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PRINTED: 01/27/2003

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: EZ CLAIMS

ALTERNATE NAMES:
CAB UNPAT. CLAIMS

GRAHAM COUNTY MILS NUMBER: 269

LOCATION: TOWNSHIP 11 S RANGE 29 E SECTION 19 QUARTER NE
LATITUDE: N 32DEG 28MIN 17SEC LONGITUDE: W 109DEG 25MIN 00SEC
TOPO MAP NAME: BOWIE - 15 MIN

CURRENT STATUS: EXP PROSPECT

COMMODITY:
ZEOLITES

BIBLIOGRAPHY:
BLM AMC FILE 39883
ADMMR EZ MINE FILE
UNPAT. CLAIMS EXTEND INTO SEC. 18, 20, 28, 30
& 33, AND ALSO SEC. 1 & 13

EZ MINE

GRAHAM COUNTY
SAN SIMON DISTRICT
~~T12S R29E Sec 2~~ to
~~T11S R28E Sec 12~~

(Lone Star District)

Sec 19 T11S R29E

AKA: San Simon Zeolite Deposits
(Part of Bowie Deposits)

MILS Graham Co. Index #269

Geology File - Eyde, Ted H. "Geology Deposits in the Gila and San Simon Valleys of Arizona and New Mexico"

See: Union Carbide (file)

Mining World, June 1961, p. 49 and 54

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

# INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA MM 3808 Chabazite

GRAHAM COUNTY

UNION CARBIDE MINE (12 mi. north of Bowie)

EZ Mine (Jack)

EZ Mine file
Cochise County

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1992

**UOP**

115 N. Fifth Street, Suite 401, Grand Junction, CO 81501
Phone (303) 245-7957.
Senior Mining Engineer Jim Kirchner
**Bowie Chabazite Operations** T11S R28E & T11S R29E
Open pit mines operated by independent contract mining company - Chabazite used for specialty adsorbants - Shipped out of state for further processing.

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1991

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ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1989

**UOP**

P.O. Box 1029, Grand Junction, Colorado 81502 - Phone (303) 245-3700.

Senior Mining Engineer ..... Jim Kirchner

**Bowie Chabazite Operations** T11S R28E & T11S R29E

Open pit mines operated by independent contract mining company - Crude chabazite used for specialty adsorbants - Shipped out of state for further processing.

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1988

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P.O. Box 1029, Grand Junction, Colorado 81502 - Phone (303) 245-3700.

Senior Mining Engineer ..... Jim Kirchner

**Bowie Chabazite Operations** T11S R28E & T11S R29E

Open pit mines operated by independent contract mining company - Crude chabazite used for specialty adsorbants - Shipped out of state for further processing.

EZ MINE

GRAHAM COUNTY
San Simon District

---

MG WR 1/30/81: Talked to James Kirchner, Manager Mine Services, Union Carbide - Metals Division, P.O. Box 1029, Grand Junction, Colorado 81501, phone (303) 245-3700. He did not want their Bowie Zeolite Mine listed in the Directory of Active Mines.

---

MG WR 10/14/83: It is reported that periodic stripping and shipping of zeolite still occurs at the EZ property (part of the Bowie area zeolites), owned by Union Carbide. Mr. Joseph Cooke, Cooke Tillage, P.O. Box 332, Bowie, Az 85605, phone 847-2405, does the contract mining and hauling to the Southern Pacific railhead at Bowie. Cochise Co. EZ mine is in Sec. 19, T11S, R29E.

---

MG WR 4/12/85: Since 1959, approximately 14,000 tons of chazazite have been shipped, by various operators, from the Bowie zeolite deposits

---

KAP WR 3/20/87: In a telephone conversation with Ted Eyde he reported that Union Carbide ships about a million tons of chabazite a year from their EZ Mine (file) Graham County.

---

KAP WR 11/27/87: Discussed zeolite operations with Kim Kirchner, Senior Mining Engineer, Union Carbide Corporation (card). They continue to mine chabazite from their deposits on their E Z Claims (EZ Mine - file) Graham County. Mining is done by a local Wilcox area contractor named Cook Brothers. The crude chazazite is shipped our of state for further treatment to be used as adsorbents. The operation is known as the Bowie Chabazite Operations. Production is currently reported to all be coming from claims on Federal Land.

---

The Chabazite properties in Graham County north of Bowie have maintained their assessment work, with Union Carbide shipping the usual 3 cars. GWI Quarterly Report 6/1968

---

Three companies, Union Carbide, Grace Chemical and Western Industrial Minerals have been doing their assessment work on their chabizite deposits in T11S, R28, 29E all just nroth of the county line. Western Minerals is supposed to obtain all their claims from Norton Abrasives for $5 the indication being that this is a subsidiary of Norton Abrasives. GWI QR 12/1968

---

Actiove Mine List May 1970 - 8 men - Wayne Berkey, Proj. Engineer

---

Vernon Dale Called and said the N.R.G. Company had replaced Systems Capital Corp. as the owner of the Chabazite property north of Bowie. So far as he knew they were probably closely related. He said that 300 tons had been shipped for testing and that they may soon be considered an active mine for tax purposes. GWI WR 9/25/73

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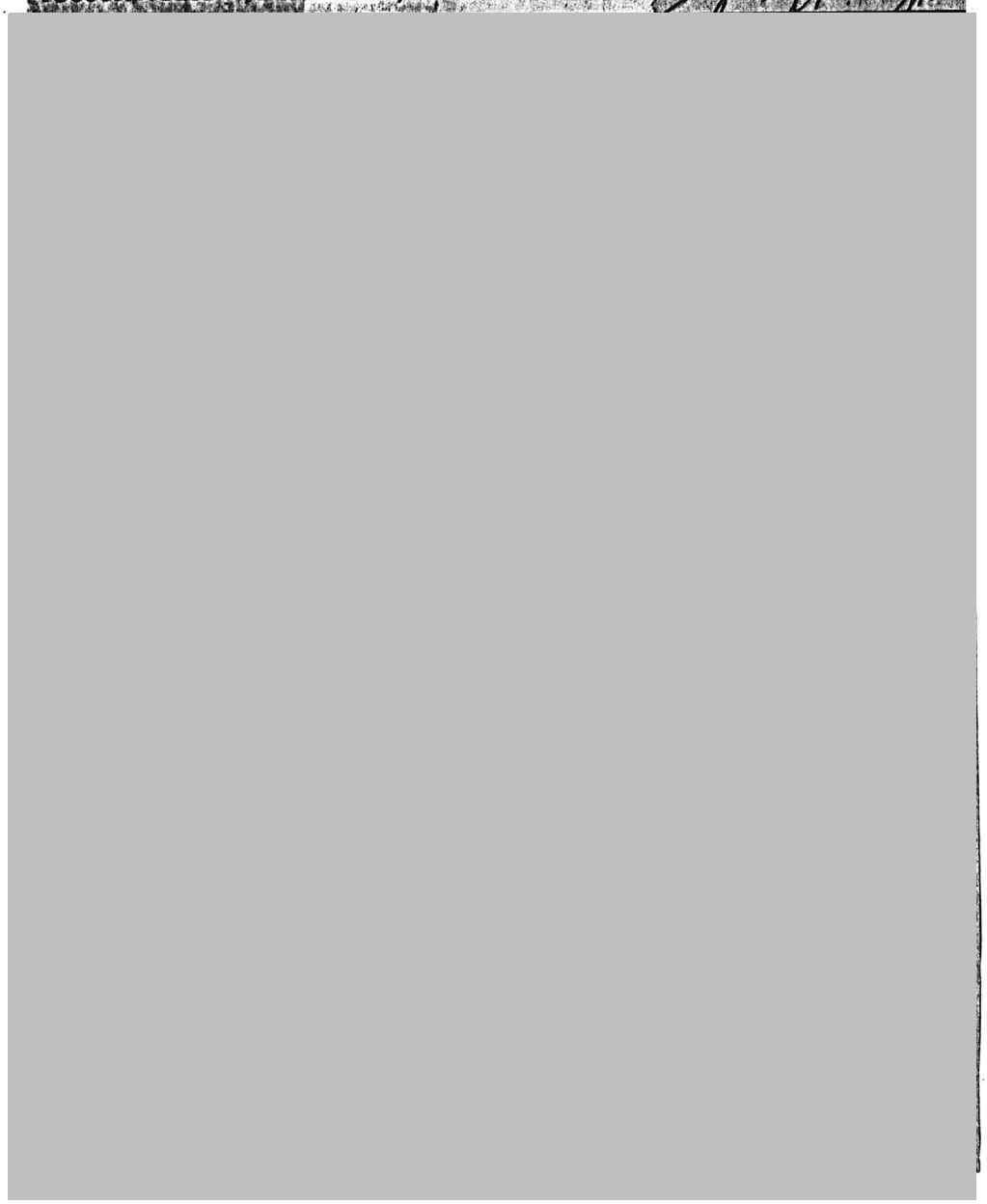
TUCSON, TUESDAY, DECEMBER 7, 1976

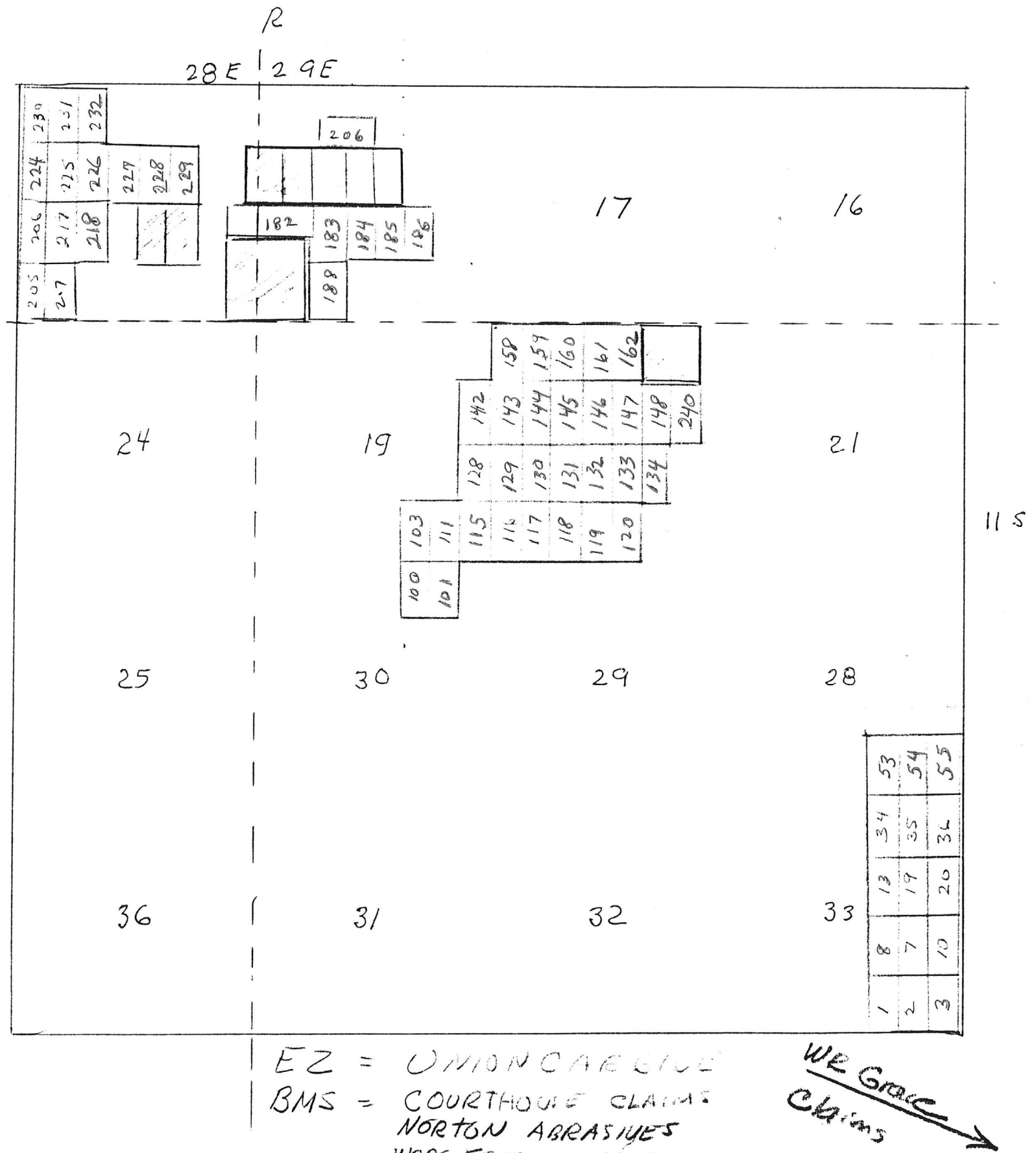


UNION CARBIDE CORPORATION
P. O. Box 1049
Grand Junction, Colorado 81501
Land Mgr.... George A. Carlyle
Bowie Property (E Z claims)
T11S, R28-29E
(15 mi. N. Bowie)
Strip-mine - Chabazite
Production: intermittent carload
shipments to Grand Jnct.
Use: Co's. nuclear operations
Employees - 1 temporary
Field contact.... - M. Grusendorf
(Bowie

GRAHAM CO.

