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Mineral Resources of the Nellis Air Force Base

and the Nellis Bombing and Gunnery Range,

Clark, Lincoln, and Nye Counties, Nevada

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SUMMARY

The Federal Land Management and Policy Act of 1976 required that the Bureau of Land Management periodically review existing and proposed withdrawals of public lands under its jurisdiction, and support such withdrawals by an appropriate environmental impact statement. In partial fulfillment of that requirement, this initial appraisal of the mineral resource potential of the Nellis Bombing and Gunnery Range, Nevada, was prepared by the U.S. Geological Survey and the Bureau of Mines at the request of the United States Air Force pursuant to a letter agreement. This report is based on a literature survey only; no on-site field work was performed.

Little or no mineral exploration or related activity has occurred in the withdrawn area for nearly a half century. Nonetheless, geologic evidence and records of past mining activity amply support a premise that portions of the area could be a future source of selected mineral commodities to meet National requirements. Detailed on-site field studies would be required to confirm this opinion and to more accurately delineate the nature and extent of significant mineral resource occurrences.

Mineral commodities found in the Nellis Air Force Base (NAFB) and the Nellis Bombing and Gunnery Range (NBGR) are gold, silver, copper, lead, zinc, mercury, tungsten, turquoise, sand, gravel, and limestone. Gypsum and limestone are probably the most valuable commodities produced in the vicinity of, but not in, the NAFB and the NGBR. The average annual gypsum and limestone output for the early 1960's was estimated at 100,000 and 500,000 tons, respectively. Significant amounts of lead, silver, copper, and zinc have been recovered from the Groom mine about 3 miles east of the NBGR.

Within the study area most of the metalliferous mineral deposits consist of gold-silver minerals, occurring as fissure fillings and replacements in shear zones. Some deposits also contain lead, zinc, and copper. Several occurrences of tungsten and molybdenite have been found in one district. One area has potential for oil and gas.

Areas having the highest geologic potential for mineral resources include that at the north end of the NBGR, east of Goldfield, which may contain significant gold-silver deposits, and the Las Vegas Range in the southeast corner of the NBGR, which has a potential for oil and gas. The Oak Spring district at the north end of Yucca Flat has potential for new discoveries of tungsten-molybdenum and lead-silver deposits (fig. 5). Also, inasmuch as uranium minerals a few miles west of NBGR and elsewhere in the Great Basin typically are found in Tertiary volcanic rocks and tuffaceous sedimentary rocks of silicic composition, particularly in the vicinity of volcanic centers, it appears that a fairly large area of ground having a potential for uranium resources could exist in the

western part of the NAFB and NBGR. Finally, some areas, mainly within mountain ranges, are covered by Tertiary volcanic rocks less than 1,000 feet thick, and areas, up to several miles wide, peripheral to the ranges are covered by alluvial material less than 1,000 feet thick. The bedrock beneath this relatively thin cover in places, as around the north end of Yucca Flat, may have a potential for mineral resources.

Further geological, geochemical, and geophysical investigations are recommended for the most promising areas described above.

 (p. 3 follows)

INTRODUCTION

This report was prepared by John R. Norberg of the Bureau of Mines and Henry R. Cornwall and others of the Geological Survey at the request of the Department of the Air Force (DAF), through the Bureau of Land Management (BLM) for a Stage 1 mineral survey of the Nellis Air Force Base (NAFB) and the Nellis Bombing and Gunnery Range (NBGR) in southern
. 1 2 Nevada (Figs. 1, 2). It is designed to provide BLM and DAF with basic mineral resource data for use in preparing an environmental impact statement covering continued withdrawal of public lands for military uses.

The Bureau of Mines at Spokane, Wash., and the Geological Survey at Menlo Park, Calif., have prepared this report by compiling geologic and mineral resource data from numerous sources listed in the bibliography below. Also Cornwall (1972) spent several years mapping and examining mineral deposits
. 3 in southern Nye County. A generalized geologic map of the NBGR (fig. 3) accompanies this report.

PHYSIOGRAPHY

The topography of the NAFB and NBGR is typical of the Basin and Range physiographic province. It is generally characterized by broad, closed basins separated by mesas and narrow north-south-trending mountain ranges (Fig. 1) except in the southeastern portion where intermittent streams drain into the Colorado River. Elevations range from less than 2,000 feet near Las Vegas to nearly 10,000 feet in the Desert National Wildlife Range, about 35 miles due north of the city. Most mountain ranges, however, average less than 7,000 feet with occasional peaks rising above 8,000 feet.

GEOLOGY

Previous Investigations

Many published works describe the various geological aspects of southern Nevada. The Nevada Bureau of Mines and Geology has published several bulletins which describe the geology and mineral deposits of Clark, Lincoln, and Nye Counties (Cornwall, 1972; Kral, 1951; Longwell and others, 1965; Tschanz and Pampeyan, 1970). Other relevant State reports cover State-wide distributions of mineral commodities (Garside, 1973; Morrissey, 1968; Papke, 1976), and the geology of given mining areas (Humphrey, 1945; Silberman and McKee, 1974). The U.S. Geological Survey (U.S.G.S.) has intensively mapped and studied portions of the study area in conjunction with the investigation of the suitability of ERDA Nuclear Testing Facility for underground weapons testing. Unclassified results of these studies have been published by the U.S.G.S. and the Geological Society of America (Anderson and others, 1965; Ekren and others, 1971; Albers, 1967; Eckel, 1968). In addition, the Bureau of Mines conducted several onsite mineral examinations with the War Minerals Examination Program during the early 1940's (W. T. Benson, unpub. reports, 1945a, b, c). Other mineral properties have been examined by representatives of the Bureau of Mines and Geological Survey as part of the Defense Minerals Exploration Administration (DMEA) program (G. G. Gentry and H. K. Stager, unpub. report, 1957, 1958; G. H. Holmes, W. P. Irwin, and Wayne Hall, unpub. report, 1953).

Rocks

Rocks representing all the geologic eras from older Precambrian through Cenozoic are exposed in the area of this study. Most of the

area is covered by Cenozoic unconsolidated sediments or Tertiary volcanics. Exposures of Precambrian and Mesozoic rocks are small.

Precambrian rocks

Older Precambrian quartz monzonite gneiss and biotite schist crop out in a small area 4 miles east of Mount Helen (Fig. 1), called Trappman Hills in the northwestern part of the NBCR. Younger Precambrian sedimentary rocks crop out in the eastern part of the study area in the Belted Range, Cockeyed Ridge, and the Papoose and Desert Ranges. These rocks consist of slightly metamorphosed quartzites, shales, dolomites, and limestones.

Paleozoic rocks

Paleozoic marine sedimentary rocks, ranging in age from Cambrian through Permian, are predominant in the southeastern part of the study area from the Spotted Range on east and are also quite widespread around Yucca Flat and in the northwestern part of the Belted Range. Longwell and others (1965, p. 14) report that the Paleozoic rocks exposed in the ranges north of Las Vegas Valley in Clark County have a maximum thickness greater than 26,000 feet. Tschanz and Pampeyan (1970, p. 7) report that the Paleozoic section in southern Lincoln County exceeds 30,000 feet in thickness.

The Paleozoic sediments were deposited in a miogeosynclinal marine environment. Dolomite and limestone are the predominant rock types except in the Cambrian section where sandstone, siltstone, and shale are most abundant. Shale is also locally abundant in the Mississippian section.

Mesozoic rocks

Mesozoic rocks are sparse in the study area. Two small igneous stocks of quartz monzonite and granodiorite crop out at the north end of Yucca Flat. Two other small granitic stocks of probable Mesozoic age crop out in the Cactus and southern Kawich Ranges.

A thick unit of clastic rocks, largely cobble conglomerate, covering large areas in the northern Spotted and Pintwater Ranges is considered by Tschanz and Pampeyan (1970, p. 67) to be probably Cretaceous or early Tertiary in age.

Cenozoic rocks

Cenozoic rocks in the study area fall mainly into two types: Tertiary volcanics and Quaternary alluvium.

Tertiary volcanic rocks with associated tuffaceous clastic rocks cover a large part of the western half of the study area in Nye County and extend into the southwest corner of Lincoln County. Pyroclastic tuffs and welded tuffs (ash flows) are most abundant but lava flows and intrusives are also common. Composition ranges from basalt to rhyolite, but the intermediate to silicic types predominate. A composite section of all the units exceeds 20,000 feet in thickness, and a drill hole in the Silent Canyon caldera on Pahute Mesa, 15 miles northeast of Timber Mountain, penetrated 14,000 feet of tuffs and lavas without reaching a basement of Paleozoic or older rocks (Cornwall, 1972, p. 16). However, some areas of Tertiary volcanic rocks within mountain ranges are less than 1,000 feet thick and may conceal potential resources in the older rocks beneath them. These vast quantities of volcanic material, mostly of Miocene age, were apparently derived from nine or ten centers, part of which are calderas.

Quaternary alluvium covers the intermontane basins, which comprise nearly half the study area. Alluvial fans consist of gravel and rubble near the highlands and grade downward into sand and silt in the valley bottoms. Generally, the alluvial material thickens from the lower slopes of the mountains toward the valleys. Commonly, within one to several miles from the mountains it is less than 1,000 feet thick. Elsewhere the fans and other alluvial and playa lake deposits are thick; drill-hole data in Yucca Flat indicate thicknesses of up to 2,200 feet. Gravity data indicate a thickness of as much as 4,500 feet for alluvium with interbedded volcanic rocks in the Kawich Valley and Gold Flat (Cornwall, 1972, p. 28). The surfaces of most fans are a mosaic of desert pavement, abandoned shallow washes, and braided stream channels.

Playa lakes occupy low areas in all the basins, and playa deposits of sand and silt, partly covered by coarser alluvium, probably extend beyond the limits of present ephemeral lakes in many areas.

Structure

Structural deformation in the study area has been intense and complex. Major deformation with folding, thrust faulting, and strike-slip faulting occurred during the Laramide period, extending from the Cretaceous to the Eocene (Cornwall, 1972, p. 28-30; Longwell and others, 1965, p. 60; Tschanz and Pampeyan, 1970, p. 80). It is probable that this deformation is in part related to the development of the Las Vegas Valley shear zone in the Middle Cretaceous (Longwell and others, 1965, p. 62). The shear zone with an estimated right-lateral displacement of 25-40 miles (Stewart and others, 1968) extends northwestward up the Las Vegas Valley just south of the study area into an oroflexural bend, the

Spotted Range oroflex (Albers, 1967), and may connect northwestward with a similar right-lateral shear zone near Goldfield, the Walker Lane (Cornwall, 1972, p. 30). In southwestern Lincoln County, Tschanz (Tschanz and Pampeyan, 1970, p. 83-84) postulates that the northeast-trending Arrowhead mine fault has 30 miles of Laramide right-lateral displacement. This fault probably projects westward to the Las Vegas Valley shear zone in central southern Nye County, but the west end is covered by younger Tertiary volcanics. Tschanz (Tschanz and Pampeyan, 1970, p. 84) also believes that this fault and several nearby ones parallel to it were reactivated in later Tertiary with as much as 10 miles of left-lateral movement.

Volcanotectonic activity in the Miocene and Pliocene in southern Nye County resulted in the development of at least ten calderas, graben, or volcanic centers near and east of the trace of the Las Vegas Valley-Walker Lane lineament. As suggested by Ekren and others (1971, p. 68), the presence of so many volcanic centers along this restricted zone suggests that a major crustal rift is present in the area along which magmas generated at great depth, moved upward.

Basin-and-range high-angle normal faults ranging in age from Miocene to Holocene (Recent) are present throughout most of the study area and bound mountains and ranges. North-trending normal faults are most common, but locally northeast and northwest trends are prevalent.

MINERAL RESOURCES

History of Mining

Mining activity in the study area began with the discovery of gold-silver deposits in the early 1900's following the discovery of major ore bodies in the Tonopah and Goldfield mining districts. Several discoveries created their own small-scale "gold rushes," but few prospectors remained after the initial period of activity (Kral, 1951, p. 11, 69, 91, 162). Although interest in the area's mineral deposits waned shortly after their discovery, activity at some prospects continued sporadically through the 1920's and 1930's.

In October 1940, large portions of Clark, Lincoln, and Nye Counties were withdrawn from further mineral entry and reserved for use as a military bombing and gunnery range. All existing mining claims within the Range were originally leased by the government for a period of 5 years, with options to renew. Many claims have since been acquired in fee by the United States, but some are still under lease agreements. Claim-holders who have leased their claims to the government retain title, but access to their property is restricted by the commander of NAFB. Hence, there has been little mining activity within the Bombing Range since the beginning of World War II.

Gypsum and limestone have been mined in the vicinity of NAFB in Clark County since the 1930's. Pabco Corporation currently mines and processes gypsum from a quarry in the southeastern part of Frenchman Mountain, while the United States Lime Products Division of the Flinkote Company owns and operates a limestone quarry and associated facilities about 19 miles northeast of Las Vegas. Neither operations are located on military lands.

Production

Total mineral production for the study area is not known, but over half of the properties described in this report are reported to have had some output. Bureau of Mines production records indicate production from 15 of these properties, while the output of the remaining 27 properties is recorded in U.S. Geological Survey or Nevada Bureau of Mines and Geology publications.

Pabco's gypsum quarry and U.S. Lime Products limestone quarry, both of which lie outside the military lands of the present study area, are undoubtedly the area's largest mineral producers. The Bureau of Mines production records for these operations are considered as confidential company data and thus cannot be revealed. In 1965, Longwell (Longwell and others, 1965, p. 204-205), however, estimated that the annual output from the gypsum and limestone quarries exceeded 100,000 and 500,000 tons, respectively. Although Longwell did not provide estimates of the production value, it probably is significant.

The Groom mine in Lincoln County and also outside the NBGR is the largest metal producer in the area. Bureau of Mines records indicate that the mine has produced almost continuously from 1915 through 1956. The total mined ore value exceeds $3.75 million at 1977 market prices.

Production from other metal mines is comparatively small. Individual mine output ranges from less than 20 tons of ore yielding a few ounces of gold and silver to several hundreds of tons of ore yielding several thousand ounces of combined gold and silver, plus appreciable amounts of copper, lead, and zinc. An unknown amount of tungsten concentrates have

been produced from the mines in the Oak Spring district near the boundary between the ERDA testing facilities and the bombing range. Sixty-eight flasks of mercury have reportedly been produced from the Black Hawk mercury mine in Kawich mining district. Individual mine production data, subject to withholding of company confidential information, is provided in the mineral property section of this report.

Mineral Deposits

The mining districts in the study area are shown in Figures 2 and 3. Individual mines with district identification are listed in Appendix A, which also includes properties near but outside the military lands (NBGR, NAFB) under investigation here. Most of the districts have gold and silver deposits in quartz veins in Tertiary volcanic rocks; in a few districts, the veins are in Paleozoic or Precambrian sedimentary and metamorphic rocks. Most of the gold-silver deposits were found in the early 1900's following the discovery of rich bonanzas at nearby Tonopah and Goldfield in 1901 and 1902, respectively. All of the districts produced ore valued at less than $1 million, most of them considerably less.

In addition to gold and silver some of the deposits contain recoverable amounts of copper, lead, and zinc. In several deposits outside but near the study area, one or more of these metals are major components of the ore; in the Groom mine, for example, located 3 miles east of NBGR in southwestern Lincoln County, 5 million pounds of lead has been produced (Tschanz and Pampeyan, 1970, p. 152). One district inside the study area, the Oak Spring district, also contains significant amounts of lead as well as tungsten and molybdenum.

The information that follows is for the most part taken directly from Cornwall (1972), Longwell and others (1965), and Tschanz and Pampeyan (1970), and describes the general geology of the mining districts (figs. 2, 3). Information concerning specific mineral properties is contained in Appendix A.

Antelope Springs district (Cornwall, 1972, p. 35)

The Antelope Springs mining district is located 30 miles southeast of Goldfield on the east slope of the Cactus Range (Tps. 3 and 4 S., R. 47 E) and has been described by Schrader (1913), Kral (1951, p. 11-13), Anderson and others (1965), and E. B. Ekren and others (written commun., 1966). The district was discovered in 1903. Several shafts were sunk along north-trending faults that dip about 30° W. The tuff of Antelope Springs has been displaced downward at least 1,000 feet on the west side along the fault zone. The tuffs are propylitically altered and, adjacent to ore-bearing veins, are intensely silicified and kaolinized. These tuffs are overlain to the south by younger alluvium and nonmineralized Thirsty Canyon Tuff. The veins average 8 feet in width and have been traced for as much as 2,000 feet along the strike.

The chief ore minerals are cerargyrite ($AgCl$) and argentite (Ag_2S) with some native silver-gold. The ore minerals are disseminated in a gangue of quartz, kaolinite, alunite, sericite, chlorite, calcite, iron oxides, and a little adularia. Bonham (1967a, b) estimates that the district produced 10,000 to 1,000,000 oz. of silver and 10 to 1,000 oz. of gold.

Arrowhead district (Tschanz and Pampeyan, 1970, p. 178)

The Arrowhead district is at the north end of the Pintwater Range near its junction with the Desert Range, about 19 miles southeast of the Groom mine. A silicified fault zone, occurring near the top of the Pogonip Group of Ordovician age, and lying structurally below a thrust sheet of Ordovician, Silurian, and Devonian dolomite, has been mineralized with copper, lead, and silver. The Arrowhead mine is described in Appendix A, p. 62.

Cactus Spring district (Cornwall, 1972, p. 37)

The Cactus Spring mining district includes the north half of the Cactus Range. According to Lincoln (1923, p. 164), turquoise was discovered at Cactus Peak in 1901 and silver at the Cactus Nevada silver mine in 1904; a small amount of ore was shipped from the latter. In addition to these discoveries, showings of gold and copper were found in the area. Kral (1951, p. 41) states:

> "The ores are found in quartz veins and stringers, usually in kaolinized or silicified rhyolite. The larger veins are 2 to 4 feet wide. The mineral turquoise occurs in sheared rhyolite and is reported to be of economic importance in the area."

Total production from the district is estimated to be less than $20,000.

