1917 but most production was after 1929. A mill was built on the property in 1930 but only operated intermittently; most ore was shipped to the Toulon mill.
Development: three adits (Machine Shop tunnel, Ranson tunnel, and Lidstone tunnel), four shallow shafts, numerous cuts and trenches
Geology: The mine is along a granodiorite contact that trends north and cuts at a slight angle nearly vertical



Glory hole and open stopes, Nightingale mine, Nightingale district. *J. Quade photo.*

beds of slate, argillite, and limestone that strike about N20°W. Irregular bodies of quartz monzonite intrude the sedimentary rocks close to the granodiorite contact and aplite and pegmatite dikes cut both sedimentary rocks and the granodiorite. Skarn in tabular bodies 10 to 50 feet thick occurs along the contact where limestone is present. Scheelite is present in mineable quantities in only part of the skarn and occurs in four principal ore shoots along a strike length of about 1,900 feet. The skarn contains abundant quartz, epidote, garnet, hornblende, calcite, pyroxene, and tremolite; and a little pyrrhotite, molybdenite, chalcopyrite, arsenopyrite, and pyrite. The skarn is layered parallel to bedding and the layers are alternately fine- and coarse-grained and vary in scheelite content. The layers are cut by joints that strike east and dip gently south, the scheelite content is greater near the joints, resulting in bands of ore that cut across bedding.

Source of information: Smith and Guild (1942); Stager and Tingley (1988, p. 183); Johnson (1977, p. 75–76)

Field examination: J. Quade, 1984

Pegmatite prospect (49)

Commodity: tungsten
Location: sec. 14, T27N, R24E
UTM 4454000N 307500E
Production: none
Development: several shallow, caved adits
Geology: Pegmatite veins cut granodiorite, strike N25° to 35°E, and contain streaks of black tourmaline along with pyrite and other fine-grained sulfides. Granodiorite near the pegmatite contact contains envelope of pink K-feldspar alteration.
Field examination: J. Quade, 1985

Poncho prospect (50)

Other names: Butch prospect, Doris prospect
Commodities: uranium and tungsten
Location: sec. 10, T26N, R24E
UTM 4445700N 305750E
Production: none
Development: over 2,000 feet of bulldozer trenching and at least one core hole
Geology: Uranium and possibly tungsten mineralization are present in a skarn zone in Auld Lang Syne sedimentary rocks. Autunite, uranophane, and possibly uraninite are present in a thin quartzite bed in hornfels in roof pendants in granodiorite of the Nightingale batholith. The pendants are cut by numerous pegmatite and granodiorite dikes.
Source of information: Smouse (1982, app. C, p. 2, no. 5)

Red Hammer claims (51)

Commodity: tungsten
Location: sec. 13, T25N, R24E
UTM 4434340N 309920E
Production: small(?)
Development: about ten small pits and bulldozer cuts
Geology: Numerous pits have been dug on small pendants of garnet skarn entirely within granodiorite. Blocks of skarn are very small and display variable attitudes from pit to pit, indicating blocks rotated within the intrusive. Pegmatitic areas in granodiorite near pendants contain cavities lined with quartz and calcite. Quartz is shattered and coated with sericite; ilsemannite coatings occur in some areas.
Field examination: J. V. Tingley, 1978, and J. Quade, 1984

Sage Hen Spring prospect (52)

Other name: Uranium Lode claims
Commodity: uranium
Location: sec. 7, T25N, R25E
UTM 4435600N 310550E
Production: none
Development: small prospect pit, bulldozer cuts
Geology: Small roof pendant of quartzite in granodiorite. Quartzite is highly fractured and has uranophane coatings on fracture surfaces in a small area.
Field examination: J. Quade, 1984

Tungsten prospect 1 (53)
Commodity: tungsten
Location: sec. 14, T25N, R24E
UTM 4433500N 307340E
Production: none
Development: one partly caved adit
Geology: Irregular skarn zone occurs along contact of Auld Lang Syne Group sedimentary rocks with granodiorite. Minor scheelite occurs in a strongly iron-oxide-stained contact zone.
Field examination: J. Quade, 1985

Tungsten prospect 2 (54)
Commodity: tungsten
Location: sec. 1, T26N, R24E
UTM 4447380N 308660E
Production: none
Development: tunnel, about 100 feet long
Geology: northwest-trending roof pendant of metashale and metasandstone in Cretaceous granitic rock
Field examination: T. L. T. Grose, 1986

Tungsten prospect 3 (55)
Commodity: tungsten
Location: sec. 14, T25N, R24E
UTM 4433580N 30800E
Production: none
Development: adit about 40 feet long, portal partially caved
Geology: The adit follows 3- to 4-foot-thick band of massive, pale garnet skarn enclosed in shaly hornfels. Metasediments strike N30°W and dip 75° to 80°SW. Minor, hairline quartz veinlets cut the skarn. Granite contact is just below the adit level and, to the north, granite is exposed in the drainage north of the portal. Skarn contains diopside and epidote as well as garnet.
Field examination: J. V. Tingley, 1987

Two Chukkars prospect (56)
Other names: Blue Star prospect, D.D.J. prospect, Two Chuckers group
Commodity: uranium
Location: sec. 18, T25N, R25E
UTM 4434600N 310600E
Production: none
Development: a number of bulldozer cuts
Geology: Anomalous radioactivity occurs in a 4-foot-wide fracture zone in granodiorite; the zone is stained with limonite, malachite, and azurite. The zone is silicified in places and contains quartz veinlets. The granodiorite adjacent to the shear zone is kaolinized. No uranium minerals were identified.
Source of information: Smouse (1982, app. C, p. 1, no. 2); Garside (1973, p. 94)

Uranium prospect 1 (57)
Commodity: uranium(?)
Location: sec. 16, T26N, R24E
UTM 4444050N 304560E
Production: none
Development: two shallow prospect pits
Geology: shear zone in granitic rock
Field examination: T. L. T. Grose, 1986

Woffer prospect (58)
Other name: Jack claims
Commodity: uranium
Location: sec. 1, T27N, R24E
UTM 4457000N 309200E
Production: none
Development: bulldozer cuts, prospect pits
Geology: Uranium mineralization in argillically altered quartz monzonite is associated with vertical veinlets of quartz; the veins contain black tourmaline and strike N85°E. No uranium minerals were identified; altered area is limonite stained.
Source of information: Smouse (1982, app. C, p. 1, no. 7)

SAN EMIDIO MINING AREA

The San Emidio area, Washoe County, includes the San Emidio Desert and the portion of the northern Lake Range that lies to the east of it, between the desert basin and the Washoe County line.

Until recently, this area had no recorded mineral production and very little has been written about it. Bonham (1969, p. 94) first noted the presence of cinnabar in this area during his examination of an old sulfur prospect. There is, however, no information on the date of the sulfur prospecting. Traces of gold occur associated with the cinnabar and sulfur and the most recent activity in this area, gold prospecting, culminated in the discovery of the Wind Mountain gold deposit in 1988.

The cinnabar occurrence described by Bonham (1969, p. 94–96) is in altered Pleistocene sands and gravels on the eastern margin of the San Emidio Desert. Cinnabar is associated with native sulfur, gypsum, opal, chalcedony, quartz, kaolinite, sericite, and other alteration minerals. The altered zone, probably of hot-springs origin, is fault controlled and is aligned in a north-south direction. Alteration can be traced for about 2 miles along strike; exposed widths are in excess of 100 feet (Bonham, 1969, p. 94). About 2 miles northeast of the northernmost cinnabar croppings, a second large area of hot-springs alteration in rhyolitic volcanic rocks has been recently prospected for gold. AMAX Gold Inc. has defined a large, bulk-mineable gold-silver orebody at this location which they plan to place into production in 1989.

