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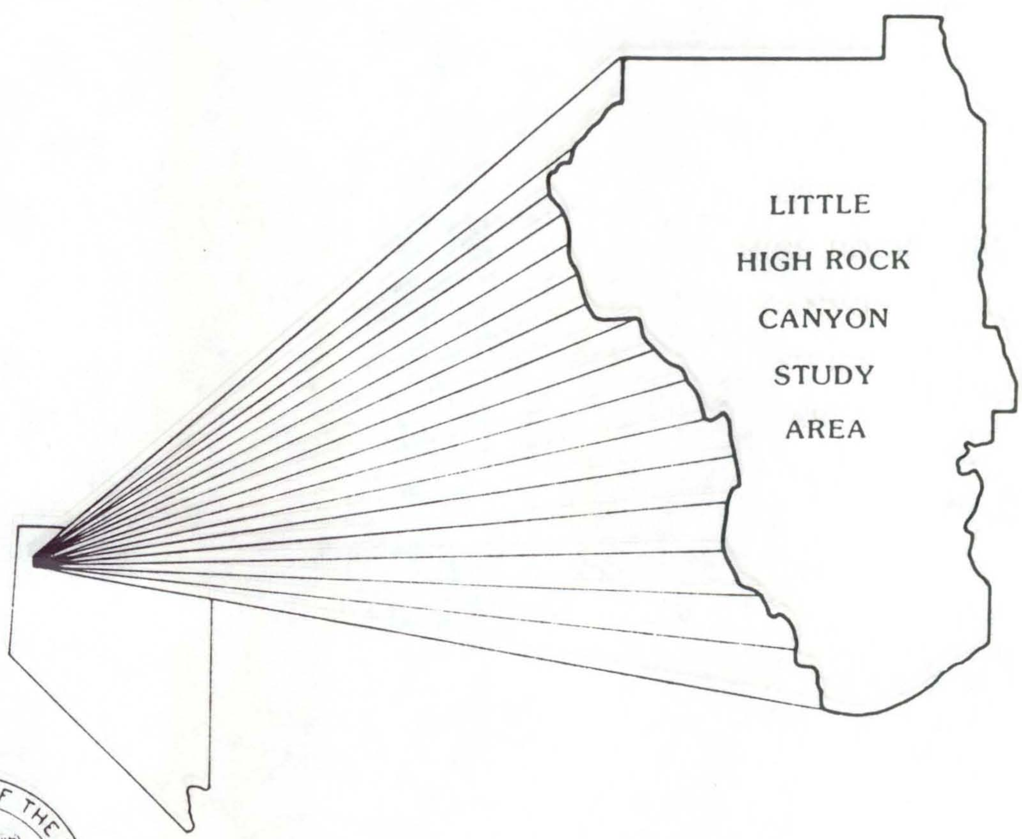
Mineral Resources of the Little High Rock Canyon Study Area, Humboldt and Washoe Counties, Nevada



BUREAU OF MINES

UNITED STATES DEPARTMENT OF THE INTERIOR

MINERAL RESOURCES OF THE LITTLE HIGH ROCK CANYON STUDY AREA, HUMBOLDT AND WASHOE COUNTIES, NEVADA

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PREFACE

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and U.S. Bureau of Mines to conduct mineral surveys on U.S. Bureau of Land Management administered land designated as Wilderness Study Areas ". . . to determine the mineral values, if any, that may be present . . . ." Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a Bureau of Mines mineral survey of a portion of the Little High Rock Canyon Wilderness Study Area (CA-020-913/NV-020-008), Humboldt and Washoe Counties, NV.

This open-file report will be summarized in a joint report published by the U.S. Geological Survey. The data were gathered and interpreted by Bureau of Mines personnel from Western Field Operations Center, East 360 Third Avenue, Spokane, WA, 99202. The report has been edited by members of the Branch of Mineral Land Assessment at the field center and reviewed at the Division of Mineral Land Assessment, Washington, D.C.

CONTENTS

ILLUSTRATIONS

TABLE

SUMMARY

In 1985, at the request of the U.S. Bureau of Land Management, the U.S. Bureau of Mines studied a 17,320-acre portion of the 52,143-acre Little High Rock Canyon Wilderness Study Area (CA-020-913/NV-020-008) in order to evaluate its identified mineral resources. The study area is located in Humboldt and Washoe Counties, NV, about 42 miles north from Gerlach.

Three areas of epithermal alteration, similar to alteration associated with disseminated gold deposits, were found in the study area. One of the areas occurs along a northeast-trending structural lineament. Southwest of the study area two gold prospects undergoing active exploration, as well as a gold deposit being prepared for production, occur along the same lineament. The Bureau of Mines examination, however, did not find evidence for gold resources in the study area.

There are 2 million tons of exposed perlitic material in and adjacent to the study area at the base of a rhyolite flow, but an expansion test in a vertical furnace indicates the product is only suitable for aggregate. There are 28 million tons of pozzolanic tuffaceous sediments in and adjacent to the study area, but expensive processing would be needed for the material to meet required standards. Both industrial mineral deposits are not classified as resources because they are poor quality and remote.

A group of uranium claims, now inactive, was located in the area of the pozzolan prospect in 1954. Uranium oxide concentrations were found in scattered petrified tree parts within tuffaceous sediment, but were too low to indicate the presence of a resource.

INTRODUCTION

This report describes the USBM (U.S. Bureau of Mines) portion of a cooperative study with the USGS (U.S. Geological Survey) to evaluate mineral resources and resource potential of the Little High Rock Canyon study area at the request of the BLM (U.S. Bureau of Land Management). The USBM examines individual mines, prospects, claims, and mineralized zones, and evaluates identified mineral and energy resources. The USGS evaluates potential for undiscovered resources based on areal geological, geochemical, and geophysical surveys. Results of the investigations will be used to help determine the suitability of the study area for inclusion into the National Wilderness Preservation System. Although the immediate goal of this and other USBM mineral surveys is to provide data for the President, Congress, government agencies, and the public for land-use decisions, the long-term objective is to ensure the Nation has an adequate and dependable supply of minerals at a reasonable cost.

Setting

The study area consists of 17,320 acres within the 52,143-acre Little High Rock Canyon WSA (Wilderness Study Area) in northeastern Nevada. The area is mainly in Washoe County, but a 1/2 mi-wide strip along the southeastern boundary is in Humboldt County. Access is north from Gerlach (42 mi) or southeast from Vya (42 mi) on Nevada State Route 34, which is mainly gravel. Four-wheel-drive dirt roads extend northeast to the study area from Route 447 (fig. 1).

The topography is rolling, with broad irregular mesas edged with discontinuous reddish-brown cliffs, and equally broad intermittent drainages. Two spectacular canyons, Little High Rock and McConnel, cut northeast across the study area. Elevations range from less than 4,960 ft, near the mouth of Little High Rock Canyon, to 6,474 ft in the south central part of the study area (fig. 2).

The climate is temperate and semiarid; most precipitation falls in the cold months as rain and snow. Vegetation consists mainly of bunch grass and sagebrush. Wildlife includes antelope, mule deer, and wild horses, and beaver along Little High Rock Creek.

Previous Studies

The general geology of the Little High Rock Canyon study area is included in county reports by Bonham (1969) and Willden (1964). The study area was also included in a regional aerial radiometric and magnetic survey by Geodata International, Inc. (1979) and in a regional geochemical and geostatistical evaluation of twenty WSA's by Connors and others (1982). Findings in the report by Conners and others relevant to the Little High Rock Canyon WSA are summarized in a BLM draft environmental impact statement (U.S. Bureau of Land Management, 1984, p. 3-68 through 3-70 and 3-72a. The Bureau of Mines WFOC (Western Field Operations Center) previously evaluated the High Rock Lake WSA (Neumann and Close, 1985), adjacent to, and east of the Little High Rock Canyon study area.

Present Study

During July 1985, WFOC personnel conducted field examinations of the Little High Rock Canyon study area; concurrently, personnel studied the High Rock Canyon (Scott, 1987) and East Fork of High Rock Canyon (Schmauch, 1986) study areas. Available information on the geology and mineral resources of the Little High Rock Canyon study area, including BLM and Washoe County mining records, and the USBM MILS (Mineral Industry Location System) files, was reviewed prior to field work. Field examination, included mapping and sampling of prospects and mineralized areas.

A total of 269 samples, including 117 rock, 106 soil, and 46 placer samples, were taken in or adjacent to the study area. Thirty-seven placer samples contained no free gold and are unnumbered on maps and tables in the appendices. Three types of rock samples were taken: chip--a series of continuous chips across laminar structures such as

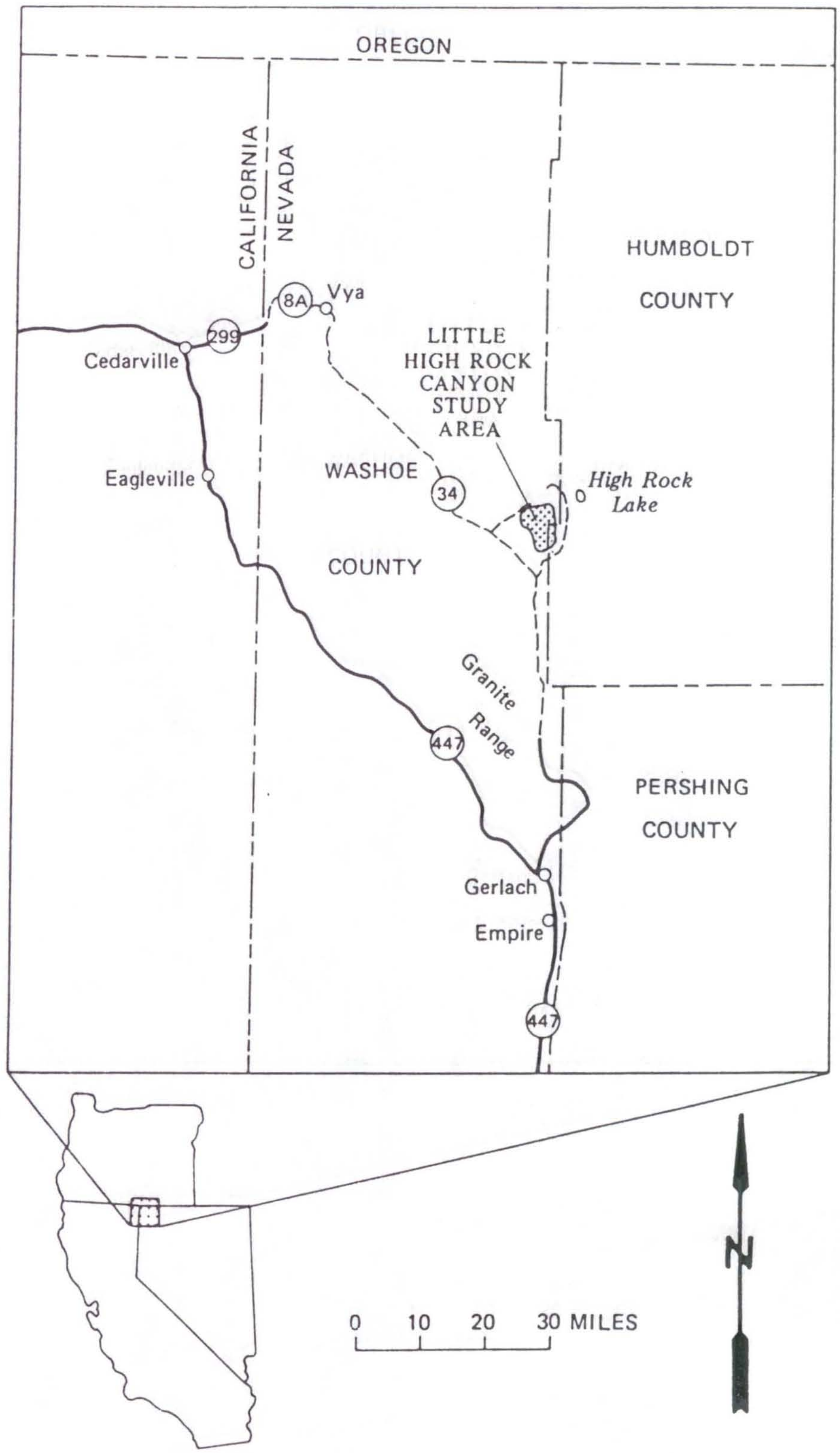

FIGURE 1.– Location of the Little High Rock Canyon study area, Humboldt and Washoe, Counties, NV

