FINAL REPORT

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

OWYHEE RIVER GEM RESOURCE AREA

(ID-010-11)

OWYHEE COUNTY, IDAHO

Prepared for

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

March 1983

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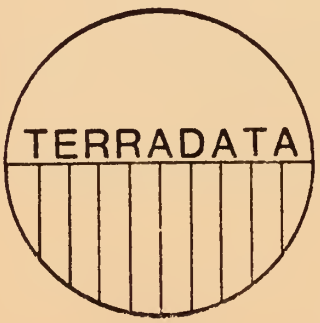

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Assessment of Geology, Energy, and Minerals (GEM) Resources

Owyhee River GRA (ID - 010 - 11) Owyhee County, Idaho

Prepared For:

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

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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.

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- 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.

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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

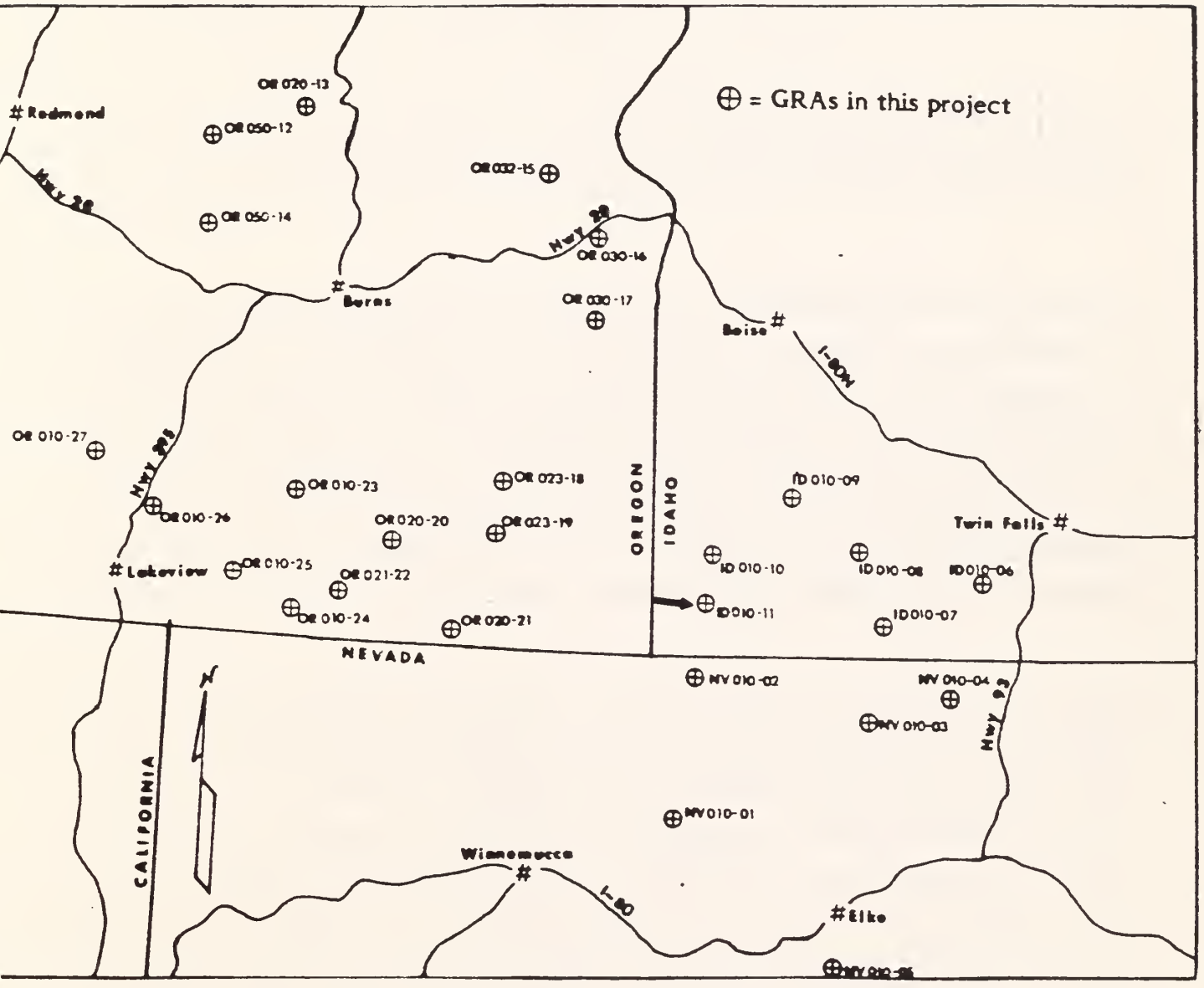
The purpose of this project is to evaluate and classify environments favorable for the occurrence of geology, energy, and minerals (GEM) resources in selected wilderness study areas (WSAs) in southeastern Oregon, southwestern Idaho, and northern Nevada. **(See TERRADATA report entitled "Procedures for 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 Owyhee River GRA (GRA number ID-010-11) which is located in southwestern Idaho along the Oregon-Nevada-Idaho State line (see attached location map). The GRA contains about 950 square miles within Townships 15S through 12S and Ranges 6W through 1E. It contains seven WSAs that have a combined area of 226,523 acres. These are WSA 16-48b (33,700 acres), WSA 16-48c (24,677 acres), WSA 16-49a (72,083 acres) WSA 16-49d (9,331 acres), WSA 16-49e (31,540 acres), WSA 16-52 (12,682 acres), and WSA 16-53 (42,510 acres). The study area is in the Owyhee and Bruneau Resource Areas of the Boise BLM District.

The GRA is within the Owyhee Upland sub-province of the Columbia Intermontane physiographic province. Rocks exposed in the GRA are all Tertiary or younger volcanic flows, domes, and related volcaniclastic sedimentary strata. Limited exposures of Miocene lacustrine units also occur within the GRA. The area contains no major structural features apparent on the surface. The area is, however, located on or near the axis of the Devonian Antler orogenic belt. Basin and Range block faulting is not apparent in the area because of the thick mantle of Tertiary and Quaternary volcanics. The Owyhee River GRA is not near any known mineral belts or mining districts. Historically, the area has had no significant production of any GEM resources.

The geologic environments and inferred processes indicate low favorability for the accumulation of most GEM resources. The nature of the data available and the geometry of potential geologic environments do not permit subdivision of the GRA into commodity specific areas of favorability.

