SHEEP RANGE G-E-M

RESOURCES AREA

(GRA NO. NV-28)

TECHNICAL REPORT

(WSA NV 050-0201)

Contract YA-553-RFP2-1054

Prepared By

Great Basin GEM Joint Venture
251 Ralston Street
Reno, Nevada 89503

For

Bureau of Land Management
Denver Service Center
Building 50, Mailroom
Denver Federal Center
Denver, Colorado 80225

Final Report

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EXECUTIVE SUMMARY

The Sheep Range Geology-Energy-Minerals (GEM) Resources Area (GRA) includes the following Wilderness Study Area (WSA): NV 050-0201. The Sheep Range GRA is located in northern Clark County and southern Lincoln County, Nevada between U. S. Highway 93 on the east and the Desert National Wildlife Range on the west.

The WSA consists primarily of alluvium with a narrow band of much older bedrock along the southwestern edge of the WSA.

There are no known metallic mineral resources in the study area. The only nonmetallic deposit in the study area is a gravel deposit adjoining the WSA on the east. There are no known strategic and critical minerals in the area.

There are no patented or unpatented mining claims in the GRA. All of the WSA has been leased for oil and gas, in part because this area is considered part of the Overthrust Belt. There are no geothermal leases in the GRA.

The available information does not indicate a favorability for metallic mineral resources or uranium or thorium in the WSA. For nonmetallics there is a moderate favorability for sand and gravel with a moderate confidence level. There is a moderate favorability for oil and gas with a very low confidence level, and only a low favorability for low-temperature geothermal resources with a very low confidence level.

I. INTRODUCTION

The Sheep Range G-E-M Resources Area (GRA No. NV-28) covers approximately 87,000 acres (350 sq km) and includes the following Wilderness Study Area (WSA):

WSA Name	WSA Number
Fish and Wildlife #1	NV 050-0201

The GRA is located in Nevada within the Bureau of Land Management's (BLM) Caliente Resource Area, Las Vegas district. Figure 1 is an index map showing the location of the GRA. The area encompassed is near 37°50' north latitude, 115°00' west longitude and includes the following townships:

T 11 S, R 62,63 E	T 13 S, R 62,63 E
T 12 S, R 62,63 E	T 14 S, R 62,63 E

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

7.5-minute:

Mule Deer Ridge, NW	Wildcat Wash, NW
Mule Deer Ridge, SE	Wildcat Wash, SW

The nearest town is Moapa which is located about 18 miles east and slightly south of the southeast corner of the GRA along U. S. Highway 93. Access to the area is via U. S. Highway 93 which forms the eastern boundary of the WSA.

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 in this GRA was not field checked.

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 a 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.

