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SACATAR MEADOW G-E-M

RESOURCES AREA

(GRA NO. CA-11)

TECHNICAL REPORT

(WSA CA 010-027)

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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ATTACHMENTS
(At End of Report)

CLAIM AND LEASE MAPS

Patented/Unpatented

Geothermal

MINERAL OCCURRENCE AND LAND CLASSIFICATION MAPS (Attached)

Metallic Minerals

Uranium and Thorium

Nonmetallic Minerals

Geothermal

LEVEL OF CONFIDENCE SCHEME

CLASSIFICATION SCHEME

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

EXECUTIVE SUMMARY

The Sacatar Meadow G-E-M Resource Area (GRA) lies astride the boundary between Tulare and Inyo Counties in the eastern Sierra Nevada mountains, about 30 miles north of the town of Inyokern. The only Wilderness Study Area (WSA) in the GRA is CA 010-027.

Granitic rocks of the Cretaceous Sierra Nevada batholith and minor related rocks, about 90 million years old, underlie nearly all of the GRA and the WSA. In the west-central part of the WSA is a small area underlain by much older rocks, perhaps 250 million years old, that were intruded and metamorphosed by the Sierra Nevada batholith.

There are no formal mining districts in the GRA. In the southern part there has been rather small production of tungsten (a strategic and critical metal), barite and feldspar. A very few patented claims and scattered unpatented claims are in the southern part of the GRA also. None of the metallic or nonmetallic mineral mines or known prospects are within the WSA, nor are any of the patented or unpatented claims.

There are two mines that have made small production of uranium. One of these may be within the southernmost part of the WSA. There are two NURE stream sediment uranium anomalies, one of which is at the western tip of the WSA.

There are no oil and gas leases. There are geothermal leases adjacent to the GRA, but none in the GRA.

Most of WSA CA 010-027 is classified as having no known favorability for metallic minerals with a low level of confidence but a small area on the west-central edge is classified as having low favorability for tungsten, a strategic and critical metal, with a very low confidence level. All of the WSA is classified as moderately favorable for uranium and thorium, with a moderate level of confidence; and as having low favorability for nonmetallic minerals and for geothermal resources with a low level of confidence. There is no indicated favorability for oil and gas, sodium and potassium, coal, oil shale or tar sands.

Field examination of the uranium mine and the uranium stream sediment anomaly that are close to or in the WSA is recommended, as is additional stream sediment sampling in and around the WSA.

I. INTRODUCTION

The Sacatar Meadow G-E-M Resources Area (GRA No. CA-11) encompasses approximately 141,000 acres (570 sq km) and includes the following Wilderness Study Area (WSA):

WSA Name	WSA Number
Sacatar Meadow	010-027

The GRA is located in California in the Bureau of Land Management's (BLM) Caliente Resource Area, Bakersfield district. Figure 1 is an index map showing the location of the GRA. The area encompassed by the GRA is near 36°00' north latitude, 118°00' west longitude and includes the following townships:

T 21 S, R 36,37 E
T 22 S, R 36,37 E
T 23 S, R 36,37 E

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

15-minute:

Little Lake	Monache Mountain
Lamont Peak	

The nearest town is Inyokern which is about 30 miles south of the GRA on U. S. Highway 395. Access to the area is via U. S. Highway 395 to Ninemile Canyon road. Access within the area is along Ninemile Canyon road to Sacatar Meadow and Sacatar Canyon trails.

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 Mineral Occurrence and 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 a 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.

Fresno, Death Valley, Bakersfield,
and Trona Sheets

Sacatar Meadow GRA CA-11

Figure 2

Fresno Sheet, Mathews and Burnett (1965); Death Valley Sheet, Streitz and Stinson (1974); Bakersfield Sheet, Smith (1964); Trona Sheet, Jennings, et. al., (1962)

