THE GEOLOGY, EXPLORATION AND PRODUCTION HISTORY OF THE URANIUM-VANADIUM MINES OF GEORGE R. SIMPSON AND GLORIA EMERSON NORTHWESTERN CARRIZO MOUNTAINS APACHE COUNTY, ARIZONA

by

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April 2018

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INTRODUCTION

George R. Simpson was issued Navajo Tribal Mining Permit No. 48 in the northwestern Carrizo Mountains, Apache County, Arizona on August 6, 1954. This permit was one mile square (Figure 1). On this permit, three uranium-vanadium mines were developed.

Two and one-half years after the mines were closed and the mining permit cancelled, Gloria Emerson acquired Mining Permit No. 535 on August 25, 1961. This permit of 80 acres covered two of the Simpson mines in the southeast corner of former Mining Permit 48. A small amount of ore was mined from a trench south of one of the Simpson mines. This mine was called the Last Chance.

In the official U.S. Atomic Energy Commission (AEC) ore production records (DOE, 1997) now available to the public at the National Archives, Rocky Mountain Region, Bloomfield, Colorado, the annual ore production from the Simpson mines and the Last Chance mine is mixed up. The purpose of this report is to record the correct ore production figures for all three Simpson mines and the Last Chance mine.

Location

The northwestern Carrizo Mountains uranium-vanadium mining area is centered around the Toh Atin anticline (Figure 1). 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.

George Simpson's mining permit was located on the west side of this canyon (Figure 2). The mines are not shown on the latest Toh Atin Mesa East quadrangle (USGS, 2014a) and the Toh Chin Lini Mesa quadrangle (USGS, 2014b). On an earlier version of the latter quadrangle (USGS, 1984) what is labeled Sah-Tah Mine is the mine on Plot 13 of the West Reservation Lease. What is labeled Martin mine is the Carson mine.

Today, the area of the Simpson No. 1 A and No. 1 Incline mines can be reached by traveling 9 miles west of Teec Nos Pos, Arizona on U.S. Highway 160. Then turning south on a dirt road to Sweetwater, Arizona via Saytah Wash. This road is now labeled as BIA-5049 on the USGS (2014a) quadrangle. After 3½ miles this road passed by the area of the Rattlesnake mines (Figure 2) and enters the canyon of Saytah Wash. The mines are 2½ miles up the canyon, across the wash on the right.

Land Status

The Simpson No. 1 mines and the Last Chance mine 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 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 were to be issued by the Navajo Tribal Council and approved by the 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 as long as 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 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. During this time the author examined all of the mines in the northwest Carrizo area.

The author reviewed the quarterly AEC ore production records (AEC, 1964) and believes the production from Simpson No. 1 A and B mines given in this report are correct.

When the author examined the area in June 1980, the Simpson No. 1 A and the No. 1 Incline mines had been abandoned and were still open, but the trench at the Last Chance mine had been filled in.

GEOLOGIC SETTING

The uranium-vanadium deposits at the Saytah mine 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-gray mudstone and siltstone, that form only five to eight percent of the total Salt Wash. The ore-bearing sandstone at the Simpson No. 1 B mine is 30 ft above the base of the Salt Wash; whereas, the ore-bearing sandstones at the Simpson No. 1 A and Incline mines and the Last Chance mine are 10 ft above the base.

The uranium-vanadium ore bodies 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. It was common to find large fossil logs completely replaced with yellow uranium minerals.

Although the uranium-vanadium deposits in the Salt Wash Member of the Morrison Formation have been referred to as carnotite deposits, that mineral, a potassium uranium vanadate, has never been identified in the Carrizo deposits (S.R. Austin, AEC mineralogist, written communication, 1967). In a study of the mineralogy and petrology of the Martin mine in Saytah Wash (Figure 2), Corey (1956) found tyuyamunite, a calcium uranium vanadate, to be the only uranium mineral. The principal vanadium mineral was 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 Simpson and Last Chance mines are located on the southwest flank of the Toh Atin anticline. Here, the beds of the Salt Wash Member strike N 75° W and dip 1 degree to the southwest.

EXPLORATION AND PRODUCTION HISTORY

Simpson No. 1 Mine (Later called the No. 1 B)

Learning that there was interest in the area of Martin Mesa west of Plot 1 and 2 of AEC Lease I-149-IND-6197, George R. Simpson, a Farmington, New Mexico businessman, applied to the Navajo Tribal Council for a one-square-mile Mining Permit on April 1, 1954. This request was approved by the Tribal Council and the Bureau of Indian Affairs on August 6, 1954 for Mining Permit (MP) No. 48 covering 612.75 acres (see appendix).

