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PRINTED: 03/21/2002

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: MONUMENT NO. 2 MINE

ALTERNATE NAMES:

V.C.A. MONUMENT VALLEY NO. 2

APACHE COUNTY MILS NUMBER: 228B

LOCATION: TOWNSHIP 41 N RANGE 23 E SECTION 28 QUARTER N2  
LATITUDE: N 36DEG 56MIN 00SEC LONGITUDE: W 109DEG 53MIN 00SEC  
TOPO MAP NAME: DINNEHOTSO - 15 MIN

CURRENT STATUS: DEVEL DEPOSIT

COMMODITY:

VANADIUM  
URANIUM

BIBLIOGRAPHY:

AZBM BULL 180, P. 285  
USGS PP #820  
RADIOACTIVE OCCUR. AND URANIUM PROD. IN AZ BY  
SCARBOROUGH 1981 GJBX 143-81  
CHENOWETH, W.L., 1973, URANIUM DPSTS OF NE ARIZ  
U.S. AEC TM 191, P.5  
AGSU CR 89-D UG MAPS OF WORKINGS-MONUMENT #2  
ADMMR MONUMENT NO. 2 MINE FILE

03/28/96

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES FILE DATA

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U.S. AEC TM 191, P.5  
AGSU CR 89-D UG MAPS OF WORKINGS-MONUMENT #2  
ADMMR MONUMENT NO. 2 MINE

365529N

1095044W

365136N  
1095059W



INFORMATION from MINE INSPECTOR'S OFFICE - August 15, 1957

V.C.A. MONUMENT VALLEY 2 Monument Valley, NAVAJO COUNTY

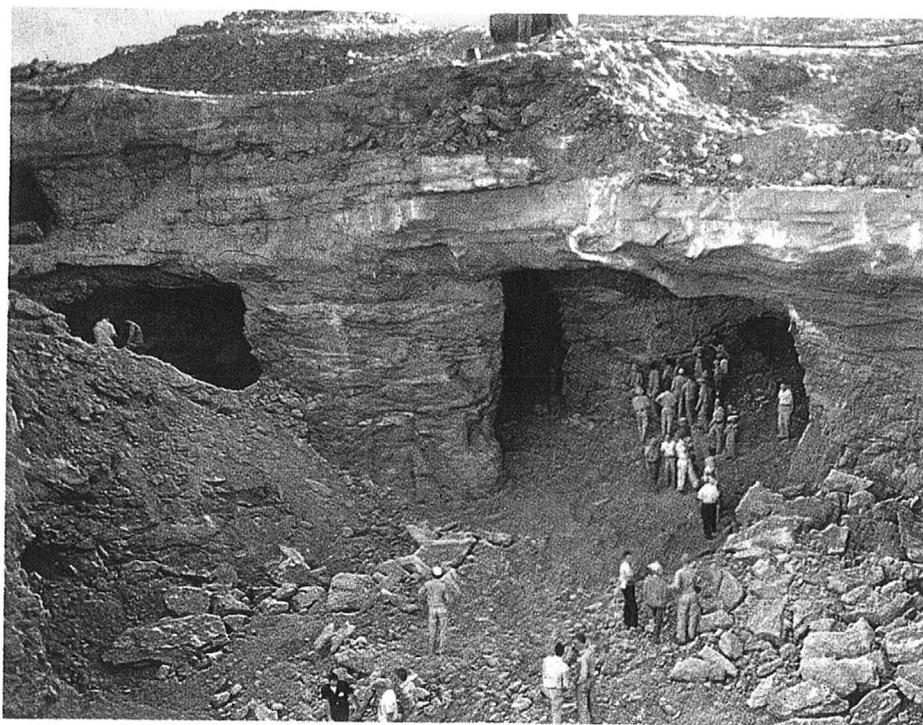
MINE & MILL

Owner - NAVAJO INDIAN COUNCIL

Operator: VANADIUM CORP. OF AMERICA, Durango, Colo.  
Pres & Agent in charge - Dan Veles, Durango  
Supt - Fred Peterson, Durango

URANIUM-VANADIUM 800 tons - 140 men

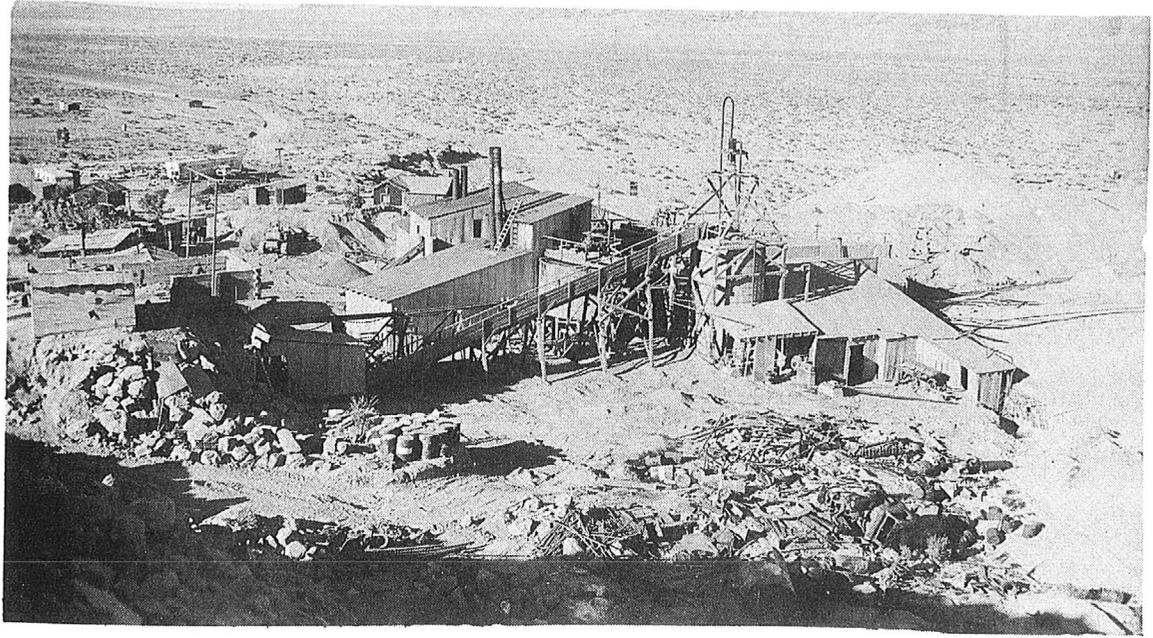
L.A.S.



Monument No. 2 mine, Apache Co., AZ.  
Field Trip June 16, 1955. Old underground workings  
exposed in open pit



Monument No. 2 mine. Open pit in upper ore zone and  
old underground workings. Summer 1959



Uranium ore concentrator, Monument No. 2 mine  
Summer 1959

5-7-58

V.C.A. MONUMENT VALLEY 2 MINE

NAVAJO COUNTY

See: MINING WORLD 4-15-58, p 48

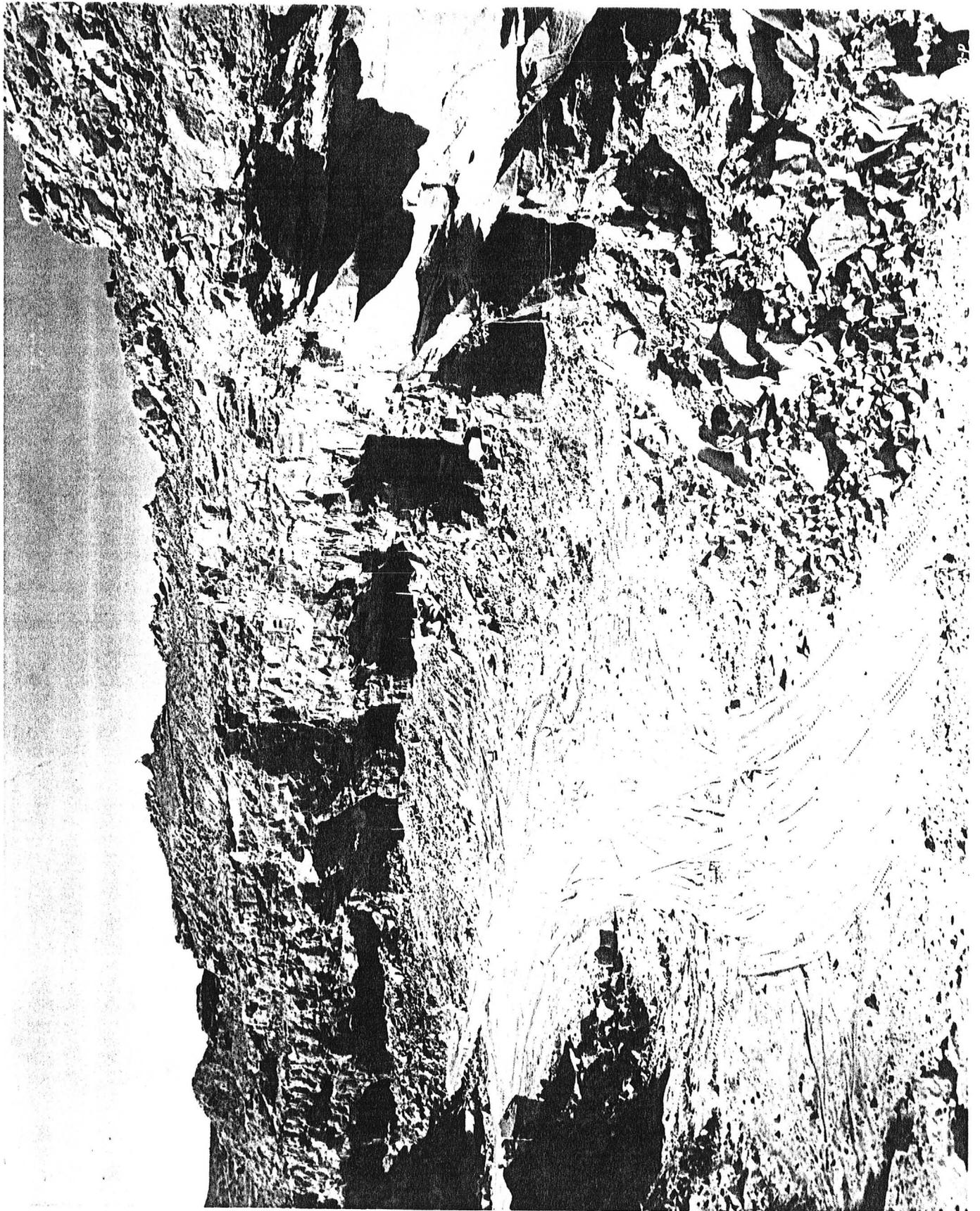
See: COVE MESA CLAIMS ET AL (file)

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MONUMENT #2 - Page Edwards, Vanadium Corp. of  
America, Durango, Colorado.  
This property active Feb. 1962.

