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AN ASSESSMENT OF HYDROTHERMAL SYSTEMS ON PORTIONS OF THE WALKER RIVER RESERVATION, AS RELATED TO THE FORMATION OF ENERGY AND METAL ACCUMULATIONS

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SUMMARY

CERT has conducted an appraisal of the energy and mineral resource on portions of the Walker River Reservation. The results of these investigations indicate the reservation hosts significant potential for iron-copper, gold, and silver deposits; and to a lesser extent uranium deposits and geothermal resources.

Overall, the reservation exhibits good potential for the location of economic mineral deposits. The primary areas for iron-copper deposits are in the skarn zones adjacent to granitic instrusives in Calico, Hottentot, and Copper Areas. Gold and silver exhibit economic potential in the quartz veins and altered fault zones of the reservation. Good potential exists for subsurface disseminated gold and silver deposits as indicated by anomalous arsenic and mercury values, in the Gillis Range. The presence of leachable uranium in the felsic tuffs of the reservation, suggests the possibility of uranium being redeposited within favorable stratigraphic sections of Walker Basin. The most likely area for location of geothermal resources is the vicinity of Double Springs or perhaps east of the area.

To further define and test the economic potential of the reservation, CERT recommends additional field work be conducted in those areas defined in Section 7.0 of this report. To accomplish this task, soil and rock sampling should be conducted on a systematic grid to further define the gold and silver potential; additional drilling is warranted in the Hottentot, Calico, and Afterthought areas to define the limits of iron-copper mineralization; exploration drilling is warranted in the Walker River Basin to test for tabular uranium deposits at depth; and additional water sampling of water wells is needed

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1.0 INTRODUCTION

In response to a technical assistance request by the Walker River Paiute Tribe in February 1983, CERT conducted a mineral resource study on portions of the Walker River Reservation. The purpose of the study is to assist the Walker River Tribe in determining which minerals and areas of the reservation may be of potential economic interest for resource development and the ultimate economic benefit to the Tribe.

Due to the varied nature and complexity of the geology of the area, this report assumes the reader has some prior knowledge of geology and the statistical treatment of geologic data. When feasible, however, the laboratory techniques utilized in analyzing the rock and water samples, and the statistical and geologic methods involved in interpreting both the field and lab data, are discussed at length for the benefit of the nontechnical reader.

1.1 LOCATION AND ACCESS

The Walker River Reservation is located in west-central Nevada, approximately 40 miles south of Fallon, Nevada (Figure 1-1). The reservation occupies portions of Mineral, Churchill, and Lyon Counties and tribal headquarters are located in Schurz. Access to the reservation is by Highway 95 south from Fallon or by alternate Highway 95 east from Yerington, Nevada. The 14 areas of the reservation covered in this report are shown on Figure 1-2.

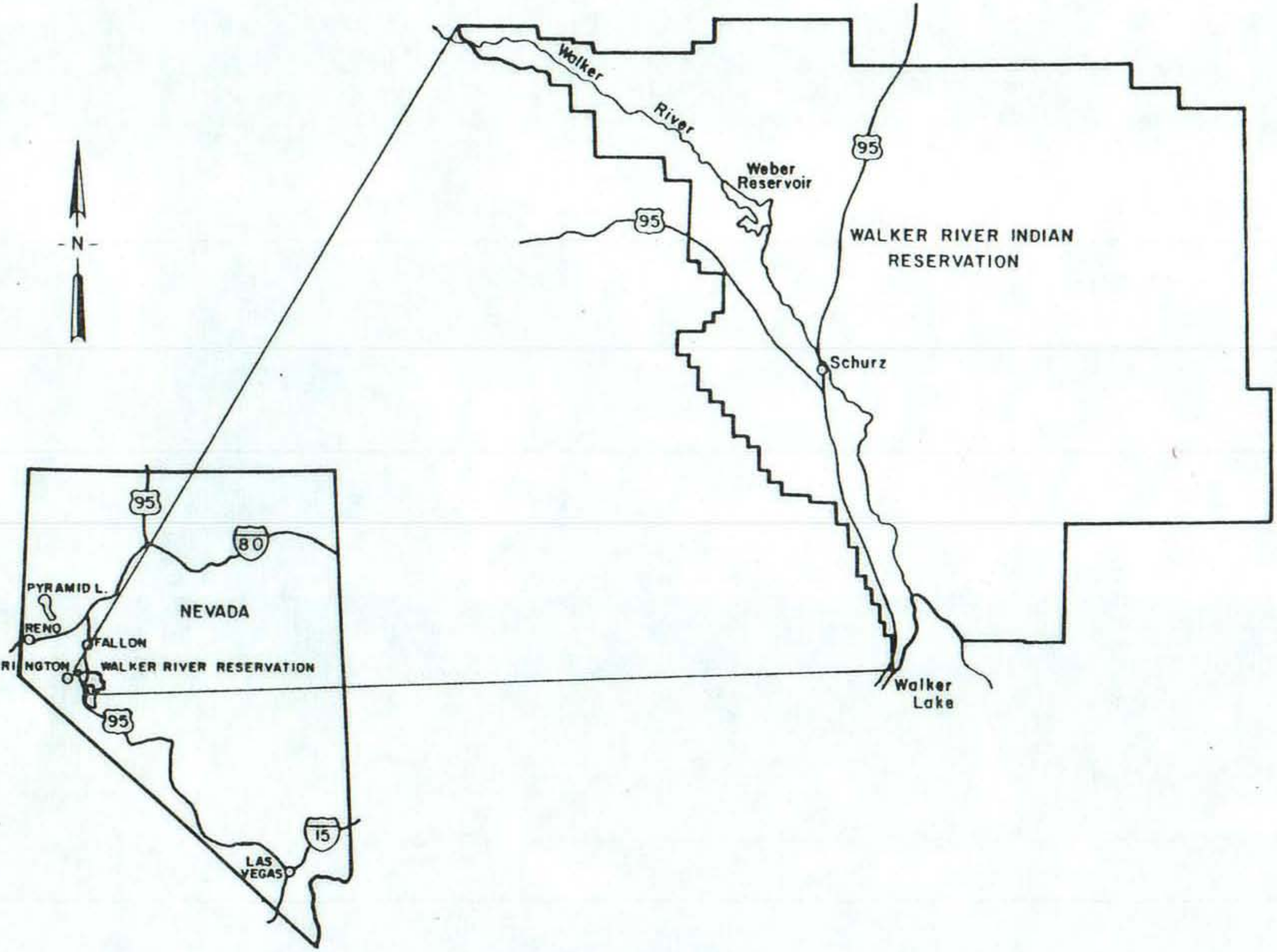

Figure 1-1. LOCATION MAP OF THE WALKER RIVER RESERVATION

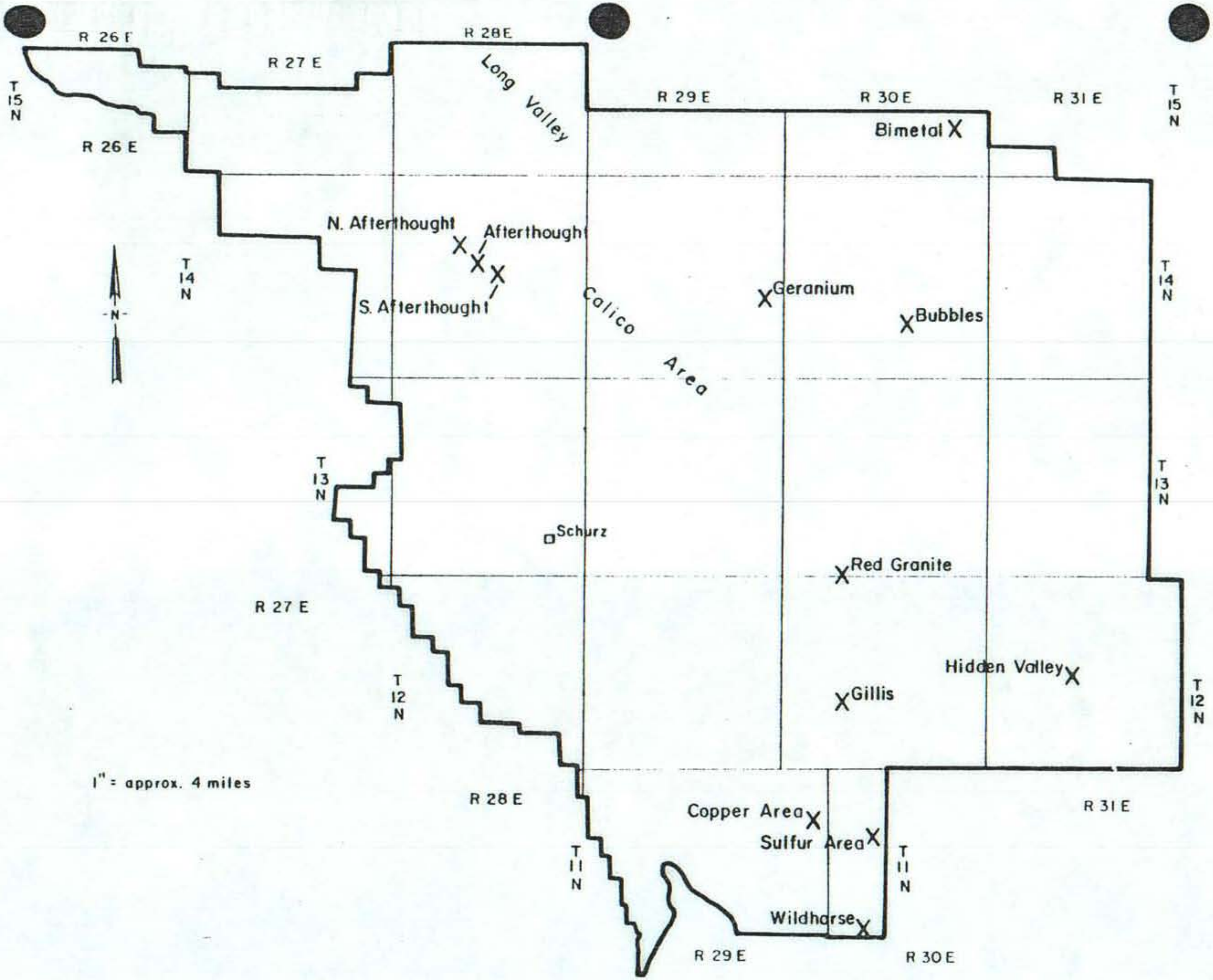

Figure 1-2. STUDY AREA LOCATION MAP

1.2 FIELD AND LABORATORY PROCEDURES

The fieldwork involved in this study included: (1) an initial carborne radiometric survey with a scintillometer (Mount Sopris Model SC-132) and chart recorder, (2) rock sampling and radiometric and magnetic traverses, (3) water sampling, and (4) detailed rock sampling in three areas. Laboratory methods used were (1) audioradiography, (2) atomic absorption, (3) fire assay, and (4) petrographic analysis. The results of each method are discussed in other sections of this report.

The carborne radiometric survey involved driving over reservation roads at 10 to 30 miles per hour with the scintillometer attached to the front bumper of the vehicle. Radiometric readings of the scintillometer were automatically recorded on a strip-chart recorder carried in the front seat of the vehicle. All radiometric readings were made on a scale setting of 200 counts per second (cps). Approximately 170 miles of road were covered during the survey.

Rock sampling was carried out in conjunction with a pediometric radiometric survey of the 14 areas of investigation. These areas were selected as priority areas by the tribe and, to limit repetition with the Bureau of Mines investigations on the reservation. During this phase both anomalously radioactive and nonradioactive rock samples were collected. The radioactive samples were collected to determine the elemental source of the radioactivity and the abundance of the elemental source. Nonradioactive samples were collected to aid in determining which elements, and the abundance of elements, are present in the absence of radioactive elements and also as an aid in determining the geothermal activity in the area. Geothermal (or hydrothermal) samples were collected, in addition to unaltered country rock, in an effort to discern if a relationship exists between past and present geothermal activity in the area. A total of 85 rock samples were collected, of these, 67 samples were submitted for geochemical analysis.

Magnetic traverses were conducted across structural lineaments, mineral occurrences, and thermal lows with a Geometrics GM-122 Proton Magnetometer in order to further delimit exploration targets. Water sampling was conducted as part of the geothermal resource evaluation. These samples were collected at three naturally occurring springs and two wells on and adjacent to the reservation. In addition, one untreated tap water sample was taken as a comparison to the other water samples. Two samples were collected at each site, one of which was acidified to a pH of 2 for specific elemental analysis. Carbonate, bicarbonate, and pH tests were conducted at each sample site.

Based on preliminary geochemical results, additional rock sampling was conducted in three areas: (1) Guranium, (2) Hidden Valley, and (3) Wildhorse Canyon. Three to seven samples were collected in each area and submitted for laboratory analysis. Rock and water samples were submitted to Barringer Resources, Inc. for analysis of select elements. In order to determine which minerals contain uranium, thorium, or other radioactive elements, autoradiographs were made of rock samples exhibiting anomalous radioactivity. The autoradiograph was accomplished by exposing a radioactive rock slab to gamma sensitive film for periods ranging from 11 days to 2 months. The sample was later polished for opaque mineral identification. In this manner the precise location of a gamma ray emitting mineral occurring in the polished section can be defined and then identified by petrographic studies or by x-ray diffraction.

An elemental analysis for each of the initial 67 rock samples was conducted for 35 elements by atomic absorption (AA), and fire assay. Sixteen elements were analyzed on the additional fourteen rock samples. Twenty three elements were analyzed on the water samples. The elements analyzed and the results are discussed in later sections.

To accomplish an AA analysis, a portion of the rock sample is reduced to solution. The solution is then vaporized by intense heat (3000° F) to reduce the solution to atomic form. The vapor is then illuminated by a characteristic light source for each element to be identified. The amount of light absorbed is directly proportional to the amount of the element present, thus allowing the quantitative determination of the element.

Fire assay was employed to determine the presence and amount of gold and silver in each sample. This method was used for these elements since fire assay is the only method accepted by the mineral industry for accurately determining the amount of gold and silver present. Fire assay involves grinding a rock sample to a fine powder and mixing the powder with a flux usually containing lead. The combination is then fired in an oven to several thousand degrees, resulting in the melting together of the powder and flux. The melt is allowed to cool and solidify forming a lead pellet containing the gold and silver surrounded by a glass slag. After the glass slag has been broken away the lead pellet is placed in a cupel composed of compressed, ground bone and fired again at high temperature. The pellet is melted down and the lead is absorbed into the cupel leaving a bead of gold and silver (if present in the sample). After cooling, the bead is weighed, and then placed in acid solution to dissolve the silver. The bead then consists only of gold and is weighed again, thus determining the amount of gold and silver present.

1.3 STATISTICAL METHODS

This section includes statistical methods employed for both rock and water geochemical data and also the methods used for geothermometry of the water data.

1.3.1 Rock Sample Data

Results of the elemental analysis were subjected to various statistical analyses to determine the relationship of each element to every other element and, in so doing, obtaining the correlation coefficient, mean, and standard deviation of the elements. In applying these determinations, the sample data were divided into 14 groups: (1) Bimetal Area, (2) Afterthought Area, (3) Calico Area, (4) Guranium Area, (5) Gillis Area, (6) Hidden Valley Area, (7) Copper Area, (8) Sulfur Area, and (9) Wildhorse Area. In addition to these nine areas, the data were also divided by lithology or mode of occurrence into: (1) Tuff, (2) Granite, (3) Quartz Vein, (4) Limestone and (5) Fault Zone. This grouping of data was used to compare the elemental values of anomalous radioactive areas and lithologies to the overall elemental values of the project area. The results of these comparisons were employed to determine if an area is significantly anomalous in selected elements relative to the regional values and/or if a given rock type hosted a particular element or group of elments that may have potential economic value. Table 1-1 is a list of elements and symbols referred to in this report.

Table 1-1. LIST OF CHEMICAL SYMBOLS

ELEMENT	SYMBOL
Gold	Au
Bismuth	Bi
Cobalt	Co
Chromion	Cr
Copper	Cu
Molybdenum	Mo
Nickle	Ni
Lead	Pb
Sulfur	S
Sulfur Oxide	SO_4
Zinc	Zn
Arsenic	As
Mercury	Hg
Silicon	Si
Silica	SiO_2
Antimony	Sb
Tin	Sn
Uranium	U
Uranium Oxide	U_3O_8
Aluminum	Al
Barium	Ba
Calcium	Ca
Iron	Fe
Potassium	K
Manganese	Mn
Magnesium	Mg
Sodium	Na
Silver	Ag
Titanium	Ti
Lithium	Li
Rubidium	Rb
Vanadium	V
Zircon	Z
Phosphorous	P
Tellurium	Te
Thorium	Th
Thallium	Tl
Chlorine	Cl

The mean, or average, value of elements is determined by:

$$\bar{x} = \frac{\Sigma x}{n}$$

where:
Σx = the sum of the values of element x
n = number of samples for element x
$\bar{x}$ = mean value of x

The standard deviation (sd) is a measure of the range of variability of an element within a data set and is determined by:

$$sd = \left[\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}\right]^{1/2}$$

Generally, a large standard deviation relative to the mean value indicates a large dispersion of values for a given element. Conversely, a small standard deviation value indicates a tight grouping of values for an element.

The correlation coefficient (r) is a measure of the relationship of one element (x) to another element (y). Determination of r will yield a value between -1.00 and +1.00. Negative values of r indicates an inverse relationship between two elements such that, as the amount of element x increases, the amount of element y decreases. For r values near 0, no relationship exists between the two elements. Positive values of r indicate a direct relationship of two elements such that, as the amount of element x increases, the amount of element y increases proportionally. A verbal description for values of r is:

-1.00 to -.80	strong inverse relationship
-.79 to -.60	moderate inverse relationship
-.59 to -.40	weak inverse relationship
-.39 to +.39	no relationship
+.40 to +.59	weak direct relationship
+.60 to +.79	moderate direct relationship
+.80 to +1.00	strong direct relationship

Determination of the correlation coefficient (r) is by:

$$r = \frac{\dfrac{\Sigma\,(x - \bar{x})\,(y - \bar{y})}{n-1}}{\dfrac{\Sigma\,(x - \bar{x})^2}{n - 1} \cdot \dfrac{\Sigma\,(y - \bar{y})^2}{n - 1}^{\;1/2}}$$

where: x = value of element x

y = value of element y

Overall, the number of samples collected is small compared to the total amount of the various rock types comprising the reservation. Thus, the data presented, both statistical and elemental values, should be considered only as a guide to a qualitative resource estimate rather than an absolute quantitative determination.

1.3.2 Water Sample Data

Similar statistical methods were applied to the elemental data of the water samples, as described above. Several geothermometry formulas were also employed for select elements of the water data.

Generally, geothermometry is a method by which, subsurface geothermal reservior temperatures may be determined by evaluating the various ratios of sodium (Na), potassium (K), calcium (Ca), and magnesium (Mg). Several equations have been empirically derived and refined by investigators over the past 10 to 15 years.

The more reliable equations, and those which are used in this report, are defined below:

(1) $\log K = \log(Na/K) + B\log(\ Ca/Na)$ (Fournier and Truesdell, 1973)

where: $B = 1/3$, if $\log(\ Ca/Na)$ is negative

$B = 4/3$, if $\log(\ Ca/Na)$ is positive

with log K, the temperature can then be derived from a graph of log K versus temperature.

If $Kv > 343^\circ$ Kelvin (or 70° C) then the following equation was applied:

(2) $$t = 10.66-4.7415R+325.87(\log R)^2-1.032\times10^5(\log R)^2/Kv-$$

$$1.968\times10^7(\log R)^2/Kv^2+1.605\times10^7(\log R)^3/T^2$$ (Fournier and Potter, 1979)

where: $R = Mg/(K+Ca+Mg)\ 100$

t = temperature in degrees Centigrade to be subtracted from equation (1)

Equation (1) is a Na-K-Ca geothermometer and equation (2) is a Mg correction factor to be subtracted from (1) when the temperature is $> 70^{\circ}$ C.

Equation 3 is another geothermometer using only Na and K:

(3) $T = (1217/(\log(Na/K) + 1.483)) - 273.15$ (Fournier, 1979)

where: T = temperature in degrees centigrade

The results and interpretations of these equations are discussed later.

1.4 PREVIOUS INVESTIGATIONS

Past geologic investigations of the Walker River Reservation have been limited primarily to regional studies. Detailed studies have been conducted by the Idaho Mining Company in several areas of the reservation including Calico Hills and the northeast end of the Gillis Range. In addition, Lawrence (1969) conducted detailed subsurface studies in the Calico Hills Area, based on drill hole data. Hardyman (1980) mapped the Gillis Range in detail and regionally mapped the Wassuk Range.

Other regional geologic studies which encompassed portions of the reservation include Willden and Speed (1974), John (1983), Bengler (1978), Moore (1969), Ross (1961), Hurley, et al (1982), and Dusham and Felmlee (1982). Geothermal investigations on the reservation were conducted by Cibola LTD in 1973. Whelan (1980) studied the geothermal potential of Navy Target Range Bravo 19, immediately north of the reservation.

With the exception of Lawrence (1979), Hardyman (1980), and Whelan (1980), these studies were directed to reporting known mineral or geothermal locations, rather than assessing mineral potential or geologic models.

Lawrence studied Idaho Mining's core data from Calico Hills and concluded that the iron-copper mineralization encountered at depth, was derived from hydrothermal alteration of sediments in contact with a granodioritic magma. Whelan's geothermal study indicates a possible geothermal reservoir of 170°C underlying the northwest portion Bravo 19. Other than these studies, no investigations have been undertaken to account for the wide spread mineral occurrences on the reservation.

2.0 GEOLOGICAL OVERVIEW

The Walker River Reservation occupies the northeast flank of the Walker Lane structural belt, in the Great Basin portion of the Basin and Range Physiographic Province (Figure 2-1). This Province is an acute structural trend extending from southeastern New Mexico through Nevada into southern Idaho. This Province is characterized by block-faulted (horst) mountain ranges separated by graben valleys trending north to northeast. Development of Basin and Range structure is related to extensional tectonics (mountain-building), while the Walker Lane belt development is related to right lateral displacement that may have followed older, Mesozoic[1] fracture trends. The Walker Lane belt is an apparent structural oddity within the Province in that the structural grain of the belt trends north-west instead of slightly east of north-south. Development of Walker Lane was either coincident with development of the Basin and Range structures (17 m.y.)[2] or represents later structural development about 11 to 15 m.y. (Stewart, 1980).

Four mountain ranges dominate the topography of the reservation: (1) Wassuk Range, (2) Gillis Range, (3) Terrill Mountains, and (4) Calico Hills. The Wassuk Range, along the western boundary of the reservation, is composed principally of a granitic batholithic intrusion that characteristically trends northwest, as do the other three mountain ranges. The Gillis Range, in the southeastern portion of the reservation, is perhaps the most structurally complex of the ranges, with at least two prominent fault sets. The principal set trends are parallel to the range, northwest, while the minor set trends east

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[1] A geologic time scale is provided in Appendix A.
[2] 17 million years ago.

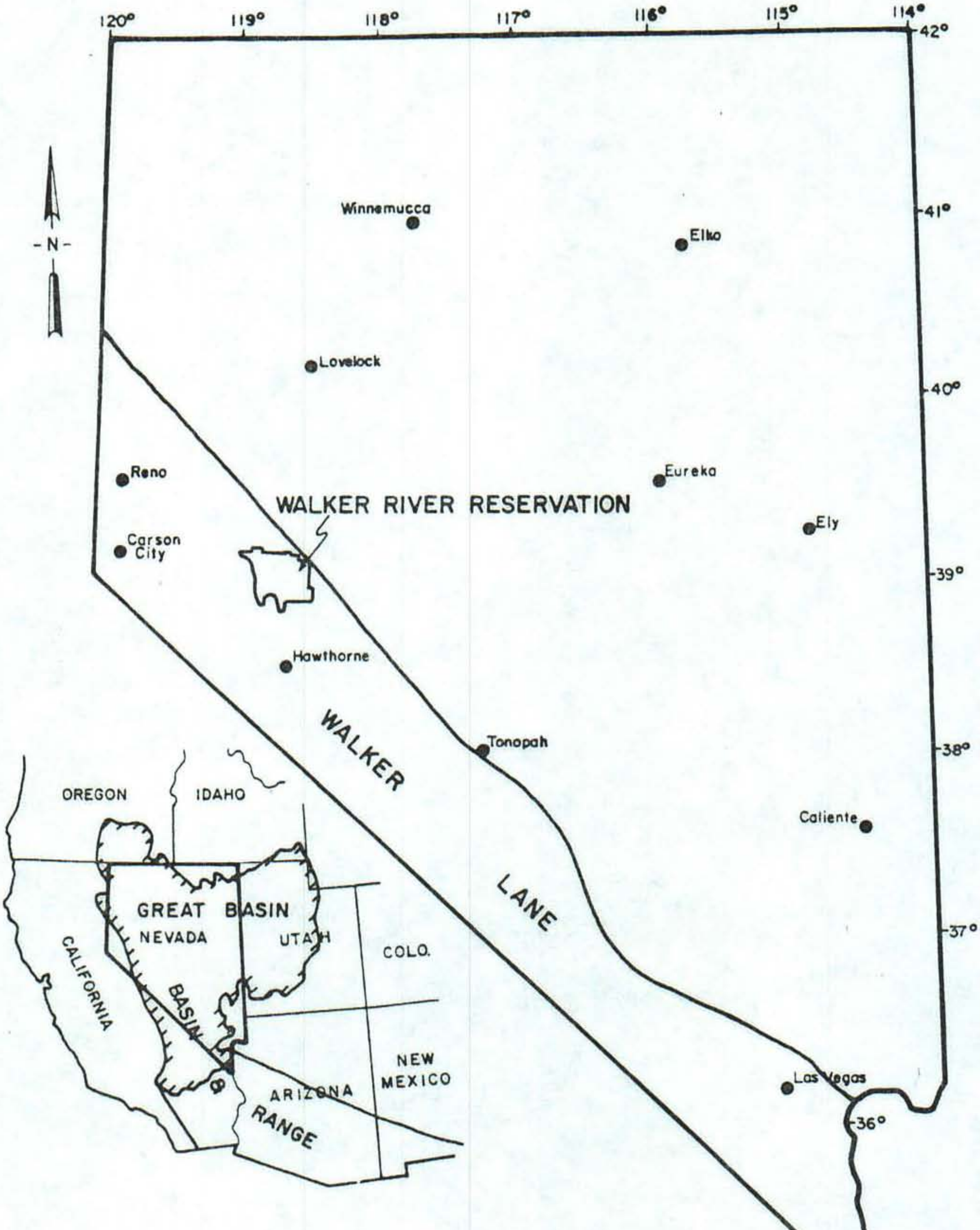

Figure 2-1. LOCATION OF WALKER LANE

to northeast. Detachment faulting has been documented along the northeast flank of the Gillis Range, and thrust faulting along the west flank of the range (Hardyman, 1980).

Based on detailed geologic mapping by E. F. Lawrence (1966) in the Calico Hills, there are two equally abundant fault sets, (1) northeast, (2) northwest giving a "checkerboard" pattern to the area. Due to the lack of one fault set offsetting the other set, both of these fault sets appear to have occurred simultaneously.

The oldest rocks exposed on the reservation are of Triassic age and occur primarily in the Wassuk and Gillis mountain ranges. The youngest rock units are Quaternary mafic volcanic rocks occurring in the Gillis and Terrill ranges. Lithologies of the area are quite varied and complex ranging from mafic to felsic volcanics and intrusions, meta-volcanics and sediments. Generally, the age sequence of rock units are:

VOLCANICS YOUNGEST (QUATERNARY)
mafic
I
intermediate
I
felsic
I
INTRUSIVES
intermediate
I
METAMORPHICS OLDEST (TRIASSIC)
(older volcanics and sediments)

A brief description of each rock unit is provided on the geologic map of the reservation (Plate I), additionally, a more detailed lithologic description of select rock samples is provided in the petrography section of this report.

Stewart (1980) has suggested that the transition from intermediate and felsic rock types, in early and middle Cenozoic time, to mafic rock types in the late Cenozoic is represented by the change from compression tectonics (subduction zone type) to extensional tectonics (back-arc spreading type) about 17 million years (m.y.) ago.

The tectonic events are intrinsicly related to mineralizing events. Keith (1983) has defined six metallogenic episodes related to igneous activity in the region:

Deposit Type	Litho-Chemistry Lithology	Associated	Time
hydrothermal tungsten	calc-alkali	granodiorite	95-80 m.y.
mesothermal molybdenum	calc-alkali	granite	85-70 m.y.
tungsten bearing veins	peraluminous granite	muscovite	74-60 m.y.
epithermal gold-copper	calc-alkali	volcanics	25-22 m.y.
epithermal lead-zinc	alkali-calcic	volcanics	22-17 m.y.
gold-flourine	alkali	volcanics	15-8 m.y.

These metallogenic events and their related rock chemistry are associated with the progressive eastward migration of a magmatic arc (145-43 m.y.) which turns southwestward 43 m.y. ago, thus creating and overprinting of magma chemistry and metallogenic types (Keith, 1983).

Table 2-1 is a summary of various metal/mineral deposits on and adjacent to the reservation. Most of these metal deposits occur principally in quartz veins or shear (fault) zones. With exception of disseminated tungsten, iron and copper deposits in tactites or contact skarns. With very few exceptions, these quartz veins, or shear-type

TABLE 2-1 METAL/MINERAL OCCURRENCES ON AND NEAR WALKER RIVER RESERVATION

NAME	LOCATION	METAL/ MINERAL	GEOLOGY
		Felsic Tuff Occurrences	
Yellow Twin Prospects	T. 14 N., R. 27 E.	U	Felsic tuff.
Guranium Group	T. 14 N., R 29, E.	U	Felsic tuff.
		Vein and Quartz Vein Occurrences	
Rawhide: Properties in vicinity; of Morning Star, Rawhide Victor, Seminole-Regent, Mascot, Bullskin dry Mtn. 1, Silver Zone, Bethania, Black Eagle, Poor Boy, Wash Vein, Gold Reef, Royal, Flynn and Nevada New Mines	All properties close to Rawhide. T. 13 N., R. 32 E.	Au, Ag	Quartz veins and lodes in kaolinized rhyolite. Ore minerals native gold alloyed with silver, argentite, and cerargyrite. Veins generally strike N. 30° W. to N. 30° E. and dips moderately to steeply to southwest and northwest. Some gold recovered by wash method south and southwest of Rawhide.
Mountain View and Granite area	T. 13 N., R. 27 E.	Au, Ag	Quartz and iron oxide veins in dioritic and granitic rocks; main veins are: Mountain View, 1-2 feet thick, largely sericitized country rock, quartz with hematite and sulfur. Big Twenty—few inches to 4 feet thick, iron-stained quartz. Both of these veins are in granodiorite and trend easterly.
Yerington Mountain Copper Co. (Beach Vein, Black Mountain Copper Co.?)	T. 13 N., R. 27 E.	Cu	Vein in crushed granodiorite is 8 to 25 ft thick, strikes N. 50° E. and underground the strike shifts to 35° E. dips 60° to 70° SE. Underground the massive vein splits into several parts, largest of which is 3 to 4 feet thick; minerals include pyrite, chalcocite, and copper carbonates; selected ore carried 10 to 15 percent copper and some silver.
Eagle Mine	T. 13 N., R. 33 E.	Au	Two quartz, veins striking northwest, 3 and 20 to 30 feet thick, respectively, dip steeply and contain much barite as well as gold in iron-stained parts.
Happy Return	3 1/2 miles northeast of Rawhide	U, Sb, Quartz	Vein up to 1 ft thick in granitic rock strikes N. 80° E. dips 55° N. over a known length of 90 ft. U.S. Bureau of Mines samples contained 6.8 to 10.8 percent Sb.
Highland Group	?	Ba	Barite occurs in fissure vein ranging in width from 6 in to 8 ft; vein can be traced on surface for 2,700 ft.
Kenyon Claims?	T. 13 N., R. 33 E.	Quartz crystals	Quartz vein no more than 4 ft thick with crystals as much as 6 in by 12 in; some smaller fragments are of optical quality. Vein nearly parallels surface and prospect pits have been dug through it to prospect underlying garnet-epidote tactite for scheelite.
King Claims? (Donnelly group)	T. 13 N., R 34 E.	Au, Ag	Quartz veins of unknown attitude in volcanic rocks of the Excelsior Formation; individual veins, small and low grade with values in Au, Ag, as well as Pb and Cu.

TABLE 2-1 METAL/MINERAL OCCURRENCES ON AND NEAR WALKER RIVER RESERVATION (cont.)

NAME	LOCATION	METAL/ MINERAL	GEOLOGY
Nevada Cons. Mines and Selling Co.	Cat Canyon, about 7 miles northeast of Hawthorne	Au, Cu	Shear zone, 25 to 100 feet thick, strikes east, and contains quarts, pyrite and chalcophyrite; country rock is granodiorite.
	T. 8 N., R. 33 E.	U	Albitized granitic rock.
Star prospect	T. 9 N., R. 28 E.	Au	Veins of quartz carrying abundant limonite with chrysocolla and visible free gold; ore said to contain as much as $150/ton in Au. Country rocks are volcanic rocks of the Excelsior Formation.
Bluebird	T. 16 N., R. 32 E.	U	Quartz vein in granite.
Bimetal Group	T. 15 N., R. 30 E.	Au, Ag	Occurences in quartz, veins in granodirite, veins parallel adjacent aplite dikes striking northwest.
Pyramid Mine	T. 14 N., R. 29 E.	Ag	Silver in quartz veins cutting welded rhyolitic tuffs. Minor occurrences of silver in the tuff. Associated with lead, both in quartz veins and tuff; also manganese and iron oxides along altered shear zones.
		Contact Metamorphic Occurrences	
Rawhide tungsten property (Cresent, Elizabeth, Nugget Oscar, Last Hope claims)	T. 14 N., R. 32 E.	W	Scheelite occurs sparsely in tactite replacing limestone intruded by granitic rocks; mostly low-grade, but locally as much as 0.4 percent WO_2.
Scheelite Extension Mine	T. 13 N., R. 32 E.	W	Scheelite sporadically distributed in tactite associated with marble and calc-hornfels in a tabular inclusion in granitic rock; scheelite also present locally in quartz stringers in nearby granitic rock.
Lucky Four	T. 11 N., R. 30 E.	W	Disseminated scheelite in tactite replacing limestone near a granitic contact; maximum grade 1 percent WO_2.
Yankee Girl	T. 13 N., R 32 E.	W, Au, Cu	Drift explores a series of marble xenoliths along a contact of hornfels and granitic rock; locally as much as 1 percent of scheelite sporadically distributed.
Unknown	T. 14, N., R. 29 E.	Au, Ag	Altered rhyolitic tuff in contact with dacite porphyry dike.

TABLE 2-1 METAL/MINERAL OCCURRENCES ON AND NEAR WALKER RIVER RESERVATION (cont.)

NAME	LOCATION	METAL/ MINERAL	GEOLOGY
Contact Metamorphic Occurrences (cont.)			
Foster prospect	18 miles east of Schurz, T. 13 N., R 31 E.	Fe	Mostly magnetite with some hematite along contact between limestone and diorite.
Nevada Scheelite Mine	T. 13 N., R 32 E.	W	Scheelite-bearing tactite bodies as much as 50 feet thick occur along contact between limestone and granitic rock; much tactite is oxidized to a rock rich in limonite that locally contains several percent of WO_2 in the form of ferritungstite.
Hooper No. 1	T. 13 N., R. 32 E.	W	Scheelite-bearing tactite developed from limestone along bend in granitic contact; in area of much faulting.
Hooper No. 2	T. 13 N., R. 32 E.	W	Workings follow tactite layer in hornfels that strike N. 40° E and dips 60° S.; tactite is 1 to 10 feet thick and scheelite is erratically distributed within the layer.
Altered Volcanic Occurrences			
Poinsettia property	T. 11 N., R. 33 E.	Hg	Cinnabar occurs in high-grade lenses and veinlets in and adjacent to a fault zone that strikes N. 65° W. and dips 85° N. Pyrite, chalcedony gypsum, sulfur,and clay associated with the cinnabar; country rock is altered andesitic tuffs and other volcanic rocks.
Cinnabar Hill	T. 15 N., R. 30 E.	Hg	Occurrences along shear zone striking N. 85°W. in altered rhyolite tuff; associated with mangonese and iron oxides.
Stockton property	T. 13 N., R 31 E.	Hg	Disseminated cinnabar and cinnabar veinlets in rhyolite tuff where it is patchily altered to opalite.
Unknown	T. 12 N., R. 31 E.	W	Altered rhyolitic tuff in contact with dacite porphyry dike.
Sunnyside (Great Eastern)	T. 13 N., R. 33. E.	Au, Ag	Free gold, horn silver, argentite, chrysocolla, and marachite in quartz in Excelsior Formation (?) near granitic rock.
Johnson	T. 16 N., R. 32 E.	U	Altered tuffs.

TABLE 2-1 METAL/MINERAL OCCURRENCES ON AND NEAR WALKER RIVER RESERVATION (cont.)

NAME	LOCATION	METAL/ MINERAL	GEOLOGY
		Other Occurrences	
Northern Light Mine	T. 12 N., R. 28 E.	Cu	Oxidized ore containing malachite, azurite, native copper, antlerite, and cuprite was the shipping product; remaining ore is chiefly sheared limestone impregnated with pyrite and some chalcopyrite and bornite.
Grant Mountain Gold Mine (Murray placer mine)	T. 8 N., R. 28 E.	Au	Placer gold in old upland channel on granitic terraine: largest nugget had a value of $30
Walker Lake prospect	T. 12 N., R. 28 E.	Fe	Magnetite is veinlets and small bunches scattered through a large area of epidotized metavolcanic rock, probably localized in part along faults.
Lee Hot Springs	T. 16 N., R. 29 E.	U	Tuffa limestone, siliceous sinter
Robinson	T. 14 N., R. 32 E.	U	Carnotite in opalized plant material, at the base of a quartz latite welded tuff.
Regan Mine	T. 12 N., R. 27 E.	Gypsum	Gypsum apparently a bedded deposit, associated with limestone, shale, chert, and epidotized diorite; probably Excelsior in age, but relations uncertain. Gypsum may be several hundred feet thick, but extent apparently limited.
Bubbles Claim	T. 14 N., R. 30 E.	U	Carnotite present in opalized wood, and along altered shsear zones in rhyolitic tuff.
Rovada Mining Co.	4 mi south of Rawhide Hot Springs	Au	Unknown

Sources: Willden & Speed (1974), Ross (1961), Durham & Femler (1982), Hurley, et al (1982) mechanisms are responsible for most mineralized areas on the reservation. Mineralying events appear to have commenced in late Cenozoic time, except for the metasedimentary occurrences, which occurred in Cretaceous time. Occurrences could be further subdivided by host rocks, namely: (1) quartz veins, (2) tactites, (3) altered fault zones, (4) possible occurrences with disseminated sulfides, (5) uraniferous tuffs.

Quartz vein occurrences are most prevalent in the Bimetal, Red Granite, and North Afterthought areas. In the Bimetal Area, mineralized quartz veins were injected into the Cretaceous granite and overlying middle to late Tertiary rhyolitic tuffs. In the Red Granite Area, quartz veins were likewise injected into the granite. The Red Granite Area also contains isolated pods of anomalous radioactivity within the granite. The North Afterthought veins were also injected into Cretaceous granitic rock. Presumably, these occurrences happened about the same time giving upper Cenozoic as the time of some of the quartz vein mineralization. Gold and silver mineralization on the reservation is predominantly associated with the quartz vein occurrences.