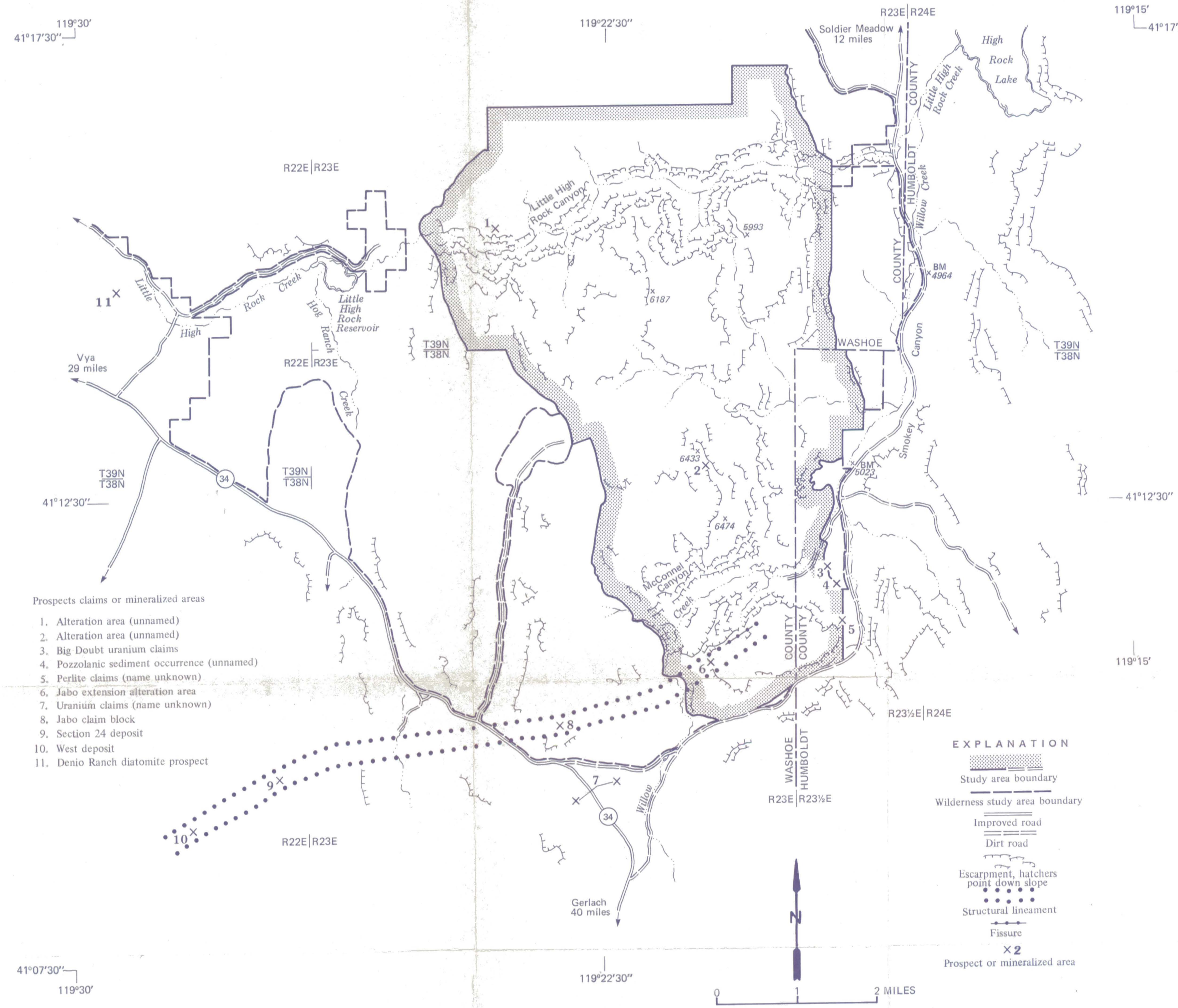

FIGURE 2.– Prospects, claims, and mineralized areas in the Little High Rock Canyon study area and vicinity, Humboldt and Washoe Counties, NV

bedding, veins, and faults; random chip--chips taken at random intervals from apparently homogenous outcrops; grab--a sample of detached rock chips (float) from soil. Soil samples were taken from the B horizon, and were also of two types: soil grid--samples taken along a set of compass lines, using a hip-chain for spacing control; soil grab--samples from an area of interest where rock or placer samples are not available. Placer samples were all placer grab--samples consisted of a measured volume of alluvium, which was partially concentrated in the field, when possible, by washing. A 14-in. diameter gold pan used in this study holds 1/250 of a cu yd (cubic yard) when filled level; each sample consisted of two level pans, or 0.008 cu yd. All samples were checked for radioactivity and fluorescence at WFOC.

Rock and soil samples were crushed and/or pulverized and sent to the USBM Reno Research Center, Reno, NV, for analysis. Most of the rock samples (85) and the soil samples (106) were analyzed for gold, silver, arsenic, antimony, and barium because of suspected disseminated gold mineralization. Many were analyzed for mercury, and some for other selected elements. Some (24 samples) were analyzed by whole rock analysis for silica and other elements to determine their industrial mineral significance. Fifteen rock samples were analyzed for uranium. Rock samples analyzed for metals weighed 5 to 10 lb (pound). Gold and silver were analyzed by combined fire assay-ICP (inductively coupled plasma) methods. Other elements were analyzed by various atomic absorption, ICP, colorimetric, and X-ray fluorometric methods. Detection limits in ppm (parts per million) were: gold, 0.007; silver, 0.3; arsenic, 2; antimony, 2; barium, 50; mercury, 2; and uranium, 0.5.

Twenty-four tuffaceous sediment samples were analyzed for industrial mineral value. The samples, which weighed between 10 and 60 lb, were examined for clay, zeolites, and other minerals by semiquantitative X-ray diffraction, and analyzed for major element content (ICP) and loss on ignition (wet chemical) as a screen for pozzolan suitability. All samples contained sufficient Al_2O_3, Fe_2O_3, and SiO_2 to meet the American Society for Testing and Materials (1985) standard of a combined minimum of 70 percent. Three pozzolan samples were subjected to 28-day compressive strength of pozzolan blend of cement (pozzolan activity index) tests. The pozzolan activity index tests were carried out by the structures laboratory, U.S. Army Corps of Engineers, Vicksburg, MS.

Eight perlite samples were taken and checked microscopically for perlitic texture and refractive index. One perlite sample was subjected to expansion in a vertical furnace, and tested for expanded density, furnace yield, percent sinkers, compacted density and compaction resistance. Perlite expansion was done by the New Mexico Bureau of Mines and Mineral Resources at Socorro, NM.

Placer samples were concentrated on a laboratory-size Wilfley table at WFOC, and examined for free gold and other heavy minerals. Sample data was manipulated and statistically analyzed, and soil grid data was contoured, on a Tektronix 4054 computer and peripheral accessories.

ACKNOWLEDGEMENTS

The authors are grateful to Siegfried Holso and Ralph Barnard of Ferret Exploration, Carl W. Herring and Paul Glavinovich of Noranda Exploration, and Fred T. Saunders and Jeffrey Wilson of Tenneco Minerals for permission to examine their companies' gold deposits, and for helpful technical advice and information on disseminated gold in the vicinity of the study area. Robert R. Swinney, Lassenite Industries, contributed helpful information on natural pozzolan. Joseph McFarlan and Richard Wessman, of the BLM, Cedarville, CA, provided much helpful information, and also helped with logistical arrangements. James A. Canwell, WFOC, did much of the microscopic work on the industrial mineral samples.

MINING HISTORY

The only historical mineral production from the vicinity of Little High Rock Canyon was from the Leadville district (Bonham, 1969, p. 67-69), 6 mi south of the study area and 1 mi west of Nevada Route 34. The Leadville mine produced over 1.3 million oz (troy oz) silver and 4.9 million lb lead from 1910 through 1927. The ore was hauled to Gerlach, NV by wagon, and on to Salt Lake City, UT, by train.

The Denio Ranch diatomite prospect occurs west of the study area (fig. 2, no. 11). Perlite claims, name unknown, were located in 1951 within and contiguous to the southeast corner of the study area (fig. 2, no. 5). Work began in September 1954 on the Big Doubt (uranium) Group fig. 2, no. 3), which also straddled the study area boundary. A similar area of uranium prospect pits (no known names) occurs southwest of the study area along both sides of route 34 (fig. 2, no. 7) and was discussed briefly by Garside (1973, p. 98, locality no. 7).

Two active claim blocks cover disseminated epithermal gold prospects west of the study area, and are being explored by mining companies. The Jabo claim block (fig. 2, no. 8), owned by Tenneco Minerals, is adjacent to the study area, and is within the Little High Rock Canyon WSA. Tenneco drilled eight holes on the Jabo during 1984, and was sufficiently encouraged by the results to justify a 35-hole drilling program in 1986.

Directly west of the Jabo Group is the Hog Ranch property, originally a uranium prospect, which is owned by Ferret Exploration. The Hog Ranch Group contains two mineralized areas: a north area which includes the Section 24 and West deposits (fig. 2, nos. 9 and 10, respectively) and a south area (not shown). As of May 1985, a total of 384 holes had been drilled on the Hog Ranch property. During the summer of 1985, the BLM granted permits for 35 more holes; in 1986, 25 of the holes were drilled on the Section 24 deposit, and 4 holes were drilled on the West deposit (Joseph McFarland, BLM-Cedarville, CA, oral commun.). Ferret is initially developing the Section 24 deposit and plans to begin processing ore at the rate of 800,000 tons annually by 1987 (Rocky Mountain Pay Dirt, March 1986, p. 31A).

There are no active or patented mining claims in the study area.

GEOLOGIC SETTING

The study area is underlain by the Canyon Assemblage (Bonham, 1969, p. 10-22), which includes the Oligocene South Willow Creek Formation (primarily andesite), the Miocene Canon Rhyolite, and the Miocene to Pliocene High Rock Sequence (tuffaceous sediments) and minor basalt. The South Willow Creek Formation is highly altered in the Leadville district near lead-silver-bearing veins, and is overlain by unaltered Canon Rhyolite (Bonham, 1967, p. 67), indicating mineralization predated the rhyolite. The formation does not crop-out, but probably occurs at depth in the study area. Study area outcrops are mainly Canon Rhyolite and High Rock sediments, units which host epithermal and industrial mineral occurrences in and near the study area.

The rhyolite is light reddish-gray, weathers brown, and is characterized by thin flow laminae. Vertical and contorted flow banding along ridges indicate formation by fissure eruption along lineaments, which extend radially from several volcanic centers in and near the study area. Eruptive fissures are the locus of epithermal alteration at two study area sites (fig. 2, nos. 2 and 6). The base of flows is typically perlitic, especially over waterlain tuffaceous sediment.

High Rock tuffaceous sediments are grayish-white to cream-colored. Nineteen of 24 tuffaceous industrial mineral samples taken by the USBM contained over 30 percent montmorillonoid clay (23 samples over 10 percent clay) indicating devitrification of glass shards in a fluviolacustrine environment (Bonham, 1969, p. 16). One sample contained 10 percent diatoms, but no commercially significant diatomite was found. None of the samples were bentonitic or zeolitic in character, but the sediment is pozzolanic. There are two tongues of sediment in the study area. A lower tongue crops-out along the eastern boundary in Smokey Canyon (fig. 2) between 5,050 and 5,200 ft in elevation, and is exposed southeast of McConnel Canyon where it hosts the Big Doubt uranium claims, and a pozzolan occurrence (fig. 2, nos. 3 and 4). The tongue can be traced 2 mi up Little High Rock Canyon before it dips out of sight. The lower tongue may correlate with an extensive sediment outcrop area west of the study area, but within the WSA. An upper tongue crops-out between 5,600 and 5,800 ft in the central part of, and southwest of the study area along Highway 34 where it hosts numerous prospect pits (fig. 2, no. 7).

Structurally, the study area is within a high plateau which has been relatively stable since the late Miocene (Bonham, 1969, p. 47-48). Minor high-angle faults trend N. 40° W., N. 20° W., N-S, and N. 60° E., and affect the location and continuity of epithermally mineralized zones. The N. 60° E. trend is seen in the orientation of McConnel Canyon (fig. 2), a broad rectangular depression which may be a small graben partially inundated by basalt. Four disseminated gold prospects occur along a northeast structural lineament (fig. 2) which borders the south side of McConnel Canyon. Siegfried Holso (Ferret Exploration, 1985, oral commun.) believes the lineament extends radially from a caldera several miles west of the study area (inferred from mapping by Bonham, 1967, pl. 1). Greene and Pluoff (1981, p. 5) postulate a hidden caldera several miles north of the study area based on gravity and aeromagnetic maps.

