DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED BY THE U.S. GEOLOGICAL SURVEY AND THE U.S. BUREAU OF MINES FOR THE U.S. BUREAU OF LAND MANAGEMENT

MISCELLANEOUS FIELD STUDIES
MAP MF-1475-D
PAMPHLET ACCOMPANIES MAP

Base from U.S. Geological Survey
Emmett Wash, 1954; House Rock Spring, 1955;
Jacob Lake, 1936-53; Lees Ferry, 1954;
Nipple Butte, 1953; Paria Plateau, 1954;
Paria, 1954; Tanner Wash, 1954;
Telegraph Flat, 1954

Geology from sources listed;
compiled by and with modifications
and additions by A. L. Bush, 1979

SCALE 1:62 500

CONTOUR INTERVAL 40 AND 80 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

MINERAL RESOURCE POTENTIAL MAP OF THE VERMILION CLIFFS-PARIA CANYON INSTANT STUDY AREA, COCONINO COUNTY, ARIZONA, AND KANE COUNTY, UTAH

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1982

INDEX MAP SHOWING VERMILION CLIFFS-PARIA CANYON INSTANT STUDY AREAS (ISA) AND ADJACENT WILDERNESS STUDY AREAS (WSA)

I-6 Ferry Swale, Judd Hollow, Paria Rim, and Cedar Mountain WSA
I-8A/19 Paria Plateau WSA
I-8B Overlook WSA

INDEX MAP SHOWING SOURCES OF GEOLOGIC DATA FOR THE VERMILION CLIFFS-PARIA CANYON INSTANT STUDY AREA AND ADJACENT WILDERNESS STUDY AREAS

1. Minard (1957).
2. Olson (1957).
3. McQueen (1958).
4. Waldrop and Sutton (1967).
5. Waldrop and Peterson (1967).
6. Wells (1960).
7. Petersen and Phoenix (1959).
8. Petersen (1961).
9. Phoenix (1963).
10. Marshall (1956).
11. Petersen and Wells (1961).
12. Petersen (1959).

INDEX MAP OF THE VERMILION CLIFFS-PARIA CANYON INSTANT STUDY AREA AND ADJACENT WILDERNESS STUDY AREAS, SHOWING U.S. GEOLOGICAL SURVEY 15-MINUTE TOPOGRAPHIC QUADRANGLES AND BOUNDARY OF THE STUDY AREA

EXPLANATION

AREAS OF LOW MINERAL POTENTIAL

A Jacob Pools-Emmett Hill
B Sun Valley Mine-Soap Creek
C Badger Canyon-Cathedral Wash
D Johnson Point-Paria River

CORRELATION OF MAP UNITS

Qaf, Qg, Qs, Qsd, Qt, Qal, Qes, Qls, Qp	Holocene and Pleistocene(?)	QUATERNARY
Unconformity		
QTg	Pleistocene and Pliocene(?)	QUATERNARY AND TERTIARY(?)
Unconformity		
Kd	Upper Cretaceous	CRETACEOUS
Unconformity		
Je, Jc, Jpt, Jcj, JTrn, Tsk, Trmos, Trmo, Trmod	San Rafael Group, Glen Canyon Group	Middle Jurassic, Upper Triassic(?) — JURASSIC, JURASSIC AND TRIASSIC(?), TRIASSIC(?)
Unconformity		
Trco, Trcu, Trcp, Trcss, Trcs		Upper Triassic — TRIASSIC
Unconformity		
Trm, Trmu, Trmm, Trms		Middle(?) and Lower Triassic
Unconformity		
Pk, Pt		Lower Permian — PERMIAN

IDENTIFICATION OF MAP UNITS

[Underlined symbol identifies rock unit below surficial deposit]

