

Sequence Stratigraphic and Depositional Facies Framework of the Lower Cretaceous McMurray Formation, Kearl Oil Sands Project, Alberta

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The McMurray Formation in the Athabasca area of northern Alberta represents Canada's most important oil sands resource with an estimated 800 billion bbl in place. Approximately 15% of this resource can be exploited by surface mining. Imperial Oil and ExxonMobil have proposed to develop 4.4 billion bbl of bitumen at 300,000 bpd over a 50 year period at their Kearl Mine. A sequence stratigraphic and facies framework was constructed at Kearl to establish the basis for reservoir prediction that is essential for mine planning and development.

Regionally, the McMurray Formation is a deepening-upward fluvial-estuarine complex deposited within a paleo-valley system controlled by the configuration of the Sub-Cretaceous unconformity. The Kearl stratigraphic study was based on ~1000 wells (75% cored), 43 km of 2D seismic and integration with previous regional work. These data show that the McMurray Formation is characterized by abrupt lithofacies changes, inclined stratal geometries and high-relief unconformities. This stratigraphic complexity can be organized within a sequence framework. Four major sequences are recognized. The oldest sequence (I) is dominated by thick amalgamated braided stream deposits overlain by a shoaling-upward succession of lacustrine muds, paleosols and coals. Sequence II is a thick, heterolithic assemblage of fluvial, floodplain, and estuarine deposits. Sequence III is distinguished by large-scale fluvial-estuarine point bars that are up to 70 m thick and represent the primary reservoirs at Kearl. Bayhead delta muds contained within deeply incised valleys typify Sequence IV.

This study has resulted in an enhanced understanding of McMurray depositional systems that is utilized for resource characterization and assessment, reservoir modeling, pit design, drilling programs, ore processing and substrate stability evaluations.