UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

MINERAL RESOURCES OF THE ESCALANTE CANYON INSTANT STUDY AREA, GARFIELD COUNTY, UTAH

By

Gordon W. Weir, U. S. Geological Survey

and

Michael E. Lane, U.S. Bureau of Mines

Open-File Report 81-559

1981

This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards.

Mineral Surveys

Wilderness Studies Related to Bureau of Land Management

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976), requires the U.S. Geological Survey and the Bureau of Mines to conduct mineral surveys on certain areas 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 Escalante Canyon Instant Study Area, Utah.

Contents

Illustrations

Tables

Mineral resource potential of the Escalante Canyon Instant Study Area, Garfield County, Utah

SUMMARY

A geologic and geochemical investigation and a survey of the existing mines and prospects have been conducted to determine the mineral resource potential of the Escalante Canyon Instant Study Area, Garfield County, Utah. The study area encompasses about 260 sq mi (670 sq km) of mesas and canyons. Paleozoic rocks known from subsurface tests are overlain by outcropping rocks of Triassic and Jurassic age. The Navajo Sandstone forms the most extensive outcrops. The dominant structures are homoclines associated with broad upwarps and basins. The mineral and energy resource potential of the Escalante Canyon Instant Study Area is low.

Along the eastern edge of the area are uranium-copper deposits in Triassic rocks. The deposits are small and relatively low grade, and no pattern of ore bodies has been recognized that would encourage exploration of the deeply buried Triassic strata. Traces of gold were found in pan concentrates, but the reported values are too low to encourage prospecting. Twenty-three wildcat wells, including eleven wells from the study area, have been drilled in central Garfield County. Shows of oil and gas were rare, and all of the wells have been abandoned. Gypsum has been mined for local use near Escalante and Boulder; it has little potential for industrial use, because it is clayey and silty, and in thin layers.

Collectors of rocks and minerals have found petrified wood, chert clasts of various colors, limonitic concretions, and large gypsum crystals in the study area.

INTRODUCTION

During 1979 and 1980 the U.S. Geological Survey and the Bureau of Mines conducted field investigations to evaluate the mineral resource potential of the Escalante Canyon Instant Study Area, Garfield County, Utah. Field studies included geological mapping and reconnaissance (Weir and Beard, 1981), geochemical sampling, and a survey of known mines, prospects, and mineralized areas (Lane, 1981).

The Escalante Canyon Instant Study Area includes about 260 sq mi (670 sq km) of mesas and canyons in Garfield County, Utah (fig. 1). The area is bounded generally on the west by a paved highway; elsewhere most of the periphery is marked approximately by improved and unimproved roads. On the south it is bounded in part by Harris Wash, and the limits of the Glen Canyon National Recreation Area. Several unimproved roads lead to drill sites and to corrals within the study area. All unpaved roads are commonly impassable in wet weather. The principal trails are along the Escalante River, The Gulch, and Harris Wash. Much of the study area is difficult to access even by foot.

No permanent residents are within the area. The nearest towns are Escalante (population 638, 1970) and Boulder (population 93, 1970). Total population of the county in 1970 was 3,157.

The Escalante Canyon Instant Study Area lies within the western part of the Canyon Lands section of the Colorado Plateau physiographic province (Thornbury, 1965, p. 426-434). Steep-walled canyons, mesas, and plateaus are the major landforms in this section. The dominant structures are homoclines associated with broad upwarps and basins in Paleozoic and Mesozoic sedimentary rocks. The study area lies southwest of the Circle Cliffs upwarp and northeast of the Kaiparowits basin. It is southeast of the basalt-capped, flat-lying rocks of the Aquarius Plateau.

