DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1755-A
PAMPHLET

# MINERAL RESOURCE POTENTIAL OF THE FIDDLER BUTTE WILDERNESS STUDY AREA AND THE FREMONT GORGE STUDY AREA, GARFIELD AND WAYNE COUNTIES, UTAH

By
**M. J. Larson, R. F. Dubiel, Fred Peterson, and W. R. Willson,**
**U.S. Geological Survey**
**and**
**J. P. Briggs, U.S. Bureau of Mines**

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 Fiddler Butte (UT-050-241) Wilderness Study Area, Garfield County, Utah. This report also contains the results of a U.S. Geological Survey resource assessment of the Fremont Gorge study area, Wayne County, Utah, which was formerly designated as the Fremont Gorge (UT-050-221) Wilderness Study Area.

## MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

Field and laboratory investigations of the Fiddler Butte WSA (Wilderness Study Area) in Garfield County, Utah, and of the Fremont Gorge study area in Wayne County, Utah, were made to determine the mineral resource potential of these lands. The investigations indicate that two areas in the northeastern and southwestern parts of the Fiddler Butte WSA have a moderate potential for uranium resources. The entire Fiddler Butte WSA has a moderate potential for petroleum resources, and the northeastern part of the WSA has a high potential for tar sand resources. The studies indicate a low potential for metallic and nonmetallic resources in the Fiddler Butte WSA. The Fremont Gorge study area has a low potential for metallic, nonmetallic, and petroleum resources.

## INTRODUCTION

From 1981 to 1983, geoscientists from the U.S. Geological Survey and the U.S. Bureau of Mines conducted field and laboratory studies to evaluate the mineral resource potential of the Fiddler Butte WSA, Garfield County, Utah, and of the Fremont Gorge study area, Wayne County, Utah (fig. 1). The studies of the U.S. Geological Survey consisted of geologic mapping (Larson and others, 1985), sedimentologic studies (Dubiel, 1983), and geochemical sampling. The U.S. Bureau of Mines investigated the mines and prospects, and studied the mining activity and production of the Fiddler Butte WSA (Briggs, 1982).

The Fiddler Butte WSA covers nearly 39 sq mi of southeast Utah and is located approximately 30 mi southeast of Hanksville, Utah. Access to the southern part of the Fiddler Butte WSA is by Utah State Highway 95 and North Wash, which coincide with the southern border of the WSA. Access to the northern part of the WSA may be gained by the Poison Spring Canyon Road. The topography is characterized by moderately incised canyons and broad mesas.

The Fremont Gorge study area occupies about 4.5 sq mi of southeast Utah, and is located 2.5 mi east-southeast of Torrey, Utah. Access to the Fremont Gorge study area from the north is by Utah State Highway 24. The main topographic features are the numerous canyons that drain the study area to the Fremont River. The Fremont Gorge study area is currently not proposed for wilderness designation and was examined solely by the U.S. Geological Survey.

## ACKNOWLEDGMENTS

The development of a mineral resource potential summary of a study area is dependent upon the expertise and contributions of many people in addition to the authors. We acknowledge the assistance of our helicopter pilots, Leonard Smith, and the late Jaxon Ruby, whose skill as pilots made many of the field tasks in remote areas considerably easier. We would also like to thank the people who assisted in the field on all aspects of this interdisciplinary study: Brad Esslinger, Joseph Fontaine, Darlene Francis, David Hammond, Carl Harris, Denise Mruk, Richard Reeves, Mike Rendina, William Thoen, Ann Tirrell, Bruce van Brundt, Shawn Yasataki, and Christine Yee.

## GEOLOGY

### Fiddler Butte Wilderness Study Area

The Fiddler Butte WSA is on the gently dipping northwest edge of the Monument upwarp and is bordered on the west by the Henry Basin. Numerous joints and normal faults of minor displacement trend northwesterly across the WSA.

