

**MAP AND GEOLOGIC SECTIONS OF  
THE UNDERGROUND WORKINGS  
OF THE MONUMENT NO. 1 AND  
MITTEN NO. 2 URANIUM-VANADIUM  
MINES, NAVAJO COUNTY, ARIZONA**

by  
Charles S. Evensen, Irving B. Gray, John R. Meador and Robert Ciesiel

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Arizona Geological Survey  
**Contributed Report 92-A**  
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416 W. Congress, Suite #100, Tucson, Arizona 85701

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Navajo County, Arizona

## INTRODUCTION

In the mid-1950's, Charles S. Evensen, Irving B. Gray, John R. Meador, and Robert Ciesiel were geologists for the Atomic Energy Commission (AEC) in Grand Junction, Colorado and worked in Monument Valley in Utah and Arizona (Figure 1). Evensen was the Area Geologist for the AEC in Monument Valley. During March and April 1955, these four geologists mapped the Monument No. 1 and Mitten No. 2 uranium-vanadium mines (Figures 2, 3, and 4). Gray and Ciesiel later mapped the Black Rock, Sally, and Harve Black No. 2 uranium mines in Navajo County, Arizona, as well as three mines in San Juan County, Utah on Holiday and Oljeto Mesas. These mines are described elsewhere (Ciesiel and Gray, 1989; Chenoweth, 1991; Gray and Ciesiel, 1991).

In 1983 the uranium resource and liaison programs of the U.S. Department of Energy (DOE) were transferred from Grand Junction to Washington D.C. The geologic data that the AEC, Energy Research and Development Administration (ERDA), and DOE had collected from 1947 to 1983, however, were relocated to the U.S. Geological Survey (USGS) in Denver.

The text of this report is primarily based on information that was obtained when William L. Chenoweth was employed by the AEC. He examined the mines in early 1955, when the mapping project was just getting started. Data on ore production, leasing, and permitting, however, were obtained from the AEC files in Denver, as were copies of the map and geologic sections (Figures 2, 3, 4, and 5).

## LOCATION AND LAND STATUS

The Monument No. 1 and Mitten No. 2 mines are on the western side of a small ridge approximately 17 mi north of Kayenta, Arizona (Figure 1). From U.S. Highway 163, 16.8 mi north of its junction with U.S. Highway 160, the mines may be reached by driving 2 mi west on unimproved dirt trails. The small ridge, called the Monument No. 1 - Mitten No. 2 Mesa, actually contains three mines: the original Monument No. 1 mine at the southern end, the new Monument No. 1 mine in the north-central part, and the Mitten No. 2 mine at the northern end (Figure 5). The 1988 Mystery Valley 7 1/2' topographic map, however, shows the location of only the original Monument No. 1 mine.

An earlier report (Scarborough, 1981, p. 222) does not distinguish between the two Monument No. 1 mines; it identifies the northern mine as the Monument No. 1 mine. It is this mine, the workings of which are connected to those of the Mitten No. 2 mine, that Evensen and others mapped (Figures 2, 3, and 4).

The area is within the Navajo Indian Reservation. All prospecting, exploration, and mining is controlled by the Navajo Tribal Council and the Bureau of Indian Affairs, U.S. Department of the Interior.

## GEOLOGIC SETTING

The Monument No. 1 - Mitten No. 2 Mesa, which rises about 30 ft above the valley floor, is a remnant of a channel deposit in the basal Shinarump Member of the Triassic Chinle Formation. The axis of this channel is near the western edge of the mesa. The channel sediments fill a scour, which has a relief of about 50 ft, that has been cut into the underlying Moenkopi Formation. The mesa is on the eastern flank of the Oljeto syncline; the beds strike about N. 20° W. and dip about 3° SW.

No information exists on the geology of the original Monument No. 1 mine because the portals were blasted shut before the AEC and USGS began uranium investigations in Monument Valley. The orebody, however, was probably similar to those of the Monument No. 1 North and Mitten No. 2 mines.

Evensen and others indicated that the better grade ore in the Monument No. 1 North and Mitten No. 2 mines was associated with argillaceous conglomerate, conglomerate, and coarse-grained sandstone

(Figures 2, 3, and 4). Near station B on cross-section B-B' and station E' on cross-section E-E' (Figures 2, 3, and 4), their mapping showed that ore extended downward into altered (bleached) mudstone of the underlying Moenkopi Formation. These areas are on the eastern flank of the channel. Notes in the AEC files stated that the ore ranged from 1 ft to 18 ft in thickness and averaged about 7 ft.

