

**THE GEOLOGY, LEASING AND PRODUCTION HISTORY
OF THE PLOT 7 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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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. Permits were issued for a 2-year period and could be renewed for an additional 2 years. Leases by contrast, were issued for periods up to 10 years. No more than 960 acres of tribal land could be held by any one company or individual. Both the permittee and the tribe would receive royalties from ore production. Based on the mine value of the ore, the tribe would receive between 10% and 20% royalties and the permittee between 2% and 5% royalties.

PREVIOUS STUDIES

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 7 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 (Figures 2 and 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 7 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 of Plot 7 lies approximately 50 feet above the base of the Salt Wash Member, within the middle lithostratigraphic unit. Its exposure on Plot 7 was mapped as the "ore rim" by VCA (Figure 2 and 3). Paleo channel directions observed by Stokes (1954) on Plot 7 indicated a S 52°E to S 70°E direction to the streams depositing its sandstone (Figures 2 and 3). 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 7 mines ranged from a feather edge to up to five 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. Later work by Corey (1958) and 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. The mineralogy of the nearby Nelson Point mine was studied by Corey (1958). In this mine, vanadium clay and montrosite were present. These minerals have been oxidized to form a number of relative rare secondary vanadium minerals that include sherwoodite, duttonite, hewettite, metahewettite, rossite, metarossite, and hendersonite (Corey, 1958). Calcite is a common cement in ore. Pyrite, iron oxides, and gypsum may also be present.

The beds of the Salt Wash on Plot 7 dip two degrees to the east due to the presence of 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 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 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 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.

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. Also in that time frame, the

Secretary of Interior was asked to take action to open the Navajo Indian Reservation for prospecting and mining.

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 7 containing 205.39 acres, covered the northeast rim of the canyon of Oak Springs Wash where several exposures of vanadium-bearing minerals had been located (Duncan and Stokes, 1942, p.27). 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. Although Plot 7 was named Lower Oak Creek, none of the mines on the plot were ever identified by this name. Oak Springs Wash is locally called Salt Canyon.

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). 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. When Plot 7 was examined by Coleman (1944), during the summer of 1944, he noted 21 vanadium/uranium exposures of which five had been mined by rim cuts and one with a 50-foot drift. The actual amount of vanadium ore produced from Plot 7 is not recorded, but it is estimated to be between 200 and 800 tons (Chenoweth, 1991).

URANIUM PRODUCTION HISTORY

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 on King Tutt Mesa (Page Edwards, 1955 personal communication). 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 increase.

During 1948 through 1950, Cato Sells held a contract with VCA which enabled him to mine on Plot 10, located northwest of Plot 7 in Apache County, Arizona. In March 1950, Sells shipped 32.14 tons of ore averaging 0.16 percent U_3O_8 and 2.76 percent V_2O_5 from the "Salt Canyon property". Bureau of Indian Affairs (BIA) royalty records indicate this shipment came from Lease I-149-IND-5705 (probably Plot 7) not, as has sometimes been thought, the adjacent ground held by Tony Garnonez by an unnumbered Navajo Tribal Mining Permit (see appendix).

In May through November 1950, another VCA contract miner, Eugene Tapahonso shipped 199.63 tons of ore averaging 0.46 percent U_3O_8 and 3.51 percent V_2O_5 from Plot 7 (Table 2). These shipments were identified to the AEC as coming from the Canyon View Mine (Figure 2).

Following the ore shipments by Tapahonso, another contractor, Hosteen Setah Begay began ore shipments from the Canyon View Mine during December 1950. These shipments continued through May 1952 and totalled 287.91 tons of ore with an average grade of 0.31 percent U_3O_8 and 3.20 percent V_2O_5 . During July and August 1951, Tom Jones Jr. shipped 9.35 tons averaging 0.16 percent U_3O_8 and 2.35 percent V_2O_5 from the Canyon View Mine (Table 2). All production from Plot 7 was trucked to the VCA mill at Durango, Colorado.

In June, August and December 1951, another contractor, Sam Harvey, made small shipments from a mine on Plot 7 named Sams Point (Figure 2). These shipments totalled 26.55 tons of ore averaging 0.20 percent U_3O_8 and 2.96 percent V_2O_5 (Table 2). Additional shipments

from Sams Point were made by Harvey in March and April 1952. These totalled 24.88 tons averaging 0.32 percent U_3O_8 and 3.41 percent V_2O_5 (Table 2). In an earlier report (Chenoweth, 1984) Sam Harvey's shipments were erroneously credited to Plot 1 on King Tutt Mesa.

