Application - Secs 1, 2, 3, 13, 15 - T.14N., R.

60-23

Mining Lease of March 23, 1955

Lessor New Mexico. to Lessee Joe R. Martinez

Sec 2. T.14 N. R10 W = 640.16 acres.

Requires consent of Lessor for assignment

above Assigned to Sabre Uranium May 23, 1955 and consented to by State of N.M. Com. of Public Lands.

Papers OK. on Sec. 2.

Mining Lease, May 10, 1955. No. 9450

Lessor Santa Fe Pacific R.R. Co. To

Lessee Victor Salazar

Secs. 1, 3, 5, 7, 21 and 23, T. 14 N., R. 10 W.

Secs. 25, 27, 29, 31, 33 and 35, T. 15 N., R. 10 W.

subject to oil & gas lease in sec 3.

Mining Lease May 10, 1955 - No. 9451

Lessor Santa Fe Pacific R.R. Co To

Lessee. Richard D. Bokum, II

then 5 years - explore
1 year - mine

copy of ~~Written permission from Lessee to transfer from above. to Sabre act submitted~~ received July 5th

~~(Expires)~~ ?

Surname copy 700

Murphy

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

NOV 1 0 1955

Mr. Hugh M. Craigie, President
Sabre Uranium Corporation
18-19 Reed Building
Box 1549
Grand Junction, Colorado

Re: Docket No. DMEA-3869 (Uranium)
State and Santa Fe Pacific R. R. Lease
Secs. 1, 2, 3, 13, and 15,
T. 14 N., R. 10 W.
McKinley County, New Mexico

Dear Mr. Craigie:

This will acknowledge your letter of November 7, 1955, advising that you wish to withdraw the above-docketed application since you are undertaking the exploration of these and other sections in the area with private financing. Accordingly, we are closing this docket on our records.

We wish to thank you for your interest in the exploration program during the period your application has been under consideration.

Sincerely yours,

C. O. Mitendorf (for)

Administrator

FMMurphy/gla
11-9-55
cc to: Admr.'s Reading File
Docket
Messrs. JECrawford, Rm. 3641
THKiilsgaard, Rm. 5224
JCHosted, Rm. 3210, GSA
Code 700
Mr. Murphy
DMEA Field Team, Region III (2)

11-9-55 zm

RECEIVED

NOV - 9 1955

Sabre Uranium Corporation

POST OFFICE BOX 1549

GRAND JUNCTION, COLORADO

TELEPHONE: 3840

November 7, 1955

Mr. C.O. Mittendorf, Administrator
Defense Minerals Exploration Administration
Department of the Interior
Washington 25, D.C.

re: Docket DMEA-3869 (Uranium)
State and Santa Fe Pacific R.R. Lease
Secs. 1,2,3,13, and 15, T14N.,R10W.,
McKinley County, New Mexico

Dear Mr. Mittendorf:

Reference is made to our application dated June 21, 1955, for a loan to explore the sections noted above.

After considerable study, we have come to the conclusion that it would be preferable for us to explore these and other sections in the area with private financing. We request, therefore, that you withdraw our application.

Thanking you for your consideration, I am,

Very truly yours,

SABRE URANIUM CORPORATION

Hugh M. Craigie

Hugh M. Craigie, President

HMC/ar

cc - Mr. Carl Belser, E.M.
DMEA Field Team, Region III
224 New Customhouse Bldg.
Denver 2, Colorado

October 17, 1955

224 New Customhouse
Denver 2, Colorado

Memorandum

To: J. F. Shaw

From: Executive Officer, DMEA Field Team, Region III

Subject: Docket DMEA 3869 (Uranium), Sabre Uranium Corporation, State and Santa Fe Pacific R. R. Lease, Secs. 1, 2, 3, 13, and 15, T. 14 N., R. 10 W., McKinley County, New Mexico

Enclosed is a copy of a letter from the subject applicant and the only copy of the certified map which was forwarded by the applicant.

The letter from the applicant is in reply to our letter to him dated September 29, 1955, copy of which was forwarded your office.

If this information is not sufficient for you to continue to process the application, will you please advise this office.

W. M. Traver

W. M. Traver

Enclosure

HMC:ab
cc: Sec. Opr. Comm. (2)
Marshman
Hasler
Docket 3869
Chron.

Sabre Uranium Corporation

POST OFFICE BOX 1549
GRAND JUNCTION, COLORADO
TELEPHONE: 3840

Date Rec'd

October 8, 1955

Best.

Mr. W.M. Traver,
Executive Officer, DMEA
Field Team, Region III
U.S. Department of the Interior
224 New Customhouse
Denver 2, Colorado

Re: Docket DMEA 3869 (Uranium), State and Santa Fe Pacific R.R. Lease, Secs. 1, 2, 3, 13, and 15, T.14N., R.10 W., McKinley Co., New Mexico

Dear Mr. Traver:

Receipt is acknowledged of your letter dated September 29 with reference to a possible conflict in the location of the southwest corner of Section 14 (southeast corner of Section 15), T. 14 N., R. 10 W., N.M.P.M.

As requested by you, enclosed please find a certified plat of Sec. 15, T. 14 N., R. 10 W. which, I believe, will answer any questions you may have. This survey is by Mr. James A. Simpson, Registered Surveyor No. 1538, in the State of New Mexico. He advises that he talked to Mr. Edward K. Elder, New Mexico Registered Surveyor No. 1323, who informed him that he had not made a survey of Section 14 but that some time ago he had located the stone marker locating the northwest corner of Section 14.

Very truly yours,

SABRE URANIUM CORPORATION

Hugh M. Craigie

Hugh M. Craigie, President

HMC/ar
enc.

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

October 17, 1955

224 New Customhouse
Denver 2, Colorado

Memorandum

To: J. F. Shaw

From: Executive Officer, DMEA Field Team, Region III

Subject: Docket DMEA 3869 (Uranium), Sabre Uranium Corporation, State and Santa Fe Pacific R. R. Lease, Secs. 1, 2, 3, 13, and 15, T. 14 N., R. 10 W., McKinley County, New Mexico

Enclosed is a copy of a letter from the subject applicant and the only copy of the certified map which was forwarded by the applicant.

The letter from the applicant is in reply to our letter to him dated September 29, 1955, copy of which was forwarded your office.

If this information is not sufficient for you to continue to process the application, will you please advise this office.

W. M. Traver

Enclosure

HMC:ab
cc: Sec. Opr. Comm. (2)
Harshman
Hasler
Docket 3869
Chron.

Sabre Uranium Corporation

POST OFFICE BOX 1549
GRAND JUNCTION, COLORADO
TELEPHONE: 3840

Date Rec'd
OCT 10 1955
BUREAU OF MINES
Denver, Colorado

October 8, 1955

Best.

Mr. W.M. Traver,
Executive Officer, DMEA
Field Team, Region III
U.S. Department of the Interior
224 New Customhouse
Denver 2, Colorado

Re: Docket DMEA 3869 (Uranium), State and Santa Fe Pacific R.R. Lease, Secs. 1, 2, 3, 13, and 15, T.14N., R.10 W., McKinley Co., New Mexico

Dear Mr. Traver:

Receipt is acknowledged of your letter dated September 29 with reference to a possible conflict in the location of the southwest corner of Section 14 (southeast corner of Section 15), T. 14 N., R. 10 W., N.M.P.M.

As requested by you, enclosed please find a certified plat of Sec. 15, T. 14 N., R. 10 W. which, I believe, will answer any questions you may have. This survey is by Mr. James A. Simpson, Registered Surveyor No. 1538, in the State of New Mexico. He advises that he talked to Mr. Edward K. Elder, New Mexico Registered Surveyor No. 1323, who informed him that he had not made a survey of Section 14 but that some time ago he had located the stone marker locating the northwest corner of Section 14.

Very truly yours,

SABRE URANIUM CORPORATION

Hugh M. Craigie

Hugh M. Craigie, President

HMC/ar
enc.

10/5/55 gla

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

September 29, 1955

224 New Customhouse
Denver 2, Colorado

Mr. Hugh M. Craigie, President
Sabre Uranium Corporation
18-19 Reed Building
Box 1549
Grand Junction, Colorado

Re: Docket DMEA 3869 (Uranium), State and Santa Fe Pacific R. R. Lease, Secs. 1, 2, 3, 13, and 15, T. 14 N., R. 10 W., McKinley County, New Mexico

Dear Mr. Craigie:

We are advised of the existence of a conflict in the location of the southwest corner of Section 14, T. 14 N., R 10 W., New Mexico Principal Meridian. There is some evidence that this corner has been moved as shown by the stone marker described in the office of Land Management Records in Santa Fe and the stone marker described by Edward K. Elder, New Mexico Registered Surveyor, Number 1323.

Before we can further process your application, will you please have a certified survey made to show the true location of this Section corner.

Upon receipt from you of a certified Plat showing the true location of the southwest corner, Section 14, T. 14 N., R. 10 W., we will continue to process your application.

Very truly yours,

W. M. Trexler

W. M. Trexler
Executive Officer, DMEA
Field Team, Region III

BMC:ab
cc: Chair. Opr. Comm. (2)
Harshman
Shaw (2)
Hasler
Docket 3869
Chron.

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

September 29, 1955

224 New Customhouse
Denver 2, Colorado

Mr. Hugh M. Craigie, President
Sabre Uranium Corporation
18-19 Reed Building
Box 1549
Grand Junction, Colorado

Re: Docket DMEA 3869 (Uranium),
State and Santa Fe Pacific
R. R. Lease, Secs. 1, 2, 3,
13, and 15, T. 14 N., R.
10 W., McKinley County, New
Mexico

Dear Mr. Craigie:

We are advised of the existence of a conflict in the location of the southwest corner of Section 14, T. 14 N., R 10 W., New Mexico Principal Meridian. There is some evidence that this corner has been moved as shown by the stone marker described in the office of Land Management Records in Santa Fe and the stone marker described by Edward K. Elder, New Mexico Registered Surveyor, Number 1323.

Before we can further process your application, will you please have a certified survey made to show the true location of this Section corner.

Upon receipt from you of a certified Plat showing the true location of the southwest corner, Section 14, T. 14 N., R. 10 W., we will continue to process your application.

Very truly yours,

Wm. Traver

W. M. Traver
Executive Officer, DMEA
Field Team, Region III

HMC:ab
cc: Chair. Opr. Comm. (2)
Harshman
Shaw (2)
Hasler
Docket 3869
Chron.

9/30/55 gla

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

RECEIVED
SEP 30 1955

September 28, 1955

224 New Customhouse
Denver 2, Colorado

Memorandum

To: Secretary to the Operating Committee, DMEA

From: Executive Officer, DMEA Field Team, Region III

Subject: Docket DMEA 3869 (Uranium), Sabre Uranium Corporation, State and Santa Fe Pacific R. R. Lease, McKinley County, New Mexico (Moving of Section corner)

Enclosed are four copies of a report concerning the suspected moving of the Section corner, southwest corner of Section 14. This is the common corner of Sections 14, 15, 22, and 23, T. 14 N., R. 10 W., New Mexico Principal Meridian.

W. M. Traver

W. M. Traver

Enclosures

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

September 28, 1955

234 New Customhouse
Denver 2, Colorado

Memorandum

To: Secretary to the Operating Committee, DMEA

From: Executive Officer, DMEA Field Team, Region III

Subject: Docket DMEA 3869 (Uranium), Sahre Uranium Corporation, Shale and Santa Fe Pacific R. R. Lease, McKinley County, New Mexico (Moving of Section corner)

Enclosed are four copies of a report concerning the suspected moving of the Section corner, southwest corner of Section 14. This is the common corner of Sections 14, 15, 22, and 23, T. 14 N., R. 10 W., New Mexico Principal Meridian.

W. M. Brewer

W. M. Brewer

Enclosures

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

September 28, 1955

[illegible] New Centennial
Denver 2, Colorado

Memorandum

To: Secretary to the Operating Committee, DMEA

From: Executive Officer, DMEA Field Team, Region III

Subject: Docket DMEA 3869 (Uranium), Sabre Uranium Corporation, Shade and Santa Fe Pacific R. R. Lease, McKinley County, New Mexico (Moving of Section corner)

Enclosed are four copies of a report concerning the suggested moving of the Section corner, southwest corner of Section 14. This is the common corner of Sections 14, 15, 22, and 23, T. 14 N., R. 10 W., New Mexico Principal Meridian.

W. M. Trever

W. M. Trever

Enclosures

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

RECEIVED
SEP 30 1955

September 28, 1955

224 New Customhouse
Denver 2, Colorado

Memorandum

To: Secretary to the Operating Committee, DMEA

From: Executive Officer, DMEA Field Team, Region III

Subject: Docket DMEA 3869 (Uranium), Sabre Uranium Corporation, State and Santa Fe Pacific R. R. Lease, McKinley County, New Mexico (Moving of Section corner)

Enclosed are four copies of a report concerning the suspected moving of the Section corner, southwest corner of Section 14. This is the common corner of Sections 14, 15, 22, and 23, T. 14 N., R. 10 W., New Mexico Principal Meridian.

W. M. Traver

W. M. Traver

Enclosures

DMEA
Date Rec'd.

SEP 28 1955

BUREAU OF MINES
Denver, Colorado

REGION III

Memorandum

Building 20
Denver Federal Center
Denver 2, Colorado
September 21, 1955

To: Executive Officer, DMEA Field Team, Region III

Through: John F. Shaw
Supervising Mining Engineer

From: Carl Belser

Subject: Sabre, DMEA 3869, Common corner of sections 14, 15, 22, and 23, T. 14 N., R. 10 W., New Mexico Principal Meridian, McKinley County, New Mexico

This corner was inspected on September 8, 1955. An old sandstone corner 3" x 10" x 15" above the ground was directly under an east-west fence line. The rock was marked with two bars on the south side and three bars on the west side. Some 600 feet east of this corner and about 10 feet north of the fence line Sabre had set an iron-capped rod as the new corner.

The Office of Land Management records in Santa Fe show that the original survey was run between August 26, 1881, and September 1, 1881. The stone set was sandstone and 4" x 12" x 22" set two-thirds in the ground and having two bars on the east side and three on the south.

Edward K. Elder, New Mexico Registered Surveyor No. 1323, on June 1, 1955, in the land office records, stated "The southwest corner of section 14 is in a new E-W fence line, faces 1/4 turn clockwise from correct position, and does not line up with other fences and corners. Has definitely been moved."

Mr. Elder is held in high regard by the Santa Fe land office.

If the new corner is contested, it will be a matter for the District Court to decide.

Carl Belser
Carl Belser
Mining Engineer

CB:ph

cc 9
B.N.Burchman
M.E. Salsbury
J.W. Mealer
Sub
Chron

DMEA
Date Rec'd.

SEP 28 1955

BUREAU OF MINES
Denver, Colorado

REGION III

Memorandum

Building 20
Denver Federal Center
Denver 2, Colorado
September 21, 1955

To: Executive Officer, DMEA Field Team, Region III

Through: John F. Shaw
Supervising Mining Engineer

From: Carl Belser

Subject: Sabre, DMEA 3869, Common corner of sections 14, 15, 22, and 23, T. 14 N., R. 10 W., New Mexico Principal Meridian, McKinley County, New Mexico

This corner was inspected on September 8, 1955. An old sandstone corner 3" x 10" x 13" above the ground was directly under an east-west fence line. The rock was marked with two bars on the south side and three bars on the west side. Some 600 feet east of this corner and about 10 feet north of the fence line Sabre had set an iron-capped rod as the new corner.

The Office of Land Management records in Santa Fe show that the original survey was run between August 26, 1881, and September 1, 1881. The stone set was sandstone and 4" x 15" x 22" set two-thirds in the ground and having two bars on the east side and three on the south.

Edward K. Elder, New Mexico Registered Surveyor No. 1323, on June 1, 1955, in the land office records, stated "The southwest corner of section 14 is in a new N-W fence line, those 1/4 turn clockwise from correct position, and does not line up with other fences and corners, has definitely been moved."

Mr. Elder is held in high regard by the Santa Fe land office.

If the new corner is contested, it will be a matter for the District Court to decide.

Carl Belser
Carl Belser
Mining Engineer

Chrgh

cc 9
E.E.Barnhart
M.M. Salsbury
J.W. Butler
Sub
Chron

DMEA
Date Rec'd.

SEP 28 1955

REGION III

BUREAU OF MINES
Denver, Colorado

Building 20
Denver Federal Center
Denver 2, Colorado
September 21, 1955

Memorandum

To: Executive Officer, DMEA Field Team, Region III

Through: John F. Shea JFS
Supervising Mining Engineer

From: Carl Belser

Subject: Sahre, DMEA 3969, Common corner of sections 14, 15, 22, and 23, T. 14 N., R. 10 W., New Mexico Principal Meridian, McKinley County, New Mexico

This corner was inspected on September 8, 1955. An old sandstone corner 3" x 18" x 15" above the ground was directly under an east-west fence line. The rock was marked with two bars on the south side and three bars on the west side. Some 600 feet east of this corner and about 10 feet north of the fence line Sahre had set an iron-capped rod as the new corner.

The Office of Land Management records in Santa Fe show that the original survey was run between August 26, 1881, and September 1, 1881. The stone set was sandstone and 4" x 18" x 22" set two-thirds in the ground and having two bars on the east side and three on the south.

Edward K. Elder, New Mexico Registered Surveyor No. 1303, on June 1, 1955, in the land office records, stated "The southeast corner of section 14 is in a new B-W fence line, there 1/4 turn clockwise from correct position, and does not line up with other fences and corners has definitely been moved."

Mr. Elder is held in high regard by the Santa Fe land office.

If the new corner is contested, it will be a matter for the District Court to decide.

Carl Belser
Carl Belser
Mining Engineer

CB:ph

cc 9
R.R.Harshman
M.K. Salisbury
J.W. Hesler
Sub
Shrve

DMEA
Date Rec'd.

SEP 28 1955

BUREAU OF MINES
Denver, Colorado

REGION XXI

Memorandum

Building 20
Denver Federal Center
Denver 2, Colorado
September 21, 1955

To: Executive Officer, DMEA Field Team, Region XXI

Through: John F. Shea
Supervising Mining Engineer

From: Carl Belser

Subject: Sabre, DMEA 3869, Common corner of sections 14, 15, 22, and 23, T. 14 N., R. 18 W., New Mexico Principal Meridian, McKinley County, New Mexico

This corner was inspected on September 8, 1955. An old sandstone corner 3" x 16" x 15" above the ground was directly under an east-west fence line. The rock was marked with two bars on the south side and three bars on the west side. Some 600 feet east of this corner and about 10 feet north of the fence line Sabre had set an iron-capped rod as the new corner.

The Office of Land Management records in Santa Fe show that the original survey was run between August 26, 1881, and September 1, 1881. The stone set was sandstone and 4" x 18" x 20" set two-thirds in the ground and having two bars on the east side and three on the south.

Edward K. Elder, New Mexico Registered Surveyor No. 1383, on June 1, 1955, in the land office records, stated "The southwest corner of section 14 is in a new R-W fence line, there 1/4 turn clockwise from correct position, and does not line up with other fences and corners. Has definitely been moved."

Mr. Elder is held in high regard by the Santa Fe land office.

If the new corner is contested, it will be a matter for the District Court to decide.

Carl Belser
Mining Engineer

CB:ph

cc 9
R.H.Hardman
H.E. Salisbury
J.W. Shaler
Reb
Chron

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

RECEIVED
JUL 25 1955

224 New Customhouse
Denver 2, Colorado

July 19, 1955

Memorandum

To: J. F. Shaw (w/brochure)
J. W. Easler

From: Field Team, Region III

Subject: Docket DMEA-3069 (Uranium), Sabre Uranium Corporation, State and Santa Fe Pacific R.R. Lease, McKinley County, New Mexico

Enclosed is the subject application in the amount of $204,790.72. A field examination and suitable report are required.

A copy of the letter from the Chairman of the Operating Committee and memoranda from the Uranium Commodity Committee are attached for your information.

W. M. TRAVER,

W. M. Traver

E. N. Harshman

E. N. Harshman

Enclosures

HMC:pw

cc: Subject
Chron
Harshman
Sec.Op.Comm. (2)

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

RECEIVED
JUL 25 1955

224 New Customhouse
Denver 2, Colorado

July 19, 1955

Memorandum

To: J. F. Shaw (w/brochure)
J. W. Hasler

From: Field Team, Region III

Subject: Docket DMEA-3869 (Uranium), Sabre Uranium Corporation, State and Santa Fe Pacific R.R. Lease, McKinley County, New Mexico

Enclosed is the subject application in the amount of $284,798.72. A field examination and suitable report are required.

A copy of the letter from the Chairman of the Operating Committee and memoranda from the Uranium Commodity Committee are attached for your information.

W. M. TRAVER,

W. M. Traver

Enclosures

E. N. Harshman

E. N. Harshman

HMC:pw

cc: Subject
Chron
Harshman
Sec.Op.Comm. (2)

Surname 700

Murphy
Ching
Kulsgaard
Geyer
Selfridge
Johnson

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

JUL 15 1955

Mr. Hugh M. Craigie, President
Sabre Uranium Corporation
18-19 Reed Building
Box 1549
Grand Junction, Colorado

Re: Docket No. DMEA-3869 (Uranium)
State and Santa Fe Pacific R.R. Lease
Secs. 1,2,3,13, and 15, T.14N., R.10W.
McKinley County, New Mexico

Dear Mr. Craigie:

The application for assistance in exploring the subject property in McKinley County, New Mexico, under the captioned docket number, has been reviewed by the Rare and Miscellaneous Metals Division of the Defense Minerals Exploration Administration. It has been referred for a field examination to the Executive Officer of Region III at the following address:

Mr. W. M. Traver
Executive Officer
DMEA Field Team, Region III
224 New Customhouse Building
Denver 2, Colorado

The Regional Office will contact you in regard to your project if additional information is required.

Sincerely yours,

C. O. Mittendorf

Administrator

FMMurphy:am
7-14-55
cc to: Admr. Reading File
Docket
Code 700
Mr. Murphy
DMEA Field Team, Region III(2)

R.L.S.

Surname 700

Murphy
Ching
Selfridge
Hyman

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

Mr. W. H. Traver
Executive Officer
DMEA Field Team, Region III
224 New Customhouse Building
Denver 2, Colorado

JUL 15 1955

Re: Docket No. DMEA-3869 (Uranium)
Sabre Uranium Corporation
State and Santa Fe Pacific R.R. Lease
Secs. 1,2,3,13, and 15, T.14N., R.10W.
McKinley County, New Mexico

Dear Mr. Traver:

The subject application is referred to Region III Field Team for investigation, a field examination, and recommendation. A copy of the application was retained by your office.

Enclosed are copies of memoranda from J. E. Crawford, dated July 6, and Thor H. Kiilsgaard, dated July 12, 1955, members of the Uranium Commodity Committee. Also enclosed are two copies of an "Assignment of Uranium Mining Lease and Agreement" by the Santa Fe Pacific Railroad Company to the Applicant on Secs. 1,3,13, and 15. Five copies of these documents were submitted to the Washington office on July 1st.

We note that Sec. 2 is State-owned land. The State of New Mexico does not grant an Owner's Consent to Lien, and it is not known here whether the Santa Fe Pacific Railroad Company will execute such documents. As part of the subject property is State land, in the event the Field Team recommends a project on the captioned property, it should advise the Applicant that we will require a performance bond if a contract is approved. At that time this office will advise the Applicant the amount of the bond DMEA will require. If a bond can not be obtained, then we will accept a written guarantee by a third financially responsible party.

Sincerely yours,

George C. Selfridge
Chairman, Operating Committee (GCS)

Enclosures

APPROVED:

/s/ Robert W. Geehan (GCS)
Member, Bureau of Mines

Thor H. Kiilsgaard (GCS)
Member, Geological Survey

Code 700
Mr. Murphy

Messrs. J. E. Crawford, Rm. 3641
T. H. Kiilsgaard, Rm. 5222
J. O. Hosted, Rm. 3210, GSA

Admr. Reading File
Operating Committee
Docket

FMMurphy:am
7-14-55
cc to:

R.C.L.

7/13/55 glc

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

RECEIVED
JUL 13 1955

July 12, 1955

Memorandum

To: E. W. Ellis, Defense Minerals Exploration Administration

From: Thor H. Kiilsgaard, U. S. Geological Survey

Subject: Review of application, Sabre Uranium Company, McKinley County, New Mexico, DMEA Docket 3869.

The applicant proposes to explore 5 sections, Nos. 1, 2, 3, 13, and 15, T. 14 N., R. 10 W., McKinley County, New Mexico, by rotary and core drilling. The project is designed to test an area surrounding a 200,000 ton ore body reported to have been found during the past spring season in section 11. Cost of the project is estimated at $284,798.72.

The 200,000 ton ore body -- reported to average 0.35 percent U_3O_8, to range from 6 to 8 feet in thickness, and to be about 350 feet below the surface -- occurs in the southwestern quarter of section 11, on the northeast flank of a salt dome which is superimposed on the west flank of the Ambrosia anticline. According to the map, the area is overlain by Mancos shale. At a depth of 350 feet, the ore body is assumed to be in the Dakota formation, and it is presumably this formation that is to be explored by the project, although it is not so stated. No mention is made of any trends the ore might be expected to have.

The program may have merit although it appears to be overly ambitious. I fail to see any reason why DMEA should drill the five sections with the drill pattern suggested on Plate 3. It would seem that a few fences of holes in each section or in the sections having the most promise should be drilled, any additional drilling to be in successive stages. Sections 1, 2, 3, and 13 appear to be so far from the reported ore body that it is wondered if work in these sections would not be more on the order of prospecting than exploration.

In addition to the need for a written consent to assignment of the Santa Fe leases, mentioned in Mr. Traver's letter, there are other parts of the application that need checking. There is no mention made of a Performance Bond on the lease of the school section. Also, some of the proposed costs appear to be out of order. As the applicant owns the bulldozer and jeep, the rental rate he is proposing for these machines is far too expensive. Certain of the overhead costs, such as air transport, could also stand pruning.

As the applicant is proposing exploration in a relatively unexplored area and as it is near a reported deposit of large proportions, I recommend the application be sent to the field for a field review. Further processing of the application should await recommendations from the Field Team.

Thor H. Kiilsgaard

Thor H. Kiilsgaard

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

RECEIVED
JUL 13 1955

July 12, 1955

Memorandum

To: E. W. Ellis, Defense Minerals Exploration Administration

From: Thor N. Killingsord, U. S. Geological Survey

Subject: Review of application, Sahara Uranium Company, McKinley County, New Mexico, DMEA Docket 3869.

The applicant proposes to explore 5 sections, Nos. 1, 2, 3, 13, and 15, T. 14 N., R. 10 W., McKinley County, New Mexico, by rotary and core drilling. The project is designed to test an area surrounding a 200,000 ton ore body reported to have been found during the past spring season in section 11. Cost of the project is estimated at $[illegible],798.72.

The 200,000 ton ore body -- reported to average 0.35 percent U_3O_8, to range from 6 to 8 feet in thickness, and to be about 350 feet below the surface -- occurs in the southwestern quarter of section 11, on the northeast flank of a salt dome which is superimposed on the west flank of the Ambrosia anticline. According to the map, the area is overlain by Mancos shale. At a depth of 350 feet, the ore body is assumed to be in the Dakota formation, and it is presumably this formation that is to be explored by the project, although it is not so stated. No mention is made of any trends the ore might be expected to have.

The program may have merit although it appears to be overly ambitious. I fail to see any reason why DMEA should drill the five sections with the drill pattern suggested on Plate 3. It would seem that a few fences of holes in each section or in the sections having the most promise should be drilled, any additional drilling to be in successive stages. Sections 1, 2, 3, and 13 appear to be so far from the reported ore body that it is wondered if work in these sections would not be more on the order of prospecting than exploration.