Rocks exposed in the WSA are sedimentary (fig. 2), and range in age from Early Permian to Middle Jurassic and have a combined thickness of nearly 2,800 ft. The Permian Organ Rock Tongue and White Rim Sandstone Member of the Cutler Formation are the oldest rocks exposed in the WSA. The Cutler is overlain by the Lower and Middle(?) Triassic Moenkopi Formation, which, in turn, is overlain by the Upper Triassic Chinle Formation. The Glen Canyon Group lies on the Chinle Formation and consists of the following formations, in ascending order: Wingate Sandstone (Upper Triassic), Kayenta Formation (Upper Triassic?), and Navajo Sandstone (Triassic? and Jurassic). Middle Jurassic formations that lie above the Navajo Sandstone include, from oldest to youngest, Page Sandstone, Carmel Formation, and Entrada Sandstone, all of the San Rafael Group. Unconsolidated fluvial sand and gravel form the Quaternary terrace deposits that occur in the lower parts of most of the stream valleys. Windblown sand covers much of the topographically high but flat areas between the major stream courses.

### Fremont Gorge Study Area

The Fremont Gorge study area is on the gently dipping western slope of the Waterpocket Fold. Several normal faults that strike northwest are present in the southeastern corner of the study area. The Permian Kaibab Limestone and overlying Lower and Middle(?) Triassic Moenkopi Formation are the only bedrock formations exposed in the study area (fig. 2). Their aggregate thickness is about 1,000 ft. No significant Quaternary deposits are present in the study area.

## GEOCHEMISTRY

A reconnaissance geochemical survey of the Fiddler Butte WSA and the Fremont Gorge study area was conducted during the summer of 1982 to contribute to the mineral resource assessment. Geochemical sample media collected comprised stream-sediment samples and heavy-mineral concentrates panned from stream sediments. A total of 52 stream-sediment samples and 52 panned concentrate samples were analyzed using semiquantitative emission spectrography (Grimes and Marranzino, 1968). Mineralogic identifications of sulfide minerals in the nonmagnetic fraction of the heavy-mineral concentrates were also made. A listing of the data and a sample locality map are given in Detra and others (1984).

### Fiddler Butte Wilderness Study Area

The analyses of stream sediments and heavy-mineral concentrates indicate a paucity of geochemical anomalies. An exception is panned concentrate sample HM413 (from the northeastern part of the WSA), which has a gold value of 100 parts per million. However, this anomaly is not confirmed by other analyses from samples taken farther downstream and appears to represent an isolated mineral occurrence. The lack of geochemical anomalies suggests that the Fiddler Butte WSA has a low potential for metallic and nonmetallic resources.

### Fremont Gorge Study Area

The geochemical survey revealed no anomalous samples, and the Fremont Gorge study area is considered to have a low potential for metallic and nonmetallic resources.

## MINING DISTRICTS AND MINERALIZATION

### Fiddler Butte Wilderness Study Area

Uranium mining and associated energy-related exploration are manifested by 6 adits, 10 prospects, and numerous drill holes at four localities along the perimeter of the WSA (Briggs, 1982). Mining at Buckacre Point and Cedar Point, which are located just northwest of Fiddler Butte (fig. 1), produced an estimated 7,500 tons of uranium ore. The principal mine workings, consisting of three adits and one prospect, are at Cedar Point. The mines are inactive; annual assessment and exploration drilling were the only activities being conducted at the time of this investigation (Briggs, 1982).

A total of 51 samples was collected from mines and prospects in the Fiddler Butte WSA. Assay data of these samples indicate that uranium contents range from less than 0.01 to 0.07 percent $U_3O_8$; average values for individual uranium mines and prospects are less than 0.02 percent. All of these values are much less than the approximately 0.15- to 0.20-percent $U_3O_8$ mill grade that was considered necessary for economic endeavors at the time of the U.S. Bureau of Mines investigation (Briggs, 1982). No uranium minerals were identified in the WSA. However, the presence of torbernite (a copper-uranium-phosphate mineral) and uraniferous petrified wood were reported by Doelling (1967).

Most silver assays are 0.2 ounces per ton or less; two samples at Cedar Point assayed 0.4 and 0.6 ounces per ton. These values are also considered to be too low for commercial exploitation. Copper values did not exceed 0.03 percent, except for three samples assaying 0.09, 0.14, and 0.20 percent; these values are too low for consideration for commercial mining endeavors, even as a by-product. Vanadium values were less than 0.02 percent $V_2O_5$ and are not of commercial value. Almost all of the vanadium produced from mining endeavors on the Colorado Plateaus province has been produced as a by-product of uranium-vanadium ore deposits in the Upper Jurassic Morrison Formation. Although the Fiddler Butte WSA contains some indications of uranium in the Chinle Formation, vanadium generally does not occur in sufficient concentrations in this formation to be extracted as a by-product of uranium ores. Assay data and locations of the mines and prospects are given in Briggs (1982).