Gass Peak district (Longwell and others, 1965, p. 145-146)

The Gass Peak district, located south and east of Gass Peak and 14 miles north of Las Vegas has a recorded production in 1916 and 1917 of 1,000 tons of ore, mainly from the June Bug mine (Longwell and others, 1965, p. 145, 146; Hewett and others, 1936, p. 55). The deposits

contain gold, silver, lead, and zinc in dolomitized and brecciated Paleozoic limestone. Primary sphalerite (ZnS) has been replaced by oxidized zinc minerals (hydrozincite and hemimorphite). (See Appendix A, p. 77, for descriptions of individual deposits.)

Gold Crater district (Cornwall, 1972, p. 37)

The Gold Crater mining district is located 10 miles east of Stonewall Mountain and south of Stonewall Flat (T. 5 S., Rs. 45 and 46 E.). Ball (1907, p. 140) reports that the district was discovered in 1904. Kral (1951, p. 69) states:

> "Considerable work was done in the early days; however, very little production has been noted. In 1916 it is reported that 120 tons of ore shipped grossed $2,015. Couch shows a recorded production of $1,208 in 1934 from 40 tons of ore. For the past several years one man has worked in the district and made intermittent shipments. His total shipments probably gross less than $5,000."

The deposits occur in intensely altered volcanic rocks, the principal rock is a quartz latite lava, and the chief alteration is dominantly argillic with some silicification (E. B. Ekren and others, written commun., 1966). Earlier mining in the district was for gold and silver, but about 1950 (Kral, 1951, p. 69-70) it included galena and cerussite plus gold and silver in brecciated pipes. The ore was reported by Kral to run 10 percent lead, 14 to 24 ounces silver, and $8 to $12 in gold per ton.

Goldfield district (Cornwall, 1972, p. 38)

All of the significant gold production in the Goldfield mining district has come from that part which lies in Esmeralda County, but numerous showings have been explored in the eastward extension of the district in Nye County (T. 2 S., R. 43 E., and T. 3 S., Rs. 43 and 44 E.). Those in R. 44 E. are in the present study area (NBGR). Most of the showings are in Milltown andesite and the dacite of Miocene age. In this area the rocks are in part intensely altered, and thus resemble rocks in the center of the Goldfield mining area. Silicified ledges, generally trending southeast or northeast, occur also along fissures and faults, with which ore shoots are commonly associated.

It is not believed that any significant production has come from the Nye County part of the district. Prospecting and exploration have continued intermittently in this area since the initial boom period in the early 1900's, and there has been exploration activity there in the 1960's.

In the present study area, Kral (1951, p. 72-73) describes a deposit at Quartz Mountain just north of the center of T. 3 S., R. 44 E. Gold mineralization occurs along shear zones in silicified dacite. Only minor shipments of ore were made from the property. R. P. Ashley (oral commun., 1977) has recently panned small amounts of free gold from altered rock in the deposit.

Kawich (Gold Reed) district (Cornwall, 1972, p. 38)

The Kawich or Gold Reed mining district, on the southeast flank of the Kawich Range (T. 4 S., R. 51 E.) in the Nellis Air Force Range, was

discovered in 1904. Ball (1907, p. 111-113) visited the area in 1905 and described free gold as occurring in silicified monzonite porphyry in an area of complex faulting. Fresh pyrite was found below 150 feet and is probably represented by iron-stained casts near the surface. Production from the district has been small. Bonham (1967a, b) listed gold production of 1,000 to 10,000 ounces and silver production of 10 to 10,000 ounces. Kral (1951, p. 92) reports a high-grade gold shipment in the late 1940's.

E. B. Ekren and others (written commun., 1966) state:

> "The principal mines are located along a northwest-trending silicified horst along which the strata have been dropped both to the northeast and southwest. The silicified zone forms a reeflike ridge, hence the original name Gold Reef . . . None of the major mines are accessible at present; however, all the deep shafts are sunk in porphyritic dacite which appears to be the principal ore bearer. The dacite is bleached to light gray and pastel shades of yellow and pink. The gold is not visible to the eye but apparently is associated with iron oxide and pyrite."

Mellan Mountain district (Cornwall, 1972)

The Mellan Mountain mining district covers a hill south of Mellan on the east side of Cactus Flat (T. 3 S., R. 48 E.). Deposits of gold and silver occur in shear zones in rhyolite and shale (Kral, 1951, p. 131-132). The deposits, known as the Mellan Gold Mines Group, are described in Appendix A, page 90.

Mine Mountain district (Cornwall, 1972)

The Mine Mountain mining district occurs on Mine Mountain on the southwest margin of Yucca Flat (T. 11 S., R. 52 E.). Deposits containing lead, silver, and mercury occur in steep normal faults trending N. 30° E. in brecciated quartzite and silicified dolomite of the Devils Gate Limestone in the upper plate of a thrust fault (Harley Barnes and others, written commun., 1963). The Mine Mountain mine is described in Appendix A, page 91.

Oak Spring district (Cornwall, 1972)

The Oak Spring mining district is located at the north end of Yucca Flat, south of Oak Spring Butte, and consists of tungsten and molybdenum deposits in tactite formed by metamorphism of limestone in the Ninemile Formation of the Pogonip Group near the Climax stock of granodiorite and quartz monzonite (Harley Barnes and others, written commun., 1963). According to Kral (1951, p. 138-141), exploration for tungsten and molybdenum started in 1937 and continued into the 1940's. Ball (1907, p. 128-130) reported that prospects were being developed in 1905 for gold associated with lesser amounts of silver and gem-quality chrysocolla and sparse pyrite, galena, chalcopyrite, and sphalerite.

The tactite, which contains the tungsten and molybdenum as scheelite and molybdenite, respectively, consists of garnet, quartz, pyroxene, calcite, idocrase, and epidote that formed by the metamorphism of silty limestone. The tungsten and molybdenum mineralization is said to be concentrated along certain beds and fracture zones. The best showings

are on the Tamney property known as the Climax claims. Individual mines are described in Appendix A, pages 91 to 97.

Papoose district (Tschanz and Pampeyan, 1970, p. 176-178)

The mineralized area is on the east side of the Papoose Range 8 miles south of Groom Lake and 13 miles south of the Groom mine. Access to this area is by the unimproved Frenchman Flat and Groom road. No description of the history and geology of the area has been published. The Kelly mine, Papoose district, is described in Appendix A, page 98.

The Papoose Range is composed of Prospect Mountain Quartzite, which appears to be complexly faulted. Tertiary volcanic rocks unconformably overlie the quartzite at the north end of the range and Cambrian carbonate rocks are present along the east side. A major north-trending fault east of the Kelly mine is inferred between the Prospect Mountain Quartzite and the low hills of Cambrian limestone and dolom. .e. In the adjacent part of the Nevada Test Site to the west, the lower Paleozoic rocks were inferred to be part of a major overthrust sheet (Johnson and Hibbard, 1957, p. 370) which rests on upper Paleozoic rocks, but the Prospect Mountain Quartzite in the Papoose Range is not part of this thrust plate. The only known deposits are in the quartzite along breccia zones or narrow fissures. The deposits probably contain only gold and silver.

Silverbow district (Cornwall, 1972, p. 40)

The Silverbow mining district is located on the west flank of the Kawich Range, 6 to 9 miles south of 38° latitude (T. 1 N. and T. 1 S.,

R. 49 E.). The district was discovered in 1904 (Ball, 1907, p. 109) and operated intermittently through 1941. In 1964 several mines in the district were reopened by the Tickabo Mining and Milling Co. (E. B. Ekren and others, written commun., 1966). Silver and gold were produced, with silver predominant. Kleinhampl (1964, p. 144) estimates a silver production of between 100,000 and 1,000,000 ounces. Gold production is estimated by Bonham (1967a) at between 1,000 and 10,000 ounces.

The mines are located along northwest- to west-trending steeply dipping faults that have dropped the Fraction Tuff and dacite lavas on the south against the tuff of White Blotch Spring and older tuffs on the north (E. B. Ekren and others, written commun., 1966). The deposits occur in and near quartz veins in the rhyolitic tuffs, which are intensely altered by silicification and kaolinization in the vicinity of the deposits. The silver occurs as cerargyrite (silver chloride), ruby silver, and stephanite disseminated in and near the quartz veins; gold occurs as the native metal (Ball, 1907, p. 109). The cerargyrite and some limonite and malachite occur as secondary, supergene minerals.

According to Kral (1951, p. 163-165), there have been four principal groups of claims worked prior to 1951. They are described in Appendix A, pages 98 to 102.

In 1964 several mines in the Silverbow district were reopened by the Tickabo Mining and Milling Co., according to E. B. Ekren and others (written commun., 1966). Ekren reports:

"Several of the prospects controlled by the Tickabo Mining Company are in Fraction Tuff and carry ore-grade

values. Inasmuch as the lavas of intermediate composition are the principal ore bearers in adjacent areas, especially Tonopah where they also underlie the Fraction Tuff, the possibility exists that those lavas may be mineralized at depth in the Silver Bow area."

Stonewall district (Cornwall, 1972, p. 40-41)

The Stonewall mining district is on the north slope of Stonewall Mountain (T. 5 S., Rs. 43 and 44 E.) about 15 miles southeast of Goldfield. According to Lincoln (1923, p. 183), the district was prospected for gold and silver as early as 1905 and small shipments were made in 1911 and 1915. According to Ball (1907, p. 88), gold values ranging from a trace to $6 per ton were found in a quartz vein along a prominent normal fault striking N. 65° E. and dipping 70° N. that bounds the north end of the mountain. The quartz vein is in rhyolitic welded tuff and intrusive quartz latite and in places is 40 feet wide; elsewhere it branches into a number of parallel veins. The quartz is stained by limonite and azurite; some pyrite was found. Similar veins were found in similar rocks at other places on Stonewall Mountain.

The Sterlog claims, which are outside NBGR, are described in Appendix A, page 102.

Tolicha district (Cornwall, 1972, p. 41)

The Tolicha mining district includes the Clarkdale area (T. 8 S., R. 45 E.), 6 miles west of Tolicha Peak, and the Quartz Mountain area (T. 7 S., R. 47 E.) 4 miles east of Tolicha Peak. Initial prospecting

was done in the Quartz Mountain area about 1905, but the first significant discovery was in 1917, when rich gold ore was found (Lincoln, 1923, p. 184) on the Landmark-Life Preserver claims. Gold-silver ore valued at nearly $1 million was found in brecciated zones cemented by quartz along shear zones in silicified rhyolite flows at Quartz Mountain and also in the Clarkdale area west of Talicha Peak (Kral, 1951, p. 167-169). The Clarksdale Camp, Landmark-Life Preserver Group, Quartz Mountain, Yellow Gold, and Wyoming-Scorpion Group are described in Appendix A, pages 103 to 106.

Trappmans district (Cornwall, 1972, p. 41)

The Trappmans mining district is located about 4 miles east of Mount Helen (T. 5 S., R. 47 E.) in an area of Precambrian gneissic quartz monzonite and biotite schist. Ball (1907, p. 138-139) states that the district was discovered in 1904. Gold and silver were found in quartz veins cutting the gneiss. He recognized three sets of quartz veins. The oldest are lenticular and of pegmatitic origin; the two younger sets contain pyrite, as does the adjacent wallrock, and carry gold-silver in the ratio of 1:4. Some cerargyrite was noted. E. B. Ekren and others (written commun., 1966) found two shafts on the property, one in a north-trending 60-foot quartz vein, the other in a pyritized fault zone that strikes north-northeast and dips 65° W.

Wahmonie district (Cornwall, 1972, p. 41)

The Wahmonie mining district is located 2 miles north of Skull Mountain and 1 mile east of Jackass Flats (T. 13 S., R. 51 E.). The

district must have been discovered prior to 1905, as Ball (1907, p. 140) mentions visiting the Horn Silver mine of that district in reporting his visit of 1905. In 1928 the district was rediscovered with a strike of high-grade silver-gold ore, but only minor shipments were made (Kral, 1951, p. 206-207). Apparently the precious metals occurred in or along quartz veins in an area of hydrothermally altered latite to dacite lava flows, tuffs, and volcanic breccias of the Salyer and Wahmonie Formations.

Wellington district (Cornwall, 1972, p. 41)

The Wellington mining district is located in T. 5 S., R. 46 E., 12 miles south of Cactus Spring. The deposits consist of gold with minor silver in and adjacent to quartz veins in a shear zone that strikes N. 70° E. in rhyolite and andesite or latite (Ball, 1906, p. 68). The rhyolite mentioned by Ball is probably the tuff of Antelope Springs, a rhyolitic welded tuff, and the andesite or latite are younger dikes. The host rocks are highly altered near the veins. The feldspar has been kaolinized and the biotite altered to white hydromica. Limonite is abundant due to oxidation of primary pyrite.

Kral (1951, p. 211-212) describes several groups of claims, but information concerning them is sketchy. Probably the most significant deposit is the Franz Hammel prospect, where, according to Kral (1951, p. 211), gold and silver occur in brecciated and silicified rhyolite near andesite. It and three other properties are described in Appendix A, pages 109 to 112.

Wilsons district (Cornwall, 1972, p. 41)

The Wilsons mining district is located 7 miles southeast of Antelope Springs and 5 miles northeast of Mount Helen (Tps. 4 and 5 S., R. 47 E.). According to Ball (1906, p. 69), the district was discovered in 1904, and the deposits consist of northeast-trending, steeply dipping quartz veins in altered rhyolite and andesite. The rhyolite is probably the rhyolitic welded tuff of the tuffs of Antelope Springs. The quartz has been stained by limonite and malachite. Two properties are described in Appendix A, pages 112 to 113.

Other mineral resource occurrences

In addition to the properties described in Appendix A, several construction-aggregate operations and several undeveloped nonmetallic occurrences are found in the study area (MINOBRAS, 1973; Nevada Industrial Commission, 1976, 1977).

Inasmuch as the construction aggregates (sand and gravel, and crushed or broken stone) are high-bulk, low-value, they tend to be produced near the point of consumption. Thus, all major permanent operations are confined to economic hauling distances of Las Vegas. During highway construction, temporary operations are established to provide the needed material, but after project completion, the deposits are usually abandoned.

Sand and gravel is obtained principally from Quaternary valley alluvium or alluvial fans (Longwell and others, 1965, p. 166). The deposits consist of a wide variety of unsorted debris; as a result, almost all material must be crushed and screened (U.S. Geol. Survey and Nevada Bur. Mines, 1964, p. 241).

Two montmorillonitic clay occurrences are found in the western portion of the study area (Ball, 1907, p. 157-158; MINOBRAS, 1973, p. 32). Both occur in altered tuffs. Ball (1907, p. 158) reported that adobe bricks were made from the Sarcabatus Flat deposit (sec. 31, T. 7 S., R. 45 E.) prior to 1905. Apparently there has been no production from the Pahute Mesa deposit (sec. 11, T. 7 S., R. 45 E.).

Playa and playa lakes are characteristic land forms in the Basin and Range province. In Nevada, playa mineral deposits have yielded borax, salt, sodium carbonate and sulfate, and lithium, and they are potential sources of other mineral commodities. Although a recent Nevada Bureau of Mines publication (Papke, 1976) made no specific comment concerning such deposits in the study area, the map accompanying the report indicated that several playas are within the area's boundaries. These playas may have some potential for mineral production.

Several warm water springs and wells are found in the Las Vegas Valley, in the vicinity of Beatty and elsewhere in the study area. In general, the water temperatures are only slightly anomalous and average between 70° and 85° F. The heat source for these warm water occurrences is open to question. Probably they are warmed by an artesian supply from deeply buried aquifers rather than magmatic sources. Regardless of origin, however, water in the 70° to 85° F range has potential for agricultural and space heating purposes.

Mineral Commodities

Geologic literature indicates that at least 16 mineral commodities are found in the vicinity of the NBGR. Although no realistic appraisals are available, it appears that the commodities most likely to be discovered in commercial quantities are gold, silver, tungsten, lead, and zinc. The following discussion provides basic information concerning the role of these five metals in the United States economy. The discussion contains a synopsis of current uses, production and consumption, and projections of anticipated demand and supply.

Gold and silver

Gold and silver are unique among mineral commodities. Both were mined before recorded history: Gold was used in Egypt 6,000 years ago and silver utensils and ornaments, 4,500 to 5,000 years old, have been found in Asia Minor (West, 1975). The metals have many similar uses; both are utilized in personal adornment, the arts, dentistry, electronics, mediums of monetary exchange, and as hallmarks of wealth.

Gold, a heavy, soft, very malleable and ductile, yellow metal is essentially inert and unaffected by most common oxidizing agents. Other physical properties include high electrical and thermal conductivities, and high reflectivity. Additionally, it readily alloys with many metals. Its concentration in the earth's crust ranges between 0.003 and 0.004 parts per million (ppm) or about 1 gram in 300 metric tons (Simons and Prinz, 1973).

Silver, although rare, is 15 to 20 times more plentiful than gold, with a crustal abundance at 0.07 ppm or about 1 gram in 14 metric

tons Heyl and others, 1973). Silver is also heavy, ductile, malleable, and alloys readily. Its thermal and electrical conductivities are the greatest of all metals. Although relatively stable in air and water, it tarnishes when exposed to sulfur compounds. Several of its chemical compounds are photosensitive.

Uses

Collectively or individually, gold and silver have formed the basis of monetary systems. Such usage dates to second millenium B.C., with gold reserved for royalty, governments, and the wealthy; while silver was employed by merchants and in trade. As trade expanded, so did the use of silver, with various governments--Rome in the third century and the U.S. Continental Congress in 1776--coming to accept it as legal tender. In 1816 Great Britain demonetized silver in favor of the gold-coin standard and by the twentieth century most nations had followed suit. During the twentieth century a series of disruptive wars, economic depressions, and govenmental actions reduced gold and silver's traditional monetary importance. Nonetheless, in 1975 about one-half of the world's gold stocks remained in government treasuries (U.S. Bur. Mines, 1977), and domestic coinage consumed 2.7 million ounces of silver (U.S. Bur. Mines, 1978, p. 154).

Gold and silver have traditionally found service in various decorative and artistic applications. Each year substantial quantities of both metals are consumed as jewelry, commemorative coins, medallions, and flat and holloware utensils.

