The Geology and Production History of the Uranium-Vanadium Mines on Plot 6, West Reservation Lease, and on Hoslie Henry's Mining Permits Northwestern Carrizo Mountains, Apache County, Arizona

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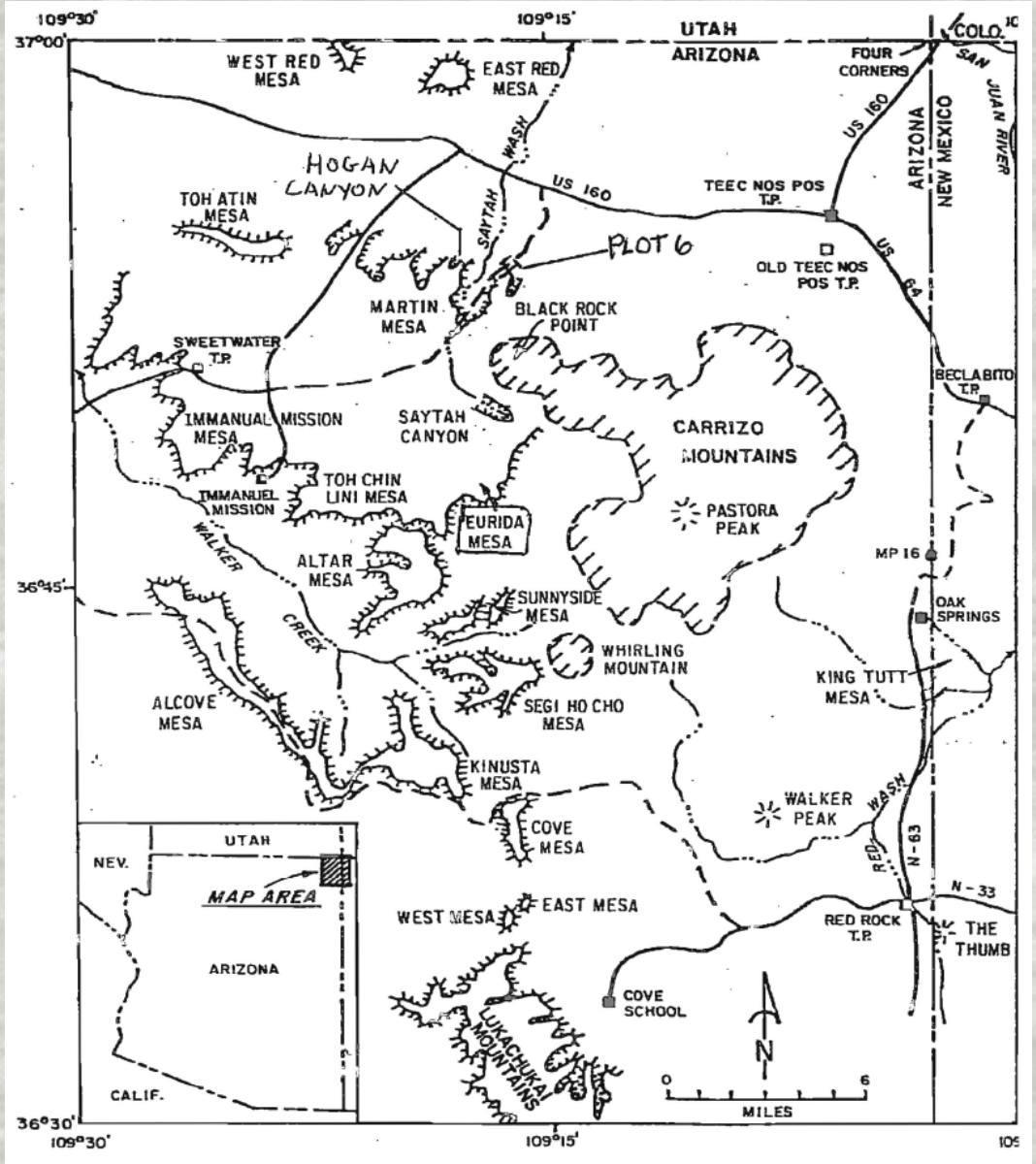

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Cover: Location map of the Carrizo Mountains and environs, Apache County, Arizona.

INTRODUCTION

Plot 6 is the largest of 16 plots (claims) of a 229.14-acre vanadium lease that was issued in 1942. This lease was named the West Reservation Lease by the lessee, the Vanadium Corporation of America (VCA). The mines on this lease were called Rattlesnake, not for the reptiles, but for the blotchy pattern of yellow uranium and black vanadium minerals in the ore that resembled a rattlesnake's back (Earl Saltwater, oral communication, 1954).

The purpose of this report is to record the best estimate of total ore production from this 52.36-acre plot and to point out an error in the official ore production records of the U.S. Atomic Energy Commission (AEC), (DOE, 1992). These records are available to the public at the National Archives, Rocky Mountain Region, Bloomfield, Colorado.

Included in this report are the production histories of mines on Hoskie Henry's Navajo Tribal Mining Permits, adjoining Plot 6. Ore on one of the permits was mined from Plot 6.

Location

The northwestern Carrizo Mountains uranium-vanadium mining area is centered around the Toh Atin (No Water) anticline. Here, the Salt Wash Member of the Morrison Formation is exposed along the rims of several canyons on the northeast flank of the anticline. The Salt Wash sandstones are host to numerous uranium-vanadium ore deposits.

Saytah (Tsitah) Wash is the largest canyon on the anticline. Plot 6 is at the mouth of the canyon (Figure 1). This large plot is located in the SE, NW, SE and the SW, NE, SE Section 6, T. 40 W, R. 29 E, Gila and Salt River Meridian, per 2011 survey (USGS, 2014).

When the mines were operating they could be reached by traveling 11 miles west ~~on~~ the old Tees Nos Pos Trading Post on the Monument Valley road (Navajo Route 1). Then turning south on a dirt road to Sweetwater Trading Post via Saytah Wash. After 3.5 miles the road comes to Plot 6. The mining area is in the left of the road.

The area of Plot 6 has been remediated by the Navajo Abandoned Mine Lands Reclamation Project.

Land Status

The West Reservation Lease mines and the Hoskie Henry mines are in 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 (BIA), 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 in the Colorado Plateau, the Tribal Council adopted new regulations. The new regulations stated that all prospectors must have a permit. 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 as long as 10 years. Any one company or individual could hold no more than 960 acres of tribal land. An exception to the 960-acre limit would be to a company who had a uranium processing mill on the Reservation. Both the permittee and the tribe would receive royalties from ore production.

Sources of Data

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 (DOE).

From December 1953 to May 1955, the author was stationed at the AEC's Rattlesnake field camp, located about one mile northeast of the Rattlesnake mines on Plot 6 (Figure 2). During this time the author examined all of the plots of the West Reservation Lease including the three on Eurida Mesa (Figure 1).

Information on the West Reservation Lease and 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. A copy of the GSA report is now in the National Archives, Rocky Mountain Region, Bloomfield, Colorado, Record Group 434-99-200.

In 1980, Robert Scarborough, Arizona Bureau of Geology and Mineral Technology, obtained a copy of a map of the mines on Plot 6 from the Foote Mineral Company, successor to VCA. This map showed all the mine workings as of June 1966. Using this data he updated a 1945 map from Harshbarger (1946) which is Figure 3 of this report.