WAINWRIGHT CONTRACTOR
P.O. Box G
Hayden, Arizona 85292
Phone: 356-7322
Refer to:
1) KENNECOTT COPPER CORP.
Chilito Mine

GILA CO


R
28 E
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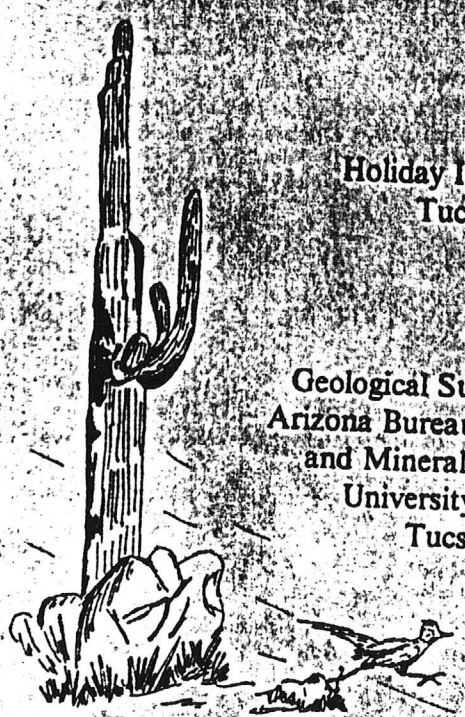
EZ = UNION CARBIDE
BMS = COURTHOUSE CLAIMS
NORTON ABRASIVES
WORCESTER MASS
W.R. Grace Claims

# 21st Forum on the Geology of Industrial Minerals

## Program With Abstracts

*Aggregates to Zeolites (AZ)*

April 9-12, 1985



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Geological Survey Branch
Arizona Bureau of Geology
and Mineral Technology
University of Arizona
Tucson, Arizona

# FIELDNOTES

From The State Of Arizona
Bureau Of Geology And Mineral Technology

Vol. 8, No. 4 | Earth Sciences and Mineral Resources in Arizona | Dec. 1978


# BOWIE ZEOLITE
# AN ARIZONA INDUSTRIAL MINERAL

by Mr. Ted H. Eyde

The following article was contributed by Ted Eyde, a Tucson consulting geologist, and edited for FIELDNOTES by H. Wesley Peirce of the Bureau staff. We thank Ted for the interest and effort represented.

## INTRODUCTION

The value of industrial materials produced in Arizona each year exceeds 100 million dollars. Although this sum is dwarfed by the billion dollar metals industry, the utility of the nonmetallic materials exceeds their value – they greatly enhance our daily lives. There are about twenty-eight major groups of nonmetallic substances inventoried in Bureau bulletin no. 180, Mineral and Water Resources of Arizona. The last item on the list is ZEOLITES. Very likely, few Arizonans have ever heard of this word even though one of our deposits is the largest known of its type and the first to be commercialized in the United States. Lack of awareness of most everything related to our earth resources is the rule, not the exception, as was suggested in the last issue of FIELDNOTES ("Back to Basics"). Anyway, we hope that this brief introduction to zeolites will prove interesting to those not already familiar with the subject.

## GENERAL STATEMENT

What is a zeolite? The question is easier to ask than to answer. Zeolites are a family of well-defined hydrous aluminum silicates of alkali and alkaline earth elements that closely resemble each other in composition and mode of occurrence. They contain

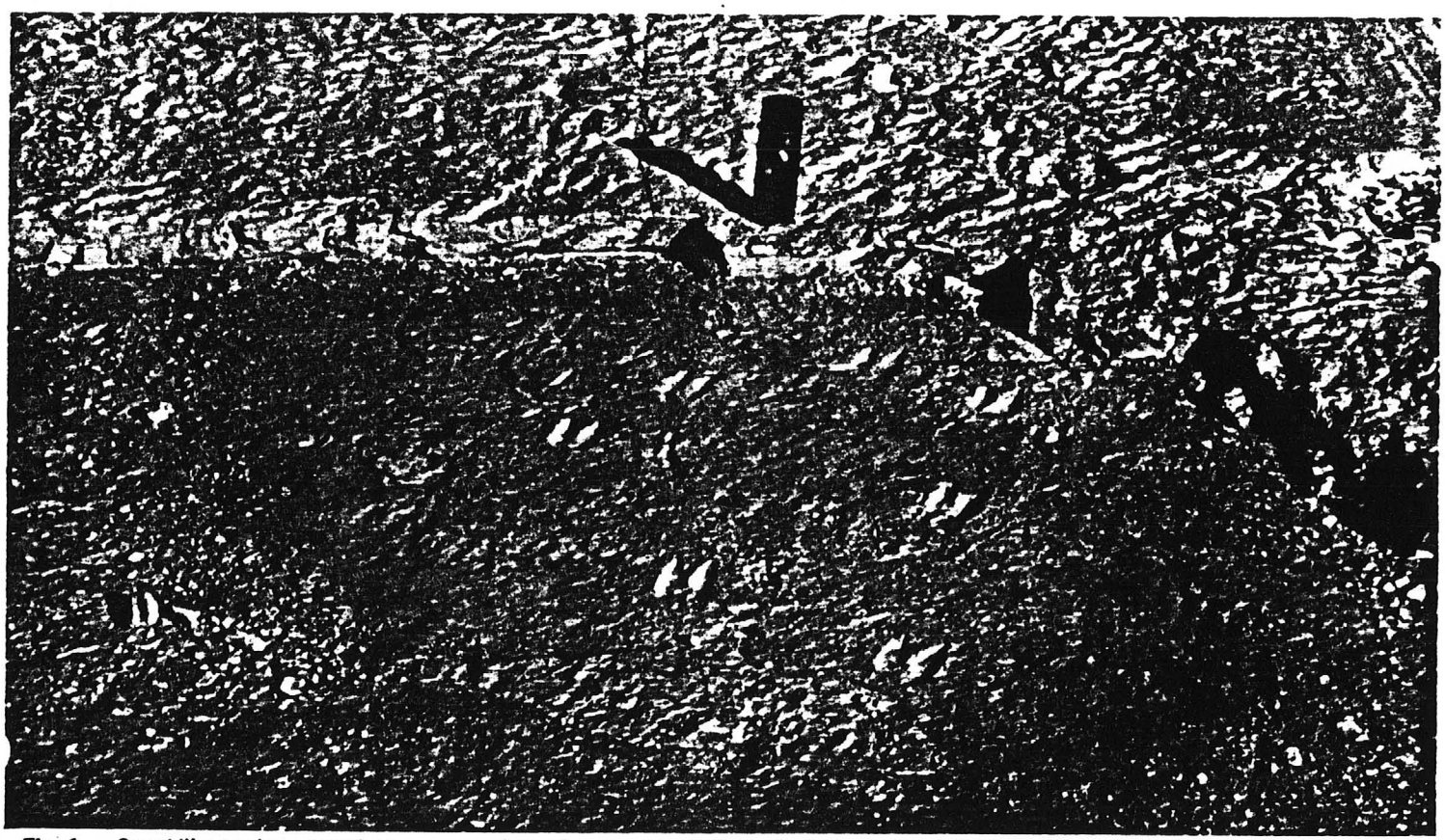


**Fig. 1 – Camel-like tracks exposed on upper surface of gray ash unit beneath lighter colored "high-grade" zeolite bed about 6" thick – Bowie chabazite deposit, Arizona.**

essential aluminum, silicon and water and in most cases calcium and/or sodium. Although there are many individual species it is not necessary to name them all here. Zeolites are especially interesting and useful because of the way they are put together in a three-dimensional network structure. On a molecular scale they are porous and full of holes, having an aperture size on the order of 10 Å in diameter.* They are literally molecular sieves that can be used for the selective separation of certain molecular mixtures based on the size and shape of molecules. Too, they are noted for their ability to selectively adsorb gases.

Many years ago an Arizonan walked into the Bureau's mineral identification laboratory wanting to know why certain rocks had "shot" at him. The episode occurred in front of a fireplace in a cabin in the White Mountains of east-central Arizona. There were some large pieces of black rock that were being heated by the fire. Soon, projectiles zinging across the room sent him and his wife for cover and, eventually, to the Bureau lab with a piece of the popping rock. It was a volcanic rock that contained a zeolite mineral. Zeolite minerals contained just beneath the rock's surface had their water converted to steam and when steam pressure overcame the confining force – POW!

The following is taken from Mumpton (1976, p. 50-51).

*In less than 20 years time, the status of the zeolite group of minerals changed from that of museum curiosity to one of a full-fledged, industrial mineral commodity. This remarkable transformation is due in large part to the belated recognition in the late 1950's of the widespread occurrence of zeolite minerals as major constituents of Cenozoic sedimentary rocks of volcanic origin, and to the research efforts of several industrial organizations during this period on the development of commercial applications for synthetic molecular sieves. The discovery that zeolite minerals formed on a large scale by reactions of volcanic tuffs and tuffaceous sedimentary rocks in marine and lacustrine environments was in itself a milestone in the geological sciences; however, the realization that such materials were also capable of being utilized in numerous areas of industrial and agricultural technology provided the impetus for the exploration and development programs that have taken place on natural zeolites since that time in dozens of countries of the world.*

*Although the commercial use of natural zeolites is still in its infancy, more than 300,000 tons of zeolitic tuff is currently mined each year in the United States, Japan, Italy, Hungary, Yugoslavia, Bulgaria, Germany, Korea, and Mexico, and used for filler in the paper industry, in pozzolanic cements and concrete, as lightweight aggregate, in fertilizer and soil conditioners, as ion exchangers in wastewater treatment, as dietary supplements in animal husbandry, in the separation of oxygen and nitrogen from air, as reforming petroleum catalysts, and as acid-resistant adsorbents in gas drying and purification. In this era of environmental concern and of energy and resource conservation, the attractive physical and chemical properties of natural zeolites will be utilized worldwide even more in the years to come in the solutions to these problems.*

Since 1961, Arizona natural zeolite has been mined from a locality in Graham County several miles north of Bowie. The major component of the deposit is the zeolite mineral chabazite, the largest deposit of it's kind known in the United States. Although not realized until recently, this deposit was first reported by Oscar Loew in 1875. It is believed that this reference is the earliest published record of a bedded zeolite deposit anywhere in the world (Sheppard, et al, 1976). Indeed, considering that the deposit was destined for rediscovery in 1959, it seems remarkable that Loew was able to diagnose the zeolitic nature of the deposit over 80 years earlier.

