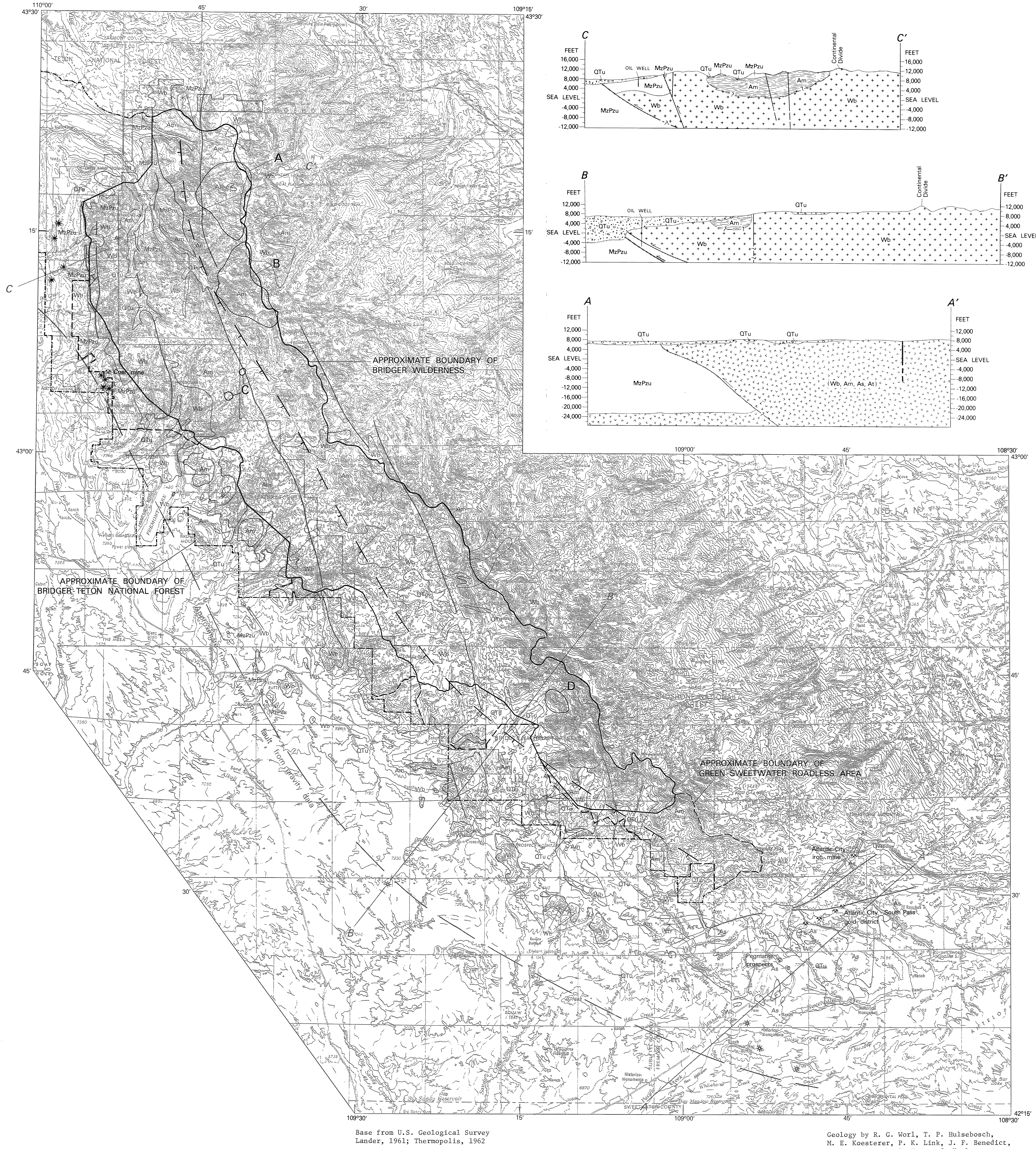
MISCELLANEOUS FIELD STUDIES
MAP MF-1636-A
PAMPHLET ACCOMPANIES MAP



Base from U.S. Geological Survey
Lander, 1961; Thermopolis, 1962

Geology by R. G. Worl, T. P. Hulsebosch, M. E. Koesterer, P. K. Link, J. F. Benedict, C. E. Seamor, B. F. Frost, G. K. Lee, Grant Kolb, and J. M. Williams, 1980-82

SCALE 1:250 000

EXPLANATION

AREA COVERED BY OIL AND GAS LEASES AS OF 1981

NORTHEAST LIMIT OF AREA OF MODERATE OIL AND GAS POTENTIAL

OIL WELL (DRY)

OIL WELL (DRY) THAT IS REPORTED TO CUT ARCHEAN CRYSTALLINE ROCKS

MINE

AREAS IN WHICH SOME ROCK SAMPLES CONTAIN ANOMALOUS CONCENTRATIONS OF MORE THAN ONE METAL—The sample source and the concentration of metals are given in parts per million (ppm) for each area

