

**THE GEOLOGY AND PRODUCTION HISTORY OF THE
URANIUM-VANADIUM DEPOSITS IN MONUMENT VALLEY
SAN JUAN COUNTY, UTAH**

by

*William L. Chenoweth
Consulting Geologist
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**CONTRACT REPORT 91-4
UTAH GEOLOGICAL AND MINERAL SURVEY
a division of
UTAH DEPARTMENT OF NATURAL RESOURCES**

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A B S T R A C T

The uranium-vanadium deposits in Monument Valley, San Juan County, Utah, occur in channels of the Shinarump Member of the Triassic Chinle Formation that were incised into the underlying Moenkopi Formation and subsequently filled with fluvial sediments. During the years 1944 through 1966, a total of 54,033.14 tons of ore containing 322,802.07 pounds of uranium oxide (U_3O_8) averaging 0.30 percent U_3O_8 was produced from 13 properties. These ores also contained 532,738.86 pounds of vanadium oxide (V_2O_5), and an unknown amount of copper. With the exception of a 51 ton shipment of high-grade ore made in 1944, all of the uranium and most of the vanadium was purchased by the U.S. Atomic Energy Commission. Nearly 51 percent of the uranium was produced from a single channel that extends from Rock Door Mesa westward through Oljeto Mesa and , to Holiday Mesa. An additional 49 percent of the uranium came from separate channels on Atene Mesa and on the northeast side of Monitor Butte. By 1966, all of the economic ore had been mined out and the mines have become inactive since that time. The channel trends are well known and well explored. The probability of new discoveries in the future is poor.

I N T R O D U C T I O N

Location

The Monument Valley mining area is in the southern portion of the Monument Upwarp in the west-central part of the Colorado Plateau. The name of the mining area is derived from Monument Valley where erosion of massive eolian sandstones has produced spectacular monolithic landforms. In Monument Valley, the Shin-arump Member of the Chinle Formation of Triassic Age, the uranium-vanadium host rock, crops out around the perimeter of the uplift and also caps mesas and monuments within Monument Valley. The mining area includes parts of San Juan County, Utah, Apache and Navajo Counties, Arizona (Figure 1). Only the exploration and mining in San Juan County, Utah will be discussed in this report.

In the Utah portion of Monument Valley, the majority of the uranium-vanadium mines are in the area of the Oljeto and Goulding's Trading Posts (Figure 1). A single mine is located to the northwest of Oljeto Trading Post, at the foot of Monitor Butte, and another mine is located in the eastern part of the valley below Comb Ridge (Figure 1).

Land Status

All of the area south of the San Juan River in the Utah Territory was added to the Navajo Indian Reservation by an Executive Order of May 17, 1884, signed by President Chester Arthur. Later, an Executive Order of November 9, 1892, signed by President Benjamin Harrison, withdrew the area west of 110 degrees of west longitude from the reservation. An Act of Congress of March 1, 1933, restored the withdrawn area to the Navajo Indian Reservation, with the exception of tracts of school land which had been deeded to the State of Utah (Correll and Dehiya, 1978).

In the Utah portion of Monument Valley, west of the 110 meridian, generally, sections 2, 16, 32 and 36 of each township are State school sections. With the exception of two mines, all

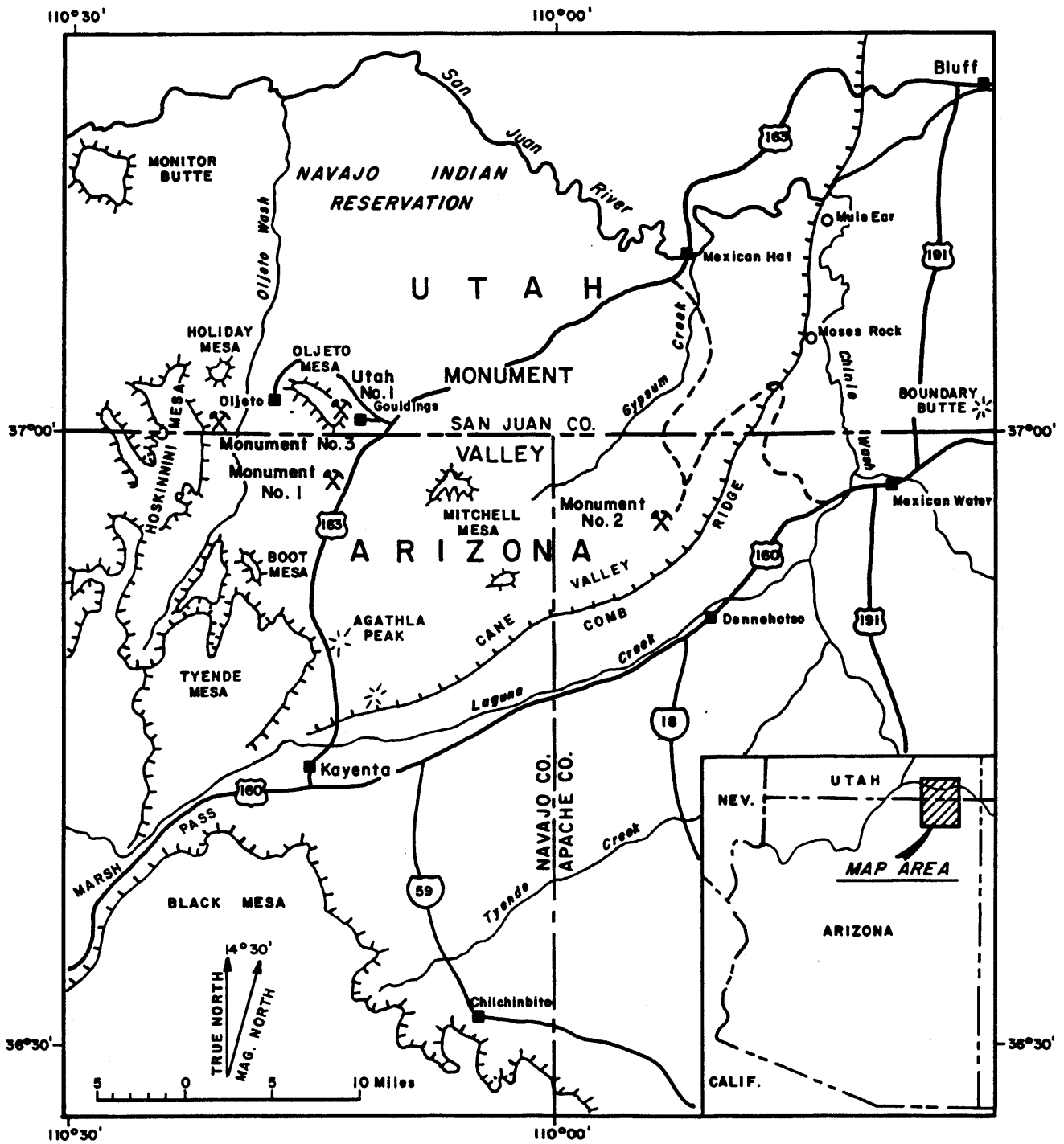


Figure 1. Index map of Monument Valley showing the location of the early carnotite leases

of the mines in the Utah portion of Monument Valley are on Navajo Tribal lands. Mining permits and/or leases are administered by the Navajo Tribal Council and are approved by the Bureau of Indian Affairs, U.S. Department of the Interior. The Navajo Tribe has no control over surface or mineral rights on State lands within the Navajo Indian Reservation.

Purpose

Monument Valley ranks third in the production of uranium from the Triassic Chinle Formation on the Colorado Plateau. Lisbon Valley, which has produced 77.9 million pounds uranium oxide (U_3O_8), is the leading area, followed by White Canyon, which has produced an estimated 11.3 million pounds U_3O_8 (Chenoweth, 1990). Both areas are located in San Juan County, Utah.

The portion of Monument Valley in San Juan County, Utah has produced only a small percentage of the total uranium produced in the mining area (Table 1).

Table 1: Uranium Ore Production, Monument Valley, Arizona-Utah

County	Ore Production Pounds U_3O_8	Years of Production
Apache, Arizona	5,286,970.08	1947 - 1968
Navajo, Arizona	3,191,435.99	1948 - 1966
San Juan, Utah	<u>322,802.07</u>	1944, 1949 - 1966
	8,801,208.14	

Sources: Unpublished mine production records, U.S. Atomic Energy Commission, Grand Junction, Colorado office, and GSA (1981).

Some early uranium mining in the Utah portion of Monument Valley took place in 1944. At that time uranium was used for the manufacture of ceramic colors, etc. Mining, for the ore procurement programs of the U.S. Atomic Energy Commission, began in the fall of 1949 and continued until early 1966. The purpose of this

report is to summarize the pertinent historical events in the exploration and development of the area, and to compile the ore production statistics.

Sources of Data

A considerable amount of the information used in this report was obtained while the author was employed by the U.S. Atomic Energy Commission (AEC) and succeeding agencies, the U.S. Energy Research and Development Administration, and the U.S. Department of Energy (DOE). A review of certain AEC documents in DOE archives at Grand Junction, Colorado aided in the compilation of data.

Most of the historical dates given were obtained from AEC Circular 6 files dealing with eligibility for the initial production bonus. Additional information was obtained from the AEC allocation files establishing the market quotas for the post April 1, 1962 period, and from files provided the AEC by the Navajo Tribal Mining Department, Window Rock, Arizona. The AEC annual ore production records for 1949 through 1966, listing ore production by individual mines were examined and the results tabulated in Tables 3, 4 and 6. No information on the copper content of the ores could be located.

The production statistics presented in these tables are believed to be as accurate as possible. Due to wrong locations of certain properties, the numbers in Tables 3 and 4 do not check with statistics published by Doelling (1969, p. 61) for Monument Valley, Utah. Certain properties, e.g., Black and Blackwater, Blackwater No. 4, Marion, Mexican Hat Stockpile, Tract 1 North, appearing on an AEC computer generated list for Monument Valley, Utah were determined to actually be located in Apache County, Arizona. Old AEC reports indicated that the Jacks mine was in Navajo County, Arizona and the Red Rock property was in the eastern Carrizo Mountains, San Juan County, New Mexico. Two properties, Point and Sundown, were determined to be located elsewhere in San Juan County, Utah. One property, Rock Hat, listed in Navajo County, Arizona, is actually located in Utah.

The Utah Department of Lands and Forestry provided leasing data on two state school sections. Plan maps of several of the larger mines were located in the files of the U.S. Geological Survey, Denver, Colorado.

G E O L O G I C S E T T I N G O F T H E O R E D E P O S I T S

Since this report deals mainly with the exploration and mining history of the area, the reader is referred to reports by Evensen and Gray (1957), Lewis and Trimble (1959), Young (1964) and Malan (1968) for detailed geologic descriptions of the ore deposits. Geologic maps of the Mitten No. 1, Mitten No. 3, and Skyline mines, made by Irving B. Gray and Robert Ciesiel of the AEC in 1955 - 1956, are in the files of the Utah Geological and Mineral Survey, Salt Lake City, Utah.

Exposures of the Shinarump Member of the Chinle Formation form a rough semicircular outcrop pattern in Monument Valley. The Shinarump caps most of the isolated buttes and mesas and is exposed over approximately 70 square miles on the tops of the larger mesas. The member is resistant to erosion and forms vertical cliffs above the steep Moenkopi Formation slopes. The thickness of the member is not uniform and ranges from a feather-edge to a maximum of 250 feet on the south side of Monitor Butte (Lewis and Trimble, 1959). North of Monitor Butte, across the San Juan River, the Shinarump crops out as isolated lenses. On the east side of the valley, between the San Juan River and the Harvey Blackwater No. 3 mine, the Shinarump is missing due to non-deposition.

The uranium deposits occur in Shinarump channels that were incised into the underlying Moenkopi Formation and subsequently filled with fluvial sediments. The channels contain discontinuous, stream-incised scours representing cut-and-fill components that developed during the lateral shifting of the main stream channel. Rocks in scours in the lower portions of channels are the hosts for uranium mineralization. Channels in Monument

Valley are U-shaped in cross section, contain mainly sandstone and conglomerate, are quite narrow, and commonly contain only one ore-bearing scour. Not all scours in paleochannels were mineralized by uranium-bearing fluids. The channels range in depth from 20 feet to 200 feet and in width from 40 feet to 2,000 feet. The wider and deeper channels generally occur in the western part of the area. Figure 2, modified from Young and Malan (1964), shows the general northwest trend to the paleodrainages.

Uranium deposits are primarily restricted to favorable carbonaceous sandstone and conglomerate beds in the lower part of the Shinarump Member. However, in a few mines, such as the Moonlight, ore extends downward as much as 15 ft into underlying beds of the Moenkopi Formation. The Moonlight mine is located 6 miles south of Oljeto Trading Post in Navajo County, Arizona.

Sedimentology studies of the Chinle Formation by R.F. Dubiel, USGS, in Monument Valley and elsewhere in southeastern Utah suggest an additional control on uranium mineralization in the Shinarump Member. These studies indicate a correspondence between facies of the Monitor Butte Member, deposited in subaqueous, reducing setting, and underlying ore-bearing Shinarump sandstones (Dubiel, 1983, and written communication, 1989).

Where uranium is present in Shinarump fluvial channel sandstones in Monument Valley, the overlying Monitor Butte Member of the Chinle and equivalent sandstone and mudstone member of the Chinle consist of black, organic-carbon-rich mudstones and green, carbonaceous plant-bearing, interbedded sandstones, siltstones, and mudstones. The black mudstones was deposited in lacustrine marshes and bog wetlands and the green strata were deposited in subaqueous lacustrine deltas and fluvial crevasse splays (Dubiel, 1983). Rapid clastic sedimentation and inclusion of organic fragments and whole plants below the water table resulted in: (1) the creation of a reducing environment that prevented oxidation of the organic matter, (2) the inhibition of the development of hematite that imparts a red coloration to other sections of the lower Chinle, and (3) the generation of reducing pore waters

that under compaction entered underlying Shinarump sandstones and localized uranium mineralization.

Ore bodies in Shinarump channels consist of closely spaced, lenticular pods that are generally concordant with bedding. Single ore pods range from a few feet to more than a few hundred feet in length and from less than 1 foot to 8 feet in thickness. The length-to-width ratio is commonly at least 5 to 1 but may reach 10 to 1. Deposits range in size from a few tons to nearly 800,000 tons of ore. The largest deposit in Monument Valley is the Monument No. 2 mine in Apache County, Arizona (Figure 1). Here, some 773,132 tons of ore averaging 0.34 percent U_3O_8 and 1.42 percent V_2O_5 were produced from an area 7,000 feet long and 900 feet wide (Gregg and Evensen, 1989).

