

**FERRON OIL AND GAS FIELD
T. 20-21 S., R. 7 E.
EMERY COUNTY, UTAH**

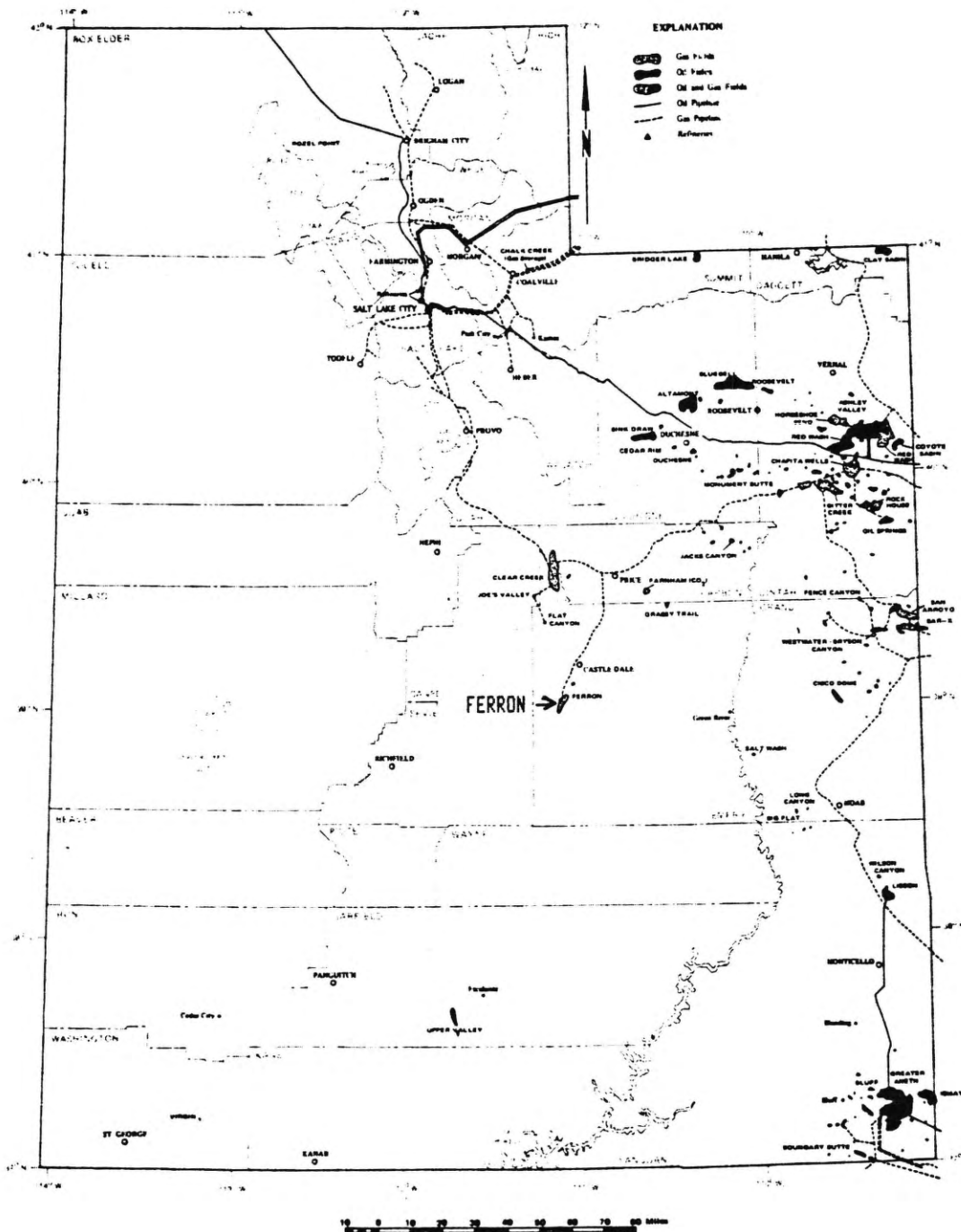
by

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UTAH GEOLOGICAL AND MINERAL SURVEY
a division of
UTAH DEPARTMENT OF NATURAL RESOURCES
OPEN-FILE REPORT 191 JULY 1990

**THE PUBLICATION OF THIS PAPER
IS MADE POSSIBLE WITH MINERAL LEASE FUNDS**

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Index map of the state of Utah showing location of the Ferron field in relation to other oil and gas fields in Utah (Adapted from Peterson, 1973).

FERRON OIL AND GAS FIELD FIELD

Townships 20-21 South, Range 7 East

Emery County, Utah

by C.N. Tripp, Consulting Petroleum Geologist

SYNOPSIS

Geologic setting: Ferron field is located in the Castle Valley, on the west flank of the San Rafael Swell. The Wasatch Plateau lies to the west.

Trap: Trapping is structural and stratigraphic within the Cretaceous Ferron Sandstone Member of the Mancos Shale.

Structural, stratigraphic, and hydrodynamic trapping occurs within the Permian Kaibab Formation.

Pay and depth: Gas is produced from the Cretaceous Ferron Sandstone Member of the Mancos Shale, and oil and gas is produced from the Permian Kaibab (Black Box Dolomite of Welsh, et al, 1979) Formation. Producing depths range from 598' to 1344' for the Ferron, and 7170' to 7712' for the Kaibab.

Surface formation and elevation: At the surface is the Cretaceous Bluegate Shale Member of the Mancos Shale. Ground level elevations are between 5813' and 6335'.

Status: Ferron field has produced gas from the Ferron since 1957. Oil production was established in 1964 from the Kaibab. Kaibab production has been shut-in for several years.

Discovery and operation: Ferron gas was discovered by American Petrofina and English Oil Company in 1957. Detailed surface mapping and a core drilling program delineating the structure preceded drilling in 1957. Kaibab oil was discovered by the Pan America Petroleum Corporation in 1964.

DISCOVERY DETAILS

Method: Detailed surface mapping and core drilling program delineated the structure, and was responsible for Ferron gas being discovered in 1957.

