Reservoir Characterization of the Bakken Formation in Elm Coulee Field, Richland County, Montana

Alexandre, Chloe S.[*1]; Sonnenberg, Steve [1]; Sarg, J. Fredrick [1] (1) Geology and Geological Engineering, Colorado School of Mines, Golden, CO.

Elm Coulee Field, discovered in 2000 in Richland County, Montana, is the largest oil field in the Williston Basin. This field produces from the Devonian-Mississippian middle Bakken formation and has an estimated ultimate recovery of 200 million barrels of oil. Horizontal drilling and fracturing lead to quick recoveries from this field due to the low permeability and porosity of the producing formation.

The Bakken Formation in Elm Coulee Field is composed of three main members with an average total thickness of 40 feet. The lower Bakken member consists of laminated, black, marine shale. This member is siltier in Elm Coulee than in other parts of the Williston Basin. It pinches out in the western and southern limits of the field and is not present locally in other parts of the field. The middle Bakken member contains five shallow marine silty-dolostone facies including two brachiopod-rich facies, two burrowed and bioturbated facies, and one laminated facies. Like the lower member, the upper Bakken member is laminated, black, marine shale, but it is continuous across the field and contains less silt than the lower Bakken member does in this part of the basin. The upper and lower Bakken members are the source beds for the oil found within the middle Bakken reservoir.

Production in the middle Bakken member within Elm Coulee is closely tied to the high percentage of dolomite located in the reservoir quality sections. The main types of porosity within the middle Bakken are intercrystalline, dissolution, and intergranular. The first two types of porosity listed are the result of dolomite crystallization and subsequent dissolution. Within portions of the middle Bakken member containing the highest dolomite percentages (up to 60%) and lowest clay percentages, some of the rhombohedral dolomites have 10 micron gaps along the edges of the crystals. These “slot pores” connect, thus acting like microfractures, and lead to preferential pathways that contribute to increased permeability and production.

The results of this study in conjunction with previous analyses of the Elm Coulee Field indicate that the Bakken system within the Williston Basin has huge potential for future discoveries. Understanding the distribution of facies and porosity within the middle Bakken reservoir member is the key to determining new drilling targets within Elm Coulee and also to the search for similar fields in this basin that may be good targets for future production.