GEOLOGIC SETTING

The uranium-vanadium deposits at the Plot 6 and Hoskie Henry mines occurred in the Salt Wash Member of the Morrison Formation of Late Jurassic age. In the northwestern Carrizo Mountains, the Salt Wash Member is approximately 200 ft thick. It is composed of pale gray to greenish-gray, fine-grained, well-sorted sandstone with rounded to sub-rounded grains of predominately quartz. The sandstone forms lenses that are rarely up to 20 ft thick. Interbedded with sandstone lenses are thin beds of reddish-brown and greenish-gay mudstone and siltstone, that form only five to eight percent of the total Salt Wash. The ore-bearing sandstones at the Plot 6 mines are 20 to 50 ft. above the base of the Salt Wash.

The uranium-vanadium orebodies were formed by the selected impregnation of the sandstone and absorption of 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 orebodies that were commonly associated with the plant material range from several feet wide to more than 100 ft long. Ore thicknesses up to 3 ft were observed in the Plot 6 mines.

In a study of the mineralogy and petrology of the Martin mine in Saytah Wash (Figure 2), Corey (1956) found tyuyamunite to be the only uranium mineral. Vanadium was in the tyuyamunite and in the mineral montrosite, an iron-vanadium oxide. Vanadium minerals pascolite and volborthite were found as stains on outcrops at the Martin mine. Calcite was the major cementing agent of the ore. The large amounts of calcite, greater than six percent $CaCO_3$, resulted in the ore being classified by the AEC as "high lime"; this created problems in the acid leach circuits of processing mills. Pyrite, limonite, hematite, and gypsum were also in the ore at the Martin mine (Corey, 1956)

The Rattlesnake and Hoskie Henry mines are located on the northeast flank of the Toh Atin anticline. Here, the beds of the Salt Wash Member strike N75° W and dip 8 degrees to the northeast.

WEST RESERVATION LEASE

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 unapproved survey as Townships 12 and 13 North, Range 7 West, and Townships 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, Naturita, Colorado, $2,000.00; and King Lease, Inc., Ouray, Colorado, $100.00 (General Services Administration, 1981, exhibit 26). Lease I-149-IND-5456 was executed with VCA on December 26, 1941, effective February 23, 1942, for ten years. Ore shipments to the Monticello mill began in early May 1942 and continued through February 1944.

In November 1942, geologists of the U.S. Geological Survey (USGS) examined the Saytah Wash area as part of the Survey's investigations of critical war materials. It the area that would later become Plot 6, Duncan and Stokes (1942, Plate 2) mapped 10 open pits, 1 underground mine, 10 prospect pits and 25 diamond drill sites. VCA officials told USGS (Duncan and Stokes, 1942, p. 22) that between May and November, 1942, the Rattlesnake mines had produced 2,000 tons of ore averaging 1.80 percent V_2O_5. Duncan and Stokes (1942, p. 17) estimated the ore reserves for the area of the Rattlesnake mines as 6,700 tons of indicated ore and 7,000 tons of inferred ore averaging between 1.50 and 2.00 percent V_2O_5.

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. Thirteen of the plots were on the Toh Atin anticline (Figure 2) and three were on Eurida Mesa (Figure 1). Details of these plots are in Table 1. These 16 plots were commonly referred to as the "West Reservation Lease" by VCA. When mining stopped in February 1944, total production for Lease I-149-IND-5456 was 7,504 tons of ore containing 274,311 pounds V_2O_5, averaging 1.83 percent V_2O_5 (Table 2). The value of the

ore was reported as $90,513.96, from which the Navajo Tribe received $8,721.35 in royalties (GSA, 1981) The ore from Lease I-149-IND-5456 was trucked to the mill at Monticello, Utah operated by VCA for the Metals Reserve Company. At the Monticello mill, VCA secretly recovered uranium from the tyuymunite ore for the Manhattan Project (Chenoweth, 1988).

MANHATTAN PROJECT

During World War II, the U.S. 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 for the exploration and development of raw materials on which the Manhattan Project was dependent. Determination and evaluation of the uranium resources of the world was done first 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 do 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.

Party No. 3 under Edward Eakland was in the northwestern Carrizo area in October and November 1943 and in July through September 1945. All of the outcrops of uranium/vanadium minerals, prospects, and mines were mapped and described by UMDC geologists. Geologic studies and resource estimates for the northwestern Carrizo Mountains are contained in reports by Eakland and Wardwell (1943) and Harshbarger (1946).The geologists also proposed an exploration program for developing additional ore reserves, but it was not approved by MED (Chenoweth, 1988).

Union Mines work in the northwestern Carrizo area was summarized by Harshbarger (1946). Included in this report are maps of the mines on the plots of the West Reservation Lease. No mining was shown on Plots 4, 8 and 14. Map AZ-CU-29 showed all of the mine workings on Plot 6. It is in the basis for Figure 3 of this report.

After reviewing the mine maps in Harshbarger (1946), the author determined that 35 to 40 percent of the ore mined during 1942-1944 came from Plot 6.

U.S. GEOLOGICAL SURVEY INVESTIGATIONS FOR THE AEC

In September 1949, the AEC requested that the Navajo Tribal Council withdraw 71 sections in Townships 40 and 41 N, Ranges 28 and 29 E, Gila and Salt River Meridian, in the northwest Carrizo area for a U.S. Geological Survey (USGS) exploration project. The request was approved by the Council and the BIA on October 14, 1949 (USDOI, 1949). To the author's knowledge this was the first, and only, withdrawal the AEC requested on the Navajo Indian Reservation.

From December 13, 1949 through January 6, 1950, the USGS core drilled 16 holes in the areas east and north of Plot 6. Two holes were drilled to the northwest along the road to Sweetwater

Trading Post and six holes were drilled along Navajo Route 1 (now U.S. Highway 160). Total footage drilled was 3,032 ft (Hall and Moore, 1950).

The USGS also mapped the geology of the northeast flank of the Toh Atin anticline from Black Rock Point to the Sweetwater Trading Post road. The location of the mines on Plots 1-8 were plotted in the geologic map (Hall and Moore, 1950, Fig. 1). Mines on Plots 6, 7 and 8 and the Black Rock Point Nos 1 and 3 were mapped (Hall and Moore, 1950, Fig. 2). Figure 4 shows the location of the Black Rock Point mines in relation to Plots 7 and 8.

PLOT 6 PRODUCTION HISTORY

Mining of ore on the West Reservation Lease, under the AEC program, began in October 1948 (Edwards, 1955). Shipments were made to the VCA mill at Naturita, Colorado and in the next year to the company's mill at Durango, Colorado. Many of these early shipments from the Saytah Wash area did not identify plot numbers in VCA's monthly reports to the AEC. Shipments from Plots 14, 15 and 16 on Eurida Mesa were always identified in the reports.

In 1952, the AEC began a study of the northwest Carrizo area for future drilling projects to locate uranium ore deposits adjacent to old vanadium mines. Hatfield and Maise (1953) mapped the mines on Plots 1, 4, 6, 9, 10, 11 and 12 and the Black Rock Point No. 3 mine.