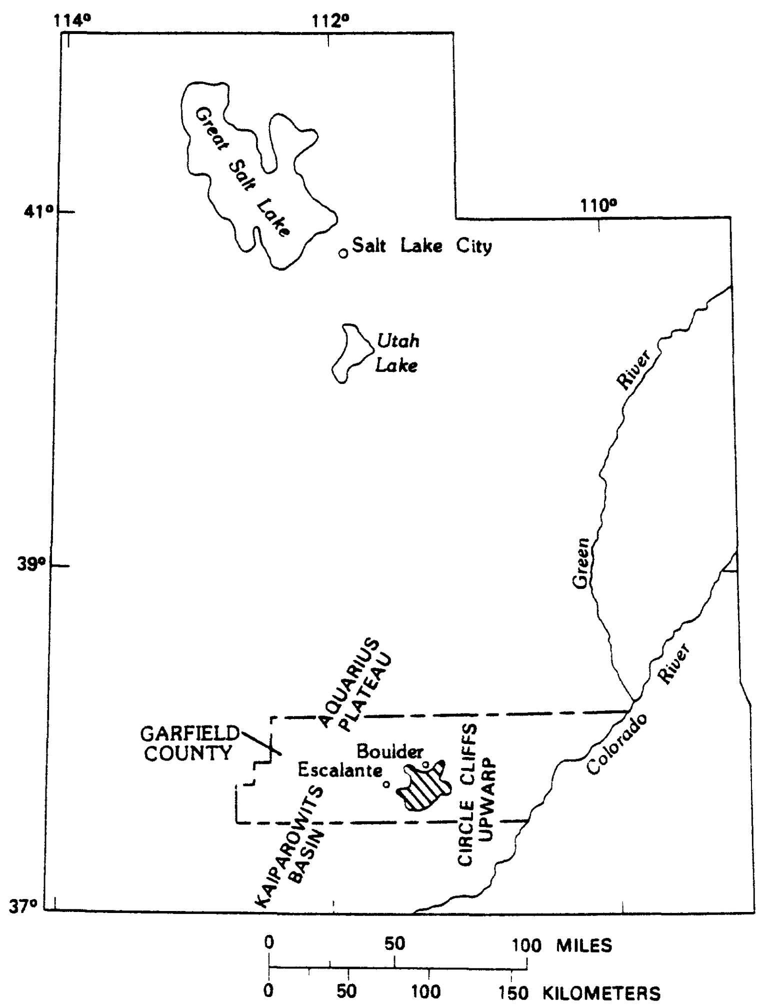

Figure 1.--Index showing location of the Escalante Canyon Instant Study Area, Garfield County, Utah.

Near the east edge of the area are a few uranium-copper propects in Triassic rocks. The deposits are generally small and low grade. The prospects appeared inactive in 1979 and 1980. None have yielded significant quantities of ore.

Eleven wildcat wells have been drilled within the study area in search for oil and gas. All have been plugged and abandoned.

Collectors of rocks and minerals visit the Escalante Canyon Instant Study Area to look for petrified wood, iron-rich concretions, and gypsum in Mesozoic strata and red, brown, and black chert in Quaternary deposits.

GEOLOGY

Rocks of Triassic and Jurassic age, totalling about 3,000 ft (900 m) crop out in the Escalante Canyon Instant Study Area (Weir and Beard, 1981). Underlying Paleozoic rocks known from subsurface tests are more than 4,000 ft (1,200 m) thick. Characteristics of the rock units are listed on table 1. Grayish-orange, crossbedded sandstone of the Navajo Sandstone forms the most extensive outcrops (fig. 2). Older formations crop out only in the eastern part of the area and along the Escalante River and its major tributaries. The Page Sandstone and Carmel Formation cap a few mesas in the central part of the area and form the major outcrops along the southwestern edge of the area.

In most of the area the rocks dip gently to the southwest. Two major folds interrupt this prevailing dip, the Boulder-Collett Canyon anticline and the Harris Wash syncline. Both folds are relatively narrow and plunge generally southward. Normal faults having a displacement of a few feet to about 150 ft (45 m) locally cut the western flank of the Harris Wash syncline.

GEOCHEMISTRY

A total of 136 samples from within and near the Escalante Canyon Instant Study Area were collected by the U. S. Geological Survey, (this report).

