

**The Geology, Leasing, and Production
History of the Uranium-Vanadium
Mines on Eurida Mesa, Apache County,
Arizona**

By

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INTRODUCTION

The exposures of the uranium-vanadium minerals on the rim of Eurida Mesa were some of the first to be discovered in the Carrizo Mountains of northeastern Arizona and northwestern New Mexico. The host rock for the ore deposits is the Salt Wash Member of the Morrison Formation of Late Jurassic age.

The area was first leased for radium ore in the 1920s, but there was no mining. In 1939 and in early 1940s, the area was again leased for mining and approximately 1,200 tons of vanadium ore were produced. In October 1944, the Federal government acquired a 20.6 acre tract on Eurida Mesa for its uranium resources, but it was never explored or mined. Under the U.S. Atomic Energy Commission (AEC) ore procurement program, mining on Eurida Mesa resumed in 1950 and 1951, with a final shipment made in 1956. Under the AEC program 486.36 tons of uranium-vanadium ore were produced.

The purpose of this report is to present the leasing and mining history of this remote area and to make available maps of the underground workings of the Eurida mines.

LOCATION

Eurida Mesa is a small, isolated mesa in the western Carrizo Mountains, Apache County, Arizona. It is located approximately seven miles east of Immanuel Mission (Figure 1). Although not labeled on the latest topographical quadrangle of the area. [U.S. Geological Survey, 1982], the name Eurida Mesa has been used by government and industry geologists since the 1920s. The largest mine, the Eurida, is shown on geologic maps of the Carrizo Mountains [Stokes, 1951, Strobell, 1956]. U. S. Mineral Monument No. 2, near the Eurida mine, is at 36°47' 52" north latitude and 109°16' 55" west longitude and has a location marked 6558T on the Toh Chin Lini Mesa topographic quadrangle [U.S. Geological Survey, 1982].

The mesa can be reached by traveling easterly from Sweetwater Trading Post onto Toh Chin Lini Mesa. Unimproved dirt roads head south and then east across the mesa into Toh Chin Lini Canyon. From the canyon a rough four-wheel drive trail goes up a small drainage to the area of the Eurida Mine (Figure 1). Except for the latter trail, the roads on the mesa are shown on the topographic quadrangle [U.S. Geological Survey, 1982]. When the author last visited the area in November 1966, the trail up the latter drainage was nearly impassable due to washouts. At that time the adits of the Eurida mine were nearly completely closed due to washed in debris and caving of the adits.

LAND STATUS

Eurida Mesa is located within the Navajo Indian Reservation. On the Reservation all prospecting, leasing, and mining are controlled by the Navajo Tribal Council and the Bureau of Indian Affairs, U.S. Department of the Interior. During the 1920s and 1940s mining companies obtained leases from the Secretary of the Interior to mine on the Navajo Reservation. Due to the uranium boom on the Colorado Plateau, the Tribal Council adopted Resolution CM-3-51 on March 22, 1951 authorizing the Advisory Committee to draft new mining regulations. New regulations pertaining to prospecting and mining were adopted on April 27, 1951 and were approved on September 19, 1951. The new regulations stated that all prospectors must have a permit. Mining permits and leases were to be issued by the Navajo Tribal Council and approved by the Bureau of Indian Affairs (BIA), U.S. Department of Interior. Mining permits could be obtained by individual Navajos only. Permit holders could assign the mining rights to another individual or a company; like the permits, these assignments had to be approved by the Tribal Council and the BIA. Leases would be issued directly by the BIA, and approved by the Secretary of the Interior. Leases were issued for a period up to 10 years. Any one company or individual could hold no more than 960 acres of tribal land. Both the permittee and the tribe would receive royalties from ore production.

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 (U.S. Energy Research and Development Administration and the U.S. Department of Energy). 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, 1983. The Grand Junction Area Office of the U.S. Department of Energy obtained a copy of the vanadium and uranium section. 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 Arizona Geological Survey Library.

GEOLOGICAL SETTING

The uranium-vanadium deposits on the Eurida Mesa occur in the Salt Wash Member of the Morrison Formation of Late Jurassic age. In the western Carrizo Mountains, the Salt Wash is approximately 200 feet thick. It is composed pale gray to greenish-gray, fine-grained, well sorted sandstone with rounded to subrounded grains of predominately quartz. The sandstone forms lenses rarely obtaining a thickness of 20 ft. Five to eight percent of the total Salt Wash Member consists of thin beds of reddish-brown and greenish-gray mudstone and siltstone that are interbedded with the sandstone lenses.

Huffman and others [1981] have subdivided the Salt Wash Member in the Carrizo Mountains into three stratigraphic units based on depositional environments. The lowermost unit is an average of 30 feet thick and was considered by those authors to be predominantly overbank deposits of alternating thin mudstone and sandstone. It reportedly contains a few channel sandstones, however, the present author notes that this unit is lithologically distinct from the overlying ore-bearing unit. It does not host any uranium-vanadium ore deposits. Recent investigations of the Morrison Formation by Anderson and Lucas [1998] have determined that this lower unit should be included with the underlying Bluff Sandstone and not with the Morrison Formation.

The middle stratigraphic unit is an average of 70 feet thick and is composed of channel-sandstone deposits, partially and completely abandoned channel-fill deposits, and overbank deposits. It rests with sharp erosional contact on the lower unit. Approximately 80 percent of the sandstone in this unit is active channel fill that was deposited in a generally eastward flowing fluvial system [Craig and others, 1955].

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 conglomerate are also present. The sequence of stratigraphic units probably represents a prograding, wet, alluvial fan [Huffman and others, 1980].

The channel sandstones that contain the ore bodies on Eurida Mesa are approximately 30 to 40 feet above the base of the Salt Wash, within the middle unit of the member. Paleo-stream directions, measured by the author, in the ore-bearing sandstones were east-west.