Simpson signed an operating agreement with Capital Uranium Company of Farmington, New Mexico to do exploration drilling on his permit west of the Martin mine on Plot 1 now leased by the Vanadium Corporation of America (VCA) from the AEC. This drilling located ore on MP-48 and confirmed ore on Plot 1 west of the Martin mine.

Simpson obtained permission from VCA to have Capital Uranium drive a drift from the Martin mine to the ore body on this MP. While driving this drift, Capital mined ore on Plot 1 for VCA. Details of Capital's mining on Plot 1 and on MP-48 are given by Chenoweth (1999). VCA required that all ore Simpson's contractor, Capital Uranium Co., mined would be shipped to the company's mill at Durango, Colorado.

Mining on MP-48 began during the record quarter 1954 and continued for two years. Total ore production was 1,627.94 tons averaging 0.25 percent U_3O_8 and 1.87 percent V_2O_5 (Table 1). This mine would later be named the Simpson No. 1 B.

Simpson No. 1 A Mine

During the period December 1943 through February 1944, 18 truckloads of vanadium ore were shipped from the Saytah mine held by Curran Brothers and Wade-U.S. Vanadium Corp. under

exploration lease I-149-IND-6107 (Chenoweth, 2015). When the lease was converted to an operating lease on March 25, 1944, the area of the Saytah mine was not included (Chenoweth, 2015).

Late in 1955 and in early 1956, Capital Uranium drilled behind the abandoned Saytah mine. Small ore bodies were located which Capital mined during the last half of 1956. Mining was via a drift from the old Saytah mine. Total ore production was 1,925.74 tons of ore which averaged 0.23 percent U_3O_8 and 1.06 percent V_2O_5 (Table 2).

In order to keep this production separate from the production from the Simpson No. 1 mine, mined via the Martin mine, the AEC named the second mine No. 1 A and the northern mine No. 1 B.

Simpson No. 1 Incline Mine

Exploration drilling by Capital Uranium west of the No. 1 A mine located additional ore bodies. On April 3, 1957, George Simpson assigned the mining right to MP-48 to Capital Uranium Co. Capital contracted the Mex Air Uranium Co. at Shiprock, New Mexico to drive a 150-ft-long, 3x8 ft decline to the ore and mine it. A gasoline-powered, single drum hoist was used to pull mine cars up the decline (AEC, 1959). Capital Uranium Co. and Seaboard Oil and Gas Co. merged into Capital-Seaboard Corp. on October 1, 1957 (AEC, 1958).

Shipments of ore to VCA's Durango, Colorado mill began in the second quarter 1957 and continued to the third quarter 1958 (Table 3). For ventilation, a 200-ft-long drift was driven into the No. 1 A mine workings (Figure 3). George Simpson cancelled Mining Permit No. 48 on April 3, 1959.

Last Chance Mine

On August 25, 1961, Gloria Emerson was issued Navajo Tribal Mining Permit No. 535. It was for 80.0 acres that covered the southeast part of George Simpson's MP-48 and an area to the east (Figure 4). The mining rights to this permit were assigned to Harold Broshers of Aztec, New Mexico on September 14, 1961.

In the AEC records (AEC, 1965) Gloria Emerson's mining permit number is listed as MP-538. The Navajo Tribal Mining Department, Window Rock, Arizona listed it as MP-535. Mining Permit No. 538 was issued to Elwood Thompson for land in the Cameron, Arizona area.

Although MP-535 covered the abandoned Simpson No. 1 A and Incline mines, he never mined there. In December 1961 and in January 1962, he mined a total of 8.66 tons of ore averaging 0.15 percent U_3O_8 from a small trench about 1,000 ft south of the No. 1 A mine (Figure 2, Table 4). This ore was labeled the Last Chance mine.

The 1961 trial shipment of 1.56 tons was sent to the mill at Tuba City, Arizona operated by the Rare Metals Corporation of America. This mill did not assay for or pay for vanadium.

In order to have a market for his ore in the post April 1962 period, Mr. Broshers needed an allocation. Since MP-535 covered the old Simpson No. 1 A and Incline mines as well as his Last Chance mine, he received a total allocation of 20,971 pounds U_3O_8 based on the historical ore production from these three mines (AEC, 1965).

