PHASE I

Geology, Energy, and Mineral (GEM) Resource Assessment of the Kinzie Butte GRA, Idaho, including the Black Butte (54-2) Lava (56-2), and Shoshone (59-7) Wilderness Study Area

Bureau of Land Management
Contract No. YA-553-CT2-1039

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WGM INC.
MINING AND GEOLOGICAL CONSULTANTS

EXECUTIVE SUMMARY

The Kinzie Butte Geology, Energy, and Mineral Resource Area (GRA) is located in south-central Idaho north of Shoshone. The GRA contains the Black Butte (54-2), Lava (56-2), and Shoshone (59-7) Wilderness Study Areas (WSAs).

Bedrock in the GRA consists of a small amount of Tertiary rhyolites and a large volume of Tertiary, Quaternary, and Recent basalt flows.

Only a minor amount of geologic data is available for the area. There is no geochemical data or information of energy or saleable resources. The overall geologic setting is favorable or moderately favorable for resources such as stone, cinder, pumice and pumicite, and decorative lava rock. The area may be moderately favorable for low to high temperature geothermal resources. The overall geologic setting is not favorable for accumulation of hydrocarbon or metallic mineral resources. The resource classification is summarized in the table which follows.

SUMMARY OF GEM RESOURCES CLASSIFICATION

KINZIE BUTTE GRA, IDAHO

Resources	Wilderness Study Areas: Black Butte (54-2)	Lava (56-2)	Shoshone (59-7)
1. Locatable			
a. Metallic Minerals	1C	1C	1C
b. Uranium and Thorium	1C	1C	1C
c. Non-Metallic Minerals			
i. Decorative Lava Rock	4D	4D	4D
ii. Other	1C	1C	1C
2. Leasable			
a. Oil and Gas	2B	2B	2B
b. Geothermal (low temp.)	3A	2B/3B	2B/3B
Geothermal (high temp.)	3A	2A/3A	2A/3A
c. Sodium-Potassium	1B	1B	1B
d. Other (1)	1B	1B	1B
3. Saleable			
a. Sand and Gravel	1B	1B	1B
b. Stone, Cinder, Pumite, Pumicite	3B	3B	3B
c. Clay, Limestone, Dolomite, Peat, Petrified Wood	1B	1B	1B

(1) Includes asphalt, oil shale, phospate and bitumen.

TABLE OF CONTENTS

Page

1.0 INTRODUCTION

- 1.1 Location
- 1.2 Population and Infrastructure
- 1.3 Basis of Report
- 1.4 Acknowledgements

2.0 GEOLOGY

- 2.1 Introduction
- 2.2 Physiography
- 2.3 Rock Units
- 2.4 Structural Geology and Tectonics
- 2.5 Paleontology
- 2.6 Historical Geology

3.0 ENERGY AND MINERAL RESOURCES

- 3.1 Introduction
- 3.2 Known Mineral and Energy Deposits
- 3.3 Known Mineral and Energy Prospect, Occurrences, and Mineralized Areas
- 3.4 Mining Claims, Leases and Material Sites
- 3.5 Mineral and Energy Deposit Types
- 3.6 Mineral and Energy Economics

4.0 LAND CLASSIFICATION FOR GEM RESOURCES POTENTIAL

- 4.1 Explanation of Classification Scheme
- 4.2 Classification of the Black Butte WSA (52-2)
  - 4.2.1 Locatable Minerals
  - 4.2.2 Leasable Resources
  - 4.2.3 Saleable Resources

- 4.3 Classification of the Lava WSA (56-2)
  - 4.3.1 Locatable Minerals
  - 4.3.2 Leasable Resources
  - 4.3.3 Saleable Resources

- 4.4 Classification of the Shoshone WSA (59-7)
  - 4.4.1 Locatable Minerals
  - 4.4.2 Leasable Resources
  - 4.4.3 Saleable Resources

5.0 RECOMMENDATIONS FOR FURTHER WORK

6.0 REFERENCES SELECTED BIBLIOGRAPHY

APPENDIX I: WILDERNESS STUDY AREA MAPS

LIST OF FIGURES

Figure		Page
1	Location Map	
2	Topographic Map	
3	Physiographic Setting	
4	Geologic Map	
5	Crustal Structure-Eastern Snake River Plain	
6	Volcanic Features of the Snake River Plain	
7	Regional Seismicity	
8	Mineral Occurrences	
9	Geothermal Data Sites	
10	Mining Claims Density Map	
11	Oil and Gas Lease Status	
12	Land Classification - Locatable Resources	
13	Land Classification - Leasable Resources	
14	Land Classification - Saleable Resources	

LIST OF TABLES

Table		Page
I	Geothermal Data from Wells in or near the Kiznie Butte GRA, Idaho	
II	Bureau of Land Management GEM Resources Classification System	

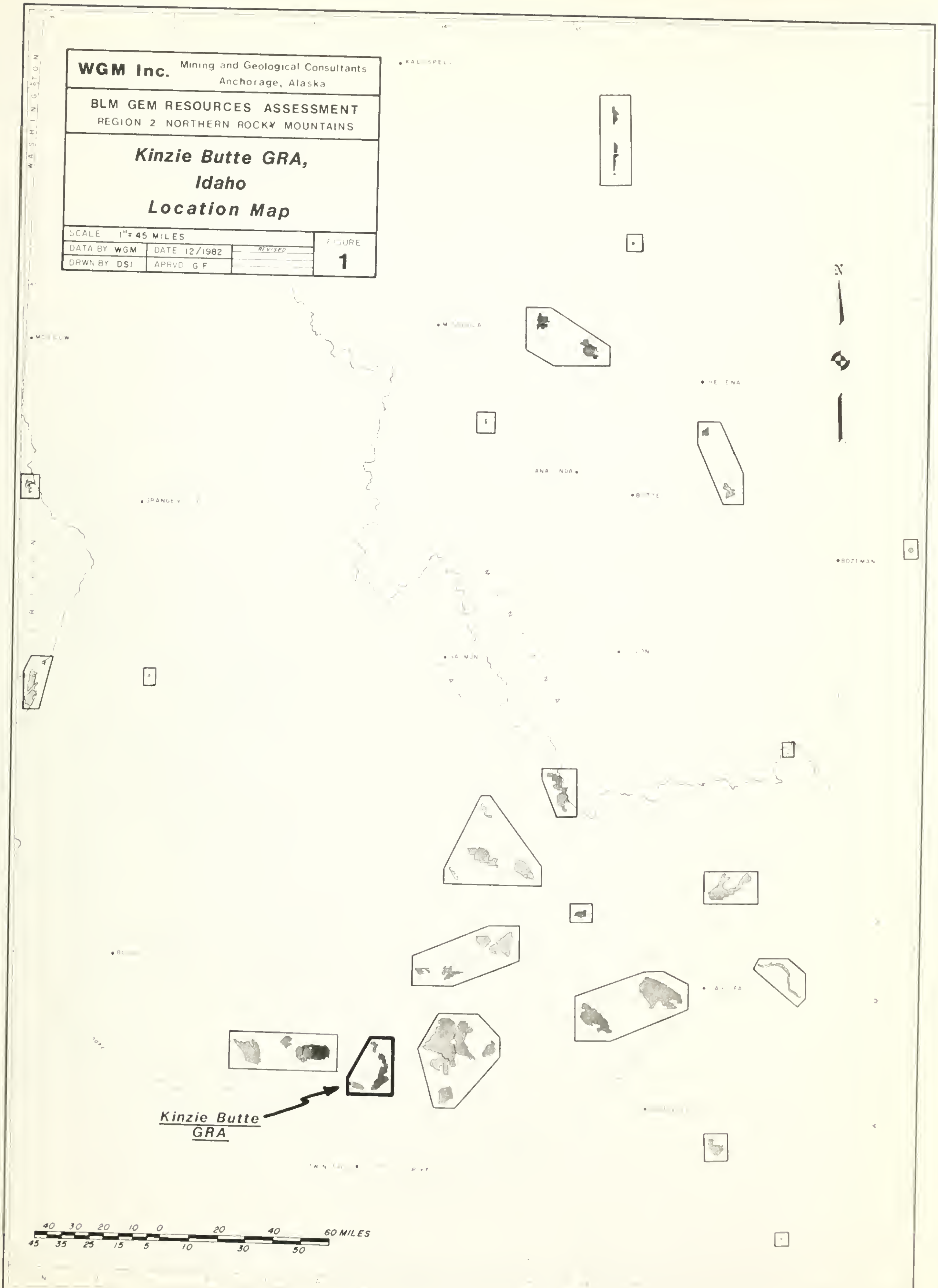
KINIZE BUTTE GRA, IDAHO

1.0 INTRODUCTION

The Bureau of Land Management has adopted a two-phase procedure for the integration of geological, energy and minerals (GEM) resources data into the suitable/non-suitable decision-making process for Wilderness Study Areas (WSAs). The objective of Phase I is the evaluation of existing data, both published and available unpublished data for interpretation of the GEM resources potential of the WSAs. Wilderness Study Areas are grouped into areas based on geologic environment and mineral resources for initial evaluation. These areas are referred to as Geology, Energy, Mineral Resource Areas (GRAs).

The delineation of the GRAs is based on three criteria: (1) a 1:250,000 scale map of each GRA shall be no greater than 8½ x 11 inches; (2) a GRA boundary will not cut across a Wilderness Study Area; and (3) the geologic environment and mineral occurrences. The data for each GRA is collected, compiled, and evaluated and a report prepared for each GRA. Each WSA in the GRA is then classified according to GEM resources favorability. The classification system and report format are specified by the BLM to maintain continuity between regions.

This report is prepared for the Bureau of Land Management under contract number YA-553-CT2-1039. The contract covers GEM Region 2; Northern Rocky Mountains (Fig. 1). The Region includes 50 BLM Wilderness Study Areas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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS
Kinzie Butte GRA,
Idaho
Location Map
SCALE 1"= 45 MILES
DATA BY WGM
DATE 12/1982
REVISED
DRWN BY DSI
APRVD G F
FIGURE
1
Kinzie Butte
GRA
40 30 20 10 0 20 40 60 MILES
45 35 25 15 5 10 30 50

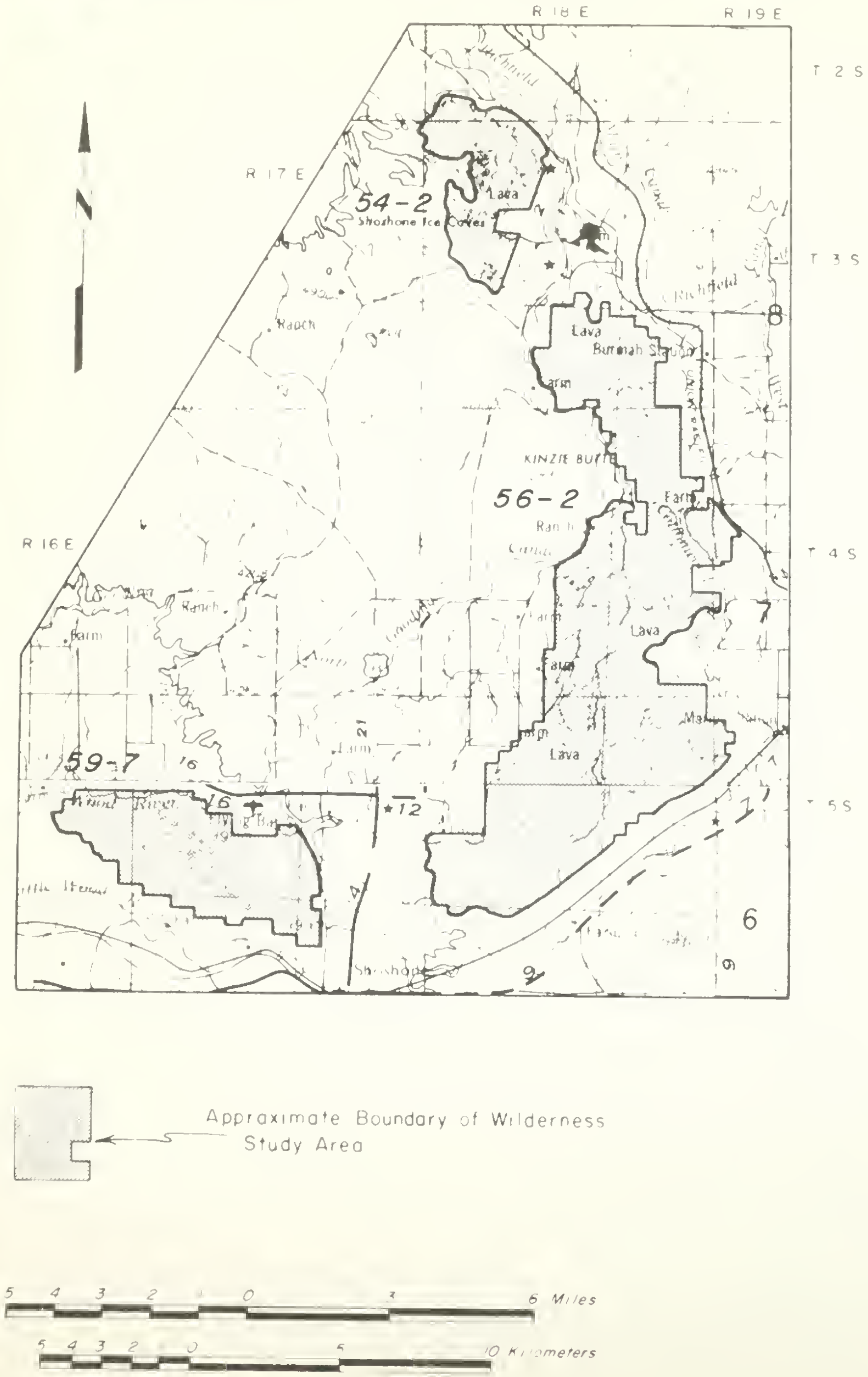
totalling 583,182 acres. The WSAs were grouped into 22 GRAs for purposes of the Phase I GEM resources evaluation.

1.1 Location

The Kinzie Butte GRA is located in southern Idaho in TS-2-5S., Rs.16-19E. in Lincoln and Blaine Counties (Figs. 1 and 2). The GRA extends between Shoshone and Magic City. Administratively the Kinzie Butte GRA is within the Monumentland Bennett Hills Resource Areas in the Shoshone BLM district. The GRA encompasses about 300 square miles and contains three Wilderness Study Areas, Black Butte (4,002 acres), Lava (23,689 acres), and Shoshone (6,914 acres).

