UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Mineral resources of the Worm Creek Wilderness Study Area, Bear Lake County, Idaho

By

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and
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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

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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 the 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 Worm Creek Wilderness Study Area (ID-037-077), Bear Lake County, Idaho.

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ILLUSTRATIONS

ABSTRACT

At the request of the U.S. Bureau of Land Management, the 40-acre Worm Creek Wilderness Study Area (ID-037-077), Bear Lake County, Idaho, was studied for its mineral resources and resource potential. Bureau of Mines studies were in 1984. There are no mines, mineralized areas, and no identified resources at the surface. The mineral resource potential for undiscovered phosphate and vanadium resources in the study area is unknown, for undiscovered lead-silver-copper-gold resources in replacement deposits it is low, and for undiscovered oil and gas, the energy resource potential is moderate.

SUMMARY

Character and setting

The Worm Creek Wilderness Study Area (ID-037-077) is in southeastern Idaho about 8 mi northwest of Bear Lake and 14 mi southwest of Montpelier, Idaho (fig. 1). The study area is on the eastern side of the Bear River Range of the Wasatch Mountains and is bounded on the west and south by the Cache National Forest. Access is by a graded road in the valley of Bloomington Creek 1/4 mi north of the area. The 40-acre wilderness study area lies on a steep north-facing slope about 200 ft above Bloomington Creek, and ranges in elevation from 6,680 ft at its northern boundary to 7,200 ft at its southern boundary.

The rocks of the study area are in the upper plate of the Paris thrust fault near the western edge of the Cordilleran overthrust belt of Idaho, Wyoming, and Utah. This is a terrane of north-south-trending, eastward-directed folds and imbricate thrust faults. The area is underlain by the upper part of the Upper Cambrian St. Charles Limestone (fig. 2) (see geologic time chart in Appendix) which is covered by unsorted rock debris of Pleistocene age in the northern half of the area. The trace of the Paris fault passes about 3 mi east of the wilderness study area. The fault plane dips at about 30° SW, and the Paleozoic rocks in the vicinity of the study area strike north-northwest and dip southwest at about 15°. The Bouguer gravity anomaly map shows only regional anomaly trends and the effects of Basin and Range normal faulting in this part of southeastern Idaho.

Identified resources and resource potential

There has been no mining activity within the study area and no mineral resources were identified. Currently (1988) there are no mining claims in the area. The study area has not been offered for oil and gas leasing because it is under wilderness consideration.

Approximately 80,000 long tons of phosphate were produced between 1916 and 1932 about 3 mi east of the area from the Paris-Bloomington deposits of the Montpelier phosphate district. These deposits are in the Permian Phosphoria Formation in the lower plate of the Paris thrust fault and contain 0.6-0.9 percent vanadium. Although the Paris fault dips westward beneath the study area, the complex folding and imbricate thrusting typical of rocks within thrust sheets make it impossible to state that the Phosphoria Formation is present at depth beneath the area. Therefore, on the basis of available data the resource potential of the wilderness study area for undiscovered phosphate and vanadium is rated as unknown with certainty level A (see mineral resource classification system in Appendix).