Sacatar Meadow GRA CA-11

Figure 3

EXPLANATION

SEDIMENTARY AND METASEDIMENTARY ROCKS

IGNEOUS AND META-IGNEOUS ROCKS

CENOZOIC	QUATERNARY	Recent	GREAT VALLEY		
CENOZOIC	QUATERNARY	Recent	Qs	Dune sand	
			Qal	Alluvium	
			Qsc	Stream channel deposits	Recent volcanic: Qrv ^r —rhyolite; Qrv ^a —andesite; Qrv ^b —basalt; Qrv ^p —pyroclastic rocks
			Qf	Fan deposits	
			Qb	Basin deposits	
		Pleistocene	Qst	Salt deposits	
			Ql	Quaternary lake deposits	
			Qg	Glacial deposits	
			Qt	Quaternary nonmarine terrace deposits	
			Qm	Pleistocene marine and marine terrace deposits	Pleistocene volcanic: Qpv ^r —rhyolite; Qpv ^a —andesite; Qpv ^b —basalt; Qpv ^p —pyroclastic rocks
			Qc	Pleistocene nonmarine	
			QP	Plio-Pleistocene nonmarine	Quaternary and/or Pliocene cinder cones
	TERTIARY	Pliocene	Pc	Undivided Pliocene nonmarine	
			Puc	Upper Pliocene nonmarine	
			Pu	Upper Pliocene marine	Pliocene volcanic: Pv ^r —rhyolite; Pv ^a —andesite; Pv ^b —basalt; Pv ^p —pyroclastic rocks
			Pmic	Middle and/or lower Pliocene nonmarine	
			Pml	Middle and/or lower Pliocene marine	
		Miocene	Mc	Undivided Miocene nonmarine	
			Muc	Upper Miocene nonmarine	
			Mu	Upper Miocene marine	Miocene volcanic: Mv ^r —rhyolite; Mv ^a —andesite; Mv ^b —basalt; Mv ^p —pyroclastic rocks
			Mmc	Middle Miocene nonmarine	
			Mm	Middle Miocene marine	
	TERTIARY	Oligocene	MI	Lower Miocene marine	
			Oc	Oligocene nonmarine	Oligocene volcanic: Ov ^r —rhyolite; Ov ^a —andesite; Ov ^b —basalt; Ov ^p —pyroclastic rocks
		Eocene	Om	Oligocene marine	
			Ec	Eocene nonmarine	Eocene volcanic: Ev ^r —rhyolite; Ev ^a —andesite; Ev ^b —basalt; Ev ^p —pyroclastic rocks
		Paleocene	E	Eocene marine	
			Epc	Paleocene nonmarine	
	TERTIARY	Paleocene	Ep	Paleocene marine	

	Paleo	Ep	Paleocene marine	EXPLANATION CONT.	
		Qr	Cenozoic nonmarine	Qrv	Cenozoic volcanic: Qr ^v —rhyolite; Qrv ^a —andesite; Qrv ^b —basalt; Qrv ^p —pyroclastic rocks
Undivided		T _o	Tertiary nonmarine	T _g	Tertiary granitic rocks
		T	Tertiary lake deposits	T _i	Tertiary intrusive (hypabyssal) rocks: T _i ^r —rhyolite; T _i ^a —andesite; T _i ^b —basalt
		T _m	Tertiary marine	T _v	Tertiary volcanic: T _v ^r —rhyolite; T _v ^a —andesite; T _v ^b —basalt; T _v ^p —pyroclastic rocks
MESOZOIC	CRETACEOUS	K	Undivided Cretaceous marine		
		Ku	Upper Cretaceous marine	Kuf	Franciscan volcanic and metavolcanic rocks
		Kl	Lower Cretaceous marine	gr	Mesozoic granitic rocks: gr ^a —granite and adamellite; gr ^b —granodiorite; gr ^c —tonalite and diorite
	JURASSIC	Ja	Knoxville Formation	Di	Mesozoic basic intrusive rocks
		Ju	Upper Jurassic marine	Ub	Mesozoic ultrabasic intrusive rocks
		Jml	Middle and/or Lower Jurassic marine	Jrv	Jura-Trias metavolcanic rocks
	TRIASSIC	Ti	Triassic marine		
	UNDIVIDED	m _{ls}	Pre-Cretaceous metamorphic rocks (ls = limestone or dolomite)	mv	Pre-Cretaceous metavolcanic rocks
		ms	Pre-Cretaceous metasedimentary rocks	gr-m	Pre-Cenozoic granitic and metamorphic rocks
		p _{ls}	Paleozoic marine (ls = limestone or dolomite)	p _v	Paleozoic metavolcanic rocks
PALEOZOIC	PERMIAN	P _m	Permian marine	P _v	Permian metavolcanic rocks
	CARBONIFEROUS	C	Undivided Carboniferous marine	Cv	Carboniferous metavolcanic rocks
		CP	Pennsylvanian marine		
		CM	Mississippian marine		
	DEVONIAN	D	Devonian marine	Dv	Devonian metavolcanic rocks
				Dv?	Devonian and pre-Devonian? metavolcanic rocks
	SILURIAN	S	Silurian marine		
		pSs	Pre-Silurian meta-sedimentary rocks	pS	Pre-Silurian metamorphic rocks
				pSv	Pre-Silurian metavolcanic rocks
	ORDOVICIAN	O	Ordovician marine		
	CAMBRIAN	E	Cambrian marine		
		E?	Cambrian—Precambrian marine	pCc	Precambrian igneous and metamorphic rock complex
PRECAMBRIAN		pC	Undivided Precambrian metamorphic rocks pCg = gneiss, pCs = schist	pCg	Undivided Precambrian granitic rocks
		lpt	Later Precambrian sedimentary and metamorphic rocks	pCn	Precambrian anorthosite
		epC	Earlier Precambrian metamorphic rocks		