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See: GJBX-220 (82), "Summary History of Domestic  
Uranium Procurement Under U.S. Atomic Energy  
Commission Contracts Final Report", Oct. 1982  
U.S. Dept. of Energy, Page 123,124,&125



A-210-20

C-1950



# Abandoned Mine Land Reclamation Award Winners

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## 1992 Awards (Presented in 1993)

- ★ Boonville Hospital RAMP Project, Indiana
  - Coppermine Abandoned Mine Project, Navajo Reservation
  - Gay Branch Gob Pile Project, Virginia
  - Lead and Zinc Mine Sites Reclamation Project, Illinois
  - Ocean Refuse Removal Project, Maryland
  - Pine Creek Mine Shafts Project, West Virginia
  - Pyramid Coal Company Reclamation Project, Illinois
  - Shiloh Reclamation Project, Arkansas
  - Veca Pit and Spoils Project, Wyoming
  - White Oak Four Reclamation Project, Ohio
- 

## 2000 Awards

### Regional Awards

- Pleasant View Mine Project, Kentucky (Appalachian Region)
- Midwestern Reclamation Project, Indiana (Mid-Continent Region)
- ★ Carrizo 1 Reclamation Project, Navajo Reservation, Arizona and New Mexico (Western Region)

### National Award

Pleasant View Mine Project, Kentucky

### People's Choice Award

Midwestern Reclamation Project, Indiana

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## 1999 Awards

### Regional Awards

- Blackwater River Limestone Drum Station, West Virginia (Appalachian Region)
- Oklahoma Partnership Approach to Reclamation of Abandoned Mine Land, Oklahoma (Mid-Continent Region)
- Socorro West, New Mexico (Western Region)

### National Award

- ★ Monument Valley 2 AML Reclamation Project, Navajo Reservation
-

## **CARRIZO 1 AMLR PROJECT**

**Location:** The radioactive abandoned uranium mine sites under this project are located in the beautiful Carrizo Mountain/Red Valley areas in the Teec Nos Pos, Beclabito, Sweetwater, and Oak Springs Chapters in Apache County, AZ, and San Juan County, NM, close to the four Corners area. Most site locations being on steep mesa tops or edges, rugged terrain and extremely deteriorated haul roads, totaling 10 miles in length, made the access to the sites very challenging.

**Nominating Team:** Following are the members of the nominating team:

Madeline Roanhorse, Director, Navajo AMLR/UMTRA Department  
S. Deb Misra, P.E., Professional Engineer  
Ernest Diswood, Manager, Shiprock AML Field Office  
Lynn Benally, Reclamation Specialist II

**Project Start Date:** June 7, 1999. **Completion Date:** December 13, 1999.

**Construction Cost:** \$892,872.75 to reclaim over 245 mine portals, vertical shafts, rimstrips, and subsidence areas; over 3,200 feet of dangerous highwalls; over 57,000 cubic yards of radioactive mine waste spread over 35 acres of land; and 7 acres of haul roads.

**Organization Responsible for Reclamation:** The Navajo Abandoned Mine Lands Reclamation Program (Program): P.O. Box 1875, Window Rock, AZ 86515. Tel. No.: (520) 871-6982; Fax No.: (520) 871-7190; E-mail: aml\_dmisra@dine.navajo.org. Planning, Design, and construction inspection were done in-house. Besides the nominating team members, other participants in this project were Messrs. Melvin Yazzie, Leon Spencer, Delbert Bekis, Darriel Yazzie, Larry Jackson, Carl Holiday, and Ms. Davida Daukei. Contractor was Silver State Construction Company, Inc.

**Accomplishments:** The project utilized award-winning maintenance-free designs, implemented cost-effective radiological clean-up standard developed in-house, and experimented with a newly-developed mine closure method using thick, reinforced polyurethane foam plugs - safeguarded against ultra-violet rays. It was a large and complex project which amidst severe physical challenges reclaimed 20 hazardous abandoned uranium mine sites inflicted by over 250 abandoned mine features. The Program proudly considers this millennium-end project which exceeded the objectives of Surface Mining Control and Reclamation Act worthy for an award.

*Uranium mining started in the Carrizo Mountains in the 1940s to satisfy America's quest for nuclear superiority by supplying some of the best fuels for the Manhattan Project. Unregulated mining left a legacy of radioactive scars on the body of Mother Earth and inflicted the lives of the Dineh (Navajo people) by disrupting their harmony with Nature. After long years, as a result of this top-quality, practically-invisible reclamation project, those scars are finally removed and the land with its radioactivity returned to pre-mining background level is available for regular use.*

**Nomination Prepared:** March, 2000.

WILLIAM L. CHENOWETH

Consulting Geologist

707 Brassie Drive  
Grand Junction, CO 81506-3911  
(970) 242-9062 (voice & fax)

1-17-02

SHPP2N NJN  
2-4-02

Hi Neal:

The Radiation Unit of the Department of Justice would like to obtain copies of the Arizona Mine Inspector for the years 1957 through 1961. Copies obtained from the Department several years ago apparently have been misplaced. As in the past please bill me for copying and shipping charges. Enclosed, for your information, is a status report on the Radiation Exposure Compensation Program.

Also enclosed, for your files, are some old photos of the Monument No. 2 mine in Apache County, and a description of the concentrator.

Sincerely,  
Bill Chenoweth



# Radiation Exposure Compensation Program

## Awards to Date

	PENDING	APPROVED	DENIED	TOTAL	% APPROVED	\$ APPROVED
<b>CHILDHOOD LEUKEMIA</b>	1	23	19	43	54.8	1,150,000
<b>OTHER DOWN WINDER</b>	1,834	2,853	1,331	6,018	68.2	142,620,000
<b>ONSITE PARTICIPANT</b>	295	305	810	1,410	27.4	21,624,405
<b>URANIUM MINER</b>	691	1,931	1,590	4,212	54.8	192,491,500
<b>URANIUM MILLER</b>	148	51	1	200	98.1	5,100,000
<b>ORE TRANSPORTER</b>	40	5	0	45	100	500,000
<b>TOTAL</b>	3,009	5,168	3,751	11,928	57.9	363,485,905

As of Dec. 12, 2001.

Read our [Privacy and Security](#) notice or go to the [DOJ Homepage](#) (each opens in a new window).

civil/torts/mcr June 18, 2001

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- EEGICPA
- Contact Us

WILLIAM L. CHENOWETH

Monument No. 2  
Mine file Apache Co.

Consulting Geologist

707 Brassie Drive  
Grand Junction, CO 81506-3911  
(970) 242-9062 (voice & fax)

10-28-00

Dear Ken:

Umeter Minerals Corp (Union Carbide Corp.) gave the DOE 114 boxes of material generated by U. A. Vanadium Corp (also Union Carbide) contractor to the Army's Manhattan Engineer District, in the 1940s. Since there were federal contract records, Umeter lawyer said they should go to the DOE. I have a contract, from DOE, to sort the material and index it for sending to the National Archives - Rocky Mt Region at Denver Colorado, where they will be available to future researchers etc.

Most of the material deals with the recovery of Uranium from vanadium mill tailings in Colorado. I did find copies of a research report that deals with tests on some Monument No. 2 ore. Since I found several copies I thought the Department could use one (#8 of 15)

Sincerely

Bill

obtained through underground room-and-pillar techniques with adits or surface declines driven from mesa rims developed on cliffs of the Salt Wash Member of the Morrison Formation.

The Salt Wash Member of the Morrison Formation is interpreted as continental fluvial-floodplain deposits (Chenoweth and Malan, 1973); the uranium-vanadium ores are stratigraphically confined to certain mudstone and sandstone layers which contain abundant fossil woody-plant trash and carbonized log fragments. Ore grade is closely associated with organic content, which, in turn may be related to the position of point bar deposits with respect to paleo-meander bends in the stream courses.

