Field Examples of Fracturing and Drainage

by Kurt Rottmann

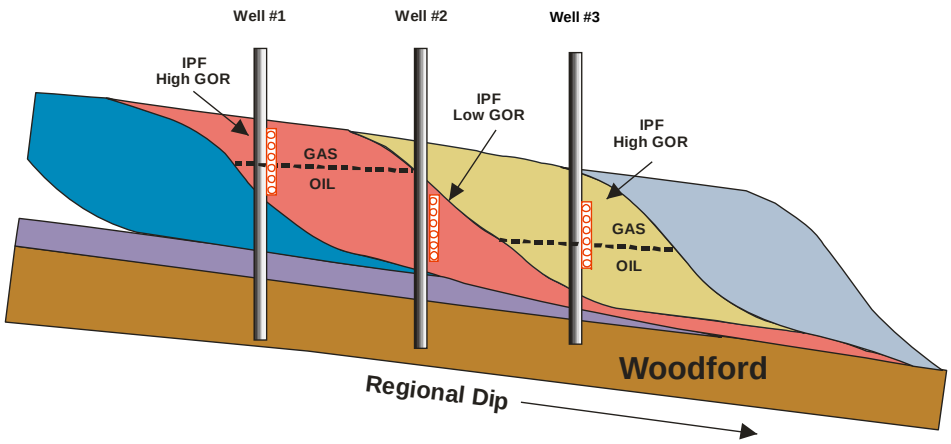
- Goals
  - Understand fracture patterns in the Mississippian Osage
  - Review older fracture identification logs
  - Review fracture components to volumetric OOIP calculations
  - Recommendations on mapping the Mississippian Osage
  - Review drainage patterns with possible frac implications

Paradoxes to Mississippian Production

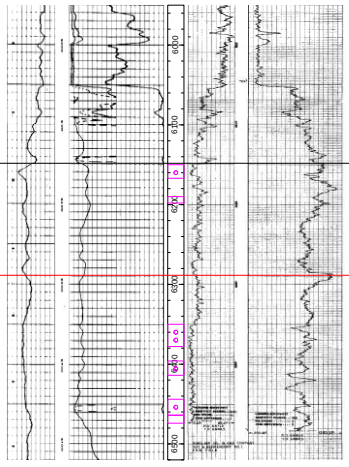
- Why do accumulations of oil and gas appear to follow no distinct law of gravitational separation?
- Do fracture systems connect the entire Mississippian section to create a common source of supply?

Harp (1965)

Hydrocarbon Separation Paradox as seen in the NE Enid Field



35047018220000
BANKERDORF ROY A
1
T22N R6W S1
C NW NW
1,205
352OSGE



Meramec

Osage

2nd Perf 6150-98 and treated with acid,

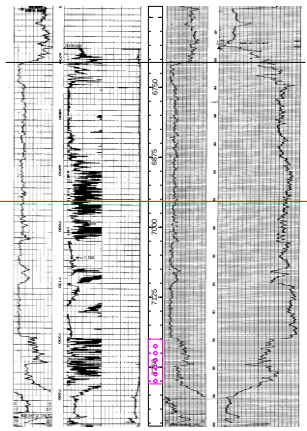
Ip 2,525 mcf/day, and 24 bbls of 54.5 api condensate, 26/64" choke, ftp 1025 psi and gor of 105,000/1

