Denver Basin

Oil and Gas Geology, Production, and Future Development

www.wsgs.uwyo.edu
Updated May 1, 2014

Basin geology

The Denver Basin has typical foreland basin-style geometry with a north-south trending basin axis. The strata on the western side of the basin dip steeply toward the east, while the strata in the eastern Denver Basin gently slope to the west. The basin is more than 3,962 m (13,000 feet) deep, as defined by the 1.6 billion year-old Precambrian basement. The bulk of the strata preserved in the Denver Basin were deposited during and after Laramide deformation, and are thus Cretaceous age and younger. Surface outcrops in the Denver Basin are generally Tertiary in age.

Tertiary White River and Arikaree formations on the Goshen Hole rim. Photo by J. Stafford.

The Silo field, discovered in 1981 (Sonnenberg, 2011), is the largest field in the basin and is also the largest horizontally-drilled field in Wyoming. It has produced more than 11.3 million barrels of oil and 10.2 billion cubic feet of gas, accounting for 36 percent of the basin's produced oil and 51 percent of the natural gas (WOGCC, 2014).

Production in the Silo field is primarily from the Cretaceous Niobrara Formation, which is predominantly fractured chalk (reservoir) encased in tight shales and mudstones (seal). This unconventional reservoir is conducive to horizontal drilling and hydraulic fracturing that significantly enhance production.

Production

Oil and gas was first discovered in the Denver Basin in 1901, and it now includes approximately 1,500 hydrocarbon fields spanning several states (Higley and Cox, 2007). The Denver Basin of Wyoming has 28 named oil and gas fields, 16 of which are not currently producing oil or gas. In 2013, there were 13 active oil and gas fields, and a sizeable wildcat well production of more than 550.8 thousand barrels of oil and 377.8 million cubic feet of natural gas (WOGCC, 2014).

The combined production in the Denver Basin of Wyoming, through 2013, was 30.7 million barrels of oil and more than 20 billion cubic feet of gas (WOGCC, 2014). However, production has fluctuated through the years. Oil production peaked in 1994, with 2.2 million barrels, while natural gas production peaked in 1995 with 1.6 billion cubic feet (WOGCC, 2014).

Future development

Although production efforts in the Denver Basin have historically focused on the Niobrara Formation, operators are beginning to explore other unconventional plays in the basin. Horizontal drilling and hydraulic fracturing have increased recent production from the tight sand formations of the Upper Cretaceous Muddy "J" Sandstone and the Codell Sandstone Member of the Carlile Shale. Codell production in Wyoming's Denver Basin jumped from 342 bbls of oil and 130 million cubic feet of gas in 2011 to over 48,000 barrels and 29,270 million cubic feet in 2013 (WOGCC, 2014). Likewise, "J" Sand oil production more than doubled between 2009 (9,838 barrels) and 2013 (27,935 barrels) (WOGCC, 2014).

As drilling techniques and reservoir characterization in the Denver Basin are refined and improved, increased production from unconventional reservoirs is expected to continue. In 2013, 60 oil wells were spudded or had permit-to-drill statuses in the Wyoming portion of the Denver Basin (WOGCC, 2014). Of these 60 oil wells, 43 are to be horizontal wells.

References

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