FINAL REPORT

Assessment of Geology, Energy, and Minerals (GEM) Resources

ALDRICH MOUNTAIN GEM RESOURCE AREA

(OR-020-13)

GRANT COUNTY, OREGON

Prepared for

United States Department of the Interior
United States Bureau of Land Management
Scientific Systems Development Branch

March 1983

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Assessment of Geology, Energy, and Minerals (GEM) Resources

Aldrich Mountain GRA
(OR - 020 - 13)
Grant County, Oregon

Prepared For:

United States Department of the Interior
United States Bureau of Land Management
Scientific Systems Development Branch

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BLM Contract No.: YA - 553 - CT2 - 1042

March, 1983

This report was prepared as part of a Phase I Assessment of GEM Resources within designated Wilderness Study Areas in Oregon, Idaho and Nevada.

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DISCLAIMER

This document is part of a report prepared under Contract Number YA - 553 - CT2 - 1042 for the United States Department of the Interior, Bureau of Land Management. Although officials of the Bureau of Land Management have provided guidance and assistance in all stages of the project, the contents and conclusions contained herein do not necessarily represent the opinions or policies of the Bureau.

ACKNOWLEDGEMENTS

The authors very much appreciate the information, interpretations, and comments made by many different people and organizations as part of the preparation of this report. Special recognition goes to Mr. Jean Juilland of the Bureau of Land Management's Scientific Systems Development Branch. As Project Manager, he has provided valuable guidance and insight in all phases of the project. Mr. Durga Rimal, BLM State Geologist for Oregon and the Contracting Officer's Authorized Representative (COAR), was very helpful in the successful completion of this project. His assistance and guidance is greatly appreciated. Mr. Larry Steward, BLM State Geologist for Nevada, and Mr. Ted Holland, BLM State Geologist for Idaho, served as Project Inspectors. Their assistance in procuring needed maps, aerial photographs, and helicopter transportation also is greatly appreciated.

All members of the panel of experts provided valuable input into these assessments of GEM resources for each of the GEM Resource Areas (GRAs). Their professional approach to the problems and their interpretations of available literature and data form the foundation upon which the assessments for this project are based. We are grateful for their efforts and skills in this project. The panelists and their area of expertise are:

- Dr. Antonius Budding - Oil Shale and Tar Sands
- Mr. Raymond Corcoran - Field Verification
- Dr. James Firby - Paleontology
- Mr. Ralph Mason - Coal
- Mr. Richard Miller - Uranium and Thorium
- Mr. Vernon Newton - Oil and Gas
- Mr. Herbert Schlicker - Industrial Minerals and Geologic Hazards
- Dr. Walter Youngquist - Geothermal
- Dr. Paul Weis - Metals and Non - Metals.

Mr. Edwin Montgomery provided valuable insight and assistance in structuring the project and these reports in order to best serve the purposes of the Bureau of Land Management. We greatly apppreciate his assistance.

Technical assistance was provided by Mr. Frederic W. Lambie, Dr. Steve N. Yee and Dr. Terence L. Lammers of TERRADATA. Their assistance is most gratefully acknowledged.

Mr. Tom Mitchell assisted in the stream sediment sampling program. Bondar - Clegg provided the geochemical analysis of stream sediment samples.

Ms. Pamela Ruhl provided clerical and editorial assistance throughout the project. Ms. Sara Mathews assisted with occurrence information and drafting. Mr. Philip R. Jones and Mr. Michael A. Becker produced all documents relating to the project using TERRADATA's word processing and document production systems.

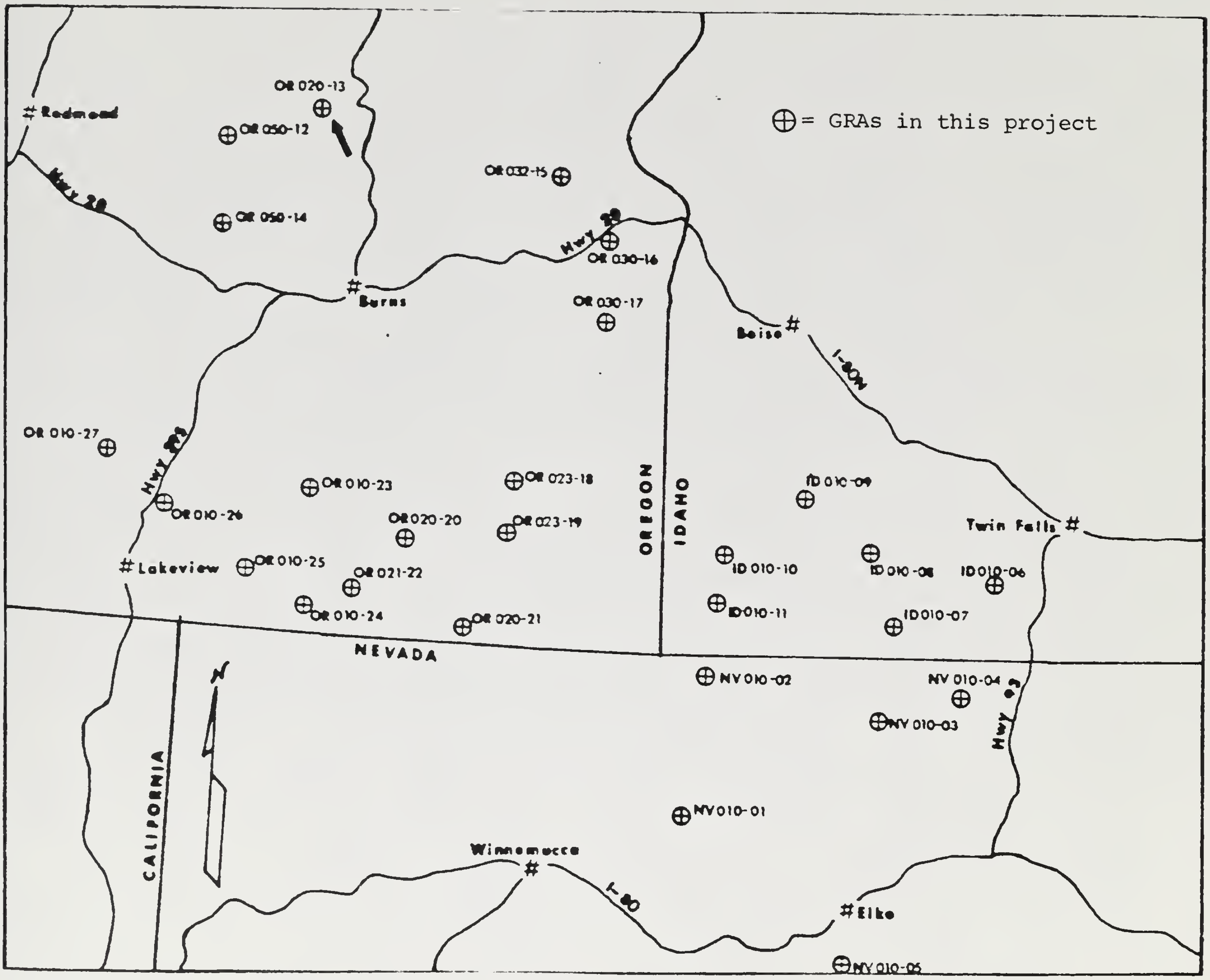
EXECUTIVE SUMMARY

The purpose of this project is to evaluate and classify environments favorable for the occurrence of GEM resources in southeastern Oregon, southwestern Idaho, and northern Nevada. **(See the TERRADATA report entitled "Procedures for the Assessment of Geology, Energy, and Minerals (GEM) Resources.")** GEM resource environments have been rated on a scale that ranges from one to four, with one being least favorable and four being most favorable. Favorability classes two and three represent low and moderate favorability, respectively. Confidence levels range from A to D with A being low confidence and D being high confidence. The confidence levels are directly related to the quantity and quality of the information available for the determination of the favorability classes.

