Regional Geology of the McMurray Formation, Athabasca Bitumen Accumulation Region, Northeastern Alberta: A Synthesis

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The Lower Cretaceous McMurray Formation of northeastern Alberta houses one of the world's most voluminous bitumen accumulations. This study focused on the comprehension of the regional geological history, deposition environments and the reservoir facies geometry of the McMurray Formation from core-derived information. There were two main objectives: firstly, to geologically assess the regional distribution of current oil sands leases; and secondly, to reconstruct the geometry and correlation of geological bodies. The latter objective should improve our understanding of complex lithological heterogeneities on a lease-scale. These results could impact the type of extraction technique to be implemented on various leases.

Four principal lithofacies associations (LA) have been recognised in the McMurray Formation based on 90 core descriptions. These are: fluvial channel fills (LA I); estuarine channel fills (LA II); tidal creek fills (LA III); and bay fills (LA IV). Their relative dimensions have been calculated and plotted spatially and temporally. The spatial distribution of LA proportions has been determined for the McMurray Formation as a whole and for intra-McMurray stratigraphic intervals. Results show that the ratio of argillaceous bay-fills to estuarine and fluvial channels becomes proportionally more important in the northern part of the Athabasca Region and towards the top of the McMurray Formation. This spatial distribution of bay-fill deposits was controlled by a transgressive event originating from the Boreal Sea to the north, causing a southward retrogradation of channel depositional environments. The southward shift of more marine-influenced argillaceous depositional environments has resulted in a general decrease of net-to-gross and continuous pay in a northern direction. A detailed understanding of the geological model of the McMurray Formation could become a useful guideline for selection of the geologically favourable regions in which to commence SAGD projects.