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# The Hoadley Glauconitic Trend: Poised for a Renaissance, New Insights into an Old Field

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## Summary

The Hoadley Glauconitic trend is a deep basin gas play located in West Central Alberta that was deposited in a wave-dominated shoreface environment (Rosenthal, 1988). The field is a roughly 100 km long, 20 km wide shoreface complex extending from Rocky Mountain House in the southwest to Rimbey in the northeast. An historical estimate stated the field may contain up to 6-7 Tcf recoverable gas (Chiang, 1984). Cumulative recovery from the fields' ~1100 producing wells is ~2.3 Tcf, the ultimate recoverable estimate of 6-7 Tcf remains valid.

The field has undergone several distinct phases of development. Prior to 2008 ~550 vertical wells were drilled into the play, primarily targeting conventional reservoir including isolated bands of NE-SW trending high permeability rock as well as several larger areas of distinctly above average reservoir quality in the Medicine River and Wilson Creek areas. In 2008 vertical drilling in the play rapidly declined following a drop in natural gas prices from ~$8 to $4. In 2010, with the widespread introduction of horizontal drilling, a resurgence in development activity took place. A total of ~550 horizontal wells have been drilled in the field, most of them from 2010-2015, targeting lower permeability areas outside the previously described conventional areas. In 2015 gas prices dropped further from ~$4 to $2 per Mcf. Correspondingly all drilling activity has dropped off from previous highs.

2021 witnessed a profound recovery in natural gas prices back to ~$4 per Mcf. The history of Hoadley Glauconitic development described previously suggests that the play is poised for a renaissance in drilling activity. Indeed, in 2021 multiple previously inactive operators have licensed new drilling locations across the length of this field. This study seeks to better understand reservoir quality and well deliverability variations along the Hoadley trend in light of this anticipated second renaissance.

## Theory / Method / Workflow

The previously mentioned 1100 producing Glauconitic Formation wells, combined with over 2500 well penetrations and roughly 300 cores provide an astounding dataset from which to understand the Hoadley Glauconitic field. This study combines a massive dataset of well logs, cores, production, reservoir pressure, temperature, and gas composition data to provide a unique synthesis of this field with a focus on changes in reservoir quality and well deliverability.

## Results, Observations, Conclusions

The producing interval in the Hoadley Glauconitic field can be divided into two distinct reservoir facies: 1) an upper, higher permeability conglomeratic to sandstone interval that occurs as isolated lenses deposited parallel to the NE-SW depositional trend of the field (equivalent to the

eolian sand ridges of Chiang (1984)) and referred to here as the Glauc A; 2) a lower fine-grained sandstone deposited across the entire Hoadley field referred to here as the Glauc B. The Glauc A and the Glauc B each exhibit distinct variations along the entirety of the Hoadley trend due to changes in deposition, burial depth, and diagenesis. Though useful, this two facies model is quite simplistic compared to other models described by Okaro (2001), Rosenthal (1988), and Chiang (1984).

The Glauc A is a distinct conglomeratic interval in the Ferrier area (centered around township 38-8W5). Updip, in the Willesden Green and Wilson Creek areas (Townships 40-44, Ranges 6-3W5) the Glauc A changes laterally from conglomeratic to medium- to fine-grained sandstone. The observation that the Glauc A contains pebble sized clasts calls into question the earlier interpretation of these high permeability bands as eolian ridges, it is possible that the Glauc A represent a beach face to upper shoreface environment, rather than eolian sand ridges. Overall, porosity and permeability in the Glauc A decrease with increasing burial depth from NE to SW, however the conglomeratic intervals in the Ferrier area have much higher permeability than equivalent sandstones found at shallower depths in the Wilson Creek and Willesden Green areas.

The Glauc B is a fine-grained sandstone throughout the Hoadley trend. Like the Glauc A, porosity and permeability decrease with increasing depth of burial with one notable exception. In the Medicine River area centered at Township 39-5W5 the Glauc B has distinctly higher than average porosity and permeability. This is due to the reservoir in this area containing much less pore occluding carbonate cements.