Fossil logs were mapped in abundance, especially in the southern part of the Monument No. 1 North mine. Most were silicified and slightly flattened. Some were up to 10 ft long and up to 4 ft in diameter. Some smaller logs were coalified. Detrital plant material was common in the channel-fill sediments.

Evensen and others completed their mapping of the Monument No. 1 North and Mitten No. 2 mines in April 1955. The following month, Irving J. Witkind and Robert H. Morris of the USGS began a detailed study of the mines. This work is summarized in a USGS bulletin by Witkind (1961).

Witkind (1961) recognized three lithologic units in the basal channel fill: trash-pocket conglomerate, silica-cemented sandstone, and calcite-cemented sandstone. Only the trash-pocket conglomerate and the silica-cemented sandstone contained ore minerals. Lenses of the calcite-cemented sandstone were enclosed within the orebody.

The uranium-vanadium minerals were disseminated throughout the conglomerate, conglomeratic sandstone, and sandstone. They filled voids and interstitial pore spaces, coated grains and pebbles, and filled fractures. Coalified logs were also impregnated with ore minerals (Witkind, 1961).

Witkind (1961) made a detailed study of the mineralogy of the Monument No. 1 and Mitten No. 2 mines. The following description is summarized from his report. Weakly oxidized minerals, such as coffinite, doloresite, corvusite, and roscoelite, formed the core of the orebody. A surrounding zone consisted of moderately oxidized minerals, predominantly corvusite, rauvite, hewettite, autunite, and tyuyamunite. An outer zone of strongly oxidized minerals contained carnotite, hewettite, meta-tyuyamunite, rauvite, tyuyamunite, and volborthite.

The copper minerals azurite, chrysocolla, and malachite were locally common. Chalcocite, which was contained in detrital plant material, was rare (Witkind, 1961). Pyrite was common, but was primarily altered to limonite. Galena was rare (Witkind, 1961).

## LAND-ACQUISITION AND PRODUCTION HISTORY

### Early Mining Activities and Leasing Regulations

The Navajo Indians reportedly used carnotite as a pigment in their sand paintings long before Gregory (1917, p. 50 and 148) first reported the presence of a uranium-vanadium mineral, probably carnotite, in the Shinarump conglomerate and petrified wood of the Chinle Formation in Monument Valley. Butler and Allen (1921, p. 19) mentioned that Ben S. Wilson, a prospector from Casa Grande, Arizona, and Frank Hess of the USGS examined carnotite deposits discovered by John Wetherill of Kayenta, Arizona. They also stated that persons from Colorado were investigating the carnotite deposits near Kayenta when Wilson and Hess were there.

Witkind (1961, p. 221) noted that vanadium was produced at the Monument No. 1 mine in the 1940's, but gave no details. A report by the Indian Trust Accounting Division of the General Services Administration (GSA) gives precise details on pre-1947 mining on the Navajo Indian Reservation. This document (GSA, 1981) was admitted as evidence in U.S. Claims Court, Navajo Tribe vs. United States, Dockets 69 and 299 (copper, vanadium, uranium, sand, rock, and gravel claims), during a hearing held in Albuquerque, New Mexico from February 24 to March 4, 1983. Information on early mining activities was obtained from this document (GSA, 1981); details on leasing regulations on the Navajo Indian Reservation are taken from a report (DeVoto and Huber, 1982) that was prepared for this case.

The Navajo Indian Reservation was closed to prospecting and mining until 1919. A congressional act of June 30, 1919 opened the Navajo Reservation to prospecting and locating mining claims in the same manner as prescribed by the U.S. Mining Law. This act allowed prospectors to enter the reservation and stake a mining claim if they discovered promising evidence of mineralization. The locator of the claim then obtained a lease on this land under terms that included escalating advance royalties and rentals, as well as annual work commitments.

During the early 1920's, three leases for carnotite mining and one for copper mining in the Carrizo Mountains were granted by the U.S. Department of the Interior, but there is no record of mining leases in Monument Valley. On March 25, 1936, the Secretary of the Interior, at the request of the Navajo Tribal Council, closed the Navajo Indian Reservation to prospecting and locating claims until further authorization.

