

Sedimentology and Stratigraphy of the Dinosaur Park Formation in Southwestern Saskatchewan, Canada.

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Introduction

A regional investigation of the geology and paleontology of the Belly River Group in Southwestern Saskatchewan and Southeastern Alberta is in progress. The objectives are to: 1) Place the Belly River Group into paleoenvironmental context utilizing facies models and depositional environments; 2) Establish a sequence stratigraphic framework for the Group and its associated interfingering formations. Microvertebrate sites of near equivalent age to Dinosaur Provincial Park have been discovered, and are being processed for paleoecological study. This material is significant, as it represent the easternmost expression of terrestrial ecosystems in this region before final transgression of the Bearpaw Sea 77 million years ago.

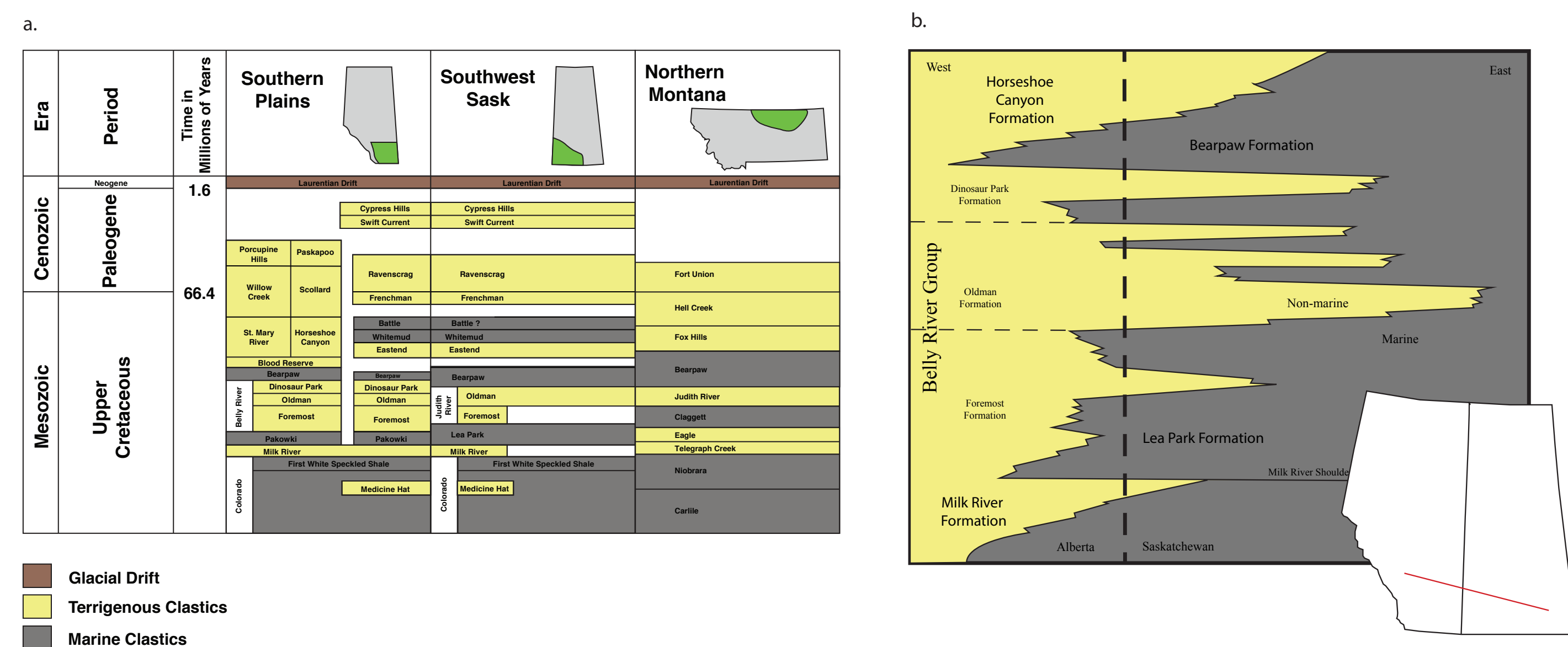


Figure 1. a. Geological formations and nomenclature throughout southeastern Alberta and southwestern Saskatchewan of the late Cretaceous. b. Interfingering of terrestrial and marine sediment shown in a cross sectional diagram through Alberta into Saskatchewan.