SURFICIAL DEPOSITS (HOLOCENE AND PLEISTOCENE?)
Qaf Coalescing alluvial fans
Qg Stream-washed sand and gravel
Qs Eolian and fluvial sand and silt
Qsd Boulders and large blocks of angular slide debris
Qt Talus
Qls Jumbled blocks and fragments
Qal Alluvium
Qes Windblown sand and silt
Qp Pediment gravel
QTg SAND AND GRAVEL (PLEISTOCENE AND/OR PLIOCENE?)
Kd DAKOTA SANDSTONE (UPPER CRETACEOUS)
Je ENTRADA SANDSTONE (MIDDLE JURASSIC)
Jc CARMEL FORMATION (MIDDLE JURASSIC)
Jcj Judd Hollow Tongue
PAGE SANDSTONE (MIDDLE JURASSIC)
Jpt Thousand Pockets Tongue
JTrn NAVAJO SANDSTONE (JURASSIC AND TRIASSIC?)
Trk KAYENTA FORMATION (UPPER TRIASSIC)
Trmo MOENAVE FORMATION (UPPER TRIASSIC?)
Trmos Springdale Sandstone Member
Trmod Dinosaur Canyon Sandstone Member
CHINLE FORMATION UPPER TRIASSIC
Trcu Owl Rock and Petrified Forest Members
Trco Owl Rock Member
Trcp Petrified Forest Member
Trcss Unnamed sandstone and mudstone unit
Trcs Shinarump Member
Trm MOENKOPI FORMATION (MIDDLE? AND LOWER TRIASSIC)
Trmu Upper red member
Trms Shnabkaib Member
Trmm Middle red member
Pk KAIBAB LIMESTONE (LOWER PERMIAN)
Pt TOROWEAP FORMATION (LOWER PERMIAN)

CONTACT--Dashed where approximately located or concealed

FAULT--Showing direction and angle of dip and amount of displacement, dashed where approximately located, queried where uncertain; D, downthrownside; U, upthrown side

FAULT ZONE--Area of multiple faults and fractures; D, downthrown side; U, upthrown side

ANTICLINE--Showing direction of plunge; dashed where approximately located

SYNCLINE--Showing direction of plunge, dashed where approximately located

ANTICLINAL BEND OF MONOCLINE--Showing axial trace and plunge, dashed where approximately located. Short arrow indicates steeper limb

STRIKE AND DIP OF BEDS

Observed
Inclined
Horizontal

Estimated
By photointerpretation
By photogrammetric methods

CARBONATE ROCK--Reefs and linear bodies of sheared and crushed Navajo Sandstone (JT n) cemented by iron and manganese oxides and carbonate minerals. Dashed where approximately located

5000 / 5200 STRUCTURE CONTOUR--Contour interval 100 ft, 200 ft, and 500 ft. Drawn on base of upper part of Kaibab Limestone (Pk) in House Rock Spring quadrangle; on base of Navajo Sandstone (JTrn) in Emmett Wash, Lees Ferry, Nipple Butte, and south half of Paria Plateau quadrangles; on base of Carmel Formation (Jc) (including Judd Hollow Tongue (Jcj)) in north half of Paria Plateau quadrangle and in Telegraph Flat and Paria quadrangles. Control scanty, even at outcrops of contacts. Dashed where projected above surface.

MINE
ADIT
PROSPECT
SHAFT
DRY HOLE (OIL)

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 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 Vermilion Cliffs-Paria Canyon Instant Study Area and adjacent Wilderness Study Areas, Coconino County, Arizona, and Kane County, Utah.

INTRODUCTION

The Vermilion Cliffs-Paria Canyon Instant Study Area is mostly in Coconino County, Ariz., but extends into Kane County, Utah. The area studied in this report encompasses about 560 mi^2 (1,450 km^2); the area identified for possible wilderness designation consists of 323,745 acres (about 130,700 hectares) of public land, about 90 percent of the area studied. The study area includes the established Paria Canyon Primitive and Vermilion Cliffs Natural Areas and lies between U.S. Highways 89 and 89A.