In terms of well deliverability, the overall decrease in reservoir quality with depth is offset by the fact that reservoir pressure increases with depth, though not in a uniform fashion. Virgin reservoir pressure at the updip limit of the trend in Wilson Creek (Township 44-2W5) is approximately 17 MPa – roughly normally pressured given TVD depths of ~1750-1800 m in the area. Moving downdip through the Wilson Creek and Willesden Green areas reservoir pressure increases at a steady 0.5 MPa per 100m subsea depth until Township 40. Between Township 40 and Township 39 there is a step-change increase in virgin pressure conditions from 19-20 to 27-29 MPa. This dramatic change from an updip normally to underpressured regime to a downdip overpressured regime corresponds with a readily mappable channel cut across the Hoadley shoreface sandstones. Moving progressively downdip from Township 39 to 37 virgin reservoir pressure again increases at a rate of ~0.5 MPa per 100m subsea depth.

Not surprisingly, reservoir temperature also shows an increase from NE to SW with increasing burial depth, however there is a second trend superimposed on this where the seaward NW margin of the Hoadley trend has distinctly higher temperatures at equivalent depths than the landward SE margin of the trend. What exactly may be causing this anomaly is the cause for some debate however what is notable is that gas geochemistry and therefore liquids yields vary in relation to this temperature anomaly.

In the Wilson Creek and Willesden Green areas, along the hotter NW seaward margin of the Hoadley trend, gas dryness factors typically range from 0.86-0.88. At identical depths along the SE landward margin of the trend gas dryness factors range from 0.82-0.84. Correspondingly free liquids yields may be up to 50 Bbl/MMcf greater along the SE margin compared to the NW margin

following the method used by Euzen et al. (2019) for the Montney Formation. Indeed, many wells in this area report very high produced liquids rates. In the overpressured area centered on Township 38-8W5 gas dryness factors of ~0.88 are observed. Produced gas in this area is fairly lean, however the increased gas rates associated with overpressuring more than make up for this economic shortfall.

Thermal maturity of gas, as demonstrated by $iC_4/nC_4$ ratio, also exhibits an increase in maturity with increasing burial depth. However, detailed evaluation of wells in the Ferrier area combined with the observation that several oil producing regions exist within the Hoadley trend suggest a complex history of oil and gas generation and migration throughout the area. This complexity adds a degree of uncertainty in terms of reservoir fluid to any wells drilled in the Hoadley field.

