

# Mineral Resources of the Hack Lake Wilderness Study Area, Garfield County, Colorado



U.S. GEOLOGICAL SURVEY BULLETIN 1717-A



# DEFINITION OF LEVELS OF MINERAL RESOURCE POTENTIAL AND CERTAINTY OF ASSESSMENT

## Definitions of Mineral Resource Potential

**LOW** mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics define a geologic environment in which the existence of resources is unlikely. This broad category embraces areas with dispersed but insignificantly mineralized rock as well as areas with few or no indications of having been mineralized.



**MODERATE** mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a reasonable likelihood of resource accumulation, and (or) where an application of mineral-deposit models indicates favorable ground for the specified type(s) of deposits.

**HIGH** mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a high degree of likelihood for resource accumulation, where data support mineral-deposit models indicating presence of resources, and where evidence indicates that mineral concentration has taken place. Assignment of high resource potential to an area requires some positive knowledge that mineral-forming processes have been active in at least part of the area.

**UNKNOWN** mineral resource potential is assigned to areas where information is inadequate to assign low, moderate, or high levels of resource potential.

**NO** mineral resource potential is a category reserved for a specific type of resource in a well-defined area.

## Levels of Certainty

 LEVEL OF RESOURCE POTENTIAL	U/A	H/B HIGH POTENTIAL	H/C HIGH POTENTIAL	H/D HIGH POTENTIAL
		M/B MODERATE POTENTIAL	M/C MODERATE POTENTIAL	M/D MODERATE POTENTIAL
	UNKNOWN POTENTIAL	L/B LOW POTENTIAL	L/C LOW POTENTIAL	L/D LOW POTENTIAL
				N/D NO POTENTIAL
	A	B	C	D
	LEVEL OF CERTAINTY 			

A. Available information is not adequate for determination of the level of mineral resource potential.

B. Available information suggests the level of mineral resource potential.

C. Available information gives a good indication of the level of mineral resource potential.

D. Available information clearly defines the level of mineral resource potential.

## Abstracted with minor modifications from:

Taylor, R. B., and Steven, T. A., 1983, Definition of mineral resource potential: *Economic Geology*, v. 78, no. 6, p. 1268-1270.

Taylor, R. B., Stoneman, R. J., and Marsh, S. P., 1984, An assessment of the mineral resource potential of the San Isabel National Forest, south-central Colorado: U.S. Geological Survey Bulletin 1638, p. 40-42.

Goudarzi, G. H., compiler, 1984, Guide to preparation of mineral survey reports on public lands: U.S. Geological Survey Open-File Report 84-0787, p. 7, 8.

## Chapter A

MINERAL RESOURCES OF WILDERNESS STUDY AREAS—  
NORTH-CENTRAL COLORADO

# Mineral Resources of the Hack Lake Wilderness Study Area, Garfield County, Colorado

By Sandra J. Soulliere and Mark A. Arnold,  
U.S. Geological Survey, and

Steven E. Kluender,  
U.S. Bureau of Mines

U.S. GEOLOGICAL SURVEY BULLETIN 1717-A

DEPARTMENT OF THE INTERIOR  
DONALD PAUL HODEL, *Secretary*

U.S. GEOLOGICAL SURVEY  
Dallas L. Peck, Director



Library of Congress Catalog Number 85-600285

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON: 1985

---

For sale by the Branch of Distribution  
U.S. Geological Survey  
604 South Pickett Street  
Alexandria, VA 22304

## STUDIES RELATED TO WILDERNESS

### Bureau of Land Management Wilderness Study Areas

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas to determine their mineral values, if any, that may be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral survey of the Hack Lake (CO-070-425) Wilderness Study Area, Garfield County, Colorado.





CONTENTS

Summary 1

Introduction 1

    Investigations by the U.S. Bureau of Mines 1

    Investigations by the U.S. Geological Survey 4

Appraisal of identified resources 4

    Mining and mineral-exploration activity 4

Assessment of potential for undiscovered resources 4

    Geology 4

    Geochemistry 4

    Mineral and energy resources 4

References cited 5

FIGURES

1. Map of the Hack Lake Wilderness Study Area 2

2. Index map showing the location of the Hack Lake Wilderness Study Area 3





# Mineral Resources of the Hack Lake Wilderness Study Area, Garfield County, Colorado

By Sandra J. Soulliere and Mark A. Arnold  
U.S. Geological Survey and  
Steven E. Kluender  
U.S. Bureau of Mines

## SUMMARY

The Hack Lake (CO-070-425) Wilderness Study Area has no identified mineral resources, and low potential for undiscovered mineral resources including oil, gas, or coal. This conclusion is based on an earlier survey of the Flat Tops Wilderness (Mallory and others, 1966) and on field investigations conducted in 1984.

