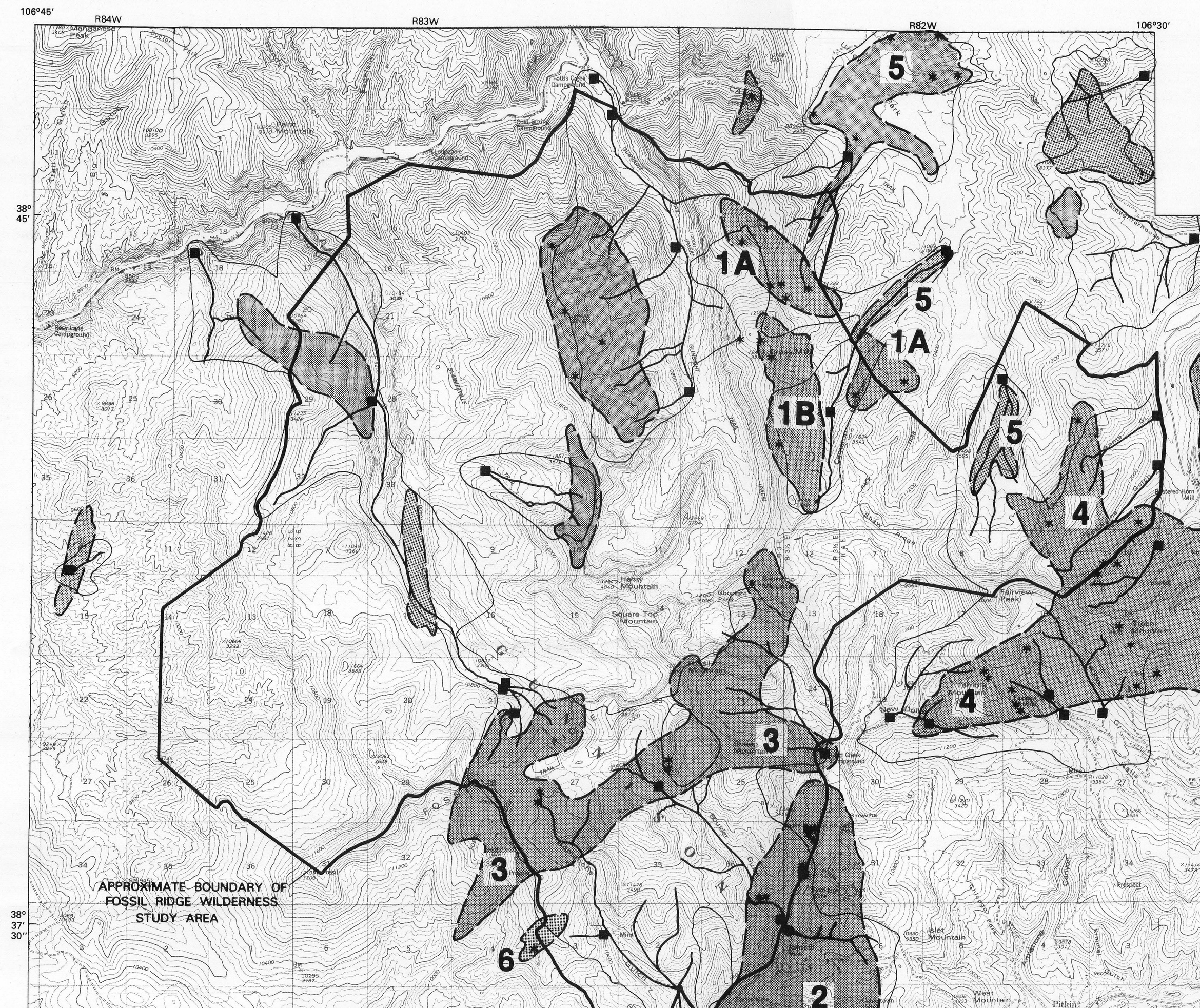
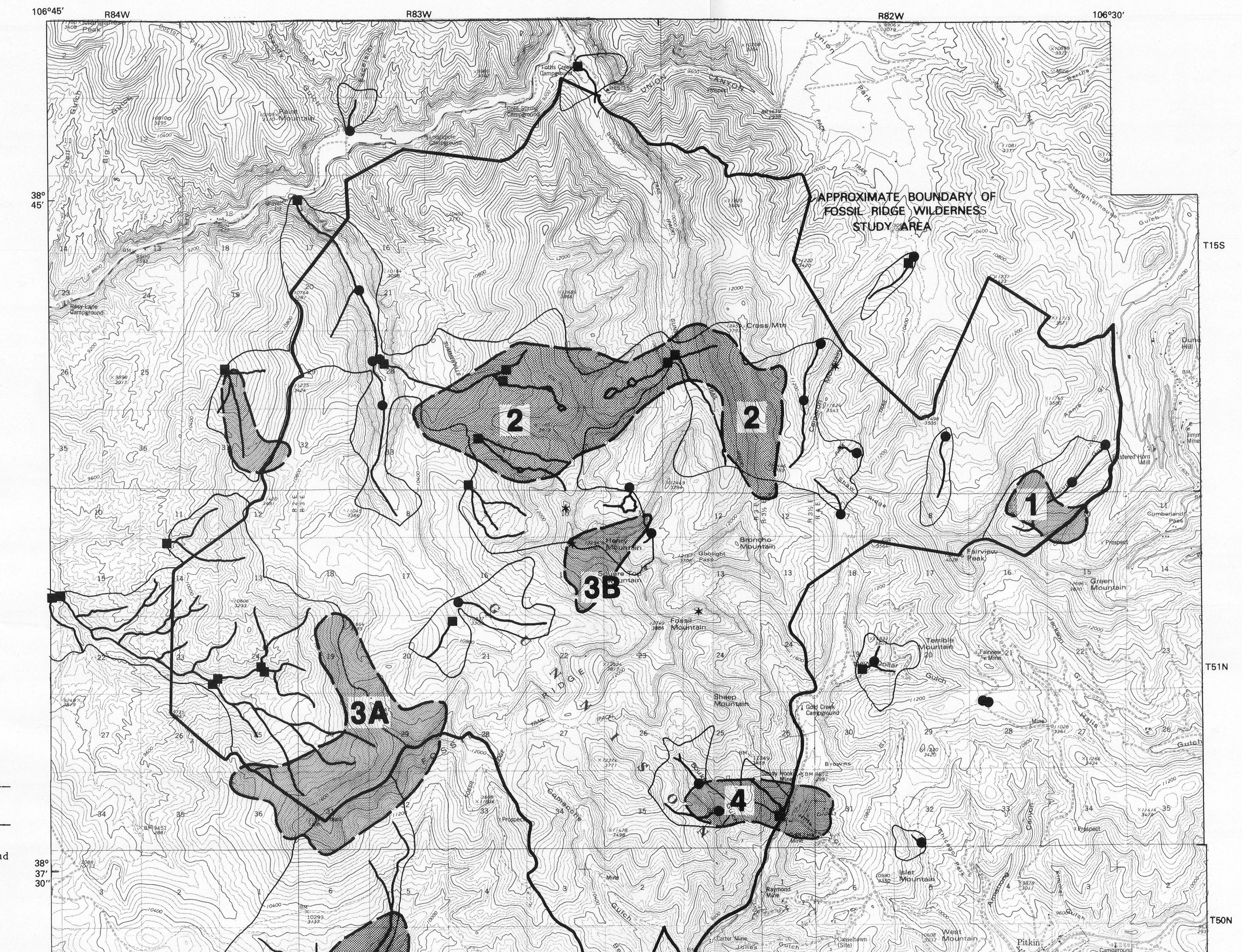