GRA Location Map

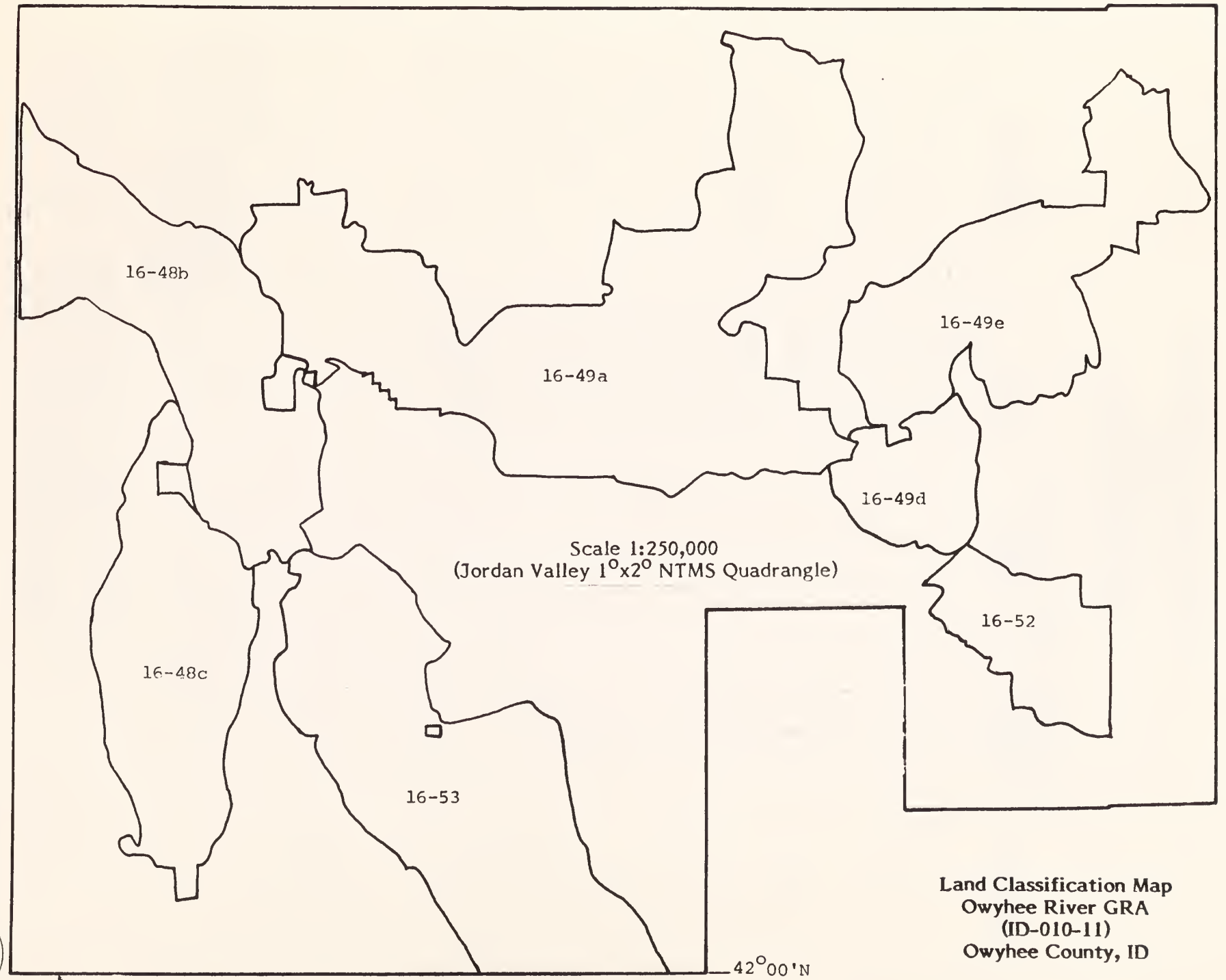


The Owyhee River GRA contains one geologic environment that is highly favorable for the occurrence of diatomite resources. The entire GRA is classified 4D for potential diatomite resources in accordance with the BLM classification scheme (see attached land classification map); the geologic environment, the inferred geologic processes, and known occurrences indicate high favorabiity for the occurrence of this resource. Deposits from which there has been minor production occur in the northern part of the GRA. Therefore, the confidence level (D) is assigned to this evaluation.

The entire area has low favorability (Class 2) for metals, coal, clinoptilolite, and bentonite resources. The confidence levels of the classifications for these commodities are low (A or B) denoting insufficient available data and a lack of reported mineral occurrences.

The area is classified least favorable (Class 1) for all remaining GEM resources (see GEM Classification and Confidence Level Table below). Evaluation of environments for geothermal, uranium and thorium, oil and gas, oil shale and tar sands, limestone, and paleontological resources have varying degrees of confidence. In general, environments essential for the accumulation of these resources do not exist within the study area. The oil shale and tar sands evaluation is based on minimal direct evidence (Level C). All other least favorable classifications have low confidence levels (A or B) signifying that insufficient or only minimal indirect evidence was available for the respective evaluations.

Further surface geologic investigations, including detailed mapping and stratigraphic studies, could enhance the confidence levels of many of the classifications in the Owyhee River GRA. It is doubtful, however, that the original classifications would change substantially. Sub-surface investigations are probably not warranted in this area due to the costly nature of the available methods. Geophysical and geochemical surveys might provide some insight into the potential resources in the study area. Particular attention should be paid to the more highly faulted parts of the area. Geochemical surveys of drainages in these faulted areas could provide additional evidence to support or refute the classification of GEM resources in this GRA.



Land Classification Map
Owyhee River GRA
(ID-010-11)
Owyhee County, ID

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Classification Of Lands Within The
Owyhee River GRA
(ID - 010 - 11)
Owyhee County, Idaho
For GEM Resource Potential

COMMODITY	AREA	CLASSIFICATION LEVEL	CONFIDENCE LEVEL	REMARKS
Metals	Entire GRA	2	B	
Geothermal	Entire GRA	1	B	
Uranium/Thorium	Entire GRA	1	A	
Coal	Entire GRA	2	B	
Oil and Gas	Entire GRA	1	B	
Tar Sands/Oil Shale	Entire GRA	1	C	
Limestone	Entire GRA	1	A	
Bentonite	Entire GRA	2	A	
Diatomite	Entire GRA	4	D	
Clinoptilolite	Entire GRA	2	A	
Paleontology	Entire GRA	1	A	
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.")

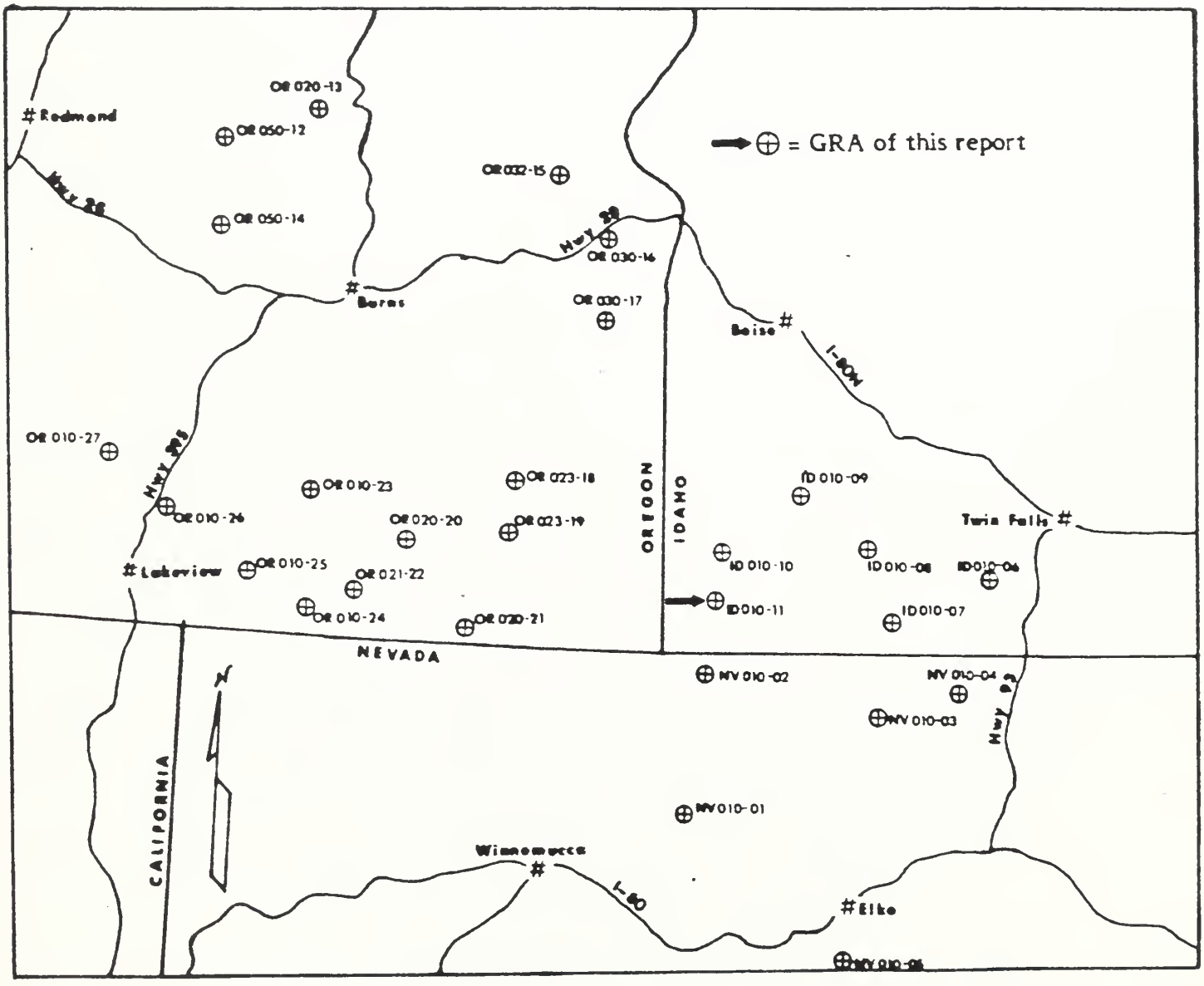
This report summarizes the assessment of the GEM resources potential of the Owyhee River GRA (ID-010-11). See Figure 1-1. Commodity categories for which this GRA was evaluated are:

- 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 Owyhee River 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 OWYHEE RIVER GRA

2.1 LOCATION

The Owyhee River GRA (ID-010-11) is in southwestern Idaho. It lies between latitudes 42°00'N and 42°25'N and longitudes 116°20'W and 117°03'W. The GRA contains approximately 936 square miles within townships 12S and 15S and ranges 1E and 6W (see Figures 1-1 and 2-1). The area contains seven Wilderness Study Areas; WSA 16-48b (33,700 acres), WSA 16-48C (24,677 acres), WSA 16-49a (72,083 acres), WSA 16-49d (9,331 acres), WSA 16-49e (31,540 acres), WSA 16-52 (12,682 acres), and WSA 16-53 (42,510 acres). The Owyhee River GRA is in the Owyhee and Bruneau Resources Area of the Boise BLM District. The area is about 85 miles from Boise, Idaho, which is the nearest transportation center offering a minimum of rail, highway, and/or charter-air services. Access to the contained WSAs is via county maintained dirt or packed-gravel roads. Vehicular access to the interior of the WSAs is poor to non-existent.

