

# Sequence Stratigraphic Analysis of the Duvernay Formation Shale, Kaybob Area, Alberta, Canada

**Daniel Shaw, Nicholas Harris**

University of Alberta

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## Abstract

The Upper Devonian Duvernay Formation mudstone is a significant unconventional reservoir in western Canada. In the West Shale Basin, development has been focused on thick, organic-rich, biosiliceous mudstones. A high resolution depositional and sequence stratigraphic model of the Duvernay in the Kaybob area (a favorable area for oil and gas development) is valuable for identification of productive intervals. Our analysis of several long cores and well logs identifies eight lithofacies based on sedimentary structures, organized into four facies associations (FA) related to depositional processes and conditions: FA1) hemipelagic suspension settling; FA2) turbidity currents and/or bottom water currents; FA3) elevated bottom water oxygen conditions; FA4) shedding of carbonate detritus from reefs. Three 3rd order depositional sequences (DS1-3) are identified within the Duvernay Formation, bounded by 4 sequence boundaries (SB0-3). Sequences are defined by vertical facies patterns in cores and by stratal stacking patterns on wireline logs. Sequence boundaries are recognized by abrupt facies shifts and locally erosive and bioturbated surfaces overlain by mm to cm scale lag deposits. Maximum flooding surfaces (MFS) are typically defined by non-erosive, gradational to sharp contacts. Maximum regressive surfaces (MRS) are defined by sharp, planar surfaces, locally bioturbated, overlain by mm-scale lag deposits. The bases of DS1 and DS2 are major flooding surfaces that mark the beginning of transgressive systems tracts (TST) and deposition of organic-rich, siliceous mudstones. These are overlain by highstand systems tracts (HST), represented by an increase in carbonate sediments and bioturbation. The base of DS3 is marked by a rapid transition to more argillaceous sediments, interpreted to be a lowstand systems tract (LST)

which is overlain by a TST and HST. These three 3rd order cycles are superimposed on a 2nd order late TST and early HST. The 2nd order MFS is interpreted to coincide with the MFS located within DS2. We have also identified likely 4th order depositional sequences (2-8 m scale) in the Duvernay, based on trends within depositional packages that include increasing calcite content, decreasing TOC, increasing abundance and size of burrows, and increasing grain size.