

# **Regional Frasnian Stratigraphic Framework, Alberta Outcrop and Subsurface\***

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Search and Discovery Article #30346 (2014)\*\*

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Please refer to related articles, “Stratigraphic Architecture of Jasper Basin, North-Central Alberta Front Ranges,” [Search and Discovery Article #10620 \(2014\)](#), and “Stratigraphic Architecture of the Frasnian Cline Channel, Central Alberta Front Ranges,” [Search and Discovery Article #50986 \(2014\)](#) .

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## **Abstract**

The latest Givetian to Frasnian succession of Alberta, Canada comprises a second-order depositional sequence. This sequence is bounded by major, regionally correlatable unconformities. These surfaces have associated siliciclastic lowstand deposits, sourced from the Canadian Shield and the Peace River Arch Landmass. The bulk of the sequence consists of shallow water carbonates (reefs and reef complexes) and basin-filling carbonates and shales sourced from the east. A major marine, euxinic shale source rock, the Duvernay Formation, was deposited during the second-order maximum transgression. Maximum syndepositional relief in the basin, on the order of 200m, occurred at this time. Nine third-order depositional sequences make up the larger sequence, correlatable across the basin. An ancestral landmass, the West Alberta Ridge, extended southwest of the Peace River Arch, precluding deposition of the three oldest third-order sequences in the Rocky Mountain outcrops. Correlations from outcrop to basin suggest progressive onlap onto the Ridge, the bulk of which was transgressed by the sediments of the Woodbend Sequence One. This is corroborated by the presence of the transitions conodont zone in the outcrop belt and adjacent subsurface. The antecedent topography favoured the growth of carbonate build-ups in a northwest-southeast trend, intersected by major marine channels and embayments. The corresponding platform margins show different character, depending on paleogeography and stratigraphic position within the second order sequence. Several in-situ carbonate lowstands have been identified, notably at the base of the Woodbend Sequences One and Two, in the Cline Channel and on the

southern margin of the Jasper Basin. Similar platform margin styles and third-order sequence architecture are seen in the Alberta subsurface as in the outcrop belt. Sequence stratigraphic correlations are supported by biostratigraphic (conodont) data. Comparisons to Tertiary/Modern carbonate platforms, such as the Great Bahama Bank and the Upper Miocene platforms of the Balearic Islands, show similar patterns of margin development, segmentation of platforms and filling of marine channels. Contrasts include the much thinner Alberta Frasnian, deposited over a longer time, compared to the Bahamian/Balearic platforms.

### **References Cited**

Blakey, R., 2013, North American Paleogeographic Maps: Web accessed July 11, 2014, <http://cpgeosystems.com/namD360.jpg>.

Potma, K.X., J.A.W. Weissenberger, P.K. Wong, and M.G. Gilhooly, 2001, Toward a sequence stratigraphic framework for the Frasnian of Alberta: Bulletin of Canadian Petroleum Geology, v. 49/1, p. 37–85.

# **REGIONAL FRASNIAN STRATIGRAPHIC FRAMEWORK, ALBERTA OUTCROP AND SUBSURFACE**



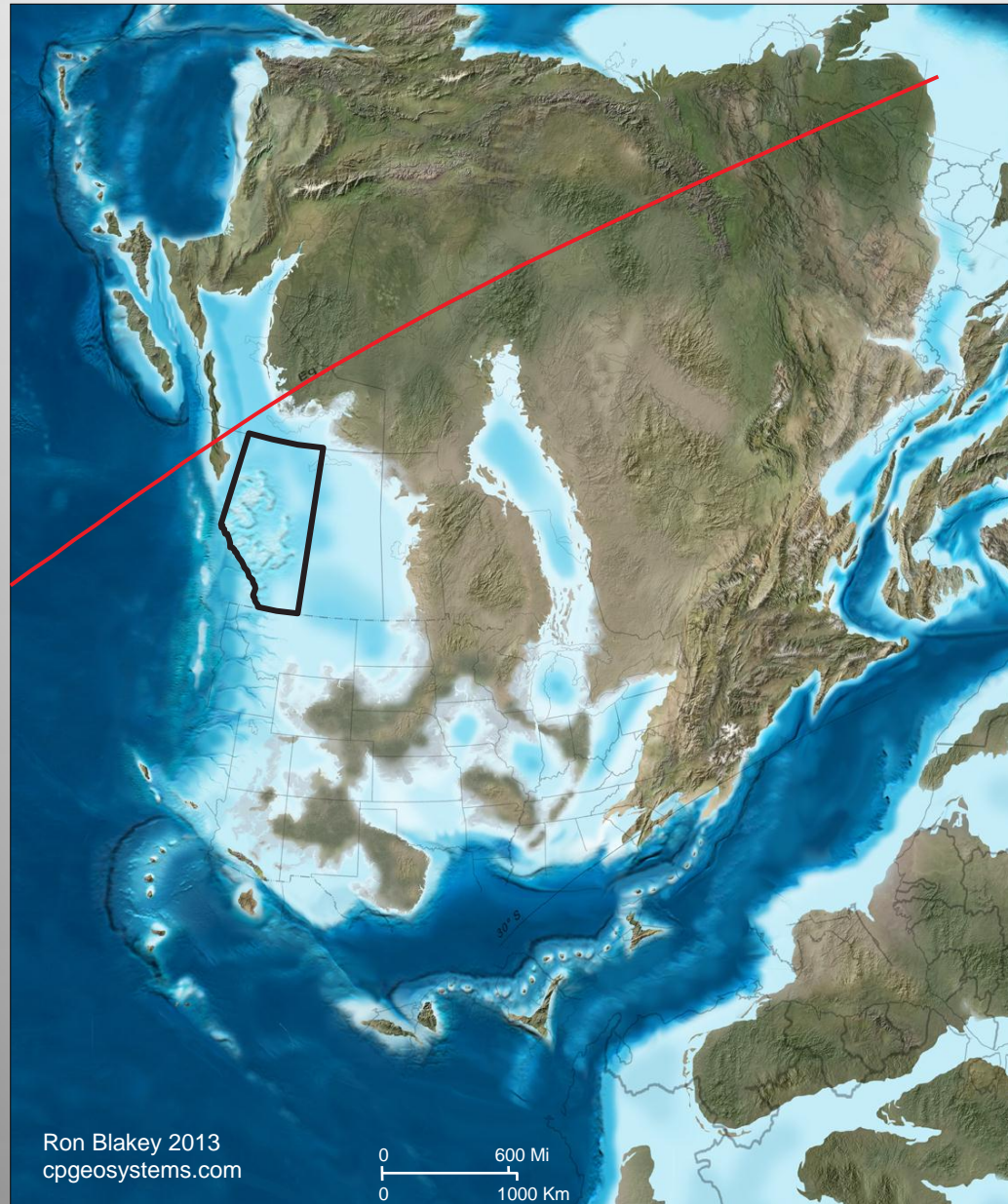
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J. Weissenberger  
K. Potma

April 2014

# Talk Outline

- Paleogeography, setting and economic significance
- Overview of a 2<sup>nd</sup> order Frasnian (late Givetian) depositional sequence
- Review of Western Canada Sedimentary Basin (WCSB) Frasnian facies and stratigraphic models
- Examples of outcrop to subsurface correlations
- Regional outcrop correlations
- Conclusions

