Stratigraphic Architecture of the Jasper Basin, North-Central Alberta Front Ranges*

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Abstract

A sequence stratigraphic framework for the Frasnian, north-central Alberta Rocky Mountains, is presented. Six third-order depositional sequences are correlated across the study area. The base of the succession unconformably overlies Middle Cambrian strata, representing transgressive onlap of the West Alberta Ridge, an antecedent landmass. This transgression initiated several large carbonate complexes: Sunwapta-Big Hill, Southesk Cairn and Miette. Three platform/basin transitions on these complexes – Toma Creek, Big Hill, and Nikanassin Range respectively – were examined. In the Jasper basin, the base Woodbend Sequence One (WD1) boundary is characterized by red, iron-oxidized carbonate breccia. At Toma Creek and Big Hill, the WD1 is comprised of aggradational to retrogradational stacking platform interior lagoonal and tidal flat cycles. The basal WD2 developed significant in situ carbonate lowstands in the Jasper basin. The WD2 margin was initiated after pronounced southward platform retrogradation. The WD3 transgression caused substantial shrinking of the carbonate platforms and deposition of nodular basinal wackestones and mudstones at all Jasper basin locations. Limited progradation characterizes the Winterburn Sequence One (WI1, Southesk Cairn, Sunwapta-Big Hill complexes). By contrast, the southeast Miette complex (Nikanassin Range) displays pronounced progradation. This is attributable to carbonate high production there, compared to the Southesk Cairn and Sunwapta-Big Hill complexes. The Miette margins display steeper foreslopes (>10 degrees) compared to the ramp margins to the south. This may be due to Ireton Formation shale basin fill in the Cline Channel region. The steep, progradational Winterburn Sequence Two (WI2) and Three (WI3) margins are best exposed at Miette, with well-defined component systems tracts. Its architecture reflects decreasing late Frasnian accommodation, manifested by decreased aggradation and increased progradation. The WI2 late highstand shows an absence of topset deposition, pronounced foreset truncation and a well-developed, abrupt downlap surface, culminating in the second-order sequence boundary. Margin styles and third-order sequence stacking controls in the Jasper basin are shale bank paleogeography, carbonate accumulation rates and relative sea level. Sequence and bounding surface correlations are well constrained and supported by biostratigraphy (conodonts).

STRATIGRAPHIC ARCHITECTURE OF THE JASPER BASIN, NORTH-CENTRAL ALBERTA FRONT RANGES

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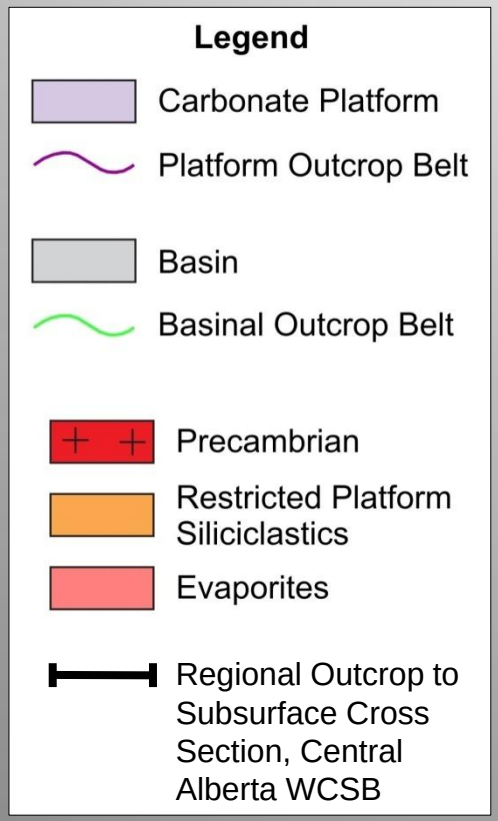
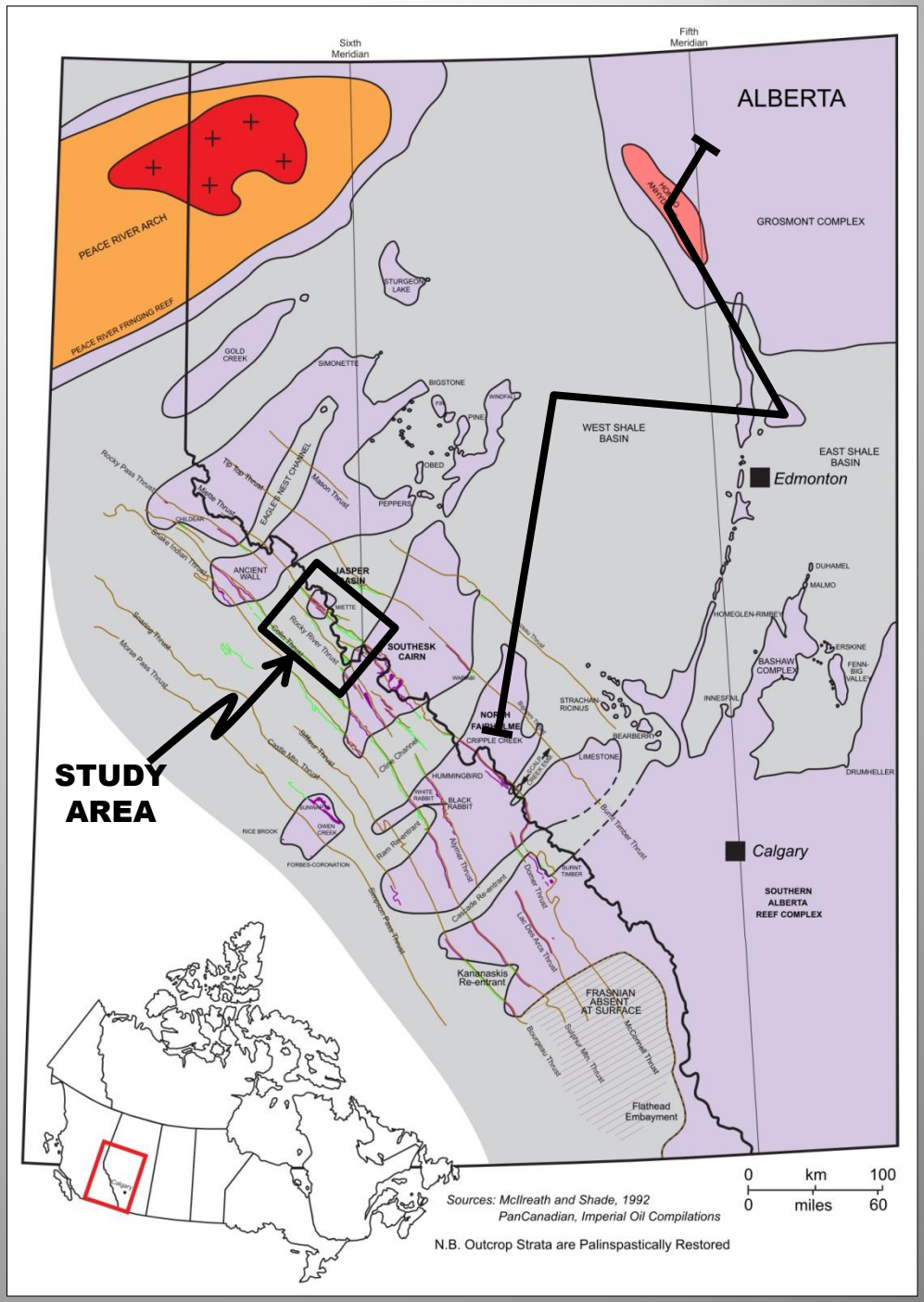
Outline

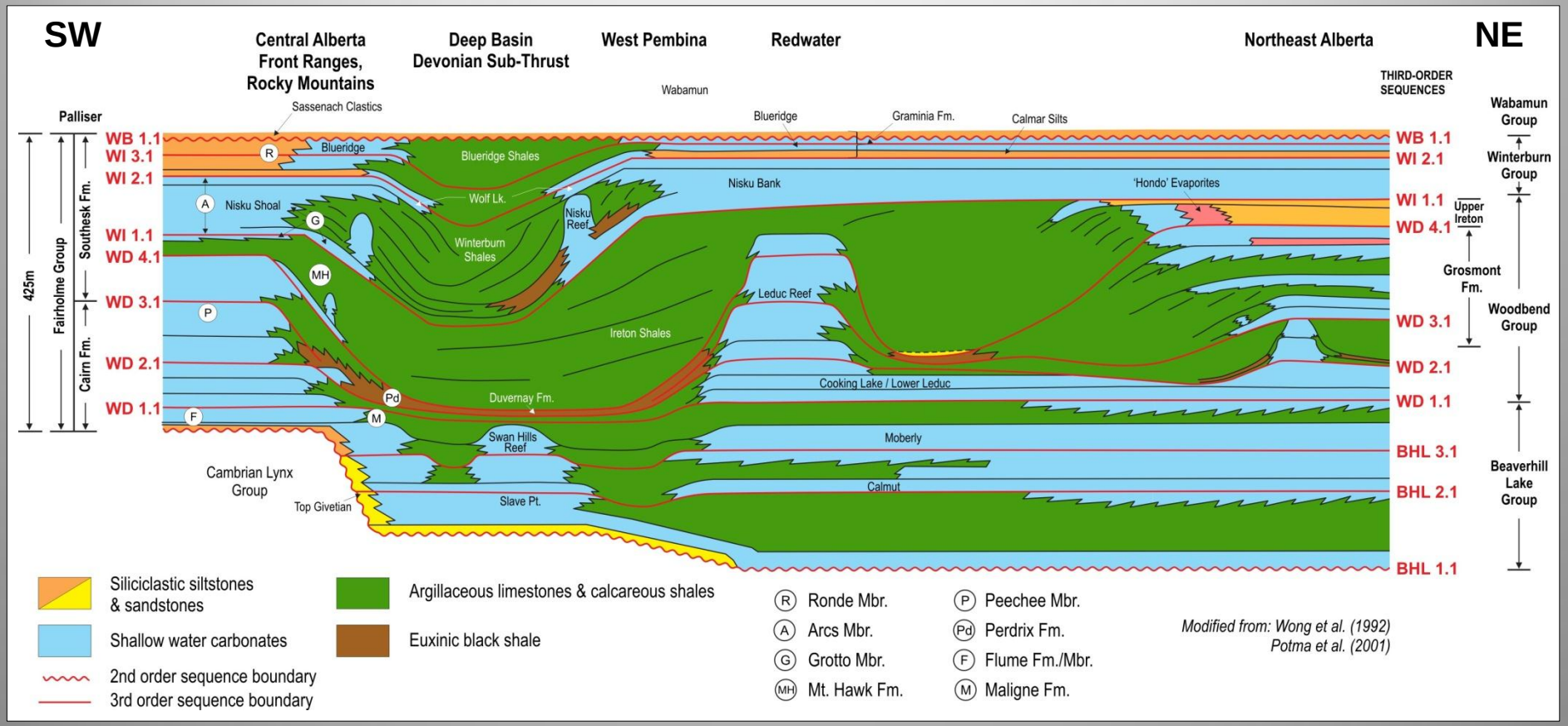
- Paleogeographic/stratigraphic setting
- Mid-Frasnian Margin of the Southesk Cairn reef complex, Toma Creek
- Latest Frasnian carbonate ramp, southern and central Jasper Basin
- Conclusions, acknowledgements

