

**THE GEOLOGY, LEASING AND PRODUCTION HISTORY
OF THE PLOT 3 URANIUM-VANADIUM MINES
SAN JUAN COUNTY, NEW MEXICO**

New Mexico Bureau of Mines and Mineral Resources

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by

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INTRODUCTION

The Plot 3 mines were developed on a Navajo lease that was specifically issued for carnotite mining in 1942. The mines - Shadyside, Lookout Point, and Nelson Point - were developed in the Salt Wash Member of the Morrison Formation. During 1948-1967 over 14,000 tons of uranium - vanadium ore was mined. Atomic Energy Commission drilling projects aided in the development of mines on this lease. The mines on Plot 3 have produced more carnotite-type ore than any other area in the eastern Carrizo Mountains.

This report is part of an ongoing study of the uranium deposits in New Mexico, especially the deposits on King Tutt Mesa and adjacent areas, in the eastern Carrizo Mountains, San Juan County.

LOCATION AND LAND STATUS

Plot 3 is a tract in Lease No. I-149-IND-5905. This plot (claim) was named Shadyside after one of the early mines in the eastern Carrizo Mountains, San Juan County, New Mexico (Figure 1). Plot 3 is located in the western portion of a small mesa, known locally as King Tutt Mesa. This name is derived from the fact that the mesa was the homestead and grazing area of King and Despah G. Tutt. In some reports, etc the name is spelled Tut, which is incorrect according to Navajo census records.

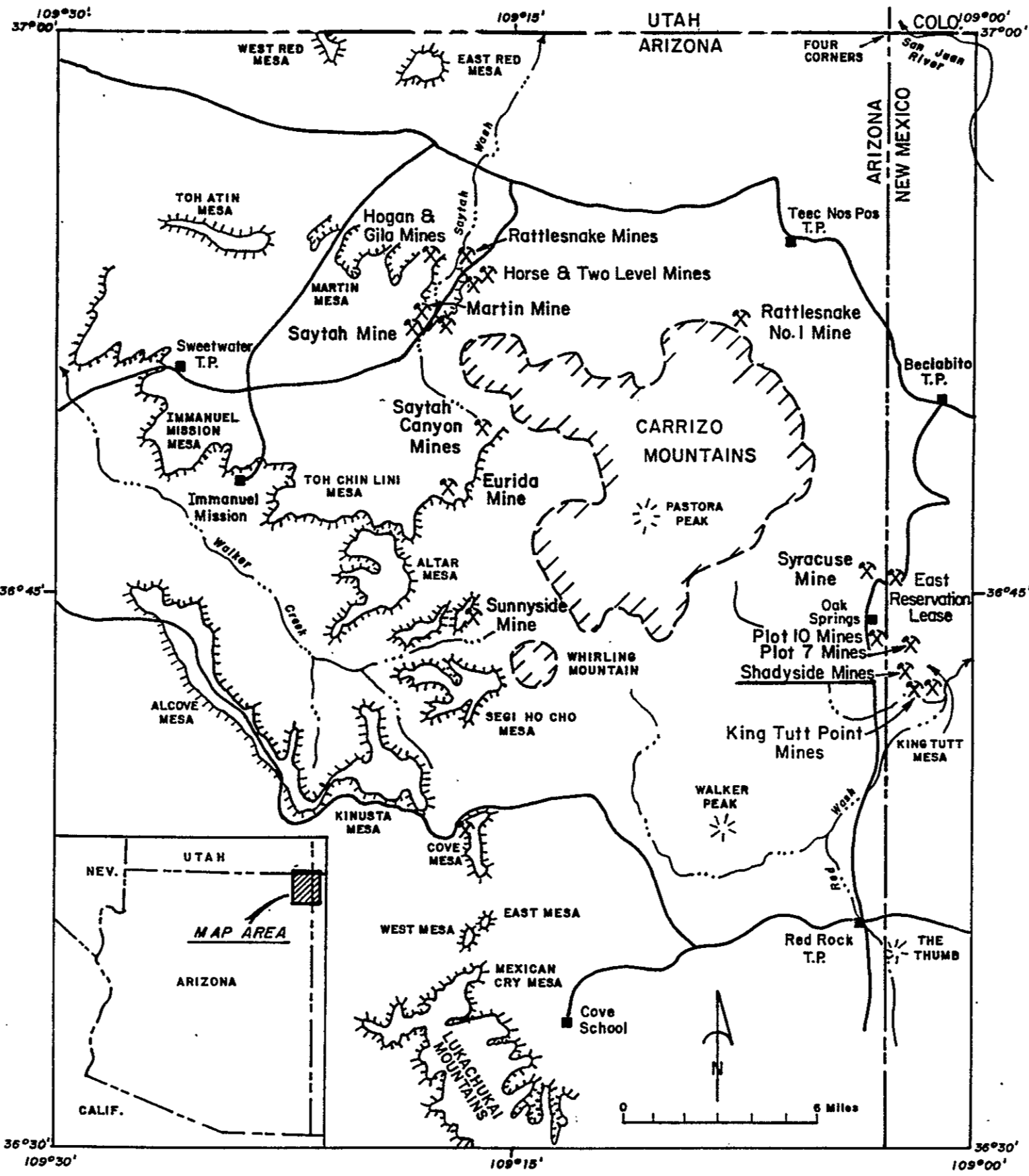


Figure 1. Index map of the Carrizo Mountains showing the location of the vanadium mines that operated in the 1940's

The mesa is a triangular shaped area bordered on the northeast by the canyon of Oak Springs Wash, on the southeast by Blackrock Wash and on the west by the Red Rock monocline. The location of the main mining area is shown on the Horse Mesa quadrangle at latitude 36° 43' 10" N and longitude 109° 02' 10" W (U.S. Geological Survey, 1982). The mesa is accessible by several dirt roads from the paved road (Navajo Route 63) that leads north from Red Rock to Oak Springs.

King Tutt Mesa is located within the Navajo Indian Reservation. On the Reservation, all prospecting, leasing and mining is controlled by the Navajo Tribal Council and the Bureau of Indian Affairs, U.S. Department of the Interior. For Lease I-149-IND-5905, the Tribe received a royalty of ^{10.0}~~100~~% of the mine-mouth value of the ore.

PREVIOUS STUDIES

The mineralogy of the Nelson Point mine was studied by Corey (1958) and the geology of the workings was mapped by Hershey (1958). Leasing and mining of the carnotite deposits in the Carrizo Mountains for radium extraction was described by Chenoweth (1989). Details of the vanadium production in the Carrizo Mountains area were presented in Chenoweth (1991). An earlier report by Chenoweth (1984) summarizes the uranium-vanadium production in the eastern Carrizo Mountains. Anderson (1981) and described photographed the condition (in 1980) of the Plot 3 mines in his summary of abandoned uranium mines in New Mexico.