Mineral occurrences within altered fault zones are found in several areas of the reservation including; Afterthought, Guranium, Calico, Hidden Valley, Gillis, and Sulfur. The northern occurrences display less gossan than the southern areas, though gossan along fault zones occurs throughout the reservation. This third type occurrence hosts mineralization of various metals, a few of those include gold, silver, copper lead, zinc and to some extent uranium.

Tactite occurrences within the metamorphic sediments generally contain anomolous tungsten. The principal areas of occurrences of this type are the Sulfur Area, and Copper, all in the Gillis Range. These occurrences are related to alteration or replacement of Triassic limestone by the encompassing Cretaceous granitic intrusions.

Occurrences of iron and copper are also associated with meta-sediments in the Calico area (Lawrence, 1969).

Other types of mineral occurrence are disseminated sulfides in limestone of Hidden Valley and secondary uranium deposits. While the exact nature of the disseminate sulfide occurrences is not known, this type of occurrence may be related to hydrothermal activity in the area.

Primary uranium appears to be genetically related to the late Cenozoic felsic tuffs which display anomalously high uranium values in several areas. In the Bubbles Area, uranium has been leached by groundwater from these tuffs and redeposited in wood fragments within the tuff layers. Therefore, leached uranium may have also been redeposited in favorable stratigraphic layers in the adjoining basins.

3.0 DISCUSSION OF FIELD RESULTS

The CERT field program was conducted in three stages: 1) carborne radiometric survey, 2) reconnaissance rock and water sampling, scintillometer, and magnetic surveys, and 3) detailed rock sampling and mapping. Results of the carborne radiometeric survey are plotted in conjunction with a previous Trac-Etch survey on Plate II.

Several areas of high anomalous radioactivity have been defined by the Trac-Etch survey. The most prominent of these is a northwest trending zone along the northeast side of Weber Reservoir possibly extending southeast to an anomalous "high" north of Schurz. Another high anomaly occurs two miles west of Double Spring and may also be related to the Weber Reservoir trend. Two other high areas, though less delineated, occur on the reservation, southeast and north of the Terrill Mountains.

The carborne survey has located several highly anamalous (f 120 cps) areas on the reservation, however, none of these are coincident with the Trac-Etch highs. This discrepancy can be accounted for in that 1) these are two distinctly different sampling methods, involving differing lengths of sample time and measuring two different radioactive by-products; 2) both surveys were conducted in different manners, Trac-Etch cups are buried in the ground, while the carborne survey was conducted over the surface; and 3) Trac-Etch Film is sensitive to alpha radiation whereas scintillometer measures alpha, beta, and gamma ratiation.

Despite this divergence of data, two areas of the reservation do show some similarities between the surveys. The more noticeable is the Weber Reservoir trend, here both surveys display some relationship with anomalous radioactivity. A less apparent similarity is also shown west of Double Spring. Idaho Mining Company drilled several barren uranium test holes along the northeast side of Weber Reservoir, however, these holes were quite shallow (Z 150') and did not adequately test the uranium potential.

On the whole, the higher anomalous (f 100cps) areas located, by the carborne survey, occur within and adjacent to tuff covered mountain ranges, suggesting the radioactive tuff both in place and redeposited on alluvial fans. Indeed, both of these surveys (Trac-Etch and carborne) may be displaying this relationship, thereby masking any subsurface uranium deposit, should such a deposit be present in these basins.

The pedometric scintillometer survey was conducted in conjunction with rock sampling (see Section 4.0) as as guide in locating anomalous rock samples. During the course of this survey, it became apparent that an unusually high amount of radioactivity was associated with felsic tuffs. In addition, anomalous radioactivity was also located along fault zones, pods within granite (Red Granite area), opalized wood and one occurrence in what appears to be an altered basalt in the Calico Area.

Since the primary source for radioactive anomalies are felsic tuffs of middle to upper Tertiary age, the uraniferous fault zone occurrence, and possibly the altered basalt and granite occurrences, may be genetically related to the same sequence of volcanic activity. As will be discussed in more detail later, these fault zone occurrences also tend to host anomalous amounts of other metals as well.

Magnetic traverses were conducted in four areas: 1) east of Double Springs, 2) Bimetal area, 3) Long Valley, and 4) Sulfur area. East of Double Springs, the traverse was across a thermal low which produced a slight, arcuate magnetic high. At Long Valley, a northeast trending linear high was located during a test traverse. One traverse was made perpendicular to the strike of mineralized quartz veins at the Bimetal area, but did not show any magnetic variation along the traverse. Similarly, a magnetic traverse was conducted across gossan zones in the Sulfur Area with no magnetic anomalies.

One test magnetic traverse in a drainage along the northeast side of Long Valley NW 1/4, NE 1/4, Sec. 36, T15N, R38E initially indicated a linear, northwest trending feature 50' to 100' wide. This linear feature yielded 600 to 800 gammas variation over a few feet of test traverses before returning to normal magnetic readings. A more detailed survey, conducted later, did define an anomalous area, however, the previous significant gamma variations were not encountered. Though the discrepancy cannot fully be accounted for two possibilities are evident, perhaps the battery pack was at low charge or the late traverse was not conducted across the same area since the anomaly was quite narrow and could be easily missed. At any rate this area should have an additional survey conducted across it as a check to be compared to this study.

On the whole, the results of the magnetometer surveys were not encouraging, since the proton magnetometer apparently cannot delineate gossan type occurrences, which indicate hydrothermal activity and commonly display other mineral occurrences. The usefulness of the magnetometer as an instrument for geothermal surveys was not verified but does look encouraging due to the correlation of a magnetic high and thermal low.

4.0 DISCUSSION OF ANALYTICAL AND STATISTICAL RESULTS

Sixty seven rock samples (Plate III) were initially collected on the reservation and submitted for analysis of 35 elements. Based on preliminary analytical results of these samples, an additional 14 rock samples were collected in three areas displaying significant or unexpected mineralization.

Results of the geochemical data were then submitted to various statistical methods to determine if elemental relationships could be derived from lithology, area of occurrence, or mode of occurrence. In this manner, and in conjunction with the petrographic results, determination of possible geologic and mineral resource models can be accomplished. Keep in mind, however, that in many instances the statistical results are based on very few samples and therefore should be treated qualitatively.

In developing geostatistical models, the first consideration must be identification of sample populations lithologically and areally where complex geology is pervasive. Therefore, this discussion will first deal with results by area and then lithology and mode of occurrence, which in some instances will be the same, such as, quartz veins are a particular lithology and the mode of occurrence for mineralization in some areas.

The rock analytical results are provided, by area, on Tables 4-1 to 4-3, mean and standard deviations for each area and lithology are in Appendix B, lithology descriptions for each sample are in Appendix C. In addition, rock sample data for NURE (National

TABLE 4-1 GEOCHEMICAL DATA FOR BIMETAL, AFTERTHOUGHT, AND LONG VALLEY AREAS

Sample Number	AU PPB	BI PPM	CO PPM	CR PPM	CU PPM	MO PPM	NI PPM	PB PPM	S %	ZN PPM	AS PPM	HG PPB	TOTAL SI02 %
						BIMETAL AREA							
WR:1	213.0	-2.0	2.0	26.0	30.0	4.0	7.0	94.0	0.07	35.0	65.0	180.0	71.6
WR:2	-2.0	-2.0	-1.0	20.0	19.0	2.0	7.0	10.0	-0.05	5.0	5.0	8.0	71.6
WR:3	-2.0	-2.0	1.0	32.0	230.0	2.0	8.0	4.0	-0.05	8.0	110.0	4.0	72.8
WR:12	2350.0	-2.0	2.0	38.0	56.0	4.0	13.0	36.0	0.07	15.0	30.0	42.0	80.8
WR:13	2900.0	-2.0	2.0	52.0	55.0	6.0	19.0	10.0	-0.05	2.0	15.0	24.0	96.0
WR:14	5.0	-2.0	1.0	14.0	12.0	-1.0	3.0	20.0	0.1	27.0	10.0	12.0	70.1
WR:15	25.0	-2.0	2.0	62.0	50.0	13.0	20.0	28.0	0.21	17.0	140.0	26.0	74.1
						AFTERTHOUGHT AREA							
WR:20	-2.0	-2.0	5.0	60.0	58.0	7.0	32.0	12.0	0.09	12.0	40.0	4.0	70.7
WR:21	-2.0	-2.0	3.0	54.0	40.0	3.0	18.0	8.0	0.15	17.0	10.0	4.0	72.9
WR:22	-2.0	-2.0	23.0	36.0	105.0	11.0	41.0	8.0	1.8	23.0	55.0	14.0	46.6
WR:23	-2.0	-2.0	3.0	50.0	46.0	6.0	18.0	4.0	0.11	26.0	25.0	8.0	73.4
WR:24	-2.0	-2.0	4.0	52.0	14.0	4.0	21.0	4.0	0.08	6.0	5.0	-4.0	74.5
WR:25	18.0	-2.0	13.0	46.0	250.0	23.0	34.0	2.0	1.4	24.0	295.0	14.0	48.8
WR:26	4.0	-2.0	50.0	50.0	330.0	2.0	52.0	8.0	0.1	6.0	40.0	16.0	45.0
WR:27	11.0	-2.0	8.0	32.0	59.0	2.0	68.0	8.0	0.15	175.0	35.0	10.0	48.3
WR:29	2.0	-2.0	8.0	26.0	16.0	-1.0	31.0	14.0	1.1	92.0	90.0	6.0	58.9
						NORTH AFTERTHOUGHT AREA							
WR:8	-2.0	-2.0	10.0	36.0	73.0	10.0	15.0	38.0	0.07	53.0	10.0	4.0	72.0
WR:9	-2.0	-2.0	20.0	22.0	83.0	2.0	15.0	4.0	0.07	74.0	5.0	12.0	54.2
WR:10	2.0	68.0	3.0	48.0	95.0	13.0	15.0	650.0	-0.05	55.0	20.0	20.0	88.8
						SOUTH AFTERTHOUGHT AREA							
WR:6	-2.0	-2.0	17.0	12.0	26.0	6.0	21.0	6.0	-0.05	19.0	5.0	8.0	63.9
WR:7	-2.0	-2.0	4.0	40.0	38.0	6.0	14.0	4.0	0.07	10.0	10.0	10.0	72.0
WR:17	4.0	-2.0	16.0	12.0	26.0	13.0	27.0	14.0	10.0	22.0	110.0	170.0	22.7
						LONG VALLEY							
WR:4	-2.0	-2.0	5.0	110.0	96.0	13.0	38.0	10.0	0.08	11.0	40.0	64.0	82.6
WR:18	-2.0	-2.0	7.0	26.0	43.0	2.0	13.0	2.0	0.08	32.0	10.0	8.0	61.3

TABLE 4-1 GEOCHEMICAL DATA FOR BIMETAL, AFTERTHOUGHT, AND LONG VALLEY AREAS (cont.)

Sample Number	SB PPM	SN PPM	U PPM	W PPM	TOTAL AL %	TOTAL BA PPM	TOTAL CA %	TOTAL FE %	TOTAL K %	TOTAL MN %	TOTAL MG %	TOTAL NA %	AG PPM
BIMETAL AREA													
WR:1	-1.0	-2.0	36.0	-4.0	6.68	490.0	0.51	1.76	3.2	0.046	0.21	2.24	1.4
WR:2	5.0	-2.0	1.6	-4.0	7.66	720.0	0.52	0.87	4.26	0.012	0.08	3.34	0.1
WR:3	2.0	-2.0	1.8	-4.0	7.08	760.0	1.22	1.12	4.3	0.025	0.11	3.12	-0.1
WR:12	-1.0	-2.0	4.4	-4.0	3.75	430.0	1.8	1.71	2.25	0.025	0.1	1.45	3.6
WR:13	-1.0	-2.0	0.6	-4.0	0.17	20.0	0.08	1.94	0.06	0.017	0.02	0.15	3.3
WR:14	-1.0	-2.0	4.6	-4.0	6.4	290.0	0.97	1.08	2.35	0.06	0.73	1.68	-0.1
WR:15	-1.0	-2.0	5.4	-4.0	5.08	450.0	0.28	5.23	3.52	0.023	0.05	2.23	0.1
AFTERTHOUGHT AREA													
WR:20	-1.0	-2.0	2.5	-4.0	4.02	570.0	3.58	4.66	0.81	0.039	0.59	2.13	-0.1
WR:21	-1.0	-2.0	1.7	-4.0	5.77	870.0	0.51	2.28	5.77	0.019	0.13	1.98	-0.1
WR:22	-1.0	-2.0	10.0	-4.0	8.8	2550.0	6.66	2.98	2.6	0.306	0.25	4.01	-0.1
WR:23	-1.0	2.0	1.5	-4.0	5.96	650.0	0.56	2.42	5.72	0.028	0.07	2.15	-0.1
WR:24	-1.0	-2.0	3.2	-4.0	7.5	2060.0	1.05	1.69	6.32	0.019	0.24	2.82	-0.1
WR:25	-1.0	-2.0	2.7	-4.0	3.43	970.0	8.92	12.7	0.96	0.27	1.75	1.55	0.1
WR:26	-.10	-2.0	3.4	-4.0	0.45	30.0	12.5	9.74	0.07	0.096	8.2	0.46	-0.1
WR:27	-1.0	-2.0	4.0	-4.0	4.46	80.0	14.0	3.01	0.37	0.05	2.0	1.45	0.6
WR:29	-1.0	-2.0	5.2	-4.0	7.52	1570.0	2.37	3.24	5.54	0.065	0.27	1.31	-0.1
NORTH AFTERTHOUGHT AREA													
WR:8	-1.0	-2.0	1.8	-4.0	5.53	980.0	0.19	2.78	6.93	0.048	0.56	0.77	0.5
WR:9	-1.0	-2.0	2.0	-4.0	9.69	540.0	4.26	5.79	1.66	0.1	2.08	3.1	0.1
WR:10	-1.0	-2.0	0.6	-4.0	0.08	20.0	0.01	2.29	0.15	0.016	0.02	0.09	64.0
SOUTH AFTERTHOUGHT AREA													
WR:6	-1.0	-2.0	1.3	-4.0	8.9	1670.0	2.07	2.82	2.99	0.053	0.66	4.83	-0.1
WR:7	-1.0	-2.0	1.7	-4.0	6.98	1280.0	0.97	1.59	6.22	0.02	0.08	2.38	-0.1
WR:17	-1.0	19.0	0.7	-4.0	0.43	380.0	0.12	31.2	1.33	0.008	0.03	2.15	0.2
LONG VALLEY													
WR:4	12.0	-2.0	0.6	-4.0	2.18	410.0	0.58	5.05	3.14	0.048	0.11	0.3	0.2
WR:18	-1.0	-2.0	1.2	-4.0	8.92	830.0	3.76	4.47	2.03	0.096	1.56	3.06	-0.1

TABLE 4-1 GEOCHEMICAL DATA FOR BIMETAL, AFTERTHOUGHT, AND LONG VALLEY AREAS (cont.)

Sample Number	TOTAL TI %	TOTAL LI PPM	TOTAL RB PPM	TOTAL V PPM	TOTAL ZR PPM	TOTAL P PPM	TE PPM	TH PPM	TL PPM
BIMETAL AREA									
WR:1	0.12	9.0	50.0	40.0	-50.0	285.0	-0.1	10.0	-0.1
WR:2	0.1	4.0	50.0	10.0	-50.0	175.0	-0.1	13.0	-0.1
WR:3	0.09	8.0	55.0	20.0	-50.0	210.0	-0.1	21.0	-0.1
WR:12	0.02	14.0	48.0	10.0	-50.0	400.0	-0.1	13.0	-0.1
WR:13	0.01	22.0	2.0	-10.0	-50.0	420.0	-0.1	-0.1	-0.1
WR:14	0.05	19.0	14.0	20.0	-50.0	200.0	-0.1	28.0	0.1
WR:15	0.04	5.0	80.0	20.0	-50.0	870.0	-0.1	23.0	-0.1
AFTERTHOUGHT AREA									
WR:20	0.14	7.0	13.0	110.0	-50.0	870.0	-0.1	3.0	-0.1
WR:21	0.05	20.0	60.0	10.0	-50.0	390.0	-0.1	23.0	-0.1
WR:22	0.54	5.0	25.0	180.0	-50.0	460.0	-0.1	7.0	5.4
WR:23	0.11	17.0	67.0	10.0	-50.0	440.0	-0.1	25.0	-0.1
WR:24	0.15	4.0	42.0	30.0	-50.0	270.0	-0.1	23.0	-0.1
WR:25	0.24	5.0	27.0	170.0	-50.0	2200.0	0.1	7.0	-0.1
WR:26	0.07	6.0	-1.0	300.0	-50.0	3200.0	-0.1	8.0	-0.1
WR:27	0.25	12.0	15.0	120.0	-50.0	630.0	-0.1	6.0	-0.1
WR:29	0.44	13.0	44.0	100.0	-50.0	480.0	-0.1	11.0	-0.1
NORTH AFTERTHOUGHT AREA									
WR:8	0.15	7.0	59.0	70.0	-50.0	540.0	0.3	7.0	-0.1
WR:9	0.55	9.0	10.0	190.0	-50.0	1060.0	-0.1	6.0	-0.1
WR:10	0.01	2.0	3.0	10.0	-50.0	500.0	8.9	-1.0	0.1
SOUTH AFTERTHOUGHT AREA									
WR:6	0.29	8.0	20.0	90.0	-50.0	490.0	-0.1	?	-0.1
WR:7	0.15	5.0	52.0	30.0	-50.0	250.0	-0.1	23.0	-0.1
WR:17	0.1	3.0	23.0	80.0	-50.0	4450.0	-0.1	6.0	0.1
LONG VALLEY									
WR:4	0.12	42.0	58.0	70.0	-50.0	980.0	-0.1	1.0	-0.1
WR:18	0.39	8.0	4.0	100.0	-50.0	715.0	-0.1	4.0	-0.1

TABLE 4-2 GEOCHEMICAL DATA FOR GURANIUM, CALICO, BUBBLES, HIDDEN VALLEY, AND RED GRANITE AREAS

Sample Number	AU PPB	BI PPM	CO PPM	CR PPM	CU PPM	MO PPM	NI PPM	PB PPM	S %	ZN PPM	AS PPM	HG PPB	TOTAL SIO2 %
GURANIUM AREA													
WR:39	-2.0	-2.0	3.0	46.0	38.0	3.0	14.0	14.0	-0.05	38.0	10.0	10.0	70.5
WR:40	35.0	-2.0	12.0	46.0	4120.0	6.0	17.0	140.0	0.05	1010.0	135.0	125.0	71.9
WR:41	610.0	415.0	-1.0	16.0	15300.0	9.0	2.0	2400.0	1.0	3000.0	27000.0	62000.0	29.0
WR:37	4.0	-2.0	5.0	14.0	22.0	5.0	10.0	18.0	0.08	40.0	20.0	18.0	73.7
WR:38	11.0	-2.0	6.0	16.0	39.0	12.0	11.0	18.0	0.08	445.0	45.0	8.0	74.8
CALICO AREA													
WR:32	-2.0	4.0	1.0	14.0	76.0	1.0	6.0	32.0	0.12	69.0	20.0	10.0	71.8
WR:33	-2.0	-2.0	10.0	10.0	31.0	2.0	17.0	4.0	0.08	68.0	5.0	4.0	61.8
WR:34	-2.0	-2.0	10.0	118.0	41.0	4.0	39.0	8.0	-0.05	37.0	20.0	6.0	21.7
WR:43	-2.0	-2.0	-1.0	14.0	21.0	-1.0	3.0	20.0	0.17	115.0	175.0	220.0	68.3
WR:45	-2.0	-2.0	5.0	60.0	48.0	4.0	28.0	6.0	-0.05	23.0	15.0	48.0	74.8
BUBBLES AREA													
WR:46	-2.0	-2.0	4.0	14.0	26.0	5.0	6.0	8.0	0.28	37.0	15.0	68.0	67.6
WR:47	-2.0	-2.0	3.0	10.0	46.0	4.0	18.0	-2.0	0.05	10.0	5.0	32.0	87.4
WR:48	-2.0	-2.0	2.0	24.0	22.0	2.0	10.0	-2.0	0.09	10.0	15.0	10.0	87.5
HIDDEN VALLEY AREA													
WR:49	115.0	-2.0	4.0	28.0	27.0	32.0	96.0	24.0	1.4	1190.0	7500.0	1840.0	20.4
WR:51	38.0	-2.0	3.0	64.0	76.0	18.0	24.0	86.0	0.56	27.0	1200.0	144.0	72.5
WR:52	-2.0	4.0	-1.0	54.0	14.0	-1.0	10.0	10.0	0.12	52.0	20.0	6.0	8.1
WR:53	2.0	-2.0	6.0	56.0	68.0	9.0	37.0	10.0	0.15	18.0	15.0	4.0	47.6
WR:54	9.0	-2.0	5.0	60.0	56.0	6.0	26.0	10.0	0.09	17.0	15.0	6.0	71.2
WR:55	-2.0	-2.0	6.0	8.0	41.0	2.0	17.0	6.0	0.09	18.0	40.0	12.0	58.3
WR:56	-2.0	-2.0	6.0	32.0	44.0	1.0	19.0	14.0	0.09	130.0	20.0	-4.0	34.7
RED GRANITE AREA													
WR:57	5700.0	-2.0	4.0	32.0	32.0	4.0	13.0	4.0	0.1	7.0	30.0	60.0	85.1
WR:63	250.0	-2.0	2.0	20.0	19.0	1.0	7.0	4.0	0.43	8.0	10.0	6.0	69.3
WR:66	27.0	-2.0	4.0	62.0	62.0	8.0	26.0	4.0	0.18	4.0	10.0	38.0	83.5

TABLE 4-2 GEOCHEMICAL DATA FOR GURANIUM, CALICO, BUBBLES, HIDDEN VALLEY, AND RED GRANITE AREAS (cont.)

Sample Number	SB PPM	SN PPM	U PPM	W PPM	TOTAL AL %	TOTAL BA PPM	TOTAL CA %	TOTAL FE %	TOTAL K %	TOTAL MN %	TOTAL MG %	TOTAL NA %	AG PPM
GURANIUM AREA													
WR:39	-1.0	2.0	2.0	-4.0	6.52	590.0	0.67	2.61	4.46	0.026	0.21	1.98	-.01
WR:40	-1.0	4.0	15.0	-4.0	6.8	410.0	0.17	3.5	6.43	0.405	0.18	0.87	2.2
WR:41	1080.0	38.0	68.0	-4.0	2.43	390.0	0.44	32.1	1.1	0.016	0.08	0.18	580.0
WR:37	-1.0	-2.0	3.9	-4.0	6.52	130.0	0.78	2.31	2.05	0.073	0.32	0.34	-0.1
WR:38	-1.0	-2.0	14.0	-4.0	6.59	160.0	0.18	1.96	2.57	0.201	0.13	0.36	-0.1
CALICO AREA													
WR:32	-1.0	-2.0	1.1	-4.0	6.17	150.0	0.42	1.55	5.66	0.05	0.16	1.75	0.3
WR:33	-1.0	2.0	0.8	-4.0	9.04	750.0	2.62	4.67	1.99	0.076	0.68	3.37	-0.1
WR:34	-1.0	-2.0	420.0	-4.0	3.27	940.0	23.2	2.23	0.48	0.845	0.8	1.06	-0.1
WR:43	-1.0	-2.0	2.8	-4.0	6.45	70.0	0.12	1.42	4.96	0.022	0.1	3.11	-0.1
WR:45	-1.0	-2.0	2.4	20.0	5.71	190.0	0.52	2.71	4.14	0.027	0.19	1.93	-0.1
BUBBLES AREA													
WR:46	-1.0	-2.0	4.0	-4.0	6.84	530.0	1.0	2.08	3.95	0.03	0.29	3.32	0.2
WR:47	-1.0	2.0	36.0	-4.0	0.08	60.0	0.23	1.83	0.05	0.015	0.03	0.59	-0.1
WR:48	-1.0	4.0	30.0	-4.0	0.25	230.0	0.24	1.18	0.09	0.009	0.05	0.63	-0.1
HIDDEN VALLEY AREA													
WR:49	185.0	-2.0	11.0	-4.0	0.25	30900.0	0.58	41.2	0.09	0.05	0.23	0.36	0.4
WR:51	6.0	4.0	2.8	-4.0	0.39	390.0	1.27	9.47	0.66	0.053	0.11	0.25	1.3
WR:52	-1.0	-2.0	3.9	-4.0	0.28	210.0	33.8	0.28	0.12	0.012	0.23	0.08	0.2
WR:53	-1.0	4.0	2.6	-4.0	8.61	930.0	9.34	6.15	4.42	0.133	1.37	1.38	-0.1
WR:54	-1.0	4.0	1.0	-4.0	7.05	600.0	0.84	3.73	4.86	0.037	0.22	2.53	-0.1
WR:55	-1.0	-2.0	1.4	-4.0	10.8	710.0	0.83	3.79	3.92	0.045	0.42	2.06	-0.1
WR:56	-1.0	-2.0	1.4	-4.0	7.76	30.0	21.2	3.7	0.08	0.095	4.35	0.09	-0.1
RED GRANITE AREA													
WR:57	-1.0	-2.0	4.1	-4.0	0.97	50.0	0.19	5.2	0.57	0.016	0.11	0.13	0.6
WR:63	-1.0	-2.0	1.6	-4.0	7.19	480.0	0.14	3.56	5.76	0.014	0.21	2.44	-0.1
WR:66	-1.0	12.0	69.0	-4.0	1.24	120.0	1.4	3.07	0.83	0.041	0.09	0.14	-0.1

TABLE 4-2 GEOCHEMICAL DATA FOR GURANIUM, CALICO, BUBBLES, HIDDEN VALLEY, AND RED GRANITE AREAS (cont.)

Sample Number	TOTAL TI %	TOTAL LI PPM	TOTAL RB PPM	TOTAL V PPM	TOTAL ZR PPM	TOTAL P PPM	TE PPM	TH PPM	TL PPM
GURANIUM AREA									
WR:39	0.17	13.0	57.0	30.0	-50.0	420.0	-0.1	18.0	-0.1
WR:40	0.17	8.0	78.0	30.0	-50.0	460.0	0.4	20.0	0.2
WR:41	0.05	9.0	32.0	70.0	-50.0	4900.0	2.3	-0.1	0.3
WR:37	0.17	27.0	36.0	40.0	-50.0	380.0	-0.1	20.0	0.2
WR:38	0.18	21.0	65.0	20.0	-50.0	320.0	-0.1	19.0	-0.1
CALICO AREA									
WR:32	0.1	12.0	99.0	10.0	-50.0	210.0	-0.1	22.0	-0.1
WR:33	0.37	14.0	23.0	100.0	-50.0	620.0	-0.1	5.0	-0.1
WR:34	0.17	9.0	11.0	50.0	-50.0	1830.0	-0.1	1.0	0.2
WR:43	0.08	13.0	140.0	-10.0	50.0	210.0	-0.1	25.0	-0.1
WR:45	0.1	13.0	58.0	20.0	100.0	460.0	-0.1	14.0	-0.1
BUBBLES AREA									
WR:46	0.18	9.0	69.0	40.0	-50.0	325.0	-0.1	18.0	-0.1
WR:47	0.02	1.0	1.0	40.0	-50.0	325.0	-0.1	-1.0	-0.1
WR:48	0.02	1.0	2.0	80.0	-50.0	250.0	-0.1	-1.0	-0.1
HIDDEN VALLEY AREA									
WR:49	0.01	8.0	2.0	400.0	-50.0	6450.0	-0.1	-1.0	32.0
WR:51	0.04	9.0	13.0	60.0	-50.0	1500.0	13.2	-1.0	1.6
WR:52	0.02	3.0	3.0	60.0	-50.0	685.0	-0.1	-1.0	0.1
WR:53	0.31	12.0	67.0	110.0	100.0	740.0	-0.1	6.0	-0.1
WR:54	0.15	12.0	68.0	20.0	-50.0	500.0	-0.1	18.0	0.1
WR:55	0.31	24.0	54.0	50.0	-50.0	400.0	-0.1	24.0	0.2
WR:56	0.09	7.0	2.0	20.0	100.0	540.0	-0.1	5.0	-0.1
RED GRANITE AREA									
WR:57	0.04	7.0	34.0	40.0	-50.0	945.0	-0.1	6.0	-0.1
WR:63	0.25	5.0	105.0	40.0	-50.0	400.0	-0.1	14.0	-0.1
WR:66	0.05	17.0	43.0	10.0	-50.0	690.0	-0.1	2.0	-0.1

TABLE 4-3 GEOCHEMICAL DATA FOR GILLIS, COPPER, SULFUR, WILDHORSE, AND OTHER AREAS

Sample Number	AU PPB	BI PPM	CO PPM	CR PPM	CU PPM	MO PPM	NI PPM	PB PPM	S %	ZN PPM	AS PPM	HG PPB	TOTAL SI02 %
GILLIS AREA													
WR:74	9.0	-2.0	7.0	60.0	110.0	5.0	34.0	12.0	0.58	13.0	85.0	60.0	33.6
WR:78	80.0	6.0	-1.0	10.0	3310.0	4.0	2.0	10.0	0.12	52.0	1800.0	4.0	2.0
WR:76	-2.0	4.0	3.0	26.0	26.0	2.0	7.0	24.0	0.16	11.0	10.0	8.0	29.6
WR:80	-2.0	2.0	-1.0	10.0	7.0	-1.0	2.0	16.0	0.09	15.0	-5.0	-4.0	8.1
WR:67	29.0	6.0	105.0	12.0	4460.0	-1.0	5.0	14.0	0.14	165.0	1900.0	118.0	1.0
WR:82	17.0	4.0	27.0	94.0	6850.0	8.0	84.0	24.0	0.10	185.0	75.0	4.0	31.5
COPPER AREA													
WR:83	4.0	4.0	-1.0	12.0	3330.0	2.0	8.0	8.0	0.09	60.0	15.0	-4.0	4.3
WR:85	5.0	2.0	7.0	172.0	67.0	26.0	23.0	40.0	0.09	530.0	5.0	-4.0	42.0
WR:86	760.0	8.0	20.0	36.0	2020.0	78.0	23.0	20.0	0.32	39.0	600.0	184.0	28.8
WR:73	73.0	-2.0	125.0	12.0	149000.0	70.0	16.0	90.0	0.1	285.0	300.0	14.0	18.5
SULFUR AREA													
WR:68	-2.0	-2.0	-1.0	12.0	98.0	-1.0	3.0	22.0	0.14	275.0	45.0	6.0	15.1
WR:70	-2.0	-2.0	6.0	64.0	1960.0	31.0	22.0	8.0	0.12	590.0	65.0	8.0	27.3
WR:65	-2.0	-2.0	3.0	8.0	50.0	105.0	-1.0	20.0	19.0	7.0	5.0	48.0	13.6
WR:72	4.0	-2.0	8.0	6.0	115.0	145.0	-2.0	12.0	14.0	18.0	950.0	24.0	2.1
WR:59	6.0	4.0	5.0	10.0	325.0	1.0	-1.0	6.0	4.9	50.0	65.0	8.0	12.5
WR:61	-2.0	8.0	1.0	10.0	225.0	430.0	-1.0	56.0	0.42	225.0	150.0	-4.0	10.2
WILD HORSE AREA													
WR:81	6.0	2.0	18.0	8.0	32.0	2.0	10.0	26.0	0.17	145.0	30.0	4.0	67.9
WR:79	-2.0	-2.0	25.0	62.0	110.0	6.0	37.0	18.0	0.17	96.0	10.0	6.0	52.5
OTHER AREAS													
WR:71	-2.0	6.0	4.0	44.0	250.0	6.0	32.0	22.0	0.14	59.0	150.0	6460.0	77.1
WR:75	-2.0	-2.0	1.0	12.0	170.0	2.0	6.0	6.0	0.17	10.0	20.0	4.0	8.8
WR:62	5.0	-2.0	7.0	42.0	265.0	5.0	12.0	8.0	0.09	18.0	90.0	-4.0	18.4

TABLE 4-3 GEOCHEMICAL DATA FOR GILLIS, COPPER, SULFUR, WILDHORSE, AND OTHER AREAS (cont.)

Sample Number	SB PPM	SN PPM	U PPM	W PPM	TOTAL AL %	TOTAL BA PPM	TOTAL CA %	TOTAL FE %	TOTAL K %	TOTAL MN %	TOTAL MG %	TOTAL NA %	AG PPM
GILLIS AREA													
WR:74	7.0	-2.0	1.1	-4.0	4.79	220.0	18.5	3.15	0.54	0.06	1.52	0.70	1.1
WR:78	42.0	-2.0	160.0	-4.0	0.08	50.0	35.3	0.96	0.05	0.104	0.16	0.06	0.1
WR:76	-1.0	-2.0	1.0	-4.0	6.66	150.0	18.0	2.44	0.93	0.02	3.75	0.22	-0.1
WR:80	-1.0	-2.0	1.0	-4.0	0.27	20.0	31.8	0.24	0.06	0.019	3.0	0.07	-0.1
WR:67	365.0	-2.0	7.5	-4.0	0.11	10.0	20.5	1.22	0.02	0.198	12.4	0.12	6.5
WR:82	9.0	2.0	7.4	-4.0	3.05	360.0	17.0	2.41	2.07	0.076	0.94	0.14	2.2
COPPER AREA													
WR:83	-1.0	-2.0	6.8	20.0	0.14	20.0	36.7	1.36	0.06	0.083	0.17	0.06	0.6
WR:85	-1.0	-2.0	8.2	1400.0	2.44	60.0	18.0	12.2	0.03	0.995	1.91	0.09	0.3
WR:86	6.0	5.0	20.0	160.0	0.17	670.0	1.96	40.7	0.04	0.027	0.45	0.12	0.5
WR:73	-1.0	-2.0	67.0	32.0	0.1	-10.0	0.23	16.3	0.04	0.031	0.96	0.1	0.6
SULFUR AREA													
WR:68	-1.0	23.0	1.1	-4.0	0.2	10.0	30.9	0.92	0.11	0.138	0.27	0.07	-0.1
WR:70	-1.0	6.0	2.6	210.0	0.11	10.0	0.2	41.6	-0.01	0.109	0.4	0.08	0.4
WR:65	26.0	4.0	0.7	-4.0	0.09	20.0	17.5	1.03	0.28	0.011	0.12	0.68	0.9
WR:72	-1.0	6.0	1.5	-4.0	0.28	170.0	10.0	22.0	0.56	0.019	0.11	1.5	-0.1
WR:59	-1.0	-2.0	1.0	-4.0	0.86	350.0	11.5	14.3	1.05	0.013	0.06	0.33	0.1
WR:61	15.0	2.0	1.4	36.0	0.14	20.0	0.05	48.6	0.02	0.016	0.02	0.05	-0.1
WILDHORSE AREA													
WR:81	-1.0	2.0	2.9	-4.0	7.52	1000.0	0.5	2.9	5.82	0.295	0.89	0.28	0.1
WR:79	-1.0	2.0	1.8	-4.0	8.85	430.0	3.92	8.01	0.85	0.135	2.55	2.68	-0.1
OTHER AREAS													
WR:71	-1.0	8.0	2.2	140.0	3.4	330.0	2.05	2.85	0.11	0.058	0.09	0.09	0.2
WR:75	-1.0	-2.0	1.0	-4.0	0.96	880.0	30.4	0.61	0.44	0.019	1.52	0.5	-0.1
WR:62	-1.0	18.0	3.0	-4.0	0.33	60.0	0.11	46.9	0.1	0.036	0.08	0.09	-0.1

TABLE 4-3 GEOCHEMICAL DATA FOR GILLIS, COPPER, SULFUR, WILDHORSE, AND OTHER AREAS (cont.)

Sample Number	TOTAL TI %	TOTAL LI PPM	TOTAL RB PPM	TOTAL V PPM	TOTAL ZR PPM	TOTAL P PPM	TE PPM	TH PPM	TL PPM
GILLIS AREA									
WR:74	0.22	9.0	16.0	90.0	-50.0	1045.0	-0.1	4.0	-0.1
WR:78	-0.01	2.0	1.0	210.0	50.0	190.0	-0.1	-1.0	-0.1
WR:76	0.37	38.0	8.0	100.0	100.0	420.0	-0.1	6.0	0.1
WR:80	0.02	3.0	-1.0	10.0	-50.0	120.0	-0.1	-1.0	-0.1
WR:67	0.04	1.0	-1.0	10.0	-50.0	210.0	-0.1	-1.0	-0.1
WR:82	0.14	14.0	50.0	670.0	100.0	1160.0	-0.1	4.0	-0.1
COPPER AREA									
WR:83	-0.01	2.0	1.0	30.0	-50.0	260.0	-0.1	1.0	-0.1
WR:85	0.1	8.0	2.0	690.0	-50.0	2300.0	-0.1	-1.0	-0.1
WR:86	0.02	4.0	2.0	170.0	-50.0	6650.0	-0.1	1.0	-0.1
WR:73	0.04	4.0	2.0	20.0	-50.0	4200.0	-0.1	2.0	-0.1
SULFUR AREA									
WR:68	0.05	7.0	4.0	30.0	-50.0	190.0	-0.1	-1.0	-0.1
WR:70	0.04	2.0	-1.0	20.0	-50.0	6550.0	-0.1	-1.0	-0.1
WR:65	0.07	2.0	5.0	-10.0	-50.0	135.0	-0.1	-1.0	-0.1
WR:72	0.1	3.0	140.0	20.0	-50.0	2000.0	-0.1	-1.0	0.2
WR:59	0.1	1.0	27.0	40.0	-50.0	1380.0	-0.1	2.0	-0.1
WR:61	0.09	1.0	1.0	10.0	-50.0	6750.0	-0.1	2.0	-0.1
WILDHORSE AREA									
WR:81	0.17	9.0	91.0	30.0	50.0	480.0	-0.1	4.0	0.9
WR:79	0.45	12.0	21.0	240.0	50.0	960.0	-0.1	12.0	-0.1
OTHER AREA									
WR:71	0.25	71.0	5.0	150.0	-50.0	560.0	-0.1	5.0	-0.1
WR:75	0.03	8.0	18.0	10.0	50.0	110.0	-0.1	3.0	-0.1
WR:62	0.07	1.0	3.0	160.0	-50.0	5300.0	-0.1	1.0	-0.1

Uranium Resource Evaluation) investigations are provided in Appendix D; these sample data were not used in the analysis. For simplicity, the elemental correlations by area, discussed below, do not include the more common rock forming elements; such as, K, Al, Si, Na, Mg, Mn, Fe, etc., but are limited only to those elements of potential economic interest. The lithologic analysis does, however, include the common rock forming elements.

4.1 AREA ROCK ANALYSIS DATA

4.1.1 Bimetal Area

The Bimetal area lies in the northeast corner of the reservation and is the location of previous gold and silver production from quartz veins injected into granitic host rocks. The quartz veins strike N 50°-75° E and dip 30°-50° NW, indicating that the shear zones along which the veins were injected may be pre-Walker Lane development. The analytical results in Table 4-1 shows strong gold anomalies up to 290 ppb (.008 oz/ton) and silver values up to 3.6 ppm (.105 oz/ton) in samples WR-13 and WR-12, respectively. Sample WR-1 contains anomalous uranium of 36 ppm (.004% U_3O_8), in addition to 213 ppb Au (.006 oz/ton), Hg (180ppm) and Ag (.04 oz/ton) from a kaolinized shear zone.