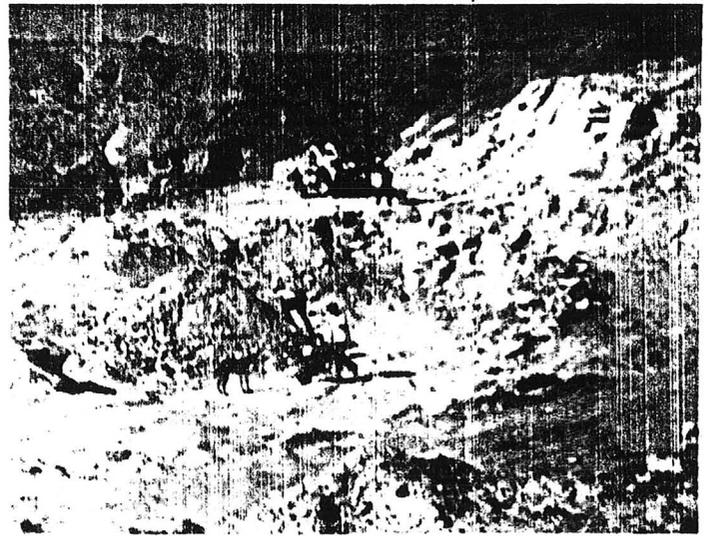
Most workers interpret the ore deposition as quickly following sediment deposition, before later diagenesis solidified the mudstones. In the Carrizo Mountains at the Zona Mine, Chenoweth and Malan (1973) interpreted the ore deposition to have taken place before the Salt Wash sediments were intruded and baked by the Laramide-age Carrizo Mountain laccoliths. Hence the ore deposition is pre-Laramide (~ 70 m.y.) in age.

An unexplained attribute of the Salt Wash ores is a ratio of vanadium to uranium of approximately 4:1 up to 8:1. This ratio is a high for Arizona uranium deposits and accounts for 17.9 million pounds of  $V_2O_5$  production from mines in the Salt Wash Member alone. The uranium and vanadium apparently migrated together under appropriate geochemical conditions, presumably from the source area of the Salt Wash sediments, somewhere to the west of what is today Lee's Ferry on the Colorado River (Craig and others, 1955).

### Chinle Formation

The basal part of the Triassic Chinle Formation in the Cameron area and in the Monument Valley region of Arizona and Utah had sustained production of uranium between 1948 and 1969. In the Cameron area, the lower part of the Chinle Formation (termed the sandstone and siltstone member by Repenning and others, 1969, p. 5) and various horizons in the Petrified Forest Member contain ore zones that consist of interbedded sands and mudstones with abundant silicified logs. These strata are exposed along both sides of the Little Colorado River for 40 miles. A total of 102 mines, most of which were open pits averaging between 20 and 60 feet deep, produced 1.24 million pounds of  $U_3O_8$  and 212,000 pounds of  $V_2O_5$  between 1954 and 1963 (see Bollin and Kerr, 1958). These mined areas represent only the most accessible ore bodies. Certainly, some potential for slightly deeper ore bodies remains in the area, as suggested by some recent drilling results. In the eastern part of the Cameron area, minor production is recorded from the basal Kayenta Formation.

Monument Valley has been the single most productive area for uranium in Arizona. In this region, well-defined channels of the basal Chinle conglomerate (the Shinarump) were cut into the underlying Triassic Moenkopi Formation and were subsequently mineralized locally. The channel fill consists of pebbly conglomerates with sandstone and mudstone lenses and locally abundant carbonized and silicified logs. Total Monument Valley production from 34 mines between 1948 and 1969 amounts to 8.7 million pounds of  $U_3O_8$  and 24.4 million pounds of  $V_2O_5$ . Arizona's largest single mine group is the Monument No. 2 mine, operated by the Vanadium Corporation of America. This Monument mine is in an erosional remnant of a low scour in a single Shinarump channel, with both upstream and downstream portions removed by later erosion. The preserved channel remnant is cut through the Moenkopi Formation into the underlying De Chelly Sandstone, and is about 700 feet wide and up to 60 feet deep. Monument No. 2 production alone accounts for 5.2 million pounds of  $U_3O_8$  and 21.8 million pounds of  $V_2O_5$  from 1952 to 1967. Earlier underground workings were eventually replaced by an open pit which followed the course of the Shinarump channel. Production was enhanced from 1955 to 1964 by a mechanical upgrader situated near the mine that separated higher grade clay-silt ore averaging 0.24%  $U_3O_8$  and 2.6%  $V_2O_5$  from more sandy materials (0.02%  $U_3O_8$  and 0.18%  $V_2O_5$ ) which were discarded. During 1964-1967, heap leaching of the sand residue and some low grade ore resulted



Mining at the Charlie Huskon No. 3 open pit in the Cameron area, April 1966. Uranium here is in sands and shales of the Triassic-age Chinle Formation. Petrified wood in the sediments is especially uranium rich. Photo by W. Chenoweth, Dept. of Energy.

in additional production. Ore minerals at Monument No. 2 are tyuyamunite, carnotite, becquerelite, hervettite and uraninite; they impregnate sandstone lenses, fill fractures, and replace clay and fossil plant fragments. Most workers hypothesize ore deposition in Shinarump channels to have occurred through the trapping of uranium-vanadium minerals by organic debris in the channels from groundwater solutions which were moving through the permeable channelways in the post-Shinarump time. However, Finnell (1957) suggests a Laramide age of low-temperature hydrothermal ore deposition.

### Breccia Pipe Sources

Breccia pipes are found in large areas of the Colorado Plateau country. More than 100 have been postulated by DOE subcontract studies to exist in the region surrounding the Grand Canyon. The pipes take the form of vertically elongate, cylindrical masses filled with heterogeneous assemblages of sedimentary rock fragments that have been displaced downward, presumably by collapse into a solution cavity formed in Mississippian-age Redwall Limestone. Radial and concentric faults and fractures mark the lateral pipe boundaries. Where explored, the pipes never contain sedimentary material that can be proven to have moved upward, nor do they contain any volcanic debris. Many, but by no means all, of the Arizona Plateau pipes contain varying degrees of copper and/or uranium mineralization. Past uranium production in Arizona is recorded from five pipes. The first four (Chapel, Hack Canyon, Ridenour and Riverview) supplied a cumulative total of 1852 tons of uraninite-type ore that contained about 0.5%  $U_3O_8$  between 1950 and 1964. The fifth, the Orphan Lode, is the second largest individual Arizona uranium mine. It is credited with 509,000 tons of ore that contained 0.43%  $U_3O_8$ , and with considerable values of copper and silver. Vanadium content was quite low.

The Orphan ores are mostly primary uraninite-pyrite-chalcocite-tennantite, with some secondary ores found near the present surface of the mine, 1,000 feet below the top of the Grand Canyon. The ores have been subdivided into basically two types. A central "B" orebody occupies a "pipe within a pipe" structure, where the ore has impregnated the highly brecciated pipe-fill derived largely from the Coconino Sandstone. The annular ring orebody is found mostly outside the pipe perimeter, 200-400 feet below the surface. Outside of the pipe perimeter, rich ore selectively replaced certain mudstone layers in the Supai Formation. For details of Orphan geology, see Gornitz and Kerr (1970) and Kofford (1969).

Ore mined in 1956 to 1959 was hoisted to the canyon rim by an aerial bucket tramway with a 1,000 ton-per-month capacity. From

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This document consists of 11 page(s)  
Number 8 of 15 copies, Series A

Mine file  
Apache  
County

— MONUMENT No. 2 — AZ  
F.A. SITTON — CO  
HENRY MTS — UT

"UNITED STATES VANADIUM CORPORATION SLUDGE PLANTS"

Research Progress Report

for

Period Ending

January 18, 1945

GOVERNMENT CONTRACT  
NO. W-747-Eng 32

This document contains information affecting the National Defense of the United States within the meaning of the Espionage Act 50 U. S. C., 31 and 32. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

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#265

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PILOT PLANT

The pilot plant has completed the crude ore schedule. The last three ores which have been treated are: Mexican Hat (reservation)\*, Sitton (Dove Creek), and Henry Mountain (Greenriver).

The material balance for each of these runs is attached.

The treatment of the Mexican Hat ore was somewhat difficult from the standpoint of keeping the digested pulp buoyant. The material (like the yellow-cat) was of a conglomerate nature made up of granite pebbles, which, when ground, gave sharp particles. These particles even with excess amounts of amine would not stay in suspension in the pulp.

In processing Batches O-43 and O-44 we first re-ground the ore through the pilot plant crushing mill. The material after grinding finer was successfully run through the filter circuit. The difference in the two grinds are shown on the attached screen analysis. This shows that this type ore and possibly the yellow-cat ore could be handled in this type filter if ground finer than 14 x D. Processing of the Sitton ore was the most successful yet encountered from the standpoint of: buoyancy of pulp, filter rates, grade of solution, and grade of product. The material was high grade enough to give an optimistic outlook on extractions and recoveries, but the tails were actually higher in % D than some of the other ore that has been treated.

In running the last lot of material - (Henry Mountain), we found only one major difficulty. The digested ore filtered so rapidly that the disc filters were carrying more weight than they were designed for. During this operation the filter sectors were always in danger of being broken away from the hub. The fast filtering rate is thought to be due to the lack of organic slimes in the raw ore.

None of the last lots of ore treated proved to be as amenable to the soda ash leach as the Uravan area ore. Further study of the available data may bring to light the reason for this variable.

At present the pilot plant is being cleaned completely and all machinery is being protected against a long time shutdown. The plant should be completely idle by January 22, 1945.

A complete report of the pilot plant operation, along with a typical plant design and cost estimate, will be submitted when all data has been assembled.