Discovery well (Ferron gas): American Petrofina Company discovered gas in the Ferron Sandstone Member of the Mancos Shale in the #1-22 well, located in the NE1/4 SW1/4 of Section 22, Township 20 South, Range 7 East. It was spudded April 25, 1957 and completed June 23, 1957. Elevations are: 5928' ground, 5929' derrick floor. Total depth: 1700'; plugged back to 827.5'. Casing: 10 3/4" @ 150', 8 5/8" @ 835'. Pay intervals: 625'-640' and 695'-720'. Initial potential: 1,280 mcf/d through 3" orifice gauge. Shut-in pressure: 240 psi. After 3 days, shut-in pressure was 350 psi. Total cumulative production as of September, 1989: 2.6 BCF.

Discovery well (Kaibab oil and gas): Kaibab production was established when Pan American drilled the Ferron Unit #3, in the SE1/4 NE1/4 of Section 21, Township 20 South, Range 7 East. The well was spudded March 26, 1964 and completed September 15, 1964. Elevations are: 5931' ground, 5948' kelly bushing. Total depth: 10,022', unknown plug back depth. Casing: 21" @ 36', 13 3/8" @ 504', 9 5/8" @ 6459', 5 1/2" liner from 6378'-7997', 2 3/8" tubing to 7193'. Pay interval: 7170'-7220'. Initial potential: 43 BOPD, 1107 mcf/d, 34 BWPD. Total cumulative production as of September, 1989: 36,441 BO; 1,400,420 mcf; 4141 BW. Well has been shut-in for several years; F.L. Energy has been the operator since 1982.

GEOLOGY

Regional setting: The field lies immediately south and east of the town of Ferron, Utah in east-central Utah. It is situated in the Castle Valley, on the west flank of the San Rafael Swell.

The Wasatch Plateau lies to the west.

Trap: Hydrocarbon accumulation in the Ferron Sandstone Member of the Mancos Shale is due to structural closure, as well as stratigraphic changes. The Ferron field structure is approximately six and one-half miles in length, and trends northeast-southwest (refer to well information and structural contour map). The anticlinal fold is composed of two highs; the northern high has approximately 130' of structural closure, and the southern high has approximately 70' of structural closure.

Stratigraphic changes within the Ferron Sandstone are caused by alternating sandstones and shales, which were deposited by deltaic systems (cross-sections A-A', B-B', and C-C') (Ryer and McPhillips, 1983 and Tripp, 1989). Offshore marine, prodelta, delta front, delta plain, and alluvial plain facies are present.

The source for Ferron hydrocarbons is thought to be the shales within the Ferron Sandstone Member (Quigley, 1961, and Tripp, 1989).

Trapping within the Kaibab Formation (Black Box Dolomite of Welsh, et al 1979) is considerably more complex. Production established from the Kaibab in the Kaiparowits Basin at Upper Valley (Townships 36-37 South, Ranges 1-2 East) is extremely dependent upon hydrodynamic factors (Sharp, 1976). The lack of successful drilling in east-central Utah within the Kaibab supports the argument for hydrodynamic trapping in this area as well. The lack of deep well control at Ferron makes it difficult to gain a clear structural interpretation on the Kaibab horizon, although existing control (cross-sections D-D' and E-E') indicates Paleozoic structure is different from the Cretaceous. In addition to structural and hydrodynamic factors creating trapping within the Kaibab, intraformational variations in porosity and permeability exist within the dolomitic reservoir rock (Kiser, 1976 and Goolsby, et al, 1988).

Producing zones: The majority of production occurs from the upper and middle Ferron Sandstone Member of the Mancos Shale.

The lowermost Ferron is composed of prodelta sediments in the northern part of the field, which become offshore marine in the southern portion of the field (Tripp, 1989). Because of this, most operators do not completely penetrate the Ferron.

Kaibab production is from the Beta Member of the Kaibab. Five wells tested the Kaibab at Ferron field; two were dry, two were uneconomic, and one is marginally economic.

Reservoir Lithology: The Ferron Sandstone Member is composed of a series of alternating sandstones and marine shales, deposited by deltaic systems. Facies include offshore marine, prodelta, delta front, delta plain, and alluvial plain (Ryer and McPhillips, 1983 and Tripp, 1989).

The Kaibab produces from dolomitic reservoir rock deposited in a relatively shallow-water shelf environment with zones of high-energy wave action (Kiser, 1976).

Other shows: The majority of the wells in the Ferron field are very shallow; penetration is only through the middle Ferron. Kaibab control exists in five wells in the field; shows in the Dakota Group, Chinle Formation, and White Rim Sandstone were reported from two of these Kaibab control wells, and are discussed below.

In Fossil Petroleum's Ferron Creek #2 well, (SE1/4 NE1/4 Section 17, Township 20 South, Range 7 East), a drill stem test of the Chinle Formation recovered 75' of oil. The John Lemon #1 well (SW1/4 NE1/4 Section 21, Township 20 South, Range 7 East),

drilled by F.L. Energy, had a drilling show of gas from the Dakota Group, and a drilling show of oil and gas from the White Rim Sandstone (Coconino).

