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GEOLOGICAL SURVEY

Mineral-Resource Potential of the Dark Canyon Instant Study Area, San Juan County, Utah

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

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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 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 Dark Canyon Instant Study Area, San Juan County, Utah.

MINERAL RESOURCE POTENTIAL

SUMMARY STATEMENT

The Dark Canyon Instant Study Area, San Juan County, Utah, (fig. 1) has a low potential for mineral and energy resources, except in the southernmost part of the area where there is a moderate potential for the discovery of uranium deposits. The potential for development of other commodities, such as evaporite minerals and construction materials, and for oil and gas is low.

The area of moderate potential for uranium deposits is underlain by conglomeratic channel sandstones of the Shinarump Member, the basal member of the Chinle Formation. The Shinarump appears to be the only host rock in the immediate vicinity for uranium deposits. Prospecting for uranium in the past has occurred in and adjacent to the southern portion of the study area, and led to mining activity which appears to have resulted in the shipping of several hundred tons of uranium ore. Chemical analyses of rock, stream-sediment, and pan-concentrate samples indicate that only the southern part of the study area has a potential for mineral resources.

The potential for the discovery of oil and gas is considered to be low, except possibly in the eastern part of the study area near the western limit of salt (fig. 1) in the Pennsylvanian Paradox Formation of Wengerd and Matheny (1958). Fifteen exploration wells have been drilled to test both stratigraphic and structural traps in and adjacent to the study area. Strata penetrated by those test wells range in age from Cambrian through Triassic. Most of the wells were drilled on or near structural highs. Oil-stained cores from Pennsylvanian strata were recovered from a few wells.

