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PHASE I

Geology, Energy, and Mineral (GEM) Resource Assessment of the Black Canyon GRA, Idaho, including the Black Canyon (32-9) Wilderness Study Area

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

By:

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ANCHORAGE, ALASKA
SEPTEMBER 1983

WGM INC.
MINING AND GEOLOGICAL CONSULTANTS

EXECUTIVE SUMMARY

The Black Canyon Geology, Energy and Mineral Resource Area (GRA) is located in the southern Lemhi Range in Butte County, Idaho. The area is in the Big Butte Resource area of the Idaho Falls BLM district and includes one wilderness study area: Black Canyon (5,400 acres).

Geologically the area is made up of folded and faulted Precambrian and Paleozoic sedimentary rocks, primarily limestone and quartzite. The rocks range in age from over 600 million years to a few thousand years. The Black Canyon WSA is almost entirely underlain by limestone.

There are reconnaissance-scale geologic maps of the Black Canyon GRA and descriptions of some mineral deposits in the area but there is very little information on energy resources. Lead and silver were mined just north of the Black Canyon GRA and there are two small lead occurrences in the GRA. There are no known mineral or energy occurrences in the Black Canyon WSA.

The GEM resources classification is summarized in the accompanying table. The area has low potential for metallic mineral and most non-metallic minerals. The area has moderate potential for oil and gas and may have moderate potential for geothermal resources. The highest resource potential is for common and uncommon varieties of limestone. The confidence in most rankings is low due to the absence of geochemical data and detailed geologic mapping.

GEM RESOURCES CLASSIFICATION OF THE BLACK CANYON WSA (32-9), IDAHO

Resource	Classification
1. Locatable Resources	
a. Metallic Minerals	2B
b. Uranium and Thorium	3A
c. Non-Metallic Minerals	3C/2B
2. Leasable Resources	
a. Oil and Gas	3C
b. Geothermal	2B/3B
c. Sodium and Potassium	2C
d. Other	2C
3. Saleable Resources	4D/2C

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BLACK CANYON 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

Black Canyon GRA, Idaho Location Map

SCALE 1" = 45 MILES			FIGURE
DATA BY WGM	DATE 12/1982	REVISED	1
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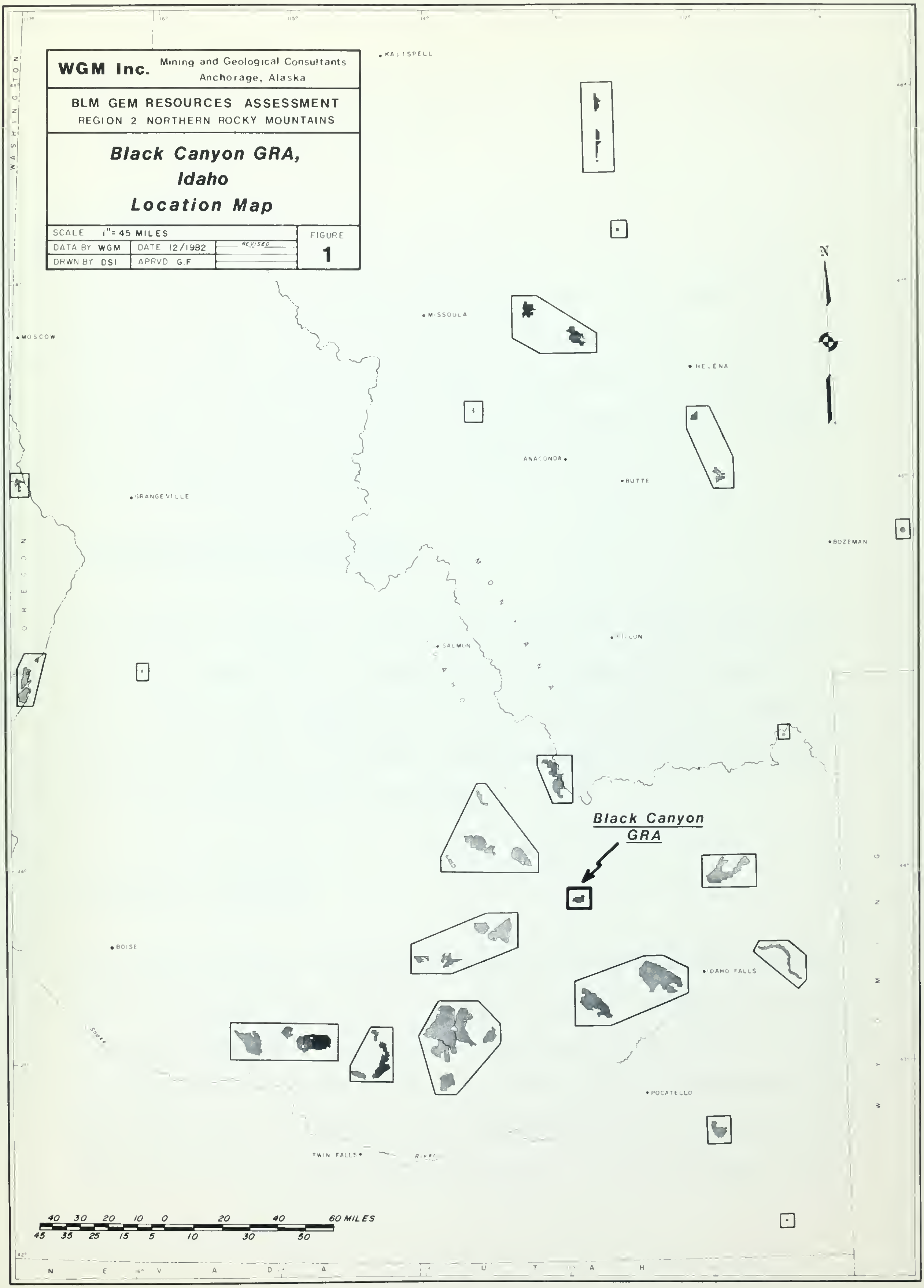


totalling 583,182 acres. The WSAs were grouped into 22 GRAs for purposes of the Phase I GEM resources evaluation.

1.1 Location

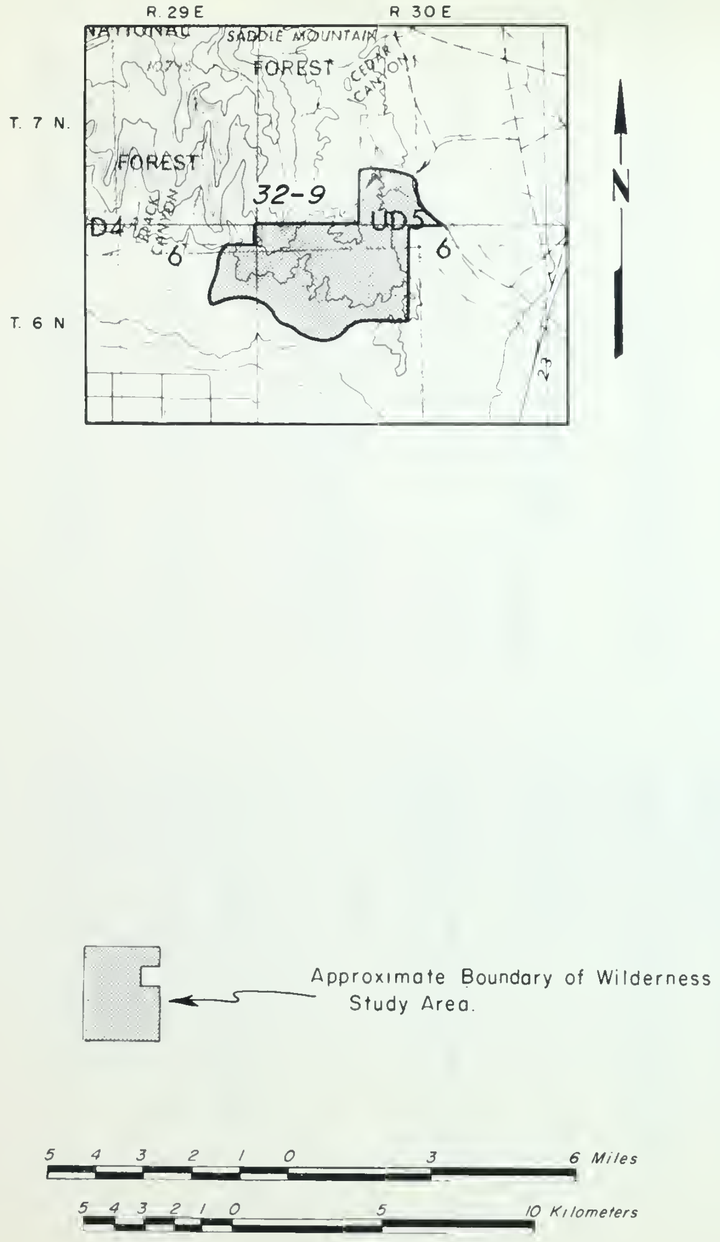
The Black Canyon GRA is located at the southern end of the Lemhi Range in east-central Idaho. The area is entirely within Ts.6 and 7N., Rs.29 and 30E (Fig. 2). The GRA is within the Big Butte Resource Area of the Idaho Falls BLM district. The GRA covers approximately 90 square miles and includes the Black Canyon WSA (32-9) comprising 5,400 acres (Fig. 2).

1.2 Population and Infrastructure

The population in the area is sparse. The town of Howe, three miles south of the Black Canyon GRA, has a population of less than 25 and there are several ranches west, respectively of the GRA. State Highways 22 and 44 are located south and west of the GRA. Numerous unimproved roads extend into the non-mountainous portions of the area.

1.3 Basis of the Report

This report is based on compilation, review, and analysis of the available published and unpublished data on the geology, energy, and mineral resources of the Black Canyon GRA. The area has been mapped by Ross (1961). Both the U.S. Geological Survey CRIB files and the USBM MILS files were checked for mineral occurrences. BLM records were reviewed to determine the status of mining claims and oil and gas leases in the area. Areal photos were also



BLM Wilderness Study Areas Included in the Black Canyon GRA.

WSA	NAME	ACREAGE
32-9	Black Canyon	5,400

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Black Canyon GRA, Idaho

Topographic Map

SCALE 1"=4 MILES (1:250,000)
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FIGURE 2

examined. The Dome district was examined by WGM personnel in the course of this study to verify the compilation of the data and inferred geologic environments.

The data was compiled and reviewed by WGM project personnel and the Panel of Experts listed below to produce the resource evaluation which comprises this report.

Project Personnel

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 minerals, mineral economics.
R.S. Fredericksen, Senior Geologist, WGM Inc.	Regional geology, metallic minerals.
David Blackwell, Ph.D., Professor 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, and 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

Tim Carroll, District Geologist at BLM-Idaho Falls, gave us invaluable assistance during the compilation phase of this program.

2.0 GEOLOGY

2.1 Introduction

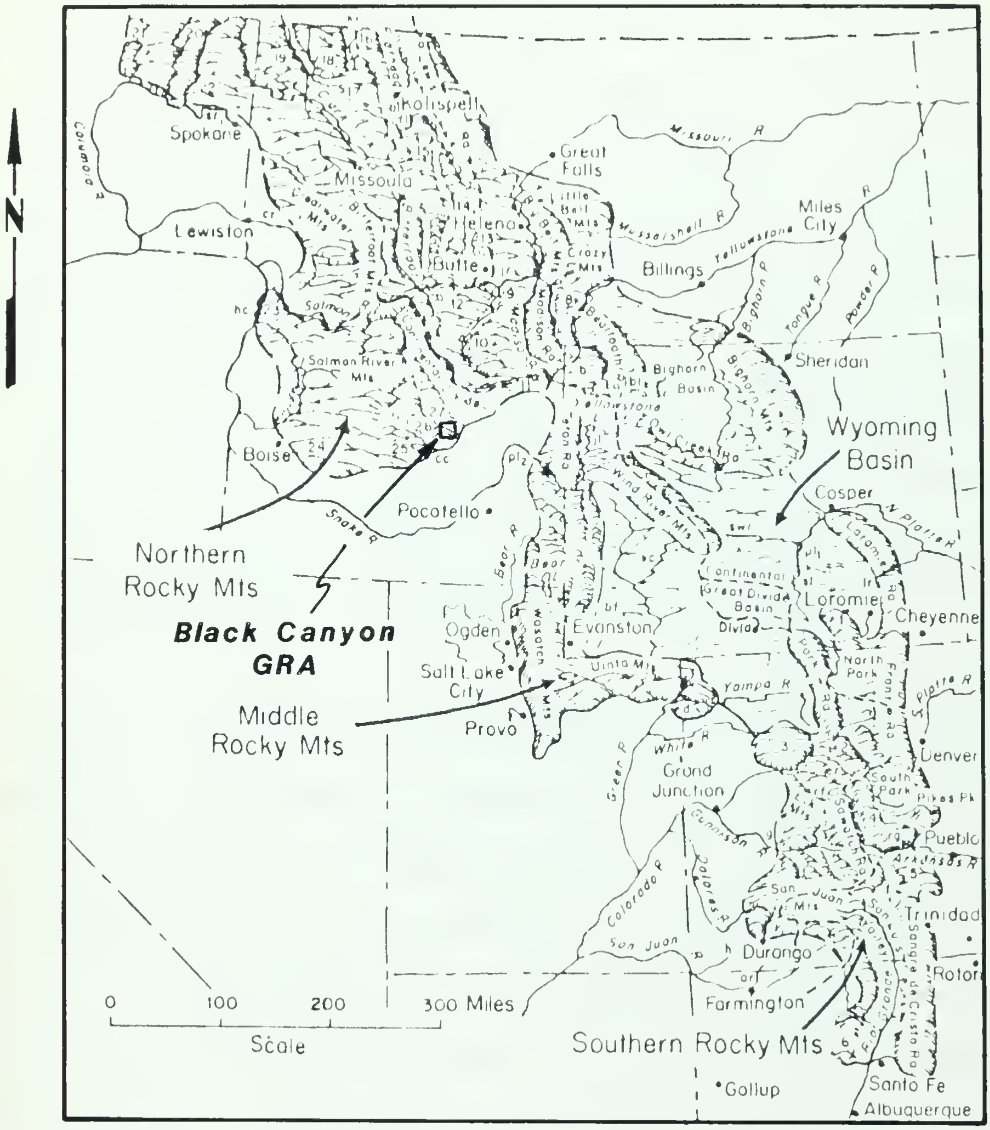
The Black Canyon GRA, located in the southern part of the Lemhi Range, was mapped on a reconnaissance scale by Ross (1961). Rember and Bennett (1979) compiled a 1:250,000 scale geologic map of the Idaho Falls Quadrangle which includes the GRA. Skipp (1981) summarizes the stratigraphic and structural studies, in the south-central Idaho area, that have been made by geologists of the U.S. Geological Survey since 1975.

