

Petroleum Hydrogeology of the Nisku Formation in the Western Canadian Sedimentary Basin

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The Nisku Formation of the Western Canadian Sedimentary Basin hosts large oil and gas accumulations. Many studies have shown that hydrogeological factors play a major role in the transportation and entrapment of hydrocarbons, yet no published work is known to exist illustrating the effects of moving groundwater on hydrocarbon migration in the Nisku Formation on a basinal scale.

A comprehensive, basin-wide, density-dependent petroleum hydrogeological study has been carried out to assess the influence of moving groundwater on the hydrocarbon migration within the Nisku Formation. The study included mapping of fluid potentials, water chemistry, and subsurface temperature distributions, augmented with publicly available topographic and structure data. Hydrocarbon impelling forces were mapped in the Nisku Formation over the entire basin using Hubbert's lateral hydrocarbon migration model, modified for groundwater density variations.

Results confirm groundwater flow patterns shown by previous, smaller scale hydrogeological studies, yet reveal major zones of anomalies not recognizable at those smaller scales. Vectorial representation of hydrocarbon driving forces, while accounting for density, gives a new insight of the dynamics of groundwater and suggests significant influences of groundwater density variations on hydrocarbon migration in several areas within the basin. Zones of strong cross-formational flow, shown as anomalies in the potentiometric surface contour map, (and confirmed by pressure-depth plots) are interpreted to indicate hydrocarbon migration into the Nisku from other formations. Understanding the regional-scale petroleum hydrogeology of the Nisku Formation in the WCSB can lead to improved exploration efficiency.