UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
FEDERAL CENTER, DENVER 25, COLORADO

IN REPLY REFER TO

RECEIVED
AUG - 9 1967
U. G. S.

August 8, 1967

Dr. William P. Hewitt, Director
Utah Geological and Mineralogical Survey
103 Utah Geological Survey Building
University of Utah
Salt Lake City, Utah 84112

Dear Bill:

Herewith are several copies of "Geologic Map and Sections of the Bituminous Sandstone Deposits in the P. R. Springs Area, Grand and Uintah Counties, Utah." Also enclosed is a map showing the status of our mapping program in the Kaiparowits area.

Bill Gere and I enjoyed our visit with you last week and your cooperation in publishing the Kaiparowits maps is appreciated.

Sincerely yours,

George H. Horn

George H. Horn
Regional Geologist

Enclosures

Brett - Interior 3787

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

For Release JANUARY 19, 1962

GEOLOGIC MAP RELEASED FOR PUBLIC INSPECTION

The Geological Survey is releasing in open files the following map:

Geologic map and sections of the bituminous sandstone deposits in the P. R. Springs area, Grand and Uintah Counties, Utah, by W. H. Whittier and R. C. Becker, one sheet.

The map includes about 30 square miles in Ts. 15, 15½, 16 S., Rs. 23 and 24 E. Ten stratigraphic sections are shown.

Copies are available for consultation at the following places: Geological Survey Library, 1033 GSA Building, Washington, D. C.; 468 New Customhouse, Denver, Colorado, and 504 Federal Building, Salt Lake City, Utah.

x x x

106119-62

August, 1966

OPEN FILE ON P.R. SPRING-ROAN CLIFFS, Grand County and So. Uintah County

Base Map of the Book Cliffs-PR Springs Area, Uintah and Grand Counties Utah	File 309D
Outcrops of Bituminous Sandstone in the PR Spring Area Scale 1"=1 mile	File 353D
Core Analysis Data from Petroleum Reservoir Engineering	File 366A
Core Analysis Data from Petroleum Reservoir Engineering	File 367A
Sheet 1 - Measured Sections 2,3,19, scale 1"=20 ft.	File 382D
Sheet 2 - Measured Sections 18,24,26, scale 1"=20 ft.	File 383D
Sheet 3 - Measured Sections 1,10,11,7, scale 1"=20 ft.	File 384D
Sheet 4 - Measured Sections 6,5,4, scale 1"=20 ft.	File 385D
Sheet 5 - Measured Sections 20,21, scale 1" =20 ft.	File 386D
Sheet 6 - Measured Sections 15,13,12, scale 1"=20 ft.	File 387D
Sheet 7 - Measured Sections 8,9, scale 1"=20 ft.	File 388D
Sheet 8 - Measured Sections 22,23,25, scale 1"=20 ft.	File 389D
Sheet 9 - Measured Sections 18, 17, scale 1"= 20 ft.	File 390D

10.1.2.6.0

July 28, 1966

Mr. Thomas A. Hendrickson
Cameron and Jones, Inc.
2150 South Bellaire
Denver 22, Colorado

Dear Mr. Hendrickson:

As per your request the following is a list of the open-file material we have on Bituminous Sandstone deposits of PR Spring-Roan Cliffs and Asphalt Ridge:

Bituminous Sandstone Deposits of PR Spring-Roan Cliffs,
Grand County and Southern Uintah County
Drawings:
382 D to 390 D Stratigraphic Sections
309 D Book Cliffs
353 D Geologic Map
366 A Analysis Sheet P.1
367 A Analysis Sheet P.2

Geology of the Bituminous Sandstone Deposits - Asphalt Ridge
Drawings:
333 G-Asphalt Ridge 1"=400' Map Series (1 thru 6)
337 A-Geologic Index Map
338 A-Structural Features
339 A-Generalized Geologic Section
340 D-Drill Hole & Core Hole Map
342 A-Reserve Calculation Map
343 B-Index Maps to Area of Study

Yours truly,

William P. Hewitt
Director, Utah Geological Survey

WPH:nn

W. P. H.

MAR 3 1 1966

SHELL OIL COMPANY

Post Office Box 1200
Farmington, New Mexico

March 30, 1966

Mr. William D. Byrd, Curator
Utah Geological and Mineralogical Survey
103 Civil Engineering Building
University of Utah
Salt Lake City, Utah 84112

Dear Mr. Byrd:

We wish to express our appreciation for your sending us the additional data to the PR Springs-Roan Cliffs open file material, it is precisely what we needed.

Thank you for your kind assistance in this matter.

Very truly yours,

ORIGINAL SIGNED BY
R. G. JOHNSON

R. G. Johnson
Geologist Assistant

RGJ:HLG

cc - Mr. William P. Hewitt - Director ← THIS COPY FOR [redacted]

~~10.1.2.6~~ 10.1.2.0
~~10.3.3.65~~
x-ref. ~~10.3.3.66~~
10.1.2.6

Letter of February 8, 1966 mailed to Max C. Gardner, Director, Utah State Land Board, delivering complete set of open file maps covering geologic conditions on Asphalt Ridge and on P.R. Springs.

Asphalt Ridge

Map File Nos.

337-A
338-A
339-A
340-D
341-E
333-G-1
3336-2
3336-3
3336-4
3336-5
3336-6

P.R. Springs

353-D
359-D-1
359-D-2
359-D-3
359-D-4
359-D-5
359-D-6
359-D-7

COPY

Same letter to: Oil and Gas Journal, Independent Petroleum Monthly, Petroleum Information, Rinehart Oil News, Rocks and Minerals, Pacific States & Rocky Mountain Oil Reporter, The Tyro Reporter, Engineering and Mining Journal, The Mines Magazine, Utah Oil Report, Utah Mining Association, Salt Lake Tribune IAG Newsletter (c/o Bill Skeeters, Mtn. Fuel Supply)

February 4, 1966

Oil and Gas Journal
Editor
Box 1260
Tulsa, Oklahoma

Dear Sir:

As described on the attached sheet, the Utah Geological and Mineralogical Survey announces the open filing of material relating to asphaltic sandstone both on Asphalt Ridge and in P.R. Springs in the Uinta Basin in northeastern Utah.

The attached sheet also announces the publication of Circular 48, a Consolidated Index to all the oil well samples that have been received in the Survey's library for geologic research since 1951.

Whatever publicity you can give these items will be appreciated.

Yours truly,

William P. Hewitt
Director

WPH:nn
Enc.

THE UTAH GEOLOGICAL AND MINERALOGICAL SURVEY announces that the following reports have been open-filed pending publication.

Geology of the Bituminous Sandstone Deposits of Asphalt Ridge:

Asphalt Ridge is a prominent northwest-southeast-trending hogback in Uintah County, Utah, separating Ashley Valley on the northeast from the Uinta Basin on the southwest. It is located in Tps. 4-5 S., R. 21 E., and Tps. 5-6 S., R. 2 E. Asphalt Ridge was mapped to determine the surface extent, thickness and degree of saturation of the bituminous sands.

4 GEOLOGIC MAP SHEETS, each on a scale of 1 in. = 400 feet, each 30 in. long x 36 in. wide.
1 LEGEND SHEET, 22 in. x 36 in.
1 DRY-HOLE CORE-HOLE MAP, scale approximately 1 in. = 0.6 mile, 19½ in. long x 30 in. wide.
5 GEOLOGIC CROSS-SECTIONS, each on a scale of 1 in. = 1,500 feet, combined on a single sheet, 23½ in. long x 29½ in. wide

P R Spring-Roan Cliffs, Grand and southern Uintah Counties, Utah:

The Utah Geological Survey has undertaken the mapping of the bituminous saturation in sandstones which crop out on land recently acquired by the State of Utah from the U. S. Government in the Roan Cliffs area of east central Utah. The sandstones belong to the Parachute Creek Member of the Green River Formation (Tertiary age). The following map and sections are the result of field work accomplished during the summer of 1965.

1 GEOLOGIC MAP, 1 in. = 1 mile, 18½ in. long x 28½ in. wide.
26 MEASURED SECTIONS, each on a scale of 1 in. = 20 feet, combined on 9 sheets that are each 30 in. long x 15 in. wide.
1 LEGEND SHEET, 8½ in. x 11 in.

The transparencies listed above cannot be released but are available for inspection at the Utah Geological Survey office (103 Civil Engineering Building, University of Utah, Salt Lake City, Utah) or copies may be purchased at $10.00 for each set.

THE UTAH GEOLOGICAL AND MINERALOGICAL SURVEY announces the following new publication.

Circular 48 - Library of Samples for Geologic Research, Consolidated Index, 1951-1965. Price 50¢.

The Utah Geological Survey
Dr. William P. Hewitt, Director
February 3, 1966

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The Utah Geological Survey
Dr. William P. Hewitt, Director
February 3, 1966

Core Laboratories, Inc.

Petroleum Reservoir Engineering

Denver, Colorado

Company State of Utah Geological Survey County Uintah-Grand

Well Outcrop Samples State Utah

Location PR Springs-Uintah County Elevation

Core Analysis Data

Sample Number	*Depth Feet	Permeability Millidarcys		Porosity Per Cent	Residual Liquid Saturation				Oil
					Oil			Total Water	
		Before Ext.	After Ext.		Per Cent Volume	Per Cent Pore	Per Cent by weight	Per Cent Pore	Gal. Per Ton
1.	3		955	31.7		18.6		1.9	7.0
2.	4-L	2578	5700	32.5	6.4	19.7	3.3	1.5	8.4
3.	4-M		1210	31.0		27.4		1.9	10.6
4.	4-U	1690	1720	33.6	0.9	2.7	0.5	1.2	1.2
5.	5-6L		3180	28.8		9.7		1.4	3.6
6.	5-7M		1655	29.9		23.1		2.7	8.6
7.	5-8U	10	3120	36.7	23.2	63.2	11.7	2.5	29.6
8.	6-2M	218	952	31.5	9.8	31.1	4.9	2.9	12.5
9.	6-7U	98	578	31.0	11.3	37.7	6.3	1.3	15.8
10.	7-2L		2610	33.2		53.3		3.0	21.6
11.	7-3		Frac Plug	35.1		11.1		1.4	5.3
12.	7-6		930	30.5		15.7		2.0	6.2
13.	7-8	13	Frac Plug	29.5	12.4	42.0	6.0	3.4	15.1
14.	7-10U	15	1425	29.0	10.6	36.6	5.1	2.7	13.0
15.	10-4U		Frac Plug	31.0		15.8		1.6	6.5
16.	11-3L		0.01	7.1		0.0		7.0	0.0
17.	11-6		0.07	16.0		54.3		4.4	9.4
18.	11-7M	0.8	132	27.3	14.7	53.9	6.8	3.7	17.3
19.	11-9		918	24.7		38.1		3.6	10.6
20.	11-10		79	24.7		12.6		4.0	3.8

Core Laboratories, Inc.

Petroleum Reservoir Engineering

Denver, Colorado

Company State of Utah Geological Survey County Uintah-Grand

Well Outcrop Samples State Utah

Location Elevation

Core Analysis Data

Sample Number	*Depth Feet	Permeability Millidarcys Before Ext.	Permeability Millidarcys After Ext.	Porosity Per Cent	Residual Liquid Saturation Per Cent Volume	Residual Liquid Saturation Per Cent Pore	Oil Per Cent by weight	Total Water Per Cent Pore	Oil Gal. Per Ton
21.	11-11U	2.7	2244	31.6	24.2	76.7	11.0	1.9	27.8
22.	12-1L		2980	28.9		48.1		3.5	17.0
23.	12-3 M		2318	23.8		29.4		3.8	7.9
24.	12-5 U		128	28.8		10.1		3.5	3.8
25.	15-L		928	24.6		35.8		2.4	10.6
26.	15-U		10	21.5		17.2		4.6	4.3
27.	16		990	28.1		31.6		1.5	9.8
28.	17-L		Frac Plug	29.7		22.9		0.7	8.6
29.	17-U		356	24.9		32.1		2.8	8.9
30.	21	86	690	25.7	3.5	13.6	1.7	2.3	4.3
31.	23-U	69	155	25.3	7.6	30.0	3.5	3.2	8.9
32.	24-1 L	186	215	24.3	2.6	10.7	1.2	0.8	3.1
33.	24-4 U		662	27.0		18.9		3.0	6.2

*The first number in Depth column is the stratigraphic section number.

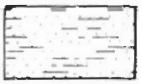
The second number is the sample number in that section, and L, M, U refer to the lower, middle, and upper zones of saturations within that section.

EXPLANATION

LITHOLOGY

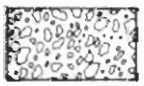

Sandstone

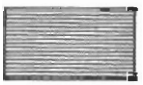

Shale


Siltstone


Mudstone


Limestone


Conglomerate


Oil shale


Algal limestone

PETROLIFEROUS SATURATION

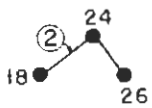

Weak


Moderate


Rich

TITLE INFORMATION

Measured Section



Sheet 2 with measured sections 18, 24, 26

Heavy connecting lines denote measured sections on subject sheet

———— Road

Sections measured by W D Byrd
Assisted by H S. Suekawa

File No: 359 D-10

24

SECTION 24. East side of canyon east of wire fence airstrip on north end El. at top of section - 7290 feet NE NE S2Z-T15S-R21E

30' Sandstone; light gray, weathers light brown, massive, medium grained, micaceous, calcareous, limonite staining, poorly sorted.