1.2 Population and Infrastructure

The southern boundary of the Kinzie Butte GRA cuts throught the town of Shoshone, population 19,226, which is the center of farming and sheep ranching in the area. The community of Richfield, population 357, is 3½ miles east of the eastern GRA boundary. U.S. Highway 93 diagonally crosses the southeastern portion of the GRA and State Highway 75, which extends northwards to Hailey, Ketchum, and Sun Valley, bisects the GRA from north to south. Secondary improved and unimproved roads criss-cross much of the area although they are relatively absent in areas underlain by young basalt flows. The Union Pacific railroad extends east-west roughly paralleling the southern GRA boundary and a branch extends from southeast to northwest across the GRA.



Approximate Boundary of Wilderness Study Area

BLM Wilderness Study Areas Included in the Kinzie Butte GRA.

WSA	NAME	ACREAGE
54-2	Black Butte	4,002
56-2	Lava	23,689
59-7	Shoshone	6,914

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Kinzie Butte GRA, Idaho

Topographic Map

SCALE	1"=4 MILES (1:250,000)			FIGURE
DATA BY	WGM	DATE	9/1982	2
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1.3 Basis of the Report

This report is based on compilation, review, and analysis of available published and unpublished data on the geology, energy, and mineral resources of the Kinzie Butte GRA. Geologic studies of importance to the Kinzie Butte GRA include maps by Malde, Powers, and Marshall (1963), Harrington (1930), LaPoint (1977), Ross (1963), and the geologic compilation by Rember and Bennett (1979), mineral occurrence compilations by Strowd et al. (1981) and Hustedde et al. (1981). The data was compiled and reviewed by WGM project personnel and the panel of experts to produce the resource evaluation which comprises this report. Personnel are as follows:

Greg Fernette, Senior Geologist, WGM Inc.	Project Manager
C.G. Bigelow, President, WGM Inc.	Chairman, Panel of Experts
Joel Stratman, Geologist, WGM Inc.	Project Geologist
Jami Fernette, Land and Environmental Coordinator, WGM Inc.	Claims and Lease Compilation

Panel of Experts

C.G. Bigelow, President, WGM Inc.	Regional geology, metallic and non-metallic minerals, mineral economics.
R.S. Fredericksen, Senior Geologist, WGM Inc.	Regional geology, metallic minerals.
David Blackwell, Ph.D., Professor of Geophysics, Southern Methodist University	Geothermal.
Jason Bressler, Senior Geologist, WGM Inc.	Regional geology, metallic minerals.
Gary Webster, Ph.D., Chairman, Department of Geology, Washington State University	Oil and gas.
William Jones, Senior Geologist, WGM Inc.	Metallic minerals, coal, industrial minerals.

J.F. McOuat, President, Watts, Griffis & McOuat Ltd.	Mineral economics, and industrial minerals.
E.F. Evoy, Senior Geologist, Watts, Griffis & McOuat Ltd.	Uranium and thorium.

1.4 Acknowledgements

We would like to acknowledge the assistance of Larry Dee, Shoshone, Idaho BLM in the compilation stage of this project.

2.0 GEOLOGY

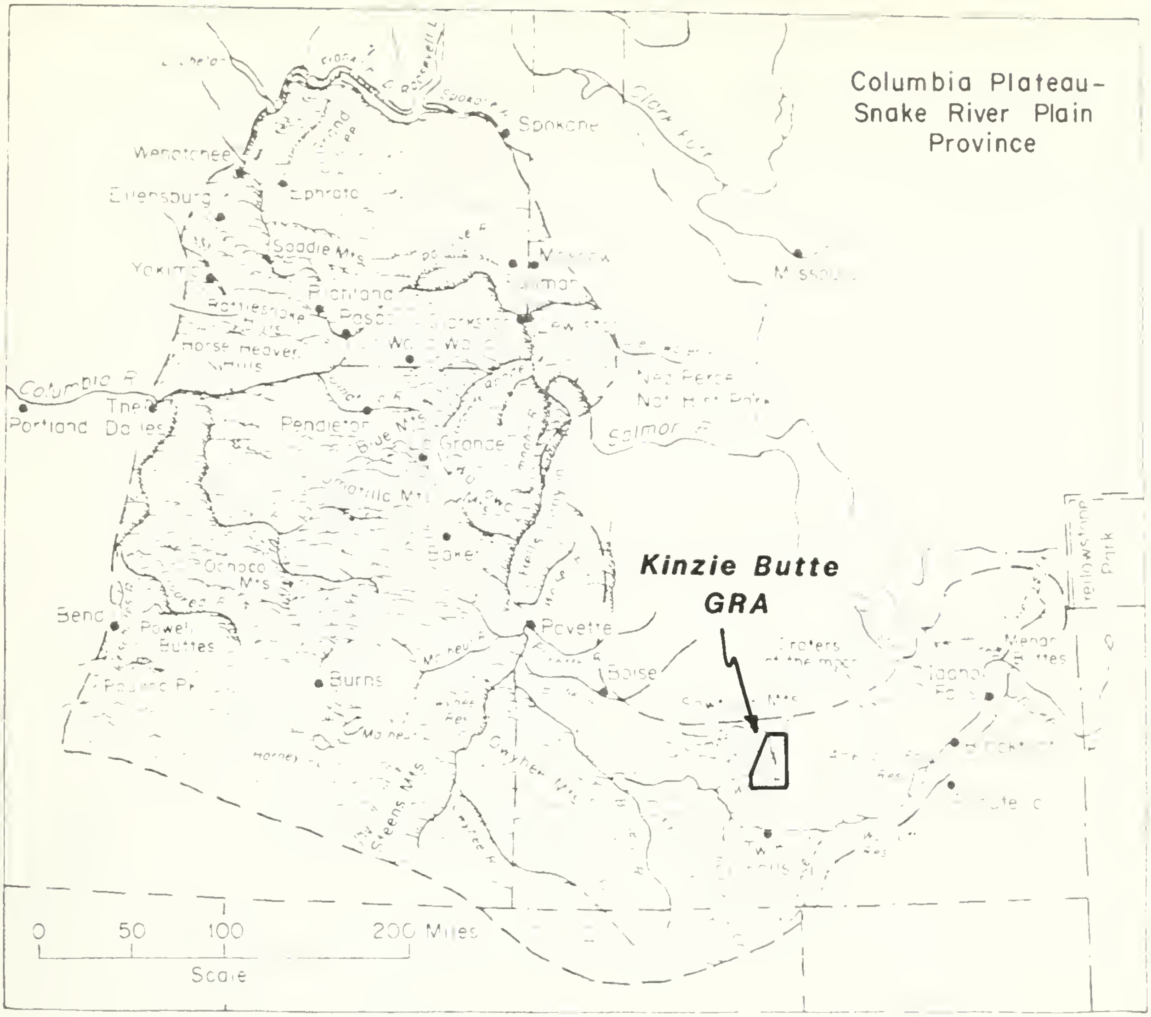
2.1 Introduction

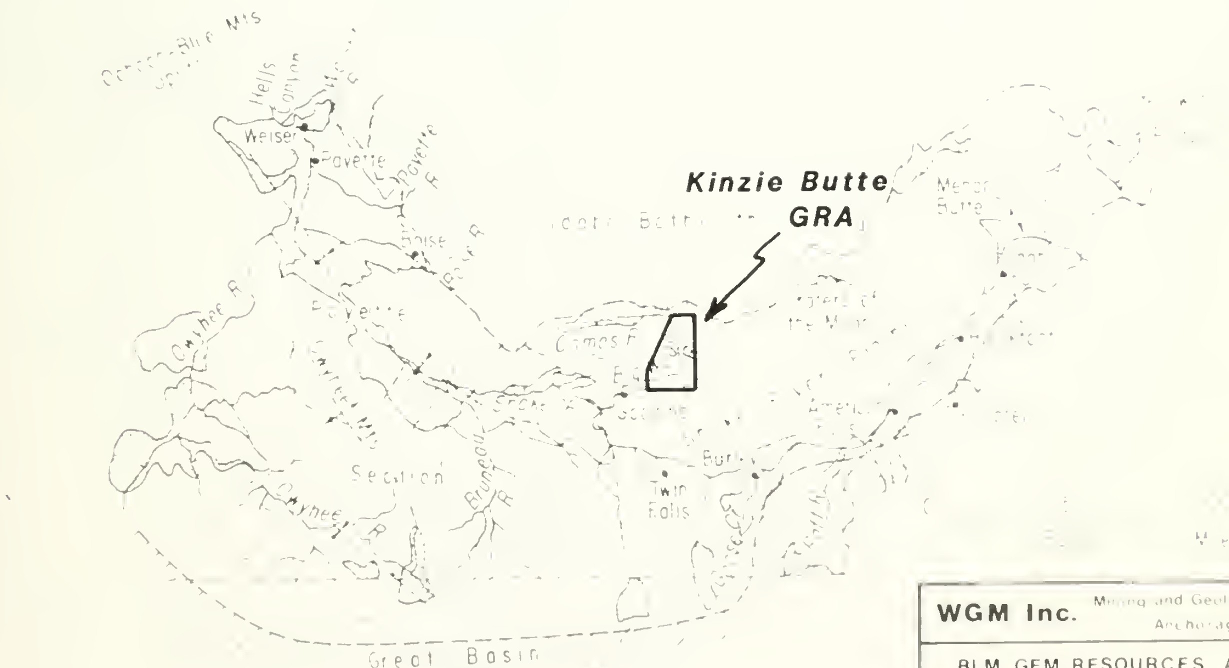
The surficial geology of the Kinzie Butte GRA is comprised of Tertiary rhyolitic volcanics and Quaternary basalts. The boundaries of the three Wilderness Study areas roughly correspond to the outlines of the youngest basalt fields in the GRA. The volcanic rocks mask the underlying stratigraphy.

2.2 Physiography

The Kinzie Butte GRA is situated in the central portion of the Snake Plain in the Columbia Plateau-Snake River Plain physiographic province (Hunt, 1974; Fig. 3). The area is drained by the Big Wood and Little Wood Rivers. A number of large canals conduct water to farms in the area. These include the Main, Richfield, and Gooding Canals, and the Cottonwood Slough.

Elevations range from about 3,800 feet in the southern portion of the GRA to 5,170 feet in the northern portion of the GRA. The climate is high desert, semi-arid and vegetation consists of sagebrush and bunch grass. Cottonwood and poplar trees grow along stream banks. Average yearly precipitation is less than 12 inches, most of which falls in winter and early spring. The summers are hot with temperatures of 100°F common and 110°F not unknown. Prevailing winds are from the west and are commonly laden with dust.





Cenozoic Lake, Playa, and stream deposits.

Lava

From Hunt (1974).

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Kinzie Butte GRA, Idaho

Physiographic Setting

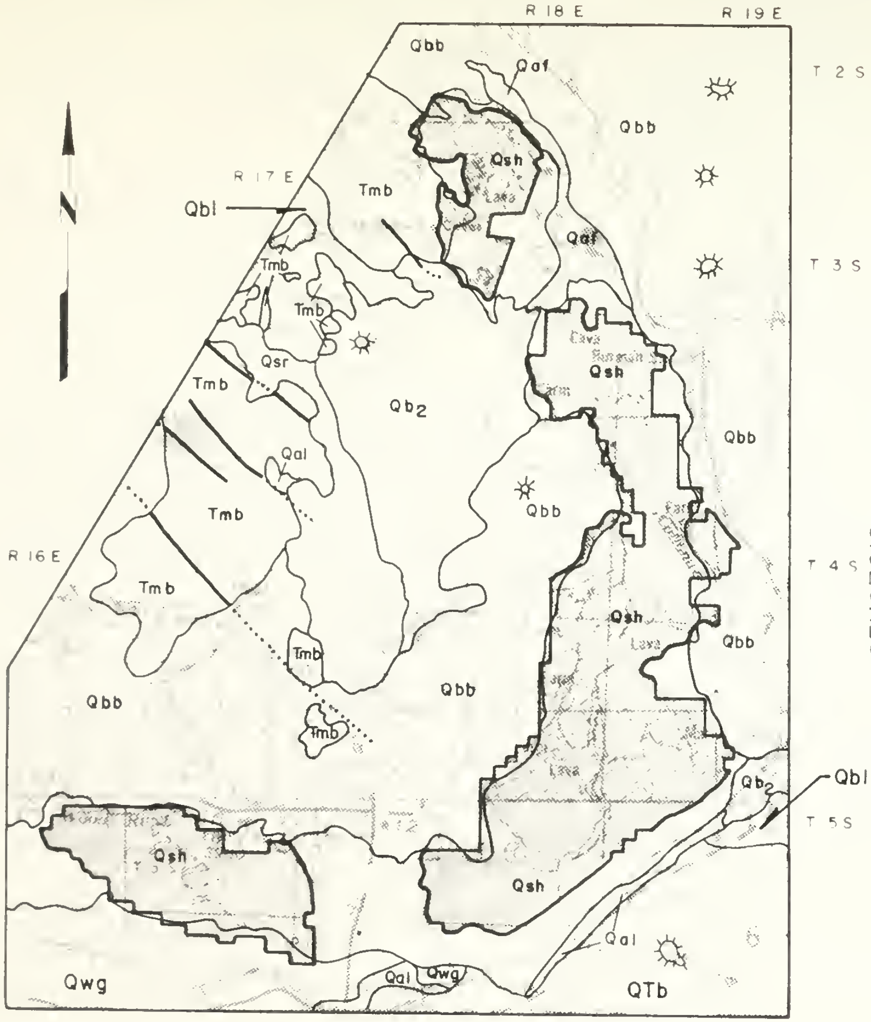
3

2.3 Description of Rock Units

The oldest bedrock in the Kinzie Butte GRA consists of Tertiary (lower Pliocene) rhyolites termed the Moonstone Rhyolite. These volcanics are referred to as the "Rhyolite of Magic Reservoir" by Malde, Powers, and Marshall (1963). The rhyolite (Tmb, Fig. 4) consists essentially of rhyolite tuff, densely welded and rich in large phenocrysts of quartz and sanidine. The aphanitic groundmass is a pale purplish-gray. The rhyolite is conspicuously broken by widely spaced columnar joints that control weathering, creating spires and domes. Weathered surfaces are commonly stained reddish brown. The rhyolites are estimated to be at least 500 feet thick southwest of Magic Reservoir (Malde et al., 1963).

