



State A Marker Oil Production within the Williston Basin of Southeast Saskatchewan (Mississippian, Frobisher Beds)

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Abstract

Horizontal well technology has made the State A Marker a viable target for oil production in southeast Saskatchewan. The reservoir is a porous microcrystalline dolomite facies within the State A Marker. The productive interval is locally referred to as the “Frobisher Marly”. The play has not been mapped regionally to date and the upside potential of the oil-producing interval has not been evaluated.

The State A Marker was deposited as a Highstand Systems Tract on top of the Frobisher Vuggy Sequence Boundary. Hydrocarbons are trapped laterally by a stratigraphic facies change and vertically by evaporites of the Frobisher Evaporite Marine Regression.

This core display will evaluate the depositional environment, facies distribution, reservoir quality and trapping potential of this resource.

Introduction

We consider the dolomitized mudstone at the base of the State A Marker to have upside potential as a secondary Mississippian horizontal oil producing interval. This core display was originally intended to compare cores from the State A at Steelman (east) and the north end of Weyburn at Ralph Pool (west). However, the State A is in the argillaceous facies at Ralph and is tight. The Ralph cores do have potential in the basal Midale Beds here.

We see a need for further facies mapping of the State A in order to delineate the upside potential of the reservoir regionally. Our main purpose of this core presentation is to alert Geologists to the upside potential of this horizon.

The underlying Frobisher Vuggy porosity represents sedimentation on a large carbonate platform within the epeiric sea of the Williston Basin. The State A Beds represent a Highstand Systems Tract which were deposited during an initial marine transgression and subsequent regression. There is a hiatus between the Frobisher Vuggy and State A cycles. Several cores have an organic-rich lense which marks this hiatus (see core photos). The State A Highstand Systems



Tract grades laterally from a nodular chicken-wire sabhka anhydrite and hypersaline nodular anhydrite dolomitic mudstone in the proximal setting to a dolomitized very restricted lagoonal mudstone ("the reservoir") and dolomitized argillaceous tight mudstone in the distal setting (input of clastic component by aeolian transport off the sabhka). The hydrocarbons are stratigraphically trapped at the base of the State A in a very restricted porous lagoonal dolomitized mudstone deposited during the initial marine transgression. They are trapped vertically by tight hypersaline nodular anhydritic dolomite mudstone and sabhka anhydrite of the subsequent marine regression. Down dip this package grades to a tight dolomitic argillaceous mudstone with the clastic component transported by the wind off the sabhka. This entire package suggests a marine regression occurred after deposition of the Highstand Systems Tract. The carbonate factory was being shut down by the input of the clastic component and is reflected in the high Gamma Ray log response.

The facies model would suggest that a State A reservoir may be present north of our display cores at Ralph Pool.

Acknowledgements

Thanks to Arden Marsh, Erik Nickel and Andrew Nimegeers (Saskatchewan Industry and Resources) for their thoughtful discussion and recommendations of representative cores. Dr. Chris Gilboy (Director of the Geological Lab, Saskatchewan Industry and Resources) and his staff are thanked for their help in providing core support in Regina. Also thanks to Robert Norris and Mark Woodward at Straterra Inc. for allowing us to test drive their new LogMASTER computer core logging programme (Straterrainc.com).

References

Lake, J.H., 1998, A Mississippian Epeiric Shelf Facies Model for the Williston Basin, in J.E.Christopher, C.F. Gilboy, D.F. Paterson and S.L. Bend, eds, Eighth International Williston Basin Symposium, Saskatchewan Geological Society Special Publication No. 13, p 69-71.

Nimegeers, A., and Nickel, E, 2003, Horizontal potential in a Lower Midale (Vuggy) reservoir of the Mississippian Midale Beds, Weyburn-Steelman area, southeast Saskatchewan in Sask. Geol. Soc. Core Workshop, April 27, 2003, Sask. Geol. Soc. Special Publication #16.