Production - Consumption

In 1977 domestic mines produced an estimated 1.02 million troy ounces[1] gold and 37.4 million ounces silver valued at $151 million and

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[1]The troy system of weights is used for gold and silver and is based on the troy ounce of 480 grams. All data in this section is in troy ounce unless otherwise noted.

$172 million respectively (U.S. Bur. Mines, 1978, p. 66, 154; 1977a). Although about 225 mines produced gold, the 25 largest yielded 95 percent of the output, with three producers accounting for about 65 percent of the total. Approximately one-third of the primary output was a by-product of base metal mining. The Homestake Mine near Lead, South Dakota was the nation's largest, producing 302,000 ounces (U.S. Bur. Mines, 1977a). Mines in Nevada, Utah, and Arizona yielded 273,000, 207,000, and 96,000 ounces respectively (U.S. Bur. Mines, 1977a).

In 1977 domestic silver production came from more than 225 domestic mines with two-thirds being recovered from copper, lead, and zinc ores (U.S. Bur. Mines, 1978, p. 154). Mines in Idaho, principally in the Coeur d'Alene mining district, accounted for 40 percent, while those in Arizona and Colorado added 18 and 12 percent respectively (U.S. Bur. Mines, 1977a). Another 24 percent was from mines in Utah, Montana, and Missouri (U.S. Bur. Mines, 1977a).

In 1977 the apparent United States gold consumption rose slightly to 5.4 million ounces, or more than 5 times domestic mine production

(U.S. Bur. Mines, 1978, p. 66-67). The deficit was met by imports, by scrap recovery, and from industry stocks. Estimated consumption by end use for 1977: jewelry and arts, 56 percent; industry, 28 percent; dentistry, 15 percent; and small bars for investment, about 1 percent (U.S. Bur. Mines, 1978, p. 66-67).

Apparent domestic industrial consumption of silver declined in 1977 by about 3 percent to 165 million ounces (U.S. Bur. Mines, 1978, p. 154-155). This was nearly 4.5 times domestic mine production, or about 53 percent of total world output. Net imports were 78 million ounces or about 47 percent of consumption. Recycling added an estimated 53 million ounces to the available supply. Major end user during 1977 were photographic supplies, 34 percent; sterling and electroplated ware, 14 percent; electrical and electronic components, 24 percent; brazing and soldering alloys, 19 percent; and other, 9 percent (U.S. Bur. Mines, 1978, p. 154; 1977a).

Prices

Gold prices increased dramatically over the past decade. From 1934 to 1968, the United State's buying and selling price of gold remained unchanged at $35 per ounce. In March 1968, members of the International Gold Pool began restricting sales from monetary stocks to official use only, and thus, established a "two-tier" pricing system--$35 per ounce for intergovernmental transactions and a floating open-market price for private accounts (West, 1975).

From the beginning of the two-tier system, the free market price of gold has been above the official price. From an average of $39.26 per ounce in 1968, the market price has increased to a yearly average of $148.00 per ounce in 1977 (U.S. Bur.Mines, 1978, p. 66). A temporary high of $197.50 was recorded on the London market on December 30, 1974 in anticipation of an American buying surge after the removal of U.S. Government restrictions on private gold ownership (West, 1977).

From 1946 to the early 1960's world silver prices were stabilized at about $0.90 per ounce through the United States silver purchase policies. During the late 1950's, however, world wide silver demand for industrial and coinage uses began to exceed production. Subsequent deficits were filled by U.S. Treasury. The Secretary of the Treasury sold silver not needed to back silver certificates at prices not less than $1.2929 per ounce. All government attempts to maintain the $1.29 per ounce price were abandoned in 1967 at which time the Treasury began holding weekly silver auctions. In 1968 the right to redeem silver certificates was terminated. Free of most governmental interference, the price of silver had increased from $1.29 in 1966 to $4.60 per ounce in 1977 (U.S. Bur. Mines, 1978, p. 155).

Reserves - Resources

In 1978 the Bureau of Mines reported domestic gold reserves at approximately 110 million ounces, and a total resource

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_/Resources are specific bodies of mineral-bearing material whose location, quality, and quantity are known from geologic evidence, supported by engineering measurement and include reserves and subeconomic resources. The reserves is that of the resource from which a useable mineral or energy commodity can be economically and legally extracted at time of determination.

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of 240 million ounces, which is almost 13 percent of the estimated world total (U.S. Bur. Mines, 1978, p. 67). The reserves were assumed to be recoverable at current market prices ($150 to $200 per ounce gold) while the remainder included identified material in deposits not currently economic. About one-half of the gold resources are assumed to be in deposits with other metals and about 25 percent are thought to be in placers. Most resources are in the 13 western states including Alaska and South Dakota. Additional resources are in Alabama, Georgia, North Carolina, South Carolina, and Virginia.

The world's total estimated gold resources are dominated by the Republic of South Africa which has over 60 percent of the world reserves (U.S. Bur. Mines, 1978, p. 67). About 15 percent of the gold reserves are in the U.S.S.R.

World silver reserves and resources are nearly 23 billion ounces at which 6 billion are classified as reserves (U.S. Bur. Mines, 1978, p. 155). The United States' total resource consists of 1.5 billion ounces of reserves

and 4.2 billion ounces in sub-economic deposits (Clark, 1975; U.S. Bur. Mines, 1978, p. 155). About two-thirds of the world's total resources are contained as by-product silver in base metal deposits while the remainder are in veins in which silver is the main product. Most domestic resources are in Nevada, Idaho, Montana, Utah, California, and Colorado (Clarke, 1975).

Outlook

Demand

In 1975, the Bureau of Mines forecasted domestic demand for newly mined gold for the year 2000. The estimate ranges between 12.9 and 25.0 million ounces, with the most probable estimate based on a 3.3 percent annual growth rate, at 15.3 million ounces (West, 1975). The recovery of secondary gold from scrap is expected to increase to 1.7 million ounces, giving a total domestic demand of 17 million ounces (West, 1975). Table 1 compares 1973 United States gold consumption by end use with forecasts for the year 2000.

World demand is expected to increase, but at a slower rate. The forecast for the year 2000 ranges between 42.1 and 55.5 million ounces with the most probable estimate 47.7 million ounces (West, 1975).

The annual United States demand for newly mined silver is expected to range between 240 and 505 million ounces in 2000, with a probable demand of 310 million ounces (Clarke, 1975). The probable demand represents an annual growth of about 1.7 percent. Demand in the rest of the world is expected to increase at a rate of 2.2 percent and reach about 530 million ounces (Clarke, 1975).

Table 1 compares 1973 domestic silver consumption by end use with projections for 2000.

Supply

Projected cumulative world primary gold demand from 1974 to 2000 amounts to over 1.1 billion ounces, or nearly 90 percent of current reserves (West, 1975). Anticipated cumulative domestic demand is over 220 million ounces, or twice current domestic resources. Domestic mine production is expected to provide approximately only 16 percent of U.S. demand through 2000, with over one-half anticipated from mining gold ores. The remainder will be from base metal mines, principally copper, and thus the amount of gold produced will be dependant in part on the demand for base metals.

Import and (or) sales from monetary stocks will be necessary to meet future United States gold requirements. Although the Republic of South Africa currently dominates world gold supplies, international political consideration and internal racial policies may limit South Africa's future role. New discoveries and production are expected in Central Asia, Siberia, the Caribbean, Central and South American, and South Pacific - Australia.

Cumulative United States' silver demand from 1974 to 2000 is expected to total 5.3 billion ounces or about 3.5 times domestic reserves (Clarke, 1975). Imports will continue to supply a major portion of domestic demand, even though higher prices will undoubtedly stimulate additional domestic exploration and production. Copper

TABLE 1. - Domestic gold and silver consumption in 1973, and gold and silver demand forecast for 2000 by end use (million troy ounces)[1/]

End Use	GOLD				End Use	SILVER			
	1973	2000				1973	2000		
		Low	High	Probable			Low	High	Probable
Jewelry and Arts	3.6	6.5	10.0	7.5	Silverware, Jewelry and Arts	52.4	65	120	90
Dental Supplies	0.7	.9	2.5	1.5	Photography	52.0	60	150	90
Electronics and others	2.6	5.5	10.0	7.0	Refrigeration, Appliances and Equipment	26.3	25	65	30
Investment	--	1.0	5.0	1.0	Batteries, Electrical and Electronics	44.0	60	110	65
					Coinage and Other	22.2	30	60	35
Total	6.9	13.9	27.5	17.0	Total	196.9	240	505	310

1/Adapted from Bureau of Mines Bulletin 667, pages 450 and 1013.

mines are expected to be the major sources of domestic by-product silver; thus, copper demand will significantly affect national silver output.

Tungsten

About 300 times as abundant as gold, tungsten is one of the most important metals in modern industry. A hard, heavy, grayish-white metal with unparalleled physical properties, it has the highest melting point (3,410°C) of any element except carbon. At elevated temperatures, its tensile strength surpasses all other metals. In addition, it has good to excellent resistance to corrosion and abrasion, good electrical and thermal conductivity, and low thermal expansion.

Uses

In 1977, tungsten's main industrial uses were in the production of of carbides (69 percent); tool, alloy, stainless, and heat resistant steels (11 percent); tungsten metal mill products (16 percent); superalloys (2 percent), and other uses (2 percent) (U.S. Bur. Mines, 1978, p. 180; 1977c).

Cemented tungsten carbide is manufactured from tungsten powder which is carburized, compacted with a cobalt binder and sintered. The hardness and durability of the resulting product is in part determined by the grain size of the tungsten powder and amount of cobalt. Major uses include cutting edges, dies, and machine parts which are subject to extreme wear. Large quantities are consumed in mining industry rock drill bits.

Cast or fused carbide is also prepared from tungsten powder and is used principally as a hard-facing material.

In alloys, tungsten imparts many of its desirable physical properties to the parent metal. Tungsten steels have high temperature applications such as in hot tool and die products, turbine blades, valves and vessels for superheated materials. Tungsten alloys of silver and copper are used for electrical contacts and welding materials while heavy metal alloys are used for high-density purposes such as counterweights or shielding.

Nearly all pure or substantially pure tungsten metal products are produced from powdered metallic tungsten. Tungsten metal is used as filaments in electric lights, as distributor points in automobiles, and other similar applications.

Tungsten chemicals are employed in dyes, luminescent pigments, ceramics, and petroleum catalysts.

Production - Consumption

In 1977 domestic production of tungsten concentrates, as measured by mine shipments, increased about 20 percent over the previous year (U.S. Bur. Mines, 1977c; 1978, p. 180). The concentrates, valued at $62.0 million, contained an estimated 7 million pounds of tungsten metal. Although 47 mines were involved, 95 percent of the United States output was from two mines (U.S. Bur. Mines, 1977c). Both mines, the Union Carbide Corporation Pine Creek mine near Bishop, California, and the AMAX Climax mine near Leadville, Colorado, recovered tungsten as co-product or by-product of molybdenum. The remainder was shipped from intermittent producers scattered through nine western states.

Total reported U.S. consumption of tungsten concentrates increased approximately 7 percent in 1977 (U.S. Bur. Mines, 1977c; 1978, p. 180). About 41 percent of 17.2 million pounds consumed was from current domestic production; imports, recycled scrap, industry stocks, and sales from the government stockpile accounted for the balance. The major consuming industries were metal-working and construction machinery (74 percent), transportation (11 percent) lamp and lighting (7 percent), electrical (4 percent), chemical and other uses (4 percent) (U.S. Bur. Mines, 1977c; 1978, p. 180).

Imports furnish a significant portion of the tungsten concentrates consumed in the United States. Between 1955 and 1974, total national consumption was about 250 million pounds (Stevens, 1975). During the same period, domestic production and imports were 175 and 145 million pounds respectively. (Purchases for the government stockpile account for the apparent excess). From 1973 through 1976 Canada, Bolivia, Peru, and Thailand collectively supplied 63 percent of the imported tunsten concentrates (U.S. Bur. Mines, 1978, p. 180). In addition to concentrates, the United States imports noteworthy amounts of finished and semi-processed tungsten products.

Prices

Average tunsten concentrate price during 1976 was $107.65, a short ton unit of WO_3, a 23.5 percent increase over the 1975 average[1] (U.S. Bur.

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[1] A short ton unit (s.t.u.) WO_3 equals 20 pounds of contained tungsten trioxide or 15.86 pounds of tungsten metal.

Mines, 1978, p. 180). The price reached a record high of about $164/s.t.u. in the European metal markets in mid-1977, and the average was $157.23 per s.t.u. (U.S. Bur. Mines, 1978, p. 180; 1977b). Figure 4 shows the average yearly domestic WO_3 prices from 1940 through 1977.

Reserves - Resources

In 1978, the Bureau of Mines reported domestic tungsten reserves at about 275 million pounds of tungsten (U.S. Bur. Mines, 1978, p. 181). The reserves occur in deposits averaging over 0.3 percent WO_3 and are principally found as scheelite ($CaWO_4$) in tactites or skarns. About one-third of the reserves occur as ferberite ($FeWO_4$), wolframite ($FeMnWO_4$) and huebnerite ($MnWO_4$) in quartz veins. Most of the reserves are in the western states (Hobbs and Elliott, 1973).

Many domestic deposits averaging less than 0.3 percent WO_3, can be considered potential tungsten sources. The Bureau of Mines reports these deposits constitute a 700 million pound tungsten resource (Larson and others, 1971). The Bureau also reports an additional 135 million pounds of tungsten are present in California's Searles Lake brines, and 88 million pounds in the tailings ponds at Climax mine, Colorado (Larson and others, 1971). The Climax tailings average 0.03 percent WO_3 or less.

Total U.S. tungsten resources are conservatively estimated at 3 times domestic reserves (U.S. Bur. Mines, 1978, p. 181). Tungsten scrap and sludge, not currently recovered because of low content, are also potential sources of additional metal.

The United States has less than 10 percent of the world's known tungsten resources (U.S. Bur. Mines, 1978, p. 181). Approximately 65 percent are in Asia; with mainland China accounting for almost 60 percent of the world's

known supply. Other nations with significant resource potentials include: Canada, the Soviet Union, Australia, and the Republic of Korea (Bur. Mines, 1978, p. 181).

Outlook

Demand

As projected by the Bureau of Mines, domestic demand for newly mined tungsten in the year 2000 will range between 47 and 76 million pounds (Steven, 1975). Based on a growth rate of 4.3 percent a year from 1973, the probable amount will be 49.4 million pounds (Stevens, 1975). Total tungsten demand in 2000 will be about 51.8 million pounds including 2.4 million recovered from recycled scrap (Stevens, 1975).

World tungsten demand in 2000, is expected to range from 159 to 218.9 million pounds with 176.8 million pounds most probable (Stevens, 1975). Demand for secondary tungsten from scrap ranges between 2 and 3 million pounds (Stevens, 1975).

Supply

Projected cumulative United State's demand from 1974 to 2000 is 764 million pounds of newly mined tungsten, (over three times current reserves) plus an additional 33.7 million pounds of secondary tungsten (Stevens, 1975). Under current and expected conditions, domestic production will increase about 1.0 percent a year until 1985 then decline from 1985 to 2000 (Stevens, 1975). Estimated cumulative production from domestic deposits total about 177 million pounds. If demand is to be met, approximately 620 million pounds will have to be obtained from imports, scrap, and government stockpiles.

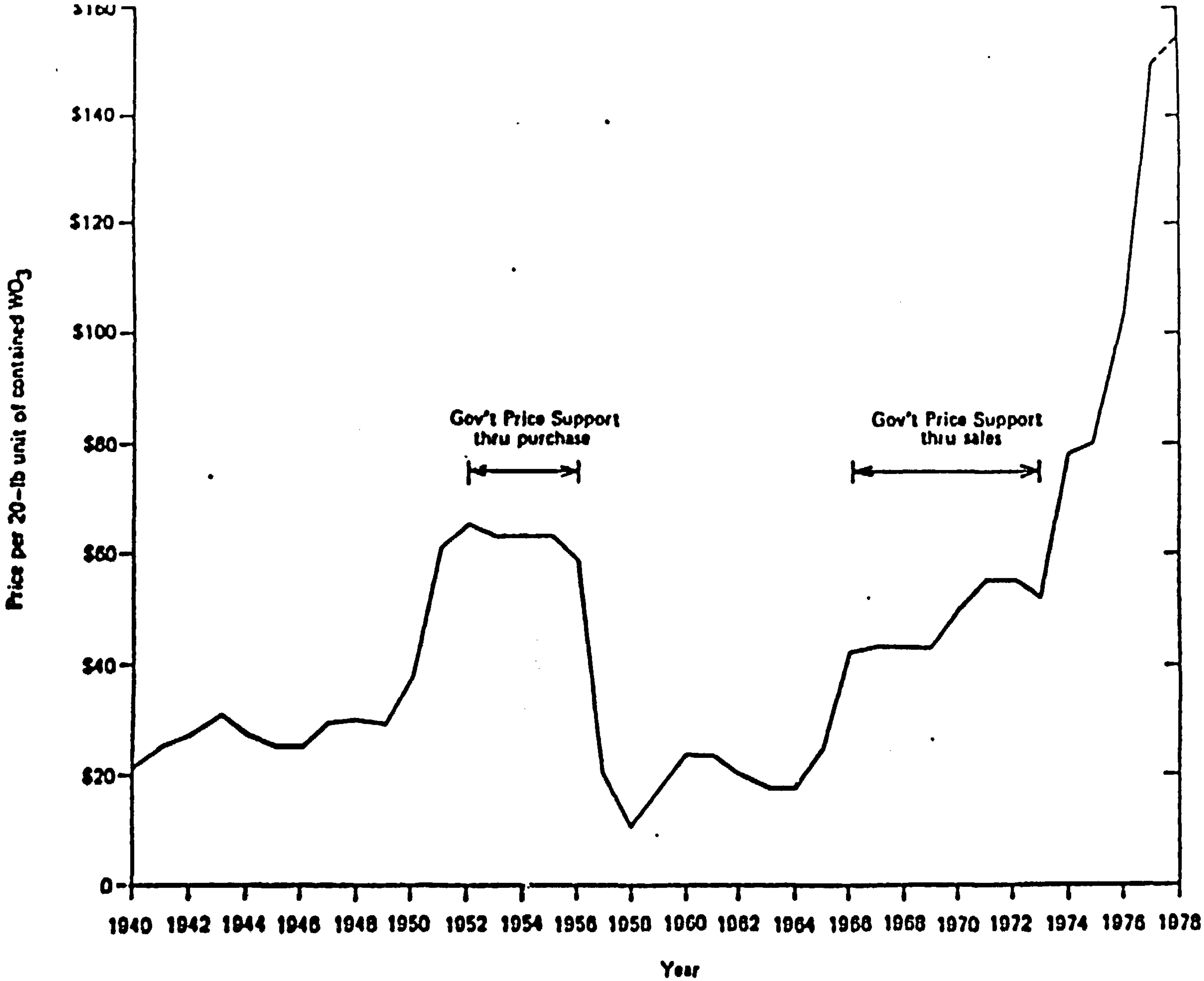

Figure 4. - Average Yearly Domestic Tungsten Trioxide (WO_3) Price

Cumulative world tungsten demand for the same time frame is expected to total 3.3 billion pounds of newly mined metal (Stevens, 1975). This amounts to about 83 percent of known reserves and 30 percent of total resources.

