Paleozoic Stratigraphic Framework Beneath the Muskeg River Mine (Twp 95, Range 9-10W4): Controls and Constraints on Present Day Hydrogeology

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Abstract

The work presented here is part of the Devonian Geoscience Program (DGP), a program initiated by Shell Canada Energy in the area of the Muskeg River Mine (MRM), northeastern Alberta. The Program objectives are to proactively identify and characterize hydraulic pathways in Devonian strata that lie beneath the bitumen-bearing McMurray Formation. This includes review of all existing data, an active drilling program and geophysics to refine the understanding of the Devonian stratigraphy in the study area. Agreements have been established with oil sands operating companies to share data on regional aquifer flows and the geology of the Devonian strata underlying the oil sands deposits. Coordination now exists amongst operating companies to expand and develop the knowledge of regional subsurface conditions in this area.

This study deals with the Middle to Upper Devonian Section that underlies the Muskeg River Mine, located on the eastern edge of the Western Canada Sedimentary Basin. It is a stratigraphic succession that has been the subject of little published geologic information. Evolution of the stratigraphic terminology has suffered due to a combination of early outcrop and later subsurface studies that evolved in widely separated geographic areas.

In this presentation, the focus will be on the Keg River (Winnipegosis) - Prairie Evaporite interval and overlying strata of the Watt Mountain Formation and Beaverhill Lake Group.

One of the most dramatic subsurface stratigraphic features in this general area is the pronounced stratigraphic thinning and resultant scarp associated with the Prairie Evaporite dissolution edge, which occurs just west of the present day Athabasca River Valley. A consequence of halite dissolution, the thinning resulted from the influx of freshwater (backwasting) laterally from the basin margin as the pre-Cretaceous unconformity downcut.

The Prairie Evaporite Section to the west of the dissolution edge comprises some 250 metres of interbedded anhydrite, dolomite and halite arrayed in highly correlatable layers. East of the dissolution edge there is a rapid decrease in thickness of the Prairie Evaporite section to around 60 metres, primarily through the removal of highly soluble halite and to a lesser extent other evaporitic components.
This basin margin dissolution event in large part predates the formation of the pre-Cretaceous unconformity in this area and overlying Beaverhill Lake Group strata (Slave Point and Waterways) show a pronounced dip reversal from southwest to northeast across this scarp. Consequently, the thinned Prairie Evaporite section to the east of the present day Athabasca River