MOUNT WILSON G-E-M

RESOURCES AREA

(GRA NO. AZ-01)

TECHNICAL REPORT

(WSA AZ 020-001A)

Contract YA-553-RFP2-1054

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Final Report

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EXECUTIVE SUMMARY

The Mount Wilson Geology-Energy-Minerals (GEM) Resource Area (GRA) contains one Wilderness Study Area (WSA): AZ 020-001A.

The Mount Wilson GRA is in western Mohave County next to Lake Mead where the Colorado River turns and flows south. The GRA is located approximately 25 miles southeast of Las Vegas, Nevada, and is adjacent to the southern and eastern boundary of the Lake Mead National Recreation Area.

The geology of the GRA consists of Precambrian (greater than 600 million years old) rocks overlain by younger volcanics and intruded by granitic rocks.

Past mineral production from within the GRA has not been recorded even though at least six known mines or prospects exist. Minor production may have come from at least some of these properties, but for the most part the commodities are unknown. Only one known prospect is located within the WSA and that is in the southern part of the GRA in Precambrian metamorphic rocks.

The major known mineral resource within the GRA is a salt deposit which has been drilled in Detrital Valley and is located in the southeast portion of the GRA outside the WSA. This area is covered by sodium leases or applications for leases.

There are no patented claims or geothermal leases within the GRA. Oil and gas leases cover all BLM lands in the GRA as this area is part of the Overthrust Belt, an area of high current oil interest.

Unpatented claims are very sparse in the area and are located near the old mines or prospects. Only two unpatented claims are located inside the WSA. There are mineral leases within that portion of the GRA which is included in Lake Mead National Recreation Area. This is because normally locatable minerals are only leasable within the recreation area.

The presence of Lake Mead National Recreation Area may have a negative effect on mineral exploration and prospecting activity because Park Service policies and regulations do not appear to encourage the development of mineral resources. The WSA immediately adjoins the recreation area.

Uranium potential is moderate with a moderate confidence level on the east side of the WSA in the Muddy Creek Formation, and is low with a low level of confidence in the remainder of the WSA. The entire WSA has low favorability for thorium resources at a low confidence level. Oil and gas resources have a low favorability and very low confidence level. Geothermal resources have a moderate to low favorability with a moderate to low confidence level.

In brief, however, the WSA is considered to have a low favorability for mineral resource potential including metallics, nonmetallics and other energy resources. This low classification also has a low confidence level, as this deduction is based on very limited information and the fact that there appears to be very little interest in the area. Much more detailed information would be needed to adequately assess the true mineral potential of the area.

Recommendations for further work to assist in better determining the mineral potential of the WSA, include mapping and sampling of known past prospects and mines, and more detailed geologic mapping in the whole northern portion of the GRA.

I. INTRODUCTION

The Mt. Wilson G-E-M Resources Area (GRA No. AZ-01) contains approximately 95,000 acres (386 sq km) and includes the following Wilderness Study Areas (WSA):

WSA Name	WSA Number
Mount Wilson	AZ 020-001A

The GRA is located in Arizona within the Bureau of Land Management's (BLM) Kingman Resource Area, Phoenix district. Figure 1 is an index map showing the location of the GRA. The area encompassed is near 36°00' north latitude, 114°30' west longitude and includes the following townships:

T 31 N, R 21,22 W
T 30 N, R 21,23 W
T 29 N, R 21,22 W

The areas of the WSA are on the following U. S. Geological Survey topographic maps:

15-minute:

Black Canyon
Hoover Dam
Senator Mountain

The nearest sizeable town is Boulder City which is located about 10 miles due west of the GRA in Nevada. Major access to the area is via Lake Mead to the north and U.S. Highway 93 to the southwest, Benelli Landing Road and Temple Bar Road to the east are secondary access roads not identified on Figure 2. Access within the area is via light duty and unimproved roads.

Figure 2 outlines the boundaries of the GRA and the WSA on a topographic base at a scale of 1:250,000.

Figure 3 is a geologic map of the GRA and vicinity, also at 1:250,000. At the end of the report, following the Land Classification Maps, is a geologic time scale showing the various geologic eras, periods and epochs by name as they are used in the text, with the corresponding age in years. This is so that the reader who is not familiar with geologic time subdivisions will have a comprehensive reference for the geochronology of events.

This GRA Report is one of fifty-five reports on the Geology-Energy-Minerals potential of Wilderness Study Areas in the Basin and Range Province, prepared for the Bureau of Land Management by the Great Basin GEM Joint Venture.

The principals of the Venture are Arthur Baker III, G. Martin Booth III, and Dennis P. Bryan. The study is principally a literature search supplemented by information provided by claim owners, other individuals with knowledge of some areas, and both specific and general experience of the authors. Brief field verification work was conducted on approximately 25 percent of the WSAs covered by the study.

The WSA was checked from the air on October 22, 1982 and ground checked on October 23, 1982.

One original copy of background data specifically applicable to this GEM Resource Area Report has been provided to the BLM as the GRA File. In the GRA File are items such as letters from or notes on telephone conversations with claim owners in the GRA or the WSA, plots of areas of Land Classification for Mineral Resources on maps at larger scale than those that accompany this report if such were made, original compilations of mining claim distribution, any copies of journal articles or other documents that were acquired during the research, and other notes as are deemed applicable by the authors.

As part of the contract that resulted in this report, a background document was also written: Geological Environments of Energy and Mineral Resources. A copy of this document is included with the GRA File to this GRA report. There are some geological environments that are known to be favorable for certain kinds of mineral deposits, while other environments are known to be much less favorable. In many instances conclusions as to the favorability of areas for the accumulation of mineral resources, drawn in these GRA Reports, have been influenced by the geology of the areas, regardless of whether occurrences of valuable minerals are known to be present. This document is provided to give the reader some understanding of at least the most important aspects of geological environments that were in the minds of the authors when they wrote these reports.