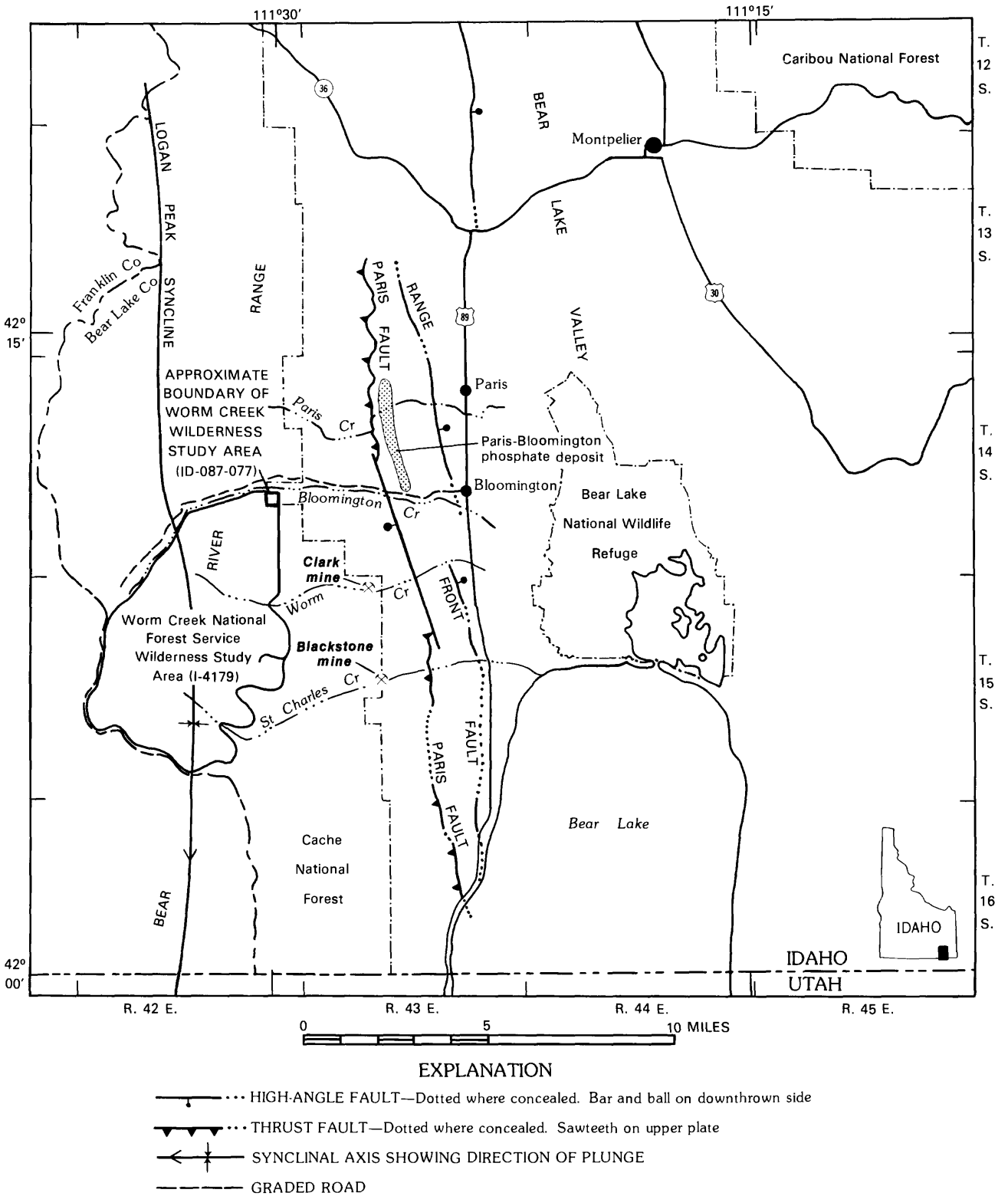


Figure 1. Index map of the Worm Creek Wilderness Study Area, Bear Lake County, Idaho, showing important geologic and topographic features.

Lead ore containing minor amounts of silver and copper, and a trace of gold has been produced from discontinuous replacement deposits at the contact between the Cambrian Ute and Blacksmith Limestones east of the study area. The mine closest to the area was the Spence mine, 1 mi to the east. Although the Ute and Blacksmith Limestones dip westward beneath the area, the small and discontinuous nature of the lead replacement deposits, in conjunction with the small size of the wilderness study area, suggests that the mineral resource potential (the likelihood of occurrence) of the study area for undiscovered lead-silver-copper-gold resources in replacement deposits is low with certainty level B.

The region surrounding the study area (excluding the study area itself) was completely covered by oil and gas leases, but as of 1988 no productive zones have been identified near the study area. In 1984 Murphy Oil USA drilled a dry hole 7,500 ft deep about 5 mi southeast of the study area (sec. 34, T. 14 S., R. 43 E.). Texaco drilled a dry hole about 9 mi north of the area in 1988. Evidence from conodonts indicates that hydrocarbons contained in the Paleozoic rocks which underlie the Bear River Range are at optimum maturation for both oil and gas generation. Although no structural traps are known in the upper plate of the Paris thrust in the vicinity of the study area, traps may be present in underlying thrust plates at depth. The energy resource potential of the wilderness study area for undiscovered oil and gas is rated as moderate, at certainty level B.

