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

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Search and Discovery Article #10728 (2015)
Posted March 16, 2015

*Adapted from extended abstract prepared in conjunction with a presentation given at CSPG/CSEG 2006 GeoConvention, Calgary, AB, Canada, May 15-16, 2006,

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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. The 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 (Figure 1).

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 (Figure 2). Several cores have an organic–rich lense which marks this hiatus

(see core photos: Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, Figure 8, and Figure 9). 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).

Selected References

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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 E. Nickel, 2003, Horizontal potential in a Lower Midale (Vuggy) reservoir of the Mississippian Midale Beds, Weyburn-Steelman area, southeast Saskatchewan: Saskatchewan Geological Society Core Workshop, Saskatchewan Geological Society Special Publication #16.

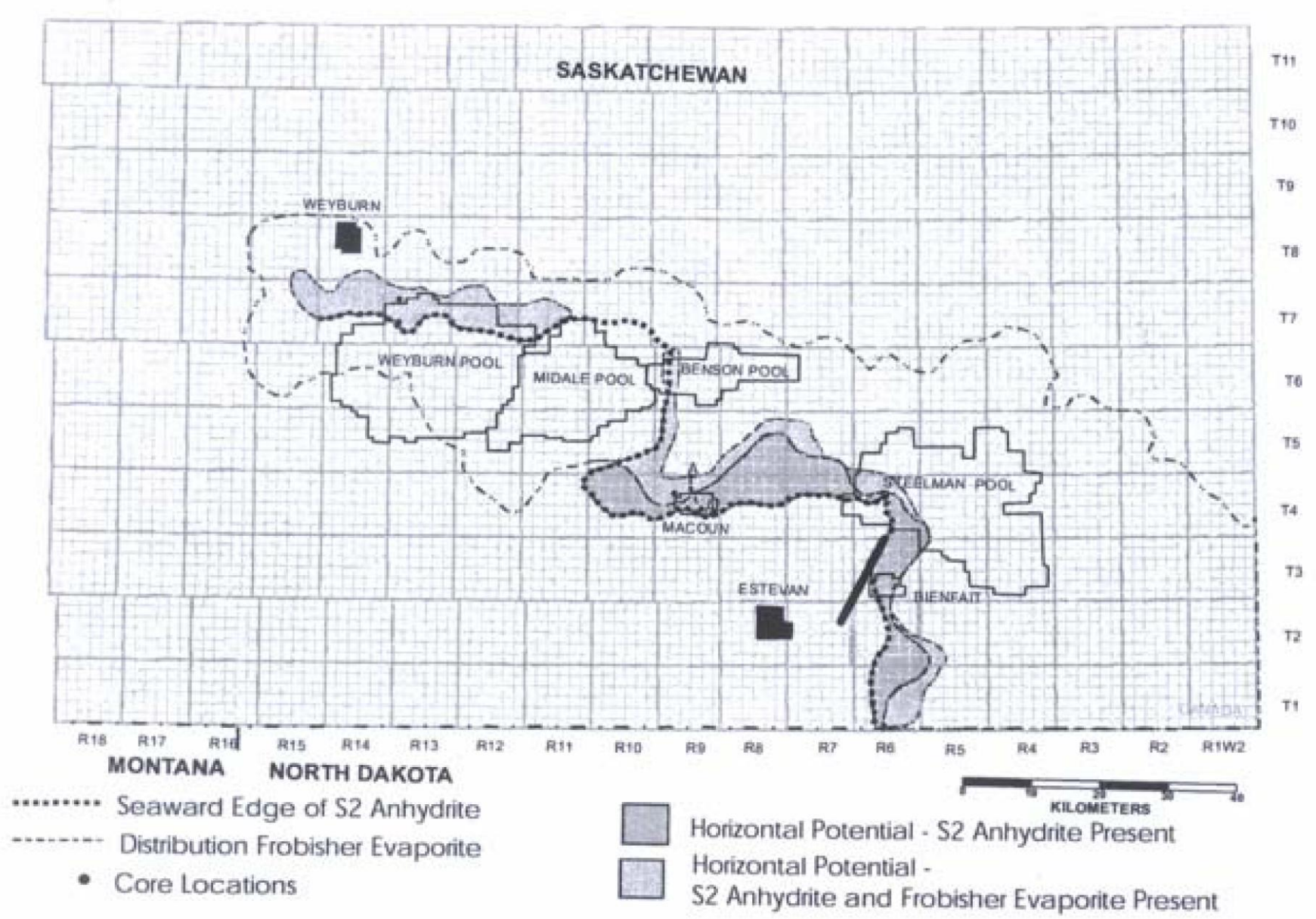


Figure 1. Location map showing the Middle Steelman oilfield trend. The seaward edge of the S2 anhydrite and distribution of Frobisher Evaporite (adapted from Kent, 2003) are shown with dashed lines. Shaded areas represent regions with possible horizontal potential in the S2 reservoir.