Area A—Scattered, iron-stained mafic boudins in migmatite and felsic dikes, both containing sparsely disseminated sulfide minerals. Ranges of concentrations were: Ag, 1-3 ppm; Co, 101-300 ppm; Cu, 151-7,000 ppm; Mo, 11-70 ppm; Pb, 101-300 ppm; Sn, 21-30 ppm; Zn, 201-1,500 ppm

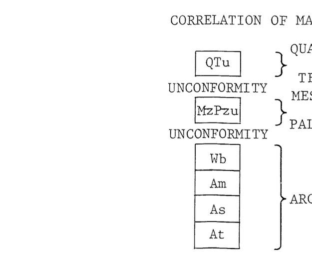
Area B—Scattered, iron-stained mafic boudins in migmatite. Sulfide minerals are commonly evident, but sparsely disseminated. Ranges of concentrations were: Ag, 1-3 ppm; Co, 101-700 ppm; Cu, 151-7,000 ppm; Mo, 11-200 ppm; Pb, 101-300 ppm; Sn, 21-30 ppm; Zn, 201-700 ppm

Area C—Mafic boudins containing small pods of nearly massive sulfide minerals. There are small prospect pits in this area. Ranges of concentrations were: Ag, 1-1.5 ppm; Co, 100-3,000 ppm; Pb, 101-500 ppm

Area D—Granite and aplite containing large crystals of molybdenite. Schiestler Peak molybdenum prospect is in this area. Ranges of concentrations were: Cu, 151-200 ppm; Mo, 11->5,000 ppm

(Note: The following correlation, list of map units, and symbols refer to the geologic map shown here in gray.)

CORRELATION OF MAP UNITS



LIST OF MAP UNITS

QTu SURFICIAL DEPOSITS, UNDIVIDED (QUATERNARY AND TERTIARY)

MzPzu SEDIMENTARY ROCKS, UNDIVIDED (MESOZOIC AND PALEOZOIC)

Wb GRANODIORITE TO GRANITE (ARCHEAN W)

Am GNEISS AND MIGMATITE OF HIGH METAMORPHIC GRADE (ARCHEAN)

As SCHIST OF LOW METAMORPHIC GRADE (ARCHEAN)

At BANDED IRON-FORMATION (ARCHEAN)

CONTACT

MAJOR FAULT OR SHEAR ZONE—Dashed where approximately located

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 the Congress. This report presents the results of a mineral resource potential survey of the Bridger Wilderness and the Green-Sweetwater Roadless Area in the Bridger-Teton National Forest, Sublette and Fremont Counties, Wyo. The Bridger Wilderness was established by Public Law 88-577. The Green-Sweetwater Roadless Area (04901) was divided into nonwilderness (108,092 acres) and wilderness (79,742 acres) during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, April 1979.

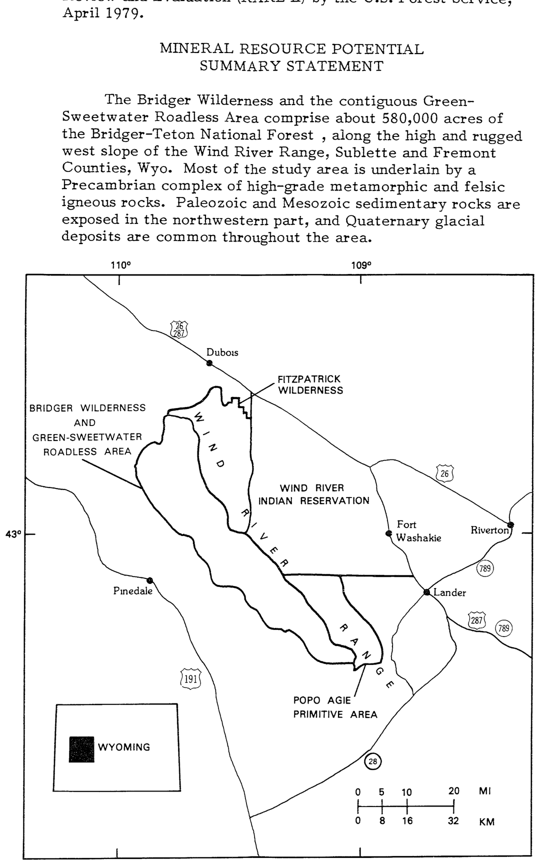
MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

The Bridger Wilderness and the contiguous Green-Sweetwater Roadless Area comprise about 580,000 acres of the Bridger-Teton National Forest , along the high and rugged west slope of the Wind River Range, Sublette and Fremont Counties, Wyo. Most of the study area is underlain by a Precambrian complex of high-grade metamorphic and felsic igneous rocks. Paleozoic and Mesozoic sedimentary rocks are exposed in the northwestern part, and Quaternary glacial deposits are common throughout the area.