1st perf- 6350-6464 and treated

Ip 160 bbls/day 37.5 api oil, 20/64" choke, ftp 100psi and gor of 532-1

64,740
1,920,429
5/23/1962

35003001030001
ENCIE MCCUNE
1
T23N R10W S7
C NE SE
H & H SUPPLY COMPANY
359MSSP

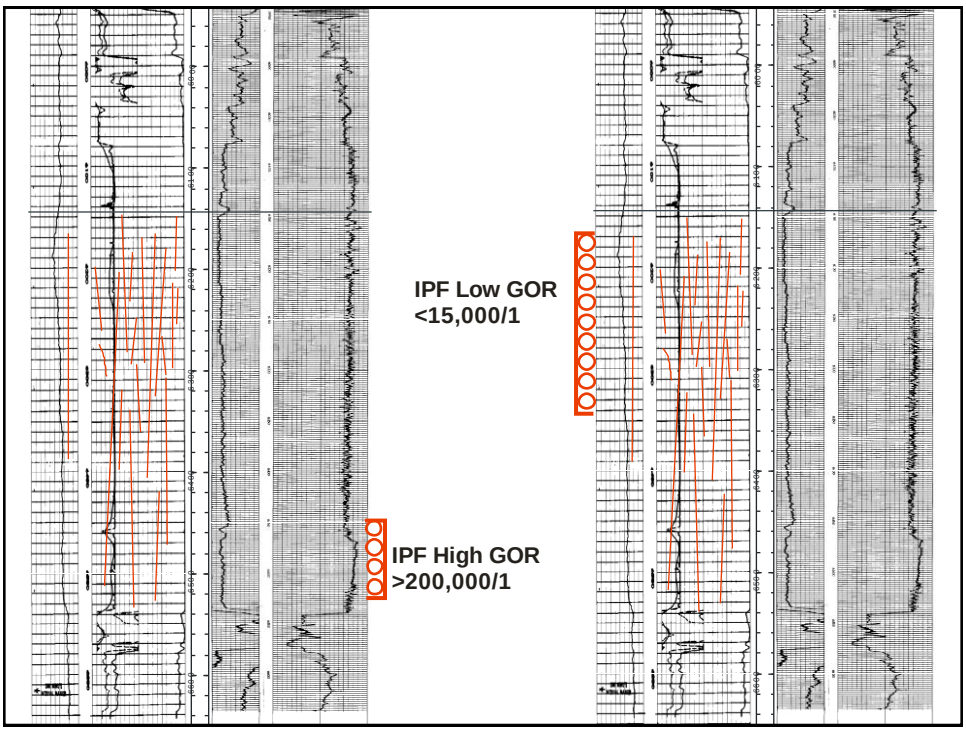


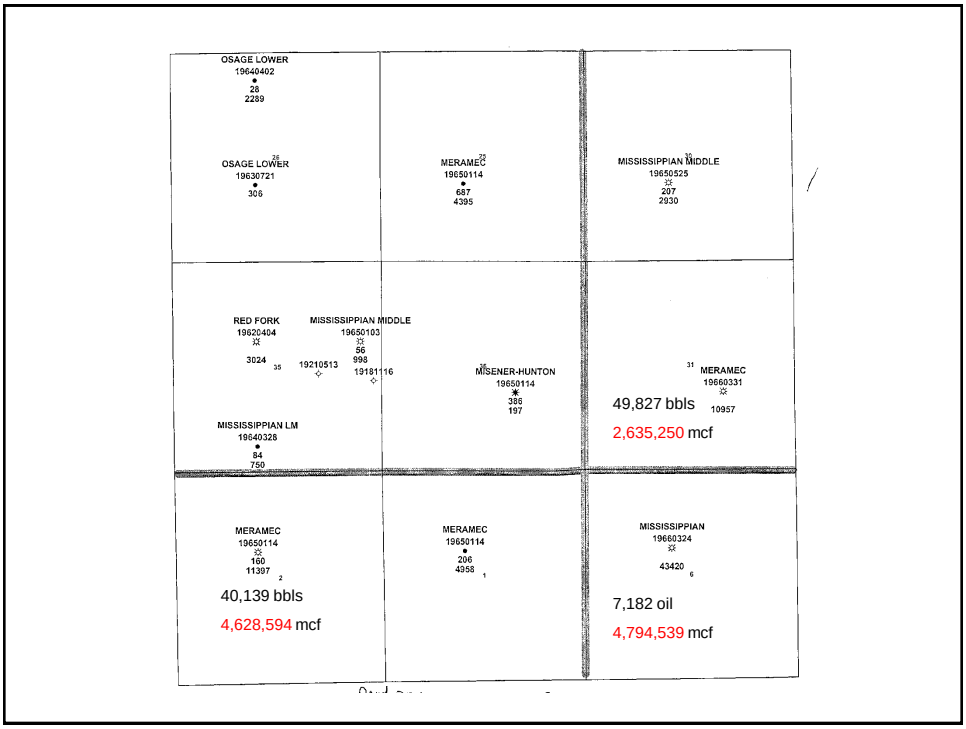
1961- Perf 6680-6759
90 bbls/day 38 api oil,
220 Mcf, ftp 100