SOURCES OF INFORMATION

Most of the information presented 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. Monthly mill receipts from the Vanadium Corporation of America (VCA) to the AEC, in the AEC files, were reviewed to obtain the names of the early Navajo contract miners, whose names do not appear in the annual AEC production records. Information on the early vanadium ore production is contained in a detailed report prepared by the General Services Administration (GSA), Indian Trust Accounting Division for the Navajo Tribe. 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, 1993. A copy of the vanadium and uranium section was obtained by the Grand Junction Area Office of the U.S. Department of Energy. Details of the mineral leasing regulations, applicable to the Navajo Indian Reservation, were taken from a report prepared by DeVoto and Huber (1982) for the U.S. Department of Justice, which was also admitted as evidence in the above case. Copies of both the GSA report and the DeVoto and Huber report have been donated to the Geotechnical Information Center at the New Mexico Bureau of Mines and Mineral Resources. The maps of the underground workings (Figure 3) were traced by the author in 1985 from the files of Foote Mineral Company, successor to VCA.

GEOLOGIC SETTING

The uranium-vanadium orebodies at Plot 3 occur in the Salt Wash Member of the Upper Jurassic Morrison Formation. In the Oak Springs - King Tutt Mesa area, the Salt Wash Member is approximately 200 feet thick. It is composed of gray, fine - to - very fine-grained, well rounded, quartz sandstone with interbedded lenses in beds of reddish-brown and greenish-gray mudstone and siltstone. The basal portion of many of the sandstone lenses contain clay clast conglomerates and coarse-grained material. The mudstone and siltstone beds comprise between 5 to 45 percent of the total thickness of the member. Huffman and others (1980) have subdivided the Salt Wash Member in the Oak Springs - King Tutt Mesa area into three lithostratigraphic units based on depositional environments. The lowermost unit is an average of 30 feet thick and is predominately overbank deposits of alternating thin mudstone and sandstone. It contains few channel sandstones.

The middle unit averages 70 feet thick and is composed of channel-sandstone deposits, partially and completely abandoned channel-fill deposits, and overbank deposits. Approximately 80 percent of the sandstone in this unit is active channel fill.

The upper unit is 120 feet thick. Most of the unit is composed of braided-stream deposits, and thin overbank deposits. Active channel-fill sandstone and conglomerates are also

present. The sequence of stratigraphic units probably represent a prograding wet alluvial fan (Huffman and others, 1980).

The channel sandstone containing the orebodies on Plot 3 occur within the middle lithostratigraphic unit. Ore zones are 30, 50 and 80 feet above the base of the Salt Wash. The uppermost ore bearing sandstone on Plot 3 was mapped as the "Ore Rim" by VCA (Figure 3). In the southeastern part of the Nelson Point Mine, Hershey (1958) observed considerable ore in flat bedded, flood plain sediments in contrast to ore-bearing channel sediments in the northwestern part of the mine.

Paleo channel directions observed by Stokes (1954) on Plot 3 were to the southeast in the western part of the plot. More easterly directions to the streams depositing the sandstones were observed in the eastern part of the plot (Figure 3). Drilling by the AEC in the Nelson Point - Shadyside area recognized a prominent sandstone they informally named the Shadyside Sandstone (Masters and others, 1955) This channel sandstone had a S 50° E depositional trend based on drill hole information (Masters and others, 1955). Detrital organic plant material, such as leaves, branches, limbs and trunks are common in the ore-bearing channel. Most all of this material is carbonized.

The uranium-vanadium orebodies were formed by the selective impregnation of the sandstone and adsorption by the mudstone and fossil plant material. Orebodies were commonly associated with detrital plant fragments in the sandstone. The orebodies were roughly tabular in cross-section and irregular in plan. They ranged from several feet in width to a few hundred

feet in length. Thicknesses at the Plot 3 mines ranged from a feather edge to up to seven feet, and averaged 2 feet. Small high-grade (+0.50 percent U_3O_8) pods of ore were associated with replaced fossil wood.

The deposits were originally called carnotite principally because of the yellow color. Carnotite, a bright yellow mineral, is a potassium uranium vanadate. However, later work by S.R. Austin (written communication, 1967) have identified tyuyamunite, a calcium uranium vanadate, and meta-tyuyamunite as the only uranium minerals in the Carrizo deposits. In the Nelson Point Mine, Corey (1958) also found tyuyamunite and meta-tyuyamunite to be the only uranium minerals. No unoxidized uranium minerals were detected. Vanadium clay and montrosite were present. Subsequent oxidation produced a large number of relative rare secondary vanadium minerals that include sherwoodite, duttonite, hewettite, meta-hewettite, rossite, metarossite, and hendersonite (Corey, 1958). Calcite is a common cement in ore. Pyrite, iron oxides, and gypsum also were present.

Petrographic examination (in thin-section) of calcite cemented sandstone, Corey (1958) found tyuyamunite coating quartz and feldspar grains in a more or less circular pattern around patches of limonite. Blebs of pyrite were partly altered to limonite and scattered clay minerals also were present. Corey (1958) suggested that this may represent alteration, in place of uraninite or coffinite, producing tyuyamunite, accompanied by oxidation of pyrite, with hydrolysis of ferric sulfate to limonite.

The beds of the Salt Wash Member on Plot 3 dip two degrees to the east, structure that is influenced by the Red Rock monocline which lies directly west of the area. Within the monocline the older Jurassic rocks have eastward dips as great as 10 degrees.

LEASING AND VANADIUM PRODUCTION HISTORY

Early Prospecting

Outcrops containing uranium and vanadium minerals in the Carrizo Mountains were discovered by John F. Wade about 1918 (personal communication, 1955). Wade of Farmington, New Mexico, operated Sweetwater Trading Post in the western Carrizo Mountains (Figure 1). Through business contacts and field trips, he had determined that the same rocks that contained the carnotite deposits of southwestern Colorado were present in the Carrizo Mountains. The newly discovered deposits could not be mined, however because the Navajo Indian Reservation was at that time closed to prospecting and mining. 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 of 1872. This Act allowed prospectors to enter the Reservation and stake a mining claim if their prospecting located promising mineral deposits. The locator of the claim could subsequently obtain a lease on this land under terms that included escalating advance royalties and rentals, and annual work commitments.