Since the historical production from the Simpson mines was used by the AEC to calculate the allocation for Harold Broshers, the AEC changed the names of the Simpson mines to Last Chance. These changes are shown in the official ore production records of the AEC now in the National Achieves, Rocky Mountain Region, Bloomfield, Colorado (DOE, 1997). Table 5 is a summary of what appears in these records. This has caused problems for current researchers.

Broshers cancelled his assignments on January 29, 1963 and the mining permit expired in August 1963.

Mining Permit 606

Sometime after Mining Permit 535 expired, Gloria Emerson was issued Mining Permit No. 606. The mining rights were assigned to Curtis W. Jones. AEC records show that on September 2, 1965 Jones requested an allocation for MP-606 (AEC, 1965). There is no record that an allocation was issued. Sometime later he mined 22.91 tons averaging 0.18 percent U_3O_8 and 1.48 percent V_2O_5 from the abandoned Simpson No. 1 Incline mine (Figure 3). In the AEC records this ore was shipped as MP-606 (DOE, 1997). This ore was shipped to the mill at Shiprock, New Mexico, now operated by VCA. AEC allocation A-248 for the Last Chance mine was cancelled on September 20, 1965 (AEC, 1965).

SUMMARY

The uranium recovered from the Simpson No. 1 and Last Chance ores at the mills at Tuba City, Arizona, Durango, Colorado, and Shiprock, New Mexico was purchased by the AEC. Vanadium recovered by VCA at the Durango mill was sold to the steel industry.

REFERENCES

Chenoweth, W.L., 1999, The geology, leasing and production history of the Martin uranium-vanadium mine, Apache County, Arizona: Arizona Geological Survey Contributed Report CR-99-B, 33 p.

Chenoweth, W.L., 2015, Geology, leasing and production history of the Saytah uranium-vanadium mine, Apache County, Arizona: Arizona Geological Survey Report, 18 p.

Corey, A.S., 1956, Petrographic report on the Martin Mine, northwest Carrizo Mountains, Apache County, Arizona: U.S. Atomic Energy Commission Technical Memorandum TM-282, 26 p. (Open-filed by AEC in 1982).

Scarborough, R.B., 1981, Radioactive occurrences and uranium production in Arizona: Arizona Bureau of Geology and Mineral Technology. Open-file Report 81-1, 297 p.

U.S. Atomic Energy Commission, 1958, Certification report and recurring visits George Simpson lease, Simpson No. 1, Shiprock district, Apache County, Arizona: File No. C-591, 27 pages, National Archives Record Group 434-99-207.

U.S. Atomic Energy Commission, 1959, Simpson No. 1, in mine operation data Report AEC-PED-1, p. 152. Open-filed by AEC 1966.

U.S. Atomic Energy Commission, 1964, Details of ore production, Shiprock district, July 1, 1947-June 30, 1964, by fiscal year quarter: Unpublished document, 88 p., Report in Chenoweth's personal files.

U.S. Atomic Energy Commission, 1965, Allocation report and recurring visit Last Chance claim, Shiprock district, Apache County, Arizona: File No. A-248, 10 pages, National Archives Record Group 43-99-204.

U.S. Department of Energy, 1997, Tabulation of uranium ore produced under AEC program, 1948-1970: 908 p., National Archives Record Group 434-00-287, box 5 of 6.

U.S. Geological Survey, 1982, Toh Chini Lini Mesa quadrangle, Arizona 7½ minute series (topographic), provisional scale 1:24,000.

U.S. Geological Survey, 2014a, Toh Atin Mesa East quadrangle, Arizona-Utah, 7½ minute series (topographic), scale 1:24,000.

U.S. Geological Survey, 2014b, Toh Chini Lini Mesa quadrangle, Arizona, 7½ minute series (topographic), scale 1:24,000.

APPENDIX

The description of Mining Permit No. 48 is as follows: Beginning at Corner No. 1, Southeast corner from where a square wood post, believed to be the southeast corner of the Old Manhatten (sic) Project lease to Vanadium Corporation of America, bears northerly about 2640 feet and from whence a knoll topped by an old rock monument, believed to be old U.S.M.M. No. 1, bears about N. 46°E. One and three-fourth miles, thence westerly about 5280 feet to corner No. 2, the southwest corner, thence northerly about 5280 feet to corner No. 3, the northwest corner, thence easterly about 5280 feet to corner No. 4, the northeast corner, thence southerly about 5280 feet to corner No. 1, the point of beginning. The claim to be called Simpson No. 1 and located in District 9, Navajo Indian Reservation Apache County, Arizona.