Formations reported: (Pan American Ferron Unit #3 well- SE NE 21-20S-7E)

Cretaceous:	Bluegate Shale Member of the Mancos Shale	Surface
	Marker bed in Bluegate Shale Member- used as datum on stratigraphic cross-sections and contour horizon on structural contour map	535'
	Ferron Sandstone Member of the Mancos Shale	754'
	Tununk Shale Member of the Mancos Shale	1113'
	Dakota Group (includes Cedar Mountain and Morrison)	1610'
Jurassic:	Summerville Formation	2425'

	Curtis Formation	2895'
	Entrada Formation	2985'
	Carmel Formation	3875'
	Navajo Sandstone	4825'
	Kayenta Formation	5415'
	Wingate Sandstone	5625'
Triassic:	Chinle Formation	5892'
	Shinarump Conglomerate Member	6068'
	Moenkopi Formation	6153'
	Sinbad Limestone Member	6808'
	Lower Member of Moenkopi Formation	6970'
Permian:	Kaibab (Black Box Dolomite) Formation	7149'
	White Rim Sandstone (Coconino)	7300'

Pennsylvanian:	Molas Formation	7782'
Mississippian:	Redwall Limestone	7813'
Devonian:	Ouray Limestone	8112'
	Elbert Formation	8284'
Cambrian:	Lynch Dolomite	8749'
	Maxfield Limestone	9082'
	Ophir Formation	9720'
	Tintic Quartzite	9931'

(Stratigraphic Nomenclature from Hintze, 1988)

Deepest Penetration: Pan American Ferron Unit #3 well in the SE1/4 NE1/4 of Section 21, Township 20 South, Range 7 East, penetrated through the Cambrian Tintic Formation (reported tops

(CNT-11)

are listed above). Total depth was 10,022'. Completion date: 9/15/64. This well was also the Kaibab Formation discovery well.

RESERVOIR DATA

Drive: Drive within the Ferron Sandstone Member of the Mancos Shale is gas solution and water (Quigley, 1961).

Kaibab production appears to be based on a water drive mechanism (Sadighi, 1983).

Pay zone thickness: Isopach values for the Ferron Sandstone Member range from 328' to 386' within the Ferron field. Net sand values for the Ferron range from 60' to 150'. Number of net feet perforated within the Ferron ranges from 4' to 64'.

The Beta Member of the Kaibab Formation is productive at the Ferron field. Four of the five Kaibab control wells at Ferron completely penetrated the Beta Member; thicknesses range from 118' to 128'. Perforated footage ranges from 16' to 50'.

Porosity and permeability: Ferron porosity for perforated intervals ranges from 12% to 17% . Average porosity within the perforated intervals is 15%. Permeability is estimated at 14 millidarcies (Quigley, 1961).

Kaibab porosity in the Pan American Ferron Unit #3 well averages 8% for the producing zone. Kaibab porosity in other producing wells within the Ferron field is slightly less. No permeability estimates are available.

Cumulative production and estimated reserves: Ultimate reserves for the Ferron were estimated at 23 BCF by Quigley (1961). No current estimates of ultimate or recoverable reserves are available. As of December, 1989 the Ferron Sandstone Member had produced a cumulative total of 8.63 billion cubic feet of gas, and 993 barrels of water. 1989 cumulative production was 267,302 mcf.

No estimates of recoverable reserves are available for the Kaibab. Cumulative total production from the Kaibab at Ferron field as of December, 1989 was 36,742 barrels of oil, 1.4 billion cubic feet of gas, and 7,167 barrels of water. Most of this production is from the Pan American Ferron Unit #3 well. Kaibab production has been shut-in for several years.

Total cumulative production for each well as of September, 1989 is listed on the well information and structural contour map.

Reservoir pressure: Original reservoir pressure for the Ferron Sandstone Member was 420 psi (Quigley, 1961).

Shut-in pressures from drill stem test data are available for two Kaibab wells. In the Ferron #2 well (SE 1/4 NE1/4 of Section 17, Township 20 South, Range 7 East) a shut-in pressure of 2501 psi was reported. A drill stem test of the Kaibab in the Ferron Unit #5 well (NW 1/4 SE 1/4 of Section 21, Township 20 South, Range 7 East) recorded a shut-in pressure of 2482 psi.

Character of hydrocarbons: Ferron Sandstone Member gas composition: Methane= 95%, Ethane= 2%, Sulfur content is nil, gravity= .59, heating value= 1040 BTU/cubic foot (Quigley, 1961).

A detailed analysis of Kaibab oil and gas is unavailable. API oil gravity values range from 40 to 43.

DEVELOPMENT DATA

Spacing and Unit Information: In December 1957, the Utah State Board of Oil, Gas, and Mining established 320-acre drilling and spacing units for the Ferron Sandstone Member of the Mancos Shale for certain lands in Townships 20 and 21 South, Ranges 7 and 8 East. In August 1983, the State Board established 160-acre spacing units for some of the lands in Township 21 South, Range 7 East. Included in this order were: all of Sections 3, 4, 5, 8, 9, 10, 16, and 17. Also included were the east 1/2 of Sections 7 and 18. In April 1984, the north 1/2 of Section 2, Township 20 South, Range 7 East was granted 160-acre spacing. In June 1984, Cause #7-13 allowed 160-acre spacing in the following lands of Township 20 South, Range 7 East: the south 1/2 of Sections 1, 2, and 3, all of Sections 10-16, 21-23, 26-28, 33, and 34, the west 1/2 of Sections 24 and 35, and the east 1/2 of Sections 17, 20, 29, and 32. The addition of this final cause completed 160-acre spacing throughout the entire Ferron field.

No exceptions to spacing for Kaibab Formation have been requested for the lands within the Ferron field. General state spacing was changed in 1985 to 40 acres for both oil and gas wells.

Unit approval was granted November 6, 1962, with Pacific Natural Gas Exploration Company designated as the unit operator. Termination of the unit occurred July 1, 1967 (Utah Department of Natural Resources, Unit file, Ferron field).

Drilling and completion methodology: The most recent wells in the Ferron field have been drilled by Mountain Resource Corporation, and are similar in drilling methodology to the original wells drilled at Ferron field. The MRC #21 (NW 1/4 NE 1/4 of Section 10, Township 21 South, Range 7 East) was completed in November 1984. The well was drilled as follows: a 9 1/2" hole was originally drilled, and 7" surface casing set at 121'. A 6 1/4" hole was then drilled to 1080'. Geophysical logs were run, and 4 1/2" casing was run to 1050'. Perforations were made from 905'-919', and 2 3/8" production tubing was run.

