

**GEOLOGIC MAPS OF THE
UNDERGROUND WORKINGS OF THE
BLACK ROCK AND SALLY URANIUM
MINES, NAVAJO COUNTY, ARIZONA**

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INTRODUCTION

Geologic maps of the underground workings of the Black Rock and Sally uranium mines were recently located in the files of the U.S. Geological Survey (USGS) at the Denver Federal Center. Warren I. Finch of the USGS permitted W.L. Chenoweth to borrow the maps so that copies could be made by the Arizona Geological Survey.

These maps are part of the collection of geologic data moved to the Denver Federal Center by the Department of Energy (DOE). In 1983 the uranium resource and liason programs of the DOE were transferred from Grand Junction, Colo. to Washington D.C. During the next few years all of the geologic data, etc., that the Atomic Energy Commission (AEC), the Energy Research and Development Association (ERDA), and the DOE had collected from 1947 to 1983 was relocated to the USGS in Denver.

Irving B. Gray and Robert Ciesiel were geologists with the Grand Junction Operations Office of the AEC and worked in Monument Valley, Utah and Arizona. During the fall of 1955 and winter of 1955 and 1956, they mapped three uranium mines in San Juan County, Utah on the Holiday and Oljeto mesas and the Harve Black No. 2, Black Rock, and Sally mines in Navajo County, Arizona (Plate 1). The Harve Black No. 2 mine and the mines in San Juan County are described elsewhere (Ciesiel and Gray, 1989; Chenoweth, 1990).

The map of the Harve Black No. 2 mine shows the geology of the underground workings in cross sections. On all of their other maps, Gray and Ciesiel show the geology on outline maps of mine workings. Much of the information presented in this text was obtained when W.L. Chenoweth was employed by the AEC.

LOCATION AND LAND STATUS

Both mines are located on the east side of U.S. 163, 14.2 miles north of the junction of U.S. 163 and U.S. 160 in Kayenta, Ariz. (Figure 1). The portals of the mines are only 800 ft apart (Plate I). On the Mystery Valley topographic map the open pit in the southwestern corner of the map is a trench on the Black Rock property and the labeled prospect is the former portal of the underground workings of the Black Rock mine. The location of the portal of the Sally mine is not shown, but is approximately 800 ft south from the Black Rock portal. The Sally mine has been mislocated on two previously published maps. Young and others (1964) show it one mile southeast of the Black Rock mine, and Scarborough (1981, Plate 7) shows it three miles northeast of the Black Rock mine.

The mines are within the Navajo Indian Reservation. Mining permits and leases are issued by the Navajo Tribal Council and are approved by the Bureau of Indian Affairs, U.S. Department of the Interior. Mining permits can only be obtained by individual Navajos. Permit holders can assign the mining rights to an individual or company. Assignments are also approved by the Tribal Council and the Bureau of Indian Affairs. No more than 960 acres of tribal land can be held by any one company or individual. Both the Tribe and the permittee receive royalties from ore production.

GEOLOGIC SETTING

The Black Rock and Sally mines are in a remnant channel deposit in the Shinarump¹ Member of the Triassic Chinle Formation on the eastern flank of the Oljeto syncline. The rocks dip approximately five degrees to the west into the syncline. The channel, which is scoured into the underlying Moenkopi Formation, is exposed in a cliff that is approximately 2,500 ft southwest of an igneous intrusion known as Black Rock. The channel is approximately 150 ft wide, 30 ft deep, and 5.5 mi long. It is filled with a massive, tan deposit of medium-to-coarse-grained sandstone and conglomerate. The trend of the channel is approximately N 10° W.

During an aerial radiometric survey of Monument Valley by the AEC in 1951, a radioactive anomaly three times greater than the background radioactivity was located on this exposure. The AEC named the channel deposit Dike because of a nearby igneous dike (Cummings, 1952). Witkind and Thaden of the USGS examined the channel exposure in 1952 and renamed it Route 1 (Witkind and Thaden, 1963). They noted some limonite staining on the deposit but no visible uranium-vanadium minerals.

The Black Rock mine was developed approximately 300 ft south of the channel exposure. The host rocks for the uranium deposits, mapped by Gray and Ciesiel, consisted of conglomeratic sandstone and conglomerate that contained between 15 and 40 percent interstitial clay (Plate I). The uranium minerals were also associated with carbonaceous material and petrified logs in the sandstone and conglomerate. The host rocks are completely oxidized, and the mineral autunite, a calcium uranyl phosphate, was reported at the Sally mine (AEC, unpublished notes).

