

-1-

UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION OF RAW MATERIALS
EXPLORATION BRANCH

ARIZONA GEOLOGICAL SURVEY
LIBRARY COPY

GEOLOGY AND DRILLING RECOMMENDATIONS
OAK SPRINGS AREA
APACHE COUNTY, ARIZONA, AND SAN JUAN COUNTY, NEW MEXICO

by
Melvin A. Swanson
and
Kenneth G. Hatfield

April 3, 1952
(Grand Junction, Colorado)

metadc784409

GEOLOGY AND DRILLING RECOMMENDATIONS, OAK SPRINGS AREA, APACHE COUNTY,
ARIZONA, AND SAN JUAN COUNTY, NEW MEXICO

<u>Distribution</u>	<u>Copy No.</u>
AEC, Washington (Jesse C. Johnson)	3
AEC, New York (P. L. Merritt)	1, 4, 5 (plus ribbon copy)
AEC, Denver (C. C. Towle)	6
AEC, Salt Lake City (E. E. Thurlow)	7
AEC, Grand Junction (CRMO - Frank H. MacPherson)	8
USGS, Grand Junction (R. P. Fischer)	9
USGS, Washington (T. B. Nolan)	14
AEC, Grand Junction (GJEB - Thomas W. Oster)	2, 10, 11, 12, 13

GEOLOGY AND DRILLING RECOMMENDATIONS, OAK SPRINGS AREA, APACHE COUNTY,
ARIZONA, AND SAN JUAN COUNTY, NEW MEXICO

CONTENTS

Abstractpage 4

Introduction 4
 Location and Accessibility 4
 Names and Addresses of Owners 4
 Map and Photo Coverage and Previous Reports 5
 Method of Investigation 5

History of Operations 5

General Geology 5
 Stratigraphy 5
 Jurassic Rocks 6
 Summerville formation 6
 Bluff formation 6
 Morrison formation 6
 Cretaceous Rocks. 6
 Burro Canyon formation 6
 Dakota formation 6

 Structure 6
 Igneous Geology 7

Geology of the Deposits 7

Summary and Conclusions 14

Drilling Project 15
 Water Supply 15
 Depth of Holes 15
 Type of Drilling Suggested 15
 Recommendations for Drilling Patterns 15
 Road Building. 16

Bibliography 17

ILLUSTRATIONS

Figure 1 - Location Map, Oak Springs Area, East Carrizo District, Arizona-New Mexico	18
2 - Oak Springs Area	19
3 - Lone Star Mine, East Carrizo Area, Arizona	20
4 - Syracuse Mine, East Carrizo Area, Arizona	21
5 - Section, Measured in Oak Creek Canyon	22
Plate I - Structure Contour Map on Top of Bluff Sandstone, Oak Springs Area, Apache Co., Arizona., San Juan Co., New Mexico	Appended
II - Topographic Map of Oak Springs Area, Apache Co., Arizona, San Juan Co., New Mexico	Appended

GEOLOGY AND DRILLING RECOMMENDATIONS

OAK SPRINGS AREA

APACHE COUNTY, ARIZONA, AND SAN JUAN COUNTY, NEW MEXICO

ABSTRACT

Uranium ore deposits on two exposed rims and past production records of tonnage and grade indicate an exploration program is justified in the Oak Springs area. A minimum of 24,000 feet of core drilling is recommended with a maximum of 75,000 feet to be based on favorability as determined by subsurface studies.

INTRODUCTION

Location and Accessibility

The Oak Springs area is in the East Carrizo district, Apache County, Arizona, and San Juan County, New Mexico, between Oak Creek and Cottonwood Creek, 15 to 20 miles south of the Four Corners (fig. 1). The area is accessible via U. S. Highway 666 to a point 6 miles south of Shiprock, New Mexico, thence west 20 miles over an improved dirt road, thence 12 miles over a truck road.

Names and Addresses of Owners

All land within the Navajo Indian Reservation is owned by the Navajo Indian Tribe and until recently only Navajos were permitted to stake mineral-bearing ground. Mineral rights in the Oak Springs area are not definitely established and are claimed by several Indians. The following Indians have claims in the Oak Springs area:

Eugene Tapohonso	Shiprock, New Mexico
Leroy Pettigrew	" "
Tony Garnanez	" "
Roland Begay	" "
Cato Sells	Farmington, New Mexico

Map and Photo Coverage and Previous Reports

There are two sets of aerial photographs that cover the Carrizo Mountains district: the Production and Marketing Administration photographs (scale 1:20,000) and the U. S. Geological Survey photographs (scale 1:47,000). A planimetric map of the area was made in 1937 by the Soil Conservation Service (scale 1" = 1 mile), and a geologic map made by the Union Mines Development Corporation was completed in 1944 (scale 1:24,000). Two fifteen minute quadrangles (Shiprock and Rattlesnake) were surveyed by the USGS in 1933-34 (scale 1:62,500 and contour interval = 20 feet) and were printed in 1937. A list of published and unpublished reports concerning this area is included in the bibliography.

Method of Investigation

The study of past production records, previous reports and investigations, and aerial photographs, and a limited amount of field work were the means by which the area was examined. A geologic and topographic map of the area is being constructed from aerial photographs using USGS and UMDC horizontal and vertical ground control. Altimeter elevations were established at various points on the Bluff-Salt Wash contact for structural control and on topographic promontories for drilling depth.

HISTORY OF OPERATIONS

Radium-uranium-vanadium ore has been produced intermittently from the Oak Springs area since 1918. Prior to 1948, the area was mined for vanadium and radium; since that date, it has been mined for uranium and vanadium. Settlement sheets indicate that at least 1,000 tons were shipped in 1950. Records are not available for the accurate appraisal of the grade and tonnage of total production, but it is doubtful that annual production in other years has equalled that of 1950. It is estimated that the average of past ore shipments has been approximately 0.3% U_3O_8 and 3.0% V_2O_5 .

Minor mining operations have been carried on at the North Star mine, Syracuse mine, and several other claims during the past year.

There has been no drilling in this area.

GENERAL GEOLOGY

Stratigraphy

Jurassic and Cretaceous rocks, from the Entrada sandstone through the Dakota sandstone, are exposed in the immediate Oak Springs area (figs. 2 and 5).

Jurassic Rocks

Summerville formation (upper part) - About 100 feet of alternating grayish-red, light brown, and white sandstone in thin beds, somewhat argillaceous, with some intercalated shaly-bedded claystone is exposed. The Summerville erodes into cliffs.

Bluff formation - Pale red to orange to brown, fine- to medium-grained sandstone with abundant white chert. Where exposed, this formation forms a reddish to buff colored cliff about 20 feet high.

Morrison formation - The Morrison is composed of four members in ascending order: Salt Wash sandstone, Recapture shale, Westwater sandstone, and Brushy Basin shale.

The Salt Wash is a series of interbedded red to brown, fine- to coarse-grained sandstones with minor interbedded claystones. It presents an outcrop appearance of ledgy slopes, slabs, and cliffs. The average thickness is about 225 feet.

The Recapture is about 200 feet thick and consists of interbedded claystones and sandstones. It weathers as blocky and ledgy slopes.

The Westwater, which is approximately 265 feet thick is a series of interbedded sandstones and claystone, with sandstone being the most prominent unit. The sandstones are massive and form cliffs in the area. The sandstones range from gray to brown in color and are fine- to medium-grained.