4' Sandstone; light yellowish-brown, weathers reddish-brown, flaggy, fine grained, micaceous, limonite staining, calcareous.

29' Shale; brown, thin bedded slightly calcareous.

6' Oil shale; black, thin bedded.

17' Siltstone; light greenish-gray, weathers medium brown; many interbeds of fine grained, thin bedded sandstone.

65' Sandstone; light green, weathers light reddish-brown, cross-bedded, massive, very fine grained, limonite staining, calcareous, becomes fine grained toward top of unit; weak saturation 62 feet from base.

74' Mudstone; light greenish-gray, very slightly calcareous, thin bedded, mostly covered, becomes shaley 2 feet from base; 1 foot oil shale 15 feet from base; 4 foot sandstone lense 27 feet from base.

4' Oolitic limestone; medium gray, conglomeratic near top.

5' Sandstone; light yellowish-brown, medium bedded, very fine grained, very calcareous, fairly porous.

25' Sandstone; light to medium gray, cross-bedded, fine grained, micaceous, calcareous, porous, weakly saturated.

18

SECTION 18. West side of Cedar Camp Ridge two miles northwest of Cedar Camp El. top of section - 7320 feet SE NE S16-T16S-R22E

5' Sandstone; light brown, flaggy, very fine grained, calcareous, tight.

9' Siltstone; light green, weathers light brown, very thin bedded, calcareous.

4' Sandstone; light brown, cross-bedded, medium grained, very calcareous.

8' Shale; brown, thin bedded, calcareous.

15' Sandstone; light redish-brown, cross-bedded, flaggy to massive, micaceous, slightly calcareous, very porous.

39' Shale; light green, thin bedded, calcareous, 3 feet of oil shale 35 feet from base; unit partly covered.

45' Sandstone; light brown, cross-bedded and massive, fine to medium grained, with limonite blebs.

7200'

12' Mudstone; green, thick bedded; 1 foot sandstone 6 feet from base.

48' Shale; green, thin bedded; 1 foot oolitic limestone 1 foot from base; 6 feet of oil shale 8 feet from base.

2' Algal limestone; whitish-orange.

8' Sandstone; light yellowish-brown, flaggy, calcareous.

3' Siltstone; light gray, slightly calcareous.

16' Shale; light green, thin bedded, calcareous, 1 foot oil shale 4 feet from base; 2 foot oil shale 14 feet from base.

8' Algal limestone; whitish- orange.

9' Mudstone; green, thick bedded, very calcareous.

26

SECTION 26. Southwest side of Winter Ridge SE SE S35-T15 1/2 S-R22E

8' Sandstone; light brown, cross-bedded and massive.

30' Shale; brown, thin bedded.

7' Oil shale; black to gray, very thin bedded.

15' Shale; brown, thin bedded.

71' Sandstone; light brownish-gray, massive and cross-bedded, weakly saturated.

12' Sandstone; light brown, massive and cross-bedded.

44' Shale; green, thin bedded.

1' Oolitic sandstone, white to orange.

2' Shale; light green, thin bedded.

46' Sandstone; light brown, cross-bedded and massive.

24' Sandstone; light brown to gray, massive and cross-bedded, weak to moderately saturated.

7000'

14' Shale; green, thin bedded.

7' Sandstone; light brownish-gray, cross-bedded, weak to moderately saturated.

3' Sandstone; light brown, cross-bedded.

4' Sandstone; gray, massive, weakly to moderately saturated.

1' Conglomerate; calcareous matrix.

17' Shale; green, thin bedded.

15' Sandstone; light brownish-gray, massive and cross-bedded, weakly saturated.

8' Sandstone; light brown, massive and cross-bedded, porous.

5' Sandstone; light brownish-gray, irregularly saturated.

17' Shale; light green, thin bedded, slightly calcareous.

8' Sandstone; light brownish-gray, massive and cross-bedded, slightly calcareous, weakly saturated.

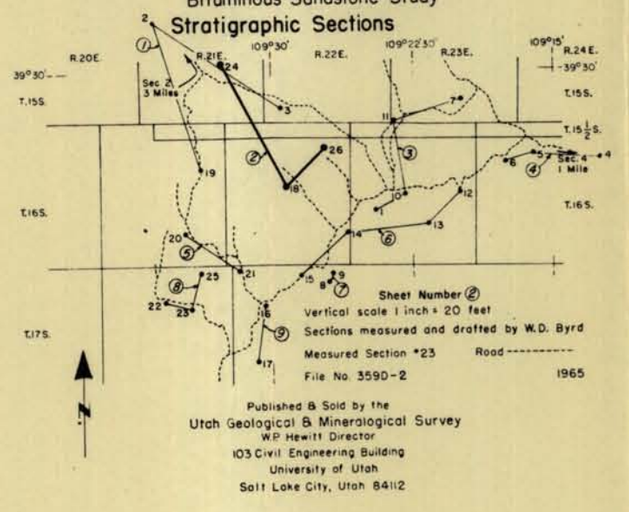
4' Interbedded sandstone and shales.

16' Sandstone; light brownish-gray, massive and cross-bedded, slightly calcareous; weakly saturated.

9' Sandstone; light brown, medium bedded, highly porous.

10' Sandstone; light brownish-gray, massive and cross-bedded, fine grained, weakly saturated.

ROAN CLIFF-PR SPRING AREA
Uintah & Grand Counties, Utah
Bituminous Sandstone Study
Stratigraphic Sections



Published & Sold by the
Utah Geological & Mineralogical Survey
W.P. Hewitt Director
103 Civil Engineering Building
University of Utah
Salt Lake City, Utah 84112

SHEET 2

Fig. 4

19

SECTION 19. Moon Ridge road to Holt's Ranch on east side of canyon
El at top of section = 7510 feet
SW NW S12-T16S-R21E

7500'

27' Sandstone; light yellowish-brown, cross-bedded, fine grained, micaceous, limonite staining, calcareous.

23' Mudstone; light gray, thin bedded, silty at base, calcareous;
1 foot oil shale 2 feet from base;
1 foot oil shale 65 feet from base;
1 foot oil shale 80 feet from base;
1 foot oil shale 90 feet from base;
1 foot oil shale 120 feet from base;
1 foot oil shale 164 feet from base;

31' Sandstone; light yellowish-brown, cross-bedded and massive, fine to medium grained, calcareous, ripple marks; 1 foot bed of very tight conglomerate 10 feet from base.

24' Mudstone; green, medium bedded, calcareous.

7200'

30' Shale; green, thin bedded, calcareous; 1 foot oil shale 2 feet from base; 3 foot oil shale 4 feet from base.

83' Sandstone; light brown, cross-bedded and massive, fine grained, calcareous; unit becomes medium to course grained 15 feet from base.

17' Shale; green, thin bedded, calcareous; 1 foot oil shale 2 feet from base.

5' Mudstone; green, medium bedded, calcareous; 1 foot oil shale 1 foot from base.

1' Algal limestone; white.

20' Sandstone; light gray to brown, cross-bedded and massive, very fine to fine grained, calcareous.

7' Siltstone; light gray, thin bedded, calcareous.

1' Algal limestone; light brown.

3' Shale; green, thin bedded.

Oil shale; black, very thin bedded.

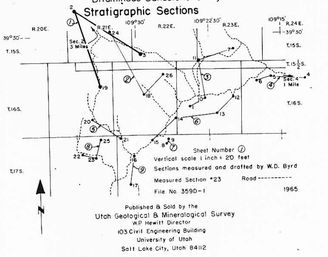
4' Shale; green, thin bedded.

Oil shale; black, very thin bedded.

Algal limestone; white

2' Oil shale; black, very thin bedded.

ROAN CLIFF-PR SPRING AREA
Uintah & Grand Counties, Utah
Bituminous Sandstone Study
Stratigraphic Sections



Published & Sold by the
Utah Geological & Mineralogical Survey
A.R. Hewitt Director
103 Civil Engineering Building
University of Utah
Salt Lake City, Utah 84112

SHEET 1

3

SECTION 3. Trapper Spring - Winter Ridge - south side of slope.
El. top of section = 6550 feet
SW NE S31-T15S-R22E

5' Sandstone; light brown with patches of red, fine grained, subangular, micaceous, iron staining, calcareous, and porous. Slightly stained.

42' Shale; light gray to brown, thin bedded.

6500'

10' Oil shale; weakly saturated at bottom grading to rich at top.

5' Shale; light gray to brown, with algal bed.

19' Covered; unit probably barren sandstone.

55' Sandstone; light brown, cross-bedded, very weak saturation in last 12 feet of unit. Unit partly covered.

2

SECTION 2. Three miles northwest of Horse Point airstrip.
NWSE S5-T 15S- R 21E.
El. top of section = 6380 feet

31' Sandstone; light brown with patches of red, cross-bedded, fine grained, subangular, iron staining, calcareous, and porous.

10' Sandstone; light brown, fine grained, subangular, micaceous, iron staining, calcareous, medium porosity; with interbedded shales.

22' Sandstone; light brown, cross-bedded, fine grained, subangular, micaceous, feldspars, iron staining, calcareous, highly porous. The upper 6 feet is weakly saturated.

8' Shale; gray, weathers light brown, thin to medium bedded, iron staining.

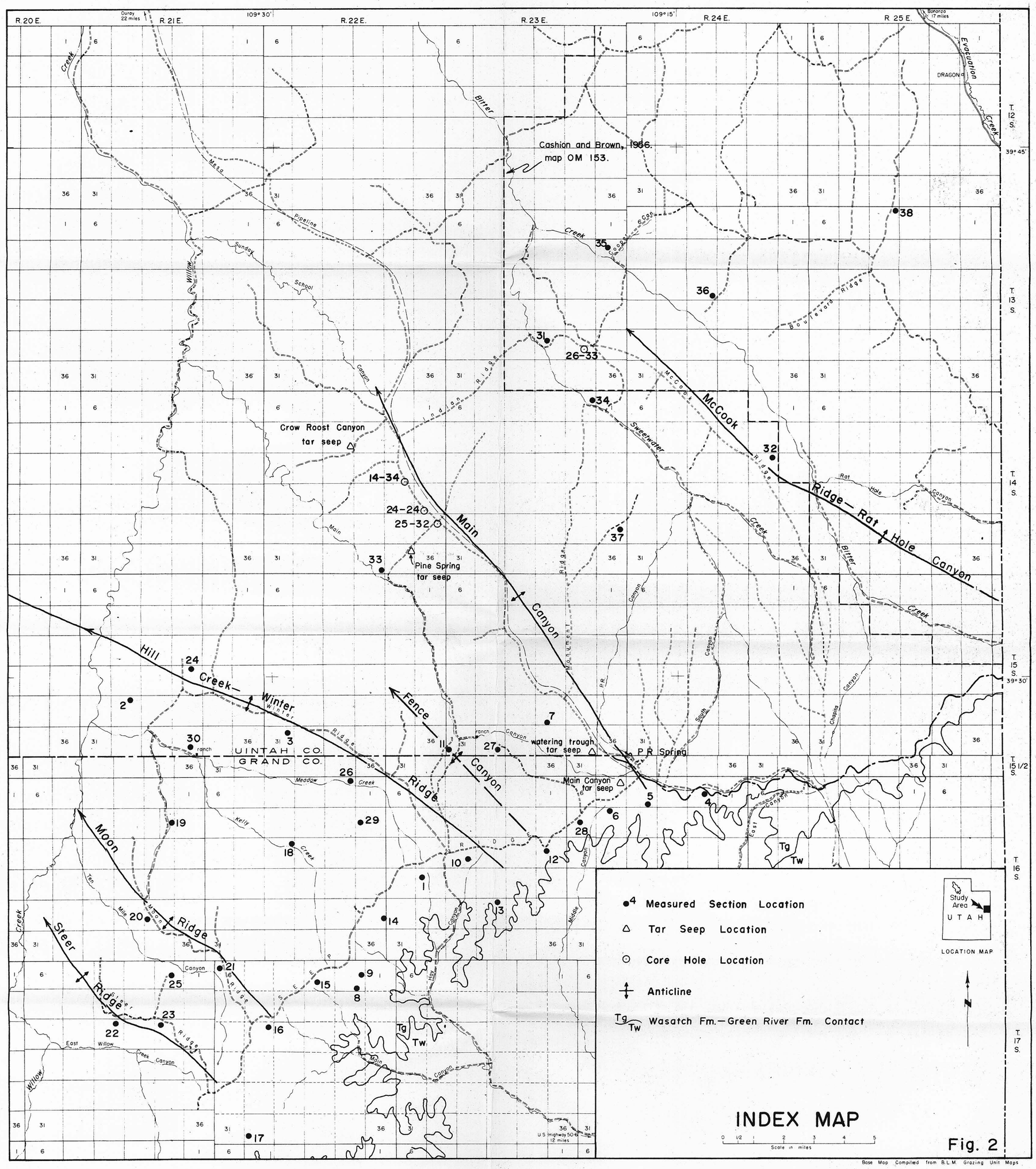
13' Oil shale; weathers chalky-white, thin bedded

1' Conglomerate; light yellow to white, with algal structures.

