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**ARIZONA DEPARTMENT OF MINERAL RESOURCES**  
**Mineral Building, Fairgrounds**  
**Phoenix, Arizona**

1. Information from: Anthony G. Ruedi, Western Nuclear, Inc.  
Address: Pueblo Plaza, 2717 N. Steves, Suite 2, Flagstaff, Arizona 86001
2. Mine: HACKS CANYON 3. No. of Claims - Patented \_\_\_\_\_  
Unpatented \_\_\_\_\_
4. Location: \_\_\_\_\_
5. Sec N $\frac{1}{2}$ -26 Tp 37 N Range 5 W 6. Mining District Hacks Canyon, Mohave Cty
7. Owner: Western Nuclear (Subsidiary of Phelps Dodge)
8. Address: \_\_\_\_\_
9. Operating Co.: Energy Fuels
10. Address: Kanab, Utah
11. President: \_\_\_\_\_ 12. Gen. Mgr.: Pat Hilliard
13. Principal Metals: Uranium, Copper 14. No. Employed: Approx 25 to 50
15. Mill, Type & Capacity: Direct shipping to Energy Fuels in Blanding, Utah.
16. Present Operations: (a) Down  (b) Assessment work  (c) Exploration   
(d) Production  (Underground Development) Rate \_\_\_\_\_ tpd.
17. New Work Planned: Development of an underground uranium mine including  
all surface plant facilities. Present work includes underground development  
and driving of escape and ventilation headings.
18. Misc. Notes: \_\_\_\_\_  
They have thus far completed construction of surface  
buildings (offices, shops, dry, etc.) and the power plant (no commercial  
power is available).  
\_\_\_\_\_ The mine will produce uranium ore containing from 4 to 8  
pounds U<sub>3</sub>O<sub>8</sub> per ton. The ore will be shipped to Energy Fuels Mill in Blanding,  
Utah, by a circulating truck fleet.  
\_\_\_\_\_ Present reserves indicate a mine life of from 8 to 10 years.  
\_\_\_\_\_  
\_\_\_\_\_

Date: October 31, 1980

  
(Signature) Ken A. Phillips Ken A. Phillips  
(Field Engineer) KAP:mmw



STATE OF ARIZONA  
DEPARTMENT OF MINERAL RESOURCES  
MINERAL BUILDING, FAIRGROUNDS  
PHOENIX, ARIZONA

May 20, 1958

To: Frank P. Knight, Director

From: Travis Lane, Field Engineer

Subject: Weekly report for week ending May 17, 1958

Monday Office details, active mine list and files.

Tuesday Conferred with Jack and Arthur Still in Prescott re status of mines in the region. Drove to Fredonia for ASMOA Conference. Only "Elondie" Jensen was in attendance. He reported that no mining work was in progress in the area. Mr. Jensen supplied the following information re the Hack's Canyon Uranium Mine. The property is owned by a partnership composed of Jensen and Pierson of Fredonia, Ray Pointer of Safford and the G. C. Howard Estate of Phoenix. The owners operated for a time in 1951-1952, and shipped approximately 1100 tons of .20 U<sub>3</sub>O<sub>8</sub> ore. Then Pointer leased from the other partners and performed some development, and made a small production. Next the property was leased to Wasatch Mining Co., who leased to U-rainbow Company. Each shipped about 50 tons of ore. The State Mine Inspector forced a shutdown of U-Rainbow, and when the company failed to correct unsafe working conditions and discontinued operations, the owners sued and after 3 years litigation recovered the property (in 1955). Rare Metals optioned the mine and drilled 6 holes (maximum depth 610') and relinquished in early 1958. At present Western Gold and Uranium Co. has a verbal option and is planning to make an economic evaluation. The road to the property is now impassable. The mine has been examined in the past by DMR and rather complete reports are available in the Department files.

Wednesday Stopped at Vermillion Cliffs and inquired re the Sun Valley Mine (formerly called Maggie's Baker) now being actively developed by Basso Mining Co. of Los Angeles. Phillip E. McCrary is manager, and Ralph Haines is superintendent. The mine is located 1 1/2 miles by road north from a point on Highway 89, 12 miles west of Navajo Bridge. The steep dirt road was too wet to reach the mine and an appointment was made to return next day.

Visited the Copper Mine on White Mesa, 22 miles southerly from Page. The property, formerly operated by the Hardin Company and more recently by Able Mining Co., was idle. Returned to Vermillion Cliffs via the Gap and Navajo Bridge.

Thursday Visited the Sun Valley Mine (noted above). Drifting was in progress from a 45 foot level in a recently completed shaft. The objective is a cluster of holes said to indicate a body of about 5,000 tons of .24%  $U_3O_8$  ore. The drift was in 195' with about 65' to go. The property comprises the Sun Valley claims 1 to 4, and the Jay Bird Claims 1 to 38. The mine is working 5 men. These people have applied for and expect DMEA assistance for further development.

Drove to Cameron and discussed activity in the area with Glenn Green, Supt. at the Jack Daniels Mine near Cameron, for Marcy-Shenandoah Corp. (formerly Marcy Exploration Co.) The mine has produced some 38,000 tons of ore and expects to exhaust its reserves in June with estimated shipments of about 1,000 tons for that month. Grade of ore .225%  $U_3O_8$ , average thickness 5 feet; and waste to ore ratio in the pit has been roughly 2½ to 1. The working force is 6 men.

Visited the Tuba City mill and discussed active mines and recent shippers with Mr. Runke, Manager for Rare Metals Corp. Returned to Cameron and visited Jim McFarland, Mine Superintendent for Rare Metals. Drove to Flagstaff and met Page Blakemore and arranged with him to cover the Cameron area next day.

Friday Inspected all independent active properties in Cameron area and some of the more important workings of Rare Metals Corp. in the company of Blakemore. Blakemore, in partnership with Steinberger as the Cameron Mining Co., conducts an engineering service and mining contract business. Blakemore does some mining for his own account, and Steinberger also conducts a contract drilling business for his own account. Checked the Department's active mine list, dated February 15, with Blakemore and made deletions, changes and additions thereto, in accordance with information furnished by him. Returned to Phoenix.

# Reconnaissance Study of Uranium Deposits in Arizona

By H. C. GRANGER and R. B. RAUP

CONTRIBUTIONS TO THE GEOLOGY OF URANIUM

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GEOLOGICAL SURVEY BULLETIN 1147-A

*Prepared on behalf of the  
U.S. Atomic Energy Commission*



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UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1962

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## CONTRIBUTIONS TO THE GEOLOGY OF URANIUM

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### RECONNAISSANCE STUDY OF URANIUM DEPOSITS IN ARIZONA

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By H. C. GRANGER and R. B. RAUP

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#### ABSTRACT

Between 1950 and 1954 a large number of deposits in Arizona were examined in search of uranium-bearing minerals in minable concentrations. This report describes most of the localities at which anomalous radioactivity was detected.

Five of the localities are of particular interest, either because uranium is produced from them or because of their unusual geologic setting. The deposit on the Orphan claim, in Coconino County, contains material equivalent in radioactivity to as much as 12.5 percent U in a pipelike body, and the deposit exposed in Hack's mine in Mohave County is in a somewhat similar pipe. The deposits in the Dripping Spring quartzite of Precambrian age in Gila County are unusual in that they appear to be genetically related to diabase. A considerable quantity of uraninite-bearing ore has been produced from several of the many deposits in siltstone, and siltstone metamorphosed to hornfels, within the Dripping Spring. The economic possibilities of the Annie Laurie prospect in Santa Cruz County could be evaluated by exploratory drilling to the east of the eastward-dipping fault zone. Earlier drilling west of the faults gave negative results. Specimens of uranium ore found on the dumps of the Abe Lincoln mine in Yavapai County may indicate the presence of small but rich pockets of ore in the mine, but the workings are inaccessible because of caving and flooding.

The deposits in the Dripping Spring quartzite have received additional study by us, and the deposit on the Orphan claim recently has been extensively developed. Additional study of Hack's mine might be profitable, and the Annie Laurie and Abe Lincoln deposits might be worthy of further study and development.

#### INTRODUCTION

As interest in the uranium deposits of Arizona increased after World War II, owing to the immediate need for fissionable materials, the U.S. Geological Survey examined known and reported occurrences of uranium in Arizona and searched for new deposits on the basis of geologic evidence. The more notable uranium deposits examined by the authors between 1950 and 1954 are described in this paper.

Granger, accompanied at times by E. P. Kaiser and J. W. Adams, examined reported occurrences of uranium in Arizona during parts of 1950 and 1951. Raup, with D. V. Haines, looked for previously unknown occurrences of uranium in Arizona from late in 1952 until March 1954. The area in which he worked did not include Coconino, Apache, and Navajo Counties, nor the northern half of Mohave County. Granger and Raup made an extensive study of deposits in the Dripping Spring quartzite in 1954-57, and Granger examined the Orphan deposit in 1958 for the U.S. National Park Service. Summaries of these later investigations are included in this report. More recent studies of several of the deposits discussed have been made by other geologists, but, except for brief statements about samples, none of the results of this later work are cited in this report. Publications of some of these workers are, however, referred to in the text. Our work was done on behalf of the Division of Raw Materials of the U.S. Atomic Energy Commission.

Uranium minerals in Arizona occur in a wide variety of geologic settings. Deposits in sandstone are common in the northern part of the State, but not all these are of the "Plateau type," or layered, nearly concordant deposits that generally occur in continental sandstones. Aberrant occurrences are found at Hack's mine and on the Orphan claim. Veinlike deposits occur abundantly in altered siltstone in Gila County, near the center of the State, and others occur in various kinds of rock throughout the southern half of the State. Deposits of disseminated uranium minerals occur in Mohave, Pima, Graham, and Gila Counties. The mineralogy of the deposits is also diverse; for example, the principal uranium-bearing mineral is carnotite, metatorbernite, kasolite, pyromorphite, or uraninite at one or more of the deposits described in this report. Some rarer minerals that have been identified include bassetite, schoepite, dumontite and saleeite.

Figure 1 shows the locations of all deposits described in this report. In the text, descriptions of the geology and mineralogy of the individual deposits are arranged alphabetically according to the counties in which they occur. Uranium-assay data given in the text are from several laboratories, not all of which use the same system of reporting results. Therefore, some analyses are in terms of percent U or eU (uranium or equivalent uranium) whereas others are in terms of percent  $U_3O_8$  or e $U_3O_8$  (uranium oxide or equivalent uranium oxide).

E. D. Wilson and J. W. Anthony of the Arizona Bureau of Mines, and Steven Malloy, LaMar Evans, and others at the Southwest Experimental Station of the U.S. Bureau of Mines extended many courtesies and gave us many helpful suggestions. R. J. Wright of

the U.S. Atomic Energy Commission conducted Granger to several deposits and supplied unpublished information. Many miners and prospectors were especially helpful.

#### DESCRIPTION OF DEPOSITS

The following descriptions of deposits are based on work that ranged from reconnaissance examinations to detailed field examinations accompanied by laboratory study. The information on the deposits therefore ranges widely in completeness. The amount of data given in the description of any deposit is not necessarily an indication of its relative economic importance. Deposits previously described in published reports have been described only briefly in the present report, and the reader should consult the articles listed under "References cited" for more details concerning these deposits.

A-4 CONTRIBUTIONS TO THE GEOLOGY OF URANIUM



FIGURE 1.—Index map of Arizona, showing location of uranium deposits described in this report. (See table on facing page for names of deposits.)

Uranium deposits shown on figure 1

*Cochise County*

1. Fluorine Hill deposit
2. Robles Spring deposit

*Cocconino County*

3. Hosteen Nez Mining Co. deposits
4. Orphan claim

*Gila County*

5. Dripping Spring quartzite

*Graham County*

6. Golondrina claims

*Maricopa County*

7. Black Mountain claims
8. Lucky Strike claim

*Mohave County*

9. Catherine and Michael claims
10. Hack's mine
11. Jim Kane mine
12. Red Hills prospect
13. Summit mine

*Navajo County*

14. Anna Bernice claims
15. Petrified Forest area
16. Tract No. 1
17. Tract No. 2

*Pima County*

18. Black Dike deposit
19. Copper Squaw mine
20. Glen claims
21. Iris and Natalia claims
22. Lena No. 1 and Genie No. 1 claims
23. Sure Fire No. 1 claim
- 24, 25. Van Hill  
Nos. 5, 7, and 8 claims

*Pinal County*

26. Honey Bee No. 4 claim
27. Shorty claims
28. Wooley No. 1 claim

*Santa Cruz County*

29. Annie Laurie claims
30. White Oak property

*Yavapai County*

31. Abe Lincoln mine
32. Cuba and Independence claims
33. Kitten No. 1 claim
34. Peoples Valley mine

*Yuma County*

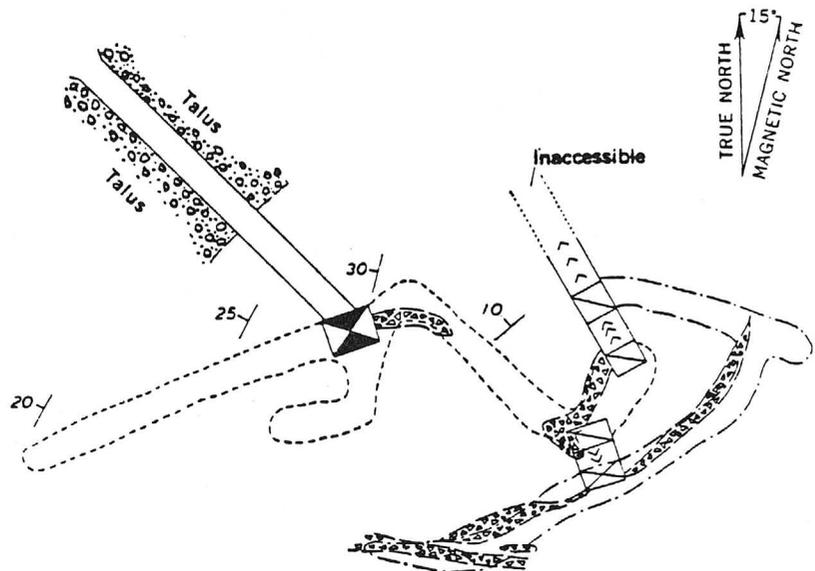
35. Atom claims
36. McMillan prospect

#### HACK'S M

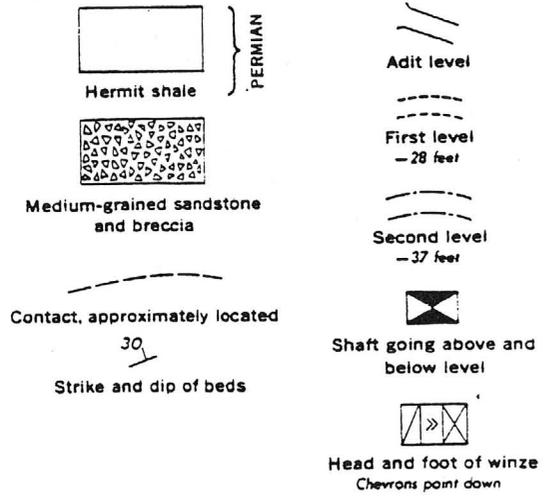
Hack's mine, also known as the Hack Canyon uranium mine, is on a group of five claims named Hack's and Hack's Nos. 2, 3, 4, and 5 claims. These claims are in Hack Canyon, in sec. 26 (?), T. 37 N., R. 5 E., about 37 miles by road southwest of Fredonia. They were acquired in 1940 by Clair Pearson, A. E. Jenson, and three associates, all of Fredonia. Only the deposits on Hack's and Hack's No. 2 claims were examined.