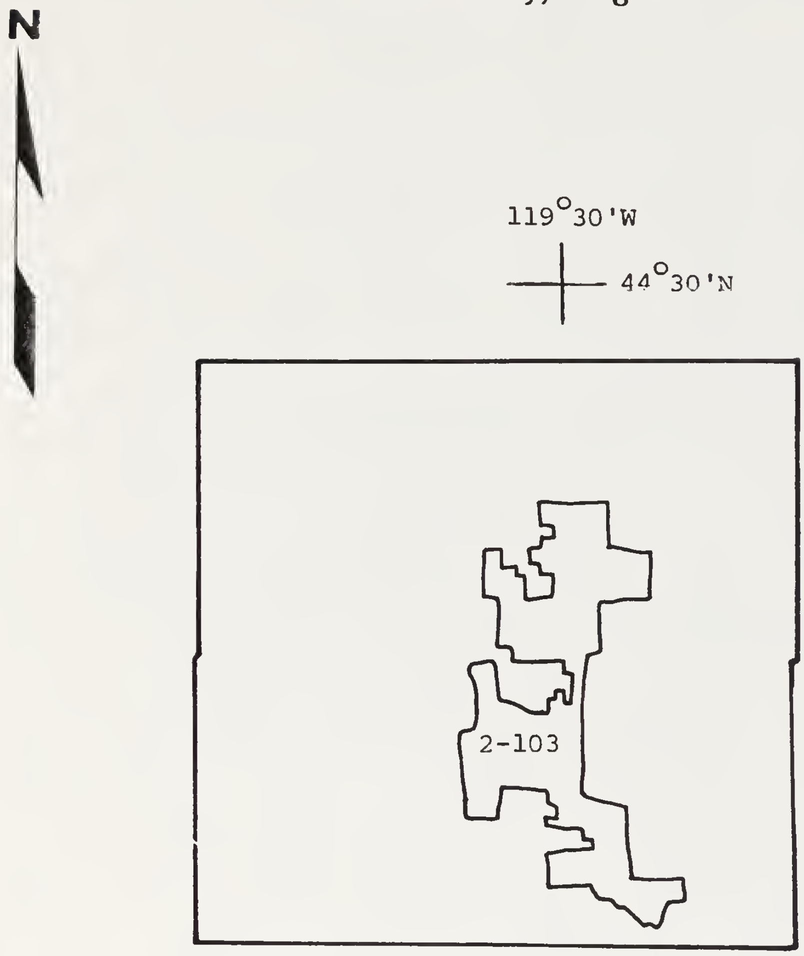
The specific area with which this report deals is the Aldrich Mountain GEM resource area (GRA OR-020-13) which is located in east-central Oregon (see attached location map). The GRA contains about 144 square miles within Townships 13S through 14S and Ranges 26E through 27E. It contains one WSA (WSA 2-103) which comprises 9,395 acres. The study area is in the John Day Resource Area of the Burns BLM District. It is about 30 miles from John Day, Oregon.

The GRA is within the Blue Mountains section of the Central Highland physiographic sub-province. Paleozoic eugeoclinal sediments may occur at depth. However, only Tertiary volcanogenic units and Quaternary deposits are exposed within the study area. The majority of the area is underlain by the Tertiary Picture Gorge Basalt. The major structural element in the area is the Columbia Arc and associated Columbia Embayment. The Aldrich Mountain GRA contains geologic environments that are variously favorable for GEM resources. The study area is is classified 3C for the occurrence of chromite and asbestos resources. The 3C rating signifies that the geologic environment, the inferred geologic processes and the reported mineral occurrences indicate moderate favorability for the occurrence of these resources, and that the available data provide direct evidence but are quantitatively minimal to support esixtence of these mineral resources. The study area also contains environments similar to those found in other Tertiary basins in which zeolite (clinoptilolite) deposits occur. The classification of the area for potential clinoptilolite resources (3A) signifies that although the necessary geologic environment is believed to be present, there is little or no evidence to support or refute this evaluation.

GRA Location Map



Land Classification Map
Aldrich Mountain GRA
(OR - 020 - 13)
Grant County, Oregon



Scale 1:250,000
(Canyon City 1°x2° NTMS Quadrangle)

The Aldrich Mountain GRA is favorable for chromite and chrysotile asbestos. These two resources are on the BLM compiled strategic and critical minerals list (see Table 3-4 of TERRADATA's report entitled "Procedures for the Assessment of Geology, Energy, and Minerals (GEM) Resources"). The entire GRA is favorable (Class 2) for coal, oil and gas, oil shale and tar sands, and bentonite resources (see Table, below). The potential for oil shale and tar sands resources is classified 2A because older rocks in the GRA include sandstones and shales of Triassic and Cretaceous age. Coal and oil and gas resources are classified 2B. There is limited indirect evidence that these resources could exist within this GRA. Bentonite favorability (2C) is based on the potential occurrence of environments analogous to favorable Tertiary sequences in other areas. The area does not exhibit characteristics favorable for other GEM resources.

TERRADATA recommends that further surface geologic investigations be undertaken in the Aldrich Mountain GRA in order to increase the confidence levels of the classifications. Detailed geologic mapping and geochemical investigations would be useful in upgrading the classifications of resource potential in this area. Selective drilling of geochemical and/or geophysical anamolous areas would contribute to the refinement of the confidence levels and the favorability ratings in this GRA.

Classification Of Lands Within The
Aldrich Mountain GRA
(OR - 020 - 13)
Grant County, Oregon
For GEM Resource Potential

COMMODITY	AREA	CLASSIFICATION LEVEL	CONFIDENCE LEVEL	REMARKS
Metals/Non-Metals	Entire GRA	3	C	Cr, Asbestos
Geothermal	Entire GRA	1	C	
Uranium/Thorium	Entire GRA	1	A	
Coal	Entire GRA	2	B	
Oil and Gas	Entire GRA	2	B	
Tar Sands/Oil Shale	Entire GRA	2	A	
Limestone	Entire GRA	1	B	
Bentonite	Entire GRA	2	C	
Diatomite	Entire GRA	1	C	
Clinoptilolite	Entire GRA	3	A	
Paleontology	Entire GRA	1	C	
Hazards	See Hazards Map (GRA File)			
ESLs	None	1	C	

LEGEND:
Class 1 - Least Favorable
Class 2 - Low Favorability
Class 3 - Moderate Favorability
Class 4 - High Favorability

Confidence Level A - Insufficient data or no direct evidence
Confidence Level B - Indirect evidence available
Confidence Level C - Direct evidence but quantitatively minimal
Confidence Level D - Abundant direct and indirect evidence

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1. INTRODUCTION

This report is one of 27 GRA technical reports that summarize the results of a Phase 1 assessment of the geology, energy, and minerals (GEM) resources in selected portions of southeastern Oregon, southwestern Idaho, and northern Nevada. The study region was subdivided into 27 GEM resource areas (GRAs), principally for ease of data management and interpretation. The assessment of GEM resources for this project consisted of an interpretation of existing literature and information by experts knowledgeable in both the geographic area and specific commodities. A restricted field verification program also was conducted. It is possible that the assessment would be different if detailed field exploration, geochemical sampling, and exploratory drilling programs were undertaken. (See the TERRADATA report entitled "Procedures for the Assessment of Geology, Energy, and Minerals (GEM) Resources.")

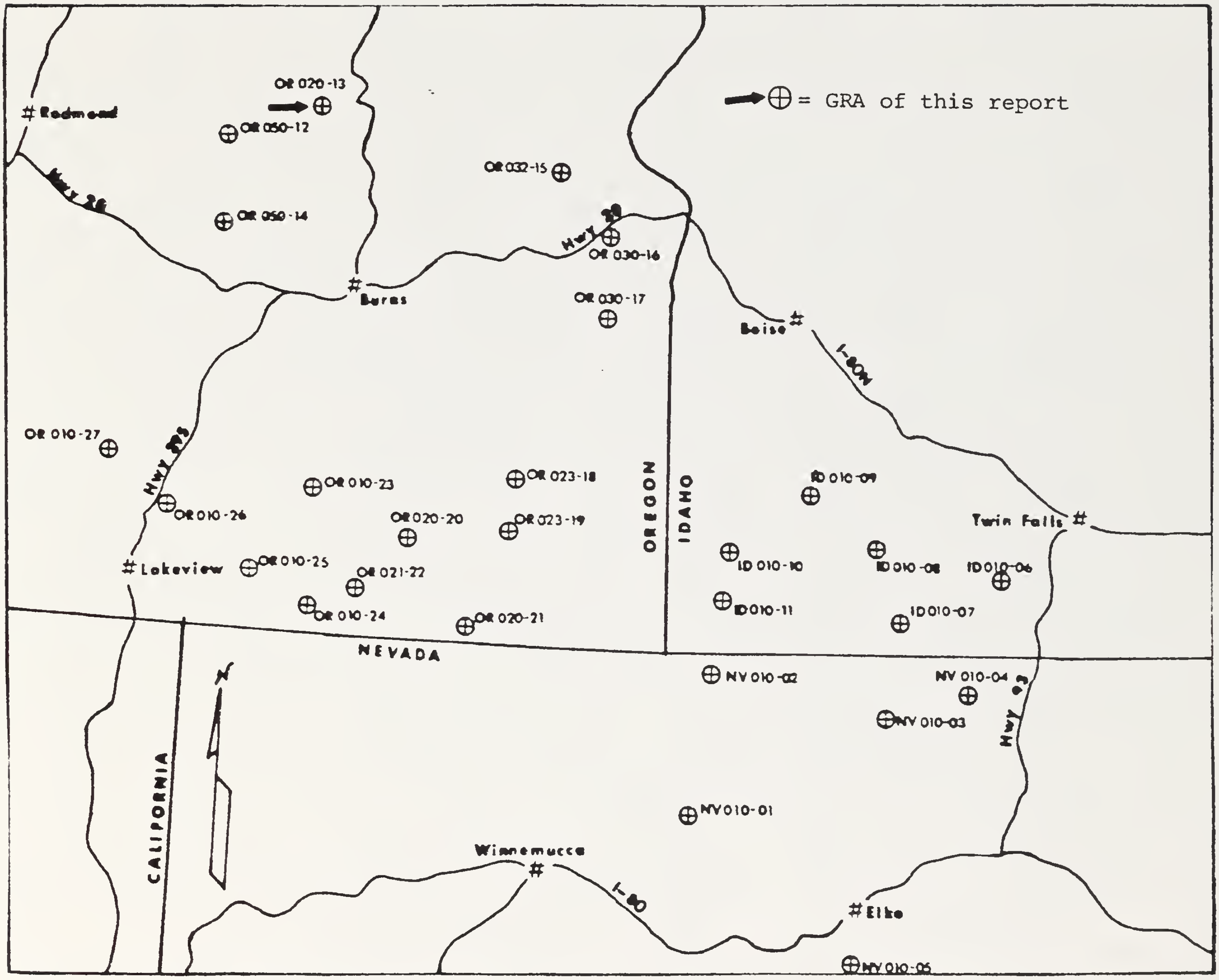
This report summarizes the assessment of the GEM resources potential of the Aldrich Mountain GRA (OR-020-13). See Figure 1-1. Commodity categories for which this GRA was evaluated are:

- Metals
- Oil and Gas
- Oil Shale and Tar Sands
- Geothermal
- Uranium and Thorium
- Coal
- Industrial Minerals
- Paleontological Resources
- Geologic Hazards
- Educational and Scientific Localities (ESLs)

Geologic environments within the Aldrich Mountain GRA have been rated with respect to their favorability for the occurrence of these different commodities. The favorability rating scale ranges from one to four, with one being least favorable and four being most favorable. Confidence levels in these ratings also have been assigned. These confidence levels range from A to D, with A being low confidence and D high confidence. Assigned confidence levels are related to the quantity and quality of the information available for the determination of the favorability ratings.

FIGURE 1-1

GRA Location Map



2. DESCRIPTION OF THE ALDRICH MOUNTAIN GRA

2.1 LOCATION

The Aldrich Mountain GRA (OR-020-13) is in east-central Oregon. It lies between latitudes 44°18'N and 44°29'N and longitudes 119°33'W and 119°40'W. The GRA contains approximately 144 square miles within Townships 13S and 14S and Ranges 26E and 27E (see Figures 1-1 and 2-1). The area contains one Wilderness Study Area; WSA 2-103 (9,395 acres). The Aldrich Mountain GRA is in the John Day Resource Area of the Burns BLM District. The area is about 30 miles from John Day, Oregon which is the nearest transportation center offering a minimum of rail, highway, and/or charter-air services. Access to the contained WSA is via county maintained dirt or packed-gravel roads. Vehicular access to the interior of the WSA is poor to non-existent.

2.2 GENERAL GEOLOGY

The Aldrich Mountain GRA is in the Canyon City 1°x2° NTMS Quadrangle. The data available for this area include one NURE investigation[(1)*], general mineral resource information[(2)], and limited small scale geologic mapping[(3)]. Occurrence information for this GRA comes from CRIB and MILS, and from claims and lease data supplied by the BLM. In general, the overall quality of commodity-specific information is fair. However, general geologic data for this area ranges from poor to fair. There are no known occurrences of most GEM resources in or near this GRA.

The Cascade Range divides the State of Oregon along the 121st meridian. The area west of this natural divide is fairly well known because of comprehensive geologic mapping published by the USGS in cooperation with the Oregon Department of Geology and Mineral Industries[(3)].

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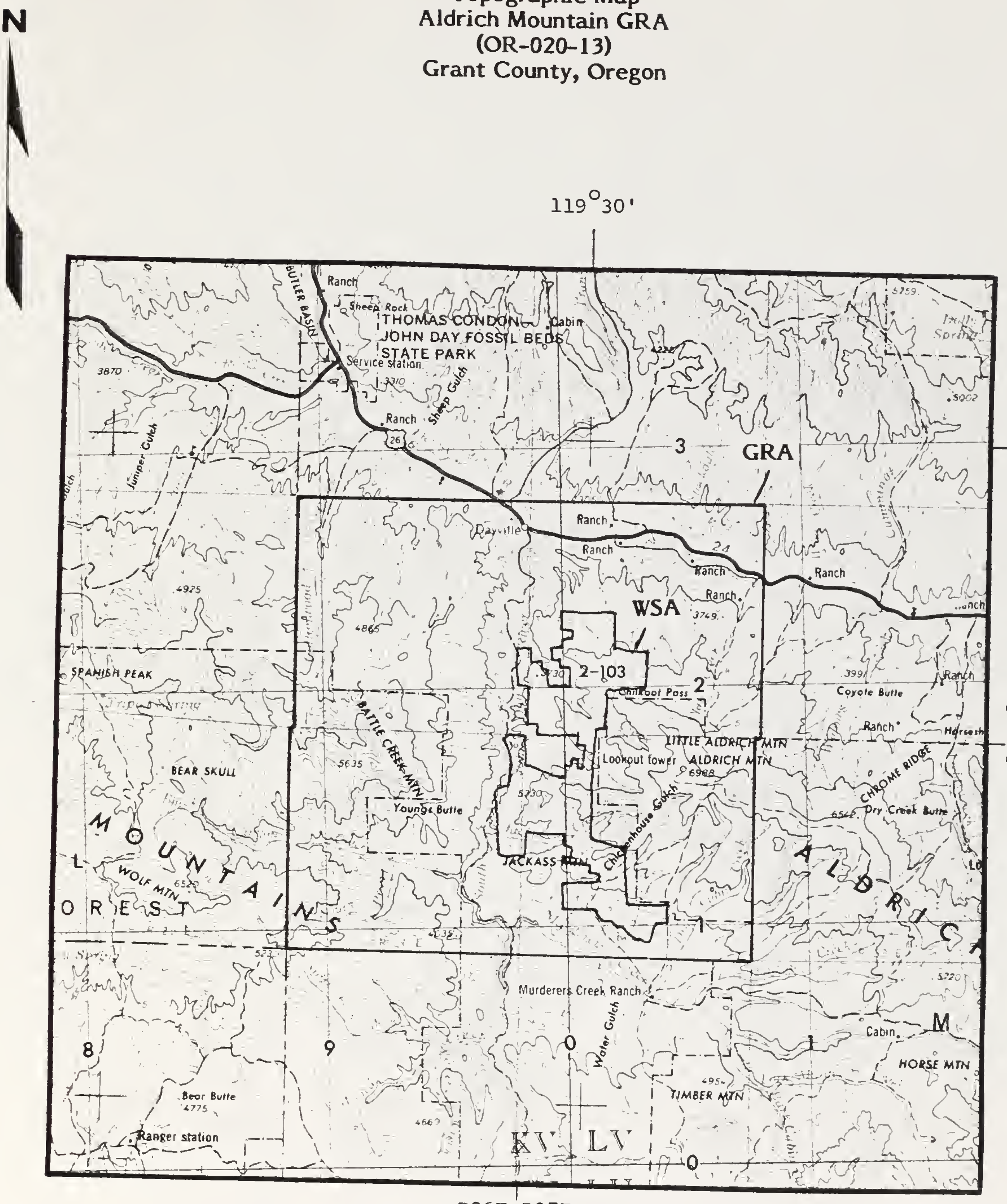
* In this report, citations are superscripted numbers. They refer to bibliographic entries listed in Appendix A, References Cited.

FIGURE 2-1

Topographic Map
Aldrich Mountain GRA
(OR-020-13)
Grant County, Oregon



Scale 1:250,000
(Canyon City 1°x2° NTMS Quadrangle)

The Aldrich Mountain GRA is within the Blue Mountain section of the Central Highland physiographic sub-province[4]. The area is typified by faulted synclinal basins and adjacent monoclinal mountain ranges. The Blue Mountain region includes, from east to northeast, the Ochoco, Strawberry, Greenhorn, Elkhorn, Wallowa, and Blue Mountains. Maximum relief is nearly 8,000 feet. Local relief varies from 2,000 feet to 5,000 feet.