2.2 Physiography

The Black Canyon GRA is located in the Northern Rocky Mountain physiographic province (Hunt, 1974; Fig. 3). Long northwest-trending ranges separated by equally long intermountain valleys with southwest- and northwest-flowing drainages are typical of the topography in this province. The major streams bordering the GRA are Birch Creek on the east and Little Lost River on the west. The highest elevation in the GRA is 10,795 feet on Saddle Mountain. The valleys average approximately 5,000 feet in elevation. The area exhibits a youthful topographic stage with deeply incised valleys draining the ridges.

2.3 Rock Units

The Black Canyon GRA is underlain by rocks of Precambrian (older 600 m.y.), Ordovician ((500-435 m.y.), Devonian (395-345 m.y.), Carboniferous (345-280



Data from: Hunt (1974).

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Black Canyon GRA, Idaho

Physiographic Setting

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m.y.), Permian (280-230 m.y.), Tertiary (65-2 m.y.), and Quaternary (2 m.y. to present) age (Fig. 5). The geology of the region has been studied by Ross (1961), but much of his report is outdated. The Precambrian and Paleozoic (600-230 m.y.) stratigraphy of east-central Idaho has been revised by several workers in the recent years (Ruppel, 1975; Ruppel et al., 1975; Shannon, 1961; Huh, 1967; Sandberg, 1975; Skipp et al., 1979), but the revisions have not been extended into the Black Canyon GRA region by detailed geologic mapping. A stratigraphic column for the southern Lemhi Range is compiled from the aforementioned sources (Fig. 4) along with the equivalent terminology of Ross (1961). Only Mississippian (345-310 m.y.) and younger Paleozoic strata, Cenozoic (65 m.y. to present) volcanics and interbedded sediments, and Quaternary alluvial deposits are exposed in the Black Canyon WSA (Ross, 1961; Rember and Bennett, 1979).

The oldest rocks in the Black Canyon GRA region belong to a group Precambrian Y (1600-600 m.y.) sedimentary rocks which crop out in a 150 mile long belt in east-central Idaho from the Snake River Plain northward to the Idaho-Montana border at Lost Trail Pass. These rocks consist of a thick sequence of impure grayish-green fine-grained feldspathic quartzites and argillitic siltites belonging to the Lemhi Group and the overlying Swauger Formation (Fig. 4). The Lemhi Group is divided into five units: (1) the Inyo Creek Formation (oldest), (2) the West Fork Formation, (3) the Big Creek Formation, (4) the Apple Creek Formation, and (5) the Gunsight Formation (youngest). Although present to the north, none of these rocks is exposed in the Black Canyon GRA. Thickness of the Lemhi Group is about 20,000 feet and the Swauger Formation is at least 10,000 feet thick (Ruppel, 1975). Correlation of these rocks with the Belt Supergroup in western

ERA	SYSTEM	SERIES	FORMATION		THICKNESS (FEET)	EQUIVALENT MAP UNITS OF ROSS(1961)
CENOZOIC	PLEIS-TOCENE		SNAKE RIVER VOLCANICS		?	
				UNCONFORMITY		
	PLIOCENE			BASALT TO RHYOLITIC FLOWS AND TUFFS	?	
				UNCONFORMITY		
PALEOZOIC	PERMIAN	EARLY	PHOSPHORIA FORMATION		97 +	BRAZER LIMESTONE
	PENNSYL-VANIAN	LATE	SNAKE CANYON FORMATION	JUMPER GULCH MEMBER	1960	
		MIDDLE		GALLAGHER PEAK MEMBER	100-195	
		EARLY		BLOOM MEMBER	1800	
	MISSIS-SIPPIAN	LATE	BLUEBIRD MOUNTIAN FORMATION		102-165	
			ARCO HILLS FORMATION		140	
			SURRETT CANYON FORMATION		220	
			SOUTH CREEK FORMATION		300	
			SCOTT PEAK FORMATION		2250	
			MIDDLE CANYON FORMATION		1000	
		EARLY	McGOWAN CREEK FORMATION		80-150	MILLIGEN FORMATION
			UNCONFORMITY			
	DEVONIAN	LATE	THREE FORKS FORMATION		30-90	THREE FORKS LIMESTONE
		MIDDLE	JEFFERSON DOLOMITE		120-750	
			UNCONFORMITY			
	SILURIAN		LAKETOWN DOLOMITE		0-7	SATURDAY MOUNTIAN FORMATION
	ORDOVICIAN	LATE	SATURDAY MOUNTIAN FORMATION		350	
		MIDDLE	KINNIKINIC QUARTZITE		210-305	KINNIKINIC QUARTZITE
			UNCONFORMITY			
		EARLY	SUMMERHOUSE FORMATION		15-300	SWAUGER QUARTZITE
			UNCONFORMITY			
PROTEROZOIC	PRE-CAMBRIAN Z		WILBERT FORMATION		950	
			UNCONFORMITY			
	PRE-CAMBRIAN Y		SWAUGER FORMATION		305	
			LEMHI GROUP	GUNSIGHT FORMATION	ABOUT 20,000	NOT EXPOSED
				APPLE CREEK FORMATION		
				BIG CREEK FORMATION		
				WEST FORK FORMATION		
				INYO CREEK FORMATION		

FROM: RUPPEL (1975)
RUPPEL et. al. (1975)
SKIPP et. al. (1979)
ROSS (1961)
SKIPP AND HAIT (1977)

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Black Canyon
GRA, *Idaho*
Stratigraphic Section

SCALE			FIGURE
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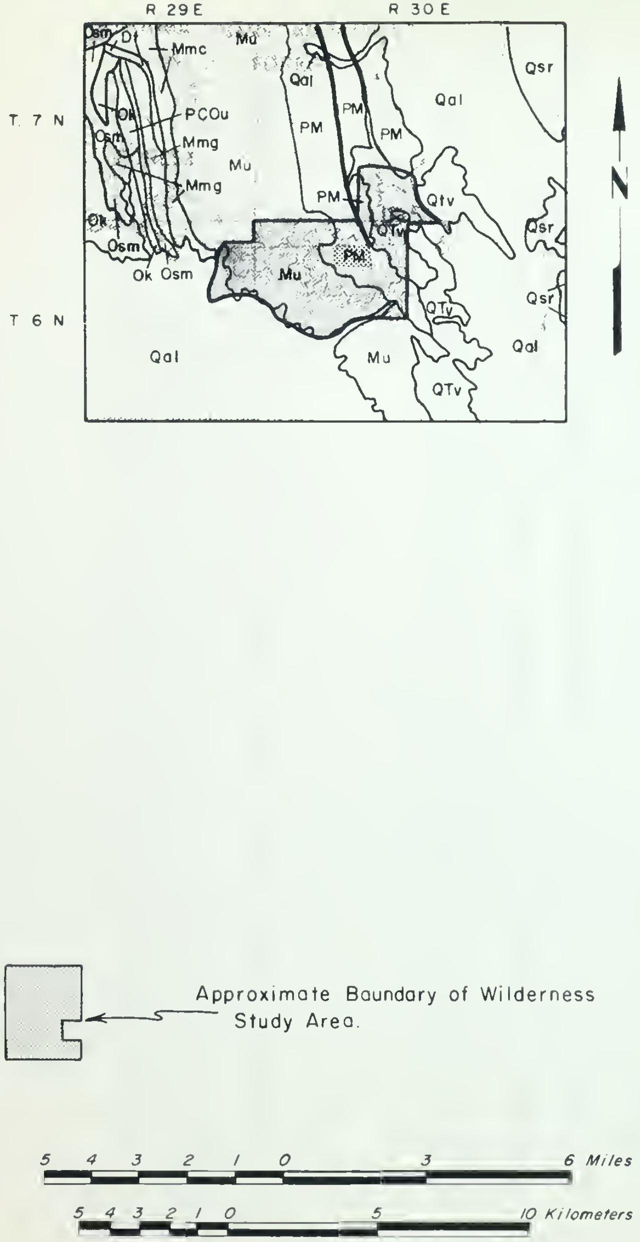

EXPLANATION

	Sedimentary	Igneous			
CENOZOIC	Qal		Alluvium	Recent	Quaternary
		Qsr	Snake River Basalt	Pleistocene	
		QTv	Rhyolite, basalt, and limestone		Tertiary or Quaternary
PALEOZOIC	PM		Mississippian to Permian rocks — undifferentiated	Mississippian to Permian	
	Mu		Late Mississippian – undifferentiated	Mississippian	
	Mmc		Middle Canyon Formation		
	Mmg		McGowan Creek Formation		
	Dt		Three Farks Limestone and alder racks	Devonian	
	Osm		Saturday Mountain Farmation	Ordovician to Silurian	
	Ok		Kinnikinic Quartzite		
	PCOu		Precambrian to Early Ordovician undifferentiated. Probably all Wilbert and Summerhouse Formotions	Precambrian Z	

Modified from : ***Ross, 1961***
Skipp and Hait, 1977
Ruppel, 1975
Ruppel et. al., 1975
Skipp et. al., 1979
Rember and Bennett, 1979

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Black Canyon GRA, Idaho
Geologic Map

SCALE 1" = 4 MILES
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FIGURE 5

Montana and northern Idaho is tenuous because of differing characteristics among the two sequences primarily due to differing depositional conditions. The Belt Group was deposited in the Belt basin whereas the east-central Idaho rocks were deposited in the Belt miogeocline. Ruppel (1975) suggests that on the basis of lithology, the Apple Creek Formation may be the equivalent of the middle belt carbonates belonging to the Wallace Formation and the Helena Dolomite. Additionally, the striking differences between the Swauger Formation and the underlying Lemhi Group may reflect the tectonic adjustments that took place during Missoula time; thus, the Swauger would be equivalent to part or all of the Missoula Group and the Gunsight Formation, at the top of the Lemhi Group, could be equivalent to part of the Wallace Formation (Ruppel, 1975).

In east-central Idaho, a confusing and controversial sequence of calcareous sandstones, shales and quartzitic rocks is present between the Precambrian Y rocks and the Middle Ordovician (479-450 m.y.) Kinnikinic Quartzite. The discovery of Early Ordovician (500-479 m.y.) fossils in the upper part of the sequence, along with recognition of angular unconformities at the base, middle and top of the sequence, has resulted in the separation of the sequence into the Wilbert Formation, tentatively of Precambrian Z (800-600 m.y.) age, and the Summerhouse Formation of Early Ordovician age (Ruppel et al., 1975).

The oldest unit exposed in the Black Canyon GRA is the Wilbert Formation. It is dominately brownish-gray to pale-red quartzitic, fine to coarse sand, grit, or conglomerate. The unit is poorly sorted, partly laminated and

cross-laminated, hematitic, occasionally glauconitic, and partly calcareous. A few beds of sandy limestone and dolomite as well as a few beds of siltstone, shale and fine-grained quartzite are present in the upper Wilbert. The formation was named for exposures near the Wilbert mine about one mile outside the northwest corner of the Black Canyon GRA and the type section is along South Creek which lies just west of the GRA. Thickness of the unit is about 950 feet in the GRA (Ruppel et al., 1975).

