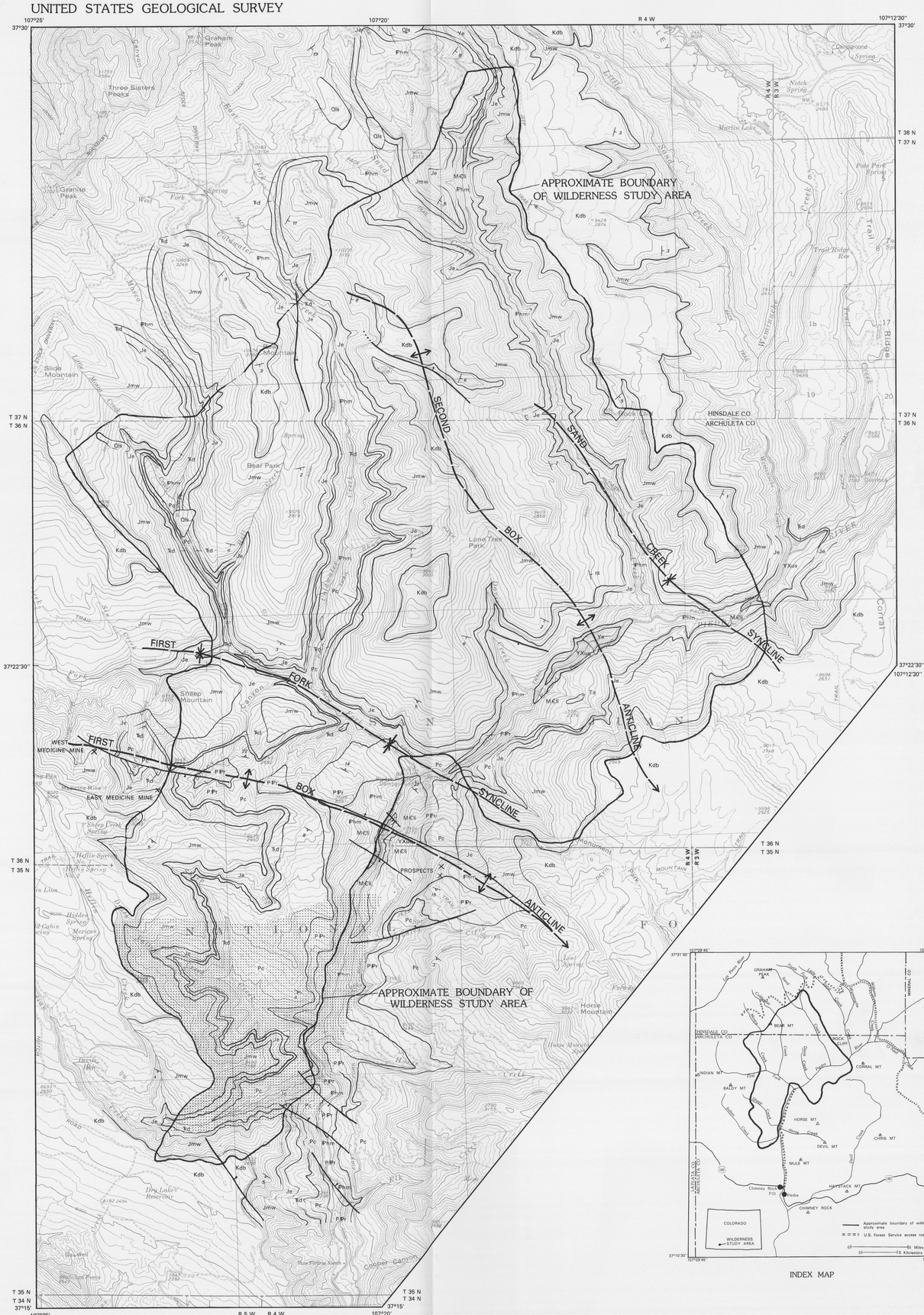
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY







INDEX MAP

Base from U.S. Geological Survey, 1:50,000 County Map Series Archuleta County, sheet 1, 1975, and Hinsdale County, sheet 2, 1978.