Wells in the Ferron field have been drilled with air, water, fresh mud, or KCl mud. The most successful wells have been drilled with air or KCl mud. Bentonites within the Ferron are extremely susceptible to damage. When fresh mud is used, the clays swell, causing formation damage. Brine drilling with KCl mud or air drilling acts to inhibit absorption of water by the clay (Tripp, 1989).

Wells penetrating the Kaibab Formation are drilled into the Upper Moenkopi Formation with Chem-Gel. After running geophysical logs, and casing, the remainder of the well is drilled with fresh water. Geophysical logs are again run, and a liner is cemented in the bottom part of the hole. 2-3/8" production tubing is used. The most recent Kaibab well in the

Ferron field was the John Lemon #1 well (SW 1/4 NE 1/4 of Section 21, Township 20 South, Range 7 East. This well was drilled in 1983 by F.L. Energy. Initial hole size was 14 3/4". 10 3/4" surface casing was run to 186'. A 9 1/2" hole was then drilled to 6400', intermediate geophysical logs were run, and 7 5/8" casing was set at 6389' in the Upper Moenkopi Formation. A 6 1/2" hole was then drilled to total depth in the White Rim Sandstone. Geophysical logs were again run over this lowermost interval, and a 4 1/2" liner was run to 7642'. After perforating, and acidizing (500 gallons of 7 1/2% HCl), production was established in the zone 7308'-7324'. 2 3/8" tubing was run to 7280'.

Logging practice: Most wells have a complete suite of geophysical logs: resistivity, gamma ray, spontaneous potential, and some kind of porosity log (sonic, neutron, or density).

Individual operators vary in their preference of logging companies, and porosity log combinations; most wells have a neutron/density log, while a sonic porosity log is not as common.

(CNT-17)

Water disposal: Ferron Sandstone wells have produced very little water. Total cumulative water production from the Ferron is only 993 barrels of water. The majority of this water appears to represent load water which is being recovered in the very earliest stages of production. It does not appear that formation water is a problem.

The Kaibab has produced a total of 7167 barrels of water. Kaibab production has been shut-in for several years, and it is assumed the produced water was evaporated.

Market: The Ferron Sandstone gas flows into Questar Pipeline Company's (previously Mountain Fuel Supply Company) lines.

Kaibab production has been shut-in for several years, and it is assumed the gas was transported by the Questar Pipeline Company (Mountain Fuel Supply), and the oil separated on location. The purchaser of the oil is unknown.

DISCUSSION

During the drilling boom of the early to mid- 1980's, activity in the Ferron field surged. Mountain Resource Corporation was the dominant operator, drilling 19 new wells;

F.L. Energy drilled 4 wells. Unfortunately, market conditions changed, and small operators like Mountain Resource and F.L. Energy experienced great difficulty marketing their new resources. Mountain Resource Corporation's wells are now owned and operated by Questar. All of Ferron field gas flows into Questar Pipeline Company's lines.

Increased drilling activity not only at Ferron field, but throughout east-central Utah created a wealth of data, and allowed explorationists to enhance their understanding of Ferron Sandstone Member deposition. Numerous deltaic systems existed along the Cretaceous shoreline during Ferron time. Recognizable facies on the outcrop, and in geophysical logs include offshore marine, prodelta, delta front, delta plain, and alluvial plain. Ferron sediments originated in the Sevier highlands to the west, from which channel systems flowed eastward into the river dominated deltaic systems along the western margin of the Cretaceous seaway in east-central Utah (Ryer and McPhillips, 1983; Tripp, 1989).

Trangressive events along the Cretaceous seaway were caused by thrust emplacement in the hinterland to the west, during the Sevier orogeny. Thrust emplacement in the hinterland caused tectonic loading in the foreland, which produced a subsiding foreland basin, with a correlative forebulge (San Rafael Swell) (Villien and Kligfield, 1986; Tripp, 1989). During tectonic quiescence, regression of the shoreline occurred.

The deltaic depositional environment is responsible for significant stratigraphic variation within the Ferron Sandstone Member of the Mancos Shale. In addition to stratigraphic entrapment potential at the Ferron field, Laramide folding created the anticlinal structure which controls much of the production at the Ferron field.

Some abandoned wells with excellent reservoir development within the Ferron Sandstone Member are present within the Ferron field and east-central Utah. Most typically, these wells were drilled with fresh mud systems, resulting in irreparable formation damage to the Ferron Sandstone Member reservoirs. A review of drilling methodologies demonstrates the necessity of drilling Ferron Sandstone Member wells with air or a KCl based mud system to prevent swelling of the bentonites within the Ferron.

It is the author's belief that significant Kaibab potential remains within the Ferron field. Exploitation of this resource will require an integrated approach addressing hydrodynamic factors, structural concerns, and intraformational variations in porosity and permeability.

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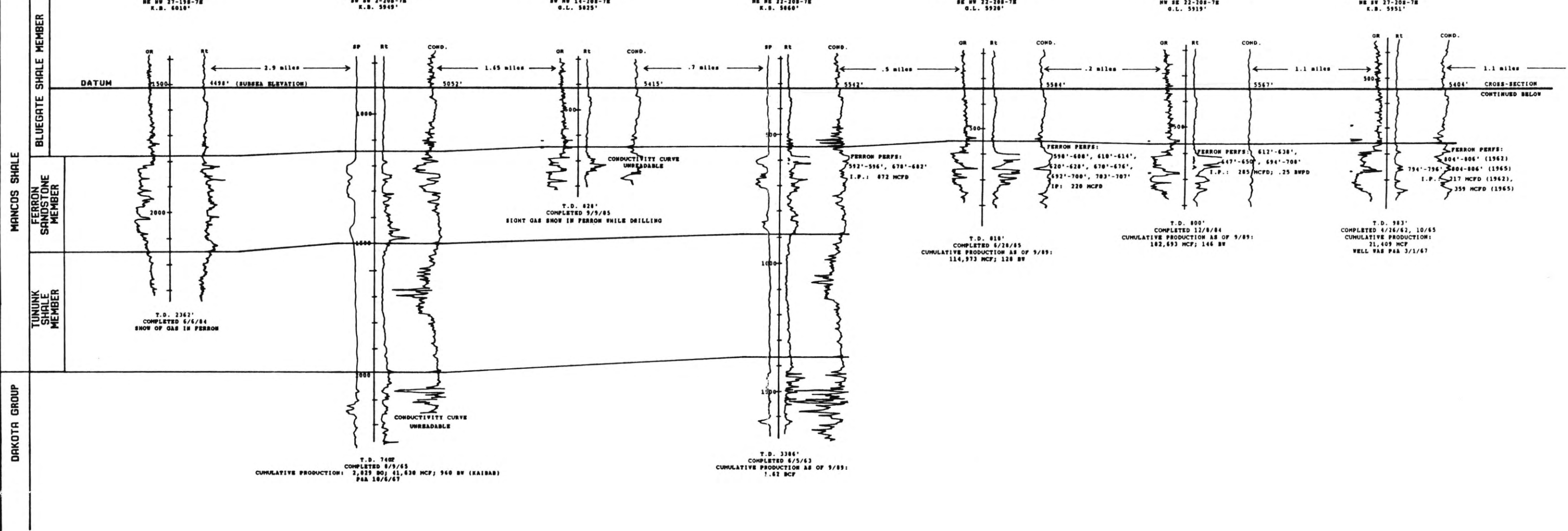
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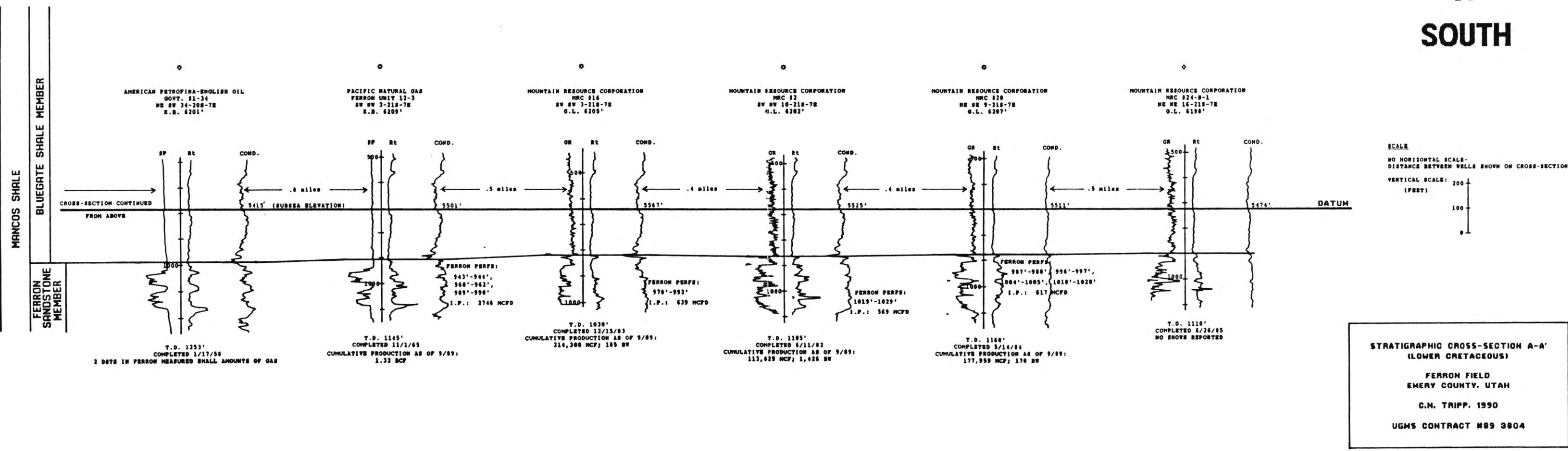
NORTH