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 7 alone, 64 holes were drilled. Drill hole spacing ranged from a 1,000 foot initial grid down to 100 feet behind mines. On Plot 7, three holes, EC-297, 305, and 317 penetrated at least one foot of uranium mineralization averaging 0.10 percent U_3O_8 (Masters and others, 1955). These three ore holes were offset on 50-foot centers, outlining three small orebodies containing a total of 180 tons averaging 0.20 percent U_3O_8 and 1.15 percent V_2O_5 (Masters and others, 1955). Private drilling would later develop mines near these AEC drill holes (Figure 2).

During 1953 there were no shipments reported from any of the mines on Plot 7, as VCA evaluated the results of the AEC drilling. In March 1954, Hosteen Setah Begay made a 21.80 ton shipment averaging 0.15 percent U_3O_8 and 0.78 percent V_2O_5 from the "Salt Canyon property". BIA royalty records indicate this shipment came from Plot 7, not the adjacent Mining Permit No. 74 held by the King Tutt and Paul Shorty (see appendix).

During 1954, VCA drilled numerous holes on Plot 7, especially near AEC holes EC-297 and EC-305. In December, VCA, using company miners, commenced mining on Plot 7. No individual mines were identified to the AEC. Shipments would continue through June, 1957 (Table 2). Some of the mines developed and mined during this period would be the large mine in the western part of the plot (Figure 3) and the "297" and "305" Mines (Figure 2). Between November 1956 and February 1957, VCA reported to the AEC that they had done 3,000 feet of drilling on Plot 7.

Kennedy and McGee Mining Company commenced shipments from the Salt Canyon Mine in October 1955. (Figure 2). The company believed they were mining ore that they had discovered, by drilling, on adjacent MP-74 (see appendix). Shipments by Kennedy and McGee would continue until May 1959, when their mining contract with VCA was cancelled. Considerable ore had been developed near AEC hole EC-317 (Figure 2). The total amount of ore produced by Kennedy and McGee from the Salt Canyon Mine was 1,621.86 tons averaging 0.28 percent U_3O_8 and 2.10 percent V_2O_5 (Table 2). This is the largest single mine on Plot 7. (Figures 2 and 3).

During January through April 1960, a non-Navajo contractor, Charles H. Corey, Jr., shipped 479.86 tons of ore averaging 0.22 percent U_3O_8 and 1.24 percent V_2O_5 from various mines on Plot 7 (Table 2). Most of the ore came from the Salt Canyon Mine (Figure 2). When Plot 7 was examined by the author on May 6, 1960, all of the mines appeared to have been abandoned.

In May and June 1961, William George, a Navajo contractor, shipped a total of 51.09 tons of ore averaging 0.25 percent U_3O_8 and 2.23 percent V_2O_5 (Table 2). These shipments came from the clean up mining in various mines on Plot 7.

In July 1961, VCA transferred company miners back to Plot 7 from the Shadyside Mine on King Tutt Mesa (Figure 1). These miners began sinking a new decline south of the "297" Mine where earlier VCA drilling had located a small orebody, and began clean up mining in the "305" Mine (Figure 2). When the author visited Plot 7 on February 19, 1962, all mining equipment had been removed and the mines appeared abandoned once again.

VCA company miners resumed mining on Plot 7 in April 1963 and made small shipments throughout the year. These shipments were trucked to the mill at Shiprock, New Mexico which VCA had acquired from Kerr-McGee Oil Industries, Inc. in March 1963. Final shipments were made from Plot 7 in March 1964. The mines were abandoned as all of the economic ore had been mined. Final shipments in 1964 totalled 57.12 tons with an average grade of 0.07 percent U_3O_8 and 1.43 percent V_2O_5 (Table 2). The mill at Shiprock closed in May 1968. Lease I-149-IND-5705 was cancelled in 1969 by Foote Mineral Company which acquired VCA in 1967.

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 7 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 7 produced nearly 800 tons of vanadium ore (Chenoweth, 1991). Under the AEC program, 3,975.03 tons of ore with an average grade of 0.27 percent U_3O_8 and 2.22 percent of V_2O_5 were produced from Plot 7 (Table 2). This production is greater than that given in an earlier report (Chenoweth, 1984) due to the addition of shipments by Cato Sells, Hosteen Setah Begay and Sam Harvey.