The next youngest volcanic unit (QTb, Fig. 4) is not described by previous workers. Ross (1963) includes this basalt in with other basalts of the lower part of the Snake River basalt which he describes as a mainly dull, weathered olivine basalt (Fig. 4).

The next youngest volcanic unit (Qbb) may be inpart correlative with unit QTb. Malde et al. (1963) include this middle Pleistocene unit in the Idaho Group which varies in age from upper Pliocene to middle Pleistocene. The unit (Qbb) is part of the Bruneau Formation which consists of undeformed, unconsolidated canyon fill gravels and interbedded basalt flows. The basalt unit (Qbb, Fig. 4) is comprised of basaltic lava flows that erupted from several vent areas at various times so as to produce a series of lava plateaus and canyon filling dams. The basalts are locally stained brown and yellow but are not generally softened by decomposition. Kinzie Butte is



EXPLANATION

CENOZOIC

Sedimentary

Qal — Stream alluvium

Igneous

Qwg — Wendall Grade Basalt

Qsh — Shoshone Basalt

Qbl, Qb2, Qb4 — Snake River Basalt, flows in stratigraphic position.

Qsr — Snake River Basalt, undifferentiated

Qbb — Bruneau Formation basaltic lava flows

QTb — Basalt

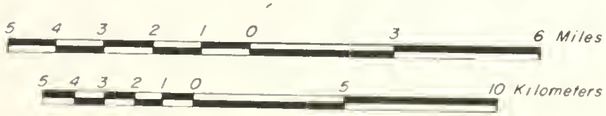
Tmb — Moonstane Rhyolite

Quaternary: Recent; Pleistcene

Tertiary: Pliocene

Data by: Rember and Bennett, 1979
Malde, et.al., 1963

Approximate Boundary of Wilderness Study Area.



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Kinzie Butte GRA, Idaho

Geologic Map

SCALE 1"=4 MILES			FIGURE 4
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identified as one of the source vents of the lava flows as is a series of three similar vents northeast of Kinzie Butte (Fig. 4) which include Burns and Marley Buttes.

A small portion of unit Qb4 (Fig. 4) extends into the GRA. Thus unit, from Rember and Bennett, has no description but is believed to be of Pleistocene age and similar to other older basalt flows.

The next youngest units are all of Recent age. This includes the unit Qbz, Qb1, the Shoshone basalt (Qsh), and the Wendell Grade basalt (Qwg). Unit Qb2 is probably the oldest of the four Recent basaltic eruptives based on the mapping of Malde et al., (1963). The next youngest lava unit is Qb1 (Fig. 4). These two lavas are basalts which conform to present topography and are largely unmodified by surficial deposits or by weathering. Age relationships to the Wendell Grade basalt appear to be equivocal.

The Wendell Grade basalt (Qwg, Fig. 4) is a lava flow of olivine basalt which originated from Notch Butte four miles south of Shoshone (Ross, 1963; Malde et al., 1963). The Wendell Grade basalt is a pahoehoe flow of black fine-grained olivine basalt.

The youngest volcanic unit in the area is the Shoshone basalt (Qsh, Fig.4). It's source vent is at Black Butte near the site of Shoshone Ice Caves. It is comprised of fresh olivine basalt and includes some cinder and ash. The lava followed the course of the Big Wood River crowding it from its former bed and forcing it to cut a deep canyon (Harrington, 1930).

Unconsolidated stream alluvium (Qal, Fig. 4) occurs in the GRA along Cottonwood Slough and along the Big Wood River.

The most recent material of geologic interest is ice which forms in tubes and other openings in the young basalt flows. Such features have become tourist attractions at several locations on the Snake River Plain and two are present in the GRA - Shoshone Ice Caves and Minadoka Ice Caves. Were it not for the advent of modern refrigeration units, these unique ice formations would be sliced into rectangular solids and used to cool scotch in the hot dusty terrain surrounding Shoshone.

2.4 Structural Geology and Tectonics

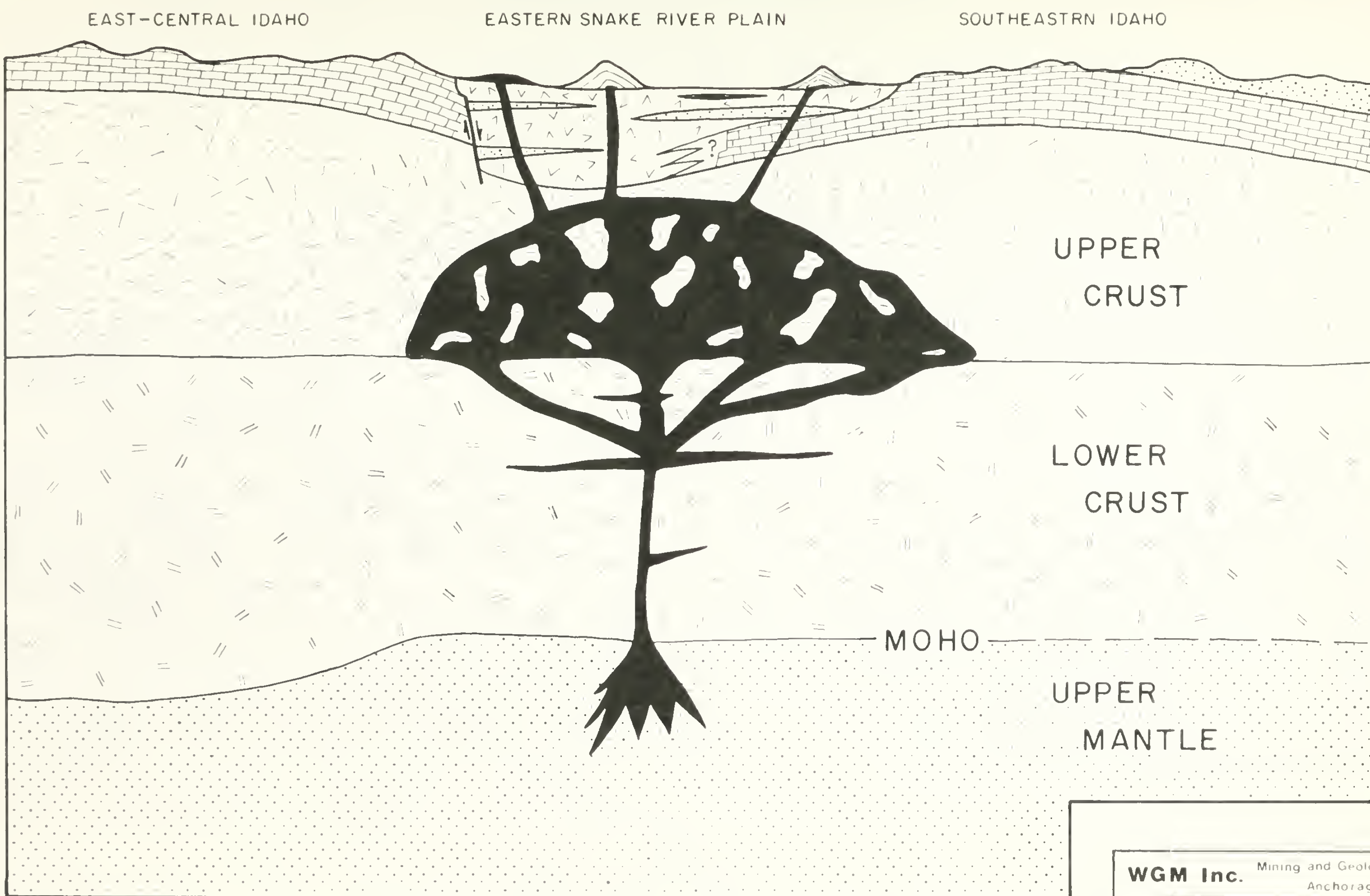
The crustal structure of the eastern Snake River Plain (ESRP) has been recently studied by Braile et al. (1982) and summarized as follows:

> Previous geological and geophysical studies of the ESRP indicate that it is a volcanic-filled depression which trends nearly perpendicular to the regional structures of the Basin and Range, Northern Rocky Mountains, and Middle Rocky Mountains provinces which bound the ESRP. To the northeast of the ESRP are the Island Park and Yellowstone Calderas which have displayed volcanic, seismic, and hydrothermal activity within the last million years. Kirkham (1931) suggested that the ESRP is a simple downwarp and that faulting along the margins of the plain has been of minor importance. However, Sparlin et al. (1982) have demonstrated the existence of major faulting along the northwestern boundary of the ESRP from seismic and gravity modelling. Gravity studies (Hill, 1963; Mabey, 1976, 1978; LeFehr and Pakiser, 1962) have identified a prominent positive gravity anomaly which approximately coincides with the axis of the ESRP, but is more localized toward the northern part of the downwarp in the western Snake River Plain. Deep crustal structure information from seismic data is absent in the ESRP, but a seismic refraction profile from Mountain City to Boise in the western Snake River Plain (Hill and Pakiser, 1966; Prodehl, 1979) has demonstrated that the western Snake River Plain consists of a thick, high-velocity (6.7 km/s) crust with a surface layer of lower-velocity volcanic materials. To the south of the ESRP, the northeastern Basin and Range province is characterized by lower, average crustal-velocity

(6.3 km/s) and a crustal thickness of about 30 km (Braile et al., 1974; Keller et al., 1975; Smith, 1977, 1978; Hill and Pakiser, 1966). Armstrong et al. (1975) utilized K-Ar dates of late Cenozoic silicic volcanic rocks of the ESRP to demonstrate a systematic age progression of volcanism along the ESRP. Their date indicate the silicic volcanic activity began about 15 m.y. ago in southwestern Idaho and progressed at an average rate of approximately 3.5 cm/yr. northeastward toward its present site at the Yellowstone plateau. They also indicate that the initiation of basaltic volcanism has followed this same time progression, with a lag of approximately 2 to 5 m.y. after the silicic volcanism. In addition, the basaltic volcanism in the southwestern portion of the ESRP has remained active sporadically to the present. Today, the Yellowstone Caldera is representative of this silicic phase of volcanism which characterizes the volcanic progression, and the Island Park region represents the leading edge of the basaltic volcanic activity. Brott et al. (1978) utilized heat flow data on the western Snake River Plain and an observed heat flow-elevation relationship for the western and eastern Snake River Plain to propose a tectonic model for the development of the Y-SRP volcanic province. According to their model, the time progression of volcanism along the eastern Snake River Plain is accompanied by intrusion into the crust and rapid transfer of heat to the surface by intrusion and eruptions. High heat-flow adjacent to the margins of the ESRP is observed, but low values are observed in the ESRP itself due to ground water circulation in the Snake River Plain aquifer (Brott et al., 1978). According to the model suggested by Brott et al., cooling of the crust after the intense silicic volcanic activity results in the subsidence which is presently observed as the eastern Snake River Plain downwarp.

Several additional tectonic models have been proposed to describe the geologic evolution of the eastern Snake River Plain during the past 15 m.y. Hamilton and Myers (1966) suggested that the ESRP consists of a tensional rift. Morgan (1972) and Smith and Sbar (1974) described the eastern Snake River Plain-Yellowstone system as the track of a mantle plume or hotspot. Finally, Taubeneck (1971) suggested that the ESRP was laterally faulted and the upper crust pervasively intruded by dikes.

A schematic diagram illustrating the crustal structure of the eastern Snake River Plain is shown in Figure 5. Braile et al. (1982, p. 2607) have suggested a tectonic model which seeks to provide a reasonable qualitative explanation for the observable crustal structure (based on seismic profiles), thermal anomalies, and volcanic history during evolution of the Yellowstone-Snake River Plain system. Their model is as follows:



From: Sparlin, et. al. (1982).

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Kinzie Butte GRA, Idaho

Schematic Diagram of Crustal Structure Eastern Snake River Plain

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When these observations are considered in conjunction with the volcanic age progression relationships described by Armstrong et al. (1975) and the thermal model proposed by Brott et al. (1978) for the evolution of the eastern Snake River Plain, a possible evolutionary model of the crust during the past 15 m.y. is suggested. Initially, a thermal perturbation of the crust results in 3 to 4 km of surface uplift, intense silicic volcanism, and subsequent caldera collapse. During this stage, basaltic magma from the upper mantle rises rapidly through the lower crust, producing only minor velocity structure perturbations. As the hot magma contacts the sialic upper crust, it causes partial melting of a part of the upper-crustal layer (as evidenced by the low velocity upper-crust beneath the Yellowstone are) during the process of rapid transfer of volcanic material and heat to the surface. Partial melting of these upper crustal rocks generates the silicic volcanism. This phase is presently represented by the Yellowstone plateau. As the 'hotspot' moves to the northeast, cooling of the intruded upper crust generates the high-density, high-velocity intermediate layer in the ESRP and results in rapid subsistence of the crust.

Continued cooling, subsistence due to thermal contraction, and minor, periodic basaltic volcanic activity persists through the remainder of the last least 15 m.y. evolutionary sequence. Due to the depletion of silicic material in the crust, this late-stage volcanism is of lesser intensity and probably represents rapid ascent of magma through small dikes or pipes from the upper mantle. An example of these late-stage volcanics is found in the Craters of the Moon, Idaho, area. Considering the potential geothermal anomalies along the Y-SRP system, the recent basaltic volcanism would represent a minor thermal anomaly in the crust. However, partial melt zones in the upper crust associated with silicic volcanism could produce significant temperature anomalies but would be restricted to the Yellowstone plateau and extreme northeastern part of the ESRP. Additional geothermal anomalies could be present near the axis of the ESRP due to shallow (7 to 10 km) intrusion of high-density and high-velocity rocks of the intermediate layer, or along the northwestern margin of the ESRP where a fault of at least 4 km offset could provide a route for upward migration of hot fluid.

Although much remains to be learned about the geology and tectonics of the Yellowstone-Snake River Plain area, the model described above provides a reasonable, qualitative explanation for the observed crustal structure, thermal anomalies, and volcanic history during crustal evolution of the Yellowstone-Snake River Plain system.

