

Regional Lithostratigraphy, Biostratigraphy and Facies Models, Athabasca Oil Sands Deposit, Northeast Alberta

Frances J. Hein*

Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor Twin Atria, 4999 - 98th Avenue, Edmonton, Alberta, T6B 2X3
fran.hein@gov.ab.ca

and

Graham Dolby

6719 Leaside Drive S.W., Calgary, Alberta T3E 6H6
g.dolby@home.com

ABSTRACT

The Athabasca oil sands deposit of northeast Alberta is notorious for its complex facies relationships as well as a fragmentary preserved stratigraphic record. Determination of the relationship of different sedimentary packages to one another, proximal to distal variations, and the identification of systems tracts boundaries has been hampered in the past by the lack of a regional biostratigraphic framework that is linked to a regional lithostratigraphic framework. In order to overcome these difficulties, a regional litho- and biostratigraphic study has been initiated to help piece together the fragmentary record.

Detailed sedimentological and stratigraphic analysis of over 80 outcrops, 140 cores and over 4000 well logs by the Alberta Geological Survey over the previous 4 years allows for a better understanding of the Athabasca oil sands deposit, hosted primarily by the McMurray Formation in northeastern Alberta. Much of this work has relied on facies mapping on a regional scale, facilitated through a multidisciplinary approach involving palynological and facies analysis of outcrops and cores, well log analysis, regional mapping, as well as comparisons with modern analogues.

Typically in the past, the McMurray succession has been interpreted as fluvial for the Lower McMurray; estuarine channel and point bar for the Middle McMurray; and, coastal plain for the Upper McMurray. Results from the present analysis show that distinctions between the Middle and Upper McMurray are not possible on a regional scale, although locally these terms may still be useful. In addition, biostratigraphic dating shows that there is no age difference between the Middle and Upper, and from a facies viewpoint these units represent end-members of the same depositional system. Thus the revised informal stratigraphy includes the Lower fluvial succession, and the Upper estuarine and coastal plain succession.

In terms of paleoenvironments, the interpretation of the Lower McMurray as fluvial remains. However, the proportion of the Upper McMurray represented by estuarine channel and point bar units changes both in time and space. Comparisons with modern barrier islands and bays from the Maritimes of Eastern Canada show that much of what was previously interpreted as estuarine channel and point bar successions can be reinterpreted as barrier island, crevasse/washover channel, and bay fill deposits. Facies models for these types of environments are significantly different from those for estuarine systems, with the most marked differences in channel sand continuity versus bay-fill shale continuity. In areas of reduced accommodation space, for example in Athabasca Central and Athabasca South, not all the environments are preserved and recognition of the proper paleoenvironmental setting is critical for prediction of reservoir heterogeneity, including lateral and vertical segregation of gas, bitumen and water reservoirs.