The Paria Plateau is the dominant topographic feature in the area, bounded by the dropoff of the nearly vertical Vermilion Cliffs on the east, south, and west, and cut by the gorges of Kaibab Gulch and Paria River Canyon to the north. North of the Kaibab-Paria drainage, the plateau loses its identity and the upland surface consists of variously named benches. Upland altitudes range from about 4,600 ft to more than 7,600 ft (1,400 m to 2,300 m), and the lowest point in the study area is 3,116 ft (950 m) at Lees Ferry, Ariz., on the Colorado River. From Lees Ferry the sheer Vermilion Cliffs increase from about 1,200 ft (370 m) to nearly 2,000 ft (about 600 m) near the southeast corner of the Paria Plateau, then decrease westward to about 800 ft (250 m) along the south side of the Plateau and virtually disappear northward along House Rock Valley. A break in the cliffs occurs where Corral Valley joins House Rock Valley, and this break affords the major road access to the Paria Plateau (an area of about 325 mi^2 (850 km^2)). Farther north the cliffs reappear as a ragged sequence of steep slopes and ledges as much as 900 ft (275 m) high that continues for more than 30 mi (50 km) to the north as the east wall of House Rock Valley and Coyote Valley.

The Paria Plateau and the flats north of the Kaibab-Paria canyons form a rolling upland that slopes gently northward at about 100 ft/mi (20 m/km). Bedrock is at or near the surface almost everywhere, and soil is thin and sandy; windblown sand is the common surficial material. All the streams on the plateau and the northern benches are ephemeral; Kaibab Gulch and some of the spring-fed streams that drain the Vermilion Cliffs are intermittent or perennial only in very short stretches. The only permanent stream is Paria River, and it occasionally has only a subsurface flow near its mouth.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Overall, the Vermilion Cliffs-Paria Canyon Instant Study Area has low mineral resource potential. A number of metallic mineral deposits (uranium-copper-vanadium-silver and gold-mercury) are present, and more of the same type undoubtedly can be found, but the prospect for discovery of other types of deposits is low. The area has potential for uranium production, but drilling would be needed to provide data for outlining ore and for reserve calculations. Probably all (certainly most) uranium copper-vanadium-silver deposits that crop out were discovered during a period of intensive prospecting during the early and mid-1950's. Only two deposits have yielded ore, the larger several hundred tons. Similar deposits can be expected below the Paria Plateau, where they will be 2,000 ft (600 m) or more below the surface, but the density of distribution is likely to be lower, as the Shinarump Member host rock, which thins and becomes discontinuous from east to west in outcrop around the plateau, probably does so below the plateau as well. Prospects for production from these deposits is virtually nil. The areas of restricted potential for additional deposits are shown on the map: A, Jacob Pools-Emmett Hill area; B, Sun Valley Hill-Soap Creek area; C, Badger Creek Canyon-Cathedral Wash area; D, Johnson Point-Paria River area.

Gold-mercury potential is low, for although a large part of the Chinle Formation is gold bearing and has a small mercury content, the grade is very low, no more than about 40-ppb gold, and because of the minute size of the gold particles, recovery is difficult. Gold in the 40-ppb range is worth about $0.80/ton at a $700/oz price, making recovery uneconomical. There is virtually no potential for mercury resources at the very low concentrations indicated, generally less than 150 ppb.

The Kaibab Limestone is a significant mineral resource for use as road metal and possibly as agricultural limestone. Large amounts are available, access is good, and the rock is at or near the surface, but the market is local. Large amounts of suitable rock are available much nearer any of the marketing centers within 100 mi (about 160 km) of the study area. Flagstone and building stone in large quantities are available from the middle red member (and to a lesser extent from the upper red member) of the Moenkopi Formation. Again, the market is strictly local. The bentonite beds of the Petrified Forest Member of the Chinle Formation do not represent a significant resource; they tend to be thin and discontinuous, and they are difficult of access because they crop out on the lower slopes of the Vermilion Cliffs. Gypsum occurring in the Moenkopi Formation has no resource potential.

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