All of the uranium concentrate produced from the processing of the ore from Plot 7 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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U.S. Geological Survey, 1982, Horse Mesa quadrangle, New Mexico-Arizona: 7.5 - minute series (topographic), provisional, scale 1:24,000.

APPENDIX

Summary of Conflict Between Plot 7 and Land Claimed by King Tutt and Paul Short as Navajo Tribal Mining Permits 74 and 320.

Sometime in the late 1940s, Tony Garnonez was issued an unnumbered mining permit for approximately 245 acres of land adjacent to the east end line of Plot 7. In early 1952 this permit was converted to Navajo Tribal Mining Permit (MP) No. 1. On February 16, 1953, Tony Garnonez relinquished his interest in MP-1 to King Tutt and Paul Shorty. Bureau of Indian Affairs (BIA) royalty records indicate there was no ore shipped from the two MP's, known as the Salt Canyon claim.

Tutt and Shorty were issued a new permit, MP-74 on March 10, 1953. In May a total of 18.41 tons of ore averaging 0.20 percent U_3O_8 and 2.35 percent V_2O_5 were mined and shipped from a short adit on the Salt Canyon claim.

The assignment of the mining rights to MP-74 to the Kennedy and McGee Mining Company of Red Rock Trading Post were approved on June 9, 1953. Kennedy and McGee drilled the claim and located some ore near Tutt and Shorty's old adit, as well as some ore in the northwest part of the claim. In February 1955, Kennedy and McGee shipped 20.76 tons of ore averaging 0.22 percent U_3O_8 and 3.60 percent V_2O_5 from two short adits near the old mine.

On March 2, 1955, Paul Shorty relinquished his interest in MP-74 and King Tutt let the permit expire on March 10, 1955. A new permit, MP-320, was issued to King Tutt on June 14, 1955. When the Navajo Tribal Minerals Department requested a legal survey of the MP in August 1955, a conflict was found between MP-320, formerly MP-74, and Plot 7. While waiting for their assignment to be approved, Kennedy and McGee had already started to develop a new mine on the Salt Canyon claim, but was actually on Plot 7.

During a resurvey of Plot 7 in October 1953, a VCA surveyor left a 2 X 2-inch post in the ground on the south line of Plot 7 (Figure 2). This post was taken on the southeast corner of Plot 7 by Tutt and Shorty when it was actually 600 feet northwest of the true corner of Plot 7. The drilling by Kennedy and McGee had actually located a sizable orebody on Plot 7, not MP-74.

When the error was discovered, VCA gave Kennedy and McGee a contract to mine on the VCA controlled land and ship the ore to the VCA mill in Durango, Colorado. Kennedy and McGee were somewhat disappointed as they had hoped to receive the AEC's initial production bonus for the Salt Canyon claim ore, while ore from Plot 7 was not eligible for this bonus. The initial production bonus would have nearly doubled the price they would be paid for the ore.

Mining Permit 320 expired with no production on June 14, 1957. According to information reviewed for this report, the correct total ore produced from MP-74, was 39.17 tons containing 164.99 pounds U_3O_8 and 2360.00 pounds V_2O_5 and averaging 0.21 percent U_3O_8 and 3.01 percent V_2O_5 . This amount of ore production is commensurate with the three short adits observed on the Salt Canyon claim.

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.W. King Tutt Mesa
3	Shadyside	145.13	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 Plot 7 Mines, San Juan County New Mexico