The Navajo Indian Reservation was again opened to mining by a congressional act of May 11, 1938, but with new procedures. This act gave the Navajo Tribal Council the authority to enter into leases for reservation land, with the approval of the Secretary of the Interior. Prospectors could no longer enter the reservation and stake a mining claim under regulations similar to those of the U.S. Mining Law. The new regulations contained escalating annual rentals, a base royalty of 10% (mine mouth value), bond requirements, acreage limitations, and a term of 10 years, which could be extended if production occurred.

On April 9, 1941, the Navajo Tribal Council asked the Secretary of the Interior to lease lands for mining purposes to the highest bidder. Leases could be written for a specific parcel of land or for a larger area, which could be reduced in size after a specified period. As a result of this action, mining companies had to request public lease sales for lands in which they were interested.

During the 1940's, four leases were issued in Monument Valley: Monument Nos. 1, 2, and 3 and Utah No. 1 (Figure 1). Only the Monument No. 1 lease is applicable to this report. Details of the other three are given in a previous report (Chenoweth, 1985).

### The Vanadium Market

By the mid-1930's, the mines in the carnotite region of southwestern Colorado and southeastern Utah were being reopened for their vanadium content. At the same time, the Secretary of the Interior was asked to open the Navajo Indian Reservation for prospecting and mining.

When the United States entered World War II, the need for vanadium for the steel industry greatly increased. Due to the uncertainty of foreign supplies and the need for vanadium for armaments, the Federal government formed the Metals Reserve Company (MRC) in December 1941. This agency, which was part of the Reconstruction Finance Corporation, began an ore-purchasing program and increased the base price paid for vanadium ore.

A vanadium mill was constructed at Monticello, Utah. Funding was provided through the government's Defense Plant Corporation. The plant was operated by Vanadium Corporation of America (VCA) for MRC. Actual construction started in February 1942; on August 24, the first vanadium was produced (Albrethsen and McGinley, 1982, p. 92).

In April 1942, while construction was under way, MRC established an ore-buying station at Monticello and appointed the U.S. Vanadium Corporation (USV) as its buying agent. All ore producers (VCA, USV, and independents) sold ore to MRC. MRC, in turn, sent the ore to the VCA mill at Monticello. MRC closed the Monticello mill in February 1944 when the government had acquired adequate vanadium stocks.

### Monument No. 1 Mine

The government subsidies for vanadium renewed interest in the carnotite deposits of Monument Valley. On October 1, 1942, the Office of Indian Affairs, U.S. Department of the Interior, advertised a lease sale for carnotite and related minerals for a 20.66-acre parcel known as the Combination Lode Claim, which was surveyed by U.S. Mineral Surveyor, A.L. Kroeger. The claim was about 17 mi north of Kayenta in Navajo County, Arizona. It is very possible that this claim covered the original discovery by John Wetherill.

When the bids were opened on October 22, 1942, three bidders had sent offers: VCA, Naturita, Colorado; Bill Barlow, Dove Creek, Colorado; and Root, Norton, and Ashack, Durango, Colorado. VCA was the highest bidder with a bonus bid of \$739.83 (GSA 1981, exhibit 36).

Lease I-149-IND-5869 with VCA was executed on November 4, 1942 and became effective on December 21, 1942 for 10 years. The lease was named Monument No. 1 by VCA.

VCA began underground mining at the mineralized outcrop on the southern end of the Shinarump-capped mesa (Figure 5). Shipments to the MRC ore-buying station at Monticello began in December 1942 and continued through February 1944, when the station and mill were closed. The MRC program ended in March 1944, at which time vanadium mining all but ceased on the Colorado Plateau.

In 1945, VCA leased the Monticello mill from the Defense Plant Corporation and purchased the remaining stockpiles from MRC. VCA processed the stockpiled ore, plus ore from other sources, until the mill was closed again in 1946 (Albrethsen and McGinley, 1982, p. 92). Shipments from the Monument No. 1 mine resumed in October 1945 and continued through January 1946.