Geostatistical associations (Table 4-4) of particular interest in the area are:

1) U, Hg, Pb, Zn
2) Au, Ag, Si.

As with uranium, Hg, Pb, and Zn also are anomalous within the kaolinized shear. The second association of Au, Ag, and Si would be expected since quartz veins are the primary hosts of gold and silver in the area.

TABLE 4-4 CORRELATION MATRIX — BIMETAL AREA

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	-.3	-.8	-	.1	-	-.7	-.6	.6	-.8	.9	-.9	-.4	-.4	-.9	-.1	0	-.7	-1	-.3	-	-.4	.9	-.1	-.5	-.4	-.3	-.2	.5	.1	-.1	.4	.5	-
Bi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Co	-.3	-.4	-	.6	-	.1	0	.3	-.5	.6	-.7	-.3	.1	-.6	.5	-.1	-.6	-.7	.3	-	-.9	.4	.4	.3	.3	.4	.4	.6	.5	-.1	.6		
Cr	-.6	-.3	-	.8	-	-.4	.2	-.1	-.6	.3	-.5	-.7	-.6	-.4	.8	-.4	-.4	-.7	-.3	-	-.5	.5	-.2	.5	-.4	.4	-.2	.9	.9	.1			
Cu	-.4	.1	-	-.2	-	0	.2	-.2	.1	-.2	.3	-.3	-.3	.3	-.2	.3	.4	.1	-.3	-	.1	-.1	-.3	.5	-.4	-.4	-.4	0	-.1				
Mo	-.5	-.1	-	.9	-	-.1	.4	-.3	-.4	0	-.2	-.6	-.4	-.1	.9	-.5	-.3	-.4	0	-	-.4	.2	0	.6	-.1	.6	0	.8					
Ni	-.6	-.4	-	.8	-	-.5	.1	0	-.7	.4	-.5	-.7	-.6	-.5	.7	-.4	-.5	-.8	-.3	-	-.4	.6	-.2	.3	-.5	.3	-.2						
Pb	-.2	-.2	-	0	-	.7	.2	-.2	.4	.1	-.1	0	.4	0	.1	-.1	-.1	.1	.9	-	-.5	-.3	.9	.1	.8	.2							
S	.2	.5	-	.7	-	.3	.4	-.3	-.3	-.3	-.1	.1	.3	.1	.8	-.2	-.2	0	.1	-	-.6	-.4	.1	.5	.5								
Zn	.4	.3	-	-.1	-	.8	.1	-.1	.3	-.2	0	.5	.8	.1	0	.1	-.1	.3	.7	-	-.5	-.6	.7	.1									
As	-.4	.3	-	.6	-	.4	.7	-.6	.1	-.4	.3	-.4	-.1	.4	.6	-.1	.3	.2	.1	-	-.3	-.3	0										
Hg	-.3	-.4	-	-.1	-	.7	.1	-.2	.4	.2	-.1	-.1	.3	-.1	0	-.2	-.1	.1	.9	-	-.4	-.2											
Si	-.4	-.8	-	.2	-	-.7	-.6	.6	-.8	.7	-.9	-.5	-.5	-.9	0	-.3	-.8	-1	-.4	-	-.4												
Sb	-.3	-.1	-	-.5	-	-.3	.2	-.6	.5	-.5	.7	-.3	-.5	.5	-.5	-.1	.6	.5	-.3	-													
Sn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-														
U	-.2	-.2	-	-.1	-	.8	.1	-.2	.5	0	0	0	.4	.1	0	-.2	0	.2															
Al	.1	.6	-	-.4	-	.6	.5	-.7	.8	-.8	.9	.3	.2	.9	-.3	.2	.8																
Ba	-.3	.3	-	-.3	-	.3	.7	-.9	.7	-.6	.9	-.2	-.2	.9	-.2	.3																	
Ca	.1	.3	-	-.4	-	0	.1	0	-.1	.1	.1	.2	.1	.2	-.4																		
Fe	-.3	.1	-	.9	-	0	.5	-.3	-.4	-.1	-.2	-.4	-.2	0																			
K	-.2	.5	-	-.2	-	.4	.7	-1	.7	-.8	.9	-.1	-.1																				
Mn	.7	.4	-	-.3	-	.6	-.3	.3	.1	-.3	-.1	.8																					
Mg	.9	.5	-	-.4	-	.3	-.5	.3	0	-.4	-.1																						
Na	-.2	.4	-	-.3	-	.4	.6	-.9	.7	-.8																							
Ag	-.4	-.8	-	0	-	-.5	-.4	.5	-.6																								
Ti	-.2	.1	-	-.5	-	.7	.3	-.7																									
Li	.4	-.3	-	-.2	-	-.4	-1																										
Rb	-.5	.3	-	.4	-	.4																											
V	.1	.3	-	-.1	-																												
Zr	-	-	-	-																													
P	-.4	0	-																														
Te	-	-																															
Th	.5																																

A dash (-) indicates insufficient data for a correlation

Neither the encompassing granitic rock nor quartz vein contain anomalous uranium. The kaolinized shear hosts only subordinate amounts of Au and Ag, while the granitic rock in contact with the veins contain no measurable Au, Ag, or U. The mineralizing event which injected the Au and Ag bearing quartz veins could have contained uranium which found a host in the kaolin of the shear.

Alternately, these metal relationships may represent two mineralizing events, rather than the one event just described. The first event consisted of the uranium and other metals injected along the shear zone followed by the second event of the gold and silver bearing quartz veins injected along the shear.

Microscopic thin section examination of WR-3 (granite) shows undulose-quartz and a variety of garnet, indicating possible low grade metamorphism. Albite sericitization was also noted, which could have resulted from hydrothermal alteration and/or metamorphism.

4.1.2 Afterthought Area

On Table 4-1 the Afterthought Area has been divided into two additional areas north and south Afterthought for convenience of map location, for this discussion, all three areas will be combined as one. The analytical results indicate that this area contains anomalous occurrences of numerous base metals and silver in various lithologies, which include quartz veins, meta-limestones, calcic hornfels, pyroxenite, clay interbedded with the calcic hornfels, gossan along shear zones, tuff, diorites, and granodiorite. Some mine development has occurred in the area with several shafts and adits. The pervasive lithologies are granites and granodiorites injected around and into sedimentary rocks of probable Triassic age. These encompassed meta-sediments include slates and limestone. The calcic hornfels and interbedded clay are also the result of "baking" and recrystallization of original sediments.

The Afterthought Area principally represents a multiple intrusive/contact metamorphic complex with minor occurrences of base and precious metals. Neither the intrusive nor meta-sediments appear to contain uranium host nor source rock potential. Felsic Tertiary-age volcanics locally are anomalously radioactive, however, primary economic occurrences in the volcanics are unlikely and proximal basins are too insignificant to postulate economic secondary occurrences. A bismuth airborne radiometric anomaly projected to the north side of the Afterthought Hills was not correlated with bed rock and may be related to local radiation mapped by car in Long Valley.

Previous prospecting activity has been concentrated on tactite zones and quartz veins. Shallow drilling and shafting has revealed minor copper mineralization and a slight gold anomaly in fine grained alkaline intrusives in contact with meta-sediments. Use of surface magnetic surveys and induced polarization surveys have not correlated significantly to shallow drilling (less than 300').

Lawrence (1966) noted mineralogical similarities between granitic rocks on the north west end of the Calico Hills and the southern and central portions of the Afterthought Area. Lawrence described the granites as containing mostly equal amounts of oligoclase and microcline with subordinate quartz, tremolite, epidote, apatite, and zoisite. There appears to be a finer grained "chilled-border" equivalent of the intrusives when in contact with meta-limestones, shales and quartzites. Some of the contact zones where exposed in outcrop are rather colorful with deep vermillion reds and yellow ochres. Samples taken along these contact skarns often show barite and gypsum enrichment with more local abundances of iron, copper, and zinc sulfides. Minor gold and arsenic anomalies have also been noted along the contact zones although no economically significant occurrences of gold were identified.

The north portion of the Afterthought Area consists mostly of dioritic bedrock that has been up-faulted to a contact with the more granitic rocks on the central and southern end. These granitic rocks may be correlative to those encountered at depth in drilling at Calico but thus far have not shown significant mineralization in the Afterthought Area.

A pyroxenite dike and olivine-rich gabbroic rocks (WR-26, WR-25 and WR-24) occurring in monzonitic to granodioritic rocks of the central portion of the Afterthought Area suggests a late stage of mafic, magmatic differentiation and intrusion that could possibly be misinterpreted as hornfels contact zonation. Clearly, the use of ferro-magnesium silicates as indicators of tactite zonation should be approached with caution. These particular rocks appear richer in chalcophile metals and gold than surrounding felsic intrusives.

One high Ag value (64 ppm, 1.87 oz/ton) occurred in a quartz vein sample (WR-10), in addition to Bi (68 ppm) and Pb (650 ppm), which are the only anomalous occurrences in the area for these elements. Other anomalous metal occurrences in the area include: Au, Cu, Zn, As, Ag, and V.

Based on Table 4-5 several elements show good correlations with other elements within a particular group. Three of the more noticeable such relationships include:

1) Hg, S, Zn
2) As, Au
3) Ag, Pb

TABLE 4-5 CORRELATION MATRIX — AFTERTHOUGHT

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	-.2	-.3	-.1	.3	-	.3	-.3	-.2	-.1	-.1	-.4	.2	.4	-.5	.3	.6	-.3	-.4	0	0	-	-.5	.1	.8	.3	.1	-.1	.5	.5	.5	0	.1	-.1
Bi	-.1	-.4	.9	-.2	-	-.4	-.4	-.4	-.4	.9	-.5	-.2	-.2	-.4	-.2	-.3	-.4	-.5	-.3	-.1	-	.4	-.1	-.2	0	-.2	.9	-.3	.2	0	.1	-.3	
Co	.2	-.4	-.3	.5	-	.8	-.6	-.3	.1	-.3	-.1	.8	.3	-.5	.3	.5	-.2	-.2	.2	0	-	-.6	.1	0	-.2	.1	-.3	.4	-.2	.7	-.2		
Cr	-.1	.4	.1	-.3	-	-.2	.1	.1	-.5	.1	-.5	.1	-.1	0	-.4	0	-.2	-.3	0	-.5	-	.5	-.5	-.1	-.4	-.5	.1	0	0	.2			
Cu	0	-.3	0	.4	-	.7	-.5	-.3	-.1	0	-.4	.8	.5	-.6	.1	.6	-.4	-.5	.1	-.2	-	-.4	-.2	.4	-.2	-.2	0	.4	.2				
Mo	.1	-.3	.2	.3	-	-.1	-.1	-.5	-.2	.2	-.1	-.3	.4	-.3	.4	-.1	0	-.4	-.2	.2	-	-.2	.3	.7	-.4	.3	.2	-.2					
Ni	.2	-.3	-.3	.2	-	.6	-.5	0	.1	-.3	-.2	.5	.3	-.6	.1	.9	-.2	-.3	.5	-.1	-	-.6	0	.2	.4	0	-.3						
Pb	-.1	-.4	.9	-.2	-	-.4	-.4	-.4	-.4	.9	-.5	-.2	-.2	-.4	-.2	-.3	-.4	-.5	-.3	-.1	-	.4	0	-.2	0	-.2							
S	.1	-.2	-.2	.7	-	0	-.1	-.3	-.1	-.2	0	-.2	-.1	-.3	.9	-.2	-.1	-.4	-.1	.9	-	-.8	.9	.3	-.2								
Zn	-.2	-.3	0	-.2	-	0	-.2	.2	.3	0	-.3	-.1	-.1	-.3	-.2	.4	-.4	0	.1	-.2	-	-.2	-.2	-.1									
As	0	-.2	-.2	.4	-	.3	-.2	-.3	0	-.2	-.2	0	.5	-.4	.5	.3	-.1	-.3	.1	.2	-	-.5	.2										
Hg	-.1	-.2	-.1	.7	-	-.1	-.2	-.4	-.2	0	-.1	-.1	-.2	-.3	.9	-.2	-.3	-.5	-.3	.9	-	-.7											
Si	-.3	.2	.4	-.8	-	-.7	.3	.1	-.4	.4	-.2	-.4	-.4	.4	-.8	-.5	0	.1	-.3	-.7	-												
Sb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
Sn	-.1	-.1	-.1	.7	-	-.1	-.1	-.3	-.3	-.1	0	-.2	-.3	-.2	.9	-.3	-.3	-.5	-.3														
U	.8	-.1	-.3	-.2	-	.4	-.1	-.1	.6	-.3	.2	0	.7	-.1	-.3	.4	.5	.3															
Al	.2	.2	-.5	-.7	-	-.1	.3	.3	.7	-.5	.7	-.4	.1	.5	-.6	-.2	.7																
Ba	.5	.2	-.4	-.5	-	-.2	.3	-.1	.5	-.4	.6	-.5	.4	.5	-.4	-.3																	
Ca	.1	-.3	-.3	.2	-	.7	-.6	-.1	.2	-.3	-.2	.7	.4	-.7	0																		
Fe	-.1	-.3	-.2	.9	-	.2	-.3	-.4	-.2	-.2	-.1	.1	0	-.5																			
K	-.1	.7	-.4	-.6	-	-.6	.9	.3	-.1	-.4	.1	-.5	-.3																				
Mn	.6	-.3	-.2	0	-	.5	-.3	-.3	.5	-.2	.2	.1																					
Mg	-.2	-.2	-.2	.4	-	.8	-.6	-.1	-.1	-.2	-.4																						
Na	.4	0	-.5	-.3	-	-.1	0	0	.5	-.5																							
Ag	-.1	-.4	.9	-.2	-	-.4	-.4	-.4	-.4																								
Ti	.5	-.3	-.4	-.3	-	.4	-.2	0																									
Li	-.2	.4	-.4	-.4	-	-.3	.5																										
Rb	-.1	.7	-.4	-.5	-	-.7																											
V	.2	-.5	-.4	.4	-																												
Zr	-	-	-	-																													
P	-.2	-.3	-.2																														
Te	-.1	-.4																															
Th	-.2																																

A dash (-) indicates insufficient data for a correlation

Each element within each group displays a good relationship for other elements within the group. Therefore, elements from a particular group might be used as pathfinders for other elements of the group. For example, "As" might be used to find accumulations of "Au". The limited number of elements for a particular suite is the result of the diverse lithologies sampled in the area, thus obscuring the correlative relationships. Since unaltered granitic rock samples (WR-6, WR-7) do not carry anomalous amounts of any metals, mineralization must have occurred after emplacement of the intrusive rocks.

4.1.3 Guranium Area

This area lies in the southern portion of the Terrill Mountains in Sec 24, T14N, R29E. The predominant rock type of the area is rhyodacite which includes both intrusive and volcanic varieties occurring with rhyolitic tuff. The area has been developed with one small shaft and adit, and several prospect pits scattered about. The principal metals of interest here appear to be gold, silver, and copper occurrences along small shear zones. During field investigations anomalous radioactivity readings were also noted along shear zones. This area was mapped during the additional sampling phase and is shown on Plate IV. The shear zone, on which the mine workings have been developed, strikes N 40° W, dips SW and displays a limonitic alteration zone extending for several feet on either side, thus, indicating that mineralizing solutions traveled along the fault zone and penetrated several feet on either side of the fault.

Although the portal exhibits about 3 to 4 times normal background radiation, uranium might not be the principal radioactive constituent as seen from the anomalous bismuth values in a composite sample (WR-41). Also, airborne radiometrics shows an enrichment of bismuth to thallium downslope from the property which may be correlative. Usually this type of uranium association to bismuth-thallium "highs" implies that uranium has been concentrated by secondary or epigenetic processes. Perhaps uranium has been leached from the felsic tuffs and locally concentrated with iron oxides as copper and iron sulfides oxided into gossans.

Thirteen metals show good anomalies from two initial samples WR-50 and WR-41. Sample WR-40 is a rhyo-dacite and shows anomalous values for Au (35 ppb, .001 oz/ton), Co (12ppm), Cu (.41%), P (.014%) and Zn (.10%). Sample WR-41 was taken along a shear zone within the adit and shows anomalous mineralization for Au (610 ppb, .018 oz/ton), Bi (.04%), Cu (1.5%), Pb (.24%), Zn (.30%), As (2.7%), Hg (6.2%), Pb (.108%), Sn (.004%), U (.008% U_3O_8), Ag (16.9 oz/ton), and P (.49%). With the possible exception of Afterthought, this area shows the most abundant and greatest selection of anomalous metal occurrences, though probably more limited in extent to shear zones and adjacent areas.

In this area there is one prominent elemental association (Table 4-6):

Au, Cu, Pb, S, Zn, As, Hg, Sb, U, Ag

Since most of the samples collected were of fault gouge or altered rock this elemental relationship becomes quite important. While there is evidence of supergene enrichment along the fault zones, as indicated by the presence of copper carbonates, the alteration halo along the fault, in conjunction with the high elemental values associated with the fault zone, suggest the migration of metalizing solutions along and near the fault. Additional sampling (Table 4-7) in the area bears out this relationship with the least mineralized sample (G-5) coming from unaltered dacite adjacent to the altered zone. Anomalous sample values taken along and near altered zones from the additional sampling include Au (.05oz/ton), Ag(6.5oz/ton), Cu(4.7%), and Hg(5.2%), in addition to other elements.

TABLE 4-6 CORRELATION MATRIX — GURANIUM AREA

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	.6	-1	.9	.9	-	.9	-.6	-.5	-1	.9	-.5	-.7	-.4	-.6	.9	-.1	.1	-1	.9	.9	.9	-1	.9	.9	.9	.9	.9	-.9	.3	.9	-.4	-.7	.9
Bi	.6	-1	.9	.9	-	.9	-.7	-.5	-1	.9	-.5	-.7	-.5	-.6	.9	-.1	.1	-1	.9	.9	.9	-1	.9	.9	.9	.9	.9	-.9	.3	.9	-.4	-.7	
Co	-.2	.7	-.6	-.7	-	-.7	.8	-.1	.6	-.7	0	.2	.9	.7	-.7	-.6	-.2	.6	-.6	-.7	-.7	.6	-.7	-.7	-.4	-.7	-.7	.8	-.1	-.5	.4		
Cr	-.3	.3	-.3	-.4	-	-.4	.6	-.6	.3	-.4	.8	0	.4	.9	-.4	-.2	.7	.4	-.4	-.3	-.4	.3	-.4	-.4	-.3	-.5	-.4	.7	-.7	-.3			
Cu	.7	-1	.9	.9	-	.8	-.5	-.7	-1	.9	-.5	-.7	-.3	-.4	.9	-.2	.2	-1	.9	.9	.9	-1	.9	.9	.9	.9	.9	-.8	.2				
Mo	0	-.4	.2	.2	-	0	0	0	-.3	.3	-.8	-.7	.1	-.5	.2	-.7	-.6	-.4	.4	.2	.3	-.3	.3	.3	.3	.3	.3	-.5					
Ni	-.6	.8	-.8	-.9	-	-.9	.8	-.1	.8	-.9	.5	.4	.6	.9	-.9	-.3	.2	.8	-.9	-.9	-.9	.8	-.9	-.9	-.8	-.9	-.9						
Pb	.6	-1	.9	.9	-	.9	-.6	-.5	-1	.9	-.5	-.7	-.4	-.6	.9	-.1	.1	-1	.9	.9	.9	-1	.9	.9	.9	.9							
S	.6	-1	.9	.9	-	.9	-.7	-.5	-1	.9	-.5	-.7	-.5	-.7	.9	-.1	0	-1	.9	.9	.9	-1	.9	.9	.9								
Zn	.7	-1	.9	.9	-	.8	-.4	-.7	-1	.9	-.5	-.8	-.2	-.4	.9	-.3	.1	-1	.9	.9	.9	-1	.9	.9									
As	.6	-1	.9	.9	-	.9	-.7	-.5	-1	.9	-.5	-.7	-.5	-.6	.9	-.1	.1	-1	.9	.9	.9	-1	.9										
Hg	.6	-1	.9	.9	-	.9	-.7	-.5	-1	.9	-.5	-.7	-.5	-.6	.9	-.1	.1	-1	.9	.9	.9	-1											
Si	-.7	.9	-1	-1	-	-1	.6	.5	.9	-1	.3	.6	.4	.5	-1	-.1	-.3	.9	-1	-1	-1												
Sb	.6	-1	.9	.9	-	.9	-.7	-.5	-1	.9	-.5	-.7	-.5	-.6	.9	-.1	.1	-1	.9	.9													
Sn	.6	-1	.9	.9	-	.9	-.6	-.6	-1	.9	-.4	-.7	-.4	-.5	.9	-.1	.2	-1	.9														
U	.6	-1	.9	.9	-	.8	-.5	-.6	-1	.9	-.6	-.8	-.3	-.6	.9	-.3	0	-1															
Al	-.7	.9	-1	-1	-	-1	.6	.4	.9	-1	.4	.6	.4	.6	-1	-.1	-.2																
Ba	-.1	-.3	.2	.1	-	.1	.2	-.8	-.2	.1	.7	-.3	-.2	.4	.1	0																	
Ca	0	-.1	-.2	-.1	-	.2	-.7	.4	-.1	-.1	.2	.6	-.8	-.4	-.1																		
Fe	.6	-1	.9	.9	-	.9	-.7	-.5	-1	.9	-.5	-.7	-.5	-.6																			
K	-.3	.5	-.5	-.6	-	-.6	.8	-.5	.5	-.6	.6	.1	.7																				
Mn	-.1	.4	-.3	-.5	-	-.6	.8	-.3	.4	-.5	-.1	-.1																					
Mg	-.1	.6	-.7	-.7	-	-.4	-.2	.6	.5	-.7	.2																						
Na	-.6	.3	-.5	-.5	-	-.5	.3	-.3	.3	-.5																							
Ag	.6	-1	.9	.9	-	.9	-.7	-.5	-1																								
Ti	-.7	.9	-1	-1	-	-1	.6	.4																									
Li	-.3	.4	-.6	-.5	-	-.4	-.4																										
Rb	-.5	.6	-.6	-.7	-	-.8																											
V	.8	-1	.9	.9	-																												
Zr	-	-	-	-																													
P	.6	-1	.9																														
Te	.7	-1																															
Th	-.6																																

A dash (-) indicates insufficient data for a correlation

Table 4-7. GEOCHEMICAL DATA GURANIUM AREA

Sample Number	AU PPB	AG PPM	BI PPM	CU PPM	PB PPM	ZN PPM
G:1	1850.0	221.0	470.0	47000.0	3830.0	2770.0
G:2	22.0	6.3	2.0	5350.0	850.0	375.0
G:3	265.0	183.0	150.0	40400.0	1440.0	610.0
G:4	60.0	3.9	2.0	185.0	540.0	730.0
G:5	5.0	0.5	-2.0	42.0	22.0	295.0
G:6	9.0	0.3	2.0	35.0	14.0	65.0
G:7	22.0	0.5	-2.0	35.0	36.0	850.0

Sample Number	AS PPM	FE %	TOTAL SI02 PPM	TOTAL S %	HG PPB	U PPM
G:1	17000.0	28.9	23.5	1.47	52000.0	21.0
G:2	350.0	2.12	68.8	-0.05	1290.0	4.2
G:3	6000.0	8.56	53.6	0.3	36000.0	22.0
G:4	120.0	2.23	66.8	-0.05	875.0	1.3
G:5	5.0	2.26	71.8	-0.05	450.0	1.5
G:6	15.0	1.95	71.6	-0.05	8.0	1.7
G:7	40.0	3.91	70.6	-0.05	30.0	0.6

Sample Number	SB PPM	SN PPM	TOTAL P PPM	TE PPM
G:1	950.0	80.0	4100.0	0.3
G:2	12.0	-2.0	340.0	-0.1
G:3	360.0	30.0	1200.0	-0.1
G:4	-1.0	2.0	310.0	0.6
G:5	-1.0	-2.0	325.0	-0.1
G:6	-1.0	2.0	320.0	-0.1
G:7	-1.0	2.0	530.0	-0.1

The correlation relationships and anomalous values in the Guranium Area yield the most indicative evidence of a middle to late Tertiary mineralizing event within the reservation, with the middle Tertiary dacite of the area providing a suitable host lithology when accessible by mineralizing solutions.

4.1.4 Calico Area

The Calico Area is located in the central portion of the reservation in Calico Hills. Surficially the area is a complex geological terrain consisting mostly of felsic volcanoclastics and subordinate flows with minor outcroppings of alkaline intrusives. Airborne and surface magnetics reveal very strong positive anomalies representing a major iron-copper tactite occurrence at depth substantiated by the drilling activities of Walker-Martel and Idaho Mining Company. Surface induced polarization surveys correlated rather well with mineralization trends which are apparently confined to a hornfels contact facies with dioritic rocks and interpreted equivalents to meta-sediments of the Excelsior-Luning Formations. Previous exploration efforts of significance largely ignored any mineralogical potential in the volcanic veneer. CERT surface evaluations and sampling revealed that volcanoclastics, particularly the felsic tuffs are anomalously radioactive and of possible uranium source rock caliber for epigenic deposits. Additionally, an unusual calic-igneous (?) rock rich in mafic constituents (WR-34) contains low grade (.042%U) uranium and anomalous chromium.

Lawrence (1969), who also did mapping in the Afterthought Area in 1966, mapped the surface geology in detail and developed a paragenetic model of the iron-copper deposit using data generated by Walker Martel, Idaho Mining, McPhar Geophysics and Aero Service Corporation. His investigation of the copper-iron deposit included geochemical analysis and mineralogical investigations using polished and thin sections.

Intrusive rocks in the Calico Area, both at the surface (limited exposures on Northwest end of hills) and in drill cores, reveal intense argillization and sericitization grading to chloritization with depth. Lawrence believes that the plutonic rocks underlying the Calico Hills consist of granodiorite intruded by quartz diorite and monzonites. The quartz diorites are chiefly in contact with meta-sediments and may in part represent contamination of the more felsic melt by the Excelsior-Luning (?) roof pendants. Most of the iron mineralization consists of magnetite partially altered to hematite accounting with the good correlation with airborne and surface magnetic anomalies.

According to Ross (1974) the drilling and magnetic data at Calico indicates a "mineralized zone more than 6000 ft long striking northwest, perhaps 1,500 ft wide in sub-outcrop pattern, dipping about 45° southwest." Massive magnetite was noted 1450 ft or deeper in the drill holes with copper mineralization occurring intermittently. The inferred iron reserves were estimated by Haxby and Chester (1967) to be 272 million tons of 36.2% iron at a 25% iron cut-off grade with copper average 0.08% (maximum over 130 ft section in hole CA-3 of 0.79% copper). In contrast Lawrence and Redmond (1967) estimated the Calico iron deposit to be 5,600 ft by 600 ft in plan and 2,000 ft in vertical extent. He estimated that the deposit contains between 600-720 million tons of 30 to 35% iron ore.

Lawrence (1969) also indicated the possibility of a post-skarn mineralizing event (hydrothermal) wherein chalcopyrite and magnetite are present in quartz/calcite veinlets. Other minerals that Lawrence postulates as being post-skarn hydrothermal are galena, sphalerite and molybenite. It is not known whether this event would be related to Tertiary volcanism but jasperoid veins have been identified at the surface truncating Tertiary volcanic rocks, indicating some late stage hydrothermal activity.

Few metal anomalies are present in the area, the most obvious being 420 ppm U (.05% U_3O_8) in sample WR-34, which also displays some Cr (118 ppm, .011%) and P(.18%). Sample WR-43 displays anomalous Zn (115 ppm), As (175 ppm), Hg (220 ppm), Rb (140 ppm), and Th (75 ppm).

Though few metal anomalies are present in the area, Table 4-8 shows strong correlations evident within two elemental groups:

1) Cr, Ni, U, Mo
2) Th, Pb, S, Zn, As, Hg

These suites are similar to those described for the Guranium Area. While the concentrations of anomalous elements are considerably less in the Calico Area, the metals involved are the same, thus suggesting the tuffs of Calico Hills have the same parent magma as the mineralizing solutions in the Guranium Area.

4.1.5 Bubbles Area

While no statistical analysis was conducted on this area data due to too few samples, it is discussed here since the felsic tuff comprising the area has been previously mined for uranium. The elemental analysis of the three samples, shows little uranium present relative to the scintillometer readings obtained in the field (900 cps), which were among the highest readings encountered during the field program. Perhaps the more interesting occurrence displayed is the unaltered tuff (WR-46) yielded uranium values substantially less than the opalized wood samples (WR-47, 48). Conversely, WR-46 yields significantly higher Th values than WR-47 or WR-48. This relationship indicates the uranium was probably mobilized from the felsic tuff and redeposited, by replacement, in the wood

TABLE 4-8 CORRELATION MATRIX — CALICO AREA

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Po	Ni	Mo	Cu	Cr	Co	Bi
Au	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bi	-.3	.4	-	-.4	-.4	-.4	.3	-.1	-.3	.9	-.3	-.4	-.3	.5	-.5	-.3	-.4	0	-.3	-.3	-	.3	-.3	-.3	.1	.3	.8	-.5	-.4	.8	-.4	-.5	
Co	.5	-1	-	.7	-.4	.8	-1	-.3	.7	-.5	-.2	.9	.5	-1	.7	.6	.9	-.1	.5	.5	-	-.7	-.7	-.7	-.6	-.8	-.9	.7	.6	-.3	.5		
Cr	.8	-.7	-	.8	0	0	-.6	-.9	-.2	-.4	-.8	.5	.8	-.7	-.2	.8	.5	-.9	.8	-.4	-	-.9	-.4	-.4	-.7	-.8	-.5	.9	.8	0			
Cu	-.1	.1	-	-.2	-.2	-.3	0	-.3	-.4	.8	-.6	-.3	-.1	.3	-.3	-.1	-.3	-.3	-.1	-.4	-	.1	-.6	-.6	-.4	-.2	.5	-.1	.1				
Mo	.5	-.8	-	.6	.2	.3	-.9	-.5	.1	-.4	-.7	.5	.5	-.7	.3	.5	.5	-.5	.5	-.1	-	-.5	-.7	-.7	-1	-1	-.7	.9					
Ni	.7	-.9	-	.8	0	.3	-.9	-.7	.1	-.5	-.7	.6	.7	-.8	.2	.7	.7	-.6	.7	-.1	-	-.8	-.6	-.6	-.9	-1	-.8						
Pb	-.3	.7	-	-.5	-.3	-.7	.7	-.1	-.6	.8	-.2	-.7	-.3	.7	-.8	-.4	-.7	-.1	-.3	-.5	-	.3	.2	.3	.5	.6							
S	-.6	.7	-	-.7	-.2	-.4	.8	.4	-.2	.3	.6	-.6	-.6	.6	-.4	-.6	-.6	.4	-.6	0	-	.4	.6	.7	.9								
Zn	-.5	.6	-	-.6	-.3	-.3	.7	.3	-.1	.1	.6	-.4	-.5	.4	-.3	-.5	-.4	.4	-.4	0	-	.2	.7	.8									
As	-.3	.6	-	-.4	.2	-.6	.7	.1	-.5	-.3	.4	-.6	-.3	.4	-.6	-.3	-.6	0	-.3	-.4	-	.1	.9										
Hg	-.4	.6	-	-.5	.4	-.6	.7	.2	-.5	-.3	.4	-.6	-.4	.4	-.5	-.4	-.6	0	-.4	-.4	-	.3											
Si	-1	.7	-	-1	.4	-.4	.6	.8	-.3	.3	.5	-.9	-1	.8	-.1	-1	-.9	.6	-1	0	-												
Sb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
Sn	-.3	-.5	-	-.1	-.4	.8	-.5	.5	.9	-.3	.6	.5	-.2	-.4	.9	-.2	.4	.7	-.3														
U	.9	-.7	-	.9	-.4	.1	-.6	-1	0	-.3	-.7	.7	.9	-.8	-.2	.9	.7	-.8															
Al	-.8	.1	-	-.7	-.1	.4	.1	.9	.5	0	.8	-.2	-.8	.2	.6	-.8	-.2																
Ba	.7	-1	-	.8	-.6	.8	-.9	-.5	.6	-.4	-.3	.9	.7	-1	.5	.7																	
Ca	.9	-.8	-	.9	-.5	.2	-.7	-.9	.1	-.3	-.7	.7	.9	-.9	-.1																		
Fe	-.2	-.7	-	.1	-.2	.9	-.7	.4	.9	-.5	.4	.5	-.1	-.6																			
K	-.8	.9	-	-.9	.3	-.8	.8	.4	-.7	.5	.2	-1	-.8																				
Mn	.9	-.7	-	.9	-.5	.2	-.7	-1	0	-.3	-.7	.7																					
Mg	.7	-1	-	.8	-.6	.8	-.9	-.5	.7	-.4	-.2																						
Na	-.7	.2	-	-.6	0	.2	.3	.8	.4	-.3																							
Ag	-.3	.4	-	-.4	-.4	-.4	.3	-.1	-.3																								
Ti	0	-.7	-	.2	-.5	.9	-.7	.2																									
Li	-1	.4	-	-.9	.3	.1	.3																										
Rb	-.6	.9	-	-.8	.2	-.8																											
V	.1	-.9	-	.4	-.5																												
Zr	-.4	.3	-	-.4																													
P	.9	-.9	-																														
Te	-	-																															
Th	-.7																																

A dash (-) indicates insufficient data for a correlation

during the opalization process. While this assumption is of little economic importance, the indication that uranium has been mobilized by groundwater action and therefore can be redeposited in other favorable locales, other than opalized wood, such as buried carbonaceous sediment in the surrounding basins, could be of significant economic importance. This hypothesis will be further developed in Section 7.0 on Geologic Models.

4.1.6. Hidden Valley Area

Hidden Valley has, as far is known, been previously unexplored for minerals potential. During field investigations silicified and sulfide-bearing limestones, sulfide bearing felsic volcanics, and gossan filled fault zones were encountered. Several metal anomalies are present in the gossan filled and other fault zones in samples WR-49 and WR-51. These metals include Au (115 ppb), Zn (1190 ppm), As (7500 ppm), Hg (1240 ppm), V (400 ppm), Ag (1.4 ppm) and U (11ppm). Subsequent sampling of the gossan zone, however, yielded substantially lower values for these elements (Table 4-9). While the metal values for the area are low, several metal anomalies unexpectedly occur in the limestone adjacent to the fault zones indicating dissemination and deposition of metals away from the fault conduits.

Mapping of the area by Hardyman (1980) shows the limestone occurrences near the mouth of Hidden Valley as detachment blocks, thus indicating the net volume of potential host rock is probably quite small. However, there is one important point to consider in evaluating the area, did mineralization occur before or after emplacement of the detachment blocks? Even though the limestone host is limited in extent, if mineralization occurred after detachment then another suitable host formation could be mineralized at depth. If mineralization occurred before detachment, then the areal

Table 4-9. GEOCHEMICAL DATA HIDDEN VALLEY AREA

Sample Number	AU PPB	AG PPM	ZN PPM	AS PPM	TOTAL BA PPM	TOTAL CA %
HV:1	7.0	0.3	970.0	45.0	120.0	31.8
HV:2	8.0	0.2	420.0	320.0	290.0	1.15
HV:3	15.0	-0.1	33.0	80.0	30.0	19.4
HV:4	11.0	0.3	56.0	130.0	610.0	0.65

Sample Number	TOTAL FE %	TOTAL SI02 %	TOTAL LI PPM	TOTAL RB PPM	TOTAL V PPM	TOTAL ZR PPM
HV:1	0.71	2.0	2.0	1.0	20.0	-100.0
HV:2	47.8	6.4	5.0	4.0	80.0	-100.0
HV:3	3.85	0.9	3.0	2.0	10.0	-100.0
HV:4	8.2	69.4	20.0	48.0	60.0	-100.0

Sample Number	S %	HG PPB	U PPM	SB PPM
HV:1	-0.05	16.0	0.7	-1.0
HV:2	-0.05	46.0	3.2	-1.0
HV:3	-0.05	-4.0	1.4	-1.0
HV:4	0.13	6.0	2.9	-1.0

structure should be studied in detail to find the origin of the detachment blocks. These detachment blocks may be related to the right lateral strike-slip fault trending northwest through the Hidden Valley Area and Red Granite Area. While the amount of displacement for the detachment blocks is not accurately known, due to cross-cutting relationships northwest of the detachment blocks, the displacement is believed to be approximately 3.5 to 4 miles along the fault.

While many of the elemental values display a significant difference between the first and second sample sets, the correlative relationships generally are the same; thus indicating that select elements may be used as pathfinders for other elements. An interesting aspect of the two correlation Tables 4-10 and 4-11 is the relationship of U with various elements, particularly base and precious metals. It appears that uranium was accompanied by these various metals during mineralization and, as noted previously, the "uranium mineralization episode" was probably coincident with the volcanic event which deposited uranium-bearing felsic tuffs in the region. The main elemental suite in this area is: U, Mo, Ni, S, As, Hg,U, V, Zn, Au.