The Brushy Basin consists of about 86 feet of very fine, sandy shales, varying from gray to green to red in color; it weathers into a shaly slope.

Cretaceous Rocks

Burro Canyon formation - This formation is about 100 feet thick and consists of interbedded medium-grained to conglomeratic sandstone and greenish-gray to maroon claystone.

Dakota formation - The total thickness of the Dakota formation is not present in this area, but where seen, it is composed of conglomerate and conglomeratic sandstone, white to grayish-orange or pink in color.

Structure

To the east of the area, the beds dip gently toward the San Juan Basin and to the west they rise sharply onto the laccolithic Carrizo Mountains. There are smaller structures superimposed upon these large

features. The easterly dipping Red Rock monocline can be seen as far as 15 miles to the south, where it is covered by the flat-lying Tertiary sandstones on top of the Chuska Mountains. The north end of the monocline merges, at the western boundary of the area, with the Syracuse nose, an easterly plunging anticline without closure extending eastward from the Carrizo Mountains. Four miles north of the area is Beclabito Dome, where a gas well was collared in the Entrada sandstone and bottomed at a depth of 4,840 feet in Cambrian quartzite (Barnes and Arnold, 1950).

Igneous Geology

Several small igneous plugs have intruded the region, probably in Tertiary time. Although the Red Rock monocline swings to the east near two plugs, there is little arching of the beds as a result of the intrusions. A few vertical dikes strike nearly north through the area. Between the two plugs on the southern boundary, is an area 2,000 feet across, which contains collapsed blocks of sedimentary rocks and intruded igneous masses. All of the sandstones and mudstones in the subsidence area have been altered to a light, gray-green color. In Oak Creek Canyon, north of the subsidence area, several irregular bodies of intrusive breccia are exposed in the canyon walls. The igneous plugs are agglomerates containing sandstone, igneous, and some metamorphic xenoliths with a ferro-magnesian, pyroclastic matrix, which is often so sparse as to be indistinguishable in the fragments. The dikes are biotite-rich minette having a much more uniform texture and composition than the plugs.

GEOLOGY OF THE DEPOSITS

Uranium-vanadium ore deposits are confined to the Salt Wash in the Oak Springs area. The ore is found in at least two horizons in a zone lying between 40 and 60 feet stratigraphically above the base of the Salt Wash. The ore zone is exposed on three sides of the area as well as in one canyon in the central portion. To the north are the Lone Star (fig. 3) and Syracuse (fig. 4) mines and the Cottonwood Butte claims; to the west and south along Oak Creek are several small adits, pits, and trenches. Two small groups of workings are located in the canyon in the central part. Several mines are located on King Tutt Mesa to the south. The King Tutt deposits have been described in a previous report (RMO-702).

The deposits are tabular, except for a few rolls, and lie conformably with the sandstone beds or cut the bedding planes at low angles. The ore is associated with erosion surfaces, with intraformational channels, or with bedding surfaces. The ore is usually in the sandstone bed above the erosion surface. Green mudstone and carbonaceous trash are commonly associated with the ore. The ore zone lies between 40 and 60 feet above the Salt Wash-Bluff contact.

The ore minerals are carnotite and the vanoxite suite. Some metaheawettite, pintadoite, and pascoite were observed. The uranium-vanadium minerals coat sand grains, fill interstices, and replace the quartz grains. Lime content of the host rock is commonly in excess of 10%.

At the time the UMDC report was written, not all sample returns were available. However, they estimated approximate grade of samples not shown in report, to be 0.28% U_3O_8 . Apparently no attempt was made to estimate percent of U_3O_8 if no uranium mineral was visible.

Union Mines assay results are reported in the following order: Office sample number; thickness, in feet and tenths; chemical (Tonawanda) % U_3O_8 and V_2O_5 ; % U_3O_8 Electroscopic (Grand Junction). Following is a brief description of the ore outcrops adapted from the Union Mines Development Corporation Report, (August 1944), Plate I:

S-B 13

25 ft. of ore occurring over total length of 50 feet. Average thickness 0.25 ft. Estimated grade 2% V_2O_5 .

S-B 14

Outcrop is 10 ft. long with average thickness of 1 ft. Estimated grade is 1% V_2O_5 .

S-B 15

Outcrop is 12 ft. long, occurring discontinuously over a distance of 50 feet; average thickness is 0.5 ft., with an estimated grade of 2% V_2O_5 .

S-B 16

Outcrop is 15 ft. long, averaging 1.0 ft. in thickness, and the estimated grade is 2% V_2O_5 , with a trace of carnotite showing.

S-B 17

Outcrop is 4 ft. long with a thickness of about 1.5 ft. and the estimated grade is 2% V_2O_5 .

S-B 18

Showing discontinuous over 20 ft; average thickness 0.15 ft. with an estimated grade of 1% V_2O_5 .

S-E 5

Outcrop has been worked for 30 ft. length. Exposure on face 4 ft. long, averages 0.4 ft. in thickness. Estimated grade 2-3/4% V_2O_5 .

S-E 6

Some ore has been removed. Exposure on face 10 ft. long, averaging 0.4 ft. thick, estimated grade 1/2% V₂O₅.

S-E 7

ore has been removed over 40 by 75 ft. area. Main exposure on NE. face exposed for 6 ft., 0.5 to 1.0 ft. in thickness, estimated grade 2 1/2% V₂O₅. 1.5 ft. above it, 25-ft. outcrop, averaging 0.15 ft. thick, estimated grade 2 1/2% V₂O₅. Main exposure on SW. face 12 ft. long, averaging 0.5 ft. thick, estimated grade 2% V₂O₅.

S-E 8

A 50-ft. drift; at portal ore has average thickness of 2 ft., estimated 2% V₂O₅. 50 ft. up-dip from portal, showing on open-cut face 12 ft. long, averaging 0.4 ft. in thickness, estimated grade 1 1/2% V₂O₅.

S-E 9

On east side of gully, 35 ft. of outcrop discontinuous over 145 ft., 0.1 to 2.0 ft. in thickness, estimated grade 2% V₂O₅. On west side of gully, 10 ft. of outcrop discontinuous over 50 ft., 0.1 to 0.4 ft., in thickness, estimated average grade 1-3/4% V₂O₅.

S-E 10

Series of very thin and discontinuous surface and float showings for 500 ft. around nose of ridge. Estimated grade 2 to 3% V₂O₅.

S-E 11

Very thin float showing. Estimated grade 2% V₂O₅.

S-E 12

Outcrop exposed for 10 ft.; average thickness 0.2 ft; estimated grade 2% V₂O₅.

S-E 13

Discontinuous, very poorly exposed outcrop over length of 50 ft. 0.1 to 1.0 ft. in thickness. Not sampled. Estimated grade 1 1/2% V₂O₅.

S-E 14

Two outcropping seams, separated from 5 to 8 ft. Lower seam 240 ft. long, averaging 0.4 ft. in thickness. Estimated grade 2% V₂O₅. Upper seam 50 ft. long, 0.5 to 2.5 ft. thick, with fair carnotite showing, estimated grade 2% V₂O₅.

S-E 15

Small local zone of vanadiferous float, similar to S-E 10.

S-E 16

Outcrop poorly exposed, length probably not exceeding 5 ft., maximum thickness 0.3 ft. Estimated grade 2% V_2O_5 .