Within the Kinzie Butte few structural features are present. A few faults are present in the Tertiary Moonstone rhyolite. The faults tend northwest-southeast and are obscrued in most of the GRA by Quaternary and Recent basalt flows (Fig. 4). Figure 6 shows the general volcanic features and structures found in the Snake River Plain.

Geologic hazards in the area are restricted to those which would be related to a renewal of volcanic activity. There is little seismic activity in the immediate area as the Snake River Plain tends to be rather aseismic with respect to terranes north and south (Fig. 7).

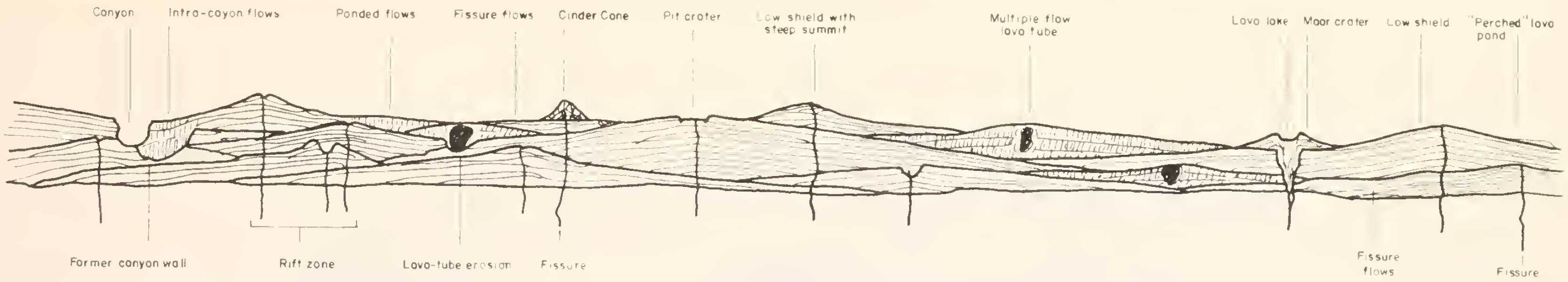
2.5 Paleontology

There are few sedimentary units in the GRA and it is unlikely that any noteworthy paleontological sites are present. Elsewhere near Hagerman and Bliss Quaternary lake beds and valley fill deposits have yielded important fossil finds. Excavations have uncovered the remains of giant sloths, mastodons, camels, bison, fresh water mollusks, and plant remains. Most fossil evidence indicates that what now is desert was luxuriant during the Quaternary.

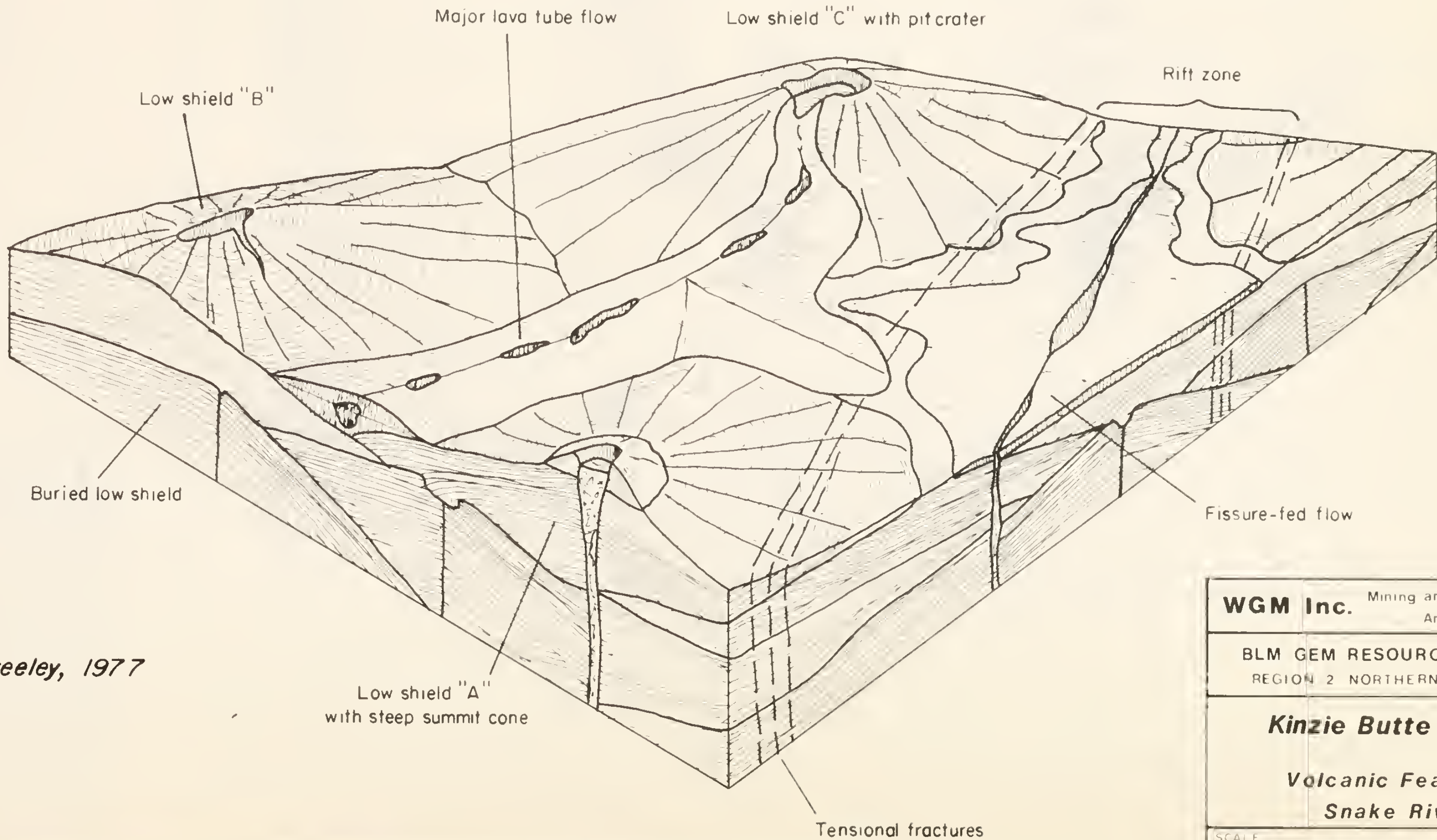
2.6 Historical Geology

A general overview of the geologic evolution of the eastern Snake River Plain is summarized in section 2.4 as put forth by Braile et al. (1982, p. 2607). The oldest units exposed within the Kinzie Butte are rhyolites of Tertiary (lower Pliocene) age (Fig. 4). This is typical throughout the central and eastern Snake River Plain and indicates melting of crustal material prior to onset of basaltic volcanism. Minor faulting occurred, as

Schematic cross section showing the salient features of a 'plains' basalt region, typified by the central Snake River Plain



Block diagram showing relationship of low shields, major lava tube flows, and fissure flows.



Source: Greeley, 1977

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Kinzie Butte GRA, Idaho	
Volcanic Features of the Snake River Plain	
SCALE	FIGURE
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evidenced by offsets in the rhyolites, prior to the basaltic extrusions. The majority of Pleistocene age rhyolites flowed from vent sites within the GRA. These sites include Kinzie Butte, Burns Butte, Marley Butte, and Dietrich Butte. These volcanic outpourings buried most of the older mixed rhyolitic and basaltic terrane. The most recent outpourings are those of the Wendell Grade basalt and Shoshone basalt flows. The source of the Wendell Grade basalt is a vent site at Notch Butte four miles south of Shoshone (just outside the southern boundary of the GRA). The source vent of the Shoshone flows is at Black Butte. The lavas which were erupted followed the oldest course of the Big Wood River, forcing it eastward from its channel. Ice now fills some of the pockets, caverns, and lava tubes in the Black Butte vicinity.

3.0 ENERGY AND MINERAL RESOURCES

No specific mineral resource studies have been published on the Kinzie Butte GRA. Mineral resources consist mostly of sand and gravel and stone or decorative lava rock. Principal references are the compilation of Hustedde et al. (1981) and Strowd et al. (1981) which are compilations of mines and prospects of the Hailey and Twin Falls Quadrangles respectively.

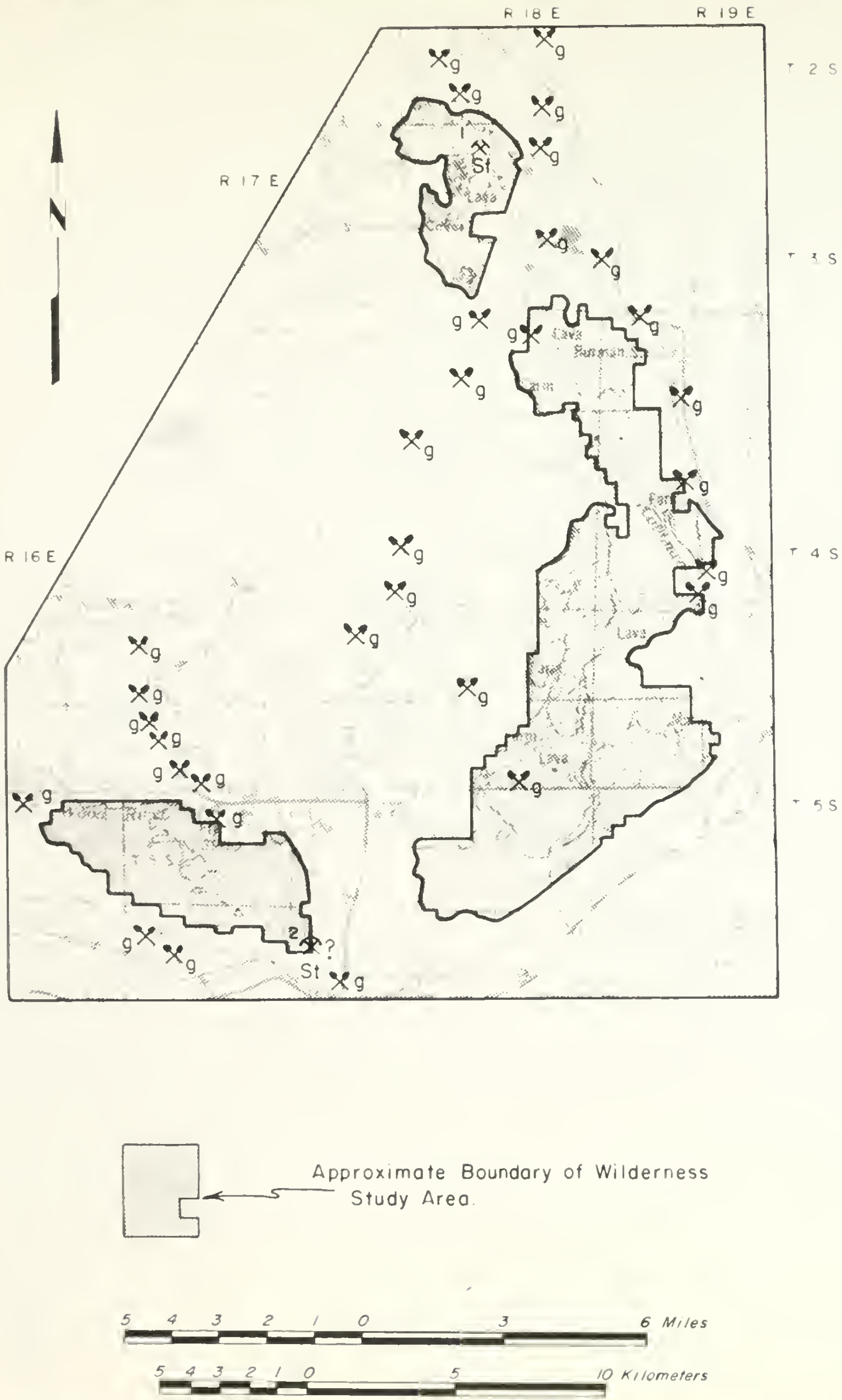
3.1 Known Mineral and Energy Deposits

The Kinzie Butte GRA contains a large number of pits which have produced sand and gravel (Fig. 8). These are located along the highways and the course of the Little Wood River, Wood River, and Gooding Canal. Thirty-one such pits are present in the GRA and one is present in the southern portion of the Lava (56-2) Wilderness Study Area.

Stone has been mined at Black Butte in the Black Butte (54-2) WSA and an occurrence is present in the southeastern portion of the Shoshone (59-7) WSA (Fig. 8).

