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Flooding and Regression of the Middle Mannville Moosebar/Clearwater Sea – Paleogeography and Depositional Trends

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Summary

The boreal Moosebar/Clearwater Sea represents a major flooding event preserved in the Middle Mannville in Western Canada. A series of regional maps is presented which illustrate paleogeography during the transgression and the subsequent multi-stage regression. The main flooding event is marked by deposition of the Bluesky Formation and Wabiskaw Member sands. The Jenner-Moulton trend in the Glauconitic Fm. marks the highstand shoreline position at the southern end of the related Ostracod Sea. The Glauconitic Fm. Hoadley Trend and Lloydminster Fm. sands mark younger regressive and transgressive stages, respectively. The Falher/Wilrich and Clearwater/Grand Rapids deposits represent the final large-scale regression of the sea to the North and Northwest.

Paleogeography

Lower Mannville: The lower Mannville is represented by continental to marginal marine deposits. These sediments were deposited in a series of north to northwesterly flowing paleovalleys. Several areas of exposed highlands were present, these helped control paleovalley orientation. In southern Alberta, the Cutbank, Whitlash and Hooker-Crossfield channels were major sediment transport sites. Other paleovalleys include the Edmonton, Bellshill Lake, St. Paul, Spirit River, and Dunlevy trends. Nomenclature varies from area to area, lower Mannville sands include the Cutbank, Sumburst, Elleslie, Dina, McMurray, Cadomin, Gething and Dunlevy. Increasing marginal marine conditions at the close of the lower Mannville indicate the onset of the middle Mannville flooding evet.

Bluesky/Wabiskaw/Ostracod Transgression: The Bluesky Fm. marks a series of southeasterly-regressing shoreface deposits, the oldest occurring in NE BC. The youngest is the 'Drayton Valley Complex' in western Alberta. To the southeast of the Drayton Valley Complex was the shallow, restricted Ostracod Sea, where thin fossiliferous limestones and the Bantry Shale were deposited. The southern end of the Ostracod Sea is marked by deposition of the Jenner-Moulton highstand shoreline within the Glauconitic Fm. The Wabiskaw Mbr. sands in the oilsands area are the southerly-regressing equivalents to the Bluesky. Figure 1 illustrates depositional trends in the Bluesky, Wabiskaw and Ostracod.

Late Glauconitic Lowstand: After the Jenner highstand event, the sea regressed and stabilized at the Glauconitic Hoadley Barrier. Equivalent shoreface deposits are identified in the Wabiskaw Mbr. in eastern Alberta and Cummings Fm. in western Saskatchewan. A series of Glauconitic channels were deposited at this time. Channels tend to be either quartzose or lithic in grain

minerology, likely resulting from change in source terrain. Several topographic highlands of non-deposition were present throughout Glauconitic times.

Lloydminster Fm. Highstand: After the Late Glauconitic lowstand event, sea level rose again, and the shoreline moved to the southeast, where Lloydminster Fm. sands were deposited. A series of narrow, arcuate shorelines and a delta complex were deposited at this time. Lloydminster-hosted oil is often trapped by mud-filled distributary channels or cross-cutting Rex-aged channels. Topographic highlands continued to influence deposition throughout Lloydminster times.

Wilrich/Falher and Clearwater Regression: Following the Lloydminster highstand event, a series of northwesterly-prograding shoreface sand bodies were developed in the deep basin area, represented by the Falher H, G, F, and E cycles (oldest to youngest). These are highly productive southwest of the Falher-Wilrich deep basin gas limit. In the oilsands area, equivalent northerly-prograding shoreface deposits are present in the Clearwater Fm. The recent Clearwater plays in the Nipisi-Marten Hills and Jarvie-Meanook areas, and the Cold Lake Clearwater bitumen deposit are hosted in these deposits. Regional correlations show the Marten Hills Clearwater deposits and the Lloydminster sands are roughly correlative.

Falher B/Rex/Grand Rapids C: After the Wilrich/Falher/Clearwater regression, sea level rise kept pace with deposition, and the upper Falher and Grand Rapids deposits accreted in a more vertical manner. The Falher B, Grand Rapids C and Rex cycles are roughly age equivalent. Falher B gas deposits are hosted primarily in conglomerate-rich shoreface deposits.

Falher A/Sparky/Grand Rapids B: Sparky Fm. shoreface sands are highly productive in the heavy oil area, often trapped by mud-filled distributary channels. Falher A gas deposits are hosted primarily in conglomerate-rich shoreface deposits.

Notikewan/Grand Rapids A/Colony: A series of Notikewan channels have been mapped in the deep basin area, these are part of a prolific gas/condensate play. The Grand Rapids A is the correlative zone in the oilsands area. Further south, in the heavy oil area, a series of stratigraphically equivalent Colony channels have been mapped. These tend to fall mineralogically into quartzose and lithic populations, similar to the Glauconitic Fm. channels.