Paleogeography Late Leduc Formation Time

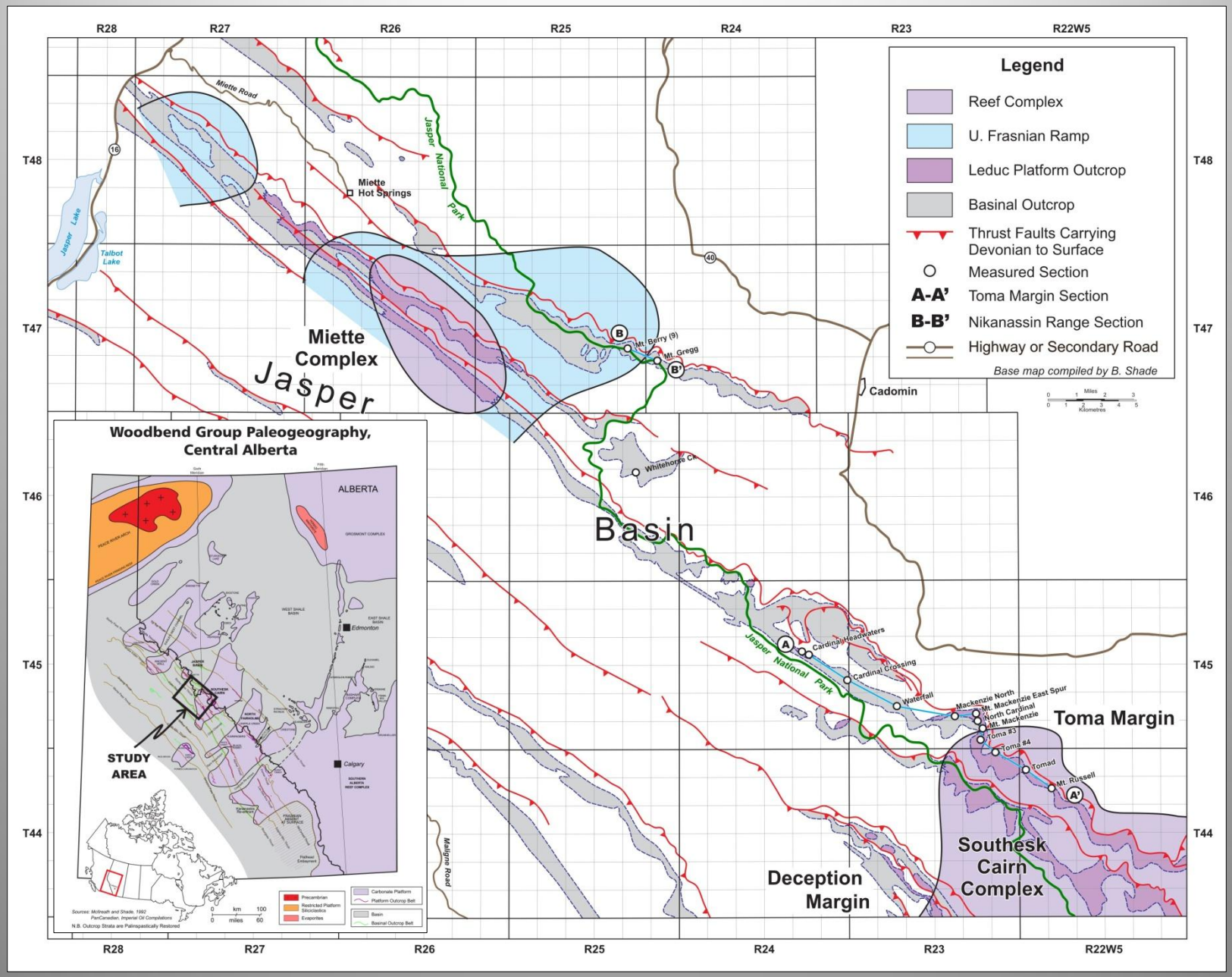




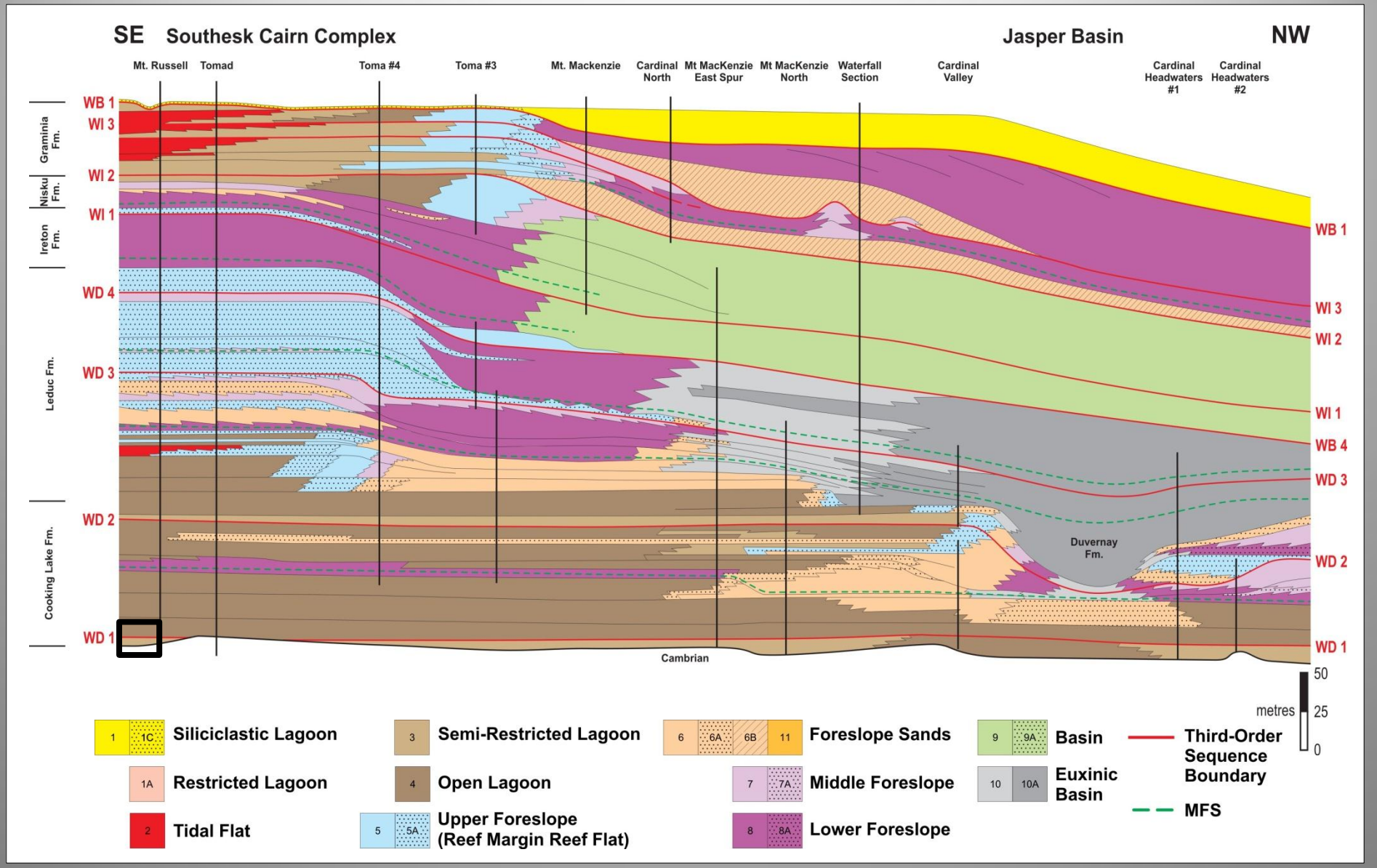
Regional Outcrop to Subsurface Cross Section, Central Alberta WCSB