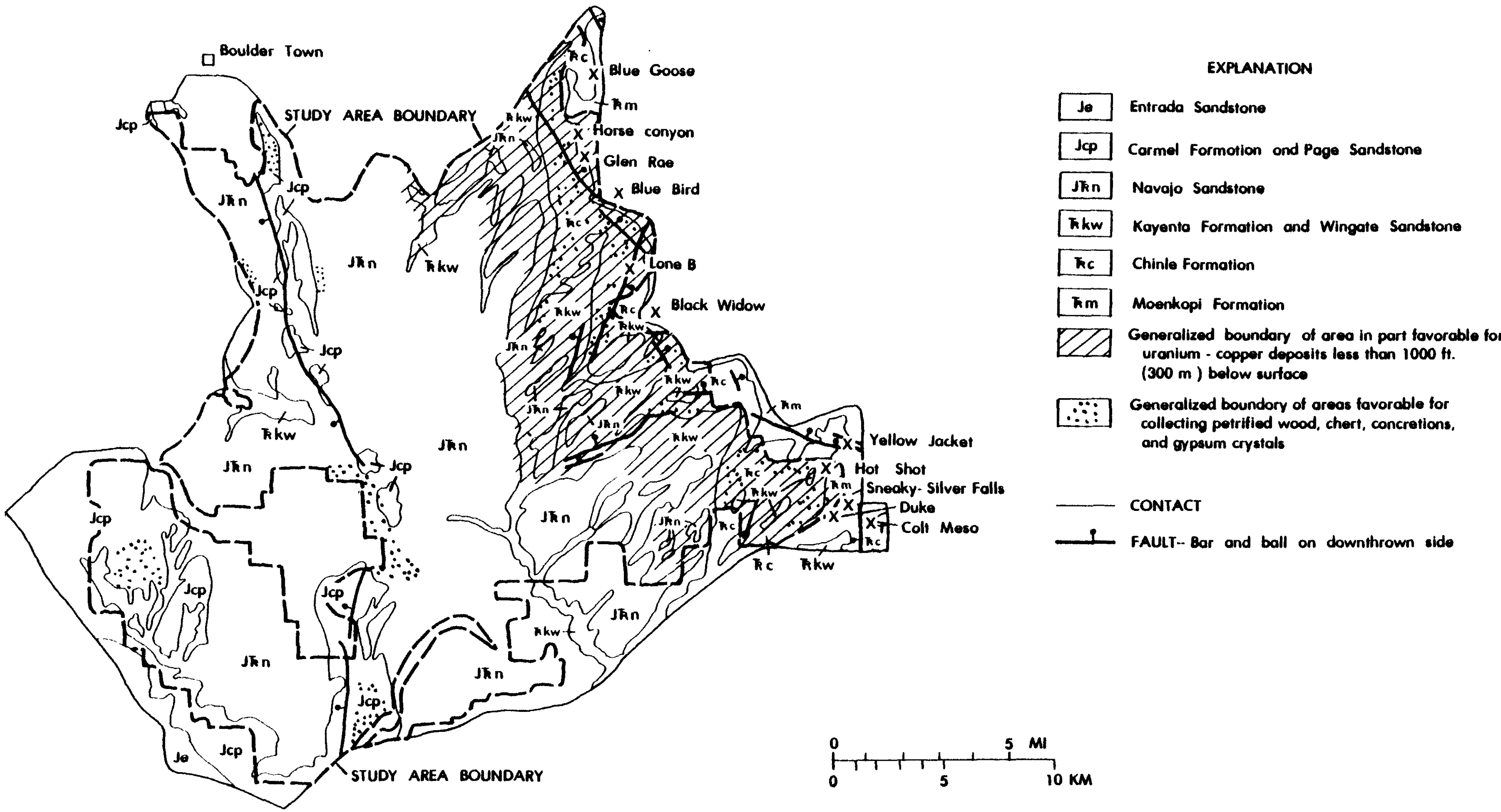

Figure 2.--Mineral resource potential and generalized geologic map of the Escalante Canyon Instant Study Area.