Lead and Zinc

Lead and zinc are two of the most essential metals. They are used in a great variety of fabricated products and chemicals. In terms of United States metal consumption, lead and zinc are surpassed only by iron, aluminum, and copper.

Lead was one of the first metals utilized by man, being used in Egypt as early as 3800 B.C. (Ryan and Hague, 1975). The Greeks and Romans employed it in coinage, weights, ceramic glazes, plumbing, corrosion resistant containers, and glass. Although now adapted to newer applications, lead is still used for many of these products.

Pure lead is very heavy and malleable, though only slightly ductile, metal. Although the most corrosion resistant of common metals, its freshly cut surface readily tarnishes when exposed to air. In spite of softness in elemental form, small additions of other metals harden lead and impart sufficient strength to permit its use in structural applications. Other physical properties include lead's ability to absorb X-ray and gamma radiation, and to form eutectics with many metals.

In terms of crustal abundance, lead ranks 34th among the elements, with an average concentration of about 15 ppm (Morris and others, 1973). In addition to being more scarce than copper and zinc, it is also less common than such rare elements as yittrium, neodymium, and lanthanum (Morris and others, 1973).

The use of metallic zinc is a comparatively recent development. Although natural occurring zinc compounds were used as alloying constituents of brass in Europe in the second century B.C., the metal, was unknown in the western world until the Middle Ages. Imports from China and India were Europe's first encounter with metallic zinc. Around 1730 zinc smelting technology was brought to Europe and in 1739 a smelter was constructed in England (Cammarota and others, 1975).

Elemental zinc, a fairly heavy though somewhat brittle metal, is bluish white on a fresh surface (Cammarota and others, 1975). In air it forms a self-protective oxide or carbonate coating and thus withstands further atmospheric corrosion. Chemically, it is moderately active and subject to oxidation by common acids. It easily alloys with several metals.

Zinc is much more common than lead, ranging 23rd in terms of crustal abundance and averaging between 65 and 96 ppm, or about half again as abundant as copper (45-63 ppm) (Wedow and others, 1973).

Uses

Although lead and zinc often occur together and are mined from the same deposits, their industrial uses differ considerably. The storage battery industry is the country's largest consumer of lead; in 1977 it consumed 52 percent (U.S. Bur. Mines, 1977b; 1978, p. 90). The transportation industry was the largest user of acid-lead batteries. The second largest use of lead is in gasoline additives. Lead compounds improve the performance and efficiency of high compression engines. Since 1975,

lead in gasoline has been limited to 1.7 grams per gallon (Ryan and Hague, 1977), and in 1977, gasoline accounted for 19 percent of United States lead consumption (U.S. Bur. Mines, 1978, p. 91).

Other principal uses include: metal sheets and foil for packaging, radiation shielding and vibration dampening; chemicals and pigments for corrosion-resistant paints, color-true enamels, and glazes; solder; and ammunition (U.S. Bur. Mines, 1978, p. 90-91).

Most zinc enters the commercial market as metal slabs and is used in four principal areas of manufacturing: galvanizing, die casting, brass and bronze products, and rolled zinc (Cammarota and others, 1975). Zinc oxide produced from ore or through oxidation of zinc metal, is the primary ingredient in zinc base chemicals and pigments.

Zinc-coated steel exposed to normal atmospheres form an insoluable, nearly impervious layer of zinc carbonate. Galvanized steel products such as roofing, siding, guttering, venting, ducting, and automotive body parts are the country's largest consumers of zinc (U.S. Bur. Mines, 1977d; 1978, p. 190).

Zinc-based alloys for die castings constitute zinc's second largest use (U.S. Bur. Mines, 1977d; 1978, p. 190). Die casting permits the production of intricate parts within extremely close tolerances. Zinc die casts are used by the automotive industry for door handles, window cranks, hood ornaments, and carburetor and fuel pump bodies. Die castings are also used in electrical appliances, business machines, tools, building hardware, toys, and novelties.

Zinc's next largest use is in brass and bronze products (U.S. Bur. Mines, 1977d; 1978, p. 180). Brass, a copper-zinc alloy, varies between 5 and 40 percent zinc (Cammarota and others, 1975). Some bronzes, basically copper-tin alloys, may be as much as 4.5 percent zinc (Cammarota and others, 1975). Both brass and bronze find widespread applications in building and plumbing fixtures such as door and window hardware, faucets, valves, traps, and piping. Brass is also used in automotive radiator cores, ammunition cartridge cases, clocks, radios, televisions, and telephones.

Although quantities are small, rolled zinc is important in dry cell battery cases, weather stripping, and photoengraving plates.

Zinc oxide is a white metallic pigment formed from zinc ore, slab, or recycled scrap (Cammarota and Babitzke, 1974). It is used in rubber, paints, ceramics, cosmetics, pharmaceuticals, textiles, and floor coverings. Rubber products contain an average 5 to 5.5 percent zinc oxide, it reduces heat in tires and reinforces the rubber bond.

Production-Consumption

During 1977 domestic mine production of lead and zinc declined from 1976 levels (U.S. Bur. Mines, 1977b, d; 1978, p. 90, 190). Although lead output for the year decreased 10 percent to 589,000 tons, the value of production rose about 24 percent to $360 million (U.S. Bur. Mines, 1977b). Missouri mines produced about 83 percent of the total primary lead supply. Mines in Idaho, Colorado, and Utah supplied 8, 4, and 2 percent of total, respectively. The remaining 3 percent was from operations in 10 other states. Recovery of secondary lead from scrap contributed an additional 723,000 short tons (U.S. Bur. Mines, 1978, p. 90).

In 1977 domestic zinc output declined about 4.5 percent in response to lower consumption, falling prices, and labor strikes (U.S. Bur. Mines, 1977d). The value of the 463,000 tons of mine output is estimated at about $318 million, or approximately 12 percent less than in 1976 (U.S. Bur. Mines, 1977d; 1978, p. 190). Twenty-five mines accounted for 89 percent of domestic production with five accounting for 41 percent (U.S. Bur. Mines, 1977d; 1978, p. 190). Major producing states were: Tennessee (20 percent), Missouri (18 percent), New York (16 percent), Colorado (10 percent), and New Jersey (7 percent). The remaining 29 percent was from mines in 14 other states (U.S. Bur. Mines, 1977d). Recycled material added 60,000 tons (U.S. Bur. Mines, 1978, p. 190).

Apparent domestic lead consumption increased slightly during 1977 and is estimated to have been nearly 1.6 million tons, or about 2.6 times U.S. mine output. The deficit was filled principally by recovery of secondary lead from scrap and by imports of ores, concentrates, and refined metal. Secondary lead production from old and new scrap is estimated at 723,000 tons (U.S. Bur. Mines, 1978, p. 90). Imports, mainly from Canada, Peru, Mexico, and Australia, added about 300,000 tons (U.S. Bur. Mines, 1978, p. 90).

Major end uses of lead included: batteries (52 percent), gasoline additives (19 percent), electrical (9 percent), ammunition (6 percent), paints (7 percent), construction (2 percent), and other (5 percent) (U.S. Bur. Mines, 1978, p. 90).

The apparent consumption of zinc in the United States declined by 11 percent in 1977 to 1.25 million tons (U.S. Bur. Mines, p. 190). Domestic mines supplied 37 percent of total consumption while imports accounted for 53 percent. The remainder was obtained from recycled scrap and industry stocks.

The construction materials and the transportation industries were major consumers of zinc based products in 1977; together they accounted for approximately 67 percent (U.S. Bur. Mines, 1978, p. 190). An additional 23 percent was used by the electrical equipment, machinery, and chemical industries.

A 1977 zinc consumption breakdown by product types is as follows: galvanizing, 35 percent; zinc based alloys (principally for diecasting), 33 percent; brass and bronze, 14 percent; zinc oxides, 12 percent, and other, 6 percent (U.S. Bur. Mines, 1977d; 1978, p. 190).

Reservces-Resources

In 1978, the Bureau of Mines reported the nation's lead and zinc reserves at 28.4 and 30.0 million tons, respectively (U.S. Bur. Mines, 1978, pp. 91 and 191). The bulk are concentrated in the central and eastern parts of the country. Southeastern Missouri's lead reserves are estimated at being 20.7 million tons, or over 72 percent of the nation's total. The remaining 28 percent are scattered in deposits in Wisconsin, eight western, and three eastern states. Total domestic lead resources are estimated to be 79 million short tons (Ryan and Hague, 1977b).

The Missouri lead deposits also contain the largest domestic zinc reserves (Cammarota and others, 1975). Combined with deposits in Illinois, Wisconsin, and in mid-Tennessee, they account for 44 percent, or 13.2 million tons, of known U.S. zinc supplies. An additional 12.0 million tons are reported in deposits in Maine, New Jersey, New York,

Table 2. *Forecasts of U.S. lead demand by end use in 2000*[1,2]

[million short tons]

End use	Low	High	Probable
Batteries and electrical[3]	1.31	2.32	1.75
Gasoline additives	.05	.30	.11
Construction materials[4]	.23	.40	.27
Ammunition and other	.19	.50	.30
Total	1.78	3.52	2.43

[1]Adapted from Bureau of Mines Bulletin 667, page 607.

[2]Includes both primary and secondary lead.

[3]Includes automotive batteries, other batteries, and cable coverings.

[4]Includes lead-based paints.

rate of 2.5 percent (25). Table 3 shows the high, low, and probable domestic zinc demand estimates for the year 2000.

Supply

Cumulative domestic demand from 1973 to 2000 for newly mined lead is forecasted to be nearly 35 million tons, and exceed domestic reserves by over 6.5 million tons (Ryan and Hague, 1975; U.S. Bur. Mines, 1978, p. 91). Even if sufficient domestic supplies were available, domestic mines would have to increase output 2.6 times to meet the projected levels; and if domestic producers attempt only to maintain their share of the market, United States mine capacity must grow by over 50 percent.

Projected cumulative United States demand for primary zinc is about 61 million tons, twoce domestic reserves (Cammarota and others, 1975; U.S. Bur. Mines, 1978, p. 191).

Thus, the nation will continue to rely heavily on foreign sources for a significant portion of primary lead and zinc supplies. It is expected that Canada, Mexico, and Australia will be the chief source of U.S. imports.

Table 3. *Forecasts of U.S. zinc demand by use in 2000*[1, 2]

[million short tons]

	Low	High	Probable
Metal			
Construction	0.8	1.4	1.1
Transportation	.4	.9	.5
Electrical	.3	.7	.5
Machinery	.2	.4	.3
Other	.2	.5	.35
Nonmetal (paint, chemicals, rubber and other nonmetal uses)	.25	.66	.45
Total	2.15	4.56	3.20

[1]Adapted from Bureau of Mines Bulletin 667, page 1239.

[2]Includes both primary and secondary zinc.

EVALUATION OF MINERAL RESOURCES

It is impossible to adequately evaluate the mineral potential of the present study area (NBGR, NAFB). The area has been closed to exploration activities since 1940. Little of its potential has been evaluated with respect to current mining and exploration techniques, and in consideration of increased commodity prices. Further investigations may determine that deposits once considered marginal or even submarginal are now economic.

With the exception of tungsten and molybdenum in the Oak Spring district at the north end of Yucca Flat, the only known mineral deposits in the study area are gold-silver with minor lead, zinc, and copper. The fact that no rich gold-silver deposits, such as those at Goldfield and Tonopah, have been found does not mean, however, that none are present. The difficulty of finding such deposits is well known to exploration geologists who have been working in the Goldfield and Tonopah districts in recent years. All of these efforts as well as the recent detailed geochemical exploration program of the U.S. Geological Survey in Goldfield (Ashley and Keith, 1977) have not yet revealed major new gold-silver mineralization. However, the geologic environment of this area is sufficiently promising that further investigation by government and private industry is warranted. Figure 5 shows areas that appear geologically favorable for mineral resources.

In spite of the failure of exploration efforts as described above, there is a potential for new discoveries in parts of the present study area. Probably the most promising area is the eastward extension

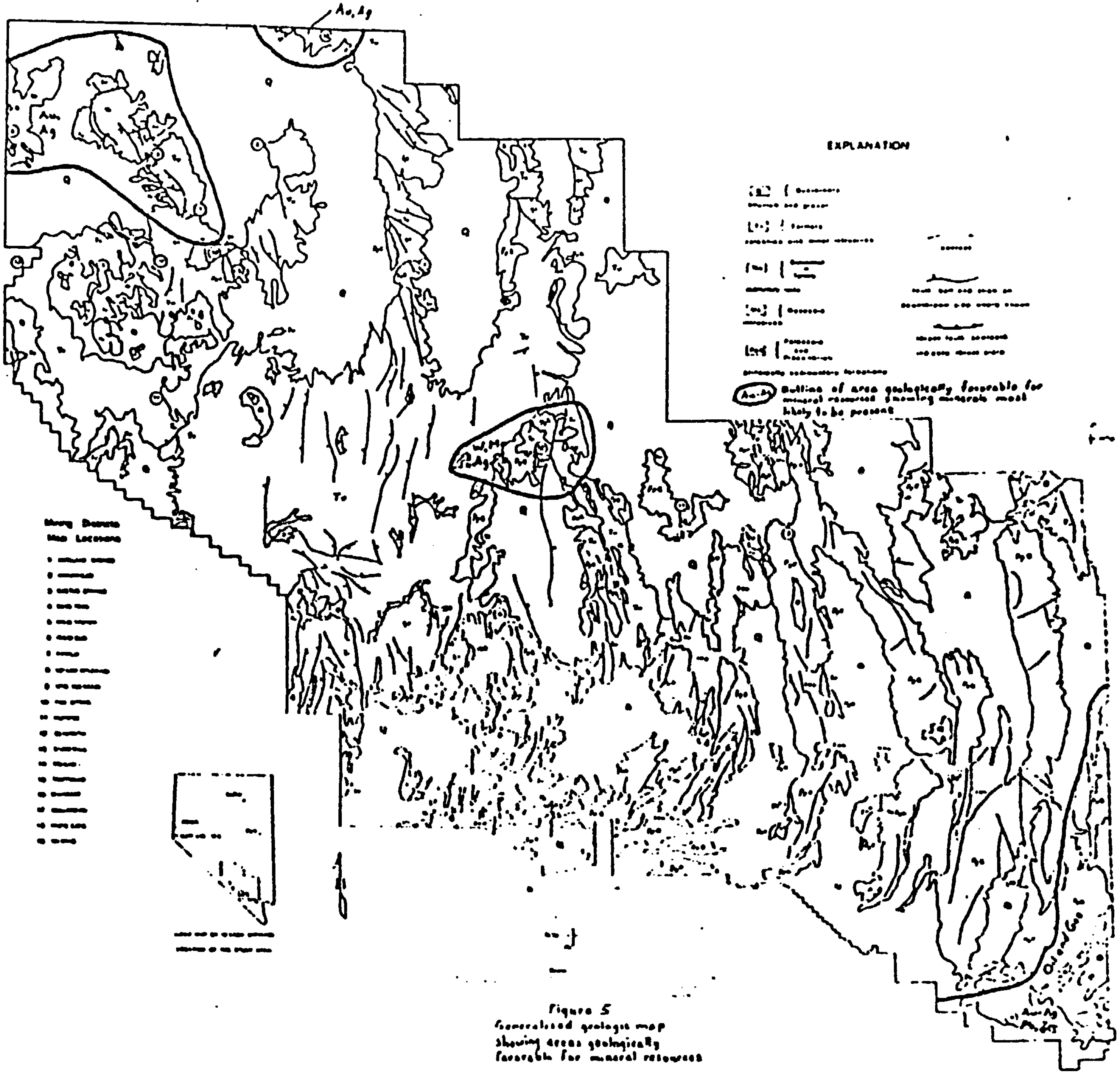

Figure 5
Generalized geologic map
showing areas geologically
favorable for mineral resources

of the Goldfield district in Tps. 2 and 3 S. across the Cactus Range, and possibly also southeastward past Antelope Springs. The latter potential mineralized zone was recognized by Anderson and others (1965). In both of these areas the rocks are intensely altered, as at Goldfield, and intermediate volcanic rocks, mostly dacite, such as those at Goldfield and Tonopah, are abundant.

Another rather promising area for as yet undiscovered gold-silver deposits is the Silverbow district at the north edge of the NBGR. This district has been prospected intermittently with minor production since 1904. Part of the area immediately outside of the NBGR is currently being explored by a major mining company (R. P. Ashley, informal communication). The geologic setting and rocks are similar to those at Tonopah.

The Oak Spring district at the north end of Yucca Flat is another area with promise for new discoveries. Deposits of tungsten and molybdenum occur in metamorphosed limestone. A DMEA project during the late 1950's outlined resources of nearly 20,000 tons of tungsten ore averaging 0.67 percent WO_3. Additional exploration may add to the total. Other deposits in the district contain silver and lead in veins.

OIL AND GAS

A number of holes have been drilled around Las Vegas in search of oil and gas. Several shows of oil or gas have been reported, but none have become producers (Longwell and others, 1965, p. 159-160; Garside and others, 1977, p. 7; Garside and Schilling, 1977). Six of the holes (Garside and Schilling, 1977) were drilled 10 to 20 miles east of the

Las Vegas Range, which extends north along the southeastern margin of the NBGR. One of these holes reported a show of gas and oil (Garside and others, 1977; Garside and Schilling, 1977).

