

## **“Glauconic” Oil Reservoirs in Southern Alberta – Creating the Correct Geological Model to Guide Development Drilling**

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### **Summary**

Many oil fields in southern Alberta produce from the Glauconic member of the Upper Mannville Formation. Examination of core and detailed mapping reveal important stratigraphic differences among these reservoirs, and show that some do not belong to the Glauconic at all. Understanding these differences is critical in efficient modeling and development of full productive potential.

In this core display, we contrast a true Glauconic reservoir at Taber South with the Medicine Hat “Glauconic” reservoir – which actually belongs to the Basal Quartz.

### **Glauconic Member Stratigraphy and Distribution**

Sherwin (1996) mapped Glauconic valley trends from Township 14 north to the Hoadley and Pembina Barriers (Township 50), which delineate a basin-scale drainage system, flowing northward to the Boreal Sea. Petrel Robertson Consulting Ltd. (1998) extended regional Glauconic valley trend mapping southward through Taber, Taber South, Wrentham, and Philp to the Montana border. Notably, Glauconic valley trends have not been mapped into the Medicine Hat area of southeastern Alberta, where Smith (1994) documented Mannville thinning across the Medicine Hat - Swift Current Highlands.

Glauconic valleys were filled as sea level rose during mid-Mannville transgression of the Wilrich / Clearwater sea. High-quality reservoirs were deposited as clean, sublithic estuarine valley-fill sandstones, sealed by equivalent estuarine muds. Several generations of younger Upper Mannville fluvial valley-fill sandstones, exhibiting a distinct volcanic / feldspathic composition and poor reservoir quality, dissect the Glauconic.

Focused studies of several Glauconic oil pools in southern Alberta document estuarine valley-fill environments, and map out reservoir stratigraphy in intricate detail. A series of papers by Wood and

Hopkins at Little Bow (Twp. 11-16, Rge. 17-19W4), building upon Wood and Hopkins (1989), is an excellent example.

### **Taber South Glauconitic Reservoirs**

At Wrentham / Taber South (Twp. 6-7, Rge. 16-17W4), a major northward-trending Glauconitic valley hosts several medium-gravity oil pools. However, they are not clearly distinguished in the official pool nomenclature from older Cut Bank / Basal Quartz reservoirs, which are incised locally by Glauconitic valleys.

Core from 12-9-7-16W4 (Fig. 1) illustrates a well-developed Glauconitic reservoir succession. Estuarine channel sandstones exhibiting mud couplets and flaser bedding lie sharply on the basal contact. They are truncated sharply by middle estuarine mudstones grading up to heterolithic sandstone/shale with soft-sediment deformation and locally intense bioturbation. Near the top of the core, these strata grade upward into estuarine shoal sandstones, within which flaser bedding highlights stacked ripple sets.

Glauconitic sandstones are clean, fine- to medium-grained sublitharenites, exhibiting excellent reservoir quality. Detailed mapping demonstrates substantial lateral continuity of specific estuarine channel and shoal reservoir elements, particularly where individual sandstone bodies range up to 10 metres thick (Petrel Robertson, 1998). Cumulative production of more than one million barrels of oil from individual wells is a good indicator of substantial drainage areas and reservoir continuity.

### **Medicine Hat “Glauconitic” Reservoir**

Core from 02/8-7-13-5W4 (Fig. 2) illustrates a typical “Glauconitic” reservoir at Medicine Hat. The 13-metre reservoir section consists of several stacked, metre-scale fining-upward successions. A typical unit lies on a sharp, scoured base, and consists of clean, medium-grained, cross-bedded litharenite, grading upward to finer sandstones with more matrix clays and thin light green-grey mud beds and/or thin, angular mud clasts. A fully-developed succession may be capped by a sandy mudstone with root traces, interpreted as a paleosol.

Estuarine facies such as those observed at Taber South and Little Bow – tidal channels, burrowed shales and heterolithic successions, and sandier-upward shoals – are conspicuously absent. Correlation of individual depositional units from well to well is very difficult. Cumulative production from individual wellbores, while influenced by many operational factors such as reservoir management, well density, and length of time on production, is generally fairly low, suggesting that only limited reservoir volumes are being drained.

Thus, reservoir facies and regional paleogeography both argue against the Medicine Hat “Glauconitic C” pool having been deposited as a true Glauconitic valley fill reservoir. Instead, we suggest deposition occurred as thin, stacked fluvial sandstones in a more continental setting. Zaitlin et al (2002) described these facies as components of the Mesa Incised Valley subdivision of the Basal Quartz member, and mapped a regional north-south Mesa I.V. trend through the Medicine Hat area. We conclude that the Medicine Hat “Glauconitic C” pool is thus better assigned to the Basal Quartz.

### **Reservoir Continuity and Development Planning Implications**

Despite intensive development drilling to date at both Taber South and Medicine Hat, considerable scope remains to further optimize recovery.

At Taber South, recognition of discrete facies assemblages with predictable vertical and lateral reservoir quality distributions within the Glauconitic can guide reservoir mapping. Production

histories of individual wells add valuable information about reservoir body size and drainage efficiency. Detailed mapping, best done within the framework of a well-constructed geological model incorporating a substantial degree of geological interpretation (i.e., predictive facies mapping), would support targeted drilling to optimize reservoir exploitation.