The deposit at Hack's mine is explored by a 30-foot shaft, a 45-foot adit, 2 inclined shafts, and over 200 feet of drifts and crosscuts (fig. 5). Small amounts of copper ore have been produced from the mine at various times since 1920, and uranium minerals were discovered while the mine was being worked for copper late in World War II (Dunning, 1948).

Upper Hack Canyon is cut into a section of Permian sedimentary rocks from the Hermit shale to the Kaibab limestone. The copper-uranium deposit on Hack's claim crops out on a steep slope just below the contact between the cliff-forming Coconino sandstone and the underlying Hermit shale. At the surface, many fractures in broken, slumped Coconino sandstone are stained with green copper minerals and minor metatorbernite. The shaft is collared in Coconino sandstone talus. Beneath this are at least 15-20 feet of slumped Coconino sandstone in the throat of a pipelike collapse structure that seems to be similar to the structure on the Orphan claim. Underlying the



EXPLANATION



Geology by H. C. Granger, 1951

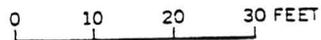


FIGURE 5.—Composite sketch of workings, Hack's mine, Mohave County, Ariz.

slumped sandstone is fractured bleached Hermit shale. Slumped coarse rock debris and talus at the outcrop of the deposit as well as in the upper workings had caused earlier investigators to believe that the deposit at Hack's mine is localized primarily in a surficial slump block of Coconino sandstone.

The rock within the mine is largely fine-grained indistinctly bedded dirty-gray altered sandstone of the Hermit shale. Near the southwest face of the first level this rock grades without any structural break into normal red unaltered Hermit shale.

Within the mine there are several elongate, ill-defined zones of breccia consisting of fragments of both fine- and medium-grained sandstone in a matrix of predominantly fine-grained sandstone. These zones generally dip steeply but locally follow bedding planes. In a thin section of the breccia it was found that many of the quartz grains were secondarily enlarged by overgrowths. Much of the medium-grained sandstone may therefore be silicified Hermit shale. As the breccia contains no cavities, it was probably cemented under considerable pressure.

The primary uranium minerals have been deposited in these brecciated zones and in some of the coarser grained sandstones. The breccia, which commonly is light red, owing to secondary iron oxides, contains black spots that are markedly radioactive. These spots probably consist of chalcocite mixed with a little pitchblende (J. W. Gruner, written communication, 1950.) No other metallic minerals were identified, but they were undoubtedly present before the rock was weathered, for the sides of fractures in the breccia are partly coated with chalcantite, brochantite, erythrite or bieberite, and yellow uranium minerals, including zippeite(?). Farther out the altered fine-grained sandstone contains malachite and metatorbernite along fractures and bedding planes and as interstitial fillings.

Nine samples taken during this examination contained 0.004 to 0.28 percent U. The samples with a higher uranium content were mainly from the breccia zones. To mine the deposit efficiently, it would be necessary to know the extent and distribution of breccia zones.

About 500 tons of the rock on a dump near the portal of the tunnel in 1951 was radioactive. The radioactivity, as measured about 2 feet from the surface by means of a portable field meter with a 6-inch probe, averaged about 0.10 mr per hr (milliroentgens per hour), which is estimated to be equivalent to nearly 0.1 percent U. Ore containing 0.1 to 0.2 percent U could be recovered by hand-cobbing.

The Hack's mine deposit seems to be in a collapse structure very similar to that in which the Orphan deposit (p. A-7 to A-12) is localized. Hack's mine is probably on the southeast side of such a structure,

as is indicated by the curvature of the breccia zones shown in figure 5. These breccia zones are quite likely the faults along which the collapse movements occurred. The talus above the mine workings probably resulted from slumping of fractured Coconino sandstone within the collapse structure after this rock was exposed by canyon cutting.

A small amount of a pale-yellow powdery uranium mineral was recovered from a prospect pit on Hack's No. 2 claim, about 500 to 600 yards northeast of Hack's mine. The mineral was not identified, but spectrographic analyses show that it contains significant amounts of uranium, silica, and phosphate. It occurs along joints and bedding planes in a shaly rock near the contact between the Coconino sandstone and the Hermit shale, probably in the Hermit shale. This pit has not uncovered an economically significant uranium deposit, but it demonstrates the possible widespread occurrence of uranium in the vicinity of Hack's mine.

Some of the deposits described in this report deserve more detailed geologic study and physical exploration. Further work has in fact been done on the deposits in the Dripping Spring quartzite since the completion of fieldwork on which this report is based, and some exploration has been conducted on the Annie Laurie claims. The Orphan claim and Hack's mine contain deposits of the same type, and the similarity in geologic setting seems too great to be accidental; further study of these would increase the possibility of finding other similar deposits on the Colorado Plateau. In fact, since this part of the report was originally written, Western Gold and Uranium, Inc., has extensively mined the Orphan claim, has explored the Hack Can-

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yon deposit, and has discovered similar structural features in the Grand Canyon region.

The source of the uranium-bearing rock on the dumps of the Abe Lincoln mine cannot be determined until the caved workings have been, at least in part, reopened. The dumps on which radioactive material was found are at the collar of the 660-foot shaft and the portal of the 145-foot-level adit. As the shaft is caved for 175 feet below the surface (M. J. Elsing and J. N. Faick, 1952, Defense Minerals Production Administration docket 2331), the 145-foot-level adit, though now partly caved at the portal and completely caved 160 feet beyond it, might be the more economical way to reenter the mine. Although only a little uranium-bearing rock was found on the dumps, it was on the top, suggesting that the source rock may still be exposed in a heading. As the uranium occurs with fluorite in a calcite gangue, a mineral association not typical of the Abe Lincoln vein system, the uranium-bearing areas may be in workings away from the main veins or they may be veins that intersect the Abe Lincoln vein system.

The Annie Laurie deposit has been examined by Wright (1951), who made a study of the geology and radioactivity, and by Anderson and Kurtz (1955), who did a biogeochemical reconnaissance of the prospect. Both of the resulting papers state that the deposit dips westward, and drilling has therefore been done west of the prospect pits. If the deposit dips eastward, however, as we believe that it does, the deposit might be explored from the hillside to the east below pits A to E, or from the bottom of the gully shown in figure 11.

As in other metallogenic provinces, small amounts of uranium minerals are present in many deposits in Arizona exploited for their base or precious metals, but most of the deposits described in this report probably have too little uranium exposed to merit further examination or exploration. With few exceptions, the concentrations of uranium appear to be small and do not necessarily indicate that there are greater concentrations elsewhere in the deposit or in the surrounding area.

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HMK  
↓  
STEVE  
MORRIS  
PIGEON (H) COCONINO  
HACK'S CANYON URANIUM (H)  
ARIZONA ONE (H) MORRIS

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Fife Symington, Governor      Russell F. Rhoades, Director

**NOTICE OF THE PRELIMINARY DECISION TO ISSUE A PERMIT  
TRANSFER OF AN INDIVIDUAL AQUIFER PROTECTION PERMIT**

Pursuant to Arizona Administrative Code, Title 18, Chapter 9, Article 1, the Director of the Arizona Department of Environmental Quality (ADEQ) intends to transfer the individual Aquifer Protection Permits (APP) issued to the following applicant:

Public Notice No. 1197APAZ      On or about March 7, 1997

Energy Fuels Nuclear, Inc.  
Three Park Central, Suite 900  
1515 Arapahoe Street  
Denver, CO 80202

Aquifer Protection Permit Numbers: P-100519, P-101898, P-102018

Responsibilities will be transferred to the following:

International Uranium (USA) Corporation  
950 Independence Plaza  
1050 17<sup>th</sup> Street  
Denver, CO 80202

Aquifer Protection Permit Numbers: P-100519, P-101898, P-102018

On or about March 31, 1997, all Hack Canyon, Pigeon, and Arizona 1 Mine assets of Energy Fuels Nuclear, Inc. (EFN), will be transferred to a new company named International Uranium [USA] Corporation (IUC). IUC will own and operate the Hack Canyon, Pigeon, and Arizona 1 mines pursuant to the conditions of the current APPs. Financial assurance for closure and post closure costs were approved by the Water Permits Section - Mining Unit (WPS-MU) of the Arizona Department of Environmental Quality (ADEQ) on February 19, 1997.

**Hack Canyon Mine**

The Hack Canyon Mine site is located approximately 30 miles southwest of the city of Fredonia in Coconino County, Arizona over groundwater of the Kanab Plateau

Groundwater Basin in Township 37 N, Range 5 W, Section 26, N½, Gila and Salt River Base Line and Meridian.

Latitude 36° 35' 3.9" North  
Longitude 112° 47' 50.9" West

The current permit authorizes clean closure of the Hack Canyon Mine, a former underground uranium mine. The site is classified as a clean closure pursuant to the APP. No mining operations are permitted at the mine site.

### **Pigeon Mine**

The Pigeon Mine site is located approximately 15 miles south of the city of Fredonia in Coconino County, Arizona over groundwater of the Kanab Plateau Groundwater Basin in Township 38 N, Range 2 W, Section 5, SW¼ and N½, Gila and Salt River Base Line and Meridian.

Latitude 36° 43' 30" North  
Longitude 112° 31' 30" West

The current permit authorizes clean closure of the Pigeon Mine, a former underground uranium mine. The site is classified as a clean closure pursuant to the APP. No mining operations are permitted at the mine site.

### **Arizona 1 Mine**

The Arizona 1 Mine site is located approximately 35 miles southwest of Fredonia, approximately 12 north of the Grand Canyon, 9 miles west of Kanab Canyon, Mohave County, Arizona over groundwater of the Kanab Plateau Groundwater Basin in Township 36 north, Range 5 west, Sections 22 & 23, Salt River Base Line and Meridian.

Latitude 36° 45' 05" North  
Longitude 112° 45' 03" West

The current permit authorizes IUC to operate the Arizona 1 Mine, an underground uranium mine. The site is classified as a temporary closure pursuant to the APP. No mining operations are permitted at the mine site.

The permits and related materials are available for public review Monday through Friday 8:00 a.m. to 5:00 p.m. at the Arizona Department of Environmental Quality, 3033 North Central Avenue, 4th Floor, Phoenix, Arizona 85012.

Persons may submit comments or request a public hearing on the proposed action, in writing, to Tony Bode, Arizona Department of Environmental Quality, 3033 North Central Avenue, Phoenix, Arizona 85012 within thirty (30) days from the date of this notice. Public hearing request must include the reason for such request.

HACK CANYON (A)

HWCC  
ic  
an

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Fife Symington, Governor Edward Z. Fox, Director

NOTICE OF THE PRELIMINARY DECISION TO ISSUE AN  
INDIVIDUAL AQUIFER PROTECTION PERMIT

Pursuant to Arizona Administrative Code, Title 18, Chapter 9, Article 1, the Director of the Arizona Department of Environmental Quality intends to issue an individual Aquifer Protection Permit to the following applicant(s) for the permanent closure of the Hack Canyon Mine:

Public Notice No.21-95AZAP

On or about June 22, 1995

Hack Canyon Mine Site  
Energy Fuels Nuclear, Inc.  
Three Park Central, Suite 900  
1515 Arapahoe Street.  
Denver, CO 80202

Aquifer Protection Permit No. P-100519

The Hack Canyon Mine site is located in the north 1/2 of Sections 26 and 27 of Township 37 N, Range 5 W, Salt River Baseline and Meridian in Coconino County, approximately 30 miles southwest of the City of Fredonia, Arizona. The facility is located over groundwaters of the Kanab Plateau groundwater basin. The facility is currently inoperative and will be permanently closed under this Aquifer Protection Permit.

The Hack Canyon Mine operated as an underground uranium mine. Major components of the mining process at the facility included mining and stockpiling of ore, collection and evaporation of mine water from a lined containment pond, routine operational and maintenance activities associated with an operation of this nature. No ore processing occurred at the facility, all ore produced was transported to a mill in Blanding, Utah for processing.

Site construction commenced at the facility during April 1980 with mining operations concluded in April 1987. Site reclamation was completed in August 1988. The mine produced approximately 570 tons of ore daily. Total ore recovered during operation was 742,000 tons.

A Notice of Disposal was filed with the Arizona Department of Environmental Quality on December 26, 1984. The facility obtained NPDES Permit No. AZ0022144 to provide for anticipated mine water discharge. Only limited connate water was encountered during mining and this was collected and evaporated from a lined containment pond. No water was

discharged under the NPDES permit.

The permit and related materials are available for public review Monday through Friday 8:00 a.m. to 5:00 p.m. at the Arizona Department of Environmental Quality, Aquifer Protection Program Section, 3033 N. Central Avenue, 4th Floor, Phoenix, AZ 85012.

Persons may submit comments or request a public hearing on the proposed action, in writing, to Michael Wood, ADEQ, at 3033 N. Central Avenue, Phoenix, AZ 85012 within thirty (30) days from the date of this notice. Public hearing requests must include the reason for such request.

UNITED STATES  
ATOMIC ENERGY COMMISSION  
Washington 25, D.C.

INFORMATION FOR THE PRESS  
SP-3  
Tel. ST 8000, Brs. 307, 308

FOR RELEASE A.M. NEWSPAPERS  
Saturday, October 16, 1948

AEC ANNOUNCES NEW  
URANIUM PRODUCTION PLANS

The United States Atomic Energy Commission announced today negotiations are being conducted with the Vanadium Corporation of America for the purchase of uranium from two treatment plants to be brought into operation by VCA in 1949.

One of these plants is the Commission-owned vanadium-uranium mill at Durango, Col., for which a lease is being arranged. The other is a new plant to be erected by the company in the White Canyon district of southeast Utah.

Under terms of the tentative agreement the government-owned processing plant at Durango will be rehabilitated by the Vanadium Corporation of America at a cost to the company estimated to be more than \$200,000. The plant, a vanadium mill formerly owned by the U. S. Vanadium Corporation, will be leased to the Vanadium Corporation of America. Operations probably will start in late 1949.

It is anticipated that ore will be supplied principally by VCA mines and independent operators will be able to deliver ore under the terms of the Commission's ore purchasing program.

Part of the ore to supply the plant may come from properties now held by the AEC on the Navajo Indian Reservation. Negotiations are in progress between the Commission and VCA for the subleasing of these properties to the company on a royalty or similar basis. If this plan is approved, royalties on all minerals extracted will be paid to the Bureau of Indian Affairs for the Navajos. A relatively small amount of ore was mined on the reservation during the war.

In the White Canyon district in San Juan county, Utah, VCA will set up a pilot treatment plant which will be in operation by next summer.

In this area which has not previously been mined, the copper-uranium ore bodies are described as small, flat, and lenticular.

The AEC and VCA are negotiating an agreement for the purchase by AEC of a high-grade refined uranium product from the new mill. Ultimately VCA may build a larger treatment plant in the White Canyon district. It is expected that the opening of this plant, capable of treating custom ores, will stimulate prospecting and mining in this new district. The White Canyon area is not well known, but scattered ore showings extend over many miles down into Arizona.