Mining and mineral exploration activity within the study area has been minor. A small amount of coal was mined during the early part of this century, and a molybdenite prospect at Schiestler Peak has been explored intermittently since the claims were first staked in 1940. Several oil and gas leases extend into the western part of the study area.

A moderate potential for oil and gas at depth is assigned to part of the study area. This classification is based upon a geologic model that places oil- and gas-bearing sedimentary rocks at depth below a low-angle fault and a wedge of Precambrian crystalline rocks. Confirmation of the geologic model would require deep seismic profiles across the central and northern parts of the study area.

Gold, base metals, molybdenite, radioactive elements, coal, banded iron-formation, and phosphate were specifically investigated as targets because of favorable geologic conditions, but no indications of a resource potential for any of these commodities were found.



MAP SHOWING LOCATION OF THE BRIDGER WILDERNESS AND THE GREEN-SWEETWATER ROADLESS AREA (04901)

INTRODUCTION

The Bridger Wilderness and the contiguous Green-Sweetwater Roadless Area (04901) comprise about 580,000 acres along the crest and west flank of the Wind River Range, Wyo. The terrain consists of a rugged, high alpine backbone with glacial cirques along the crest and old, deeply incised peneplains along the western edge.

The Bridger Wilderness and the Green-Sweetwater Roadless Area, hereafter called the "study area," is a heavily used recreational area. Access is from numerous trailheads along the west boundary.

Mineral resource studies in contiguous areas concern the Fitzpatrick Wilderness, formerly known as the Glacier Primitive Area (Granger and others, 1971); the Popo Agie Primitive Area, east of and adjacent to the study area (Pearson and others, 1971); and the Scab Creek Instant Study Area, a small U.S. Bureau of Land Management area along the west border of the present study area (Worl and others, 1980).

GEOLOGY

The study area is underlain mainly by ancient (Precambrian) crystalline rocks of a basement complex that makes up the core of the Wind River Range. Younger (Paleozoic and Mesozoic) sedimentary rocks are in depositional and fault contact with the crystalline rocks in the northwestern part of the study area. The Wind River fault, along the southwest side of the range, dips northeast and places Precambrian crystalline rocks over upturned and folded Paleozoic and Mesozoic sedimentary rocks (refer to map cross sections A-A', B-B', and C-C'). The west flank of the range and the trace of the Wind River fault are covered by Tertiary gravels and Pleistocene glacial deposits.

As shown on the map, rocks of the Precambrian complex are grouped into three broad assemblages: gneiss and migmatite of high metamorphic grade (unit Am), schist of low metamorphic grade (unit As), and felsic igneous rocks (unit Wb).

The rocks of high metamorphic grade (unit Am) are migmatite and felsic gneiss containing some zones of pyroxene gneiss. Even the gneisses are migmatitic in the sense that there are generally two fractions to the rock, an igneous-appearing (or geochemically mobile) felsic part and a metamorphic-appearing (or geochemically immobile) mafic part (Worl and others, in press).

The felsic portion of the migmatite and gneisses is massive and even-grained and varies from hornblende tonalite to granite. Dark, mafic rocks are complexly intermixed with the light-colored, felsic part in bands, pods, and boudins. The mafic part is mainly amphibolite, biotite schist, or hornblende-biotite gneiss, but also locally includes banded iron-formation (taconite, unit At), metagabbro, mafic gneiss, ultramafic rock, ferruginous-garnet gneiss, sillimanite gneiss, and diopside-hornblende gneiss. The migmatite and gneiss complex contains dikelike bodies of amphibolite and hornblende-biotite gneiss that may represent metamorphosed and partially assimilated mafic dikes.

Contacts between different map units of the high-metamorphic-grade rocks are gradational, and there is evidence for injection, metasomatic alteration, partial melting, and more than one period of penetrative deformation--in many places within a small area (Worl, 1972). The metamorphic rocks are foliated and generally layered. Boudins, schlieren, ghost structures, highly attenuated layering, and appressed and rootless fold hinges are common features.

The schists of low metamorphic grade (unit As) that occur as a belt across the southern part of the range are well stratified and of sedimentary and volcanic origin. The occurrence of similar rocks in small pods in the rocks of high metamorphic grade (unit Am) suggests a similar origin for both units, but the rocks of high metamorphic grade represent a zone of deeper burial in the past.

