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January 20, 1983

NBMG OPEN-FILE REPORT **83-3**

# A MINERAL INVENTORY OF THE SHOSHONE-EUREKA RESOURCE AREA, BATTLE MOUNTAIN DISTRICT, NEVADA

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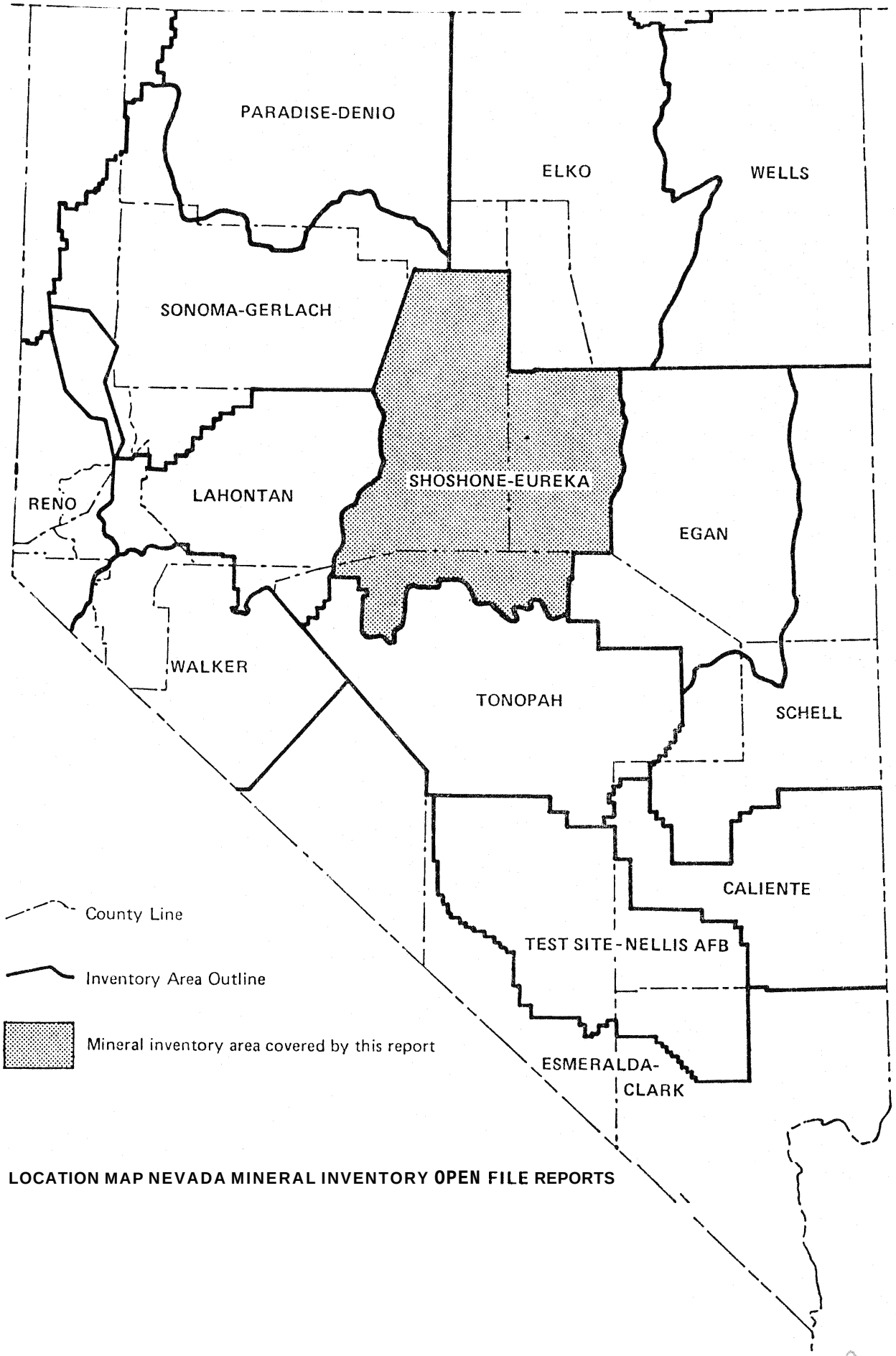
Prepared for the UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT, BATTLE MOUNTAIN DISTRICT OFFICE, BATTLE MOUNTAIN, NEVADA 89820, under Contract #YA-553-CTI-1058.

This information should be considered preliminary. It has nor been edited or checked for completeness or accuracy.

See SBMG 33-4 for Geochemical Sampling.




**LOCATION MAP NEVADA MINERAL INVENTORY OPEN FILE REPORTS**

Summary of Work Performed
Mineral Inventory Eureka-Shoshone Resource Area
Contract YA-553-CTI-1058
Bureau of Land Management

Work was completed on the Eureka-Shoshone Mineral. Resource Inventory in two complementary stages. First, a search of the literature was made, and data on mineral occurrences within the project area were compiled on short form Nevada CRIB forms. Courthouse records were then examined to obtain names and locations of active mining claims within the inventory area. All of the information was plotted on maps for field use. Folios were then prepared for each mining district, which included the CRIB forms, notes on mining claims, and pertinent references. This material provided the basis for planning the second stage of the inventory, the field examinations.

During the field stage of the project, every mining district within the Resource Area was visited and selected properties were examined. Important properties as well as outlying prospects were examined and described in order to provide more complete and accurate information on the occurrences beyond that provided in the literature. During the examination, emphasis was placed on collecting geologic information on the mineral occurrences and on noting current activity.

Photos were taken in each area to document activity, type of mine workings and geologic relationships. In addition, 274 samples showing typical mineralization were collected from most of the visited properties. All of the samples, many of which were broken down into A and B because of different rock types at the properties, were high-graded and usually taken from dumps, ore piles, or outcrops. Some samples of nearby intrusive rock or altered material were collected for comparison purposes.

The samples were then prepared for analysis by the Nevada Mining Analytical Laboratory, UNR, Reno and analyzed for elements (semi-quantitative spectrographic technique) by the Branch of Exploration Research, U.S. Geological Survey, Denver, Colorado. The mineral analyses for the Eureka-Shoshone Resource Area has encountered an unavoidable delay due to the laboratory's increased work load generated by Congress' desire to evaluate federal and public lands slated to become Wilderness Areas. The laboratory results from the samples are not expected until late 1982, An amended report will be forthcoming upon receipt of the analyses. We would like to express our gratitude to these laboratories, for without their cooperation important information on element interrelationships within mining districts and between the various districts would not be provided.

Information collected in the field was compiled on prospect forms, and new CRIB sheets were prepared for those properties examined in the field. For some properties it was only necessary to change or add to the existing form.

The information collected during the course of the Eureka-Shoshone project has been compiled and is presented in this report in the following form:

1) Mining District folios:

   a) Prospect forms describing each property examined in the field. Sample descriptions accompany forms of sampled properties.

   b) Completed CRIB forms.

   c) CRIB forms which are incomplete due to lack of available information.

2) Photo Album, organized by mining district, containing slides of visited properties and documentation of new work.

'3) Maps

a) 30' scrics for project areas showing location of mining districts, and sample locations.

b) USGS 7 1/2' and 15' topographic maps showing sample locations and prospect names.

4) Summary report, a brief report including location, history, comments based on field observations, and some comments on ongoing mining activity.

In addition to this information, topographic field sheets and field notes are on fils at the Nevada Bureau of Mines and Geology. Also, splits of all the samples taken as well as selected hand specimens have been retained at the Nevada Bureau of Mines and Geology. This material may be useful for additional studies in selected areas.

In reporting on this project, no attempt has been made to compile detailed geologic information on the districts. Since this project was a mineral inventory, our efforts were confined to acquiring new information on prospects, and no time was available to collect new regional geologic data. Local or regional geologic interpretations were derived from published geologic maps or other pertinent literature sources. Perhaps the best summary of the geology within much of the Eureka-Shoshone liesource Area is found in the following publications:

a) Nevada Bureau of Mines and Geology Bulletin 64, entitled Geology and Mineral Deposits of Eureka County, Nevada by R. J. Roberts, K. M. Montgomery and R. E. Lehner (1967).

b) Nevada Bureau of Mines and Geology Bulletin 88, entitled Geology and Mineral Deposits of Lander County, Nevada by J. H. Stewart and E. H. McKee, with a section of Mineral Deposits by H. K. Stager (1977).

c) Nevada Bureau of Mines and Geology Bulletin, unnumbered, entitled Geology and Mineral Deposits of Northern Nye County, Nevada, Parts A and B, by F. J. Kleinhampl and J. I, Ziony, currently in press.

## Mining Districts

Alpha

Antelope

Aspen

Battle Mountain

Big Creek

Birch Creek

Bruner

Buffalo Valley

Carico Lake Turquoise Area

Bullion

Danville

Diamond

Dobbin's Summit Area

Eureka

Fish Creek-Gibellini

Gold Basin

Huntington Creek

Hilltop

Jackson

Kingston

Lewis

Lone Mountain

McCoy

Mt. Hope

New Pass

Northumberland

Ravenswood

Reese River

Roberts

Skookum

Spencer Hot Springs

Twin Rivers

Union

Washington

Wild Horse

## ALPHA DISTRICT

The Alpha (Irwin?) mining district is located in the north trending Sulphur Springs Range between Garden Pass to the south and Telegraph Canyon to the north in T23, 24, 25, R52E, Eureka County. There is access to all areas of the district from Nevada Highway 20 along reasonably good dirt roads.

The extent of early mining activity in the district is largely unknown. The oldest working.; in the district consist of shallow inclined shafts and tunnels that were developed before 1910. A concentration plant was built approximately 3 miles west of the mines, hut the treatment of ore was apparently unsatisfactory and it was abandoned (Emmons, 1910). During some period prior to 1951, limestone was mined fur road beds (Forsman, 1951). The Old Whalen Mine had a period of activity from 1909-1913 when it produced small amounts of lead and copper, but there has been no recorded production since that time. Small shipments of silver and copper from the Prince of Wales Mine were made during World War I. Recent activity in the district consists of extensive drilling and geochemical sampling around the older workings.

The Sulphur Springs Range is a north trending graben-horst structure flanked on the east and west by north trending, high angle, en echelon faults. Silurian-Devonian carbonates of the lower plate of the Roberts Thrust fault arc in contact with Permian conglomerates for approximately 11 miles in the southern part of the range (Merriam, Anderson, 1943) and with the Ordovician Vinini Formation in the north. Porsmnn (1951) suggests a north trending anticline in the middle of the range. The north trending, steeply east dipping reverse Irwin Faults (named by Forsman) brings the anticlinaly folded carbonate rocks into contact with Permian conglomerates. The fault cuts off increasingly more of the Permian sediments northward (DeJoia, 1952). The lower, undeformed carbonate plate was found to lie unconformably on the steeply dipping, highly faulted and contorted bedded cherts of the allochthonous Vinini Formation. This has been

suggested to be the result of gravity slides during the Cretaceous (Forsman, 1952, Winterer, 1968). On the east facing slope of the Sulphur Springs Range are arcuate beach lines and terraces of Pleistocene Lake Lahonton (Forsman, 1951). Within the district ore minerals appear in replacement deposits in the east dipping Silurian Lone Mountain and Devonian Nevada Formations, both dolomites, in sheet zones that follow stratification (Emmons, 1910), and in breccia along north trending Fault zones associated with the Roberts Thrust fault, gravity slide blocks, and basin and range faulting. Mineable ores include argentiferous galena, sphalerite, pyrite, and copper carbonates. The sulfide ores are oxidized to a depth of several hundred feet (Roberts, et al., 1967). Bedded and vein barite, calcite, and dolomite occur as gangue minerals and cement the fault breccia. The silicified dolomite is stained with copper oxides and calcite and silica fill vugs and fractures. Roberts (1960) suggests that since the Sulphur Range, which includes the Alpha, Mineral Hill, and Union mining districts, lies between the Shoshone-Eureka and Lynn-Pinon northwest trending mineral belts, that these districts identify a separate, less distinct, parallel mineral belt.

The Old Whalen Mine workings, which includes the Klondike Claims and the Vigilante Claims, are located on a northeast trending, steeply dipping fault contact between north trending, southeast dipping Paleozoic carbonates and the siliccous western assemblage. Sulfides occur in barite which, along with calcite, cements the fault breccia. The carbonate wall rocks have been silicified in the vicinity of the fault. The site has over 1,000 feet of underground workings at the main mine with peripheral surface workings.

The Pince of Wales mine consists of several thousand feet of workings following a north trending contact between the Ordovician Vinini Formation and the Devonian Nevada Formation.

The rocks along the contact are highly brecciated and silicified. Copper minerals occur as replacement pods in the limestone host rock and as a cement in the breccia. It was noted that the degree of mineralization of the limestone

decreases from south to north. Southeast of the Prince of Wales Mine, about one and one quarter miles, the MS Claims (Eastern Morn) follow a N10°-40°E southwest dipping fault and shear zone in the Nevada Formation. The fault breccia and shear zones are cemented by copper minerals and calcite with the mineralized zone marked by gossan outcrops. The mine workings total less than 300 feet.

The Frazier Creek Claims are located west of the district on a Low hill approximately 1 mile west of Nevada Highway 20, along dirt roads which are often washed out. Most of the previous workings have been obliterated by drilling done within the last 5 years. Here, the medium grey dolomite host rock (Nevada Formation) is fractured, with copper minerals coating surfaces and infilling fractures.

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## ANTELOPE DISTRICT

The Antelope mining district is located on the western slope of the Koberts Mountains, Eureka County and is accessible along good dirt roads from Nevada Highway 21 from the east and from U.S. Iighway from the south.

The district was discovered in the late 1880's during the period of early operations at nearby Eureka, and while the area was prospected during that time, no significant production was reported. The district has recently experienced a surge of surface and subsurface exploration, probably due to the recent increase in gold and silver prices.

The Roberts Mountains were the first site where the Roberts Thrust Fault was identified and described. Merriam and Anderson (1942) state that major low angle thrust faulting occurred over a minimum distance of 16 km when the Ordivician Vinini Formation overrode lower Paleozoic carbonates. The thrust fault is a thick breccia zone separating the siliceous volcanic rocks of the Vinini Formation from the lower Paleozoic carbonates. The Roberts Mountain Thrust Fault has been tentatively dated as Late Devonian and Early Mississippian (Stewart, 1980). Winterer (1968) suggests that early Cretaceous doming, possibly from a hidden intrusive, arched the Roberts Mountains into a 30 km wide, north trending anticline. The upper part then eroded, by normal means, and by low angle gravity slides, which carried the upper and lower plate blocks as far as 15 km radially from the structural high. Lenses of the autochthonous rock interlayered between the allochthonous I-oclts, resulting in eastern assemblages overlaying western assemblages. The lenses range from blebs of a few meters to units kilometers long and hundreds of meters thick. Outliers of the lower plates can be found overlapping the upper plate. The thinly bedded siliceous rocks often show intense deformation and folding. Later Alaskite stocks and rhyolitic plugs intruded and lava flow:, and tuffs covered the area. Normal faulting broke the thrust plate and volcanics into blocks (Anderson, Merriam, 1942).

Most of the mineralization in the district occurs in or near the windows in the Roberts Thrust plate, and at the contacts between individual slide blocks, Sulfide-bearing quartz, calcite, and barite veins occur along fault and shear zones which cut both upper and lower plate rocks. Silicification of the carbonates is associated with these fault zones.