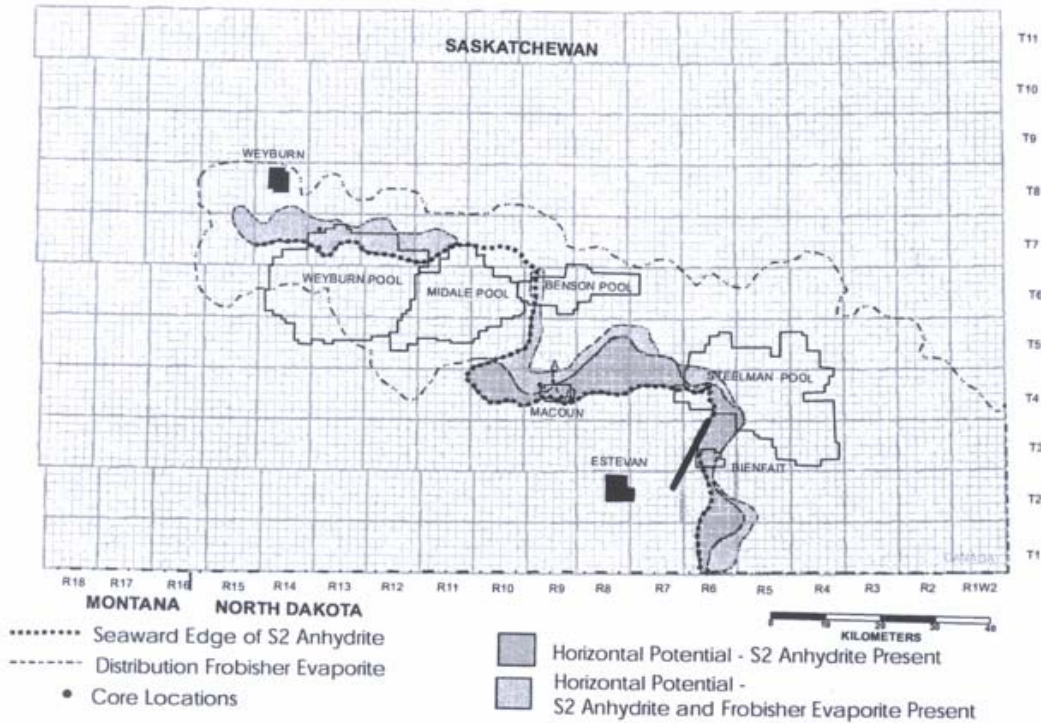


Figure 1. Location map showing the Midale-Steelman oilfield trend. The seaward edge of the S2 anhydrite and distribution of Frobisher Evaporite (adapted from Kent, 2003) are shown with dashed lines. Shaded areas represent regions with possible horizontal potential in the S2 reservoir.