II. GEOLOGY

The Sacatar Meadow GRA is the southernmost GRA in Region 3. It is located in the southern Sierra Nevadas west of Rose Valley.

The southern Sierras are composed of a series of intrusive and metamorphic rocks. The granitoid mass was uplifted at the end of the Miocene to its present elevation along north-northwest trending normal faults. Glaciation and subsequent erosion has carved the present topography of the GRA.

1. PHYSIOGRAPHY

Sacatar Meadow GRA is located in the southern Sierra Nevadas approximately 10 miles north of the mutual boundary point of Tulare, Inyo, and Kern Counties. U. S. Highway 395 in Rose Valley borders the GRA on the east.

The GRA lies in the southeastern Sierra Nevada Province along the border with the Basin and Range Province. The major rock types are granitic intrusives and remnants of metamorphic roof pendants associated with the Sierra Nevada batholith.

Along the eastern flank of the Sierra Nevadas, granitic intrusives were upthrown and tilted west along northwest trending faults. The tilted fault block forms a steep escarpment elevated 3,000 feet above the valley floor. Kennedy, Sacatar and Big Pine Meadows, with an average elevation of 6,500 feet, form the upper level of the fault block within the GRA. The highest elevation is Ball Mountain at 9,256 feet.

East-west drainage dissects the eastern slope forming Little Lake, Five Mile, Dead Foot and other canyons that drain into Rose or Indian Wells valleys at elevations of about 3,500 feet. In the higher elevations, spring fed creeks discharge into the South Fork of the Kern River west of the GRA and into Chimney Creek in the southern portion of the GRA at elevations of about 6,000 feet.

2. ROCK UNITS

The oldest rocks in the Sacatar Meadow GRA are metasedimentary. The Kernville Series, described by Webb (1946), are remnants of Paleozoic-Mesozoic marine sediments that were metamorphosed prior to the intrusion of the Sierra Nevada batholith. The metasediments form roof pendants and xenoliths within the intrusives and generally trend N 30-40°W (Webb, 1946).

The Kernville series is composed of phyllites, quartzite, marble, hornfels, slate, and metavolcanics. The age of these rocks is probably PermoCarboniferous (Webb, 1946).

The Summit Gabbro is the next oldest unit in this GRA. This unit is represented by small isolated bodies of basic intrusives and shows evidence of strain produced by the subsequent intrusion of the batholith. The Summit Gabbro is medium to fine grained, porphyritic, and contains hornblende, biotite, plagioclase, and pyrite. The age of this unit is probably mid-Mesozoic.