S.E.D. prospect (59)
Commodity: gold(?)
Location: sec. 3, T29N, R23E
UTM 4476100N 298020E
Production: none
Development: two short adits at the southern end of claim group
Geology: On the south end of the claim block, an adit follows a brecciated quartz vein which occurs at the contact of volcanic rocks (to the north) and metasedimentary rocks (to the south). The vein strikes N70°E. Mercury-sulfur mineralization occurs in altered, brecciated, rhyolite on the north end of the claim group in sec. 26, T30N, R23E. The prospect is immediately south of the Wind Mountain mine.
Field examination: R. B. Jones, 1984

San Emidio prospect (60)
Other name: Mud Flat prospect
Commodities: mercury and sulfur
Location: sec. 9, T29N, R23E
UTM 4474875N 296225E
Production: none
Development: 12 trenches over about ¼ mile
Geology: Hot springs sinter deposit along range-front fault locally contains cinnabar and native sulfur.
Sources of information: Bonham (1969, p. 94–96); Papke (1969, p. 130)
Field examination: R. B. Jones, 1984

Wind Mountain mine (61)

Other names: TBM Associates prospect, Lake Range montmorillonite prospect, San Emidio deposit
Commodities: gold, silver, and montmorillonite
Location: sec. 27, T30N, R23E
UTM 4478400N 297450E
Production: none
History: Known as a clay occurrence for many years, it was explored for precious metals beginning in 1978 and a gold mining plan was announced in 1988.
Development: several miles of drill roads, drill holes, cuts, and trenches
Geology: An area of about 1 square mile in Pliocene tuffaceous and volcaniclastic sedimentary rocks is argillized and silicified. A small hill on the property is capped by strongly silicified material, probably in part subaqueous spring sinter. Some sinter has abundant silicified reeds. Some lenses of light gray chalcedony and a few silicified hydrothermal breccias.
Remarks: Announced recoverable reserves are estimated at 178,000 ounces gold and 2,028,000 ounces silver which would come from approximately 16 million tons averaging 0.02 ounces gold and 0.42 ounces silver per ton.
Sources of information: AMAX Gold Inc. (1988); Papke (1969, p. 113; 1970, p. 39–40)
Field examination: L. J. Garside, 1983

SAND PASS MINING AREA

Only one metallic occurrence, the Adobe Springs prospects east of Zenobia in the Virginia Mountains, has been reported from this area; prospecting, probably for gold, was confined to a fault zone in silicified volcanic rocks. Additional information on this mining area is given in the section on nonmetallic occurrences.

Adobe Springs prospects (62)

Commodities: gold, copper, and tungsten(?)
Location: sec. 8, T26N, R20E
UTM 4445520N 264280E
Production: none
Development: several prospect pits within a square mile area
Geology: N60°W-trending fault zone in altered and silicified Miocene intermediate volcanic rocks, probably a fossil hot spring zone
Field examination: T. L. T. Grose, 1986

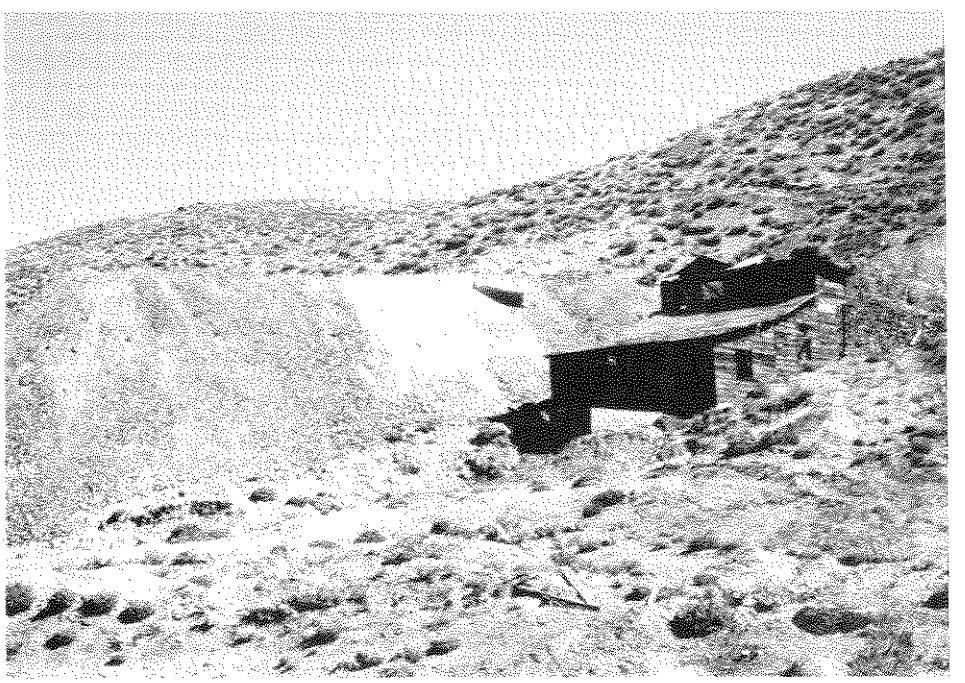
STAGGS MINING AREA

The Staggs mining area, Pershing County, is located in what are known as the Lava Beds, a mountain range lying north of the Blue Wing Mountains. The Lava Beds, and most of the mining area, lie outside of the quadrangle but one property, the Twin Buttes mine, is at the northeast corner of the quadrangle.

The Twin Buttes mine, the principal mine in the district, was discovered in the 1930's. At this mine, metallic mineralization occurs in a quartz vein which follows a shear zone in Jurassic and Triassic metasedimentary rocks. Mining began in 1940 and a 15-ton gravity concentrating mill was constructed in 1942; gold, silver, and lead production is credited to the mine in 1941–43 and again in 1949 (Johnson, 1977, p. 92).

Twin Buttes mine (63)

Commodities: gold, silver, and lead
Location: sec. 1, T30N, R26E
UTM 4484600N 329510E
Production: 636 ounces gold, 7,577 ounces silver, 40,400 ounces lead
History: It was discovered in the 1930's. A 15-ton gravity concentrator was built in 1943. Last recorded production was in 1949.
Development: adit
Geology: The main adit was driven on east-bearing quartz vein which occupies a south-dipping shear zone cutting black metasedimentary rocks. Vein material contains arsenopyrite, pyrite, some galena, and possibly some silver sulfides.
Source of information: Johnson (1977, p. 92)
Field examination: J. Quade, 1984



Main dump and mill remains, Twin Buttes mine, Staggs area. *J. Quade photo.*

STATE LINE MINING AREA

The State Line mining area, Washoe County, covers the eastern flanks of State Line Peak in the Fort Sage Mountains. The area is south of Honey Lake Valley in the southwestern corner of the quadrangle. The Stateline Peak district, as defined by Bonham (1969, p. 88), is about 20 miles further south and is not included in this area.

The only prospecting in this area has been for iron and possibly for uranium but there has been no recorded mineral production.

Small deposits of magnetite have been prospected at three localities along the east side of State Line Peak. The magnetite occurs in veins associated with faults which cut both granodiorite and metavolcanic rocks. Uranium minerals are reported from a location near the Black Hawk prospect, the northernmost iron locality (Garside, 1973, p. 106).

Black Hawk prospect (64)
Other name: Black Hawk claims
Commodities: iron and uranium
Location: sec. 16, T25N, R18E
UTM 4436400N 247000E
Production: none
Development: adits, pits
Geology: The iron deposit occurs as a magnetite vein in the hanging wall of a north-striking fault zone cutting porphyritic metavolcanic rocks. The orebody is about 15 feet wide and 50 feet long. Small outcrops and float in the immediate vicinity indicate that other veins occur nearby but magnetic surveys in the area indicate that they are of small size. Garside (1973) reported the presence of torbernite, autunite, and carnotite occurring in a N56°W-trending, 80° NE-dipping fault zone that cuts pre-Jurassic metamorphic rocks near a granite contact in the vicinity of the magnetite occurrences.
Sources of information: Shawe and others (1962, p. 118); Garside (1973, p. 106)

Iron prospect 1 (65)
Commodity: iron
Location: sec. 28, T25N, R18E
UTM 4432280N 245730E
Production: none
Development: an adit, 40 to 50 feet long, driven southwest to intersect a vein exposed in a cut on the slope above the adit; a cut on slope east of the adit; and several road cuts
Geology: N20° to 30°W, 65°NE-dipping quartz-hematite-magnetite veins cutting coarse-grained biotite granite. A vein cropping in the canyon north of the adit is about 2 feet thick, is lenticular, and has clots of hematite and magnetite up to 1 foot across and 2 to 3 feet long in direction of strike. This structure projects across the canyon to the southeast and may be exposed in the cut directly east of the adit. There are other parallel, narrow veins cutting the granite. Fracture surfaces of the granite are coated with fine-grained magnetite and pyroxene. The cut directly above the adit exposes a 1- to 2-foot-wide brecciated magnetite-hematite vein striking N10° to 20°W and dipping 75°NE. This zone is narrow in outcrop but appears to widen to 4 to 5 feet where exposed in the toe of the cut. The granitic wall rock in the vicinity of the veins is cut by numerous thin quartz-hematite-magnetite veins and aplite dikes. The granite has inclusions of fine-grained, altered diorite and some metasedimentary rocks.
Remarks: There was evidence of small amount of hand-digging at the two cuts, but no major work has taken place on this property for many years.
Field examination: J. V. Tingley, 1986

Iron prospect 2 (66)
Commodity: iron
Location: sec. 22, T25N, R18E
UTM 4434100N 247580E
Production: none
Development: one long cut down the crest of a ridge and two small pits
Geology: The cut exposes sugary-textured welded tuff at the north end and schistose metasedimentary rock at the south end. A small pit about 20 feet southeast of the south end of the cut exposes lenses of quartz-hematite-magnetite formed within the metasedimentary rock. The lenses strike N20°W and dip 40°SW. One lense is exposed for about 5 feet of thickness in the pit; another is exposed for 1 to 2 feet of thickness. Lenses are mostly massive hematite and are conformable to bedding in the metasedimentary rock. Wall rocks near the pit are cut by quartz-epidote veinlets, and clots of massive, fine-grained epidote occur within the rock.
Field examination: J. V. Tingley, 1986

NONMETALLIC OCCURRENCES

COTTONWOOD MINING DISTRICT

This district is described in the section on metallic occurrences.