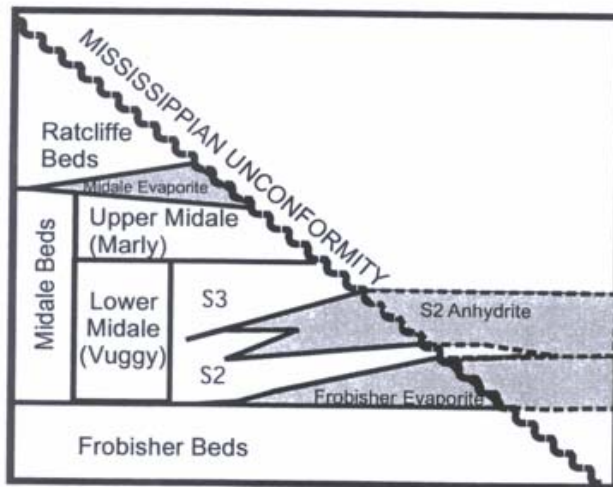
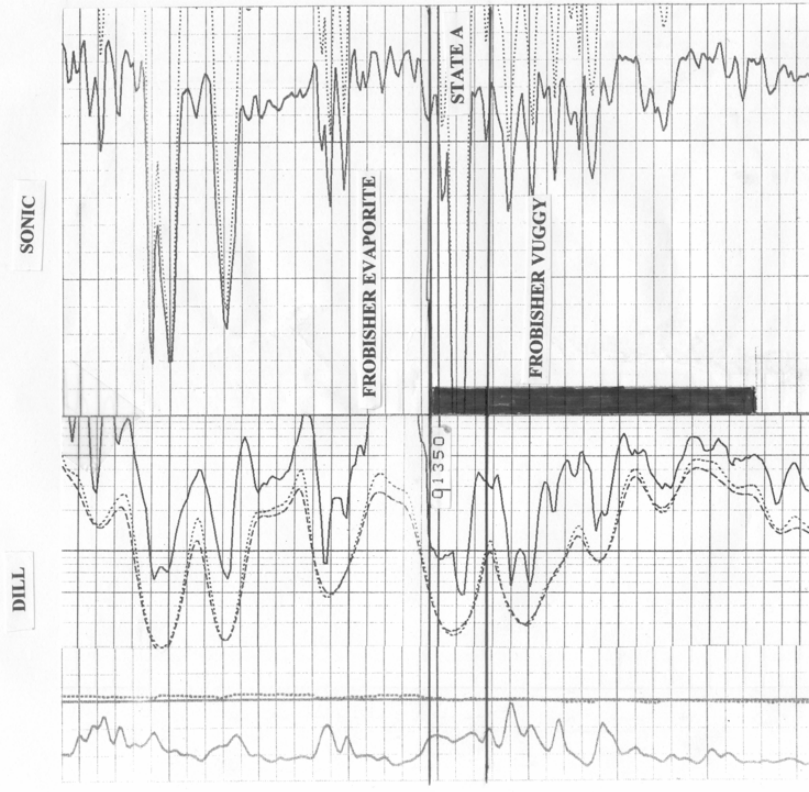


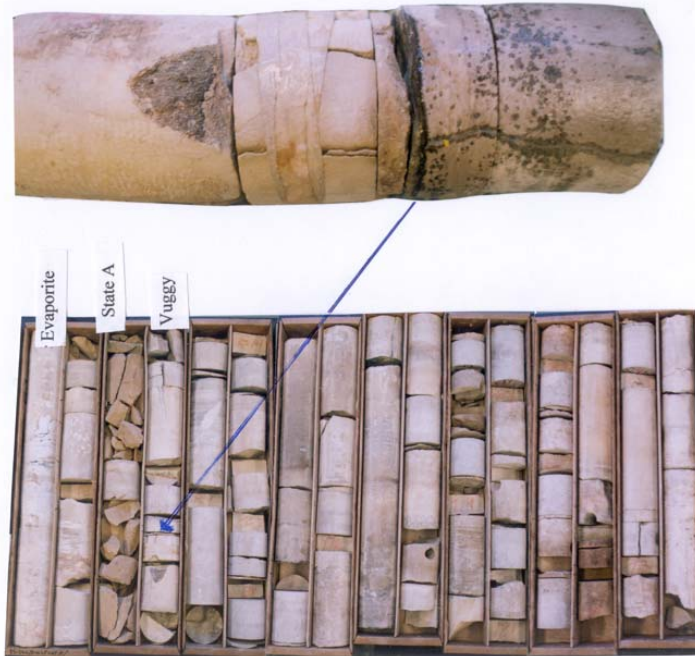
Figure 2. Midale nomenclature and stratigraphy, southeastern Saskatchewan. Informal subdivisions for the lower Midale (S2 and S3) are also shown.

Facies map and stratigraphic column of Midale beds from Nimegeers and Nickel, 2003. They map an S2 and S3 with intervening S2 Anhydrite between Weyburn and Steelman Fields.