YEAR	OPERATOR	TONS OF ORE	POUNDS OF U ₃ O ₈	% U ₃ O ₈	POUNDS OF V ₂ O ₅	% V ₂ O ₅
1950	Cato Sells	32.14	100.00	0.16	1,775.00	2.76
1950	Eugene Tapahanso	199.63	1,827.36	0.46	13,999.00	3.51
1950	Hosteen Setah Begay	23.27	139.60	0.30	1,409.00	3.03
1951	Hosteen Setah Begay	229.09	1,507.51	0.33	14,867.00	3.24
1951	Tom Jones, Sr.	9.35	30.41	0.16	440.00	2.35
1951	Sam Harvey	26.55	104.39	0.20	1,574.00	2.96
1952	Sam Harvey	24.88	158.25	0.32	1,695.00	3.41
1952	Hosteen Setah Begay	35.55	163.65	0.23	2,155.00	3.03
1954	Hosteen Setah Begay	21.80	66.30	0.15	338.00	0.78
1954	VCA	92.95	488.23	0.26	5,696.00	3.06
1955	VCA	506.23	2,790.76	0.28	23,694.00	2.34
1955	Kennedy and McGee	187.34	1,322.37	0.35	8,793.00	2.34
1956	VCA	143.69	603.85	0.21	7,888.00	2.74
1956	Kennedy and McGee	301.50	1,575.90	0.26	13,022.00	2.16
1957	VCA	76.67	455.17	0.30	4,012.00	2.62
1957	Kennedy and McGee	509.20	1,922.87	0.19	20,494.00	2.01
1958	Kennedy and McGee	541.73	3,816.96	0.35	22,331.00	2.06
1959	Kennedy and McGee	82.09	605.72	0.37	3,553.00	2.16
1960	Charles H. Corey, Jr.	479.86	2,076.07	0.22	11,919.00	1.24
1961	William George	51.09	253.18	0.25	2,281.00	2.23
1961	VCA	49.38	312.34	0.32	2,937.00	2.97
1962	VCA	37.11	158.23	0.21	1,925.00	2.59
1963	VCA	256.18	852.11	0.17	8,233.00	1.60
1964	VCA	57.12	75.48	0.07	1,630.00	1.43
Total		3,975.03	21,406.79	0.27	176,650.00	2.22