3.2 Known Mineral and Energy Prospects, Occurrences and Mineralized Areas

No geothermal manifestations occur in the GRA or within the WSAs. Thermal data from wells in and near the GRA are shown in Table I and Figure 9. The temperatures from wells above and in the Snake River Plain Aquifer (SPA) are 12.5-13.5°C. The thickness of the SPA is not known; it may be quite thin



LEGEND

- Mineral Orebody
- Mineral Deposit
- Mineral Occurrence
- Quarry
- Gravel or clay pit

1 — occurence number
Cu — commodity

g - Sand and gravel
st - Stone

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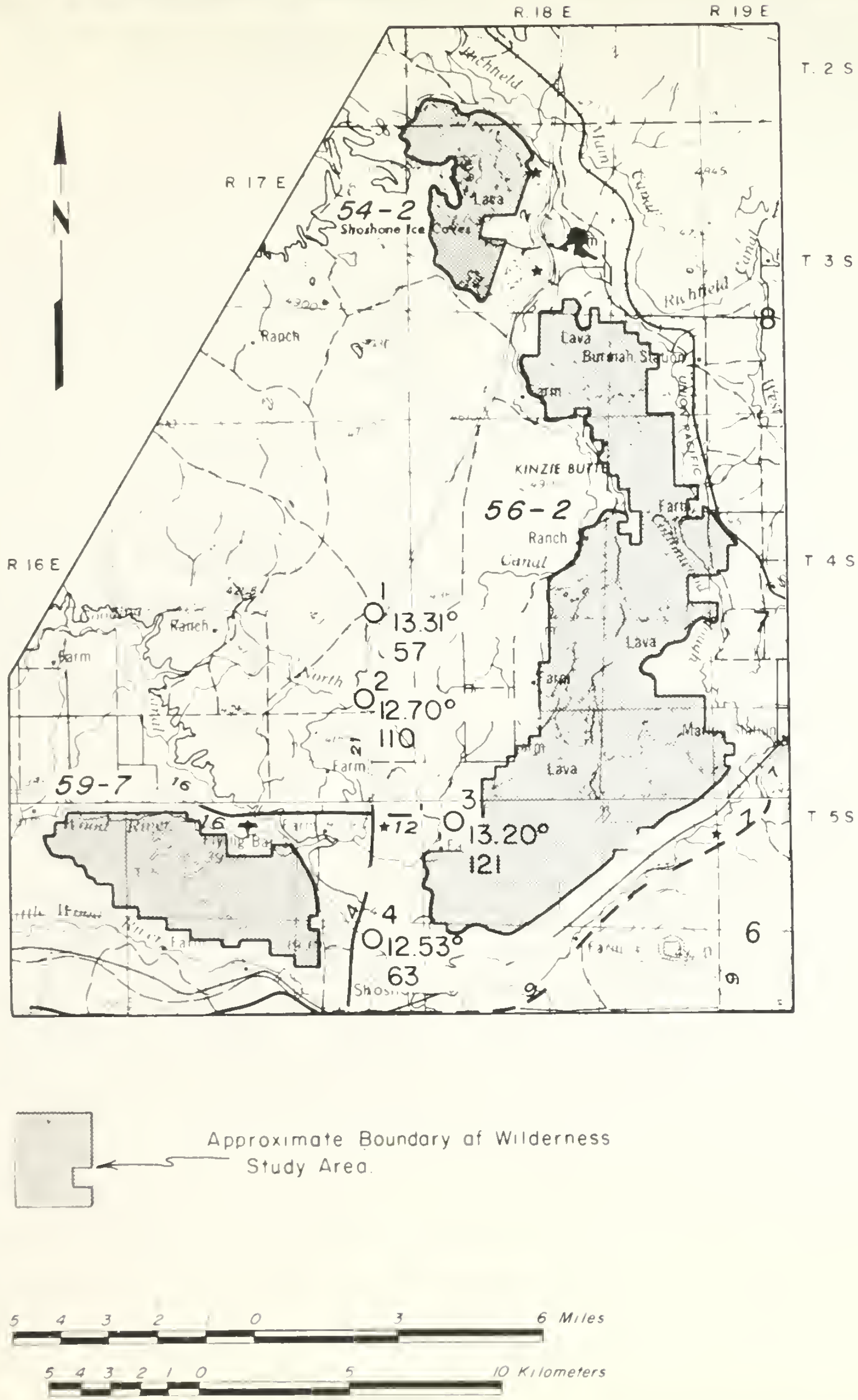
BLM GEM RESOURCES ASSESSMENT REGION 2 NORTHERN ROCKY MOUNTAINS	
Kinzie Butte GRA, Idaho	
Mineral Occurrences	
SCALE 1" = 45 MILES	FIGURE 8
DATA BY WGM — DATE 1/1983	
DRWN BY DSI — APRVD G.F.	

because of the proximity of the WSAs to exposures of silicic volcanic rocks in the Mt. Bennett Hills.

The Black Butte WSA is 3-4 miles south of Magic Reservoir (Fig. 9). Analyses of water from a hot well at the north end of the reservoir (T.1S., R.17E., sec. 23 AAB1, 72°C with a flow of 20 l/min.) indicate potential reservoir temperatures of 140-200°C (Mitchell, 1976). The fluids tapped by the well "may be circulating to depths approaching 1,800 to 2,500 m along faults or fissures; or may be due to leakage from an aquifer heated by a shallow heat source, related perhaps to the Holocene basalt flows south of Magic Reservoir" (Mitchell, 1976c, p. 1). The hot well, together with three holes discussed by Brott et al. (1981) outline an area at least 4 mi. square with highly anomalous gradients and heat flow. Hole T.2S., R.17E., sec. 1, 1AAC (Table I) is the southwesternmost of the four holes and the one closest to the Black Butte WSA (5 miles NNW). It is also the one with the highest gradients (not including the Magic Reservoir Hot Well).

The probable existence of the Snake Plain Aquifer beneath the WSAs might preclude the existence of shallow warm water except that the aquifer may be very thin and warm or hot water might occur beneath the aquifer. It is probable that commercial geothermal exploration attention will be focused on the Magic Reservoir area at a future time and some of the area of interest would include the Black Butte WSA.

No hydrocarbon tests have been drilled in the eastern Snake River Plain. The nearest hydrocarbon tests to the Kinzie Butte GRA were drilled in the thrust belt of southeastern Idaho approximately 60 miles southeast and in



BLM Wilderness Study Areas Included in the Kinzie Butte GRA.

WSA	NAME	ACREAGE
54-2	Black Butte	4,002
56-2	Lava	23,689
59-7	Shoshone	6,914

LEGEND

Well Location —— O 1 —— Number
13.20° —— Temp. (°C)
110 —— Depth (meters)

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Kinzie Butte GRA, Idaho
Location of Geothermal Well Site Data

SCALE 1"=4 MILES (1:250,000)			FIGURE
DATA BY WGM	DATE 9/1982	REV SEQ	9
DRWN BY DSI	APRVD GF		

TABLE I

GEOTHERMAL DATA FROM WELLS IN OR NEAR THE KINZIE BUTTE GRA, IDAHO

(Brott et al., 1981)

Map No.	Location	Collar Elevation meters	Depth Interval meters	Geothermal Gradient °C/km	Heat Flow 10^{-6} cal/cm^{2}sec.	Maximum Temp. °C	Relation to SPA
1	T.4S., R.17E. sec. 24CDD	1,474	20- 57	31.8/ 0.8	1.14	13.31	ABOVE
2	T.4S., R.17E. sec. 35DA1	1,341	20- 70	30.2/ 2.2	1.09		ABOVE
3	T.5S., R.18E. sec. 6AAC	1,310	70-121	0.1/ 0.1	0.01	13.20	IN
4	T.5S., R.17E. sec. 26ACA1	1,210	10-62.5	35.0/ 2.6	1.26	12.53	ABOVE
5	T.2S., R.17E. sec. 2ACC	1,474	5-100	136.2/13.6	4.10	22.42	OUTSIDE

the western Snake River Plain approximately 60 miles west. Both were dry holes as were numerous other tests drilled in both regions (Breckenridge, 1982).

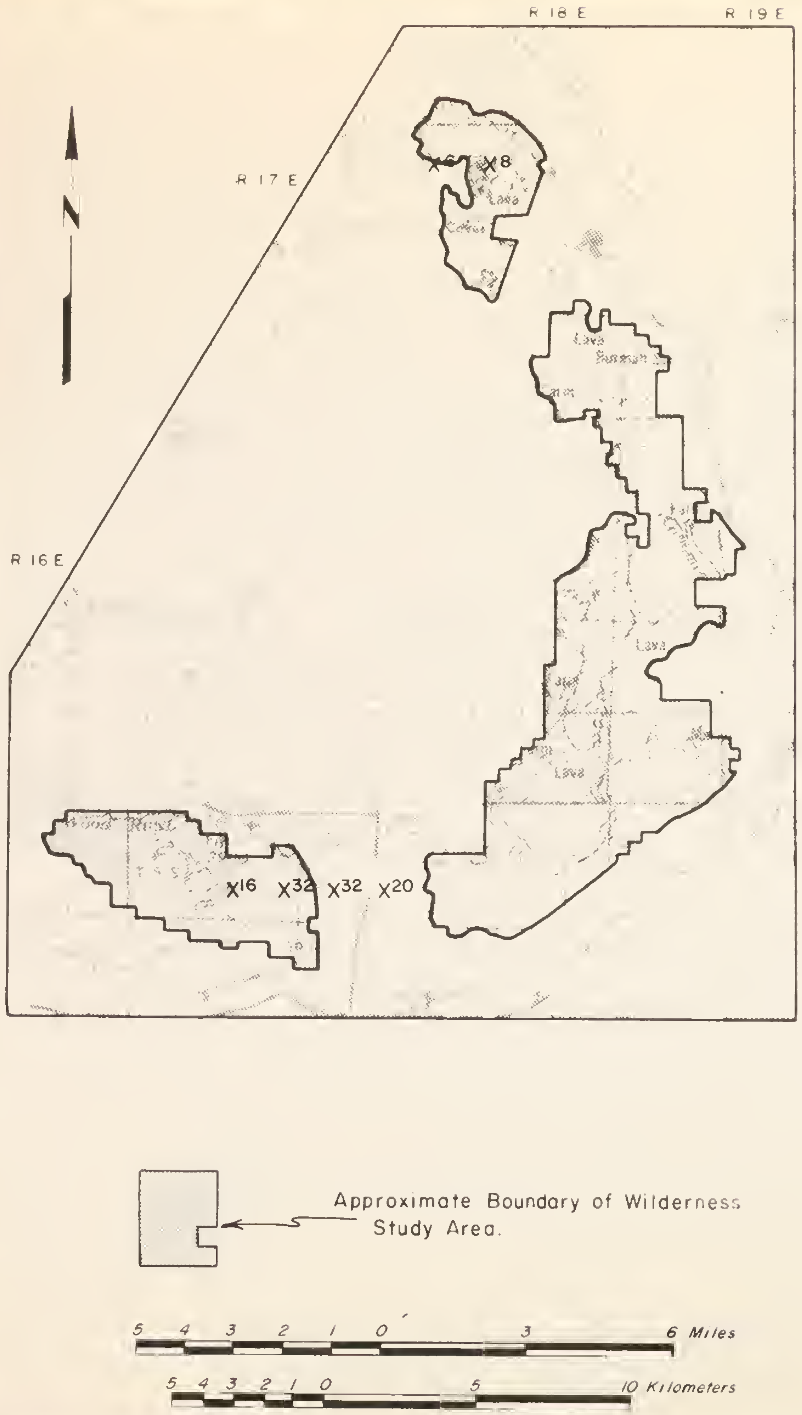
3.3 Mining Claims, Leases, and Material Sites

A reivew of BLM claim records current to June 7, 1982 shows the presence of two cluster of unpatented mining claims (Fig. 10). One group of lode claims occurs in the vicinity of Black Butte within the Black Butte (54-2) WSA, and along the western border of the WSA. These claims were located on occurrences of stone. A second large cluster of unpatented mining claims are present in the eastern half of the Shoshone (59-7) WSA and the gap between the Shoshone (59-7) and Lava (56-2) WSAs. These are also presumably located on decorative lava or slab lava resources. All mining claims in the Kinzie Butte GRA are located on exposures of the Recent Shoshone lava field.

Oil and gas leases cover approximately six square miles in the northern portion of the GRA (Fig. 11). Portions of these leases cover the north end of the Black Butte (54-2) WSA.

3.4 Mineral and Energy Deposit Types

The geologic character of the Kinzie Butte GRA precludes the presence of a wide variety of deposit types. The absence of known metallic mineral deposits and occurrences in the eastern Snake River Plain makes evaluation of the metallic mineral potential difficult. The potential of the area must



EXPLANATION

x Unpatented Mining Claim

▲ Patented Mining Claim

Notes: 1) Number adjacent to symbol indicates number of mining claims in that section.

2) Area of search: Entire GRA

3) Source of Data: BLM claim files

4) Data current to: June 7, 1982

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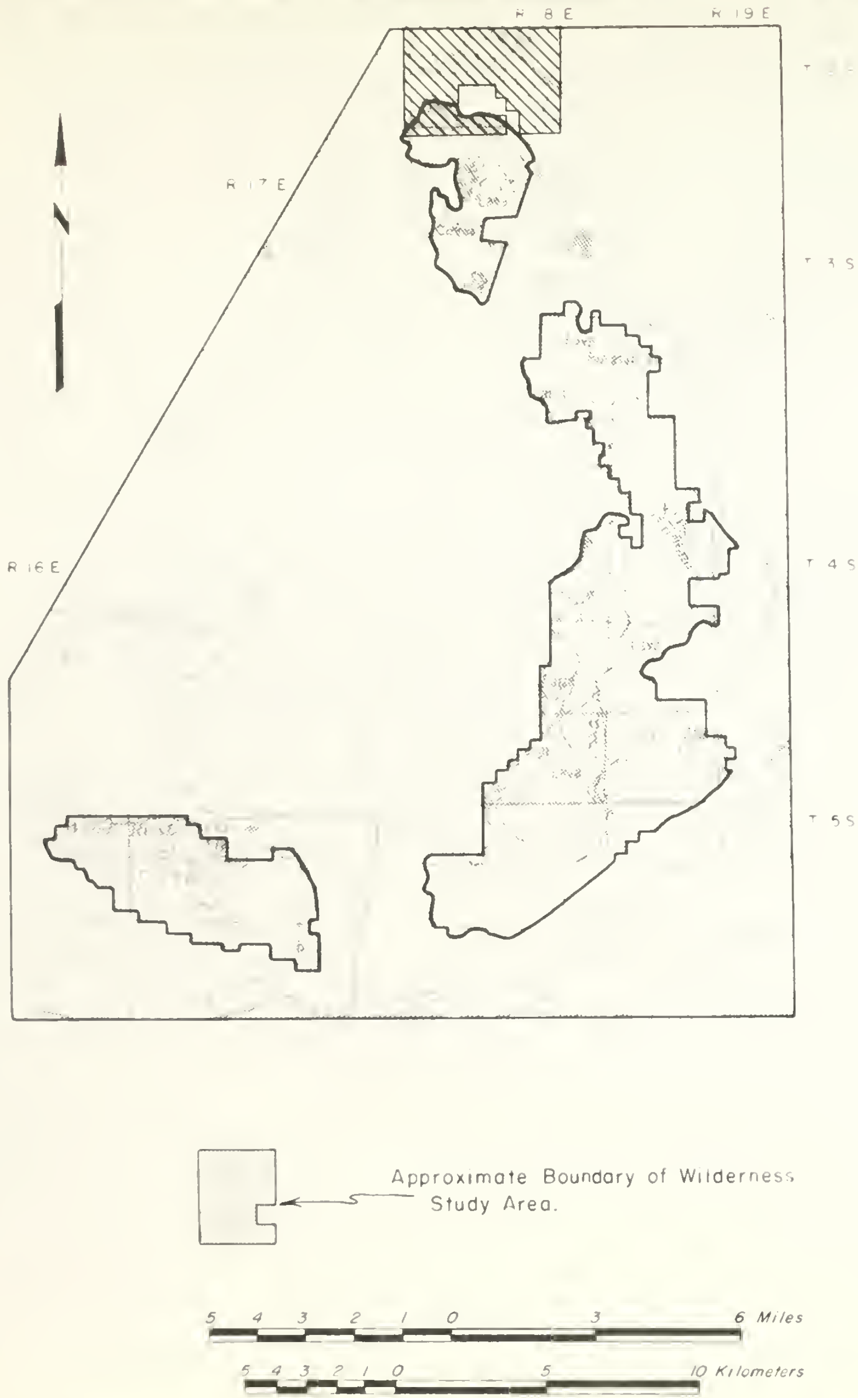
BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Kinzie Butte GRA, Idaho

Mining Claims Density Map

SCALE 1" = 45 MILES			FIGURE
DATA BY WGM	DATE 1/1983	REVISED	10
DRWN BY DSI	APPVD G.F.		