During the 1920s the Office of Indian Affairs (later changed to Bureau of Indian Affairs), U.S. Department of the Interior, issued four leases for metal mining in the Carrizo Mountain (GSA, 1981). Three of these were for carnotite mining. A fourth lease, located in the northeastern Carrizo Mountains is believed to have been for copper. One of the leases, in the northwestern Carrizo Mountains, produced some carnotite ore for radium extraction in November 1920 (Chenoweth, 1989).

By 1922 the radium industry in southwestern Colorado was beginning to decline as the carnotite ores were no longer competitive with the newly developed high-grade pitchblende ore in the Belgian Congo (now Zaire). A vanadium market never developed, as there was little demand for domestic vanadium because of highly-competitive imports from Peru.

In spite of the lack of demand for carnotite ores, George O. Williams and Nephi Johnson leased 20.661 acres on June 8, 1923, effective January 22, 1924. This lease covered the Upper Bell Lode Claim of U. S. Mineral Survey Number 1887. The only description of the location is T. 11 N., R. 5W., Navajo Baseline and Meridian, San Juan County, New Mexico. Since King Tutt Mesa is located in the north-central part of this township, it is very possible that the lease was located here. No production was located by the GSA (1981), but an Office of Indian Affairs memorandum of December 4, 1936 noted "a 20-foot-deep shaft, or hole, had been dug on the claim, and approximately one ton of ore had been hauled to Durango, Colorado". Williams and Johnson paid rental on their lease for five years, totalling \$47.27, through February, 1927 (Chenoweth, 1989).

On March 25, 1936, the Secretary of the Interior closed the Navajo Indian Reservation to claim location and prospecting for minerals until further authorization. In July 1936, an application to prospect was made to the Executive Committee of the Navajo Tribal Council. The application asked the council to pass a resolution requesting the Secretary of the Interior to open the Navajo Indian Reservation for mining to the applicant. The resolution was rejected by the Executive Committee, which evidently was opposed to mineral resource development on the Reservation at that time.

Leasing Regulations

By the mid-1930s, the mines in the carnotite region of southwestern Colorado and southeastern Utah were being reopened for their vanadium content. The Navajo Indian Reservation was subsequently opened 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 Reservation land with approval of the Secretary of Interior. Prospectors no longer could enter the Reservation and stake a mining claim under regulation similar to those of the United States Mining Law. The new mining regulation contained escalating annual rentals, a base royalty of 10 percent (mine mouth value), bond requirements, acreage limitations, and a term of 10 years which could be extended by production.

On April 9, 1942, the Navajo Tribal Council requested the Secretary of the Interior lease approve regulations wherein mining leases would be granted to the highest bidder. These leases were written for large areas and subsequently reduced in acreage at the end of the specified time period. The net effect of this type of lease was that a prospecting permit was issued to the highest bidder, who then had the right to lease land within the permit area up to a maximum acreage. The maximum acreage a company could lease on the Reservation was 960 acres.

The East Reservation Lease

When the United States entered World War II, the demand for vanadium by the steel industry increased significantly. Due to the uncertainty of foreign supplies and the need for vanadium in war armaments, the Federal government had formed Metals Reserve Company in December 1941. This agency was part of the Reconstruction Finance Corporation. The Metals

Reserve program with increased ore prices, buying stations, etc., was the stimulus to renew interest in the carnotite deposits in the Carrizo Mountains.

On May 29, 1942, in response to requests by several mining companies, the Office of Indian Affairs advertised an exploration lease sale for carnotite and related minerals in the eastern Carrizo Mountains. The area offered was described as follows: "beginning at a point on the New Mexico-Arizona State Line which is approximately 8 1/3 miles south of the corner common to the states of Colorado, Utah, New Mexico, and Arizona; thence east 6 miles, thence south 12 miles; thence west 6 miles to the Arizona-New Mexico state line; thence west 3 1/2 miles; thence north 2 miles; thence east one mile ; thence north 10 miles; thence east 2 1/2 miles to the Arizona-New Mexico state line and in the point of beginning." The area contained approximately 104 square miles. This was the second carnotite lease sale for Navajo lands held under the bidding procedures. The first was held in December, 1941 for a lease in the western Carrizo Mountains (Chenoweth, 1991).

Bids were opened on June 15, 1942, at which time VCA bid \$7,600, and John F. Wade and Thomas F .V. Curran, partners, bid \$7,550 (GSA, 1981, Exhibit 31). As the bids were nearly equal, and since Wade and Curran offered to pay \$2,000 over and above the highest bid received, the General Superintendent of the Navajo Service requested that the Commissioner of Indian Affairs make the decision to award the lease. VCA was awarded the lease I-149-IND-5705, which was executed on July 14, 1942, effective July 23, 1942, for a period of 10 years. The Navajo Tribe were to receive a royalty of 10 percent of the mine-mouth value of the ore produced from this lease.

On September 2, 1943, the lease was reduced to a permanent operating lease and 12 plots totalling 436.79 acres were selected to be retained. Six of the plots (1-6) were on King Tutt Mesa, two of the plots (7,10) were along the north side of the canyon of Oak Springs Wash and the remaining four plots (8,9,11, and 12) were in the vicinity of Milepost 16 on the New Mexico-Arizona State line. Each of the plots were named by VCA (Table 1). Plot 3 containing 145.13 acres, covered the western, southwestern and northern rims of King Tutt Mesa where exposures of vanadium minerals cropped out (Figure 2). The plot was named Shadyside, a name taken from one of the early mines. Lease I-149-IND-5705 was renamed as the "East Reservation Lease" by VCA. The mines on this lease were originally known as the Eastside mines, a name still used today in U.S. Geological Survey (USGS) reports.

Vanadium Mining

Mining on the East Reservation Lease commenced in August 1942 on King Tutt Mesa and continued through August 1944. Single shipments were recorded in February 1945 and in July 1947. Ore was mined from all the plots of the lease, but the majority came from Plot 3 on King Tutt Mesa (Chenoweth, 1991). When the vanadium operations were examined by the USGS in November 1942, approximately 1,800 tons of ore with an average grade of 2.30 percent V_2O_5 had been produced from King Tutt Mesa (Duncan and Stokes, 1942, p. 26). The USGS map of King Tutt Mesa (Duncan and Stokes, 1942, Plate 3) showed numerous small open pits and rim cuts in the area where the Shadyside Incline and the Nelson Point Mines were later developed. In the Lookout Point mines area there were several small underground mines and rim cuts. A large open pit was mapped in the southwestern part of the plot. A photograph of