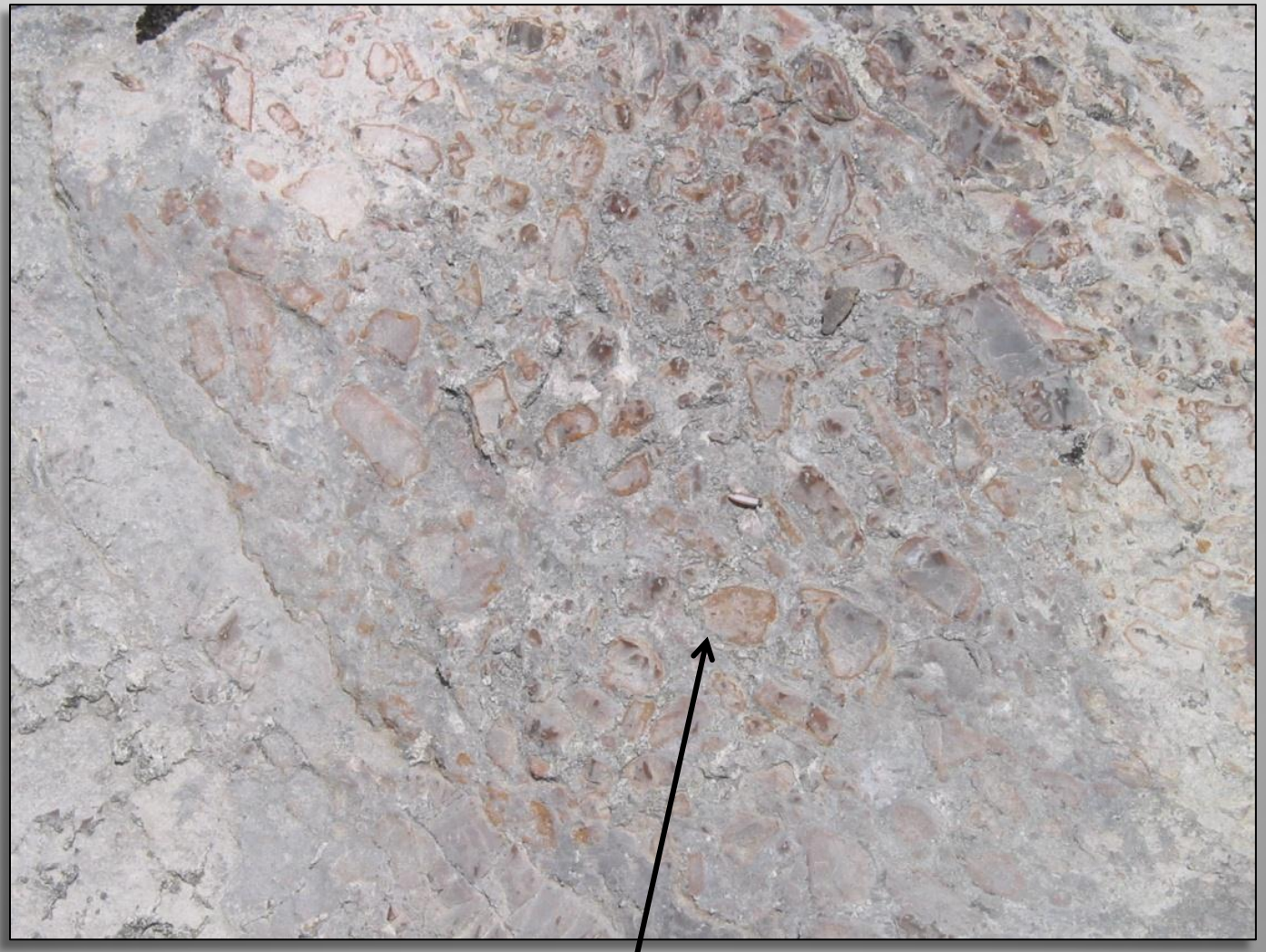
Frasnian Outcrops, Jasper Basin



Southern Jasper Basin, Toma Margin

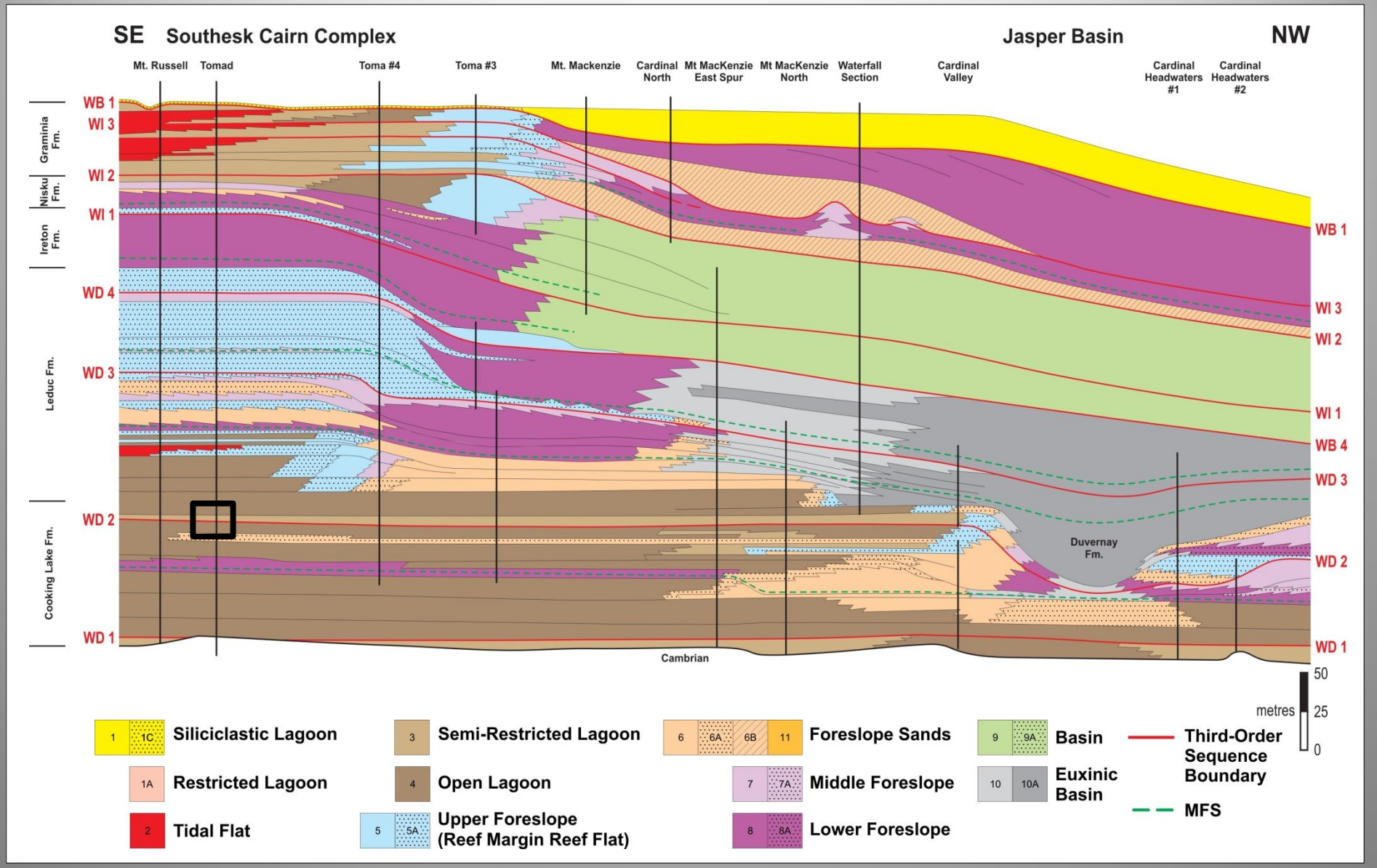


Base Woodbend Sequence 1, Big Hill Outcrop

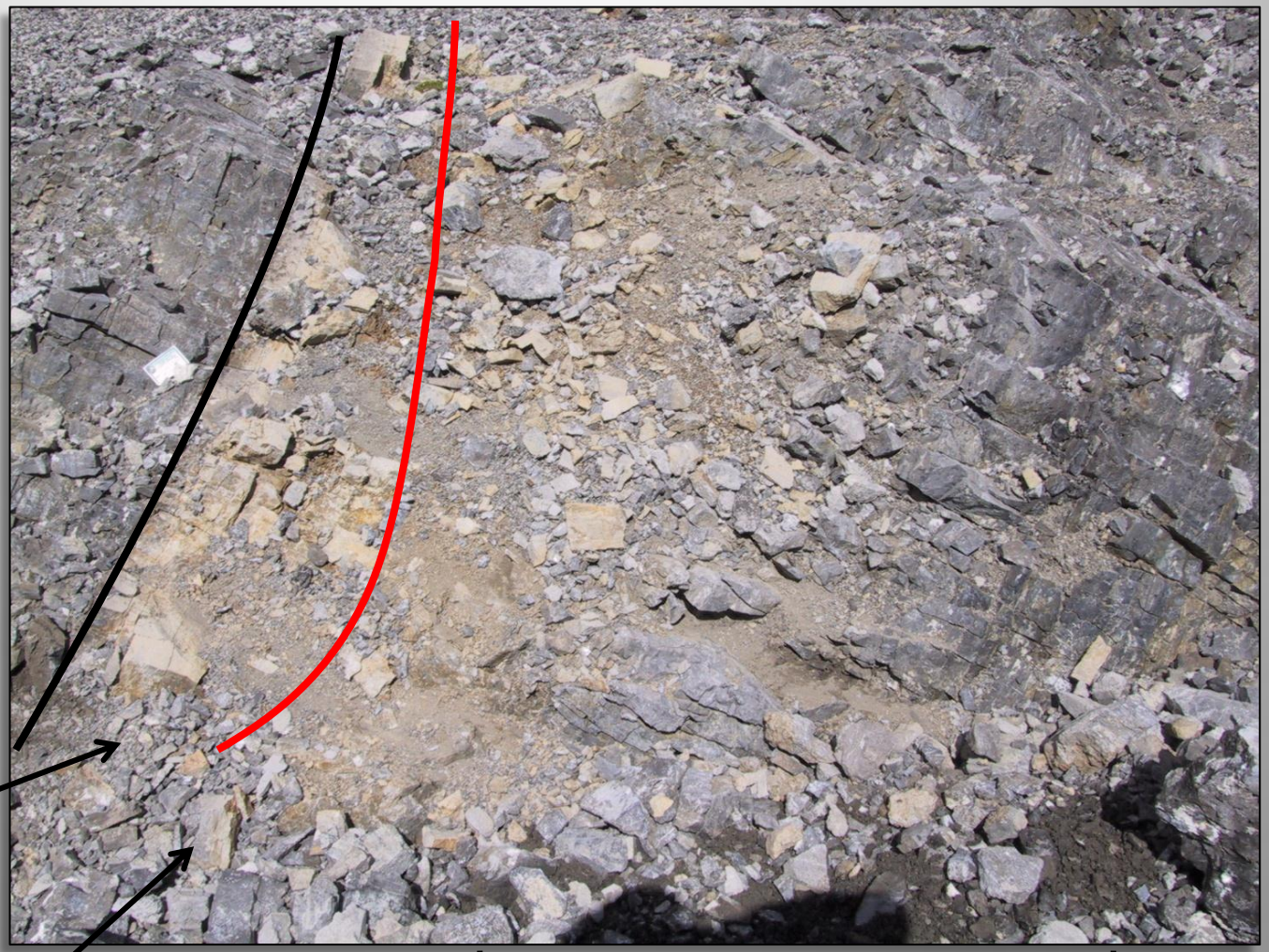


Reddened intraclast breccia at sequence boundary

Southern Jasper Basin, Toma Margin



