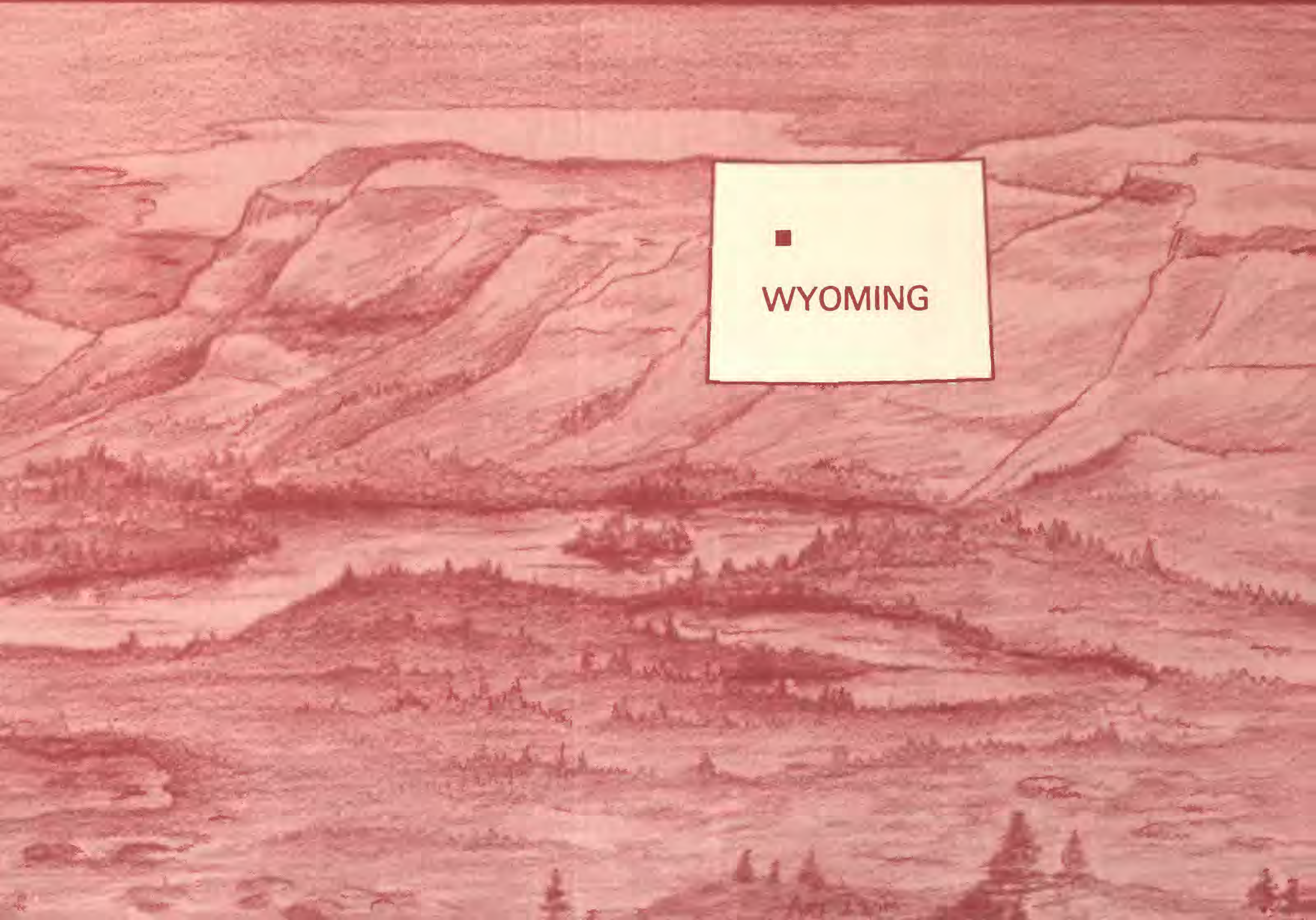
Mineral Resources of the Owl Creek Wilderness Study Area, Hot Springs County, Wyoming

U.S. GEOLOGICAL SURVEY BULLETIN 1756–D



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Chapter D

Mineral Resources of the Owl Creek Wilderness Study Area, Hot Springs County, Wyoming

By DANA J. BOVE, ROBERT R. CARLSON, and
DOLORES M. KULIK
U.S. Geological Survey

WILLIAM LUNDBY
U.S. Bureau of Mines

U.S. GEOLOGICAL SURVEY BULLETIN 1756

MINERAL RESOURCES OF WILDERNESS STUDY AREAS—NORTHERN WYOMING

DEPARTMENT OF THE INTERIOR
MANUEL LUJAN, JR., Secretary

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

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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 Owl Creek (WY-010-104 A/B/C) Wilderness Study Area, Hot Springs County, Wyoming.

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Mineral Resources of the Owl Creek Wilderness Study Area, Hot Springs County, Wyoming

By Dana J. Bove, Robert R. Carlson, *and*
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ABSTRACT

At the request of the U.S. Bureau of Land Management, 710 acres of the Owl Creek Wilderness Study Area (WY–010–104 A/B/C) were studied for mineral endowment. Field and laboratory studies were conducted by the U.S. Geological Survey and the U.S. Bureau of Mines. A search of U.S. Bureau of Land Management, State, and county records showed no current or previous mining claim activity and, other than common-variety sand and gravel, no mineral resources were identified during field examination of the study area. Sand and gravel is classified as an inferred subeconomic resource; however, the remoteness of the area precludes much usage of this material. About two-thirds of the study area is under lease for oil and gas. The entire study area has moderate resource potential for undiscovered oil and gas and low resource potential for undiscovered metals, coal, zeolites, and geothermal energy.

SUMMARY

Character and Setting

The Owl Creek (WY–010–104 A/B/C) Wilderness Study Area comprises 710 acres in the southeastern Absaroka Range, Hot Springs County, Wyo. (figs. 1, 2). The Owl Creek Wilderness Study Area is adjacent to the 703,961-acre Washakie Wilderness, Shoshone National Forest. The study area lies in relatively remote country, about 30 mi (miles) west of the town of Hamilton Dome and about 45 mi west of Thermopolis. Due to the small size and proximity of parcels A, B, and C, they will be referred to collectively as the "wilderness study area," or simply the "study area;" these parcels will be referred to individually if a more specific geographic notation is required.

The Absaroka Range is the largest Eocene volcanic field in the northern Rocky Mountains (9,000 mi^2) and straddles northwestern Wyoming and adjacent parts of Montana. The rocks of the range are predominately Eocene (see geologic time chart in Appendix) lava flows and volcaniclastic rocks. Rocks of the Absaroka volcanic plateau cover the west flank of the Bighorn basin, where they conceal Paleozoic and Mesozoic sedimentary strata (Brittenham and Tadewald, 1985). A thick sequence of middle Eocene volcaniclastic rocks [as much as 4,000 ft (feet); K.A. Sundell, Ram Oil, Corp., unpub. data] covers the entire study area. The Tepee Trail Formation, which is the oldest volcaniclastic unit exposed in the study area, typically consists of olive-gray, well-bedded volcanic sandstone and conglomerate, lesser amounts of volcanic breccia, and minor siltstone. The Tepee Trail Formation is overlain by the Wiggins Formation, which is characterized by white to light-colored tuffaceous volcanic conglomerate and sandstone and contains massive, unsorted landslide-debris flow breccias. Although no intrusions have been identified within the study area, the Washakie Needles, which are the topographic expression of a 38-m.y. (million year old) porphyritic dacite plug (Love and others, 1976), crop out about 1 mi north of parcel A (fig. 1).

