



Revisiting Glauconitic Sandstone in Countess Field, Southern Alberta

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Summary

The Lower Cretaceous Glauconitic Sandstone Member, is a part of the Upper Mannville Group; and has been targeted by oil producers for many decades. About seventeen and a half million (17.7) barrels of light-medium grade oil has already been produced from the Upper Mannville 'H' Pool of the Countess Field, Southern Alberta out of estimated 37.5 million barrels of recoverable original oil in place (OOIP). The aim of this study is to revisit the architecture of 'H' Pool reservoir and to evaluate the new potential. Conventional wireline logs, existing cores and petroleum production data is used to conduct this study. Glauconitic Sandstone Member mainly consists of fine to upper medium grained sandstone interpreted as channel deposits in an incised valley. This member is underlain by the Lower Mannville Ostracod beds and overlain by the Upper Mannville shale. Two important facies have been identified in the Glauconitic sandstone member. The lower facies unit was deposited in a fluvial system, whereas the upper one had local tidal influences. The revisited architectural elements, revised maps and constructed new geo-model suggest that the paleovalley was flowing southeast-northwest direction. The southern part of the reservoir has the highest petroleum production with good reservoir properties, however, the lower facies unit contains the most petroleum fluids. Remaining potential have been identified from the new interpretation.

Methods and Workflow

A total of 536 wells within six Sections (Townships 17-18 and Range 15-17) are studied using the existing database to identify the top and bottom of Glauconitic Sandstone Members. The conventional log suits like gamma ray (GR), neutron-density porosity and resistivity logs are used for this study. Maps, Isopachs and models are generated using Petrel. For examining the pool, all the 47 existing wells of the pool are studied. The wireline logs of these wells are very old and do not contain digital data. All the wireline log curves has been digitized for this study. The Upper Mannville coal bed has been identified as a marker and used as the datum for all the correlations. Electrofacies analyses have been performed to construct lithology and reservoir rock types. Various cross-plot (density vs neutron porosity, neutron minus density porosity vs GR, RhoB vs deep resistivity, RhoB vs neutron porosity and deep resistivity vs GR) are used to predict lithology using commercial software. In addition, cores from 6 wells within the pool area were examined to verify the lithology with estimated electrofacies. Finally, the estimated and interpreted reservoir properties have been used to reconstruct a geomodel and the volumetric (reserve) calculations have also been performed.

Results, Observations & Conclusions

A new geo-model for the Glauconitic Sandstone Member has been built. Three cross-sections are made to display the distribution of sandstone throughout the pool area. One cross-section is built along the presumed paleoflow from southeast to northwest. Two other cross-sections are constructed across the paleovalley. One is relatively downstream of the valley and other one is the upstream that is in the southeast side of the pool. The lithostratigraphic correlation of Glauconitic Sandstone along the valley shows that the thickness of sand beds is decreasing downstream. However, few wells have relatively higher thickness compared to the adjacent wells. The reason could be the stacking of the channels within the paleovalley. Cross-sections

oriented across the paleovalley indicate greater thickness of the sandstone body, tapering towards the valley edge. Overall the thickness of sandstone body varies from 0 to 35 meter throughout the pool area.

Sharp decrease of GR values at the bottom of the Glauconitic Sandstone intervals at the wells clearly consistent with an erosional contact between the Ostracod Member below and the Glauconitic Sandstone Member. The scoured surfaces in the cores corroborate the log response. Core study have identified two distinct sedimentary facies within the Glauconitic Sandstone Member that could be compared to Lower and Upper Glauconitic Sandstone (Farshori, 1983). The contact between Glauconitic Sandstone and Upper Mannville is also erosional. The term erosional inferred could be appropriate here for most of these contacts because in many cases the contacts are missing. The calculated values of log-derived effective porosity are compared with core analysis data. Core porosities are found to be slightly higher than the log-derived porosities. Typically, core plugs are picked from the good reservoir intervals, such as sandstone zone with higher porosity. On the other hand, regular well logs cannot resolute very specific location. It accounts all the facies in a particular location and provides an average porosity of this interval.

There are a number of reasons for the differences in log-derived and core-derived permeability values. Meyer and Krause (2006) found that the permeability values depend the geological attributes (lithology, thickness, length, stratigraphic distribution). This is, nevertheless, a challenge to interrelate wireline log and core-derived permeability because it depends on three important factors: measurement scale, measurement environment, and measurement physics (Ahmed et al., 1991). Helle et al., (2001) suggested that the small-scale heterogeneity in the reservoir can also make the difference between log and core derived permeability because this feature is less apparent in log data. Moreover, the wireline log measurements are taken directly from the borehole at insitu hydrocarbon situation whereas the core values represent absolute permeability in absence of insitu pressure, temperature and saturation condition (Ahmed et al., 1991).

