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Facies Control on Fluid Accumulation, Viking Formation, Elrose Field, Saskatchewan, Canada

Stefan Wieclawek

Summary

Depositionally, the Saskatchewan Viking represents the most eastward progradational front of an Upper Cretaceous aged shoreline, sitting conformably above the Joli Fou shales and below the Westgate shales. The focus area of this study consists of three facies (Facies 1, Facies 2, Facies 3, Figure 2) in the Saskatchewan Viking formation near Elrose, Saskatchewan , (Figure 1). The study area consists of normally regressive sandstones, distal offshore transitional silty/sandy mudstones and the coarse-grained, poorly sorted remnants of an erosive transgressive shoreline.

Regionally, the fluid accumulation within the Viking follows that of a conventional hydrocarbon system with structure being the primary trapping mechanism (Kohlruss, 2015). Locally, in Elrose, there is a trend of increasing water production from North to South which appears not to be entirely structurally controlled.

The three facies in this study were examined to determine if sequence stratigraphy, facies distribution mapping, and routine core analyses could be used to understand and predict fluid accumulation within the Elrose Saskatchewan Viking study area.

Method / Workflow

Sequence stratigraphy, facies distribution mapping and routine core analysis were incorporated with reservoir data and fluid properties to predict higher oil cut regions and further exploitation efforts. Following the identification of the Saskatchewan Viking reservoir unit in the Elrose area, several SW-NE dip-oriented cross-sections were produced and stratigraphic correlations constructed. Once a sequence stratigraphic framework was built, facies distribution maps were produced. These facies maps were then correlated to historical total fluid production in the area from both vertical and horizontal wellbores.

Observations, Results

Facies 1 (Figure 2a) is an intensely bioturbated, sandy/silty mudstone representing a normally regressive shoreline. Due to the intense bioturbation it is difficult to assign the exact depositional setting under which Facies 1 was deposited based on any sedimentary structures. However, the *Cruziana* ichno trace fossil assemblage best places this unit in an offshore transitional setting.

Facies 2 (Figure 2b) is a laminated silty mudstone with 05.cm to 1.0cm thick silt beds. The distinguishing features of this facies are the overall lack of bioturbation, graded bedding and soft sediment deformation which places it in a more stressed environment than Facies 1. Facies 2 was likely deposited in a more distal offshore transition setting with some deltaic, fresh water influence above storm weather wave base as seen by the preservation of 0.5 to 1.0cm thick tempestites.

Facies 3 (Figure 2c) is a medium to coarse grained poorly sorted cherty marine sandstone. It is interpreted that this unit was deposited during a period or periods of shoreline transgression during Viking deposition. This can be seen in the erosive nature of the contact between Facies 3 and Facies 2, the existence of a coarse-grained pebble lag mantling the contact between Facies 2 & Facies 3, a *Glossifungites* trace fossil assemblage and evidence of *Thalassinoides* burrows truncated by a Transgressive Surface of Marine Errosion. (Thomas 2007).

The distinct differences in permeability, porosity and stratigraphic position between Facies 1 and 2 and 3 act as the primary mechanisms for controlling the fluid accumulation within the Viking at Elrose. The more permeable Facies 3 is the principal reservoir for fluid migration and storage and has historically been the primary target for vertical and horizontal exploitation in the area. Facies 3 can deliver high rates of initial oil production with sustained declines. However, more recently, with the evolution of horizontal drilling and hydraulic fracturing techniques, the more distal reservoir comprised of Facies 1 and 2 have been proven to deliver economic results with extensive local running room.