SCALE 1:50 000

1 ½ 0 1 2 3 MILES
1 .5 0 1 2 3 KILOMETERS

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology from Hail, W. J., Jr., 1971, and unpublished mapping, 1965-1966, and from Read and others, 1949, modified by Condon, S. M., Franczyk, K. J., and Bush, A. L., 1982

# MINERAL RESOURCE POTENTIAL OF THE PIEDRA WILDERNESS STUDY AREA, ARCHULETA AND HINSDALE COUNTIES, COLORADO

By

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MISCELLANEOUS FIELD STUDIES
MAP MF-1630-A
PAMPHLET ACCOMPANIES MAP

## CORRELATION OF MAP UNITS

| | | |
|---|---|---|
| Qls | Holocene and Pleistocene | QUATERNARY |
| Ta | Miocene(?) and Oligocene | TERTIARY |
| Kdb | Upper and Lower Cretaceous | CRETACEOUS |
| UNCONFORMITY | | |
| Jmw | Upper and Middle Jurassic | JURASSIC |
| Je | Middle Jurassic | |
| UNCONFORMITY | | |
| Trd | Upper Triassic | TRIASSIC |
| UNCONFORMITY | | |
| Pc | Lower Permian | PERMIAN |
| PPr | Lower Permian and Upper Pennsylvanian | |
| IPhm | Upper Pennsylvanian | PENNSYLVANIAN |
| UNCONFORMITY | | |
| MCli | Lower Mississippian, Upper Devonian, and Upper Cambrian | MISSISSIPPIAN DEVONIAN CAMBRIAN |
| UNCONFORMITY | | |
| Ye | | PRECAMBRIAN Y |
| YXuq YXus | Relation uncertain | PRECAMBRIAN Y and X |

## DESCRIPTION OF MAP UNITS[1]

**Qls** LANDSLIDE DEBRIS (HOLOCENE AND PLEISTOCENE)

**Ta** ANDESITE (MIOCENE? TO OLIGOCENE)—Age from Lipman and others (1970); not examined in this survey

**Kdb** DAKOTA SANDSTONE AND BURRO CANYON FORMATION UNDIFFERENTIATED (UPPER AND LOWER CRETACEOUS)—Maximum combined thickness 300-400 ft
Dakota Sandstone (Upper Cretaceous)—Light-gray to brown sandstone with interbedded siltstone and carbonaceous shale; may contain chert-pebble conglomerate or conglomeratic sandstone at base. Unconformably overlies Burro Canyo Formation
Burro Canyon Formation (Lower Cretaceous)—Lenticular chert-pebble conglomerate interbedded with green and gray claystone. Unconformably overlies the Morrison Formation

**Jmw** MORRISON FORMATION AND WANAKAH FORMATION UNDIFFERENTIATED (UPPER AND MIDDLE JURASSIC)—Maximum total thickness 900-1,000 ft
Morrison Formation (Upper Jurassic)—Conformably overlies the Wanakah Formation
Brushy Basin Member—Variegated claystone and mudstone with lenticular, light-brown sandstone
Salt Wash Member—Lenticular, light-brown sandstone interbedded with green and gray claystone, mudstone, and siltstone
Wanakah Formation (Middle Jurassic)—Reportedly interfingers with the underlying Entrada Sandstone (Read and others, 1949)
Junction Creek Sandstone Member—Light-gray crossbedded sandstone
Middle member—Light- to dark-red limy shale, siltstone, and lenticular sandstone
Pony Express Member—Can be divided into two parts in many places
Upper part—Massive gypsum or gypsum and limestone breccia, as much as 15 ft thick
Lower part—Dark-gray, thin-bedded to thinly laminated, fetid, bituminous limestone, as much as 15 ft thick, but characteristically less than 5 ft thick

**Je** ENTRADA SANDSTONE (MIDDLE JURASSIC)—Informally divided into two parts:
Upper part—light- to medium-yellow, moderately sorted sandstone with horizontal bedding and medium-scale tangential crossbedding
Lower part—Light-gray, well-sorted sandstone with large-scale tangential crossbedding and minor horizontal bedding; locally contains conglomerate at base. Unconformably overlies rocks ranging in age from Triassic to Precambrian. Truncates progressively older units from south to north. Maximum thickness is about 300 ft

**Trd** DOLORES FORMATION (UPPER TRIASSIC)—Red to purple shale and siltstone; gray to light-brown, lenticular sandstone and limestone-pebble conglomerate; locally contains phyllite clasts near the mouth of Weminuche Creek. Unconformably overlies rocks ranging in age from Permian to Precambrian. Thickness ranges from 0 to about 350 ft

**Pc** CUTLER FORMATION (LOWER PERMIAN)—Red to purple shale and siltstone; gray, red, or brown lenticular sandstone, arkosic sandstone, and arkosic conglomerate. Interfingers with underlying Rico Formation. Thickness ranges from 0 to about 850 ft