Clay deposit 1 (1)
Commodity: halloysite clay
Location: secs. 3 and 10, T28N, R21E
UTM 4467000N 278000E
Production: none
Development: none
Geology: Deposits of impure halloysite clay occur in a lapilli tuff unit deposited between flows of vesicular basalt and andesite. Satkoski and Berg (1982) infer that the geology of this occurrence is similar to deposits to the southwest in T28N, R20E (Clay deposit 1, Sand Pass area).
Remarks: This occurrence is much smaller than the deposit in T28N, R20E.
Source of information: Satkoski and Berg (1982, p. 40)

HOOKER MINING DISTRICT

Gypsum was the first mineral commodity discovered in the Hooker district. In 1922 a crushing and calcining plant was constructed at Empire, just north of the quadrangle boundary, and gypsum deposits in the district have been continually mined to the present. The gypsum deposits, on the western side of the Selenite Range on the northern edge of the quadrangle, occur as part of the Nightingale sequence of Triassic and Jurassic age; gypsum crops out in about 10 bodies within an area 2 miles in diameter (Papke, 1987, p. 22). Further information on this district is given in the section on metallic occurrences.

Empire gypsum quarry (2)
Other name: Selenite quarry
Commodity: gypsum
Location: sec. 5, T30N, R23½E
UTM 4486000N 304740E

Production: 6,051,431 tons during 1937–70 and still in operation
History: The property was patented between 1910 and 1916, operated by Pacific Portland Cement Co. 1922–48, and acquired by U.S. Gypsum Co. in 1948.
Development: a series of large open pits along the western front of the Selenite Range
Geology: Gypsum and anhydrite occur as part of the Nightingale sequence of Triassic or Jurassic age. The gypsum crops out in about 10 bodies within an area 2 miles in diameter. Adjacent rocks are dark limestone, marble, and calcareous metasiltstone. All the bodies have a northwest trend, but most of them appear to be discrete pods. The largest body, the Selenite, is 4,000 feet long and trends north-northwest; it pinches out at both ends and has a maximum width of 2,200 feet. The gypsum generally is well bedded with beds of slightly different color less than 2 inches thick. Bedding angle is usually steep—70° or more—but is as low as 20° in a few places. Strikes are quite varied but mostly are from N45°W to N20°E. Some faults and breccia are present. A few thin beds of limestone are present within the gypsum, and altered diabasic igneous dikes up to 3 feet thick intrude the gypsum locally. The gypsum passes into anhydrite about 85 feet below the surface; the generally semi-horizontal contact is fairly sharp and distinct. Small amounts of halite are present, mostly in the upper 20 feet or so of the gypsum. Most of the gypsum is white, fine grained, and friable. Gypsum content ranges from about 85 to 95 percent. Impurities are calcite, quartz, mica, and montmorillonite.
Remarks: The deposits extend northwest into sec. 31, T31N, R24E. Crushed gypsum is hauled 6 miles to the plant at Empire where it is calcined and used to manufacture wallboard at Empire, Nevada, and at Fremont, California. Some is used to manufacture plaster. Some uncalcined material is used a soil additive.
Source of information: Papke (1987, p. 22–23)

LAKE RANGE MINING AREA

The single known nonmetallic occurrence in this mining area, a deposit of calcium carbonate, is on the east side of the Lake Range, about 4 miles southeast of Tohakum Peak. This property has had no production and little is known about it. Information on the location and mining history of this district is given in the section on metallic occurrences.

Calcium carbonate deposit 1 (3)
Commodity: calcium carbonate
Location: sec. 34, T27N, R23E
UTM 4448600N 297400E
Production: none
Development: none
Source of information: Papke (1969, p. 109)

SAN EMIDIO MINING AREA

Nonmetallic minerals in this mining area include montmorillonite clay, in the northern area of hot-springs alteration, and a slate occurrence. This mining area is described in the section on metallic occurrences.

Lake Range montmorillonite prospect (4)
Other names: San Emidio deposit, TBM Associates prospect, Wind Mountain mine
Commodities: montmorillonite, gold, and silver
Location: secs. 27 and 34, T30N, R23E
UTM 4478400N 297450E
Production: none
History: Known as a clay occurrence for many years, it was explored for precious metals beginning in 1978.
Development: several miles of drill roads, drill holes
Geology: An area of about 1 square mile in Pliocene tuffaceous and volcaniclastic sedimentary rocks is argillized and silicified. A small hill on the property is capped by strongly silicified material, probably subaqueous spring sinter; some lenses of light gray chalcedony and a few silicified hydrothermal breccias are present.
Remarks: Presence of a large, low-grade, bulk-mineable gold orebody on the property was announced in 1988.
Sources of information: Papke (1969, p. 113; 1970, p. 39–40); AMAX Gold Inc. (1988)
Field examination: L. J. Garside, 1983

San Emidio prospect (5)
Other name: Mud Flat prospect
Commodities: sulfur and mercury
Location: sec. 9, T29N, R23E
UTM 4474875N 296225E
Production: none
Development: 12 trenches over about ¼ mile
Geology: Hot springs sinter deposit along range-front fault locally contains cinnabar and native sulfur.
Sources of information: Bonham (1969, p. 94–96); Papke (1969, p. 130)
Field examination: R. B. Jones, 1984

Slate occurrence 1 (6)
Commodity: slate
Location: sec. 23, T29N, R23E
UTM 4471250N 298500E
Production: none
Development: none
Geology: metasedimentary rocks with a nearly vertical dip, slaty structures
Remarks: possibly commercial grade slate
Field examination: T. L. T. Grose, 1986

SAND PASS MINING AREA

The Sand Pass mining area, Washoe County, includes the northern tip of the Virginia Mountains and the Terraced Hills. Sand Pass, the division point between Smoke Creek Desert and Honey Lake Valley, is on the north end of the area; Zenobia, a point on the old Western Pacific line south of Astor Pass, is near the southern end.

Bog lime deposits (marl, calcium carbonate) were discovered in the Sand Pass area in 1919 (Overton, 1947, p. 63), and the first shipment was made in 1922 (Lincoln, 1923, p. 234). Large shipments were made from these deposits and from deposits south of Astor Pass in 1945 and 1946. Production was again recorded for the period 1952 through 1966 (Papke, 1969, p. 110).

Clay deposit 1 (7)
Commodity: halloysite clay
Location: secs. 1,2,11,12,13,22,23, and 24, T28N, R20E
UTM 4465000N 274000E
Production: none
Development: none
Geology: Halloysite clay occurs in a lapilli tuff unit deposited between flows of vesicular basalt and andesite. The unit is about 200 feet thick and includes some impure diatomite. The clay unit and enclosing rock strike north and dip about 20°E.
Remarks: Papke (1969) considered the clay to have formed by hydrothermal alteration of the tuff caused

by thermal solutions ascending along a series of northwest-trending faults that cut the volcanic section. Satkoski and Berg (1982), however, feel that the large areal extent of the deposits suggests their origin was from lateritic weathering rather than from hydrothermal alteration.