The wilderness study area is about 20 mi northeast of Glenwood Springs, in Garfield County, Colo. It consists of two small plots of land that total about 10 acres adjoining the Flat Tops Wilderness in the White River National Forest. The wilderness study area consists of steep cliffs of basalt, 10,860 ft to 11,034 ft in altitude (fig. 1).

An extensive geochemical sampling survey of the Flat Tops Wilderness included the Hack Lake Wilderness Study Area (Mallory and others, 1966). Analyses of stream-sediment samples, taken from streams which drain the Wilderness, revealed no anomalous concentrations of any elements. During the present field investigation, five representative rock samples were collected to evaluate the undiscovered mineral resource potential of the basalt which is the bedrock in the area. Geochemical analyses of the samples indicate that the basalt contains no anomalous concentrations of any elements indicative of mineralization.

No mines or prospects are in or adjacent to the wilderness study area. No mineralized areas were identified during field investigations. An examination of U.S. Bureau of Land Management and county records disclosed no patented or unpatented mining claims or mineral leases in or adjacent to the wilderness study area.

Based upon geochemical analyses, geological surveys, and the absence of mines, prospects, and mineralized areas, the wilderness study area is considered to have low mineral resource potential. Although gypsum and anhydrite may be present in the Middle and Upper Pennsylvanian Eagle Valley Evaporite, approximately 3,000 ft beneath the wilderness study area, the

potential for these resources is unknown. The Lower and Middle Pennsylvanian Belden Formation may contain beds of coaly shale approximately 4,000 ft beneath the wilderness study area, but the potential for coal resources is low. Thin coal beds in the Belden near the wilderness study area are discontinuous. Oil and gas potential is also considered low because the wilderness study area lacks favorable host rocks and structural traps for oil and gas. Host rocks favorable for the occurrence of uranium are not present.