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

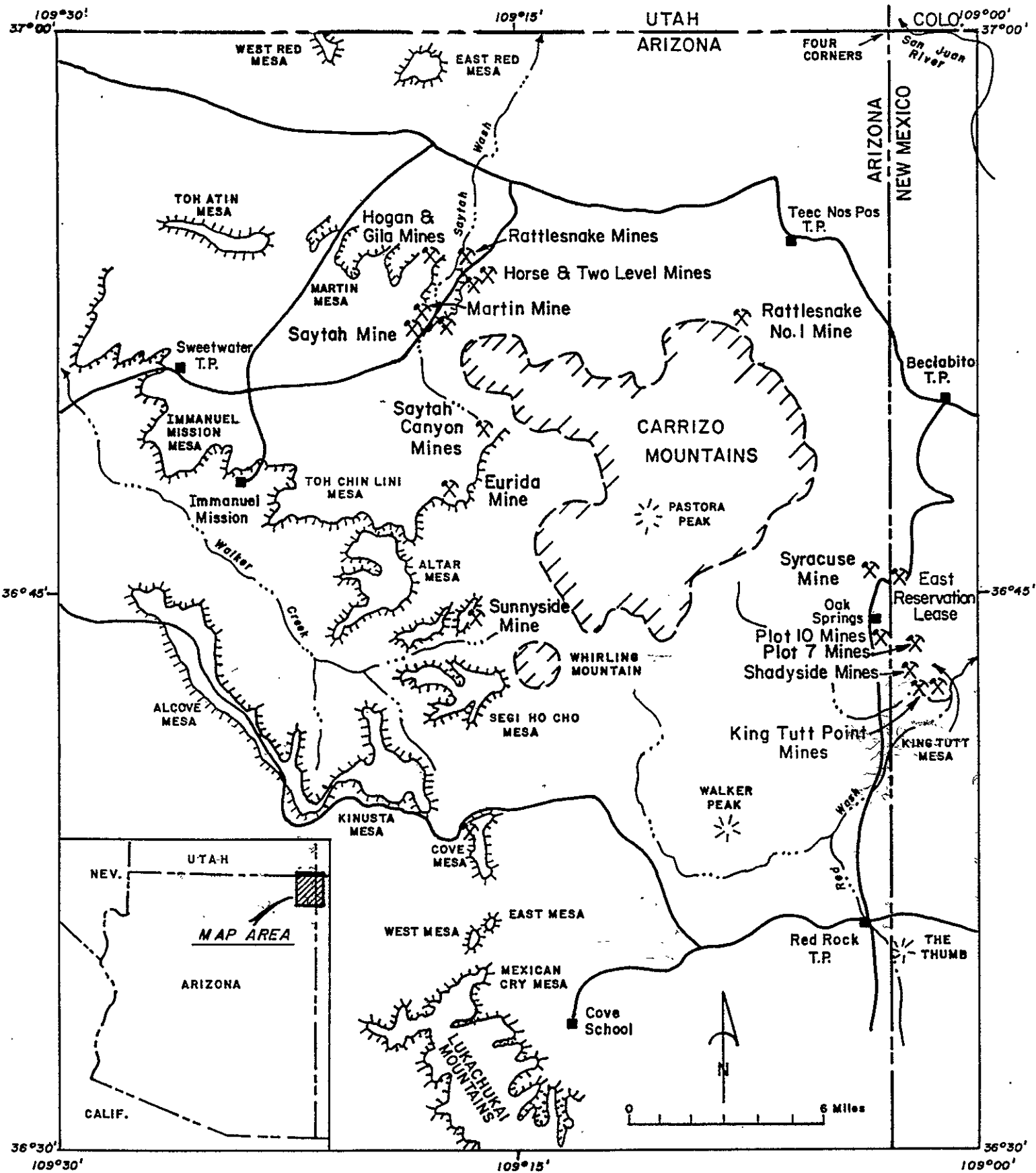


Figure 1. Index map of the Carrizo Mountains showing the location of the vanadium mines that operated in the 1940's

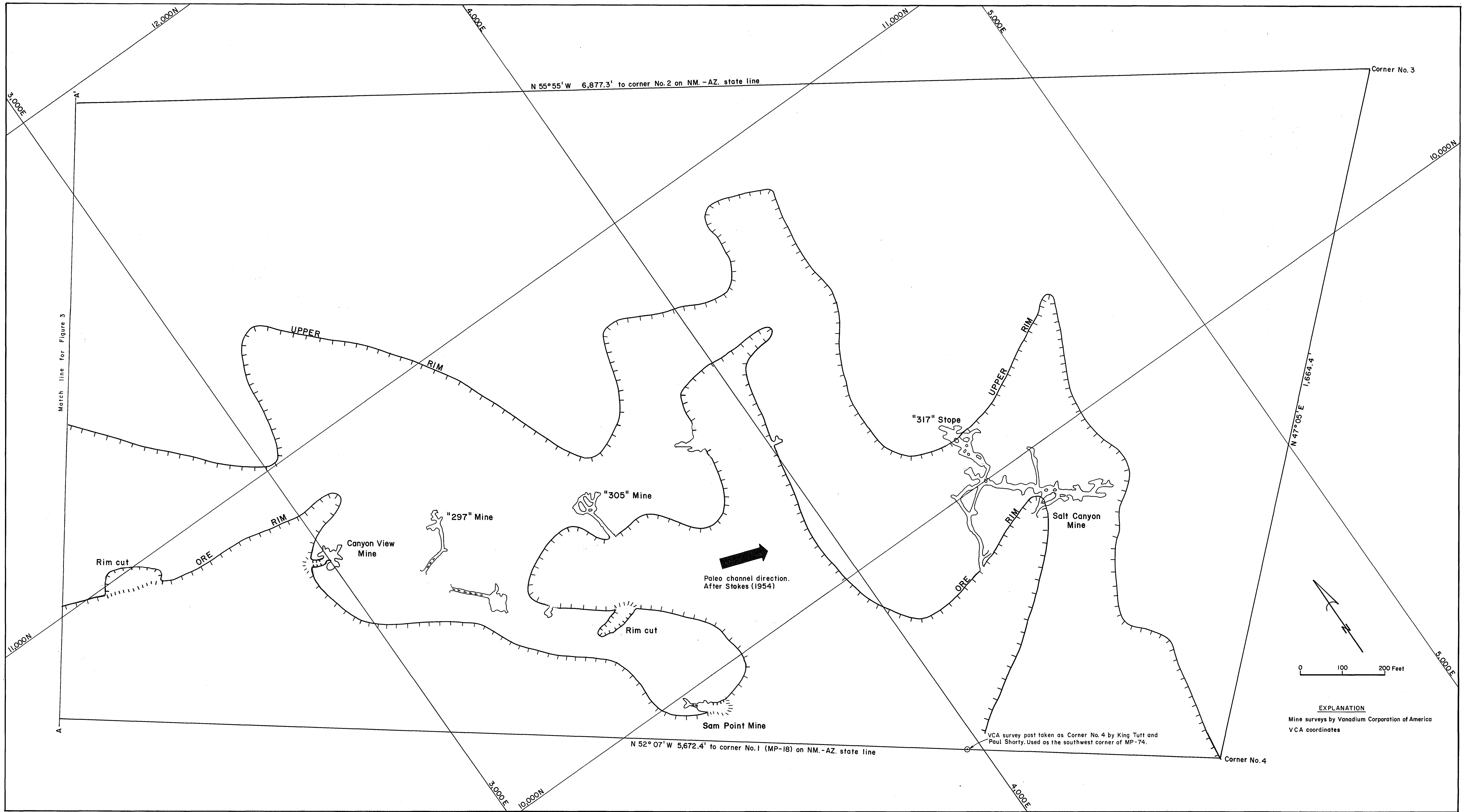


Figure 2. Plan map of mine workings, Plot 7, East Reservation Lease, San Juan County, New Mexico, southeast part