UNITED STATES  
ATOMIC ENERGY COMMISSION  
DIVISION OF RAW MATERIALS  
NEW YORK OFFICE

ADDRESS REPLY TO:

DIVISION OF RAW MATERIALS  
U. S. ATOMIC ENERGY COMMISSION  
P. O. BOX 30, ANSONIA STATION  
NEW YORK 23, NEW YORK

and refer to:

RME:MM

September 10, 1948

Mr. Charles H. Dunning, Director  
Department of Mineral Resources  
State of Arizona  
Mineral Building, Fairgrounds  
Phoenix, Arizona

Subject: HACK'S CANYON URANIUM MINE

Dear Mr. Dunning:

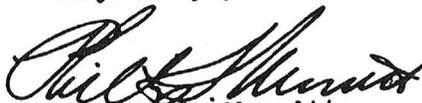
Reference is made to your letter of September 3 enclosing your report on Hack's Canyon Uranium Mine.

I am extremely interested in all of the information outlined therein and appreciate the difficulties and problems attendant to completing it. I feel that your report is indeed well done and that it reflects all of the effort you may have put into it. It outlines the problem most effectively.

We are anxious to cooperate with you in the further study of this region and as we pointed out in our letter of September 3, we plan to send a field man to the area in October. We would be happy to have you or one of your men accompany him if you find that convenient.

If you have available another copy of your report, we would appreciate your sending it to Dr. Wallace G. Fetzner, Chief, Grand Junction Extension, New York Division of Raw Materials, P. O. Box 270, Grand Junction, Colorado. He would probably like to read this before he or one of his field men visit the area.

Very truly yours,

  
Phillip L. Merritt  
Assistant Director

September 22, 1951

MEMORANDUM

Subject: REEXAMINATION OF THE PROPERTY KNOWN AS "JACK'S CANYON MINE"  
IN MOHAVE COUNTY, ARIZONA

This property was originally examined by Dr. Charles A. Razor (see his report of February, 1949). The writer, accompanied by Dr. Herbert Wright, made a brief examination of the mine on June 20, 1949. Without previous knowledge of Dr. Razor's report, Dr. Wright and the writer came to the conclusion that the deposit is confined to a block of white Coconino sandstone which appears to have slid down to the level of the red Hermit shale. This belief was based mainly on the following observations:

1. White sandstone is surrounded by red sandstone. The Hermit shale at this horizon is not shale but sandstone. It is not possible to see the contacts, as the talus slopes are extensive.
2. Underground, no bedding corresponding to that of the strata in the canyon walls is found. The mineralized sandstone seems to consist of masses either without bedding or having strikes and dips which conform to no pattern.
3. No mineralization occurs in the Coconino sandstone where it is in place above the mine.

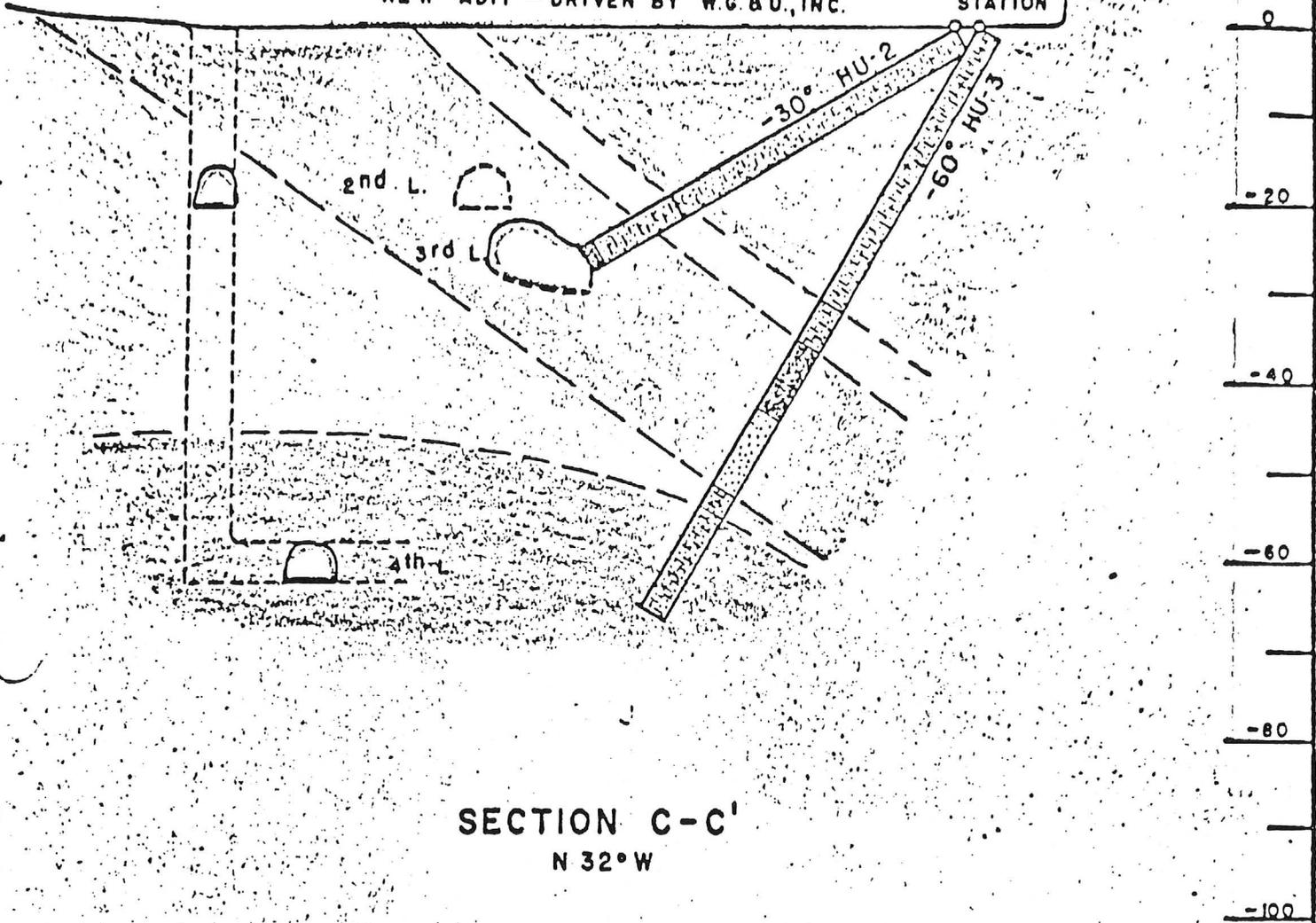
In the reexamination, the following additional facts were brought out:

1. There is a small cut in the canyon wall about 700 feet south of the shaft which we did not see last year. Here, the rock is white or cream in color as in the mine, but it appears to be definitely a part of the red Hermit, as it has the same attitude and can be almost traced into it except for some talus. It contains a little green torbernite and malachite at about the same stratigraphic level as the mineralization in the mine when prospected along the beds.
2. On close inspection of the Hermit formation along the canyon walls, places can be found where it has been bleached from red to yellowish and white. Such bleached rock looks like the friable lower portion of the Coconino in most respects.

OPEN PIT

NEW ADIT - DRIVEN BY W.G. & U., INC.

DRILL  
STATION



SECTION C-C'  
N 32° W

WESTERN GOLD AND URANIUM, INC.

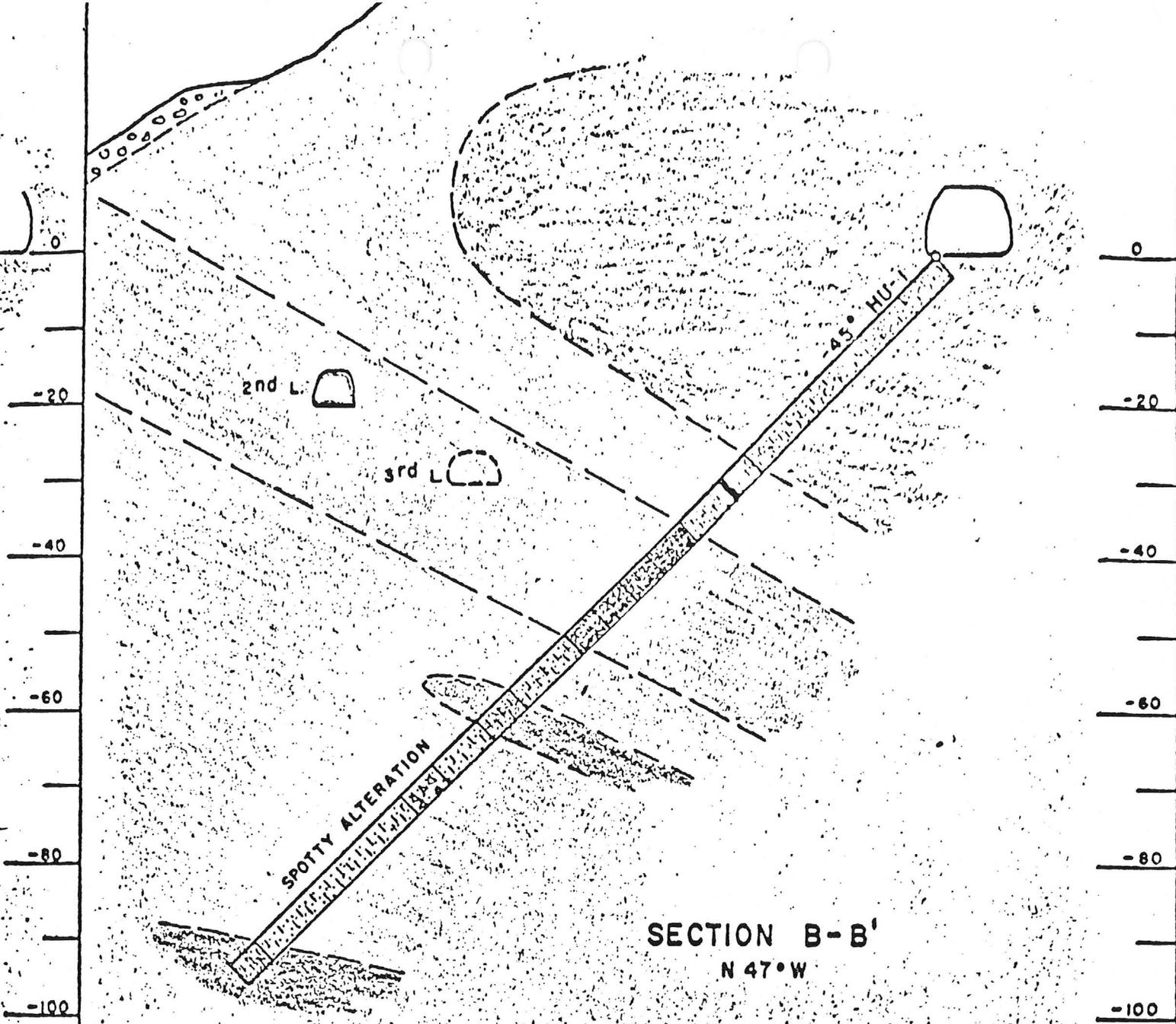
HACKS CANYON MINE

PLAN AND SECTIONS OF DRILL  
HOLES HU-1 THRU HU-5

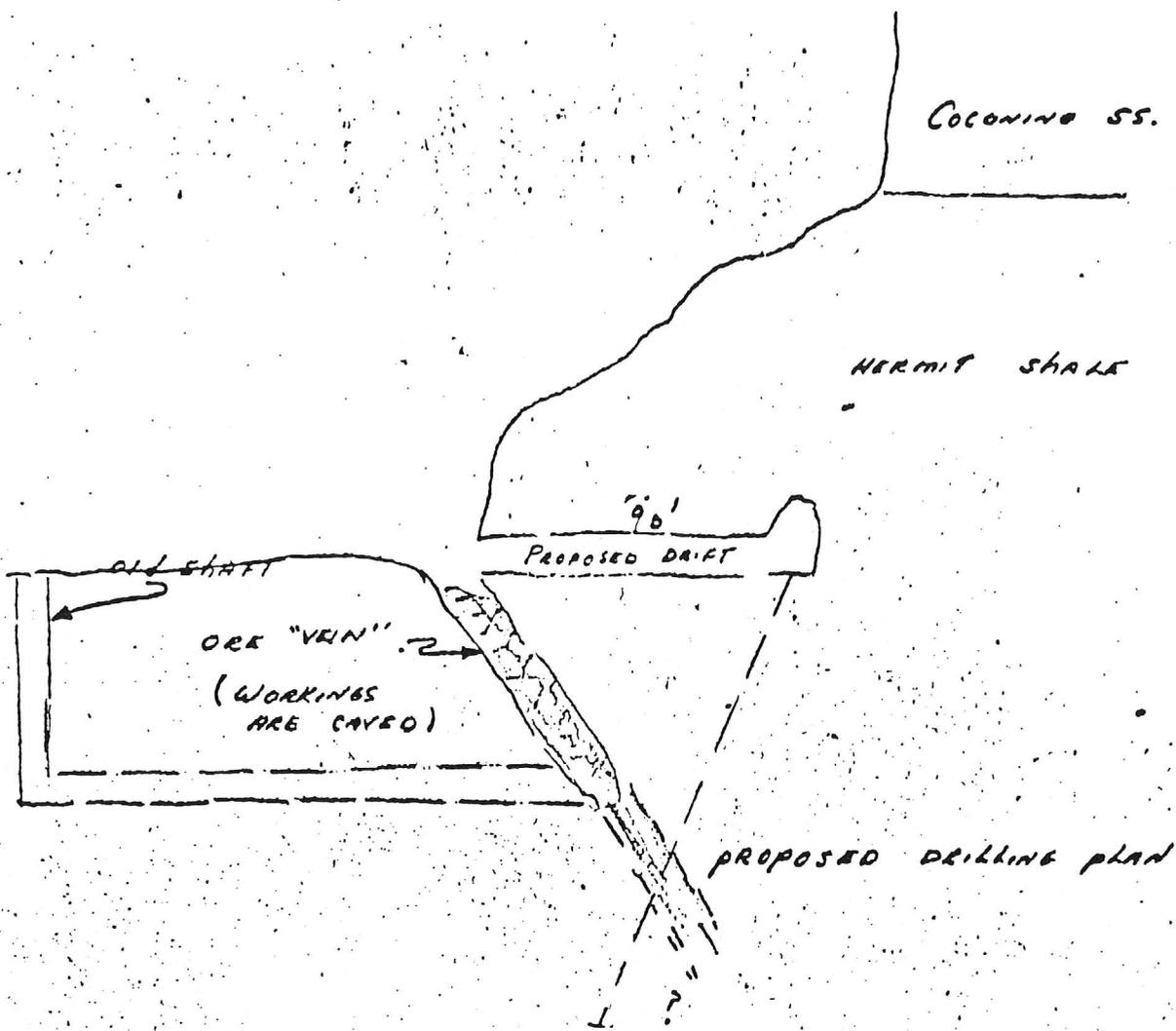
SCALE: 1" = 20'

DEC. 3, 1958

E.C.W.



SECTION B-B'  
N 47°W



Diagrammatic Section through workings at Hacks Canyon, showing the proposed exploration. Not to scale. Drift would be about 90 ft in length.

SUPAI Fm?

**Subject: REEXAMINATION OF THE PROPERTY KNOWN AS "HACK'S CANYON MINE"  
IN MOHAVE COUNTY, ARIZONA**

3. Last year, the water in the underground workings was about twenty feet higher than now. It was practically impossible to see the red Hermit under the white rock. This year, with the aid of a good flashlight, it may be observed, also the green staining by copper minerals, though these places cannot be reached without some new timbering and ladders. There is apparently no sharp division between white and red sandstone but a gradual transition from one to the other in these lower workings (see Razor's map).