The Rattlesnake No. 2 wagon drill project drilled 206 holes with a total footage of 15,645 ft behind mines and mineralized outcrops in the northwestern Carrizo ore from September 16 to November 4, 1954 (Bollin et al, 1956). In the areas of Plot 6, 41 holes with a total footage of 3,137 ft were drilled. Eight holes encountered ore grade material, 12 were mineralized and 21 were barren (Bollin, et al, 1956). No maps of this drilling could be located.

After reviewing the mine maps in Harshbarger (1946), maps in Hall and Moore (1950) and maps in Hatfield and Maise (1953) the author confirmed there had been early mining for the AEC program on Plots 1, 6, 7, 9, 10 and 11. A new mine, the Gila, had been developed on Plot 4 as had two mines near Plot 8 (Figure 4). These two mines, later known as the Black Rock Point Nos. 1 and 3, had been mined in trespass by VCA (Chenoweth, 2014).

Edwards (1955) told the author that the majority of the ore without plot numbers came from Plot 6. The author estimated that of 5,410.11 tons without plot numbers (Table 3) some 1,500 tons came from non-Plot 6 mines. This would indicate that 72 percent or 3,895 tons came from Plot 6.

Shipments identified as Plot 6 began in March 1950 (Allport, 1950). Table 4 lists all the shipments that can be credited to Plot 6. In the AEC (1964) records, shipments in 1950-51 by Saltwater and Clani were listed as from the West Reservation Lease. However, in an AEC (1953) report there was data that stated these shipments came from Plot 6. There are no records that show ore was mined from Plot 6 in 1952.

VCA company miners operated on Plot 6 in 1953-1956. During this period, Earl Saltwater was VCA's mine foreman (Chenoweth's field notes) and the majority of this mining was in the Central Mine (Figure 3). Thomas Clani made a small shipment in late 1956 and no ore was

mined in 1957. Capital-Seaboard Corp. of Farmington, New Mexico, having an operating agreement with VCA, mined on Plot 6 in 1958-59.

The only mining on the West Reservation Lease in 1960-61 was on Plot 2 by Thomas Clani and Charley Corey, Jr. (Chenoweth's 1961 field notes). In the AEC records (DOE, 1997, p. 674) these shipments are credited to Plot 6. In 1962, VCA company miners resumed mining on Plot 6 and continued until June 1966 when the last ore was shipped. Areas mined on Plot 6 from May 1963 to July 1966 are shown on Figure 3.

On August 31, 1967, VCA merged into the Foote Mineral Company.

HOSKIE H. HENRY'S MINING PERMITS

Mining Permit No. 531

On December 10, 1958, Hoskie H. Henry was issued Navajo Tribal Mining Permit No. 531. This permit was for 84.1 acres adjacent to the southwest corner of Plot 6 (Figure 5). The mining rights to this permit were assigned to the Capital-Seaboard Corp. of Farmington, New Mexico on February 18, 1959. This assignment was approved on March 26, 1959.

Capital-Seaboard did 6,000 feet of drilling in 100 holes and discovered a small orebody in the southeast corner of the permit. It was mined via a 60 ft long, 20 degree decline. The mine was named the Pope No. 1 for W.A. Pope, Jr., the Secretary of Capital-Seaboard.

During the period April through July 1959, the Pope No. 1 mine produced 422.58 tons of ore averaging 0.34 percent U_3O_8 and 1.80 percent V_2O_5 (Table 5). This ore was shipped to the VCA mill at Durango, Colorado.

Mining Permit No. 588

After the AEC geologists, including the author, mapped the ore trends in the Incline mine (Figure 6) the AEC drilled a fence of holes along the eastern boundary of Plot 6 in 1954. A few of these holes penetrated uranium-vanadium mineralization. Ten years later this ore would be mined from a Hoskie Henry mining permit.

On March 1, 1963, VCA acquired from Kerr-McGee Oil Industries, Inc. the Shiprock processing mill and all their mines on the Navajo Reservation. Now having a mill on the Reservation, this allowed VCA to increase their holdings to unlimited acreage on the Reservation.

On August 7, 1963, Navajo Tribal Mining Permit No. 588 was issued to Hoskie H. Henry. It was a horseshoe-shaped tract surrounding Plot 6 on its west, north and east sides (Figure 5). Approval of the mining rights to VCA was on September 12, 1963.

VCA did some drilling to confirm there were orebodies on the east of Plot 6. They also drilled northwest of the Incline and West mines. Mining in the latter area commenced in 1962 and continued to 1965. By 1964 the mine working had extended eastward on the MP-588 (Figure 3).

Also in 1954, VCA began to mine an orebody southeast of the Incline mine via a new decline (Figure 3).

In 1964, VCA combined ore from Plot 6 with Hoskie Henry's ore in reports to the AEC (DOE, 1997, p. 638). In a memorandum to the AEC, VCA (1965) separated the two properties. See Table 6 for details.

In 1965, mining continued east of the Incline mine and from a new decline into Hoskie Henry's permit. The only mining in 1966 was in the West mine, in the northwest corner of Plot 6. This mining also mined some ore on Hoskie Henry's permit (Figure 3). Total production from Mining Permit No. 558 was 978.00 tons of ore averaging 0.20 percent U_3O_8 and 1.29 percent V_2O_5 (Table 7).

VCA's shipments in June 1966, from the West mine on Plot 6, were the last uranium-vanadium ore mined in the northwestern Carrizo Mountains.

SUMMARY

After reviewing all available sources of information, the author concluded that a total of 6,733.48 tons of ore averaging 0.21 percent U_3O_8 and 1.41 percent V_2O_5 were identified as having been produced from Plot 6 (Table 4). An additional 3,895 tons averaging 0.20 percent U_3O_8 and 1.81 percent V_2O_5 mined on the West Reservation Lease are estimated to have come from Plot 6. The 52.36-acre Plot 6 is, without a doubt, the most productive uranium area in the northwestern Carrizo Mountains (Chenoweth, 1985).

All of the uranium recovered from ores at the VCA mills at Naturita and Durango, Colorado and at Shiprock, New Mexico was sold to the AEC. The vanadium that was recovered was sold to the steel industry. Vanadium not purchased by the steel industry was purchased by the AEC.

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Table 1. Name, size and location of plots, West Reservation Lease.

NUMBER	MINE NAME	ACRES	LOCATION
1	Hogan	10.33	Hogan Canyon
2	Plot 2	10.33	Hogan Canyon
3		10.33	Hogan Canyon
4	Gila	10.33	Hogan Canyon
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	Rattlesnake 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 Saytah Wash
14	Eurida	20.66	N. Eurida Mesa
15	Eurida	31.74	S. Eurida Mesa
16	Eurida	6.75	S.W. Eurida Mesa
TOTAL		**229.14**	

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

*Correct location – between Canyon east of Saytah Wash and Rattlesnake Canyon. See Figure 2.

Table 2. Vanadium ore production, 1942-1944, West Reservation Lease.

YEAR	OPERATOR	MONTHS	TONS OF ORE	POUNDS V_2O_5	% V_2O_5
1942	VCA	May-Dec	1,468	55,111	1.88
1943	VCA	Jan-Dec	5,636	204,919	1.82
1944	VCA	Jan-Feb	400	14,381	1.80
TOTALS			**7,504**	**274,411**	**1.83**

Source: GSA (1981)

Table 3. Uranium-vanadium ore production 1948-1952, without plot numbers, West Reservation Lease.