**PPr** RICO FORMATION (LOWER PERMIAN AND UPPER PENNSYLVANIAN)—Interbedded light-gray, crinoidal, sandy, and clay-rich limestone; light- to dark-brown, arkosic and crinoidal sandstone; and gray, olive, and red shale. Interfingers with underlying Hermosa Formation. Thickness ranges from 0 to about 185 ft

**IPhm** HERMOSA FORMATION AND MOLAS FORMATION UNDIFFERENTIATED (UPPER PENNSYLVANIAN)—Combined thickness about 1,000 ft
Hermosa Formation—Interbedded medium- to dark-gray limestone; gray, olive, and red shale and mudstone; dark- to light-brown sandstone, arkose, and conglomerate. Limestone and gray to olive shale are dominant rocks in south part of area; clastics and red shale increase in thickness and abundance to north and northeast
Molas Formation—Basal red and brown breccia, dark-red to purple, siliceous shale and siltstone, limestone-pebble conglomerate, and lenticular quartzose sandstone. Unconformably overlies Leadville Limestone

**MCli** LEADVILLE, OURAY, ELBERT, AND IGNACIO FORMATIONS UNDIFFERENTIATED (LOWER MISSISSIPPIAN, UPPER DEVONIAN, AND UPPER CAMBRIAN)—Maximum combined thickness of the undifferentiated formations about 200 ft
Leadville Limestone (Lower Mississippian)—Dark-gray, dense to coarsely crystalline, thin- to medium-bedded, oolitic limestone; minor red shale, siltstone, and sandstone; commonly contains a basal limestone breccia. Maximum thickness about 100 ft
Ouray Limestone (Upper Devonian)—Light-gray, dense to finely crystalline, locally dolomitic, thin- to medium-bedded limestone; sandy limestone; calcareous sandstone; quartzitic sandstone; and calcareous shale. Maximum thickness about 45 ft
Elbert Formation (Upper Devonian)—Varicolored calcareous shale, limestone, quartzitic sandstone, and siltstone. Maximum thickness about 25 ft
Ignacio Quartzite (Upper Cambrian)—Light-gray to brown, quartzitic sandstone and siltstone; locally conglomeratic in lower part. Maximum thickness about 30 ft

**Ye** EOLUS GRANITE (PRECAMBRIAN Y; 1,460 m.y.)—Pink to brick-red massive, homogeneous, porphyritic, biotite-hornblende quartz monzonite, lesser amounts of biotite quartz monzonite and biotite granite (Steven and others, 1974). Intrudes Uncompahgre Formation
UNCOMPAHGRE FORMATION (PRECAMBRIAN Y AND Z; 1,460-1,700 m.y.)

**YXus** Slate-gray, green, and black slate, phyllite and schist. Approximately 7,000 ft exposed in WSA

**YXuq** Quartzite—Light gray to pale blue, thin to thick bedded; contains a few thin layers of quartz-pebble conglomerate and sericitic siltstone; nearly vertical foliation in Second Box Canyon

[1]/Descriptions are drawn from Hail (1971, and unpublished mapping 1965-1966), Steven and others (1974), and personal observations.

## EXPLANATION OF SYMBOLS

- CONTACT—Approximately located
- FAULT—Bar and ball on downthrown side; dotted where concealed
- STRIKE AND DIP OF BEDS
  - Observed
  - Calculated
- ANTICLINE—Showing approximate trace of axial plane and direction of plunge
- SYNCLINE—Showing approximate trace of axial plane and direction of plunge
- MINE OR PROSPECT PIT
- AREA OF CONCENTRATION OF SAMPLES CONTAINING ANOMALOUS METAL VALUES

## STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and Congress. This report presents the results of a mineral resource potential survey of the Piedra Wilderness Study Area in the San Juan National Forest, Archuleta and Hinsdale Counties, Colorado. The Piedra Wilderness Study Area was established in Public Law 96-560, known as the Colorado Wilderness Act of 1980.

## MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

The mineral resource potential of the Piedra Wilderness Study Area is low. No occurrences of metallic minerals, of valuable industrial rocks and minerals, or of useful concentrations of organic fuels are known in the study area. However, a noneconomic occurrence of gypsum in the Jurassic Wanakah Formation lies a few hundred feet west of the WSA boundary. Particular attention was paid to the possible occurrence of organic fuels in the Pennsylvanian Hermosa Formation, of uranium and vanadium in the Jurassic Entrada Sandstone and Morrison Formation, and of coal in the Cretaceous Dakota Sandstone. Extensive sampling of stream sediments, limited sampling of rock outcrops and springs, and a number of scintillometer traverses failed to pinpoint significant anomalies that might be clues to mineral deposits.