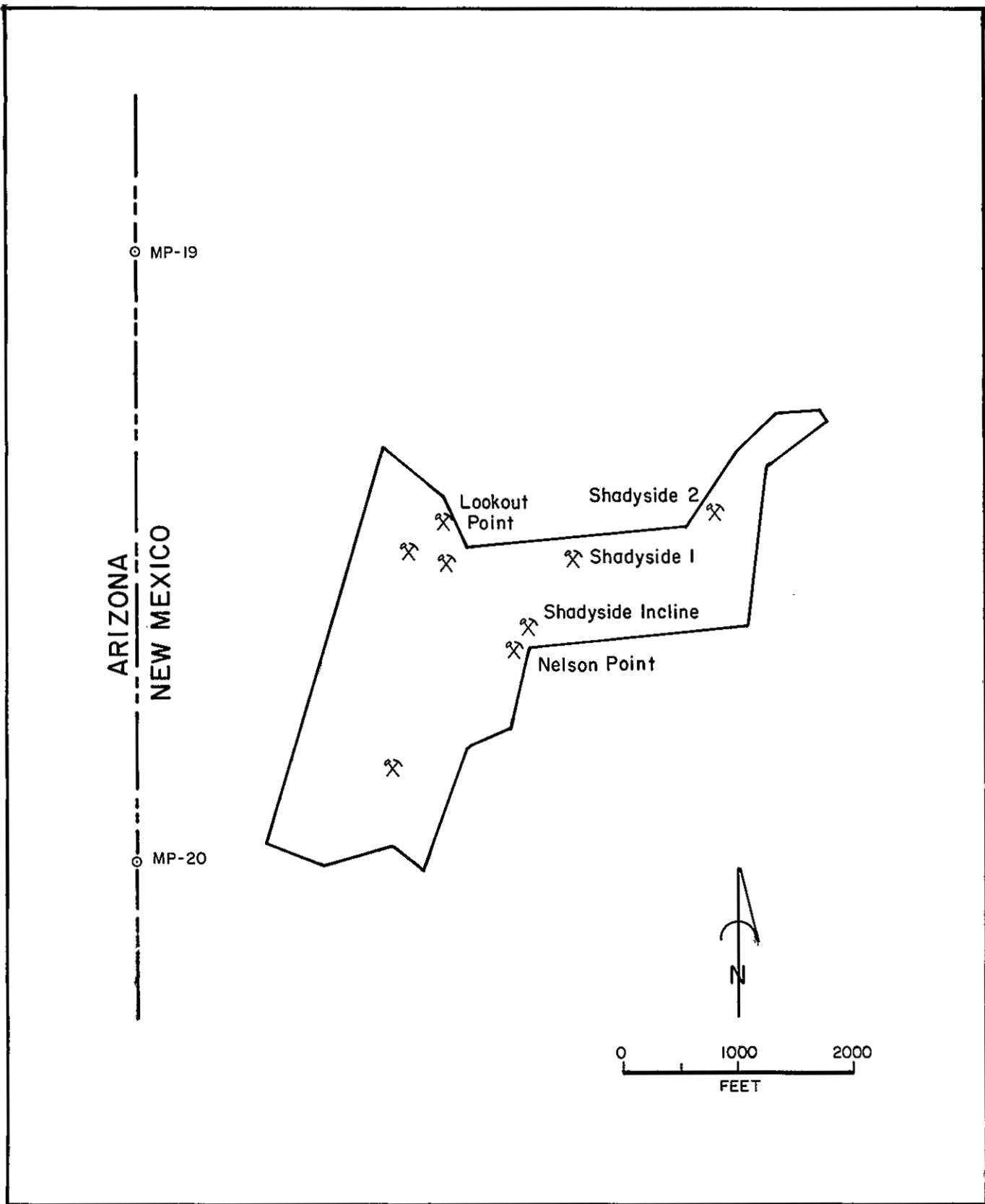


Figure 2. Index map of Plot 3 showing the locations of the larger mines

the 1942 miners is duplicated in this report (Figure 4). Total vanadium production from Lease I-149-IND-5705 was 10,294.74 tons of ore containing 504,822.27 pounds V_2O_5 and averaging 2.47 V_2O_5 (Chenoweth 1991). With the exception of the 1947 shipment, which was made to its mill at Naturita, Colorado, VCA shipped ore from this lease to the Monticello, Utah mill operated by VCA for the Metals Reserve Co. The Metals Reserve vanadium program ended in February, 1944. At that time, mining all but ceased in the Four Corners area including the Carrizo Mountains. The actual amount of vanadium ore produced from Plot 3 is not recorded, however, it was estimated to be in excess of 6,000 tons (Chenoweth, 1991).

URANIUM PRODUCTION HISTORY

Initial Activities

During 1947, the U.S. Atomic Energy Commission (AEC) began a procurement program on the Colorado Plateau to obtain uranium. The first domestic contract was signed with VCA on August 29, 1947, retroactive to May 20, 1947, to purchase uranium concentrates from the company's mill in Naturita, Colorado. The AEC also contracted with VCA, effective October 8, 1948 to buy concentrates from the AEC-owned mill at Durango, Colorado, which VCA had leased with an option to buy (Albrethsen and McGinley, 1982).

Since a market had developed, VCA began prospecting and mining on their East Reservation Lease. In March 1948, shipments began from the lease, mainly from Plot 3 (Page Edwards, 1955 personal communication). These initial shipments went to the mill at Naturita, Colorado. The reopening of the Durango mill in March 1949 resulted in a shorter haulage for the mines in the Carrizo Mountains and production from the East Reservation Lease began to



Figure 4. Navajo vanadium miners at the Shadyside area of King Tutt Mesa. Note the stacked ore above the pit, ready for shipment, November 1942. Photo from Duncan and Stokes (1942)/

increase (Table 2). The distance to Durango, from Plot 3, was 117 miles compared to 178 miles to Naturita.

Throughout the years 1948 through 1950, VCA did not separate the ore production from the East Reservation Lease by individual plots where the company miners were working. During these three years, a total of 6,757.68 tons of ore averaging 0.22 percent U_3O_8 and 2.30 percent V_2O_5 were shipped from the lease (Table 2). In discussions with Page Edwards (personal communication, 1955), Manager of Mines for VCA, it was determined that all but approximately 700 tons came from Plot 3-Shadyside, Lookout Point, Nelson Point Mines and numerous small open pits and rim cuts, not shown on Figure 3.

Besides the VCA company miners, VCA contracted with individual Navajos to mine at various locations on the East Reservation Lease, including Plot 3. Mining by these contractors will be discussed under the individual mines.