2.2 GENERAL GEOLOGY

The Owyhee River GRA is in the Jordan Valley 1°x2° NTMS quadrangle map in the southwestern most corner of Idaho. The data available for this area includes NURE investigations[1, 2, 3, 4]*, general mineral resource information[5], and limited large scale geologic mapping[6]. Detailed mapping (scale 1:62,500) is available north of the GRA[7], but is not available for areas within the GRA. The available information regarding commodities in the region is fair to poor.

The Owyhee River GRA is within the Owyhee Upland sub-province of the Columbia Intermontane physiographic province[8]. The Owyhee Upland is a plateau and mountainous region in northern-most Nevada, southwest Idaho, and southeast Oregon. The Owyhee Upland sub-province is separated from the Great Basin by a major drainage divide located south of the Owyhee River GRA in Nevada. The area is bounded on the north by the High Lava Plains (Snake River Plain) sub-province of the Columbia Intermontane province. Tertiary rhyolites, andesites, and basalts comprise the oldest rocks exposed in the GRA. The youngest rocks are Quaternary tuffaceous units (Figure 2-2).

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

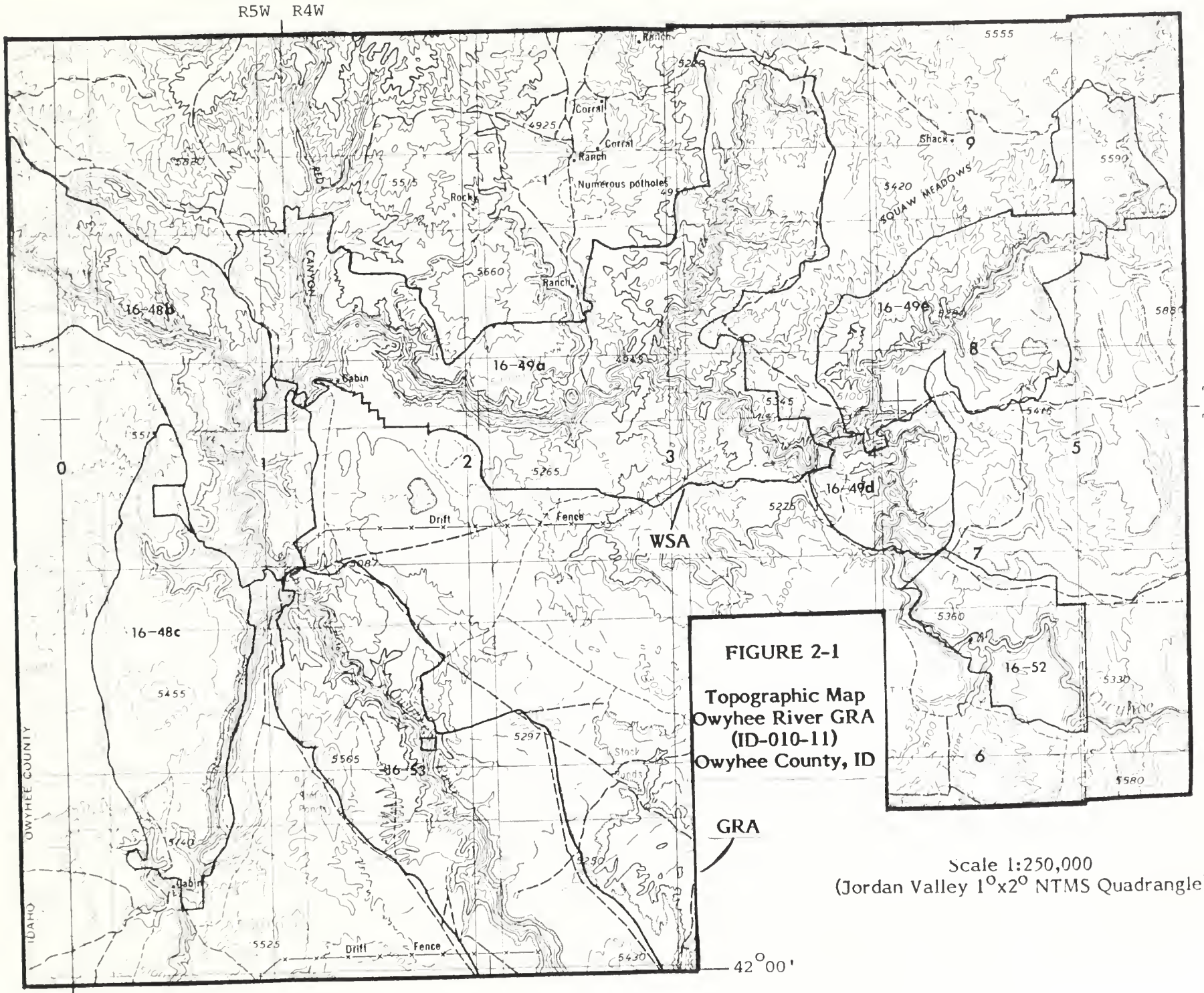


FIGURE 2-1

Topographic Map
Owyhee River GRA
(ID-010-11)
Owyhee County, ID

Scale 1:250,000
(Jordan Valley 1°x2° NTMS Quadrangle)