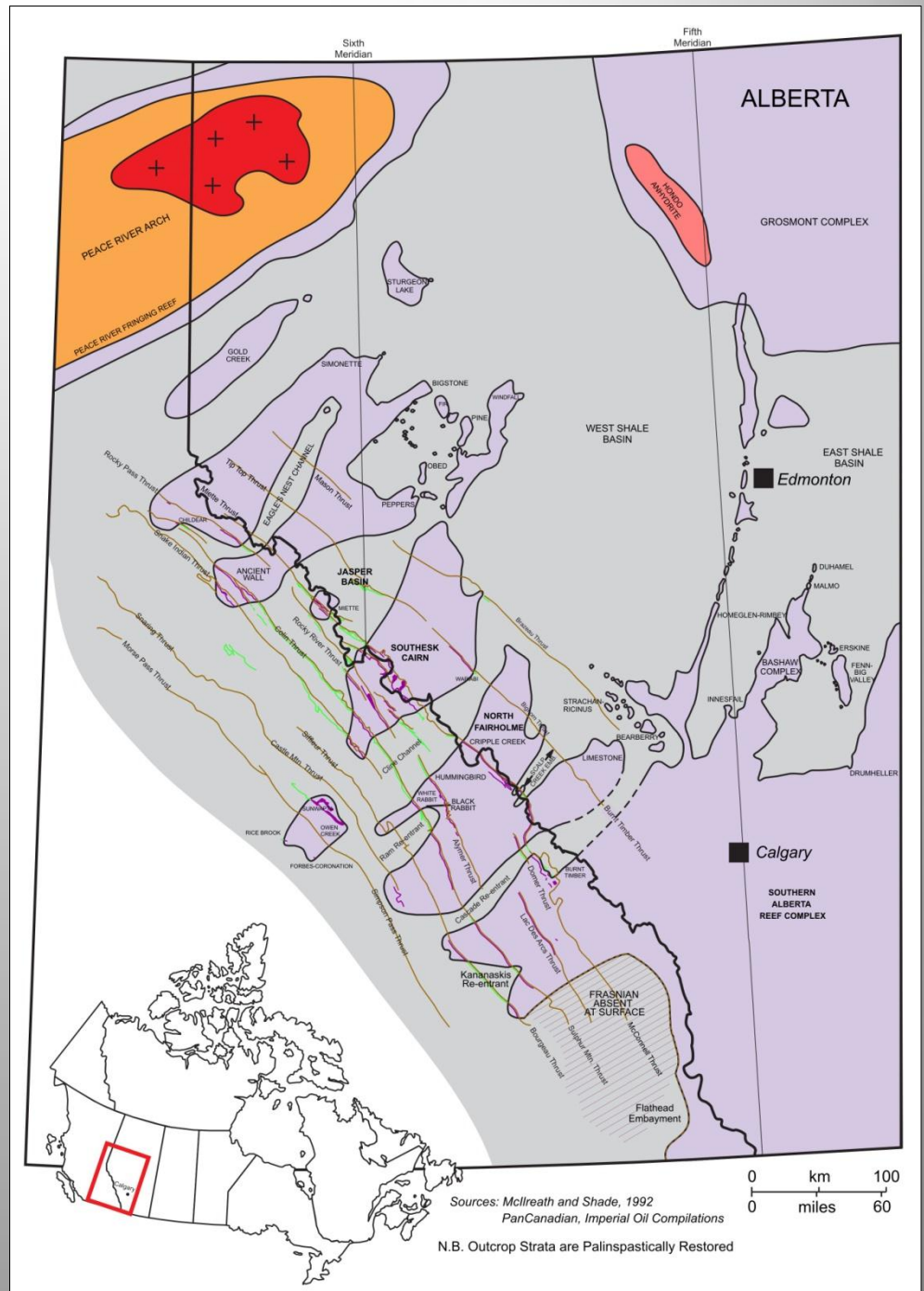
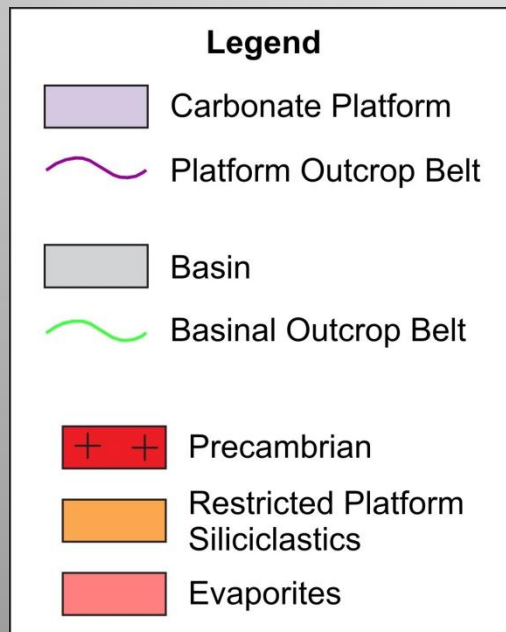
# Paleogeography, Late Devonian 375 Ma