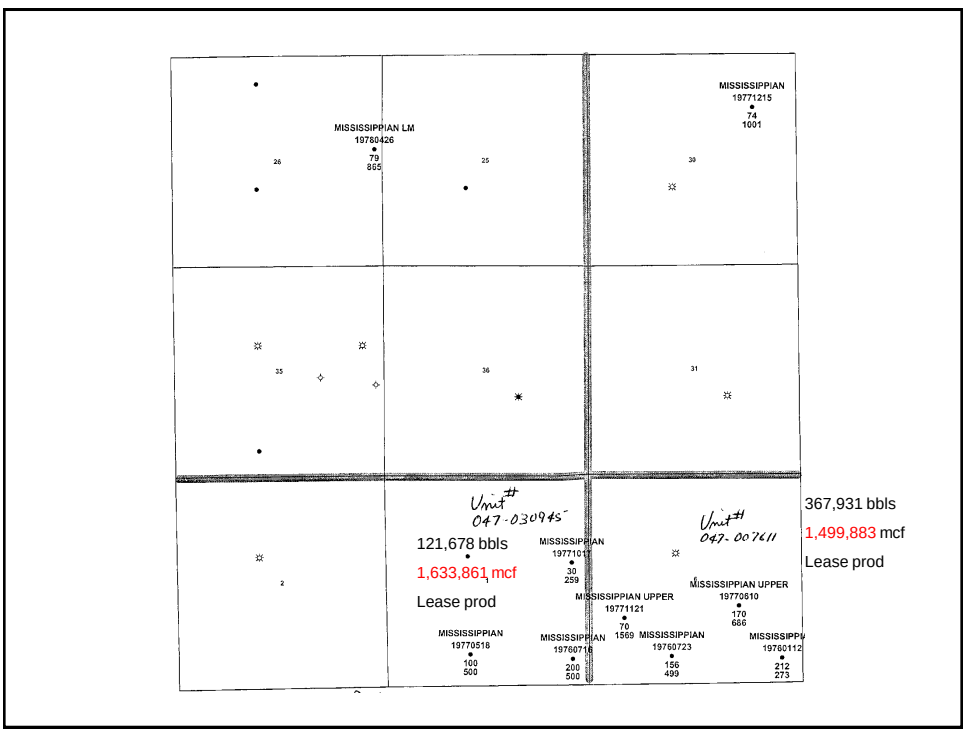
1964 perf 7200-7280

206 bbls/day 38.2 api oil
68 bbls water

9,868
1,387
4/12/1964
7,500
206
68



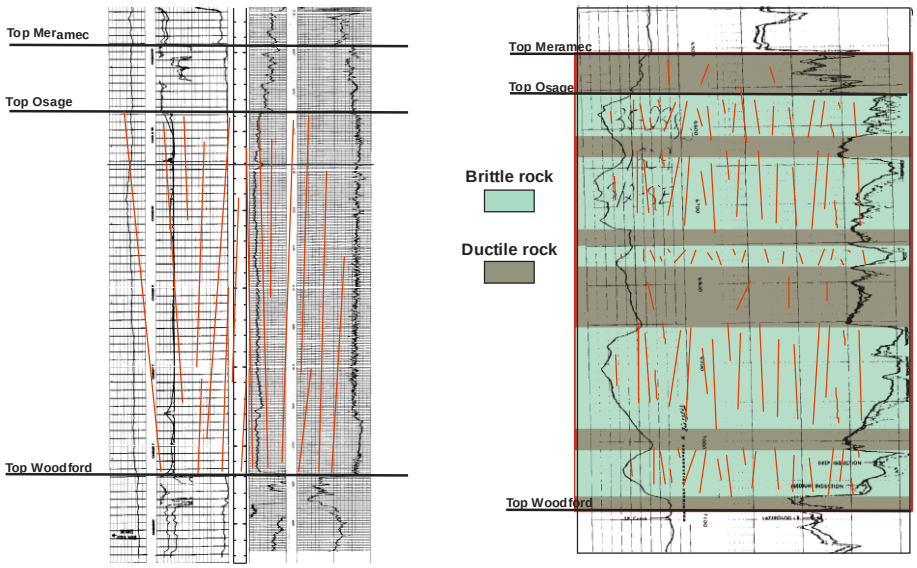

OSAGE LOWER
19640402
28
2289
OSAGE LOWER
19630721
306
MERAMEC
19650114
687
4395
MISSISSIPPIAN MIDDLE
19650525
207
2930
RED FORK
19620404
3024
MISSISSIPPIAN MIDDLE
19650103
56
998
19210513
19181116
MISENER-HUNTON
19650114
386
197
MERAMEC
19660331
10957
49,827 bbls
2,635,250 mcf
MISSISSIPPIAN LM
19640328
84
750
MERAMEC
19650114
160
11397
40,139 bbls
4,628,594 mcf
MERAMEC
19650114
206
4958
MISSISSIPPIAN
19660324
43420
7,182 oil
4,794,539 mcf


MISSISSIPPIAN LM
19760426
79
865
MISSISSIPPIAN
19771215
74
1001
Unit#
047-030945
121,678 bbls
1,633,861 mcf
Lease prod
MISSISSIPPIAN
19771011
30
259
Unit#1
047-007611
367,931 bbls
1,499,883 mcf
Lease prod
MISSISSIPPIAN UPPER
19770610
170
686
MISSISSIPPIAN UPPER
19771121
70
1569
MISSISSIPPIAN
19770518
100
500
MISSISSIPPIAN
19760716
200
500
MISSISSIPPIAN
19760723
156
499
MISSISSIPPI
19760112
212
273

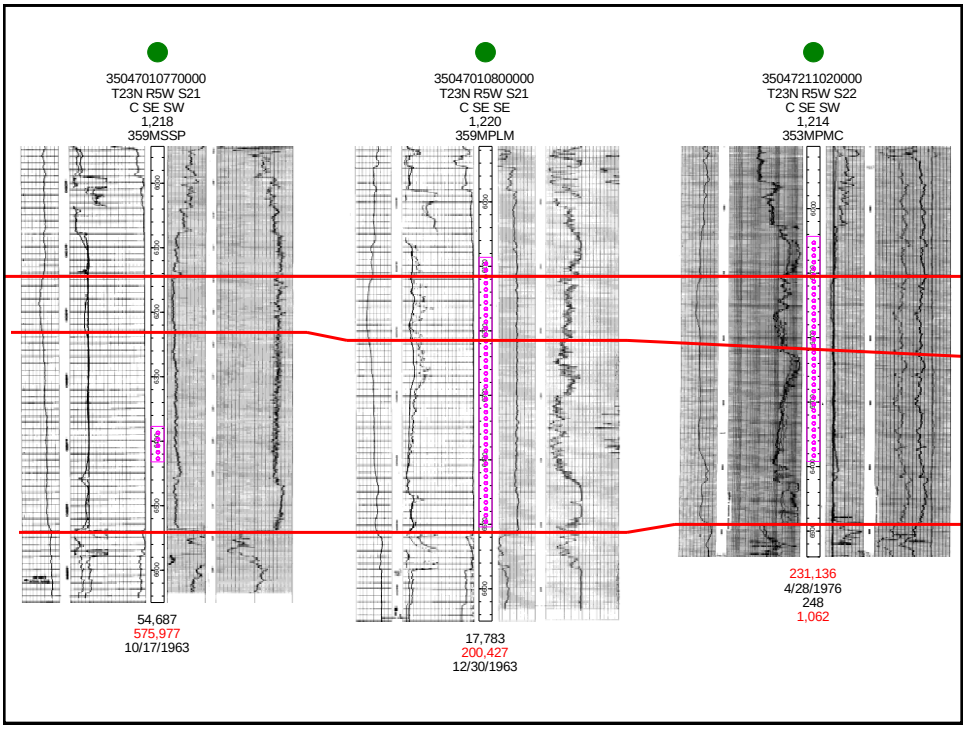
Paradoxes to Mississippian Production

- Why do accumulations of oil and gas appear to follow no distinct law of gravitational separation?
- Do fracture systems connect the entire Mississippian section to create a common source of supply?

Harp (1965)



Fracture Orientation and Extent

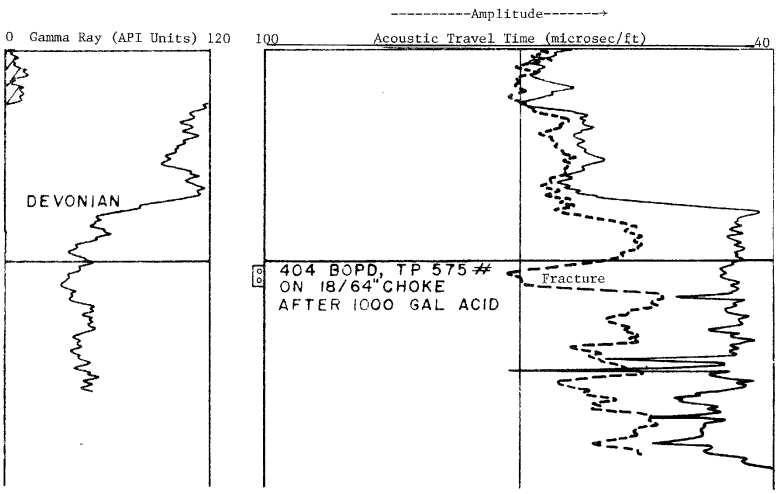


Field Examples of Fracturing and Drainage

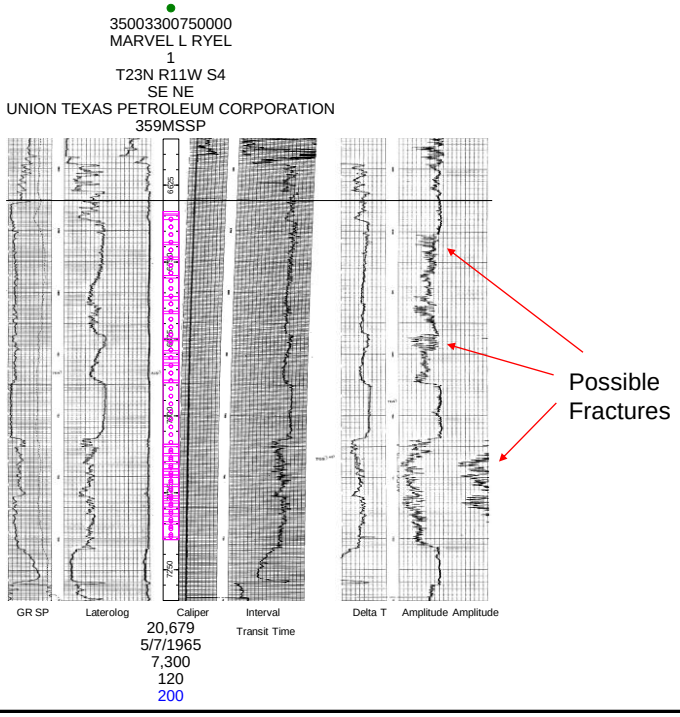
by Kurt Rottmann

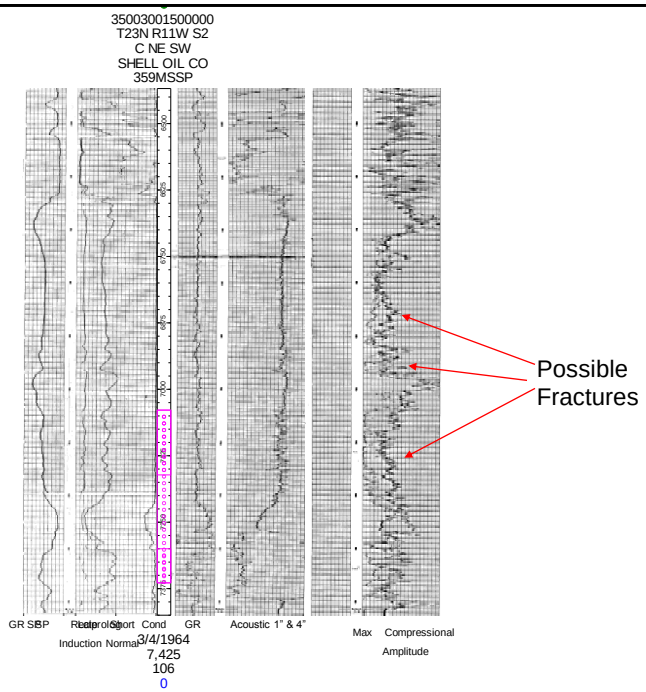
- Goals
  - Understand fracture patterns in the Mississippian Osage
  - Review older fracture identification logs
  - Review fracture components to volumetric OOIP calculations
  - Recommendations on mapping the Mississippian Osage
  - Review drainage patterns with possible frac implications

Figure 16-5 Fracture finding with an acoustic amplitude and travel time log (courtesy Welex)



Hilchie, 1982, Fig 16-5, Reprinted by permission of Douglas W. Hilchie, Inc.





Field Examples of Fracturing and Drainage

by Kurt Rottmann

- Goals
  - Understand fracture patterns in the Mississippian Osage
  - Review older fracture identification logs
  - Review fracture components to volumetric OOIP calculations
  - Recommendations on mapping the Mississippian Osage
  - Review drainage patterns with possible frac implications

Hilchie, D.W., 1982

- "**Density and neutron logs generally do not see fractures conclusively. The .5 to 1.5 % porosity increase is almost impossible to see on these logs unless the matrix porosity is very low and constant**. Once in a while if the formation is badly fractured these logs will show an abnormally high porosity due to the "streaming" of the gamma rays and neutrons up toe fracture. This streaming phenomena has been noticed in surface test pits. The density log correction curve will sometimes pick up a fracture as an increase in correction. In any of these cases the identification is not conclusive."

Volumetric Calculations

- 2% matrix porosity
- 30% water saturation
- 40 foot payzone
- 40 acre drainage
- FVF 1.25

- OOIP 139,023 BO
- 10% Rf ~14,000 BO

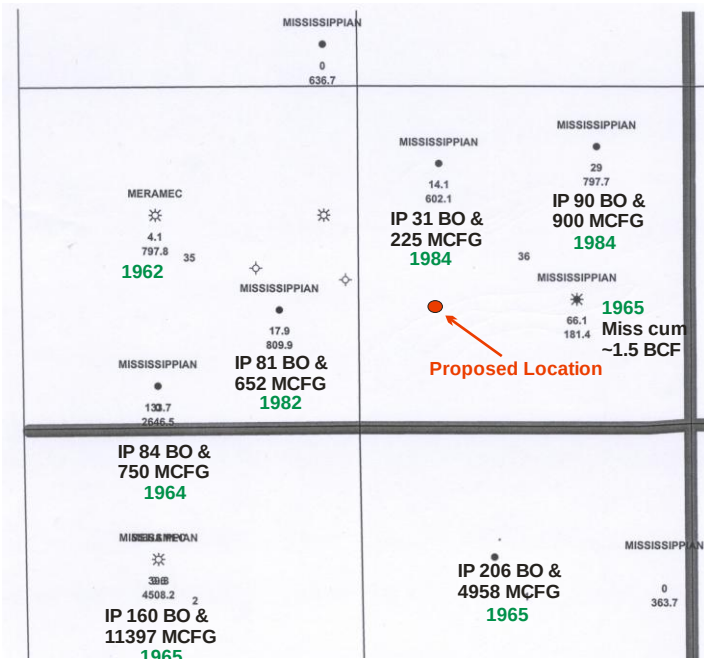
- 4% por w/ frac
- 30% water saturation
- 40 foot payzone
- 40 acre drainage
- FVF 1.25

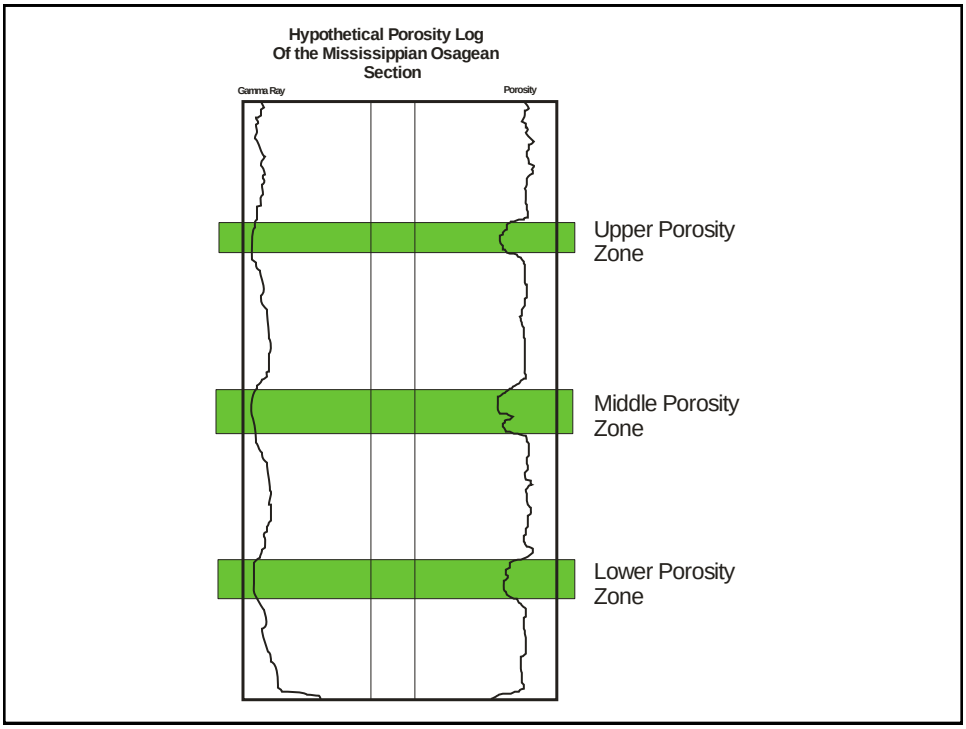
- OOIP 278,046 BO
- 10% Rf ~ 29,000 BO

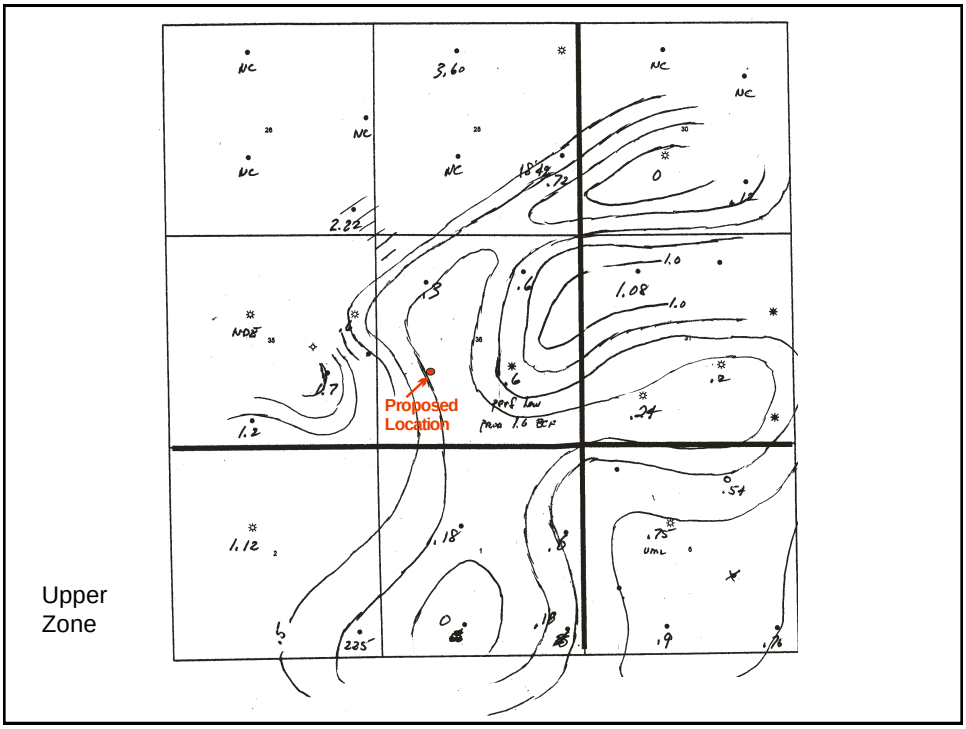
Field Examples of Fracturing and Drainage

by Kurt Rottmann

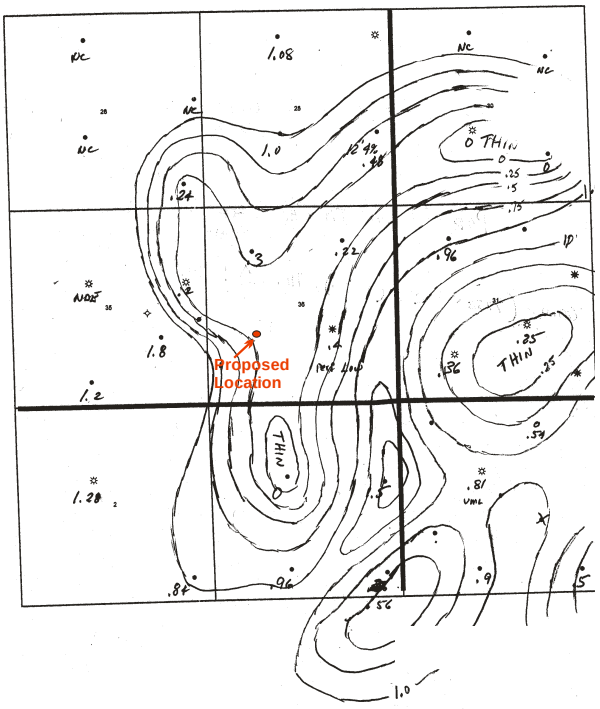
- Goals
  - Understand fracture patterns in the Mississippian Osage
  - Review older fracture identification logs
  - Review fracture components to volumetric OOIP calculations
  - Recommendations on mapping the Mississippian Osage
  - Review drainage patterns with possible frac implications



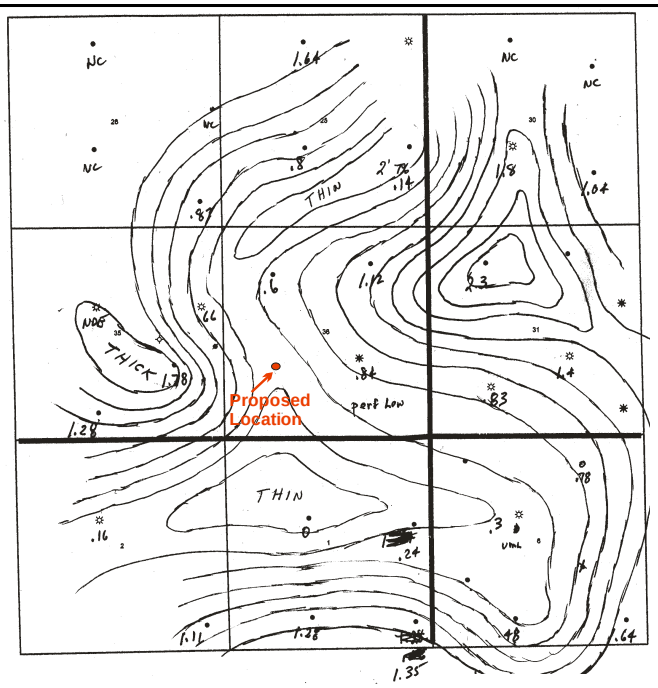

Hypothetical Porosity Log
Of the Mississippian Osagean
Section
Gamma Ray
Porosity
Upper Porosity
Zone
Middle Porosity
Zone
Lower Porosity
Zone

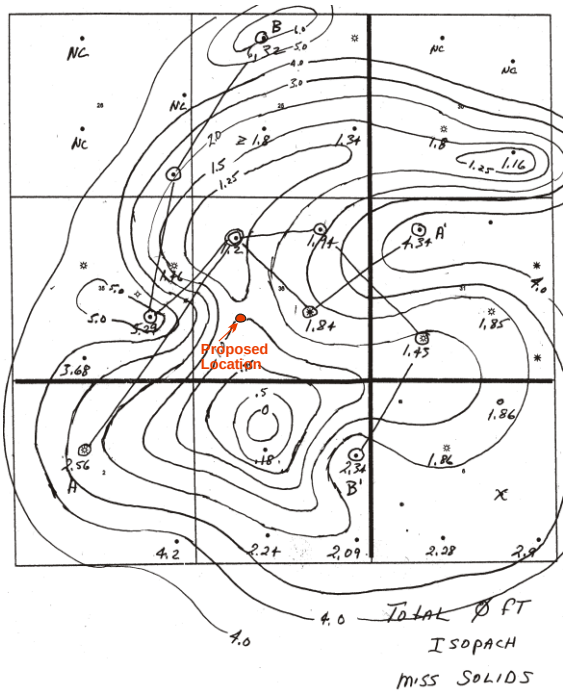

Proposed
Location
Upper
Zone

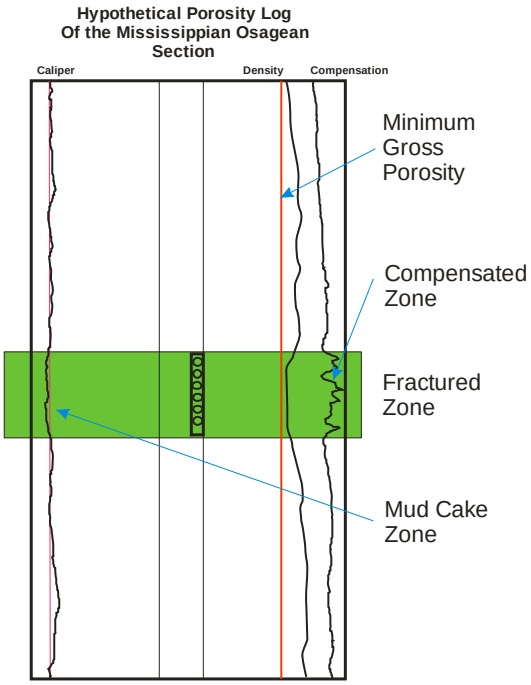
Middle Zone



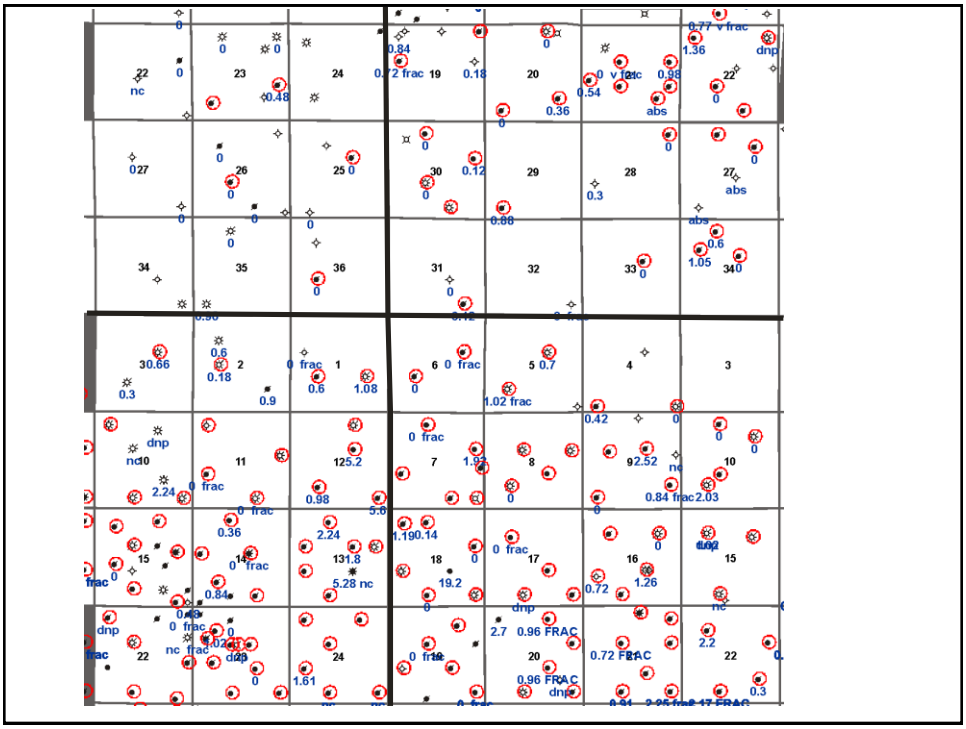
Lower Zone

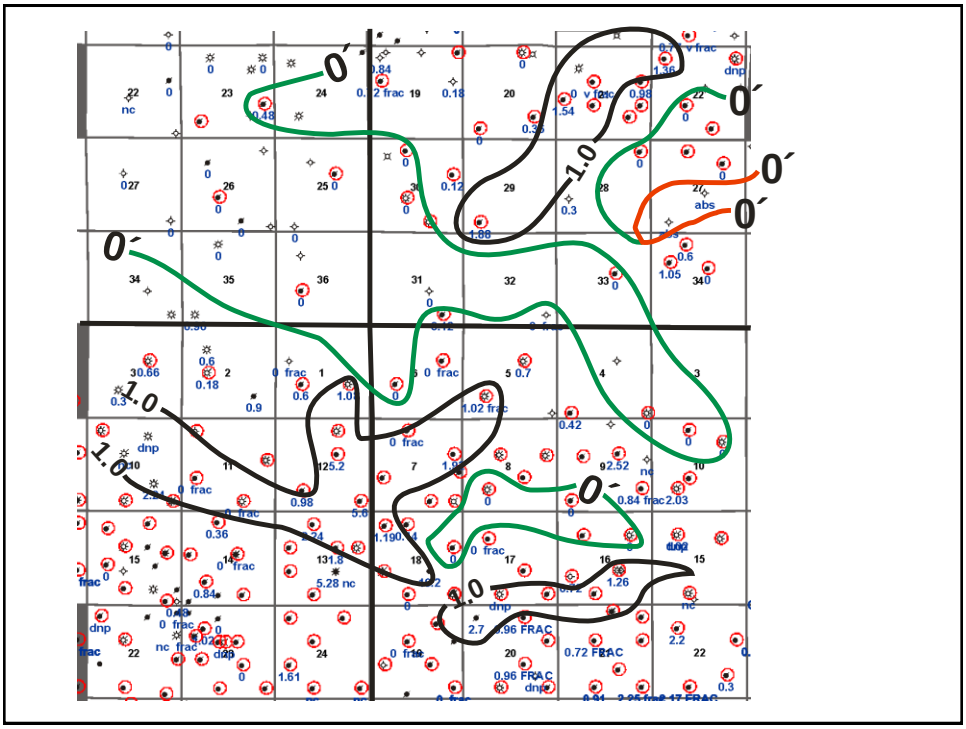






Cumulative Production 40,000 BO + 1.4 BCFG

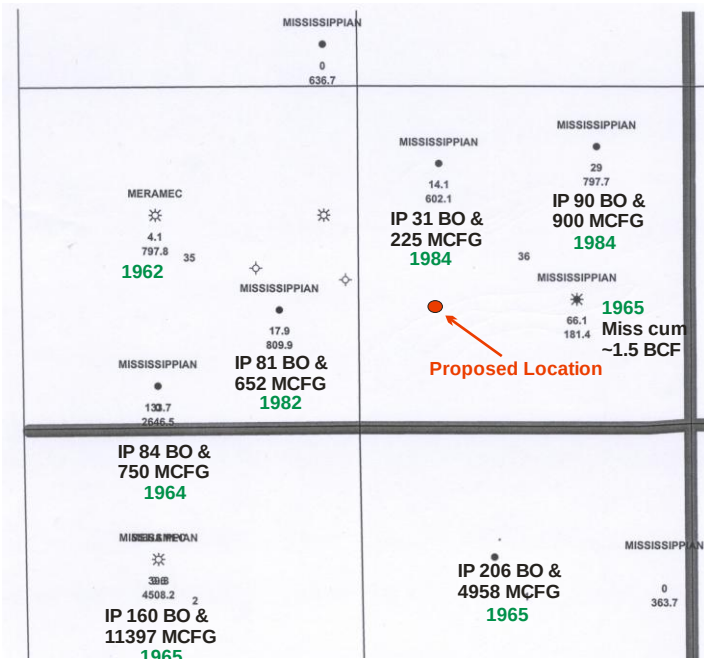


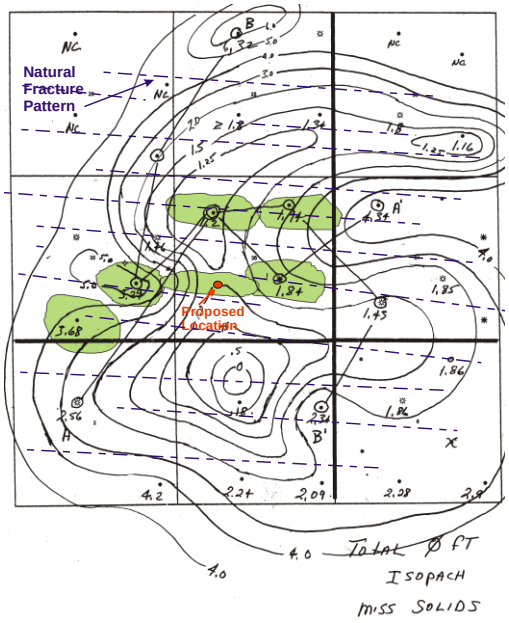

0´
1.0
0´
0´
0´
1.0
1.0
0´
1.0

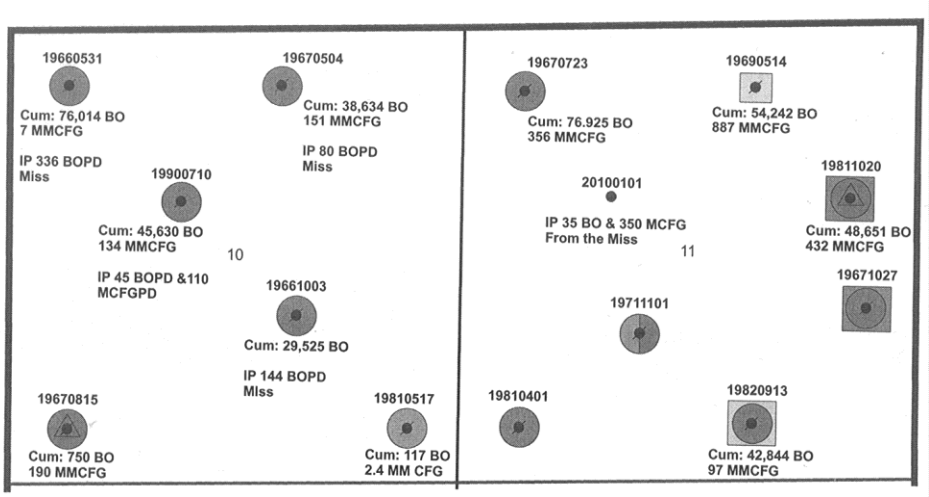
Field Examples of Fracturing and Drainage

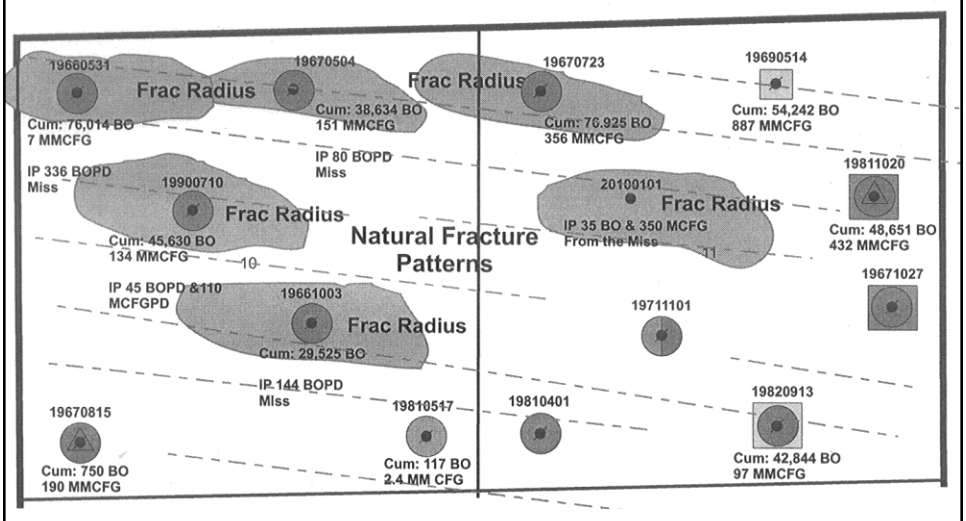
by Kurt Rottmann

- Goals
  - Understand fracture patterns in the Mississippian Osage
  - Review older fracture identification logs
  - Review fracture components to volumetric OOIP calculations
  - Recommendations on mapping the Mississippian Osage
  - Review drainage patterns with possible frac implications