The overlying Summerhouse Formation appears to represent a near-shore, perhaps lagoonal environment; thus, the unit differs widely in lithology and thickness from place to place. The type section for the Summerhouse is on the east wall of Summerhouse Canyon (SE¼, SE½, sec. 25, T.12N., R.25E.) about 35 miles northwest of the Black Canyon GRA. At South Creek the Summerhouse includes 200 feet of greenish-gray to light gray fissile to pencilly glauconitic shale overlain by 500 feet of dominately brownish, reddish or gray dolomitic or calcareous glauconitic quartzite and well-cemented sandstone that is fine- to medium-grained. Some beds in the upper 500 feet are strongly cross-laminated and many beds contain abundant worm tracks and <u>Scolithus</u> tubes. Conodonts from the Summerhouse Formation near North Creek, about two miles northwest of the Black Canyon GRA, indicate an Early Ordovician age for the Formation. In addition, trilobites and brachiopods collected from the Summerhouse at the type locality indicate that it is correlative with the Garden City Formation south of the Snake River Plain supporting an Early Ordovician age for the unit. The Summerhouse is about 700 feet thick along South Creek, but it has been completely eroded farther north (Ruppel et al., 1975).

The Kinnikinic Quartzite unconformably overlies the Summerhouse Formation. The Kinnikinic is composed of nearly white, moderately coarse quartzite. Conglomerate lenses are occasionally present, especially near the base of the formation. These lenses consist of resistant white and purple pebbles derived from the Swauger quartzite. Dolomite lenses are present in the upper portion of the unit. The Kinnikinic and some resistant beds underlying it frequently have a similar appearance; thus, problems are encountered in differentiating between the two units where stratigraphic relationships are unclear. The Kinnikinic is about 1,000 feet thick in the southern Lemhi Range. Fossils collected from a lense of dolomite near the top of the Kinnikinic in the southern Lemhi Range include Diceromyonia, Glyptorthis and Streptelasma and indicate a Middle or Late Ordovician (450-435 m.y.) age for the Kinnikinic (Ross, 1961).

The Kinnikinic is conformably overlain by the Saturday Mountain Formation, a moderately thick-bedded light- and dark-gray dolomite with some chert. A few beds are argillaceous and some, particularly near the base are quartzitic. Many of the quartzite beds in the lower part of the unit are cemented by magnesian carbonate (Ross, 1961). An irregular network of hair-like wisps of white dolomite is present in a 50 foot interval lying about 50 feet above the base of the Saturday Mountain Formation in the Gilmore Quadrangle, about 30 miles to the northwest (Ruppel and Lopez, 1981). This "wispy" dolomite along with an underlying basal sandstone-shale-quartzite transition sequence is correlated with the Middle Ordovician Lost River Member of the Fish Haven Dolomite (Churkin, 1962). Haylsites sp. is present 100 feet from the top of the Saturday Mountain Formation on the south side of the Hawley Mountain about 15 miles northwest; thus, the upper

part of the Saturday Mountain is Silurian (435-395 m.y.) (Mapel and Shropshire, 1973). Ross (1961) also noted Halysites sp. in rocks mapped as Saturday Mountain Formation in the southern Lemhi Range, but these rocks could be thin erosional remnants of the overlying Laketown Dolomite. In the Black Canyon GRA, the Saturday Mountain Formation is about 350 feet thick (Ross, 1961).

To the west and northwest of the Black Canyon GRA, the Laketown Dolomite conformably overlies the Saturday Mountain Formation. The Laketown is finely crystalline to medium-crystalline granular vuggy dolomite which is locally cherty. Fossils (including Heliolites sp., Amplexus sp., Diphyphyllum sp., Favosites sp., Halysites catenulatus, Atrypa reticularis, Cyathophyllum sp. and Cladopora sp.) establish that the Laketown is in part Middle Silurian (430-410 m.y.) (Ross, 1947). An erosional unconformity is present at the top of the Laketown and the unit has been almost completely eroded in the Black Canyon GRA. Isolated thin erosional remnants may be present in the area, but they are included in the Saturday Mountain Formation (Ross, 1961).

Devonian rocks present in the Black Canyon GRA include the Jefferson Dolomite and Three Forks Formation of current usage. These units are poorly exposed and Ross (1961) lumped them together into the Three Forks Limestone for mapping purposes. These units have an aggregate thickness of about 350 feet near Black Canyon but thicken to the northwest.

In the Black Canyon GRA the unconformably overlying Jefferson Dolomite is dominately a massive nearly black dolomite with common calcite stringers. Some interbedded lighter gray dolomite is present, especially near the base. The base of the Jefferson commonly is marked by yellow calcareous sandstone lenses from a few inches up to a foot thick. The lighter gray dolomites associated with the sandstone lenses often contain abundant stromatolites including Collenia frequens (Ross, 1961). Ross (1961) does not describe the Three Forks Formation separately from the remaining Devonian (395-345 m.y.), however his lithologic descriptions of the upper part of the Devonian section in the southern part of the Lemhi Range are similar to the Three Forks Formation as described farther northwest in the Donkey Hills region. In this area, the Three Forks Formation is a medium- to dark-gray argillaceous limestone and interbedded calcareous argillite. The limestone is thin-bedded and very finely crystalline. A 5 to 10 foot thick bed of dark-gray bioclastic limestone is present at the top of the Three Forks. The Formation is non-resistant and weathers to brittle yellow chips (Mapel and Shropshire, 1973; Ruppel and Lopez, 1981). Within the Borah Peak Quadrangle, the Three Forks contains lenses in which fossils are abundant and well preserved. The presence of Spirifer sp., particularly Spirifer whitneyi, in these lenses indicates that the Three Forks is Late Devonian (Ross, 1947).

Early Mississippian (345-322 m.y.) rocks unconformably overlie Late Devonian rocks throughout most of Idaho (Skipp et al., 1979) including the Black Canyon GRA. The youngest Mississippian unit is the McGowan Creek Formation which regionally consists of a lower member of orogenic detritus, specifically fine-grained, thinly bedded turbidites, and an upper member of

calcareous siltstone interbedded with silty micritic limestone, probably a starved-basin facies. The turbidite sequence ranges in thickness from about 100 feet in the Beaverhead Mountains to about 4,000 feet in the White Knob Mountains. The upper member of the McGowan Creek ranges in thickness from 200 to almost 500 feet (Skipp et al., 1979) and is not present in the southern Lemhi Range (Skipp and Hait, 1977).

In the Black Canyon GRA, the McGowan Creek Formation consists dominately of dark-gray to black carbonaceous shale with some fine-grained siltstone. Interbeds of black chert are common. Thickness of the McGowan Creek is estimated at about 200 feet near the mouth of Black Canyon (Ross, 1961). In the southern Lemhi Range, Ross (1961) correlated these rocks now classified as McGowan with the Milligen Formation. It is now known, however, that the McGowan Creek rocks are younger than the rocks belonging to the Milligen Formation (Mapel and Shropshire, 1973). On the basis of conodont studies, the McGowan Creek Formation is dated as Early Mississippian.

Ross (1961) lumped the upper Paleozoic rocks overlying the McGowan Creek Formation, a sequence about 8,000 feet thick, into the Brazer Limestone, but he recognized that the unit he mapped as Brazer Limestone in the southern Lemhi Range was not equivalent to the Late Mississippian (332-310 m.y.) Brazer in its type locality. He recognized that some of these "Brazer" beds in the southern Lemhi Range were Middle Pennsylvanian (305-290 m.y.) or possibly as young as Permian (280-230 m.y.) based on faunal evidence (Ross, 1961). Later workers (Huh, 1967; Skipp et al., 1979) have subdivided these rocks. Although the recent subdivisions have not been extended throughout the southern Lemhi Range by regional geologic mapping, the subdivision is

based largely on exposures found in or very near to the Black Canyon GRA. For this reason the new terminology will be used in this report. Most of the Black Canyon WSA is underlain by these rocks.

The McGowan Creek Formation is conformably overlain by carbonate bank and forebank deposits belonging to the Middle Canyon (oldest), Scott Peak, South Creek, and Surrett Canyon Formations (youngest). The type sections for these units occur along the walls of Middle Canyon and East Canyon (Huh, 1967) in the Black Canyon GRA, just west of the WSA. These formations represent a prograding carbonate-bank complex which generally thickends westward. Thicknesses range from 1,280 to 4,225 feet (Skipp et al., 1979). The basal part of the complex, the Middle Canyon Formation, is a thin-bedded, dark-gray cherty, fine-grained limestone in the upper part and a light-brown weathering, calcareous quartz siltstone to fine sandstone in the lower part. In the Black Canyon GRA, the Middle Canyon is about 1,000 feet thick (Huh, 1967) and it represents in part, the forebank deposit formed in front of the prograding bank (Skipp et al., 1979). The succeeding Scott Peak Formation (2,250 feet thick in East Canyon) consists of an upper and lower crinoid bryozoan calcarenite and cyclically interbedded cherty, crystalline limestone with an intervening medial massive medium- to medium-dark-gray mixed crystalline limestone. The overlying South Creek Formation (300 feet thick in East Canyon) is a thin-bedded alteration of fine-grained, dark limestone with 3 to 6 inch chert beds and 1 to 2 inch beds of clayey to silty, dark, fissile limestone. The uppermost Surrett Canyon Formation (220 feet thick in East Canyon) is a massive, dark-gray to black, finely crystalline limestone with scattered bioclastic grains (Huh,

1967). The Scott Peak and Surrett Canyon Formations represent a carbonate-bank accumulation whereas the intervening South Creek Formation indicates a period of relatively deep water marine circulation that temporarily interrupted carbonate-bank buildup (Skipp et al., 1979). Fossil evidence indicates that all of the units belonging to the carbonate-bank complex are Late Mississippian in age (Huh, 1967; Skipp et al., 1979).

North of the Snake River Plain in east-central Idaho, about 4,600 feet of interbedded carbonate rocks, sandstone, siltstone and mudstone of latest Mississippian to Early Permian (280-251 m.y.) age are assigned to the Arco Hills (oldest), Bluebird Mountain, and Snaky Canyon (youngest) Formations (Fig. 4). In the southern Lemhi and Lost River Ranges, these rocks conformably overlie the Surrett Canyon Formation (Skipp et al., 1979).

The Arco Hills Formation is composed of interbedded medium-gray, olive-gray, yellowish-brown, and grayish-red thin-bedded, argillaceous, and silty or sandy limestone, calcareous mudstone or shale, siltstone and minor sandstone, and medium- to thick-bedded pure limestone. In the Lemhi Range some phosphatic limestone is also present. The unit is a slope-former and is often buried beneath sandstone debris from the overlying Bluebird Mountain Formation. The upper contact with the Bluebird Mountain is sharp and is placed at the base of the stratigraphically lowest thick (12 feet or more) sandstone or siltstone bed. Brachiopods including Orbiculoidea sp. bryozoans, crinoid debris, and calcareous Foraminifera are abundant in the Arco Hills Formation. The Arco Hills is dated as Late Mississippian based on fossil evidence and stratigraphic position. In the southern Lemhi Range thickness ranges from 140 to 170 feet. Reference sections for both the Arco Hills and overlying Bluebird Mountain Formations are present in the Black

Canyon WSA (SE¼, sec. 6, T.6N., R.30E.) and in the GRA SE¼, sec. 36, T.7N., R.29E.) along the ridge east of East Canyon (Skipp et al., 1979).

In the southern Lemhi Range, the Bluebird Mountain Formation consists of interbedded medium-gray to brownish-gray quartzite, pale-yellowish-brown, very fine-grained, calcareous sandstone, and medium-gray sandy limestone. The upper contact with the overlying Snaky Canyon Formation is gradational and placed at the position in the section above which limestones are predominate. Foraminifera and the conodonts, *Gnathodus* bilineatus and *Cavusgnathus* sp., indicate that the Bluebird Mountain is Late Mississippian. The Bluebird Mountain is 102 feet thick near East Canyon, but its thickness appears to range from 130 to 165 feet elsewhere in the Lemhi Range.

The Mississippian-Pennsylvanian contact is gradational in the Black Canyon GRA, and the Pennsylvanian rocks are represented by the lower part of the recently defined Snaky Canyon Formation (Skipp et al., 1979) which is comprised of the basal Bloom Member, the succeeding Gallagher Peak Sandstone Member, and the lower part of the overlying Juniper Gulch Member. The Pennsylvanian part of the Snaky Canyon ranges from 1,970 feet thick in the Arco Hills-Howe Peak area to about 3,280 feet thick in the southern Beaverhead Mountains. The Bloom Member consists of medium-bedded gray limestone, largely sandy or silty, interbedded with thin beds of very fine-grained, yellowish-brown weathering sandstone and siltstone. Fossil evidence indicates that the Bloom Member spans Early (310-305 m.y.) and Middle Pennsylvanian (305-290 m.y.) time. The overlying Gallagher Peak Sandstone Member, less than 200 feet thick, is dominately a very fine-grained calcareous sandstone. It is probably Late Pennsylvanian (290-280 m.y.) in

age. The uppermost member of the Snaky Canyon Formation, the Juniper Gulch, spans the Pennsylvanian-Permian (280-230 m.y.) boundary without any major depositional change. The boundary is near the middle of the member in a 330-600 foot hydrozoan(?) algal buildup. The Juniper Gulch Member consists of interbedded sandy and cherty, generally light-gray weathering, thin- to thick-bedded limestone and dolomite. Sand and chert is most common in the basal 330 feet (Skipp et al., 1979).