Base Woodbend Sequence 2, Tomad Section



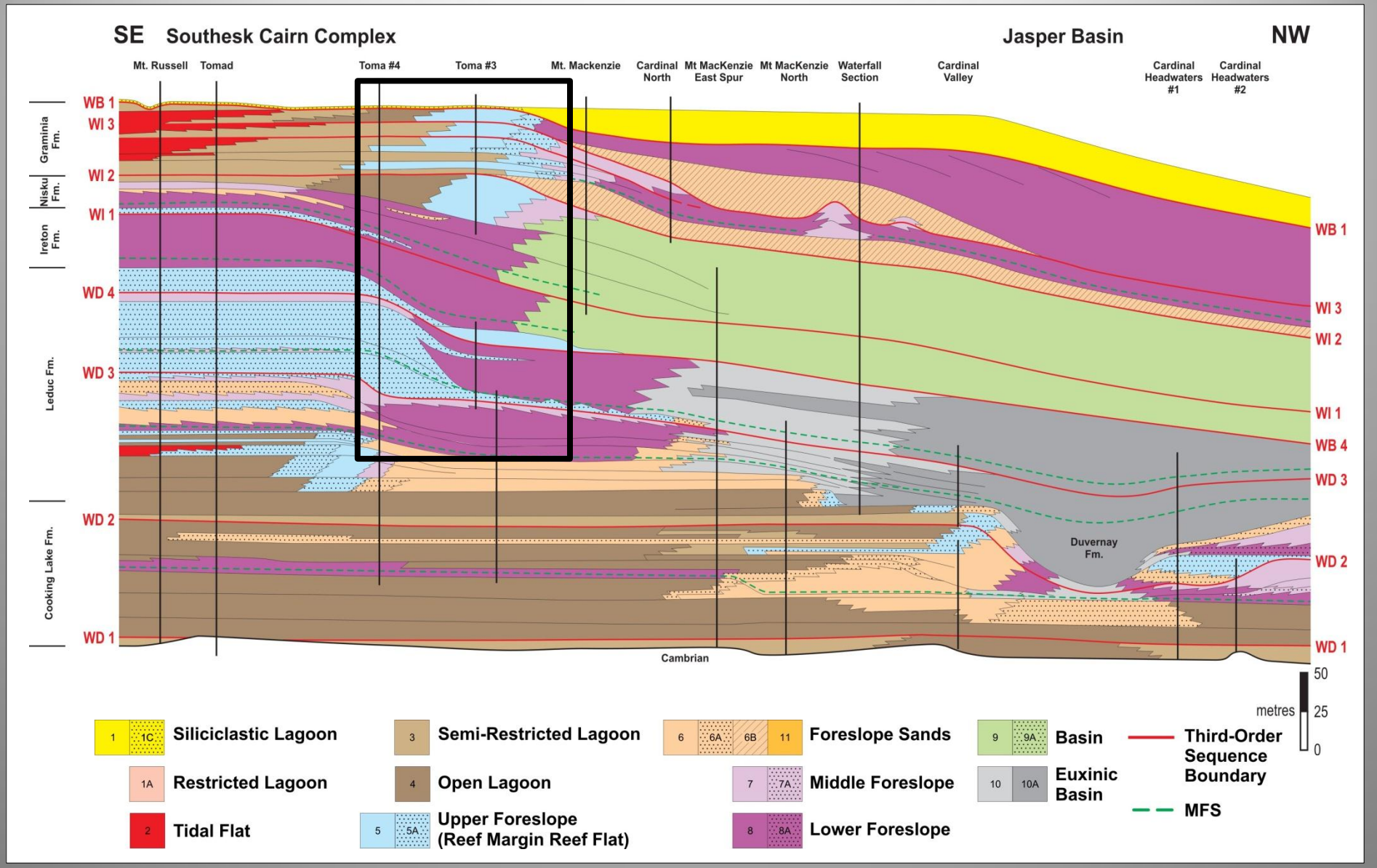
Restricted *Amphipora* lagoon

Silty dolostone

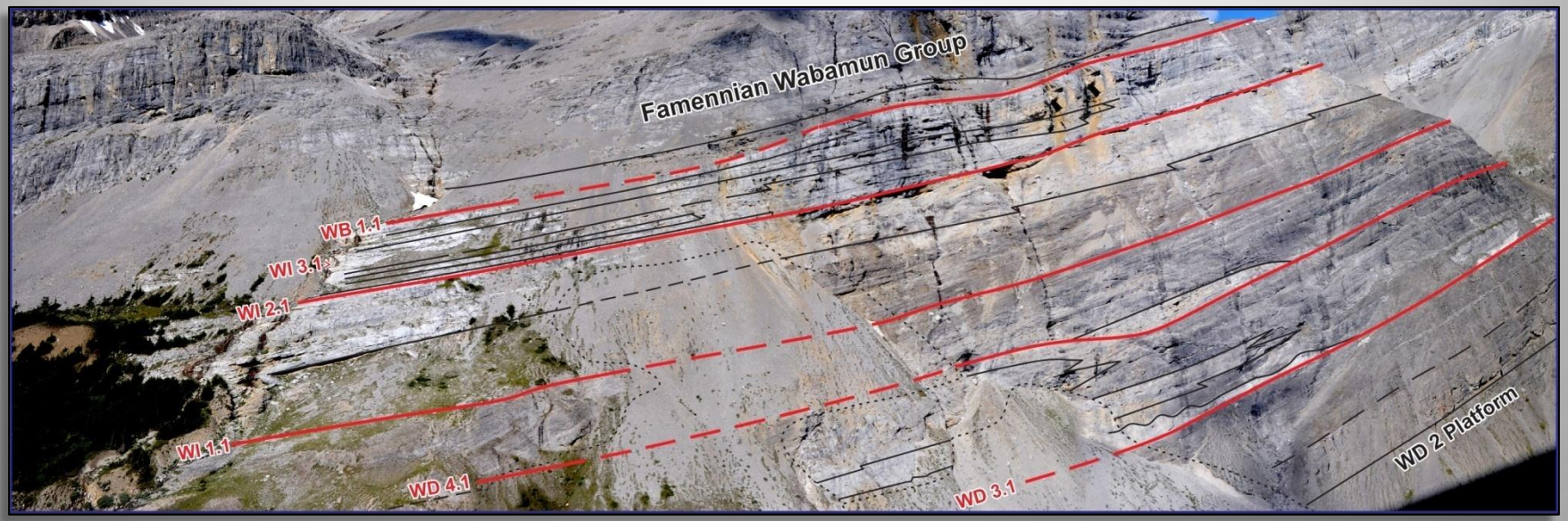
Sequence Boundary with 0.5m erosional relief

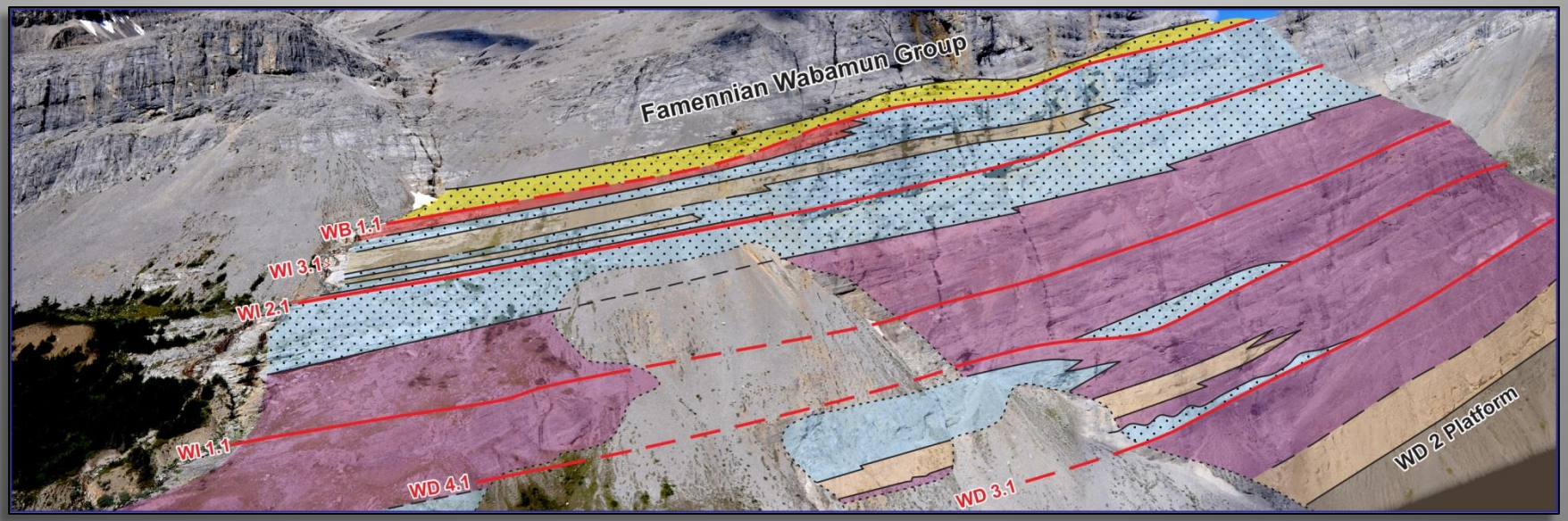
Open, *Amphipora,* bulbous stromatoporoid lagoon