INTRODUCTION

The U.S. Geological Survey (USGS) and U.S. Bureau of Mines (USBM) studied the 40-acre Worm Creek Wilderness Study Area (ID-037-077) in Bear Lake County, Idaho (fig. 1), as requested by the U.S. Bureau of Land Management (BLM). In this report the area studied is referred to as the wilderness study area or simply the study area. The Worm Creek Wilderness Study Area is in southeastern Idaho at the eastern edge of the Bear River Range, about 8 mi northwest of Bear Lake and about 14 mi southwest of Montpelier, Idaho, the nearest sizeable community. The study area is square in shape, 1/4 mi per side, and is bounded on the west and south by the Cache National Forest. Bloomington Creek is just 1/4 mi north of the area. Access is by a graded road in the valley of Bloomington Creek that leaves U.S. Highway 89 at the community of Bloomington, 5 mi east of the area (fig. 1).

The study area is on a fairly steep north-facing slope about 200 ft above Bloomington Creek; its elevation ranges from 6,680 ft on the north to 7,200 ft on the south. Bloomington Creek valley has nearly 2,000 ft of relief in the vicinity of the study area. The area is within the Cordilleran overthrust belt of Idaho, Wyoming, and Utah and is underlain by the Cambrian St. Charles Limestone.

This report presents an evaluation of the mineral endowment (identified resources and mineral resource potential) of the study area and is the product of several separate studies by the USBM and the USGS. Identified resources are classified according to the system of the U.S. Bureau of Mines and U.S. Geological Survey (1980) which is shown in the Appendix of this report. Identified resources are studied by the USBM. Mineral resource potential is the likelihood of occurrence of undiscovered metals and nonmetals, industrial rocks and minerals, and of undiscovered energy sources (coal, oil, gas, oil shale, and geothermal sources). It is classified according to the system of Goudarzi (1984) and is shown in the Appendix. Undiscovered resources are studied by the USGS.