LEGEND

Area covered by oil and gas leases.

Area covered by oil and gas lease application.

Notes: 1) Area of Search: Entire GRA
2) Data current to: Aug. 12, 1982
3) Source of Data: BLM Oil & Gas Lease Plats

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Kinzie Butte GRA, Idaho

Oil and Gas Lease Status

SCALE 1" = 45 MILES			11
DATA BY WGM	DATE 1/1983		
DRAWN DSI	APPROVED G.F.		

be evaluated by analogy and by comparison of the tectonic setting and geologic processes active in the area to those of similar mineralized areas. The eastern Snake River Plain, as discussed earlier, can be described as a continental hotspot, rift zone or aulacogen. Most workers favor the mechanism described by Morgan (1972) and Burke and Dewey (1973) which envisions formation of the Plain by movement of a continental plate over a fixed "hotspot" of rising mantle material (Smith and Christiansen, 1980).

The near-surface rocks in the Snake River Plain are subareal basalt flows which cover a series of rhyolitic calderas (Armstrong et al., 1975; Walker, 1964; Eaton et al., 1975; Christiansen and McKee, 1978; Mabey et al., 1978; Protska and Embree, 1978). The underlying rocks are rhyolitic flows and volcaniclastic caldera-fill deposits (Doherty et al., 1979). The volcanics have been intruded by rhyolitic to latitic plugs (Schoen, 1974; Spear, 1977; Kuntz, 1978). Thus the eastern Snake River Plain consists of three lithologic environments: (1) subareal basalt flows; (2) rhyolitic calderas; and (3) felsic plugs.

Mineral deposits associated with submarine basaltic volcanism along submarine rift zones such as the Red Sea and East Pacific Rise are well known. However, there are no known metallic mineral deposits associated with the subareal basaltic volcanism of the eastern Snake River Plain (Kuntz et al., 1980). The deposits in oceanic settings are formed within hydrothermal systems involving convective circulation of sea water. The apparent absence of hydrothermal activity in basaltic plains volcanism (Greeley, 1977, 1982) precludes formation of this type of mineral deposit in the eastern Snake River Plain.

Mineralization of several types, including precious metal-rich veins (Lipman et al., 1976) and massive sulfide deposits (Hodgson and Lyden, (1977) are associated with caldera systems. The current hydrothermal activity in the Yellowstone Caldera indicates that similar processes may have been active in the older calderas buried beneath the basalt plains (Smith and Christiansen, 1980). It is virtually impossible to evaluate the potential of mineralization in the buried calderas because of the thickness of the basalt cover. In addition the basalts obscure most caldera associated structures which could serve as hydrothermal conduits (Kuntz, 1978; Mabey, 1978; Protska and Embree, 1978).

In a recent review of the relationship of mineral deposits and tectonic settings Mitchell and Garson (1981) suggest that mineral deposits in rifted continental settings such as the Snake River Plain are mainly related to alkaline intrusives and peraluminous granites. Deposits of tin, uranium and molybdenum could be expected in this environment (Mitchell and Garson, 1981). Rhyolitic and ferrolatite domes occur at Big Southern, East, Middle and Cedar Buttes in the eastern Snake River Plain and are indicative of possibly more widespread intrusive activity. There are no reported occurrences of metallic mineral deposits at these domes. However, recent exploration work by AMAX Inc. at Big Southern Butte has resulted in discovery of subsurface stockwork molybdenum mineralization (S. Hamilton pers. comm., 1982).

The average uranium content of the earth's crust is about 2 ppm, and that of granite is about 4 ppm. Felsitic volcanic rocks generally contain more uranium than their plutonic equivalents, perhaps as much as 50% more. To be commercially exploitable, a uranium deposit must ordinarily contain at least 1,000 ppm or one kilogram per ton. Thus, concentration by later geologic processes is usually necessary to form an economic uranium deposit. The uranium minerals in igneous rocks are mostly in the tetravalent state and oxidize readily to provide hexavalent uranium. Hexavalent uranium is soluble in ground waters. During transport by ground water, uranium may be: (1) partially absorbed by clay or carbonaceous matter, (2) precipitated in a chemically hospitable environment by reduction or evaporation, or (3) combine with another element to form a mineral stable in the oxidized state. If carried to the ocean, it tends to: (1) precipitate with phosphatic sediments, or (2) be absorbed by organisms and/or carbonaceous mud. The uranium-bearing accessory minerals, being resistant to erosion, are more likely to weather out of the igneous host as detritus and become dispersed in detrital sediments or, more rarely, concentrated into placers.

Sandstone deposits account for about 95% of United States uranium reserves. The hosts are river-borne arkosic sandstone deposits, commonly intercalated with acidic tuff and clay beds. The tuffs and/or nearby granitic uplifts, and the arkose itself, are thought to be the source rocks. The uranium is dissolved from the source rocks by meteroic water. The course of these uranium-bearing meteoric waters is directed by clay beds or old channel scours, and the precipitating medium for the uranium is believed to be organic matter. Deposits are individually small (with exceptions) with grade ranging from 3 to 8 pounds per ton. Uranium in peneconcordant sandstone deposits is accompanied by iron (as pyrite if the ore is unoxidized) and in many cases by copper, molybdenum, selenium, and vanadium.

From the preceeding discussion, it is evident that the silicic volcanics present in the subsurface of the Kinzie Butte GRA are possible source rocks for uranium. In order to test the uranium favorability of these rocks, rhyolites were sampled around the Island Park Caldera by Suekawa et al (1982). The rhyolite sample sites were concentrated along rim fractures of the caldera and were found to contain 2.0 to 12.0 ppm U_3O_8 and 10.0 to 40.0 ppm thorium. The thorium-to-uranium ratios are typical of original composition and do not indicate any uranium mobilization. Radiometric anomalies are associated with the volcanics, but no uranium occurrences were reported in the literature. Due to the lack of evidence of hydrothermal alteration and vein development and the overall absence of evidence that any concentrating processes have taken place, the Island Park Caldera is considered unfavorable for uranium deposits (Suekawa et al., 1982).

Building stone, cinder and common stone are the most abundant mineral resources in the eastern Snake River Plain (Asher, 1965; Kuntz et al., 1980). Of these resources, building stone is the most valuable. The best building stone is pahoehoe lava (Maley and Holland, 1981). Slab pahoehoe occurs mainly along flow margins and at the rims of lava lakes (Kuntz et al., 1980). Cinders occur in cinder cones, around the margins of Holocene lava flows and along rift zones (Kuntz et al., 1980; Asher, 1965).

In the most recent geothermal classification of the United States (Muffler, 1979), geothermal resources were divided into six categories. These are:

1. Conduction-dominated regions
2. Igneous-related geothermal systems

3a. High temperature (over 150°C) hydrothermal convection systems

b. Intermediate temperature (90-150°C) hydrothermal convection systems

4. Low temperature (less than 90°C) hydrothermal convection systems

5. Geo-pressured geothermal energy systems

For the purposes of this Wilderness Study Area assessment these classes can be reduced to two: (1) high temperature (over 150°C) hydrothermal convection systems, and (2) low/intermediate temperature (40-150°C) hydrothermal convection systems. Geo-pressured geothermal energy systems do not exist in the areas discussed. Theoretically, geothermal resources exist everywhere because the temperature of the earth's crust everywhere increases with depth; thus, high temperatures are reached at some depth below any given point on the earth's surface. At the present time, and in the foreseeable future, a naturally occurring hot fluid coupled with sufficiently porous and permeable rocks to allow fluid migration are prerequisites for practical use of geothermal energy; thus conduction-dominated and "magma-tap" geothermal systems are not included in this evaluation.

There are many exploration techniques used in the evaluation of geothermal systems. The most practical techniques, in order of costs and recommended application, are: geologic mapping; spring and well geochemical analysis for "reservoir" temperature determination (Ellis and Mahon, 1977); and temperature gradient/heat flow determination in existing wells and drill holes. Other geophysical techniques such as electrical resistivity, gravity, seismic studies, etc., are not specific to geothermal resources and may generate anomalies which little or no relationship to geothermal systems. However, in specific geothermal areas, all of these techniques are often used in exploration. Ball et al. (1979) present a brief discussion of exploration and reservoir assessment techniques and costs.

The Kinzie Butte GRA is on the western edge of the Snake River Plain geothermal province. This area is one of the major volcanic and tectonic provinces of the western United States and consequently has major geothermal potential. The volcanic history of the Snake River Plain is quite varied and extends into the Holocene. Buried calderas in the Snake River Plain were once the source of extensive siliciic ash flow tuffs underlying the eastern Snake River Plains. These deposits range in age from approximately 12 m.y. at the western edge of the eastern Snake River Plain to approximately 4 m.y. at the eastern margin of the province. Siliciic ash flow tuffs as young as 1.2 m.y. are present in the Island Park Caldera. In the middle of the Snake River Plain, the Big Southern Butte dome has been dated as approximately 300,000 years old (Armstrong et al., 1975). Basaltic volcanic activity throughout the whole area succeeded the silicic volcanic activity and has been continuous up into the Holocene. Large areas of the eastern Snake River Plain are covered by basalts which are less than 10,000 years old (Greeley, 1977). So far there has been no deep drilling in the vicinity of any of these sites of Pleistocene and Holocene volcanism so the potential for geothermal resource is as yet unexplored.

The geothermal character of the Snake River Plain has been discussed by Mitchell et al. (1980) and by Brott et al. (1976, 1981). Surface evidence of any geothermal systems present in much of the area is obliterated by a major, rapidly moving, ground water aquifer in the near-surface Quaternary Snake River basalts; therefore, the geothermal character can only be evaluated by drilling beneath this aquifer, or by making estimates of heat input into the aquifer, and by evaluating the local geochemical variations within the aquifer (the latter has not yet been done).

As yet exploration drilling in this area has been quite sparse. In the eastern Snake River Plain only one deep hole, located on the Idaho National Engineering Laboratory test site, has been drilled (Walker, 1964). The bottom hole temperature at a depth of 3 kilometers (9,845 feet) was approximately 150°C. While there is evidence for circulation of water within the hole, economic quantities of fluid were not produced (Prestwich and Mink, 1979). A deep drill hole west of the eastern Snake River Plain near the town of Mountain Home encountered temperatures of 190°C at a depth of 3 kilometers (9,845 feet) (Arney et al., 1981). It is not known whether the hole was capable of producing fluid because it was initially drilled as a hydrocarbon test.

There are numerous hot and warm springs and wells on both the north and south margins of the Snake River Plain where the geothermal systems present are less diluted by the effects of the Snake Plain aquifer. In most areas along these margins where extensive drilling has been conducted, warm water has been discovered, but no economic high grade (greater than 150°C) geothermal systems have been located. However, in view of the extensive warm water occurrences in shallow wells, the demonstrated existence of such temperatures at depths of less than 3,000 meters (9,845 feet) and the favorable volcanic history, it seems quite likely that in the future such systems will be discovered. Major areas of warm water occurrences along the north margin of the Snake River Plain are present near Magic Reservoir and near Arco. Along the southern margin extensive warm water resources occur near Rexburg and near Twin Falls.

No hydrocarbon tests have been drilled in the eastern Snake River Plain. The nearest hydrocarbon tests to the Kinzie Butte GRA were drilled about 60 miles southeast in the Thrust Belt of southeastern Idaho and 60 miles to the west in the western Snake River Plain. All were dry holes (Breckenridge, 1982).

Sparlin et al. (1982) interpret the eastern Snake River Plain to have a fault along the northwestern side with downward displacement to the south of several kilometers. They interpret the structures of southeastern Idaho tog radually dip to the north under the Plain.

The Kinzie Butte GRA lies along the extreme western edge of the thrust belt as projected across the Snake River Plain. Skipp and Hait (1977) summarized the thrust belt structures along the north side of Snake River Plain. Blackstone (1977) described the thrust plates of southeastern Idaho and adjacent areas.

Many similarities in thickness and lithology are present between Paleozoic strata exposed in mountain ranges north and south of the Snake River Plain. Geophysical studies also suggest that Paleozoic strata continue across or extend into the Snake River Plain from the north and south (Stanley et al., 1977; Kuntz et al., 1980; Sparlin et al., 1982; Braile et al., 1982). These geophysical studies clearly show that several intervals of distinct rock types may be recognized under the Snake River Plain. Stanley et al. (1977)

interpreted the third layer below the surface to represent the basement complex including sedimentary and metamorphic rock units. These are probably of Paleozoic and Mesozoic age. Strata overlying the basement complex and below the surficial volcanics are interbedded alluvial and fluvial clastics and volcanics (Walker, 1964; Stanley et al., 1977).

If the thick Paleozoic section as described by Skipp and Hait (1977) edtends under the Plain from the north and the thick Paleozoic section as described by Trimble and Carr (1976) extends under the Plain from the south, the Paleozoic sections should interfinger in the subsurface of the Kinzie Butte area. Thrust belt structures from producing hydrocarbon fields in southwestern Wyoming and northeastern Utah (McCaslin, 1981; Powers, 1977) and in north-central Montana (McCaslin, 1980). These structures trend towards the eastern Snake River Plain and similar structures should be present in the subsurface of the Plain.