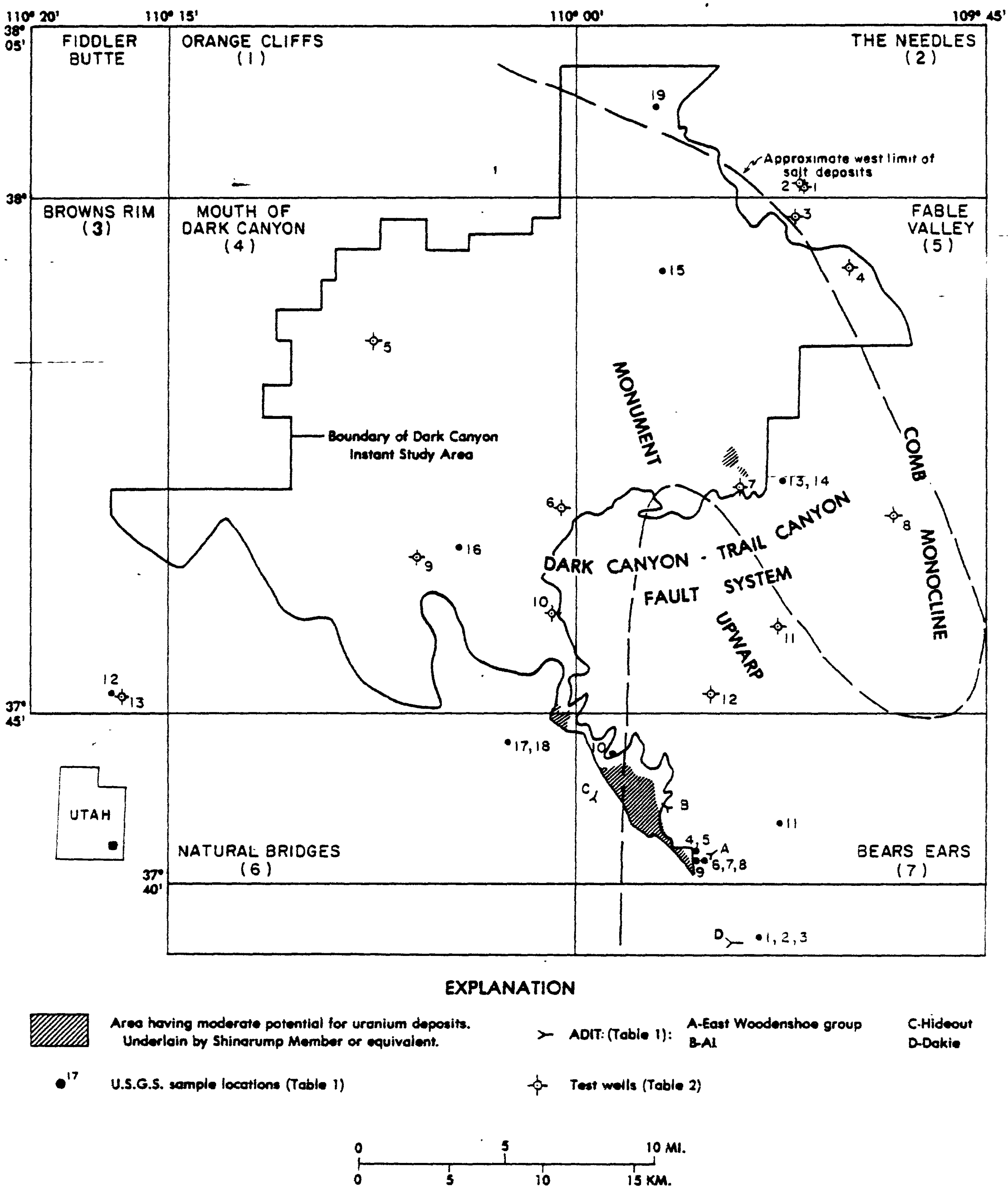

Figure 1.—Index showing location of the Dark Canyon Instant Study Area, Utah, and areas having moderate potential for uranium deposits.

Gypsum is exposed along the Colorado River and in lower Gypsum Canyon within the study area, and is present in the subsurface elsewhere. The potential for development of gypsum is low because of its distance from markets, difficult access, and depth of burial.

Salt is present in a few localities near the eastern margins of the study area in the Paradox Formation, but has virtually no resource potential because of its irregular distribution and thickness; underground solution has differentially removed much of the deposit, which was a thin deposit originally.

INTRODUCTION

During 1978 and 1979 the U.S. Geological Survey and the U.S. Bureau of Mines conducted field investigations to evaluate the mineral resource potential of the Dark Canyon Instant Study Area, San Juan County, Utah. Field studies included geologic mapping, geochemical sampling, and a survey of known mines, prospects, and mineralized areas.

The Dark Canyon Instant Study Area is located in southeastern Utah aproximately 35 miles west of Monticello, east of the Colorado River, and south of Canyonlands National Park. The Instant Study Area encompasses 57,248 acres along Dark and Bowdie Canyons and portions of adjacent plateaus. Much of the Instant Study Area is very deeply incised by stream valleys and access is commonly limited to stream courses.

Geologic Setting

The Dark Canyon Instant Study Area is southeast of the Colorado River in the northern plunging end of the Monument Upwarp, a broad anticlinal structure bounded by the Comb (Ridge) Monocline on the east, by the Orange Cliffs on the northwest and west, and by the Needles district of Canyonlands National Park on the north (Weitz, 1981). Sedimentary rocks exposed within the study area range in age from Triassic to Pennsylvanian, and the few test wells penetrate Pennsylvanian through Cambrian strata; one well reached Precambrian crystalline rocks.

Mining Activity

The principal mineral commodities mined or prospected have been uranium and copper. Uranium was the object of intense exploration activity during the mid-1950's and again from the mid-1970's to the present. A location within half a mile of the study area has been prospected for jasper, but there are no known concentrations of jasper within the study area.

GEOLOGY

The Dark Canyon Instant Study Area is in a part of the Colorado Plateau physiographic province; the northern portion of the broad anticlinal Monument Upwarp, which extends 75 mi north from the Arizona border and plunges gently northward in and north of Dark Canyon. Several gentle and minor anticlines, synclines, and monoclines have been mapped in the eastern portion of the study area and to the southeast, most trending northeast, north, and northwest and are parts of the upwarp. The upwarp is asymmetrical. It is bounded on the east by the north-trending Comb Monocline, with structural relief of about 2,500 ft. The western margin is structurally indistinct; the regional dip is gently inclined to the west and northwest.