MAP A. GOLD-SILVER-ARSENIC-ANTIMONY

MAP A

Map area	Resource potential	Commod- ity	Size and type of deposit
1A------	High--------	Au, Ag	Small; vein.
1B------	--do--------	Au, Ag	Small; replacement and (or) vein.
2*------	--do--------	Au, Ag	Medium; vein and (or) shear zone.
2**-----	Moderate----	Au, Ag	Small; vein.
3-------	Low---------	Au, Ag	Small; vein and (or) fracture.
4**-----	Low-moderate	Au, Ag	Small; vein.
4*------	High--------	Au, Ag	Medium; replacement.
	--do--------	Au, Ag	Small(?); vein.
5-------	Moderate----	Au----	Small-medium; placer.
6-------	--do--------	Au----	Small; vein.

*Area outside Fossil Ridge Wilderness Study Area.
**Area inside Fossil Ridge Wilderness Study Area.



MAP D. BERYLLIUM-LITHIUM-BORON-TIN

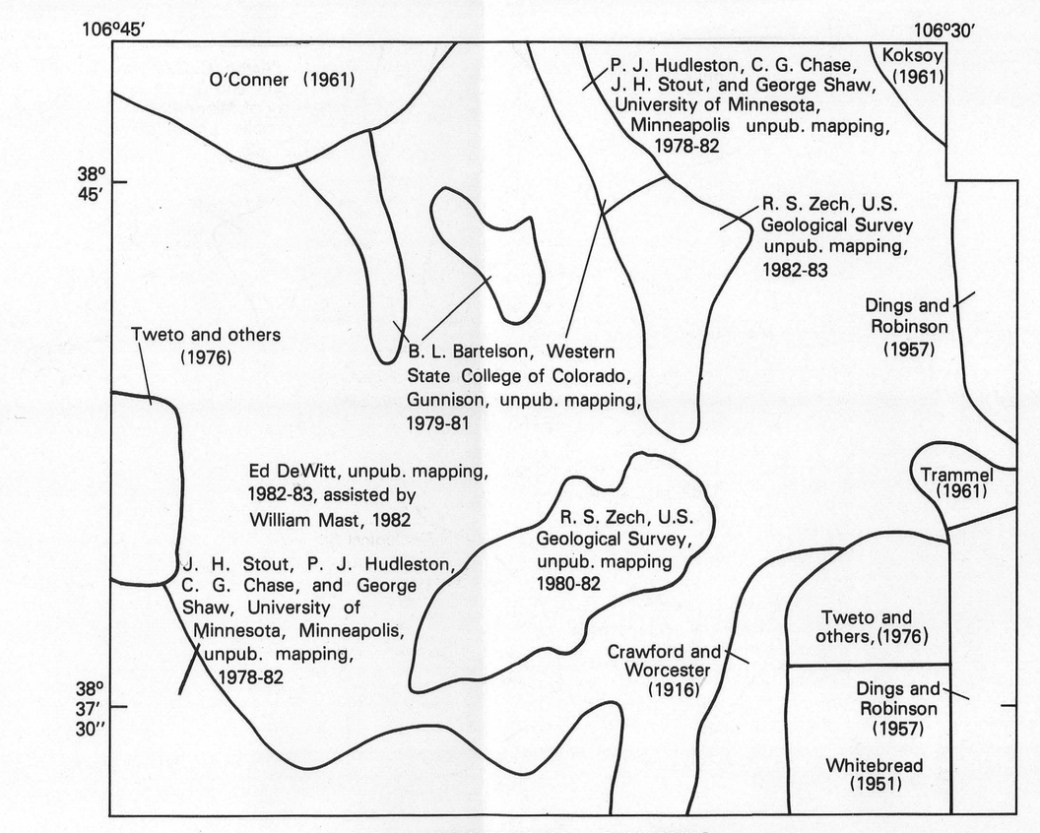
MAP D

Map area	Resource potential	Commod- ity	Size and type of deposit
1--------	Low---------	Sn-----	Small; vein.
	Low---------	Sn-----	Medium; disseminated and (or) porphyry.
2--------	Low---------	Be, Sn-	Small; disseminated.
3A-------	Low---------	B------	Small; vein and (or) disseminated.
3B-------	Low---------	B------	Do.
4--------	Low-moderate	Sn-----	Small(?); disseminated and (or) porphyry or vein.

