DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1627-A
PAMPHLET ACCOMPANIES MAP

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 Kanab Creek Roadless Area in the Kaibab National Forest, Coconino and Mohave Counties, Ariz. The Kanab Creek Roadless Area (B3060) was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

A moderate mineral resource potential for uranium, copper, and other metals in breccia pipes is assigned to collapse structures (see map), four of which extend into or are near the boundary of the roadless area. Energy Fuels Nuclear, Inc., Denver, Colo., has located a significant deposit of uranium in one of these breccia pipes on the north rim of Snake Gulch at Pigeon Point. The other three collapse structures along the boundary of the roadless area have not been explored, but geochemical sampling on the surface has shown enrichment of several metals.

Gypsum, which occurs in the Woods Ranch Member of the Toroweap Formation along the rim of the canyon, is a common mineral in the region. Historic prospects in the Kanab Creek Roadless Area are nonexistent. No significant geochemical anomalies, other than those related to collapse structures on both the east and west rims of the Kanab Creek area, were found within the roadless area.

No oil or gas occurrences are known in the roadless area, but there is a low potential for such resources in the area and the surrounding areas, on the basis of known shows or production relatively nearby in rocks correlative with those exposed in or underlying the roadless area.

INTRODUCTION

The Kanab Creek Roadless Area is comprised of the canyon of Snake Gulch about 15 mi south of Fredonia, Ariz., between Kanab Creek and the Kaibab Plateau (fig. 1). It is contiguous with the Kanab Canyon Roadless Area on the west side and lies within the Grand Canyon Game Preserve of the Kaibab National Forest. The Kanab Creek Roadless Area encompasses just over 14 mi^2 at elevations ranging from 3,720 to 6,200 ft above sea level. Dirt roads provide access to both the north and south rims of the canyon and a four-wheel-drive trail provides access along the floor of the canyon for its entire 22 mi length.

GEOLOGIC SETTING

Snake Gulch (in the Kanab Creek Roadless Area) lies within the Colorado Plateau province 18 mi north of the central region of Grand Canyon, Ariz. Horizontal layers of sandstone, shale, and limestone, all of Early Permian age, have been incised by Snake Gulch and crop out along the canyon walls. The exposed rock units include (in ascending order) the Esplanade Sandstone, Hermit Shale, Coconino Sandstone, Toroweap Formation (including the Seligman, Brady Canyon, and Woods Ranch Members), and the Kaibab Formation (including the Fossil Mountain and Harrisburg Gypsiferous Members; fig. 2). The Triassic Moenkopi Formation is not present in the Snake Gulch area, due to erosion, but it is found 15 mi to the north.

STRUCTURE

At least two fault systems, including the Crazy Jug fault and the Big Springs fault, occur at the east end of Snake Gulch. They have a minimum displacement of 1,200 ft. One large fault, the Gunsight Point fault, having an estimated displacement 180-200 ft down to the west, occurs in Kanab Canyon just west of Snake Gulch (see map). The sedimentary rocks of Snake Gulch dip from east to west with a regional dip of 1^{0}. Collapse structures (possible breccia pipes at depth) as well as breccia pipes exposed at the surface, are randomly scattered on the Plateau surface on both sides of the canyon (see map). These structures are circular depressions characterized by strata that dip gently (1^{0}-10^{0}) towards the central point (fig. 3). The collapsed areas vary in size from 40 ft to more than 0.75 mi in diameter. These structures are believed to have originated due to solution of the underlying Redwall Limestone by ground water. The roof of the produced caverns then collapsed under the burden of the overlying rocks forming a brecciated "pipe" at depth (Wenrich-Verbeek, 1980).