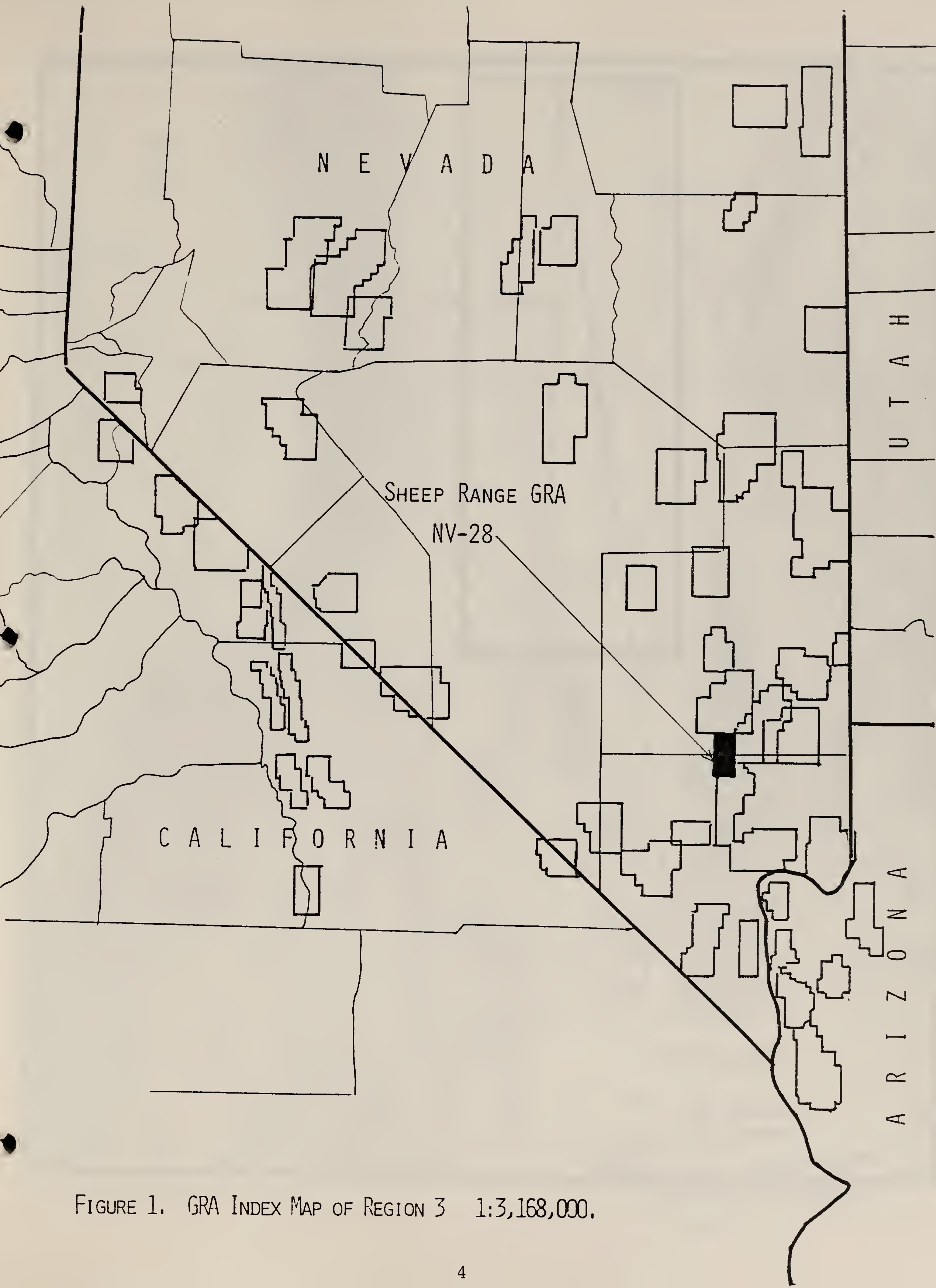
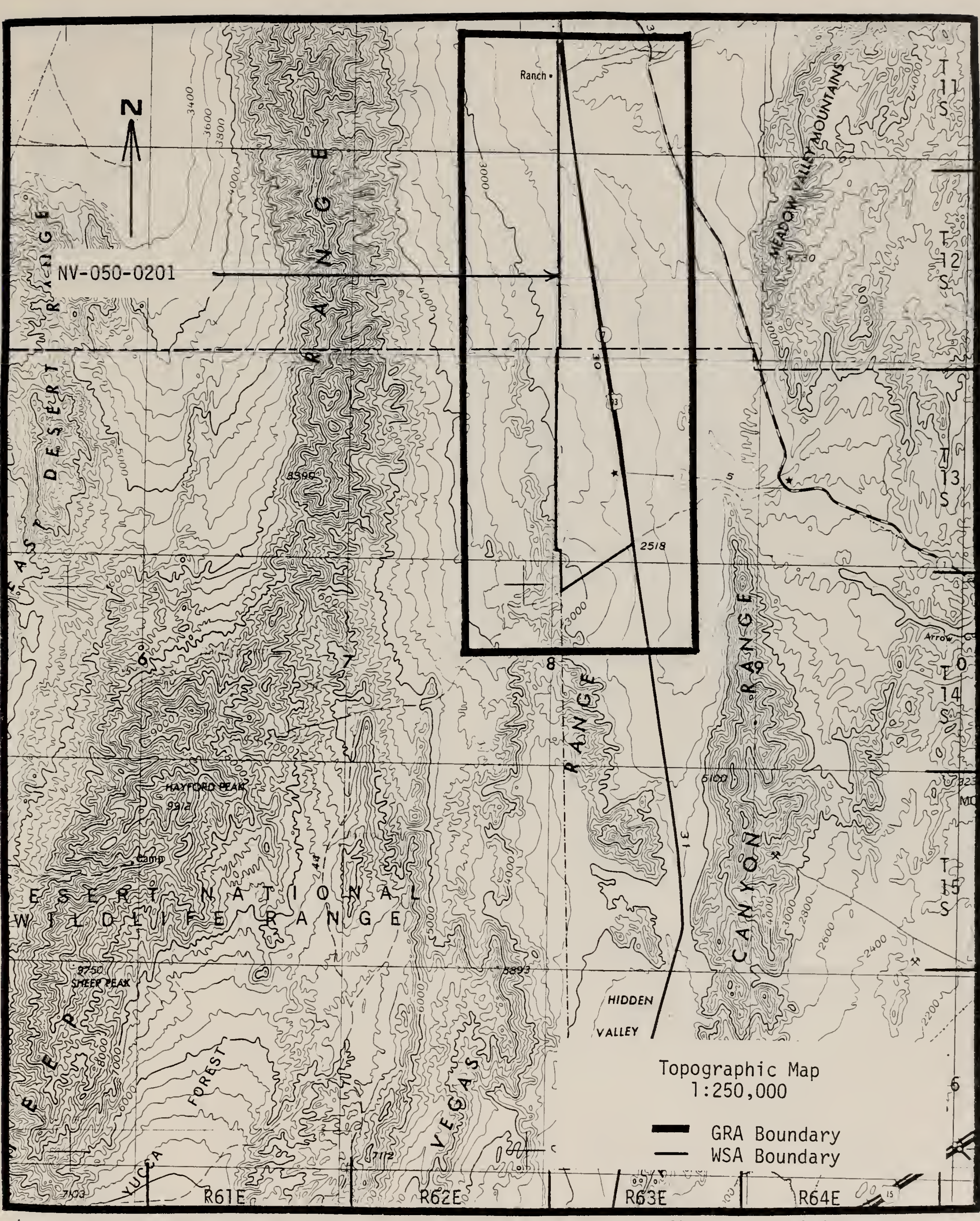
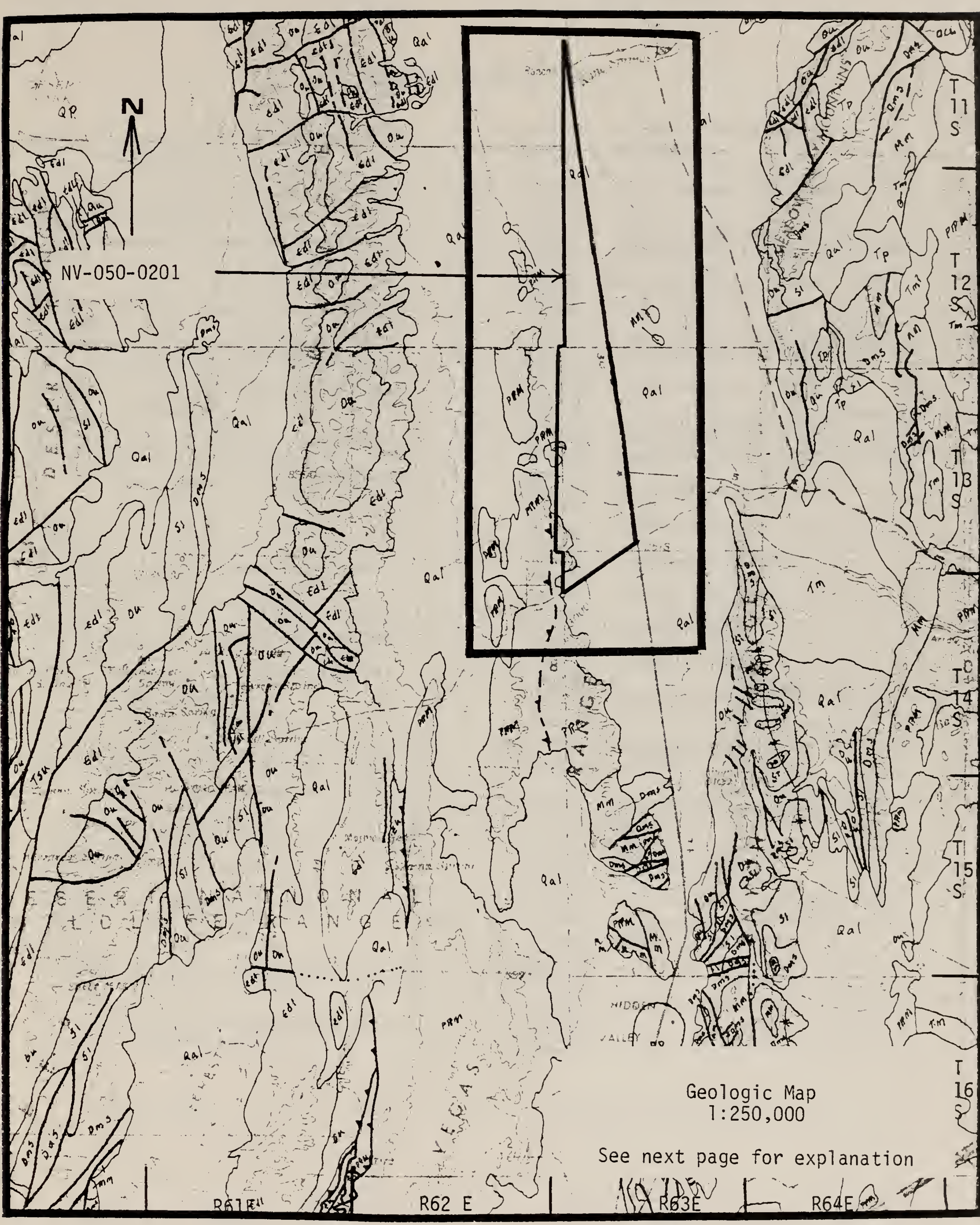


Figure 1. GRA Index Map of Region 3 1:3,168,000.