Sources of information: Satkoski and Berg (1982, p. 40); Papke (1969, p. 110–113)

Double Check deposit (8)

Commodity: calcium carbonate
Location: sec. 23, T27N, R19E
UTM 4452600N 260700E
Production: moderately large
History: first mining in 1919
Development: open pits
Geology: Unconsolidated deposits of calcium carbonate of algal origin are remnants of a single, flat-lying bed within a sequence of impure diatomite. The carbonate bed ranges up to 12 feet in thickness. The deposits are lacustrine deposits which accumulated in shallow embayments along the relatively open shoreline of Lake Lahontan.
Source of information: Papke (1969, p. 110)

Rivermott deposit (9)

Commodity: calcium carbonate
Location: sec. 29, T27N, R20E
UTM 4450800N 264900E
Production: moderately large
History: first mining in 1919
Development: open pits
Geology: Unconsolidated deposits of calcium carbonate of algal origin are remnants of a single, flat-lying bed within a sequence of impure diatomite. The carbonate bed ranges up to 12 feet in thickness. The deposits are lacustrine deposits which accumulated in shallow embayments along the relatively open shoreline of Lake Lahontan.
Source of information: Papke (1969, p. 110)

Terraced Hills deposit (10)

Commodity: halloysite clay
Location: sec. 13, T27N, R19E
UTM 4454620N 261440E
Production: small to moderate
History: First described in 1947, it was explored by Nevada Cement in 1963 and mined for use in portland cement.
Development: open pit
Geology: A series of andesite and basalt flows of late Miocene to Pliocene age are separated by a pyroclastic unit. Most of the pyroclastic unit has been converted to halloysite by hydrothermal processes, forming clay horizons that are nearly conformable to the underlying and overlying volcanic rocks. The halloysite is a compact, brittle material with a dull to slightly waxy luster.
Source of information: Papke (1969, p. 110–113)
Field examination: J. Quade, 1985

Zenobia clay prospects (11, 12, 13, 14)

Commodity: clay
Location: secs. 4, 9, and 16, T26N, R20E
UTM 4446450N 266100E
Production: small
Development: small open pits
Geology: Lahontan deposit of calcium carbonate with probable layers of diatomite and possible relatively pure (altered?) volcanic ash
Remarks: four locations along a 2½-mile-long northwest trend
Field examination: T. L. T. Grose, 1986

SMOKE CREEK DESERT

Several occurrences of nonmetallic minerals occur in the mountains west of the Smoke Creek Desert in the northwest corner of the quadrangle, Washoe County. These deposits are not within the boundaries of any recognized mining district or area. Two perlite occurrences, one north of Willow Canyon and the other west of Dry Valley, are reported in an area of extensive Tertiary basalt flows. A deposit of fuller's earth is on a plateau on the west side of the Smoke Creek Desert near the northern edge of the quadrangle. Deposits of montmorillonite and zeolite are also reported from this area.

Broken Shovel claims (15)

Commodity: perlite
Location: sec. 25, T29N, R18E
UTM 4471200N 253200E
Production: none
History: The claims were located in 1955.
Development: none
Geology: Perlitic rocks occur near the base of a high north-trending cliff of late Miocene and Pliocene basalt flows. The perlite has a banded structure and cross-cuts the horizontal volcanic rocks; the perlite is intrusive into the volcanic rocks. The perlite zone is in a disrupted mass as much as 125 feet thick, 100 feet wide, and 700 feet long; perlite crops out locally over a distance of 1¼ miles with a northerly trend along the range front.
Remarks: The largest exposed part of the deposit contains an estimated 100,000 tons of perlite that would be suitable for lightweight aggregate.
Sources of information: Papke (1969, p. 126); Diggles and others (1988, p. 17)

Capricorn claims (16)

Commodity: montmorillonite clay
Location: sec. 18, T30N, R19E
UTM 4484500N 254800E
Production: none
Development: three trenches between 20 and 100 feet long and as much as 3 feet deep, and one pit 2 feet deep and 5 feet in diameter
Geology: Remnant pediment or fan of pre-Lake Lahontan alluvial sediments over an area of about 300 acres with an estimated thickness of 50 feet. The material consists of more than 30 percent montmorillinitic clay, less than 30 percent feldspar, and less than 10 percent each of calcite, gypsum, and diatoms.
Source of information: Diggles and others (1988, p. 17)

Red Rock zeolite occurrence (17)

Commodity: zeolite
Location: sec. 12, T30N, R18E
UTM 4485500N 253300E
Production: none
Development: none
Geology: Chabazite fills voids in altered basalt over an area of about 150 acres with an estimated thickness of 200 feet. The deposit centers on a basalt dike and may be related to a north-trending fault.
Remarks: The deposit contains an estimated 70 million tons of subeconomic zeolite-bearing resources.
Source of information: Diggles and others (1988, p. 17)

Rocky Springs zeolite occurrence (18)
Commodity: zeolite
Location: sec. 25, T30N, R18E
UTM 4481300N 253250E
Production: none
Development: none
Geology: Chabazite fills voids in altered basalt over an area of about 20 acres with an estimated thickness of 25 feet. The deposit may be related to a north-trending fault.
Remarks: Four samples contained between 10 and 45 percent chabazite with a weighted average of 29 percent.
Source of information: Diggles and others (1988, p. 17)

Smoke Creek Desert clay deposit (19)
Commoditv: fuller's earth
Location: sec. 17, T30N, R19E
UTM 4484500N 256500E
Production: none
History: It was described by Lincoln (1923) and prospected by Standard Oil Co.; Papke (1969) could not locate it.
Development: trenches, boreholes
Geology: The clay bed is 2,100 feet by 3,300 feet, 60 feet thick, and overlain by lime-cemented gravel and gravel.
Sources of information: Lincoln (1923, p. 238–239); Papke (1969, p. 113–114)

Willow Springs perlite deposit (20)
Commodity: perlite
Location: secs. 32 and 33, T30N, R19E
UTM 4479000N 256500E
Production: none
Development: 25-foot vertical shaft
Geology: A bluish-gray, dense, and friable perlite layer, extensively brecciated, is in flat-lying Miocene to Pliocene basalt. Good-quality perlite has a thickness of 25 to 38 feet.
Source of information: Papke (1969, p. 126)

Willow Springs zeolite occurrence (21)
Commodity: zeolite
Location: sec. 6, T29N, R19E
UTM 4478000N 254000E
Production: none
Development: none
Geology: Chabazite fills voids in altered basalt over an area of about 70 acres with an estimated thickness of 100 feet. The deposit may be related to a north-trending fault.
Remarks: Three samples contained from 35 to 65 percent chabazite with a weighted average of 52 percent. The deposit contains an estimated 15 million tons of subeconomic zeolite-bearing resources.
Source of information: Diggles and others (1988, p. 17)

GEOTHERMAL OCCURRENCES

Thermal springs and wells occur at five localities within the Kumiva Peak 30′ by 60′ Quadrangle: at an area on the east side of the San Emidio Desert, in the central Lake Range, at The Needle Rocks on the northwest tip of Pyramid Lake, along the west side of the Smoke Creek Desert, and at Fish Springs in Honey Lake Valley. All of these locations are in Washoe County. Only two of these areas, The Needle Rocks and San Emidio Desert, have been extensively drilled for geothermal resources; production of geothermal power is planned at the San Emidio Desert site.

HONEY LAKE VALLEY

Fish Springs (1)
County: Washoe
Location: sec. 19, T26N, R19E
UTM 4442900N 254200E
Temperature: 23°C
Source of information: Garside and Schilling (1979, p. 133, no. 268)

LAKE RANGE MINING AREA

Spring 1 (2)
Location: sec. 27, T28N, R23E
UTM 4459300N 297700E
Temperature: 86°C
Source of information: Garside and Schilling (1979, p. 133, no. 267)

SAN EMIDIO DESERT

Empire geothermal project (3)
Location: sec. 21, T29N, R23E
UTM 4471350N 296500E
Development: One test well and one production well; the production zone in the second well is from 220 to 280 feet in depth.
Geology: The plant site rests on Pleistocene Lake Lahontan sedimentary deposits. Just to the north of the site, cinnabar, native sulfur, gypsum, and chalcedony occur in an altered zone in the Pleistocene deposits; the altered zone is associated with a former hot springs site along a fault zone.
Remarks: Plans for the project call for the construction and operation of a 3.66 megawatt geothermal power plant and wellfield at this site. Power will be delivered to the Sierra Pacific Power Co.
Source of information: Geothermal Development Associates, (1987, p. 1–18)