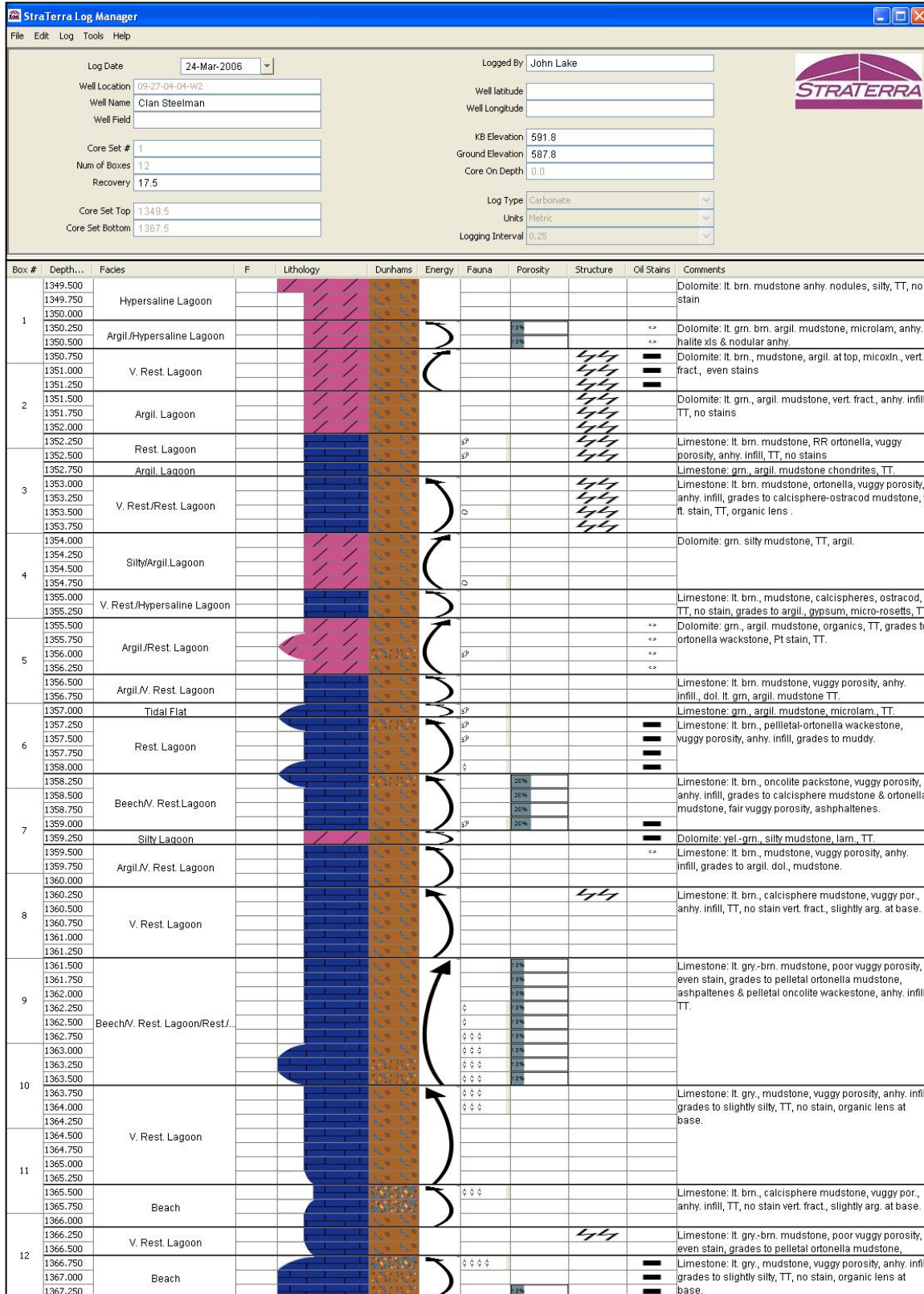
9A-27-4-4W2M Clan Steelman k.b.: 591.8m



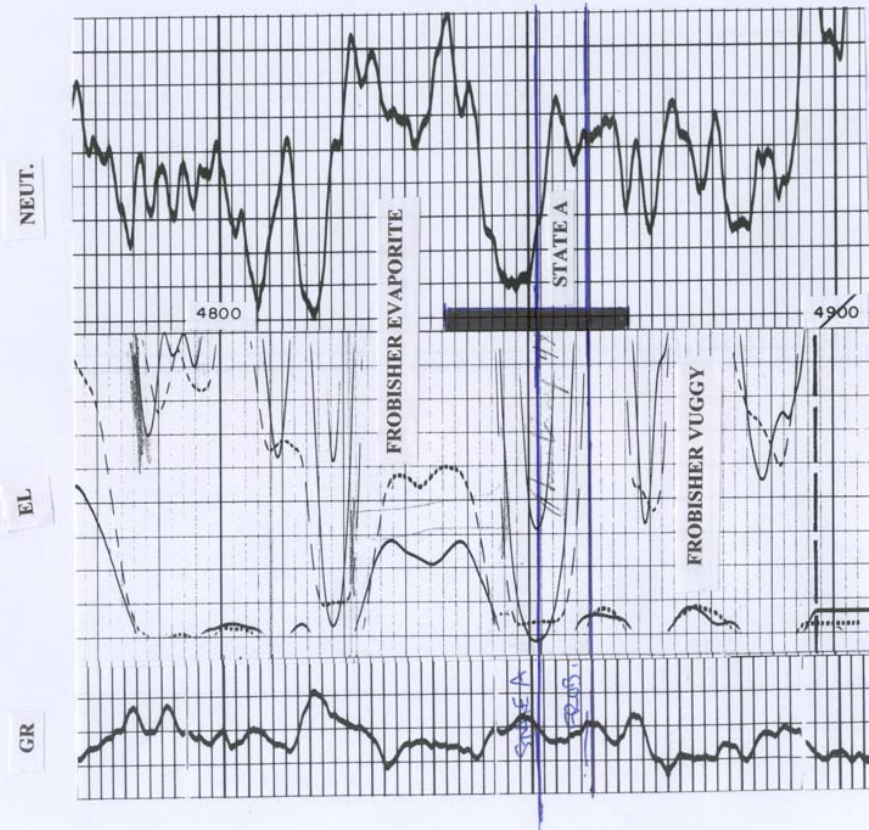
9A-27-4-4W2M Clan Steelman k.b.: 591.8m



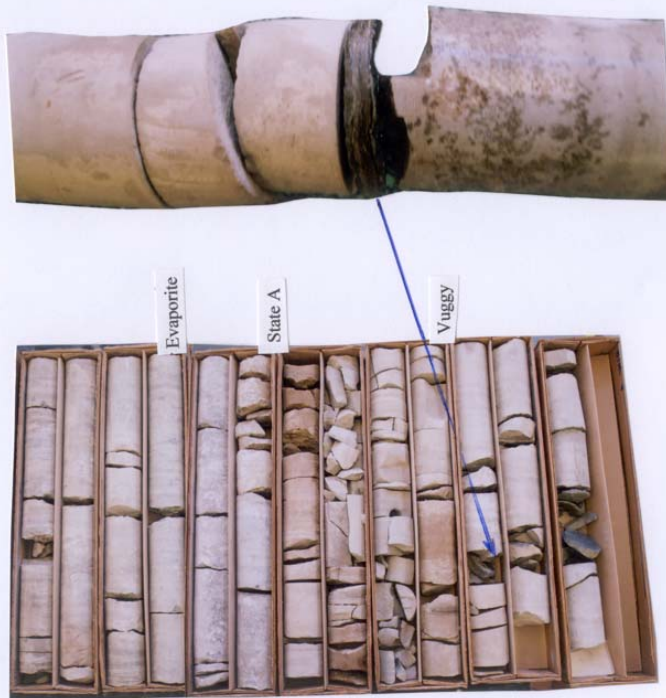
Oil is trapped in fractured State A Marker dolomite mudstone between the Frobisher Evaporite and the underlying anhydrite-plugged Frobisher lime mudstone. Note organic lense at the base of the State A in the detailed photo, suggesting a hiatus in sedimentation. (1352.3m)



5-7-4-5W2M IMP. STEELMAN k.b.: 1945'