4.1.7 Red Granite Area

Small mine workings have been developed along a gold bearing quartz vein in this area. The quartz vein was injected along a kaolinized shear zone in the granitic rocks of the area. The red color of the granite is, in part, attributable to iron oxidation, but also to an abundance of K-feldspar. The Red Granite Area appears to correlate granitic intrusion four miles southeast of the area, which was displaced by the same northwest trend right lateral fault in the Hidden Valley Area. The quartz vein strikes N 10° W, dips 25o east and attains a maximum thickness of four inches. The overlying kaolin zone,

TABLE 4-10 CORRELATION MATRIX — HIDDEN VALLEY AREA

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	.9	-.5	.1	.9	-.4	.9	-.5	-.3	-.6	.4	-.4	-.4	-.2	-.5	.9	-.5	.9	-.6	.9	-.2	.9	-.3	.9	.9	.9	.9	.3	.9	.9	-.2	-.2	-.2	-.3
Bi	-.2	-.4	-.2	-.2	-.3	-.2	-.4	-.6	-.4	-.1	-.4	-.3	-.6	-.4	-.3	.8	-.2	-.5	0	-.4	-.2	-.7	-.2	-.2	-.2	-.3	-.2	-.4	-.4	-.7	.2	-.9	
Co	-.1	.5	-.3	-.2	.5	-.1	.5	.6	.6	-.5	.5	.4	.6	.5	0	-.6	-.1	.8	-.3	.1	-.1	.4	-.1	-.1	-.1	-.2	-.3	.1	-.1	.4	-.5		
Cr	-.4	-.5	.4	-.3	0	-.3	0	-.6	-.3	.3	-.1	-.3	0	0	-.3	.1	-.4	-.5	-.2	.7	-.4	.2	-.3	-.3	-.4	-.2	.4	-.3	0	.4			
Cu	-.4	.1	.5	-.4	.2	-.4	.4	.2	.3	.3	.2	0	.5	.4	-.3	-.6	-.4	.2	-.5	.8	-.4	.8	-.4	-.4	-.5	-.2	.5	-.2	0				
Mo	.8	-.5	.3	.9	-.3	.8	-.3	-.2	-.4	.5	-.3	-.4	0	-.3	.9	-.6	.8	-.6	.8	.1	.8	-.1	.8	.9	.8	.9	.4	.8					
Ni	.9	-.4	-.2	.9	-.2	.9	-.2	-.2	-.3	.1	-.2	-.2	.1	-.3	.9	-.5	.9	-.4	.8	-.2	.9	-.3	.9	.9	.9	.9	0						
Pb	0	-.5	.9	.1	-.3	0	-.4	-.3	-.5	.9	-.5	-.3	-.1	-.4	.1	-.4	0	-.6	0	.4	0	.3	0	.1	0	.3							
S	.9	-.5	.1	.9	-.4	.9	-.5	-.3	-.6	.4	-.4	-.4	-.2	-.5	.9	-.4	.9	-.7	.9	-.2	.9	-.3	.9	.9	.9								
Zn	.9	-.4	-.2	.9	-.3	.9	-.5	-.3	-.5	.1	-.4	-.2	-.1	-.5	.9	-.3	.9	-.5	.9	-.5	.9	-.5	.9	.9									
As	.9	-.5	-.1	.9	-.4	.9	-.5	-.2	-.5	.2	-.4	-.3	-.2	-.5	.9	-.4	.9	-.6	.9	-.3	.9	-.4	.9										
Hg	.9	-.4	-.1	.9	-.3	.9	-.5	-.2	-.5	.1	-.3	-.3	-.2	-.5	.9	-.4	.9	-.5	.9	-.4	.9	-.4											
Si	-.5	.5	.4	-.4	-.1	-.5	.6	.5	.4	.2	.6	-.2	.1	.6	-.3	-.8	-.5	.4	-.6	.7	-.5												
Sb	.9	-.4	-.2	.9	-.3	.9	-.4	-.2	-.5	.1	-.3	-.3	-.2	-.4	.9	-.4	.9	-.5	.9	-.4													
Sn	-.4	0	.4	-.3	0	-.3	.5	0	.2	.3	.3	-.3	.3	.5	-.3	-.5	-.4	0	-.4														
U	.9	-.6	-.1	.9	-.3	.9	-.5	-.4	-.6	.2	-.5	-.3	-.2	-.5	.9	-.2	.9	-.7															
Al	-.5	.7	-.5	-.6	.4	-.5	.7	.7	.8	-.7	.6	.4	.4	.7	-.5	-.2	-.5																
Ba	.9	-.4	-.2	.9	-.3	.9	-.4	-.2	-.4	.1	-.3	-.3	-.2	-.4	.9	-.4																	
Ca	-.4	-.5	-.3	-.4	.2	-.3	-.5	-.7	-.4	-.3	-.6	.3	-.1	-.5	-.5																		
Fe	.9	-.4	-.1	.9	-.3	.9	-.4	-.2	-.4	.2	-.3	-.3	-.1	-.4																			
K	-.4	.7	-.3	-.5	0	-.4	.9	.6	.8	-.5	.9	-.3	.2																				
Mn	-.2	-.1	-.1	-.2	.9	-.1	.2	0	.4	-.3	0	.5																					
Mg	-.3	-.1	-.3	-.3	.8	-.3	-.3	-.2	0	-.4	-.4																						
Na	-.3	.8	-.4	-.4	-.2	-.3	.9	.7	.7	-.5																							
Ag	.1	-.6	.9	.2	-.4	.1	-.5	-.3	-.6																								
Ti	-.5	.7	-.4	-.5	.3	-.4	.8	.7																									
Li	-.2	.8	-.2	-.3	-.2	-.2	.6																										
Rb	-.5	.7	-.3	-.5	.1	-.4																											
V	.9	-.5	-.2	.9	-.2																												
Zr	-.3	-.2	-.3	-.3																													
P	.9	-.5	-.1																														
Te	-.2	-.4																															
Th	-.4																																

A dash (-) indicates insufficient data for a correlation

TABLE 4-11 CORRELATION MATRIX — HIDDEN VALLEY AREA (ADDITIONAL SAMPLING)

	Sb	U	Hg	S	Zr	V	Rb	Li	Si	Fe	Ca	Ba	As	Zn	Ag
Au	-	-.1	-.7	.1	-	-.5	.1	.1	0	-.4	-.1	-.2	-.3	-.9	-.8
Ag	-	.1	.2	.4	-	.4	.4	.4	.4	0	-.1	.6	0	.5	
Zn	-	-.6	.3	-.5	-	-.2	-.5	-.6	-.5	-.1	.6	-.4	-.2		
As	-	.8	.8	-.1	-	.8	-.1	0	-.1	.9	-.8	.3			
Ba	-	.7	0	.9	-	.7	.9	.9	.9	.1	-.8				
Ca	-	-1	-.4	-.6	-	-.9	-.6	-.7	-.7	-.7					
Fe	-	.7	.9	-.3	-	.8	-.2	-.1	-.2						
Si	-	.5	-.3	.9	-	.4	.9	.9							
Li	-	.5	-.3	.9	-	.4	.9								
Rb	-	.5	-.4	.9	-	.3									
V	-	.9	.7	.3	-										
Zr	-	-	-	-											
S	-	.4	-.4												
Hg	-	.4													
U	-														

A dash (-) indicates insufficient data for a correlation

which is also gold bearing, is 6"-8" thick. In addition to the gold occurrence, a uranium bearing pod (WR-66, 875 cps) in granite was located approximately 500 feet northwest of the mine workings.

While there were too few samples collected in this area for a correlation, some relationships between this area and the similar Bimetal Area can be discerned. The quartz veins for both areas display high gold values with subordinate silver values. Base metal values are quite low in both areas for quartz veins. The kaolinized zones, adjacent to the quartz veins in both areas, also display good gold values with subordinate silver. However, the kaolinized zone at Bimetal displays significantly higher base metal and uranium values. The encompassing granitic rocks of the Bimetal area display no gold values, while the Red Granite area does show some minor gold values. Perhaps more important is the apparent differing characteristic of the granitic rocks in the two areas; the Red Granite Area obviously contains more hematite.

While the data is insufficient to describe a definitive conclusion from this relationship, the present evidence indicates the Red Granite Area has undergone only one metalizing event, that of the gold and silver quartz vein emplacement, with no base metalization occurring. The mineralizing event appears to post-date the right-lateral faulting in that the mineralization subparallels the fault trend. Although the similarity in trends could be coincidental, the siliceous veins could have formed along tensional fractures. The uranium anomaly at the prospect could be related to secondary enrichment since the Red Granite and other granitic intrusions to the south exhibit bismuth to thallium highs on the airborne surveys. Whether the enrichment is related to supergene processes versus hydrothermal differentiation is unclear.

4.1.8 Gillis Area

The Gillis Range consists of a variety of lithologies including meta-sediments, volcanics, and intrusives. The Gillis Area, as referred to in this report, consists solely of the area north of Gillis Canyon. While some mine development has taken place in the canyon in the past, no development, other than prospect pits, was noted in the study area.

Metalization, in this area, is associated with meta-limestones, in addition to fault breccia. Several metals show anomalous values in the area including Au (17-80 ppb), Cu (.33% to .69%), As (.18% to .19%), U (.016%, .019% U_3O_8), Ag (.1-6.5 ppm) and V (100-670 ppm). From the correlation matrix on Table 4-12, three elemental groups are evident:

1) U, Au, As
2) Hg, Sb, Ag
3) Cr, Mo, Ni

These elemental relationships are similar to several previously discussed. While conclusive evidence is lacking, this area also appears to be subjected to late stage mineralization as with the other areas, since many of the high elemental values are associated with fault zones.

4.1.9 Copper Area

This area lies south of the Gillis Area and has been developed with several adits. Most of the mineralization occurs within limestone and limey sandstone metamorphosed by

TABLE 4-12 CORRELATION MATRIX — GILLIS AREA

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	-.4	-.6	-	-.3	0	.1	-.3	-.5	-.6	0	-.4	-.2	.5	-.4	-.4	.5	-.3	-.6	.9	-.1	.2	-.6	-.1	.8	.1	-.3	-.6	-.2	.1	.4	-.3	0	.6
Bi	0	-.4	-	-.5	.3	.1	-.2	-.1	-.4	.4	-.8	.3	.6	-.1	-.5	.2	-.4	-.5	.5	0	.5	-.7	.1	.7	.5	-.8	0	-.3	-.2	.5	-.4	.4	
Co	-.3	-.4	-	-.2	-.3	-.2	-.1	-.4	-.3	.9	-.2	.9	.8	-.2	-.2	-.4	-.3	-.4	-.3	0	.9	-.4	.8	.5	.7	-.2	-.1	-.1	-.3	.5	-.2		
Cr	-.2	.6	-	.9	.4	.8	.9	.2	.3	0	.4	-.5	-.2	.8	.7	-.7	.9	.4	-.4	.8	-.4	.7	-.2	-.6	.3	.3	.4	.9	.8	.4			
Cu	-.5	-.2	-	.2	.3	.7	.5	-.3	-.4	.5	-.5	.1	.6	.4	-.1	-.2	.3	-.4	.1	.7	.3	-.2	.1	.4	.9	-.5	.1	.5	.4				
Mo	-.2	.4	-	.8	.5	.8	.8	.1	.2	-.2	.3	-.7	-.2	.7	.6	-.4	.8	.3	.1	.7	-.5	.6	-.4	-.3	.3	.2	.2	.9					
Ni	-.3	.4	-	.8	.4	.8	.9	.1	.1	0	.2	-.4	-.1	.8	.5	-.6	.9	.2	-.3	.9	-.3	.6	-.2	-.5	.5	.1	.4						
Pb	.5	.6	-	.3	.7	.5	.5	.7	.6	-.1	-.2	-.1	-.5	.7	.3	-.6	.5	.5	-.6	.5	-.3	.5	-.4	-.6	.2	-.4							
S	-.1	.3	-	.5	-.4	-.3	0	0	.3	-.1	.9	-.2	-.2	-.1	.6	-.4	.2	.4	-.3	-.3	-.2	.5	.3	-.3	-.4								
Zn	-.4	-.2	-	.2	.1	.5	.5	-.3	-.4	.7	-.4	.4	.6	.4	0	-.4	.2	-.4	-.1	.6	.5	-.2	.3	.3									
As	-.4	-.7	-	-.6	-.3	-.3	-.5	-.6	-.6	.5	-.4	.4	.8	-.6	-.5	.3	-.6	-.7	.6	-.3	.7	-.8	.5										
Hg	-.3	-.3	-	-.1	-.6	-.5	-.3	-.4	-.2	.8	.2	.8	.7	-.4	.1	-.4	-.3	-.2	-.3	-.3	.8	-.3											
Si	.3	.9	-	.8	.4	.4	.6	.6	.8	-.4	.6	-.5	-.6	.7	.8	-.8	.8	.8	-.6	.4	-.6												
Sb	-.3	-.5	-	-.4	-.5	-.4	-.4	-.5	-.4	.9	-.3	.9	.9	-.4	-.3	-.2	-.5	-.5	-.1	-.3													
Sn	-.2	.3	-	.6	.5	.9	.9	0	0	.1	-.2	-.3	-.1	.8	.2	-.5	.8	0	-.2														
U	-.3	-.5	-	-.4	0	0	-.3	-.4	-.5	-.3	-.4	-.4	.2	-.4	-.4	.7	-.3	-.5															
Al	.7	.9	-	.5	.5	.1	.3	.8	.9	-.4	.5	-.3	-.6	.5	.8	-.7	.5																
Ba	0	.7	-	.9	.5	.8	.9	.3	.4	-.2	.3	-.5	-.3	.9	.7	-.7																	
Ca	-.4	-.8	-	-.7	-.4	-.3	-.6	-.6	-.8	-.4	-.5	-.3	-.1	-.7	-.9																		
Fe	.3	.8	-	.8	.3	.3	.5	.5	.7	-.1	.7	-.3	-.2	.6																			
K	.1	.7	-	.7	.7	.8	.9	.5	.4	-.1	0	-.4	-.3																				
Mn	-.5	-.6	-	-.2	-.4	-.1	-.2	-.6	-.5	.8	-.2	.6																					
Mg	0	-.4	-	-.5	-.4	-.5	-.4	-.2	-.2	.8	-.2																						
Na	0	.5	-	.6	-.3	-.2	.1	.1	.5	-.1																							
Ag	-.4	-.3	-	-.1	-.4	-.1	0	-.4	-.3																								
Ti	.8	.9	-	.4	.5	0	.2	.9																									
Li	.9	.8	-	.2	.7	.1	.2																										
Rb	-.2	.5	-	.8	.5	.9																											
V	-.2	.3	-	.6	.6																												
Zr	.5	.6	-	.3																													
P	-.2	.6	-																														
Te	-	-																															
Th	.6																																

A dash (-) indicates insufficient data for a correlation

encompassing granitic intrusions. Several elements reveal anomalous abundances in this area, these include: Au (.002-.022 oz/ton), Cu (.20-14.9%), As (15-600 ppm), Hg (184 ppm), W (160-1400 ppm), Ag (.009-.018 oz/ton), U (.002-.008% U_3O_8), and V (170-690 ppm).

4.1.10 Sulfur Area

The Sulfur Area is located approximately .5 miles east of the Copper Area. This area has been developed with several shafts and adits in altered limestone. Presumably the mine development was an effort to produce tungsten since scheelite was noted in the mine workings. The area has undergone significant alteration, principally along shear zones where gossan is in abundance. During field investigations a strong sulfur odor was detected in several of the shafts and native sulfur and travertine were located in the vicinity of the shafts in a nearby drainage. In the vicinity of the sulfur and travertine deposits, the strongest alteration along fault zones was also noted. These surface deposits of sulfur and travertine are a good indication of fairly recent geothermal activity in the area.

As with the Copper Area, several anomalous elements are noted in the Sulfur Area: Cu (.011%-.19%), Mo (.01%-.04%), S (4.9-19%), Zn (.02-.06%), As (150-950 ppm), W (210 ppm and Ag (.01-.03 oz/ton). Several of these high values can be accounted for in the travertine sample, such as Mo, S, Hg, Sb, and Ag. Conversely, travertine is conspicuously depleted in Au, Cr, Cu, Ni, Zn, As, Sn, Al, and U. Considering this relationship in conjunction with these elemental suites from Table 4-13:

1) Cr, Cu, Ni, Zn
2) Ag, Hg, Sb, S

TABLE 4-13 CORRELATION MATRIX — SULFUR AREA

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	.4	.3	-	-.3	-	.6	.5	-.3	.7	-.4	.4	-.5	-.5	.9	-.2	-.1	.9	.8	-.3	-.5	-.5	-.5	-.1	.4	-.6	.1	-.6	-.4	-.3	-.3	-.4	.5	-
Bi	-.3	.9	-	.5	-	0	-.3	-.6	.5	-.4	-.4	-.7	-.5	0	.5	-.3	.1	.2	-.2	-.5	.2	-.3	-.6	-.2	-.1	-.4	.7	-.4	.7	-.2	-.3	-.4	
Co	.6	-.3	-	0	-	.1	.7	-.4	.2	0	.6	0	-.3	.4	.1	-.5	.4	.2	.4	-.5	-.4	-.2	.2	.6	-.1	.3	-.7	.2	-.3	.3	.2		
Cr	-.3	-.3	-	.5	-	0	-.4	-.2	-.7	.2	-.4	.8	.5	-.5	.4	-.5	-.4	-.3	.8	-.1	-.4	.8	-.3	-.3	.8	-.5	-.4	.9	-.3	.9			
Cu	-.3	-.2	-	.6	-	0	-.3	-.3	-.6	.1	-.4	.7	.4	-.4	.5	-.6	-.3	-.2	.9	-.2	-.4	.8	-.3	-.3	.8	-.5	-.4	.9	-.3				
Mo	0	.4	-	.5	-	-.6	0	-.5	.4	-.3	-.1	-.6	-.5	-.4	.6	-.6	-.3	-.4	-.1	-.4	.4	-.4	-.2	.1	-.2	-.1	.8	-.4					
Ni	-.3	-.4	-	.5	-	0	-.3	-.1	-.8	.1	-.4	.8	.6	-.5	.4	-.4	-.4	-.4	.8	0	-.4	.8	-.3	-.3	.9	-.5	-.4						
Pb	-.3	.4	-	.4	-	-.5	-.4	-.2	.1	-.3	-.4	-.5	-.2	-.6	.4	-.3	-.5	-.5	-.2	-.1	.4	-.3	-.3	-.2	-.1	-.3							
S	.4	-.4	-	-.6	-	-.5	.4	-.2	.3	.5	.7	-.4	-.6	.3	-.5	.1	.1	-.1	-.5	-.3	.5	-.5	.9	.3	-.8								
Zn	-.4	-.2	-	.6	-	0	-.5	.1	-.8	-.1	-.7	.8	.7	-.7	.5	-.4	-.6	-.4	.8	.2	-.4	.8	-.6	-.4									
As	.9	-.3	-	-.1	-	0	.9	0	.5	-.4	.8	-.3	-.3	.2	.1	-.2	.2	0	.1	-.1	-.4	-.7	.1										
Hg	.2	-.6	-	-.6	-	-.6	.2	-.1	0	.7	.5	-.2	-.4	.1	-.6	.2	-.1	-.3	-.5	-.2	.6	-.3											
Si	-.7	-.3	-	.3	-	0	-.8	0	-.9	.3	-.7	.7	.6	-.5	.1	-.2	-.4	-.3	.5	.1	-.1												
Sb	-.4	0	-	-.1	-	-.9	-.4	-.4	0	.6	-.1	-.5	-.5	-.3	-.2	-.1	-.5	-.5	-.5	-.4													
Sn	-.1	-.6	-	-.4	-	.2	-.2	.9	-.6	-.3	-.2	.5	.8	-.5	-.5	.7	-.5	-.4	-.1														
U	0	-.3	-	.7	-	0	0	-.2	-.5	-.2	-.2	.6	.4	-.5	.7	-.7	-.3	-.3															
Al	0	.5	-	-.3	-	.7	.1	-.3	.5	-.4	0	-.4	-.4	.9	-.2	0	.9																
Ba	.2	.4	-	-.3	-	.6	.4	-.4	.7	-.4	.3	-.5	-.5	.9	-.2	-.1																	
Ca	-.1	-.4	-	-.9	-	.2	-.1	.8	-.3	0	0	.1	.3	0	-1																		
Fe	0	.3	-	.9	-	-.2	-.1	-.6	0	-.4	-.3	0	-.1	-.4																			
K	.2	.3	-	-.5	-	.5	.4	-.3	.6	-.2	.4	-.5	-.6																				
Mn	-.3	-.5	-	0	-	.3	-.4	.7	-.9	-.2	-.5	.8																					
Mg	-.2	-.7	-	.1	-	.1	-.3	.4	-1	.1	-.4																						
Na	.9	-.4	-	-.4	-	-.2	.9	-.1	.5	0																							
Ag	-.4	-.4	-	-.2	-	-.7	-.4	-.3	-.4																								
Ti	.4	.5	-	-.2	-	.1	.5	-.5																									
Li	0	-.6	-	-.5	-	.2	0																										
Rb	.9	-.3	-	-.3	-	.1																											
V	0	.2	-	-.2	-																												
Zr	-	-	-	-																													
P	-.2	.3	-																														
Te	-	-																															
Th	-.4																																

A dash (-) indicates insufficient data for a correlation

suggests two separate mineralizing events. The most recent mineralization occurred with geothermal activity in the area depositing Ag, Hg, Sb, S, which followed a previous mineralizing period for the other element suite.

4.1.11 Wild Horse Area

Wild Horse Canyon lies along the southern boundary of the reservation, the area of study primarily includes the south side of the canyon in the vicinity of the Luck Four Mine (NW1/4, Sec 32, T11N, R30E). The mine was developed along an inclined, altered shear zone in granitic rocks.

Two preliminary samples from the area yielded minor amounts of Au, Cu, Zn, Ag, Th and Tl. The area is described (Ross, 1961) as a tungsten mine, however, no tungsten was detected, but gold was detected. Three additional samples were collected in and near the mine. These samples yielded (Table 4-14): Au (.001-.251 oz/ton), Ag (.061-.201 oz/ton), Cu (.01%), Zn (.29%), and As (235 ppm). Once again the most abundant elements are associated with the altered shear zone, as evidenced throughout the reservation.

4.1.12 Summary

From the foregoing discussion, three areas have similar elemental suites consisting of numerous elements; these elements are U, Au, Ni, As, S, Hg, Sb, Zn and Mo in the Guranium, Calico and Hidden Valley Areas. While variations do occur within this grouping, i.e., some elements may occur within separate suites in an area; this grouping is quite definite and could well represent a particular mineralizing event in the region. Assuming the uranium bearing tuffs are the last major felsic volcanic event in the area

Table 4-14. GEOCHEMICAL DATA WILDHORSE AREA

Sample Number	AU PPB	AG PPM	CO PPM	CR PPM	CU PPM	ZN PPM
WH:1	8596.0	2.1	8.0	8.0	119.0	74.0
WH:2	50.0	2.5	8.0	12.0	36.0	2870.0
WH:3	73.0	6.9	17.0	22.0	112.0	390.0

Sample Number	AS PPM	TOTAL BA PPM	TOTAL CA %	TOTAL SI02 %	TOTAL LI PPM	TOTAL RB PPM
WH:1	235.0	1360.0	2.11	57.9	13.0	110.0
WH:2	10.0	80.0	13.1	37.5	15.0	19.0
WH:3	5.0	750.0	2.26	55.9	13.0	38.0

Sample Number	V PPM	S %	W PPM
WH:1	80.0	0.05	-4.0
WH:2	40.0	0.13	-4.0
WH:3	90.0	0.05	-4.0

and considering the nature of occurrence of uranium with various base and precious metals indicates that the major metalization event on the reservation occurred simultaneously, or nearly so, with the last major felsic volcanism in the region. More importanly, uranium which occurs in a variety of terrains, was not detected in above background proportions in unaltered intrusive rocks.

The variable occurrence of uranium with other elements is probably due to the ability of uranium to complex with many different oxides, silicates and sulfates that may be available in solution. The more noteable uranium minerals in Nevada are listed in Appendix F.

Though a particular elemental suite for uranium may vary between areas, this is probably due to the availability of the elements in solution for complexing with uranium. The principal consideration is the availability of uranium in solution for complexing with other elements. As indicated throughout this discussion uranium occurrence appears to be a late stage event in all areas of the reservation. Since uranium occurs in concert with so many different elements, of potential economic interest, it is reasonable to assume that these elements were also emplaced at the time of the initial uranium mineralizing event. Four areas, 1) Bimetal, 2) Afterthought, 3) Gillis, and 4) Sulfur appear to have similar elemental relationships which include Au, Ag, U, Hg, Zn, S, and As. Many of these elements occur in the three previously discussed areas, and may indeed be related to the same mineralizing event. The principal difference between these two major groupings, however, is that the Guranium, Calico, and Hidden Valley elements are generally all correlative to each other; while the Bimetal, Afterthought, Gillis, and Sulfur grouping is less well defined, in that, a given element may be correlative with only two or three other elements within a given group. These two separate groupings may be related to a particular lithology or mode of occurrence in an area. For instance, Guranium and Calico area lithologies are predominantly felsic to intermediate tuffs, within which occur slightly to strongly altered shear zones. On the otherhand, the Bimetal, Afterthought, Gillis, and Sulfur Areas are generally quartz veins and meta-sediments, in addition to altered shear zones.

The feasibility of this assumption will be further discussed in the following section on lithologic elemental relationships.

4.2 LITHOLOGIC ANALYSIS

In order to determine if a particular lithology or mode of occurrence hosted specific and anomalous elements, geostatistics were calculated for seven potential host types. These include quartz vein, granite, limestone, gossan zones, kaolinized shear zones, radiometric, and non-radiometric tuff. Geochemical data was employed from all over the reservation, regardless of the particular area of occurrence. For instance, quartz vein data was integrated from several areas, including Red Granite, Afterthought and Bimetal for this analysis.

4.2.1 Quartz Veins

Five samples (WR 12, 13, 8, 19, & 57) were integrated from the Red Granite, Afterthought, and Bimetal Areas. The elemental relationships from Table 4-15 indicate three strong elemental groupings:

TABLE 4-15 CORRELATION MATRIX — QUARTZ VEINS

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	B
Au	-.6	-.3	-.6	.2	-	.5	-.2	.3	.2	-.6	-.5	.6	-.4	-.4	.2	0	-.4	-.4	.1	-	-	.2	.8	-.5	-.7	-.2	-.6	-.5	-.9	-.8	-.8	.5	-.
Bi	.9	-.5	.9	-.3	-	-.3	-.6	-.6	-.6	.9	-.5	-.6	-.5	-.5	-.4	-.4	-.5	-.5	-.6	-	-	.2	-.5	-.3	.9	-.5	.9	-.2	.6	.9	0	.2	
Co	.2	-.4	.2	.5	-	.7	-.3	-.5	.3	.2	-.6	.3	-.7	-.5	.4	-.4	-.6	-.5	-.1	-	-	.1	.6	-.4	.1	-.1	.2	-.6	-.2	-.2	-.7		
Cr	0	.3	0	-.1	-	-.5	.2	-.1	-.1	0	.4	-.8	.1	.3	0	-.4	.2	.3	-.1	-	-	-.2	-.9	.6	.1	.3	0	.9	.7	.2			
Cu	.9	-.4	.9	-.6	-	-.6	-.5	-.4	-.8	.9	-.3	-.7	-.2	-.3	-.6	-.2	-.3	-.4	-.7	-	-	.2	-.8	-.3	.8	-.6	.9	0	.6				
Mo	.6	.2	.6	.1	-	-.2	.1	-.7	-.1	.5	.2	-.7	-.1	.2	.1	-.5	0	.1	-.2	-	-	-.3	-.8	.5	.6	.2	.6	.5					
Ni	-.2	.2	-.2	0	-	-.4	.1	.1	0	-.2	.3	-.7	0	.2	.1	-.5	.1	.2	-.1	-	-	-.1	-.7	.5	-.2	.2	-.2						
Pb	.9	-.5	.9	-.3	-	-.3	-.5	-.6	-.6	.9	-.4	-.6	-.5	-.4	-.4	-.4	-.4	-.5	-.6	-	-	.2	-.5	-.3	.9	-.5							
S	-.5	.9	-.5	.7	-	.5	.9	-.4	.8	-.6	.8	.3	.5	.8	.7	0	.7	.8	.8	-	-	-.9	.2	.9	-.3								
Zn	.9	-.3	.9	-.3	-	-.2	-.3	-.7	-.4	.9	-.2	-.5	-.2	-.2	-.3	-.2	-.2	-.3	-.4	-	-	-.1	-.5	-.1									
As	-.3	.8	-.3	.5	-	.2	.8	-.4	.6	-.4	.8	-.1	.5	.8	.6	-.1	.6	.8	.6	-	-	-.9	-.2										
Hg	-.5	0	-.5	.4	-	.7	.2	-.1	.5	-.5	-.2	.9	-.1	-.1	.4	.3	0	0	.5	-	-	-.2											
Si	.2	-1	.2	-.6	-	-.5	-1	.5	-.8	.2	-.9	-.5	-.8	-1	-.6	-.4	-.9	-1	-1	-	-												
Sb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
Sn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-														
U	-.6	.8	-.6	.6	-	.5	.9	-.3	.8	-.7	.7	.7	.6	.8	.6	.4	.7	.8															
Al	-.5	.9	-.5	.2	-	.1	.9	-.2	.5	-.5	.9	.3	.9	.9	.3	.5	.9																
Ba	-.5	.9	-.5	0	-	-.1	.8	-.1	.4	-.5	.9	.3	.9	.9	.1	.6																	
Ca	-.4	.3	-.4	-.4	-	-.2	.3	.2	-.1	-.4	.4	.5	.7	.4	-.4																		
Fe	-.4	.5	-.4	.9	-	.8	.6	-.6	.9	-.4	.2	.3	-.1	.3																			
K	-.5	.9	-.5	.3	-	.1	.9	-.3	.5	-.5	.9	.2	.8																				
Mn	-.5	.8	-.5	-.2	-	-.2	.7	0	.2	-.5	.8	.3																					
Mg	-.6	.3	-.6	.3	-	.6	.4	-.1	.6	-.6	.1																						
Na	-.5	.9	-.5	.2	-	0	.9	-.2	.4	-.5																							
Ag	.9	-.6	.9	-.4	-	-.3	-.6	-.6	-.6																								
Ti	-.6	.6	-.6	.9	-	.8	.7	-.5																									
Li	-.6	-.3	-.6	-.6	-	-.6	-.3																										
Rb	-.6	.9	-.6	.5	-	.4																											
V	-.3	.2	-.3	.8	-																												
Zr	-	-	-	-																													
P	-.3	.4	-.3																														
Te	.9	-.5																															
Th	-.5																																

A dash (-) indicates insufficient data for a correlation

1) Cu, Mo, Pb, Zn, Ag, Te
2) U, Th, As, Al, Ba, K, Mn, Na, Ti, Rb
3) Au, Hg, Co, Mg, V

Unlike the quartz vein occurrences described for the Bimetal Area, silica does not correlate with any elements, when the quartz veins are considered as the only sample population.

Though many different elements occur within the quartz veins, with few exceptions, only gold and silver display consistent anomalous values. Interestingly, these elements have an inverse relationship in quartz veins. This relationship in addition to the values of gold indicates, in general, gold may be the only economically productible metal on the reservation from quartz veins.

4.2.2 Tuff

For this analysis, the tuff was divided into radiometric tuff, as detected in the field, and nonradiometric tuff. Radiometric tuff samples used were WR-14, 21, 32, 43, and 39; nonradiometric tuff samples were WR-40, 38, 33, 46, and 23.

The radiometric tuff displays two correlative elemental suites (Table 4-16):

1) U, Ca, Mn, Mg, Th
2) P, Co, Cr, Mo, Ni, Sr, Ba, Fe

Nonradiometric tuff, on the otherhand, displays three elemental suites (Table 4-17):

TABLE 4-16 CORRELATION MATRIX — RADIOMETRIC TUFF

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	.9	.7	-	-.5	-.3	.2	-.8	.5	-.5	-.3	-.5	.9	.7	-1	-.7	.7	-.2	.2	.8	-.3	-	-.2	-.3	-.3	-.4	-.1	0	-.5	-.5	-.6	-.5	-.3	-.3
Bi	-.3	-.2	-	-.4	-.3	-.2	.2	-.6	.1	.9	-.4	-.3	.4	.4	-.3	-.3	-.5	-.2	-.6	-.3	-	.3	-.3	-.2	.2	.1	.8	-.3	-.3	.8	-.5	-.3	
Co	-.3	-.7	-	.9	-.7	.6	-.6	.3	.3	-.3	-.5	-.2	-.4	.2	.8	.3	.9	-.5	-.4	.5	-	.6	-.7	-.7	-.8	-.6	-.7	.9	.8	.1	.9		
Cr	-.5	-.6	-	.9	-.5	.3	-.3	.3	.2	-.5	-.2	-.4	-.7	.3	.9	.1	.9	-.5	-.5	.4	-	.5	-.5	-.5	-.7	-.4	-.9	.9	.9	0			
Cu	-.6	-.6	-	0	-.4	-.1	.2	-.5	.3	.8	-.4	-.6	0	.6	.2	-.3	-.1	-.4	-.9	0	-	.5	-.4	-.4	0	-.1	.4	.2	.2				
Mo	-.5	-.5	-	.8	-.5	.1	-.3	.4	0	-.3	-.3	-.5	-.6	.5	.8	0	.9	-.8	-.6	.2	-	.7	-.5	-.5	-.7	-.1	-.8	.9					
Ni	-.5	-.7	-	.9	-.5	.3	-.3	.3	.2	-.3	-.3	-.5	-.7	.4	.9	0	.9	-.6	-.6	.4	-	.7	-.5	-.5	-.7	-.3	-.8						
Pb	0	.1	-	-.8	0	-.3	.3	-.7	0	.8	-.1	0	.6	-.1	-.7	-.2	-.9	.2	-.1	-.4	-	-.2	0	.1	.5	.1							
S	-.1	.6	-	-.6	.5	-1	.4	.2	-.9	.1	.4	-.3	-.2	.3	-.6	-.6	-.3	-.5	0	-1	-	-.1	.5	.5	.4								
Zn	-.4	0	-	-.6	.8	-.7	.9	-.8	.1	.2	.8	-.5	-.2	.2	-.4	-.9	-.8	.4	-.2	-.3	-	-.7	.8	.8									
As	-.3	.2	-	-.5	.9	-.8	.8	-.4	-.2	-.2	.9	-.4	-.4	.1	-.4	-.8	-.6	.3	.1	-.3	-	-.8	.9										
Hg	-.3	.2	-	-.5	.9	-.7	.7	-.4	-.2	-.3	.9	-.4	-.4	.1	-.4	-.8	-.6	.3	.1	-.3	-	-.8											
Si	-.2	-.4	-	.4	-.8	.1	-.4	.3	-.2	.3	-.7	-.2	-.1	.4	.4	.2	.6	-.9	-.6	-.1	-												
Sb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
Sn	-.3	-.8	-	.6	-.3	.7	-.2	-.4	.9	-.3	-.2	-.2	-.3	-.1	.7	.2	.3	.4	-.2														
U	.8	.7	-	-.5	.1	.1	-.5	.4	-.5	-.6	0	.8	.4	-1	-.7	.5	-.3	.4															
Al	.2	-.1	-	-.3	.3	.3	0	-.6	.5	-.2	.2	.2	.2	-.6	-.3	.1	-.6																
Ba	-.2	-.4	-	.8	-.6	.4	-.5	.5	0	-.5	-.4	-.2	-.5	.2	.7	.3																	
Ca	.7	.1	-	.1	-.8	.7	-1	.5	-.1	-.3	-.8	.8	.5	-.8	-.1																		
Fe	-.7	-.9	-	.9	-.4	.4	-.1	-.1	.6	-.3	-.2	-.6	-.7	.4																			
K	-1	-.6	-	.3	.1	-.5	.6	-.4	.1	.4	.2	-1	-.7																				
Mn	.7	.4	-	-.7	-.5	.2	-.5	0	-.3	.4	-.7	.7																					
Mg	.9	.6	-	-.4	-.4	.4	-.8	.4	-.4	-.3	-.5																						
Na	-.5	.1	-	-.2	.9	-.7	.7	-.4	-.1	-.4																							
Ag	-.3	-.2	-	-.4	-.3	-.2	.2	-.6	.1																								
Ti	-.5	-.9	-	.4	-.2	.5	.1	-.8																									
Li	.5	.5	-	.1	-.4	0	-.7																										
Rb	-.8	-.2	-	-.3	.7	-.8																											
V	.2	-.5	-	.5	-.7																												
Zr	-.3	.2	-	-.4																													
P	-.5	-.8	-																														
Te	-	-																															
Th	.7																																

A dash (-) indicates insufficient data for a correlation

TABLE 4-17 CORRELATION MATRIX — NONRADIOMETRIC TUFF

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	.9	-.6	-	0	.9	-.3	.6	-.6	-.3	.1	-1	.7	.9	.5	-.1	-.5	.8	0	.2	.3	-	-.4	-.4	.6	.9	0	.9	-.4	-.6	-.2	-.5	.8	.9
Bi	.9	-.6	-	0	.9	-.3	.6	-.6	-.3	.1	-1	.7	.9	.5	-.1	-.5	.8	0	.2	.3	-	-.4	-.4	.6	.9	0	.9	-.4	-.6	-.2	-.5	.8	
Co	.8	-.9	-	.4	.8	.1	.2	-.5	.2	-.1	-.8	.9	.9	.1	.3	-.1	.9	.5	0	.4	-	-.6	-.6	.2	.9	-.2	.8	-.2	-.9	-.3	-.7		
Cr	-.5	.8	-	-.3	-.5	-.7	0	.7	-.6	-.5	0	-.9	-.6	.4	-.5	-.5	-.4	-.8	-.4	.2	-	0	-.2	.3	-.7	-.3	-.5	.5	.8	.9			
Cu	-.2	.5	-	.1	-.2	-.6	0	.8	-.5	-.8	-.3	-.6	-.2	.5	-.2	-.4	0	-.6	-.6	.6	-	-.4	-.6	.4	-.3	-.6	-.3	.7	.4				
Mo	-.6	.9	-	-.8	-.6	-.7	.2	.3	-.7	.1	.2	-1	-.7	.3	-.8	-.5	-.8	-.9	.2	-.5	-	.6	.4	.2	-.9	.2	-.6	0					
Ni	-.4	.1	-	.6	-.4	.1	-.6	.9	.2	-1	0	-.2	-.3	-.2	.5	.3	0	.1	-1	.7	-	-.8	-.8	-.2	-.3	-1	-.5						
Pb	.9	-.6	-	-.1	.9	-.3	.7	-.7	-.3	.3	-.9	.7	.9	.5	-.2	-.5	.8	0	.4	.1	-	-.2	-.2	.6	.9	.2							
S	0	.2	-	-.9	0	-.4	.5	-.8	-.4	.9	0	-.2	-.1	.1	-.8	-.5	-.4	-.4	.9	-1	-	.9	.8	.1	-.1								
Zn	.9	-.9	-	.3	.9	0	.3	-.6	.1	0	-.8	.9	.9	.2	.2	-.2	.9	.4	.1	.3	-	-.5	-.5	.4									
As	.6	.1	-	-.4	.6	-.9	.9	-.2	-.9	.1	-.9	0	.5	.9	-.7	-1	.4	-.7	.3	.2	-	0	-.3										
Hg	-.4	.3	-	-.8	-.4	-.2	.1	-.6	-.3	.8	.4	-.5	-.5	-.2	-.6	-.2	-.8	-.4	.7	-1	-	.9											
Si	-.4	.5	-	-1	-.4	-.4	.3	-.5	-.5	.8	.3	-.6	-.5	.1	-.8	-.4	-.7	-.6	.8	-1	-												
Sb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
Sn	.3	-.4	-	.7	.3	0	-.2	.5	.1	-.9	-.5	.3	.4	.1	.5	.1	.6	.2	-.8														
U	.2	.1	-	-.9	.2	-.5	.6	-.9	-.5	.9	-.2	-.1	.1	.3	-.8	-.6	-.2	-.4															
Al	0	-.9	-	.7	0	.9	-.7	-.2	.9	-.3	.2	.7	.2	-.8	.9	.8	.3																
Ba	.8	-.8	-	.5	.8	0	.3	-.3	0	-.3	-.9	.8	.9	.2	.3	-.2																	
Ca	-.5	-.5	-	.7	-.5	.9	-1	.2	.9	-.4	.6	.2	-.3	-1	.8																		
Fe	-.1	-.7	-	.9	-.1	.8	-.8	.2	.9	-.7	.2	.5	.1	-.8																			
K	.5	.3	-	-.5	.5	-1	.8	-.1	-1	.1	-.8	-.2	.3																				
Mn	.9	-.8	-	.2	.9	-.1	.5	-.6	-.1	0	-.9	.8																					
Mg	.7	-1	-	.5	.7	.4	0	-.6	.4	0	-.5																						
Na	-1	.2	-	-.1	-1	.5	-.8	.2	.4	0																							
Ag	.1	0	-	-.8	.1	-.3	.5	-.9	-.3																								
Ti	-.3	-.7	-	.7	-.3	.9	-.9	0																									
Li	-.6	.4	-	.3	-.6	-.1	-.5																										
Rb	.6	.1	-	-.7	.6	-.9																											
V	-.3	-.7	-	.6	-.3																												
Zr	.9	-.6	-	0																													
P	0	-.7	-																														
Te	-	-																															
Th	-.6																																

A dash (-) indicates insufficient data for a correlation

1) Co, Pb, Zn, As, Mn, Mg, Rb, Ba
2) P, Ni, Sn, Al, Ca, Fe, Ti, V
3) S, Hg, Si, U

From the geochemical data, the radiometric source is not apparent since the potential sources of any radiometric activity (K, U, Tl, Bi, Th) display nearly equal amounts in both radiometric and nonradiometric tuffs. The above correlative relationships show uranium and thorium having a direct correlation in the radiometric tuffs and no relationship in the non-radiometric tuffs, thus indicating that uranium and thorium could be acting in concert to produce the radiometric anomalies encountered in the field. This would also appear to indicate that magmatic differentiation has produced some volcanic rocks that are better source rocks than others.