6300'

72' Sandstone; light brown, cross-bedded, fine grained, angular to subangular grains, micaceous, feldspars, iron stained, calcareous, highly porous.

Fig. 3


R. 20 E.
R. 21 E.
R. 22 E.
R. 23 E.
R. 24 E.
R. 25 E.
109° 30'
109° 15'
39° 45'
39° 30'
Ouray 22 miles
Bonanza 17 miles
T. 12 S.
T. 13 S.
T. 14 S.
T. 15 S.
T. 15 1/2 S.
T. 16 S.
T. 17 S.
Cashion and Brown, 1966. map OM 153.
Crow Roost Canyon tar seep
Pine Spring tar seep
watering trough tar seep
Main Canyon tar seep
P R Spring
UINTAH CO.
GRAND CO.
McCook Ridge
Ridge – Rat Hole Canyon
Hill Creek – Winter Ridge
Fence Canyon
Moon Ridge
Steer Ridge
Main Canyon
Sweetwater Ridge
Boulevard Ridge
Sunday School Canyon
Pipeline Mesa
Willow Creek
Bitter Creek
Evacuation Creek
Meadow Creek
Kelly Creek
Tg
Tw
Measured Section Location
Tar Seep Location
Core Hole Location
Anticline
Wasatch Fm. – Green River Fm. Contact
Study Area
UTAH
LOCATION MAP
INDEX MAP
Scale in miles
Fig. 2
Base Map Compiled from B.L.M. Grazing Unit Maps

S

N

SECTION 9
SE ¼ NE ¼ Sec. 2, T. 17S., R. 22E.

SECTION 14
NE ¼ SE ¼ Sec. 25, T. 16S., R. 22E.

SECTION 29
SW ¼ Sec. 12, T. 16S., R. 22E.

SECTION 26
NE ¼ NE ¼ Sec. 2, T. 16S., R. 22E.

SECTION 33
SE ¼ SE ¼ Sec. 34, T. 14S., R. 22E.

SECTION 31
SE ¼ NW ¼ Sec. 27, T. 13S., R. 23E.

SECTION 35
C Sec. 12, T. 13S., R. 23E.

DATUM

7 miles

9.4 miles

saturation

Vertical scale in feet
30
20
10
5

0 ½ 1 2 3
Horizontal scale in miles

CORRELATION OF MEASURED SECTIONS
NORTH-SOUTH LINE
Uintah and Grand Counties, Utah
by
William D. Byrd
1967

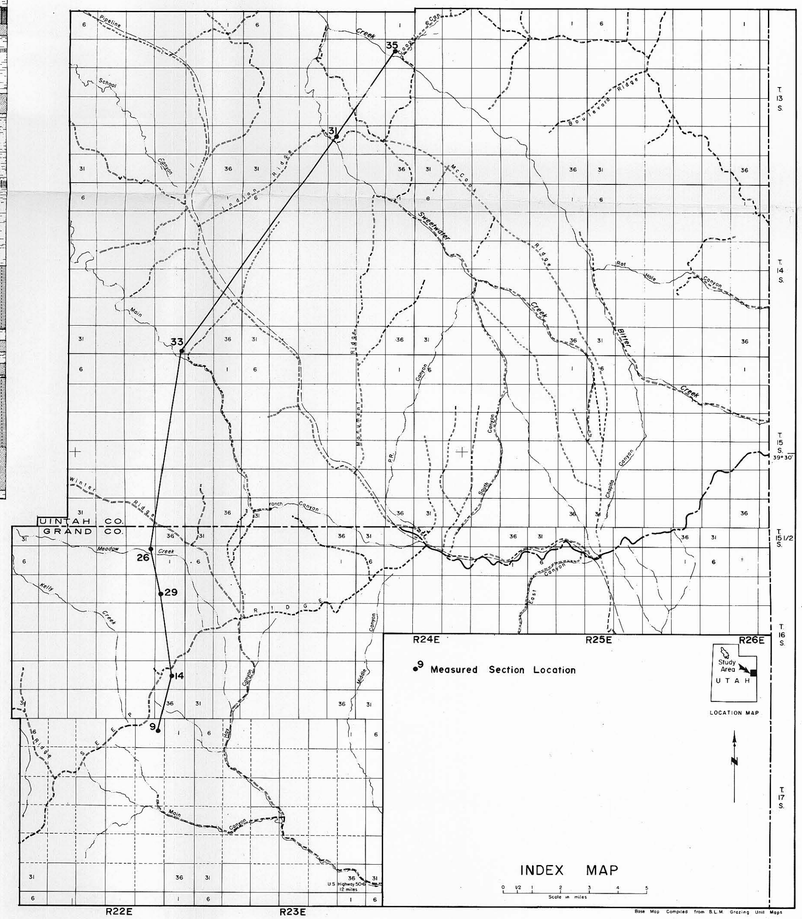
EXPLANATION

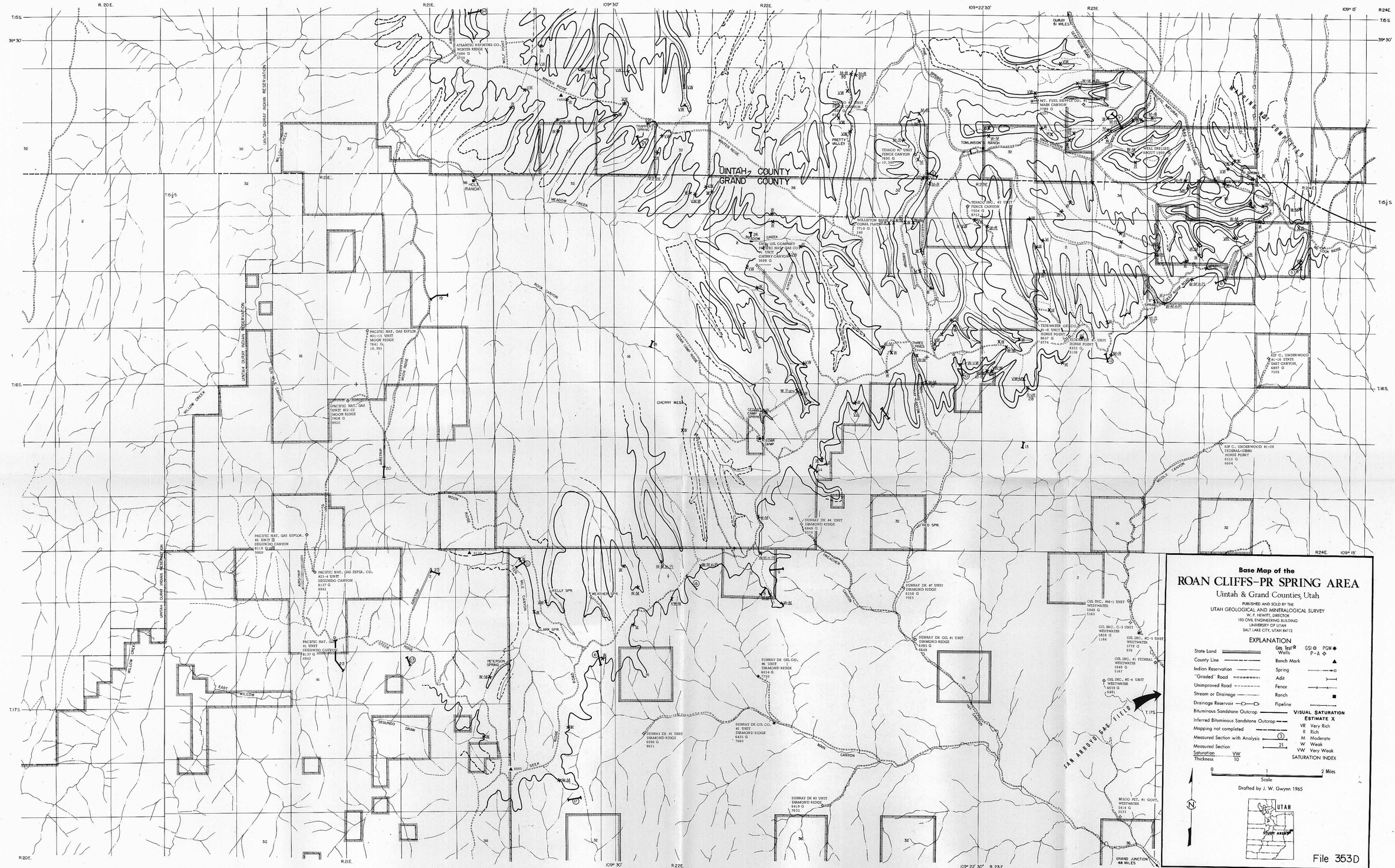
LITHOLOGY

- Sandstone
- Shale
- Siltstone
- Mudstone
- Limestone
- Conglomerate
- Oil Shale
- Algal limestone

BITUMINOUS SATURATION

- Weak
- Moderate
- Rich





Base compiled from Soil Conservation Service mosaics and survey plats.
FIELD WORK by J. W. GWYNN & W. D. BYRD – SUMMER 1965
ASSISTED by H. SUEKAWA & Wm WHITE

OUTCROPS OF BITUMINOUS SANDSTONE IN THE PR SPRING AREA

Base Map of the

ROAN CLIFFS–PR SPRING AREA

Uintah & Grand Counties, Utah

PUBLISHED AND SOLD BY THE
UTAH GEOLOGICAL AND MINERALOGICAL SURVEY
W. P. HEWITT, DIRECTOR
103 CIVIL ENGINEERING BUILDING
UNIVERSITY OF UTAH
SALT LAKE CITY, UTAH 84112

EXPLANATION

State Land	Gas Test Wells ☆	GSI ☆	PGW ✱
County Line	Bench Mark	P-A ✧	▲
Indian Reservation	Spring		
"Graded" Road	Adit		
Unimproved Road	Fence		
Stream or Drainage	Ranch		■
Drainage Reservoir	Pipeline		
Bituminous Sandstone Outcrop	**VISUAL SATURATION ESTIMATE X**		
Inferred Bituminous Sandstone Outcrop	VR Very Rich		
Mapping not completed	R Rich		
Measured Section with Analysis ③	M Moderate		
Measured Section 21	W Weak		
Saturation VW	VW Very Weak		
Thickness 10	SATURATION INDEX		

0 1 2 Miles
Scale

Drafted by J. W. Gwynn 1965

File 353D

☆ GSI – Gas Shut in , PGW – Producing Gas Well , P–A – Plugged & Abandoned

W

E

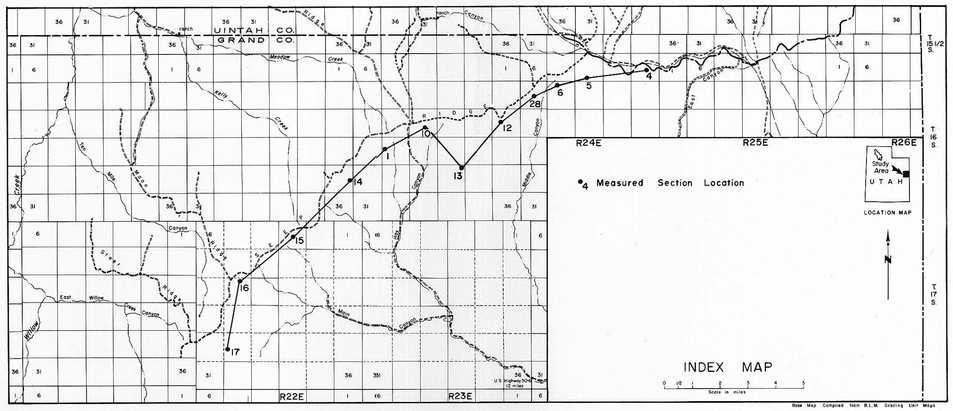
EXPLANATION

LITHOLOGY

- Sandstone
- Shale
- Siltstone
- Mudstone
- Limestone
- Conglomerate
- Oil Shale
- Algal limestone

BITUMINOUS SATURATION

- Weak
- Moderate
- Rich



SECTION 17
NW ¼ SW ¼ Sec. 29, T. 17S., R. 22E.

SECTION 16
NW ¼ NE ¼ Sec. 17, T. 17S., R. 22E.

SECTION 15
NE ¼ SW ¼ Sec. 3, T. 17S., R. 22E.

SECTION 14
NE ¼ SE ¼ Sec. 25, T. 16S., R. 22E.

SECTION 1
SW ¼ NW ¼ Sec. 20, T. 16S., R. 23E.

SECTION 10
NW ¼ SE ¼ Sec. 16, T. 16S., R. 23E.

SECTION 13
NE ¼ NE ¼ Sec. 27, T. 16S., R. 23E.

SECTIION 12
SE ¼ NW ¼ Sec. 12, T. 16S., R. 23E.

SECTION 28
SW ¼ NE ¼ Sec. 7, T. 16S., R. 24E.

SECTION 6
NE ¼ NW ¼ Sec. 8, T. 16S., R. 24E.

SECTION 5
SW ¼ SE ¼ Sec. 4, T. 16S., R. 24E.