In 1957 the Linde Division of Union Carbide Corporation planned to expand it's synthetic zeolite manufacturing facilities. This is a rare case in which a synthetic mineral product was utilized industrially before the discovery and development of suitable natural material. In this same year, 1957, a large bedded deposit of the zeolite mineral erionite was discovered in Pine Valley near Carlan, Nevada. This development, along with recognition of the fact that molecular sieves made from natural zeolites could be competitive with synthetic products, set off a major exploration program by the Union Carbide Nuclear Company on behalf of the Linde Division.

In early 1958 a sample of zeolitic tuff (glass particles produced by explosive volanic activity) was submitted to the Linde Company. The sample was supposed to have been collected somewhere near the Cochise-Graham County line north of Bowie in the vicinity of San Simon Wash. The sample, which laboratory tests proved to be high purity chabazite, was traced back to a group of three prospectors who had staked placer claims on what they believed to be a unique deposit of light-weight ornamental stone. The actual "rediscovery" was made by a retired railroad engineer, Ernest Baugher, from Buffalo, New York. He interested two fellow railroad men, Frank Meadows and Paul Sanger, in providing for expenses and manpower for staking claims. Another part-time prospector, Frank Clark, a retired butcher, staked claims in the southeast portion of the deposit. The chabazite from this part of the deposit contains abundant iron oxides that make a beautiful mottled and banded texture. He made bookends, paper weights, and pencil holders that were sold to souvenir stores in Bowie. At the time that the sample was submitted to the Linde Division no one knew the true nature of the material. However, some of the outward manifestations seemed unusual thus generated interest in determining the mineralogy of this natural substance that occurred in relative abundance.

In 1959 a Union Carbide Nuclear Company geologist sampled the outcrops on the B.M.S. claims and submitted them to the company laboratory. X-ray diffraction techniques suggested a low zeolite (chabazite) content. Because questions then arose, the deposit was revisited and resampled with similar laboratory results. Actually, the original sample had been run by a technique referred to as oxygen adsorption, not x-ray diffraction as in the later tests. Had the initial sample not been done that way curiosity might not have been aroused.

**Plate 1**

**A.** Outcrop of zeolitized tuff along bank of San Simon Wash, Graham County.

**B.** Core drilling to determine nature, distribution and depth to buried zeolite.

**C.** Core of chabazite.

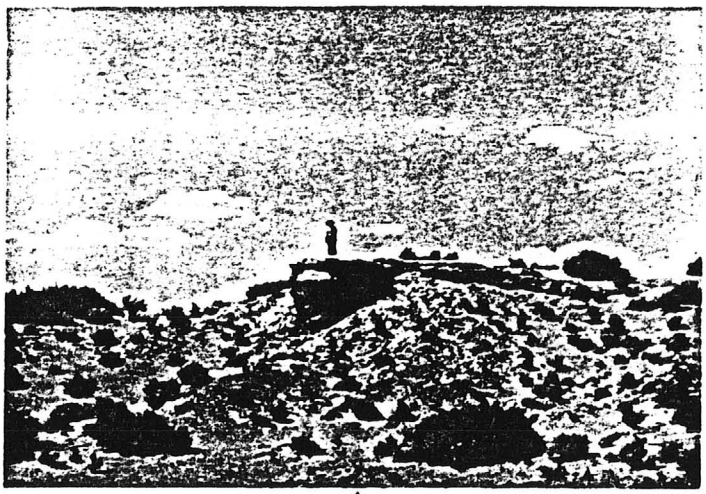
**D.** An organized core record.

**E.** Removal of overburden above 6" "high-grade" zeolite bed.

**F.** Final scraping to expose top surface of 6" "ore" horizon.

*1 Å is an angstrom unit of size. One inch equals 254,000,000 Å.

# PLATE 1



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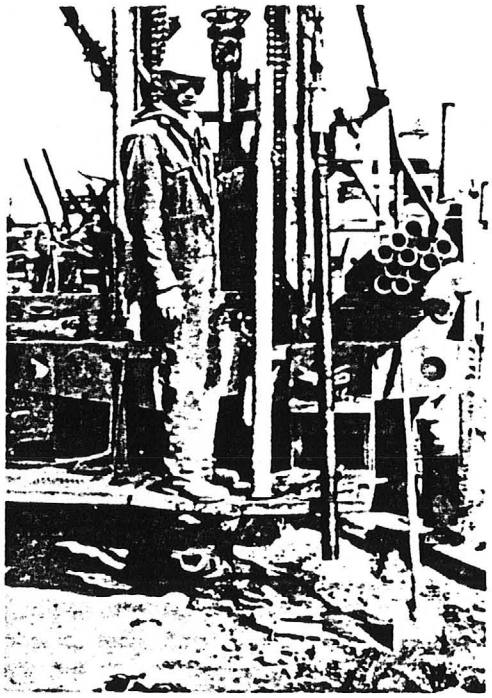

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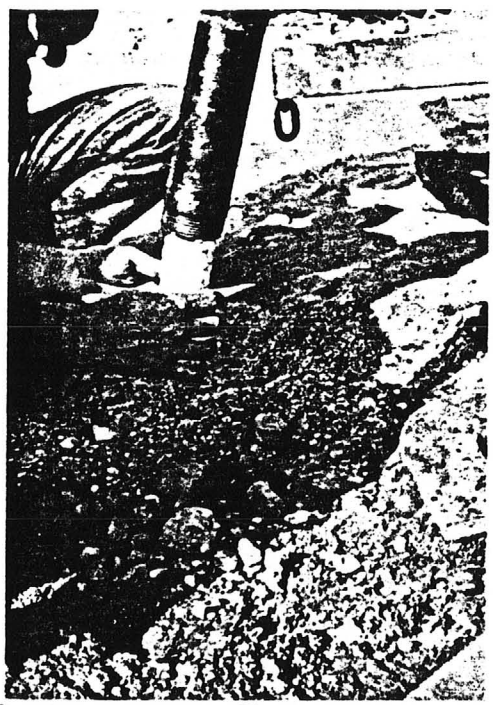

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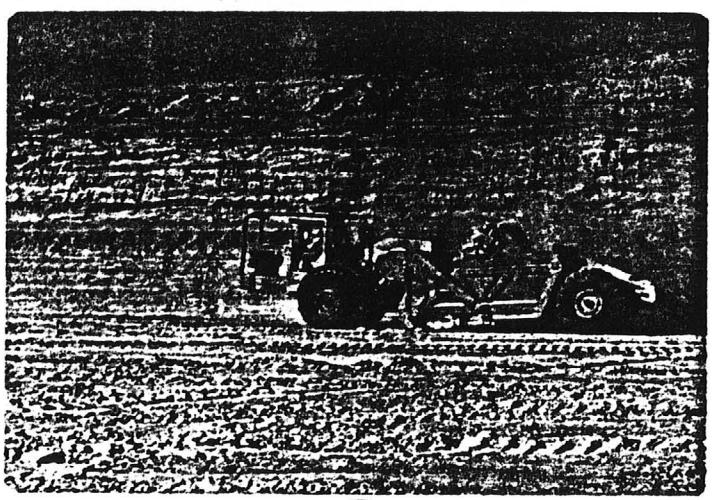

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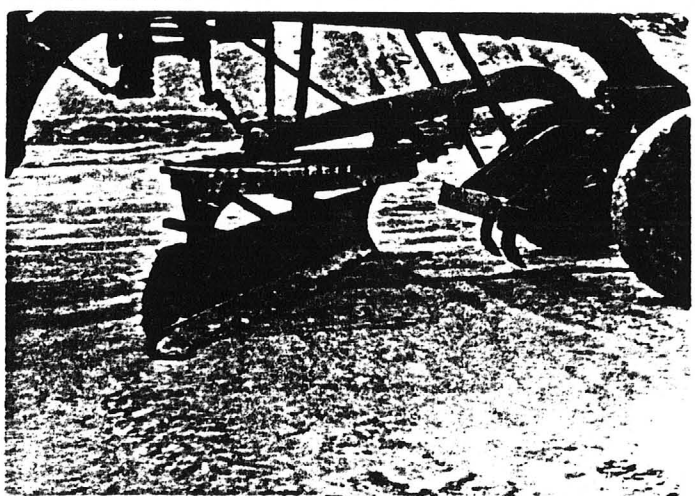
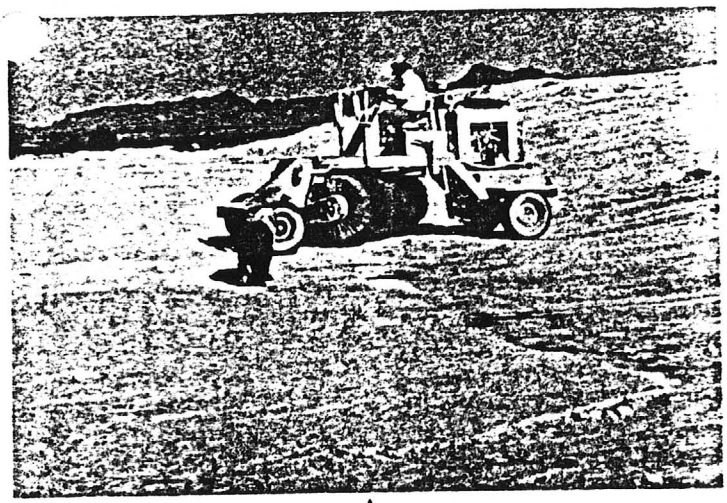


F

Photos by Ted H. Eyde

# PLATE 2



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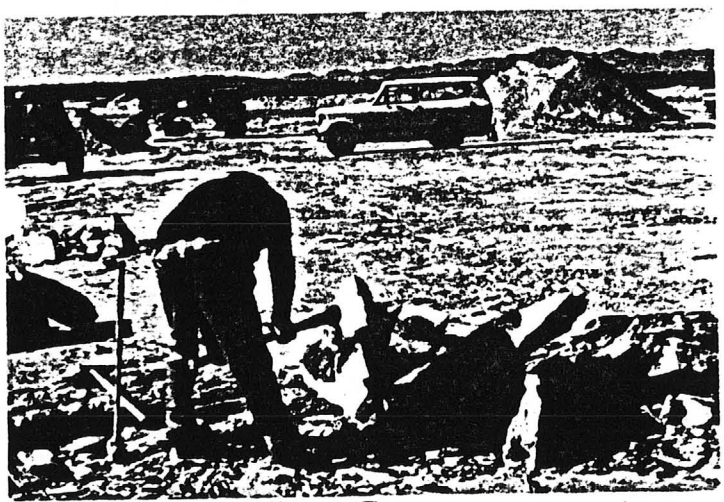

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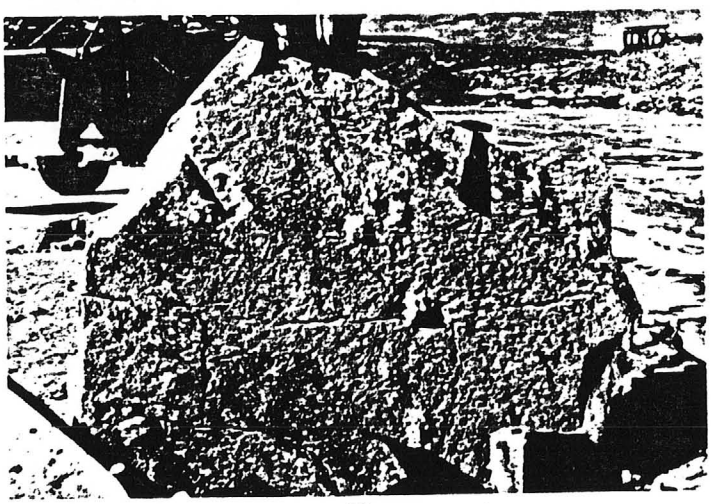

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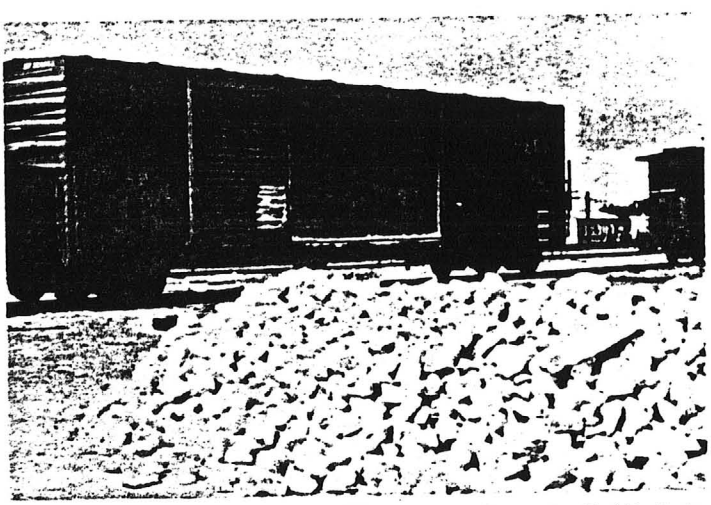

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Photos by Ted H. Eyde

**Plate 2**

**A.** Brushing top surface of zeolite (chabazite) bed so as to minimize contamination.

Zeolite pit showing 6" zeolite bed on pit floor, front end loader used in loosening blocks of zeolite, men cleaning impurity (ash) from base of zeolite blocks, and "ore" pile. Note thickness of overburden removed to expose 6" bed.