The surface expression of the upwarp is the stripped surface of the Cedar Mesa Sandstone Member of Permian age, with Permian and Triassic rocks forming buttes rising above it and deep canyons (Cataract, Dark, Woodenshoe, and Gypsum Canyons) incised through it into the Pennsylvanian rocks beneath. Older sedimentary units, ranging in age from Cambrian to Pennsylvanian, are not exposed in the study area but have been penetrated by test wells, as has the Precambrian basement. The regional dip carries this surface downward to the west, and the western margin of the upwarp is topographically defined by the cliffed erosional edge of the overlying resistant Triassic sandstones.

The Henry Mountains, an isolated group of mid-Cenozoic laccolithic and stock-like intrusives, lie about 30 mi to the west; the Abajo (Blue) Mountains, a similar but smaller group of intrusives, lie about 25 mi to the east.

A long narrow graben, formed by less than 100 ft of downdropping of a wedge of sedimentary units, extends east-west south of the Abajo Mountains for 25-30 mi, terminating near the Comb Monocline at the east-central edge of the study area. A smaller group of similar grabens trends southwestward north of the Abajos in an en echelon pattern; each one includes a more southerly bend, then turns westward. The Dark Canyon-Trail Canyon fault system, with minor and variable vertical movement, follows this trend and may represent this group of grabens within the study area. If, however, the grabens are deep, basement-controlled features, the Dark Canyon faults may extend downward through the entire sedimentary sequence into the Precambrian rocks.

An arcuate swarm of near-vertical faults trending east, then swinging northeast, is the main structural feature of the northern part of the study area and adjacent areas to the north. These faults, with minor displacements indicated by the surface topography, form a series of horsts and grabens cut by cross faults of similar displacement. These faults have been described (Lewis and Campbell, 1965) as joint-controlled features resulting from solution removal of evaporite units (gypsum and salt) of the Paradox Formation of Wengerd and Matheny (1958), and hence are restricted to units above the Paradox. At least some of the solution postdates the cutting of Cataract Canyon of the Colorado River and continues to the present time--large blocks slumping along arcuate fractures are well displayed in upper Gypsum Canyon.

The Dark Canyon-Trail Canyon fault system resembles the extensive graben features in length, and it resembles the Cataract Canyon features in part in arcuate trend. It is not yet known whether this system is deep-seated, extending into the Precambrian basement, or is restricted to units of Paradox age and younger.

Faults in the study area serve as channelways and barriers for ground water movement. Most of the limited number of permanent and temporary springs are located on the updip side and at canyon bottom levels where faults intersect the canyons. Percolation is assumed to be from the higher plateau areas (which receive higher precipitation) down through the permeable Cedar Mesa Sandstone Member and older units, and along faults which serve as barriers to direct ground water movement.

GEOCHEMISTRY

The procedure for geochemical sampling was to obtain stream-sediment samples (240) from each major drainage and most minor drainages, including areas downstream from each exposed geologic formation--from the Triassic(?) Kayenta to the Pennsylvanian Paradox. Also, representative pan concentrates from drainages (24) and representative rock samples (103) from each formation were collected as well as from outcrops in the vicinity of faults. Mine openings and dumps were also sampled.

Rock samples from each exposed geologic formation were analyzed for 30 elements by semiquantitative spectrographic methods, for copper, lead, and zinc by atomic absorption methods, and for uranium by radiometric methods. Stream-sediment samples and pan concentrates were analyzed by the same methods; pan concentrates were also analyzed for gold. A total of 367 samples was collected and analyzed.

MINING DISTRICTS AND MINERALIZED AREAS

The Dark Canyon Instant Study Area lies within the Deer Flats and Elk Ridge mining districts. Examination of mining claim records at the San Juan County Recorder's office in Monticello, Utah, revealed that several hundred mining claims have been located in and around the study area. Mining claims which could be plotted are shown on a mines and prospects map (Light, 1981); however there were many additional claims that could not be plotted because of inadequate location descriptions in courthouse records.