In addition to the need for a written consent to assignment of the Santa Fe lease, mentioned in Mr. Trever's letter, there are other parts of the application that need checking. There is no mention made of a Performance Bond on the lease of the school section. Also, some of the proposed costs appear to be out of order. As the applicant owns the bulldozer and jeep, the rental rate he is proposing for these machines is far too expensive. Certain of the overhead costs, such as air transport, could also stand pruning.

As the applicant is proposing exploration in a relatively unexplored area and as it is near a reported deposit of large proportions, I recommend the application be sent to the Field for a field review. Further processing of the application should await recommendations from the Field Team.

Thor H. Kiilsgaard

THKiilsgaard:iml
6-7/12/55

cc: Director's reading, 4212
Branch reading, 4212
BMRA (3)
Docket file
J. E. Crawford, 3641
J. O. Hosted, 3210

7/7/55 gh

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
WASHINGTON 25, D. C.

RECEIVED
JUL - 7 1955

July 6, 1955

Memorandum

To: Ernest William Ellis, DMEA Member
Uranium Commodity Committee, Room 4445

From: John E. Crawford, Bureau of Mines Member
Uranium Commodity Committee

Subject: Application for assistance, DMEA Docket 3869, Sabre Uranium Corporation, Grants District, McKinley County, New Mexico.

I have reviewed the attached application for assistance, Sabre Uranium Corporation, DMEA Docket 3869; and I have discussed it with Joseph O. Hosted, Washington representative of the Atomic Energy Commission.

We suggest that the application be referred to the Field Team for study and possible examination, and that the Field Team contact Ernest R. Gordon, Atomic Energy Commission, Grand Junction, Colorado, for any information that he may have about the property and the area.

Mr. Hosted and I believe that a modified drilling program, limited to Sec. 2, T.14N., R10W, would be a more favorable course of action.

John E. Crawford

John E. Crawford

Attachment

7/5/55 gla

Sabre Uranium Corporation

RECEIVED
JUL - 5 1955

POST OFFICE BOX 1549

GRAND JUNCTION, COLORADO

July 1, 1955

Mr. Robert E. Adams, Chief
Operations Control and
Statistics Division
Defense Minerals Exploration Administration
Department of the Interior
Washington 25, D.C.

re: DMEA-3869
Exploration Assistance

Dear Sir:

We are in receipt of your letter of June 28 acknowledging receipt of our application which has been referred to the Rare and Miscellaneous Metals Division under the above mentioned docket number.

In connection with this application, we are enclosing herewith four copies each of Assignments of Uranium Mining Lease and Agreement Nos. 9450-A and 9451-A, which are to form part of the said application.

July 13
Mr. Webb submitted another copy
to wash. office. JAYM.

Sincerely yours,

SABRE URANIUM CORPORATION

Hugh M. Craigie

Hugh M. Craigie, President

HMC/ar
encs.
4 copies 9450-A
4 " 9451-A

Santa Fe Pacific R. R. Co.
LEASE NO. 9450-A.

ASSIGNMENT OF URANIUM MINING LEASE AND AGREEMENT

KNOW ALL MEN BY THESE PRESENTS, That VICTOR SALAZAR and LUPE SALAZAR, his wife, of Albuquerque, New Mexico, parties of the first part, and hereinafter called Assignors, for and in consideration of the sum of One ($1.00) Dollar and other valuable considerations to them in hand paid by SABRE URANIUM CORPORATION, a Delaware corporation, party of the second part, and hereinafter called Assignee, the receipt of which considerations is hereby acknowledged, have bargained, sold and assigned, and by these presents do bargain, sell and assign unto the Assignee and its successors and assigns all of their right, title and interest in and to that certain Uranium Mining Lease and Agreement known as Lease No. 9450, dated May 10, 1955, made by Santa Fe Pacific Railroad Company, as Lessor, to VICTOR SALAZAR, as Lessee, and covering the following described lands situate in the County of McKinley, State of New Mexico, to wit:

NEW MEXICO MERIDIAN, NEW MEXICO

Township fourteen North, Range ten West

Sections 1, 3, 5, 7, 21 and 23.

Township fifteen North, Range ten West

Sections 25, 27, 29, 31, 33 and 35.

Containing in the aggregate seven thousand, seven hundred sixteen and forty-eight hundredths (7,716.48) acres.

TO HAVE AND TO HOLD the said described lands unto the said Assignee and its successors and assigns for and during the full term of the said Uranium Mining Lease and Agreement.

The said Assignee shall succeed to all and singular the rights, benefits and privileges of the said lease; and the said Assignee, by the acceptance of this assignment, assumes and agrees to perform all and singular the obligations of the said lease.

IN WITNESS WHEREOF, the said Assignors and Assignee have hereunto set their hands this twenty-sixth day of May, 1955.

Victor Salazar
Lupe Salazar
ASSIGNORS

ACCEPTED:

SABRE URANIUM CORPORATION
By W. R. Montgomery
Treasurer ~~XXXXXXXX~~

ATTEST: Eilene Hick
Assistant Secretary

ASSIGNEE

CONSENT OF LESSOR

SANTA FE PACIFIC RAILROAD COMPANY, a corporation, Lessor named in the lease hereinabove described, hereby consents to the foregoing assignment of lease, without releasing Assignors from any obligations previously accrued, this 8th day of June, 1955.

SANTA FE PACIFIC RAILROAD COMPANY
By R. S. Ryder
Vice President

ATTEST: C. C. Brown
Assistant Secretary

Santa Fe Pacific R. R. Co.
LEASE NO. 9451-A

ASSIGNMENT OF URANIUM MINING LEASE AND AGREEMENT

KNOW ALL MEN BY THESE PRESENTS, That RICHARD D. BOKUM, II and MARGARET BARKER BOKUM, his wife, of Santa Fe, New Mexico, parties of the first part, and hereinafter called Assignors, for and in consideration of the sum of One ($1.00) Dollar and other valuable considerations to them in hand paid by SABRE URANIUM CORPORATION, a Delaware corporation, party of the second part, and hereinafter called Assignee, the receipt of which considerations is hereby acknowledged, have bargained, sold and assigned, and by these presents do bargain, sell and assign unto the Assignee and its successors and assigns all of their right, title and interest in and to that certain Uranium Mining Lease and Agreement known as Lease No. 9451, dated May 10, 1955, made by Santa Fe Pacific Railroad Company, as Lessor, to RICHARD D. BOKUM, II, as Lessee, and covering the following described lands situate in the County of McKinley, State of New Mexico, to wit:

NEW MEXICO MERIDIAN, NEW MEXICO

Township fourteen North, Range ten West

Sections 9, 13, 15, 17 and 25, containing three thousand, two hundred and no hundredths (3,200.00) acres.

TO HAVE AND TO HOLD the said described lands unto the said Assignee and its successors and assigns for and during the full term of the said Uranium Mining Lease and Agreement.

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IN WITNESS WHEREOF, the said Assignors and Assignee have hereunto set their hands this twenty-sixth day of May, 1955.

Richard D. Bokum II
Margaret Barker Bokum
ASSIGNORS

ACCEPTED:

SABRE URANIUM CORPORATION
By W. R. Montgomery
Treasurer ~~Assignee~~

ATTEST:
Eileen Shick
Assistant Secretary.

ASSIGNEE

CONSENT OF LESSOR

SANTA FE PACIFIC RAILROAD COMPANY, a corporation, Lessor named in the lease hereinabove described, hereby consents to the foregoing assignment of lease, without releasing Assignors from any obligations previously accrued, this 8th day of June, 1955.

SANTA FE PACIFIC RAILROAD COMPANY
By R. S. Ryder
Vice-President

ATTEST:
P. O. Brown
Assistant Secretary

Santa Fe Pacific R. R. Co.
LEASE NO. 9450-A.

ASSIGNMENT OF URANIUM MINING LEASE AND AGREEMENT

KNOW ALL MEN BY THESE PRESENTS, That VICTOR SALAZAR and LUPE SALAZAR, his wife, of Albuquerque, New Mexico, parties of the first part, and hereinafter called Assignors, for and in consideration of the sum of One ($1.00) Dollar and other valuable considerations to them in hand paid by SABRE URANIUM CORPORATION, a Delaware corporation, party of the second part, and hereinafter called Assignee, the receipt of which considerations is hereby acknowledged, have bargained, sold and assigned, and by these presents do bargain, sell and assign unto the Assignee and its successors and assigns all of their right, title and interest in and to that certain Uranium Mining Lease and Agreement known as Lease No. 9450, dated May 10, 1955, made by Santa Fe Pacific Railroad Company, as Lessor, to VICTOR SALAZAR, as Lessee, and covering the following described lands situate in the County of McKinley, State of New Mexico, to wit:

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Township fourteen North, Range ten West

Sections 1, 3, 5, 7, 21 and 23.

Township fifteen North, Range ten West

Sections 25, 27, 29, 31, 33 and 35.

RECEIVED
JUL - 5 1955

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Victor Salazar
Lupe Salazar
ASSIGNORS

ACCEPTED:

SABRE URANIUM CORPORATION
By W. R. Cunningham
Treasurer

ATTEST: Eileen Hick
Assistant Secretary

ASSIGNEE

CONSENT OF LESSOR

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SANTA FE PACIFIC RAILROAD COMPANY
By R. S. Ryder
Vice President

ATTEST: R. E. Brown
Assistant Secretary

Santa Fe Pacific R. R. Co.
LEASE NO. 9451-

ASSIGNMENT OF URANIUM MINING LEASE AND AGREEMENT

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JUL - 5 1955

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Richard D. Bokum II
Margaret Barker Bokum
ASSIGNORS

ACCEPTED:

SABRE URANIUM CORPORATION
By W. K. Montgomery
Treasurer

ATTEST:
Eileen Shish
Assistant Secretary.

ASSIGNEE

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SANTA FE PACIFIC RAILROAD COMPANY
By R. S. Ryder
Vice-President

ATTEST:
P. O. Brown
Assistant Secretary

Santa Fe Pacific R. R. Co.
LEASE NO. 9450-A.

ASSIGNMENT OF URANIUM MINING LEASE AND AGREEMENT

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JUL - 5 1955

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Victor Salazar
Lupe Salazar
ASSIGNORS

ACCEPTED:

SABRE URANIUM CORPORATION
By [illegible]
Treasurer ~~XXXXXXXX~~

ATTEST:
Eileen Hick
Assistant Secretary

ASSIGNEE

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SANTA FE PACIFIC RAILROAD COMPANY
By R. S. Ryder
Vice President

ATTEST:
R. O. Brown
Assistant Secretary

SANTA FE PACIFIC RAILROAD COMPANY INCORPORATED UNDER ACT OF CONGRESS 1897

Santa Fe Pacific R. R. Co.
LEASE NO. 9451-A

ASSIGNMENT OF URANIUM MINING LEASE AND AGREEMENT

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Richard D. Bokum II
Margaret Barker Bokum
ASSIGNORS

ACCEPTED:

SABRE URANIUM CORPORATION
By W. K. Montgomery
Treasurer ~~President~~

ATTEST:
Eileen Shick
Assistant Secretary.

ASSIGNEE

CONSENT OF LESSOR

SANTA FE PACIFIC RAILROAD COMPANY, a corporation, Lessor named in the lease hereinabove described, hereby consents to the foregoing assignment of lease, without releasing Assignors from any obligations previously accrued, this 8th day of June, 1955.

SANTA FE PACIFIC RAILROAD COMPANY
By R. S. Ryder
Vice-President

ATTEST:
P. O. Brown
Assistant Secretary

June 28, 1955

Memorandum

To: Executive Officer, DMEA Field Team, Region III

From: Chief, Operation's Control and Statistics Division

Subject: Assignment of Docket Number

There is listed below the assigned docket number to an application recently received from Region III.

DMEA-3869 Sabre Uranium Corp.

Robert E. Adams,
Chief, Operation's Control
and Statistics Division

June 28, 1955
Subject: DMEA-3869
Re: Exploration Assistance

Sabre Uranium Corp.
18-19 Reed Building
Box 1549
Grand Junction, Colo.

Gentlemen:

The receipt of your application dated June 21, 1955 for exploration assistance under the Defense Production Act of 1950, as amended, is hereby acknowledged.

Your application has been assigned Docket Number DMEA-3869 and referred to the Rare and Miscellaneous Metals Division.

Kindly identify all future correspondence relating to your application by this docket number.

Sincerely yours,

Robert E. Adams, Chief
Operations Control and
Statistics Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

June 23, 1955

Memorandum

To: Secretary to the Operating Committee, DMEA

From: Executive Officer, DMEA Field Team, Region III

Subject: Application for DMEA assistance (Uranium), Sabre Uranium Corporation, Grants District, McKinley County, New Mexico

Enclosed are the original and two copies of the subject application for Government assistance in the amount of $284,798.52.

Written permission from the Santa Fe Railroad Company is necessary before assignments of lands leased from them can be made to the Sabre Uranium Corporation. This written permission was not supplied with the application. It should be obtained unless Owner's Consent to Lien forms will cover this deficiency.

As usual one copy of the application has been retained in this office.

W. M. Traver

W. M. Traver

Enclosures

MF-103
(Revised April 1952)

UNITED STATES DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION

DMEA
Date Rec'd
JUN 22 1955

Form Approved.
Budget Bureau No. 42-R1035.2.

RECEIVED
BUREAU OF MINES
Denver, Colorado

Not to be filled in by applicant.

Docket No. 3869
Metal or Mineral Uranium
Date Received 6/27/55
Estimated Cost $284,798.52
Participation (Government %)

APPLICATION FOR AID IN AN EXPLORATION PROJECT, PURSUANT TO DMEA ORDER 1, UNDER THE DEFENSE PRODUCTION ACT OF 1950, AS AMENDED

INSTRUCTIONS

1. *Name of applicant.*—(*a*) State here your full legal name, in the form in which you will wish to contract, and your mailing address: Sabre Uranium Corporation
18-19 Reed Building
P.O. Box 1549
Grand Junction, Colorado

(*b*) If other than an individual, add to your name above whether a corporation, partnership, etc., and the name of the State in which incorporated or otherwise organized.

(*c*) If a corporation, add to above statement, titles, names and addresses of officers.

(*d*) If a partnership, add to the above statement the names and addresses of all partners.

2. *General.*—Read DMEA Order 1, "Government Aid in Defense Exploration Projects," before completing this application. Submit this application and all accompanying papers in quadruplicate (four copies), with your name and address on each sheet of the application and on all accompanying papers. Where sufficient space is not provided on the form for all required information, state it on an accompanying paper, with a reference in each case to the instruction to which it refers by number. Comply with all applicable instructions; or, if not applicable, so state. File the application with Defense Minerals Exploration Administration, Department of the Interior, Washington 25, D. C., or with the nearest field executive officer thereof.

3. *Applicant's property rights.*—(*a*) State the legal description of the land upon which you wish to explore, including all land which you possess or control that may be benefited by the exploration, and excluding any land or interest in land which is not to be included in the exploration project contract T. 14 N., R. 10 W., Sections 1, 2, 3, 13, 15 - McKinley County, New Mexico, Grants District.
Sec. 2 - Mining lease from State
Sec. 1,3,13,15 - Mining lease from Santa Fe Pacific Railroad Co.

(*b*) State any mine name by which the property is known. No mining has been done.

(*c*) State your interest in the land, whether owner, lessee, purchaser under contract, or otherwise see 3 (a)

(*d*) If you are not the owner, submit with this application a copy of the lease, contract, or other document under which you control the property. Sec. 2 - enclosed copy of lease & assignment to Sabre
Sec. 1, 3, 13, 15 -

(*e*) If you own the land, describe any liens or encumbrances on it ---

(*f*) If the land consists of unpatented claims, add to the description above, the book and page numbers for each recorded location notice. ---

4. *Physical description.*—(*a*) Describe in detail any mining or exploration operations which have been or now are being conducted upon the land, including existing mine workings and production facilities. State your interest, if any, in such operations. Also describe accessibility of mine workings for examination purposes. No mining or exploration has been done.

(*b*) State past and current production, and ore reserves, if any, giving quantities and grades. ---

(*c*) Describe the geologic features of the property, including mineralization, type of deposit (vein, bedded, etc.), and your reasons for wishing to explore. Illustrate with maps or sketches. Send with your application (but not necessarily as a part of it) any geologic or engineering report, assay maps, or other technologic information you may have, indicating on each whether you require its return to you.

(*d*) State the facts with respect to the accessibility of the project: Access roads, distances to shipping, supply and residence points.

(*e*) State the availability of manpower, materials, supplies, equipment, water, and power.

5. *The exploration project.*—(*a*) State the mineral or minerals for which you wish to explore .....

(*b*) Describe fully the proposed work, including a map or sketch of the property showing a plan (and cross sections if needed) of any present mine workings, and the location of the proposed exploration work as related to such features as contact veins, ore-bearing beds, etc.

(*c*) The work will start within ..... days and be completed within ..... months from the date of an exploration project contract.

(*d*) State the operating experience and background of the applicant with relation to the ability to carry out such exploration project, and also that of the person or persons who will supervise the operations.

6. *Estimate of costs.*—Furnish a detailed estimate of the costs of the proposed work (you will have to use a separate sheet), under the following headings. Add the totals under all headings to give the estimated total cost of the project:

(*a*) *Independent contracts.*—(Note.—If the applicant does not intend to let any of the work to contractors, write "none" after this item. To the extent that the work is to be contracted, do not repeat the cost of the contract-work in subsequent items.) State the cost of any proposed independent contracts for the performance of all or any part of the work, expressed in terms of units of work (such as per foot of drilling, per foot of drifting, per hour of bulldozer operations, per cubic yard of material moved, etc.).

(*b*) *Labor, supervision, consultants.*—Include an itemized schedule of numbers, classes and rates of wages, salaries or fees for necessary labor, supervision and engineering and geological consultants.

(*c*) *Operating materials and supplies.*—Furnish an itemized list, including items of equipment costing less than $50 each, and power, water and fuel.

(*d*) *Operating equipment.*—Furnish an itemized list of any operating equipment to be rented, purchased, or which is owned and will be furnished by the Operator, with the estimated rental, purchase price, or suggested use-allowance based on present value, as the case may be.

(*e*) *Rehabilitation and repairs.*—Furnish a detailed list showing the cost of any necessary initial rehabilitation or repairs of existing buildings, installations, fixtures, and movable operating equipment, now owned by the Operator and which will be devoted to the exploration project.

(*f*) *New buildings, improvements, installations.*—Furnish a detailed list showing the cost of any necessary buildings, fixed improvements, or installations to be purchased, installed or constructed for the benefit of the exploration project.

(*g*) *Miscellaneous.*—Furnish a detailed list showing the cost of repairs to and maintenance of operating equipment (not including initial rehabilitation or repairs of the Operator's equipment), analytical work, accounting, workmen's compensation and employers' liability insurance, and payroll taxes.

(*h*) *Contingencies.*—Give an estimate of any necessary allowances for contingencies not included in the costs stated above.

NOTE.—No items of general overhead, corporate management, interest, taxes (other than payroll and sales taxes), or any other indirect costs, or work performed or costs incurred before the date of the contract, should be included in the estimate of costs.

7. (*a*) Are you prepared to furnish your share of the cost of the proposed project in accordance with the regulations on Government participation (Sec. 7, DMEA No. 1)? Yes

(*b*) How do you propose to furnish your share of the costs? By use of equipment, and cash to make up difference to arrive at 25% of costs of program, as indicated above.

☐ Money ☐ Use of equipment owned by you ☐ Other

Explain in detail on acompanying paper.

CERTIFICATION

The undersigned, whether as an individual, corporate officer, partner, or otherwise, both in his own behalf and acting for the applicant, certifies that the information set forth in this form and accompanying papers is correct and complete, to the best of his knowledge and belief.

Dated June 21, 1955

SABRE URANIUM CORPORATION
(Applicant)

By Hugh M. Craigie
Hugh M. Craigie, President

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

U. S. GOVERNMENT PRINTING OFFICE 16—66551-1

Sabre Uranium Corp.
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P.O. Box 1549
Grand Junction, Colo.

3. (d)

Application No. 239 Lease No. 60-23

GENERAL MINING LEASE

THIS AGREEMENT, dated this 23rd day of March 1955, made and entered into between the State of New Mexico, acting by and through the undersigned its Commissioner of Public Lands, hereinafter called the "lessor", and
JOE R. MARTINEZ
HEREINAFTER CALLED THE "LESSEE".

WITNESSETH:
THAT WHEREAS, the said lessee has filed in the State Land Office an application for a lease for the purpose of prospecting, mining, development, and production of all minerals, except potassion, sodium, phosphorus and other minerals of similar occurrence, and their salts and compounds, oil and gas, salt, coal, shale, clay, gravel, building stone and building materials upon the lands hereinafter described, and has tendered the sum of $32.01 which sum includes first annual rental thereof, together with the sum of $5.00 application fee, and the sum of ---nil --- representing bid bonus, evidenced by official receipt No. 88599D:

NOW, THEREFORE, in consideration of the above tender, receipt of which is acknowledged, and the covenants herein, the lessor does hereby grant, demise, lease and let to the lessee, exclusively, for the sole and only purpose of prospecting for, exploration, mining development, production, and removal of the aforesaid minerals, in, upon, from and under the following described lands situated in the State of New Mexico:

INSTITUTION	SEC.	TWP.	RGE.	SUBDIVISION	ACRES
Common Schools	2	14N	10W	All	640.16

together with the right to use so much of the surface as may be reasonably necessary to prospect for, mine and remove the minerals therefrom.

TO HAVE AND TO HOLD the said lands and privileges granted hereunder for a term of three (3) years and so long thereafter as the said minerals or any of them in paying quantities shall be produced or mined from the leased lands, subject to all the terms and conditions as hereinafter set forth.

In consideration of the premises, the parties covenant and agree as follows:

1. Lessee shall pay to the Lessor as royalty two per cent (2%) of the gross returns from the smelter, mill, reduction process or other sale, less reasonable transportation and smelting or

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18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colo.

3. (d) Continued

reduction charges, if any, of all ores and materials mined and extracted from the land and two per cent (2%) of any and all premiums and bonuses received by lessee in connection with the discovery, production or marketing of such ores or materials. Provided, that on deposits of rare earths, precious stones or semi-precious stones, and all uranium, thorium, plutonium, or any other material which may have been or may hereafter be determined by the Atomic Energy Commission of the United States to be peculiarly essential to the production of fissionable materials, lessee shall pay a royalty of five per cent (5%) of the gross returns from the smelter, mill, reduction process or other sale, less reasonable transportation and smelting or reduction charges, if any, of all such ores or materials mined and extracted from the land, and five per cent (5%) of any and all premiums and bonuses received by the lessee in connection with the discovery, production or marketing of such ores or materials.

2. Lessee agrees to make full settlement for all royalties on the twentieth (20th) day of the month following the month of sale or receipt of premium or bonus.

3. The consideration jereinbefore specified is a good and valid consideration, subject in all respects to support each and every covenant herein, including specifically the option granted the lessee to prevent the termination of this lease from year to year by payment or tender of further rental as hereinafter provided.

4. An annual rental at the rate of five cents (5¢) per acre shall become due and payable to the lessor by the lessee, or by any transferee or assignee of the same or any part hereof where such transferee or assignee has been recognized, and such transfer or assignment approved by the lessor as hereinafter provided, upon each acre of the land described and then claimed by such lessee, transferee or assignee hereunder, and the same shall be due and payable in advance to the lessor on the successive anniversary dates of this lease, but the annual rental on any lease or assignment shall in no event be less than ten ($10.00) dollars.

5. If lessee shall fail to discover and produce minerals in paying quantities during the primary term of this lease, the lessee may continue this lease in full force and effect for the additional and secondary term of two (2) years, and as long thereafter as any mineral or minerals in paying quantities be produced from the land, by paying each year in advance ten times the rental provided in the primary term.

Provided, further, that if for any reason beyond the control of the lessee production of minerals in paying quantities shall cease after the secondary term has expired, a producing lessee may,

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colo.

3. (d) Continued.

with the written permission of the commissioner, continue said lease in operation and effect from year to year for an additional period of not to exceed three (3) years by continued payment inadvance of annual rentals at the rate provided in the secondary term of the lease.

6. With the consent of the lessor and upon payment of all rentals due and a fee of ten dollars ($10.00), the lessee may surrender or relinquish this lease, in whole or in part, to the lessor; provided, however, that no relinquishment of an undivided interest herein nor less than a legal subdivision shall be approved or recognized by the lessor; provided, further that this surrender clause shall become absolutely inoperative immediately and concurrently with the filing of any suit in any court of law or equity by the lessee, lessor, or any assignee, to enforce this lease or any of its terms, express or implied.

7. The lessee, with the consent of the lessor, may assign this lease, in whole or in part; provided, however, that no assignment of any undivided interest in the lease, or any part thereof, nor any assignment of less than a legal subdivision, shall be recognized or approved by the lessor. Upon approval of an assignment in writing by the lessor, the assignor shall stand relieved from all obligations to the lessor with respect to the lands embraced in the assignment, and the lessor shall likewise be relieved from all obligations to the assignor as to such tracts, and the assignee shall succeed to all of the rights and privileges of the assignor with respect to such tracts and shall be held to have assumed all of the duties and obligations of the assignor to the lessor as to such tracts.

8. After production is once had, leasee shall use reasonable diligence in prospecting for and developing all commercial deposits of mineral or minerals upon the land, and lessee shall market all mineral or minerals so produced within a reasonable time after production is had.

9. The lessor may cancel this lease for nonpayment of rentals, nonpayment of royalties, or for violation of any of the terms, covenants or conditions thereof; provided, however, that before any such cancellation shall be made, the lessor must mail to the lessee or assignee, by registered mail, addressed to the post office address of such lessee or assignee, shown by the records, a thirty-day notice of intention to cancel said lease, specifying the default for which the lease is subject to cancellation. No proof of receipt of notice shall be necessary and thirty days after such mailing, the lessor may enter cancellation unless the lessee shall have sooner remedied the default.

10. The lessor shall have the right to inspect the records, books or accounts pertaining to the mining, extraction, transportation and returns of ores takem from the lands, and, at

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colo.

3. (d) Continued.

the request of the lessor, lessee shall furnish such reports, samples, logs, assays or cores within reasonable bounds, as the lessor may deem to be necessary to the proper administration of the lands.

11. Lessee may make or place such improvements and equipment upon the land as may be reasonably necessary to explore for, mine and remove the minerals, and upon termination of this lease for any reason, lessee may remove such improvements and equipment as can be removed without material injury to the premises; provided, however, that all rentals and royalties have been paid and that such removal is accomplished within two years of the termination date or before such earlier date as the lessor may set upon thirty days' written notice to the lessee. All improvements and equipment remaining upon the premises after the removal date, as set in accordance with this paragraph, shall be forfeited to the lessor without compensation.

12. Before lessee shall commence development or operations upon the lands embraced herein, he shall execute and file with the lesser a good and sufficient bond in an amount of five thousand dollars ($5,000.00) in favor the State of New Mexico, for the benefit of the lessor, its surface lessee, patentee or contract purchaser, to secure the payment of such damage to the livestock, water, crops, or other tangible improvements on the lands as may be suffered by reason or development, use and occupation of the lands by the said lessee, and the lessee shall be liable and agrees to pay for all such damages to the livestock, growing crops, or other improvements upon the land. In addition, lessor may, upon notice given to lessee, require lessee to furnish a bond in a reasonable amount to guarantee payment of royalties to become due under the lease.

13. This lease is made subject to all the provisions and requirements applicable thereto which are to be found in various acts of the legislature of New Mexico, the same as though they were fully set forth herein, and said laws, so far as applicable to this lease, are to be taken as a part hereof.

14. All of the obligations, covenants, agreements, rights and privileges of this lease shall extend to and be binding upon and inure to the benefit of the lawful and recognized assigns or successors in interest of the parties hereto.