**C.** Hand removal of impurity clinging to base of zeolite blocks.

**D.** Casts of tracks on underside of block from zeolite bed. The primary tracks (see front page picture) are not zeolitized whereas the casts are. This emphasizes the amazing selectivity of the zeolitizing process.

**E.** Loading truck for the haul to railroad.

**F.** Ore pile awaiting shipment in box car. Variable moisture content causes weight fluctuations.

Anyway, there were contrasting analytical results and it was determined that more had to be learned about the deposit itself. Ted Eyde, a geologist assigned to the zeolite program, was sent to study the deposit in more detail. He collected samples from each of the lithologies in the zeolitic tuff zone. As a result he discovered that the basal unit, a bed about six inches thick, could be traced for nearly seven miles along both sides of San Simon Wash. This thin unit now is known as the high-grade bed (see plates). Overall, it appeared as though the tuffs, subsequently zeolitized, had accumulated in a shallow lake environment. Younger erosion has dissected and removed some of the originally more extensive deposit.

X-ray diffraction tests again proved disappointing. This time, however, Dr. E.M. Flanigen and Dr. F.A. Mumpton, researchers working for Dr. D.W. Breck, a prominent inorganic chemist at the Linde Research Laboratory at Tonawanda, New York, puzzled by the contradictory analytical data, reran the original sample by x-ray diffraction, and yes, disappointing results! They then conducted oxygen adsorption analysis on the lower bed and made an amazing discovery. The material from the Bowie chabazite deposit, the lower bed in particular, adsorbed more oxygen than the company's natural chabazite standard from Reece River, Nevada, that was assumed to be 100% chabazite! Impossible you say? You are right. Actually, the lower high-grade bed is not pure chabazite. It's spectacular adsorption performance is believed to be directly related to the minute size (microcrystallinity) of the chabazite crystals. Following this discovery large bulk samples were sent to the Linde Company for additional laboratory testing.

The EZ (Eyde's Zeolites) claim group was staked on April 15, 1961. Exploration drilling was initiated and it was determined that the deposit was cut up by erosion into five separate bodies, and they were so numbered.

The first shipment of chabazite from the Bowie deposit was made in 1962. Several carloads amounting to about 165 tons was shipped. By 1977 four companies were involved and about 2,000 tons of product were shipped that year. Most of the production is used in natural gas purification facilities where hydrogen sulfide, carbon dioxide, and water are removed.

Union Carbide Corporation ships the mine run zeolite by rail to Riverside, Texas for grinding and on to their Chickasaw, Alabama plant for final processing. Norton Company ships by rail East Greenville, Pennsylvania for grinding and on to Chattanooga, Tennessee for final processing. Both W. R. Grace Company and Letcher and Associates have their zeolite ground at Bowie. The former then ships in barrels by rail to its plant in Baltimore, Maryland while the latter ships in bulk by truck to its processing plant in Lancaster, California (Eyde, 1978).

Of major importance in the use of this natural chabazite from Bowie is its relative stability in low pH (acid) environments where it out performs the synthetic materials. "Beds" of this processed zeolite can be used repeatedly before replacement is necessary.

Geologically, it is not precise to say that these bedded zeolites are sedimentary deposits. In actuality they are alteration products derived from a volcanic product, ash, or tuff, that occurs in a layered or bedded form. It is the lateral continuity associated with the characteristic of being bedded that is important. How it got that way is a technical consideration subject to available evidence on a case by case basis.

Certain aspects of the zeolite mining process in the Bowie deposit are illustrated in Plates 1 and 2.

In the light of contemporary emphasis on land use, classification, and management, perhaps this Bowie zeolite deposit can be used to illustrate a principle or two:

1. Discovery has many interesting facets. Eighty years ago recognition of the Bowie zeolite occurrence was but a curiosity whereas rediscovery in 1959 lead to utilization after the true nature of the deposit was again determined.
2. The utility of earth substances varies through time in response to technological change and requirements. In the present case the utility spectrum ranged from none through ornamental stone to a natural gas purifying agent that is assisting in the alleviation of the energy shortage and in pollution control.
3. Discovery and development cannot take place if access to the land for mineral exploration and development purposes is foreclosed. In this case both State and Federal lands contain the zeolite reserves. However, those agencies with custodial responsibilities did not recognize that these lands contained potentially important zeolite deposits.
4. Very often sophisticated laboratory techniques are required in order to properly characterize an earth substance. An earth substance may be useful for itself in contrast to having a metal, like copper, extracted from it.
5. Discovery-recognition and demand for a substance might not coincide. The need for rediscovery can be trimmed by the routine collection, inventorying and organization of appropriate data, and its utilization.
6. A mineral substance might not have a formal value until it is discovered in sufficient quantity to encourage the development of uses. Many uses for zeolite minerals today, in particular those for pollution abatement importance, did not exist at the time the Bowie Arizona deposit was found.

**References Cited**

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Loew, Oscar, 1875, Report upon mineralogical, agricultural, and chemical conditions observed in portions of Colorado, New Mexico, and Arizona, in 1873, Pt. 6 of U. S. Geog. and Geol. Explor. and Surveys West of 100th Meridian (Wheeler): v.3, p. 569-661. Cited in Sheppard et al.

Mumpton, F. A., 1976, Natural zeolites – A new industrial mineral commodity: abs. *in:* Zeolite, '76, p. 50-51.

Sheppard, R. A., Gude, 3rd A. J., and Edson, G. M., 1976, Bowie zeolite deposit, Cochise and Graham Counties, Arizona: *in* Zeolite '76, p. 73-90.

* * *

# DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine: San Simon Zeolite Deposits — Date: Dec. 11, 1973

District: San Simon Creek — Engineer: R.E. Lehner

Subject: Engineer's Report - Field Visit

Location: T 12 S, R 29 E, Sec. 2 northwest to T 11 S, R 28 E, Sec. 12 along San Simon Creek, Cochise & Graham Counties (15 miles northeast of Bowie, Ariz.)

Owners:

(1) Union Carbide Corporation
P.O. Box 1049
Grand Junction, Colorado
Land Mgr. - Mr. Geo. A. Carlyle
Field Contact - M. Grusendorf
Bowie Lumber Yard - Bowie, Ariz.
Property: E-Z claims (#225 EZ claim in contest with U.S.G.S., stockpile: in tomotoe shed and coal shute at Bowie.

(2) N.R.G. Inc. (name change 4/73) (Formerly Systems Capital Corp. - subsidiary of Highes?)
3443 N. Central Ave.
Suite 1200
Phoenix, Arizona 85012
Phone: 264-9521
Controller - Thomas J. Orloski
Public Relations - Allen Clift
Legal Counsel - Sam Weir
(Home Office: 1607 Babcock St., Newport Beach, Calif.)
Property consists of 54 claims.
Stockpile: In large metal warehouse bldg, W side of Bowie

(3) W.R. Grace Co. - reported to have land holdings, but nothing known. Not worked for 3 yrs.

Commodity: ZEOLITES (hydrous feldspar)

Use: Molecular sieve for hydro carbons purification and drying of liquids and gases; decontamination of radioactive wastes; soil conditioner.

On Sept. 27th 1973 I travelled to Bowie to learn of zeolite operations in San Simon valley northeast of town. Upon questioning around I learned that I should contact "Dutch" Grusendorf, proprietor of the Bowie Lumber Yard. Mr. Grusendorf was not in (he works at Morenci and is only home in the evenings) but I was able to talk to his partner Mr. Gates. I learned that Mr. Grusendorf is the general caretaker of the properties northeast of town. He does the assessment work, quarrying and hauling, etc. for the property owner. If they need a gondola load of material they call down and inform Grusendorf, who loads the train car and also keeps the warehouse stockpiled.

The zeolites in this locality consist primarily of the minerals, chabazite, erionite, and clinoptilolite. These occur in bedded altered silicic tuff deposits of Miocene age. The

zeolite originally was deposited as an air borne tuff that settled in an ancient lake bed. The zeolite formed after deposition of the rock mainly by reaction of the ash with interstitial water. The bedded deposits are a potential resource because they can be extensive and high in purity. The beds are flat layers 0" to 15" thick and consist of more than 90% zeolite. Sometimes as much as 20 feet of overburden is present.

The operations at the property consist of drilling (auger) to test for thickness of deposit and amount of over burden. The overburden is then stripped away. The surface of the deposit is broomed off. A blade is ued with teeth on it to slide under the bed of zeolite, lift, shake, and break it up. The material is then hand-cobbed, loaded on trucks, hauled to the warehouse at the railroad siding in Bowie. Here, plastic-lined gondolas are loaded (plastic keeps water absorption and impurities down) and shipped to Gallop, New Mexico. The material is then run through a ball mill and pelletized. The material is mixed with synthetics.

The zeolites in this area are worth about $1,000,000/acre at the present price of $1.65/lb. The mining costs are about $50/ton of ore.

A telephone call (Dec. 11th) from Mr. Pete Aguilar, U.S.G.S. geologist from Roswell, New Mexico called in reference to a geologic map of the area that I had made a written request for. He told me that he couldn't give me a copy of the map until it was open-filed. He said that perhaps Bob McColly, U.S. Bureau of Land Management in Phoenix could show me his copy. Mr. Aguilar discussed the zeolite properties and the general operation as he knew them. Most of the information from the conversation is contained in here. I asked him if there was much of a future for zeolites and he was very enthusiastic about their demand and new uses that have been made of them. He though it would be an excellent commodity study for us to persue, when I asked him. He said that he would be back in this sometime in January and that if I were willing, he would get in touch with me and he would take me on a field trip with him through the area. He said he had been over every foot of the ground; so I could gain a lot of first hand knowledge very quickly from his experience.

Industry now uses snythetic zeolites almost exclusively but as economic methods are developed to convert material into a commercial product, large natural deposits may become important.

This locality has only been commercially exploited since 1968. The bedded zeolites of Arizona are potentially exploitable but studies to determine their size and value await further industrial development and the establishment of suitable markets.

