Cores from the Fluvial Channel Sediments of the Lower McMurray Formation in the Northeastern Athabasca Oil Sands Area: Guiding Exploration at the Northern Lights Project

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ABSTRACT

The oilsand resources of the Ft. McMurray area are hosted in the Early Cretaceous (Albian) McMurray Formation of the Mannville Group. The McMurray Formation is a sequence of fluvial to estuarine and near-shore marine sediments that was deposited on exposed Devonian strata during the early stages of a marine transgression. Deposition was controlled by the topography of the Devonian surface, and was centered in a basin that had formed due to the dissolution of thick salt deposits within the Middle Devonian Prairie Evaporite Formation. The Northern Lights Project, which is located 110 kilometers north of Fort McMurray, lies near the northeast edge of the basin, and the cores and geophysical logs on display illustrate the nature of the McMurray sediments and the underlying Devonian strata in that area.

In the surface mineable area, the McMurray Formation is informally subdivided into a lower fluvial member, a middle estuarine member and an upper marginal marine member. Typically the majority of the bitumen is contained in the upper members, and part or all of the fluvial sand is saturated with water rather than bitumen. In contrast, at the northeastern edge of the basin the marine member and most or all of the estuarine member have been removed by erosion, but the fluvial member is thick and saturated with bitumen.

In the northeast part of the basin, the fluvial member was deposited by river systems that drained the nearby Precambrian Athabasca quartzite, which is still exposed to the east today. As a result, most of the bitumen at the Northern Lights Project is contained within relatively clean, medium- to coarse-grained quartz sand. Compared to deposits in the estuarine and marine members, the pore water is relatively fresh, and the amount of 'fine' (-44μm) clay material is significantly lower. This 'low-fines' situation presents an opportunity to apply innovative mining, ore handling and pre-processing methods, because the relative absence of 'fine' material means that traditional approaches to primary ore processing are not necessary.

The challenge of delineating and modeling the fluvial channel trends has called for detailed observation and interpretation of sedimentary structures and palynological data. The application of fundamental sedimentology combined with interpreted structural controls is guiding the exploration strategy for the Northern Lights Project. The integration of core interpretation, core analyses and down-hole geophysics has proven to be an effective tool for interpreting the channel trends.

The Northern Lights Project has also generated new information about the Devonian formations. Throughout most of the basin, the McMurray Formation rests unconformably on the Upper Devonian Waterways Formation. Much of the Northern Lights Project lies east of the Waterways subcrop, however, and in some places the McMurray Formation rests directly on a thick breccia that formed in response to salt dissolution in the Prairie Evaporite Formation. The breccia consists of clasts of limestone, mudstone and dolostone in a matrix of silty calcareous mud. It is well consolidated and impermeable to groundwater. The Methy Formation, which underlies the breccia, is occasionally seen in cores at the base of oilsand-filled sinkholes.

The Northern Lights Project is on track to be a fully integrated oilsand operation. The ore will be produced by open-pit mining methods, and the Project is designed to produce more than 100,000 barrels per day of synthetic crude over a 30-year life. The first production is planned for 2008. The Project is comprised of Oil Sands Permits 02, 05, 80, and 81, which cover Townships 98 and 99, Ranges 5 to 7 west of the Fourth Meridian. The Permits are held by Synenco Energy Inc., a private company that was incorporated in 1999.