San Emidio Desert wells (4)
Location: sec. 9, T29N, R23E
UTM 4474500N 296200E
Temperature: boiling
Development: Two wells were drilled by Chevron Oil Co.: Kosmos 1-8 (1,223 feet) and Kosmos 1-9 (1,772 feet)
Geology: A zone of hydrothermal alteration 100 feet wide and 2 miles long trends north along the east side of the San Emidio Desert. This zone is thermally active, and waters standing in shallow boreholes 3 feet below the surface have temperatures of 53°C. A drill hole 90 feet deep encountered boiling water. Bottom-hole temperatures in Chevron drill holes Kosmos 1-8 and 1-9 were measured at 103°C and 120°C respectively.
Sources of information: Garside and Schilling (1979, p. 133, no. 265); Trexler and others (1983)

SMOKE CREEK DESERT

Buckbrush Spring (5)
Location: sec. 11, T29N, R19E
UTM 4475320N 260240E
Temperature: warm
Source of information: Garside and Schilling (1979, p. 133, no. 264)

Jack Bonham Ranch well (6)
Location: sec. 12, T28N, R19E
UTM 4466350N 262350E
Temperature: 23°C
Source of information: Garside and Schilling (1979, p. 133–134, no. 266)

Rotten Egg Spring (7)
Location: sec. 2, T28N, R19E
UTM 4468080N 261480E
Temperature: 33°C
Remarks: Water smells strongly of H_2S.
Source of information: Garside and Schilling (1979, p. 133, no. 263)

Round Hole Spring (8)
Location: sec. 12, T28N, R19E
UTM 4466400N 262430E
Temperature: warm
Remarks: also several flowing wells
Source of information: Garside and Schilling (1979, p. 133, no. 264)

THE NEEDLE ROCKS

Needles No. 1 well (9)
Location: sec. 6, T26N, R21E
UTM 4447200N 272080E
Temperature: 60°C at well head, about 118°C at 5,888 feet
Remarks: Western Geothermal well
Source of information: Garside and Schilling (1979, p. 133, no. 269)

Needles No. 2 well (10)
Location: sec. 12, T26N, R20E
UTM 4446560N 271340E
Temperature: 88°C (water escaping from capped well)
Remarks: Western Geothermal well
Source of information: Garside and Schilling (1979, p. 133, no. 269)

The Needle Rocks spring 1 (11)
Location: sec. 12, T26N, R20E
UTM 4446500N 271300E
Temperature: 61°C
Source of information: Garside and Schilling (1979, p. 133, no. 269)

The Needle Rocks spring 2 (12)
Location: sec. 12, T26N, R20E
UTM 4446700N 270900E
Temperature: 98°C
Source of information: Garside and Schilling (1979, p. 133, no. 269)

The Needles Spring (13)
Location: sec. 6, T26N, R21E
UTM 4447100N 272320E
Temperature: hot
Source of information: Garside and Schilling (1979, p. 133, no. 269)

OIL AND GAS OCCURRENCES

Honey Lake Valley occurrence (1)
Location: sec. 33, T27N, R19E
UTM 4450000N 255000E
Production: none
History: In 1920, flammable gas was reported from a shallow water well in Honey Lake Valley about 2 miles east of Flanigan.
Remarks: Considerable promotion and speculation occurred, but no oil exploration wells are known to have been drilled.
Source of information: Garside and others (1988, p. 79)

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APPENDIX A.—*Sample Descriptions*

District/area	Occurrence (no.)	Sample no.	UTM		Description
Blue Wing	Black Mountain claims (1)	2855	4473940N	329100E	Quartz vein material, quartz breccia with gray sulfides in matrix; collected from placer gravels
	Black Mountain lode prospect (2)	2854	4473490N	329190E	Quartz vein in metasedimentary rocks
	Bluewing prospect (3)	3219	4468350N	329000E	Silicated metasedimentary rocks, brick-red hematite staining, white vein quartz
	Springer prospect (4)	2856	4473980N	328600E	Prospect in metasedimentary rocks, no visible scheelite
Cottonwood	Packard mine (7)	2912	4466000N	276500E	Iron-oxide-stained calcite vein in limestone near contact with andesite intrusive
		2913	4465850N	276700E	Gossan-like vein, 2 to 3 feet thick
	Wild Horse mine (8)	2443	4475950N	280000E	Vein quartz with dark gray streaks, may be sulfides, vein fractured
		2914	4476000N	279850E	Quartz vein with visible arsenopyrite, pyrite; sample selected from large dump near caved lower adit
		2915	4476200N	279850E	Quartz vein with visible arsenopyrite, pyrite, sample chipped from quartz vein in a shear zone
		2916	4475850N	280000E	Quartz vein with pyrite, large vein system along a shear zone in gabbro
		2917	4475800N	280250E	Strong gossan in quartz vein, minor breccia, sample from north-trending vein 3 to 4 feet thick
Hooker	Gold prospect 1 (10)	2923	4478120N	310280E	Quartz vein, sample from small prospect on NE-trending vertical shear zone
	Jeakins mine (11)	2411	4483800N	305580E	Skarn with visible molybdenite, sample from adit dump
	Stormy Day mine (18)	2921	4478570N	305650E	Skarn with scheelite and molybdenite, sample selected from dump
		2922	4478750N	305700E	Quartz veins near contact, veins contain pyrite, molybdenite, scheelite, chalcopyrite
Juniper Range	Blue Wing mine (23)	2865	4431230N	323610E	Skarn zone with quartz veins, garnet, epidote, brecciated quartz with sulfides
	Star mine (27)	2863	4431150N	318800E	Quartz, calcite, and garnet with minor scheelite; chipped from contact zone in a small pit
		2864	4431000N	319270E	Copper-stained quartz vein with bornite, chalcopyrite, chalcocite; may be gold, silver, and uranium values present
	Three X prospects (28)	3220	4447500N	324500E	White to pink aplite dike, points of cinnamon brown limonite staining

APPENDIX A.—*Sample Descriptions (continued)*

District/area	Occurrence (no.)	Sample no.	UTM		Description
Nightingale	Alpine mine (38)	2860	4433675N	308820E	Quartz vein material containing galena(?) and minor scheelite, vein cuts skarn zone
	Four Jacks prospect (41)	2908	4445400N	305890E	Vein quartz, series of 8- to 10-inch veins cut granodiorite
		2909	4445540N	306000E	Sample taken from metasedimentary rocks adjacent to granodiorite contact
		2910	4445070N	305900E	Partly brecciated and iron-stained quartz vein
	Highgrade prospect (42)	2862	4430220N	310100E	High-grade sample from narrow contact zone, skarn containing scheelite, copper-stained
	M.G.L. mine (44)	2896	4433750N	306840E	Skarn, garnet with scheelite, high-grade sample selected from mine dump
		2897	4433770N	306880E	Skarn, garnet with scheelite, high-grade sample chipped from contact zone
	Mammoth prospect (46)	2859	4432500N	309785E	Skarn containing garnet, calcite, quartz, scheelite, minor molybdenite and copper minerals
	Nightingale mine (48)	2861	4430930N	309950E	Skarn containing scheelite and powellite
	Pegmatite prospect (49)	2907	4454000N	307500E	Pegmatite with tourmaline, pyrite, and other unidentified sulfides
	Red Hammer claims (51)	2858	4434360N	309910E	Skarn containing garnet, epidote, scheelite, ilsemannite, calcite, molybdenite, and minor copper staining; sample from contact zone exposed in open pit
	Tungsten prospect 1 (53)	2898	4433450N	307380E	Contact zone, iron-stained garnet with minor scheelite
San Emidio	S.E.D. prospect (59)	2401	4478650N	297400E	Brecciated outcrop of altered rhyolite; makes up spine of small ridge
		2403	4476100N	298020E	Vein material, may be along contact between metasedimentary rocks on the south and Tertiary volcanic rocks on the north, sample taken from old adit
	San Emidio prospect (60)	2402	4474875N	296225E	Sample showing visible cinnabar and sulfur, collected at northernmost group of trenches
	Wind Mountain mine (61)	476	4478000N	297300E	Finely laminated, subaqueous sinter, grab sample from outcrop
		477	4478800N	297600E	Siliceous, reed-bearing, subaqueous spring sinter; grab sample from outcrop
Sand Pass	Terraced Hills deposit (10)	2911	4454620N	261440E	Iron-stained Tertiary sedimentary rocks at contact with volcanic flows
Staggs	Twin Buttes mine (63)	2857	4484680N	329650E	Quartz vein material and some replacement ore, contains pyrite, galena, arsenopyrite; sample taken from heap-leach pile and mine dump