4.2.3 Granite

Samples included in this analysis include WR-2, 3, 6, 7, & 66 from the Bimetal and Afterthought Areas. With the exception of slight anomalies for Cu and As in sample WR-3, the granitic rocks do not display any anomalous values. The correlation matrix on Table 4-18 displays three elemental suites:

1) Mn, Pb, Zn, Ca
2) K, Na, Si, Al
3) Co, Mo, Ni, Fe, Mg, U

The relationship of Suite #1 is uncertain at this point, but probably reflects the association of common trace minerals within granites. Suite #2 consists of the common

TABLE 4-18 CORRELATION MATRIX — GRANITE

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Co	-	-.5	-	.4	-	.6	-.3	.4	.9	-.4	.6	.7	-.1	-.1	.5	-.4	.7	.4	-.2	-.4	-.5	.2	.2	-.5	-.4	-.4	-.4	.5	.6	-.4	-.2		
Cr	-	.2	-	.6	-	.4	.1	-.1	-.1	-.3	-.2	0	-.5	0	.6	-.5	-.1	-.1	.9	-.5	-.3	.5	-.4	.1	-.5	.1	-.3	.6	.6	0			
Cu	-	.3	-	-.3	-	-.4	.2	.5	-.5	-.4	-.2	-.4	0	-.1	-.3	.1	-.4	-.2	0	.1	0	-.1	-.7	.9	.1	-.1	-.1	-.4	-.5				
Mo	-	-.1	-	.7	-	.7	-.1	0	.7	-.4	.4	.5	-.5	.1	.8	-.7	.6	.4	.5	-.7	-.5	.6	.1	-.4	-.7	-.2	-.6	.8					
Ni	-	-.4	-	.9	-	.9	-.4	.2	.5	-.4	.3	.7	-.3	-.2	.9	-.5	.3	.1	.7	-.6	-.5	.4	-.2	-.3	-.5	0	-.3						
Pb	-	-.7	-	0	-	0	-.8	0	-.6	0	-.8	.1	.8	-.9	-.1	.8	-.9	-.9	-.3	.8	-.2	-.9	-.3	-.1	.8	.7							
S	-	-.4	-	.1	-	.1	-.7	0	-.5	-.5	-1	0	.7	-.6	.1	.7	-.7	-1	-.1	.7	-.6	-.8	-.2	-.1	.7								
Zn	-	-.5	-	-.3	-	-.2	-.7	.1	-.5	-.3	-.8	-.1	.9	-.7	-.4	.9	-.7	-.9	-.6	.9	-.4	-1	-.2	0									
As	-	.2	-	-.2	-	-.2	.1	.5	-.5	-.4	-.3	-.3	0	-.2	-.2	.1	-.5	-.3	.2	.1	-.1	-.1	-.8										
Hg	-	.2	-	-.4	-	-.3	.3	-.7	.3	.2	.2	-.3	-.2	.5	-.4	-.2	.5	.4	-.5	-.2	0	.1											
Si	-	.5	-	.2	-	.1	.6	-.3	.3	.2	.7	-.1	-1	.6	.3	-1	.6	.8	.6	-1	.3												
Sb	-	.3	-	-.5	-	-.6	.5	-.6	-.4	.9	.2	-.6	-.5	.3	-.5	-.4	-.2	.3	-.1	-.3													
Sn	-	-.5	-	-.4	-	-.3	-.7	.1	-.6	-.2	-.8	-.1	.9	-.7	-.4	.9	-.8	-.9	-.6														
U	-	.2	-	.6	-	.4	.1	-.1	-.1	-.1	0	.1	-.6	0	.6	-.6	-.1	0															
Al	-	.4	-	-.1	-	-.1	.6	-.2	.6	.2	.9	-.1	-.9	.7	0	-.9	.8																
Ba	-	.2	-	.1	-	.2	.3	0	.8	-.1	.8	.2	-.6	.6	.2	-.8																	
Ca	-	-.6	-	-.3	-	-.2	-.7	.1	-.5	-.3	-.9	0	.9	-.7	-.3																		
Fe	-	-.5	-	.9	-	.9	-.5	.3	.4	-.4	.1	.8	-.2	-.4																			
K	-	.8	-	-.5	-	-.5	.9	-.5	.1	.2	.5	-.6	-.8																				
Mn	-	-.7	-	-.1	-	0	-.8	.3	-.3	-.4	-.7	.2																					
Mg	-	-.8	-	.8	-	.9	-.8	.5	.6	-.5	.2																						
Na	-	.1	-	.1	-	.2	.4	0	.7	.2																							
Ag	-	.1	-	-.4	-	-.5	.3	-.8	-.3																								
Ti	-	-.3	-	.4	-	.6	-.2	.2																									
Li	-	-.4	-	.3	-	.4	-.5																										
Rb	-	.9	-	-.6	-	-.7																											
V	-	-.7	-	.9	-																												
Zr	-	-	-	-																													
P	-	-.5	-																														
Te	-	-																															
Th	-																																

A dash (-) indicates insufficient data for a correlation

rock forming elements for a typical granite. The relationship indicated by Suite #3 shows that Co, Ni, Mo, and perhaps U may be associated with biotite which is an Fe, Mg silicate.

4.2.4 Fault Zone

This section has been subdivided into two sections, to separately discuss the two distinctively different fault zones on the reservation, those that have been intensively altered to gossan, and those that have been only slightly altered to kaolinite or limonitic kaolinite zones.

Gossan zones account for many of the anomalous metal occurrences on the reservation; some of the elements are Au, (115ppb), As (.75%), Hg (.18%), Zn (.12%), Ba (3.1%), Fe (49%), Ag (.4ppm), and Cu (.33%). The samples included in the gossan analysis are WR-17, 49, 59, 76, and 83. From Table 4-19 one elemental suite is shown:

Tl, Mo, Ni, Zn, As, Hg, Sb, U, Ba, Fe, V, P, Au.

Since many of the elements in this suite also display anomalous values, it appears that these elements were deposited during a single mineralizing event injected along and responsible for altered shear zones.

For the kaolinized or slightly altered fault zone analysis, samples employed were WR-1, 41, 37, and 63. Samples WR-1 and 63 are kaolinized fault gouge, while WR-41 and 37 are limonitic kaolinized fault gouge. As with the gossan zones, the kaolinitic and limonitic shear zones also contain abundant anomalous elements, which include Au (610ppb), As

TABLE 4-19 CORRELATION MATRIX — GOSSAN ZONES

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	In	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	.9	-.6	.1	.7	-.4	.9	-.5	-.2	-.5	.2	-.2	-.3	.2	-.6	.6	-.5	.9	-.4	.8	-.3	.9	.1	.9	.9	.9	-.3	.2	.9	.9	-.3	.3	-.2	-.6
Bi	-.5	.1	-.5	-.8	.4	-.5	-.1	.2	.4	-.5	-.5	.4	0	-.1	-.8	.8	-.5	.4	-.3	-.6	-.5	-.6	-.6	-.6	-.5	-.4	-.6	-.7	-.9	.4	-.5	-.5	
Co	-.2	.5	-.2	.5	-.2	-.1	.6	-.3	0	-.4	.9	-.3	-.7	.7	.5	-.6	-.1	-.2	-.5	.9	-.2	-.1	-.1	-.2	-.2	.9	-.2	0	.1	-.5	-.3		
Cr	.1	-.3	.9	-.1	0	0	-.2	.2	-.1	.8	-.3	0	.2	-.2	-.2	-.5	0	-.1	0	-.2	0	.9	.1	.2	0	-.5	.9	.1	.4	-.4			
Cu	-.3	-.3	-.3	-.5	-.3	-.4	-.5	-.4	-.4	.1	-.4	-.3	.7	-.6	-.5	.8	-.3	-.3	.3	-.3	-.3	-.5	-.3	-.3	-.2	-.4	-.4	-.4	-.5				
Mo	.8	-.5	.2	.8	-.4	.8	-.3	-.2	-.5	.3	.1	-.4	.1	-.4	.7	-.7	.8	-.5	.6	.1	.8	.3	.8	.8	.8	-.1	.3	.9					
Ni	.9	-.4	-.1	.8	-.3	.9	-.5	-.2	-.4	.1	0	-.3	.1	-.5	.8	-.6	.9	-.4	.7	-.1	.9	0	.9	.9	.9	-.1	.1						
Pb	-.1	-.4	.9	-.1	-.1	-.1	-.1	.1	-.2	.8	-.2	-.1	.2	-.1	-.2	-.5	-.1	-.1	-.1	-.1	-.1	.9	0	.1	-.1	-.4							
S	-.2	.5	-.3	.4	-.4	-.2	.7	-.5	-.1	-.4	.9	-.4	-.7	.7	.5	-.5	-.2	-.3	-.5	.8	-.2	-.3	-.2	-.3	-.2								
In	.9	-.5	-.3	.7	-.3	.9	-.5	-.2	-.4	-.1	-.2	-.2	.2	-.6	.7	-.4	.9	-.3	.8	-.3	.9	-.2	.9	.9									
As	.9	-.6	-.1	.7	-.3	.9	-.5	-.1	-.4	.1	-.2	-.3	.2	-.6	.7	-.5	.9	-.3	.8	-.3	.9	0	.9										
Hg	.9	-.5	-.2	.8	-.3	.9	-.5	-.2	-.4	0	-.1	-.3	.1	-.6	.7	-.5	.9	-.3	.8	-.2	.9	-.1											
Si	-.1	-.2	.9	-.1	0	-.1	0	.2	0	.7	-.1	0	0	.1	-.2	-.6	-.2	0	-.3	.1	-.2												
Sb	.9	-.5	-.2	.7	-.3	.9	-.5	-.1	-.4	-.1	-.2	-.2	.2	-.6	.7	-.4	.9	-.3	.8	-.3													
Sn	-.3	.5	0	.3	-.3	-.2	.5	-.3	-.1	-.1	.9	-.3	-.5	.6	.4	-.5	-.3	-.3	-.5														
U	.8	-.7	-.2	.4	-.4	.7	-.8	-.3	-.6	.2	-.4	-.3	.6	-1	.4	0	.8	-.4															
Al	-.3	.6	-.3	-.5	.9	-.1	-.2	.9	.9	-.5	-.3	.9	-.4	.2	-.5	.1	-.3																
Ba	.9	-.5	-.2	.8	-.3	.9	-.5	-.1	-.4	-.1	-.2	-.2	.1	-.6	.7	-.4																	
Ca	-.4	-.1	-.4	-.8	.2	-.5	-.5	0	0	-.2	-.5	.2	.5	-.4	-.8																		
Fe	.7	-.1	-.3	.9	-.5	.7	.1	-.4	-.4	-.2	.5	-.5	-.3	0																			
K	-.6	.7	-.1	-.1	.2	-.5	.8	.1	.5	-.4	.6	.1	-1																				
Mn	.2	-.8	.2	-.2	-.3	0	-.8	-.3	-.6	.6	-.6	-.3																					
Mg	-.2	.5	-.3	-.4	.9	-.1	-.3	.9	.9	-.5	-.3																						
Na	-.2	.5	-.2	.4	-.3	-.1	.5	-.3	-.1	-.3																							
Ag	0	-.7	.8	-.1	-.5	-.1	-.3	-.3	-.6																								
Ti	-.4	.7	-.3	-.4	.9	-.2	.1	.8																									
Li	-.1	.4	-.1	-.3	.9	0	-.3																										
Rb	-.5	.3	0	-.1	-.2	-.5																											
V	.9	-.3	-.3	.8	-.1																												
Zr	-.3	.6	-.2	-.4																													
P	.7	-.2	-.2																														
Te	-.2	-.5																															
Th	-.5																																

A dash (-) indicates insufficient data for a correlation

(27000ppm), Hg (62000ppm), and Ag (580ppm) in addition to several other elements.

The correlation matrix on Table 4-20 indicates one good elemental suite:

Tl, Mo, Zn, As, Hg, Fe V, P, Bi, Cu, Ph, S, Ag, Au, U

This suite is similar to the previous suite described for the gossan zones, though some variation is present, this is probably the result of differing compositions of the fault gouge, owing to the particular lithology through which the fault passes. The similarity between these two suites in conjunction with similar anomalous elements between the two types of shear zones suggests the same mineralizing solutions were responsible for metal/mineral occurrences along the shear zones.

Considering the juxaposition of the kaolin zones (WR-1 and WR-63) and quartz veins (WR 12, 13, and WR 57, respectively), the quartz veins appear to host only anomalous gold and silver. While the anomalous elements displayed in the fault zones are present in the quartz veins, these elements are not anomalously high in the quartz veins. This indicates two possible relationships between the fault zone mineral occurrences and the quartz veins.

First, this exclusion of anomalous metals from the quartz veins (except Au and Ag) could indicate two separate mineralizing episodes. Second, both the quartz veins and fault mineralizations could be from the same mineralizing event, but because the fault gouge contained more chemically reactive lithologies, other than just silica (SiO_2) for the quartz veins, anomalous amounts of metals were deposited along the fault zones. While it is not possible to determine which of these two relationships is responsible for the metal anomalies, based solely on geochemical data, the more likely relationship is the

TABLE 4-20 CORRELATION MATRIX — KAOLINIZED ZONES

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	.4	-1	.9	.9	-	.9	-.2	-.7	-.7	.9	-.3	-1	-.8	-.4	.9	-.5	.4	-.9	.8	.9	.9	-1	.9	.9	.8	.9	.9	-1	.5	.9	-.1	-1	.9
Bi	.7	-.9	.9	.9	-	.9	-.5	-.3	-.8	.9	-.7	-.9	-.6	-.7	.9	-.1	0	-1	.8	.9	.9	-1	.9	.9	.9	.9	.9	-1	.8	.9	-.4	-.8	
Co	-.2	.9	-.8	-.8	-	-.8	-.1	.8	.5	-.8	-.1	.9	.8	0	-.8	.6	-.8	.6	-.8	-.8	-.8	.7	-.8	-.8	-.8	-.8	-.8	.9	-.4	-.8	-.3		
Cr	-.8	-.2	-.4	-.4	-	-.4	.3	-.7	0	-.4	.8	-.2	-.2	.4	-.4	-.4	.7	.4	0	-.4	-.4	.3	-.4	-.4	-.4	-.4	-.4	0	-.5	-.4			
Cu	.7	-.9	.9	.9	-	.9	-.5	-.3	-.8	.9	-.7	-.9	-.6	-.7	.9	-.1	0	-1	.8	.9	.9	-1	.9	.9	.9	.9	.9	-1	.8				
Mo	.8	-.7	.8	.8	-	.8	-.9	.1	-1	.8	-.9	-.6	-.1	-1	.8	.4	-.3	-1	.8	.8	.8	-.9	.8	.8	.8	.6	.8	-.7					
Ni	-.5	.9	-1	-1	-	-1	.1	.6	.6	-1	.2	.9	.7	.3	-1	.4	-.5	.8	-.9	-1	-1	.9	-1	-1	-1	-1	-1						
Pb	.7	-.9	.9	.9	-	.9	-.5	-.3	-.8	.9	-.7	-.9	-.6	-.7	.9	-.1	0	-1	.8	.9	.9	-1	.9	.9	.9	.9							
S	.6	-.9	.9	.9	-	.9	-.2	-.5	-.5	.9	-.5	-.9	-.8	-.4	.9	-.5	.2	-.9	.6	.9	.9	-1	.9	.9	.9								
Zn	.7	-.9	.9	.9	-	.9	-.5	-.3	-.8	.9	-.7	-.9	-.5	-.7	.9	-.1	0	-1	.8	.9	.9	-1	.9	.9									
As	.7	-.9	.9	.9	-	.9	-.5	-.3	-.8	.9	-.7	-.9	-.6	-.7	.9	-.1	0	-1	.8	.9	.9	-1	.9										
Hg	.7	-.9	.9	.9	-	.9	-.5	-.3	-.8	.9	-.7	-.9	-.6	-.7	.9	-.1	0	-1	.8	.9	.9	-1											
Si	-.8	.8	-1	-1	-	-1	.3	.3	.7	-1	.5	.8	.5	.5	-1	.1	-.2	.9	-.9	-1	-1												
Sb	.7	-.9	.9	.9	-	.9	-.5	-.3	-.8	.9	-.7	-.9	-.6	-.7	.9	-.1	0	-1	.8	.9													
Sn	.7	-.9	.9	.9	-	.9	-.5	-.3	-.8	.9	-.7	-.9	-.6	-.7	.9	-.1	0	-1	.8														
U	.5	-1	.8	.8	-	.8	-.6	-.4	-1	.8	-.4	-.9	-.4	-.7	.8	0	.2	-.9															
Al	-.9	.8	-1	-1	-	-1	.5	.1	.8	-1	.6	.7	.3	.7	-1	-.1	0																
Ba	-.6	-.6	0	0	-	0	.5	-1	0	0	.7	-.6	-.8	.5	0	-.9																	
Ca	.4	.3	-.1	-.1	-	-.1	-.9	.8	-.4	-.1	-.7	.4	.8	-.8	-.2																		
Fe	.7	-.9	.9	.9	-	.9	-.5	-.3	-.8	.9	-.7	-.9	-.6	-.7																			
K	-.9	.4	-.7	-.7	-	-.7	.9	-.5	.8	-.7	.8	.2	-.4																				
Mn	0	.6	-.6	-.6	-	-.6	-.5	.8	0	-.6	-.3	.8																					
Mg	-.4	.9	-.9	-.9	-	-.9	0	.7	.6	-.9	.1																						
Na	-1	.2	-.7	-.7	-	-.7	.7	-.7	.5	-.7																							
Ag	.7	-.9	.9	.9	-	.9	-.5	-.3	-.8																								
Ti	-.7	.7	-.8	-.8	-	-.8	.8	-.1																									
Li	.4	.6	-.3	-.3	-	-.3	-.6																										
Rb	-.8	.2	-.5	-.5	-	-.5																											
V	.7	-.9	.9	.9	-																												
Zr	-	-	-	-																													
P	.7	-.9	.9																														
Te	.7	-.9																															
Th	-.4																																

A dash (-) indicates insufficient data for a correlation

second with anomalous metals being deposited in the more chemically reactive shear zones. This assumption is in part suppported by the correlation data. While the suite of elements that occur within the fault zone occur primarily within two separate suites in the quartz veins, this is probably the result of additional minerals being present in the fault zones, thus complicating the chemistry and the correlation relationship.

4.2.5 Limestone

All of the limestone samples have been subjected to some metamorphism and therefore may more accurately be termed skarn or tactite. Samples included in the analysis are WR-27, 51, 52, 53, 56, 67, 80, and 82. Some of the anomalous metals contained within the meta-limestones are Au (38ppb); As (1900ppm), Cu (4460ppm), and Ag (6.5ppm). From Table 4-21 three principal elemental suites are evident:

1) Au, Ag, Mg, Mn, U, As, Zn, Cu, Co, Sb
2) Th, Si, Al, Fe, Na, Ti
3) P, U, Mo, Ni, Ba, K, V

As would be expected in meta-limestones with silica replacement of carbonates the Si-Ca correlation is -0.9. Calcium shows an inverse relationship with several elements, including Th, Li, Ti, Na, Fe, Ba, Al, Sn, Hg, S, Mo, and little or no relationship with remaining elements. The inverse Ca relationships suggests that Ca was selectively replaced with these elements, in addition to Si, since all of the elements related to silica in Suite #2 also show strong inverse relationships to Ca.

The first suite of elements is particularly similar to the suite of elements listed for the gossan zone, discussed above. This relationship between the two elemental suites

TABLE 4-21 CORRELATION MATRIX — LIMESTONE

	Tl	Th	Te	P	Zr	V	Rb	Li	Ti	Ag	Na	Mg	Mn	K	Fe	Ca	Ba	Al	U	Sn	Sb	Si	Hg	As	Zn	S	Pb	Ni	Mo	Cu	Cr	Co	Bi
Au	-.3	-.3	-	-.1	-.1	.2	.2	-.3	-.3	.9	-.2	.7	.6	.2	-.3	0	-.3	-.4	.9	-.3	.8	-.4	-.3	.8	.7	.1	0	.2	-.1	.7	-.1	.8	.4
Bi	.1	-.6	-	-.2	-.4	0	-.1	.4	-.4	.5	-.7	.2	.1	-.1	-.6	0	.1	-.7	.5	.4	.5	-.2	.5	.5	-.1	-.1	.3	-.2	0	.4	0	.4	
Co	-.3	-.2	-	-.3	-.1	-.1	-.1	-.3	-.2	.9	-.1	.8	.8	0	-.1	-.1	-.3	-.3	.6	-.2	.9	-.4	-.2	.9	.5	.2	0	-.2	-.2	.6	-.3		
Cr	.1	.4	-	.9	.5	.8	.8	.1	.3	-.3	.2	-.6	-.2	.8	.3	-.4	.8	.3	.2	.2	-.5	.3	0	-.5	.2	0	.5	.7	.7	.4			
Cu	-.3	-.3	-	.3	.3	.6	.6	-.2	-.3	.7	-.3	.3	.4	.6	-.2	-.1	.1	-.3	.8	-.1	.4	-.3	-.2	.4	.6	-.2	.4	.4	.3				
Mo	-.4	.6	-	.7	.4	.8	.7	.5	.6	-.2	.3	-.5	0	.7	.5	-.8	.8	.4	.1	.6	-.4	.6	.3	-.4	.2	.2	.7	.7					
Ni	-.3	.4	-	.7	.4	.8	.8	.1	.4	-.1	.3	-.5	-.1	.8	.3	-.5	.4	.3	.3	.1	-.4	.4	-.1	-.4	.6	.1	.3						
Pb	-.5	.2	-	.3	.4	.6	.5	.5	.2	0	-.2	-.3	.1	.5	.2	-.5	.6	.1	.1	.6	-.2	.3	.4	-.1	-.1	-.2							
S	-.1	.5	-	.2	-.4	-.1	0	.2	.7	.1	.7	0	.4	-.1	.5	-.7	.4	.2	0	.2	.1	.4	.2	.2	.1								
Zn	-.4	.2	-	.3	.4	.4	.5	-.3	.1	.5	.1	.3	.5	.4	.2	-.3	-.1	.2	.7	-.3	.3	0	-.4	.3									
As	-.2	-.4	-	-.5	-.3	-.3	-.3	-.2	-.4	.9	-.3	.9	.7	-.3	-.3	0	-.4	-.5	.6	-.2	.9	-.5	-.1										
Hg	-.2	0	-	-.1	-.3	-.1	-.2	.9	.2	-.2	-.3	-.3	-.2	-.3	0	-.6	.3	-.1	-.3	.9	-.2	.6											
Si	-.4	.7	-	.4	.1	.2	.2	.8	.7	-.5	.4	-.6	-.1	.1	.6	-.9	.5	.6	-.4	.7	-.5												
Sb	-.2	-.4	-	-.5	-.3	-.3	-.3	-.3	-.4	.9	-.3	.9	.7	-.3	-.3	0	-.5	-.5	.6	-.3													
Sn	-.3	.3	-	.2	-.1	.2	.1	.9	.4	-.2	-.1	-.4	-.1	0	.2	-.8	.6	.1	-.2														
U	0	-.4	-	.2	0	.4	.4	-.3	-.3	.8	-.3	.4	.4	.4	-.3	0	0	-.5															
Al	-.4	.9	-	.4	.5	.1	.2	.1	.7	-.5	.6	-.3	.2	.2	.9	-.7	.3																
Ba	0	.6	-	.8	.2	.6	.6	.4	.6	-.3	.4	-.6	-.1	.6	.5	-.7																	
Ca	.5	-.8	-	-.5	-.2	-.4	-.4	-.7	-.9	0	-.6	.1	-.4	-.3	-.8																		
Fe	-.4	.9	-	.5	.4	.2	.3	.1	.9	-.3	.8	-.2	.4	.2																			
K	-.2	.3	-	.8	.6	.9	.9	-.1	.3	0	.2	-.4	0																				
Mn	-.5	.2	-	-.1	.1	-.1	0	-.2	.2	.7	.2	.8																					
Mg	-.4	-.3	-	-.6	-.2	-.4	-.4	-.5	-.4	.8	-.2																						
Na	-.3	.8	-	.4	0	.1	.2	-.1	.8	-.3																							
Ag	-.2	-.4	-	-.3	-.2	0	0	-.3	-.4																								
Ti	-.4	.9	-	.5	.1	.3	.3	.3																									
Li	-.3	.2	-	.1	-.2	.1	0																										
Rb	-.3	.3	-	.8	.5	.9																											
V	-.2	.7	-	.8	.5																												
Zr	-.3	.3	-	.5																													
P	0	.6	-																														
Te	-	-																															
Th	-.4																																

A dash (-) indicates insufficient data for a correlation

indicates the same, or at least similar, mineralizing solutions account in large part for both mineral occurrences.

The implication of ths relationship is that some of the mineral occurrences of the meta-limestones are the result of considerably more recent hydrothermal activity than previous thought. Previous investigators had considered the meta-limestone mineral occurrences to be related to contact metamorphism which resulted from the granitic intrusions in the region during Cretaceous time. However, since altered fault zones are known to exist in the upper Tertiary tuffs in the northern portion of the reservation, this indicates the upper Tertiary volcanism, and probable subsequent hydrothermal activity, is responsible for a major mineralizing episode in the reservation. Also to be considered is the ubiquitous nature of uranium and its relationship to many other metals in both the upper Tertiary tuffs, in altered fault zones and to some degree in the meta-limestones. With the exception of a small uranium bearing pod in the granite of the Red Granite Area, no anomalous uranium was encountered in any of the known Cretaceous intrusions. These relationships further indicate an upper Tertiary age for mineralization in the region.

5.0 DISCUSSION OF WATER SAMPLE ANALYSIS

As part of the geothermal resource assessment, water samples were collected at four sites on and adjacent to the reservation. These four sites are located on Figure 5-1. One additional sample of untreated tap water was collected as a test sample for analysis. Figure 5-1 also shows the location of water samples collected by the USGS (Schaefer, 1980) and Whelan et al., (1980) on and near the reservation. Results of the water sample analysis of the four water samples are presented on Table 5-1.

Data gathered by Whelan et al., (1980) was used in their study to determine the geothermal potential of Target Range Bravo 19 north of the reservation. Water sample data gathered by the USGS was used only to determine water quality and usage on the reservation. Whelan's temperature data is presented in original form, while the USGS data was employed in the equations discussed in a previous section of this report.

Meteoric water (precipitation) is relatively pure and contains small concentrations of sodium (Na) and potassium (K) ions. Upon reaching the surface and entering the natural groundwater system, this water slowly acquires increasing amounts of sodium and potassium as well as other cations from a natural weathering breakdown of the enclosing country rocks. The longer this water resides within the groundwater system, the higher the sodium and potassium ion concentration that will be achieved. Therefore, low total concentrations of sodium plus potassium ions in groundwater indicate areas with short residency duration (recharge areas) while high total concentrations of sodium plus potassium ions in groundwater indicate areas with long residency duration (discharge areas).

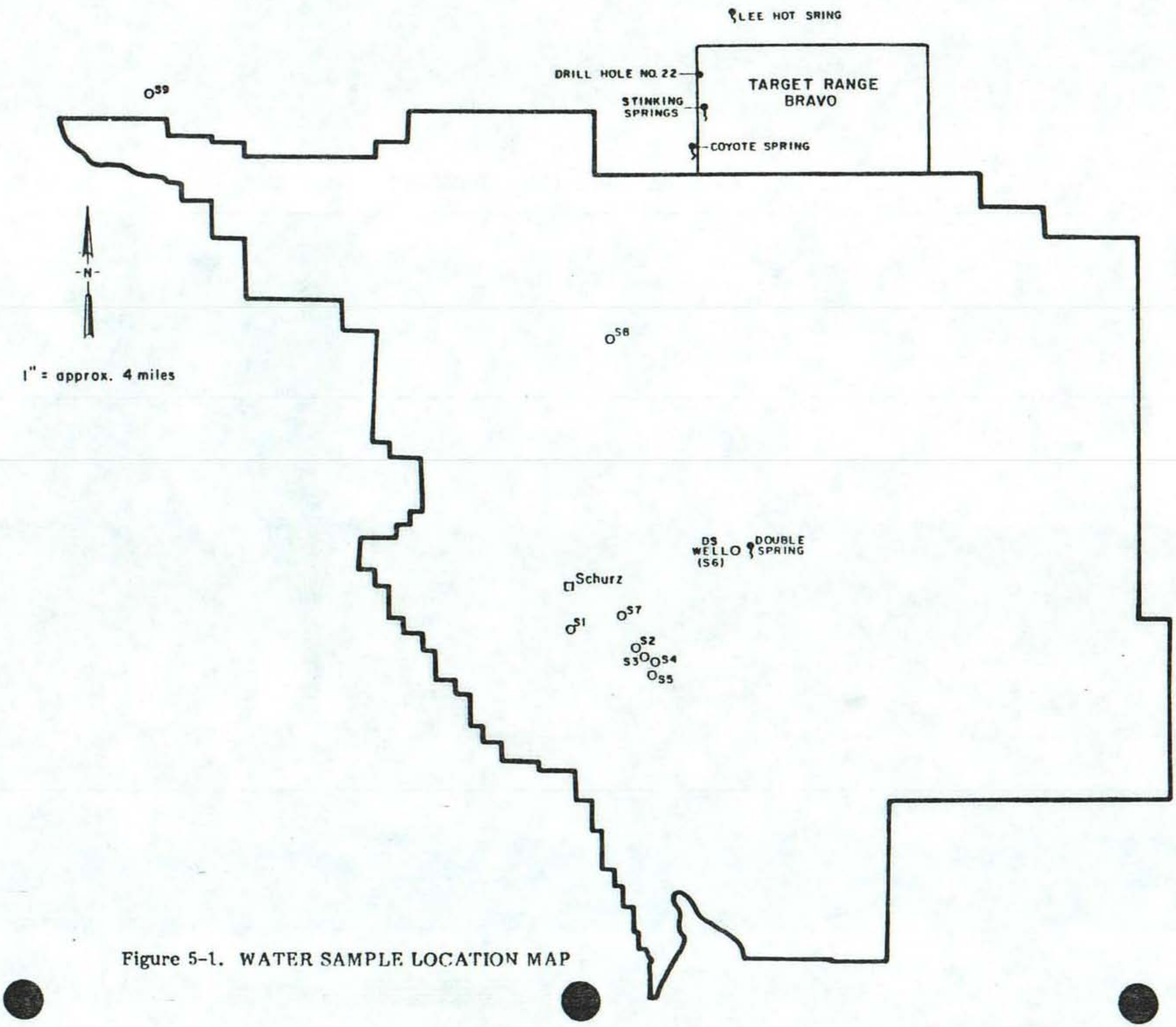

Figure 5-1. WATER SAMPLE LOCATION MAP

Table 5-1. WATER SAMPLE DATA
(values in Mg/l)

Sample Number	AG	AL	AU	AS	BI	CA	CU
Coyete Spring	-.002	-.1	-.001	1.8	-.05	10.0	-.01
DS Well	-.002	-.1	-.001	1.16	-.05	.22	-.01
Double Spring	-.002	-.1	-.001	.6	-.05	.05	-.01
Lee Hot Spring	-.002	-.1	-.001	-.05	-.05	12.2	-.01
Tap Water	-.002	-.1	-.001	-.05	-.05	3.75	-.01

Sample Number	FE	HG	K	LI	SO4	F	FREE CHLORINE
Coyete Spring	.6	-.001	1070	1.10	7250	92.0	-.1
DS Well	.09	-.001	8.0	.01	320	9.1	-.1
Double Spring	.1	-.001	6.0	-.01	240	8.9	-.1
Lee Hot Spring	.08	-.001	10.3	.19	410	5.6	-.1
Tap Water	.06	-.001	1.8	.03	17	.67	-.1

Sample Number	TOTAL CHLORINE	MG	MN	MO	NA	NI	PB
Coyete Spring	.-1	7.5	-.01	.06	23900	-.01	.12
DS Well	.-1	.06	-.01	.02	698	-.01	-.02
Double Spring	.-1	-.01	-.01	.02	673	-.01	-.02
Lee Hot Spring	.-1	.18	-.01	-.02	288	-.01	-.02
Tap Water	.-1	.50	-.01	-.02	38.6	-.01	-.02

Sample Number	SB	ZN	SI02	U308 PPB	ALKALINITY HYDROXIDE	ALKALINITY CARB.	ALKALINITY BICARB	FpH
Coyete Spring	-.005	.01	105	5.8	0	4560	2520	9.5
DS Well	-.005	-.01	35	5.5	0	280	280	9.0
Double Spring	.02	-.01	38	10.0	0	280	240	9.0
Lee Hot Spring	-.005	-.01	101	-.02	0	0	80	6.0
Tap Water	-.005	.01	40	1.1	0	0	60	5.0

dash (-) indicates less than

Figure 5-2 graphically depicts on a cation ternary diagram the distribution of the water sample data. Those samples that appear in the lower right apex represent groundwater enriched in concentrations of sodium plus potassium in relation to the total dissolved cations in the sample. These samples, therefore, are in areas with long residency duration in the groundwater system (discharge areas). Short residency duration groundwater samples (recharge areas) are depleted in sodium plus potassium concentrations in relation to the total dissolved cations and appear in the lower center portion of the diagram.

The chemical thermometers are shown on Table 5-2 for all three data sources. Based on this data, most of the thermometers indicate equilibrium temperatures in excess of 70°C (158°F) and approximately half of the sites show equilibrium temperatures in excess of 100°C (212°F). All of the high temperatures occurring on the reservation are in the vicinity of Double Springs. Double Springs was reported as a warm spring by Russell (1885). However, recent tectonic activity in the area has apparently "shutoff" the flow of warm water and Double Spring is presently a cool spring as is the adjacent well.

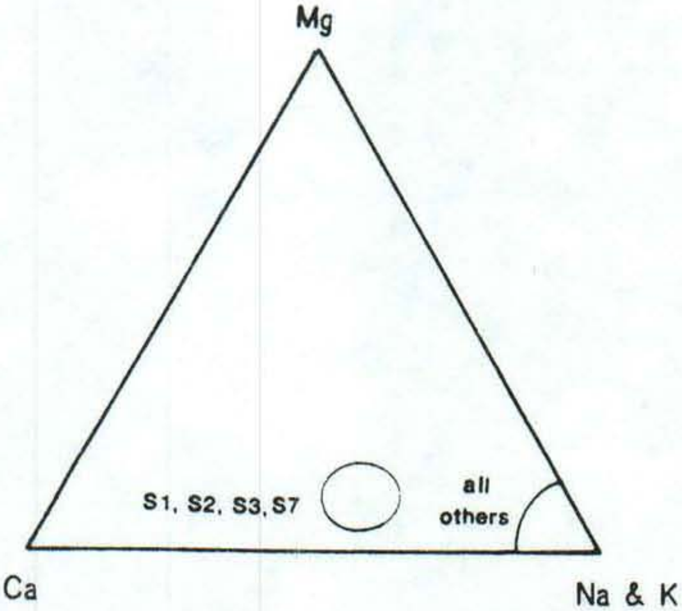

Figure 5-2. CATION TENARY DIAGRAM

TABLE 5-2 GEOTHERMOMETERS
(in degrees centigrade)

	Na-K-Ca			Na-K-Mg			Na-K			
Springs	CERT*	Whelan*	USGS*	CERT	Whelan	USGS	CERT	Whelan	USGS	Measured Surface Temp.
Coyote Sp	240	216	-	234	162	-	157	155	-	-
Lee Hot Sp	150	162	-	150	162	-	142	174	-	88
Stinking Sp	-	164	-	-	59	-	-	117	-	-
Double Sp	138	-	-	N/A	-	-	71	-	-	11
Wells										
Tap Water	86	-	-	86	-	-	159	-	-	18
Drill Hole 22	-	152	-	-	53	-	-	147	-	12
DS Well	143	-	-	136	-	-	82	-	-	-
S1	-	-	65	-	-	65	-	-	187	13
S2	-	-	90	-	-	84	-	-	286	11
S3	-	-	40	-	-	40	-	-	180	7
S4	-	-	140	-	-	131	-	-	120	6
S5	-	-	131	-	-	114	-	-	113	12
S6	-	-	N/A	-	-	N/A	-	-	110	12
S7	-	-	75	-	-	75	-	-	280	12
S8	-	-	98	-	-	98	-	-	132	13
S9	-	-	175	-	-	132	-	-	124	12

*Source of original data

When the results plotted on the ternary diagram are compared to the equilibrium temperatures, the high residency groundwater areas coincide well with the higher equilibrium temperature areas. Sites S1, S2, S3, and S7 show the shortest residency time and also the lower calculated temperatures for the area. Two sites, (S4, S5) adjacent to these four, show high temperatures and residency time, thus indicating a possible mixing of groundwaters in the area.

Figure 5-3 is a ground heat flow map of the reservation. Two of the areas that show high heat flow, from which water samples were attainable, coincide with high equilibrium temperatures. These two areas are approximately three miles and eight miles, southeast and east of Schurz, respectively. The close relationship of the heat flow and geothermometers suggests that both of these methods, and the data presented above, are reliable, accurate and can be useful as guides in geothermal assessment of the reservation.