The Blue Mountain sub-province is divided into two distinct sub-groups by Dixie Mountain. The sub-group east of Dixie Mountain comprises the Wallowa-Seven Devils volcanic arc terrane, oceanic crustal terrane, forearc basin, and the Huntington volcanic arc terrane. These units lie in four sub-parallel belts that are interpreted to be remnants of acreted mini-plates[5]. The sub-group west of Dixie Mountain is composed of Paleozoic age ophiolite series and Mesozoic clastic sequences. Tertiary and Quaternary units are the only rocks exposed within the Aldrich Mountain GRA.

2.2.1 Geomorphology

The Aldrich Mountain GRA is an upland area currently in a degredational cycle. It is characterized by deeply incised streams that occupy V-shaped valleys. The area is drained by Black Canyon Creek and Murderous Creek in the southern part of the GRA. These drain into the South Fork of the John Day River. Tributaries to Murderous Creek exhibit trellis-type drainage patterns that are fault controlled. The area is undergoing a stable degredational cycle. There are no large alluvial deposits and streams are able to transport bedload materials out of the GRA via the John Day River system. The total relief in the Aldrich Mountain GRA is in excess of 4,200 feet. Relief in the western portion of the GRA is about 3,600 feet.

2.2.2 Lithology and Stratigraphy

The Miocene Columbia River Group underlies 70 percent of the GRA. Older rocks crop-out near Aldrich Mountain and along the John Day River. Younger units in the GRA include Quaternary basalts and volcaniclastic sediments and tuffs of the Rattlesnake Formation.

The Columbia River Group is undivided, however, individual fissure flows can be identified. The Picture Gorge Basalt is differentiated and mapped in the northeast corner of the GRA. The Columbia River Basalt is an originally low-viscosity, ferromagnesian-rich unit. It is younger than the Picture Gorge Basalt. The Picture Gorge Basalt contains higher concentrations of olivine, less silica, and was more viscous than younger flows.

The oldest rocks in the Aldrich Mountain GRA are Cretaceous buff-colored marine sandstones and conglomerates indicating that the Cretacous sea once covered the Blue Mountains.

Thousands of feet of basaltic and rhyolitic flows unconformably covered the Cretaceous rocks in Late Eocene time. These rocks include water-lain tuffs, breccias, and volcanic conglomerates. The lower Clarno Formation consists of massive hornblende-bearing andesitic to dacitic flows with locally occurring breccias. Lateritic soils developed on the Clarno surface during a long period of tropical and sub-tropical weathering. The lateritic zone is not mapped, but is seen as a reddish basal layer in the lower John Day Formation.

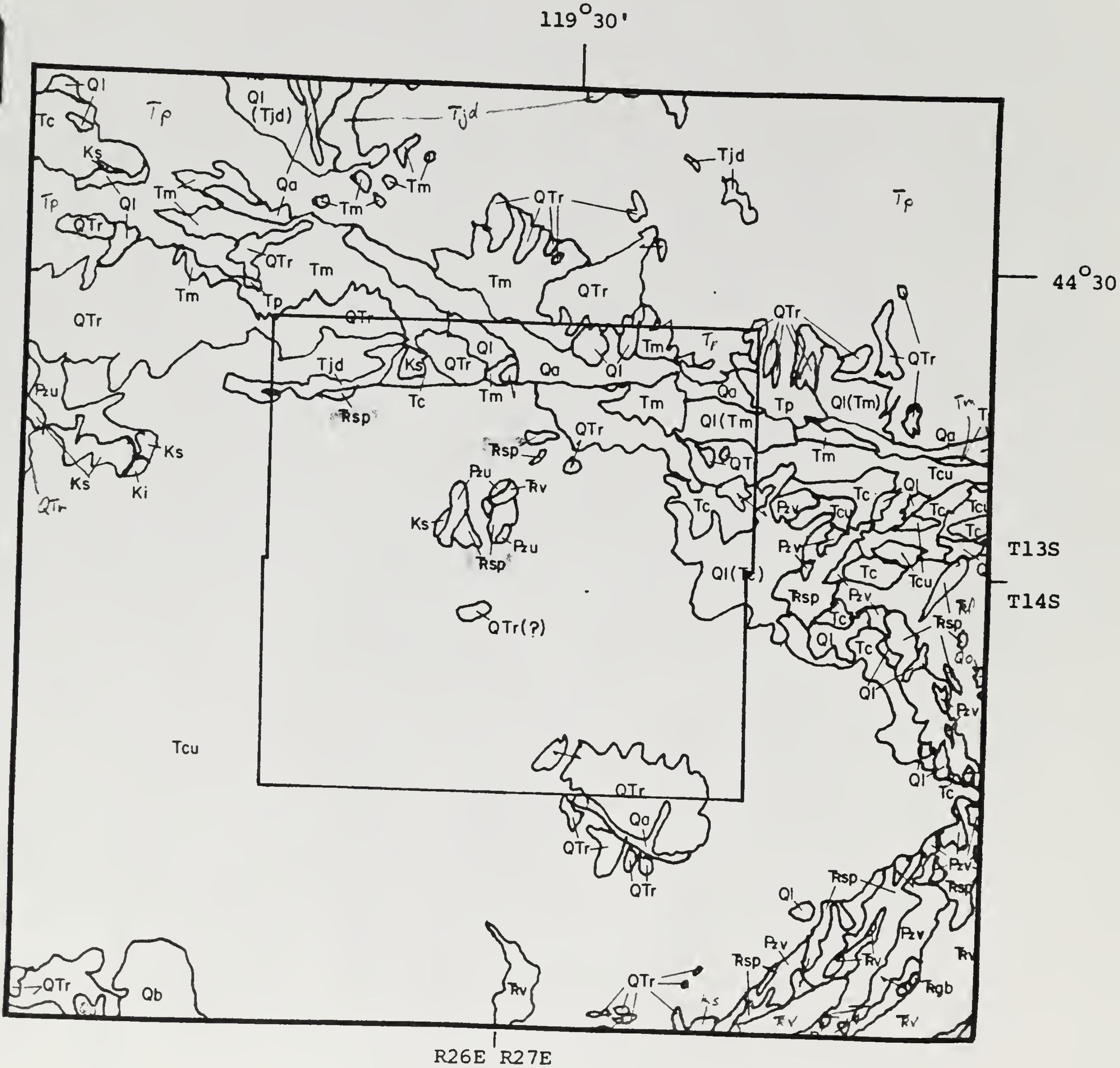
A long hiatus preceded deposition of the John Day Formation. Angular unconfomities between the Clarno and John Day Formations approach 60 degrees[(2)]. Wind blown ash from the Cascade area was the source for white to green tuffaceous siltstones and rhyolitic eolian tuffs of the lower John Day Formation. A prominent welded tuff marks the upper John Day Formation. Although the John Day Formation is known for its fossil localities, no such areas exist within the Aldrich Mountain GRA. Local folding and erosion occurred before the flood basalts of the Columbia River Group were deposited.

The Columbia River Group covered the Blue Mountain area. Individual flows were continuous over hundreds of miles. Local unconformaties and interbeds of the Mascall Formation occur in the area. Folding and faulting raised the study area about 5,000 feet above the adjacent valley floor. Erosion from the rising mountains filled the valleys with fanglomerates, gravel, sand, and clay. Ash flows up to 100 feet thick also occurred in this area. These ash flows make up the Rattlesnake Formation which forms conspicuous rimrocks along the John Day River.

FIGURE 2-2

Geologic Map
Aldrich Mountain GRA
(OR-020-13)
Grant County, Oregon

N



Scale 1:250,000
(Canyon City 1°x2° NTMS Quadrangle)

FIGURE 2-2
(Continued)

Geologic Map Legend For
Aldrich Mountain GRA
(OR-020-13)
Grant County, Oregon

Qal - Alluvium: Mainly valley fill consisting of silt, sand and gravel.

Ql - Landslide Debris: Where known, underlying formation is indicated by symbol in parentheses.

Qb - Basalt and Basaltic Cinders

QŦr - Rattlesnake Formation: Fanglomerate, gravel, sand, and clay along the John Day River valley above the present streams; includes a prominent interbedded rhyolitic welded tuff member, which, in places, extends areally beyond the sedimentary rocks.

Tcu - Columbia River Group, Undivided: Includes fissure flows of the Picture Gorge and Yakima Basalts.

Tm - Mascall Formation: Drab to cream-colored water-laid tuff and ash near Dayville, becoming coarser eastward in the John Day Valley, with an increasing proportion of polished-pebble conglomerate and rhyolitic welded tuff. In places contains lignitic beds.