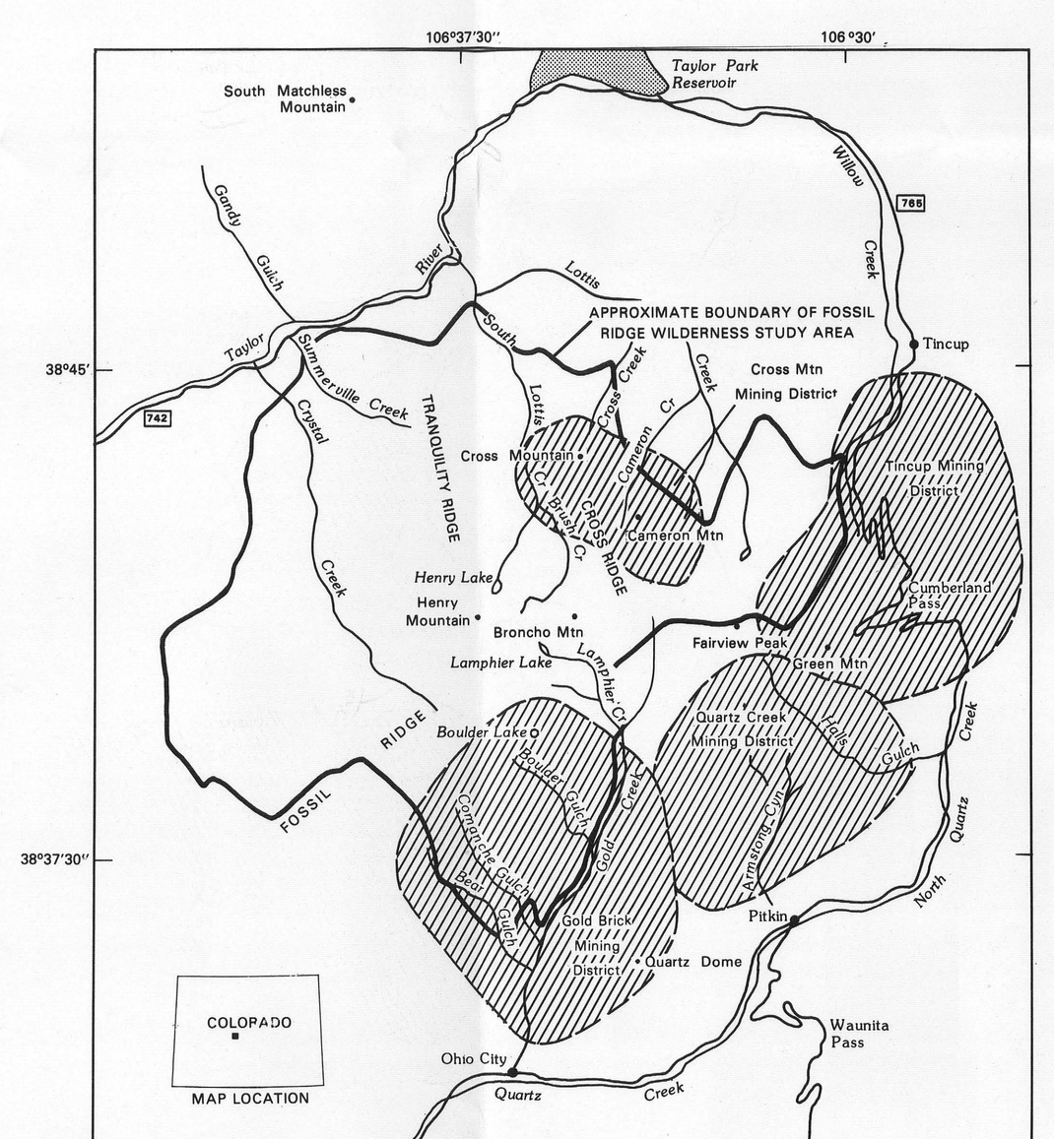
EXPLANATION

Note: The following explanation is for maps A-F

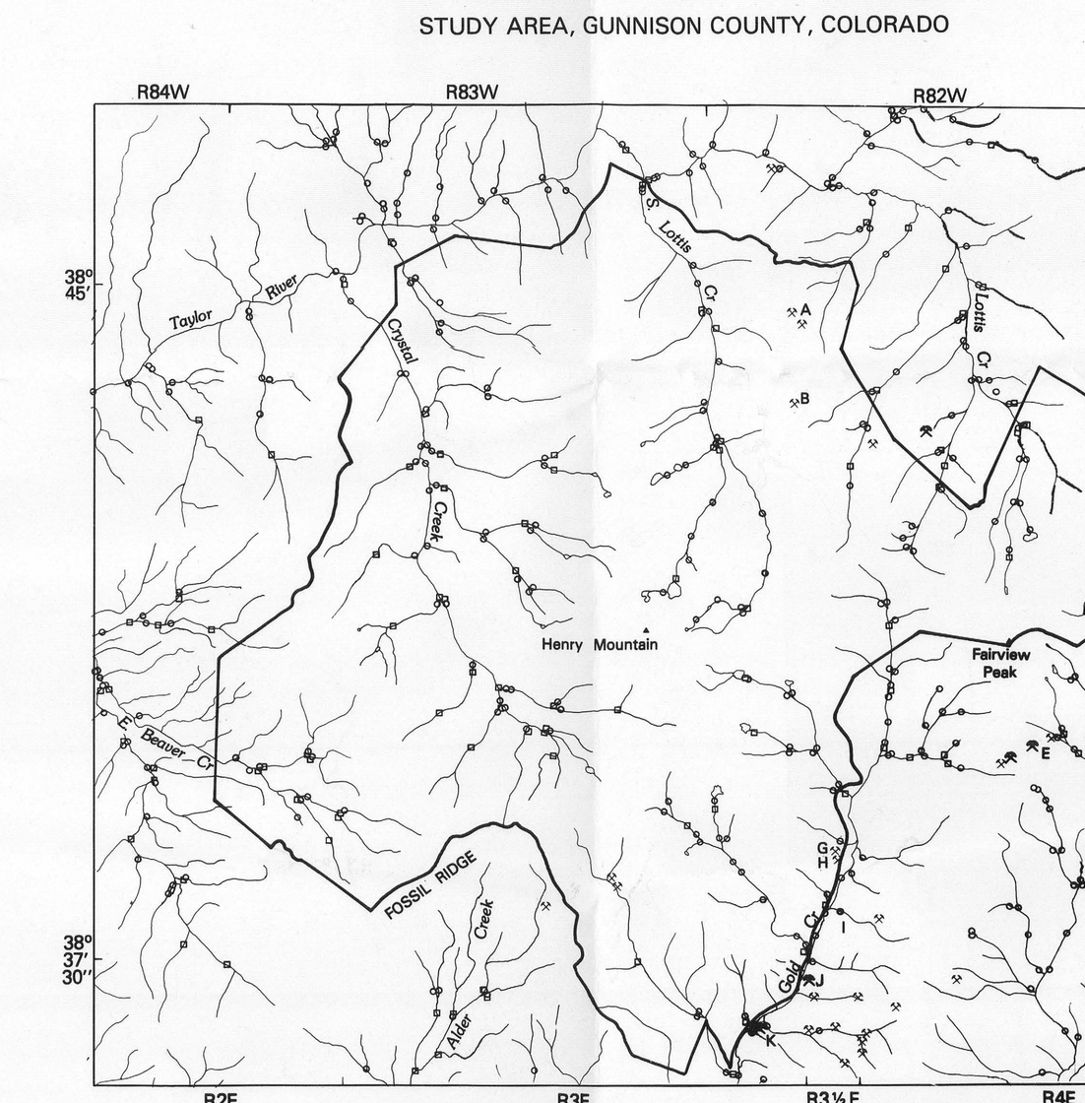
- ● ANOMALOUS STREAM-SEDIMENT SAMPLE LOCALITY--Analyses reported by Maasen (1981) and Broxton and others (1979).
- ▲ Analyses reported by Rocky Mountain Energy (unpub. data, 1982)
- ■ STREAM-SEDIMENT OR PANNED-CONCENTRATE SAMPLE LOCALITY--Analyses reported by Adrian and others (1984). Solid square indicates anomalous values in sample
- * ROCK SAMPLE LOCALITY--Samples contained anomalous values; analyses reported by Adrian and others (1984) and Kluender and McColly (1983)
- PART OF STREAM THAT CONTAINS ANOMALOUS CONCENTRATION OF ELEMENT
- DRAINAGE AREA THAT COULD HAVE PRODUCED ANOMALOUS STREAM-SEDIMENT OR PANNED-CONCENTRATE SAMPLE--Dashed lines signify drainage basin considered anomalous by data from Maasen (1981), but not corroborated by data from Rocky Mountain Energy (unpub. data, 1982)
- 2 AREA MOST LIKELY TO CONTAIN MINERAL OCCURRENCES--Evaluation based on geologic factors. Unnumbered areas are considered to have no mineral resource potential or are outside the wilderness study area
- × PROSPECT PIT
- ⊙ DIAMOND DRILL HOLE



INDEX TO GEOLOGIC MAPPING



LOCATION MAP OF THE FOSSIL RIDGE WILDERNESS STUDY AREA, GUNNISON COUNTY, COLORADO



STREAM-SEDIMENT SAMPLE LOCALITIES

EXPLANATION

- ○ STREAM-SEDIMENT SAMPLE LOCALITY--Analyses reported by Maasen (1981) and Broxton and others (1979)
- □ STREAM-SEDIMENT OR PANNED-CONCENTRATE SAMPLE LOCALITY--Analyses reported by Adrian and others (1984)