Submitted by: Howard R. Downing  
Research Engineer

\* MONUMENT NO. 2 ORE

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SCREEN ANALYSIS OF TWO GRINDS ON MEXICAN HAT ORE ✓

A. Grind which was not satisfactory for pilot plant filtering operation.

Mesh	Grams	% Retained	% Cumulative
/ 14	17.4	3.5	3.5
- 14 / 20	56.2	11.4	14.9
- 20 / 28	64.5	13.0	27.9
- 28 / 40	102.5	20.8	48.7
- 40 / 50	80.0	16.2	64.9
- 50 / 65	58.1	11.8	76.7
- 65 / 100	42.1	8.5	85.2
- 100 / 150	21.3	4.3	89.5
- 150 / 200	16.1	3.3	92.8
- 200	35.5	7.2	100.0

B. Grind which was satisfactory for pilot plant filtering operation.

Mesh	Grams	% Retained	% Cumulative
/ 14	10.0	2.0	2.0
- 14 / 20	50.9	10.2	12.2
- 20 / 28	72.0	14.5	26.7
- 28 / 40	80.0	16.0	42.7
- 40 / 50	78.8	15.7	58.4
- 50 / 65	70.2	14.0	72.4
- 65 / 100	47.8	9.5	81.9
- 100 / 150	28.9	5.7	87.6
- 150 / 200	18.0	3.6	91.2
- 200	44.4	8.8	100.0

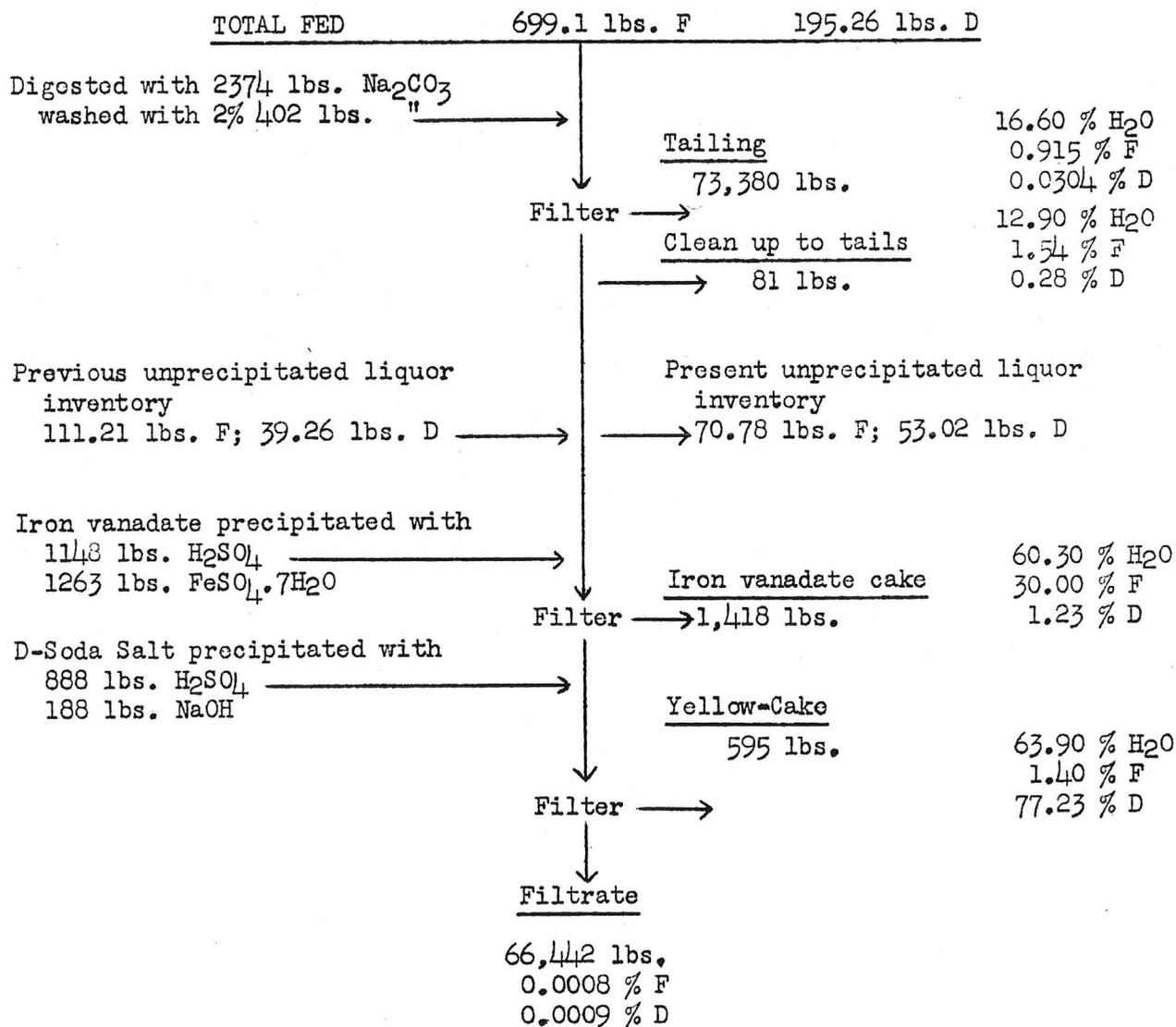
\* MONUMENT NO. 2 ORE

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MATERIAL BALANCE MEXICAN HAT ORE \*  
Batches 0-40 through 0-44

Batch No.	Type Ore	Lbs. Wet	% H <sub>2</sub> O	Lbs. Dry	% F	% D
0-40	Mexican Hat	12,500	3.13	12,109	1.11	0.353
0-41	"	12,490	1.90	12,253	1.08	0.336
0-42	"	12,590	1.45	12,407	1.04	0.254
0-43	"	12,820	1.67	12,606	1.22	0.321
0-44	"	12,440	1.40	12,266	1.22	0.321
Totals		62,840	1.91	61,641	1.13	0.317



\* MONUMENT NO. 2 ORE

F = V<sub>2</sub>O<sub>5</sub>  
D = U<sub>3</sub>O<sub>8</sub>

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Mexican Hat Batches 0-40 through 0-44

SUMMARY OF RECOVERIES

Material	# F	% of Feed F	% of Feed - Inv. F	% of Feed Adj. to 100% F	# D	% of Feed D	% of Feed - Inv. D	% of Feed Adj. to 100% D
Heads	699.10	100.0	105.78	100.0	195.26	100.00	92.95	100.00
Tailing plus cleanup	560.09	80.12	75.74	76.46	18.82	9.64	10.37	9.79
Difference in inventory	- 40.43	- 5.78			13.76	7.05		
Clarifier Cake	--	--	--	--	--	--	--	--
Z-2	168.87	24.16	22.83	23.05	6.92	3.54	3.81	3.60
N-2	3.01	0.43	0.41	0.41	165.89	84.96	91.40	86.31
Filtrates	0.56	0.08	0.08	0.08	0.58	0.30	0.32	0.30
TOTALS	692.1	99.01	99.06	100.00	205.97	105.49	105.90	100.00

Avg. loss in weight (digestion)	0.71 %
" filtration rate solids (tails)	1368 lbs. d.s./leaf/hr.
" filtration rate - solution	743 lbs./leaf/hr.
Na <sub>2</sub> CO <sub>3</sub> usage	90.0 lbs./ton
Avg. grade of pregnant solution	0.526 % F; 0.546 % D
" moisture in tails	16.60 %
" W.S. in tails	0.018 % F; 0.010 % D
Filter cloth consumption	\$0.75/ton
Avg. Amine consumption	0.983 lbs./ton

\* MONUMENT NO. 2 ORE

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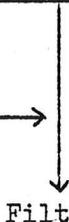
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MATERIAL BALANCE SITTON ORE  
Batches 0-45 through 0-49

Batch No.	Type Ore	Lbs. Wet	% H <sub>2</sub> O	Lbs. Dry	% F	% D
0-45	Sitton	12,500	5.30	11,838	3.08	0.565
0-46	"	12,500	5.15	11,856	3.05	0.563
0-47	"	12,470	5.40	11,797	3.12	0.585
0-48	"	12,510	5.27	11,851	3.21	0.612
0-49	"	15,770	4.92	14,994	2.91	0.545
TOTALS		65,750	5.19	62,336	3.066	0.5725

TOTAL FED 1911.0 lbs. F 356.89 lbs. D

Digested with 2664 lbs. Na<sub>2</sub>CO<sub>3</sub>  
washed with 2% 536 lbs. "



Tailing  
60,208 lbs. 19.08 % H<sub>2</sub>O  
2.72 % F  
0.035 % D

Clean up to tails  
→ 2,910 lbs. 20.30 % H<sub>2</sub>O  
2.14 % F  
0.34 % D

Previous unprecipitated liquor  
inventory  
70.78 lbs. F; 53.02 lbs. D →

Present unprecipitated liquor  
inventory  
→ 49.63 lbs. F; 63.86 lbs. D

Iron vanadate precipitated with  
1226 lbs. H<sub>2</sub>SO<sub>4</sub>  
1506 lbs. FeSO<sub>4</sub>·7H<sub>2</sub>O →



Iron vanadate cake  
→ 1,640 lbs. 57.77 % H<sub>2</sub>O  
29.62 % F  
0.89 % D

D-Soda Salt precipitated with  
1536 lbs. H<sub>2</sub>SO<sub>4</sub>  
326 lbs. NaOH →



Yellow Cake  
1,181 lbs. 64.00 % H<sub>2</sub>O  
1.70 % F  
80.18 % D

Filtrate

93,453 lbs.  
0.0009 % F  
0.0016 % D

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Sitton Ore Batches 0-45 through 0-49