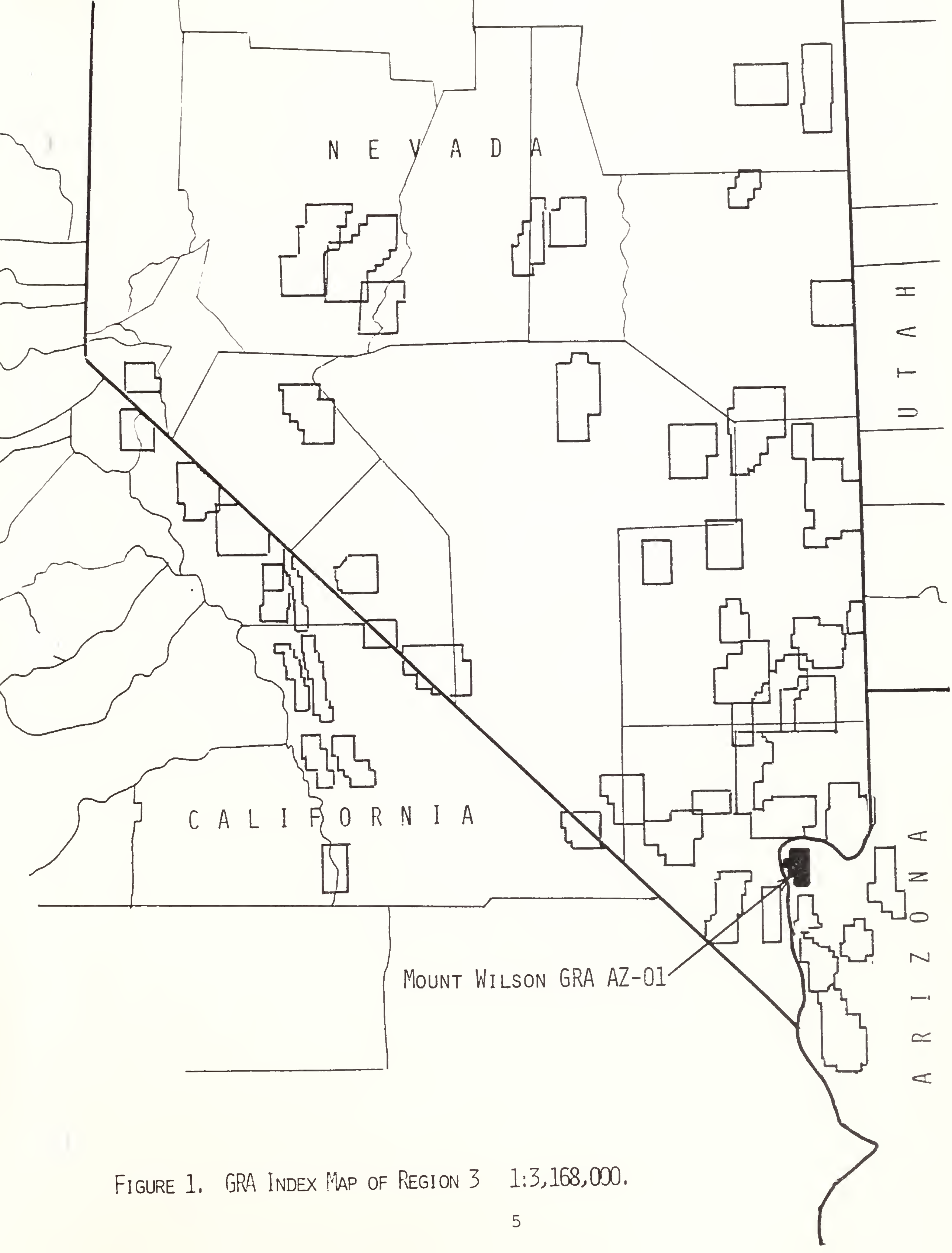
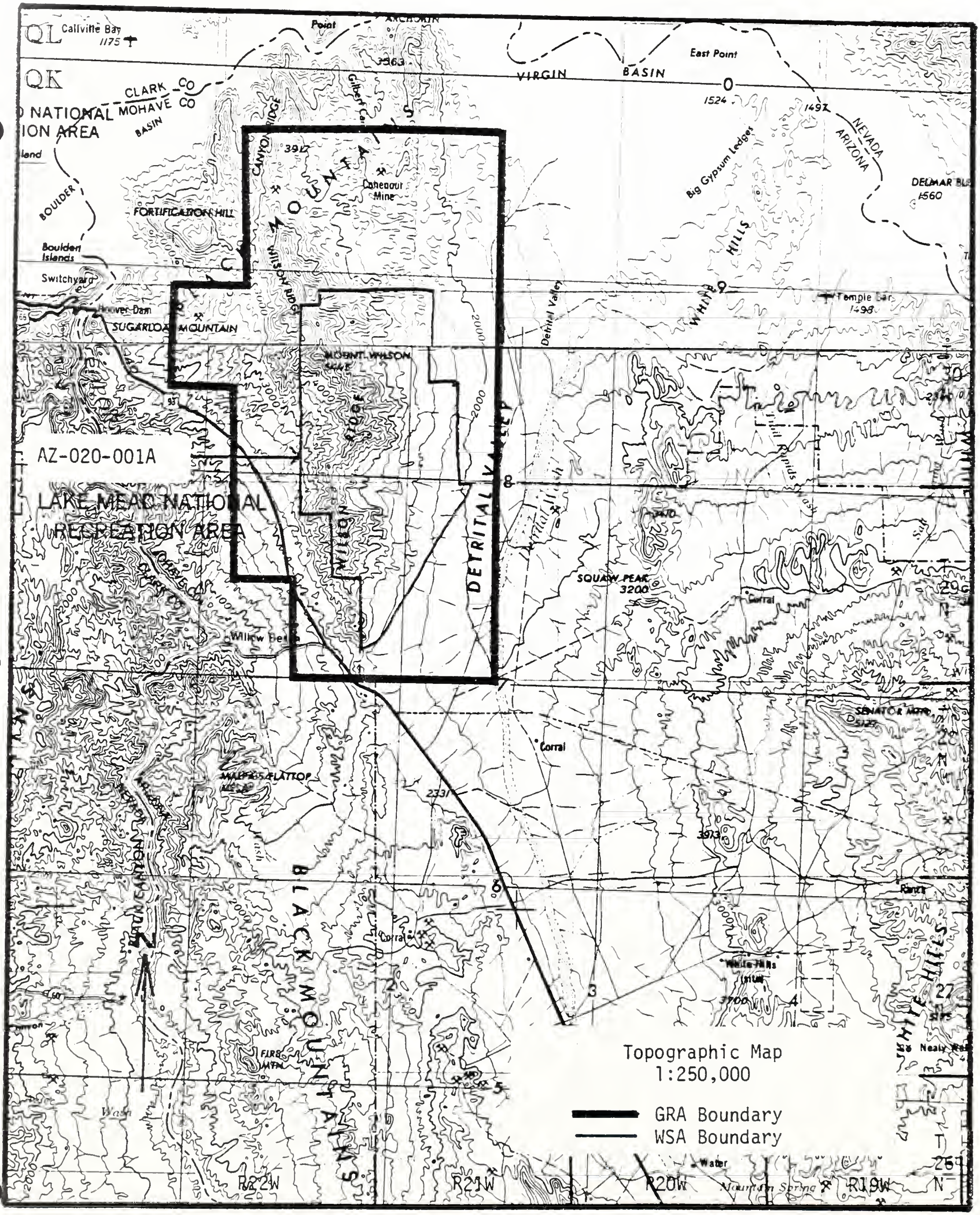


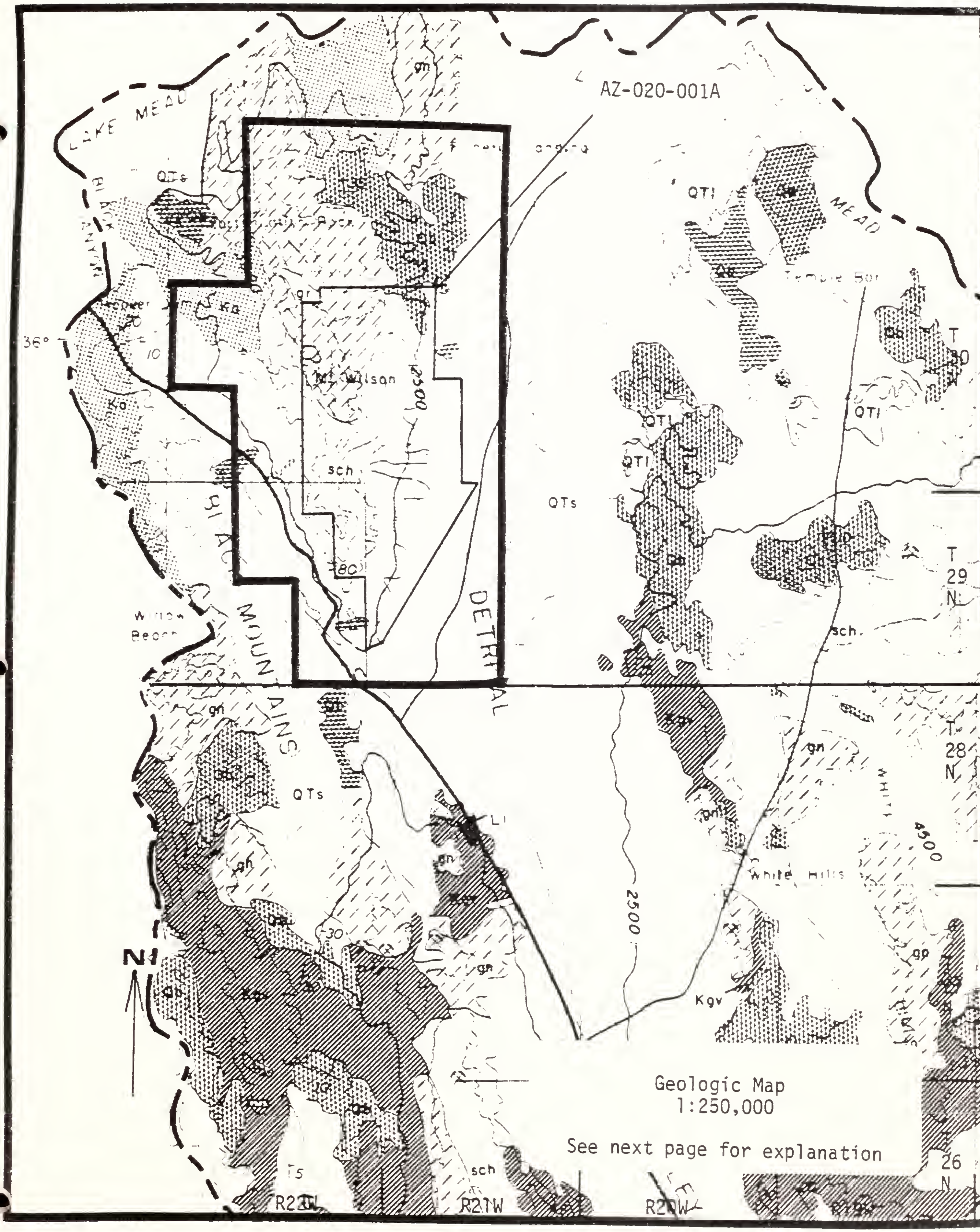
FIGURE 1. GRA INDEX MAP OF REGION 3 1:3,168,000.



Las Vegas Sheet

Mount Wilson GRA AZ-01

Figure 2



Mohave County Geologic Map, Wilson and Moore (1959)

Mount Wilson GRA AZ-01

Figure 3

E X P L A N A T I O N

QUATERNARY

Qs Silt, sand, and gravel.	Qb **Basalt** *Locally includes tuff and agglomerate.*	**Dikes and plugs**

QUATERNARY – TERTIARY

QTs **Sand, gravel, and conglomerate.**	QTl **Lake Deposits** *Siltstone, sandstone, and limestone.*	QTb **Basalt** *Locally includes tuff and agglomerate.*

TERTIARY

Ts **Sand, gravel, and conglomerate.**	Tr **Rhyolite** *Includes tuff and agglomerate*	Ta **Andesite** *Flows, tuff, and agglomerate*

TERTIARY – CRETACEOUS (LARAMIDE)

TKs **Sandstone, shale and conglomerate** *Includes some basalt.*	Lg **Granite and related crystalline rocks**	Ti **Dikes and plugs** *Rhyolitic to andesitic in composition.*

CRETACEOUS

Ks **Limestone conglomerate**	Ka **Andesite** *Flows, tuff, and agglomerate*	Kr **Gold Road volcanics** *Includes rhyolite, latite, and andesite. Locally contains volcanic glass.*

TRIASSIC AND JURASSIC

ℛJg
Glen Canyon group
Includes in descending order, Navajo sandstone Kayenta formation, Moenave formation, and Wingate sandstone.

