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

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Abstract

The Crow Reservation is a 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

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.

Location of Crow Reservation
Under Explored Area
All Wells in Reservation Area
Wells Deeper than Lower Cretaceous

Producing Oil Fields Crow Reservation

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

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
Dakota Silt
Greybull Channels (7)
Structure
Kootenai

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

**Introduction**
- Tensleep/Minnelusa most prolific oil-producing play in the Northern Rockies Region of the U.S.
- Region has produced 2B BBL
- 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 Bighorn and PRB, but exploration focused on zero-edge, pinch-out.

**General Stratigraphy**
- Rocky Mt Naps – Mid-Jurassic sequences represent continuous depositional systems, but were separated by Laramide deformation into Bighorn and PRB.
- Permo-Penn System is bounded by unconformities.
- Bighorn/Penn reservoirs in Bighorn correlate roughly with the Goose Egg Fm in PRB.
- Permo-Tensleep SSs in Bighorn, in general, with part of the Minnelusa Fm in PRB.
- Most 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 created 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:
  - Near-shore marine or sabkha type or dune deposits over porous and permeable eolian sand, which in turn is capped by marine SS.
  - Eolian sandstone may be blown inland.

**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 sabkha sandy facies and dolomites.
  - Upper: cycles of marine ss, marine SS, and/or sabkha (inter-dune) sandy facies and dolomites.
- East: only Lower Tensleep; rocks in similar cycles with dune as developed in the section.

**Play Summary**
- Stratigraphy of the Tensleep is complicated by rapid facies changes and substantial relief on the 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 Crow; J-J types.

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**Generalized Regional Tensleep Stratigraphy**
South-Central Montana

**Tensleep in Dry Head Canyon showing dune-sabkha cycles.**
Porous dune sandstone is white, light 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**

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**Diagram of Tensleep Sandstone Play Potential**

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**Piper**

**Chugwater/mid-Jurassic Unconformity**

**Madison Group**

**Tensleep**

**Amsden**

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**Text in Images**

- Typical unidirectional planar cross-bedding
- Hoodoos of Greybull Sandstone near Pryor, MT