MINES, PROSPECTS, CLAIMS, AND MINERALIZED AREAS

There are no mines in the study area, however, six mineral occurrences have been identified. These are discussed together with five similar or related prospects near the study area (fig. 2). Three disseminated epithermal gold prospects near the study area (fig. 2, nos. 8, 9, and 10) are being actively explored or developed, and indications of similar mineralization were found at three alteration areas within the study area (fig. 2, nos. 1, 2, and 6). Uranium, pozzolanic tuffaceous sediment and perlite are also represented in study area occurrences (fig. 2, nos. 3-5). Data from all occurrences within the study area are summarized in table 1, following this section.

Epithermal Prospects

The Section 24 deposit, West deposit, Jabo prospect, and Jabo extension (fig. 2, nos. 9, 10, 8, and 6), occur along the same northeast structural lineament. The geology of these four sites as observed through discontinuous outcrop areas (natural or excavated), is extremely varied, but with some common features.

During July 1985, the Section 24 deposit was exposed in two 200- by 30-ft trenches from which bulk samples had been removed for metallurgical tests (Ralph Barnard, Ferret Exploration, oral commun.). Mineralization occurred near the base of a kaolinized and silicified tuffaceous sediment bed and in an underlying silicified rhyolite flow (north trench), and near the top of a tuffaceous bed and in an overlying silicified rhyolite flow (south trench). The northeast-trending lineament is represented by a fault which bisects the deposit between the trenches. The Section 24 deposit appears to be a volcanic sediment equivalent of the Carlin (Nevada) deposit which is in calcareous sediments (Carl Herring, Noranda Exploration, and Fred Saunders, Tenneco Minerals, 1985, oral commun.). The West deposit is probably similar to the Section 24, but is not yet as well understood. Deposit area characteristics include white-colored silicified outcrops and anomalous concentrations of the pathfinder elements, arsenic, antimony, and mercury in rock and soil.

The Jabo prospect (fig. 2, no. 8) consists of a fresh water, fossil reed-bearing siliceous hot spring sinter, deposited within and over rhyolite flows and tuffaceous sediments, which is intruded by a diapiric breccia, with clasts of varied lithologies, including sinter, rhyolite and andesite. Both the sinter and the breccia are gold-bearing (Fred Saunders, Tenneco Minerals, 1985, oral commun.). Anomalous pathfinder elements in rock and soil include arsenic, antimony, and mercury. The sinter deposit is bordered by unmineralized South Willow Creek andesite to the west, which forms the upthrown side of a north-south high angle fault which postdates the northeast lineament.

The Jabo extension (fig. 2 and table 1, no. 6, appendix C) appears to be a silicified northeast-trending volcanic vent. Flow-banding in the lineament zone (fig. 2) strikes east-northeast and dips vertically, or is highly contorted. To the south, flow bands dip gently north toward the vent, and the rhyolite is less silicified and increasingly kaolinized. Farther south, along the southeast face of the mesa near the southeast boundary of the study area, banding is relatively flat or locally dips gently south, and the rhyolite is unaltered. Arsenic anomalies are defined by rock and soil samples, but antimony and mercury anomalies are lacking (appendices E and H). A 40-ft-wide fissure on the east side of the prospect area (fig. 2, no. 6, appendix C) strikes N. 57° E., dips 90°, and is filled with flowbanded, vesicular, partially devitrified obsidian, which is kaolinized and silicified and contains cobble- and boulder-sized rhyolite clasts. The fissure appears to be predominantly a volcanic feature, rather than a later hydrothermal alteration phenomena. It is capped by rhyolite to the east and west, but is exposed on the sides of a small box canyon (open to the north), which may represent an exhumed volcanic vent. Aerial photographs and contoured data from a USBM soil sample grid (appendix I) on the west side of the alteration zone along the study area boundary suggest the northeast lineament is cut by north-south and northeast-trending faults.

To reiterate, these four sites (fig. 2, nos. 6, 8, 9, and 10), although geologically varied, occur along the same northeast lineament and, are similarly altered. Alteration at them is characterized by a silicified core area, an increase in argillization peripherally, and a high concentration of arsenic relative to expected crustal abundance (Parker, 1967, p. D13-D14). Siegfried Holso (Ferret Exploration, 1985, oral commun.) also noted an outer zone of opalization peripheral to argillization at the Section 24 and West deposits (fig. 2, nos. 9 and 10).

Two smaller areas of epithermal alteration were noted in the study area. A sill-like zone of yellowish-brown chalcedony crops out along the north wall of Little High Rock Canyon (fig. 2 and table 1, no. 1). An area of silicified rhyolite with chalcedony void-fillings occurs along a ridge in the central part of the study area (fig. 2 and table 1, no. 2).

Industrial Mineral and Energy-Related Occurrences

Tuffaceous sediment with pozzolanic qualities (U.S. Bureau of Mines, 1969, p. 1) occurs throughout the study area, but in most places it is capped by rhyolite, discontinuous due to erosion, or relatively inaccessible. A total of 24 pozzolan samples (appendices A and B) were taken. Eleven of the samples came from a 130-acre occurrence southeast of McConnel Canyon (fig. 2 and table 1, no. 4, appendix B), which includes approximately 28 million tons of well-stratified montmorillonitic tuffaceous lake sediment over 100 ft thick in many places. The base of the deposit is readily accessible by an unimproved road along the east side of the study area. Chemically, $SiO_2 + Al_2O_3 + Fe_2O_3$ (silica plus alumina plus iron oxide) exceeded 70 percent and MgO (magnesium oxide) was less than 5 percent in all samples, and LOI (Loss on Ignition) was less than 10 percent for most samples (table 1, no. 4; appendix E), indicating the sediment is mainly within the range of natural pozzolans. The alkali-metal oxides, K_2O + Na_2O (potassium-oxide plus sodium oxide), appear to exceed the 1.5 percent maximum in all samples (American Society for Testing and Materials, 1985); however, the alkalies are not available to the pozzolan reaction because they occur mainly as relatively inert feldspar minerals, and should not affect pozzolan suitability.

Three samples from the occurrence, representing fairly complete stratigraphic thicknesses at two locations, were subjected to a 28-day Pozzolan Activity Index with Portland cement test. One sample exceeded the required compressive strength of 75 percent of the 4870 psi (pounds per square inch) control cube strength. None of the samples were within the maximum allowable water requirement of 115% of the control cube requirement (Toy S. Poole, Cement and Pozzolan Unit, Army Corps of Engineers, 1985, written commun.). High water requirements of the samples are probably caused by the montmorillonoid clay content (Robert R. Swinney, Lassenite Industries, 1986, oral commun.).

Perlite is common in the study area at the base of rhyolite flows, especially where flows were extruded over tuffaceous waterlain sediments, which is in contrast to most commercial deposits which formed as rhyolite domes (Kadey, 1983, p. 997). Seven perlite samples from the study area had refractive indices of 1.496 ($\pm$ 0.004), similar to commercial perlite (Kadey, 1963, p. 334). The main perlite occurrence (fig. 2 and table 1, no. 5, appendices B, E) occurs south of the pozzolan occurrence. Approximately 2 million tons of perlitic material is present in a north- to northwest-trending 2,600-ft-long by 200- to 400-ft-wide belt (Appendix B) along the northeast-facing slope of a rhyolite mesa. The perlite is capped by rhyolite to the southwest and removed by erosion to the northeast; a few thin discontinuous patches cap the pozzolanic deposits. One of four perlite samples from the prospect, which was subjected to expansion in a vertical furnace, indicates the perlite has a high expanded density making it unsuitable to "lighter weight" uses, such as filter aid or cryogenics; however, high compaction resistance (table 1, no. 5) would make the product excellent for building and construction product end uses (James M. Barker and John S. Hingtgen, New Mexico Bureau of Mines and Mineral Resources, 1985, written commun.).

Uranium occurs at the Big Doubt prospect (fig. 2 and table 1, no. 3; appendix B) in scattered petrified tree parts in the upper part of the pozzolanic deposits. Uranium concentrations were minor; all samples contained less than 0.2 lb per ton (Appendix D). Uranium also occurs in association with petrified wood (Garside, 1973, p. 98) southwest of the study area (fig. 2, no. 7).

Approximately 1,640 acres of the southeastern portion of the study area (the Humboldt County portion) is considered prospectively valuable for geothermal energy (U.S. Bureau of Land Management, 1984, p. 3-69 and 3-72a). This designation is probably related to the proximity of a known geothermal resource area about 12 miles northeast at Soldier Meadow (Joselph McFarland, 1986, oral commun.). Surface evidence for geothermal activity was not observed.

TABLE 1.--Prospects, claims, and mineralized areas in the Little High Rock Canyon study area, Humboldt and Washoe Counties, NV

[Asterisk (*) indicates prospect straddles the study area boundary]

Map no.	Name	Summary	Workings and production	Sample and resource data
1	Alteration area (unnamed)	A 5- to 30-ft-thick sill-like zone of limonite-colored and black chalcedony and opal extends for approximately 0.5 mi along the north wall of Little High Rock Canyon. Similar irregular void-fillings and veins, 0.5 to 2 ft thick, are fairly common in the west and central part of the study area north of the canyon.	None.	Six chip samples (appendix A) from the sill-like zone, two chip samples from dikes, and two grab samples were taken. Gold was not detected. Silver was detected in two samples; 0.79 and 0.55 ppm (appendix D). Antimony was detected in seven samples; 3 to 5 ppm. Arsenic, detected in all samples, ranged from 4 to 170 ppm. No resources were found, but pathfinder elements indicate epithermal mineralization has occurred.,
2	Alteration area (unnamed)	An approximately 60-acre area of intensely silicified and commonly brecciated gray rhyolite occurs along a north-northwest-trending ridge. Chalcedony and opal are locally common as small fracture- and irregular void-fillings.	None.	Three chip, one grab, and two soil grab samples (appendix A) contained no detectable gold or silver (appendix D). Antimony was detected in one sample; 3 ppm. Arsenic, detected in all samples, ranged from 8 to 29.7 ppm. No free gold was found in a placer grab sample. No resources were found, but pathfinder elements indicate epithermal mineralization has occurred.
3*	Big Doubt uranium claims	Scattered fossil tree parts, partially replaced with silica and occurring near the top of a sequence of tuffaceous sediments, emitted up to 250 cps (counts per second) gamma radiation (40-50 cps background). Co-extensive with prospect no. 4.	One 10-ft-long adit and at least 12 small prospect pits, approximately 15 ft by 10 ft by 5 ft deep. No production is recorded or indicated by excavations at the site.	Ten rock samples taken from fossil tree parts contained 28 to 84 ppm uranium (0.07 to 0.2 lb/ton U_3O_8) (appendices B, D). Resources are not indicated because of insufficient grade and tonnage. Petrified tree parts are potentially of value to collectors.
4*	Pozzolanic sediment occurrence (unnamed)	A 100-ft-thick pile of poorly consolidated water-lain tuffaceous sediment with pozzolanic qualities occurs as a partially dissected mesa over an 130-acre area east of the mouth of McConnell Canyon. The deposit is readily accessible from an unimproved road along the east side of the prospect, and is not capped by overburden requiring stripping, except for a few local 10-ft-thick patches of unconsolidated perlite. Coextensive with prospect no. 3.	None.	Ten chip samples from the occurrence contained 59.1 to 71.0% $SiO2$, 12.9% to 20.3% Al_2O_3, 1.3% to 6.0% Fe_2O_3, 0.21% to 0.99% MgO, 1.9% to 7.2% K_2O, and 1.1% to 1.8% Na_2O (appendices B, E). LOI ranged from 5.51 to 10.57%. No samples passed all chemical standards. Three samples (appendix E, nos. 72, 82, and 83) subjected to a 28-day Pozzolan Activity Index with Portland cement had compressive strengths of 3950, 3250, and 3400 psi (pounds per square inch), water requirements of 127%, 124%, and 122% were above ASTM maximums. Specific gravity was 2.54, 2.51, and 2.43, respectively. The pozzolan occurrence contains 28 million tons (at 12.8 ft^3/ton) of material 1/, 14 million tons within, and 14 million tons contiguous to the study area.