YEAR	OPERATOR	TONS OF ORE	POUNDS U_3O_8	% U_3O_8	POUNDS V_2O_5	% V_2O_5
1948	VCA	566.99	2,419.89	0.21	18,818.00	1.66
1949	VCA	3,448.24	12,469.98	0.18	120,808.00	1.75
1950	VCA*	198.92	898.90	0.22	7,374.00	1.85
1950	VCA	874.90	4,400.58	0.25	36,098.00	2.06
1951	Thomas Clani	251.58	1,216.04	0.29	9,655.00	1.92
1951	Thomas Benally	5.05	37.35	0.37	293.00	2.90
1952	Thomas Clani	64.76	241.46	0.19	2,538.00	1.96
TOTALS		**5,410.44**	**21,679.20**	**0.20**	**195,584.00**	**1.81**

Sources: AEC (1964)
Allport (1950, 1951, 1952)

Thomas Clani and Thomas Benally were VCA contractors.

*These shipments were made by VCA (Allport, 1950) listed as by Thomas Clani in AEC (1964).

Table 4. **Uranium-vanadium ore production, 1950-1966, identified as Plot 6, West Reservation Lease.**

YEAR	OPERATOR	TONS OF ORE	POUNDS U_3O_8	% U_3O_8	POUNDS V_2O_5	% V_2O_5
1950	Earl Saltwater	676.82	3,554.04	0.26	21,394.00	1.58
1951	Earl Saltwater	6.11	31.79	0.26	2,100.00	1.72
1951	Thomas Clani	46.04	234.19	0.25	1,547.00	1.65
1952	-----					
1953	VCA	296.10	990.66	0.17	8,041.00	1.36
1954	VCA	559.63	2,484.00	0.22	17,966.00	1.61
1955	VCA	695.46	3,958.44	0.28	26,430.00	1.90
1956	VCA	551.70	2,279.58	0.21	18,472.00	1.67
1956	Thomas Clani	28.83	79.61	0.14	351.00	0.60
1957	-----					
1958	Capital-Seaboard	234.79	1,342.93	0.29	8,649.00	1.84
1959	Capital-Seaboard	47.82	272.91	0.29	1,514.00	1.58
1960	-----					
1961	-----					
1962	VCA	14.05	52.87	0.19	329.00	2.12
1963	VCA	1,521.80	5,979.32	0.20	33,711.00	1.11
1964	VCA	865.85	2,583.73	0.15	19,740.00	1.14
1965	VCA	1,129.42	4,780.92	0.21	28,103.00	1.29
1966	VCA	59.06	297.63	0.25	2,197.00	1.86
TOTALS		**6,733.48**	**28,922.62**	**0.21**	**190,544.00**	**1.41**

Sources: AEC (1953)
AEC (1964)
Allport (1950, 1951)
DOE (1997)
VCA (1965)

Earl Saltwater and Thomas Clani were VCA contractors.

Capital-Seaboard Corp. had an operating agreement with VCA.

Table 5. **Uranium-vanadium ore production, Pope No. 1 mine, Apache County, Arizona.**

YEAR	QTR	OPERATOR	TONS OF ORE	POUNDS U_3O_8	% U_3O_8	POUNDS V_2O_5	% V_2O_5
1959	2nd	Capital-Seaboard	385.82	2,580.65	0.33	13,781.00	1.79
1959	3rd	Capital-Seaboard	36.76	269.27	0.37	1,415.00	1.92
TOTALS			**422.58**	**2,849.92**	**0.34**	**15,196.00**	**1.80**

Source: AEC (1964)

Table 6. **Uranium-vanadium ore production by VCA from Plot 6 in 1964, Apache County, Arizona.**

TONS OF ORE	POUNDS U_3O_8	% U_3O_8	POUNDS V_2O_5	% V_2O_5
1,598.33	5,620.20	0.18	39,873.00	1.14

Source: DOE (1997, p. 638)

Production as Separated by VCA (1965)

MINE	TONS OF ORE	POUNDS U_3O_8	% U_3O_8	POUNDS V_2O_5	% V_2O_5
Plot 6	865.85	2,583.73	0.15	19,740.00	1.14
Hoskie Henry	732.48	3,036.47	0.21	20,133.00	1.37

Source: VCA (1965)

Table 7. **Uranium-vanadium ore production, Hoskie Henry mine, Apache County, Arizona.**

YEAR	OPERATOR	TONS OF ORE	POUNDS U_3O_8	% U_3O_8	POUNDS V_2O_5	% V_2O_5
1964	VCA	732.48	3,036.47	0.21	20,133.00	1.37
1965	VCA	173.34	576.06	0.17	3,817.00	1.21
1966	VCA	72.18	221.51	0.15	1,326.00	0.92
TOTALS		**978.00**	**3,834.04**	**0.20**	**25,276.00**	**1.29**