AEC Exploration

In an effort to increase the ore production in the eastern Carrizo area, the AEC did diamond core drilling behind the existing mines searching for additional orebodies. Between February 11, 1952 and August 17, 1952, a total of 948 holes with a footage of 100,038 feet were drilled in the King Tutt Mesa - Oak Springs area (Masters and others, 1955). The drilling project was known as the East Carrizo No. 1 project - Contract No. AT (30-1)-1260. All drill holes had the prefix EC. The middle and lower units of the Salt Wash were cored. On Plot 3 drill hole spacing ranged from a 1,000 foot initial grid down to 100 feet near the Shadyside No. 1 Mine, to 25 feet when ore (1 foot of 0.10 percent U_3O_8) was located.

The East Carrizo No. 1 project located several orebodies adjacent to and southwest of the Shadyside No 1 Mine. A small orebody was located 1,000 feet northeast of the mine (Masters and others, 1955).

During the spring and summer of 1953, the AEC conducted two additional drilling projects on King Tutt Mesa and adjacent areas. The East Carrizo No. 2 project - Contract AT (30-1)-1364 drilled 49 core holes with a total footage of 4,653 feet. The East Carrizo No. 3 project-Contract AT (05-1)-231 drilled 169 percussion wagon drill holes with a total footage of 11,977 feet (Blagbrough and Brown, 1955).

In the Shadyside area of Plot 3, 10 core holes were drilled for stratigraphic information and 11 wagon drill holes on 50 foot centers, further delineated orebodies located during the No. 1 project. In the Lookout Point-Nelson Point area, three core holes at 73 wagon drill holes were completed. The wagon drilling was on 200, 100 and 50 foot centers and located orebodies north of the Nelson Point Mine workings, and west and southeast of the Lookout Point Mine workings (Blagbrough and Brown, 1955). Drilling by VCA further defined the orebodies discovered by the AEC.

Mining Methods

The mineralized outcrops that were initially located on Plot 3 were mined as rim cuts or shallow open pits. Four of the larger open pits are shown on Figure 3. The large, shallow open pit in the southwest corner of the plot was never given a name by VCA. The ore produced from it was shipped as the East Reservation Lease.

Orebodies located by drilling behind rims were mined by open stope with random pillar methods. Rock pillars were usually left to support the back, but in places timber, from the Carrizo Mountains, was used. Rail haulage in the ore horizon was used in the larger mines. Manpower moved the ore cars from the mine to the surface. At one time a mule was used at the Nelson Point Mine. In short adits of the Lookout Point Mine wheelbarrows were used to move ore and waste. Declines, also known as inclines, were used to develop two orebodies on the plot and to provide access to the northwest of the Nelson Point Mine (Figure 3). Compressed air hoists were used to pull the mine cars up the declines. In the mines, ore was recognized by eyesight, with geiger counters used only rarely.

Navajos who did contract mining for VCA learned their skills by working for VCA in the 1940s. They put together a team of other former VCA miners to form small mining companies. Traders at Red Rock and Shiprock helped them with their payrolls and taxes.

VCA furnished the contractor with all supplies and equipment. The company paid for all development work and received 60 percent of the gross value of the ore. Mining was overseen by a VCA supervisor and was based in Durango, Colorado and had a cabin on Plot 3 (Figure 3). Contractors usually paid their employees \$1.50-1.25 per hour, in 1955.

Following the period of intense mining in 1948-1950, the mines on Plot 3 never again attained significant size. For example, during the years 1952-1958, Paul Shorty's operations at the Nelson Point Mine averaged 30 tons per month. The author never observed more than two men underground at any one visit. During 1956, federal mine inspectors counted a total of eight men underground at the three active mines on Plot 3. However, in August 1960, the author observed four men underground at Charles Corey's operation at the Lookout Point Incline, the

only active mine on Plot 3. The production history of the individual miners will be discussed in the following sections.

Shadyside No. 1

This individual mine received its name from the fact that much of the early mining was along the north facing rim of King Tutt Mesa. These rim cuts were in the shade much of the day in contrast to other mines on east and south facing rims.

When the USGS examined the area in November 1942, open pit mining was noted along the north rim of the mesa and in the area of the present Shadyside Incline Mine (Duncan and Stokes, 1942, Plate 3). In 1944, Coleman (1944) noted an underground mine where the Shadyside No. 1 is located (Figure 3). Much of the uranium-vanadium ore credited to the East Reservation Lease came from the Shadyside Mines.

The first shipments identified as the Shadyside Mine were made by Navajo contractors, King Tutt and Carl Thomas in September 1950. In October 1950, King Tutt and Paul Shorty made a 15.86 ton shipment. During October through December 1950, another partnership of King Tutt and William Tanner made shipments. Total shipments during 1950 were 154.72 tons of ore averaging 0.40 percent U_3O_8 and 4.01 percent V_2O_5 (Table 3). Tutt and Tanner made additional shipments during April, May, and June 1951, and Harry Russell made shipments in October, November and December 1951. At the same time Harry Russell was working, VCA company miners made shipments from the Shadyside Mines. When King (1951) examined the Shadyside No. 1 Mine in 1951, he noted that the mine workings covered an area of 12,000

square feet and consisted of a large room with pillars. Total ore production in 1951 was 231.51 tons which averaged 0.27 percent U_3O_8 and 2.61 percent V_2O_5 (Table 3).

During April through June 1951, King Tutt shipped 44.56 tons of ore averaging 0.19 percent U_3O_8 and 2.69 percent V_2O_5 from the Shadyside Mines (Table 3).

In June 1956, VCA miners made a 9.37 ton shipment from the Shadyside Mines. It is not certain if the ore came from the Shadyside No. 1 or the Incline Mine.

On March 1, 1963, VCA acquired the Shiprock mill from Kerr McGee Oil Industries, Inc. and the Durango mill was closed (Albrethsen and McGinley, 1982). By the mid 1960s ore shipments to the mill had decreased significantly and VCA began clean-up mining at many of their inactive mines. Low grade shipments from the Shadyside Mines commenced in late 1964 and continued until early 1965 (Table 3). Some of this ore no doubt came from the Incline Mine, but no records exist to substantiate this. Total shipments identified as the Shadyside Mine (not including the No. 2 Mine) were 1,725.59 tons averaging 0.26 percent U_3O_8 and 3.14 percent V_2O_5 (Table 3).

Shadyside Incline

In 1953, VCA miners drove a 200 foot long, minus 20 degree decline to mine an orebody northeast of the Nelson Point Mine (Figure 3). This orebody had been discovered by AEC drilling and further delineated by VCA drilling. Although the production from this mine is not separated in the AEC records, it is believed, by the author, that all of the 1953, 1954, and 1955 production listed as Shadyside came from the Shadyside Incline. Shipments ended in January 1955. Total shipments during the three years would total 1,145.21 tons averaging 0.25 percent U_3O_8 and 3.45 percent V_2O_5 (Table 3).

Shadyside No. 2

The initial mining in the Shadyside No. 2 area was mainly in the form of rim cuts. In 1944, Coleman (1944) noted a rim cut 50 feet long and 20 feet wide in this area. The first production identified from this area was in March through December 1951 when Harry Russell shipped 139.89 tons of ore which averaged 0.29 percent U_3O_8 and 2.69 percent V_2O_5 (Table 4).

Shipments from the underground mine commenced in January 1953 by Harry Russell. This ore deposit had been located by AEC drilling and further delineated by VCA drilling. Shipments by Russell continued through December 1954 (Table 4).

In December 1954, VCA company miners shipped 20.49 tons of ore from the Shadyside No. 2 Mine (Table 4). VCA miners returned to the mine in June 1955 and shipped 11.56 tons averaging 0.29 percent U_3O_8 and 1.70 percent V_2O_5 (Table 4). The mine was idle until the summer of 1966 when VCA miners, doing clean up mining shipped 44.98 tons of low grade ore averaging 0.12 percent U_3O_8 and 2.28 percent V_2O_5 (Table 4). Total production identified in the AEC records from the Shadyside No. 2 was 889.94 tons of ore averaging 0.35 percent U_3O_8 and 3.75 percent V_2O_5 (Table 4).

Lookout Point

This area of Plot 3 took its name from a prominent topographic knob developed on a resistant sandstone bed in the upper unit of the Salt Wash member. This sandstone bed was mapped as the Upper Rim by VCA (Figure 3).

Due to good exposures of uranium - vanadium minerals on the east side of the point, this area was one of the first to be mined in 1942. These mines have been called Sunnyside in some

AEC reports in contrast to the north facing Shadyside Nos 1 and 2 Mines. No doubt much of the uranium - vanadium credited to the East Reservation Lease came from the Lookout Point Mines.

The first shipments identified as Lookout Point were made by a partnership of Navajo contractors in March, 1950. These contractors, Joe Billy, Harry Peterson and Paul Shorty, shipped a total of 148.40 tons of ore averaging 0.21 percent U_3O_8 and 2.50 percent V_2O_5 in March, April, and May (Table 5).

In June and July, 1950, a new partnership of Joe Billy and Paul Shorty shipped 51.98 tons of ore averaging 0.29 percent U_3O_8 and 2.67 percent V_2O_5 (Table 5). When the Lookout Point Mines were examined by King (1951), he noted six adits with a combined length of 285 feet.

Beginning in July, 1950, Paul Shorty would operate the Lookout Point mines through March of 1955 (Table 5). No doubt some of the ore Paul Shorty mined was discovered by the AEC's East Carrizo drilling project No. 2.

In June, 1956, VCA company miners shipped 8.47 tons of ore averaging 0.21 percent U_3O_8 and 1.59 percent V_2O_5 from Lookout Point (Table 5). The mines were idle until June and July 1959 when VCA company miners made final shipments of 165.48 tons averaging 0.24 percent U_3O_8 and 1.59 percent V_2O_5 from Lookout Point (Table 5). A total of 2,555.85 tons of ore averaging 0.32 percent U_3O_8 and 2.28 percent V_2O_5 was identified as being produced from the Lookout Point Mines (Table 5).

Lookout Point Incline

Early in 1960, Charles H. Corey, Jr., of Cortez, Colorado began driving a 80 foot long, minus 25 degree decline to an orebody on the southwest side of the Lookout Point knoll (Figure 3). This orebody had been discovered by AEC drilling in 1953. During April through September, Corey shipped 332.15 tons of ore that averaged 0.27 percent U_3O_8 and 2.88 percent V_2O_5 (Table 6).

Corey cancelled his contract in September, 1960 and another contractor, William George, took over operations in October 1960. By May, 1961, the orebody had been mined out and the mine was abandoned. A total of 506.20 tons of ore averaging 0.27 percent U_3O_8 and 2.81 percent V_2O_5 was produced from this small mine (Table 6).

Nelson Point

This area of King Tutt Mesa probably received its name from Alfred Nelson, a old-time Navajo miner who lived in this area. In November, 1942, Duncan and Stokes (1942, Plate 3) mapped several shallow open pits and rim cuts in the Nelson Point area. The first shipment identified as the Nelson Point Mine, to the AEC, was made by Paul Shorty in July 1950.

In 1951, King (1951) noted a small mine in the Nelson Point area so underground mining had commenced by that time. Beginning in July, 1950, Paul Shorty would continue to make small monthly shipments through November, 1958 (Table 7). No ore shipments were made in 1959-1960.

Between April 10, and June 6, 1961, dates of the author's visits, Paul Shorty shipped 23.21 tons averaging 0.20 percent U_3O_8 and 4.53 percent V_2O_5 (Table 7). At the time of the June visit the Nelson Point Mine appeared to be abandoned.

During September, 1961, VCA company miners shipped 12.93 tons of ore averaging 0.23 percent U_3O_8 and 3.31 percent V_2O_5 (Table 7). At that time Paul Shorty was employed by VCA. When the author examined the property on November 20, 1961, it appeared to be abandoned.

With the acquisition of the Shiprock mill by VCA in March 1, 1963 (Albrethsen and McGinley, 1982), the company returned to Plot 3 in early 1964 to do clean-up mining of the lower grade ore that remained in the mines. VCA made small shipments from the Nelson Point in 1964, 1965, 1966 and 1967 (Table 7). The August 1967 shipment marked one of the final shipments from the eastern Carrizo Mountains. Total production from the Nelson Point Mines was 2,683.72 tons of ore averaging 0.25 percent U_3O_8 and 3.94 percent V_2O_5 (Table 7).

Later Developments

Foote Mineral Company acquired VCA on August 31, 1967 and closed the Shiprock mill in May 1968 (Albrethsen and McGinley, 1982). Lease I-149-IND-5705 was cancelled by Foote Mineral in 1969.

In the late 1970s, the Grand Junction office of DOE received reports of some uranium mining was taking place on King Tutt mesa, but was terminated by the Navajo Police Department as the individuals from Farmington, New Mexico did not have the proper permits. When the area was examined by the author and Virginia McLemore in September 1983, a three

ton stockpile of ore grade material was observed in the vicinity of the southwest stripped area. This ore had apparently been hand sorted from the waste left by VCA in the stripped area.

Today (1996) the clean up and reclamation of the mines on Plot 3 are a high priority of the Navajo Abandoned Mine Lands Reclamation Program.