Acknowledgements

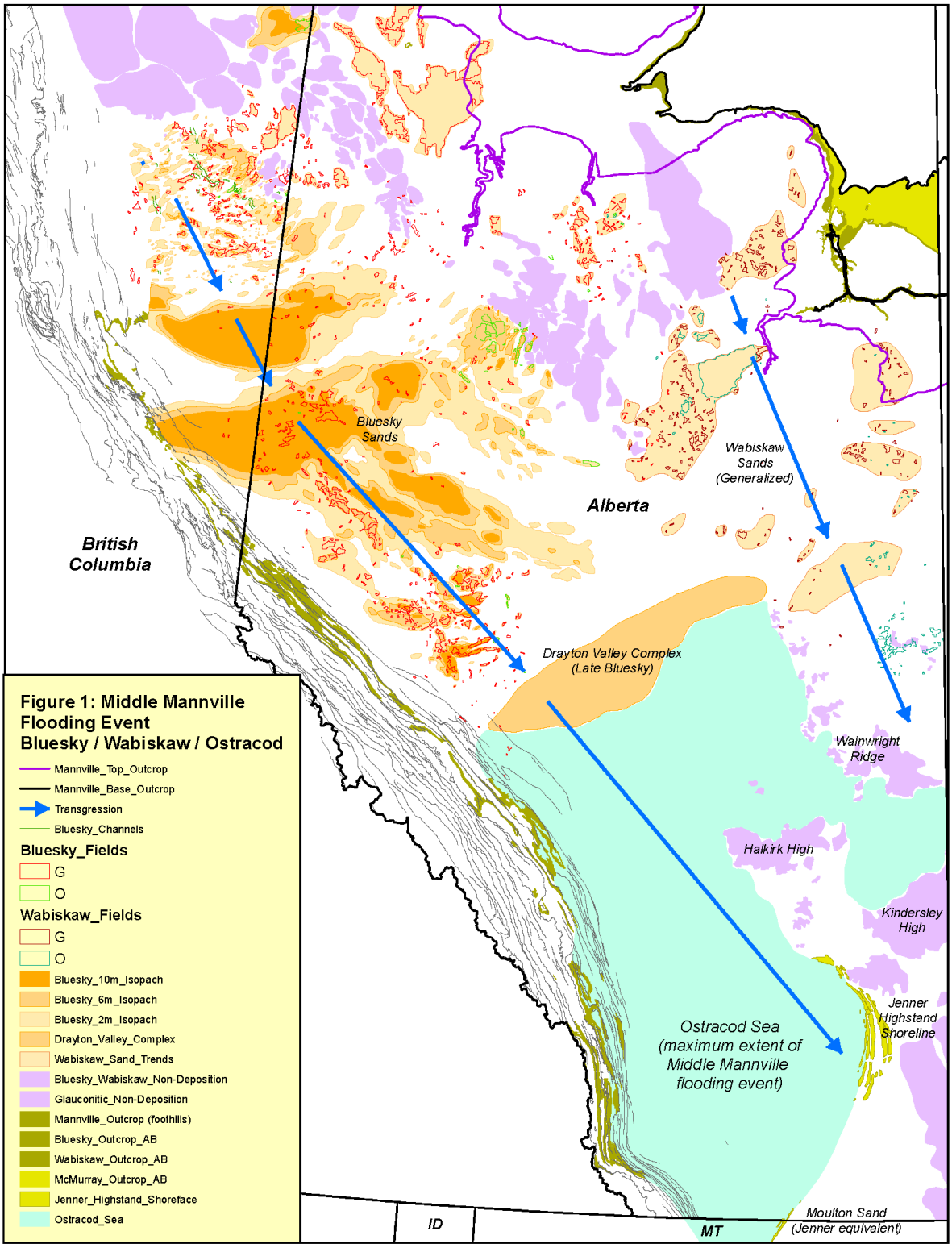
The paleogeographic maps presented here are based primarily on GeoEdges Inc.'s regional map and cross-section suite. Work published previously by Jackson and Smith et al. is incorporated in some areas.

References

Jackson, P. C., 1984, Paleogeography of the Lower Mannville Group of Western Canada, AAPG Memoir 38.

Sherwin, M. D., 1996, Channel Trends in the Glauconitic Member, Southern Alberta, CSPG Bulletin, Sept. 1996.

Smith et al., 1984, The Paleogeography of the Lower Cretaceous of Western Alberta and Northeastern British Columbia in and Adjacent to the Deep Basin of the Elmworth Area; AAPG Memoir 38.


Bluesky Sands
Wabiskaw Sands (Generalized)
Alberta
British Columbia
Drayton Valley Complex (Late Bluesky)
Wainwright Ridge
Halkirk High
Kindersley High
Jenner Highstand Shoreline
Ostracod Sea (maximum extent of Middle Mannville flooding event)
Moulton Sand (Jenner equivalent)
ID
MT
Figure 1: Middle Mannville Flooding Event
Bluesky / Wabiskaw / Ostracod
Mannville_Top_Outcrop
Mannville_Base_Outcrop
Transgression
Bluesky_Channels
Bluesky_Fields
G
O
Wabiskaw_Fields
G
O
Bluesky_10m_Isopach
Bluesky_6m_Isopach
Bluesky_2m_Isopach
Drayton_Valley_Complex
Wabiskaw_Sand_Trends
Bluesky_Wabiskaw_Non-Deposition
Glauconitic_Non-Deposition
Mannville_Outcrop (foothills)
Bluesky_Outcrop_AB
Wabiskaw_Outcrop_AB
McMurray_Outcrop_AB
Jenner_Highstand_Shoreface
Ostracod_Sea