The Early Permian Phosphoria Formation conformably overlies the Snaky Canyon Formation. On the southeastern flank of the southern Lemhi Range, an incomplete section of the Phosphoria is preserved in a north-northwest-trending narrow graben part of which is present in the north-central part of the Black Canyon GRA. In the graben, about 15 feet of interbedded grayish-black chert and light-gray to medium-gray dolomite overlie light-gray weathering dolomite belonging to the Snaky Canyon Formation. The chert is medium to irregularly (nodular) bedded and is a conspicuous ledge-former. The dolomite is fine-grained with a few lenses of bioclastic material. Nodules and lenses of phosporite are present in this chert unit which is tentatively correlated with the Rex Chert member of the Phosphoria Formation. The chert unit is overlain by at least 82 feet of very dark-gray organic-rich mudstone, coarse-grained oolitic phosporite, and phosphatic siltstone which is similar to rocks assigned to the Retort Phosphatic Shale Member near Snaky Canyon in the southern Beaverhead Mountains. The brachiopod Orbiculoidea sp. occurs in all facies of the Phosphoria and Orbiculoidea cf O. missouriensis and Cancrinella cf C. phosphatica are present in the siltstone and phosphorite belonging to the Retort.

Lava and associated rocks are present along the eastern flank of the southern Lemhi Range in the Black Canyon GRA. Their age is placed at Pliocene (6-2 m.y.) to Pleistocene (2-0.1 m.y.) based upon fossils found in tuffaceous limestone. The volcanic rocks are probably not all the same age based upon the differences in erosion of the different outcrops. Rock types included in this unit are silicic flows, welded tuffs, porous tuffs, basalt, and tuffaceous limestone.

Pleistocene to Holocene (0.1 m.y. to present) basalt of the Snake River Plains occurs on the extreme east edge of the Black Canyon GRA. The basalts were deposited from vents aligned along rift zones and form low shields made up of overlapping multiple flows units which comprise a style of volcanism referred to as "Plains Volcanism" by Greeley (1977, 1982).

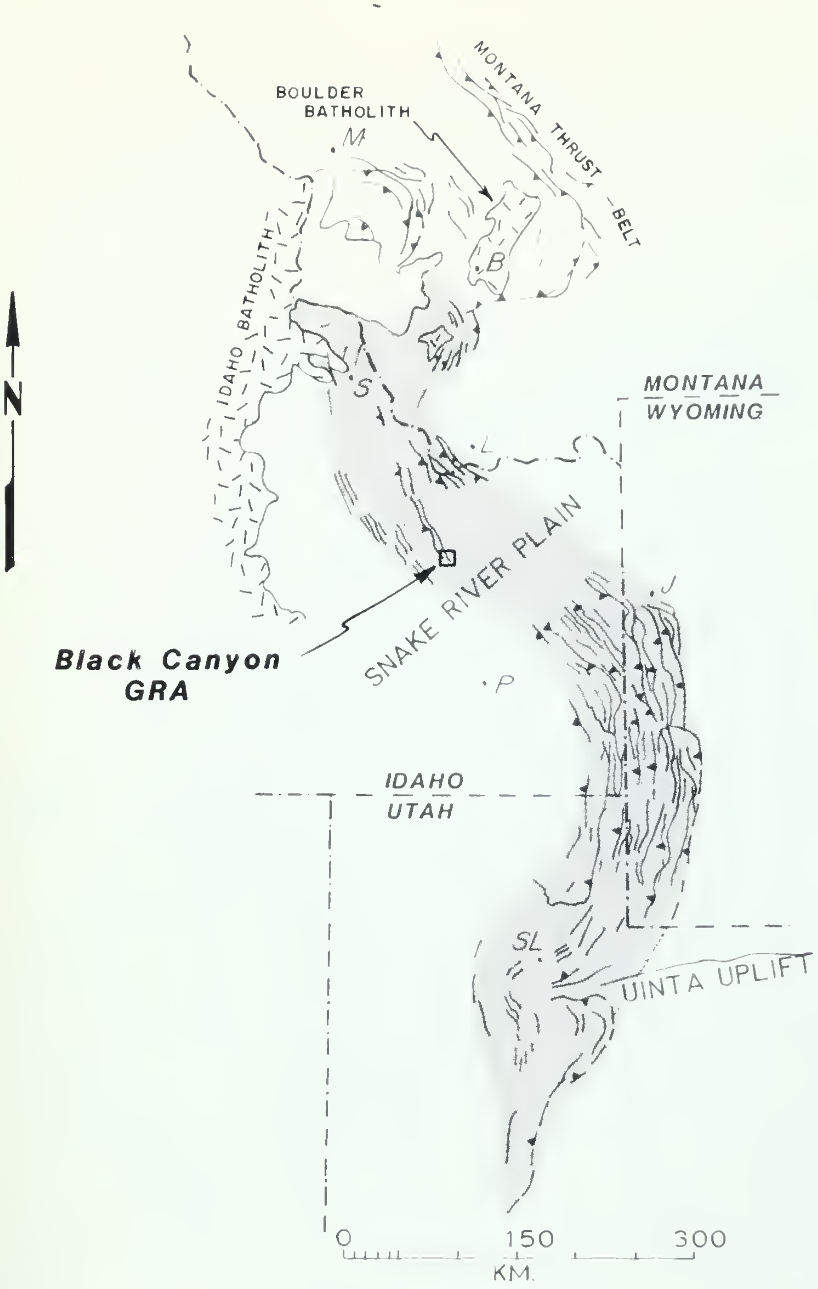
Recent alluvial gravel, sand and silt deposits blanket valleys in the southwest and eastern portion of the Black Canyon GRA. The surficial geology of southeastern and south-central Idaho is summarized by Scott (1981).

2.4 Structural Geology and Tectonics

The structural geology of the southern Lemhi Range, including the Black Canyon GRA, has been studied by Ross (1961), Ruppel (1982), Skipp (1981) and Skipp and Hait (1977) of the U.S. Geological Survey, as well as several thesis, including Beutner (1968) and Hait (1965). The local structure within the GRA is described by Ross (1961).

Regionally the Black Canyon GRA is within the frontal Sevier orogenic belt of the Cordilleran fold-thrust belt (Fig. 6). In the area northwest of the Snake River Plain and east of the Idaho batholith, a minimum of nine major allochthons are recognized including (from west to east): the Wood River, Milligen, Copper Basin, White Knob, Lost River-Arco Hills, Lemhi, Beaverhead, Medicine Lodge and Tendoy allochthons (Fig. 7). Each of these allochthons has an internally consistent stratigraphy that differs from adjacent plates. All of the allochthons, except the structurally highest Wood River, are bounded above and below the thrust faults. The allochthons can be grouped into three stacks consisting of: (1) the Pioneer or western stack, structurally the highest, comprising the Wood River, Milligen and Copper Basin allochthons, (2) the Lemhi or middle stack comprising the Lost River-Arco Hills, Lemhi, and Beaverhead allochthons, and (3) the Lima or eastern stack, structurally the lowest, comprising the Medicine Lodge and Tendoy allochthons (Skipp and Hait, 1977).

The Black Canyon GRA is within the Lemhi stack of allochthons (Fig. 7). The allochthons in the Lemhi stack contain thick sequences of Precambrian Y rocks overlain locally by Precambrian Z rocks. The Precambrian rocks are overlain by thick Paleozoic miogeoclinal sequences which exhibit a general resemblance to each other from allochthon to allochthon. The Lemhi stack is underlain by a major thrust zone within the Precambrian Y sequence. Preliminary unstacking of the allochthons indicates a total movement of 125 to 150 miles, but relative movements between the Lost River-Arco Hills, Lemhi and Beaverhead allochthons appears to be small (Skipp and Hait, 1977). The boundary between the Lost River-Arco Hills and Lemhi allochthons passes through the southwestern corner of the Black Canyon GRA (Fig. 7).



Structural trends in the frontal Sevier orogenic belt (stippled), Utah-Montana. Principal folds trends shown by lines; teeth on major thrust faults. M=Missoula; B=Butte; S=Salmon, L=Lima, P=Pocatello; J=Jackson; SL=Salt Lake City.

Data by: Beutner (1977)

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REGION 2 NORTHERN ROCKY MOUNTAINS

Black Canyon GRA, Idaho

Regional Geologic Setting

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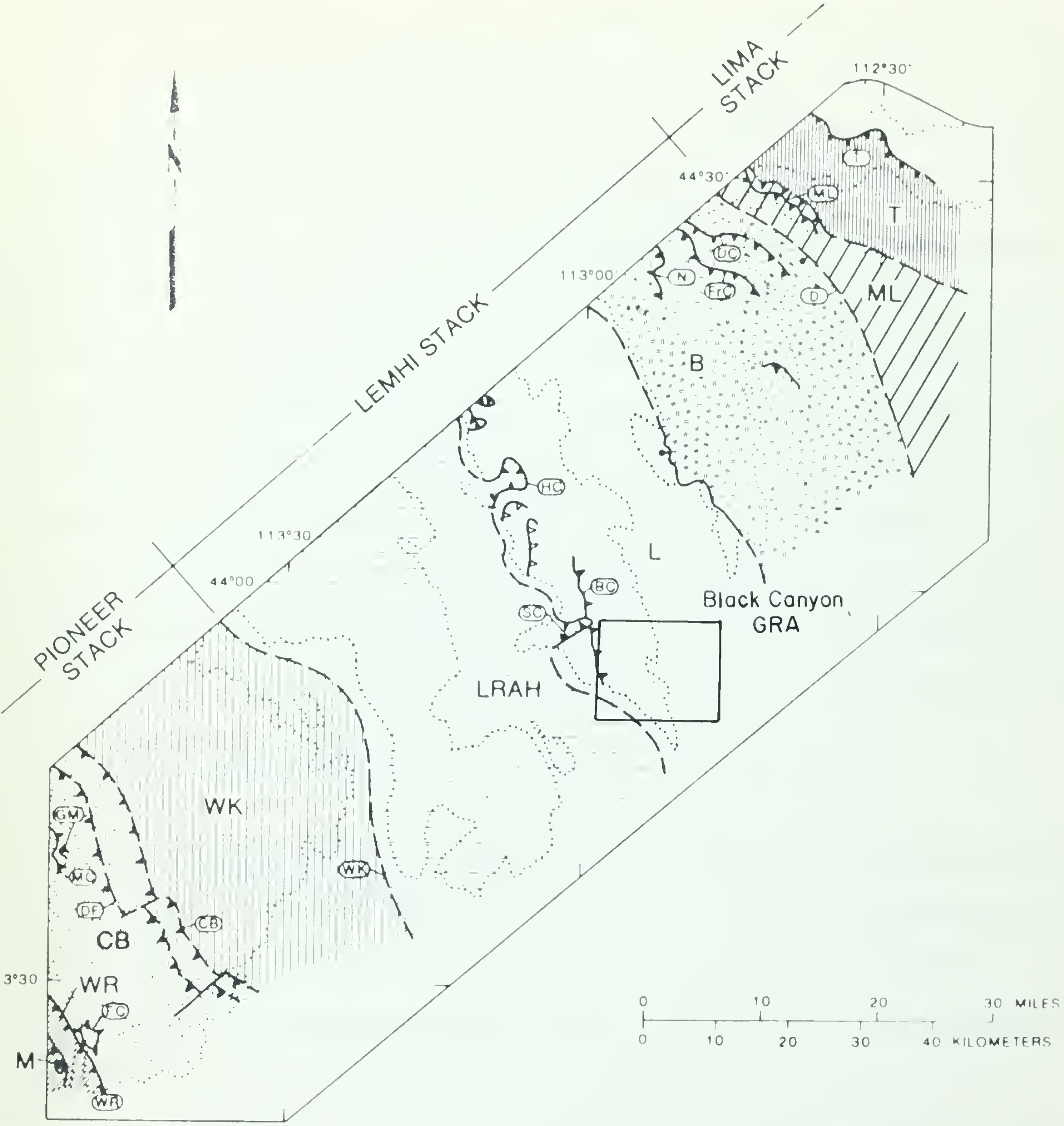

Figure 2 Map showing location and extent of allochthons along northeast margin of Snake River Plain. WR = Wood River; M = Milligen; CB = Copper Basin, WK = White Knob; LRAH = Lost River-Arco Hills, L = Lemhi; B = Beaverhead, ML = Medicine Lodge (restricted); T = Tendoy and related plates. Dotted lines outline the mountain ranges (ref fig. 3). Faults identified on map are: WR = Wood River thrust, FC = Fish Creek thrust, GM = Glide Mountain thrust, MC = Muldoon Canyon thrust, DF = Dry Fork thrust, CB = Copper Basin thrust, WK = White Knob thrust, SC = South Creek thrust, HC = Horse Creek thrust, BC = Black Canyon thrust, N = Nicholia thrust, FrC = Fritz Creek thrust, DC = Divide Creek thrust, D = Deadman normal fault, ML = Medicine Lodge thrust. T = Tendoy thrust

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REGION 2 NORTHERN ROCKY MOUNTAINS