# Paleogeography

## Late Leduc

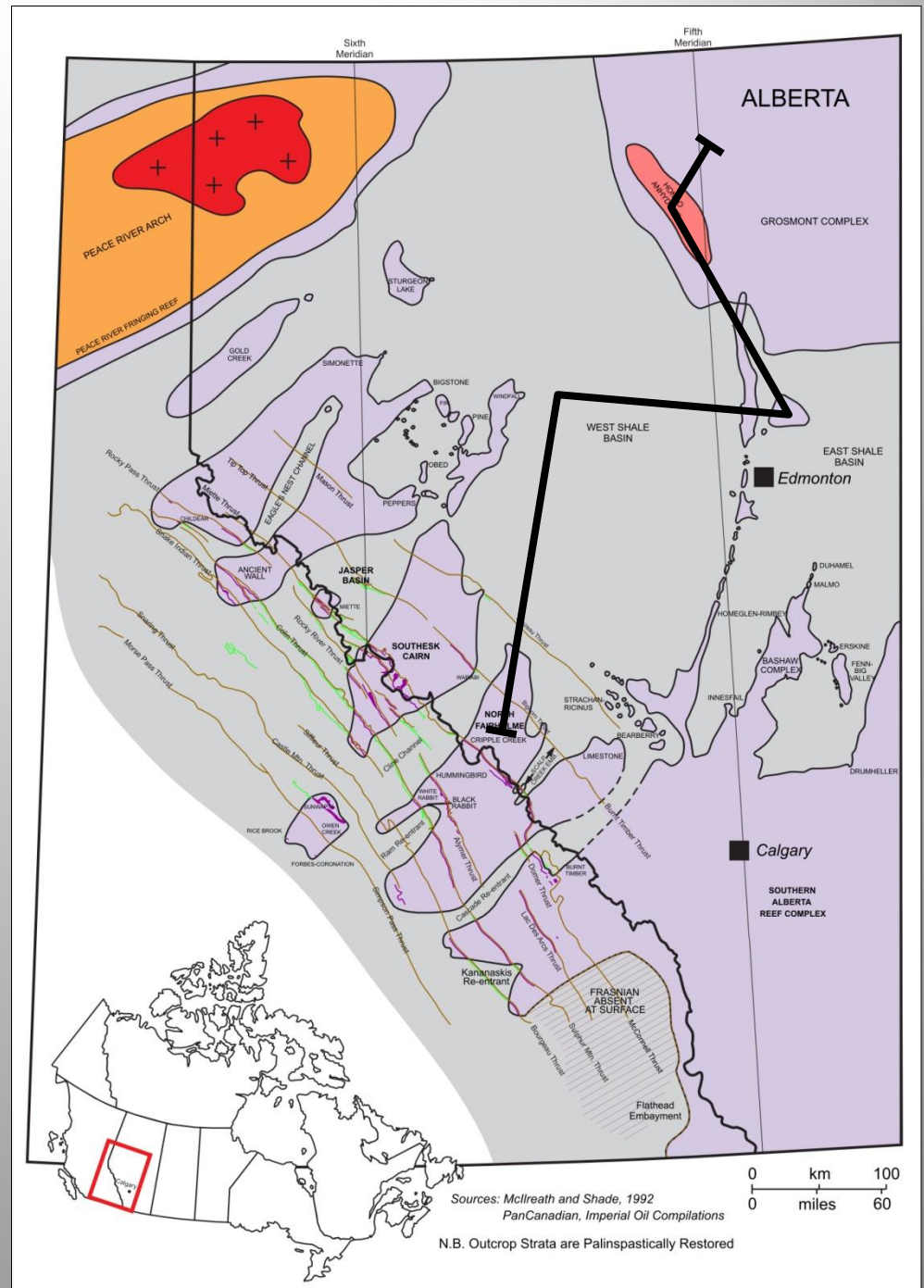
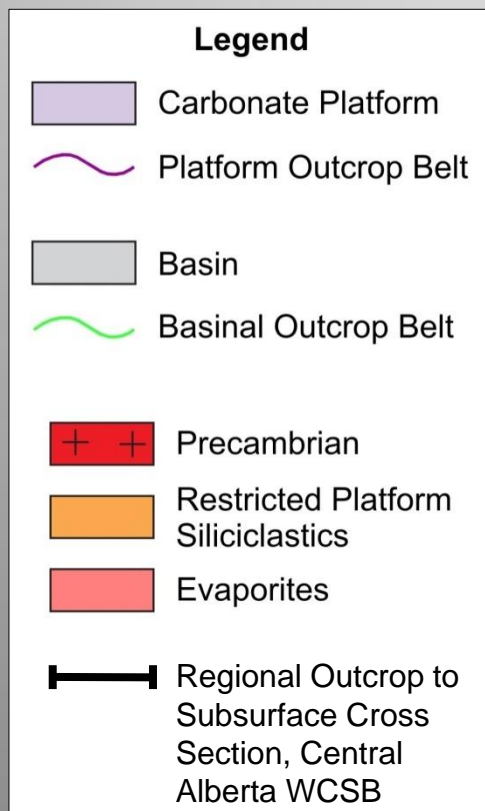
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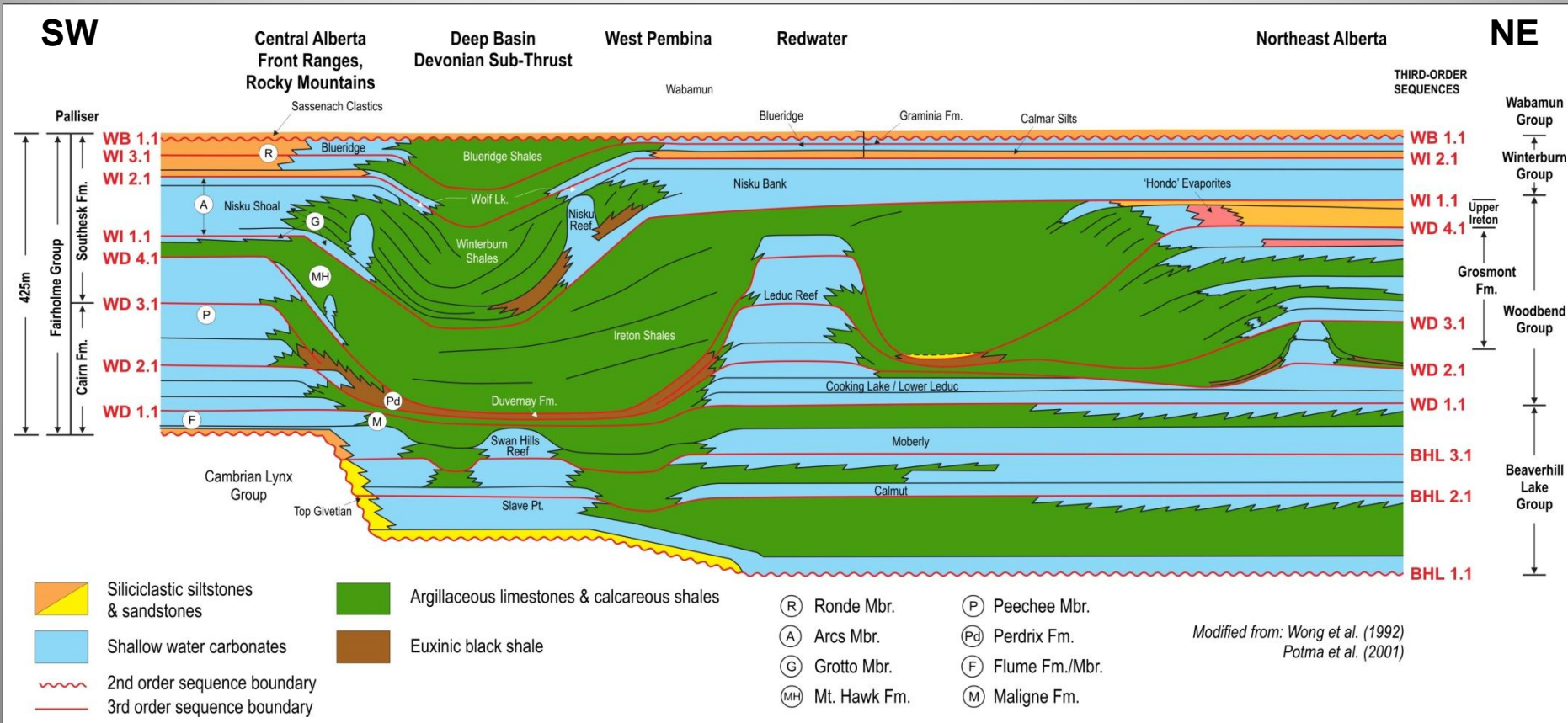
# Paleogeography