The uranium-vanadium ore bodies were formed by the selected impregnation of the sandstone and adsorption by the mudstone and fossil plant material. Detrital organic plant material, such as leaves, branches, limbs, and small trunks are common in the ore-bearing sandstone. Most all of this material is carbonized. The larger ore bodies were commonly associated with the plant material. Ore thicknesses ranged from a featheredge to a maximum of four feet with an average of two feet.

The ore deposits in the Carrizo Mountains were originally called carnotite after the bright yellow mineral carnotite, a potassium uranium vanadate. After studying dozens of samples, including work by Corey [1956, 1958], S. Ralph Austin, AEC petrologist, identified only tyuyamunite, a calcium uranium vanadate, and metatyuyamunite as the only uranium minerals in the Carrizo deposits [written communication, 1967].

In a study of the mineralogy and petrology of the Martin mine in Saytah Wash, Corey [1956] found tyuyamunite to be the only uranium mineral present. Vanadium was present in the tyuyamunite and in the mineral montrosite, an iron-vanadium oxide. Vanadium minerals pascolite and volborthaite were found as stains on surface outcrops at the Martin mine. Calcite was the major cementing agent of the ore. Pyrite, limonite, hematite and gypsum were also present in the ore at the Martin mine [Corey, 1956].

The beds of the Salt Wash on Eurida Mesa dip 10 degrees to the northwest. This deformation is due to igneous sills of the Carrizo laccolith, which are exposed east of the mesa.

EARLY LEASING

The discovery of radium by Marie and Pierre Curie in 1898 led to the realization that all uranium ores contained this new element. Radium is a radioactive decay product of uranium. Experiments indicating that radium inhibited the growth of certain cancers so astonished the medical profession that an incentive to mine the uranium-bearing ores was created.

Shortly before 1910, metallurgical processes for relatively large-scale recoveries of radium from carnotite ores were perfected. The improved processes resulted in greatly increased demands for carnotite and in accelerated prospecting in western Colorado. About one gram of radium is present in every 200 to 300 tons of ore containing 2.0 percent U_3O_8 .

Shortly after 1910, the carnotite deposits in southwestern Colorado and southeastern Utah became one of the principal world sources of radium [Tyler, 1930]. For about 12 years, these deposits were mined for radium and yielded some byproduct uranium and vanadium. These activities lead to prospecting and the discovery of similar deposits in the Carrizo Mountains.

Outcrops containing uranium and vanadium minerals in the Carrizo Mountains were discovered by John F. Wade in about 1918 with the assistance of local Navajos [oral communication, 1955]. Wade came from Farmington, New Mexico and operated the 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 because the Navajo Indian Reservation was then 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 then obtained 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 Mountains [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.

After the Navajo Indian Reservation was opened to prospecting, Radium Ores Company, John F. Wade, president, located 28 claims in the northern and western Carrizo Mountains (Figure 1). Details of the location and size of the claims are given in Table 1. Another of Wade's companies, Carriso Uranium Company, located 41 claims in the vicinity of the Arizona-New Mexico state line Milepost 16, in the eastern Carrizo Mountains (Figure 1).

In November, 1920 Radium Ores Company produced 40,000 pounds of ore valued at \$1,600. A transportation charge of \$1,200 left the value at only \$400 [GSA, 1981]. It is possible that this material was shipped to the Standard Chemical Company's ore-buying station near Naturita, Colorado, which was buying carnotite ores for their radium content in the 1910s and 1920s. The November, 1920 shipment represented the first production of carnotite ore from the Carrizo Mountains. According to Wade [oral communication, 1955] this shipment came from mineralized exposures along Saytah Wash and none came from Eurida Mesa. This shipment was apparently made in trespass, as Radium Ore Company's lease did not become effective until December 23, 1922 [GSA, 1981]. At that time, Radium Ores paid their first year's rental of \$142.50 for the 570.016 acres held under lease [GSA, 1981].

Radium Ores apparently never canceled their lease and by 1931, some \$3,990.00 in back rent was due [DeVoto and Huber, 1982]. The Federal government apparently settled with the bonding company in 1932 for \$500.00 [DeVoto and Huber, 1982].

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 Congo). A vanadium market never developed, as there was little demand for domestic vanadium because of imports from Peru.

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 did not want prospecting or mining on the Reservation at that time.

VANADIUM LEASING AND MINING

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

A Congressional Act of May 11, 1938 opened the Navajo Indian Reservation 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.

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, and other strategic materials, the Federal government had formed Metals Reserve Company in December 1941. This agency was part of the Reconstruction Finance Corporation. The Metals Reserve vanadium program with increased ore prices, buying stations, etc., was the stimuli to renew interest in the carnotite deposits in the Carrizo Mountains. At Monticello, Utah and Durango, Colorado, Metals Reserve had mills to process vanadium ore.

Lease I-149-IND-3798

On December 4, 1939, effective January 19, 1940, John F. Wade, Thomas F. V. Curran, and H.R. Redington (d.b.a. Wade, Curran and Company.) leased 65.02 acres in the Carrizo Mountains. Their lease, I-149-IND-3798, covered the Martin Claim, Say-Tah Claim, and the Eurida No. 2 Claim as described in U.S. Mineral Survey Nos. 3701 and 3703. The lease was for a period of five years.

These were three of the properties formerly held by Wade's Radium Ores Company. Shipments from Lease I-149-IND-3798 were recorded from August 1942 through November 1943 [GSA, 1981].

Although the production is not separated by claim, Wade [oral communication, 1955] stated the ore-bearing outcrops along Saytah Wash were the first to be mined. Ore mined by Wade, Curran and Company was shipped by truck to Farmington, New Mexico and then by rail to the mill at Durango, Colorado. The Durango mill was operated by U.S. Vanadium Corporation for the Metals Reserve Company. Lease I-149-IND-3798 was due to expire on January 19, 1945 but was apparently canceled earlier.

As part of the U.S. Geological Survey's (USGS) investigations of critical war materials, the vanadium deposits of the Carrizo Mountains were examined during October and November, 1942. The USGS geologists examined and mapped the existing mines, and acquired production history and statistics from the mine operators.