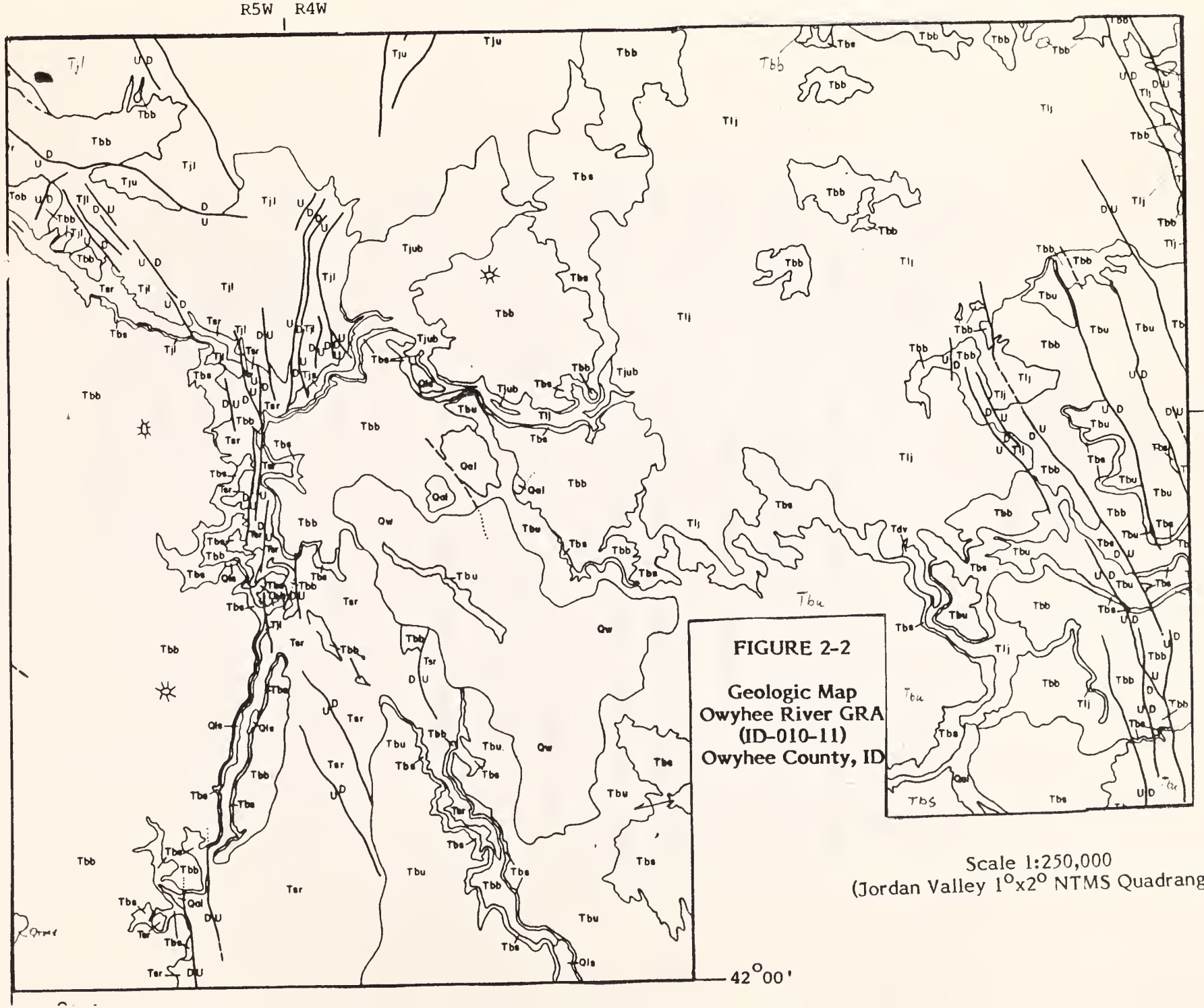


FIGURE 2-2

Geologic Map
Owyhee River GRA
(ID-010-11)
Owyhee County, ID

Scale 1:250,000
(Jordan Valley 1°x2° NTMS Quadrangle)

FIGURE 2-2
(Continued)

Geologic Map Legend For
Owyhee River GRA
(ID-010-11)
Owyhee County, Idaho

Qal - Alluvium

Qls - Landslide Deposits

Qw - Wind Blown Sand and Silt

QTmv - Rocks of Mafic Vents: Basaltic and andesitic breccia, scoria, and flows.

Tob - Tuffaceous Sedimentary Rocks, Tuffs, and Interbedded Basaltic and Andesitic Flows: Thin, diktytaxitic basalt flows.

Tbb - Banbury Basalt: Olivine basalt and minor interbedded stream and lake deposits.

Tbu - Banbury Basalt: Upper basalt mesa-forming sequence of thin basalt flows.

Tlj - Tuff of Little Jacks Creek: Extremely densely welded flow-layered rhyolite tuff.

Ttr - Tuffaceous Sedimentary Rocks, Tuffs, and Silicic Flows: Partly to densely welded tuffs and rhyolite or dacite flows.

Tdv - Tuff of Duck Valley: Red, densely welded flow-layered rhyolite tuff.

Tjub - Badland Tuff of Juniper Canyon: Pink to red, flow-layered, densely welded rhyolite tuff.

Tjs - Tuffaceous Sedimentary Rocks.

Tju - Upper Flows of Juniper Mountain: Red, densely welded rhyolite tuff.

Tjl - Lower Flows of Juniper Mountain: Red, densely welded rhyolitic tuff, largely remobilized to viscous lava.

Tsr - Tuff of Swisher Ridge: Densely welded rhyolite tuff with minor vitrophyres and non-welded tuff.

 - Fault (dashed where inferred).

 - Geologic contact (dashed where inferred).

 - Volcanic center.

2.2.1 Geomorphology

The southern portion of the Owyhee Upland is characterized by an extensive flat-lying basalt plain that contains numerous basalt capped mesas, tables, and buttes as well as basalt rimmed canyons and valleys. This area lies in a broad (50 to 60 mile wide) intermontaine basin between the Bull Run Mountains, to the east-southeast, and the Santa Rosa Range, to the west. The average elevation of the basin is 5,000 to 6,000 feet. The depression is a major graben of the Basin and Range system. It has been filled, for the most part, with Tertiary basalts, andesites, and fluvial sedimentary rocks.

The northern part of the Owyhee Upland includes the Owyhee Mountains and the Silver City Range. The Owyhee River GRA is about 20 miles south of South Mountain, a prominent feature in the Owyhee Mountains.

The GRA contains seven WSAs; WSA 16-48b, WSA 16-48c, WSA 16-49a, WSA 16-49c, WSA 16-49d, WSA 16-52, and WSA 16-53, that have a combined area of 226,523 acres (Figure 2-1). The area is drained by the Owyhee River system. Perennial tributaries of the Owyhee include Battle Creek, Deep Creek, Juniper Creek, Red Canyon Creek, the Little Owyhee River, and the South Fork Owyhee River; the overall stream pattern is dendritic. All of the WSAs in the Owyhee River GRA are adjacent to, or centered on canyons of the Owyhee River and its tributaries. The Owyhee River flows in a westerly direction through the middle of the study area. The river system is incised in deep (500 to 900 feet) canyons in an otherwise flat upland surface. The average gradient of the Owyhee River is about 15 feet per mile.

Precipitous basalt cliffs whose tops are at a constant constant elevation of 5,000 to 5,300 feet comprise the rims of the canyons throughout most of the WSAs. Upland surfaces in the area consist of basalt capped mesas and tables. They are drained by intermittent streams and may contain ephmeral lakes. Total relief in the GRA is about 1,500 feet. Local relief along the canyons is between 500 and 900 feet. Local relief on the upland surfaces is generally less than 200 feet. The highest point (5,820 feet) and lowest point (4,350 feet) are in the northwest corner of the study area.

2.2.2 Lithology and Stratigraphy

Rocks within or near the Owyhee River GRA range from Paleozoic metamorphic units to the Tertiary Banbury Basalt (Figure 2-2). This discussion relies heavily upon the work by Berry and others[2].

Paleozoic metamorphic rocks and Mesozoic intrusives comprise the Pre-Tertiary basement exposed in the Owyhee Mountains portion of the Owyhee Uplands sub-province. These rocks underlie the Castle Creek and South Mountain areas and the Silver City Range. Paleozoic metamorphic rocks in the Silver City Range consist of quartz-biotite schists and quartzite. Quartzite-biotite schists comprise the bulk of the Paleozoic rocks exposed in the Castle Creek area. The age of these units is not well known. Neill[14] suggests that the metaquartzites represent turbidite sequences that were derived from a stable Paleozoic shelf to the east. This is consistent with Newton's[9] depositional basin model (Figure 2-3) if the actual margin of the western Late Paleozoic is somewhat east of where it has been mapped, or if the metamorphic rocks in this area are Middle or Early Paleozoic. Pre-Cenozoic rocks in the South Mountain area compose a sequence of schists, quartzites, and marbles that are over 3,000 feet thick. These occur as roof pendants and xenoliths in Late Mesozoic and Cenozoic intrusive masses. Paleozoic intrusives in the South Mountain area include gray, locally gneissic, biotite-hornblende-quartz diorite and granodiorite[10]. Aplite and pegmatite dikes and a large mass of hornblende gabbro also are exposed. Intrusives in the Silver City Range are dominantly biotite granodiorite with lesser qmounts of quartz monzonite, granite, and alaskite. This Paleozoic assemblage is not exposed in the Owyhee River GRA; however, similar rocks may occur at depth beneath the Tertiary cover. The Eocene Challis Volcanics are the oldest Tertiary rocks in the Owyhee Upland. They consist of compound cooling units of densely welded rhyodacitic tuffs up to 1,000 feet thick. The Challis Volcanics are not exposed in this GRA; however, they comprise an extensive unit in the northwestern United States, and they may exist at depth in the GRA.

The bulk of the rocks in the Owyhee Upland resulted from bimodal basalt-rhyolite Miocene volcanism. In the Idaho and Oregon portions of the Owyhee Upland, the Miocene volcanics are divided into three major sequences: a lower basalt sequence, a middle silicic sequence, and an upper basalt sequence. The lower basalt sequence consists of latite and alkaline olivine basalt flows whose aggregate thickness is up to several thousand feet. The latite and basalt occur as thin, vesicular, interbedded flows that

unconformably overlie the Pre-Tertiary basement. This lower basalt unit is the same age as the Columbia River basalt group; however, it is much more alkaline that the Columbia River basalt group.