The Belmont Mine is the largest of the older workings, consisting of two main shafts with several hundred feet of underground workings, surrounding trenchesand prospect pits, and the remains of a stamp mill and ore chute. The workings have recently been drilled and sampled. The principle ores produced were argentiferous galena and sphalerite which occur with pyrite and bornite. The sulfides occur as replacement deposits in limestone and, along with crystalline calcite, cement the fault breccia. The mine is in one of the Roberts Mountain windows and mineralization follows an east trending shear zone in the lower plate Devonian Devil's Gate Limestone and the Nevada Formation. On either side of Dry Canyon Road leading to the Belmont Mine, the DCEX Claims have been extensively drilled and sampled. These recent workings are in the black shales and cherts of the Vinini Formation.

At the Big Scoop Mining Project, a small barite deposit is currently being mined (open pit) by the Big Scoop Mining Company from Battle Mountain. Disseminated and crystalline vein barite along with wad gangue occurs in the Devil's Gate Limestone. A small amount of iron staining was observed. The ore zone is controlled by local faulting and shearing. There is a base camp in the drainage below with new heavy equipment and living quarters. The ore was being crushed at the mouth of Dry Canyon.

The Blue Eagle Prospect is a minor working in a highly oxidized shear zone in the Vinini Formation. The total workings were two parallel N85W trending trenches, each 25 feet long and 15 feet deep, with a few outlying prospect pits. Stibnite cements the breccia and replaces light to dark grey, shaley quartzite. Crystalline

barite occurs as gangue. Minor gossan along with pyrite was observed. The stibnite had been oxidized to stibiconite. There appears to have been no work on this prospect for at least 25 years.

The Lander Barite Mine (Elizonda Claims, Wildfire), owned by Jose Coyeneche, is located 2 miles east of the junction of Three Bar Ranch Road and the Jackass Creek Road and is currently being mined for barite. The barite is finely disseminated in a cherty unit of the Vinini Formation. The chert is slightly calcareous and contains minor shales and gossan. The barite was high graded at a specific gravity of 4.4 and is currently being mined at a specific gravity of 3.8. The main workings are along a northeast trending, 10-15 foot wide, highly altered shear zone.

The Carter Mine, a reported oil shale deposits in the Vinini Creek area, was not located.

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## ASPEN DISTRICT

The Aspen mining district is located at the south end of the Desatoya Mountains about 70 kilometers southwest of Austin and on the Lander-Churchill County line. The district adjoins the Eastgate district that is located just to the northwest. Probably the mines and prospects in this portion of the Desatoya Mountains should be considered as one district. The majority of the production from mines in the Aspen and Eastgate districts was probably from the Churchill County part of the area. Except for the Buffalo Hump Mine, these mines and prospects were not visited during this study because the Eastgate district is outside of the Eureka-Shoshone Resource area.

The mines and prospects in the Alpine district explore epithermal gold-silver-bearing quartz veins which cut Tertiary felsic pyroclastic rocks or flows and intrusive rocks of intermediate composition. The veins exhibit open-space textures, and contain sparse pyrite and, locally, free gold. The wallrocks are silicified adjacent to the major veins, and argillic alteration is common further from the veins in some areas,

Gold was probably discovered in the district in the early 1900's. There was some prospecting and small-scale production in the 1930's and 1950's. Except for recent sampling at the Highland Mine, the district was inactive in 1981. The total production from the district is estimated to be less than $5,000 (Stewart and others, 1977). The adjacent Eastgate district has produced over 3,000 ounces of gold and 38,000 ounces of silver (Willden and Speed, 1974).

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## BATTLE MOUNTAIN DISTRICT

The Battle Mountain mining district, which includes the subdistrict of Copper Canyon, Bannock, Copper Basin, Cottonwood Creek, and Galena, is located in the southeast corner of the Battle Mountain Range, 10 miles southwest of the town of Battle Mountain in T31 and 32N,R43 and 44W. The district is principally in Lander County, but extends into southeast Humboldt County. The district originally was bound by the Reese River on the east, Summit Springs Valley on the west, Humboldt Valley on the north, and Buffalo Valley on the south. Access to the area is south from Interstate 80 on Nevada Highway 8A, then west along heavily used dirt roads. The district is located at the northwest end of the Battle Mountain-Eureka mineral belt.

The Battle Mountain district is perhaps the best described mining area within the Shoshone-Eureka project boundaries. Mining activity has been more or less continuous within the district since its discovery, and the prospects, veins and characteristics of the mineralization are well described in numerous publications. We have, therefore, confined our work at Battle Mountain to compiling data from literature and restricted our field reconnaissance to the collection of several samples, mainly for comparison purposes.

The Battle Mountain mining district, named for the 1857 battle between the Shoshone Indians and a government surveying expedition, was formally organized in 1866. The Shoshone Indians already had knowledge of copper ore and prospectors were making copper and silver discoveries in the early 1860's. Development followed organization and by 1868, the district was in full production with over 30 mines, 2 smelters and a mill in operation. Antimony was discovered in Cottonwood Creek in 1871 and minor production resulted from the deposits. The boom lasted until 1885 when the rich surface ore was finally exhausted, and except for minor leasing operations, the district was idle until 1900. The district experienced minor booms in 1900, 1909, and 1910 with the discovery of lode and

placer gold, and during World War I due to the demand for copper (Vanderberg, 1938). After the war, production fell until 1935 when the Copper Canyon Mining Company began a development program. Over the next 50 years, the copper producing mines frequently have changed owners and experienced various stages of exploration and production. Placer gold, antimony and arsenic ores had been produced intermittently throughout the district'' history. In 1957, Duval Corpvrntion brought the Copper Canyon and Copper Basin open pit: mines and mill into operation and became one of Nevada's three major producers of copper. These mines arc still in operation today. Union Pacific Railroad (Rocky Flt. Energy) has drilled to a depth of at least 4000 feet on a deep molybdenum porphyry (Climax type) deposit at the Buckingham Mine (Schilling, 1972, oral communication). In 1981, Amax continued exploratory drilling but reported no plans to develop the prospect.

The total mineral production for the district from 1868 to 1969 is estimated to be about $50 million, principally from copper, with lesser amounts coming from gold, silver, lead, zinc, antimony, arsenic, and turquoise (Stager, 1977).

The Battle Mountain range is a roughly circular, isolated group of hills that are underlain by Cambrian to Ordovician siliceous and volcanic rocks which are unconformably overlain by the Pennsylvanian-Permian hntler Sequence. Thrust over the Antler sequence from the west are the Pennsylvanian-Permian Pumpernickel and Havallah Formations along the Golconda Thrust. The sediments are intruded by an 87 m.y. old granitic pluton (Theodore, ~~et al.~~, 1973), and by numerous 38-41 m.y. old dikes and stocks (Silberman, McKee, 1971). Tertiary to Quaternary ash tuffs, basalts, glassy rhyolites, and augitc andesite occur locally. The Paleozoic sediments are complexly folded and faulted with normal and thrust faults trending north and northeast.

According to Hill (1915), there are four principle modes of ore occurrence:

1) The silver-lend lodes - the ore bodies occur in sandstone and quartzite in narrow fissure veins that can be traced for thousands of feel along strike, and

as replacement lodes, along north trending fault zones on the fringe:; of the copper-gold zones. Ore minerals include argentiferous galena, sphalerite, native gold, tetrahedrite and in the oxidized zones, cerrusite, anglesite, and cerargyrite. There are also occurrences of polybasite, pyrargyrite, and argentite. Gangue minerals include quartz, calcite and pyrite.

2) The copper deposits in the vicinity of the intrusions - the auriferous primary and secondary copper ore occurs in the siLiccous and carbonate sediments in the contact metamorphic zone associated with the granitic porphyry intrusive.

3) Pyritic gold quartz veins - gold occurs in narrow white quartz veins in short shoots. The ore bodies tend to be small pockets with production coming from the enriched oxidized zone.

4) Stibnite veins and replacement lodes - Veins carrying high-grade antimony with minor pyrite occur along the outer zone of the ore deposits in Galena Canyon in carbonaceous shales and sandstones. Light and dark quartz with stibnite and pyrite replace shale Locally. The ore zones are lenticular, narrow and production was small.

Other mineral occurrences in the district are as follows: Arsenopyrite is widespread in the ore deposits, occurring in quartz veins along the faults in the quartzite and hornfels of the Harmony Formation. Placer gold has been worked from the alluvial fans in front of the canyons along the range front. Placer gold deposits are also found in the older terraces and gravels. Bismuth has been reported in several mines, but its occurrence is unknown since there has been insuificient quantities produced. The turquoise deposits occur along limonitic stained shear zones in argillized quartz monzonite and in hornfels and quartzite of the Harmony Formation. Nodules and veins up to four inches are localized in the fractures. Production of turquoise in the district has been greater than $1 million (Morrissey, 1968). Molybdenite has been detected at both Copper Basin and Copper Canyon in fault zones and in narrow veins. No production has been noted. Scheelite occurs in the calc-silicate skarn zone.

The main copper and gold producing properties in the district have been the Copper Canyon and Copper Basin open pit mines, both currently owned by Duval Corp. The auriferous copper deposits are located near and are probably genetically related to the granitic porphyry intrusive. The Copper Canyon deposits are located in a series of subparallel fractures in shale and sandstone of the Harmony Formation with ore occurring in the crushed zone in the quartz monzonite porphyry, and in the conglomerate member of the Battle Mountain Formation. The ore minerals include the sulfide, sulfate, and oxidized copper minerals and are associated with pyrite and pyrrhotite, The Copper Basin ore is principally secondary copper minerals and sulfides. The largest deposit fills the cracks and replaces the host rocks near a diorite mass. Turquoise occurs as *a* network of veinlets in shale. Gold occurs in silicified sediments in irregular deposits, as free gold in narrow seams in diorite, and as narrow quartz veins cutting shales and quartzite. In December 1981, Duval suspended operations at the Copper Basin Mine, but continued gold and silver production at the Copper Canyon Mine. A new gold-silver deposit was discovered adjacent to the Copper Canyon Mine, with estimated 16 million tons of ore at 0.15% gold and 0.59% silver (2.4 million ounces gold, 9.2 mil-lion ounces silver). The total reserve of the new and known ore bodies is 2.7 million ounces gold and 62.8 million ounces silver (Schilling, 1981).

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# BIG CREEK DISTRICT

The Big Creek mining district is located on the west side of the central Toiyabe Range in Lander County, about 10 miles south-southwest of Austin in T17 and 18, R43E. The area is accessible on good dirt roads south from U.S. Highway 50.

Early mining in the district dates from the 1860's when silver bearing veins were discovered. Large amounts of antimony and copper in the ore made the extraction of the silver difficult and many of the early mines, and consequently the early towns, were soon abandoned. Interest was rekindled briefly in 1890 when the large antimony deposits at the Pine Mine (Antimony King) in Dry Canyon were discovered. The district was again active in 1916-1918 when demand for antimony was high due to World War I. Sporadic production from 1935-1969 reflects the fluctuating market price of antimony, but in general, production was small and erratic. The total production of the district is less than $500,000 (Stager, 1977).

The Big Creek mining district is situated aiong the west side of a well defined horst which makes up the central part of the Toiyabe Range. The most prevalent structures in the range are the high angle, dip-slip faults, thrust faults, and folds. The most recent of these are the high angle normal faults that cut across and parallel the range, the most prominent being the north trending Eastside (Kingston Cnnyon-Big Creek) Fault, that runs duwn the middle of the range and is downthrown on the western side. The early Paleozoic sedimentary rocks are composed of at Least three and locally more, thrust plates. The first plate, Lower Cambrian quartzites, shales, and limestones, and the second plate, Cambrian/Ordovician limestones and phyllites, are lithologically similar (Stager, 11377). The third plate consists of Ordovician cherts and argillites of the Valmy Formation. The first and second plates are separated by the Eastside Fault. The second and third plates are separated by the Roberts

Mountain Thrust. Both structures show evidence of two generations of folding (Washburn, 1966, 1970). The cherts and argillites of the third plate are in small isoclinal folds with fold axis parallel to the formation strike. There is a strong northwest trend in bedding planes and fold axis (Mean, 1962); elongation of outcrop belts and orienration of the margins of intrusive rocks (Stager, 1977). Small bedding faults are common in the formations (Hansen, 1961). In Dry Canyon, the autochthonous and allochthonous sequences are in both thrust and normal fault contact. The contacts trend north, follow the topographic contours and are offset by an inferred strike-slip fault in the vicinity of the Antimony King Mine (Hanson, 1961). In the northern part of the district, Mesozoic granitic rocks outcrop, possibly related to the Austin pluton. Locally, rhyolite dikes cut the sedimentary rocks. Patches of Tertiary pyroclastics overlie the Paleozoic sediments (Stager, 1977).

The ore minerals, principally stibnite with pyrite, argentiferous tetrahedrite, and galena, occur in and intergrown with white crystalline quartz which fills fissures and fractures in the sedimentary rocks. Some of the deposits have a network of small interlacing quartz veinlets cutting the beds in all directions and ranging from inches to 2 feet (Hill, 1915).

There are two principal workings in the district: The Bray-Beulah-Hard Luck-Pradier workings in the Big Creek Canyon and the Dry Canyon-Antimony King workings in Dry Canyon. The patented Bray-Beulah Mine (Genessee) is located on the west side of Big Creek, 4.8 miles from the canyon mouth in the Ordovician Valmy Formation. The Hard-Luck Pradier is located about 1,000 feet to the north. The Bray-Beulah was originally located as a silver mine in 1864. Its antimony was not recognized until 1891 when it was relocated by J. Bray. Over 1,000 tons of 60% antimony was produced from 1891-1898 from at least two adits, now caved, with over 900 feet of underground workings. Water flows freely from the portal of one of the adits at the rate of several gallons per minute. No activity was noted at

this time. The Valmy Formation at this location is black, thinly bedded, and platy, consisting of intensely folded shales and phyllites. The siliceous beds show a prominent NW-SE strike. Abundant fissure veins of vuggy quartz cut the host rock and carry crystalline stibnite with minor amounts of galena, pyrite, tetrahedrite, and covellite. Along the contact between the quartz vein and the host rock, the stibnite has been altered to white and yellow oxides which coat silica boxworks. The sulfides occur in pods and blebs and fill the vugs and fractures of the vein quartz. Some of the veins exhibit post-mineralization faulting.

The Dry Canyon Nine (Antimony #4, Pine, Stakes, Mammoth) is located at the head of Dry Canyon, 1.8 miles from the canyon mouth and down slope from the Antimony King. The mine had produced 165 tons of antimony and in World War I, 300 tons of 55% antimony ore was shipped. The mine has several hundred feet of underground workings with outlying pits and cuts in thinly bedded, shaley limestone (Silurian Roberts Mountain Formation?). Stibnite, the principal sulfide, occurs with minor amounts of pyrite and tetrahedrite in quartz veins that cut the limestone host- rock. The workings are along a contact between the upper and lower plates of the Roberts Thrust Fault. There has been no recent activity at this site. On the top of the ridge north of the Dry Canyon Mine is the Antimony King Mine, a 250 foot shaft with crosscuts, open cuts, and pits in a silicified fault breccia along the thrust plane. Vein quartz carries intergrown stibnitc that has been oxidized on the surface. The older workings have been recently open pitted and extensively drilled. At the time of this examination (1981), FMC Corporation was conducting exploration for gold in the area of Dry Canyon.