Table 1.—Generalized stratigraphic section of the Escalante Canyon Instant Study Area, Utah

[Data on Chinle Formation from Davidson (1965); data on units below Chinle from Zeller (1973) and Peterson (1973) based on wells in and near the Upper Valley about 12 mi (19 km) west of study area]

System	Series	Formation	Member	Thickness Feet	Thickness (Meters)	Description
Quaternary	Holocene and Pleistocene	Alluvial and eolian deposits		0-40	(0-12)	Clay, silt, sand, and gravel along streams; silt and sand on mesas; pediment gravels, consisting chiefly of pebbles to boulders of basalt, on mesa tops.
		Unconformity				
	Middle	Entrada Sandstone		150+	(45+)	Reddish-brown silty sandstone. Only lower part of formation present in area; as much as 1,000 ft (300 m) thick in adjoining Dave Canyon quadrangle (Zeller, 1973).
	Middle	Carmel Formation	Upper member	260-300	(80-10)	Mudstone and minor fine-grained sandstone, chiefly reddish-brown; light-gray gypsum in irregular lenses; thin-bedded yellowish-gray limestone near base.
Jurassic	Middle	Page Sandstone	Thousand Pockets Tongue	20-80	(6-24)	Sandstone, chiefly yellowish-gray, fine-grained; crossbedded, locally contorted. Contains layer of reddish-brown mudstone near middle of unit.
	Middle	Carmel Formation	Judd Hollow Tongue	0-50	(0-15)	Mudstone, reddish brown grades to sandstone and merges with Thousand Pockets Tongue in southwest corner of area.
	Middle	Page Sandstone	Harris Wash Tongue	10-100	(3-30)	Sandstone, grayish-orange, crossbedded; contains chert pebbles at base.

Table 1.—Generalized stratigraphic section of the Escalante Canyon Instant Study Area, Utah—Continued

System	Series	Formation	Member	Thickness Feet	Thickness (Meters)	Description
Jurassic and Triassic		Navajo Sandstone		1,200-1,500	(360-460)	Sandstone, grayish-orange, crossbedded in part contorted; contains sparse, thin lenses of limestone and reddish-brown siltstone, mostly near base.
Triassic(?)	Upper	Kayenta Formation		200-400	(60-120)	Sandstone interbedded with siltstone, reddish-brown
Triassic	Upper	Wingate Sandstone		200-260	(60-80)	Sandstone, light-reddish-orange to reddish-brown, fine-grained, cross-bedded.
		Unconformity				
Triassic	Upper	Chinle Formation	Church Rock Member	0-25	(0-8)	Sandstone, brown, fine- to medium-grained.
			Owl Rock Member	150-250	(45-75)	Sandstone and mudstone, red, brown, and greenish-gray; limestone, greenish-gray, in thin lenses.
			Petrified Forest Member	150-350	(45-105)	Mudstone, bentonitic, variegated, and sandstone; contains silicified wood.
Triassic			Monitor Butte Member	100-200	(30-60)	Mudstone, bentonitic, green and grayish-red; sandstone, light-brown, micaceous, ripple-laminated.
			Shinarump Member	0-130	(0-40)	Sandstone, conglomeratic, yellowish-gray, crossbedded; mudstone, greenish-gray, in thin lenses. In same general stratigraphic position as mottled unit.
			or			
			Mottled silt-stone unit	0-50	(0-15)	Siltstone and minor sandstone, mottled red and white; generally absent where Shinarump Member present.