MINES

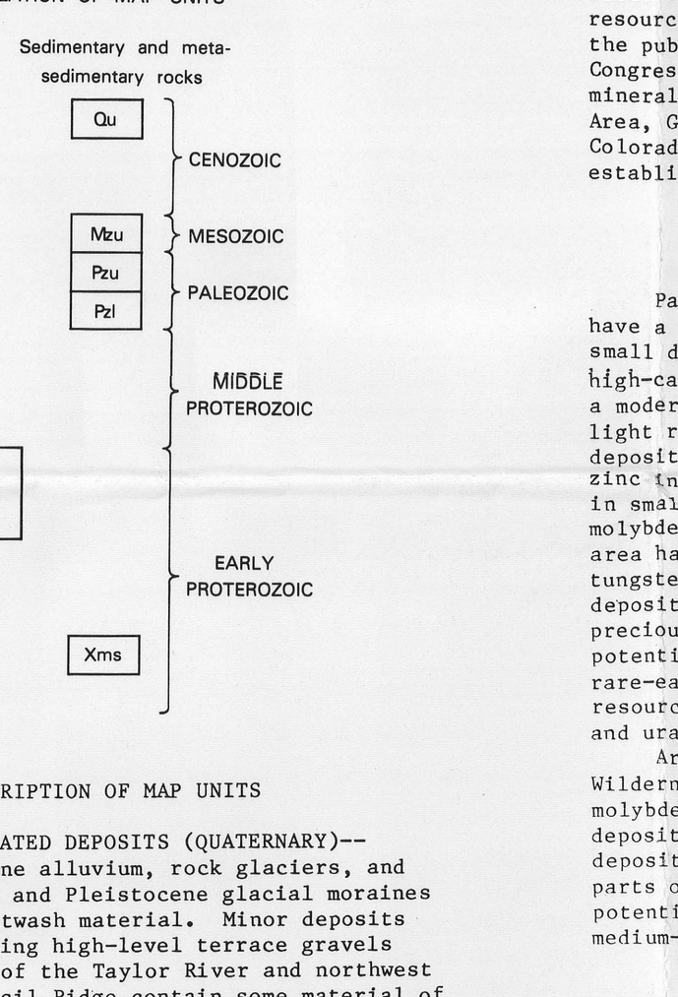
A, Gold Bug	G, Chronicle
B, Wahl Lode	H, Sandy Hook, McCarty-Clark
C, Anna Dedrika	I, Gold Links
D, Little Anna	J, Raymond
E, Fairview-Cleopatra	K, Carter
F, Swiss Bell	

- ⚒A Having past production
- ⚒D Currently producing or produced in last 10 years

MAP G. GEOLOGY

The following explanation is for the geologic map, map G.

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qu UNCONSOLIDATED DEPOSITS (QUATERNARY)--Holocene alluvium, rock glaciers, and talus, and Pleistocene glacial moraines and outwash material. Minor deposits including high-level terrace gravels south of the Taylor River and northwest of Fossil Ridge contain some material of possible Tertiary age

Tr RHYOLITE (MIDDLE TO LOWER MIOCENE?)--Dikes and small plugs of porphyritic (quartz-feldspar) rhyolite

Ta ANDESITE (PRE-OLIGOCENE?)--Sills, laccoliths, and stocks of porphyritic (plagioclase-hornblende) andesite-latite and porphyritic dacite

Mzu UNDIFFERENTIATED SEDIMENTARY ROCK UNITS (MESOZOIC)--Dakota Sandstone, Morrison Formation, and Junction Creek Sandstone

Pzu UNDIFFERENTIATED SEDIMENTARY ROCKS, UPPER UNITS (PALEOZOIC)--Belden Formation and Leadville Limestone

Pzl UNDIFFERENTIATED SEDIMENTARY ROCKS, LOWER UNITS (PALEOZOIC)--Chaffee Formation, Fremont Limestone, Harding Sandstone, Manitou Dolomite, and Sawatch Quartzite

Ydb DIABASE AND DIORITE (MIDDLE? PROTEROZOIC)--Dikes of biotite-rich diabase and diorite

Yt GRANITE OF THE TAYLOR RIVER (MIDDLE PROTEROZOIC)--Small and large plutons of muscovite granite

Xg UNDIFFERENTIATED GRANITIC ROCKS (EARLY PROTEROZOIC)--Stocks, sills, and plutons of granite

Xs UNNAMED SYENITE (EARLY PROTEROZOIC)--Zoned pluton of quartz monzonite-syenite that may possibly be partly Proterozoic Y in age

Xh GRANITE OF HENRY MOUNTAIN (EARLY PROTEROZOIC)--Large pluton of coarse-grained, porphyritic (microcline) biotite-muscovite granite

Xr GRANITE OF ROOSEVELT GULCH (EARLY PROTEROZOIC)--Large pluton of biotite granite

Xf GRANODIORITE OF FAIRVIEW PEAK (EARLY PROTEROZOIC)--Large pluton of well-foliated biotite granodiorite

Xd UNNAMED DIORITE (EARLY PROTEROZOIC)--Stocks and subvolcanic sills of diorite, quartz diorite, and metagabbro

Xms UNNAMED METASEDIMENTARY UNITS (EARLY PROTEROZOIC)--Muscovite-biotite-andalusite-cordierite schist, metaquartzite, metagraywacke, and minor metaconglomerate

Xfv UNNAMED FELSIC METAVOLCANIC UNITS (EARLY PROTEROZOIC)--Metarhyolite and metadacite tuffs and intrusive bodies

Xmv UNNAMED MAFIC METAVOLCANIC UNITS (EARLY PROTEROZOIC)--Amphibolite, metabasalt, meta-andesite, layered calc-silicate gneiss, and meta-agglomerate

CONTACT--Dashed where approximately located; queried where inferred; dotted where concealed