Igneous rocks (unit Wb) of the Precambrian complex, varying from diorite to granite, intrude the metamorphic terranes as plutons, pods, dikes, and irregular bodies. Genetically related granodiorite, granite, and porphyritic granite were delineated by field mapping (shown undivided on map). The granodiorite is similar to and, in part, physically continuous with, rocks of the Lewis Lake batholith (Pearson and others, 1971; Bayley and others, 1973) east of the southern part of the study area. Granite is exposed as small plutons in the southwestern part of the Wind River Range, mostly outside the study area. The granite and granodiorite are equivalent in age and have been dated as 2,642±9 Ma old by the U-Pb zircon method (Stuckless and Van Trump, 1983). Porphyritic granite forms several plutons and numerous dikes that cut the metamorphic rocks. This rock is similar to those of the Middle Mountain batholith (Granger and others, 1971) to the northwest and to those of the Popo Agie batholith (Pearson and others, 1971) southeast of the study area. The porphyritic granite has been dated as 2,575±509 Ma old by the U-Pb zircon method (J. S. Stuckless, written commun., 1983). Unmetamorphosed Precambrian diabasic dikes (not shown on map) intrude all the metamorphic and igneous rocks. The dikes typically exhibit chilled, fine-grained margins and medium-grained interiors.

Paleozoic and Mesozoic sedimentary rocks exposed in the northwestern part of the Wind River Range represent a complete section from Cambrian through Cretaceous. The Cambrian Flathead Quartzite unconformably overlies the Precambrian rocks in several areas, and in the exposure just north of the study area it is nearly flat lying. This sedimentary rock sequence within the study area is folded and complexly faulted. Names and thicknesses of the formations are listed in table 1.

Table 1.--Measured thicknesses of Mesozoic and Paleozoic sedimentary rocks in and near the Bridger Wilderness and the Green-Sweetwater Roadless Area, Sublette and Fremont Counties, Wyoming

Stratigraphic unit	Thickness[1] (ft)
Mesozoic	
Frontier Formation	600
Mowry and Thermopolis Shales	800
Cloverly Formation	200
Morrison Formation	370
Sundance Formation	650
Gypsum Springs Formation	75
Nugget Sandstone	300
Chugwater Formation	1,015-1,235
Dinwoody Formation	200
Paleozoic	
Phosphoria Formation	260
Tensleep Sandstone	330
Amsden Formation	300
Madison Limestone	800-1,000
Darby Formation	200-380
Bighorn Dolomite	325-500
Gallatin Limestone	200-295
Gros Ventre Formation	560-765
Flathead Quartzite	260

[1]Richmond (1945).

Precambrian rocks in the core of the Wind River Range are highly fractured and sheared along major zones of Laramide age that generally trend parallel to the length of the range and dip steeply east. The centers of the major shear zones are easily eroded masses of rock flour and clay.

The most significant structure in the area is the Wind River fault, along the west flank of the range. This is a major structure that places the Precambrian rocks of the Wind River Range over Paleozoic and Mesozoic rocks at the northeastern margin of the Green River Basin. The trace of the fault is covered by late Tertiary coarse clastic sedimentary rocks and Pleistocene glacial debris.

The approximate trace of the Wind River fault was determined from oil well information and from gravity and seismic data (see, for example, Gries, 1981). The dip of this fault at depth has long been in question and is of paramount interest because the sedimentary rocks that underlie the fault and Precambrian rocks are potentially oil and gas bearing. Several structural models have been proposed, including a low-angle thrust, a low-angle thrust that steepens with depth, a high-angle reverse fault, and a high-angle fault that flattens with depth.

Low-angle thrust faulting is currently the most accepted model for the Wind River fault and seems to be well documented in the southern part of the range. Data provided by a deep seismic-reflection profile by COCORP (Consortium for Continental Reflection Profiling) across the southernmost end of the range along section A-A' (Smithson and others, 1979), support a low-angle thrust model. Several oil wells southwest of the study area, in the vicinity of the line of section A-A', reportedly penetrated a wedge of Precambrian crystalline rocks above the fault. Cross section B-B', adapted from Gries (1981), shows a low-angle fault similar to a giant fold thrust suggested by Berg (1962). Cross section C-C' is across a structure called the Kendall platform (Skinner, 1960) and shows high-angle faults that cut Precambrian and Paleozoic rocks above, presumably, the same low-angle thrust fault. On the basis of a computer-generated down-plunge projection of structures at the northeastern end of the range, Mitra and Frost (1981) suggested that these faults dip 35°-40° east.

Although the low angle of the Wind River fault seems to be well documented in the southern part of the range by the COCORP line, data are not available to define adequately the nature of the fault along the rest of the range. Other models, namely high-angle reverse faults, have credence and must also be considered. The nature of the fault determines how far eastward beneath the study area the potentially oil-bearing sedimentary rocks extend. Low-angle thrusting would place the sedimentary rocks at possibly exploitable depths under the study area, as can be seen in cross-sections A-A' and B-B'. In the other models the sedimentary rocks do not extend beneath the study area except at considerable depth.