Shaly carbonaceous beds near the base of the Bird Spring Formation of late Paleozoic age represent a potential source of oil (Longwell and others, 1965, p. 160). The Bird Spring Formation underlies most of the Las Vegas Range and possible traps for oil and gas are present, such as an anticline south and east of Gass Peak (fig. 1).

Two oil fields have been developed in Railroad Valley, northern Nye County, about 50 miles northeast of the NBGR. Some geologists believe that part or all of this oil came from shaly rocks correlative in age with those underlying the Las Vegas Range, the Bird Spring Formation.

CONCLUSIONS

The two areas of greatest promise for the discovery of new gold-silver deposits are the eastward extension of the Goldfield district across the Cactus Range and the Silverbow district on the west margin of the Kawich Range. Further investigation of these areas by the Geological Survey, Bureau of Mines and private industry is recommended. It is quite possible that significant mineral deposits exist in these areas, and exploration, utilizing the most up-to-date methods and tools, could result in the discovery of rich bonanzas similar to those found at Goldfield and Tonopah.

In the case of the Oak Spring district, mentioned in the preceding section as having some promise for new discoveries, an investigation of this district by the Geological Survey and Bureau of Mines might be advisable.

It was pointed out in the preceding section that the potential for oil and gas pools is present in the Las Vegas Range. This potential could be tested by further investigations in the area including drilling, but the cost would be great.

Although no uranium resources within NBGR are known, uranium minerals at two localities a few miles west of NBGR and elsewhere in the Great Basin typically are found in silicic volcanic rocks of Tertiary age, especially near volcanic centers. Inasmuch as nine or ten large volcanic centers are known in the western part of NBGR, and silicic volcanic rocks abound, a large area having a potential for uranium resources may exist. To our knowledge, no exploration for this resource has been conducted, but the Department of Energy is planning an investigation of uranium resources in the general area of the NBGR under the National Uranium Resources Evaluation Program (NURE) (R. C. Horton, oral commun., 1978).

Finally, areas of substantial size around the peripheries of the mountain ranges and also within the ranges are covered by either alluvium or Tertiary volcanic rocks less than 1,000 feet thick. The bedrock beneath this relatively shallow cover may have a potential for mineral resources in some places.

REFERENCES

Albers, J. P., 1967, Belt of sigmoidal bending and right-lateral faulting in the western Great Basin: Geol. Soc. America Bull., v. 78, no. 2, p. 143-156.

Anderson, R. E., Ekren, E. B., and Healey, D. L., 1965, Possible buried mineralized areas in Nye and Esmeralda Counties, Nevada, in Geological Survey research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D144-D150.

Ashley, R. P., and Keith, W. J., 1978, Geochemical exploration for gold deposits at Goldfield, Nevada: U.S. Geol. Survey Open-file Rept. 78-228, 8 p.

Ball, S. H., 1906, Notes on ore deposits of southwestern Nevada and eastern California: U.S. Geol. Survey Bull. 285, p. 53-73.

_____1907, A geologic reconnaissance in southwestern Nevada and eastern California: U.S. Geol. Survey Bull. 308, 218 p.

Bonham, H. F., 1967a, Gold producing districts of Nevada: Nevada Bur. Mines Map 32, scale 1:1,000,000.

_____1967b, Silver producing districts of Nevada: Nevada Bur. Mines Map 33, scale 1:1,000,000.

Clarke, T. E., 1975, Silver, in Mineral facts and problems: U.S. Bur. Mines Bull. 667, p. 1001-1015.

_____1976, Silver: U.S. Bur. Mines Mineral Yearbook 1974, v. 1, p. 1181-1199.

Commarota, V. A., Jr., Babitzke, H. R., 1976, Zinc: U.S. Bur. Mines Yearbook 1974, v. 1, p. 1363-1396.

Cammarota, V. A., Jr., Babitzke, H. R., and Hague, J. M., 1975, Zinc, in Mineral facts and problems: U.S. Bur. Mines Bull. 667, p. 1223-1241.

Cornwall, H. R., 1972, Geology and mineral deposits of southern Nye County, Nevada: Nevada Bur. Mines and Geology Bull. 77, 49 p.

Couch, B. F., and Carpenter, J. A., 1943, Nevada's metal and mineral production (1859-1940, inclusive): Nevada Univ. Bull., v. 37, no. 4, Geol. and Min. Ser no. 38.

Eckel, E. B., (editor), 1968, Nevada Test Site: Geol. Soc. America Mem. 110, 290 p.

Ekren, E. B., Anderson, R. E., Rogers, C. L., and Noble, D. C., 1971, Geology of northern Nellis Air Force Base Bombing and Gunnery Range, Nye County, Nevada: U.S. Geol. Survey Prof. Paper 651, 91 p.

Ferguson, H. G., 1917, The Golden Arrow, Clifford, and Ellendale districts, Nye County, Nevada: U.S. Geol. Survey Bull. 640-F, p. 113-123.

Garside, L. J., 1973, Radioactive mineral occurrences in Nevada: Nevada Bur. Mines and Geology Bull. 81, 121 p.

Garside, L. J., and Schilling, J. H., 1977, Wells drilled for oil and gas in Nevada through 1976: Nevada Bur. Mines and Geology Map 56.

Garside, L. J., Weimer, B. S., and Lutsey, I. A., 1977, Oil and gas developments in Nevada, 1968-1976: Nevada Bur. Mines and Geology, Rept. 29, 31 p.

Hewett, D. F., Callaghan, E., Moore, B. N., Nolan, T. B., Rubey, W. W., and Schallar, W. T., 1936, Mineral resources of the region around Boulder Dam: U.S. Geol. Survey Bull. 871, 197 p.

Heyl, A. V., Hall, W. E., Weissenborn, A. E., Stager, H. K., Puffett, W. P., and Reed, B. L., 1973, Silver, in United States mineral resources: U.S. Geol. Survey Prof. Paper 820, p. 581-603.

Hobbs, S. W., and Elliott, J. E., 1973, Tungsten, in United States mineral resources: U.S. Geol. Survey Prof. Paper 820, p. 667-678.

Humphrey, F. L., 1945, Geology of the Groom district, Lincoln County, Nevada: Nevada Univ. Bull., v. 39, no. 5, Geol. and Min. ser. no. 42, 53 p.

Johnson, M. S., and Hibbard, D. E., 1957, Geology of the Atomic Energy Commission Nevada proving grounds area, Nevada: U.S. Geol. Survey Bull. 1021-K, p. 333-384.

Kral, V. E., 1951, Mineral resources of Nye County, Nevada: Nevada Univ. Bull., Geology and Mining Ser., no. 50, 223 p.

Larson, L. P., Lowrie, R. L., and Leland, G. R., 1971, Availability of tungsten at various prices from resources in the United States: U.S. Bur. Mines IC 8500, 65 p.

Lincoln, F. C., 1923, Mining districts and mineral resources of Nevada: Reno, Nevada Newsletter Publishing Co., 295 p.

Longwell, C. R., Pampeyan, E. H., Bowyer, B., and Roberts, R. J., 1965, Geology and mineral deposits of Clark County, Nevada: Nevada Bur. Mines Bull. 62, 218 p.

MINOBRAS, 1973, Nevada industrial minerals, Dana Point, California, 62 p.

Morris, H. T., Heyl, A. V., and Hall, R. B., 1973, Lead, in United States mineral resources: U.S. Geol. Survey Prof. Paper 820, p. 313-332.

Morrissey, F. R., 1968, Turquoise deposits of Nevada: Nevada Bur. Mines Rept. 17, 30 p.

Nevada Industrial Commission, Office of State Inspector of Mines, Directory of Nevada mine operations active during Calendar Year 1976, January 31, 1977, 59 p.

1976, Directory of Nevada mine oeprations active during Calendar Year 1975, April 1976, 70 p.

Olson, R. H., 1966, A survey of industrial mineral possibilities in Nevada, in AIME Pacific Southwest Mineral Industry Conf., Sparks, Nevada, 1965, Papers, Pt. B: Nevada Bur. Mines Rept. 13, pt B, p. 25-38.

Papke, K. G., 1976, Evaporites and brines in Nevada playas. Nevada Bur. Mines and Geol. Bull. 87, 35 p.

Ryan, J. P. and Hague, J. M., 1975, Lead, in Mineral facts and problems: U.S. Bur. Mines Bull. 667, p. 591-610.

_____. 1977a, Lead: Preprint from the 1975 U.S. Bur. Mines Minerals Yearbook, 28 pp.

_____, 1977b, Lead - 1977: U.S. Bur. Mines Mineral Commodity Profiles (MCP-9), 23 p.

Schrader, F. C., 1913, Notes on the Antelope district, Nevada: U.S. Geol. Survey Bull. 530, p. 87-98.

Silberman, M. L. and McKee, E. H., 1974, Ages of Tertiary volcanic rocks and hydrothermal precious-metal deposits in central and western Nevada, in Guidebook to the geology of four Tertiary volcanic centers in central Nevada: Nevada Bur. Mines Rept. 19, p. 67-72.

Simons, F. S., and Prinz, W. C., 1973, Gold, in United States mineral resources: U.S. Geol. Survev Prof. Paper 820, p. 263-275.

Stevens, R. F., Jr., 1975, Tungsten, in Mineral facts and problems: U.S. Bur. Mines Bull. 667, p. 1161-1176.

_____, 1977, Tungsten: Preprint from the 1975 U.S. Bur. Mines Minerals Yearbook, 19 p.

Stewart, J. H., Albers, J. P., and Poole, F. G., 1968, Summary of regional evidence for right-lateral displacement in the western Great Basin: Geol. Soc. America Bull., v. 79, no. 10, p. 1407-1413.

Tschanz, C. M., and Pampeyan, E. H., 1970, Geology and mineral deposits of Lincoln County, Nevada: Nevada Bur. Mines Bull. 73, 187 p.

U.S. Army Corps of Engineers, 1967, Miscellaneous reality reports and correspondence, Nellis Air Force Bombing and Gunnery Range, Nevada, 1952-1967.

U.S. Bureau of Mines, 1978, Mineral commodity summaries 1978, January 1978.

_____, 1977a, Gold and silver: Mineral Industry Surveys (Annual Preliminary), December 21, 1977, 2 p.

_____1977b, Lead: Mineral Industry Surveys (Annual Preliminary), December 20, 1977, 2 p.

_____1977c, Tungsten: Mineral Industry Surveys (Annual Preliminary), December 27, 1977, 2 p.

_____1977d, Zinc: Mineral Industry Surveys (Annual Preliminary), December 20, 1977, 2 p.

U.S. Geological Survey, 1952, Topographic map, Cactus Springs, Nevada, scale 1:62,500, 15-minute quadrangle series.

U.S. Geological Survey and Nevada Bureau of Mines, 1964, Mineral and water resources of Nevada: U.S. Cong., 88th, 2d Sess., Senate Doc. 87, 314 p. (Nevada Bur. Mines Bull. 65).

Wedow, H., Jr., Kiilsgaard, T. H., Heyl, A. V., and Hall, R. B., 1973, Zinc, in United States mineral resources: U.S. Geol. Survey Prof. Paper 820, p. 697-711.

West, J. M., 1975, Gold, in Mineral facts and problems: U.S. Bur. Mines 667, p. 437-453.

_____1977, Gold: Preprint from the 1975 U.S. Bur. Mines Minerals Yearbook, 28 p.

UNPUBLISHED BUREAU OF MINES DOCUMENTS

Benson, W. T., 1945a, Summary report of war minerals examination: Groom mine district, Lincoln County, Nevada (with supplements): Bureau Mines War Minerals Exam., WFOC Mineral Property File No. 37.52 (Nevada), January 31, 1945, and September 1945.

_____1945b, Summary report of war mineral examination: Jackson mine, Lincoln County, Nevada: Bur. Mines War Mineral Exam., WFOC Mineral Property File No. 37.44 (Nevada), April 26, 1945.

_____1945c, Summary report of war minerals examination: Don-Dale mine, Lincoln County, Nevada: Bur. Mines War Minerals Exam., WFOC Minerals Property File No. 37.92 (Nevada), April 27, 1945.

_____1947a, Preliminary examination report: The Hammel gold-silver prospect, Nye County, Nevada: Bur. Mines WFOC Minerals Property File No. 30.27 (Nevada), June 1947.

_____1947b, Preliminary examination report: Clifford gold-silver prospect, Nye County, Nevada: WFOC Minerals Property File No. 30.43 (Nevada), January 27, 1947.

_____1954, Memorandum report of examination: Oak Spring tungsten, Nye County, Nevada: WFOC Minerals Property File No. 7472 (Nevada), June 28, 1954.

Geehan, R. W., 1945, Summary report of war minerals examination: Black Top and Red Group, Nye County, Nevada: Bur. Mines War Minerals Exam., WFOC Minerals Property File No. 25.17 (Nevada), May 5, 1945.

Gentry, G. G., and Stager, H. K., 1957, Application report: Mullen Buckley Uranium Corporation (Andies mine), Lincoln County, Nevada: Bur. Mines and U.S. Geol. Survey DMEA File No. 4660 (mercury), WFOC Minerals Property File No. 42.4 (Nevada), May 13, 1957.

_____1958, Final Report: Climax Tungsten Company (Climax mine), Nye County, Nevada: Bur. Mines and U.S. Geol. Survey DMEA File No. 4301, Contract Idm E1028 (Tungsten), WFOC Minerals Property File No. 74.16 (Nevada), August 28, 1958.

Holmes, G. H., Jr., 1959, Preliminary examination report: Black Hawk Mercury mine, Nye County, Nevada: WFOC Minerals Property File No. 42.6 (Nevada), January 27, 1959, 5 p.

Holmes, G. H., Jr., Irwin, W. P., and Hall, Wayne, 1953, Report of examination by Field Team, Region III, Lead King mine, Clark County, Nevada: Bur. Mines and U.S. Geol. Survey DMEA File No. 2836, WFOC Minerals Property File No. 37.47 (Nevada), February 26, 1953.

Trengove, R. R., 1945, Dutton gypsum deposits, Clark County, Nevada: WFOC Minerals Property File No. 32.1 (Nevada), August 1945.

U.S. Bureau of Mines, Golden Star mine, Lincoln County, Nevada: WFOC Minerals Property File No. 37.98 (Nevada).

_____, White Caps mine, Clark County, Nevada: WFOC Minerals Property File No. 37.56 (Nevada).

APPENDIX A--MINERAL PROPERTY DATA FOR MINES AND PROSPECTS IN THE VICINITY OF THE NELLIS AIR FORCE BASE AND THE NELLIS BOMBING AND GUNNERY RANGE, CLARK, LINCOLN, AND NYE COUNTIES, NEVADA

This report describes about 80 mines and prospects (Appendix A) in and adjacent to the Nellis Air Force Base and the Nellis Bombing and Gunnery Range. These properties represent only those deposits that have been reported in geologic literature. They do not include all claims in the study area. The U.S. Army Corps of Engineers, for example, reports that at least 316 individual claims in 105 groups were at one time inside the NBGR (U.S. Army Corps of Engineers). Inasmuch as the Range's boundaries have been modified several times since 1940, it is not known how many claims are inside the current boundaries. In addition, several mining districts adjacent to the Range have prospects which have been only casually mentioned in the literature and thus not included in this report.

The mineral property narratives in Appendix A are arranged alphabetically by mining district. They provide data for each deposit concerning its approximate location[1] and mining district, as well as a synopsis of its

[1] The locations must be considered approximate because much of the study area is unsurveyed and because many locations in the literature refer to reference points no longer identifiable.

geologic setting and mining history.

Map numbers correspond to the mining district location given on figure 2. The MILS sequence number is the property's identification number in the Bureau of Mines Mineral Industry Location System computer file.

Map No. 1

Mining District: Antelope Springs

Mine Name: Antelope View

MILS Sequence No.: 3202300234

Location: Sec. 9, T. 4 S., R. 47 E.

County: Nye

Commodity: Gold, silver

Production: Kral (1951) stated that about $80,000 is purported to have been produced; the U.S.B.M. has no record of production.

Geology: The ore occurs in narrow quartz veins in rhyolite. Several veins extend 2,000 feet or more. Vein anastomosing seems common. At 85-foot depth, the main vein is about 3 feet wide.

Development: The principal working is a 240-foot inclined shaft with 240 feet of laterals on the 60-foot level.

Periods of Activity: The property was located in 1906-1907. Mine development apparently occurred shortly after location.

References: (Cornwall, 1972, p. 35; Kral, 1951, p. 12; Ekren and others, 1971, p. 78-79; Schrader, 1913, p. 87-98).

Map No. 1--Continued

Mining District: Antelope Springs

Mine Name: Gold Bug group

MILS Sequence No.: 3202300235

Location: Sec. 18, T. 4 S., R. 47 E.

County: Nye

Commodity: Gold

Production: None reported

Geology: The narrow quartz veins are reported to be in rhyolite.

Development: The property was developed by three shafts and several pits and trenches.

Periods of Activity: Unknown

References: (Kral, 1951, p. 12)

Mining District: Antelope Springs

Mine Name: Jay group

MILS Sequence No.: 3202300236

Location: Sec. 18, T. 4 S., R. 47 E.

County: Nye

Commodity: Silver

Production: None reported

Geology: Silver ore occurs in narrow quartz veins in rhyolite.

Development: The deposit has been explored by a 100-foot shaft and several smaller ones. The total workings amount to about 600 feet.

Periods of Activity: Unknown

References: (Kral, 1951, p. 12-13)

Map No. 2

Mining District: Arrowhead(?)

Mine Name: Arrowhead (Southeastern) mine

MILS Sequence No.: 3201700231

Location: Sec. 33, T. 9 S., R. 57 E.

County: Lincoln

Commodity: Copper, lead, silver

Production: None reported

Geology: The mine is in a silicified fault zone near the top of the Pogonip group, and copper-lead-silver(?) minerals crop out along this zone for 100 feet.

Development: A shaft, inclined 60°, follows the mineralized zone to a depth of at least 60 feet.