At Medicine Hat, stacked Basal Quartz fluvial sandstone bodies have very poor lateral and vertical continuity. Individual reservoir sandstones were deposited in metre-scale beds over limited areas, and capping paleosols further isolate reservoir-quality sandstones. Thus, the geocellular model we build of this reservoir exhibits abrupt vertical and lateral variations in reservoir quality, distributed on the basis of geostatistics, rather than imposed by specific facies concepts.

## **Acknowledgements**

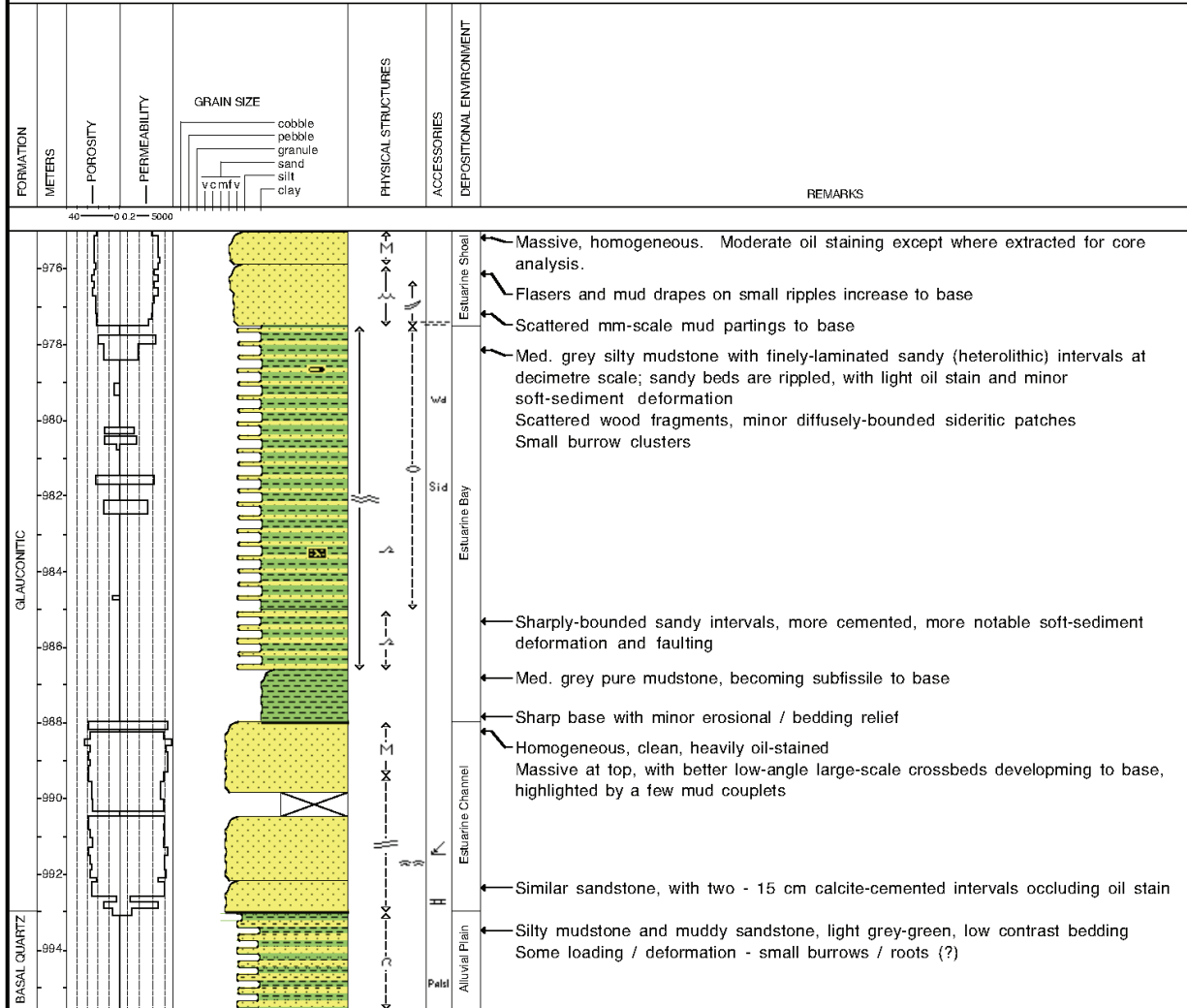
This project arose from construction of a geological reservoir model of the Medicine Hat “Glaucconitic C” Pool by Petrel Robertson Consulting Ltd., for Enerplus Resources Fund and their partner, the City of Medicine Hat. We thank Enerplus, the City of Medicine Hat, and PRCL for providing resources and permission to publish.