Tp - Picture Gorge Basalt: Olivine-bearing basalt flows exposed in Picture Gorge. Includes thin, ashy beds between the lower flows. Exposed along the John Day structural trough from the vicinity of Mount Vernon to the west edge of the map; probably forms the bulk of unit Tcu mapped to the north and in the Aldrich and Ochoco Mountains.

Tjd - John Day Formation: White, buff, and green water-laid tuffaceous siltstones, rhyolitic eolian tuff, and welded tuff; lower part reddened by admixture of lateritic material from underlying Clarno Formation.

Tc - Clarno Formation: Basaltic to rhyolitic flows, breccia, tuff, and volcanic conglomerate, with thin lenses of fine-grained water-laid ash; thick hornblende-bearing porphyritic andesitic to dacitic flows and breccia occur locally.

Ks - Sedimentary Rodks: Buff-colored marine sandstone and conglomrate, locally fossilferous.

Ki - Dioritic Intrusive Rocks: Intrusive masses ranging in size from dikes to a batholith.

Ŧrv - Vester Formation: Massive conglomerate, and well-bedded shale, graywacke, and volcanic sandstone; interbedded basaltic flows and breccias near base. Includes Begg and Brisbois Formations.

Ŧrsp - Igneous and Metamorphic Rocks: Sheared serpentine, mostly derived from peridotite, but original rock-type not readily determinable.

- Geologic contact (dashed where inferred).

2.2.3 Structural Geology

Major structural events that affected Oregon include orogenic episodes and extensional movements accompanied by outpourings of flood basalts. The latter have obscured much of the earlier geologic history in the area. Devonian sedimentation reflects a near-shore marine environment. During the Pennsylvanian, this part of Oregon was mantled by regressive sandstones of the Spotty Ridge Formation in response to the Antler orogenic event that occurred farther south in Nevada. Episodes of mini-plate acretions occurred during the Permian and Triassic in the eastern Blue Mountains, resulting in four sub-parallel belts of oceanic and forearc basin rocks. A Late Jurassic to Early Cretaceous orogenic event is characterized in southwestern Oregon by strong folding, faulting, and regional metamorphism. Ultramafic bodies that are associated with the Idaho Batholith were emplaced at this time. This event was significant in that it was the driving mechanism for the concentration of valuable mineral deposits that occur in the Dixie Butte area.

A eugeocline formed in the Middle to Late Mesozoic. This structure was the repository for tens of thousands of feet of Triassic and Jurassic sediments that are potentially favorable for the accumulation of oil and gas. Nevadan and Laramide orogenies at the end of the Mesozoic rotated this structure, forming what is now known as the Columbia Arc. At about the same time, the Klamath Mountains were thrust westward. Stratigraphic offsets suggest that rotation of the Columbia Arc continued into the Oligocene[5].

In eastern Oregon, northwest-trending fault patterns resulted from extensional faulting similar to that in the Basin and Range Province[6]. Some faults, such as the Brothers fault zone, can be seen to curve more northward near Bend, Oregon. This may be related to the rotational movements of the Columbia Arc.

2.2.4 Paleontology

Three localities of marine mollusks are known within the Aldrich Mountain GRA. They occur in an upper Cretaceous shale located in the northwestern section of the study area. Tertiary strata of the Mascall and John Day Formations also occur in this area. No fossil localities are recorded for these units[7]. The most common lithologies are the Picture Gorge and Columbia River Group basalts. These units may contain lacustrine fossil assemblages in limited areas.

2.2.5 Historical Geology

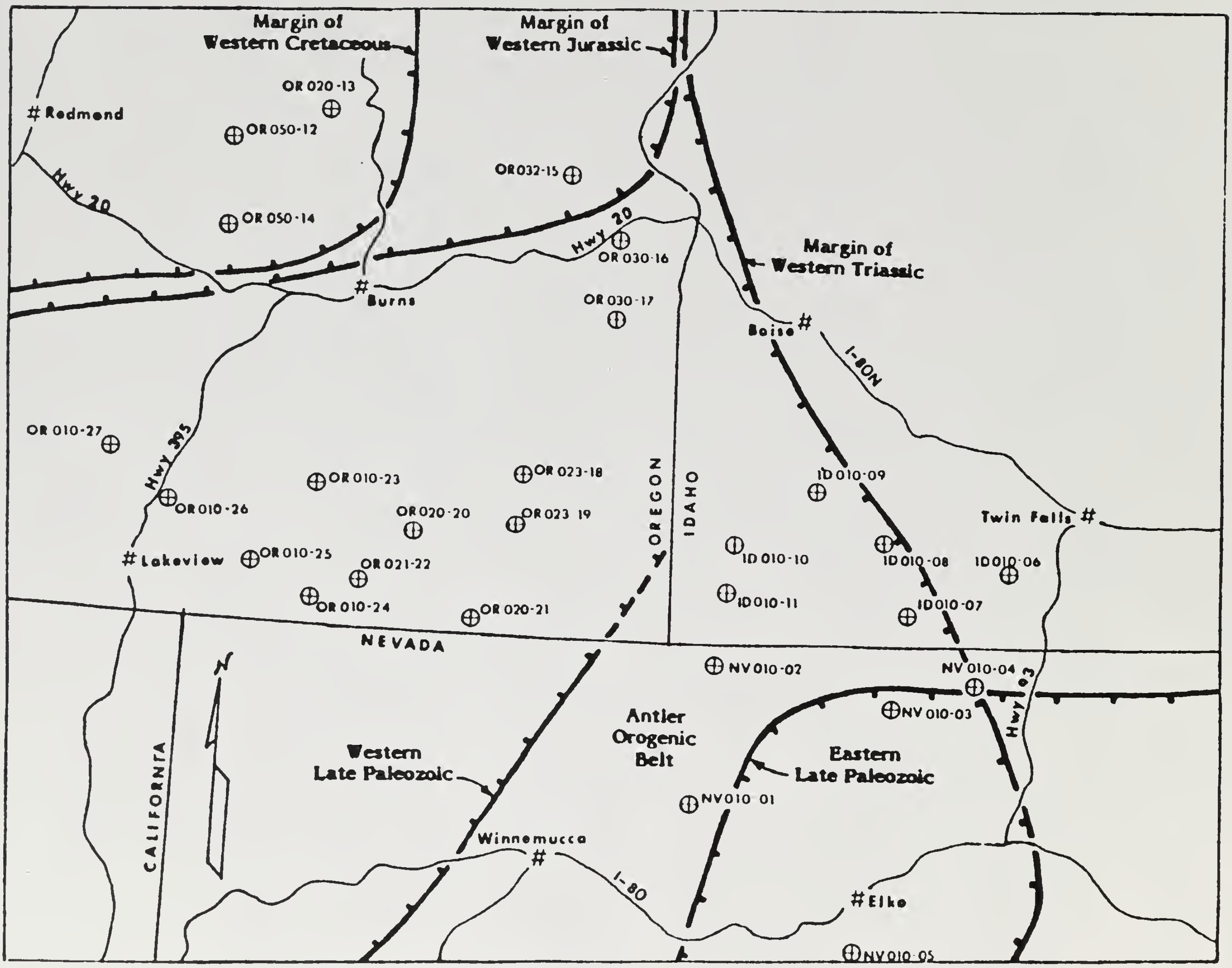
The evolutionary history of this area during Paleozoic and Early Mesozoic time is incompletely known because of the paucity of exposures. Devonian, Late Mississippian, and Permian limestones and shales suggest a transgressive-regressive sequence that developed in warm epirogenic seas. These strata were subsequently folded and faulted in Early Mesozoic time. Dynamothermal metamorphism and syntectonic intrusions further obscured the previous geologic history of these strata. The eroded roots of these Early Mesozoic structures are unconformably overlain by Late Triassic and Jurassic strata.

The Late Mesozoic and Cenozoic history of the area is much clearer. Two major tectonic features formed during this time. These were the Columbia Arc, which consisted of Paleozoic and Mesozoic rocks, and the Columbia Embayment, which was the locus of Cenozoic sedimentation and volcanic activity. The Columbia Embayment was a eugeoclinal trench that developed between the Klamath and Wallowa Mountains. Thousands of feet of graywacke, lava flows, and volcaniclastic sediments were deposited in the Columbia Embayment. There was nearly continuous volcanism in the southwestern part of this trough. This is reflected in the thick sequence of volcanics near Willowdale and Ashwood[5]. Conversely, the northeastern part of the trough received only intermittent volcanics. Limestone reefs formed in this area during episodes of diminished volcanic activity.

