

# **PS Petroleum Geology of the Crow Indian Reservation, South-Central Montana\***

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Search and Discovery Article #10985 (2017)\*\*

Posted August 21, 2017

\*Adapted from poster presentation given at AAPG Rocky Mountain Section Annual Meeting, Billings, Montana, June 25-28, 2017

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## **Abstract**

The Crow Reservation is very under-explored area in the northern Powder River Basin of Montana. Producing reservoirs on the Reservation include the Cretaceous Shannon Sandstone, Pennsylvanian Tensleep Sandstone, and the Mississippian Madison Limestone. Of these, the Tensleep probably has the greatest potential for discovery of new oil accumulations. Recent detailed surface and subsurface research has led to a good understanding of the geometry and distribution of Tensleep Sandstone reservoirs. The Shannon Sandstone has potential in a limited area in the southern part of the Reservation. The Madison has widespread occurrence of porous reservoir rocks but requires significant structural closures in order to protect oil accumulations from groundwater flow. Potential also exists in Cretaceous Muddy Sandstone, Greybull Sandstone, and Pryor Conglomerate (Lakota equivalent). The Muddy and Greybull are well known channel sandstone reservoirs in the region and produce from combination structural-stratigraphic traps. Porosity in the Pryor Conglomerate is widespread and would require significant structural closures to trap oil.

## **Reference Cited**

Mohl, K., 2006, Grey Blanket Field: T 6 S, R 36 E: Big Horn County, Montana: Montana Oil and Gas Fields, Montana Geological Society, p. 45-49.



# PETROLEUM GEOLOGY OF THE CROW INDIAN RESERVATION, SOUTH-CENTRAL MONTANA

## ABSTRACT

The Crow Reservation is:  
 In the Northern Powder River Basin.  
 Very under-explored area.

Producing Reservoirs on the Reservation  
 Cretaceous Shannon Sandstone  
 Pennsylvanian Tensleep Sandstone  
 Mississippian Madison Limestone.

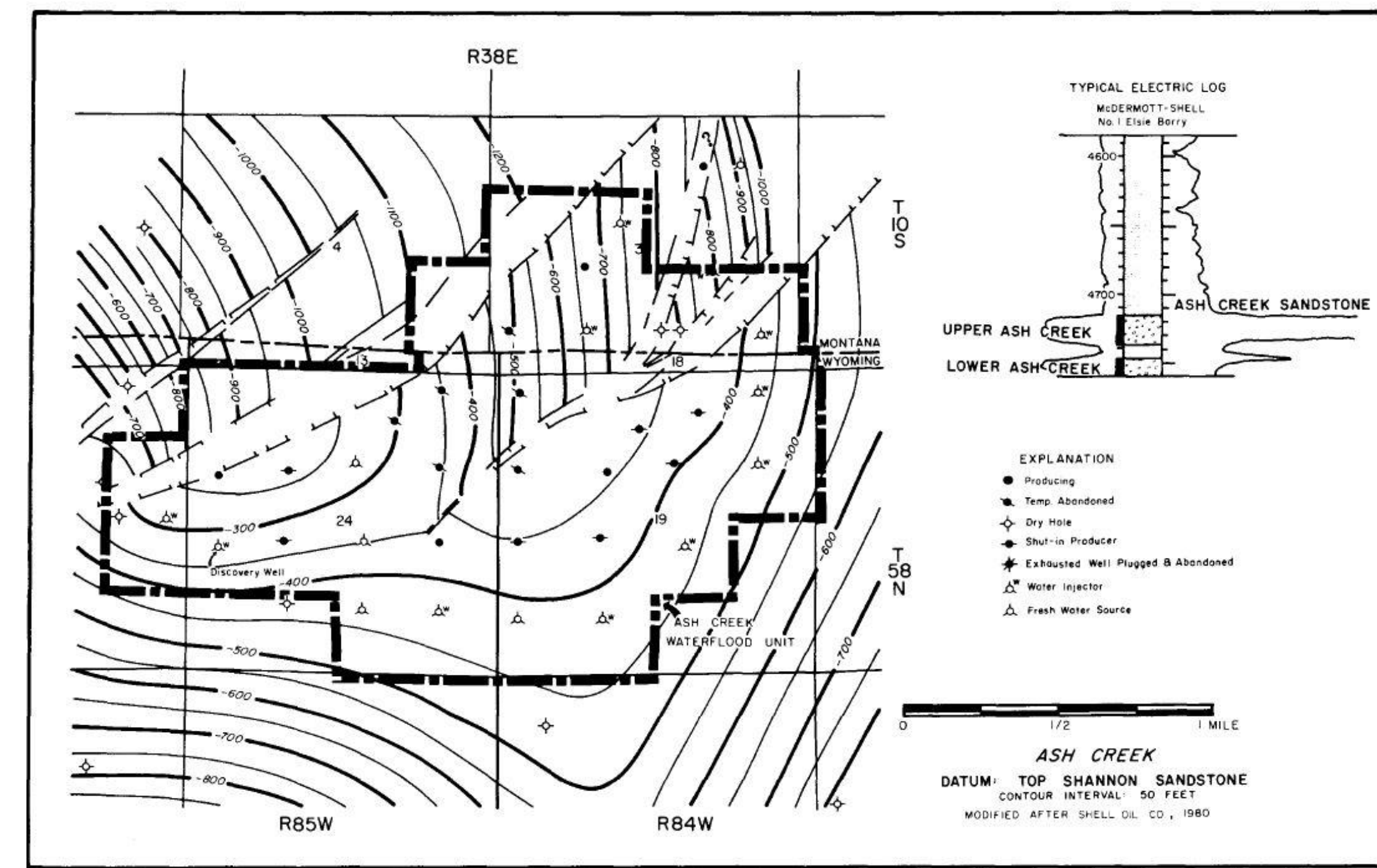
The Shannon Sandstone is limited to the southeastern part of the Reservation.  
 The Tensleep is widespread and has the greatest potential.  
 The Madison has widespread porous reservoir, but requires significant structural closure.

Potential also exists in:  
 Cretaceous Muddy Sandstone  
 Greybull Sandstone  
 Pryor Conglomerate (Lakota equivalent)  
 Ordovician Big Horn Dolomite

The Muddy and Greybull are channel sandstone reservoirs and produce from combination structural-stratigraphic traps.  
 Porous Pryor Conglomerate is widespread and would require structural closures to trap oil.  
 Porous Ordovician Big Horn Dolomite is widespread and would require structural closures to trap oil.