## Novel/Additive Information

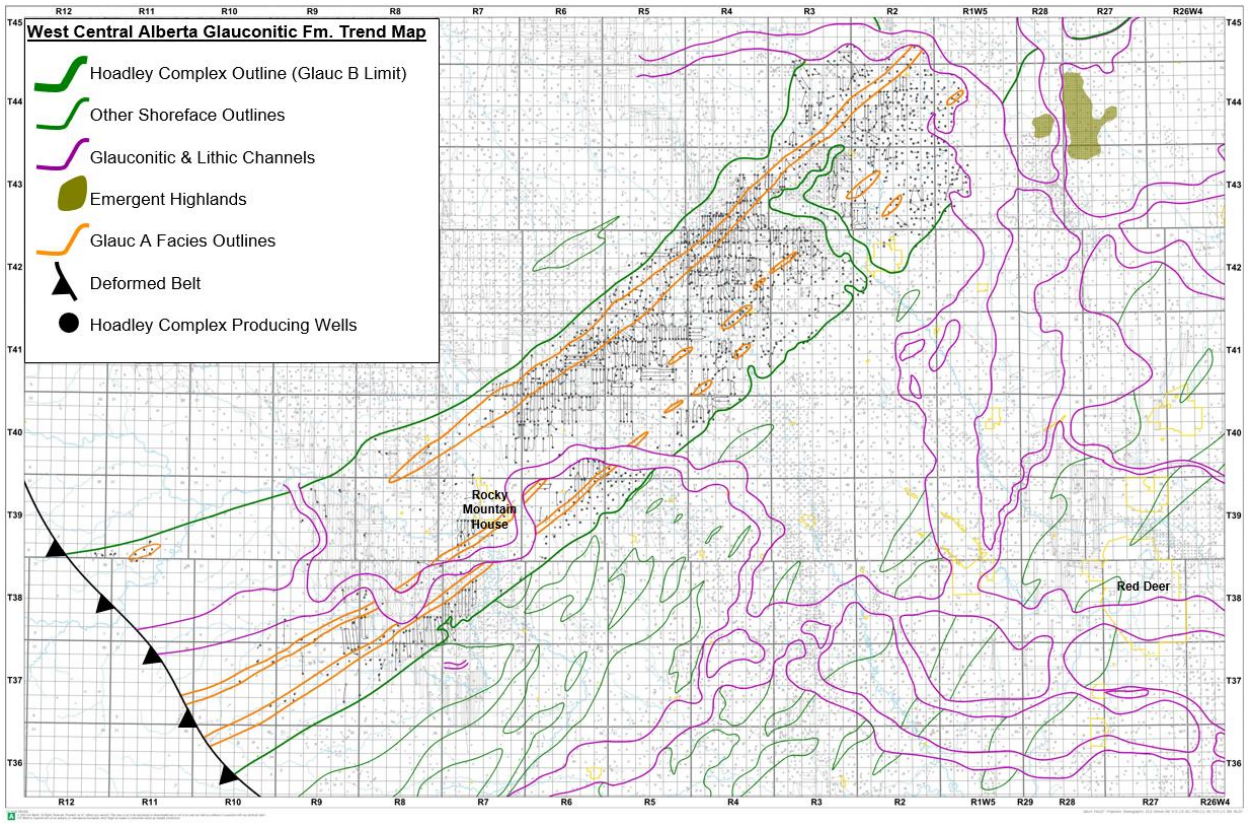


Figure 1: West Central Alberta Glauconitic Formation trend map.