S-E 17

Outcrop has been worked over 18 ft. by 40 ft. area. On face outcrop is 50 ft. long, 0.2 to 1.5 ft. thick. Estimated average grade 2½% V_2O_5 . Seam 1½ ft. above west end of above seam is 12 ft. long, averaging 0.5 ft. thick, estimated grade 2% V_2O_5 . 10 ft. long, 0.25 ft. thick showing 55 ft. from west end.

S-E 18

Outcrop is 14 ft. long, 0.2 to 1.0 ft. thick. Sample No. 1397; 0.45 ft., 0.03% U_3O_8 , 0.75% V_2O_5 .

S-E 19

Outcrop poorly exposed in part, but apparently continuous over 85 ft. Average thickness 0.5 ft. Estimated grade 2½% V_2O_5 .

S-E 20

25 ft. zone of vanadiferous float.

S-E 21

25 ft. zone of vanadiferous float. Ore exposed for 3 ft., average thickness 0.5 ft., with an estimated grade of 2-¾% V_2O_5 .

S-E 22

Outcrop has been worked. Face shows a lower seam, 20 ft. long, average thickness 0.5 ft., estimated grade 3% V_2O_5 . Nine feet above it, an upper seam 40 ft. long, 0.7 to 1.0 ft. thick, with an estimated grade of 2% V_2O_5 .

S-E 23

Poorly exposed 25 ft. showing, thickness does not exceed 0.25 ft. Fair carnotite showing.

S-E 24

Outcrop shows 30 ft. of ore over 37 ft. in length, average thickness 0.5 ft., estimated grade 2% V_2O_5 .

S-E 25

Zone of estimated 2% vanadiferous float 70 ft. long, continuous for 35 ft.

S-E 26

60 ft. of ore showing in zone 85 ft. long. Thickness of main 50 ft. showing averages 2 ft. Sample No. 1399: 2.2 ft. -0.04-1.54 (T); 0.11 (E).

S-E 27

Outcrop is 21 ft. long, 0.8 to 2.5 ft. thick. Sample No. 1394: 0.8 ft.-0.03-0.35(T); 0.08(E).

S-E 28

Outcrop is 34 ft. long, 0.25 to 1.3 ft. thick. Sample No. 1379: 0.25 ft.-0.03-2.06(T); 0.07(E).

S-E 29

110 ft. of outcrop over 200 ft. distance. Thickness averages 0.25 ft. except as below:

S-E 29 (a) is 40 ft. long, 0.2 to 2.5 ft. thick

Sample No. 1371 1.1 ft.-0.09-1.59(T); 0.15(E)

S-E 29 (f) is poorly exposed for 20 ft., 0.6 to 4 ft. thick.

Sample No. 1392: 1.0 ft.-0.07-1.68(T); 0.135(E).

S-E 30

90 ft. of outcrop over 150 ft. distance, maximum thickness 0.1 ft. Estimated grade 2% V₂O₅.

S-E 31

Outcrop is 20 ft. in length, 1 to 4 ft. in thickness.

Sample 1376: 2.3 ft.-0.23-4.53(T); 0.20(E).

S-E 32

S-E 32 (a), is 20 ft. long, 0.4 to 1.4 ft. thick.

Sample No. 1381: 1.4 ft-0.21-3.25(T); 0.23(E).

S-32 (b) is 50 ft. from S-E 32(a), 5 ft. in length, 0.4 to 1.3 ft. thick.

Sample No. 1383: 1.3 ft. -0.06-1.37(T); 0.10(E).

S-E 33

Outcrop is 12 ft. long, 0.5 to 1.5 ft. in thickness.

Sample No. 1372: 1.5 ft. -0.04-1.16-(T); 0.20(E).

S-E 34

A 200-ft. poorly exposed glauconitic zone that is locally vanadiferous. Thickness averages 0.1 ft. This occurrence is 105 ft. above the principal ore horizon.

S-E 35

A negligible occurrence of vanadiferous float.

S-W 9

Small patches of secondary carnotite on sandstone surfaces. No vanadiferous sandstone noted.

S-W 10

Outcrop is 5 ft. in length, 0.17 to 0.75 ft in thickness. Estimated grade is 0.5 to 3.0% V_2O_5 , 0.15 U_3O_8 .

S-W 11

Outcrop is 8 ft. long, 0.37 to 0.5 ft. in thickness. Sample No. 1391: 0.37 ft., 0.04% U_3O_8 , 2.79% V_2O_5 .

S-W 12

Outcrop is 29 ft. long, 0.5 to 0.75 ft. in thickness. Sample No. 1380: 0.5 ft, 0.03% U_3O_8 , 1.73% V_2O_5 .

S-W 13

Outcrop poorly exposed for 3 ft., 0.6 to 1.08 ft. in thickness. Sample No. 1375: 1.08 ft., 0.16% U_3O_8 , 3.15% V_2O_5 .

S-W 14

Outcrop is 15 ft. long, 1 to 1.3 ft. in thickness. Estimated grade is 1% V_2O_5 , 0.09 U_3O_8 .

S-W 15

Outcrop is 3 ft. long, 0.5 ft. in thickness. Estimated grade is 3% V_2O_5 , 0.2 U_3O_8 .

S-W 16

Outcrop is 3 ft. long, 0.17 to 0.4 ft. in thickness. Estimated grade is 2% V_2O_5 , 0.1% U_3O_8 .

S-W 17

Ore is discontinuous over 105 ft.

S-W 17 (a). Outcrop is 12 ft. long, average thickness 0.5 ft.

S-W 17 (b) is 35 ft. long, 0.1 to 0.2 ft in thickness.

S-W 17 (c) is 8 ft. long, 0.5 ft. in average thickness.

Estimated grade of (a), 2½% V_2O_5 , 0.15% U_3O_8 ; (b) 2½% V_2O_5 , 0.1% U_3O_8 ; (c) 1½% V_2O_5 , 0.1% U_3O_8 . From S-W 17 SE., 150 ft. negligible and poorly exposed vanadiferous outcrop.

S-W 18

Outcrop is 33 ft. long, 0.5 to 3.0 ft. in thickness. Estimated grade averages 0.4 to 0.75% V_2O_5 for 26 ft. with trace of U_3O_8 , 2.5% V_2O_5 , 0.2% U_3O_8 for 7 ft.

S-W 19

Outcrop is 20 ft. long, 0.5 to 1.7 ft. in thickness.
Estimated grade is 1.5% V_2O_5 , 0.15% U_3O_8 .
Sample No. 1396: 0.75 ft., 0.03% U_3O_8 , 1.42% V_2O_5 .

S-W 20

Outcrop is 12 ft. long, 0.5 to 0.8 ft. in thickness. Estimated grade is 2% V_2O_5 , 0.15% U_3O_8 .

S-W 21

Outcrop is 62 ft. long, 0.3 to 1.0 ft. in thickness. Estimated grade is 1½% V_2O_5 , 0.15% U_3O_8 .

S-W 22

Outcrop is on a narrow point. On NE. side length of 19 ft., thickness is 0.5 to 0.7 ft. Estimated grade is 0.75% V_2O_5 , trace of U_3O_8 . On S. side, showing is discontinuous over 27 ft., 0.5 to 1.0 ft. in thickness. Estimated grade is 1 to 2% V_2O_5 , 0.1% U_3O_8 .

