SE Saskatchewan Depositional models & small-pool exploration

Evidence-and-test atlas | 22 October 2026

Focus: Wapella and North Wapella; Tyvan, Chapleau Lake and Montmartre; Parkman and the Souris Valley interval. Follow-on investigation to the regional Walpole/Wawota-to-Indian Head screening.

Working conclusion

The small pools can guide a reconstruction, but each accumulation must be assigned to its own stratigraphic interval and trapping history. The best immediate targets for interpretation are facies transitions around the Jurassic Wapella valleys, pore-system changes around the northern Red River pools, and preserved Mississippian remnants beneath effective seals. A continuous oil-bearing shoreline across the whole corridor has not been demonstrated.

Reconstruction	Feature to pursue	Main rejection test
Jurassic Wapella	Estuary mouth, tidal channel and possible barrier/shoreface sand	Proposed sand is absent, younger, cemented or breached.
Northern Red River	Dolomitized muddy reservoir and locally proved grain shoals	Apparent facies margin is only cementation; no seal or charge.
Parkman / Souris Valley	Preserved reservoir cycles, caprock, local mound or bank margins	Reservoir cycle was eroded or was never deposited; seal fails.

What was examined

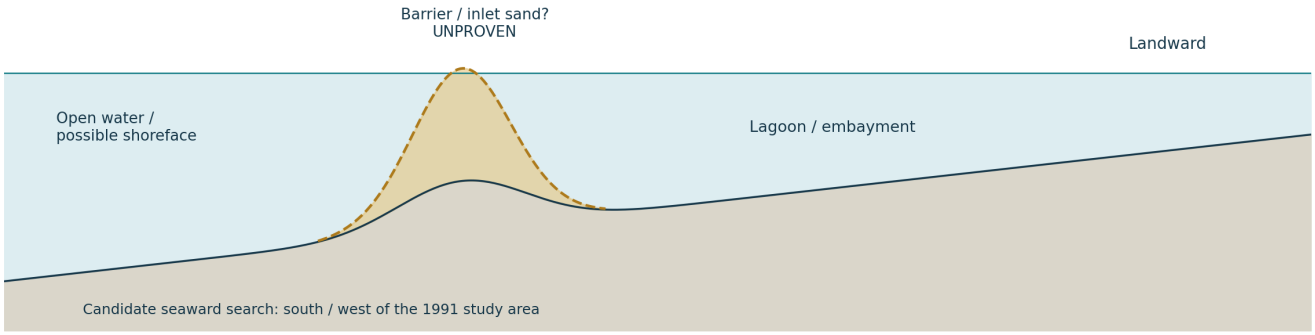
Published core photographs, thin-section images, interpreted wireline panels, graphic core descriptions, stratigraphic maps and regional interpretations were reviewed. Public well-header and sample-inventory records were matched to the published wells. Original LAS suites, complete original core-photo runs and raw well-test files were not obtained; physical samples were not examined. GeoAtlas currently reports that well-document downloading is disabled [S16].

Evidence labels used here: observation = identifiable published or public-record evidence; interpretation = the cited author's explanation; prediction = a new, testable extension proposed in this atlas. None of the conceptual figures is a mapped reservoir, shoreline, reserve estimate or drilling location.

1. Wapella: reconstruct two separate coastal systems

1 JURASSIC WAPELLA | A testable estuary-to-open-water transition

Moosomin A2 working model. The barrier is hypothetical; the later Moosomin B channels are a separate interval.



Test a sand body and its age first; then test sealing, preservation and oil charge.

Jurassic: distinguish valley fill, lagoon and tidal channels

Use the local Jurassic sources [S6, S7] with the evidence index on page 6. Keep observed structures, fossil assemblages and environmental interpretations in separate columns. Within each core, record where the evidence changes; do not assign one environment to an entire formation simply because one bed fits it.

Reconstruction tests: does valley incision predate the candidate sand? Do younger beds onlap adjacent highs? Is an apparent shallowing sequence complete or truncated? Build independent A1, A2 and B correlation panels. The figure shows a working hypothesis, with the barrier location and sand continuity remaining questions to resolve.