In Utah, two mines, School Section 36, and Whirlwind, have produced between 10,000 and 20,000 tons of ore and four other mines, C-3, Mitten No. 1, Skyline, and Taylor Reid No. 1, have produced between 5,000 and 10,000 tons of ore. Seven other mines have produced less than 1,000 tons of ore and only one of those, Harvey Blackwater No. 3, produced more than 100 tons of ore.

The deposits contain variable amounts of vanadium and copper.

At the Monument No. 2 mine (Figure 1) the vanadium exceeded the uranium content by four times, with little or no copper. In other deposits for which some data are available, vanadium ranges from 0.05 percent to 1.85 percent and copper ranges from 0.29 percent to 2.50 percent; weighted averages are 0.60 percent V_2O_5 and 0.71 percent copper (Malan, 1968). These averages are not representative because they are based solely on production from mines for which the vanadium and copper content was recorded. No values for copper in the ore shipments could be located for this study.

The deposits are largely oxidized. In the unoxidized parts of the C-3, School Section 36, and Taylor Reid No. 1 mines, uraninite, coffinite, corvusite, and montroseite have been identified (E. B. Gross, written communication, 1957). Uraninite also has been identified at the Mitten No. 1 and Skyline mines.

Navajoite also was found at the Mitten No. 1 mine (Lewis and Trimble, 1959).

Tyuyamunite is the most common ore mineral in the oxidized deposits. Other ore minerals in the oxidized deposits include uranophane, autunite, torbernite, hewettite, johannite, and schroekingerite (Bain, 1952; Evensen and Gray, 1957; Lewis and Trimble, 1959).

Copper minerals occurring with the uranium and vanadium minerals include malachite, azunite, and chalcantite are abundant on weathered exposures, and the copper sulfides, chalcocite, chalcopyrite, and bornite are common in the mines (Lewis and Trimble, 1959). In the large, deep channels on Hoskinnini Mesa, copper is more abundant than uranium.

Calcium carbonate is present in ore primarily as cementing material in the sandstone host rock and probably was precipitated during mineralization. In the Monument Valley mines, calcium carbonate ranges from 1.4 percent to 10.3 percent and averages 4.6 percent. Although calcium carbonate content generally is inversely proportional to vanadium content, it does not correlate with copper (Malan, 1968).

The orebodies at the Harvey Blackwater No. 3 mine were exploited using open pit methods. All of the other mines in the Utah portion of Monument Valley were underground operations. Access to the ore deposits were with adits and declines from the rims of the mesas, or in the case of the mines in School Section 36, declines from the top of Atene Mesa.

EXPLORATION AND PRODUCTION HISTORY

Early Activities and Leasing Regulations

The Navajo Indians reportedly used carnotite as a pigment in their sandpaintings long before Gregory (1917, p. 50 and 148) first reported the occurrences of a uranium-vanadium mineral,

probably carnotite, in the Shinarump and Chinle rocks of the Monument Valley area. Butler and Allen (1921, p. 19) mentioned that Ben S. Wilson, a prospector from Casa Grande, Arizona, and Frank Hess of the U.S. Geological Survey, examined carnotite deposits discovered by John Wetherill of Kayenta, Arizona. Butler and Allen (1921, p. 19) also state that people from Colorado were investigating the carnotite deposits near Kayenta at the time Wilson and Hess were there.

The mining of carnotite in the Arizona portion of Monument Valley during the early 1940's is briefly mentioned in reports on the Monument No. 1 mine (Witkind, 1961, p. 221) and on the Monument No. 2 mine (Witkind and Thaden, 1963, p. 68-69), but there is virtually no mention of any mining in the Utah portion of the valley until the uranium boom of the 1950's.

A report prepared by the General Services Administration (GSA), Indian Trust Accounting Division for the Navajo Tribe 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, Docket Nos. 69 and 299 (copper, vanadium, uranium, sand, rock and gravel claims) held in Albuquerque, New Mexico, February 24-March 4, 1983. A copy of the vanadium and uranium section was obtained by the Grand Junction, Colorado office of the Department of Energy.

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 United States Mining Law. This act allowed prospectors to enter the Reservation and stake a mining claim if their prospecting located promising mineralization. The locator of the claim then obtained a lease on this land under terms that included escalating advance royalties and rentals, and annual work commitments.

During the early 1920's, three leases for carnotite mining were granted by the Interior Department in the Carrizo Mountains, but there is no record of any leases in the Monument Valley area.

On March 25, 1936, the Secretary of the Interior at the request of the Tribal Council, closed the Navajo Indian Reservation to claim location and prospecting for minerals 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 Tribal Council the authority to enter into leases for the Reservations lands with approval of the Secretary of Interior. Prospectors no longer could enter the Reservation and stake a mining claim under regulations similar to those of the United States Mining Law. The new mining 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 by production.

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

During the 1940's two leases were issued in the Utah portion of Monument Valley. Data on these properties, given below, is summarized from the GSA (1981) document.

Monument No. 3

In the summer of 1943 the Vanadium Corporation of America (VCA) requested that the Office of Indian Affairs hold a lease sale for a 12.7 acre parcel of land located three miles southwest of Oljeto Trading Post, on the hogback east of Hoskinnini Mesa. The sale was advertized on September 22, 1943 and when the bids were opened on October 11, 1943, VCA was the only bidder with a bonus bid of \$500.00 (GSA, 1981, exhibit 48).

The claim, named Monument No. 3, was described as follows: "beginning at a point which is north 44°28'30" west, 3,455.62 feet from Mile Post #205, Utah-Arizona state line and running

thence north 47°23' east, 270 feet, thence north 12°26' west, 2,500 feet, thence west 200 feet, thence south 11°37' east, 2,679.91 feet more or less to the point of beginning, containing 12.72 acres more or less."

Lease I-149-IND-6256 was executed with VCA on October 23, 1943, effective January 14, 1944, for a period of ten years. No production was reported from this lease, however, a U.S. Geological Survey engineer's examination of the property in the fall of 1944, noted some rim stripping had been done by VCA (GSA, 1981, exhibit 52).

Utah No. 1

In February 1944, a group of Blanding, Utah men asked that 40 acres of land on the eastern tip of Oljeto Mesa be made available for leasing. A sale was held on April 10, 1944, with only one bid of \$505.00 received from Wayne E. Carroll, Lee Shumway, E.H. Carroll and Harris Shumway, a partnership doing business as Carroll and Shumway (GSA, 1981, exhibit 52).

Lease I-149-IND-6435 was executed on April 25, 1944, effective May 26, 1944, for 40 acres described as the SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 26, T.43S., R.15E., San Juan County, Utah. The lease was made for a period of 10 years. Carroll and Shumway designated the lease as Utah No. 1.

Mining for uranium commenced in June 1944 and continued through December of that year. Details of the production are given in Table 1. Lease I-149-IND-6435 was cancelled by Carroll and Shumway on July 16, 1946.

A U.S. Geological Survey (USGS) engineer examined the property in the fall of 1944 and reported that the uranium ore was mined by hand from in, and around, chunks of silicified wood in the Shinarump conglomerate (GSA, 1981, exhibit 52). The ore was lowered from the mesa in tram buckets. At the base of the mesa it was loaded onto trucks and hauled to Thompson, Utah where the ore was loaded onto railroad cars. The USGS reported the ore was sold to Howard Balsley of Moab, Utah.

Mr. Balsley was an ore buyer for Vitro Manufacturing Company of Pittsburgh, Pennsylvania (written communication, 1970). He bought ores with minimum grades 1.50% U_3O_8 and 5.00% V_2O_5 during the years 1934 through 1944. The ores were shipped to Vitro's plant at Canonsburg, Pennsylvania, for the manufacture of ceramic colors, etc.

Table 2: Uranium and Vanadium Ore Production, Utah No. 1 Lease, 1944.

Month	Pounds of Ore	Pounds U_3O_8	% U_3O_8	Pounds V_2O_5	% V_2O_5
June	8,732	333.14	3.82	386.71	4.43
July	9,598	386.88	4.03	485.66	5.06
August	18,207	660.67	3.63	1,298.28	7.13
September	34,281	1,280.85	3.74	1,988.91	5.80
October	10,933	438.22	4.01	570.34	5.22
November	5,747	313.37	5.45	307.81	5.36
December	<u>16,265</u>	<u>770.12</u>	<u>4.74</u>	<u>665.98</u>	<u>4.09</u>
Total	103,763	4,185.25	4.03	5,703.69	5.50

Source: General Services Administration (1981, p. 64-67 of Appendix)

The AEC's Procurement Program

Summary of the Program

The ultimate procurement aim of the U.S. Atomic Energy Commission (AEC) was to purchase uranium in concentrates. Its first uranium procurement action was execution of a contract with Vanadium Corporation of America (VCA) on May 28, 1947, for the delivery of concentrates from its mill at Naturita, Colorado. This was followed with another contract with VCA on October 8, 1948 for delivery of concentrates from a government owned mill at Durango, Colorado. VCA had mined carnotite deposits in the Arizona portion of Monument Valley in the 1940's for vanadium. These early AEC contracts would revive mining of these same deposits for uranium and vanadium.

It was obvious that production of concentrates was directly dependent upon an assured supply of uranium ores, which in turn required a rapid expansion of exploration and mining efforts. To provide an incentive for those efforts, in April 1948, the AEC announced a domestic procurement program designed to stimulate prospecting and to build a domestic uranium mining industry. Private industry would be tasked with finding, mining, and processing uranium ores. The AEC would assist by making geologic surveys (including drilling), furnishing free testing and assaying services, and, most important, guaranteeing a market for uranium ores.

The AEC ore market guarantee was promulgated by a series of Domestic Uranium Program Circulars, several of which were occasionally revised and extended. On April 11, 1948, the agency issued its initial ore purchase schedule and bonus incentives in the form of Domestic Uranium Program Circulars 1, 2, and 3. Circular 1 guaranteed for 10 years a minimum price for certain high-grade uranium ores. Circular 2 offered a \$10,000 bonus for the discovery and production of high-grade uranium ores from new domestic deposits. This bonus was collected only once, by a mine in Lisbon Valley, Utah, before Circular 2 expired on April 11, 1958. Circular 3 provided for minimum prices, specifications and conditions under which the AEC would purchase carnotite and roscoelite - type ores at Monticello, Utah. It also established payment of \$0.31 a pound for vanadium content (V_2O_5) of the ores.

On June 1, 1948, the AEC issued Circular 4. It was a revision of Circular 3 and added an additional \$0.50 per pound premium for ores assaying 0.20% U_3O_8 or more, and set forth a haulage allowance of \$0.06 per ton mile, up to 100 miles.

On February 1, 1949, the AEC issued Circular 5. It consolidated Circulars 3 and 4 and increased the price for U_3O_8 in ore, and established premium prices for higher grade ore.

Circular 5 was revised and broadened on March 1, 1951. Circular 5, Revised, stayed in effect until April 1, 1962. More important was the fact that the prices set forth in Circular 5, Revised, became the base of the industry's economics while it was in effect. This schedule contained a base price of \$3.50 per pound U_3O_8 for ores containing 0.20% U_3O_8 or greater uranium oxide. Ores containing less than 0.20% U_3O_8 received a base price grading down to \$1.50 per pound U_3O_8 in ores containing the minimum acceptable grade of 0.10% U_3O_8 . All ores received a mine development allowance of \$0.50 per pound U_3O_8 , and ores containing 0.21% U_3O_8 and better received a \$0.75 per pound grade premium. Vanadium-bearing ores received \$0.31 per pound vanadium oxide (V_2O_5) for their vanadium content. Circular 5 Revised also paid a \$0.06 per ton-mile haulage allowance for the first 100 miles.

Circular 6, issued June 29, 1951, established an initial production bonus for new discoveries. This bonus could amount to \$35,000 on the first 10,000 pounds U_3O_8 produced from a new property. This Circular expired March 31, 1960.

A corollary to the price guarantee set forth in the Circulars was the provision of Government ore-buying stations in areas of expected production. The AEC opened its initial ore-buying station at Monticello, Utah in April 1948. Another AEC ore-buying station, that received Monument Valley ores, was opened at Shiprock, New Mexico on January 17, 1952. At mills that were later built at Moab and Mexican Hat, Utah, the mill operators operated ore-buying stations for the AEC during the early phases of mill operation. The Monticello station closed on March 31, 1962 with the expiration of Circular 5 Revised, however, the station at the Moab mill continued to operate until mid-1963.

On May 24, 1956, the AEC announced the establishment of a new domestic uranium procurement program for the period April 1, 1962, through December 31, 1966. The new program guaranteed a Government market for 500 tons of U_3O_8 , in concentrate, per

year from any one mining property or operation at a flat price of \$8 per pound. Thus, in 1956, the stage was set for a continuing AEC concentrate procurement program after March 31, 1962, with an established price for concentrates rather than for ores. The prices, premiums, and allowance paid under Circular 5, Revised, would no longer be in effect. After March 31, 1962, the AEC required that the mill operator pay "reasonable" prices to independent producers.

By late 1957, dramatic increases in reported ore reserves and in milling capacity prompted an AEC announcement that "it no longer is in the interest of the Government to expand production of uranium concentrate." Then, on November 24, 1958, in order to prevent further expansion of production under its essentially unlimited purchase commitment, the AEC redefined its 1962-1966 procurement program by withdrawing portions of the program announced in May 1956. The Government stated it would buy, in the 1962-1966 period, only "appropriate quantities of concentrate derived from ore reserves developed prior to November 24, 1958, in reliance upon the May 24, 1956, announcement." Other aspects of the program announced in 1956 were retained: the AEC would buy only concentrates; the U_3O_8 price would remain at \$8 per pound; and ores would not be purchased nor ore prices guaranteed. Independent producers had to negotiate ore purchase contracts with milling companies in order to sell their ores.

Since most small uranium operators did not block out large reserves prior to mining, the AEC modified the November 24 announcement to meet their needs. In the case of the small operator, historical production records were used to establish allocations for the 1962-1966 period. Only four properties in the Utah portion of Monument Valley: C-3, Skyline, Taylor Reid No. 1, and the Whirlwind participated in the allocation program.

In 1962, it was apparent to the AEC that the private market for uranium concentrates would not be sufficient to sustain a viable domestic uranium industry by the end of 1966 when the AEC

procurement program was scheduled to end. Thus, on November 20, 1962, the AEC announced its "stretchout" program for 1967 through 1970. Under the program, the milling companies could voluntarily defer delivery of a portion of their 1963-1966 contract commitments until 1967 and 1968 in return for an AEC commitment to purchase, in 1969 and 1970, an additional amount of U_3O_8 equal to the quantity so deferred. The "stretchout" program was the last of the major policy changes made in the AEC procurement program.