Southern Jasper Basin, Toma Margin

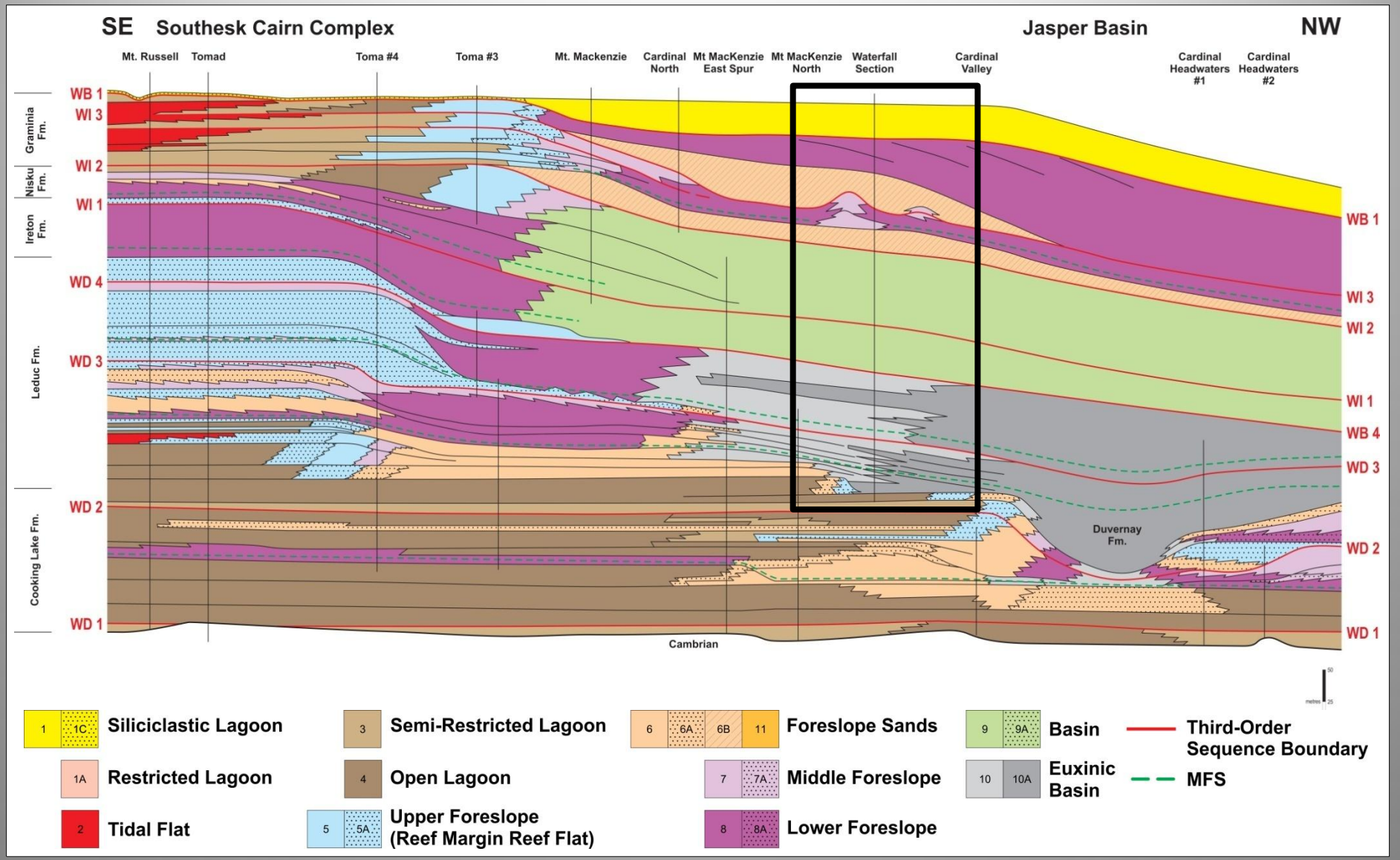


Southesk Cairn Complex: Toma Creek Margin

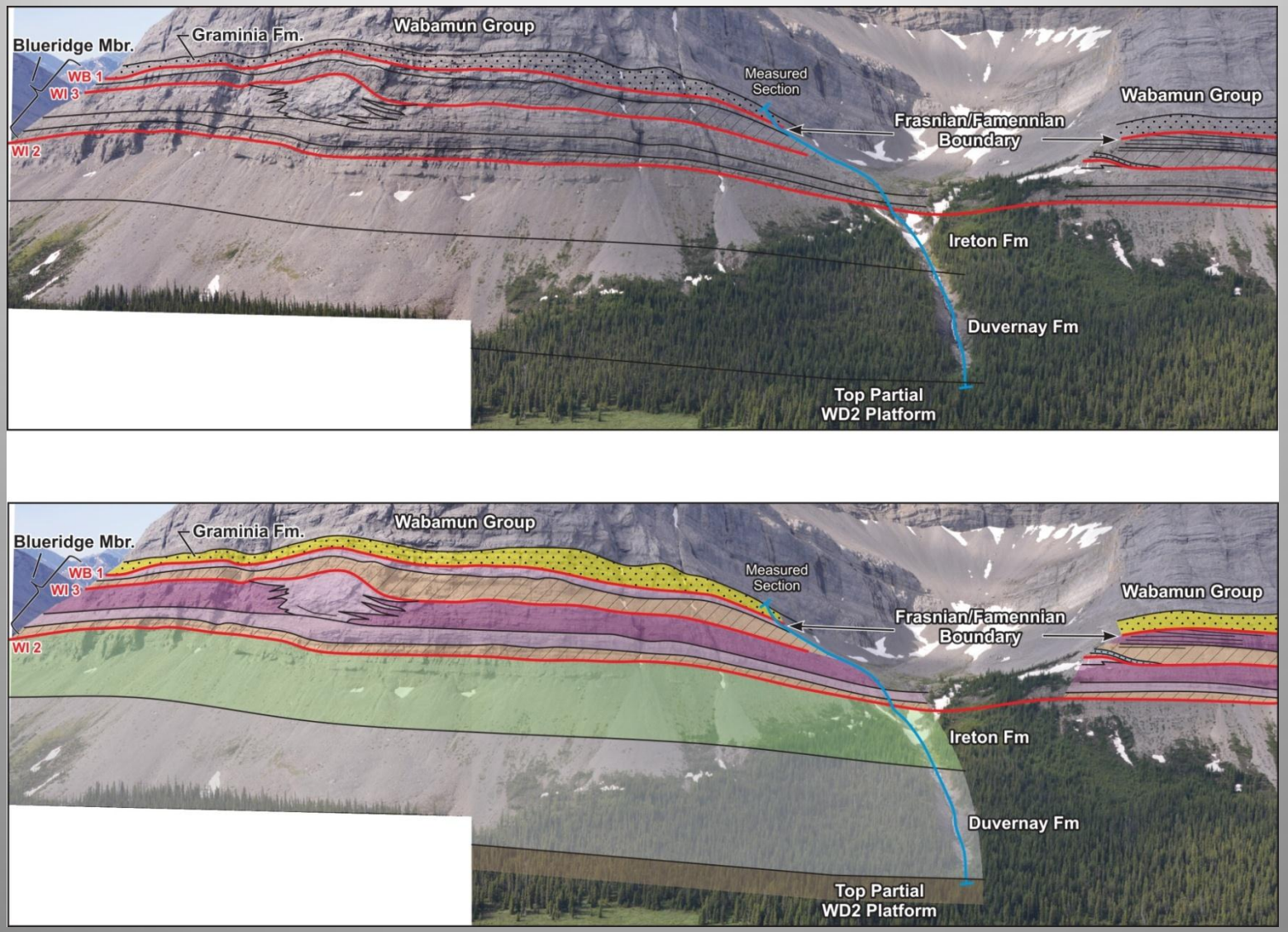




Southern Jasper Basin, Toma Margin



Late Frasnian Second-Order Highstand, Cardinal Valley



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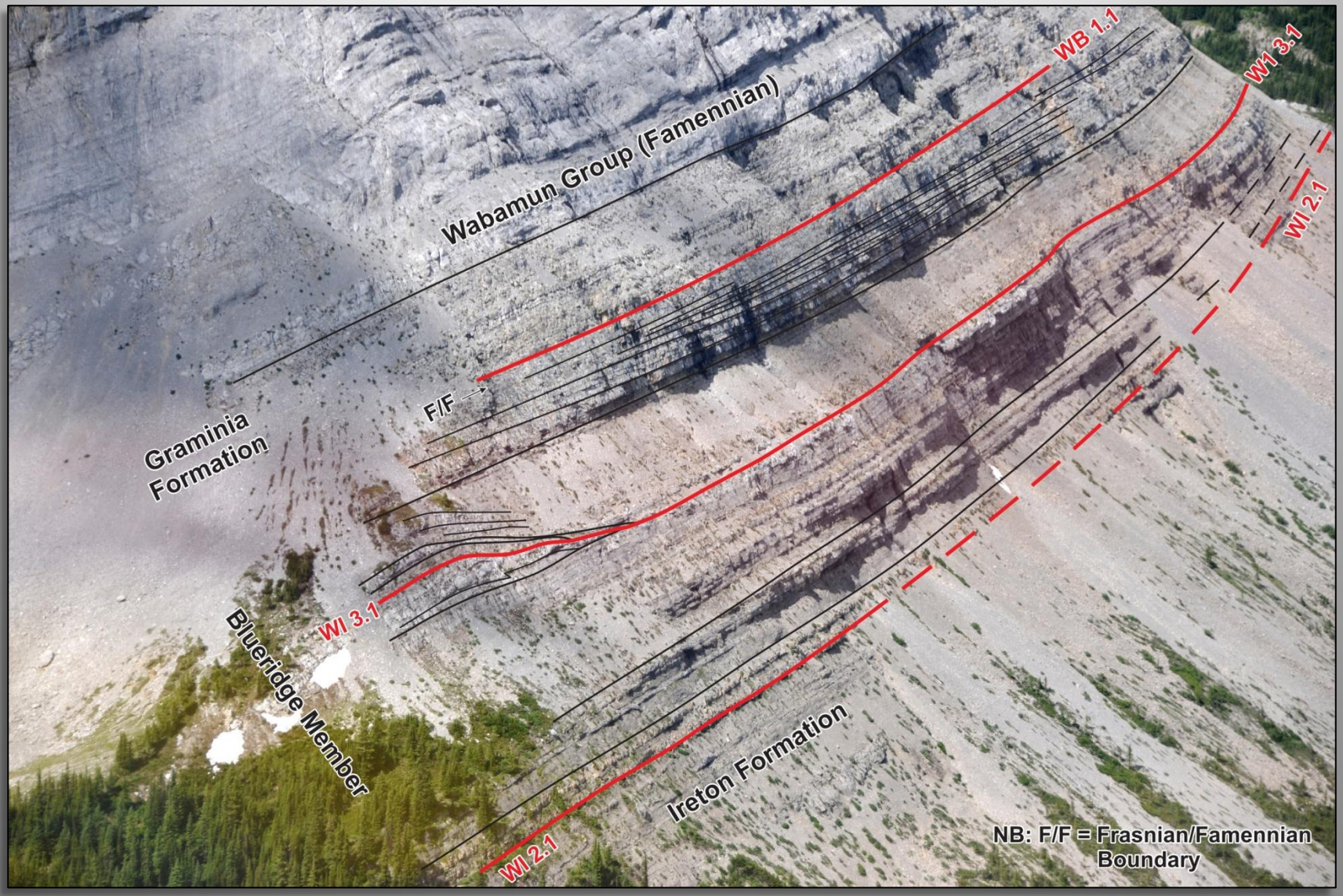