The tract is further delineated in that any included parts of the Sells Permits or Saytah and Saytah Extension claim and the Manhatten (sic) Project lease to Vanadium Corporation of America are specifically excluded from the above claims, but that any and all ground lying along the rim as well as to the South and West away from the rim and not held in such excluded claims is specifically claimed in the Simpson No. 1 tract. The Simpson No. 1 contains 612.75 acres.

Source: AEC (1958)

Table 1. Uranium-vanadium ore production, Simpson No. 1 B mine, Apache County, Arizona.

YEAR	QUARTER	TONS OF ORE	POUNDS U_3O_8	% U_3O_8	POUNDS V_2O_5	% V_2O_5
1954	2nd	14.01	72.87	0.26	210.20	0.75
1954	3rd	17.93	39.45	0.11	329.99	0.92
1954	4th	-0-	-0-		-0-	
1955	1st	62.58	360.37	0.29	2,524.26	2.02
1955	2nd	543.90	2,749.43	0.25	22,391.69	2.06
1955	3rd	432.09	1,934.10	0.22	16,535.61	1.91
1955	4th	403.72	1,817.70	0.23	13,376.34	1.66
1956	1st	67.86	558.65	0.41	3,121.67	2.30
1956	2nd	156.15	839.70	0.27	4,970.70	1.59
TOTAL		1,697.24	8,372.27	0.25	63,460.46	1.87

Operator: Capital Uranium Co.

Source: AEC (1964)

Table 2. Uranium-vanadium ore production, Simpson No. 1 A mine, Apache County, Arizona.

YEAR	QUARTER	TONS OF ORE	POUNDS U_3O_8	% U_3O_8	POUNDS V_2O_5	% V_2O_5
1956	2nd	714.28	3,497.24	0.22	27,081.58	1.83
1956	3rd	1,211.46	5,345.46	0.24	44,381.60	1.90
TOTAL		1,925.74	8,842.70	0.23	71,463.18	1.86

Operator: Capital Uranium Co.

Source: AEC (1964)

Table 3. Uranium-vanadium ore production, Simpson No. 1 Incline mine, Apache County, Arizona.

YEAR	QUARTER	TONS OF ORE	POUNDS U_3O_8	% U_3O_8	POUNDS V_2O_5	% V_2O_5
1957	2nd	473.44	1,706.77	0.18	11,834.00	1.25
1957	3rd	452.63	1,418.66	0.16	11,783.00	1.30
1957	4th	431.35	1,419.25	0.16	11,992.00	1.39
1958	1st	318.77	1,592.71	0.25	9,666.00	1.53
1958	2nd	172.77	980.58	0.28	5,905.00	1.71
1958	3rd	151.23	782.86	0.26	4,980.00	1.65
SUBTOTAL		2,000.19	7,900.83	0.20	56,160.00	1.40
1965		22.91	80.66	0.18	678.00	1.40
TOTAL		2,023.10	7,981.49	0.20	56,838.00	1.40

Operator: 1957-58 – Mex Air Uranium Co. for Capital Uranium/Capital-Seaboard Corp.
1965 – Curtis Jones

Note: 1965 ore shipped as MP-606.

Source: 1957-1958 – AEC (1964)
1965 – DOE (1979)

Table 4. Uranium-vanadium ore production, Last Chance mine, Apache County, Arizona.

YEAR	QUARTER	TONS OF ORE	POUNDS U_3O_8	% U_3O_8	POUNDS V_2O_5	% V_2O_5
1961	4th	1.56	6.54	0.21	---	
1962	1st	7.10	19.87	0.14	178.80	1.26
TOTAL		8.66	26.41	0.15	178.80	1.26

Operator: Harold Broshers

Source: AEC (1964)

Table 5. Summary of AEC ore production from the Simpson No. 1 mines and the Last Chance mine available at the National Archives Report Group 434-00-287.