The price to be paid for the deferred material in 1967 and 1968 would be \$8.00 per pound, the same as the 1962-1966 contracts. The price to be paid in 1969 and 1970 for concentrate produced from properties controlled by the milling company would be calculated with a formula based on costs during the 1963-1968 period, not to exceed \$6.70 per pound. The price for all concentrates produced from ores purchased from independent producers would be \$6.70 per pound of contained U_3O_8 . All of the mines in the Utah portion of Monument Valley has closed before the "stretchout" went into effect. The AEC procurement program ended at midnight, December 31, 1970.

Exploration Activities of the AEC

The AEC began field investigations in Monument Valley in 1951. Elmer V. Reinhardt made a reconnaissance trip to the area during January 23-26, 1951. At that time he examined the Skyline, Tom Holliday and Whirlwind mines in Utah, and the Monument Nos. 1 and 2, and the Cato Sells mines in Arizona. (Reinhardt, 1951). He recommended drilling near the Monument No. 2 and the Cato Sells mines in Arizona, and near the Tom Holliday prospect on Oljeto Mesa (Reinhardt, 1951).

During July and August 1951, 417 core holes with a total footage of 16,834 feet were drilled on the eastern part of Oljeto Mesa. These holes were generally drilled in fences, normal to the trend of the channel. Fences were about 100 feet apart with holes spaced 25 feet apart on each fence. Ore was discovered behind the workings of the Skyline mine and on ground claimed by Cecil Parrish Jr. (Chester and Donnerstag, 1952).

The AEC conducted an aerial radiometric survey of the outcrops of the Shinarump Member of the Chinle Formation in Monument Valley during the period June 22 through December 8, 1951. In Utah, three areas of anomalous radioactivity were located on Hoskinnini Mesa, two on Oljeto Mesa and one on Nokai Mesa (Cummings, 1952). Late in 1951, Cutter (1952) mapped additional channels on Oljeto Mesa. As the result of this work additional drilling was done in 1954 in the area to the west of the initial drilling. Some 214 holes with a total footage of 10,684.0, of which 5,369 feet were cored, were drilled on land claimed by Walker Norcross (Presley, 1957). The holes were drilled in fences normal to the channel trend. The fences were spaced 150 feet apart with the holes spaced 60 feet apart on each fence. The results of the drilling were not encouraging.

In the western part of the valley, the AEC began reconnaissance studies in 1952, especially on Hoskinnini and Nokai Mesas (Chester and Pitman, 1952; Reinhardt, 1952). The AEC built a road up onto Hoskinnini Mesa in April and May 1952 in order to provide access of drilling equipment. During May 15 through June 30, 1952, the AEC drilled 14 core holes with a total footage of 2,018 feet to locate mineralization in a channel behind a mineralized outcrop (later known as Tract 9, on Figure 2). All of the holes were barren (Gregg, 1952).

During a reconnaissance of Holiday Mesa in June 1952, Donald E. Trimble of the USGS, located an exposure of uranium-bearing minerals on the west end of the mesa (Trimble, 1952). This area would be later claimed by Taylor Reid. After additional studies on Holiday Mesa, including seismic work to trace buried channels, the USGS recommended to the AEC that the channel on the mesa be drilled (Lewis, 1954).

Holiday Mesa was drilled by the AEC in the fall of 1954. A total of 200 holes with a footage of 32,620.5 feet were completed, including 5,838.5 feet of core drilling (Presley, 1957). The drilling was done with fences normal to the channel spaced 150

feet apart. Holes in the fences were spaced at intervals of 60, or at intervals of 30 feet where more geologic information was required. This drilling discovered significant ore on the Taylor Reid and Cecil Parrish Jr. (C-3) mining permits. AEC studies of the Holiday Mesa drilling project are summarized by Evensen and Gray (1957).

Overview of Mining and Exploration

With a contract with the AEC to produce uranium, the Vanadium Corporation of America (VCA) began operating the inactive Monument Nos. 1 and 2 mines in Arizona (Figure 1). These mines had been operated for their vanadium content in the years 1942-1946 (GSA, 1981). Shipments from Monument No. 2 commenced in October 1947 and from No. 1 in July 1948. In October 1949, a small, high grade shipment was made from the Monument No. 3 lease in Utah.

During 1949, the Office of Indian Affairs revised mining lease regulations for the Navajo Indian Reservation. Leases would be issued for a 10-year period without having a lease sale with sealed bids. Only non-Navajos would be issued leases. A new lease was issued for the old Utah No. 1 mine on Oljeto Mesa and shipments commenced in November 1949 from the property, now known as the Skyline mine. Shipments from the Skyline mine would continue through 1955. Annual ore production statistics for both uranium and vanadium are given in Tables 3 and 4. Details of the annual ore shipments are given in the appendix.

About 1950, the Navajo Tribal Council adopted a series of resolutions affecting prospecting and mining on the reservation. All prospectors, Navajos and non-Navajos must have a prospecting permit. Once a discovery is made, only a Navajo can apply for a mining permit. The permit holder can assign his mining rights to a company or individual. Mining permits are good for two years, subject to renewal for two additional years. The maximum amount of land an individual Navajo, or company, can hold is 960 acres.

Table 3: Uranium Ore Production, Monument Valley,
San Juan County, Utah, 1944-1966.

Year	Number of Mines	Tons of Ore	Pounds U ₃ O ₈	Percent U ₃ O ₈
1944	1	51.88	4,185.25	4.03
1945	0	-0-	-0-	-
1946	0	-0-	-0-	-
1947	0	-0-	-0-	-
1948	0	-0-	-0-	-
1949	2	211.52	1,398.10	0.33
1950	4	1,515.61	4,248.34	0.14
1951	3	520.93	2,408.43	0.23
1952	3	866.04	5,045.70	0.29
1953	4	2,974.30	36,906.88	0.62
1954	6	3,080.55	33,112.03	0.54
1955	8	4,128.83	16,772.10	0.20
1956	4	4,550.98	30,167.90	0.33
1957	2	9,270.00	69,551.80	0.37
1958	2	5,727.51	25,945.87	0.23
1959	3	6,968.59	31,335.99	0.22
1960	3	2,508.15	11,011.47	0.22
1961	4	3,605.68	16,571.46	0.23
1962	5	5,529.43	25,552.26	0.23
1963	2	759.81	3,967.66	0.26
1964	0	-0-	-0-	-
1965	3	1,129.94	3,522.33	0.16
1966	2	633.39	1,098.50	0.09
TOTAL		54,033.14	322,802.07	0.30

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

Table 4: Uranium Ores Analyzed For Vanadium, Monument Valley, San Juan County, Utah, 1944-1966.

Year	Number of Mines	Tons of Ore	Pounds V_2O_5	Percent V_2O_5
1944	1	51.88	5,703.69	5.50
1945	0	-0-	-0-	-
1946	0	-0-	-0-	-
1947	0	-0-	-0-	-
1948	0	-0-	-0-	-
1949	2	211.52	3,426.65	0.81
1950	4	1,515.61	17,246.26	0.57
1951	3	520.93	23,805.54	2.28
1952	3	866.04	8,497.19	0.49
1953	4	2,974.30	60,866.18	1.02
1954	5	3,080.55	55,571.82	0.91
1955	8	4,128.83	56,718.06	0.69
1956	4	4,550.98	36,019.77	0.40
1957	2	9,270.00	69,702.68	0.38
1958	2	5,727.51	107,424.91	0.94
1959	3	2,823.82	37,628.00	0.67
1960	0	-0-	-0-	-
1961	1	912.43	12,690.00	0.70
1962	5	2,333.34	22,739.13	0.49
1963	1	128.23	282.98	0.11
1964	0	-0-	-0-	-
1965	3	1,129.94	6,943.00	0.30
1966	2	<u>633.39</u>	<u>7,473.00</u>	<u>0.59</u>
TOTAL		40,859.30	532,738.86	0.65

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

Drilling and exploration permits, issued for 120 days, are not renewable. Both mining permits and assignment of the mining rights would 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, but due to the large amount of prospecting and new discoveries on the Reservation, the Navajo Tribal Mining Department began numbering the permits in 1952.

Production increased greatly in 1950 as shipments began from the Whirlwind mine located on a Utah School Section (Section 2, T.41S., R.13E.). With the exception of 1956, production from the Whirlwind mine would continue into 1960. Also in 1950, a small shipment was made from Tom Holliday's mining permit on the eastern end of Oljeto Mesa.

As the result of favorable results from AEC drilling, shipments began from the Mitten No. 1 mine on Oljeto Mesa in 1952. Shipments from the high-grade deposit would continue into 1956.

Shipments from the Mitten No. 1 mine in 1953 increased the annual production to nearly 37,000 pounds U_3O_8 averaging 0.63 percent U_3O_8 (Table 3). Also in 1953 and 1954, small shipments were made from the Rock Door No. 1 mine, on Rock Door Mesa near Goulding's Trading Post. In 1954 and 1955, several shipments were made from Harvey Blackwater's No. 3 mine, located just inside Utah, in the eastern part of Monument Valley (Figure 2).

The Utah No. 1 mine on a Utah School Section (Section 36, T.43S., R.14E.) commenced production in 1955 and would continue into 1957. Also in 1955, small shipments were made from Charles Keith's mining permit on the west end of Oljeto Mesa, from the Mitten No. 3 mine on Holiday Mesa, and from Henry Lee Sampson's mining permit.

Due to confusion and conflict regarding mining permits in the extreme western part of Monument Valley, the Navajo Tribal Council withdrew a large area from mining on July 19, 1955. This withdrawal was approved by the Commissioner of Indian Affairs on November 8, 1955. The area withdrawn was described as follows:

The point of beginning is at the junction of Oljeto Wash with the San Juan River; thence south along the western bank of Oljeto for a distance of approximately 25 miles to the junction of Oljeto Wash and Taeye-ha-tsazi Canyon; thence westward around the northern base of Tyende Mesa, Skeleton Mesa, to the head of Nokai Canyon; thence around the northern end of Zilner Mesa to the head of Piute Canyon; thence northward along the eastern bank of Piute Wash to its junction with the San Juan River; thence easterly along the south bank of the San Juan River to its junction with Oljeto Wash; the point of beginning.

Areas of former mining permits were described as "tracts". Six of the tracts were in Utah. They were numbered 7, 8, 9, 12, 15 and 25 (Figure 2). When the tracts were put up for sealed bids for the purpose of issuing mining leases in 1956, the only tract in Utah to receive a bonus bid was Tract 25. After doing a small amount of drilling, which was negative, Copper Canyon Mining Industries declined to lease the tract.

Initial shipments were made from the Taylor Reid No. 1 and the C-3 mines on Holiday Mesa during 1956, mining ore that had been discovered by AEC drilling. The Taylor Reid No. 1 mine would not ship any ore in 1957 but did in 1958 and in 1961 through 1963. The C-3 mine did not ship in 1957 or 1958 but commenced again in 1959 and continued into 1963, with the exception of 1961.

On July 17, 1956, Texas-Zinc Minerals Corporation signed a contract with the AEC to produce concentrates from a mill to be built on the Navajo Indian Reservation, two miles south of Mexican Hat, Utah (Figure 2). The mill began operations in November 1957 with an initial capacity of 775 tons of ore per day, which was expanded to 1,000 tons per day in 1958. The mill had two circuits, one for uranium and one for copper. The uranium circuit used acid leaching and solvent extraction. Copper sulfides were recovered by flotation and shipped to a smelter (Albrethsen and McGinley, 1982). During the period June 1959 through February 1960, Texas-Zinc operated an ore-buying station for the AEC at the mill site (Albrethsen and McGinley, 1982). Most of the mill feed from the Mexican Hat mill came from mines in the Red

and White Canyon area of San Juan County, Utah, and from the AEC ore-buying station in White Canyon. Since no payment was made for vanadium at Mexican Hat most operators of the mines in Monument Valley continued to ship to the AEC ore-buying stations at Monticello, Utah and/or Shiprock, New Mexico.

Uranium ore production in the Utah portion of Monument Valley reached an all time high in 1957 when 9,270.00 tons of ore averaging 0.37 percent U_3O_8 and containing 69,551.80 pounds U_3O_8 were mined (Figure 3). The majority of the ore (93 percent) came from the Radium Hill mine on School Section 36 T.43S., R.14E.

In June 1958, the AEC closed its ore-buying station at Shiprock, New Mexico. The mill operator, Kerr-McGee Oil Industries, Incorporated, became responsible for purchasing independent ores in accordance with Circular 5 Revised.

During the mid 1950's there was some exploration drilling on the Shinarump channels in the western part of the valley. Texas-Zinc Minerals and Tidewater Oil Company were the principal explorers. The drilling was reported to be negative. The AEC's November 24, 1958 announcement limiting future uranium purchases to ore discovered prior to that date, virtually ceased all further exploration drilling. Table 5 lists all of the non-AEC drilling in the Utah portion of Monument Valley that was reported to the AEC prior to July 1, 1962.

Table 5: Exploration Drilling By Private Companies, As Of July 1, 1962, Monument Valley, Utah.

<u>Area</u>	<u>No. of Holes</u>	<u>Total Footage</u>
Eastern		
Comb Ridge	165	23,000
Central		
Oljeto, Little Oljeto and Atene Mesas	338	34,320
Western		
Hoskinnini, Pickell, Monitor and Nokai Mesas, Copper and Nokai Canyons	366	54,605

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

In 1960, A & B Mining Company of Moab, Utah became interested in several of inactive mines in the Utah portion of Monument Valley. Mining rights were acquired to the Tribal Mining Permits and portions of two State School Sections were leased. During 1960 and 1962 the Skyline mine was operated, and in 1961 the Mitten No. 1 was mined. The mines on School Section 36 were active in 1961 and 1962 and the Whirlwind mine was operated in 1962. A & B operated the Taylor Reid No. 1 and the C-3 mines in 1963. A & B's operations consisted of clean-up mining such as pulling pillars, etc. that were left by the previous operators.

The decline in ore production which started in 1958 was reversed in 1962 when the annual production was 5,529.43 tons of ore, averaging 0.23 percent U_3O_8 and containing 25,552.26 pounds U_3O_8 (Table 3). This increase was due to Dumont Development Corporation's large shipments from the Taylor Reid No. 1 and C-3 mines.

In March 1963, VCA acquired the Kerr-McGee mill at Shiprock, New Mexico as well as all of the Kerr-McGee mines in the Lukachukai Mountains, Apache County, Arizona. VCA subsequently closed its Durango, Colorado mill, and all of its ore was process at Shiprock. On July 31, 1963, the Atlas Corporation acquired Texas-Zinc Minerals. Atlas operated the Mexican Hat mill through its subsidiary A-Z Minerals until it closed in February 1965. The former AEC contract with Texas-Zinc was incorporated into Atlas's contract at Moab.