15. Nothing herein contained shall be held or construed to prevent the lessor from leasing or letting the said lands or any portion thereof for grazing or agricultural purposes, or for leasing them for the exploration, development and production of products from deposits other than the item, including oil and gas, potash, coal, salt, or for leasing them for the operation of a business, or for selling them under a deferred

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colo.

3. (d) Continued.

purchase contract with minerals reserved, or for patenting them with minerals reserved, or for the issuance of rights of way, and easements over, upon or across for public highways, railroads, tramways, telephone, telegraph and power lines, irrigation works, mining, logging and for any of the purposes mentioned hereinabove in this paragraph, and for other purposes.

16. The lease herein is subject to all valid existing rights and w with special but not exclusive reference to the present existence of any of the matters mentioned in the paragraph next above.

17. All mining operations hereunder shall conform with good mining practices, shall be carried on in a workmanlike manner, and shall conform with all of the laws of the State of New Mexico and all rules and regulations of the State Land Office as may be issued from time to time under authority of law for the protection of valuable deposits of other minerals in or upon the lands but not covered by this lease.

18. Payment of all sums due the lessor by the lessee under the terms of this lease, including but not limited to payment for rentals, royalties, bonuses, and fees shall be made at the office of the Commissioner of Public Lands, State Capitol, Santa Fe, New Mexico, and, after notice given, lessor may require such payments to be made in cash or certified exchange.

IN WITNESS WHEREOF, the State of New Mexico has hereunto signed and caused its name to be signed by its Commissioner of Public Lands thereunto duly authorized, with the seal of his office affixed, and the lessee has signed this agreement to be effective the day and year above written.

STATE OF NEW MEXICO

by /s/ E.S. Walker
Commissioner of Public Lands
Lessor.

/s/ Joe R. Martinez
Lessee (SEAL)

Distributed the 9th day of April, 1955.

STATE OF NEW MEXICO }
COUNTY OF BERNALILLO } ss:

On this the 12th day of April, 1955, personally appeared before me Joe R. Martinez to me known to be the person who executed

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colo.

3. (d) Continued.

the foregoing instrument as lessee, and acknowledged that he executed the same as his free act and deed.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year in this certificate above written.

My commission expires:
Feb. 14, 1959

/s/ Roy Bright
Notary Public

(SEAL)

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colo.

3. (d) ASSIGNMENT OF MINERAL LEASE

KNOW ALL MEN BY THESE PRESENTS:

That Joe R. Martinez

and Stella P. Martinez, wife

Hereinafter called "Assignors", parties of the first part, for an in consideration of the sum of One Dollar, and other good and valuable consideration paid by

Sabre Uranium Corporation

whose post office address is Box 1549, Grand Junction, Colorado, hereinafter sometimes called the Assignee", party of the second part, have sold, transferred, set over and assigned, and by these presents do sell, transfer, set over and assign to the assignee, heirs, successors and assigns, all of the assignor's right, title, interest and claim in and to that certain Mineral Lease No. 60-23 Made by the State of New Mexico to JOE R. MARTINEZ under date of March 23, 1955, and more particularly described as follows:

SEC. 2 TWP. 14 N., Rge. 10 W, ALL SUBDIVISION, 640.16 ACRES

The Assignee assumes and agrees to perform all obligations to the State of New Mexico insofar as said described lands are affected, and to pay such rentals and royalties, and to do such other acts as are by said lease required as to the above described subdivisions, to the same extent and in the same manner as if the provisions of said lease were fully set out herein.

It is agreed that the Assignee shall succeed to all the rights, benefits and privileges granted the Lessee by the terms of said lease, as to the lands above described.

IN WITNESS WHEREOF, the said parties of the first part have hereunto set their hands and seals on this 23rd day of May 1955.

/s/ Joe R. Martinez

/s/ Stella P. Martinez

State of New Mexico)
) ss.
County of Bernalillo)

On this 23rd day of May 1955, before me personally appeared Joe R. Martinez and Stella P. Martinez to me known to be the persons described in and who executed the foregoing instrument, and acknowledged that they executed the same as their free

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colo.

3. (d) Continued

act and deed.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year in this certificate above written.

/s/ Roy Bright
Notary Public

My commission expires February 14, 1959

Office of Commissioner of Public Lands
Santa Fe, New Mexico

I hereby certify that the within assignment was filed in my office on the 24th day of May, 1955, and approved by me on May 25, 1955.

/s/ E.S. Walker
Commissioner of Public Lands

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

SANTA FE PACIFIC R.R. Co.
LEASE No. 9450

Lease No. 9450

URANIUM MINING LEASE AND AGREEMENT

THIS INDENTURE, entered into in duplicate this tenth day of May, 1955, by and between SANTA FE PACIFIC RAILROAD COMPANY, a corporation created by Act of Congress approved March 3, 1897, with its principal offices in Albuquerque, New Mexico, first party, hereinafter called the "Lessor", and VICTOR SALAZAR, of Albuquerque, New Mexico, second party, hereinafter, whether one or more, called the "Lessee".

WITNESSETH, that the parties hereto, for the considerations hereinafter expressed, covenant and agree as follows:

1. Lessor, upon the terms and conditions and subject to the reservations hereinafter set forth, hereby grants to Lessee the exclusive right and privilege for a period of twelve (12) months, beginning with the date hereof, to search and explore for uranium-bearing ore by methods used and recognized in the industry and, thereafter for a period of five (5) years, to conduct mining operations on areas where uranium ore is discovered on the following described lands situated in the County of McKinley, State of New Mexico :

NEW MEXICO MERIDIAN, NEW MEXICO

Township fourteen North, Range ten West

Sections 1, 3, 5, 7, 21 and 23.

Township fifteen North, Range ten West

Sections 25, 27, 29, 31, 33 and 35.

Containing in the aggregate seven thousand, seven hundred sixteen and forty-eight hundredths (7,716.48) acres.

Subject to easement to Malco Pipeline Company, Inc., dated September 24, 1941, for oil pipe line across section 3, township 14 north, range 10 west, and section 27, township 15 north, range 10 west.

Subject also to oil and gas lease to J.K. Wadley, dated December 15, 1952, on lots 1, 2, 3, 4, S½N½ and SE¼ section 3, township 14 north, range 10 west.

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

including the right to construct and maintain thereon at the sole cost and expense of Lessee all works, buildings, plants, waterways, roads, telephone or telegraph lines or other structures necessary and desirable in the exploration, development or conduct of mining operations upon said lands.

SUBJECT to the rights of grantees, vendees and licensees of the surface of said lands under deeds, contracts of purchase or other agreements heretofore made by Lessor and to the obligations of Lessor under the provisions thereof.

SUBJECT also to all leases or agreements now outstanding for use of said lands, or any portion thereof, for agricultural, horticultural, grazing, mining or other purposes, but Lessor represents that there are no such leases or agreements valid and outstanding made by Lessor for the development and production of uranium-bearing ore and associated minerals.

SUBJECT also to the right of Lessor (which right is hereby expressly reserved) to enter into leases, permits, or other agreements with others covering said lands or any portion thereof for any purpose whatsoever not inconsistent with the rights of Lessee hereunder.

SUBJECT ALSO to all existing easements, servitudes and rights of way for canals, ditches, levees, roads, highways, telegraph, telephone and electric power lines, railroads, pipe lines and any other purposes, to any public roads heretofore laid out or established, and to rights of way for ditches and canals which may be constructed under authority of the United States.

Lessee accepts this lease subject to and agrees to comply with the provisions of that certain Purchase Agreement between Anaconda Copper Mining Company and Santa Fe Pacific Railroad Company, dated July 14, 1952, which gives Anaconda the first right to purchase any limestone gangue, low-vanadium ores produced by Santa Fe.

It is understood that the Lessee is hereby granted the right to mine only within the exterior boundaries, extended vertically downward, of the land hereby leased.

2. Lessee agrees on or before the expiration of the first twelve (12) months period above mentioned to surrender to Lessor by an appropriate instrument, in writing, all of the land described above on which uranium ore has not been discovered, retaining only such lands as appear to contain uranium-bearing ore in commercial quantities. Lessee further agrees the retained lands shall be divided into units, to be designated by Lessee, of not to exceed six hundred and forty (640) acres each, conforming as nearly as possible to legal subdivisions, and that all of the terms and covenants of this lease shall separately apply to each such unit as fully as if covered by a separate lease.

3. Lessee agrees to enter into and upon the said premises within sixty (60) days from the date hereof and to work and operate on the leased premises steadily and continuously during the period of this lease in accordance with approved methods so as to discover, mine and remove the greatest amount of uranium-bearing ore possible in a manner proper and necessary to good and economical mining with due regard to the development and preservation of the said premises as mining ground. Lessee further agrees that all work done in and upon said premises and property shall be done in full compliance with the mining laws and regulations of the State, the United States and any other competent public authority.

4. Lessor reserves the right through its agents or representatives to enter from time to time into and upon all parts of said premises and workings thereon for the purpose of inspection, surveys, or taking samples therefrom, and Lessee agrees to render said agents or representatives proper assistance in making said inspection, surveys or examinations. Lessee shall furnish quarterly reports to the Lessor, including maps, showing all exploration data and all of the mining and exploration work done, or in progress, upon the property, together with assays of the ore encountered, during the preceding quarter.

5. On all ores mined or removed from demised premises for the purpose of milling, treatment, stockpiling, sale, or other disposition, Lessee shall pay to the Lessor a percentage royalty of the mined value per dry ton as set forth in the following schedules:

(a) Lessee shall pay Lessor on all underground ore mined from the demised premises through shaft or tunnel on the following royalty schedule:

Percentage Royalty Schedule

Mine Value per Dry Ton	Royalty Percentage of Mine Value per Dry Ton
$ 0.01 to $10.01	10%
$10.01 to $20.01	11%
$20.01 to $30.01	12%
$30.01 to $40.01	13%
$40.01 to $50.01	14%
$50.01 or more	15%

(b) Lessee shall pay Lessor on all open pit ore

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

mined by surface mining methods on the following royalty schedule:

Percentage Royalty Schedule

Mine Value per Dry Ton	Royalty Percentage of Mine Value per Dry Ton
$ 0.01 to 10.01	10%
$10.01 to 20.01	14%
$20.01 to 30.01	18%
$30.01 to 40.01	22%
$40.01 to 50.01	26%
$50.01 or more	30%

"MINE VALUE PER DRY TON," wherever used herein, is hereby defined as the dollar value per dry ton of crude ores at the mine as determined by the application to the valuable metal content of such ore of the price schedules for such ores established and currently in effect by the Atomic Energy Commission or other government authorized agencies, but excluding any allowance for transportation or development, and all mine production bonuses. However, if the Government at any time hereafter does not establish or have in effect a price schedule for the purchase of such ores on a fixed or scheduled dollar value per dry ton of crude ores at the mine, or said ores contain salable minerals, some, or all, of which are disposed of to a custom treatment plant or smelter for treatment and sale, then mine value per dry ton shall be the gross value per dry ton of said crude ores paid therefor by the Atomic Energy Commission, or other Government authorized agency, or by a mill or other buyer less any allowances or reimbursements for the following specific items:

(1) Transportation of ores.

(2) Allowances paid to Lessee by the Atomic Energy Commission or other Government authorized agency for exploration for or development of ores.

Wherever minerals or other products associated with uranium-bearing ore are recovered from the ores which are not included in determining "mine value per dry ton" as heretofore defined, there shall be paid by Lessee to the Lessor for such minerals or other products, a royalty of ten per cent (10%) of the gross value of such products, less milling cost charged to Lessee thereon.

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

All royalty payments to be made by Lessee to Lessor shall be made on or before the twentieth day of the month next following receipt by Lessee of payments for the products sold or disposed of.

Lessee shall keep accurate account of all mining operations, showing the sales, prices, dates, purchasers, and the whole amount of minerals mined, the amount removed and the gross receipts derived therefrom, together with any bonus or other payments, and furnish to Lessor sworn monthly reports thereon not later than the twentieth day of the succeeding month.

6. In addition to the payments hereinabove mentioned, Lessee shall pay Lessor as rental for the leased premises upon the execution of this lease the sum of One Dollar ($1.00) per acre and thereafter One Dollar ($1.00) per acre a year for each year this lease may be in effect, to be paid annually in advance; provided, however, that beginning with the second year and each year thereafter the rental so paid for any one year shall be credited on the royalty due to Lessor for that year.

7. Lessee shall not subject Lessor or the leased premises to any liability or lien for or on account of any work done or improvements made or materials placed on or used upon said premises, and if by reason of the failure of Lessee to pay bills or expenses incurred by Lessee any lien or liens shall be filed against the leased premises, Lessor may forthwith pay and discharge the same and hold Lessee bound to repay to Lessor all sums so advanced or paid to clear said premises from liens which may be filed as aforesaid, and Lessor may also at its election declare a forfeiture of this lease. Lessee agrees to post forthwith and keep posted on said property in all places required by law, a notice of nonliability of the Lessor for labor or materials furnished the Lessee, and the Lessor agrees to furnish such notices.

8. Lessee shall file returns with the proper taxing authorities covering the mineral estate hereby leased, the uranium-bearing ore or other minerals produced from the leased premises, and all personal property which may be placed upon said premises by Lessee; and shall pay, before the same shall become delinquent, all taxes, charges, rates and assessments which may, during the term of this lease, be levied upon or assessed in any respect upon or against said mineral estate, ore, mineral products or personal property, together with all increases in such charges, rates or assessments upon the land, by reason of the discovery or production of such minerals or on account of

improvements erected upon said land, including buildings, machinery and other fixtures placed thereon by Lessee. Where any such taxes, charges, rates or assessments may be embraced in the general amount of taxes charged upon the leased premises, separately or in conjunction with other property of the Lessor or of the surface owner, and the Lessor shall pay such taxes or refund the same to the surface owner, then Lessee shall promptly repay or refund to Lessor the amount or part of the tax, charge, rate or assessment attributable under this lease to Lessee. All such payments by Lessor on account of Lessee shall bear interest at the rate of eight per cent (8%) per annum until paid.

9. Lessee shall save harmless and indemnify Lessor against all claims, demands, suits, judgments, expenses and costs of any and every kind on account of the injury to or death of persons or loss of or damage to property arising in any manner out of or in connection with the operations of Lessee hereunder and Lessee shall at Lessee's sole cost and expense defend all such claims, demands or suits; and if at any time Lessee employs any person or persons to work upon the leased premises, Lessee shall comply with the provisions of the Workmen's Compensation Act of New Mexico and all regulations and requirements of competent public authority.

10. At the expiration of this lease, or upon its earlier termination as herein provided, Lessee shall surrender the leased premises in good order and condition and remove therefrom all machinery, tools, and improvements, except such as may become the property of the Lessor under this lease by purchase or otherwise; provided, however, that no such tools, machinery, or improvements shall be removed while Lessee may be in any manner indebted to Lessor under any obligation incurred under this lease. Lessee shall not, however, remove any timbers or improvements which may be necessary or desirable to leave in the workings to protect same from subsidence or as a mining property unless requested by Lessor to do so.

11. Any notice to be given by Lessor to Lessee hereunder shall be deemed to be properly served if the same be deposited in a United States post office, registered mail postpaid, return receipt requested, addressed to Victor Salazar, 324 Simms Building, Albuquerque, New Mexico, and any notice to be given by Lessee to Lessor hereunder shall be deemed to be properly served if the same be deposited in a United States post office, registered mail postpaid, return receipt requested, addressed to Lessor at 314 First Street SW, Albuquerque, New Mexico, or at such other address as Lessor may request.

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

12. Lessor does not warrant the quiet possession of said lands by the Lessee and Lessor shall in no event become liable for damage arising from any lack or failure of title in the Lessor to said lands or eviction of the Lessee therefrom by title paramount to the title of the Lessor. The Lessor covenants, however, and warrants that it has made no agreement on its part in reference to said lands, or any conveyance thereof which will give to third parties right to interfere in any way with the operations of the Lessee under this lease.

Lessor has, however, sold and conveyed all of said lands by deed, in which it has expressly reserved and excepted all oil, gas, coal and minerals whatsoever, already found or which may be found upon or under said lands, with the right to prospect for, mine and remove the same, and to use so much of the surface of said lands as shall be necessary and convenient for shafts, wells, tanks, pipe lines, rights of way, railroad tracks, storage purposes and other and different structures and purposes necessary and convenient for the digging, drilling, and working of any mines or wells which may be operated on said lands. Lessee accepts this lease and agreement subject to the terms and provisions of said deed reservation.

Lessee agrees (a) to pay all damages to the surface owner's buildings and growing crops caused by the erection or construction of facilities to be used in connection with mining operations; (b) that all pipe lines shall be buried below plow depth where such lines cross cultivated lands; and (c) that where there are fences, to construct gates or cattle guards therein where necessary for Lessee to cross the same, and to keep such gates and cattle guards in repair and the gates closed.

Lessee will also indemnify and save Lessor harmless from any and all claims or of liability to the owner or owners of the surface of the land leased by reason of the failure of Lessee to perform the requirements mentioned in clauses (a), (b) and (c) hereof.

Any amounts which Lessor shall be required to pay to any such surface owner or owners by reason of the failure of the Lessee to perform such obligations shall be refunded by Lessee to Lessor within thirty (30) days after demand therefor, and upon failure to make such payment within said time, all amounts so due shall become a lien upon all property of the Lessee upon said premises and all of the Lessee's interest in any uranium ore produced therefrom and the proceeds thereof.

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

13. No termination of this lease, whether by lapse of time or otherwise, shall release Lessee from any liability or obligation hereunder, whether of indemnity or otherwise, resulting from any acts, omissions, or events happening prior to the date of such termination.

14. Lessee shall not assign this lease or any interest therein nor sublet any portion of the leased premises except with the written consent of Lessor first had and obtained in each instance.

15. Lessor agrees that if during the term of this lease Lessee has found and is, at the expiration hereof, producing uranium-bearing ore in commercial quantities from the demised premises, Lessor will, upon written request from Lessee, made prior to the expiration date hereof, renew this lease for an additional three-year period, upon the same terms and conditions, including the right to like and successive renewals thereafter, upon the same conditions, subject always during any such extended period to termination whenever uranium-bearing ore in commercial quantities shall cease to be produced for sixty (60) consecutive days; provided, however, that in all instances in which Lessee is required to perform any particular act or to begin or to carry on any operation, except payment of rentals or other money due Lessor, any delay on account of floods, washouts, strikes, lockouts, the elements, acts of God or the public enemy, or other causes beyond Lessee's control, shall not be computed as any part of the time within which any such act shall be begun or performed. Lessor shall be under no obligation to renew this lease at any time or times if Lessee shall then be in default hereunder, or if this lease has been previously terminated by reason of any such default.

16. Lessee may, at any time, surrender any unit of the leased premises to the Lessor by an appropriate instrument, in writing, duly executed and acknowledged so as to entitle the same to be recorded, and thereupon all rights and obligations of the parties hereto, one to the other, shall cease and determine as to the premises thereby surrendered, provided, however, the Lessee shall have first paid all rentals, taxes or royalties due and shall have performed all obligations of the Lessee hereunder.

17. If Lessor at any time believes that Lessee is in default under the terms and provisions of this lease, it shall notify Lessee in writing of the particular default claimed, and if such default shall not be cured within thirty (30) days after the giving of such notice, Lessor may terminate this lease by written notice to Lessee. In

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

the event Lessee shall fail to make any payment of rentals or royalties or other fixed amounts when due, Lessor may terminate this lease upon ten (10) days' written notice to Lessee and Lessee's failure to pay the full amount due within that time.

13. All of the covenants and agreements of this lease shall extend to and be binding upon and every benefit hereof shall inure to the heirs, executors, administrators, successors or assigns of the parties hereto, as the case may be.

IN WITNESS WHEREOF, this lease and agreement has been executed by the parties thereunto duly authorized the day and year first above written.

SANTA FE PACIFIC RAILROAD COMPANY

By /s/ R.S. Ryder
Vice-President

LESSOR

ATTEST:

/s/ R.D. Brown
Assistant-Secretary
(SEAL)

/s/ Victor Salazar

LESSEE

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

SANTA FE PACIFIC RAILROAD Co.
LEASE No. 9451

Lease No. 9451

URANIUM MINING LEASE AND AGREEMENT

THIS INDENTURE, entered into in duplicate this tenth day of May, 1955, by and between SANTA FE RAILROAD COMPANY, a corporation created by Act of Congress approved March 3, 1897, with its principal offices in Albuquerque, New Mexico, first party, hereinafter called the "Lessor", and

RICHARD D. BOKUM, II
of Santa Fe, New Mexico,

second party, hereinafter, whether one or more, called the "Lessee".

WITNESSETH, that the parties hereto, for the considerations hereinafter expressed, covenant and agree as follows:

1. Lessor, upon the terms and conditions and subject to the reservations hereinafter set forth, hereby grants to Lessee the exclusive right and privilege for a period of twelve (12) months, beginning with the date hereof, to search and explore for uranium-bearing ore by methods used and recognized in the industry and, thereafter for a period of five (5) years, to conduct mining operations on areas where uranium ore is discovered on the following described lands situated in the County of McKinley, State of New Mexico :

NEW MEXICO MERIDIAN, NEW MEXICO

Township fourteen North, Range ten West

Sections 9, 13, 15, 17 and 25, containing three thousand two hundred and no hundredths (3,200.00) acres.

Subject to easement to Malco Pipeline Company, Inc., dated September 24, 1941, for oil pipe line across sections 9 and 17.

Subject also to oil and gas lease to J.K. Wadley, dated November 1, 1952, on N½ and SE¼ section 13 and N½ and SE¼ section 15.

Subject also to oil and gas lease to J.K. Wadley, dated December 15, 1952, on N½ and SE¼ section 9.

including the right to construct and maintain thereon at the sole cost and expense of Lessee all works, buildings, plants, waterways, roads, telegraph and telephone lines or other

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

structures necessary and desirable in the exploration, development or conduct of mining operations upon said lands.

SUBJECT to the rights of grantees, vendees and licensees of the surface of said lands under deeds, contracts of purchase or other agreements heretofore made by Lessor and to the obligations of Lessor under the provisions thereof.

SUBJECT ALSO to all leases or agreements now outstanding for use of said lands, or any portion thereof, for agricultural, horticultural, grazing, mining or other purposes, but Lessor represents that there are no such leases or agreements valid and outstanding made by Lessor for the development and production of uranium-bearing ore and associated minerals.

SUBJECT ALSO to the right of Lessor (which right is hereby expressly reserved) to enter into leases, permits, or other agreements with others covering said lands or any portion thereof for any purpose whatsoever not inconsistent with the rights of Lessee hereunder.

SUBJECT ALSO to all existing easements, servitudes and rights of way for canals, ditches, levees, roads, highways, telegraph, telephone and electric power lines, railroads, pipe lines and any other purposes, to any public roads heretofore laid out or established, and to rights of way for ditches and canals which may be constructed under authority of the United States.

Lessee accepts this lease subject to and agrees to comply with the provisions of that certain purchase agreement between Anaconda Copper Mining Company and Santa Fe Pacific Railroad Company, dated July 14, 1952, which gives Anaconda the first right to purchase any limestone gangue, low-vanadium ores produced by Santa Fe.

It is understood that the Lessee is hereby granted the right to mine only within the exterior boundaries, extended vertically downward, of the land hereby leased.

2. Lessee agrees on or before the exploration of the first twelve (12) months period above mentioned to surrender to Lessor by an appropriate instrument, in writing, all of the land described above on which uranium ore has not been discovered, retaining only such lands as appear to contain uranium-bearing ore in commercial quantities. Lessee further agrees the retained lands shall be divided into units, to be designated by Lessee, of not to exceed six hundred and forty (640) acres each, conforming as nearly as possible to legal subdivisions, and that all of the terms and covenants of this lease shall separately apply to each such unit as fully as if covered by a separate lease.

3. Lessee agrees to enter into and upon the said premises within sixty (60) days from the date hereof and to work and operate on the leased premises steadily and continuously during the period of this lease in accordance with approved methods so as to discover, mine and remove the greatest amount of uranium-bearing ore possible in a manner proper and necessary to good and economical mining with due regard to the development and preservation of the said premises as mining ground. Lessee further agrees that all work done in and upon said premises and property shall be done in full compliance with the mining laws and regulations of the State, the United States and any other competent public authority.

4. Lessor reserves the right through its agents or representatives to enter from time to time into and upon all parts of said premises and workings thereon for the purpose of inspection, surveys, or taking samples therefrom, and Lessee agrees to render said agents or representatives proper assistance in making said inspection, surveys or examinations. Lessee shall furnish quarterly reports to the Lessor, including maps, showing all exploration data and all of the mining and exploration work done, or in progress, upon the property, together with assays of the ore encountered, during the preceding quarter.

5. On all ores mined or removed from demised premises for the purpose of milling, treatment, stockpiling, sale or other disposition, Lessee shall pay to the Lessor a percentage royalty of the mined value per dry ton as set forth in the following schedules:

(a) Lessee shall pay Lessor on all underground ore mined from the demised premises through shaft or tunnel on the following royalty schedule:

Percentage Royalty Schedule

Mine Value Per Dry Ton	Royalty Percentage of Mine Value Per Dry Ton
$ 0.01 to $10.01	10%
$10.01 to $20.01	11%
$20.01 to $30.01	12%
$30.01 to $40.01	13%
$40.01 to $50.01	14%
$50.01 or more	15%

(b) Lessee shall pay Lessor on all open pit ore

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

mined by surface mining methods on the following royalty schedule:

Percentage Royalty Schedule

Mine Value Per Dry Ton	Royalty Percentage of Mine Value Per Dry Ton
$ 0.01 to $10.01	10%
$10.01 to $20.01	14%
$20.01 to $30.01	18%
$30.01 to $40.01	22%
$40.01 to $50.01	26%
$50.01 ore more	30%

"MINE VALUE PER DRY TON", wherever used herein, is hereby defined as the dollar value per dry ton of crude ores at the mine as determined by the application to the valuable metal content of such ore of the price schedules for such ores established and currently in effect by the Atomic Energy Commission or other government authorized agencies, but excluding any allowance for transportation or development, and all mine production bonuses. However, if the Government at any time hereafter does not establish or have in effect a price schedule for the purchase of such ores on a fixed or scheduled dollar value per dry ton of crude ores at the mine, or said ores contain salable minerals, some, or all, of which are disposed of to a custom treatment plant or smelter for treatment and sale, then mine value per dry ton shall be the gross value per dry ton of said crude ores paid therefor by the Atomic Energy Commission, or other Government authorized agency, or by a mill or other buyer less any allowances or reimbursements for the following specific items:

(1) Transportation of ores.

(2) Allowances paid to Lessee by the Atomic Energy Commission or other Government authorized agency for exploration for or development of ores.

Wherever minerals or other products associated with uranium-bearing ore are recovered from the ores which are not included in determining "Mine value per dry ton" as heretofore defined, there shall be paid by Lessee to the Lessor for such minerals or other products, a royalty of ten per cent (10%) of the gross value of such products, less milling cost charged to Lessee thereon.

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1542
Grand Junction, Colorado

All royalty payments to be made by Lessee to Lessor shall be made on or before the twentieth day of the month next following receipt by Lessee of payments for the products sold or disposed of.

Lessee shall keep accurate account of all mining operations, showing the sales, prices, dates, purchasers, and the whole amount of minerals mined, the amount removed and the gross receipts derived therefrom, together with any bonus or other payments, and furnish to Lessor sworn monthly reports thereon not later than the twentieth day of the succeeding month.

6. In addition to the payments hereinabove mentioned, Lessee shall pay Lessor as rental for the leased premises upon the execution of this lease the sum of One Dollar ($1.00) per acre and thereafter One Dollar ($1.00) per acre a year for each year this lease may be in effect, to be paid annually in advance; provided, however, that beginning with the second year and each year thereafter the rental so paid for any one year shall be credited on the royalty due to Lessor for that year.

