

Three-Dimensional Geometry of Fluvial-Estuarine Oil-Sand Deposits of the Clarke Creek Area, Northeastern Alberta

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Most of the bitumen resources in the Athabasca oil-sand area are contained in fluvial and estuarine channel deposits of the Lower Cretaceous McMurray Formation. Integration of subsurface data shows that seismic surveys give an accurate three-dimensional picture of the various structures in the subsurface. Identification of bounding surfaces of specific strata and lithofacies associations have identified channel complexes.

Two channel complexes can be recognized in the Upper McMurray Formation at Clarke Creek, both interpreted as estuarine meandering channel/point-bar complexes. The older channel complex was oriented to the northwest, with prominent low-angle crossbedding (seen in core and interpreted on dipmeter logs and seismic sections) striking parallel to the main channel axis and dipping variably at 90° to the channel-axis trend. This crossbedding is interpreted as being due to the lateral migration of point bars within the estuarine complex. A younger channel complex removed much of the older estuarine meandering-channel–point-bar complex. The younger channel complex trends to the north, and has similarly associated lateral-accretion surfaces, due to point bars bordering along the axial trend of the main channel. The lower part of each channel complex contains the highest bitumen grades. Tops of channel complexes are outlined by dipping surfaces of lateral-accretion crossbedding (sandy or muddy, inclined, heterolithic stratification) of estuarine point-bar successions, with reduced permeabilities and containing lower bitumen grades.

A large percentage of the oil sands are contained in the central, younger channel complex. Results from the present study indicate that channel complexes can be realistically imaged by seismic methods.