VCA acquired the mining rights to the Taylor Reid No. 1 and C-3 properties in early 1965. Contract miners produced 50.74 tons of ore averaging 0.13 percent U_3O_8 from the C-3 mine in 1965 and 1,062.28 tons of ore averaging 0.15 percent from the Taylor Reid No. 1 in 1965 and 1966, with the final shipment made in February 1966. The same contract miners also operated the Whirlwind mine in 1965 and 1966, producing a total of 650.31 tons of ore that averaged 0.10 percent U_3O_8 . There has been no mining in the Utah portion of Monument Valley since June 1966.

During the AEC program, 12 properties in the Utah portion of Monument Valley produced a total of 53,981.26 tons of ore which

contained 318,616.82 pounds of U_3O_8 with an average grade of 0.29 percent U_3O_8 (Table 3).

All of the uranium was purchased by the AEC. Some 40,807.42 tons of ore was analyzed for vanadium oxide (V_2O_5). These ores contained 527,035.17 pounds V_2O_5 and graded 0.65 percent V_2O_5 (Table 4). The vanadium was purchased by the AEC at ore-buying stations and by companies such as VCA and Union Carbide Nuclear, Incorporated, at mills in Colorado and New Mexico. Not all the vanadium was recovered as stockpiles at ore-buying stations were later sold to some mills without vanadium circuits, such as those at Mexican Hat and Moab, Utah.

Description of the Individual Properties

During the years 1944 through 1966, 12 individual properties produced uranium-vanadium ore in the Utah portion of Monument Valley. Summaries of the individual mines are given in Table 6. Details of the annual ore shipments are tabulated in the appendix. Three of the properties, Mitten No. 1, School Section 36, and Whirlwind, produced more than 50,000 pounds U_3O_8 each, two properties, Skyline and Taylor Reid No. 1 each produced between 25,000 and 50,000 pounds U_3O_8 , and the C-3 mine produced between 20,000 and 25,000 pounds U_3O_8 . The remaining seven properties each produced less than 5,000 pounds U_3O_8 , and all but one, Harvey Blackwater No. 3, were less than 1,000 pounds U_3O_8 each. The following is a brief description of the mining activities at each of the 12 producing properties.

C-3

The C-3 mine is located on the southeast rim of Holiday Mesa, 1.8 miles northwest of Oljeto Trading Post (Figure 2). Navajo Tribal Mining Permit (MP) 148, covering 98 acres of the central part of Holiday Mesa, was approved to Cecil Parrish Jr. and Tom Holliday on June 14, 1954. The property takes its name from the fact that Cecil Parrish Jr. and Tom Holliday had five

separate parcels of land held under mining permits in the Oljeto area. C was for Cecil and this was parcel number three. This permit included a large portion of the area drilled by the AEC where orebodies were discovered (Evensen and Gray, 1957).

The assignment of the mining rights to Copper Canyon Mining Industries, Incorporated was approved November 29, 1955. Copper Canyon was a partnership of Charles Ashcroft Sr. and J.L. Foutz of Farmington, New Mexico. Copper Canyon drove an 8 by 10 foot decline from the rim of Holiday Mesa to the ore deposit. The portal of the decline was on MP-66 of Taylor Reid (Figure 3). Shipments to the AEC's ore-buying station at Monticello, Utah began in early 1956. Mining was in wet ground because a perched water table was encountered in the basal Shinarump. No shipments were made in 1957, and Copper Canyon cancelled its mining assignment during that year.

Capital Uranium Corporation, of Farmington, New Mexico, was assigned the mining rights in mid-1958. Capital, which later became Capital-Seaboard Corporation, had been a mining contractor for Howard Wilson at the nearby Taylor Reid No. 1 mine and mined the eastern Taylor Reid orebody via the C-3 decline (Figure 3). Capital Seaboard made shipments to Monticello in 1959 and to Texas-Zinc Minerals at Mexican Hat in 1960 and cancelled its mining assignment in late 1960.

Dumont Development Corporation of Montrose, Colorado, received the approval of the assignment on July 3, 1961 and made shipments to the Texas-Zinc at Mexican Hat in 1961 and 1962. During 1962, Dumont also mined the eastern Taylor Reid orebody for which they had the mining assignment. Some 984.65 tons of ore averaging 0.25 percent U_3O_8 and 0.36 percent V_2O_5 from both properties was shipped to Union Carbide Nuclear, Incorporated's mill at Uravan, Colorado in 1962, so as to receive payment for the vanadium. The AEC records do not give the breakdown between properties. Dumont cancelled its assignment on September 26, 1962.

A new permit, MP-586, was issued to Cecil Parrish Jr. and

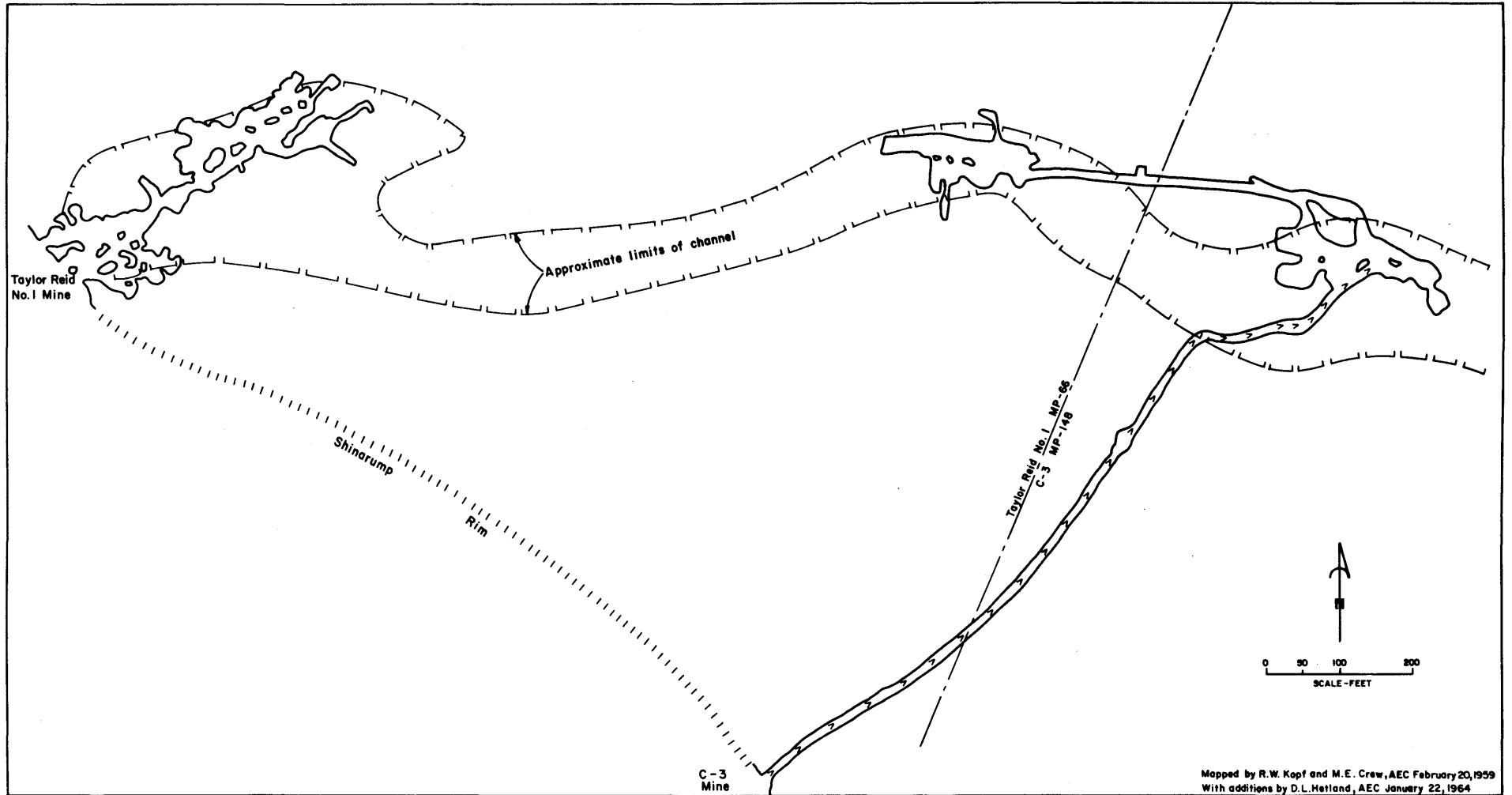


Figure 3. Plan map of the C-3 and Taylor Reid No. 1 mines

Mapped by R.W. Kopf and M.E. Crew, AEC February 20, 1959
With additions by D.L. Hetland, AEC January 22, 1964

Tom Holliday on December 21, 1962. This permit covered the same ground as the original MP-148. The assignment of the mining rights to Ivor Adair, doing business as A & B Mining Company of Moab, Utah was approved January 28, 1963. A & B shipped 209.05 tons of ore averaging 0.21 percent U_3O_8 to the Mexican Hat mill during 1963 and cancelled its assignment on December 13, 1963.

Shumway Brothers Mining Company and Kay P. Johnson, of Blanding, Utah, were approved the assignment on December 23, 1963. There is no recorded production by the Shumways and Johnson and the permit and assignment expired on December 21, 1964.

A new permit, MP-603, covering the same ground as MP-586 was issued to Parrish and Holliday in early 1965. The assignment to the Vanadium Corporation of America of Durango, Colorado was approved April 26, 1965. The Shumway Brothers Mining Company mined under contract for VCA and shipped 50.74 tons of ore averaging 0.13 percent U_3O_8 and 0.07 percent V_2O_5 to VCA's Shiprock, New Mexico mill in 1965. VCA cancelled its assignment in 1966.

Total production from the C-3 mine was 5,007.99 tons of ore which averaged 0.21 percent U_3O_8 (Table 6). Ore that was analyzed for vanadium averaged 0.36 percent V_2O_5 (Table 6). Not included in the above totals are the 1962 shipments which were comingled with the Taylor Reid No. 1 ores.

Charles Keith

During 1950, Charles Keith was issued an unnumbered mining permit for 240 acres on the western tip of Oljeto Mesa, approximately 0.8 miles east of Oljeto Trading Post (Figure 2). When this occurrence was examined by Bain (1952 p. 43) in early 1952, he noted a 25-foot adit had been driven to explore the mineralized outcrop. Bain referred to this occurrence as the Oljeto Mesa West prospect.

On May 25, 1954, a new mining permit, MP-134, was issued to Charles Keith for the same 240 acres. The assignment of the mining rights to Shasta Copper and Uranium Company of Salt Lake

City, Utah was approved July 15, 1954. Shasta did a small amount of drilling and in October, 1954, made a small shipment to the AEC ore-buying station at Monticello, Utah. This shipment was assayed for copper and not vanadium. The copper content of the ore could not be located in 1990 for this report. Shipments to Monticello continued into early 1955. Total production by Shasta Copper and Uranium was 58.59 tons of ore that averaged 0.20 percent U_3O_8 and 0.21 percent V_2O_5 (Table 6). Mine workings consist of two short adits and some rim stripping.

Harvey Blackwater No. 3

The No. 3 claim of Harvey Blackwater is the only one of Blackwater's five claims that is in Utah (Figure 2). Some confusion has resulted in the past, due to mislabeling on published maps and errors in the AEC production records (U.S. Atomic Energy Commission, 1959; Young and Malan, 1964). Records of the Navajo Tribal Mining Department indicate that the open pit on the Harvey Blackwater No. 3 property is approximately 300 feet northeast of milepost monument no. 235 on the Utah-Arizona boundary.

Mining permit no. 142 covering the no. 3 claim, 64.85 acres, as well as the contiguous no. 2 claim, 65.98 acres, in Arizona, was issued to Harvey Blackwater on May 24, 1954. The assignment to Mex-Air Uranium Company, of Farmington, New Mexico was approved on July 26, 1954. Mex-Air was a partnership of C.E. Culver, D. B. Warren, C.H. Teague and V.O. Marrs. The company did a small amount of wagon drilling to block out an orebody. In August 1954, Mex-Air shipped 446.63 tons of ore averaging 0.16 percent U_3O_8 and 0.05 percent V_2O_5 to the AEC ore-buying station at Monticello, Utah. The ore was mined from a shallow open pit in a small, shallow, east - west trending Shinarump channel. An additional 130.45 tons were shipped to Monticello in early 1955 and the property has been idle since that time. Total production from the Harvey Blackwater No. 3 mine was 577.08 tons of ore that averaged 0.16 percent U_3O_8 and 0.05 percent V_2O_5 (Table 6).