TRIASSIC

ℛc
Chinle formation

ℛs
Shinarump conglomerate

ℛm
Moenkopi formation

EXPLANATION CONT.

TRIASSIC

- Rc — **Chinle formation**
- Rs — **Shinarump conglomerate**
- Rm — **Moenkopi formation**

PERMIAN

- Pk — **Kaibab limestone**
  Includes Toroweap formation
- Pc — **Coconino sandstone**
- Ph — **Hermit shale**

PENNSYLVANIAN AND PERMIAN

- PPs — **Supai formation**
- PPc — **Callville limestone**

MISSISSIPPIAN AND DEVONIAN

- CDl — **Redwall and Martin limestones**

CAMBRIAN

- **Tonto group**

OLDER PRECAMBRIAN

- gr — **Granite and related crystalline intrusive rocks**
- di — **Diorite porphyry**
- sch — **Schist**
- gn — **Granite gneiss**

SYMBOLS

- Contact, showing dip
- Fault, showing dip
  Dashed where approximately located
- Thrust fault
  (T, upper plate)
- Axis of anticline
- Axis of syncline
- Strike and dip of beds
- 90 — Strike of vertical beds
- Mine

II. GEOLOGY

The Mount Wilson GRA is an assemblage of Precambrian basement rocks overlain by Tertiary volcanics. This sequence has been intruded by a sizeable Tertiary granitic pluton. The Precambrian consists predominantly of metamorphosed gneiss and schist with intercolated granitic assemblages. The Tertiary volcanics can be divided into two distinct assemblages, both Miocene in age, and consisting of rhyolitic to intermediate flows and tuffs. Detrital valley fill makes up most of the remaining section in the area.

Structure in the area is dominated by basin and range influences but modified by the extensive incising of the Colorado River. Drainage flows to the river and especially on the western slope of the range where deep canyons have been cut, stripping off most of the previous valley fill and exposing the underlying bedrock.

Recent geological mapping in the northwest part of Arizona is lacking, and the only geologic map available which covers all the GRA is Wilson and Moore's county map published in 1959 at a scale of 1:375,000. Many of the units on this map have subsequently been found to be radically different than when originally mapped, both in age and origin. The principal source of information for this geologic description for this GRA is from Anderson, 1978, Geologic Quadrangle Map of the Black Canyon Quadrangle which covers approximately the southern two thirds of the GRA. Information on the geology on the northern portion of the GRA is therefore sketchy and has had to be interpolated.

1. PHYSIOGRAPHY

The Mt. Wilson GRA is located in the Basin and Range Province in northwestern Mohave County, Arizona due east of Boulder City, Nevada. The study area contains the northern portion of the Black Mountains which is a southern extension of the Muddy Range located to the north across the Colorado River in southeastern Nevada. The northern Black Mountains is bounded on the east by Detrital Valley and on the north and west by the Colorado River.

The topography is similar to that of the Basin and Range except that the Colorado River has altered the usual drainage patterns. The area of the GRA has been stripped of much of its original valley fill exposing underlying bedrock. Maximum elevations along the crest of the range average about 5,000 feet while Detrital Valley to the east is near 2,000 feet.

2. ROCK UNITS

The Black Mountains in the study area are composed of a Precambrian metamorphic gneissoid complex intruded by the

Wilson Ridge pluton and overlain or flanked by Tertiary volcanics and detrital sediments.

The oldest rocks in the study area are metamorphosed Precambrian rocks consisting of biotite-almandine gneiss and schist and garnetiferous granite pegmatite. The unit is often segregated into bands of granite gneiss and schist a few feet to many tens of feet wide. There are locally both mafic and siliceous segregations. These metamorphic rocks are found throughout the GRA. The Precambrian metamorphics had previously been mapped as extending all the way north to the Colorado River but more recent information by Anderson (1978) indicates that much of this outcrop area is actually a Tertiary pluton.

According to the county geologic map there are two small remnants of Paleozoic sediments in the northern part of the GRA. Nothing else is known about them.

Deposited unconformably over the Precambrian metamorphics is a series of Tertiary volcanics. These volcanic rocks include the Patsy Mine Volcanics and the Mount Davis Volcanics, both of Miocene age. The Patsy Mine Volcanics consist of rhyolite lavas and tuffaceous sedimentary rocks in its upper part to andesite lava and breccia in its lower part. The Mount Davis Volcanics unconformably overlie the Patsy Mine Volanics and consist of mafic lavas and flow breccias in its upper part to dacite lava and flow breccia in its lower part. Sedimentary rocks consisting of volcaniclastic and tuffaceous rocks are also present locally.

These volcanics are found along the western and northern boundary of the GRA. It is unclear as to which series predominates in the north because adequate geologic mapping is not available. On Wilson and Moore's Mohave County geologic map these volcanics have been dated as Cretaceous.

Intruded into the above assemblage is the Wilson Ridge pluton in the north-central part of the GRA. It ranges in composition from biotite granite to granodiorite to diorite. Elongated inclusions of darker mafic rock are sometimes included, especially along the margins of the intrusive, and zenoliths of metamorphic rocks are common and generally their foliation parallels faint foliation in the host.

Intrusive dikes, oriented generally north-south, ranging from rhyolite to basalt cut all the older rock units.

Unconformably overlying the above metmorphic volcanic and intrusive assemblage is the Muddy Creek Formation of Pliocene-Miocene age. It has previously been primarily mapped as alluvium on the 1959 county geologic map and is located along the western and eastern flanks of Wilson Ridge in the GRA. It consists of mostly detrital alluvial deposits derived from the Black Mountains subsequent to their uplift by basin and range faulting. One member of the Muddy Creek Formation is the Fortification Basalt member described by Anderson (1978) as lavas which are intercalated with and overlying the sedimentary rocks of the Muddy Creek Formation. This basalt is found capping Fortification Hill just west of the GRA boundary, in a large area on the eastern edge of the Black Mountains and in several small exposures to the south within the GRA. On the county geologic map this unit is identified as Quaternary Basalt.

Quaternary alluvium is found in all the washes flowing west and north into the Colorado River and to the east in Detrital Valley.

3. STRUCTURAL GEOLOGY AND TECTONICS

The oldest structures preserved in the GRA are found in the Precambrian metamorphic rocks and consists of schistosity, folding and minor thrusting. Structural trends in the metamorphics are in a northerly direction.

Tertiary basin and range faulting has obviously had an influence on the present day topography of downdropped valleys and uplifted ranges. The Black Mountains is a compound horst block. Much tectonic movement was taking place during mid-Teritary with basin and range faulting starting in the Miocene. Along the western boundary of the Black Mountains, but outside the GRA, there are steeply dipping, northerly trending faults with large displacements.

4. PALEONTOLOGY

Paleontological formations within the Mount Wilson GRA are restricted to units mapped as Quaternary, which include correlatives of the Chemehuevi and Gila Formations. The presence of mammalian fossils at several localities in the Chemchuvei, including the elephant Mammuthus Primagenus, has been established for over 100 years (e.g. Newberry, 1861). Nonmaime mollussks are also known to occur in these strata (Longwell, 1946) and correlative units, although neither mammalian or molluscan fossils have been recorded from within the GRA. Other lithologies exposed within the Mount Wilson GRA do not contain paleontological resources.

5. HISTORICAL GEOLOGY

During the Precambrian, existing granitic igneous rocks were extensively deformed and metamorphosed to gneiss and schist. Following this deformation, the terrain was eroded and later covered by a sequence of Paleozoic carbonate sediments. A long period of erosion followed, erasing most traces of the Paleozoic sediments in this area until the activation of volcanism during the late Tertiary. Basin and range faulting was active apparently during this same time. Renewed uplift during this late Tertiary period resulted in erosion which stripped away much of the volcanics exposing the Precambrian core.

In more recent time the Colorado River cut into the nearby landscape to the west and erosion proceeded rapidly carving steep canyons along the west slope of the range. The alluvial gravels of both the Muddy Creek Formation and the Quaternary time were eroded away to a great extent exposing the underlying Precambrian metamorphics and Tertiary volcanics. This is the same geological regime which dominates the area at present. Recent alluvium is found in the western drainage and in the wide valley to the east.

III. ENERGY AND MINERAL RESOURCES

A. METALLIC MINERAL RESOURCES

1. Known Mineral Deposits

No major mining districts are located within the Mt. Wilson GRA or the included WSA. Although mine locations are indicated on topographic maps of the area, specific production and geologic information regarding them was not found in any available information during the course of this investigation.

Several "mines" listed by the Arizona Dept. of Mineral Resources in their study conducted in 1981 occur within the study area, but due to the lack of data discussion of them would be strictly conjecture.

The following table lists the known "mines" within the study area their reported commodities according to the Arizona Department of Mineral Resources and their locations:

Mine	Location
Two B's mine (Unknown commodity)	Sec. 11, T 29 N, R 22 W
Old Johnny mine (Grand View) (Au, Ag, Cu)	Sec. 6, T 30 N, R 22 W
Old Pope mine (Au)	Sec. 15, T 31 N, R 22 W
Cohenour mine (Ag, Zn, Cu)	Sec. 18, T 31 N, R 21 W

The Two B's mine, approximately five miles northeast of Willow Beach, and shown on the metallic minerals Land Classification Map, is located on a northwest trending structure that cuts Precambrian metamorphic rocks just outside the western boundary of the WSA. A field check of the mine was conducted as no additional information was available. The underground workings and surface prospect pits are many years old and appear to be following small, narrow mineralized veins trending northerly. Secondary iron and copper minerals are present locally. It is unknown whether there was any production from the property, but from the size of the workings it seems unlikely.