Both the stratigraphic sections to the north and south of the Plain have recognized potential source and reservoir beds in them. The dark shales of the Trail Creek, Milligan, and McGowan Creek Formations are potential major source beds and shaley limestones in the White Knob and Wood River Formation are potential minor source beds on the north side of the Plain. The dark shales of the Manning Canyon Formation are potential major source beds and dark shaley limestones of the Laketown, Deep Creek, and Oquirrh Formations are potential minor source beds to the south of the Plain. Two samples of the Milligan Formation (probably McGowan Creek Formation) from the White Knob and Lost River Ranges approximately 70 miles northeast of the Kinzie Butte GRA were analyzed by Geochemical Laboratories for Nance

Petroleum of Billings, Montana. These analyses revealed that the Milligan Formation in those areas has a mature, very poor oil, good to excellent wet gas-condensate source character (pers. comm., November 1982).

The presence of several volcanic vents decrease considerably the hydrocarbon potential within the Kiznie Butte GRA. Extent of the metamorphism surrounding the vents and depth to the magmatic masses that the events were derived from are unknown. The position of the magmatic masses could probably be determined by geophysical studies. The extent of the metamorphism could be determined only by drilling.

3.5 Mineral and Energy Economics

The only commodities mined in any quantity from the Kinzie Butte GRA are sand and gravel and lava rock. Sand and gravel is used on an as-needed basis and as such is exploited as a high site-value commodity. Most pits are located close to highway and access routes.

Some potential is recognized for geothermal resources in the Kinzie Butte GRA, especially the northern third. Based on present requirements for use of hot fluids in electrical generating techniques, geothermal systems with temperatures of less than 150°C do not have significant potential for electrical exploitation. These systems, however, can have a significant potential for low and intermediate temperature geothermal utilization for space heating, material processing, etc. if their minimum temperature exceeds 40°C. At the lower end of the spectrum, as the energy content of the resource becomes less, or the drilling depth necessary for exploitation becomes greater, there is a very ill-defined cutoff. For example, shallow ground water temperatures on the order of 10-20°C can be used for heat pump applications, and in some cases these are considered geothermal resources. However, for the purpose of this evaluation, a lower temperature than approximately 40°C is considered an economic cutoff for a geothermal resource. Another important economic factor affecting the viability of a geothermal resource is the distance from the source to the point of consumption. At lower temperatures it is not feasible to consider long-distance transportation of geothermal energy whereas for electrical grade resources long transportation distances are of course feasible. The presence of developments within and adjacent to the GRA would ensure that geothermal resources, even low temperature ones, would be exploited.

Commercial quantities of decorative slab lava are likely present in the three WSAs. The mostly likely sources to be exploited first are those nearest access routes along the edges of the rough youngest lava flows. Decorative lava rock and cinders are both sensitive to transportation costs but the markets in the Twin Falls and Boise areas are likely close enough by rail that slab lava could be profitably exploited.

4.0 LAND CLASSIFICATION FOR GEM RESOURCES POTENTIAL

4.1 Explanation of Classification Scheme

In the following subsections the land in the GRA is classified for geology, energy and mineral (GEM) resources potential. The classification scheme used is shown in Table II. Use of this scheme is specified in the contract under which WGM prepared this report.

The evaluation of resource potential and integration into the BLM classification scheme has been done using a combination of simple subjective and complex subjective approaches (Singer and Mosier, 1981) to regional resource assessment. The simple subjective approach involves the evaluation of resources based on the experience and knowledge of the individuals conducting the evaluations. The complex subjective method involves use of rules, i.e. geologic inference, based in expert opinion concerning the nature and importance geologic relationships associated with mineral and energy deposits (Singer and Mosier, 1981).

The GEM evaluation is the culmination of a series of tasks. The nature and order of the tasks was specified by the BLM, however they constitute the general approach by which most resource evaluations of this type are conducted. The sequence of work was: (1) data collection, (2) compilation, (3) evaluation, and (4) report preparation. No field work was done in the Kinzie Butte GRA.

TABLE II

BUREAU OF LAND MANAGEMENT GEM RESOURCES LAND CLASSIFICATION SYSTEM

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.

LEVELS OF CONFIDENCE

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 or 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.

Each WSA is classified for locatable, leasable, and saleable resources potential.

Locatable minerals are those which are locatable under the General Mining Law of 1872, as amended, and the Placer Act of 1870, as amended. Minerals to which are locatable under these acts include metals, ores of metals, non-metallic minerals such as asbestos, barite, zeolites, graphite, uncommon varieties of sand, gravel, building stone, limestone, dolomite, pumice, pumicite, clay, magnesite, silica sand, etc. (Maley, 1983).

Leasable resources include those which may be acquired under the Mineral Leasing Act of 1920 as amended by the Acts of 1927, 1953, 1970, and 1976. Materials covered under this Act include: asphalt, bitumen, borates of sodium and potassium, carbonates of sodium and potassium, coal, natural gas, nitrates of sodium and potassium, oil, oil shale, phosphate, silicates of sodium and potassium, sulfates of sodium and potassium, geothermal resources, etc. (Maley, 1983).

Saleable resources include those which may be acquired under the Materials Act of 1947 as amended by the Acts of 1955 and 1962. Included under this Act are common varieties of sand, gravel, stone, cinders, pumice, pumicite, clay, limestone, dolomite, peat and petrified wood (Maley, 1983).

4.2 Classification of the Black Butte WSA (54-2)

4.2.1 Locatable Minerals

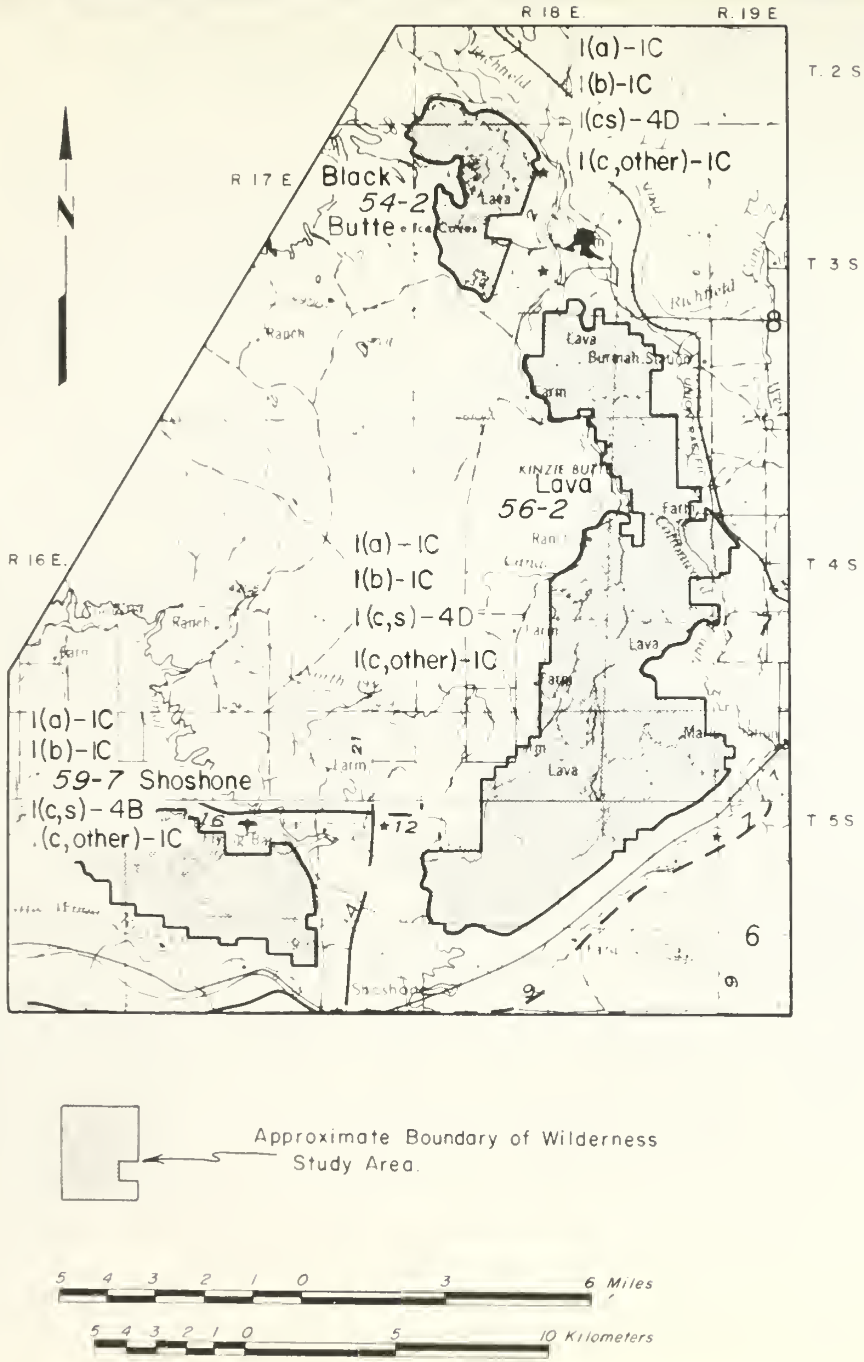
4.2.1a Metallic Minerals. The entire area of the Black Butte (54-2) WSA (1a, Fig. 12) is classified as unfavorable for metallic mineral resources based on direct but minimal evidence (1C). The basis of the classification is the data and concepts outlined in Section 3.0

4.2.1b Uranium and Thorium. The entire area of the Black Butte (54-2) WSA (1b, Fig. 12) is classified as unfavorable for uranium and thorium based on direct but minimal evidence (1C). The basis of this classification is the data and concepts outlined in Section 3.0.

4.2.1c Non-Metallic Minerals. The entire area of the Black Butte (54-2) WSA (1cs, Fig. 12) is classified as highly favorable for the presence of decorative lava rock based on direct and indirect evidence (4D); the entire area of Black Butte (54-2) WSA (1c other, Fig. 12) is classified as unfavorable for other non-metallic mineral resources based upon direct but minimal evidence (1C).

4.2.2 Leasable Resources

4.2.2a Oil and Gas. The entire area of Black Butte (54-2) WSA (1a, Fig. 13) is classified as having low favorability for accumulation of hydrocarbon resources based on indirect evidence (2B). The basis for the classification is the data and concepts outlined in Section 3.0



BLM LAND CLASSIFICATION SYSTEM FOR GEM 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.

LEVELS OF CONFIDENCE

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 QUANTITATIVLEY MINIMAL TO SUPPORT OR 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.

EXPLANATION

I(a)-4D — Area I.D. Number; Commodity; Classification; Level of Confidence

a) Metallic Minerals
b) Uranium and Thorium
c) Non-Metallic Minerals

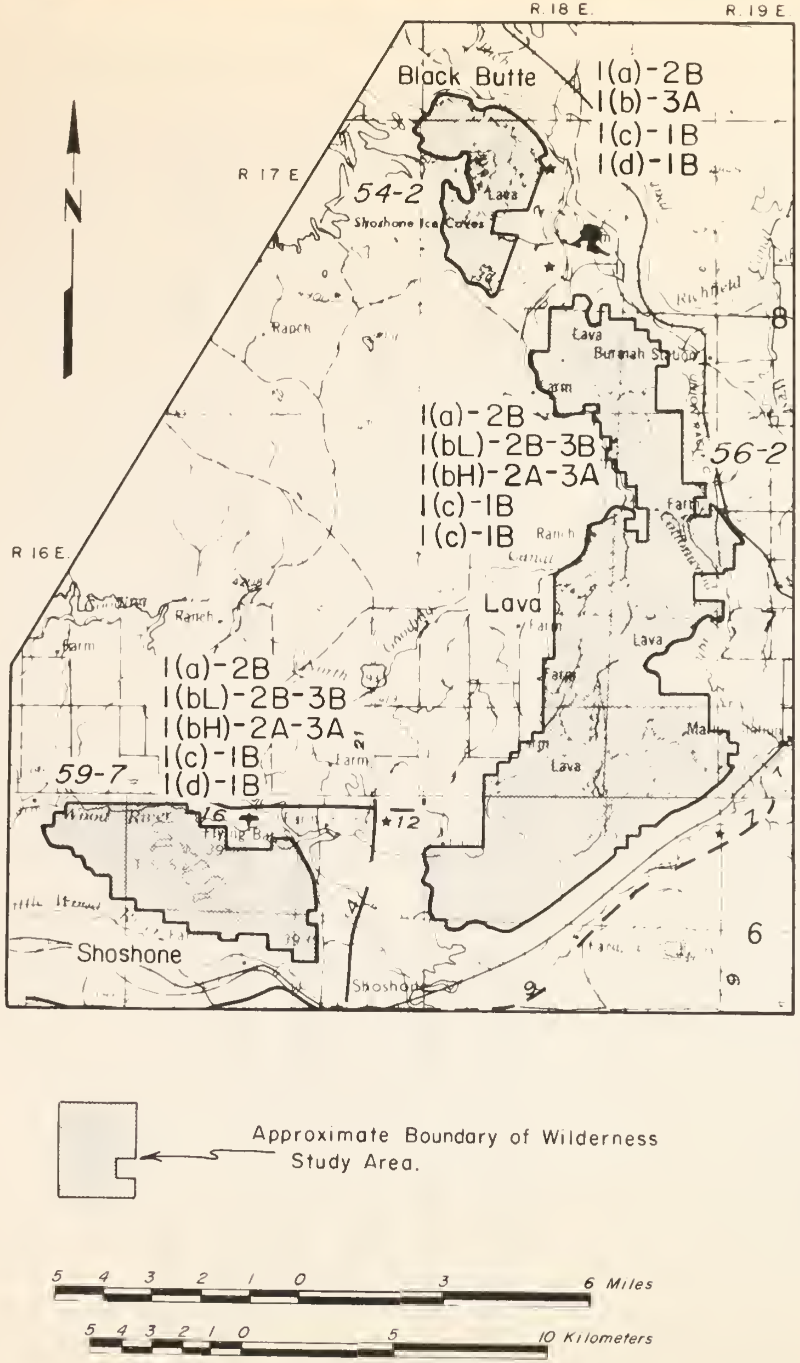
WGM Inc. Mining and Geological Consultants, Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Kinzie Butte GRA, Idaho
Wilderness Study Area
Land Classification
Locatable Resources

SCALE 1" = 4 MILES (1:250,000)
DATA BY WGM | DATE 9/1982 | REVISED
DRWN BY DS1 | APRVD GF

FIGURE 12



BLM LAND CLASSIFICATION SYSTEM FOR GEM 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.

LEVELS OF CONFIDENCE

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 QUANTITATIVLEY MINIMAL TO SUPPORT OR 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.