The Wind River Range was glaciated during the Pleistocene, as evidenced by large cirques and sharp arêtes in the higher peaks, U-shaped valleys, and abundant glacial debris. The major lakes along the west flank of the range are impounded behind terminal moraines of the Pinedale Stage of glaciation (Richmond, 1973).

GEOCHEMISTRY

About 4,000 samples were collected within the study area, and another 550 were collected at and near the Schiestler Peak molybdenum prospect. The sample set comprised about 50 percent rock, 28 percent stream sediment, 15 percent panned concentrate, and 5 percent soil. Stream sediment and panned concentrates of heavy minerals were collected from all second-order and larger streams and from most flowing first-order streams. Bedrock samples were spaced about a mile apart; areas of mineral occurrences, altered rock, or geologic interest were sampled in more detail. Soil samples were collected in areas of sparse outcrop. Six-step, semiquantitative emission-spectrographic analyses for 31 elements were made of all samples, and atomic-absorption determinations for antimony, bismuth, cadmium, lead, and zinc were made on selected rock samples. Atomic-absorption analysis for gold was made on all panned-concentrate samples.

About 94 rock samples were collected from prospect pits and altered and mineralized zones and were analyzed by the U.S. Bureau of Mines (Ryan, 1982). All were analyzed by semiquantitative spectrographic methods, and those from areas of placer claims were analyzed by fire-assay methods for gold and silver.

The results of the geochemical survey do not indicate any major target areas, although many samples did contain one or more metals in slightly anomalous concentrations. Thresholds for anomalous values of an element were determined from statistical parameters (see Lee and Antweiler, in press). The anomalous values for each element were ranked and partitioned into ranges of values (Lee and Antweiler, in press).

Localities of stream-sediment samples showing anomalous metal values are widely dispersed through the study area. Silver content was anomalous (0.5-7.0 ppm) in 6 samples, copper (101-200 ppm) in 9, molybdenum (7-20 ppm) in 8, lead (151-200 ppm) in 16, tin (21-50 ppm) in 1, and zinc (all 200 ppm) in 12. Panned concentrate from streams contained anomalous concentrations of silver (1.0-10 ppm) in 5 samples, gold (0.05-1.0 ppm) in 12, gold (10.0-50.0 ppm) in 1, cobalt (101-150 ppm) in 6, molybdenum (11-20 ppm) in 3, molybdenum (201-700 ppm) in 1, and tin (21-70 ppm) in 1.

Most anomalies from stream sediments are lithologically controlled: those of molybdenum and tin are derived from areas of felsic plutonic rocks, and those of silver, cobalt, copper, lead, and zinc are derived from areas of igneous and metamorphic mafic pods in gneiss and migmatite. Zinc was slightly anomalous in several stream-sediment samples from the section of Pine Creek that drains a large area containing numerous pods of metagabbro and other mafic bodies. Rock samples from the mafic pods in the drainage basin were also anomalous in zinc. Gold was present in three panned-concentrate samples from the Roaring Fork drainage basin; other samples containing detectable gold were from localities widely dispersed through several drainage basins. Except for gold and zinc, no more than one sample contained anomalous concentrations of any one element within one drainage basin.

Soil and rock samples locally contained anomalous concentrations of silver, cobalt, copper, molybdenum, lead, tin, and zinc. In the soil samples, silver was present in anomalous concentrations of 0.5-2.0 ppm; cobalt, 70-150 ppm; copper, 100-1,000 ppm; molybdenum, 5-10 ppm; lead, 100-150 ppm; tin, 10-15 ppm; and zinc, 200-700 ppm. In the rock samples, silver was present in anomalous concentrations of 1-7 ppm; cobalt, 100-700 ppm and, in three mineralized samples, 1,501-3,000 ppm; copper, 150-1,000 ppm and, in mineralized samples, 1,001-7,000 ppm; molybdenum, 10-200 ppm and, in two samples, 701->1,500 ppm; lead, 101-1,500 ppm and, in three mineralized samples, 701-5,000 ppm; tin, 21-30 ppm; and zinc, 201-1,500 ppm and 3,001-5,000 ppm in one mineralized sample. Rock samples from four areas contained anomalous values of more than one metal; these areas are shown on the map as areas A-D.

Area A is a terrane of migmatite containing abundant mafic and amphibolite pods and a small taconite body. The pods and taconite body are cut by numerous felsic dikes and pegmatites. Silver, copper, molybdenum, lead, and tin are in mafic and ferruginous pods, some of which contain visible sulfides. The pods are all small, a few feet in length, and widely scattered. Samples from pegmatites and aplite dikes within area A also contained molybdenum.

Area B is characterized by a variety of iron-stained ultramafic, mafic, and metasedimentary pods in migmatite. Many pods are sulfide bearing, and a few contain lenses of nearly massive sulfides. Concentrations of the metals silver, copper, cobalt, molybdenum, lead, tin, and, less commonly, zinc, were anomalous in samples from some of these pods. Felsic dikes cutting these pods generally contain disseminated sulfides, and samples from these dikes were slightly enriched in the same suite of metals as were the pods.