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## BIRCH CREEK DISTRICT

The Birch Creek district is located on the eastern slope of the Toiyabe Range about 10 miles southeast of Austin in Townships 17 and 18 North, 44 East, Lander County. The district includes the former Big Smoky and Smoky Valley districts. Discovery of silver here dates back to 1863 when Charles C. Breyfogle and others found silver ores near the mouth of Birch Creek. The district was organized as the Smoky Valley district, and two small town, Clinton and Geneva sprang into existance. A 30-stamp mill was constructed near the mouth of Birch Creek Canyon in 1866, but it operated for only a short time, and by 1867, the camp was deserted. There was a short period of activity between 1910 and 1912, again in 1916-1919, and minor production is reported from several old mines during the 1940's and 1950's. Tungsten was discovcrcd about 1942, uranium in 1955, and small production resulted from both. Beryl was found in the area in 1960, but the deposits proved too small for development. Total production of all mines in the district for the period 1863 to 1967 is estimated at less than $100,000 (Stager, 1977). Major commodities produced have been gold, silver, lead, tungsten and uranium with minor copper. Molybdenum is reported present in the district.

The southern part of the Toiyabe Range near the Birch Creek district consists primarily of sedimentary rocks of Lower Paleozoic age (Stewart and McKee, 1977). These rocks are exposed in three primary thrust sheets which have brought together rocks of contrasting types. The lowermost major plate consists predominantly of Lower Cambrian quartzice, shale and limestone. The middle plate consists of Cambrian and Ordovician limestone and phyllite and the uppermost Ordivician plate consist:; predominantly of chert and argillite that has been transported into the area along the Roberts thrust fault. Jurassic granitic rocks are exposed in the northern part of the district and probably underlie most of the district. Sedimentary rocks along and near the contact with these granitic rochs are folded and metamorphosed. Major ore deposits consist of silver bearing quartz veins in and

near the granitic rocks, tungsten-bearing layers in the metasedimentary rocks along the granitic contact, and n uranium deposit in metasedimentary rocks near the granitic contact (Stager, 1977). Pegmatite bodies in the metamorphics near the granite also are reported to contain both scheelite and small pockets and disseminations of beryl.

Workings throughout the district consist of numerous adits, trenches, shafts, small pits and benches with activity concentrated in the Cahill/Smoky Valley mine areas and to a lesser extent in the Lynch Creek/T-bone mine areas.

In the late 1970's. Birch Creek, along with that portion of the Reese River district over the crest of the Toiyabe Range immediately to the west of Eirch Creek, was the site of a large-scale uranium exploration project. Several exploration holes were drilled, but the results of the program are unknown. At the time of examination (1981) there was no mining activity in the district although there was a concentration of exploration activity centered in the Cahill Mine area and to a lesser extent to the immediate north of this area. No drill rigs were observed and it is thought that work, at least at that time of visitation, was coniincd to surficial mapping (with some underground mapping at the Cahill Mine) and geochemical sampling.

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## BKUNER DISTRICT

'She Bruner mining district is located in the northern end of the Paradise Range, a short distance south of Burnt Cabin Summit. The workings consist of numerous adits and shafts, most of which are probably the result of mining activity in the 1920's and 1930's. The history and geology of the district are described in detail in Kral (1951, p. 26-28) and Kleinhampl and Ziony (in press). The only recent activity noted in the district was a small open cut and nearby small mill in operation at the Paymaster Mine (see Schilling and Hall, 1980). Some ore may also have been hauled to this mill from the nearby Derelict Mine.

The ore deposits in the Bruner district are free-gold bearing quartz veins along fractures, faults, and breccia zones in rhyolitic volcanic rocks, which are probably mainly intrusive plugs and domes. The mineralized breccia zones are probably, in part, hydrothermal breccias which were later silicified and filled with drusy to chnlcedonic quartz vein material with pyrite and free gold. The wallrocks are silicified and locally argillized; biotite in the rhyolites is converted to sericite near the veins. Some quartz-vein matter exhibits a platy or lamellar texture, which is believed to represent a pseudomorphic replacement of calcite. Iron-oxide minerals and jarosite are present in the oxidized vein material present on most of the dumps. Most of the workings are in the oxidized zone. Many of the mineralized structures are high angle and generally northerly trending, based on the properties visited. Rhyolitic porphyry that is probably equivalent to the mineralized rhyolites in the mines has been age dated by K-Ar methods at 19.3 m.y. (Kleinhampl and Ziony, in press). The mineral deposits are probably younger than that age date.

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## BUFFALO VALLEY DISTRICT

The Buffalo Valley district is centered around one major mine, the Buffalo Valley Gold Mine, and is located west of Battle Mountain, on the western margin of the Antler Peak quadrangle. The district is in northeastern Lander County on the eastern margin of Buffalo Valley.

The district was organized in 1866 or 1867 when silver-copper ores were discovered at the Trenton ?line in Trenton Canyon. No major production resulted from this property, and little was done in the district until the Buffalo Valley deposit was discovered in 1912. Some ore was mined and milled from the Buffalo Valley deposit, but the total production is estimated to have been less than 3000 tons of ore. Manganese was found in the district in 1940, and about 21,000 tons of manganese ore was produced from the Black Rock Mine between 1942 and 1954. No mining has been done on the area recently, although some exploration has been done in Trenton Canyon and at the Buffalo Valley Mine. Utah International. has explored for copper on their property in Trenton Canyon, and a company from Winnemucca conducted exploration on the Buffalo Valley Mine during the late 1970's. A column leach operation was planned to treat gold ores from the Buffalo Valley property, but apparently no mining took place.

Rocks cropping out in the Buffalo Valley district are composed primarily of cherts, quartzites, and limestones of the Pennsylvanian-Permian Havallah Formation. These rocks have been locally (at Trenton Canyon) intruded by granitic rocks, and are, in areas, overlain by Tertiary volcanics (Roberts, 1964). Coppcr-silver ores in Trenton Canyon arc associated with a granodiorite-sediment contact. The Buffalo Valley gold ores occur in fractures and veinlets associated with an aplite dike.

No activity in the area was noted at the time of this examination (1982).

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## CARICO LAKE TURQUOISE AREA

The workings in the Cnrico Lake Turquoise Arc:~consists of older small open pits and trenches in the Ordovician Valmy Formation, Tertiary tuffaceous sediments, and shallow prospect pits in Quaternary lake bed sediments. Recent drilling and building of drill roads on the properties have obliterated many of the older workings. Most of the observed activity had bcen centered around occurrences of various grades of turquoise which formed in vugs and fractures in the rocks, and as nodules along bedding planes in the thinly bedded, calcareous Valmy Formation. In Cnrico Lake Valley the Valmy is intensely folded and faulted and shows evidence of thrust faulting. Vein barite was also noted in the Havallah Formation at Palo Alto in the siliceous sediments along the thrust fault. Tertiary sediments in the valley are generally tuffaceous, interbedded or overlain by volcanics and pyroclastics. It has been suggested that the recent exploration in these sediments has been for uranium. Anomalous radioactivity has been reported from the lake beds, but no uranium or thorium minerals were observed. At the time of the 1982 field inspection there was no observed ongoing exploration or mining activity.

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## BULLION MINING DISTRICT

'rile Bullion mining district, which includes the subdistrict of Tennbo, Lander, Gold Acres, and Campbell, is located on the eastern side of the Shoshone Range in T28, 29, and 30N, R4G and 47E, Lander County, approximately 25 air miles southeast of Battle Mountain and 23 miles southwest of Beowawe. The district is accessible from Nevada Highway 21, south from Interstate SO. The district adjoins the Hilltop district on the southeast and is aligned along the Battle Mountain-Eureka mineral belt.

The first locations in the district were made in the 1860's with the discovery of silvcr. Production began in 1869, when the now abandoned town of Lander was settled. In 1905, Charles Montgomery discovered gold two miles southeast of Lander at the site of Tenabo. Tenabo boomed in 1907, began declining in 1910 and was all but abandoned by 1912. Activity at Tennbo was resumed in 1916 when A. J. Raleigh discovered placer gold (Vanderberg, 1938). The Gold Acres Mine, which produced over 90% of the gold in the district, along with minor silver and tungsten, began producing in 1936. Bullion has been one of the most estensive turquoise producing areas in Nevada, producing solid ore and gem quality spider web turquoise. The existancc of turquoise in the district had been known for some time by the local Tndians, but the prospectors were unable to find the source until the 1930's since the Indians had removed all traces of the turquoise in float. The turquoise whose value is exceeded only by gold and barite is mined from both surface and subsurface workings(Morrissey, 1968). The district has experienced a surge of barite exploration and production in recent years. There were no production figures published prior to 1902, however, the estimated total productiun for the district is approximately $16 million from gold (lode and placer), silver, turquoise, copper, lead, and barite (Stager, 1977).

For the general geology of the Shoshone Range, refer to the section on the Hilltop district. Locally, Paleozoic sediments arc intruded by a 36-38 m.y. old

(McKee and Silberman, 1971) granodiorite/quartz monzonite pluton, much of which has been altered hydrothermally. Large flows of Miocene andesitic basalt Lie on the eastern flank of the range (Gilluly and Gates, 1965). The gold deposits are found in shear zones and replacement deposit..; in Paleozoic Limestone, which have been intruded by the porphyry, in breccia zones associated with the Roberts Thrust Fault, and in faulted fissure veins in fine grained andesite. The silver bearing deposits are generally located in the upper plate of the Roberts Thrust, in quartz veins along fault:; in granitic rock, and in the adjacent sedimentary rocks (Stager, 1977). Turquoise generally occurs as nodules and veinlets in fractured zones in the Slaven Chert or in the siliceous shales and cherts of the Ordovician Valmy Formation (Stager, 1977) and in thin interbedded tuffaceous lenses. Massive and bedded barite, interbedded with chert and limestone, is found in the Slaven Chert. Locally the beds are highly contorted by folding and faulting.

At the Grey Eagle Nine, deposits are located in quartz fissure veins in granodiorite which strilie N70E and dip 70N. The ore includes sphalerite, galena, pyrite, and tetrahedrite. The mine has produced several hundred thousand dollars of ore intermittently since the 1870's (Vanderberg, 1938). At the present the mine is nonproducing due to litigation between the owners and the current leasees.

The Gold Acres deposit, one of the early "Carlin-type" gold deposits, is located near the western edge of a window in the Roberts Thrust and is localized in thrust hreccin with the better ore grades in lenses near the middle and bottom of the brecciated zones. A highly altered northeast trending quartz latite porphyry dike has intruded the fault zone (Stager, 1977, Anctil, 1967). The entire mine area has been subjected to hydrothermal alteration consisting of argillization, pyritization, and possible sericitizatiou which Anctil (1967) suggest:; is genetically related to the igneous mass on the west wall of the pit. Tactite zones were developed in the carbonaceous lower plate. Northeast trending normal faulting has broken the mineralized area into three main blocks. The mine site is a large open pit with several thousand feet of underground workings.

Union Pacific Railroad, National Resource Division conducted an extensive surface and subsurface exploration project in 1967.

The Gold Acres Mine produced over $5 milion in gold between 1936 and 1955. The area was extensively explored by several companies in the period between 1960 and 1970, and additional gold ore was produced from the Little Gold Acres portion of the deposit by Placer Amex.

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Wrucke, C. T. (1974) Geologic map of the Tenabo area, Lander County, Nevada. U.S.G.S. Map MG 647.

# DANVILLE DISTRICT

The Danville mining district is located in the central part of the Monitor Range County approximately 100 km southwest of Eureka. The district is located on the east side of the mountain range; the workings are in middle and upper Paleozoic rocks exposed in the lower portions of the range. Most of the mines and prospects arc located in Danville and Green Monster Canyons.

The district was discovered in 1866 and has had several periods of activity since that time (Kleinhampl and Ziony, in press). The recorded production is only $31,212, although there was probably significant additional but unreported production (Kleinhampl and Ziony, in press; Kral, 1951).

Mineralization in the main mining area near Danville consists of oxidized lead-zinc-silver irregular replacement bodies and veins in dolomites. The veins and mineralized zones usually trend northerly or northeasterly and contain some quartz gangue as well as silicified wallrock and oxidized lead-zinc-silver minerals. A thin phosphate-rich shale bed of no commercial importance is also present in Danville Canvon. Argillized rhyolite porphyry is associated with jasperoid at one prospect. Silicification is a common wallrock alteration associated with the lead-zinc-silver veins in the Danville district.

Mineralization in the vicinity of Green Monster Canyon consists of stibnite-bearing veins and replacements with quartz and barite gangue. Iron-oxide minerals (possibly after pyrite) are also present, and the mineralization appears to be associated with jasperoid zones. The prospected for disseminated gold deposits in the mid-1970's (Kleinhampl and Ziony, in press), and exploration was again underway for this type of deposit in 1981.

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## DIAMOND DISTRICT

The Diamond (Phillipsburg) mining district is located 21 miles north of Eureka on the west facing slopes of the Diamond Range in T22N,R54E Eureka County. Access to the district is north of U.S. Highway 50 by way of Nevada Highway 46, which is partially paved, and by good dirt roads along the range front. There are numerous new roads which are not shown on the current topographic maps.

'The district was organized in 1864 when silver was discovered by a man named Phillips (Vandenberg, 1938). Development in the district was slow due to metallurgical problems but tlie district boomed in 1869, aided by the completion of the Central Pacific (now Southern Pacific) Railroad. A small amount of bullion was produced in 1873, but by 1887 the bonanza ore was exhausted and production was thereafter sporadic. In 1922, the Eureka Silver Mining Co. undertook the development of the area (Lincoln, 1923) but no production was noted. Total production for the district is about $250,000 from gold, silver, lead, and zinc, with the biggest production in lead (Roberts, et al., 1967). Recent activity, probably generated by the huge jump in gold and silver prices, has prompted extensive exploration work in and around the old workings. The entire west side of Diamond Range, including areas well outside the district, has many miles of new roads with extensive drilling and trenching obliterating many of the older workings.

The Diamond mining district is along the west facing slope of the Diamond Range, a north trending graben-horst structure which resulted from basin and range faulting. The Paleozoic limestones and dolomites, predominantly Silurian and Devonian eastern and Carbonaceous-Permian transitional sequences with several nappé of the allochthonous Vinini Formation, dip steeply west and are overturned (Roberts, et al., 1967). The Paleozoic carbonates crop out in steeply dipping northwest trending belts. The overlap sequence formations parallel the range and arc folded into a syncline with its fold axis along the ridge crest (Roberts, et al., 1967). Cutting the carbonates arc fault and breccia zones, cemented with

sulfide bearing hydrothermal quartz veins. Silicificntkon of the carbonates is associated with these fault zones. Ore minerals include argentiferous galena, pyrite, sphalerite, and antimony, forming pods and stringers in the vein quartz. Also occurring arc anglesite, cerrusite, malachite, and azurite. Gangue minerals are quartz and calcite. The Diamond district is aligned along the Eureka-Battle Mountain mineral belt.

The principle working in the district is the Phillipsburg Mine, located in 3 north trending shear zone with argentiferous galena-bearing quartz veins cutting the silicified carbonates. There are several thousand feet of underground workings and tailings cover several acres. Extensive trenching and surface cuts surround the site. North of the district are the remains of the Steel-Galena Mine, located on 3 contact between an erosional remnant of the Vinini Formation, the upper plate of the Roberts Mountain Thrust Fault, and the lower plate of the Paleozoic carbonates. The remnant is made up of quartzite, shales, and phyllites and is cut with galena bearing quartz veins that are coated with secondary copper minerals. The workings consist of several hundred feet of vertical and inclined shafts. Between the two workings are recent exploration sites connected bv new drill and light use roads.