Based on this new information, the problem of the position of the ore body cannot be said to be solved. If the sandstone is Hermit instead of Coconino, the ore may extend into the wall of the canyon as well as to depth. As small amounts of sulfides and pitchblende are present, it is possible that we are dealing with a deposit similar to the Happy Jack mine. In this case, the tonnage estimate of Dr. Razor may need revision.

I have recommended to Mr. Clarence Pearson and Mr. A. F. Jensen, of Fredonia, to extend the adit into the wall of the canyon until they strike Hermit sandstone. This cannot be more than 50 feet unless they were following an ore shoot by accident. Another suggestion I made is to pump the water out and determine the value of the ore now inaccessible.

John W. Gruner

Grand Junction, Colorado

COPY/ejs  
5/24/51



ORL. SHIPMENTS MADE FROM HACK-  
MINING CO. PROPERTY-MOHAVE  
COUNTY, ARIZONA

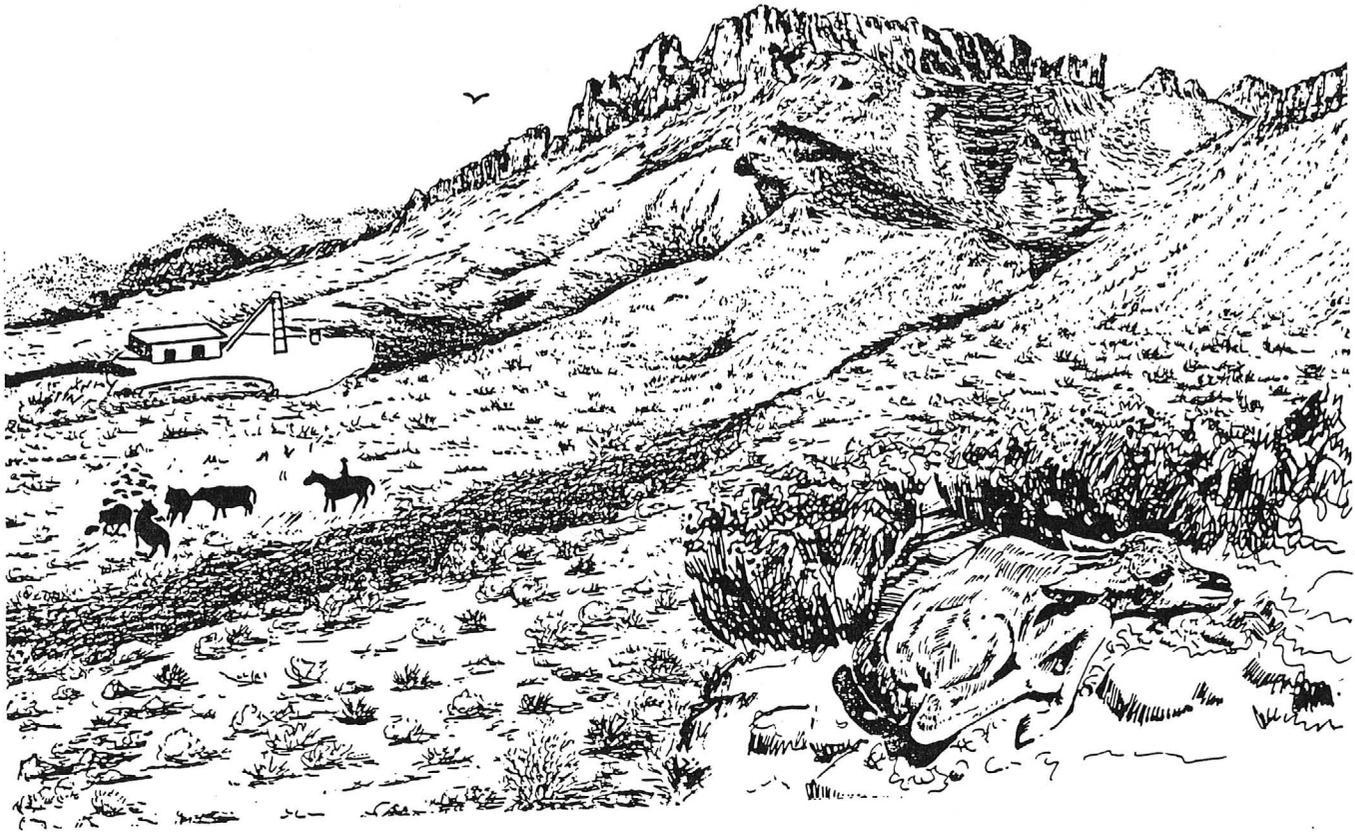
DATE	WET WT. POUNDS	DRY WT. POUNDS	SHORT TONS	SETTLEMENT ASSAYS			Contents Pounds		
				U308	CaCO3	Cu	U308	CaCO3	Cu
2-3-5-6/51	67520	66097	33.0485	.19	0.9	1.66	125.58	594.87	1097.21
11-12-13/51	70740	68438	34.2190	.20	1.0	1.26	136.88	684.38	862.32
16-17-19/51	56100	53407	26.7035	.14	1.4	1.70	74.77	747.70	907.92
26-27-31/51	74350	71619	35.8095	.24	0.5	1.13	171.89	358.10	809.29
3/1/51	18910	18087	9.0435	.26	0.2	.94	47.03	36.17	170.02
6-7-1-11/51	77960	74289	37.1445	.16	1.50	1.95	118.86	1114.34	1442.54
12-13-17/51	80090	77911	38.5055	.16	2.6	2.18	123.22	2002.29	1678.84
18-19-21/51	81090	78608	39.3040	.10	2.0	1.96	78.61	1572.16	1540.72
21-24-25/51	67590	64673	32.3365	.11	2.7	1.26	71.14	1746.17	814.88
2-3-4/51	71440	67462	33.7310	.18	1.5	.85	121.43	1011.93	573.43
4-5-9/51	71420	67878	33.9390	.17	0.8	1.01	115.39	543.02	685.57
8-9-10/51	71860	69504	34.7520	.11	1.0	.89	76.45	695.04	618.59
10-11/12/51	73160	69903	34.9513	.11	.60	.93	76.89	419.42	650.10
12-15-17/51	67300	63426	32.1630	.15	.20	.98	96.49	128.56	630.39
19-24-28/51	72830	69095	34.5475	.20	.10	.76	138.19	69.10	525.12
31/51	35960	34105	17.0525	.36	.10	1.10	122.78	34.11	375.16
2-6-7/51	55570	52985	26.4925	.20	.10	.80	105.97	52.99	423.88
12-13/52	70030	67672	33.8360	.21	.50	.73	142.11	338.36	494.01
4-6/52	59590	67617	33.8085	.30	.40	.86	202.85	270.47	581.51
1-15/52	70570	68759	34.3795	.20	.4	.63	137.52	275.04	433.18
1/52	70170	67934	33.9670	.24	.60	.77	163.04	407.60	523.09
18/52	34880	33843	16.9215	.21	.50	.47	71.07	169.22	159.06
27/52	36570	35688	17.8440	.11	.60	.38	39.26	214.13	135.61
4/52	15300	14856	7.4280	.16	.60	.56	23.77	89.14	83.19
17-21/52	54850	52011	26.0055	.14	1.10	.47	72.82	572.12	244.45
28-29/52	28920	27185	13.5925	.33	1.6	1.14	89.71	434.96	309.91
1-2-5-6/52	61770	58141	29.0705	.32	1.2	2.16	186.05	697.69	1255.85
6-7/52	38660	36826	18.4130	.36	1.0	2.67	132.57	368.26	983.25
13-20/52	40160	37881	18.9405	.13	.30	.90	49.25	113.64	340.93
22-26-28/52	59240	56349	28.1745	.14	.60	.51	78.89	338.09	287.38
Sept./53	105950	102836	51.4180	.2637	1.1	1.12	271.20	1130.81	1149.37
Nov./53	71030	68000	34.0000	.1714	.4	1.98	116.56	296.83	1346.91
24/54	8310	8002	4.001	1.05	.18		84.02		
Vitro Chemical)									
2/16-28/53	24790	23065	11.5325	.10	.70	2.38	23.07	161.46	548.95
March/54	117840	113040	56.5200	.28696	.60	2.07	324.39	626.56	2344.24
16/54	10720	10140	5.070	1.08			107.48		
Vitro Chemical)									
7/54	10700	10367	5.1835	.27	.40	1.82	27.99	41.47	189.68
11-13/54	21730	21232	10.6160	.30	.30	1.98	63.70	63.70	420.39
10-24/54	22500	21765	10.8825	.29	.20	1.50	63.12	43.53	325.48
54	11400	11286	5.643	.17	1.8	1.10	19.19	203.15	124.15
				9.4	47.58				
1027.748(				.26	)	(1.25%)	4291.20		

ORPHAN Mine  
U-42% Cu-1.2%

ABJ - P. 45, P. 46

*Handwritten initials and "on"*

# HERMIT (A)



*source:*

EA No. AZ-010-87-013

## THE HERMIT PROJECT

### DRAFT ENVIRONMENTAL ASSESSMENT

A Major Modification to the Hunt Project  
 Plan of Operations for Uranium Ore Extraction



Bureau of Land Management



USE ☆ SHARE ☆ APPRECIATE

It is apparent from the above table, that within the last 7 years, exploration activities has resulted in approximately 648.6 acres of disturbance. However of this disturbance, approximately 533.5 acres have been reclaimed.

Even if reclamation were not a requirement, the total percent of surface disturbances compared to that in the resource area or the area of high mineral activities would be very small, generally far less than one tenth of a percent.

Cummulative Surface Disturbance Resulting From Uranium Production

Since 1980, the following cumulative surface impacts from mining have resulted.

<u>Hack's 1, 2</u>	<u>Hack's 3</u>	
9.1 acres disturbance	2.55 acres disturbance	=
4.5 miles existing access upgraded	.77 miles additional access	=

Total 11.66 ac + 10 acres buffer zone = 22.0 acres  
 Total 5.27 miles of access.

- original access was existing but upgraded to accomodate ore haulage
- 48 people are employed.
- EFN busses employees.
- All three mines are in the first phases of reclamation.
- Mt. Trumbull road is maintained by EFN and the county.
- 14.5 miles of powerline on public lands. This powerline will remain because of the Hermit and Pinenut Mine use.

Pigeon

- 40 acres (including 10 acre buffer zone).
- 10 miles of existing access upgraded to accomodate ore haulage plus 1/4 mile new access.
- 38 people are employed.
- EFN busses employees.
- Hauling is approximately 10-15 trips per day on Ryan road.
- Life expectancy is approximately 1990-1991, reclamation is scheduled immediately afterwards.
- 8.0 miles of powerline .

HACK  
 (ANTOP #)

Pigeon  
 mine (P)

To the Files

May 11, 1951

John W. Chester and Russell C. Cutter

TECHNICAL MEMORANDUM #31 - INVESTIGATION OF THE HACKS CANYON  
MINE, MOHAVE COUNTY, ARIZONA

(file)  
SYMBOL: GJEB:JWC, RCC

#### ABSTRACT

The Hacks Canyon Mine has a good tonnage of commercial grade ore, of the copper-uranium type. The deposit occurs in the Hermit Shale well below the contact with the Coconino Sandstone. No drilling has been recommended due to the steep backslope of the canyon. The chief need of the mine is six miles of access road which would cost about \$700.00.

#### INTRODUCTION

On April 8, 1951, we were sent to examine the Hacks Canyon Mine. About six hours were spent in and around the mine. Maps were taken from the report of C. A. Razor. No samples were taken since there has been no further development work since the examination by Mr. Razor.

#### LOCATION

The Hacks Canyon Mine, consisting of fourteen unpatented claims, is located in Hacks Canyon, thirty-seven miles from the town of Fredonia, Arizona. The area is unsurveyed, but as near as can be determined it lies in T37N, R5W, Gila and Salt River Meridian. The last six miles of the road follows the bottom of a steep walled canyon and is passable with difficulty in a four-wheel drive vehicle.

The haulage distance to market for the ore, in this case Marysvale, Utah, is one hundred and sixty miles.

#### OWNERSHIP

The fourteen claims are held by Messrs. A. F. Jensen and Clair Pierson of Fredonia, Arizona, A Mr. Pointer of Klondike, Arizona, and C. G. Harwood of Phoenix, Arizona. The mine was originally worked some fifty years ago, but according to Mr. Jensen, a search of the records does not show any record of the original owners. The claims were relocated in late 1940 by Jensen and Pierson who later took Pointer and Harwood into partnership. The mine was worked during the war for copper, but the amount mined or the grade is not known. No further work has been done since that time.

## GENERAL GEOLOGY

The Hacks Canyon Mine is located near the crest of the Kaibab uplift in a region of gently dipping sedimentary rocks. The principal formations of the area are, the Kaibab Limestone, Coconino Sandstone, and the Hermit Shale.

The Kaibab Limestone is a blue gray, dense, fossiliferous limestone containing some chert. It caps the uplift and forms steep walls along the rim of Hacks Canyon. This formation seems to thicken to the north.

The Coconino Sandstone is white to buff, fine to medium grained, poorly rounded, quartz sandstone. This massive sandstone forms sheer cliffs along the sides of the canyon and the upper contact may be traced for miles. The Coconino thins toward the north.

The Hermit shales are red interbedded siltstones and shales. In many places the Hermit shales are poorly exposed as they are covered by talus or fragments of a boulder conglomerate. The Hermit shales thicken to the north.

In many places along the sides of the canyon, large remnants of a boulder conglomerate may be observed lying on the Hermit shales. On first examination this conglomerate appears to be formed only below the Coconino-Hermit contact, but detailed examination reveals that the conglomerate contains large pieces of Coconino and Kaibab and is therefore younger than the Kaibab.

## LOCAL GEOLOGY

A previous report on this mine by Mr. Razor stated that the ore was found in a block of Coconino Sandstone that had dropped to the level of the Hermit shales. However, in our opinion, on the following observations, the ore occurs in a siltstone member of the Hermit Shale.

1. Observations in the canyon showed other areas where the Hermit Shale had been bleached from its normal red to a gray color. Observations were difficult due to the fact that in many places the Hermit is hidden by a talus slope.
2. In this area the Hermit is a siltstone. Comparison of the particle size of samples taken from the mine with the Coconino Sandstone, and the known Hermit Shale, showed that the samples from the mine and the Hermit were practically identical, whereas the Coconino Sandstone was much coarser.
3. A drift in the mine passes from gray siltstone to red siltstone without a break. There is no evidence of faulting

in this drift nor any evidence of breccia or talus that should be present if this was a block of Coconino Sandstone that had dropped down.

4. Uranium mineralization was found in a cut about 1/4 mile east of the mine. The amount of uranium mineralization in this cut was small, being confined chiefly to slippage plane in the Hermit near the contact with the Coconino. Meta-torbernite was also found in another cut about 300 yards southwest of the mine. This cut was in a bleached area of the Hermit and showed bedding continuous with the red Hermit.

5. In this area the Coconino Sandstone has a thickness of approximately fifty feet. The mine workings can be observed to a depth of approximately seventy feet. If this were a block of Coconino, a definite break should be observed in the workings, but no break was observed.

6. The Coconino Sandstone is cross bedded. No cross bedding can be observed in the mine.

#### MINERALIZATION

The mineralization is of the copper-uranium type. The minerals have been only tentatively identified. The copper occurs as antlerite, a basic copper sulphate. The chief uranium mineral is a green substance which has been identified as either metatorbernite or meta-zeunerite. Some yellow mineral was seen which has been identified as autunite and a black mineral which has not been identified.

