

What if the Glau is Really not the Glau...and should we Care?

Med Hat Glau C Pool

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Summary

A detailed geological reservoir study was commissioned for the Med Hat Glau C Pool, T.12-13, R.4,5w4 by Enerplus and their unit partners, the City of Med Hat, as a precursor for a geological model and possible reservoir simulation model. In the course of core examination, it was noted that the reservoir rock was not the Glauconite Formation, but rather the older and more heterogeneous Basal Quartz. This important observation, tied to the logs and seismic, resulted in a different understanding of the reservoir geometry, controls on reservoir variability, and a different approach to building the reservoir model itself.

Introduction

The Med Hat Glau C oil pool was discovered in 1984. In 1998, Enerplus acquired an interest, and by 2001 the pool was unitized and immediately put on waterflood. Performance of the pool has been less than optimal to date for a variety of reasons. Although the the pool traps 41,176e3m3 (259MMbbls) OOIP, after 23 years it has produced only 3182 e3m3 oil (20MMbbls) for a reported recovery of 7.7%. While describing the reservoir, it became clear that the producing formation was not the Glauconite Formation. At this advanced point in the pool's production history, does it matter what name we give the reservoir? Will it make any difference to how we produce and understand the pool? With apologies to Will Shakespeare, "Is a reservoir by any other name still a reservoir?" .

Data

Luckily, the Med Hat Glau C pool is data rich. More than 200 vertical, deviated and horizontal wells have been drilled in the pool, and a 3D seismic survey acquired over the western half of the pool in 1996, to be viewed for interpretation. There are 27 cores, 11 sampled for thin sections. Several previous geological models have been developed: the most recent version divided the reservoir into

four vertically stacked, laterally correlatable units. The decision was made to revisit the model, starting with the rocks.

Previous Work

There were no core descriptions in the files or in reports for the Med Hat pool. Initial scans of the logs showed a characteristic clean, blocky gamma response (sandstone) over an underlying low resistivity (2 ohm) shale similar to the response of many Glauconite/Ostracod-Bantry wells in southern Alberta (Fig. 1). Porosity and permeability values were also in the range of some of the best of the Glauc reservoirs: up to 29 porosity units and 9000 md. In keeping with interpretations of other Glauconite pools, an incised valley filled with channel deposits was a logical depositional model. The thickest reservoir, trending north-south down the center of the pool, was interpreted as the deepest part of the valley.

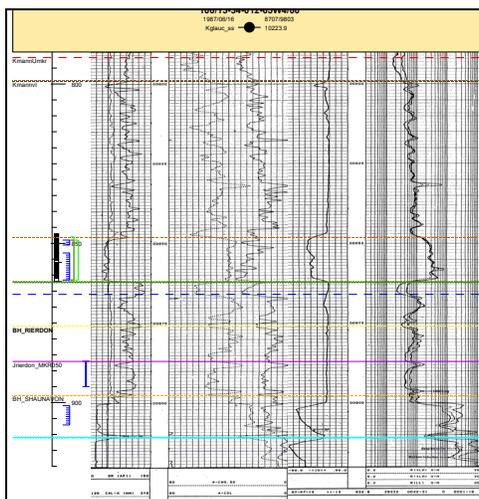


Figure 1: Type Log from Med Hat Glauc C Pool

Core

An idealised average rock description of the reservoir would have 14m of sandstone in erosional contact with an underlying mustard yellow, green and/or red-purple shale or interbedded siltstone and shale. The oil saturated sandstone would be a poorly sorted litharenite, ranging from fL to mU – or even vcU, organized into 1m to 3m thick units. The basal contacts of many units would be scoured, and floored with abundant mud rip-up clasts. The sandstones would often display current-generated large-scale cross-beds. Topping the sandstones would be thin, light coloured, rippled to rooted sandy shales. There would be no trace fossils.

These observations are consistent with deposits from low-accommodation meandering fluvial environments. The accompanying wild fluctuations in porosity and permeability, and the the poorly sorted sediments don't resemble Glauconite core, but have been observed and described in Basal Quartz core (Zaitlin et al, 2002). Observed differences in petrology, as well as changes in the interpretation of depositional environment, have implications for the spatial arrangement of reservoir properties, and implications about lateral continuity of facies.

Seismic and Log Correlations

The interpretation of depositional environment carries with it logical extrapolations of overall sand body geometry and potential trapping configurations. Log correlations and seismic are needed to verify these predictions, and to understand the relationships between individual wells. This pool is underlain by the regionally correlatable Jurassic Ellis Group (Swift, Rierdon and Sawtooth Fms). Not only do the Swift and Rierdon have several prominent log markers, but the Jurassic also creates an easily recognized seismic reflection. If the sandstones were deposited in an incised valley, an important criteria for recognizing the valley would be truncation of these regional markers. In contrast, one would expect a more sheet-like geometry from a low-accommodation fluvial deposit.

In combination, parallel stratigraphic and seismic cross-sections clearly show the low-relief erosional base of the reservoir unit running sub-parallel to the Jurassic markers. The Jurassic and Paleozoic seismic reflectors are in low angle disconformity to the overlying upper Mannville Cretaceous sediments, and in fact the Jurassic subcrops just east of the Med Hat pool. Several interesting inferences can be drawn from the relationship between the reservoir and the Jurassic:

1. The reservoir has a structural history more similar to the Jurassic than to the overlying Cretaceous.
2. The reservoir subcrops (rather than onlaps) the Cretaceous sediments to the east. The eastern edge of the pool is therefore controlled by the updip (regional) subcrop edge of the reservoir, not onlap to a Paleozoic high, or a depositional incision.
3. This deposit does not fulfill the incised valley criteria of truncating regional markers.

Finally, it was previously mentioned that the pool gross sand map shows a “thick” down the center of the pool. Can these revised stratigraphic relationships be applied to understanding variations in the thickness of the reservoir? Again, insights into the origin of the sand thick can be drawn from log correlations coupled with seismic. Log cross-sections datumed on the top of the Mannville Fm demonstrate that increases in reservoir sand thickness correspond to downward inflections on the Jurassic markers. On seismic, the Jurassic reflectors parallel relief in the Paleozoic. The interpretation is made that the sand thicks are preserved on the low side of drape over underlying topography, while the thins reflect bevelling at Cretaceous time. The thicks are preservational features, not depositional ones.

Conclusions

In summary, recognition of the reservoir rock as Basal Quartz triggered several other changes in the interpretation. These ideas were verified and augmented with the seismic data. These changes, in turn, had influences on how the reservoir model was built.

A partial list of elements of the interpretation that were impacted includes:

1. Different depositional model,
2. Less correlatability of the interior shales and channel cuts
3. Geostatistical propagation of porosity and permeability through the model
4. Adoption of base-parallel gridding for the lower half of the model
5. Use of structure map on the Jurassic markers (seismic+geology) to guide the structure of the reservoir (*key map*). (Need to look beyond the reservoir unit to understand it.)

6. The predicted preservational reservoir geometry is more dependent on structure than on original depositional geometry.

In addition, three other notable conclusions can be drawn from this case study.

1. Looking at core is invaluable. Looking at lots of core over your career so that you can build up a mental 'library' of formations is even better.
2. Tying the geology to seismic is key to revising ideas.
3. Changes in understanding the pool have implications for exploration.

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References

Zaitlin, B.A., M.J. Warren, D. Potocki, L. Rosenthal, and R. Boyd, 2002. Depositional styles in a low accommodation foreland basin setting: an example from the Basal Quartz (Lower Cretaceous), southern Alberta. *Bulletin of Canadian Petroleum Geology*, v. 50, #1, p. 31-72.