Selected References:

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## DOBBIN SUMMIT AREA

Workings just to the north of the Dobbin Summit in the Monitor Range consist of a single adit and several small, shallow prospect pits. The adit explores a gossan zone in Paleozoic siltstone and carbonate rocks. The wallrock is locally argillized. The gossan may represent an oxidized sulfide replacement deposit. Kleinhampl and Zionv report that a grab sample contained 0.5X Mn, 15 ppm Ag, 0.7% Zn, 2000 ppm Ba, 15 ppm Be, 300 ppm Co, 300 ppm Y, and 0.1% Ni. The area was recently drilled by Dome Exploration as part of a precious-metals exploration program.

Selected References:

Kleinhampl, F. J. and Ziony, J. I. (in press) Geology and mineral resources of Northern Nye County, Nevada: NBMC Bull.

## EUREKA DISTRICT

The Eureka mining district is located on the west slope of the Diamond Range in T18 and 19N, R53E, in the southeast part of Eureka County. The district extends from Secret Canyon on the north end to Adam Hill on the south end. Access to the district is north and east from U.S. Highway 50, along poor to well used dirt roads.

Rich silver and lead discoveries werc first made in New York Canyon, south of Eureka, in the fall of 1864. Production did not begin until 1569 because the high lead content in the ore prevented treatment by conventional methods. After developing new smelting techniques and building the first successful smelter in 1869 (Lincoln, 1923) the district grew rapidly. With the completion of the Eureka and Palisade Railroad in October 1877, Eureka became the center of wagon and stage transportation for all eastern Nevada (Vandenberg, 1938). During this boom period, the Eureka Consolidated Mining Company and the Richmond Mining Company acquired most of the smaller claims and became the largest producers of ore in the district. About 1885 the bonanza ore was finally exhausted and the holdings werc passed to leasees, and by 1891 most of the mining operations had shut down. Mining interest was briefly revived in 1905-6 with the consolidation of the Eureka Consolidated and Richmond Mining Companies and with the reopening of the smelter which had closed in 1890. However, that same year rain washed out the railroad and activity was again suspended. In 1963, the Hecla Mining Co., was named operator in a joint mining venture. Drilling for the project was completed in 1960. In 1963, the property was leased to several mining companies to provide capital to finance the first stage of the venture. Hecla then worked approximately 15 months dewatering and securing the underground workings. Recent field examinations, of the district indicates moderate interest in surface and subsurface exploration, probably the result of the recent increase in gold and silver prices. The district is being drilled and some of the older dumps are being reworked for

residual minerals. Peaking from 1870-1890, the total production of the district has been estimated by Nolan (1962) to be about $122 million, originating mostly from the Ruby Hill area.

The district is underlain by a thick section of Paleozoic calcareous sediments broken by post-Jurassic movement into structural blocks separated by fault zones of large displacement (Hague, 1892). Within the blocks, the rocks show evidence of local thrusting with the thrust faults broadly folded (Roberts, et al., 1967). Normal and transverse faulting also occurs within the blocks. Nolan (I962) suggests that the Eureka structural features are believed to represent near surface disturbances in front of the Roberts Thrust. The sediments are intruded by Late Mesozoic granite porphyry and quartz porphyry and Tertiary intrusions and flows are exposed locally throughout the district.

According to Nolan (1962) the Eureka ore bodies occur as 5 general types: irregular replacement deposits, the most numerous and economically feasible; bedded replacement deposits, fault zone deposits, disseminated deposits, and contact metasomatic bodies. Almost all the ore bodies occur in limestone and dolomite with dolomite the more favored rock type. Oxidization of the ore produced solution cavities over the larger ore bodies. The ore is oxidized to a depth of approximately 1,000 feet (Lincoln, 1923). According to Curtis (1884), the ore above the water table consists of galena, anglesite, ccrussite, mimetite, and wolfenite in a gangue consisting of iron oxides with quartz and calcite. Below the water table, the ore consists of pyrite, arsenopyrite, galena, and sphalerite. The lead minerals carry more silver than gold and the iron minerals more gold than silver. Silver occurs both as a chloride and sulfide, and gold is found in its native state. Hague (1892) stated that all. ores arc ascending and were originally deposited as sulfides and were subsequently oxidized.

The Ruby Hill area, the major producer in the Eureka district, is underlain with brecciated Eldorado Dolomite (Cambrian). The formation forms the upper

plate of the Ruby Hill thrust zone and is cut with the NW trending, normal Ruby Hill Fault (Nolan, 1962). A quartz diorite plug of Late Cretaceous(?) age outcrops south of Ruby Hill. The early ores were oxidized sulfides in the upthrown side of the Ruby Hill fault. Sulfides were also found on the downthrown side, but working below the water table proved difficult because of flooding in the shafts. The Ruby Hill area has produced approximately $100 million of ore (Roberts, et al., 1967).

There is currently (1981) ongoing mining and leaching operations at the General Minerals Mine and the Western Windfall Mine, both open pit ventures. The Western Windfall is thought to be in the Late Cambrian Hamburg Dolomite, a sanded dolomite, where the original cement is destroyed (Wilson, 1976). The gold occurs in the sanded dolomite, principally along the contact between the Hamburg Dolomite and the overlying Dunderberg Shale or between the contact between the dolomite and the Tertiary andesitic intrusive rock. Anomalous amounts of arsenic, mercury, and silver are also present. In 1976, known reserves wcrc estimated to be three million tons of .03 oz/ton gold, and a potential of several million tons of like grade.

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## FISH CREEK-GIBELLINI DISTRICTS

The Fish Creek mining district is located in the southeast corner of Eureka County, in the southern half of the Mahogany Hills and on the west facing slope of the Fish Creek Range in T18N,R52E. This report also includes the Gibellini mining area in T16N,R52E. Access to the district is from good dirt roads, south from U.S. Highway 50; southwest, 35 miles from Eureka; and cast from Nevada Highway 20.

There has been little recorded history on early mining in the district. In the 1880's James Butler, who 30 years later discovered the Tonopah silver deposits, and Angelo Belli located the Angelo Belli Claims on the west facing slope of the Mahogany Hills. Butler later acquired patents on the North and South Antelope, which the county subsequently took from his heirs in the 1930's to be sold for taxes. The Gibellini manganese-nickel deposits were located in 1942 by L. P. Gibellini. A small shipment of 31.6% manganese ore was shipped in 1953, however, there has been no recorded production since. In 1959-60, fluorite was discovered by Maynard and Lester Bisoni on the northwest side of the Fish Creek Range around McCullough Butte, and later discoveries were made on the east flanks of Ditto Peak. The McCullough Butte area is interesting geologically, in that fluorite occurs with some beryl and scheelite in the Ordovician Hansen Creek Formation. The mineralized rock is overlain by a thrust sheet of Eureka quartzite. Small bodies of rhyolitic intrusive rocks have been mapped at two areas within the Hansen Creek. The intrusions are sericitized, and have silicated the surrounding rocks. There has been extensive trenching and drilling at the Bisoni-McCullough Butte property by various mining companies up to the present, but mineable fluorite ore has yet to be produced. The reserves are estimated to be many million at 10% $CaF_2$ (Papke, 1979). The sporadic production of the district has resulted in less than $1700 in gold, silver, and lead ores in 1938 and 1955 (Vandenberg, 1938, Roberts, et al., 1967). The district was experiencing an ongoing ,surge of surface and subsurface exploration during our field examinations.

The Mahogany Hills and Fish Creek Range are two of several structural blocks of approximately 30,000 feet of Cambrian to Ordovician, calcareous sedimcnts broken by post-Jurassic movement and separated by fault zoncs of Large displacement (Hague, 1892). The sediments generally strike north and dip east at a low angle. with steep dips near faults. Within the Fish Creek block, the rocks show evidence of local thrusting with the thrust blocks broadly folded and cut with high angle faults. Small erosional remnants of the Ordovician Vinini Formation outcrop in the middle of the district in thrust contact with the autochthonous rocks. A Late Mesozoic-Early Tertiary granodiorite porphyry intrudes the thinly bedded, shaley, carbonaceous Ordovician Pogonip Formation at Wood Cone Peak. Locally throughout the district, the sediments are overlain by Tertiary rhyolite tuffs, agglomerates, and flows. The variety of minerals located in the district indicate the different deposition environments. Sulfides (auriferous pyrite, argentiferous galena, sphalerite) occur in hydrothermal quartz veins cutting the carbonaceous sedimcnts and cementing shear zones. The manganese-nickel deposits appear as replacement in limestone, associated with fault zones. The vanadium minerals appear in bituminous phosphatic marine shales with secondary minerals in the oxidized zones (Hausen, 1962). Low grade fluorite, along with beryl and some scheelite, occurs in thrust zones.

The Gibellini (Niganz, Black Iron) manganese-nickel depsoits are located in a Devonian limestone which strikes northwest and dips 20-35" southwest. The ore body occurs on the footwall of *a* northwest striking fault; the ore minerals consisting of wad, pyrolusitc, and dense nodules of psilomelane. The day the drposit was inspected it was being drilled by Host Ventures of Canada.

South of the Gibellini arc the Bisoni-McKay vanadium deposits, located in highly contorted and sheared Dcvoninn bituminous phosphatic marine shales. The shales are interlayered with bedded cherts, calcareous shales and limestone, implying that this is a lithologic transitional sequence between east and west

rocks. Secondary vanadium has been found locally in the oxidized zones (Hausen, 1962).

The patented Antelope Nine, south of Mahogany Hills, is underlain by north trending, steeply dipping, thinly bedded, shaley limestone that is locally disturbed by minor folds. The North and South Antelope each follow fissures in the limestone that range from one to five feet wide and carry oxidized pyrite and galena. The degree of mineralization is greater at the North Antelope workings. The Antelope produced minor amounts of lead, silver, and zinc. Two days following our inspection, drilling crews arrived at the North Antelope Mine.

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## COLD BASIN DISTRICT

The Gold Basin district is located near the Churchill-Lander County line on the east side of the Desatoya Mountains about 65 km southwest of hustin in T16N, R48E. The workings consist of a few pits and trenches, a short adit (caved), and several shallow shafts. These workings arc located north of Nevada Highway 2 and east of Carroll Summit.

Gold was discovered in the district in 1911, but the amount of gold found was relatively small, and the camp was almost deserted one year later. The recorded production is only about 100 tons of ore having a value of less than $20,000 (Stager, 1977). The latest mining claims noted were staked in 1973; there was no activity at the time of examination.

The mineralization occurs in light gray, rhyolitic ash-flow tuffs of Miocene age. Minor silicification and argillization of the wallrock was observed in dump samples; iron- and manganese-oxide minerals arc also found along fractures. Mineralization reportedly consists of thin quartz veins with gold, silver, and traces of copper and lead (Stager, 1977). No quartz vein matter was observed on dumps during this property examination, although a few samples of calcite with disseminated pyrite were observed.

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## HUNTINGTON CREEK DISTRICT

Early mining in the Huntington Creek district was centered around Diamond Peak, an 8970' peak that crowns the northern Diamond Range. The district is approximately thirty-five miles north of Eureka and is bisected by the Eureka/White Pine County line. The main workings surround Diamond Peak and are reached by a rocky dirt road leading up Davis Canyon from Diamond Valley, Other workings south and east of the peak arc accessible from Huntington Valley on the east side of the range.

The Diamond Range near Diamond Peak is underlain by carbonate and clastic sediments ranging from upper Mississippian through Permian in age. The sediments are folded into an asymmetrical syncline which traces a northwest-trending axis just east of Diamond Peak. A small circular exposure of Tertiary granodiorite forms the summit of the peak. The granodiorite intrudes cherty limestones and minor clastic rocks of the Pennsylvanian Ely limestone on the west limb of the syncline.

The intrusion of igneous rocks in the summit area resulted in the formation of copper-bearing replacement deposits in the limestone host rocks. Several adits and open cuts located below the peak expose skarn deposits adjacent to sill-shaped bodies of granodiorite. The intrusive rocks are relatively unaltered and show a range of conpositions and textures. The skarn is mainly composed of green garnets and contains chalcopyrite, pyrite, copper, and iron oxides and minor scheelite. Marbleization of the wallrock extends for more than ten feet beyond the "sills". At least two periods of emplacement of felsic dikes and siliceous veins were observed that post-date the igneous intrusions. Minor faulting displaces the wallrock and steeply dipping fissures show concentrations of copper and iron oxides. Sknrn samples from this locality contain anomalous tin (70-200 ppm) in addition to high copper values.

A few copper prospects are located in canyons on the east side of the range. In these deposits, copper minerals occur in the Diamond Peak Formation along

steep fault zones. At one copper prospect (unnamed) crystalline barite veins cut silicified clastic rocks and arc, in turn, cut by veinlets of secondary malachite.

Sample 833, collected from the Mulligan prospect on the east side of the range, reported a high tin value (700 pm) and anomalous arsenic and antimony.

The only reported production from the district is from the Diamond Copper mine which yielded two tons of copper ore in 1950. Nickel is reportedly associated with the copper at the Keystone patented claim, but we were unable to locate the property.

There were no signs of recent exploration work within the district at the time of our examination.

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## HILLTOP DISTRICT

The Hilltop (Kimberly, Maysville, Pittsburg) mining district is located on the northeast slope of Shoshone Peak in the north central part of the north-northeast trending Shoshone Range in T29 and 30N, R46E, Lander County. Access to the district is 18 miles southeast from Battle Mountain and Interstate 80 along moderately used dirt roads. The Hilltop district is adjoined by the Bullion district on the southeast and the Lewis district on the northwest and is aligned along the Battle Mountain-Eureka mineral belt.

The district was explored in the 1860's when miners were prospecting radially outward from Austin. Prospecting continued through the 1870's and 1880's, but with no production recorded. The district was formally established in 1906, and in 1907 Scow, Anderson, and DuBorg discovered gold around the older workings (Vandenberg, 1939). This and other discoveries resulted in a boom in 1908. A 10-stamp almagamation mill was built that year and milling operations began in 1912. In 1914 placer gold was discovered in Crum Canyon by John Nelson, but recorded production from the placer was less than $3,000. No accurate records exist, but production of gold and silver from 1887 to 1908 probably did not exceed $200,000. Sporadic activity from 1908 to 1951 produced over $800,000 from gold, silver, copper, and lead ores (Stager, 1977). There has been a recent surge of surface and subsurface exploration in the district, probably due to the increase in gold and silver prices. There are indications that some of the older dumps are being milled for residual minerals.