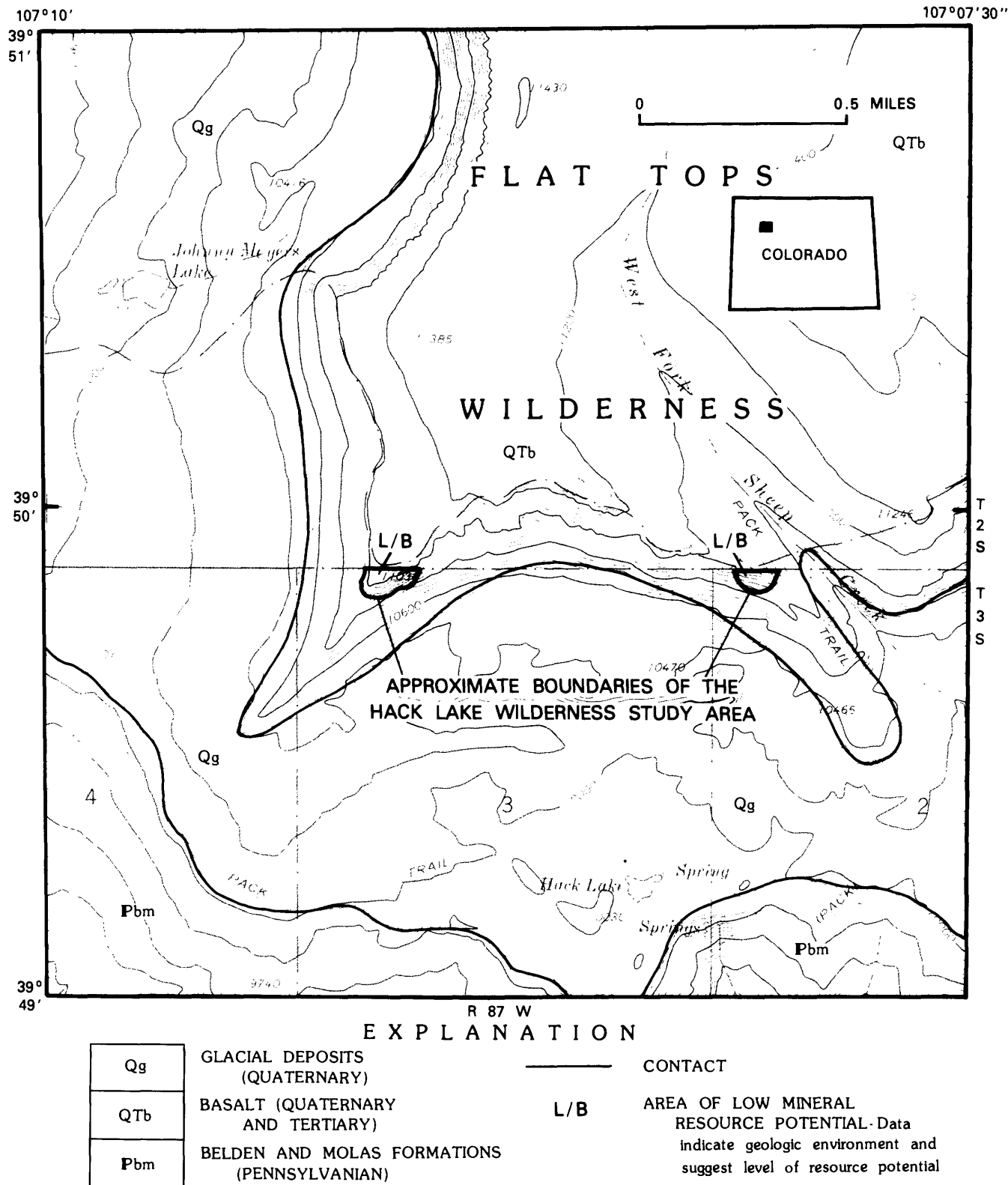
## INTRODUCTION

The Hack Lake (CO-070-425) Wilderness Study Area is about 20 mi northeast of Glenwood Springs, in Garfield County, Colo. (fig. 2). The area consists of two small plots of land of about 5 acres each adjoining the Flat Tops Wilderness in the White River National Forest. The area is accessible from White River National Forest trails on the northern and western boundaries and from the road along Sweetwater Creek to the south.

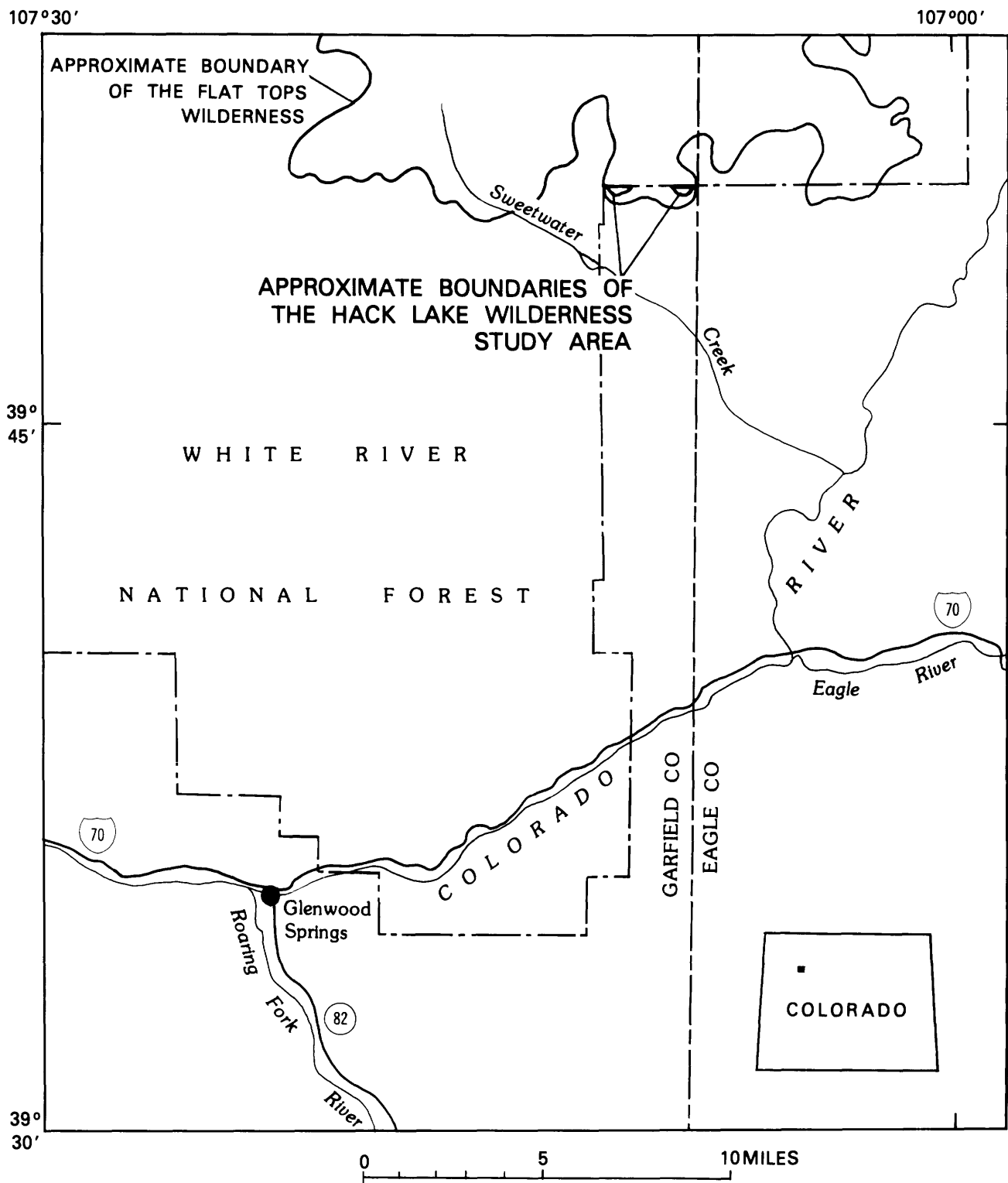
The wilderness study area is in the Colorado Plateau physiographic province at the southern edge of the Flat Tops Wilderness. The entire wilderness study area consists of steep basalt cliffs, 10,860 ft to 11,034 ft in altitude (fig. 1).