Geological Framework

The Belly River Group comprises an eastward thinning marginal marine to non-marine Campanian clastic succession in the Western Canadian Sedimentary Basin. Three formations are formally recognized in the western Canadian Plains. In ascending order, these are the Foremost (marginal marine to non-marine; FF), Oldman (alluvial to marginal marine; OF), and the Dinosaur Park (alluvial, estuarine, and marginal marine; DPF) formations. The Dinosaur Park Formation is a distal, primarily transgressive third-order succession, dominated by stacked fluvial sands and siltstones in the lower portion, and muds, silts, and coals in the upper unit. The DPF is overlain by marine shales of the Bearpaw Formation (BP).

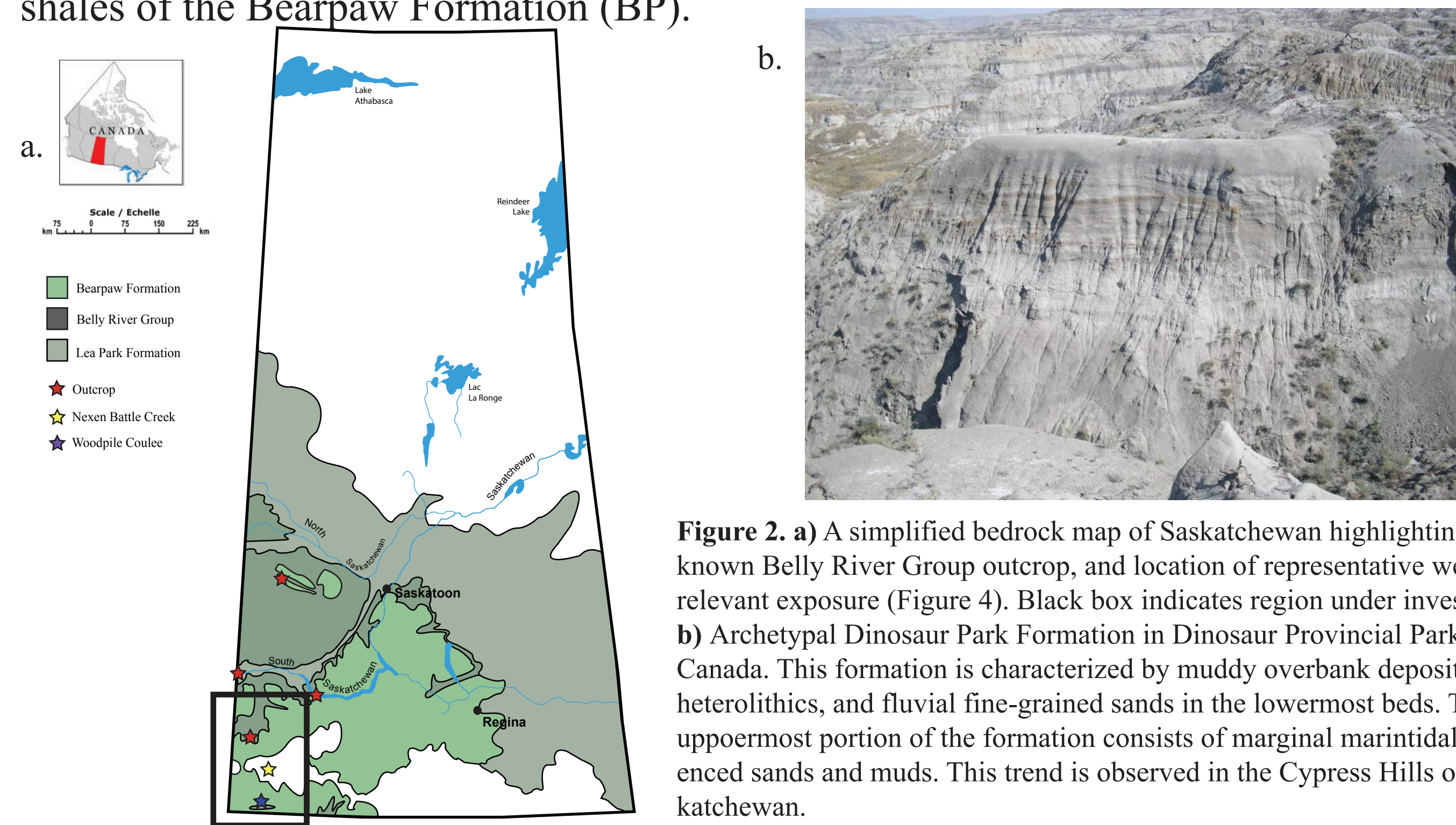


Figure 2. a) A simplified bedrock map of Saskatchewan highlighting all known Belly River Group outcrop, and location of representative well log and relevant exposure (Figure 4). b) Archetypal Dinosaur Park Formation in Dinosaur Provincial Park, Alberta, Canada. This formation is characterized by muddy overbank deposits, inclined heterolithic, and fluvial fine-grained sands in the lowermost beds. The uppermost portion of the formation consists of marginal maritidally influenced sands and muds. This trend is observed in the Cypress Hills of Saskatchewan.

Methods

Picks are being made on geophysical well logs using a series of closely spaced, overlapping cross sections. On average, one well per township is picked, however, this is not always possible due to lack of available well data. To date, several hundred picks have been made. Well log analysis has determined that it is possible to pick tops for all three formations in the Group. Outcrop and core data are being integrated with facies models to gain paleoenvironmental insight. Comparison with outcrop and subsurface data from west-central Saskatchewan and southern Alberta is ongoing.