7. Lessee shall not subject Lessor or the leased premises to any liability or lien for or on account of any work done or improvements made or materials placed on or used upon said premises, and if by reason of the failure of Lessee to pay bills or expenses incurred by Lessee any lien or liens shall be filed against the leased premises, Lessor may forthwith pay and discharge the same and hold Lessee bound to repay to Lessor all sums so advanced or paid to clear said premises from liens which may be filed as aforesaid, and Lessor may also at its election declare a forfeiture of this lease. Lessee agrees to post forthwith and keep posted on said property in all places required by law, a notice of nonliability of the Lessor for Labor or materials furnished the Lessee, and the Lessor agrees to furnish such notices.

8. Lessee shall file returns with the proper taxing authorities covering the mineral estate hereby leased, the uranium-bearing ore or other minerals produced from the leased premises, and all personal property which may be placed upon said premises by Lessee; and shall pay, before the same shall become delinquent, all taxes, charges, rates, and assessments which may, during the term of this lease, be levied upon or assessed inany respect upon or against said mineral estate, ore, mineral products or personal property, together with all increases in such charges, rates or assessments upon the land, by reason of the discovery or production of such minerals or on account of

improvements erected upon said land, including buildings, machinery and other fixtures placed thereon by Lessee. Where any such taxes, charges, rates or assessments may be embraced in the general amount of taxes charged upon the leased premises, separately or in conjunction with other property of the Lessor or of the surface owner, and the Lessor shall pay such taxes or refund the same to the surface owner, then Lessee shall promptly repay or refund to Lessor the amount or part of the tax, charge, rate or assessment attributable under this lease to Lessee. All such payments by Lessor on account of Lessee shall bear interest at the rate of eight per cent (8%) per annum until paid.

9. Lessee shall save harmless and indemnify Lessor against all claims, demands, suits, judgments, expenses and costs of any and every kind on account of the injury to or death of persons or loss of or damage to property arising in any manner out of or in connection with the operations of Lessee hereunder and Lessee shall at Lessee's sole cost and expense defend all such claims, demands or suits; and if at any time Lessee employs any person or persons to work upon the leased premises, Lessee shall comply with the provisions of the Workmen's Compensation Act of New Mexico and all regulations and requirements of competent public authority.

10. At the expiration of this lease, or upon its earlier termination as herein provided, Lessee shall surrender the leased premises in good order and condition and remove therefrom all machinery, tools, and improvements, except such as may become the property of the Lessor under this lease by purchase or otherwise; provided, however, that no such tools, machinery, or improvements shall be removed while Lessee may be in any manner indebted to Lessor under any obligation incurred under this lease. Lessee shall not, however, remove any timbers or improvements which may be necessary or desirable to leave in the workings to protect same from subsidence or as a mining property unless requested by Lessor to do so.

11. Any notice to be given by Lessor to Lessee hereunder shall be deemed to be properly served if the same be deposited in a United States post office, registered mail postpaid, return receipt requested, addressed to Richard D. Bokum, II, P.O. Box 23, Santa Fe, New Mexico, and any notice to be given by Lessee to Lessor hereunder shall be deemed to be properly served if the same be deposited in a United States post office, registered mail postpaid, return receipt requested, addressed to Lessor at 314 First Street SW, Albuquerque, New Mexico, or at such other address as Lessor may request.

Sabre Uranium Corporation
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

12. Lessor does not warrant the quiet possession of said lands by the Lessee and Lessor shall in no event become liable for damage arising from any lack or failure of title in the Lessor to said lands or eviction of the Lessee therefrom by title paramount to the title of the Lessor. The Lessor covenants, however, and warrants that it has made no agreement on its part in reference to said lands, or any conveyance thereof which will give to third parties right to interfere in any way with the operations of the Lessee under this lease.

Lessor has, however, sold and conveyed all of said lands by deed, in which it has expressly reserved and excepted all oil, gas, coal and minerals whatsoever, already found or which may be found upon or under said lands, with the right to prospect for, mine and remove the same, and to use so much of the surface of said lands as shall be necessary and convenient for shafts, wells, tanks, pipe lines, rights of way, railroad tracks, storage purposes and other and different structures and purposes necessary and convenient for the digging, drilling, and working of any mines or wells which may be operated on said lands. Lessee accepts this lease and agreement subject to the terms of provisions of said deed reservation.

Lessee agrees (a) to pay all damages to the surface owner's buildings and growing crops caused by the erection or construction of facilities to be used in connection with mining operations; (b) that all pipe lines shall be buried below plow depth where such lines cross cultivated lands; and (c) that where there are fences, to construct gates or cattle guards therein where necessary for Lessee to cross the same, and to keep such gates and cattle guards in repair and the gates closed.

Lessee will also indemnify and save Lessor harmless from any and all claims of or liability to the owner or owners of the surface of the land leased by reason of the failure of Lessee to perform the requirements mentioned in clauses (a), (b) and (c) hereof.

Any amounts which Lessor shall be required to pay to any such surface owner or owners by reason of the failure of the Lessee to perform such obligations shall be refunded by Lessee to Lessor within thirty (30) days after demand therefor, and upon failure to make such payment within said time, all amounts so due shall become a lien upon all property of the Lessee upon said premises and all of the Lessee's interest in any uranium ore produced therefrom and the proceeds thereof.

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

13. No termination of this lease, whether by lapse of time or otherwise, shall release Lessee from any liability or obligation hereunder, whether of indemnity or otherwise, resulting from any acts, omissions, or events happening prior to the date of such termination.

14. Lessee shall not assign this lease or any interest therein nor sublet any portion of the leased premises except with the written consent of Lessor first had and obtained in each instance.

15. Lessor agrees that if during the term of this lease Lessee has found and is, at the expiration hereof, producing uranium-bearing ore in commercial quantities from the demised premises, Lessor will, upon written request from Lessee, made prior to the expiration date hereof, renew this lease for an additional three-year period, upon the same terms and conditions, including the right to like and successive renewals thereafter, upon the same conditions, subject always during any such extended period to termination whenever uranium-bearing ore in commercial quantities shall cease to be produced for sixty (60) consecutive days; provided, however, that in all instances in which Lessee is required to perform any particular act or to begin or to carry on any operation, except payment of rentals or other money due Lessor, any delay on account of floods, washouts, strikes, lockouts, the elements, acts of God or the public enemy, or other causes beyon Lessee's control, shall not be computed as any part of the time within which any such act shall be begun or performed. Lessor shall be under no obligation to renew this lease at any time or times if Lessee shall then be in default hereunder, or if this lease has been previously terminated by reason of any such default.

16. Lessee may, at any time, surrender any unit of the leased premises to the Lessor by an appropriate instrument, in writing, duly executed and acknowledged so as to entitle the same to be recorded, and thereupon all rights and obligations to the parties hereto, one to the other, shall cease and determine as to the premises thereby surrendered, provided, however, the Lessee shall have first paid all rentals, taxes or royalties due and shall have performed all obligations of the Lessee hereunder.

17. If Lessor at any time believes that Lessee is in default under the terms and provisions of this lease, it shall notify Lessee in writing of the particular default claimed, and if such default shall not be cured within thirty (30) days after the giving of such notice, Lessor may terminate this lease by written notice to Lessee. In

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

the event Lessee shall fail to make any payment of rentals or royalties or other fixed amounts when due, Lessor may terminate this lease upon ten (10) days' written notice to Lessee and Lessee's failure to pay the full amount due within that time.

18. All of the covenants and agreements of this lease shall extend to and be binding upon and every benefit hereof shall inure to the heirs, executors, administrators, successors or assigns of the parties hereto, as the case may be.

IN WITNESS WHEREOF, this lease and agreement has been executed by the parties thereunto duly authorized the day and year first above written.

SANTA FE PACIFIC RAILROAD COMPANY

By /s/ R.S. Ryder
Vice-President

LESSOR

ATTEST:

/s/ R.D. Brown
Assistant Secretary

/s/ Richard D. Bokum II

LESSEE

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colo.

3. (d) AGREEMENT

THAT on the 12th day of May, 1955, Victor Salazar and C.J. Warren, both of Albuquerque, New Mexico, and Richard D. Bokum of Santa Fe, New Mexico, Assignors, in consideration of ninety-five thousand (95,000) shares of the common stock of Sabre Uranium Corporation, to be distributed as follows:

Richard D. Bokum	11,666 shares
Victor Salazar	41,667 shares
C.J. Warren	41,667 shares,

hereby let, grant, and assign to SABRE URANIUM CORPORATION, P.O. Box 1549, Grand Junction, Colorado, Assignee, all the mineral rights held by, or may hereafter be held at the assignors under any lease agreement with the Santa Fe Railroad on the following described lands, to-wit:

TOWNSHIP 14 NORTH:	RANGE 10 WEST
Section 1: all	Section 15: all
Section 3: all	Section 17: all
Section 5: all	Section 19: all
Section 7: all	Section 21: all
Section 9: all	Section 23: all
Section 13: all	Section 25: all

and

TOWNSHIP 15 NORTH:	RANGE 10 WEST
Section 25: all	Section 31: all
Section 27: all	Section 33: all
Section 29: all	Section 35: all

containing 11,520 acres more or less, located in the aforementioned townships, in the County of McKinley, State of New Mexico. Assignee agrees to assume payment of all royalties due Santa Fe Railroad under the lease from the Santa Fe Railroad. The assignors also hereby let, grant, and assign to SABRE URANIUM CORPORATION all the mineral rights held by, or may hereafter be held by the assignors on the following described lands, to-wit:

TOWNSHIP 16 NORTH: RANGE 11 EAST
72 mining claims known as the Dunes Group, Thunderbird Group, and Frontier Group, located in Sections 29, 30 and 31

and

TOWNSHIP 15 NORTH: RANGE 11 EAST
115 acres of fee land in Section 6,

containing 1,535 acres more or less, all located in Santa Fe County, New Mexico.

Assignors warrant that they now hold title to the above described lands, and agree to defend such title should any person or party challenge or jeopardize the title to the aforementioned properties.

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colo.

3. (d) Continued.

IN WITNESS WHEREOF, THIS AGREEMENT HAS BEEN EXECUTED BY THE PARTIES HERETO THE DAY AND THE YEAR FIRST ABOVE WRITTEN.

SABRE URANIUM CORPORATION

by /s/ Hugh M. Craigie
President

by /s/ W.R. Montgomery
Treasurer

by /s/ Hugh Bradford
a Director

/s/ Victor Salazar
Victor Salazar

/s/ C.J. Warren
C.J. Warren

/s/ Richard D. Bokum
Richard D. Bokum

STATE OF NEW MEXICO }
COUNTY OF BERNALILLO } ss

On this 23 day of May, 1955, before me personally appeared Victor Salazar and C.J. Warren, to me known to be the persons described in and who executed the foregoing instrument, and acknowledged they executed the same as their free act and deed. Witness my hand and seal on this 23 day of May, 1955.

/s/ Mary R. Dey
Notary Public

(SEAL)
My commission expires 3-31-59

Bernalillo County, New Mexico

STATE OF NEW MEXICO }
COUNTY OF SANTA FE }

On this 23rd day of May, 1955, before me personally appeared Richard D. Bokum, to me known to be the person described in and who executed the foregoing instrument, and acknowledged he executed the same as his free act and deed. Witness my hand and seal on this 23rd day of May, 1955.

/s/ Celine Cordilia Casador
Notary Public

(SEAL)
My commission expires June 20, 1958

Santa Fe County, New Mexico

STATE OF NEW MEXICO }
COUNTY OF BERNALLLO }

On this 23rd day of May, 1955, before me personally appeared Hugh M. Craigie, W.R. Montgomery, and Hugh Bradford to me personally known who being by me duly sworn, did say that they are respectively the President, Treasurer, and a Director of SABRE URANIUM CORPORATION, and that the seal affixed to said instrument is the corporate seal of said corporation, and that said

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

3. (d) Continued

instrument was signed and sealed in behalf of said corporation, by authority of its board of directors, and said persons acknowledged said instrument to be the free act and deed of said corporation. Witness my hand and seal on this 23rd day of May, 1955.

/s/ Mary R. Dey, Notary Public

Bernalillo County, New Mexico

(SEAL)
My commission expires 3-31-59

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colorado

4. (c) Describe the geologic features of the property, including mineralization, type of deposit (vein, bedded, etc.), and your reasons for wishing to explore. Illustrate with maps or sketches. Send with your application (but not necessarily as a part of it) any geologic or engineering report, assay maps, or other technologic information you may have, indicating on each whether you require its return to you.

The Grants district has become of increasing importance since the discovery of uranium in 1950 just to the south of Haystack Mountain (Sec. 19, T. 13 N., R. 10 W.). Ore has now been found in three different formations: the Dakota, the Morrison and the Todilto. Average size of the ore bodies is greater than that of those generally found in the Colorado-Utah area. During the months of April and May 1955, a major discovery was made in Sec. 11, T. 14 N., R. 10 W. by Ellis Dunn. An ore body of more than 200,000 tons was blocked out by the drilling of less than one hundred holes. The average grade is in the neighborhood of 0.35% U_3O_8 and the average width from six to eight feet at a depth of some 350 ft. below the surface. This ore is located on the north flank of a salt dome which is superimposed on the west flank of the Ambrosia anticline. Enclosed are two copies of report RME-3050, Fracture Pattern of the Zuni Uplift, by Arthur K. Gilkey. This gives details of the geology of the area and is of great assistance in understanding ore deposition in the Grants district.

Also enclosed is a report by Geoprofessional Services, Inc. on Sabre Uranium Corporation's New Mexico properties in the Grants area, prepared by A.J. Eardley, dated August, 1954. Further information on the geology of the area was obtained by consulting RMO-1031, Interim Report on the Ore Deposits of the Grants District, New Mexico, by Irving Rapaport, dated November 1952, and RMO-642, Jurassic Rocks of the Zuni Uplift, New Mexico, by Irving Rapaport, J.P. Hatfield and Richard H. Olson, dated March 1952. Since it is believed that you have available copies of these reports, they are not enclosed.

It is proposed to do exploration drilling in T. 14 N., R. 10 W., in the following sections which are now under lease to Sabre Uranium Corporation: 1, 2, 3, 13 and 15. These are in a favorable location for exploration due to their proximity to the ore discovered in Sec. 11 (see plates 1 and 2.) Plate No. 1 is a partial copy of Plate No. 18 in U.S.G.S. Bulletin No. 860 and shows the geology of the Ambrosia Lake area, which includes T. 14 N., R. 10 W. Plate No. 2 is a partial enlargement of the same map showing the geology of the sections on which it is proposed to explore.

Sabre Uranium Corp.
18-19 Reed Bldg.
P.O. Box 1549
Grand Junction, Colo.

4. (c) Continued.

On approval of this loan application, Sabre proposes to start exploration by drilling on 500-ft. centers, as shown by plate No. 3.

SABRE URANIUM CORP.
P. O. Box 1549
Grand Junction, Colo.

. J. EARDLEY
PRESIDENT 8-9448
F. W. CHRISTIANSEN
VICE-PRESIDENT 7-4980
N. C. WILLIAMS
VICE-PRESIDENT 87-1812
W. L. STOKES
VICE-PRESIDENT 6-5614
A. W. ROGERS
SEC.-TREAS. 84-1748
C. L. ASHTON
DIRECTOR 8-1115

GEOPROFESSIONAL SERVICES, INC.

1311 WALKER BANK BUILDING — SALT LAKE CITY 1, UTAH

RECEIVED
JUN 8 1976

NEW MEXICO PROPERTIES, GRANTS AREA

Subject to option held by Sabre Uranium Corporation

The various state lands comprising the New Mexico properties subject to options held by Sabre Uranium Company lie between Grants and Gallup, McKinley County, New Mexico in one of the chief uranium-producing districts of the Colorado Plateau. In this district ore deposits are found in three formations, the Todilto limestone, the Morrison formation and the Dakota sandstone. Practically all the deposits which are being mined at present were discovered at the surface or were found by following surface indications. There are, however, many deposits which have been discovered by drilling and these are being opened up on an increasing scale. It may be reasonably assumed that deeper holes into covered ground will be increasingly necessary.

The Todilto limestone contains deposits of all sizes ranging in content from 10 to several thousand tons. The ore is unusual in the fact that it occurs in limestone where the minerals not only coat fractures and stratification planes but also impregnate the mass of the rock itself. A special mill is being created for the limestone ores which were formerly impossible to treat.

The Morrison formation consists of three members which are in ascending order the Recapture shale member (100 to 250 feet thick), the Westwater member (150 to 300 feet) and the Brushy Basin shale (80 to 100 feet). In fact, ore seems to range throughout the entire thickness of the two higher members. The ore lies in distinct "channels" of coarser material and appears to be associated with carbonaceous material of several kinds. Most of the bodies are elongate in the direction of channel trend. No ore has been found in the Recapture Member.

The Dakota sandstone is known to contain ore in commercial quantities only in the Grants area.

The fact that the Dakota is a persistent rim-former and is exposed over many miles of sloping territory, makes possible the drilling of exploratory holes with depths of between 200 and 500 feet which would penetrate not only the Dakota but also the favorable horizons of the Morrison. An additional 250 feet would also test the Todilto.

Sabre Uranium Corporation option covers 14 tracts of land in the area. The location, geology and potential value of these tracts are discussed below and shown on the maps.

DESCRIPTION OF INDIVIDUAL SECTIONS

Sec. 2, T. 13 N., R. 9 W.: Accessible by a poor road. The bedrock is Mancos shale. Depth to the first favorable bed, the Dakota, would average about 400 feet. The area is considered somewhat favorable. Drilling is not being done at present in the Grants area to

GEOPROFESSIONAL SERVICES, INC.

SABRE URANIUM CORP.
P. O. Box 1549
Grand Junction, Colo.

the depth required on this tract except on the almost certain prospects of finding ore.

Sec. 16, T. 12 N., R. 9 W.: The tract is readily accessible by road and there is little or no overburden over the ore-bearing formation. About 125 acres of Todilto limestone occurs in the northeastern part of the Section. No ore is definitely known.

Sec. 16, T. 13 N., R. 9 W.: Easily accessible by several roads. The surface rocks are Dakota and Mancos. This is the most favorable tract in the Sabre holdings. Inasmuch as depth to favorable ground ranges from 175 to 225 feet, it is within the range of commercial exploitation if ore should be found. Inasmuch as Sections 15 and 21 are not open for exploration at present, it is obvious that Section 16 is favorable not only geologically but also in other ways.

Sec. 36, T. 13 N., R. 10 W.: Easily accessible by good roads. This tract is entirely out of the favorable formations except for a small prong or perhaps one acre in the northeast corner. On this outcrop mining on the Todilto has already been done with the production of perhaps 100 tons of ore. Other ore bodies may be found by shallow drilling.

Sec. 16, T. 15 N., R. 10 W.: This is a small tract of 12 acres along the east side of the section. Although most of the tract is covered by alluvium it is estimated that about 4 acres is underlain by the Todilto. There is good prospects of uranium deposits in this portion.

GEOPROFESSIONAL SERVICES, INC.

SABRE URANIUM CORP.
P. O. Box 1549
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Sec. 36, T. 15 N., R. 11 W.: Accessible by a poor road. The bedrock over the area is Mancos shale. Distance to outcrops of the Dakota sandstone is about three miles. Depth to the favorable formations is estimated at about 500 feet. Drilling at this depth is not being undertaken in the area except with the practical certainty of finding ore.

Sec. 16, T. 14 N., R. 11 W.: Accessible by a fair road. The surface rocks include Dakota and Morrison and about half the section is obscured by alluvium. There is a fair chance that ore may be present in the Morrison or Dakota and the Todilto several hundred feet deeper may eventually be prospected.

Sec. 2, T. 14 N., R. 12 W.: Accessible by a good road. The tract is mainly covered by alluvium except along the west side where the upper part of the Morrison crops out. The Todilto limestone lies from 120 to 300 feet in depth and could be drilled if conditions warranted. No ore is known.

Sec. 16, T. 14 N., R. 12 W.: Accessible by a fair road. The tract is mostly covered by alluvium except for about 100 acres of Todilto limestone in the southwest corner. It is evident that the Todilto can be reached by drilling under the alluvium with holes averaging about 75 feet.

Sec. 36, T. 16 N., R. 15 W.: Accessible by fair roads. The bedrock over the entire section is Dakota sandstone but the favorable part of the Morrison lies only 200 to 300 feet below the surface. The Dakota itself would range from about 40 to 100 feet in thickness. Inasmuch as no ore is known nearer this section its potential must be considered only fair.

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W½ Sec. 26, T. 15 N., R. 15 W.: Accessible by good gravel road. The tract is surfaced by alluvium and Chinle. No ore has been found. It lies well below the formations currently producing ore.

S½ Sec. 16, T. 15 N., R. 15 W.: Accessible by wagon roads. This section lies entirely in the upper part of the Chinle formation below the massive Wingate cliff. No ore is known to occur in the Chinle formation in the Grants district but it does contain ore in Utah and Arizona.

Sec. 34, T. 16 N., R. 15 W.: Accessible throughout by wagon trails. The surface is mostly heavily wooded and much alluvium is present. The bedrock is chiefly Recapture and there may be Bluff sandstone along the south edge. Since the younger ore-bearing formations are eroded the Todilto limestone is the only potential producer in the section. The depth to this would be on the order of 200 feet.

Sec. 36, T. 16 N., R. 16 W.: The section is accessible by a fairly good road along the west margin. Surface rocks include the Dakota, Brushy Basin, Westwater, and Recapture. There is relatively little alluvium. The rim of the Dakota and Westwater which constitute the favorable ground are well exposed and could be easily prospected. No ore is known. Prospects for hidden deposits are fair.

Submitted by,
GEOPROFESSIONAL SERVICES, INC.

A. J. Eardley

A. J. Eardley

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4. (d) State the facts with respect to the accessibility of the project: Access roads, distances to shipping, supply and residence points.

These five sections are approximately 12 miles from the Bluewater mill of the Anaconda Mining Co. A pipe line road passes through Sec. 3 to the Prewitt Oil refinery. A number of ranch roads exist in the area.

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4. (e) State the availability of manpower, materials, supplies, equipment, water, and power.

Power lines are available at ranches within one or two miles. Labor, materials, supplies, are available in Grants. Sufficient water for drilling can be obtained from wells in the vicinity.

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5. (a) The Exploration Project. State the mineral or minerals for which you wish to explore.

The purpose of this exploration project is to find uranium (U_3O_8) in commercial quantities.

(b) Describe fully the proposed work, including a map or sketch of the property showing a plan of any present mine workings, and the location of the proposed exploration owrk as related to such features as veins, ore-bearing beds, etc.

Plate No. 2 shows a rough location of the ore body found in Sec. 11. The proposed drilling will prospect both flanks of the Ambrosia anticline to the north of Sec. 11 (Sec. 1, 2 and 3). It will also explore both flanks of the anticline to the south of Sec. 11, as well as the southwestern flank of the salt dome (Sec. 13 and 15). Drilling in Sec. 3 will explore both sides of the Ambrosia fault, and in Sec. 15 the east side of the fault.

(c) The work will start within ..... days and be completed within ..... months from the date of an exploration project contract.

Work will start immediately on signing the exploration project contract and will be terminated within eight (8) months.

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5. (d) State the operating experience and background of the applicant with relation to the ability to carry out such exploration project, and also that of the person or persons who will supervise the operations.

Hugh M. Craigie is a mining engineering graduate of the Massachussetts Institute of Technology. He has held positions with the American Smelting & Refining Co., Phelps-Dodge Co., and from November, 1933, to May, 1954, with San Francisco Mines of Mexico, Ltd. He commenced his employment with San Francisco Mines of Mexico, Ltd., as Assistant Superintendent, and later held the positions of Mine Superintendent, General Mine Superintendent, General Superintendent, and Assistant General Manager. As Assistant General Manager, Mr. Craigie was in charge of all operations in that company's lead-zinc mines in San Francisco del Oro, Chihuahua, Mexico. His duties included Supervision of exploration, acquisition of new mining properties, development, diamond drilling, mining, estimates of ore reserves, evaluation of properties, outcome of operations and computation of cost and operational data. The mine is one of the largest lead-zinc mines in Mexico, employing 3,300 persons.

Clyde E. Collins has been active in the mining business since 1921, having held such positions as: Mine Manager, Mine Superintendent and Development Engineer. From 1947 to 1951, Mr. Collins was engaged in the private practice of mining engineering and metallurgy with a laboratory in Carson City, Nevada. From 1951 to June of 1953 he was Senior Mining Engineer of the Atomic Energy Commission for the area from the Green River in Utah west to the Pacific Coast, and south to the Mexican border. From June, 1953, to the present time, he has been employed by Plateau Uranium Mining Corporation as a mining engineer.

Charles C. Green has been in the oil business since 1937. His experience includes the positions of: Assistant District Geologist for the Shell Oil Company for West Texas and New Mexico, and Chief Geologist for the Western Division of Texas Gulf Producing Co. From July, 1950, to November, 1952, Mr. Green was one of the principal owners of Cactus Drilling Corporation, a contract drilling and development company, operating principally in West Texas, New Mexico and Colorado. Since November, 1952, he has devoted his full time to independent oil operations and as a consulting geologist.

W.R. Montgomery was for many years prior to 1952 treasurer and financial officer of the Southland Life Insurance Company. Since 1952, he has been president of the Realty Trust Company, a trust and corporation finance company. In addition, he is President of Northwood Oil Company and a director of the Home Life and Accident Insurance Co., Home Services CAsualty Insurance Co. and Borne-Scrymser Oil Co.

Robert F. Thompson became Vice-President in 1945 of City Construction Company, highway and airport construction contractors. In 1951, he became Executive Vice-President and a Director of Tecon Corporation, which, in addition, to taking over the

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5. (d)

operations of City Construction Company, also engaged in the construction of bulk fuel-storage facilities, underground utilities, dams, bridges, spillway and outlet structures, and military and defense housing projects, wharves, piers, locks and water treatment plants. Mr. Thompson is also a Director of Millwood Development Co., Island Properties Company, and Texas Ideal HOmes, Inc.

Jack C. Vaughn has been actively engaged in the oil business since 1947. He is co-owner of the Spartan Drilling Co., which does business in a fifteen state area, Canada and Cuba. In addition, Mr. Vaughn is a large investor in Southwestern real estate, cattle and timber. He is a director of the Texas Bank and Trust Company, Dallas, Texas, Texas Empire Life and Accident Company, Spartan National Life Insurance Company, G.H. Vaughn Production Company, and the Dixie Drilling Company. Mr. Vaughn, who owns 6.1% of the outstanding capital stock of Plateau Uranium Mining Corp., was selected by Plateau as one of its nominees to the Board of Directors of Sabre Uranium Corp.

Roy A. Hardy is a geologist and engineer. He has held positions as General Superintendent and as General Manager of gold and silver, lead and zinc-flotation mines, mining engineer for the Reconstruction Finance Corporation, and as a consulting mining engineer in private practice. Since 1935, Mr. Hardy has been consulting engineer for Getchell Mine, Inc., a gold and tungsten mine, and, since 1940, a consulting engineer for uranium properties.

S.Y. Guthrie is a mechanical engineering graduate of Texas A. & M. College. Since 1932, he has been president of Dallas Air Conditioning Co., Inc., distributors and contractors of York Corporation air conditioning and refrigeration equipment as well as process piping contractors. Since 1946, Mr. Guthrie has been an officer and director of Coastal Equipment Co., Inc., He is also president of S.Y. Guthrie and Associates, Inc., which owns and leases commercial property. From 1950 to 1952, Mr. Guthrie was a partner of S.Y. Guthrie and Associates, predecessor of Plateau Mines, Inc., of which he was president from 1952 to 1953. Since 1953, he has been president of Plateau Uranium Mining Corporation.