Fremont Gorge Study Area

No mines, prospects, or mining activity are known in the Fremont Gorge study area.

## ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Evaluation of the mineral resource potential of the Fiddler Butte WSA and the Fremont Gorge study area is based on: (1) investigations of mines and prospects; (2) geochemical investigations; and (3) geologic investigations. Three levels of potential for the occurrence of mineral resources (high, moderate, and low) were defined on the basis of the following criteria.

High mineral resource potential is assigned to areas where geologic and geochemical characteristics indicate a geologic environment favorable for resource occurrence, where interpretation 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.

Moderate mineral resource potential is assigned to areas where geologic and geochemical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a reasonable chance for resource accumulation, or where an application of mineral deposit models indicates favorable ground.

Low mineral resource potential is assigned to areas where geologic and geochemical characteristics define a geologic environment in which the existence of resources is unlikely.

Fiddler Butte Wilderness Study Area

The mineral resource potential of the Fiddler Butte WSA (fig. 3) is moderate for uranium, low for metallic and nonmetallic resources, moderate for oil and gas, high for tar sand, and moderate for materials used in construction. Uranium deposits containing minor copper and vanadium mineralization are known in exposures of the Chinle Formation (Upper Triassic) and the Moenkopi Formation (Lower and Middle? Triassic) 10 mi east of the northeastern part of the Fiddler Butte WSA and along North Wash in the southwestern part of the WSA. These deposits are small and irregularly spaced. The uranium deposits are restricted to fluvial sandstone beds of the Shinarump and Monitor Butte Members of the Chinle Formation and the uppermost few feet of the Moenkopi Formation that directly underlies the Chinle fluvial beds. Sedimentologic analysis of the fluvial depositional systems (Dubiel, 1983) indicates that the fluvial systems trend north to northwest in two parts of the WSA (fig. 4).

Detailed mineralogic and geochemical studies by Northrop (1982) of uranium ore deposits in Jurassic rocks of the Henry Basin about 15 mi southwest of the Fiddler Butte WSA demonstrate that authigenic dolomite occurs in fluvial sandstone beds containing uranium ore deposits, either in the mineralized areas or within about 1-2 mi of the mineralized area. Rock samples were collected for dolomite analyses from the lower part of the Chinle Formation, including the Shinarump and Monitor Butte Members, where it crops out in the WSA and in adjoining areas just east of the WSA. The mineralogic analyses (done by X-ray diffraction) indicate that areas of greatest concentration of dolomite coincide with the areas of the two fluvial systems (fig. 4), supporting the contention that the fluvial systems may have some potential for uranium mineralization. Detailed sedimentologic studies by Peterson (1980) in Jurassic rocks of the Henry Basin about 15-30 mi west of the Fiddler Butte WSA show that uranium mineralization in fluvial sandstone beds occurs where the sandstone beds are overlain or underlain by carbonaceous mudstone strata. Sedimentologic studies in the Chinle by Dubiel (1983), both within the WSA and just to the east of the WSA, show concentrations of carbonaceous mudstone in the lower part of the Chinle in the same areas as the two fluvial systems and the dolomite concentrations (fig. 4). Although these criteria are conducive to uranium mineralization, the lack of any significant deposits in these two areas, which have been heavily prospected, suggests that large deposits do not occur there. Thus, the evidence indicates that the two areas underlain by authigenic dolomite, carbonaceous mudstone, and the two fluvial systems have a moderate potential for containing uranium deposits.

Analyses of samples of stream sediments and panned concentrates from stream sediments were conducted to determine the potential for metallic resources other than uranium in the Fiddler Butte WSA. These analyses indicate that there is a low potential for metals other than uranium in the WSA.

The Fiddler Butte WSA has a moderate potential for petroleum resources (Molenaar and others, 1983, and Molenaar and Sandberg, 1983). No wells have been drilled in the WSA; nearby wildcat wells are shown in Briggs (1982, pl. 1). Oil and gas shows in these nearby wildcat wells have been reported from Triassic (Moenkopi Formation) sandstone beds, and Permian (Cutler Formation) and Pennsylvanian (Hermosa Formation) sandstone, limestone, and dolomite beds (Briggs, 1982). These formations are present in the subsurface of the WSA.