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

1. Information from: Personal Visit and Wayne Berkey
   Address: Union Carbide, Grand Junction Colorado 81501
2. Mine: EZ
3. No. of Claims - Patented
   Unpatented Probably over 1 township II-1200
4. Location: 7 miles north of Bowie in Graham County
5. Sec 36 or more Tp 11S Range 28E
6. Mining District ?
7. Owner: Union Carbide Corp.
8. Address: Grand Junction Colorado 81501
9. Operating Co.: same
10. Address:
11. President:
12. Gen. Mgr.:
13. Principal Metals: Chabazite
14. No. Employed: 5 to 8
15. Mill, Type & Capacity:
16. Present Operations: (a) Down ☐ (b) Assessment work ☐ (c) Exploration ☒
    (d) Production ☒ (e) Rate _____ tpd.
17. New Work Planned: The Union Carbide Company is careful when replacing the mined out areas to leave ~~it~~ it in such condition that erosion will not take place, and that the natural vegation will return within a few years. The local ranchers and the BLM have approved of the way they are mining. The mine can be seen from the Airlines flying east out of Tucson.
18. Miscl. Notes: Mr. Jack Foote a local rancher has the mining contract. He sublets to M. C. Grusendorf of Bowie. 5 to 8 men are employed . The surface is carefully ~~removed exposing a horizontal layer of Chabazite that is from a few to a maximum of 8" thick.~~ This is carefully cleaned with brooms and then removed by a loader and trucked to Bowie where it is loaded into the old SP coaling station that holds three carloads. Thence it is shipped to the Union Carbide plant for processing. It had not been decided at time of visit whether the program would be extended beyond the requirements for assessment work.

Date: 2-4-70

G W Im.
(Signature) (Field Engineer)

# DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

**Mine** EZ
(Formerly Union Carbide Non-Metallic Expl.

**Date** December 8, 1966

**District** San Simon Dist. Cochise Co.

**Engineer** G. W. Irvin

**Subject:** Field Engineers report.
Infomation from M. C. Grusendorf, Bowie, Arizona. & BLM Safford Office.

The map while not complete approximates the claim area.

See A. Johnson report of 12/ 31/ 64

# DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine EZ Mine (formerly Union Carbide Non-Metallic Exploration)
District San Simom District, Graham Co.

Date December 31, 1964
Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Ted H. Eyde, geologist for Union Carbide.

References: Report of Oct. 31, 1963 & previous reports.

Present Activity: No work being done at the property at present.

Review of Recent Operations: During the past few months, 2 carloads of the ore was mined and shipped to Grand Junction, Colo. for use in the Union Carbide Nuclear Co. operations.

Additional stripping was also done to take care of the annual assessment work.

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Union Carbide had shipped the bin of Chabazite from RR storage bin. No Activity at present.

Field Interview GWI WR 6/5/65

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Only activity is assessment work (GWI WR 10/11/65).

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# DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine Union Carbide Non-Metallic Exploration Date Oct. 31, 1963

District San Simon District, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Ted H. Eyde, geologist for Union Carbide.

References Report of May 10, 1962 & previous reports.

Present Activity No work being done on the property at present. The annual assessment work was done prior to Sept. 1.

Review of Recent Operations The work during the past fiscal year has consisted of stripping of overburden, and also mining and shipping ~~about~~ 3 carloads of ore (about 150 tons) to Grand Junction, Colo. for testing and use. This shipment of ore was made in October and November, 1962.

Future Plans The company plans to mine and ship about 4 or 5 carloads of ore every year. This will take care of the annual assessment work. The ore shipments will be made to Grand Junction, Colo., where it will be used by the Union Carbide Nuclear Co., at 1600 Ute Ave., Grand Junction, Colo. Mr. Eyde states that they are able to use very little of the material at the present time, but that they expect that the uses of the material will increase gradually year after year.

# DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Union Carbide Non-Metallic Exploration Date May 10, 1962

District San Simon District, Graham Co. Engineer Axel L. Johnson

Subject: Information from Ted H. Eyde & John Herron, geologists and personal visit.

References: Reports of May 24, 1961 and April 28 - May 1, 1961.

Location: (1) Sections 13, 17, 18, 19, 20, 21, 27, 28, 29, 33 & 34 - T. 11 S., R. 29 E., Graham County. (Federal land)
(2) Sections 1, 2, 3, 4, 10, 11 & 12 - T. 12 S., R. 29 E. - Cochise County. (State)

Number of Claims: (1) Over 200 claims on Federal land in Graham County (single placer claims of 20 acres - 660' x 1320') (see location above) amounting to over 4,000 acres.

(2) State mineral prospecting permits on State land in Cochise County (see location above) divided into 128 - 20 acre claims (660' x 1320') - a total of 2,560 acres - covered by State permits #47, #48, #49, #50, #51, #127 & #128. (Issued Aug. 15, 1961)

Owners: Union Carbide Nuclear Co., 1600 Ute Ave., Grand Junction, Colo.

Principal Minerals: A 6 inch bed of zeolitized volcanic ash.

Present Activity: Rotary drilling with 1 drill rig working, one shift. The rotary drilling is being done on contract to Mitchell Co., Inc. drillers, Grand Junction, Colorado.

5 men working - viz:
(1) 1 geologist and 2 assistant geologists employed by Union Carbide.
(2) 2 drillmen with Mitchell Drilling Co.

Geology & Mineralization: See report of April 28 - May 1, 1961. Additional as follows: - The geology was described by John Herron on May 10th as follows: - The zeolitized bed was laid down as a fresh water lake deposit in the Pliocene or early Pleistocene period and is pre-glacial.

The fresh water lake was slightly alkaline, and this alkalinity caused the deposition of the zeolitized volcanic ash.

Ore Values: See Report of April 28 - May 1, 1961.

Milling: A concentrating plant for the material has been considered, but no plans have been made as yet, according to Mr. Eyde.

Review of Recent Operations: (1) Drilling by Mitchell Co., Inc. of Grand Junction, Colo., was discontinued last summer, and was resumed on March 15th, 1962. Drilling will be finished, for the time being at least, in about 10 days. The drilling method is described in report of April 28 - May 1, 1961 on page 2 under "Review of Operations." Mr. Herron reports that the holes have a depth of 10' to 70', with an average of 30', and that an average of 4 holes are drilled per day. He states that the cores obtained of the zeolitized material is BH size and larger.

(2) Open cut made (March 25 to April 25) about 200' square by 6' deep, exposing the zeolitized volcanic ash bed. It was estimated that about 100 tons of the zeolitized material is exposed.

(3) Also small open cuts have been made in 5 other places - two of these being in the State prospecting permit area.

# DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine * Union Carbide Non-Metallic Exploration Date April 28, 1961 & May 1, 1961

District San Simon District, Graham County. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Ted H. Eyde, et. al. & Personal visit.

Location Sections 13, 17, 18, 19, 20, 21, 27, 28, 29, 33, & 34 -- T 11 S -- R 29 E. About 12 to 15 miles NE of Bowie. Cross RR tracks near the Bowie RR depot, and drive N on a gravel county road for a distance of 0.8 miles, the E for 1.2 miles, then N for 1.4 miles, then E for 1.0 miles, then N for 5.1 miles, then E for 2.2 miles along county line, and then N from 1/4 to 3 miles to the exploration work.

Number of Claims Over 200 claims (single placer claims of 20 acres -- 660' x 1320'), amounting to over 4,000 acres. The first claims were staked out on Apr. 13, 1961. Mr. Eyde states that they staked out individual placer claims instead of association placer claims, because there are questions as to the validity of association placer claims by a company, as a company might be regarded as a single party.

Owners and Officers Union Carbide Nuclear Co., 1600 Ute Ave., Grand Junction, Colo., J. L. Lake, Gen. Manager.

Exploration Department of Union Carbide, 325 E. 4th St., Reno, Nev. H. E. Vitz, Research Geologist.

Ted H. Eyde, Geologist in charge of project, 6602 Cooper St., Tucson, Ariz.

Principal Minerals A 6 inch bed of zeolitized volcanic ash.

Present Mining Activity and drill holes. (1) Bulldozing access roads for location holes and rotary
(2) Rotary drilling with one rotary drill rig.
5 men working on the project at the present time.

Geology & Mineralization The claims are located in the San Simon Valley on the west side of San Simon Creek. The terrain is quite flat, with some low hills rising from 10 to 60 ft. above the level of San Simon Creek. The non-metallic deposit being explored is covered by 0 to 60 ft. of overburden. Below this overburden, there is a top layer of from 3 to 4 ft. of soft, powdery, dark green material, which has been classified as "partially altered volcanic ash". Below this, there is a bed of lightweight, porous, yellowish-orange material, about 6 inches thick, which breaks off in slabs like flagstone, and can be easily crushed to a fine powder. This material has been classified as "zeolitized volcanic ash". Below this 6 inch bed, there is a thick deposit of dark green, fine grained sediments, with a fairly high clay content. Mr. Eyde calls this montmorillonite clay, and Mr. Peirce of the Arizona Bureau of Mines says that probably some of it is montmorillonite. The writer is indebted to the Arizona Bureau of Mines, the U. S. Bureau of Mines, and Ted H. Eyde, Geologist, Union Carbide Nuclear Co. for these classifications. The bed of zeolitized volcanic ash, according to Mr. Eyde, is flat as a pancake and outcrops in the lower elevations near San Simon Creek. At the higher elevations, it is covered by overburden to a depth of 10 to 60 ft., with an average overburden of 10 to 15 ft. Mr. Eyde states that the bed is quite uniform in thickness and composition.

Ore Values According to Mr. Eyde, the Union Carbide Nuclear Co. is only interested in the 6 inch bed of zeolitized volcanic ash, and this material is now being tested in their Grand Junction, Colo. laboratories for its contents and possible industrial uses. Mr. Eyde mentioned "testing with X Ray defraction analyses" but did not state which minerals of the Zeolite Group were found in the deposit.

(continued from page 1)

Union Carbide Non-Metallic Exploration — April 28, 1961 & May 1, 1961

San Simon District, Graham County — Axel L. Johnson

Ore Values (con't) Regarding the value of the lower bed of fine grained sediments or clay, according to the U. S. Bureau of Mines, who have made tests of this material in their laboratories, the material is definitely not bauxite, but a plastic clay, and a report from their experimental laboratory states that a visual microscopic examination shows from 15 % to 20 % of $Al_2O_3$.

Ore in Sight and Probable The deposit covers about 10 sections in Graham County, besides about 3 sections in Cochise County.

Past History According to Mr. Eyde, the Union Carbide Nuclear Co. has known about this deposit for about 3 years, but did not stake claims. However, when the news of the reported bauxite find came out in the newspapers about 3 to 4 months ago, they deemed it necessary to go in there and stake claims to keep ahead of other locators.

Mine Workings None, except location holes and rotary drill holes now being put down.

Review of Operations The company has one bulldozer operating, making access roads for claim location work and for the rotary drilling operations.

Rotary drilling is being done on contract by Mitchell Co. Inc.,drillers from Grand Junction, Colo., one rotary drill rig being used. This drilling was started on the afternoon of April 26, 1961, and at quitting time on April 27, Mr. J. C. Mitchell, Jr of the Mitchell Co. reported that 4 holes had been drilled to a depth of 20 to 70 ft.

5 inch diameter holes are drilled, using a Mayhew Rotary drill, mounted on a Ford truck, and run by means of an air compressor, which is also mounted on the truck.

When the bed of zeolitized volcanic ash is encountered, the drill is equipped with a core bit, and a core is obtained from this material. These drill cores will be shipped to Union Carbide laboratories in Grand Junctionk, Colo. for testing.

Mr. J. C. Mitchell, Jr. reports having trouble with alluvial material running into the holes, and says that he finds it necessary to plaster the holes. For this purpose, he uses wall plaster, mixed with bentonite and a small amount of lime.

According to Mr. Eyde, the present drilling program calls for over 200 holes ---- one hole on each claim to show discovery. The maximum depth of the holes will be about 70 ft., and minimum depth 10 ft., with an average depth of about 35ft. One additional test hole may be drilled to a depth of 150 ft.