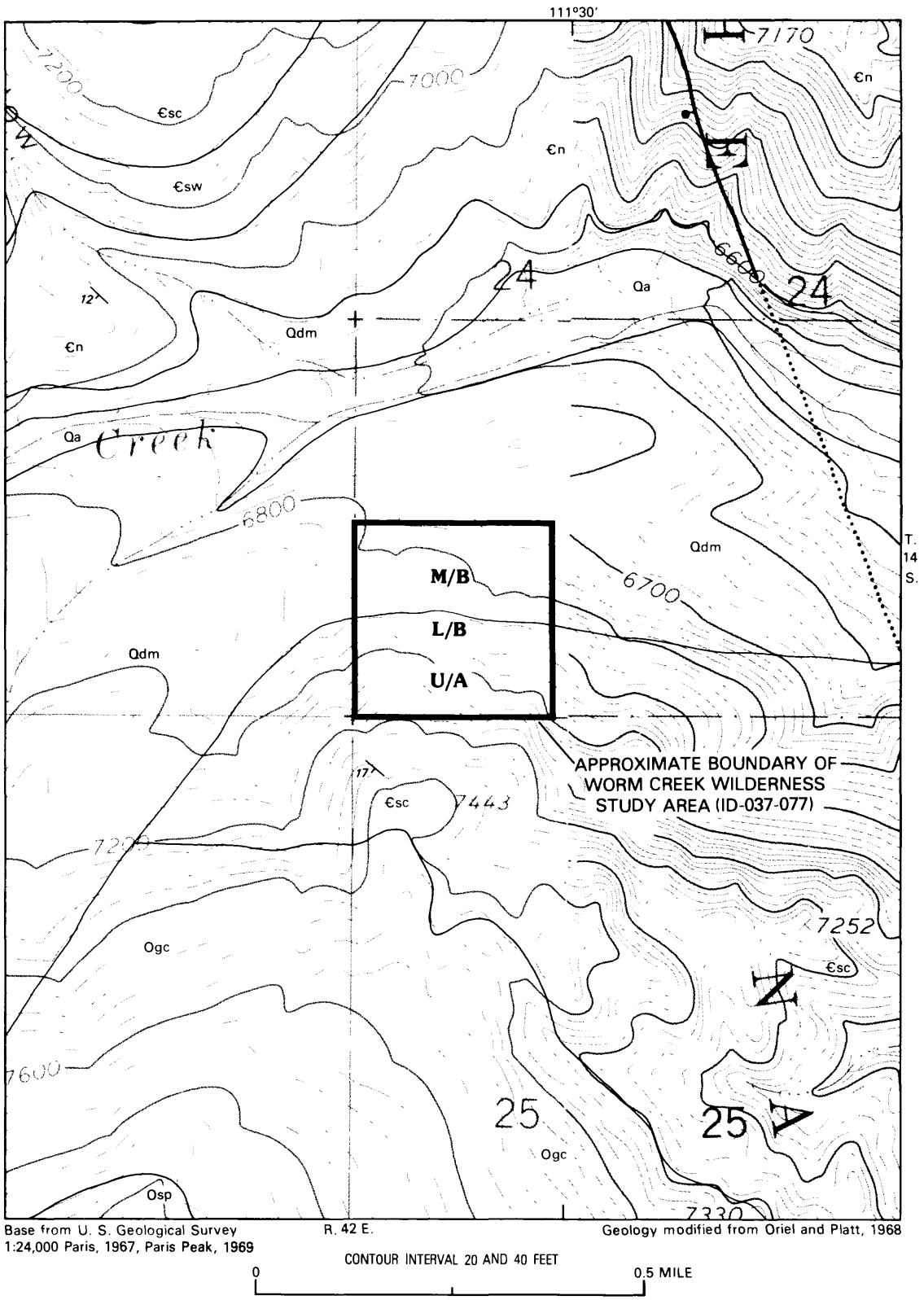


Figure 2. Map showing mineral resource potential and geology of the Worm Creek Wilderness Study Area.

EXPLANATION OF MINERAL RESOURCE POTENTIAL

(All assessments of mineral resource potential apply to entire study area)

M/B Geologic terrane having moderate energy resource potential for oil and gas, with certainty level B (available information suggests the level of potential)

L/B Geologic terrane having low mineral resource potential for lead, silver, copper, and gold, with certainty level B

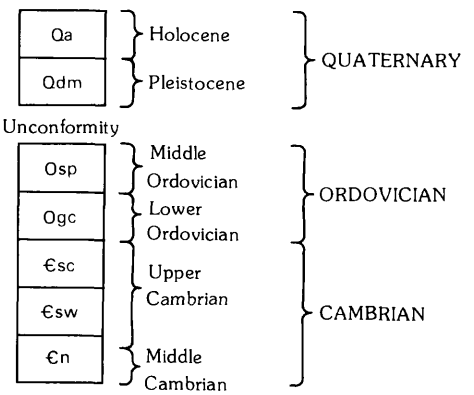
U/A Geologic terrane having unknown mineral resource potential for phosphate and vanadium, with certainty level A (available information is inadequate to determine the level of potential)

——— Contact

———•••— High-angle fault—Dotted where concealed. Bar and ball on downthrown side

12 Strike and dip of bedding

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

(Modified from Oriel and Platt, 1968 and 1980)

Qa **Alluvium (Holocene)**--Well to poorly sorted, unconsolidated gravel, sand, and silt in channel and floodplain of Bloomington Creek. Probably less than 20 ft thick

Qdm **Diamicton (Pleistocene)**--Unconsolidated, strikingly unsorted clastic material that ranges in size from clay and silt to blocks of quartzite and other massive units. Deposited as mudslides, rock glaciers, and hillwash. As much as 150 ft thick

Osp **Swan Peak Quartzite (Middle Ordovician)**--White, tan, and pink, well-sorted, well-rounded fine- to medium-grained massive quartzite. About 650 ft thick