Upper Triassic and Jurassic strata compose fluvial conglomerates, sandstones, siltstones and mudstones, and freshwater limestones. Some red beds occur in Silvies River Canyon. The Hyde Formation of the Izee Group represents a minor marine transgression; it contains as much as 1,000 to 1,500 feet of marine sediments. The Mesozoic strata were subsequently folded and faulted during a Late Jurassic to Early Cretaceous orogenic event. Syntectonic intrusives and regional metamorphism accompanied this event. Most of the metallic mineralization in this part of Oregon is related to these intrusives.

FIGURE 2-3

Paleogeographic Map(8)
Oregon-Idaho-Nevada
Tri-State Area



The geologic evolution of Oregon was characterized by continued uplift and volcanism during Cenozoic time. In western Oregon volcanics filled the remaining geosynclines. Sporatic eruptions of basalt and rhyolite in the Paleocene dammed streams and filled basins in central Oregon. Central and western Oregon were blanketed by laval flows and pyroclastic deposits from the emerging Cascades. In the Miocene, basalt flows in northern Oregon covered 100,000 square miles, forming the Columbia River Basalt Plateaus. The southern Blue Mountains contained basaltic and rhyolitic volcanoes that eventually inundated them with thick volcanogenic deposits.

The tropical climate during the Tertiary was conducive to the development of limonite and lateritic bauxites on the flat basaltic plateaus in western Oregon. By Pliocene time, nearly all of Oregon was above sea-level. Climatic differentation became more pronounced as a result of further development of the Cascades.

2.3 ENVIRONMENTS FAVORABLE FOR GEM RESOURCES

Aldrich Mountain GRA is classified moderately favorable for the occurrence of chrysotile asbestos and chromite. Sheaved serpentine under appropriate conditions could be a favorable environment for chrysotile asbestos. The presence of dioritic intrusives, west of the GRA, suggests the possibility of other metallic accumulations. Mineralization of this type is charactristically associated with intrusive igneous rocks in portions of Nevada, Oregon, Washington, Idaho, and Montana[(9)]. Chromite occurs in and near the Aldrich Mountain GRA.

The John Day Formation is moderately favorable for the occurrence of zeolite (clinoptilolite). Under certain weathering conditions volcanics alter to form this clay. The John Day Formation is exposed in the northwest portion of the GRA. Deposits of clinoptilolite are known to occur in T11S, R26E[(6)].

2.3.1 Environments for Metals and Non-Metals Resources

The Aldrich Mountain GRA contains environments that are considered moderately favorable for the accumulation of metallic and non-metallic resources[(9)]. The presence of serpentine and associated ultramafic intrusives enhances the favorability of the area for the accumulation of chrysotile asbestos and chromite.

2.3.2 Environments for Oil and Gas Resources

The Aldrich Mountain GRA has a low favorability for the occurrence of oil and gas resources. Potentially favorable environments include Triassic, Jurassic, and Cretaceous marine sedimentary units that underlie the study area(8). Structural deformaton is relatively intense in this area, therefore, the probablility of the occurrence of these resources is lessened.

2.3.3 Environments for Oil Shale and Tar Sands Resources

The Aldrich Mountain GRA contains environments that have low favorability for the occurrence of oil shale or oil impregnated sand(10). Potentially favorable lithologies include Triassic and Cretaceous shales and sandstones.

2.3.4 Environments for Geothermal Resources

The Aldrich Mountain GRA contains no environments that are favorable for geothermal resources. Requisite geologic recognition criteria are not present in the area(11). There are no geothermal occurrences and no young volcanics in the area.

2.3.5 Environments for Uranium and Thorium Resources

The Aldrich Mountain GRA contains no environments that are favorable for the occurrence of uranium or thorium(12). The GRA does not exhibit any of the lithology, alteration, or geochemical recognition criteria for environments that may be favorable for uranium or thorium. There are no uranium occurrences in or near the area; and no evidence to indicate the presence of uranium or thorium in association with any other mineralization.

2.3.6 Environments for Coal Resources

The Aldrich Mountain GRA has a low favorability for the occurrence of coal and lignite deposits(13). The chances for coal or carbonaceous materials to have formed in the study area are remote. The geology of the Aldrich Mountain GRA does not support environments favorable for the formation of coal deposits. Much of the area is either mantled with accumulations of lavas and related volcanic products or has been modified by adjacent volcanic activity.

2.3.7 Environments for Industrial Minerals Resources

The John Day and Clarno Formations are favorable for clinoptilolite and bentonite resources. Volcanogenic facies of these two formations are favorable for bentonite and clinoptilolite if the right diagenetic environments were present. There are known occurrences of clinoptilolite in nearby towhships[6].

2.3.8 Environments for Paleontological Resources

The Aldrich Mountain GRA contains environments that are favorable for paleontological resources[7]. Fossil localities occur in Cretaceous shales near the area. The John Day and Mascall Formations are known to be fossilferous elsewhere.

2.3.9 Environments for Geologic Hazards

Potential geologic hazards in the Aldrich Mountain GRA consist of mapped and interpreted faults, landslides, and/or volcanic centers[6]. These features were noted from aerial photographs, geologic maps, and topographic maps. There is no historical record of violent seismic or volcanic activity in the area. The potential for mass movement exists along all over-steepened slopes within the GRA.

2.3.10 Educational and Scientific Localities

There are no known ESLs in the Aldrich Mountain GRA.

3. ENERGY AND MINERAL RESOURCES IN THE ALDRICH MOUNTAIN GRA

The Aldrich Mountain GRA is moderately favorable for asbestos and clinoptilolite resources. The overall favorability of the GRA for other GEM resources is low.

3.1 KNOWN DEPOSITS

The Aldrich Mountain GRA contains no known deposits of GEM resources.

3.2 OCCURRENCES

The Aldrich Mountain GRA contains two CRIB localities, three MILS localities, and no NURE-related occurrences (Figures 3-1 and 3-2). The CRIB localities are concerned with chromite occurrences. One of these localities has a record of past production. Production amounts are unknown, but are believed to have been small. The MILS localities include three chromite-related sites.

3.3 CLAIMS

The Aldrich Mountain GRA contains no known claims. Claims data are current as of 15 August, 1982.

3.4 LEASES

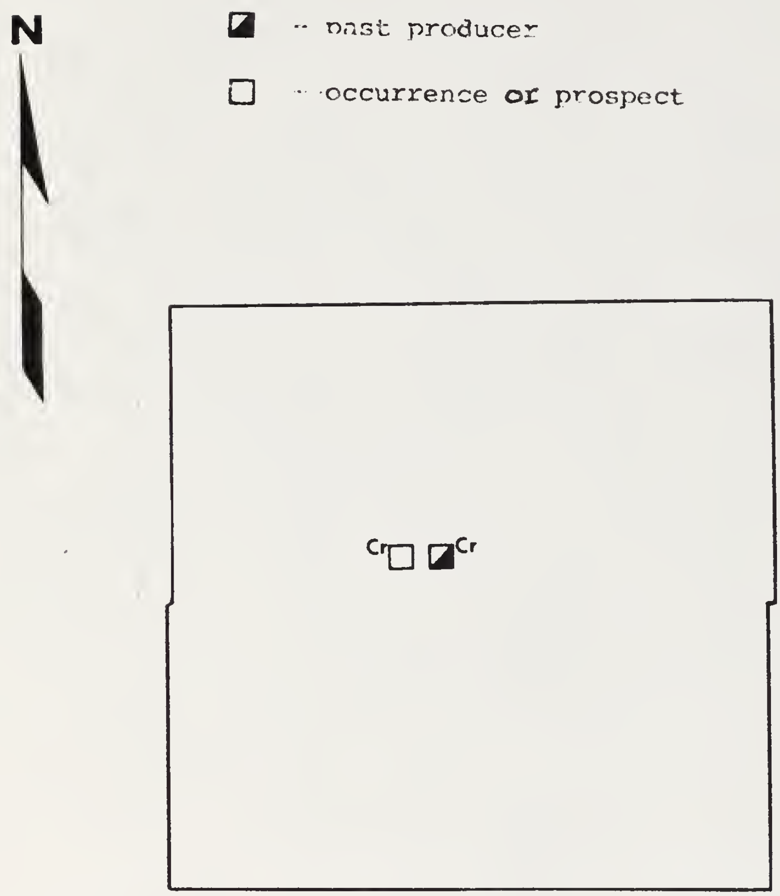
Townships 13S and 14S and Ranges 26E and 27E are completely leased or are under lease application. This leasing activity covers all of the Aldrich Mountain GRA and includes all of WSA 2-103. Lease information is current as of 15 August, 1982.

3.5 DEPOSIT TYPES

There are no known deposits within the Aldrich Mountain GRA.

FIGURE 3-1

CRIB Localities Map
Aldrich Mountain GRA
(OR-020-13)
Grant County, Oregon



This map is an overlay for Figures 2-1 and 2-2.