The detailed results of the October-November 1942 investigations are in a report by Duncan and Stokes [1942], which was submitted to the U.S. Army's Manhattan Engineer District. The general geology and the description of the ore deposits were later published by Stokes [1951]. Duncan and Stokes [1942, Figure 4] mapped the Eurida mine and stated that approximately 100 tons of ore averaging 3.00 percent V_2O_5 had been mined to date. At that time the mine workings consisted an open cut and shallow underground workings [Duncan and Stokes, 1942, p. 24].

When shipments from Lease I-149-IND-3798 ceased in November 1943, a total of 2,198.05 tons of ore averaging 2.91 percent V_2O_5 had been produced (Table 2). The value of the ore was reported as \$54,380.69 from which the Navajo Tribe received \$8,157.09 in royalties [GSA, 1981].

The mines developed by Wade, Curran and Company were mapped by Union Mines Development Corporation in September 1945 [Harshbarger, 1946, figs. 26,27]. Figure 2 is a map of the main Eurida mine. The eastern workings consist of three short adits and some rim stripping (Figure 3). Based on the extent of these workings, I would estimate that at least 800 tons of high-grade vanadium ore was shipped from the Eurida mines in 1942-1943.

New Regulations

On April 9, 1941, the Navajo Tribal Council requested the Secretary of the Interior to lease lands for mining purposes to the highest bidder. In order to take care of this situation, the mining leases were written for large areas and subsequently reduced in acreage at the end of a 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.

Lease I-149-IND-5456

The first sale to be held under the new bidding regulations was in the northwestern Carrizo Mountains. On November 28, 1941, the Office of Indian Affairs advertised an exploration mining lease sale, for carnotite and related minerals, for 144 square miles in Apache County, Arizona. The tract was described as: “unsurveyed land which was designated on an unapproved survey as Township 12 and 13 North, Range 7 West, and Township 12 and 13 North, Range 6 West, Navajo Meridian.”

Bids were opened on December 19, 1941, at which time two bids were received; Vanadium Corporation of America (VCA), Naturita, Colorado, \$2,000.00; and King Lease, Inc., Ouray, Colorado, \$100.00 (GSA, 1981, exhibit 26). Lease I-149-IND-5456 was executed with VCA on December 26, 1941, effective February 23, 1942 for a period of ten years. Ore shipments to the Monticello mill commenced in early May 1942 and continued through February 1944.

The early May 1942 shipment from this lease was the first vanadium ore produced in the Carrizo Mountains under the Metals Reserve program. The ore came from the Rattlesnake mines in the Saytah Wash area (Duncan and Stokes, 1942, p.22).

On September 2, 1943, the lease was reduced to a permanent operating lease and VCA selected 16 plots (claims) totaling 229.14 acres to be retained. Details of these plots are given in Table 3. These 16 plots were commonly referred to as the “West Reservation Lease” by VCA. When mining stopped in February 1944, total production for lease 1-149-IND-5456 had been 7,504 tons of ore containing 274,411 pounds V_2O_5 , averaging 1.83 percent V_2O_5 (Table 4). The value of the ore was reported as \$90,513.96, from which the Navajo Tribe received \$8,721.35 in royalties [GSA, 1981]. All of the ore from Lease 1-149-IND-5456 was trucked to the mill at Monticello, Utah operated by VCA for the Metals Reserve Company.

When Duncan and Stokes [1942, p. 24] were on Eurida Mesa in late 1942, they noted that VCA had mineralized exposures north and east of the Eurida mine and the company planned prospecting and development. In September 1945, geologists of the Union Mines Development Corporation examined the mine workings on Eurida Mesa. They mapped outcrops of uranium-vanadium exposed for a total distance of 400 feet on Plot 14, three shallow open pits on Plot 15 and 700 feet of rim stripping and six short adits on Plot 16 [Harshbarger, 1946, figs. 28, 29 and 30]. Based on the size of these workings, I would estimate that some 400 tons of vanadium ore was produced in 1942 and 1943.

After acquiring some six million pounds of vanadium concentrate for the nation's strategic stockpile, the Metals Reserve program ended in February 1944. This action brought to an end nearly all vanadium mining on the Colorado Plateau including the Carrizo Mountains.

Lease I-149-IND-6107

On July 21, 1943, in response to requests from mining companies, the Office of Indian Affairs advertised an exploration mining lease sale for carnotite and related minerals in the northern and western Carrizo Mountains. The area offered consisted of 168 square miles in a tract 7 mi wide east-west, and 24 mi long, north-south, with the southeast corner located near Cove School (Figure 1). Excluded were all lands subject to prior approved mineral leases.

Bids were opened on August 3, 1943 at which time the only bid received was \$5,085.00 from Thomas F.V. Curran, Charles F. Curran, and John F. Wade, d.b.a. Curran Brothers and Wade [GSA, 1981]. Lease I-149-IND-6107 was executed on August 6, 1943, effective October 27, 1943 for a period of ten years. On the date the lease became effective, a two-thirds interest was assigned to U.S. Vanadium Corporation (USVC).

Shipments commenced in December 1943 and continued through February 1944. Total production from the lease was 388.35 tons with an average grade of 1.94 percent V_2O_5 (Table 5). The ore was mined from the Saytah Canyon mine, the CB & W Main Claim mine in Saytah Canyon, and from the North Martin mine in Saytah Wash. A small amount may have been mined from the west side of Cove Mesa [Harshbarger, 1946, fig. 3]. The ore was shipped by truck and rail to the mill at Durango, Colorado. The value of ore was reported as \$6,605.69 from which the Navajo Tribe received \$660.57 in royalties [GSA, 1981].

On March 22, 1944 the lease was reduced to a permanent operating lease with 12 plots, totaling 959.7 acres, selected to be retained. The location and size of the plots is given in Table 6. Plot 6 was a single, rectangular claim of 20.6 acres on Eurida Mesa, which covered the old Wade, Curran and Company workings (Figure 4). This claim was tied to U.S. Mineral Monument No. 2, which was located near the northwest corner of Plot 6.