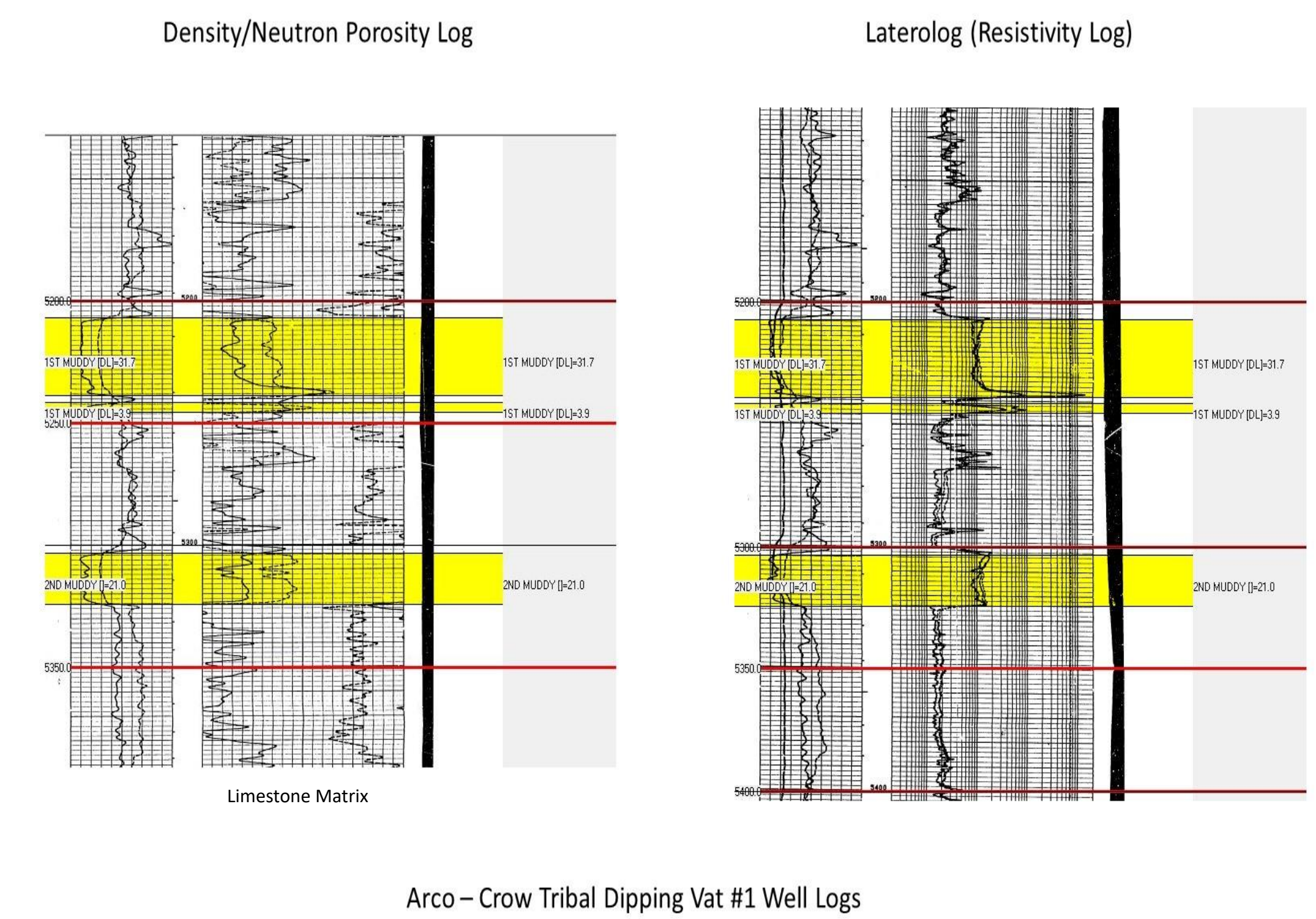
### Shannon Potential

Produces at Ash Creek Field in fault-bounded structural traps. Potential exists in other similar structural blocks and possibly in up-dip stratigraphic pinch out. The Shannon Sandstone (locally called Ash Creek Sandstone) is an isolated marine shelf sandstone.