Table 1.—Generalized stratigraphic section of the Escalante Canyon Instant Study Area, Utah—Continued

System	Series	Formation	Member	Thickness Feet	Thickness (Meters)	Description
		Unconformity				
	Middle(?) and Lower	Moenkopi Formation		600–880	(180–270)	Sandstone, shale, and siltstone, reddish-brown; minor limestone.
			Timpoweap Member	60–70	(18–21)	Dolomite, light-brown to light-yellowish-red.
		Unconformity				
Permian	Lower	Kaibab Limestone[1]		140–200	(45–60)	Dolomite, light-gray to light-brown; contains abundant chert.
	Lower	Cutler Formation	White Rim Sandstone Member	140–170	(45–52)	Sandstone, dolomitic light-gray; some interbedded, light-brown dolomite.
	Lower	Toroweap Formation		360–420	(110–130)	Dolomite, light-brown dense; interbedded light-gray sandstone and anhydrite.
	Lower	Coconino Sandstone[1]		50	(15)	Sandstone, light-gray.
	Lower	Cutler Formation	Organ Rock Member	140–160	(45–50)	Siltstone, light-gray to light-red, some brown sandstone.
	Lower	Cutler Formation	Cedar Mesa Sandstone Member	1,350–1,400	(410–425)	Sandstone, light-gray to light-yellowish-red, fine-to medium-grained; lower one-third contains interbedded light-brown to light-yellowish-red limestone and dolomite.

Table 1.—Generalized stratigraphic section of the Escalante Canyon Instant Study Area, Utah—Continued

System	Series	Formation	Member	Thickness Feet	Thickness (Meters)	Description
Unconformity						
Pennsylvanian		Hermosa Formation		340	(105)	Sandstone, light-gray; interbedded light-yellowish-red dolomite and reddish- and purplish-gray siltstone.
		Molas Formation		40-70	(12-21)	Shale, reddish-gray, some limestone concretions and sandstone.
Unconformity						
Mississippian	Upper and Lower	Redwall Limestone		900	(270)	Limestone and dolomite, light-gray to light-yellowish-red; extensive karst surface at top; in part cavernous.
Devonian	Upper	Ouray Limestone		160	(50)	Limestone, light-yellowish-red, dense.
Devonian		Unnamed		230	(70)	Dolomite, light-yellowish-red, some interbedded sandstone and greenish-gray shale.
Unconformity						
Cambrian		Unnamed		100	(30)	Dolomite, light-yellowish-red and interbedded greenish- and reddish-gray shale.

[1]Subsurface terminologoy.

These samples include: 71 stream-sediment samples collected along Harris Wash and the Escalante River and their principal tributaries; 19 representative rock samples from the major sedimentary units; 9 mineralized-rock samples from workings and dumps of uranium-copper prospects; pan concentrates of four samples of stream sediments and three of sedimentary rocks; and 26 water samples from streams, springs, and seeps.

The analyses of stream sediments and rocks from in and near the Escalante Canyon Instant Study Area appear characteristic of the country rock, mostly sandstone and shale of Jurassic and Triassic age (this report). A few analytical values appear anomalous because they are high, relative to the whole set of analyses. Most relatively high values in stream-sediment samples are probably caused by the presence of debris derived from volcanic rocks that crop out north of the area (McFall and Peterson, 1971). Most anomalous values detected in the rock samples are less than an order of magnitude higher than the lower limit of spectrographic detection. The mineralized rocks are all slightly uraniferous and most contain detectable amounts of copper and other metallic elements. The detection of uranium in several widely spaced water samples suggests the water has passed through uraniferous rocks--probably the Chinle and Moenkopi Formations (Triassic), which contain uranium-copper prospects near the east edge of the area. Gold values detected in a few pan concentrates are very low.

MINING DISTRICTS AND MINERALIZED AREAS

Mining activity in or near the Escalante Canyon Instant Study Area consists of numerous workings in the Circle Cliffs area near the east boundary (Lane, in press). Counthouse records indicate that at least 2,000 claims were located in the Circle Cliffs area during the 1950's in the search for uranium. The workings are small, for the most part, and the mineralized rock is spotty and irregular in grade. The total tonnage of ore produced from all these deposits was probably very small. All the prospects and mines appeared dormant in 1979 and 1980.