Scale 1:250,000
(Canyon City 1°x2° NTMS Quadrangle)

FIGURE 3-1
(Continued)

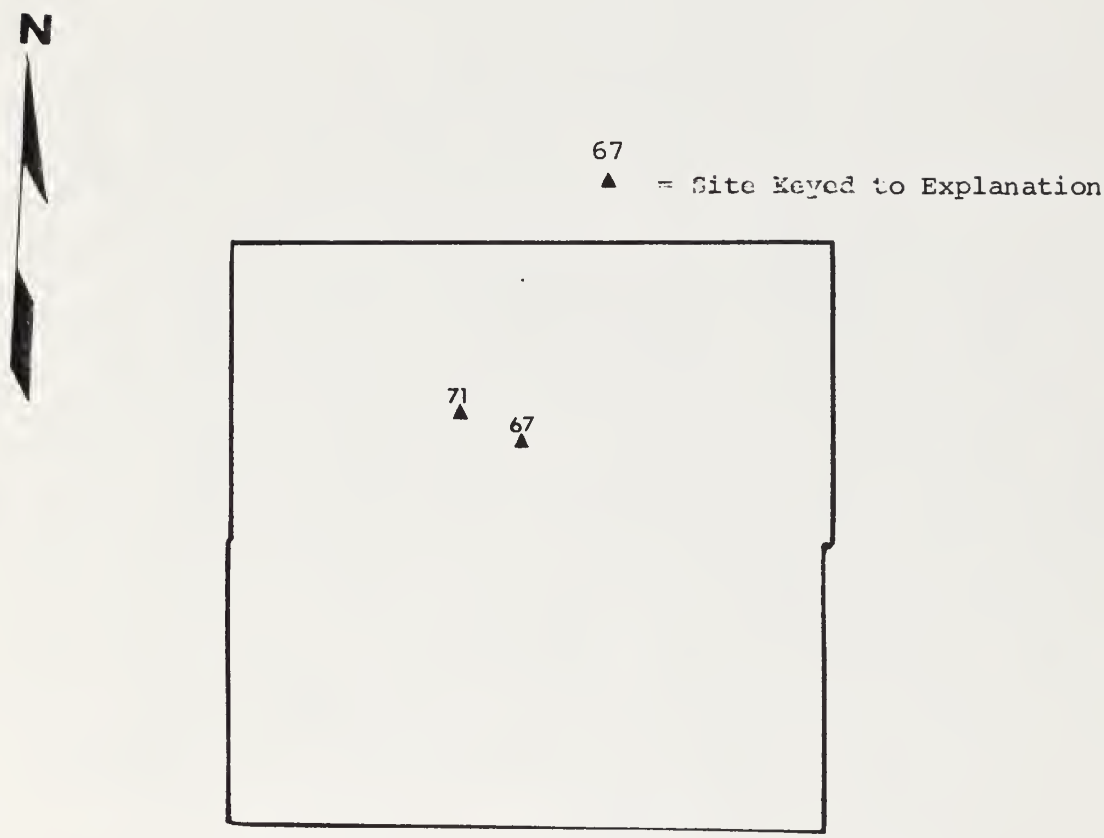
Legend For
CRIB Localities Map
Aldrich Mountain GRA
(OR-020-13)
Grant County, Oregon

1. CRIB No.: MO14842
   Location Name: Lee, W., O.R. Mascall Claims
   Latitude: 44°24'07"N
   Longitude: 119°33'42"W
   Commodities: Chromite
   Production: No
   Production Size: Not Applicable
   References: Westgate, L.G.; 1920; Deposits of Chromite in Eastern Oregon; USGS Bulletin 725-A, p.53.

2. CRIB No.: MO 14843
   Location Name: Lee, W. Eastside
   Latitude: 44°24'25"N
   Longitude: 119°32'13"W
   Commodities: Chromite
   Production: Yes
   Production Size: Unknown
   References: Westgate, L.G.; 1920; Deposits of Chromite in Eastern Oregon; USGS Bulletin 725-A, p.53.

FIGURE 3-2

MILS Localities Map
Aldrich Mountain GRA
(OR-020-13)
Grant County, Oregon



This map is an overlay for Figures 2-1 and 2-2.

Scale 1:250,000
(Canyon City 1°x2° NTMS Quadrangle)

FIGURE 3-2
(Continued)

Explanation For
MILS Localities Map
Aldrich Mountain GRA
(OR-020-13)
Grant County, Oregon

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 131
67 NAME- MASCALL
                                                          REFERENCE NUMBER- 0410230291
   STATE- OREGON                          COUNTY- GRANT
   LATITUDE-    N 44 25 33              PRECISION-  500M                              ELEV:PREC- 0792M:100M
   LONGITUDE- W 119 32 29  REFERENCE POINT- APPROX
   UTM:  ZONE 11N  NORTHING 4922015  EASTING 297702
   PUBLIC LAND SURVEY  TOWNSHIP- 013 S   RANGE- 026 E
       DESCRIPTION      SECTION- 24  SECTION SUBDIVISION- C
   RIVER BASIN- 74I   JOHN DAY RIVER                    DOMAIN- UNKNOWN
   STATUS- PAST PRODUCER  OPERATION TYPE- UNDERGROUND
   MESA ID NO.              YEAR FIELD CHECKED-        MAP REPOSITORY- WFOC
   MAP NAME- DAYVILLE              TYPE- 7.5 MIN
   1:250.000 MAP NAME- CANYON CITY              MINERAL PROPERTY FILE-
   PRIMARY NAME- MASCALL
   COMMOD MOD-
   MINE MAP REPOSITORY
   U S GEOL SURVEY-STRATEGIC MINERAL MAPS-CHROMITE

 132
67 NAME- OREGON CHROME
                                                          REFERENCE NUMBER- 0410230023
   STATE- OREGON                          COUNTY- GRANT
   LATITUDE-    N 44 25 05              PRECISION-  500M                              ELEV:PREC- 0914M:500M
   LONGITUDE- W 119 32 12  REFERENCE POINT- ORE BODY
   UTM:  ZONE 11N  NORTHING 4921219  EASTING 298051
   PUBLIC LAND SURVEY  TOWNSHIP- 013 S   RANGE- 026 E
       DESCRIPTION      SECTION- 35  SECTION SUBDIVISION- NENENE
   RIVER BASIN- 74E   JOHN DAY RIVER                    DOMAIN- BLM ADMIN
   STATUS- UNKNOWN            OPERATION TYPE- SURFACE
   MESA ID NO.              YEAR FIELD CHECKED-        MAP REPOSITORY- WFOC
   MAP NAME- CANYON CITY           TYPE- 1:250K
   1:250.000 MAP NAME- CANYON CITY              MINERAL PROPERTY FILE- 15.088
   PRIMARY NAME- OREGON CHROME
   COMMOD/MOD-   CHROMIUM          CHROMITE

 138
71 NAME- EAST SIDE
                                                          REFERENCE NUMBER- 0410230290
   STATE- OREGON                          COUNTY- GRANT
   LATITUDE-    N 44 25 34              PRECISION-  500M                              ELEV:PREC- 1012M:100M
   LONGITUDE- W 119 33 41  REFERENCE POINT- APPROX
   UTM:  ZONE 11N  NORTHING 4922176  EASTING 296111
   PUBLIC LAND SURVEY  TOWNSHIP- 013 S   RANGE- 026 E
       DESCRIPTION      SECTION- 23  SECTION SUBDIVISION- C
   RIVER BASIN- 74E   JOHN DAY RIVER                    DOMAIN- UNKNOWN
   STATUS- PAST PRODUCER  OPERATION TYPE- UNDERGROUND
   MESA ID NO.              YEAR FIELD CHECKED-        MAP REPOSITORY- WFOC
   MAP NAME- DAYVILLE              TYPE- 7.5 MIN
   1:250.000 MAP NAME- CANYON CITY              MINERAL PROPERTY FILE-
   PRIMARY NAME- EAST SIDE
   COMMOD/MOD-
   MINE MAP REPOSITORY
   U S GEOL SURVEY-STRATEGIC MINERAL MAPS-CHROMITE
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TERRADATA
San Francisco
Denver

3.6 MINERAL ECONOMICS

The Aldrich Mountain GRA is classified moderately favorable for the occurrence of chrysotile asbestos, chromite, and clinoptilolite resources.

3.6.1 Asbestos

In 1981 the uses of asbestos included asbestos-cement pipe, 40 percent; flooring products, 25 percent; friction products, 12 percent; roofing, coatings, insulation, and other miscellaneous applications, 23 percent. Total 1981 domestic mine production was about 81,000 metric tons. The apparent United States consumption was 401,000 metric tons. The United States net import reliance was about 80 percent of the total apparent consumption. No significant amount of asbestos can be recycled. The demand for asbestos in the United States has been decreasing since the late 1970's. the future demand for asbestos is expected to show no growth through 1990[14].