S-W 23

Outcrop is 28 ft. long, 0.5 to 2.5 ft. in thickness. Continuous seam averaging 1 ft. in thickness has estimated grade of 1-¾% V_2O_5 to 2½% V_2O_5 , 0.15% U_3O_8 . Remainder of mineralized zone, 18 ft. long discontinuous over entire length, estimated to run less than 1% V_2O_5 .

S-W 24

Outcrop is 9 ft. long, 0.5 to 0.7 ft. in thickness. Estimated grade is 0.7% V_2O_5 , 0.05% U_3O_8 .

S-W 25

Outcrop is 10 ft. long, 0.17 to 0.4 ft. in thickness. Estimated grade is 1½% V_2O_5 , 0.1% U_3O_8 .

S-W 26

Outcrop is 57 ft. in length, 0.5 to 1.0 ft. in thickness for 44 ft; 0.1 to 0.2 ft. for 13 ft. Estimated grade is 1½% V_2O_5 , 0.1% U_3O_8 .

S-W 27

Outcrop is 48 ft. long, 1 to 3 ft. in thickness. Sample No. 1393: 2.5 ft., 0.32% U_3O_8 , 3.55% V_2O_5 .

S-W 28

Outcrop is part of surface showing of VCA's North Star mine, at tunnel portal. Showing on SW. side of portal is 20 ft. in length, 0.1 to 0.2 ft. in thickness. Estimated grade is $2\frac{1}{2}\%$ V_2O_5 , 0.15% U_3O_8 . Showing on NE. side of portal is 22 ft. in length, 1 ft. in average thickness. Estimated grade is 3% V_2O_5 , 0.15% U_3O_8 .

S-W 29

Outcrop is at portal of the North Star mine. Showing on NE. side of portal is 23 ft. long, of which 16 ft. is 0.1 ft. thick or less, running less than 1% V_2O_5 , with trace of U_3O_8 (estimated); remaining 7 ft. length has thickness of 0.33 ft., estimated grade of 1% V_2O_5 , trace of U_3O_8 . No showing on SW side.

S-W 30

Consists of surface outcrops at portals of two small stopes. Between the two stopes there are two seams about 1 ft. apart. Lower seam, 2 ft. long, is 0.5 ft. in thickness; estimated grade $2\frac{1}{2}\%$ V_2O_5 , 0.2% U_3O_8 . Upper seam is 4 ft. long, 0.2 to 0.3 ft. in thickness; estimated grade is $3\frac{1}{2}\%$ V_2O_5 , 0.25% U_3O_8 . On NE. side of E. stope, outcrop is 9 ft. long, 1 to 2 ft. in thickness; estimated grade is $1\frac{1}{2}\%$ V_2O_5 , 0.15% U_3O_8 . North-easterly from the above showing, 18 and 28 ft. respectively, are two small vanadiferous seams; the first is 4 ft. in length, 0.5 to 1.0 ft. in thickness, estimated grade $1\frac{1}{2}\%$ V_2O_5 , 0.1% U_3O_8 ; the latter is 5 ft. long, 0.1 to 2.0 ft. thick, estimated grade 3% V_2O_5 , 0.15% U_3O_8 . Part of North Star mine workings.

S-W 31

Outcrop is 40 ft. in length, 0.17 to 0.33 ft. in thickness; estimated grade is $2\frac{1}{2}\%$ V_2O_5 , 0.2% U_3O_8 .

S-W 32

Outcrop is 43 ft. long, 0.1 to 0.2 ft. in thickness. Estimated grade is $2\frac{1}{2}\%$ V_2O_5 , 0.15% U_3O_8 .

SUMMARY AND CONCLUSIONS

Intermittent and limited mining operations since 1918 indicate the area has produced several thousand tons of uranium-vanadium ore. Accurate records are not available for estimates of past production and grade. At least two horizons of uranium-vanadium-bearing rock exist in the area. An inspection of the Salt Wash rims and of the mine workings has revealed many small ore deposits. The ore is in thin tabular

bodies, with a rare tendency to roll, and is associated with carbonaceous trash, erosion surfaces, and green mudstone. The main ore zones lie between 40 and 60 feet above the Salt Wash-Bluff contact.

It is reasonable to expect several of the deposits to extend into the zone behind the rim, and similar deposits not exposed on the rims to exist throughout much of the area. The apparent success with which sandstone units may be correlated on King Tutt Mesa immediately to the south of the area indicates that it may be possible to trace favorable zones with a drilling program and to locate ore bodies within these zones by a careful study of the first drill logs. Based on past production records and the number of ore showings, it is believed that a core drilling exploration program is justified.

DRILLING PROJECT

Water Supply

A year around supply of drilling water is available in the wash between King Tutt and Horse Mesa.

Depth of Holes

By superimposing a topographic map (pl. II) on a structural map of the area (pl. I), the average drill hole depth to the Bluff sandstone was calculated to be about 210 feet. This averaged depth would apply to the holes drilled for structural control, but would be approximately 40 feet less for the holes that penetrated only through the ore horizon. The minimum-maximum drill depth is 50 and 250 feet.

Type of Drilling Suggested

The greater percentage of drill holes would be too deep for wagon drilling, and the information necessary for correlation between holes can only be obtained from detailed core logs. It is suggested that the area be explored by core drilling.

Recommendations for Drilling Patterns

It is recommended that the area be drilled first on a wide spaced pattern of 1,000-foot centers to define favorable ground. The second phase would consist of a pattern of holes on 500-foot centers to locate and define ore bodies within the favorable ground.

A minimum footage of 24,000 feet and a maximum footage of 75,000 feet of core drilling is recommended in the Oak Springs area. The minimum footage is based on an average hole depth of 210 feet (top of Bluff) and the 1,000-foot centers. This minimum footage is further divided into 19,000 feet for the holes drilled on 1,000-foot centers and 5,000 feet for the offset holes that encounter ore. The maximum footage is the minimum (24,000 feet) plus 54,000 feet, which is based on a grid of 500-foot centers, with average drill hole depth of 175 feet (bottom of ore zone). Of this 54,000 feet of holes, 43,000 feet would be required for the 500-foot grid spacing and 11,000 feet for offsetting ore holes.

Drilling based on the maximum footage recommendation included in this report will be done only if the subsurface studies in progress in the area justify such expenditure. If the widespaced drilling fails to disclose any favorable zones, it is doubtful if work beyond the minimum is warranted.