The Sacatar Quartz Diorite is the youngest pre-batholith intrusion. This unit intrudes the Summit Gabbro in the form of tongues and dikes. The quartz diorite grades to a quartz monzonite and granodiorite and contains abundant ferro-magnesians.

The Sierra Nevada batholith was emplaced during the Cretaceous in a series of intrusions cutting the metasedimentary and mafic rocks described above. The Isabella granodiorite varies to granite, quartz monzonite and quartz diorite and may be distinguished from the Summit and Sacatar intrusives by its lack of dark minerals.

Various pegmatites and granodiorite and aplite dikes crosscut the Kernville Series and the Sacatar and Isabella intrusions.

Older alluvium in the Sacatar Meadow GRA consists of fine grained sediments mapped near Chimney Peak. These Quaternary lake sediments were deposited in shallow water in high upland depressions of the Sierras. Younger alluvium has been deposited in the meadows and forms alluvial fans along the range front to the east.

Within WSA CA 010-027 there is a strip of Kernville Series rocks, a west-central protuberance and Quaternary alluvium in small areas of valley bottom within the WSA; otherwise the only rock type in the WSA is intrusive granitics.

3. STRUCTURAL GEOLOGY AND TECTONICS

The oldest structures in the Sacatar Meadow GRA are folds in the Kernville Series. The folds were produced sometime during the mid-Mesozoic when the marine sediments were compressed and deformed prior to the intrusion of the batholith.

Veins and joint structures associated with the intrusives are minor in this GRA (Miller and Webb, 1940).

The predominant structure is the northwest-trending Sierra frontal fault located at the base of the eastern slope. Major uplifting occurred during the Pleistocene though, the fault may have been more recently active (Oliver, 1956).

4. PALEONTOLOGY

Pre-Cretaceous metamorphic rocks, Mesozoic granitic rocks and basic intrusives are the dominant lithologies within the Sacatar Meadow GRA. These lithologies have no potential for paleontological resources. The only possible lithology with potential for fossils is Quaternary alluvium.

5. HISTORICAL GEOLOGY

During the Paleozoic and early Mesozoic, shallow marine sediments and volcanic debris were deposited in thick sequences in the southern Sierra Nevada region. Mid-Mesozoic compressional forces folded these sediments and produced the metamorphic sequence of the Kernville Series. Mafic intrusives (Summit Gabbro, Sacatar Quartz Diorite) cut the metasediments during the folding and shortly after it occurred. By the Late Cretaceous, the Sierra Nevada batholith (Isabella granodiorite) had been intruded producing contact metamorphism of the older rocks.

The Sierra Nevada underwent a series of uplifts between the late Miocene and early Pleistocene. Northwest-southeast trending, normal faults elevated and tilted the intrusive block to the west and erosion produced the present configuration of the eastern slope. The upper levels of the fault block were carved by glaciation during the Pleistocene and contain remnants of lake sediments deposited during that period.

III. ENERGY AND MINERAL RESOURCES

A. METALLIC MINERAL RESOURCES

1. Known Mineral Deposits

The only known metallic mineral deposit found in the Sacatar Meadow GRA is tungsten.

The Kern-Sierra Group, located in sections 29, 30, and 31 of T 23 S, R 36 E, developed scheelite-bearing tactite bodies in several locations. The Sierra claim contains two tactite bodies 25 feet long and 300 feet apart on the contact between marble and quartz diorite. The ore zone averages three to four feet in width and WO grades are reported to be 0.6-1.5%. At the Jupiter claim, tactite with scheelite-rich lenses about a foot long are interbedded with schists. An 8 foot thick tactite layer contains 0.25% WO₃, plus considerable molybdenite and chalcopyrite. Production data for these properties is not available (Krauskopf, 1953).

2. Known Prospects, Mineral Occurrences and Mineralized Areas

The only known mineralized areas within the Sacatar Meadow GRA occur in the vicinity of the above described deposits located in the southern portion of the GRA. Specific information concerning them is not available.

3. Mining Claims

There are no patented claims in the vicinity of the tungsten mines. Patented claim(s) in one of two sections in the southeast corner of the GRA may lie just within the WSA. Unpatented claims are all in the southwest corner of the GRA and none are close to the WSA.