#### TONNAGE

The mine has been worked with no real system. It is actually just several drifts following the higher grade copper ore. Because of this, an accurate estimate of the ore in place is impossible. The fact that the lower workings were not accessible due to the water and that several drifts were still in ore when stopped, add to the difficulty. However, the accessible workings would define approximately 2500 tons of ore with the possibility that several times this amount of ore could be uncovered by further development and by pumping out the lower workings.

#### RECOMMENDATIONS

The property is not recommended for drilling because of the steep backslope which would limit the number of holes possible.

The only access to the mine is by a road passable with difficulty. This road follows the bottom of the canyon and has been washed out. The chief need of this mine is for a passable road for hauling the ore. The road could be repaired to the extent that trucks could use it with about a weeks work with a bulldozer. However, the danger of washouts would still exist.

Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed in this report, or represents that its use would not infringe privately owned rights. Reference therein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Besides uranium there are only two other radioactive elements that occur in nature. One is radium which you all know about, and the other is thorium. So far the Atomic Energy Commission is not equipped to handle thorium and there is no regular market or price.

### Procedure Under the Law

Whenever one finds or suspects that he has found a deposit of any of these minerals he should take up the matter with his own mining department or with the Atomic Energy Commission. There are certain rules that pertain. Some make sense - some don't. I will try to give you a brief outline of those rules, but may I say that they are really not very complicated and that you are quite safe in locating claims; carrying on development or experiments; or doing anything else to further the discovery or the economics of the use of these fissionable elements.

Two or three years ago the President came forth with a proclamation withdrawing all lands containing fissionable elements from mineral entry. Someone woke up to the fact that that was a poor way to get a supply. Then comes forth the Atomic Energy Commission which quite reverses the policy and offers various bonuses for discovery and production. Then comes forth the Land Office and says the old restrictions still apply. The miner becomes most frustrated and confused.

So the Land Office now says you may locate a claim for uranium provided you don't locate it for uranium. What they meant was that although uranium may be your prime object - you must locate it for some other mineral. That one was a puzzler because in my experience I have never seen a case - or any reason why - a mining location was ever made for any special mineral or element. A mining location is predicated on the discovery of "mineral in place", and I know of no law or form of location notice that requires a locator to name his minerals.

But anyway - the Bureau of Land Management has ameliorated its directives to the extent of permitting fissionable element locations provided one has some other element also. And the Atomic Energy Commission says (and I have the letter here in my file) that if the impossible should occur and these minerals were found without so called supporting minerals - then take it up with them and they will see that the locator is protected. And I feel sure that anyone finding himself in such a situation would be amply protected.

But, getting back to the basic rules - they really are simple. You are free to prospect and locate all you wish. But when you get ready for production you must obtain a license from the Atomic Energy Commission, and they are the only ones to whom you can sell - and their price is what you can get. You can't sell to the Russians even though they might offer you a really fair price!

### Prices and Bonuses

The price structure as offered by the Atomic Energy Commission is rather complicated. For the carnotite ores there is one set of prices and for the other types another set. This is due to the fact that they know how to concentrate and extract the uranium from carnotite and know what costs pertain, so

they will pay for such ores on a gross content basis. But the treatment of other types may be unknown so they buy them subject to the unknown cost of treatment. Various bonuses for grade and for development, and freight allowances are made, which are too detailed to set forth here. It all totals to about \$4.00 per pound of  $U_3O_8$ . These schedules are available in mimeographed form from the Atomic Energy Commission.

Much has been said about the special bonus or prize of \$10,000 offered for certain new production of uranium. There has been a great deal of misunderstanding and misinformation in regard to that. We are continually beset by prospectors and others who ask us to come and see if their property will qualify for the prize. And recently, in regard to this new discovery in Hack's Canyon, Arizona, many papers announced that the Atomic Energy Commission was sending a geologist to determine if the property qualified for the prize.

This prize is not given for any physical aspects or attributes of a property, but is given only for certain actual production. Namely, for the production of the first 20 tons of crude ore or mechanically produced concentrates assaying 20% uranium oxide. Ore of the carnotite type is excluded and you cannot treat your ore chemically to bring it up to that grade. Furthermore, we are quite sure that they will not settle for an equivalent amount of, say, 40 tons of 10% ore.

We are also quite sure that no one yet has achieved this honor and it seems very doubtful if anyone ever will. Twenty percent uranium is exceedingly high grade. When one considers that the market value alone of such a shipment would be about \$32,000 the importance of the prize diminishes to becoming merely a psychological inducement.

#### Possibilities of Finding New Deposits

Somehow many people look to Arizona to come forth and supply this new mineral as she has so many others. This is especially true because the Colorado Plateau area is apparently the most fertile field. But our experience so far has not been good. The Hack's Canyon Mine may become an important producer. There are some other newly discovered prospects in the plateau area, but they are all apparently very low grade. And although we have probably tested over a hundred samples from other parts of Arizona, they have all been either negative or very low grade.

not

Although we are/competent to speak for other states, from what we have learned they are not having any better luck except in the newspapers, and the possibility of obtaining any large supply of high grade uranium ore in the United States seems doubtful.

Possible answers to this situation will be taken up later on in this talk.

#### Use of the Geiger Counter

The Geiger Counter is an instrument that detects radioactivity, or the emission of rays. It consists principally of a glass tube filled with certain

gases and containing two electrodes or the terminals of an electric circuit, separated by the gas. When a ray strikes the tube it imparts an electric charge to the gas causing a momentary circuit to cross through the gas, thus causing a click in attached earphones, or a reading on a dial.

Cosmic rays are picked up as well as rays from the specimen being examined, and as we have cosmic rays with us everywhere the instrument will, if working, always give forth a certain measure of clicks. This is called the background count and it varies according to the sensitivity of the instrument, its location, the time of day, and weather conditions.

When it is desired to test a specimen or sample, or a location, the background count is first obtained, and then the specimen is brought near the counter tube and any increase in count is noted. If there is no increase in the count obtained over a period of several minutes it is quite certain that the specimen is negative. If there is an increase it means that the specimen is emitting rays. To put this increase into quantitative terms, however, requires more technique.

The number of rays per minute received by the tube will vary according to the mass or weight of the specimen, and inversely as the square of the distance between the specimen and the tube.

It therefore makes little sense when we read of someone having uranium ore that gives a certain count or dial reading. To use the instrument quantitatively it is necessary to have standards of known weight, and assay, obtained chemically. The sample in question should then be reduced to identical weight and shape and held at the same distance as used for the standard. The results in clicks per minute or dial readings will then be in proportion to the uranium content, after subtracting the background count.

I have been talking about the laboratory use of the Geiger Counter. As a rough detector in the field it is of even more service to those searching for uranium deposits. But here again warning should be given not to confuse indications with quantitative results. If you get indications in the field it means just that and no more. For a large mass of low grade ore can give you as much activity as a small mass of high grade, or vice versa. The procedure then is to take cut or type samples of the suspected material and test it at some location away from the general activity. Follow the counter for the best indications but then take samples just as you would in any other mine.

At the Hack's Canyon Mine we found that a detailed inspection of the surface area was quite impossible because of the general activity caused by the widespread dumps. And underground the general effect of the whole mass would preclude any detailed determinations. So we had to cut samples in the usual manner and get them away from the active area before we could make any concrete determination. And after all, in spite of all that activity, the deposit is quite low grade when considered from the angle of what can be mined or produced.

So don't let your imagination interpret counter readings in the field into terms of \$10,000 prizes.

You will all want to know - and we do too - just how far below the surface the counter will detect or denote activity. That is also a matter of degree and no rules can be laid down. If you have a large mass it might be detected through several feet of barren overburden. A small ~~high grade~~ spot would probably be undetectable through a foot of overburden, just as these specimens I have here give practically no reaction at a few feet distance. The only thing to do is to follow the lead thus given you until you can or cannot find representative samples of interesting grade.

#### Demonstration of the Counter

Type samples:

The standards we use:

Effect of distance:

#### What We Need and Why

Outside of the use of uranium in military bombs there is much talk about its great possibilities as a servant to bring us a more abundant life.

Scientists tell us that a pound of uranium can produce as much energy as is obtained in burning 150 million pounds of coal; one carload of uranium would exceed in fuel value all the coal that has ever been mined.

Making use of this potential energy in a practical manner is another problem, and quite beyond the field of us miners. But recent press releases quote scientists as saying the problem has been 99% solved. Some time it surely will be solved - just when we, of course, do not know.

What is uranium really worth? We only know that it should be worth far more than its present set price. If I were to set a price or value, I would arrive at it by considering the following three potentials:

1. The law of supply and demand;
2. Its value to our economy;
3. Its cost of production.

It may become far more valuable than gold, platinum or diamonds. It may be vital to our security and our economy. But from all I can learn, the present price program of the Atomic Energy Commission is resulting in production that is most disappointing.

We are faced with the fact that all authorities seemingly agree that we are not getting adequate supplies or any reasonable facsimile thereof.

But we are also faced with the fact that we have potential deposits that are so low grade that they cannot furnish us with supplies at present set prices.

We should impress on the powers that be the fact that they may be jeopardizing our future. And that they had better wake up and offer a price for such a vital article high enough to bring us self-sufficient production, or turn the thing loose to the law of supply and demand, and maintain only a police power to protect us as a nation.

The half way policy which now controls is getting us nowhere.

Chas. H. Dunning, Director  
Department of Mineral Resources  
State of Arizona  
Mineral Building, Fairgrounds  
Phoenix, Arizona



**DEPARTMENT OF MINERAL RESOURCES**  
STATE OF ARIZONA  
**FIELD ENGINEERS REPORT**

Mine Hack #1, Hack #2, & Hack #3

Date October 19, 1983

District Hacks Canyon

Engineer Ken A. Phillips  
Nyal J. Niemuth

Subject: Mohave

Subject: Mine visits on above date.

Refer to: "Mine and Prospect Field Visit Data Summary" of same date.

: Az. DMR Hack's Canyon Uranium Mine (files)

In the company of Nyal Niemuth a visit was made to the Energy Fuels (Nuclear) Company office in Fredonia, Arizona and their mines in Hacks Canyon. Two additional reports forms have been completed and a set of access and area maps have been made for the file.

The Hack Canyon mines consists of a mining operation involving the mining of uranium ore from three distinct mineralized breccia pipe deposits known as the Hack #1, Hack #2, and Hack #3. The Hack #1 is the same deposit as the old Hacks Canyon copper and uranium mine. Some equipment, old buildings and old mine opening from the 1900-1955 sporadic operations can be seen in the vicinity.

A single group of surface facilities has been established for the three producing deposits. Facilities consist of a 24' wide mobile building which houses the mine office, laboratory and change room. A separate steel building is used as an equipment shop and supply warehouse.

The Hack #1 pipe was developed by a spiral decline (inclined shaft) using all rubber tired equipment. The decline was driven around the perimeter of the mineralized pipe to a point below the lowest level of known ore. A ventilation raise was bored from that point to intersect an old incline. The cylindrical shaped ore body was then prepared for mining by driving drifts through the ore body and stoping a slot through the ore in 200' foot increments. Mining is accomplished by ring drilling at the intersections of the drifts (on 50' level intervals) with the slots. The ring holes are then loaded and shot breaking the ore which allows it to fall the the bottom of the slot where it is pulled from draw points, loaded by LHD's and trucked in 10 ton WIMCO mine trucks to the surface. Mining proceeds downward through the series of 200' levels (stopes) starting at the bottom of each slot and proceeding upward through the floor pillar of the previously mined out stope.

Hack pipes #2 and #3 share the same decline and have been developed in a fashion similar to that described above for pipe #1.

KAP/NJN/ah

MINE AND PROSPECT FIELD VISIT DATA SUMMARY

Sheet 1 of 2

COMMODITIES Uranium

MILS ID No. 242A Date October 19, 1983

ENGINEER Ken A. Phillips & Nyal J. Niemuth

INFORMATION FROM: Field visit

PROPERTY SUMMARY

- I. MINE NAME Hack Canyon Mine OTHER POSSIBLE NAMES Hack #1 Mine, Hack #2 Mine  
Hack #3 Mine INCLUDING ANY CLAIM NAMES NOTED
- II. LOCATION: T 37N R 5W SEC(S) 23 & 26 MINE DISTRICT Hacks Canyon  
 ELEV. 4,400' COUNTY Mohave TOPO QUAD. Heaton Knolls 15 Min.  
 DIRECTIONS Forty miles by road south-southwest of Fredonia by road. See maps in file.  

MAP ATTACHED x
- III. OWNERSHIP: NAME Energy Fuels Company PHONE 643-5823  
 ADDRESS: P.O. Box 36, Fredonia, Az.  
 COMPANY NAME IF ANY: Energy Fuels Company  
 PERTINENT PEOPLE Roger Smith, Manager Mining Operations, Pete Caulfield, Mine  
Superintendent. James Rasmussen, Dist. Exploration Geologist.
- IV. PROPERTY AND HOLDINGS: Unpatented Mining Claims
- V. PAST PRODUCTION - NOTED, KNOWN, PROBABLE, UNKNOWN, NONE Yes
- VI. CURRENT STATUS: Active Producer
- VII. WORKINGS: Underground mines access by spiral inclines using rubber tired equipment.  
Mining by modified shrink stoping and ring drilling.
- VIII. GEOLOGY AND MINERALOGY: DEPOSIT TYPE: Breccia Pipe  
 LENGTH: 100 - 600' WIDTH: 100-600' VEIN STRIKE Near vertical cylindrical pipe  
 HOST ROCK: Mineralization exists in Coconino Sandstone, Hermit Shale and exists at  
depth in other formations.  
 ECONOMIC MINERALS: Uranite and other uranium minerals.  
Other minerals: some nickel and cobalt is reported occuring in the pipes as sulfides.  
 COMMENTS: The Coconino with its high porosity makes an excellent host formation.  
Though the deposits are known as breccia pipes the ground is generally very  
competent and stable.
- IX. EQUIPMENT ON SIGHT: Underground operating mine with surface offices, shops and dry.

X. SAMPLING: NOTE TYPE IF ANY, DRILLING? Drilling for additional reserves is on going  
activity at Hack #1, & Hack #2.

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XI. REFERENCES AND REMARKS \_\_\_\_\_

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# UNITED STATES VANADIUM CORPORATION

UNIT OF UNION CARBIDE **UCC** AND CARBON CORPORATION

GRAND JUNCTION, COLORADO

June 9, 1949

Mr. Charles H. Dunning  
Director of Mineral Resources  
Phoenix, Arizona

Dear Sir:

On June 3rd and 4th, I made a hurried trip to Marysvale, Utah, to examine a uranium occurrence in porphyry; and while I was there, I chanced to meet Mr. Ted Atherby of Kanab, Utah, who told me that there was considerable activity in Arizona, south of Short Creek and Fredonia, in the development of uranium ore, of the carnotite type, that has been found in sandstone.

Our corporation has a uranium-vanadium concentration plant at Rifle, Colorado, that is at this time purchasing those ores at the Atomic Energy Commission's prices as detailed in their Domestic Uranium Program Circular No. 5. This plant has a capacity of 200 tons per day. We are also rehabilitating a similar plant at Uravan, Colorado.