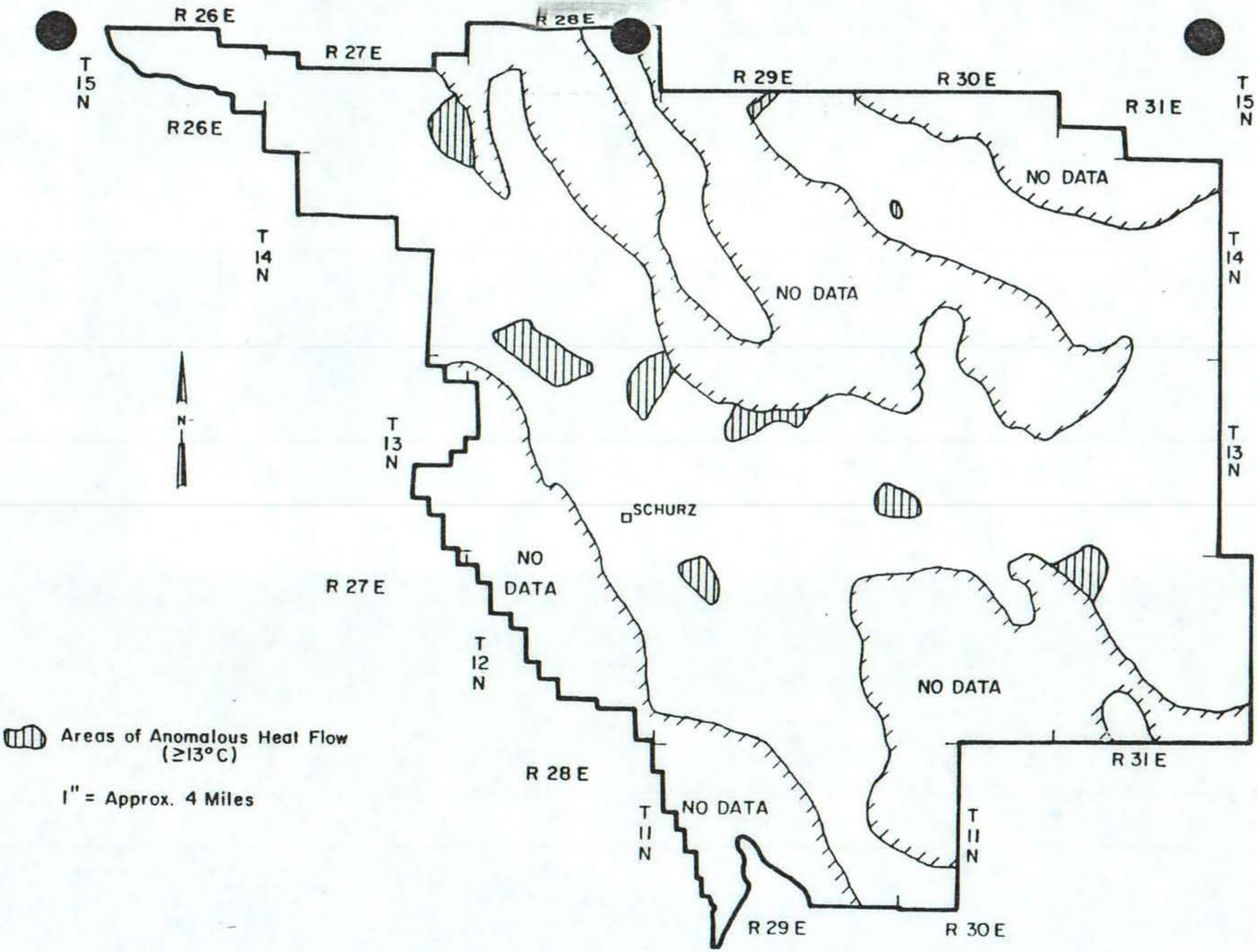

Figure 5-3. HEATFLOW MAP OF THE WALKER RIVER RESERVATION

6.0 GEOLOGIC MODELS

The purpose of this section is to develop geologic models for the various metals and geothermal indications discussed in previous sections. Development of models is necessary in order to assess the resource potential of the reservation.

6.1 URANIUM

Based on the analytical data, the occurrence of uranium as a primary metal within the various lithologies of the reservation probably does not host significant economic potential. However, uranium does occur in adequate amounts, in many of the felsic tuffs, to provide a source of leachable uranium; which can be redeposited elsewhere. As pointed out previously, uranium has been concentrated in wood fragments which are encompassed by uranium bearing tuffs.

Two possible ways in which significant amounts of leached uranium can be redeposited are the roll fronts and the tabular deposits. Roll front type deposits are responsible for the large uranium deposits located in Wyoming (Powder River and Shirley Basins), New Mexico (San Juan Basin), and South Texas. Tabular type deposits are small in comparison to the roll front deposits but generally contain higher grades of ore. Tabular deposits are confined primarily to the Four Corners Area of the Colorado Plateau.

Development of roll front deposits is by oxidized uranium bearing groundwater encountering reduced sediments. When the oxidized groundwater is reduced by the sediments, uranium is deposited from the groundwater, hence uranium is deposited along the reduced-oxidized (redox) interface, with the oxidized sediments located upstream of the groundwater flow direction. As oxidized groundwater dissolves previously reduced uranium and sediments, the roll front continually moves downstream as the uranium is redeposited in reduced sediments. In this manner, the roll front deposits are progressively moving along with the groundwater flow direction.

Tabular deposits, on the otherhand, are static deposits with very little migration of deposits involved. These deposits are usually formed by uranium bearing groundwaters permeating through oxidized sediments. The uranium is fixed from solution by carbonaceous, clayey material and sometimes humates contained within the host sediments.

Generally, roll fronts are developed in large basins (f 1000 mi^2) where the groundwater has essentially unrestricted lateral movement. More importantly, larger basins allow for the accumulation and rapid deposition of large volumes of permeable sands and more abundant carbonaceous debris. Smaller basins, with restricted groundwater flow, generally accumulate thinner, oxidized sediment piles.

The Walker River Basin, in the vicinity of Schurz, is probably too small for the development of a roll front type deposit. However, tabular deposits of uranium could conceivably underly the basin. Groundwater samples from Double Spring and Double Spring Well yielded U_3O_8 values of 10 and 5.5 ppb, respectively. This amount of uranium in the groundwater is more than adequate to allow for the economic accumulation of uranium in the basin.

The constraining parameter to the deposition of tabular deposits in the basin is the unknown subsurface stratigraphy of the basin. While the upper few hundred feet of the basin are probably composed of unfavorably alluvial sediments, the sediments underlying alluvial deposits are probably Lake Lahonton sediments, which were deposited during the Pleistocene Epoch. These lacustrine sediments could provide favorable locations for the accumulation of uranium deposits.

6.2 OTHER METALS

Developing geologic models for the other metals of potential economic interest (gold, silver, copper) on the reservation involves an understanding of the past structural and magmatic events of this portion of the Basin and Range Province. There have been several investigations (Section 1.4) pertaining to unraveling the geologic history of the region. While progress is continuing in this area, in the final analysis, development and evaluation of the Basin and Range is quite varied and complex; with structural and magmatic events overprinting each other, thus obscuring the sequence of occurrences leading up to and following mineralizing events.

From the foregoing discussion on lithology, it is apparent that certain metals of potential economic interest show an affinity for a particular lithology or mode of occurrence. The crux of the problem is to determine at what stage (in time) of development did mineralization occur; at what level of magmatic differentiates did mineralization take place; the spatial distribution of magmatic differentiates and associated elemental association; and what part of the system is presently exposed within the reservation.

Clearly, the most abundant surface mineralization is related to fault zones and quartz veins. However, subsurface metalization, as described by previous investigators, is related to contact metamorphism of sediments by granitic intrusions. While contact meta-sediment metal deposits are evident on the surface (Afterthought, Copper, and Sulfur areas), with the exception of Afterthought, these areas display less abundant occurrences of metals (except tungsten) than the fault zone and vein occurrences. Even though the Afterthought Area shows anomalous gold values, these values appear to be related to a later metalization period, i.e., after intrusion and metamorphism. The meta-sediment occurrences at depth are related to iron-copper metalization, while the fault zone-quartz vein system primarily hosts gold and silver metalization.

These relationships indicate at least two metalizing events occurred on the reservation. First, iron-copper metalization associated with contact metamorphism, probably during the Cretaceous Period. Tungsten may also be associated with these tactites, as demonstrated at the Copper Area, where the only consistent tungsten values are reported.

The gold and silver bearing fault zone-quartz veins post date the tactites and probably occurred in the upper Cenozoic. Indications of this relationship are given by these two occurrences located within the granitic intrusions (Bimetal, Afterthought, and Red Granite areas) and the Tertiary felsic tuffs and intrusions (Guranium area). In addition to the gold-silver deposits, fault-quartz vein occurrences within kaolinized zones host several base metals with anomalous values including uranium, lead, zinc, and iron.

These Pb, Za, and Fe base metal occurrences suggest a possible third metalization event in the area. The relationship of base metal event to the precious metal event is not clear, due to the lack of base metals occurring within the quartz veins. There is spatial evidence to suggest that quartz veins post-date the base metalization.

Lawrence (1969) notes that the iron-copper deposit underlying Calico Hills may represent two metalizing events. There are good indications that the iron deposit was emplaced during the contact metamorphic stage of the intrusion. While some copper was emplaced during this stage, Lawrence also notes the presence of galena (Pb), sphalerite (Pb-Zn), and molybdinite (Mo). He attributes these metals to late stage hydrothermal activity resulting from the Mesozoic intrusions.

A generalized sequence of metalization in the Calico deposit is:

metamorphic (tactite)	Fe (magnetite → pyrrhotite → pyrite) → Cu (chalcopyrite)
hydrothermal	Pb (galena) → Pb-Zn (sphalerite) → Mo (molybdenite)

In the Gillis Range, several areas show anomalous amounts of iron, copper, lead, zinc, and molybdenum. These areas are Gillis, Copper, and Sulfur. The Copper and Sulfur areas also display anomalous values of tungsten. Scheelite (tungsten) has reportedly been produced from the Gentry Mine, along the south side of Gillis Canyon. In general, iron, copper, zinc, and tungsten appear to be predominantly associated with the skarn or altered limestones; while the molybdenum is associated within the altered fault zones and travertine. Molybdenum also occurs in lesser, though anomalous amounts in skarns and altered limestone. Although these metals occur in an oxidized state in these areas, rather than sulfide, the intimate association with skarn near the periphery of Mesozoic granitic intrusions indicates a similar nature and time of occurrence with the deposits underlying Calico Hills.

Due to the lack of data, the depth and temperature range of the granitic intrusions and associated tactite cannot be accurately determined (pyrrhotite and pyrite can form in temperatures ranging from 100°C to 1000°C). The presence of tungsten does indicate possible high temperature and pressure emplacement, however. The proximity of these deposits to the surface thus indicates the "roots" of a paleometalizing event is presently being exposed by erosion.

The fault-vein systems of the reservation host anomalous amounts of gold, silver, and base metals. The presence of base metals in these systems indicates a second, later, base metal event has occurred in addition to the previously described occurrences in the older Mesozoic deposits. The relationship of the base metalization and the gold and silver metalization is unclear. In the Bimetal Area the kaolinized zone, super-adjacent to the quartz vein, hosts anomalous Pb, Zn, As, Hg, and U values while the quartz vein displays significantly less values. Both the kaolinized and quartz vein host anomalous gold and silver, though the quartz vein displays substantially greater values. One possible explanation of this relationship is the base metals were deposited prior to a quartz vein injection. Another explanation is that the base metals were injected along with the quartz vein but the base metals were hosted only in the kaolinized zone. When the relationship of base to precious metals from the correlation matrices are considered, gold and silver show strong correlation with base metals in quartz veins and in both kaolinized and gossan zones; thus, suggesting one metalization event for both base and precious metals.

The source for the fault-vein metalization is the more perplexing problem in developing a model for this event. Rawhide east of the reservation, has produced gold and silver from quartz veins in Tertiary tuffs and on the reservation mineralized fault zones have been noted in Tertiary tuff. There can be little doubt of the age of these metal deposits being middle to upper Tertiary. The origin, while less clearly defined, could be from the same magma source as the tuffs. Though the depth of the source is not known, the multiple vein-like occurrence of these deposits and the late stage mineral assemblages indicates the upper portion of the system is exposed on the reservation.

Keith (1983) noted epithermal gold-copper mineralization associated with calic-alkalic volcanism 25-22 m.y. ago; epithermal lead and zinc associated with alkalic-calcic volcanism 12-17 m.y.; and gold-flourine associated with alkalic volcanism 15-8 m.y. The volcanic tuff deposits of the reservation occur predominately in the alkali and calc-alkalic ranges and to a lesser degree in the calcic and alkalic-calcic ranges. Based on this data, the reservation area could have been subjected to three mineralizing episodes from 25-8 m.y. ago. This relationship of metalizing events to volcanic events can account for the base metalization associated with the fault zone base metal occurrences. Also, this relationship can account for the lack of correlation between gold and silver in many areas and lithologies on the reservation. The spatial distribution of these events appear to be superimposed in many areas, thus a particular area may have undergone more than one metalizing event.

Berger (1983) has indicated that arsenic, mercury, antimony, and thallium are useful indicators for carbonate or volcanic hosted gold and silver deposits. In addition to these elements, Bonham and Giles (1983) have also suggested bismuth and tellurium are important trace elements in volcanic hosted enargite-gold epithermal deposits; molybdenum, tungsten, manganese, and flourine are anomalous in volcanic silver-base metal epithermal deposits; and fluorine and tellurium are indicators for volcanic hosted gold telluride deposits.

Both investigations indicate that Hg, Sb, and As are usually present in siliceous zones overlying any potential precious or base metal deposits. Anomalously high values for these metals were encountered in the Guranium, Hidden Valley, Gillis, Wildhorse, and to a limited extent Calico and Copper Areas; thus indicating the possible presence of metals deposits at depth, below these areas. While supergene enrichment may, in part, be responsible for concentrations of the elements in these areas, proximity to and along shear zones indicates possible epithermal enrichment has also taken place.

Bonham and Giles (1983) further indicate that in carbonate hosted epithermal deposits in addition to mercury, antimony, arsenic, thallium, barium, and gold in chemical association; tungsten, molybdenum, tin, and fluorine are usually anomalously present. These chemical relationships are quite similar to those noted for the volcanic hosted epithermal deposits. In both the volcanic and carbonate hosted epithermal deposits, hypogene, and later supergene, oxidation are common.

In summary, the metamorphic skarn, iron-copper deposits are clearly older (Mesozoic) than the precious metals deposits. The precious metal deposits have probably occurred over a period from 25-8 m.y. ago. The most likely scenario for these deposits is the alkalic-calic trend, since lead and zinc metalization (22-17 m.y.) followed by the alkalic gold metalization event (15-8 m.y.). The calc-alkalic volcanism (25-22 m.y.) may also account for gold, and to some extent copper metalization on the reservation. While there are apparently two, and perhaps three or four stages of mineralization on the reservation, the sequence of mineralization for later events is not clearly defined. Perhaps of more importance are the elemental associations and anomalies indicating that many areas of the reservation, particularly in the Gillis Range, show good potential for locating untested mineral potential.

6.3 GEOTHERMAL

In developing a geothermal model, two points should be considered. First, potential sources of heat and second, groundwater flow patterns. Since Lee Hot Springs occurs a few miles north of the reservation and Double Spring has previously been described as a hot spring, there is little doubt that a heat source occurs near or on the reservation. In addition to Double Spring, there is evidence of recent hot spring activity on the reservation. Sulfur and travertine deposits were located on the surface in the Sulfur Area and a four inch thick cap of travertine is draped over rock outcrops located on the northeast flank of the Terrill Mountains (Sec. 3, R29E, T14N). Groundwater patterns are of importance with respect to location of the heat source. For instance, the groundwater flow patterns were altered during tectonic activity in the area to the extent that Double Spring is now a cool spring, but was originally reported as a hot spring in 1885.

Schaefer (1980) studied groundwater flow patterns of the reservation and determined a flow direction which parallels Walker River to Schurz, where the flow pattern divides with part of the groundwater continuing south to Walker Lake and part of the groundwater turning east to Double Spring and Rawhide Flats. Figure 6-1 depicts the flow pattern for the reservation.

When the spatial distribution of those sites yielding high equilibrium temperatures are considered in conjunction with the groundwater flow pattern, sites S1, S2, S3, and S7 (lower temperatures) probably are more representative of the ambient groundwater conditions. Sites S4, S5, S6, S8 and Double Spring may represent a mixing of near surface groundwater and deeper circulating geothermal waters. The evidence suggesting this is the substantially higher (2x-10x) Na + K values encountered at the higher temperature

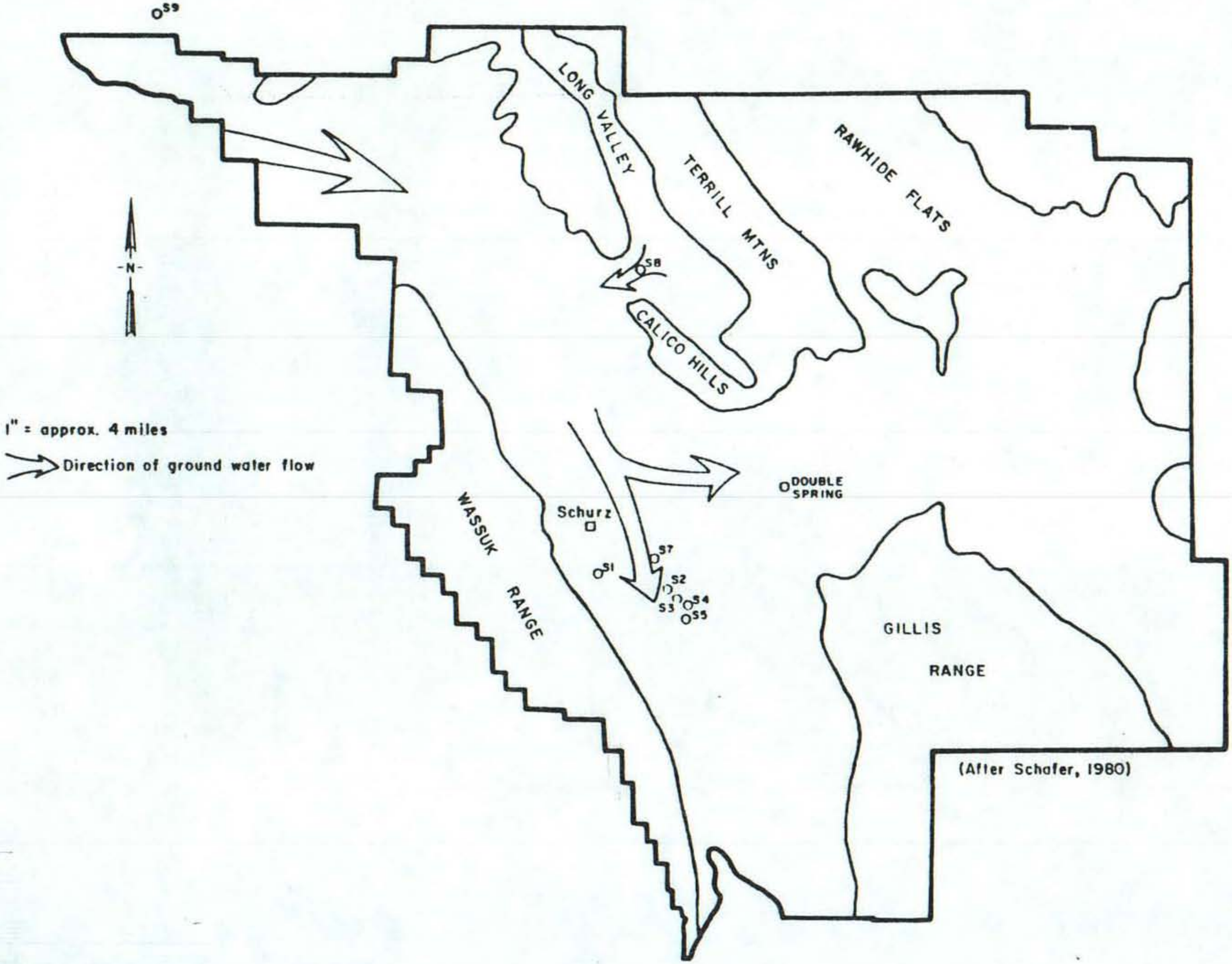

Figure 6-1. GROUNDWATER FLOW PATTERN, WALKER RIVER RESERVATION

sites. These lower Na + K values at sites S1, S2, S3, and S7, represent a shorter residency time which would be expected considering the near surface groundwater is probably continually interchanging with Walker River (Na + K values of 37-80 mg/l, Schaefer, 1980).

Site S8, in Long Valley, lies northeast of the main Walker Basin groundwater drainage. Any groundwater encountered at this site would be expected to have a short residency due to the small size of the valley, however, this is not the case. Groundwater at this location shows a long residency period with Na + K values of 165 ppm, which also indicates a possible mixing of near surface water with deeper circulating geothermal waters. Similar circumstances are presented for site S9, northwest of site S8.

The evidence presented suggests deep circulating geothermal water is mixing with near surface groundwater on the reservation. With increasing distance from Walker River, Na + K values increase substantially more than would be expected if no mixing of water occurred. Alternately, Na + K values are highest in the Double Spring area and decrease to the west (no data east of Double Spring), thus indicating the source for the geothermal waters may be in the vicinity of Double Spring.

7.0 RESOURCE POTENTIAL

This section is directed to defining those areas and resources of potential economic importance based on the geologic models. While quantitative abundances cannot be defined for a resource in a given area, this information will be useful in developing future exploration/explortation programs within the reservation.

7.1 URANIUM

The uranium potential of the reservation is primarily within the lacustrine sediments of Walker River Basin. While some shallow (150-200') drilling has been conducted northeast of Weber Reservoir for uranium, these holes were probably too shallow to adequately test the uranium potential.

Based on the Trac-Etch, carborne radiometric surveys and water sample data the most likely location of uranium is along a northwest-southeast trend, along the northeast flank of Weber Reservoir, extending southeast to Schurz and possibly east to Double Spring (Figure 7-1). This area covers approximately 30 mi^2. While the abundance of uranium is not known for the described area, this area offers the best potential for hosting economic uranium deposits.

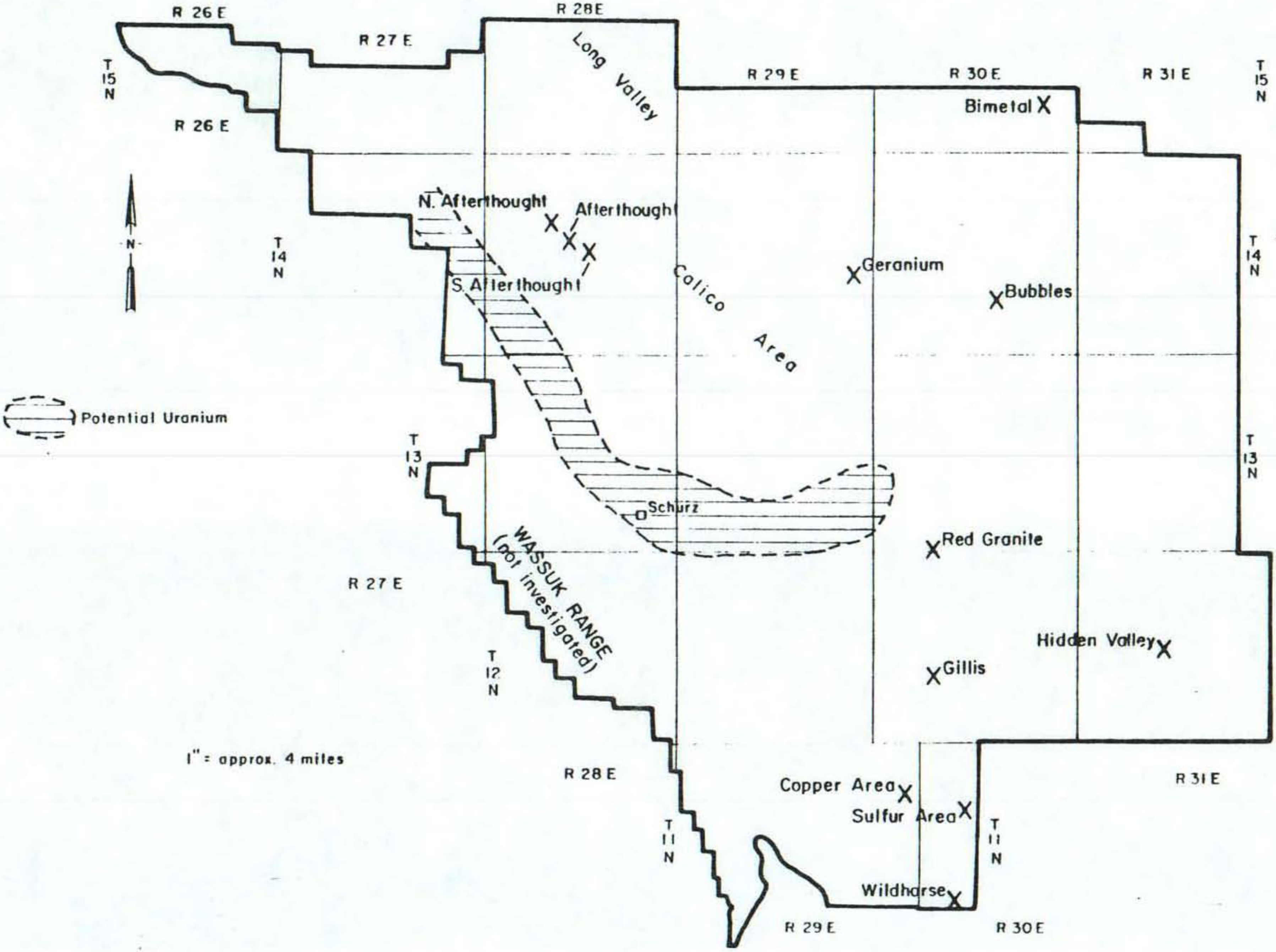

Figure 7-1. URANIUM RESOURC[illegible]AP, WALKER RIVER RESERVATION

7.2 OTHER METALS

The reservation hosts potential for various metal deposits, including iron, copper, gold, silver, and tungsten. Previously, Idaho Mining Company had located iron-copper metalization associated with skarn in two areas, Calico and Hottentot (not covered in this report). Lawrence (1969) believes these two deposits are the same, off-set by a right-lateral strike-slip fault. Additional evidence for this fault is given by the apparent offset of the Red Granite intrusive along the fault. The Calico-Hottentot displacement is about 8-9 miles, while the Red Granite displacement is about 4 miles. This fault can also be used to account for the occurrence of the limestone detachment blocks at Hidden Valley. Hardyman (personal communication, 1984) as informally named this fault the Gumdrop Hills fault.

The Calico and Hottentot deposits are characteristically defined by their magnetic highs (Plate V). One additional magnetic high occurs in Sec. 32, T14N, R31E, as far is known, this magnetic high has not been tested for possible subsurface iron-copper metalization.

The Copper and Sulfur areas in the Gillis Range exhibit potential for iron-copper deposits, based on the occurrence of skarn and associated geochemical values. These occurrences, however, do not show well delineated magnetic highs as the Calico-Hottentot deposits do. In addition to the known surface occurrences, limited potential exists for iron-copper skarn deposits underlying the alluvial deposits immediately west of the Gillis Range in Sec. 31, T12N, R30E and Sec. 1, 2, 11, 12, and 13, T11N, R29E. This potential is based on extrapolating the semicircular occurrence of meta-limestone deposits into these sections. The areas of known and potential iron-copper deposits are illustrated on Figure 7-2.

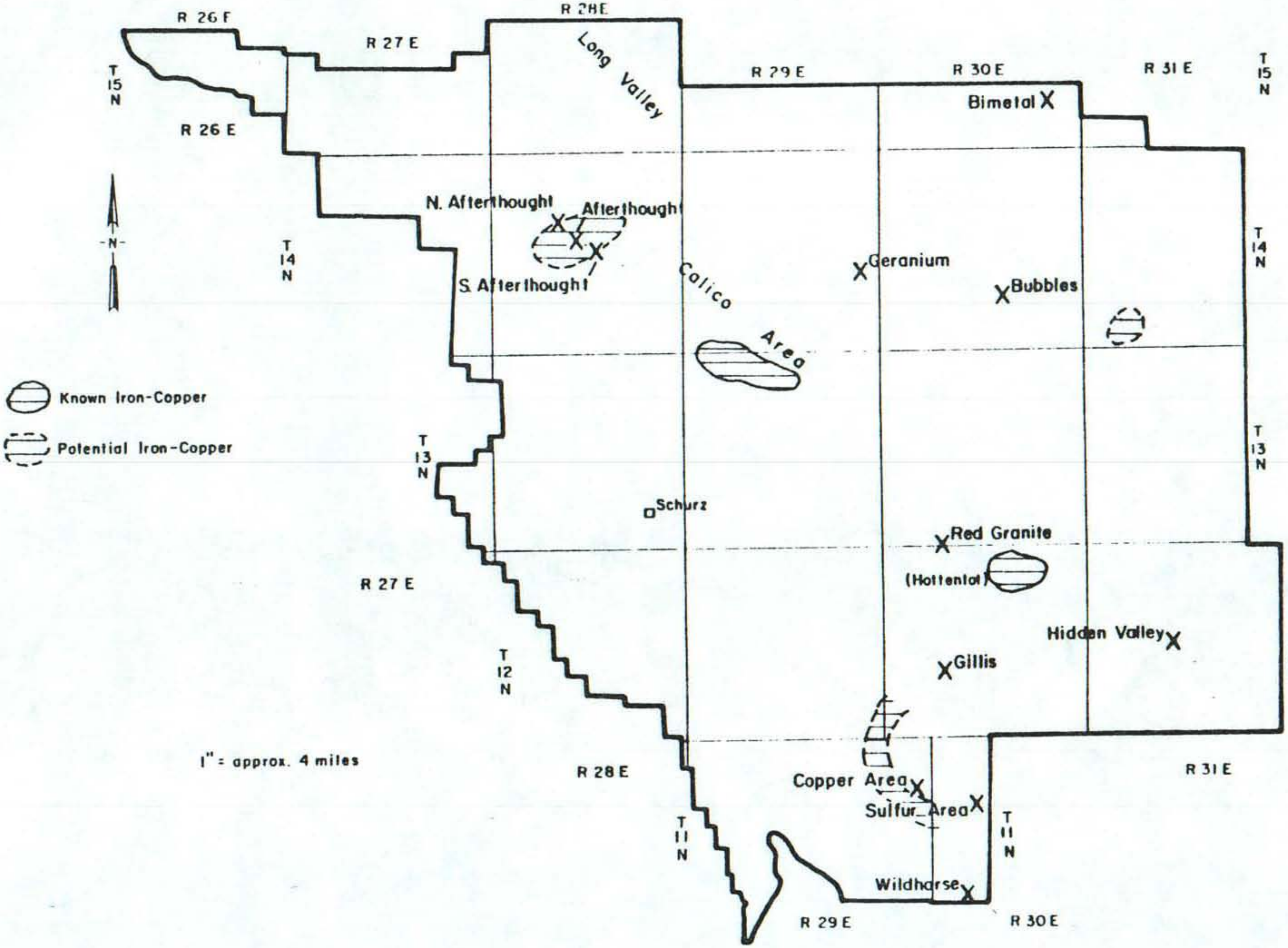

Figure 7-2. KNOWN AND POTENTIAL IRON-COPPER DEPOSITS

Occurrences of gold and silver are scattered throughout the reservation in and along fault zones and quartz veins. Based upon results of surface sampling, potentially economic gold and silver may be present in many areas, if a high grade of ore can be maintained or several adjacent mineralized zones can be located. Among the areas that host the best potential are Bimetal, Guranium, Red Granite, Copper, and Wildhorse. Limited potential is exhibited in the Gillis and Hidden Valley areas.

Other areas, though not detailed in this report, of potential economic importance for the fault-vein occurrence are based on structural relationships. Right-lateral displacement of the Red Granite intrusion, along the Gumdrop Hills fault, occurs in Sec. 12 and 13, T12N, R30E and Sec. 7 and 18, T12N, R13E. Previously, limited mining activities have occurred in this displaced block. While no samples were collected on this granite block, the association of the displaced granite with the Red Granite granite indicates gold and silver potential for the area.

Approximately 3.5 miles northeast of the Gumdrop Hills fault is another right-lateral fault, the Red Ridge fault, trending northwest-southeast. While the evidence for this fault is less substantial, the presence of this fault can account for the apparent offset of Tertiary volcanics and the offset of the Jurassic intrusion along the northeast flank of the Terrill Mountains. Hardyman (personal communication, 1984) has indicated a maximum displacement along this fault of approximately six miles, this amount of displacement is also evidenced by the apparent offset of magnetic highs on Plate V.

While the mineral occurrence at Pyramid Mine, in the Terrill Mountains, was not studied, the potential exists that similar mineralization may have occurred northeast of the Pyramid Mine. If this is the case, these deposits would be displaced southeast of the present mine, along the Red Ridge fault. Unfortunately, since the age of the Pyramid deposit is not presently known, the expected lateral displacement cannot be determined, however, the maximum displacement is thought to be six miles. Assuming the Pyramid deposit predates faulting, six miles would be the maximum displacement of the deposit.

Another limited potential resource for gold and silver is as a disseminated sulfide deposit. Disseminated sulfides were sampled in limestone and volcanic rocks in the Hidden Valley. While these samples yielded quite low gold values, the presence of the sulfides and the higher gold values encountered along altered shear zones, indicates the possible presence of a sulfide deposit at depth. Further study should be taken in the Hidden Valley area and along the Gumdrop Hills fault northwest of Hidden Valley to discern the potential for this type of deposit. Areas of potential economic gold and silver deposits are outlined on Figure 7-3.

Applying the geochemical indicators, commonly associated with gold and silver deposits for epithermal type deposits, arsenic, mercury antimony, and thallium, gives further evidence to the location of potential gold and silver deposits in several areas including those areas in the Gillis Range, and in the Guranium and Bimetal Areas.

7.3 GEOTHERMAL

The potential for locating geothermal resources on the reservation is probably in the vicinity of Double Spring. While data is lacking to determine the potential geothermal reservoir size, evidence indicates a reservoir temperature range of $70^{\circ}C$-$140^{\circ}C$ ($158^{\circ}F$-$284^{\circ}F$) is most probable in the area defined in Figure 7-4.

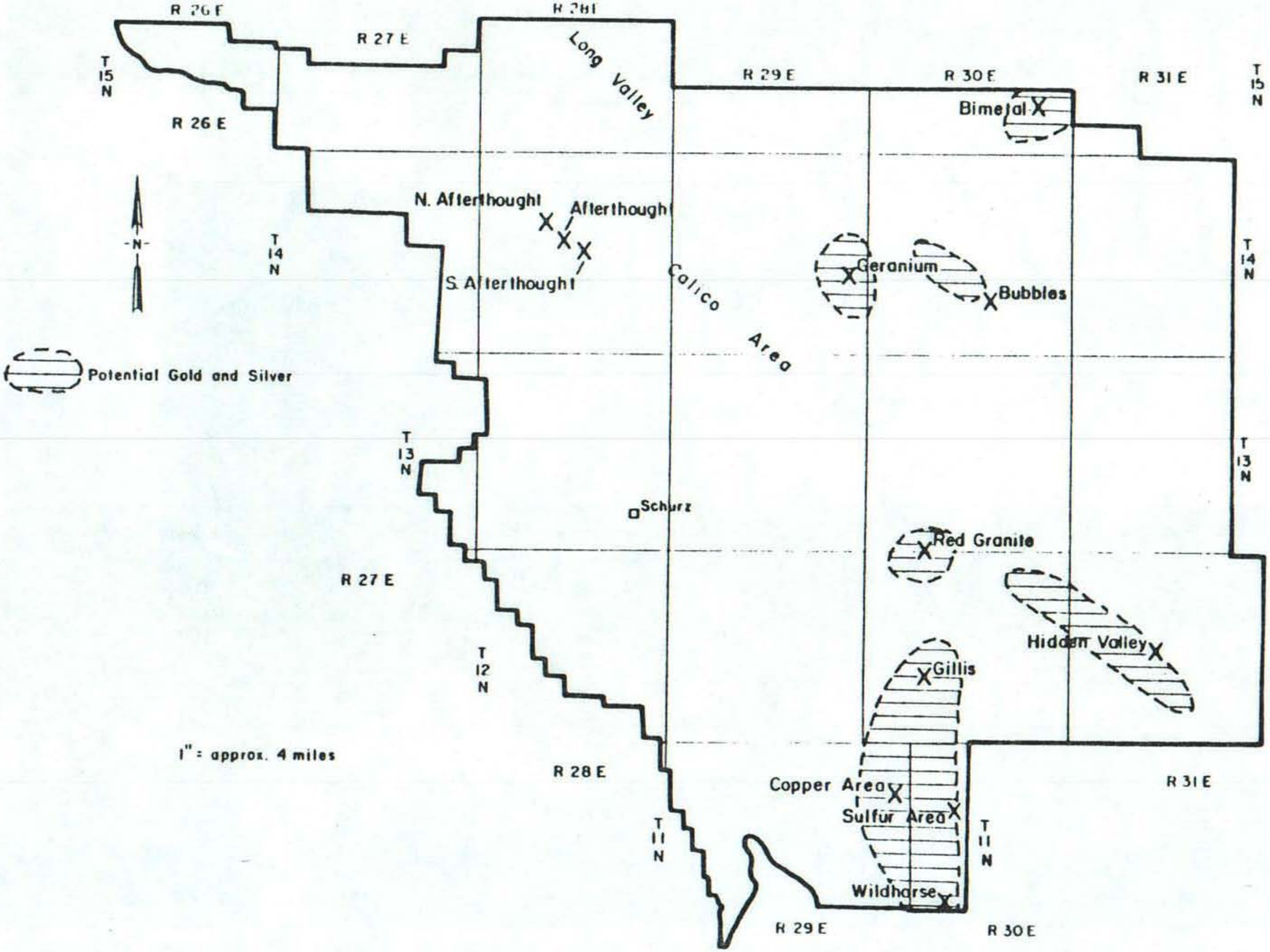

Figure 7-3. POTENTIAL GOLD AND SILVER DEPOSITS

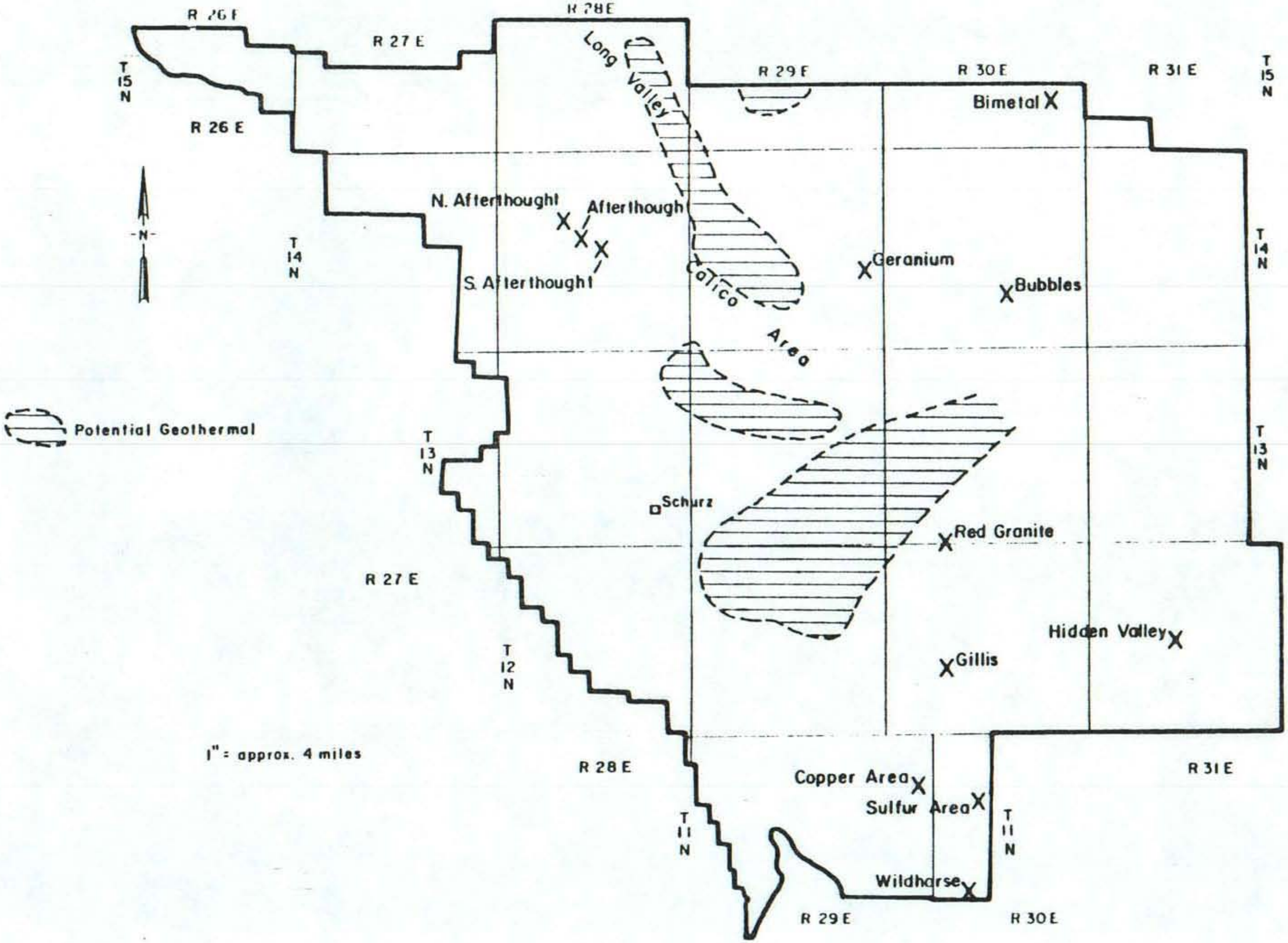

Figure 7-4. POTENTIAL GEOTHERMAL RESOURCES

Other areas of the reservation may also host geothermal potential, particularly along the southwest flank of Calico Hills and Long Valley. While no data was available for Rawhide Flats, the juxaposition of the flats to Lee Hot Spring suggests the northern portion of Rawhide Flats may have limited geothermal potential.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The Walker River Reservation hosts significant potential for several metals including iron, copper, gold, silver, tungsten, and uranium in descending order of abundance. Iron and copper skarn deposits are known to exist in the Calico and Hottentot areas, numerous gold and silver bearing zones are located in several areas; the Copper Area, in addition to possible iron-copper deposits, also shows potential for tungsten deposits, and the Walker River Basin, southeast from Weber Reservoir to Double Springs hosts potential for tabular type uranium deposits.