Identified Mineral Resources

In addition to field examination, the U.S. Bureau of Mines (USBM) conducted a literature search for geologic

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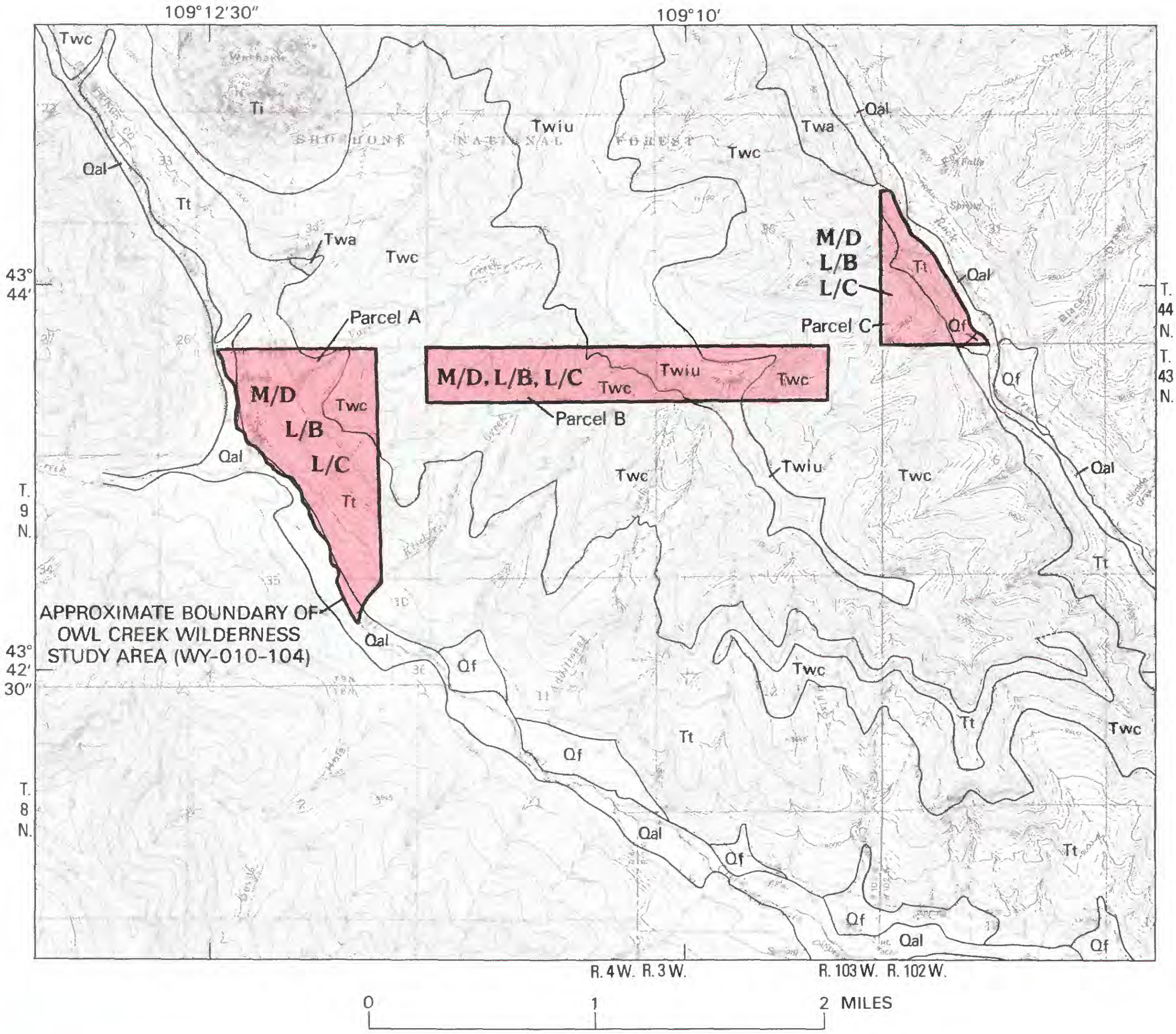

EXPLANATION

M/D	Geologic terrane having moderate mineral resource potential for oil and gas, with a certainty level of D	Qal	Alluvium (Quaternary)
L/B	Geologic terrane having low mineral resource potential for coal, zeolites, and geothermal energy, with a certainty level of B	Qf	Debris fan deposits (Quaternary)
		Ti	Tertiary intrusive rocks (Oligocene)
L/C	Geologic terrane having low mineral resource potential for all metals, with a certainty level of C		Wiggins Formation (middle Eocene)
		Twiu	Upper member
	Levels of Certainty	Twc	Chaos member
B	Available information suggests the level of mineral resource potential	Twa	Allochthonous member
C	Available information gives a good indication of the level of mineral resource potential	Tt	Tepee Trail Formation (middle Eocene)
D	Available information clearly defines the level of mineral resource potential	———	Contact—Dashed where inferred

Figure 1. Mineral resource potential and geology of the Owl Creek Wilderness Study Area, Wyoming. Geology modified from K.A. Sundell (Ram Oil, Corp., unpub. map).

information and locations of patented and unpatented mining claims, mineral leases, and oil and gas leases in and near the study area. A search of U.S. Bureau of Land Management, State, and County records showed no current or previous mining claim activity and, other than common-variety sand and gravel, no mineral resources were identified during field