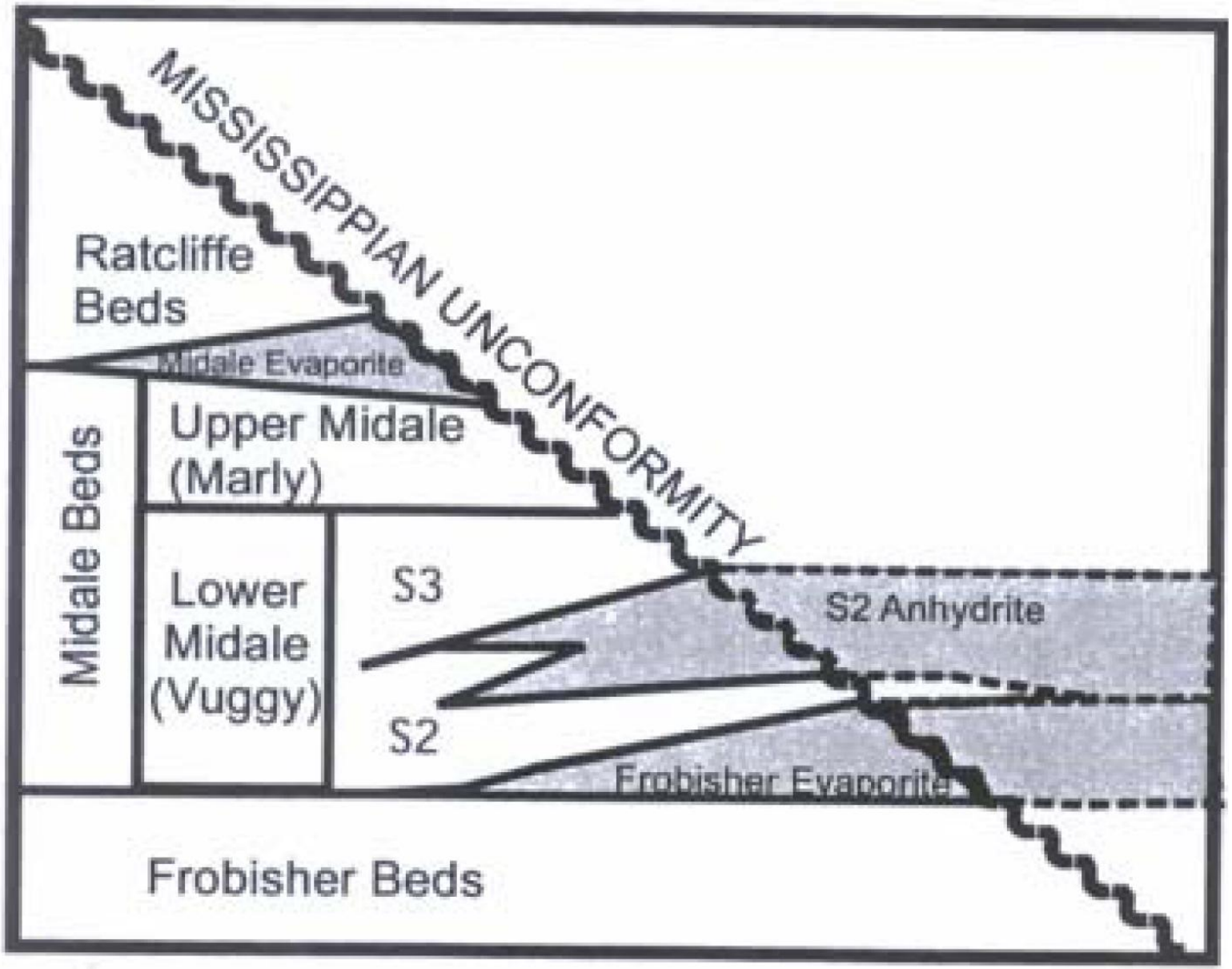


Figure 2. Midale nomenclature and stratigraphy, southern Saskatchewan. Informal subdivisions for the lower Midale (S2 and S3) are also shown. Facies map and stratigraphic column of Midale beds from Nimegeers and Nickel, 2003. They map an S2 and S3 with intervening S2 Anhydrite between Weyburn and Steelman Fields.

