

Depositional Controls on Reservoir Quality in the Dundee-Rogers City Interval: Lithofacies and Production Characteristics

Peter J. Voice¹ and William B. Harrison, III¹

¹Department of Geosciences, Western Michigan University

ABSTRACT

The Dundee-Rogers City interval has been a prolific producer of hydrocarbons since the 1920's in the Michigan Basin with cumulative production of more than 360 million barrels of oil. Three general categories of reservoirs are found in the Dundee-Rogers City: 1.) primary and intercrystalline porosity in dolomites sealed by anhydrites (western central Lower Peninsula), 2.) vuggy and intercrystalline porosity in hydrothermal dolomite reservoirs (central Lower Peninsula), and 3.) primary porosity in limestone reservoirs (eastern Lower Peninsula). In the central and eastern basin, the Dundee-Rogers City reservoirs are sealed by a combination of tight limestone (Dundee-Rogers City) or shale (Bell Shale). The Dundee Formation consists of a paralic to open shelf carbonate deposits. The Dundee exhibits a trend of deeper water deposits to the east, with dominantly tidal flat, sabkha and shallow lagoon deposits in the west, followed by sand shoals, patch reefs, and open shelf deposits in the central and eastern Lower Peninsula. The overlying Rogers City Formation represents a flooding event with deeper water outer shelf deposits laid on top of the Dundee. Grain-rich beach deposits bear both intergranular and open fenestral porosity. In the eastern basin, primary porosity includes intraskeletal (patch reefs), intergranular (shoals) and vugs. Dolomitization in the western Dundee was early and preserved primary depositional fabrics. In the central basin, primary porosity provided pathways for dolomitizing fluids to invade fractured Dundee-Rogers City limestones. Dolomitization enhanced the porosity generating both intercrystalline and vuggy porosity. This phase of dolomitization is not fabric preserving. Fracturing and fluid migration are linked to reactivation of basement structures during the Acadian and Alleghanian orogenies. Limestone and Dolomite Reservoirs in the Dundee-Rogers City interval behave differently during production. Dolomite reservoirs maintain near virgin reservoir pressure throughout their production history. Strong bottom water drive pushes the oil-water contact up during production and produced water increases throughout the lifetime of wells in the dolomite reservoirs. Conversely, the limestone Dundee reservoirs tend to exhibit overall decrease in reservoir pressure during production. Water production is much lower in the limestone reservoirs. The limestone reservoirs are more productive during secondary production operations.