During the 38 months that the mine was producing, a total of 3,524.69 tons of ore, with an average grade of 1.94%  $V_2O_5$ , was extracted from the underground mine at the southern end of the mesa (Figure 5; Table 1). The value of this ore was reported at \$54,619.48, of which the Navajo Tribe received \$5,011.66 in royalties (GSA, 1981, p. 49).

At the Monticello mill, MRC and later VCA secretly recovered uranium oxide from the ores. This uranium was sold to the U.S. Army's Manhattan Engineer District (MED) for use in the first atomic bombs (Albrethsen and McGinley, 1982). Shipments from the Monument No. 1 mine contained an estimated 29,738 pounds of  $U_3O_8$  (Chenoweth, 1988).

### The AEC Program

On January 1, 1947, the AEC was created to take over the work of the MED. The AEC continued to procure uranium concentrates on the Colorado Plateau, as the MED had done. On May 28, 1947 the AEC signed a contract with VCA to purchase uranium concentrates from VCA's Naturita mill (Albrethsen and McGinley, 1982). This contract was followed by contracts with other vanadium mills in western Colorado. The price schedules, bonuses, haulage allowances, and vanadium payments that the AEC established were strong incentives to explore for and produce uranium. By the 1950's, the first uranium boom was under way.

The Monument No. 1 mine was reopened during the summer of 1948 for the production of uranium and vanadium. Ore was shipped to VCA's mill at Naturita from July through October 1948 and in January and February 1949. During April and May 1949, 50 tons were shipped to the AEC ore-buying station at Monticello. From April through June 1950, shipments were made to VCA's mill at Durango.

During the 11 months that the mine produced ore, 610.77 tons averaging 0.20%  $U_3O_8$  and 1.21%  $V_2O_5$  were shipped to mills or ore-buying stations (Table 2). In the summer of 1950, the mine was abandoned and the portals were blasted shut. When the site was visited by George Bain of Amherst College in the summer of 1952, he noted that Navajo miners were reopening the mine (Bain, 1952, p. 35). No shipments, however, were recorded by the AEC. Lease I-149-IND-5869 was allowed to expire on December 21, 1952, after being in effect for 10 years.

### New Regulations

In response to uranium prospectors, the Navajo Tribal Council adopted in 1950 a series of resolutions to regulate prospecting and mining on the reservation. All prospectors, both Navajos and non-Navajos, were required to obtain a prospecting permit. Once a discovery was made, only a Navajo could apply for a mining permit; the permit holder, however, was allowed to assign his mining rights to a company or individual. Mining permits were valid for 2 years and could be renewed for an additional 2 years. The maximum amount of land an individual Navajo or company could hold was 960 acres. Drilling and exploration permits, issued for 120 days, were not renewable. Both mining permits and assignment of mining rights had to be approved by the Bureau of Indian Affairs (formerly the Office of Indian Affairs), U.S. Department of the Interior. Initially, mining permits were not numbered; however, because prospecting activities and new discoveries burgeoned, the Navajo Tribal Mining Department began numbering permits in 1952.

## Monument No. 1 Mine North

On April 10, 1953, Cecil Parrish, Jr. of Oljeto, Utah was issued Navajo Tribal Mining Permit (MP) 77, which covered the same 22.66 acres as the former VCA lease. The assignment of the mining permit to Charles Ashcroft, Sr. and J.L. Foutz of Farmington, New Mexico was approved on July 22, 1953. In October 1953, Ashcroft and Foutz shipped 28.4 tons of ore averaging 0.14%  $U_3O_8$  and 0.95%  $V_2O_5$  to the AEC ore-buying station at Shiprock, New Mexico. This ore was reportedly produced from clean-up mining near the portal of the old VCA mine (Table 2).

During January 1954, the AEC drilled 25 holes with a total footage of 805.5 ft on MP-77 (Anthony, 1955). This drilling occurred in the area between the old mine and the northern boundary of the permit. The holes were drilled on 30-ft centers in fences across the channel. The southern fences were 50 ft apart; the northern fences were 100 ft apart (Anthony, 1955). All of the holes encountered mineralized rock; four holes in the southernmost fences penetrated ore-grade material (at least 1 ft of 0.20%  $U_3O_8$ ).

Ashcroft and Foutz contracted with the Texas Mining Company to do additional drilling in the northern part of the permit area. This drilling was highly successful, and a new orebody was located that extended from MP-77 to MP-15.