The northeastern part of the Fiddler Butte WSA has a high potential for tar sands (oil-impregnated sandstones) in the Moenkopi Formation and White Rim Sandstone Member of the Cutler Formation (Ritzma, 1973). The tar sands in these two formations are part of Ritzma's (1973) tar sand triangle deposit, which underlies the northeastern part of the Fiddler Butte WSA. Briggs (1982) estimated that approximately 260-320 million barrels of heavy crude oil occur in these formations.

Materials that could be used for construction purposes are present in the WSA and have some resource potential. Sand and gravel are present in terrace deposits along the major stream courses, and most of the formations could be sources of building stone (sandstone and limestone). However, larger and more accessible deposits of the same materials are available outside the WSA and are much closer to potential markets.

Fremont Gorge Study Area

The mineral resource potential of the Fremont Gorge study area (fig. 3) is low. No metallic or

nonmetallic mineral deposits of any kind are known in the study area. Analyses of samples of stream sediments and panned concentrates from stream sediments in and near the Fremont Gorge study area indicate a low potential for metallic mineral resources.

The two formations that contain most of the uranium deposits in the region, the Upper Triassic Chinle Formation and the Upper Jurassic Morrison Formation, have been eroded from the study area. The remaining formations lack any indications of containing uranium or any other metalliferous deposits.

No oil and gas test holes have been drilled in the study area, but all wells that have been drilled in the nearby region have been barren of hydrocarbons. The Fremont Gorge study area has been assessed as having a low potential for petroleum resources by Molenaar and others (1983) and Molenaar and Sandberg (1983).

Few materials that could be used for construction purposes occur in the study area. Quaternary gravel deposits along the stream courses are either lacking or are of such limited extent that they could not even be mapped. Some flagstone or "ripple rock" in the Moenkopi Formation has been mined nearby, but the endeavor is no longer in operation, and abundant supplies of this material could easily be obtained elsewhere.

## REFERENCES CITED


Briggs, J. P., 1982, Mineral investigation of the Fiddler Butte Wilderness Study Area, Garfield, County, Utah: U.S. Bureau of Mines Open-File Report MLA 132-82, 19 p.

Detra, D. E., Erickson, M. S., Kemp, W. M., 3rd, and Willson, W. R., 1984, Analytical results for stream sediments and panned concentrates from stream sediments collected from the Fiddler Butte and Fremont Gorge Wilderness Study Areas, Wayne and Garfield Counties, Utah: U.S. Geological Survey Open-File Report 84-677.

Doelling, H. H., 1967, Uranium deposits of Garfield County, Utah: Utah Geological and Mineralogical Survey Special Studies 22, 113 p.

Dubiel, R. F., 1983, Sedimentology of the lower part of the Upper Triassic Chinle Formation and its relationship to uranium deposits, White Canyon area, southeastern Utah: U.S. Geological Survey Open-File Report 83-459, 48 p.

Grimes, D. J., and Marranzino, A. P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semiquantitative analysis of geologic materials: U.S. Geological Survey Circular 591, 6 p.

Larson, M. J., Bromfield, C. S., Dubiel, R. F., Orkild, P. P., Patterson, C. G., and Peterson, Fred, 1985, Geologic maps of the Fiddler Butte Wilderness Study Area and the Fremont Gorge study area, Garfield and Wayne Counties, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1755-B, scale 1:50,000.

Molenaar, C. A., and Sandberg, C. A., 1983, Petroleum potential of wilderness lands in Utah: U.S. Geological Survey Circular 902-K, 14 p.

Molenaar, C. A., Sandberg, C. A., and Powers, R. B., 1983, Petroleum potential of wilderness lands, Utah: U.S. Geological Survey Miscellaneous Investigation Series Map I-1545, scale 1:1,000,000.

Northrop, H. R., 1982, Origin of the tabular-type vanadium-uranium deposits in the Henry structural basin, Utah: Golden, Colo., Colorado School of Mines, Ph.D. thesis T-2614, 340 p.

Peterson, Fred, 1980, Sedimentology as a strategy for uranium exploration--Concepts gained from analysis of a uranium-bearing depositional sequence in the Morrison Formation of south-central Utah, in Turner-Peterson, C. E., ed., Uranium in sedimentary rocks--Application of the facies concept to exploration: Rocky Mountain Section, Society of Economic Paleontologists and Mineralogists, p. 65-126.