Hugh Bradford has been in the investment banking business since 1947. He has been a general partner of Southwestern Securities Company since 1950. From March, 1948, to March, 1950, he was associated with Lynch, Allen & Co., investment brokers. Mr. Bradford owns 38% of the capital stock of Mountain States Securities Corporation.

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6. Estimate of Cost. Furnish a detailed estimate of the costs of the proposed work.

(a) Independent Contracts.

Drilling will be let under contract. Standard rates for dry rotary drilling in the area are:

0 - 200'	@ $0.50	=	100.00		
200 - 300'	@ $1.00	=	100.00		
300 - 400'	@ $1.50	=	150.00	$350./hole	

103 - 9 = 94 holes/section x 5 = 470 holes @ 350.=$164,500.00

Coring for information as to structure will be done with the diamond drill, using BX rods , and will cost $3.50/ft. Assume 9 holes per section x 5 = 45 holes @ 400 = 18,000'

18,000' @ $3.50 = $63,000.00

A D-6 tractor, with blade, owned by company, will be available for road work and to prepare drilling sites ahead of the drills. Proposed rate per hour, with operator, $12.50.

A Joy 105 compressor, with L-47 jackhammer and jackleg, owned by company, will be available when required. Proposed rate per hour with driller - $5.00.

A Willys 1953 jeep pickup, owned by company, is available for transportation on property. Proposed rate/mile $0.15, including gas, oil, tires, repairs and depreciation.

(b) Labor, supervision, consultants.

Labor, supervision, consultants - per month :

one geologist @ $400.00, one junior geologist @ $300.00	= $700.00
one helper @ $200.00	= 200.00
one transit man @ $300.00 and helper @ $200.00 for	= 250.00
auditing and secretarial work - 25% @ $500.00	= 125.00
	$1,275.00

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6. Estimate of Cost. Continued.

(c) Operating materials and supplies.

	Per month
Repairs and replacements	$ 75.00
Engineering supplies	50.00
Food and living expenses -	
Geologists 6 meals/day	
Engineers 3 meals/day	
Tractor operator 3 meals/day	
12 meals/day @ $1.00 = 12.00 x 30 =	360.00
	$485.00

(d) Operating equipment -(owned by company)

1 D-6 Caterpillar tractor with blade	$7,975.00
1 Joy 105 compressor	1,850.00
1 L-47 Joy Jackhammer with jackleg	300.00
1 Willys 1953 jeep pickup 3/4 ton	1,975.47
1 Anderson house trailer	1,500.00

Suggested rental for house trailer - $40.00/month
Office rent - Grants - $125.00/month

(e) Rehabilitation and repairs.

Non-existent.

(f) New buildings, improvements, installations.

Not needed.

(g) Miscellaneous.

Air transportation in company Cessna 180 airplane, 10 round trips/month, Grand Junction-Grants

10 x 520 miles = 5200 x -20/mile = $1,040.00/month

or 10 x 4 hrs. = 40 hrs. @ 24.00/hr=$ 960.00/month

Miscellaneous repairs and maintenance to operating equipment will be covered by rental allowance.
Analytical work will be covered by allowance made under 6 (b).

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6. Estimate of Cost. Continued

(g) Miscellaneous - continued

Accounting - use of accountant as a consultant - 8 x 100.00	$ 800.00
Workmen's compensation :	
on $1150.00 @ 3.99 = $46.00 x 8	
on 125.00 @ .07 = .09 x 8	368.72
Employer's liability - 3% of payroll 1,275 x 8 - 10,200 x 03 =	306.00
Company's share F.I.C.A. taxes - 2% of payroll 10,200 x 02	204.00
Over 8 months - total	$1,678.72

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6. Estimate of Cost.

SUMMARY

(a)	Dry rotary 470 - 400' holes @ $350.00	$164,500.00
	Diamond drill - coring-18000' @ $3.50	63,000.00
	D-6 tractor-4months @ 5 hrs. daily, 20 days/month = 400 hrs. @ $12.50	5,000.00
	Compressor and rock drill 50 hrs. @ $5.00	250.00
	Jeep transportation @ 0.15/mile 8 months @ 30 miles/day 8x30x30 = 7200 7200 miles @ $0.15 =	1,080.00
(b)	Labor, supervision and consultants - $1275.00/month x 8 =	10,200.00
(c)	Operating materials and supplies $485.00 x 8 =	3,880.00
(d)	House and office rent - $165.00 x 8	1,320.00
(g)	Air transport $1000.00 x 8	8,000.00
	Accounting, workmen's compensation, FICA taxes	1,678.72
		$258,908.72
(h)	Contingencies - 10% of above	25,890.00
		$284,798.72

UNITED STATES ATOMIC ENERGY COMMISSION

RME-3050

FRACTURE PATTERN OF THE ZUNI UPLIFT

Final Report

By
Arthur K. Gilkey

June 1953

Columbia University
New York, New York

Technical Information Service, Oak Ridge, Tennessee

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Walter H. Bucher, Project Director

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TABLE OF CONTENTS

	Page
Abstract	1
Acknowledgments	4
Objectives of the Study	5
Procedures and Data	5
General Plan	5
Specific Procedures and Data	6
Maps of Zuni Uplift	6
Ground Samples of Jointing, Zuni Uplift, New Mexico	6
Faults and Joints of a Part of the Northeast Rim of the Zuni Uplift, New Mexico	8
Maps of Smaller Uplifts of Known Origin	11
Laterally Compressed Folds	11
Passively Domed Anticlines	13
Evaluation of Results	15
Interpretation of Data	15
Theoretical Grounds for Prediction of Patterns	15
Test of Predicted Criterion	18
Application of Criterion to the Zuni Uplift	18
Implications of the Interpretation	23
References	27
Maps	29-34

MAPS

Page

1. Ground Samples of Jointing, Zuni Uplift, New Mexico ..... Insert

2. Faults and Joints of a Part of the Northeast Rim, Zuni Uplift, New Mexico ..... Insert

3. Topographic and Geologic Map of an Anticline in the Woods Hollow Mountains, Marathon, Texas 29

4. Faults and Joints. Anticline in Woods Hollow Mountains, Marathon, Texas 30

5. Attitude of Beds. Anticline in Woods Hollow Mountains, Marathon, Texas 31

6. Joint Measurements, Wills Mountain Anticline, Maysville Gap, West Virginia 32

7. Joint Measurements Rotated to Position of Horizontal Bedding, Wills Mountain Anticline, Maysville Gap, West Virginia 33

8. Maze Arch, Henry Mountains, Utah 34

FRACTURE PATTERN OF THE ZUNI UPLIFT

by
Arthur K. Gilkey

ABSTRACT

The objectives of this study have been to determine the nature of the major fracture pattern of the Zuni uplift; to analyze this pattern for evidence of the mode of origin of the uplift; and to compare the fracturing in the ore areas with that elsewhere on the uplift to see whether diagnostic features exist that might make it possible to indicate other favorable areas.

The general procedure followed was to measure samples of the jointing at numerous points distributed areally and stratigraphically over the entire Zuni uplift; to plot these together with observed and compiled fault orientations; and then to compare the resulting fracture pattern with those of several smaller uplifts of known origin. Folds of two types of origin were studied: long, narrow anticlines typical of belts ascribed to horizontal compression, and broad domings demonstrably produced by materials injected at depth. Of two anticlines studied, taken to have been formed by horizontal compression, one is a fold in the Marathon region, West Texas, and the other, a fold of the Appalachian folded belt near Maysville, West Virginia. In both, the most continuous fracturing strikes at an angle of about 75° with the fold axis. Only one example of the second type was studied in the field, a laccolithic structure, the Maze Arch in the Henry Mountains, Utah. Its fracture pattern was compared with several structures described in the literature. All these structures, "passively" domed by the rise of masses from below, are characterized by having the most continuous fractures parallel to their long axes.

A comparison of these contrasting patterns leads to the conclusion that the Zuni uplift bears stronger relationships to the second group than to the first. This

suggests that it is the result of doming of the rocks over masses rising from beneath, rather than the result of folding by lateral compression. Other characteristics of the overall uplift support this judgment, such as the parallelism of the fractures in the sedimentary flanks with those in the crystalline core; the prominent horsting in the crystalline core; and the various structures that indicate deep-seated fracturing below the sedimentary rocks on the flanks (such as large faults, monoclines, and volcanic phenomena). All these require that the doming was produced by large horsts in the basement crystallines rising differentially. The age of this doming is mainly Tertiary, but it is possible that movements of these horsts have occured as early as pre-Pennsylvanian and Permian time and may have continued until the present, impressing similar joint directions recurrently.

The general area over which most of the ore has been found is a prominently faulted part of the uplift, characterized further by associated volcanic phenomena. The jointing there follows essentially two main directions, either one or both of which may be present at any one point and at least one of which has the direction of the major fractures in corresponding parts of the crystalline core. The line of outcrops of the Jurassic-Cretaceous formations along this northeast flank displays several large "scallops". These are structural features due to the combined effects of flexing and faulting. That they are not merely erosional features is demonstrated by structural contours drawn upon the Entrada sandstone for a portion of that flank. Most of the deposits known elsewhere on the uplift lie upon or near to major monoclines or faults.

The structural setting of the main ore body suggests the possibility that the ore is related to fracturing. Faults are prevalent in the ore area, and jointing seems to be especially dense near the faults. The abundant fluorite which is associated with some of the ore in the Todilto limestone suggests a possible

connection with the occurrence of fluorspar, in economic amounts, in veins on faults within the crystalline core, although the so-far barren Permian and Chinle interval separates the two regions areally. Some cutoff maps of the uranium ore bodies show well-defined elongations along the directions of the principal fracturing. There are also two general characteristics of the passively domed type of uplift which help explain the Zuni uplift as a favorable structure for uranium mineralization: Passive doming produces a lateral dilation of the sedimentary rocks which creates new open spaces; and it causes the structure to increase in severity with depth, affording easy access to deep sources of mineralization, if such were indeed responsible for the introduction of the ore.

The structural concept derived from the Zuni uplift applies to larger areas. The directions of several flexures and volcanic belts suggest that the major fracture zones extend beyond the limits of the uplift itself. These zones may extend as far as adjacent uplifts, including the large fractures along which fault blocks rose there, as did the fault blocks of the Zuni uplift. If so, they might be regarded as possible loci of mineralization. Considering still larger features, the whole Zuni uplift may be described as a unit of the "Zuni-Sacramento fractured belt", which extends southeastward toward the Sacramento uplift and the Guadalupe Mountains, and it may further be described as lying with its southeastern end at the intersection of this fracture belt with not only the Mount Taylor volcanic syncline, but with the more inclusive belt which trends from about Taos, New Mexico, (or even Trinadad, Colorado) to Globe, Arizona. Deep fracture belts of such dimensions, on the order of magnitude of the Colorado porphyry belt, may lie beneath the surface of the Colorado Plateau, evidencing themselves by monoclines, faults, and volcanic phenomena. They might be considered as the next larger loci of structures possibly favorable to mineralization.

ACKNOWLEDGMENTS

Professor Walter H. Bucher, Department of Geology, Columbia University, directed the study, overseeing the first half of the field work and counseling upon the study throughout. Professor Paul F. Kerr of the same department aided in formulating the project and provided help upon other occasions. Close and helpful cooperation in the administration of the contract was provided by Dr. Phillip L. Merritt and Dr. Donald L. Everhart of the U.S. Atomic Energy Commission. In the field, personnel of the Grants office of the U.S. Atomic Energy Commission facilitated the work in every way. Thanks are owed especially to Irving Rapaport, John Hadfield, and Richard Olsen; and, more recently, to Paul Melancon and Arthur Mirsky. The Atcheson, Topeka, and Santa Fe Railroad provided important subsurface data, and special gratitude is owed to Jack Knaebel of the Anaconda Copper Company. James H. Mallory of the Zuni Milling Company gave access to one of the fluorspar mines. Dr. Clay T. Smith, New Mexico School of Mines, kindly discussed some aspects of the Zuni uplift and provided a preliminary review of the Thoreau Quadrangle. Thanks go also to Erland Frederickson, a most helpful field assistant for the first field season.

OBJECTIVES OF THE STUDY

The basic purpose of this study has been to determine the major fracture pattern of the Zuni uplift as a whole and to analyze the results for their bearing upon the origin of the uplift. It was hoped that this fracture information might afford a verdict upon whether the uplift had formed as a horizontally-compressed fold or whether it had arisen through passive doming of the rocks by masses rising from below them. Beyond these fundamental objectives was the intention of examining especially closely the fracture pattern of that part of the northeast flank of the uplift where most of the uranium ore has so far been found, to determine whether it has any structural peculiarities which might prove of use in considering ore possibilities elsewhere.

This report is the outcome of five months of field work, four of which were spent in the vicinity of Grants, New Mexico, and one of which was divided between the Marathon region of West Texas and the Henry Mountains, Utah. In addition one week of independent work outside of the contract was spent at Maysville Gap, West Virginia.

PROCEDURES AND DATA

General Plan

The general plan was to determine the principal characteristics of the fracture pattern of the Zuni uplift and then to compare that pattern with the fracturing found on several smaller anticlines whose mode of origin is reasonably certain. It was thus hoped that something about the origin of the Zuni uplift might be learned by analogy with those of the smaller structures with which it shares structural features that are believed to be diagnostic. The smaller structures of known origin selected for this purpose represent two general types: (1) anticlines formed by lateral compression, and (2) anticlines domed up passively by the rise of masses from below them. From theretical considerations, it was expected that the first group would

exhibit predominantly fracturing transverse to the fold axis while the second would show longitudinal fractures predominating. This criterion, or whatever other criteria would be found in its stead were to be applied to the Zuni uplift, as an approach toward understanding its origin. Then the other structural characteristics of the uplift were to be considered for any additional light they might provide.

Specific Procedures and Data

The following structures were studied in the field as examples of smaller anticlines of known origin: for the laterally compressed type, one anticline in the Woods Hollow Mountains of the Marathon folded belt, west Texas, and a part of the Wills Mountain anticline in the folded Appalachians of northeastern West Virginia (a study done independently of this contract); and for the passively domed type, one laccolithic dome, Maze Arch, in the Henry Mountains of Utah. The data for these and for the Zuni uplift are presented on the attached maps, and the procedures and data will be described with reference to the individual maps.

Maps of the Zuni Uplift

Ground Samples of Jointing, Zuni Uplift, New Mexico:

This map gives the most general picture of the Zuni uplift. On it are included as many of the major faults as could be compiled from other sources, in addition to those which were observed in the field, in the course of the joint measurements. Faults in the pre-Cambrian are taken entirely from the map of that region made by E. N. Goddard, et al (1951), and faults of part of the northeast flank are from maps by the U.S. Atomic Energy Commission geologists, Grants, New Mexico. Geological contacts, shown only where they could be confidently identified, were transferred by pantograph from controlled serial mosaics. Beyond these features, the map represents essentially a plot of the joint data. It cannot be regarded as a complete indication of the jointing which will be found in any given part of the

uplift, but instead merely summarizes the joints which were found at approximately one hundred and twenty-five points distributed areally and stratigraphically over the uplift. At each such point, the procedure was to find an outcrop completely exposing a statistically significant number of joints. Where jointing is complicated, especially in the crystalline rocks, this meant eighty to one hundred and fifty joints; in the sedimentary rocks, where the joint pattern is very regular and the joints are exposed on broad flat surfaces, as few as thirty joints proved to be adequate. At each point, all joints within the selected area were measured, so as not to bias that aspect of the sampling. The area comprising all measured joints at an individual locality varied from about 75 square feet to about 10,000 square feet, according to the joint density. The measurements were later plotted stereographically and the mean directions of the maxima were determined and entered upon the map. For approximately one-third of these joint localities, sketch maps of the jointing were made on the spot, providing an important record that is available, though not here reproduced.

One further characteristic of the jointing is noted on the map: the "relative continuity" of the various joint sets. Where the joints of one set commonly terminate against the joints of a second set, the first is labelled the less continuous and is represented on the map by a shorter strike line. At some localities, especially on horizontal surfaces, this relationship is immediately obvious. In others, especially in cliff exposures, it was necessary to adopt the method of recording which of two joints terminates against the other. An entry would be made, e.g., that "9 stops 7", meaning that the seventh joint measured terminates against the ninth joint measured. If, upon plotting these points, it became evident that one set nearly always terminates against another, then it was identified as the less continuous in the symbol entered on the map. Where no systematic difference in continuity can be clearly recognized in two sets of joints, the strike symbols are drawn equally long on the map. At such points the possibility exists that differences in continuity exist but could not be detected in the sample studied.

An exception to the above symbolism is made in the pre-Cambrian area, where the relative lengths of the strike lines stand for the relative strengths of the maxima in the point plots, for the reason that relative continuity could not be readily detected in the crystalline rocks.

The number of joints measured was usually thirty in the sedimentary rocks. Larger samples there, where the pattern is generally a very simple one of two or three joint sets, seemed much less desirable than a larger number of samples which could be secured with the time saved. In fact, at the conclusion of the study it is felt that where the joints are simple and well exposed, measurement may be less desirable than summaries by inspection, considering the many more localities which could be so treated. For the purposes of this project, though, it was felt that the sampling should be on as firm a basis as circumstances allowed. since the project was undertaken in order to define and test principles, not to apply principles which had already been well established.

Faults and Joints of a Part of the Northeast Rim of the Zuni Uplift, New Mexico:

This map gives more detailed information about one part of the uplift (K-15 to T-11 on previous map), showing more completely the faults which have been mapped by the U.S. Atomic Energy Commission geologists at Grants and showing also three additional types of information: (1) joint orientations taken entirely from low altitude aerial photographs; (2) structural contours for a part of the Todilto bench; and (3) locations of most of the uranium deposits now known in that area.

That jointing is well displayed in some of the low altitude aerial photographs provided originally for use in trace element investigations being carried out at Grants by Mr. Perry Narton of the U.S. Geological Survey was pointed out to the writer by Mr. Narton, and it developed that a wealth of information could be obtained by inspection of all of the photographs available. Previously, it had been found that the mosaics give no direct information of this kind and that the regular altitude stereoscopic pairs gave only a little. These low altitude photographs, however,

intended to be used for the identification of individual trees, furnish much more extensive and accurate sampling than could be accomplished in the field in any reasonable time. Many joints, in some cases many hundreds, can be seen over continuous areas, and so summaries can be made of samples very much larger than could be obtained on the ground. Furthermore, the length of individual fractures can be observed in some cases, and some impressions of jointing densities can be gained. Thus, the map compiled from these photographs provides fracture data of great reliability and usefulness. Fortunately, almost all of the joints in this area dip steeply, so that the strike itself is significant.

One importance of this map to the present study is that it provides a thorough check upon the validity of the ground sampling methods used for the map previously described. A comparison of the two gives one considerable confidence in the general trend of the jointing over a considerable area; individual points cannot be taken as decisive, and the local continuity is sometimes at odds with the more general continuity so accurately shown by the aerial photographs, but the general trend and the most common continuity shown on the overall map give a fairly correct impression. Thus it is thought that the map first discussed offers quite a useful picture of the uplift as a whole.

Because individual fractures can be observed for great distances on some of the low altitude air photographs, the present map also gives a valuable test of the validity of "relative continuity", and shows it to be a real and valuable characteristic. In many places, the aerial photographs show hundreds of joints of one set, with individual joints running actually for miles, and over these areas there may be almost no visible second set, even though the exposure is very nearly complete. In such places, what other joints may occur may run for only a few feet, merely dividing the segment between two adjacent joints of the more continuous set, and this may be especially true near the cliff fronts, where joint blocks have begun to pull away. At other points, less common, two sets may be seen of nearly equal continuity. What-

ever the significance of the relative continuity criterion may be, it is at least very real and it constitutes a striking difference between the several joint sets which may be observed at a given point, a difference which deserves recording as a prime characteristic of the jointing there.

Measuring the density of jointing on the ground would be a difficult process requiring careful technique. In some cases, the low altitude aerial photographs are an easy source of information on this problem. No systematic study was given this matter, but it was evident in the inspection of the aerial photographs for the preparation of the present map that there are pronounced differences in density from place to place. The impression is that the jointing is dense in the vicinity of the major faults and less dense elsewhere. This map, however, is not intended to imply anything about densities. The symbols are merely shown wherever the photographs reveal them with sufficient certainty.

This variation in the density of jointing is best shown in the Entrada formation, a very thick aeolian sandstone. In places it has a prominent major joint every few tens of feet, while in other places, stretches of hundreds of feet are free of any joints visible on the photographs. In the thinner sandstones, by contrast, the difference is less obvious, and the reason is presumably that, because the jointing is fairly dense in even the least fractured places, the density elsewhere either is a little greater or contrasts less prominently. That the density of the jointing increases with decreasing thickness of bedding became obvious early in the study, and whatever roles other factors such as lithology, cross-bedding, etc., play, thickness is a very important variable.

The common parallelism between faults and joints is well shown on this map and will be discussed in the interpretation.

If the fracture pattern is to be considered in relation to the form of the uplift, then detailed information about the shape is useful. The structural contours

drawn for a part of one rim have been constructed for that general purpose and for the specific purpose of investigating one of the large "scallops" in the outcrop pattern of the Jurassic-Cretaceous rim, in this case the one between Haystack Mountain (Q-13, on the first map) and the San Mateo fault (S-12). Subsurface information furnished the control for the solid contours, while the dashed connections follow the topography fairly closely, since that is a good indication of the attitude in this area. The contours can be seen to swing around with the outline of the "scallop".

The location of the ore bodies has been supplied by the Grants office of the U.S. Atomic Energy Commission and is presented on this map to allow comparison with the information concerning the shape of the structure and the fracture pattern. The shapes of the larger ore-rich areas are only roughly indicative of their accurate shapes as shown on the large-scale cutoff maps from which they were taken.

Maps of Smaller Uplifts of Known Origin

Laterally Compressed Folds:

Fold in Marathon Region, Texas — 3 Maps: The "Topographic and Geologic Map of an Anticline in the Woods Hollow Mountains, Marathon, Texas" is a modified enlargement of a small part of Philip B. King's map of that area (1937). The faults other than the two largest in the southwest end of the fold were added by the writer as a result of his field observations, as details were too small to be shown on the scale of King's map. "Attitude of Beds, Anticline in Woods Hollow Mountains, Marathon, Texas" is included to give a clearer picture of the shape of the fold in the absence of a structural contour map. The data shown on the map bearing the title, "Faults and Joints; Anticline in Woods Hollow Mountains, Marathon, Texas", were obtained by the same ground sampling methods described for the overall map of the Zuni uplift. Again, it is a record of the measurements made, not a representation of the fracture orientations at any given point. The most continuous set of joints can be seen to parallel in general the direction of the faults and to intersect the axis of the

fold at about seventy-five degrees, in one direction only. Almost all of the measurements were made in the Caballos novaculite, a very closely fractured unit, which, however, has some five to ten foot-thick ledges with joints of that stratigraphic penetration. As on the Zuni map, nothing is implied about joint density in this representation. But it seemed in the field to be true that the densest and the most pronounced jointing was in the highest and the most deformed parts and that there also the orientation was most uniform.

Fold in Central Appalachians, West Virginia — 2 Maps: A part of Wills Mountain Anticline at Maysville Gap, West Virginia, was selected because it is doubly-plunging, a condition necessary for the criterion to be tested, and because the outcrops are sufficiently large to allow study in at least a part of the fold, where the White Medina forms high cliffs above Maysville Gap. The doubly-plunging part shown is only a small part, a local culmination, of Wills Mountain anticline, a fold which continues for many miles in both directions. In this case, at least twenty joints were taken for each sample; otherwise, the procedure was the same as described for the overall Zuni uplift map.

The map entitled, "Joint Measurements, Wills Mountain Anticline, Maysville Gap, West Virginia", represents the joints as found, while the other map, "Joint Measurements Rotated to Position of Horizontal Bedding", gives the same information, but with the effect of the dip of the beds removed by rotation of the beds into the horizontal by graphical methods. The direction of the contours across the space of the gap — where the lines are dashed — is not clear, but on either side of it they are accurate. The contours drawn on the top of the White Medina sandstone are not continued farther out on the flanks. because the flanks are too steep for them to be effective; instead strike lines on the Helderberg-Oriskany have been indicated. While the most continuous set in the White Medina intersects the axis at about 70 degrees, the four localities lying on either side, measured along the Helderberg-

Oriskany escarpment have the most continuous set intersecting the strike line at twenty degrees or less, after rotation. Whether the results obtained by such a rotation back to the original horizontal position correspond to anything real remains to be seen. The results are here presented for whatever they may be worth.

One characteristic of the density of the jointing was apparent in the field, the very marked increase in density toward the crest of the fold. For several hundred feet above the bottom of the gap, the orientations are less pronounced and the jointing is relatively sparse, while above that, the density increases to almost a sheetiness along the highest part of the fold.

Passively Domed Anticlines:

Maze Arch, Henry Mountains, Utah. Fractures and Sketch Structural Contours on Top of the Kayenta Formation: Maze Arch was chosen as a dome almost certainly distended by the intrusion of igneous matter. When structural contours had been constructed, by identifying geological contacts on aerial photographs, transferring them to the recently available U.S. Geological Survey topographic map, and computing elevations from dips and stratigraphic thicknesses, it became clear that the dome is elongated northwestward in the direction of Mt. Ellen, a principal center of radiating laccolithic tongues, as shown by Charles B. Hunt's study of the area (1952). Thus it appears that Maze Arch is very likely a dome above a linguiform intrusion whose source was the Mt. Ellen stock.

In the field, joints were measured principally along the Morrison escarpment east and northeast of the dome. Samples of only ten joints were taken at a number of points and the directions at others were determined by inspection, in order to treat as many joints as possible in the short time available. Later, it proved possible to recognize jointing in some of the thicker beds from the aerial photographs, jointing which is too widely spaced to be measured by the regular methods in the field. Even those joints on the map which were taken directly from the air photographs do not tell much directly about jointing densities, because they lie in

several different beds, from the Kayenta through the Carmel, according to the beds outcropping at given points.

The reference on the map to joint sets filled with mineral matter pertains to certain structures in sandstones of the Morrison which weather so as to leave protruding joint fillings of sand and calcite. These structures usually appear in conjugate pairs and often show shear displacement along both sets.

It is not known whether this rather strikingly longitudinal pattern is restricted to the dome itself or whether it is more widespread.

Discussion of Two Other Domes from the Literature: The only other structure in this category which was visited was Mt. Ellsworth, also in the Henry Mountains. There the beds are so thick that almost no measurable joint localities were found on the side visited (west). This structure, originally chosen for the purpose, was accordingly abandoned for the thinner Morrison sandstones of Maze Arch. However, a sketch structural contour map of the Henry Mountains by Charles B. Hunt (1952) shows not only faults, but also swarms of joints on the Mt. Ellsworth-Mt. Holmes dome, especially on the east side. From it, the impression of a dominantly longitudinal pattern is also gained. In this case, direction of fracturing is almost at right angles to the regional jointing off the dome, to the southeast.

There can be little doubt that salt domes are passively uparched structures. For the purposes of this discussion, the structure of the Hawkins field, Wood County, Texas, serves very well, since it is a dome which is not only elongate (the criterion being tested breaks down for circular domes), but for which there is also available a great deal of subsurface control (Parker and McDowell, 1951). Its fracture (fault) pattern is less decisive than the two examples just described, but it still looks as if the dominant trend of the faults was essentially parallel to the axis of the uplift (i.e., longitudinal).

One experimental example might be added: the model of the Azores structure made by Hans Cloos. Its shape is much like Maze Arch, and the fracturing is also very similar, with longitudinal fractures dominating the picture (H. Cloos, 1939).