## Investigations by the U.S. Bureau of Mines

In October 1983 the U.S. Bureau of Mines (USBM) conducted a mineral investigation to evaluate the identified mineral resources of the wilderness study area as part of a joint effort with the U.S. Geological Survey. U.S. Bureau of Land Management (BLM) and county records were examined for information regarding mining claims and leases in or adjacent to the wilderness study area. Published and unpublished information was re-



**Figure 1.** Geologic and mineral resource potential map of the Hack Lake Wilderness Study Area (two locations), Garfield County, Colorado (geology modified from Bass and Northrop, 1963). Base from U.S. Geological Survey, Sweetwater Lake, Colo., 1977, 1:24,000.



**Figure 2.** Index map showing the location of the Hack Lake Wilderness Study Area, Garfield County, Colorado.

viewed; local residents and personnel from the USBM and the BLM were interviewed regarding minerals in the wilderness study area. A field investigation consisted of a

search for any evidence of mines, prospects, or mineralized areas in and within 0.5 mi of the wilderness study area.

## Investigations by the U.S. Geological Survey

In August 1984, the U.S. Geological Survey conducted an investigation to assess the potential for undiscovered mineral resources of the Hack Lake Wilderness Study Area. This assessment is based on published information on the Flat Tops Wilderness (Mallory and others, 1966) and a field investigation of the wilderness study area. The study consisted of a review of published material; a field check of existing geologic mapping at a scale of 1:24,000; a search for mines, prospects, and mineralized areas; and rock sampling for geochemical analyses. Mineral resource potential was classified according to the system of Goudarzi (1984).

*Acknowledgments.*—We thank the personnel of the U.S. Bureau of Land Management in Glenwood Springs for providing information on access to the wilderness study area and N. M. Conklin for analyses of the geochemical samples.

## APPRAISAL OF IDENTIFIED RESOURCES By Steven E. Kluender, U.S. Bureau of Mines

### Mining and Mineral-Exploration Activity

There are no mines or prospects in the wilderness study area, and no mining activity has occurred in or adjacent to it. Neither mineralized areas nor altered or stained areas indicative of mineralization were identified in or near the wilderness study area during the field investigation. An examination of BLM and county records disclosed no patented or unpatented mining claims or mineral leases in or adjacent to the wilderness study area at the time of the study. An oil-and-gas lease application has been filed in sec. 6, T. 3 S., R. 86 W., less than 2 mi east of the wilderness study area (Kluender, 1984).

## ASSESSMENT OF POTENTIAL FOR UNDISCOVERED RESOURCES By Sandra J. Soulliere and Mark A. Arnold, U.S. Geological Survey

### Geology

The Hack Lake Wilderness Study Area is in the northeastern part of the White River Plateau, a broad northwest-trending dome of the Colorado Plateau physiographic province. The wilderness study area consists of steep cliffs of basalt, 10,860 ft to 11,034 ft in altitude.