Predictions around a lagoonal control

A seaward transect should test for a shift toward better sorted, wave- or tide-worked sand and a stronger marine fauna. An along-margin transect should test whether the sand is elongate, segmented by inlets or laterally replaced by mud. A valley-axis transect should instead test scour surfaces, basal lags and stacked channel fills. These three geometries can produce similar clean-log intervals but imply different extensions.

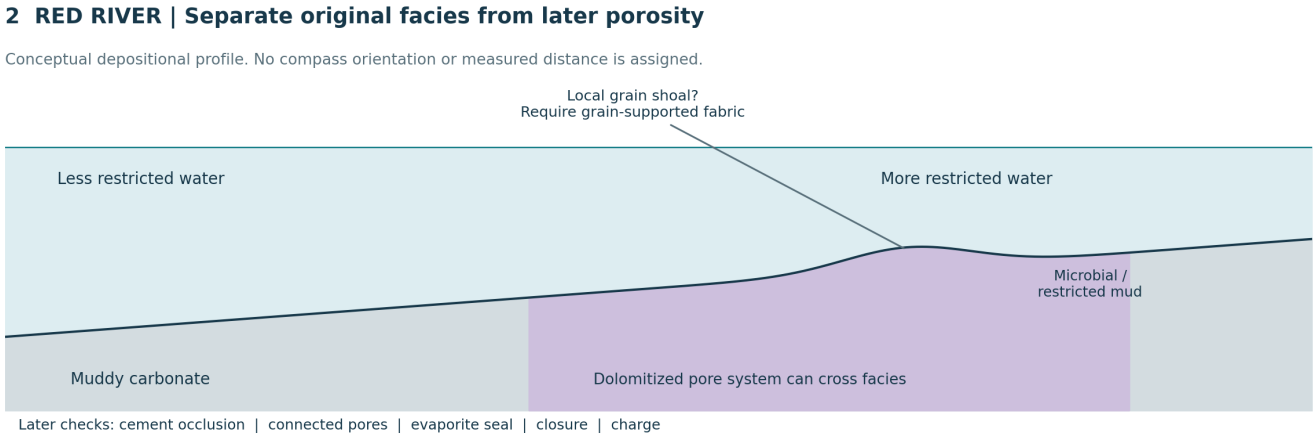
Reject a barrier interpretation if the body is confined to an incised thalweg, lacks an appropriate coeval lagoon-to-open-water transition, or belongs to a different sequence. A depositional barrier may also have been removed during later erosion; that would leave a valid palaeogeographic hypothesis without a surviving exploration target.

Early Cretaceous: Cantuar/Dina is a separate map

Christopher describes the Wapella Dina reservoir against inherited Jurassic relief [S8]. The W Wapella 16-33-14-2W2 description provides an additional core-based check: the interval assigned to Dina is 684.7-704.1 m, with finer burrowed and glauconitic beds above coaly sandstone [S9]. That is compatible with increasing marine influence upward, but it does not place a Jurassic barrier or prove a single connected Cretaceous sand sheet.

Exploration consequence: investigate age-controlled sand terminations, channel margins and shale envelopes independently of the Jurassic interpretation. Source access and charge remain separate conditions.

2. Red River: map facies and pore systems separately



Anchor the interpretation to the local published controls

Use GR2025-9 [S1] and the Chapleau graphic core [S3] as primary anchors, with the exact figure and well index on page 6. Tie each inferred facies to a described or photographed interval. Keep sampled observations separate from the unsampled gaps and the interpolated connections between wells.

Competing models are worth retaining

A muddy tidal-flat/lagoon interpretation is useful for predicting protected facies and restriction. A subtidal interpretation of some laminated beds changes the predicted position of an emergent shoreline. Pratt & Haidl provide the latter alternative [S4]. Older work also identifies separate small oolitic bodies around the northern pools [S2]. These observations must be compared within the same stratigraphic slice before they are combined into a map.