Current primary recovery factor of this pool is 0.105 and enhanced recovery factor is 0.37 using ASP (Alkali-Surfactant-Polymer) flooding as per Alberta Energy Regulator (AER) Reserve Report of 2012. This study didn't focus on enhance oil recovery (EOR) aspects, but helpful for reservoir engineers to obtain geological data from this study to utilize the effective and cost-effective EOR scheme to further extraction of oil from this pool.

Based on the existing production data for the pool along with the newly interpreted results of the architecture of the pool, new potential drilling locations could be identified to extact a large portion of the rest of the recoverable oil (about 18 million barrels as per September, 2018) from this pool. An effective recovery method for enhancing oil recovery could be very useful for this project to raise the current production level.

Examples / Figures

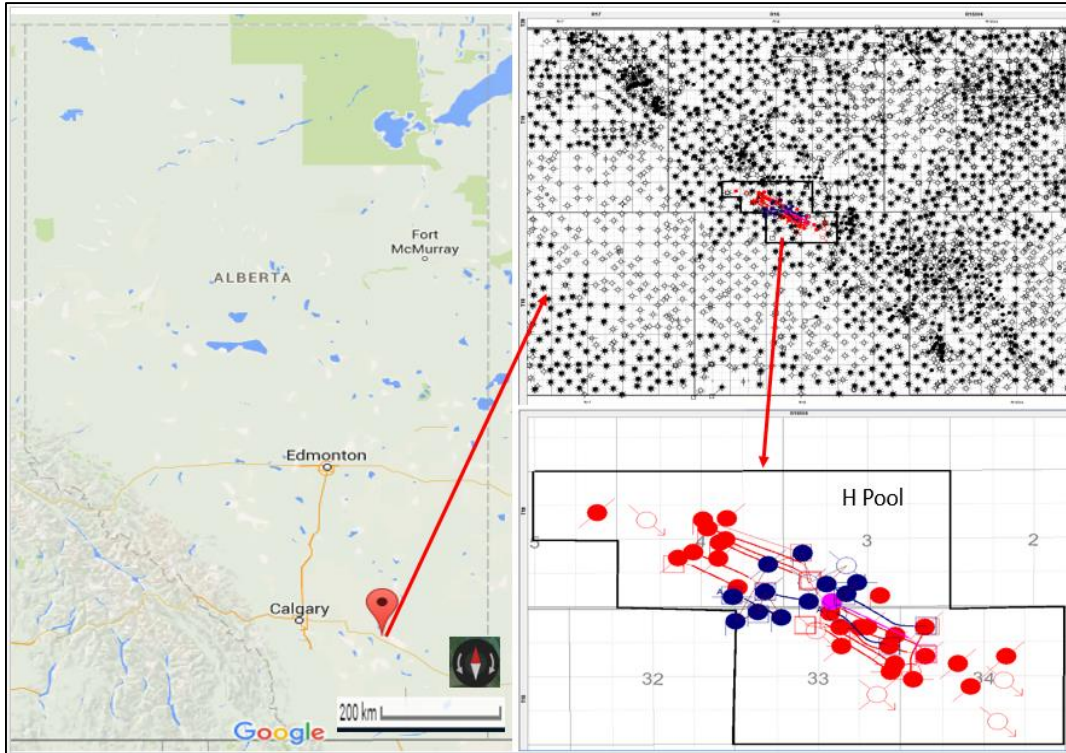


Figure 1: The location of Upper Mannville 'H' Pool of the Countess Field, Southern Alberta.