The majority of the prospects consists of small- to medium-length adits, mostly less than 100 ft (31 m) metric in length. All are easily accessible by road or a short walk.

The uranium mineralization is limited to the basal part of the Chinle Formation, mostly in the Shinarump Member, and in the upper few feet of the underlying Moenkopi Formation. Oxidized copper minerals are frequently associated with the uraniferous rock, and one deposit, Colt Mesa Mine, was developed primarily for its copper content. All prospects are in stream channels of varying widths. According to Davidson (1967) some attain widths of as much as 1,500 ft (460 m). The paleochannels are usually less than 50 ft (15 m) deep.

The channels vary in composition but are usually conglomeratic with different degrees of sorting. Frequently, large siltstone fragments and carbonaceous material are present.

During the field investigation, a total of 78 samples were taken. Two samples contained above 1.0 percent U_3O_8. These samples, taken at the Yellow Jacket and Sneaky Prospects (Lane, in press) contained 1.09 percent U_3O_8 and 2.25 percent U_3O_8, respectively. However, the majority of U_3O_8 values were between 0.01 and 0.2 percent. The highest copper value was 15.5 percent taken at Colt Mesa Mine (Lane, in press). Where copper was analyzed, values range from 36 parts per million to 15.5 percent with the majority of values greater than 0.1 percent but less than 2 percent.

MINERAL RESOURCE POTENTIAL

The mineral resource potential of the Escalante Canyon Instant Study Area is low. Uranium-copper deposits are in Triassic rocks along the eastern edge of the area (fig. 2). Most of the deposits are in the basal part of the Chinle Formation and in the upper part of the Moenkopi Formation on the edges of channels filled with sandstone of the Shinarump Member of the Chinle. The principal ore minerals are yellow and yellowish-green oxide minerals of uranium and green and blue oxide minerals of copper. Analyses of samples from these deposits show that the metallic content varies greatly but indicate that the overall grade of the deposits is low. The presence of uranium in several widely spaced water samples suggests that the weakly mineralized rocks may underlie much of the area. None of the deposits have been extensively mined, and probably none have yielded a significant amount of ore.

Davidson (1967, p. 70-71) lists five criteria of favorable environments for uranium deposits in the Circle Cliffs area, which includes the Triassic outcrops near the Escalante Canyon Instant Study Area: 1) a channel cut in the Moenkopi filled with sandstone of the Shinarump, 2) carbonaceous material in the sandstone, 3) lenticular mudstone-rich sandstone continuous with the rest of the sandstone unit, 4) an overlying cap of relatively impermeable mudstone, and 5) nearness to the regional pinchout of the Shinarump. These criteria are generally present in ground containing the known deposits. As presently known, however, the deposits are small and relatively low grade, and no pattern of ore bodies has been recognized that would encourage exploration of the deeply buried Triassic strata. Consequently, the uranium and copper potential of the Escalante Canyon Instant Study Area is judged to be low.

Although traces of gold were found in pan concentrates of stream sediments and shale from the Chinle Formation as part of this investigation, the reported values (less than 1 ppm) are too low to encourage prospecting.

The oil and gas potential of the study area appears low. The oil and gas possibilities of the region including the Escalante Canyon area have been reviewed by Heylmun (1958), Kunkel (1965), Blakey (1974), and Doelling (1975, p. 90-102). Oil has been produced since 1964 from the Upper Valley field, about 12 mi (19 km) west of the study area. Production is from the Kaibab Limestone (Permian) and from the Timpoweap Member (Lower Triassic) of the Moenkopi Formation along the crest of an asymmetric anticline (Peterson, 1973; Doelling, 1975, p. 91-96). Oil in non-commercial amounts was discovered in Mississippian strata.

Twenty-three wildcat wells including eleven wells within the study area, have been drilled in central Garfield County (fig. 3). Most of the wells were drilled on anticlines into Permian strata. Shows of oil and gas were rare, and all the wells have been abandoned. Most of the obvious structural traps have been tested at least in part. Stratigraphic traps within the deeply buried rocks of the region are possible, but none have yet been found.