Ogc **Garden City Limestone (Middle and Lower Ordovician)**--Dark-gray limestone; minor dolomite. Abundant bioclastic and intraformational conglomerate and chert increasing toward top. 1,300 ft thick

€sc **St. Charles Limestone (Upper Cambrian)**--Medium-gray crystalline limestone containing beds of intraformational conglomerate and chert; some thin-bedded dolomite near top. About 600 ft thick

€sw **Worm Creek Quartzite Member**--Gray to tan arkosic quartzite; some sandy dolomite beds in lower part. About 200 ft thick

€n **Nounan Limestone (Upper and Middle Cambrian)**--Gray and blue-gray, thin-bedded crystalline dolomite; minor dark-gray silty limestone and limestone conglomerate. About 1,000 ft thick

Investigations by the U.S. Bureau of Mines

U.S. Bureau of Mines personnel examined the Worm Creek Wilderness Study Area during the summer of 1984 in conjunction with a mineral study of the adjacent U.S. Forest Service 15,770-acre Worm Creek Roadless Study Area (I-4179) (Rains, 1985). The study of the much larger roadless area included a review of available published and unpublished data related to mineral deposits in or near the roadless area, examination of Bear Lake County mining claim records and BLM records of claims and leases, and a field examination involving 16 employee-days. No samples were collected in or near the present wilderness study area during the investigation of the roadless study area. Additional information is available from the Bureau of Mines, Western Field Operations Center, E. 360 Third Avenue, Spokane, WA 99202.

Investigations by the U.S. Geological Survey

The Worm Creek Wilderness Study Area is within the area mapped geologically by Coulter (1956) in his investigation of the southeastern part of the Preston 30-minute quadrangle. Other geologic mapping in the region surrounding the study area was done by Mansfield (1927), McKelvey and Strobell (1955), and Oriel and Platt (1968, 1980). Because of the high quality of the previous geological mapping and the small size of the study area, only limited geologic field work was done by B.B. Houser. This consisted of several traverses across the area and inspection of quarries, mines, and prospects in Bloomington Creek valley east of the area. Two rock samples were collected for petrographic study. No geochemical or new geophysical studies were done.

APPRAISAL OF IDENTIFIED RESOURCES

By R.L. Rains, U.S. Bureau of Mines

Mining and mineral exploration and occurrences

There has been no mining activity within the study area and no mineral resources were identified. Currently (1988) there are no mining claims in the area. Phosphatic shale, replacement-type lead-silver deposits, and manganese occur 1 to 6 mi east of the study area near the trace of the Paris thrust fault. Phosphate, lead, and silver have been produced from these deposits (Rains, 1985).

Phosphate was produced from the Paris-Bloomington deposits (fig. 1) of the Montpelier phosphate district (Service, 1967) east of the study area from 1916 to 1932. This production was from the Permian Phosphoria Formation and yielded approximately 80,000 long tons of phosphate rock worth about $360,000 (USBM files). Service (1967) noted the high content of vanadium and associated metals in the Paris-Bloomington phosphate deposits and suggested that these metals might constitute more valuable mineral resources than phosphate. Surveys indicated the presence of 50-60 million tons of inferred phosphate ore containing 0.6-0.9 percent V_2O_5 (vanadium pentoxide). The vanadium-bearing phosphatic beds may dip under the study area but would be at great depths.

Nineteen carloads of concentrates that contained 78-80 percent lead were reported to have been shipped in 1896 from the Blackstone Mine in St. Charles Canyon about 6 mi southeast of the study area (fig. 1) (Mansfield, 1927). USBM files show that in 1924, 5,632 lb (pounds) of lead and 5 oz (troy ounces) of silver were recovered from 7 tons of ore. The Clark Mine on Worm Creek about 5 mi southeast of the study area produced 29,542 lb of lead, 397 oz of

silver, 70 lb of copper, and 1 oz of gold from 148 tons of ore between 1927 and 1963 (USBM files). Host rocks of these two mines (Middle Cambrian Blacksmith and Ute Limestones) are present at depth in the wilderness study area.

Limestone within the study area may be suitable for some industrial uses, but deposits outside the area are closer to markets and could be mined more effectively. Sand and gravel occurrences along streams are not extensive enough to be classified as identified resources.