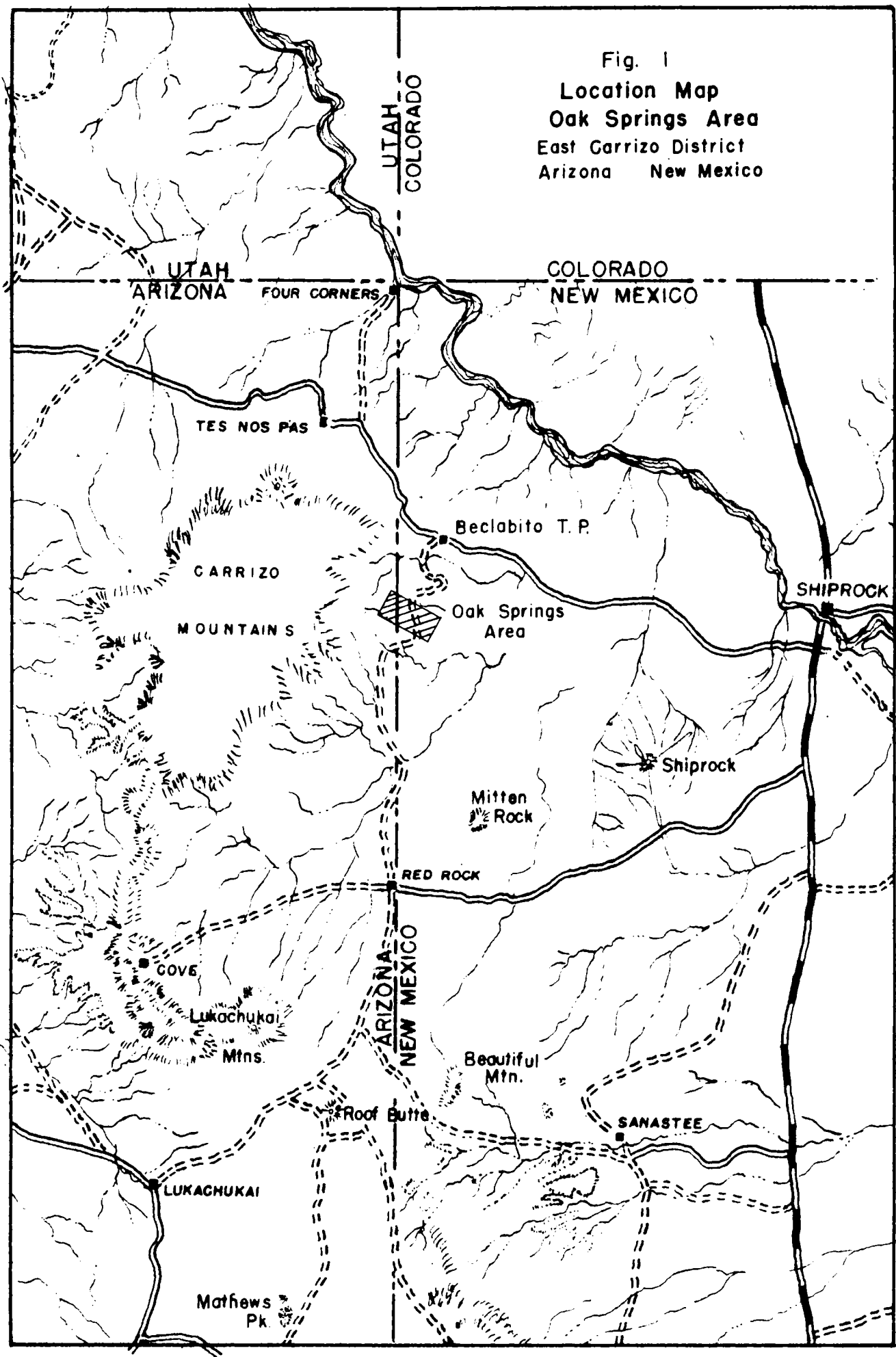
Road Building

Most of the area will be accessible with a minimum of bulldozer work. Little or no rock blasting will be required to build drill hole access roads.

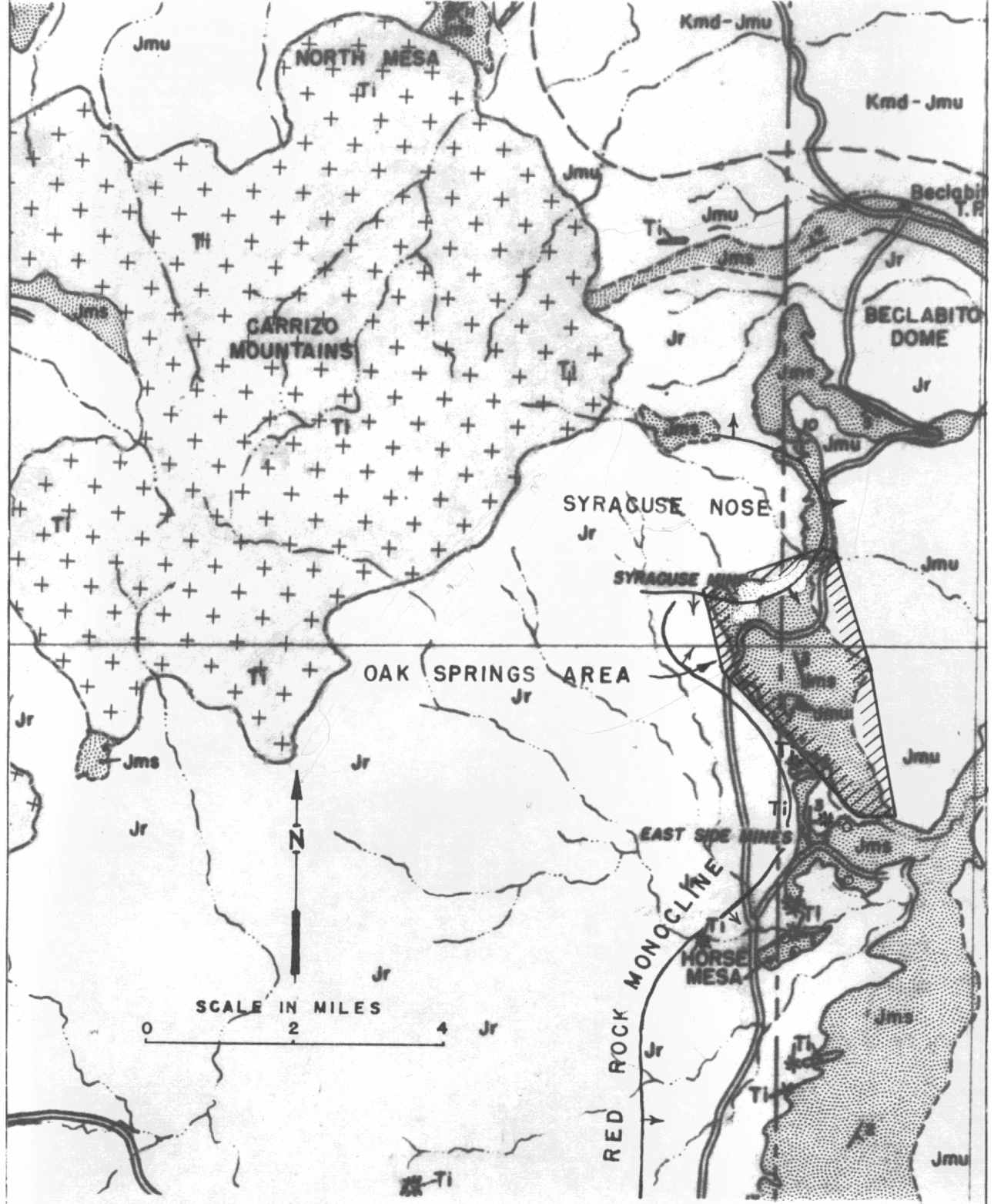
BIBLIOGRAPHY

- Coleman, A. H., Sept. 10, 1944, Report on the Geology and the Ore Deposits of the B'Cla B'toh District, Carrizo Uplift area, Arizona: Union Mines Development Corporation Report.
- Craig, L. C., and Freeman, H., 1951, Recommendations on Geologic Mapping and Exploration of the Morrison Formation in the Carrizo and Northern Chuska Mountains: U. S. Geol. Survey TEMR 209.
- Emery, W. B., October 1916, The Igneous Geology of Carrizo Mountain, Arizona: Am. Jour. Sci., vol. 42.
- Gregory, H. E., 1917, Geology of the Navajo Country: U. S. Geol. Survey Prof. Paper 93.
- Guidebook of the San Juan Basin, New Mexico and Colorado: New Mexico Geological Society, 1950.
- King, J. W., September 20, 1951, Geological Reconnaissance of King Tutt Mesa, East Carrizo District, Arizona-New Mexico: USAEC Grand Junction Exploration Branch, RMO-702 (unpublished).
- Stokes, W. L., May 1951, Carnotite Deposits in the Carrizo Mountains Area, Navajo Indian Reservation, Apache County, New Mexico: U. S. Geol. Survey Circ. 111.