## Late Leduc

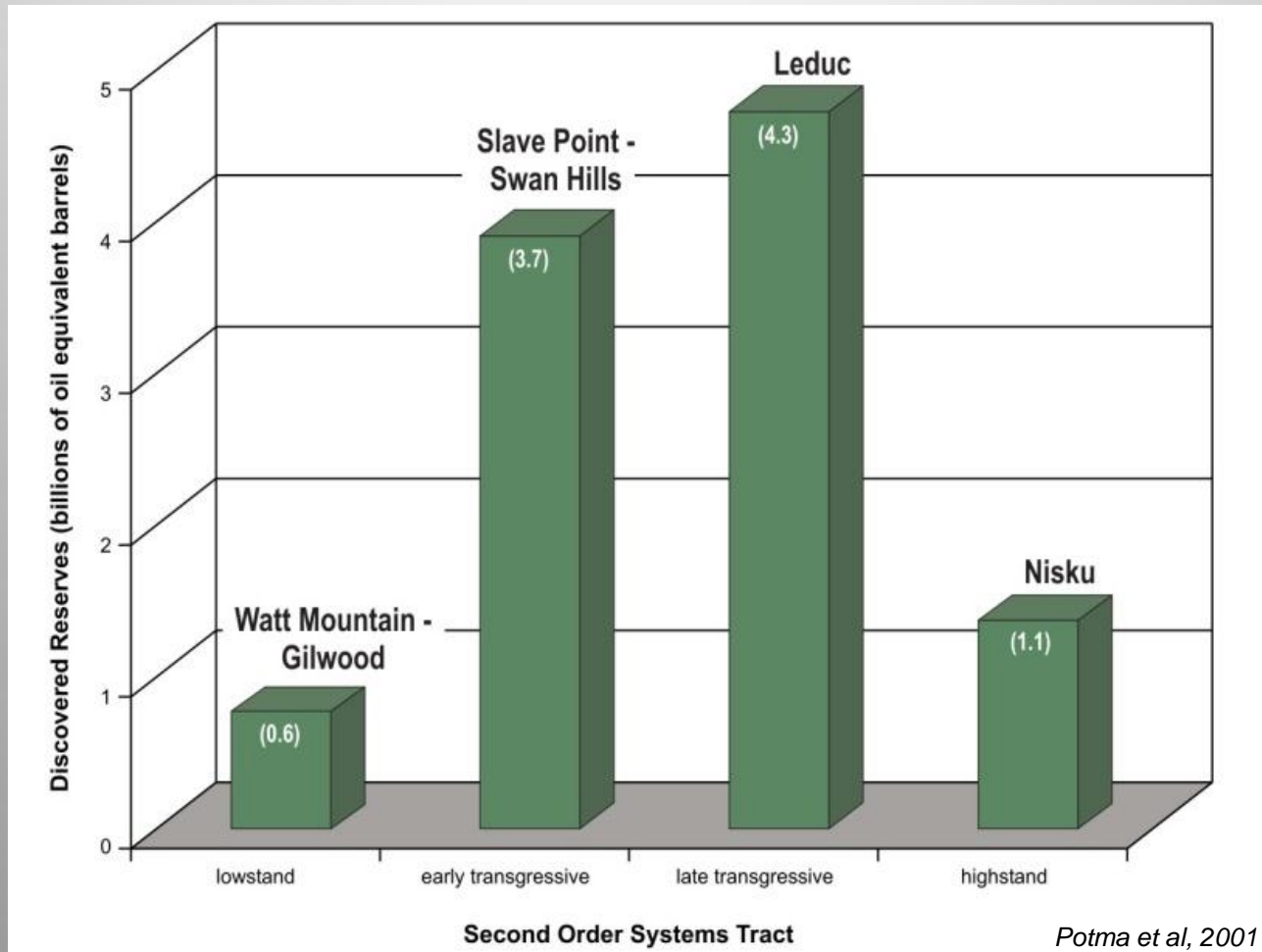
## Formation Time



# Regional Outcrop to Subsurface Cross Section, Central Alberta WCSB



# Conventional Reserves of the Late Givetian to Frasnian 2<sup>nd</sup> Order Depositional Sequence

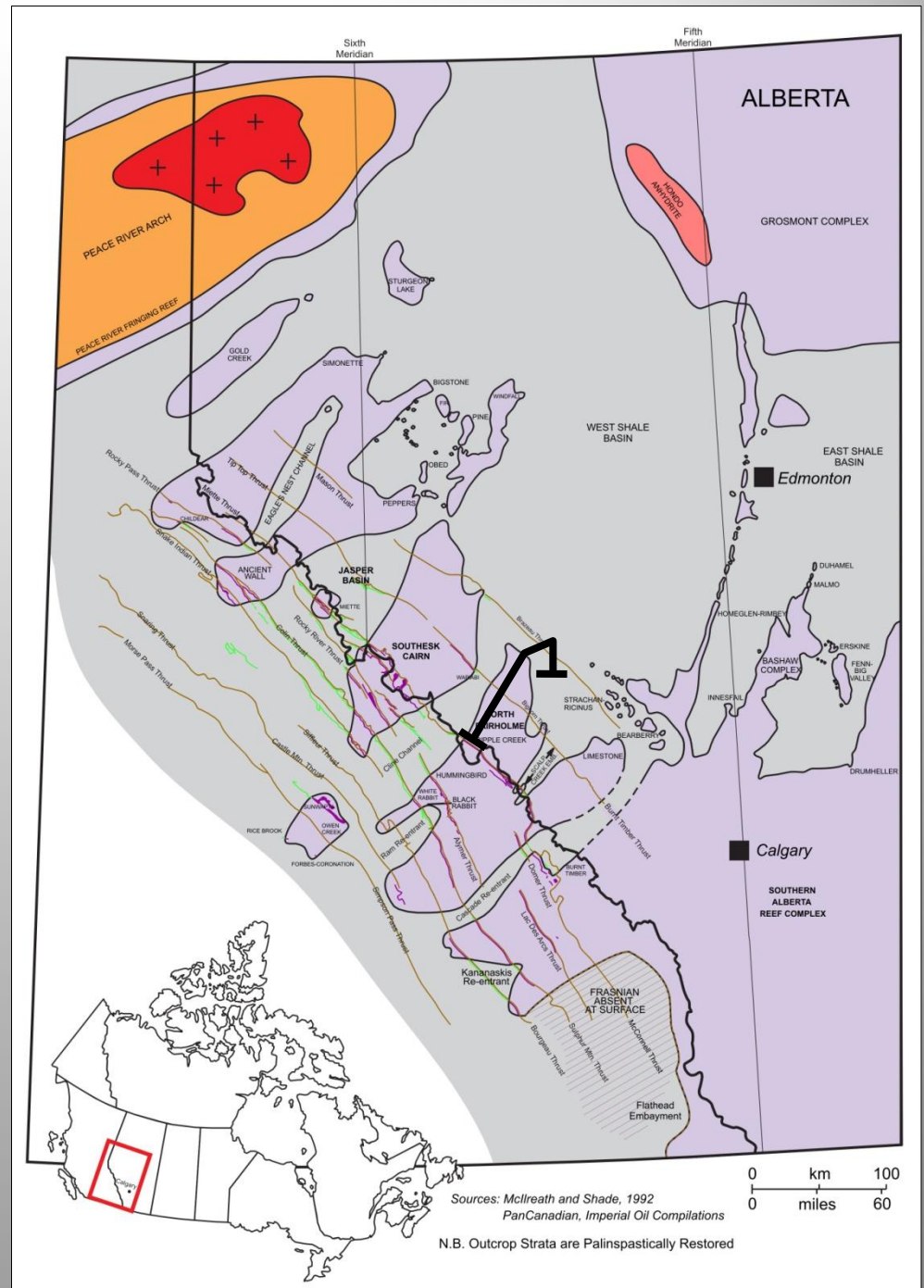
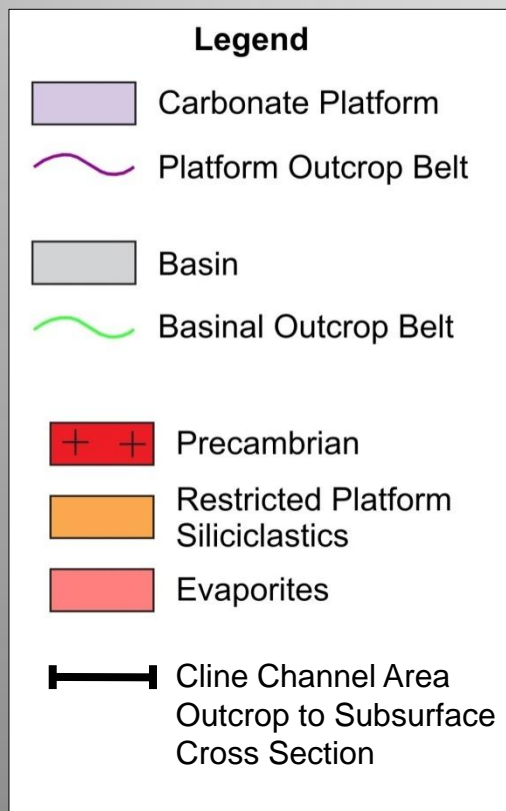


- Current exploration and resource development plays focussed on basinal mudrocks (Duvernay Fm) and subcrop heavy oil (Grosmont and Nisku Fm)