4. Mineral Deposit Types

The metallic mineral deposits in the Sacatar Meadow GRA are all contact metamorphic deposits. Tungsten deposits were emplaced along the margins between intrusive bodies and calcareous roof pendants of the Kernville Series, forming veins and replacement pods in the metamorphic rocks.

5. Mineral Economics

Tungsten, listed as a strategic and critical mineral, was produced from pods in small tactite bodies. The potential exists for additional minor production of tungsten, but

the limited tonnage of these deposits would make them unattractive to most mining companies.

More than half of all tungsten used is in the form of tungsten carbide, a hard and durable material used in cutting tools, wear-resistant surfaces and hard-faced welding rods. Lesser quantities are used in alloy steels, in light bulb filaments, and in chemicals. World production of tungsten is nearly 100 million pounds annually, of which the United States produces somewhat more than six million pounds, while using more than 23 million pounds. The shortfall is imported from Canada, Bolivia, Thailand and Mainland China, as well as other countries. Tungsten is a strategic and critical metal. United States demand is projected to about double by the year 2000, and most of the additional supply will probably be imported, because large reserves are in countries in which profitability is not a factor -- they need foreign exchange, and therefore sell at a price that few domestic mines can match. Tungsten prices F.O.B. mine are quoted for "short ton units", which are the equivalent of 20 pounds of contained tungsten. At the end of 1982 the price of tungsten was about \$80 per short ton unit.

B. NONMETALLIC MINERAL RESOURCES

1. Known Mineral Deposits

The Paso-Baryta mine produced impure barite from a 10 to 15-foot wide zone with a strike length of about one mile. The zone strikes N 10°W to N 40°E, dips 65°SW and appears to be conformable with the enclosing metasedimentary rocks. The northwest end of the deposit splits into three narrow branches. During the 1950's, 400 tons of ore grade barite per day was processed in a nearby mill (Goodwin, 1958).

Feldspar was extracted from the White King mine, also located in the southern part of the GRA. The mineral was mined from massive pegmatitic feldspar outcrops. Several railroad cars of this material were shipped in 1933. No other production data is available (Goodwin, 1958).

2. Known Prospects, Mineral Occurrences and Mineralized Areas

There are some prospects in the vicinity of the barite and feldspar mines noted above.

3. Mining Claims, Leases and Material Sites

Patented claims in the southeast corner of the GRA are presumably on the feldspar deposits described above; there are no unpatented claims in this vicinity. Some of the unpatented claims in the southwest corner of the GRA probably cover barite occurrences.

4. Mineral Deposit Types

The origin of the barite deposits is unknown. They may be bedding deposits similar to those known in central Nevada, that have been metamorphosed along with their enclosing rocks; or barite remobilized from such deposits during metamorphism or intrusion, and redeposited in their present sites; or deposits formed by mineralizing solutions flowing directly from the granitic intrusive bodies.

The feldspar deposits are pegmatites that were emplaced during or shortly after the intrusion of the quartz diorite.

5. Mineral Economics

The Paso-Baryta mine has large probable reserves, however, most of the barite does not meet gravity specifications for drilling mud and would require beneficiation. This increase in production cost and the present low market for barite probably precludes economic development of this property at this time. However, should the barite market revive, profitable production at the Paso-Baryta mine would be possible.

Feldspar was mined during 1933 from massive pegmatite outcrops. The paucity of pertinent data precludes further discussion of the potential of this property.

More than 90% of all barite mined is used to make mud for oil and gas well drilling, where the high specific gravity, softness and chemical inertness of the mineral are essential characteristics. Other uses of barite are in barium chemicals that have a wide variety of applications. In recent years the United States has used nearly three million tons of barite annually; usage fluctuates with oil and gas drilling activity. Domestic sources produced about two-thirds of the barite used, with Nevada being by far the largest producer. Most imported barite is used in the states near the Gulf of Mexico, where shipping costs by sea from foreign sources are lower than rail transportation costs from Nevada. Barite consumption in the United States is forecast to be about the same in the year 2000 as it presently is, although

this will depend largely on oil and gas drilling activity and the forecast may be greatly in error. Domestic production is expected to continue to satisfy about two-thirds of the demand. The price for crude barite is about \$25 per ton, while crushed and ground barite ready for use as drilling mud is about \$50 per ton.