Flat-lying Quaternary and Tertiary basalt lava flows (unit QTb, fig. 1) form the cliffs which make up the wilderness study area. The basalt consists of several separate flows, ranging from fine-grained andesitic basalt to vesicular basalt. Talus, composed of angular blocks of basalt,

covers the foot of the cliffs. Quaternary glacial moraine and outwash deposits (unit Qg) surround Hack Lake and are well below the study area (fig. 1).

Ordovician through Pennsylvanian sedimentary rocks exposed to the south may underlie the wilderness study area. Geologic formations which may be in the subsurface include the Pennsylvanian Belden and Molas Formations (unit Pbm, fig. 1) (base approximately 4,000 ft below the surface) and the Middle and Upper Pennsylvanian Eagle Valley Evaporite (base approximately 3,000 ft below the surface). The depths to these formations were approximated using the published geologic map of the Glenwood Springs quadrangle by Bass and Northrop (1963).

### Geochemistry

A geochemical survey to evaluate the mineral potential of the Flat Tops Wilderness included samples from streams which drain the Hack Lake Wilderness Study Area (Mallory and others, 1966). The analyses of these samples revealed no anomalous concentrations of any elements which might indicate outcropping mineralized rocks.

The present field investigation included the collection and analysis of five basalt samples representative of the bedrock of the area. These samples were pulverized to less than 100 mesh (0.0059 in.). The samples were then analyzed for 31 elements by the six-step, direct-current arc, optical-emission semiquantitative spectrographic method (Grimes and Marranzino, 1968). Geochemical analyses indicate that the basalt contains no anomalous concentrations of elements which might indicate mineralization.

### Mineral and Energy Resources

No mineralized areas were identified in the wilderness study area; however, gypsum and anhydrite may be present in the Eagle Valley Evaporite. In the vicinity of Eagle, about 20 mi southeast of the study area, the Eagle Valley Evaporite is about 9,000 ft thick and contains isolated pods and lenses of gypsum and anhydrite (500–1,000 ft thick; Mallory, 1971). The Eagle Valley Evaporite thins northeast of Eagle and is not exposed in the study area. It may be present beneath a thick cover of basalt (base approximately 3,000 ft beneath the area). The resource potential for gypsum and anhydrite is unknown, because their extent beneath the wilderness study area is unknown.

The Belden Formation, approximately 4,000 ft beneath the wilderness study area, may contain beds of coaly shale. Bass and Northrop (1963) noted that coal in the Belden is discontinuous near the wilderness study

area. They found a 9-in.-thick coal bed in an outcrop of the Belden near Sweetwater Creek about 3 mi south of the wilderness study area. The resource potential for coal is low because coal beds in the Belden are discontinuous. The wilderness study area lacks favorable host rocks and structural traps for oil and gas. The potential for uranium is low because the wilderness study area lacks host rocks favorable for uranium.

The low mineral resource potential in the wilderness study area is assigned a certainty level of B for all commodities because the distribution of occurrences in rocks beneath the area cannot be observed and has not been well defined near the wilderness study area.

## REFERENCES CITED

- Bass, N. W. and Northrop, S. A., 1963, Geology of the Glenwood Springs quadrangle and vicinity, northwestern Colorado: U.S. Geological Survey Bulletin 1142-J, 74 p.
- Goudarzi, G. H., compiler, 1984, Guide to preparation of mineral survey reports on public lands: U.S. Geological Survey Open-File Report 84-787, 42 p.
- Grimes, D. J., and Marranzino, A. P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semiquantitative analysis of geologic materials: U.S. Geological Survey Circular 591, 6 p.
- Kluender, S. E., 1984, Mineral investigation of the Hack Lake Wilderness Study Area, Garfield County, Colorado: U.S. Bureau of Mines Open-File Report MLA 34-84, 7 p.
- Mallory, W. W., 1971, The Eagle Valley Evaporite, northwest Colorado—a regional synthesis: U.S. Geological Survey Bulletin 1311-E, 37 p., 3 pl.
- Mallory, W. W., Post, E. V., Ruane, P. J., Lehmbeck, W. L., and Stotelmeyer, R. B., 1966, Mineral resources of the Flat Tops Primitive Area, Colorado: U.S. Geological Survey Bulletin 1230-C, 30 p., 2 pl.