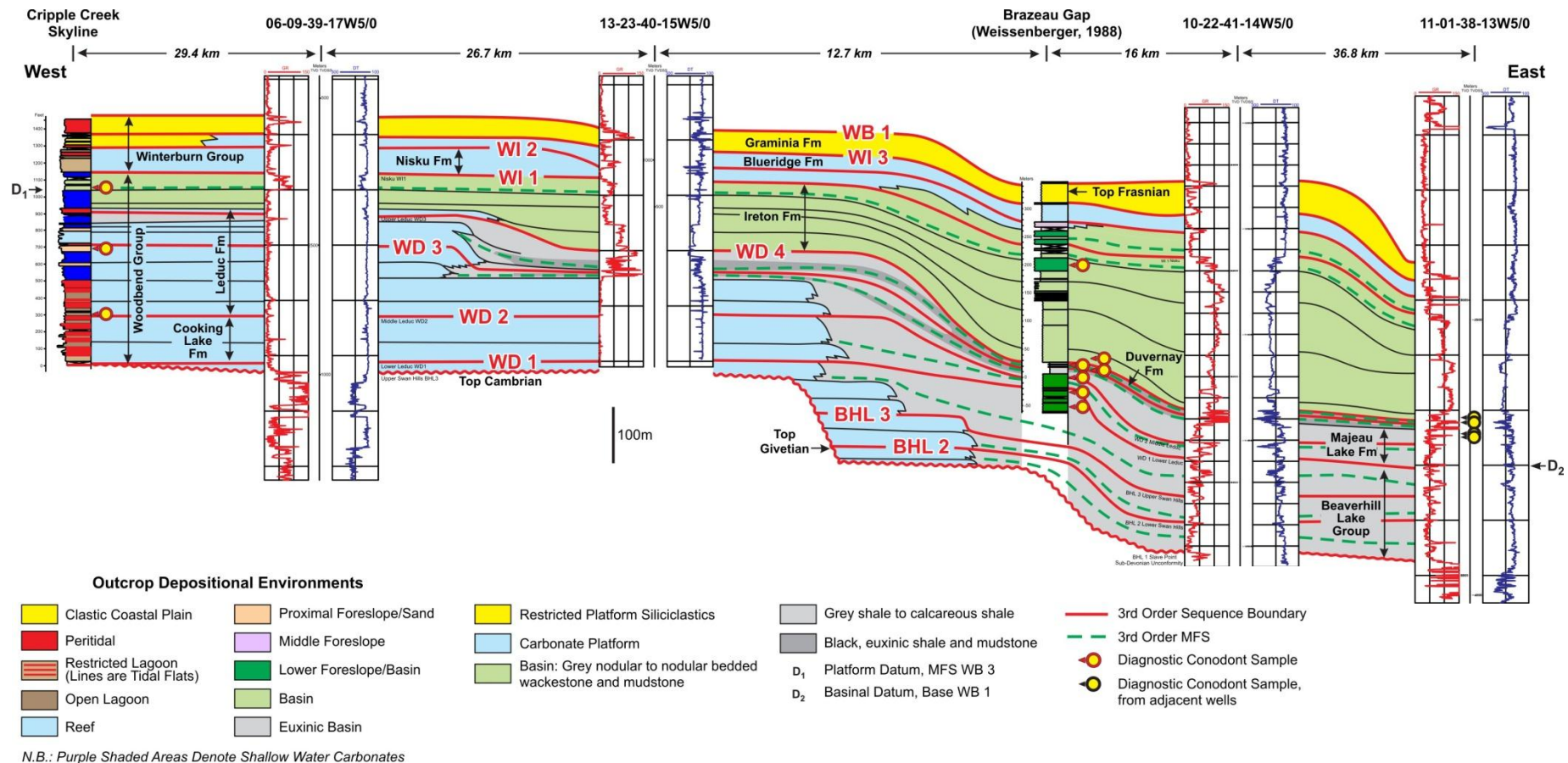
# Paleogeography

## Late Leduc

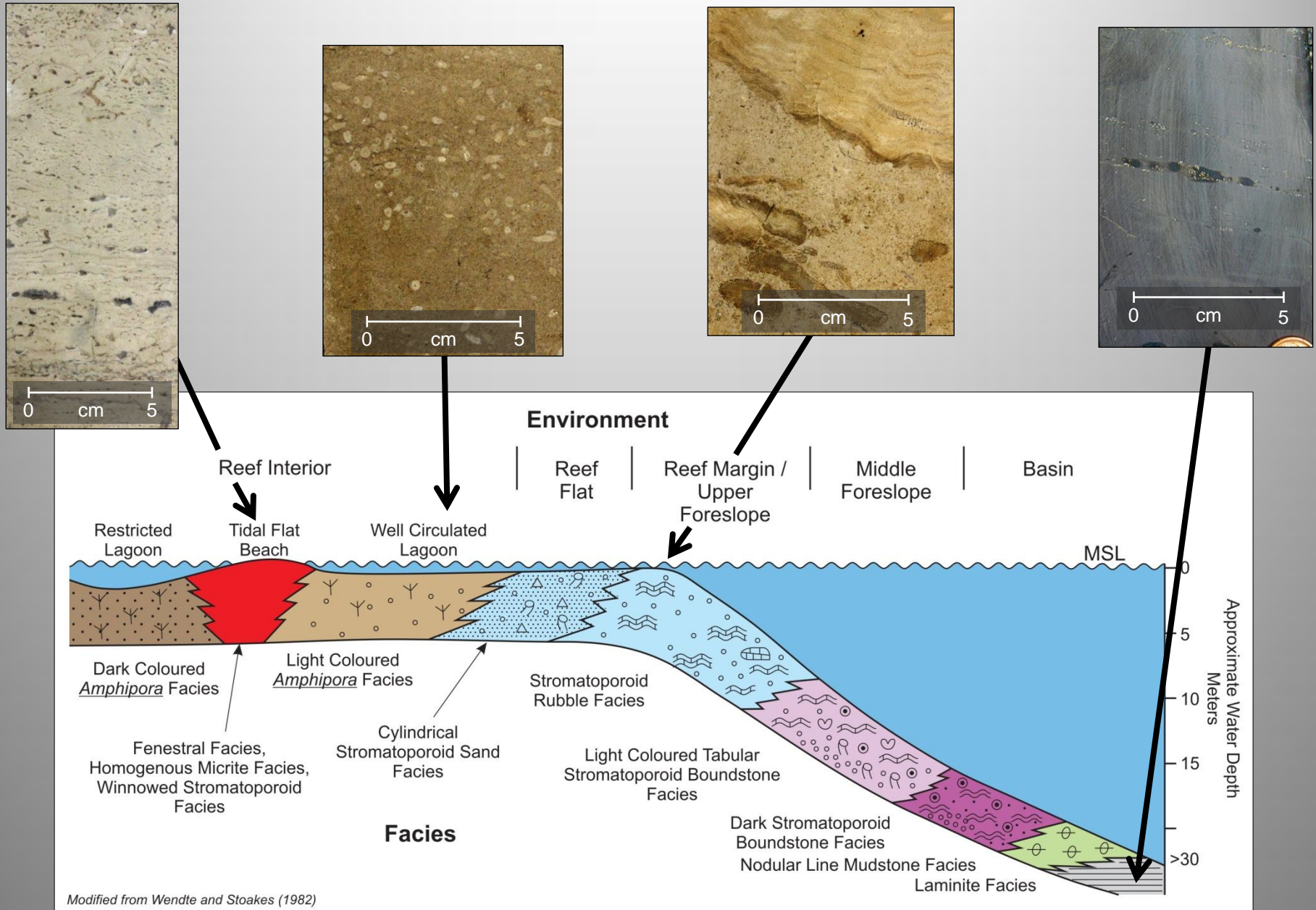
### Formation Time



# Frasnian Outcrop - Subsurface Stratigraphy Cline Channel Area, Alberta

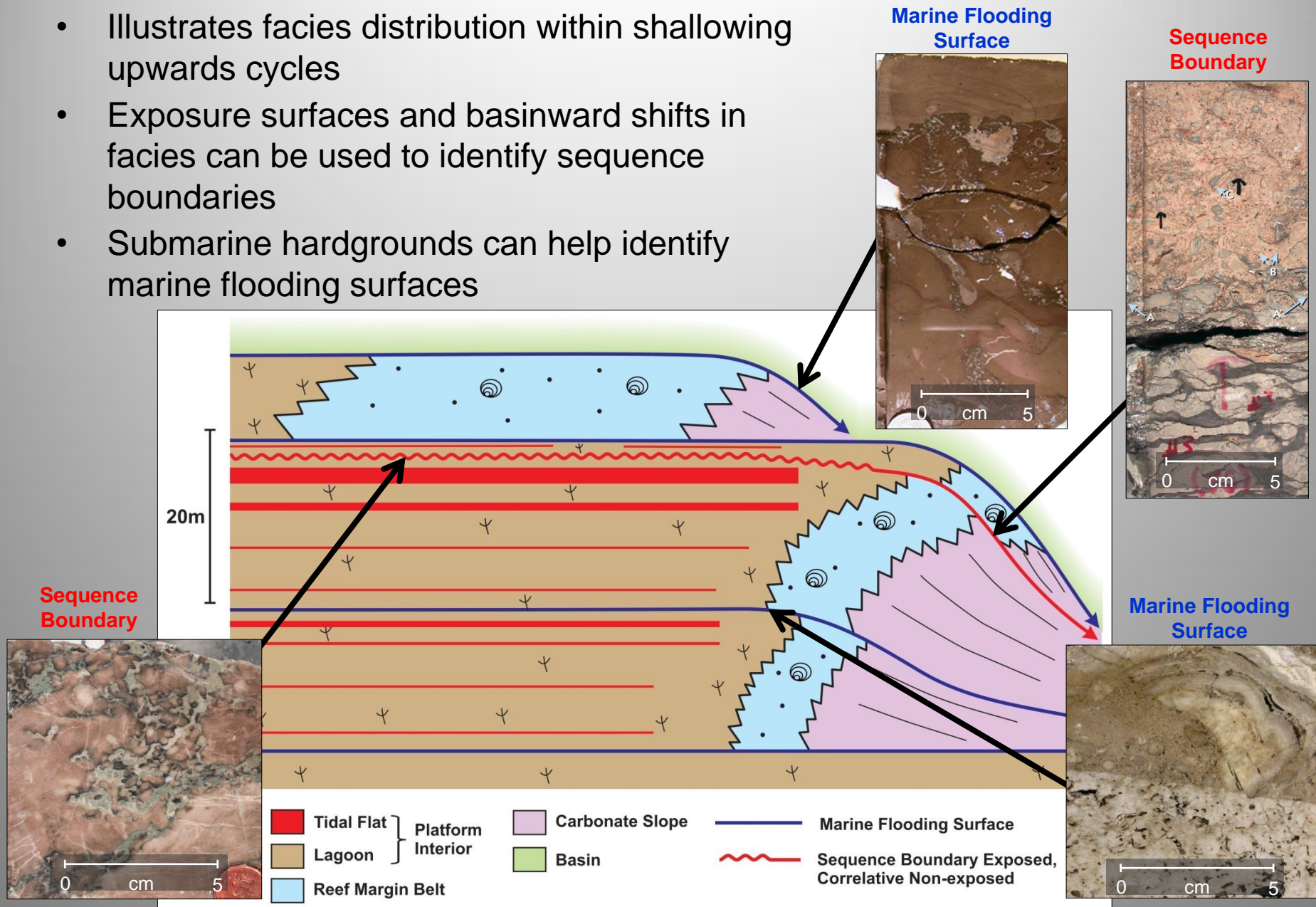


# Upper Devonian Reef to Basin Profile



# WCSB Frasnian Stratigraphic