Las Vegas Sheet

Sheep Range GRA NV-28
Figure 2



Bohannon (1978)

Sheep Range GRA NV-28

Figure 3

DESCRIPTION OF MAP UNITS

Qal	ALLUVIAL DEPOSITS (HOLOCENE AND PLEISTOCENE?)
Qp	PLAYA DEPOSITS (HOLOCENE AND PLEISTOCENE?)
Qc	CHEMEHUEVI FORMATION (PLEISTOCENE)
Ql	LAS VEGAS FORMATION (PLEISTOCENE)
Qm	CALICHE OF MORMON MESA (PLEISTOCENE)
Qrd	GRAVEL OF THE COLORADO AND VIRGIN RIVERS (LOWER PLEISTOCENE)
QTal	ALLUVIAL FAN DEPOSITS (QUATERNARY AND TERTIARY)
Tb	BASALT (PLIOCENE AND MIOCENE)
	MUDDY CREEK FORMATION (PLIOCENE? AND MIOCENE)
Tm	Claystone unit
Tmf	Fortification Basalt Member
Tpw	ASH-FLOW TUFF (MIOCENE)
Tp	ROCKS OF PAVITS SPRINGS (MIOCENE)
Thv	ROCKS OF THE HAMBLIN-CLEOPATRA VOLCANO (MIOCENE)
Thvi	INTRUSIVE ROCKS (MIOCENE)
Tmdv	MOUNT DAVIS VOLCANICS (MIOCENE)
	HORSE SPRING FORMATION (MIOCENE)
Ths	Sandstone and silver tuff
Thl	Rocks of Lovell Wash
Thb	Limestone of Bitter Ridge
Tht	Lower member
Tsu	UNDIFFERENTIATED SEDIMENTARY ROCKS (TERTIARY)
Kb	BASELINE SANDSTONE (UPPER AND LOWER CRETACEOUS)
Kwt	WILLOW TANK FORMATION (LOWER CRETACEOUS)
Ja	AZTEC SANDSTONE (JURASSIC)
℞mc	MOENAVE (UPPER TRIASSIC?) AND CHINLE (UPPER TRIASSIC) FORMATIONS
℞m	MOENKOPI FORMATION (MIDDLE? AND LOWER TRIASSIC)
Pkt	KAIBAB LIMESTONE AND TOROWEAP FORMATION (LOWER PERMIAN)
Pc	CLASTIC ROCKS (LOWER PERMIAN)
PPM	CALLVILLE LIMESTONE AND BIRD SPRING FORMATION (LOWER PERMIAN, PENNSYLVANIAN AND UPPER MISSISSIPPIAN)
Mm	MISSISSIPPIAN ROCKS
	DEVONIAN ROCKS
Dmp	Muddy Peak Limestone
Ds	Sultan Limestone
Sl	SILURIAN ROCKS
Ou	ORDOVICIAN ROCKS
OCu	UNDIFFERENTIATED ORDOVICIAN AND CAMBRIAN ROCKS
Cdl	CARBONATE ROCKS (UPPER AND MIDDLE CAMBRIAN)
Cu	UNDIFFERENTIATED CLASTIC ROCKS (MIDDLE AND LOWER CAMBRIAN)
C-Du	UNDIFFERENTIATED DEVONIAN THROUGH CAMBRIAN ROCKS
Pzu	UNDIFFERENTIATED PALEOZOIC ROCKS
pCzj	STIRLING QUARTZITE AND JOHNNIE FORMATION (PRECAMBRIAN)
pCu	ULTRAMAFIC ROCKS (PRECAMBRIAN)
pCgn	GNEISS AND SCHIST (PRECAMBRIAN)
pCrg	RAPAKIVI GRANITE (PRECAMBRIAN)

CONTACT

FAULT

THRUST FAULT

LOW-ANGLE FAULT

ANTICLINE

SYNCLINE

II. GEOLOGY

The Sheep Range GRA lies within the Basin and Range province and is located in southern Lincoln and northern Clark Counties, Nevada (see Figure 2). The WSA is adjacent to the Desert National Game Range to the west. The study area includes a portion of Coyote Spring Valley with the northern portion of the Las Vegas range, known as the "Elbow Range" extending into the southern part of the GRA.

Late Tertiary-Early Quaternary gravels are the most abundant rock type in Coyote Spring Valley (see Figure 3). Carboniferous Bird Spring Formation limestone forms the Elbow Range and several small outcrops of Mississippian Monte Cristo limestone occur along the eastern border of the GRA, but outside the WSA.

The WSA is almost exclusively composed of alluvium with the Bird Spring carboniferous unit forming the only bedrock outcrops along the WSAs southwestern border.

Structure in the study area is limited to thrusting and folding of the Bird Spring Formation and is related to the Cretaceous Laramide Orogeny.

Most of the following geologic description is taken from Longwell, and others, 1965, and Tschanz and Pampeyan, 1970.

1. PHYSIOGRAPHY

The Sheep Range GRA lies within the Basin and Range province and is located in southern Lincoln and northern Clark Counties, Nevada. The study area includes the northern tip of the Las Vegas Range called the Elbow Range, and the alluvium filled Coyote Spring Valley between the Meadow Valley Mountains on the east and the Sheep Range on the west.

U. S. Highway 93 traverses the length of the GRA from north to south and forms the eastern boundary of WSA NV 050-0201.

The most abundant rock type in the area is a Late Tertiary Early Quaternary sequence of older gravels which occurs in Coyote Spring Valley. Late Paleozoic limestone crops out in the northern tip of the Las Vegas Range which extends into the southern portion of the study area.

Elevations in the area average about 3,000 feet, with the highest point of about 4,100 feet in the Elbow Range at the southern boundary of the GRA.