Three maps are required: (1) original texture and biota; (2) present dolomite, cement and connected pores; (3) closure, seal and fluid evidence. A productive porosity boundary can cut across the first map. Conversely, a grain-supported shoal can be non-reservoir if its pores are cemented.

Testable adjacent features

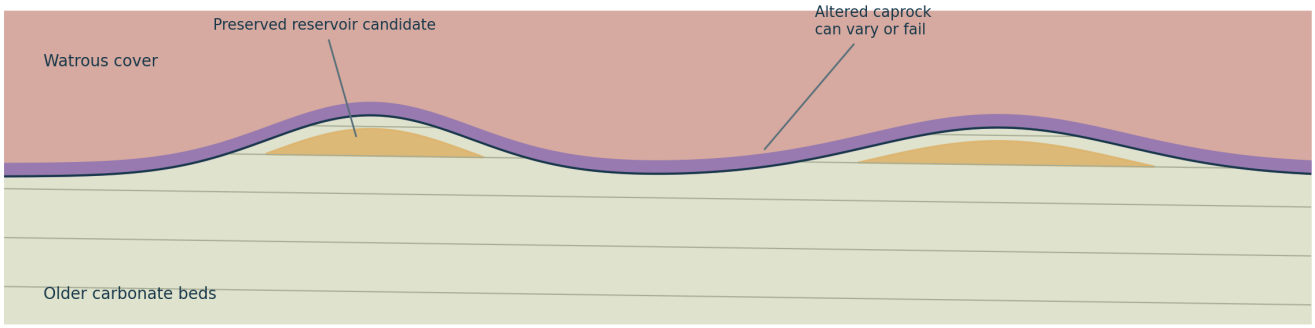
If the control shows...	Look for...	What would weaken the prediction?
Restricted muddy carbonate	Changes in fossil diversity, lamination, bioturbation and evaporite association	The same features reflect burial alteration, or correlations cross a sequence boundary.
A proved grain shoal	Grain-supported crest/flank facies grading into muddy equivalents	No grain-fabric gradient, or present structure formed after deposition.
Porous dolostone beside tight limestone	The replacement front and its relation to permeability and oil/water data	Dolomite is equally tight, or the apparent edge is a saturation effect.

Use contemporary relief only where growth, onlap or thickness evidence demonstrates it. A modern structural high or a basement lineament alone cannot establish an Ordovician shoal. No precise shoreline azimuth or spacing between undiscovered pools is assigned here.

3. Parkman and Souris Valley: deposition plus preservation

3 PARKMAN | A pool can follow an erosional remnant

Conceptual present-day section after erosion and burial. This is not a paleoshoreline profile.



Test missing cycles, caprock and lateral/basal seals. An erosional edge does not locate the original coast.

The trap geometry can be younger than the reservoir

Miller's Parkman abstract describes erosional remnants at the Tilston subcrop [S17]. Bates & Kendall's local comparison adds a seal test: 4-34-8-33W1 has an alteration cap, while 12-16-9-33W1 records inferred anhydrite dissolution and oil entry into basal Watrous [S10]. These are constraints on retention; they do not orient the original carbonate shoreline.

Reconstruction: establish the original carbonate cycles; identify internal erosion separately from sub-Mesozoic truncation; reconstruct surviving beds below the unconformity; then map alteration, cover and oil/water evidence. A nearby isolated pool could occupy a surviving remnant of the same broader depositional body.

Distinguish the two Souris Valley explanations

Explanation	Predicted observation	Best discriminating section
Depositional transition into muddy facies	Time-equivalent beds survive while texture and depositional structures change	Flatten on a valid time marker and follow the entire cycle.
Removal of a formerly grainier interval	Upper cycles disappear beneath a truncation surface	Map preserved thickness and termination of internal markers.
Local mound development	Stratigraphic thickening plus mound-core/flank fabrics	Tie core, adjacent wells and seismic; test for later cement occlusion.