Possible Uses

(1) Regarding the zeolitized volcanic ash, which is the only part of the deposit the Union Carbide Co. claims it is interested in:

Mr. Eyde stated that the company expects to find commercial uses for the product by private companies in private industry. He did not mention that the Union Carbide Co. expected to use the product in their own plants, nor did he suggest any specific uses for the product. The writer presumes that the company regards this as a trade secret, and suggests the possibility that they may expect to use the product in their Uranium mills as a filtering agent. However, this is merely a speculation.

(2) Regarding the fine grained sedimentary deposit of clay:

The conclusions reached by the U. S. Bureau of Mines laboratories are as follows: " There would be a possible chance of using this clay for a plastic mixer to be blended with other less plastic clays and sand to make common brick, if fired at 1800 deg. F. or less "

Proposed Plans

(1) To explore by means of drill holes the lateral extent, average thickness and approximate tonnage of the deposit.

(2) To test the drill cores in their laboratories at Grand Jct. Colo.

# DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Union Carbide Non-Metallic Exploration Date May 24, 1961

District San Simon District, Graham Co. Engineer Axel L. Johnson

Subject: Information from Ted H. Eyde, Geologist in charge.

References Report of April 28, 1961 & May 1, 1961

Present Activity Rotary and diamond drilling with 2 drill rigs working. Also bulldozer work, making access roads. The rotary drilling is being done on contract to Mitchell Co. Inc., drillers, Grand Junction, Colo. 137 holes have now been drilled, and another 100 holes remain to be drilled.

Proposed Plans Plans are now being considered for the construction of a 100 tons per day concentrating plant to be used for treatment of the zeolitized volcanic ash to be mined from their property. The location of the plant has not, as yet, been decided upon, but will, most likely,be near the town of Bowie, if a sufficient supply of water can be obtained there, and a suitable building site can be obtained. Mr. Eyde stated that air separation would be used principally for the concentration of the material, but that there will also be a considerable amount of water used.

Remarks Mr. Eyde asked the field engineer for information on the Arizona tax laws, and the cost of labor to assist him in the preparation of an estimate on plant construction and stripping costs. Engineer gave Mr. Eyde a copy of our bulletins "Arizona Mine Tax Laws- Past and Present", and also a copy of our bulletin "Mine Taxation in Arizona". He also showed him wage statistics in Arizona copper mines, and referred him to Frank J. Tuck of our Phoenix office for further information in regard to this.

# A ZONA DEPARTMENT OF MINER RESOURCES

**Mineral Building, Fairgrounds**
**Phoenix, Arizona**



1. Information from: Grusendorf Hardware store, Bowie
   Address:
2. Mine: EZ
3. No. of Claims - Patented
   Unpatented
4. Location: Graham County
5. Sec Tp Range
6. Mining District San Simon
7. Owner: Union Carbide
8. Address:
9. Operating Co.:
10. Address:
11. President:
12. Gen. Mgr.:
13. Principal Metals: Chabazite
14. No. Employed:
15. Mill, Type & Capacity:
16. Present Operations: (a) Down ☐ (b) Assessment work ☒ (c) Exploration ☒
    (d) Production ☐ (e) Rate tpd.
17. New Work Planned:
18. Miscl. Notes: Three carloads of Chabazite have been loaded in the old coaling station at the SP station in Bowie. Will be shipped when needed.

Date: 11-15-57

G. W. Irwin
(Signature)

(Field Engineer)

STATE OF ARIZONA
DEPARTMENT OF MINERAL RESOURCES
MINERAL BUILDING, FAIRGROUNDS
PHOENIX, ARIZONA 85007
602/271-3791

MEMORANDUM

TO: J. H. Jett
FROM: G. W. Irvin
SUBJECT: Quarterly Report - Commodity Study
DATE: April 5, 1977

Enclosed is a preliminary rough draft of the Zeolite study. Of the eighteen reported areas of Zeolites shown on the State map, only one has been visited. The Bowie area which is probably the most important Zeolite producing area in the U. S., has been visited several times by Department engineers since its inception. The other reported areas of potential commercial Zeolites should be visited before the final draft of this report. This will depend upon available time and travel money. In one instance a material is being marketed in Maricopa County that is not called a Zeolite, but a description of its properties would indicate that it is. Because of identification difficulty it would appear that the reserves in Arizona may be quite large but at present not recognized or identified.

The abstracts of the 65 papers that were presented at the Zeolite 76 International Conference are in the Tucson office. It is hoped that some of the complete papers will be published soon as some of the contained information would be a valuable addition to this report.

For the next quarter, the Zeolite report should be completed except for visiting all of the properties. If time and finances permit, three or four areas should be visited and reports written.

The Uranium study will be started the next quarter. First phase will be a bibliography and a general discussion.

## ABSTRACT

ZEOLITES HAVE BEEN KNOWN SINCE THE 1750's. THE FOURTH EDITION OF "DANA" LISTS MORE THAN 50 IDENTIFIABLE ZEOLITE MINERALS. THE ZEOLITES THAT WERE RECOGNIZED EARLIER WERE THOSE THAT OCCURRED AS FRACTURE AND VESICLE FILLINGS IN MAFIC ROCKS. SINCE 1950, ZEOLITES HAVE BEEN RECOGNIZED AS AN IMPORTANT ROCK FORMING CONSTITUENT OF MANY LOW GRADE METAMORPHIC AND SEDIMENTARY ROCKS. MOST OF THE AVAILABLE ZEOLITE RESERVE IS IN THE SEDIMENTARY ROCKS AND WERE FORMED BY THE REACTION OF SALINE ALKALINE WATERS WITH VOLCANIC GLASS. OF THE FIFTY OR MORE NATURAL OCCURING ZEOLITES, 20 HAVE BEEN FOUND IN SEDIMENTARY ROCKS. A FEW BEDS CONTAINING ONLY ONE VALUABLE ZEOLITE ARE KNOWN BUT MOST CONTAIN CLAY AND SILICA MINERALS ALONG WITH FELDSPARS OF SIMILAR DERIVATION. THERE IS A LARGE TONNAGE AND VARIETY OF ZEOLITES AVAILABLE AT A REASONABLE MINING COST. AT THE PRESENT TIME, 1977, THE UNITED STATES PRODUCTION IS AT THE RATE OF SEVERAL HUNDRED TONS PER YEAR. IT WOULD APPEAR THAT NEW MARKETS WILL BE DEVELOPED ALONG WITH TREATMENT PROCESSES THAT WILL MAKE LARGE TONNAGES OF NATURAL ZEOLITES AVAILABLE FOR THE MANY USES THAT THEIR UNIQUE CHARACTERISTICS PROVIDE.

SIXTEEN IDENTIFIABLE AREAS OF ZEOLITE OCCURRENCE ARE SHOWN ON THE ACCOMPANYING MAP WITH SHORT DESCRIPTION OF THE OCCURENCE AND ITS LOCATION.

STATE OF ARIZONA
DEPARTMENT OF MINERAL RESOURCES
MINERAL BUILDING, FAIRGROUNDS
PHOENIX, ARIZONA 85007
602/271-3791

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Zeolite 76 "An International Conference on the Occurrence, Properties, and Utilization of Natural Zeolites" Held at Tucson, Arizona, June 6-June 14, 1976. 65 papers by well known experts on Zeolites. Abstracts only available at present.

## INTRODUCTION

ZEOLITES ARE CRYSTALLINE HYDRATED ALUMINOSELICATES THAT ARE IMPORTANT ROCK FORMING CONSTITUIENTS IN SEDIMENTARY ROCKS. THEIR UNIQUE PROPERTIES ARE DUE TO THEIR STRUCTURE THAT ALLOWS AN INTERNAL FREEDOM OF MOVEMENT THAT GIVE THEM THEIR CATION-EXCHANGE AND REVERSE DEHYDRATION PROPERTIES. THE GAROUS FRAME-WORK ALLOWS THEM TO ACT AS MOLECULAR SIEVES FOR THE SEPARATION OF MOLECULAR MIXTURES ACCORDING TO THE SIZE AND SHAPE OF THEIR MOLECULAR COMPOUNDS.

SYNTHETIC ZEOLITES HAVE BEEN PRODUCED IN THIS COUNTRY FOR THE PAST 25 YEARS. THESE HAVE BEEN USED IN MOST OF THE PETROLEUM CRACKING INSTALLATIONS RESULT-ING IN A GREATLY INCREASED GASOLINE RECOVERY. THEY ARE ALSO USED AS CATALYSTS, DESICCANTS AND FOR THEIR SELECTIVE ABSORBENT CAPABILITIES. THE ADVANTAGE OF USING THE SYNTHETIC ZEAOLITES WOULD BE THEIR UNIFORM STRUCTURE AS MAKE UP. THE DISADVANTAGE AND DETERENT TO OTHER APPLICATIONS AND USES IS THE COST. PROPER RECOGNITION, DELINATION AND TREATMENT PROCESSES FOR NATURAL OCCURRING ZEOLITES SHOULD CREATE A DEMAND FOR THE NATURAL PRODUCT.

THE PRIMARY APPLICATION OF NATURAL ZEOLITES SHOULD BE IN POLUTION CONTROL PROCESSES.

## EXPLOITATION

THERE ARE NO PUBLISHED FIGURES ON NATURAL ZEOLITE PRODUCTION IN THE UNITED STATES. SINCE THE EARLY 1950's ACTIVE EXPLORATION, HAS BEEN GOING ON IN ARIZONA, CALIFORNIA, NEVADA, OREGON, TEXAS, AND WYOMING. MOST OF THE PRODUCTION IN ARIZONA HAS BEEN FROM THE FIELD ALONG SAN SIMON CREEK IN GRAHAM COUNTY NORTH OF BOWIE. ALL OF THE PICTURES OF ACTIVE MINING SHOWN IN THIS STUDY ARE FROM THE BOWIE AREA. THIS AREA HAS PROBABLY PRODUCED NEARLY $7,000,000 SINCE ITS DISCOVERY.

## USES

NATURAL ZEOLITES ARE USED IN GAS PURIFICATION, THE SEPARATION OF NITROGEN FROM OXYGEN TO SUPPLY OXYGEN RICH AIR FOR AN IRON FOUNDRY. THEY ARE USED EXTENSIVELY FOR PAPER FILTERS, LIGHTWEIGHT AGGREGATES, PUZZOLANS, SOIL CONDITIONER, DIMENSION STONE, AS FEED ADDITIVE, AGRICULTURAL FERTILIZER, FOR THE REMOVAL OF AMMONIA, AND ALSO THE PURIFICATION OF SEWAGE.

## GEOLOGY

WHILE ZEOLITES HAVE BEEN RECOGNIZED IN IGNEOUS ROCKS FOR TWO CENTURIES. THIS WAS DUE TO THE ATTRACTIVE SPECIMENS FROM THIS SOURCE THAT FOUND THEIR WAY INTO MUSEUM COLLECTIONS. THE ZEOLITES FOUND IN SEDIMENTARY ROCKS SINCE THE EARLY 1950's ARE NOT ATTRACTIVE TO MINERAL COLLECTORS, BUT THE QUANTITY AND END USES HAVE GREAT ECONOMIC POTENTIAL. MOST OF THE REPORTS DESCRIBING ZEOLITES HAVE OCCURRED WITH THE PAST 10 TO 15 YEARS. AN INTERNATIONAL CONFERENCE ON THE OCCURRENCE, PROPERTIES AND UTILIZATION OF NATURAL ZEOLITES WAS HELD IN TUCSON, ARIZONA, JUNE 6 TO 14, 1976. SIXTY-FIVE PAPERS BY 104 AUTHORS WERE LISTED IN THE CONFERENCE PROCEEDINGS.

WHILE ZEOLITES ARE AMONG THE MOST COMMON AUTHIGENIC SILICATE MINERALS THAT OCCUR IN SEDIMENTARY ROCKS, SOME ARE ONLY IN TRACE AMOUNTS AND MAY NOT BE REPORTED. THE NINE ZEOLITES THAT COMMONLY MAKE UP A MAJOR PART OF ZEOLITES ROCKS ARE ANALCUME, CHABAZUTE, CLENAPTILOLITE, ERIONITE, FERRIERITE, HEULANDITE, LAUMONTITE, MORDENITE, AND PHILLIPSITE.