A new drift was started on the western rim of the mesa, approximately 1,000 ft north of the portal of the old VCA mine (Figure 5). Beginning in mid-1954, ore was shipped to the AEC ore-buying stations at Monticello and Shiprock. Ashcroft and Foutz continued to ship ore to Monticello until early 1956. Shipments in late 1956, however, were made by Copper Canyon Mining Industries, Inc., a company formed by Ashcroft and Foutz. When mining ceased in late 1956, Ashcroft and Foutz had produced 28,941.31 tons of ore with an average grade of 0.30%  $U_3O_8$  and 1.41%  $V_2O_5$  (Table 3). Copper Canyon Mining Industries canceled its mining assignment in early 1957, and the permit expired in April 1957.

In April 1960, Tom Holliday and Cecil Parrish, Jr. were issued MP-543. This permit covered the same 31.66 acres included in Parrish's previous permits (MP-15 and MP-77), as well as 32.14 acres included in a permit formerly held by Tom Holliday on Little Oljeto Mesa in San Juan County, Utah (Chenoweth, 1991). The assignment of the mining rights to the A and B Mining Company of Moab, Utah was approved in September 1960. One of the conditions of approval was that mining would be restricted to the western side of the mine near the two portals (Figure 5). The Navajo Tribal Mining Department considered the central part of the mine to be too dangerous because of unstable ground and caving. A and B canceled its assignment in late 1961, and MP-543 expired in April 1962. There is no record of ore shipments from the Monument No. 1 North mine during the time it was held by MP-543.

On June 24, 1964, MP-592 was issued to Tom Holliday and Cecil Parrish Jr. This permit covered the same 63.8 acres as the former MP-543. The mining rights to this permit were assigned to A and B Mining Company on August 7, 1964. The same conditions that applied to MP-543 applied to MP-592. A and B began some clean-up mining in September 1964 and shipped 27.31 tons of ore averaging 0.19%  $U_3O_8$  and 1.24%  $V_2O_5$  to the Kerr-McGee Oil Industries, Inc. mill at Shiprock in October. Kent Johnson, a contractor for A and B, shipped 45.9 tons to Shiprock in May and June 1965, and Don Tripp, another contractor, shipped 43.25 tons to Shiprock in April 1966. Shipments by A and B and its contractors totaled 116.46 tons of ore, which averaged 0.16%  $U_3O_8$  and 0.99%  $V_2O_5$  (Table 3). A and B canceled its assignment in May 1966, and the mining permit expired in June 1966. Total production from the Monument No. 1 North mine during the period 1954-66 was 29,057.77 tons of ore, which averaged 0.30%  $U_3O_8$  and 1.41%  $V_2O_5$  (Table 3).

## Mitten No. 2 Mine

In the fall of 1950, Charles Keith of Oljeto apparently obtained an unnumbered mining permit covering the area north of the VCA lease. Bob Lyman of Blanding, Utah, a contractor for Keith, rim stripped an area on the northern point of the mesa (Figure 5). Shipments to the AEC ore-buying station at Monticello commenced in September 1950 and continued to April 1951. The reported origin of these shipments was "Jacks mine" in Monument Valley, Utah. An examination by Sheridan (1950), however, confirmed that the ore was being mined in Arizona at the northern end of the mesa on which VCA's

Monument No. 1 mine was located. Keith produced 597.60 tons of ore, which averaged 0.17%  $U_3O_8$  and 0.16%  $V_2O_5$  (Table 4).

On April 26, 1952, Cecil Parrish, Jr. was granted MP-15. This large permit covered the Mitten No. 1 and Mitten No. 3 tracts on Oljeto and Holiday Mesas, respectively, in Utah, as well as the Mitten No. 2 tract in Arizona (Chenoweth, 1991). The Mitten No. 2 tract of 11 acres was contiguous with the northern boundary of the VCA lease and covered the unleased portion of the Shinarump-capped mesa (Figure 5). The mining rights to this permit were assigned to J.L. Foutz on May 9, 1952, but the assignment was not approved by the Navajo Tribal Council and the Bureau of Indian Affairs until October 1, 1952.