Model

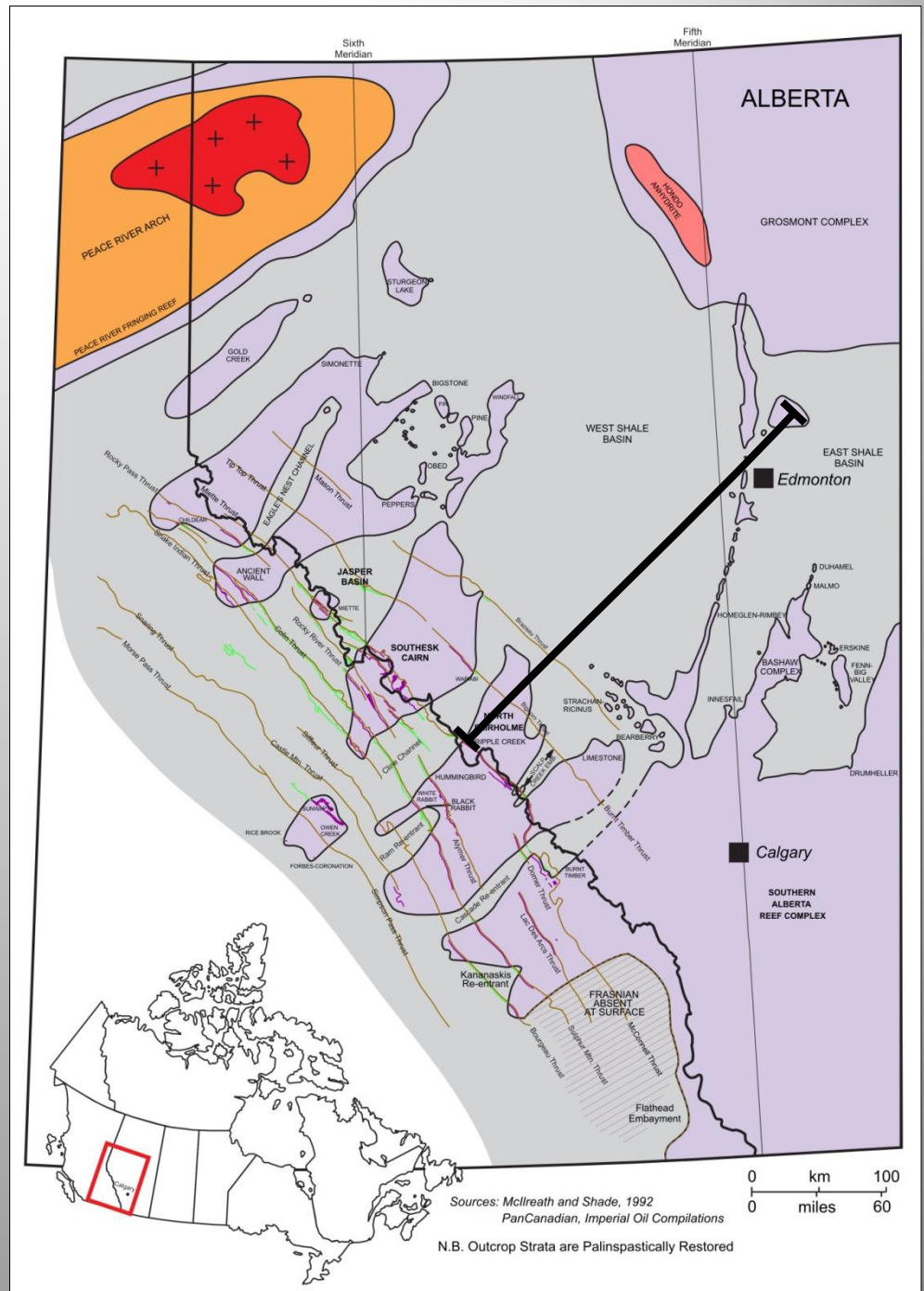
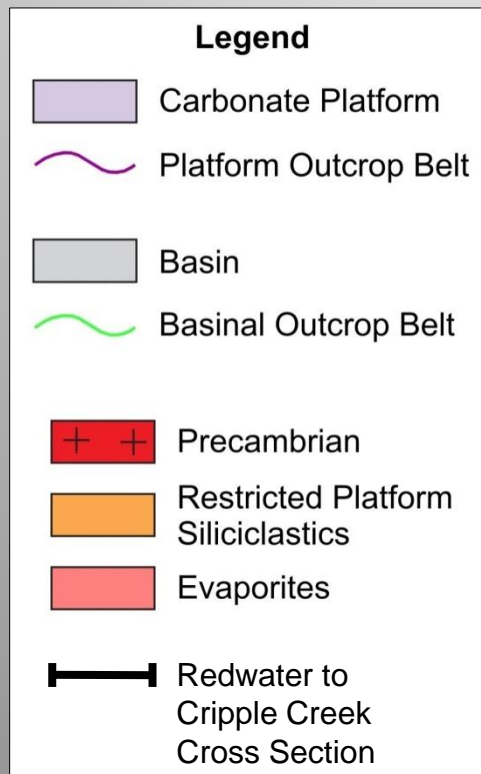
- Illustrates facies distribution within shallowing upwards cycles
- Exposure surfaces and basinward shifts in facies can be used to identify sequence boundaries
- Submarine hardgrounds can help identify marine flooding surfaces