TABLE 1.--Prospects, claims, and mineralized areas in the Little High Rock Canyon study area, Humboldt and Washoe Counties, NV--Continued

Map no.	Name	Summary	Workings and production	Sample and resource data
5*	Perlite claims (name unknown)	An approximately 2,600-ft-long by 200- to 400-ft-wide belt of dark gray perlite trends north to northwest along the northeast facing slope of a rhyolite mesa. The perlite, which apparently formed as a chill zone at the base of the rhyolite, is approximately 50 ft thick along the southwest margin of the belt where it extends under the rhyolite; it pinches-out along the northeast margin of the belt because of erosion, giving an average thickness of 25 ft.	Four trenches, 40 ft by 7 ft by 4 ft deep, 50 ft by 6 ft by 4 ft deep, 13 ft by 2 ft by 2 ft deep, and 40 ft by 12 ft by 6 ft deep, are spread over a distance of approximately 700 ft from north to south along the length of the deposit. No production is indicated by excavations at the site.	Four perlite chip samples (appendices B, E) had refractive indices of 1.496 ($\pm$ 0.004). Data from one sample expanded in a vertical furnace includes: expanded density--10.7 lb/ft^3; furnace yield--97%; sinkers (unexpanded fraction--11%; compacted density--14 lb/ft^3; compaction resistance--280 lb/in^2 (at 1 in.), --410 lb/in^2 (at 2 in.). Tests indicated the material is unsuitable for lightweight aggregate, but suitable for end use such as road material. The perlite occurrence contains 2 million tons (at 12.6 ft^3/ ton of material 1/, 1 million tons within and 1 million tons contiguous to the study area.

TABLE 1.--Prospects, claims, and mineralized areas in the Little High Rock Canyon study area, Humboldt and Washoe Counties, NV--Continued

Map no.	Name	Summary	Workings and production	Sample and resource data
6*	Jabo extension alteration area	An area of altered rhyolite extends over more than 320 acres in the vicinity of a northeast-trending structural lineament which extends into the southern part of the study area from the west (fig. 2). In the study area, the lineament appears to have been the locus of an elongate rhyolitic vent, marked by vertical or highly contorted flow bands. A northeast-trending fissure, 40 ft wide and over 1,000 ft long, formed within the vent. Subsequent epithermal mineralization was marked by silicification, local kaolinization, and the introduction of arsenic.	None. Southwest of the study area along the same structural lineament, two disseminated gold prospects are being actively explored and a third is undergoing pre-production development.	A total of 102 soil grid, 35 rock, 2 soil grab, and 15 placer grab samples were taken. Four north-south soil lines, 600 ft apart and approximately 6,000 ft long, were run across the northeast lineation west of the prospect symbol (fig. 2, no. 6, appendix C) along the study area boundary between the unimproved road on the south and McConnel Canyon on the north; sample spacing was 300 ft. Gold was detected in 92 soil samples (0.017 to 0.287 ppm), silver in 21 (0.35 to 23.2 ppm), mercury in 11 (2 ppm), arsenic in 63 (3 to 15 ppm), and barium in all samples (430 to 1060 ppm); antimony was not detected (<2 ppm). Contours of arsenic and barium soil data (appendix I) show the northeast-trending lineament; mafic rocks in McConnel Canyon are the source of elevated barium along the north boundary of the grid area. A crosscutting north-south fault is suggested by gold contours, and a N. 20° E. fault by mercury and silver contours. Thirty-five rock and 2 soil grab samples were taken in and near the alteration area, including two samples from the volcanic fissure northeast of the prospect symbol (fig. 2, no. 6, appendix C). Gold, mercury, and antimony were not detected, and silver (1.198 ppm) was found in only one sample. Arsenic, however, was detected in 22 samples (3 to 100 ppm). Barium, detected in all samples, had a wide range of values (14 to 1900 ppm). Placer grab samples were taken from stream beds; six of 15 samples contained free gold [0.003 to 0.038 mg (milligrams)]. No resources were found, but pathfinder elements indicate epithermal mineralization has occurred.

1/ The "material" is not designated "resources" because factors such as product quality and distance to markets make mining unlikely.

APPRAISAL OF MINERAL RESOURCES

There are no prospects or mineralized areas with identified resources (U.S. Bureau of Mines and U.S. Geological Survey, 1980, p. 1) within the Little High Rock Canyon study area.

Three study area occurrences hold the possibility of gold deposits (fig. 2, nos. 1, 2, and 6) because the rhyolite has been epithermally altered, mainly by silicification and the introduction of arsenic, a pathfinder element that commonly indicates the presence of disseminated gold in the vicinity (Lewis, 1982, p. 56-57). The Bureau of Mines did not find significant gold values at prospects in the study area, even within a favorable-looking fissure structure at the Jabo extension (appendix C and E, nos. 94 and 95). Disseminated gold may occur at depth, but a low-grade disseminated deposit that is not at, or near, the surface cannot be economically mined. Pathfinder element concentrations do not indicate the presence of an economic gold deposit in the study area (see Silberman and Berger, 1985), but the possibility of such an occurrence cannot be ruled out.

The pozzolanic sediment occurrence (fig. 2 and table 1, no. 4) contains 28 million tons of material. Most pozzolan used in the United States is fly ash, a by-product of coal-fired furnaces. Perhaps the only domestic producing natural pozzolan deposit, Lassenite Industries mine at Doyle, CA, is located at a rail head. The Lassenite product is calcined (roasted) to ensure a low water requirement, but calcining alone would probably not produce a suitable product from pozzolanic material in the study area; montmorillonoid clay would also need to be removed. Remoteness, coupled with expensive processing, make exploitation of the deposit unlikely.

The perlite occurrence (fig. 2 and table 1, no. 5) contains approximately 2 million tons of material, is considerably smaller than typical economic deposits, which generally exceed 10 million tons. More importantly, however, the occurrence is 45 mi from the nearest railhead at Gerlach (including 4 mi of unimproved and 25 mi of gravel road). In addition, the perlite is only suitable for aggregate, a high bulk-low value end use, and firing produces large sinker fraction (table 1, no. 5), which is inefficient. Alternate materials can be substituted for all uses of perlite, if necessary (U.S. Bureau of Mines, 1986, p. 115).

Mining of perlitic and pozzolanic materials from the study area could conceivably be feasible if a major local construction project were required by a government agency such as the U.S. Bureau of Reclamation, Department of Defense, or Department of Energy. Product quality and remoteness, however, preclude the usefulness of these materials to the general economy for the foreseeable future, and large amounts of these materials, of equal or better quality, occur in the vicinity of the study area.

Uranium occurrences at the Big Doubt prospect (fig. 2 and table 1, no. 3) are too low in grade and too scattered to be of economic interest. The best material found, 0.2 lb per ton U_3O_8, is only worth \$3.45 per ton at a price of \$17.25 per lb U_3O_8 (Engineering and Mining Journal, May 1986, p. 9). No evidence was observed for geothermal or other possible mineral resources within the study area.