The immediate study area has not been offered for oil and gas leasing because it is under wilderness consideration. However, the surrounding area was completely covered by oil and gas leases as of 1988. Exploration for oil and gas in the region continues, but no productive zones have been identified in or near the study area. In 1984 Murphy Oil USA drilled a dry hole 7,500 ft deep about 5 mi southeast of the study area (sec. 34, T. 14 S., R. 43 E.). A well drilled by Texaco about 9 mi north of the area in 1988 was also dry.

ASSESSMENT OF POTENTIAL FOR UNDISCOVERED RESOURCES

By B.B. Houser

Geology

The Worm Creek Wilderness Study Area is in the Cordilleran overthrust belt of Idaho, Wyoming, and Utah (Armstrong and Oriel, 1965; Wiltschko and Dorr, 1983), a terrane of north-south-trending, eastward-directed folds and imbricate thrust faults. The rocks of the study area are on the east limb of the Logan Peak syncline (fig. 1) in the upper plate of the Paris thrust fault near the western edge of the overthrust belt. The trace of the Paris thrust fault crosses Bloomington Creek 3 mi east of the study area where its angle of dip is about 30° SW (McKelvey and Strobell, 1955). There is evidence that initial movement of the Paris thrust fault occurred in latest Jurassic to earliest Cretaceous time, and that later movements may have continued into early Late Cretaceous time (Wiltschko and Dorr, 1983). Eastward displacement along the Paris thrust is modest, about 4-7 mi (Wiltschko and Dorr, 1983), but stratigraphic throw is estimated to be about 20,000 ft (Armstrong and Cressman, 1963).

North-south-trending block faulting began during the Neogene and produced the modern Basin and Range topography of the region. The wilderness study area is on the eastern side of the uplifted block of the Bear River Range, about 4 mi west of the range front fault which separates the range from the Bear Lake basin on the east (Oriel and Platt, 1980).

Only one bedrock unit, the upper part of the Upper Cambrian St. Charles Limestone, is present in the 40-acre study area (Coulter, 1956). Other Paleozoic units in the immediate vicinity of the area (fig. 2) are the Middle and Upper Cambrian Nounan Limestone; the Upper Cambrian Worm Creek Quartzite Member, which is the lower member of the St. Charles Limestone; the Lower and Middle Ordovician Garden City Limestone; and the Middle Ordovician Swan Peak Quartzite. The Paleozoic rocks strike north-northwestward and dip generally southwestward at about 15°. In the northern half of the wilderness study area, the St. Charles Limestone is covered by Pleistocene diamicton (Oriel and Platt, 1980). Holocene alluvium is present in the channel and floodplain of Bloomington Creek.

Geochemistry and geophysics

There are no streams in the area, and nearby streams drain larger areas underlain by other rock units in addition to the St. Charles Limestone, thus no stream-sediment samples were taken for geochemical evaluation. A scintillometer was carried during the geologic investigation of the area; no radiation levels above background were noted.

No new geophysical studies were done. There are no Landsat linear features in the region of the Worm Creek Wilderness Study Area (D.L. Sawatzky, written commun., 1988), and in this part of southeastern Idaho the Bouguer gravity anomaly map (Bankey and others, 1985) shows only regional anomaly trends and the effects of Basin and Range normal faulting (M.D. Kleinkopf, oral commun., 1988).

Mineral and energy resources

Metals

No mines, prospects, or evidence of mineralized rock were found in the study area. About 3 mi east of the area, however, phosphate was mined from deposits in the lower part of the Permian Phosphoria Formation between Paris and Bloomington Creeks (Mansfield, 1927; McKelvey and Strobell, 1955). Mines of the Paris-Bloomington deposit have produced phosphate, vanadium, and associated metals (selenium, zinc, silver, uranium, chromium, molybdenum, cadmium, fluorine, thallium, and rare earth elements) (Mitchell and others, 1981).