2. Known Mineral Prospects, Mineral Occurrences and Mineralized Areas

Information concerning prospects located in the study area is lacking. The unknown "tunnels" prospect two miles southeast of the Two B's mine as identified on the Black Canyon 15-minute topographic map was field checked and found to consist of shallow inclined workings following quartz stringers in the Precambrian schists. Dark grey to black iron oxides were associated with these stringers and there did not appear to be any additional mineralization.

3. Mining Claims

There are no known patented claims within the GRA.

Only eight unpatented claims, all lode, are located within the GRA, four at the Two B's mine, two at the unknown "tunnels" prospect (as identified on the U. S. Geological Survey topographic maps) and two miles south of the Old Johnny mine west of Mt. Wilson. Only the two claims at the unknown "tunnels" prospect are inside the WSA boundary. The other claims all are within the Lake Mead National Recreation Area boundary. The status of these claims within the boundary of Lake Mead National Recreation Area is uncertain as locating mining claims in the recreation area is not permitted.

The Alfred & Whitmore lease within the recreation area is located approximately one mile north of the Cohenour mine along the northern boundary of the GRA. The Cohenour mine also involves a mineral lease. There is also an additional mineral lease application covering four sections in the southwest corner of the GRA. All these leases are presumed to be for locatable mineral commodities as mining claims are not allowed within the Lake Mead National Recreation Area. Mineral commodities which are locatable on the outside are leasable within the recreation area.

4. Mineral Deposit Types

The absence of data precludes detailed discussion concerning the genetic relationships and nature of mineralization occurring at most of the reported "mines" in the GRA.

The limited copper and iron secondary mineralization at the Two B's mine indicates oxidized sulfide in narrow veins in Precambrian rocks. The unknown "tunnels" prospects and the pegmatite to the southeast of the Two B's mine appears to follow Precambrian structures which have iron oxides along narrow fractures.

5. Mineral Economics

The lack of historical mining activity and the small number of mineral claims and leases in the area indicate that current mineral exploration interest within the GRA is low.

Based on available information on the known mines and prospects within the study area, they appear to be small and mostly narrow vein type thereby making costs of mining considerably higher than deposits which could be bulk mined.

The existence of the Lake Mead National Recreation Area in the northern and western portions of this GRA may also have a negative influence on the economics of mineral exploration or mine development.

B. Nonmetallic Mineral Resources

1. Known Mineral Deposits

There is no reported nonmetallic production from within the GRA or the included WSA. The Old Johnny mine near the west edge of the GRA is reported as containing feldspar and quartz in pegmatite (Arizona Department of Mineral Resources) but it is unknown whether there was any production.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

The most important prospect in the GRA is the Detrital Valley salt prospect located on the southeast border of the GRA. Information from more than a dozen drill holes indicates that the bedded rocksalt occurs from 300-800 feet beneath the surface and attains a maximum thickness of about 715 feet. The Detrital Valley salt prospect has not been developed but possesses significant potential for salt production and possibly subsurface storage of liquid petroleum gas products (Pierce, 1981).

Both the Detrital Valley Salt Prospect and a few gypsum prospects to the north but outside the GRA are associated with the gypsum-anhydrite-clastic sequence of the Miocene Muddy Creek Formation.

A field check of a pegmatite near the unknown "tunnels" prospect as mapped by Anderson (1978) showed the unit to be only a coarse grained granitic rock. There was no indication of some of the relatively rare mineralization that is sometimes associated with zoned pegmatites.

The same field check of the "unknown tunnels" prospect and nearby pegmatite also revealed stringers and more massive concentrations (up to 15 feet across) of blackish iron oxides.

3. Mining Claims, Leases and Material Sites

Some of the same unpatented claims within the GRA described above under metallics could possibly be for nonmetallics as pegmatites are known to exist but since we have very limited occurrence data it is unknown why the claims were staked.

Sodium leases cover several square miles of Detrital Valley along the southeastern border of the GRA but do not include any part of the WSA.

Sand and gravel material sites are located along U.S. Highway 93 which crosses the southwest edge of the GRA but none are known within the WSA.

4. Mineral Deposit Types

The Detrital Valley salt deposit was formed during the Miocene and is associated with the gypsum-andydrite-clastics evaporite sequence of the Muddy Creek Formation. The bedded salt occurs from 300-800 feet below the surface and was discovered by drilling (Pierce. 1969). Evaporite outcroppings of this formation to the north are in the form of gypsum. The deposit attains a maximum thickness of about 715 feet. In addition to salt production, this deposit could possibly be utilized for the storage of liquid petroleum products in man-made solution cavities.

The reported occurrence of quartz and feldspar at the Old Johnny mine is in Precambrian pegmatites.

The iron oxide in pegmatitic rocks near the unknown "tunnels" prospect is of unknown origin.

5. Mineral Economics

The Detrital Valley salt prospect may be economically feasible to mine utilizing solution mining and solar evaporation. It is also being considered for the storage of liquid petroleum products. Not enough is known about the associated gypsum to make a statement concerning its economic potential.

Possible nonmetallics in the pegmatites in the area are also not well enough known for a discussion of their economics but in all likelihood their economic potential is low. A field check of one pegmatite outcrop showed what is mapped as pegmatite to be a coarse-grained granite.

C. ENERGY RESOURCES

Uranium and Thorium Resources

1. Known Mineral Deposits

There are no producing uranium or thorium mines and no significant uranium or thorium deposits within or adjacent to the GRA.

2. Known Prospects, Mineral Occurrences, and Mineralized Areas.

Radioactive occurrences are indicated on the Uranium Land Classification and Mineral Occurrence Map included at the back of the report.

There is one uranium occurrence within the GRA, on the western border of the WSA, the Rainy Day claim. There are several uranium occurrences near the GRA, including the Plendina claims on the southwest border of the GRA. The uranium occurrences in and near the GRA are tabulated from Luning and others (1981) as follows:

U. Occurrence	Location	Type of Uranium Deposit
Rainy Day claim	S.27(?),T 30 N, R 22 W	Fluvial placer in alluvial fan. (Muddy Creek Fm?)
Plendina claims	S.32&33,T 29 N, R 22 W S.4&5,T 28 N, R 22 W	Uranium in pegmatite
Cisco (Getty-East Mesa)	SW/4 S.23,T 30 N, R 20 W	In tuffaceous limestone of Muddy Creek Fm.
Dab No.1,Dreamer (Getty-East Mesa)	SW/4 S.22,T 30 N, R 20 W	In tuffaceous mudstone of Muddy Creek Fm.
Lucky 44	NE/4 S.18,T 30 N, R 20 W	In fluviatile seds. of Muddy Creek Fm.
Kidd claims	S.12&13,T 29 N, R 21 W	In limestone of Muddy Creek Fm.
Big Ledge mine	S.33,T 28 N, R 20 W	Slight radioactivity with metal sulfides in granite.

There are no known thorium occurrences within or near the GRA.

3. Mining Claims

There is one uranium claim or lease noted within the GRA, the Rainy Day claim, and it has probably lapsed. There are no known thorium leases within the GRA.

4. Mineral Deposit Types

The Rainy Day claim is recorded as a fluvial placer in an alluvial fan (Luning and others, 1981). It is more probably an epigenetic sandstone type deposit in fluvial sands of the Miocene-Pliocene Muddy Creek Formation.

5. Mineral Economics

The available data prevents an economic evaluation for uranium and thorium in the area. There are no known significant uranium or thorium deposits within or near the GRA or the WSA.

Uranium in its enriched form is used primarily as fuel for nuclear reactors, with lesser amounts being used in the manufacture of atomic weapons and materials which are used for medical radiation treatments. Annual western world production of uranium concentrates totaled approximately 57,000 tons in 1981, and the United States was responsible for about 30 percent of this total, making the United States the largest single producer of uranium (American Bureau of Metal Statistics, 1982). The United States ranks second behind Australia in uranium resources based on a production cost of $25/pound or less. United States uranium demand is growing at a much slower rate than was forecast in the late 1970s, because the number of new reactors scheduled for construction has declined sharply since the accident at the Three Mile Island Nuclear Plant in March, 1979. Current and future supplies were seen to exceed future demand by a significant margin and spot prices of uranium fell from $40/pound to $25/pound from January, 1980 to January, 1981 (Mining Journal, July 24, 1981). At present the outlook for the United States uranium industry is bleak. Low prices and overproduction in the industry have resulted in the closures of numerous uranium mines and mills and reduced production at properties which have remained in operation. The price of uranium at the end of 1982 was $19.75/pound of concentrate.