Structures defined in the study area are limited to folding and a north-south-trending thrust, both of which are found in the Bird Spring limestone in the Elbow Range in the southern

portion of the study area. Later Tertiary Basin and Range faulting is responsible for the present physiography.

2. ROCK UNITS

The oldest rocks in the Sheep Range GRA are Carboniferous limestones of the Monte Cristo and Bird Spring Formations. The Bird Spring Formation forms the Elbow Range and the Monte Cristo limestone crop out in three small areas near the eastern border of the GRA.

Lake beds consisting of clay shale and siltstone of the Late Tertiary Muddy Creek Formation crop out along the valley floor following the Coyote Spring Valley drainage. Unconformably overlying the Muddy Creek Formation are older gravels deposited during the Early(?) Quaternary. These gravels are the most abundant rock type found in the GRA and the WSA.

3. STRUCTURAL GEOLOGY AND TECTONICS

Structure in the Sheep Range GRA, as identified on available maps is limited to the Late Cretaceous Laramide orogeny thrusting and folding of the Carboniferous Bird Spring limestones in the Elbow Range. The north-south-trending thrust, approximately seven miles long, is totally within the Bird Spring Formation placing lower units of the formation over the younger units. Folds and overturned beds in the area are related to the deformation forces of the thrusting. It is believed by Longwell and others (1965) that the Elbow Range represents the folded block beneath the Gass Peak thrust plate.

4. PALEONTOLOGY

Undivided Pennsylvanian and Permian strata exposed in the northern part of the Las Vegas Range are sparsely fossiliferous (Tschanz and Pampeyan, 1970). Where fossils are found in that part of the Las Vegas Range within the GRA, they indicate correlation with the Bird Spring formation, representing a thin shelf facies of that unit which contains poorly preserved fusulinids. No specific localities have been found for this area in a search of pertinent literature.

5. HISTORICAL GEOLOGY

Throughout the Paleozoic era a thick sequence of predominantly carbonate marine sediments was deposited.

At the end of the Paleozoic the area was uplifted and eroded. Cretaceous tectonic forces of the Laramide orogeny caused thrusting and faulting of the Paleozoic sediments. The area

was further modified by mid-Tertiary Basin and Range type normal faulting. Late Tertiary Basin and Range faulting has uplifted the Elbow Range and has led to the development of the present physiography.

Lake beds of the Muddy Creek Formation were deposited during the Late Tertiary. Subsequently, thick clastic sequences of detrital alluvium accumulated in structural basins during the Late Tertiary to Early Quaternary.

III. ENERGY AND MINERAL RESOURCES

A. METALLIC MINERAL RESOURCES

1. Known Mineral Deposits

There are no known metallic mineral deposits located within the Sheep Range GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

Based on available information, there are no metallic minerals prospects, occurrences or mineralized areas located within the study area.

3. Mining Claims

There are no patented or unpatented claims located within the study area.

4. Mineral Deposit Types

Since there are no occurrences a discussion of deposit types is not applicable.

5. Mineral Economics

Due to the apparent lack of metallic mineralization in the Sheep Range GRA, it is doubtful that this area would be of interest to prospectors or mining companies exploring for metallic mineral deposits.

B. NONMETALLIC MINERAL RESOURCES

1. Known Mineral Deposits

The only nonmetallic mineral deposit located in the GRA is a gravel pit in the western one-half of Sec. 28, T 13 S, R 63 E, just east of U.S. Highway 93. The gravel pit is outside the WSA boundary.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

Based on available information, there are no reported nonmetallic minerals prospects, occurrences, or mineralized areas located within the GRA.

The limestone in the study area could possibly be utilized in cement or lime manufacture as this same geologic unit, the Bird Spring Formation, has been staked or considered as a raw material for cement manufacture. Detailed chemistry would be necessary for proper evaluation for both cement and lime.

The alluvium could be utilized for sand and gravel or other construction uses.

3. Mining Claims, Leases, and Material Sites

There are no patented or unpatented claims for nonmetallic minerals located within the GRA. The one material site which has been exploited for sand and gravel was discussed above under deposits. There are other material sites reported within the WSA but they have not as yet been utilized.

4. Mineral Deposit Types

The sand and gravel comes from the alluvial fans derived from the Elbow Range. The carbonates which have potential for cement and lime are marine sediments.

5. Mineral Economics

The only nonmetallics in the GRA or the WSA which would probably be of interest are the carbonates for lime or cement manufacture and the alluvium for sand and gravel.

Because the carbonate units within the WSA are too small, and their westward extensions cross over the boundary into the Desert National Wildlife Range which presumably precludes mining, these potential deposits would not be economical to mine. An open pit operation such as a cement plant would require a large reserve of mineable carbonates.

The alluvium could probably be economically mined for nearby use, and with the adjacent highway a good transportation route is provided. The quality, along with the proposed uses of the material, would have to be evaluated.

The most common use of sand and gravel is as "aggregate" -- as part of a mixture with cement to form concrete. The second largest use is as road base, or fill. About 97 per cent of all sand and gravel used in the United States is in these applications in the construction industry. The remaining three percent is used for glassmaking, foundry sands, abrasives, filters and

similar applications. The United States uses nearly one billion tons of sand and gravel annually, all of it produced domestically except for a very small tonnage of sand that is imported for highly specialized uses. Since construction is by far the greatest user of sand and gravel, the largest production is near sites of intensive construction, usually metropolitan areas. Since sand and gravel are extremely common nearly everywhere, the price is generally very low and mines are very close to the point of consumption -- within a few miles as a rule. However, for some applications such as high-quality concrete there are quite high specifications for sand and gravel, and acceptable material must be hauled twenty miles and more. Demand for sand and gravel fluctuates with activity in the construction industry, and is relatively low during the recession of the early 1980s. Demand is expected to increase by about one third by the year 2000. In the early 1980s the price of sand and gravel F.O.B. plant averaged about $2.50 per ton but varied widely depending upon quality and to some extent upon location.

C. ENERGY RESOURCES

Uranium and Thorium Resources

1. Known Mineral Deposits

There are no known uranium or thorium deposits in the WSA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

There are no known uranium or thorium prospects or occurrences within the GRA. There is one uranium occurrence east of the GRA shown on the Uranium Land Classification and Mineral Occurrence Map included at the back of the report, the Fry and Jeffers claim, Sec. 6 or 7, T 13 S, R 64 E (Garside, 1973). Radioactivity is present in black Paleozoic limestone at this claim.

3. Mining Claims

There are no known uranium or thorium claims or leases within the GRA.

4. Mineral Deposit Types

Deposit types cannot be discussed as there are no known occurrences of radioactive minerals within the WSA or the GRA.

5. Mineral Economics

Uranium and thorium would appear to have no economic value for the area as there are no deposits within the WSA or the GRA.