CRETACEOUS



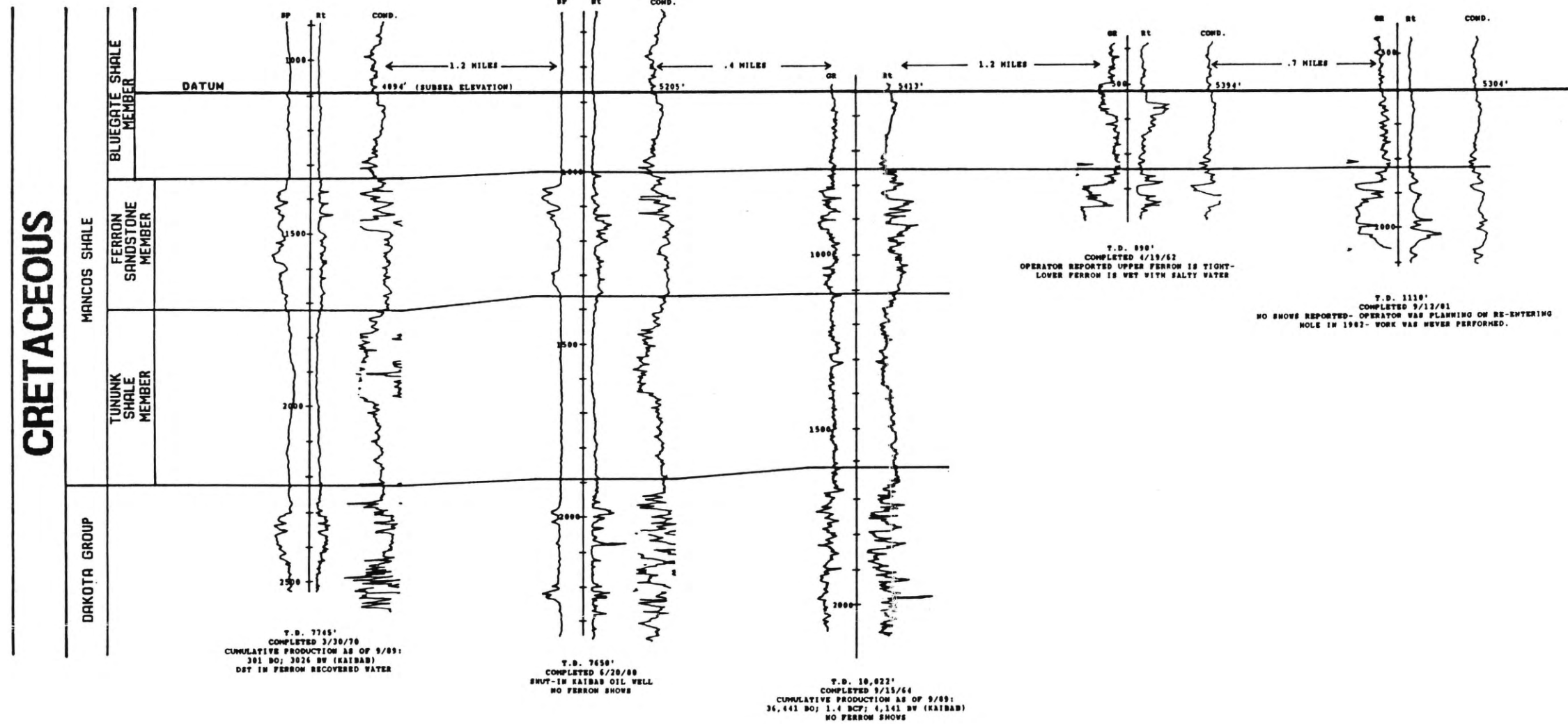
A'
SOUTH

CRETACEOUS



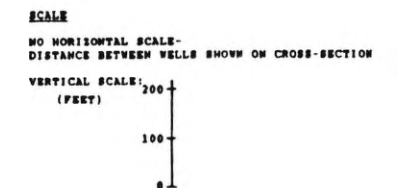
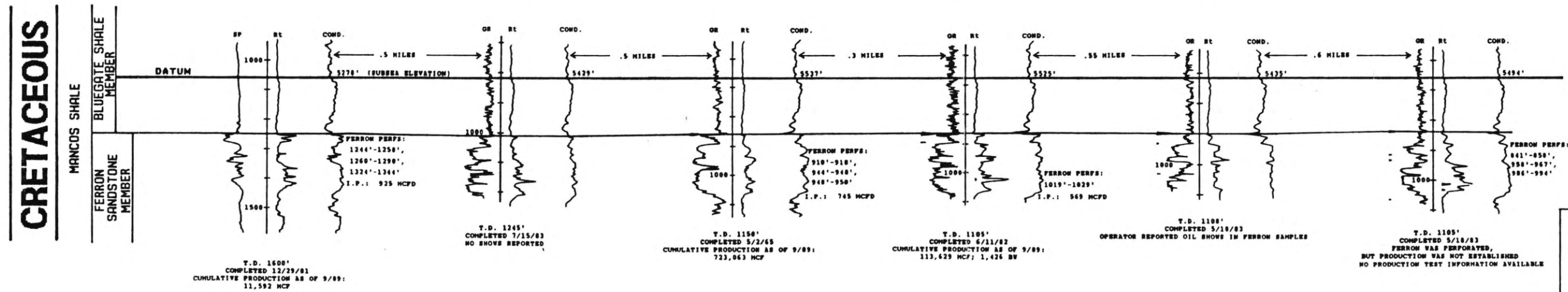
B
NORTHWEST

B'
SOUTHEAST



C
WEST

C'
EAST



STRATIGRAPHIC CROSS-SECTIONS B-B' AND C-C'
(LOWER CRETACEOUS)

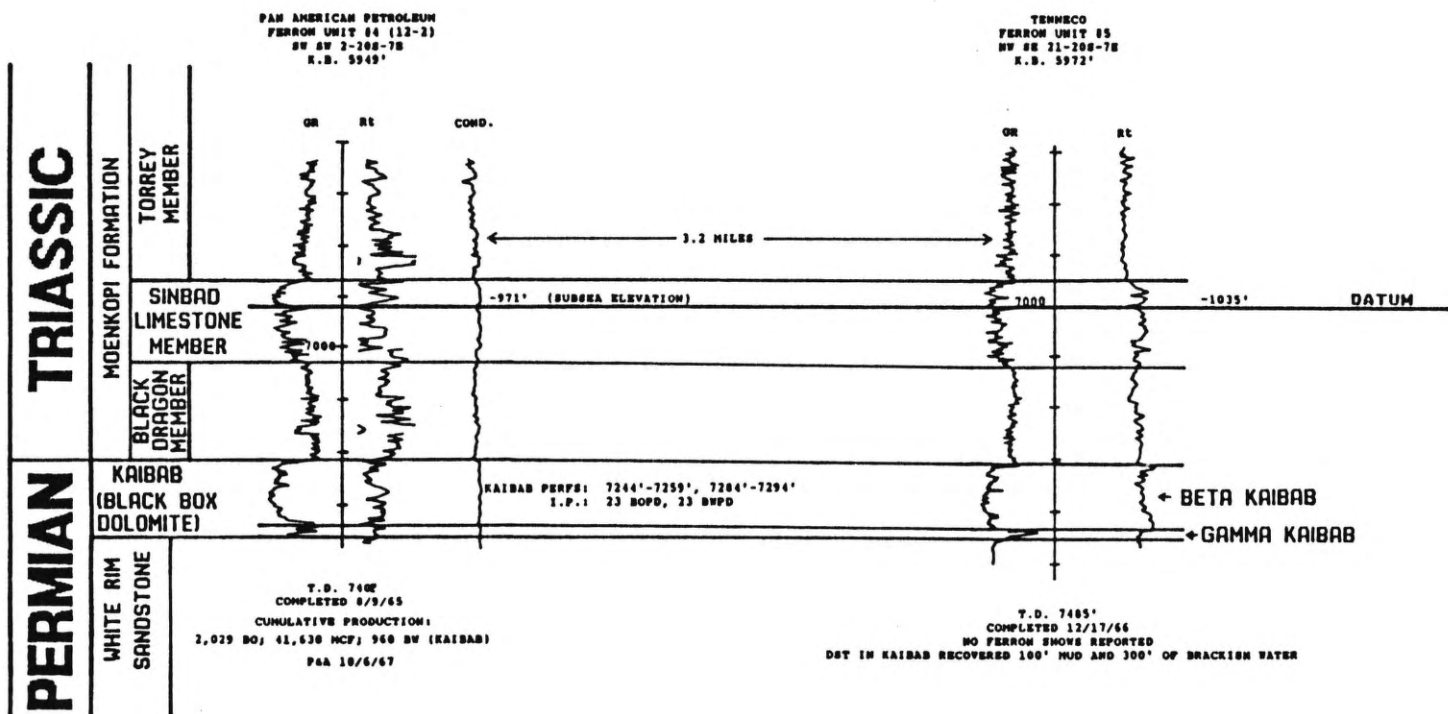
FERRON FIELD
EMERY COUNTY, UTAH

C.N. TRIPP, 1990

UGMS CONTRACT #89 8804

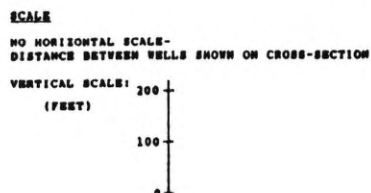
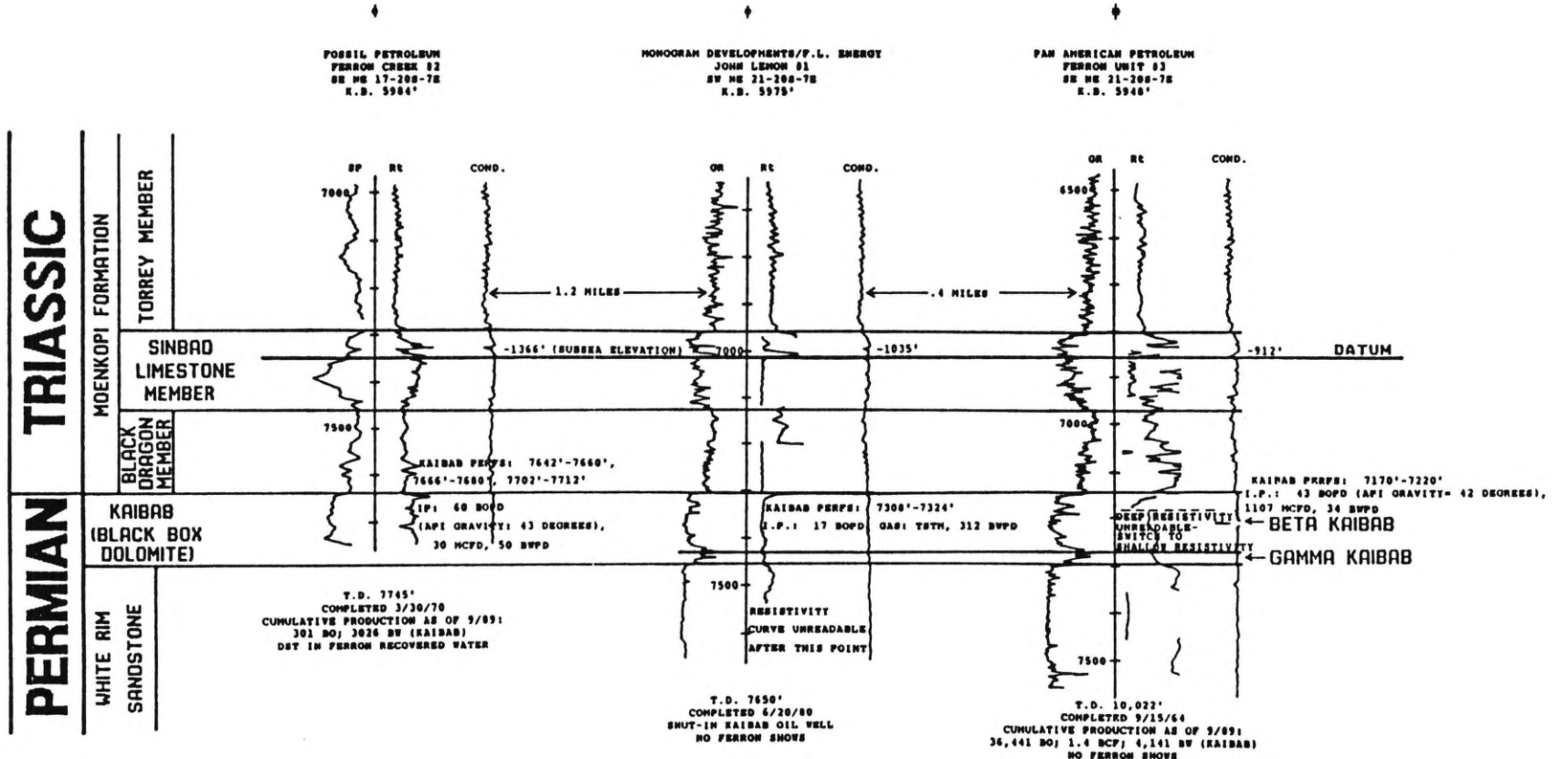
D
NORTHEAST