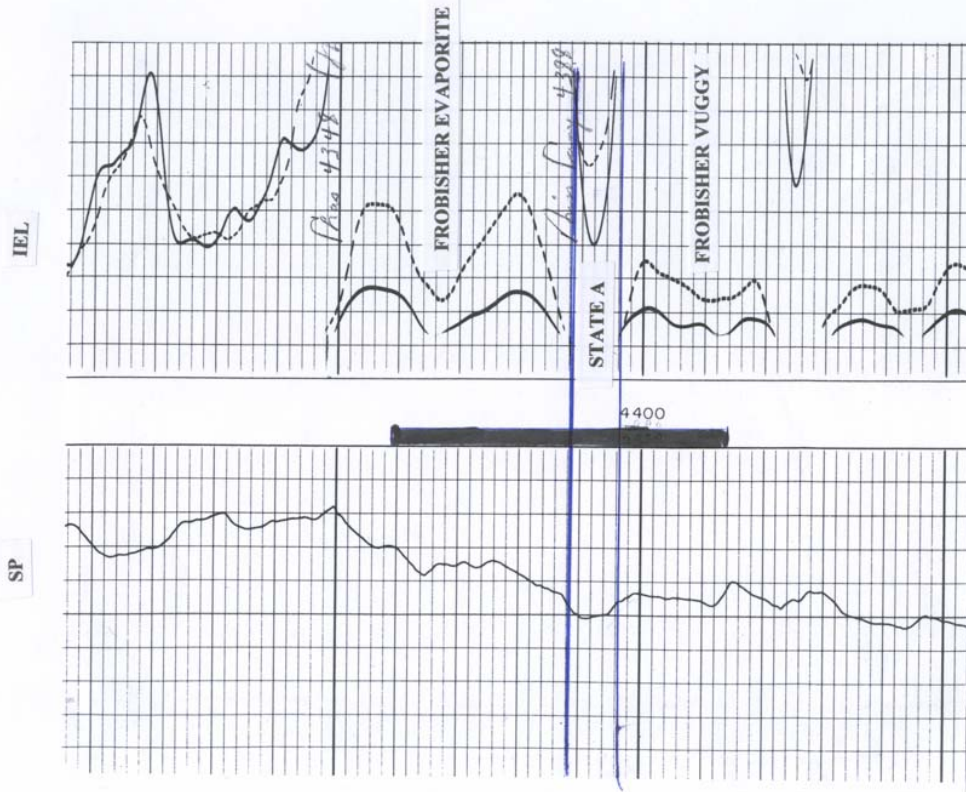


5-7-4-5W2M IMP. STEELMAN k.b.: 1945'

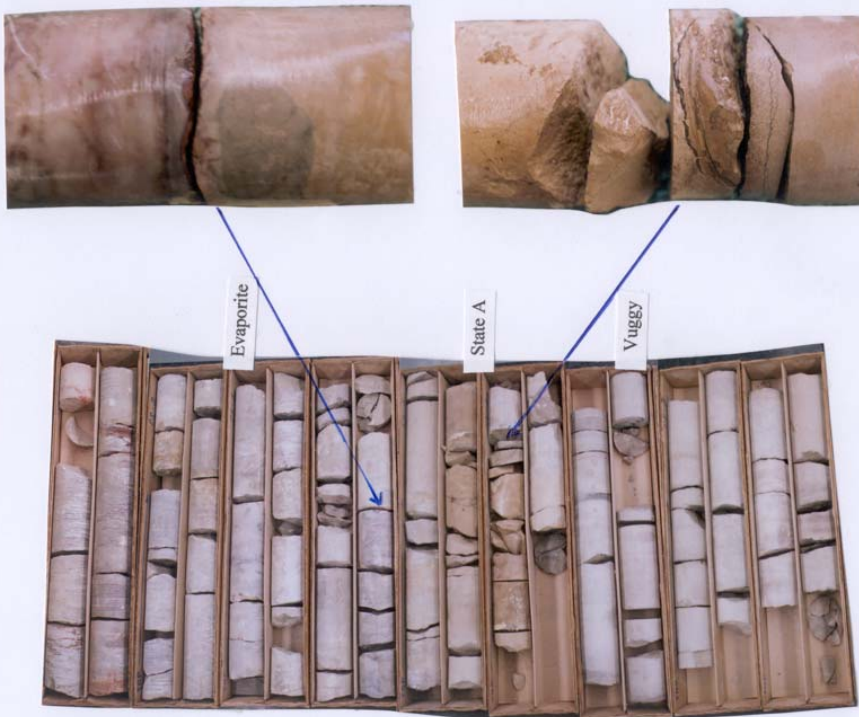


Oil hosted in dolomitized Ortonella-ostracod mudstone at the top of the State A. Note organic lense (hiatus) separating argillaceous State A muds from underlying anhydrite-plugged vuggy porosity Ortonella muds in detailed photo. (4860').