Periods of Activity: The Arrowhead is an old mine, but its history and dates of operation are not known.

References: (Tschanz and Pampeyan, 1970, p. 176-178; Plate No. 1)

Map No. 3

Mining District: Cactus Springs

Mine Name: Adolph Neher Adit

MILS Sequence No.: 3202300277

Location: Sec. 35, T. 2 S., R. 46 E.

County: Nye

Commodity: Unknown

Production: None reported

Geology: Unknown

Development: The workings consist of an adit over 1,000 feet long. Reportedly, little ore is indicated either inside or on the dump.

Map No. 3--Continued

Period of Activity: Kral (1951) stated that the adit was driven prior to World War II.

References: (Kral, 1951, p. 42)

Map No. 3--Continued

Mining District: Cactus Springs

Mine Name: Cactus Nevada Silver mine (Silver Sulphide group)

MILS Sequence No.: 3202300230

Location: Sec. 3, T. 3 S., R. 46 E.

County: Nye

Commodity: Silver

Production: The mine is reported to have produced a small amount of ore about 1920, but there is no record in U.S.B.M. files.

Geology: Ore occurs in numerous quartz veins and stringers in rhyolite. Silver is the principal mineral value. Small amounts of gold occurs in some ore.

Development: A 265-foot vertical shaft and about 800 feet of drifts and other workings.

Periods of Activity: Kral (1951) reported the property was operated by the Cactus Silver Mining Co. in the early 1920's.

References: (Cornwall, 1972, p. 37; Kral, 1951, p. 41)

Map No. 3--Continued

Mining District: Cactus Springs

Mine Name: Cactus Range

MILS Sequence No.: 3202300657

Location: Sec. 6, T. 3 S., R. 46 E.

County: Nye

Commodity: Gemstones (Turquoise)

Production: Morrissey (1968) stated that previous production has amounted to about $25,000.

Geology: Turquoise occurs as nodules and veinlets in altered quartz monzonite.

Development: Unknown

Periods of Activity: Unknown

References: (Morrissey, 1968, p. 28)

Mining District: Cactus Springs

Mine Name: Urania mine

MILS Sequence No.: 3202300633

Location: Sec. 10, T. 3 S., R. 46 E.

County: Nye

Commodity: Gold, silver

Production: None reported

Geology: Unknown, probably similar to the Cactus Nevada Silver mine.

Development: Workings include several adits, trenches, and pits.

Periods of Activity: Unknown

References: (U.S. Geol. Survey, 1952)

Map No. 4:

Mining District: Dike(?)

Mine Name: Apex Limestone Quarry (U.S. Lime Products Division of the Flintkote Co.)

MILS Sequence No.: 3200300061

Location: NW¼ sec. 26, T. 18 S., R. 63 E.

County: Clark

Commodity: Limestone

Production: The Nevada Bureau of Mines and Geology reported that production from the quarry averages over 500,000 tons annually. This generally agrees with U.S.B.M. records for 1971-1975.

Geology: The quarry lies in a group of low hills composed of limestone and dolomite of Devonian and Mississippian Age. Production comes from upper member of the Sultan Limestone (Devonian). The limestone contains less than 2 percent combined SiO_2, Fe_2O_3, and $MgCO_3$.

Development: The operation includes a crushing and calcining plant in addition to the quarry.

Periods of Activity: The property is currently active.

References: (Longwell and others, 1965, p. 205; Hewett and others, 1936, p. 164; MINOBRAS, 1973, p. 10; Nevada Indust. Comm., 1977, p. 5; Nevada Indust. Comm., 1976, p. 4)

Map No. 4--Continued

Mining District: Dike

Mine Name: Lead King mine

MILS Sequence No.: 32000300065

Location: SE¼ sec. 6, T. 19 S., R. 63 E.

County: Clark

Commodity: Lead

Production: Two carloads of ore averaging 59 percent lead have been reportedly shipped. There is no record of production in U.S.B.M. files.

Geology: Ore consists of galena and cerussite in a 1- to 4-foot-wide shear zone in carboniferous limestone. The shear zone is cut off at the bottom of the shaft by a nearly horizontal bedding plane [thrust(?)] fault.

Development: The workings consist of a 242-foot shaft with laterals at the 26-, 135-, and 242-foot levels.

Periods of Activity: The claims were originally located about 1916 and worked intermittently. Most mine workings were opened in the late 1920's and early 1930's.

References: (Longwell and others, 1965, p. 144, 180; Holmes and others, 1953).

Map No. 5:

Mining District: Don Dale

Mine Name: Andies mine

MILS Sequence No.: 3201700063

Location: Sec. 36, T. 4 S., R. 55 E.

County: Lincoln

Commodity: Mercury

Production: Two flasks were produced in 1955.

Geology: Rocks exposed near the claims are chiefly Tertiary andesite and rhyolite flows underlain by limestone. Ore consists of disseminated crystals of cinnabar localized in fractured and altered volcanic rocks.

Development: The workings include a 31-foot vertical shaft, 140-foot inclined adit, over 5,200 feet of drill holes, and numerous pits and trenches.

Periods of Activity: Mercury was discovered in 1919 and the claims were located in 1955; exploration and development work was done in 1955 and 1956.

References: (Tschanz and Pampeyan, 1970, plate 1; Gentry and Stager, 1957).

Map No. 5--Continued

Mining District: Don-Dale

Mine Name: Don-Dale mine

MILS Sequence No.: 3201700217

Location: Sec. 12, T. 5 S., R. 55 E.

County: Lincoln

Commodity: Lead, silver, copper, zinc

Production: None reported

Geology: Ore occurs in fissure and replacement deposits in lime-shale along a major fault zone. It is highly siliceous and is comprised largely of oxides with occasional small flecks of galena.

Development: The workings include a 90-foot adit with a 45-foot winze, a 40-foot shaft, and a 25-foot opencut.

Periods of Activity: The property was explored during and after World War II.

References: (Tschanz and Pampeyan, 1970, p. 174, plate 1; Benson, 1945c).

Map No. 5--Continued

Mining District: Don-Dale

Mine Name: Jackson mine (Sun Rise No. 4)

MILS Sequence No.: 3201700050

Location: Sec. 24, T. 5 S., R. 55 E.

County: Lincoln

Commodity: Lead, silver, zinc, copper

Production: About 10 tons of $50 ore were shipped in 1942.

Geology: Ore occurs in a small fissure along fractures between lime-shale and quartzite.

Development: The workings include three small shafts and several small surface cuts.

Periods of Activity: The property was explored prior to and during World War II.

References: Benson (1945b).

Map No. 6

Mining District: Eden (Eden Creek, Gold Belt)

Mine Name: Golden Crown group (Eden mine)

MILS Sequence No.: 3202300294

Location: Sec. 5, T. 1 N., R. 50 E.

County: Nye

Commodity: Silver

Production: None reported

Geology: The country rock is rhyolite which has been intruded by porphyritic andesite. Dump material consists of rock with quartz seams containing pyrite.

Development: The workings consist of a 1,700-foot and a 500-foot adit.

Periods of Activity: The deposit was discovered in 1906; most of the work was done in 1923 and 1924. There has been little activity since.

References: Cornwall (1972, p. 37); Kral (1951, p. 54).

Map No. 6--Continued

Mining District: Eden (Eden Creek, Gold Belt)

Mine Name: Nevada Triumph group

MILS Sequence No.: 3202300291

Location: Sec. 6, T. 1 N., R. 50 E.

County: Nye

Commodity: Gold, silver

Production: None reported

Geology: Gold occurs in iron-stained silicified shear zone in rhyolite. Values vary considerably but are usually low. Kral (1951) states the property may have potential for the development of a large low-grade deposits.

Development: The workings include several shallow shafts and cuts and trenches, in addition to two adits with about 300 feet of laterals.

Periods of Activity: The claims were located in 1926 and were actively explored into the early 1930's.

References: Cornwall (1972, p. 37); Kral (1951, p. 53).

Mining District: Eden (Eden Creek, Gold Belt)

Mine Name: Ore Cache Mining and Milling Company

MILS Sequence No.: 3202300293

Location: Sec. 3, T. 1 N., R. 49 E.

County: Nye

Commodity: Gold

Production: None reported

Geology: Free milling gold is reported to occur in vein and shear zones in rhyolite. Assays are reported to range between $2 and $250 per ton with a large percentage between $10 and $70 [$20.67(?) per ounce Au].

Development: The workings include a shallow shaft (50 feet) with drifts on two levels plus a 218-foot adit with drifts.

Periods of Activity: The claims were explored between 1929 and 1934.

References: Cornwall (1972, p. 37); Kral (1951, p. 54).

Mining District: Eden (Eden Creek, Gold Belt)

Mine Name: South Gold Mining Company

MILS Sequence No.: 3202300292

Location: Sec. 20, T. 1 N. R. 50 E.

County: Nye

Commodity: Silver

Production: About $5,000, part from placers, has been reported. U.S.B.M. records indicate that 17 ounces gold and 66 ounces silver were mined from underground working between 1935 and 1942.

Geology: Gold occurs, with little or no silver, in veins and shear zones in rhyolite. Overburden is reported to carry gold values. Assays ranged between $3 and $5 per ton ($35 per ounce gold).

Development: Workings include a 1,000-foot adit caved at the portal, a 500-foot adit, and a 300-foot adit. A 35-ton-per-day mill was built about 1938.

Periods of Activity: The property was worked between 1930 and World War II.

References: Cornwall (1972, p. 37); Kral (1951, p. 53-54).

Map No. 7:

Mining District: Fluorine (Beatty, Bare Mountain, Carrara, Big Dunes, Lee Telluride)

Mine Name: Black Top and Red group (Red Placer claim)

MILS Sequence No.: 3202300175

Location: N½ sec. 2, R. 10 S., T. 47 E.

County: Nye

Commodity: Fluorspar

Production: None reported

Geology: A mineralized felsite flow reportedly contains a few percent of fluorite.

Development: The workings include several pits and (10- to 15-foot) adits.

Period of Activity: The claims were staked in 1940; the area was probably prospected for gold-silver at an earlier date.

Reference: Geehan (1945).

Mining District: Fluorine (Beatty, Bare Mountain, Carrara, Big Dunes, Lee, Telluride)

Mine Name: Paramount Placer Property

MILS Sequence No.: 3202300311

Location: Sec. 9, T. 11 S., R. 49 E.

County: Nye

Commodity: Gold (?)

Production: No appreciable production; no record in U.S.B.M. files.

Geology: Partly cemented gravels

Development: There has been some drifting on higher grade material.

Periods of Activity: Unknown

References: Kral (1951, p. 68).

Map No. 8

Mining District: Frenchman Mountain(?)

Mine Name: Las Vegas Pit and Apex Plant--Pabco Corp. [Schumaker (Apex) Gypsum mine]

MILS Sequence No.: 3200300066 and 3200300067

Location: Sec. 5, T. 20 S., R. 64 E.

County: Clark

Commodity: Gypsum

Production: The Nevada Bureau of Mines estimates the production at over 100,000 tons annually.

Geology: The ore occurs as a gypsum-silt-clay caprock deposit of Pliocene or younger age. The deposit is immense, with reserves in the hundreds of millions of tons.

Development: The property's facilities include the quarry, washing plant, and gypsum wallboard plant.

Period of Activity: The washing plant was built in 1959 and the wallboard plant in 1964. Pabso Corporation took over operation of the properties in February 1977.

References: Longwell and others (1965, p. 154, 204; Olson (1965, p. 26); MINOBRAS (1973, p. 10); Nevada Indust. Comm., 1976, 1977).

Mining District: Frenchman Mountain

Mine Name: Dasida, Stevens, Sproul, Bracken group

MILS Sequence No.: 3200300312

Location: Sec. 21, T. 20 S., R. 63 E.

County: Clark

Commodity: Gypsum

Production: None reported

Geology: Massive gypsum occurs in beds up to 300 feet thick, with a limestone footwall and hanging wall. The gypsum and limestone may be in either the Kaibab or Moenkopi Formations.

Development: Unknown.

Periods of Activity: The deposits have been recognized for many years, but it is not known when they were discovered. The U.S. Bureau of Mines examined the properties in 1945.

References: Trengove (1945).

Mining District: Frenchman Mountain(?)

Mine Name: Gypsum Cave

MILS Sequence No.: 3200300067

Location: Sec. 11, T. 20 S., R. 63 E.

County: Clark

Commodity: Gypsum

Production: None reported

Geology: Gypsum occurs as lenses in the Muddy Creek Formation (Tertiary).

Development: Unknown

Periods of Activity: Unknown

References: Longwell and others (1965, p. 204); MINOBRAS (1973, p. 10).

Mining District: Frenchman Mountain(?)

Mine Name: Sunrise Mountain

MILS Sequence No.: 3200300424

Location: W½ sec. 1, T. 20 S., R. 62 E.

County: Clark

Commodity: Gypsum

Production: None reported

Geology: Gypsum is expoded in rock outcrops.

Development: Unknown

Periods of Activity: Unknown

References: MINOBRAS (1973, p. 9).

Mining District: Frenchman Mountain(?)

Mine Name: White Eagle

MILS Sequence No.: 3200300070

Location: Secs. 8 and 17, T. 21 S., R. 63 E.

County: Clark

Commodity: Gypsum

Production: The Nevada Bureau of Mines estimated that the production was 100,000 tons annually prior to 1960.

Geology: Gypsum occurs in 15-foot-thick beds in the Moenkopi Formation.

Development: Open-pit mine

Periods of Activity: The mining began around 1938 and continued to 1956.

References: Longwell and others (1965, p. 204).

Mining District: Frenchman Mountain(?)

Mine Name: Unnamed gypsum deposit

MILS Sequence No.: 3200300357

Location: Sec. 14, T. 20 S., R. 62 E.

County: Clark

Commodity: Gypsum

Production: None reported

Geology: Gypsic material is reported to be 100 to 125 feet thick and cropping out for nearly a mile.

Development: Unknown

Periods of Activity: Unknown

References: Longwell and others (1965, p. 204).

Mining District: Frenchman Mountain(?)

Mine Name: Unnamed gypsum deposit

MILS Sequence No.: 3200300358

Location: E½E½ sec. 1, T. 20 S., R. 62 E.

County: Clark

Commodity: Gypsum

Production: None reported

Geology: Several hundred acres are underlain by up to 15-foot-thick beds of gypsite.

Development: Unknown

Periods of Activity: Unknown

References: Longwell and others (1965, p. 204).

Map No. 9

Mining District: Gass Peak

Mine Name: June Bug mine

MILS Sequence No.: 3200300063

Location: SE¼ sec. 20, T. 18 S., R. 61 E.

County: Clark

Commodity: Zinc, silver, lead, gold

Production: Longwell (1965) reports that 1,000 tons were shipped from the district in 1916 and 1917. Most ore was from the June Bug property. The shipment yielded 9.25 ounces gold, 2,418 ounces silver, 16,707 pounds lead, and 620,650 pounds zinc. U.S.B.M. production records generally agree with these figures.

Geology: Oxidized zinc ore is found as replacements along shear zones in dolomitized Paleozoic limestone.

Development: Unknown

Periods of Activity: The property was operated in 1916 and 1917.

References: Longwell and others (1965, p. 145, 182); Hewett and others (1936, p. 55).

Mining District: Gass Peak

Mine Name: Marble Quarry

MILS Sequence No.: 3200300064

Location: SW¼ sec. 24, T. 18 S., R. 61 E.

County: Clark

Commodity: Building stone(?)

Production: None reported

Geology: Very fine grained marble in limestone of Carboniferous Age.

Development: Unknown

Periods of Activity: Unknown

References: Longwell and others (1965, p. 205).

Mining District: Gass Peak

Mine Name: Sampson claims

MILS Sequence No.: 3200300062

Location: NW¼ sec. 24, T. 18 S., R. 61 E.

County: Clark

Commodity: Zinc, copper, gold, silver

Production: None reported

Geology: Hydrozincite and calamine occur along fractures in brecciated zones in dolomitized Monte Cristo Limestone. Malachite, chrysocolla, gold, and silver are also present. In addition, a select sample contained 0.068 percent U_3O_8.

Development: Principal workings include a 15-foot vertical shaft and a 75-foot inclined shaft having several drifts and winzes.

Periods of Activity: Unknown

References: Carside (1973, p. 36); Longwell and others (1965, p. 145, 182).

Map No. 10

Mining District: Gold Crater

Mine Name: Pius Kaelin group

MILS Sequence No.: 3202300312

Location: Sec. 34, T. 4 S., R. 45 E.

County: Nye

Commodity: Lead, gold, silver

Production: Small, unknown amount; no record in U.S.B.M. files.

Geology: Galena and cerussite occur in brecciated, pipelike zones. Mining ore reportedly contained 10 percent lead, 14 to 24 ounces silver and $8 to $12 gold ($35/ton) per ton. Possibly mineralized altered rocks extend beneath the Thirsty Canyon Tuff adjacent to the mining area (Ekren and others, 1971).

Development: The workings reportedly consist of a 20-foot inclined shaft and a 30-foot shaft with minor laterals.

Periods of Activity: Apparently the property was operated after World War II.

Other: Mine run ore was apparently shipped to a small two-stamp and gravity mill at Stonewall Spring, 24 miles by road, west of the mine.

References: Kral (1951, p. 69-70); Ekren and others (1971, p. 79).

Map No. 11

Mining District: Golden Arrow (Blakes Camp)

Mine Name: Clifford gold-silver prospect (Jeep group)

MILS Sequence No.: 3202300172

Location: Sec. 12, T. 1 N., R. 48 E(?)

County: Nye

Commodity: Silver, gold

Production: Kral (1951) estimated that about 200 tons of ore valued between $18 and $70 per ton were shipped prior to 1951.

Geology: The Clifford vein is in a 3- to 4-foot-wide, crushed fault zone in silicified rhyolite. The ore occurs in quartz stringers and extends 12 to 18 inches into the silicified footwall. The ore mineral is primarily cerargyrite, but disseminated flecks of argentite and finely divided native gold are also found.

Two parallel veins have been exposed within 300 feet of the main vein; a cross vein is about 600 feet west of the 1947 workings.