The Hilltop district is underlain by an east-tilted, fault block of Paleozoic siliceous sediments that has been intruded and overlain by Tertiary igneous rocks. The west side of the range is marked by a steep fault scarp cut with deeply incised valleys. The east side has a rolling topography with moderate relief. Two major periods of tectonic activity preceeded basin and range faulting: The Roberts

Mountains Thrust, suggested to be middle Paleozoic, and the Lewis orogeny (named by Gullily and Gates, 1965), tentatively dated as post-early Triassic and prior to the intrusion of Tertiary stocks. Windows in the Roberts Mountain thrust sheet are exposed in several nearby areas of the Shoshone Range. Within the upper plate of the thrust fault are at least 10 subordinate thrust faults and innumerable small ones which superimpose wedges and slices of rocks upon one another (Gates, 1956). The upper plate is highly folded, with minor thrust faulting producing isoclinal and recumbent folds. The moderately folded, single thrust sheet of the Lewis orogeny extends across the exposed edges of four or five lower thrust sheets of the Roberts Mountain Thrust (Gilluly and Gates, 1965). There are at least two stages of Cenozoic volcanism in the area: the earlier is marked by the intrusion of quartz monzonite/granodiorite porphyry stocks, and the later by volcanic eruption (Gilluly and Gates, 1965) and suggested subsidence of the Mt. Lewis Cauldera (Wruckc and Sflberman, 1975). Near the crest of the range are the remains of a volcanic complex which Wrucke and Silberman (1975) suggest to be a 31-33 m.y. old, 10-mile wide subsided caudera, which they named the Mt. Lewis Cauldera. The physical features have been deformed by subsidence and erosion, but the area is ringed by concentric, steeply inward dipping faults. Plugs, breccia pipes and intrusive breccia are found along the ring fault. In the center of the complex are quartz monzonite, rhyolite porphyry and pumiceous vitrophyre. After the volcanic eruptions, normal Faulting associated with basin and range movement resulted in a northwest facing fault scarp (Gilluly and Gates, 1965).

A belt of intrusives and associated mesothermal silver, gold, copper and lead deposits extend northwest across the Shoshone Range, encompassing three districts: Bullion, Hilltop, and Lewis (Gilluly and Gates, 1965). In the Hilltop district many of the Former producing mincs are located at the contact between the Tertiary granodiorite intrusives and the Paleozoic country rocks. The wallrock located in the mincs is commonly recrystallized, bleached, and sericitizcd. Many ore deposits

localized in quartz veins along faults and shear zones in the upper plate of the Roberts Thrust Fault. These deposits occur in tabular lodes, sheeted zones, and fissure veins with a short vertical range and are oxidized down to approximately 100 feet (Gilluly and Gates, 1965). The ore minerals include native gold, auriferous pyrite, arsenopyrite, galena, sphalerite, tetrahedrite, chalcopyrite, native copper and pyargyrite. Gangue minerals include quartz, calcite, barite, and iron oxides. Small bodies of sulfide ore also occurs in fractures in the quartzite which is cut by leached porphyry carrying gold-bearing quartz stringers. The quartzite near the ore is impregnated with pyrite and is locally kaolinized (Emmons, 1910). Gold tellurides have also been reported (Vandenberg, 1938). In Crum Canyon, minor low grade manganese deposits of wad, pyrolusite and psilomaline have been found along fracture zones in the cherts of the Valmy Formation. Barite has been found throughout the district with commercial size replacement deposits confined to the Devonian Slaven Chert and as replacement veins below the thrust plate (Cowan, 1950). Bedded barite extends along a northeast trend and appears to be unrelated to the metallic deposits in the district in both distribution and origin (Gilluly and Gates, 1965). Previous production of barite in the district has exceeded more than 50,000 tons from open workings, however, no activity associated with barite was observed.

The only activity noted during the field inspection of the district was the old Hilltop (Independent) Mine being drilled by Boyles Drilling from Salt Lake City. There were indications that the older dumps around the Hilltop Mine were being milled for residual minerals.

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# JACKSON (GOLD PARK) DISTRICT

The Jackson or Gold Park mining district is located in the central Shoshone Mountains, near the Nye and Lander County boundary. Most of the mines and prospects are located on the western side of the range; however, properties located 10 km or more to the east or south of the main mining area have also been included in the district.

Gold was first discovered in the Jackson district in 1864, but much of the production was probably during the late 1800's and early 1900's. The main value of production (possibly $500,000 to $1 million) is in gold, with lesser amounts of silver, lead, and copper. There has been little activity in the main district since the early 1900's. Minerals Management Co. was surveying mining claims in the main district in August, 1981.

The mineral deposits at the main productive mines are precious metal-bearing base metal (lead and copper) quartz veins which cut Permian(?) meta-andesite. The hypogene ore minerals are galena, pyrite and chalcopyrite. Most of the mining was in the oxidized zone, where cerrusite and other oxide minerals are present (Kleinhampl and Ziony, in press). Most of the mineralized quartz veins strike northeast, dip southeast, and range in thickness from a few centimeters to 3 mctcrs. The veins arc probably Mesozoic in age (Bonham, 1970). Locally the rocks near the veins are argillized, but in many cases the wallrock mineralogy does not appear to change systematically outward from the veins. All of the Permian andesite are metamorphosed to the greenschist facies.

Outside of the main part of the Jackson district, gold, mercury, and uranium mineralization occurs in Tertiary felsic ash-flow tuffs and intrusive rocks. Alteration in these mineralized areas and elsewhere consists of silicification, sericitization, calcitization, zeolitization and chloritization (Kleinhampl and Ziony, in press). Gold mineralization in Tertiary rhyolitic rocks is associated with drusy quartz veins containing sparse pyrite (Vernol claims). The wallrocks

are argillized. Cinnabar and minor fluorite occur in silicified and/or argillized zones in ash-Flow tuffs at a locality on the east side of the Shoshone Range (Dottie Lee claim, War Cloud property).

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# KINGSTON DISTRICT

The Kingston district is on the east side of the northern Toiyabe Range in southern Lander County and includes parts of Ts 15 and 16N, Rs 43 and 44E in the area immediately north of the Nye County line. The district, also known as the Victorine district, includes areas earlier referred to as the Bunker Hill, Summit, and Santa Fe districts.

Gold and silver bearing quartz veins were discovered at the Victorine Mine in Kingston Creek Canyon and at the Mother Lode Mine near Santa Fe Creek Canyon in the early 1860's, and by 1875 there were four stamp mills in operation in Kingston Canyon. The ores proved to be difficult to treat as well as low grade, and little production is credited to the district. Total production, through 1969, is less than $100,000 (Stager, 1977).

Rocks in the Kingston portion of the Toiyabe Range consist mainly of complexly faulted Paleozoic sediments. The area lies slightly to the west of the axis of the Antler Orogenic Belt, and rocks of miogeosynclinal, eugeosynclinal, as well as transitional facies are present, mainly as stacked thrust slices. In the Kingston district the Paleozoic sediments are exposed in three, and locally more, thrust sheets. The lower two major plates consist predominantly of Lower Cambrian quartzite, shale, and limestone, overlain by Cambrian and Ordovician limestone and phyllite. The uppermost of the three plates consists predominantly of chert and argillite of possible Ordovician age (Stewart and McKee, 1977).

Granite rocks of Jurassic age intrude the older sediments, and are exposed in the southern part of the district (Broad Canyon). Emmons (1870) mentioned that a 50-foot basic dike occurred about 200 feet below the Victorine vein on the north side of Kingston Creek chat, along with the vein, paralleled the structure in the sedimentary rocks.

The major ore deposits in the district occur along silicified zones in limestone at the top of a sequence of quartzite, phyllite, and limestone of Cambrian age.

At the Victorinc (Kingston) mine, the largest in the district, ore occurs as pockets and veinlike masses of quartz in silicified, carbonaceous limestone. The ore trends east, dips 20° to 30° to the north, generally conformable with bedding. The mineralized structure is said to be traceable for more than a mile along strike, extending to the Bi-Metallic Mine on the west. The ore consists chiefly of gold and silver associated with tetrahedrite, sphalerite, chalcopyrite, and pyrite which occur with quartz and calcite in silicified, carbonaceous limestone. The quartz is dark colored, shows evidence of brecciation, and clots of graphitic material occur along the quartz-sulfide lenses.

The Golden Star (Mother Lode) Mine, at the edge of Smoky Valley northeast of the Victorine, shows similar structure and mineralization. The vein forms a prominent white outcrop high on the mountain front which is clearly visible from Highway 376 to the east. Galena, tetrahedrite, sphalerite, chalcopyrite are present in the vein material, and scheelite was seen in one sample from the upper dump of the old workings.

At the time of this visit (1981), Brazos Industries was operating at the Victorine site. They were mining underground at what they refer to as the Klondike Mine (across the canyon to the west of the old Victorine). Ore was being hauled by truck to a small concentrating plant alongside State Route 376 in Smoky Valley.

Evidence of recent claim staking was seen in Broad Canyon, and numerous flagged locations marking geochemical sample sites were scattered throughout the district.

Other than the Victorine, however, no properties were being actively worked at the time of examination.

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## LEWIS DISTRICT

The Lewis district, also known as the Dean district, includes the portion of the northern Shoshone Range between Lewis and Horse Canyons on the northwest front of the range. The district is about 15 miles south of Battle Mountain, Lander County in T29 and 30N, R45 and 46E. Vandenberg (1939) included the Pittsburg Mine ares in the Lewis district, hut it is now usually included in the adjoining Hilltop district to the east.

Silver was discovered in Lewis Canyon in 1867, and stamp mills were built near the mouth of Lewis Canyon to treat ores from the Starr Grove and Eagle Mines. A narrow gauge railway, the Battle Mountain and Lewis Railway, was built from the Nevada Central line in Reese River Valley to the mills in 1880 (Stager, 1977). The ruins of these mills and of the railroad grades can still be seen in the lower narrows of Lewis Canyon. The Dean and Betty O'Neal Mines were discovered around 1880, and they contributed to production for several years following 1880. The Betty O'Neal developed as the largest producer in the district, operating between 1880-1882, and 1922-1929.

Extensive exploration has taken place in the district over the years since production ceased, but only minor amounts of metal have been produced since the Betty O'Neal last operated. Estimated total production for the district is about $4 million (Stager, 1977).

The north end of the Shoshone Range in the area of the Lewis district is underlain principally by siliceous and volcanic assemblage rocks of Ordovician and Silurian age in a complex array of thrust slices. These rocks are intruded locally by Tertiary granitic rocks and overlain in a few places by small patches of Tertiary volcanic rocks. A series of northeast-striking faults, that dip steeply northwest, cut the sedimentary rocks along the northwest side of the range (Stewart and McKee, 1977).

According to an interpretation by Wrucke and Silberman (1975) of the geology in the northern Shoshone Range around Mt. Lewis, a circular fault structure southeast of Mt. Lewis outlines a deeply eroded cauldron. This fault bounds Paleozoic and blesozoic stratified rocks that foundered during volcanic collapse. Within the subsided mass, breccia pipes, plugs, and dikes, together with remnants of tuffs and volcaniclastic deposits record an episode of Oligocene volcanism. The collapse structure, named the Mt. Lewis Cauldron, is one of the oldest Tertiary volcanic centers in Nevada (Wrucke and Silberman, 1975). Three large breccia pipes and plugs, and several smaller breccias, dikes and veinlets occupy the central portion of the described cauldron. Some of these are altered, and may be associated with mineralization within the district.

The silver bearing deposits within the Lewis district, in general, are localized in quartz, calcite, and barite veins along faults and shear zones in thin bedded limestones and shales of the Ordovician Valmy Formation. At the Betty O'Neal Mine, orebodies have been mined from veins along several sets of steep faults. A series of rhyolite porphyry dikes in the mine area may be associated with ore deposition. Average ore mined at the Betty O'Neal was about 25 to 30 ounces of silver per ton. Values were contained in freibergite, stephanite, cerargyrite, with some native silver, galena, chalcopyrite, and sphalerite in veins of quartz, calcite and barite. Stibnite was produced from one area within the mine, but it was mined by a leasor long after the mine ceased silver production, and the exact location of the antimony production is not known.

The Dean Mine (Cumberland) and the prospects in Horse Canyon appear to be located near the plugs and breccia zones described by Wrucke and Silberman (1975), and the prospects in Whiskey Canyon are in an area where veins mined on the adjacent Betty O'Neal property project to an intersection with a thrust fault.

At the time of examination, some exploration drilling was in progress in the district, but no mining activity was noted.

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## LONE MOUNTAIN DISTRICT

The Lone Mountain mining district is located on Lone Mountain in T20N, R51E Eureka County, approximately 18 miles west of Eureka. Accessibility to the district is from the east side of the mountain, north from U.S. Highway 50, along good dirt roads. The only workings of the district are on the north side of the mountain.

The first claims were located in 1920. High grade zinc carbonate ore was discovered by the U.S. Smelting Company in 1942 on the Mountain View claims (Roberts, et al., 1967), and there was small and sporadic production in the district until 1964. There have been a few new roads added that are not shown on the current topographic maps, but with the exception of recent minor drilling and trenching there has been no significant activity since the 1960's. Production for the district shows a dollar value of at least $750,000 from over 2 million tons of zinc, 1/3 million tons of lead, 4000 ounces of silver, and minor copper (Roberts, et al., 1967).

The Long Mountain is a relatively undeformed homoclinal block of northwest striking autochonrhous Paleozoic carbonates that is thought to be an erosional window in the Roberts Mountain Thrust sheet (Roberts, et al., 1967). On the north, east, and southeast of Lone Mountain are outcropping of shales and cherts of the allochthonous Ordovician Vinini Formation. Deformation of the carbonate block is limited to minor faulting and tilting of the block northeast approximately 25-55' (Gronberg, 1967). There is minor vertical faulting. The ore bodies are localized in breccia zones at the intersection of 2 sets of faults: the prominent zone strikes northeast and dips southeast and the lesser zone strikes northwest and dips southwest (Roberts, et al., 1967). The ore is principally sphalerite, galena, smithsonite, zincite(?) and hydrozincite(?) with occurrences of cerrusitc, rhodochrosite, anglesite, and trace copper. Gangue minerals are barite, calcite, and iron and manganese oxides. The ore occurs in pods and masses and as cementing material in the fault breccia.

The Lone Mountain Mine and the adjacent Lone Mountain extension has at least 3 vertical and inclined shafts for over 1000 feet of underground workings with surrounding surface workings in the dolomite of the Devonian Devils Gate Limestone. Jasperoid masses outcrop near the mine workings.

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# McCOY DISTRICT

The McCoy mining district is located on the eastern flank of the northern part of the Fish Creek Range, approximately 30 miles southwest of Battle Mountain in Lander County, with mining activity confined to the northern part of T28N,R42E. Access to the district is from the west along good dirt roads from Nevada Highway 8A.

The McCoy mining district was formed in 1914 when Joseph H. McCoy discovered gold in the vicinity of what is now known as the Iron King Mine. No significant activity occurred until 1928 when high grade ore was discovered at the adjoining Gold Dome Mine and McCoy sold his claims to H. W. Boyer, who then leased the claims back to McCoy. By 1938, however, production at the mines had ceased and the town of McCoy was deserted. Interest in the district was revived in 1941 when high grade iron ore deposits were discovered at the Hancock and Uhalde-New World deposits in the southern part of the district. Mining after World War I and up to the present has been sporadic. There is currently ongoing surface and subsurface gold and copper exploration throughout the district. Total production for the district in gold and iron with minor amounts of lead, silver, and copper has been less than $1 million, with the dollar value of iron far exceeding that of gold (Schrader, 1934; Stager, 1977).

The main part of the McCoy district is in a basin which opens to the east, in the low rolling hills of the Fish Creek Mountains, the site of an early Miocene volcano that produced the Fish Creek Mountain Tuff. These tuffs are separated from the Triassic Augusta Sequence by an angular unconformity (McKee, 1970). The mine workings are in carbonates and quartzites of the Cane Spring and the Osobb Formations. These sediments were gently folded into a south plunging anticline (Ferguson, Muller, and Roberts, 1951), intruded by Jurassic to Tertiary porphyritic diorite and granodiorite, and then overlain locally by Tertiary ash flow tuffs. The intrusive has been altered to a greenish-grey medium-grained

granitoid, slightly speckled with ferromagnesium minerals, and stained with oxidized pyrite and hematite. The tuffs are locally altered to epidote and nontronite. The iron ores are replacement and contact metamorphic deposits (Schrader, 1934) consisting of bands, lenses, and pods of magnetite, hematite, and minor pyrite which replaced dolomite of the Osobb Formation. The ore runs approximately 70% iron. Gangue minerals include dolomite, calcite, quartz, apatite, and andrndite (Schrader, 1934).