## **References**

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**Amoco et al TABER SOUTH**  
12-9-7-16W4

Remarks: Core #1 : 975 - 990.5 (Rec. 14.85 m)  
Core #2: 990.5 - 997.5 (Rec. 5.1 m)



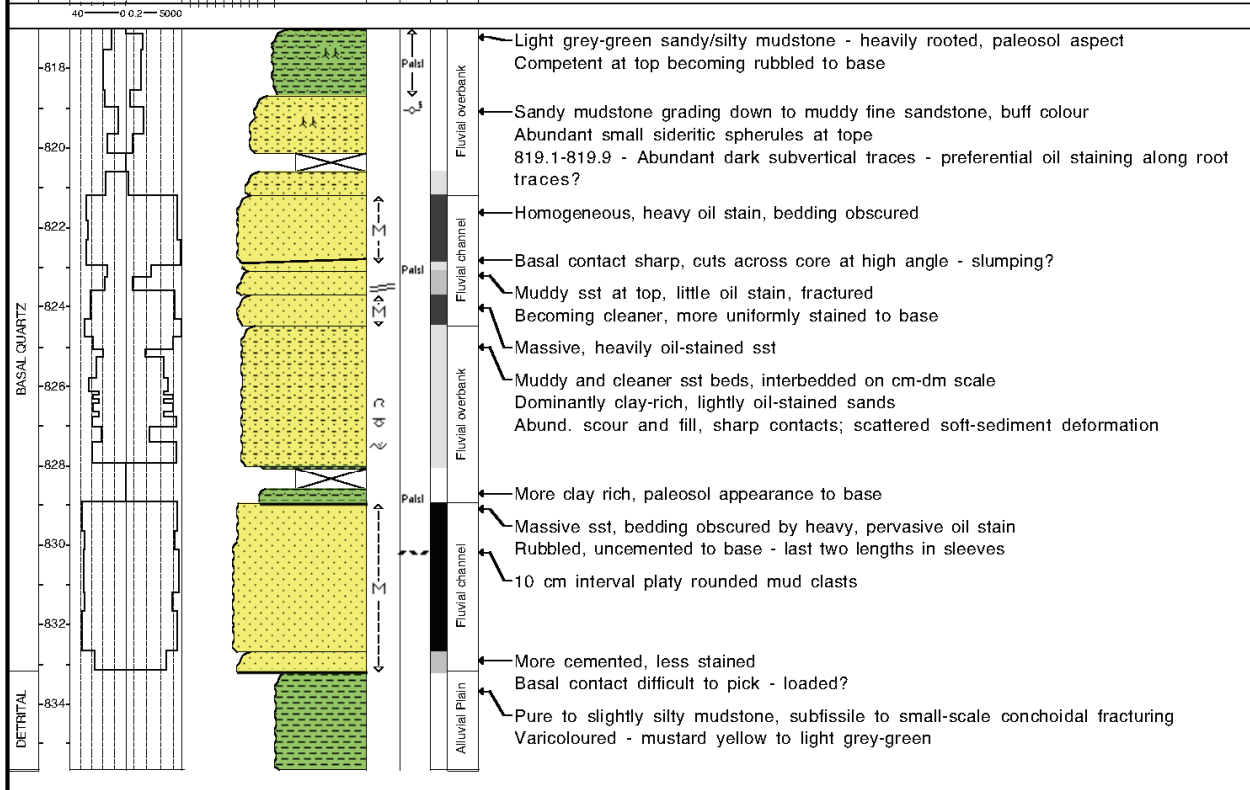
**LEGEND**

<b>LITHOLOGY</b>				
SANDSTONE	Argillaceous Sst	SHALE/MUDSTONE	Silty Shale	Lost Core
<b>CONTACTS</b>				
— Sharp				
<b>PHYSICAL STRUCTURES</b>				
Low Angle Tabular Bedding	Flaser Bedding	Wavy Parallel Bedding	Lenticular Bedding	Double Mud Drapes
Slump, Flow Structure	Massive	Undifferentiated Ripples	Soft sed. def.	
<b>LITHOLOGIC ACCESSORIES</b>				
Shale Lamina	Calcareous	Siderite	Wood Fragments	Paleosol Horizon
Carbonaceous Partings				
<b>ICHTHOFOSSILS</b>				
Planolites	Chondrites			

**City of Medicine Hat**  
02 / 8-7-13-5W4

Remarks: Core #1: 817 – 820.6 (Rec. 3.15 m)  
Core #2: 820.6 – 828.6 (Rec. 7.5 m)  
Core #3: 828.6 – 835.7 (Rec. 7.1 m)

FORMATION METERS	POROSITY	PERMEABILITY	GRAIN SIZE cobble pebble granule sand silt clay	PHYSICAL STRUCTURES	ACCESSORIES	STAIN	DEPOSITIONAL ENVIRONMENT	REMARKS
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**LEGEND**

LITHOLOGY

SANDSTONE	Argillaceous Sst	SHALE/MUDSTONE	Sandy Shale	Lost Core
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CONTACTS

Sharp	Inclined
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PHYSICAL STRUCTURES

Low Angle Tabular Bedding	Load Casts	Massive	Scour and Fill	Soft sed. def.
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LITHOLOGIC ACCESSORIES

Rip Up Clasts	Paleosol Horizon	Nodule, Siderite
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ICHOFOSSILS

Rootlets
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