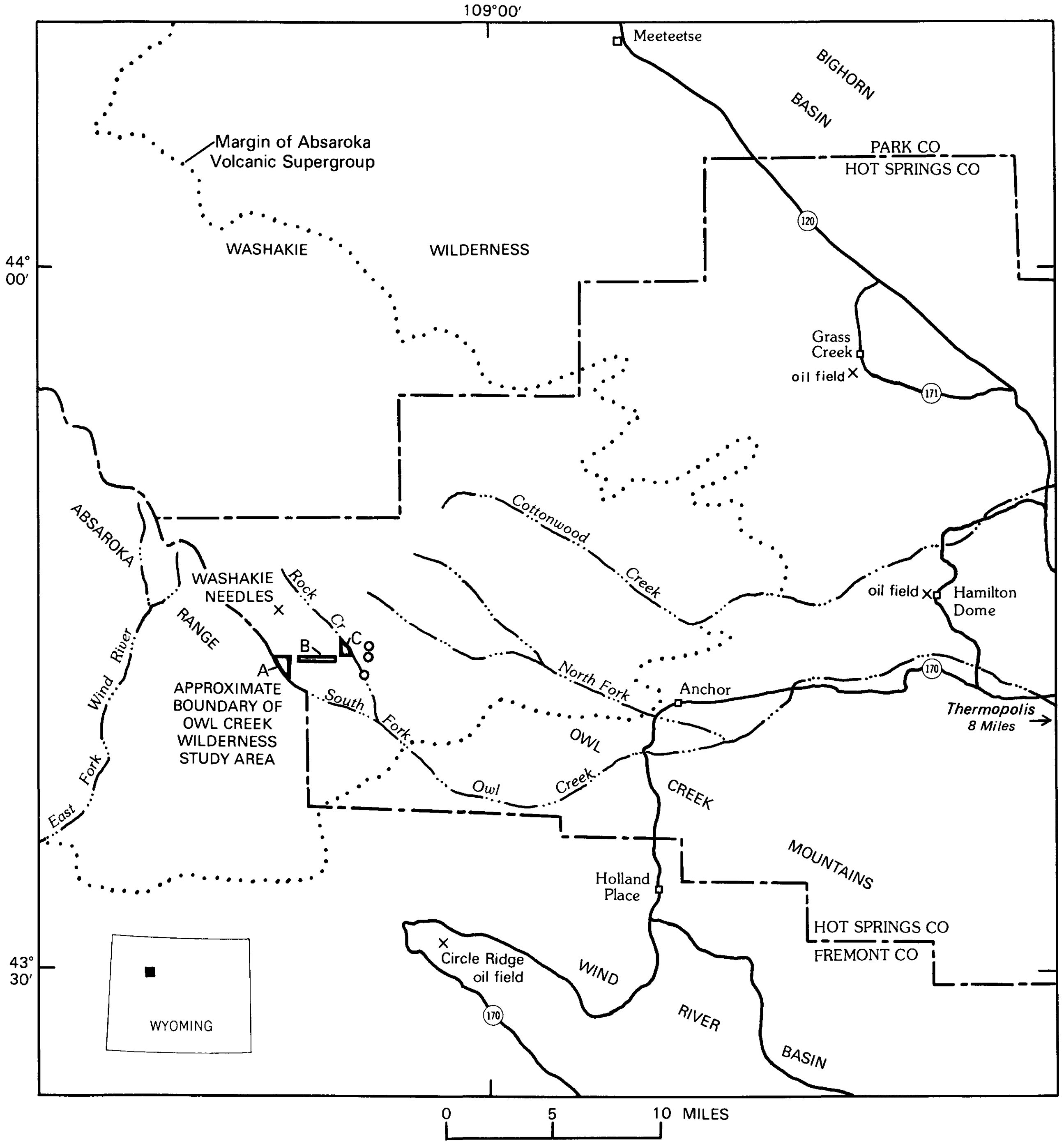

Figure 2. Location of the Owl Creek Wilderness Study Area, Wyoming. Parcels identified by letters (A, B, C). Open circles show location of drill holes.

examination. Sand and gravel is classified as an inferred subeconomic resource; however, the remoteness of the area precludes much usage of this material. About two-thirds of the study area is under lease for oil and gas, but no evidence of drilling was found there (fig. 3).

The study area, which is situated in the southwestern Bighorn basin (Sundell, 1982, 1986), is underlain by many of the same Mesozoic and Paleozoic sedimentary rocks that produce oil and gas in the Bighorn and Wind River basins to the east and south, respectively (fig. 2) (Sundell, 1982; Bailey and Sundell, 1986; Brittenham and Tadewald, 1985). Three holes drilled less than 5 mi to the east of the study area (fig. 2) penetrated anticlinal structures in known oil-producing formations including the Madison, Amsden, Tensleep, and Phosphoria Formations (Bailey and Sundell, 1986; Sundell, 1982; K.A. Sundell, Ram Oil, Corp., unpub. data). Although

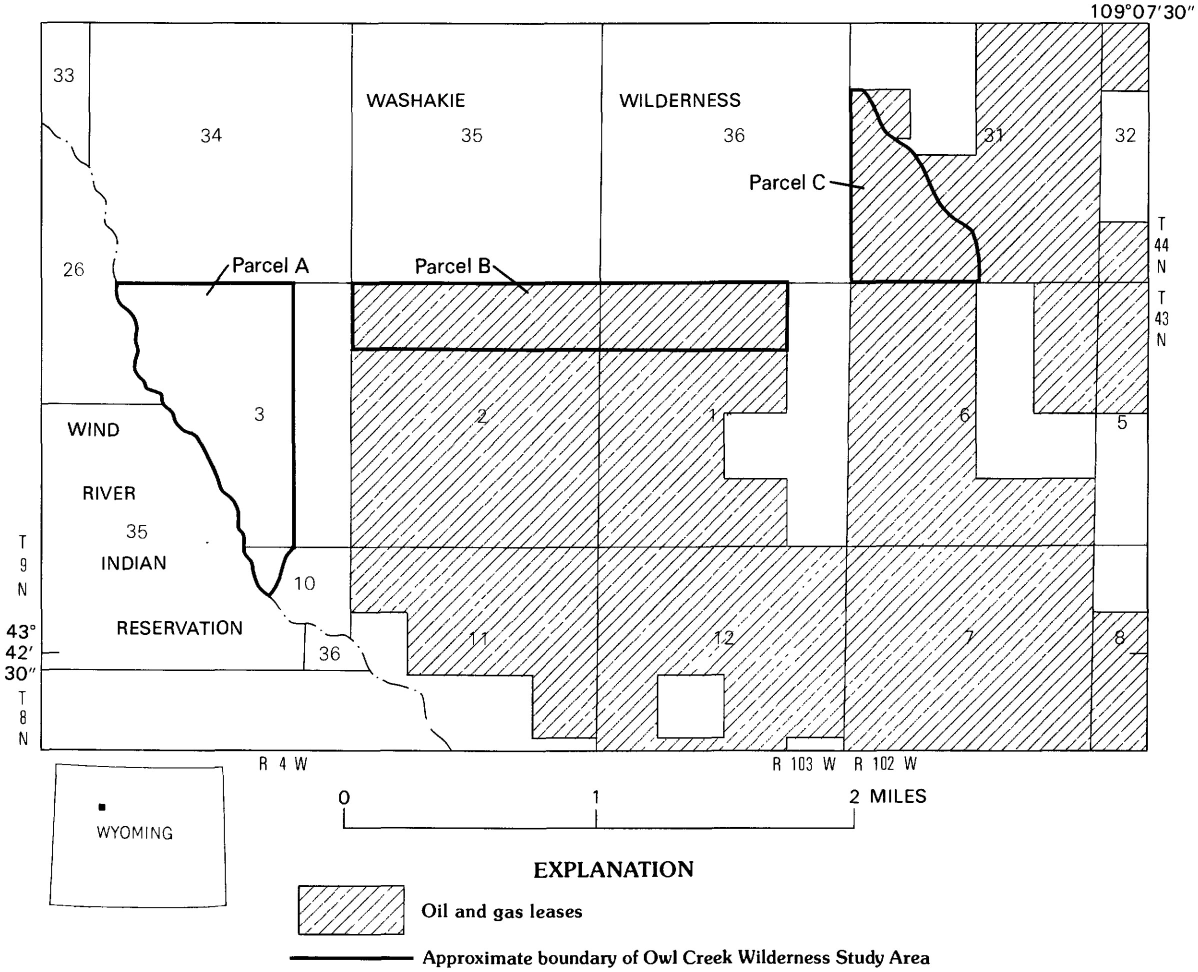

Figure 3. Index map of the Owl Creek Wilderness Study Area, Wyoming, showing location of oil and gas leases and drill holes. Lease information from U.S. Bureau of Land Management: current as of 1986.

asphaltum and oil and gas shows were recorded in all three drill holes, the holes were economically nonproducing and were abandoned (Bailey and Sundell, 1986; Sundell, 1986).