SUMMARY OF RECOVERIES

Material	# F	% of Feed F	% of Feed - Inv. F	% of Feed Adj. to 100% F	# D	% of Feed D	% of Feed - Inv. D	% of Feed Adj. to 100% D
Heads	1911.0	100.00	101.11	100.00	356.89	100.00	96.96	100.00
Tailing plus cleanup	1687.33	88.30	87.33	89.99	29.06	8.14	8.40	8.45
Clarifier Cake	--	--	--	--	--	--	--	--
Difference in Inventory	- 21.15	- 1.11	--	--	10.84	3.04	--	--
Z-2	180.42	9.44	9.34	9.62	5.56	1.56	1.61	1.62
N-2	6.36	0.33	0.33	0.34	307.82	86.25	88.95	89.50
Filtrates	0.88	0.05	0.05	0.05	1.49	0.42	0.43	0.43
Totals	1853.84	97.01	97.05	100.00	354.77	99.41	99.39	100.00

Avg. loss in weight (digestion)	3.41 %
" filtration rate solids (tails)	905 lbs. d.s./leaf/hr.
" filtration rate - solution	637 lbs./leaf/hr.
Na <sub>2</sub> CO <sub>3</sub> usage	102.7 lb.s/ton
Avg. grade of pregnant solution	0.466 % F; 0.812 % D
" moisture in tails	19.08 %
" W.S. in tails	0.0102 % F; 0.0112 % D
Filter cloth consumption	\$0.48/ton
Avg. amine consumption	0.502 lbs./ton

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~~SECRET~~

Henry Mountain Ore Batches 0-50 through 0-54

SUMMARY OF RECOVERIES

Material	# F	% of Feed F	% of Feed - Inv. F	% of Feed Adj. to 100% F	# D	% of Feed D	% of Feed - Inv. D	% of Feed Adj. to 100% D
Heads	697.47	100.00	100.24	100.00	150.74	100.00	122.87	100.00
Tailing plus cleanup	618.18	88.63	88.42	77.38	22.21	14.73	11.99	9.95
Clarifier Cake	19.81	2.84	2.83	2.48	1.01	0.67	0.55	0.46
Difference in Inventory	- 1.69	- 0.24	--	--	- 34.48	- 22.87	--	--
Z-2	151.71	21.75	21.70	18.99	3.78	2.51	2.04	1.69
N-2	6.11	0.88	0.87	0.76	195.35	129.59	105.47	87.52
Filtrates	3.05	0.44	0.44	0.39	0.86	0.57	0.46	0.38
Totals	797.17	114.30	114.26	100.00	188.73	125.20	120.51	100.00

Avg. loss in weight (digestion)	1.27 %
" filtration rate solids (tails)	1395 lbs. d.s./leaf/hr.
" filtration rate - solution	814 lbs./leaf/hr.
Na <sub>2</sub> CO <sub>3</sub> usage	96.9 lbs./ton
Avg. grade of pregnant solution	0.386 % F; 0.434 % D
" moisture in tails	17.40 %
" W.S. in tails	0.0162 % F; 0.008 % D
Filter cloth consumption	\$0.58/ton
Avg. amine consumption	0.271 lbs./ton

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COMPARISON OF COLORIMETRIC AND CUPFERRON  
 "D" ANALYSES ON FILTRATE SAMPLES

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A number of precipitated filtrate samples and mill filtrate samples have been analyzed at the Uravan Laboratory by both the colorimetric method and the cupferron method for "D" content. The results of these analyses are reported below:

<u>Date</u>	<u>Batch No.</u>	<u>Cup-ferron % D</u>	<u>Color-metric % D</u>	<u>Date</u>	<u>Batch No.</u>	<u>Cup-ferron % D</u>	<u>Color-metric % D</u>
12-29-44	A1138	0.002	0.002	1-4-45	A1160	0.003	0.002
	A1139	Trace	0.003		A1161	0.003	0.003
	A1140	0.002	0.004		A1163	0.001	0.002
12-31-44	A1147	0.002	0.002		A1164	0.002	0.002
	A1148	0.001	0.001		WAA Mill Filtrate Filtered	0.001	0.002
	A1149	0.002	0.001		WAA Mill Filtrate Unfiltered	0.002	0.002
12-31-44	WSP Mill Filtrate Filtered	Trace	0.003	1-5-45	A1165	0.002	0.003
	WSP Mill Filtrate Unfiltered	0.001	0.003		A1166	0.003	0.003
	WAA Mill Filtrate Filtered	Trace	0.001		A1167	Trace	0.004
	WAA Mill Filtrate Unfiltered	0.001	0.001		A1168	0.004	0.005
1-1-45	A1150	0.002	0.004		A1169	0.002	0.004
	A1151	0.002	0.004		A1170	0.006	0.004
	A1152	0.002	0.005		A1172	0.006	0.006
	A1153	0.002	0.004		WAA Mill Filtrate Filtered	0.002	0.003
	A1154	0.002	0.001		WAA Mill Filtrate Unfiltered	0.002	0.003
	WSP Mill Filtrate Filtered	0.001	0.001	1-6-45	A1171	0.002	0.003
	WSP Mill Filtrate Unfiltered	0.002	0.006		A1173	Trace	0.004
	WAA Mill Filtrate Filtered	Trace	0.003		A1175	0.007	0.008
	WAA Mill Filtrate Unfiltered	0.001	0.002		A1176	0.002	0.003
1-2-45	A1155	0.002	0.005		A1177	0.002	0.003
	A1156	0.002	0.002		A1178	0.002	0.002
	WAA Mill Filtrate Filtered	0.001	0.002		WAA Mill Filtrate Filtered	0.001	0.003

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WSP = 1st Uravan sludge plant

WAA = 2nd Uravan sludge plant

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Date	Batch No.	Iron % D	Color-metric % D	Date	Batch No.	Cup-ferron % D	Color-metric % D
1-2-45	WAA Mill Filtrate			1-6-45	WAA Mill Filtrate		
	Unfiltered	0.002	0.004		Unfiltered	0.001	0.003
1-3-45	All57	0.002	0.005	1-7-45	All79	0.001	0.001
	All58	0.004	0.005				
	All59	0.006	0.004				
	All62	0.002	0.007				
	WAA Mill Filtrate						
	Filtered	Trace	0.002				
	WAA Mill Filtrate						
	Unfiltered	Trace	0.002				

The cupferron analyses on the precipitation filtrates and the color-metric analyses on the mill filtrates has been temporarily discontinued.

**THE USE OF ORGANIC REAGENTS IN LABORATORY TESTS  
TO INCREASE THE FILTERING OF ACID LEACH SANDS**

A number of additional leaches have been carried out on the effects of organic reagents on the filtering rate of acid leached sands. These experiments were made in the same manner as reported in the Research Progress Report of January 5, 1945. The sands used in the series shown below contains a larger quantity of clay and slime material than those reported in the earlier work.

The tests recorded below were run at 90° C and each contained 60% solids.

Volume of Filtrate Collected (ML.)

	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Control														
Period of Flow (Min.)	2.5	5.5	10.0	16.3	23.5	32.0	42.0	54.0	66.0	79.0	101	131	165	206
2 Lb/Ton Bone Glue														
Period of Flow (Min.)	1.7	4.0	6.7	10.0	13.5	16.7	20.5	23.7	27.0	30.0	33.0	36.0	39.0	41.7
2 Lb/Ton No.1 Tech. Gelatin														
Period of Flow (Min.)	1.1	2.5	4.5	7.5	11.0	14.5	18.0	21.7	25.0	29.3	33.5	37.3	40.1	43.2
2 Lb/Ton Amine 230														
Period of Flow (Min.)	0.9	2.2	3.8	5.2	7.4	9.6	12.2	16.7	20.2	23.4	27.0	30.8	33.2	35.7
2 Lb/Ton Sodium Silicate														
Period of Flow (Min.)	1.2	2.6	5.1	7.8	11.5	16.3	19.5	24.6	29.4	34.3	37.7	41.3	44.6	49.1

Submitted By: James L. Lake

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V.C.A.

MONUMENT #2 APACHE CO (A)  
FALLS

EARLY VANADIUM-URANIUM MINING  
IN MONUMENT VALLEY, APACHE AND NAVAJO COUNTIES,  
ARIZONA, AND SAN JUAN COUNTY, UTAH

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Prepared For The Arizona Department of Mines  
And Mineral Resources

October 1984  
Grand Junction, Colorado

EARLY VANADIUM-URANIUM MINING  
 IN MONUMENT VALLEY, APACHE AND NAVAJO COUNTIES,  
 ARIZONA, AND SAN JUAN COUNTY, UTAH

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EARLY VANADIUM-URANIUM MINING IN  
IN MONUMENT VALLEY, APACHE AND NAVAJO COUNTIES,  
ARIZONA, AND SAN JUAN COUNTY, UTAH

ABSTRACT

During the period 1942 through 1944, the Office of Indian Affairs, U. S. Department of the Interior, leased four parcels of land in Monument Valley, Arizona and Utah for carnotite mining. Two leases in Arizona, Monument No. 1 and Monument No. 2, produced a total of 4,014 tons of ore averaging 1.87%  $V_2O_5$ . Another lease, Utah No. 1, located on the eastern tip of Oljeto Mesa, produced nearly 52 tons of ore averaging 4.03%  $U_3O_8$  and 5.50%  $V_2O_5$ . Since the ore averaged greater than 1.50%  $U_3O_8$ , payment was received for the uranium, in addition the vanadium. This represents the initial mining of uranium ore on the Navajo Indian Reservation.