MANHATTAN PROJECT ACTIVITIES

During World War II the Army Corps of Engineers formed the Manhattan Engineer District (MED) for the development of atomic weapons and acquisition of raw materials for the production of weapons. The Murray Hill Area of MED was established on June 15, 1943 for the major purpose of the exploration and development of raw materials on which the entire Manhattan Project was dependent. Determination and evaluation of the

uranium resources of the world was first undertaken, and the program was later expanded to include thorium ores.

Union Mines Development Corporation (UMDC), a subsidiary of Union Carbide and Carbon Corporation, was contracted to carry out the work (contract, No. W-7405, effective May 11, 1943). On the Colorado Plateau, UMDC's geologic investigations were limited to the Salt Wash Member of the Morrison Formation, and the Entrada Sandstone in the areas of the roscoelite deposits.

Geologic studies and resource estimates for the northwestern Carrizo Mountains are contained in reports by Eakland and Wardwell [1943] and Harshbarger [1946]. All of the known outcrops of uranium/vanadium minerals, prospects, and mines were mapped and described by UMDC geologists. The geologists also proposed an exploration program for developing additional ore reserves. Activities of the Manhattan Engineer District in Arizona have been summarized by Chenoweth [1998].

As part of their investigations, UMDC geologists recommended areas that should be acquired by the Federal government for the development of uranium resources. In the northern and western Carrizo Mountains, UMDC took action to acquire the lease of Curran Brothers and Wade-U.S. Vanadium, which consisted of 12 plots UMDC had helped to select (Table 6). On April 17, 1944, the one-third interest in Lease I-149-IND-6197 held by Curran Brothers and Wade, was reassigned to Union Mines. The two thirds interest held by USVC was reassigned to UMDC on April 24, 1944. The Office of Indian Affairs approved both reassignments on October 31, 1944. The cost of acquiring the lease was reported at \$16,000 or about \$16.50 per acre [Manhattan District Engineers, 1948].

There was no mining on the lease after it was acquired by UMDC. Contractors to the Manhattan Engineer District secretly recovered uranium values from all of the ores shipped to both the Monticello, Utah and Durango, Colorado mills by Wade, Curran and Company, VCA and Curran Brothers and Wade- U.S. Vanadium [Chenoweth, 1988].

URANIUM-VANADIUM MINING

The U.S. Atomic Energy Commission was established by the Atomic Energy Act of August 1, 1946, in recognition of a need to provide for a civilian Government agency that could assure the continued development of atomic energy for military purposes and also promote the research and development necessary to the utilization of atomic energy for peaceful applications. During World War II the Manhattan Engineer District (MED), under the Army Corps of Engineers, had been charged with the development of atomic weapons. Its activities in-

cluded research and development, engineering and design, the operation of production facilities for weapons materials and components, and the acquisition of uranium for the production of nuclear weapons. All of these MED functions, and the numerous Government-owned facilities in which many of them were being performed, were transferred to the AEC by Executive Order 9816, effective at midnight, December 31, 1946. An Office of New York Directed Operations was established by the AEC on June 9, 1947, and that office supervised the procuring and processing of uranium until the AEC's Division of Raw Materials was formed in October 1947 to direct those activities from the AEC's Headquarters office in Washington, D.C.

On the Colorado Plateau, the AEC began a procurement program for uranium concentrate. The first domestic contract was signed with VCA on August 28, 1947, effective May 20, 1947, to purchase uranium concentrates from the company's Naturita, Colorado mill. The AEC also contracted with VCA, effective October 8, 1948, to buy concentrates from the AEC owned mill at Durango, which VCA had leased with an option to buy [Albrethsen and McGinley, 1982].

Lease I-149-IND-6197

With emergence of a new market VCA began reopening their inactive mines in the Carrizo Mountains, which had previously been mined for vanadium. On February 17, 1949, effective October 8, 1948, VCA entered into contract AT (49-1)-305 with the AEC to mine the plots covered by lease I-149-IND-6197. This lease was officially transferred from Union Mines Development Corp. to the AEC, effective February 28, 1949 [unpublished document in the AEC files]. VCA concentrated their mining on Plot 7 on Cove Mesa and also reopened the Martin mine on Plot 1 and mined some ore on Plot 4 in Saytah Canyon and on Plot E on Kinusta Mesa. There was no mining on Plot 6, Eurida Mesa.

VCA's contract with the AEC to operate Lease No. I-149-IND-6197 expired on June 30, 1958. Up to that time VCA has produced ore from Plots 1, 4, 7 and E (Table 4). On July 1, 1958, a new contract, AT (05-1)-756, went into affect, but this contract covered only Plot 7 on Cove Mesa (Figure 1). The other 11 plots, including Plot 6, were dropped from the lease for lack of recent production, and control of the land reverted to the Navajo Tribe [unpublished AEC document, 1962].

Lease I-149-IND-5456

When VCA resumed mining on Eurida Mesa, under the AEC program, the company did not separate the different plots in their reports to the AEC. Ores received at the Durango mill were only identified as Eurida.

Thomas Clani, a Navajo contract miner, began shipping ore from Eurida Mesa in August 1950. By January 1951, when he ceased production, he had produced 417.01 tons of ore averaging 0.16 percent U_3O_8 and 2.81

percent V_2O_5 (Table 7). In January 1951, another Navajo miner, John Joe, shipped 7.74 tons averaging 0.17 percent U_3O_8 and 3.40 percent V_2O_5 (Table 7). In June through August 1951, Mike Brodie, a Navajo contractor, shipped 28.50 tons averaging 0.16 percent U_3O_8 and 2.40 percent V_2O_5 (Table 7). Thomas Clani resumed mining in August and September 1951, producing 28.50 tons that averaged 0.16 percent U_3O_8 and 2.40 percent V_2O_5 (Table 7).