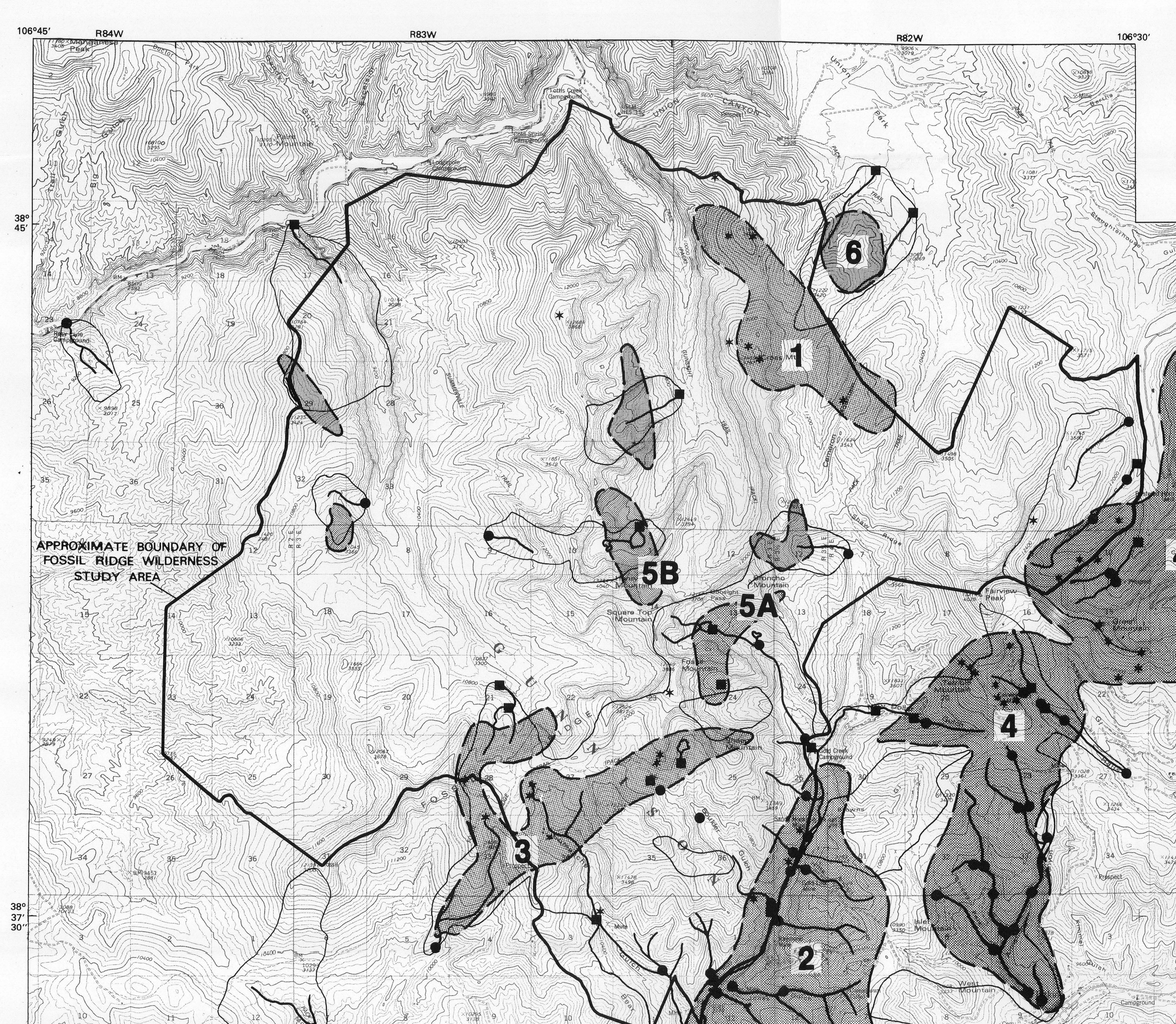
FAULT--Dashed where approximately located, queried where inferred; dotted where concealed. f? indicated questionable fault or fracture zone. Sawteeth on upper plate of low-angle thrust fault. Bar and ball on downthrown side of normal or reverse fault

THRUST FAULT--Sawteeth on upper plate

ANTICLINE

SYNCLINE

MONOCLINE

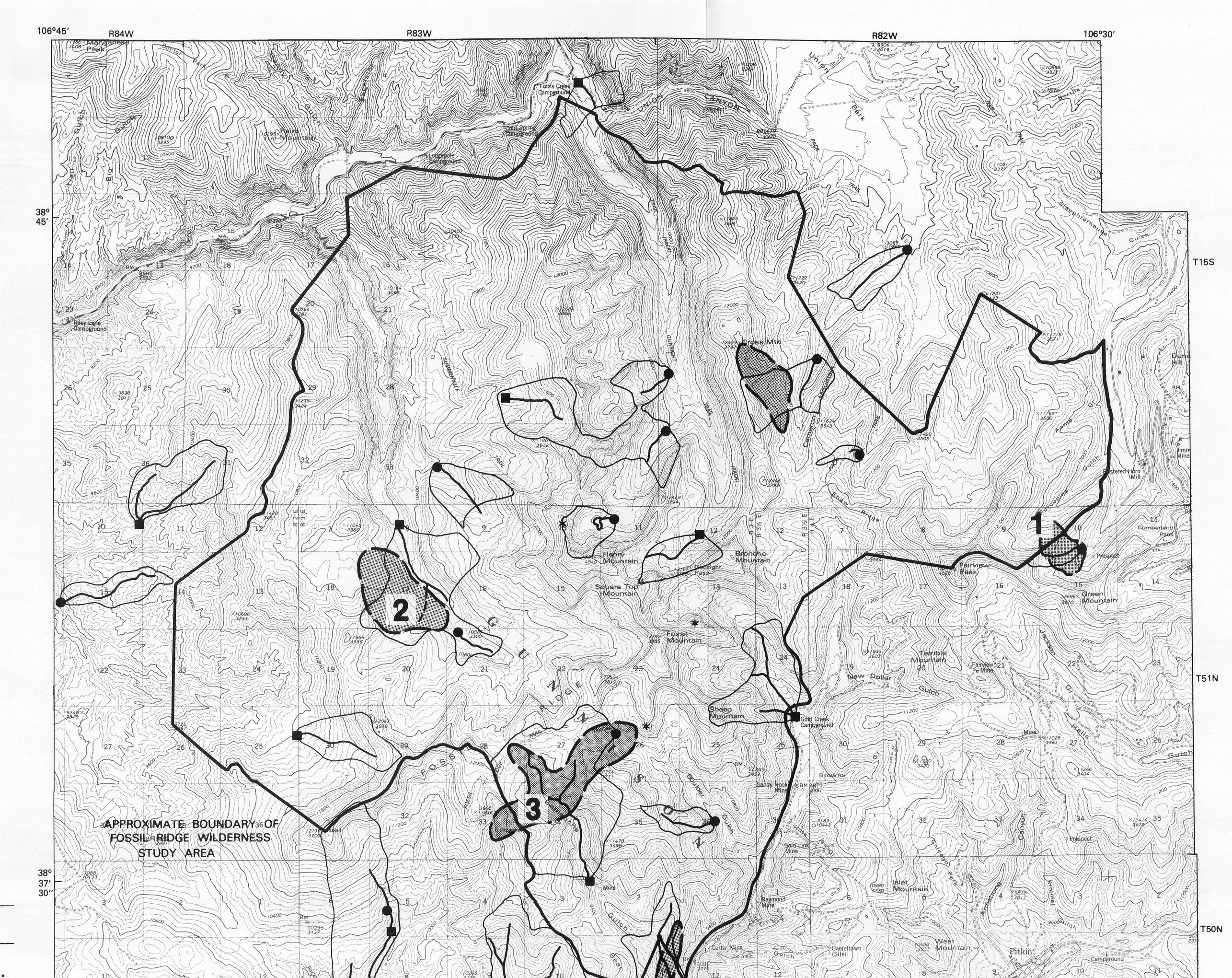


MAP B. COPPER-LEAD-ZINC-MOLYBDENUM-BISMUTH-CADMIUM

MAP B

Map area	Resource potential	Commod- ity	Size and type of deposit
1-----------	Moderate--	Cu---------	Small; vein and (or) replacement.
	Low-------	Pb, Zn-----	Do.
2*----------	High------	Pb---------	Medium; vein and (or) shear zone.
2**---------	Moderate--	Pb---------	Small; vein.
3-----------	Low-------	Cu, Pb, Zn-	Small; vein and (or) fracture.
4**---------	Moderate--	Cu, Pb, Zn-	Do.
4* Green Mountain area.	High------	Mo---------	Large; disseminated and (or) porphyry.
4* Halls Gulch area.	--do------	Pb, Zn-----	Small-medium; replacement and (or) vein.
5A----------	Low-------	Mo---------	Small; vein.
5B----------	Low-------	Mo---------	Small; unknown.
6-----------	Unknown---	Mo---------	Small-medium; disseminated and (or) porphyry.