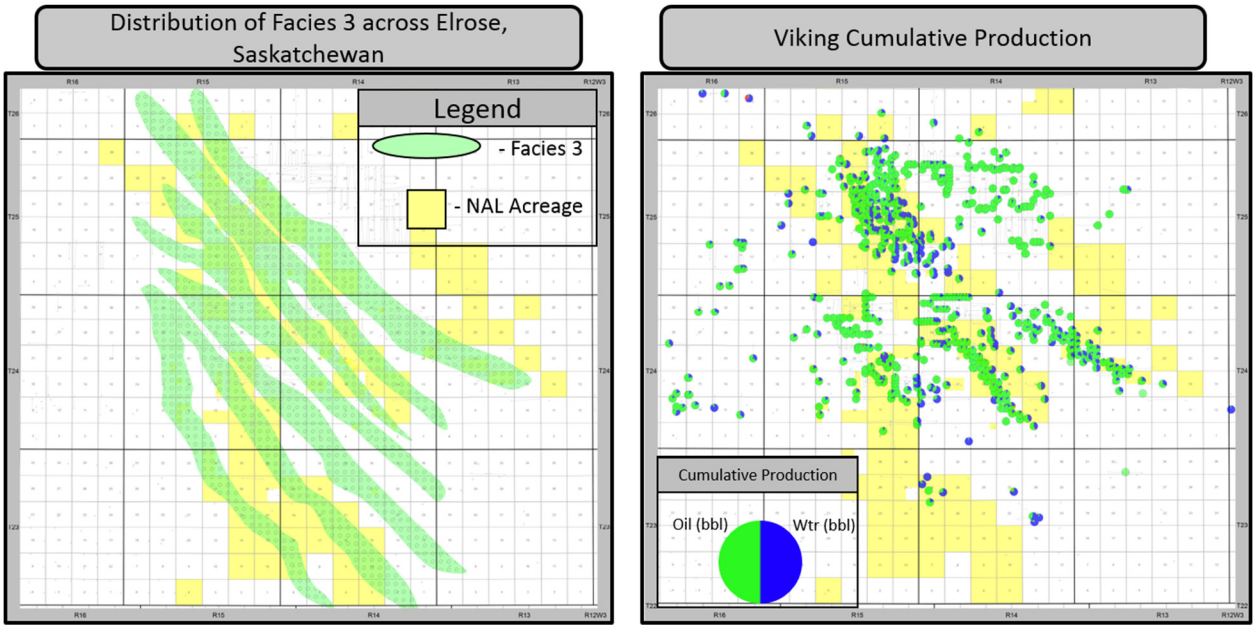

Figure 1: A.) A facies map illustrating the distribution of Facies 3, a coarse grained, chert-pebble rich marine sandstone across the Elrose field. B.) A cumulative production map highlighting fluid distribution across Elrose.

Conclusions

The correlation of total fluid production to facies has shown that in areas of high water production, Facies 3 appears to be water saturated yet the tighter, more distal facies of 1 and 2 remain oil saturated and could be targeted.

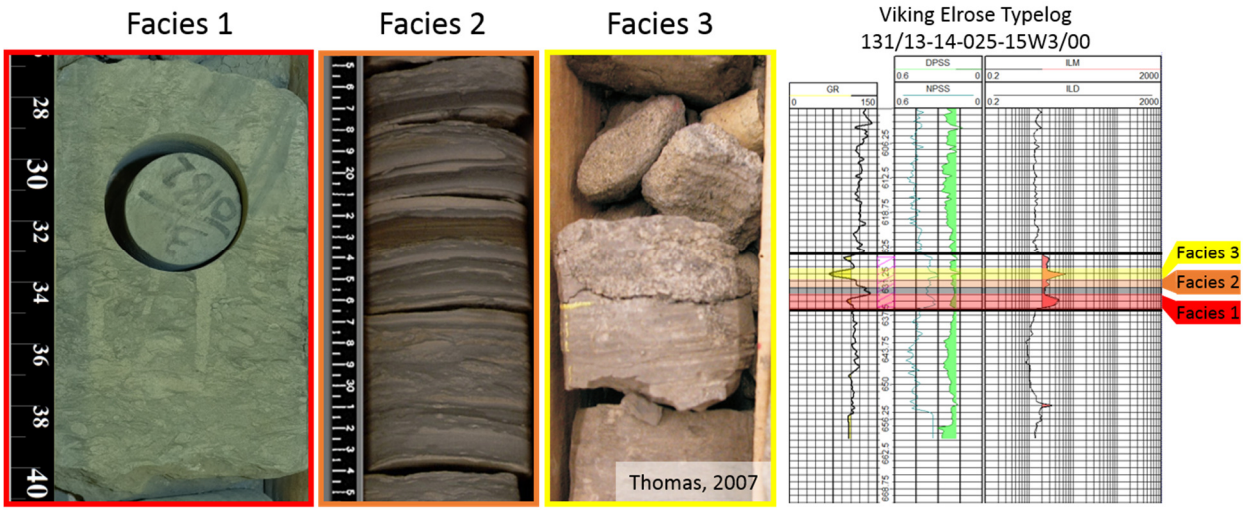

Figure 2: Photos of each different facies. A) 101/11-19-25-15W3, Facies 1, intensely bioturbated sandy/silty mudstone with sand filled vertical burrows. B) 111/11-15-24-14W3, Facies 2, laminated silty mudstone with very little bioturbation. C) 101/04-15-24-14W3, Facies 3, *Thalassinoides* burrow truncated by TSME (Thomas, 2007). D) Viking Typelog from 13-14-025-15W5 illustrating the log signatures associated with each Facies, 105 API GR cut off, 18% DPSS cut off, 4 ohm.m cut off.

Acknowledgments

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References

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