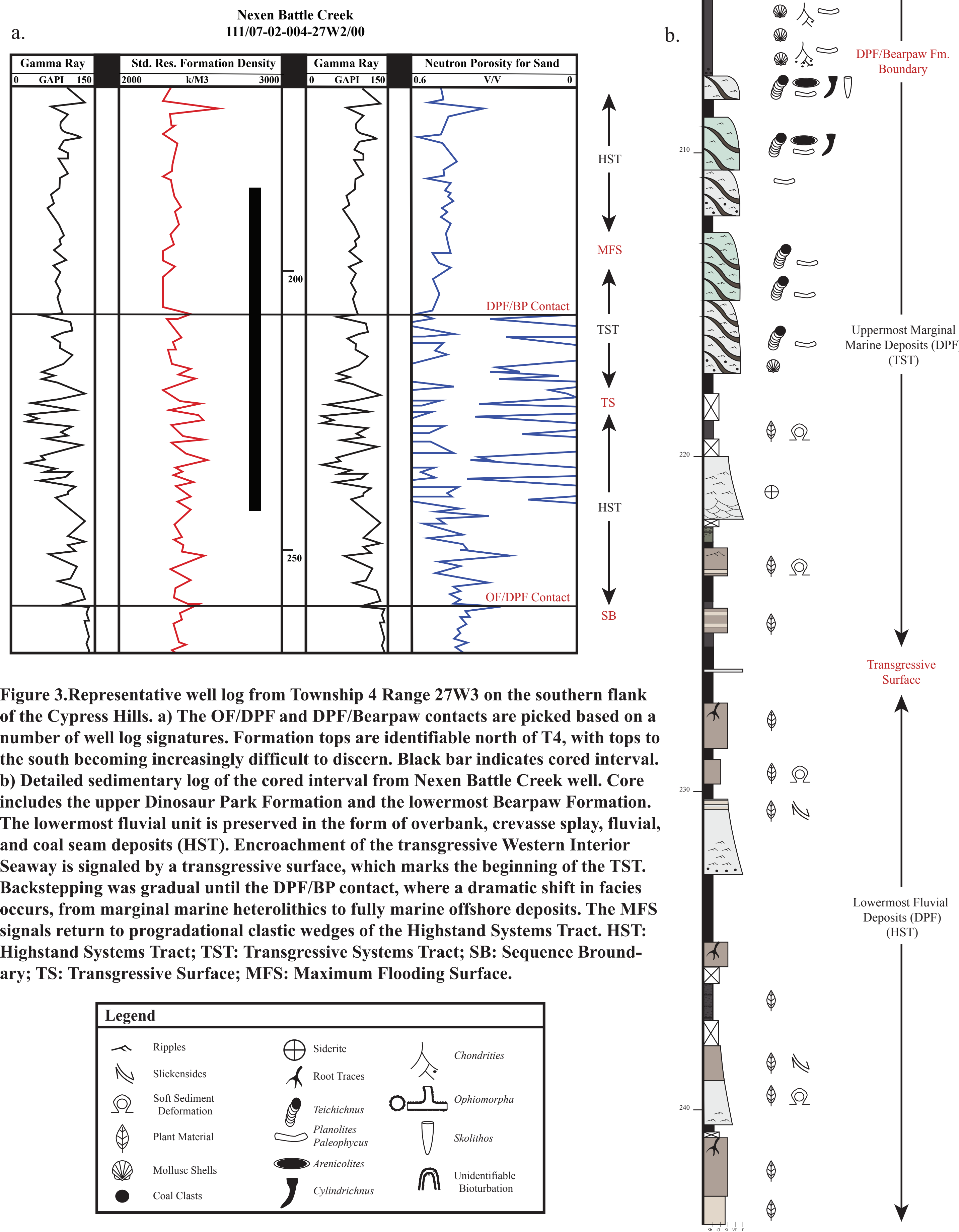


Figure 3. Representative well log from Township 4 Range 27W3 on the southern flank of the Cypress Hills. a) The OF/DPF and DPF/Bearpaw contacts are picked based on a number of well log signatures. Formation tops are identifiable north of T4, with tops to the south becoming increasingly difficult to discern. Black bar indicates cored interval. b) Detailed sedimentary log of the cored interval from Nexen Battle Creek well. Core includes the upper Dinosaur Park Formation and the lowermost Bearpaw Formation. The lowermost fluvial unit is preserved in the form of overbank, crevasse splay, fluvial, and coal seam deposits (HST). Encroachment of the transgressive Western Interior Seaway is signaled by a transgressive surface, which marks the beginning of the TST. Backstepping was gradual until the DPF/BP contact, where a dramatic shift in facies occurs, from marginal marine heterolithic to fully marine offshore deposits. The MFS signals return to progradational clastic wedges of the Highstand Systems Tract. HST: Highstand Systems Tract; TST: Transgressive Systems Tract; SB: Sequence Boundary; TS: Transgressive Surface; MFS: Maximum Flooding Surface.

Legend		
Ripples	Siderite	Chondrites
Slickensides	Root Traces	Ophiomorpha
Soft Sediment Deformation	Teichichnus	Skolithos
Plant Material	Planolites	Unidentifiable Bioturbation
Mollusc Shells	Arenicolites	
Coal Clasts	Cylindrichnus	