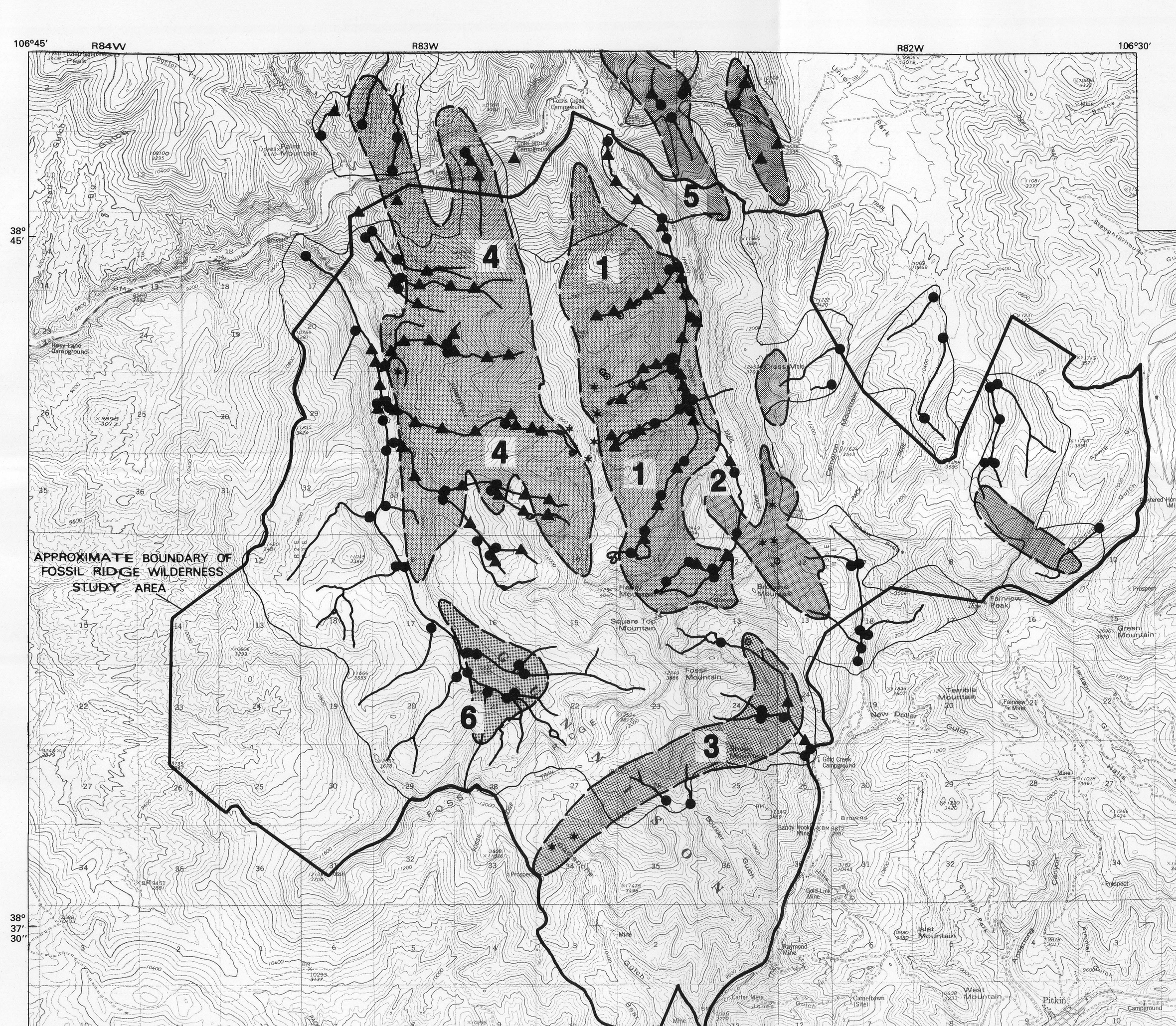
*Area outside Fossil Ridge Wilderness Study Area.
**Area inside Fossil Ridge Wilderness Study Area.



MAP E. COBALT-CHROMIUM-NIOBIUM-TANTALUM-TUNGSTEN

MAP E

Map area	Resource potential	Commod- ity	Size and type of deposit
1--------	Low------	W--------	Small; vein.
2--------	Low------	W, Co, Cr	Small; disseminated.
3--------	Low------	Cr, Co---	Small; vein.