EVALUATION OF RESULTS

Interpretation of Data

It is thought that, with certain important qualifications, the data presented largely verify the predicted difference in the fracture patterns of laterally compressed and passively domed types of anticlines. Before applying this distinction to the Zuni uplift, it is advisable to mention briefly the theoretical reason for expecting this difference.

Theoretical Grounds for Prediction of Patterns:

In a laterally compressed fold, two given points on opposite limbs approach each other during the folding. In an anticline domed by masses rising from below, this is not true; instead, the arc length between two points on opposite limbs must stretch to some value greater than the original linear distance between them. This stretching is greatest in the direction of least radius of curvature and so the first-formed fractures may relate to that direction; in the case of tensional failure, this would result in early fractures at right angles to the direction of the least radius of curvature. Thus, if the first-formed fractures become the most continuous set, then a pattern with that set essentially longitudinal to the anticlinal axis would result. In the case of the laterally compressed fold, on the other hand, opposite points approach each other so that up to a certain point no increase in the arc length between them need take place. In that case stretching incurred at first only in a longitudinal direction, giving rise to tension fractures essentially at right angles to the fold axis.

Evidently the second case includes many possible relationships, depending upon the relative magnitudes of the two quantities discussed above, one the measure of the

approach of opposite points toward each other, and the other the measure of the change in length of a line between the two points measured along the surface of the bedding. In the first case, on the other hand, the first quantity is everywhere nil. This suggests that the fracture pattern of the passively domed type of uplift can be predicted with considerable confidence, while the pattern of a laterally compressed fold may include a range of special cases which are more difficult to foresee; this, in fact, seems to be the case in the smaller uplifts studied, inasmuch as the passively domed structures have rather decisively longitudinal fracture patterns, while the laterally compressed folds show several characteristics which are not readily explained, even though their overall pattern is within twenty degrees of the transverse direction first expected.

It is possible to develop this approach more fully by actually plotting the variation of the above two quantities as functions of direction in respect to the fold axis, measuring the second quantity and assuming the function of the first, each for an increment of the fold surface. Their difference can then be plotted, giving a third quantity which is an expression of the actual stretching incurred along each direction through the increment. It is hoped that it may become possible to predict from this the fracture pattern. A comparison with the real fracture pattern then gives a test of the assumptions involved. (This development is being carried out, but is omitted here as not of immediate importance to this report.)

In addition to the assumption of a function for the first quantity, there is implicit in all of this the assumption that the fracture pattern can be explained wholly by the present shape of the uplift. This certainly is not always true. It is, for instance, possible that faults affect the region around them, quite independently from the regional curvature of the bedding surfaces near them; or, the fracturing may be a result of transmitted stresses so that the regional shape of the surrounding structure is a companion effect to the fracturing and not its cause; or, again, the fractures may be the result of some deformation different, more extensive than, or

distinct from, merely the fold on which they are found, e.g., in the case of the epeirogenic uplift of a folded belt, long after the individual folds had been formed. A few observations bearing upon these possibilities may be recalled from the discussion of the data.

In respect to the first alternative mentioned in the preceding paragraph: The impression that the joint densities increase near faults on the detailed map of a flank of the Zuni uplift, and the parallelism of the joints and faults on the same map, suggest that the faults there may have had some such effect, although other equally reasonable interpretations are possible. It is, for instance, quite possible that heavily jointed areas were utilized in differential movements that produce the faults which appeared later in the deformational process. The other alternatives seem to be somewhat at odds with the overall map of the Zuni uplift, upon which the fracture pattern can be seen to vary from place to place in close relationship to the uplift itself. Similarly, the suggestions of denser jointing in the more deformed parts of the Marathon fold, the Appalachian fold, and the laccolithic dome seem also to relate jointing directly to the uplifts themselves. All in all, these considerations require much future study for their proper assessment, and they are listed here only as necessary qualifications.

The question arises, how large an increment of structure should be treated in the above type of analysis? It appears from the Maze Arch map, as well as several other maps in the literature, that the fracture pattern is sometimes constant over all or most of the uplift, rather than being different from point to point. This shows conspicuously on the map giving detail of one flank of the Zuni uplift where the joints maintain a nearly constant attitude across the "scallop" in the structural contours, which is the opposite of what would be expected if there were a point-to-point determination of the fracture pattern by the details of shape on the structure. Apparently the areal increment treated statistically must be quite large, in some

cases, nearly as large as the entire uplift, and as large as considerable parts of it in others.

Test of Predicted Criterion:

With that indication of the theoretical reasoning which led to the predicted difference in fracture patterns, the discussion of the facts will be resumed. It appears from the smaller uplifts of known origin that the passively domed uplifts are indeed characterized by longitudinal fracturing, and, in this respect the prediction was upheld. The folded uplifts, however, supported the prediction that the pattern would be transverse to the axis of laterally compressed folds, only to the extent of a seventy or seventy-five degree angle with the fold axes. In the case of the Appalachian fold, the dominance of longitudinal joints (rotated) on the Helderberg-Oriskany flanks in the pattern obtained by rotation appears at first abnormal, if we accept it as real. But at that stratigraphic level the anticline is not doubly plunging; as is shown by the straight strike lines of these beds. There is, accordingly, no reason to expect cross-joints to be well developed. This, in fact, had been anticipated originally. We may say, therefore, that with the above qualifications, the criterion has stood the test afforded by the structures studied.

Application of Criterion to the Zuni Uplift:

The Fracture Pattern: The most continuous sets of joints in the Zuni uplift are most generally longitudinal, if the direction of the uplift along different parts of its length is carefully considered. The statement does not fit a number of points, especially in the vicinity of some of the faults, but it has considerable validity in the overall picture. We may, accordingly, conclude that the Zuni uplift resembles the passively domed structures more nearly than it resembles those which arose from lateral compression.

The most striking single characteristic of the overall fracture pattern, as depicted on the map of the whole Zuni uplift, is the strong parallelism between the

faults in the crystalline core and the form of the uplift. The outcrop patterns near the crystalline core follow the boundary faults of the crystallines closely, and even the stratigraphically higher beds of the flanks parallel the boundary faults with considerable fidelity. In fact, the railroad, sensitively following directions of low and constant grade, traces out a line which is very nearly a strike line and which follows the directions of the crystalline faulting at the same time, illustrating the close correspondence between the crystalline faulting and the form of the uplift as a whole.

The form of the whole uplift has a conspicuous parallelism also to large faults and monoclines in the sedimentary flanks, structures which must be faults in the crystalline rock below those points. The general trend of these monoclines and large faults is either parallel to those in the corresponding part of the crystalline outcrop, as in the cases of the main northwest - and west northwest - striking faults, or the faults are actually continuous, as is true of some of the northeast-striking faults which pass from the crystalline area into the sedimentary flank. When this fact is combined with the conspicuously flat top of the Zuni uplift, the impression grows that its fundamental pattern is that of a group of blocks bounded by faults raised differentially above its surroundings.

That the major fractures are deep-seated is proven by the various volcanic phenomena, including lines of cinder cones (J-2 to N-6), various lava flows, e.g., the one associated with the cinder cone El Tintero (Q-12), and older phenomena such as the volcanic necks in the area where pumice is now being mined (T-10, although the necks are not specifically indicated).

The uplift has the peculiarity of rising fairly steeply over narrow monoclines and yet dipping only very gently elsewhere. A traverse across the uplift near its northwest end shows this well: the dip is very steep, up to eighty degrees, for the brief space of the Nutria monocline, and then it leads very gently in the opposite direction for fifteen miles across the width of the uplift, until the twenty degree

dips of the Coolidge monocline on the northeast flank are encountered for another brief space (see Rapaport et al, 1952, figure on page 10). This very flat topped shape is not the picture which is conveyed by the remark, often made, that the Zuni uplift is "very assymetrical to the northwest". In other parts of the uplift, monoclines occupy various other positions, so that the flat-topped form does not apply everywhere; but in each case the block-like behavior is clearly seen.

Horsting as Doming Mechanism: All these lines of evidence of deep fracturing and faulting support thus the conclusion that the doming is the result of differential movement of fault blocks in the basement crystallines, which had risen along fractures from below the sediments, shaping them into the Zuni uplift. Thus the uplift might be pictured as a sort of horst complex, draped with sedimentary rocks. The writer had already formulated this concept when the map of the main crystalline area made by E. N. Goddard et al in the course of an investigation of the Zuni fluorspar deposits became available. On it Goddard characterizes the core as comprising three major fault blocks, within each of which there are numerous less persistent faults. His map of that structure, incorporated into the overall map of the Zuni uplift, gives thus a graphic picture of the horsting in the crystallines where those rocks are exposed in outcrop. Extrapolating beyond the outcrop, we may conclude that the fracture pattern of the crystalline rocks beneath the sediments, outside of the crystalline areas, is much the same, and that the whole horst complex can be visualized in these terms.

In earlier reports of the present project, the writer had postulated a rough gridwork of basement fractures of essentially constant direction over the whole uplift, interpreting the westward swerve of the axis at the north end of the main crystalline area (J-10 to N-9) as a jog along one of the northeastward fracture zones, before the northwestward trend resumes beyond. However, Goddard's map shows that, instead, the northwesterly structures actually change their direction,

bending west-northwesterly for that interval. This picture is more satisfactory, especially when the major structures in the immediately adjacent sedimentary rocks are seen to swing similarly. The "swayback" appearance of the map outline of the Zuni uplift reflects this swing in the basement trends.

The resumption of the northwest trend beyond the north end of the main crystalline area is shown not only by the trend of the sedimentary structures beyond, but also by the joint measurements taken in two small crystalline areas to the northwest, (I-10, and F-12 to E-13), which show strong and consistent northwest trends. That they may be taken as indications of the major faulting in the crystalline rocks is established by the quite dependable parallelism of the joint orientations in the main crystalline area with the faults mapped there by Goddard. Here again, this is not true of every single locality, but the overall agreement is good. It is interesting to note in passing that where this structural relation exists such joint sampling offers a quick means of detecting the main trends of such a terraine; for a few points sampled give information about extensive areas.

The cause of this large swerve in the basement trends is certainly not known, but it should be remarked that the primary foliation of the crystalline rocks is followed conspicuously in some places, especially where that foliation is pronounced and steeply dipping, e.g., at K-10. Areas mapped by Goddard as meta-rhyolite have especially strong foliation. Goddard shows the crystalline area to be quite complicated and made up of a number of rock types, mapped as hornblende gneiss and quartzite, gneissic granite, gneissic aplite, and meta-rhyolite. It seems likely that the fracturing, whatever its age or ages, has followed certain of the strong primary trends in several of these rocks.

The group of faults that lies in general west and northwest of the town of Bluewater (P-11) is enigmatic to the writer. The faults roughly radiate from the northeast corner of the main crystalline area, as Clay T. Smith has indicated in

conversation. Smith has made the further point that the point of maximum displacement along at least some of these faults lies some distance out from the crystalline area, i.e., the displacement does not simply increase toward the core. It would seem that these faults are a consequence of the swerve in the trend of the axis, but no further explanation is here offered.

Timing of the fracturing is a very difficult problem about which this study has little to offer. It is possible that some of the basement fracturing may have had its origin early, even before the oldest sediments were deposited, especially since the coarse Permian (and Pennsylvanian) basal conglomerates suggest that the crystalline area stood high in late Paleozoic time. It is also clear that very recent volcanism has gone on in parts of the uplift, for pottery fragments considered to be one thousand years old have been found in the McCarty's lava flow and the most faulted flanks show deeply incised river meanders which suggest some upward movements during the lives of the present streams. It can only be concluded that the main lines of failure have remained about the same throughout whatever period of deformation has produced the jointing in the various beds, in view of the consistency of this jointing. It is surmised that the movement has been a sort of recurrent jostling among the major basement horsts. Of course, the great part of the deformation is post-Dakota and pre-Tertiary volcanics, the first being tilted and the second not. Other deformations must have been very slight, since the most severe of these, a pre-Dakota tilting which produced a truncation of underlying beds, is hardly perceptible over the uplift. It may be that whatever slight movements there were prior to the full development of the present uplift, impressed on the rocks joint patterns quite similar to those produced by the main disturbance, because the major units involved in it remained the same.

Nature of the Ore-bearing Flank: The ore-bearing flank of the Zuni uplift may now be considered in its relationship to the structure as a whole. It is apparent, first of all, that it is a heavily faulted part of the uplift, probably

the most faulted part. Detailed mapping may eventually show considerable faulting in the southwest part of the uplift also, but the southeast half of the northeast flank will probably still be seen to be the most highly faulted. This faulting, in combination with the sort of gentle flexing shown by the structural contours in the detailed map of part of the northeast flank is responsible for the "scallops" in the trend of the Jurassic-Cretaceous outcrops. Haystack Mountain (Q-13) lies structurally low on one of these. Its very position as a butte indicates that the capping Dakota sandstone is somewhat abnormally low, causing it to outcrop farther updip than does the Dakota rim to the east and south. The map shows how the faults to the northeast of it combine to drop down the quadrant in which it lies. Other parts of the area shown on this map can be seen to be prominently faulted, and farther southeast (T-12 to T-8) the faulting is still more severe, though partly obscured by volcanics.

Volcanics increasingly characterize the ore flank from as far northwest as El Tintero (Q-12) toward the southeast, where the pumice mining area (T-10) is rich in volcanic phenomena. Structure in the Chinle strike valley is almost entirely covered, but the flows at least indicate fissures, and the presence of El Tintero within close view of Haystack Mountain demonstrates the existence of some volcanic channels there.

Implications of the Interpretation

Implications Concerning the Zuni Uplift Itself:

So far, no positive causal relationship between an individual uranium deposit and an individual fault has been established, to the writer's knowledge, and the origin of the ore remains in doubt. It is possible that the ore depositing agents reached the rocks in the Zuni region by travelling upward along fractures. In that case, a tangible relation should exist between the fracture pattern and the ore deposits. What are the facts?

(1) It appears that faulting characterizes the ore-rich areas in a general way, regardless of the lack of known relationships of ore to specific faults. The better prospects recorded to date away from the area shown on the detailed map of part of the ore flank lie also at places of intensified structure. Those nearest to Gallup lie on a severe monocline, which must pass into large basement faults below. Those northeast of Grants are located very near a major fault and volcanic zone. The prospects known so far in areas of little structure are not promising.

(2) Volcanism also seems to go with much of the ore, though only in a general way. Volcanic phenomena demonstrate that the fractures involved are able to carry fluids.

(3) Of more direct interest is the association of fluorite with the uranium minerals in the Grants area, where locally up to 40% of the Todilto limestone is replaced by fluorite. The commercial fluorspar deposits within the crystalline area lie in veins, i.e., in fractures that served as channels and sites of deposition there. But there seems to be no uranium associated with the fluorite and there is no known physical continuity between the two areas, the so-far barren Permian and Triassic flank lying between them. But the strike of the fluorite veins fits into the fracture pattern and the lack of horizontal continuity with the joints near the uranium concentration cannot be taken as proof against a common origin.

(4) Several of the cut-off maps of the individual uranium ore bodies in the Grants region which were shown to the writer are definitely elongated in the principal fracture directions of their particular locality. While this does not prove a hydrothermal origin of the ore, it at least testifies to the uranium-carrying capacity of the joints.

Two aspects of the interpretation of the fracture pattern given above may help to explain why the Zuni uplift as a whole was favorable for ore deposition. One is that its structures increase in severity downward, e.g., a uniform dip at a high

stratigraphic level passes downward into a monocline at a lower level and the monocline in turn passes downward into a basement fault. This is inherent in the general nature of the uplift, as here interpreted, and can be seen, in a manner of speaking, by observing the way in which faults dominate the crystalline core while monoclines and lower dips characterize the outer flanks. It should be visualized as the upward decreasing effects of the movement of crystalline horsts at depth. If, then, it should be true that the source of the ore lay somewhere below the present position of the ore bodies, then it may have been important that the Zuni uplift has a type of structure which facilitates access to greater depths.

The second consideration is that the passive doming of the Zuni uplift resulted in a dilation of the rocks in all directions parallel to the bedding (though perhaps a bulk decrease in volume, due to the vertical forces). This dilation, probably accomplished mainly by the appearance of joints, could have afforded numerous new spaces available for the passage of fluids.

Both of these considerations apply, of course, to most of the Colorado Plateau structures, in view of the common presence of monoclines and horsts.

Implications Concerning Regions Beyond the Zuni Uplift:

If the main lines of fracturing are to be regarded as loci of favorable structure, it is important to note that they extend beyond the uplift itself. Their general strike reappears in structures beyond the limits of the Zuni uplift. One gains the impression that deep fracture zones in the basement rocks control a larger pattern, and that the Zuni uplift itself is only one element of high horsting along them. Thus there is the possibility that some of the northwesterly fracture zones along which the horsting occurred (and individual fractures associated with them) may extend into the Lucero uplift, and also into the Chuska Mountains and the north end of the Defiance monocline, and that some of the northeastward trending fractures may extend toward the Jemez Springs and Nacimiento areas. At the same time, the "swayback"

in the axis of the Zuni uplift itself shows how sharply the trends may vary from a previous direction. Whatever relationship prevails between the Zuni and adjacent uplifts, the analogy between them at least leads us to suspect the presence of large fracture zones.

On the next larger order of magnitude, the Zuni uplift as a whole lies along a large structural trend which has been referred to in the literature as the "Zuni-Sacramento lineament", extending southeastward toward the Sacramento uplift and the Guadalupe Mountains, and intersecting a number of uplifts along its length. Furthermore, the southern end of the Zuni uplift lies at the intersection of this trend with the Mt. Taylor volcanic syncline and its considerable volcanic and structural features farther to the northeast. It does appear, thus, that the Zuni uplift may owe its existence to its position at the intersection of major trends of long and deep-seated fracture zones. This leads to the conclusion that ore prospects should be sought elsewhere along these trends, especially at their intersections with any similar structural trends.

This direction of thought brings one to the largest size structures of the region, deep-seated zones on the order of magnitude of the Colorado porphyry belt, the elongate zone several hundred miles long and at places fifty miles wide which embraces the Tertiary intrusions and also the principal mining areas of Colorado (Spurr, 1908). Whatever else may be true of the trend, it must be a locus of deep fractures along which intrusive material and ore fluids have been able to rise. When the two lineaments at whose intersection the Zuni uplift lies are followed beyond it, the northwesterly one appears to be headed toward Lukachuka; where it intersects the southwesternmost tip of the Colorado tertiary belt, and from there to proceed past the south end of the Monument uplift to the Circle Cliffs uplift (Waterpocket monocline). Such a hypothetical belt would be parallel to the prominent trends of the La Sal Mountains and the Uncompahgre uplift, which itself

is a member of a similar trend intersecting the Colorado porphyry belt near Ouray, Colorado. The other lineament spoken of can be projected northeastward into a zone of striking volcanism which includes the Jemez Springs volcanic area, the Taos region, and, eventually, the volcanic region in the general vicinity of Trinidad, Colorado. Southwesterly, this lineament might be carried toward Globe, Arizona. These and several other such zones, defined by monoclines, faulting, volcanism, and demarcations between typical Colorado Plateau structure and the more severe structure and volcanism of the Great Basin deserve study as the very large loci of deep-seated fracture belts which afford possibilities of movement, fluid transport, and mineralization.

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Also of use in connection with this report:

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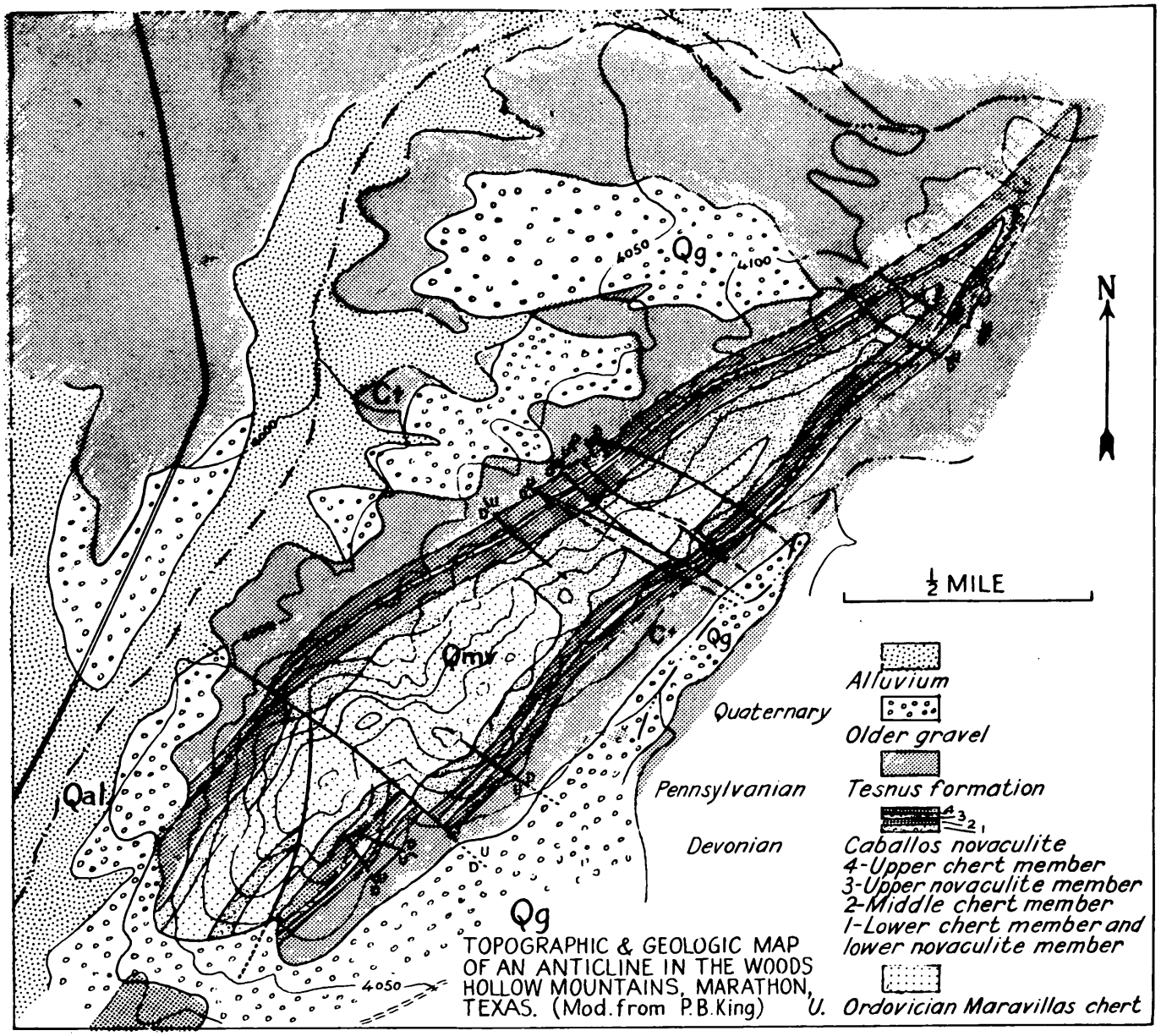
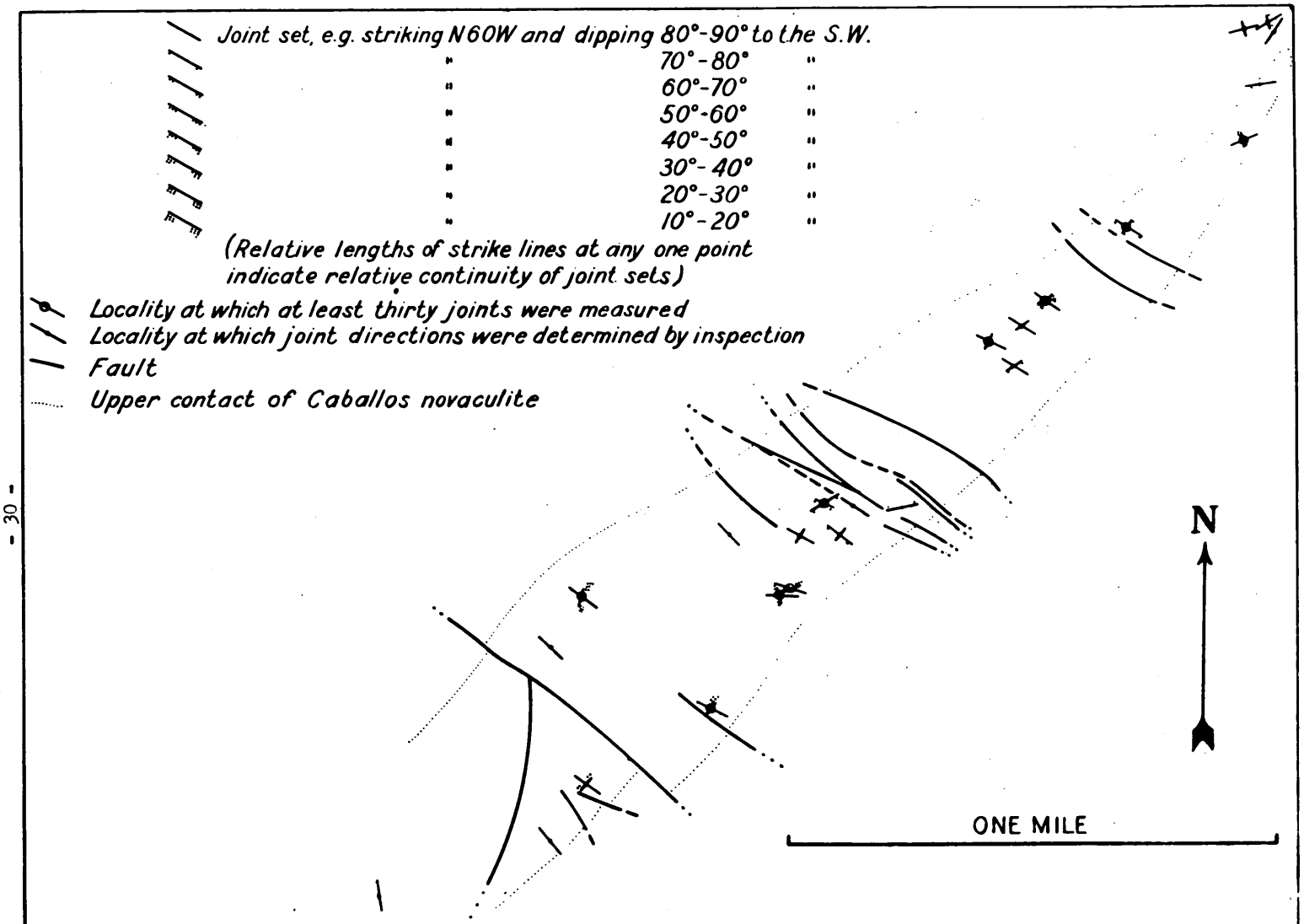
Geologic Map of North America, edited by George W. Stose, 1946.