Thorium is used in the manufacture of incandescent gas mantles, welding rods, refractories, as fuel for nuclear power reactors and as an alloying agent. The principal source of thorium is monazite which is recovered as a byproduct of titanium, zirconium and rare earth recovery from beach sands. Although monazite is produced from Florida beach sands, thorium products are not produced from monazite in the United States. Consequently, thorium products used in the United States come from imports, primarily from France and Canada, and industry and government stocks. Estimated United States consumption of thorium in 1980 was 33 tons, most of which was used in incandescent lamp mantles and refractories (Kirk, 1980b). Use of thorium as nuclear fuel is relatively small at present, because only two commercial thorium-fueled reactors are in operation. Annual United States demand for thorium is projected at 155 tons by 2000 (Kirk, 1980a). Most of this growth is forecast to occur in nuclear power reactor usage, assuming that six to ten thorium-fueled reactors are on line by that time. The United States and the rest of the world are in a favorable position with regard to adequacy of thorium reserves. The United States has reserves estimated at 218,000 tons of ThO_2 in stream and beach placers, veins and carbonatite deposits (Kirk, 1982); and probable cumulative demand in the United States as of 2000 is estimated at only 1800 tons (Kirk, 1980b). The price of thorium oxide at the end of 1981 was $16.45 per pound.

Oil & Gas Resources

There are no known known oil and gas deposits, hydrocarbon shows in wells or as surface seeps in the region. However, essentially all the Federally-administered lands within and in the vicinity of the WSA are leased for oil and gas resources (see Oil and Gas Lease Map). This part of Arizona is part of the Overthrust Belt and is therefore considered to have potential for oil and gas as an exploration target area. There is no oil and gas occurrence and land classification map with the report.

Geothermal Resources

There are no known geothermal deposits within the Mt. Wilson GRA, but three miles west of the GRA on the Arizona/Nevada border in Black Canyon along the Colorado River, there is a six-mile-long series of warm springs with temperatures of up to 63°C (see Geothermal Occurrences and Land Classification Map). The six springs are either sodium chloride or sodium sulphate and have a total dissolved solids content of 1040 to 5600 ppm (NOAA, 1982).

There are no Federal geothermal leases present, and no geothermal lease map is included in the report.

Geothermal resources are utilized in the form of hot water or steam normally captured by means of drilling wells to a depth of a few feet to over 10,000 feet in depth. The fluid temperature, sustained flow rate and water chemistry characteristics of a geothermal reservoir determine the depth to which it will be economically feasible to drill and develop each site.

Higher temperature resources (above 350°F) are currently being used to generate electrical power in Utah and California, and in a number of foreign countries. As fuel costs rise and technology improves, the lower temperature limit for power will decrease appreciably -- especially for remote sites.

All thermal waters can be beneficially used in some way, including fish farming (68°F), warm water for year around mining in cold climates (86°F), residential space heating (122°F), greenhouses by space heating (176°F), drying of vegetables (212°F), extraction of salts by evaporation and crystallization (266°F), and drying of diatomaceous earth (338°F).

Unlike most mineral commodities remoteness of resource location is not a drawback. Domestic and commercial use of natural thermal springs and shallow wells in the Basin and Range province is a historical fact for over 100 years.

Development and maintenance of a resource for beneficial use may mean no dollars or hundreds of millions of dollars, depending on the resource characteristics, the end use and the intensity or level of use.

D. OTHER GEOLOGICAL RESOURCES

No other geological resources have been recognized in this GRA except that the northern portion of the GRA is within the Lake Mead National Recreation Area, which is known for its scenic geologic erosional landforms.

E. STRATEGIC AND CRITICAL MINERALS AND METALS

A list of strategic and critical minerals and metals provided by the BLM was used as a guideline for the discussion of strategic and critical materials in this report.

The Stockpile Report to the Congress, October 1981-March 1982, states that the term "strategic and critical materials" refers to materials that would be needed to supply the industrial, military and essential civilian needs of the United States during a national emergency and are not found or produced in the United States in sufficient quantities to meet such need. The report does not define a distinction between strategic and critical minerals.

No strategic and critical minerals are known to have been produced from this GRA. Silver, zinc and copper, however, are reported at locations inside the GRA but outside the WSA. No additional information is known concerning these commodities however.

IV. LAND CLASSIFICATION FOR GEM RESOURCES POTENTIAL

Land classification areas are numbered starting with the number 1 in each category of resources. Metallic mineral land classification areas have the prefix M, e.g. M1-4D. Uranium and thorium areas have the prefix U. Nonmetallic mineral areas have the prefix N. Oil and gas areas have the prefix OG. Geothermal areas have the prefix G. Sodium and potassium areas have the prefix S. The saleable resources are classified under the nonmetallic mineral resource section. Both the Classification Scheme, numbers 1 through 4, and the Level of Confidence Scheme, letters A, B, C and D, as supplied by the BLM are included as attachments to this report. These schemes were used as strict guidelines in developing the mineral classification areas used in this report.

Land classifications have been made here only for the areas that encompass segments of the WSA. Where data outside a WSA has been used in establishing a classification area within a WSA, then at least a part of the surrounding area may also be included for clarification. The classified areas are shown on the 1:250,000 mylars or the prints of those that accompany each copy of this report.

In connection with nonmetallic mineral classification, it should be noted that in all instances areas mapped as alluvium are classified as having moderate favorability for sand and gravel, with moderate confidence, since alluvium is by definition sand and gravel. All areas mapped as principally limestone or dolomite have a similar classification since these rocks are usable for cement or lime production. All areas mapped as other rock, if they do not have specific reason for a different classification, are classified as having low favorability, with low confidence, for nonmetallic mineral potential, since any mineral material can at least be used in construction applications.

Approximately the southern two thirds of the GRA and 90 percent of the WSA is covered by Anderson's (1978) geologic map at a scale of 1:62,500. This map is excellent for rock types and structure but makes no mention of mineralization. The northern portions of both the WSA and GRA are covered by either the 1:375,000 county geologic map by Wilson and Moore (1959) or Longwell's 1963 reconnaissance geology map of the Lake Mead area. Both of these maps are not detailed in either geology or structure.

With respect to the WSA, the geology coverage is adequate for the lower 90 percent of the WSA, but totally inadequate for the northern 10 percent of the WSA. The available information on mineralization or occurrences in the GRA is totally lacking. Overall our confidence level in the information available is high for Anderson's (1978) map and moderate for the other information.

1. LOCATABLE RESOURCES

a. Metallic Minerals

WSA AZ 020-001A

M1-2B. This classification area indicates low favorability for mineral resources with a low confidence level and includes the granitic Tertiary intrusive Mount Wilson pluton covering much of the northwestern two-thirds of the GRA and the northern portion of the WSA. Due to the lack of detailed mapping and other basic geologic information in the northern part of the WSA, however, the boundaries of the northern portion of the classification area may be subject to change. There is at least one old mine and possibly two mines or prospects in this unit to the north indicating mineralization in the unit, but more detailed geological information is unknown. Since there has been little previous evidence of mining or prospecting activity in this unit in the WSA, and the limited geological information does not indicate mineral potential in the WSA, however, we have ranked the area with a 2 classification indicating low favorability for the accumulation of mineral resources.

M2-2B. This classification is one of low favorability with a low confidence level and covers the metamorphosed Precambrian rocks in the WSA. These exposures are where the Two B's mine is located and also where some adits called unknown "tunnels" is found to the southwest of the Two B's. We do not know what commodities were produced, if any, at these locations however. Based on the limited past mining activity and limited geological information we classify this area as low favorability (2) with a low confidence level of (B).

M3-2B. This classification is for low favorability with a low confidence level. This area includes the outcrop area of the Tertiary Fortification Basalt in a small portion of the northeast corner of the WSA. Nothing in the way of mineral potential or past prospecting is known within the basalt unit and we have no geologic indication nor do we even suspect that the unit would be mineralized. There is a possibility though that beneath the basalts, the underlying Precambrian unit or intrusive could be mineralized, so we have retained a low favorability for mineral resources (2) with a low confidence level (B), the same classification for the previously described classification areas above M1-2B and M2-2B.

M4-2B. This classification area is one of low favorability with a low confidence level and covers the alluvial cover flanking both sides of the range. The nature of the bedrock beneath the alluvial cover is unknown, but because the adjacent bedrock units are classified as having a low potential then the same units beneath the alluvium would also have a low potential using the same rationale as above.

b. Uranium & Thorium

WSA AZ 020-001A

U1-2B. This area includes Precambrian granite, gneiss, and schist and Tertiary granite and rhyolitic to andesitic flows and tuffs along the western half of the WSA. The area is considered to be of low favorability for uranium and thorium with a low confidence level because there are no known uranium or thorium occurrences in these units in the area. However, uranium does occur in pegmatite near Willow Bend (Luning and others, 1981), just southwest of the GRA, though the pegmatite may not be related to the same granitic intrusion. The granitic and rhyolitic rocks are a potential source of uranium. Uranium and thorium minerals may be prospective in the granites and pegmatites in the area and uranium may also occur as intrusive-contact and vein-type deposits.

U2-3C. This classification indicates that the area has moderate favorability for uranium deposits at a moderate confidence level. This area includes the Miocene-Pliocene alluvial deposits of the Muddy Creek Formation along the western border and eastern half of the WSA. The Rainy Day claim on the western border of the WSA is an epigenetic sandstone-type uranium occurrence in the Muddy Creek Formation. Similar uranium occurrences may occur in the Muddy Creek Formation within and near the WSA. The source of the uranium may be the Tertiary granitic and rhyolitic rocks outcropping on the western half of the WSA.

There is a large aerial radiometric uranium anomaly to the east of the GRA over the Muddy Creek Formation (Luning and others, 1981). This anomaly is associated with uranium occurrences and with a geochemical stream sediment uranium anomaly. These anomalies indicate the possibility for uranium occurrences in the Miocene-Pliocene Muddy Creek Formation within the GRA.