SECTION 4
SW ¼ NE ¼
Sec. 2, T. 16S., R. 24E.

DATUM

DATUM

DATUM

vertical scale in feet: 30, 20, 10, 5

horizontal scale in miles: 0, 1/2, 1, 2, 3

CORRELATION OF MEASURED SECTIONS

SEEP RIDGE-ROAN CLIFFS

Grand County, Utah

by

William D. Byrd

1967

R. 20 E. | R. 21 E. | R. 22 E. | R. 23 E. | R. 24 E. | R. 25 E.

109° 30' | 109° 15'

39° 45' | 39° 30'

T. 12 S. | T. 13 S. | T. 14 S. | T. 15 S. | T. 15 1/2 S. | T. 16 S. | T. 17 S.

Ouray 22 miles

Bononza 17 miles

DRAGON

Saturated outcrop

Saturated outcrop

Saturated outcrop

250 of overburden

Evacuation Creek

Bitter Creek

Mesa

Pipeline

Sunday School

Willow Creek

Canyon

Ridge

Lyman Ridge

Boulevard Ridge

McCook Ridge

Sweetwater Ridge

Rat Hole Canyon

Main Canyon

Monument Ridge

P.R. Canyon

South Chapita Canyon

Ranch Canyon

Meadow Creek

Kelly Creek

Ten Mile Creek

Moon Canyon

Middle Canyon

Hay Canyon

Sleeper Ridge

East Willow Creek Canyon

Willow Creek

PR Spring

UINTAH CO.

GRAND CO.

U S Highway 50-6
12 miles

EXPLANATION

Outcrops of saturated zones;

exposed

extrapolated between exposures

Saturated areas

surrounded by saturated outcrops that have been mapped.

probably underlain by saturation, based on measured sections and drill cores that contain saturation

Study Area
UTAH

LOCATION MAP

N

Saturation Distribution, PR Spring and Vicinity

0 1/2 1 2 3 4 5
Scale in miles

Fig. 20

Base Map Compiled from B.L.M. Grazing Unit Maps

1

SECTION #1 Seep ridge one mile southwest of Three Pines
El. 7780'-top of bituminous sand.

4' Sandstone; light brown to gray, fine grained, cross-bedded, calcareous, weakly saturated
21' Shale; light green weathers light brown, calcareous.
7' Sandstone; light green, weathers light brown, very fine grained, calcareous,slightly porous.
13' Shale; light green, weathers light brown, calcareous, unit partly covered
4' Oil Shale; black, weathers light gray to white
4' Shale; light green to white, very slightly calcareous.
50' Sandstone; light brown with irregular patches of red staining, micaceous, angular to sub-angular grains, calcareous, highly porous, 12' of weak saturation 20' from base. interbeds of algal limestone above saturation
32' Shale; light green to brown, calcareous.
9' Sandstone; light brown, fine grained, micaceous, iron stained, angular to subangular, cross-bedded.
63' Shale; light green to brown, calcareous
4' Oil Shale; dark gray, weak saturation
18' Shale; light green to brown,algal bed 9' from base 1' thick
35' Sandstone; light brownish-gray, weathers more gray, medium grained, angular to subangular grains, calcareous, micaceous, some iron staining, highly porous.

10

SECTION 10. First fence east of Three Pines on south side of ridge
El. top of section - 7920 feet
NW SE S16-T16S-R23E

10-4 U
26' Sandstone; light grayish-brown, cross-bedded, fine grained, subangular, micaceous, iron staining, calcareous, porous; stained to weakly saturated.
99' Shale; green, thin to medium bedded; calcareous; 1 foot of algal limestone 6 feet from base; 4 foot oil shale 25 feet from base, 1 foot algal bed 42 feet from base; 1 foot oil shale 43 feet from base.
50' Sandstone; light brown, cross-bedded and massive, fine grained, subangular, iron staining, micaceous, calcareous, porous.

11

SECTION 11. Cat blaze - west side of Whetrock Canyon.
El. top of section - 7780feet
SW SW S31-T15S-R23E

11-11U
15' Sandstone; black, cross-bedded, medium grained, subangular, sugary texture, non-calcareous, non-porous, richly saturated.
11-10
23' Sandstone; dark brown, very fine grained, flaggy, calcareous, slightly porous, stained to very weakly saturated.
39' Shale; green, thin bedded, calcareous, 1 foot oil shale 7 feet from base; weathers light brown toward the top of the unit.
11-9
2' Sandstone; dark gray, fine to medium grained, subangular, oolitic, tight, weakly saturated.
7700'
15' Shale; green, thin bedded, calcareous, unit partly covered; 1 foot oil shale 10 from base.
6' Sandstone; dark brown, very fine grained, calcareous, slightly porous, oolitic, stained; 3 foot algal limestone 3 feet from base with 1 foot oil shale in middle of algal bed.
14' Siltstone; green, medium bedded, calcareous, unit partly covered.
11-7M
12' Sandstone; dark gray to black, cross-bedded and flaggy, fine to medium grained, subangular, non-porous, non-calcareous, moderately saturated.
3' Shale; green, thin bedded, slightly calcareous.
11-6
3' Oolitic limestone; dark brown, very dense, irregular saturation.
35' Sandy siltstone; green to light green, medium bedded, calcareous, 1 foot sand stringer 19 feet fron base.
11-3L
10' Sandstone; light brownish-gray, weathers lighter, cross-bedded, fine grained, subangular, micaceous, iron staining, calcareous, porous barren to weakly stained.
44' Siltstone; green, calcareous, medium bedded; 2 foot algal conglomerate 25 feet from base; unit partly covered.
48' Sandstone; light brown, cross-bedded, fine to medium grained, subangular, iron staining, micaceous, calcareous, porous, upper 2 feet are weakly saturated.

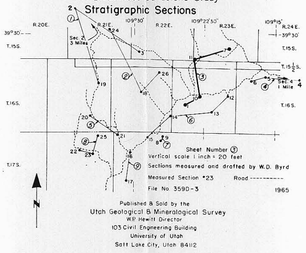
7

SECTION 7. One mile west of Stevenson's corrals, north of P. R. Spring
El. top of section - 7990 feet.
SE SW S27-T15S-R23E

7-10 U
28' Sandstone; dark grayish-brown, weathers light gray with red patches, limonite staining, fine grained, subangular, non-calcareous, very slightly porous, moderately saturated.
10' Sandstone; light gray, weathers light orange-brown; fine grained, subangular, iron staining, micaceous, slightly porous.
55' Shale; green, thin bedded, slightly calcareous, 1 foot oil shale, 7 feet from base.
30' Oolitic limestone; white, weathers light brownish-white, algal structures.
7-8
15' Sandstone; black to dark gray, fine to medium grained, subangular grains, calcareous, slightly porous, moderate to rich saturation, unit partly covered.
2' Shale; green, weathers brown, slightly calcareous, medium bedded.
3' Oolitic sandstone; light gray, fine to medium grained, angular to subangular, very calcareous, poor porosity, dense, algal structures, stained saturation.
9' Siltstone; green, medium bedded, calcareous, porous, unit partly covered.
53' Sandstone; medium gray, cross-bedded, medium to course grained, angular to subangular, stringers of iron staining, very porous, weakly saturated;
7-6
13' Sandstone; green, weathers to yellow-orange, flaggy, fine grained, subangular grains, iron staining, highly porous.
3' Shale; green, thin to medium bedded, calcareous, unit partly covered.
4' Oolitic sandy limestone; white to chalky-gray, very dense; top foot contains algal structures.
5' Sandstone; light brown, massive, fine grained, angular to subangular, calcareous.
13' Covered; most likely a green shale as found above,thick bedded, iron concreations.
7-3
Oolitic sandstone; light yellowish-brown, weathers white, calcareous; weak saturation 5-10 feet from base; moderate to rich 10-12 feet from base, this unit is cross-bedded; 4 feet of weak to moderately saturated, oolitic, calcareous, conglomerate - 12 feet from base; cross-bedded, weak to moderately saturated sandstone - 9 feet thick, 16 feet from the base.
25' 7-2L

7500'

ROAN CLIFF-PR SPRING AREA
Uintah & Grand Counties, Utah
Bituminous Sandstone Study
Stratigraphic Sections



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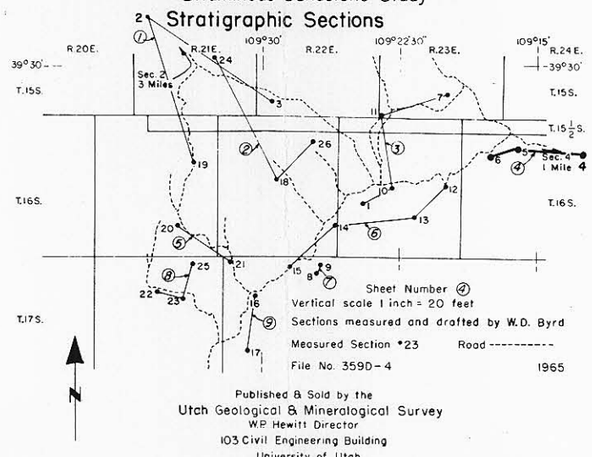
SHEET 3

Fig. 5
File 384D

ROAN CLIFF–PR SPRING AREA
Uintah & Grand Counties, Utah
Bituminous Sandstone Study
Stratigraphic Sections



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SHEET 4

4

SECTION 4. Two miles southeast of P. R. Spring Junction on McCook Ridge Road.
El. 8240 ± at top of section
SW NE 52-T16S-R24E

4U	10'	Sandstone; medium gray, very fine grained, weakly saturated.
	73'	Interbedded sandstones and shales; an algal bed 25 feet from base, mostly soil cover.
	3'	Algal limestone; very light brown to white, limonite inclusions.
	27'	Sandstone; light brown, weathers gray, fine grained, subangular, highly porous and friable. A bed of fossil coelna 4 feet from the base 1 foot thick, no identifiable except some fish scales; upper 25 feet covered.
	25'	Shale; light green, thin bedded, partly covered
	22'	Sandstone; light gray to white, weathers very light brown to white, very fine grained, calcareous, porous; oolites larger than rest of grains scattered through rock; some algal structures interbedded.
	15'	Shale; green, thin bedded with a 1 foot interbed of sandstone 4 feet from base.
4M	21'	Sandstone; light to medium gray, fine grained, cross-bedded, subangular, thin stringers of iron staining 10 feet from base, non-calcareous, highly porous and friable, weakly saturated.
	3'	Shale; light green, very thin bedded, calcareous.
	2'	Siltstone; light brown, calcareous, magnetite blebs oxidizing to iron staining, very hard.
4L	15'	Sandstone; light gray, fine grained, subangular, micaceous, non-porous and non-calcareous. Weak to moderate saturation but saturation becomes irregular toward top. Fish scales.
	23'	Shale; light green, thin bedded, slightly calcareous.
	30'	Sandstone; light brown, fine grained, angular to subangular, micaceous, porous.

5

SECTION 5. One quarter mile southeast of P. R. Spring Junction on McCook Ridge Road.
El. at top of section – P210 feet.
SW SE 54-T16S-R24E

8200'

	70'	Shale; green, very thin bedded, calcareous, interbeds of algal limestone; 2 feet of oil shale, 6 feet from base.; interbed of oil stained oolitic sandstone 1 foot thick, 13 feet from base of unit; 1 foot oil shale, 19 feet from base.
	17'	Covered; most likely algal limestone- from float.
5-8U	18'	Sandstone; dark gray to black, fine grained, subangular, highly porous, moderately saturated; saturation decreases toward the top of unit.
	10'	Shale; green, silty at base, thin bedded, calcareous, partly covered.
5-7M	3'	Sandstone; medium gray, seathers light brownish-gray, fine grained, subangular, calcareous, porous, limonite staining, weakly saturated.
	14'	Shale; green, thin bedded, calcareous, partly covered.
5-6L	39'	Sandstone; dark to medium gray, fine grained, subangular, slightly porous, weakly saturated.

6

SECTION 6. West side of ridge by airstrip west of P. R. Spring Junction
El. at top of sandstone cap – 8139 feet
NE NW 54-T16S-R24E

8000'

6-7U	15'	Sandstone; black, weathers light brownish-gray, fine to medium grained, subangular grains, non-porous and non-calcareous, friable (sugary), moderate to rich saturation.
	7'	Sandstone; light yellowish-brown, weathers with red patches on surface, flaggy, fine to medium grained, micaceous, iron staining, highly porous, non-calcareous, barren to slightly stained saturation; the unit becomes weakly saturated toward top.
	90'	Shale; green, weathers light brown, medium bedded, calcareous, unit partly covered; 1 foot oil shale – 9 feet from base; 4 foot yellow fine-grained sandstone –74 feet from base.
	3'	Oolitic sandstone, light brown to white, calcareous, unit becomes more silty toward top.
	40'	Shale; green, medium bedded, slightly calcareous, with interbeds of algal limestone conglomerate – 2 feet thick, 71 feet from base. 1 foot oil shale – 31 feet from base.
6-2M	28'	Sandstone; dark brown to black, fine grained, angular to subangular, irregular patches of red iron staining on surface, slightly calcareous, poor porosity, micaceous; 7 foot cross-bedded unit, 2 feet from base – irregularly saturated, saturation increases above the cross-bedded unit to moderately saturated.