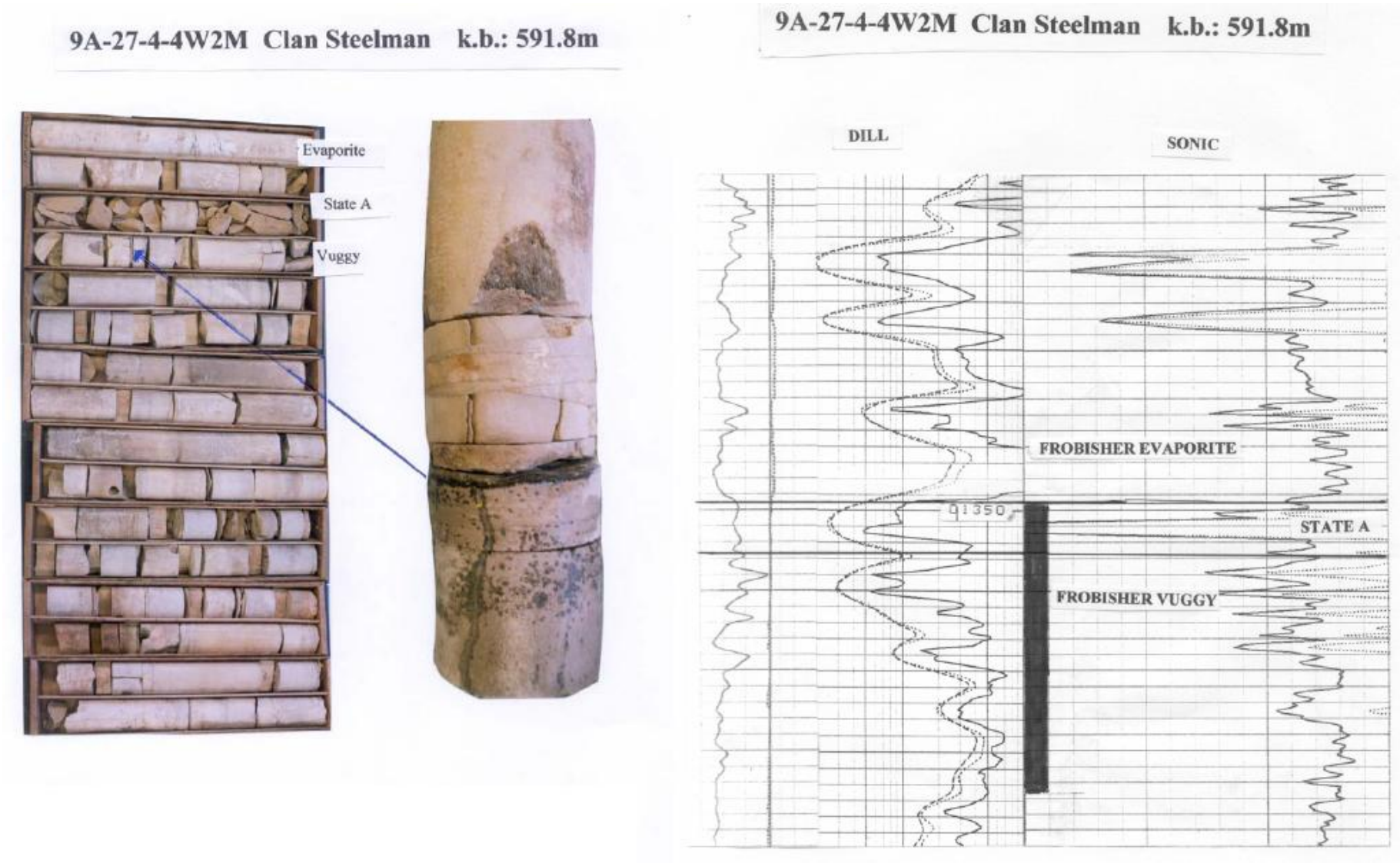


Figure 3. Core and corresponding electrical log of State A Marker in the Clan Steelman Well located at 9A-27-4-4W2M. Oil is trapped in fractured State A Marker dolomite mudstone between the Frobisher Evaporite and the underlying anhydrite-plugged Frobisher lime mudstone. Note organic lense at the base of the State A Marker in the detailed photo, suggesting a hiatus in sedimentation (1352.3 m).

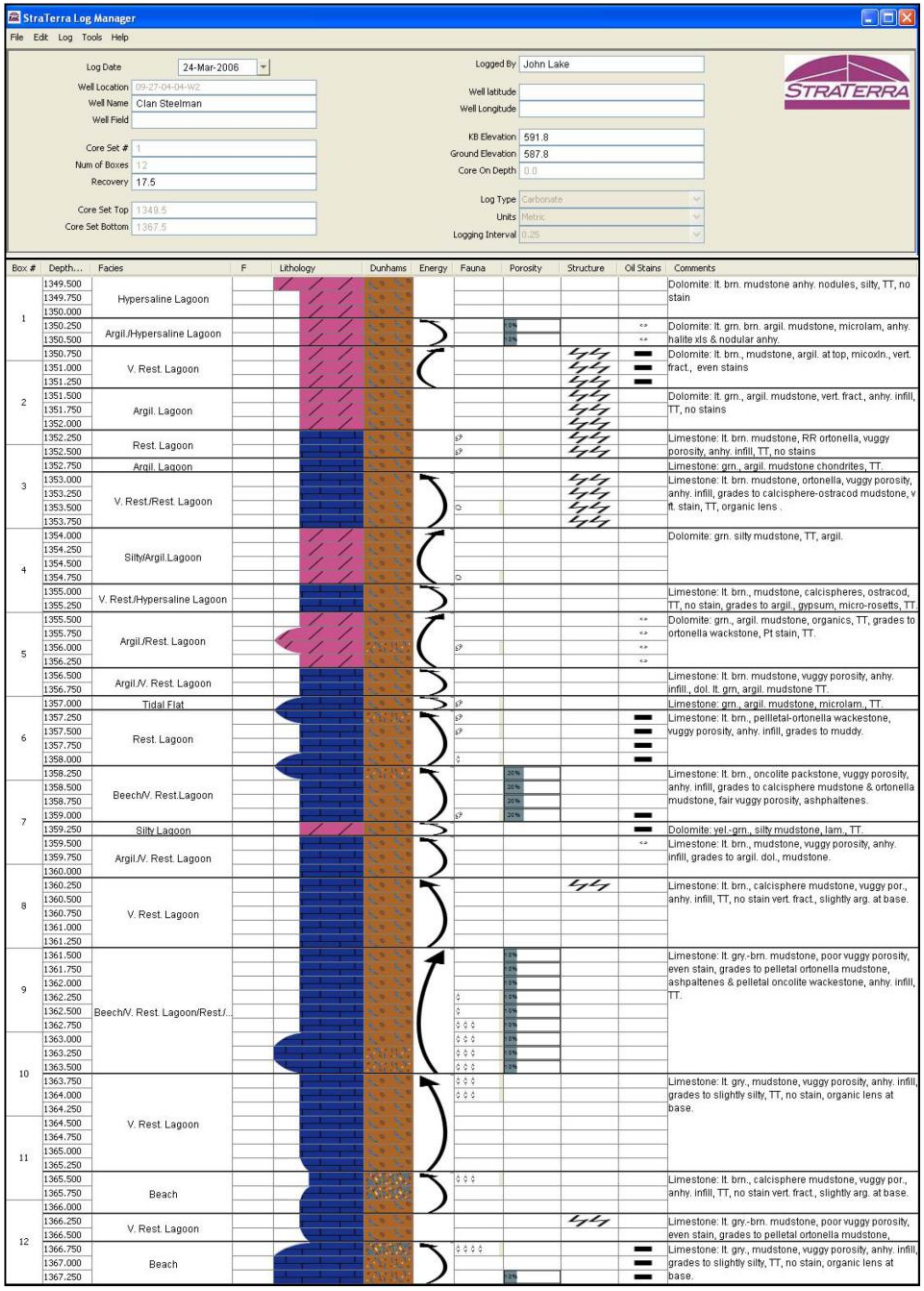


Figure 4. Lithology log of the State A Marker in the Clan Steelman Well located at 9A-27-4-4W2M.

