

Red River B Reservoir Properties on the Nesson Anticline, North Dakota

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Abstract

The Nesson anticline is a major, south-plunging anticline that lies in northwest North Dakota. The Red River B zone is a dolostone flow unit that spans the Laminated Member to uppermost Burrowed Member of the Ordovician Red River Formation. Oil and gas production occurs at depths from 12,600 to 13,950 feet. Red River B production and oil shows (>50% oil recovery or $S_w < 35\%$) come from 62 wells that occur along crestal portions of the anticline. Intercrystal porosity is developed in dolostone with an average crystal size of 15 microns. Oil-bearing cored porosity varies from 4-20% (average 9%) and permeability varies from 0.02–5 md (average 0.75 md Ka). Average cored water saturation is 22% and average cored net pay is 8 feet for core $S_w < 35\%$. The logged oil-productive water saturation varies from 6-35%. Much of the B accumulations consist of volatile oil (48-50° API, with 2,100-3,200 GOR at virgin pressure) that comes from off-closure anticlinal locations. In gas caps on structural closures, oil gravity is 53-58° API and GOR is 3,600-10,000+. Capillary pressure and saturation data are consistent with intermediate wettability conditions and the presence of two large accumulations: 1) Beaver Lodge and 2) Antelope-Blue Buttes-Charlson. Both accumulations have free-water levels tilted 35 ft/mile to the east-southeast. Red River B oil producing characteristics are illustrated in Blue Buttes field on the southern portion of the Nesson anticline. Average logged net pay in oil-bearing wells is 8.8 feet, with 20% water saturation and 11.4% porosity. Four vertical completions (including three commingles) were made and four wells with B pay were completed in other formations. Two structure-flank horizontal re-entry wells produced water and oil. One grass-roots horizontal well (Olson 9-11H) targeted the crestal portion of the plunging anticline in Sec. 9, T150N-R95W. Due to drilling challenges, the well only achieved 1,872 feet in-zone. Due to hole-obstruction issues, the well was not acidized or fracked. Initial (30-day) production was 221 BOPD (48° API), 733 MCFD and 30 BWPD and the well produced 219,939 BO, 869 MCFG and 15,352 BW in 11 years. It is likely that modernized horizontal drilling technology can overcome drilling and completion issues to achieve improved production.