The middle silicic sequence composes a large volume of ash-flow tuffs and ignimbritic units that underlie most of the Owyhee Upland. Oldest of these is the Silver City rhyolite, a compound cooling unit of remobilized, densely welded tuffs that are up to 600 feet thick. The Silver City rhyolite is followed by units from the Juniper Mountain volcanic center that include the tuff of Swisher Ridge, the Badland tuff, and interbedded tuffaceous sandstones and siltstones. Younger Miocene silicic flows in the Owyhee Upland include flow-layered and flow-banded rhyolites and tuffs of Duck Valley, Black Mountain, Browns Creek, and Little Jacks Creek.

The upper basalt sequence comprises the wide-spread flows of the Banbury Basalt. The Banbury Basalt sequence contains many thin flows of fine-grained, vesicular, alkaline-olivine basalt and minor interbedded sedimentary units. The sedimentary units contain basalt clasts, tuffaceous sands and gravels, ash beds, and local diatomite, and alluvial and fanglomeratic sediments.

2.2.3 Structural Geology

Structural information in the Owyhee River GRA is minimal due to the amount of Tertiary cover. Lineaments of Basin and Range origin have been interpreted from LANDSAT imagery and topographic maps by Schlicker[11] specifically for this project. The origin of these linears and the nature of the Pre-Tertiary basement is unknown. Cretaceous intrusive bodies and associated mineralization occur at a considerable distance to the north, in Idaho, and south of the area, in Nevada. Cretaceous rocks are not exposed even in the deepest parts of the Owyhee River Canyon.

Paleozoic metasedimentary rocks north of the GRA present an enigma. If the northeast-trending Antler orogenic belt extends to the margin of the Idaho Batholith, then virtually all of the Owyhee Upland would have been above sea-level during the Late Paleozoic[9]. Therefore, the Paleozoic units of undetermined age that occur near South Mountain would have to be Early Paleozoic. Conversely, if the Antler orogenic belt takes a more easterly trend in southern Idaho, it is conceivable that the same units could be part of the western Late Paleozoic assemblage. The estimation of the potential for oil and gas

in several GRAs in the Owyhee Upland may be affected, at least in part, by this problem. The presence of potential Late Paleozoic petroleum-bearing host rocks would enhance the oil and gas potential of the study area. Newton[9] suggests that the area was affected by the Antler and subsequent Sonoma orogenies, and is devoid of Late Paleozoic units.

By Late Devonian time, the Antler Orogeny developed along a north-northeast trending swath through northwest Elko County, Nevada, and on into southwestern Idaho. The Owyhee River GRA lies near the axis of the Antler orogenic belt. As a direct result of the Antler orogenic uplift, a Pennsylvanian clastic wedge developed along the margins of the uplift. The orogeny culminated in a period of extensive thrust faulting that includes the Roberts' Mountain thrust south of the GRA.

The Sonoma Orogeny occurred during the Permian in north-central Nevada[62]. This deformational episode included more thrust faulting.

A tremendous increase in volcanic activity occurred in the tri-state area during the Late Cenozoic. This is recorded by the large volume of Tertiary extrusives that blanket the area. The influence of Late Cenozoic Basin and Range block-faulting is not well known in the Owyhee River GRA.

2.2.4 Paleontology

Little is known about the paleontology of the Owyhee River GRA because fossilferous strata are virtually non-existent. The area is characterized primarily by welded rhyolite tuffs or other non-fossilferous lithologies. Miocene fossil assemblages including mammals, fish, shellfish, and plants may exist in restricted lacustrine environments[12].

2.2.5 Historical Geology

Pre-Tertiary basement rocks that occur near the Owyhee River GRA consist of Paleozoic metamorphic rocks and Mesozoic intrusives. They are exposed in the Silver City Range at South Mountain and in the Castle Creek areas of the Owyhee Uplands. Paleozoic structural evolution of the Owyhee Upland is not well known. There are no contiguous exposures of definitive Paleozoic lithologies due to the overlying Tertiary deposits. Therefore, the position of the Owyhee Upland relative to the Paleozoic Antler orogenic

belt is not fully understood. A few exposures of Paleozoic turbidite sequences suggest that the Owyhee Upland area was part of the Late Paleozoic eugeoclinal depositional basin (Figure 2-3). Mesozoic intrusive acitivity has affected parts of the province and is associated with minor amounts of metallic mineralization north of the GRA. Intrusives in the South Mountain area have radiometric ages between 87 million years[13] and 45.2 million years[10].

The oldest Tertiary rocks in the province are the Challis Volcanics of Eocene age. They form an extensive sequence in the vicinity of Poison and Castle Creeks. The Challis Volcanics have been dated at 43.6 million years[14].

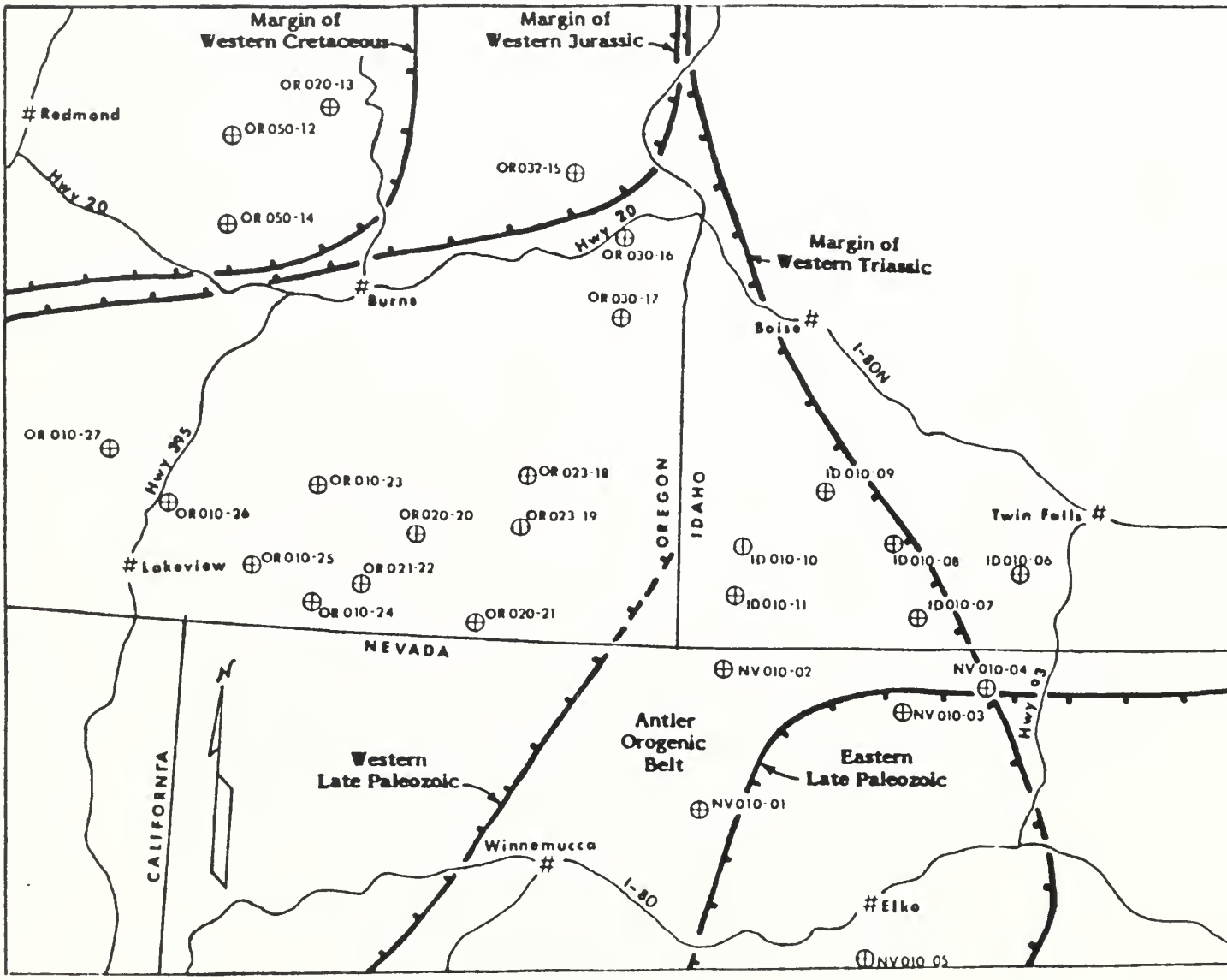
During Miocene time the Owyhee Upland sub-province was subjected to Basin and Range-type extensional faulting that was accompanied by bimodal rhyolite-basalt volcanism. The Miocene bimodal volcanic rocks form the bulk of the rocks in the Owyhee Upland. In Idaho, they are divided into three subunits; an older basaltic sequence, a middle unit composed of silicic flows and tuffs, and a younger basaltic sequence that is equivalent to the rocks in the adjacent Snake River Plain[2].