A sample of radioactive rock, collected during the National Uranium Resource Evaluation (NURE) program from the dump of the Sally mine, contained 0.20 percent U₃O₈, 30 ppm vanadium, and 300 ppm copper (Field and Blauvelt, 1982, Appendix C). Scanning electron microscope (SEM) and energy dispersive spectroscopy (EDS) examinations of this sample revealed the mineral metatorbernite, a copper uranyl phosphate (Field and Blauvelt, 1982, Appendix D).

¹When Gray and Ciesiel mapped the Black Rock and Sally mines, they considered the Shinarump Conglomerate to be a formation. It is now considered to be a member of the Chinle Formation. This difference is reflected in the legend on their original map (Plate 1), which uses the old nomenclature, and in the text, which uses the current nomenclature.

PRODUCTION HISTORY

Black Rock Mine

In March 1954, Jack Crank was granted Navajo Tribal Mining Permit No. 103 (MP-103), which covered 155.8 acres and included the channel deposit outcrop. The assignment of the permit's mining rights to Charles L. Spencer and C.C. Mumma of Farmington, New Mexico was approved on April 14, 1954. Spencer and Mumma did a small amount of drilling and located a small orebody approximately 300 ft south of the channel deposit outcrop.

In late 1954, a 110-foot, north-trending decline was driven to reach the orebody. The portal of the decline was in a 160-ft-long trench excavated in the Moenkopi Formation (Plate I). The small mine was named Black Rock due to the nearby igneous plug of that name. In January 1955, Spencer and Mumma made a 36.78-ton shipment to the AEC's ore-buying station in Monticello, Utah. This shipment assayed 0.08 percent U_3O_8 and 0.13 percent V_2O_5 (Table 1). Because the grade of the shipment was below the 0.10 percent U_3O_8 minimum set by the AEC, no payment was received.

West of the underground mine, a small trench was excavated in the Moenkopi Formation to explore the west flank of the channel, but no ore was located. Gray and Ciesiel mapped the Black Rock mine on February 7, 1956, nearly one year after it had been abandoned. The portal of the decline has since been caved shut for safety reasons.

Sally Mine

On February 11, 1955, Mining Permit No. 262 (MP-262), bordering the northwestern side of MP-103 for 40.2 acres, was issued to Alvin Bailey. The assignment of the mining rights to the Texas Mining Company of Austin, Texas was approved on July 15, 1955. Texas Mining drilled 60 holes with an average depth of 50 ft for a total footage of approximately 3,000 ft. This drilling revealed a small orebody south of the Black Rock mine. The orebody, as delineated by drilling, had a thickness ranging from 1 to 5 ft, with an average of 2 ft (AEC, unpublished notes).

A 150-foot, slightly inclined, east-heading drift was started from a trench in the Moenkopi Formation (Plate I). A survey by the Navajo Tribal Mining Department indicated that the portal of the mine was near the northwestern boundary of MP-262 and that the trench was actually on MP-103. The mine originally was named the Alvin Bailey No. 1 but (for some unknown reason) it was changed to Sally.

During August and September 1955, a total of 66.81 tons of ore was shipped to the AEC's ore-buying station in Monticello, Utah. These shipments averaged 0.10 percent U_3O_8 and 0.04 percent V_2O_5 (Table 1). The value of the ore, based on the AEC's Circular 5 (revised) and Circular 6, was \$7.00 per ton, making the total value of the shipment \$467.67, which was not economical. The mine was abandoned in late 1955 and was mapped by Gray and Ciesiel on January 27, 1956. The portal was later caved shut for safety reasons.

Other Mines in the Channel Deposit

Farther to the northwest, but still in the Oljeto syncline, the same channel deposit in the Shinurump Member hosts the Alma-Seegan, Noschoy, and Big Chief mines (Young and others, 1964). These deposits were much larger and produced a total of 41,743.68 tons of ore, averaging 0.22 percent U_3O_8 and 0.96 percent V_2O_5 (Table 2).

ACKNOWLEDGMENTS

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Table 1. Ore production, Black Rock and Sally mines, Navajo County, Arizona.

<u>YEAR</u>	<u>TONS OF ORE</u>	<u>POUNDS U₃O₈</u>	<u>% U₃O₈</u>	<u>POUNDS V₂O₅</u>	<u>% V₂O₅</u>
Black Rock					
1955	36.78	58.64	0.08	95.41	0.13
Sally					
1955	66.81	139.99	0.10	46.93	0.04

Source: Unpublished records, U.S. Atomic Energy Commission, Grand Junction, Colorado office.

Table 2. Other ore production from the Shinarump channel deposit containing the Black Rock and Sally mines, Navajo County, Arizona.