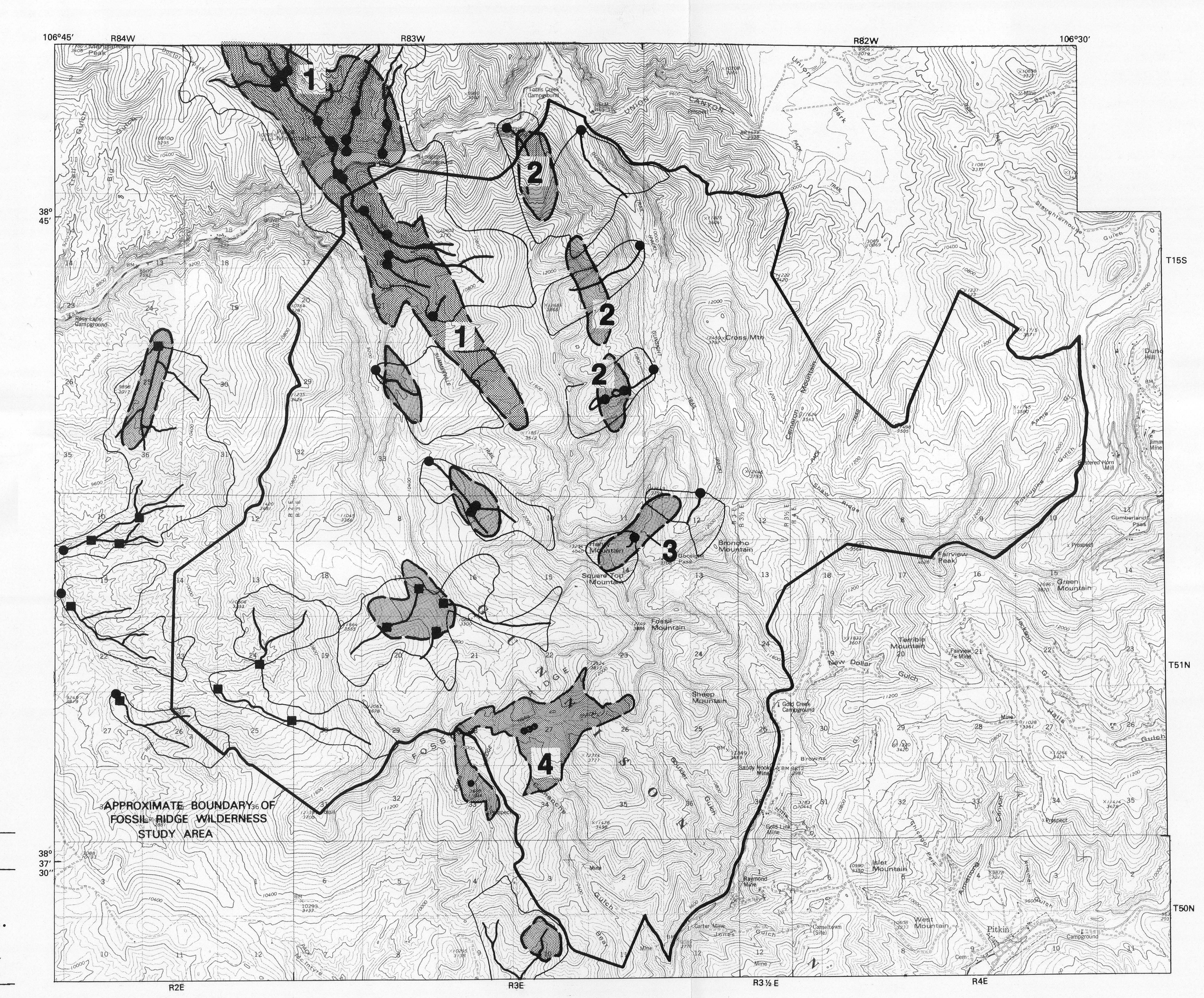


Base from U.S. Geological Survey Gunnison County, CO, sheets 3 and 5, 1976, scale 1:50,000

MAP C. URANIUM

MAP C

Map area	Resource potential	Size and type of deposit
1-------	High---------	Medium; shear zone and (or) vein.
2-------	Moderate-----	Small; shear zone.
3-------	--do---------	Small; vein.
4-------	Moderate-high	Medium; vein(?) and (or) shear zone(?).
5-------	Low-moderate-	Small; shear zone.
6-------	Low----------	Small; unknown.



MAP F. THORIUM-LANTHANUM-RARE EARTH ELEMENTS-LIMESTONE

MAP F

Map area	Resource potential	Commod- ity	Size and type of deposit
1-------	Moderate-high	Th, La, Ce	Small-medium(?); vein and (or) pegmatite(?).
2-------	Low----------	Sm--------	Medium; shear zone.
3-------	Low----------	La, Ce----	Small; unknown.
4-------	High---------	Limestone-	Large; sedimentary and (or) bedded.

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 survey of the Fossil Ridge Wilderness Study Area, Gunnison National Forest, Gunnison County, Colorado. The Fossil Ridge Wilderness Study Area was established by Public Law 96-560, 1980.

MINERAL RESOURCE POTENTIAL
SUMMARY STATEMENT

Parts of the Fossil Ridge Wilderness Study Area have a high resource potential for gold and silver in small deposits, uranium in medium-size deposits, and high-calcium limestone in large deposits. Parts have a moderate to high potential for uranium, thorium, and light rare-earth elements in small- to medium-size deposits, a moderate potential for copper, lead, and zinc in small deposits, a low potential for molybdenum in small deposits, and an unknown potential for molybdenum in deposits of unknown size. Parts of the area have a low potential for cobalt, chromium, tungsten, beryllium, boron, and tin in small deposits. And, depending on the extraction of precious metals, parts of the area could have a low potential for arsenic in small deposits. Tungsten, rare-earth elements, and tin could not be considered resources except for coexisting base metals, thorium, and uranium.

Areas that immediately adjoin the Fossil Ridge Wilderness Study Area have a high potential for molybdenum in large deposits, lead in medium-size deposits, and zinc in small- to medium-size deposits. Depending on the extraction of base metals, parts of the adjoining areas could have a low resource potential for bismuth and cadmium as byproducts from medium-size deposits.

INTRODUCTION

The Fossil Ridge Wilderness Study Area occupies 85.5 sq mi within the Gunnison National Forest of central Colorado. Access to the area is by paved roads along the Taylor River and Quartz Creek, and by graveled roads along Willow Creek and Gold Creek. The Gold Brick and Quartz Creek mining districts border the area on the southeast, and the Tincup district adjoins the area on the east. The Cross Mountain mining district is within the north-central part of the area. Elevations range from 9,200 ft along the Taylor River and Gold Creek to more than 13,200 ft on Fairview Peak and Henry Mountain. Steep-sided glacial valleys and cirques are typical features in the central and eastern parts of the area, but the topography is more subdued, though very mountainous, in the western part. Thick conifer forests at the lower elevations change to alpine tundra and meadows above 11,400 ft.

GEOLOGY

The Fossil Ridge Wilderness Study Area is underlain chiefly by granitic and metamorphic rocks of Proterozoic age, which are partly mantled by a thin cover of Paleozoic strata (map G). The Proterozoic and Paleozoic rocks are cut by many small Tertiary and pre-Tertiary(?) intrusive bodies. Pleistocene glacial deposits locally obscure much of the bedrock. Faults of probable Laramide to middle Tertiary age cut all but the youngest rock units and locally have vertical offsets of 2,300 to 2,950 ft.

The layered Proterozoic rocks consist of an older bimodal metavolcanic assemblage and a younger pelitic metasedimentary assemblage. The metavolcanic rocks were subaqueous pillowed basalt flows and felsic to intermediate tuffs. Subvolcanic sill-like bodies of diorite or metagabbro are associated with the mafic rocks. The metasedimentary rocks were shales, siltstones, and quartzites. The layered rocks are intruded by at least five major plutonic bodies that range in age from about 1,700 to 1,400 m.y., and in composition from biotite granodiorite to muscovite granite.

The Paleozoic rocks consist of the Cambrian Sawatch Quartzite, Ordovician Manitou Dolomite, Ordovician Harding Sandstone, Ordovician Fremont Limestone, Devonian and Mississippian(?) Chaffee Group (dolomite, siltstone, and sandstone), Mississippian Leadville Limestone, and Pennsylvanian Belden Shale. Pennsylvanian rocks younger than the Belden Shale and Mesozoic strata are present in surrounding areas but not within the study area. Lithologies and thicknesses of Paleozoic strata in the area are typical of central Colorado, except that the Sawatch Quartzite is locally thicker near the Taylor River than in outlying regions.

Two ages and types of Tertiary and pre-Tertiary igneous rocks are noted: an older andesite-latite porphyry that forms sill-like to laccolithic bodies within the Paleozoic strata, and a younger porphyritic rhyolite that forms high-angle dikes and small plugs in the Proterozoic and Paleozoic rocks.

GEOCHEMISTRY

Geochemical data from uranium resource studies (Broxton and others, 1979; Maasen, 1981) and from the present wilderness assessment (Adrian and others, 1984) have been utilized in this mineral resource appraisal, and selected data from those studies are shown on maps A-F. Also, Goodknight and Ludlam (1981) and Bolivar and others (1981) characterize the uranium occurrences and give background geochemical values for selected elements within and surrounding the Fossil Ridge Wilderness Study Area.