Uranium

The majority of mining claims are concentrated along the southern portion of the study area in the vicinity of Deer Flat and Woodenshoe Buttes where uranium occurs in the Shinarump Member of the Chinle Formation (fig. 1 and table 1).

The largest workings in the area (Light, 1981) are at the Woodenshoe Mine in secs. 3 and 10, T. 36 S., R. 18 E. Adit No. 1 trends S. 7° E. and is accessible for 750 ft. Beyond 750 ft the adit is flooded, but continues for at least another 200 ft. Adit No. 2 trends N. 68° E. for 17 ft. Adit No. 3 trends N. 30° E. for 834 ft. No production data are available for the Woodenshoe Mine, but the size of the workings indicate that several hundreds of tons of ore may have been produced. Samples from the Woodenshoe Mine contained as much as 5.20 percent U_3O_8 and as much as 3.10 percent copper.

Table 1.--Mineral deposits and occurrences near Dark Canyon Instant Study Area, Utah

No.	Name	Location	Development category[1]	Resource	Type of deposit[2]	Brief remarks	References
1	Hideout	Sec. 30, T. 35 S., R. 18 E. (unsurveyed)	M/I	Uranium	Stream channel	Caved adit	
2	Al	Sec. 28, T. 35 S., R. 18 E. (unsurveyed)	M/I	Uranium	Stream channel	Two adits with minor concentrations of low-grade U_3O_8 in Shinarump Member of Chinle Formation	
3	East Woodenshoe	Sec. 3 and 10, T. 36 S., R. 18 E.	M/I	Uranium	Stream channel	Three adits and one prospect with low- to high-grade concentrations of U_3O_8 in Shinarump Member of Chinle Formation	Lewis and Campbell, 1965.
4	Jasper Knoll	Sec. 5, T. 35 S., R. 17 E.	P/I	Jasper	Bedded	Discontinuous, nodular jasper and chert in Chinle Formation	
5	Unknown	Sec. 35, T. 33 S., R. 18 E.	P/I	Uranium	Stream channel	Dozer cut in Shinarump Member of Chinle Formation	

[1]Symbols used
- P - Prospect
  - I - Inactive, no known exploration or development work since 1975.
- M - Mine
  - I - Inactive, no known production since 1975.

[2]Single designation of known, or suspected, geometry of deposit or occurrence of mineralization.

The Al Mine consists of two adits 1 mi east of The Heel of Woodenshoe Buttes in sec. 28, T. 35 S., R. 18 E. (unsurveyed). The north adit of the Al Mine contains at least 150 ft of workings, but is caved at 66 ft. The south adit trends N. 70° W. and is caved at 62 ft. The Al Mine may have produced a few hundred tons of ore, but no production data are available. Samples from the Al Mine contained as much as 0.038 percent U_3O_8 and a maximum of 0.02 percent copper.

The Hideout deposit consists of a caved adit 1 1/2 mi west of the Heel in sec. 30., T. 35 S., R. 18 E. No production is known from the property, and two samples from the dump contained a high of 0.005 percent U_3O_8 and 0.03 percent copper.

Other commodities

The Jasper Knoll prospect lies in the NW1/4 sec. 5, T. 35 S., R. 17 E. The prospect consists of a dozer cut in sandstone containing chert and jasper in the lower Chinle Formation. Most of the jasper is nodular and discontinuous, fractured, and impure--containing abundant lithic fragments--and would not be suitable for gems or specimens. Locally, abundant hydrous copper oxides coat the weathered surfaces of the nodules.

MINERAL-RESOURCE POTENTIAL

The Dark Canyon Instant Study Area, San Juan County, Utah (fig. 1) has a low potential for mineral and energy resources, except in the southernmost part of the area where there is a moderate potential for the discovery of uranium deposits. The potential for development of other commodities, such as evaporite minerals and construction materials, and for oil and gas is low.