In the Paris-Bloomington deposit, the Phosphoria Formation is in the lower plate of the Paris thrust fault, which projects to a depth of greater than 9,000 ft beneath the study area (assuming a constant westward dip of 30° for the Paris thrust). Although individual phosphatic beds of the lower part of the Phosphoria Formation in southeastern Idaho commonly pinch or swell, the overall phosphatic nature of the unit tends to be fairly uniform (Mansfield, 1927). Thus, if the Phosphoria Formation is present beneath the wilderness study area it is likely that it contains a significant amount of phosphate and vanadium. However, on the basis of available data it is impossible to know if the Phosphoria is present beneath the area. Uncertainties of structure caused by imbricate faulting within the lower plate of the Paris thrust fault render the extension of surface structures to depth highly tentative. The mineral resource potential of the study area for phosphate and vanadium is therefore rated as unknown, with a certainty level of A.

Lead-silver-copper-gold replacement deposits occur about 1 mi east of the study area at the contact between the Middle Cambrian Ute and Blacksmith Limestones in the upper plate of the Paris thrust fault (Mansfield, 1927). This contact dips about 25° SW and projects to a depth of about 2,500-3,000 ft beneath the study area. Similar deposits are present along the outcrop belt of this stratigraphic contact on both the east and west sides of the synclinal Bear River Range (Butler and others, 1920; Mansfield, 1927; Dover and Bigsby, 1983). The deposits are in the form of small, discontinuous pockets and consist chiefly of lead ore containing minor amounts of silver, copper, and gold. Although these replacement-type ore bodies are apparently widespread at the Ute-Blacksmith Limestone contact, their occurrence as small, discontinuous pockets suggests that the probability of a replacement type ore body being present directly beneath the study area is statistically low (considering the small acreage of the wilderness study area). Thus the mineral resource potential of the study area for lead-silver-copper-gold replacement deposits is low with certainty level B.

Oil and gas

Although the study area has not been offered for oil and gas leasing because it is under wilderness consideration, the surrounding area was completely covered by oil and gas leases as of 1988. Sandberg (1983) assigned a moderate resource potential for oil and gas to the Bear River Range in southeastern Idaho. This rating was based, in part, on evidence from conodonts indicating that hydrocarbons contained in the Paleozoic rocks which underlie the range are at optimum maturation for both oil and gas generation. Although no structural traps are known in the upper plate of the Paris thrust in the vicinity of the study area, traps may be present in underlying thrust plates at depth. In agreement with Sandberg's assessment (1983), the energy resource potential for oil and gas is rated as moderate, with certainty level B.

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APPENDIX

GEOLOGIC TIME CHART

Terms and boundary ages used in this report

EON	ERA	PERIOD		EPOCH	BOUNDARY AGE IN MILLION YEARS
Phanerozoic	Cenozoic	Quaternary		Holocene	0.010
				Pleistocene	1.7
		Tertiary	Neogene Subperiod	Pliocene	5
				Miocene	24
			Paleogene Subperiod	Oligocene	38
				Eocene	55
				Paleocene	66
	Mesozoic	Cretaceous		Late Early	96 138
		Jurassic		Late Middle Early	205
		Triassic		Late Middle Early	~ 240
	Paleozoic	Permian		Late Early	290
		Carboniferous Periods	Pennsylvanian	Late Middle Early	~ 330
			Mississippian	Late Early	360
		Devonian		Late Middle Early	410
		Silurian		Late Middle Early	435
		Ordovician		Late Middle Early	500
		Cambrian		Late Middle Early	~ 570[1]
Proterozoic	Late Proterozoic				900
	Middle Proterozoic				1600
	Early Proterozoic				2500
Archean	Late Archean				3000
	Middle Archean				3400
	Early Archean				
pre-Archean[2]		3800?			4550

[1] Rocks older than 570 m.y. also called Precambrian, a time term without specific rank.

[2] Informal time term without specific rank.

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.