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- Last Chance – Harold Brushers

1961	1.56 tons	(Last Chance)
1962	7.10 tons	(Last Chance)

- Last Chance – Capital-Seaboard

1957	1,357.42 tons	(Incline Mine)

- Last Chance – George Simpson

1955	1,441.29 tons	(1 B Mine)

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- MP-606 – Curtis Jones

1965	22.91 tons	(Incline Mine)

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- Simpson No. 1 – Capital Uranium

1958	642.77 tons	(Incline Mine)

- Simpson No. 1 – George Simpson

1954	31.94 tons	(1 B Mine)
1956	1,993.60 tons	(1 A Mine – includes 67.86 tons 1 B Mine)

- Simpson – George Simpson

1956	156.15 tons	(1 B Mine)

Source: DOE (1997)

Note: Names in parenthesis indicate correct source of the ore; added by Chenoweth.

COMMENTS ON TABLE 5

Table 5 is a summary of the ore production from the three Simpson No. 1 mines and the Last Chance mine as shown in the records of the AEC at the National Archives, Rocky Mountain Region, Bloomfield, Colorado (DOE, 1997). Under the mine name and the mine controller's name, only the year and the tons of ore are shown in this table.

The 1957 ore production from Simpson's No. 1 Incline mine is shown as Last Chance production as is the 1955 ore production from Simpson's No. 1 B mine. There is no way to determine the production from the Nos. 1 A and B from these records. In this table the correct location of these shipments is indicated in the parenthesis, added by the author.