The final recorded shipment from Plots 14-16 was in the fall of 1956 when VCA company miners shipped 10.68 tons averaging 0.12 percent U_3O_8 and 2.89 percent V_2O_5 (Table 7). During the AEC program, VCA and their contractors shipped a total of 486.36 tons of ore that averaged 0.17 percent U_3O_8 and 2.82 percent V_2O_5 (Table 7). All of this ore was shipped to VCA's mill at Durango, Colorado, a distance of 130 miles.

When the author examined the Eurida Mesa mines on November 29, 1966, it appeared most of VCA's 1950s mining had taken place on Plot 14. On this plot there were three short adits and several rim cuts, not recorded by Harshbarger [1946] in September 1945.

Mining Permits

In December 1954, Robert Fulton and Mrs. Kee Bylilly were issued Navajo Tribal Permit No. 221 for two claims that covered 98.34 acres on Eurida Mesa, immediately north of Plot 6. There was no mining and the permit expired in two years. The claims were named Ruin Mesa and Ruin Mesa Extension due to the ruins of an Anasazi dwelling near Mineral Monument No. 2.

On March 10, 1965, the same 98.34 acres was included in Mining Permit No. 601 issued to Fulton and Bylilly. Again, there was no mining and the permit expired. The last mining on Eurida Mesa was by VCA in the fall of 1956.

SUMMARY

During 1942 to 1943 Wade, Curran and Company, and VCA produced an estimated 1,200 tons of vanadium ore from exposures on Eurida Mesa, Apache County, Arizona. All of the vanadium concentrate produced at mills at Monticello, Utah and Durango, Colorado went into the nation's strategic stockpile, a program operated by the Metals Reserve Company. Uranium in the ore was secretly recovered at both mills for use in the atomic bombs of the Manhattan Project. The uranium concentrate produced from VCA's ore production in the 1950s was purchased by the AEC. The vanadium concentrate was sold to the steel industry with any excess purchased by the AEC [Albrethsen and McGinley, 1982, p. A15].

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FIGURES

- Figure 1. Index map of the Carrizo Mountains, Arizona-New Mexico showing the location of the Eurida Mesa.
- Figure 2. Map of the main Eurida mine, September 1945. From Harshbarger [1946, fig. 26].
- Figure 3. Map of the east workings, Eurida mine, September 1945. From Harshbarger [1946, fig. 27].
- Figure 4. Index map of Eurida Mesa showing the location of Plots 6, 14, 15 and 16. From Harshbarger [1946, map CU-28].

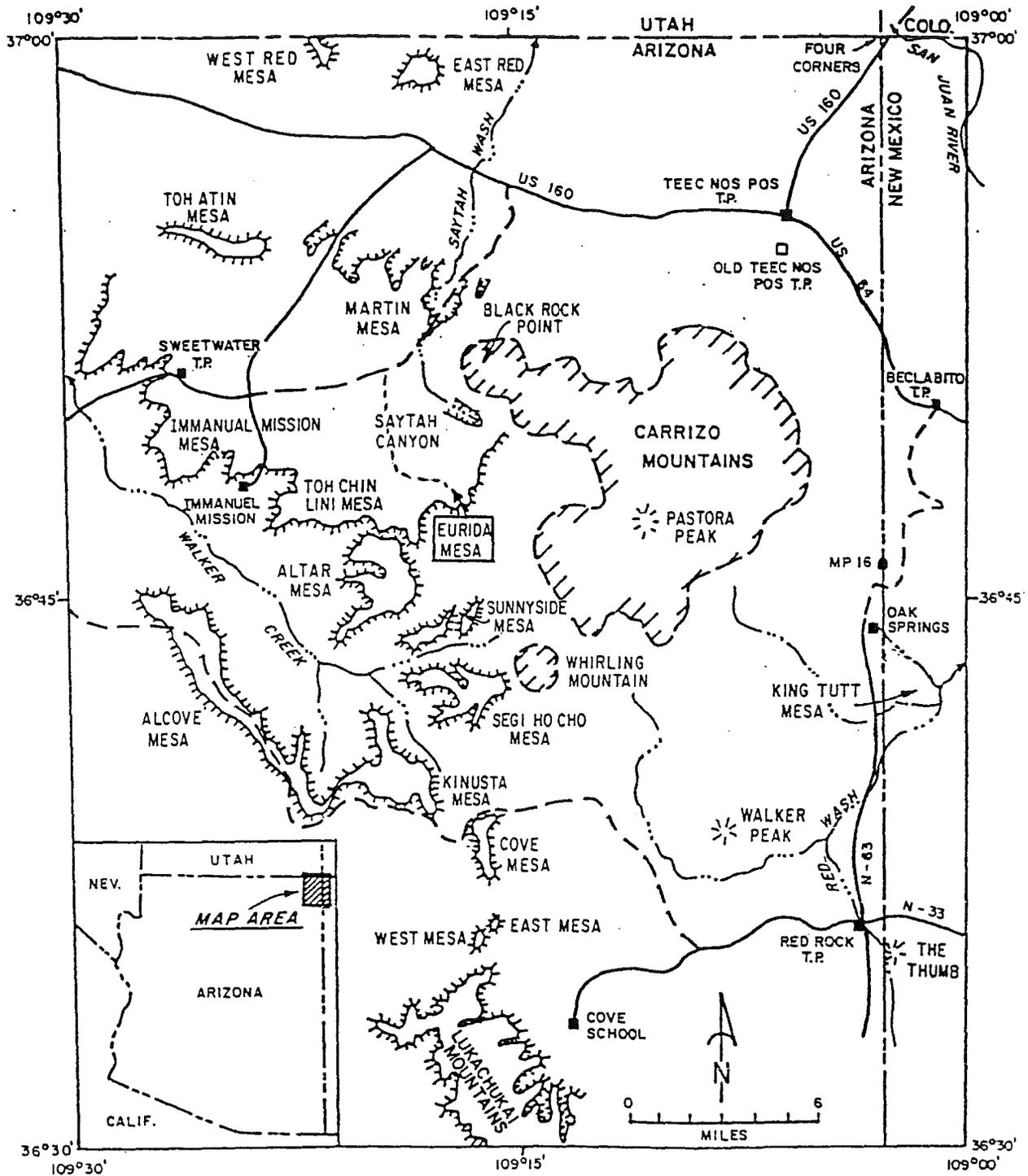


Figure 1. Index map of the Carrizo Mountains, Arizona-New Mexico showing the location of the Eurida Mesa.

