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URANIUM-COPPER DEPOSITS NEAR COPPER CANYON, NAVAJO INDIAN RESERVATION, ARIZONA

By
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March 1952

Division of Raw Materials
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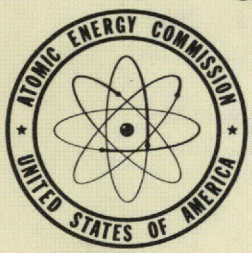
Grand Junction, Colorado



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URANIUM-COPPER DEPOSITS NEAR COPPER CANYON, NAVAJO INDIAN RESERVATION, ARIZONA

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INTRODUCTION

In the summer of 1951, certain Navajo Indians conducted John W. Chester, Russell C. Cutter, and E. V. Reinhardt, of the Grand Junction Exploration Branch, U. S. Atomic Energy Commission, to a copper deposit in Copper Canyon, Arizona and Utah. Little radioactivity was noted, and no further work was done in the area at that time. In October, the same group of Navajos reported the discovery of uranium ore in another portion of the same area. A visit at that time found that an excavation by the Navajos had disclosed a 3-foot thickness of low-grade uranium ore. In November, a third visit noted that the Navajos had opened a 5-foot face of good ore.

Subsequent examinations disclosed that many portions of the area, which were believed to contain only copper, were mineralized also with uranium at the base of the cliffs beneath the talus slopes. From December until February 1952, snow and muddy roads forced a suspension of examinations. This report, therefore, is necessarily preliminary in nature.

From aerial reconnaissance, the mineralized area is known to lie within a rectangle about 25 miles north to south, by 20 miles east to west. The map (Plate 2), however, covers only the portion of the area that has been most intensively examined, embracing about 150 square miles.

LOCATION AND ACCESSIBILITY

The Copper Canyon district is the southwestern Monument Valley region and is situated in San Juan County, Utah, and Navajo County, Arizona, entirely within the Navajo Indian Reservation. The natural boundaries are the San Juan River on the north, Oljetoh Wash on the east, Piute Canyon on the west, and Skeleton Mesa on the south. (Plate 1).

An unimproved dirt road branches from State Highway 47 in Monument Valley 3 miles south of the Utah state line and extends to the Oljetoh Trading Post 8 miles to the northwest, in Utah. From Oljetoh Trading Post, an unimproved truck trail continues for 22 miles to the Whirlwind mine near the junction of the San Juan River and Oljetoh Wash. The Whirlwind mine road branches 3 miles north of Oljetoh Trading Post. The left, or west, branch goes to Copper Canyon. It is suited for travel only in jeeps and is so indistinct that it may be followed only with difficulty. The ore horizon rims the canyon walls 1500 feet above the bottom. A horse trail from the bottom of the Canyon ends at one mineralized outcrop; the others are accessible only by climbing from the canyon floor.

The mesas surrounding the Canyons are traversed by several indistinct Navajo horse trails.

A road is now under construction by the Atomic Energy Commission into Hoskinnini Mesa, which bounds Copper Canyon on its eastern side, and will probably be ready for travel in jeeps by May 1952.

CLIMATE, TIMBER, AND WATER SUPPLY

There is no running water in Copper Canyon. The nearest available water is in the San Juan River, 20 miles to the north, where it is joined by Oljetoh Wash.

Rainfall averages about 6 inches a year and is insufficient to allow the growth of any timber except juniper and pinion.

The summers are hot and the winters are not severe. Temperatures are seldom as low as zero and snowfall, though sufficient to prevent travel over the present poorly developed roads, would not impede transportation if good roads were constructed into the area.

GENERAL GEOLOGY

Stratigraphy

The sedimentary rocks in the area, from youngest to oldest, are described as follows:

Jurassic

Wingate - Massive, cliff-forming red sandstone capping some of the higher mesas in the area. It is about 400 feet thick.

Triassic

Chinle - An upper member of red shale with a basal portion of red to gray or gray-green shale. Irregular sandstone lenses occur within the formation, especially in the lower one-third. Thickness is 600 to 700 feet.

Shinarump - Interbedded sandstone and conglomerate ranging in thickness from 0 to 500 feet. The base of the Shinarump is the ore-bearing horizon.

Moenkopi - Red shales and siltstones containing lenses of red sandstone. Thickness in this area is about 300 feet.

Permian

DeChelly - A cross-bedded, red sandstone forming prominent cliffs. In this area, the thickness is about 300 feet.

Organ Rock - Red siltstone which has been eroded into peculiar, layered columns, in this area, about 600 feet thick.

Cedar Mesa - A white, cross-bedded sandstone of unknown thickness forming the floors of the canyons.

Details of the Shinarump Formation

The Shinarump is lenticular in its occurrence, and in the Copper Canyon area it is thicker than elsewhere on the Colorado Plateau. It caps the surface over an area of nearly 500 square miles of the Copper Canyon area. At Oljetoh Wash to the eastward, the Shinarump has been eroded; southward, beneath Skeleton Mesa, it pinches out; and, on the western and northern sides, it dips under younger formations.

Throughout the region of the Colorado Plateau, the Shinarump rests on the underlying formation with an erosional unconformity. In many places, the Shinarump-filled channels are barely discernible, being a hundred or more feet wide by a few feet deep. Some of the largest known channel

structures in the Plateau are in the Copper Canyon area, where they range in size from a few feet to 1500 feet in width, and from a few inches to 300 feet in depth. The Shinarump formation in these channels reaches a maximum thickness of 500 feet, the normal thickness being 0 to 200 feet.

Structure

A monocline dipping easterly as steeply as 50° lies immediately south of the mapped area. Along the fold, the formations have been elevated on its western side between 800 and 1000 feet. West of the fold, the dip is 1° to 2° to the northwest. The monocline does not appear to have been a factor of control in the deposition of the ore, as some of the mineralized outcrops are near it and others are many miles away.

COPPER-URANIUM DEPOSITS

Localization of the uranium-copper minerals

The mineral-bearing outcrops are confined to the channel structures eroded into the Moenkopi formation and filled with Shinarump sands and gravels. In the mapped area, 42 channel outcrops are now known; 18 have been examined and 24 have been observed by aerial reconnaissance and study of photographs. Of the 18 channels examined, 17 were found to be copper-bearing and 15 contained copper and uranium.

No uranium minerals have been found higher than 20 feet above the base of the channels and the best concentrations are in the lower 5 feet. In some channels, the copper minerals are confined to the lower part of

the channel; in one, however, on the western side of Hoskinnini Mesa, abundant copper minerals were found from the base upward through a vertical interval of 100 feet.

Uranium occurs as carnotite, filling interstices between the sand grains and as a replacement of fossil trees, twigs, and carbonaceous trash; copper occurs as chalcocite surrounded by halos of malachite, azurite, chrysocolla, and brochantite in bedding-plane seams and replacements of fossil woody material. It is believed that there is no constant ratio between copper and uranium, as some of the best copper deposits are low in uranium.

Size and shape of the deposits

The mineralized deposits, being confined to fossil channel-bottoms, are elongated along the courses of the channels. As the channels are roughly U-shape, the mineralized portions are not as large as the tops of the channels. A channel 1800 feet wide at the top probably nowhere contains more than 1000 to 1100-foot widths of mineralized material at its base. As uranium minerals have, in no locality, been observed higher than 20 feet above the channel base and are, in some places, confined to horizons as thin as a few inches, it is believed that the average thickness of the ore does not exceed 10 feet.

Drilling near the Monument No. 2 mine and elsewhere in the Monument Valley region has indicated that ore occurs in lenses in the channels, and that about 6% of the total length of a channel is mineralized.

Lateral extent of the deposits

Several channels have been observed crossing promontories on Hoskinnini Mesa; others have been projected across the mesa; several of them have been observed entering Nokai Mesa on the western side of Copper Canyon. Those channels which have been projected with a reasonable assurance of accuracy are shown on Plate 2, and embrace a surface area of 3.8 square miles. In the entire Copper Canyon district, it is calculated that 38 square miles of the surface is underlain by channels, of which about 2.25 square miles may reasonably be expected to be mineralized.

Grade of the material

A face of ore 40 feet long by 5 feet thick opened by Navajos on the western side of Copper Canyon averages 0.35% U_3O_8. Samples assaying from 0.10% to 0.68% U_3O_8 have been obtained from widely separated points. Copper assays as high as 18% have been obtained. A copper-bearing outcrop 100 feet high on the eastern side of Copper Canyon appears, from visual examination, to contain a minimum of 1% copper. Some of the uranium-bearing outcrops, on the other hand, are quite low in copper content. From data now at hand, it seems likely that the grade of material, if mined from 5 to 20 feet thick, might range around 0.10% U_3O_8 and 1.0% copper. These figures may have to be revised as drilling proceeds.

Obstacles to mining

1. The ore does not occur in one large body, but in a large number of bodies scattered over 500 square miles.

2. The nearest adequate supply of water is the San Juan River, which

flows at distances of 3 to 25 miles from the deposits.

3. There is no suitable mine timber in the area.

4. Some of the deposits could be stripped and mined by open-pit methods; others are buried beneath 200 to 480 feet of over-burden and would have to be mined underground. Block caving could not be accomplished because the underlying Moenkopi formation is too soft to withstand erosion at draw-raises. The underground mining method would have to be a modified room and pillar system, by which 20% to 25% of the ore would be left in pillars.

5. Extensive metallurgical testing will have to be done to assure good recovery of both uranium and copper and a clean separation of the two metals.

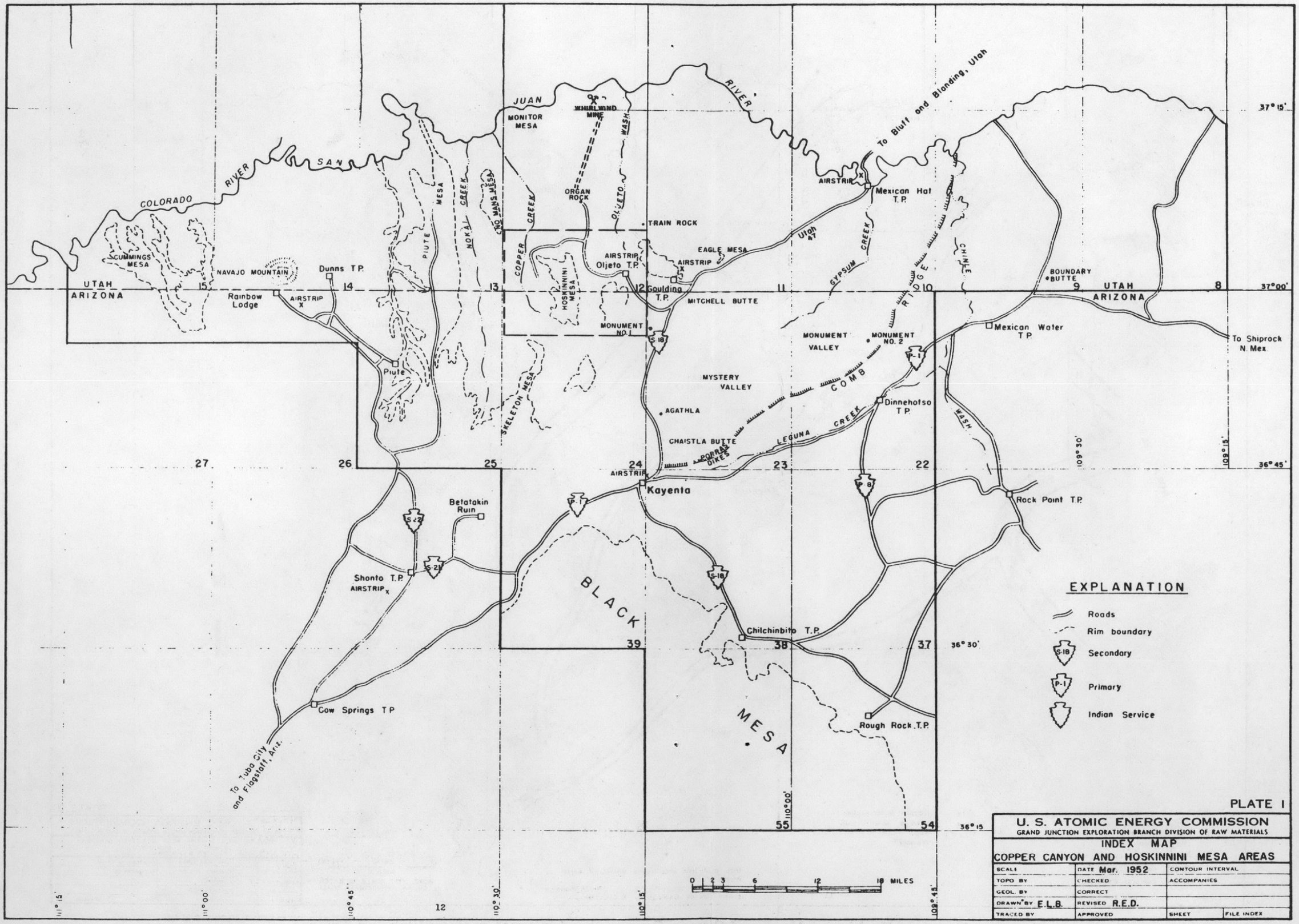

Plate 1—Index map Copper Canyon and Hoskinnini Mesa Areas.

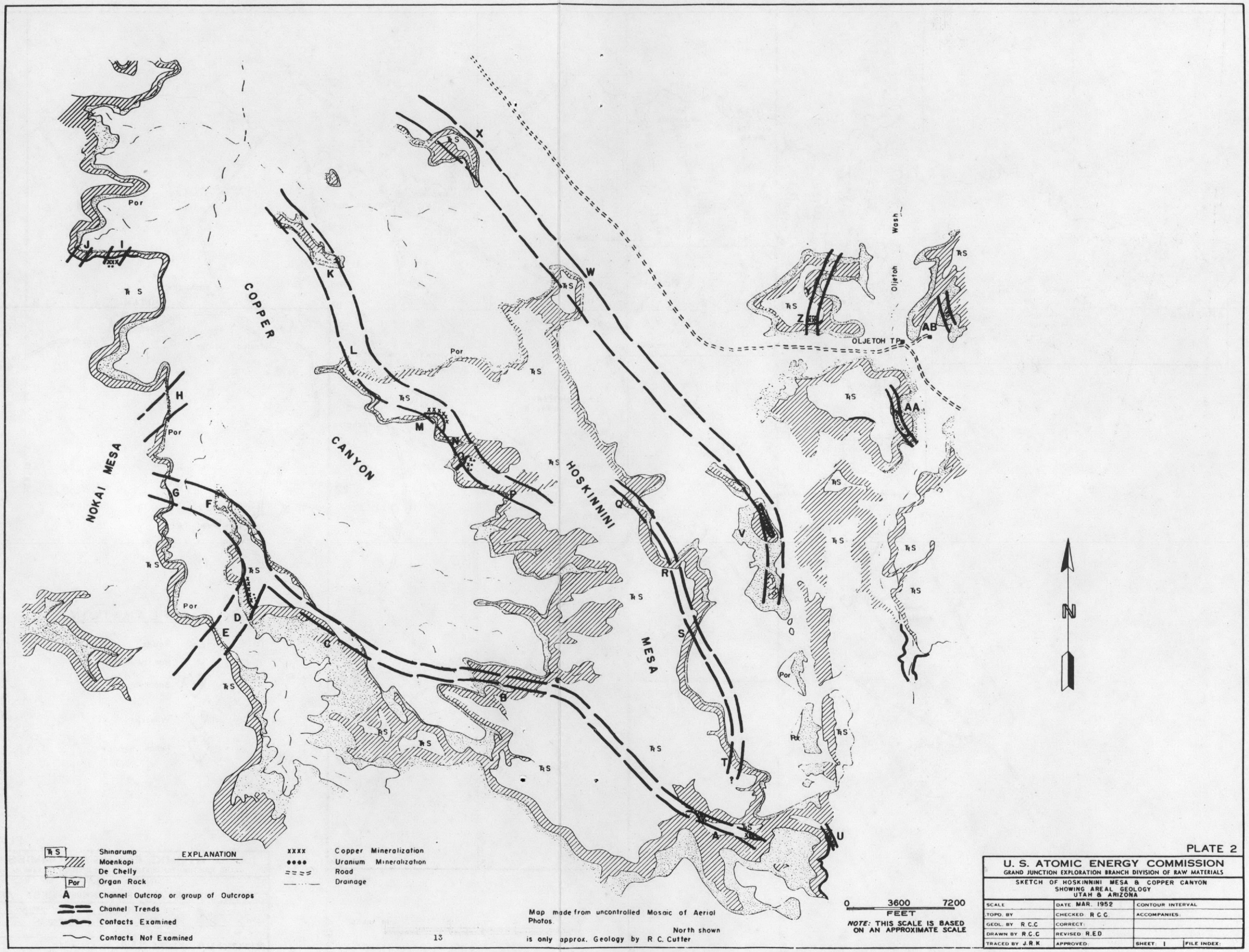

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Plate 2—Sketch of Hoskinnini Mesa and Copper Canyon showing areal geology Utah and Arizona.