Nickel & Kent describe a carbonate bank, south-dipping muddy clinoforms and local Waulsortian mounds [S12]. Sereda's thesis contains actual mound textures east of Parkman [S14]. These support a regional mound hypothesis, not a continuous reef belt through Wawota.

Lake's alternative preservation model places its proposed fairway from Northgate to South Fillmore, about 60 km downdip of the Souris Valley subcrop [S13]. Its displayed Daly cores are Manitoba analogues. This is a meaningful refinement: it does not substantiate a northern preserved-shoal corridor to Indian Head.

4. Diagnostic observations and interpretation tests

The following are analyst criteria for comparing hypotheses. Use assemblages of observations, appropriate stratigraphic context and independent fluid evidence. No single curve, fossil or sedimentary structure uniquely establishes an environment.

Candidate setting	Core / sample discriminators	Log and geometric support
Wave-worked shoreface	Upward grain-size/energy changes; wave or combined-flow structures; marine biota; laterally organized sand	Potential upward cleaning; appropriate lateral facies transition. An isolated funnel-shaped GR curve is insufficient.
Estuary / tidal channel	Scours, lags, reactivation surfaces, paired mud drapes or bidirectional structures; brackish assemblage	Stacked variable fills, confined geometry, abrupt bases. Core is needed to distinguish fluvial channels and tidal sand.
Lagoon / sheltered flat	Mud retention, stressed or restricted fauna, microbial textures; tidal structures or repeated exposure if preserved	Heterolithic or quiet-water interval; contrast with coeval open-water facies. A lagoon does not prove a sandy barrier.
Carbonate grain shoal	Grain-supported ooid/bioclast fabric, sorting, abrasion and current structures; distinction from transported storm layers	Low GR and porosity alone cannot diagnose a shoal. Require core-tied geometry and petrophysics.
Reef / microbial buildup	In-place binding/framework, growth fabric, local depositional relief and flanking sediments	Localized thickness and depositional architecture. Coral fragments, boundstone name or current closure alone do not locate a reef.
Waulsortian mud mound	Characteristic mud/skeletal/cement fabric and mound-flank relations; assess early marine spar	Localized relief within the proper Souris Valley interval. Do not treat it as a shoreline coral reef.
Diagenetic pore body	Equivalent precursor texture but contrasting dolomite, dissolution and calcite/anhydrite cement	PE/mineralogy and porosity changes without corresponding depositional facies change; permeability and pressure are essential.

What the logs can resolve

Interpret GR, PE, density-neutron, sonic and resistivity jointly, using the stated matrix scale, borehole condition and fluid properties. High resistivity in dense anhydrite can be a seal response. Carbonate GR can remain low across contrasting facies. Effective porosity, permeability and saturation require calibration; no new numerical saturation or reserve estimate has been derived from the published images.

The Tyvan reference panel has relative vertical scale but lacks absolute depth ticks suitable for digitizing a full petrophysical dataset. Published interpolations between wells are hypotheses about continuity, not independent observations [S1].

5. Selected published well evidence

Depths below reproduce the cited publications in metres. They are not corrected to a uniform log datum. Full official IDs, coordinate matches and discrepancies are retained in the companion files.

Well / area	Evidence to inspect	Source
Tyvan 10-8-13-13W2	Published wireline suite and interpreted facies; relative scale only	S1 Fig. 5
Chapleau 2-23-14-12W2	Microbial fabric, 2115.2 m	S1 Fig. 6
Montmartre 8-21-13-11W2	Water-saturated limestone/dolostone comparison, 2163.1-2167.05 m	S1 Fig. 9
Chapleau 1-33-14-12W2	Graphic core 2088-2108 m; DST annotation	S3 PDF 5-6
Wapella 6-2-15-1W2	Moosomin A1 cross-strata, 739.3-743.6 m	S6 Photo 18
Wapella 12A-34-14-1W2	Moosomin A2 ripples, about 712.3 m	S6 Photo 21
North Wapella 16A-14-15-1W2	Moosomin B mud drapes, about 678.6 m; event 102	S6 Photo 32
Red Jacket 2-4-14-32W1	Moosomin B basal lag/contact, about 669.8 m	S6 Photo 33
W Wapella 16-33-14-2W2	Dina core description; Cummings and Vanguard context	S9 A-7/A-8
Parkman 4-34-8-33W1 and 12-16-9-33W1	Comparative caprock panels; variable retention	S10 Fig. 2
5-7-9-30W1, east of Parkman	Souris Valley mound petrography, 922.3-929.8 m	S14 Plate 8
Wawota 13-29-12-33W1 and 13-30-11-33W1	Analyzed-core inventory only; original target/test identity still required	S15