MOST OF THE SEDIMENTARY ZEOLITES HAVE BEEN FORMED FROM THE ACTION OF SILICIC VOLCANIC GLASS WITH SALINE OR ALKALINE WATER AFTER BURIAL OF ENCLOSING SEDIMENTS. MOST OF THESE DEPOSITS OCCUR IN TUFFACEOUS SEDIMENTS THAT HAVE NEITHER BEEN DEEPLY BURIED OR EXPOSED TO HYDROTHERMAL SOLUTIONS.

## RESERVES

IN 1968, DEFFEYES ESTIMATED THAT THERE WERE ABOUT 120,000,000 TONS OF ZEOLITES IN NEAR SURFACE DEPOSITS OF THE BASIN AND RANGE PROVINCE: MUCH RESEARCH IS NEEDED ON THE GENESIS OF ZEOLITES, THE RECOGNITION OF AND USES. IT IS DIFFICULT TO RECOGNIZE ZEOLITES FROM DRILL CORE LET ALONE THAT OBTAINED BY PERCUSSION BIT, ROTARY OR CHURN DRILL CUTTINGS OR OTHER METHODS. IT REQUIRES A PERSON WELL TRAINED AND OBSERVANT TO DO THIS. THERE ARE PROBABLY MANY UNTOUCHED AND UNRECOGNIZED ZEOLITE DEPOSITS THAT ARE WAITING TO BE RECOGNIZED.

# BEDDED ZEOLITE DEPOSITS IN ARIZONA

## MOHAVE COUNTY

| LOCATION | QUADRANGLE MAP | OCCURENCE | OWNER (S) OF RECORD (IF ANY) |
|---|---|---|---|
| SEC 11<br>21N20W | UNION PASS 7½ | MORDENITE IN TUFF & LAPILLI OF GOLDEN DOOR VOLCANIC (TERTIARY) | UNION CARBIDE |
| SEC 11<br>16N-13W | WIKIEUP 7½ | ANALCIME, CHABAZITE, ERIONITE, PHILLIPSITE, CLINOPTILOLITE IN LACUSTRINE TUFF (PLIOCENE) | |
| SEC 24-25-26<br>16N-13W | WIKIEUP 7½ | GREEN ANALCIME IN MUDSTONES, BIG SANDY FORMATION (PLIOCENE) | |
| SEC 18<br>15N-12W | WIKIEUP 7½ | GREEN ANALCINE, CHABAZITE ERUNITE IN BIG SANDY FORMATION (PLIOCENE) LACUSTRINE TUFF | |
| SEC 29-30<br>15N-12W | GREENWOOD PK 7½ | YELLOW CLINOPTILOLITE IN TUFF WITHIN SILTSTONE, SANDSTONE | |
| SEC 20<br>15N-12W<br>SEC 1-2<br>15N-13W | WIKIEUP 7½ | ANALCIME, CHABAZITE, ERONITE IN LACUSTRINE TUFF(PLIOCENE) | |
| SEC 30-31<br>12 N-13W | ARTILLERY PK 15<br>(MAGGIE CANYON) | ANALCIME IN SANDSTONE (PLIOCENE) | |
| | LIVINGSTON HILLS 15<br>(CASTLE DOME MTS.)<br>NEAR STONE CABIN | YUMA COUNTY<br>CLINOPTILIOLITE | YUMA ZEOLITE CORP. |
| NE ¼<br>85-21W | LAGUNA 15<br>(DOME) | CLINOPTILIOLITE ASSOCIATED WITH BENTONITE IN LACUSTRINE TUFF. (TERTIARY) | |
| SEC 3<br>7N-6E | HORSESHOE DAM 7½<br>(HORSESHOE RESEVOIR AREA) | MARICOPA COUNTY<br>CLINOPTILIOLITE ASSOCIATED WITH TUFF OF VERDE FORMATION (CIGTACEOUS) | |
| SEC 25<br>7S-8E | PICACHO RESEVOIR 7½ | ANALCIME IN SILTY CLAYSTONE (TERTIARY)<br>PINAL COUNTY | |

| LOCATION | QUADRANGLE MAP | OCCURENCE | OWNER (S) OF RECORD (IF ANY) |
|---|---|---|---|
| SEC 12<br>15S-24E | COCHISE<br>(WILLCOX PLAZA) | COCHISE COUNTY<br>ANALCIME IN MUDSTONE<br>PLEISTOCENE | |
| SEC 14<br>23S-19E | SUNNYSIDE 15<br>(EUICHA CANYON) | REPORTED OCCURENCE AT<br>LEANHARDITE (LAUMONTITE) | |
| SEC 1 & 2<br>12S-29E | BOWIE 15<br>(SAN SIMON CREEK) | CHABAZITE, ANACLIME, CLINOPTILOLITE<br>ERONITE IN LACUSTRINE VOLCANIC TUFF<br>(CENEZOIC) | |
| SEC 2<br>6N-30E | ALPINE 15<br>NUTRIOSO AREA | APACHE COUNTY<br>ANALCIME, CLINOPTILOLITE IN<br>SANDSTONE | |
| SEC 15-16<br>6N-30E | ALPINE 15<br>NUTRIOSO AREA | ANALCIME, CLINOPTILOLITE IN<br>SANDSTONE | |
| SEC 11<br>5N-30E | ALPINE 15<br>NEAR ALPINE | CLINOPOTILOLITE IN TUFF | |
| 11S-29E | BOWIE 15 | GRAHAM COUNTY<br>CHABAZITE, ERICURITE, ANALCIME,<br>CLIMOPTILOLITE, MOIDENITE & PHILLIESITE<br>TUFFS IN LACUSTRINE FORMATION<br>(LATE CENEZOIC) | |
| SEC 16<br>3S-9E | CLIFTON 15 | GREENLEE COUNTY<br>CLINOPTILOLITE & MORDENITE IN<br>LAPILLI & TUFF (TERTIARY) | |

THE MOST IMPORTANT PRODUCTIVE IN ARIZONA AND THE UNITED STATES ALONG SAN SIMON CREEK IN GRAHAM AND COCHISE COUNTIES. UNION CARBIDE, THE NORTON COMPANY, FILTROL CORPORATION, AND RESERVE SYNTHETIC FUELS INCORPORATED EITHER MINE OR HOLD LAND POSITIONS ON THIS LARGEST KNOWN HIGH PURITY CHABAZITE DEPOSIT.

THE ACCOMPANYING PHOTOGRAPHS WERE TAKEN OF THE BOWIE FIELD OPERATIONS DURING 1976. 1A THRU 1F = UNION CARBIDE OPERATION, THE MATERIAL BEING MINED IS LOW GRADE MIXED AND AT PRESENT TIME NOT ECONOMIC, AS CAN BE SEEN IT IS BEING STOCKPILED. A FEW MORE FEET WILL REACH THE HI-GRADE MATERIAL AND THE STRIPPING WILL CEASE.

2A THRU F = MORE VIEWS OF THE SAME OPERATION. 1A SHOWS THE PINALENO MOUNTAINS IN THE BACKGROUND.

3A - THE LOW-GRADE HAS BEEN REMOVED AND THE LOADER IS CLEANING THE SURFACE BY FLOATING THE BUCKET ACCROSS THE SURFACE OF THE ZEOLITE BED. THE MEN IN THE PICTURE ARE CLEANING THE SURFACE WITH COMPRESSED AIR SAMPLE PICKS AND BROOMS. 3C and 3D SHOW UP THE UNEVEN NATURAL SURFACE OF THE ZEOLITE BED. IN THIS PIT A CONSIDERABLE SHORTAGE BETWEEN DRILLING AND MINING OCCURRED.

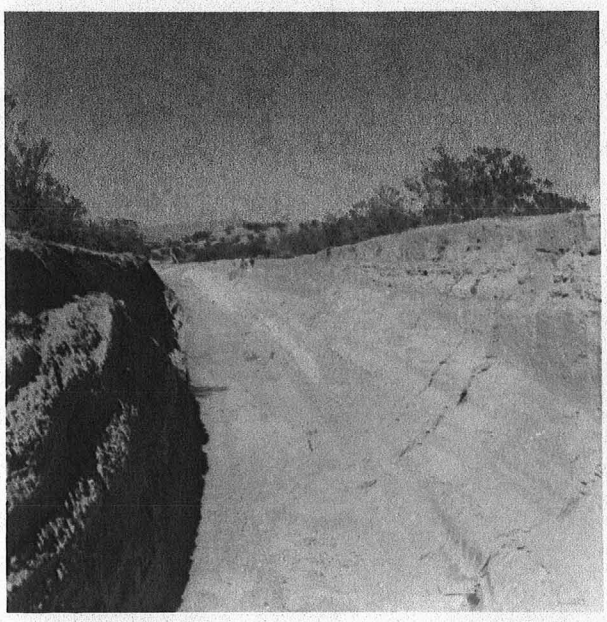
PICTURES 3E & 3F SHOW 4,000,000 YEAR OLD CAMEL TRACKS THAT WERE JUST UNDER THE ZEOLITE BED A LARGE PIECE OF CHABAZITE WITH THE INVERTED TRACK IS IN THE DEPARTMENT MINERAL MUSEUM. PICTURES ON PAGE FOUR WERE ALL TAKEN IN THE NORTON WORKINGS. THE THICKNESS OF THE BED CAN BE SEEN ALONG WITH THE PILE.

5A SHOWS BED THICKNESS. 6B THE UNION CARBIDE LOADING BIN AT BOWIE. THIS WAS AN S. P. COAL LOADING STATION AT ONE TIME. PHOTO 5C SHOWS THE NRG MINING CORPORATION STORAGE FACILITIES AT BOWIE JUST WEST OF THE SAFFORD, GLOBE "Y" ON THE MAIN LINE.

1

The photos on this and the following page show the method of uncovering the hi-grade bed. This is a Union Carbide operation.

a



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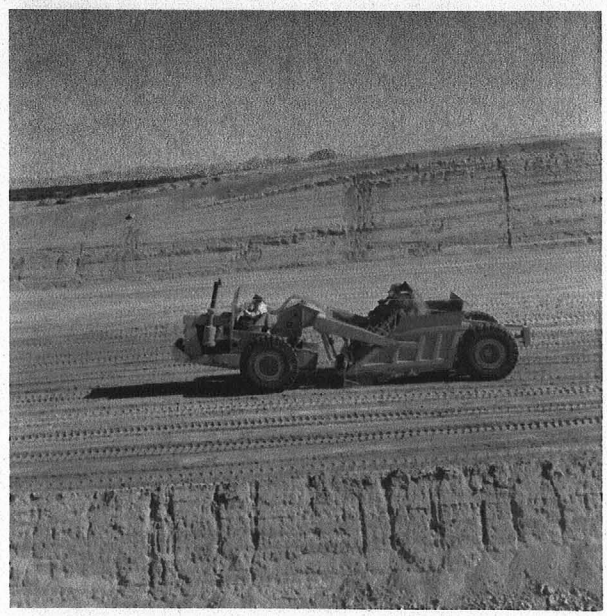