The area of moderate potential for uranium deposits is underlain by conglomeratic channel sandstones of the Shinarump Member, the basal member of the Chinle Formation (fig. 1). Outcrop distribution of the channel sandstones is shown on the geologic map. The Shinarump appears to be the only host rock in the immediate vicinity for uranium deposits. Prospecting for uranium occurred in and adjacent to the southern portion of the study area (fig. 1). Although no production records are available, the size of the workings indicates that several hundred tons of uranium ore was mined. Chemical analyses of rock, stream-sediment, and pan-concentrate samples indicate that only the southern part of the study area has a potential for mineral resources. Samples collected from mine workings or downstream from workings (nos. 1-9, 12, 17, and 18, fig. 1) contained higher than normal values of base metals and, in some cases, precious metals as well (table 1). In contrast, only three widely scattered samples collected within the remaining portion of the study area have values above the normal background observed: pan-concentrate sample 15, 0.2 parts per million (ppm) gold; rock-chip sample 16, approximately 40 ppm lead and 53 ppm zinc; and stream-sediment sample 19, 45 ppm zinc. These values are quite low compared to those in many unmineralized areas (J. Antweiler, USGS, personal commun., 1980). Owing to their random distribution and the fact that the area is underlain by subhorizontal clastic strata that are unmineralized over most of the region, these values are not considered to indicate the presence of mineralization.

There has been no petroleum production within the study area to date, although six test wells have been drilled within the study area and nine wells nearby (fig. 1, and table 2). Oil-stained cores from the Paradox Formation were recovered from three wells, and similar cores from the underlying

Table 2.--Test wells drilled in the Dark Canyon Instant Study Area and vicinity

[( ), data from USGS Conservation Division; prospect and adit status of all wells, No. 5 and 6 uncertain]

No.	Operator: Well Name	Total Depth (feet)	Year
1.	Occidental: #1 Cataract Canyon Gov't.	1,821	1968
2.	Occidental: #2 Cataract Canyon Gov't.	2,947	1968
3.	Texaco: #2 Cataract Canyon Unit------	2,829	1958
4.	Texaco: #1 Cataract Canyon Unit------	4,944	1956
*5.	Mobil: #2 (Middle Point, Dark Canyon Plateau)---------------------------	3,665	?
*6.	Sinclair: #2 Dark Canyon Unit--------	3,425	1958?
7.	Sinclair: #1 Dark Canyon Unit--------	4,041	1958
8.	Pan American: #1 Elk Ridge Unit------	4,218	1956
9.	General Petroleum: #1 Lean To--------	3,627	1959
10.	Sinclair: #3 Dark Canyon Unit--------	3,727	1958
11.	Midwest: #1 (Rig Canyon)-------------	4,422	1927
12.	Lumm and Maiatico: #1 Dry Mesa Gov't.	3,950	1960
13.	Skelly: #1 Utah-Federal "C"----------	4,533	1961
x14.	Pan American: #1 Bears Ears Unit - SE1/4 SE1/4 sec. 17, T. 36 S., R. 19 E.---	3,590	1957
x15.	Sinclair: #1 Federal-McLane - NE1/4 NE1/4 sec. 25, T. 36 S., R. 16 E.---------	4,007	1958

*Record incomplete.

xNot shown on map.

Mississippian limestone were recovered in one well. Most wells bottomed in the Mississippian, three in the Cambrian, and one in the Precambrian. The target formation was most frequently the Paradox, a prolific producer in the Aneth field about 50 mi to the southeast. One well was drilled in 1927, a dozen in the period 1956-60, and two in 1968.

Lewis and Campbell (1965, p. B7) describe "petroliferous residue" in a black shale overlying the highest gypsum unit exposed in Gypsum Canyon. Local reports of "oil seeps" in exposures of the Honaker Trail Formation of the Hermosa Group of Wengerd and Matheny (1958) in Dark Canyon were investigated during the current study, but they are apparently only irridescence caused by decaying vegetation in localized spring-fed areas.