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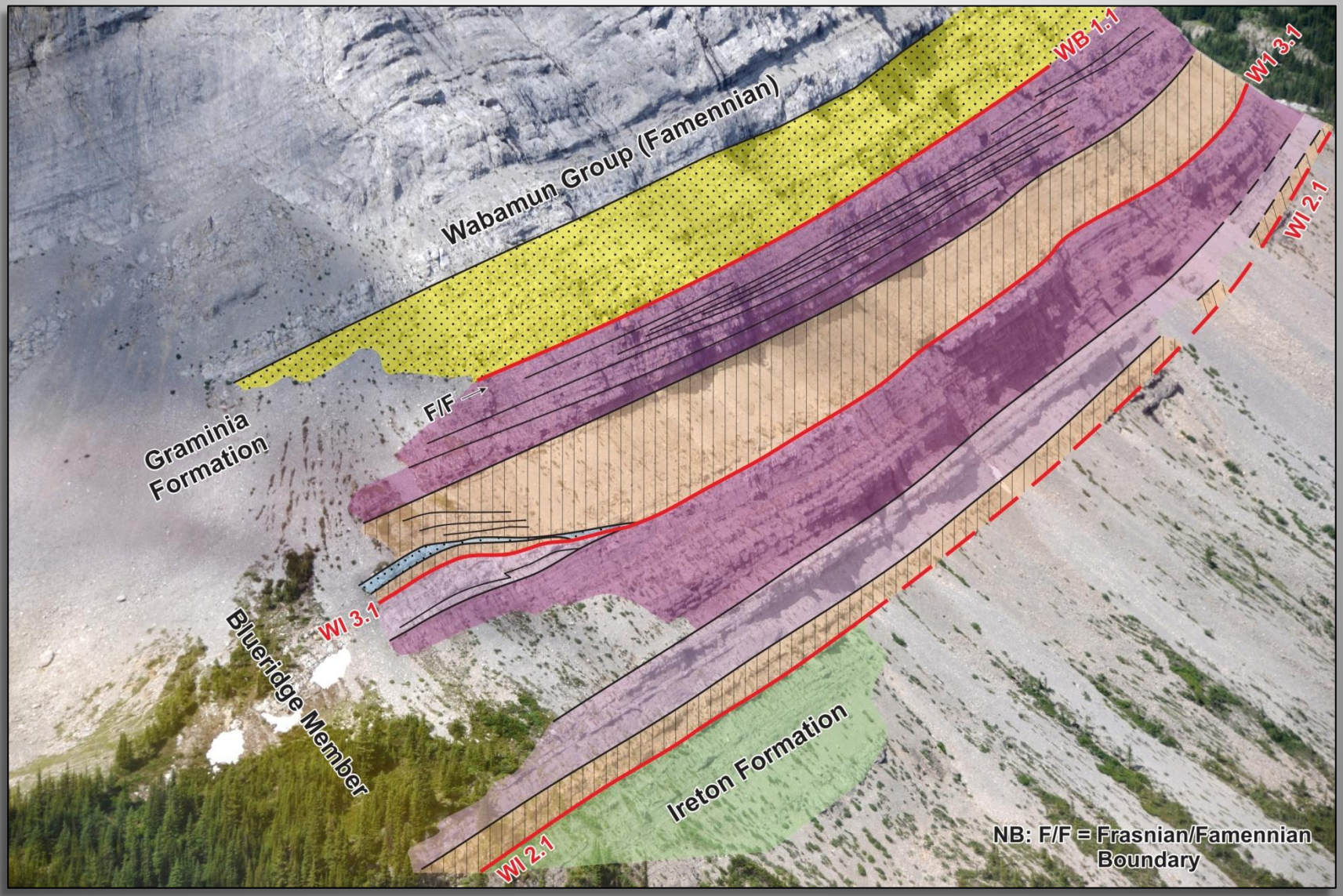
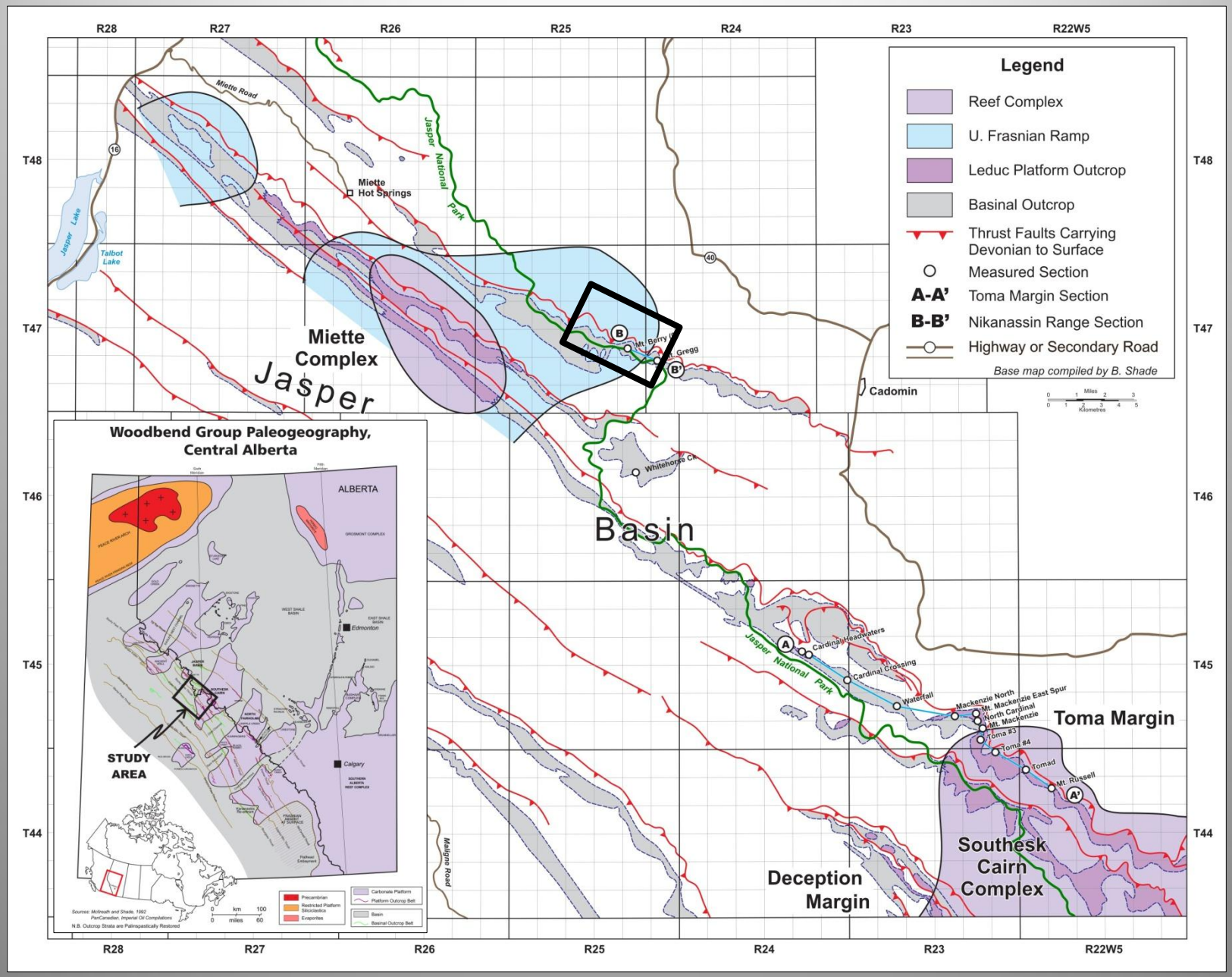
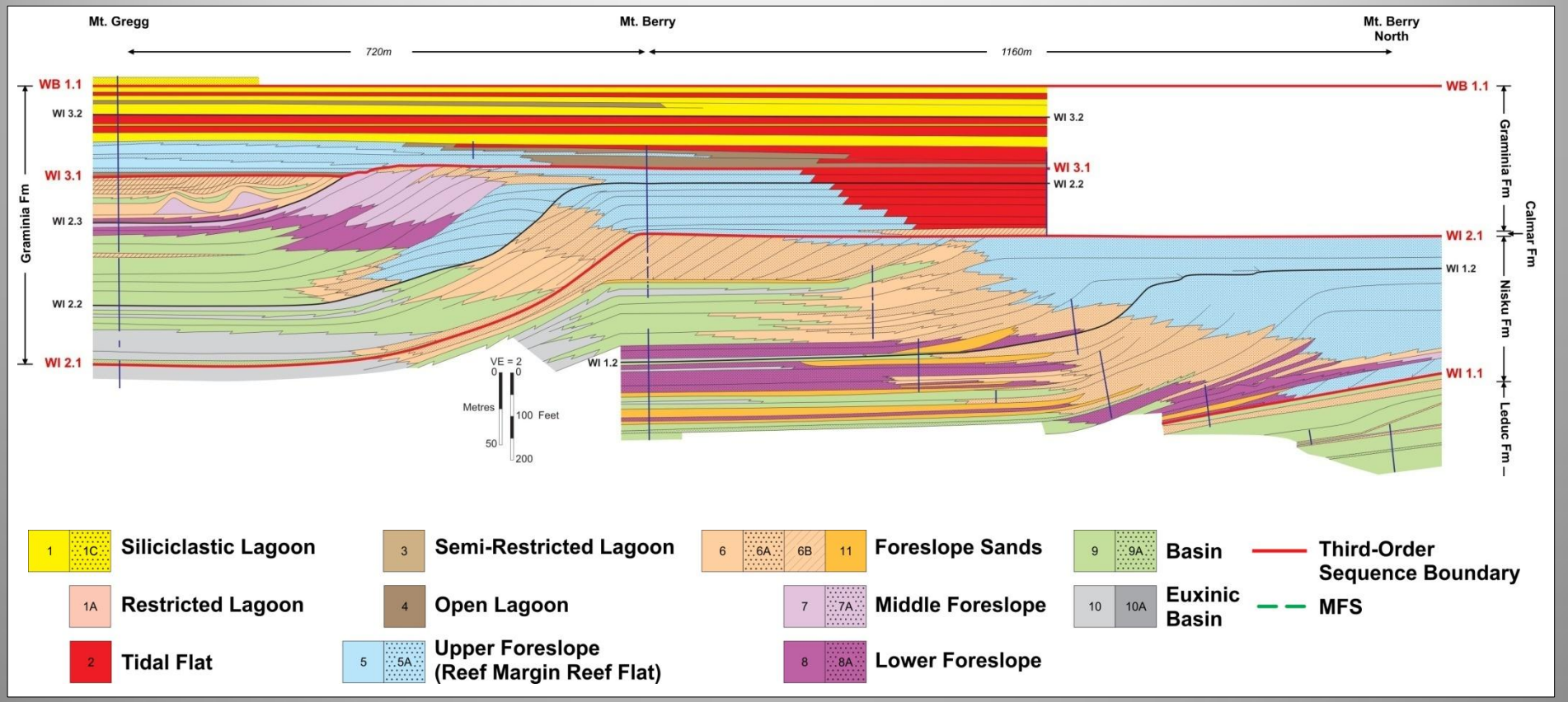