Oil and Gas Resources

1. Known Oil and Gas Deposits

There are no known oil and gas deposits in the GRA.

2. Known Prospects, Oil and Gas Occurrences and Petroliferous Areas

There are no known prospects, oil and gas seeps or shows in the GRA or immediate region. Nine miles east of the GRA Texaco Inc. drilled the Federal No. 1 (Locality #1 on Oil and Gas Occurrence and Land Classification Map) to 7050 feet in 1972 (Garside and others, 1977). To the southeast near Crystal three more exploration wells were drilled (Lintz, 1957; Schilling and Garside, 1968):

Locality Number	Operator/Well TD, Date
#2	Last Chance Oil Co. Crystal No. 1 TD 1,002', 1950
#3	G & G Exploration Exploration Co. No. 1 TD 1,130', 1949
#4	Southern Great Basin Oil & Gas Inc. Government No. 1 TD 5,085', 1954

The latter well is known to have encountered oil and gas shows (Nevada Bureau of Mines and Geology Oil and Gas Files, 1982).

3. Oil and Gas Leases

Oil and gas leases cover at least the eastern one-half of the GRA

4. Oil and Gas Deposit Types

Oil deposits that have been found and developed, and those that are being explored for in the Basin and Range to date, have been limited to the Upper Paleozoic section of the miogeosyncline and the Tertiary section of the intermontane basins. The source rocks are assumed to be in Paleozoic horizons, such as the Mississippian Chainman Shale, and perhaps also Tertiary section.

The reservoirs at the Trap Spring and Eagle Springs oil fields in Railraod Valley are the Oligocene Garrett Ranch volcanics or equivalent, which produce from fracture porosity; or the Eocene Sheep Pass Formation, a freshwater limestone. Minor production has been recorded from the Ely(?) Formation of Pennsylvanian age at Eagle Springs. It may be that production also comes from other units in the Tertiary or Paleozoic sections in the Blackburn oil field in Pine Valley or the Currant and Bacon Flat oil fields in Railroad Valley.

The GRA is within or close to the North American Overthrust Belt which has good oil and gas production in Wyoming/Utah, Mexico and Canada (Oil and Gas Jour., May 12, 1980). The Federal leases in Nevada are for rank wildcat acreage, and surficial stratigraphic units do not necessarily have a direct bearing on possible drilling objectives at depth, considering overthrust structural implications.

Recent seismic surveys (e.g., Seisdata Services, 1981; Geophysical Service Inc., 1981; GeoData, 1981: Index maps in GRA File) indicate, in part, the general area of industry interest. This and certain other data may be purchased, but deep exploratory test data are not readily available. Published maps of the Overthrust Belt in Nevada are very generalized, and are not necessarily in agreement because exploration is at an early stage (Oil and Gas Jour., May 12, 1980; Western Oil Reporter, June, 1980; Keith, 1979: Index maps in GRA File).

5. Oil and Gas Economics

The low level of production from Nevada Basin and Range oil fields, which are remote from existing pipeline, existing refineries and consuming areas, necessitates the trucking of the crude oil to existing refineries in Utah, California and Nevada. Since the discovery of oil in Nevada in 1953, the level of production has fluctuated. Factors which have affected the production from individual wells are: reservoir and oil characteristics; Federal regulations; productivity; environmental constraints; willingness or ability of a refiner to take certain types

of oil; and of course, the price to the producer, which is tied to regional, national and international prices.

Geothermal Resources

1. Known Geothermal Deposits

   There are no known geothermal deposits in the GRA or surrounding valleys.

2. Known Prospects, Geothermal Occurrences, and Geothermal Areas

   There are no known prospects or occurrences in the GRA, but it is located in a part of the Basin and Range province that has shallow, often high-volume, low-temperature resources.

3. Geothermal Leases

   There are no geothermal leases in the GRA or the region around it.

4. Geothermal Deposit Types

   Geothermal resources are hot water and/or steam which occurs in subsurface reservoirs or at the surface as springs. The temperature of a resource may be about 70°F (or just above average ambient air temperature) to well above 400°F in the Basin and Range province.

   The reservoirs may be individual faults, intricate fault-fracture systems, or rock units having intergranular permeability -- or a combination of these. Deep-seated normal faults are believed to be the main conduits for the thermal waters rising from thousands of feet below in the earth's crust.

   The higher temperature and larger capacity resources in the Basin and Range are generally hydrothermal convective systems. The lower temperature reservoirs may be individual faults bearing thermal water or lower pressured, permeable rock units fed by faults or fault systems. Reservoirs are present from the surface to over 10,000 feet in depth.

5. Geothermal Economics

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, as well as the end use, 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-round 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 cyrstallization (266°F), and drying of diatomaceous earth (338°F). These are only a few examples.

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

There are no other unique geological resources known to exist within the GRA or the WSA. Coal is not known in the GRA, and there is no known potential for coal.

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.

There are no known strategic and critical minerals within the GRA or the WSA.

IV. LAND CLASSIFICATION FOR G-E-M RESOURCES POTENTIAL

Geologic maps which cover the GRA and the WSA are all at a scale of 1:250,000 and include the Lincoln County report, Tschanz and Pampeyan, 1970, the Clark County report, Longwell and others, 1965, and Howard, 1978. The scale of these maps is too small to adequately assess mineral potential; however, their quality is good and the confidence level in these maps is high. There is little data on mineral resources in the GRA, but because the vast majority of the WSA is alluvium, little data on mineral resources is to be expected. The available data, however, has a high confidence level.

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 the WSA has been used in establishing a classification area within the 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.

1. LOCATEABLE RESOURCES

a. Metallic Minerals

WSA NV 050-0201

M1-1B. This classification area of very low potential with a low confidence level covers the very southwest edge of the WSA and includes the carbonate units within the WSA. There are no reported deposits, occurrences or claims and the geology does not indicate favorable potential.

M2-2A. This classification area of low favorability with a very low potential includes the majority of the WSA and includes all the alluvium. The nature of the bedrock beneath the alluvium is unknown and since Paleozoic rocks elsewhere in southern Nevada do contain mineralization the possibility of mineralization, here beneath the alluvium exists. The very low confidence level here indicates there is no evidence to support this low favorability classification, however.

b. Uranium and Thorium

WSA 050-0201

U1-1A. This land classification area of very low favorability with a very low confidence level covers the entire WSA indicating that the area is not favorable for uranium or thorium concentration. Though the Quaternary alluvium is a potential host rock for epigenetic sandstone type uranium deposits and for resistate mineral concentrations which may contain uranium and thorium, there are no prospective source rocks in the vicinity. The range to the west of the WSA is composed of the Carboniferous Bird Spring Formation limestone, which is probably a poor source for both uranium and thorium.

c. Nonmetallic Minerals

WSA NV 050-0201

N1-3C. This classification area of moderate favorability with a moderate confidence level includes the carbonate rocks along the very southwestern border of the WSA. These rocks have a potential for cement and lime manufacture, therefore the 3C classification. Detailed chemistry would be necessary to more adequately evaluate this unit for cement and lime potential.