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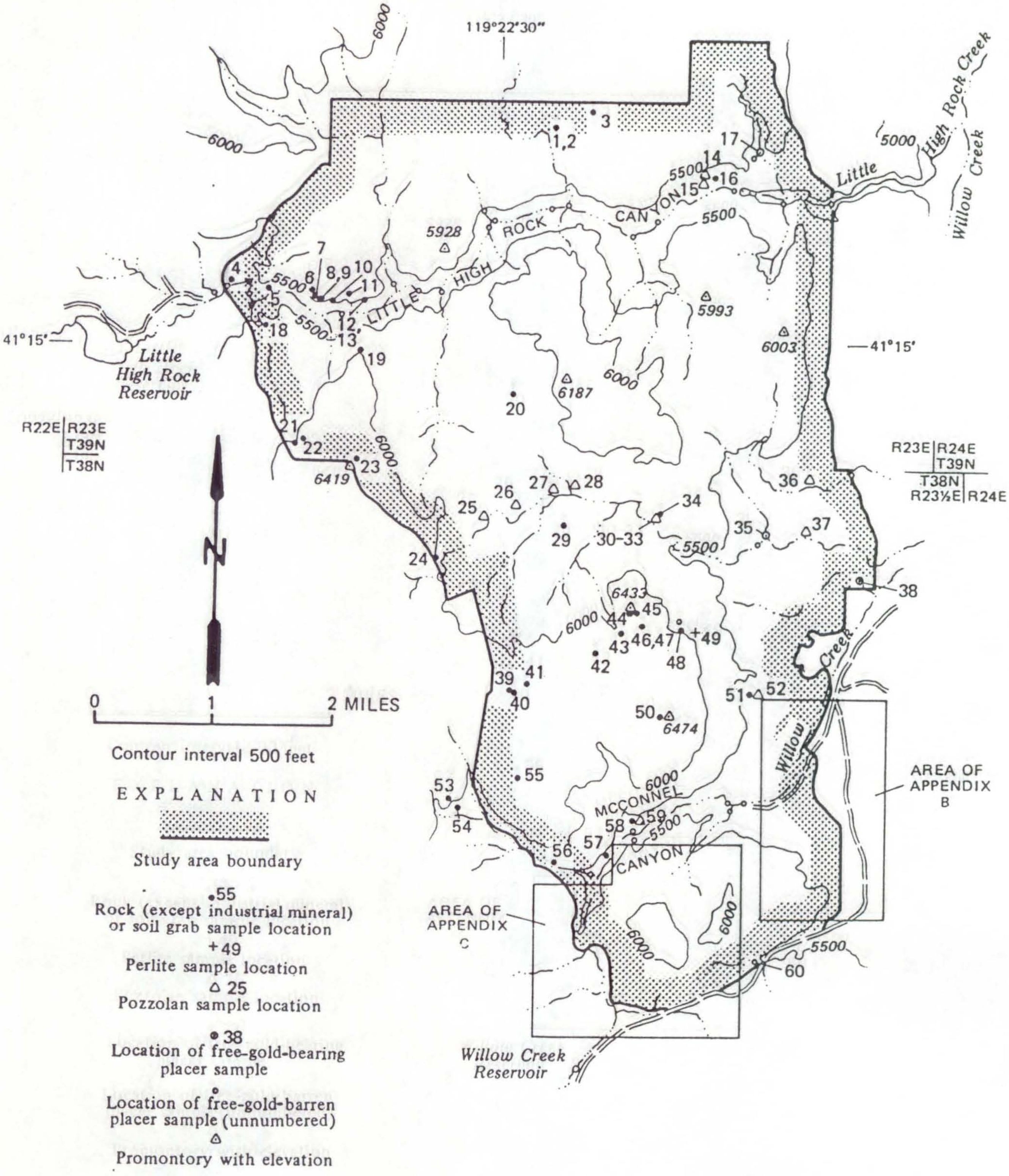
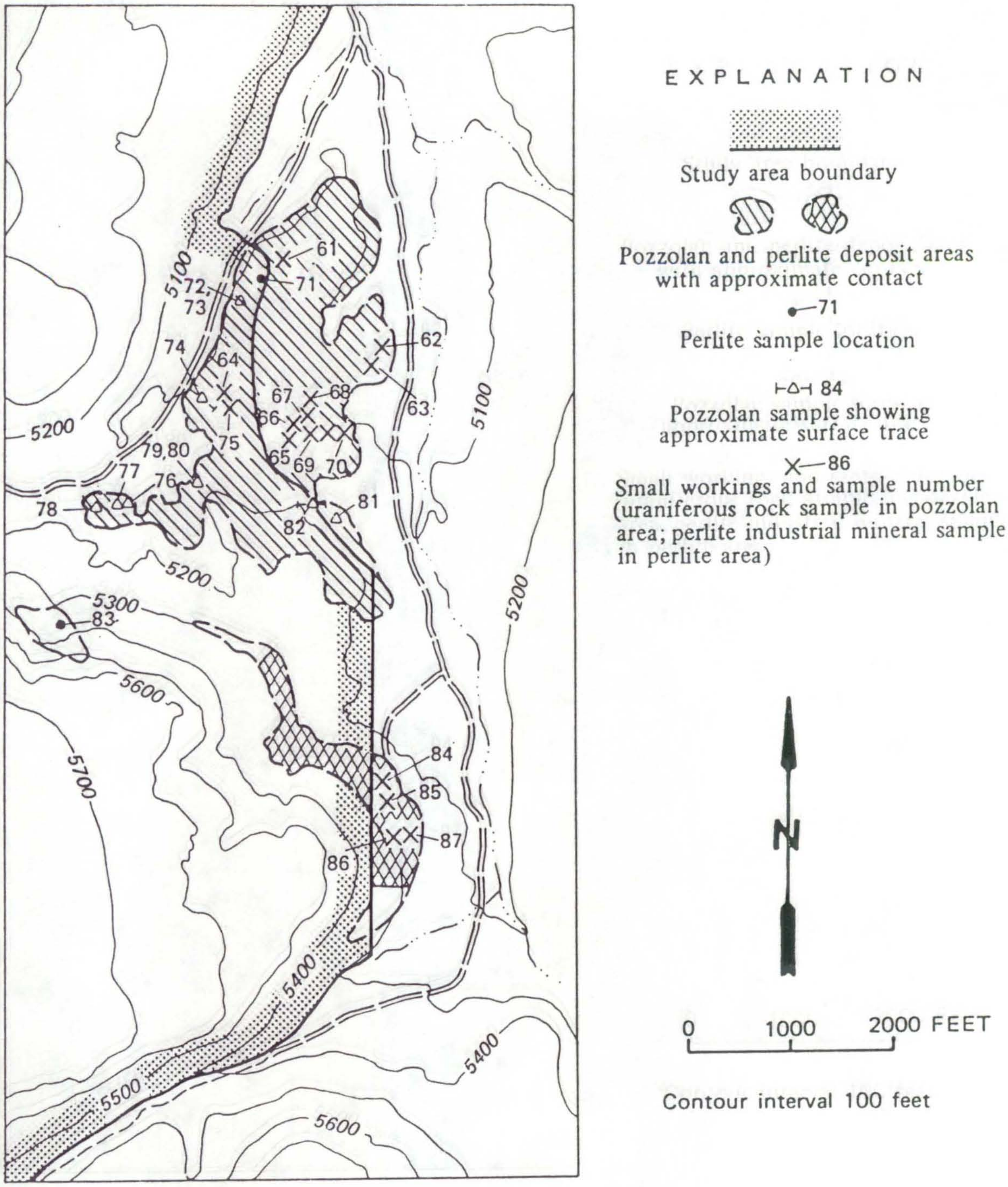
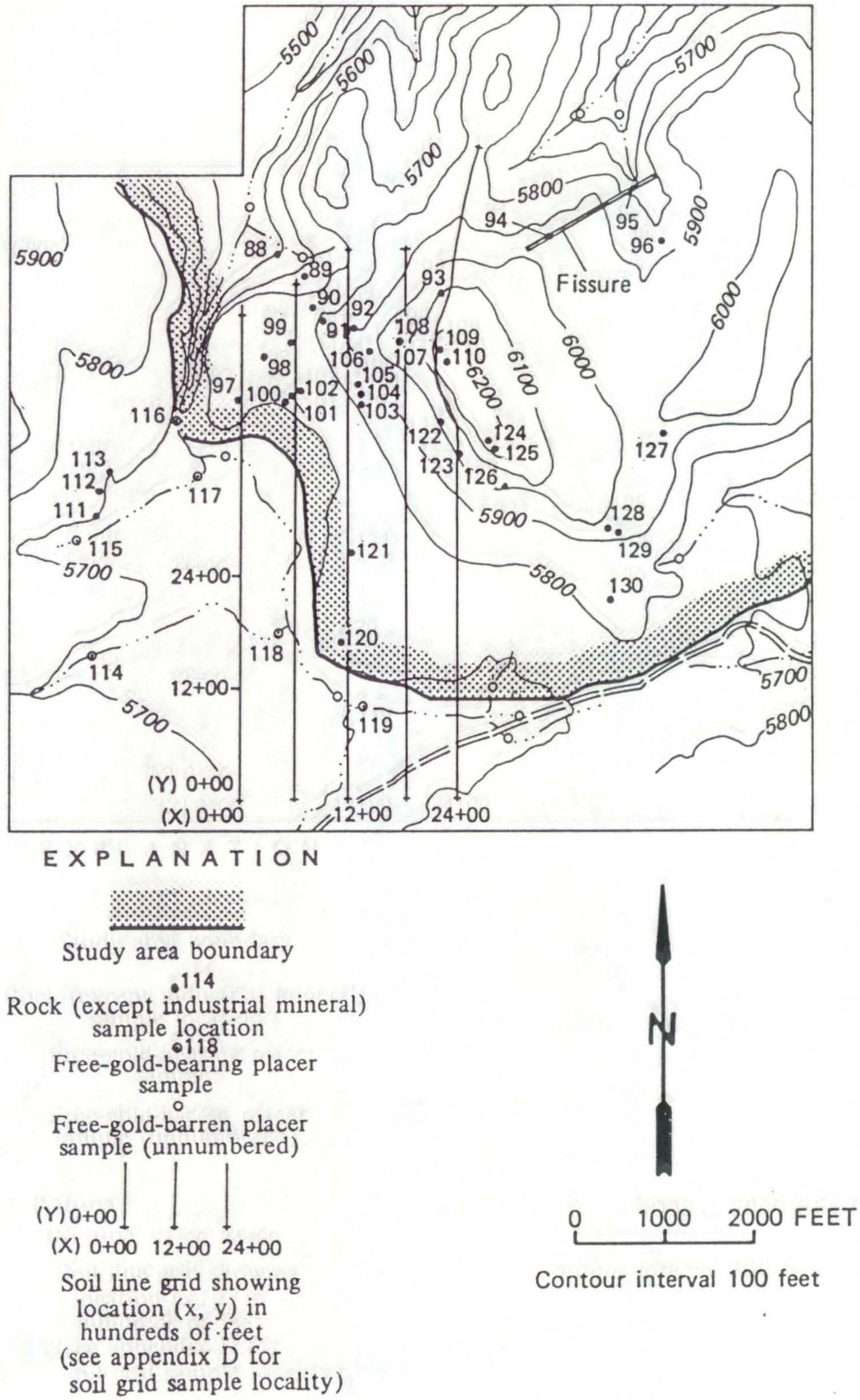


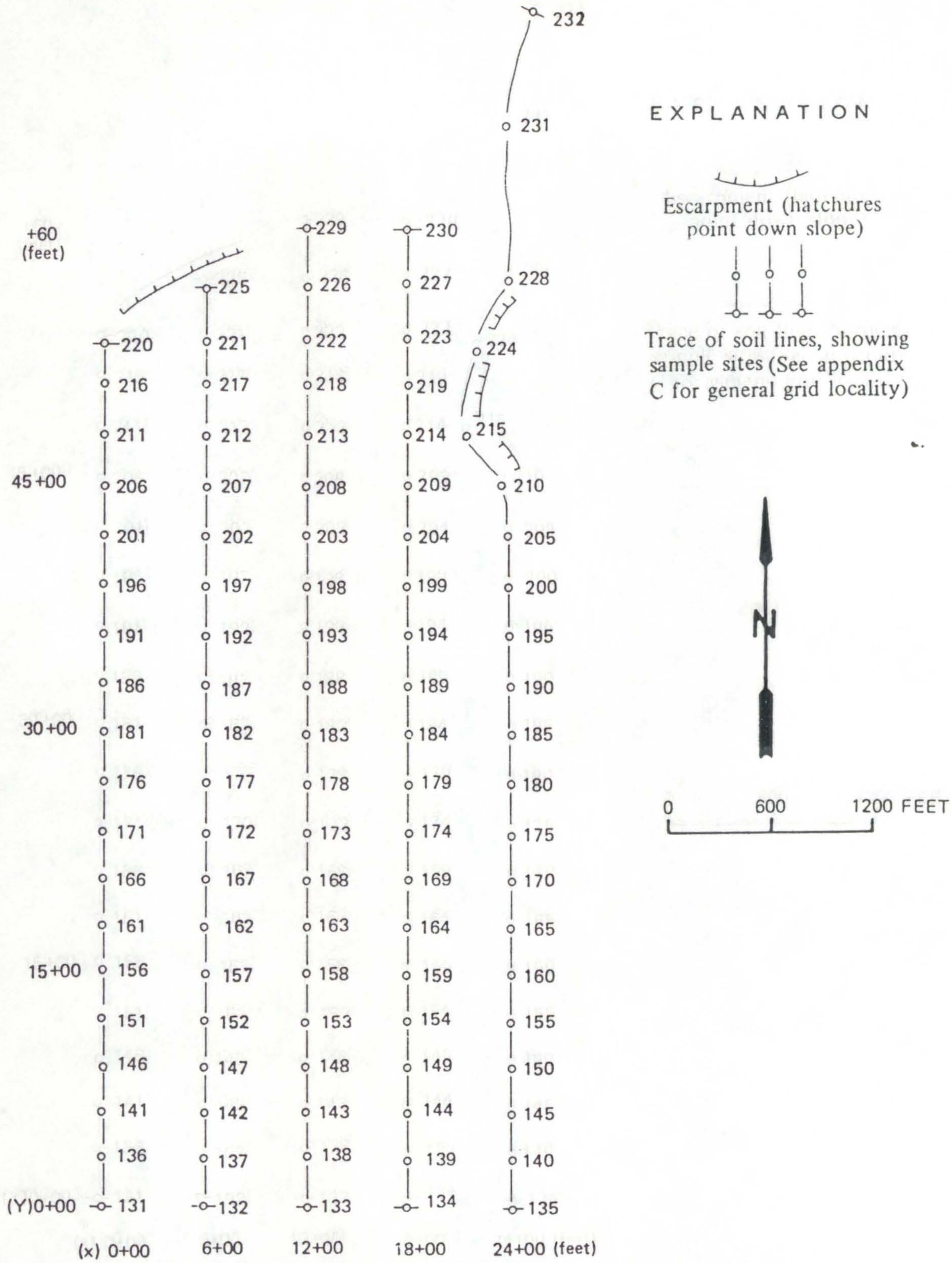
Appendix A.– Sample locations, Little High Rock Canyon study area, Humboldt and Washoe Counties, NV



Appendix B.– Sample locations, Big Doubt uranium claims (fig. 2, no. 3), pozzolan (fig. 2, no. 4) and perlite (fig. 2, no. 5) occurrences, Little High Rock Canyon study area Humboldt and Washoe Counties,



Appendix C.—Sample locations, Jabo extension mineralized area (fig. 2, no.6), Little High Rock Canyon study area, Humboldt and Washoe Counties, NV



Appendix D.– Numbered soil grid sample locality map, Little High Rock Canyon study area, Humboldt and Washoe Counties, NV

Appendix E.--Rock and soil grab sample data (except industrial minerals), Little High Rock Canyon study area, Humboldt and Washoe Counties, NV

[N, none detected; --, not analyzed; NA, not applicable]

Sample					Analysis (in parts per million)							
Map no. (Appendix A-C)	Prospect no. (fig. 2)	Type	Length (ft)	Description	Gold	Silver	Mercury	Arsenic	Antimony	Molybdenum	Barium	Uranium
1	NA	Chip	0.8	Yellowish-brown chalcedony vein, strike N. 24° E., dip 90°------------	<0.007	<0.3	<2	28.4	3	18	210	--
2	NA	do--	2.0	Pinkish-gray rhyolite; sample extends northwest from chalcedony vein-------	<.007	<.3	<2	6	<2	18	590	--
3	NA	Grab	NA	Lavender-gray rhyolite; area of reported mercury anomaly (U.S. Bureau of Land Management, 1984, map 3-21)--	<.007	<.3	<2	<2	<2	19	630	--
4	1	do--	NA	Yellowish-brown and black chalcedony--	<.007	<.3	--	21.5	<2	--	780	--
5	1	Chip	1	Yellowish-brown and black chalcedony, sill-like zone in rhyolite-----------	<.007	<.3	--	4	<2	--	1110	--
6	1	do--	20	Twenty-ft-thick sill-like zone of yellowish-brown and black chalcedony	<.007	<.3	--	23.6	3	--	1170	--
7	1	do--	20	Twenty-five-ft thick sill-like zone of yellowish-brown and black chalcedony	<.007	<.3	--	23.6	3	--	1130	--
8	1	do--	5	Five-ft-thick sill-like zone of yellowish-brown and black chalcedony	<.007	<.3	--	51	4	--	1110	--
9	1	do--	.8	Vein of yellow and black chalcedony; strike N. 50° W., dips 90°-----------	<.007	<.3	--	64	5	--	<50	--
10	1	do--	5	Limonitic rhyolite breccia cemented by chalcedony--------------------------	<.007	.55	--	33	<2	--	670	--
11	1	do--	.4	Chalcedony vein in gray flow laminated rhyolite, strikes N. 45° W., dips 90°	<.007	.79	--	33	<2		<50	--
12	1	do--	5	Yellow- to red-weathering silicified and brecciated rhyolite; poorly exposed, flat-lying, 20-ft-thick zone--------------------------------	<.007	<.3	--	170	4	--	<50	--
13	1	Grab	NA	Yellow chalcedony float pieces to 1-ft-thick; local orange Liesegang bands------------------------------	<.007	<.3	--	69	11	--	200	--
16	NA	do--	NA	Green, white, and brown opal and minor opal breccia collected from talus----	<.007	<.3	<2	<2	<2	9.8	67	--