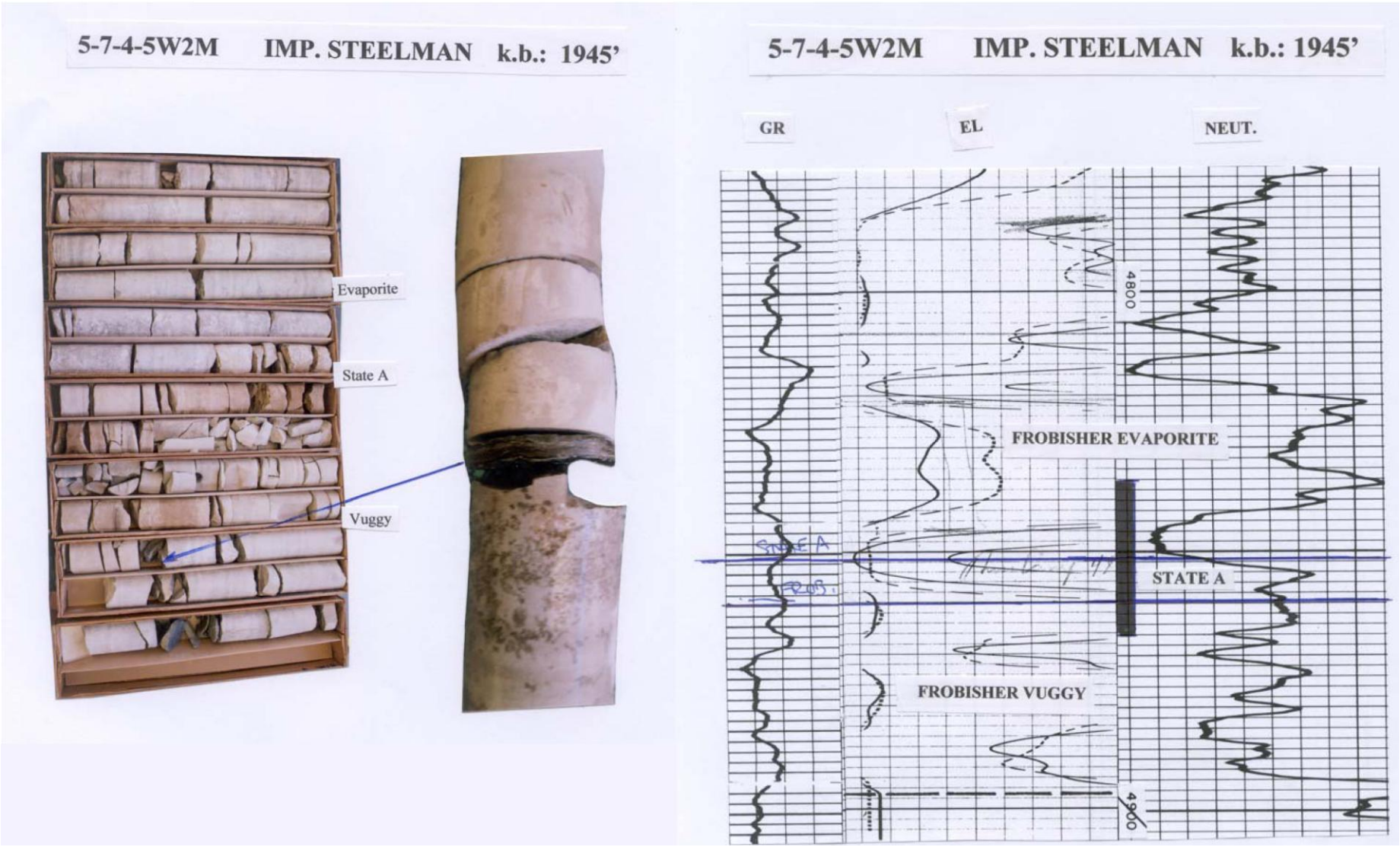
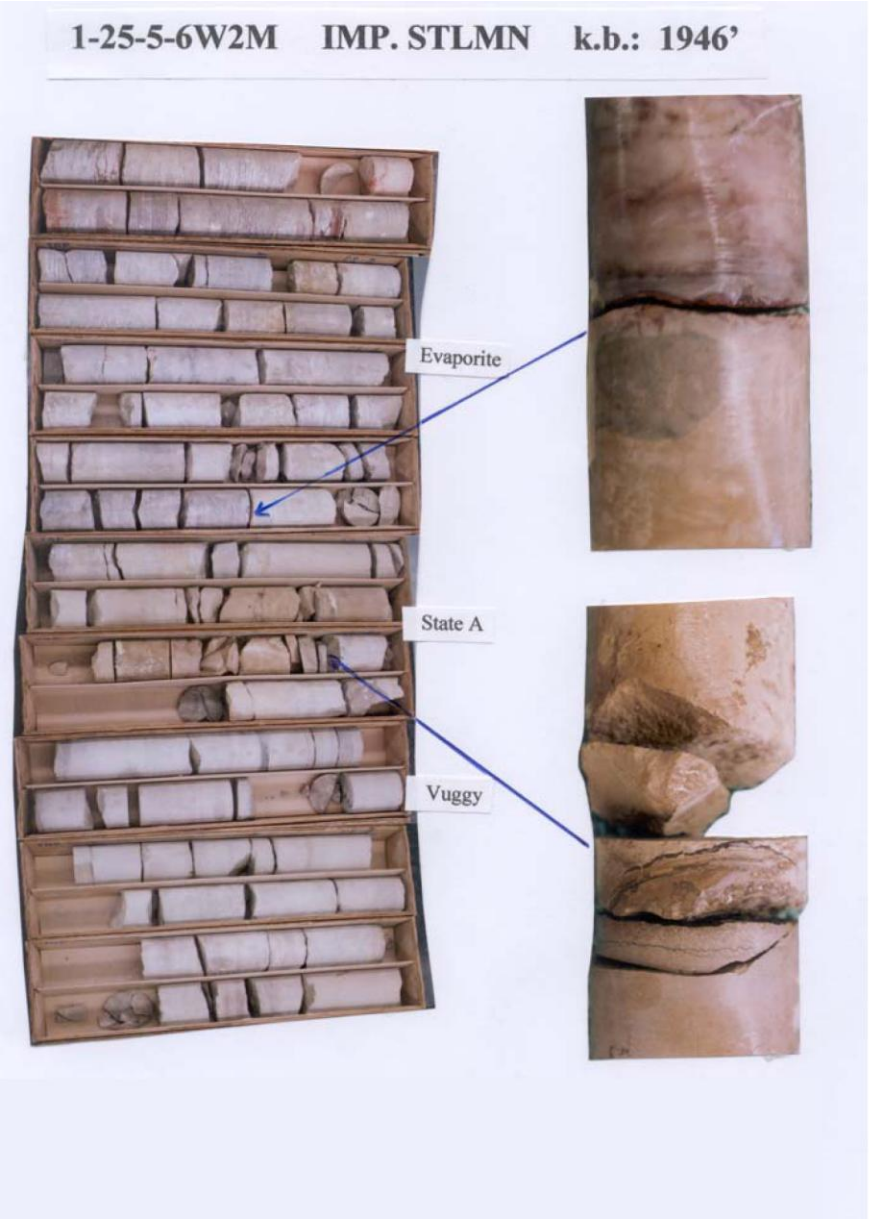