2.3 ENVIRONMENTS FAVORABLE FOR GEM RESOURCES

The Owyhee River GRA contains one environment that is highly favorable for potential diatomite resources[11]. One occurrence in the northernmost portion of the GRA has produced a small quantity of commercial grade diatomite[15]. Diatomite beds are present in this GRA in Townships 12S. 2W and 13S, 2W (Figure 2-1). The environment favorable for the formation of diatomite deposits occurs within the Banbury Basalt (Figure 2-2, Map Unit Tbs). Periods of volcanic quiescence during the Tertiary permitted the formation of lakes on the surface of the relatively flat-lying Banbury Basalt. These lakes provided the necessary environment for diatoms to flourish and to form accumulations of their siliceous tests. The size of potential diatomite deposits is dependant on two primary factors; the length of the period of quiescence and the lateral extent of the favorable lacustrine environment. Whereas the diatomite deposits may occur as interbeds at differing stratigraphic intervals within the basalts, it is impossible to predict the spatial distribution of potential deposits except where they are exposed.

FIGURE 2-3

Paleogeographic Map[9]
Oregon-Idaho-Nevada
Tri-State Area



The likelihood that unknown diatomite deposits exist within the Tbs map unit is excellent. The depositional model does not, however, allow the prediction of the precise location of such deposits.

The Owyhee River GRA has a low favorability for the occurrence of environments favorable for metals[16], coal[17], clinoptilolite and bentonite[11]. The area contains no environments favorable for other GEM resources.

2.3.1 Environments for Metals Resources

The entire Owyhee River GRA is underlain by un-mineralized volcanic and volcaniclastic rocks[16]. Occurrences of metallic mineralization are not known in the area. There are some parts of the GRA, however, that demonstrate characteristics that may be favorable for the accumulations of metals deposits. One recognition criterion for environments favorable for metals is the presence of evidence of structural site preparation. As seen on the geologic map of the area (Figure 2-2), there are areas of relatively dense faulting. These faulted areas provide the requisite conduits for mineralizing solutions. There is no indication on the surface, however, that a mineralizing process has occurred. The nature of the Paleozoic surface also is not known in the GRA. There could be major structural features on the older surface that would be condusive to the formation of deposits. Tertiary volcanics in the GRA that are up to thousands of feet thick completely mask the older units.

2.3.2 Environments for Oil and Gas Resources

The Owyhee River GRA has a low favorability for the occurrences of oil and gas resources. Nearly 50 percent of the GRA, including portions of several WSAs, is currently leased or under application for oil and gas leases. The area is within the boundaries of Miocene Humboldt and Bruneau Lakes. There is no direct evidence, however, that the GRA is favorable for potential oil and gas resources[9]. It is not known whether favorable Paleozoic strata exist at depth.

2.3.3 Environments for Oil Shale and Tar Sands Resources

The Owyhee River GRA contains no environments favorable for the occurrence of oil shale or oil impregnated sands[18]. The area is underlain predominantly by Tertiary volcanics of felsic to ferromagnesian composition. Potential host rocks are largely tuffaceous and contain only minor amounts of non-volcanic clastic material. Favorable lithologies are not present.

2.3.4 Environments for Geothermal Resources

The Owyhee River GRA contains no environments favorable for geothermal resources. There exist none of the criteria that would indicate the presence of a favorable environment[19]. There are no known major Basin and Range faults; there are no known geothermal occurrences associated with Tertiary volcanism.

2.3.5 Environments for Uranium and Thorium Resources

The Owyhee River GRA does not contain any environments that are favorable for the occurrence of uranium or thorium deposits[20]. The GRA does not exhibit any of the lithological, alteration, or geochemical criteria that would suggest the presence of uranium or thorium. Volcanogenic environments, such as McDermitt caldera and Virgin Valley, are not present in the study area.

2.3.6 Environments for Coal Resources

The Owyhee River GRA contains no environments favorable for the occurrence of coal and lignite deposits[17]. The chances for coal or carbonaceous materials to have formed in the study area are remote. The geologic history of the GRA does not support the conclusion that euxinic environments favorable for the formation of coal deposits existed in the area. Much of the area either is 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

Volcanic rocks in the Owyhee River GRA may contain environments favorable for the development of bentonite and clinoptilolite as alteration products of felsic flows and

tuffs. There is no direct evidence, however, that the felsic volcanics in this area have been altered in this manner.

As discussed in Section 2.3, above, diatomite occurs in and near WSA 16-49a. All of the WSAs in this GRA are underlain, at least in part, by potential diatomite-bearing rocks of geologic map unit Tbs.

2.3.8 Environments for Paleontological Resources

Environments that are potentially favorable for the occurrence of fossiliferous strata are limited because the majority of the Owyhee River GRA is underlain by welded rhyolite tuffs or other non-fossiliferous lithologies. No fossil localities or other direct or inferred evidence exist in the study area that indicates favorability[12].

2.3.9 Environments for Geologic Hazards

Potential geologic hazards in the Owyhee River GRA consist of faults, landslides, and volcanic centers[11]. 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 the over-steepened slopes within the GRA.

2.3.10 Educational and Scientific Localities

There are no known ESLs in the Owyhee River GRA.

3. ENERGY AND MINERAL RESOURCES IN THE OWYHEE RIVER GRA

The entire Owyhee River GRA is highly favorable for the occurrence of diatomite deposits. WSA 16-49a contains known occurrences of diatomite.

3.1 KNOWN DEPOSITS

This area contains no significant deposits nor is it located in any known mineral belt or mining district.

3.2 OCCURRENCES

The Owyhee River GRA contains one CRIB occurrence that has produced a small amount of diatomite (Figure 3-1). Details regarding the geometry of the occurrence are not known. The occurrence is located just outside the northern edge of WSA 16-49a. There are no known MILS occurrences in the GRA.

3.3 CLAIMS

The Owyhee River GRA contains a total of 24 claims (Figure 3-2). There are 12 claims clustered near the northernmost edge of WSA 16-49a. These claims are associated with the CRIB diatomite occurrence. The eight claims along the border between WSA 16G48a and WSA 16-48b and the four claims near the southern edge of WSA 16-48c are all on private lands outside the WSAs. Some of the claims in this GRA are reported to be on locatable chalcedonic quartz and clay deposits considered to be of nominal value[21]. Claims data are current as of 15 August, 1982.

3.4 LEASES

Approximately 50 percent of the Owyhee River GRA is leased or under lease application for oil and gas. This leasing activity is somewhat discontinuous and does not follow any known geologic trend. Lease information is current as of 15 August, 1982.

3.5 DEPOSIT TYPES

Even though the geometry of the diatomite occurrence is unknown, it probably similar to known stratiform deposits.