Fig. 6
File 385D

21

SECTION 21. West side of Moon Ridge
El. at top of section - 8060 feet
NW NW S6-T17S-R22E

8000'

17' Shale; light brown, thin bedded, calcareous.

20' Sandstone; light yellowish-brown, flaggy, fine grained, very calcareous and porous.

79' Shale; green, thin bedded, calcareous; 1 foot oil shale 55 feet from base.

5' Sandstone; light yellowish-brown, flaggy, fine grained, calcareous.

83' Shale; brown, thin bedded, calcareous; 1 foot oil shale 33 feet from base; 1 foot oil shale 40 feet from base; unit partly covered.

15' Siltstone; green, thin bedded, calcareous; 1 foot oil shale 7 feet from base; 1 foot oil shale 10 feet from base.

42' Sandstone; light gray, massive and cross-bedded, very fine to fine grained, micaceous, calcareous, weakly saturated 4 feet from base.

25' Shale; green, thin bedded, calcareous; 5 foot oil shale 3 feet from base.

1' Algal limestone; white to light brown.
1' Conglomerate; light brownish-orange, broken algal structures make up the large pieces.

13' Sandstone; light greenish-gray, medium bedded, fine to medium grained, micaceous, calcareous, porous.

13' Mudstone; green, thin bedded, calcareous.

20

SECTION 20. South end of Moon Ridge airstrip
El. at top of section - 7800 feet
NW SW S26-T16S-R21E

7800'

17' Sandstone; light brown, massive and cross-bedded, fine to medium grained, limonite blebs, porous.

12' Shale; green, thin bedded, calcareous.

4' Sandstone; light yellowish-brown, flaggy, very fine grained, calcareous.

159' Shale; green, thin bedded, calcareous; 1 foot oil shale 3 feet from base; 1 foot oil shale 9 feet from base; 1 foot oil shale 28 feet from base; 1 foot oil shale 43 feet from base; 10 foot oil shale 56 feet from base; 1 foot oil shale 75 feet from base; 1 foot oil shale 86 feet from base; 1 foot oil shale 95 feet from base; 1 foot oil shale 146 feet from base.

8' Mudstone; light grayish-green, medium bedded, calcareous.

12' Shale; green, thin bedded calcareous.

2' Siltstone; light gray, medium bedded, biotite, very tight.
2' Shale; green, thin bedded.
1' Oil shale; black, very thin bedded.
4' Mudstone; light greenish-gray, thin bedded.

12 Shale; green, thin bedded, calcareous; 1 foot oil shale 8 feet from base; 1 foot oil shale 11 feet from base.
1' Oil shale; black, very thin bedded.
2' Sandstone; light yellowish-brown, thick bedded, fine grained, micaceous, limonite staining, calcareous.
9' Shale; green, thin bedded.

1' Conglomerate; light orange, rounded grains, calcareous matrix, extremely hard.
5' Sandstone; light brown, thick bedded, fine grained, calcareous.
Shale; green, thin bedded, calcareous.
7' Sandstone; light yellowish-brown, massive and cross-bedded, fine grained, micaceous, limonite blebs, calcareous.
1' Shale; green, thin bedded, calcareous.
4' Sandstone; light yellowish-brown, massive and cross-bedded, fine grained, micaceous, limonite blebs, calcareous.
3' Shale; green thin bedded, calcareous.
2' Sandstone; light greenish-brown, cross-bedded and massive, micaceous, calcareous.
3'

11' Shale; green, thin bedded, calcareous.

14' Sandstone; light brown, massive and cross-bedded, fine grained, calcareous, fairly tight.

11' Shale; green, thin to medium bedded, calcareous.

6' Oil shale; black, thin bedded.

1' Algal limestone; light orangish-white;

ROAN CLIFF–PR SPRING AREA

Uintah & Grand Counties, Utah
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SHEET 5

Fig. 7
File 386D

15

SECTION 15. One and one half miles west of Holt's corral on south side of ridge.
El. at top of section - 8200 feet
NE SW 53-T17S-R22E

8200'

1' Algal limestone; orange to chalky white.
5' Shale; light brown, thin bedded.

18' Covered; soil and float of barren flaggy medium grained sandstone.

114' Shale; green, thin bedded; 1 foot algal limestone 4 feet from base; 1 foot oil shale 5 feet from base; 1 foot oil shale 9 feet from base; 1 foot algal limestone 12 feet from base; 1 foot oil shale 14 feet from base; 2 foot oil shale 40 feet from base; 1 foot oil shale 48 feet from base; unit partly covered.

15-U
2' Oil shale.
3' Sandstone; medium brown, fine grained; weak to moderately saturated.
10' Siltstone; medium brown, thin bedded, calcareous; some weakly saturated stringers.

15-L
14' Sandstone; dark gray, massive and cross-bedded, fine grained, micaceous and calcareous; weak to moderately saturated.
4' Siltstone; light greenish-brown, thin bedded, micaceous, calcareous.
7' Sandstone; medium gray, cross-bedded and massive, fine grained, micaceous and slightly calcareous; irregular saturation.
13' Shale; green, thin bedded, calcareous.
6' Oil shale; very thin bedded.
3' Algal limestone; light orangish-white.

8000'

49' Sandstone; light greenish-brown, massive and cross-bedded, fine grained, with parts covered.

83' Shale; light green; 1 foot oolitic algal limestone 20 feet from base; 6 foot sandstone 42 feet from base; 1 foot oil shale 61 feet from base. Unit partly covered.

14

SECTION 14. One half mile southeast of Cedar Camp on south side of ridge
El. at top of section - 7950 feet
SE NE 52S-T16S-R22E

4' Sandstone; light gray, cross-bedded, fine grained to medium grained, iron staining.

18' Shale; light green, very thin bedded; 3 foot oil shale 5 feet from base; 6 foot algal limestone on top of oil shale.

47' Sandstone; light yellowish-brown, flaggy, fine grained, slightly calcareous and porous.

64' Shale; light green to brown; 1 foot oil shale 17 feet from base; 2 foot sand lense 19 feet from base; 1 foot oil shale 36 feet from base.

17' Siltstone; green, medium bedded; 1 foot of oolitic limestone with 1 foot of algal limestone on top of it, 15 feet from base.

20' Sandstone; light brown, cross-bedded and massive, medium grained, subangular, limonite blebs, calcareous.

25' Mudstone; light green, medium bedded, calcareous, unit partly covered.

45' Sandstone; light brown, fine to medium grained, cross-bedded and massive; 3 feet of weak saturation 3ft feet from the base.

13

SECTION 13. Long point west of Tidewater Horse Point well, south side of Seep Ridge
El. top of section - 8130 feet
NE NE 52S-T16S-R23E

3' Sandstone; light grayish-white, thin bedded, very fine grained.
5' Shale; light to medium brown, very thin bedded, very non-resistant, unit partly covered.
5' Shale; green thin bedded, calcareous; upper 2 feet are oil shale.
2' Algal limestone; light to medium gray, irregularly saturated.
6' Sandstone; light to medium gray, cross-bedded, massive, fine to medium grained, very calcareous, porous; weak to moderately saturated.
8' Sandstone; medium brown, weathers light yellowish-brown, flaggy, very fine to fine grained calcareous, irregularly stained to weakly saturated.
6' Shale; green thin bedded, calcareous, partly covered.

23' Sandstone; light greenish-brown, weathers light brown, cross-bedded, fine to medium grained, poorly sorted, micaceous, iron staining, calcareous and porous; last 3 feet weak to moderately saturated.

94' Shale; green, slightly calcareous; 1 foot oil shale 1 foot from base; 1 foot oil shale 44 feet from base.

29' Sandstone; green, very fine grained, calcareous, 6 foot algal bed with oolites 17 feet from base; unit partly covered.

25' Sandstone; medium gray, cross-bedded, medium grained, subangular, well weathered feldspar grains a little larger than quartz, micaceous; moderately saturated.

12

SECTION 12. One mile east of Tidewater Horse Point well
El. top of section - 8190 feet
SE NW 51S-T16S-R23E

12-5U
5' Sandstone; light yellowish-brown, weathers lighter, flaggy, fine grained, iron staining, stained near top of unit.

63' Siltstone; white to light gray, very thin bedded, very fine grained, non-calcareous; 1 foot moderate to weakly saturated conglomeratic sandstone 13 feet from base; 1 foot oil shale 19 feet from base, unit partly covered above oil shale.

12-3M
8' Sandstone; white to light brown, weathers light gray to white, thick bedded, fine to medium grained, very calcareous in places, medium porosity, conglomeratic in places; top foot is very oolitic.
12' Sandstone; white to gray, flaggy, thin bedded, ripple marks and mud cracks.

12-1L
8' Sandstone; black, cross-bedded, medium grained, subangular, micaceous, calcareous, non-porous, moderate to richly saturated.
10' Sandstone; light green, weathers light yellow-brown, fine grained subangular, calcareous, unit partly covered.
16' Mudstone; green non-calcareous, medium bedded.
32' Sandstone; light brown, weathers light grayish-brown, cross-bedded, fine to medium grained, angular to subangular.

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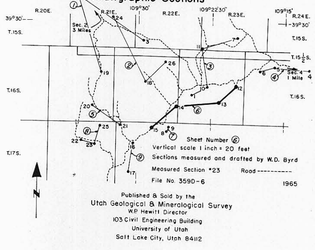

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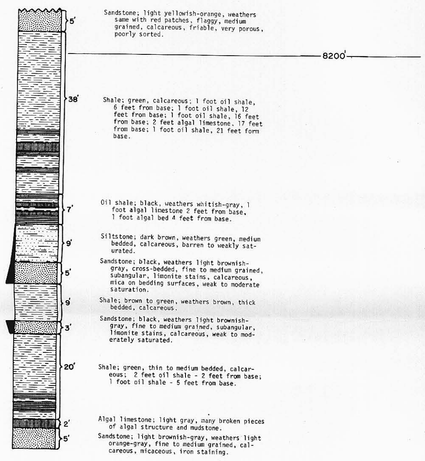
SHEET 6

Fig. 8

File 387D

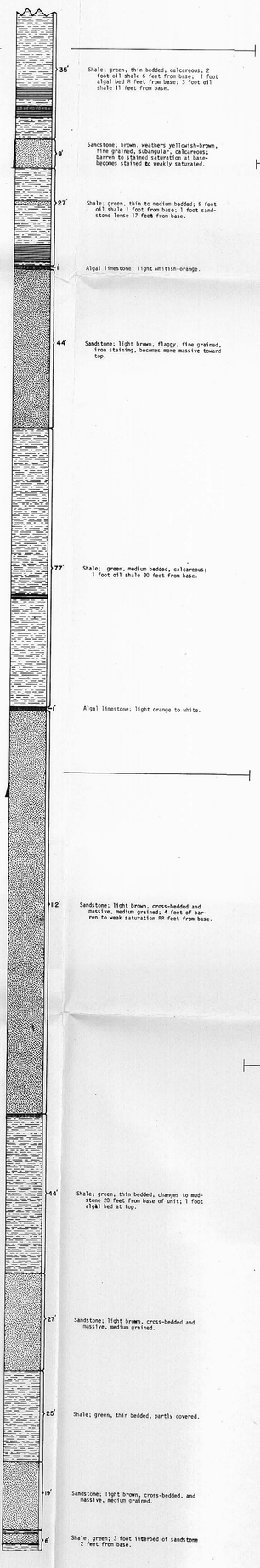
8

SECTION 8. West side of ridge, south of Holt's corral
El. top of flaggy brown sandstone 8210 feet.
SE SZ-T17S-R22E

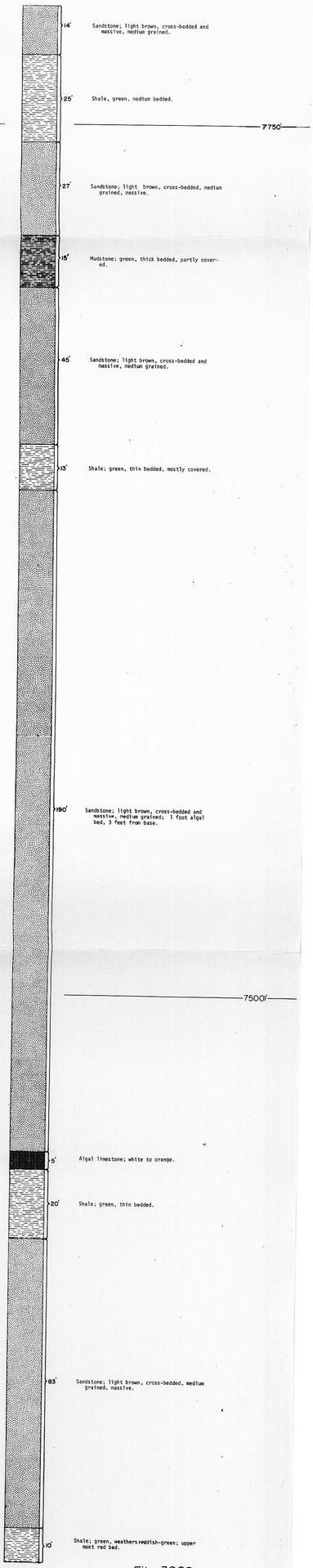


9

SECTION 9. East side of ridge south of Holt's corral
El. top of flaggy brown sandstone 8210 feet.
SE NE SZ-T17S-R22E



Continued from Section 9



7750'

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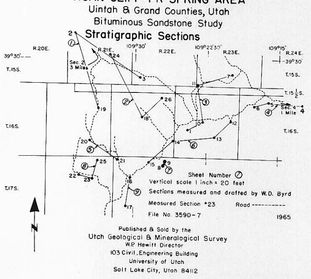

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Fig. 9

22

SECTION 22. West side of Steer Ridge near Pacific Natural Gas Segundo #1
El. at top of section - R360 feet
NW SE S9-T17S-R21E

65' Shale; light brown, thin bedded, unit mostly covered; 50 feet from base float from a weakly saturated sandstone.