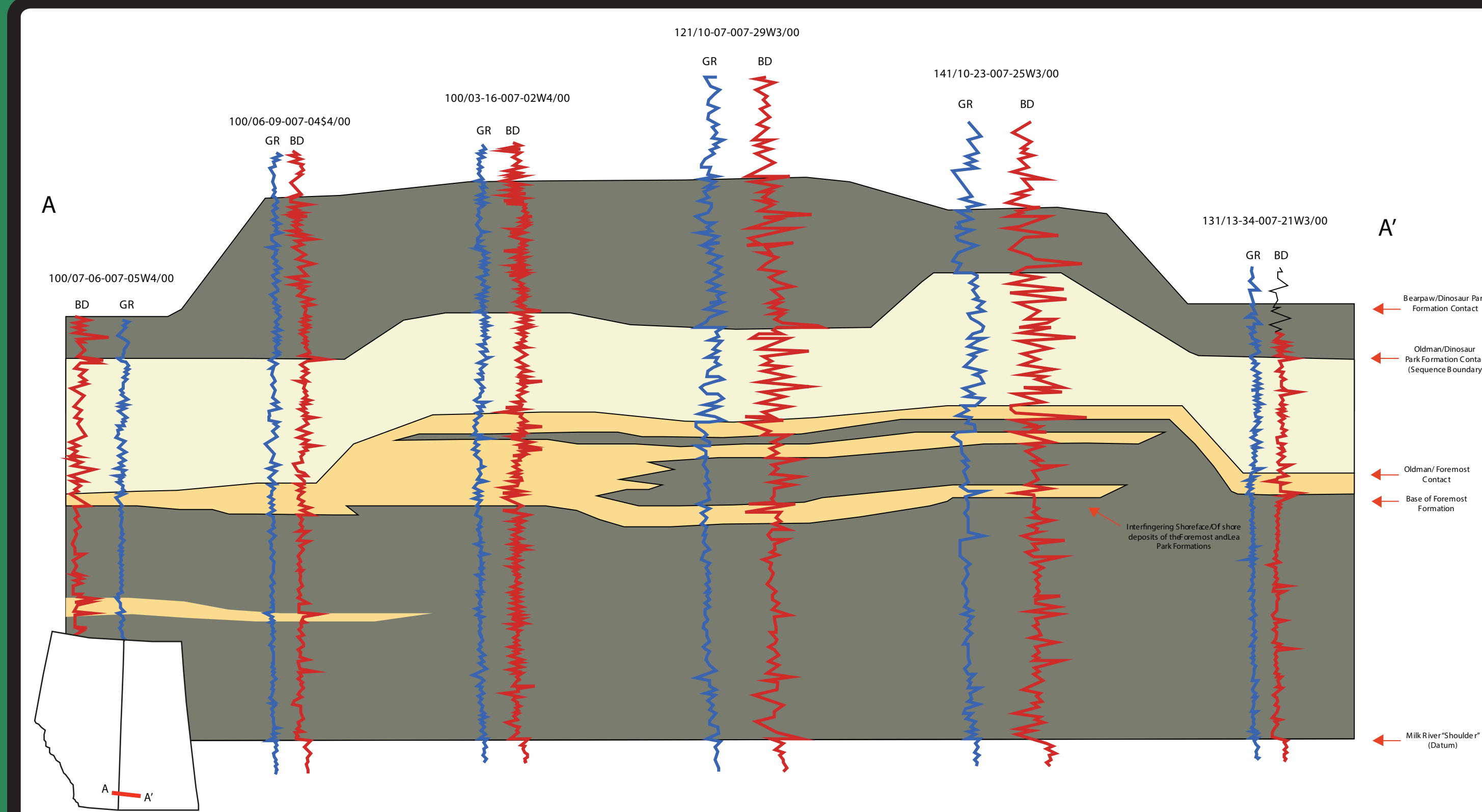


Figure 4. Dip section through Township 7, Range 7W4 to 21W3. West to east dip section showing the contacts between different formations of the Belly River Group. Note the interfingering coastal plain and shoreface deposits of the Foremost Formation. The Oldman Formation thins to the east, but thickens to the south. In Montana, the OF and DPF are grouped into a single unit referred to as the Judith River Formation. Contact between the OF/DPF is a sequence boundary, with the DPF becoming increasingly mud dominated due to encroachment of the Bearpaw Sea. Plunging observed between the last two wells is due to regional deformation caused by the Coburg Syncline.

Bearpaw/Dinosaur Park Formation Transition

Tongues of the Dinosaur Park Formation diachronously interfinger with overlying Bearpaw Formation shales and sands. Core, trace fossil and outcrop data suggest marginal marine conditions were ubiquitous throughout the region before final transgression of the Bearpaw Sea. DPF/Bearpaw transition outcrops in the southern Cypress Hills records a coquina (pelycopods, *Crassostrea*, *Anomia*, and various gastropods) lag deposit separating the formations. This is absent in outcrops recording the transition in the north flank of the Hills near Maple Creek, suggesting regional transgressive erosion.



Figure 5. Core from 07-02-004-27W3. a) Photo taken directly below Bearpaw/DPF contact. Trace fossils and sedimentary structures suggest a marginal marine environment with brackish water. Coal seams and brackish water signatures commonly mark the transition to the overlying marine Bearpaw Formation in the Cypress Hills. Cy. *Cylindrichnus* P. *Planolites*; Pl. *Paleophycus*; Te. *Teichichnus*; Sk. *Skolithos*; Sy. *Syneresis* Cracks.

Conclusion and Future Directions

Outcrop, core, and geophysical well log data are successfully being combined to map the Belly River Group in the Cypress Hills region of Saskatchewan. This is the first time the group and all of its associated formations have been studied across western Saskatchewan. Though mapping these formations is possible, it becomes increasingly more difficult to do so south of Township 4. Further investigation is ongoing to determine why this may be.

An additional study is currently underway by the author focusing on the vertebrate paleontology of the Group throughout Saskatchewan. An intensive bulk sampling program is in place to acquire a statistically significant data set. Ichnofossils and vertebrate microfossils are being integrated with sedimentology and sequence stratigraphy to provide a comprehensive understanding of paleoenvironmental and paleoecological parameters in the the Dinosaur Park Formation of Saskatchewan.

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