MINING DISTRICTS AND MINERALIZATION

Parts of the Cross Mountain, Gold Brick, and Tincup (Kluender and McColly, 1983) organized mining districts are within the Fossil Ridge Wilderness Study Area. Two mines having past production in the Cross Mountain district, the Gold Bug and Wahl Lode, are inside the wilderness study area boundary, and a third, unnamed, mine that is currently being worked is less than 0.3 mi outside the boundary. Three mines in the Gold Brick district, the Chronicle, Sandy Hook, and McCarty-Clark, are inside the study area. Also, the three largest mines in the Gold Brick district (Crawford and Worcester, 1916), the Carter, Raymond, and Gold Links, are less than 0.2 mi outside the study area. Only two mines in the Tincup district, the Anna Dedrika and Little Anna, are within the study area. Numerous small mines in the Tincup district are adjacent to the study area.

At the Gold Bug mine (maps A-F), gold, silver, and lead have been produced from a vein deposit in Paleozoic and Proterozoic rocks (Hill, 1909; Goddard, 1935). The Wahl Lode was described by Goddard (1935) as a replacement deposit in Paleozoic limestone, but R. S. Zech (unpub. mapping, 1983) notes that a vertical vein constitutes most of the deposit. Gold, copper, and manganese were produced from the Wahl Lode. The unnamed workings on the northeast side of Cameron Mountain are similar to the Gold Bug. Deposits in the Gold Brick district are localized along veins and shear zones in Proterozoic metamorphic and plutonic rocks and a small stock of Tertiary(?) rhyolite (Crawford and Worcester, 1916). Gold, silver, and lead were produced in the Gold Brick district mainly from the Carter, Raymond, and Gold Links mines, all of which were being actively prospected in 1983. Mines in the Tincup district contain vein deposits of tungsten, molybdenum, and silver in Proterozoic and Tertiary plutonic rocks, and replacement deposits of gold, silver, and lead in Paleozoic sedimentary rocks (Goddard, 1935). Placer gold has been produced from the Union Park area and Cameron and Lottis Creek drainages (Goddard, 1935).

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Parts of the Fossil Ridge Wilderness Study Area have a high resource potential for gold and silver in small deposits, uranium in medium-size deposits, and high-calcium limestone in large deposits. Parts have a moderate to high potential for uranium, thorium, and light rare-earth elements in small- to medium-size deposits, a moderate potential for copper, lead, and zinc in small deposits, a low potential for molybdenum in small deposits, and an unknown potential for molybdenum in deposits of unknown size. Parts of the area have a low potential for cobalt, chromium, tungsten, beryllium, boron, and tin in small deposits. And, depending on the extraction of precious metals, parts of the area could have a low resource potential for arsenic in small deposits. Tungsten, rare-earth elements, and tin could not be considered resources except for coexisting base metals, thorium, and uranium.

Areas that immediately adjoin the Fossil Ridge Wilderness Study Area have a high potential for molybdenum in large deposits, lead in medium-size deposits, and zinc in small- to medium-size deposits. Depending on the extraction of base metals, parts of the adjoining area could have a low resource potential for bismuth and cadmium as byproducts from medium-size deposits.

Evaluation of the resource potential is based on studies of the geology (Ed DeWitt, unpub. mapping, 1980-83), stream-sediment and rock geochemistry (Adrian and others, 1984; Kluender and McColly, 1983; Broxton and others, 1979; Maasen, 1981), and production and assay records from mines that have operated in the past (Kluender and McColly, 1983). Areas within the Fossil Ridge Wilderness Study Area that have a mineral resource potential for certain commodities are shown on maps A-F.

REFERENCES CITED

Adrian, B. M., Clark, J. R., Arbogast, B. F., and Gruzensky, A. L., 1984, Analytical results and sample locality map of stream-sediment, panned-concentrate, and rock samples from the Fossil Ridge Wilderness Study Area, Gunnison County, Colorado: U.S. Geological Survey Open-File Report 84-419, 29 p., 1 pl.

Bolivar, S. L., Balog, S. H., Campbell, Katherine, Fugelso, L. E., Weaver, T. A., and Wecksung, G. W., 1981, Multisource data set integration and characterization of uranium mineralization for the Montrose quadrangle, Colorado: U.S. Department of Energy and University of California, Los Alamos Scientific Laboratory Informal Report LA-8807-MS, 172 p.

Broxton, D. E., Morris, W. A., and Bolivar, Stephen, 1979, Uranium hydrogeochemical and stream sediment reconnaissance of the Montrose NTMS quadrangle, Colorado, including concentrations of forty-three additional elements: Grand Junction, Colo., U.S. Department of Energy GJBX-175 (79), 255 p.

Crawford, R. D., and Worcester, P. G., 1916, Geology and ore deposits of the Gold Brick district, Colorado: Colorado Geological Survey Bulletin 10, 116 p.

Dings, M. G., and Robinson, C. S., 1957, Geology and ore deposits of the Garfield quadrangle, Colorado: U.S. Geological Survey Professional Paper 289, 110 p.

Goddard, E. N., 1935, The geology and ore deposits of the Tincup mining district, Gunnison County, Colorado: Colorado Scientific Society, v. 13, no. 10, p. 551-595.

Goodknight, C. S., and Ludlam, J. R., 1981, National uranium resource evaluation, Montrose quadrangle, Colorado: Grand Junction, Colo., U.S. Department of Energy GJQ-010 (81), 91 p.

Hill, J. M., 1909, Notes on the economic geology of southeastern Gunnison County, Colorado, in Contributions to economic geology, 1908, Part I: U.S. Geological Survey Bulletin 380, p. 21-40.

Kluender, S. E., and McColly, R. A., 1983, Mineral investigation of the Fossil Ridge Wilderness Study Area, Gunnison County, Colorado: U.S. Bureau of Mines Open-File Report MLA 66-83, 47 p., 1 plate, scale 1:30,000.

Koksoy, Mumin, 1961, Geology of northern part of Tincup mining district, Gunnison County, Colorado: Golden, Colorado School of Mines M.S. thesis, 99 p.

Maasen, L. W., 1981, Detailed uranium hydrogeochemical and stream sediment reconnaissance data release for the eastern portion of the Montrose NTMS quadrangle, Colorado, including forty-five additional elements: Grand Junction, Colo., U.S. Department of Energy GJBX-105 (81), 208 p.

O'Connor, T. E., 1961, The structure and stratigraphy of an area west of Taylor Park, northeast Gunnison County, Colorado: Boulder, University of Colorado M.S. thesis, 97 p.

Trammell, J. W., 1961, Geology of the Cumberland Pass area, Gunnison County, Colorado: Boulder, University of Colorado M.S. thesis, 109 p.

Tweto, Ogden, Steven, T. A., Hail, W. J., Jr., and Moench, R. H., 1976, Preliminary geologic map of the Montrose 1° by 2° quadrangle, southwestern Colorado: U.S. Geological Survey Miscellaneous Field Studies Map MF-761, scale 1:250,000.

Whitebread, D. H., 1951, Geology of the Pitkin area, Gunnison County, Colorado: Boulder, University of Colorado M.S. thesis, 37 p.

0 1 2 3 4 5 MILES
0 1 2 3 4 5 6 7 8 KILOMETERS

MINERAL RESOURCE POTENTIAL MAP OF THE FOSSIL RIDGE WILDERNESS STUDY AREA, GUNNISON COUNTY, COLORADO

By

Ed DeWitt, Rebecca J. Stoneman, and J. Robert Clark, U.S. Geological Survey

and

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

1985

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1985

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