Source: VCA (1965) for 1964
DOE (1997) for 1965-66

AEC geologist Dick Maise mapping ore trends in the Incline mine, 1953

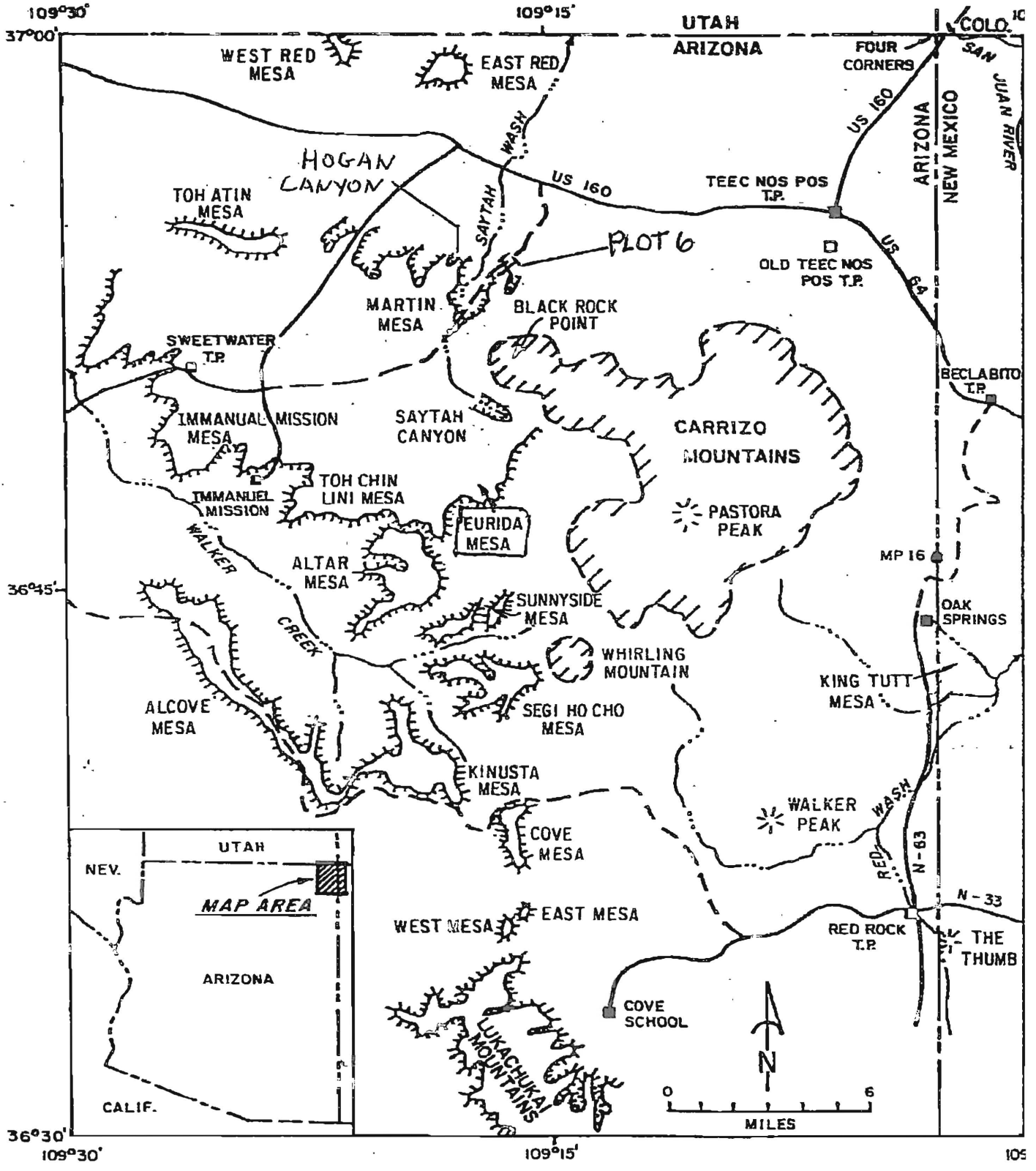

Figure 1. **Index map of the Carrizo Mountains, Apache County, AZ, San Juan County, NM showing the location of Plot 6.**

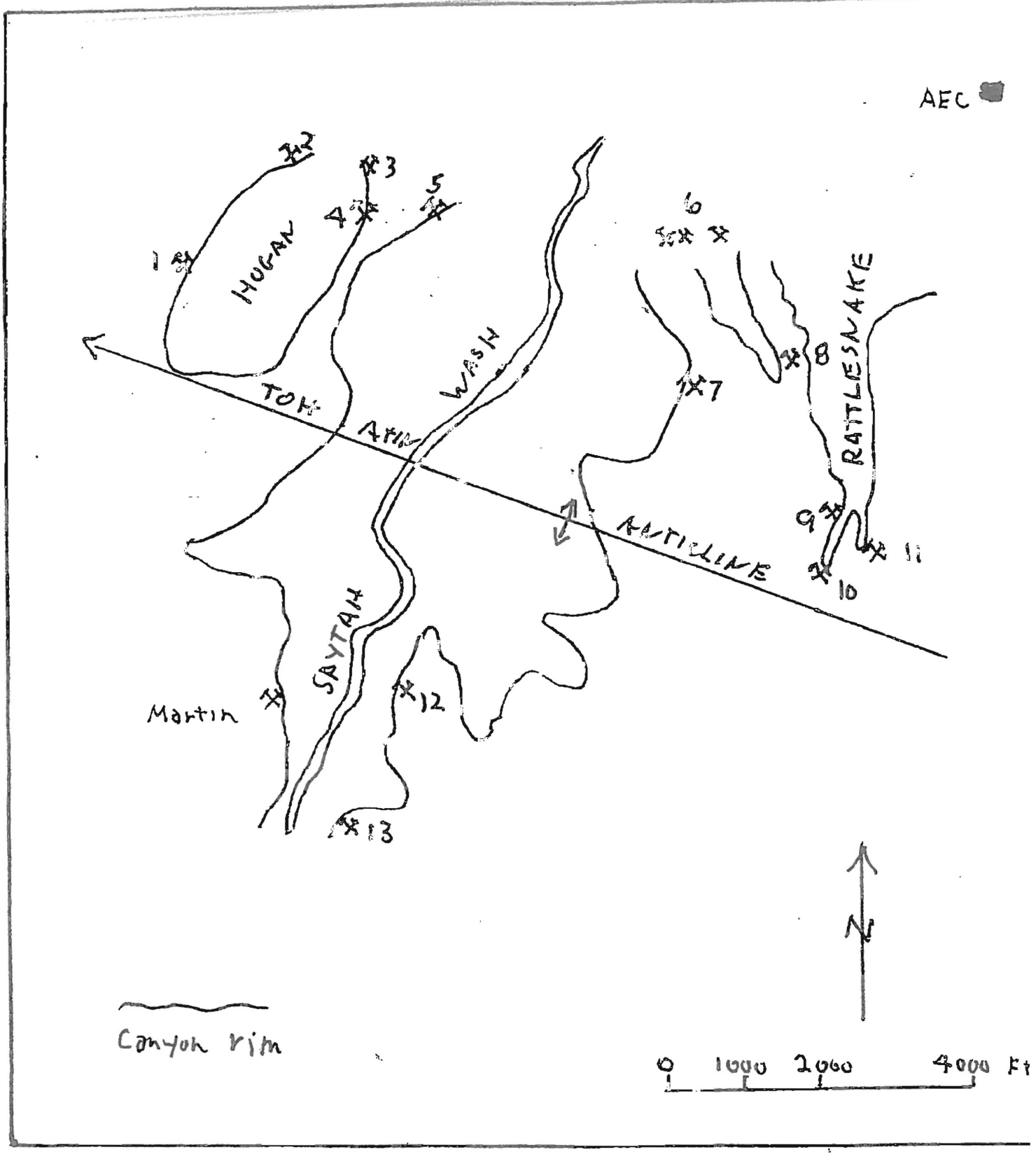

Figure 2. **Map of the Saytah Wash area showing the location of Plots 1-13, West Reservation Lease, Martin mine and AEC camp.**