SUMMARY

Initial interest in metal mining in the Carrizo Mountains dates back to the early 1920s, when the Department of the Interior issued three leases for carnotite mining. A small ore shipment was made for radium extraction and this mining activity was short-lived.

During the late 1930s and early 1940s, six leases were issued for the production of vanadium from the carnotite deposits. Plot 3 was included in one of these leases. It has been estimated that during the vanadium mining era of the early 1940s the mines on VCA's Plot 3 produced over 6,000 tons of vanadium ore with an average grade of 2.47 percent V_2O_5 (Chenoweth, 1991). Under the AEC program, 14,033.30 tons of ore with an average grade of 0.26 percent U_3O_8 and 2.98 percent of V_2O_5 were produced from Plot 3. Production under the AEC program reached a high level in 1950 when 15,327.93 pounds of U_3O_8 , in ore, was mined. Following that year, production declined rapidly as the ore reserves were depleted (Figure 5). Shipments from the AEC discovered orebody, being accessed by the Shadyside Incline, reversed this trend in 1953 and 1954 (Figure 5). Another reversal in the trend came in 1960 with the new production from the Lookout Point Incline.

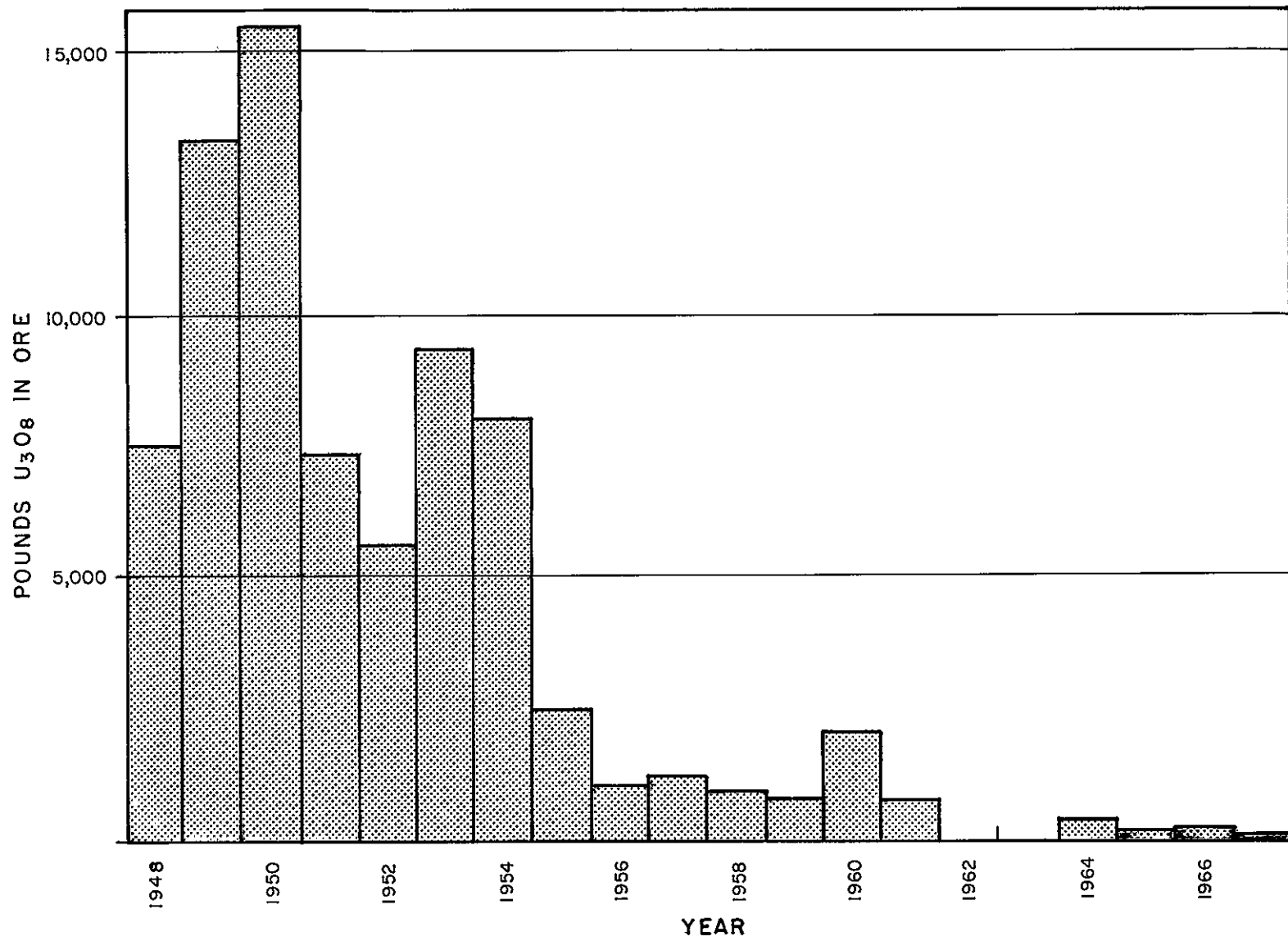


Figure 5. Annual uranium production, Plot 3, San Juan County, New Mexico

Production from the mines on Plot 3 ceased in 1961 when the Lookout Point Incline and the Nelson Point Mine were closed. Clean up mining of the lower grade material in the Nelson Point and Shadyside Mines resumed in 1964 as VCA had acquired the Shiprock mill during the previous year. The final shipment from Plot 3 was made in August 1967. The East Reservation Lease was cancelled in 1969 after being in effect for 28 years.

The mines on Plot 3 account for 33 percent of the total uranium - vanadium production from the eastern Carrizo Mountains (Chenoweth, 1984).

All of the uranium concentrate produced from the processing of the ore from Plot 3 was purchased by the AEC. Only 20 percent of the vanadium concentrate was purchased by the AEC, the remainder was sold to the steel industry by VCA (Albrethsen and McGinley, 1982).

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Table 1. Name, size and location of Plots

NO.	PLOT NAME	ACRES	LOCATION
1	Red Wash Point	3.53	S.E. King Tutt Mesa
2	King Tutt Point	9.14	S. King Tutt Mesa
3	Shadyside	145.13	W. Central King Tutt Mesa
4	Williams Point	8.62	N. Central King Tutt Mesa
5	Fissure	1.57	N. Central King Tutt Mesa
6	Franks Point	6.23	N.W. King Tutt Mesa
7	Lower Oak Creek	205.39	Oak Creek Canyon
8	Cottonwood Butte	20.66	Cottonwood Butte
9	Lone Star	6.20	E. of MP-16
10	Oak Springs	5.53	S.E. of Oak Springs
11	White Cap	20.66	S.W. of MP-16
12	Syracuse	4.13	W. of MP-16
	TOTAL	436.79	

All were located in San Juan County, New Mexico except numbers 10, 11, and 12 in Apache County, Arizona.