Fig. 1
Location Map
Oak Springs Area
East Carrizo District
Arizona New Mexico



OAK SPRINGS AREA
 EAST CARRIZO DISTRICT ARIZONA - NEW MEXICO



- Ti - TERTIARY INTRUSIVES
- Jmu - UPPER MORRISON
- Jms - SALT WASH MEMBER
- Jr - SAN RAFAEL GROUP

Fig. 2

AFTER DUNCAN & STOKES
 U. S. ATOMIC ENERGY COMMISSION
 GRAND JUNCTION EXPLORATION BRANCH DIVISION OF RAW MATERIALS

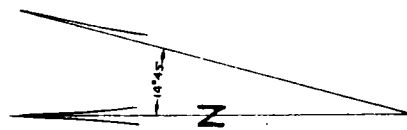
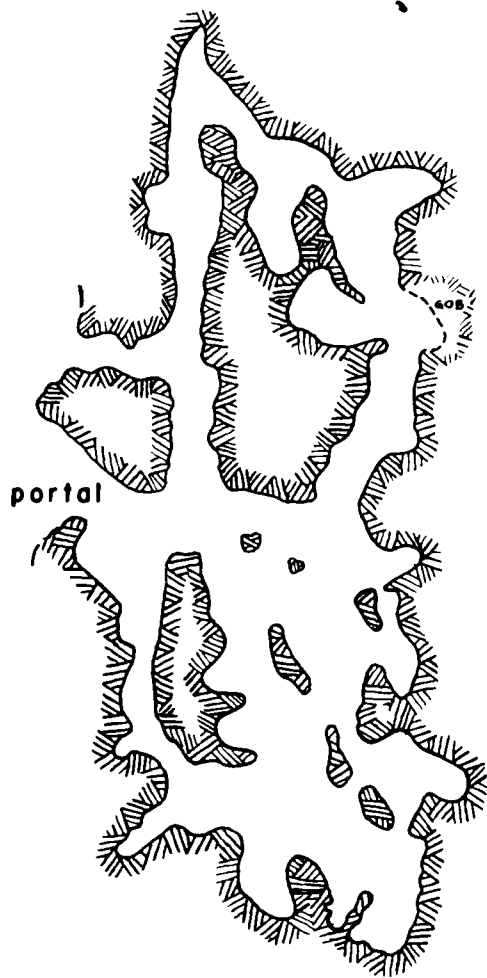


Fig. 3

U. S. ATOMIC ENERGY COMMISSION
GRAND JUNCTION EXPLORATION BRANCH DIVISION OF RAW MATERIALS

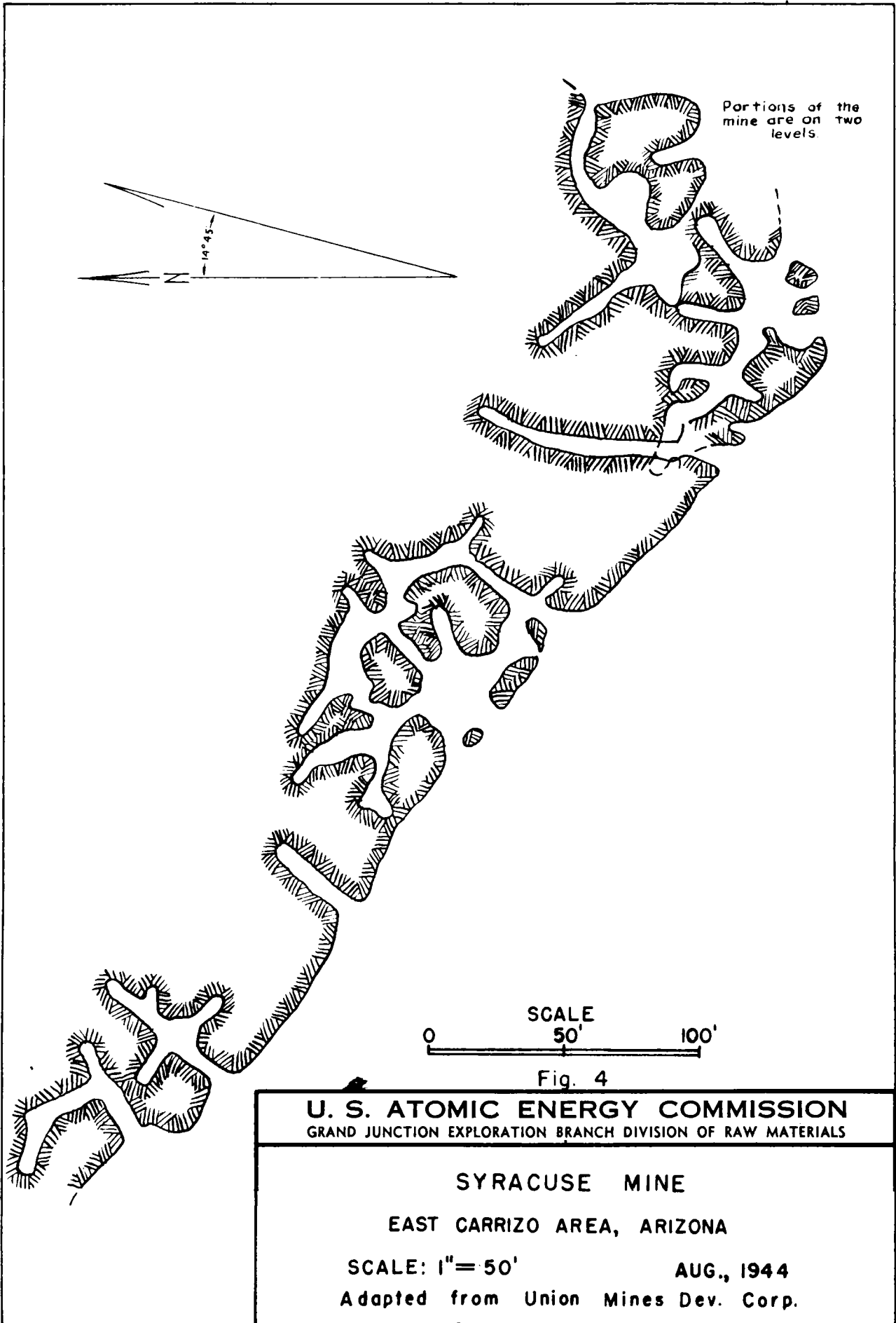
LONE STAR MINE

EAST CARRIZO AREA, ARIZONA

SCALE: 1" = 40'