Mineral Resource Potential

Stream-sediment samples were collected by the U.S. Geological Survey (USGS) in and adjacent to the study area for geochemical analysis. Examination of analytical results from these samples revealed no anomalous amounts, groupings, or patterns of elements commonly associated with ore deposits, other than barium. In the absence of other anomalous elements that indicate hydrothermal activity, barium—probably present in the mineral barite—is thought to be of sedimentary origin.

Gravity and magnetic studies are largely of a reconnaissance nature and are adequate only to define regional features with respect to the subsurface distribution of rock masses and the structural framework of the area. Gravity data suggest that the study area lies near the leading edge of one or more thrust faults in an area where anticlines commonly form during fault-related deformation; these anticlines could be traps for oil and gas.

The mineral resource potential for all undiscovered metals is low in the study area (fig. 1). The geologic environment for metal deposits is unfavorable; mineralized rock was not seen at the surface; and there are no anomalous element concentrations in the geochemical data indicative of metal deposits.

The proximity of the study area to large oil and gas fields in the Bighorn and Wind River basins, the presence of reservoir-quality sedimentary rocks of Paleozoic age and live oil and gas shows in the subsurface in drill holes within 5 mi, and the possibility of anticlinal structures and stratigraphic traps as indicated by drill-hole and regional gravity data indicate a moderate resource potential for undiscovered oil and gas in the study area (fig. 1).

The study area has low resource potential for undiscovered coal, geothermal energy, and zeolites (fig. 1). Although these commodities occur elsewhere in similar geologic environments, geologic investigations during this study, and studies of the adjacent Washakie Wilderness to the north (Ketner and others, 1966), indicate that these resources either are not present in the study area or, if present, are deeply buried.

INTRODUCTION

At the request of the U.S. Bureau of Land Management (BLM), 710 acres of the Owl Creek Wilderness Study Area (WY–010–104 A/B/C) were studied for mineral endowment. The study area is in the southeastern Absaroka Range, Wyoming, which is a 150-mi-long northwest-trending mountain range in northwestern Wyoming that extends into southwestern Montana. The study area, which is located about 45 mi west of Thermopolis, is accessed by driving 8 mi northwest from Thermopolis along State Highway 120 and continuing 25 mi westward along State Highway 170 to the end of the pavement and about 12 mi along dirt roads and trails leading to the confluence of the South Fork of Owl Creek and Rock Creek (fig. 2). The study area is bounded by Rock Creek to the northeast and South Fork to the southwest; elevations range from about 9,400 to 11,000 ft above sea level.

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 Bureau of Mines (USBM) and the U.S. Geological Survey (USGS). Identified resources are classified according to the system of the U.S. Bureau of Mines and the 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 resources). It is classified according to the system of Goudarzi (1984) and is shown in the Appendix. Undiscovered resources are studied by the USGS.

Investigations by the U.S. Bureau of Mines

The USBM examined BLM records of mining claims and oil and gas leases in and adjacent to the study area. Field studies were conducted during the summer of 1987 to examine, map, and sample all known mines, prospects, and mineralized zones in and near the study area in order to inventory past production, reserves, and subeconomic resources. Results of these studies have been published by the USBM (Lundby, 1988).

Investigations by the U.S. Geological Survey

From 1987 to 1988 the USGS conducted field and laboratory studies to evaluate the potential for undiscovered mineral resources in the Owl Creek Wilderness Study Area (WY–010–104 A/B/C). The USGS (1) field-checked previous mapping (K.A. Sundell, Ram Oil, Corp., unpub. data; Sundell, 1986), made revisions in previous interpretation, and added Quaternary geology to the unpublished map by Sundell; (2) examined and sampled rock units within potentially mineralized areas; (3) collected stream-sediment samples for geochemical analysis (Malcolm and Carlson, in press); (4) conducted gravimetric and aeromagnetic studies; and (5) searched for previously published and unpublished data on the geology and mineral resources in and adjacent to the study area.

Acknowledgments.—We thank Kent A. Sundell of Ram Oil, Corp., for providing invaluable information on the local and regional geology, furnishing unpublished geologic maps of the area, and allowing access to critical drill-hole information.

APPRAISAL OF IDENTIFIED RESOURCES

By William Lundby U.S. Bureau of Mines

Mining and Exploration History, and Identified Resources

No mining claims are on record with the BLM (August 1987), and no evidence of mining or prospect excavating was found in the study area during the field examination.

Parcels B and C of the study area are under lease (post-Federal Land Policy and Management Act of 1976) for oil and gas, but no holes have been drilled within the boundaries of the study area (fig. 3). Two exploratory oil and gas wells, about 3 mi east of the study area, were drilled and abandoned (fig. 2) (Lundby, 1988).

Appraisal of Industrial Mineral Resources

Sand and gravel deposits present in the study area along stream channels can be classed as inferred subeconomic resources. The remoteness of the study area would preclude usage of this material except for local needs.

Petrified wood stumps have been described in all units of the Wiggins Formation and are reported as most abundant about 20 mi west-northwest of the study area (Ketner and others, 1966). Such material is of interest to collectors and can be used for decorative purposes. No petrified wood was found in the study area during the field examination.

ASSESSMENT OF POTENTIAL FOR UNDISCOVERED RESOURCES

By Dana J. Bove, Robert R. Carlson, and Dolores M. Kulik
U.S. Geological Survey

Geology

The study area lies in the southeastern portion of the Absaroka Range. The Absaroka Range is the largest Eocene-age volcanic field in the northern Rocky Mountains (9,000 mi^2) and straddles northwestern Wyoming and adjacent parts of Montana. The geology of the range is predominately lava flows and volcaniclastic rocks. Rocks of the Absaroka volcanic plateau cover the west flank of the Bighorn basin, where they conceal Paleozoic and Mesozoic sedimentary strata (fig. 2) (Brittenham and Tadewald, 1985). The Absaroka Range is bounded on the east by the Bighorn basin, on the northeast by the Beartooth Mountains, on the northwest by the Madison and Gallatin Ranges, on the west by the Yellowstone plateau, and on the south by the Wind River basin.

Volcanic rocks of the Absaroka Range, which are known as the Absaroka Volcanic Supergroup (Smedes and Prostka, 1972) and were derived from local volcanic centers, erupted episodically during Eocene time. The primary volcanic rocks were rapidly and continuously reworked to form a complex assemblage of primary-vent and alluvial-facies rocks derived from multiple source areas (Sundell, 1986). The Eocene volcanics unconformably overlie Precambrian, Paleozoic, Mesozoic, and lower Tertiary rocks that were folded and faulted primarily during the Laramide orogeny (Keefer, 1957; Love, 1934; Sundell, 1986; Brittenham and Tadewald, 1985).