The Muddy Creek Formation is composed of shallow marine to continental lacustrine and fluvial sediments. There are some interbedded tuffaceous units within the formation, a probable source for uranium. The Muddy Creek Formation is not considered favorable for large sandstone-type uranium deposits as it lacks reductants (e.g. organic material), there are no channel-fill permeable sandstones (fine-grained lacustrine and shallow marine sediments predominate) and there is little evidence of post-depositional ground-water alteration.

This area has low favorability for thorium deposits at a low level of confidence. There is no land classification and mineral occurrence map for thorium in this report. There is some potential for fluvial and lucustrine resistate thorium mineral concentration (i.e. monazite sands) in the Muddy Creek Formation though there is no published evidence for such deposits within or near the WSA.

c. Nonmetallic Minerals

WSA AZ 020-001A

N1-4D. This classification indicates high favorability for nonmetallic resources with a high degree of confidence. This area consists of that part of the alluvium in Detrital Valley that is or may be underlain by the salt deposits described earlier. These deposits are known to exist and have been partially drilled. The boundary of area N1 may be subject to adjustment depending on inferred interpretation of the buried extent of the salt. This area has been classified as a 4 (high favorability) with a confidence level of D (high confidence level) based on drill hole evidence. Gypsum is associated with this same unit but its extent is not known.

N2-2B. This classification indicates a low favorability with a low confidence level. This area includes the Precambrian rocks within the WSA. Based on the fact that these rocks contain pegmatitic phases, and there is apparently feldspar and quartz in a pegmatite at the Old Johnny mine, we have classified this area 2 (low favorability) with a confidence level of B (low confidence level). On Anderson's (1978) geologic map he includes pegmatitic phases in some of the Precambrian, yet we did not see this in our limited field checking of one of the pegmatites.

N3-2B. This classification indicates low favorability with a low confidence level. This area is underlain by the granite intrusion and the basalts in the northern portion of the WSA. There is no reason to believe that industrial mineral deposits occur here, but the rock units could be used for at least construction material purposes -- hence the 2B (low favorability for metallic mineral resources but with a low confidence level -- indirect evidence only).

N4-3C, N5-3C. These classification areas include the sand and gravel in the alluvium on either side of the mountain range. N5-3C falls within the eastern portion of the WSA. The 3 classification indicates moderate favorability for the accumulation of sand and gravel, and the C confidence level indicates there is direct evidence to support this classification as the unit has been mapped as alluvium indicating the presence of sand and gravel. The physical and chemical properties of the material is unknown however.

2. LEASABLE RESOURCES

a. Oil & Gas

WSA-020-001A

OG1-2A. There has been little or no serious oil and gas exploration within the region, and no indications of oil or gas occurrences in Mohave County. The GRA is within the Overthrust Belt which has prolific production in Wyoming/Utah, Mexico and Canada. The Federal leases are for rank wildcat acreage, and surficial stratigraphic units do not necessarily have a bearing on possible drilling objective at depth, considering overthrust structural implications.

b. Geothermal

WSA AZ-020-001A

G1-3C. The presence of a relatively large Quaternary basalt field indicates the probability of a heat source at depth.

G2-2C. There is a small outcropping of Quaternary basalt which indicates there is a probable heat source at depth. The fact that the outcropping is small may indicate it is a remnant which is geographically removed from the volcanic vent.

G3-2A. This classification is in an area dominantly underlain by Precambrian schist and granite gneiss, and Cretaceous andesite. The area is on regional trend with known geothermal deposits, therefore a low favorability classification.

c. Sodium and Potassium

S1-4D. The discussion of the salt deposits, which are leasable, is included under nonmetallics in a previous section in classification area N1-4D (high favorability for the accumulation of salt with a high confidence level).

3. SALEABLE RESOURCES

The sand and gravel discussion and rationale for classification for the WSA has been included above under the nonmetallic classification and includes areas N4-3C and N5-3C, which indicate a moderate favorability for sand and gravel resources with a moderate confidence level.

V. RECOMMENDATIONS FOR ADDITIONAL WORK

1. We would recommend that other major mining companies, which may have worked in the area in the past be sought out and contacted to see if they could contribute further information. None of the major mining companies contacted during this study had any direct evidence which would indicate mineral favorability in the Mount Wilson GRA.

2. More detailed geology is needed in the northern portion of the WSA. Detailed mapping and geochemical sampling is needed at the reported mine locations in the GRA as nothing of any detail is available concerning them. Even though they are outside the WSA, information obtained in a detailed evaluation of them could lead to a better understanding of mineral potential within the adjacent WSA.

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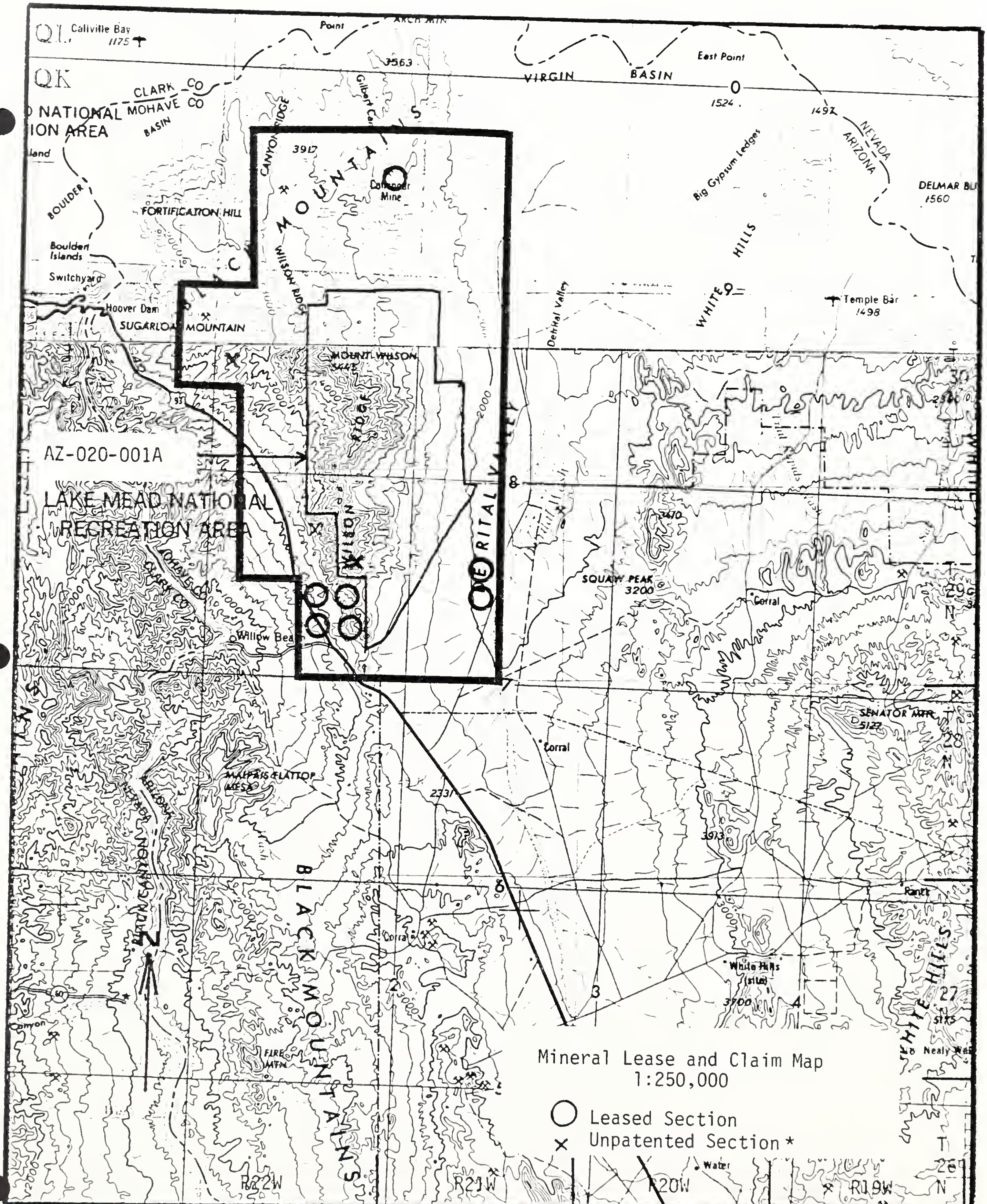
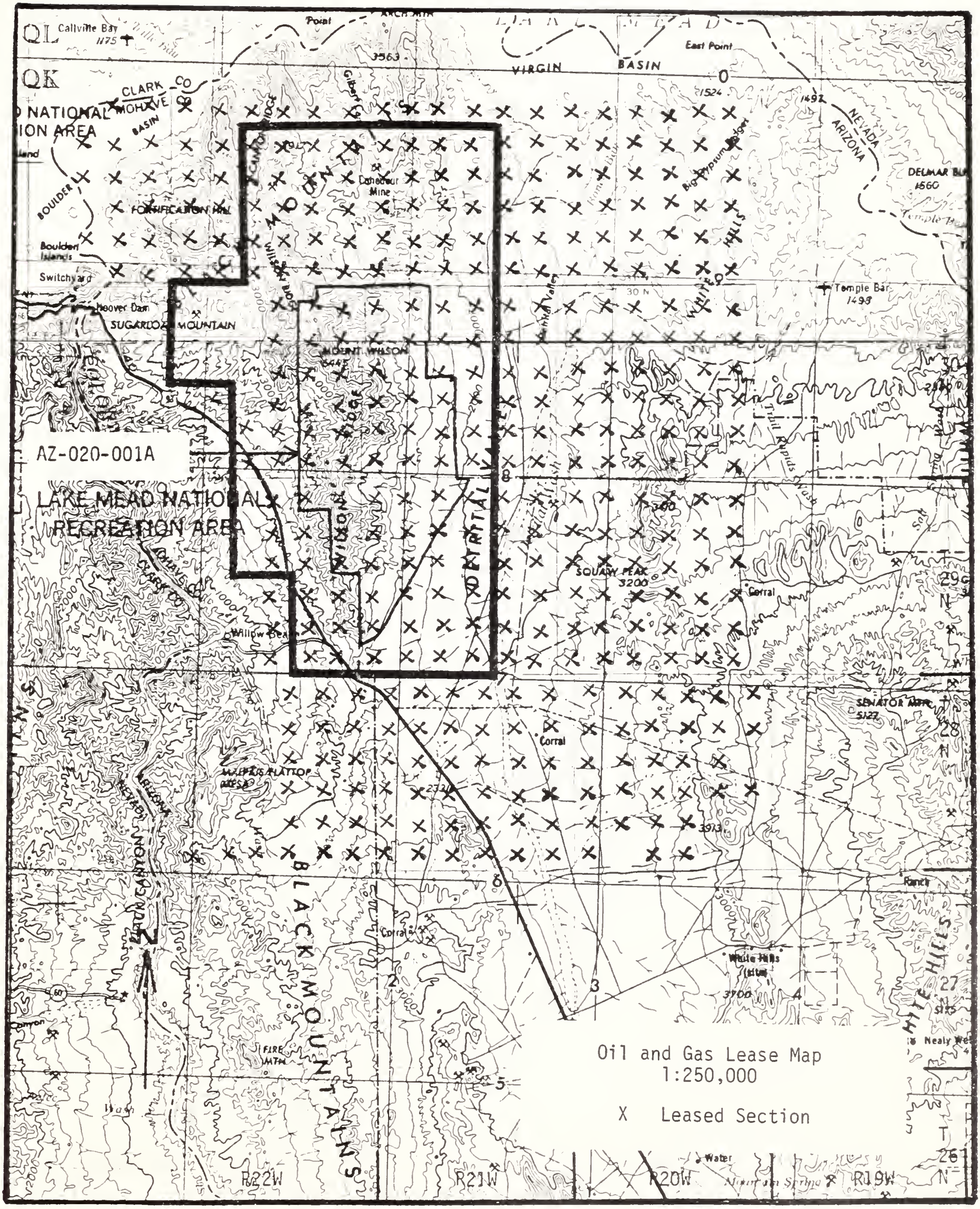