Copper, gold, silver, antimony, zinc, arsenic, mercury, and lead anomalies at Guranium bears some similarities to the Pyramid Mine occurrence on the northeast side of the Terrill Range; although the ore at Guranium is more highly oxidized and richer in arsenides such as enargite. Extensions of this deposit may prove noteworthy for gold and silver with antimony and arsenic being good potential indicator elements. Both soil and rock samples should be collected on systematic grids to further define the anomalous extent of arsenic, mercury, and antimony, which may indicate the possible subsurface location of gold and silver deposits.

Soil samples should be collected southeast of the Pyramid Mine and northeast of the Red Ridge fault to aid in determining the possible presence of gold and silver mineralization displaced along the fault from the Pyramid Mine area. Also, to determine the areal extent of the Pyramid Mine mineralization on the reservation and as a guide to defining the anomalous occurrence of mercury, arsenic, and antimony southeast of the mine, soil samples should be collected adjacent to the mine (disturbed areas should be avoided).

Similarly, soil samples should be collected in all study areas of the Gillis Range to aid in defining the subsurface potential for mineralization in these areas. These samples should also be analyzed for arsenic, mercury, and antimony content. Once anomalous locations have been identified in these areas; a drilling program should be defined to test the subsurface potential for mineral deposits.

To test for subsurface uranium potential in Walker River Basin, a four to six hole drilling program should be considered. Depending on drilling conditions, the depth of these holes should be 500'-600' to adequately test the potential. Drilling cuttings should be sampled through five foot intervals for the entire depth of the hole. These cuttings should then be descriptively logged. After drilling is completed, each hole should be logged, by an electric log, for gamma, resistivity, and self potential. To further aid in defining geothermal potential, bottom hole temperatures, and if possible water samples, should be gathered.

The uranium potential of the Calico Hills deserves more attention in the vicinity of WR-34. Specifically, the mineralogy of the uranium species will require X-ray diffraction analysis. Further thin section analysis should be attempted to ascertain the original and characterization of the calc-mafic host rock. The diffuse nature of the radioactive mineralization in the rock does not suggest secondary enrichment with exception of the local autinite blebs. Therefore, concentration of uranium in the rock by nearby leaching of tuffs is deemed unlikely. If the rock represents a calc-hornfels skarn, the possibility for more massive occurrences of uranium could be good along other portions of the igneous meta-sediment contact. If the rock represents a hydrothermally altered volcanic, the ultimate interpretation will be much more complex. Unfortunately, faulting separates proximal drill holes from the WR-34 site; therefore, more detailed field mapping of the locale will be required before developing models of more regional significance. Airborne radioactive anomalies of bismuth over the calicos may be in part related to other similar uranium occurrences.

To further define the geothermal potential, the inactive livestock water wells on the reservation should be activated and water samples collected for determination of geothermal equilibrium temperatures. With this additional data, a more precise geothermal test well location can be defined.

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APPENDIX A

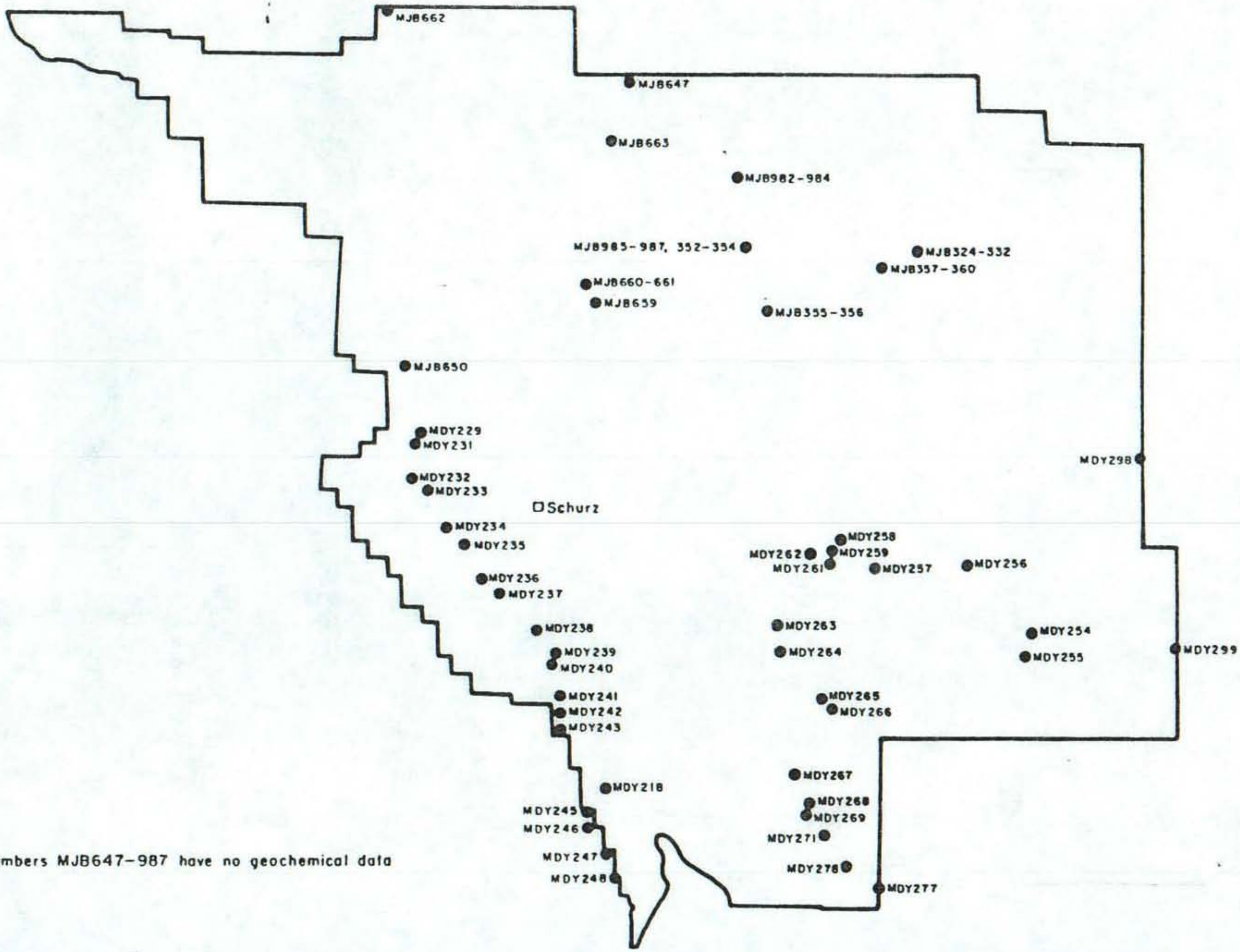
GEOLOGIC TIME SCALE

Figure A-1. GEOLOGIC TIME SCALE

Era	*Period*	*Epoch*	*Duration (millions of years)*	*Dates (millions of years)*
Cenozoic	Quaternary	Recent	0.01	0.00 0.01
		Pleistocene	1	1
	Tertiary	Pliocene	10	11
		Miocene	14	25
		Oligocene	15	40
		Eocene	20	60
		Paleocene	10	70 ± 2
Mesozoic	Cretaceous		65	135 ± 5
	Jurassic		30	165 ± 10
	Triassic		35	200 ± 20
Palezoic	Permian		35	235 ± 30
	Pennsylvanian		30	265 ± 35
	Mississippian		35	300 ± 40
	Devonian		50	350 ± 40
	Silurian		40	380 ± 40
	Ordovician		70	460 ± 40
	Cambrian		90	550 ± 50
Precambrian			4,500 ±	

APPENDIX B

NURE SAMPLE DATA
OF THE WALKER RIVER RESERVATION



Sample numbers MJB647–987 have no geochemical data

Figure D-1. NURE SAMPLE LOCATIONS

NURE SAMPLE DATA OF THE WALKER RIVER RESERVATION
PORTION OF THE RENO QUANDRANGLE

SAMPLE	U3O8	Ag	Al%	As	B	Ba	Be	Ca%	Co	Cr	Cu
MJB324	8	<1	7.79	165	160	135	3	.73	<1	17	91
MJB325	6	<1	7.46	135	185	120	2	.33	<1	9	74
MJB326	6	<1	8.09	165	190	125	2	.32	<1	6	150
MJB327	7	<1	7.49	125	180	830	3	.37	<1	2	74
MJB328	6	<1	7.26	130	220	305	3	.12	<1	8	70
MJB329	6	<1	7.13	140	87	430	3	.86	<1	4	48
MJB330	8	<1	7.07	150	115	760	2	1.04	<1	16	79
MJB331	6	<1	7.00	160	115	780	2	.74	<1	22	84
MJB332	2	<1	7.19	155	110	905	1	.89	<1	4	66
MJB352	33	15	2.53	7205	<10	295	9	.15	11	22	17200
MJB353	12	4	4.10	170	<10	500	1	.53	5	37	580
MJB354	2	<1	8.65	220	58	955	3	4.21	12	46	78
MJB355	4	<1	7.92	160	180	855	2	.71	<1	7	85
MJB356	6	<1	7.63	160	165	800	1	.99	<1	16	70
MJB357	338	<1	.49	<100	300	335	1	.36	<1	49	110
MJB358	12	<1	7.27	155	185	865	1	.64	<1	16	78
MJB359	8	<1	6.39	135	155	810	1	1.04	<1	8	78
MJB360	114	<1	3.02	<100	250	1330	2	1.51	<1	19	76

	Fe%	La	Li	Mn	Mo	Na%	Nb	Ni	Pb	Sb	Sc	Sn
MJB324	1.62	27	12	215	14	2.74	3	33	82	<50	1	21
MJB325	1.55	48	<10	160	11	2.01	2	23	65	<50	1	21
MJB326	1.74	67	10	165	14	2.28	3	37	74	<50	1	30
MJB327	1.36	37	<10	110	9	2.65	3	17	52	<50	1	13
MJB328	1.45	45	31	640	10	1.93	3	22	72	<50	1	15
MJB329	1.35	39	<10	155	11	2.82	3	18	62	<50	4	14
MJB330	1.99	27	<10	455	16	2.43	2	34	64	<50	4	16
MJB331	2.24	28	18	315	15	2.43	2	37	65	<50	4	20
MJB332	1.33	44	<10	320	12	1.52	2	25	41	<50	5	14
MJB352	>9.99	47	<10	76	24	.11	1	34	3810	695	5	26
MJB353	2.35	25	<10	120	20	1.30	2	31	125	80	5	28
MJB354	5.07	28	10	855	22	2.15	1	27	53	54	9	29
MJB355	1.79	37	30	140	14	2.43	2	26	49	<50	3	16
MJB356	2.16	28	20	305	13	2.74	1	17	36	<50	4	18
MJB357	3.12	10	<10	220	<1	1.52	<1	32	<1	<50	<1	<1
MJB358	2.21	31	<10	270	16	2.50	1	22	40	<50	5	17
MJB359	1.71	18	10	385	11	2.43	1	19	36	<50	4	14
MJB360	2.62	16	18	185	<1	1.59	1	21	1	<50	3	19

Unless otherwise noted, all values in parts per million (ppm)

NURE SAMPLE DATA OF THE WALKER RIVER RESERVATION PORTION OF THE WALKER LAKE QUADRANGLE

SAMPLE #	U	Th	Al%	Ca%	Fe%	K%	Mg%	Na%
MDY218	3.69	14.80	7.40	2.70	3.00	2.70	2.20	2.70
MDY229	.83	<1.70	9.90	1.90	1.10	3.30	.38	5.70
MDY230	.95	<1.80	8.90	1.80	1.00	2.70	.36	4.30
MDY231	2.00	4.93	11.00	6.80	5.60	1.90	2.70	3.60
MDY232	2.25	5.82	9.70	4.00	3.90	2.00	1.80	3.50
MDY233	1.18	<1.80	11.00	7.80	5.60	1.60	3.50	2.80
MDY234	2.80	5.20	10.00	4.20	4.30	2.40	2.00	3.20
MDY235	2.28	5.52	9.40	2.60	2.60	2.20	.76	3.90
MDY236	1.19	<2.10	11.00	7.80	6.20	2.00	4.10	3.90
MDY237	3.11	5.30	9.10	6.50	4.60	2.40	4.10	3.20
MDY238	3.24	17.90	6.70	.55	.84	4.70	.18	4.30
MDY239	2.29	17.50	7.70	.44	1.10	4.10	.30	3.80
MDY240	1.91	14.30	7.10	1.00	.90	4.40	.20	4.20
MDY241	1.83	5.32	11.00	8.20	5.90	1.40	2.20	2.90
MDY242	3.72	9.51	7.90	11.00	7.90	3.20	5.50	.91
MDY243	2.37	10.40	10.00	6.90	5.90	3.60	3.00	3.70
MDY245	3.72	11.20	9.00	.94	2.50	2.70	.86	5.70
MDY246	3.92	12.80	8.20	1.80	2.10	3.20	.57	2.80
MDY247	4.59	19.60	7.00	.84	1.10	4.80	.20	3.40
MDY248	3.02	15.10	8.10	1.60	1.60	3.70	.38	3.98
MDY254	.91	<1.70	10.00	4.50	4.00	1.70	1.90	3.30
MDY255	2.83	<2.40	.44	>20.00	<.05	.27	.32	<.15
MDY256	4.05	11.10	9.70	2.20	2.60	3.30	.57	2.60
MDY257	4.46	16.20	8.90	.68	1.20	>5.00	.24	4.90
MDY258	5.19	13.50	8.20	1.80	1.50	3.90	.25	3.30
MDY259	4.28	17.30	--	.53	<.10	--	<.20	2.20
MDY261	4.51	10.90	10.00	3.70	2.70	3.70	1.10	3.60
MDY262	4.86	11.00	8.10	.85	1.60	4.90	.20	3.90
MDY263	5.22	24.80	6.90	.92	.39	4.00	.14	2.60
MDY264	4.94	22.40	6.60	.52	.39	4.10	.11	2.80
MDY265	1.73	<2.00	<.25	>20.00	.22	.08	11.00	<.15
MDY266	.85	<1.70	.38	>20.00	<.05	.33	1.80	<.15
MDY267	1.57	5.15	9.50	1.80	1.10	3.00	.45	6.50
MDY268	7.90	14.80	8.60	1.40	1.30	3.50	.28	3.50
MDY269	4.40	10.50	9.10	2.00	2.10	2.60	.64	3.70
MDY271	2.74	8.39	9.90	3.40	3.00	2.00	.58	4.70
MDY277	3.13	7.12	10.00	2.40	4.70	2.01	1.70	4.80
MDY278	8.72	12.40	7.60	.27	1.80	3.60	.67	4.30
MDY298	3.66	7.23	9.00	2.10	2.30	2.20	.85	3.50
MDY299	5.67	12.80	6.90	.96	1.20	2.50	.25	2.10

Unless otherwise noted, all values in parts per million (ppm)

SAMPLE #	Sr	Te	Tl	V	W	Y	Zn	Zr
MDY218	270	<50	<10	120	<100	15	<50	28
MDY229	1200	<50	<10	47	<100	<10	<50	<20
MDY230	1000	<50	<10	46	<100	<10	<50	<20
MDY231	530	<50	<10	270	<100	31	<50	<20
MDY232	1100	<50	<10	160	<100	19	<50	<20
MDY233	800	<50	<10	310	<100	19	<50	<20
MDY234	600	<50	<10	160	<100	26	<50	81
MDY235	870	<50	<10	73	<100	13	<50	48
MDY236	1500	<50	<10	260	<100	33	<50	33
MDY237	1000	<50	<10	210	<100	24	<50	<20
MDY238	110	<50	<10	11	<100	20	<50	<20
MDY239	170	<50	<10	16	<100	20	<50	<20
MDY240	170	<50	<10	16	<100	19	<50	<20
MDY241	580	<50	<10	260	<100	26	<50	78
MDY242	1300	<50	<10	310	<100	27	<50	110
MDY243	830	<50	<10	320	<100	24	<50	91
MDY245	220	<50	<10	56	<100	19	<50	23
MDY246	400	<50	<10	42	<100	19	<50	<20
MDY247	210	<50	<10	19	<100	15	<50	<20
MDY248	390	<50	<10	37	<100	19	<50	25
MDY254	1200	<50	<10	140	<100	20	<50	140
MDY255	3000	<50	<10	100	<100	22	<50	39
MDY256	600	<50	<10	52	<100	22	<50	190
MDY257	230	<50	<10	26	<100	20	<50	<20
MDY258	370	<50	<10	36	<100	21	<50	73
MDY259	<100	<100	<20	<20	<200	34	<100	130
MDY261	820	<50	<10	130	<100	21	<50	73
MDY262	220	<50	<10	28	<100	32	<50	93
MDY263	98	<50	<10	<10	<100	26	<50	21
MDY264	110	<50	<10	14	<100	19	<50	<20
MDY265	84	<50	<10	27	<100	13	<50	<20
MDY266	570	<50	<10	36	0	13	.0	43
MDY267	1100	<50	<10	54	<100	<10	<50	<20
MDY268	420	<50	<10	45	<100	19	<50	34
MDY269	530	<50	<10	54	<100	26	<50	180
MDY271	1800	<50	<10	95	<100	23	<50	90
MDY277	320	<50	<10	110	<100	24	99	91
MDY278	180	<50	<10	59	<100	22	<50	150
MDY298	520	<50	<10	53	<100	18	<50	86
MDY299	260	<50	<10	26	<100	28	<50	71

Unless otherwise noted, all values in parts per million (ppm)

SAMPLE	Sr	Ti	V	W	Y	Zn	Zr
MJB324	<100	730	8	55	22	230	89
MJB325	<100	655	<1	46	42	220	150
MJB326	<100	730	5	61	55	370	175
MJB327	<100	685	<1	47	46	420	170
MJB328	<100	625	41	56	40	395	145
MJB329	<100	895	12	46	23	175	130
MJB330	<100	1630	25	58	16	515	48
MJB331	<100	1690	29	67	14	325	49
MJB332	<100	945	2	58	27	535	130
MJB352	130	950	39	83	10	1465	38
MJB353	<100	1520	33	75	16	520	38
MJB354	190	3110	115	70	10	140	78
MJB355	100	1490	10	58	26	475	68
MJB356	120	1800	34	52	17	295	45
MJB357	200	125	100	<10	13	165	2
MJB358	100	1780	45	54	17	350	57
MJB359	100	1820	25	41	14	170	44
MJB360	120	1680	40	<10	2	150	46

APPENDIX C

FIELD ROCK DESCRIPTIONS

ROCK SAMPLE DESCRIPTIONS

— BIMETAL AREA —

WR-1	Kaolinized shear zone, sample taken form portal
WR-2	Granite from hanging wall in portal
WR-3	Granite
WR-12	Quartz vein, 2' wide, strike N55E, dip 35NW
WR-13	Quartz vein, strike N75E, dip 50NW
WR-14	Felsic tuff, 350 cps
WR-15	Aplite vein, fine grained in granite, Mn oxide, bornite

— AFTERTHOUGHT AREA —

WR-20	Granodiorite, fractured, slightly altered
WR-21	Felsic tuff, 180 cps
WR-22	Calcic hornfels, gypsum along fractures
WR-23	Welded felsic tuff
WR-24	Quartz monzonite, highly fractured, limonite stained, gypsum along fractures
WR-25	Granodiorite, highly fractured, limonite stained, gypsum along fractures
WR-26	Pyroxenite plug in granodiorite
WR-27	Meta(?)-limestone
WR-29	Clay, dark red brown, interbedded with calcic hornfels

— NORTH AFTERTHOUGHT AREA —

WR-8	Quartz, hematized, highly fractured
WR-9	Diorite(?)
WR-10	Quartz vein

— SOUTH AFTERTHOUGHT AREA —

WR-6	Granite
WR-7	Granite
WR-17	Gossan, along shear zone in granite

— LONG VALLEY AREA —

WR-4	Silicified breccia in basalt
WR-18	Andesite, with leucite(?) crystals

— GURANIUM AREA —

WR-39	Welded tuff, rhyolite to dacite, 250cps
WR-40	Rhyo-dacite, buff colored, Cu oxidizes along fractures

— COPPER AREA —

WR-83	Limestone, highly altered, gossan in contact with quartz monzonite, malachite
WR-85	Limestone, highly altered, in contact with monzonite, limonite, hematite, malachite, zone 10'-15' wide
WR-86	Limestone, highly altered
WR-73	Dump sample, limey sandstone, abundant limestone

— SULFUR AREA —

WR-68	Calcite vein in granite
WR-70	Skarn
WR-65	Travertine
WR-72	Goethite
WR-59	Limestone, highly altered, abundant gossan, gypsum along fractures
WR-61	Limestone, dense black to brownish-yellow, gossan, copper oxide

— WILDHORSE AREA —

WR-81	Welded tuff
WR-79	Limestone, silicified, sulfides along fractures

— OTHER AREAS —

WR-71	Limestone, silicified, abundant hematite
WR-75	Travertine, fossiliferous, 4" thick cap over rhyolite
WR-62	Magnetite

GURANIUM AREA

WR-41	Fault gouge and dump sample composite, 1000 cps
WR-37	Fault gouge, kaolinized, 250 cps
WR-38	Felsic tuff, altered

— CALICO AREA —

WR-32	Rhyolitic tuff, 300 cps
WR-33	Rhyolitic tuff
WR-34	Basalt, greenish-gray, 750 cps
WR-43	Rhyolitic tuff, 300 cps
WR-45	Fault breccia, silicified, strike N70°, dips 65°W

— BUBBLES AREA —

WR-46	Tuff, unaltered
WR-47	Opalized wood, 600 cps
WR-48	Opalized wood, 900 cps

— HIDDEN VALLEY AREA —

WR-49	Gossan, along fault in limestone
WR-51	Limestone fault breccia, silicified
WR-52	Limestone, black to dark gray, limonitic
WR-53	Limestone, silicified, sulfide bearing, sampled as float
WR-54	Diorite
WR-55	Felsic volcanics, sulfides
WR-56	Limestone, metamorphosed, epidote(?)

— RED GRANITE AREA —

WR-57	Quartz vein, limonite
WR-63	Clayey material above WR-57
WR-66	Silicified pod in granite, 875 cps

— GILLIS AREA —

WR-74	Limestone, dark gray, pyritized
WR-78	Fault breccia, malachite
WR-76	Gossan, in contact with limestone and aplite dike
WR-80	Limestone, metamorphosed
WR-67	Limestone, altered, copper and manganese oxides
WR-82	Limestone, silicified, copper and iron oxides, 250 cps

APPENDIX D

MEAN AND STANDARD DEVIATION, BY AREA AND LITHOLOGY

HIDDEN VALLEY AREA

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	23.4	42.6	Bi	.57	1.5
Co	4.28	2.21	Cr	43.1	20.7
Cu	46.5	21.9	Mo	9.71	11.6
Ni	32.7	29.1	Pb	22.8	28.4
S	.357	.489	Zn	207	435
As	1258	2787	Hg	287	686
Si	44.6	24.8	Sb	27.2	69.5
Sn	1.71	2.13	U	3.44	3.4
Al	5.01	4.55	Ba	4824	11502
Ca	9.69	13	Fe	9.75	14.1
K	2.02	2.25	Mn	.06	0
Mg	.989	1.54	Na	.964	1
Ag	.27	.477	Ti	.131	.1
Li	10.7	6.62	Rb	29.8	31.5
V	102	134	Zr	28.5	48.7
P	1545	2193	Te	1.88	4.9
Th	7.57	9.65	Tl	0	0

GURANIUM AREA

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	132	267	Bi	83	185
Co	5.19	4.43	Cr	27.6	16.8
Cu	3903	6611	Mo	7	3.5
Ni	10.8	5.62	Pb	518	1053
S	.241	.423	Zn	906	1236
As	5442	12051	Hg	12432	27709
Si	63.9	19.6	Sb	216	482
Sn	8.8	16.4	U	20.5	27.1
Al	5.77	1.87	Ba	336	191
Ca	.448	.277	Fe	8.49	13.2
K	3.32	2.12	Mn	.143	.1
Mg	.184	.089	Na	.744	.7
Ag	116	259	Ti	.147	0
Li	15.6	8.17	Rb	53.5	19.4
V	38	19.2	Zr	0	0
P	1296	2015	Te	.54	.9
Th	15.3	8.64	Tl	0	0

CALICO AREA

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	0	0	Bi	.8	1.7
Co	5.19	4.76	Cr	43.2	46.5
Cu	43.4	20.8	Mo	2.2	1.7
Ni	18.6	15	Pb	14	11.8
S	.073	.073	Zn	62.4	35.4
As	47	71.8	Hg	57.5	92.5
Si	59.6	21.7	Sb	0	0
Sn	.4	.894	U	85.4	187
Al	6.12	2.05	Ba	420	396
Ca	5.37	10	Fe	2.51	1.3
K	3.44	2.15	Mn	.204	.3
Mg	.385	.327	Na	2.24	.9
Ag	.06	.133	Ti	.163	.1
Li	12.1	1.92	Rb	66.1	53.6
V	36	40.3	Zr	30	44.7
P	666	673	Te	0	0
Th	13.3	10.4	Tl	0	0

GILLIS AREA

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	22.5	30.2	Bi	3.66	2.3
Co	23.6	41.1	Cr	35.3	34.5
Cu	2460	2879	Mo	3.16	3.1
Ni	22.3	32.5	Pb	16.6	6
S	.197	.187	Zn	73.5	80.3
As	645	934	Hg	32.3	47.6
Si	17.6	15.5	Sb	70.5	145
Sn	.332	.816	U	29.6	63.9
Al	2.49	2.8	Ba	135	137
Ca	23.5	7.93	Fe	1.73	1.1
K	.611	.8	Mn	.078	0
Mg	3.62	4.49	Na	.217	.2
Ag	1.64	2.52	Ti	.13	.1
Li	11.1	14	Rb	12.5	19.4
V	181	250	Zr	41.6	49.1
P	524	460	Te	0	0
Th	2.33	2.65	Tl	0	0

BIMETAL AREA

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	784	1269	Bi	0	0
Co	1.42	.785	Cr	34.8	17.2
Cu	64.5	75	Mo	4.42	4.2
Ni	11	6.5	Pb	28.8	30.8
S	.064	.076	Zn	15.5	11.9
As	53.5	53.3	Hg	42.2	62
Si	76.7	9.19	Sb	1	1.9
Sn	0	0	U	7.77	12.5
Al	5.25	2.6	Ba	451	252
Ca	.768	.597	Fe	1.95	1.4
K	2.84	1.47	Mn	.029	0
Mg	.184	.247	Na	2.02	1
Ag	1.21	1.6	Ti	.06	0
Li	11.5	6.94	Rb	42.7	26.3
V	17.1	12.5	Zr	0	0
P	365	242	Te	0	0
Th	15.4	9.35	Tl	0	0

AFTERTHOUGHT AREAS

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	2.73	5.16	Bi	4.53	17.5
Co	12.4	12.3	Cr	38.4	15
Cu	83.9	89.3	Mo	7.4	5.9
Ni	28.1	15.6	Pb	52.2	165
S	1.01	2.55	Zn	40.9	45.1
As	50.3	74.6	Hg	20	41.8
Si	60.8	16.6	Sb	0	0
Sn	1.39	4.89	U	2.82	2.3
Al	5.3	3.13	Ba	948	756
Ca	3.85	4.6	Fe	5.94	7.6
K	3.16	2.6	Mn	.075	0
Mg	1.12	2.08	Na	2.07	1.2
Ag	4.35	16.5	Ti	.216	.1
Li	8.19	5.18	Rb	30.6	21.7
V	100	82.5	Zr	0	0
P	1082	1233	Te	.612	2.2
Th	10.3	8.69	Tl	0	0

SULFUR AREA

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	1.66	2.65	Bi	2	3.3
Co	3.83	3.06	Cr	18.3	22.4
Cu	462	740	Mo	118	163
Ni	4.16	8.81	Pb	20.6	18.4
S	6.43	8.16	Zn	194	224
As	213	363	Hg	15.6	17.7
Si	13.4	8.18	Sb	6.83	11.1
Sn	6.83	8.25	U	1.38	.6
Al	.28	.292	Ba	96.6	138
Ca	11.6	11.6	Fe	21.4	20.1
K	.335	.405	Mn	.051	0
Mg	.163	.143	Na	.451	.5
Ag	.233	.36	Ti	.073	0
Li	2.66	2.25	Rb	29.5	55
V	20	14.1	Zr	0	0
P	2834	3040	Te	0	0
Th	.665	1.03	Tl	0	0

NONRADIOMETRIC TUFF

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	1.5	3	Bi	.5	1
Co	8.75	6.09	Cr	20.5	19.7
Cu	33.7	8.57	Mo	3.75	2
Ni	12.6	5.73	Pb	10.5	10.5
S	.159	.087	Zn	69	53.5
As	18.7	11	Hg	21	31.2
Si	75	15.6	Sb	0	0
Sn	1.5	.999	U	2.29	1.3
Al	7.33	1.29	Ba	732	199
Ca	1.16	.99	Fe	3	1.1
K	4.36	1.79	Mn	.105	.1
Mg	.481	.368	Na	2.26	1.3
Ag	.075	.095	Ti	.206	.1
Li	12.1	3.94	Rb	62.5	28.3
V	45	38.7	Zr	12.5	25
P	466	121	Te	0	0
Th	13	10.1	Tl	0	0

GOSSAN ZONES

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	27.8	44.9	Bi	2	2.1
Co	5.16	5.56	Cr	25.3	20.4
Cu	635	1325	Mo	11.3	12.2
Ni	27	35.3	Pb	27	29.8
S	2.85	3.93	Zn	226	472
As	1483	2983	Hg	361	728
Si	27	23.9	Sb	31.8	75
Sn	3.83	7.59	U	3.88	4.1
Al	1.45	2.56	Ba	5365	12510
Ca	11.3	14.3	Fe	16.6	16.1
K	.685	.52	Mn	.036	0
Mg	.723	1.48	Na	.56	.7
Ag	.432	.476	Ti	.103	.1
Li	10.1	14	Rb	12.3	10.8
V	118	140	Zr	16.6	40.8
P	2410	2488	Te	2.2	5.3
Th	2.5	2.81	Tl	0	0

LIMESTONE

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	7.12	10.9	Bi	2.75	2.5
Cc	21.0	35.1	Cr	42.5	27.7
Cu	1474	2659	Mo	2.87	3.2
Ni	32.1	30	Pb	15.7	5.4
S	.125	.029	Zn	109	63.7
As	276	657	Hg	825	2277
Si	32.6	26.2	Sb	46.7	128
Sn	1.5	2.77	U	3.65	2.5
Al	3.52	3.38	Ba	183	171
Ca	18	11.5	Fe	2.71	2.4
K	.459	.705	Mn	.08	0
Mg	3.19	3.99	Na	.59	.9
Ag	1.21	2.25	Ti	.157	.1
Li	15.3	22.9	Rb	12	17.1
V	160	221	Zr	31.2	45.8
P	608	346	Te	0	0
Th	4	4.1	Tl	0	0

RADIOMETRIC TUFF

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	1	2.23	Bi	.8	1.7
Co	1.6	1.34	Cr	28.3	19.9
Cu	37.4	24.5	Mo	2	2.5
Ni	8.8	6.83	Pb	18.7	8.8
S	.108	.065	Zn	53.2	39.6
As	45	72.8	Hg	51.2	94.4
Si	70.7	1.74	Sb	0	0
Sn	.4	.894	U	2.43	1.3
Al	6.26	.304	Ba	394	331
Ca	.537	.312	Fe	1.78	.6
K	4.64	1.38	Mn	.035	0
Mg	.266	.261	Na	2.09	.5
Ag	.06	.133	Ti	.089	0
Li	15.3	3.78	Rb	74	47.6
V	14	11.4	Zr	10	22.3
P	286	109	Te	0	0
Th	23.2	3.7	Tl	0	0

QUARZ VEINS

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	2195	2362	Bi	13.6	30.4
Co	2.59	.894	Cr	46.4	11.7
Cu	57.5	23	Mo	8	4.6
Ni	16	3.31	Pb	147	281
S	.076	.086	Zn	19.2	20.9
As	47	52.3	Hg	34.4	16.5
Si	84.9	8.24	Sb	0	0
Sn	0	0	U	3.02	2.2
Al	2	2.27	Ba	194	225
Ca	.472	.749	Fe	3.27	1.7
K	1.31	1.51	Mn	.019	0
Mg	.06	.043	Na	.81	.9
Ag	14.3	27.8	Ti	.024	0
Li	10	8.03	Rb	33.4	32.7
V	16	15.1	Zr	0	0
P	627	260	Te	1.77	3.9
Th	8.39	9.76	Tl	0	0

GRANITE

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	0	0	Bi	0	0
Co	4.5	6.47	Cr	29.3	18.7
Cu	78.1	79.6	Mo	3.83	2.8
Ni	14.1	10.7	Pb	9.66	6.8
S	.05	.059	Zn	54.8	107
As	35.8	40.4	Hg	6.66	2.4
Si	61	22.7	Sb	1.16	2
Sn	3.83	9.38	U	1.66	.4
Al	5.8	3.18	Ba	835	577
Ca	6.54	11.9	Fe	1.99	1.4
K	3.11	2.31	Mn	.046	0
Mg	.297	.263	Na	2.64	1.5
Ag	.016	.04	Ti	.136	0
Li	6.5	1.64	Rb	32.3	22.5
V	48.3	41.1	Zr	0	0
P	364	273	Te	0	0
Th	10	10.4	Tl	0	0

KAOLINIZED ZONES

ELEMENT	MEAN	STD. DEV.	ELEMENT	MEAN	STD. DEV.
Au	269	251	Bi	103	207
Co	2.25	2.06	Cr	19	5.2
Cu	3842	7638	Mo	4.75	3.2
Ni	6.5	3.31	Pb	629	1181
S	.395	.435	Zn	770	1486
As	6773	13484	Hg	15551	30966
Si	60.9	21.3	Sb	270	540
Sn	9.5	19	U	27.3	31.3
Al	5.7	2.2	Ba	372	167
Ca	.466	.261	Fe	9.93	14.7
K	3.02	2.01	Mn	.036	0
Mg	.204	.097	Na	1.29	1.2
Ag	145	289	Ti	.146	0
Li	12.5	9.84	Rb	55.7	33.7
V	47.5	15	Zr	0	0
P	1491	2273	Te	.574	1.1
Th	11	8.4	Tl	0	0

APPENDIX E

POLISHED SECTION AND THIN SECTION DESCRIPTIONS

THIN SECTION DESCRIPTIONS

WR-3 Peraluminous Granite

Containing stressed quartz (> 20%), microperthitic K-spar (> 20%), sericitized albite (≃ 20%), possibly allanite* (> 10%) and minor hornblende (< 3%) and biotite (< 1%). Isotropic grains (< 1%) may be spessartite var. garnet.

WH-3 Altered Volcanic (?) Rock

Groundmass identification is largely complicated by abundance (≃ 10%) of opaques. Relict phenocrysts have been intensely sericitized. Minor biotite (3-5%) is also present. Monolinic phenocrysts exhibiting first order yellow retardation colors under cross-nicols may be pyrophyllite (> 20%) with smaller grains of the same in the groundmass.

WR-22 Baritic Tactite

Predominantly barite (> 50%) with subordinate plagioclase (10-15%), quartz (10%) and biotite (5-10%). Gypsum (20%) fills fracture zones.

WR-24 Olivine Gabbro

Olivine-rich (≃ 50%) gabbro containing plagioclase (15-20%) and augite (5%). Contains either barite or alunite* in veinlets and sanidine (> 1%). Olivine is confined to only portions of the gabbro.

WR-25 Pyroxenitic Diorite

Augite-rich (30-40%) diorite with abundant oligoclase (20-30%) and quartz (> 20%). Quartz exhibits undulose extinction.

WR 26 Pyroxenite

Heavily-stained (iron-oxides), pyroxenite consiting mostly of hedenbergite (50-60%) and undeterminable groundmass. Sample contains cristobalite (> 20%) and biotite mica (> 5%).

WR-34 Meta-pyroxenite (?) or Pyroxene Hornfels

Highly sericitized augite-rich rock with > 20% opaque minerals. Contains porphroblasts or altered phenocrysts of calcite exhibiting undulose extinction but very poor optical characteristics.

WR-38 Rhyolite

Dark grey groundmass (> 60%) of probable amphibolic composition (highly sericitic) with numerous non-welded glass fragments. Contains about 5% opaques and vein-like limonitic staining. Irregular shaped phenocrysts of quartz (≈ 10-20%) and minor zircon* (< 5%) and hedenbergite (< 1%). Also contains smaller hexagonal quartz phenocrysts (≈ 5%) and larger highly sericitized, re-welded rock fragments (≈ 15%).

WR-40 Rhyodacite

Dark grey groundmass (≈ 50%) is probably composed of aphanitic amphibole (almost looks isotropic under cross-nicols). Hypocrystalline texture contains larger phenocrysts of quartz (< 10%) and smaller phenocrysts of albite (5-10%). Also sericitized phenocrysts of plagioclase (10%) are also evident.

WR-54 Peraluminous Microdiorite

Predominantly oligoclase (40-50%) and quartz (20-30%) with abundant twinned plagioclase (20-30%) of an undetermined variety (albite?) orthopyroxene (< 5%) is the major mafic constituent.

WR-55 Peraluminous Rhyloite (Potasic)

Dark groundmass (> 25%) contains 5-10% opaques. Groundmass is probably aphanitic pyroxenes or amphiboles and is slightly sericitized. Large phenocrysts of quartz (> 20%) and twinned sanidine (20%) occur with smaller subordinate dioside (5-10%) phenocrysts.

WR-66 Altered Quartz Vein

Mostly quartz (80%) with subordinant hornblende (5-10%) in a limonitic (?) and highly sericitic groundmass.