Nearly all feldspar is used in either glassmaking or the ceramic industry, but small amounts are used as a powdered abrasive, frequently in household applications. The United States produces nearly three-quarters of a million short tons annually and uses a little less than this, the remainder being exported. United States consumption is forecast to increase to well over one million tons by the year 2000, with domestic production supplying all or most of this. Feldspar is a very common mineral everywhere in the world, and the only reason for any increase in imports into the United States will be lower foreign production costs. The price of feldspar F.O.B. mine is about \$30 per ton.

C. ENERGY RESOURCES

Uranium and Thorium Resources

1. Known Mineral Deposits

There are two known uranium deposits within the GRA, one of which (the Lamont Meadows mine) may be within the southern border of the WSA. The Lamont Meadows mine is in T 24 S, R 37 E and the Long Valley mine is in T 24 S, R 36 E (Minobras, 1978). More precise locations are not available. Both mines have had some small scale uranium production. Uranium and thorium minerals occur in a pegmatite related to the Cretaceous Isabella granodiorite and are associated with magnetite, ilmenite, and molybdenite. There is no mention of thorium production from these deposits.

The location of the deposits is shown on the Uranium Mineral Occurrence and Land Classification Map included at the back of this report.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

Uranium occurrences are also found in altered shear zones within the intrusives, along with primary minerals in pegmatites. These occurrences are in the southern portion of the GRA but their exact locations are not given. Some may be within the southern border of the WSA.

The location of radioactive occurrences is shown on the Mineral Occurrence and Land Classification Map included at the back of this report.

3. Mining Claims

There are a number of claims in the southern portion of the GRA some of which may be for uranium. None of these claims are within the WSA.

4. Mineral Deposit Types

Uranium and thorium deposits occur as primary mineral concentrations in pegmatites (e.g. uraninite and monazite) in the GRA. Uranium also occurs as secondary minerals in altered shear zones in the GRA, though apparently not in economic concentrations.

5. Mineral Economics

Past production of uranium from the two uranium and thorium pegmatite deposits indicates that uranium has been of some economic importance within the GRA. However, these small deposits are probably not economic for uranium at the present time due to the oversupply of uranium on the market. Thorium will not be in much demand for some time especially since breeder reactors are not being developed.

A lack of published information on the known deposits and occurrences prevents an economic determination for uranium and thorium in the area.

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 and Gas Resources

There are no known oil and gas deposits, hydrocarbon shows in wells, or surface seeps in the region; nor are there any Federal oil and gas leases in the immediate region. The Sierran granitic batholith underlies the entire GRA; no potential petroleum source beds are present in the area. There is no oil and gas lease map, nor is there an oil and gas occurrence and land classification map in this report.

Geothermal Resources

1. Known Geothermal Deposits

There are no known geothermal deposits within the Sacatar Meadow GRA.

2. Known Prospects, Geothermal Occurrences, and Geothermal Areas

Within the GRA there are no recorded geothermal prospects, occurrences, or areas. Six miles north of the northwest corner of the GRA, Soda Springs (38°C and flowing 8 l/min) is situated in a probable fault-controlled linear in the mountain valley (Geothermal Occurrence and Land Classification Map). This fault does not appear to extend southward into the GRA. Seven miles due west of Soda Springs, Jordan Hot Spring flows 51°C water at a rate of 285 l/min (NOAA, 1980).

Immediately to the east seven miles, within the Coso Mountains, is the Coso Hot Springs geothermal resource area. Over an area of several square miles, Devil's Kitchen Fumerole, Coso Hot Springs, and an unnamed fumerole all have measured temperatures of 97°C (NOAA, 1980). Drilling within this Pleistocene volcanic field, where numerous cinder cones are present, has proven the presence of a steam reservoir above a hot-water reservoir with temperatures of at least 204°C-218°C (California Energy Company, personal communication, 1982).