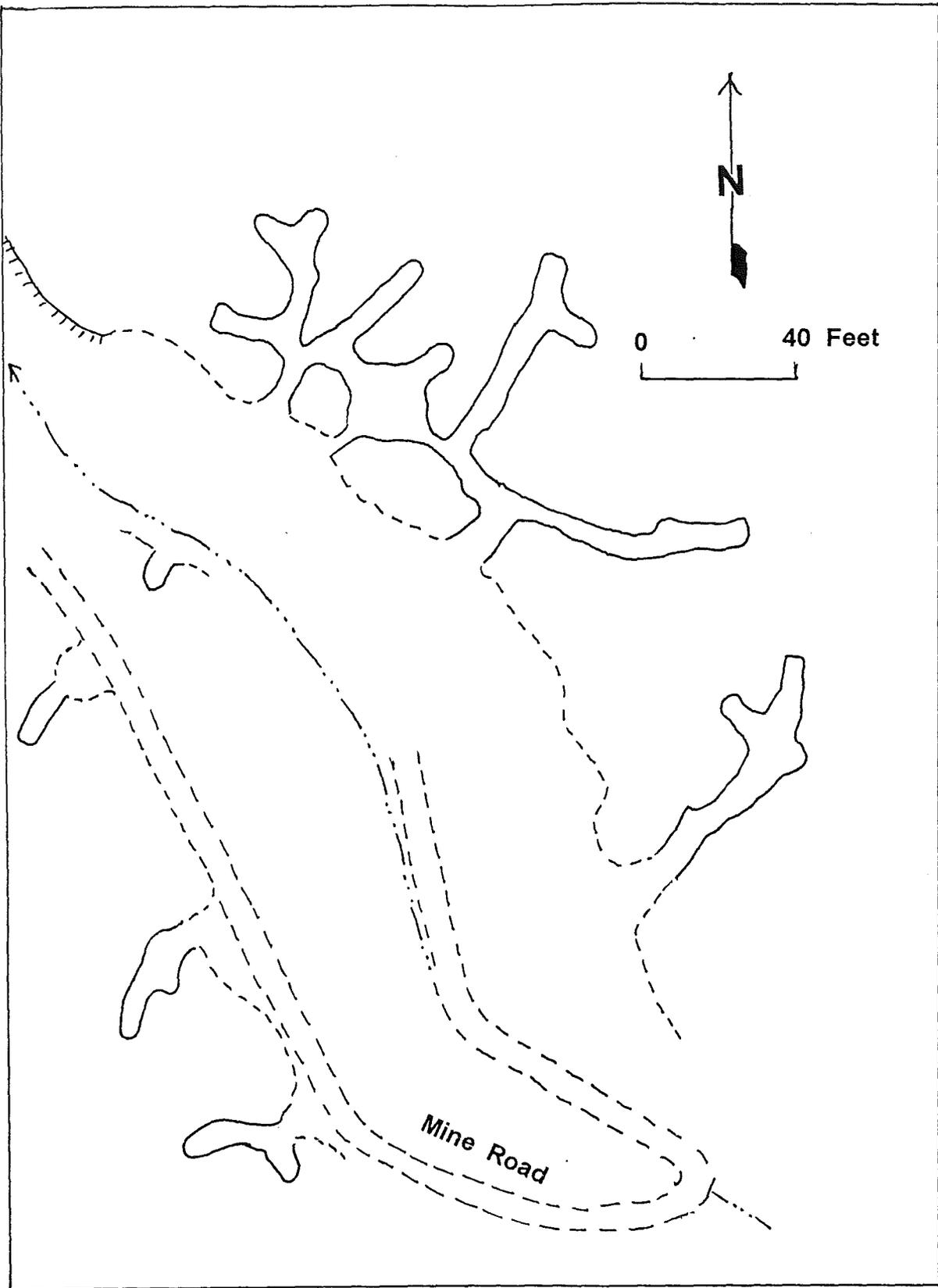


Figure 2. Map of the main Eurida mine, September 1945. From Harshbarger [1946, fig. 26].