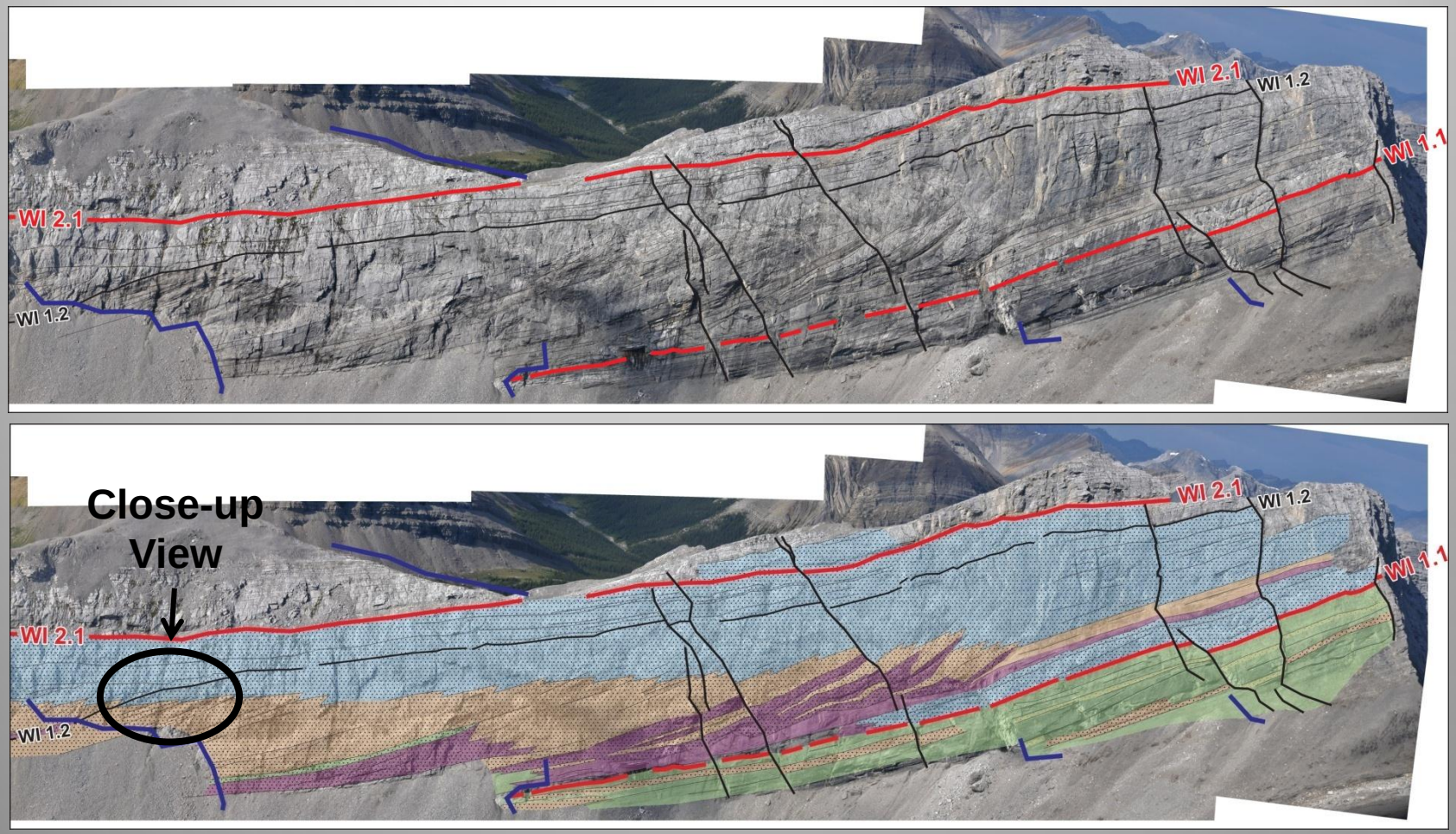
Frasnian Outcrops, Jasper Basin



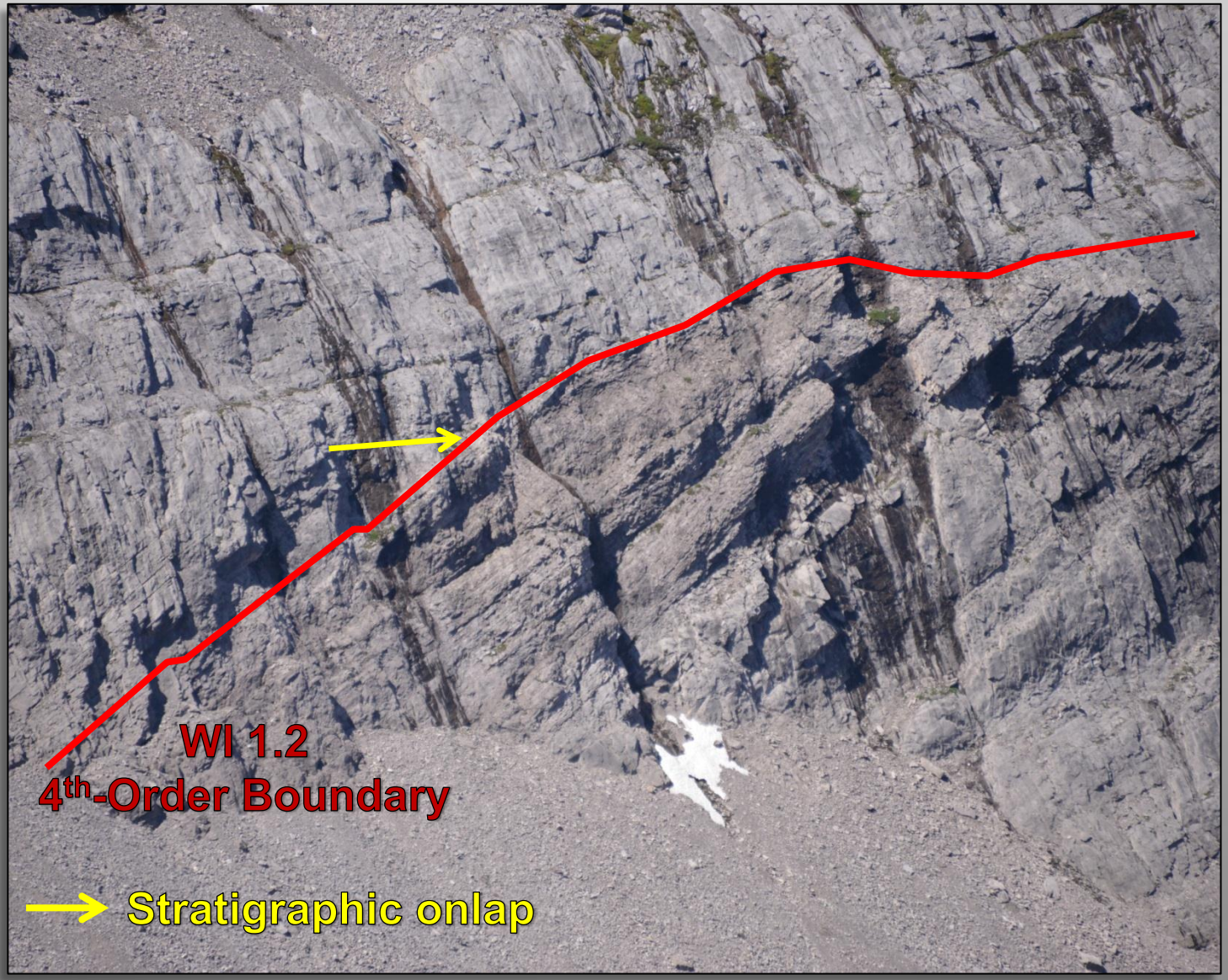
Frasnian Second-Order Highstand, Nikanassin Range, Alberta