Figure 5. Core and corresponding electrical log of State A Marker in the Imp. Steelman well located at 5-7-4-5W3M. Oil hosted in dolomitized Ortonella-ostracod mudstone at the top of the State A. Note organic lense (hiatus) separating argillaceous State A muds from underlying anhydrite-plugged vuggy porosity Ortonella muds in detailed photo (4860 ft).



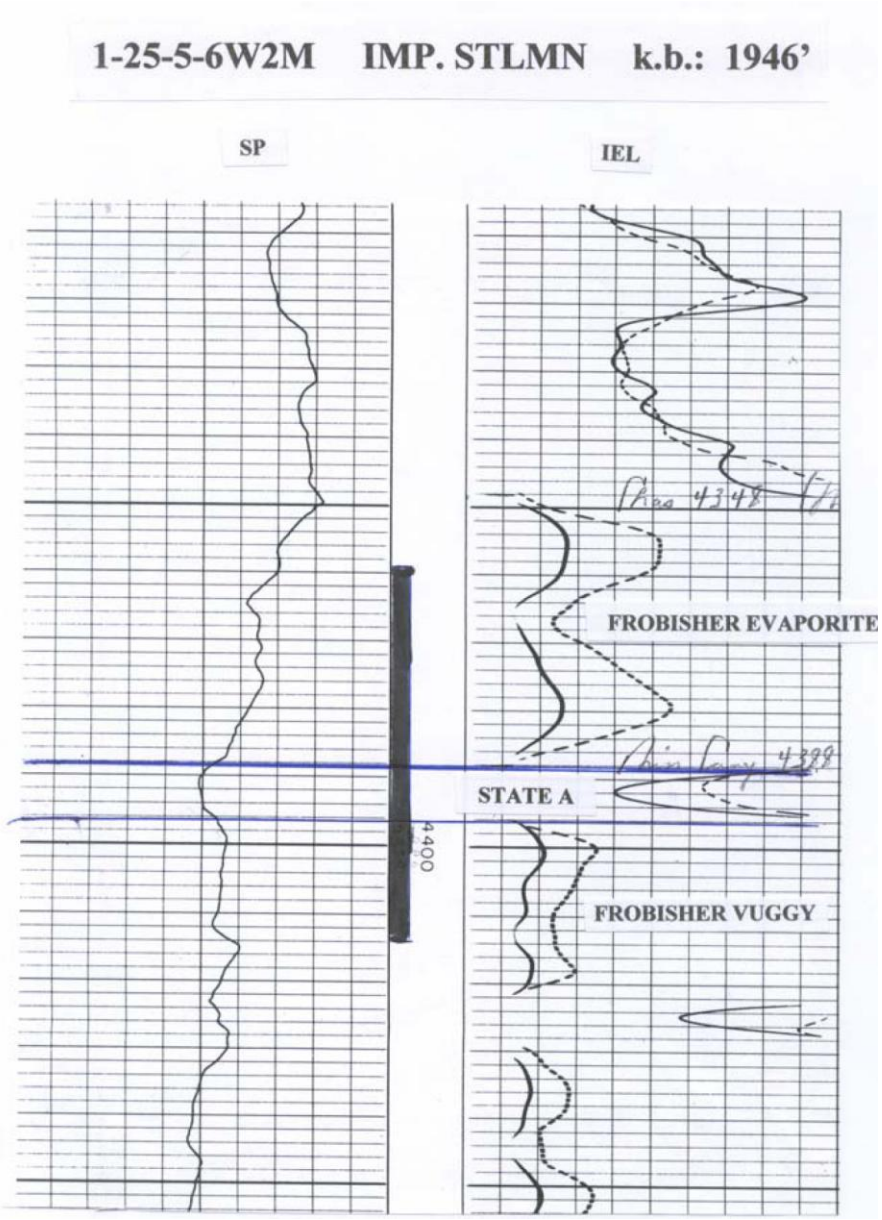
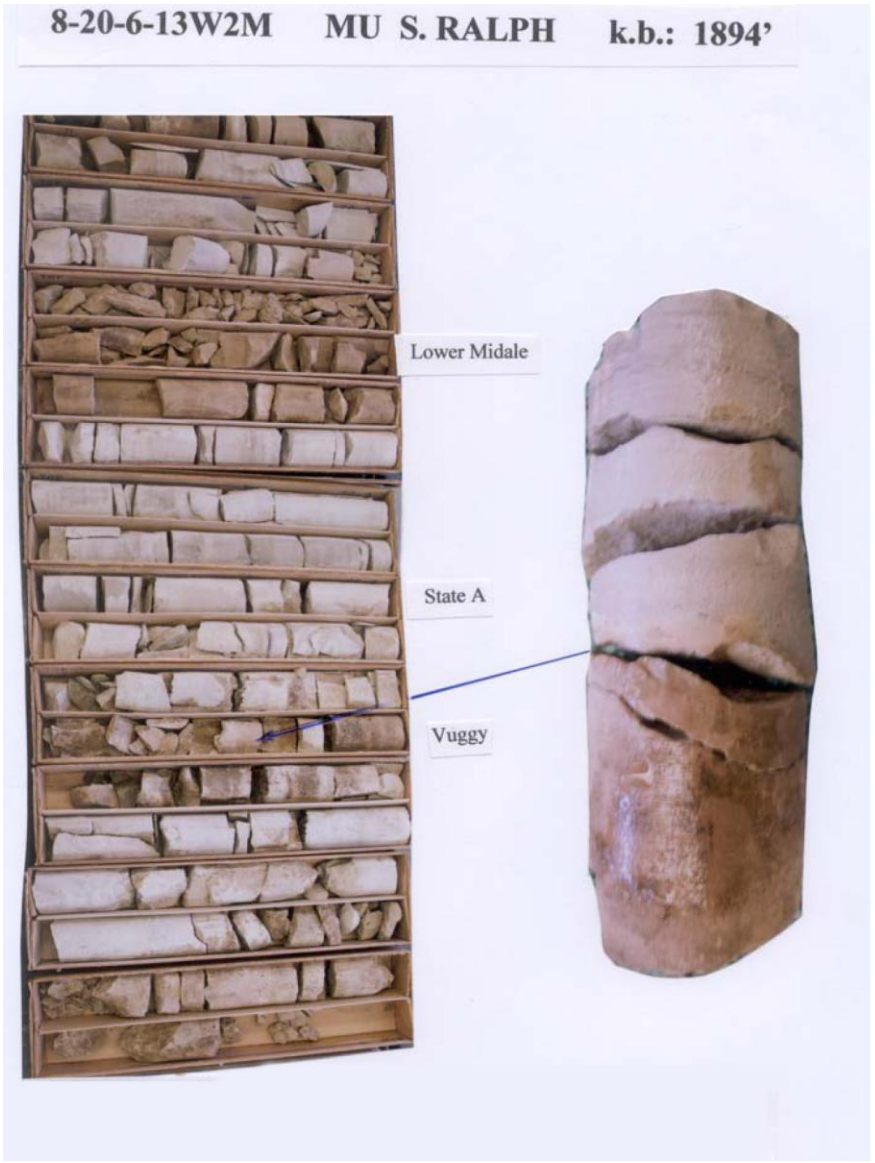