Ritzma, H. R., 1973, Oil-impregnated rock deposits of Utah: Utah Geological and Mineralogical Survey Map 33, scale 1:1,000,000.

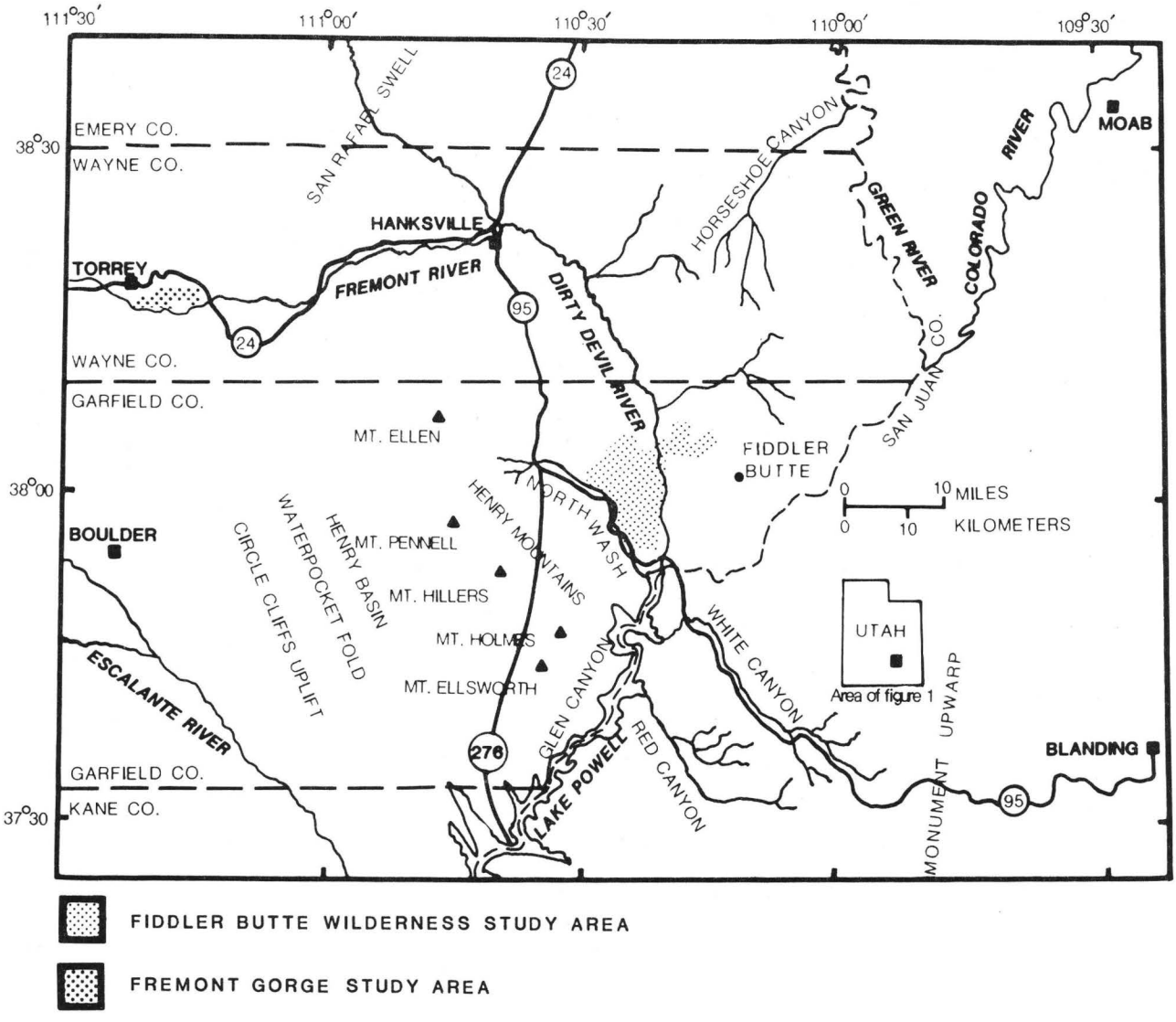
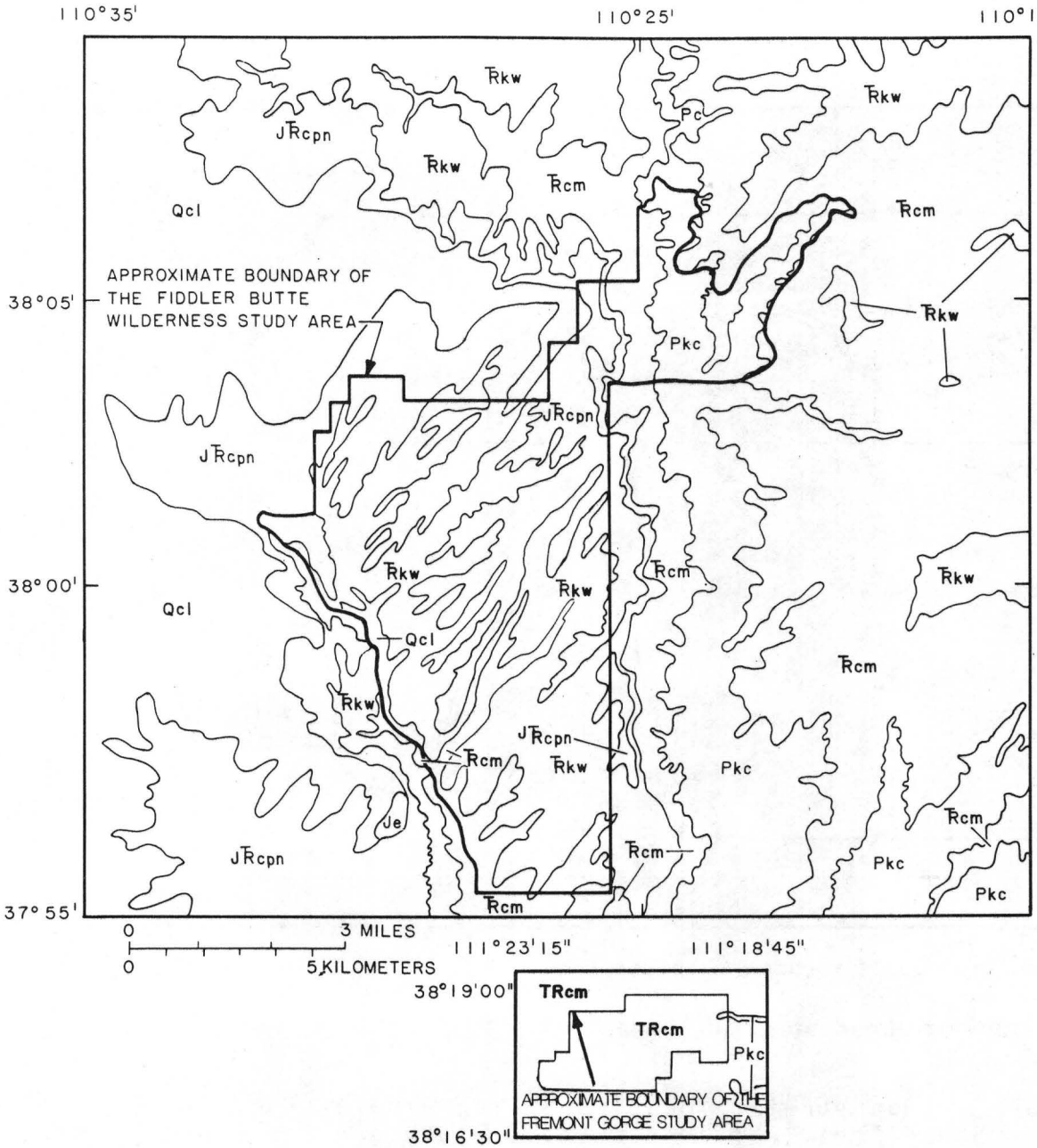