At the Hancock Mine, iron ore is mined from replaced dolomite with an overlying unconformable layer of nontronite that is in turn overlain by ashfall tuffs and alluvium. Within the small open pit are a prominent set of vertical fractures trending N25W. Further north is the Uhalde-New World Mine covering several acres of open pits. This area was being staked when it was field checked in November 1981.

The gold, which is relatively free, occurs in steeply dipping replacement deposits that strike northeast and run parallel with the axis of the range. The replacement deposits are irregular and occur along faults and fractures in the diorite and limestone. There were no observed veins or fissures associated with the deposits. The ore minerals include native gold, silver, cerargyrite, malachite, azurite, cerrusite, pyrite, chalcopyrite, and galena. The ore bodies range from small pods to large irregular masses.

The gangue is principally a mixture of silica (quartz, opal, jasper), iron oxides, and clay with some calcite, pyrite, epidote, and garnet (Schrader, 1934). The quartz, as described by Schrader, is hydrous silica, and grouped into "opalite ore", and "siliceous sinter". At the Gold Dome Mine, the gangue is a siliceous mass of partly altered, replaced diorite.

Schrader's description of the gold ores and their setting seem to describe a hot-springs type gold occurrence.

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# MT. HOPE DISTRICT

The Mt. Hope mining district is located on the southeast side of Mt. Mope in T22N,R51 and 52E, 21 miles northwest of Eureka. Access to the area is along good dirt roads west of Nevada Highway 20, north of U.S. Highway 50.

Lead and zinc were first discovered in the area in 1870 by Basque sheep-herders. The main workings at the Mt. Hope Mine were opened by Thomas Wren in 1886 with subsequent shafts sunk in 1890. No additional activity was recorded until 1928 when the U.S. Smelting, Refining and Mining Co. sank additional shafts and crosscuts for a total of over 8,000 feet of underground workings. After the 1943 flooding of the mine, the Callaghan Pb-Zn Corp. leased Mt. Hope from Universal Exploration Co., a subsidiary of U.S. Steel Corp., from 1943-1947 and produced 250 tons per day of zinc concentrate, $10,000 per month of cadmium, and for each 50 tons of concentrate, 120 ounces of silver (Forsman, 1951). Production ceased for 10 years following the 1947 fire in the power house, Phillips Petroleum drilled the area in 1970-71, but no development was indicated. Exxon Minerals Co., a division of Exxon Corp., began drilling at Mt. Hope in 1978 and the discovery of a molybdenum porphyry deposit was announced by them in 1981. Over 450 million tons of ore with grades ranging between 0.13 to 0.32% $MoS_2$ have been reported. As of this data there has been no recorded production from Exxon's discovery. The total production of zinc, lead, gold, silver, and copper from the district has been more than $1.3 million.

Situated between the southern ends of the Roberts Mountains and the Sulphur Springs Range, Mt. Hope, a prominent local geographical landmark, is a rhyolite porphyry plug which intruded the siliceous Ordovician Vinini Formation. The Vinini Formation, which locally forms the upper plate of the Roberts Thrust, had been carried over Paleozoic carbonates by the thrust fault and subsequently overlain by the clastic transitional sequence of the Permian Garden Valley Formation. Outliers of Devonian Nevada Formation ,outcrop on the west side of the

district. Within the Vinini Formation are three distinct thrust plates, with the base of the lowest plate being the Roberts Thrust (Walker, 1962). Within each thrust plate, the beds of the Vinini are tightly folded on a small scale. Where the thrust plate is exposed, it is marked by a pronounced 30-40 foot wide breccia zone (Merriam and Anderson, 1942). The Paleozoic rocks have been faulted and intruded by the 36 m.y. old (Oligocene) rhyolite porphyry of Mt. Hope (Walker, 1962, Silberman and McKee, 1971). The exposed porphyry is an iron stained, vuggy, fine crystalline, white groundmass with smokey quartz and pale cream-colored sanidine phenocrysts (Walker, 1962, Missallati, 1973).

The earlier Pb-Zn ore occurrences were disseminated sulfide deposits, bedded veins and replacement sulfide deposits, and as irregular veins and replace-ment sulfide deposits, and as irregular veins and replacement sulfide deposits. The ore zones only occur in well developed skarns and are structurally controlled by low angle thrust faults, high angle fissures, fractures and fault zones, irregular contact of the sediments with the intrusive, and bedding planes, (Missallati, 1973). The principal ore minerals include marmatite, sphalerite, galena, with occurrences of pyrrhotite, chalcopyrite, and minor gold and silver. The gangue minerals include calcite, garnet, tremolite, and diopsite. The ore minerals grade from low to high temperature and the skarn assemblages and ore textures suggest a formational temperature from 200°-600°C (Missallati, 1973).

The recent activity at the Mt. Hope Mine possibly resulted from the data obtained from drill hole #15, drilled by Phillips Petroleum in 1970-71. The hole was drilled through an ignimbrite unit in the southeast corner of an igneous complex. At the 1292-foot level a veined rhyolite porphyry was encountered and at the 1504-foot level, a low grade, but continuous molybdenum-mineralized zone. This mineralization continued for 464 feet to the bottom of the drill hole at 1908 feet. The zonal pattern of mineralization in the veined porphyry was zinc, at the top, copper, in the middle, and at depth, molybdenum (Missallati, 1973).

Based on their drilling and mapping, Exxon geologists describe five pulses of intrusive activity at Mount Hope. The molybdenum zone that has been defined by drilling has the form of two overlapping inverted teacups. Each teacup would represent a molybdenum rich halo around a central intrusive porphyry mass. In the area of overlap, the two molybdenum halos form a zone of enriched values which may define an orebody.

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# NEW PASS DISTRICT

The New Pass mining district is Located in Ts. 20 and 21N, Rs. 40 and 41E and because of the relaignment of Churchill and Lander Counties, the boundary passes through the middle of the district. The district is accessible from the southeast from U.S. Highway 50 along good dirt roads.

The district was organized in the 1860's when gold was discovered by miners from Austin. Periods of activity up to the present have been sporadic with about 35,000 tons of ore produced at a little less than 1 ounce of gold and silver per ton. Manganese was discovered in 1918 and 5,000 tons, valued at more than $100,000 were produced from 1940-1953 at 30% manganese (Stager, 1977).

The district is made up of Late Paleozoic and Early Mesozoic siliceous and volcanic clastics of the transitional sequence above the Roberts Mountain Thrust Plate that are conformably deposited with some low angle thrust faulting. The beds are generally north striking with an isoclinal west dip. Tertiary ash-flow tuffs overlay the district in all but the western part. Subsequent faulting produced gently east dipping fault blocks (Stager, 1977). The gold and manganese ore occurs along or near faults that cut the rocks of the Triassic Havallah Sequence, implying the district's mineralization is post-Triassic. Supergene copper minerals coat fractures and fault surfaces. Gabbros have been encountered at depth in the Thomas W. Mine and outcropping at some of the minor workings north of the New Pass Mine. Most of the workings follow sulfide bearing quartz veins.

The major gold producer in the district is the New Pass Mine with 7 patented and 20 unpatented claims, currently owned by Don Jung. The mine has been producing since the 1880's and is currently being leased by a Candian mining company which is in the process of esploratory drilling and trenching. The mine site is covered with numerous shafts and tunnels, the deepest being the Thomas W, at 550

feet. There are several miles of underground workings. At this mine, free gold occurs in steeply dipping banded quartz veins in gouge zones. The veins are from 6 inches to 6 Eeet wide, averaging 2-4 feet. The gold runs a Au:Ag ration of 1:1 and produces up to 10 ounces per ton. At the 240 foot level of the Thomas W shaft, sulfides (pyrite sprays and galena pods) occur in brecciated veins. At the 490 foot level, a crosscut was run due east through gabbro. On the west side were the thinly bedded shales and limestones of the Triassic Favret Formation. Quartz is a gangue mineral and ore minerals include gold, argentiferous galena, argentiferous galena enclosing native gold, auriferous pyritecopper sulfide, azurite, and malachite (Lincoln, 1923). Most of the ore is oxidized.

Small deposits of manganese occur at scattered localities within the New Pass district. At these deposits, crystalline pyrolusite and wad occurs parallel to the northeast striking interbedded chert and shale of the Havallah sequence with local concentrations along faults and fractures. Crystalline pyrolusite is also disseminated throughout the adjacent country rock. The deposits are probably the result of oxidation of primary manganese carbonates which were deposited by hydrothermal solutions, and later concentrated during the weathering process (Stager, 1977). There is minor limonite staining and quartz is a gangue mineral. There has been no activity in these areas since 1954.

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## NORTHUMBERLAND DISTRICT

The Northumberland district covers that portion of the northern Toquima Range which extends from Northumberland Canyon north to the general vicinity of the Lander-Nye county line. All of the district is within the Toiyabe National Forest. Most of the mineral occurrences arc located along East and West Northumberland Canyons, and the Northumberland Gold Mine is at the pass where both canyons meet at the range crest. Barite occurrences are being mined in both canyons, but the major deposits are near the mouth of East Northumberland Canyon. Small copper, gold, and turquoise prospects occur in the area surrounding the Clipper Gap pluton northwest of the central part of the district, and uranium has been reported in altered tuffs in Willow Canyon, north of West Northumberland Canyon. Total production of the district, through 1962, is given as about $1.2 million (Kleinhampl, in press). Considerable barite has hecn produced since then, however, and the Cyprus Gold Mine is presently operating and will contribute significantly to production from the district.

Silver was discovered in the district in 1866, and ores from the Monitor and Blue Bell Mines were treated at a 10-stamp mill located at a spring in West Northumberland Canyon (Kral, 1951). Stone ruins mark the site of the old mill in the canyon and more stone foundations can be seen at the site of the original mine camp just east of the summit at Northumberland Pass. The silver mining activity was intermittent, and apparently stopped about 1891. Cold was discovered slightly cast of the old silver prospects in 1936, and by 1939 the Northumberland Elining Company was in operation. Gold mining continued until 1942 when operations ceased due to the wartime closure order. Gold exploration resumed in the late 1960's, and in 1981, mining began on low-grade gold ore developed in the area of the old mines. Barite was discovered in the late 1960's, and significant production of this material continues irom several deposits.

According to Kleinhampl, Paleozoic strata and Mesozoic plutons underlie about two-thirds of the district, and Tertiary volcanic and sedimentary rocks underlie the remainder. The Paleozoic rocks have been cut and moved along thrust faults, and segments of eastern facies carbonate rocks, transition facing carbonates and siliceous rocks, and western facies detrital and volcanic rocks are present in the district.

The largest plutonic body in the district, Clipper Gap pluton, lies north of West Northumberland Canyon. Several small intrusives, ranging from granite to quartz diorite in composition, crop out in the heart of the district. These smaller intrusives are surrounded by a well-developed metamorphic aureole (Kleinhampl, in press).

Oligocene and Miocene welded tuffs and tuffaceous sediments lie discordantly on the older rocks, and megabreccia units are exposed west of Northumberland Pass and north of West Northumberland Canyon. These formation are related to a large collapsed caldera, the Northumberland Caldera, which occupies the north-central part of the Toquima Range.

The early mined silver ores at Northumberland were in veins which were in plutonic rocks. The ores contained ruby silver and cerargyrite with some malachite and azurite (Raymond, 1869). The Northumberland Gold Mines is a disseminated deposit which occurs primarily in silicified, argillaceous and carbonaceous limestone of the Ordovician Pogonip group. Silicified horizons of the Pogonip have been extensively fractured. Economic gold mineralization occurs in microfracture fillings of quartz and barite within the silicified horizons (Goldstein, 1973). The silicified, mineralized zones are generally associated with the margins of a monzonite intrusive (Kral, 1951).

Barite cements silicified breccia in the vicinity of the gold mines, and the earliest-explored barite occurrences were in the gold-silver part of the district. The major barite reserves, however, occur as thick sections of bedded barite near the mouth of East Northumberland Canyon.

Outside of the central Northumberland district in Northumberland Canyon, only limited mining activity has occurred. Small quartz vein occurrences of gold-silver bearing pyrite-chalcopyrite were prospected in the Clipper Gap area, and small turquoise showings were prospected south of Pete's Canyon. At the Rifle prospect, in Willow Canyon, the uranium mineral, coffinite, has been reported from spring deposits.

Present activity in the district is centered at the disseminated gold and barite properties. Cyprus Mines is mining the gold property and is processing the ore at a leach facility located in Smoky Valley.

Barite mining is in progress at locations in both East and West Northumberland Canyons.

Large areas of the Northumberland Caldera are claimed by Noranda Mines, and they have done some drilling for uranium on their claim block. No activity was noted, however, in late 1981.

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## RAVENSWOOD DISTRICT

The Ravenswood district, which includes what was once the Shoshone district, lies west of the Reese River about 25 miles northwest of Austin in the Shoshone Mountains.

Silver-lead-copper-bearing quartz veins were discovered southwest of Ravenswood Peak in 1863, and the district was organized the same year, one of the earliest districts to be organized in Lander County. The early activity was short-lived with little production resulting from it. Some activity is reported for the period 1906-1907, and the Rast Mine produced a small quantity of ore in 1924. Uranium prospecting activitywasreported in the northeast corner of the district in 1954-55 (Stager, 1977). Tungsten-molybdenum mineralization was discovered just south of the old silver properties in the 1960's, and extensive exploration was done in the Reward Claim area by several companies during the 1970's. The area also received attention for disseminated gold following publication of U.S.G.S. Circular 563 in 1968. This circular described outcrops of Roberts Mountain Formation, host rocks for disseminated gold at other localities in northern Nevada, to be present in the Ravenswood area. Intense prospecting resulted and several mineralized areas were discovered. None of these have developed beyond the prospect stage, but exploration is continuing on some properties. Barite has been mined from one occurrence in the southern part: of the district, and small turquoise prospects are mentioned south of the Reward area. Production from the district through 1969 is estimated at less than $10,000 (Stager, 1977).

The Ravenswood district is located in what is described by Stewart and McKee (1968) as the Ravenswood window, where Cambrian, Ordovician and Silurian quartzite limestones and shale are exposed in the lower plate of the Robert's Mountain Thrust, and nearby, Ordovician and Silurian chert, shale, sandstone, and quartzite, are exposed in the upper plate. The Roberts Mountains Formation crops out in

two small areas in the northern part of the window and in a fairly large area directly below the Roberts Mountains Thrust in the southern part of the window. The strata of the lower plate have been intruded by a porphyritic quartz monzonite that crops out over an area of about 2 square miles in the central part of the window. Tertiary welded tuffs cap much of the higher portion of the area (Stewart and McKee, 1968). The deposits in the old part of the Ravenswood district, in the northern part of the window, consist of small lenslike quartz veins that are predominantly in shale, quartzite and shale of early Cambrian age. The deposits, according to Hill (1916), contain chalcopyrite, galena, and tetrahedrite, all said to carry silver and a little gold.

The uranium prospects in the northeast part of the district cover disseminations of an unidentified radioactive mineral which occurs along the mudstone layers adjacent to fractures cutting tuffaceous lake beds of Miocene and Pliocene age (Stager, 1977).