Figure 6. Core and corresponding electrical log of State A Marker in the Imp. Steelman well located at 1-25-5-6W3M. Oil hosted in State A. Note sharp contact between Frobisher Evaporite and State A in detailed photo. Chert nodule developed near top of State A. Contact of State A and Frobisher Vuggy is erosional (4386 ft).



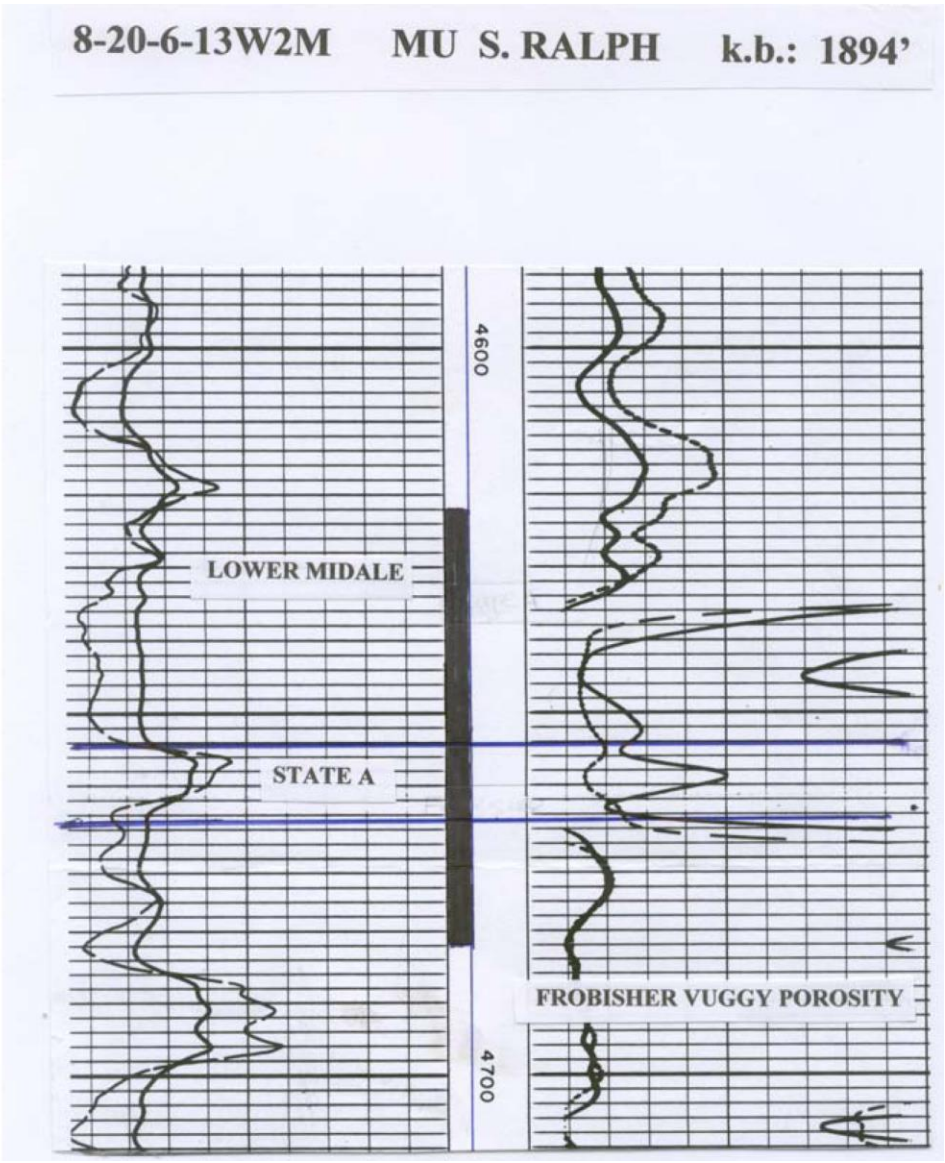


Figure 7. Core and corresponding electrical log of State A Marker in the MU S. Ralph well located at 8-20-6-12W2M. Oil is contained within Lower Midale mudstones. The State A is composed of a thin package of tight stacked argillaceous mudstones. Note erosional contact between tight argillaceous mudstone of the State A and the oil-stained Frobisher Vuggy Porosity (4662 ft).