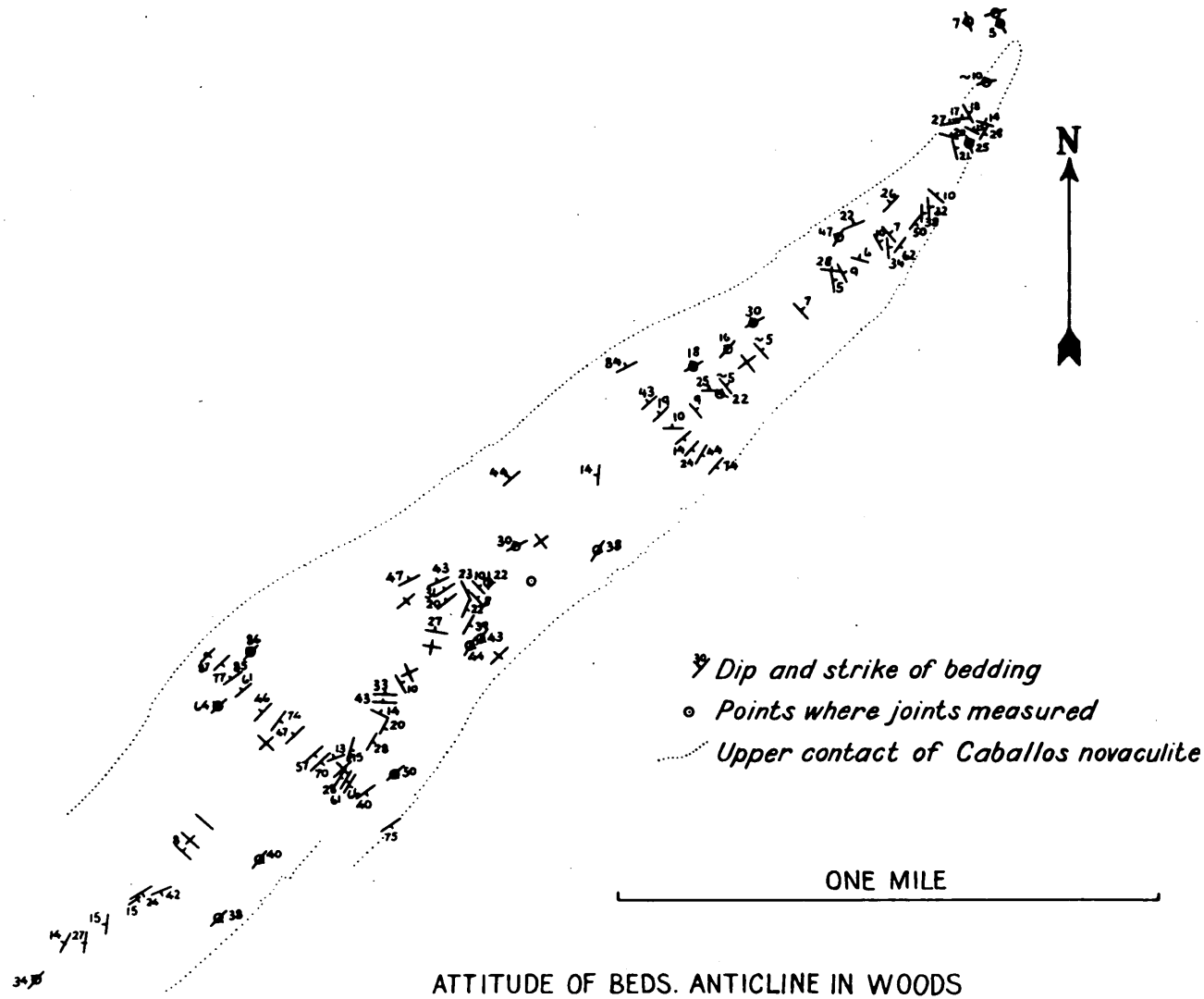
Geologic Map of New Mexico, prepared by N. H. Darton and edited by George W. Stose, 1928.



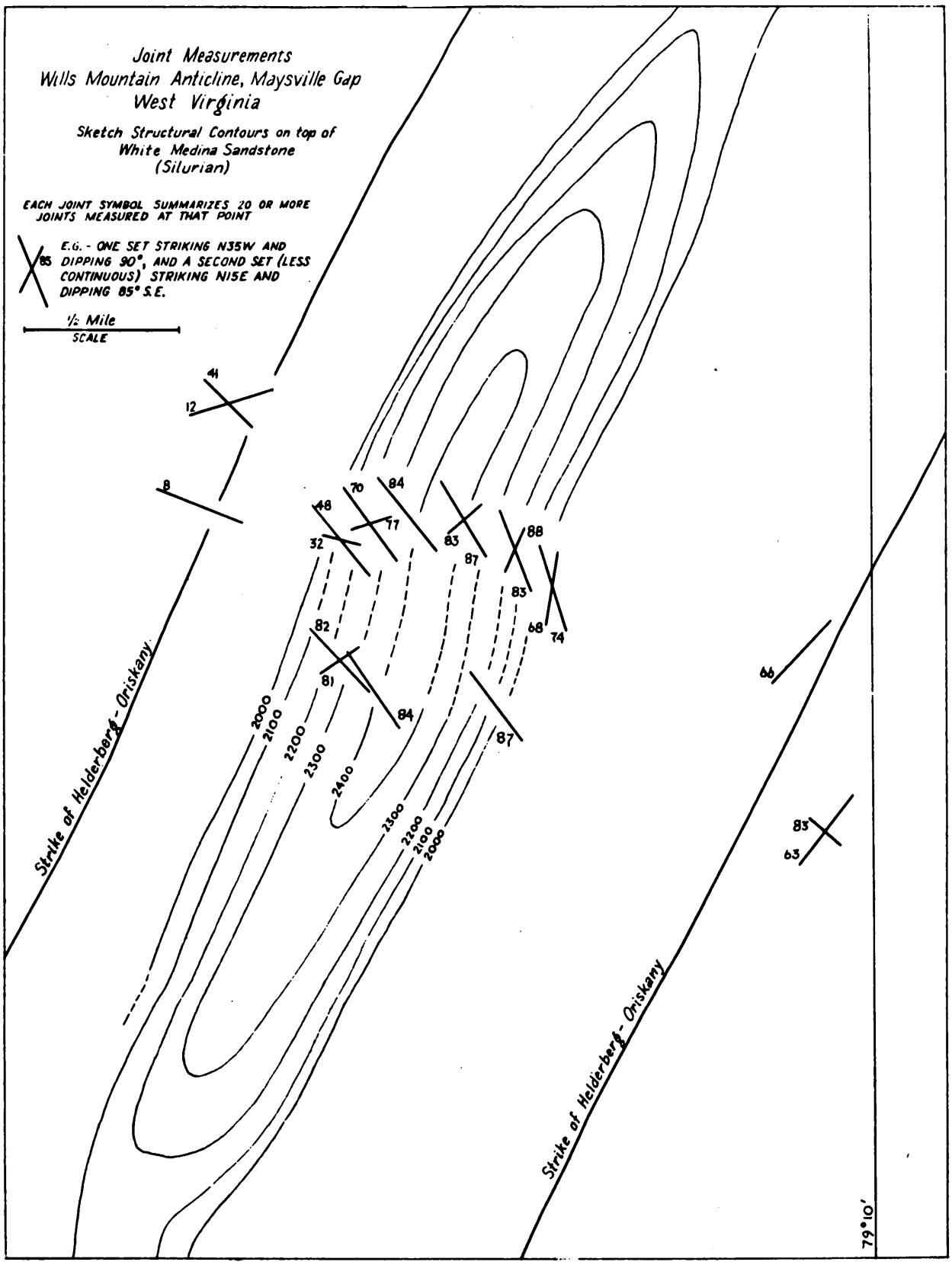
TOPOGRAPHIC & GEOLOGIC MAP OF AN ANTICLINE IN THE WOODS HOLLOW MOUNTAINS, MARATHON, TEXAS. (Mod. from P.B. King)

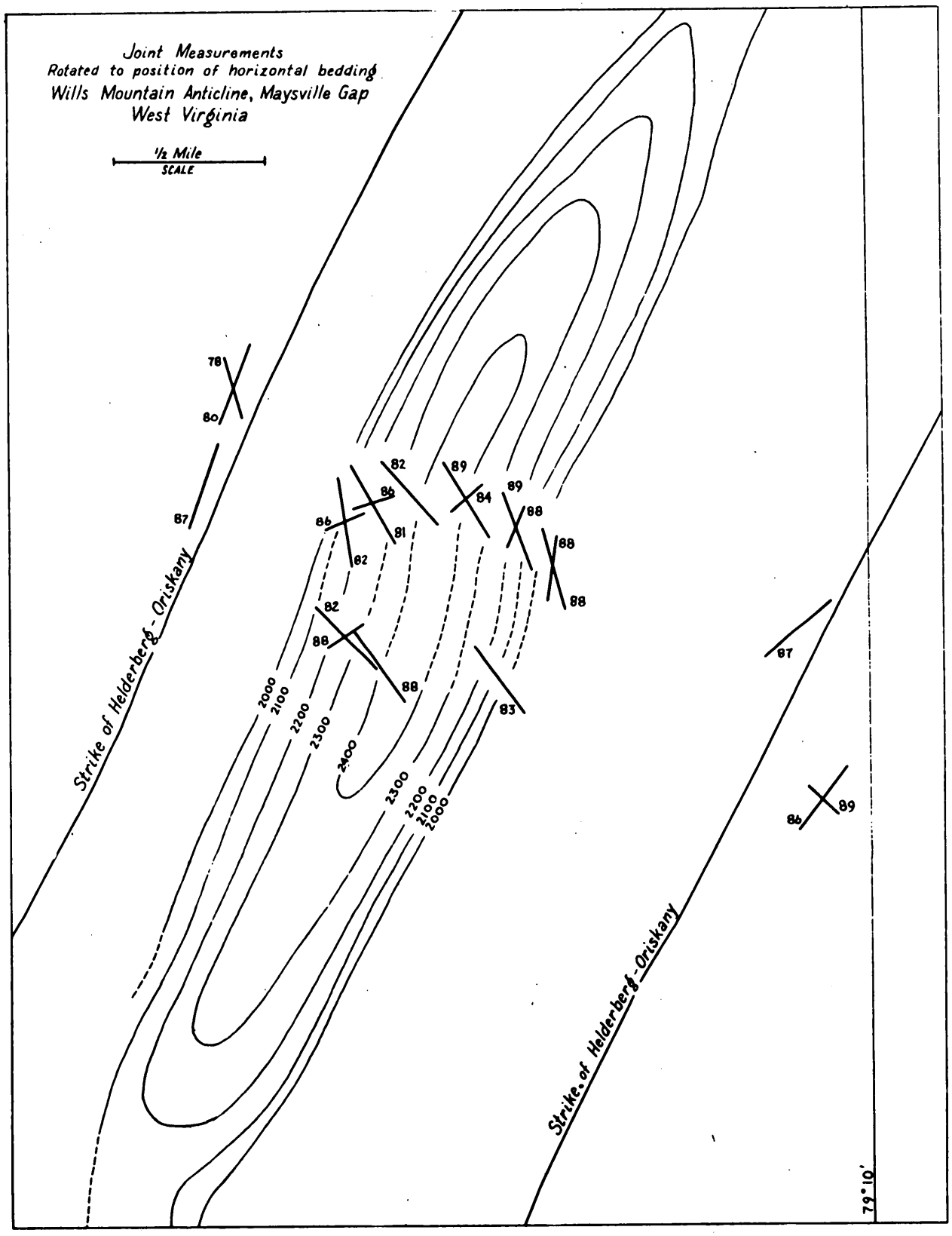


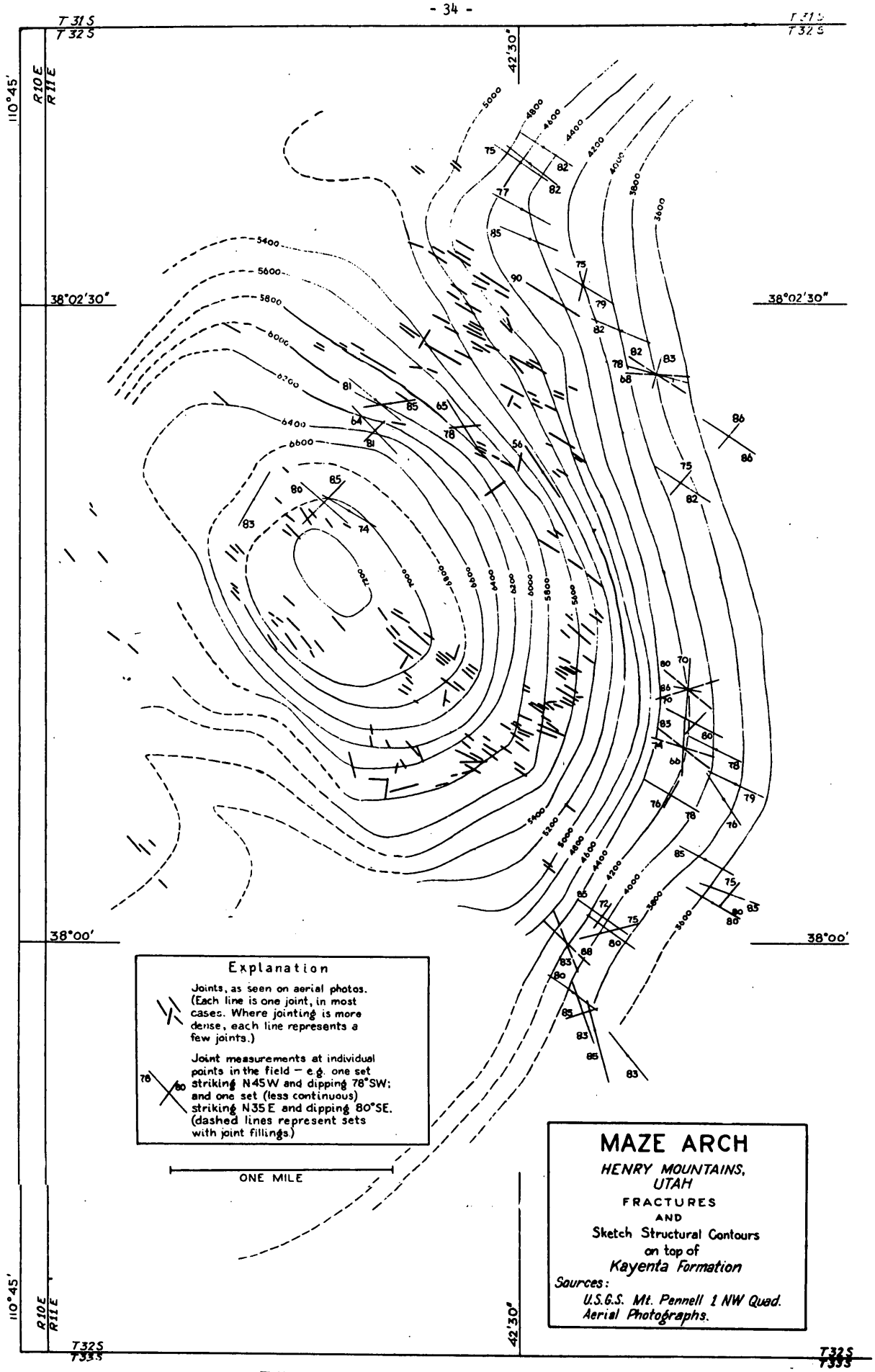
FAULTS AND JOINTS ANTICLINE IN WOODS HOLLOW MOUNTAINS, MARATHON, TEXAS.

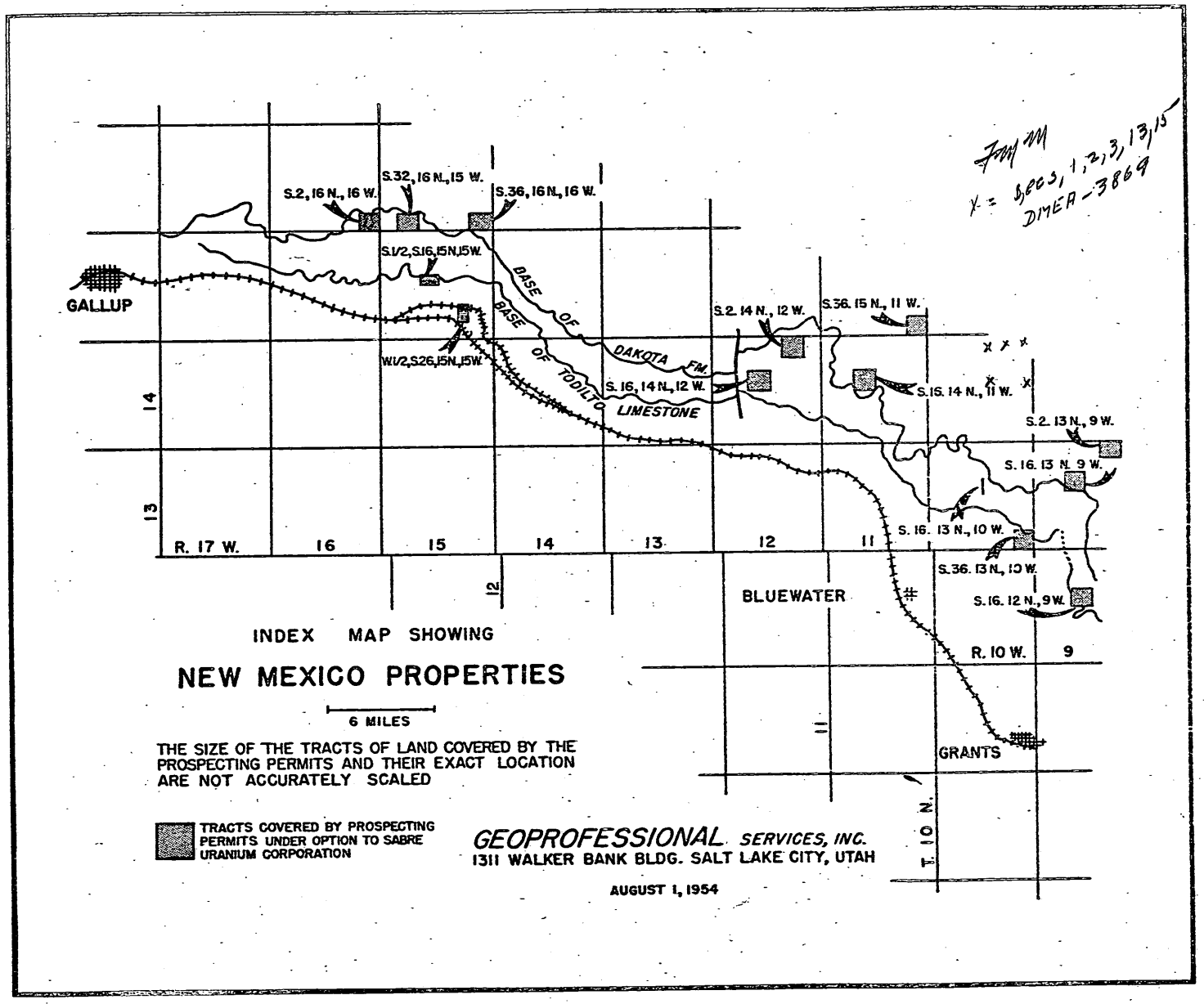


ATTITUDE OF BEDS. ANTICLINE IN WOODS
HOLLOW MOUNTAINS, MARATHON, TEXAS


Joint Measurements
Wills Mountain Anticline, Maysville Gap
West Virginia
Sketch Structural Contours on top of
White Medina Sandstone
(Silurian)
EACH JOINT SYMBOL SUMMARIZES 20 OR MORE JOINTS MEASURED AT THAT POINT
E.G. - ONE SET STRIKING N35W AND DIPPING 90°, AND A SECOND SET (LESS CONTINUOUS) STRIKING N15E AND DIPPING 85° S.E.
85
½ Mile
SCALE
Strike of Helderberg - Oriskany
Strike of Helderberg - Oriskany
2000
2100
2200
2300
2400
2300
2200
2100
2000
41
12
8
48
70
84
77
32
83
87
88
83
68
74
82
81
84
87
66
83
63
79°10'


Joint Measurements
Rotated to position of horizontal bedding
Wills Mountain Anticline, Maysville Gap
West Virginia
1/2 Mile
SCALE
Strike of Helderberg - Oriskany
Strike of Helderberg - Oriskany
2000
2100
2200
2300
2400
2300
2200
2100
2000
79°10'


T 31 S
T 32 S
R 10 E
R 11 E
110°45'
42'30"
38°02'30"
38°00'
Explanation
Joints, as seen on aerial photos. (Each line is one joint, in most cases. Where jointing is more dense, each line represents a few joints.)
Joint measurements at individual points in the field — e.g. one set striking N45W and dipping 78°SW; and one set (less continuous) striking N35E and dipping 80°SE. (dashed lines represent sets with joint fillings.)
ONE MILE
MAZE ARCH
HENRY MOUNTAINS, UTAH
FRACTURES
AND
Sketch Structural Contours
on top of
Kayenta Formation
Sources:
U.S.G.S. Mt. Pennell 1 NW Quad.
Aerial Photographs.



From M
X = S,ec 3, 1, 2, 3, 13, 15
DIMEA-3869

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Grand Junction, Colo.

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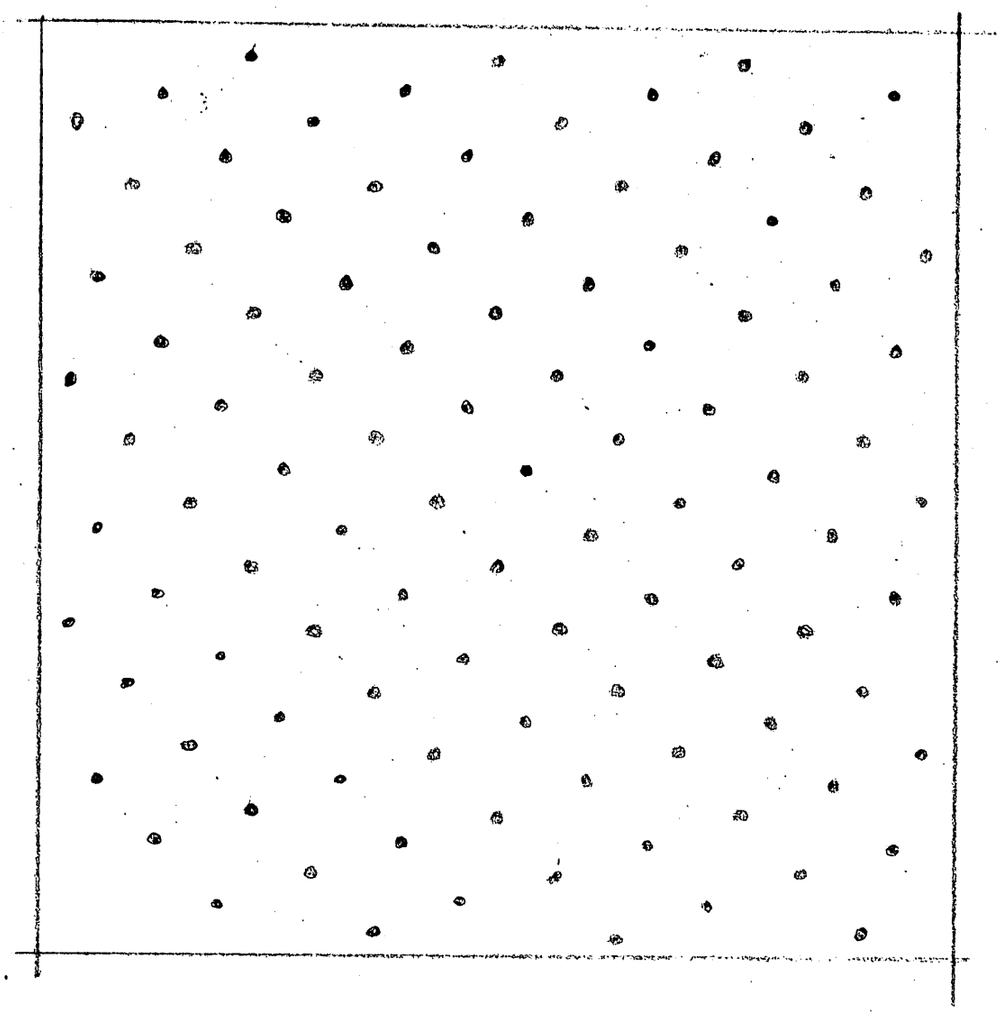
Proposed Drilling Pattern - T 14 N R 10 W

McKinley County New Mexico

Sec 1, 2, 3, 15. For Sec. 13 reverse the sketch.



N

Scale

1" = 1000'

500' spacing -

103 holes - ave. depth 400' = 41200'

200' @ 50¢ = $100.00

100' @ 1.00 = 100.00

100' @ 1.50 = 150.00

$350.00 / hole. × 103 = $36050.00

Plate # 3.

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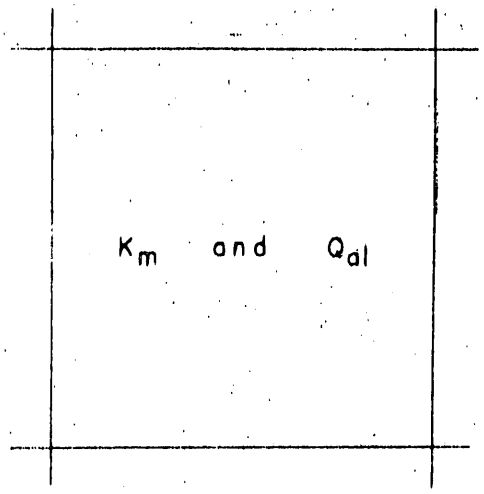
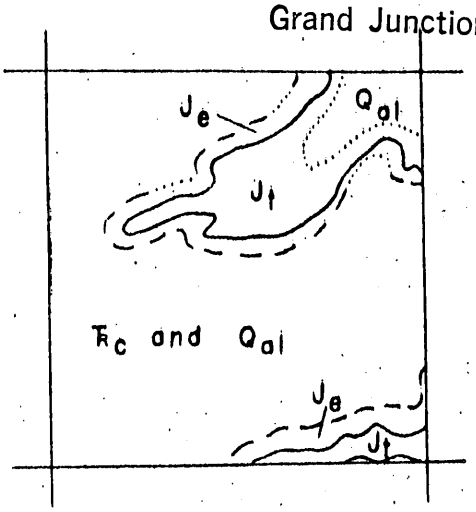
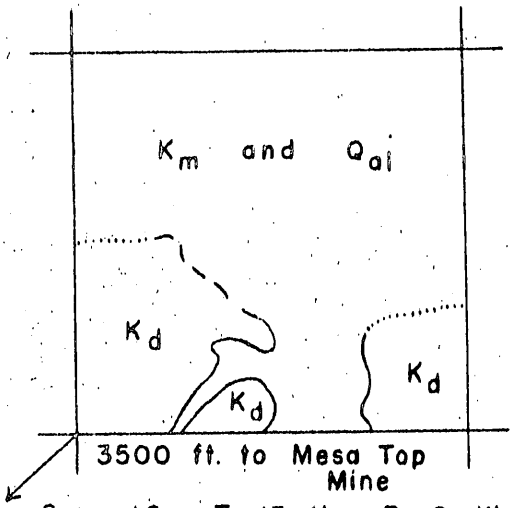


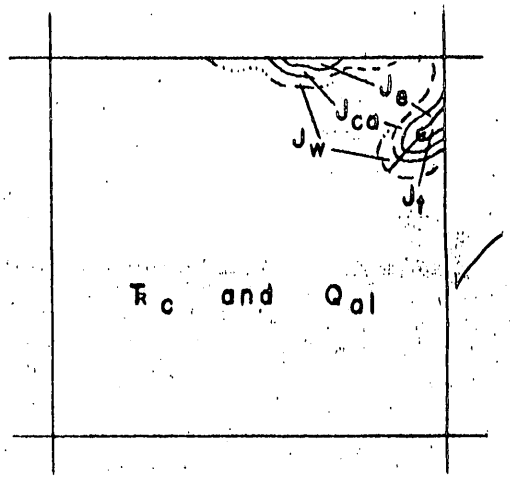
Sec. 2 T. 13 N. R. 9 W.



Sec. 16 T. 12 N. R. 9 W.



Sec. 16 T. 13 N. R. 9 W.



Sec. 36 T. 13 N. R. 10 W.

SABRE URANIUM PROPERTIES

LEGEND

Q_{al}	alluvium	
K_m	Mancos sh.	
K_d	Dakota ss.	
J_{mbb}	Brushy Basin	Morrison formation
J_{mwc}	Westwater Canyon	Morrison formation
J_{mrc}	Recapture Creek	Morrison formation
J_b	Bluff ss.	
J_t	Todilto ls.	
J_e	Entrada ss.	
J_{ca}	Carmel fm.	
J_w	Wingate ss.	
$T_{\bar{R}c}$	Chinle fm.	