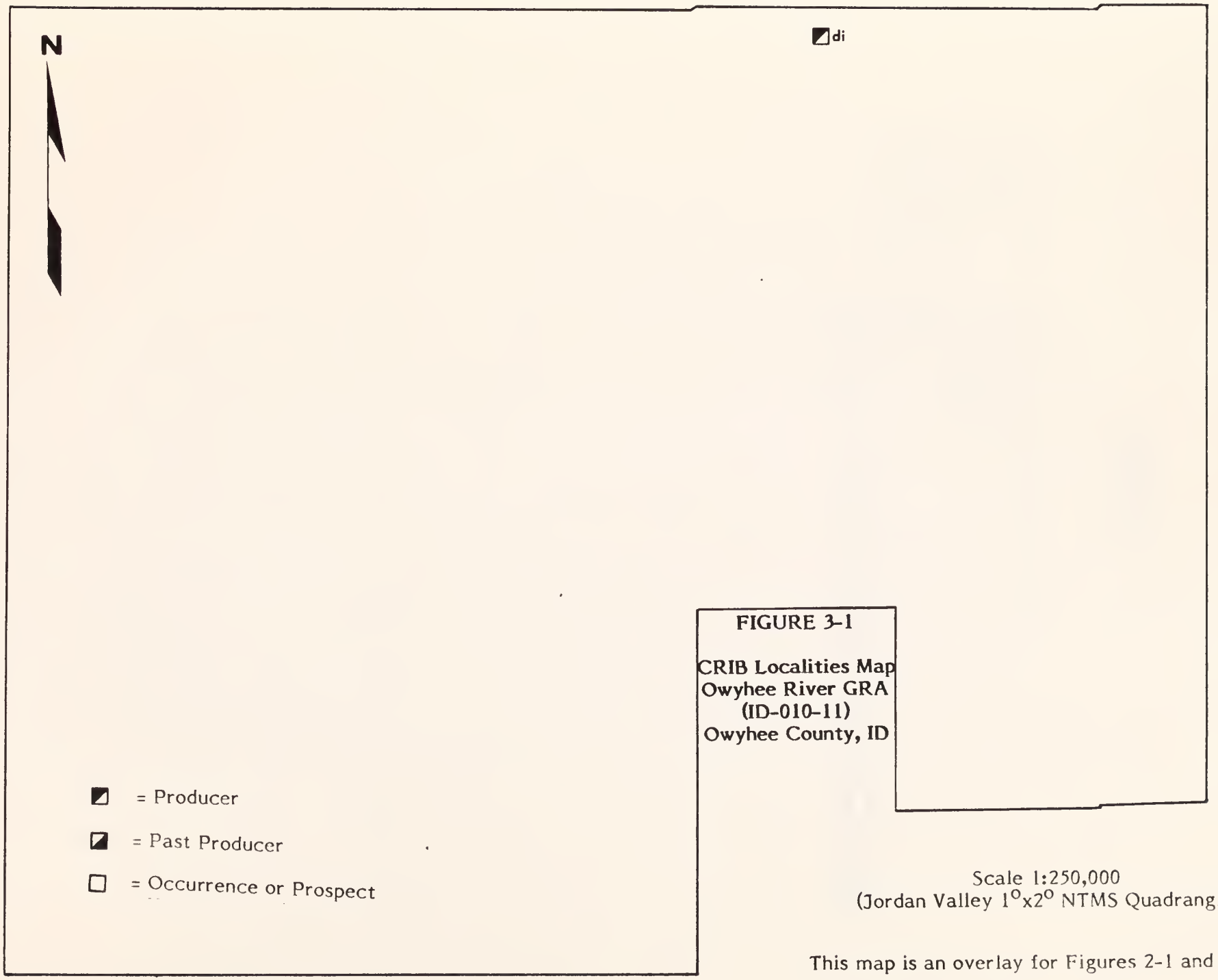


FIGURE 3-1

CRIB Localities Map
Owyhee River GRA
(ID-010-11)
Owyhee County, ID

Scale 1:250,000
(Jordan Valley 1^{o}x2^{o} NTMS Quadrangle)

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

FIGURE 3-1
(Explanation)

1. CRIB No.: W026794
   Location Name: Seifken, R. Diatomite Occurrence
   Latitude: 42°-24'37"N
   Longitude: 116°-33'32"W
   Commodities: Diatomite
   Production: Yes
   Production Size: Small
   References: Powers, H.A.; 1947; Diatomite Deposits of Southeastern Idaho; Idaho Bureau of Mines and Geology, Mineral Resource Report No. 4, 27p.

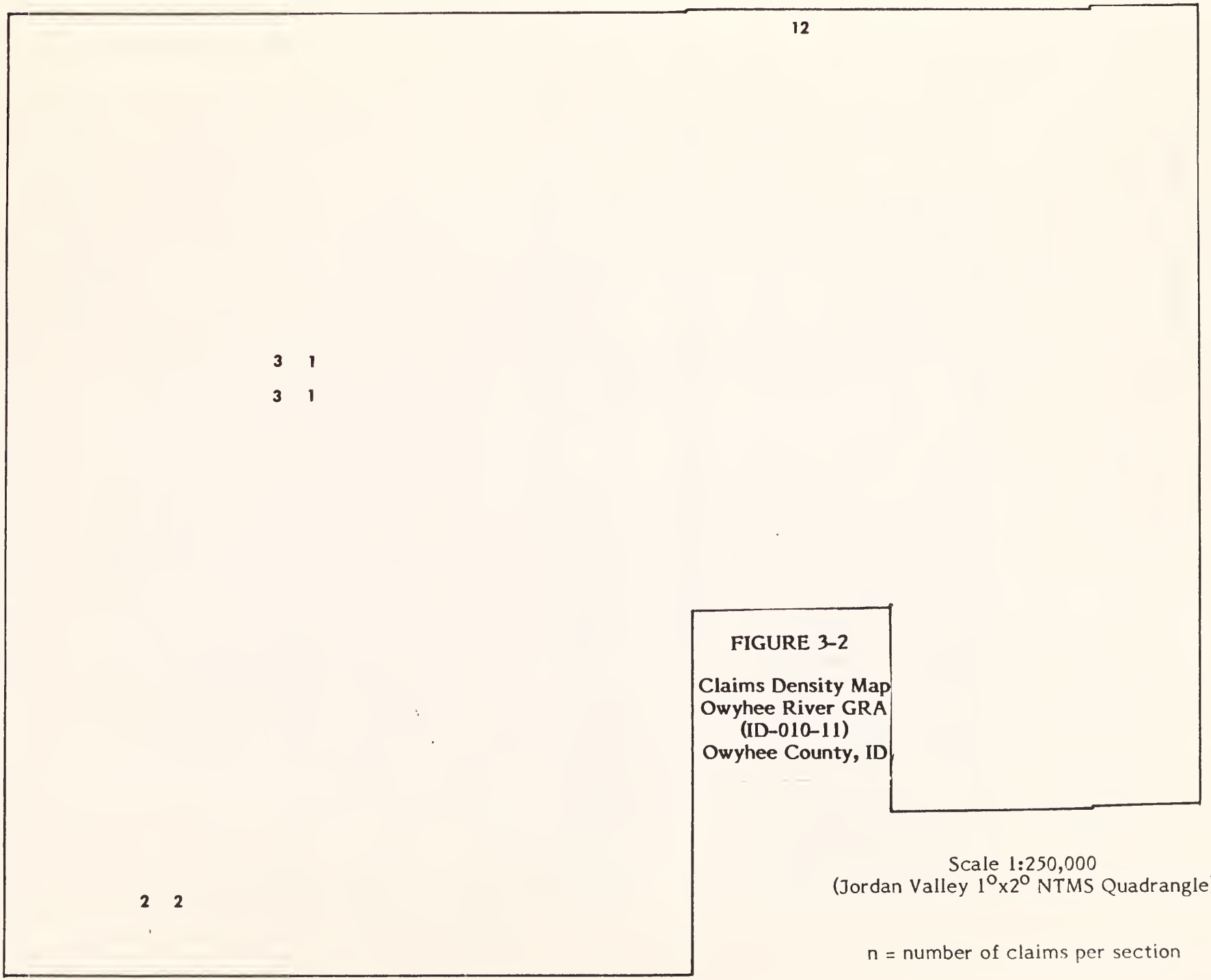


FIGURE 3-2

Claims Density Map
Owyhee River GRA
(ID-010-11)
Owyhee County, ID

Scale 1:250,000
(Jordan Valley $1^{o}x2^{o}$ NTMS Quadrangle)

n = number of claims per section

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

3.6 MINERAL ECONOMICS

The Owyhee River GRA is highly favorable for the occurrence of diatomite resources.

3.6.1 Diatomite

Diatomite is used primarily as a filter-aid, as an industrial filler, and other miscellaneous applications, including insulation[25]. Diatomite was produced by seven companies in four states in 1981[26]. California accounted for more than 50 percent of total diatomite production. The United States is the largest world producer and consumer of diatomite. The United States, however, is a net exporter of this commodity. Demand for diatomite is expected to increase at an annual rate of three percent through 1990. World resources of diatomite are adequate for the foreseeable future, but the need for near-market sources will encourage development of new sources.