District/area	Occurrence (no.)	Sample no.	Ca (0.05)	Fe (0.05)	Mg (0.02)	Ti (0.002)	Ag (0.5)	As (200)	Au (10)	B (10)	Ba (20)	Be (1)	Bi (10)	Cd (20)	Co (5)	Cr (10)	Cu (5)
Blue Wing	Black Mountain claims (1)	2855	L	0.7	0.2	0.15	0.7	L	N	100	150	L	N	N	N	10	100
	Black Mountain lode prospect (2)	2854	0.15	3	0.1	0.1	5	N	N	100	100	1	N	N	N	10	150
	Bluewing prospect (3)	3219	0.3	0.5	0.3	0.3	N	N	N	30	150	1	N	N	N	50	L
	Springer prospect (4)	2856	0.07	5	0.5	0.2	0.5	200	N	200	150	1	N	N	N	15	15
Cottonwood	Packard mine (7)	2912	7	3	1	0.2	2	700	N	70	200	L	70	N	70	20	50
		2913	1.5	3	0.07	0.05	150	5,000	L	70	70	L	N	200	5	10	700
	Wild Horse mine (8)	2443	1.5	15	0.3	0.03	2	7,000	N	100	1,500	N	15	N	70	L	700
		2914	2	7	0.7	0.07	3	>10,000	N	70	1,500	L	150	50	70	L	300
		2915	1.5	10	0.15	0.07	7	2,000	N	200	2,000	L	15	N	100	L	700
		2916	0.3	15	0.5	0.07	50	N	N	10	700	L	N	N	150	L	1,000
		2917	0.1	5	0.15	0.03	1.5	N	N	20	500	L	L	N	7	10	100
Hooker	Gold prospect 1 (10)	2923	0.15	3	0.3	0.15	2	N	N	500	700	1.5	N	N	15	10	150
	Jeakins mine (11)	2411	0.2	3	0.15	0.15	N	N	N	50	200	2	N	N	20	30	50
	Stormy Day mine (18)	2921	10	7	0.3	0.1	7	N	N	N	N	L	N	N	15	15	100
		2922	7	5	0.5	0.015	7	N	N	150	N	3	N	N	20	L	5,000
Juniper Range	Blue Wing mine (23)	2865	20	15	0.15	0.1	L	N	N	L	50	N	N	N	10	L	150
	Star mine (27)	2863	G	15	1	0.15	1	N	N	L	200	N	N	N	15	L	100
		2864	15	20	1	0.2	30	N	N	50	700	3	>1,000	N	30	20	>2,000
	Three X prospects (28)	3220	1	0.15	0.05	0.03	N	N	N	15	200	N	N	N	15	L	L
Nightingale	Alpine mine (38)	2860	15	10	1	0.15	150	700	N	100	N	3	N	N	N	10	200
	Four Jacks prospect (41)	2908	0.15	1.5	0.03	0.007	L	N	N	15	300	1	700	N	N	30	20
		2909	0.3	3	0.7	0.3	1	300	N	150	1,000	1.5	N	N	L	10	50
		2910	0.15	1	0.05	0.02	L	300	N	30	200	2	N	N	5	70	30
	Highgrade prospect (42)	2862	10	5	2	0.2	100	N	N	20	1,500	1.5	N	N	7	L	150
	M.G.L. mine (44)	2896	15	3	1.5	0.05	N	N	N	500	N	N	30	N	5	20	10
		2897	15	3	1	0.1	0.5	N	N	10	N	L	15	N	5	50	30
	Mammoth prospect (46)	2859	15	20	1	0.15	5	200	N	30	50	N	N	N	20	30	2,000
	Nightingale mine (48)	2861	>20	10	1	0.2	30	N	N	L	50	L	1,000	N	15	30	200
	Pegmatite prospect (49)	2907	0.1	1.5	0.2	0.01	7	N	N	2,000	150	L	200	N	15	20	30
	Red Hammer claims (51)	2858	20	10	0.7	0.3	3	500	N	700	100	N	30	N	20	15	1,500
	Tungsten prospect 1 (53)	2898	7	2	1	0.1	N	N	N	50	100	2	N	N	5	30	100
San Emidio	S.E.D. prospect (59)	2401	0.3	2	0.15	0.15	7	N	N	50	200	2	N	N	N	10	150
		2403	L	5	0.02	L	20	N	N	30	N	3	N	N	N	10	15
	San Emidio prospect (60)	2402	0.15	0.05	0.02	0.2	N	N	N	50	500	N	N	N	N	L	10
	Wind Mountain mine (61)	476	0.07	L	0.02	0.1	5	N	N	10	1,000	1.5	N	N	N	L	20
		477	0.07	L	0.02	L	1.5	N	N	50	500	2	N	N	N	L	10
Sand Pass	Terraced Hills deposit (10)	2911	3	3	0.1	0.7	N	N	N	50	700	5	N	N	30	50	30
Staggs	Twin Buttes mine (63)	2857	1	20	0.3	0.05	200	>10,000	15	70	100	L	L	200	—	—	10

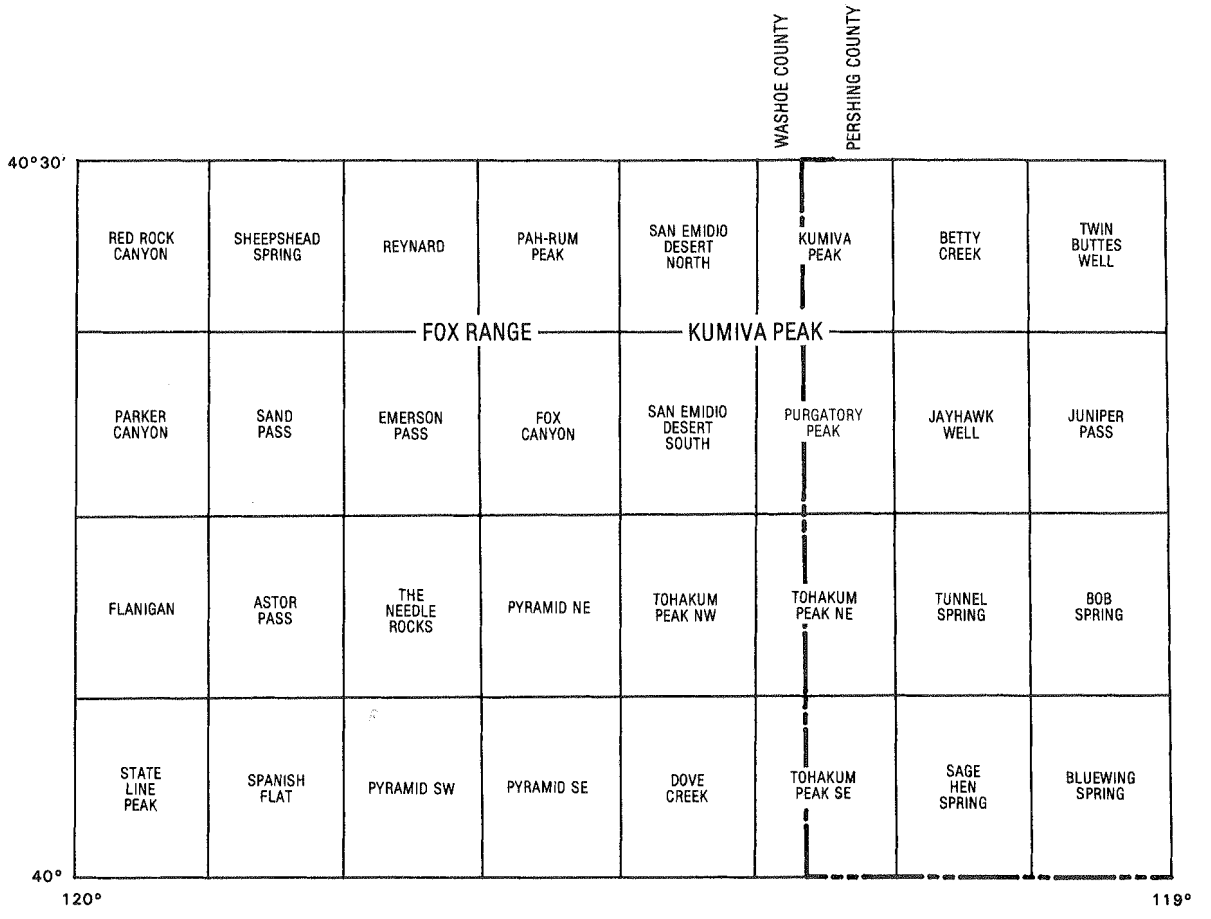
Spectrographic analyses (columns headed by element symbol) and atomic absorption analyses (columns headed by AA + element symbol) by the Branch of Geochemistry, U.S. Geological Survey, Denver, Colorado. Ca, Fe, Mg, and Ti values are in percent; all others are in ppm. Detection limit is under element symbol. L = less than detection limit. N = not detected. — = not tested.