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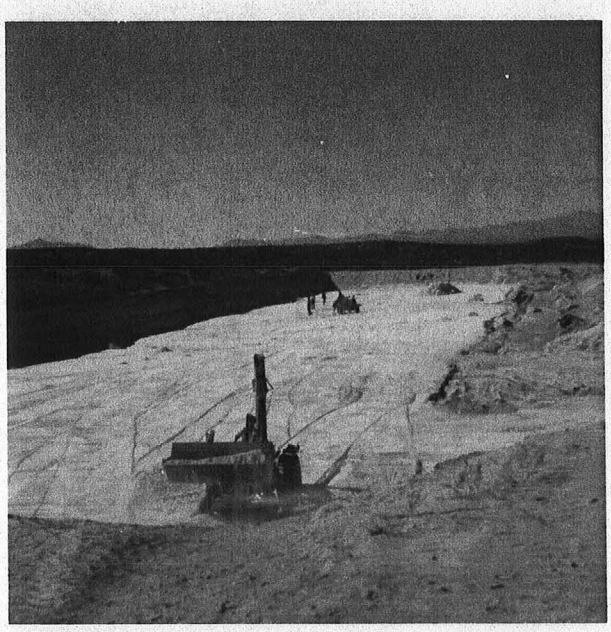

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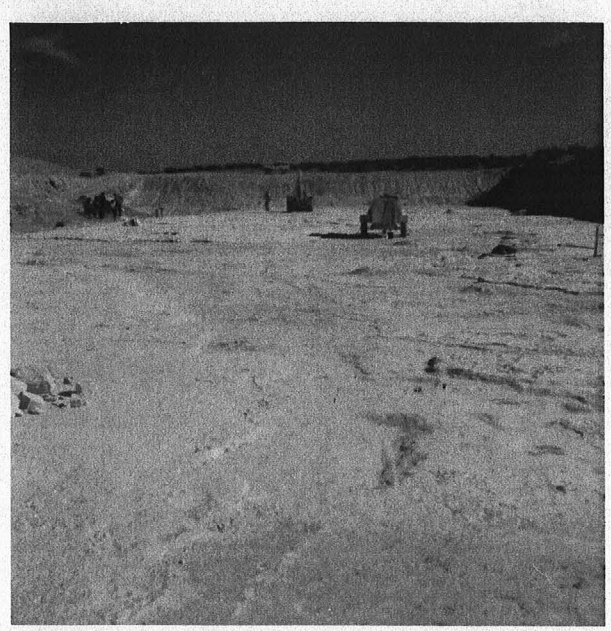

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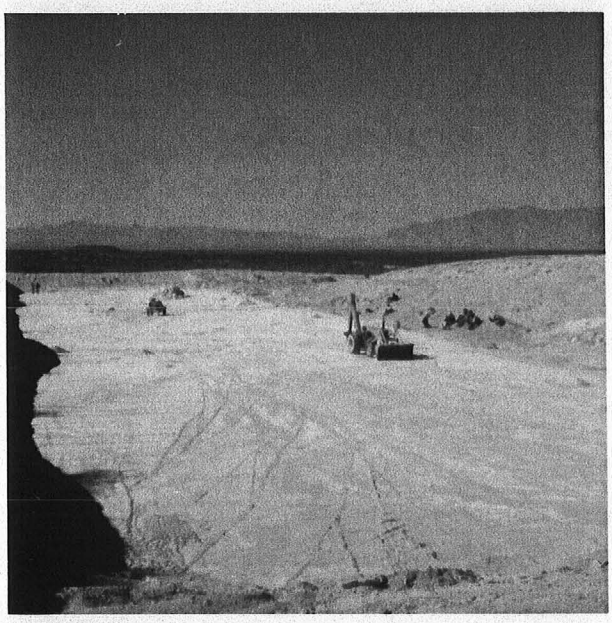

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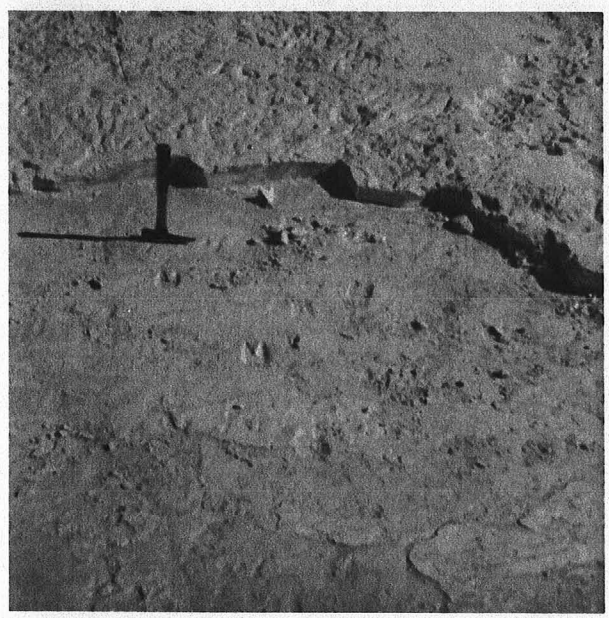

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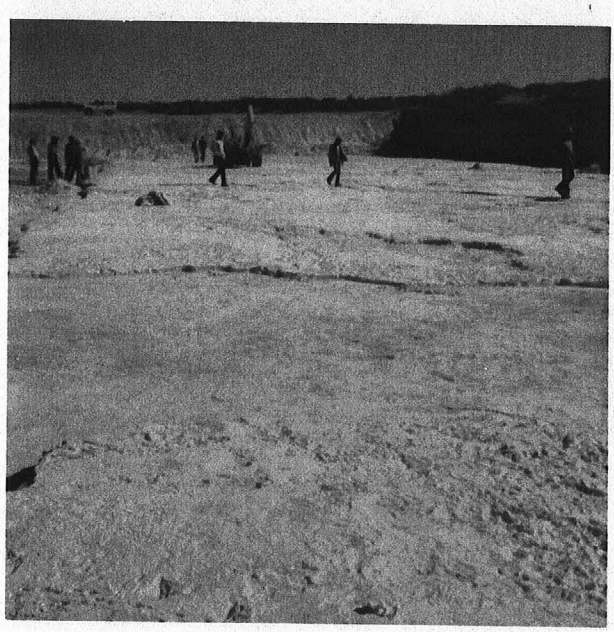

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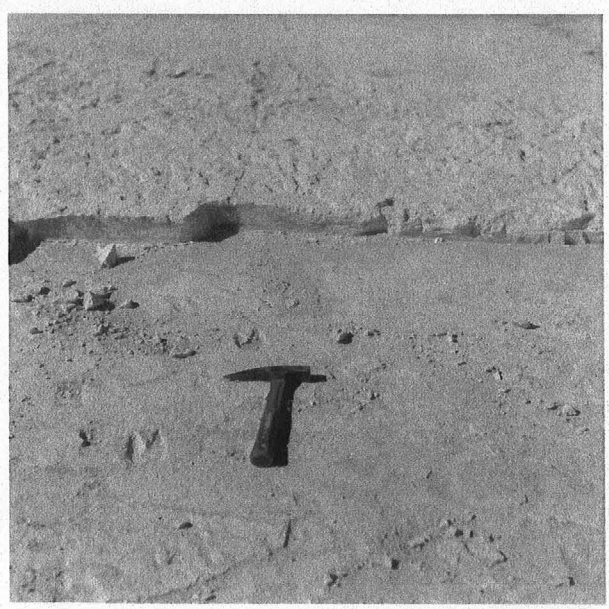

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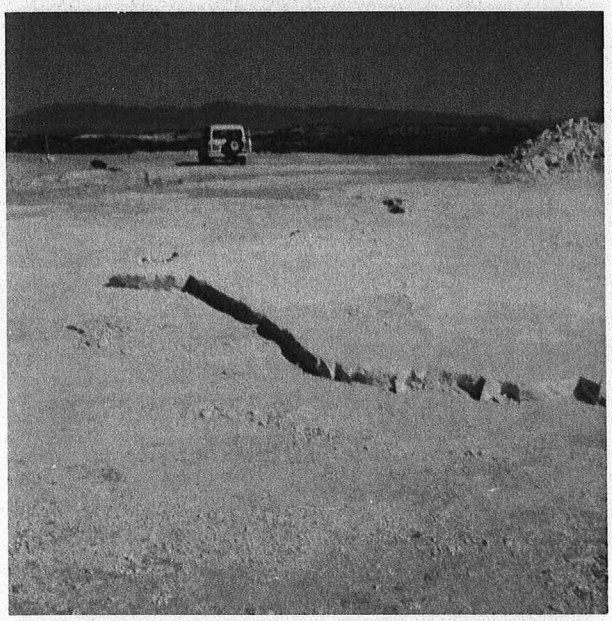

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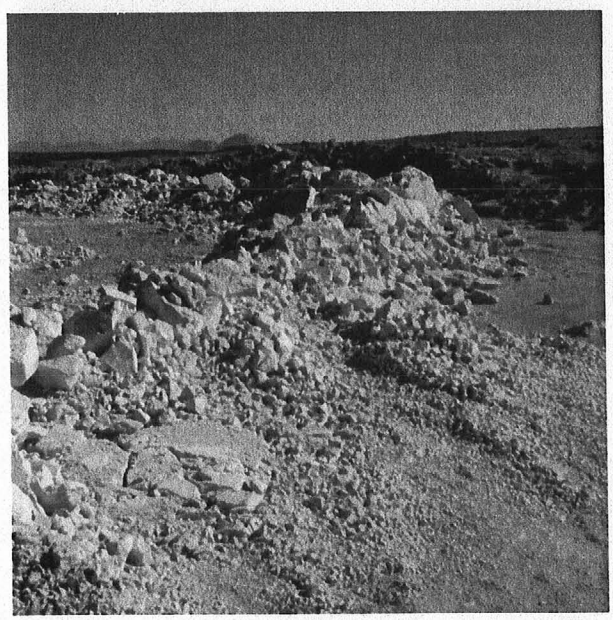

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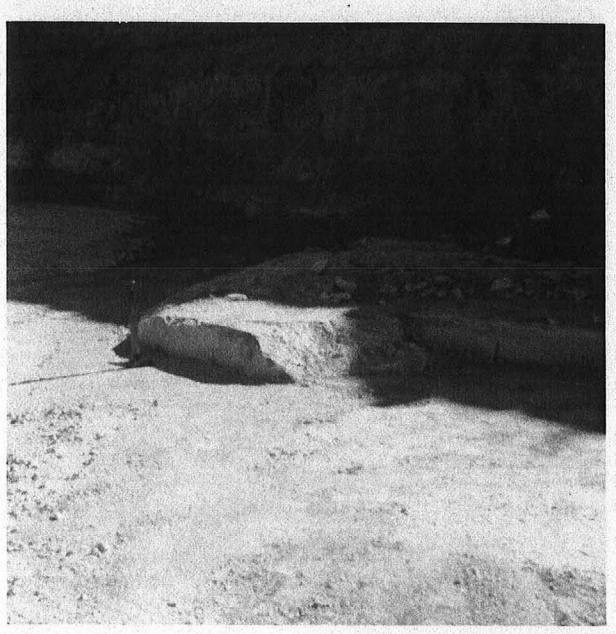

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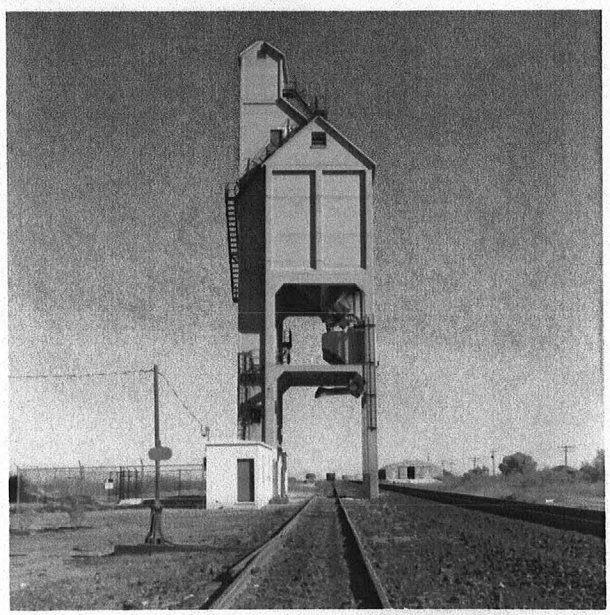

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