At the Reward tungsten area, scheelite occurs as disseminations and thin fracture coatings in a silicated limestone horizon, probably of Cambrian age. Extensive trenching at the Reward has exposed a large area of mineralization, but it is of low grade. The scheelite appears to be confined to one major limestone horizon which has been complexly folded, this horizon appears to be repeated in several exposed benches. The host rocks are silicated, but do not contain typical dark-silicate skarn minerals. No intrusive contact is exposed at Reward, but intrusives are mapped to the southwest. Samples of silicated, K-feldspar rich rock have been seen from this same general area, and it is possible that some of the most recent exploration near Reward has been for molybdenum.

Disseminated gold exploration has been concentrated in the southern part of the district, extending south along the eastern front of the Shoshone Range from the Reward area to the Tempo Claim (Maloy Mine) area. At Tempo, anomalous

Formation which has been slightly altered (bleached, silicated) and cut in one area by barite veining.

No activity was noted in the district: at the time of examination, but roads are maintained, and there was evidence of current assessment work on various claim blocks.

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# REESE RIVER DISTRICT

The Reese River (Austin, Amador, Yankee Blade) mining district is located north and south of Austin, in the central part of the north-northwest trending Toiyabe Range. Access to the district is along good paved and dirt roads north and south from U.S. Highway 50, which bisects the district. The Reese River district is adjoined on the southeast by the Birch Creek district, on the southwest by the Big Creek district, and on the northwest by the Skookum district. The district originally measured 75 miles long and 20 miles wide, but was eventually reduced to an area eight miles long and one mile wide (Vandenberg, 1938: Stager, 1977).

The Reese River mining district was formally organized in July 1862, following William Talcott's discovery of silver ore in Pony Canyon in May of that year (Hill, 1910, Vanderberg, 1938). A rush ensued and the town of Austin was established. By late 1863, Lander County had been separated from Humboldt and Churchill Counties and the seat moved from Jacobsville to Austin. The Manhatran Silver Mining Company consolidated most of the mines by 1865 and became the major producer in the district. By the time it shut down its mill in 1887, the company produced more than $19 million from 100,000 tons of silver ore. After 1887 only minor leasing operations with sporadic activity continued in the district until recently when the increase in gold and silver prices made mining ventures economically feasible. The greatest production in the district came from about a half a mile square area on Lander Will. There are no accurate production records available prior to 1903, however, estimates place the production value of the district at approximately $26 million (Stager, 1977). After 1903 there has been less than $500,000 produced in the district. The principle ore produced was silver with minor amounts of gold, copper, lead, antimony and zinc. Turquoise was discovered in 1930 about 10 miles northeast of Austin but produced less than $50,000 (Stager, 1977). There has been recent surface and subsurface exploration

throughout the district, though not as extensive as in other areas of the Eureka-Shoshone Project area.

The district is located around a Jurassic quartz monzonite/granodiorite pluton dated at 156±6 million years (Krueger and Schilling, 1971). The pluton intrudes siliceous sediments of the Ordovician Valmy Formation that have been displaced from the west to the east by the Roberts Thrust Fault. The pluton has been cut with numerous north trending lamphophyric and aplite dikes which have been altered to sericite and chlorite. Small patches of Tertiary volcanics locally cover the sedimentary and granitic rocks with ash fall tuffs and vesicular andesitic flows. Silver mineralization in the Austin mines occurs in a network of narrow, parallel, northwest striking, northeast dipping quartz veins which fill joints, fractures and fissures in the intrusive and surrounding sediments. The quartz veins range from inches to over five feet and can be followed underground for thousands of feet. The ore minerals include chlorides, bromides, and antimony-arsenic compounds of silver, which occur with pyrite, chalcopyrite, arsenopyrite, marcasite, galena, sphalcrite, wurtzite and tetrahedrite. All the sulfides, except pyrite and sphalerite, are argentiferous. Gangue minerals include iron stained quartz with manganese oxides *on* the surface and rhodochrosite at depth (Lincoln, 1923).

Due to the increase in gold and silver prices in recent years, the current owners of mines arc milling the older dumps for residual silver. At the Watt Shaft, north of Austin, silver was being recovered from the dumps at six ounces per ton. Even though the district is principally a silver producer, recent activity concerning the other minerals has increased, but none of these ventures have recorded any production.

In the northern part of the district is a 3/4 square mile zeolite deposit that has been heavily trenched and dozed. The surface workings are limonite stained in tuffaceous lake sediments that have abundant glass shards and remnant

flow patterns. The sediments are cut with quartz vcinlets, dip steeply southwest, and are overlain with lithified alluvium. The site shows anomalous radioactivity but no recognizable uranium or thorium minerals were observed (Garside, 1973).

Immediately north of the Toiyabe National Forest boundary on the Grass Valley Road (Nevada High 20), and for about six miles north to Cottonwood Springs, the east facing slope of the Toiyabe Range has had extensive surface and sub-surface exploration mainly for turquoise. Turquoise fills fissures, fractures, and coats bedding planes of the thinly bedded metasediments of the Ordovician Valmy Formation. Minor pyrite is disseminated throughout the formation. Above the workings the hills are capped with andesite flows.

At Cottonwood Springs, several companies held claims during the early 1970's covering small outcrops of jasperoid which occur in eastern facies carbonate rocks. These areasweresampled and drilled for gold, apparently with no success, as there is no activity in the area at this time.

East of the turquoise deposits in Grass Valley is a sinter deposit in the Miocene Bates Mountain Tuff that has been extensively trenched. The deposit is vuggy opaline/chalcedony with disseminated cinnabar.

Further east on the north tip of part of the Simpson Park Range southeast of Grass Valley Ranch, is a small skarn deposit formed where a plug of Cenozoic quartz monzonite intruded into and interfingered with the Paleozoic carbonates (Silberman and McKee, 1971). There is a minor showing of scheelite/powellite in the garnet/epidote tactite and sulfides are disseminated in the hornsfelsic zone.

The Apex Mine (Rundberg, Early Day), which is located southwest of Austin, lies on the sericitized and kaolinized contact between Cambrian quartzite and black shales and the Jurassic quartz monzonite of the Austin Yluton. The siliceous rocks are folded into a northwest trending, southeast plunging syncline between two quartz monzonite stocks. North trending Basin and Range faults cut both the sediments and the intrusive. Uraninite and coffinite are found both in

the sediments adjacent to rhyolite dikes and the brecciated contact zone between the sediments and intrusive. According to Nye (1958), during the Tertiary, hypogene uranium minerals were deposited at depth. During erosion and oxidation, uranium was leached and redeposited as autunite and torbernite. North trending normal faults have downdropped the ore body to the west, The eastern limit of the ore body is where the rhyolite dikes enter the quartz monzonite. The vertical range is unknown. Since 1954 several tons of ore have been produced, valued at more than $100,000 (Stager, 1977). There are at least 8100 feet of underground workings.

The Rundberg area has been extensively explored for additional uranium reserves. Drilling was done in the early 1960's and again in the late 1970's, but these programs were apparently not successful in developing minable resources. No activity was noted at the time of this examination.

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## ROBERTS DISTRICT

The Roberts mining district is located on the west side of the Simpson Park Mountains, south of McClusky Pass and north of Walti Hot Springs, in T24N,R48E, Eureka County. The district is bordered on the west by Nevada Highway 21, approximately 42 miles northeast of Austin.

The district was organized in 1870 with the discovery of the O'Dair Mine, now the Keystone Mine, by Roberts and Tucker (White, 1871; Lincoln, 1923). Earlier production from the district was unrecorded, but production figures were published in 1948, 1949, and 1962 for silver, lead, copper, and zinc, for a total dollar value of less than $5,000 (Roberts, et al., 1967). No production was noted from 1950 through 1961.

The district is located in the Keystone Window of the Roberts Mountain Thrust Plate. Exposed in the window is the autochthonous Devonian Nevada Formation, a dolomite, surrounded almost entirely by the allochthonous Ordivician-Silurian siliceous clastics of the Valmy and Vinini Formations. The west side of the range has been downdropped along an inferred, north trending, high angle fault and is covered with alluvium. The fault is inferred by the presence of Walti Hot Springs, which is currently depositing sinter (Garside and Schilling, 1979), and the steepness of the range front. Intruding the Paleozoic sediments is a 33.0 million year old porphyritic granodiorite stock (Silberman and McKee, 1970). The district is within and aligned along the Battle Mountain-Eureka mineral belt.

The principal working of the district is the Keystone Mine located along the contact between the dolomite and the intrusive. At the Keystone, sulfide ore (pyrite, sphalerite, and chalcopyrite) occurs as lenticular pods in garnet/epidote tactite along the contact. Galena located near the surface is said to be argentiferous and at 25 feet, copper ore was found (Lincoln, 1923; Roberts et al., 1967). Pyrite and sphalerite are disseminated in the granodiorite.

Minor copper oxides occur in gossan with the sulfides. The limestone is faulted and sheared with calcite cementing the breccia. The underground workings total over 1,500 feet and peripheral shafts and prospect pits surround the main workings. Chevron Resources of Sparks staked the area around the mine the week following our field inspection (August, 1981) and the mine area had recently been drilled.

The Z Claims, which extend from the Keystone Mine north along the west facing slope of the range front to the Bauman Ranch, have been extensively drilledandtrenched, possibly as late as 1980. No other activity was observed. The claims are in the shales and quartzites of the Vinini-Valmy Formations, and no surface mineralization was observed.

Other minor workings around the district include the Pat Prospect, which is entirely surrounded by the Tonkin Claims and are located 3 miles west of the Tonkin Range and south of Pat Canyon. The workings are in the Simpson Park Window of the Roberts Mountain Thrust Plate and are currently under exploration by U.S. Exploration Co. Minor gold, zinc, and arsenic anomalies have been reported from a jasperoid outcrop on these claims.

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## SKOOKUM DISTRICT

The Skookum mining district is located on the low rolling hills of Vigus Butte, 8 miles northwest of Austin in T19 and 20N, R42 and 43E in Lander County. Access to the district is from the west along good dirt roads, which are occasionally washed out by the Reese River, from Nevada State Highway 8A, north of U.S. Highway 50.

Mineralized quartz fragments were found in the district in 1907 by an India11 who then sold the discovery to the LeMaire brothers of Enttle Mountain. Operations commenced in 1908 with rich silver and gold ore being produced. The subsequent stampede of claim stakers and tent towns of Skookum and Greenah lasted only months. By the fall of 1908, most of the miners were gone and by 1912 the hills were as bare as before (Hill, 1915, Stager, 1977). A small amount of ore was produced in 1914 (Lincoln, 1923), but there has been no recorded activity until the late 1960's when Humble Oil (Exxon) staked the district and explored for disseminated gold. Early production ran 750 ounces silver to 1 ounce of gold (Hill, 1915). The Greenah Mine had the largest production of the district with values up to $100,000 in gold and silver.

Vigus Butte is a series of low rolling hills underlain by the north striking, dark, fine-grained quartzite beds of the Ordovician Valmy Formation that are overlain and intruded by Tertiary volcanics. An augite andesite flow covers a large portion of the hills (Hill, 1915). The metasediments are cut by small gold and silver bearing, highly fractured, white, crystalline quartz veins which follow faults and fractures and cement breccia zones on the south and southwest side of Vigus Butte. Some veins show post-mineralization brecciation and faulting H i , 9 5 ) . The ore minerals are argentiferous tetrahedrite, minor pyrite intergrown with quartz, and small quantities of copper and lead oxides. A thin film of chrysocolln coats fracture surfaces. The mineralization of the district is post-Triassic and pre-Tertiary (Hill, 1915, Stager, 1977).

The two main workings of the Skookum district are the Greenah (LeMaire) Mine and, 1 1/2 miles south, the Skookum (Walt) Mine. The 6 main shafts of the Greenah Mine lie along a N25W trend with underground workings totaling more than 1,000 feet. The workings follow a 2-4 foot wide brecciated quartz vein with the ore unevenly distributed along the vein (Hill, 1915). Since the workings are collared in alluvium, there are no outcroppings of country rock to observe.

The Skookum property follows a north striking quartz vein and fault zone. A rhyolite dike was observed at depth (Hill, 1915). The main shaft is 100 feet deep with more than 500 feet of crosscuts. The numerous trenches and pits which dot the district follow other narrow quartz veins. No recent activity was observed in the district.

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# SPENCER HOT SPRINGS DISTRICT

The Spencer Hot Springs district includes the area surrounding the Linka-Conquest Tungsten Mines and Spencer Hot Springs in the northern Toquima Range southeast of Austin, Lander County. The district covers a very small area north of the Pete's Canyon road on the edge of Smoky Valley. The National Forest boundary extends through the center of the district, the Linka Mine is west of the boundary on BLM land, the Conquest Mine is to the east, inside the National Forest.

Recorded mining activity in the district began in 1941 with the discovery of the Linka Tungsten deposit by Steve Linka. Tungsten ores were mined on a small scale at the Linka and later at the adjoining Conquest Mine in the 1945's and again in 1955-56. About 66,420 tons of ore averaging 0.45% $WO_3$ were produced during this period. The Spencer Hot Springs, about one mile west of the tungsten deposits on the edge of Smoky Valley, is a well-known hot spring, and has been used by the local residents for years as a hot bath-recreation area. Until recently, there was a large concrete-lined pool at the site and the area was used for swimming.

Several well sites are visible near the hot springs, but it is not known who drilled them or what the geothermal potential of the area might be. Two old shafts to the east of the springs but west of the Linka Mine appear to pre-date the work at Linka but there are no records on these properties.

The Spencer Hot Springs district covers a group of low hills and are slightly separated from the main portion of the Toquima Range and are surrounded on all sides by alluvium and Tertiary tuffs. The hills are underlain primarily by Paleozoic sedimentary rocks which have been locally intruded by Jurassic aged granitic rocks. The Roberts Mountain Thrust Fault is exposed in the central portion of the district; eastern facies carbonate rocks of the Ordovician Anteleop Valley Formation are exposed west of the fault and chert and shale of

the western facies Vinini Formation, also Ordovician age, are exposed on the ridges east of the fault trace.

Ash flow tuffs of Miocene or Oligocene age are exposed in the southern part of the district.

Scheelite mineralization at Linka-Conquest occurs in lenses and tabular masses of skarn which have formed along the contact of the intrusive and limestones of the Ordovician Antelope Valley Formation. The contact zone is poorly exposed, and is cut by dikes and high angle faults. The granite mass is to the west of the contact, extending under tuffs and alluvium westward into Smoky Valley. The exposed carbonate rocks at Linka are all in the lower plate of the Roberts Mountain Thrust zone, and the thrust contact crops out a few hundred feet southeast of the Linka. At the Conquest Mine, east of the Linka, skarns have formed in rocks which are mapped as upper plate Vinini Formation. Complex folding and silification of the rocks makes structural and lithologic correlations in this area questionable, but it appears that skarns have formed in both upper and lower plate rocks. The lower plate Antelope Valley Formation carbonates, however, appear to be more favorable for the formation of skarns. If the Antelope Valley Formation is present beneath a thrust contact below the Conquest outcrops, larger skarn deposits could await discovery there.

Tungsten occurs at Linka-Conquest in the form of scheelite, and forms as fine to medium grained crystals along bedding and fracture surfaces in the skarn. Small amounts of molybdenite and chalcopyrite are also present.

The old shaft on the west edge of the district, east of the hot springs, explores an altered skarn zone, highly iron stained and fractured. This alteration is probably related to recent hot springs activity.