Important separation

A sample inventory is a catalogue, not a core image or laboratory result. A well assigned to a Red River pool may contain a shallower core from another formation. The 31-well priority inventory and seven-well Jurassic addendum retain such uncertainties instead of forcing every specimen into the producing interval.

The Chapleau 2010 DST notation uses metres of recovered fluid column. It must not be reinterpreted as a flow rate, net pay or oil-column thickness in the formation.

6. From these models to a defensible local prospect map

A. Correlate an age-controlled slice

For each pool, choose the actual producing bed and bracket it with defensible surfaces. Build one section along the candidate depositional feature and one across it. Compare a stratigraphic flattening with a TVDss structural section. Preserve MD, TVD, KB/GL elevation, core shifts and event/sidetrack identities. A single regional top can hide internal erosion or correlate non-contemporaneous sands.

B. Record independent attributes

At each well record original texture, grain types, fossils/ichnology, bedding, exposure/scour surfaces, matrix mineralogy, cement, pore type, measured permeability, fluids and test quality. Keep unobserved fields blank. Store uncertainty separately from the interpretation. Use thin sections to determine whether a porous interval is a grainstone, a replaced muddy rock or a cement-leached interval.

C. Restore geology in the right order

Map depositional thickness and facies before adding later structure. Then identify removal, compaction, salt-related movement, dolomitization, cementation and fractures. Map seal and charge last as independent requirements. A restored shoreline should follow coeval environmental gradients; it must not be traced along a younger erosional zero edge.

D. Attempt to reject each exploration prediction

Proposed extension	Minimum evidence before treating it as a prospect
Wapella seaward sand	Correct age, actual sand geometry, reservoir-quality pores, lateral/top seal and oil access.
Red River extension	Core-calibrated connected pore body plus closure or sealing termination; fluid evidence beyond staining.
Parkman-like remnant	Surviving reservoir cycle, demonstrable caprock and lateral/basal retention, coherent structural/fluid geometry.
Souris Valley mound	Mound architecture independently tied to core, a connected pore system and an effective trap.

Current limits and highest-value controls

Raw LAS, original DST reports, pressure and water data, completion histories and seismic would resolve the remaining local geometry. Core candidates near Wawota and the published Jurassic western controls are concrete next records. Bemersyde/Kendal, Kennedy/Wawota and the Indian Head end remain lower-confidence extrapolations where equivalent local facies panels were not found.

This atlas is a completed public-data geological screening. It does not establish that a specific unleased parcel, closed structure or commercially producible accumulation exists.

References and companion-data guide

All links refer to public primary sources. Some repositories are intermittently unavailable to automated readers; the cited documents were obtained through their public download routes where indicated. The accompanying ZIP contains derived selections and source links, not redistributed full published reports.