A thick sequence of middle Eocene volcaniclastic rocks (as much as 4,000 ft; K.A. Sundell, Ram Oil, Corp., unpub. data) cover the entire study area. The Tepee Trail Formation (unit Tt, fig. 1), which is the oldest of these units exposed in the study area, typically consists of olive-gray, well-bedded volcanic sandstone and conglomerate, lesser amounts of volcanic breccia, and minor siltstone. The Tepee Trail Formation is overlain unconformably by the Wiggins Formation, which is characterized by white to light-colored tuffaceous volcanic conglomerate and sandstone and contains massive, unsorted landslide-debris flow breccia. The Wiggins Formation was subdivided into four units by Sundell (1982) for mapping purposes. Figure 4 compares the units of Sundell (1982) with the informal nomenclature used in this report. All units but the lower member of the Wiggins are present in the study area. Two bodies of the allochthonous member crop out just outside the study area; one body is in Needle Creek, north of parcel A, and the other body is above Rock Creek, northwest of parcel C (fig. 1). The allochthonous member consists of large, detached plates of well-bedded Wiggins lithologies (Sundell, 1982, 1986). Conspicuous, reworked white and lime-green tuff beds ("Sugar loaf tuff beds"; Sundell, 1982) are present in the allochthonous member in the study area and have been used as a key stratigraphic marker throughout the region. The chaos member, which unconformably overlies the allochthonous member and the Tepee Trail Formation, is interpreted as large-scale landslide or debris-flow deposits and consists of large blocks and contorted masses of andesitic breccia in an unsorted, boulder- to clay-size matrix. The upper member caps the rocks of the study area and unconformably rests upon the chaos member. Strata of the upper member of the Wiggins consist of volcanic conglomerate,

Sundell (1982)		This report	
Wiggins Formation	upper Wiggins	Wiggins Formation	upper member
	Castle Rocks chaos		chaos member
	allochthonous Wiggins		allochthonous member
	lower Wiggins		lower member

Figure 4. Chart showing terminology for members of the Wiggins Formation used in this report (modified from Sundell, 1982).

sandstone, laharic breccia, and tuff beds. Clasts of the chaos member are abundant at the base of the upper member.

Although no intrusions have been identified within the study area, the Washakie Needles, which are the topographic expression of a 38-m.y. porphyritic dacite plug (unit Ti, fig. 1) (Love and others, 1976), crop out about 1 mi north of parcel A.

The study area, which is situated in the southwestern Bighorn basin (Sundell, 1982, 1986), is underlain at depth by many of the same Paleozoic and Mesozoic sedimentary rocks that are present in the Bighorn and Wind River basins to the east and south, respectively (fig. 2) (Sundell, 1982; Bailey and Sundell, 1986; Brittenham and Tadewald, 1985). Wells drilled less than 5 mi to the east of the study area (fig. 2) penetrated the Madison, Amsden, Tensleep, and Phosphoria Formations (Bailey and Sundell, 1986; Sundell, 1982; K.A. Sundell, Ram Oil, Corp., unpub. data). An isopach map of the Tensleep Sandstone that was constructed on the basis of drill-hole and seismic data indicates that this unit occurs beneath the study area at an elevation of about 6,000–7,000 ft above sea level (K.A Sundell, Ram Oil, Corp., oral commun., 1987).

Quaternary rocks in and adjacent to the study area are confined to locations in and around present streams (Rock Creek, South Fork, and Cabin Creek) and consist of alluvial sand and gravel (unit Qal) and relatively small debris fans (unit Qf) (fig. 1).

Geochemistry

A reconnaissance geochemical survey was conducted in the Owl Creek Wilderness Study Area in July 1987. Stream sediments and panned concentrates were collected at 11 sites and were subsequently prepared and analyzed as minus-80-mesh sediments and nonmagnetic heavy-mineral concentrates, respectively. These sample media represent a composite of rock and soil materials exposed in the drainage basin upstream of each sample site. The minus-80-mesh sediment gives the general chemical signature of the drainage basin, with some enhancement of elements that tend to be adsorbed by clay minerals. The heavy-mineral concentrate enhances the detection of mineral deposits that may occur in the drainage basin.

Seven of the sampled sites were on first-order (unbranched) streams that drain the study area; these samples represent a sampling density of one site per 0.5 mi^2. In addition, two sampled sites were located on Rock Creek (a second-order stream) and two sampled sites were located on the South Fork of Owl Creek (at second- and third-order localities); these streams flank the study area ridge on the northwest and southwest sides. These last four sites were sampled to yield information on the general geochemical setting of the study area.

The stream sediments and nonmagnetic heavy-mineral concentrates were analyzed for 35 and 37 elements, respectively, by a semiquantitative emission spectrographic method (Grimes and Marranzino, 1968). The analytical data, a description of the sampling and analytical techniques used, and a sample locality map are in the files of M.J. Malcolm and R.R. Carlson (USGS, Lakewood, Colo.).

Examination of analytical results for the sites on streams that drain the study area, and comparison to the results for the four sites of the general area, showed no anomalous concentrations, groupings, or patterns of elements associated with mineral deposits, other than barium. The pattern of barite occurrence in the mineralogical split of the nonmagnetic heavy-mineral concentrates indicates that the source of the barium is the Tepee Trail Formation. However, in the absence of other anomalous elements that indicate hydrothermal activity, the barite is considered to be of authigenic sedimentary origin.

Geophysics

Gravity and magnetic studies were undertaken as part of the mineral resource assessment of the Owl Creek Wilderness Study Area and to provide information on the subsurface distribution of rock masses and the structural framework. The gravity and magnetic data are of a reconnaissance nature and are adequate only to define regional features; however, the regional structural features defined by geophysics and geology are pertinent to an evaluation of the potential for oil and gas beneath the study area.

The gravity data were obtained in and adjacent to the study area in 1987. These data were supplemented by data maintained in the files of the U.S. Defense Mapping Agency, Aerospace Center (1974), of the Department of Defense; along the western map margin (fig. 5) by unpublished data of the USGS; and in the northwest corner of the map (fig. 5) by data from Long (1982). Stations measured during this study were established using a Worden Model W–177 gravimeter. The data were tied to the International Gravity Standardization Net 1971 (U.S. Defense Mapping Agency, Aerospace Center, 1974) at base station ACIC 1661–1 at Shoshone, Wyo. Station elevations were obtained from benchmarks, spot elevations, and estimates from 1:24,000- and 1:62,500-scale topographic maps and are accurate to ±20 and ±40 ft, respectively. The error in the Bouguer value is less than 2.5 mGal (milligals) for errors in elevation control. Bouguer gravity values were computed