INTRODUCTION

The Navajo Indians reported used carnotite as a pigment in their sandpaintings long before Gregory (1917, p. 50 and 148) first reported the occurrences of a uranium-vanadium mineral, probably carnotite, in the Shinarump and Chinle rocks of the Monument Valley area. Butler and Allen (1921, p. 19) mentioned that Ben S. Wilson, a prospector from Casa Grande, Arizona, and Frank Hess of the U. S. Geological Survey, examined carnotite deposits discovered by John Wetherill of Kayenta, Arizona. Butler and Allen (1921, p. 19) also state that people from Colorado were investigating the carnotite deposits near Kayenta at the time Wilson and Hess were there.

The mining of carnotite in the Arizona portion of Monument Valley during the early 1940s is briefly mentioned in reports on the Monument No. 1 Mine (Witkind, 1961, p. 221) and on the Monument No. 2 Mine (Witkind and Thaden, 1963, p. 68-69), but there is virtually no mention of any mining in the Utah portion of the Valley until the uranium boom of the 1950s.

A report prepared by the General Services Administration (GSA) Indian Trust Accounting Division for the Navajo Tribe gives precise details on pre-1947 mining on the Navajo Indian Reservation. 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. A copy of the vanadium and uranium section has been made available to the Grand Junction Area Office of the Department of Energy.

Two leases in the Arizona portion of Monument Valley produced ore in the early and middle 1940s, and two leases in the Utah portion of the Valley were active in 1944. Data on those properties in this brief report is summarized from the GSA (1981) document. Location of the leases is shown on Figure 1.

### LEASING REGULATIONS

The Navajo Indian Reservation was closed to prospecting and mining until 1919. 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. This act allowed prospectors to enter the Reservation and stake a mining claim if their prospecting located promising mineralization. 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 early 1920s, ten leases for carnotite mining were granted by the Interior Department in the Carrizo Mountains, but there is no record of any leases in the Monument Valley area. On March 25, 1936, the Secretary of the Interior closed the Navajo Indian Reservation to claim location and prospecting for minerals until further authorization.

The Navajo Indian Reservation was again opened to mining 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 Reservations lands with approval of the Secretary of Interior. Prospectors no longer could enter the Reservation and stake a mining claim under regulations similar to those of the United States Mining Law. The new mining regulations contained escalating annual rentals, a base royalty of 10% (mine mouth value), bond requirements, acreage limitations, a term of 10 years which could be extended by production.

On April 9, 1941, the Navajo Tribal Council requested the Secretary of the Interior lease lands for mining purposes to the highest bidder. Leases could be written for a specific parcel of land, or for a large area which could be subsequently reduced in size at the end of a specified time period. As the result of this action, mining companies had to request public lease sales for lands they were interested in.

### THE VANADIUM MARKET

Due to the uncertainty of foreign supplies and the need for vanadium for war armaments, the federal government formed the Metals Reserve Company in 1942. The company began an ore-

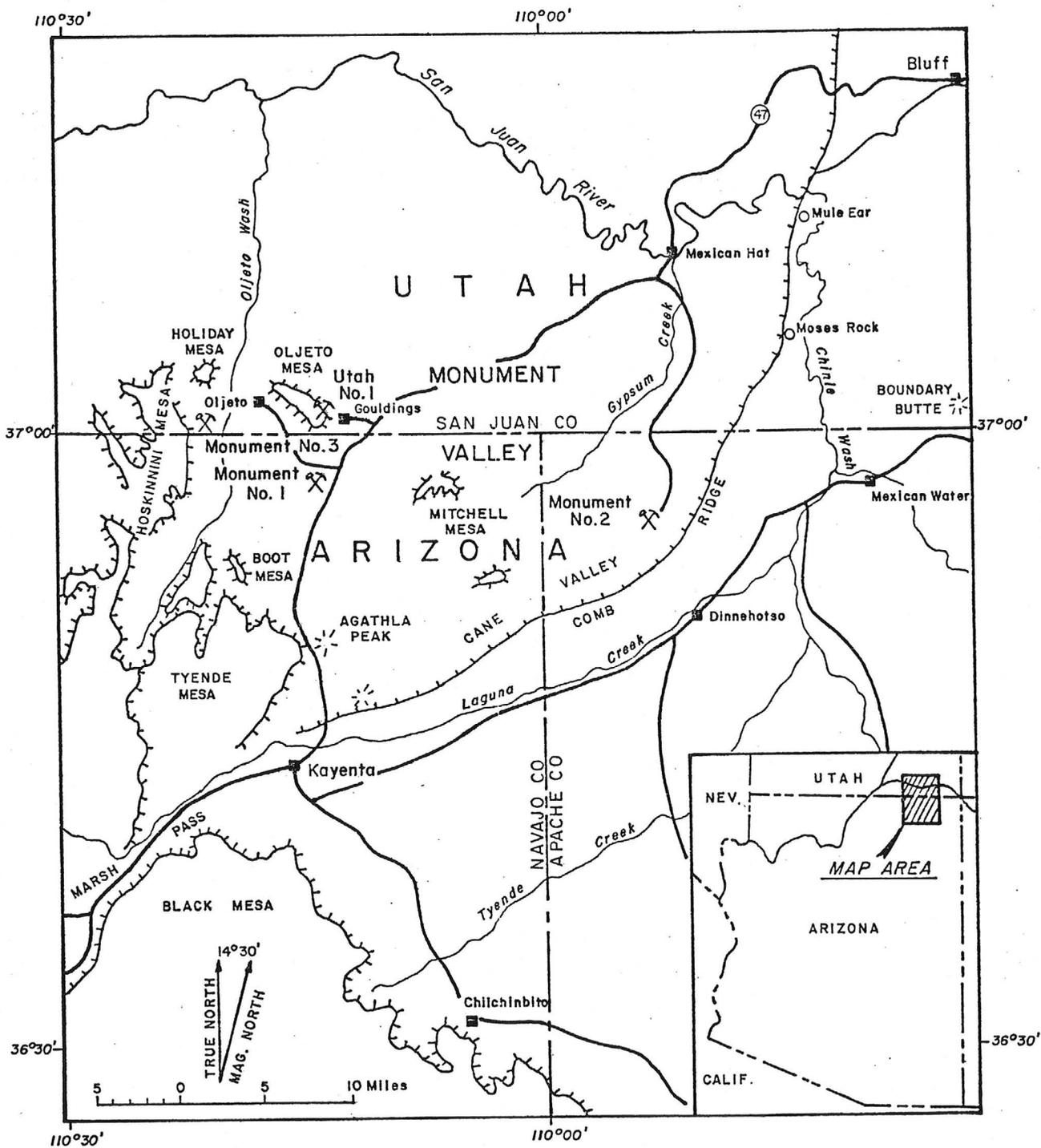


Figure 1. Index map of Monument Valley showing the location of the early carnotite leases.

purchasing program and increased the base price paid for vanadium ore. At Monticello, Utah, the Defense Plant Corporation, a government agency, funded the construction of a vanadium plant to be operated by the Vanadium Corporation of America (VCA). Actual construction started in February, and on August 24, 1942, the first vanadium was produced. In April 1942, while construction was under way, the Metals Reserve Company (MRC) established an ore-buying station at Monticello and appointed the United States Vanadium Corporation (USV) as its buying agent. All ore producers, independents and VCA, then sold ore to the MRC. MRC in turn had the ore milled by VCA or other mills.

At Durango, Colorado, the Reconstruction Finance Corporation, a government agency, contracted with USV to convert and operate an old lead smelter for vanadium production. The vanadium was supplied to Metals Reserve Company. United States Vanadium operated the plant for the government until early 1944, when the government vanadium purchasing program was terminated because of adequate vanadium stocks. U. S. Vanadium Corporation then purchased the facilities from the Reconstruction Finance Corporation and operated them for the production of vanadium for commercial sales until August 31, 1945, when the plant was closed.

The Metals Reserve's program was the stimulus to commence vanadium mining in Monument Valley. However, the Metals Reserve program was short-lived as the Monticello plant closed in February 1944.

In 1945, VCA leased the Monticello mill from the Defense Plant Corporation and purchased the remaining ore stockpiles from Metals Reserve. VCA processed the stockpiled ore, plus ore from other sources, until the mill closed again in 1946.

#### MONUMENT NO. 1 LEASE

The government subsidiaries for vanadium renewed interest in the carnotite deposits of Monument Valley. On October 1, 1942; the Office of Indian Affairs, U. S. Department of the Interior, advertised a lease sale for carnotite and related minerals for a 20.66 acre parcel of ground known as the Combination Lode Claim, as surveyed by U. S. Mineral Surveyor, A. L. Kroeger. The claim was located about 20 miles north of Kayenta in Navajo County, Arizona. It is very possible that this claim covered the original discovery by John Wetherill.

When the bids were opened on October 22, 1942, bids from three organizations had been received. They were: VCA, Naturita, Colorado; Bill Barlow, Dove Creek, Colorado; and Root, Norton, and Ashack of Durango, Colorado. VCA was the highest bidder with a bonus bid of \$739.83 (GSA 1981, exhibit 36).

Lease I-149-IND-5869 with VCA was executed November 4, 1942, effective December 21, 1942, for a period of 10 years. The lease was named Monument No. 1 by VCA.

Ore shipments to Metals Reserve at Monticello, Utah began December 1942 and continued through February 1944 when the plant was closed.