Late Frasnian Ramp Margin, Nikanassin Range

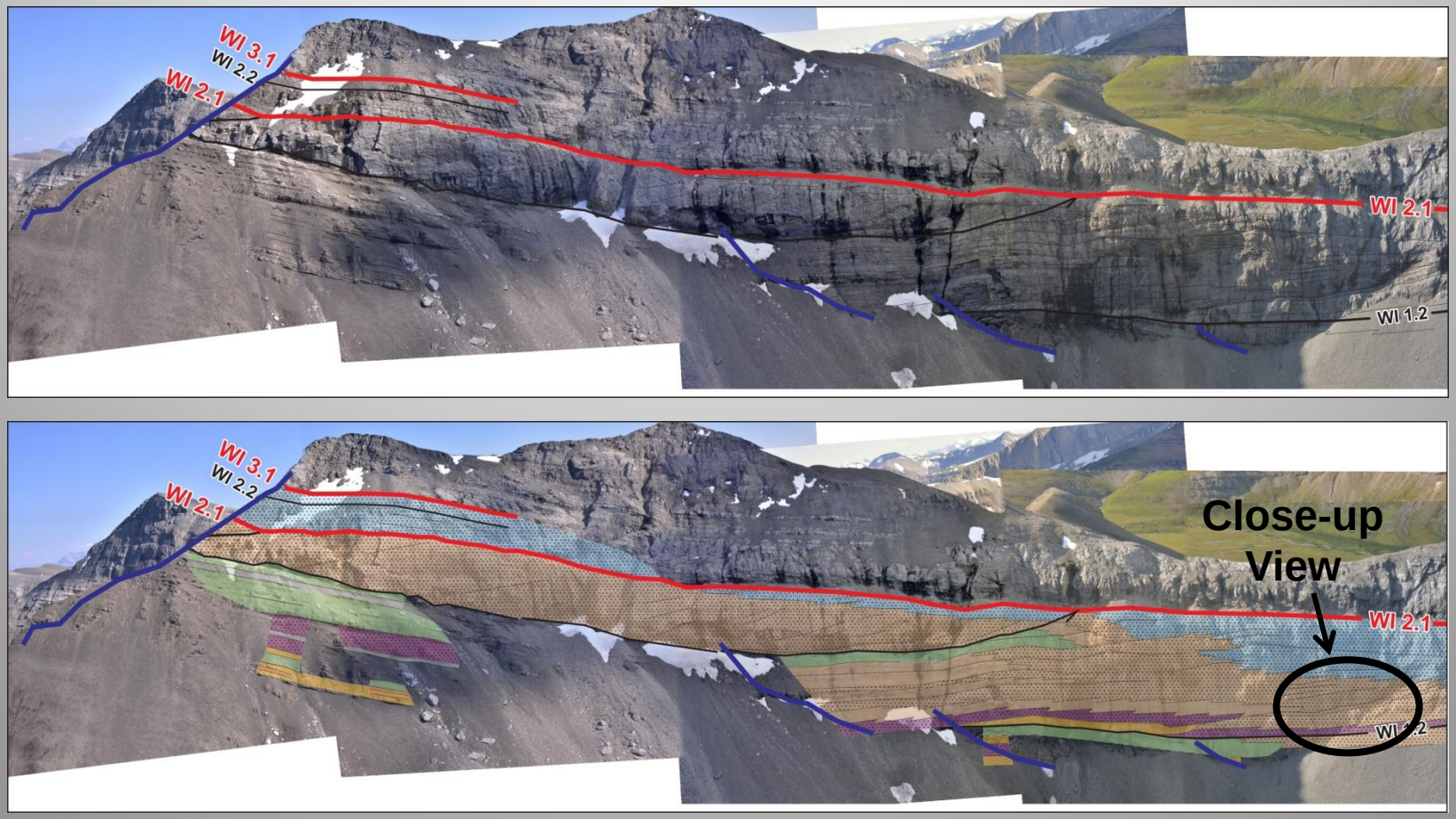


Frasnian Second-Order Late Highstand Geometries



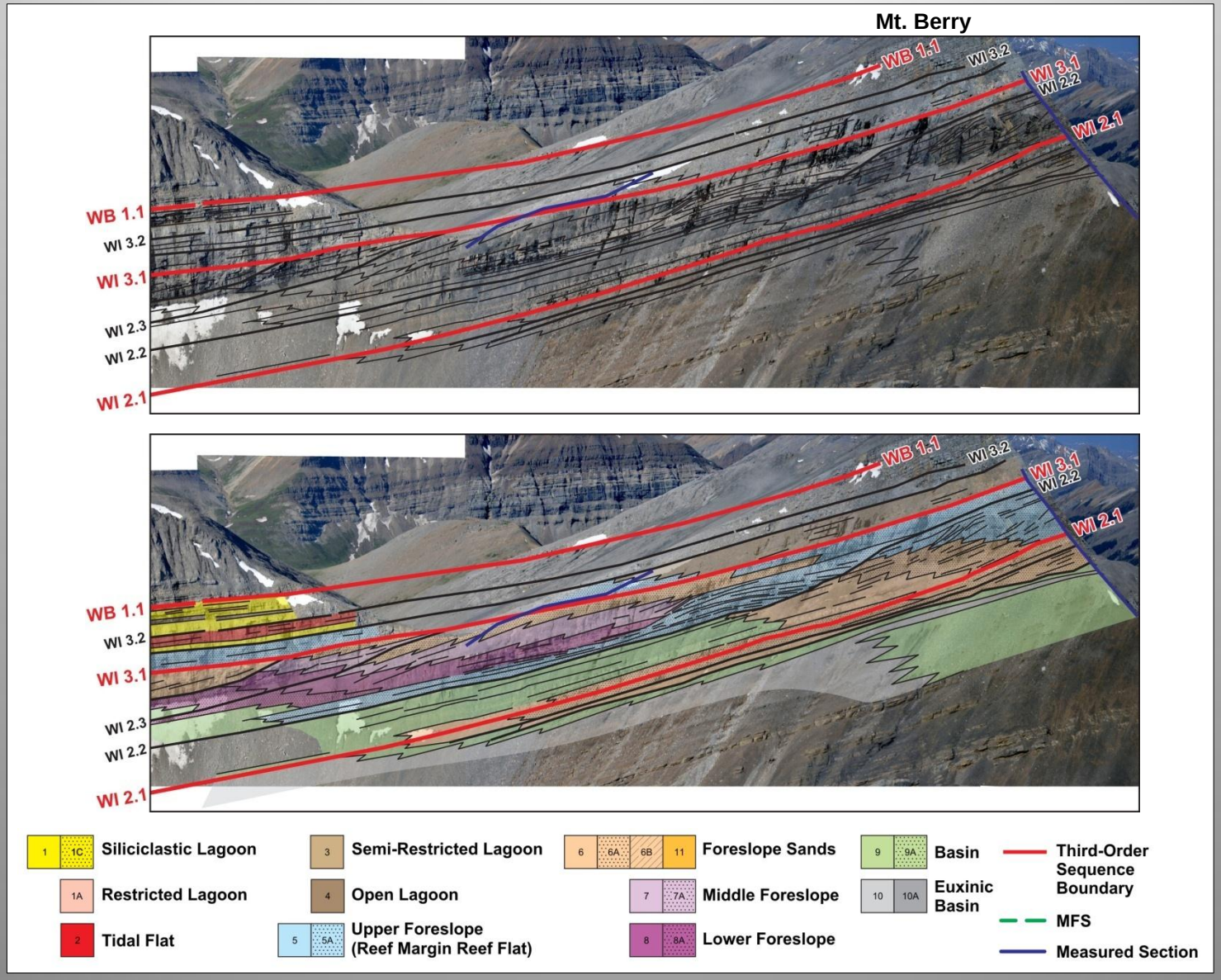
Late Frasnian Ramp Margin, Nikanassin Range II

Mt. Berry

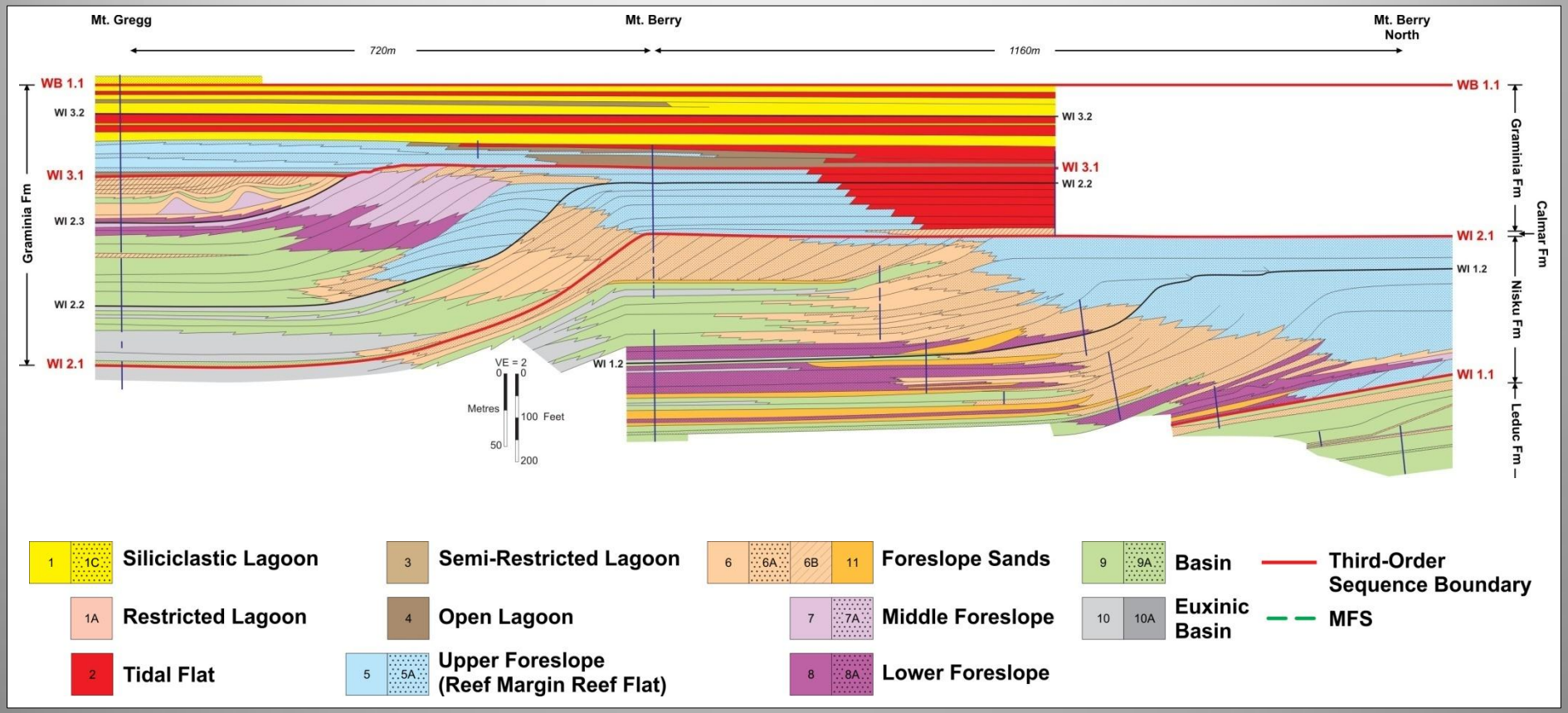


Intraclast Grainstone, Late Frasnian Second-Order Highstand

Late Frasnian Ramp Margin, Nikanassin Range III



Frasnian Second-Order Highstand, Nikanassin Range, Alberta



Conclusions

- Mid-Frasnian reef margins and basin-fill in the Jasper Basin similar to the central Alberta outcrops/sub-surface
- Late Frasnian highstand displays complex off-lapping and basinally-restricted geometries
- Reflects influence of second-order stratigraphic position and basin-fill history

Acknowledgements

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