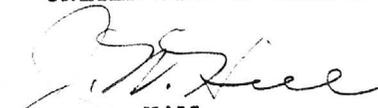
The Rifle Plant has a railroad siding off of the Denver & Rio Grande Western Railroad Company's main line on which we receive ores from southeastern Utah mines.

It occurred to me that it might be feasible during the development period of this new discovery in your state to ship ore to our plant; of course, as the district develops, a plant should be considered and located as close as possible to the mining area.

I would appreciate hearing from you at your convenience regarding the possibilities of this new district. Can you tell me if this ore contains copper as well as vanadium and uranium? I would be happy to discuss this subject with you should you be in this vicinity at any time.

Very truly yours,

UNITED STATES VANADIUM CORPORATION

  
J. W. Hill

JWH:lmf

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
BUREAU OF MINES

SOUTHWEST EXPERIMENT STATION

~~WESTERN REGION~~

Metallurgical Division

BOX 4097  
UNIVERSITY STATION  
TUCSON, ARIZONA

July 13, 1949

Mr. Chas. H. Dunning, Director  
Department of Mineral Resources,  
Mineral Bldg., Fairgrounds  
Phoenix, Arizona

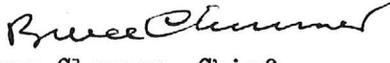
Subject: Sample for Analyses  
Reference Number UP-33

Dear Mr. Dunning:

This will acknowledge your letter of July 5 transmitting a two pound carton of "Hack's Canyon" sample for radioactivity standardization.

A radiometric analyses of the material gave an activity equivalent to 0.43 percent  $U_{308}$  determined by our automatic scaler unit calibrated with radiometric standards of the Atomic Energy Commission.

Very truly yours,

  
J. Bruce Clemmer, Chief  
Tucson Branch, Metallurgical Division



UNITED STATES  
ATOMIC ENERGY COMMISSION  
WASHINGTON 25, D. C.

August 10, 1949

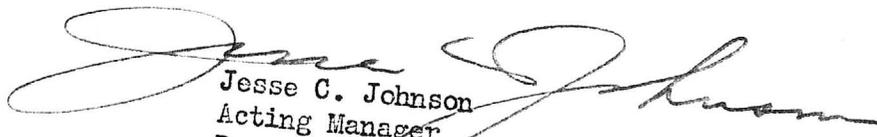
Mr. Charles H. Dunning, Director  
Department of Mineral Resources  
Mineral Building, Fairgrounds  
Phoenix, Arizona

Dear Mr. Dunning:

In the absence of Mr. Gustafson, I have written to Mr. S. B. Atherly of Fredonia, Arizona as suggested in your letter of August 2. A copy of our letter to Mr. Atherly is enclosed.

We appreciate your bringing this matter to our attention.

Very truly yours,

  
Jesse C. Johnson  
Acting Manager  
Raw Materials Operations

Encl.

UNITED STATES DEPARTMENT OF THE INTERIOR

OFFICE OF INDIAN AFFAIRS

FIELD SERVICE

NAVAJO SERVICE

WINDOW ROCK, ARIZONA

JULY 19, 1949

Mr. Clair Pearson  
Redonia, Arizona

Dear Sir:

We have your letter of June 22, 1949, and also two notices of location of mining claims containing 20 acres each, which are located, according to your description, in the NW $\frac{1}{4}$  of Sec. 24, Township 39N, Range 7W, G. and S.R. meridian, Arizona, unsurveyed.

Since your claims, as submitted, are located on an unsurveyed area of the Reservation, it is necessary to describe the claims by a metes and bounds description. If you can locate the claims by approximate Section, Township, and Range with the aid of a surveyor, such a description would be more suitable than the metes and bounds description.

It is not necessary to confine yourself to the 20 acre claims on the Reservation unless you desire to, since the mining regulations allow a total of not to exceed 960 acres that can be held under a mining lease by any one individual, company, or association. You can, therefore, combine your two claims into one, and for that matter, increase this acreage, if necessary, to include the deposits of mineral which you have discovered.

It would be necessary to furnish this office with information concerning the assayer's reports of the minerals on these claims. When we secure the above information, we will then be in a position to refer the matter to the Mining Division of the U.S. Geological Survey for recommendation in regard to setting up the plot or plots for sale to the highest bidder for mining leases. Before we can advertise the land for sale for lease, we must also secure authority from the Commissioner of Indian Affairs in Washington, D.C.

As applicants for leases, it is also necessary that you and your partners furnish this office with a financial statement which would indicate your financial ability to handle a mining lease in case you are the successful bidder for the lease.

Please furnish your reply in triplicate.

Very truly yours,  
Allan G. Harper for Walter O. Olsen, General Superintendent.

*It is surveyed I helped do it for the Gen. Land Soc.*

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
BUREAU OF INDIAN AFFAIRS  
NAVAJO AGENCY  
WINDOW ROCK, ARIZONA

August 9, 1949

NOTICE OF MINERAL LEASE FOR SALE

SEALED BIDS WILL BE RECEIVED AT THE NAVAJO AGENCY, Window Rock, Arizona, until 2:00 P.M. MST, September 9, 1949, and then publicly opened for mining leases for copper, vanadium-uranium, and other minerals on the following described Navajo Indian tribal land:

APACHE COUNTY, ARIZONA (Unsurveyed Lands) Copper and/or other minerals,

"Commencing at the northeast corner of Boundary Butte bear south 62 degrees 00 minutes west for a distance of 81,510.67, thence bear north 31 degrees 00 minutes for a distance of 463.02 feet to a large pile of black rock to be known as the center of the tract, which tract when surveyed will be approximately all of Section 36, T. 40 N., R. 24 E., G.&S.R.M., containing 640 acres more or less."

SAN JUAN COUNTY, UTAH (Surveyed Lands) Vanadium-Uranium and/or other minerals.

S<sup>W</sup>/<sub>4</sub> NW/4, S<sup>2</sup>c. 26, T.43 S. R. 15E., S.L.M., containing 40 acres, more or less.

Each of the above described tracts are offered separately to qualified bidders of the highest cash amounts per acre as a bonus for the privilege of leasing said lands, in addition to stipulated royalties and annual acreage rentals. The successful bidder for the 640 acre tract will be required to have the tract surveyed by a registered land surveyor within 6 months after approval of the lease. Boundaries of the tract to be posted and a tie established with the nearest corner of a public land survey, certified copies of the survey plats to be filed at Window Rock, Arizona, and with the U.S. Geological Survey at Carlsbad, N.M.

The primary term of the leases will be for 10 years, and will continue so much longer thereafter as minerals are producing in paying quantities. The leases are offered for a cash bonus in addition to the annual rentals (rentals: 25 cents per acre for first calendar year or fraction thereof, 50 cents per acre for the second and third years, and \$1.00 per acre for the fourth and each succeeding calendar year during the term of the lease) and the following stipulated royalties on production:

"Ten percent of the gross sale price of all mineral products recovered and sold except vanadium compounds which shall be subject to a royalty rate of 10% of the vanadium oxide or the equivalent in other compounds contained in the ore, the minimum royalty to be ~~xxxx~~ not less than \$1.00 per ton of ore milled on the leased land or shipped for milling or treatment elsewhere.

The royalty payment for vanadium compounds shall be based on values of ore in accordance with the payments and bonuses offered by the Atomic Energy Commission."

A deposit of 20% of the bonus bid and 20% of the first year's annual rental must accompany the bid and be in the form of a certified check or bank draft drawn on a solvent bank payable to the Treasurer of the United States. Amounts received from unsuccessful bidders will be immediately returned to persons submitting the remittances.

The sale will be held and the leases executed in accordance with the Act of May 11, 1938, (52 Stat. 347) and Part 186, Title 25 of the Code of Federal regulations, as amended or supplemented.

The successful bidders must complete and return the leases and all supporting papers, including the surety bonds in the amount of \$8,000 for the 640 acre tract and a \$1,000 bond for the 40 acre tract, make payment of all balances due, together with a filing fee of five dollars, within 20 days after the leases have been sent to them for execution. Failure to comply within the time allotted (unless extension had been granted by the General Superintendent) ~~XXXXXXXXXXXXXXXXXXXX~~ renders the lease null and void, and all payments previously made subject to forfeiture for the benefit of the Indians.

The right is reserved to reject any and all bids and to disapprove any lease made on an acceptance bid prior to its approval by the Commissioner of Indian Affairs. Should any bid be rejected after deposit has been made, through no fault of the bidder, all monies deposited will be promptly returned.

The leases will contain a provision to the effect that the lessors shall employ Navajo labor in all positions for which they are qualified, including truck drivers, and the lessee shall protect the Indian grazing rights to the surface of the leased premises.

All bids should be marked on the outside of the envelope "Bid for Mineral Lease, Tribal Lands, to be opened at 2:00P.M., MST, September 9, 1949.

Allan G. Harper  
General Superintendent.

Eureka, Utah  
Sept. 19, 1949

Mr. Chas. H. Dunning  
Department Of Mineral Resources  
Mineral Bldg., Fairgrounds  
Phoenix, Arizona

Dear Mr. Dunning;

Enclosed is a copy of 32 samples taken from the Hack's Canyon Mine.

The samples were taken in the same manner you and Mr. Manning used when you sampled the mine. The only difference is, our samples were taken at shorter intervals, to give a more definite out line of the ore.

We feel there is something wrong. All previous samples have shown a much higher assay.

We had a Milling Company, who would install a mill at Fredonia on a small down payment and the balance on a royalty basis of so much per ton until the cost was paid, providing we could show an average of .30%  $U_3O_8$  on fifteen or twenty thousand tons. We were confident we could do this easily. The results were very disappointing.

Could it be that, V.C.A. or U.S.V.C. have had any influence on Mr. Browns results? Both of them have examined the property. U.S.V.C's. representative was very much impressed.

We have the rejects of the samples we sent to Brown. I talked it over with Blondie and Clair and they suggested we send some of them to you to see what you could determine. We would appreciate it if you would give us an accurate check on them as soon as possible.

We have a diamond drill ready to start drilling the property, providing we can prove reasonable values from the samples.

Please send your results to me at Eureka, Utah.

Very truly yours,



S. B. Atherley

CC: GCH, AFJ

Brown Laboratory  
Route # 3  
Grand Junction, Colorado.

CERTIFICATE of ANALYSIS % U3O8

No.	%U <sub>3</sub> O <sub>8</sub>	
1	0.010	Samples 1,2, 3 and 4 were taken vertically from entrance tunnel, beginning about 30 feet from shaft.
2	0.010	
3	0.020	
4	0.030	
✓ 5	0.520	Sample 5- horizontal on landing going down shaft.
✓ 6	0.060	Sample 6- " on bottom of shaft.
7	0.009	
8	0.005	
9	0.010	Samples 7,8 and 9 vertical from walls of drift going west from shaft.
10	0.040	
11	Nil	
✓ 12	0.040	Samples 10, 11, 12 and 13 vertical on walls of drift going south and southwest from shaft.
13	0.040	
14	0.030	Samples 14, 15, 16, 17, 18, 19 and 20 vertical along wall of drift going east to sublevel, to a point about fifteen feet from winz to lower level.
15	0.030	
16	0.020	
17	0.010	
18	0.050	
19	0.050	
✓ 20	0.070	Samples A, B, C, D, E, F, G, H, I, J, K, and L taken vertically along wall on the lower level in six or seven foot intervals, beginning at the face of drift.
A	0.150	
B	0.050	
C	0.060	
D	0.220	Sample A to D composite taken horizontal on east wall for a check on ABC and d taken vertically.
E	0.280	
F	0.100	
G	0.070	
H	0.110	
I	0.130	
J	0.190	
K	0.030	
A to D	0.120	Composite

Copy of H. D. Brown Uranium Determination.

# THE MINERALOGIST

A NATIONAL MAGAZINE DEVOTED TO MINERALOGY,  
GEM CUTTING, GEMMOLOGY AND THE COLLECTOR  
DR. H. C. DAKE, Editor : : HILDA DAKE, Circulation

329 S. E. 32ND AVENUE  
PORTLAND 15, OREGON

September 14th 1948

Chas. H. Dunning, Director,  
Arizona Dept. Mineral Resources,  
Phoenix, Ariz.

Dear Mr. Dunning,

We want to thank you for that most excellent and comprehensive report on HACK'S CANYON URANIUM MINE. This is appreciated very much, we can assure you.

The sale on HANDBOOK URANIUM MINERALS has been so great that we will shortly put out a 2nd edition, and your report will be included, and due credit given.

It would seem like this property has many possibilities, especially when the present developments in handling low grade ores are worked out on a commercial basis.

Thanking you again for this kind courtesy.

Yours Very Truly,

*H.C. Dake*

H. C. Dake  
Jack DeMent

ADDRESS REPLY TO:

DIVISION OF RAW MATERIALS  
U. S. ATOMIC ENERGY COMMISSION  
P. O. BOX 30, ANSONIA STATION  
NEW YORK 23, NEW YORK

UNITED STATES  
ATOMIC ENERGY COMMISSION  
DIVISION OF RAW MATERIALS  
NEW YORK OFFICE

and refer to:

RME:MM

September 10, 1948

Mr. Charles H. Dunning, Director  
Department of Mineral Resources  
State of Arizona  
Mineral Building, Fairgrounds  
Phoenix, Arizona

Subject: HACK'S CANYON URANIUM MINE

Dear Mr. Dunning:

Reference is made to your letter of September 3, enclosing your report on Hack's Canyon Uranium Mine.

I am extremely interested in all of the information outlined therein and appreciate the difficulties and problems attendant to completing it. I feel that your report is indeed well done and that it reflects all of the effort you may have put into it. It outlines the problem most effectively.

We are anxious to cooperate with you in the further study of this region and as we pointed out in our letter of September 3, we plan to send a field man to the area in October. We would be happy to have you or one of your men accompany him if you find that convenient.

If you have available another copy of your report, we would appreciate your sending it to Dr. Wallace G. Fetzer, Chief, Grand Junction Extension, New York Division of Raw Materials, P. O. Box 270, Grand Junction, Colorado. He would probably like to read this before he or one of his field men visit the area.

Very truly yours,

  
Philip L. Merritt  
Assistant Director

UNITED STATES  
ATOMIC ENERGY COMMISSION  
DIVISION OF RAW MATERIALS  
NEW YORK OFFICE

ADDRESS REPLY TO:

DIVISION OF RAW MATERIALS  
U. S. ATOMIC ENERGY COMMISSION  
P. O. BOX 30, ANSONIA STATION  
NEW YORK 23, NEW YORK

and refer to:

RME:MM

September 10, 1948

Mr. Charles H. Dunning, Director  
Department of Mineral Resources  
State of Arizona  
Mineral Building, Fairgrounds  
Phoenix, Arizona

Subject: HACK'S CANYON URANIUM MINE

Dear Mr. Dunning:

Reference is made to your letter of September 3 enclosing your report on Hack's Canyon Uranium Mine.

I am extremely interested in all of the information outlined therein and appreciate the difficulties and problems attendant to completing it. I feel that your report is indeed well done and that it reflects all of the effort you may have put into it. It outlines the problem most effectively.

We are anxious to cooperate with you in the further study of this region and as we pointed out in our letter of September 3, we plan to send a field man to the area in October. We would be happy to have you or one of your men accompany him if you find that convenient.

If you have available another copy of your report, we would appreciate your sending it to Dr. Wallace G. Fetzer, Chief, Grand Junction Extension, New York Division of Raw Materials, P. O. Box 270, Grand Junction, Colorado. He would probably like to read this before he or one of his field men visit the area.