*X denote one or more claims per section

Mount Wilson GRA AZ-01



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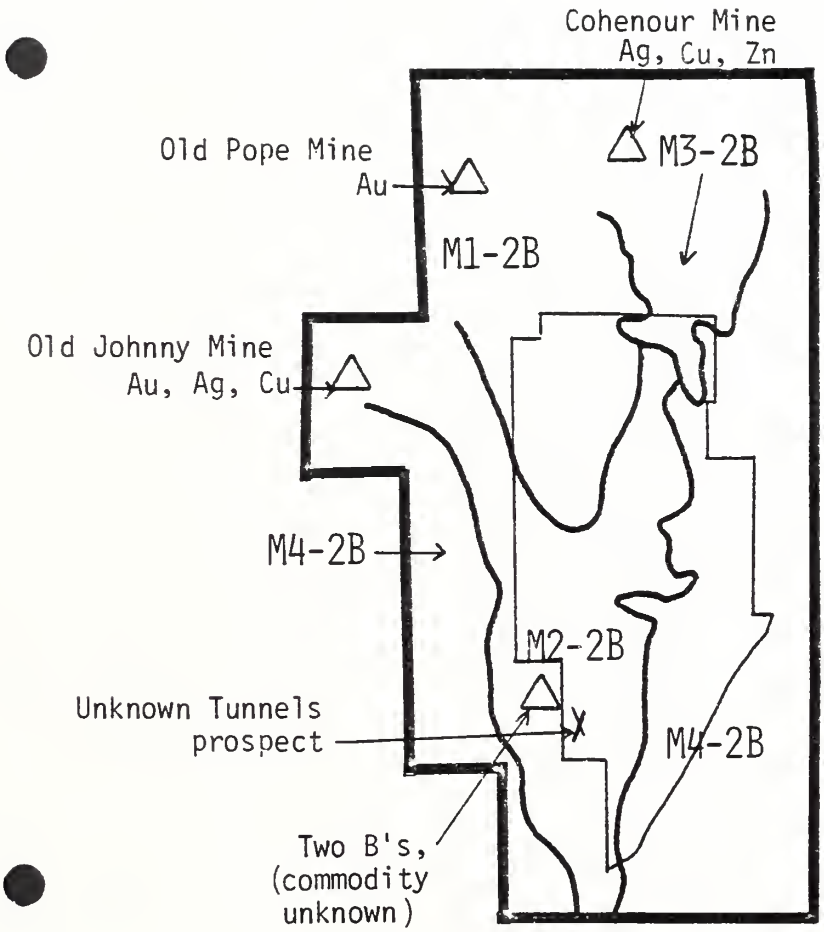