The Metals Reserve's program terminated in March 1944, at which time vanadium mining all but ceased in Monument Valley.

Shipments to Monticello, Utah resumed in October 1945 and continued in December 1945, and in January 1946, at which time VCA operated the mill. Details of the vanadium production are given in Table 1.

Table 1  
Vanadium Production 1942-1946  
Lease I-149-IND-5869  
Monument No. 1

<u>Year</u>	<u>Tons of Ore</u>	<u>Pounds V<sub>2</sub>O<sub>5</sub></u>	<u>Percent V<sub>2</sub>O<sub>5</sub></u>
1942	76.57	3,883.00	2.52
1943	2,261.42	86,017.65	1.90
1944	940.09	37,308.93	1.98
1945	227.73	8,984.00	1.97
1946	<u>18.88</u>	<u>603.00</u>	<u>1.59</u>
Totals	3,524.69	136,796.58	1.94

Source: GSA (1981, p. 43-49 of Appendix)

Over the span of the 38 months the lease was active, a total of 3,524.69 tons of ore containing 136,796.58 pounds vanadium oxide (V<sub>2</sub>O<sub>5</sub>) was mined from the south end a small remnant of a Shinarump channel. Mining was by underground methods. The value of this ore was listed at \$54,619.48, of which the Navajo Tribe received \$5,011.66 in royalties (GSA, 1981, p. 49).

#### MONUMENT NO. 2 LEASE

Luke Yazzie discovered carnotite mineralization southeast of Yazzie Mesa in the eastern part of Monument Valley in 1942. He told Harry Goulding, a local trader of this discovery, and

he in turn contacted VCA. As news of this discovery spread, other firms and individuals examined the area (Witkind and Thaden, 1963, p. 68-69).

As the result of interest in the area, the Office of Indian Affairs advertised an exploration lease sale for carnotite and related minerals on July 21, 1943. The area in Apache County, Arizona, was described as follows: "beginning at a point south 32°28' east, 28,949.78 feet from mile post 227 on the Utah-Arizona line and running thence north 25°00' east one mile; thence east one and one quarter miles; thence south 25°00' west one mile; thence south one and one quarter miles; then west one and one quarter miles; thence north one and one quarter miles to the point of beginning, containing approximately 1,845 acres."

Bids were opened on August 3, 1943 with the only bidder being VCA, with a bonus bid of \$3,000.00 (GSA, 1981, exhibit 43). At the same time as the Monument Valley lease sale, another sale was being held for some 168 square miles in the northern and western Carrizo Mountains. Vanadium companies such as Wade, Curran and Company and USV apparently were more interested in the carnotite deposits in the Morrison Formation of the Carrizo Mountains than in the deposits in the Shinarump Conglomerate in Monument Valley.

Lease I-149-IND-6204 with VCA was executed on August 6, 1943, effective September 23, 1943, for a period of ten years. The lease as named Monument No. 2 by VCA.

On March 6, 1944, the exploration lease was reduced to a permanent operating lease with two plots (claims) totalling 42.09 acres selected to be retained. Plot 1, about 39 acres, covered the mineralized Shinarump channel on the south side of Main Ridge, and Plot 2, about 3 acres, covered the projection of the channel on South Ridge.

Ore shipments to Metal Reserve at Monticello, Utah, began in October 1943 and continued until April 1944. Later shipments were recorded in February and December 1945 and in January 1946, at which time VCA operated the Monticello mill. Details of the vanadium production are given in Table 2.

Table 2  
Vanadium Production 1943-1946  
Lease I-149-IND-6204  
Monument No. 2

<u>Year</u>	<u>Tons of Ore</u>	<u>Pounds V<sub>2</sub>O<sub>5</sub></u>	<u>Percent V<sub>2</sub>O<sub>5</sub></u>
1943	94.35	2,662.76	1.41
1944	186.44	5,242.07	1.41
1945	48.93	336.00	0.37
1946	<u>159.45</u>	<u>5,496.00</u>	<u>1.72</u>
Totals	489.17	13,736.83	1.40

Source: GSA (1981, p. 55-60 of Appendix)

During the interval of the 28 months the mine was active, a total of 489.17 tons of ore containing 13,736.83 pounds V<sub>2</sub>O<sub>5</sub> was mined from mineralized outcrops on the lease. The value of the ore was listed at \$6,574.85, of which the Navajo Tribe received \$646.83 in royalties (GSA, 1981, p. 49).

#### MONUMENT NO. 3 LEASE

In the summer of 1943 VCA requested that the Office of Indian Affairs hold a lease sale for 12.7 acre parcel of land located three miles southwest of Oljeto Trading Post, on the hogback east of Hoskinnini Mesa. The sale was advertized on September 22, 1943 and when the bids were opened on October 11, 1943, VCA was the only bidder with a bonus bid of \$500.00 (GSA, 1981, exhibit 48).

The claim, named Monument No. 3, was described as follows: "beginning at a point which is north 44°28'30" west, 3,435.62 feet from Mile Post #205, Utah-Arizona state line and running thence north 47°23' east, 270 feet, thence north 12°26' west, 2,500 feet, thence west 200 feet, thence south 11°37' east, 2,679.91 feet more or less to the point of beginning, containing 12.72 acres more or less."

Lease I-149-IND-6256 was executed with VCA on October 23, 1943, effective January 14, 1944, for a period of ten years. No production was reported from this lease, however, a U. S. Geological Survey engineer's examination of the property noted some rim stripping had been done by VCA (GSA, 1981, exhibit 52).

## UTAH NO. 1 LEASE

In February 1944, a group of Blanding, Utah men asked that 40 acres of land on the eastern tip of Oljeto Mesa be made available for leasing. A sale was held on April 10, 1944, with only one bid of \$505.00 received from Wayne E. Carroll, Lee Shumway, E. H. Carroll and Harris Shumway, a partnership d.b.a. Carroll and Shumway (GSA, 1981, exhibit 52).

Lease I-149-IND-6435 was executed on April 25, 1944, effective May 26, 1944, for 40 acres described as the SW $\frac{1}{4}$ , NW $\frac{1}{4}$  Section 26, T43S, R15E, San Juan County, Utah. The lease was made for a period of 10 years. Carroll and Shumway designated the lease as Utah No. 1.

Mining commenced in June 1944 and continued through December of that year. Details of the production are given in Table 3. Lease I-149-IND-6435 was cancelled by Carroll and Shumway on July 16, 1946.

A U. S. Geological Survey (USGS) engineer examined the property and reported (GSA, 1981, exhibit 52) that the ore was mined by hand from in, and around, chunks of silicified wood in the Shinarump Conglomerate. The ore was lowered from the mesa in tram buckets. At the base of the mesa it was loaded on to trucks and hauled to Thompson, Utah where the ore was loaded on to railroad cars. The USGS reported the ore was sold to Howard Balsley of Moab, Utah.

Mr. Balsley was an ore buyer for Vitro Manufacturing Company of Pittsburgh, Pennsylvania (written communication, 1971). He bought ores with minimum grades 1.50% U<sub>3</sub>O<sub>8</sub> and 5.00% V<sub>2</sub>O<sub>5</sub> during the years 1934 through 1944. The ores were shipped to Vitro's plant at Canonsburg, Pennsylvania, for the manufacture of ceramic colors, etc. It is the opinion of the writer that the ore from Utah No. 1 Lease was shipped to Canonsburg for processing rather than to Uravan, Colorado as suggested by the USGS.

## THE URANIUM MARKET

During the late 1930s and early 1940s, the carnotite deposits of the Four Corner area were mined for their vanadium content. Beginning in 1942, the Manhattan District Engineers, as part of the secret, wartime Manhattan Project, began purchasing a uranium sludge from the vanadium mills at Monticello, Utah and Naturita, Colorado. The recovery of uranium from vanadium mill tailings took place at Durango and Uravan, Colorado. Due to the secrecy of the project, miners were not told about the uranium recovery, or paid for the uranium in their ore.

The Interior Department was aware of the War Department's uranium procurement activities and was concerned that the

Table 3  
 Uranium and Vanadium Production, 1944  
 Lease I-149-IND-6435  
 Utah No. 1

<u>Month</u>	<u>Pounds of Ore</u>	<u>Pounds U<sub>3</sub>O<sub>8</sub></u>	<u>% U<sub>3</sub>O<sub>8</sub></u>	<u>Pounds V<sub>2</sub>O<sub>5</sub></u>	<u>% V<sub>2</sub>O<sub>5</sub></u>
June	8,732	333.14	3.82	386.71	4.43
July	9,598	386.88	4.03	485.66	5.06
August	18,207	660.67	3.63	1,298.28	7.13
September	34,281	1,280.85	3.74	1,988.91	5.80
October	10,933	438.22	4.01	570.34	5.22
November	5,747	313.37	5.45	307.81	5.36
December	<u>16,265</u>	<u>770.12</u>	<u>4.74</u>	<u>665.98</u>	<u>4.09</u>
Total	103,763	4,183.25	4.03	5,703.69	5.50

Source: GSA (1981, p. 64-67) of Appendix)

Navajo Tribe was not receiving uranium royalties. On April 14, 1944, the Vanadium Corporation of America informed the Office of Indian Affairs that they were paying for uranium only if the grade of the ore averaged over 0.75% U<sub>3</sub>O<sub>8</sub>. Vitro Manufacturing had a higher cutoff at 1.50% U<sub>3</sub>O<sub>8</sub> (H. W. Balsley, written communication, 1971).