D'
SOUTHWEST



E
NORTHWEST

E'
SOUTHEAST

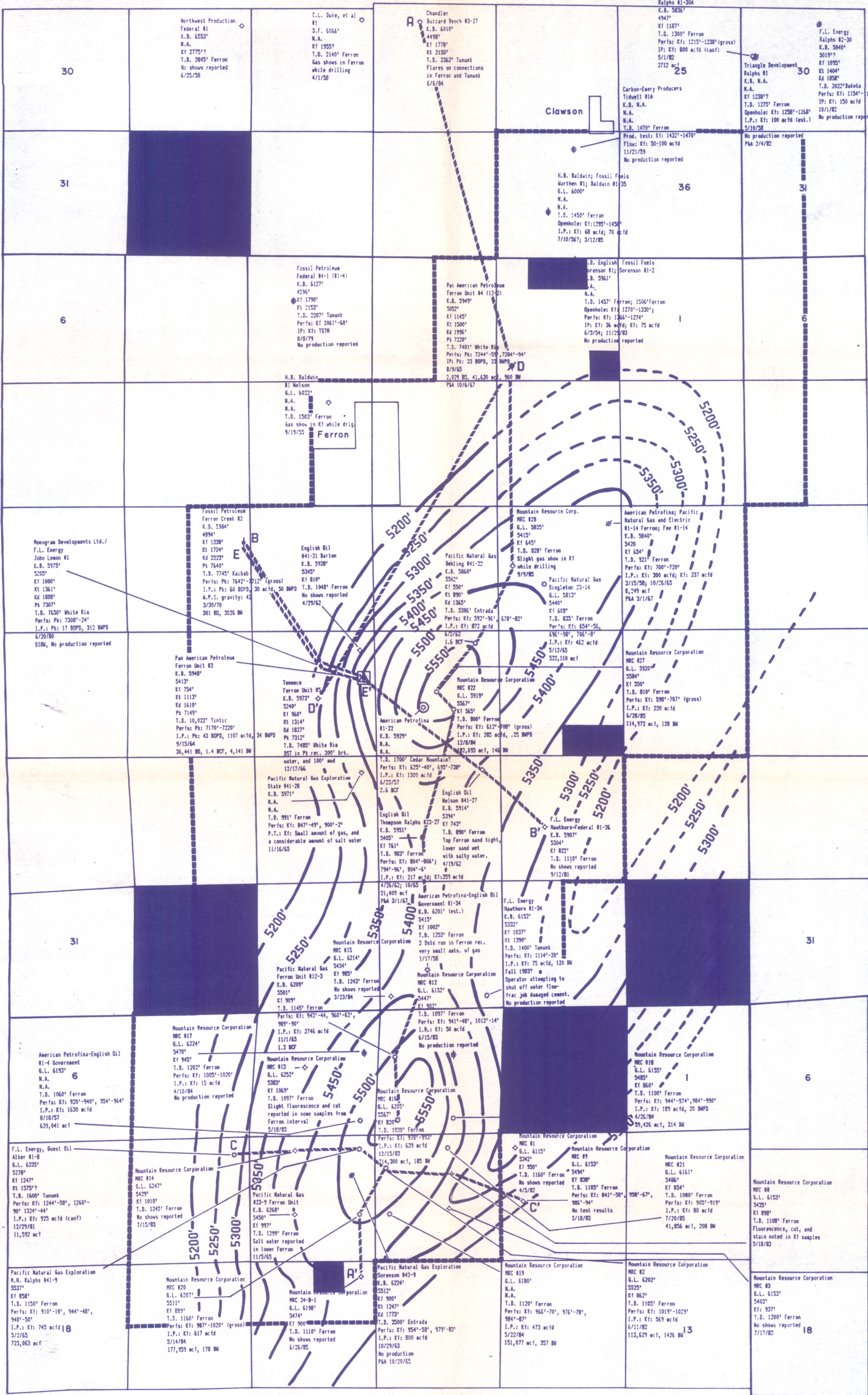


STRATIGRAPHIC CROSS-SECTIONS D-D' AND E-E' (LOWER TRIASSIC THROUGH PERMIAN)

FERRON FIELD
EMERY COUNTY, UTAH

C.N. TRIPP, 1990

UGMS CONTRACT #89 3804



EXPLANATION FOR PRODUCTIVE WELLS

Mountain Resource Corporation
 NRC 82
 G.L. 6202'
 5525'
 K.F. 862'
 T.B. 1105' Ferron
 Perfs: Kf: 1019'-1029'
 I.P.: Kf: 569 acf
 6/11/82
 113,629 acf, 1425 BW

Operator
 Well Name
 Elevation
 Subsea value of Bluegate marker bed
 Depth to specific horizon (Kf= Ferron)
 Total depth, and formation at total depth
 Formation and perforations
 Initial potential, formation, flow
 Completion date
 Cumulative production as of September, 1989

EXPLANATION FOR NON-PRODUCTIVE WELLS

Mountain Resource Corporation
 NRC 83
 G.L. 6153'
 5402'
 K.F. 937'
 T.B. 1200' Ferron
 No shows reported
 7/17/82

Operator
 Well Name
 Elevation
 Subsea value of Bluegate marker bed
 Depth to specific horizon (Kf= Ferron)
 Total depth, and formation at total depth
 Hydrocarbon show information
 Completion date

WELL SYMBOLS:

- Dry and abandoned well
- ◊ Dry and abandoned well with a show of oil
- ◊ Dry and abandoned well with a show of gas
- ◊ Dry and abandoned well with a show of oil and gas
- Gas well
- ◊ Gas well with a show of oil
- ◊ Shut-in gas well
- ◊ Plugged and abandoned gas well
- Oil well
- ◊ Oil well with a show of gas
- ◊ Shut-in oil well
- ◊ Plugged and abandoned oil well
- ◊ Gas and oil well

FORMATION ABBREVIATIONS:

- Kf: Cretaceous Ferron Sandstone Member
- Ks: Cretaceous Tamm Shale Member of the Bancos Shale
- Kd: Cretaceous Dakota Group
- Pf: Permian Kaibab Formation
- Ferron Discovery Well
- △ Kaibab Discovery Well
- Well With Deepest Penetration
- ▭ Original Unit Outline
- State Land
- Stratigraphic cross-section lines

STRUCTURAL CONTOUR AND WELL INFORMATION MAP OF THE FERRON FIELD

Erry County, Utah

Structural Datum: Marker bed within the Bluegate Shale Member of the Bancos Shale (see stratigraphic cross-sections)

50' Contours
 Scale= 1:24,000
 C.N. Tripp, 1990
 URS Contract 889 3004

N.A.: Not Available
 Note: Information for wells completed more than once is separated by semi-colons (;).