EXPLANATION

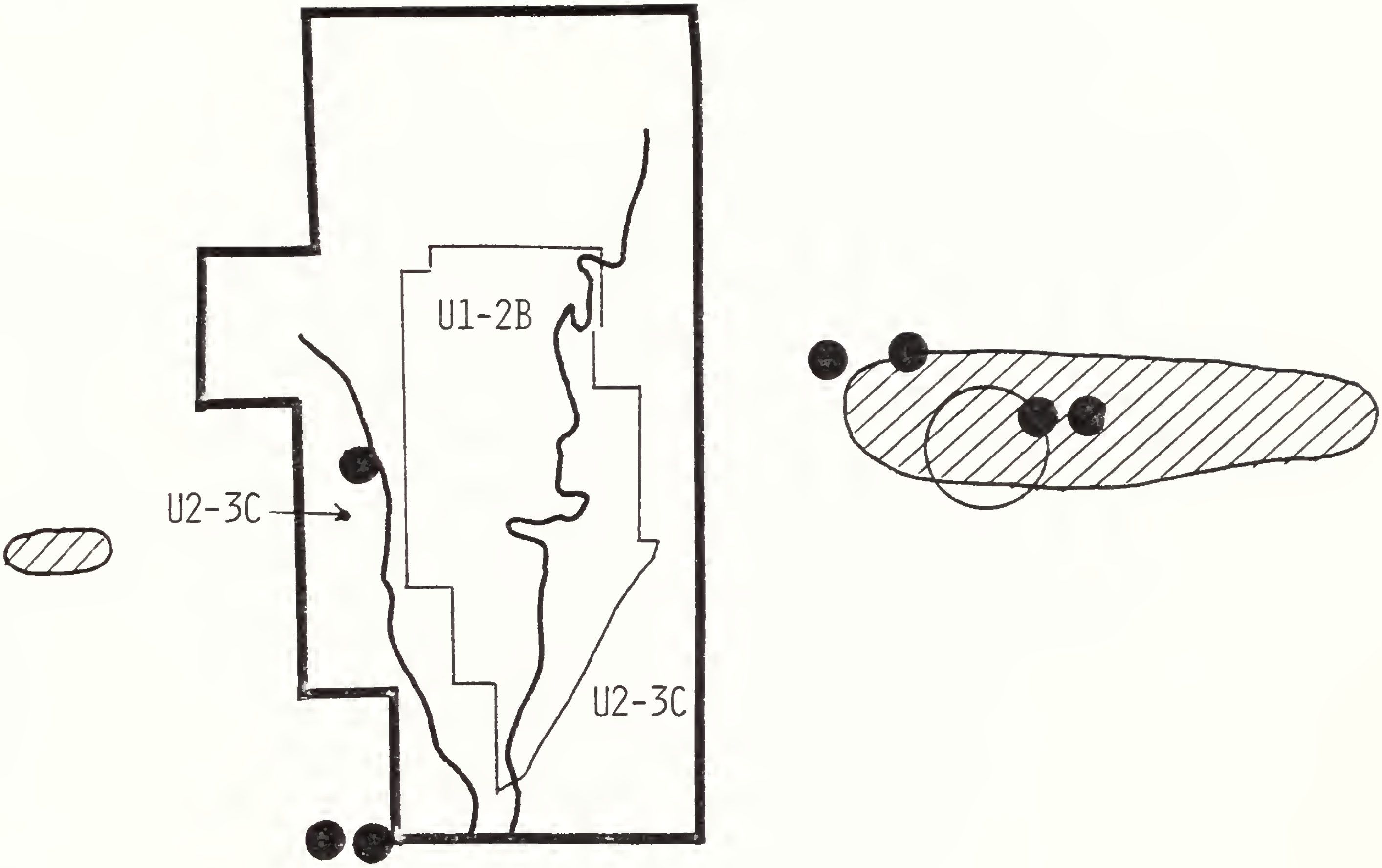
△ Mine, Commodity

Land Classification Boundary

— WSA Boundary

Land Classification - Mineral Occurrence Map/Metallics

Mount Wilson GRA AZ-01
Scale 1:250,000

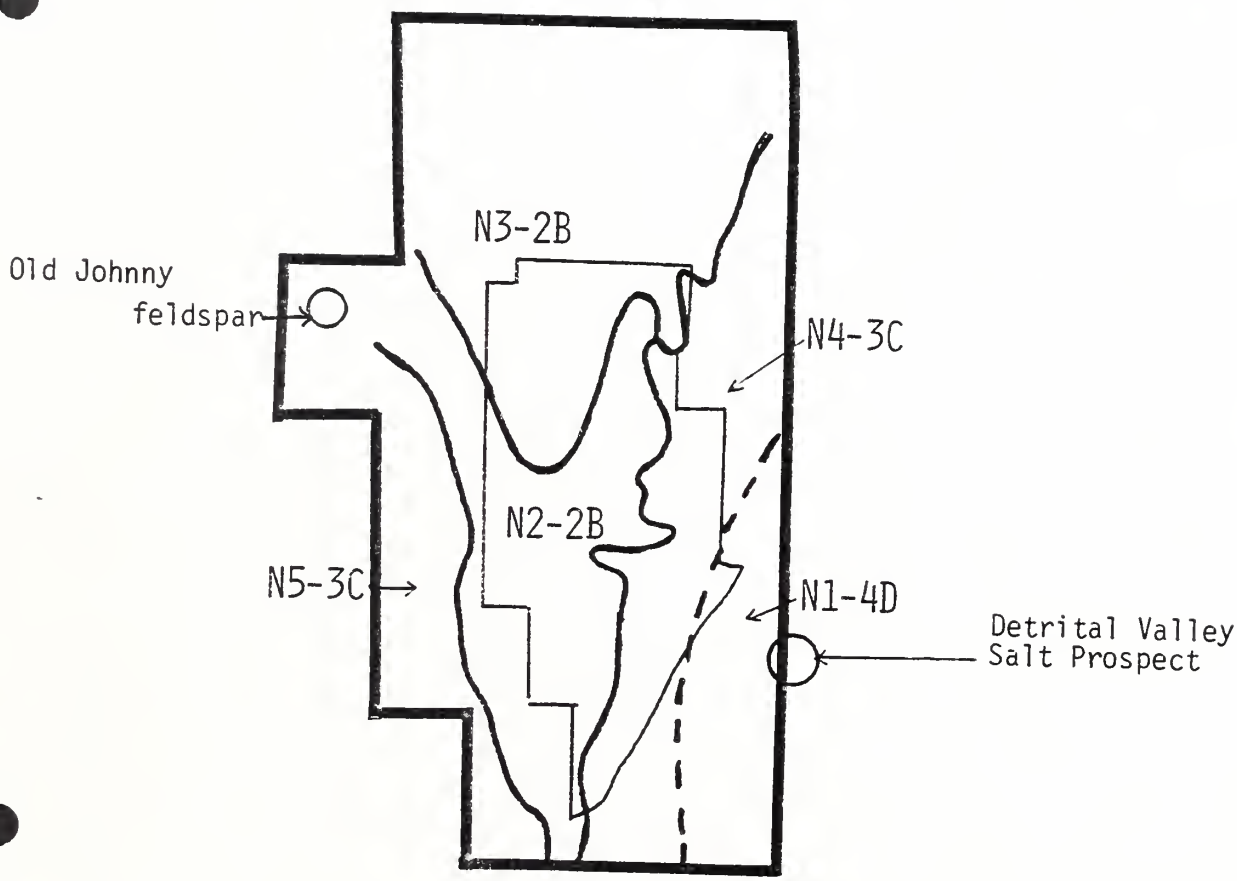


EXPLANATION

- Land Classification Boundary
- WSA Boundary
- Uranium Occurrence
- Aerial radiometric uranium anomaly
- Uranium anomaly from stream sediment samples

Land Classification - Mineral Occurrence Map/Uranium

Mount Wilson GRA AZ-01
Scale 1:250,000



EXPLANATION

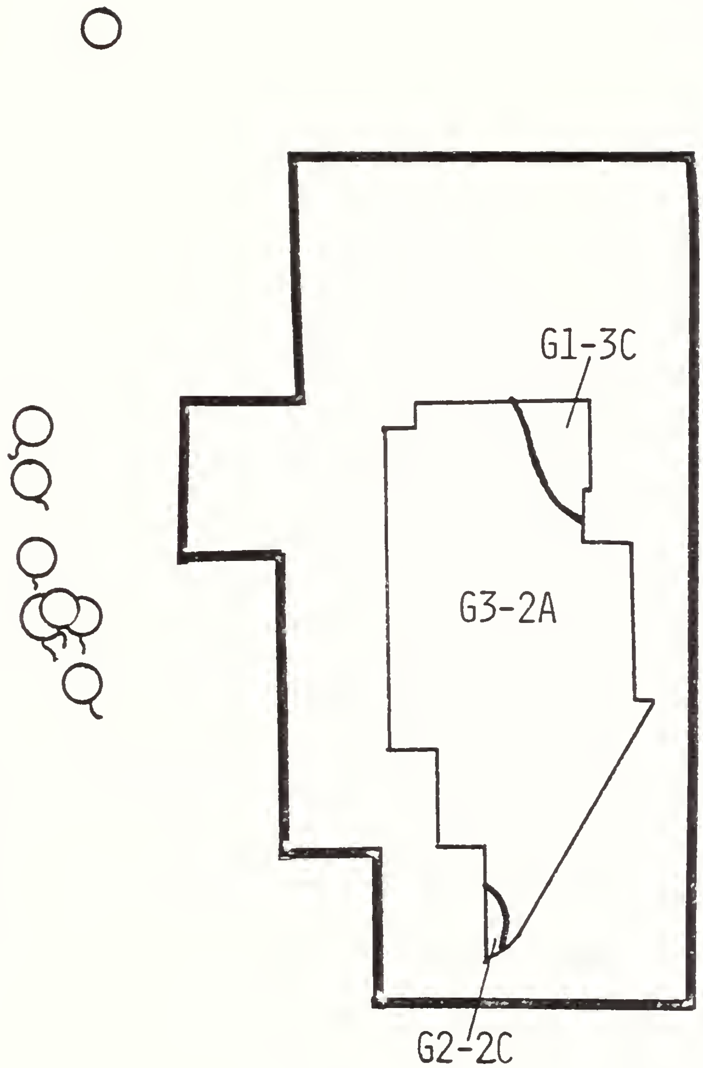
○ Occurrence, commodity

- - - Land Classification Boundary

— WSA Boundary

Land Classification - Mineral Occurrence Map/Nonmetallics

Mount Wilson GRA AZ-01
Scale 1:250,000



EXPLANATION

Thermal well

Thermal spring

Land Classification Boundary

WSA Boundary

Land Classification - Mineral Occurrence Map/Geothermal Mount Wilson GRA AZ-01

Scale 1:250,000

LEVEL OF CONFIDENCE SCHEME

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVELY MINIMAL TO SUPPORT TO REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

MAJOR STRATIGRAPHIC AND TIME DIVISIONS IN USE BY THE U.S. GEOLOGICAL SURVEY

Erathem or Era	System or Period	Series or Epoch	Estimated ages of time boundaries in millions of years
Cenozoic	Quaternary	Holocene	
		Pleistocene	2-3[1]
	Tertiary	Pliocene	12[1]
		Miocene	26[2]
		Oligocene	37-38
		Eocene	53-54
		Paleocene	65
Mesozoic	Cretaceous[4]	Upper (Late) Lower (Early)	136
	Jurassic	Upper (Late) Middle (Middle) Lower (Early)	190-195
	Triassic	Upper (Late) Middle (Middle) Lower (Early)	225
Paleozoic	Permian[4]	Upper (Late) Lower (Early)	280
	Carboniferous Systems: Pennsylvanian[4]	Upper (Late) Middle (Middle) Lower (Early)	
	Carboniferous Systems: Mississippian[4]	Upper (Late) Lower (Early)	345
	Devonian	Upper (Late) Middle (Middle) Lower (Early)	395
	Silurian[4]	Upper (Late) Middle (Middle) Lower (Early)	430-440
	Ordovician[4]	Upper (Late) Middle (Middle) Lower (Early)	500
	Cambrian[4]	Upper (Late) Middle (Middle) Lower (Early)	570
Precambrian[4]		Informal subdivisions such as upper, middle, and lower, or upper and lower, or younger and older may be used locally.	3,600+[3]

[1] Holmes, Arthur, 1965, Principles of physical geology: 2d ed., New York, Ronald Press, p. 360-361, for the Pleistocene and Pliocene; and Obradovich, J. D., 1965, Age of marine Pleistocene of California: Am. Assoc. Petroleum Geologists, v. 49, no. 7, p. 1087, for the Pleistocene of southern California.

[2] Geological Society of London, 1964, The Phanerozoic time-scale; a symposium: Geol. Soc. London, Quart. Jour., v. 120, supp., p. 260-262, for the Miocene through the Cambrian.

[3] Stern, T. W., written commun., 1968, for the Precambrian.

[4] Includes provincial series accepted for use in U.S. Geological Survey reports.

Terms designating time are in parentheses. Informal time terms early, middle, and late may be used for the eras, and for periods where there is no formal subdivision into Early, Middle, and Late, and for epochs. Informal rock terms lower, middle, and upper may be used where there is no formal subdivision of a system or of a series.

GEOLOGIC NAMES COMMITTEE, 1970