

Mega-regional Depositional Environment Map of the Western Canadian Sedimentary Basin in the Middle Aptian

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Summary

The scale of the Athabasca oil sands deposit is vast; to fully understand depositional patterns, sediment entry points, and provenance, a new basin-scale depositional environment map has been developed. Outcrop information from geologic maps, CANSTRAT lithology, well data, and published compilations have been used to construct a mega-regional depositional environment map for the middle Aptian. The map represents the most likely depositional environment one would expect to encounter rather than a snapshot in time. The map extends from Banks Island in the Canadian Arctic to the US border in the south, and from the reconstructed Cretaceous thrust front in the west to the depositional onlap edge of the Canadian Shield in the east. The interpretation of depositional environments is broadly consistent with existing facies maps (e.g. Smith, 1994); however it is more expansive in areal extent and is drawn to a greater level of detail. Three main drainage basins and thalwegs are highlighted (Spirit River, Edmonton, and Assiniboia valleys); these delivered sediment from the western thrust belt, southern highlands, Canadian Shield, and intra-basinal lowlands. The map also suggests that the connection to the open ocean in the north was a via a relatively narrow (circa 300 km) epicontinental seaway extending along the Yukon-Northwest Territories border then across northern British Columbia and northern Alberta. This differs from previous interpretations that suggest a very wide seaway extended south from the Arctic.

In tandem with the depositional environment map, subcrop lithology information including the Canadian Shield was compiled. Together, the two maps provide a model-driven approach to estimate sediment provenance. For the Assiniboia Valley where the McMurray Formation was deposited it appears that eroded Middle Jurassic clastics of the Williston Basin and the Canadian Shield were the two main sediment source terranes. Carbonate lowlands to the west likely contributed a minor amount of sediment. The two maps can be used to put petrographic analysis into context and to predict local provenance variability.

References

Smith, D.G., 1994. Paleogeographic evolution of the Western Canada Foreland Basin, in: Geological Atlas of the Western Canada Sedimentary Basin. G.D. Mossop and I. Shetsen (comps.). Canadian Society of Petroleum Geologists and Alberta Research Council, p. 277–296.