<u>MINE</u>	<u>TONS OF ORE</u>	<u>POUNDS U₃O₈</u>	<u>% U₃O₈</u>	<u>POUNDS V₂O₅</u>	<u>% V₂O₅</u>
Alma-Seegan	6,769.27	25,540.90	0.19	NA	NA
Big Chief	32,833.75	151,221.03	0.23	11,490.45	0.96
Noschoy	<u>2,140.66</u>	<u>7,610.96</u>	<u>0.18</u>	<u>180.78</u>	<u>0.13</u>
TOTAL	41,743.68	184,372.89	0.22	11,671.23	0.96

Note: Vanadium grade calculated on the actual tons analyzed for vanadium oxide.

NA: Not analyzed.

Source: Unpublished records, U.S. Atomic Energy Commission, Grand Junction, Colorado office.

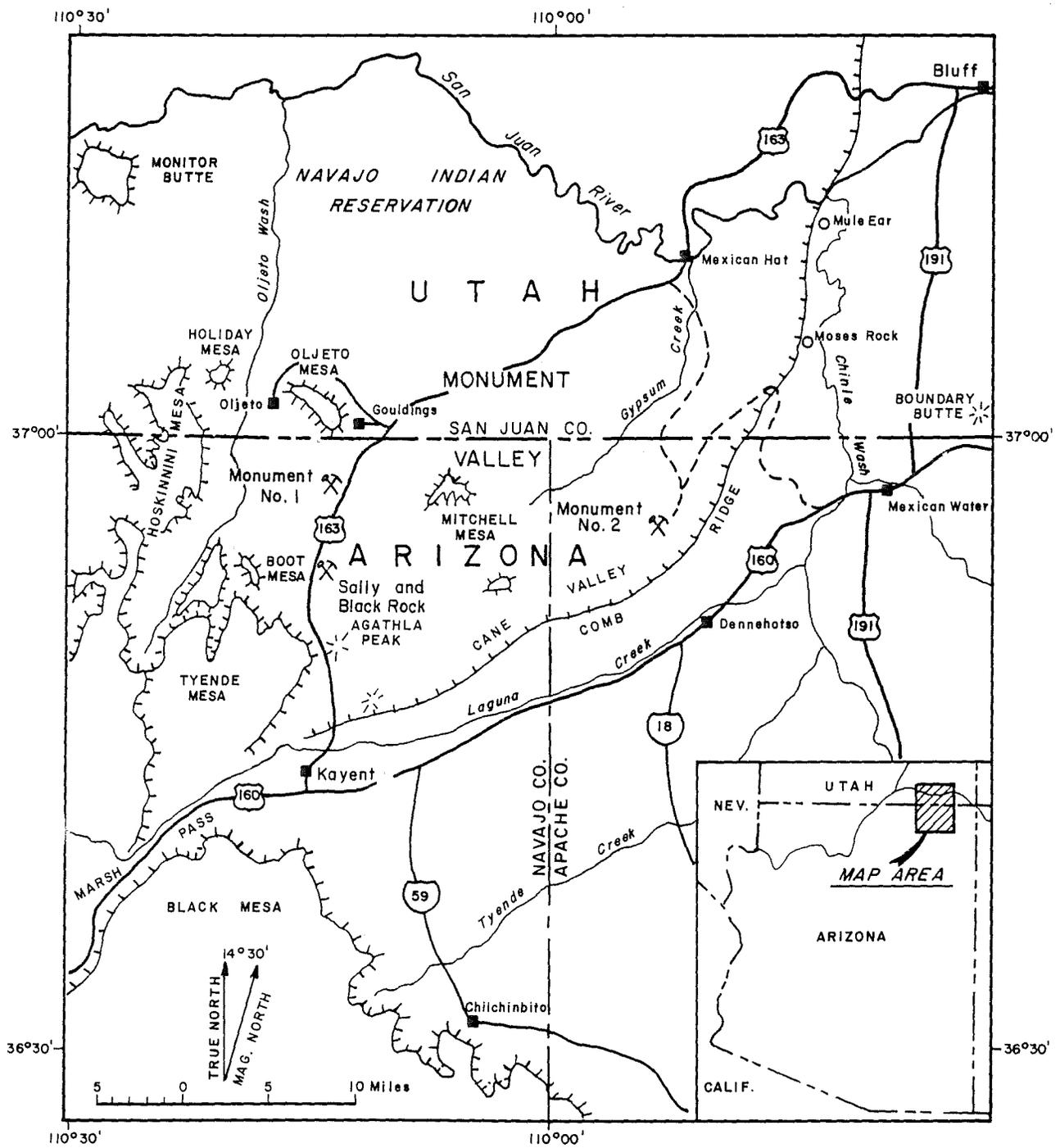


Figure 1. Index map of Monument Valley, Arizona-Utah, showing the location of the Black Rock and Sally uranium mines.