Black Canyon GRA, Idaho
Structural Setting

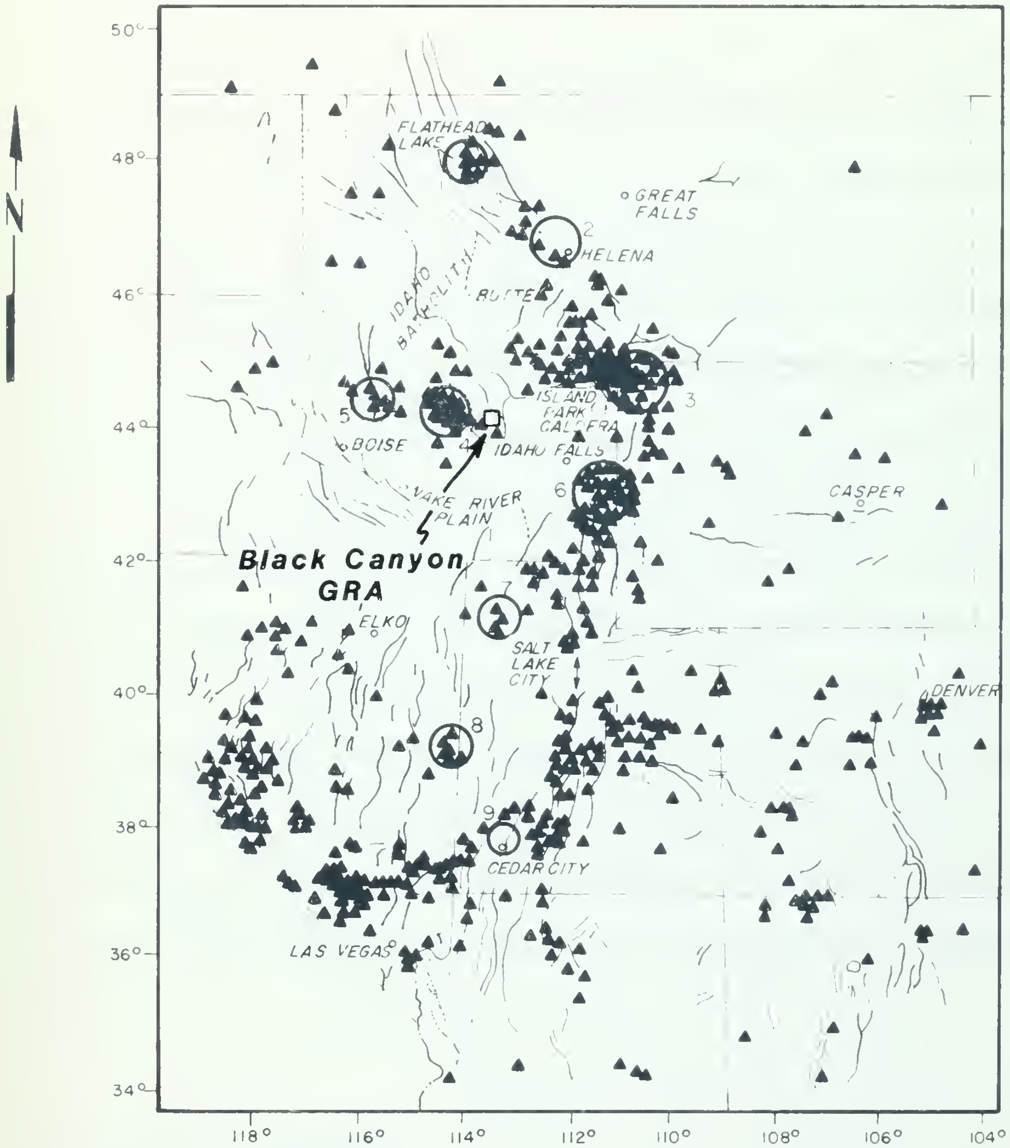
SCALE AS SHOWN
DATA BY
DATE
REVISED
DRWN BY
APPR'D
FIGURE 7

The Lost River-Arco Hills allochthon encompases the southern part of the Lost River Range, the Arco Hills and two "slide" blocks on the western side of the Lemhi Range. It is about 22 miles wide at the surface and more than 6,200 feet thick. Rocks ranging from Precambrian Y to Permian in age are exposed in the Lost River-Arco Hills allochthon. These rocks are unconformably overlain by the Challis Volcanics. The allochthon is broken by several major basin and range faults, with displacements of as much as 20,000 feet, which have tilted the resulting blocks eastward. The 15 to 20 degree dip on the Challis Volcanics gives an indication of the amount of eastward tilting. The Lost River-Arco Hills allochthon is also cut by east-trending normal faults and, in the southernmost part, by westward curving faults. Both of these fault systems are cut by still active range-front normal faults along which the Lost River Range and the Arco Hills have been elevated and tilted to the east (Skipp and Hait, 1977).

The Lemhi allochthon (Fig. 7) is about 15 miles wide at the surface extending from the range-front fault on the west side of the Lemhi Range northeast to the range-front fault on the west side of the Beaverhead Mountains. The allochthon includes the down-faulted Blue Dome block and an imbricate thrust zone on the west side of the Beaverhead Mountains. Unlike the Lost River-Arco Hills allochthon, the Lemhi is demonstrably imbricate. The thickness of the Lemhi allochthon is 6,000 feet, and strata exposed within the allochthon range from the Precambrian Y Lemhi Group to the Permian Phosphoria Formation. Challis Volcanics unconformably overlie the Paleozoic rocks. Later structural development of the Lemhi allochthon is similar to that of the Lost River-Arco Hills allochthon (Skipp and Hait, 1977).

Previously, the regional structure of the Lemhi Range has been described as an anticlinal fold having a complexly folded and thrust-faulted, steeply dipping eastern limb (Hait, 1965), but recent detailed mapping indicates that the range is a broad, northwest-trending, nearly flat-topped uplift flanked by monoclinal limbs that dip steeply into adjacent basins (Ruppel, 1968, 1980; Ruppel and Lopez, 1981). The complex folding of the rocks in the Lemhi Range is related to thrust-faulting which predates the uplift of the range. The thrusts are not folded in the axial part of the range. Multiple imbricate thrusts in the Lemhi Range dip 5-15° southwest almost everywhere except along its flanks. The monoclinal folding on the flanks is abrupt and steep. Steep range-front normal and reverse faults cut the flanks of the Lemhi Range. On the west flank of the range is bounded by steeply west-dipping normal faults that cut even the youngest surficial deposits and are recognizable by the conspicuous fault scarps present. The folded thrusts are nearly as steep as the range-front faults and may have provided slip surfaces for normal fault movement. Range-front normal faults, broken by north-trending vertical faults that are probably mostly strike-slip bound the central and northern Lemhi Range everywhere to the northwest, but none have been mapped in the southern Lemhi Range (Ruppel, 1982). The precipitous east front, however, suggests fault control (Ross, 1961).

The principal geologic hazard in the area is earthquakes (Fig. 8). The region is cut by many faults, some of which have been active as recent as the Pleistocene (Ruppel, 1982). The area is in the Intermountain Seismic belt (Smith and Sbar, 1974) and is adjacent to a seismic trend which extends westward from Yellowstone Park (Smith, 1978).



EPICENTERS FOR INTERMOUNTAIN SIESMIC BELT SHOWING ALL EARTHQUAKES REPORTED BY NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) OF ABOUT MAGNITUDE 3.0 OR GREATER FROM 1961 THROUGH 1970. DOUBLE ARROW SHOWS ZONE OF LOW SIESMICITY. CIRCLES MARK EARTHQUAKE SWARMS: 1, FLATHEAD LAKE, MONT.; 2, HELENA, MONT.; 3, YELLOWSTONE PARK; 4, SAWTOOTH RANGE, IDAHO; 5, IDAHO BATHOLITH; 6, CARIBOU RANGE, IDAHO; 7, GREAT SALT LAKE DESERT, UTAH; 8, LEHMAN CAVE MONUMENT, NEVADA; 9, CEDAR CITY, UTAH

DATA FROM SMITH AND SBAR (1974)

0 70 140 210 MILES
SCALE APPROXIMATE

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REGION 2 NORTHERN ROCKY MOUNTAINS

Black Canyon GRA, Idaho

Regional Seismicity

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2.5 Paleontology

The Paleozoic section in the Black Canyon GRA is moderately fossiliferous, but no index or special localities are described. The Kinnikinic quartzite has a few poorly preserved fossils on the ridge south of South Creek (Ross, 1961). Ross (1961) also reports that the Saturday Mountain Formation locally contains numerous well preserved fossils. Generally the best fossils in the Saturday Mountain are within 100 feet stratigraphically of the base of the formation. The rest of the Saturday Mountain contains thinly scattered and poorly preserved cup corals and crinoid stems. The fossils in the Saturday Mountain are Ordovician although a few Silurian fossils are present near the top of the unit when the Laketown Dolomite is present. Approximately a half dozen collections of fossils have been made by the U.S. Geological Survey from the Three Forks Limestone and older rocks in the Black Canyon GRA (Ross, 1961). The fossils in the uppermost beds have proved most diagnostic. The Mississippian limestones are commonly fossiliferous. Numerous collections which have been made by the U.S. Geological Survey within the boundaries of the GRA are summarized in Ross (1961).

2.6 Historical Geology

During Precambrian Y time, the Black Canyon GRA was located on a high area separating the Belt Basin in northern Idhao and northwestern Montana from the Cordilleran Miogeocline. The sediments comprising the Lemhi Group rocks were deposited in the miogeocline 150 to 200 miles southwest of the Lemhi Range. The change from fine-grained feldspathic quartzite in the Gunsight

Formation to medium-grained, hematitic, non-feldspathic quartzite in the Swauger Formation may reflect the major tectonic adjustments of early Missoula time (Ruppel, 1975). The pronounced unconformity between the Swauger Formation and the overlying Precambrian Z Wilbert Formation reflects major deposition and erosion of the Precambrian Y rocks. Regional uplift, folding, and some faulting ended sedimentation in the Precambrian Y miogeocline, and is probably closely related to deformation associated with the East Kootenay orogeny in Canada about 800 m.y. ago (Ruppel et al., 1975).

The Precambrian Z Wilbert Formation was deposited in a near-shore environment. The northward thinning recognizable in the Lemhi Range reflects both on-lap and Late Cambrian emergence and erosion. The shoreline was probably over 100 miles west of the Black Canyon GRA (Ruppel et al., 1975).

Formerly, south-central Idaho was thought to have been a relatively stable miogeosynclinal area during early Paleozoic time, but evidence of an Ordovician disturbance is accumulating (Skipp, 1981). The Early Ordovician Summerhouse Formation represents a near-shore perhaps lagoonal environment. The Summerhouse is overlain in slight angular unconformity by the Kinnikinic Quartzite (Ruppel et al., 1975) which indicates a period of emergence and folding. In addition, an intrusive complex in the southern Beaverhead Mountains is dated as latest Early Ordovician and syndepositional faulting in the Kinnikinic Quartzite is described in the same area (Skipp, 1981).

From the Middle Ordovician through Silurian time, the Black Canyon GRA was encompassed by the Lemhi arch, a northwest-trending intermittently emergent landmass that separated the Cordilleran miogeocline in western Idaho from a

shelf embayment in southwestern Montana. During this time, the eastern side of the arch was probably continuous with the large landmass to the east since Ordovician and Silurian rocks are absent in Montana (Ruppel, 1978). The Middle Ordovician through Silurian rocks in the Black Canyon GRA are characteristic of a shallow, very gradually deepening sea. The Kinnikinic, a near-shore clean sand probably derived from a mature landmass to the east, is succeeded by reefal dolomites (Ross, 1947). Sometime toward the end of Silurian or beginning of Early Devonian time the seas withdrew and a widespread erosion surface developed, exposing successively older rocks (from Silurian to Cambrian) in an easterly direction (Scholten and Hait, 1962).

Beginning in Middle Devonian time a deep basin developed in central Idaho. To the east, a miogeosyncline developed which eventually became distinctly differentiated from the semi-stable cratonic shelf along a sharp hinge line near the present Lemhi Range. Seas were regionally transgressive during all of Middle and part of Late Devonian time (Scholten and Hait, 1962).

Latest Devonian to early Mississippian time was a period of upheaval assocaited with the Antler orogeny. Devonian and older rocks were uplifted and eroded as the Antler highland developed in southwestern Idaho and northern Nevada (Skipp, 1981). Turbidites filled a deep and narrow flysch trough developed adjacent to the eastern margin of the Antler highland. East of the flysch trough, thick orogenic, thin starved-basin, and thick carbonate sequences were deposited in an outer cratonic platform or foreland basinal environment. Sedimentation continued without major interruption through Mississippian time (Skipp et al., 1979). The flysch basin had filled by Early Pennsylvanian time and was succeeded by a carbonate bank. Coincident

with the rise of the ancestral Rocky Mountains during Middle Pennsylvanian time, the sediments in the western portion of the flysch basin were uplifted to form the Copper Basin highland. Minor coarse detritus from this highland was shed eastward into the shallow water carbonate bank regime of the Snaky Canyon Formation (Skipp, 1981).

The time gap between Permian rocks and the Eocene Challis Volcanics represents the Sevier orogeny. During Early Cretaceous to Paleocene the major thrust sheets developed forming the allochthonous terrane presently underlying the Black Canyon GRA (Skipp, 1981). Eastward telescoping due to thrusting across the northeast margin of the Snake River Plain is estimated to have produced crustal shortening in excess of 180 miles, and possibly as much as 400 miles (Skipp and Hait, 1977).