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

Table 2. Ore Production From The East Reservation Lease Mines, San Juan County, New Mexico, and Apache County, Arizona

YEAR	OPERATOR	TONS OF ORE	POUNDS U ₃ O ₈	% U ₃ O ₈	POUNDS V ₂ O ₅	% V ₂ O ₅
1948	VCA	1,302.62	7,613.87	0.29	67,386.00	2.59
1949	VCA	4,331.62	15,090.72	0.17	174,222.00	2.01
1950	VCA	1,123.44	7,081.30	0.32	69,895.00	3.11
	TOTAL	6,757.68	29,785.89	0.22	311,503.00	2.30
	Of this total, an estimated 6,000 tons was mined from Plot 3					

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

Table 3. Ore production from the Shadyside Mines, San Juan County, New Mexico

YEAR	OPERATOR	TONS OF ORE	POUNDS U ₃ O ₈	% U ₃ O ₈	POUNDS V ₂ O ₅	% V ₂ O ₅
1950	King Tutt-Carl Thomas	59.41	514.68	0.43	5,171.00	4.35
1950	King Tutt-Paul Shorty	15.86	146.81	0.46	1,467.00	4.82
1950	King Tutt-William Tanner	79.45	586.44	0.37	5,771.00	3.63
1951	King Tutt-William Tanner	137.72	863.50	0.31	7,597.00	2.76
1951	Harry Russell	36.76	171.15	0.23	1,569.00	2.13
1951	VCA	57.03	234.26	0.21	2,908.00	2.55
1952	King Tutt	44.56	170.51	0.19	2,397.00	2.69
1953	VCA	356.96	2,030.45	0.28	29,475.00	4.13
1954	VCA	778.72	3,660.15	0.24	48,985.00	3.15
1955	VCA	9.53	55.32	0.29	473.00	2.48
1956	VCA	9.37	48.72	0.26	279.00	1.49
1964	VCA	121.27	322.55	0.13	2,141.00	0.88
1965	VCA	20.95	36.45	0.09	356.00	0.85
	TOTAL	1,727.59	8,840.99	0.26	108,589.00	3.14

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

Table 4. Ore Production From The Shadyside No. 2 Mine, San Juan County, New Mexico

YEAR	OPERATOR	TONS OF ORE	POUNDS U ₃ O ₈	% U ₃ O ₈	POUNDS V ₂ O ₅	% V ₂ O ₅
1951	Harry Russell	139.89	809.62	0.29	7,513.00	2.69
1953	Harry Russell	402.37	3,335.29	0.41	37,188.00	4.62
1954	Harry Russell	270.65	1,744.27	0.32	18,551.00	3.42
1954	VCA	20.49	121.25	0.30	1,144.00	2.79
1955	VCA	11.56	65.92	0.29	393.00	1.70
1966	VCA	44.98	106.95	0.12	2,052.00	2.28
	TOTAL	889.94	6,183.30	0.35	66,842.00	3.75

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

Table 5. Ore Production From The Lookout Point Mines, San Juan County, New Mexico

YEAR	OPERATOR	TONS OF ORE	POUNDS U ₃ O ₈	% U ₃ O ₈	POUNDS V ₂ O ₅	% V ₂ O ₅
1950	Billy, Peterson, Shorty	148.40	627.96	0.21	7,418.00	2.50
1950	Joe Billy, Paul Shorty	51.98	301.07	0.29	2,778.00	2.67
1950	Paul Shorty	566.76	4,254.07	0.37	35,255.00	3.11
1951	Paul Shorty	726.82	4,488.92	0.31	47,313.00	3.25
1952	Paul Shorty	536.37	4,013.51	0.37	27,691.00	2.58
1953	Paul Shorty	230.41	1,268.62	0.28	10,837.00	2.35
1954	Paul Shorty	102.01	455.08	0.22	4,049.00	1.98
1955	Paul Shorty	19.15	86.81	0.23	775.00	2.20
1956	VCA	8.47	35.57	0.21	269.00	1.59
1959	VCA	165.48	795.18	0.24	7,952.00	2.40
	TOTAL	2,555.85	16,326.79	0.32	144,337.00	2.82

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

Table 6. Ore Productin From The Lookout Point Incline Mine, San Juan County, New Mexico

YEAR	OPERATOR	TONS OF ORE	POUNDS U ₃ O ₈	% U ₃ O ₈	POUNDS V ₂ O ₅	% V ₂ O ₅
1960	Chas. H. Corey, Jr.	332.15	1,776.83	0.27	19,128.00	2.88
1960	William George	72.04	343.14	0.24	4,144.00	2.88
1960	Willaim George	102.01	593.53	0.29	5,213.00	2.56
	TOTAL	506.20	2,712.50	0.27	28,484.00	2.81

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

Table 7. Ore Productin From The Nelson Point Mine, San Juan County, New Mexico

YEAR	OPERATOR	TONS OF ORE	POUNDS U ₃ O ₈	% U ₃ O ₈	POUNDS V ₂ O ₅	% V ₂ O ₅
1950	Paul Shorty	89.84	658.37	0.37	6,567.00	3.65
1951	Paul Shorty	145.79	786.96	0.27	11,729.00	4.02
1952	Paul Shorty	244.41	1,378.65	0.28	24,410.00	4.99
1953	Paul Shorty	397.70	2,671.03	0.34	42,954.00	5.40
1954	Paul Shorty	513.21	2,034.24	0.20	40,206.00	3.92
1955	Paul Shorty	427.00	2,321.23	0.27	41,493.00	4.86
1956	Paul Shorty	201.76	962.16	0.24	12,430.00	3.08
1957	Paul Shorty	302.67	1,188.45	0.20	16,700.00	2.76
1958	Paul Shorty	195.83	923.87	0.24	9,224.00	2.36
1961	Paul Shorty	23.21	94.04	0.20	2,102.00	4.53
1961	VCA	12.93	59.20	0.23	856.00	3.31
1964	VCA	41.29	56.97	0.07	512.00	0.62
1965	VCA	51.27	107.37	0.10	1,051.00	1.02
1966	VCA	23.03	56.34	0.13	675.00	1.53
1967	VCA	14.78	65.33	0.22	438.00	1.48
	TOTAL	2,683.72	13,364.21	0.25	211,347.00	3.94

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