

# **Parshall Field, North Dakota—Discovery of the Year for the Rockies and Beyond\***

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## **Abstract**

Parshall Field, a Bakken reservoir, located in Mountrail County, North Dakota, is the discovery of the year for the Rockies. Discovered in 2006 by EOG Resources, it is an unusual and complex, stratigraphic-type trap. It has developed into a huge resource play covering some 40 townships, over 950,000 acres, and still expanding. The North Dakota Department of Mineral Resources estimates recoverable Bakken oil reserves for North Dakota at 2.1 billion barrels, less than 1.5% of oil in place. It owes its existence to the development of horizontal drilling and modern frac techniques. Geochemistry, seismic, faulting, stratigraphy and trap components are discussed. Parshall gives credence to the belief that large, commercial oil and gas reserves in similar-type traps and reservoirs exist in the U.S.

## **Selected References**

Gerhard, L.C., S.B. Anderson, and J.A. Le Fever, 1987, Structural history of the Nesson anticline, North Dakota, *in* M.W. Longman, ed., Williston basin: Anatomy of a cratonic oil province: Rocky Mountain Association of Geologists, p. 337-354.

Penner, L.H., and Cosford, J., 2006, Evidence linking surface lineaments and deep-seated structural features in the Williston Basin: Saskatchewan and Northern Plains, *in* Oil & Gas Symposium: Saskatchewan Geological Society, p. 19-39.

AAPG ANNUAL CONVENTION AND  
EXHIBITION 2009  
DENVER, COLORADO

TOPIC

PARSHALL FIELD, NORTH DAKOTA

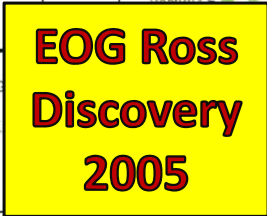
Discovery of the Year for the  
Rockies and Beyond

by

MICHAEL S. JOHNSON



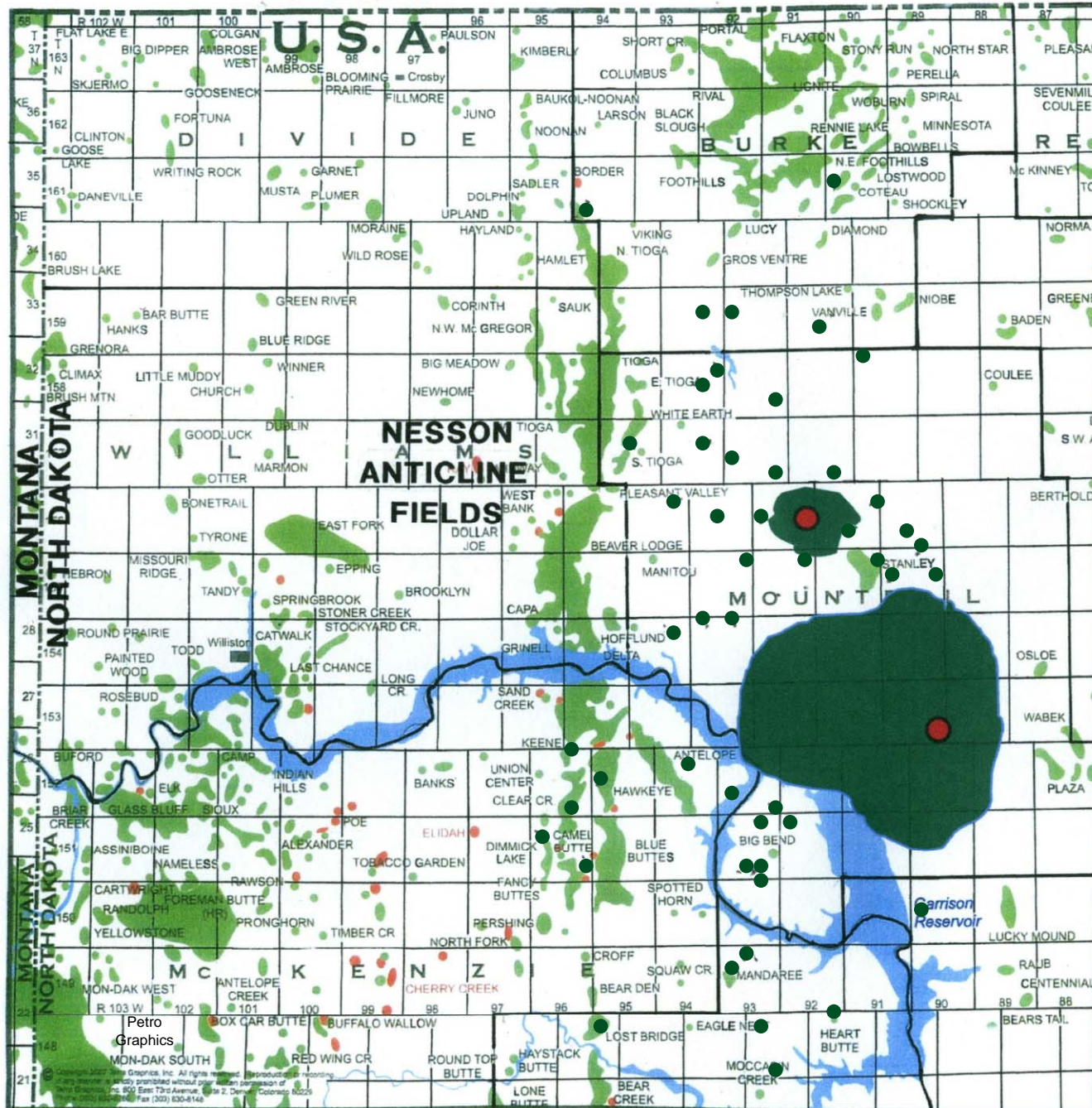
U. S. A.



**EOG  
Parshall  
Discovery  
2006**



## U. S. A.

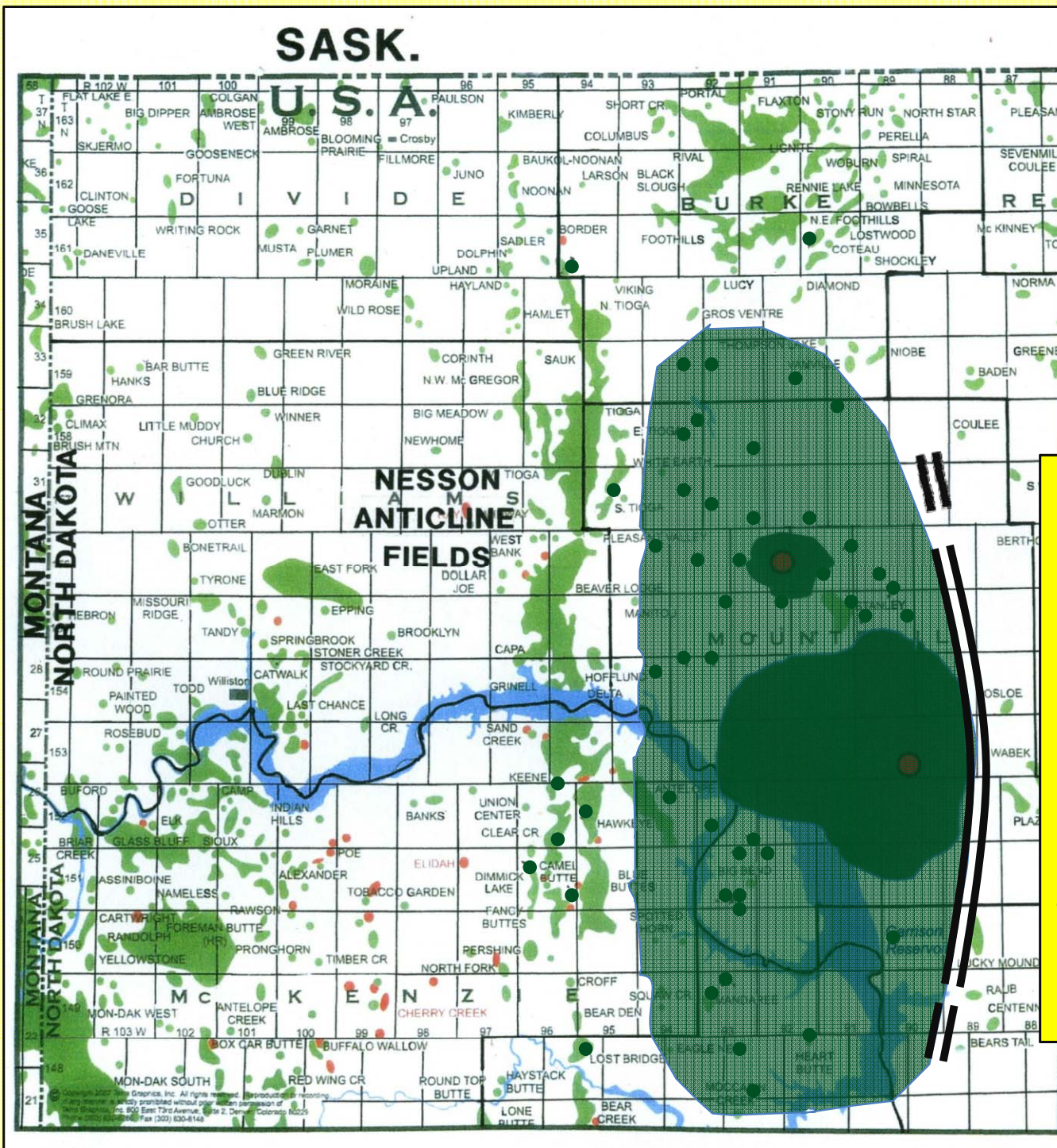


## Activity End-2008



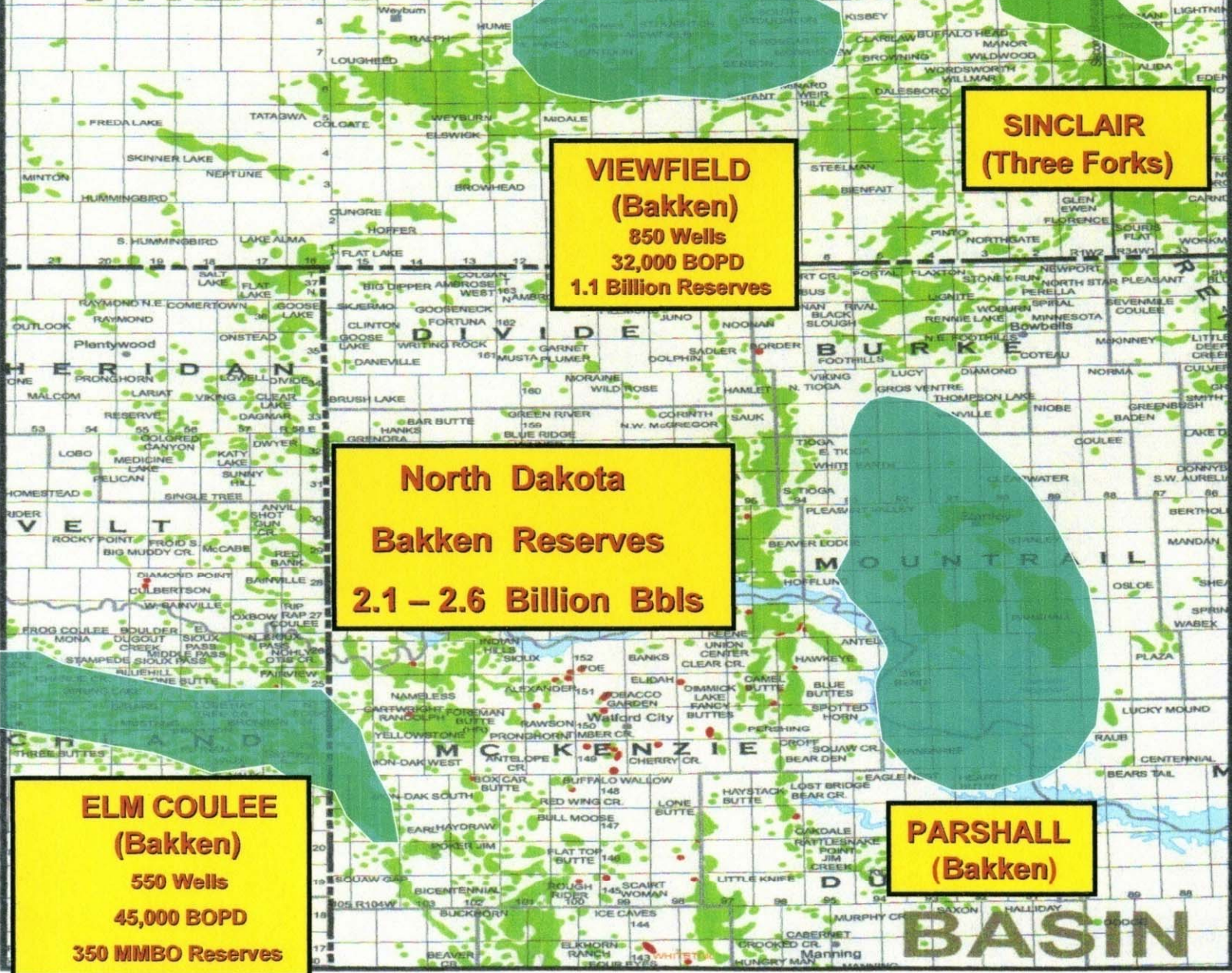
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1,245,000 Acres  
1,950 Wells  
640 Acres  
350 MBO/well  
REC. 700 MMBO  
plus  
Extensions  
Downspacing  
Secondary Rec.  
Three Forks  
**ONE BILLION BBLS  
ATTAINABLE**



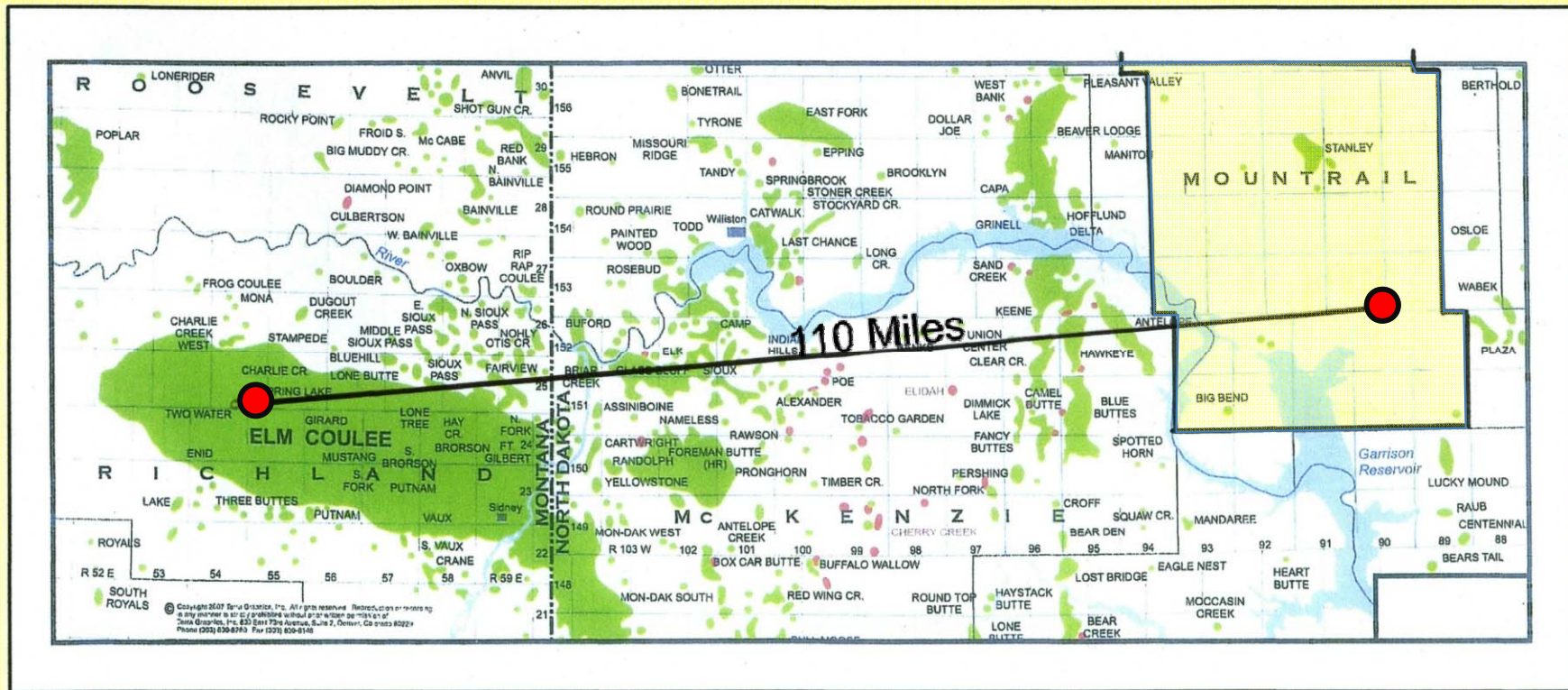


# WILLISTON





# 2004-PARSHALL PROSPECTIVE AREA

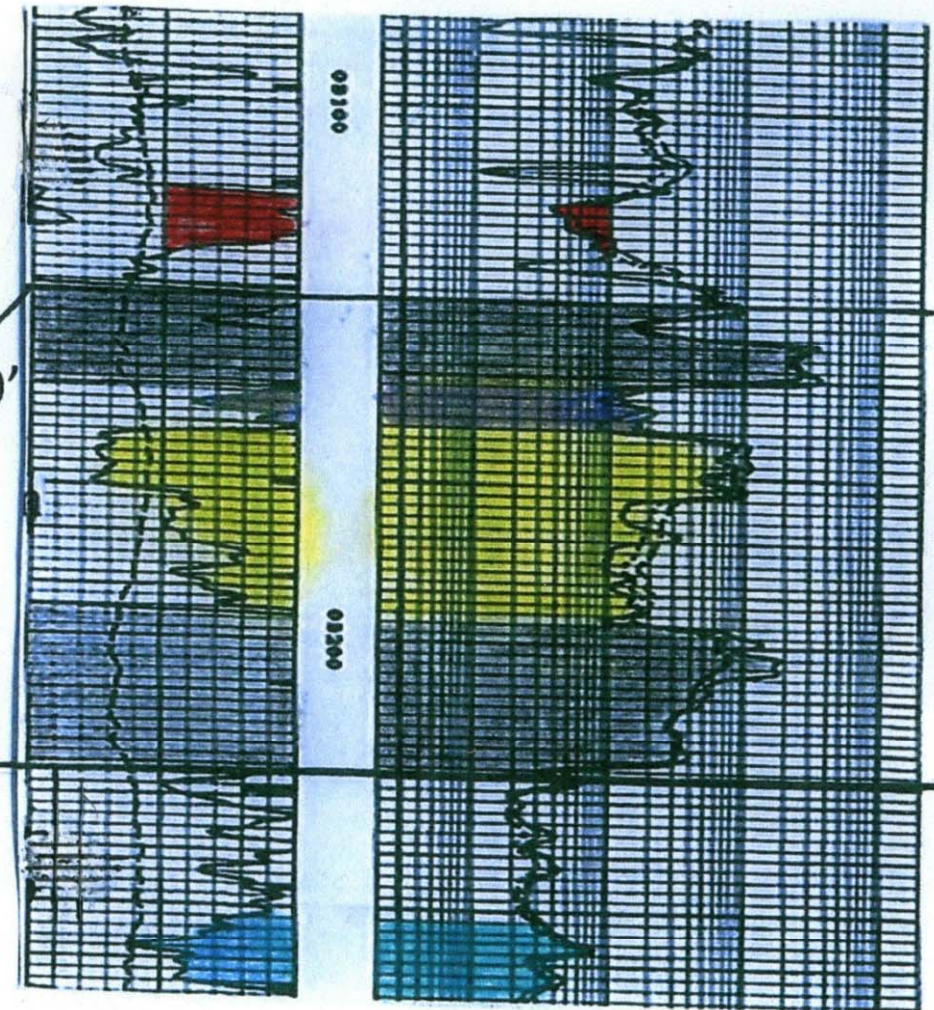
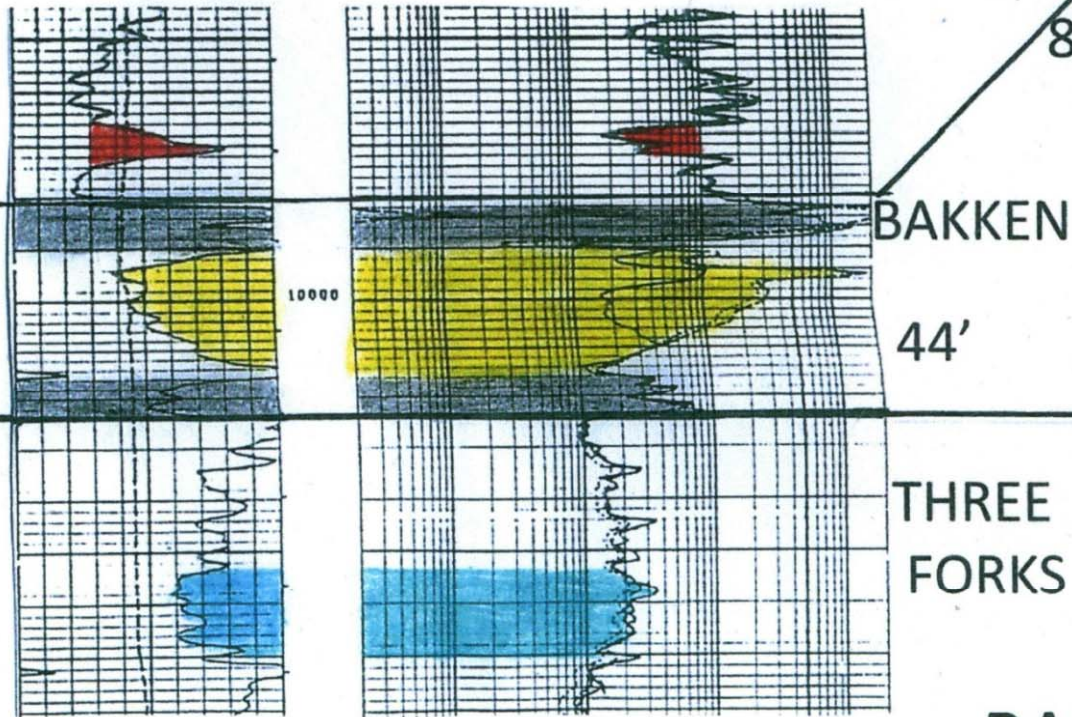


# Mountrail County, North Dakota



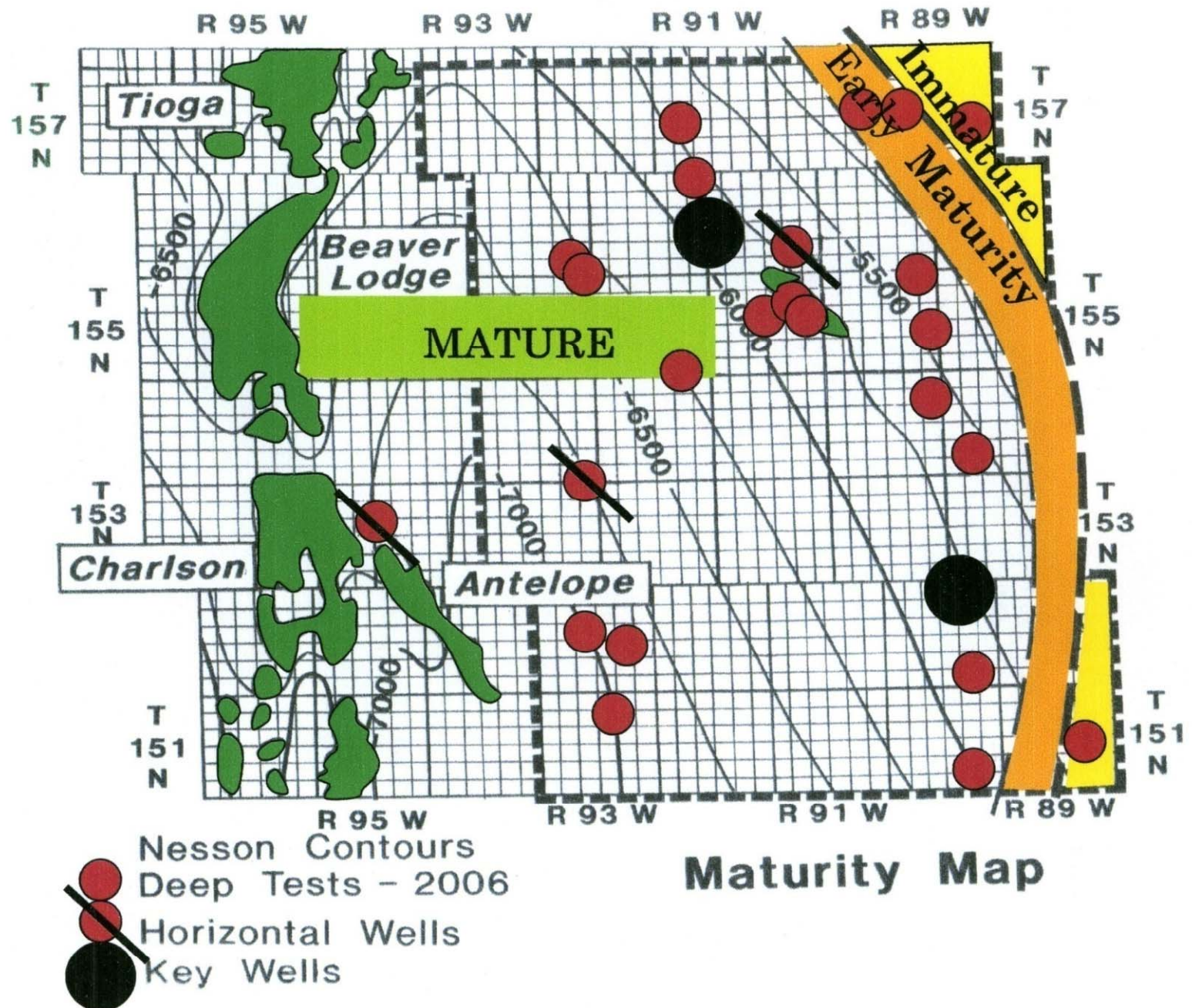
## PARSHALL AREA

## ELM COULEE FIELD TYPICAL WELL



## BAKKEN CROSS-SECTION ELM COULEE FIELD TO PARSHALL AREA





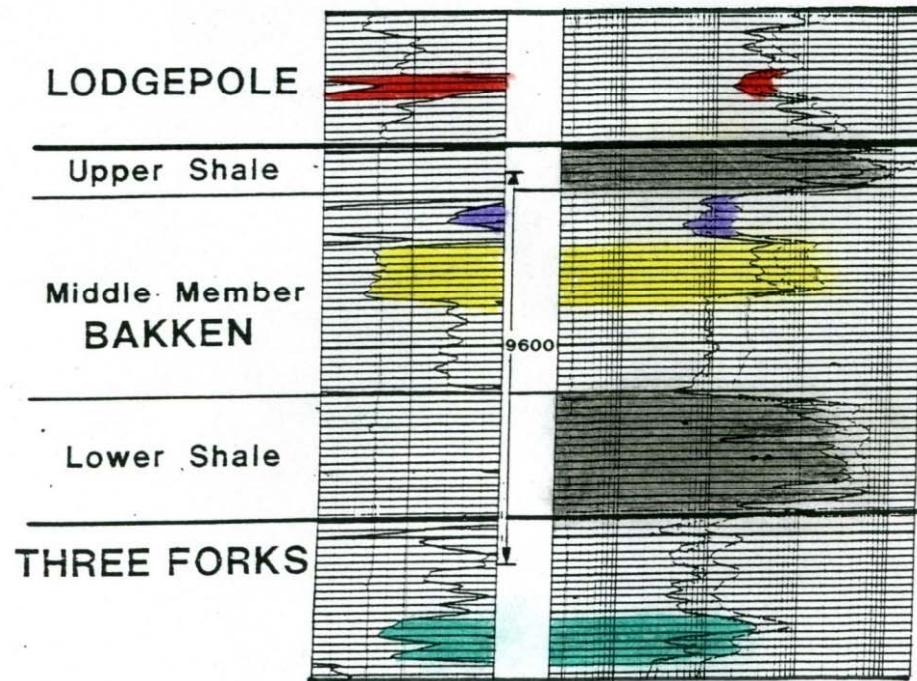


(1982)



GULF-No. 1-24-2B Nelson  
NE NE Sec. 24, T156N-R92W

K.B. 2344'



T.D. 10,505' (DUPEROW)

DST 9556'-9657' (BAKKEN)

REC. 30' OGCM, 140 CC OIL, 1260 CC MUD

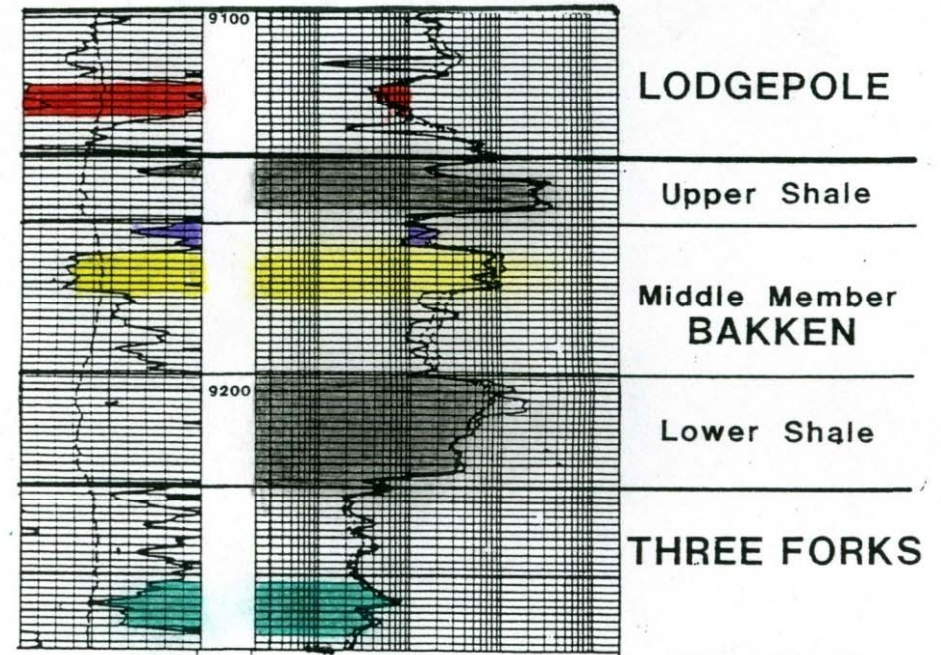
FP 178-193#, SIP 2535-5084#

(1981)



LEAR-No. 1 Parshall S D  
NE NW Sec. 3, T152N-R90W

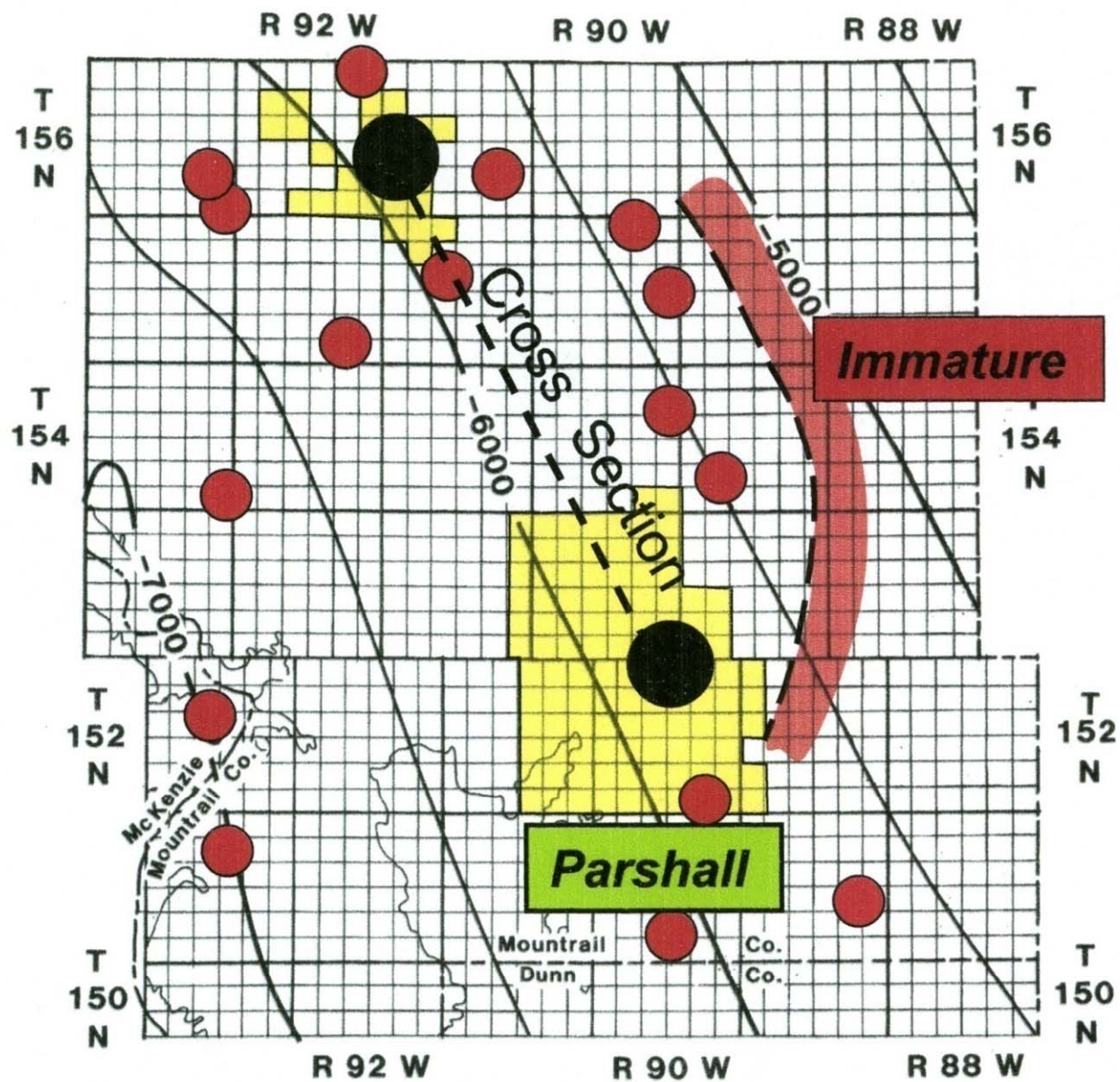
K.B. 1967'



T.D. 12,555' (RED RIVER)

BAKKEN- NO CORES OR TESTS



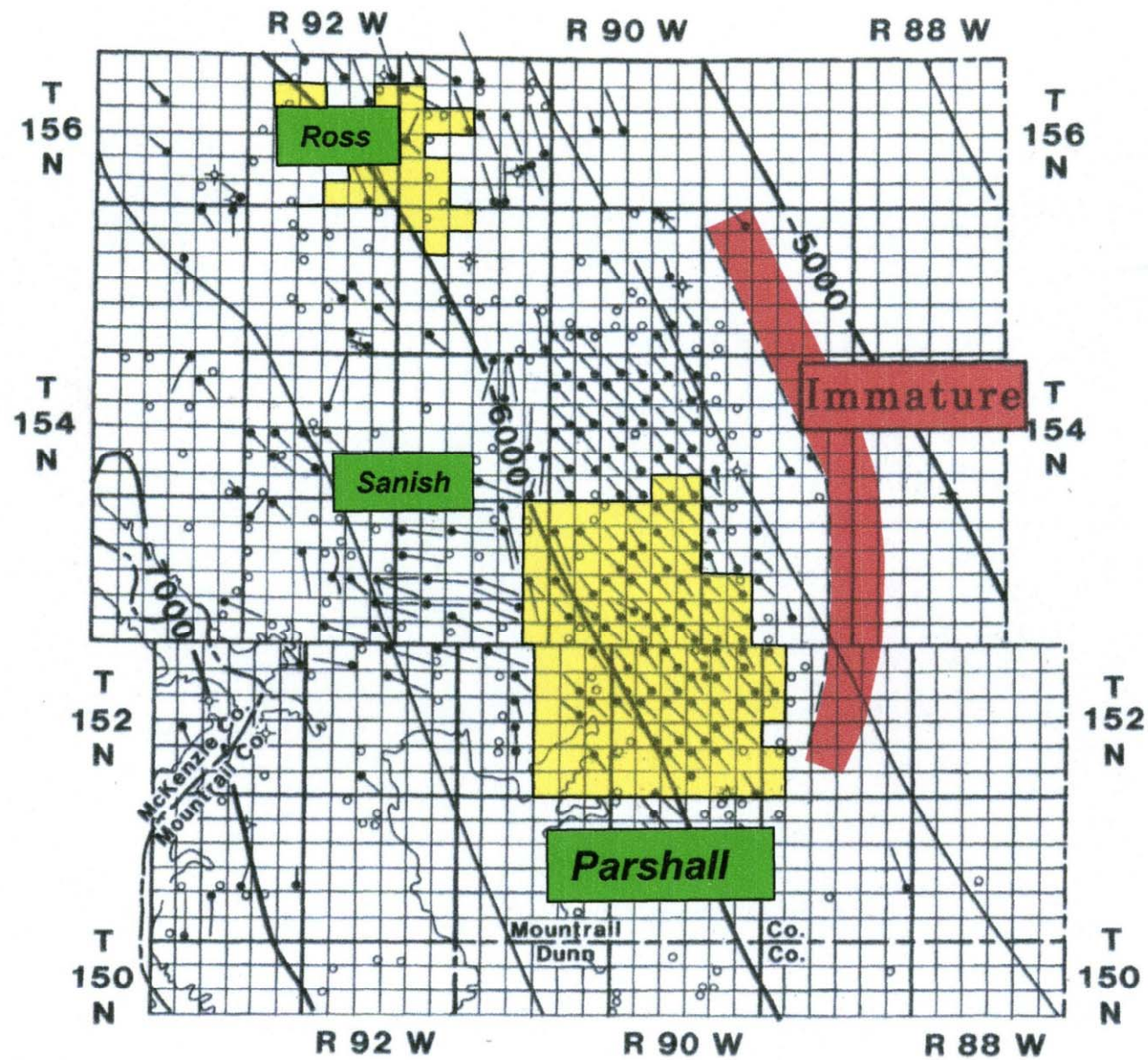


Madison Contours

## PARSHALL AREA

● Bakken Wells Drilled Till 2006





**PARSHALL - SANISH FIELDS - 2009**



# BAKKEN TRAP MECHANISM-PARSHALL FIELD

## A UNIQUE-TYPE STRATIGRAPHIC TRAP

- Carbon dioxide and water are released during kerogen formation and in the early stages of hydrocarbon generation resulting in increased acidity of formation waters.
- Hydrocarbon generation from the Bakken Shale appears to occur at a low thermal maturity (420-430 degree C Tmax range), which is lower than most sulfur-lean shales.
- These processes generate migration conduits (acid etching, secondary porosity) and hydrocarbons of very high quality (high gravity, low viscosity).
- **Hydrocarbon generation and perhaps carbon dioxide volumetrically pressure the rock matrix. This volume increase generates superlithostatic pore pressure causing fracturing and oil migration.**



# BAKKEN TRAP MECHANISM-PARSHALL FIELD

## A UNIQUE-TYPE STRATIGRAPHIC TRAP

**The unique feature of this trap is that the mature-immature boundary is a barrier to oil migration and forms the eastern boundary of the oil accumulation at +/- 8750 feet.** This boundary is likely caused by the lack of migration conduits, secondary porosity and pressure from hydrocarbon generation.



# BAKKEN TRAP MECHANISM-PARSHALL FIELD

## A UNIQUE-TYPE STRATIGRAPHIC TRAP

Production rate in a given area is affected by:

- A. Organic richness, labile organofacies and thermal maturity.
- B. Thickness of the Bakken Shales.
- C. Facies and stratigraphy of the reservoir beds in the Middle Member.
- D. Periodic, compartmented tectonic faulting, including wrench-type.
- E. Drilling and completion program.



# BAKKEN TRAP MECHANISM-PARSHALL FIELD

## A UNIQUE-TYPE STRATIGRAPHIC TRAP

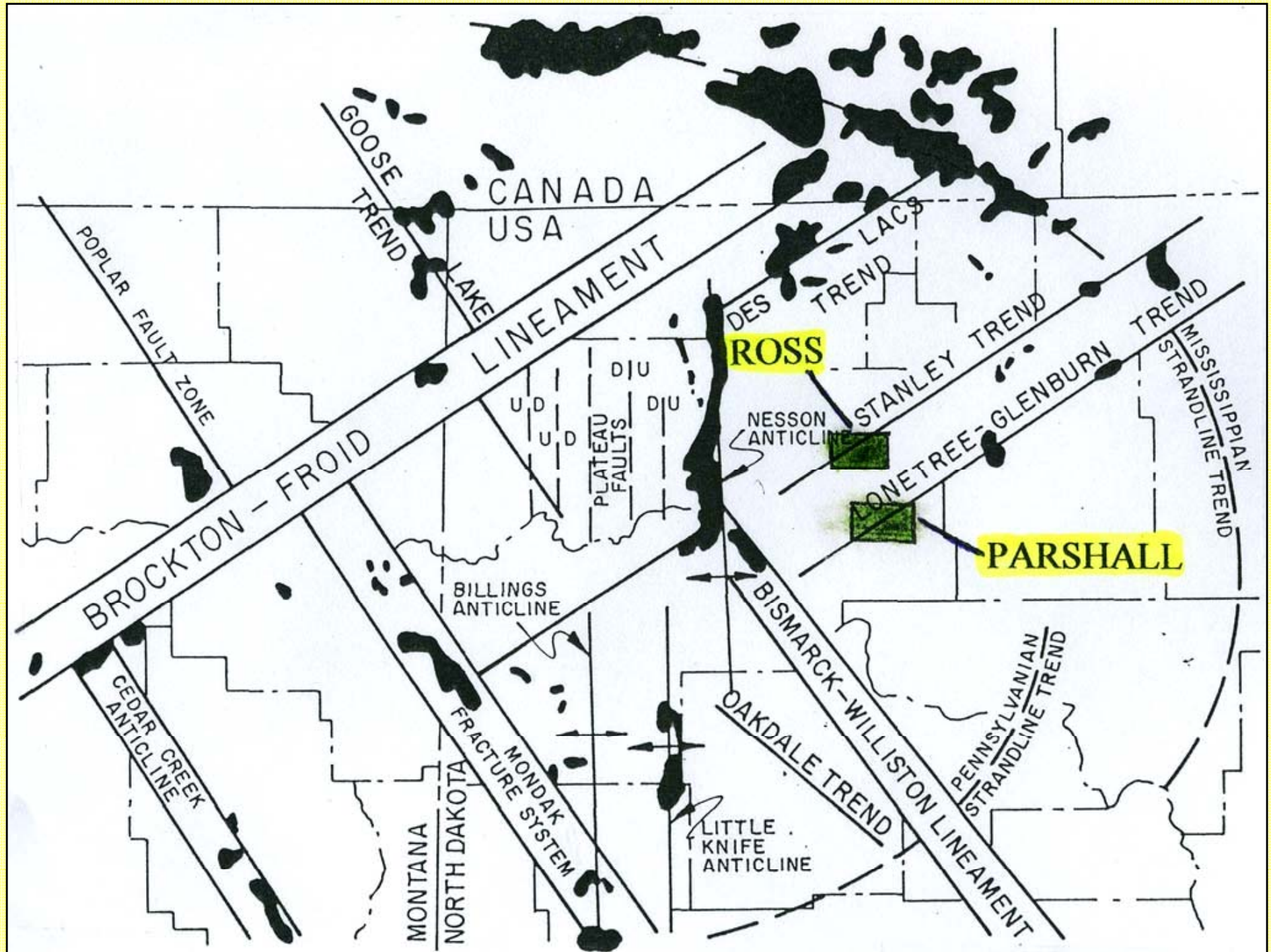
Characteristics are:

- A. It is one of the lowest thermal maturity oils in the basin based on oil light hydrocarbon analysis comparable to the Lodgepole Mound oils although there may be mixing with more mature oil.
- B. Very high productivity.
- C. Low Rt.
- D. Fracturing is the dominant porosity-type.
- E. Gamma ray is affected by high uranium content.
- F. Pyrite affects log analysis.

JOHNSON AND JARVIE  
2009

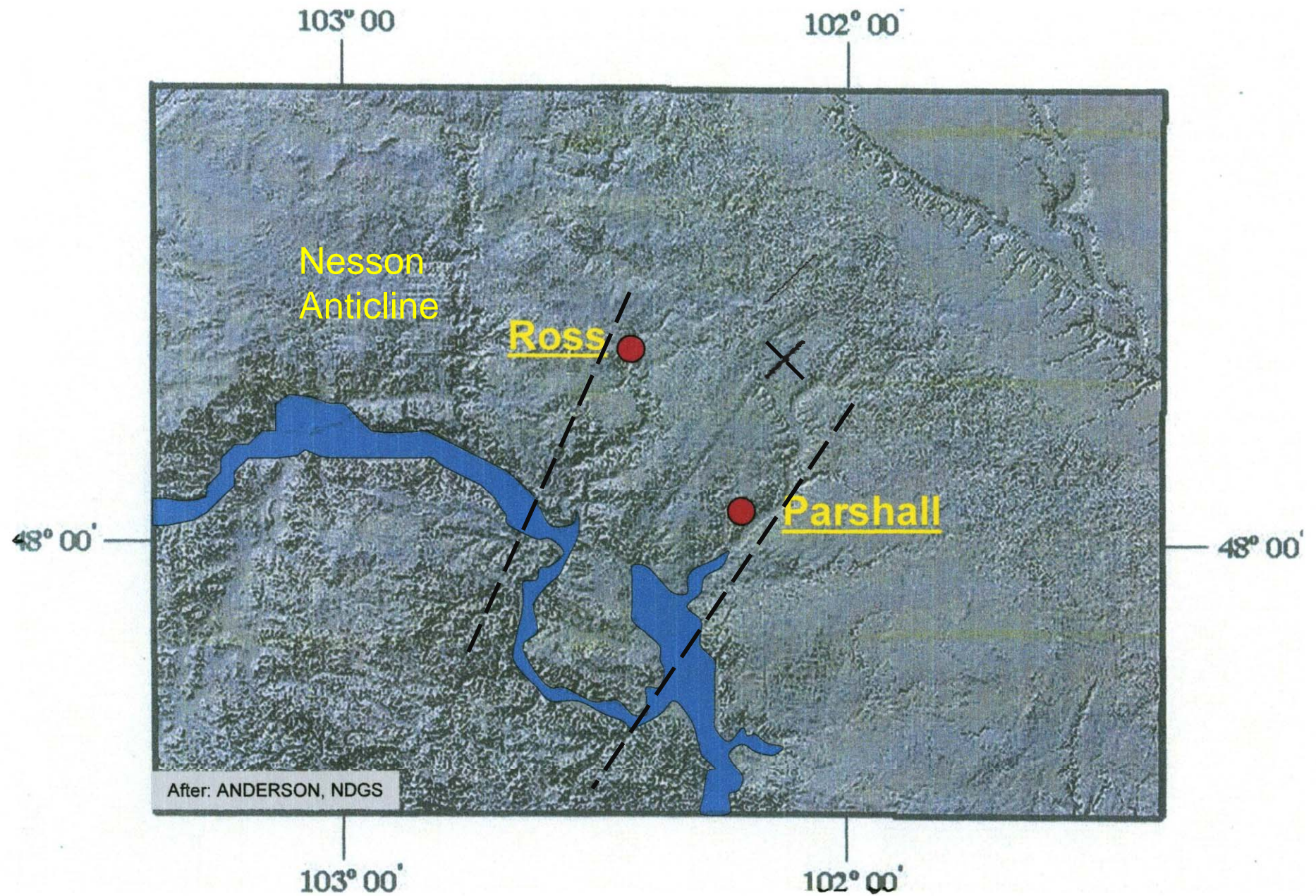


# Lineaments-Parshall-Ross Area



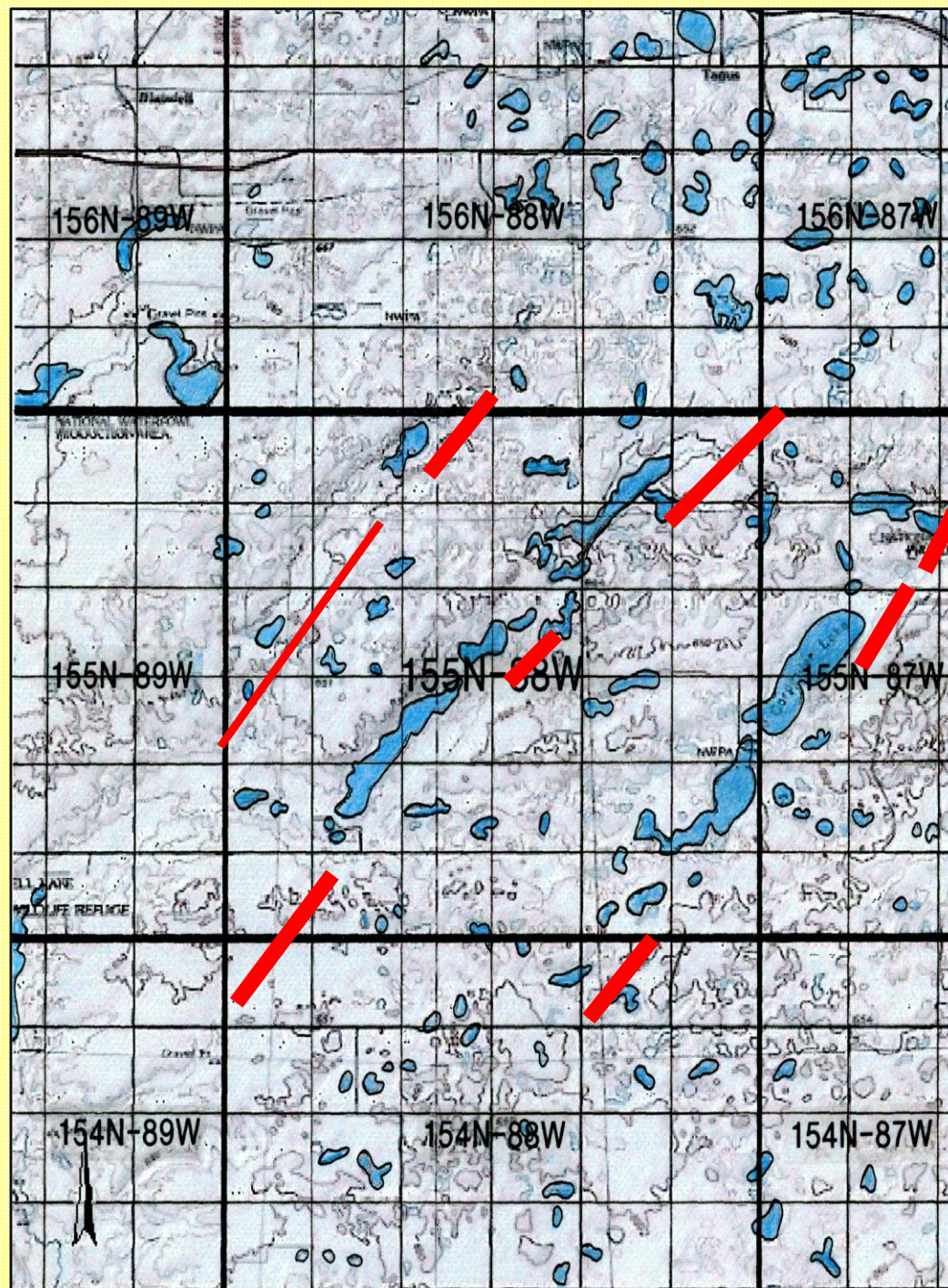
After Gerhard et al 1987





Satellite Photography





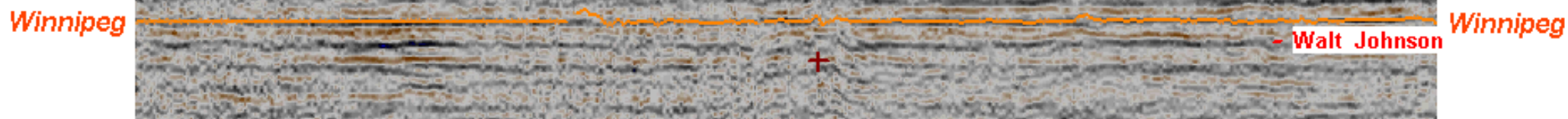
## Lineament Trends NE of Parshall Field



W

6 MILES

E



Seitel Data

2 D Seismic Line  
T155N-R88W



S

8 MILES

N



Winnipeg

Winnipeg

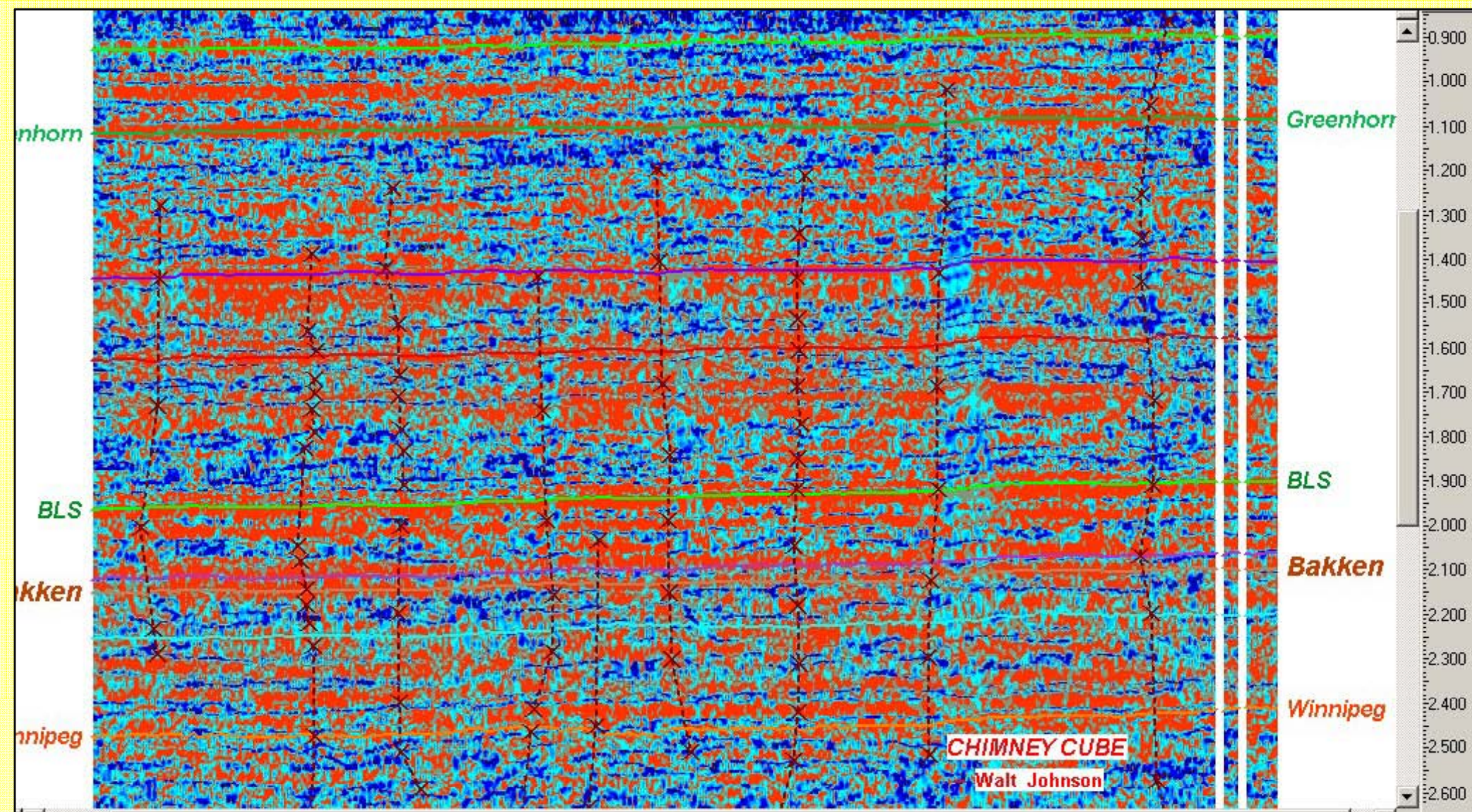
Seitel Data

2D Seismic Line  
Parshall Field  
T153N-R91W



S

N

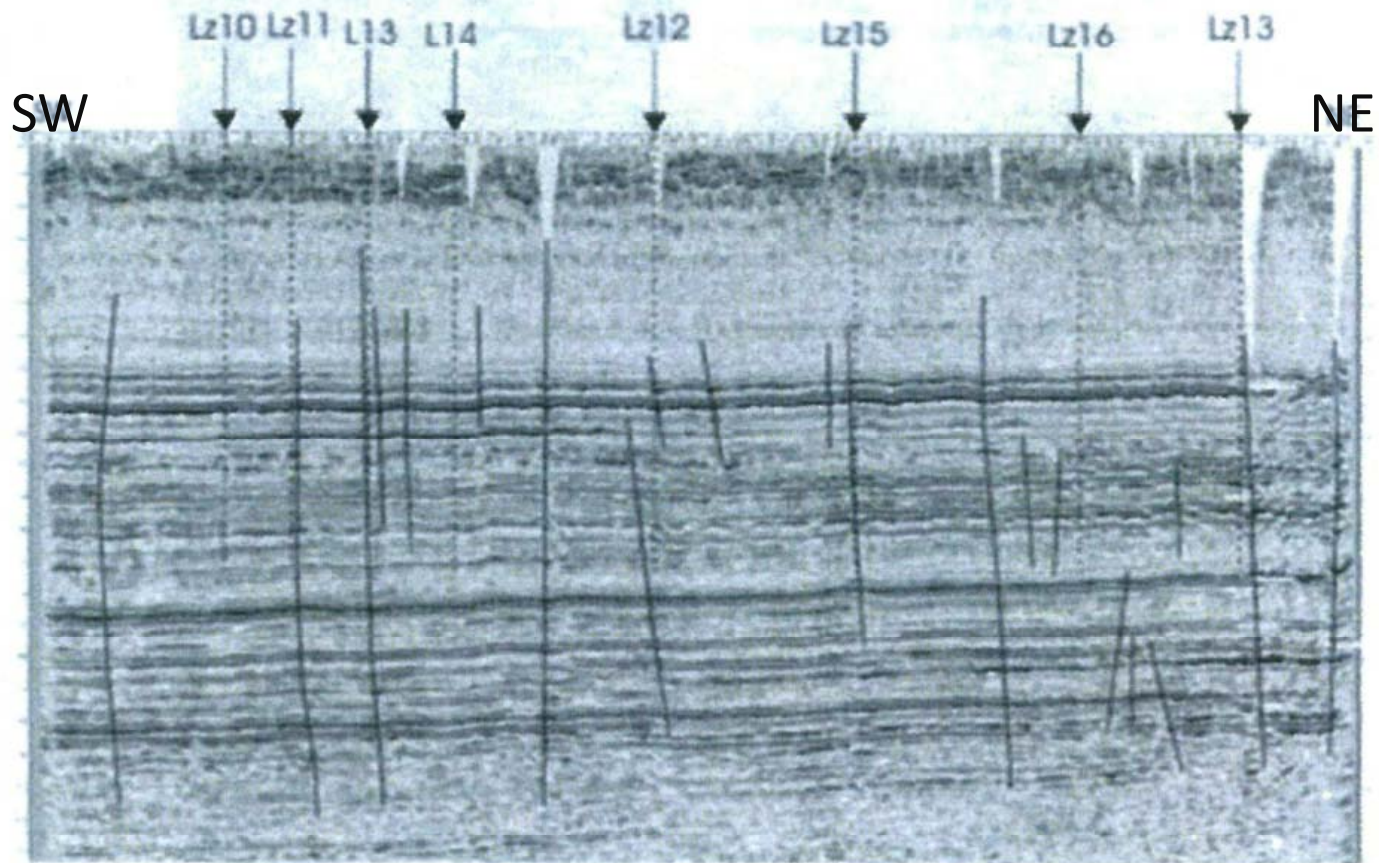


Seitel Data

2D Seismic Line  
Parshall Field  
T153N-R91W



22 miles approx.



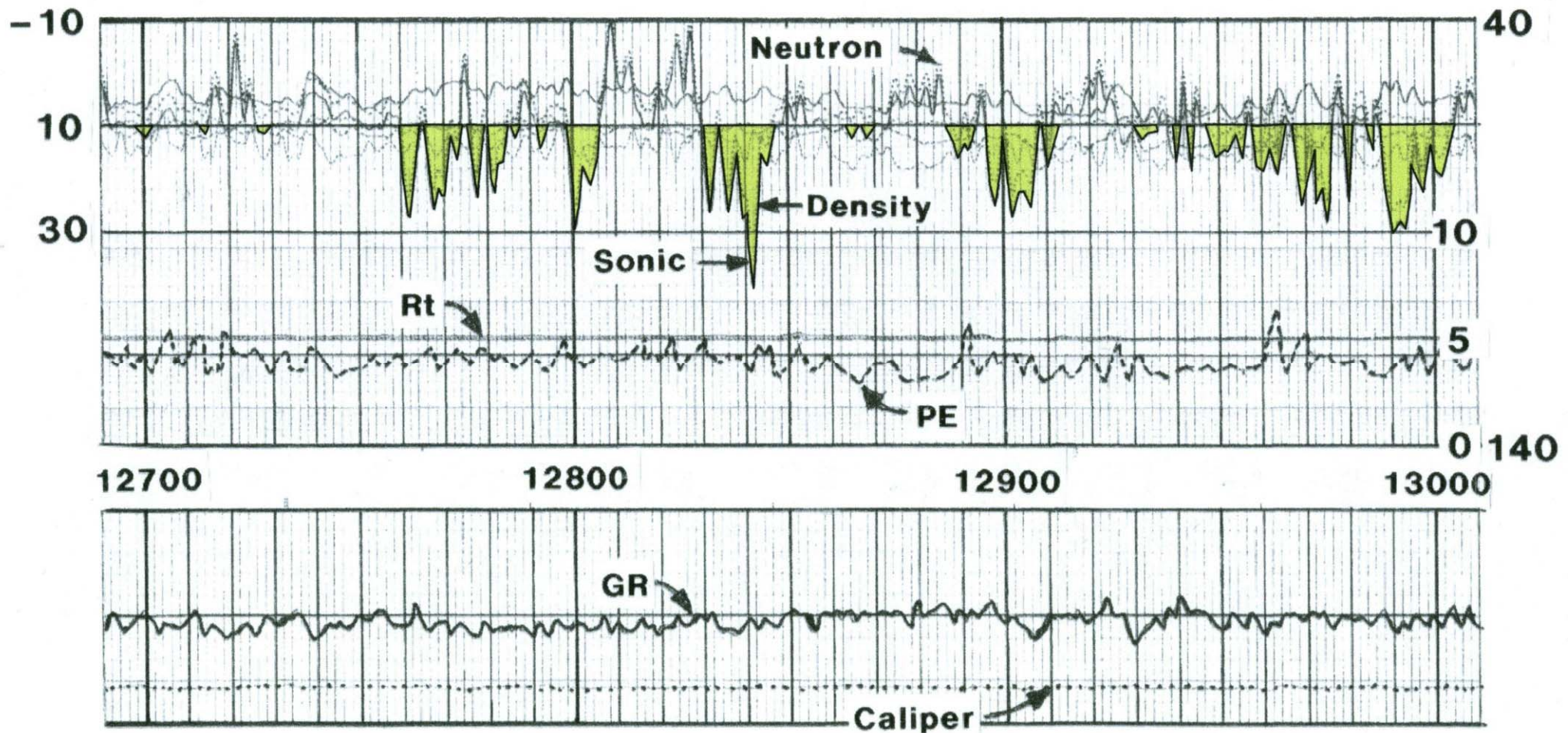
After Penner  
and Cosford, 2006

Correlation of seismic faults  
with lineaments  
SE Saskatchewan



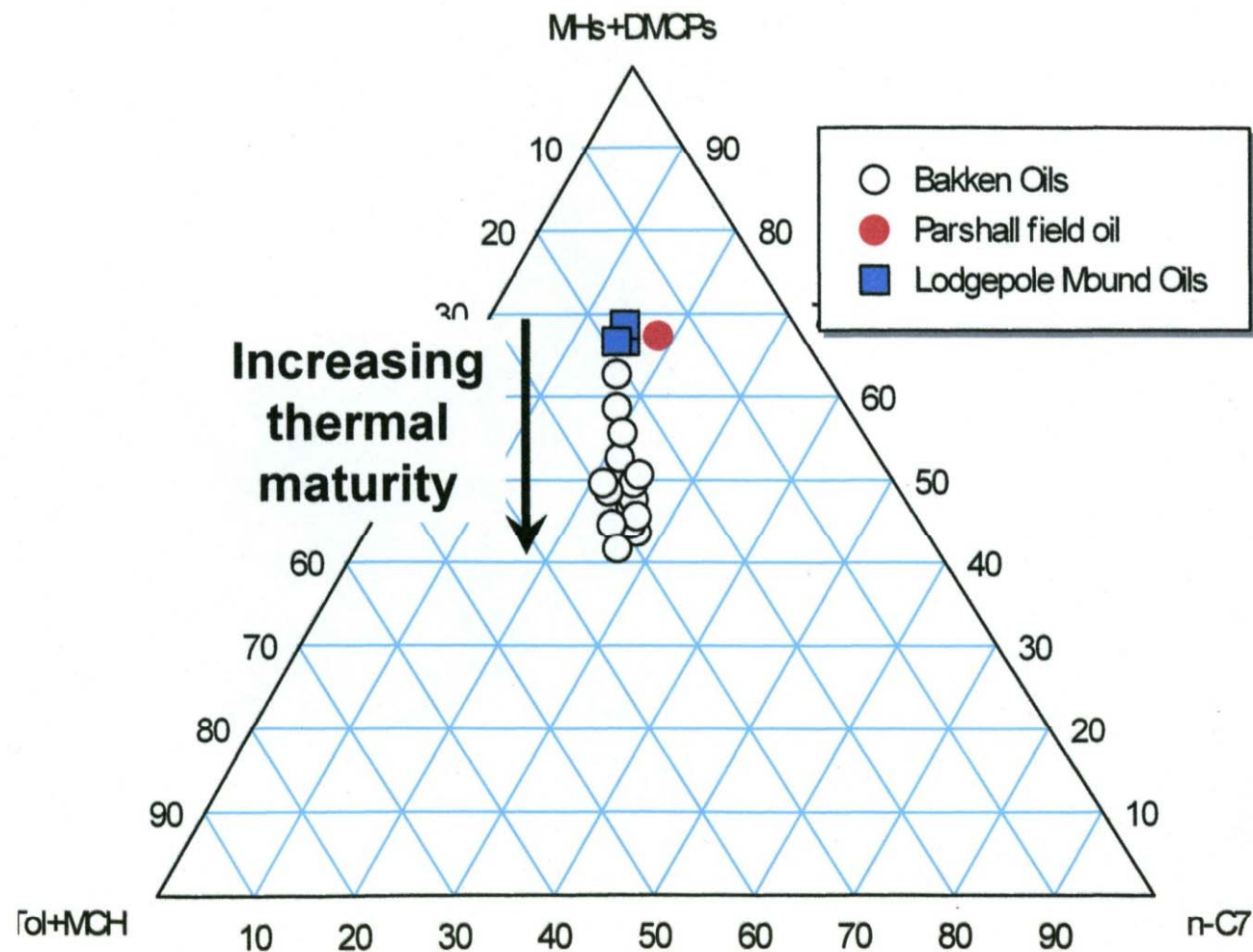
# Composite Log

## Showing Cycle Skipping in Horizontal Lateral-Parshall Field





# Comparison of Bakken-sourced Oils

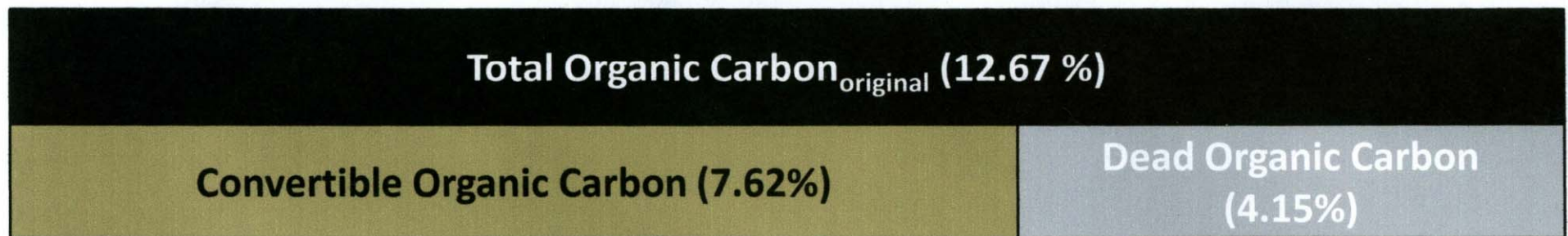


After Jarvie



**60% of U. Bakken Kerogen  
convertible to hydrocarbons upon maturation !**

**Original Parshall U. Bakken Shale**

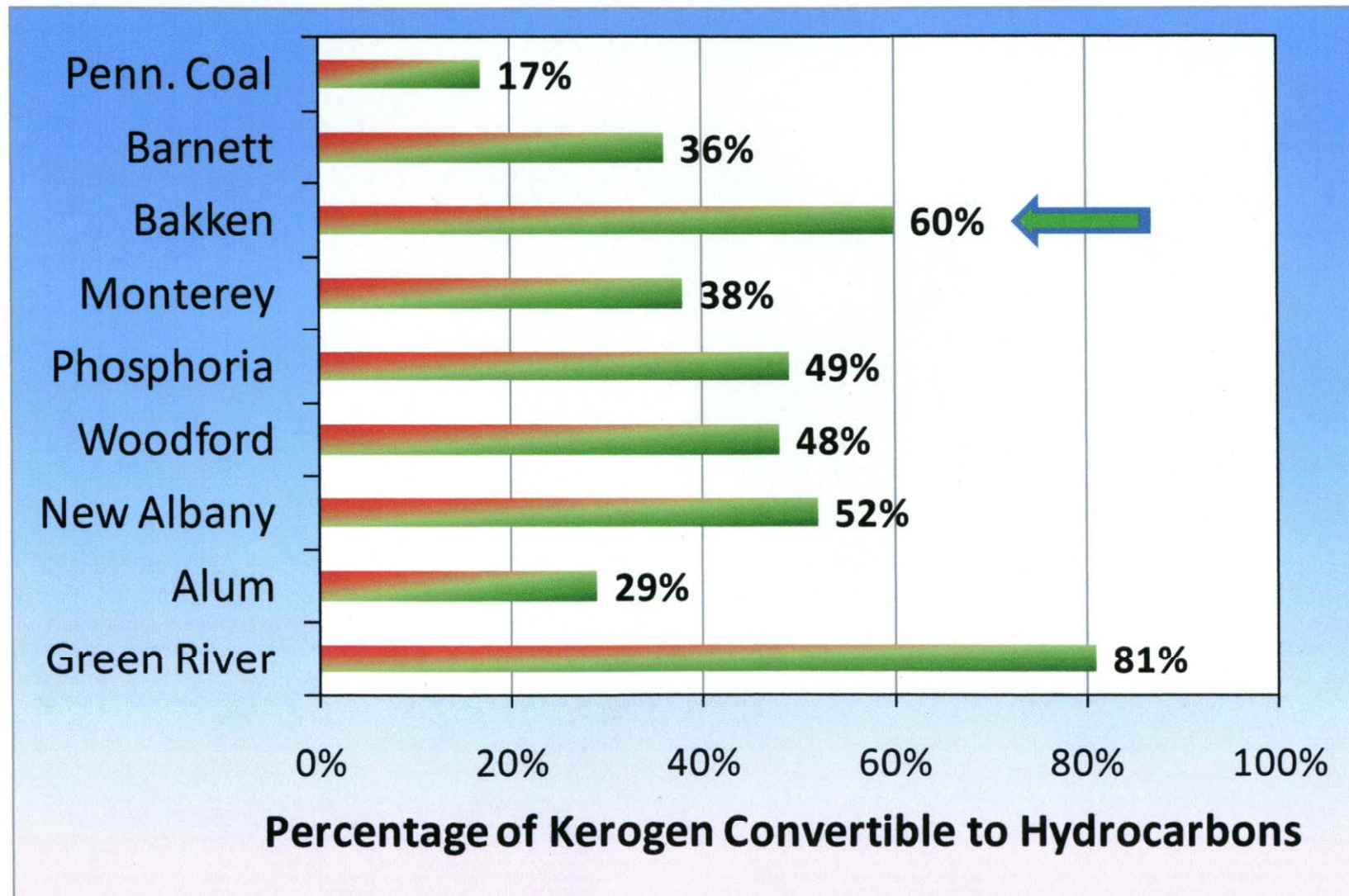


**60% of TOC<sub>original</sub> convertible to hydrocarbons !!!**

After Jarvie

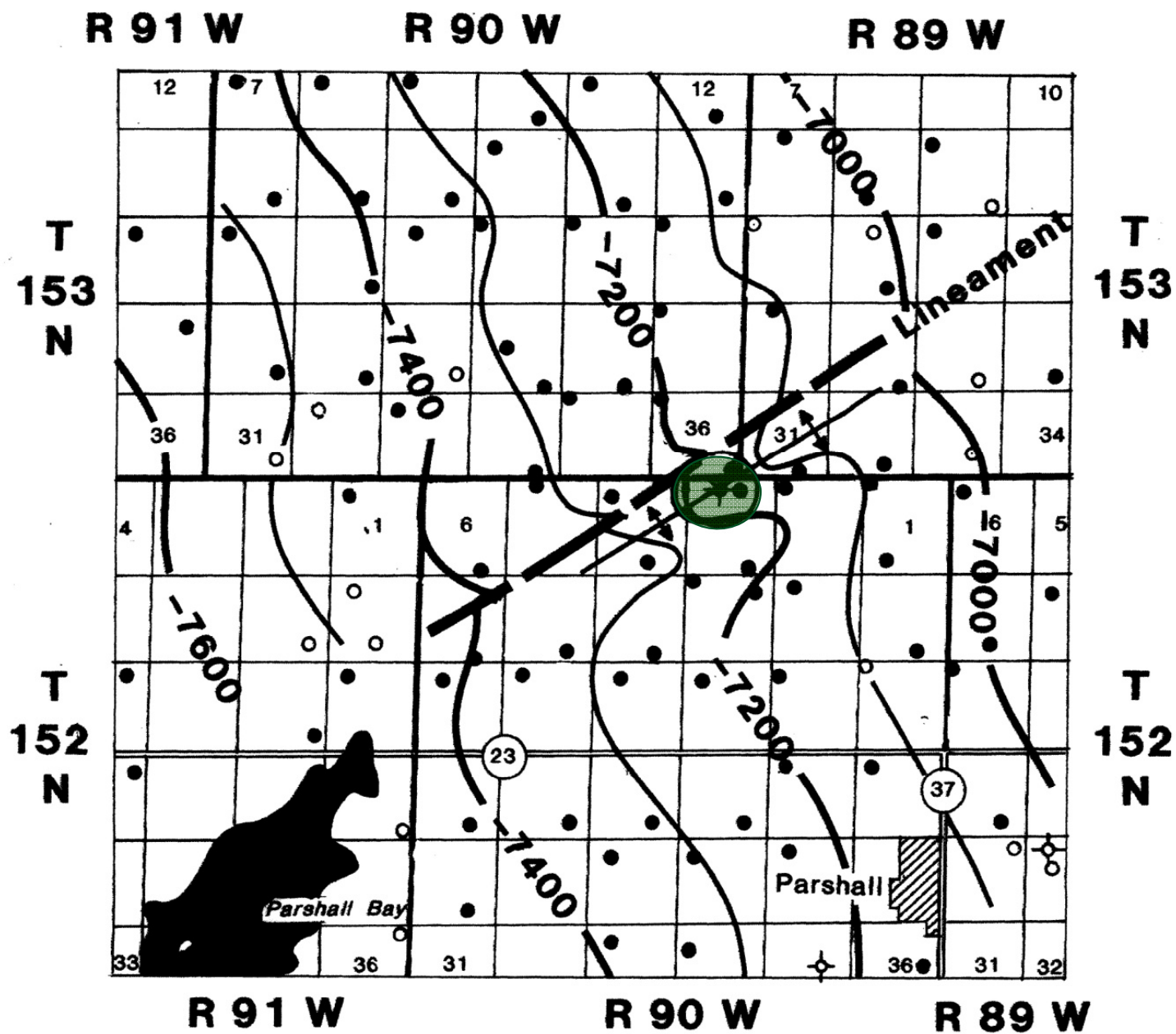


# U. Bakken Shale has one of the highest contents of hydrogen-rich kerogen (fast acting, quick saturating)



After Jarvie





**PARSHALL FIELD**  
**Structure Map**  
**Bakken Contours**



# ACKNOWLEDGEMENTS

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JOHN ROBINSON

SLIDES BY COLUMBINE GRAPHICS

POWER POINT BY ALICIA JOHNSON