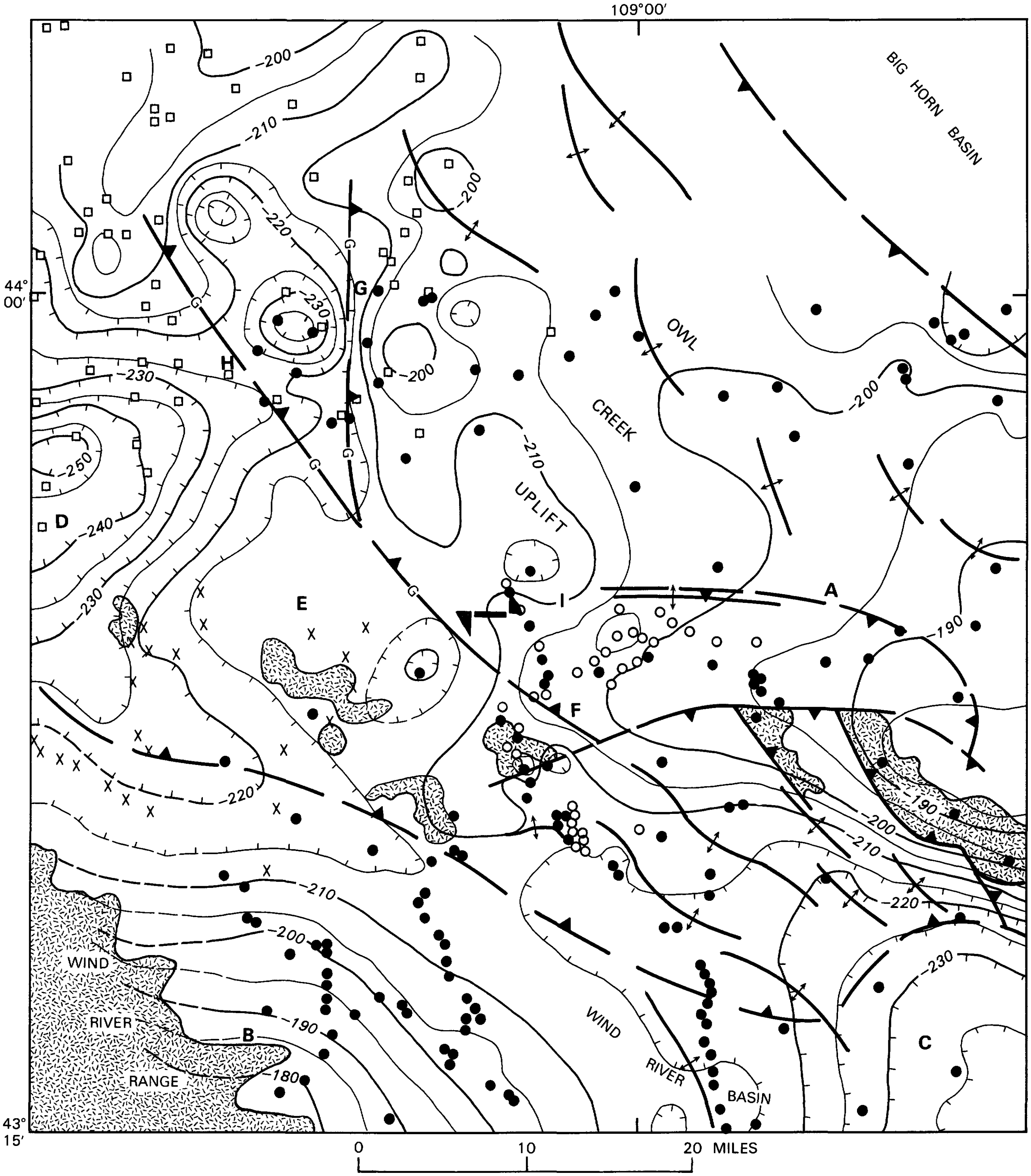

Figure 5 (above and facing page). Bouguer anomaly and generalized structure map of the Owl Creek Wilderness Study Area and surrounding area. Contour interval, 5 milligals. Contours dashed where inferred; hachures indicate closed lows. Letters identify features discussed in text. Geology and structure from Love and others (1955).

using the 1967 gravity formula (International Association of Geodesy, 1967) and a reduction density of 2.67 g/cm³ (grams per cubic centimeter). Mathematical formulas are given in Cordell and others (1982). Terrain corrections were made by computer for a distance of 100 mi from the station using the method of Plouff (1977). The data are shown in figure 5 as a complete Bouguer gravity map with contour interval of 5 mGal.

EXPLANATION

Owl Creek Wilderness Study Area

Anticline

Thrust or reverse fault—Sawteeth on upper plate; dashed where covered or inferred

G Thrust or reverse fault—Sawteeth on upper plate; inferred from gravity data

O Gravity station location measured for this study

● Gravity station from U.S. Defense Mapping Agency, Aerospace Center (1974)

□ Gravity station from Long (1982)

X Gravity station from U.S. Geological Survey unpublished data

Precambrian rocks

A major gravity high (A) is associated with the Owl Creek uplift and extends north across the flank of the uplift to the edge of the Bighorn basin (fig. 5). It is caused by relatively dense Precambrian crystalline rocks in the core of the uplift and in the shallow subsurface on its north flank. Another gravity high (B) is associated with relatively dense Precambrian rocks of the Wind River Range in the southwest corner of the map area. A gravity low (C) is associated with a thick section of sedimentary rocks in the Wind River basin. The extension of gravity low C over the south edge of the Owl Creek uplift suggests that the crystalline rocks are thin in the area of the gravity low and that the underlying thrust fault dips at a low angle to the north. Northwest-trending thrust faults bring Precambrian rocks to the surface in the uplift in the eastern part of the map area. These faults occur on the south flank of gravity high A. The steep gravity gradient and higher gravity values here suggest that the northwest-trending faults segment the crystalline rocks of the upper plate and that the low-density sedimentary rocks of the Wind River basin do not extend beneath these parts of the faults. The northwest-trending faults that have been mapped do not coincide with the gravity gradient and are, therefore, probably confined to the thin leading edge of the upper plate. The major gravity gradient reflects the juxtaposition of thicker Precambrian rocks in the core of the uplift with the lower density sedimentary rocks that wedge out beneath the uplift.

The gravity low over the Wind River basin narrows and decreases northwestward across a gravity saddle and again broadens and decreases at D at the western edge of the map area. The thrust fault that bounds the Owl Creek uplift on the south bends northward and probably continues as the Buffalo Fork thrust fault (Antweiler and others, 1983) west of the map area. Gravity low D is part of a more extensive low that is interpreted as being associated with a sedimentary basin beneath the volcanic rocks of the Absaroka Volcanic Supergroup (Kulik, 1981; Antweiler, and others, 1983). Volcanic rocks occur in the area of moderate gravity values east, west, and north of the study area. Part (gradient F) of this more extensive gravity low continues for a short distance along a mapped fault just southeast of the study area. Another part (gradient G) of this more extensive gravity low trends north about 10 mi north-northwest of the study area. These gradients may be continuous across the area of no data and may be caused by a fault that is concealed beneath volcanic cover. A saddle (H) in the gravity low west of gradient G suggests that a fault splay may also occur beneath cover here. The interpreted faults are identified by the dashed traces with the letter "G" on figure 5. The gravity contours (I) northeast of the study area suggest that the southward-dipping fault northeast of the study area and its associated anticline may continue westward just north of the study area. The study area lies near the leading edge of one or both interpreted thrust faults in an area where anticlines commonly form during thrusting.