S1 Thomas, A.D. & Qing, H. (2025). Lithofacies Analysis and Petroleum Reservoir Characteristics of the Ordovician Red River Formation. SGS GR2025-9. See Figs 5-15 and Table 1. Open source

S2 Kreis, L.K. & Kent, D.M. (2000). Basement controls on Red River sedimentation and hydrocarbon production in southeastern Saskatchewan. See especially Fig. 16 and discussion. Open source

S3 Kent, D.M. & Lake, J. (2010). How to Log Core. GeoCanada core workshop. Chapleau Lake graphic core and photographs, PDF pp. 5-6. Open source

S4 Pratt, B.R. & Haidl, F.M. (2008). Microbial patch reefs in Upper Ordovician Red River strata, Williston Basin, Saskatchewan: Signal of heating in a deteriorating epeiric sea. Author-uploaded full text. Open source

S5 Pak, R. & Pemberton, S.G. (2003). Ichnology of the Yeoman Formation. SGS Summary of Investigations, Paper A-3. Open source

S6 Kreis, L.K. (1991). Stratigraphy of the Jurassic System in the Wapella-Moosomin Area, Southeastern Saskatchewan. Report 217. See pp. 33-39, Fig. 24 and Photos 17-40. Official ZIP package. Open source

S7 Kreis, L.K. (1987). Regional stratigraphic correlation and lithology of the Jurassic, Wapella-Moosomin area. Includes detailed core descriptions. Open source

S8 Christopher, J.E. (2003). Jura-Cretaceous Success Formation and Lower Cretaceous Mannville Group of Saskatchewan. Report 223. Regional facies, Wapella setting and exploration discussion. Open source

S9 Christopher, J.E. (2003). Report 223, Appendix A. Detailed core descriptions, especially TW Sohio W Wapella, pp. A-7 to A-8; Earlswood, Broadview and Oakshella controls. Open source

Companion files

priority_wells.csv / JSON: 31 selected bores, original identifiers, coordinates, raw core intervals and caveats.
jurassic_published_wells_addendum.csv / JSON: seven historical-to-modern identity matches.
priority_core_records.csv: selected raw inventory records; overlapping slab/whole records are retained.
priority_archived_thin_section_records.csv: archived specimen records, kept separate from study-generated sections.
sources.json: reference index.
reproduce/build_depositional_atlas.py: figure/report-generation code.

References, continued

S10 Bates, G. & Kendall, A.C. (2008). Understanding the origin of the sub-unconformity diagenetic caprock. GeoConvention, pp. 809-813. Parkman panel, Fig. 2. Open source

S11 Bates, G.S., Kendall, A.C. & Millar, I.L. (2008). Determining the origin of karst fill at the sub-Mesozoic unconformity. SGS Paper A-6. Open source

S12 Nickel, E. & Kent, D.M. (2008). Facies relationships and hydrocarbon potential in the Souris Valley Beds. GeoConvention core-display abstract. Open source

S13 Lake, J. (2023). Upside potential of the basal Mississippian Souris Valley Beds/Lodgepole Formation. SGS core-talk notice and abstract, 24 May. Hypothesis with Manitoba analogues. Open source

S14 Sereda, R.D. (1990). Aspects of sedimentology, stratigraphy, and diagenesis of Lower Mississippian shelf margin carbonates: Souris Valley-Lodgepole interval of Williston Basin. University of Saskatchewan thesis. Plates 4, 8 and Fig. 16. Open source

S15 Government of Saskatchewan. GeoAtlas petroleum well headers and drill-core, cuttings and thin-section inventories. Extracts inspected 22 October 2026; raw records retained in companion data. Open source

S16 Government of Saskatchewan. GeoAtlas well-document availability notice. Public production configuration states that document downloading is disabled; requests may incur cost. Open source

S17 Miller (1972). Parkman Field, Williston Basin, Saskatchewan: Case Histories. Public abstract only; subscription full paper not inspected. Open source

Data reconciliation retained

Examples include an out-of-inventory photograph depth in the Chapleau 1-27 caption; slightly different reported and archived core bases; distinct 101/102 events at North Wapella; and a Bemersyde shallow core that must not be assigned to Red River from the pool name. These are recorded as unresolved provenance issues, not silently corrected.

Scope of confidence

Confidence is strongest for the identity of photographed or described beds and for the existence of different reservoir/trap mechanisms. It is lower for interpolation between wells, the position of a hypothesized barrier, complete diagenetic event timing and migration paths. It is presently insufficient for a parcel-scale drilling recommendation anywhere beyond a specifically demonstrated trap.