The major part of the Eocene Challis Volcanics was erupted from about 51 to 45 m.y. ago. Minor volcanism and associated intrusive activity continued in the south-central Idaho region until about 40 m.y. ago. Normal and strike-slip faulting preceeded and accompanied volcanism (Skipp, 1981).

After a tectonically relatively inactive period during Oliogence (38-23 m.y.) and early Miocene (23-6 m.y.) time, major basin-and-range extension faulting commenced about 17 m.y. ago. Eastward tilting of the uplifted fault blocks along moderately dipping normal faults located on their west flank formed the narrow, linear north- to northwest-trending mountain range (Skipp, 1981). The inception of basin-range faulting was followed closely by the initial downwarping and faulting of the north margin of the Snake River Plain, located south of the Black Canyon GRA (Pankrantz and Ackerman,

1982). Biomodal volcanism related to the development of the Snake River Plain began at least 14 m.y. ago (Christiansen and McKee, 1978) and continued to less than 20,000 years ago (Kuntz et al., 1979).

3.0 ENERGY AND MINERAL RESOURCES

3.1 Introduction

Data on the mineral and energy resources of the Black Canyon GRA was compiled from all available sources. Mineral resource information is from the USGS CRIB file, the USBM MILS file, Ross and Carr (1941), and the Idaho Bureau of Mines Mines and Prospect Map Series (Strowd et al., 1981). Detailed descriptions of mineral deposits in and near the GRA are given by Ross (1933, 1961) Anderson (1947, 1948) and Umpleby (1914). Information of limestone and dolomite resources is from Ross (1961), Skipp et al. (1979) and Savage (1969). The primary sources of geothermal data were reviews by Ross (1971) and Mitchell et al. (1980). Oil and gas resource data is from Breckenridge (1982). WGM geologists visited the area in October 1982 to examine the mineralization in the Dome district and determine the nature of an uncertain occurrence in the east part of the Black Canyon WSA.

3.2 Known Mineral and Energy Deposits

There are no mineral or energy deposits within the Black Canyon GRA.

Lead, silver, and copper deposits have been mined in the Dome and Hamilton districts located just northeast of the GRA. Production from the two districts as given by Ross (1961) is summarized below (Table I).

TABLE I

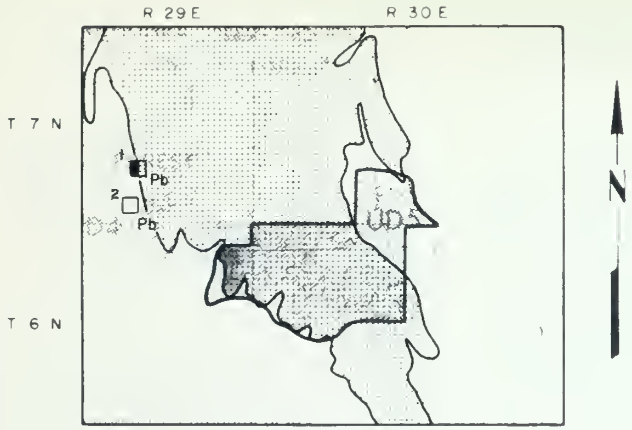
METAL PRODUCTION OF THE DOME AND HAMILTON MINING DISTRICTS (1901-1955)

District	Ore (Short tons)	Gold (ounces)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dome	124,174	50	365,702	54,358	39,390,189	142,000
Hamilton	2,126	59	11,825	38,852	599,339	-------

The majority of the production in the Dome district was from the Wilbert Mine (Ross, 1933) which had over 12,000 feet of underground development (Anderson, 1947, 1948). The mineralization consists of masses of galena, pyrite and sphalerite within dolomitic beds belonging to the upper part of the Swauger Quartzite (Anderson, 1947, 1948; Umpleby 1914; Ross, 1933). The mineralization may actually occur in that part of the Swauger which is now grouped into the Wilbert Formation. While the descriptions in the literature emphasize an epigenetic origin (Ross, 1933), the persistence of the mineralization in a particular stratigraphic horizon suggests that it may be stratabound.

3.2 Known Mineral and Energy Prospects, Occurrences and Mineralized Areas

There are two reported metallic mineral prospects within the Black Canyon GRA, neither of which are within WSA 32-9 (Fig. 9, Table II): (1) the Protection and (2) the Whiterock prospects. Both are located within Black Canyon two or three miles west of WSA 32-9. The Protection prospect (loc. 1, Fig. 9, Table II) consits of a 100 foot drift along a fault zone (Anderson, 1948). Anderson describes the mineralization as mainly limonite with small amounts of lead and copper minerals. Mineralization at the



LEGEND

- ■ Mineral Orebody
- ◧ Mineral Deposit
- ☐ Mineral Occurrence
- ⚒ Active Quarry
- ⚒ Inactive Quarry
- ⚒ Active gravel or clay pit
- ⚒ Inactive gravel or clay pit

Area underlain mainly by carbonate rocks.

1 ☐ Cu
occurence number
commodity

Approximate Boundary of Wilderness Study Area.

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Black Canyon GRA, Idaho

Mineral Occurrences

SCALE 1"= 4 MILES		REVISED	FIGURE 9
DATA BY WGM	DATE 1/1983		
DRWN BY DSI	APRVD G F		

TABLE II

MINERAL OCCURRENCES OF THE BLACK CANYON GRA, IDAHO

Map No.	Name	Location Sec.	T.	R.	Commodity	Description	Source of Data
1	Protection Prospect	27	7N	29E	Pb, Ag, Cu	Minor limonite with some lead and copper in gouge the fault contact between Swauger Quartzite and dolomite of the Saturday Mountain Formation (dated terminology).	Anderson (1948) Ross (1961)
2	Whiterock Prospect	34	7N	29E	Pb	Galena in fractured white quartzite associated with east-west trending shear zones.	Anderson (1948) Ross (1961)

Whiterock prospect (loc. 2, Fig. 9, Table II) consists of galena within fractured quartzite. Ross (1961) reports numerous other prospect pits in the area.

The mineralization occurs in fractures within dolomite of the Saturday Mountain Formation and Swauger Quartzite (dated stratigraphic terminology) along the Black Canyon fault (Anderson, 1948; Ross, 1961). This association of lead mineralization with faulted dolomite and quartzite was confirmed by WGM geologists during their visit to the Dome district (Appendix II).

Strowd et al. (1981) show a mineral occurrence of unknown type just east of WSA 32-9. WGM geologists examined the occurrence in October 1982 (Appendix II). It was found to be a pit dug in alluvial terrace gravels. Numerous other pits were found to the east. No mineralization of any kind was noted and the reason for the pits could not be determined.

Carbonate rocks underlie much of the Black Canyon GRA and most of WSA 32-9 (Figs. 5 and 9). No data on the economic potential of the carbonate rocks in the GRA is available. Regionally the Mississippian carbonates equivalent to those underlying the GRA contain high calcium limestone (Savage, 1969).

There are no known energy occurrences in the GRA.

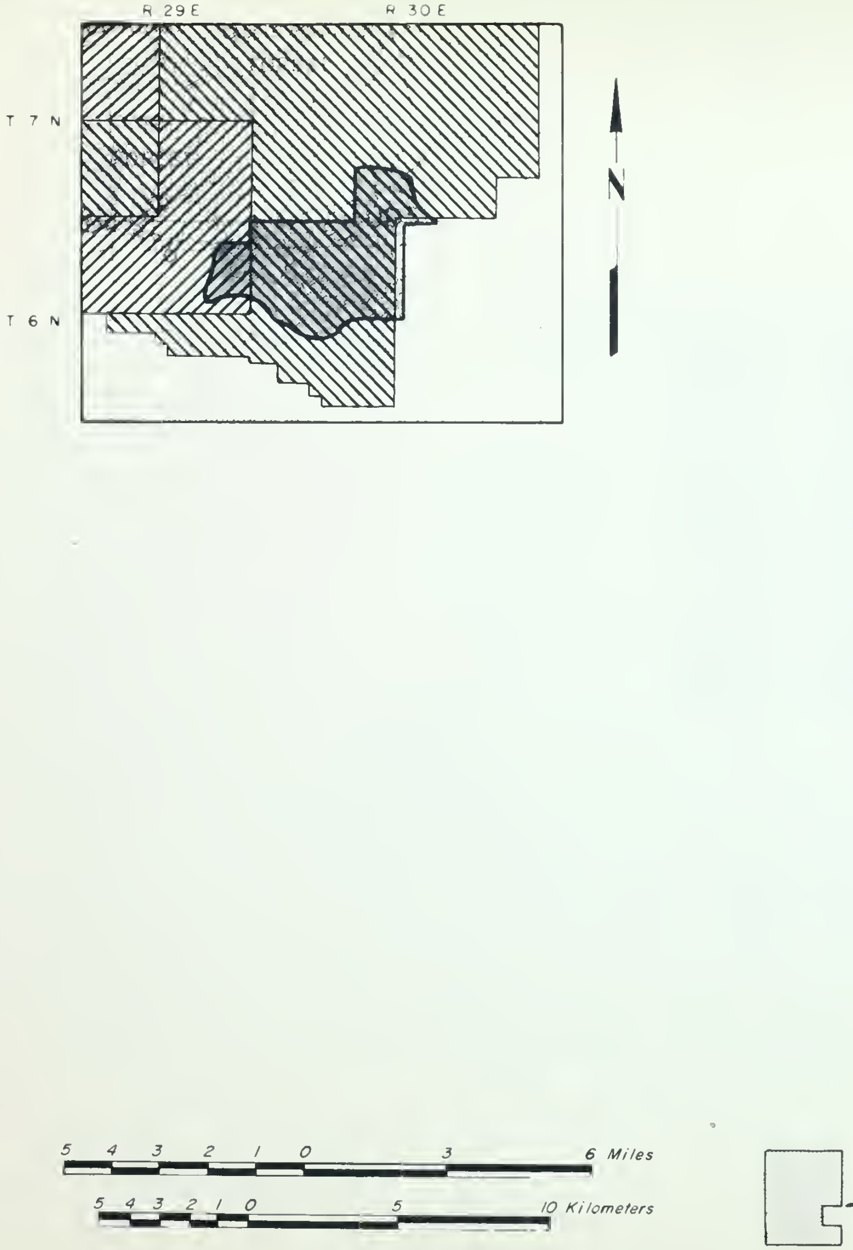
3.4 Mining Claims, Leases and Material Sites

A review of BLM claims records and mineral title plats current to June 6, 1982 shows there are no patented or unpatented mining claims within the Black Canyon GRA.

BLM oil and gas plats current to June 6, 1982 show that 70% of the Black Canyon GRA and is covered by oil and gas leases or lease applications (Fig. 10). Eighty percent of the Black Canyon WSA is covered by oil and gas leases with the remainder covered by oil and gas lease applications (Fig. 10, Table III).

3.5 Mineral and Energy Deposit Types

The metallic mineral deposits in the southwestern Lemhi Range, which includes the Black Canyon GRA, are apparently of two types: (1) stratabound lead-zinc mineralization, and (2) structurally controlled lead-copper mineralization. The first type of mineralization occurs in dolomite beds in the upper part of the Swauger Quartzite, probably the Wilbert Formation as now defined. Anderson (1947) describes both the sulfides and dolomite as being epigenetic and ascribes a replacement origin to the mineralization. His conclusion is based on the ore-host rock textural relationships and on the association of the mineralization with faults and dikes. This mineralization is similar to Mississippi Valley-type deposits (Sangster, 1970; Callahan, 1967) and sandstone-hosted lead deposits (Bjorlykke and Sangster, 1981) which are stratabound. The favorable ore horizon does not crop out in WSA 32-9. The second class of metallic mineralization found in the area consists of lead and copper mineralization in fractures associated with fault zones. Examples of this type occur at the Ajax mine (Appendix II) and in the prospects on Black Canyon (Table III). The nature of the host rock is an important controlling factor in this type of mineralization as most of the prospects are in quartzite rather than carbonate rocks.



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: June 6, 1982.
3) Source of Data: BLM OG Plats.

Approximate Boundary of Wilderness Study Area.

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Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Black Canyon GRA, Idaho

Oil and Gas Lease Status

SCALE 1"=4 MILES
DATA BY NGM DATE 1/1983
DRWN BY DSI APPRVD GF
FIGURE 10

TABLE III

OIL AND GAS LEASES IN THE BLACK CANYON WSA, IDAHO

Lease No.	Owner of Record	Date Issued
I 13709	Mark W. Richey P.O. Box 1603 Boise, Idaho 83707	8-19-77
	Overlapped by:	
	Wolter Oil Company P.O. Box 8686 Boise, Idaho 83707	2-03-82 (Applic. Filed)
I 13723	Phillips Petroleum Company 1300 Security Life Bldg. Denver, Colorado 80202	11-06-78
I 13724	Phillips Petroleum Company 1300 Security Life Bldg. Denver, Colorado 80202	11-06-78
I 13732	Phillips Petroleum Company 1300 Security Life Bldg. Denver, Colorado 80202	11-06-78
I 13733	Phillips Petroleum Company 1300 Security Life Bldg. Denver, Colorado 80202	3-05-79

A large part of WSA 32-9 is underlain by Mississippian carbonate rocks which may contain units of high purity limestone (Savage, 1969). No sample data are available from carbonate rocks within the Black Canyon GRA so the potential for this type of resource cannot be evaluated.