Foutz drove a short drift into the mineralized Shinarump Member in the area where Charles Keith had formerly mined (Figure 5). In October 1952, an 80.55-ton shipment was made to the AEC ore-buying station at Shiprock. This shipment averaged 0.15%  $U_3O_8$  and 0.38%  $V_2O_5$  and reportedly contained mineralized fossil logs, many of which were petrified. The shipment was made under Parrish's name because Foutz' mining rights had not yet been approved.

In the spring of 1954, exploration drilling discovered an orebody on the Mitten No. 2 tract. This orebody was an extension of the ore that was found on MP-77. A new drift was started on the western side of the mesa about 350 ft north of the new mine on MP-77. The portal was on the boundary that was common to both permits (Figure 5). Foutz began ore shipments to the Shiprock station in the summer of 1954 and continued until early 1956. Final shipments in 1956 were made by Copper Canyon Mining Industries, Inc. to the Monticello ore-buying station. When mining ceased in mid-1956, Foutz and Copper Canyon had produced 7,193.44 tons of ore that averaged 0.31%  $U_3O_8$  and 1.30%  $V_2O_5$  (Table 4). The assignment of the mining permit was canceled in 1957, and the permit expired in April 1958.

As previously stated, MP-543, issued to Tom Holliday and Cecil Parrish, Jr. in April 1960 and assigned to A and B Mining Company, also covered the Mitten No. 2 mine (former permit MP-15). A and B began shipping ore to Monticello in late 1960 and continued until early 1961. A total of 887.11 tons was shipped to the Texas Zinc Minerals mill at Mexican Hat, Utah in 1960, which did not pay for or recover vanadium. The Mexican Hat plant, however, did pay for and recover copper in uranium ores. No information on the copper content of these shipments could be located. When A and B ceased mining in 1961, it had shipped a total of 1,561.46 tons of ore that averaged 0.21%  $U_3O_8$ . Shipments analyzed for vanadium averaged 1.10%  $V_2O_5$  (Table 4). This ore came from clean-up mining near the mine portal (Figure 5). Much of the ore that A and B identified as Mitten No. 2 shipments came from the area covered by the old Monument No. 1 permit. A and B canceled its assignment in late 1961, and the permit expired in April 1962. Although the Mitten No. 2 mine was controlled by A and B Mining Company in 1964-66 by the assignment of the mining rights to MP-592, no ore was shipped. Total production from the Mitten No. 2 tract during the period 1950-61 was 9,433.05 tons of ore, which averaged 0.28%  $U_3O_8$  and 1.19%  $V_2O_5$  (Table 4.)

## SUMMARY

The channel-fill sediments of the Shinarump Member of the Chinle Formation that form Monument No. 1 - Mitten No. 2 Mesa have been very productive for uranium and vanadium. Orebodies in this 1,750-foot-long channel remnant have produced a total of 42,654.68 tons of ore, which averaged 0.31%  $U_3O_8$  and 1.40%  $V_2O_5$  (Table 5). With the exception of the huge Monument No. 2 deposit (773,132 tons of ore averaging 0.34%  $U_3O_8$  and 1.42%  $V_2O_5$  in 7,000 feet of channel), the Monument No. 1 - Mitten No. 2 channel segment represents the largest concentration of oxidized uranium and vanadium minerals in Monument Valley.

## ACKNOWLEDGMENTS

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**Table 1.** Early vanadium ore production, Monument No. 1 mine (south), Navajo County, Arizona.

Year	Tons of Ore	Pounds U <sub>3</sub> O <sub>8</sub>	%U <sub>3</sub> O <sub>8</sub>	Pounds V <sub>2</sub> O <sub>5</sub>	%V <sub>2</sub> O <sub>5</sub>	Shipper
1942	76.57	NA	---	3,883.00	2.52	VCA
1943	2,261.42	NA	---	86,017.65	1.90	VCA
1944	940.09	NA	---	37,308.93	1.98	VCA
1945	227.73	NA	---	8,984.00	1.97	VCA
1946	18.88	NA	---	603.00	1.59	VCA
TOTAL	3,524.69	29,738.00 <sup>1</sup>	0.42 <sup>1</sup>	136,796.58	1.94	

Source: GSA (1981, p. 43-49 of appendix).

<sup>1</sup> Uranium content estimated by Chenoweth (1988).