Possible structural traps include anticlines and faults. Test wells have been drilled on the main Monument Upwarp (locally the Elk Ridge anticline which enters the study area from the southeast a few miles east of the confluence of Woodenshoe and Dark Canyons) and on subsidiary, probably related structures between that confluence and Trail Canyon. Several wells were drilled on minor anticlines in or near the northeast portion of the study area. Some or most of these structures may be related to solution removal of evaporite rocks in the Paradox, which has taken place at various times between the Late Pennsylvanian and the present; these structures may not be present in the potential horizons in the Paradox.

Possible fault traps include the long, linear systems of faults with minor vertical movement which enter the Dark Canyon area from the east. Some graben structures extend for tens of miles from the Blanding-Monticello area; most die out near the Comb monocline, though the Dark Canyon-Trail Canyon system extends well into the study area. Hydrocarbons migrating updip in the nose of the Monument upwarp could be trapped along the north side of such faults. Because of their extent it is possible that some of these faults may be basement related, and that they cut through the entire stratigraphic sequence. Several of the wells drilled in the northeastern part of the area may have been located to test this possibility.

A swarm of faults forming an arcuate pattern and trending east to northeast in the northern part of the area are very probably joint-controlled (Lewis and Campbell, 1965) and related to late evaporite removal (possibly extending to the present) and may have little effect on potential horizons in the Paradox Formation.

Facies traps may be of most interest in the study area. According to R. Hite (U.S. Geological Survey, personal commun., 1980), the western limit of salt deposition in the Paradox basin extends southeastward along the northeast edge of the area, then southerly as shown on the accompanying map. Breccias formed by collapse of overlying beds attendant upon solution removal of salt and (or) gypsum could provide reservoir capacity; where these units feather out updip along the northeast flanks of the upwarp a stratigraphic trap could be present. Several of the wells in the northeast portion of the study area, and in and near the southern portion as well, may have been located to test either that possibility or perhaps combined facies and fault traps.

The potential for oil and gas in the eastern part of the area remains unproven. It may be low, but it cannot be discounted.

The Dark Canyon Instant Study Area lies within the depositional basin of the Pennsylvanian Paradox Formation, which includes evaporite units. The approximate western margin of evaporite deposition lies a few miles west of the study area. According to Lewis and Campbell (1965, plate 1), the Paradox Formation is approximately 500 ft thick; in Gypsum Canyon in the northwest part of the area about 300 ft of rock is exposed, consisting of bedded gypsum and minor amounts of interbedded limestone, dolomite, shale, and sandstone. Lewis and Campbell indicate that about 80 percent of the formation is gypsum. Well records (table 2) for three of the dry holes in and near the study area give a thickness range of 754 to 846 ft of "salt," which presumably includes the entire Paradox Formation and makes no distinction between gypsum and salt. According to R. Hite (U.S. Geological Survey, personal commun., 1980), the western edge of salt deposition runs southeastward through the extreme northeastern part of the area; the trace of the western edge of the salt (fig. 1) is from Mallory (1972). Potash salts are located farther to the northeast. Both gypsum and salt are abundant closer to transportation; thus it does not seem likely that either commodity could qualify as a potential resource in the foreseeable future.

REFERENCES

Lewis, R. Q., Sr., and Campbell, R. H., 1965, Geology and uranium deposits of Elk Ridge and vicinity, San Juan County, Utah: U.S. Geological Survey Professional Paper 474-B, 69 p.

Light, T. D., 1981, Mines, prospects, mining claims, and sample localities of the Dark Canyon Instant Study Area and vicinity, San Juan County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map, in press.

Mallory, W. W., ed., 1972, Geologic Atlas of the Rocky Mountain Region: Rocky Mountain Association of Geologists, 331 p.

Weitz, J. L., 1981, Geologic map and geochemical survey of the Dark Canyon Instant Study Area, San Juan County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map, in press.

Wengerd, S. A., and Matheny, M. L., 1958, Pennsylvanian system of Four Corners Region: American Association of Petroleum Geologists Bulletin, v. 42, no. 9, p. 2048-2106.