N2-3C. This classification area of moderate favorability with a moderate confidence level includes all the alluvium in the WSA. This material could probably be used for various nearby construction applications. There is one borrow pit adjacent to the WSA which has been utilized in the past. The quality of the material would need further evaluation, however, to assess the particular applications it could be utilized in.

2. LEASABLE RESOURCES

a. Oil and Gass

WSA NV 050-0201

OG1-3A. This WSA is underlain by valley fill sediments of Quaternary and older ages, except for some Upper Paleozoic rocks on the western edge. It is assumed that there could be a sufficient prospective stratigraphic section for the generation and entrapment of hydrocarbons.

There is a question as to whether this WSA is within the prospective Overthrust Belt, but the density of leasing indicates industry's interest in the area regardless.

b. Geothermal

WSA NV 050-0201

G1-2A. The WSA is underlain by Quaternary alluvium in a narrow valley similar to those in the region where major deep-seated faults or fault zones host important low-temperature resources. Two such areas are the Hiko-Crystal-Ash Springs to the north and the Moapa Spring area to the southeast. It is believed that a similar zone of weakness lies hidden beneath the valley fill.

c. Sodium and Potassium

S1-1D. This classification applies to the entire WSA. There is no indication of favorability for the accumulation of resources of sodium and potassium.

There are no sodium or potassium resources known to exist in the GRA or the WSA.

3. SALEABLE RESOURCES

The saleable resources, sand and gravel, have been discussed above under nonmetallic mineral resources and include the classification area N2-3C.

V. RECOMMENDATIONS FOR ADDITIONAL WORK

A field check of the area could be undertaken to further evaluate sand and gravel potential. No other work is deemed necessary for this GRA.

VI. REFERENCES AND SELECTED BIBLIOGRAPHY

Armstrong, R. L., 1963, Geochronology and geology of the eastern Great Basin in Nevada and Utah: Ph.D. thesis, Yale University, New Haven, Conn.

Bohannon, R. G., 1978, Preliminary geologic map of Las Vegas 1° x 2° Quadrangle, Nevada, Arizona, and California: U. S. Geol. Survey Open File Report 78-670.

Garside, L. J., 1973, Radioactive mineral occurrences in Nevada: Nevada Bureau of Mines and Geology, Bull. 81.

Garside, L. J. and Schilling, J. H., 1979, Thermal waters of Nevada: Nevada Bur. of Mines and Geol. Bull. 91.

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

Geodata, 1981, Eastern Nevada multifold seismic data available: Geodata Corp., Denver, Colorado.

Geophysical Service In.c, 1981, Southeastern Nevada Hingeline: Non-exclusive seismic surveys available.

Howard, E. L., ed., 1978, Geologic map of the Eastern Great Basin Nevada and Utah, TerraScan Group Ltd.

Keith, S. B., 1979, The great southwestern Arizona Overthrust oil and gas play: Arizona Bur. of Geol. and Mineral Technology, March.

Kellogg, H. E., 1963, Paleozoic stratigraphy of Southern Egan Range, Nevada: Geol. Society America Bull., v. 74, No. 6.

Langenheim, R. L., Jr., Carss, B. W., Kennerly, J. B., McCutcheon, V. A., and Waines, R. H., 1962, Paleozoic section in Arrow Canyon Range, Clark County, Nevada: Am. Assoc. Petroleum Geologists Bull., v. 46, p. 592-609.

Lintz, J. L., Jr., 1957, Nevada oil and gas drilling data, 1906-1953: Nevada Bur. Mines Bull. 52.

Longwell, C. R., Pampeyan, E. H., and Bowyer, Ben, 1965, Geology and mineral deposits of Clark County, Nevada: Nevada Bureau of Mines. Bulletin 62.

Nevada Bureau of Mines and Geology Oil and Gas Files, 1982b.

Oil and Gas Jour., May 12, 1980, What's been found in the North American Overthrust Belt.

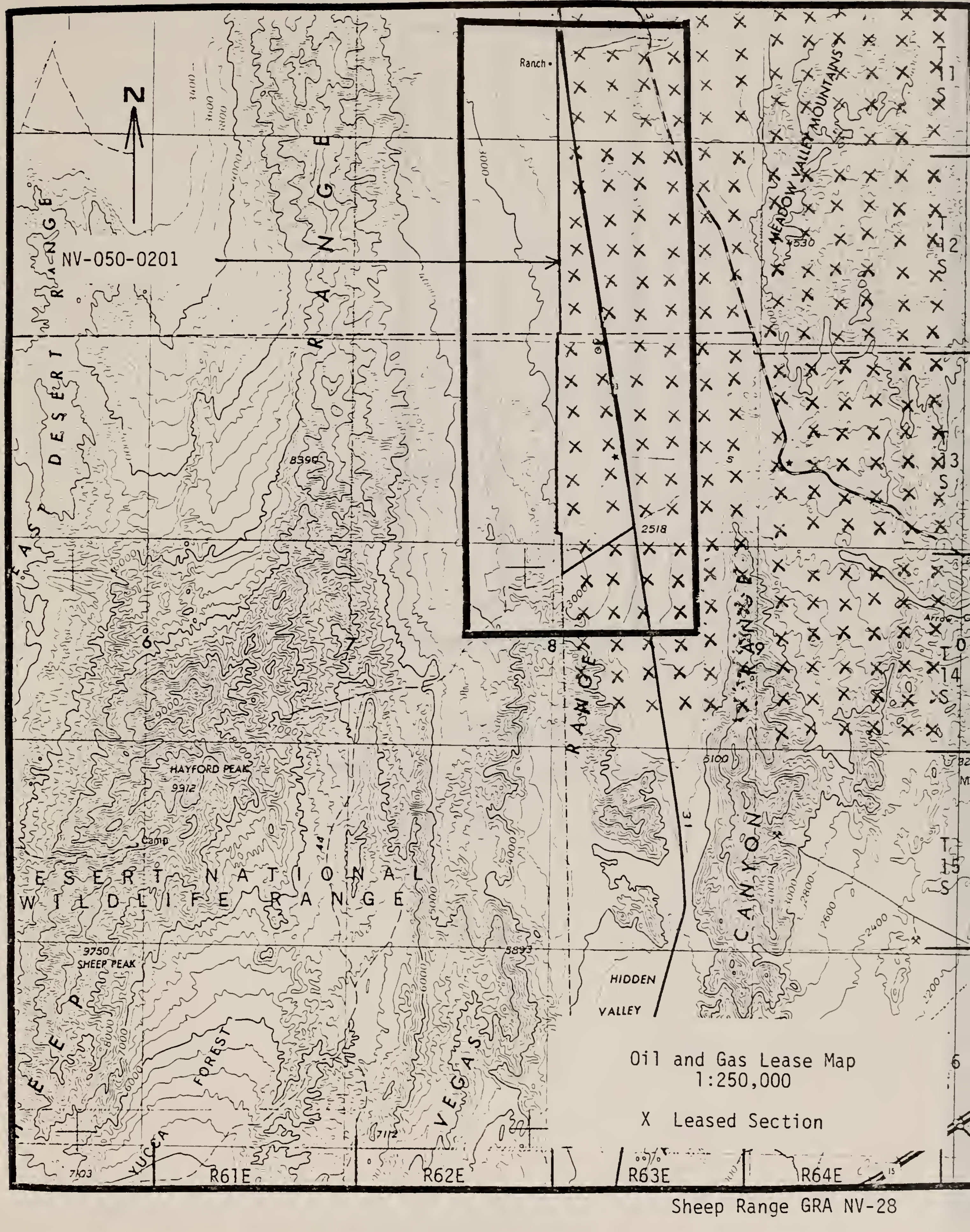
Schilling, J. H. and Garside, L. J., 1968, Oil and gas developments in Nevada 1953-1967: Nevada Bur. Mines and Geol. Rept. 18.