35' Sandstone; light yellowish-brown, flaggy, fine grained; unit mostly covered.

40' Shale; light green, thin bedded, calcareous, unit partly covered.

13' Sandstone; light brown, flaggy, very fine grained, calcareous.

22' Shale; green, thin- bedded, calcareous.

10' Sandstone; light yellowish-brown, flaggy, fine grained, calcareous.

1012' Shale; green, thin bedded, calcareous;
1 foot oil shale 2 feet from base;
2 foot sandstone 4 feet from base;
2 foot sandstone 39 feet from base;
1 foot algal limestone 41 feet from base;
1 foot algal limestone 59 feet from base;

17' Sandstone; light yellowish-brown, flaggy, fine grained, micaceous, limonite staining, calcareous, porous, ripple marks.

74' Shale; green, thin bedded, calcareous;
1 foot oil shale 33 feet from base;
1 foot oil shale 73 feet from base.

1' Algal limestone; whitish-orange.
3' Mudstone; green, thin bedded.
2' Sandstone; yellowish-brown, cross-bedded and massive, fine grained, micaceous, limonite staining, calcareous and porous.

32' Shale; dark greenish-brown, thin bedded, calcareous.

45' Sandstone; light yellowish-brown, massive and cross-bedded, medium grained, micaceous, calcareous and porous, friable; weak saturation starts 32 feet from base.

32' Mudstone; light greenish-brown, thin bedded, calcareous.

8' Oil shale; black, very thin bedded.

4' Algal limestone; dolomitic.

1' Siltstone; light brown, weathers with green siliceous rind.

2' Conglomerate; light brown, siliceous pebbles with a calcareous matrix.

29' Sandstone; light yellowish-brown, flaggy, cross-bedded, very fine grained, very micaceous, limonite blebs.

7' Mudstone; green, thin bedded.

23

SECTION 23. West side of Steer Ridge
El. at top of section - R301feet
NW NW S14-T17S-R21E

25' Sandstone; light orange, weathers light brownish-orange, massive and cross-bedded, fine grained and friable, micaceous, iron staining, calcareous, porous.

78' Mudstone; brown, thin bedded, slightly calcareous; 1 foot oil shale 28 feet from base; unit partly covered.

8200'

6' Algal limestone; light brown to white.

8' Sandstone; light yellowish-brown, massive and cross-bedded, fine to medium grained, poorly sorted, limonite blebs, calcareous, porous.

20' Mudstone; light green, thin bedded, calcareous.

8' Sandstone; light to medium gray, weathers light brownish-gray, medium to coarse grained, subangular to sub-rounded, micaceous, weakly saturated.

12' Mudstone; green, thin bedded, calcareous.

3' Sandstone; light orange-brown, weathers light brown, massive and cross-bedded, fine grained, calcareous, porous.

7' Siltstone; light brown, thin bedded, very calcareous.

9' Sandstone; light gray, weathers light brownish-gray, massive and cross-bedded, fine to medium grained, porous, stained saturation.

36' Shale; light brown, weathers light greenish-gray, thin bedded; 2 feet of oil shale 3 feet from base; becomes silty above 20 feet.

1' Algal limestone; light orange-brown to white, mostly broken algal structures.

5' Siltstone; green, thin bedded, slightly calcareous, non-resistant.

12 Sandstone; light yellowish-brown, massive and cross-bedded, fine grained, micaceous, calcareous and porous.

10' Siltstone; green, thin bedded, slightly calcareous, non-resistant.

31' Sandstone; light gray, massive and cross-bedded, medium grained, subangular, limonite blebs, calcareous.

5' Sandstone; light greenish-gray, massive and cross-bedded, very fine grained, limonite blebs, calcareous.

20' Mudstone; light greenish-gray, thin bedded, calcareous; oil shale zone 2 feet thick at base.

8000'

15' Sandstone; light yellowish-brown to gray, massive and cross-bedded, fine to medium grained, subangular, calcareous, porous.

25

SECTION 25. North end of eastern airstrip on Steer Ridge on east side of strip
El. at top of section - R350feet

8' Sandstone; light gray, weathers light brownish-gray, cross-bedded, medium grained, subangular, limonite staining, non-calcareous, very porous.

4' Sandstone; light yellowish-brown, thin bedded, fine grained, limonite blebs, slightly calcareous and porous.

169' Mudstone; light green to white, calcareous;
7 foot oil shale 42 feet from base;
1 foot oil shale 54 feet from base;
4 foot sandstone 97 feet from base;
becomes shaley above 150 feet from base.

6' Sandstone; light yellow, thin bedded, very fine grained, micaceous, calcareous and porous.

86' Siltstone; green, thin bedded, calcareous;
1 foot oil shale 9 feet from base;
1 foot oil shale 12 feet from base;
1 foot algal limestone 15 feet from base;
1 foot tuff? 20 feet from base;
1 foot oil shale 48 feet from base;
1 foot oil shale 58 feet from base.

2' Oil shale; black, very thin bedded.

14' Sandstone; light gray, weathers light orange, fine to medium grained, poorly sorted subangular grains, some reworked siltstone at base.
Siltstone; green, thin bedded, calcareous.

16' Sandstone; light yellowish-orange, weathers light brown, medium bedded, fine grained, micaceous, limonite staining, ripple marks; some bituminous staining 4 feet from base; 1 foot of weak saturation 11 feet from base; 1 foot of weak saturation 14 feet from base.

14' Siltstone; light green, thin bedded, calcareous, porous.

10' Sandstone; light yellowish-gray, thin to medium bedded, very fine grained, micaceous, calcareous and porous.

24' Mudstone; light gray, weathers white, thin bedded; 1 foot oil shale 1 foot from base; 5 feet of oil shale 3 feet from base.

2' Algal limestone, white.

41' Sandstone; light yellowish-gray, medium bedded, fine to medium grained, subangular, poorly sorted, very friable, micaceous, limonite staining, calcareous and porous; 1 foot of conglomerate with broken algal structures 34 feet from base.

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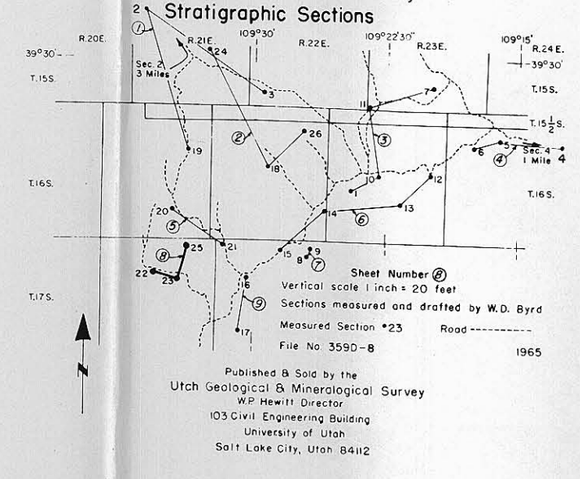

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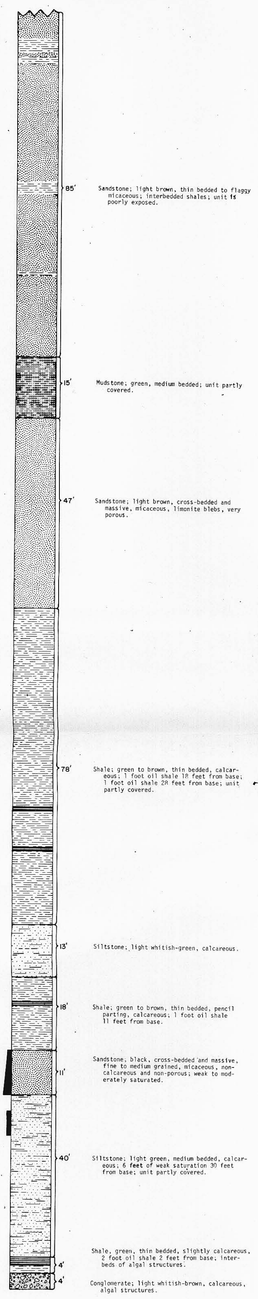
Fig. 10

17

SECTION 17. West side of Westwater Point near Steer Ridge turnoff
El. at top of section - 4690 feet
NW SW 529-T17S-R22E



85' Sandstone; light brown, thin bedded to flaggy micaceous; interbedded shales; unit is poorly exposed.

15' Mudstone; green, medium bedded; unit partly covered.

47' Sandstone; light brown, cross-bedded and massive, micaceous, limonite blebs, very porous.

8500'

78' Shale; green to brown, thin bedded, calcareous; 1 foot oil shale 15 feet from base; 1 foot oil shale 28 feet from base; unit partly covered.

13' Siltstone; light whitish-green, calcareous.

18' Shale; green to brown, thin bedded, pencil parting, calcareous; 1 foot oil shale 11 feet from base.

11' Sandstone, black, cross-bedded and massive, fine to medium grained, micaceous, non-calcareous and non-porous; weak to moderately saturated.

40' Siltstone; light green, medium bedded, calcareous; 6 feet of weak satyration 30 feet from base; unit partly covered.

4' Shale, green, thin bedded, slightly calcareous, 2 foot oil shale 2 feet from base; interbeds of algal structures.

4' Conglomerate; light whitish-brown, calcareous, algal structures.

16

SECTION 16. South side of Seep Ridge near Moon Ridge turnoff.
El. at top of section - 8369 feet
NW NE 517-T17S-R22E

8' Sandstone; red to reddish-brown, flaggy, non-calcareous.

19' Shale; light-brown, thin bedded.

22' Sandstone; light brown, fine grained, micaceous and some iron staining, slightly calcareous. barren.

9' Shale; green,thin bedded, calcareous.

8300'

58' Sandstone; light brown, massive, cross-bedded, fine grained, calcareous, porous, iron staining.

73' Shale; green, thin bedded; 1 foot oil shale; 1 foot oil shale 10 feet from base; 2 foot algal limestone 17 feet from base; 1 foot oil shale 39 feet from base; 1 foot oil shale 49 feet from base; unit partly covered.

8' Sandstone; medium gray, weathers light brownish-gray, fine grained, micaceous, weakly calcareous; weakly saturated.

52' Shale; green, thin bedded; 1 foot algal limestone 1 foot from base; 1 foot oil shale 2 feet from base; 1 foot algal limestone 3 feet from base; 6 feet of oil shale 6 feet from base, unit becomes brown and silty toward the top.

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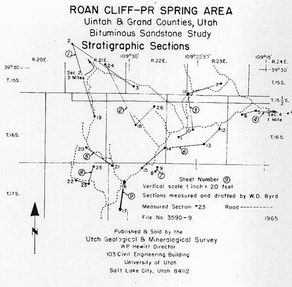

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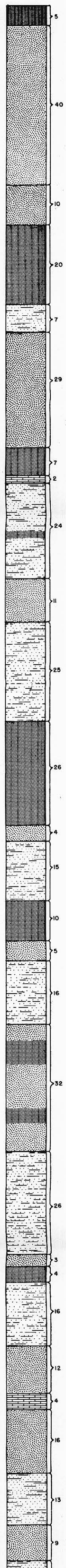
SHEET 9

Fig. 11


Section 30
SE ¼ Sec. 34, T 15 S, R 21 E
Section 33
SE ¼ Sec. 34, T 14 S, R 22 E
Section 27
SE ¼ Sec. 32, T 15 S, R 23 E
Section 28
SW ¼ NE ¼ Sec. 7, T 16 S, R 24 E
SHEET 10

Fig. 12

Section 32
SE ¼ Sec. 11, T 14 S, R 24 E



5 — Algal limestone; light brown, weathers light orange-brown, oolitic and ostracodal, very large silicified algal heads.

40 — Sandstone; light gray, massive, cross-bedded, medium grained, micaceous, calcareous, very porous and permeable.

10 — Sandstone; light brown, flaggy, fine grained, calcareous, very porous and permeable.

20 — Algal limestone; light brown, weathers light orange-brown, oolitic and ostracodal, very large silicified algal heads.

7 — Siltstone; light green, thin bedded, calcareous.

29 — Sandstone; light brown, massive, cross-bedded, fine to medium grained, micaceous, very calcareous, very porous and permeable.

7 — Algal limestone; light brown, weathers light orange-brown, oolitic and ostracodal, very large silicified algal heads.