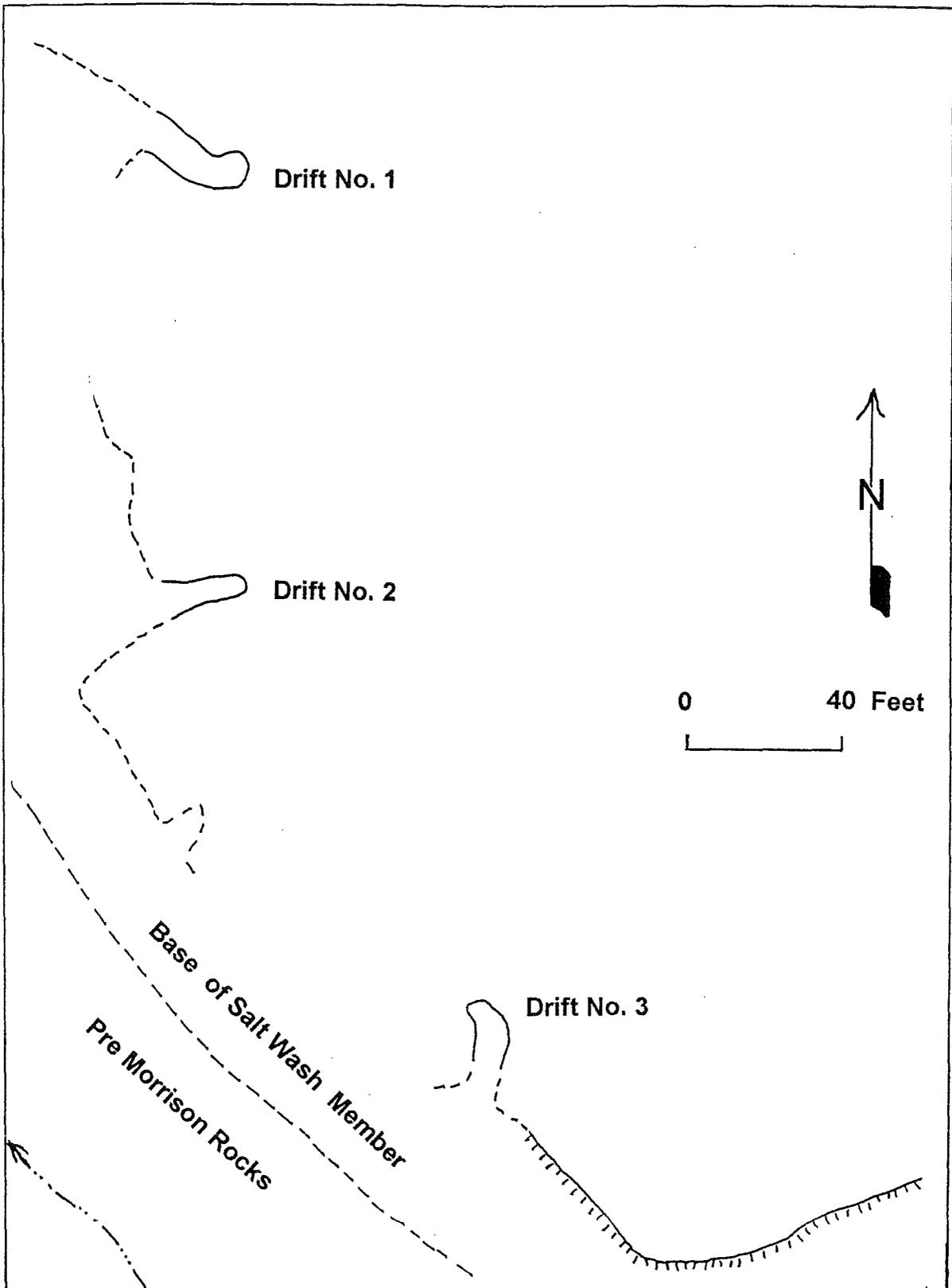


Figure 3. Map of the east workings, Eurida mine, September 1945. From Harshbarger [1946, fig. 27].

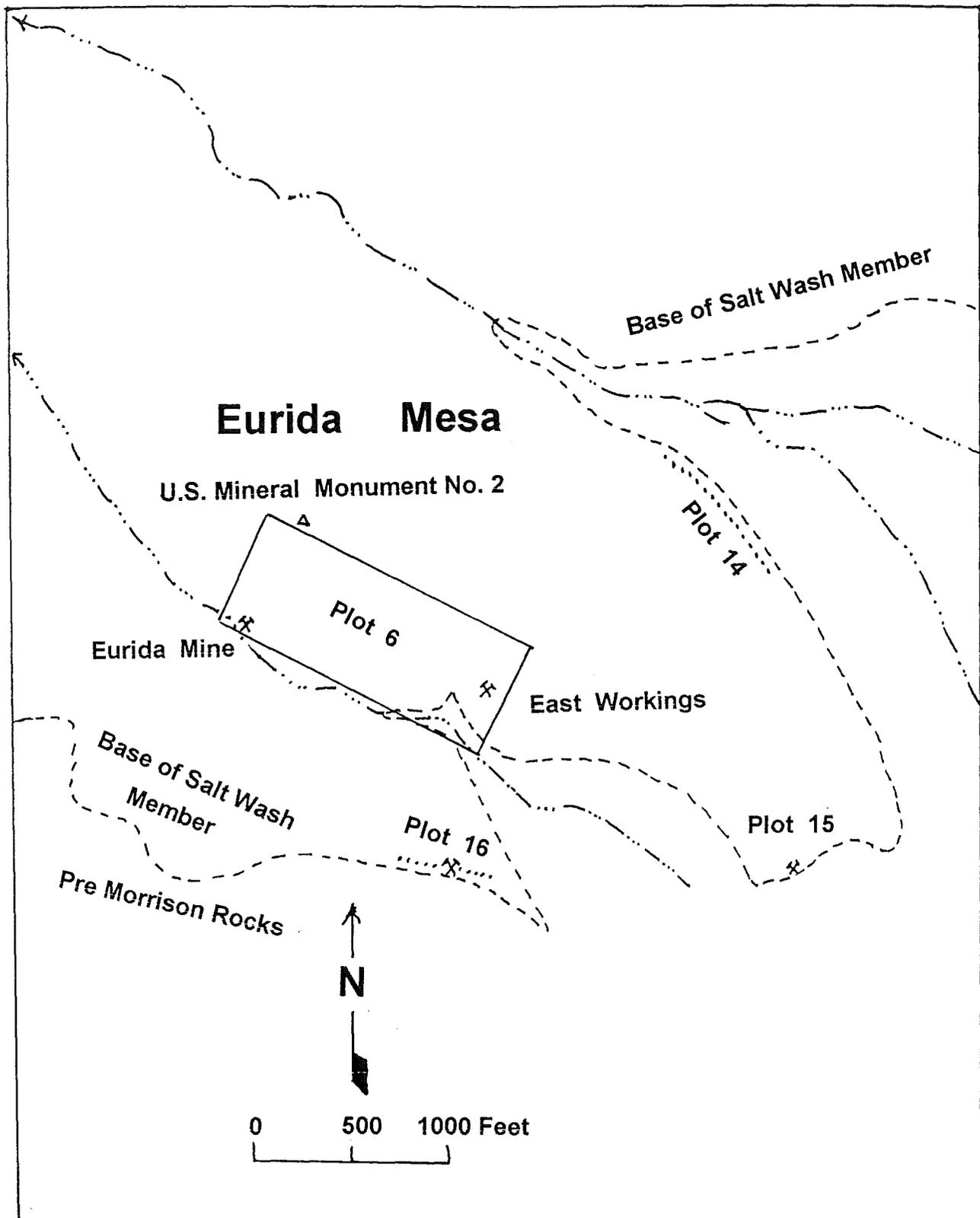


Figure 4. Index map of Eurida Mesa showing the location of Plots 6, 14, 15 and 16. From Harshbarger [1946, map CU-28].