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## TWIN RIVER DISTRICT

The Twin River district covers the arcuate eastern slope of the central Toiyabe Range and extends from South Twin River north to the Nye-Lander County border. The district is restricted largely to the east slope of the Toiyabes and includes areas or sub-districts sometimes referred to as Twin River, North Twin River, Clear Creek, Ophir, and Millett. In this segment of the Toiyabe Range, almost every canyon contains small mines and prospects which could be described separately. None of these areas, however, produced such significant amounts of ore that they can stand as separate districts.

Major production from Twin River has been in gold, silver, and tungsten along with minor amounts of lead, zinc and copper. Barite has been produced from Summit Canyon. Mercury and fluorite are reported present, but no production has been recorded for these commodities. Sodium chloride was mined from a salt marsh on the edge of Smoky Valley near Bowman Ranch sometime prior to 1900. The salt was used in early gold-silver milling operations, but none has been mined recently

The first activity in the district followed discovery in 1863 of silver ores at the Murphy (Ophir) Mine in Ophir Canyon. This property is credited with the major production (as much as $750,000 total) from the entire district. Other producing mines were the Giant in Park Canyon, and the Buckeye in Summit Canyon. The districts total production, through 1969, is given as $759,675 (Kleinhampl, 1980).

The eastern portion of the Toiyabe Range, essentially from its crest to the eastern range front, is composed of complex thrust slices of Paleozoic sediments which have been intruded by a linear belt of granitic intrusives. The intrusives form prominent, rugged outcrops in the lower portion of the eastern range front, and the Paleozoic rocks are metamorphosed near the granitic contacts. The complex of Paleozoic sediment-intrusive rocks is overlain to the south and west by large outcrops of Tertiary volcanic rocks, largely welded tuffs.

According to Ferguson and Cathcart (1954), the pre-Tertiary sedimentary rocks of the Twin River district arc composed of the Cambrian Gold Hill Formation, disconformably overlain by the Ordovician Palmetto Formation and unconformably overlain by two Permian Formations (Diablo and Pablo Formations). Wilden (1982, verbal communication) feels that preCambrian rocks may be exposed in one outcrop near the mouth of Ophir Canyon where the Cambrian Gold Hill Formation overlies metamorphic rocks. If these are of preCambrian age, they would be the oldest rocks in the Toiyabe Range. All of the pre-Tertiary Formations are metamorphosed, both due to regional deformation to local plutonism.

There are four major granitic plutons exposed in the district. The largest, the Aiken Creek pluton, is slightly to the north of the district. A smaller granodiorite mass crops out in Ophir Canyon and even smaller exposures occur in Broad and Park Canyons. The granitic plutons are all considered to be Jurassic(?) or younger. The Ophir pluton has been dated at about 54 m.y., the dike at Broad Canyon has been dated at about 30 m.y. (Kleinhampl, 1980). Small bodies of serpentinite crop out throughout the area. They are lensoid and irregular, all are fault bounded and may be serpentinized ultramafics (Kleinhampl, 1980).

Tertiary rocks in the Twin River district consist of thick sections of volcanic rocks which overlie the older rocks. The thick Darrough Felsite crops out between South and North Twin River, but most of the formation lies to the south of the district where it is inferred to fill the cauldron from which it erupted (Kleinhampl, 1980).

Two younger sequences of Tertiary volcanics crop out on the western crest of the range north of North Twin River. The youngest of these, the Toiyabe Quartz Latite is generally unaltered but the oldest, termed the middle volcanic sequence by Kleinhampl, is usually altered and serves as host to some orebodies in parts of the district.

Metallic mineral deposits in the Twin River district include tungsten in skarn deposits near the granitic contacts, base metal-silver deposits as sulfide replacements along veins, usually also near intrusive contacts, and gold-silver occurrences in pyrite hearing quartz veins, again usually in areas near granitic bodies. Barite has been mined from a small, lenticular pod in sediments in Summit Canyon. Mercury and fluorite have been reported from locations within the district, but neither have been produced.

The major tungsten activity has been at the Warfield-New Year-Bottom properties located near the mouth of Ophir Canyon. Scheelite at the Warfield occurs in irregular pods in quartz with some molybdenum and traces of beryllium in calcareous schist near a granodiorite contact (Kleinhampl, 1980). Other small occurrences of tungsten were seen near the mouth of Summit Canyon, where scheelite occurs in a narrow zone in metalimestone, and at small prospects along the range front between Summit Canyon and Timblin Creek which explore poorly developed skarn zones.

The largest of the base metal silver deposits in the district, the Murphy or Ophir Mine in Ophir Canyon, was not active in 1981, and has not produced for many years (produced mainly between 1866-68, and 1935-37). The ore at the Murphy consists chiefly of tetrahedrite, galena, sphalerite with stibnite and pyrite which occurs in a quartz vein. The vein strikes north, dips about 45°E, and is in shale. The mine has been developed to a depth of 360 feet, with several Levels of mining above that. At another base metal-silver deposit, in Park Canyon at the Giant Patent (Nevada Silver Producers, Park Canyon Mine), mine development was in progress during 1981. In the past, mining was done here on sulfide replacement ore (sphalerite, galena, pyrite) which occurs along bedding in a limestone. Some mining was done along a cross fault which cuts the main replacement lens. The replacement orebodies occur in the limestone just south of a limestone granite contact.

The Buckeye Mine, at the mouth of Summit Canyon on the north side of the creek is similar to the Murphy property, but has less extensive workings. Old workings at the Buckeye explore a N40°E quartz vein which follows a shear zone in phyllite. Vein material on the dump contained clots of sphalerite with minor galena and pyrite.

Small quartz-pyrite veins, presumably carrying gold values, were examined at the Gold Pocket (Millett) mine north of Park Canyon, and at an unnamed mine high on the range front south of Park Canyon. At both properties, N55°E-trending veins follow shear zones in granodiorite.

At the Tom Cat claims, south of South Twin River, spotty sulfide mineralization (pyrite, galena) occurs in a silicified shear zone which occurs along a contact between a rhyolite dike and metamorphics (phyllite, greenstone). The dike is sericitized, and the larger quartz grains can be seen, in thin section, to contain euhedral tourmaline crystals.

At the head of Ophir Canyon, and extending to the west, a large area of alteration occurs in older metavolcanic rocks. The rocks are locally iron stained, fractured, silicified and show some kaolinization especially along shear and breccia zones. Specimens found on dumps in this area showed stockworks silica veining, with pyrite, chalcopyrite, galena, barite, and some zoned fluorite. There is evidence here of past exploration, mainly trenching and surface sampling, but the area was not active when visited in 1981.

Most of the prospects and mines visited in the Twin River district were posted with recent claim markers, but the only activity noted was in Park Canyon (Giant Mine), Summit Canyon (Republic Resources Barite) and recent roadwork at Ophir.

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## UNION DISTRICT

The Union mining district is located on the west flank of the southern Shoshone Mountains in Nye County, in T11,12N,R39E. The district is geographically separated into two more or less distinct mining centers, the Berlin-%onearea and the Grantsville area. The district is accessible along good roads from Nevada Highway 25, 50 miles south from U.S. Highway 50 and 55 miles from Austin. The district is partially located in the Ichthyosaur Paleontological National Monument and the Toiyabe National Forest.

The Union district was organized and the towns of Ione and Grantsville established in 1863 after ore was discovered by P. A. Haven. In 1864 Nye County was formed from Esmeralda County, and Ione became the first county seat. The county seat was moved from Ione to Belmont in 1867 and by 1869 mining activity in the district had begun to decline. The district boomed briefly from 1878-1885, but thereafter enjoyed only minor periods of activity up to World War II. Berlin was founded in the 1890's and became the site of mining activity until 1909. The tailings were milled from 1911-1914 and production in the area was sporadic. Hercury was discovered at the Quicksilver property near Ione in 1907 and became the chief commodity from the district up to 1920, with over 10,000 Flasks produced for the period. Afterwards the annual production until 1944 was 50 flasks (Bailey, et al., 1944). There were small production figures for fluorite in the 1950's and for tungsten in 1960. More recently the Standard Slag Company drilled the district in 1971. The district has had nearly continuous activity since its organization producing over $4 million (Kleinhampl, in press), principally from mercury, gold (lode and placer), and silver, with minor amounts of antimony, fluorite and tungsten.

The southern Shoshone Mountains are a narrow, north-northeast trending range on the west side of the Reese River Valley. Silberling (1959) suggests that the rocks underlying the Union district are a window of north-seriking,

east-dipping Permian, Triassic, and Jurassic meta-andesite, clastics and calcareous bedded sediments. Most of the workings are in the Triassic Luning and Grantsville Formations. The sediments are flanked by Tertiary lavas and pyroclastics. Locally the sediments are intruded by Tertiary aplite and rhyolite porphyry dikes and a granodiorite stock intrudes near Ione. Quaternary black lavas cap the volcanic sequence. Locally the sediments are in thrust contact and overturned to the east. The area was deformed in the early Middle Jurassic prior to the emplacement of the Late Mesozoic or early Tertiary granitic intrusions. Localized fold and thrust faults developed, possibly related to the Nevada Jurassic orogeny (Silberling, 1959). East-west transverse faults cur the north-northeast trending normal faults which shape the Shoshone Range. Tingley (1971) suggests that the sediments north and south of Grantsville Canyon are folded into a north trending, south plunging anticline.

The mineral occurrences for the district are as follows: The gold and silver ore lodes occur as replacement deposits in brecciated limestone which are associated with the normal fault zones, in fissure quartz vein deposits, and in shear seams in Tertiary rhyolites (Kral, 1951, Kleinhampl, in press). Ore minerals include argentiferous galena, sphalerite, pyrite, and tetrahedrite. The tungsten minerals are located in the contact metamorphic zone associated with the intrusions. The antimony ore fills fissure veins in the north trending, steeply dipping fractured fault zone in the Luning Formation. Associated with the stibnite is pyrite, copper carbonates, silver and selenium (Kleinhampl, in press). Copper ore (sulfide and carbonate) was mined from east-west shear zones in Triassic metasediments (Kral, 1951). Cinnabar deposits are found at shallow depth in the Triassic clastics following fractures, near gouge zones, as painty films on fracture surfaces, and locally as replacement and disseminated deposits. Cinnabar is also found in Tertiary agglomerates, and in rhyolitic and andesitfc tuffs (Kral, 1951). The fluorite ore is scattered throughout the district and

is associated with the north and west trending fault zones. The ore occurs as small irregular masses in replacement bodies in silicified zones adjacent to the faults. The 1971 drilling by Standard Slag indicated a shallow ore deposit with reserves of over 400,000 tons of 18.5% $CaF_2$ at shallow depth (Papke, 1979).

Union Carbide Corporation has held property in the Crantsville pare of the district for several years, and has been exploring the base metal-tungsten potential of that area.

During the recent (1981) field examination of the district, work was in progress at the Mercury Mining Company Mine, where the previously underground operation was being converted to an open pit. A mill was nearing completion and it appeared that it would soon be in operation.

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## WASHINGTON DISTRICT

The Washington mining district is located on the west side of the Toiyabe Range about 50 km southwest of Austin. Most of the mines and prospects are in several canyons located in T14 and 15N,R42E, in northernmost Nye County.

The recorded production in the district is only approximately $30,008 (Kleinhampl and Ziony, in press), but the amount of workings suggests that there could be considerable unrecorded production. The district was discovered in the early 1860's, and some of the unrecorded production may be from early mining by Mexicans. There are probably over 1000 meters of workings. The district has been intermittently active in the 1920's and 1940's; some claim staking and churn drilling was done in the late 1970's and early 1980's. There was no activity at the time of examination.

The mineral deposits of the Washington district consist predominantly of two types: silver-lead bearing quartz veins in Paleozoic argillite and carbonate rocks, and tungsten mineralization in tactites; The silver-lead quartz veins are reported to contain argentite(?), argentiferous galena, tetrahedrite, sphalerite, stibnite, pyrite, and arsenopyrite as well as the gangue minerals quartz, calcite, and siderite. The ores are also strongly anomalous in bismuth and cadmium (Kleinhampl and Ziony, in press). The sulfide minerals occur as pods, seams, or shoots in quartz veins which range in thickness from a few centimeters to several meters. The veins locally exhibit a symmetrical zoning from sulfide-rich massive quartz matter near the walls to low-sulfide, drusy quartz- and calcite-bearing material near the center of the vein. Kleinhampl and Ziony (in press) report that ores contain up to 20-30% Pb, PO-20% Zn, 0-2% As, and 8-15 oz/ton Ag. Cold was apparently low in the ores. The veins are partially oxidized near the surface, and supergene silver minerals could have been important in the early period of mining. Veins trend both northeast and northwest in the district. The wallrocks are locally somewhat nrgillized near the veins. The mineralization is

most likely pre-Tertiary, and is believed to be related to Mesozoic? plutonic rocks; however, as stibnite is reported from nearby Tertiary volcanic rocks, it is not possible to rule out a Tertiary age.

Tungsten mineralization is reported from the high ridges north of Washington Canyon. Kleinhampl and Ziony (in press) report that the distribution of the tungsten prospects near a granitic pluton suggests that the prospects are reportedly developed in recrystallized limestone. These prospects were not visited during this study.

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# ~~WILD~~ ~~HORSE~~ DISTRICT

The Wild Horse mining district is located approximately 30 miles northwest of Austin in T23N,R40E, in the low rolling hills of the Augusta Mountains. The district is accessible along good, but occasionally washed out dirt roads, north of U.S. Highway 50. With the realignment of Churchill and Lander Counties, the new county line passes through the district and most of the older workings fall in Churchill County, therefore, out of the Eureka-Shoshone project area.

Originally, the Wild Horse district was formed when mercury was discovered in 1916 by Bert McCoy (Dane and Ross, 1942). Mercury was produced for over 20 years from the McCoy and Wild Horse Mines. The only remaining working in the district after the realignment was the Black Devil manganese deposit in the southern part of the district. The Black Devil deposit was discovered in 1954 by G. M. Packard and W. L. Peterson and produced between $5,080 and $100,000 worth of 47.6% manganese ore (Stager, 1977).

The Wild Horse district is located in the Lower and Middle Triassic Augusta Sequence. The lower part of the sequence is chiefly sandstone, shale, and conglomerate, with the upper sequence being limestone, shale, and sandstone. The beds dip gently to steeply west except in the southern part of the district where they dip steeply south and southwest (Dane and Ross, 1942). There is local silicification of the sediments. The beds appear to be a northward continuation of the west dipping homocline structure found in the New Pass Range (Stager, 1977). Locally, the sedimentary rocks are unconformably overlain by Tertiary volcanics: andesite, dacite, ash flow tuffs, and tuffaceous lake sediments. Faulting has resulted in a number of east dipping fault blocks. The Pre-Tertiary rocks of the district are cut with high angle faults with an average northward trend and the downthrown sides to the south (Dana and Ross, 1942). Exposures of outcrops are poor due to alluvium and vegetation.

The workings at the Black Devil manganese deposit consist of a small open pit with a winze, and peripheral prospect pits and dumps that cover several acres. Pods and lenses of wad, pyrolusite, and psilomenlane replace chert and opaline in Miocene volcanic ash and tuffaceous lake sediments. The limonite stained pyroclastics are bleached and weathered to friable masses. Patches of gossanandspecularite occur in the vugs and fractures of the host rock. Gangue minerals include silica, clays, and iron oxides (Stager, 1977). The deposit had been staked in 1979, but no recent activity at the deposit or elsewhere in the district was noted.

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