Very truly yours,

  
Philip L. Merritt  
Assistant Director

UNITED STATES  
ATOMIC ENERGY COMMISSION  
DIVISION OF RAW MATERIALS  
NEW YORK OFFICE

ADDRESS REPLY TO:

DIVISION OF RAW MATERIALS  
U. S. ATOMIC ENERGY COMMISSION  
P. O. BOX 30, ANSONIA STATION  
NEW YORK 23, NEW YORK

and refer to:

**RME:MM**

September 10, 1948

Mr. Charles H. Dunning, Director  
Department of Mineral Resources  
State of Arizona  
Mineral Building, Fairgrounds  
Phoenix, Arizona

Subject: HACK'S CANYON URANIUM MINE

Dear Mr. Dunning:

Reference is made to your letter of September 3 enclosing your report on Hack's Canyon Uranium Mine.

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Very truly yours,



Phillip L. Merritt  
Assistant Director

ADDRESS REPLY TO:

DIVISION OF RAW MATERIALS  
U. S. ATOMIC ENERGY COMMISSION  
P. O. BOX 30, ANSONIA STATION  
NEW YORK 23, NEW YORK

UNITED STATES  
ATOMIC ENERGY COMMISSION  
DIVISION OF RAW MATERIALS  
NEW YORK OFFICE

and refer to:

RME:MM

September 3, 1948

Mr. Charles H. Dunning, Director  
Department of Mineral Resources  
State of Arizona  
Mineral Building, Fairgrounds  
Phoenix, Arizona

Subject: SAMPLES FOR ANALYSIS

Dear Mr. Dunning:

Reference is made to your letters of June 21, July 8, July 13 and August 5 together with the eleven samples that you sent us for analysis.

The samples have been studied with the following results; in each case the percentage of  $U_3O_8$  is the equivalent percentage as determined radiometrically on split portions of ground material against our pitchblende standards.

Sample No. 1, received July 15, our No. 583 A, 2.5%  $U_3O_8$  equivalent, is a dark sandstone cemented together with a black and a green cementing material. The green material is a secondary non-fluorescent uranium mineral and it occurs either as a cement or in thin plates disseminated throughout the sandstone. This uranium mineral is probably metatorbernite. Some of the black cementing material is strongly radioactive and this suggests pitchblende. Throughout the sandstone there are small black grains surrounded by yellow halos; superficially these resemble a uranium mineral but repeated tests on them give negative bead tests for uranium, and hence it is believed that these are iron oxides. There are in addition small patches of black throughout the rock that represent segregations of a black copper mineral. We believe that the radioactivity originates to some extent in the metatorbernite but largely in the black cementing material, the exact composition of which we have not yet determined.

Sample No. 2, received July 15, our No. 583 B, 0.30%  $U_3O_8$  equivalent, is a sandstone cemented together with white cementing material and secondary copper minerals. Thin green plates of a secondary uranium mineral are disseminated throughout the sandstone and occur as incrustations on the surface. Most of the green material that is radioactive is not fluorescent and is probably metatorbernite. In addition there is a small amount

Mr. Charles Dunning  
September 3, 1948

of faintly fluorescent secondary uranium mineral that may be autunite or some other rare secondary uranium mineral.

Sample No. 3, received July 15, our No. 583 C, 0.29%  $U_3O_8$  equivalent, is a white sandstone, the quartz grains of which are cemented together with a non-radioactive substance. A green secondary uranium mineral, probably metatorbernite, exists as a coating and also in disseminated grains throughout the rock.

Sample No. 4, received July 15, our No. 583 D, 0.08%  $U_3O_8$  equivalent, is a copper stained sandstone in which the rounded quartz grains are cemented together with a non-radioactive white material. There are patches of hard black non-radioactive minerals throughout the sandstone that are probably copper sulfides. The sample shows only a minor amount of green secondary uranium minerals, most of the green coloring resulting from copper carbonates.

Sample No. 5, received July 15, our No. 583 E, 2.45%  $U_3O_8$  equivalent, is a small sample of a sandstone in which the quartz grains are cemented together with a black cementing material. This sample shows a minor amount of metatorbernite and a surface coating of a slightly fluorescent yellow secondary uranium mineral. Since this yellow mineral displays faint fluorescence it is probably not carnotite. The bulk of the radioactivity originates, we believe, in the black cementing material. The sample is similar to your Sample No. 1 except that it contains less metatorbernite.

Sample No. 6, received July 15, our No. 583 F, 0.35%  $U_3O_8$  equivalent, is a fine grained gray and buff colored sandstone in which the grains are cemented together with a black (probably copper rich) cementing material. Disseminated throughout the rock there are occasional grains of chalcopyrite and of a yellow secondary uranium mineral. The pink or lavender mineral gives a strong positive test for cobalt and has been identified as erythrite. The rock is also coated in places with a fine blue mineral that may contain zinc, such as calamine. In any event the presence of cobalt is extremely interesting to us since cobalt minerals are occasionally indicators of primary radioactive minerals. We wonder if there are any cobalt arsenides or sulfarsenides in the vicinity.

Unnumbered sample, received July 26, our No. 583 G, 1.40%  $U_3O_8$  equivalent, has been described to some extent in our letter of July 21. Repeated radiometric tests against pitchblende standards show 1.40%  $U_3O_8$  equivalent radioactivity for this sample. It is a black sandstone, the fine grains of which have been cemented together with a black cementing material. It shows, in addition, copper minerals such as chalcopyrite, chalcocite (?) and malachite. Crushed portions of this sample were fractionated in heavy liquids in an endeavor to concentrate the radioactive mineral. One such concentrate shows 3.40%  $U_3O_8$  equivalent when tested radiometrically. Further examination of this

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
BUREAU OF MINES

SOUTHWEST EXPERIMENT STATION  
Box 4097  
UNIVERSITY STATION

TUCSON, ARIZONA  
September 28, 1948

Mr. Chas. H. Dunning, Director,  
Department of Mineral Resources,  
Mineral Building, Fairgrounds,  
Phoenix, Arizona.

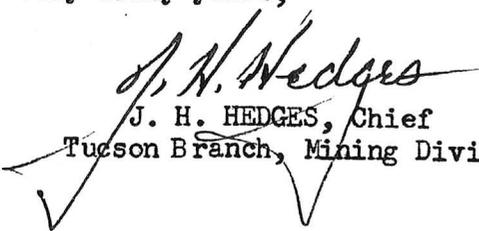
Dear Mr. Dunning:

Thanks very much for the copy of your report on the Hack's Canyon uranium mine. I am very glad to have this report and have read it with great interest.

It is my understanding that the Atomic Energy Commission is prepared to investigate and possibly assist in the development of potential sources of uranium minerals. No doubt you have already explored this possibility.

The Bureau of Mines might be able to help in development of a suitable concentrating method. If you or the owners of the property could supply us with about 300 pounds of representative ore we would be glad to undertake the necessary tests. We might get this sample ourselves but I do not have anyone footloose just at this time.

Very truly yours,

  
J. H. HEDGES, Chief  
Tucson Branch, Mining Division



C O P Y

UNITED STATES  
ATOMIC ENERGY COMMISSION  
WASHINGTON

October 12, 1948

Honorable Carl Hayden  
Senate Office Building  
Washington 25, D. C.

Dear Senator Hayden:

We wish to acknowledge your letter of September 28, 1948 transmitting a copy of a report on the Hack's Canyon Uranium Mine by Mr. Charles H. Dunning, Director, Arizona Department of Mineral Resources and a copy of a letter from Mr. W. C. Broadgate, Consultant, Mining and Minerals Industry Subcommittee.

Our Exploration Branch has been in touch with Mr. Dunning during the past month and a geological examination of the Hack's Canyon property is being undertaken at this time. Any assistance toward the development of this property which the Commission might be able to offer will depend upon the results of our investigation. It is the policy of the Commission to encourage development and production of domestic uranium ores by establishing guaranteed minimum prices for various grades of uranium ores. If possible, we prefer to avoid operating or financing operation of mines but to leave development and operation to private industry. The Commission's price schedules are described in Circulars No. 1, 2, 3, and 4, copies of which are enclosed.

The uranium deposit described by Mr. Dunning is of considerable interest as it occurs in the same general geologic horizon as the deposits in southeastern Utah. It appears that a large area of northern Arizona and southern Utah constitutes a favorable field in which to prospect for uranium.

We are returning Mr. Broadgate's letter but are retaining Mr. Dunning's report for our files unless you request its return.

We wish to express our appreciation to both you and Mr. Dunning for bringing this matter to our attention.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION

/s/ Carroll L. Wilson

Carroll L. Wilson  
General Manager

STYLES BRIDGES, N. H., CHAIRMAN

CHAN GURNEY, S. DAK.  
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HENRY C. DWORSHAK, IDAHO

KENNETH MCKELLAR, TENN.  
CARL HAYDEN, ARIZ.  
ELMER THOMAS, OKLA.  
MILLARD E. TYDINGS, MD.  
RICHARD B. RUSSELL, GA.  
PAT MCCARRAN, NEV.  
JOSEPH C. O'MAHONEY, WYO.  
THEODORE FRANCIS GREEN, R. I.  
DENNIS CHAVEZ, N. MEX.

## United States Senate

COMMITTEE ON APPROPRIATIONS

October 18, 1948

EVERARD H. SMITH, CLERK  
CECIL H. TOLBERT, ASST. CLERK

Dr. Charles H. Dunning, Director  
Arizona Department of Mineral Resources  
Minerals Building  
Arizona State Fairgrounds  
Phoenix, Arizona

My dear Dr. Dunning:

With reference to Bill Broadgate's letter to you of September 13, I am taking the liberty in the absence of Senator Hayden who is now in Arizona, of sending you herewith for your information and file the text of the reply addressed to the Senator on October 12, by Mr. Carroll L. Wilson, General Manager of the United States Atomic Energy Commission, relative to the Hack's Canyon mine.

On the basis of a newspaper story which appeared in the Arizona Republic of October 5, it would appear that Dr. Alfred Razor recently accompanied you on an investigation of this particular property.

In the event you believe there is anything more Senator Hayden can do to be helpful, please let us know.

With all good wishes, I am,

Yours very sincerely,

*Don A. Gustin*

Don A. Gustin  
Administrative Assistant to  
Senator Carl Hayden

UNITED STATES  
ATOMIC ENERGY COMMISSION  
WASHINGTON

October 12, 1948

Honorable Carl Hayden  
Senate Office Building  
Washington 25, D. C.

Dear Senator Hayden:

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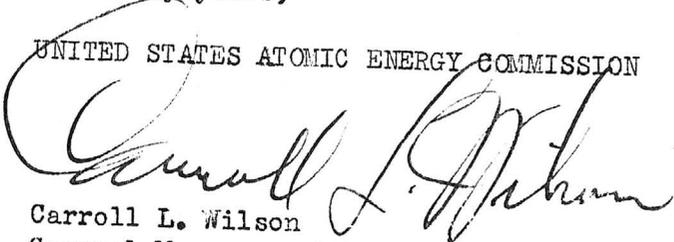
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We are returning Mr. Broadgate's letter but are retaining Mr. Dunning's report for our files unless you request its return.

We wish to express our appreciation to both you and Mr. Dunning for bringing this matter to our attention.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION

  
Carroll L. Wilson  
General Manager

Enclosures

ADDRESS REPLY TO:

RAW MATERIALS OPERATIONS  
U. S. ATOMIC ENERGY COMMISSION  
P. O. BOX 30, ANSONIA STATION  
NEW YORK 23, NEW YORK

UNITED STATES  
ATOMIC ENERGY COMMISSION  
RAW MATERIALS OPERATIONS  
NEW YORK OFFICE

and refer to:

RME:RDN

February 8, 1949

Mr. Chas. H. Dunning, Director  
Department of Mineral Resources  
Phoenix, Arizona

Subject: HACKS CANYON URANIUM PROSPECT

Dear Mr. Dunning:

Your letter of January 29, 1949, expressing the dissatisfaction of the owners of the Hacks Canyon prospect because of the apparent lack of interest of the Commission since making our field examination, has been received.

We can understand the owners feelings in light of the recent publicity given to the search for uranium ores in questioning the reasons why the Commission has not moved more rapidly to initiate further exploration activities in the area or to give notification to the people concerned that the prospect is of no interest. Procedures for the release of information developed during the course of examinations by our staff have only recently been completed, and it is expected that within the near future the report by Dr. Rasor can be made available to owners. In order to receive this report or the parts thereof pertaining to their specific holdings the owners must submit proof, satisfactory to Counsel for the Commission, of ownership of the property involved. Ordinarily this requirement will be satisfied by receipt of a statement in writing from a responsible official of the taxing authority having jurisdiction of the property in question that, to the best of his knowledge, the individual requesting information is currently liable for taxes on said property.

We can say in advance that our report on this property although not entirely negative, is not encouraging, at least insofar as the area covered by the examination is concerned, and it is certainly not a blueprint for mining and production of uranium. The examination was purely of a reconnaissance nature and was made primarily to provide additional information to us on the copper-uranium type of occurrence in connection with our program of exploration for and assessment of resources of uranium in the United States. It continues to be the policy of the Commission to rely on private enterprise to develop and mine new uranium properties and our circulars describing our purchase program and guaranteed prices for uranium ores have been previously furnished you. If a 10% or better concentrate can be produced

Chas. H. Dunning  
February 8, 1949

from the property, it will be purchased by the Commission f.o.b. the nearest railhead in lots of 10 tons or more, in accordance with our Circular No. 1, at \$3.50 per pound of contained  $U_3O_8$  less our estimate of refining cost, which will be determined upon receipt of satisfactory samples and reasonable proof that significant production is possible. If a 10% concentrate is not feasible but proof of potential production is available, the Commission, through Mr. Jesse Johnson in its Washington Office, will negotiate a schedule for the purchase of lower grade material.

These statements of Commission prices and policy are included in the information which you have. The Commission does not expect itself to handle the development and production of ores from private property. It is interested only in the purchase of such ores after production and in information as to the possible extent of reserves. Preliminary information of this type has been acquired and continuing studies will be made from time to time. We feel that in the meantime, on the basis of information already provided, the owners should make their own evaluation of the deposit's possibilities and their own plans for its development and the sale of the product to the Commission on the basis of the Commission's announced domestic uranium policy.

After considerable effort we have still been unable to identify the black radioactive mineral. We are continuing to work on the problem and will give you a report as soon as our study is completed whether or not the results are conclusive.

Very truly yours,



Phillip L. Merritt  
Assistant Manager

Enclosure:  
Press Release No. 157 dtd 7 Feb 49

STYLES BRIDGES, N. H., CHAIRMAN

CHAN GURNEY, S. DAK.  
C. WAYLAND BROOKS, ILL.  
CLYDE M. REED, KANS.  
JOSEPH H. BALL, MINN.  
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JOSEPH C. O'MAHONEY, WYO.  
THEODORE FRANCIS GREEN, R. I.  
DENNIS CHAVEZ, N. MEX.

EVERARD H. SMITH, CLERK  
CECIL H. TOLBERT, ASST. CLERK

## United States Senate

COMMITTEE ON APPROPRIATIONS

February 25, 1949

Mr. Charles H. Dunning, Director  
Department of Mineral Resources  
Mineral Building, Fairgrounds  
Phoenix, Arizona

My dear Dunning:

Referring to my letter of February 4,  
I attach hereto a report received today  
from David E. Lilienthal, Chairman of the  
Atomic Energy Commission, along with a  
copy of Mr. Merritt's letter of February 8  
addressed to you.