Area C consists of two small prospects along mafic pods that contain lenses of massive sulfide minerals, mainly pyrite. Concentrations of cobalt, molybdenum, lead, and silver were anomalous in the sulfide-rich samples from these pods. A sample from one of the prospects contained 8,000 ppm cobalt (Ryan, 1982). Neither zone is more than a few feet long.

The Schiestler Peak molybdenum prospect (area D) was extensively sampled for this study (Benedict, 1982; Lee and others, 1982; Ryan, 1982). Results indicate that the molybdenite occurrences are narrowly localized and insignificant. Only a few samples from area D contained anomalous amounts of molybdenum. A mineralized sample from the prospect contained 1 percent molybdenum (Ryan, 1982).

Many samples from outside areas A-D showed slightly anomalous values in only one metal. Copper and zinc were shown most commonly in samples from mafic pods in the metamorphic rocks. Anomalous values of silver and lead were shown in samples from widely scattered localities within the metamorphic rocks. Molybdenum, lead, and zinc occur locally in anomalous amounts in the Phosphoria Formation in the northern part of the study area.

Twelve metamorphic rock samples and 34 granite samples were collected from within the Bridger Wilderness and the contiguous Green-Sweetwater Roadless Area to evaluate radioelement favorability within the crystalline rocks. None of the samples contained anomalous amounts of either uranium or thorium (Stuckless and Van Trump, 1983).

GEOPHYSICS

Aeromagnetic, gravity, and electromagnetic data were used in the evaluaton of the study area (Long, in press). The primary aeromagnetic data used were two lower-level surveys conducted by the U.S. Department of Energy and flown with a 400-ft terrain clearance at a flight-line spacing of about 3 mi (Geodata International, 1979). The data were compiled to produce a residual-intensity magnetic-contour map, having a contour interval of 20 gammas, that would help identify any large, near-surface mineral deposits. Most anomalies are consistent with the magnetic properties of the rocks exposed at or near the surface.

The study area is characterized by a large, northwest-trending magnetic high, which covers the northern and central parts of the Wind River Range. This magnetic high is terminated at its southern end by a large, broad magnetic low, which separates it from a large magnetic anomaly associated with the known iron-ore deposit farther south. The northern magnetic high indicates magnetic variability that could be the result of susceptibility contrasts in the Precambrian rocks or the result of a deeper seated body. A northeast lobe of the northern magnetic-high area is set off by a magnetic-low area, which suggests either a broad shear zone or the topographic effect of a steep-walled, narrow canyon of the upper Green River.

A broad magnetic-low anomaly at the southern end of the range may be indicative of the more felsic granitic rocks reflecting a lower magnetic susceptibility than do the surrounding metamorphic rocks.

The diabase dikes and the ultramafic bodies show little magnetic expression, although most have moderate to high magnetic susceptibilities. They are probably too small in proportion to their distance below the aircraft to have any magnetic expression in the data. One exception is an east-west magnetic trend that is coincidental with a narrow, east-west line of exposed Precambrian dikelike amphibolite bodies (Worl and others, in press). This east-west trend suggests a major lithologic change across this area of the map.

An AMT (audio-magnetotelluric) survey was made in the area of the Schiestler Peak molybdenum prospect. For a discussion of the method as applied to mineral exploration, see Strangway and others (1973). The AMT data show high resistivities rather than the usual low resistivities associated with mineral deposits.

A ground magnetic survey was conducted in the area of the body of banded iron-formation (taconite) near Downs Mountain (Worl, 1968). Six profiles across the deposit indicate that the taconite, with its very high magnetic susceptibility compared to the surrounding area, does not extend beyond its limits of outcrop. Analysis of the profiles indicates that the sources of the anomalies are at or near the ground surface.

Gravity data gathered for the study area indicate a positive Bouguer anomaly parallel to the structural trend of the Wind River uplift. The gravity data verify a suggestion by Hurich and Smithson (1982) that the axis of the gravity field is northeast of the axis of the entire uplift. Steepening of the magnetic contours along the southwestern edge of the Wind River Range is partially coincident with steepening of the gravity contours, which suggests a relationship to the Wind River fault.

Due to the density contrast between the sedimentary rocks and the overthrust Precambrian rocks, it is possible to infer the strike of the fault from the trend of the gravity contours. It can be inferred that the northwest-trending fault is continuous from the fault trace shown by Hurich and Smithson (1982) northward to an area near New Fork Lakes. At this point, part of the contours trend slightly westward. The remaining contours bend north and show a gradient change that may imply a structural difference between this trend and the trend of the fault.