Appendix E.--Rock and soil grab sample data (except industrial minerals), Little High Rock Canyon study area, Humboldt and Washoe Counties, NV--Continued

Sample					Analysis (in parts per million)							
Map no. (Appendix A-C)	Prospect no. (fig. 2)	Type	Length (ft)	Description	Gold	Silver	Mercury	Arsenic	Antimony	Molybdenum	Barium	Uranium
18	NA	Chip	3	Iron-stained rhyolite breccia, minor chalcedony----------------------------	<0.007	<0.3	<2	33	<2	10	870	--
19	NA	do--	6	Iron-stained flow-laminated gray rhyolite----------------------------	<.007	<.3	<2	42	<2	21	180	--
20	NA	Random chip	NA	Silicified gray rhyolite; locally brecciated--------------------------	<.007	<.3	<2	5	<2	13	850	4
21	NA	Soil grab	NA	Gray silt to sandy soil; taken in drainage, insufficient gravel for placer sample-----------------------	.053	<.7	<2	5	<2	<15	440	--
22	NA	Grab	NA	Yellow-orange-weathering gray rhyolite; a few orbicules subparallel foliation	<.007	<.3	<2	71	3	30	210	--
23	NA	Chip	4	Gray brown rhyolite; agate-filled vesicles to 1 in. diameter-----------	<.007	<.3	<2	15.4	<2	15	260	--
24	NA	Random chip	NA	Iron-stained and silicified light gray rhyolite----------------------------	<.007	<.3	<2	6	<2	21	110	6
29	NA	Chip	3.3	Gray to yellow rhyolite dike; strikes N. 60° W., dips 60° to 90° SW.-------	<.007	<.3	--	44	3	16	270	--
34	NA	do--	4	Red scoraceous basalt breccia; basal 4 ft over tuffaceous sediments-------	<.007	6.1	--	14.5	5	25	1930	--
39	NA	Random chip	NA	Silicified gray rhyolite; chalcedony-filled vugs, minor limonite----------	<.007	<.3	--	5	<2	--	90	--
40	NA	do--	NA	do----------------------------------	<.007	<.3	--	5.8	<2	--	440	--
41	NA	Soil grab	NA	Gray silty to sandy soil with rhyolite pebbles; taken in drainage, insufficient gravel for placer sample-------------	.038	.3	<2	3	<2	<15	660	--
42	NA	do--	NA	do----------------------------------	.024	.3	<2	7	<2	<15	700	--
43	2	do--	NA	Gray silty to sandy soil at base of talus apron along rhyolite cliff to the east----------------------------	.06	<.7	<2	8	<2	<15	620	--
44	2	Chip	4.4	Brecciated and silicified scoraceous rhyolite----------------------------	<.007	<.3	<2	16.1	<2	17	100	--

Appendix E.--Rock and soil grab sample data (except industrial minerals), Little High Rock Canyon study area, Humboldt and Washoe Counties, NV--Continued

Sample					Analysis (in parts per million)							
Map no. (Appendix A-C)	Prospect no. (fig. 2)	Type	Length (ft)	Description	Gold	Silver	Mercury	Arsenic	Antimony	Molybdenum	Barium	Uranium
45	2	Grab	NA	Similar to sample no. 44--------------	<0.007	<0.3	<2	29.7	3	12	130	--
46	2	Chip	4.6	do-----------------------------------	<.007	<.3	<2	10.7	<2	16	140	--
47	2	do--	7	do-----------------------------------	<.007	<.3	<2	8.6	<2	14	310	--
48	2	Soil grab	NA	Gray silty and sandy soil in silicified rhyolite talus----------------------	.092	<1	<2	9	<2	<15	440	--
50	NA	Random chip	NA	Dark gray silicified rhyolite breccia	<.007	<.3	<2	9.3	<2	15	200	--
51	NA	do----	NA	Buff- to cream-colored pumiceous ash and minor siltstone-----------------	.052	.36	--	<2	<2	<15	210	11
53	NA	do----	NA	Rhyolite flow top (?) with whitish-gray chalcedony and cream-colored opal	<.007	<.3	--	3	<2	--	360	--
54	NA	Grab--	NA	do-----------------------------------	<.007	<.3	--	<2	<2	--	580	--
55	NA	Random chip	NA	Silicified rhyolite breccia; bluish gray clasts in creamy white matrix	<.007	<.3	<2	9.3	<2	15	200	--
56	NA	do----	NA	Red-weathering siliceous orbicular rhyolite-----------------------------	<.007	<.3	<2	<2	<2	<5	160	--
57	NA	Grab--	NA	Silicified rhyolite breccia from landslide deposit-------------------	<.007	<.3	<2	5	7	9.4	120	--
58	NA	Chip--	6	Gray silty and sandy tuffaceous sediment----------------------------	<.007	<.3	--	<2	<2	<15	730	3.1
60	NA	Random chip	NA	Yellow tuffaceous sediment; slightly radioactive--70 cps (counts per second)----------------------------	<.007	<.3	--	<2	<2	13	640	7.5
61	3	Grab--	NA	White and yellow-green opalized wood from pit (4-ft diameter, 1 ft deep)--	<.007	<.3	<2	<30	<30	<5	310	67
62	3	do----	NA	White, yellow, and orange opalized wood from small pit-----------------	<.007	<.3	<2	<2	<2	<5	180	28
63	3	do----	NA	Yellow and orange opalized wood from three closely spaced small pits------	<.007	<.3	<2	<30	<30	<5	220	58
64	3	do----	NA	Similar to sample no. 62; 100 cps; from a small pit--------------------	<.007	<.3	<2	<30	<30	<5	410	32

Appendix E.--Rock and soil grab sample data (except industrial minerals), Little High Rock Canyon study area, Humboldt and Washoe Counties, NV--Continued

Sample					Analysis (in parts per million)							
Map no. (Appendix A-C)	Prospect no. (fig. 2)	Type	Length (ft)	Description	Gold	Silver	Mercury	Arsenic	Antimony	Molybdenum	Barium	Uranium
65	3	Grab--	NA	Pale green opalized wood from pit (5-ft diameter, 2 ft deep)-----------	<0.007	<0.3	<2	<30	<30	<5	120	28
66	3	Random chip	NA	Yellow-orange opalized tree trunk; 250 cps; from small pit-------------	<.007	<.3	<2	<30	<30	<5	220	58
67	3	Grab	NA	Yellow-orange opalized wood from a small pit---------------------------	<.007	<.3	<2	<30	<30	<5	370	39
68	3	do--	NA	Green and yellow opalized wood; 150 cps; from small pit-----------------------	<.007	<.3	<2	<30	<30	<5	450	70
69	3	Random chip	NA	Green and yellow opalized log (1-ft diameter) from 6-ft- by 4-ft- by 2-ft-deep trench---------------------	<.007	<.3	<2	31	<30	<5	84	84
70	3	Grab--	NA	White, green, yellow-green, and black opalized wood; one 10-ft adit and three small pits--------------------	<.007	<.3	<2	<2	<2	<5	120	54
88	6	Soil grab	NA	Gray silty soil; taken in drainage, insufficient gravel for placer sample	.103	<1	<2	8	<2	<15	360	--
89	6	do--	NA	Gray to brown silty to sandy soil; 100 ft below base of cliff-----------	.901	7	<2	<2	<2	<15	310	--
90	6	Random chip	NA	Light gray silicified rhyolite breccia	<.007	<.3	<2	<2	<2	<5	140	--
91	6	do----	NA	Cataclastic breccia; pebble- to boulder-sized rhyolite clasts in a siliceous and jarosite-stained argillaceous matrix; joints strike N. 45° W., dip 85° N. and strike N. 35° E., dip 48° E.	<.007	<.3	<2	<2	10	<5	31	--
92	6	do----	NA	Gray, fine-grained amygdaloidal andesite	<.007	1.198	<2	<2	<2	20	1200	--
93	6	do----	NA	Epidotized andesite-------------------	<.007	<.3	<2	15.4	<2	21	1100	--
94	6	do----	NA	Fissure-filling volcanic breccia with pebble- to boulder-sized rhyolite clasts (35%) in a whitish flow-banded vesicular kaolinitic silica matrix---	<.007	<.3	<2	4	<2	11	59	--
95	6	do----	NA	Similar to sample no. 94; fissure is 40 ft wide, apparent strike N. 57° E., dip 75° S.---------------------------	<.007	<.3	<2	7.2	<2	12	42	--

Appendix E.--Rock and soil grab sample data (except industrial minerals), Little High Rock Canyon study area, Humboldt and Washoe Counties, NV--Continued

Sample					Analysis (in parts per million)							
Map no. (Appendix A-C)	Prospect no. (fig. 2)	Type	Length (ft)	Description	Gold	Silver	Mercury	Arsenic	Antimony	Molybdenum	Barium	Uranium
96	6	Random chip	NA	Silicified and partially kaolinized rhyolite from a zone of narrow fissures, strike N. 40°-60° W., dip 75°-90° W.	<0.007	<0.3	<2	6.6	<2	16	92	--
97	6	do	NA	Yellow and oranage weathering, partially silicified gray rhyolite	<.007	<.3	<2	<2	<2	16	680	--
98	6	do	NA	Intensely silicified rhyolite breccia	<.007	<.3	<2	<2	<2	12	180	--
99	6	do	NA	do	<.007	<.3	<2	10.8	<2	5	110	--
100	6	do	NA	Intensely silicified rhyolite breccia and minor flow rock; gray clasts in light gray to white matrix	<.007	<.3	<2	<2	<2	10	56	--
101	6	do	NA	Partially silicified flow banded rhyolite; kaolinized vesicules (<1 mm) along flow bands	<.007	<.3	<2	3	<2	11	610	--
102	6	do	NA	Silicified rhyolite breccia and flow rock; flow banding generally strikes N. 60° E., dips 90°; tight chevron folds are common	<.007	<.3	<2	38	<2	13	130	--
103	6	do	NA	Lavender gray rhyolite weathers reddish-brown; apparently unaltered	<.007	<.3	<2	4	<2	<5	460	--
104	6	do	NA	Silicified massive gray rhyolite weathers pinkish-brown	<.007	<.3	<2	<2	<2	<5	99	--
105	6	do	NA	Silicified rhyolite; flow bands strike E-W, dip 90°, minor brecciation parallel to banding	<.007	<.3	<2	<2	<2	<5	170	--
106	6	do	NA	Silicified and partially kaolinitized gray to lavender rhyolite breccia	<.007	<.3	<2	22	<2	12	170	--
107	6	do	NA	Light- to lavender-gray silicified banded rhyolite; banding contorted, but generally strikes N. 65° E., dip 60° S.	<.007	<.3	<2	<2	<2	14	45	--
108	6	do	NA	Light gray silicified rhyolite breccia; limonite spots (1 mm across)	<.007	<.3	<2	<2	<2	12	83	--

Appendix E.--Rock and soil grab sample data (except industrial minerals), Little High Rock Canyon study area, Humboldt and Washoe Counties, NV--Continued