GEOCHEMISTRY

A reconnaissance geochemical study to assess the mineral resource potential of the Kanab Creek Roadless Area, Ariz., was conducted in March 1982. A total of 80 minus-80-mesh stream-sediment, soil, and clay samples, 16 panned concentrates, 23 rock samples, and 6 water samples were collected from the roadless area. Water samples were analyzed for anions and cations. All samples except the water samples were analyzed for 31 elements by semiquantitative methods (Grimes and Marranzino, 1968). Panned concentrates were analyzed for Au, As, Cu, Cd, Sb, Bi, Ag, and Zn using atomic absorption methods described by Viets and others (1979). Water samples were analyzed for Cu, Pb, Zn, Mo, U, Cl-, F, SO_4=, and conductivity, using methods described by Miller and others (1982). Concentrations of uranium and thorium were determined using a delayed neutron activation technique (Millard and Keaton, 1982). Anomalous thresholds were based primarily on concentration contrasts for selected elements.

The few geochemical anomalies that were found in the roadless area were weakly anomalous with the exception of iron-rich concretions in the drainage below Willow Spring. These concretions were enriched in Ag, As, Cu, Mo, Pb, and Zn, however, their bedrock source is unknown. The most likely source is the Fossil Mountain Member of the Kaibab Limestone because they are noted almost everywhere the Fossil Mountain is exposed.

Water from Pigeon Spring contained 44 ppb (parts per billion) uranium, the highest level of uranium found in the roadless area. Although Pigeon Spring is east of the breccia pipe at Pigeon Point, a possibility exists that water which emerges in Pigeon Spring had dissolved uranium from another mineralized breccia pipe similar to the ore at Pigeon pipe (see map). No other geochemical anomalies were found associated with this area.

Anomalous concentrations in samples from the main drainage of Snake Gulch are probably attributable to contamination from formation of the Jacob Lake Warm-Springs copper deposits and ore-processing activity at Ryan, just east of the roadless area. Geochemical anomalies of Cu, Ba, As, and Mo, although weak, do increase in intensity at the upper end of the roadless area in the drainage directly below Ryan (see map).

The plateau surrounding Snake Gulch has a number of collapse structures, some of which may be mineralized breccia pipes at depth. The most notable of these is the Pigeon pipe on the north rim of Snake Gulch. At the time of the field studies for this report, overburden was being removed there preparatory to mining by Energy Fuels Nuclear, Inc., of Denver, Colo. Through their courtesy, fresh-cut rock, soil, and clay samples were taken and analyzed. The analytical data on these samples showed a weakly anomalous suite of elements in limonitically altered rock and clay samples that included Ag, Ba, B, Co, Mo, Ni, Pb, and Sr.

Stronger geochemical anomalies were found in samples from other collapse structures, particularly the one in Table Rock Canyon. The strongest anomalies were of Ag, As, Mo, and Zn, both in panned concentrates and rock samples. Subsurface sampling would be required to evaluate the significance of these areas.

In summary, the geochemical sampling study of the Kanab Creek Roadless Area resulted in identification of several anomalies. Geochemical anomalies associated with collapse structures on both the north and south rims of Snake Gulch, outside the roadless area, are much stronger than anomalies in the canyon itself and may warrant further study. Some of the breccia pipes, including the Pigeon pipe, may be partially within the roadless area. Alluvium within the canyon may conceal other collapse features.

MINING DISTRICTS AND MINERALIZED AREAS

Near Jacob Lake, east of the roadless area (fig. 1), the Jacob Lake-Warm Springs district includes a few copper deposits. These deposits consist of ribbonlike bodies of azurite and malachite at the intersection of vertical joints and favorable beds of cherty, sandy limestone in the Kaibab Formation. The closest deposit to the Kanab Creek Roadless Area is 4 mi to the east.

The deposits were known by 1900, and mills to process the ore were built in 1901 and 1928 at Ryan, near the mouth of Warm Springs Canyon, 2.5 mi southeast of the head of Snake Gulch. Both mills were destroyed by fire within a year of construction (Tainter, 1947).

No significant production occurred until 1942 when the U.S. Government closed gold mines to concentrate mining efforts on critical war materials. In 1944, the U.S. Bureau of Mines drilled 152 holes on claim groups about 6 mi east of Snake Gulch. Only one group was active after the end of World War II (Tainter, 1947).

The district produced 241 oz of gold, 29,504 oz of silver, 6,821,826 lb of copper, and 2,010 lb of lead from 1937 to 1956 when all activity ceased (Tainter, 1947).

MINING ACTIVITY

As of September 1982, considerable exploration interest in mineral resources was evident on the plateau surrounding the Kanab Creek Roadless Area. The main commodity being sought is uranium; however, precious and base metals accompany uranium in some of the mineralized areas in the Grand Canyon area and thus conceivably can occur near Kanab Creek. Uranium is currently being produced from the Hacks Canyon mine about 6 mi west of the roadless area (Energy Fuels Nuclear, Inc., oral commun., 1982).

Large blocks of claims were staked on both the north and south rims of Snake Gulch, bordering the Kanab Creek Roadless Area during 1980-82 by Energy Fuels Nuclear, Inc., Denver, Colo. Corners of these claim blocks extend into the area. At least one block of claims on the north rim, known as the Pigeon pipe, was found to be sufficiently mineralized to encourage further development (see map). In March 1982, several men were employed there, operating earth-moving equipment to remove overburden. Several drill rigs were also in operation.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

There is little indication of potential for metallic mineral resources in the majority of the area included within the Kanab Creek Roadless Area. Layers of gypsum occur in the Woods Ranch Member of the Toroweap Formation along the rim of the canyon of Snake Gulch. Because of the remoteness, relative inaccessibility, and distance from markets, the gypsum deposits are less attractive than many other deposits in southern Utah and northern Arizona.

Collapse structures are randomly scattered on the surrounding plateau just outside the roadless area and some extend a short distance into the area. The areas having potential for mineral resources in the Grand Canyon region are in mineralized breccia pipes found underneath collapse structures. Most of the breccia pipes are not mineralized, but substantial production of uranium, copper, and other metals has come from some of them, such as the Grandview mine on Horseshoe Mesa, eastern Grand Canyon; the Orphan mine, south rim of the Grand Canyon; and the Hacks Canyon mine about 6 mi west of Kanab Creek.

A moderate mineral resource potential for uranium, copper, and other metals is assigned to collapse structures (see map), four of which extend into or are near the Kanab Creek Roadless Area.

A low resource potential for oil and gas is assigned to the Kanab Creek Roadless Area because the Paleozoic section in northwestern Arizona is considered favorable for the occurrence of oil and gas resources. Although canyon cutting generally reduces the possibility of accumulations in the incised rocks near the canyons, the unexposed rocks should not be adversely affected (Pierce and others, 1970). The closest drill hole, about 12 mi northwest of Snake Gulch, penetrated Cambrian strata but was dry.

The breccia pipe at Pigeon Point, called Pigeon pipe, has inferred resources of uranium and is currently being developed by Energy Fuels Nuclear, Inc., Denver, Colo. (see map). Although many of the collapse structures on the surrounding plateau may not mark the location of mineralized breccia pipes at depth, the probability is high that some of them may be mineralized. Geochemical sampling on the surface has shown enrichment of several metals, most notable Ag, As, Mo, and Zn (but also at some localities Ba, B, Co, Ni, Pb, and Sr). These geochemical anomalies were strongest just south of the Kanab Creek Roadless Area.

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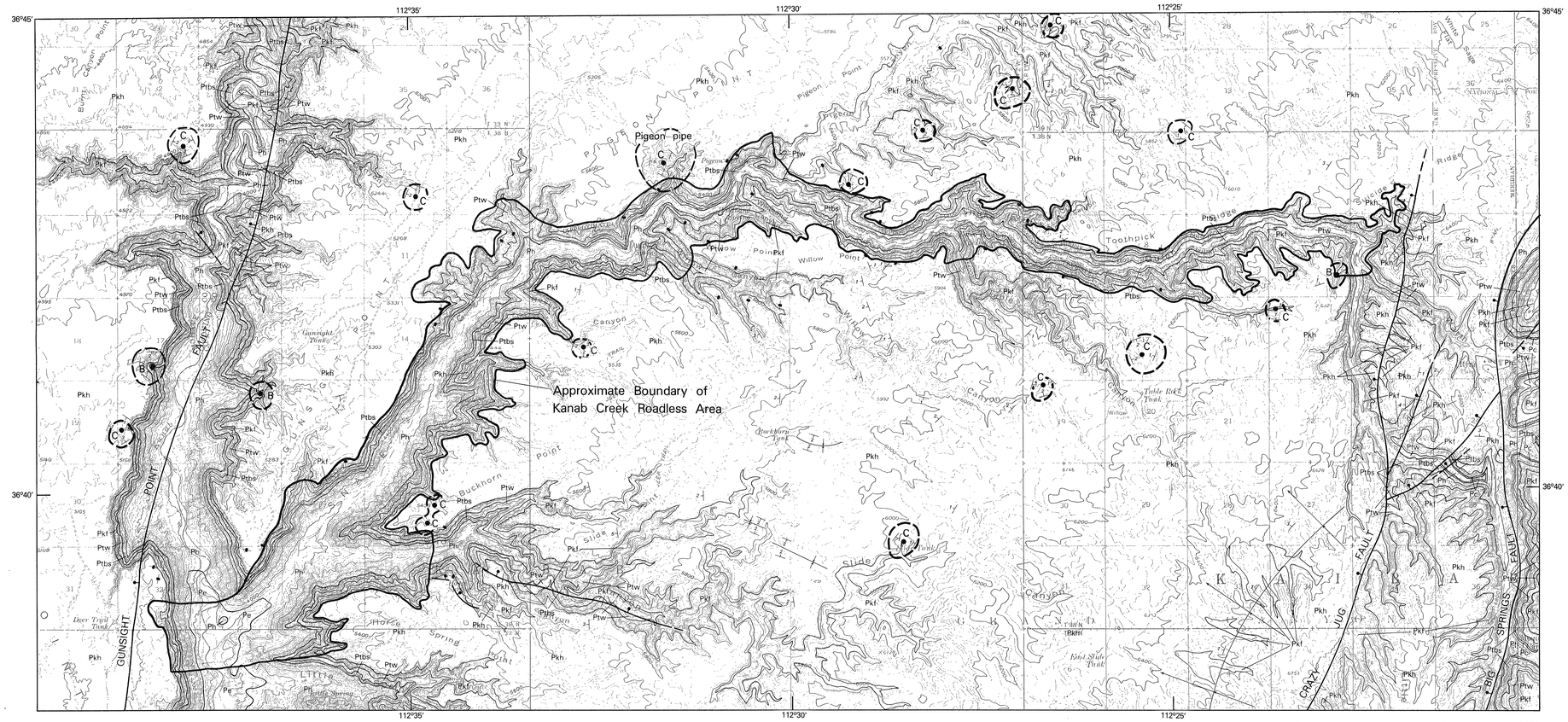

Base from U.S. Geological Survey, 1:62,500
Big Springs, 1958; Jumpup Canyon, 1957

Geology mapped by George H. Billingsley in 1982

SCALE 1:48 000

1 ½ 0 1 2 3 MILES

1 .5 0 1 2 3 KILOMETERS

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

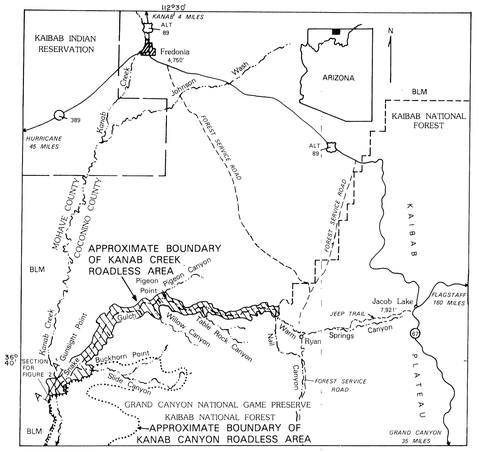

Figure 1.--Location map of the Kanab Creek Roadless Area (B3060), Coconino and Mohave Counties, Ariz.

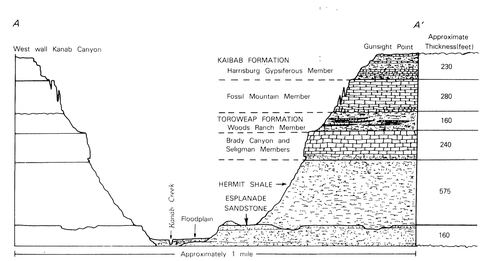

Figure 2.--Geologic cross section of the western Kanab Creek Roadless Area. (See fig. 1 for section location.)

EXPLANATION OF RESOURCE POTENTIAL

AREAS HAVING MODERATE RESOURCE POTENTIAL FOR URANIUM, COPPER, AND OTHER METALS IN BRECCIA PIPES

C Collapse structure--Circular depression with inward dipping beds

B Breccia pipe--Collapse structure with exposed breccia

CORRELATION OF MAP UNITS

Pkh	
Pkf	
Unconformity	
Ptw	UPPER PERMIAN
Ptbs	
Unconformity	
Pc	
Unconformity	
Ph	
Unconformity	
Pe	Supai Group

DESCRIPTION OF MAP UNITS

KAIBAB FORMATION (PERMIAN)

Pkh Harrisburg Gypsiferous Member--Slope-forming gray and pale-red shale and gypsiferous siltstone interbedded with gray ledge-forming limestone. Approximately 230 ft thick

Pkf Fossil Mountain Member--Cliff-forming, yellowish-gray fossiliferous, cherty limestone. Approximately 280 ft thick

TOROWEAP FORMATION (PERMIAN)

Ptw Woods Ranch Member--Slope-forming pale-red and gray siltstone and shale with interbedded thick beds of massive gypsum. Approximately 160 ft thick

Ptbs Brady Canyon and Seligman Members, undifferentiated--Brady Canyon is a cliff-forming, fossiliferous, gray limestone; basal portion (Seligman) contains reworked white Coconino sandstone and red Hermit shale, forms recess in basal part of cliff. Approximately 240 ft thick

Pc COCONINO SANDSTONE (PERMIAN)--A cliff-forming, white, crossbedded, quartz sandstone in the upper 6 mi of Snake Gulch, discontinuous elsewhere. Approximately 14 ft thick

Ph HERMIT SHALE (PERMIAN)--Slope-forming, alternating beds of bright-red-brown shaly mudstone and siltstone interbedded with pale-red-brown, ledge-forming sandstone. Approximately 575 ft thick

Pe ESPLANADE SANDSTONE (PERMIAN)--Upper Supai Group. Deep-reddish-brown mixture of siltstone and mudstone capped with a resistant reddish-brown to white, massive sandstone. Approximately 160 ft thick

CONTACT

FAULT--Bar and ball on downthrown side; dashed where approximately located

STRIKE AND DIP OF BEDS

MONOCLINE--Axis located approximately midway between anticlinal and synclinal hinges of fold. Length of arrow indicates map distance between fold hinges

SYNCLINE

VERTICAL JOINTS

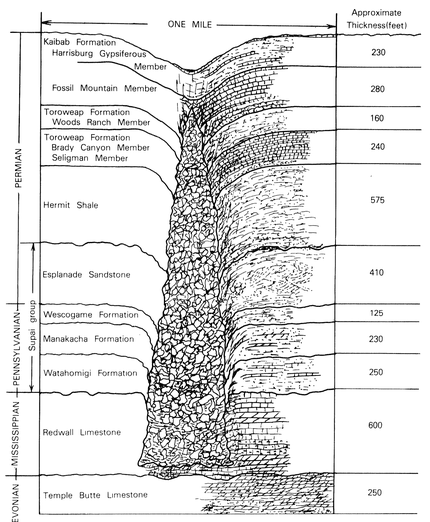

Figure 3.--Schematic cross section of a collapse structure (breccia pipe) based on exposed sections in the Grand Canyon, Ariz.

MINERAL RESOURCE POTENTIAL MAP OF THE KANAB CREEK ROADLESS AREA, COCONINO AND MOHAVE COUNTIES, ARIZONA

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