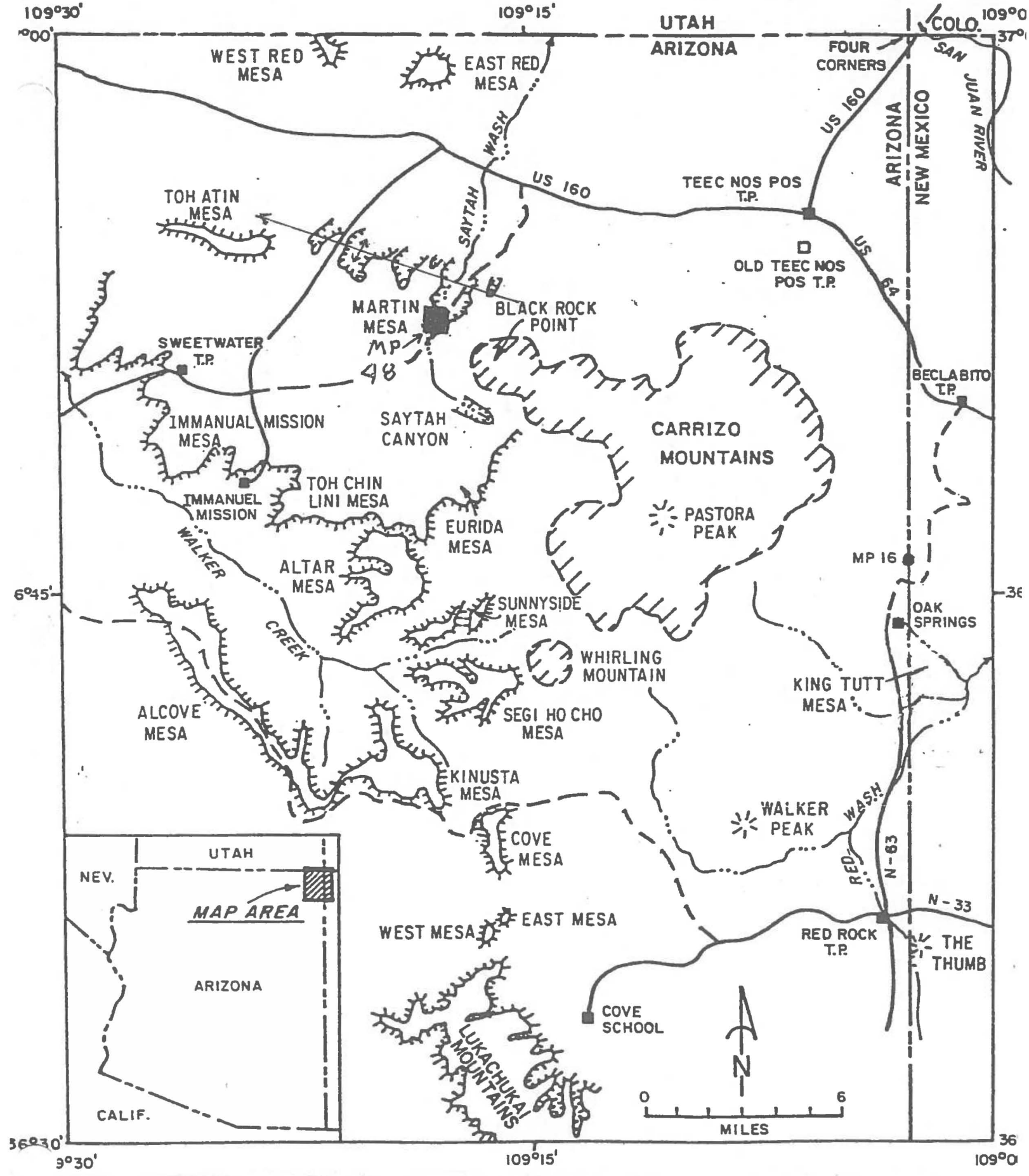

Figure 1. **Index map of the Carrizo Mountains, Arizona, New Mexico showing the location of Mining Permit No. 48.**

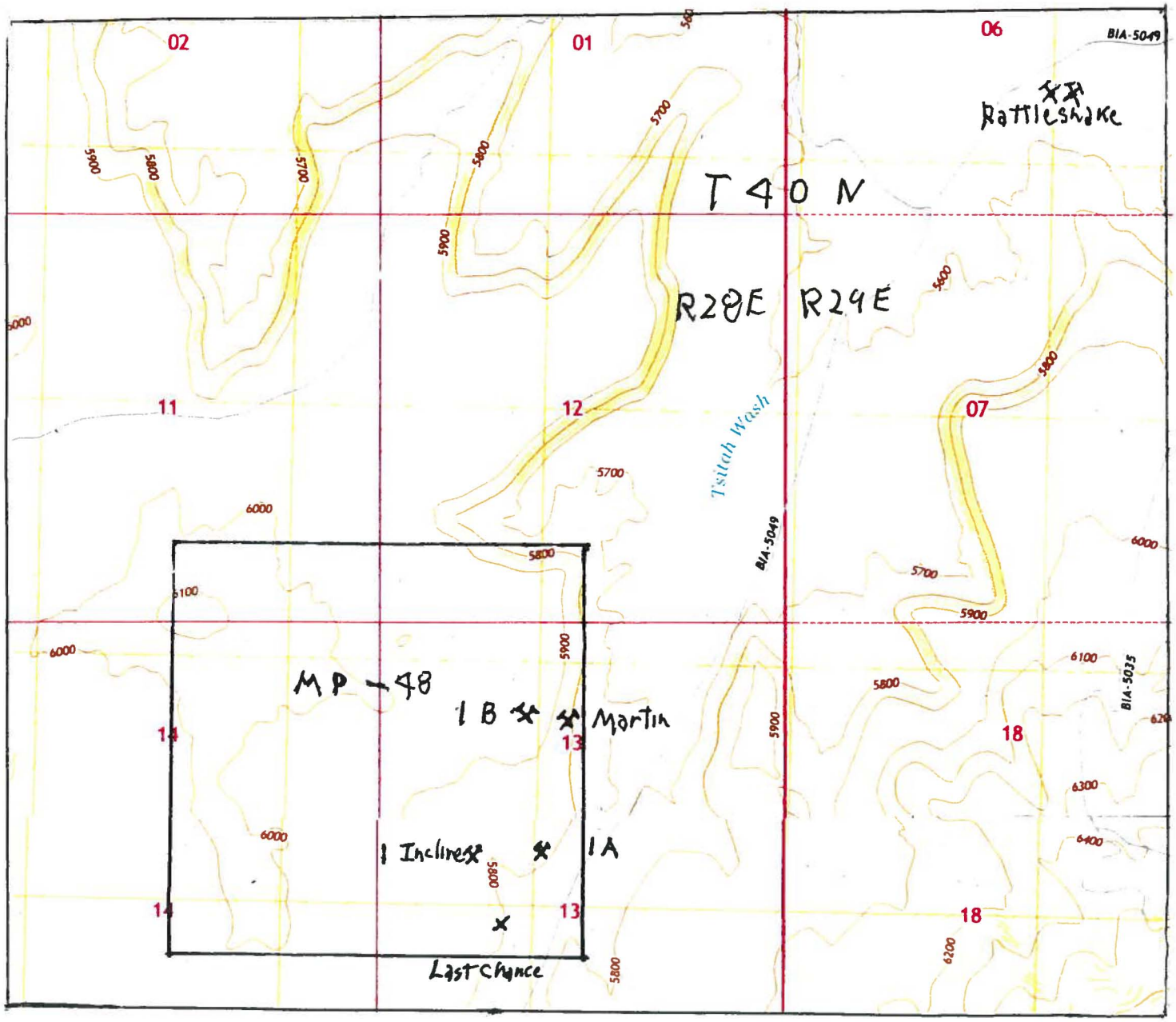

Figure 2. **Sections of the Toh Atin Mesa East and the Toh Chini Lini Mesa quadrangles (USGS, 2014a,b) showing the area of Saytah (Tsitah) Wash.**