Carroll and Shumway were paid on a sliding scale ranging from \$0.50 per pound U<sub>3</sub>O<sub>8</sub> in ore averaging 1.65% U<sub>3</sub>O<sub>8</sub> to 2.65 per pound for ore containing 19.00% U<sub>3</sub>O<sub>8</sub>. The vanadium prices ranged from \$0.25 per pound V<sub>2</sub>O<sub>5</sub> in ore averaging 2.40% V<sub>2</sub>O<sub>5</sub> to \$0.43 per pound for ore containing 13.50% V<sub>2</sub>O<sub>5</sub>. Carroll and Shumway received \$6,289.80 for 103,763 pounds of carnotite ore (GSA, 1981, p. 49). The Navajo Tribe received \$606.13 in royalties.

Production from the Utah No. 1 Lease represents the first ore mined on the Navajo Indian Reservation for which uranium was paid for.

#### SUMMARY

During the period 1942 through 1946, three carnotite leases on the Navajo Indian Reservation in Monument Valley produced a total of 156,237.10 pounds of vanadium oxide. A year by year summary is given in Table 4. In addition, 4,783.25 pounds of uranium oxide contained in the ore from the Utah No. 1 Lease was also sold.

Table 4  
Vanadium Production 1942-1946  
Monument Valley, Arizona-Utah  
(Pounds V<sub>2</sub>O<sub>5</sub>)

Year	Lease Name			Totals
	Monument No. 1	Monument No. 2	Utah No. 1	
1942	3,883.00	--	--	3,883.00
1943	86,017.65	2,662.76	--	88,680.41
1944	37,308.93	5,242.07	5,703.69	48,254.69
1945	8,984.00	336.00	--	9,320.00
1946	<u>603.00</u>	<u>5,496.00</u>	<u>--</u>	<u>6,099.00</u>
Totals	136,796.58	13,736.83	5,703.69	156,237.10

Source: GSA (1981).

## LATER DEVELOPMENTS

In the early 1950s, the Navajo Tribal Council adopted a series of resolutions dealing with uranium mining which were approved by the Commissioner of Indian Affairs. These resolutions developed the regulations for prospecting and mining permits, mining leases, and royalty schedules. All prospectors needed to obtain permits for prospecting. Mining permits were granted only to Navajos, who could assign them to non-Navajos. Mining leases were no longer the subject of competitive bidding, but were negotiated with the Tribal Council, subject to approval by the Bureau of Indian Affairs.

Records of the Department of Energy's Grand Junction Area Office indicate that mines on all four leases produced ore under the Atomic Energy Commission's (AEC) ore procurement program, which lasted from 1947 through 1970.

VCA resumed mining on the Monument No. 1 Lease in July 1948 and continued into 1950. The mine was abandoned and the adits caved shut. The lease expired in December 1952 and the ground was acquired by Cecil Parrish, Jr. as Mining Permit No. 77. The permit was approved on April 10, 1953 and its assignment to Charles Ashcroft, Sr. and J. L. Foutz of Farmington, New Mexico was approved June 13, 1953. They mined an orebody which had been discovered by AEC drilling just north of the abandoned VCA workings (Anthony, 1955).

Ashcroft and Foutz (a.k.a Copper Canyon Mining Industries, Inc.) produced ore in 1953 through 1956. Final clean up mining of the property occurred in 1964-1966 by A and B Mining Co. Total production under the AEC program was 29,697 tons of ore averaging 0.30%  $U_3O_8$  1.40%  $V_2O_5$ . Not included in these figures is production from the Mitten No. 2 Mine (Cecil Parrish Jr.'s Mining Permit No. 15) which was a northwest extension of the Monument No. 1 orebody outside the boundary of the original 20.66 acre lease.

At the Monument No. 2 Lease, VCA resumed mining in October 1947, and continued into 1969. The original lease was modified in 1959 to include adjacent holdings of Cato Sells and other individual Navajos. The amended lease consisted of three plots totalling 220.69 acres, with single plots being located on Yazzie Mesa, Main Ridge, and South Ridge, respectively. Total production from the Monument No. 2 Lease was 767,166 tons of ore averaging 0.34%  $U_3O_8$  and 1.42%  $V_2O_5$ . Included in these production statistics are products from a mechanical upgrader, a concentrator, and heap leaching which operated at various times at the mine site. The Monument No. 2 Mine has produced more uranium than any other mine in Arizona.

A USGS examination of the Monument No. 2 Mine in April 1948 reported that low grade ore from the mine was being mechanically

upgraded at a small plant on the bank of the San Juan River at the Mexican Hat bridge (GSA, 1981, exhibit 52). This upgrader no doubt was a prototype for the plant that began operating in 1955 at the mine site. A 1952 shipment of 676 tons of ore averaging 0.11%  $U_3O_5$  and 0.71%  $V_2O_5$  reported to the AEC as the Mexican Hat Stockpile may have been from the clean up of this plant.

In 1949, VCA shipped six tons of ore from the Monument No. 3 Lease which averaged 0.49%  $U_3O_8$  and 3.60%  $V_2O_5$ . The lease was later cancelled.

The area of the Utah No. 1 Lease was acquired on October 6, 1949 by Morgan Nielson of Blanding, Utah as Lease I-149-IND-8310 and named the Skyline Mine. Nielson produced ore in 1949 and 1950. Barney Cockburn of Artesia, New Mexico acquired the lease in 1950 with Nielson retaining a 7 1/2% interest. Cockburn made shipments in 1950, and in January 1952 he acquired full interest in the lease. On December 3, 1952 the assignment of the lease from Cockburn to Archie Garwood and R. C. Gerlach of Cortez, Colorado was approved. Garwood and Gerlach produced ore in 1952-55. The lease was later cancelled, and Jimmie Goodman acquired the 40 acre tract as Mining Permit No. 401. It was assigned to A and B Mining Company, who did clean up mining in 1960 and 1962. Production from the Skyline Mine was 5,137 tons of ore that averaged 0.30%  $U_3O_8$  and 0.29%  $V_2O_5$ .

June 11, 1959

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42002*

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Source Material Procurement Division, OS  
(MEMO) Frank R. McKinley, Chief, Proc. Serv. Br.  
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VCA UPGRADE IN KAMMONT VALLEY

SYMBOLS SKINDS

On May 22, the writer visited the upgrading mill, operated by Vanadium Corporation of America, in Kammont Valley, Arizona. It is thought that the following description and attached flowchart may be of interest to the SMD staff.

The VCA Upgrader is located on the Navajo Reservation in Arizona about 20 miles south and east of the Mexican Hat, Utah mill of Texas-Zinc Minerals Corporation. Access to the mill is by an improved gravel road from the Mexican hat millsite or by means of an unimproved gravel road running almost due west from Shiprock, New Mexico.

All feed for the mill is obtained from the VCA Kammont No. 2 mine. The bedding horizon is the Shinarump. Mineralization is of the carbonate type. In the past, the mine had a sizeable production of high grade and direct shipping grade ore which was produced by selective underground mining. Subsequently, the property was converted to an open pit and, except for one or two tonslands per week of shipping grade ore, the ore ranges in grade from 0.04% to 0.06% U<sub>3</sub>O<sub>8</sub> and 0.4 to 0.8% V<sub>2</sub>O<sub>5</sub>. This is the mill feed.

The upgrader consists of two nearly identical parallel circuits each operating at a feed rate of about 250 tons per day, although it is reported that at times the total feed rate has exceeded 700 tons per day.

The flowchart for the operation is very simple. The run of mine ore is crushed to about one inch and is then ground in two, approximately 3' x 6', rod mills to about 10 mesh. The ground pulps are then classified in spiral classifiers and the slime fractions are thickened and the sands are pumped to tails. The thickener underflows are subsequently further classified with cyclones to reject additional barren sand. This sand fraction is then combined with the primary sands from the classifiers and the mixture is further cycloned. The sand fraction is discarded to tails and the slime fraction or overflow is returned to one of the two thickeners. The primary slimes from cyclone treatment of the thicker underflows are filtered with disc filters and the wet cake is dried in two steps in all fired rotary driers. The first

June 10, 1959

drying stage yields a lumpy product containing about 20% moisture whereas the discharge from the second drier consists of a nodulized material ranging in diameter from one half to one and one half inches. This is the final product. It contains approximately 10% moisture and assays 0.25 to 0.3%  $U_3O_8$  and 1.5 to 3%  $V_2O_5$  depending upon the millfeed assay. Production is 40 to 50 tons per day. Thus assuming an average ratio of concentration of 5:1 the recovery is probably only 50 to 60 percent. All of the concentrate is trucked 170 miles to the VCA mill in Durango.

The mill staff consists of 30 Navajo Indians, two white shift bosses and a superintendent. All of the mill equipment, except for a new diesel generator, was probably of second-hand origin but the general condition of the mill is as good or better than the mill at Durango.

Mr. Brinker remarked that the upgrading operation was very cheap but he did not volunteer any information on actual operating costs. However, assuming a recovery of 50% and a millfeed grade of 0.05%  $U_3O_8$ , direct mining and milling costs would probably not be less than \$4.00 per pound of  $U_3O_8$ . Added to this would be haulage to Durango at a cost of about \$1.50 per pound of  $U_3O_8$  or a minimum overall cost of \$5.50 per pound of  $U_3O_8$ .

Attachment:

Flowsheet - VCA Upgrader in Monument Valley

cc: JTSherman, Wash.  
KLBurson, FD, GJ

bc: DRGeorge, SMPD, GJ