Gypsum has been mined for local use from the Carmel Formation near Escalante and Boulder (Doelling, 1975, p. 149). It is in wavy layers and pod-like lenses irregularly interstratified with red mudstone and siltstone and yellowish-gray sandstone and limestone of the Carmel Formation in the southwestern part of the study area. The gypsum has little potential for industrial use, because it is mostly clayey and silty, is in generally irregular layers only a few feet thick, and is not readily accessible.

Other construction materials within the study area include gravels in Quaternary alluvium and pediment deposits, sand in Quaternary eolian and alluvial deposits, and limestone in the Carmel Formation. Except for borrow pits in red mudstone and siltstone of the Carmel Formation and in gravels of

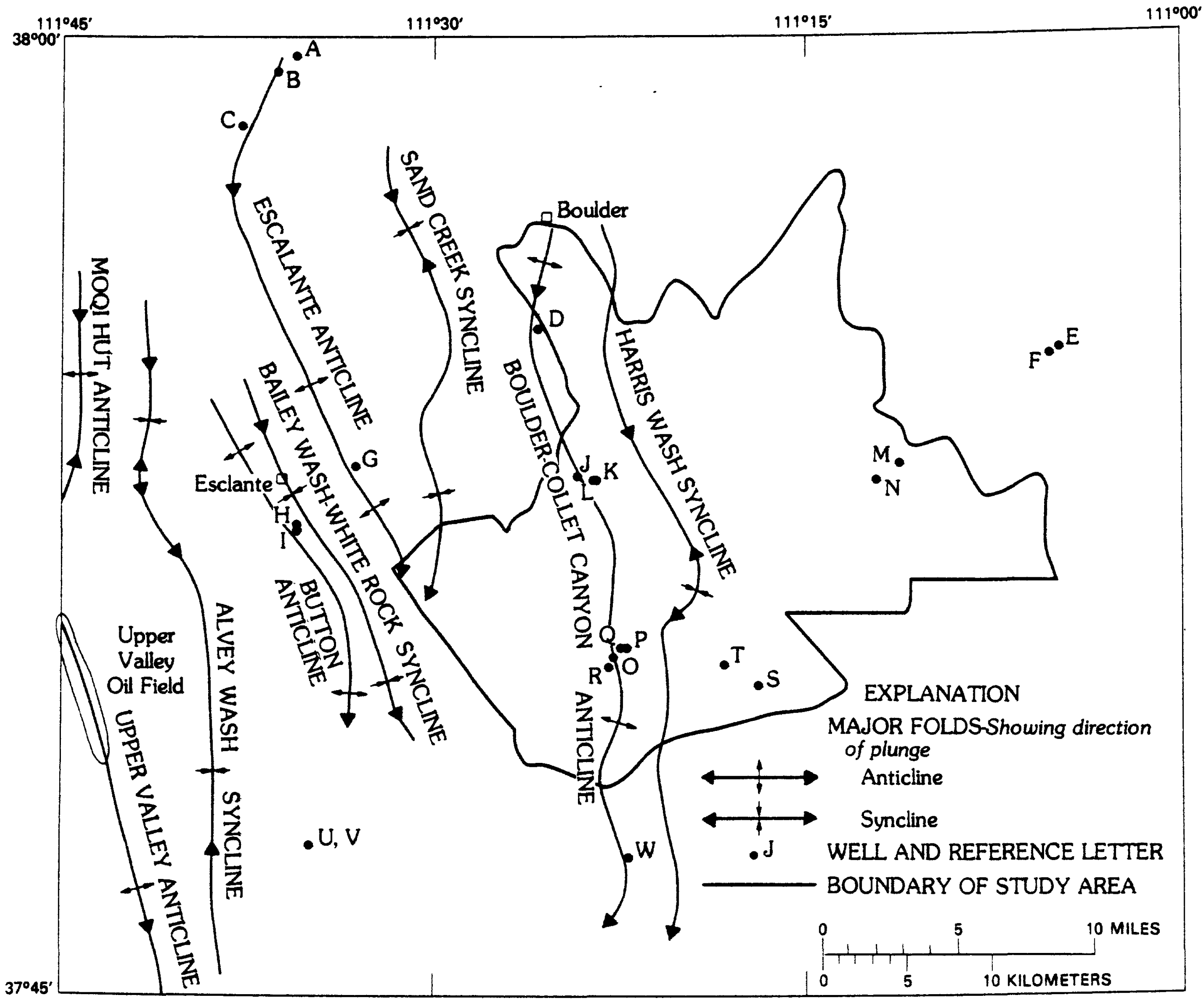

Figure 3.--Index showing the location of exploratory wells in the Escalante Canyon Instant Study Area.

pediment deposits, little of this material has been used, because adequate supplies of these materials are readily available outside the study area.

Collectors of rocks and minerals search the Escalante Canyon and surrounding areas for noteworthy specimens. Chief among these are the reddish-brown to black petrified wood common in the lower part of the Chinle Formation and in colluvial and alluvial deposits derived from them. Chert clasts of various colors are locally common in pediment gravels and deposits derived from them. Small, spheroidal, limonitic concretions are common in the Navajo Sandstone on Spencer Flat and near Red Breaks in the southwestern part of the area. The concretions consist of a layer of iron oxides enclosing loosely cemented sand. The spheroids range from a fraction of an inch to a few inches in diameter. They are known to collectors as "Moqui balls" or "Navajo cherries" (Doelling, 1975, p. 156). Large gypsum crystals are common in the Carmel Formation. The value of collected mineral specimens is small, but the presence of these materials is an attraction within the study area.