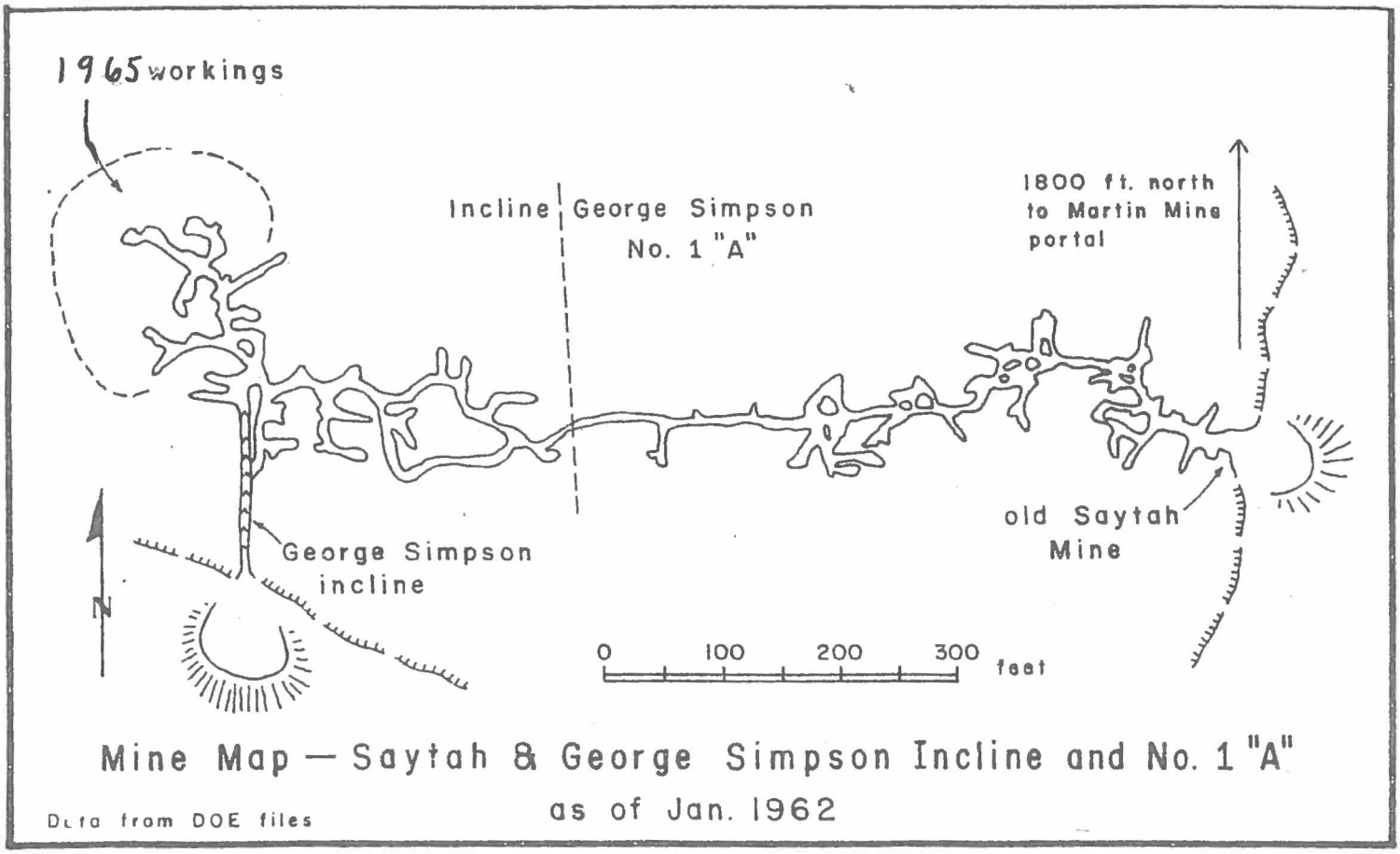

Figure 3. **Plan map of the Simpson No. 1 A and No. 1 Incline mines. Modified from Scarborough (1981).**