La (20)	Mn (10)	Mo (5)	Nb (20)	Ni (5)	Pb (10)	Sb (100)	Sc (5)	Sn (5)	Sr (100)	Th (100)	V (10)	W (50)	Y (10)	Zn (200)	Zr (10)	AAAu (0.05)	AAAs (10)	AASb (2)	AAZn (5)	Sample no.
N	20	N	N	5	10	N	L	N	N	N	50	N	N	N	150	0.05	340	4	10	2855
N	15	N	N	10	L	N	L	N	L	N	30	N	15	N	100	N	190	18	10	2854
N	200	L	N	5	20	N	7	N	200	N	30	L	20	N	300	N	N	N	15	3219
N	100	N	N	7	50	N	5	N	100	N	70	N	50	N	200	N	540	4	20	2856
L	3,000	N	N	20	200	N	7	N	300	N	100	N	15	200	15	0.10	1,000	14	220	2912
N	500	50	N	L	20,000	700	L	N	300	N	30	N	N	7,000	15	2.0	>1,200	420	>1,200	2913
100	300	N	N	10	70	N	L	N	100	N	10	N	20	L	20	0.20	>1,000	18	100	2443
30	700	N	N	L	300	N	N	N	200	N	15	N	15	1,000	20	0.05	>1,200	26	750	2914
70	300	N	N	7	300	N	N	N	200	N	20	N	20	1,000	20	0.15	>1,200	8	1,200	2915
N	300	15	N	30	30	N	L	N	100	N	100	N	10	300	20	N	20	2	120	2916
N	200	15	N	7	20	N	L	N	N	N	70	N	N	N	20	N	30	L	30	2917
L	150	20	N	10	70	N	5	N	200	N	50	N	15	L	50	N	110	2	170	2923
N	200	30	L	5	100	200	N	N	L	N	50	L	50	N	700	N	10	N	100	2411
N	>5,000	200	N	20	15	N	L	N	N	N	70	1,500	15	300	20	N	N	6	80	2921
L	5,000	30	N	7	10	N	L	N	200	N	100	700	15	300	20	N	N	L	180	2922
N	>2,000	15	N	5	L	N	N	30	N	N	200	N	N	L	100	N	35	L	80	2865
N	>2,000	10	N	5	30	N	L	30	150	N	150	N	20	200	100	N	25	L	170	2863
50	>2,000	200	N	20	100	N	5	20	700	N	500	150	30	500	30	0.15	40	2	160	2864
N	200	L	N	5	100	N	L	N	300	N	L	L	N	200	30	N	N	N	10	3220
N	5,000	15	N	10	5,000	N	5	N	1,000	N	150	1,000	20	300	100	L	630	L	170	2860
N	50	30	N	L	20	N	N	N	N	N	L	N	N	N	10	N	90	4	10	2908
L	100	15	N	50	15	N	7	N	100	N	100	N	20	L	150	N	330	10	90	2909
N	700	15	N	10	15	N	N	N	N	N	L	N	N	N	L	N	220	L	20	2910
N	1,000	5	N	20	2,000	N	10	N	500	N	150	200	30	2,000	100	N	75	16	2,000	2862
20	5,000	N	N	5	N	N	L	15	100	N	100	150	10	200	50	0.05	10	L	120	2896
30	5,000	N	N	5	20	N	5	20	L	N	150	150	15	L	50	N	10	N	210	2897
N	>5,000	1,000	N	20	50	N	5	N	500	N	1,000	1,000	30	500	50	0.05	320	2	180	2859
N	>5,000	15	N	30	1,000	N	7	30	200	N	100	1,000	30	300	50	0.10	90	2	300	2861
N	50	100	N	10	200	N	N	N	150	N	70	500	N	N	L	0.15	10	20	L	2907
N	>5,000	150	N	15	200	N	10	N	500	N	1,000	300	30	N	50	0.05	300	2	150	2858
30	3,000	7	N	10	L	N	5	N	500	N	70	150	15	200	30	N	50	N	160	2898
N	70	L	N	5	50	N	N	N	700	N	30	L	N	N	15	N	20	11	10	2401
N	10	N	N	10	N	N	N	N	L	N	20	N	30	N	N	0.15	35	7	15	2403
N	N	5	N	L	L	N	N	N	L	N	20	N	N	L	100	0.1	N	N	170	2402
50	100	N	L	N	100	L	N	N	100	N	20	N	N	N	30	0.05	L	8	—	476
50	20	N	L	N	100	N	N	N	100	N	20	N	N	N	10	L	5	6	—	477
20	300	N	N	15	50	N	20	N	150	N	150	N	50	L	150	N	N	2	90	2911
N	100	N	N	5	20,000	1,000	N	N	150	N	15	N	N	5,000	N	39.0	>2,000	690	1,800	2857

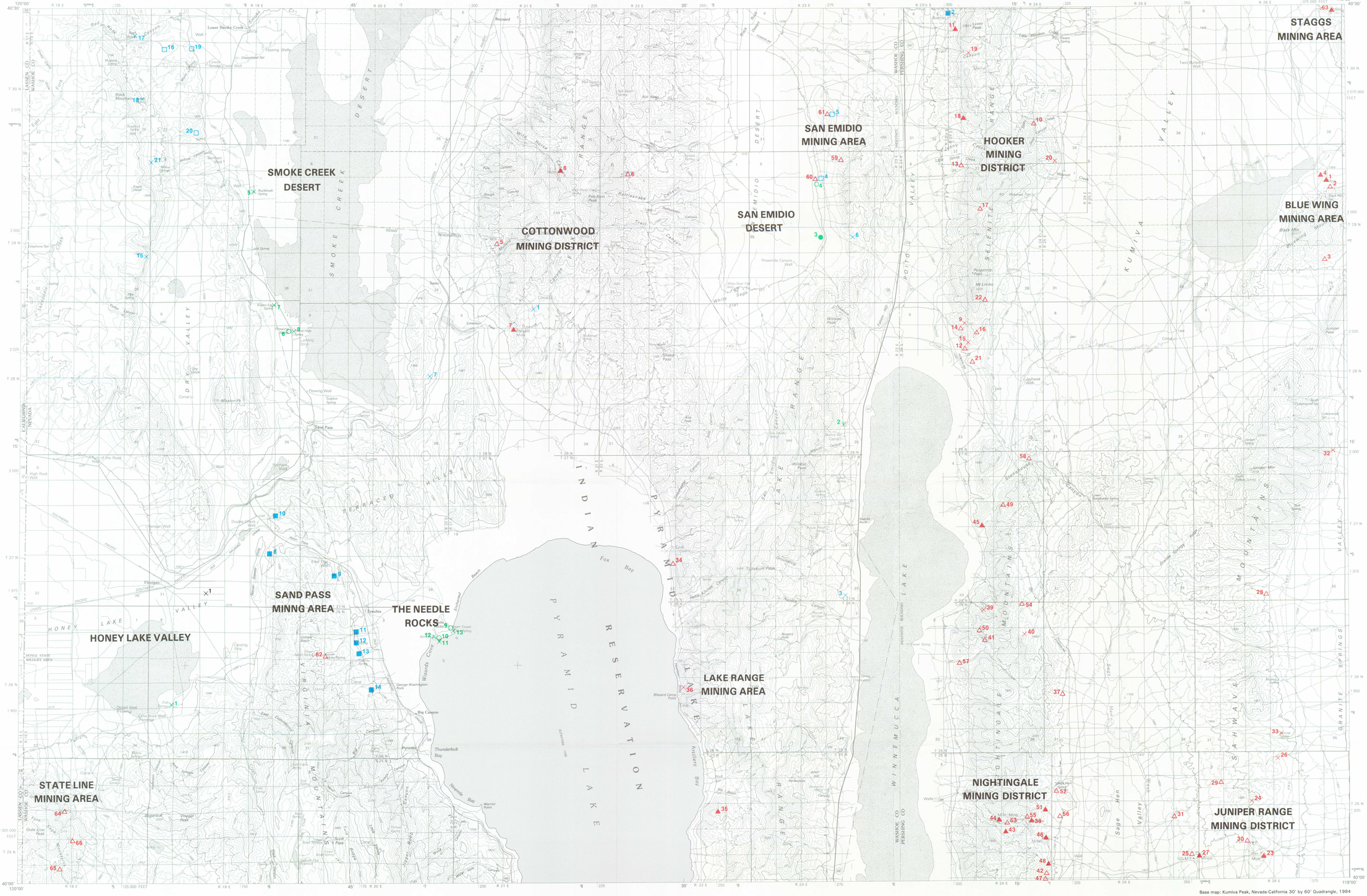
INDEX

(mining districts, mining areas, mines, prospects, and occurrences)

INDEX (continued)



Index of USGS 7½′ and 15′ quadrangle maps within the Kumiva Peak 30′ by 60′ Quadrangle.