Seisdata Services, 1981, Seismic data available in southern Nevada.

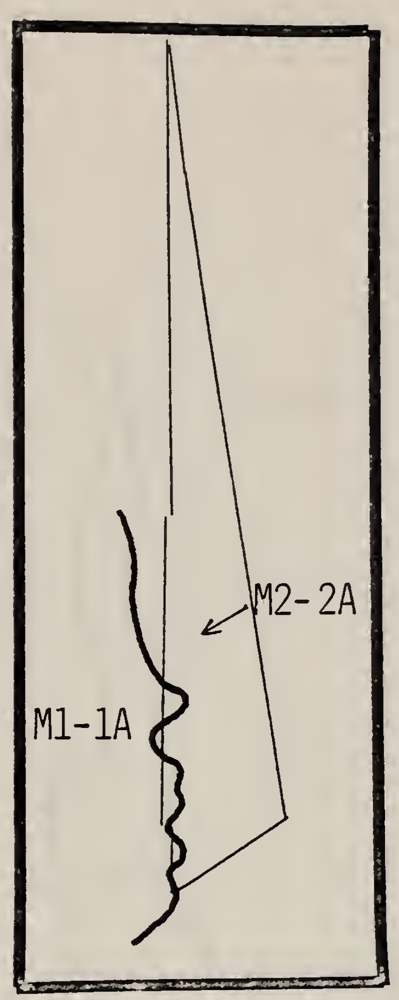
Stewart, J. H., 1980, Geology of Nevada -- a discussion to accompany the geologic map of Nevada: Nevada Bur. of Mines and Geology Spec. Pub. 4.

Stewart, J. H., and Carlson, J. E., 1978, Geologic map of Nevada: U. S. Geol. Survey in cooperation with Nevada Bur. of Mines and Geology.

