

Evolution of the Giant, Continuous Bakken-Three Forks Play, Williston Basin

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Abstract

The Bakken-Three Forks play in the Williston Basin has seen three cycles of exploration and development since the 1950s. Cumulative production from this unconventional play is 3.9 billion barrels oil and 6.1 trillion cubic feet of gas. The first cycle is the Antelope Field discovery and development (Bakken and Three Forks vertical drilling). The next cycle is the upper Bakken shale Billings Nose edge play (vertical and horizontal drilling for the upper Bakken shale). The last cycle is the basin-wide middle Bakken-Three Forks horizontal play. Changing geologic concepts, drilling and completion technologies, and petroleum prices have influenced the various cycles. The earliest discovery occurred in the Antelope Field of North Dakota in 1953, and development continued into the 1960s. Antelope is a structural anticline, and all members of the Bakken and the upper Three Forks were perforated and produced. The next significant discovery in the Bakken was in the Billings Nose area in 1961. The upper Bakken shale was completed in a well as a secondary objective after the deeper primary objective was not successful. The well showed that significant reserves could be found in the upper Bakken fractured shale. Because of product prices and the remoteness of the area, the next Bakken well was not drilled until 1976. This vertical play for the upper Bakken shale lasted from 1976 to 1987 and was replaced by horizontal drilling. This area became known as the “fairway” trend. Horizontal drilling in the upper Bakken shale commenced in 1987 in the Bakken “fairway” area. The first horizontal well, drilled by Meridian had a horizontal displacement of 2603 ft in the Bakken and was completed for 258 BOPD and 299 MCFGD. The success of this well set off the horizontal drilling phase of the upper Bakken shale. The lesson of increased formation contacts to the well bore for increased production was established. The last cycle starts with the discovery of the Elm Coulee Field of northeast Montana in 2000 with horizontal completions in the middle Bakken. The middle Bakken was successfully developed via horizontal wells. Initial drilling and spacing units were one section and wells drilled had multilaterals (bilateral or trilateral configurations). The wells were also fracture stimulated using one fracture stage. The cycle continues with discoveries of important fields in North Dakota using improved technologies (longer laterals and multistage completions). The Three Forks was also found to be productive across the area (an old lesson from Antelope Field). Some of the keys for the Bakken and Three Forks production include: overpressured reservoirs, high API gravity oil, pervasive petroleum saturation, mature Bakken source rocks over a large area and the very important technologies of horizontal drilling and multistage completions.