MINERAL RESOURCES OF THE THE KUMIVA PEAK 30' BY 60' QUADRANGLE

SCALE 1:100,000

0 1 2 3 MILES

0 1 2 3 4 5 KILOMETERS

METALLIC OCCURRENCES
- ▲ Mine, recorded production
- △ Prospect, no known production
- × Occurrence

NONMETALLIC OCCURRENCES
- ■ Mine, recorded production
- □ Prospect, no known production
- × Occurrence

GEOTHERMAL
- ● Well, production
- ○ Well, no production
- × Hot spring or other occurrence

OIL AND GAS
- ● Well, past or present production
- ○ Well, no past or present production
- × Seep or other occurrence

METALLIC OCCURRENCES

Blue Wing mining area
1. Black Mountain claims — Au, Ag
2. Black Mountain lode prospect — Au
3. Bluewing prospect — Au, Ag(?)
4. Springer prospect — W

Cottonwood mining district
5. Boundary prospect — Cu
6. Garnet tungsten prospect — W
7. Packard and Sano properties — Ag, Pb, Au
8. Wild Horse mine — Au, Ag

Hooker mining district
9. Black Granite group — U
10. Gold prospect 1 — Au
11. Jeakins mine — W
12. Limbo group — U, Ag, Au
13. Pinto prospect — Ag, U
14. Silver-gold-uranium prospect 1 — Ag, Au, U
15. Silver-uranium occurrence 1 — Ag, U
16. Silver-uranium prospect 1 — Ag, U
17. Silver-uranium prospect 2 — Ag, U
18. Stormy Day mine — W
19. Uranium occurrence 1 — U
20. Uranium occurrence 2 — U
21. Uranium prospect 1 — U
22. Uranium prospect 2 — U

Juniper Range mining district
23. Blue Wing mine — W
24. Copper occurrence 1 — Cu
25. Dewdrop #2 prospect — W
26. Silver occurrence 1 — Ag
27. Star mine — W, Cu
28. Three X prospects — U(?)
29. Tungsten prospect 1 — W, Cu(?)
30. Tungsten prospect 2 — W, Cu(?)
31. Tungsten prospect 3 — W
32. Uranium occurrence 1 — U
33. Uranium occurrence 2 — U

Lake Range mining area
34. Gold prospect 1 — Au, Ag, Pb, Zn
35. Lakeview mine — Ag, Au, Pb, Zn
36. Pyramid Lake copper deposit — Cu

Nightingale mining district
37. AAA uranium prospect — U
38. Alpine mine — W, Ag, Pb, Mo, Zn
39. Big Question uranium occurrence — U, W(?)
40. Cay claims — U
41. Four Jacks prospect — Au, U
42. Highgrade prospect — W, Ag, Cu, Pb, Zn
43. Hunt and Grunt mine — W
44. M.G.L. mine — W, Mo
45. Maher mine — W
46. Mammoth prospect — W
47. Marvelous prospect — W
48. Nightingale mine — W, Mo
49. Pegmatite prospect — W
50. Poncho prospect — U, W
51. Red Hammer claims — W
52. Sage Hen Spring prospect — U
53. Tungsten prospect 1 — W
54. Tungsten prospect 2 — W
55. Tungsten prospect 3 — W
56. Two Chukars prospect — U
57. Uranium prospect 1 — U(?)
58. Woffer prospect — U

San Emidio mining area
59. S.E.D. prospect — Au(?)
60. San Emidio prospect — Hg, S
61. Wind Mountain mine — Au, montmorillonite

Sand Pass mining area
62. Adobe Springs prospects — Au, Cu, W(?)

Staggs mining area
63. Twin Buttes mine — Au, Ag, Pb

State Line mining area
64. Black Hawk prospect — Fe, U
65. Iron prospect 1 — Fe
66. Iron prospect 2 — Fe

NONMETALLIC OCCURRENCES

Cottonwood mining district
1. Clay deposit 1 — halloysite

Hooker mining district
2. Empire gypsum quarry — gypsum

Lake Range mining area
3. Calcium carbonate deposit 1 — $CaCO_3$

San Emidio mining area
4. Lake Range montmorillonite prospect — montmorillonite, Au
5. San Emidio prospect — S, Hg
6. Slate occurrence 1 — slate

Sand Pass mining area
7. Clay deposit 1 — halloysite
8. Double Check deposit — $CaCO_3$
9. Rivermott deposit — $CaCO_3$
10. Terraced Hills deposit — halloysite
11. Zenobia clay prospect 1 — clay
12. Zenobia clay prospect 2 — clay
13. Zenobia clay prospect 3 — clay
14. Zenobia clay prospect 4 — clay

Smoke Creek Desert
15. Broken Shovel claims — perlite
16. Capricorn claims — montmorillonite
17. Red Rock zeolite occurrence — zeolite
18. Rocky Springs zeolite occurrence — zeolite
19. Smoke Creek Desert clay deposit — fuller's earth
20. Willow Springs perlite deposit — perlite
21. Willow Springs zeolite occurrence — zeolite

GEOTHERMAL OCCURRENCES

Honey Lake Valley
1. Fish Springs

Lake Range mining area
2. Spring 1

San Emidio Desert
3. Empire geothermal project
4. San Emidio Desert wells

Smoke Creek Desert
5. Buckbrush Spring
6. Jack Bonham Ranch well
7. Rotten Egg Spring
8. Round Hole Spring

The Needle Rocks
9. Needles No. 1 well
10. Needles No. 2 well
11. The Needle Rocks spring 1
12. The Needle Rocks spring 2
13. The Needles Spring

OIL AND GAS OCCURRENCES

1. Honey Lake Valley occurrence

The Nevada Bureau of Mines and Geology is part of the Mackay School of Mines at the University of Nevada-Reno and is the state geological survey. Scientists at the Nevada Bureau of Mines and Geology conduct research and publish reports on mineral resources and various aspects of general, environmental, and engineering geology.

Current activities in mineral resources and general geology include detailed geologic mapping and stratigraphic studies in Nevada, comparative studies of bulk mineable precious-metal deposits, geochemical investigations of mining districts, resource assessments, igneous petrologic studies, hydrothermal experiments, research on the origin of hydrothermal platinum-group-element occurrences, and examination of the origin and distribution of borate deposits in Nevada.

Environmental, engineering, and urban geology projects include investigations of earthquake hazards and related aspects of neotectonics, examination of issues involved in siting nuclear and hazardous wastes, mapping of geomorphic features, radon hazard studies, and studies of landslide hazards.

Geologic information activities include creating and updating databases on mining districts, active mines and prospects, and geothermal and petroleum exploration and production; implementation and development of statewide geographic information systems; and maintenance of core and cuttings facilities, rock and mineral collections for research, aerial photographic imagery and maps, and extensive files on Nevada geology and resources.

The Nevada Bureau of Mines and Geology cooperates with numerous state and federal agencies in providing geologic and resource information and in conducting research. Research results are published as Nevada Bureau of Mines and Geology bulletins, reports, maps, and special publications as well as in federal publications and scientific journals. In addition to addressing the needs for geologic information by conducting research, publishing reports and maps, and creating computer databases, staff members assist the public, industry, and government agencies by answering specific questions regarding Nevada geology and resources and by providing some chemical and mineralogical analyses.

Individuals interested in the state's geology are encouraged to visit or write the Nevada Bureau of Mines and Geology or call (702) 784-6691. NBMG offices are located in the west wing of the Scrugham Engineering-Mines Building on the University of Nevada-Reno campus. When visiting NBMG by car please stop at the information booth just inside the Center Street entrance on the south end of the UNR campus. The attendent will issue you a temporary parking permit and give you directions to parking areas and the NBMG offices. Address mail to: Director/State Geologist, Nevada Bureau of Mines and Geology, University of Nevada-Reno, Reno, NV 89557-0088. A publication list will be sent upon request.