Magnetic data are from U.S. Department of Energy (1982). Flight lines were flown east-west at 2–5-mi intervals and 400 ft above the ground elevation. Magnetic data commonly reflect variations in magnetic susceptibility in basement rocks, although short-wavelength anomalies may be caused by volcanic rocks near the surface. Magnetic highs A and B on figure 6 appear to be associated with exposed Precambrian rocks of the Owl Creek uplift. Another short-wavelength magnetic high (C) has no correlation with crystalline rocks at the surface; it may be caused by Precambrian rocks that do not crop out and (or) by an intrusive body at a shallow depth. Magnetic high D is partially coincident with the edge of a thrust fault that may have brought Precambrian rocks near the surface. Other magnetic anomalies in the map area probably represent variations in the susceptibility of the basement rocks. No identifiable magnetic signature is associated with the surface volcanic rocks in the area shown in figure 6.

Mineral and Energy Resources

Metallic Deposits

The mineral resource potential for all undiscovered metals in the wilderness study area is low (fig. 1). The geologic environment is unfavorable; mineralized rock was not seen at the surface during field studies; and there were no anomalous element concentrations, other than barium, in the geochemical data. These findings are supported by studies of the adjacent Washakie Wilderness (Ketner and others, 1966). The entire study area has been assessed to have low mineral resource potential for all undiscovered metals, with a certainty level of C.

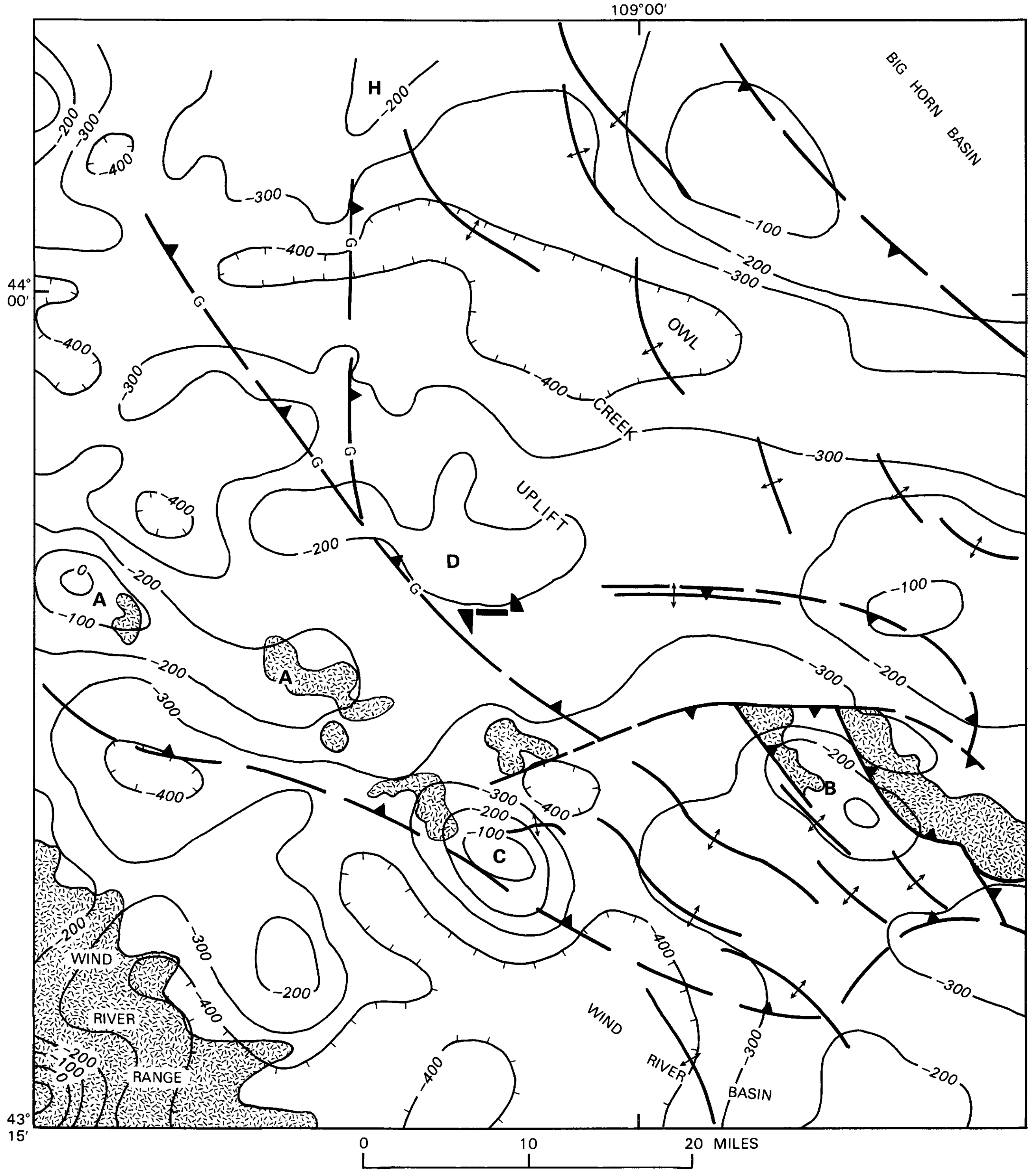

Figure 6 (above and facing page). Residual-intensity aeromagnetic anomaly and generalized structure map of the Owl Creek Wilderness Study Area and surrounding area. Contour interval, 100 nanoteslas. Hachures indicate closed lows. Letters identify features discussed in text. Geology and structure from Love and others (1955).

Oil and Gas

Rocks of the Absaroka volcanic field unconformably overlie oil- and gas-producing formations on the western margin of the Bighorn basin and portions of the northwestern Wind River basin. The majority of petroleum from the Bighorn basin (over 2.3 billion barrels of oil; Brittenham and Tadewald, 1985) has been

EXPLANATION

Owl Creek Wilderness Study Area

Anticline

Thrust or reverse fault—Sawteeth on upper plate; dashed where covered or inferred

G Thrust or reverse fault—Sawteeth on upper plate; inferred from gravity data

Precambrian rocks

produced from strata on anticlines with large amounts of structural closure. Principal reservoir rocks include carbonates of the Mississippian Madison Formation, the Pennsylvanian Tensleep Sandstone, and carbonates of the Lower Permian Phosphoria Formation. However, minor production has occurred from Cambrian, Ordovician, Triassic, and Cretaceous rocks (Stone, 1967; Brittenham and Tadewald, 1985). Two major oil fields, Hamilton Dome and Grass Creek, occur along the eastern margin of the Absaroka volcanic field in the southwestern Bighorn basin, about 20 mi east and northeast of the study area, respectively. Total production from both fields has exceeded 400 million barrels of oil and 7 trillion cubic feet of natural gas (Sundell, 1982). The principal producing formations from these fields include the Upper Cretaceous Frontier Formation, Upper Triassic Crow Mountain Formation of the Chugwater Group, Lower Permian Phosphoria Formation, Pennsylvanian Tensleep Sandstone, Upper Mississippian Darwin Sandstone Member of the Amsden Formation, Mississippian Madison Formation, and Upper and Middle Ordovician Bighorn Dolomite. The Circle Ridge oil field (more than 20 million barrels of oil; Stone, 1967), located about 11 mi to the south of the study area in the northwestern Wind River basin, produces from near-surface rocks in a dome, primarily from the Madison and Phosphoria Formations.