1-25-5-6W2M IMP. STL MN k.b.: 1946'

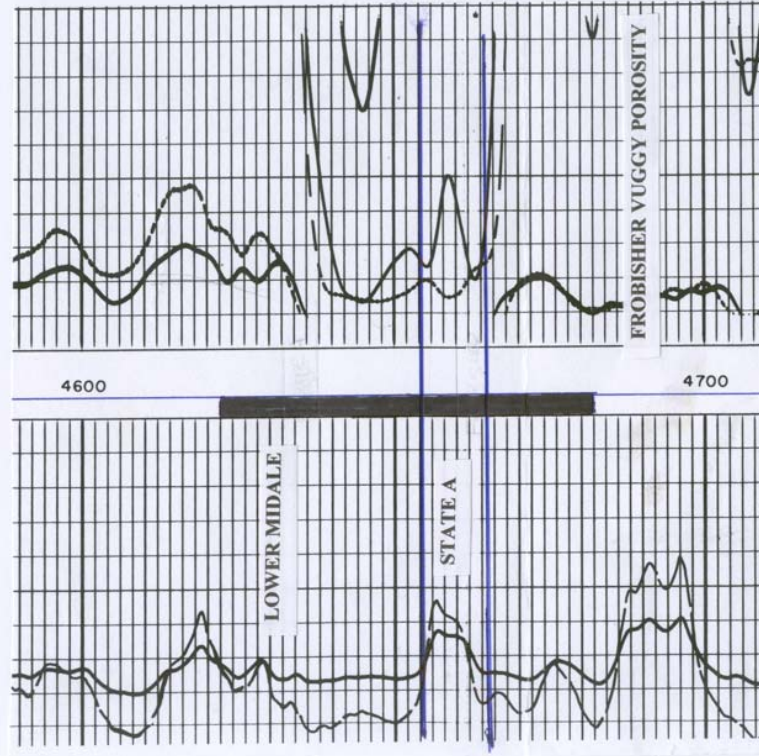


1-25-5-6W2M IMP. STL MN k.b.: 1946'



Oil hosted in State A. Note sharp contact between Frobisher Evaporite and State A in detailed photo. Chert nodule developed near the top of State A. Contact of State A and Frobisher Vuggy is erosional. (4386')

8-20-6-13W2M MU S. RALPH k.b.: 1894'



8-20-6-13W2M MU S. RALPH k.b.: 1894'



Oil is contained within Lower Midale mudstones. The State A is composed of a thin package of tight stacked argillaceous mudstones. Note erosional contact between tight argillaceous mudstone of the State A and the oil-stained Frobisher Vuggy Porosity. (4662').



StraTerra Log Manager

File Edit Log Tools Help

Log Date: 28-Mar-2006

Well Location: 08-20-06-13-W2

Well Name: MGS Ralph

Well Field:

Core Set #: 2

Num of Boxes: 12

Recovery: 55.0

Core Set Top: 4622.0

Core Set Bottom: 4682.0

Logged By: John Lake

Well latitude:

Well Longitude:

KB Elevation: 1894.0


Ground Elevation: 1874.0

Core On Depth: 0.0

Log Type: Carbonate

Units: FPS

Logging Interval: 1



Box #	Depth...	Lithology	Dunhams	Energy	Fauna	Poro...	Struct...	Oil Stains	Comments	Facies
1	4622' 0"	[Blue pattern]	[Brown pattern]						Limestone: light brn., ortonella-ostreod mudstone., grades to oncolite mudstone, even stains, poor vuggy porosity.	Rest. Lago...
	4623' 0"									
	4624' 0"									
	4625' 0"									
2	4626' 0"	[Blue pattern]	[Brown pattern]						Limestone: lt. gry., mudstn., argil., slightly silty, mottled, tt, no stains	Argil. Lago...
	4627' 0"									
	4628' 0"									
	4629' 0"									
3	4630' 0"	[Pink pattern]	[Brown pattern]						Limestone: brn., ortonella mudstone., grades to pelletal-ortonella mudstone., even stains, fair vuggy porosity, dolomitised	Rest/Shall...
	4631' 0"									
	4632' 0"									
	4633' 0"									
4	4634' 0"	[Pink pattern]	[Brown pattern]						Dolomite: light brn., mudstone., slightly silty, even stains, TT	Very Rest...
	4635' 0"									
	4636' 0"									
	4637' 0"									
5	4638' 0"	[Pink pattern]	[Brown pattern]						Dolomite: lt. brn. mudstone., muddy even stains, poor porosity, intensely fract., grades to ostracod mudstn. & biv. mudstn., TT at base, sharp base, erosional	Argil. Lago...
	4639' 0"									
	4640' 0"									
	4641' 0"									
6	4642' 0"	[Pink pattern]	[Brown pattern]						Dolomite: lt. brn. mudstone., muddy even stains, poor porosity, intensely fractured, grades to ostracod mudstone. & bivalve. mudstone., TT at base, sharp base, erosional.	Very Rest...
	4643' 0"									
	4644' 0"									
	4645' 0"									
7	4646' 0"	[Blue pattern]	[Brown pattern]						Limestone: lt. gry. mudstone., lam., slightly silty, chondrites, organics, organic lense, rootlets, lam., TT	Tidal Flat
	4647' 0"									
	4648' 0"									
	4649' 0"									
8	4650' 0"	[Blue pattern]	[Brown pattern]						Limestone: lt. gry., mudstn., muddy rootlets, lam., TT, no stains.	Tidal Flat
	4651' 0"									
	4652' 0"									
	4653' 0"									
9	4654' 0"	[Blue pattern]	[Brown pattern]						Limestone: lt. gry., mudstone., burrow-mottled, grades to microlam, TT	Tidal Flat
	4655' 0"									
	4656' 0"									
	4657' 0"									
10	4658' 0"	[Blue pattern]	[Brown pattern]						Limestone: lt. brn., ortonella mudstns, even stains, poor vuggy porosity, grades to ortonella wackstn., good vuggy porosity	Argil/Very ...
	4659' 0"									
	4660' 0"									
	4661' 0"									
11	4662' 0"	[Blue pattern]	[Brown pattern]						Limestone: lt. brn., ortonella mudst., vuggy porosity, anhy infills, spotty st, TT, grades to pelletal, heavy stn, good vuggy por., sharp base.	Restricted ...
	4663' 0"									
	4664' 0"									
	4665' 0"									
12	4666' 0"	[Blue pattern]	[Brown pattern]						Limestone: lt. gry. ortonella mudstone, vuggy porosity, anhy. infill, spotty stains, TT, grades to pelletal, heavy stains, good vuggy porosity, sharp base.	Rest/Shall...
	4667' 0"									
	4668' 0"									
	4669' 0"									
13	4670' 0"	[Blue pattern]	[Brown pattern]						Limestone: lt. gry. mudstone,RR, ortonella, sty argil, anhy. infills, vuggy porosity, TT, no stains, sharp base.	Rest. Lago...
	4671' 0"									
	4672' 0"									
	4673' 0"									
14	4674' 0"	[Blue pattern]	[Brown pattern]						Limestone: lt. brn., ortonella mudstone, even stains, poor vuggy porosity, grades to ortonella wackstone, good vuggy porosity	Restricted ...
	4675' 0"									
	4676' 0"									
	4677' 0"									
15	4678' 0"	[Blue pattern]	[Brown pattern]							
	4679' 0"									
	4680' 0"									
	4681' 0"									