Henry Lee Sampson Nos. 1 and 9

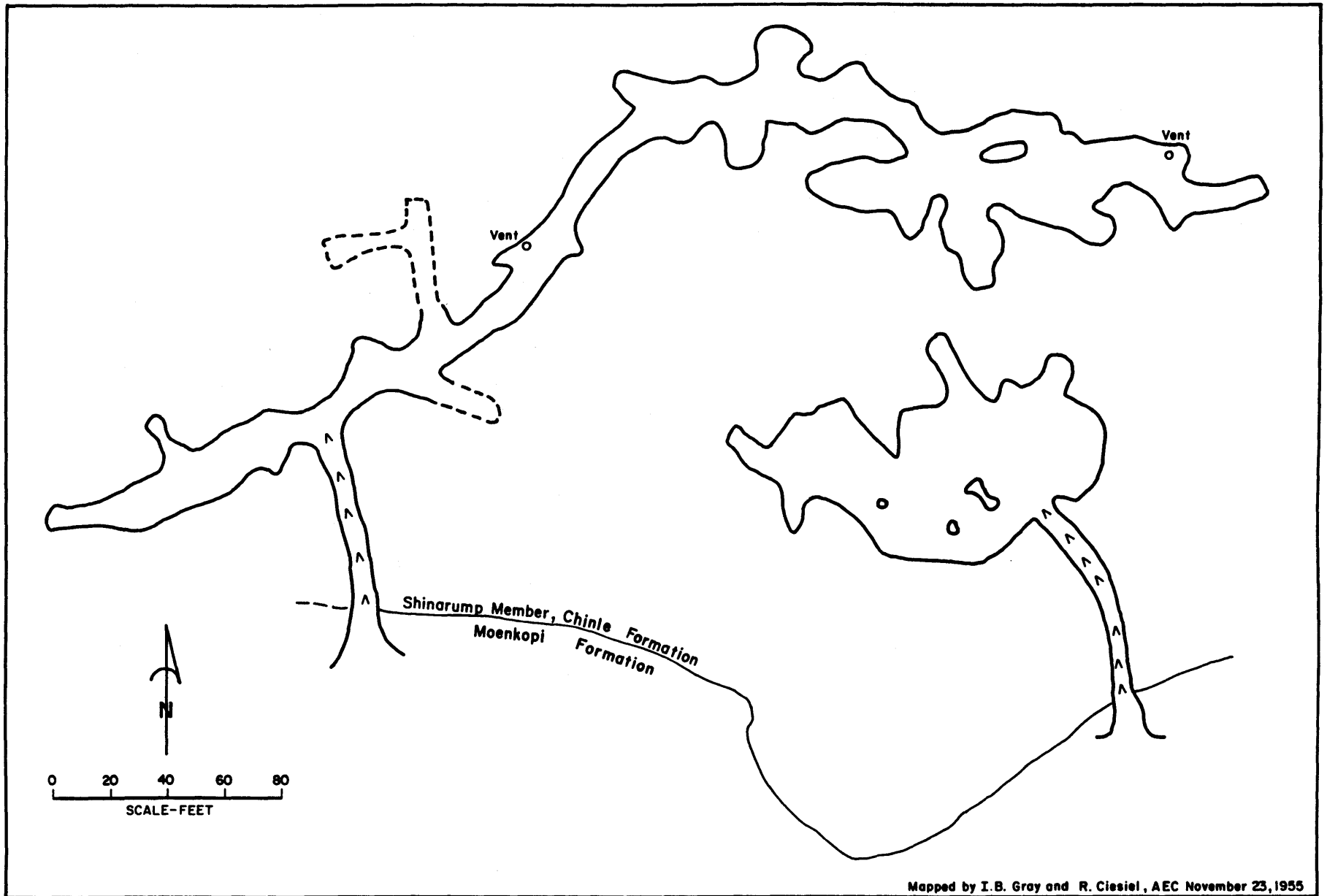
The exact location of this property is not known. Records of the AEC identify it as located in the Comb Ridge area of San Juan County, Utah. A map, prepared by the Navajo Tribal Mining Department, in the AEC files, showing mining permits and leases in Monument Valley, does not show any land claimed by Henry Lee Sampson. The records do show that MP-269, covering 160 acres, was issued to Lee West, Many Boys, and H.L. Sampson in February, 1955. The assignment to Spencer Uranium Company of Salt Lake City, Utah was not approved until June 7, 1955.

During February and March, 1955, the Spencer Uranium Company made two shipments to the AEC ore-buying station at Shiprock, New Mexico. These shipments totalled 31.84 tons of ore that averaged 0.10 percent U_3O_8 and 0.12 percent V_2O_5 (Table 6). During 1954-1957, Spencer operated the John M. Yazzie mine adjacent to the Monument No. 2 mine in Cane Valley (Gregg and Even- sen, 1988). John J. Borkert (oral communication, 1990), formerly of the Navajo Tribal Mining Department, believes the property is in the vicinity of the Harvey Blackwater No. 3 mine, possibly in Arizona.

Mitten No. 1

The Mitten No. 1 mine is in a remnant of Shinarump channel - fill sediments on the eastern tip of Oljeto Mesa (Figure 2). The portals of the mine are 3,200 feet west of the west portal of the Skyline mine. The channel-fill sediments are missing, due to erosion, between the two mines.

Mining Permit No. 15, covering the area of the Mitten No. 1 mine, was issued to Cecil Parrish, Jr. on April 26, 1952. The assignments of the mining rights to J.L. Foutz, of Farmington, New Mexico, was approved October 7, 1952. Foutz began under- ground mining in late 1952 and continued shipments into early 1956. The original ore deposit had been discovered by AEC drill- ing on Oljeto Mesa in 1951 (Chester and Donnerstag, 1952). Other shipments in 1956 were made by Copper Canyon Mining Industries, Incorporated, a company formed by Charles Ashcroft Sr. and Foutz.



Mapped by I. B. Gray and R. Cissiel, AEC November 23, 1955

Figure 4. Plan map of the Mitten No. 1 mine

Shipments in 1952 and 1953 were made to the AEC ore- buying station at Shiprock, New Mexico. Shipments in 1954 through 1956 were made to the AEC ore-buying station at Monticello, Utah. MP-15 expired in 1958.

When A and B Mining Company of Moab, Utah became interested in the property in 1960, a new permit, MP-546, was issued to Cecil Parrish, Jr. and Tom Holliday in December 1960. The assignment of the mining rights to A and B was approved on March 30, 1961. As the result of clean up mining, pulling pillars etc., A and B shipped 912.43 tons of ore averaging 0.30 percent U_3O_8 and 0.70 percent V_2O_5 during 1961. All of A and B's shipments were made to Monticello, Utah. The company cancelled its assignment on December 29, 1961. Total production from the Mitten No. 1 mine was 6,419.64 tons of ore that averaged 0.55 percent U_3O_8 and 1.09 percent V_2O_5 (Table 6). The Mitten No. 1 mine is the second largest in Monument Valley, Utah. The extent of the mine workings are shown in Figure 4.

Mitten No. 3

The Mitten No. 3 mine is located on the southeastern tip of Holiday Mesa, approximately 0.8 miles west-northwest of Oljeto Trading Post (Figure 2). The mineralized exposure was claimed by Cecil Parrish Jr. as a 17.6 acre parcel of MP-15. The ground held by MP-15 was contiguous on the west with MP-148 of Parrish and Tom Holliday. The only ore production shown in the AEC records is a 1955 shipment by J.L. Foutz to the AEC ore-buying station at Shiprock, New Mexico. This shipment, made in January 1955, consisted of 9.60 tons of ore that averaged 0.31 percent U_3O_8 and 0.71 percent V_2O_5 (Table 6). Mine workings at the Mitten No. 3 consist of a short adit (Figure 5).

Monument No. 3

The Monument No. 3 mine is located on a hogback ridge, approximately three miles southwest of Oljeto Trading Post (Fig

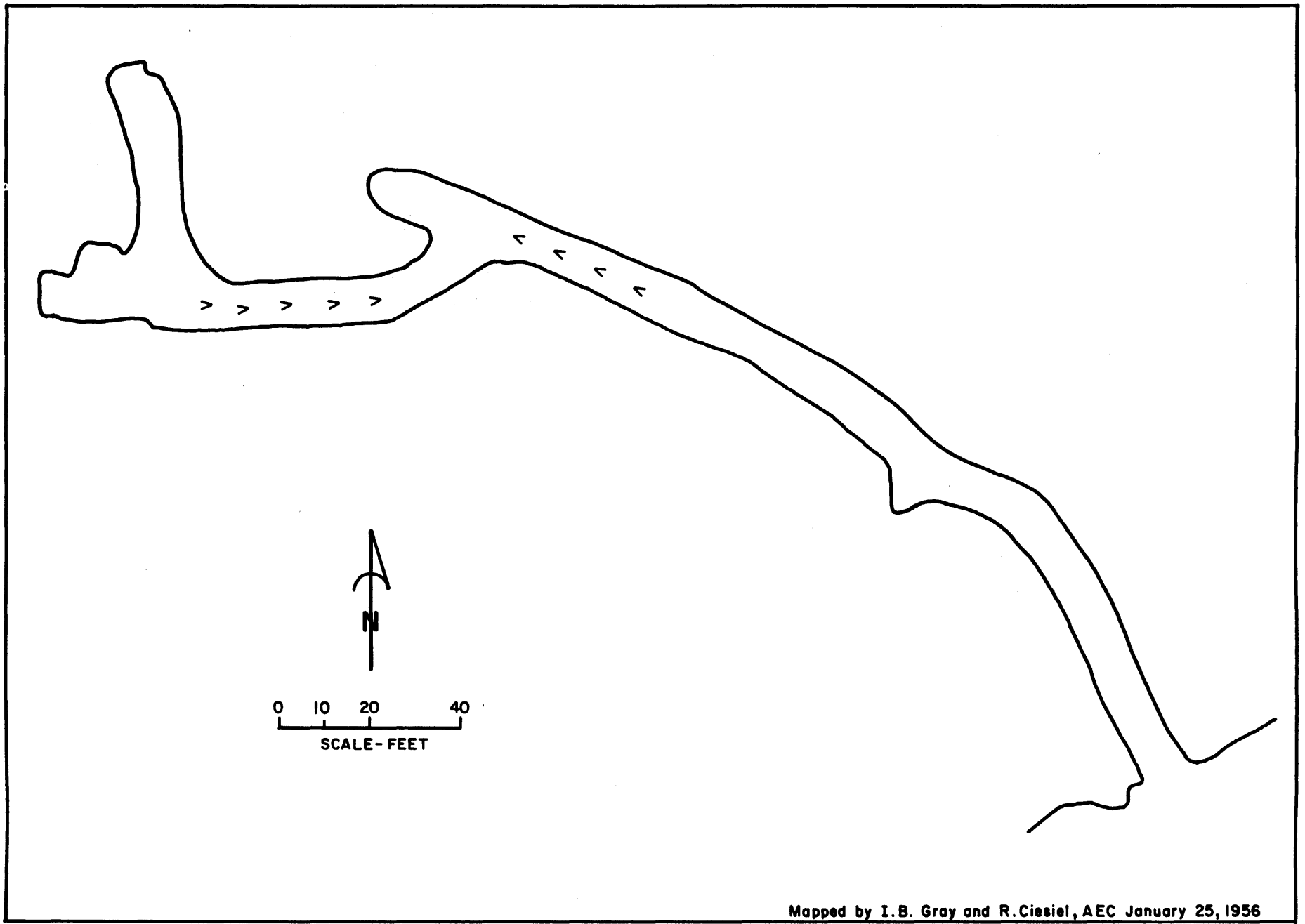


Figure 5. Plan map of the Mitten No. 3 mine

ure 2). The hogback ridge is capped with sediments of a north-south trending Shinarump channel. Lease I-149-IND-6256, held by VCA, covered 12.7 acres of the hogback.

The only shipment from this lease was made in October 1949 by VCA to its mill at Naturita, Colorado. It consisted of 6.29 tons of ore which averaged 0.47 percent U_3O_8 and 3.60 percent V_2O_5 (Table 6). The ore came from a rim stripped area and a small adit at the southern end of the hogback. VCA reportedly cancelled its lease in the early 1950's.

Rock Door No. 1

The Rock Door No. 1 mine is located in a small remnant of Shinarump channel-fill sediments that cap Rock Door Mesa, 0.8 miles northwest of Goulding's Trading Post (Figure 2). A total of 3.92 acres surrounding the mineralized outcrop was claimed by Harry A. Binale as MP-32 issued on May 1, 1952. Mining rights of the permit were assigned to Harry Goulding on May 2, 1952. Goulding contacted VCA who did some exploratory drifting into the mineralized exposure, but shipped no ore. Access to the mesa top was via a steep trail up a talus slope. Goulding relinquished his assignment on June 11, 1953.

The assignment of MP-32 to Dean Nicholson was approved on July 29, 1953. Nicholson mined and shipped two 13-ton loads to the AEC ore-buying station at Shiprock, New Mexico. One in late 1953 and the other in early 1954. The ore was lowered in sacks to the valley floor via a cable. The property has been idle since April 1954. Total production was 25.33 tons of ore that averaged 0.65 percent U_3O_8 and 1.85 percent V_2O_5 (Table 6). The mine workings consist of three short adits.

School Section 36

Section 36, T.43S., R.14E. is located on Atene Mesa three miles south of Oljeto Trading Post. All but the $NW\frac{1}{4}$, $NW\frac{1}{4}$ of the section is Utah school land. The $NE\frac{1}{4}$ was leased by A.F. Allen

in 1951 and 1952, and the NE $\frac{1}{4}$, SE $\frac{1}{4}$ was leased by Newlyn A. Nordeen in 1952 and 1953. The Nordeen lease was terminated on March 6, 1953. All of the state land in the section was leased by Reubin M. Heflin of Flagstaff, Arizona on Utah State Mineral Leases ML-5109 and ML-5113, dated March 6 and 20, 1953. On August 20, 1954, Heflin assigned his leases to the Texas Mining Company of Austin, Texas, retaining a 12 $\frac{1}{2}$ percent royalty. The assignment was approved by the Utah State Land Board on September 17, 1954. The Texas Mining Company entered into an agreement with Monument Exploration and Mining Company a November 13, 1954 to drill the leases. Some 8,000 feet of drilling located two orebodies in the northward projection of the channel containing the Fern mine in Arizona (Figure 2).

The Oljeto Venture Agreement between all parties was signed on April 10, 1955 and the operating partner was known as Radium Hill Uranium, Incorporated. Ores produced from Section 36 were subject to royalties totalling more than 30 percent (Unpublished AEC report, 1955). The Oljeto Venture was approved by the State Land Board on April 6, 1956.

The first orebody to be mined was located 2,000 feet northwest milepost monument no. 207 on the Utah-Arizona boundary. A 100-foot decline was sunk to the orebody and the initial shipment was made to the AEC's ore-buying station at Monticello in August, 1955. A small shipment in late 1955 was sent to the AEC's ore-buying station at Shiprock, New Mexico. This mine was known as the Utah No. 1. By early 1956, the mined out area at the Utah No. 1 decline covered an area 250 feet by 50 feet. Production continued until mid-1956 with the shipments going to Monticello. A perched water table in the basal Shinarump was encountered during mining at the Utah No. 1.

During May 1956, a new decline was started 900 feet northwest of milepost monument no. 207. This mine was known as Radium Hill No. 1 (Figure 2). By December 1956, the mine workings of the Radium Hill had connected with those of the Fern mine on adjacent Navajo land in Arizona. Production from the Radium Hill mine continued into late 1957 with all shipments going to Monticello.

AEC records do not break down the shipments between the two mines, and list all shipments as School Section 36.

On March 22, 1957, Texas Mining Company assigned its interest in the leases to Radium Hill Uranium, Incorporated. The leases (ML-5109, ML-5113) were both terminated on February 19, 1960.

A & B Mining Company of Moab, Utah acquired a new lease on the area of the mines in mid-1960, and began some clean-up mining at the two mines in 1960 and 1961. Shipments in 1960 went to the Texas-Zinc mill at Mexican Hat, Utah and those in 1961 went to Monticello. When the two mines on Section 36 closed in mid-1961, they had produced a total of 12,776.09 tons of ore averaging 0.34 percent U_3O_8 and 0.21 percent V_2O_5 (Table 6). School Section 36 has produced more uranium than any other property in the Utah portion of Monument Valley.

Skyline

The Skyline mine is located in a small remnant (5 acres) of Shinarump channel-fill sediments on the easternmost tip of Oljeto Mesa. There are portals at both the east and west ends of the Shinarump remnant (Figure 6). The area of the mine is approximately two miles west northwest of Goulding's Trading Post (Figure 2).