If there is anything further I can do  
to be helpful, please feel free to call  
on me.

With kindest regards, I am,

Yours very sincerely,

*Carl Hayden*

UNITED STATES  
ATOMIC ENERGY COMMISSION  
WASHINGTON 25, D. C.

February 18, 1949

Dear Senator Hayden:

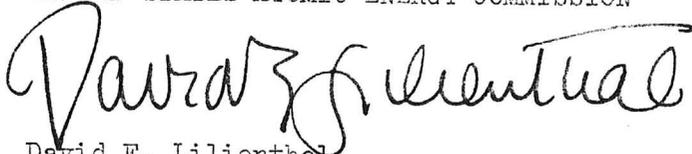
As requested in your letter of February 4, we have looked into the matter of the Hacks Canyon mine investigation.

Enclosed is a copy of a letter dated February 8, from Dr. Phillip L. Merritt, Assistant Manager, Raw Materials Operations, to Mr. Charles H. Dunning, Director of the Department of Mineral Resources, State of Arizona, replying to his letter to the Commission of January 29. We believe that Dr. Merritt's letter will answer your questions and Mr. Dunning's.

Sometime ago our New York Raw Materials Office furnished to Mr. Dunning copies of press releases and circulars explaining the Commission's domestic uranium program, and we thought that the Commission's policy of leaving development and mining of uranium resources to private business wherever possible had been adequately conveyed in this correspondence. We regret that we did not more clearly explain this policy in our earlier letter.

Sincerely yours,

UNITED STATES ATOMIC ENERGY COMMISSION



David E. Lilienthal  
Chairman

Honorable Carl Hayden  
Senate Office Building  
Washington, D. C.

Encl. cy. ltr dtd 2/8/49 fr PLMerritt to CHDunning

C O P Y

February 8, 1949

Mr. Chas. H. Dunning, Director  
Department of Mineral Resources  
Phoenix, Arizona

Subject: HACKS CANYON URANIUM PROSPECT

Dear Mr. Dunning:

Your letter of January 29, 1949, expressing the dissatisfaction of the owners of the Hacks Canyon prospect because of the apparent lack of interest of the Commission since making our field examination, has been received.

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After considerable effort we have still been unable to identify the black radio-active mineral. We are continuing to work on the problem and will give you a report as soon as our study is completed whether or not the results are conclusive.

Very truly yours,

Phillip L. Merritt  
Assistant Manager

ADDRESS REPLY TO:

GRAND JUNCTION EXTENSION  
DIV. OF RAW MATERIALS, NEW YORK OFFICE  
U. S. ATOMIC ENERGY COMMISSION  
P. O. BOX 270  
GRAND JUNCTION, COLO.

UNITED STATES  
ATOMIC ENERGY COMMISSION  
GRAND JUNCTION, COLORADO

May 11, 1949

AND REFER TO: GJENY:CAR

*acc*

Mr. C. H. Dunning, Director  
Department of Mineral Resources  
Minerals Building, Fairgrounds  
Phoenix, Arizona

Dear Mr. Dunning:

The sample of mineralized logs from the Lees Ferry occurrence in northern Arizona which you sent was received May 9, 1949.

A portion of the sample is being assayed here for the uranium content and the remainder has been sent to the U. S. Bureau of Mines Laboratory in Salt Lake City, Utah, for metallurgical tests pertaining to its amenability.

The results of these investigations will be sent to you as soon as they are made available.

I appreciate your interest in sending us the sample of this new occurrence in Arizona.

Very truly yours,

  
Wallace G. Fetzner, Chief

ADDRESS REPLY TO:

RAW MATERIALS OPERATIONS  
U. S. ATOMIC ENERGY COMMISSION  
P. O. BOX 30, ANSONIA STATION  
NEW YORK 23, NEW YORK

UNITED STATES  
ATOMIC ENERGY COMMISSION  
RAW MATERIALS OPERATIONS  
NEW YORK OFFICE

and refer to:  
RMEL:MM

May 17, 1949

Mr. Charles H. Dunning, Director  
Department of Mineral Resources  
State of Arizona  
Mineral Building, Fairgrounds  
Phoenix, Arizona

Subject: SAMPLES FOR ANALYSIS

Dear Mr. Dunning:

Reference is made to your letter of April 29, 1949 and to my letters of September 3, 1948 and February 8, 1949.

As we outlined in our correspondence, we have been studying your samples of the Hacks Canyon material in more detail in an effort to determine the radioactive minerals definitely. We have studied sample No. 583A (your sample No. 1) more carefully, but have been unable to determine definitely the black radioactive mineral contained therein.

The radioactive constituents in this sample No. 1 were concentrated and an attempt was made to obtain an X-ray diffraction pattern on this concentrate. The pattern obtained was not definite enough to permit certain identification of the material as uraninite. A number of diffuse lines contained in the pattern are in fair agreement with lines of uraninite, but this identification was not conclusive. Most of the lines present in this pattern are in good agreement with those in patterns of isometric chalcocite (digenite). Another portion of the radioactive concentrate was briquetted and a polished surface studied. This section showed six positively identified ore minerals: chalcopyrite, bornite, chalcocite, covellite, malachite, and pyrite. It showed two tentatively identified minerals: gummite and torbernite. It also showed two unidentified metallic minerals which appear to be related to the cobalt-nickel-arsenide group, but do not possess any of the characteristics of uraninite.

Thus we regret to inform you that we still cannot positively identify the mineral which we suspect so strongly of being pitchblende. If you are able to obtain any of this material that is more strongly radioactive than that which we have, we would appreciate receiving it.

Mr. Charles H. Dunning, Director  
May 17, 1949

On a recent visit by one of our representatives to the U. S. Bureau of Mines office at Tucson, this Hacks Canyon material was discussed with Mr. J. B. Clemmer. It was agreed at that time that Mr. Clemmer would endeavor to concentrate the various radioactive constituents by flotation tests and that the various products of his tests would be sent to our New York Laboratory for mineral identification. If the results of this work are any more conclusive, we shall most certainly contact you.

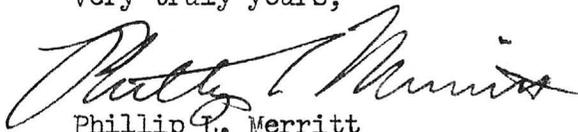
In reference to your letter of April 29, 1949 concerning Mr. and Mrs. Riley Baker, we have given their names to our Licensing Division. By now they have probably already received blanks to complete prior to the issuance of a license.

Since the ore you describe is Plateau type material, it will be handled by our Grand Junction office. We have called Dr. Fetzer on this matter and by now he has probably already contacted you concerning additional samples and the point at which shipment of ore should be made.

There is no rule prohibiting the sale of specimens from a deposit such as this if the licensing regulations are complied with.

Enclosed herewith you will find two copies of the literature concerning our Domestic Uranium Program that we are presently distributing. We thank you for your interest in this Uranium Program. If we can be of further help to you, please do not hesitate to write us again.

Very truly yours,



Phillip L. Merritt  
Assistant Manager

Enclosures:

1. Group A documents (2 sets)
2. Group B documents (2 sets)
3. Group C documents (2 sets)

DISPATCHED

C  
O  
P  
Y

UNITED STATES  
ATOMIC ENERGY COMMISSION  
Division of Raw Materials  
New York Office

September 3, 1948

Mr. Charles H. Dunning, Director  
Department of Mineral Resources  
State of Arizona  
Mineral Building, Fairgrounds  
Phoenix, Arizona

Subject: SAMPLES FOR ANALYSIS

Dear Mr. Dunning:

Reference is made to your letters of June 21, July 8, July 13 and August 5, together with the eleven samples that you sent us for analysis.

The samples have been studied with the following results; in each case the percentage of  $U_3O_8$  is the equivalent percentage as determined radiometrically on split portions of ground material against our pitchblende standards.

Sample No. 1, received July 15, our No. 583 A, 2.5%  $U_3O_8$  equivalent, is a dark sandstone cemented together with a black and green cementing material. The green material is a secondary non-fluorescent uranium mineral and it occurs either as a cement or in thin plates disseminated throughout the sandstone. This uranium material is probably metatorbernite. Some of the black cementing material is strongly radioactive and this suggests pitchblende. Throughout the sandstone there are small black grains surrounded by yellow halos; superficially these resemble a uranium mineral but repeated tests on them give negative bead tests for uranium, and hence it is believed that these are iron oxides. There are in addition small patches of black throughout the rock that represent segregations of a black copper mineral. We believe that the radioactivity originates to some extent in the metatorbernite but largely in the black cementing material, the exact composition of which we have not yet determined.

Sample No. 2, received July 15, our No. 583 B, 0.30%  $U_3O_8$  equivalent, is a sandstone cemented together with white cementing material and secondary copper minerals. Thin green plates of a secondary uranium mineral are disseminated throughout the sandstone and occur as incrustations on the surface. Most of the green material that is radioactive is not fluorescent and is probably metatorbernite. In addition there is a small amount of faintly fluorescent secondary uranium mineral that may be autunite or some other rare secondary uranium mineral.

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Sample No. 3, received July 15, our No. 583 C, 0.29%  $U_3O_8$  equivalent, is a white sandstone, the quartz grains of which are cemented together with a non-radioactive substance. A green secondary uranium mineral, probably metatorbernite, exists as a coating and also in disseminated grains throughout the rock.

Sample No. 4, received July 15, our No. 583 D, 0.08%  $U_3O_8$  equivalent, is a copper stained sandstone in which the rounded quartz grains are cemented together with a non-radioactive white material. There are patches of hard black non-radioactive minerals throughout the sandstone that are probably copper sulfides. The sample shows only a minor amount of green secondary uranium minerals, most of the green coloring resulting from copper carbonates.

Sample No. 5, received July 15, our No. 583 E, 2.45%  $U_3O_8$  equivalent, is a small sample of a sandstone in which the quartz grains are cemented together with a black cementing material. This sample shows a minor amount of metatorbernite and a surface coating of a slightly fluorescent yellow secondary uranium mineral. Since this yellow mineral displays faint fluorescence it is probably not carnotite. The bulk of the radioactivity originates, we believe, in the black cementing material. The sample is similar to your Sample No. 1 except that it contains less metatorbernite.

Sample No. 6, received July 15, our No. 583 F, 0.35%  $U_3O_8$  equivalent, is a fine grained gray and buff colored sandstone in which the grains are cemented together with a black (probably copper rich) cementing material. Disseminated throughout the rock there are occasional grains of chalcopyrite and of a yellow secondary uranium mineral. The pink or lavender mineral gives a strong positive test for cobalt and has been identified as erythrite. The rock is also coated in places with a fine blue mineral that may contain zinc, such as calamine. In any event the presence of cobalt is extremely interesting to us since cobalt minerals are occasionally indicators of primary radioactive minerals. We wonder if there are any cobalt arsenides or sulfarsenides in the vicinity.

Unnumbered sample, received July 26, our No. 583 G, 1.40%  $U_3O_8$  equivalent, has been described to some extent in our letter of July 21. Repeated radiometric tests against pitchblende standards show 1.40%  $U_3O_8$  equivalent radioactivity for this sample. It is a black sandstone, the fine grains of which have been cemented together with a black cementing material. It shows, in addition, copper minerals such as chalcopyrite, chalcocite (?) and malachite. Crushed portions of this sample were fractionated in heavy liquids in an endeavor to concentrate the radioactive mineral. One such concentrate shows 3.40%  $U_3O_8$  equivalent when tested radiometrically. Further examination of this fraction reveals the presence of quartz grains cemented together with two types of black cementing material. One kind of cementing material shows conchoidal fracture and gives a positive uranium bead and in rare cases shows the yellow alteration characteristic of pitchblende. The other type of cementing material is non-radioactive and it is thought to be a copper sulfide.

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Sample No. 3, received August 12, our No. 583 H, 0.39%  $U_3O_8$  equivalent, is crushed material consisting of gray and black sandstone in which the quartz grains are cemented together with a black cementing material suggestive of a copper mineral and a grayish white cementing material. There is some blue and green copper carbonate on the surface. A heavy mineral fraction from this sample shows approximately 0.9%  $U_3O_8$  equivalent and consists of a motley assemblage of minerals among which are iron sulfides and oxides, malachite and azurite, a green radioactive mineral that is probably metatorbernite, a fluorescent mineral suggestive of zircon, rare fragments of a yellow mineral that resembles monazite, but is probably iron-stained quartz and fragments of quartz to which copper minerals have adhered. None of the black material tested is radioactive.

Sample No. 4, received August 12, our No. 583 I, 0.89% equivalent, appears to be similar to No. 583 H except that it runs higher radiometrically. Oddly, the heavy fraction shows only approximately 0.9%  $U_3O_8$  equivalent.

Sample No. 5, received August 12, our No. 583 J, 0.29%  $U_3O_8$  equivalent, is also similar to No. 583 H. The heavy fraction shows approximately 0.6%  $U_3O_8$  equivalent.

Sample No. 6, received August 12, our No. 583 K, 0.005%  $U_3O_8$  equivalent, is crushed material. It consists largely of white sandstone with a very little copper staining on occasional fragments.

All of the samples represent material that is of definite interest to us and we would be pleased to see a copy of your report on the region and also to receive any further comments you may care to make. Can you offer an estimate of the available tonnage of the various types of material you have sent us? You mention other similar locations in Arizona; do you know of many such with indications of extensive tonnage?

At the present time we are having a group of the samples that you submitted sent out for chemical analyses in an endeavor to establish standards on rocks of this type. We cannot be too certain of our radiometric analyses without some such chemical check on our Geiger counters. The presence of metatorbernite in these samples may mean that the radioactive constituents are not in equilibrium and that we are obtaining spurious readings by comparing the beta count derived from these samples with our pitchblende standards. As soon as the results of the chemical analyses become available, we will advise you.

In addition, we will try to definitely determine the black radioactive mineral that frequently cements the quartz grains; we have reason to believe that it may be pitchblende. If you have obtained the results of the x-ray diffraction pattern on this mineral from Smith Emery, we would be interested in seeing it. We would also like to obtain a sample of the most radioactive variety of this black sandstone if you have such available.

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I seriously question whether you can do much in a quantitative way with your Omaha Scientific Company field counter especially in the low grade material. We find that the field counters are useful for only very rough quantitative work and even our expensive laboratory counter requires careful scrutiny of the results and continuous standardization to produce reliable results. In addition it represents a considerable expenditure. I regret also that at present we are unable to supply you with a counter.

We are forwarding a complete copy of this file to Dr. Wallace G. Fetzer, Chief Exploration Branch of the Division of Raw Materials at Grand Junction, at P. O. Box 270, Grand Junction, Colorado. He is in charge of exploration for the Raw Materials Division in your area. I have advised him to send a field man to this region to study it in greater detail but at the present we doubt whether anyone will reach there before October. In any event Dr. Fetzer will contact your office before sending anyone to Hacks Canyon and I am certain that he will appreciate any cooperation you may give him.

We thank you for all the work you have done in connection with these deposits and regret that we have been unable to reply sooner. The overwhelming number of samples we have recently received has prevented our keeping up to date with many of them. If you care to send us any more samples we will endeavor to work them more quickly; in any event we shall send you the radiometric analyses on them immediately.

Very truly yours,

/Sgd/ Phillip L. Merritt

Phillip L. Merritt  
Assistant Director