2 — Oolitic limestone; white, weathers light grange, medium bedded.

24 — Siltstone; light green, thin bedded, calcareous, 2 feet of algal limestone 10 feet from base.

11 — Sandstone; light brown, massive, cross-bedded, medium grained, micaceous, very calcareous, very porous and permeable.

25 — Siltstone; light green, thin bedded, calcareous.

26 — Algal limestone; light brown, weathers light brown-orange, oolitic and ostracodal, very large algal heads.

4 — Sandstone; light gray, massive, cross-bedded, medium grained, micaceous, calcareous, very porous and permeable.

15 — Siltstone; light green, thin bedded, calcareous.

10 — Algal limestone; light brownish-white, weathers light brown to light orange, oolitic and ostracodal, very large algal heads.

5 — Sandstone; light brown, massive, cross-bedded, fine to medium grained, micaceous, very calcareous, very porous and permeable.

16 — Siltstone; light green, thick bedded, calcareous.

32 — Sandstone; light brown, massive, cross-bedded, fine to medium grained, micaceous, very calcareous, very porous and permeable, 4 feet of algal limestone 7 feet from base, 6 feet of algal limestone 22 feet from base.

26 — Siltstone; light green, thick bedded, calcareous.

3 — Sandstone; light brown, massive, cross-bedded, fine to medium grained, micaceous, very calcareous, very porous and permeable.

4 — Algal limestone; white, weathers light orange, massive, recrystallized, silicified, oolitic and ostracodal.

16 — Siltstone; light green, thick bedded, calcareous.

12 — Sandstone; light brown, massive, cross-bedded, fine to medium grained, micaceous, very calcareous, very porous and permeable.

4 — Limestone; white, weathers light orange, oolitic and ostracodal, fragmental, fairly permeable.

16 — Sandstone; light brown, massive, cross-bedded, fine to medium grained, micaceous, very calcareous, very porous and permeable.

13 — Siltstone; light green, thick bedded, calcareous.

9 — Sandstone; light yellow-brown, massive, cross-bedded, fine to medium grained, micaceous, very calcareous, very porous and permeable.

31 — Siltstone; light green, thick bedded, calcareous.

21 — Sandstone; light brownish-yellow, massive, cross-bedded, fine to medium grained, micaceous, very calcareous, very porous and permeable.

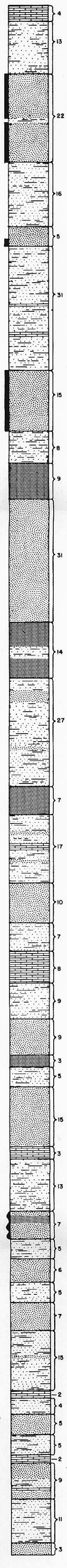
7 — Siltstone; light green, thick bedded, calcareous.

8 — Sandstone; light brownish-yellow, massive, cross-bedded, fine to medium grained, micaceous, very calcareous, very porous and permeable.

7 — Siltstone; light green, thick bedded, calcareous.

2 — Sandy limestone; light brownish-gray, medium bedded, a few ostracods.

Section 37
SE ¼ Sec. 25, T 14 S, R 23 E



4 — Oolitic, ostracodal limestone; light gray, massive, weakly saturated.

13 — Siltstone; light green, thin bedded, calcareous, slope former, some covered.

22 — Sandstone; medium gray, massive, cross-bedded, fine grained, micaceous, calcareous, weakly saturated, 1 foot of siltstone 10 feet from base.

16 — Siltstone; light green, thin bedded, calcareous, slope former.

5 — Sandstone; light brown, flaggy, fine grained, micaceous, calcareous, lower 2 feet are weakly saturated.

31 — Siltstone; light green, thin bedded, calcareous, 2 feet of oolitic, ostracodal limestone 8 feet from base, 1 foot of oolitic, ostracodal limestone 16 feet from base.

15 — Sandstone; medium gray, massive, cross-bedded, fine to medium grained, micaceous, calcareous, irregular to weakly saturated.

8 — Siltstone; light green, thin bedded, calcareous, slope former.

9 — Oolitic, ostracodal, algal limestone; white, massive, porous and permeable.

31 — Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, calcareous.

14 — Oolitic, ostracodal, algal limestone; white, massive, 3 feet of siltstone 5 feet from base.

27 — Siltstone; light green, thin bedded, calcareous, 1 foot of sandstone 9 feet from base, 3 feet of sandstone 21 feet from base.

7 — Oolitic, ostracodal, algal limestone; white, massive.

17 — Siltstone; light green, thin bedded, calcareous, 1 foot of sandstone 5 feet from base, 2 feet of oolitic, ostracodal limestone 8 feet from base, 1 foot of sandstone 12 feet from base.

10 — Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, calcareous.

7 — Siltstone; light green, thin bedded, calcareous.

8 — Oolitic, ostracodal, algal limestone; white, massive.

9 — Siltstone; light green, thin bedded, calcareous.

9 — Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, calcareous.

3 — Algal limestone; white, weathers light orange, massive.

5 — Siltstone; light green, thin bedded, calcareous.

15 — Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, calcareous.

3 — Oolitic, ostracodal limestone; white, weathers light orange, massive.

13 — Siltstone; light green, thin bedded, calcareous.

7 — Sandstone; light gray to brown, massive, cross-bedded, fine grained, micaceous, calcareous, irregularly saturated, 2 feet of algal limestone 4 feet from base.

5 — Siltstone; light green, thin bedded, calcareous.

6 — Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, calcareous.

5 — Siltstone; light green, thin bedded, calcareous.

7 — Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, calcareous.

15 — Siltstone; light green, thin bedded, calcareous, 1 foot of sandstone 8 feet from base.

2 — Limestone; light gray, massive, medium crystalline, porous and permeable.

4 — Siltstone; light green, thin bedded, calcareous.

5 — Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, calcareous.

5 — Siltstone; light green, thin bedded, calcareous.

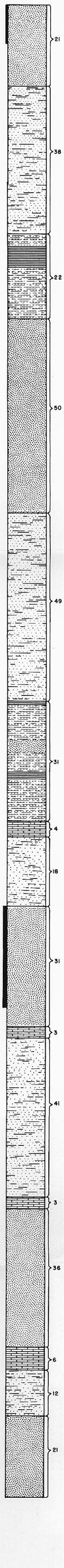
2 — Limestone; white, weathers light brown, medium crystalline, some oolites, porous and permeable.

9 — Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, calcareous, 1 foot of oolitic, ostracodal limestone 2 feet from base, 2 feet of light green siltstone 4 feet from base.

11 — Siltstone; light green, thin bedded, calcareous.

3 — Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, very calcareous.

Section 29
SW ¼ Sec. 12, T 16 S, R 22 E



21 — Sandstone; light gray, weathers with light orange-brown rind, flaggy, fine to medium bedded, some clay, limonite, becomes coarser grained and very weakly saturated 10 feet from the top.

38 — Siltstone; light green to brown, thin platy bedding, calcareous, slope former.

22 — Mudstone; light greenish-gray, thin platy bedding, calcareous, 6 feet of oil shale 13 feet from base.

50 — Sandstone; light brown, cross-bedded, massive, very fine grained, micaceous, calcareous.

49 — Siltstone; light green to brown, thin platy bedding, calcareous, slope former.

31 — Mudstone; light greenish-gray, thin platy bedding, calcareous.
2 feet of oil shale 12 feet from base
3 feet of sandstone 19 feet from base
1 foot of oil shale 30 feet from base

4 — Oolitic limestone; orange to gray, ostracods and algal structures.

18 — Siltstone; light green, thin bedded, calcareous.

31 — Sandstone; light brown at base and gray above 5 feet, cross-bedded and massive, fine to medium grained, sub-angular, weakly saturated above 5 feet.

3 — Silty limestone; light brown, weathers light orange-brown, ostracods and oolites.

41 — Siltstone; light green, thin bedded, slightly calcareous, slope former.

3 — Limestone; light gray, massive and dense.

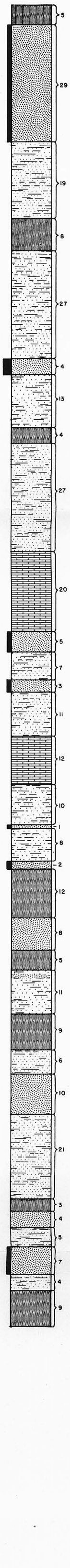
36 — Sandstone; light brown, cross-bedded, massive, fine to medium grained, micaceous, limonite, slightly calcareous, very porous.

6 — Limestone; light gray, massive, some silt, ostracods and oolites.

12 — Siltstone; light green, some fine sand grains, calcareous, slope former.

21 — Sandstone; light brown, massive and cross-bedded, fine grained, sub-angular, very permeable and slightly calcareous.

Section 36
NE ¼ Sec. 21, T 13 S. R 24 E



5 — Oolitic, ostracodal, algal limestone; dark gray, weathers light orange, weakly saturated.

29 — Sandstone; dark gray, massive, cross-bedded, fine grained, micaceous, calcareous, weakly saturated.

19 — Siltstone; light green, thin bedded, calcareous.

8 — Algal limestone; white, weathers light orange, massive.

27 — Siltstone; light green, thin bedded, calcareous.

4 — Sandstone; dark gray, massive, cross-bedded, medium grained, micaceous, calcareous, weak to moderate saturation.

13 — Siltstone; light green, thin bedded, calcareous.

4 — Algal limestone; dark gray, weathers light orange, massive, weakly saturated.

27 — Siltstone; light green, thin bedded, calcareous.

20 — Oolitic, ostracodal limestone; dark gray, weathers light orange, massive, weakly saturated.

5 — Sandstone; light gray, massive cross-bedded, fine grained, micaceous, calcareous, weakly saturated.

7 — Siltstone; light green, thin bedded, calcareous.

3 — Sandstone; medium gray, massive, cross-bedded, fine grained, micaceous, calcareous, weakly saturated.

11 — Siltstone; light green, thin bedded, calcareous.

12 — Oolitic, ostracodal limestone; light gray, weathers light orange, some thin algal layers.

10 — Siltstone; green, thin bedded, calcareous.

1 — Sandstone; dark gray, massive, cross-bedded, fine grained, micaceous, calcareous, weakly saturated.

8 — Siltstone; green to brown, thin bedded, calcareous, slope former.

2 — Sandstone; dark gray, massive, cross-bedded, fine grained, micaceous, calcareous, weakly saturated.

12 — Algal limestone; dark gray, weathers light orange, massive, oolitic-ostracodal matrix between heads is saturated.

8 — Sandstone; light gray to white, massive, cross-bedded, fine grained, micaceous, very calcareous.

5 — Algal limestone; white, weathers light orange, massive, large silicified algal heads, oolitic-ostracodal matrix between heads is weakly saturated.

11 — Siltstone; light green, thin bedded, calcareous, slope former, 1 foot of sandstone 9 feet from base.

9 — Algal limestone; white, weathers light orange to white, massive, oolitic and ostracodal.

6 — Siltstone; light green, thin bedded, calcareous, 1 foot of sandstone 3 feet from base.

10 — Sandstone; light brown, massive, cross-bedded, fine to medium grained, micaceous, calcareous.

21 — Siltstone; light green, thin bedded, calcareous.

3 — Oolitic, algal limestone; dark gray, weathers light orange, massive, some ostracods.

4 — Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, limonitic, calcareous.

5 — Siltstone; light green, thin bedded, calcareous.

7 — Sandstone; dark gray, massive, cross-bedded, fine grained, micaceous, very calcareous, weakly saturated.

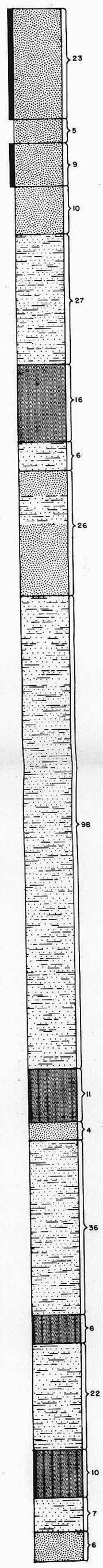
4 — Siltstone; light green, thin bedded, slightly calcareous.

9 — Oolitic, ostracodal, algal limestone; dark gray, weathers white, massive, weakly saturated.

SHEET 11

Fig. 13

Section 38
NE ¼ Sec. 4, T 13 S, R 25 E



Sandstone; medium gray, cross-bedded, fine to medium grained, micaceous, slightly calcareous and permeable, weakly saturated.

Sandstone; light yellowish-brown, very fine grained, very permeable and friable.

Sandstone; medium gray, flaggy, fine grained, micaceous, slightly calcareous, slightly permeable, weakly saturated.

Sandstone; light brown, very fine grained, very permeable and friable.

Siltstone; light green, thin bedded, calcareous.

Algal limestone; white, weathers white to light orange, massive.

Siltstone; light green, thin bedded, calcareous, slope former.

Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, slightly calcareous, friable, very permeable, 6 feet of siltstone 15 feet from base.

Siltstone; light green, thin bedded, calcareous, slope former.

Algal limestone; white, weathers light gray to white, massive, upper 9 feet have oolites and ostracods with patches of weak saturation.