In August, 1949, Morgan Neilson of Blanding, Utah, applied to the Office of Indian Affairs for a 40 acre lease covering the SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 26, T.43S., R.15E. This was the same 40 acres leased to Carroll and Shumway in 1944. Lease I-149-IND-8310 was approved to Neilson on October 6, 1949. Neilson commenced shipments to the AEC's ore-buying station at Monticello, Utah and identified the property as the Skyline mine. During 1950, Neilson transferred the lease to Barney Cockburn of Artesia, New Mexico, but retained a seven and one-half percent royalty. Cockburn continued shipments to Monticello. During 1951, Cockburn used the Garwood and Gerlach Mining Company of Cortez, Colorado as a mining contractor, and they continued shipments to Monticello.

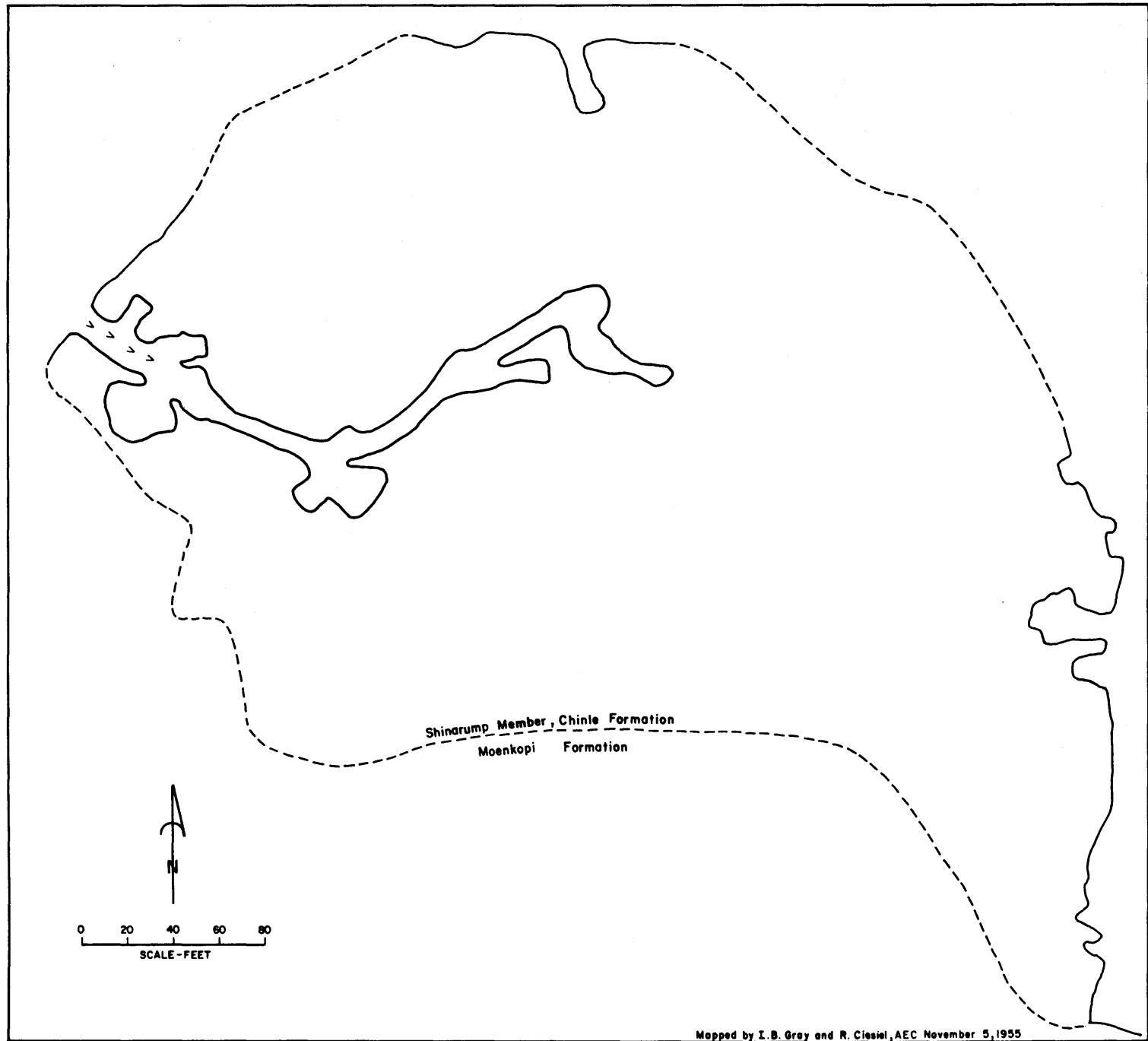


Figure 6. Plan map of the Skyline mine

In January 1952, Neilson relinquished his seven and one-half percent royalty to Cockburn, and on December 3, 1952, the assignment of Lease I-149-IND-8310 to Archie Garwood and R.C. Gerlach was approved by the Bureau of Indian Affairs (formerly the Office of Indian Affairs).

Garwood and Gerlach continued mining during the years 1952 through 1953. With the exception of some small shipments to the AEC ore-buying station at Shiprock, New Mexico in 1952 and 1953, all of the Skyline ore was shipped to Monticello. Garwood and Gerlach completed mining in early 1955 and the lease was cancelled late that year.

Jimmie Goodman acquired the same 40 acres of Lease I-149-IND-8310 as MP-401 on January 12, 1956. The assignment of the mining rights to this permit were approved to A & B Mining Company of Moab, Utah in early 1960. A & B did some clean-up mining and shipped some 1,613.78 tons of ore averaging 0.20 percent U_3O_8 to the Texas-Zinc Minerals Corporation mill at Mexican Hat, Utah during 1960. A & B cancelled its assignment in late 1960.

MP-401 expired after six years and a new permit, MP-562, was granted to Jimmie Goodman on January 12, 1962. The assignment to A & B Mining Company was approved on May 23, 1962. A & B shipped 83.60 tons of ore that averaged 0.13 percent U_3O_8 and 0.29 percent V_2O_5 to the ore-buying station at the Atlas Minerals mill at Moab, Utah in June 1962, and cancelled its assignment on February 5, 1963.

Total production from the Skyline mine was 5,089.61 tons of ore that averaged 0.33 percent U_3O_8 and 0.35 percent V_2O_5 (Table 6). The Skyline mine is the fourth largest uranium mine in Monument Valley, Utah.

Taylor Reid No. 1

The adit of the Taylor Reid No. 1 mine is located near the western tip of Holiday Mesa, 1.9 miles northwest of Oljeto Trading Post (Figure 2). The original mineralized outcrop at the

adit was located by D.E. Trimble of the U.S. Geological Survey in June 1952 (Trimble, 1952).

MP-66, covering 40.9 acres of the western end of Holiday Mesa, was issued to Taylor Reid on September 26, 1952. Parcel No. 1 of this mining permit was on Holiday Mesa, and Parcel No. 2 was in the Cameron mining area, Coconino County, Arizona. The AEC drilled Holiday Mesa in 1954-55 and discovered orebodies in the area of the permit and the adjacent permit (MP-148) of Cecil Parrish Jr. (Evensen and Gray, 1957).

The assignment of the rights to MP-66 were approved to Howard Wilson of Gallup, New Mexico on April 10, 1953. In 1956, Wilson contracted with Vernon Bloomfield of Farmington, New Mexico to mine the ore discovered by the AEC. Other contract miners used by Wilson included Harry Kildow and Capital Uranium Corporation. In late 1958, Capitol Uranium Corporation began shipments from the eastern Taylor Reid orebody which was accessible via the C-3 mine workings (Figure 3). Wilson shipped ore to the AEC ore-buying station at Monticello, Utah in 1956, 1958, and 1959. Wilson cancelled his assignment in 1960.

Dumont Development Corporation of Montrose, Colorado was approved the assignment of the mining rights to MP-66 on January 6, 1961. Dumont shipped ore to Texas-Zinc Minerals' mill at Mexican Hat, Utah in 1961 and 1962. During 1962, Dumont mined the eastern orebody on the Taylor Reid No. 1 via the C-3 mine, which they also controlled. A total of 489.27 tons were shipped to the Union Carbide Nuclear mill at Uravan, Colorado in 1962. A 984.65 ton shipment of comingled ore from Taylor Reid and C-3 mines also was made to Union Carbide in 1962. At Uravan, payment was received for the vanadium. Dumont cancelled its assignment on September 26, 1962.

A new permit, MP-585, was issued to Taylor Reid, for the same 40.9 acres, on December 21, 1962. The assignment to A & B Mining Company of Moab, Utah was approved January 26, 1963. During July and August 1963, A & B shipped 550.76 tons of ore averaging 0.28 percent U_3O_8 to the Mexican Hat mill and to the ore-buying station at Moab, Utah. The majority of this ore

came from the Taylor Reid workings contiguous with its C-3 mine. A & B cancelled its assignment on December 13, 1963.

The assignment of MP-585 to the Shumway Brothers Mining Company and Kay P. Johnson was approved December 23, 1963. The Shumways and Johnson shipped no ore during 1964 and the mining permit and assignment expired December 21, 1964.

A new permit, MP-604, was issued to Taylor Reid in early 1965 for the same 40.9 acres as MP-585. The assignment to VCA was approved April 26, 1965. VCA used the Shumway Brothers Mining Company to contract mine for them in 1965 with shipments made to the VCA mill at Shiprock, New Mexico. The Rodgers Brothers Mining Company of Monticello, Utah assumed contract mining for VCA in January and February 1966. The final shipment from the Taylor Reid permit was made to Shiprock in February 1966. These latter shipments probably came from the workings via the C-3 decline.

Total production from the Taylor Reid mining permit was 7,266.64 tons of ore which averaged 0.22 percent U_3O_8 . Shipments that were analyzed for vanadium averaged 0.31 percent V_2O_5 (Table 6). Not included in these totals are the 984.65 tons of ore comingled with the C-3 ore shipped in 1962. The Taylor Reid No. 1 property is the fifth largest uranium producer in Monument Valley, Utah.

Tom Holliday (Rock Hat)

The Tom Holliday prospect is located at the eastern end of Oljeto Mesa approximately 0.7 miles southwest of the Mitten No. 1 mine. It occurs in the same Shinarump channel on Oljeto Mesa as the Mitten No. 1 and Skyline mines (Figure 2).

The area of the prospect was claimed by Tom Holliday as an unnumbered mining permit issued in early 1950. In October and November 1950, a total of 11.54 tons averaging 0.12 percent U_3O_8 and 1.25 percent V_2O_5 were shipped to the VCA mill at Durango, Colorado (Table 6). The shipper was listed as Tom Holliday but the mining was done by VCA. In the AEC records the property was identified as Rock Hat and listed on Oljeto Mesa,

Navajo County, Arizona. The mine workings consist of one short adit. The ground was later held by Tom Holliday as MP-160.

Whirlwind

The Whirlwind mine is located on the northeast side of Monitor Butte in the SW $\frac{1}{4}$ Section 2, T.41S., R.13E., which is Utah State School land. The mine is on the south bank of San Juan River (Glen Canyon National Recreation Area), approximately 16 miles northwest of Oljeto Trading Post (Figure 2).

Utah State Mineral Lease ML-3226, for the SW $\frac{1}{4}$ Section 2, was issued to Lee, Mervin, Harris, and Burdett Shumway of Blanding, Utah on April 7, 1950. On October 6, 1950, Harris Shumway assigned his 25 percent interest to Calvin Black, also of Blanding. To reach the area where a mineralized outcrop had been located, 19 miles of Indian trails had to be improved and three miles of a rough road constructed (U.S. Atomic Energy Commission, 1951). Mining commenced in October 1950, and in November Calvin Black and Burdett Shumway made an initial 76.78 ton shipment to the VCA mill at Durango, Colorado. During the period 1950-1953, shipments were made by Calvin Black, Black and Burdett Shumway, Mervin and Burdett Shumway and sub leasor, Lark Washburn. Ore was also shipped by the Whirlwind Mining Company (Black and the Shumways) (Table 6). These individuals made small shipments to mills and/or ore-buying stations at Durango, Naturita, and Rifle, Colorado; Monticello and Salt Lake City, Utah; and Shiprock, New Mexico. Early shipments averaged 1.00 - 2.00 percent copper, in the form of chalcocite (U.S. Atomic Energy Commission, 1951).

On May 1, 1953, Lee, Mervin, and Burdett Shumway assigned their 75 percent of the lease to Calvin Black. Black now controlled 100 percent of the lease. On the same date, May 1, 1953, Calvin Black assigned 40 percent to Keith C. Jones and 20 percent to Carl Perkins. Further assignments of Lease ML-3226 were made on May 21, 1954. On that date, Perkins assigned his 20 percent, Black, his 40 percent, and 20 percent of Jones' interest to Oljeto Uranium Company. Jones' other 20 percent was assigned to Max K. Magnum. Oljeto Uranium began shipments in mid-1954, and

with the exception of 1956, would continue into 1960. The 1954 shipments were made to the VCA mill at Durango, Colorado. Those shipments in 1955, and 1957 through 1959 went to the AEC ore-buying station at Monticello, Utah, and the 1960 shipments were sent to the Kerr- McGee Oil Industries mill at Shiprock, New Mexico.

Oljeto Uranium Company assigned its 80 percent interest in the lease to Ivor Adair of Moab, Utah on October 20, 1961. Adair, doing business as A and B Mining Company, operated the mine in November and December 1962, with 56.91 tons of low-grade ore shipped to the Kerr-McGee mill at Shiprock, New Mexico in December 1962. Lease ML-3226 was terminated on March 1, 1963.

A new State Mineral Lease, ML-22960, for the SW $\frac{1}{4}$ Section 2, was issued to the Shumway and Rodgers Mining Company (Gilbert Shumway and Fredrick Rodgers) of Monticello, Utah on July 12, 1965. During July and August 1965, Shumway and Rodgers shipped 134.68 tons of ore that averaged 0.18 percent U_3O_8 and 0.71 percent V_2O_5 to the mill at Shiprock, now operated by VCA. The mine was closed in late August 1965.

Lease ML-22960 was transferred from Shumway and Rodgers to Fredrick and Kent Rodgers of Monticello, Utah on February 28, 1966. The Rodgers Brothers reopened the mine in March 1966 and made shipments to the mill at Shiprock through June 1966. Most all of the ore the Rodgers Brothers produced, 515.63 tons averaging 0.08 percent U_3O_8 and 0.67 percent V_2O_5 , was the result of clean-up mining such as pulling pillars, etc. The Whirlwind mine was closed for the final time in July 1966. The Whirlwind is the third largest mine in the Utah portion of Monument Valley. Total production was 15,777.85 tons of ore that averaged 0.22 percent U_3O_8 and 1.08 percent V_2O_5 (Table 6). A plan map of the workings is shown in Figure 7.