There are no known uranium occurrences in the Black Canyon GRA or the southern Lemhi Range (Armstrong, 1964). Assessment of the uranium potential of the GRA is difficult because there are no NURE reports or other data on the area. However, the McGowan Creek Formation in the adjacent Beaverhead Range is uraniferous (Wodzicki and Krason, 1981). This unit is present in the GRA and is probably present in the subsurface of the Black Canyon WSA (Fig. 5). No data is available however on the uranium content of the McGowan Creek Formation in the southern Lemhi Range.

The Black Canyon GRA is a part of the Cordilleran fold-thrust belt. Major hydrocarbon reserves are present 200 miles southeast of the GRA in western Wyoming where three giant oil fields (Lamb, 1980; McCaslin, 1981) and 12 other fields are currently being developed. Some of the latter may be classed in the giant ranks when fully developed. Production within this area is from several horizons including Ordovician, Devonian, Mississippian, Pennsylvanian, Triassic, and Jurassic units (McCaslin, 1980, 1981). In the Black Canyon GRA most of these Paleozoic units have equivalents, but Triassic and Jurassic rocks are not present. The nearest test well to the GRA was drilled in sec. 16, T.12N., R.28E., approximately 36 miles north-northwest of the Black Canyon WSA. No information is available on this test other than it was plugged and abandoned. As shown by Breckenridge (1982) numerous dry holes have been drilled in southeastern Idaho 50 to 165 miles

to the southeast of the Black Canyon GRA. Hydrocarbon shows have been reported in some of these tests. Except for the absence of a relatively thick Mesozoic section the Black Canyon GRA is similar stratigraphically and structurally to southwestern Montana. General evaluations of the hydrocarbon shows have been reported in some of these tests. Except for the absence of a relatively thick Mesozoic section the Black Canyon GRA is similar stratigraphically and structurally to southwestern Montana. General evaluations of the hydrocarbon potential of the southwestern Montana area have been made by Scholten (1967), Perry et al. (1981) and Peterson (1981). Scholten (1967) considered the area to have a low potential whereas both Peterson (1981) and Perry et al. (1981) considered the area to have some potential but concluded that further study was necessary.

Potential hydrocarbon source beds in the Black Canyon GRA are the dark shales of the McGowan Creek Formation, argillaceous limestones and calcareous shales of the Jefferson Formation, and dark clayey-silty limestones of the South Creek Formation. All of these units except the South Creek Formation have had hydrocarbon analyses made on them from localities in east-central Idaho or southwestern Montana. A petroleum company had samples of the McGowan Creek Formation from the White Knob and Lost River Ranges west of the Black Canyon GRA analyzed. The results of these analyses indicate that the unit has a mature, very poor oil, good to excellent wet-gas condensate source character (Nance Petroleum pers. comm., 1982). The organic carbon content of well-cuttings from the Three Forks Formation in southwestern Montana is 7.5% (Perry et al., 1981). This clearly implies that the Three Forks could be a hydrocarbon source bed where similar lithologies are present in the Black Canyon GRA.

Thermal maturity of source beds within the Black Canyon GRA has not been studied. However, the data known from the west (Nance Petroleum pers. comm., 1982) and the conodont color alteration indices reported for Mississippian strata in southwestern Montana (Perry et al., 1981) indicate that the thermal maturity has been of sufficient magnitude within the region to generate hydrocarbons.

Potential hydrocarbon reservoir beds in the Black Canyon GRA include vuggy dolostones of the Laketown Dolomite, surcosic dolostones in Ordovician, Silurian and Devonian strata, and sandstones and conglomerates within the late Paleozoic strata. Fracture porosity may also occur in these units. The thrust faults and block uplifts of the region should provide structural traps for the reservoir beds.

The Black Canyon GRA is part of the Central Idaho Basin and Range geothermal province, but it is near the northeastern boundary of the Snake River Plains geothermal province. Specifically the GRA is near the extreme southeast end of the Lemhi Range at the margin of extensive Quaternary and Tertiary volcanic cover characteristic of the eastern Snake River Plain. Shallow low/intermediate geothermal resource are present along the margins of the Snake River Plain (Brott et al., 1976, 1981; Mitchell et al., 1980), but there is very little information available on the deep geothermal potential along the margins of the Plain. At present, there are fewer known geothermal resource areas along the northwestern margin of the Snake River Plain than there are along the southeastern margin. However, the number of water wells, which provide the major source of information on shallow

geothermal resources, is also much less along the northwestern margin of the Plain.

There is no geothermal data from any wells within the Black Canyon GRA, and well information in the vicinity of the GRA is limited. Shallow wells in the Butte City area, at the southern end of the adjacent Lost River Range 20 miles southwest of the Black Canyon WSA, have encountered very warm temperatures. About 20 miles northeast of the WSA, Liddy Hot Springs (sec. 2, T.9N., R.33E. and sec. 35, T.10N., R.33E.) is located in a similar setting in relation to the Snake River Plain as is the Black Canyon WSA. The surface temperature at Liddy Hot Springs ranges from 50° to 58°C and the total discharge is 11,733 liters per minute. The estimated aquifer temperature is 68°C (Mitchell et al., 1980). Southeast of the Black Canyon GRA, deep wells (sec. 15, T.5N., R.32E. and sec. 1, T.3N., R.29E.) in the Snake River Plain have geothermal gradients of 2.2 to 3.3°F/100 feet (Brott et al., 1981). One of the aforementioned wells, the INEL-1 (sec. 1, T.3N., R.29E.) had a bottom hole temperature of about 150°C (Doherty et al., 1979).

The Black Canyon WSA is along the boundary between a region with moderate geothermal potential and a region with low geothermal potential. Mapping along the northwestern margin of the Snake River Plain coupled with interpretation of the geophysical and deep borehole data suggests that a major caldera ring fracture lies at the edge of the Black Canyon WSA. A major ash flow was probably erupted from the caldera about 6 m.y. ago. In addition, more recent basalts occur in Birch Creek Valley southeast of the Black Canyon GRA. However, the Black Canyon WSA is elevated 1,000 feet or more above the Snake River Plain and Paleozoic carbonate rocks underlie most of

the WSA; both negative factors with respect to geothermal potential. More direct evidence from the Black Canyon WSA is needed to confidently evaluate its geothermal potential.

3.6 Mineral and Energy Economics

Production data given in Table I indicate that the grade of the ore in the Dome district was about 16% lead and 3 ounces/ton silver. Even small deposits of ore at these grades might be economically viable given somewhat higher metal prices. There are good water sources and numerous roads in the Black Canyon GRA, both positive factors for mineral developments. Evidence of recent mineral exploration activity was noted during the field examination (Appendix II).

Limestone and dolomite have a variety of uses including aggregate, cement, lime, building stone, fluxes, glass raw material, refractories fillers, abrasives, and soil conditioners (Savage, 1969). The generally low unit value of most limestone and dolomite dictates that production and transportation cost be low (Carr and Rooney, 1975); thus, distance to market is a major factor affecting the economic viability of these deposits. The distance between the Black Canyon GRA and major population centers probably makes transportation costs relatively high. Use is a major factor in determining how far limestone and dolomite can be shipped. High calcium limestone (95% $CaCO_3$) and high purity dolomite (40% $MgCO_3$) which have a variety of uses in the chemical and metallurgical industries are less common and hence have a higher unit value than most grades of limestone and dolomite (Brobst and Pratt, 1973); thus, they can be shipped greater distances.

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 of the point of consumption. A 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.

4.0 LAND CLASSIFICATION FOR GEM RESOURCES POTENTIAL

4.1 Explanation of Classification Scheme

In the following section the land in the Black Canyon WSA is classified for geology, energy and mineral (GEM) resources potential. The classification scheme used is shown in Table IV. 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. geology inference, based on expert opinion concerning the nature and importance geologic relationships associated with mineral and energy deposits (Singer and Mosier, 1981).

The GEM resource 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. A one-day field visit was made to the area by WGM geologists to verify the nature of mineral occurrences in and adjacent to the Black Canyon GRA.

TABLE IV

BUREAU OF LAND MANAGEMENT GEM RESOURCES LAND CLASSIFICATION SYSTEM

CLASSIFICATION SCHEME	LEVELS OF CONFIDENCE
1. The geologic environment and the inferred geologic processes do not indicate favorability for accumulation of mineral resources.	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.
2. The geologic environment and the inferred geologic processes indicate low favorability for accumulation of mineral resources.	B. The available data provide indirect evidence to support or refute the possible existence of mineral resources.
3. The geologic environment, the inferred geologic processes, and the reported mineral occurrences indicate moderate favorability for accumulation of mineral resources.	C. The available data provide direct evidence, but are quantitatively minimal to support or refute the possible existence 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.	D. The available data provide abundant direct and indirect evidence to support or refute the possible existence of mineral resources.

4.2 Classification of the Black Canyon (32-9) Wilderness Study Area

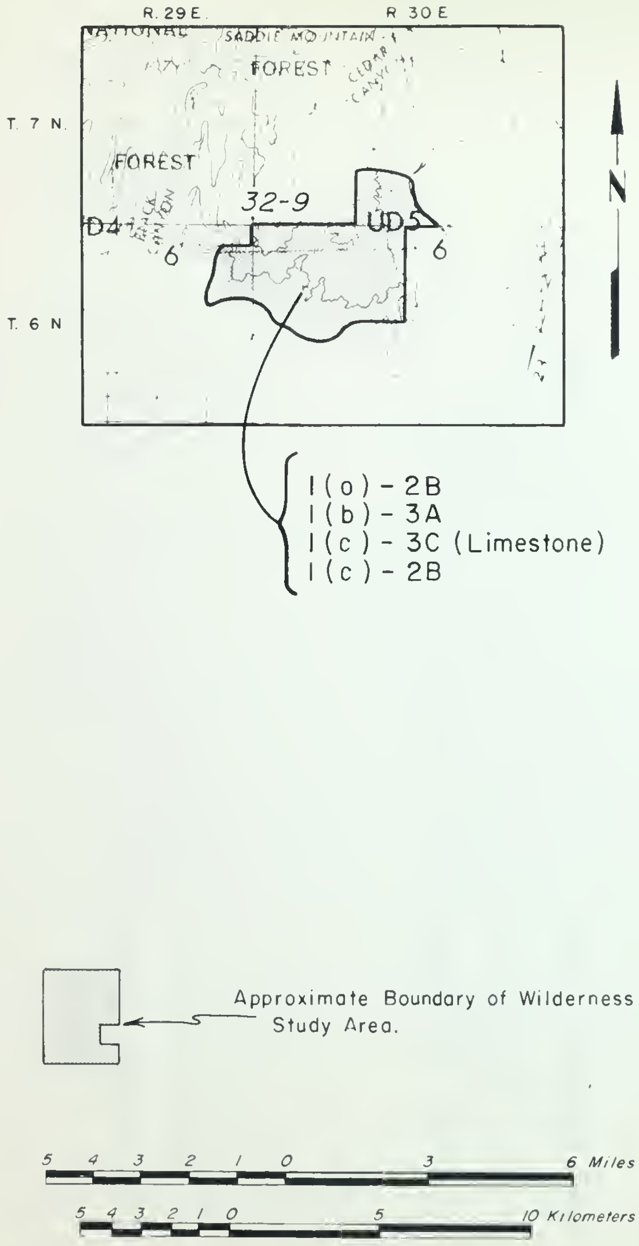
4.2.1 Locatable Minerals

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 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, pumitice, clay, magnesite, silica sand, etc. (Maley, 1983).

4.2.1a Metallic Minerals. WSA 32-9 (1a, Fig. 11) is classified as having low favorability for metallic mineral resources based on indirect evidence (2B). The basis of the classification is the absence of metallic mineral occurrences in carboniferous carbonate rocks in the Lemhi Range, but detailed data on the subsurface structure is not available. Consequently, more favorable units might be present in the subsurface of the WSA.

4.2.1b Uranium and Thorium. All of WSA 32-9 (1b, Fig. 11) is classified as having moderate favorability for uranium based on inadequate evidence (3A). The McGowan Creek Formation which is uraniferous in the Beaverhead Mountains is probably present in the subsurface of the WSA. However, the distribution of the McGowan Creek within the WSA is not known in detail nor is there any data on its uranium content in the GRA.

4.2.1c Non-Metallic Minerals. WSA 32-9 (1c, Fig. 11) is classified as having moderate favorability for uncommon varieties of limestone based on



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

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Black Canyon 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 DS APRVD G.F
FIGURE 11

minimal direct evidence (3C). The WSA is classified as having low favorability for other non-metallic mineral resources based on indirect evidence (2B).