A ridge in the gravity contours separating two deeper parts of the Green River Basin, near Pinedale, indicates a deep-seated structural ridge or a lithologic change. This feature is complemented by an aeromagnetic low and possibly extends eastward, as shown by a magnetic trend.

MINING ACTIVITY

Mineral exploration and mining has been minimal in the study area. A small tonnage of coal was mined near the Willow Creek Ranger Station in the early part of this century. The Schiestler Peak molybdenite prospect in unsurveyed T. 32 N., R. 104 W., of the Temple Peak quadrangle, is the site of the only exploration activity within the study area. This prospect has been explored intermittently by surface excavations, diamond drilling, and underground mining since the claims were filed in 1940. Only 15 claims or groups of claims are in the study area or within 0.5 mi of the boundary, and they are mainly 61 lode claims in the Schiestler Peak area and a few placer claims in the Sweetwater and Big Sandy drainage basins.

Oil and gas leases cover the basin along the west margin of the study area. Many of these leases extend into the study area; the eastern borders of the leases are shown on the map. Several wells have been drilled close to the study area; eight are within 1 mi of the boundary. Oil and gas shows in these wells have been recorded, but there has been no production, and the wells are now capped.

MINERALIZED AREAS

Mineralized rock is rare in the Bridger Wilderness and the contiguous Green-Sweetwater Roadless Area. The Precambrian granitic complex that makes up the core of the Wind River Range is not of a type that contains abundant metal deposits. The area lacks the Tertiary volcanic and intrusive rocks that are progenitors of mineralization elsewhere in the region. Mineralized rock that is present consists of minor, scattered occurrences of base-metal sulfides, small pods of molybdenite-bearing rock in one area, scattered small pegmatites, and a small body of banded iron-formation (taconite).

The base-metal sulfides, mainly pyrite, with minor chalcopyrite and sphalerite, are found in three types of occurrences: disseminations along and in sheared rock, pods and disseminations in mafic to ultramafic boudins in migmatite and gneiss, and disseminations along felsic dikes where they cut mafic bodies. These occurrences of sulfides are most common in the northern half of the study area within the gneisses and migmatites. The metals are endogenetic, and the meager amount of associated altered rock is related to shearing or supergene processes.

Molybdenite is a common trace mineral occurring as large flakes and coarse-grained crystals in pegmatites and pegmatitic granite, and as small, well-formed flakes or rosettes in aplite. Most of the occurrences are within porphyritic granite in the Schiestler Peak area. At Schiestler Peak, significant mineralized rock forms two small pods wherein large grains and rosettes of molybdenite are scattered through aplite and porphyritic granite (Benedict, 1982). Pyrite and chalcopyrite also occur locally at Schiestler Peak. They are found with the molybdenite grains and as separate clusters of small euhedral to subhedral crystals; pyrite is found as thin veinlets along fractures. Altered rock is limited in extent, consisting of an area of bleaching and silicification about 4 in. in diameter rimming molybdenite grains.

Small pegmatite dikes, less than 3 ft wide, occur mainly in the gneisses and migmatites. All outcrops of pegmatites seen in the field are simple pegmatites that are generally unzoned and composed of quartz, feldspar, and mica. Magnetite is locally abundant, and single small beryl crystals were noted at two locations within the study area.

Banded iron-formation (taconite) occurs as discrete bodies in migmatite and migmatitic gneiss in the northern part of the study area. The largest occurrence is discontinuous, lenticular lenses of taconite in gneiss, with taconite making up 50 percent of the exposures in an area 3,600 ft long and 2,500 ft wide (Worl, 1968). The resistant, dark-green to dark-brown taconite stands in dark contrast to the surrounding light- to medium-gray gneiss and migmatite. The iron content of 30 hand samples ranged from 11 to 36 percent and averaged 25 percent. A similar rock is mined as iron ore at the Atlantic City iron mine of the U.S. Steel Corporation, about 6 mi east of the southern tip of the study area.

The Permian Phosphoria Formation contains beds of a marine phosphorite that in other parts of the Western United States is a major source of phosphate for fertilizer. The Phosphoria Formation is about 260 ft thick in the Green River Lakes area. Phosphate rock contains abundant fluorine and potentially recoverable amounts of vanadium, uranium, and the rare earths. Trenching and sampling in the Gypsum Creek area by the U.S. Geological Survey in 1950 (Swanson and others, 1951) indicated that no beds contained more than 12.7 percent P_2O_5.

A study initiated by the U.S. Department of Energy (1979, p. 17) concluded that "the Wind River Range could contain a major uranium district." This conclusion was based upon the assumption that the lithologies in the Wind River Range were similar to those of the Granite Mountains to the northwest. Radioactive granite from Fremont Butte, secs. 17 and 21, T. 32 N., R. 107 W., outside the study area, showed low uranium content (Love, 1954). The radioactive rocks are in fine- to medium-grained, equigranular dikes and pods. Numerous uranium claims have been located south and west of the study area, but no significant amount of uranium has been discovered.