3. Geothermal Leases

Potentially, there are an estimated 72,000 acres for geothermal leasing within the Coso Study Area. Public lands comprise 25,650 acres, and 41,560 acres are in the Naval Weapons Center Withdrawal. There are a few thousand acres of acquired and fee land as well (National Geothermal Service, June 5, 1981).

The Coso Hot Springs KGRA extends westward into Rose Valley. The eastern part of the Sacatar Meadow GRA includes three sections of the KGRA (see Geothermal Lease Map). Recorded leases are adjacent to the GRA boundary.

4. Geothermal Deposit Types

There are no geothermal resources recognized within the GRA, but in the Coso area the U.S. Geological Survey describes the resource as a hot-water hydrothermal convection system (Muffler, 1979). Recent drilling has confirmed a hot-water reservoir with a bottom hole

temperature in the 204°C to 218°C range beneath a steam cap.

5. Geothermal Economics

California Energy Company, Santa Rosa, California is operating a joint venture which has a contract with the China Lake Naval Weapons Center to develop the geothermal resource, construct and operate a power plant(s), and sell the electricity to the Navy (Geothermal Resources Council Bulletin, February, 1982). The contract stipulates that the contractor will deliver electricity at a cost guaranteed to be no more than 95% of commercial electricity rates. The Navy expects significant savings by 1985, the initial year projected for power production (Geothermal Resource Council Bulletin, February, 1982).

The U.S. Geological Survey in Circular 790 (Muffler, 1979) gives the following Coso reservoir estimates, based on the geothermometry and other studies:

190°-240°C	Estimates of reservoir temperature
220° <u>±</u> 11°C	Mean reservoir temperature
46 <u>±</u> 12	Mean reservoir volume (km ³)
25 <u>±</u> 7	Mean reservoir thermal energy (10 ¹⁸ J)
6.3	Wellhead thermal energy (10 ¹⁸ J)
1.55	Wellhead available work (10 ¹⁸ J)
650	Electrical energy (MW for 30 yr)

The USGS estimates were made prior to the California Energy Company discovery, and should therefore be revised accordingly.

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 are known. There is no potential for coal, oil shale, tar sands or sodium and potassium.

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.

Tungsten, listed as a strategic and critical mineral, has been produced from small deposits in the southern portion of the GRA. Because of the limited tonnage potential of these ore bodies and the reported decrease in grade of ore with depth, these would be unlikely exploration targets for significant additional production.

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

Geologic mapping in the Sacatar Meadow GRA is rather generalized and it seems likely that some small roof pendants of pre-intrusive rocks have escaped mapping, although whether any of the not-mapped ones are large enough to host tungsten deposits large enough to mine is debatable. Because of this possibility our confidence in the quality of geologic mapping is only moderate. In other respects it is high: except for the known roof pendant of classification area M2-2A, and for the possibility of other small pendants, WSA CA 010-027 is underlain by granitic intrusives.

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.

1. LOCATABLE RESOURCES

a. Metallic Minerals

WSA CA 010-027

M1-1B. This classification area covers most of the WSA. The classification of no known favorability is assigned because almost all of this part of the WSA, except for possible small roof pendants of metamorphic rocks, is underlain by granitic rocks, and there is no evidence that any occurrences of metallic minerals have ever been found in them. The confidence level is rather low because there is nothing published about metallic minerals in the WSA, although this may well be simply because, as already stated, there is no evidence that there are any.

M2-2A. This classification area covers the west-central protuberance in the outline of the WSA, which is underlain by a roof pendant of the Paleozoic-Mesozoic sediments. Rocks of the roof pendants contain practically all of the mineral deposits of the southern Sierra Nevada: they provide an appreciably more favorable environment for ore deposition than do the intrusive rocks. This is the reason for classifying this area as having low favorability, with a very low level of confidence because there is no other evidence of favorability.

b. Uranium and Thorium

WSA CA 010-027

U1-3C. This land classification covers the entire WSA and most of the GRA. It indicates that uranium concentration is moderately favorable at a moderate level of confidence within the WSA. The area is covered by the Cretaceous Isabella granodiorite. Associated pegmatites in the area are prospective for primary mineral uranium and thorium concentration (e.g. uraninite and monazite). The area is also prospective for fracture filling secondary uranium mineralization.