Natural
Fracture
Pattern
Proposed
Location
Total Ø FT
ISOPACH
MISS SOLIDS


19660531
Cum: 76,014 BO
7 MMCFG
IP 336 BOPD
Miss
19900710
Cum: 45,630 BO
134 MMCFG
IP 45 BOPD &110
MCFGPD
19670504
Cum: 38,634 BO
151 MMCFG
IP 80 BOPD
Miss
10
19661003
Cum: 29,525 BO
IP 144 BOPD
Miss
19670815
Cum: 750 BO
190 MMCFG
19810517
Cum: 117 BO
2.4 MM CFG
19670723
Cum: 76.925 BO
356 MMCFG
19690514
Cum: 54,242 BO
887 MMCFG
20100101
IP 35 BO & 350 MCFG
From the Miss
11
19811020
Cum: 48,651 BO
432 MMCFG
19671027
19711101
19810401
19820913
Cum: 42,844 BO
97 MMCFG



References

- Harp, L.J., 1965, Mississippian Trend, Garfield, Major and Alfalfa Counties, Oklahoma, The Western Company, Oklahoma City, OK
- Hilchie, D.W., 1982, Applied Openhole Log Interpretation for Geologists and Engineers, Douglas W. Hilchie, Inc, Golden Colorado, page 16-8