As the cumulative production of oil from the Big Horn basin approaches the 2 billion bbl mark, it is appropriate that we look at the geology once again.

The Big Horn basin, located in northwestern Wyoming and south-central Montana, is bordered on the east by the Big Horn Mountains; on the south by the Owl Creek Mountains; on the west by the Absaroka and Beartooth Mountains; and on the north by the Nye-Bowler lineament. The combination of a great reservoir-source duet in the Paleozoic rocks and the creation of large anticlines during the Laramide orogeny has been the key to the Big Horn basin's success as an oil producer.

Stratigraphy of the Big Horn basin can be divided generally into (1) the Middle Cambrian clastics, (2) the Paleozoic shelf carbonates, (3) the Mesozoic clastics, (4) the Late Cretaceous to Tertiary synorogenic clastics, and (5) the Tertiary post-orogenic clastics and volcanics.

By far the most economically important formations have been the Permian Phosphoria and Pennsylvanian Tensleep Formations. This dynamic duo consists of porous eolian and shallow marine, quartz sandstones of the Tensleep overlain by shallow marine, oil-rich carbonates of the Phosphoria. The two have combined to produce over 1.5 billion bbl of oil in the Big Horn basin alone.

The draping of the Tensleep and Phosphoria over large Laramide structures (closures of over 5,000+ ft, 1,500 m, and areal extents up to 15 mi^2, 40 km^2) was the final key. An upcoming afternoon session of papers will explore the proposed anatomies and mechanisms of folding in the Cordilleran foreland.

There is a controversy over the morphology of the folds in the foreland. Put simply, there is some disagreement over how much the horizontal or thrusting component contributes to these folds. Stearns, who described the fold at Rattlesnake Mountain in the 1971 Wyoming Geological Association guidebook, favors drape folding over near-vertical faults in the Precambrian. Berg in the 1962 AAPG *Bulletin* and Gries in the 1983 AAPG *Bulletin* favor a more thrusted model with reverse fault planes dipping 60° to 30°. Sales in the 1968 AAPG *Bulletin* agrees with the morphology of Berg and Gries, but feels that the folds in the foreland were generated by faults with strong lateral components.

Concerning other problems, Stone in the October 1967 AAPG *Bulletin* pointed out that the Paleozoic reservoirs often have a common oil-water contact (OWC) within individual structures. He attributed the common OWC to fractures joining the reservoirs. The OWC is commonly tilted; this he attributed to hydrodynamic flow. An understanding of fractures and tilted oil-water contacts is imperative for successful exploration and production programs in the Big Horn basin.

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Paleotectonic Control of Depositional Facies (Mississippian), Southwest Montana

Mission Canyon deposition occurred in southwest Montana on a shallow carbonate platform that extended to the Antler orogenic foreland basin, the eastern margin of which is near the Idaho-Montana border. Deposition on this platform did not take place in regular facies belts paralleling depositional strike, but instead occurred on fairly regular shelves (Alberta and Beartooth) in the east, and along shoals, emergent islands, and deeper water channels throughout most of the area. The facies that were deposited in these zones are directly related to the northeast-southwest and northwest-southeast structural trend imposed on the area during late Precambrian time, and the movement of paleostructural elements during Mission Canyon and pre-Big Snowy time. The thickest sequences in the Mission Canyon are those comprised of low-energy mudstones and wackestones, which were deposited in trough areas such as the Ruby and Centennial troughs, and the high to moderate-energy grainstone and packstone sections that typify the far western shelf margin sequences.

High-energy shoal (lime grainstone) and low-energy island (algal boundstone) deposits are concentrated both on and around fault-bounded paleohighs (e.g., Pioneer Mountains in the Belt Island Complex) present during early Mission Canyon time; they are represented by thins on the Mission Canyon isopach map. Paleolows, such as the Ruby-Crazy Mountain and Centennial troughs, developed on east-northeast-trending, downdropped, fault-bounded basement blocks, and were filled with thick sequences of mostly restricted marine dolomite mudstones and wackestones. These restricted marine lithologies also occur as relatively thin zones in the upper portions of the fining upward high-energy shoal sequences in the lower Mission Canyon. However, they are most extensively developed in the upper Mission Canyon, where they contain regionally correlative evaporite units that are represented on outcrop by solution collapse breccias. Only minor amounts of low energy, normal marine rocks occur in the Mission Canyon Formation, and most of these were deposited near the far western margins of the carbonate platform.

A major lowering of sea level took place in middle Mission Canyon time. This resulted in the deposition of a regionally correlative supratidal sequence. The ensuing regional transgression resulted in the development of a new shelf margin farther to the west, and deposition of the restricted marine and evaporite units, mentioned above, behind it. Deposition of the Mission Canyon Formation ended with the total withdrawal of the sea from southwest Montana, regional exposure, and the formation of an extensive karst system and widespread solution collapse breccias.

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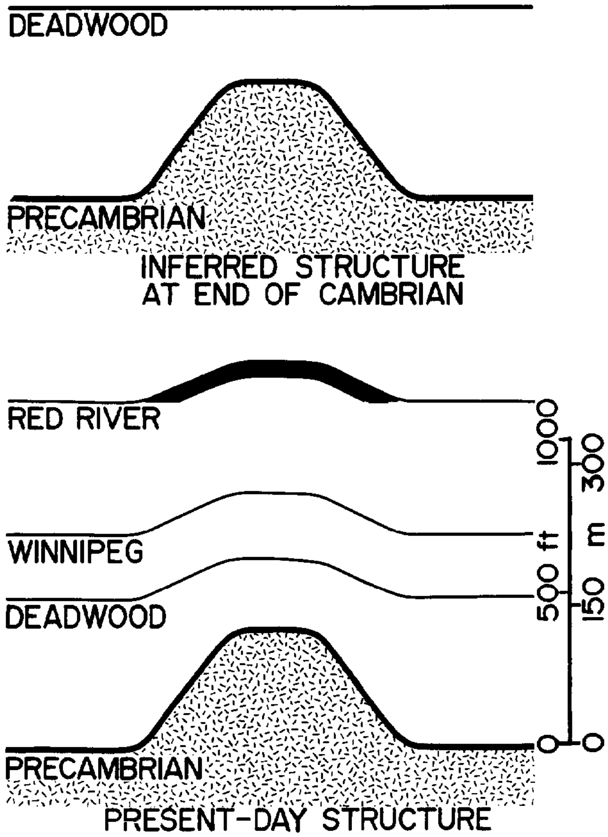
Development of Structure and Porosity at Medicine Lake Field in Northeast Montana Williston Basin

Medicine Lake field produces oil from the Mississippian Charles, Devonian Winnipegosis, Silurian Interlake, and Ordovician Gunton and Red River formations, and drill-stem tests show a potential for production from the Devonian Nisku and Deperow Formations. Porosity in the field is the result of bioclastic bank development, dolomitization, solution, and fracturing. Porosity development in the Winnipegosis and Red River Formations may have been influenced by the Medicine Lake paleostructure. The source of the oil in each of the producing formations is probably within that formation itself.



The Medicine Lake structure is roughly elliptical, 1 mi (1.6 km) in diameter, and has 125 ft (38 m) of structural closure at the top of the Red River Formation. Growth of the structure was essentially complete by the end of the Devonian. However, a similar structure at nearby Outlook field can be mapped from Paleocene outcrops, which shows that structural movement there continued into the Cenozoic.