EXPLANATION

1(a) - 4D

- 1 — Area I.D. Number
- (a) — Commodity
- 4 — Classification
- D — Level of Confidence

a) oil and gas

b) Geothermal: high temperature (H), Low temperature (L)

c) Sodium and Potassium

d) others: Asphalt (As) bitumen (bt), phosphate (ph), No specific commodity designation indicates that the rating applies to all of the above.

WGM Inc. Mining and Geological Consultants, Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Kinzie Butte GRA, Idaho

Wilderness Study Area
Land Classification
Leasable Resources

SCALE 1" = 4 MILES (1:250,000)		REVISED	FIGURE 13
DATA BY WGM	DATE 9/1982		
DRWN BY DSI	APRVD G.F.		

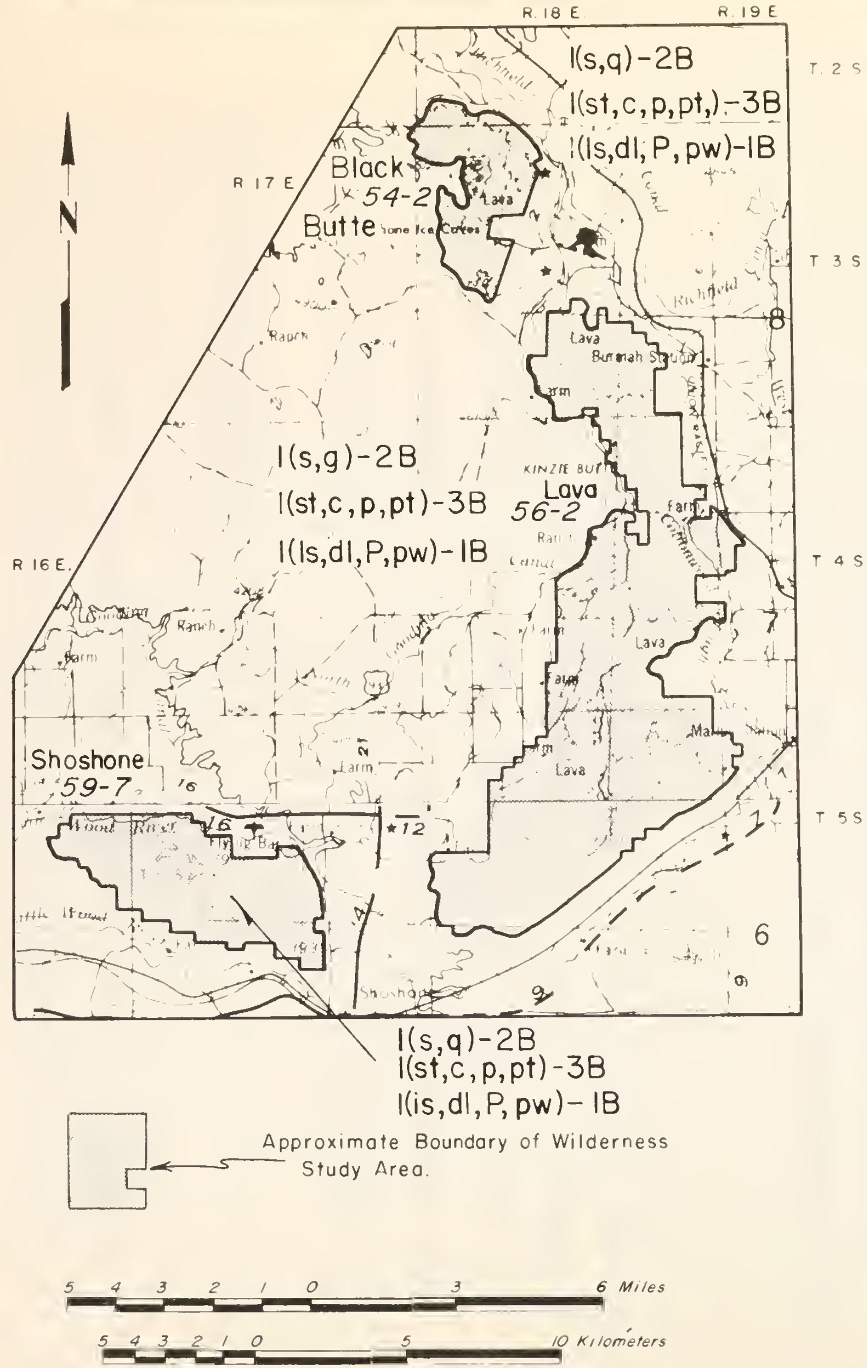
4.2.2b Geothermal. The entire area of Black Butte (54-2) WSA (1b, Fig. 13) is classified as having moderate favorability for high, intermediate, and low temperature geothermal resources based on minimal evidence (3A). The classification is based on proximity to the Magic Reservoir geothermal anomaly, location of the WSA on the edge of the Snake River Plain, limited well data, and by analogy with surrounding areas.

4.2.2c Sodium and Potassium. The entire area of Black Butte (54-2) WSA (1c, Fig. 13) is classified as unfavorable for accumulation of sodium and potassium resources based on indirect evidence (1B). The classification is baed on the geologic setting and on data and concepts outlined in Section 3.0.

4.2.2d Others. The entire area of Black Butte (54-2) WSA (1d, Fig. 13) is classified as unfavorable for accumulation of other leasable resources based on indirect evidence (1B). The classification is based on the geologic setting and on data and concepts outlined in Section 3.0.

4.2.3 Saleable Resources

The entire area of Black Butte (54-2) WSA (1s, g; Fig. 14) is classified as having low favorability for sand and gravel based on indirect evidence (1B). The classification is based upon the surficial geology. The Black Butte (54-2) WSA (1st, c, p, pt; Fig. 14) is classified as moderately favorable for accumulation of stone, cinders, pumice, and pumicite based on indirect evidence (3B). The entire Black Butte (54-2) WSA (1 cl, 1s, dl, P, pw; Fig.



BLM LAND CLASSIFICATION SYSTEM FOR GEM 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.

LEVELS OF CONFIDENCE

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 QUANTITATIVLEY MINIMAL TO SUPPORT OR 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.

EXPLANATION

I(ls) - 4D

Area I.D. Number; Commodity; Classification; Level of Confidence

s	Sand
g	Gravel
st	Stone
c	Cinders
p	Pumice
pt	Pumicite
cl	Clay
Ls	Limestone
dl	Dolomite
P	Peat
pw	Petrified wood

WGM Inc. Mining and Geological Consultants
Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Kinzie Butte GRA, Idaho

Wilderness Study Area
Land Classification
Saleable Resources

SCALE 1" = 4 MILES (1 250,000)			FIGURE
DATA BY W G M	DATE 9/1982	REVISED	14
DRWN BY D S I	APRVD G F		

14) is classified as unfavorable for accumulation of clay, limestone, dolomite, peat, and petrified wood based on indirect evidence (1B). The classification is based upon the surficial geology.

4.3 Classification of the Lava WSA (56-2)

4.3.1 Locatable Minerals

4.3.1a Metallic Minerals. The entire area of the Lava (56-2) WSA (1a, Fig. 12) is classified as unfavorable for metallic mineral resources based on direct but minimal evidence (1C). The basis of this classification is the data and concepts outlined in Section 3.0.

4.3.1b Uranium and Thorium. The entire area of the Lava (56-2) WSA (1b, Fig. 12) is classified as unfavorable for uranium and thorium based on direct but minimal evidence (1C). The basis of this classification is the data and concepts outlined in Section 3.0.

4.3.1c Non-Metallic Minerals. The entire area of the Lava (56-2) WSA (1cs, Fig. 12) is classified as highly favorable for the presence of decorative lava rock based on direct and indirect evidence (4D); the entire area of Lava (56-2) WSA (1c other, Fig. 12) is classified as unfavorable for other non-metallic mineral resources based upon direct but minimal evidence (1C).

4.3.2 Leasable Resources

4.3.2a Oil and Gas. The entire area of Lava (56-2) WSA (1a, Fig. 13) is classified as having low favorability for accumulation of hydrocarbon resources based on indirect evidence (2B). The basis for the classification is the data and concepts outlined in Section 3.0.

4.3.2b Geothermal. The entire area of Lava (56-2) WSA (1bl, Fig. 13) is classified as having how to moderate favorability for low to intermediate temperature goethermal resources based on indirect evidence (2B-3B). The classification is based on limited well data, and by analogy with surrounding areas. The Lava (56-2) WSA (1bH, Fig. 13) is classified as having low to moderate favorability for accumulation of high temperature geothermal resources based upon minimal data (2A-3A). The classification is based on concepts and data outlined in Section 3.0.

4.3.2c Sodium and Potassium. The entire area of Lava (56-2) WSA (1c, Fig. 13) is classified as unfavorable for accumulation of sodium and potassium resources based on indirect evidence (1B). The classification is based on the geologic setting and on data and concepts outlined in Section 3.0.

4.3.2d Others. The entire area of Lava (46-2) WSA (1d, Fig. 13) is classified as unfavorable for accumulation of other leasable resources based on indirect evidence (1B). The classification is based on the geologic setting and on data and concepts outlined in Section 3.0.

4.3.3 Saleable Resources

The entire area of Lava (56-2) WSA (1s, g; Fig. 14) is classified as having low favorability for sand and gravel based on indirect evidence (1B). The classification is based upon the surficial geology. The Lava (56-2) WSA

(1st, c, p, pt; Fig. 14) is classified as moderately favorable for accumulation of stone, cinders, pumice and pumicite based on indirect evidence (3B). The entire Lava (56-2) WSA (1cl, 1s, dl, p, pw; Fig. 14) is classified as unfavorable for accumulation of clay, limestone, dolomite, peat, and petrified wood based on indirect evidence (1B). The classification is based upon the surficial geology.

4.4 Classification of the Shoshone WSA (59-7)

4.4.1 Locatable Minerals

4.4.1a Metallic Minerals. The entire area of the Shoshone (59-7) WSA (1a, Fig. 12) is classified as unfavorable for metallic mineral resources based on direct but minimal evidence (1C). The basis of this classification is the data and concepts outlined in Section 3.0.

4.4.1b Uranium and Thorium. The entire area of the Shoshone (59-7) WSA (1b, Fig. 12) is classified as unfavorable for uranium and thorium based on direct but minimal evidence (1C). The basis of this classification is the data and concepts outlined in Section 3.0.

4.4.1c Non-Metallic Minerals. The entire area of the Shoshone (59-7) WSA (1cs, Fig. 12) is classified as highly favorable for the presence of decorative lava rock based on direct and indirect evidence (4D); the entire area of Black Butte (54-2) WSA (1c other, Fig. 12) is classified as unfavorable for other non-metallic mineral resources based upon direct but minimal evidence (1C).

4.4.2 Leasable Resources

4.4.2a Oil and Gas. The entire area of Shoshone (59-7) WSA (1a, Fig. 13) is classified as having low favorability for accumulation of hydrocarbon resources based on indirect evidence (2B). The basis for the classification is the data and concepts outlined in Section 3.0.

4.4.2b Geothermal. The entire area of Shoshone WSA (1bL, Fig. 13) is classified as having low to moderate favorability for low to intermediate temperature geothermal resources based on indirect evidence (2B-3B). The classification is based on limited well data, and by analogy with surrounding areas. The Shoshone (59-7) WSA (1bH, Fig. 13) is classified as having low to moderate favorability for accumulation of high temperature geothermal resources based upon minimal data (2A-3A). The classification is based on concepts and data outlined in Section 3.0.

4.4.2c Sodium and Potassium. The entire area of Shoshone (59-7) WSA (1c, Fig. 13) is classified as unfavorable for accumulation of sodium and potassium resources based on indirect evidence (1B). The classification is based on the geologic setting and on data and concepts outlined in Section 3.0.

4.4.2d Others. The entire area of Shoshone (59-7) WSA (1d, Fig. 13) is classified as unfavorable for accumulation of other leasable resources based on indirect evidence (1B). The classification is based on the geology setting and on data and concepts outlined in Section 3.0.

4.4.3 Saleable Resources

The entire area of Shoshone (59-7) WSA (1s, g; Fig. 14) is classified as having low favorability for sand and gravel based on indirect evidence (1B). The classification is based upon the surficial geology. The Shoshone (59-7) WSA (1st, c, p, pt; Fig. 14) is classified as moderately favorable for accumulation of stone, cinders, pumice and pumicite based on indirect evidence (3B). The entire Shoshone (59-7) WSA (1cl, 1s, dl, p, pw; Fig. 14) is classified as unfavorable for accumulation of clay, limestone, dolomite, peat, and petrified wood based on indirect evidence (1B). The classification is based upon the surficial geology.

5.0 RECOMMENDATIONS FOR FURTHER WORK

Evaluation of the geothermal potential of the WSAs might be relatively easy or difficult, depending on the thickness of the Snake Plain Aquifer. If the aquifer is thin, then relatively shallow holes (100-300 m deep) with geochemical analyses of the water found in the holes would suffice to evaluate the shallow low and intermediate geothermal potential. Intermediate drilling will be required to test the high temperature potential. As was the case for the other WSAs in the Eastern Snake River Plain, evaluation of the geothermal potential will be difficult and expensive if the aquifer is thick. Deep drilling supplemented by a deep-seeking resistivity survey are the only practical ways to approach the evaluation. Electromagnetic techniques used to look for conductors below the high resistivity basalts of the Snake Plain Aquifer could be used. The presence of a conductor would not necessarily mean geothermal potential, however, and drilling would be required to identify the geothermal significance of any conductive anomaly located.

Various suggestions are offered to more fully assess the hydrocarbon potential of the Kinzie Butte GRA. Geophysical studies in the Eastern Snake River Plain should be continued in greater detail. This will aloow the recognition of subsurface structures that could contain potential hydrocarbon reservoirs. Hydrocarbon characterizatin and thermal maturity studies should be made of potential source beds on both sides of the Snake River Plain since these same units are believed to extend beneath the Plain. This will indicate the types of hydrocarbons to be anticipated in the area and delineate those horizons where burial depths have removed hydrocarbons. One or two deep tests need to be drilled in the Snake River Plain. These tests would provide data to verify geophysical interpretations of the deeper structures and stratigraphy. They would also give some indication of the extent of metamorphism from the voclanic vents if located in proximity to a vent. Potential hydrocarbon source and reservoir beds could be evaluated by a test well.

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