Figure 1--Map showing location of the Fiddler Butte Wilderness Study Area, Garfield County, Utah, and the Fremont Gorge study area, Wayne County, Utah.




EXPLANATION

| | |
|---|---|
| Qcl | COLLUVIUM AND EOLIAN DEPOSITS (QUATERNARY)--SAND AND SILT |
| Je | ENTRADA SANDSTONE (JURASSIC)--SANDSTONE |
| JTrcpn | CARMEL FORMATION AND PAGE SANDSTONE (JURASSIC) AND NAVAJO SANDSTONE (TRIASSIC? AND JURASSIC)--SANDSTONE AND SHALE |
| Trkw | KAYENTA SANDSTONE (TRIASSIC ?) AND WINGATE SANDSTONE (TRIASSIC)--SANDSTONE |
| Trcm | CHINLE AND MOENKOPI FORMATIONS (TRIASSIC)--SANDSTONE AND SHALE |
| Pkc | KAIBAB LIMESTONE AND CUTLER FORMATION (PERMIAN)-- LIMESTONE AND SANDSTONE |

Figure 2--Map showing generalized geologic units in the Fiddler Butte Wilderness Study Area, and the Fremont Gorge study area, and vicinity.

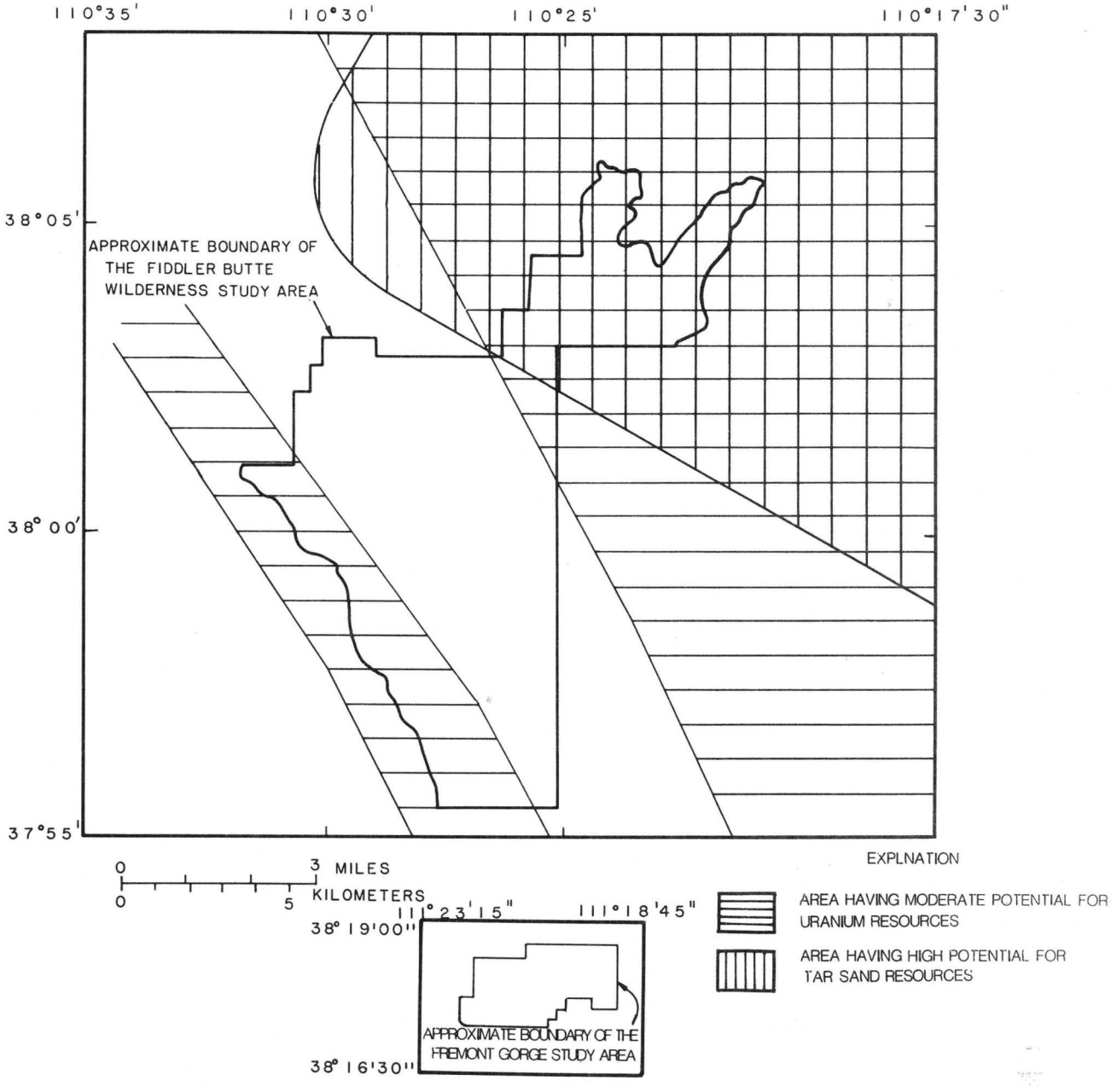



Figure 3--Map showing mineral resource potential of the Fiddler Butte Wilderness Study Area, and the Fremont Gorge study area, and vicinity.