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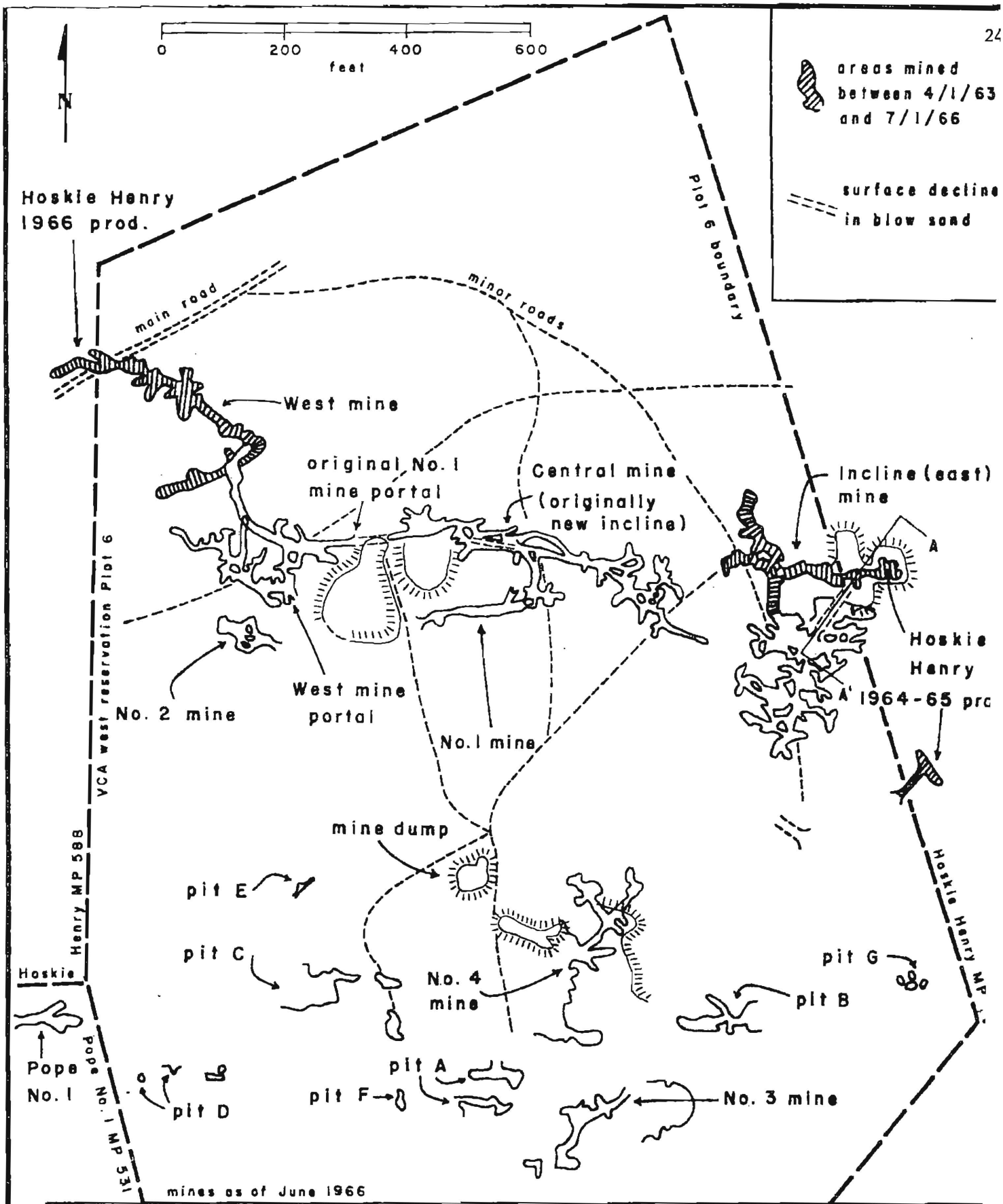
Figure 3. **Map of Plot 6 showing all of the mine workings. Compiled by R.B. Scarborough (1981, p. 24) from Harshbarger (1946) and a map he received from the Foote Mineral Company in 1980.**



Mine Outline Map, VCA Plot 6 (Rattlesnake) group, northwest Carrizo Mountains, Apache County

(mines 3 & 4 are reversed on UMDC map dated 1945 by Harshbarger

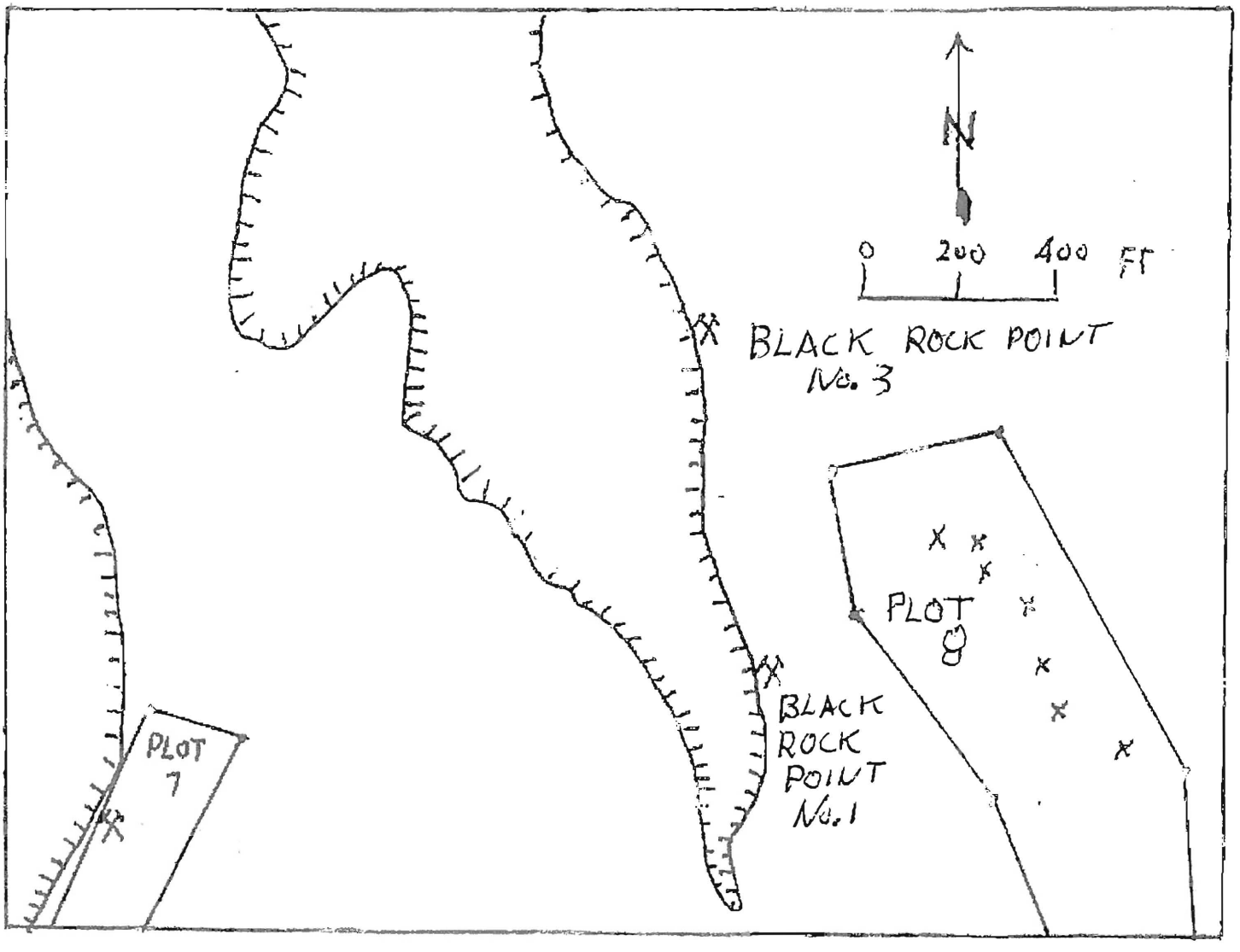


Figure 4. **Map showing the location of the Black Rock Point Nos. 1 and 3 mines. From Hall and Moore, 1950.**

