SASKATCHEWAN GEOLOGICAL SOCIETY

Winter 2023 Speaker Series

Upside Potential of the Basal Mississippian Souris Valley Beds/Lodgepole Formation in Southeast Saskatchewan

An alternate model using evidence from drill core

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Core Talk

Live in person at Saskatchewan Geological Subsurface Laboratory

201 Dewdney Ave, Regina

Talk to start at 12:00 noon (*Central Standard Time*)

Please RSVP by noon, Tuesday May 23

Abstract

Prospecting for hydrocarbons along the Souris Valley Beds subcrop edge in Southeast Saskatchewan has met with very disappointing results (save for the Parkman Pool). This core display suggests an alternative model for future exploration activity. Klassen (1996) mapped Lodgepole shelf, slope and basin facies in Southwestern Manitoba and suggested that Southeast Saskatchewan represents deposition in a deeper non-reservoir facies.

This core presentation suggests erosion removed the reservoir in Southeast Saskatchewan and northwestern North Dakota. Stratigraphic cross-sections through the Daly and Virden Lodgepole Pools in southwestern Manitoba were studied as an analogue for exploring elsewhere in the basin and revealed Sequence Boundaries and ravinement surfaces/sea cliffs which show rapid sea level changes affecting preservation of the section.

The two cores on display are a composite of the Lodgepole Formation from Bakken/Lodgepole contact to top of the Lower Daly Member reservoir (Cruickshank Member in the Daly Pool (100/01-30-009-28W1/00; Cal. Stan. Daly), which represents the lower portion of the Lodgepole

Formation, and Lower Daly Member reservoir facies at the top of the Lodgepole Formation (100/11-04-010-28W1/00; Daly Unit No. 1) in southwestern Manitoba). Erosion of the reservoir was likely initiated by reactivation of sinistral faults along the Churchill/Superior Boundary.

Conclusions:

1. The Souris Valley Beds/Lodgepole Formation carbonate platform underwent considerable post-depositional erosion.
2. Drilling for hydrocarbons along the Souris Valley Beds/Lodgepole Formation subcrop edge was unsuccessful because the high energy oolite and crinoid shoal reservoir facies has been removed by erosion.
3. The isopach of the Souris Valley Beds/Lodgepole Formation is a topographic map of the geomorphology of the erosional valley etched into this landscape. Criteria for minimum isopach thickness required for reservoir preservation is a first step to exploring for downdip Souris Valley Beds/Lodgepole Formation reservoirs (Daly-Virden Pools in Manitoba as analogues). The potential Souris Valley Beds exploration fairway extends northwest from the Northgate Pool area (Twp 2, Rge 2W2) to the South Fillmore Pool (Twp 9, Rge 11W2) with several offset faults. The fairway is 60 km downdip from the Souris Valley Beds subcrop. 4. The thickness of section with oil staining in the 101/12-29-002-02W2/00 (Can Gulf Neuman No 12) well would suggest that we are dealing with the escape pathway for Bakken Formation oil infiltrating overlying Mississippian formations. The basal intervals of the Souris Valley Beds/Lodgepole Formation are good aquitards but the oil is reaching the high energy transgressive reservoir facies
5. Similar erosional valleys occurred: in the Ordovician Winnipeg and Red River formations infilling an erosional valley cut into the Middle Cambrian Deadwood Formation; Devonian Winnipegosis Formation; the basal Mississippian Souris Valley Beds/Lodgepole Formation, and; uppermost Alida Beds deposition. Each represents complete drainage and subaerial exposure of the Williston Basin and shows how tectonic subsidence and eustatic seal level change influence the topographic expression of each stratigraphic unit.
6. The erosional topography on top of the Souris Valley Beds/Lodgepole Formation controlled facies distribution of reservoir facies in subsequent Mississippian sedimentation.
7. Collapse of the Devonian Prairie Evaporite could have played a role in preservation potential of the reservoir facies, but this was secondary to the amount of erosion required to create the large topographic relief.
8. Typically with facies models the simplest explanation is usually the best. If a ramp model does not explain what you see in the rocks then try something else.

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Speaker Biography

John Lake

Lake Geological Services Inc.

John received an Honours B.Sc in Earth Sciences from the University of Waterloo in 1973 and M.Sc in Earth and Atmospheric Sciences from McGill in 1977. Worked for Mobil Oil Canada in Calgary from 1979-1989 (Production Geology in Saskatchewan from 1983). Worked for Saskoil in Regina and Swift Current from 1990-1995, and has been a Consulting Geologist from 1995 – present. Experience includes Wellsite Geology and describing cores.