Uranium has been mined on a small scale from the Lamont Meadows mine at the southern tip of the WSA and from the Long Valley mine west of the WSA, in the southwestern corner of the GRA. Both of these deposits are associated with thorium (monazite), ilmenite, and magnetite in pegmatites. The exact location of the Lamont Meadows mine is not available and it is not known if it is within the borders of the WSA. Uranium also occurs in the southern portion of the GRA as secondary minerals in altered shear zones in the granitic rocks.

NURE data (Oak Ridge Gaseous Diffusion Plant, 1981) shows two anomalous uranium stream sediment samples near the WSA. The sample near the southern tip of the WSA indicates uranium between 7.5 and 11.9 ppm. This site is downstream from the Lamont Meadows mine and probably reflects past mining activity at the mine. The second anomaly is on the west central border of the WSA and indicates between 5.6 and 7.5 ppm uranium. This anomaly is near the contact of the Cretaceous granitic intrusion and Paleozoic metamorphic rocks. It may indicate a nearby contact metamorphic uranium deposit, presumably upstream within the WSA. No stream sediment sampling was done within the WSA for this NURE report.

The area is moderately favorable at a moderate confidence level for thorium deposits in pegmatites. Thorium mineralization occurs in pegmatites at the uranium mines mentioned above.

c. Nonmetallic Minerals

WSA CA 010-027

N1-2B. This classification area covers the entire WSA. The granitic rocks and the small area of metamorphics do not have any known occurrences of nonmetallic minerals. However, any mineral material can become an economic nonmetallic mineral if an entrepreneur can find a use for its particular chemical or physical properties. Additionally, all rock can be used as fill or in other very low-cost applications. These are the reasons for the low favorability classification and the low level of confidence in it.

2. LEASABLE RESOURCES

WSA CA 010-027

a. Oil and Gas

G1-1D. There has been no serious oil and gas exploration, nor are there any recorded occurrences of oil and gas in this westernmost sector of the Basin and Range province where it meets the Sierra Nevadas. The entire WSA is underlain by the Sierran granitic batholith and pre-Cretaceous metamorphic rocks. There is no evidence of source beds being present in the area. No lease map is presented for oil and gas.

b. Geothermal

G1-2B. Even though this WSA is geographically close to an excellent, proven geothermal resource, the geologic environment does not appear to be very conducive to geothermal resources. Although some faulting is present, the essentially monolithic granite which underlies the area is not thought to be very favorable for the geologic processes necessary for a viable geothermal system.

c. Sodium and Potassium

S1-1D. There is no potential for sodium and potassium in WSA CA 010-027. No map is presented for sodium and potassium.

3. SALEABLE RESOURCES

Saleable resources have been covered under the appropriate headings above.

V. RECOMMENDATIONS FOR ADDITIONAL WORK

1. The location of the Lamont Meadows uranium mine should be determined in the field, to learn whether or not it is within WSA 010-027.
2. The NURE stream sediment uranium anomaly at the southwest point of the WSA should be field checked to attempt to determine the source of the uranium-bearing material.
3. A stream sediment sampling program should be undertaken in and around the edges of the WSA to determine whether there are uranium or other metal occurrences that may be within the WSA, and to locate them if possible.

VI. REFERENCES AND SELECTED BIBLIOGRAPHY

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*X denotes one or more claims per section

Sacatar Meadow GRA CA-11

Sacatar Meadow GRA CA-11

EXPLANATION

- Mine, commodity
- Land Classification Boundary
- WSA Boundary

EXPLANATION

- Uranium Mine
- Uranium anomaly from stream sediment samples
- Land Classification Boundary
- WSA Boundary

EXPLANATION

- △ Mine, commodity
- Land Classification Boundary
- WSA Boundary

EXPLANATION

- Thermal well
- Land Classification Boundary
- WSA Boundary

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)	
		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.

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. 1987, for the Pleistocene of southern California.

² Geological Society of London, 1964, The Phanerozoic time-scale: a symposium: Geol. Soc. London, Quart. Journ., v. 120, suppl., 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.