Sample					Analysis (in parts per million)							
Map no. (Appendix A-C)	Prospect no. (fig. 2)	Type	Length (ft)	Description	Gold	Silver	Mercury	Arsenic	Antimony	Molybdenum	Barium	Uranium
109	6	Chip--	3.5	Gray brecciated and opalized rhyolite weathers yellow or orange; brecciation subparallel to foliation--------------	<0.007	<0.3	<2	100	<2	<5	120	--
110	6	do----	1	Gray rhyolite weathers orange; flow bands strike N. 80° W., dip 40° S.----	<.007	<.3	<2	10.8	<2	<5	860	--
111	6	Random chip	NA	Partially silicified banded rhyolite---	<.007	<.3	<2	5	<2	17	150	--
112	6	do----	NA	Silicified rhyolite breccia within northwest-trending topographic depression (fault zone?)--------------	<.007	<.3	<2	5.8	<2	16	290	--
113	6	Chip--	10	Ten-ft-wide silicified and kaolinized fault breccia zone strikes N. 10° W., dips 83° NE.--------------------------	<.007	<.3	<2	<2	<2	14	<50	--
120	6	do----	2	Gray flow banded vesicular rhyolite strikes N. 85° E., dips 50° N.; some chalcedony amygdules------------------	<.007	<.3	<2	<2	<2	7.3	190	--
121	6	Random chip	NA	Silicified gray flow banded rhyolite strikes N. 35° E., dips 90°, weathers orange; some chalcedony amygdules-----	<.007	<.3	<2	30	<2	5.4	190	--
122	6	do----	NA	Silicified and partially kaolinized rhyolite breccia and flow rock--------	<.007	<.3	<2	6.6	<2	13	160	--
123	6	do----	NA	do-------------------------------------	<.007	<.3	<2	<2	<2	13	150	--
124	6	do----	NA	Partially silicified gray to brown rhyolite; flow bands strike N. 60° E., dip 60°-90° N.------------------------	<.007	<.3	<2	<2	<2	<5	740	--
125	6	do----	NA	Gray to brown rhyolite stained with black manganese oxide-----------------	<.007	<.3	<2	<2	<2	8.7	670	--
126	6	do----	NA	Kaolinitized earthy-white rhyolite-----	<.007	<.3	<2	8	<2	8.9	14	--
127	6	do----	NA	Partially silicified and manganese oxide stained rhyolite; flow banding strikes N. 35° E., dips 30° N.--------	<.007	<.3	<2	6.6	<2	13	370	--
128	6	do----	NA	Gray rhyolite; flow bands strike N. 40°-80° W., dips 10°-20° N.---------------	<.007	<.3	<2	3	<2	11	85	--

Appendix E.--Rock and soil grab sample data (except industrial minerals), Little High Rock Canyon study area, Humboldt and Washoe Counties, NV--Continued

Sample					Analysis (in parts per million)							
Map no. (Appendix A-C)	Prospect no. (fig. 2)	Type	Length (ft)	Description	Gold	Silver	Mercury	Arsenic	Antimony	Molybdenum	Barium	Uranium
129	6	Random chip	NA	Partially silicified rhyolite breccia; apparent basal flow breccia-----------	<0.007	<0.3	<2	4	<2	21	140	--
130	6	do----	NA	Grayish-lavender fine-grained welded tuff; approximately 10% 1- to 5-mm feldspar and hornblende crystals, and rock fragments--------------------	<.007	<.3	<2	<2	<2	17	1900	--

Appendix F.--Industrial mineral sample data, Little High Rock Canyon study area, Humboldt and Washoe Counties, NV

[--, not analyzed; NA, not applicable; analysis symbols, respectively, include the oxide compounds of silicon, aluminum, phosphorus, potassium, sodium, calcium, magnesium, iron, manganese, and titanium, as well as loss on ignition (moisture included)]

Sample					Analysis (in percent)										
No. (appendices A, B)	Prospect no. (fig. 2)	Type	Length (ft)	Description	SiO_2	AL_2O_3	P_2O_5	K_2O	Na_2O	CaO	MgO	Fe_2O_3	MnO	TiO_2	LOI
14	NA	Chip	20	Pink pumiceous tuff; predominantly glass shards and feldspar, trace montmorillonoid clay---------------	66.9	12.4	0.057	7.0	2.9	0.59	0.25	3.0	0.061	0.3	2.18
15	NA	do---	2	White pumiceous tuffaceous sediment; predominantly montmorillonoid clay, minor glass shards, trace feldspar, and quartz-------------------------	62.6	13	.061	4.6	1.1	2	2.3	3	.078	.24	10.93
25	NA	Random chip	NA	Light greenish- and yellowish-gray tuffaceous sediment; predominantly montmorillinoid clay and glass shards, minor feldspar-------------	59.9	16.3	.1	1.9	1.5	4.2	1.2	6.8	.055	.9	7.35
26	NA	Chip	2	Gray, green, and brown pumiceous tuffaceous sediment; predominantly montmorillonoid clay and glass shards, trace feldspar-------------	65.7	12.6	.043	4.9	1.4	1.8	.65	7.5	.14	.34	7.61
27	NA	do--	3.3	Gray to brown pumiceous tuff; predominantly glass shards, minor montmorillonoid clay and feldspar---	64.3	15.7	.085	4.1	1.1	1.7	.78	5.3	.13	.62	9.88
28	NA	do--	2	Gray volcaniclastic breccia; obsidian and pumice fragments (45%, to 1 in. long) in tuffaceous matrix of montmorillonoid clay and glass shards, minor feldspar-------------	62.9	13.5	.11	4.9	1.5	2.4	.73	5.6	.14	.54	7.58
30	NA	do--	13.9	White pumiceous tuffaceous sediment, strikes N. 40° W., dips 14° NE.; predominantly montmorillonoid clay and glass shards, trace feldspar----	64.4	13.9	.077	7	1.6	1.5	.81	2.2	.13	.28	7.09
31	NA	do--	59.2	Light buff-gray tuffaceous sediment; predominantly montmorillonoid clay and minor glass shards-------------	63.6	16.6	.26	3.5	1.9	4.3	1.3	5.2	.093	.60	5.39
32	NA	do--	95.8	Light brown tuffaceous sediment; predominantly montmorillonoid clay with minor glass shards and feldspar	65.2	15.9	.075	4.2	1.6	2.7	1.1	4.5	.11	.64	6.29
33	NA	do--	33.7	Red tuffaceous sediment; predominantly montmorillonoid clays and feldspar-----------------------	60.8	17.0	.53	3.3	2	3.9	1.8	6.7	.13	.87	5.2

Appendix F.--Industrial mineral sample data, Little High Rock Canyon study area, Humboldt and Washoe Counties, NV--Continued

Sample					Analysis (in percent)										
No. (appendices A, B)	Prospect no. (fig. 2)	Type	Length (ft)	Description	SiO_2	AL_2O_3	P_2O_5	K_2O	Na_2O	CaO	MgO	Fe_2O_3	MnO	TiO_2	LOI
36	NA	Chip	50	White pumiceous tuffaceous sediment, with 10-ft tan zone in center of section; predominantly montmorillonoid clay and glass shards, minor feldspar and trace quartz----------------------------	62.9	16.2	0.14	3	1.5	2.5	0.76	6.0	0.081	0.83	8.03
37	NA	do--	23	White, gray, tan, and yellow 2-ft-interbeds of pumicite and tuffaceous sediment; predominantly montmorillonoid clay and glass shards, trace feldspar	66.8	13.7	.06	5	1.4	1.2	.52	3.7	.16	.56	8.18
49	NA	do--	8	Fifty-ft-thick zone of poorly exposed gray banded perlite, 30% rhyolite and vitrophyre inclusions; RI = 1.496 1/----------------------------	--	--	--	--	--	--	--	--	--	--	--
52	NA	Random chip	NA	Buff to cream pumiceous tuffaceous sediment; predominantly montmorillonoid clay and feldspar, minor glass shards, trace quartz----	68	15.4	.092	5.1	1.5	1.4	.57	3.6	.063	.3	6.95
59	NA	Chip	6	Gray tuffaceous sediment, strikes N. 5° W., dips 40° E. (may be slumped); predominantly montmorillonoid clay and feldspar---	59.7	19.7	.22	4.4	1.3	1.4	.5	6.4	.034	.95	
71	4	Random chip	NA	Perlite outlier (on tuffaceous sediment) may be up to 15 ft thick; R.I. = 1.496 1/--------------------	--	--	--	--	--	--	--	--	--	--	--
72	4	Chip	38.6	Light brown tuffaceous sediment, subhorizontal, predominantly montmorillonoid clay, trace feldspar; S.G. = 2.54, W.R. = 127%, C.S. = 3,950 psi (81%) 2/-----------	63.1	17.7	.069	2.6	1.1	1.7	.83	6.0	.042	.73	10.16
73	4	do--	23.8	Similar to, and overlying, sample no. 73-----------------------------	64.3	16.1	.066	3.6	1.4	1.7	.68	4.7	.14	.6	7.92
74	4	do--	117.5	Two to 30-ft-thick beds of brown to white tuffaceous sediment, subhorizontal; predominantly montmorillonoid clay, minor glass shards and feldspar, trace quartz	64	17.2	.09	2.9	1.2	1.8	.73	5.3	.11	.69	8.67

Sample					Analysis (in percent)										
No. (appendices A, B)	Prospect no. (fig. 2)	Type	Length (ft)	Description	SiO_2	AL_2O_3	P_2O_5	K_2O	Na_2O	CaO	MgO	Fe_2O_3	MnO	TiO_2	LO
75	4	Chip	5	Perlite outlier (on tuffaceous sediment) may be up to 15 ft thick, R.I. = 1.496 1/---------------------	--	--	--	--	--	--	--	--	--	--	
76	4	do--	13	Gray pumiceous tuffaceous sediment; predominantly glass shards, minor montmorillonoid clay and feldspar---	70.7	12.9	.015	7.2	1.6	1	0.21	1.9	0.041	0.2	5.
77	4	do--	8.8	Gray pumiceous tuffaceous sediments, strike N. 60° W., dips 20° S., overlies sample no. 76; predominantly glass shards, minor montmorillonoid clay and feldspar------------------	71	13.8	.034	6.2	1.7	1.6	.35	2.3	.049	.37	5.
78	4	do--	22.9	Gray pumiceous tuffaceous sediment overlies sample no. 77 after 18.5-ft-gap; predominantly montmorillonoid clay, minor glass shards and feldspar	65.4	15.4	.093	3.7	1.3	1.7	.73	4.1	.15	.55	8.2
79	4	do--	7	Grayish-tan tuffaceous sediment, subhorizontal; predominantly montmorillonoid clays and feldspar	59.1	20.3	.12	1.3	1.6	2.8	.68	3.8	.036	1.1	10.5
80	4	do--	34	One- to 6-ft- thick beds of gray to brown pumiceous tuffaceous sediment, subhorizontal, overlies sample no. 79; predominantly montmorillonoid clay and glass shards, minor feldspar, trace quartz--------------	71	13.5	.046	6.1	1.5	1.2	.26	2.5	.04	.32	6.1
81	4	do--	30	One to 4-ft-thick beds of brown to white pumiceous tuffaceous sediment; predominantly montmorillonoid clay and glass shards, minor feldspar, trace quartz; S.G. = 2.51, W.R. = 124%, C.S. = 3250 psi (<7%) 2/------	63.5	18.9	.11	2.8	1.8	2.7	.99	4.3	.11	.91	7.4
82	4	do--	24.9	Similar to and overlying sample no. 81; S.G. = 2.43, W. R. = 122%, C.S. = 3400 psi (70%) 2/-----------	69.7	15.4	.05	5.1	1.4	1.7	.62	2.7	.039	.46	6.6

Appendix F.--Industrial mineral sample data, Little High Rock Canyon study area, Humboldt and Washoe Counties, NV--Continued

Sample					Analysis (in percent)										
No. (appendices A, B)	Prospect no. (fig. 2)	Type	Length (ft)	Description	SiO_2	Al_2O_3	P_2O_5	K_2O	Na_2O	CaO	MgO	Fe_2O_3	MnO	TiO_2	LOI
83	NA	Random chip	NA	Perlitic zone, 40% inclusions of rhyolite (to 1 ft long) and obsidian (to 1 in. long) in perlite matrix; 80% to 90% glass, R.I. = 1.496 1/---	--	--	--	--	--	--	--	--	--	--	--
84	5	Chip	3	Six-in. clasts of bluish-black perlite in ash matrix, R.I. = 1.496; from face of SW-trending 35-ft trench---------	--	--	--	--	--	--	--	--	--	--	--
85	5	do--	6	Gray to bluish-black perlite (altered flow banded obsidian), R.I. = 1.496; from face of SW-trending 45-ft trench	--	--	--	--	--	--	--	--	--	--	--
86	5	do--	4	Pinkish-gray rhyolitic obsidian and gray perlite, R.I. = 1.496; from face of SW-trending 12-ft trench---------	--	--	--	--	--	--	--	--	--	--	--
87	5	do--	6	Bluish-black perlite; breaks down into 0.125 in. beads, R.I. = 1.496; sample consists of three 2-ft chipped lines on sides of SE-trending 40-ft trench; furnace expansion by the New Mexico Bureau of Mines Sucorro indicates expanded density 10.7 lb/ft^3, furnace yield - 97.0%, sinkers - 11.0%, compacted density - 14.0 lb/ft^3, compaction resistance - 280 lb/in^2 at 1 in. - 410 lb/in^2 at 2 in.	--	--	--	--	--	--	--	--	--	--	--

1/ R.I. = refractive index of perlite

2/ Results of 28-day pozzolan activity index test: S.G. - specific gravity; W.R. - water requirement as % of control cube; C.S. - compressive strength of cement/pozzolan blend in pounds per square inch (and as % of control cube). Laboratory cement was Ideal, Ft. Collins, CO (WES number RC - 175); W.R. = 106; C.S. = 4870 psi.