## INTRODUCTION

The Piedra Wilderness Study Area in southwestern Colorado covers 41,500 acres located mainly in Archuleta County and extending north into Hinsdale County. The wilderness study area (WSA) is approximately 30 mi east-northeast of Durango, Colo., and approximately 20 mi west-northwest of Pagosa Springs, Colo. A U.S. Forest Service access road that extends from U.S. Highway 160 to the confluence of First Fork and the Piedra River provides access to the southern portion of the WSA. Another U.S. Forest Service access road follows the northern and northwestern boundaries of the study area.

The Piedra Wilderness Study Area is in the southern foothills of the San Juan Mountains, southwest of the Continental Divide. Altitudes range from below 7,000 ft along the Piedra River to nearly 10,500 ft at Bear Mountain. The Piedra River is the principal stream; its tributaries include First Fork, Mosca, Coldwater, Sand, Indian, and Sheep Creeks. Numerous smaller creeks flow into these main tributaries. All of the stream valleys in the WSA are very steep sided, and two box canyons are present along the Piedra River where the river has breached major structural features. Exposures of bedrock in the WSA are very rare due to dense vegetation cover. The Jurassic Entrada Sandstone forms a few isolated cliffs where the entire formation is exposed, but only a few outcrops that expose a small portion of each formation are present for the remaining geologic units in the WSA. Timber in the area is mainly Ponderosa pine, Douglas fir, and other fir species; aspen is present at the higher elevations.

The Piedra Wilderness Study Area is along the northern border of the San Juan Basin, at the boundary of the Colorado Plateau and the Southern Rocky Mountain physiographic provinces. The regional structural dip in the northern San Juan Basin is to the south, but anticlinal and synclinal folding in the WSA has produced variable dip directions. Larger faults and the axes of structural features in the study area have a dominant north-northwesterly trend. Many of the streams in the WSA also trend in this direction, possibly because their position is controlled by these structural features.

## ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Overall, the potential for mineral or fuel resources in the Piedra Wilderness Study Area is low. Although there are suitable host rocks for both metallic and nonmetallic ores, and although some units may be suitable lithologically as oil or gas reservoirs, there are no indications that any useful resources are present.

Precambrian metamorphic and igneous rocks are exposed only in two small, virtually inaccessible areas along the Piedra River.

The Pennsylvanian Hermosa Formation is the target of oil and gas exploration in the San Juan Basin to the south and the Paradox Basin to the southwest; in the WSA the Hermosa is at or near the surface along the up-dip edge of the San Juan Basin, is broken by faults, and shows no indication of live or dead oil at the outcrop. It seems likely that any previously contained hydrocarbons have escaped to the atmosphere or are no longer recoverable.

The Jurassic Entrada Sandstone, where it is overlain by the Pony Express Limestone Member of the Wanakah Formation, is known to contain uraniferous stratabound vanadium deposits in areas 30-40 mi to the west and northwest. Visual examination and sampling of the Entrada showed no such occurrences in the Piedra Wilderness Study Area.

In many places outside the WSA, the upper part of the Pony Express Limestone Member contains bedded gypsum; nowhere has it been found to be commercially valuable. About 400 ft west of the WSA on the ridge between Johnny Canyon and Medicine Creek, bedded gypsum occurs in the Wanakah Formation at the East Medicine Mine. Poor exposure prevents definite identification of the host member, but it seems likely that the gypsum lies stratigraphically above the Pony Express Limestone Member. Areal extent of the deposit could not be determined, but several small prospect pits are present at the East and West Medicine Mines. The maximum thickness of gypsum exposed is about 15 ft, and a small amount of gypsum has been mined according to the claim owner, William Lyons of College Place, Wash. (oral commun., June 15, 1982). Because of the thinness of the gypsum at the only relatively well-exposed occurrence, and the distance from any major market, the resource potential of the study area for gypsum is considered to be low.

The Salt Wash Member of the Morrison Formation and less commonly the Brushy Basin Member of the Morrison contain uranium-vanadium deposits in the southwestern Colorado and southeastern Utah parts of the Colorado Plateau Province. However, radiometric traverses with a scintillometer across the Morrison Formation in a number of places showed no significant radiometric anomalies in the WSA.

Carbonaceous shales and thin, low-rank coal are present in the Cretaceous Dakota Sandstone in the WSA. The thickest coal bed seen was only about 1 ft, and the organic carbon content of the shales is too low to be useful. Accordingly, the cool resource potential of the study area is classed as low.

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For sale by Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225