The Atlantic City-South Pass gold districts are 5-7 mi southeast of the southern tip of the study area. Gold occurs in quartz veins in graphitic schist and metadiorite and locally in graywacke (Bayley and others, 1973). There are a few minor workings just south of the southeastern tip of the study area (Ryan, 1982) and a couple of placer claims within the study area. The study area itself is devoid of quartz veins and of the rock types that host the gold-bearing quartz veins in the mining districts.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

A moderate potential for oil and gas at depth is assigned to the western one-third of the study area. The geologic, geochemical, and geophysical surveys conducted for this evaluation did not locate deposits of any other commodity of significance. Several geologically permissible conditions are listed and discussed below, but few indications of mineral resources were found.

Oil and gas

The Paleozoic and Mesozoic sedimentary rocks of the Green River Basin are known to be oil and gas bearing. Although there are no producing wells in the study area, minor shows have been recorded in several of the wells, some of which are next to the northwestern boundary of the study area. Exposures of Paleozoic and Mesozoic rocks in the study area are limited, and the oil and gas potential of the areas of these exposures is considered to be low.

Potential oil- and gas-bearing reservoirs may exist at depth beneath the study area in sedimentary rocks that may underlie the Wind River fault and the wedge of Precambrian rocks that was thrust over them. The dip of the fault is an important consideration in determining the oil and gas potential of the study area. The steeper the angle of the Wind River fault, the shorter the distance would be that the wedge of sedimentary rocks would extend eastward.

Because the dip of the fault is not exactly known along much of the range, the potential for oil and gas at depth is difficult to assess. The area shown on the map as having moderate oil and gas potential is the western one-third of the study area, which is approximately that area covered by oil and gas leases (Ryan, 1982). Assignment of a moderate potential to this area is based upon the assumption that the Wind River fault dips at a shallow angle to the east and that the oil- and gas-bearing units underlie the fault.

Molybdenum

Molybdenite is present at the Schiestler Peak prospect; several rock samples from scattered localities in the range contained more than 10 ppm molybdenum. Extensive sampling (Benedict, 1982; Lee and others, 1982; Ryan, 1982) indicates that the molybdenite in the Schiestler Peak area is restricted to two small pods about 200 by 300 ft; no resources were identified.

Gold

Trace amounts of gold were found in panned concentrates of heavy minerals from a few streams, mainly in the southern part of the study area. The major gold-mining districts of Atlantic City and South Pass are a few miles southeast of the southern tip of the study area, where gold occurs in extensive quartz veins in low-metamorphic-grade schists. Such veins and country rocks are lacking in the study area.

Base metals

Sulfide minerals in shear zones, mafic pods, and felsic dikes are sparse and generally disseminated. Samples from the shear zones containing pyrite did not contain anomalous quantities of metals, but those from the small sulfide-bearing pods and crosscutting felsic dikes contained copper, lead, zinc, cobalt, silver, and molybdenum, in slightly anomalous amounts. All these occurrences are small, discontinuous, and widely scattered mafic pods.

Radioactive elements

Although a study by the U.S. Department of Energy (1979, p. 17) suggests that a major uranium district might be developed in the Wind River Range, no geologic, geochemical, or geophysical evidence for the occurrence of uranium or thorium deposits was found during this investigation. The granites of the Wind River Range are not those conducive to granitic-type deposits (Stuckless and Van Trump, 1983).

Banded iron-formation

Banded iron-formation (taconite) intimately mixed with granite gneiss crops out in an area of about 2 mi^2 in the northern part of the study area. About half of the outcrop is taconite in pods and lenses 2-30 ft wide and 5-250 ft long. The iron content of each taconite lens is highly variable. The iron content of 30 samples ranged from 11 to 36 percent and averaged 25 percent. A magnetic survey by Long (in press) suggests that the banded iron-formation does not extend to any significant depth.

Phosphate

The Paleozoic Phosphoria Formation, exposed in the northern part of the area, contains beds of marine phosphorite and, elsewhere in the region, is a major source of phosphate for fertilizer. Trace to anomalous amounts of molybdenum were detected in samples from the Phosphoria Formation. The beds in the study area are thin and contain less than 12.7 percent P_2O_5 (Swanson and others, 1951). Other elements present in phosphorite are extracted only as a byproduct of phosphate mining.

Coal

A little coal was mined from a small area just inside the study area. This is the only exposure of the coal-bearing Frontier Formation within the study area. The coal seams shown by drill-hole data from nearby oil wells are thin.

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By
R. G. Worl, G. K. Lee, and C. L. Long, U.S. Geological Survey
and
G. S. Ryan, U.S. Bureau of Mines

1984

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1984

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