GEOPROFESSIONAL SERVICES INC.
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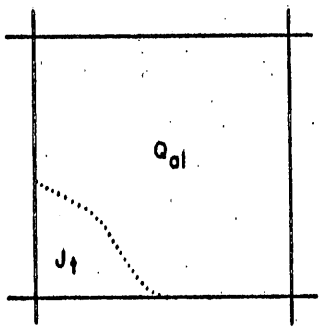
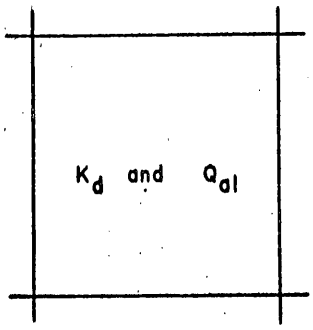
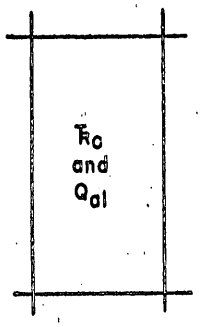


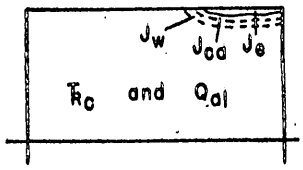
Sec. 16 T. 14 N. R. 12 W.



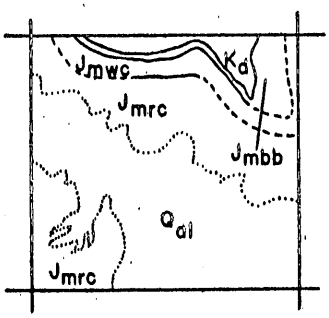
Sec. 36 T. 16 N. R. 15 W.



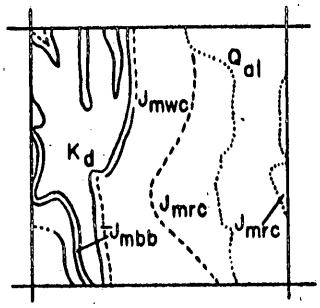
W½ Sec. 26 T. 15 N. R. 15 W.



S½ Sec. 16 T. 15 N. R. 15 W.



Sec. 32 T. 16 N. R. 15 W.



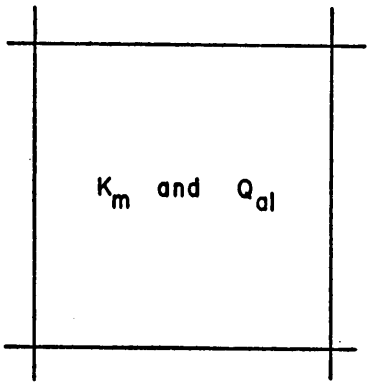
Sec. 36 T. 16 N. R. 16 W.

DETAIL MAP OF NEW MEXICO LANDS COVERED BY PROSPECTING PERMITS UNDER OPTION TO SABRE URANIUM CORPORATION

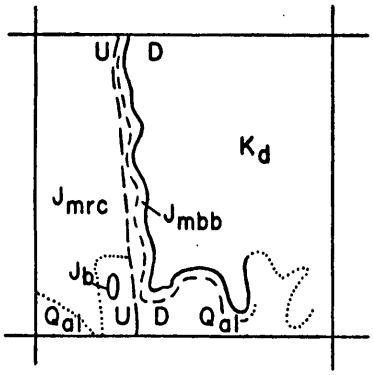
GEOPROFESSIONAL SERVICES, INC.
1311 WALKER BANK BLDG. SALT LAKE CITY, UTAH

AUGUST 1, 1954

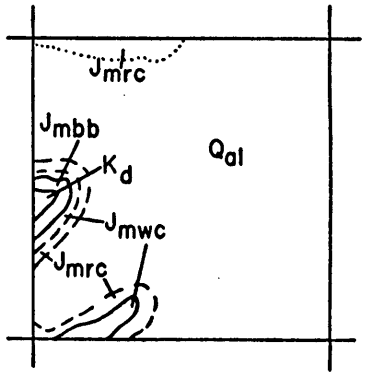
SABRE URANIUM CORP.
P. O. Box 1549
Grand Junction, Colo.



Sec. 36 T. 15 N. R. 11 W.



Sec. 16 T. 14 N. R. 11 W.

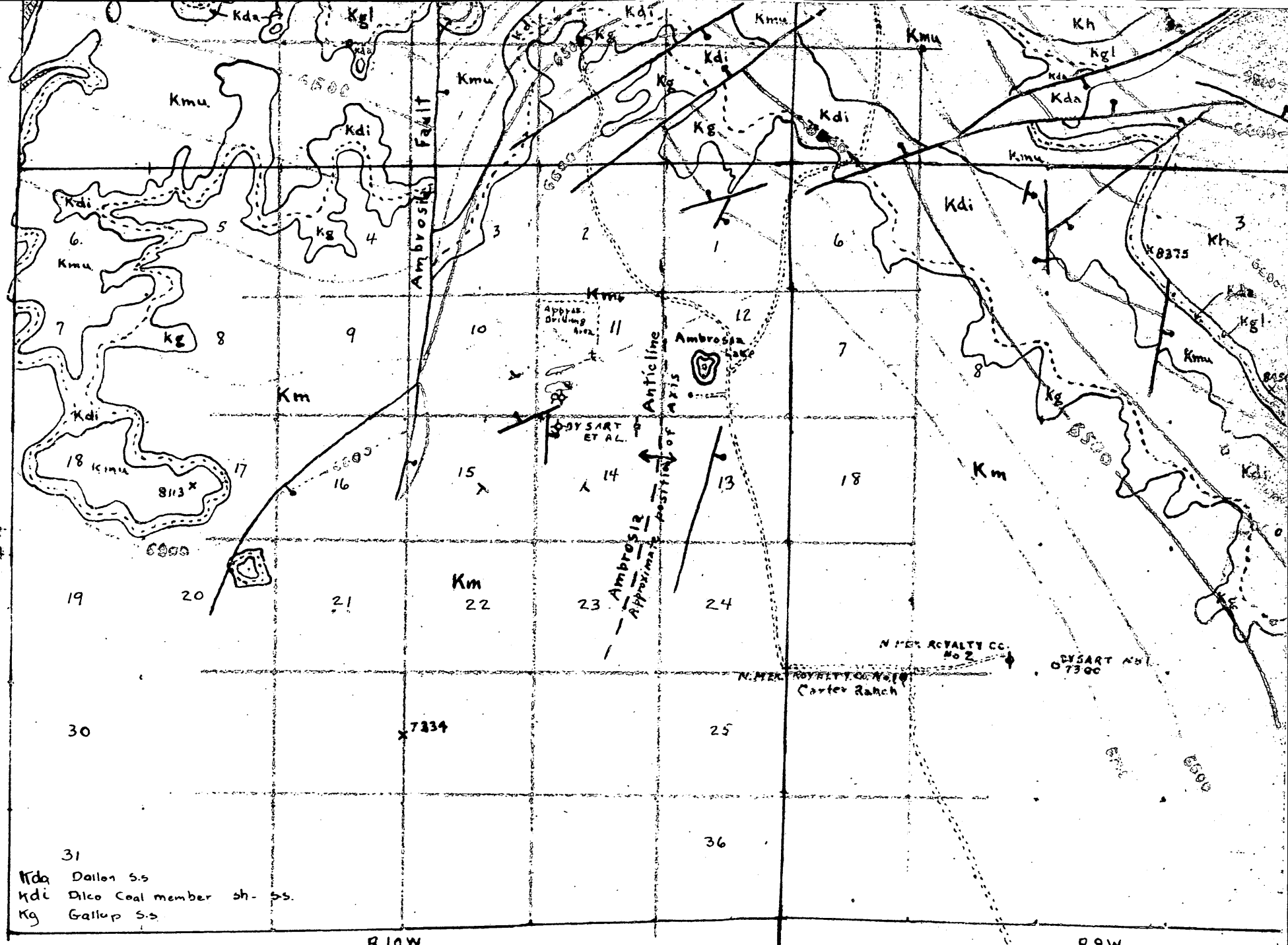


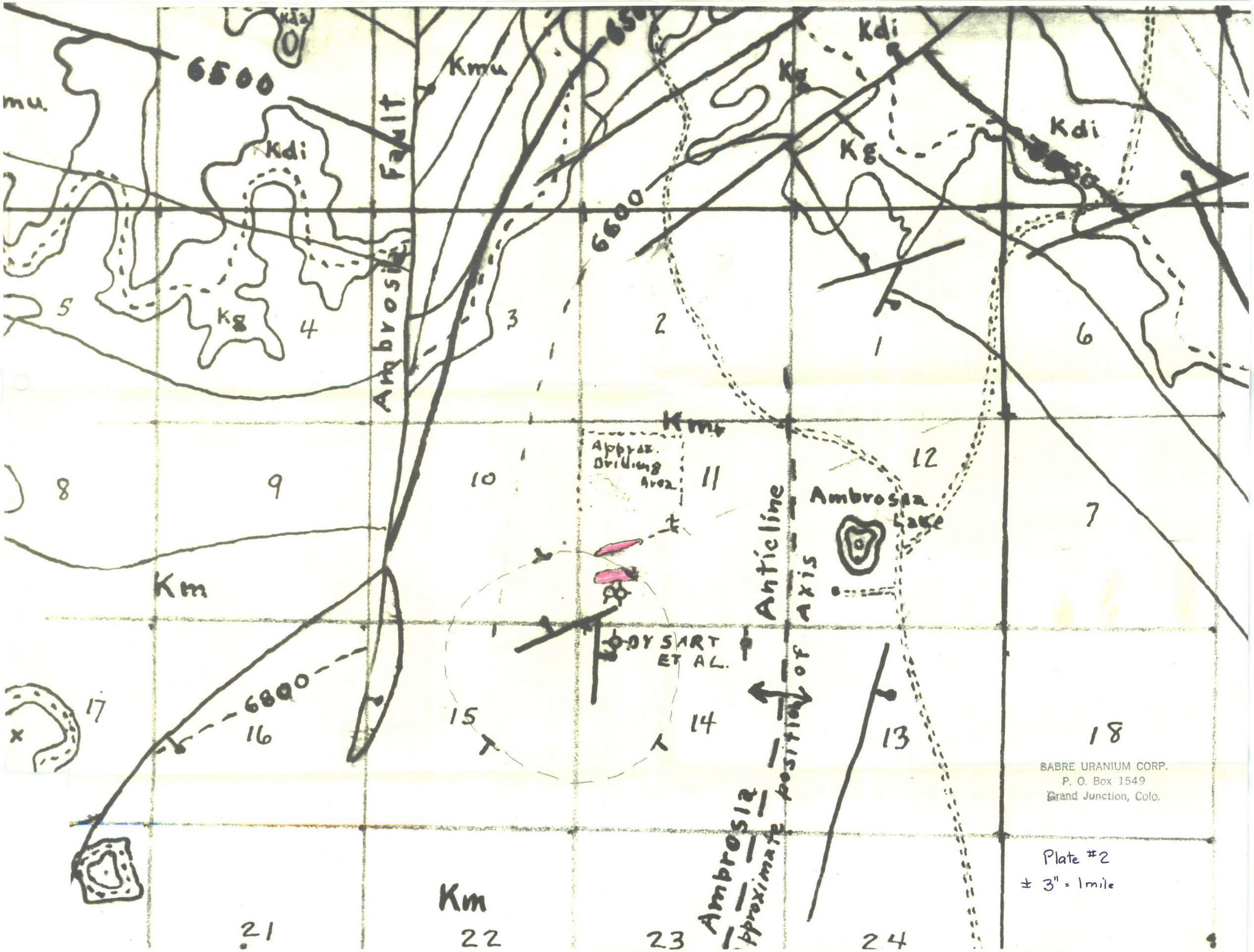
Sec. 2 T. 14 N. R. 12 W.

DETAIL MAP OF NEW MEXICO LANDS COVERED BY PROSPECTING PERMITS UNDER OPTION TO SABRE URANIUM CORPORATION

GEOPROFESSIONAL SERVICES, INC.
1311 WALKER BANK BLDG. SALT LAKE CITY, UTAH

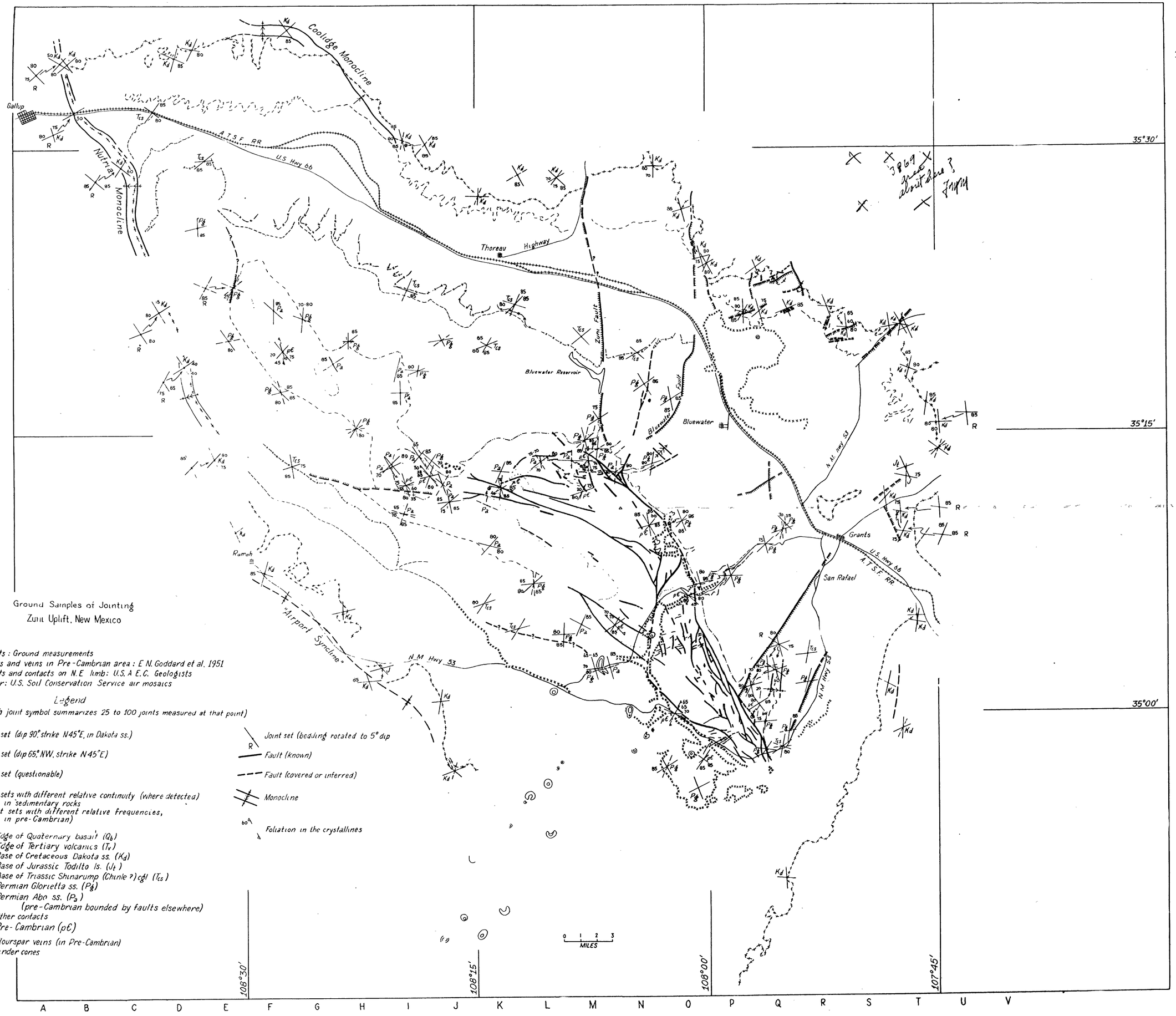
AUGUST 1, 1954

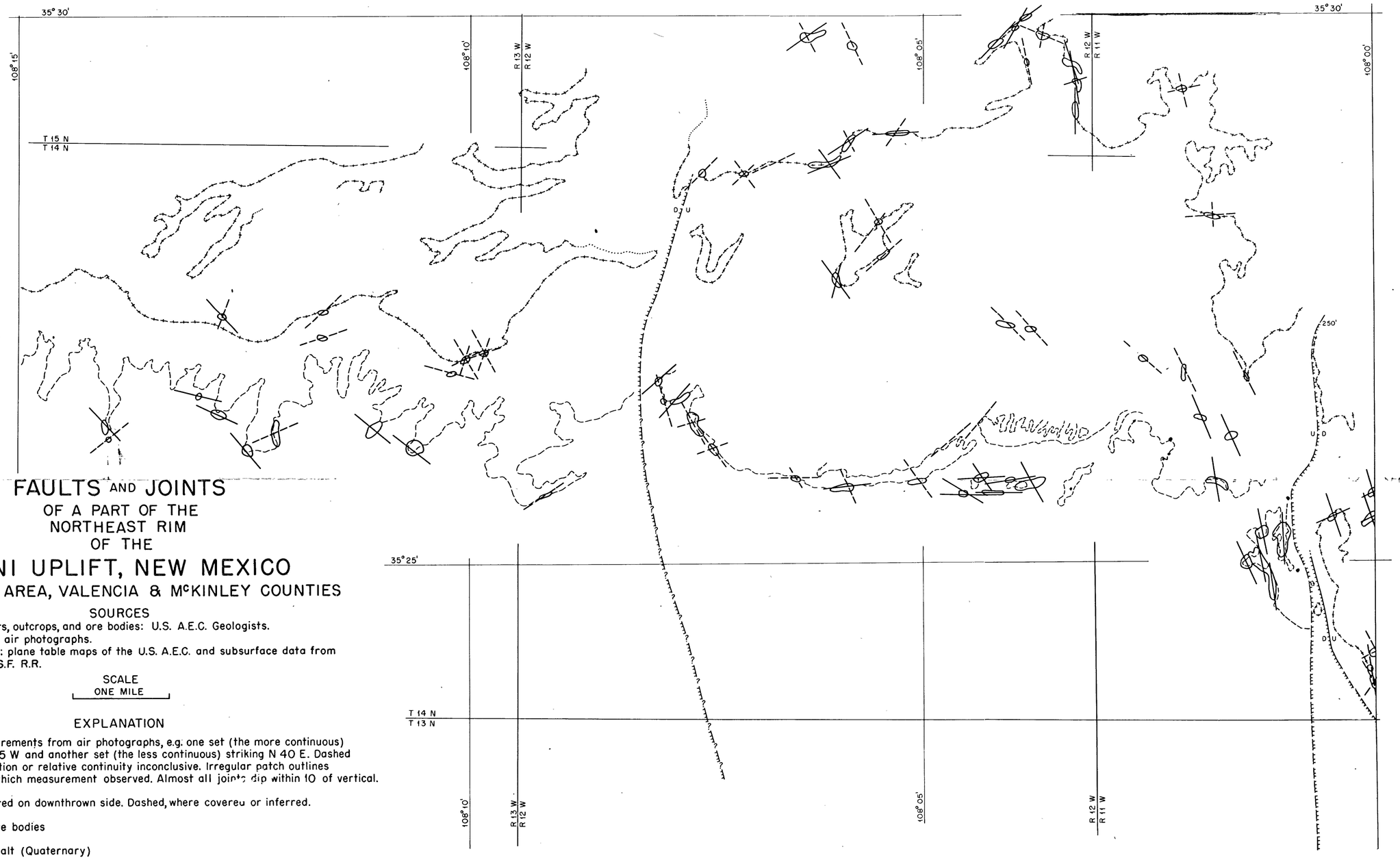

Kda
Kgl
Kmu
Kdi
Kg
Kh
Km
Ambrosia Fault
Ambrosia Anticline
Approximate position of axis
Approx. Drilling area
Ambrosia Lake
DYSART & ET AL.
N. MEX. ROYALTY CO. No 2
N. MEX. ROYALTY CO. No 1
Carter Ranch
DYSART No 1
7300
8113
7334
8375
6500
6600
6800
6900
T 14 N
R 10 W
R 9 W
Kda Dalton S.S
Kdi Dilco Coal member sh- ss.
Kg Gallup S.S
KM- Mancos Shale
Kmu - Marine shale tongue of the Mancos
Kd Dakota S.S
Scale 1" = 1mile
May 17, 1955
S. J.
SABRE URANIUM CORP.
P. O. Box 1549
Grand Junction, Colo.
Plate #1



SABRE URANIUM CORP.
P. O. Box 1549
Grand Junction, Colo.

Plate #2
± 3" = 1 mile


Coolidge Monocline
Gallup
A.T.S.F. RR
U.S. Hwy 66
Nutria Monocline
Thoreau
Highway
Zuni Fault
Bluewater Reservoir
Bluewater Fault
Bluewater
N.M. Hwy 53
Grants
U.S. Hwy 66
A.T.S.F. RR
San Rafael
Ramah
"Airport Syncline"
N.M. Hwy 53
35°30'
35°15'
35°00'
108°30'
108°15'
108°00'
107°45'
0 1 2 3
MILES
Ground Samples of Jointing
Zuni Uplift, New Mexico
Sources:
Joints: Ground measurements
Faults and veins in Pre-Cambrian area: E.N. Goddard et al. 1951
Faults and contacts on N.E. limb: U.S.A.E.C. Geologists
Other: U.S. Soil Conservation Service air mosaics
Legend
(Each joint symbol summarizes 25 to 100 joints measured at that point)
Joint set (dip 90°, strike N45°E, in Dakota ss.)
Joint set (dip 65°, NW, strike N45°E)
Joint set (questionable)
Joint sets with different relative continuity (where detected) in sedimentary rocks
(Joint sets with different relative frequencies, in pre-Cambrian)
Edge of Quaternary basalt (Qb)
Edge of Tertiary volcanics (Tv)
Base of Cretaceous Dakota ss. (Kd)
Base of Jurassic Todilto ls. (Jt)
Base of Triassic Shinarump (Chinle?) cgl (Tcs)
Permian Glorietta ss. (Pg)
Permian Abo ss. (Pa)
(pre-Cambrian bounded by faults elsewhere)
Other contacts
Pre-Cambrian (pЄ)
Flourspar veins (in Pre-Cambrian)
Cinder cones
Joint set (bedding rotated to 5° dip
Fault (known)
Fault (covered or inferred)
Monocline
Foliation in the crystallines



FAULTS AND JOINTS

OF A PART OF THE
NORTHEAST RIM
OF THE

ZUNI UPLIFT, NEW MEXICO

BLUEWATER AREA, VALENCIA & McKINLEY COUNTIES

SOURCES

Base map, with faults, outcrops, and ore bodies: U.S. A.E.C. Geologists.
Joints: low altitude air photographs.
Structural contours: plane table maps of the U.S. A.E.C. and subsurface data from A.C.M. Co. and A.T.S.F. R.R.

SCALE
ONE MILE

EXPLANATION

Joint measurements from air photographs, e.g. one set (the more continuous) striking N 15 W and another set (the less continuous) striking N 40 E. Dashed where direction or relative continuity inconclusive. Irregular patch outlines area over which measurement observed. Almost all joints dip within 10 of vertical.

Fault. Hatured on downthrown side. Dashed, where covered or inferred.

Uranium ore bodies

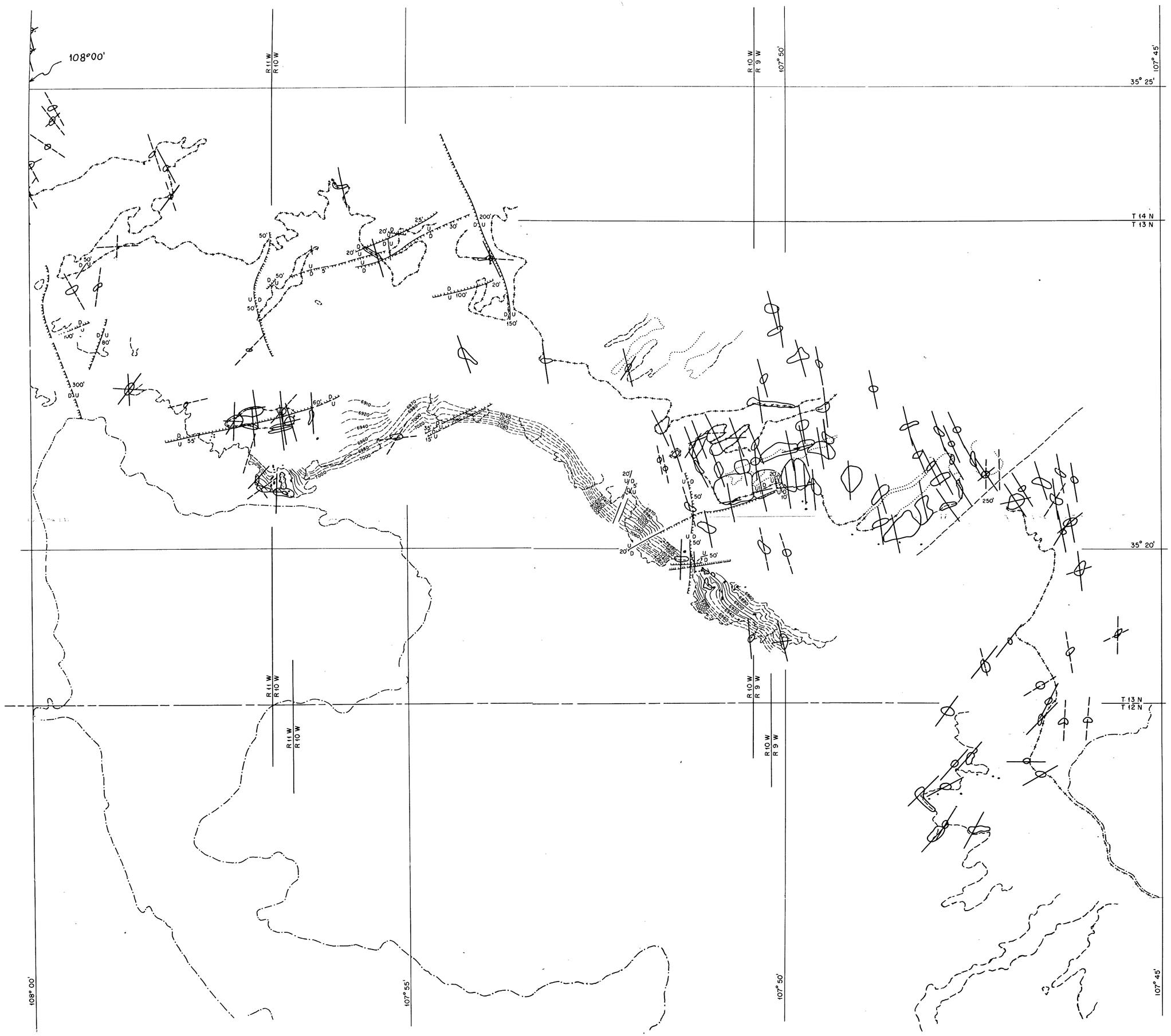
Edge of basalt (Quaternary)

Lower contact of Dakota SS. (Cretaceous)

Lower contact of Todilto LS. (Jurassic)

Structural contours on base of Todildo LS. Solid where subsurface data used; dashed where inferred.

These Maps Do not show the Faults & Joints in the subject sections


108°00'
R 11 W
R 10 W
R 10 W
R 9 W
107° 50'
107° 45'
35° 25'
T 14 N
T 13 N
35° 20'
T 13 N
T 12 N
108° 00'
107° 55'
107° 50'
107° 45'