Development: Early workings (about 1920) include several shallow trenches and cuts, plus a 60-foot shaft. Later workings (1947) consisted of three inclined shafts varying in depth from 10 to 15 feet. Kral (1951) reported that one shaft had been sunk to a 100-foot depth.

Periods of Activity: The claims were originally located in 1920 and abandoned a short time later. They were relocated in late 1946. The property was active in the early 1950's.

Other: Benson (1947b) described the deposit as ". . .probably the most important discovery made in recent years in Nevada."

References: Cornwall (1972, p. 37); Kral (1951, p. 72); Benson (1947b).

Mining District: Golden Arrow (Blakes Camp)

Mine Name: Gold Bar group

MILS Sequence No.: 3202300313

Location: Sec. 2, T. 1 N., R. 48 E.

County: Nye

Commodity: Silver, gold

Production: Ferguson (1917) reported almost no production prior to 1915. Kral (1951) states the Gold Bar produced 73 tons valued at $4,246 in 1941 and 1946. Production during the early 1940's may have been included with the Golden Arrow.

Geology: The vein consists of a series of closely spaced, parallel veinlets with pyrite, and in some places, small amounts of finely divided gold with the composition of electrum. Ferguson (1917) reported that the ore averaged about $25 a ton ($20.67 per ounce gold) and could be upgraded by hand sorting to about $100 per ton.

Development: In 1916, the property was developed by a 500-foot inclined shaft that was accessible for 140 feet.

Periods of Activity: Most workings were probably completed prior to 1915. Kral (1951) states that both the Gold Bar and Golden Arrow were operated by lessees in the early 1940's.

References: Cornwall (1972, p. 37); Kral (1951, p. 71-72); Ferguson (1917, p. 120).

Mining District: Golden Arrow (Blakes Camp)

Mine Name: Golden Arrow (Page) group

MILS Sequence No.: 3202300314

Location: Sec. 11, T. 1 N., R. 48 E.

County: Nye

Commodity: Silver, gold

Production: Ferguson (1917) reported almost no production prior to 1915; U.S.B.M. production records indicate an output of 744 tons of ore, yielding 193 ounces gold and 12,139 ounces silver in 1940 and 1941.

Geology: The shaft of the Golden Arrow mine appears to follow the Page fault. Both andesite and rhyolite are found on the mine dump, but the ore seems to lie in the rhyolite only. The ore consists of small quartz-filled fissures carrying specks of sulfides. The wallrock is silicified but not sericitized.

Development: The workings consists of a shaft of unknown depth.

Periods of Activity: Most work done on the mine was completed prior to 1915. Kral (1951) states that lessees shipped ore from the Golden Arrow and Gold Bar groups in the early 1940's.

References: Cornwall (1972, p. 37); Kral (1951, p. 71-72); Ferguson (1917, p. 119-120).

Map No. 12

Mining District: Goldfield (Quartz Mountain)

Mine Name: Free Gold and Extension group

MILS Sequence No.: 3202300315

Location: Sec. 1, T. 3 S., R. 44 E.

County: Nye

Commodity: Gold

Production: Kral (1951) reported only minor shipments from property. No production records in U.S.B.M. files.

Geology: Gold occurs in highly oxidized shear zones in dacite. Samples reportedly contained up to one-half ounce gold per ton.

Development: Principal workings consist of an adit with about 1,800 feet of workings and several smaller adits and shafts totalling 500 feet.

Periods of Activity: Unknown

References: Kral (1951, p. 72-73).

Map No. 13

Mining District: Groom

Mine Name: Black Metal (Lane, Black Medal)

MILS Sequence No.: 3201700225

Location: Sec. 14, T. 7 S., R. 55 E.

County: Lincoln

Commodity: Lead, zinc

Production: None has been recorded, but some ore has undoubtedly been mined.

Geology: Most of the Black Metal claim is covered by alluvium; however, the inclined shaft is in a dark-gray limestone, similar to the limestone found at the Groom mine. The ore carries much more zinc than is found in the Groom mine; however, its distribution is erratic: above the 110-foot level a sample from a stope assayed 6.3 percent zinc, while a sample from a shallow winze a short distance away assayed 22.2 percent zinc.

Development: The prospect has been developed by a 110-foot inclined shaft with a short drift on the 100-foot level. There has been some stoping above the drift and north of the shaft.

Period of Activity: The Lane claims were originally located in 1917.

References: Humphrey (1945, p. 45); Tschanz and Pampeyan (1970, p. 149, Plate 1).

Mining District: Groom(?)

Mine Name: Golden Star mine

MILS Sequence No.: 3201700002

Location: Sec. 11, T. 6 S., R. 55 E.

County: Lincoln

Commodity: Lead, silver, gold(?)

Production: None reported

Geology: Unknown

Development: As of 1942, the property was developed by numerous cuts and trenches and a 300-foot-long crosscut.

Periods of Activity: Original claims were located in 1907. The claims were relocated in 1931 and 1934.

References: U.S. Bureau of Mines Property File No. 37.98.

Mining District: Groom

Mine Name: Groom

MILS Sequence No.: 3201700224

Location: Sec. 14, T. 7 S., R. 55 E.

County: Lincoln

Commodity: Lead, silver, copper, zinc

Production: U.S.B.M. production records show that except for 7 years, the Groom mine produced continuously from 1915 to 1956. The value of ore in 1977 prices exceeds $3.75 million.

Geology: The mine is in a 2,000-foot-wide, complexly faulted grabben. Productive ore bodies are bedded and irregular replacement bodies in limestone. The primary ore mineral is argentiferous galena with subordinate sphalerite; the small amount of copper occurs as chalcopyrite or tetrahedrite. A little pyrite is present, but the amount of gold is nil.

Development: The Groom mine is developed by a 210-foot shaft, two adits, and extensive underground workings.

Periods of Activity: The claims were located in 1864. In 1872, an unsuccessful attempt was made to develop the property. The mine remained essentially idle until 1915 when lessees began production. Except for 7 years, the mine operated continuously until 1956.

References: Humphrey (1945, p. 35-45); Tschanz and Pampeyan (1970, p. 148, Plate 1); Benson (1945a).

Mining District: Groom

Mine Name: Hanus

MILS Sequence No.: 3201700221

Location: Sec. 33, T. 6 S., R. 55 E.

County: Lincoln

Commodity: Gold

Production: None reported

Geology: The prospect is in a west-dipping gold-bearing quartzite breccia zone. A sample of dump material assayed 1.08 ounces gold per ton.

Development: The workings consist of a 60-foot inclined shaft in the fracture zone.

Periods of Activity: Prior to 1945

References: Humphrey (1945, p. 47); Tschanz and Pampeyan (1970, Plate 1).

Mining District: Groom(?)

Mine Name: Unnamed limestone

MILS Sequence No.: 3201700098

Location: Sec. 10, T. 7 S., R. 55 E.

County: Lincoln

Commodity: Limestone (Dimension stone)

Production: Small but unknown amount quarried local ornamental building and aquarium stone.

Geology: Platy Upper Cambrian limestone

Development: Unknown

Periods of Activity: Unknown

References: Tschanz and Pampeyan (1970, p. 125).

Map No. 14

Mining District: Kawich (Gold Reed, Queen City)

Mine Name: Black Hawk Mercury mine

MILS Sequence No.: 3202300125

Location: Sec. 13, T. 2 S., R. 53 E.

County: Nye

Commodity: Mercury

Production: In 1951, Kral (1951) reported that 68 flasks of mercury have been produced since 1929.

Geology: The deposit is in a silty limestone in fault contact with a quartzite sandstone. The ore occurs as cinnabar in botryoidal masses with associated quartz veins.

Development: The workings consist of a 100-foot vertical shaft adit on two levels and two exploration pits (Cornwall, 1972).

Periods of Activity: The property was discovered in 1929. There has been no activity since the early 1940's.

References: Cornwall (1972, p. 39); Kral (1951, p. 92); Holmes (1959).

Mining District: Kawich (Gold Reed, Queen City)

Mine Name: Gold Reed mine

MILS Sequence No.: 3202300342

Location: Sec. 33, T. 4 S., R. 51 E.

County: Nye

Commodity: Gold

Production: Kral (1951) reported that a shipment of high-grade ore was made; U.S.B.M. records indicate that 13 tons of ore yielding 2 ounces gold and 2 ounces silver were mined in 1941.

Geology: Ore containing free gold occurs in a silicified monzonite porphyry. Most of the better grade ore came from near the surface; pyrite was encountered at about 150 feet in deeper workings.

Development: The main working is a 300-foot shaft; shallow workings are found south of the shaft.

Periods of Activity: Apparently the mine was active prior to World War II and may also have been between the war and 1950.

References: Kral (1951, p. 92)

Mining District: Kawich (Gold Reed, Queen City)

Mine Name: Mercury group

MILS Sequence No.: 3202300344

Location: Sec. 27, T. 2 S., R. 53 E.

County: Nye

Commodity: Mercury

Production: None reported

Geology: Cinnabar occurs as nuggets and as a coating of limestone and quartzite gravel in crevices in a limestone cave.

Development: Unknown

Periods of Activity: Unknown

References: Kral (1951, p. 92).

Mining District: Kawich (Gold Reed, Queen City)

Mine Name: Oswald claims

MILS Sequence No.: 3202300343

Location: Sec. 11, T. 4 S., R. 52 E.

County: Nye

Commodity: Mercury

Production: Kral (1951) reported 14 pounds of mercury was recovered from 1,400 pounds of cinnabar ore during a test run. No record of the property is found in U.S.B.M. files.

Geology: Occurrences of argentiferous galena, smithsonite, and cinnabar are found in narrow veins and lenses in quartzite intruded by andesite dikes.

Development: Workings consist of a 200-foot adit, several shallow shafts, and some trenching.

Periods of Activity: The property was located in 1938.

References: Kral (1951, p. 92).

Mining District: Kawich (Gold Reed, Queen City)

Mine Name: Queen City claims

MILS Sequence No.: 3202300233

Location: Sec. 16. T. 2 S., R. 53 E.

County: Nye

Commodity: Manganese

Production: None reported

Geology: Several veins, up to 100 feet long and 40 feet wide, of gibbsite and manganese occur as replacements in hydrothermally altered limestone. The manganese minerals are mixtures of pyrolusite and lithiophorite.

Development: The deposit has been explored by several trenches and pits.

Period of Activity: The claims were located in 1935; it is not known when the property was last active.

Reference: Cornwall (1972, p. 40).

Mining District: Kavich (Gold Reed, Queen City)

Mine Name: Unnamed mercury deposit

MILS Sequence No.: 3202300676

Location: Sec. 19, T. 2 S., R. 54 E.

County: Nye

Commodity: Mercury

Production: None reported

Geology: Cinnabar occurs in shears in highly altered andesite.

Development: The workings include a 45-foot shaft with 160 feet of drifting on the 22-foot and bottom levels, plus a few large surface cuts and trenches.

Period of Activity: Unknown

Other: This deposit was described by Kral (1951, p. 92) as the Black Hawk mercury mine, but Cornwall (1972, p. 39) states that the Black Hawk is about 2 miles northwest of this property.

References: Cornwall (1972, p. 39); Kral (1951, p. 92).

Map No. 15

Mining District: Mellan Mountain

Mine Name: Mellan Gold mines group

MILS Sequence No.: 3202300399

Location: Sec. 3, T. 3 S., R. 48 E.

County: Nye

Commodity: Gold

Production: Kral (1951) estimated production at about $1,000 prior to World War II. U.S.B.M. records indicate that 33 tons of ore yielding 11 ounces gold and 50 ounces silver were mined in 1936 and 1937.

Geology: The gold-silver ore occurs in shear zones in rhyolite and shale. Ore zones are reported to be 4 to 6 feet wide. Four samples, containing primarily gold values, ranged between $17 and $27 per ton.

Development: The workings include a 400-foot inclined shaft with levels at 40, 80, 160, and 400 feet with laterals totalling about 700 feet; a 100-foot shaft with a 40-foot drift on the 50-foot level; 600 feet of workings on the 100-foot level; and a 100-foot adit.

Periods of Activity: The property was located in 1930 and was operated prior to World War II.

References: Cornwall (1972, p. 38-39); Kral (1951, p. 131-132).

Map No. 16

Mining District: Mine Mountain

Mine Name: Mine Mountain

MILS Saquence No.: 3202300232

Location: T. 11 S., R. 52 E.

County: Nye

Commodity: Lead, mercury, silver

Production: None reported

Geology: All workings are in high-angle, normal faults, in brecciated quartzite and silicified dolomite. According to Cornwall (1972, p. 39), one sample contains 10 percent lead, 0.5 percent mercury, and 0.07 percent silver.

Development: Workings include four adits and two shallow shafts.

Periods of Activity: Claim notices indicate that the property was located in 1928.

References: Cornwall (1972, p. 39).

Map No. 17

Mining District: Oak Spring

Mine Name: Climax (Tamney)

MILS Sequence No.: 3202300009

Location: S½ sec. 18, T. 8 S., R. 53 E.

County: Nye

Commodity: Tungsten

Production: Some ore was reportedly shipped in 1917.

Geology: Ore occurs in several parallel tactite beds interbedded with marbleized limestone. It is concentrated in layers mostly

along the hanging walls. The ore mineral is scheelite in a gangue of dark brown to black garnet, calcite, epidote, feldspar, and quartz.

Development: The property is developed by 882 feet of drifts in the Goldfield adit and 625 feet of drifts, 91 feet of raises, and 69 feet of stopes in the Carlisle adit. The two adits are not connected.

Other: As of September 1958, total indicated and inferred resources were 42,750 tons averaging 0.675 percent WO_3.

Periods of Activity: Initial mining activity began in 1905 when gold, silver, copper, and turquoise were discovered. Tungsten was discovered in 1937; Defense Minerals Exploration Administration (DMEA) exploration of the project occurred from 1956 to 1957.

References: Cornwall (1972, p. 39); Kral (1951, p. 139); Morris and others (1973, p. 156); Gentry and Stager (1958).

Mining District: Oak Spring

Mine Name: Crystal claims

MILS Sequence No.: 3202300011

Location: Sec. 19, T. 8 S., R. 53 E.

County: Nye

Commodity: Tungsten, gold

Production: Kral (1951) reported that several tons of ore were milled; however, the tungsten content was not known.

Geology: Scheelite occurs in shear zones in limestone.

Development: The workings consist of a 30-foot shaft with 20 feet of laterals; a 70-foot shaft connected with a 150-foot adit, and many trenches.

Periods of Activity: Unknown, but some workings appear to be the result of early gold prospecting around the turn of the century. Other workings are the result of tungsten mining prior to World War II.

References: Kral (1951, p. 140).

Mining District: Oak Spring

Mine Name: Garnetyte lode

MILS Sequence No.: 3202300015

Location: SE¼SW¼ sec. 18, T. 8 S., R. 53 E.

County: Nye

Commodity: Tungsten

Production: Kral (1951) reported that about 2,500 tons of ore valued at $4,000 was mined and concentrated in 1940.

Geology: The ore occurs in a garnetite bed.

Development: Principal working is a large opencut.

Periods of Activity: The principal work was done during 1940; the mill was removed shortly before World War II.

References: Cornwall (1972, p. 39); Kral (1951, p. 138-140).

Mining District: Oak Spring

Mine Name: Indian Trail group

MILS Sequence No.: 3202300017

Location: Sec. 18, T. 8 S., R. 53 E.

County: Nye

Commodity: Tungsten

Production: Kral (1951) reported 110 tons of ore containing 0.94 percent WO_3 was mined in 1940. Recovered concentrates were valued at $1,150.

Geology: Unknown; presumably similar to the Crystal claims.

Development: Workings include a shallow inclined shaft which has been developed into an open pit.

Periods of Activity: It is unknown when the claims were first located; apparently mining ceased after 1940.

References: Kral (1951, p. 140).

Mining District: Oak Spring

Mine Name: Michigan Boy group

MILS Sequence No.: 3202300406

Location: Sec. 22, T. 9 S., R. 53 E.

County: Nye

Commodity: Silver, lead

Production: None recorded

Geology: Partly oxidized argentiferous galena occurs in a vein in flat-lying calcareous shale. The 8- to 24-inch vein can be traced for several hundred feet. Ore on dumps assayed 11 to 16 ounces silver per ton and 1.5 percent lead.

Development: The workings consist of a 50-foot inclined shaft, several shallow pits and trenches.

Periods of Activity: Unknown

References: Cornwall (1972, p. 39); Kral (1951, p. 140-141).

Mining District: Oak Spring

Mine Name: Oak Springs Tungsten prospect

MILS Sequence No.: 3202300132

Location: Sec. 2, T. 8 S., R. 53 E.

County: Nye

Commodity: Tungsten

Production: Between 5,000 to 6,000 tons were reportedly mined in 1941; about 80 pounds of scheelite were produced.

Geology: Scheelite accompanied by powellite occurs associated with a quartz vein in limestone. In places the mineralized zone extends out into the limestone, forming small irregular pods. Sample material assayed 0.22 percent WO_3. Estimated reserves published in 1957 were: 35,000 tons of probable and possible ore at 0.5 percent or higher WO_3 and 6,000 tons of possible "marginal and submarginal" ore at 0.1 to 0.49 percent WO_3 (Johnson and Hibbard, 1957, p. 381).

Development: Workings include a 1,000-foot adit, trenches, and test pits along a vein for about 200 feet.

Periods of Activity: Seventeen claims were located in 1937. All activity apparently ended around 1941.

References: Johnson and Hibbard (1957, p. 380-381); Benson (1954).

Mining District: Oak Spring

Mine Name: Old Glory patented claim

MILS Sequence No.: 3202300408

Location: Sec. 15, T. 9 S., R. 52 E.

County: Nye

Commodity: Silver

Production: None reported

Geology: Workings were driven on shears in a highly altered calcareous shale.

Development: Workings consist of a caved adit and a shallow shaft.

Periods of Activity: The claim was patented in 1927, and Kral (1951) states that apparently that was the last time work was done on the property.

References: Kral (1951, p. 141).

Mining District: Oak Spring

Mine Name: Rainstorm group

MILS Sequence No.: 3202300407

Location: Sec. 15, T. 11 S., R. 53 E.