3.7 STRATEGIC AND CRITICAL MINERALS AND METALS

The Owyhee River GRA is not favorable for any strategic or critical minerals. (See Table 3-4 in the TERRADATA 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:

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

Information in the Owyhee River GRA is limited and very general. Sub-surface information is virtually non-existent. Therefore, the entire area, rather than specific subareas, has been classified for individual GEM resources. (see Figure 4-1 and Table 4-1)

The Owyhee River GRA is highly favorable (Class 4) for potential diatomite resources because it contains the appropriate geologic environment and known occurrences of the resource[11]. Diatomite occurs within the GRA near WSA 16-49a. Similar lacustrine environments may occur as interbeds within the Banbury Basalt throughout the GRA. The confidence level (D) is assigned to this classification because the available data provide direct, irrefutable evidence for the occurrence of this commodity within the study area.

The Owyhee River GRA has a low favorability (Class 2) for the occurrence of metallic deposits[16]. The area does not exhibit sufficient geologic characteristics to warrant a higher classification. It is underlain by thousands of feet of young, un-mineralized volcanogenic rocks. There is no evidence of a mineralizing process having been active in the area and no associated metallic mineral deposits, occurrences, or trends. The confidence level (B) of this evaluation signifies that the available geologic data, in this case negative data, provide indirect evidence to refute the possible existence of metallic resources.

The study area has a low favorability (Class 2) for coal resources[17]. Environments favorable for the accumulation of coal deposits do not exist in the area. The geologic history of the study area does not support environments favorable for the formation of coal deposits because much of the area is mantled with and/or modified by Tertiary volcanism. Low-grade lignite occurs in Oregon, northwest of the study area, and a minor amounts of coal has been mined for domestic consumption in parts of southwest Idaho. Lacustrine units within the volcanic strata may contain thin lignite beds; therefore, a low (B) confidence level is assigned.

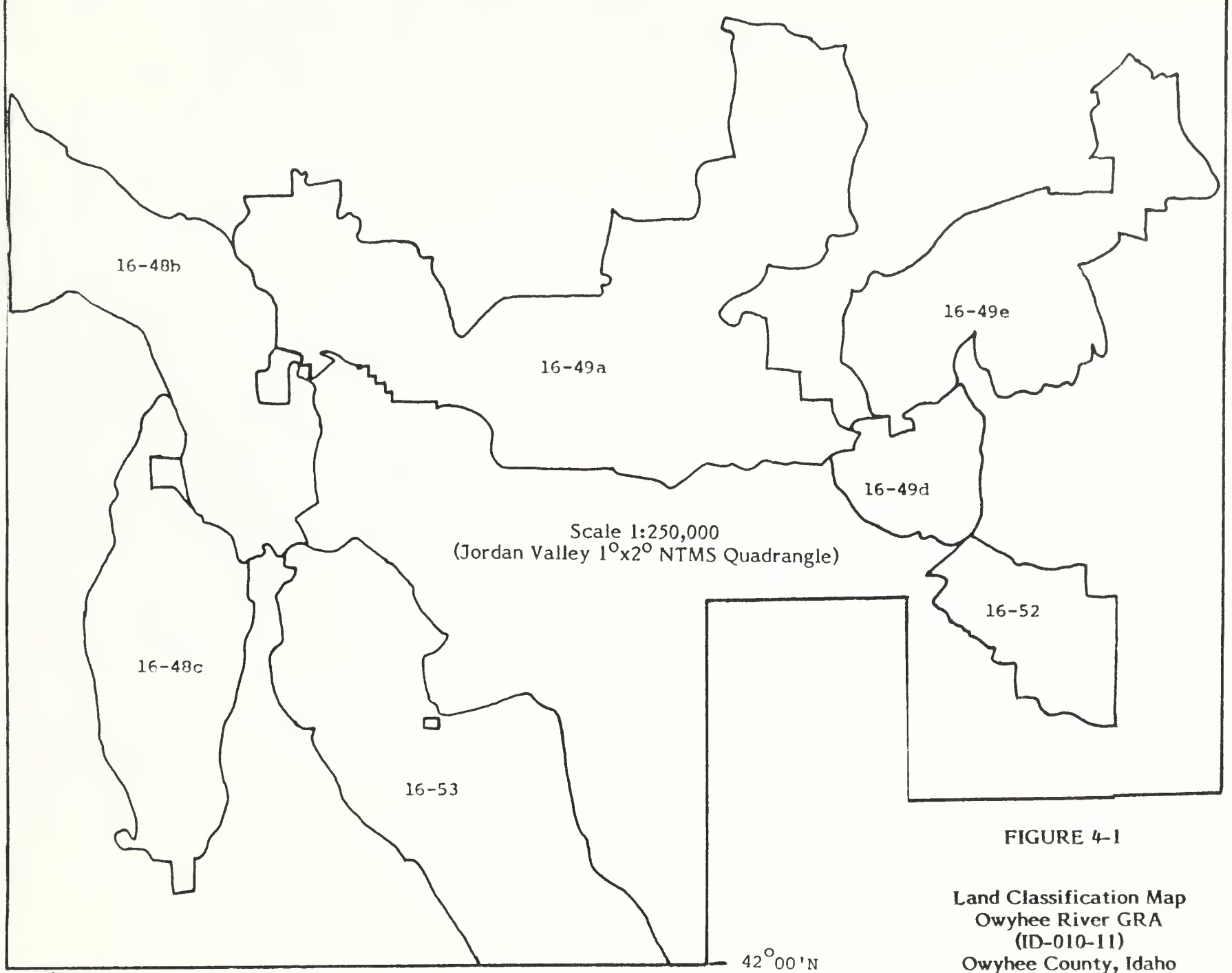


FIGURE 4-1

Land Classification Map
Owyhee River GRA
(ID-010-11)
Owyhee County, Idaho

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

TABLE 4-1

Classification Of Lands Within The
Owyhee River GRA
(ID - 010 - 11)
Owyhee County, Idaho
For GEM Resource Potential

COMMODITY	AREA	CLASSIFICATION LEVEL	CONFIDENCE LEVEL	REMARKS
Metals	Entire GRA	2	B	
Geothermal	Entire GRA	1	B	
Uranium/Thorium	Entire GRA	1	A	
Coal	Entire GRA	2	B	
Oil and Gas	Entire GRA	1	B	
Tar Sands/Oil Shale	Entire GRA	1	C	
Limestone	Entire GRA	1	A	
Bentonite	Entire GRA	2	A	
Diatomite	Entire GRA	4	D	
Clinoptilolite	Entire GRA	2	A	
Paleontology	Entire GRA	1	A	
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

Clinoptilolite and bentonite are common alteration products in volcanic terraines. The entire GRA is assigned a low favorability (Class 2) for these commodities because the requisite favorable geologic environment is inferred, but not known to be present[11]. There are no known occurrences or other direct or indirect data to substantiate this classification. Therefore, the lowest confidence level (A) is assigned.

The Owyhee River GRA is classified least favorable (Class 1) for geothermal[19], uranium and thorium[20], tar sands and oil shale[18], limestones[11], and paleontological[12] resources because the geologic environments and inferred geologic processes do not indicate favorability for the presence or accumulation of these commodities. All of these least favorable classifications have low confidence levels (A or B) because there is little or no evidence to support or refute the assessments (Table 4-1).

TERRADATA's classification of the Owyhee River GRA as being unfavorable (Class B) for the occurrence of oil and gas resources is in direct disagreement with the USGS classification of leasable commodities in the same area[22]. The USGS considers this area to be land that is prospectively valuable for oil and gas. Although the area is within the limits of Miocene Lake Bruneau and may contain some Triassic marine shelf deposits, it is likely that the area was a topographic high in Late Paleozoic and Mesozoic time. Therefore, the favorable geologic environment is not present[9]. TERRADATA's classification of the area for other leasable commodities is in agreement with that of the USGS[23, 24].

5. RECOMMENDATIONS FOR FUTURE WORK

Further surface geologic investigations, including detailed mapping and stratigraphic studies, could enhance the confidence levels of many of the classifications in the Owyhee River GRA. It is doubtful, however, that the original classifications would change substantially. Sub-surface investigations are probably not warranted in this area due to the costly nature of the available methods. Geophysical and geochemical surveys might provide some insight into the potential resources in the study area. Particular attention should be paid to the more highly faulted parts of the area. Geochemical surveys of drainages in these faulted areas could provide stronger evidence to support or refute the classification of this GRA for metallic GEM resources.

- APPENDIX A -

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