The Aspen Creek and Dickie Creek oil fields, located within the southeastern Absaroka volcanic field, indicate that oil fields can be located beneath the Tertiary volcanic rocks in the same formations and along similar structures as discussed above. The oil-producing Aspen Creek anticline was recurrently uplifted after deposition of the overlying Tertiary volcanic rocks (Love, 1985) indicating post-Laramide deformation. Other studies also document prominent surface anticlines in the volcanics, which may reflect underlying structures critical to oil and gas targets in the underlying Paleozoic and Mesozoic rocks (Brittenham and Tadewald, 1985; K.A. Sundell, Ram Oil, Corp., oral commun., 1987).

To date no holes have been drilled within the study area, although three holes (Federal 4–1, High Island Ranch 33–1, Rock Creek State 16–1; K.A. Sundell, Ram Oil, Corp., unpub. data; Bailey and Sundell, 1986) were drilled less than 5 mi to the east and southeast (fig. 2). Two of these holes (Federal 4–1 and High Island Ranch 33–1) were drilled at the crest of a northwesterly trending anticlinal structure, which is about 8 mi long and 2 mi wide (K.A. Sundell, Ram Oil, Corp., unpub. data). The anticline, which is mappable in the Tertiary volcanics, is expressed in the underlying Paleozoic and Mesozoic strata as evidenced by seismic and drill-hole data (K.A. Sundell, Ram Oil, Corp., unpub. data; Bailey and Sundell, 1986). Both drill holes penetrated about 3,400 ft of volcanics and as much as 875 ft of Paleozoic rocks including the Lower Triassic Dinwoody, Phosphoria, and Tensleep Formations. Asphalt, averaging 1–2 percent of the total cuttings, was present in both holes from about 2,000 to 3,700 ft and occurred as dikes and fracture-filling veins. Shows of wet gas, heavy oil, and traces of hydrogen sulfide were also encountered in both holes from about 1,200 ft to the bottom of the hole (Bailey and Sundell, 1986; K.A. Sundell, Ram Oil, Corp., unpub. data). The best oil shows were reportedly present in the Phosphoria Formation.

Favorable aspects in regards to oil and gas resources within the study area include the proximity of the study area to large oil and gas fields in the Bighorn and Wind River basins, the likelihood of anticlinal structures occurring in the study area as suggested by regional geophysical studies, and the presence of asphaltum and live oil and gas shows in nearby drill holes that penetrate anticlinal structures in known oil- and gas-producing Paleozoic rocks. The criterion considered unfavorable for oil and gas resources in the study area is the absence of proven, overlying sealing rocks, such as Cretaceous rocks, which are present in oil fields to the east (Spencer, 1981). The angular unconformity between the Tertiary volcanics and underlying Paleozoic rocks has been proposed as a barrier to upward migration of hydrocarbons from reservoir rocks (Sundell and Bailey, 1986); however, the presence of asphaltum in Tertiary rocks in nearby drill holes suggests that these rocks are too brittle to form an effective seal (C.W. Spencer, oral commun., 1987). Considering all the above data, the entire study area has been assessed to have moderate potential for undiscovered oil and gas resources, with a certainty level of D (fig. 1).

Coal

Due to the absence of Cretaceous rocks beneath the study area (Bailey and Sundell, 1986; K.A. Sundell, Ram Oil, Corp., unpub. data), which are known to contain low-quality coal deposits in parts of northwestern Wyoming (Ketner and others, 1966), the entire study area has been assessed to have low resource potential for undiscovered coal, with a certainty level of B (fig. 1). The Washakie Wilderness to the north of the study area also was documented to have low resource potential for coal (Ketner and others, 1966).

Zeolites

Altered lime-green and white rhyolitic tuff beds within a block of the allochthonous member of the Wiggins Formation north of parcel C contains zeolites, identified by X-ray diffraction as heulandite. However, the tuff beds, which occur only in the small block of the allochthonous member (fig. 1), are generally less than 100 ft thick, and zeolite content is estimated to be significantly less than 50 percent of the rock. There is no evidence that zeolites occur elsewhere in the study area. The entire study area has been assessed to have low resource potential for undiscovered zeolites, with a certainty level of B (fig. 1).

Geothermal Energy

No thermal springs are present in or near the study area, although hot springs are present at Thermopolis about 45 mi east of the study area. The entire study area has been assessed to have low potential for undiscovered geothermal resources, with a certainty level of B (fig. 1).

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APPENDIX

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.

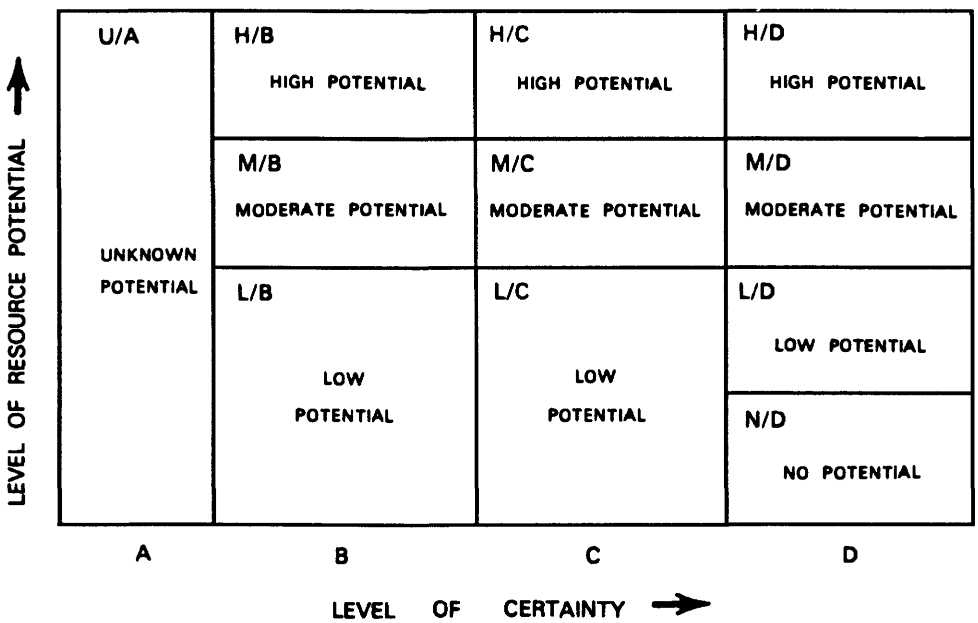
MODERATE mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a reasonable likelihood of resource accumulation, and (or) where an application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

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RESOURCE/RESERVE CLASSIFICATION

	IDENTIFIED RESOURCES			UNDISCOVERED RESOURCES	
	Demonstrated		Inferred	Probability Range (or)	
	Measured	Indicated		Hypothetical	Speculative
ECONOMIC	Reserves		Inferred Reserves		
MARGINALLY ECONOMIC	Marginal Reserves		Inferred Marginal Reserves		
SUB-ECONOMIC	Demonstrated Subeconomic Resources		Inferred Subeconomic Resources		

Major elements of mineral resource classification, excluding reserve base and inferred reserve base. Modified from McKelvey, 1972, Mineral resource estimates and public policy: American Scientist, v.60, p.32-40, and 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.

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	96
				Early	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				3800?
pre-Archean[2]					4550

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

[2] Informal time term without specific rank.

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