

PERMEABILITY HETEROGENEITY IN BIOTURBATED STRATA, CARDIUM FORMATION, PEMBINA FIELD, ALBERTA, AND THE IDENTIFICATION OF POTENTIAL WATERFLOOD OPPORTUNITIES

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Abstract

Bioturbated sediments representing distal expressions of paralic reservoirs are increasingly being exploited for oil in the supergiant Cardium Formation, Pembina Field, Alberta, Canada. These sedimentary strata were previously considered unproductive due to the limited vertical and horizontal connectivity between permeable beds. In these “tight oil” plays (0.1 – 10 md), sand-filled burrows connect bioturbated and parallel laminated sandstone beds creating hydrocarbon migration pathways exploitable via horizontal drilling and multi-stage fracking. To assess the viability of waterflooding the bioturbated strata of the Cardium Formation, a regional-scale core-based study was undertaken.

Bioturbated lithofacies will be identified by logging 40 cores from the study area. An additional 600 Pressure Decay Profile Permeametry measurements will be acquired. Microperm values enable correlation of bulk permeability from plugs to the heterogeneous permeability distributions in intensely bioturbated strata. Bulk and microperm permeability data are graphically compared, and permeability distributions are mapped across the field. Using isopach thicknesses of bioturbated facies, production data, and permeability data, “sweet spots” are identified for placement of effective waterfloods.

Production information for recently drilled horizontal wells in the Pembina Field demonstrate that bioturbated muddy sandstones can be economically exploited when sand-filled burrows provide connectivity between sand beds. However, well performance within these poorly understood tight oil plays can be better predicted with an in depth characterization of their facies and complex permeability heterogeneities. It is believed that micropermeability analysis can be effectively employed to differentiate between economic and sub-economic plays, and to high-grade areas for enhanced oil recovery schemes.