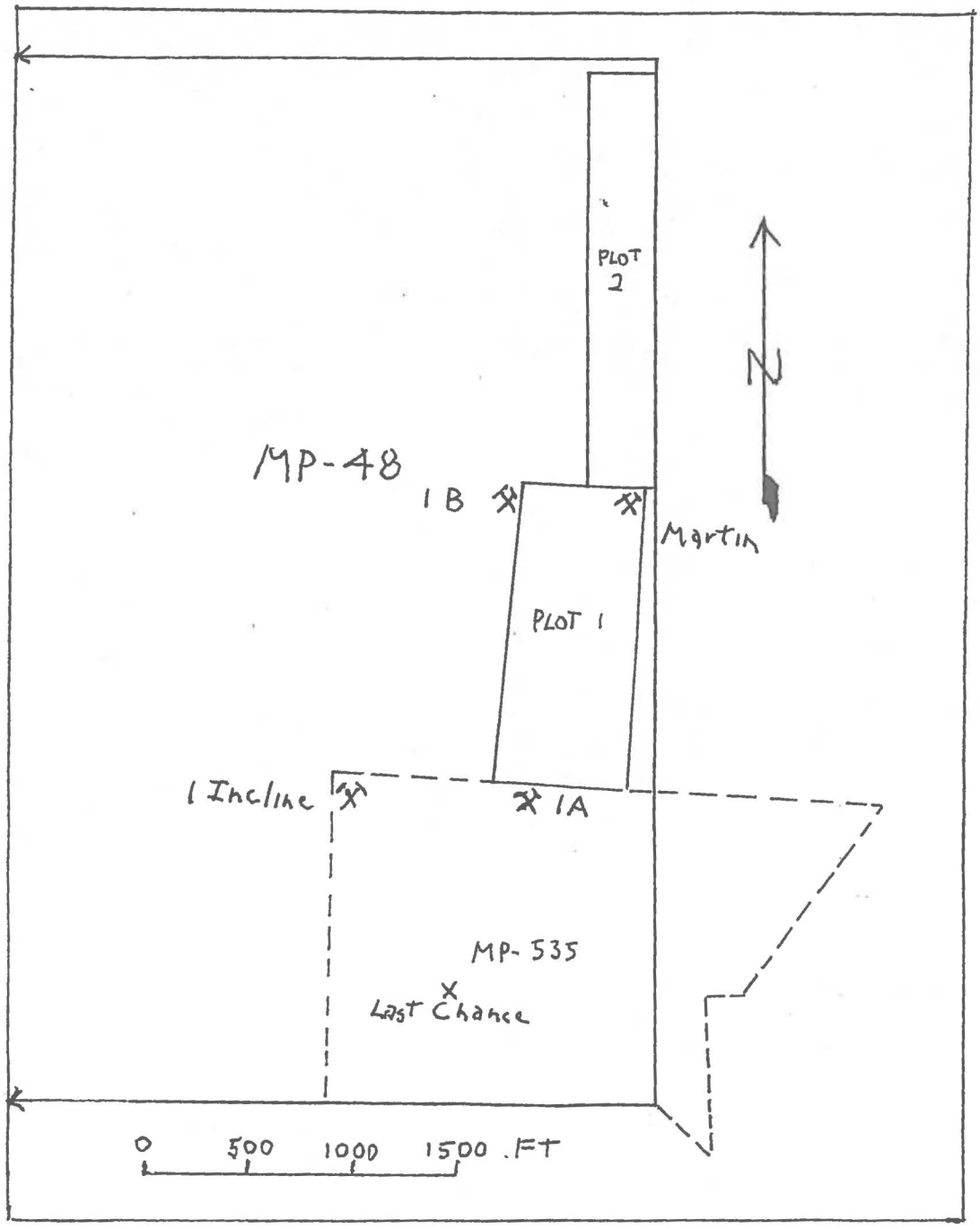

Figure 4. **Map of the eastern portion of Mining Permit No. 48 showing the location of Mining Permit No. 535 and Plots 1 and 2 of AEC Lease I-149-IND-6197 leased to VCA (AEC, 1962).**