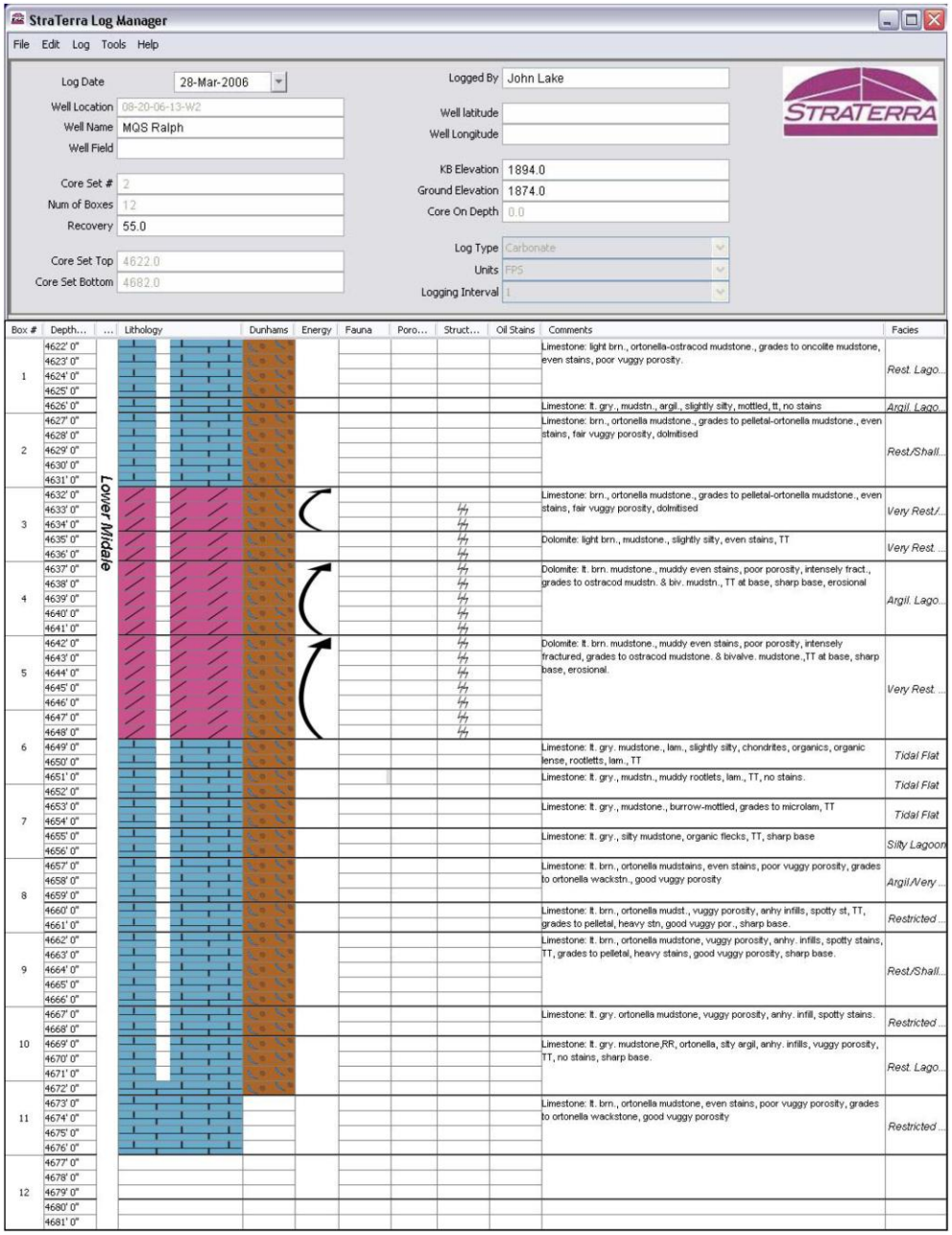
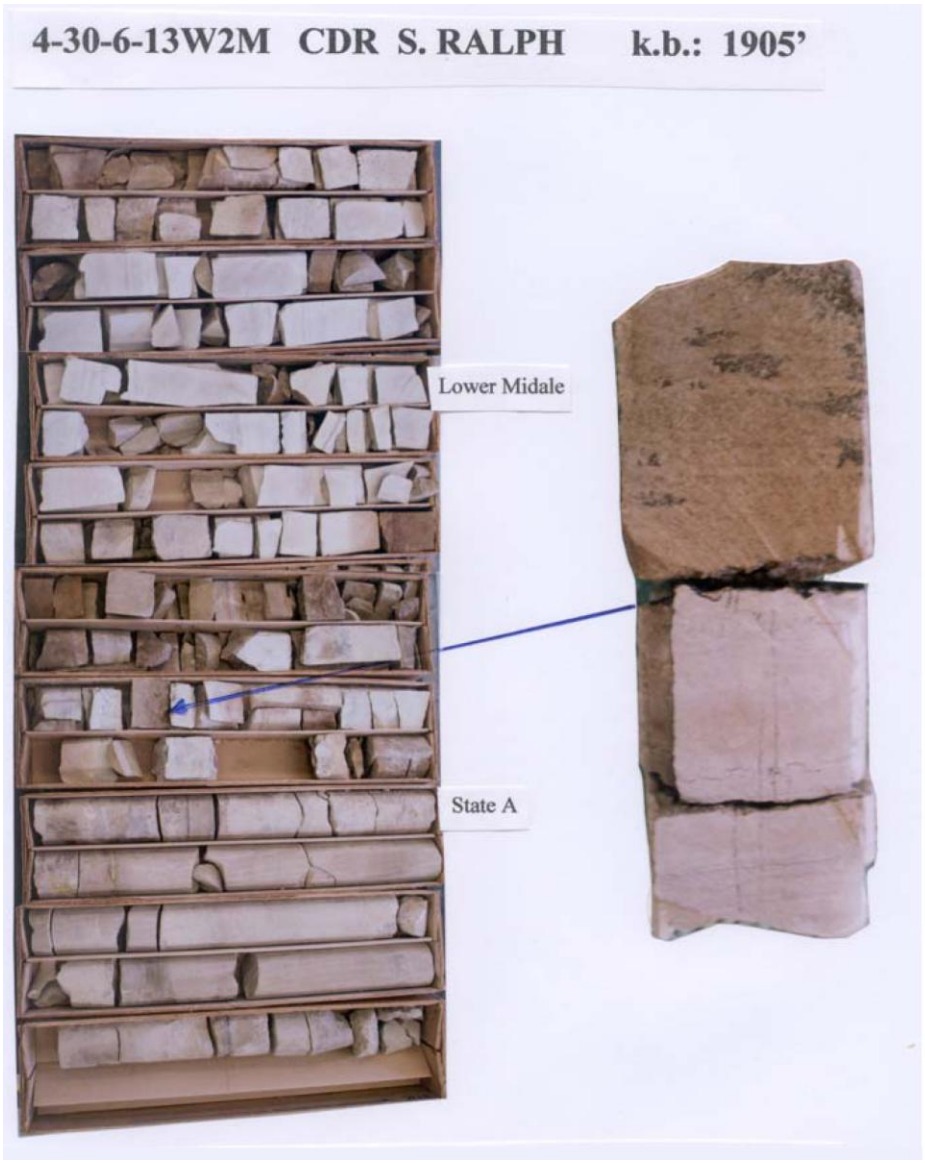