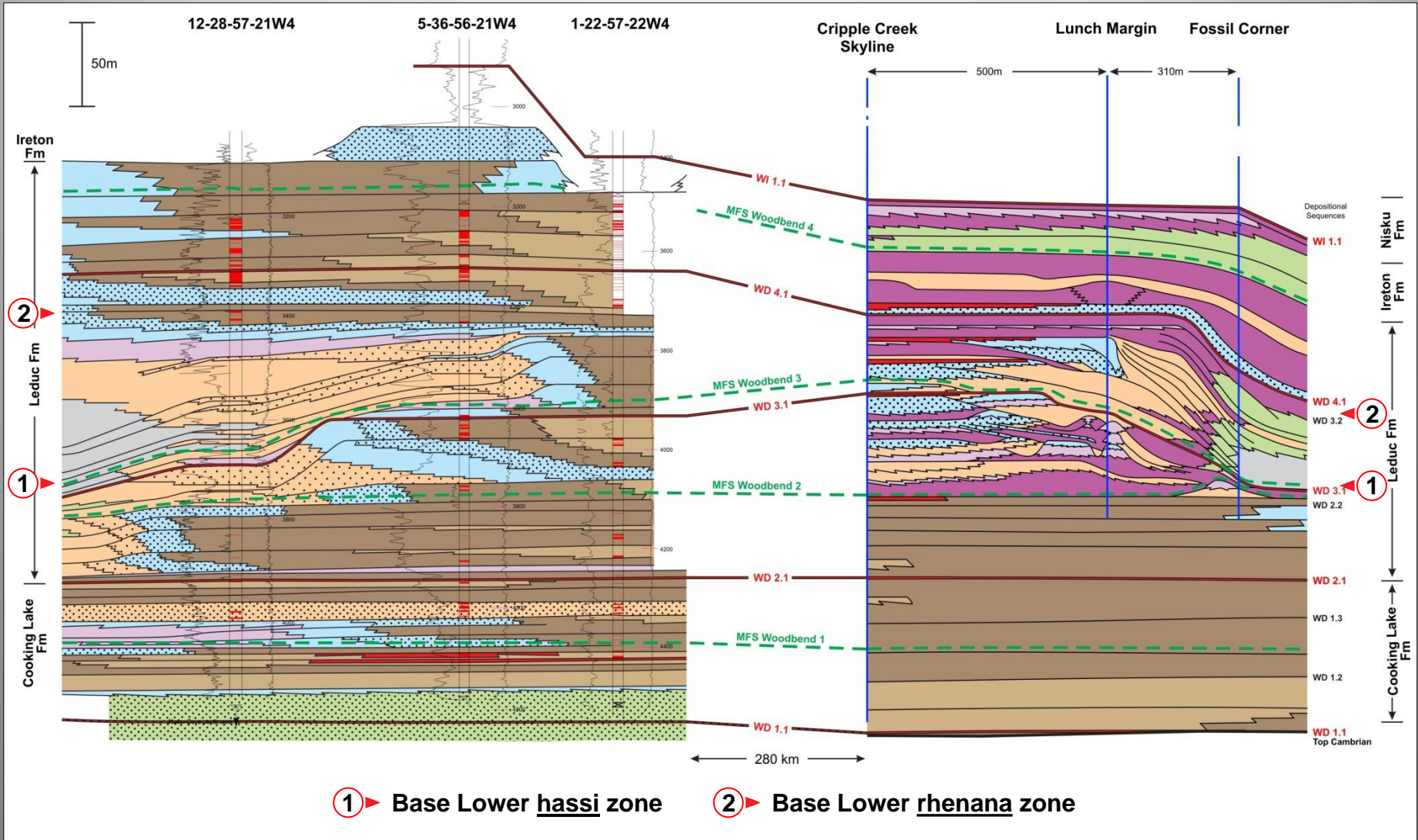
# Paleogeography

## Late Leduc

## Formation Time



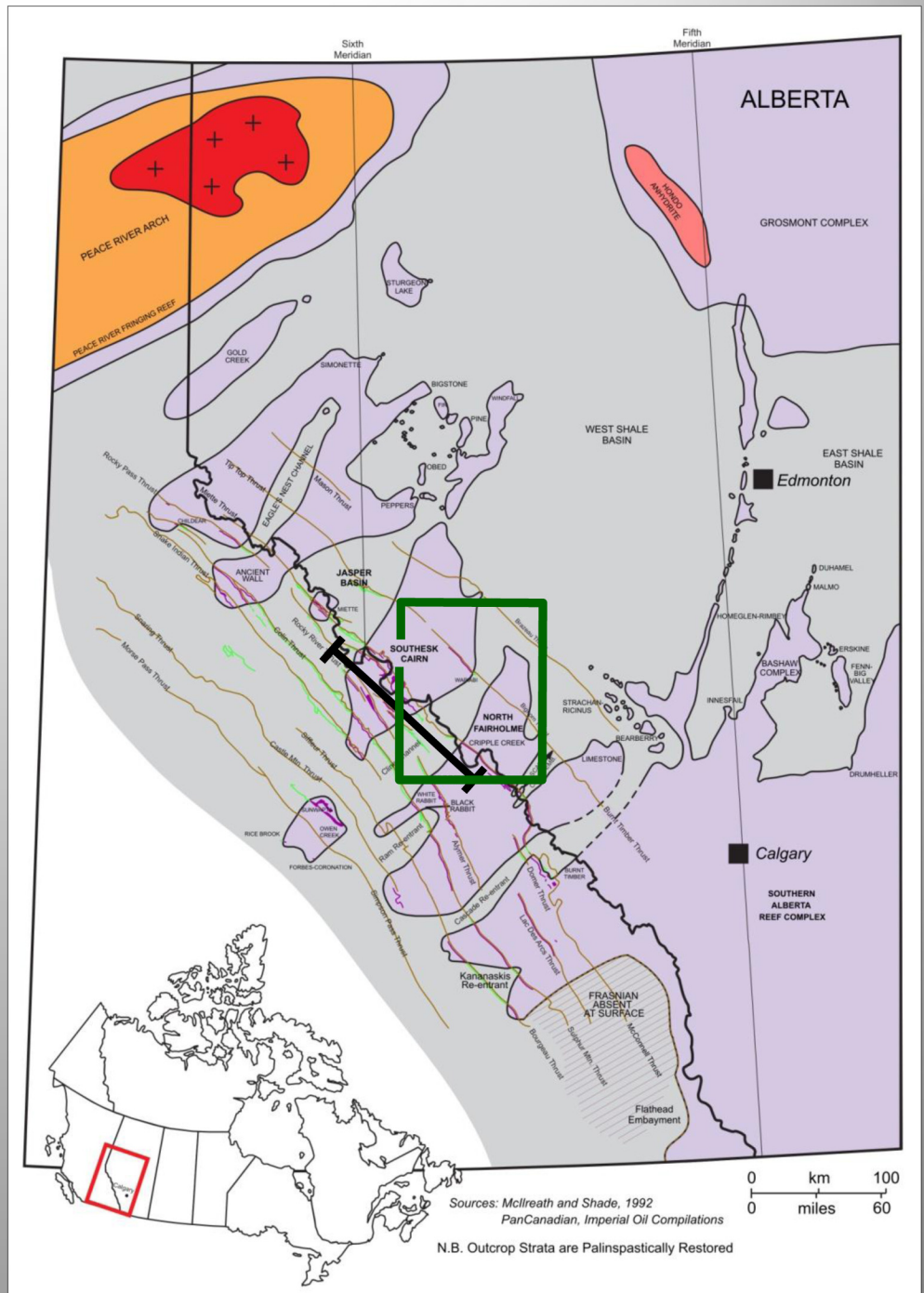
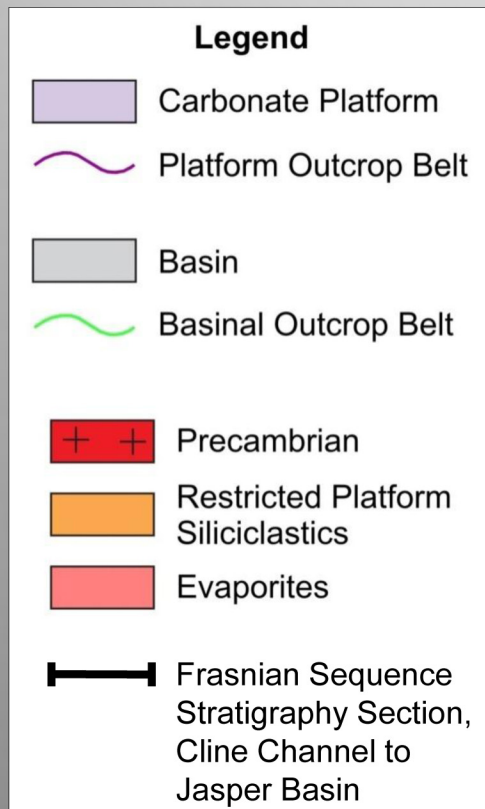
# Comparison of Redwater Oilfield with Cripple Creek Outcrop, Woodbend Group