3.6.2 Chromium

Chromium is used by the metallurgical industry, 57 percent; chemical industry, 25 percent; and the refractory industry, 18 percent[15]. Demand for chromium in 1981 dropped to its lowest level since 1975. This decline continued into July, 1982, when chromuim consumption decreased 26 percent in the metallurgical industry, 75 percent in the refractory industry, and 30 percent in the chemical industry (compared to July, 1981)[16]. Demand for chromium is expected to continue to be directly related to the demand of the steel industry. However, the long-term demand for chromium is expected to increase at an annual rate of about 3.2 percent through 1990[17].

The United States has no domestic mine production of chromite. Estimated 1982 consumption will be about 530,000 metric tons. Since 1977 the United States net import reliance has been about 90 percent of apparent consumption. The price of South African chromite has decreased from a year-end high of $59.00 per metric ton in 1977 to $55.00 per metric ton in 1981. The price of Turkish chromite has been about twice that of South Africa. International relations are expected to continue to influence the United States chromium supply-demand position as they have in the past.

3.6.3 Zeolite

The uses and potential uses of zeolites include antibiotic and pesticide carriers, heat-storage systems, methane recovery systems, detergents, catalysts, hydrogen storage, and molecular sieves. The production of natural zeolite in the United States was estimated to have doubled in 1981, from 5,000 tons in 1980. About 4,000 tons were produced at Adrian, Oregon. The 1981 price of natural zeolites ranged from $300.00 per ton to $400.00 per ton, whereas the price of synthetic zeolites ranged from $500.00 per ton to $6,000.00 per ton. Supply and demand statistics are not readily available for this commodity. Production figures also are not well known. One 1981 estimate predicts that the natural zeolite market will exceed one billion dollars in the early 1990's[18, 19].

3.7 STRATEGIC AND CRITICAL MINERALS AND METALS

Strategic and critical minerals for which the Aldrich Mountain GRA is moderately favorable include chrysotile asbestos and chromium resources. The GRA is not favorable for any other strategic and critical minerals or metals as listed in the BLM-supplied compilation given in Table 3-4 of TERRADATA's report entitled "Procedures for the Assessment of Geology, Energy, and Minerals (GEM) Resources."

4. CLASSIFICATION OF LAND FOR GEM RESOURCES POTENTIAL

The precise location of specific favorable environments within a given GRA depends upon three principal factors:

- o The precision and specificity of avaliable data;
- o The nature (size and spatial distribution) of anticipated deposits as predicted from known models; and
- o The geometry of the favorable geologic environments.

Commodity-specific information in the Aldrich Mountain GRA is limited. Sub-surface information is virtually non-existent. Therefore, the entire area, rather than specific subareas, has been classified for individual GEM resources (Figure 4-1 and Table 4-1).

The Aldrich Mountain GRA is moderately favorable (Class 3A) for the occurrence of chrysotile asbestos and chromite resources. The presence of sheared serpentine in an igneous body of peridiorite is one factor suggesting a favorable environment for the formation of chrysotile asbestos[9]. Asbestos may occur as a secondary alteration product of ultramafic bodies after serpentinezation has occurred.

Chromite is a crystallization product from fluid magma. The presence of Cretaceous intrusives shows the area is environmentally favorable for this resource. CRIB and MILS data indicate chromite occurrences that have limited past production.

Clinoptilolite has a moderate favorability (Class 3A) in the Aldrich Mountain GRA. No occurrences are known, but the John Day Formation is known to have occurrences of clinoptilolite in T11S, R26E[6].

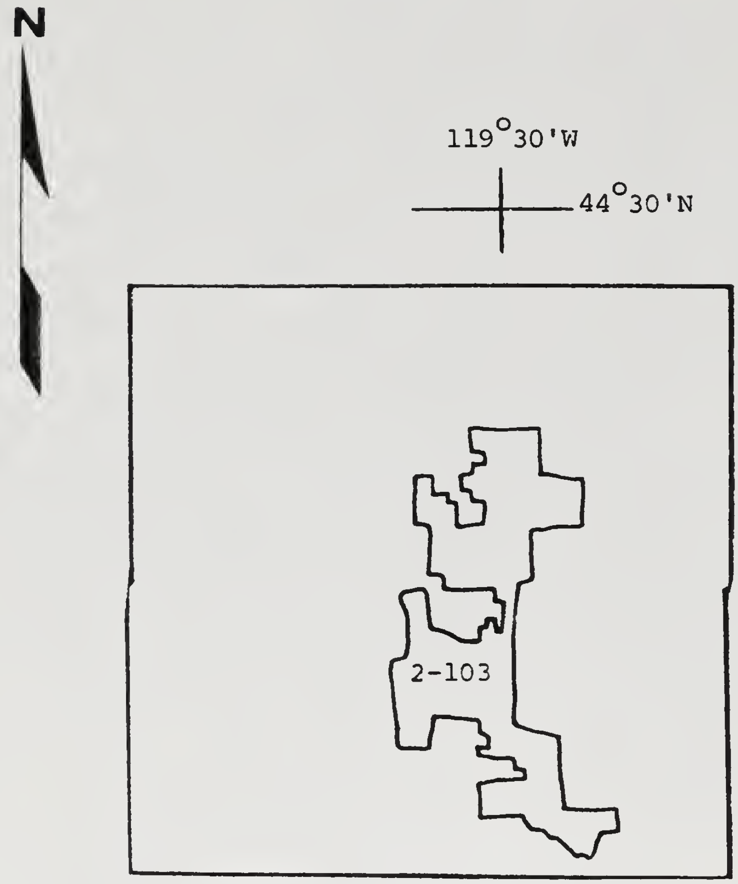
All fossil fuels have low favorabilities (Class 2) in the Aldrich Mountain GRA. The GRA is contained within the Triassic sedimentary marine basin. It is overlain by Tertiary volcanics and depth to potential source rocks exceeds 5,000 feet. There are no known wells or seeps in the area. Historical references to lignite seams used for local consumption have been reported.

The Aldrich Mountain GRA is least favorable (Class 1) for geothermal[11], uranium[12], diatomite[16], or paleontological[7] resources because the geologic environments and inferred geologic processes do not indicate favorablity for the accumulation or preservation of these resources.

TERRADATA's evaluation of the Aldrich Mountain GRA is in agreement with the USGS evaluation of the same area for leasable commodities[20, 21, 22].

FIGURE 4-1

Land Classification Map
Aldrich Mountain GRA
(OR-020-13)
Grant County, Oregon



This map is an overlay for Figures 2-1 and 2-2.

Scale 1:250,000
(Canyon City 1°x2° NTMS Quadrangle)

Table 4-1

Classification Of Lands Within The Aldrich Mountain GRA (OR - 020 - 13) Grant County, Oregon For GEM Resource Potential

COMMODITY	AREA	CLASSIFICATION LEVEL	CONFIDENCE LEVEL	REMARKS
Metals/Non-Metals	Entire GRA	3	C	Cr, Asbestos
Geothermal	Entire GRA	1	C	
Uranium/Thorium	Entire GRA	1	A	
Coal	Entire GRA	2	B	
Oil and Gas	Entire GRA	2	B	
Tar Sands/Oil Shale	Entire GRA	2	A	
Limestone	Entire GRA	1	B	
Bentonite	Entire GRA	2	C	
Diatomite	Entire GRA	1	C	
Clinoptilolite	Entire GRA	3	A	
Paleontology	Entire GRA	1	C	
Hazards	See Hazards Map (GRA File)			
ESLs	None	1	C	

LEGEND:
Class 1 - Least Favorable
Class 2 - Low Favorability
Class 3 - Moderate Favorability
Class 4 - High Favorability

Confidence Level A - Insufficient data or no direct evidence
Confidence Level B - Indirect evidence available
Confidence Level C - Direct evidence but quantitatively minimal
Confidence Level D - Abundant direct and indirect evidence

5. RECOMMENDATIONS FOR FUTURE WORK

Further surface geologic investigations, including detailed mapping and stratigraphic studies, would enhance the confidence levels of many of the classifications in the Aldrich Mountain GRA. It is highly probable that the original classifications would change with detailed field verification for metallic and non-metallic resources. Sub-surface investigations are probably not warranted in this area due to the costly nature of the available methodology. Geophysical and geochemical surveys might provide some insights into the potential resources of the study area, particularly by indicating areas of concealed ultramafic rocks. Geophysical surveys might help to delineate structural traps for oil and gas resources.

- APPENDIX A -

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