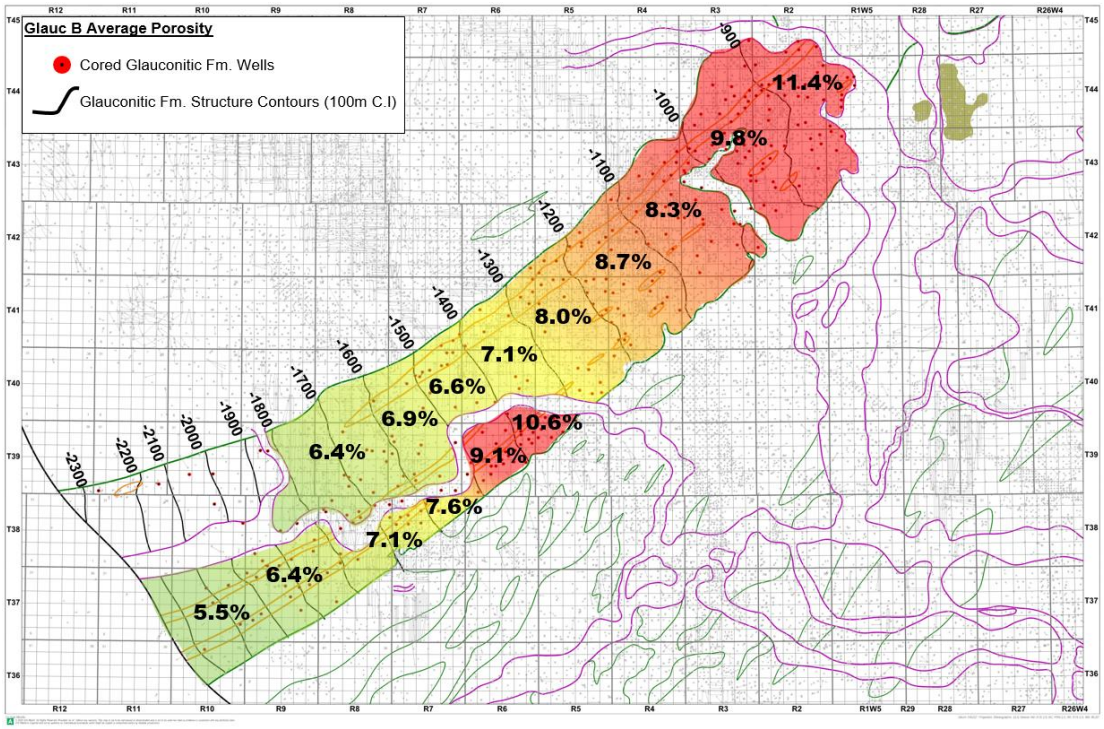


Figure 2: Glauc B average porosity variation along Hoadley trend.

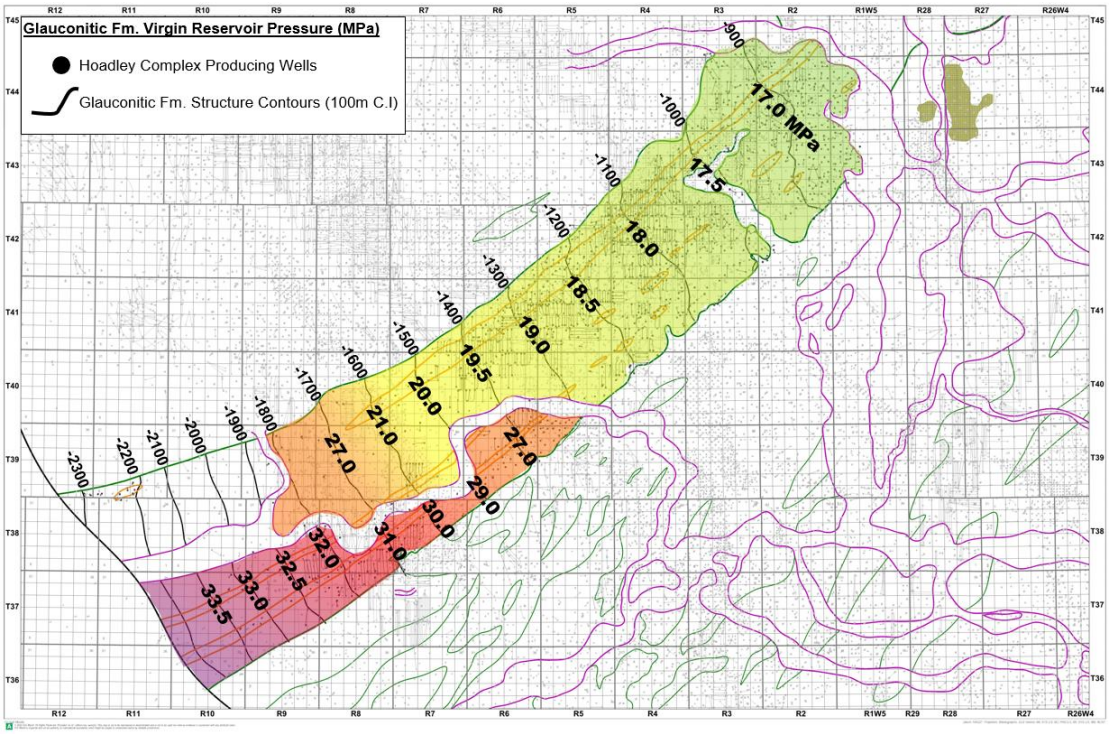


Figure 3: Glauconitic Formation virgin reservoir pressure along Hoadley trend.

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