# Paleogeography

## Late Leduc

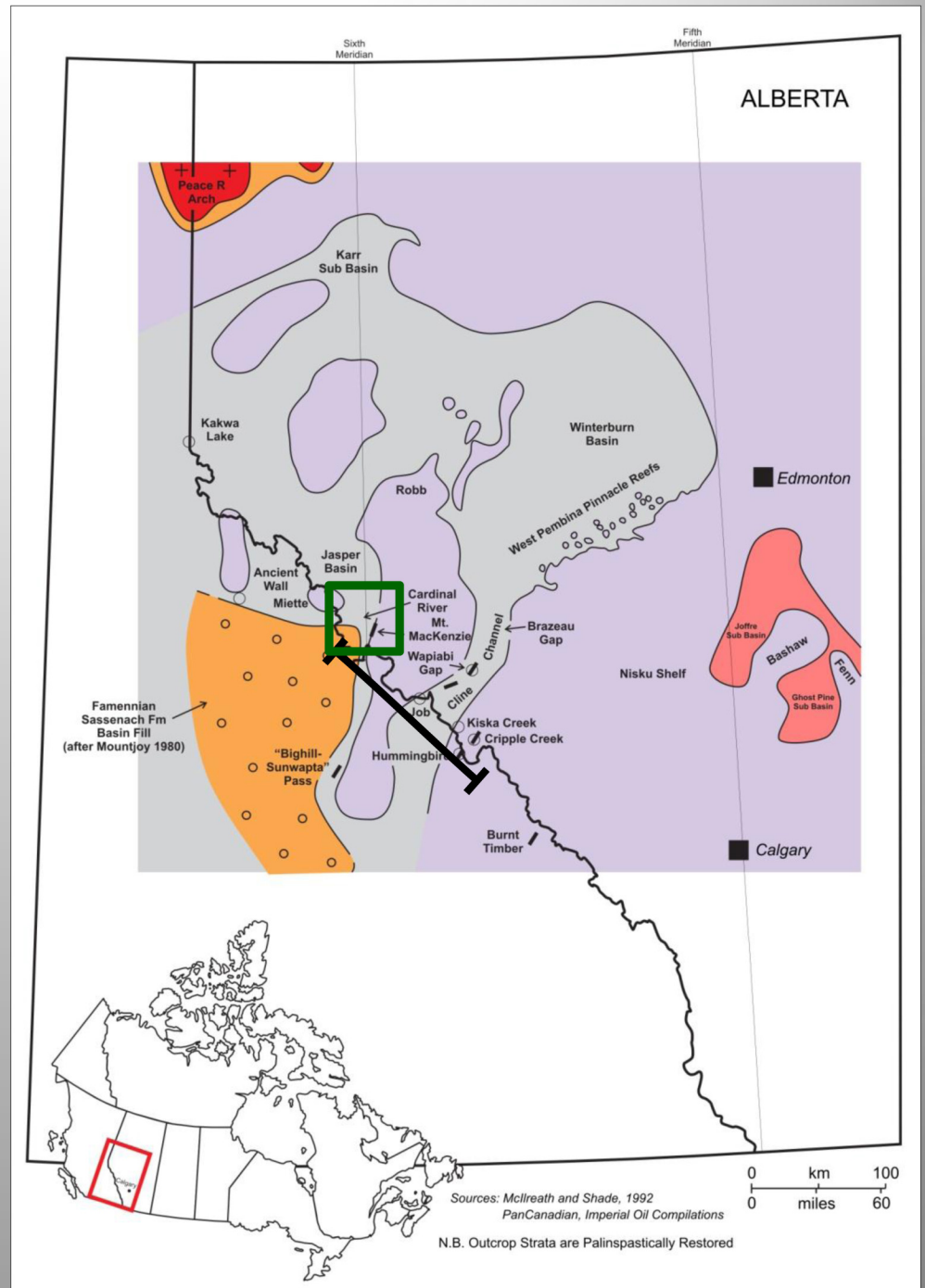
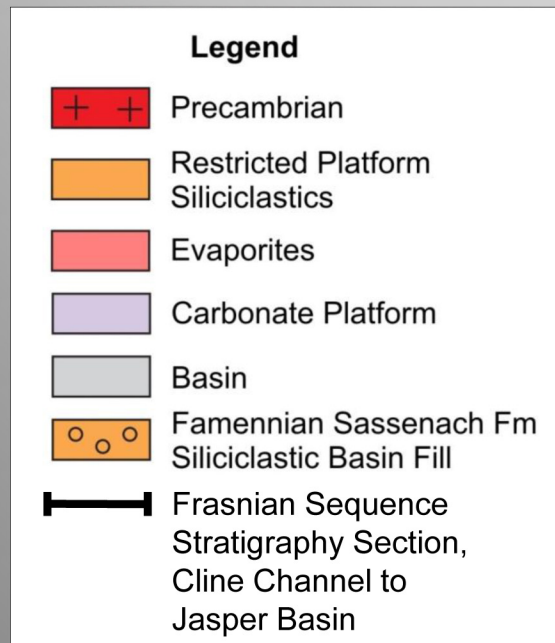
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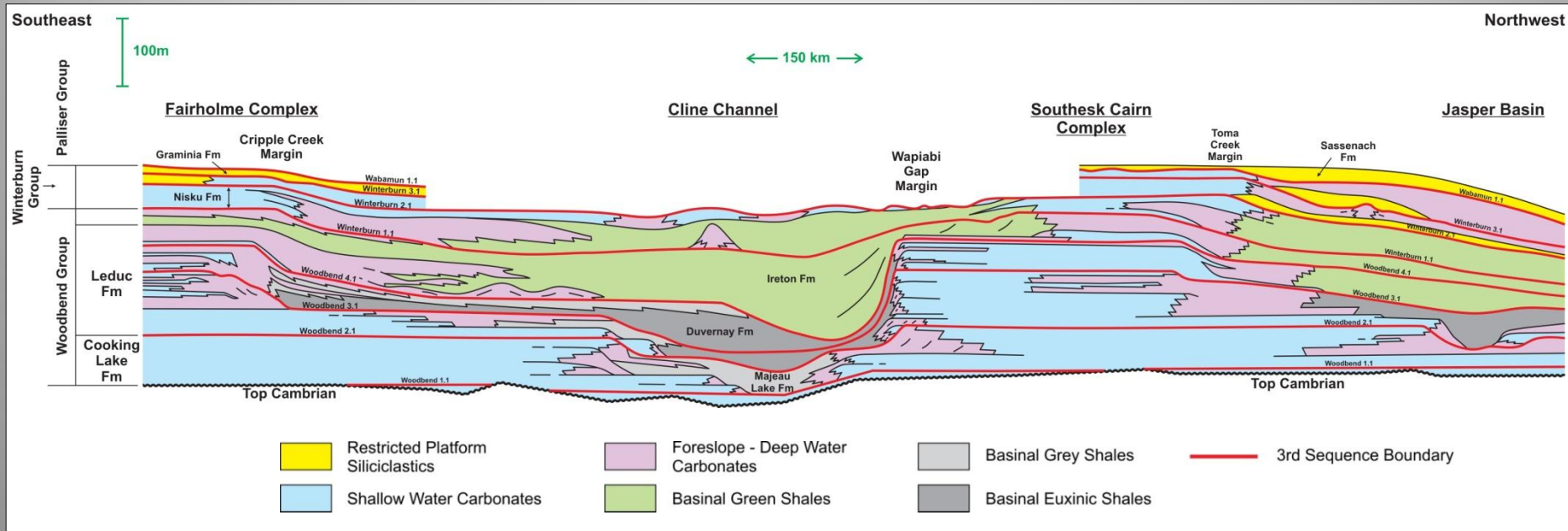
# Paleogeography

## Late Nisku

## Formation Time



# Frasnian Sequence Stratigraphy Cline Channel to Jasper Basin



# Conclusions

- A large scale transgressive – regressive 2<sup>nd</sup> order depositional sequence within Frasnian and late Givetian is recognized within subsurface and outcrop, Alberta portion of WCSB
- 3<sup>rd</sup> order depositional sequences are recognized and can be correlated from outcrop to subsurface using sequence stratigraphy and conodont biostratigraphy
- Basin fill within the 2<sup>nd</sup> order sequence was not uniform across the Alberta portion of WCSB and influenced subsequent carbonate platform stacking patterns
- Petroleum resources can be placed into context within this 2<sup>nd</sup> order depositional sequence in the Alberta portion of WCSB

# Future Work

- Additional subsurface to outcrop stratigraphic and biostratigraphic work to test models
- Potential for high resolution photopan collection and interpretation, tied to existing models
- Chemostratigraphic analysis in both subsurface and outcrop to test and refine models

# Acknowledgements

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