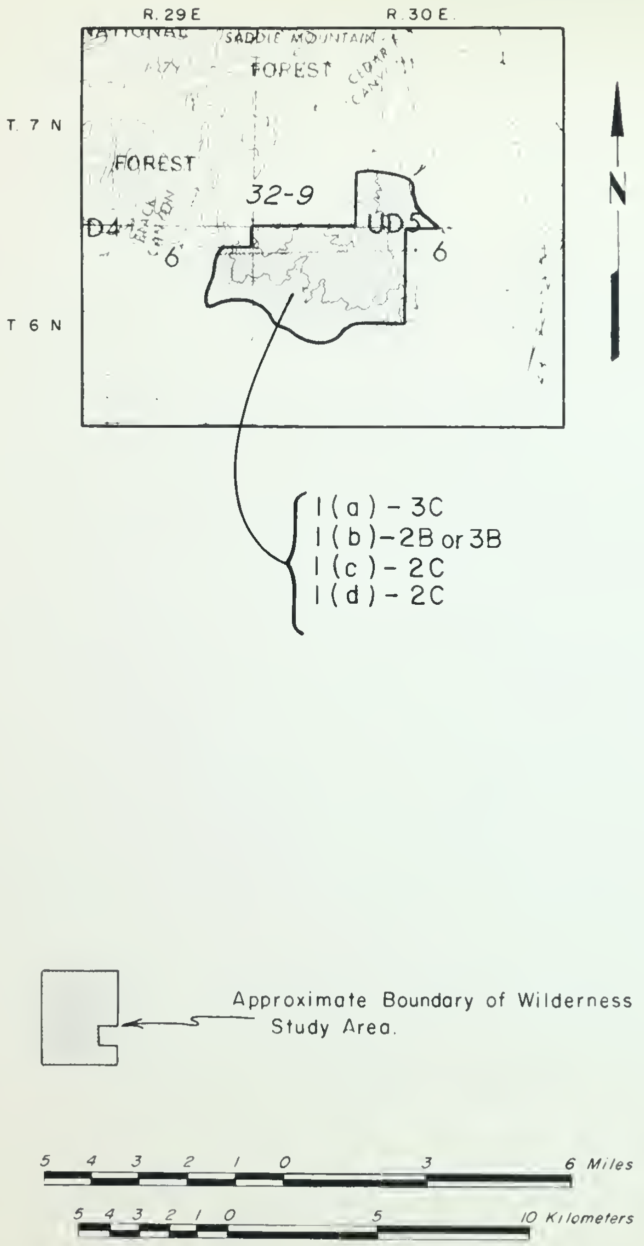
4.2.2 Leasable Resources

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, and 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).

4.2.2a Oil and Gas. WSA 32-9 (1a, Fig. 12) is classified as having moderate favorability for oil and gas based on minimal direct evidence (3C) as outlined in Section 3.5.

4.2.2b Geothermal. WSA 32-9 (1b, Fig. 12) has low to moderate favorability for both high and low/intermediate temperature geothermal resources based on indirect evidence (2B to 3B). The basis of this classification is discussed in Section 3.5.

4.2.2c Sodium and Potassium. WSA 32-9 (1c, Fig. 12) is classified as having low favorability for sodium and potassium based on minimal direct evidence (2C). The basis of the classification is the regional absence of occurrences in similar geologic environments.



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

Area I.D. Number

1 (a) - 4D

Commodity — Classification — 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.

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Black Canyon GRA, Idaho
Wilderness Study Area
Land Classification
Leasable Resources

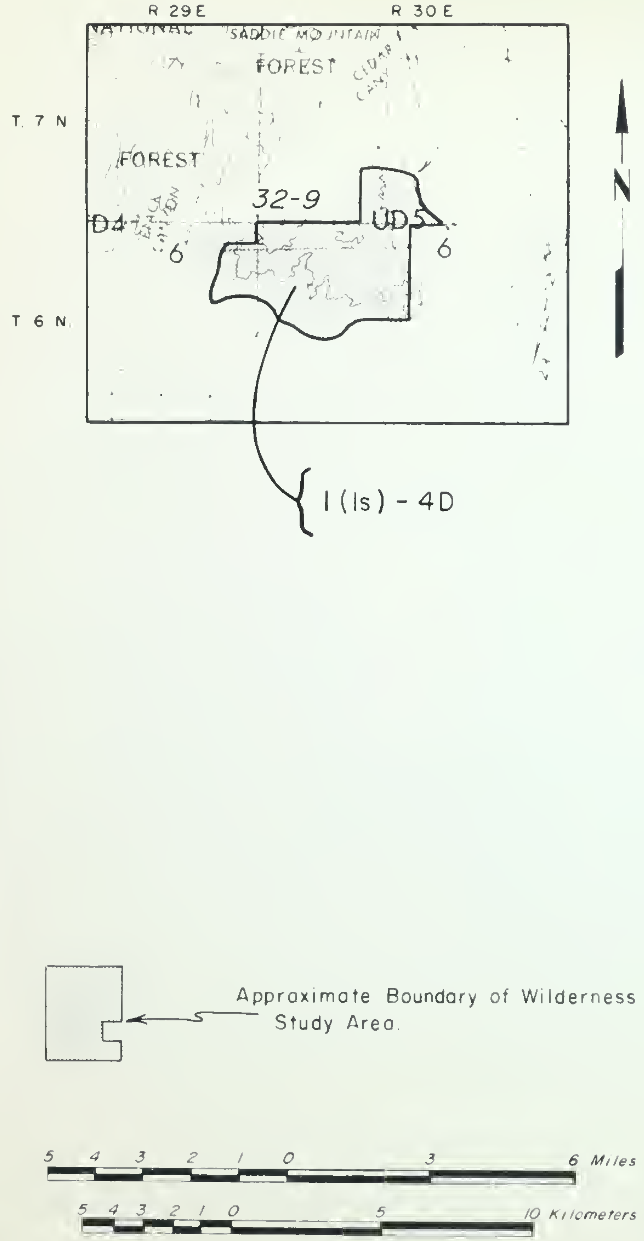
SCALE 1" : 4 MILES (1:250,000)
DATA BY WGM | DATE 9/1982 | REVISED
DRWN BY DS | APRVD G.F
FIGURE 12

4.2.2d Other. WSA 32-9 (1d, Fig. 12) is classified as having low favorability for other leasable resources based on minimal direct evidence (2C).

4.2.3 Saleable Resources

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 pertrified wood (Maley, 1983).

The entire area of WSA 32-9 (1, Fig. 13) is classified as having a high favorability for common varieties of limestone based on direct evidence (4D). The WSA is classified as having low favorability for other saleable resources based on minimal direct evidence (2C).



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 (ls) - 4D

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

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

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Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Black Canyon GRA, Idaho
Wilderness Study Area
Land Classification
Saleable Resources

SCALE 1" = 4 MILES (1:250,000)
DATA BY WGM DATE 9/1982 REVISED
DRWN BY DS1 APRVD GF
FIGURE 13

2. Analyses of potential reservoir beds should be made. These studies will aid in the location of more favorable traps.

3. Conodont color alteration index studies should be made of all Paleozoic carbonates in the Black Canyon GRA. This will provide a thermal maturation history of the Paleozoic stratigraphic section and help indicate the types of hydrocarbons generated in the area.

4. Geophysical studies should be made of the region. This will provide a better structural interpretation within the region and will help select the most favorable traps and drill sites.

Most of these recommended oil and gas studies will probably be conducted, if not already completed, by industrial firms if hydrocarbon exploration continues within the area.

5.0 RECOMMENDATIONS FOR FURTHER WORK

The area needs to be mapped at a minimum scale of 1:62,500. Older mapping is at reconnaissance scales and was completd at a time when the stratigraphy was not as well understood as today. More detailed mapping of the area would improve the evaluation for oil and gas, metallic minerals and geothermal resources.

Geochemical stream sediment samples should be collected from the area to increase the data base and improve the level of confidence in the mineral assessment. Samples should be collected at a density of 3 to 5 per square mile due to the limited secondary dispersion of base metals in carbonate terrains. The samples should be analyzed for copper, lead, zinc, molybdenum, and uranium. During this program the McGowan Creek Formation should also be sampled for uranium.

The limestone units should be mapped and sampled to determine if high purity limestone is present.

The hydrocarbon assessment would be upgraded by the completion of the following:

1. Potential hydrocarbon source beds within the Black Canyon GRA should be sampled and analyzed for hydrocarbons. The results would indicate the types of hydrocarbons that might be expected within the area. It would also provide a thermal maturity history of the area.

2. Analyses of potential reservoir beds should be made. These studies will aid in the location of more favorable traps.

3. Conodont color alteration index studies should be made of all Paleozoic carbonates in the Black Canyon GRA. This will provide a thermal maturation history of the Paleozoic stratigraphic section and help indicate the types of hydrocarbons generated in the area.

4. Geophysical studies should be made of the region. This will provide a better structural interpretation within the region and will help select the most favorable traps and drill sites.

Most of these recommended oil and gas studies will probably be conducted, if not already completed, by industrial firms if hydrocarbon exploration continues within the area.

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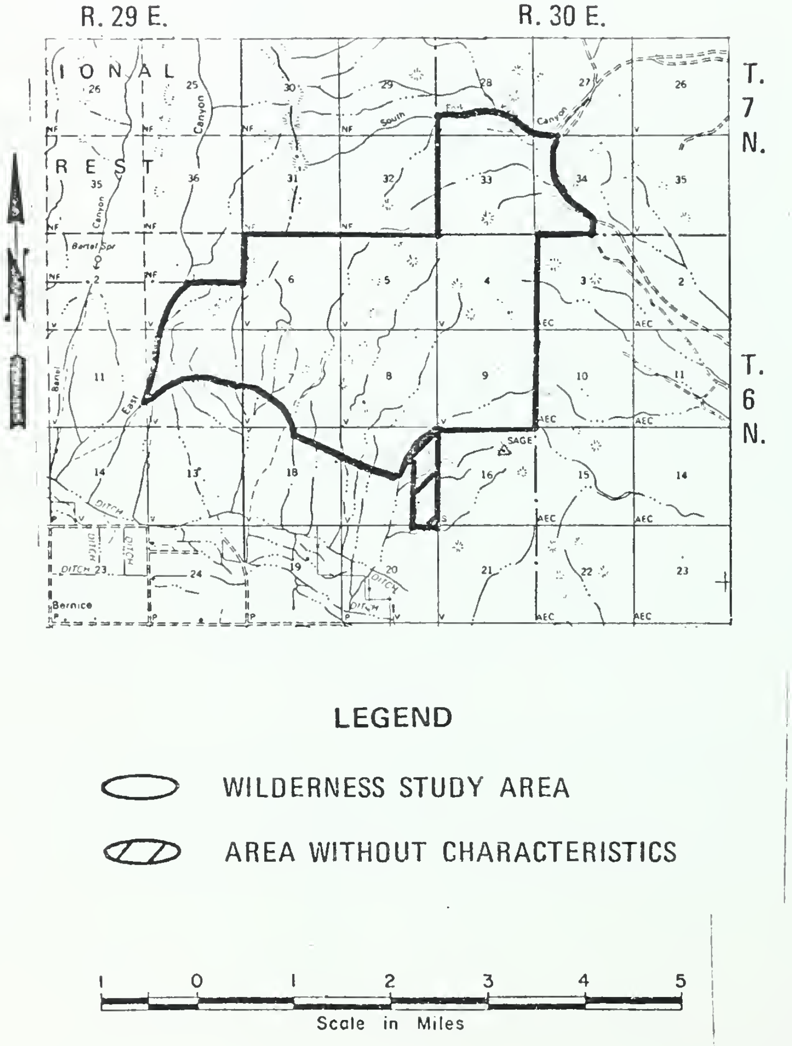
APPENDIX I

WILDERNESS STUDY AREA MAP

32–9
BLACK CANYON



APPENDIX II

FIELD VISIT REPORT

To: Black Canyon GRA Files

Fm: Greg Fernette, Bill Jones

On October 11, 1982 we visited the Black Canyon GRA as part of Task 4 in the GEM Project. The trip had two objectives: (1) to visit the Dome Mining district and confirm the structural control on the mineralization in order to assess the potential for similar mineralization in WSA 32-9 and (2) to locate and examine the unidentified prospect shown near the east boundary of the WSA by Strowd et al. (1981).

In the Dome district, we examined the Ajax Mine on South Canyon just north of the GRA and visited a recently explored copper prospect on the ridge south of the mouth of South Canyon.

The Ajax Mine consists of three shallow adits, two open and one caved. The adits are driven on a fault zone which trends N20 to 30E. The country rock is white Kinnikinic quartzite. The mineralization was galena, tetrahedrite and malachite filling fractures and shears, and locally in vugs.

We also examined a second prospect located near the mouth of South Canyon. There were several roads and drill sites which suggested exploration activity 3 to 5 years ago. Veins of malachite, chalcocite(?), and barite are exposed in two trenches along a fault which strikes N51W and dips 55W. The host rocks are brown Swauger quartzite.

The mineralization at the two prospects confirms the published descriptions by Ross and Anderson. Brittle host rocks, such as quartzite, are important in providing sites for sulfide deposition. Similar mineralization is unlikely in areas underlain by limestone.

We then located the prospects shown near the east boundary of the WSA on the Mines and Prospects Map Series. The "prospects" consist of two pits measruing 10 feet by 5 feet by 5 feet deep. The pits are dug into pediment gravels above the level of the nearby wash. Bedrock, consisting of porphyritic dacitic tuff is exposed about 1/4 mile away on the valley slope. As we drove out down another wash we saw other pits, usually in pairs, spaced 300-400 feet apart most of the way to the highway. We could find no reason for the pits. They looked more like soil test pits than placer samples.