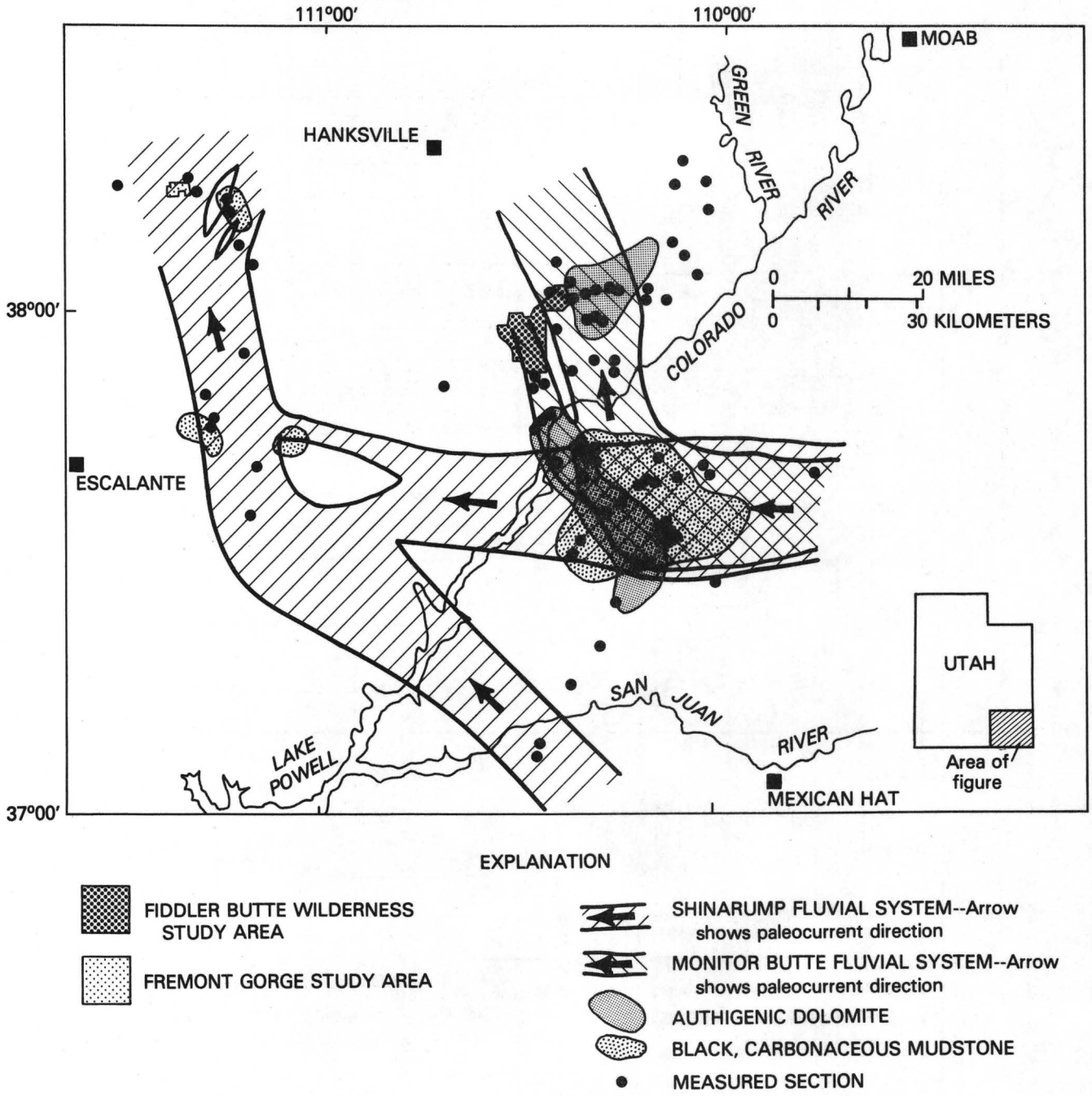



Figure 4--Map showing distribution of Shinarump and Monitor Butte fluvial systems, authigenic dolomite, and black, carbonaceous mudstone used to evaluate uranium potential in the Fiddler Butte Wilderness Study Area, and the Fremont Garge study area, and vicinity.