Appendix G.--Free-gold-bearing placer sample data, Little High Rock Canyon study area, Humboldt and Washoe Counties, NV

(<, less than shown)

Sample no. (appendices A and C)	Sample: Volume (yd^3)	Sample: Description	Gold content: mg	Gold content: oz/yd^3	Gold content: \$/yd^3 1/
17	0.008	Extremely fine, bright subrounded gold; trace scheelite and zircon	0.001	0.000004	<0.01
35	.008	Extremely fine, bright subrounded to subangular gold; trace of scheelite and zircon	.027	.000100	.04
38	.008	Extremely fine, bright subrounded gold; trace scheelite and zircon	.011	.000044	.02
114	.008	Extremely fine, bright flat gold flake; trace scheelite and zircon	.003	.000012	<.01
115	.008	Extremely fine, bright subangular gold; trace scheelite and zircon	.01	.000040	.01
116	.008	do	.009	.000036	.01
117	.008	do	.005	.000020	<.01
118	.008	Extremely fine, bright flat gold flake; trace scheelite and zircon	.027	.000008	<.01
119	.008	Extremely fine, bright angular gold; trace scheelite and zircon	.038	.000152	.05

1/ At a price of $350/oz gold.

Appendix H.--Soil grid sample data, Little High Rock Canyon study area
Humboldt and Washoe Counties, NV

(Analyses in parts per million; <, less than shown)

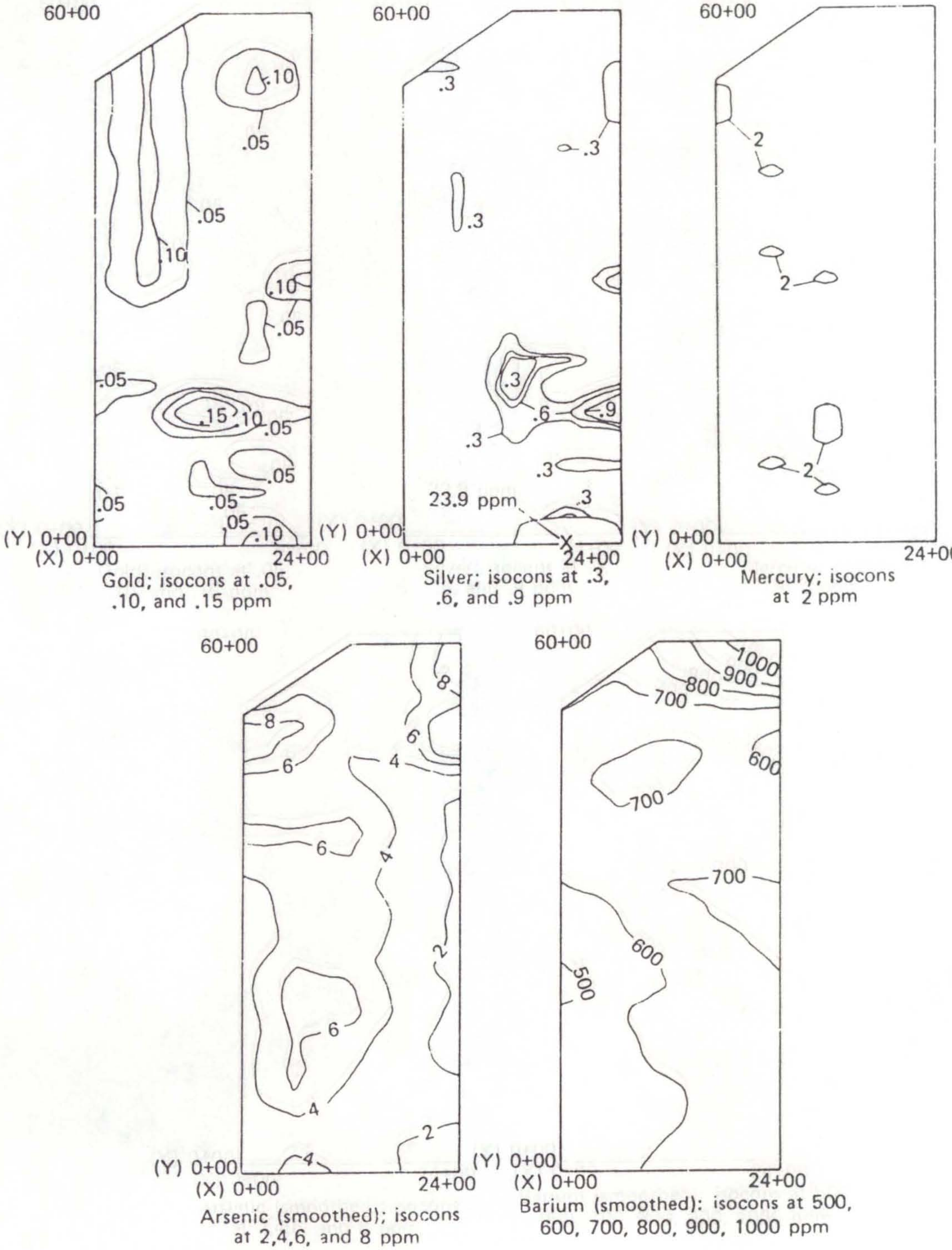
Sample no.	Location X(ft)	(Appendix C) Y(ft)	Gold	Silver	Mercury	Arsenic	Barium
131	0	0	0.021	<0.3	<2	<2	530
132	600	0	.021	<.3	<2	8	620
133	1200	0	<.007	<.3	<2	4	630
134	1800	0	.146	23.2	<2	<2	570
135	2400	0	.018	<.3	<2	<2	620
136	0	300	<.007	<.3	<2	<2	430
137	600	300	.021	<.3	<2	<2	650
138	1200	300	.024	<.3	<2	3	630
139	1800	300	.053	.82	<2	<2	450
140	2400	300	.023	<.3	<2	<2	900
141	0	600	<.007	<.3	<2	<2	600
142	600	600	.025	<.3	<2	4	650
143	1200	600	<.007	<.3	<2	3	540
144	1800	600	<.007	<.3	<2	3	700
145	2400	600	.022	<.3	<2	2	550
146	0	900	.021	<.3	<2	<2	530
147	600	900	.025	<.3	<2	12	360
148	1200	900	<.007	<.3	<2	<2	570
149	1800	900	.113	.52	<2	<2	730
150	2400	900	.028	.39	<2	3	600
151	0	1200	.048	<.3	<2	<2	680
152	600	1200	.030	<.3	<2	11	520
153	1200	1200	.050	.4	<2	4	650
154	1800	1200	.025	<.3	<2	<2	730
155	2400	1200	.029	<.3	<2	2	660
156	0	1500	<.007	<.3	<2	<2	510
157	600	1500	.024	<.3	<2	9	580
158	1200	1500	.287	.43	<2	5	600
159	1800	1500	.083	.52	<2	<2	680
160	2400	1500	.054	2.0	<2	<2	680
161	0	1800	<.007	<.3	<2	<2	570
162	600	1800	<.007	<.3	<2	8	570
163	1200	1800	.032	.928	<2	11	720
164	1800	1800	.027	<.3	<2	<2	680
165	2400	1800	.030	.36	<2	<2	720
166	0	2100	.018	<.3	<2	<2	290
167	600	2100	.025	<.3	<2	11	630
168	1200	2100	.036	.72	<2	8	580
169	1800	2100	.056	.72	<2	<2	600
170	2400	2100	.034	<.3	<2	2	700
171	0	2400	<.007	<.3	<2	<2	510
172	600	2400	.022	<.3	<2	9	600
173	1200	2400	.019	.36	<2	5	590

Appendix H.--Soil grid sample data, Little High Rock Canyon study area Humboldt and Washoe Counties, NV--Continued

Sample no.	Location X(ft)	(Appendix C) Y(ft)	Gold	Silver	Mercury	Arsenic	Barium
174	1800	2400	0.055	<0.3	<2	<2	650
175	2400	2400	.025	<.3	<2	<2	740
176	0	2700	.018	<.3	<2	<2	450
177	600	2700	.047	<.3	<2	5	610
178	1200	2700	.021	<.3	<2	8	660
179	1800	2700	.056	<.3	<2	3	670
180	2400	2700	.025	<.3	<2	<2	740
181	0	3000	.036	<.3	<2	<2	520
182	600	3000	.116	<.3	<2	5	550
183	1200	3000	.026	<.3	2	11	690
184	1800	3000	.029	<.3	<2	<2	720
185	2400	3000	.129	.99	<2	<2	790
186	0	3300	.018	<.3	<2	3	550
187	600	3300	.121	<.3	<2	5	710
188	1200	3300	.022	<.3	<2	5	750
189	1800	3300	.035	<.3	<2	2	760
190	2400	3300	.023	<.3	<2	2	710
191	0	3600	.021	<.3	<2	4	660
192	600	3600	.109	.35	<2	5	640
193	1200	3600	.024	<.3	<2	9	620
194	1800	3600	.032	<.3	<2	<2	650
195	2400	3600	.028	<.3	<2	<2	600
196	0	3900	.022	<.3	<2	9	580
197	600	3900	.111	.38	2	5	650
198	1200	3900	.024	<.3	<2	11	730
199	1800	3900	.022	<.3	<2	2	660
200	2400	3900	.025	<.3	<2	<2	590
201	0	4200	<.007	<.3	<2	3	680
202	600	4200	.116	.35	2	3	730
203	1200	4200	.026	<.3	<2	8	690
204	1800	4200	.026	<.3	<2	3	680
205	2400	4200	.025	<.3	<2	<2	660
206	0	4500	.024	<.3	<2	4	650
207	600	4500	.113	<.3	<2	4	800
208	1200	4500	.022	<.3	<2	5	690
209	1800	4500	.030	.36	<2	<2	640
210	2375	4500	.024	<.3	<2	<2	630
211	0	4800	.022	<.3	2	12	670
212	600	4800	.106	<.3	<2	8	600
213	1200	4800	.025	<.3	<2	<2	920
214	1800	4800	.026	<.3	<2	<2	730
215	2150	4800	.028	.38	<2	15	470
216	0	5100	.018	<.3	2	8	650
217	600	5100	.104	<.3	<2	14	740
218	1200	5100	.019	<.3	<2	<2	570
219	1800	5100	.120	<.3	<2	6	600

Appendix H.--Soil grid sample data, Little High Rock Canyon study area Humboldt and Washoe Counties, NV--Continued

Sample no.	Location X(ft)	(Appendix C) Y(ft)	Gold	Silver	Mercury	Arsenic	Barium
220	0	5325	0.024	0.63	<2	2	760
221	600	5400	.109	.36	<2	7	640
222	1200	5400	.021	<.3	<2	7	610
223	1800	5400	.102	<.3	<2	2	800
224	2225	5300	.032	.36	<2	7	700
225	600	5658	.105	<.3	<2	8	630
226	1200	5700	.026	<.3	<2	5	890
227	1800	5700	.028	<.3	<2	2	900
228	2400	5700	.025	<.3	<2	14.4	1130
229	1200	6000	.017	<.3	<2	5	820
230	1800	6000	.056	<.3	<2	<2	1060
231	2400	6600	.025	<.3	<2	7.8	1080
232	2570	7250	.022	<.3	<2	6	720



Appendix I.– Isocon (lines connecting points of equal geochemical concentration) maps of soil grid sample data, Little High Rock Canyon study area, Humboldt and Washoe Counties, NV