2-12-52

Swanson and Hatfield



SECTION

MEASURED IN OAK CREEK CANYON BY
J. D. STROBELL AND L. C. CRAIG OF
THE U.S.G.S. IN SEPTEMBER OF 1949

VERTICAL SCALE: 1" = 30'

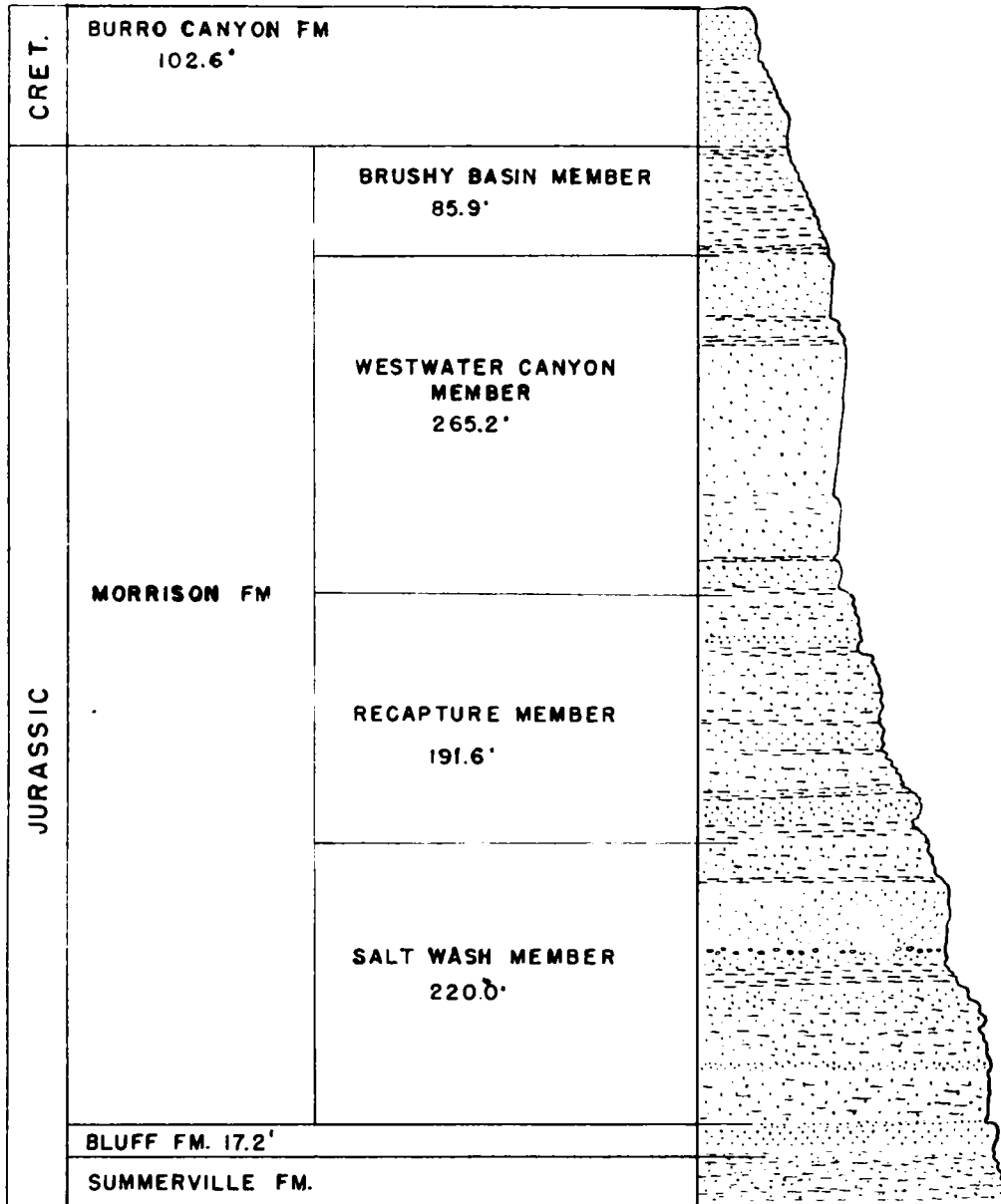
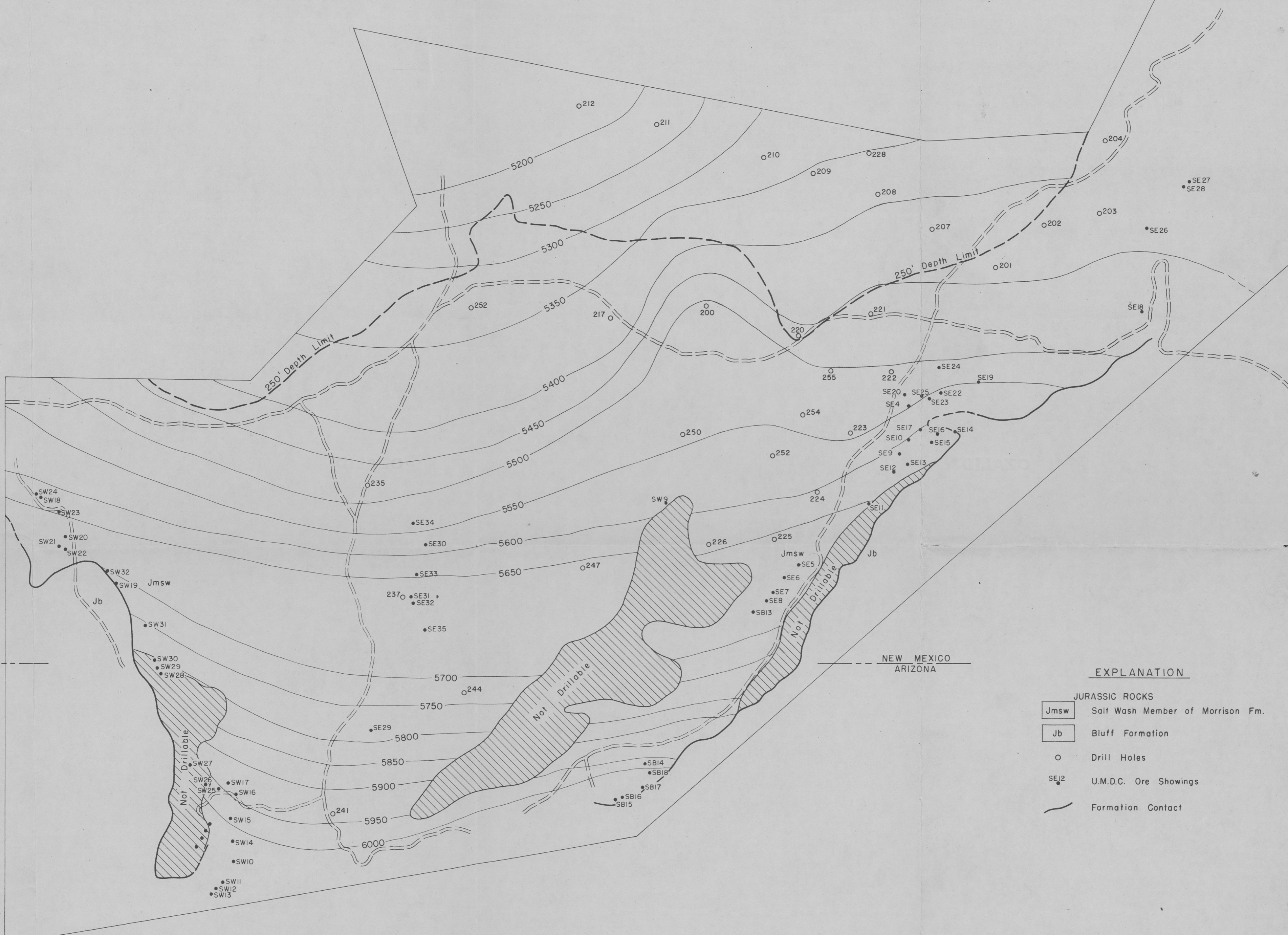
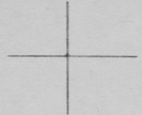