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



Sheep Range GRA NV-28



EXPLANATION

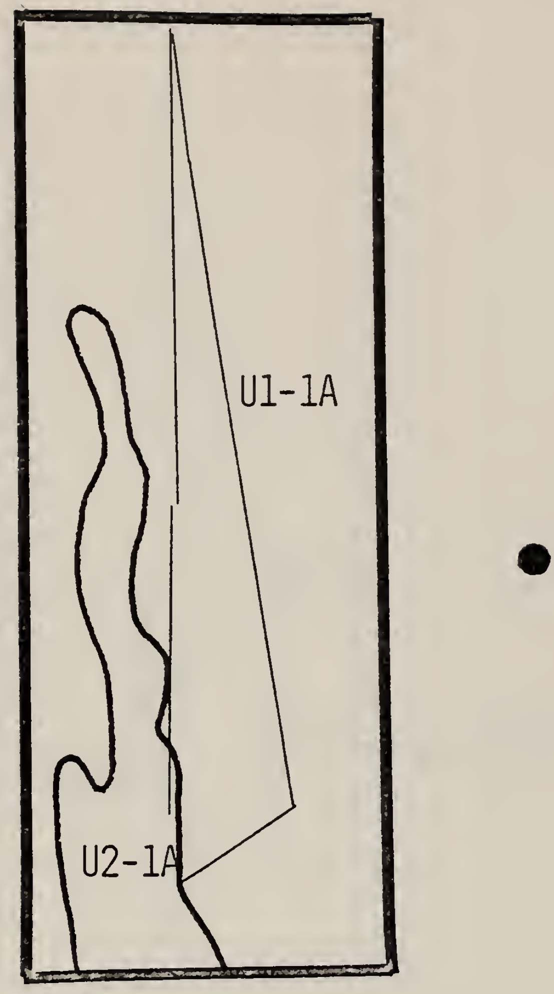
Land Classification Boundary

WSA Boundary

Land Classification - Mineral Occurrence Map/Metallics

Sheep Range GRA NV-28

Scale 1:250,000



EXPLANATION

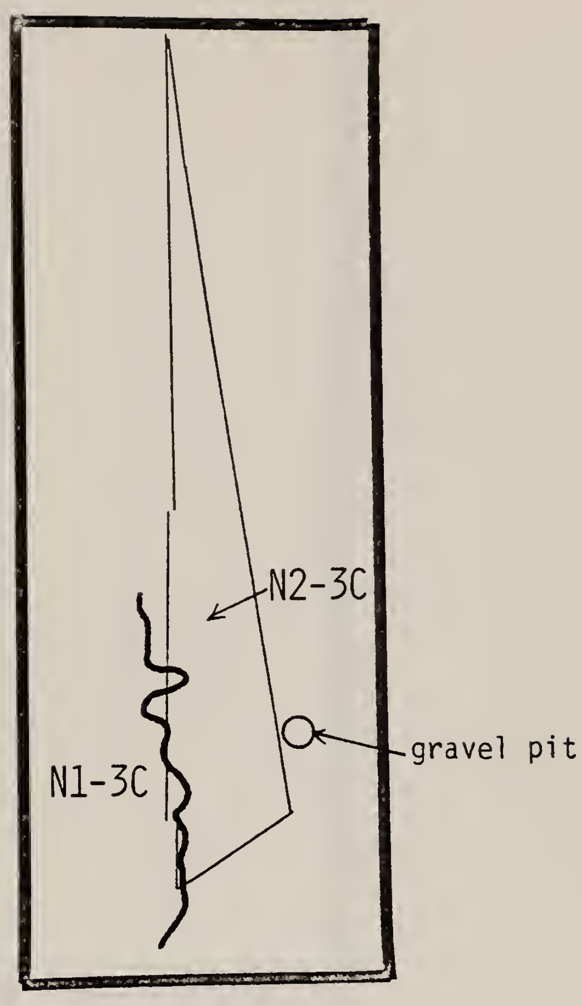
● Uranium Occurrence

▬ Land Classification Boundary

— WSA Boundary

Land Classification - Mineral Occurrence Map/Uranium

Sheep Range GRA NV-28
Scale 1:250,000



EXPLANATION

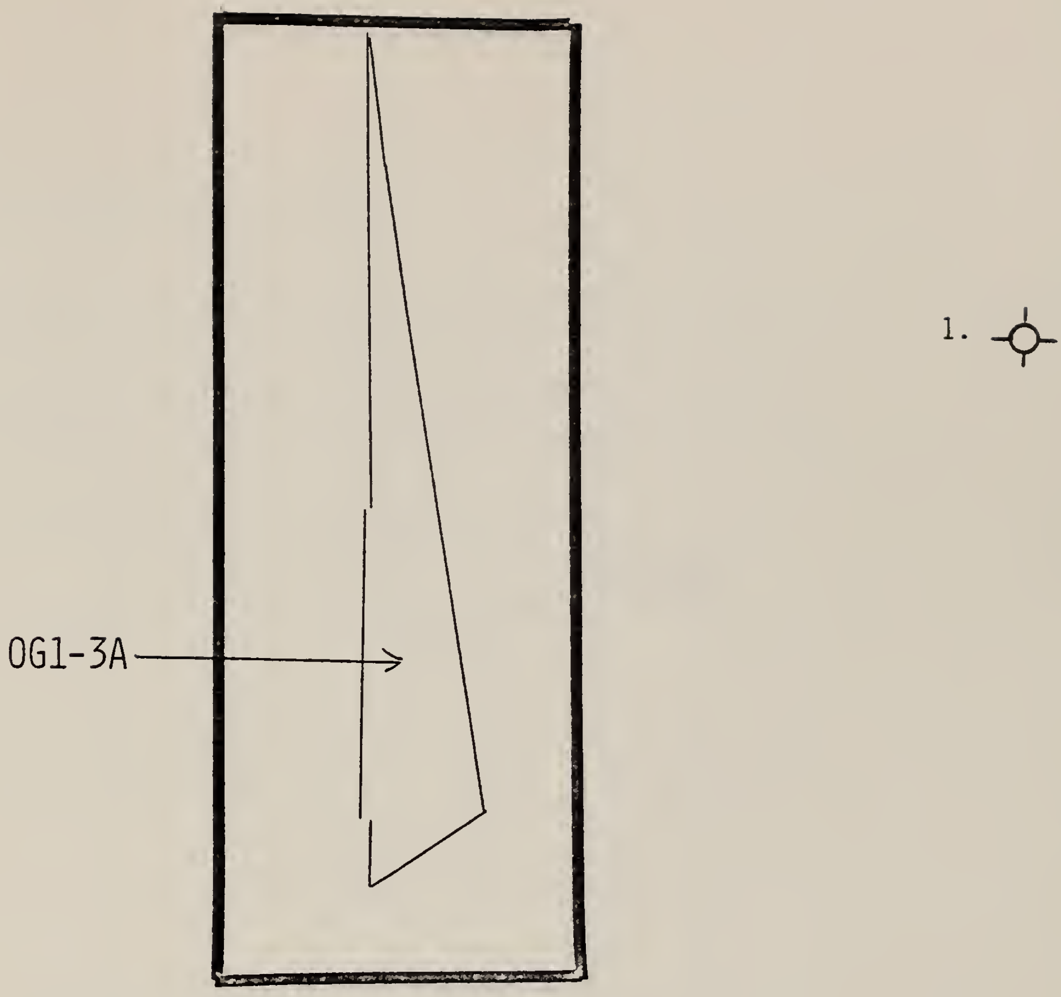
○ Occurrence, commodity

▬ Land Classification Boundary

— WSA Boundary

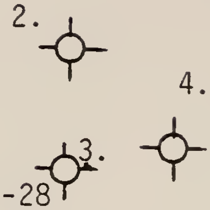
Land Classification - Mineral Occurrence Map/Nonmetallics

Sheep Range GRA NV-28
Scale 1:250,000



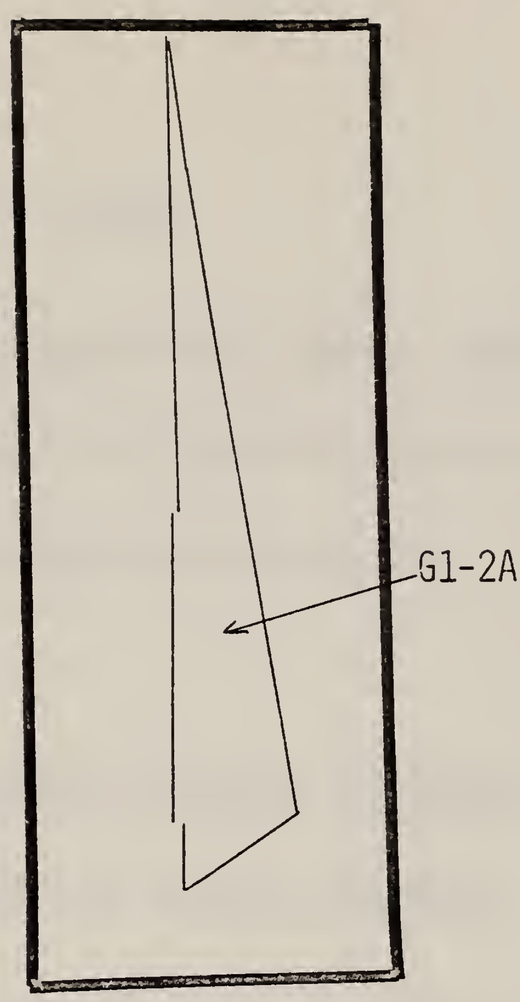
EXPLANATION

- Dry Hole
- WSA and Land Classification Boundary
- 1. Reference location, (see text)



Land Classification - Mineral Occurrence Map/
Oil and Gas

Sheep Range GRA NV-28
Scale 1:250,000



EXPLANATION

—— WSA and Land Classification Boundary

Land Classification - Mineral Occurrence Map/Geothermal

Sheep Range GRA NV-28

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 [3]		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

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