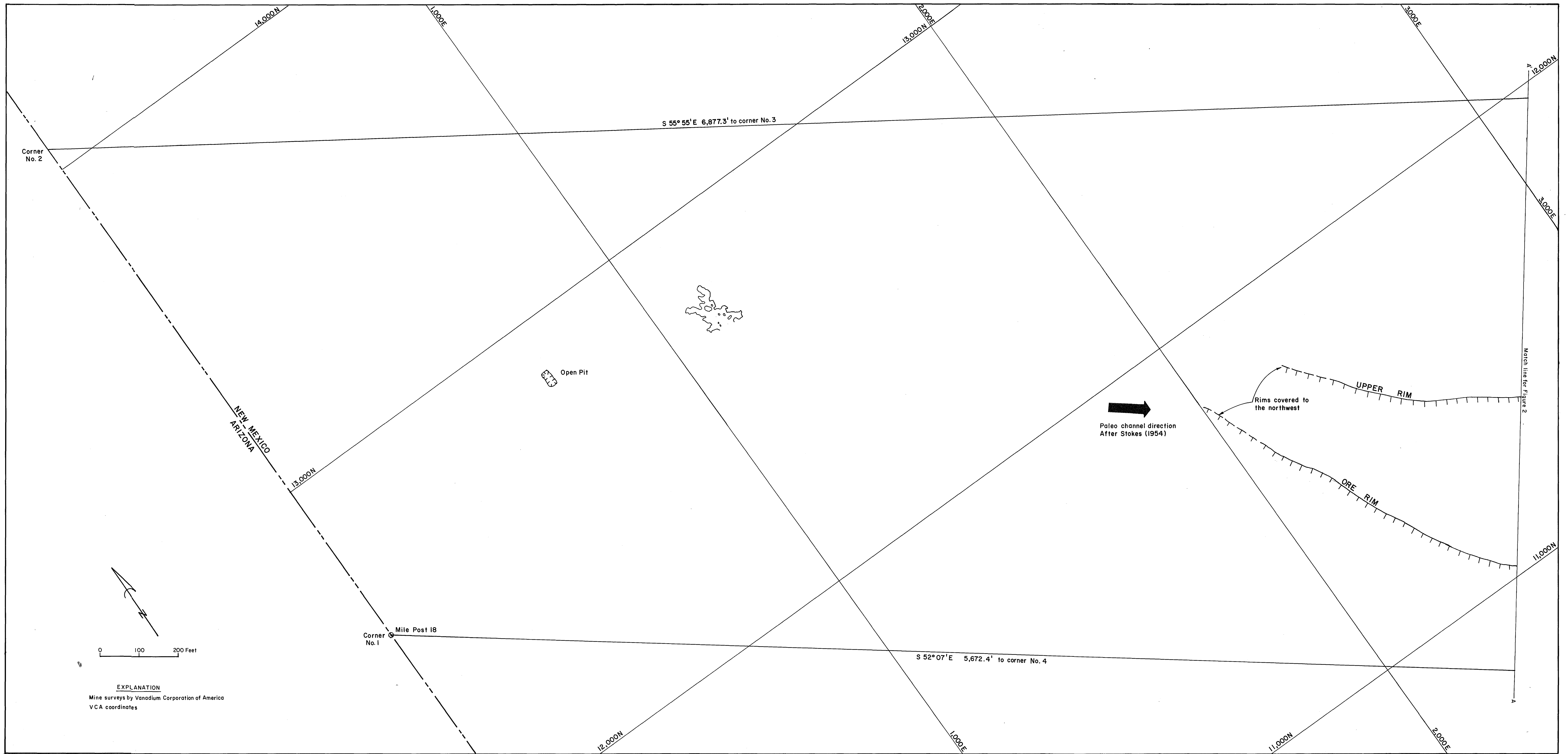


Figure 3. Plan map of mine workings, Plot 7, East Reservation Lease, San Juan County, New Mexico, northwest part