Sandstone; light brown, massive, friable, fine grained, micaceous, calcareous, very permeable.

Siltstone; light green, thin bedded, calcareous, slope former.

Algal limestone; white, weathers light orange to white, massive, some oolites and ostracods with irregular saturation.

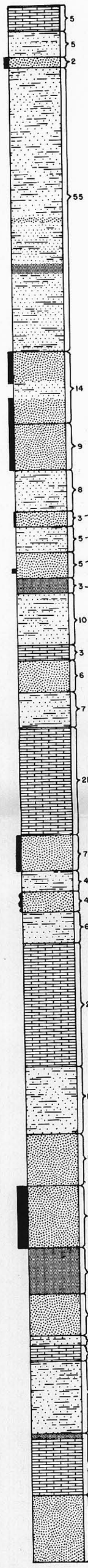
Siltstone; light green, thin bedded, calcareous, slope former.

Algal limestone; white, weathers light orange, massive, a few oolites and ostracods, patches of irregular saturation.

Siltstone; light green, thin bedded, calcareous, slope former.

Sandstone; light brown, massive, cross-bedded, fine grained, micaceous, calcareous, very permeable and friable.

Section 34
NE ¼ Sec. 2, T 14 S, R 23 E



Ostracodal limestone; medium gray, massive, weakly saturated.

Siltstone; light green, thin bedded, calcareous.
Sandstone; gray to dark gray, massive, cross-bedded, medium grained, micaceous, calcareous, weakly saturated.

Siltstone; light green, thin bedded, calcareous, 2 feet of algal limestone 15 feet from base, 1 foot of sandstone 25 feet from base very weakly saturated.

Sandstone; light gray, flaggy, very fine grained, calcareous, ostracodal, very weakly saturated, 3 feet of siltstone 5 feet from base.

Sandstone; light gray, massive, cross-bedded, very fine grained, micaceous, calcareous, weakly saturated.

Siltstone; light green, thin bedded, calcareous, satin spar stringers.

Sandstone; light gray, massive, cross-bedded, very fine grained, micaceous, calcareous, very weakly saturated.

Siltstone; light green, thin bedded, calcareous.

Sandstone; light brown, thin bedded, very fine grained, calcareous, poor porosity and permeability, 1 foot of weak saturation 2 feet from base of unit.

Algal limestone; dark gray, weathers light orange, large silicified algal heads with weak saturation.

Siltstone; light green, thin bedded, calcareous.

Limestone; light gray to white, very dense, massive, top 1 foot is algal limestone with ostracods.

Sandstone; light brown, massive, cross-bedded, fine to medium grained, calcareous, porous and permeable.

Siltstone; light green, thin bedded, calcareous.

Ostracodal limestone; white, weathers light orange, massive, 2 feet of oolitic limestone with very weak saturation 3 feet from base.

Sandstone; gray, massive, cross-bedded, fine grained, micaceous, calcareous, weakly saturated.

Siltstone; light green, thin bedded, calcareous.

Sandstone; light gray to brown, massive, cross-bedded, fine grained, micaceous, calcareous, very weak irregular saturation.

Siltstone; light green, thin bedded, calcareous.

Oolitic limestone; gray to dark gray, massive, silty, ostracodal.

Siltstone; light green, thin bedded, calcareous.

Sandstone; light brown, massive, cross-bedded, fine to medium grained, calcareous, porous and permeable.

Sandstone; dark gray to black, weathers light gray, massive, cross-bedded, medium grained, slightly calcareous, moderately saturated.

Algal limestone; light orange-brown, medium crystalline, massive, much of the matrix is oolites and ostracods.

Sandstone; light brown, thin bedded, very fine grained, calcareous, poor porosity and permeability.

Siltstone; green to brown, thin bedded, calcareous.

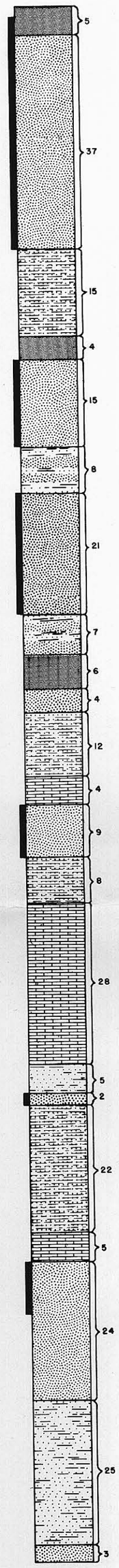
Silty limestone; light gray, weathers light brown, medium bedded, coarsely crystalline, fossil fragments.

Siltstone; green to brown, thin bedded, calcareous, mud cracks.

Oolitic limestone; white, medium bedded, becomes ostracodal above 2 feet from base, 1 foot of algal limestone on top.

Sandstone; light brownish-gray, massive, cross-bedded, fine to medium grained, calcareous, porous and permeable.

Section 31
NW ¼ Sec. 27, T 13 S, R 23 E



Algal limestone; dark gray, massive, oolitic, lower 3 feet are weakly saturated.

Sandstone; light gray, massive, cross-bedded, fine grained, micaceous, calcareous, weakly saturated.

Mudstone; light green, thin bedded.

Algal limestone; light orange, very dense.

Sandstone; light gray, massive, cross-bedded, fine to medium grained, sub-angular, calcareous, weakly saturated.

Interbedded sandstone and siltstone; 50% sandstone; thin bedded, very fine grained, calcareous. 50% siltstone; light green, thin bedded, calcareous.

Sandstone; medium gray, massive, cross-bedded, fine to medium grained, sub-angular, micaceous, slightly calcareous, weakly saturated.

Interbedded sandstones and mudstones; thin units, (1 foot maximum).

Algal limestone; light orange, 4 to 5 foot algal heads, very dense.

Sandstone; light gray, thin to medium bedded, medium grained, sub-angular, micaceous, slightly calcareous, porous.

Mudstone; light green, thin bedded.

Limestone; white to light orange, oolitic, ostracodal, large pebbles at base of unit, irregularly saturated in some places.

Sandstone; medium gray, cross-bedded, medium grained, sub-angular, micaceous, slightly calcareous, weakly saturated.

Mudstone; light green, thin bedded.

Limestone; chalky-white, oolitic and ostracodal, top 8 feet are weakly saturated.

Siltstone; light green, thin bedded, calcareous, slope former.

Sandstone; light gray, massive, cross-bedded, fine to medium grained, sub-angular, limonite, micaceous, calcareous, weakly saturated.

Mudstone; green, thin bedded, slope former.

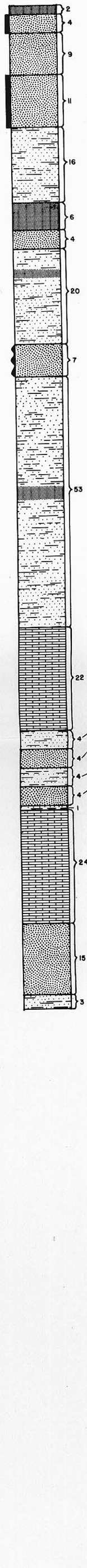
Oolitic limestone; light orange to white, ostracods.

Sandstone; light brown, massive, cross-bedded, medium grained, slightly calcareous, oolitic, very permeable, ostracods, becomes weakly saturated 15 feet from base.

Siltstone; light green, thin bedded, calcareous.

Sandstone; light green, massive, fine grained, sub-angular, calcareous, fossil fragmental.

Section 35
C Sec. 12, T 13 S, R 23 E



Algal limestone; dark gray, massive, ostracodal, weakly saturated.
Sandstone; dark gray, flaggy, fine grained, micaceous, calcareous, weakly saturated.
Sandy siltstone; light brown, thin bedded, calcareous.

Sandstone; medium gray, massive, cross-bedded, fine grained, micaceous, limonite, calcareous, weakly saturated.

Siltstone; light green, thin bedded.

Algal limestone; white to dark gray, weathers white, large silicified algal heads, with weakly saturated ostracodal matrix.
Sandstone; light brown, massive, cross-bedded, very fine grained, micaceous, calcareous, porous and permeable.

Siltstone; light green, thin bedded, 2 feet of algal limestone with large algal heads 14 feet from base.

Sandstone; light gray to light brown, massive, cross-bedded, fine grained, micaceous, very calcareous, irregular saturation.

Siltstone; light green, thin bedded, 3 feet of algal limestone with large algal heads 27 feet from base.

Oolitic limestone; white, weathers light orange to white, large oolites, ostracodal, some thin algal layers.

Siltstone; light green, thin bedded.
Sandstone; light gray, weathers light brownish-gray, massive, cross-bedded, medium grained, poor sorting and rounding, micaceous, calcareous, porous and permeable.
Siltstone; light green, thin bedded.
Sandstone; light gray, weathers light brownish-gray, massive, cross-bedded, medium grained, poor sorting and rounding, micaceous, calcareous, porous and permeable.
Siltstone; light green, thin bedded.

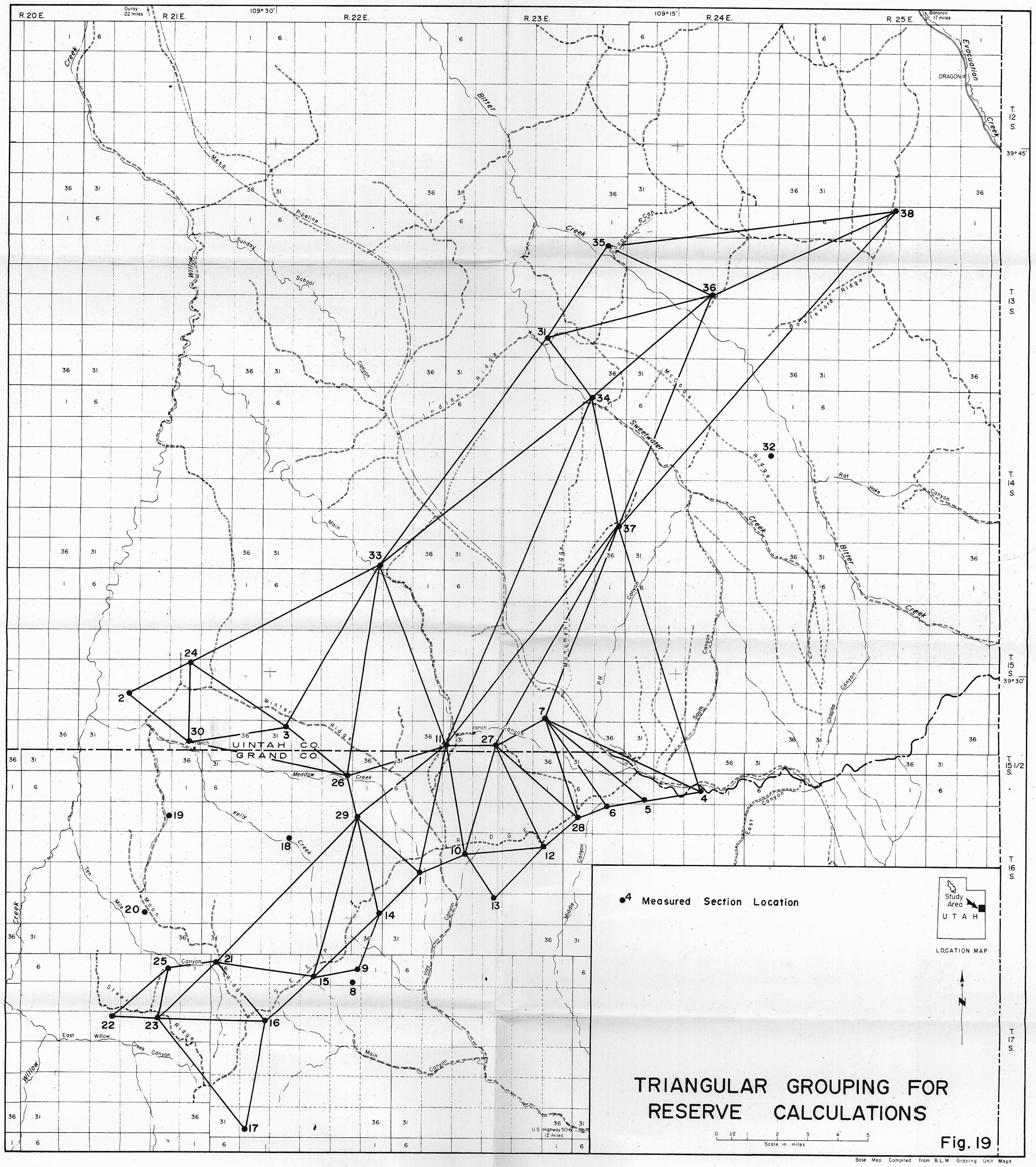
Oolitic limestone; white, weathers light orange to white, large oolites, ostracodal, some thin algal layers.

Sandstone; light brown, massive, cross-bedded, medium grained, micaceous, very calcareous, porous and permeable, fossil fragments at base, poorly sorted, larger grained toward top of unit.

Siltstone; light green, thin bedded, calcareous, satin spar stringers.

SHEET 12

Fig. 14



TRIANGULAR GROUPING FOR RESERVE CALCULATIONS

Fig. 19

Base Map Compiled from B.L.M. Grazing Unit Maps