Wind River Basin

Oil and Gas Geology, Past Production, and Future Development

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Basin geology

Significant deformation occurred in the Wind River Basin during the Laramide orogeny that resulted in a basin center greater than 7,620 m (25,000 feet) deep, beds dipping 10–20 degrees toward the basin center on the south and western margins, and near-vertical to overturned strata on the north and eastern margins (Keefer, 1969). A thick succession of undeformed post-Laramide basin-fill strata was deposited unconformably on the pre-Laramide (pre-Eocene) rocks.

In the Wind River Basin, hydrocarbon traps typically consist of structural features such as domes, anticlines, or faulted anticlines (Keefer, 1969) situated on the basin margins, in rocks deposited previous to or coincident with Laramide-age faulting. Other types of structural traps include anticlines or domes near the basin axis, generally in the north and northeast, as well as traps beneath the basin-bounding thrust faults, or sub-thrust plays (Fox and Dolton, 1996).

Some purely stratigraphic traps are also found in the Wind River Basin. The most frequent stratigraphic traps are lateral up-dip (to the east) facies changes in the Phosphoria, Park City, and Goose Egg formations. Others include sandstone pinch-outs in the sandstone reservoirs of the Frontier Formation, Mesaverde Group, and Muddy Sandstone, as well as vertical and lateral cementation variations in Tensleep Sandstone reservoirs. In some cases, structural traps are enhanced by the effects of stratigraphic-trapping. For example, oil and natural gas in Morrison Formation sands are held by a combination structural-stratigraphic trap on the nose of a domal structure in the Poison Spider West field (Gouger, 1989).

The Tensleep Sandstone and Phosphoria and Park City formations comprise the primary reservoir rocks in the basin. The bulk of the hydrocarbons in these formations were sourced from the black shales of the Mead Peak and Retort members of the Phosphoria Formation in western Wyoming and eastern Idaho (Sheldon, 1967; Stone, 1967; Kirschbaum and others, 2007). Migration began soon after generation, and may have been associated with Sevier orogenesis. Hydrocarbons moved up-dip, likely via the porous and permeable Tensleep Sandstone, into the area that is now the Wind River Basin and were trapped by the overlying impermeable Goose Egg Formation (Stone, 1967; Kirschbaum and others, 2007). Laramide faulting and folding was

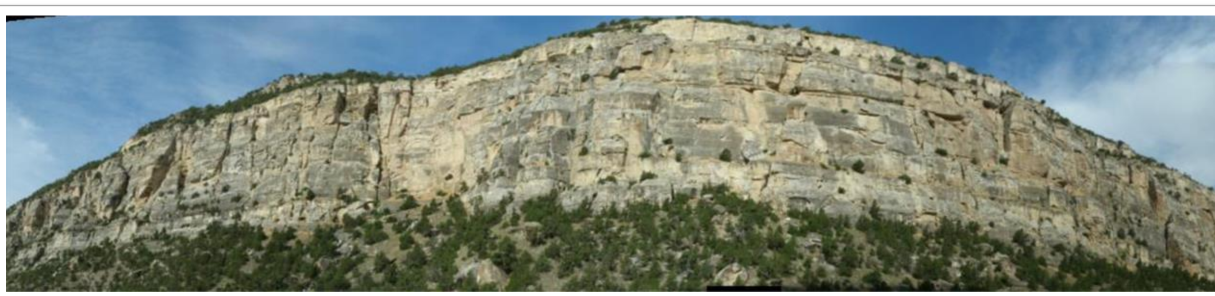

Photo mosaic of the Tensleep Sandstone in Wind River Canyon. Photo by R. Lynds.

responsible for the subsequent rearrangement of the hydrocarbons into their present day structural and stratigraphic traps. Phosphoria-sourced hydrocarbons are commonly high in sulfur, exhibit high API gravities, and are Type-IIS kerogen (Kirschbaum and others, 2007).

The Cretaceous and Tertiary petroleum system includes sources of the Fort Union, Meeteetse, and Mesaverde formation coals and carbonaceous shales, as well as the organic-rich marine shales of the Cody Shale, Belle Fourche Member of the Frontier Formation, Mowry Shale, and Thermopolis Shale (Johnson and others, 2007).

Past production

Oil production in the Wind River Basin, and Wyoming, began with the completion of the Mike Murphy #1 well in 1884, just five years after America's first commercial oil well, the Drake well, was drilled. Mike Murphy #1, completed in the Chugwater Group to a depth of 91 m (300 feet) (Mullen, 1989; De Bruin, 2012), was the discovery well for the Dallas (or Dallas Dome) field in the southwestern Wind River Basin. The basin contains the first oil well drilled in Wyoming (Mike Murphy #1), the first logged well in Wyoming (Atlantic Richfield Company Muskrat 2C, September 1936), and the deepest completed well in the Rocky Mountain region (Burlington Resources Big Horn 1-5, completed between 23,758 and 23,902 feet in the Madison Limestone, Madden field).

Triassic Chugwater Group, near Burris, WY. Photo by N. Gribb.

Of the 117 named fields in the Wind River Basin, 62 primarily produce oil and 55 produce natural gas; 38 of these fields are currently abandoned (Toner and others, 2016). Additionally, a handful of these reservoirs produce condensate liquids which are reported as oil by the Wyoming Oil and Gas Conservation Commission. Oil production in the Wind River Basin declined from 1978 through 1995, held steady from 1995 until 2010 at near 4 million barrels per year, and has slowly been increasing over the past few years (WOGCC, 2017). Natural gas production in the basin generally increased through 2005, decreased since 2009, and is slowly beginning to increase again (WOGCC, 2017). Reservoirs range from Mississippian to Eocene in age.

The decline in oil production in the Wind River Basin has been offset recently with the use of efficient secondary and tertiary production techniques like those employed at the current CO_2-EOR project at Beaver Creek field. Although it is possible that small undiscovered petroleum accumulations may exist in the basin (Fox and Dolton, 1996), as with most hydrocarbon fields throughout Wyoming, it is more likely that any future increases in production will be the result of improved recovery methods.

Future development

That said, the Moneta Divide project, proposed by Aethon Energy and Burlington Resources, may be a game changer. Although still in the federal review process, the Moneta Divide project, near the large Madden gas field in the northeastern Wind River Basin, plans to drill 4,250 wells and produce oil and gas from the Paleocene (Fort Union Formation), Cretaceous (Lance, Mesaverde, Cody, and Frontier formations), and the Mississippian (Madison Limestone) (Toner and others, 2016). An environmental impact statement (EIS) is currently being developed for this project, and concerns raised from public scoping can be found at www.blm.gov/wy/st/en/info/NEPA/documents/lfo/moneta-divide.html. No information is publicly available on the expected total production from this proposed project.

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