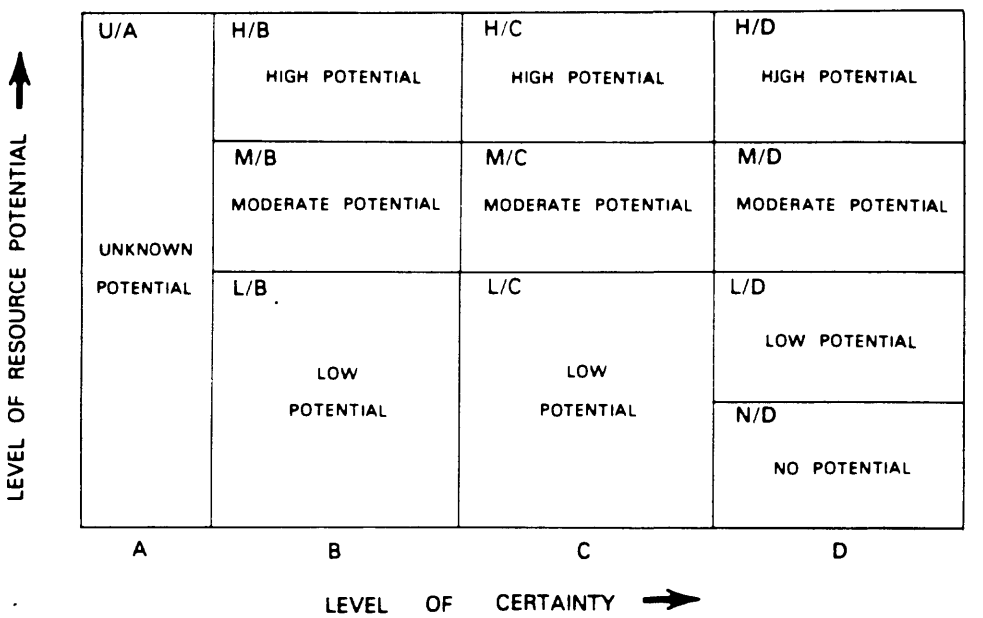
MODERATE mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a reasonable likelihood of resource accumulation, and (or) where an application 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



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.

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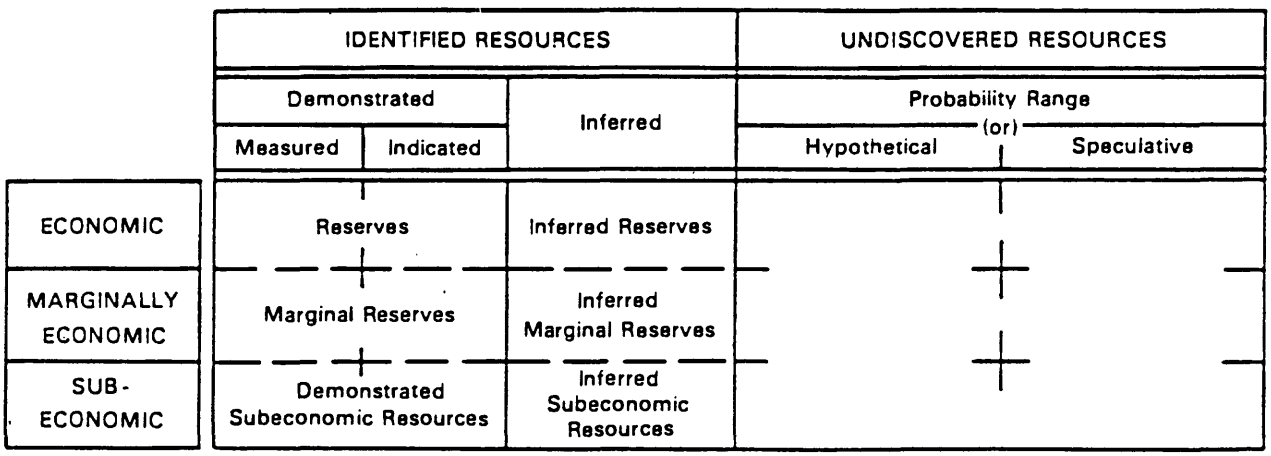
RESOURCE/RESERVE CLASSIFICATION



Major elements of mineral resource classification, excluding reserve base and inferred reserve base. Modified from U. S. Bureau of Mines and U. S. Geological Survey, 1980, Principles of a resource/reserve classification for minerals: U. S. Geological Survey Circular 831, p. 5.