Figure 8. Litholoogy log of the State A Marker in the MU S. Ralph well located at 8-20-6-12W2M.



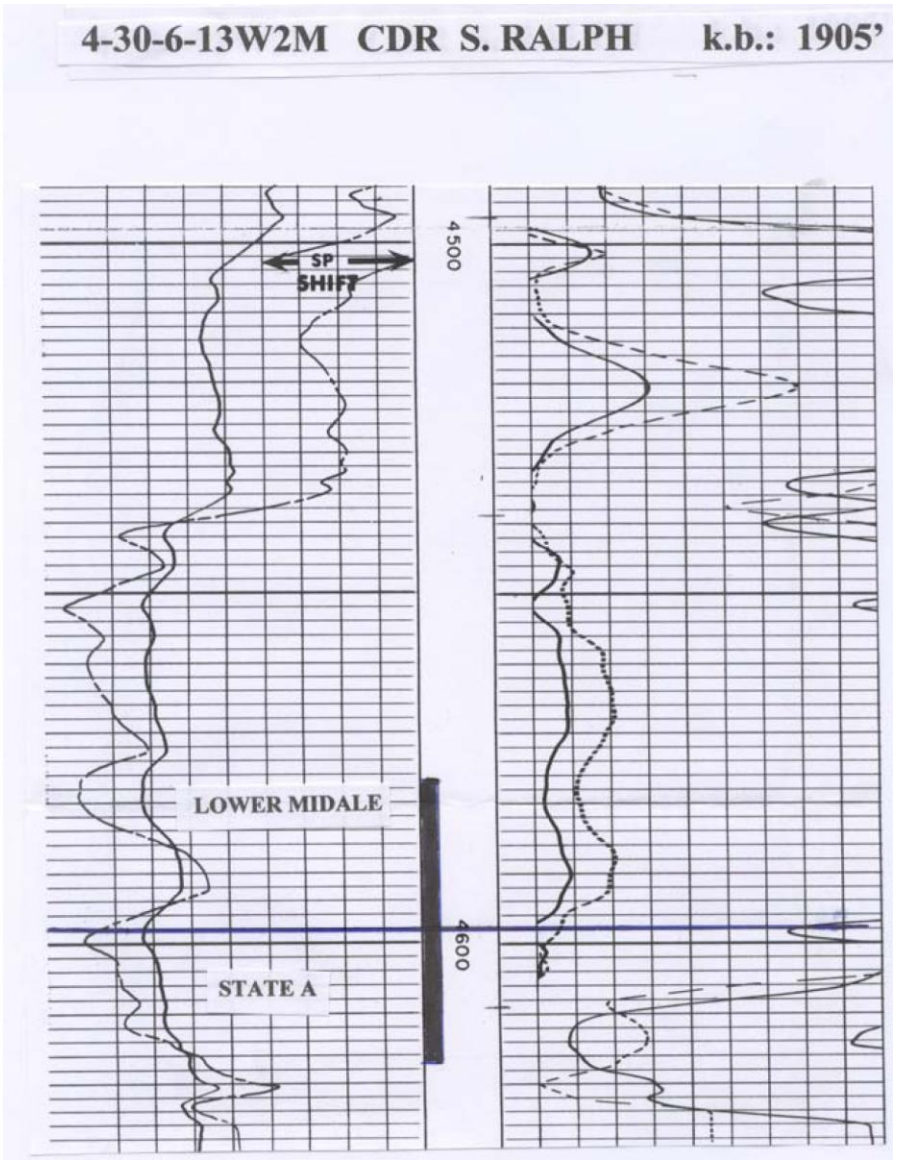


Figure 9. Core and corresponding electrical log of State A Marker in the CDR S. Ralph well located at 4-30-6-13W2M. Reservoir quality is restricted to Basal Midale beds. The upper portion of the State A is faintly stained dolomite mudstone: the lower portion is tight argillaceous mudstone. Notice sharp contact between oil stained Lower Midale and the tight State A mudstone (4598 ft).