**Table 2.** Uranium-vanadium ore production, Monument No. 1 mine (south), Navajo County, Arizona.

Year	Tons of Ore	Pounds U <sub>3</sub> O <sub>8</sub>	%U <sub>3</sub> O <sub>8</sub>	Pounds V <sub>2</sub> O <sub>5</sub>	%V <sub>2</sub> O <sub>5</sub>	Shipper
1948	237.24	1,093.00	0.23	7,916.00	1.67	VCA
1949	120.28	364.07	0.15	2,171.41	0.90	VCA
1950	253.25	1,026.00	0.20	4,704.00	0.93	VCA
1953	28.40	79.51	0.14	539.51	0.95	Ashcroft & Foutz
TOTAL	639.17	2,562.58	0.20	15,330.92	1.20	

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

**Table 3.** Uranium-vanadium ore production, Monument No. 1 mine (north), Navajo County, Arizona.

Year	Tons of Ore	Pounds U <sub>3</sub> O <sub>8</sub>	%U <sub>3</sub> O <sub>8</sub>	Pounds V <sub>2</sub> O <sub>5</sub>	%V <sub>2</sub> O <sub>5</sub>	Shipper
1954	9,130.90	65,827.42	0.36	298,126.99	1.63	Ashcroft & Foutz
1955	17,826.11	100,458.88	0.28	465,442.25	1.31	Ashcroft & Foutz
1956	937.29	4,587.83	0.24	24,196.18	1.29	Ashcroft & Foutz
1956	1,047.01	5,157.33	0.25	27,558.68	1.32	Copper Canyon Mining
1964	27.31	104.89	0.19	677.00	1.24	A & B Mining
1965	45.90	161.70	0.18	853.00	0.93	A & B Mining
1966	43.25	117.38	0.14	769.00	0.89	A & B Mining
TOTAL	29,057.77	176,415.43	0.30	817,623.10	1.41	

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

**Table 4.** Uranium-vanadium ore production, Mitten No. 2 mine, Navajo County, Arizona.

Year	Tons of Ore	Pounds U <sub>3</sub> O <sub>8</sub>	%U <sub>3</sub> O <sub>8</sub>	Pounds V <sub>2</sub> O <sub>5</sub>	%V <sub>2</sub> O <sub>5</sub>	Shipper
1950	380.78	1,359.00	0.18	1,332.11	0.17	Charles Keith
1951	216.82	656.30	0.15	623.51	0.14	Charles Keith
1952	80.55	240.20	0.15	610.58	0.38	Cecil Parrish, Jr.
1954	3,974.23	27,581.48	0.35	115,312.44	1.45	J.L. Foutz
1955	2,821.98	14,839.51	0.26	63,186.72	1.12	J.L. Foutz
1956	62.90	251.61	0.20	1,207.75	0.96	J.L. Foutz
1956	334.33	1,651.65	0.25	6,953.49	1.04	Copper Canyon Mining
1960	437.78	2,079.46	0.24	10,069.00	1.15	A & B Mining
1960	887.11 <sup>1</sup>	3,360.71	0.19	---	---	A & B Mining
1961	236.57	1,158.15	0.24	4,713.00	1.00	A & B Mining
TOTAL	9,433.05	53,178.07	0.28	204,008.60	1.19	

<sup>1</sup> Shipments to the Mexican Hat, Utah mill were not analyzed for vanadium.

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

**Table 5.** Summary of uranium-vanadium ore production, Monument No. 1 - Mitten No. 2 Mesa, Navajo County, Arizona.

Mine	Tons of Ore	Pounds U <sub>3</sub> O <sub>8</sub>	%U <sub>3</sub> O <sub>8</sub>	Pounds V <sub>2</sub> O <sub>5</sub>	%V <sub>2</sub> O <sub>5</sub>
Monument No. 1 (early, south)	3,524.69	29,738.00	0.42	136,796.58	1.94
Monument No. 1 (south)	639.17	2,562.58	0.20	15,330.92	1.20
Monument No. 1 (north)	29,057.77	176,415.42	0.30	817,623.10	1.41
Mitten No. 2	9,433.05	53,178.07	0.28	204,008.60	1.19
TOTAL	42,654.68	261,894.07	0.31	1,173,759.20	1.40

Source: Unpublished records, U.S. Atomic Energy Commission, Grand Junction, Colorado and GSA (1981).