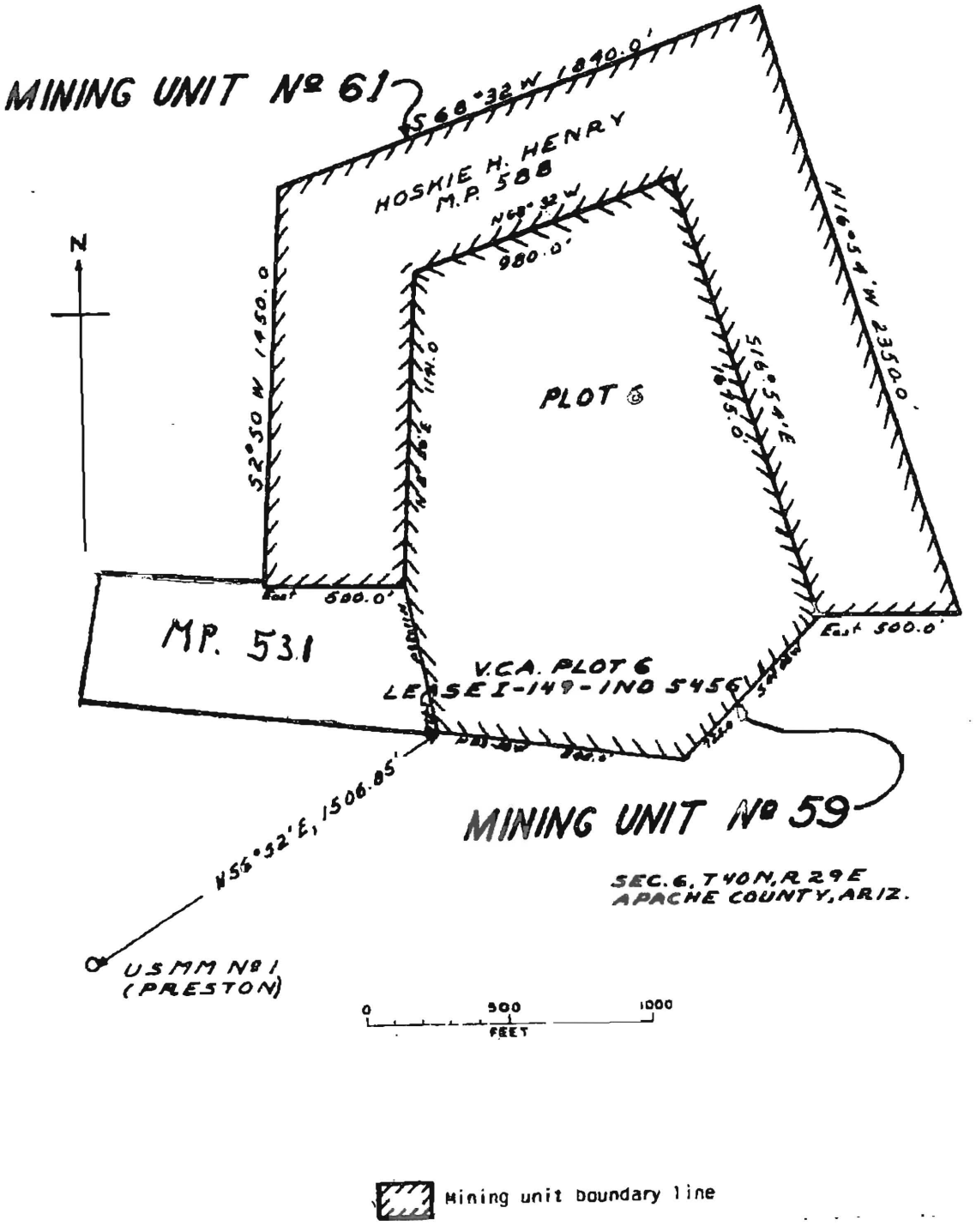


Figure 5. **Map showing the location of Mining Permits 531 and 588 in relation to Plot 6. Mining units are claims VCA planned to mine, post 1961. From AEC files.**

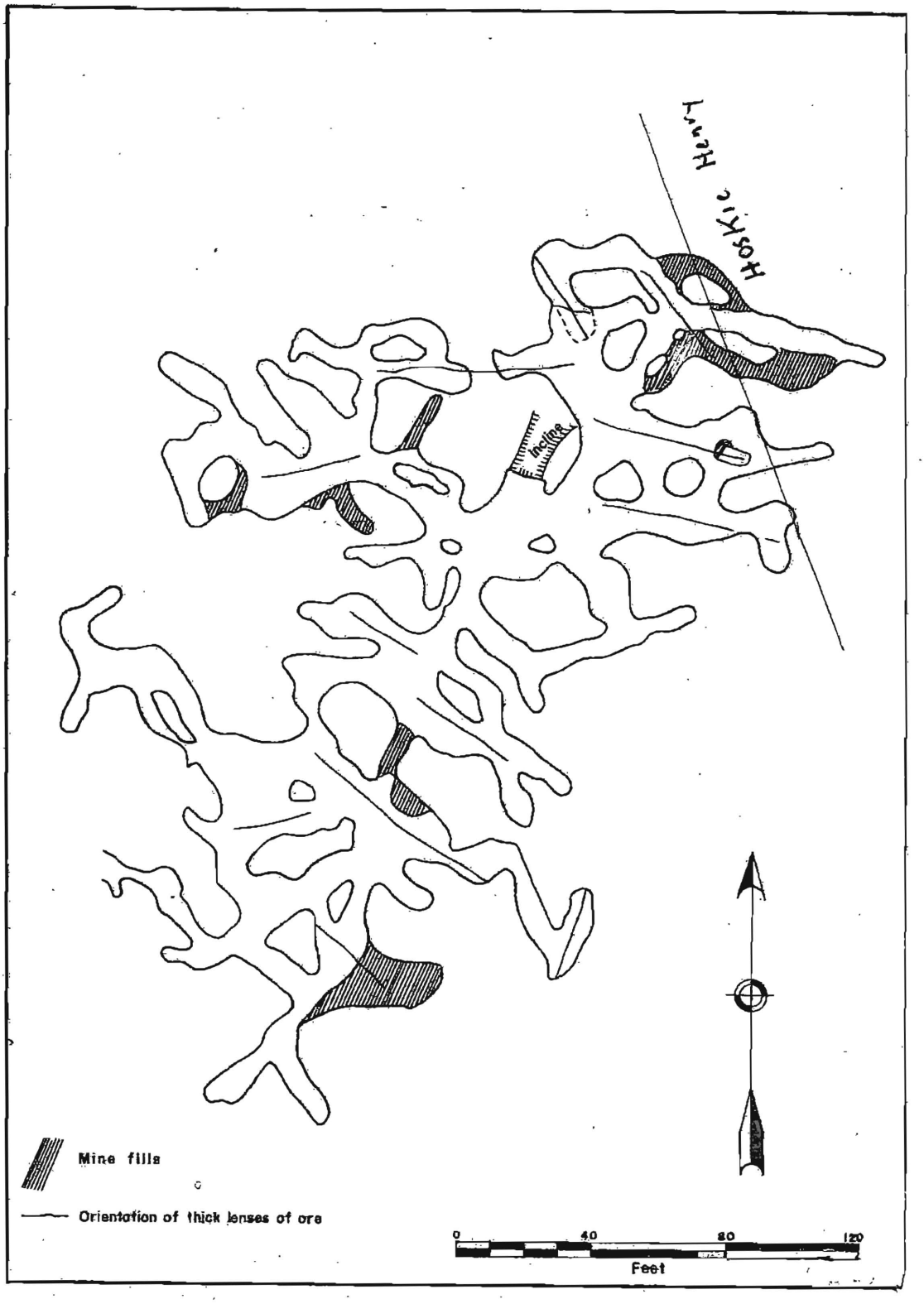


Figure 6. **Map of the Incline mine showing ore trends mapped by AEC geologists.**