OUTLOOK AND POTENTIAL RESOURCES

When mining ceased in the Utah portion of Monument Valley in mid-1966, all of the economic uranium ore had been depleted. Some lower grade material remained in many of the mines and in

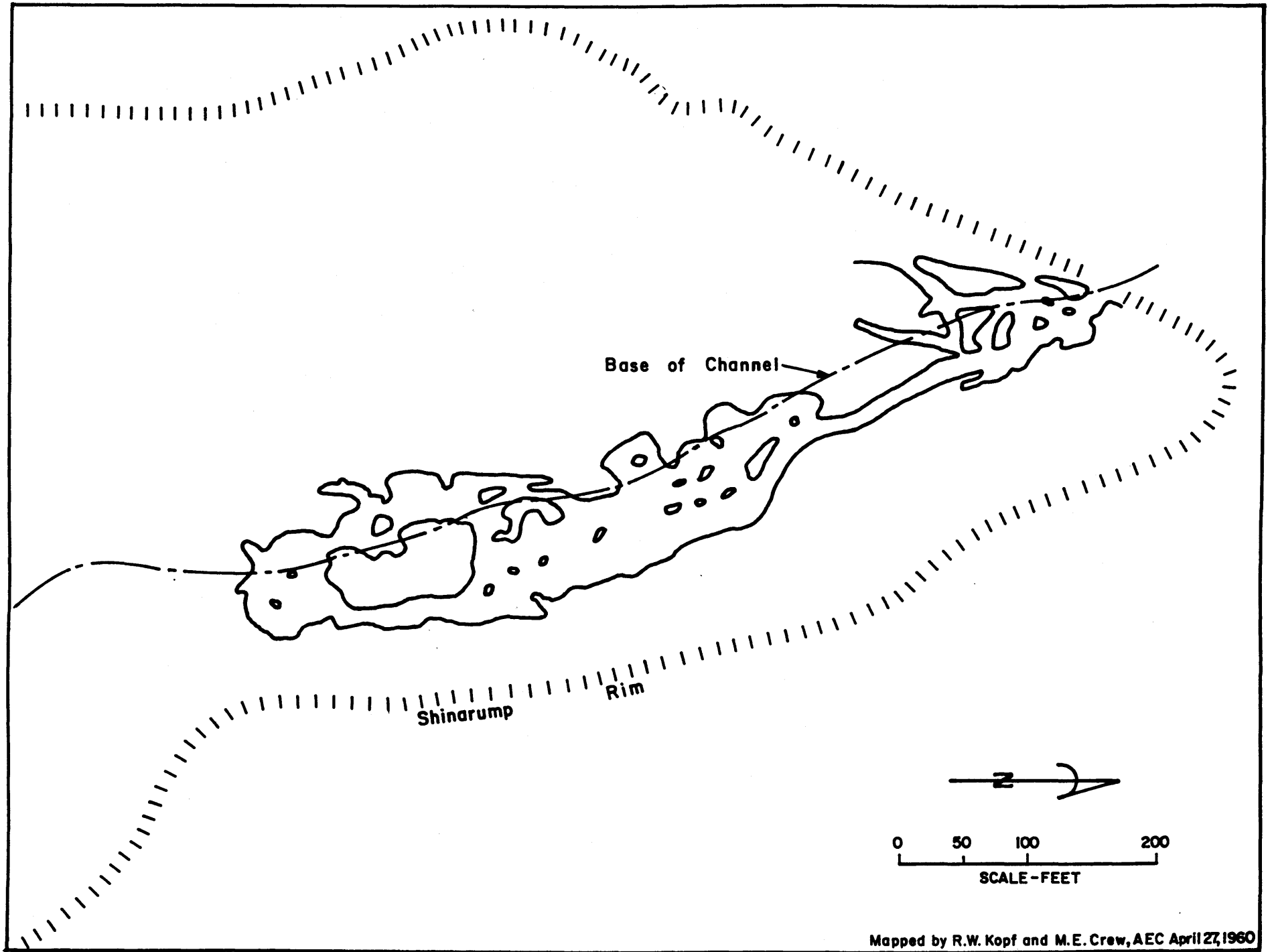


Figure 7. Plan map of the Whirlwind mine

Mapped by R.W. Kopf and M.E. Crew, AEC April 27, 1960

Table 6: Details of Uranium-Vanadium Production, Monument Valley, San Juan County, Utah

Mine	Tons of Ore	Pounds U_3O_8	Percent U_3O_8	Pounds V_2O_5	Percent ^{1/} V_2O_5	Period of Production	Operator
C-3	5,007.99	20,809.50	0.21	15,906.93	0.36	1957 1959-60 1961-62 1963 1965	Copper Canyon Mining Capital-Seaboard Dumont Development A & B Mining VCA
C-3 and Taylor Reid No. 1 ^{2/}	984.65	4,952.64	0.25	7,117.72	0.36	1962	Dumont Development
Charles Keith	58.59	236.57	0.27	178.67	0.21	1954-55	Shasta Copper & Uranium
Harvey Blackwater No. 3	557.08	1,794.40	0.16	514.14	0.05	1954-55	Mex-Air Uranium
Henry L. Sampson Nos. 1 and 9	31.84	65.63	0.10	77.38	0.12	1955	Spencer Uranium
Mitten No. 1	6,419.64	71,599.15	0.56	139,837.71	1.09	1951-56 1956 1961	J. L. Foutz Copper Canyon Mining A & B Mining
Mitten No. 3	9.60	61.43	0.32	136.31	0.71	1955	J. L. Foutz
Monument No. 3	6.29	59.16	0.47	453.00	3.60	1949	VCA
Rock Door No. 1	25.33	331.26	0.65	936.92	1.85	1953-54	Dean Nicholson
School Section 36	12,776.09	87,736.66	0.34	50,898.10	0.21	1955-57 1961-62	Radium Hill A & B Mining
Skyline	5,089.61	33,927.14	0.33	24,664.96	0.35	1944 1949-50 1950-51 1951-55 1960, 1962	Carroll & Shumway Morgan Neilson Barney Cockburn Garwood & Gerlach A & B Mining

Table 6: Continued

Mine	Tons of Ore	Pounds U_3O_8	Percent U_3O_8	Pounds V_2O_5	Percent ^{1/} V_2O_5	Period of Production	Operator
Taylor Reid No. 1	7,266.64	31,857.60	0.22	14,026.25	0.31	1956, 1959 1958 1961-62 1963 1965-66	Howard Wilson Harry Kildow Dumont Development A & B Mining VCA
Tom Holliday (Rock Hat)	11.54	28.84	0.12	288.00	1.25	1950	Tom Holliday
Whirlwind	15,777.85	69,403.52	0.22	277,779.08	1.08	1950-51 1950-52 1951 1952-53 1952 1954-55 1957-60 1962 1965 1966	Black & Shumway Calvin Black Lark Washburn M & B Shumway Whirlwind Mining Oljeto Uranium Oljeto Uranium A & B Mining Shumway & Rodgers Rodgers & Rodgers
TOTALS	<u>54,033.14</u>	<u>322,802.07</u>	<u>0.30</u>	<u>532,738.86</u>	<u>0.65</u>		

^{1/} Grade calculated on the actual tons of ore analyzed for vanadium oxide.

^{2/} 1962 shipments to Union Carbide Nuclear at Uravan, Colorado with no breakdown between mines.

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

the unmined Norcross deposit on Oljeto Mesa (Figure 2). Most of the mines are now inaccessible due to the portals being blocked and also due to flooding by ground water.

The channel trends are well known and have been fairly well explored. A study of the potential resources of Monument Valley by DOE geologists as part of the National Uranium Resource Evaluation (NURE) program determined that the only area in Utah where new deposits might be found was in the eastern, and downdip, projection of the small channel containing the Harvey Blackwater No. 3 deposit (R.C. Malan, written communication, 1979). Even with a large increase in the price of uranium, and a strong market, the future of uranium mining in Monument Valley, Utah appears to be poor.

A C K N O W L E D G E M E N T S

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REFERENCES

- Albrethsen, H., Jr., and McGinley, F. A., 1982, Summary history of domestic uranium procurement under U. S. Atomic Energy Commission contracts, final report: U. S. Department of Energy Report GJBX-220 (82) 162 p.
- Bain, G. W., 1952, Uranium deposits in southwestern Colorado Plateau: U. S. Atomic Energy Commission Raw Materials Operations Report RMO-982 (rev.), 59 p.
- Butler, G. M., and Allen, M. A., 1921, Uranium and radium: University of Arizona Bulletin No. 117, Mineral Technology Series No. 27, 26 p.
- Chenoweth, W. L., 1990, A history of uranium production in Utah: Utah Geological Association, Guidebook, in preparation.
- Chester, J. W., and Donnerstag, P. H., 1952, Drilling in Monument Valley area of Arizona and Utah: U. S. Atomic Energy Commission Raw Materials Operations Report RMO-830, 95 p.
- Chester, J. W., and Pitman, R. K., 1952, Investigational drilling, Hoskinnini Mesa: U. S. Atomic Energy Commission Technical Memorandum TM-13, 2 p.
- Correll, J. L., and Dehiya, A., 1978, Anatomy of the Navajo Indian Reservation, how it grew: Navajo Times Publishing Co., Window Rock, Arizona, 63 p.
- Cummings, W. L., 1952, Airborne radioactivity survey of part of the Navajo Indian Reservation of Utah and Arizona: U. S. Atomic Energy Commission Raw Materials Operations Report RMO-808, 26 p.
- Cutter, R. C., 1952, Investigation of Shinarump channels on Oljeto Mesa, Arizona and Utah: U. S. Atomic Energy Commission Technical Memorandum TM-3, 2 p.
- Doelling, H. H., 1969, Mineral resources, San Juan County, Utah and adjacent areas, Part II: uranium and other metals in sedimentary host rocks: Utah Geological and Mineral Survey Special Studies, Part II, 64 p.
- Dubiel, R. F., 1983, Sedimentology of the lower part of the Upper Triassic and its relationship to uranium deposits, White Canyon area, southeastern Utah: U. S. Geological Survey Open-File Report 83-459, 48 p.

- Evensen, C. G., and Gray, I. B., 1957, Geology of Monument Valley uranium deposits, Arizona and Utah: U. S. Atomic Energy Commission Raw Materials Exploration Report RME-95, 38 p.
- General Services Administration, 1981, Navajo vanadium narrative in Accounting report on Navajo property, copper, missions, National Monuments, rights of way, sand, rock, gravel, and vanadium, Dockets 69, 299, 353, volume 1: General Services Administration, Indian Trust Accounting Division Report, p. 46-65, appendix 67 p., exhibits 19-54.
- Gregg, C. C., 1951, Reconnaissance and investigational drilling on Hoskinnini and Nokai Mesas, San Juan County, Utah, and Navajo County, Arizona: U. S. Atomic Energy Commission Raw Materials Operations Report RMO-987, 10 p.
- Gregg, C. C., and Evensen, C. G., 1989, Maps of the underground workings, Monument No. 2 mine, Apache County, Arizona, with a text by W. L. Chenoweth: Arizona Geological Survey Contributed Report CR-89-D, 35 p.
- Gregory, H. E., 1917, Geology of the Navajo country, a reconnaissance of parts of Arizona, New Mexico and Utah: U. S. Geological Survey Professional Paper 93, 161 p.
- Gruner, J. W., Gardiner, L., and Smith, D. K., Jr., 1954, Mineral associations in the uranium deposits of the Colorado Plateau and adjacent regions: U. S. Atomic Energy Commission Raw Materials Exploration Report RME-3092, 48 p.
- Lewis, R. Q., Sr., 1954, Appraisal and recommendations for drilling on Holiday Mesa, Monument Valley, Utah: U. S. Geological Survey Trace Elements Memorandum Report TEM-712, 12 p.
- Lewis, R. Q., Sr., and Trimble, D. E., 1959, Geology and uranium deposits of Monument Valley, San Juan County, Utah: U. S. Geological Survey Bulletin 1087-D, p. 105-131.
- Malan, R. C., 1968, The uranium mining industry and geology of the Monument Valley and White Canyon districts, Arizona and Utah, in Ridge, J. D., ed., Ore deposits of the United States 1933-1967: American Institute of Mining, Metallurgical, and Petroleum Engineers, p. 790-804.
- Presley, C. K., 1957, Drilling in the Monument Valley area, San Juan County, Utah and Navajo County, Arizona: U. S. Atomic Energy Commission Technical Memorandum TM-137, 6 p.
- Reinhardt, E. V., 1951, Reconnaissance trip to Monument Valley in Utah and Arizona: U. S. Atomic Energy Commission Raw Materials Operations Report RME-624, 13 p.

- Reinhardt, E. V., 1952, Uranium-copper deposits near Copper Canyon, Navajo Indian Reservation, Arizona: U. S. Atomic Energy Commission Raw Materials Operations Report RMO-709, 9 p.
- Trimble, D. E., 1952, Unclaimed mineralized area in the Shinarump conglomerate, northwest of Oljeto Trading Post, Utah: U. S. Geological Survey Trace Elements Memorandum Report TEM-353, 4 p.
- U. S. Atomic Energy Commission, 1951, Uranium exploration on the Colorado Plateau, interim staff report: U. S. Atomic Energy Commission Raw Materials Operations Report RMO-1000, 75 p.
- U. S. Atomic Energy Commission, 1959, Monument Valley district in Guidebook to uranium deposits of western United States: U. S. Atomic Energy Commission Raw Materials Exploration Report RME-141, p. 2-55 - 2-64.
- Witkind, I. J., 1961, The uranium-vanadium ore deposit at the Monument No. 1 - Mitten No. 2 mine, Monument Valley, Navajo County, Arizona: U. S. Geological Survey Bulletin 1107-C, p. 219-242.
- Witkind, I. J., and Thaden, R. E., 1963, Geology and uranium-vanadium deposits of the Monument Valley area, Apache and Navajo Counties, Arizona, with sections on serpentine at Garnet Ridge by H. E. Malde and R. E. Thaden and mineralogy and paragenesis of the ore deposit at the Monument No. 2 and Cato Sells mines by D. H. Johnson: U. S. Geological Survey Bulletin 1103, 171 p.
- Young, R. G., 1964, Distribution of uranium deposits in the White Canyon-Monument Valley district, Utah-Arizona: Economic Geology vol. 59, p. 850-873.
- Young, R. G., and Malan, R. C., 1964, Geologic map showing uranium deposits and Shinarump channels in the Monument Valley district, San Juan County, Utah, Navajo and Apache Counties, Arizona: U. S. Department of Energy Preliminary Map No. 34, scale 1:95,000.