References cited

Blakey, R. C., 1974, Petroliferous lithosomes in the Moenkopi Formation, southern Utah: Utah Geology, v. 4, no. 2, p. 67-84.

Davidson, E. S., 1967, Geology of the Circle Cliffs area, Garfield and Kane Counties, Utah: U. S. Geological Survey Bulletin 1229, 140 p.

Doelling, H. H., 1975, Geology and mineral resources of Garfield County, Utah: Utah Geological and Mineral Survey Bulletin 107, 175 p.

Hackman, R. J., and Wyant, D. G., 1973, Geology structure and uranium deposits of the Escalante quadrangle, Utah and Arizona: U. S. Geological Survey Miscellaneous Geologic Investigations Map I-744, scale 1:250,000.

Heylmun, E. B., 1958, Paleozoic stratigraphy and oil possibilities of Kaiparowits region, Utah: American Association of Petroleum Geologists Bulletin, v. 42, no. 8, p. 1781-1811.

Kunkel, R. P., 1965, History of exploration for oil and natural gas in the Kaiparowits region, Utah _in_ Goode, H. D., and Robison, R. A., eds., Geology and resources of south-central Utah - Resources for power: Utah Geological Society Guidebook to Geology of Utah, no. 19, p. 93-111.

Lane, M. E., in press, Mines and prospects map of the Escalante Canyon Instant Study Area, Utah, by the Bureau of Mines: U. S. Geological Survey Miscellaneous Field Studies Map.

McFall, C. C., and Peterson, P. R., 1971b, Geology of the Escalante-Boulder area, Garfield County, Utah: Utah Geological and Mineralogical Survey Map 31, scale 1:62,500.

Peterson, P. R., 1973, Upper Valley Field: Utah Geological and Mineralogical Survey Oil and Gas Field Studies 7.

Thornbury, W. D., 1965, Regional geomorphology of the United States: New York, John Wiley, 609 p.

Weir, G. W. and Beard, L. S., 1981, Geologic map of the Escalante Canyon Instant Study Area, Garfield County, Utah: U. S. Geological Survey Miscellaneous Field Studies Map MF-_A.