Fig. 5

109°00'

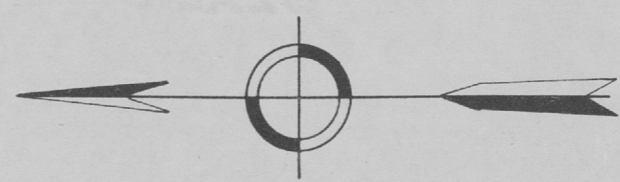
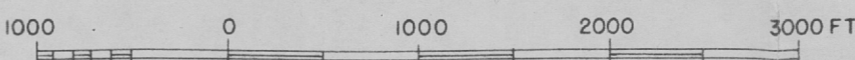


EXPLANATION

- JURASSIC ROCKS
- Jmsw Salt Wash Member of Morrison Fm.
- Jb Bluff Formation
- Drill Holes
- SE12 U.M.D.C. Ore Showings
- Formation Contact

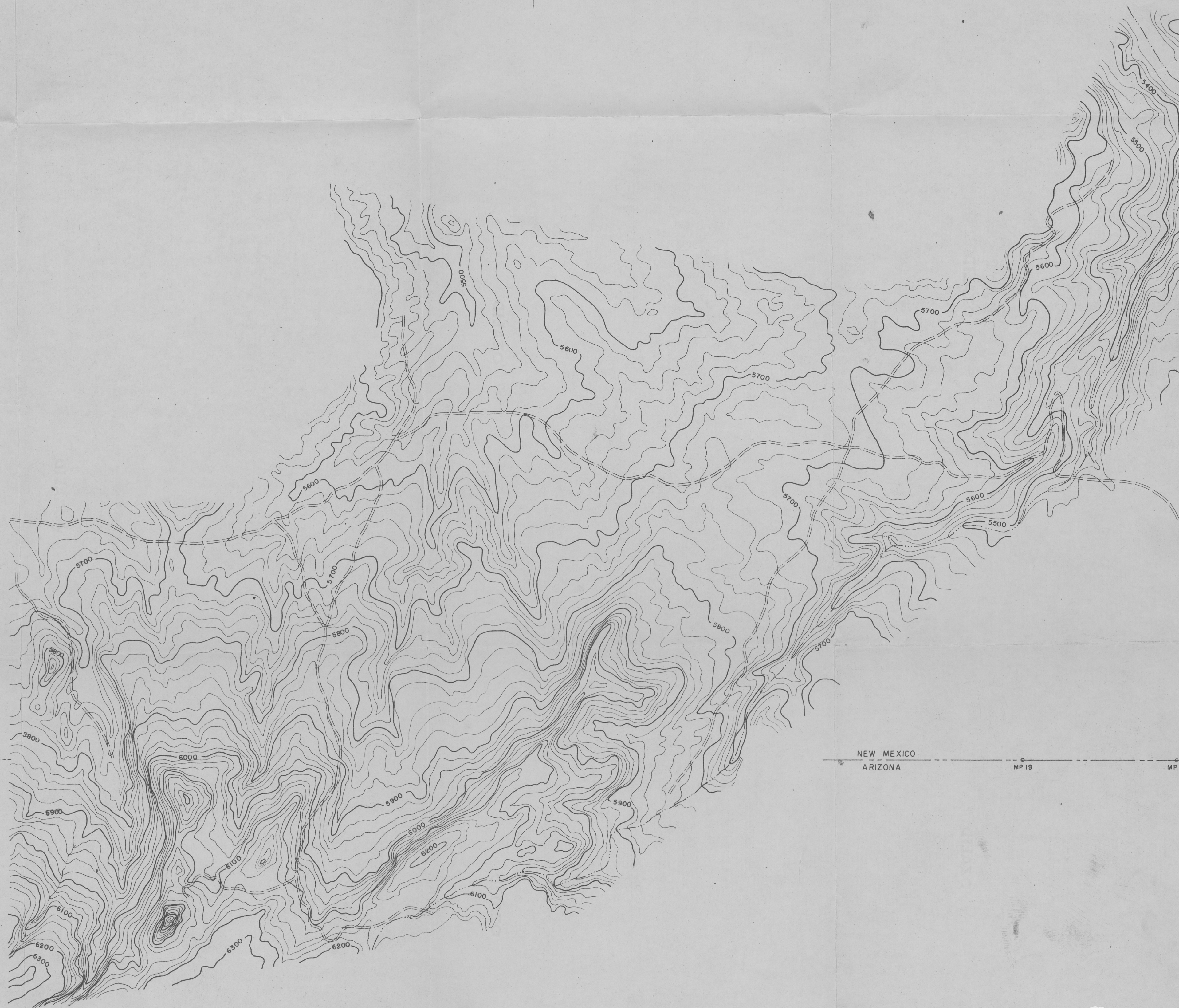
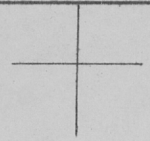
PLATE I

U. S. ATOMIC ENERGY COMMISSION		
GRAND JUNCTION EXPLORATION BRANCH DIVISION OF RAW MATERIALS		
STRUCTURE CONTOUR MAP ON TOP OF BLUFF SANDSTONE		
OAK SPRINGS AREA		
APACHE CO., ARIZONA - SAN JUAN CO., NEW MEXICO		
SCALE: 1" = 1000'	DATE: APRIL 1952	CONTOUR INTERVAL: 50'
TOPO. BY:	CHECKED:	ACCOMPANIES:
GEOLOG. BY:	CORRECT:	
DRAWN BY: M.A.S.	REVISED:	
TRACED BY: E.L.B.	APPROVED:	SHEET: FILE INDEX:



36°45'

109° 00'



NEW MEXICO
ARIZONA

MP 19

MP 19 1/2



1000 0 1000 2000 3000 FT.

36° 45'

PLATE II

U. S. ATOMIC ENERGY COMMISSION		
GRAND JUNCTION EXPLORATION BRANCH DIVISION OF RAW MATERIALS		
TOPOGRAPHIC MAP OF OAK SPRINGS AREA		
APACHE CO. ARIZONA - SAN JUAN CO. NEW MEXICO		
SCALE: 1" = 1000'	DATE: MAR. 1952	CONTOUR INTERVAL: 20'
TOPO. BY: J.W.S.	CHECKED:	ACCOMPANIES:
GEOL. BY:	CORRECT:	
DRAWN BY:	REVISED:	
TRACED BY: J.R.K.	APPROVED:	SHEET: FILE INDEX: