Reservoir Development in the Tensleep Sandstone, Pryor and Bighorn Mountains, South-Central MT

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2 Introduction
The Permian-Pennsylvanian is the most prolific oil-producing system in the Northern Rockies Region.
- Bighorn Basin (BBB) produced over 2.8 BBO.
- Powder River Basin (PRB) produced over 500 MBD.
- Production is stratigraphically controlled.
- In the region, most production is associated with structural highs, as evaporite has focused on those areas.
- Possibility of a major stratigraphic accumulation in south-central Montana has long been recognized, but exploration has focused on the western part of the region.
- Working Hypothesis: A primary regional stratigraphic trap occurs south of the core of the region related to the truncation of reservoir facies within the depositional system and oil in the Tensleep in both the BBB and PRB represent one regional petroleum system.

3 Project Goals
- Develop new exploration model for the Permian-Pennsylvanian system in south-central Montana.
- Define an exploration fairway for the system.
- Ultimately, add oil and gas reserves from new discoveries.

4 General Stratigraphy
- Mississippian through Mid-Jurassic sequences represent continuous depositional across the region, but were separated by Laramide deformation into BBB and PRB.
- Perm-Penn system is bounded by unconformities.
- Permian phosphorite in BBB correlates roughly with the Goose Egg Formation in the PRB.
- Penn Tensleep Sandstone correlates, in general, with the Minnelusa Fm in PRB.
- Reservoir facies in the Tensleep and the Minnelusa are mainly eolian sandstone.
- The Penn-Perm system hydrocarbon source has been linked to organic-rich beds of the Phosphoria.

5 Field Investigations
- Sections were measured at 8 localities.
- At Dry Head Canyon the Tensleep is exposed continuously for about 5 mi.
- Therefore 5 sections were measured at that locality.
- The figure to the right illustrates the thickness variations as well as the distribution of the lower and upper Tensleep sections.

6 Summary of Field Relationships
- Measured sections show significant lateral differences indicating that the Tensleep is a complex system.
- Total Tensleep thickness varies greatly.
- Sequences were deposited in near-shore marine, sabkha, and dune environments.
- In the West: Lower and Upper Tensleep are transgressive systems.
- In the East: Lower Tensleep sabkha facies are similar, but clastics have developed in this part of the section.

7 Regional Petroleum System
- Working hypothesis: That oil was generated and migrated before development of Laramide structural features. Therefore, oil in fields in the region should be similar and regional stratigraphic traps probably exist.
- Oil samples were recovered from existing Tensleep producing fields to test our idea.
- The chemical results confirm our interpretation and indicate "close agreement between all samples from both a thermal maturity history and a common organic source organic" (Cheek, Bayless, Geochim Labs Inc.).

8 Conclusions
- Stratigraphy of the Tensleep is complicated by rapid facies changes and substantial relief on bounding unconformities.
- Reservoir facies are mainly eolian sandstones that pinch out within very short distances. Therefore, well spacing as small as 10 acres may be necessary to tap all potential reservoirs in a field.
- Organic maturity of oils from Tensleep fields in the region document one continuous petroleum system from the same organic source.