A P P E N D I X

Details of the Annual Uranium-Vanadium Ore Production, 1944 - 1966, Monument Valley, Utah.

<u>Mine</u>	<u>Tons of Ore</u>	<u>Pounds U₃O₈</u>	<u>%U₃O₈</u>	<u>Pounds V₂O₅</u>	<u>%V₂O₈</u>	<u>Shipper</u>
1944						
Utah No. 1 (Skyline)	51.88	4,183.25	4.03	5,703.69	5.50	Carroll & Shumway
1945 - 1948						
No reported production						
1949						
51 Monument 3 Skyline	6.29 <u>205.23</u>	59.16 <u>1,338.94</u>	0.47 <u>0.33</u>	453.00 <u>2,973.65</u>	3.60 <u>0.72</u>	VCA Morgan Neilson
1949 TOTAL	211.52	1,398.10	0.33	3,426.65	0.81	
1950						
Rock Hat Skyline Skyline Whirlwind Whirlwind (3226) Whirlwind	11.34 733.11 509.74 117.99 76.78 <u>66.43</u>	28.84 1,489.79 1,975.42 405.31 145.79 <u>203.19</u>	0.12 0.10 0.19 0.17 0.09 <u>0.15</u>	288.00 2,404.60 3,242.31 5,018.21 3,109.00 <u>3,184.14</u>	1.25 0.16 0.32 2.13 2.02 <u>2.39</u>	Tom Holliday Barney Cockburn Morgan Neilson Calvin Black Black & Shumway Black & Shumway
1950 TOTAL	1,515.61	4,248.34	0.14	17,246.26	0.57	

<u>Mine</u>	<u>Tons of Ore</u>	<u>Pounds U₃O₈</u>	<u>%U₃O₈</u>	<u>Pounds V₂O₅</u>	<u>%V₂O₈</u>	<u>Shipper</u>
1951						
Skyline	21.93	106.16	0.24	140.56	0.32	Barney Cockburn
Skyline	20.79	137.32	0.33	271.57	0.65	Garwood & Gerlach
Whirlwind	452.84	2,087.93	0.23	22,586.41	2.49	Calvin Black
Whirlwind	17.36	57.00	0.16	535.00	1.54	Black & Shumway
Whirlwind	8.01	20.02	0.12	272.00	1.70	Lark Washburn
1951 TOTAL	520.93	2,408.43	0.23	23,805.54	2.28	
1952						
Mitten No. 1	8.39	28.53	0.17	21.81	0.13	J. L. Foutz
Skyline	635.91	4,396.10	0.35	2,660.67	0.21	Garwood & Gerlach
Whirlwind	186.72	395.45	0.11	4,372.03	1.17	Calvin Black
Whirlwind	6.10	37.84	0.31	269.00	2.20	M & B Shumway
Whirlwind	28.92	187.78	0.32	1,173.68	2.03	Whirlwind Mining
1952 TOTAL	866.04	5,045.70	0.29	8,479.19	0.49	
1953						
Mitten No. 1	2,207.04	26,147.73	0.59	50,607.37	1.14	J. L. Foutz
Rock Door 1	12.54	209.94	0.84	562.25	2.24	Dean Nicholson
Skyline	611.19	10,112.19	0.83	5,020.01	0.41	Garwood & Gerlach
Whirlwind	143.53	437.02	0.15	4,676.55	1.63	M & B Shumway
1953 TOTAL	2,974.30	36,906.88	0.62	60,866.18	1.02	
1954						
Charles Keith	16.86	67.43	0.20	-	-	Shasta Copper & Uran.
Harvey Blackwater3	446.63	1,459.29	0.16	377.22	0.05	Mex-Air Uranium
Mitten 1	2,021.21	29,348.70	0.73	50,905.93	1.26	J. L. Foutz
Rock Door 1	12.79	121.32	0.47	374.67	1.46	Dean Nicholson
Skyline	488.34	1,804.95	0.18	1,507.33	0.15	Garwood & Gerlach
Whirlwind	94.72	310.34	0.16	2,406.67	1.27	Oljeto Uranium
1954 TOTAL	3,080.55	33,112.03	0.54	55,571.82	0.91	

<u>Mine</u>	<u>Tons of Ore</u>	<u>Pounds U₃O₈</u>	<u>% U₃O₈</u>	<u>Pounds V₂O₅</u>	<u>% V₂O₈</u>	<u>Shipper</u>
1955						
Charles Keith	41.73	169.14	0.20	178.67	0.21	Shasta Copper & Uran.
Harvey Blackwater 3	130.45	335.11	0.13	136.92	0.05	Mex-Air Uranium
Henry L. Sampson 1&9	31.84	65.63	0.10	77.38	0.12	Spencer Uranium
Mitten 1	671.73	5,271.27	0.39	13,598.62	1.01	J. L. Foutz
Mitten 3	9.60	61.43	0.32	136.31	0.71	J. L. Foutz
School Section 36	1,249.50	3,030.71	0.12	2,364.50	0.09	Radium Hill Uranium
Skyline	114.11	280.21	0.12	255.72	0.11	Garwood & Gerlach
Whirlwind	<u>1,879.87</u>	<u>7,558.60</u>	<u>0.20</u>	<u>39,969.94</u>	<u>1.06</u>	Oljeto Uranium
1955 TOTAL	4,128.83	16,772.10	0.20	56,718.06	0.69	
1956						
C-3	221.81	1,703.80	0.38	2,008.84	0.45	Ashcroft and Foutz
C-3	1,365.76	6,649.24	0.24	10,028.09	0.37	Copper Canyon Mining
Mitten 1	572.70	5,089.14	0.44	11,533.38	1.01	Copper Canyon Mining
Mitten 1	26.12	282.09	0.54	480.60	0.92	J. L. Foutz
School Section 36	2,163.69	15,221.36	0.35	9,797.86	0.23	Radium Hill Uranium
Taylor Reid 1	<u>200.90</u>	<u>1,222.27</u>	<u>0.30</u>	<u>2,171.00</u>	<u>0.54</u>	Howard Wilson
1956 TOTAL	4,550.98	30,167.90	0.33	36,019.77	0.40	
1957						
School Section 36	8,120.47	64,739.67	0.40	38,219.68	0.24	Radium Hill Uranium
Whirlwind	<u>1,149.53</u>	<u>4,812.13</u>	<u>0.21</u>	<u>31,483.00</u>	<u>1.37</u>	Oljeto Uranium
1957 TOTAL	9,270.00	69,551.80	0.37	69,702.68	0.38	
1958						
Taylor Reid No. 1	58.74	259.63	0.22	516.91	0.44	Harry Kildow
Whirlwind	<u>5,668.77</u>	<u>25,686.24</u>	<u>0.23</u>	<u>106,908.00</u>	<u>0.94</u>	Oljeto Uranium
1958 TOTAL	5,727.51	25,945.87	0.23	107,424.91	0.94	

<u>Mine</u>	<u>Tons of Ore</u>	<u>Pounds U₃O₈</u>	<u>%U₃O₈</u>	<u>Pounds V₂O₅</u>	<u>%V₂O₈</u>	<u>Shipper</u>
1959						
C-3	2,375.14	8,523.03	0.18	3,799.00	0.35	Capital-Seaboard
Taylor Reid 1	337.11	1,127.96	0.17	2,725.00	0.40	Howard Wilson
Whirlwind	<u>4,256.34</u>	<u>21,685.00</u>	<u>0.25</u>	<u>31,104.00</u>	<u>0.80</u>	Oljeto Uranium
1959 TOTAL	6,968.59	31,335.99	0.22	37,628.00	0.67	
1960						
C-3	273.57	591.26	0.11	-	-	Capital Seaboard
Skyline	1,613.78	7,888.48	0.24	-	-	A & B Mining
Whirlwind	<u>620.80</u>	<u>2,531.73</u>	<u>0.20</u>	-	-	Oljeto Uranium
1960 TOTAL	2,508.15	11,011.47	0.22			
1961						
C-3	139.02	767.39	0.28	-	-	Dumont Development
Mitten 1	839.25	5,197.27	0.31	11,999.00	0.71	A & B Mining
Mitten 1	73.20	234.42	0.16	691.00	0.47	Bill Adair
School Section 36	819.42	3,105.37	0.19	-	-	A & B Mining
Taylor Reid 1	<u>1,734.79</u>	<u>7,267.01</u>	<u>0.21</u>	-	-	Dumont Development
1961 TOTAL	3,605.68	16,571.46	0.23	12,690.00	0.70	
1962						
C-3	372.90	1,567.32	0.21	-	-	Dumont Development
C-3 + Taylor Reid	984.65	4,952.64	0.25	7,177.72	0.36	Dumont Development
School Section 36	423.01	1,639.55	0.19	516.06	0.06	A & B Mining
Skyline	83.60	212.33	0.13	484.85	0.29	A & B Mining
Taylor Reid 1	3,312.46	15,620.35	0.24	2,642.05	0.27	Dumont Development
Whirlwind	56.91	92.20	0.08	1,149.64	1.01	A & B Mining
Whirlwind	<u>295.90</u>	<u>1,167.87</u>	<u>0.25</u>	<u>10,768.81</u>	<u>1.82</u>	Ivor Adair
1962 TOTAL	5,529.43	25,552.26	0.23	22,739.13	0.49	

<u>Mine</u>	<u>Tons of Ore</u>	<u>Pounds U₃O₈</u>	<u>%U₃O₈</u>	<u>Pounds V₂O₅</u>	<u>%V₂O₈</u>	<u>Shipper</u>
1963						
C-3	209.02	875.54	0.21	-	-	A & B Mining
Taylor Reid 1	<u>550.76</u>	<u>3,092.12</u>	<u>0.28</u>	<u>282.98</u>	<u>0.11</u>	A & B Mining
1963 TOTAL	759.81	3,967.66	0.26	282.98	0.11	
1964						
No recorded shipments						
1965						
C-3	50.74	131.92	0.13	71.00	0.07	VCA
Taylor Reid 1	944.52	2,892.80	0.15	4,950.00	0.26	VCA
Whirlwind	<u>134.68</u>	<u>497.61</u>	<u>0.18</u>	<u>1,922.00</u>	<u>0.71</u>	Shumway & Rodgers
55 1965 TOTAL	1,129.94	3,522.33	0.16	6,943.00	0.30	
1966						
Taylor Reid 1	117.76	314.03	0.13	602.00	0.26	VCA
Whirlwind	103.52	220.04	0.11	1,048.00	0.51	Rogers & Rogers
Whirlwind	<u>412.11</u>	<u>564.43</u>	<u>0.07</u>	<u>5,823.00</u>	<u>0.71</u>	Rogers Brothers
1966 TOTAL	<u>633.39</u>	<u>1,098.50</u>	<u>0.09</u>	<u>7,473.00</u>	<u>0.59</u>	
GRAND TOTAL	54,033.14	322,802.07	0.30	532,738.86	0.65	

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

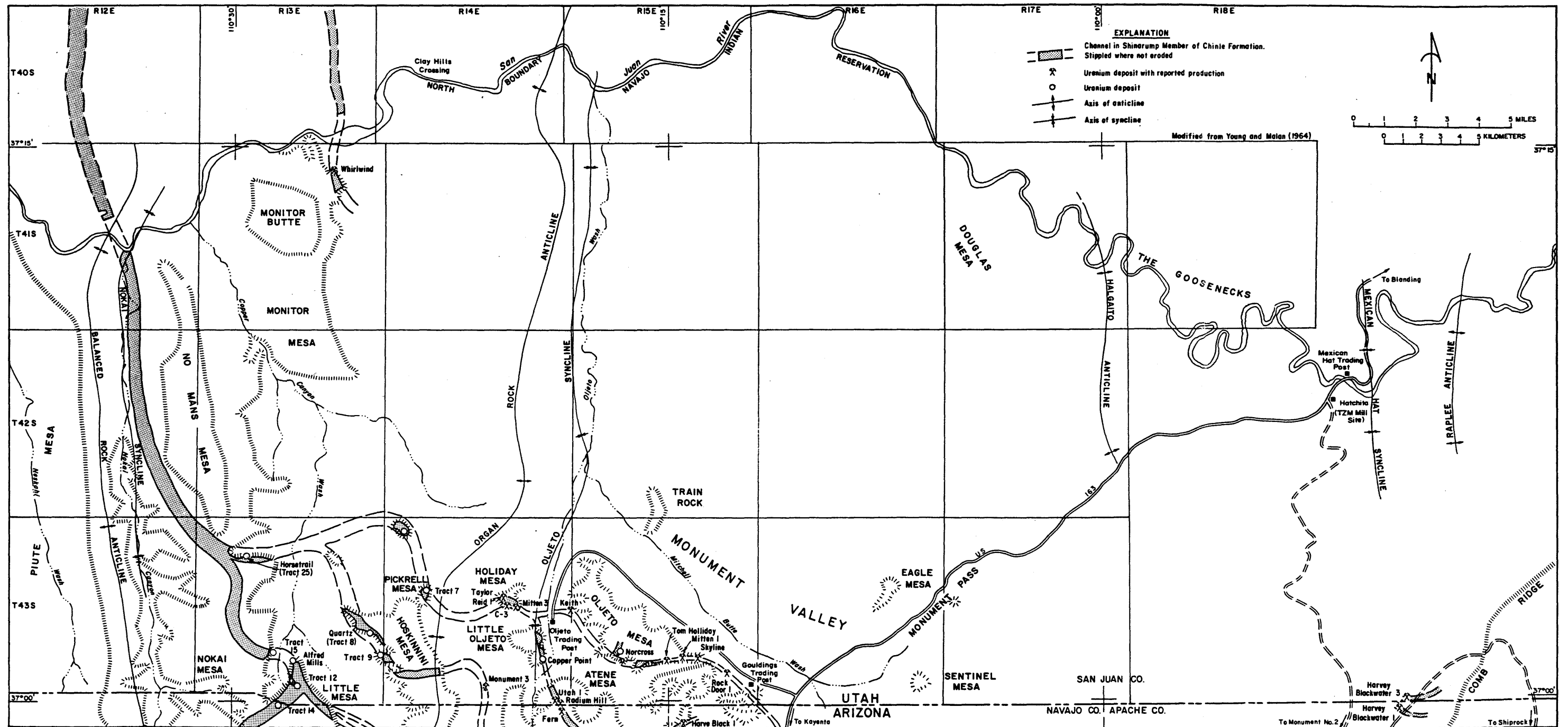


Figure 2. Map of Monument Valley, Utah showing location of uranium deposits and Shinarump channels