WR-82

Highly iron stained siderite with possible remnant calcite intruding dark, seemingly isotropic groundmass of hornblendite.*

POLISHED SECTION DESCRIPTIONS

BIMETAL AREA

WR-1	No polished section was prepared.
WR-2	No visible opaque minerals; sample may be an aplite dike versus a granite.
WR-3	Granite with abundant quartz and about 2% biotite; no visible opaque minerals.
WR-12	No polished section was prepared.
WR-13	Minor hematite in fractures and vugs.
WR-13φ	Intensely fractured quartz with abundant hematite fill; dendritic pyrolusite coats quartz grains and appears to post-date the hematite.
WR-14	Too friable to make a section.
WR-15	No polished section was prepared.
COMMENTS:	No gold was visible, however, rock relationships suggest a late-stage hydrothermal event (apilitic intrusive) followed by low temperature hydrothermal activity (quartz vein formation). Also, there may be a correlation between volcanism and late stage hydrothermal activity as evidenced by anomalous gold and lithium values in nearby felsic tuff (WR-14).

AFTERTHOUGHT AREA

WR-20	Granodiorite with abundant biotite, minor sphene (?) but no opaques evident.
WR-21	Felsic tuff with no opaques.
WR-22	Intensely hematized barite; vuggy and fractured; high bireflectance.
WR-23	No polished sample was prepared.
WR-24	Sectile transparent dark crystals could be olivine. Trace hematite. About .5% magnetite. Occurs as subhedral blebs. Minor isolated rutile occurs with distinct red internal reflections.
WR-25	Predominantly goethite coated grains with some highly bireflective mineral. Little evidence of granitic origin, could be roof pendant, sedimentary material.
WR-26	Pyroxene-rich rock with minor magnetite. Cristobalite (?) occurs in relative high abundances-between pyroxene laths.
WR-27	No polished section was prepared.

WR-29	Goethite-rich silicate. No indication of calcite. Some skeletal crystal outlines.
COMMENTS:	Mineralization appears to be confined to skarn zones. Pyroxenitic intrusives could be a source for the chalcophile metals.

NORTH AFTERTHOUGHT AREA

WR-8	Hematitic fill in fractured quartz.
WR-9	Biotite-rich diorite with no opaque minerals.
WR-10	Hematite-rich (≃ 30%) quartz breccia. Quartz boundaries appear structurally broken and are hematite filled. No lead minerals evident.
COMMENTS	Diorite appears to be a poor source rock. Fractured and hematized quartz veins appear to be a late-stage, non-mineralizing event.

SOUTH AFTERTHOUGHT AREA

WR-6	No polished section was prepared.
WR-7	No polished section was prepared.
WR-17	Goethite-rich siderite (?). Siderite appears to post-date the goethite with sharp euhedral boundaries.
COMMENTS:	Gossan (WR-17) may cap a gold bearing zone judging from anomalous mercury and arsenic values. Granites in this area may not be source rocks.

LONG VALLEY AREA

WR-4	No polished section was prepared.
WR-18	Felsic volcanic with phlogopite (?) and leucite (?) phenocrysts. No opaques observed.
COMMENTS:	Volcanic rocks in this area do not appear to be favorable metal targets.

GURANIUM AREA

WR-39	No polished section was prepared.
WR-40	Volcanic rock exhibits extensive iron pyritization (> 15%) and coating of quartz and feldspar grains with copper carbonates (2-3%) which could be primary or source related. Limonitization is an obvious secondary event. Occurring as botryoidal goethite which fills

fractures with calcite or siderite gangue. Enargite ($< 1\%$) is replaced by supergene hematite (10%).

WR-41	Enargite (10-15%) and pyrite (10%) extensively rimmed by goethite ($> 40\%$). Minor exsolution blebs of chalcopyrite in the goethite. Radioactivity is diffuse and limonite related.
WR-37	Hematitized tuff (?). Some of the calcic (?) grains appear rounded. Hematite is largely aphanitic with the matrix. No radioactive pattern was observed.
WR-38	Limonitic tuff with minor, unaltered hematite euhedrals.
COMMENTS:	Source for the copper appears to be the felsic volcanics. Although the source for uranium has not been documented, it appears to be localized by gossan processes.

CALICO AREA

WR-32	No polished section was prepared.
WR-33	Abundant K-spar (zoned) and biotite phenocrysts. Radiation was slight and diffuse on the autoradiograph. No opaques observed.
WR-34	Cryptocrystaline igneous (?) rock with minor limonitic staining locally in the groundmass. Partially reactive to hydrochloric acid. Probably pyroxene rich. Although the radiation pattern was strong and diffuse only three blebs of autunite were observed. Primary uranium minerals yet undetected is probable.
WR-43	No polished section was prepared.
WR-45	No opaques observed. Zircon was observed as flourscent orange. No tungsten species were found. A limonitic ground mass is possible but could not be documented.
COMMENTS:	It is unusual that a silica deficient, calcium rich igneous (?) would contain primary uranium. The possibility that WR-34 is an odd calc-silicate skarn should not be discounted.

BUBBLES AREA

WR-46	Sample did not make a good polished section. Radiation was not documented on the autoradiograph.
WR-47	Carnotite observed as key source for radioactivity on autoradiograph. Autinite observed in fine fractures with ultraviolet light.
WR-48	No carnotite observed. Autunite observed as WR-47.

COMMENTS:	If the tuffacous sample (WR-46) was a source rock, most of the uranium has been leached. The high level of chemical disequilibrium in the wood samples implies remobilization perhaps with the opalization event.

HIDDEN VALLEY AREA

WR-49	Predominately hematite with subordinate juggy to framboidal limonite (later). Calcite or siderite appears to fill many of the voids. No other opaques identified.
WR-51	No polished section was prepared.
WR-52	Calcite-rich. Minor limonite (goethite) in fractures.
WR-53	Abundant subhedral to euhedral marcasite rimmed by limonite (goethite). Numerous unaltered grains and some diffuse limonite in the ground mass.
WR-54	Slightly pyritic diorite (?).
WR-55	Felsic volcanic rock containing minor subhedral arsenopyrite grains and vein fill. Goethite (< 1%) coats portions of some of the arsenopyrite (2%) and pyrite veins were observed cross-cutting arsenopyrite.
WR-56	No polished section was prepared.
HV-1	Minute pyrite grains have been largely oxidized to goethite (< 1%).
HV-2	Predominantly psilomelane (90%) with relect goethite (≃ 10%) and trace pyrolusite. Exsolution remnants of pyrolusite occur in psilomelane. Exsolution structure of goethite also occur in psilomelane.
COMMENTS:	The diorite (WR-54) would be a logical source rock for gold, however, the relationship to base metal concentrations is not as apparent. Both felsic volcanics and primarily pyritic sediments could contribute to the formation of gossans. The greater the limonite (goethite) content of the gossan, the greater the gold is likely to be.

RED GRANITE AREA

WR-57	No polished section was prepared.
WR-63	No polished section was prepared.
WR-66	Quartz has been locally altered to smokey variety but only a faint, diffuse pattern was seen on the autoradiograph. The quartz is moderately fractured and contains local abundances of aphanitic hematite.

COMMENTS:	Gold apparently is late stage hydrothermal but related to the granitic intrusion. Radiometrics might be a good gold exploration tool across the intrusive.

GILLIS AREA

WR-67	No polished section was prepared.
WR-78	No polished section was prepared.
WR-76	No polished section was prepared.
WR-80	No polished section was prepared.
WR-82	Most radioactivity occurs along hematitic veinlets in the silicified limestone. Calcite fill in fractures appears to post date hematization. No other opaque minerals identifiable. Minor malachite visible as staining.
COMMENTS:	Copper and gold appear to mutually prefer the limestone host rocks. As in the Red Granite Area, radioactivity might be a good prospecting tool (Re: WR-78).

COPPER AREA

WR-83	No polished section was prepared.
WR-85	No polished section was prepared.
WR-86	No polished section was prepared.
WR-73	Mostly limonite (goethite-30%) and malachite (35%) coated sand grains. Minor cuprite occurs winterstitially with goethite. Limonitization preceded copper carbonatization and completely replaces pyrite in some instances.
COMMENTS:	Similar elemental assemblages as the Gillis Area.

SULFUR AREA

WR-68	Hematized calcite. No tungsten minerals observed.
WR-70	Mostly hematite (50-60%) with minor goethite replacing pyrite particularly along fractures. Some secondary hematite also fills fractures.
WR-65	No polished section was prepared.
WR-72	No polished section was prepared.
WR-59	Predominantly specular hematite with gypsum.

WR-61	Mostly goethite with about 15-20% psilomelane. Some reflect pyrite in goethite zone. Ilmenite (≃ 1%) appears to be secondary and fill vugs in hematite.
COMMENTS:	Samples WR-68 and WR-70 appear to be high temperature skarns in contrast to WR-72, WR-59, and WR-61 which appear to be lower temperature hydrothermal assemblages possibly related to hot spring activity in vicinity of the travertine (WR-65) and native sulfur occurrences.

WILDHORSE AREA

WR-81	No polished section was prepared.
WR-79	No polished section was prepared.
WH-1	Hematitic altered volcanic (?) kaolinized phenocrysts have weathered-out of the rock. Possible cinnabar.
WR-2	Hematized igneous (?) rock. Highly altered. No other visible opaque minerals.
WR-3	Sodic (?) basalt with minor biotite mica. No visible opaque minerals, however, groundmass is quite dark.
COMMENTS:	Not enough data or opaque minerals.

PYRAMID MINE

PM-1	Predominantly sphalerite rimmed with tetrahydrite or occurring within internal fracture. Chalcopyrite occurs as exsolution blebs in sphalerite as well as discreet grains. Galena is moderately abundant with tetrahedrite post-dating galena and often occurring along structure cleavage weaknesses. Trace pyrite are replaced by tetrahedrite.

APPENDIX F

RADIOACTIVE MINERALS OF NEVADA

Allanite $(Ca, Ce, Th)_2 (Al, Fe, Mg)_3 Si_3O_{12} (OH)$. May contain up to 2.95 percent uranium, but usually contains a few hundredths of a percent. May also contain thorium in amounts up to 4.35 percent. Brown to black mineral similar to epidote; crystals tabular or long and slender. May be metamict due to radiation damage. Most commonly found as an accessory mineral in plutonic rocks and pegmatites.

Apatite $Ca_5(PO_4)_3 (F, OH, Cl)$. May contain up to 0.08 percent uranium when found in igneous rocks, but usually less than 0.01 percent. May contain up to 0.003 percent thorium. Apatite crystals common in igneous and metamorphic rocks.

Autunite $Ca(UO_2)_2(PO_4)_2 \cdot 10\text{-}12\ H_2O$. Thin to thick tabular crystals with rectangular or, less commonly, an octagonal outline. Hardness 2-2½. Luster vitreous to pearly. Color lemon yellow to sulfur yellow; sometimes greenish yellow to pale yellow. Streak pale yellow. Strong fluorescence to yellowish green in ultraviolet light (brighter fluorescence on fractured surfaces than on weathered ones). Meta-autunite and autunite may be mistaken for each other in the field. Very common secondary uranium mineral.

Brannerite AB_2O_6; A is mainly U but also Ca, Fe, Th, Y; B is mainly Ti and Fe. Contains 26.5 to 43.6 percent uranium and 0.26 to 11.3 percent thorium. Color black, brown, and yellowish brown. Found in granitic rocks, pegmatites, and placers.

Carnotite $K_2(UO_2)_2(VO_4)_2 \cdot 1\text{-}3\ H_2O$. Occurs as powder, disseminated, in crusts or aggregates, or as coatings. Soft. Dull and earthy to pearly. Color bright yellow to lemon yellow, also greenish yellow. Not fluorescent. Common secondary uranium mineral. May be deposited by the action of meteoric waters.

Chevkinite (or Tscheffkinite) $(C, Y, Ca, U, Th)_2 (Ti, Fe, Mg)_2(Si, Al)_2O_{11}$ (?). Contains up to 2.3 percent uranium and 18.4 percent thorium. Color black, in orthorhombic or monclinic crystals. Occurs in certain plutonic rocks and pegmatites.

Clevite A variety of uraninite containing rare earths.

Coffinite $U(SiO_4)_{1-x}(OH)_{4x}$. Color black; luster dull to adamantine. Pulverulent to friable or brittle. Hardness 5-6. Often occurs as very fine particles. Occurs in many deposits in sandstones and hydrothermal veins.

Cuprosklodowskite $Cu(UO_2)_2(SiO_3)_2(OH)_2 \cdot 5\ H_2O$. Isostructural with uranophane. Often found as thin films or crusts, or as minute acicular crystals, often radiating from a center. Color yellowish green to grass green and greenish yellow. Luster of aggregates dull to silky. Has a superficial resemblance to chrysocolla and malachite. A secondary mineral, often formed by the alteration of earlier formed uranium minerals, or deposited from solution in the oxidized zone of uranium deposits.

Dumontite $Pb_2(UO_2)_3(PO_4)_2(OH)_4 \cdot 3H_2O$. Occurs as small elongated crystals, striated parallel to the c-axis. Color and streak yellow to ocher yellow. Translucent. Fluoresces weakly green in ultraviolet light. Rare.

Euxenite $(Y, Ca, Ce, U, Th) (Nb, Ta, Ti)_2 O_6$. Part of the euxenite-polycrase series. Pseudo-orthorhombic. Crystals rare; commonly massive. Hardness 6.5. Color brownish black. Found in certain granite pegmatites, commonly with other rare-earth minerals.

Gummite Vague term used to designate fine-grained, dense uranium minerals, usually alteration products of uraninite; whose true identity is unknown. Minerals are usually highly colored, often in shades of yellow or orange. Often associated with uranophane. The term has been used for any colored, earthy, secondary uranium minerals which could not be readily identified.

Huttonite $ThSiO_4$. A dimorph of thorite; isostructural with monazite. It can be distinguished from thorite by X-ray diffraction if the mineral is not metamict. Colorless to pale cream. Rare mineral from granitic pegmatites, alaskite granite, and placers.

Kasolite $Pb(UO_2)(SiO_3)(OH)_2$. An ochre-yellow to brown secondary mineral. Occurs in compact granular masses and crusts as well as small groups of lathlike crystals or radial fibrous aggregates. Not fluorescent. Lustre dull to earthy. Occurs in oxidized uranium-bearing veins, especially in the presence of base metals.

Meta-Autunite $Ca(UO_2)_2(PO_4)_2 \cdot nH_2O$. A dehydration product of autunite, the value of n ranges from 2½ to 6½ and possibly up to 8. Crystal morphology is that of autunite. Color lemon yellow to greenish yellow and yellowish green. Luster pearly to dull. Fluoresces yellowish green in ultraviolet light, but less strongly than autunite. Autunite rapidly dehydrates to meta-autunite at or near ordinary conditions of temperature and humidity. The change is reversable. Differences between autunite and meta-autunite are not often discernable in the field.

Metatorbernite $Cu(UO_2)_2(PO_4)_2 \cdot nH_2O$. A dehydrated form of torbernite. Found in thin tablets as sheaflike aggregates, also as rosettes. Color pale green to dark green. Hardness 2½. Luster vitreous to subadamantine. Not fluorescent. A secondary mineral with the same general occurrence and association as torbernite.

Metazeunerite $Cu(UO_2)_2(AsO_4)_2 \cdot 8\ H_2O$. Found as distinct crystals closely resembling those of torbernite and metatorbernite. Usually in rectangular flattened tablets; also as aggregates of platy crystals. Hardness 2-2½. Luster vitreous. Color grass green to emerald green. Fluoresces weakly in yellow green in both long- and short-wave ultraviolet light.

Monazite $(Ce, La, Nd)PO_4$, with Th substituting for (Ce, La) and Si for P. Thorium content normally from a few percent to 10.6 percent, but possibly up to 26.4 percent. Usually contains less than 0.1 percent uranium. Principal ore mineral of thorium (from placers). Commonly found in small euhedral crystals, but sometimes found in pegmatites as large crystals weighing several pounds. Common detrital mineral. Hardness 5-5½. Luster usually resinous or waxy, but inclining to vitreous or subadamantine. Color yellowish or reddish brown to brown; also shades of yellow, greenish, and nearly white. Not fluorescent. Widely disseminated as an accessory mineral in granites, gneisses, and pegmatites. In placer deposits and rarely in veins.

Novacekite $Mg(UO_2)_2(AsO_4)_2 \cdot 8\text{-}10\ H_2O$. Arsenate end of the saleeite-novacekite series. Isostructural with autunite and torbernite. Single crystals occur as rectangular plates. Also as crusts and scales. Color yellow. A rare secondary mineral, known chiefly from oxidized zones of veins containing primary uranium minerals as well as nickel, arsenic, and cobalt. See saleeite.

Phosphuranylite $Ca(UO_2)_4(PO_4)_2 \cdot (OH)_4 \cdot 7\ H_2O$. Found as thin coatings or aggregates that appear dense, earthy, or minutely scaly to the eye. Hardness 2½. Color deep golden yellow to rich yellow. No fluorescence in ultraviolet light. Has the same chemical composition as autunite or meta-autunite, but displays a more intense and more golden yellow color. A widespread secondary mineral but found in very small amounts. Occurs as an alteration product of primary uranium minerals and of autunite, and in some sandstone-type deposits on the Colorado Plateau.

Pitchblende A variety of uraninite which forms microcrystalline masses that, when developed as crusts, often show concentric banding and form botryoidal surfaces. The particle size of pitchblende is small. The relation between the names uraninite and pitchblende is similar to that between quartz and chalcedony.

Sabugalite $HAl(UO_2)_4(PO_4)_4 \cdot 16\ H_2O$. Isostructural with fully hydrated autunite. Single crystals are very thin plates, but the mineral typically occurs as densely aggregated crusts. Hardness 2½. Color bright yellow to lemon yellow, closely resembling that of autunite. Fluoresces bright lemon yellow in ultraviolet light. Resembles autunite, metaautunite, and saleeite in color, habit and occurrence. A rare secondary mineral which occurs in oxidized uranium-bearing veins and sandstone-type deposits.

Saleeite $Mg(UO_2)_2(PO_4)_2 \cdot 8\text{-}10\ H_2O$. The phosphate end-member of the saleeite-novacekite series. Single crystals are rectangular flattened plates. Saleeite often occurs as crusts or interlocking aggregates of plates or scales. Color, pale yellow to straw yellow; also lemon yellow. Luster weak to waxy. Saleeite fluoresces a bright lemon yellow in long-wave and less brightly in short-wave ultraviolet radiation. In hand specimen, closely resembles autunite, meta-autunite, sabugalite, and uranospinite. Saleeite resembles autunite in occurrence and association, and is commonly associated with many of the phosphates, particularly autunite, torbernite, sabugalite, and phosphuranylite.

Samarskite (Y, Ce, U, Ca, Fe, Pb, Th) $(Nb, Te, Ti, Sn)_2O_6$. Contains 8.4 to 16.6 percent uranium, and up to 3.7 percent thorium. Commonly massive and in flattened, embedded grains. Hardness 5-6. Luster vitreous to resinous. Color velvet black. Streak dark reddish brown. From granite pegmatites.

Schroeckingerite $NaCa_3(UO_2)(CO_3)_3(SO_4)F \cdot 10\ H_2O$. Crystals rare; ordinarily found as crusts, clusters, rosettes or aggregates. Hardness 2½. Luster weakly vitreous. Color greenish yellow. Brightly fluorescent in yellowish green in ultraviolet light. Soluble in water. Somewhat resembles the various green members of the torbernite and metatorbernite groups. A secondary mineral. May be deposited in near-surface environment by meteoric waters. Found as a post-mine mineral at some localities.

Sphene $CaTiSiO_5$. May contain very minor amounts of uranium and thorium. Color brown, gray, yellow, green, rose red, and black. Luster adamantine to resinous. Common rock-forming mineral, especially in intermediate plutonic rocks.

Thorianite $(Th, U)O_2$. Forms a complete series with uraninite. The division between thorianite (ThO_2) and uraninite (UO_2) is at 1:1 atomic ratio. Crystals are simple cubes. Hardness 6½-7. Luster submetallic when fresh, changing to resinous or hornlike. Color black, brownish black, and dark reddish brown. Not fluorescent. Occurs as primary mineral in pegmatites. Widespread as a detrital mineral. Usually found in placer deposits.

Thorite $ThSiO_4$. Contains up to 10.1 percent uranium and 25.2 to 64.1 percent thorium. Crystals closely resemble those of zircon, and thorite is isostructural with zircon. Often metamict. Hardness 4½. Luster vitreous to resinous, sometimes greasy. Color brownish yellow, yellow to orange yellow, also brownish black to dark brown to reddish brown. Very closely resembles zircon and huttonite. Occurs in pegmatites and placers.

Torbernite $Cu(UO_2)_2(PO_4)_2 \cdot 12\,H_2O$. Crystals commonly thin to thick tabular, with a rectangular or octagonal shape. Also as scaly or granular masses. Luster vitreous to subadamantine. Color emerald green to grass green, less commonly leek green, apple green, or siskin green. Contradictory reports on fluorescence: apparently not fluorescent or very weakly fluorescent in green in ultraviolet light. Cannot be distinguished at sight from metatorbernite, zeunerite, or metazeunerite. Usually occurs as an alteration product of uranium-bearing veins; also present in oxidized zones of some sulfide vein deposits.

Tscheffkinite See chevkinite.

Tyuyamunite $Ca(UO_2)_2(VO_4)_2 \cdot 5\text{-}8\,H_2O$. Crystals are tiny scales. Commonly massive, compact to microcrystalline, also pulverulent, and as thin films and coatings. Usually more coarsely crystallized than carnotite, which it resembles in hand specimen. Hardness 2. Luster of crystals adamantine to waxy, massive material may be dull to waxy. Color yellow to canary yellow or lemon yellow. Color usually appears somewhat greenish as compared to carnotite. Either not fluorescent or very weakly fluorescent in yellow green in ultraviolet light. Widespread occurrence, but less abundant than carnotite. Common in the oxidized zone of sandstone-type deposits on the Colorado Plateau.

Uraninite Ideally UO_2 but better expressed as $(U^{+4}_{1-x}, U^{+6}_{x})O_{2+x}$. Forms a complete series with thorianite. See also pitchblende and cleveite. Uraninite crystals are commonly cubes. Hardness 5½-6. Luster submetallic and ironlike in unaltered crystals, usually pitchlike to greasy. Color dark gray to black; also dark brown or brownish black in altered crystals. Occurs in granite and syenite pegmatites (crystals); in hydrothermal sulfide veins (pitchblende); and in sandstone-type deposits.

Uranophane $Ca(UO_2)_2(SiO_3)_2 \cdot 5\,H_2O$. Probable structure of an inosilicate, as suggested by its acicular crystal habit. Crystals are minute needles, occurring as stellate tufted aggregates or crusts. Also massive or microcrystalline. Hardness 2½. Luster vitreous; massive material may appear dull or earthy to waxy. Color lemon yellow to pale straw yellow and honey brown; also greenish yellow to yellowish green and orange yellow. Crystals are weakly fluorescent in green in ultraviolet light; massive material usually is not fluorescent. Uranophane is of supergene origin; often deposited from meteoric waters or formed as an oxidation product of uraninite, especially in pegmatites. A common secondary uranium mineral.

Uranospinite $Cu(UO_2)_2(AsO_4, PO_4)_2 \cdot 11\,H_2O$(?). Belongs to the torbernite or metatorbernite groups. Easily confused with novacekite and meta-autunite. Hardness 2-3. Luster pearly. Color lemon yellow to siskin green. Fluoresces bright lemon yellow in ultraviolet light. A rare secondary mineral, often derived from the alteration of uraninite and primary arsenides in hydrothermal veins.

Uranothorite A variety of thorite containing up to about 12 percent uranium. Uranoan thorite.

Xenotime YPO_4. May contain up to 3.6 percent uranium, and 2.2 percent thorium. Crystals resemble zircon in habit. Hardness 4-5. Luster resinous to vitreous. Color yellowish brown, reddish brown, red, grayish white, wine yellow or pale yellow. Occurs as an accessory mineral in pegmatites, and sometimes distributed in granitic and gneissoid rocks. Also found in placers.

Zeunerite $Cu(UO_2)_2(AsO_4)_2 \cdot 10\text{-}16\,H_2O$. Found as distinct crystals closely resembling those of torbernite and metatorbernite. Hardness 2½. Luster weakly vitreous. Color green to emerald green. Fully hydrated zeunerite does not fluoresce in ultraviolet light. May dehydrate in air to metazeunerite. Almost all reported specimens of zeunerite have proved to be metazeunerite.

Zircon $ZrSiO_4$. May contain small amounts of uranium, thorium, and rare earths. Crystals commonly in square prisms, sometimes pyramidal. Hardness 7½. Luster adamantine. Colorless, pale yellowish, grayish, yellowish green, brownish yellow, reddish brown. A common constituent of igneous rocks, especially granites and pegmatites. Also found in placers.

From Garside (1973)

(191)
Item 22
(1 of 5)

PLATE I

0170 0071

GENERALIZED GEOLOGIC MAP OF THE WALKER RIVER INDIAN RESERVATION

Modified from Bingler (1978), Hardyman (1980), Moore (1969), Ross (1961), Stewart (1982), Willden (1974)

Council of Energy Resource Tribes

PREPARED BY: Ray Loloff
SCALE: 1 inch = 1 mile
GEOLOGIST: S. C. Muller
DATE: November, 1983
DRAWING NO.:

EXPLANATION

Qal
Alluvium
Includes alluvial fan, bajada, talus, fluvial and lacustrine deposits

Qp
Recent playa deposits

Tvm/i
Basaltic andesite
Dark gray to black aphanitic flows and plugs containing oxidized hornblende phenocrysts in a groundmass of plagioclase and iron oxides

Ts
Sedimentary rocks
Includes Wassuk Group. Consists of thin-bedded pale-gray to pale greenish-gray and pinkish gray tuffaceous and diatomaceous silty sandstone to sandy siltstone interbedded with mafic flows and flow breccias (Tvm/i) overlying well reddish to yellowish-brown sandy pebble conglomerate

Tvm
Basaltic flow and tuffs

Tvi
Intermediate flows, plugs, and dikes
Medium to dark gray porphyritic to aphanitic lavas containing phenocrysts of plagioclase, hornblende, or pyroxene. Locally may be flow breccia

Tvf
Felsic flows, plugs, and dikes
Greenish gray dikes and plugs, dark to medium gray lava both containing hornblende phenocrysts

Td
Diorite
Medium gray, equigranular to porphyritic hornblende diorite

Ttf
Felsic Tuff
Includes Blue Sphinx Tuff, Singatse Tuff, Micky Pass Tuff, and Poinsetta Tuff, in addition to other vitric, rhyolitic, and dacitic tuff units

Ttfd
Dacite flows and intrusions

Tt
Felsic Flow Breccia and Ash Flows
Includes Ghost Dance Lava and Nugent Tuff in some areas

Thn
Nugget Tuff
Felsic to intermediate at ash flow tuff, tuff breccia, and tuffaceous debris flows

Tti
Intermediate Tuffs
Includes Petrified Spring Tuff

Km
Granodiorite, Quartz Monzonite, Monzonite

Kd
Diorite
Light to dark gray and greenish gray containing abundant hornblende and plagioclase

Kgd
Granodiorite of Hidden Wash
Light to medium gray containing feldspar, quartz, and biotite

Kg
Granite
Reddish brown to brownish gray

Jff
Dacite Porphyry
Greenish gray to pale lavender, abundant plagioclase, with minor quartz, biotite

Jm
Quartz Monzonite and altered Quartz Monzonite
Includes Gray Hills Pluton, pale to medium gray and pinkish white, consists of abundant plagioclase hornblende, and biotite. Alluvial quartz Monzonite consists of chalky white plagioclase and pale bluish—green mafic minerals with epidote and chlorite

Jg
Granodiorite
Includes Black Mtn. Pluton, medium gray to light greenish-gray to dark greenish-gray, consists primarily of plagioclase with subordinate amounts of orthoclase, hornblende, and quartz

Jd
Hornblende quartz diorite and quartz diorite breccia
Medium to dark gray, abundant plagioclase, subordinate quartz, orthoclase, hornblende, and biotite

Jgd
Brecciated porphyritic meta-andesite
Breccia intruded by dikelets of hornblende quartz diorite

Jif
Latite and quartz latite porphyry
Dark gray to black, porphyitic to aphanitic, abundant plagioclase and quartz

Ji
Undivided intrusives
Containing plagioclase, with or without quartz or hornblende

Js
Metasedimentary rocks
Light to medium gray, yellowish to orangeish brown, fine grained tuffaceous siltstone and very fine grained siliceous argillite. Siltstone is interbedded with limestone and limestone breccia

JTRms
Shale, slate, tuffaceous siltstone, sandstone and greywacke, metamorphosed

JTRv
Andesite breccia
Tuff and flows, basalt, and rhyolite with interbedded volcanic derived sedimentary rocks. Metamorphosed to green schist or higher facies

TRsg
Schistose Metamorphic Rocks
Medium to dark gray, foliated biotite rich, metasomatically altered sedimentary rocks

TRsh
Shale and Argillite
Dark grayish-brown thinly laminated shales, siltstones, and argillites

TRv
Undivided volcanic rocks
Volcaniclastic rocks, and interelated limestones, includes TRvi and TRtf

TRlm
Limestone
Dark gray, thin to moderately bedded, locally recrystallized to calcsilicate hornfels

TRvi
Meta-andesite
Bluish to greenish-gray, and greenish-black, contains subequal amounts of plagioclase and hornblende, minor biotite

TRtf
Meta-latitic pyroclastic rocks

Fault, dashed where inferred
Bells on downthrown side
Detachment fault
Thrust Fault, teeth on upper plate

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Item 22
(2 of 5)

PLATE II

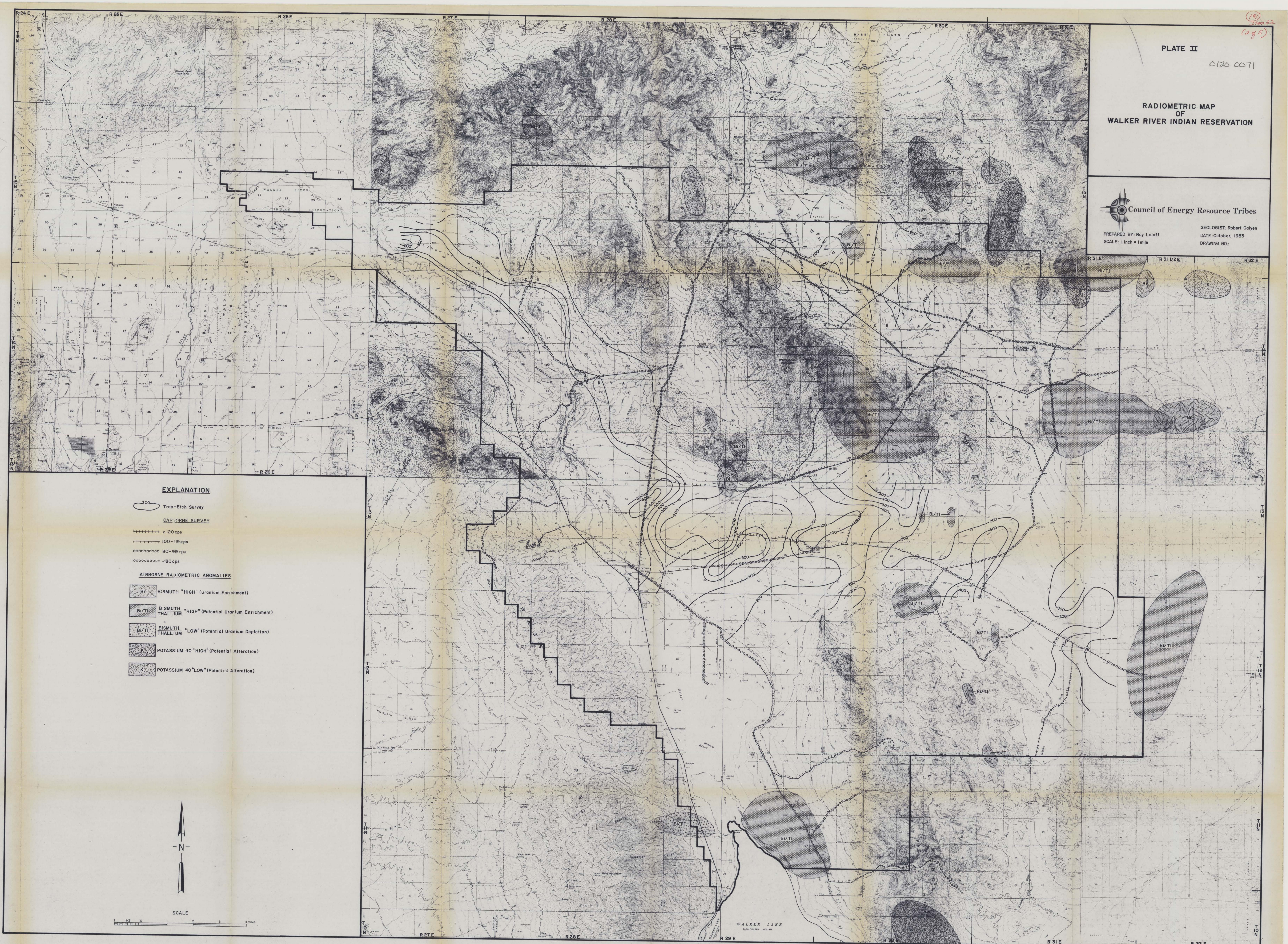
0120 0071

RADIOMETRIC MAP
OF
WALKER RIVER INDIAN RESERVATION

Council of Energy Resource Tribes

PREPARED BY: Ray Loloff
SCALE: 1 inch = 1 mile

GEOLOGIST: Robert Galyen
DATE: October, 1983
DRAWING NO.:



EXPLANATION

200 Trac-Etch Survey

CARBORNE SURVEY

- ┼┼┼┼┼┼┼┼ ≥120 cps
- ┬┬┬┬┬┬┬┬ 100-119 cps
- □□□□□□□□□□ 80-99 cps
- oooooooooo <80 cps

AIRBORNE RADIOMETRIC ANOMALIES

- Bi BISMUTH "HIGH" (Uranium Enrichment)
- Bi/Tl BISMUTH/THALLIUM "HIGH" (Potential Uranium Enrichment)
- Bi/Tl BISMUTH/THALLIUM "LOW" (Potential Uranium Depletion)
- K POTASSIUM 40 "HIGH" (Potential Alteration)
- K POTASSIUM 40 "LOW" (Potential Alteration)

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Item 22
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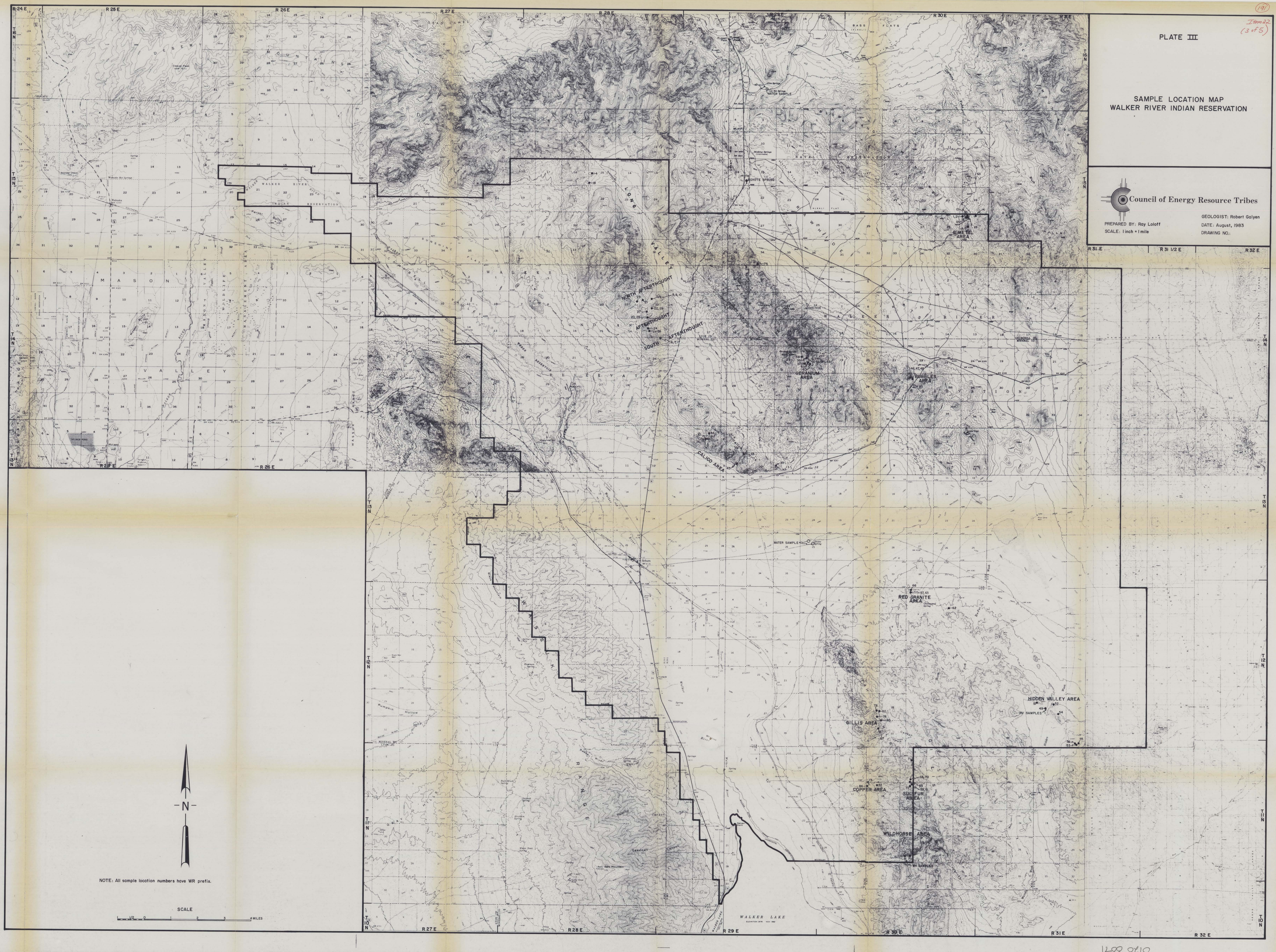

PLATE III

SAMPLE LOCATION MAP
WALKER RIVER INDIAN RESERVATION

Council of Energy Resource Tribes

PREPARED BY: Ray Loloff
SCALE: 1 inch = 1 mile

GEOLOGIST: Robert Galyen
DATE: August, 1983
DRAWING NO.:

NOTE: All sample location numbers have WR prefix.

0170 0071

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PLATE IV

WALKER RIVER INDIAN RESERVATION

0120 0071

GERANIUM MINE AND SAMPLE LOCATIONS

Council of Energy Resource Tribes

PREPARED BY: Ray Loloff
SCALE: 1" = 20'

GEOLOGIST: Robert Galyen
DATE: Oct., 1983
DRAWING NO.:

(191) Item

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PLATE V

0120 0071

AERO-MAGNETIC MAP
WALKER RIVER INDIAN RESERVATION

(from Walker Martel Mining Co.)

Council of Energy Resource Tribes

PREPARED BY: Ray Loloff
SCALE: 1 inch = 1 mile

GEOLOGIST: Robert Galyen
DATE: November, 1983
DRAWING NO.: