UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

URANIUM DEPOSITS IN THE COCHETOPA DISTRICT, COLORADO, IN RELATION TO THE OLIGOCENE EROSION SURFACE

By

Jerry C. Olson

Open-File Report 76-222

1976

Contents

Illustrations

URANIUM DEPOSITS IN THE COCHETOPA DISTRICT, COLORADO, IN RELATION TO THE OLIGOCENE EROSION SURFACE[1/]

By Jerry C. Olson

ABSTRACT

In the Cochetopa district, Colorado, the sequence of Mesozoic and Cenozoic events is as follows: development of a relatively smooth, planar erosion surface in Jurassic time; deposition, on this surface, of the Junction Creek Sandstone and Morrison Formation of Jurassic age, followed by deposition of the Dakota Sandstone and Mancos Shale of Cretaceous age; Laramide tilting and faulting; erosion to form a terrane of moderate relief in Oligocene time; deposition of lava flows and volcanic breccia of intermediate composition and of ash-flow tuff, all of Oligocene age; and subsequent erosion and canyon-cutting by Cochetopa Creek, a superimposed stream, and its tributaries.

[1/]Based on talk given at the U.S. Geological Survey Uranium and Thorium Research and Resource Conference held December 8-10, 1975, at Golden, Colorado.

The principal uranium deposit in the district, at the Los Ochos mine, is in Junction Creek Sandstone, Morrison Formation, and Precambrian rocks. The deposit is localized just beneath the restored position of the old land surface that was buried by Oligocene volcanic rocks and has since been eroded away near the mine. Contours drawn on this ancient surface show the position of the paleovalley of the ancestral Cochetopa Creek, which flowed northward through the district slightly east of its present position. The Los Ochos uranium deposit is in the Los Ochos fault zone near the point where it is crossed by the pre-volcanism Cochetopa paleovalley. This localization suggests the possibility that the fault zone provided the conditions favorable for deposition of uranium from ground waters moving through overlying volcanic rocks and down the ancient paleovalley on the pre-Oligocene unconformity. Delineation of ancient erosion surfaces and paleodrainage systems, such as those at the base of the Tertiary volcanics, may be useful guides in exploration for deposits in similar geologic settings.

INTRODUCTION

The principal uranium occurrences in the Cochetopa district lie very close to the old erosion surface on which Oligocene volcanic rocks were deposited. The uranium deposits have generally been considered hypogene--and they may be--but this localization near the unconformity suggests that the possibility of a supergene origin should also be considered.

Uranium was discovered in the Cochetopa district in 1954 and mined until about 1962. If classified as a hypogene vein-type deposit, the principal mine, the Los Ochos, may be among the six most productive deposits of this type in the country.

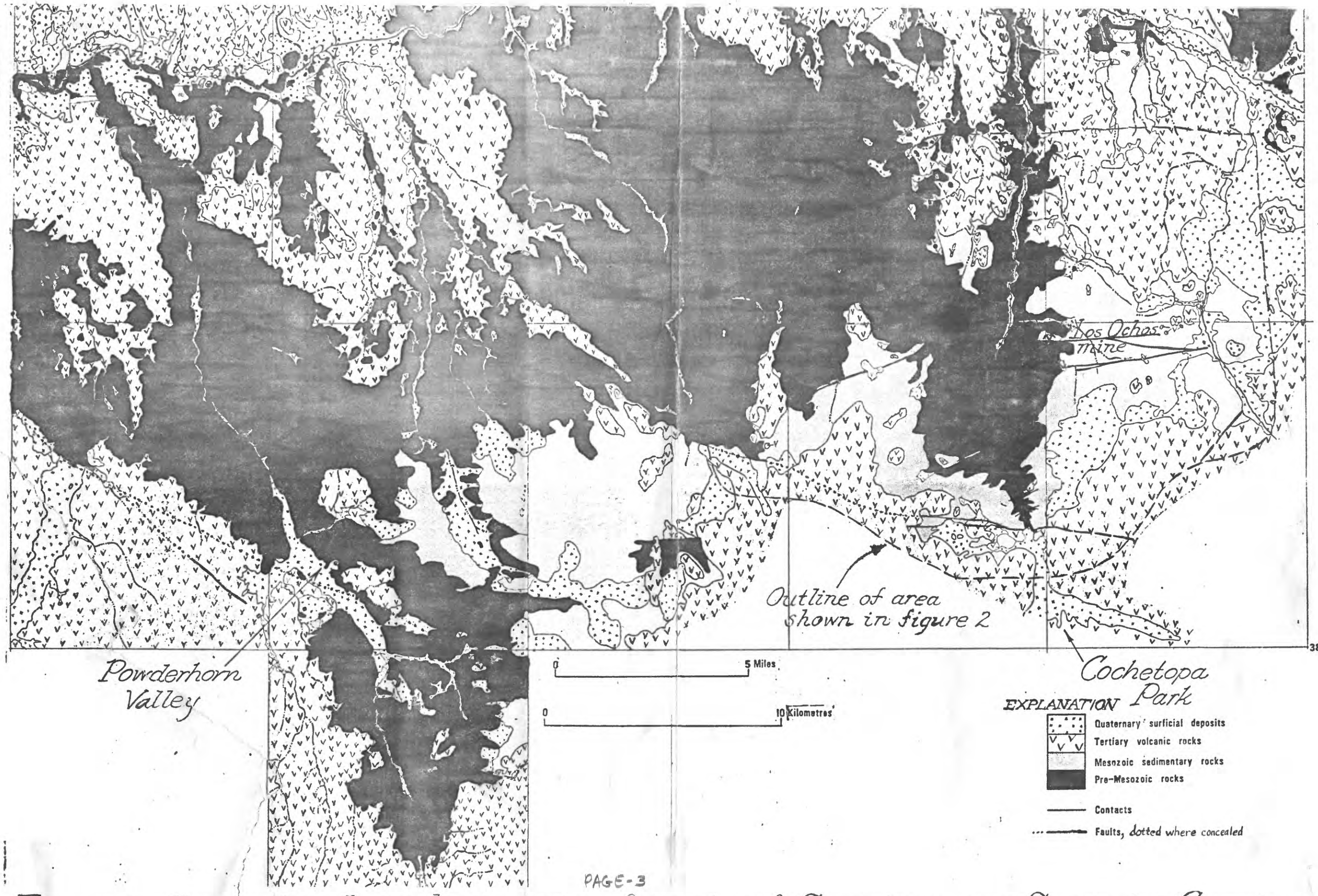

Figure 1. Generalized geologic map of parts of Gunnison and Saguache Counties

The generalized regional geology is shown in figure 1. Eleven 7 1/2-minute quadrangles have been mapped in the area south of Gunnison, which is just off the north central edge of the map. The western part of the area includes the thorium veins and niobium-bearing carbonatite of the Powderhorn district. The Gunnison gold belt, in which sulfide mineral deposits occur in a Precambrian greenstone sequence, extends eastward across the entire area. The Cochetopa uranium district, discussed in this paper, comprises about four quadrangles at the east end of the area.

Throughout the area of figure 1, pre-Mesozoic rocks are overlain by many scattered remnants of Mesozoic sedimentary and Tertiary volcanic rocks. The patchy distribution of Tertiary volcanic rocks provides generally good control for contouring the basement surface (fig. 3) underlying the volcanic rocks.

GENERAL GEOLOGY

The geology of the Cochetopa district is shown on a generalized map in figure 2. Precambrian gneiss and schist and Precambrian granodiorite to quartz monzonite are overlain by the Junction Creek Sandstone of Upper Jurassic age, which is about 1 to 30 metres thick. The Junction Creek and the overlying Morrison Formation, Dakota Sandstone, and Mancos Shale are mapped as one unit in figure 2. Oligocene volcanic rocks comprise older flows and breccias of intermediate composition and younger, more silicic ash-flow tuffs. A few small rhyolite plugs cut the older flows in one area.

Faults in the district have a predominantly east-west trend. The important Los Ochos fault zone strikes eastward in the center of the map, where the Los Ochos mine is indicated. Several other uranium occurrences are indicated by Xs. The Los Ochos fault cuts Mesozoic sedimentary rocks but does not appear to displace the Tertiary volcanics, although some renewed Tertiary movement

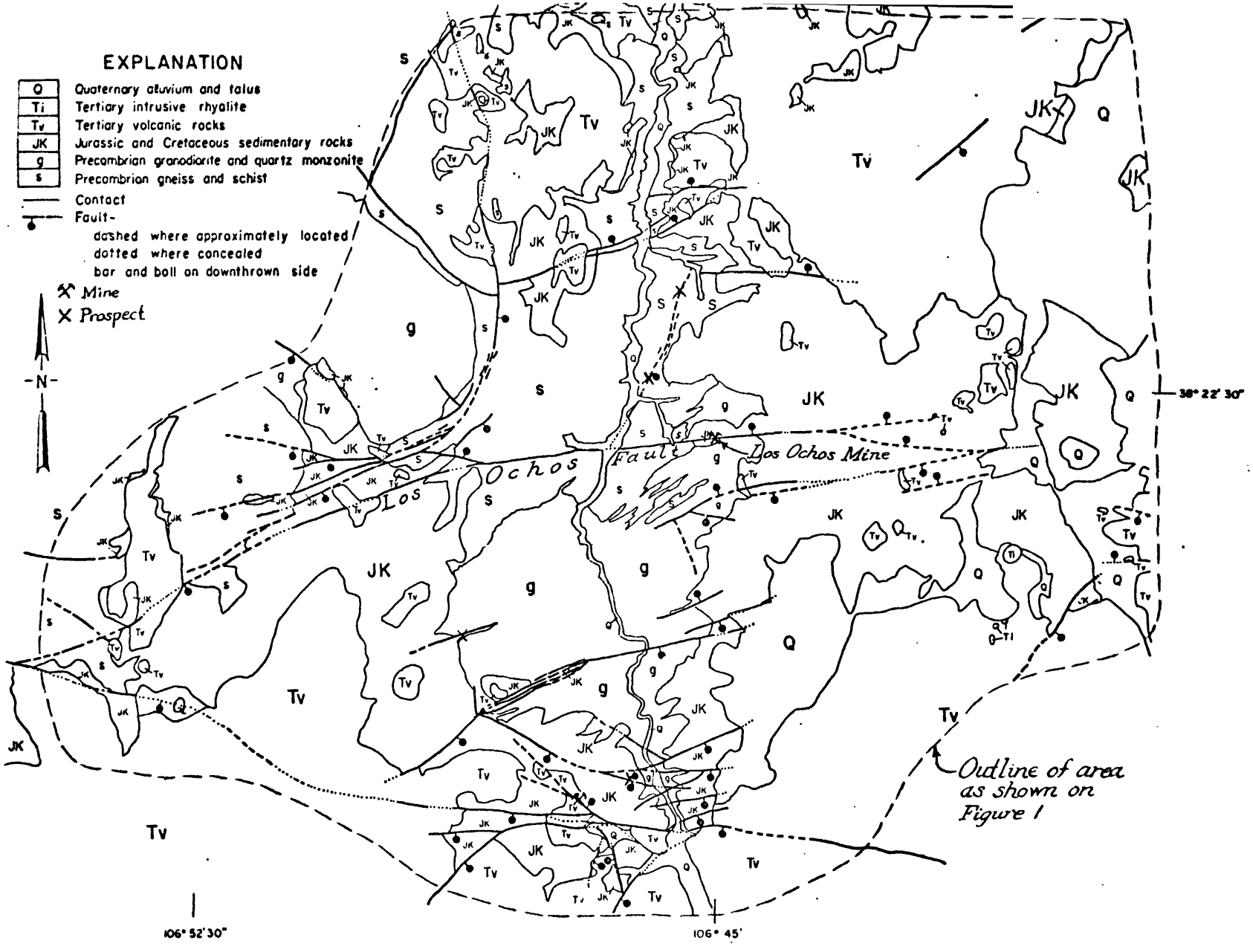

Figure 2. Generalized geologic map of the Cochetopa district, Colorado

is suggested by breccia associated with the ore deposit (Malan and Ranspot, 1959) p. 7). A series of east-west faults in the south center of the map are downthrown to the south, in step-like fashion. These faults adjoin the north margin of the Cochetopa Park caldera, one of the major calderas of the San Juan volcanic field and the eruptive source of some of the ash flows in the district. The Cochetopa Park caldera extends southward from the southernmost fault and is about 20 km in diameter.

The Los Ochos fault zone is well exposed at the main workings and at the west portal of the mine. Precambrian granite and schist form the south wall of the fault; Mesozoic sediments on the north side have been downthrown about 35 to 45 metres. Generally speaking, the ore deposits are irregularly pipelike in shape and occur chiefly in the Junction Creek Sandstone and Morrison Formation. The richest concentrations are in and near the fault zone, but the enrichment does not terminate abruptly northward away from the fault, as some weakly mineralized rock is found as far away as 150 metres. The boundaries of the deposit, therefore, are relatively sharp in places against Precambrian rock but may be irregularly gradational in the sedimentary rocks.

The deposits in the district are rather simple in number of mineral species. The principal minerals in the Los Ochos deposit are pitchblende and its alteration products, marcasite, chalcedony, barite, clay minerals, and quartz. The mineralogy, structure, and other features of the deposits have been discussed in some detail by Malan and Ranspot (1959).

PALEOTOPOGRAPHY AND PALEODRAINAGE

Figure 3 shows 200-foot (61-m) contours drawn on the base of the Oligocene volcanic rocks over the entire region south of Gunnison, including the Powderhorn district to the west. The relief of the area was probably a little less rugged but comparable to that of today. Drainage seems to have been generally northwestward; it probably continued for a considerable distance beyond the area as the volcanic pile of the West Elk Mountains did not yet exist. A major valley probably extended northwestward from the Powderhorn area along the Cimarron fault zone. The contours delineate a composite erosion surface that did not exist at any one time over the entire area, because different volcanic units overlie the surface in different places. Age determinations on similar rocks elsewhere in the San Juan region indicate that the composite erosional surface beneath the volcanics is within the age range of 34 to 26 m.y.

Figure 4 shows only the Cochetopa district, and the prevolcanic surface is depicted by 100-foot contours. The present-day Cochetopa Creek flows northward through the center of the district. Contours, as interpreted here, indicate the paleovalley of an ancient Cochetopa Creek and its tributary drainage pattern. The Los Ochos mine, as well as several other uranium occurrences, is near the bottom of this paleovalley, and all the occurrences shown on the map are within 70 metres vertically of the prevolcanic erosion surface as restored; the occurrences are mostly below the surface, but in several places the tuff just above it is mineralized. Faults of Laramide age, such as the Los Ochos, do not displace the contoured surface appreciably, but toward the south the prevolcanic erosion surface is disrupted by many post-volcanic faults and the paleodrainage features are obscured by the Cochetopa Park caldera.

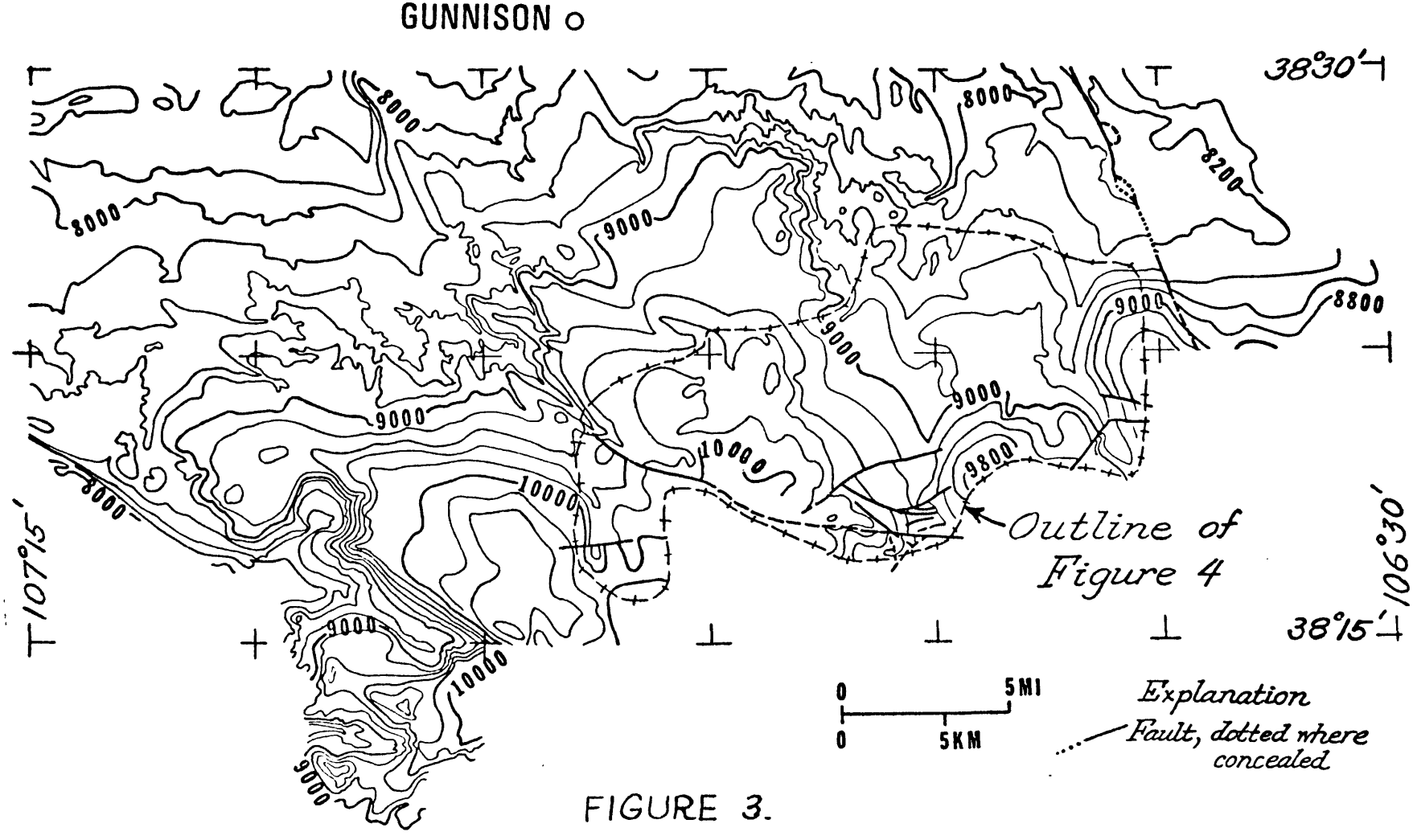

FIGURE 3.

PALEOTOPOGRAPHIC CONTOURS ON SURFACE BENEATH TERTIARY ROCKS IN PARTS OF GUNNISON AND SAGUACHE COUNTIES, COLORADO
CONTOUR INTERVAL 200FT.

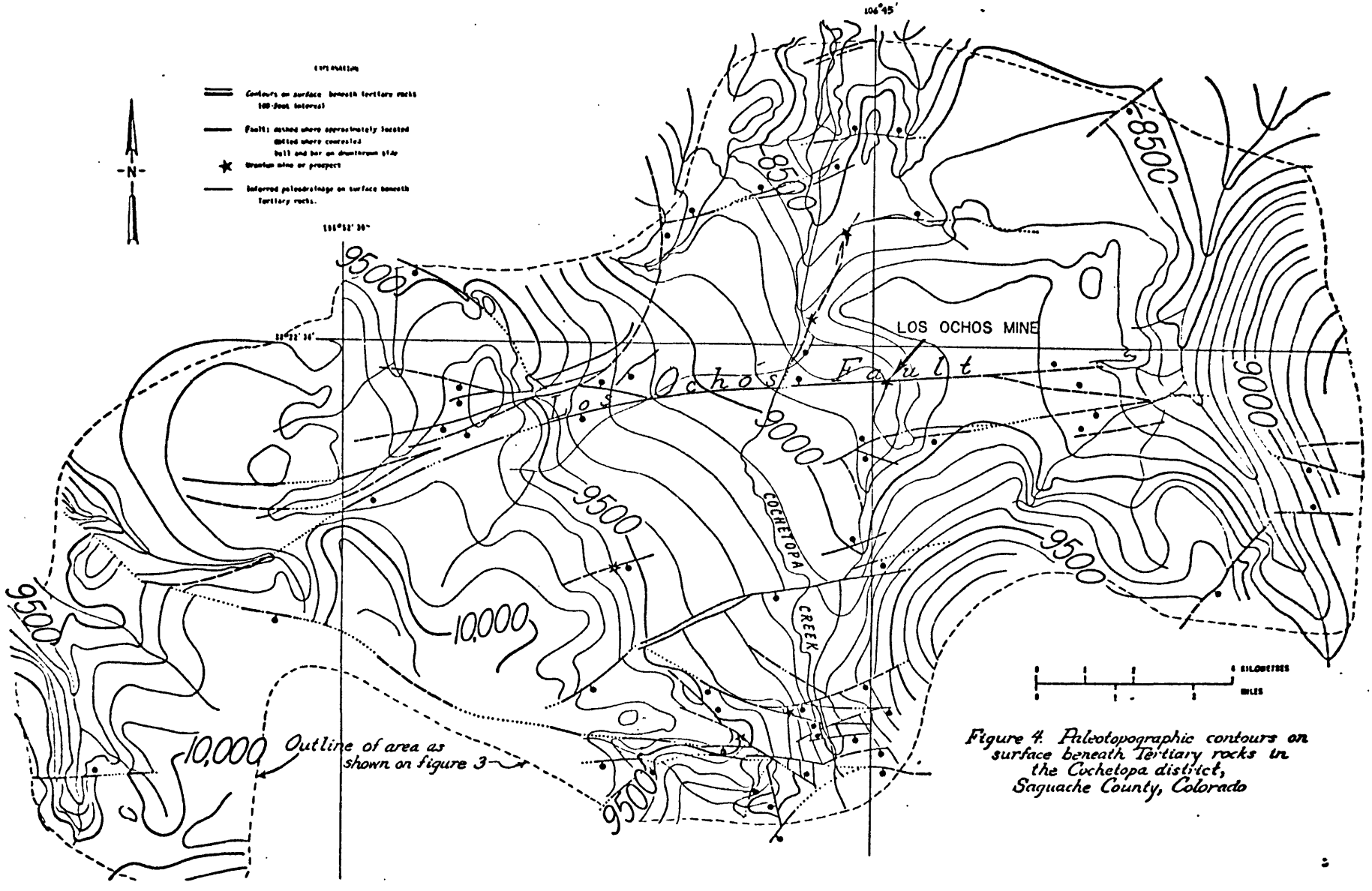

Figure 4. Paleotopographic contours on surface beneath Tertiary rocks in the Cochetopa district, Saguache County, Colorado

Two cross sections (figs. 5 and 6) illustrate the position of ore deposits in relation to the Oligocene erosion surface. Figure 5 shows the bottom of the ancestral Cochetopa valley (restored) and geologic features along its course, projected to a north-south plane. The lowest line represents the projected profile of the bottom of present-day Cochetopa Creek. The dashed line is the bottom of the Oligocene prevolcanic Cochetopa valley; it has largely been eroded away as is shown by the solid line representing the present topography along the inferred bottom of the old valley. Where it crossed the Los Ochos fault zone, the ancestral valley floor is interpreted to have been probably less than 40 metres above the present surface. A trap for ore deposition may have been formed at that point by the fault and the small block of Mesozoic sediments on its north side. Such a trap could have been effective in ore deposition either from hypogene fluids moving up the fault or supergene fluids moving laterally above the erosion surface.

In figure 6, the nearly vertical Los Ochos fault is taken as the plane of the section; the observer looks northward at the fault plane and sees the geology of the north wall of the fault. The plane of unconformity at the base of the Mesozoic rocks, near which the Los Ochos deposits are found, dips at a low angle northeastward. The restored surface at the base of the Oligocene volcanics is shown by a dashed line; the ore deposits are found near the lowest point in that paleotopographic surface, the bottom of the Oligocene valley. If hypogene, the ore-forming fluids might also be expected to rise at other places along the fault zone; hence, the position of the ore at the old valley floor may be more than fortuitous and suggests that the paleodrainage was a factor in ore deposition.

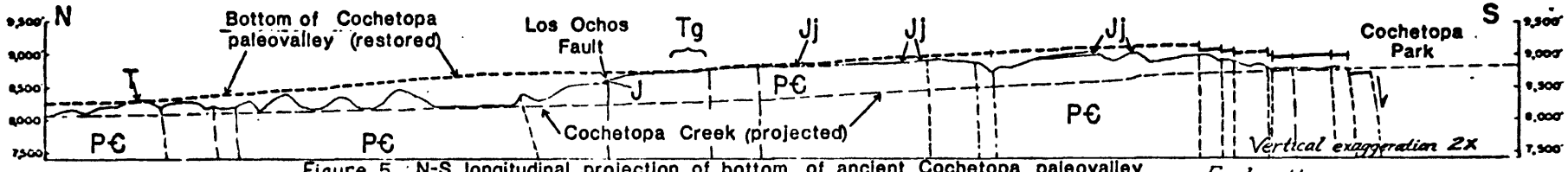

Figure 5. N-S longitudinal projection of bottom of ancient Cochetopa paleovalley and modern Cochetopa Creek

2,000 0 2,000 4,000 6,000 8,000 10,000 12,000 FEET

0 1 2 3 KILOMETRES

Explanation

T *Tertiary volcanic rock*
Tg *Tertiary gravels*
J *Junction Creek Sandstone and Morrison Formation*
Jj *Junction Creek Sandstone*
P€ *Precambrian rock*
⁘ *Uranium deposit (diagrammatic)*

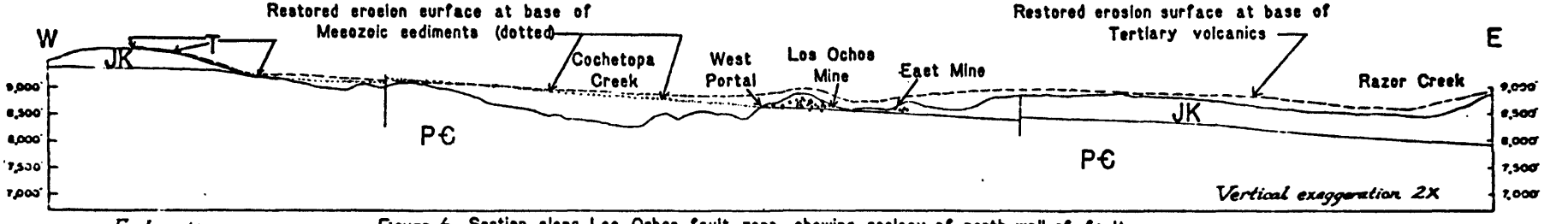

Figure 6. Section along Los Ochos fault zone, showing geology of north wall of fault

2,000 0 2,000 4,000 6,000 8,000 10,000 12,000 FEET

0 1 2 3 KILOMETRES

Explanation

T *Tertiary rocks*
JK *Mesozoic sedimentary rocks*
P€ *Precambrian rocks*
⁘ *Uranium deposit (diagrammatic)*

During Oligocene volcanism, early flows and breccias were mostly of intermediate composition; later ash flows were more silicic. Some ash flows and older lavas remain on the ridge to the west (fig. 6), and the ancient valley may have been filled with volcanic rocks up to at least that level. When the Oligocene topography was blanketed by volcanic rocks, ground waters may possibly have percolated downward to low points in the basement surface where locally favorable conditions caused precipitation of the dissolved uranium.

The surface of the Oligocene volcanic field was constantly subject to erosion, and a new Cochetopa Creek valley became incised in a position about 2 km west of the ancestral valley. The modern canyon of this superimposed stream is about 150-180 metres deep below the rim and deeper than that below the prevolcanic surface. Curiously, if the modern canyon had been cut in the same place as is inferred for the ancestral valley (fig. 6), the Los Ochos uranium deposits would have been eroded away as the canyon deepened.

The spatial associations presented above suggest that old erosion surfaces, such as the Oligocene prevolcanic surface discussed here, may be factors in the formation and localization of some uranium deposits. Although this localization can be interpreted as compatible with hypogene vein-forming processes, it also is favorable to supergene processes, which should therefore be considered in geologic studies and in the search for uranium in similar geologic settings.

REFERENCE

Malan, R. C., and Ranspot, H. W., 1959, Geology of the uranium deposits in the Cochetopa mining district, Saguache and Gunnison Counties, Colorado: Econ. Geology, v. 54, no. 1, p. 1-19.