Table 1. Claims included in Radium Ores Company carnotite lease

NAMES	ACRES	LOCATION
Sunnyside	20.661	Sunnyside Mesa
Eurida Nos., 1,2,3,5	103.305	Eurida Mesa
Eurida No. 4	20.661	Eurida Mesa
Preston, Preston No. 1, Stormy Day	61.983	Saytah Wash
Preston Nos. 2,3,4,5	82.644	Saytah Wash
Say Tah, Martin	41.322	Saytah Wash
Martin Nos. 2-13	230.440	Saytah Wash
Total Acres	570.016	

Source: GSA [1981]. See Figure 1 for locations.

Table 2. Vanadium ore production, Lease I-149-IND-3798, Apache County, Arizona

YEAR	MONTH(S)	TONS OF ORE	POUNDS V ₂ O ₅	% V ₂ O ₅
1942	Aug-Dec	301.56	44,948.28	7.45
1943	Jan-Nov.	1,896.49	82,960.75	2.19
Total		2,198.05	127,909.03	2.91

Shipped by Wade, Curran and Company from the Martin, Say-Tah and Eurida No. 2 claims. Source: GSA [1981].

Table 3. Location and Size of Plots, Lease I-149-IND-5455.

NUMBER	MINE NAME*	ACRES	LOCATION
1	Hogan	10.33	Canyon W. Of Saytah Wash
2		10.33	Canyon W. Of Saytah Wash
3		10.33	Canyon W. Of Saytah Wash
4	Gila	10.33	Canyon W. Of Saytah Wash
5		10.33	W. side of Saytah Wash
6	Rattlesnake Mines	52.36	E. of Saytah Wash
7	Rattlesnake No. 5	2.14	E. side of Saytah Wash
8		10.41	Canyon E. of Saytah Wash
9		9.77	Rattlesnake Canyon
10	Horse	10.19	Rattlesnake Canyon
11	Two Level	7.41	Rattlesnake Canyon
12	Rattlesnake No. 8	18.13	E. side of Saytah Wash
13		7.92	E. side of Saytah Wash
14	Eurida	20.66	N. Eurida Mesa
15	Eurida	31.74	S. Eurida Mesa
16	Eurida	6.76	S.W. Eurida Mesa
Total		229.14	

* Mining and prospecting occurred on all plots, but only ten have named mines.

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

Table 4. Vanadium ore production, Lease I-149-IND-5456, Apache County, Arizona

YEAR	MONTH(S)	TONS OF ORE	POUNDS V ₂ O ₅	% V ₂ O ₅
1942	May-Dec	1,468	55,111	1.88
1943	Jan-Dec	5,636	204,411	1.82
1944	Jan-Feb	400	14,381	1.80
Total		7,504	274,411	1.83

Shipped by VCA from Plots 1 through 12, 15, 16.

Source: GSA [1981].

Table 5. Vanadium ore production, Lease I-149-IND-6197, Apache County, Arizona

YEAR	MONTH(S)	TONS OF ORE	POUNDS V ₂ O ₅	% V ₂ O ₅
1943	Dec	170.65	7,390.63	2.17
1944	Jan, Feb	217.70	7,669.65	1.76
Total		388.35	15,060.28	1.94

Shipped by Curran Brothers and Wade - U.S. Vanadium Company before the 12 plots of the lease were selected. Mines were on Plots 2,4,5 and 7.

Source: GSA [1981].

Table 6. Location, mine name, and size of Plots, Lease No. I-149-IND-6197

NUMBER	MINE NAME	ACRES	LOCATION
1	Martin	20.2	Saytah Wash, west rim
2	North Martin	14.4	Saytah Wash, west rim
3	--	2.2	Saytah Wash, east rim
4	Saytah Canyon	10.4	Saytah Wash Canyon, north rim
5	CB & W Main Claim	5.7	Saytah Wash Canyon, south rim
6	Eurida	20.6	Eurida Mesa
7	Cove Mesa	246.2	Cove Mesa, southern 3/4ths
A	--	16.0	Saytah Canyon, north rim
B	--	17.3	Segi Ho Cho Mesa, north point
C	--	39.9	Segi Ho Cho Mesa, southwest pont
D	--	37.8	Segi Ho Cho Mesa, southwest pont
E	Tree Mesa	529.0	Kinusta Mesa, eastern end
Total		959.7	

No mines were developed on Plots 3, A, B, C, D

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

Table 7. Uranium-vanadium ore production Plots 14, 15, 16, Lease I-149-IND-5456, Apache County, Arizona

YEAR	QUARTER	OPERATOR	TONS OF ORE	POUNDS U ₃ O ₈	% U ₃ O ₈	POUNDS V ₂ O ₅	% V ₂ O ₅
1950	3rd	Thomas Clani	89.56	351.26	0.20	4,782.00	2.67
1950	4th	Thomas Clani	307.99	961.33	0.16	17,965.00	2.92
1951	1st	Thomas Clani	19.46	56.34	0.14	695.00	1.79
1951	1st	John Joe	7.74	26.30	0.17	526.00	3.40
1951	2nd	Mike Brodie	16.20	76.25	0.24	1,094.00	3.38
1951	3rd	Mike Brodie	6.23	24.91	0.30	374.00	3.00
1951	3rd	Thomas Clani	28.50	92.62	0.16	1,369.00	2.40
1956	4th	VCA	10.68	25.65	0.12	617.00	2.89
Total			486.36	1,614.66	0.17	27,422.00	2.82

Source: AEC unpublished ore production records.