APPENDIX

SUMMARY OF URANIUM-VANADIUM ORE PRODUCED BY MINES ON THE WEST RESERVATION LEASE

PLOT NO.	YEARS	TONS OF ORE	POUNDS U_3O_8	% U_3O_8	POUNDS V_2O_5	% V_2O_5	REFERENCE
Not Given	1942-1944	7,504	---	---	274,411.00	1.83	This Report
Not Given	1948-1952	5,410.44	21,679.20	0.20	195,584.00	1.81	This Report
2	1960-1961	163.04	710.41	0.22	5,934.00	1.82	This Report Chenoweth (2017)
6	1950-1951 1953-1956 1958-1959 1962-1966	6,733.48	28,922.62	0.21	190,544.00	1.41	This Report
8	1950	27.78	97.56	0.18	1,000.00	1.80	AEC (1964) Chenoweth (2014)
Nez 1 (10)	1957	8.18	16.36	0.10	195.00	1.19	AEC (1964) Chenoweth (1985)
Eurida Mesa	1950-1951 1956	486.36	1,614.66	0.17	27,422.00	2.82	Chenoweth (2003)
TOTALS		**20,333.28**	**53,040.81**	**0.21**	**695,090.00**	**1.71**	

FOOTNOTES

Uranium Grade:

The grade of the uranium is based on 12,829.28 tons of uranium-vanadium ore.

Vanadium:

A review of the mine maps in Harshbarger (1946) indicates ore was mined on all but Plots 4, 8 and 14. The author estimates that 35 to 40 percent of this ore came from Plot 6. Using a uranium to vanadium ratio of 1 : 9.0 (Chenoweth, 1985), the author estimates that this ore contained 30,490 pounds of U_3O_8.

No Plots:

After reviewing mine maps in Harshbarger (1946), Moore and Hall (1950) and Hatfield and Maise (1953), it appears that this ore came from Plots 1, 6, 7, 9, 10, 11, 15 and 16. Of this total, it is estimated that 3,895 tons came from Plot 6.

Plot 2:

Chenoweth, W.L., 2017, The geology, leasing and production history of the uranium-vanadium mines on Plot 2, West Reservation Lease, Apache County, Arizona: Arizona Geological Survey Report, 14 p.

Plot 8:

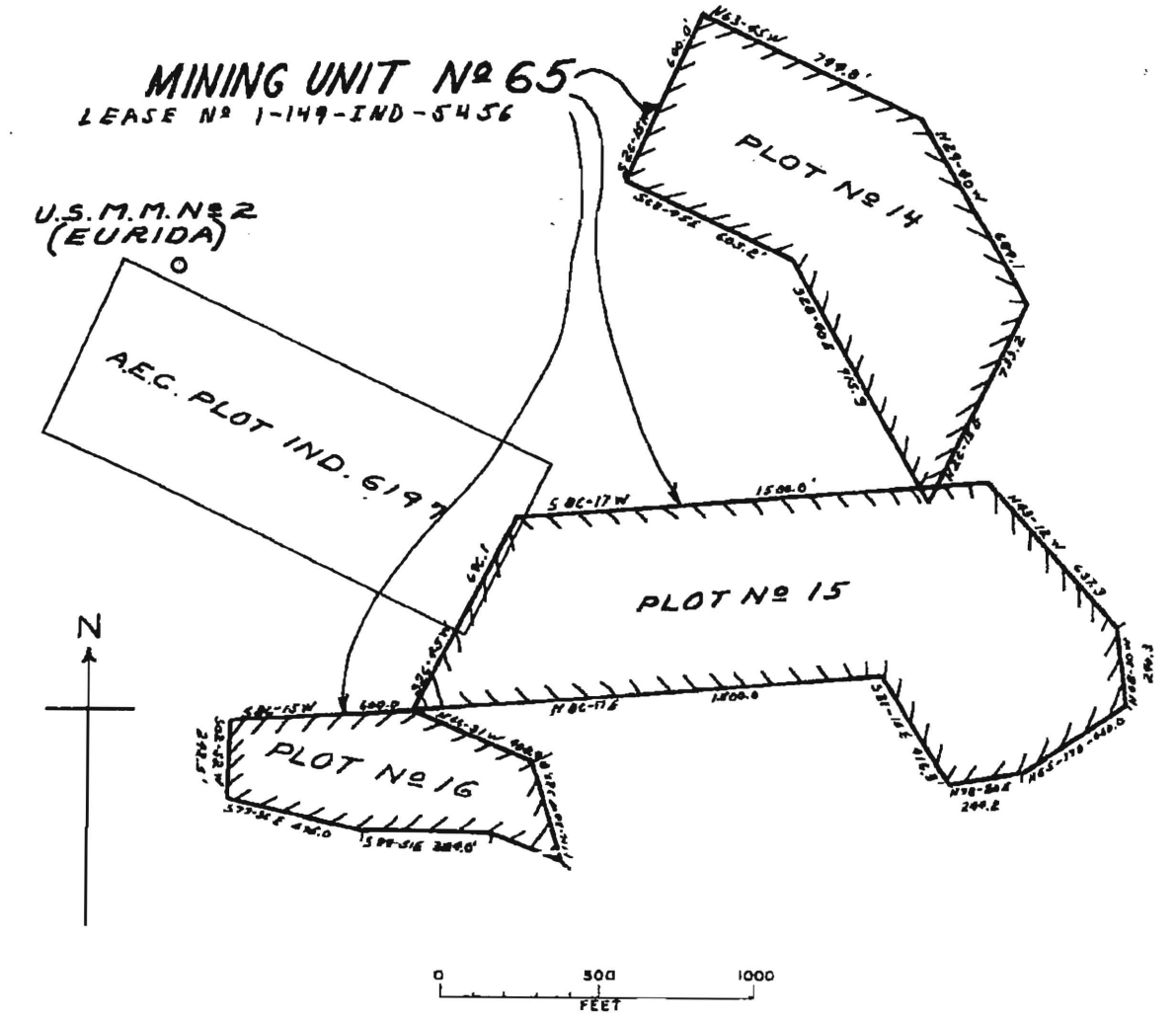
Chenoweth, W.L., 2014, The geology and production history of the Black Rock Point Nos. 1 and 3 uranium-vanadium mines, Apache County, Arizona: Arizona Geological Survey Contributed Report CR-14-B, 12 p.. The ore body on Plot 8 extended onto Thomas Clani's Black Rock Point No. 3 claim which he mined in the mid 1950s.

Plot 10:

Ore mined in trespass from the dump of the Horse mine on Plot 10 by U&L Mining Company. This mine got its name by AEC geologists for a drawing of a horse, made by a miner using a carbine lamp, over the portal.

Plots 14-16:

Chenoweth, W.L., 2003, The geology, leasing and production history of the uranium-vanadium mines on Eurida Mesa, Apache County, Arizona: Arizona Geological Survey Contributed Report CR-03-C, 20 p. In 1969, the author noted mine workings on all three plots in Eurida Mesa. See Figure 7.



Mining unit boundary line

NOTE: Each mining unit is identified by its number and is defined as the volume within the vertical projection of the mining unit boundary lines as set forth on this map.

Location of Mining Unit

Section UNSURVEYED T. 39 N R. 29 E M. G&SR

County: Apache State: Arizona

VANADIUM CORPORATION OF AMERICA

SHIPROCK, NEW MEXICO

Figure 7. **Map of a portion of Eurida Mesa showing the location of Plots 14, 15 and 16. Mining units are claims that VCA expected to mine in post 1961. From AEC files.**