

Duperow Reservoir Characteristics in the Beaver Lodge Field, North Dakota

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Abstract

Beaver Lodge Field lies on the Nesson anticline in northwest North Dakota near the center of the Williston basin. The upper Devonian Duperow oil accumulation is situated on a four-way closure and covers 14,750 acres at a depth of 10,300 feet. To date, 74 million barrels of 42° oil have been produced from the Duperow in Beaver Lodge Field since the initial discovery in 1951. The Duperow Formation is a 450 foot-thick, carbonate-evaporite sequence defined by prominent gamma-ray marker beds. It consists of stacked, brining-upward or shoaling-upward, carbonate to anhydrite cycles that parallel thin marker beds. The uppermost productive cycle lies between the “A” and “B” marker beds of Wilson (1967); this is the most productive cycle within the field. Most reservoir-quality porosity occurs in the dolomite matrix of stratiform flow units that are commonly 2 to 10 feet thick, and occur interbedded with subtle, low-permeability, silt and clay-rich, gamma-ray marker beds. There are five dolostone flow units within this cycle (A1 at top, A2, A3, A4, and A5 at base). The A2 zone is the most widely porous flow unit in the field and is used to illustrate reservoir properties. As the most widely productive zone and the uppermost porous zone of significance, there is much flow test data and excellent control on the location of the oil-water contact. Porosity occurs dominantly in a burrowed to poorly laminated, dolomitic, skeletal-peloidal packstone-wackestone. Reservoir rock in the A2 zone is developed in a north-south area where porosity is commonly 18-24%, and permeability is typically 10-20 md (Ka). Field-wide, cycle-top anhydrite beds form vertical seals that separate stacked oil columns with separate oil-water contacts. The occurrence of structurally lower oil production in the southeast portion of the field, relative to porous and permeable, water-bearing wells in the northwest portion of the field,

indicates that the oil columns are tilted. There is no evidence that stratigraphic pinchouts, fault barriers or capillarity characteristics could have produced an apparent tilt. The mappable Beaver Lodge Duperow oil-column tilt (average 30 ft/mile east-southeast) is similar to the documented hydrodynamic tilt in the overlying Madison reservoir and this suggests that a similar hydrodynamic gradient affects Duperow accumulations.