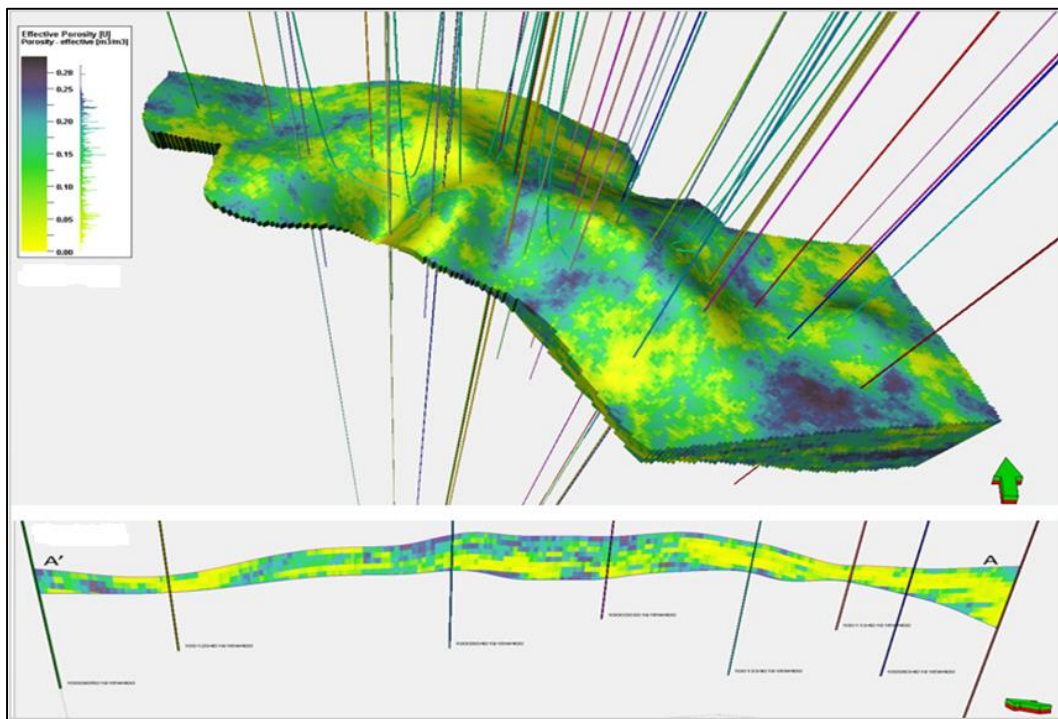


Figure 2: Showing the distribution of porosity throughout the reservoir. Cross-section (A'-A) shows a vertical slice of the 3D model viewing from southwest.

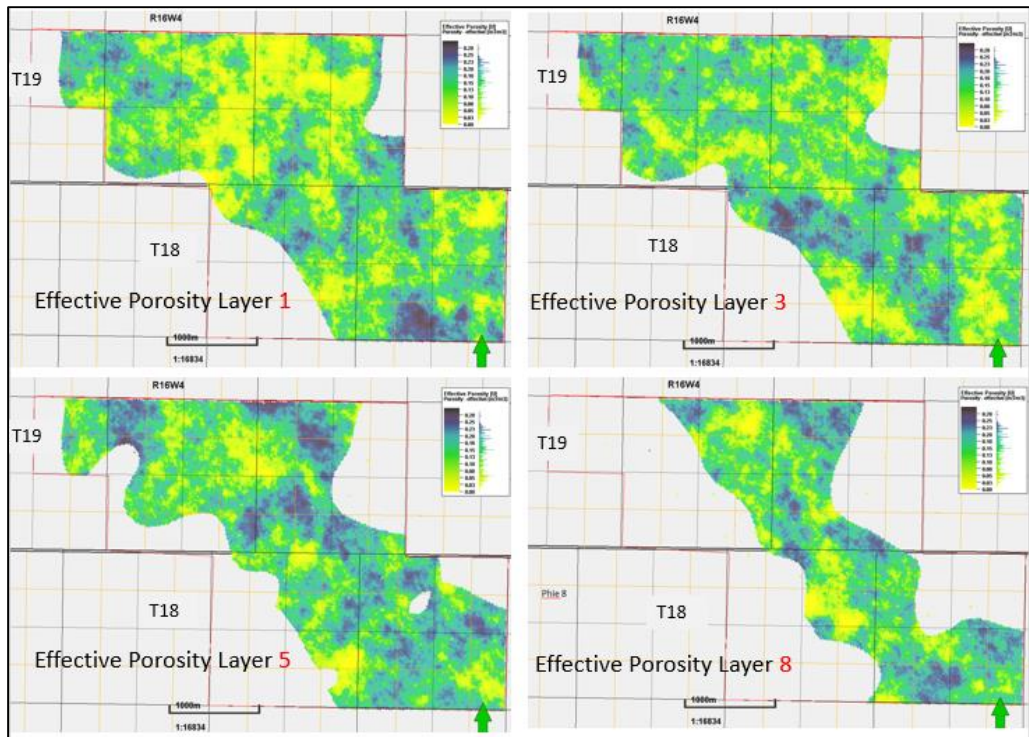


Figure 3: Distribution of porosity showing in four layers (Layer 1, 3, 5 and 8) viewing from the top.

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