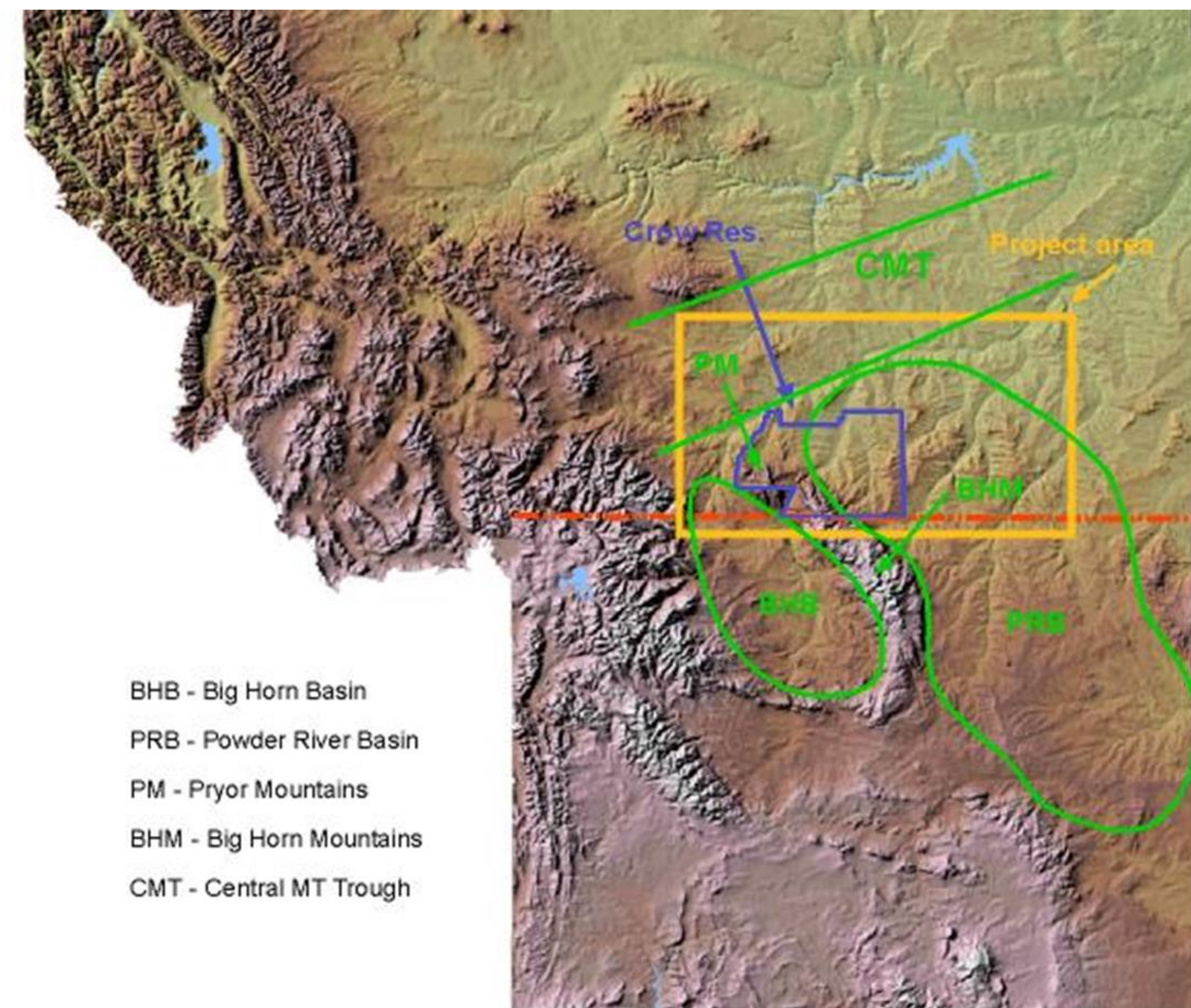


### Muddy Potential

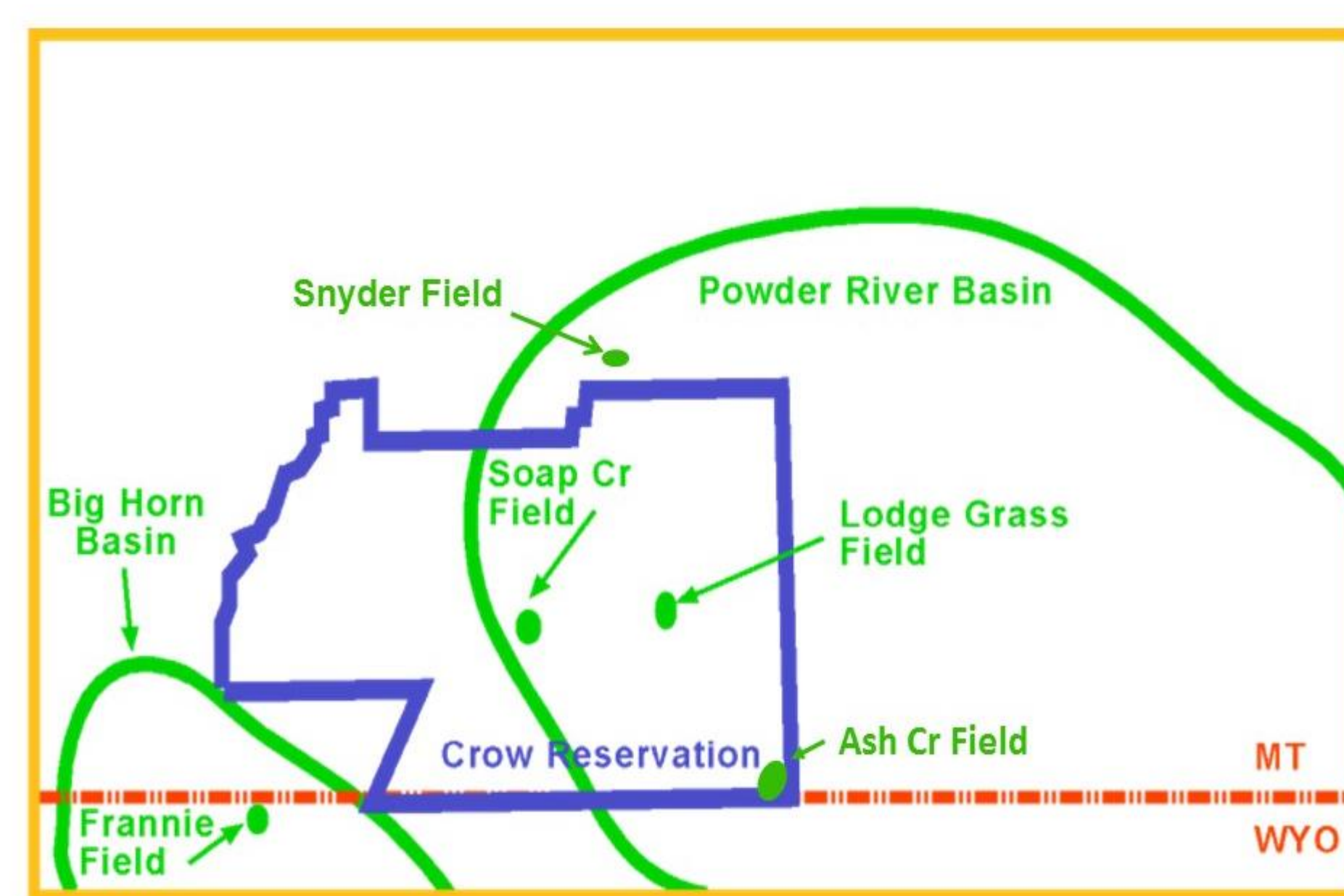
Channels Present, Requires Structural-Stratigraphic Trap



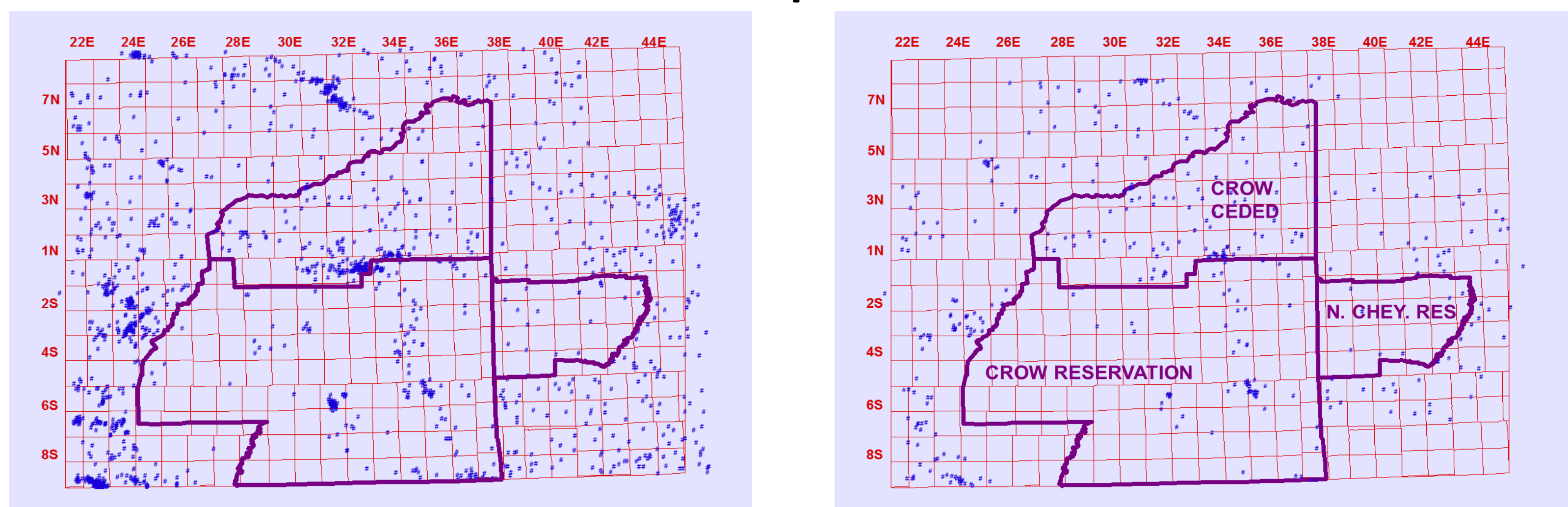
## Location of Crow Reservation



## Producing Oil Fields Crow Reservation



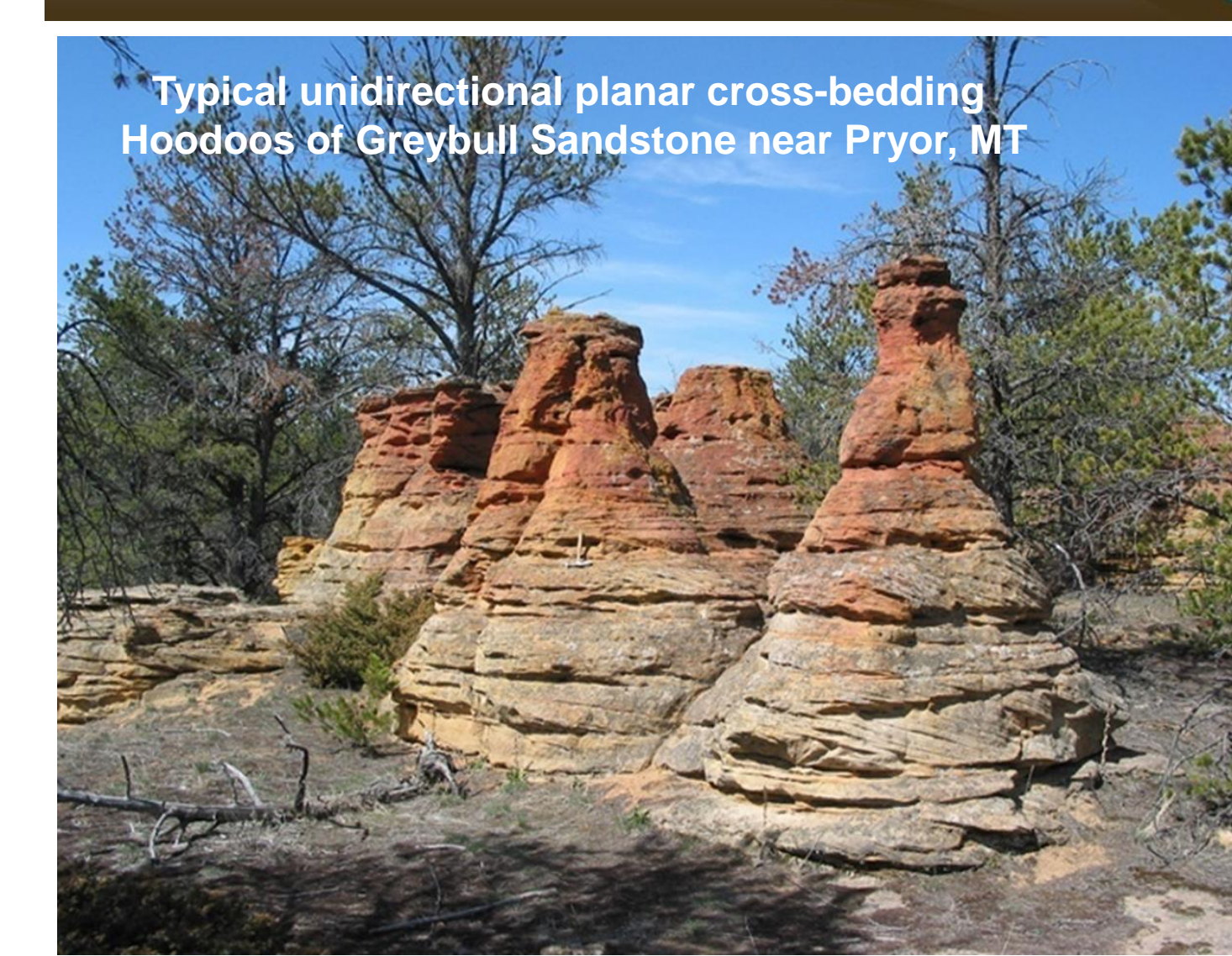
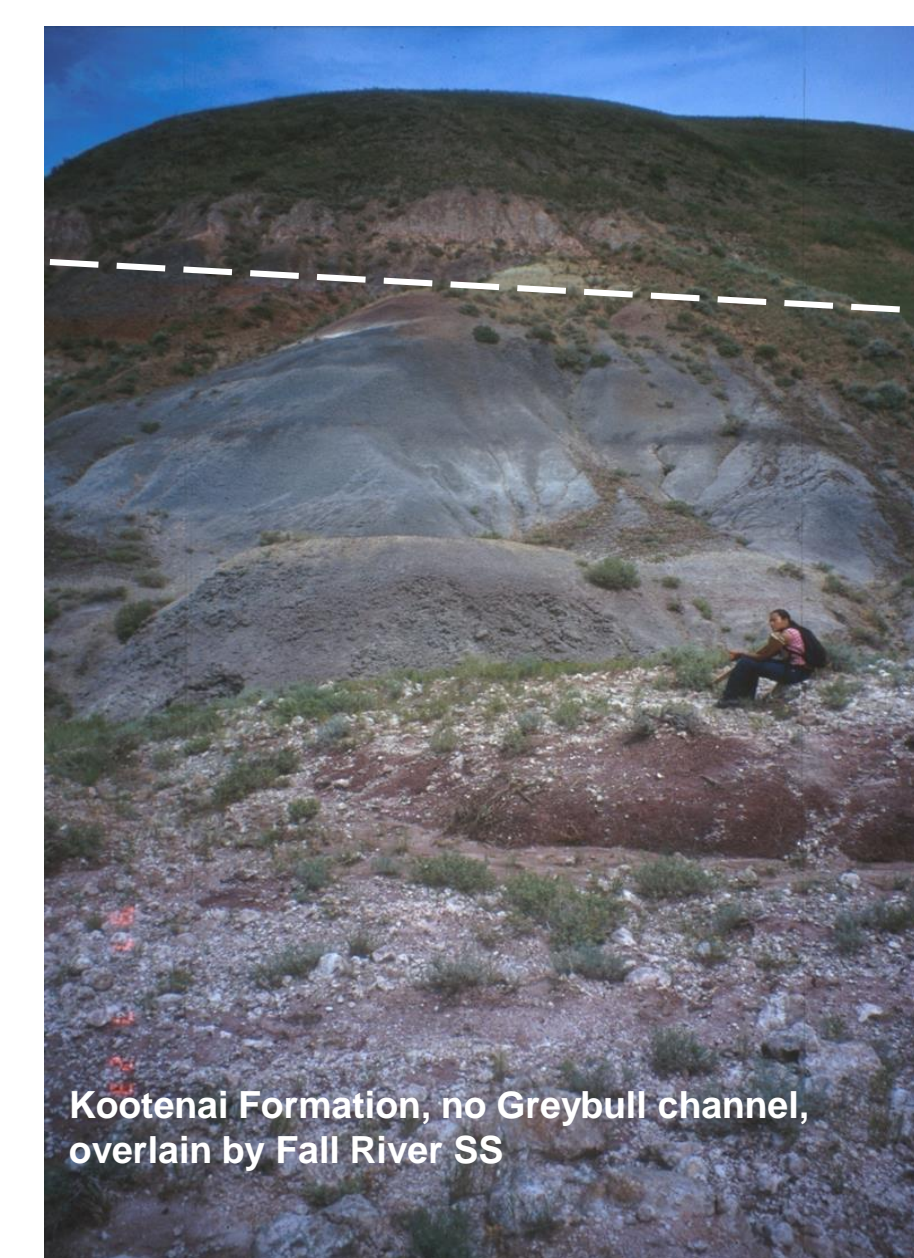
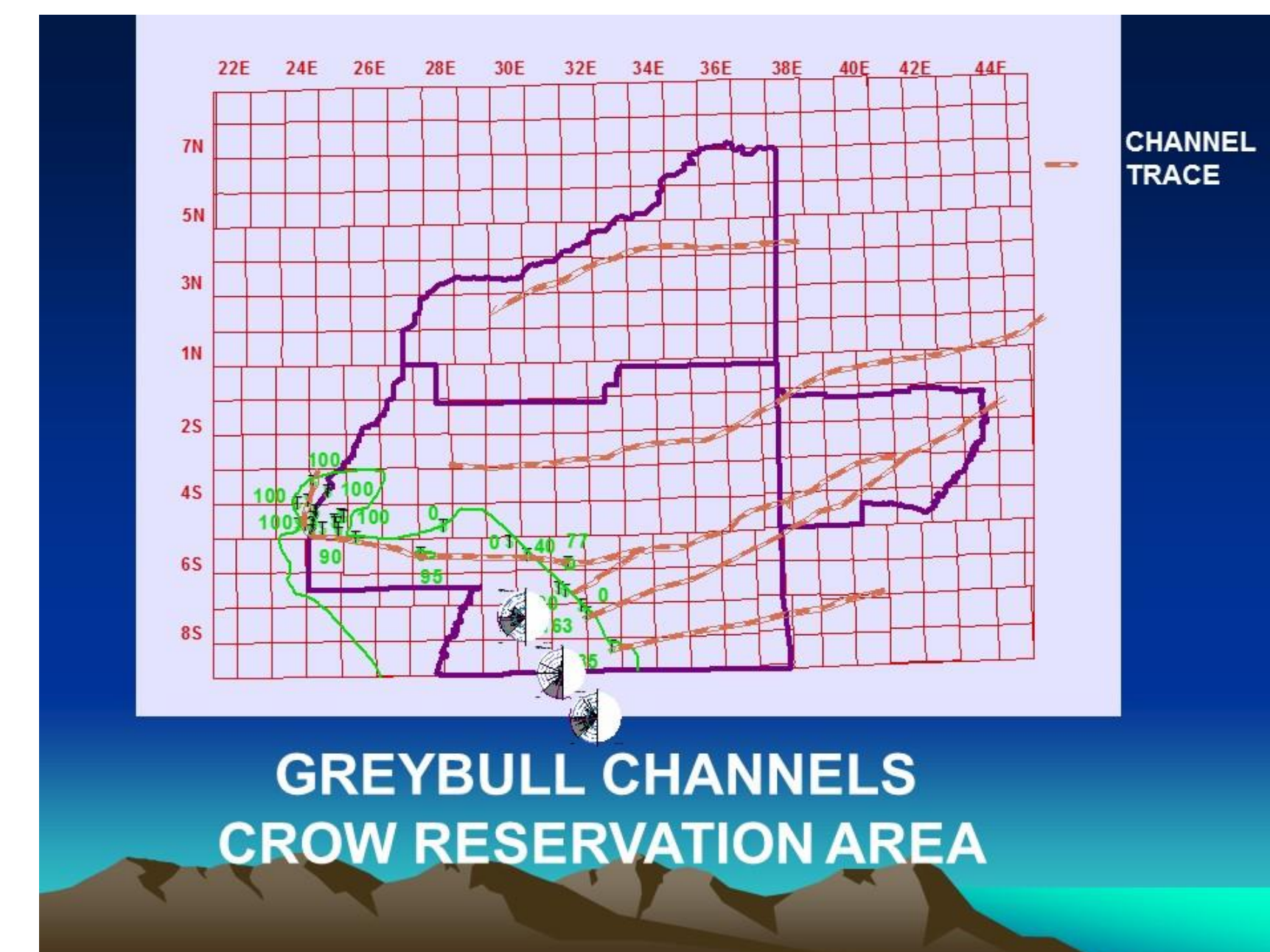
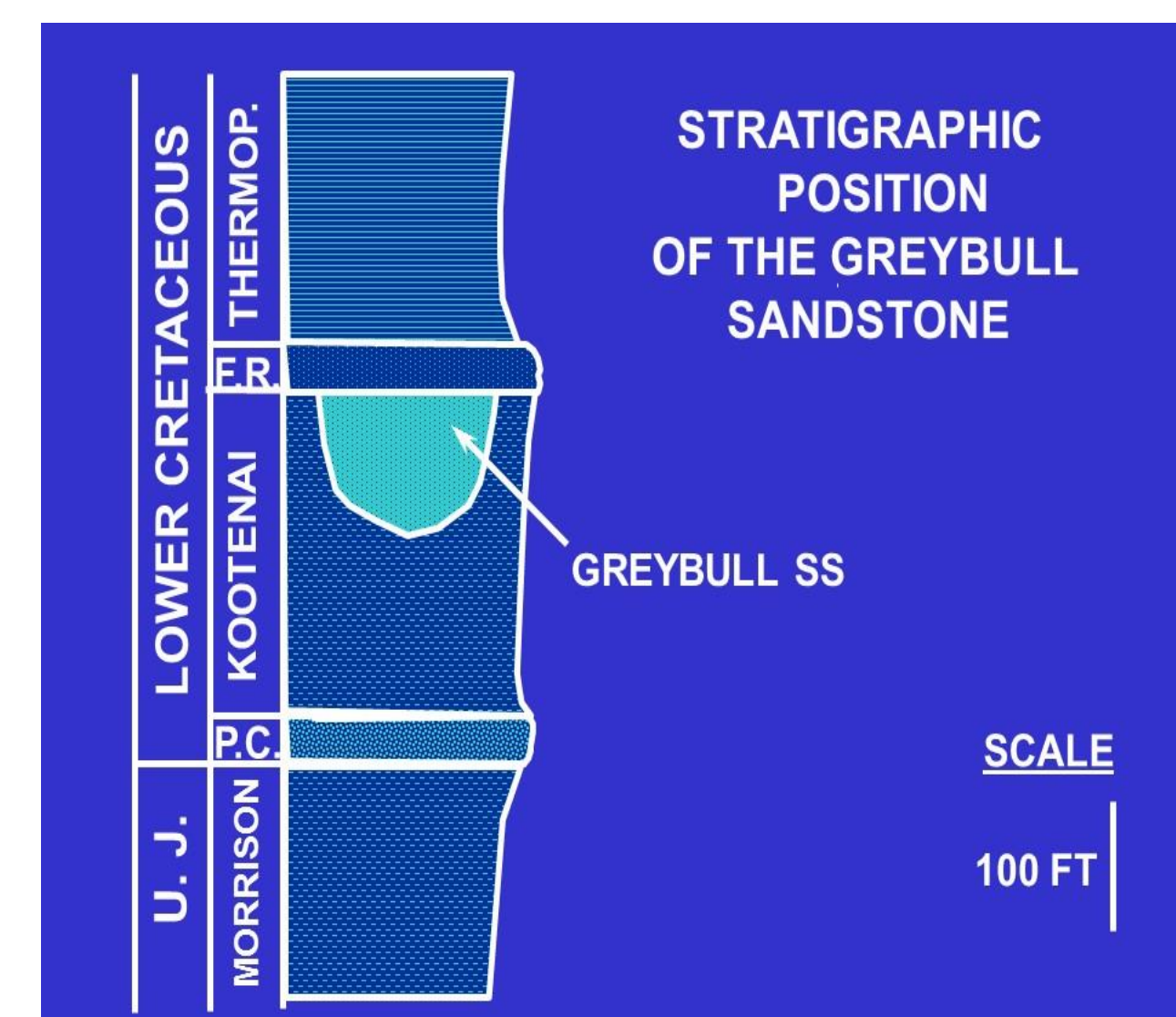
## Under Explored Area



All Wells in Reservation Area

Wells Deeper than Lower Cretaceous

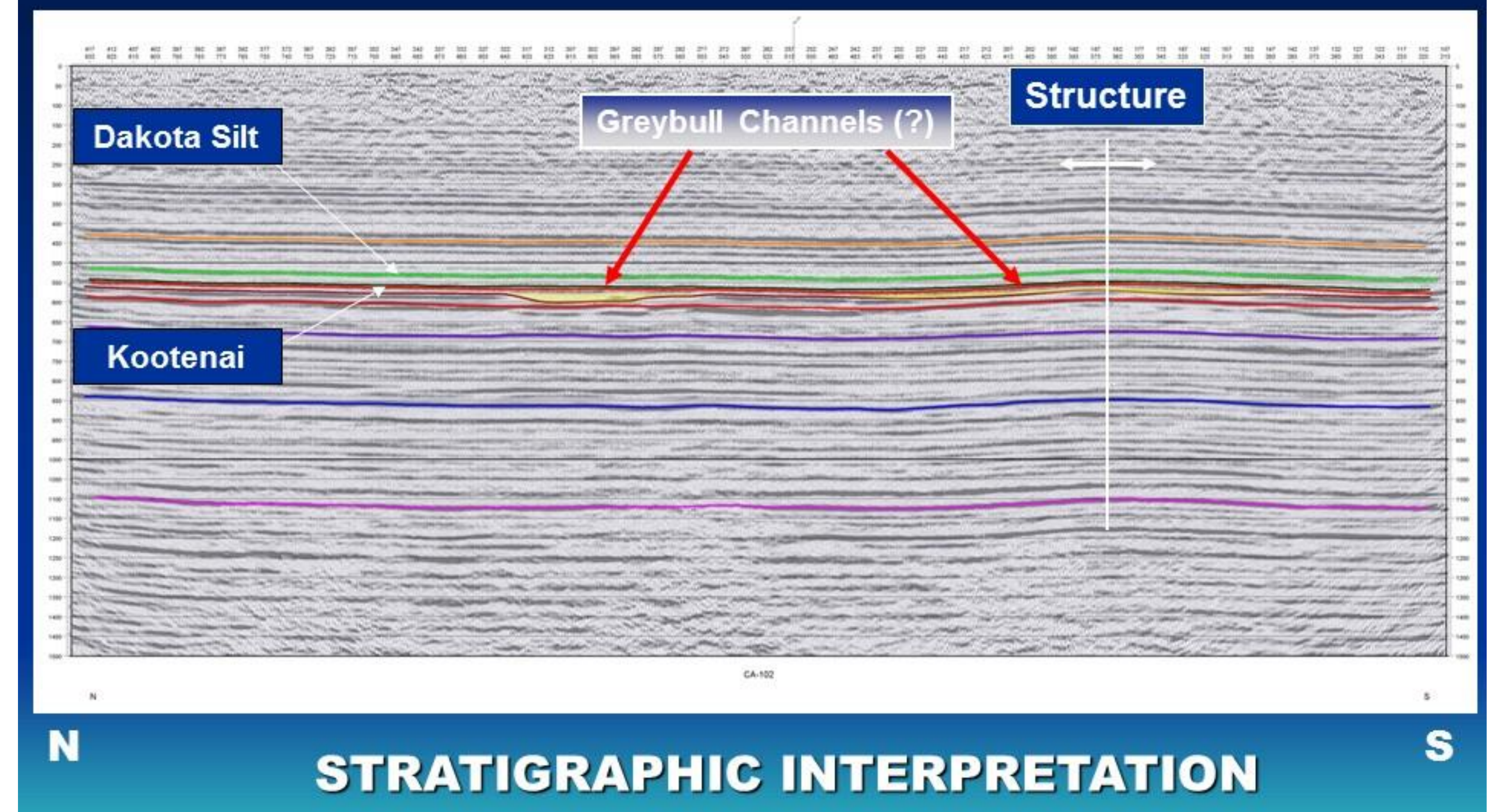
## Greybull Sandstone Potential: Requires Combination Stratigraphic-Structural Trap



## RESULTS OF FIELD & SUBSURFACE INVESTIGATIONS

- Four major channels identified along outcrop belt
  - 100+ feet of sandstone present in channels
  - Width of channels, 1 to 3 miles
  - Transport directions in all channels is W-SW
- Two more channels identified in the subsurface
- Stat-Seismic Modeling successfully identified channels

## Line CA-102





# PETROLEUM GEOLOGY OF THE CROW INDIAN RESERVATION, SOUTH-CENTRAL MONTANA

## Tensleep Sandstone Play Potential

### Introduction

- Tensleep/Minnelusa most prolific oil-producing play in the Northern Rockies Region of the U. S.
  - Big Horn Basin over 2 BBO
  - Powder River Basin 0.5 BBO
- Production is stratigraphically controlled.
- In this region most production associated with structural highs & exploration focused on structure.
- The possibility of major stratigraphic accumulations long recognized in the northern BHB and PRB, but exploration focused on zero-edge, pinch-out.

### General Stratigraphy

- Rocky Mtn Miss – Mid Jur sequences represent continuous depositional systems, but were separated by Laramide deformation into BHB and PRB.
- Permo-Penn System is bounded by unconformities.
- Permian Phosphoria in BHB correlates roughly with the Goose Egg Fm in PRB.
- Penn Tensleep SS in BHB correlates, in general, with part of the Minnelusa Fm in PRB.
- Best Reservoir facies of the Tensleep and Minnelusa are eolian sandstone.

### Sequence Stratigraphic Relationships

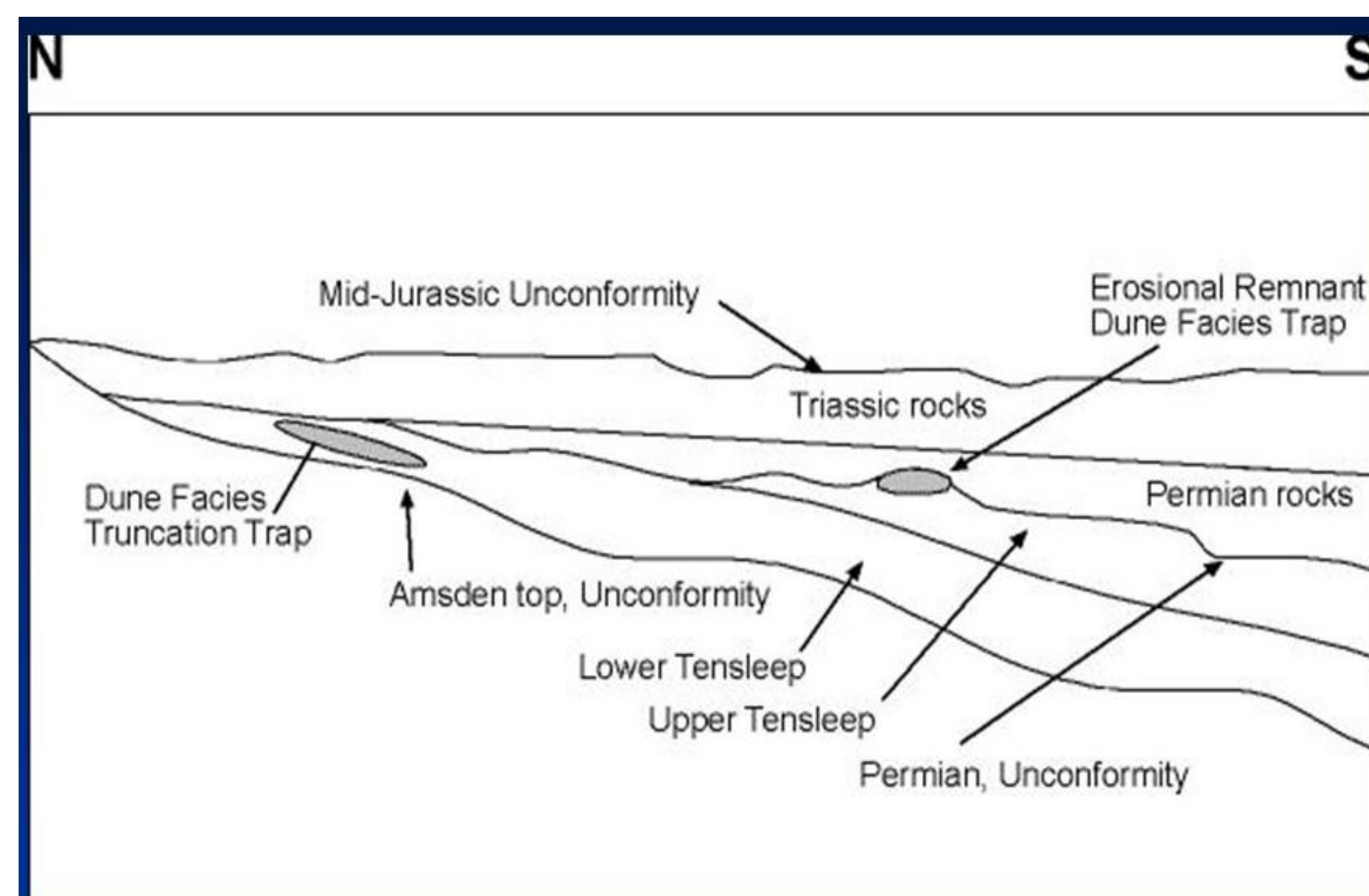
- Basal sequence boundary: Erosional surface on the Mississippian Madison Group.
- The Overlying Amsden began with terrestrial deposits.
- Upper sequence boundary: erosional surface on Tensleep.
- Tensleep sandstones built out onto shallow, low-gradient shelf.
- Regional uplift & erosional truncation in central Montana caused preservation of younger rocks progressively to the southeast.
- Eolian reservoir rocks deposited near shore along a westward migrating shoreline; interplay of near-shore marine, sabkha, and eolian environments.
- Eolian SS occurs in cycles:
  - Basal marine or sabkha limy ss or dolomitic ss overlain by porous and permeable eolian ss, which in turn is capped by marine ss.
  - Very low shelf gradient, so small changes in relative sea level resulted in repeated marine incursions over eolian sand deposits.

### Summary of Field Relationships

- Measured sections show significant relief on unconformity bounding the Tensleep Sandstone.
- Total Tensleep thickness varies greatly.
- Sequences were deposited in near-shore marine, sabkha, and dune environments.
- West:** Lower and Upper Tensleep present:
  - Lower: cycles of marine ss and probable sabkha sandy limestone and dolomite.
  - Upper: cycles of dune ss, marine ss, and/or sabkha (interdune) sandy limestone and dolomite.
- East:** only Lower Tensleep; rocks in similar cycles with dune ss developed in the section.

### Play Summary

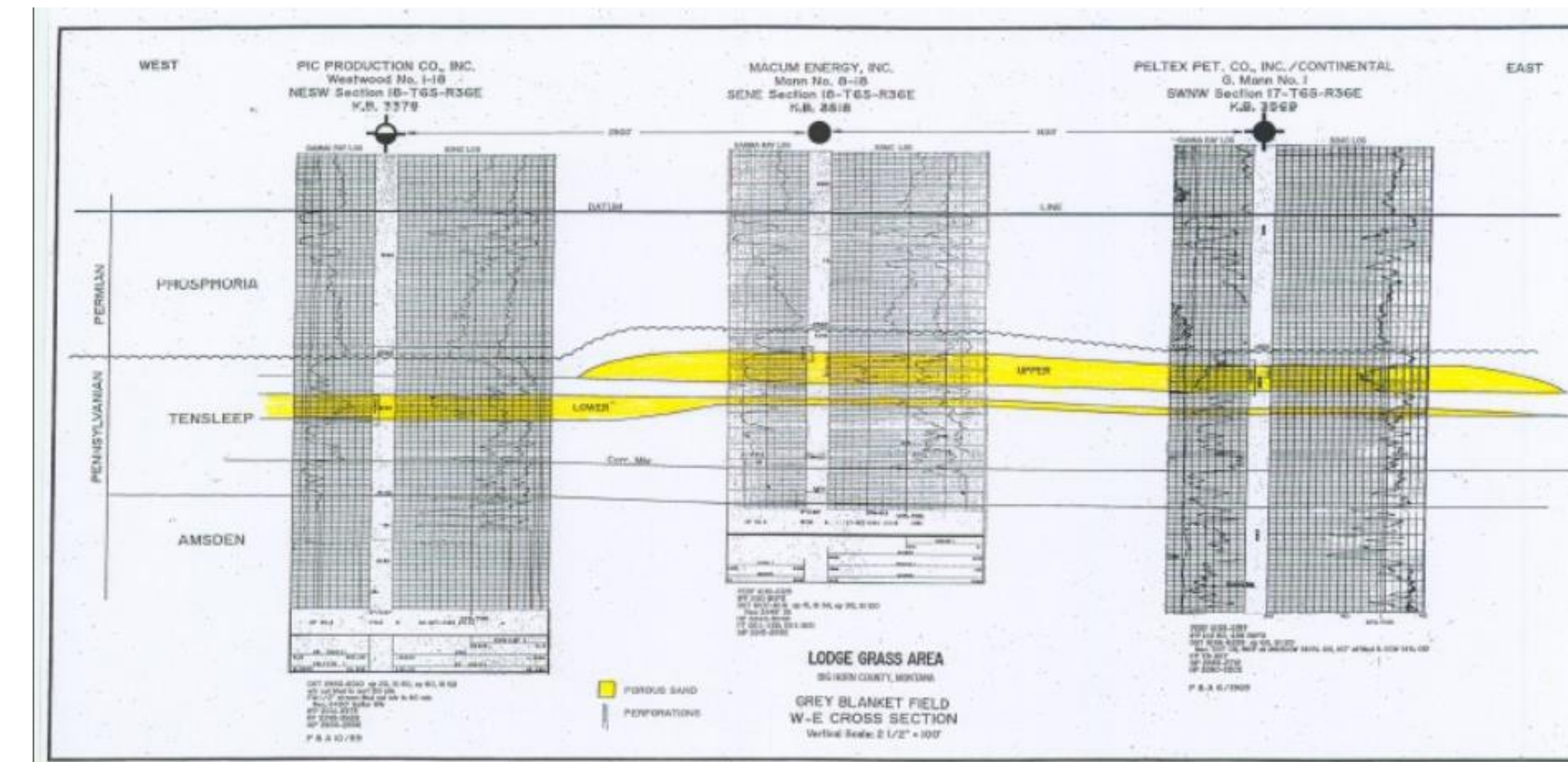
- Stratigraphy of the Tensleep is complicated by rapid facies changes and substantial relief on upper bounding unconformity.
- Reservoir facies are mainly eolian sandstones that pinch out within very short distances.
- Traps are stratigraphic and combination structural-stratigraphic.
- Organic chemistry of oils from Tensleep fields in the region document one common petroleum system from the same Phosphoria organic source in SW Wyoming.
- Potential exists for Tensleep discoveries south of zero J-T Isopach



Generalized Regional Tensleep Stratigraphy South-Central Montana



Tensleep in Dry Head Canyon showing dune-sabkha cycles. Porous dune sandstone is white, tight rocks yellow.



Grey Blanket Field (Lodge Grass) Stratigraphic Cross Section Courtesy of Keith Mohl (2006)



Dune preserved at top of Tensleep, Upper Soap Creek Outcrop analogue for Grey Blanket Field