County: Nye

Commodity: Lead, silver, gold

Production: Kral reported (1951) that 80 tons containing 55 percent lead, plus 25 ounces silver and 0.25 ounces gold, were shipped prior to World War II. No production is recorded in U.S.B.M. files.

Geology: Not much is known about the geology. Samples of vein material assayed 31.5 percent lead, plus 0.07 ounces gold and 11.6 ounces silver per ton.

Development: Workings consist of a 220-foot shaft and a 150-foot adit, and several shallow shafts and cuts.

Periods of Activity: Prior to World War II.

References: Cornwall (1972, p. 39); Kral (1951, p. 141).

Mining District: Oak Spring

Mine Name: "Bone" Magnesite deposit

MILS Sequence No.: 3202300409

Location: Sec. 10, T. 9 S., R. 53 E.

County: Nye

Commodity: Magnesite

Production: None reported

Geology: Magnesite is reported in limestone near beds of chert. Sorted ore assayed 43.6 percent MgO, 2.1 percent SiO_2, and 3.4 percent CaO.

Development: None reported

Periods of Activity: Unknown

References: Kral (1951, p. 141).

Map No. 18

Mining District: Papoose

Mine Name: Kelly (Blue Bell)

MILS Sequence No.: 3201700230

Location: Sec. 21, T. 9 S., R. 55 E.

County: Lincoln

Commodity: Silver, gold, lead

Production: U.S.B.M. records indicate the mine produced 183 tons of ore yielding 2 ounces gold, 1,082 ounces silver, 423 pounds copper, and 118,649 pounds lead prior to 1938.

Geology: The ore occurs in quartzite along breccia zones or narrow fissures.

Development: Unknown

Periods of Activity: Apparently the property was active during the 1930's; however, no other information is available.

References: Tschanz and Pampeyan (1970, p. 176, pl. 1).

Map No. 19

Mining District: Silverbow

Mine Name: Blue Horse mine

MILS Sequence No.: 3202300425

Location: Sec. 35, T. 1 N., R. 49 E.

County: Nye

Commodity: Silver, gold

Production: Bureau of Mines records indicate that the mine produced a total of 529.17 ounces gold and 5,825 ounces of silver in 1920, 1923, and 1934.

Geology: Ore occurs in a northwest-bearing vein averaging 2 to 4 feet wide near a silicified rhyolite ridge. Ore minerals probably include ruby silver (proustite and (or) pyrargyrite), cerargyrite, stephanite, and free gold.

Development: In 1951, the property's workings included a 100-foot shaft, several cuts, and a 300-foot adit which was caved at the portal. In 1929, the mine was equipped with a 50-ton-per-day flotation mill. The mill has since been removed.

Periods of Activity: The mine was active in the 1920's and 1930's; however, it is not known when the property was discovered. Ekren (1971, p. 80) reported that the Tickabo Mining and Milling Co. was reopening mines in the Silverbow district in 1964; it is not known to which property he was referring.

References: Kral (1951, p. 163); Ekren and others (1971, p. 80).

Mining District: Silverbow

Mine Name: Catlin group

MILS Sequence No.: 3202300427

Location: Sec. 35, T. 1 N., R. 49 E.

County: Nye

Commodity: Silver, gold

Production: Kral (1951) reported that shipments were made as early as 1906; however, the amount is unknown. About 241 tons valued at $3,672 was reportedly shipped in 1941. Much of this material is believed to have come from the mine dumps. U.S.B.M. indicates the property produced a total of 552 tons yielding 74 ounces gold and 20,050 ounces silver from 1907 to 1944.

Geology: Ore occurs in a quartz vein 2 to 8 feet wide in rhyolite country rock. Silver chloride (cerargyrite) is the main ore mineral near the surface, and silver sulfide at depth.

Development: The workings include several adits and short shafts and some drifts and stopes on the vein.

Periods of Activity: This is one of the older mines in the district. It was operated prior to 1906. There was some underground activity from 1941 to 1944. Ekren (1971) reported that some properties in the district were being reopened in 1964; it is not known which properties were involved.

References: Kral (1951, p. 164); Ekren and others (1971, p. 80).

Mining District: Silverbow

Mine Name: Hillside mine

MILS Sequence No.: 3202300428

Location: Sec. 36, T. 1 N., R. 49 E.

County: Nye

Commodity: Silver, gold

Production: Kral (1951) recorded that some shipments from the property were made in 1941. They reportedly amounted to 285 tons yielding $7,307. U.S.B.M. records show that 746 tons yielding 97 ounces of gold and 13,251 ounces of silver were mined from 1940 to 1942.

Geology: The mineral occurrence is reported to be similar to that found at Catlin group.

Development: In 1951, the workings included an adit with 700 feet of laterals and 500 feet of raises and winzes with sublaterals. Other workings included a 300-foot adit with 100 feet of laterals and several shallow shafts.

Period of Activity: It is not known when the property was discovered. It was active from 1940 to 1942. Ekren (1971) reported that in 1964 a company was reopening some workings in the district, but it is not known which properties were involved.

References: Kral (1951, p. 164-165); Ekren and others, 1971, p. 80).

Mining District: Silverbow

Mine Name: Silver Glance group

MILS Sequence No.: 3202300426

Location: Sec. 35, T. 1 N., R. 49 E.

County: Nye

Commodity: Silver, gold

Production: Kral (1951) reported that small shipments were made prior to 1928 and that lessees shipped 160 tons of ore averaging 35 ounces silver and 0.05 ounces gold per ton between 1940 and 1942. U.S.B.M. records show it produced 265 tons from 1908 to 1910 and 128 tons in 1941 and 1942. Total output for the two periods was 47.05 ounces gold and 12,390 ounces of silver.

Geology: "The country rock is rhyolite; the ore is quartzose and contains pyrite" (Kral, 1951, p. 164). The ore minerals are probably similar to those found at the Blue Horse mine.

Development: In 1951, the working included several short adits with the lower one having track and ore cars. A blacksmith shop was located near the lower portal.

Periods of Activity: The property is believed to be the oldest in the district, having been located in 1900 or 1901. Most workings were developed prior to 1928. The property was active in 1941 and 1942. This property may be one of those mines reopened by the Tickabo Mining and Milling Company in 1964.

References: Kral (1951, p. 163-164); Ekren and others (1971, p. 80).

Map No. 20

Mining District: Stonewall

Mine Name: Sterlog group

MILS Sequence No.: 3202300429

Location: Sec. 4, T. 5 S., R. 44 E.

County: Nye

Commodity: Silver

Production: None reported

Geology: Little is known of the deposit's geology other than the vein contained some silver minerals.

Development: Workings include a 240-foot shaft and a mile-long adit.

Periods of Activity: The Stonewall district was first propsected in 1905, and apparently small shipments were made in 1911 and 1915. The long adit on the Sterlog claims was driven in the 1920's; the property was subsequently abandoned.

References: Cornwall (1972, p. 40-41); Kral (1951, p. 165-166).

Map No. 21

Mining District: Tolicha (Clarkdale, Monte Cristo, Quartz Mountain)

Mine Name: Clarkdale Camp

MILS Sequence No.: 3202300433

Location: Sec. 3, T. 8 S., R. 45 E.

County: Nye

Commodity: Gold, silver

Production: U.S.B.M. records indicate that between 1936 and 1938, the mine produced 238 tons of ore yielding 45 ounces of gold, 32 ounces of silver. According to Hewett and others (1936), a shipment valued at less than $1,000 was made in 1933.

Geology: The ore-bearing vein is in a brecciated shear zone in rhyolite.

Development: The vein is developed by six shafts within a distance of 700 feet.

Periods of Activity: Gold was discovered about 1933 and the property was worked into the late 1930's. There was intermittent exploratory work done in the area after World War II.

References: Cornwall (1972, p. 41); Kral (1951, p. 168-169); Hewett and others (1936, p. 67).

Mining District: Tolicha (Clarkdale, Monte Cristo, Quartz Mountain).

Mine Name: Landmark-Life Preserver group

MILS Sequence No.: 3202300431

Location: Sec. 29, T. 7 S., R. 46 E.

County: Nye

Commodity: Gold, silver

Production: U.S.B.M. records indicate that the mine produced 391 tons of ore containing 482 ounces gold and 735 ounces silver between 1923 and 1940. Kral (1951) reported that lessees shipped $750,000 during the late 1930's; however, there is no record of such production.

Geology: Ore occurs in brecciated zones that have been recemented by cherty quartz in or parallel to a strong and continuous shear zone in silicified rhyolite flows.

Development: The Landmark workings include a 140-foot inclined shaft, a connecting adit, and laterals; total workings amount to 1,500 feet. The Life Preserver workings include several shallow shafts connecting workings totalling about 1,000 feet.

Periods of Activity: Gold was discovered on the Life Preserver claims in 1917, and it was explored in 1920. The Landmark claims were actively worked in the 1930's.

References: Cornwall (1972, p. 41); Kral (1951, p. 167-168).

Mining District: Tolicha (Clarkdale, Monte Cristo, Quartz Mountain).

Mine Name: Quartz Mountain

MILS Sequence No.: 3202300432

Location: Sec. 35, T. 7 S., R. 46 E.

County: Nye

Commodity: Gold

Production: None reported

Geology: Apparently similar to the Landmark-Life Preserver group.

Development: Several shallow shafts, two caved adits, and trenching. The vein was stoped near the surface for a distance of about 100 feet.

Periods of Activity: Gold was discovered in 1905; more recent work was done in the 1930's.

References: Kral (1951, p. 168).

Mining District: Tolicha (Clarkdale, Monte Cristo, Quartz Mountain)

Mine Name: Yellow Gold (Carr's mine)

MILS Sequence No.: 3202300434

Location: Sec. 10, T. 8 S., R. 45 E.

County: Nye

Commodity: Gold

Production: None reported

Geology: Free gold occurs in brecciated rhyolite that has been highly kaolinized and in places silicified with opaline silica. The gold is found in vugs containing small amounts of limonite indicating that it was originally associated with pyrite.

Development: Workings consist of a 150-foot adit, several large opencuts, and an old shaft.

Periods of Activity: Discovery was made during the 1930's and there was intermittent activity after World War II.

References: Kral (1951, p. 169).

Mining District: Tolicha (Clarkdale, Monte Cristo, Quartz Mountain)

Mine Name: Wyoming-Scorpion group

MILS Sequence No.: 3202300435

Location: Sec. 10, T. 8 S., R. 45 E.

County: Nye

Commodity: Gold, silver

Production: None reported

Geology: Similar to the Yellow Gold property

Development: The property is developed by a 100-foot shaft and 40 feet of drifts.

Periods of Activity: Apparently it was discovered about the time of the Yellow Gold and Clarkdale properties. Some exploration was done on the property after World War II.

References: Kral (1951, p. 169).

Map No. 22

Mining District: Trappmans

Mine Name: Trappmans

MILS Sequence No.: 3202300674

Location: Sec. 12, T. 5 S., R. 47 E.

County: Nye

Commodity: Gold, silver

Production: None reported

Geology: The district is in an area of Precambrian gneissic quartz monzonite and biotite schist. Gold and silver are found in quartz veins cutting the gneiss.

Development: Unknown

Periods of Activity: The district was discovered in 1904, and Kral (1951) reported that there has been no report of activity since.

References: Cornwall (1972, p. 41); Kral (1951, p. 174-175); Ball (1907, p. 137-139).

Map No. 23

Mining District: Wahmonie

Mine Name: Horn Silver mine

MILS Sequence No.: 3202300065

Location: Sec. 18, T. 14 S., R. 52 E.

County: Nye

Commodity: Silver, gold

Production: None reported

Geology: Apparently the precious metals occurred in or along quartz veins in an area of hydrothermally altered latite to dacite lava flows, tuffs, volcanic breccias of the Salyer and Wahmonie Formations.

Development: The extent of the workings is not known, but Johnson reported that ". . .judging from the size of the shaft, the mine operated on a fairly large scale at one time" (1957, p. 381).

Periods of Activity: The mine was noted by Ball (1907) in 1905.

References: Cornwall (1972, p. 41); Kral (1951, p. 206); Ball (1907, p. 147); Johnson and Hibbard (1957, p. 381).

Mining District: Wahmonie

Mine Name: Lucky group

MILS Sequence No.: 3202300069

Location: Sec. 15, T. 15 S., R. 50 E.

County: Nye

Commodity: Copper

Production: Kral (1951) reported that a trial shipment was made, but returns were not available.

Geology: The copper occurs as a carbonate in 500-foot-long and 1- to 4-foot-wide shear zones in quartzite.

Development: In 1950, a 140-foot adit-drift was being driven.

Periods of Activity: The prospect was discovered in 1946. It was active in 1950.

References: Kral (1951, p. 207).

Mining District: Wahmonie

Mine Name: Travertine deposit

MILS Sequence No.: 3202300068

Location: Sec. 10, T. 13 S., R. 53 E.

County: Nye

Commodity: Travertine (building stone?)

Production: None reported

Geology: A 4- to 5-foot zone of travertine occurs in Cambrian limestone.

Development: The travertine is exposed by several opencuts or trenches.

Periods of Activity: Unknown, but probably prior to World War II.

References: Kral (1951, p. 207).

Mining District: Wahmonie

Mine Name: Wahmonie property (Sylvanite group)

MILS Sequence No.: 3202300066

Location: Sec. 17, T. 13 S., R. 53 E.

County: Nye

Commodity: Silver, gold

Production: The amount is unknown; however, it was probably small.

Geology: The geology is presumably similar to the Silver Horn mine. Some $32 (per ton) ore was reportedly found on the 65-foot level.

Development: Workings include a 500-foot shaft; all surface building have been removed.

Periods of Activity: The district was discovered prior to 1905 and rediscovered in the 1920's. A strike of high-grade silver-gold was made in 1928.

References: Kral (1951, p. 207).

Map No. 24

Mining District: Wellington (Jamestown, O'Briens)

Mine Name: Golden Chariot group

MILS Sequence No.: 3202300078

Location: Sec. 18, T. 4 S., R. 47 E.

County: Nye

Commodity: Gold, silver, copper

Production: A few tons of ore valued at about $200 per ton ($20.67 per ounce gold) was shipped in 1908.

Geology: Gold and silver ore with some copper occurs in quartz veins in rhyolite. The ore is "bunchy" but often high grade.

Development: In 1951, the workings included a 300-foot shaft with headframe and hoist.

Periods of Activity: The mine was worked during the early 1900's; Kral (1951) reported that there has been no activity in many years.

References: Cornwall (1972, p. 41); Kral (1951, p. 212).

Mining District: Wellington (Old Jamestown, O'Briens)

Mine Name: Hammel (Guy Puh property, Franz Hammel mine)

MILS Sequence No.: 3202300179

Location: Sec. 34, T. 4 S., R. 45 E.

County: Nye

Commodity: Gold, silver, copper

Production: None reported

Geology: Rhyolite and andesite are cut by a quartz vein averaging from a few inches to a foot or more in thickness. The vein has been brecciated and the interstices filled with calcite and limonite. In the oxidized portion, the ore contains free-milling gold with a little silver; in the sulfide zone, the ore contains gold associated with pyrite.

Development: The workings consist of a 30-foot inclined shaft and a 150-foot vertical shaft.

Periods of Activity: Locations were made in the late 1920's and early 1930's. It was active in 1946 and 1947.

References: Cornwall (1972, p. 41); Kral (1951, p. 211-212); Benson (1947a).

Mining District: Wellington (Jamestown, O'Briens)

Mine Name: Mohawk, Daisy and Last Chance Claim

MILS Sequence No.: 3202300079

Location: Sec. 18, T. 4 S., R. 47 E.

County: Nye

Commodity: Gold, silver

Production: None reported

Geology: The mineral occurrence is reported to be similar to the other properties in the district.

Development: The workings include a 200-foot shaft.

Periods of Activity: Unknown

References: Kral (1951, p. 212).

Mining District: Wellington (Jamestown, O'Briens)

Mine Name: Surprise group

MILS Sequence No.: 3202300077

Location: Sec. 2, T. 5 S., R. 46 E.

County: Nye

Commodity: Gold, silver

Production: Kral (1951) reported about 100 tons were shipped, but no values given. U.S.B.M. has no record of production.

Geology: Gold- and silver-bearing quartz veins and stringers are found in a diorite intrusive overlain by rhyolite flows.

Development: The veins have been explored by a 100-foot and a 30-foot shaft in addition to several opencuts and trenches.

Periods of Activity: Unknown

References: Cornwall (1972, p. 41); Kral (1951, p. 212).

Map No. 25

Mining District: White Caps(?)

Mine Name: White Caps mine

MILS Sequence No.: 3200300325

Location: Sec. 9, T. 16 S., R. 61 E.

County: Clark

Commodity: Lead

Production: None reported

Geology: A mineralized porphyry dike in limestone beds in the Ophir shale strikes from the northwest into the south end of the claims.

Development: Surface prospecting only

Periods of Activity: Prior to and during World War II

References: U.S. Bureau of Mines Property File No. 37.56.

Map No. 26

Mining District: Wilsons (Wilsons Camp)

Mine Name: Pittsburg group

MILS Sequence No.: 3202300088

Location: Sec. 27, T. 4 S., R. 58 E.

County: Nye

Commodity: Silver, gold

Production: None reported

Geology: Tertiary rhyolite country rock is cut by quartz veins containing silver and gold with trace amounts of copper. Assays of $110 to $180 per ton in gold and silver have been reported.

Development: The workings include a 425-foot adit and a 300-foot shaft with 40 feet of laterals on the 100-foot level, 175 feet on the 200-foot level, and 350 feet on the 300-foot level.

Periods of Activity: Unknown

References: Cornwall (1972, p. 41); Kral (1951, p. 218).

Mining District: Wilsons (Wilsons Camp)

Mine Name: Unknown

MILS Sequence No.: 3202300675

Location: Sec. 35, T. 4 S., R. 47 E.

County: Nye

Commodity: Silver, gold(?)

Production: None reported

Geology: Near-surface enrichment of oxidized silver minerals in a 4-foot quartz vein in rhyolite.

Development: Old workings include a 150-foot inclined shaft and a 100-foot adit.

Periods of Activity: Kral (1951) stated that the condition of workings and buildings indicate that the property may have been active in the 1930's.

References: Kral (1951, p. 218).