

May 12, 2025

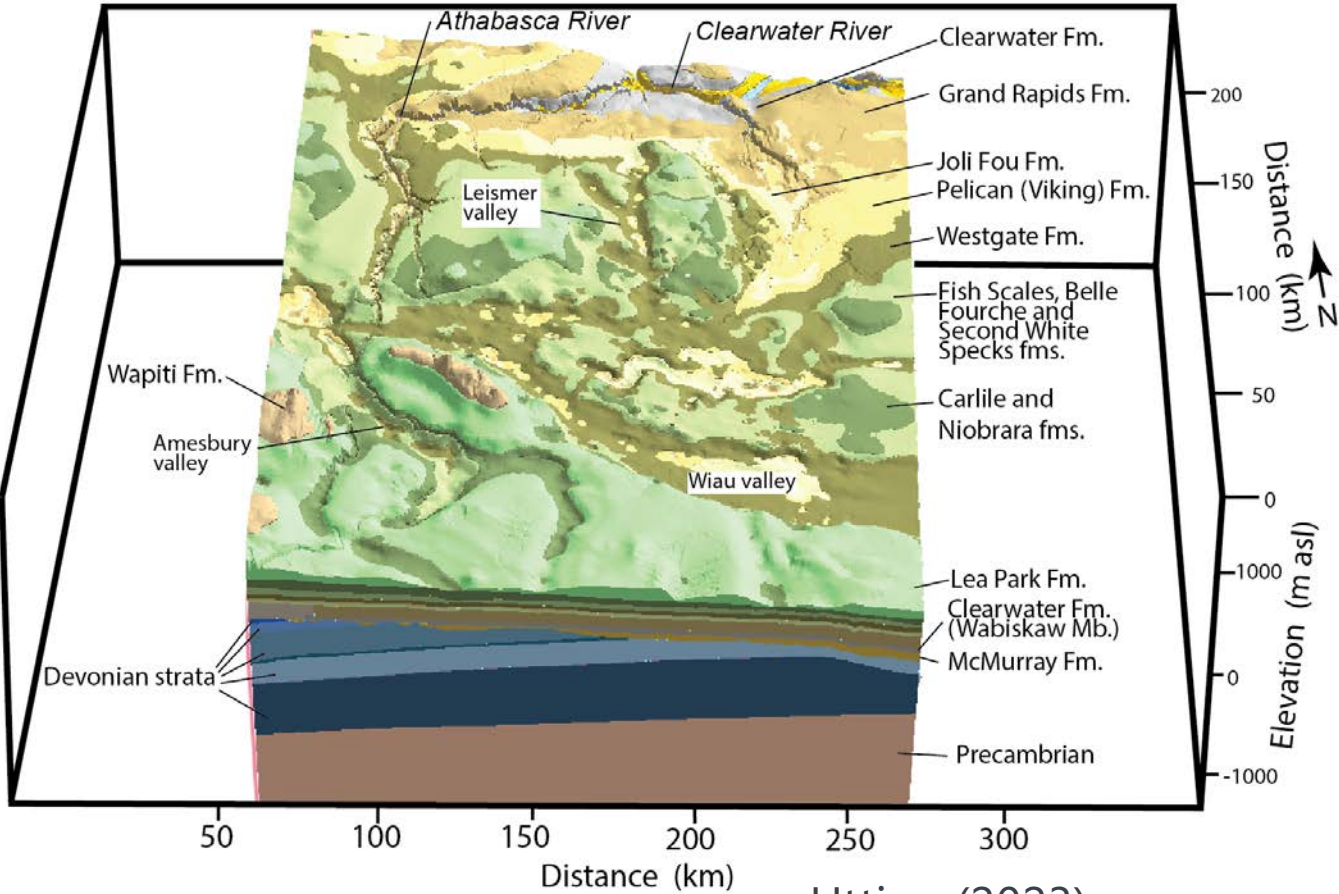
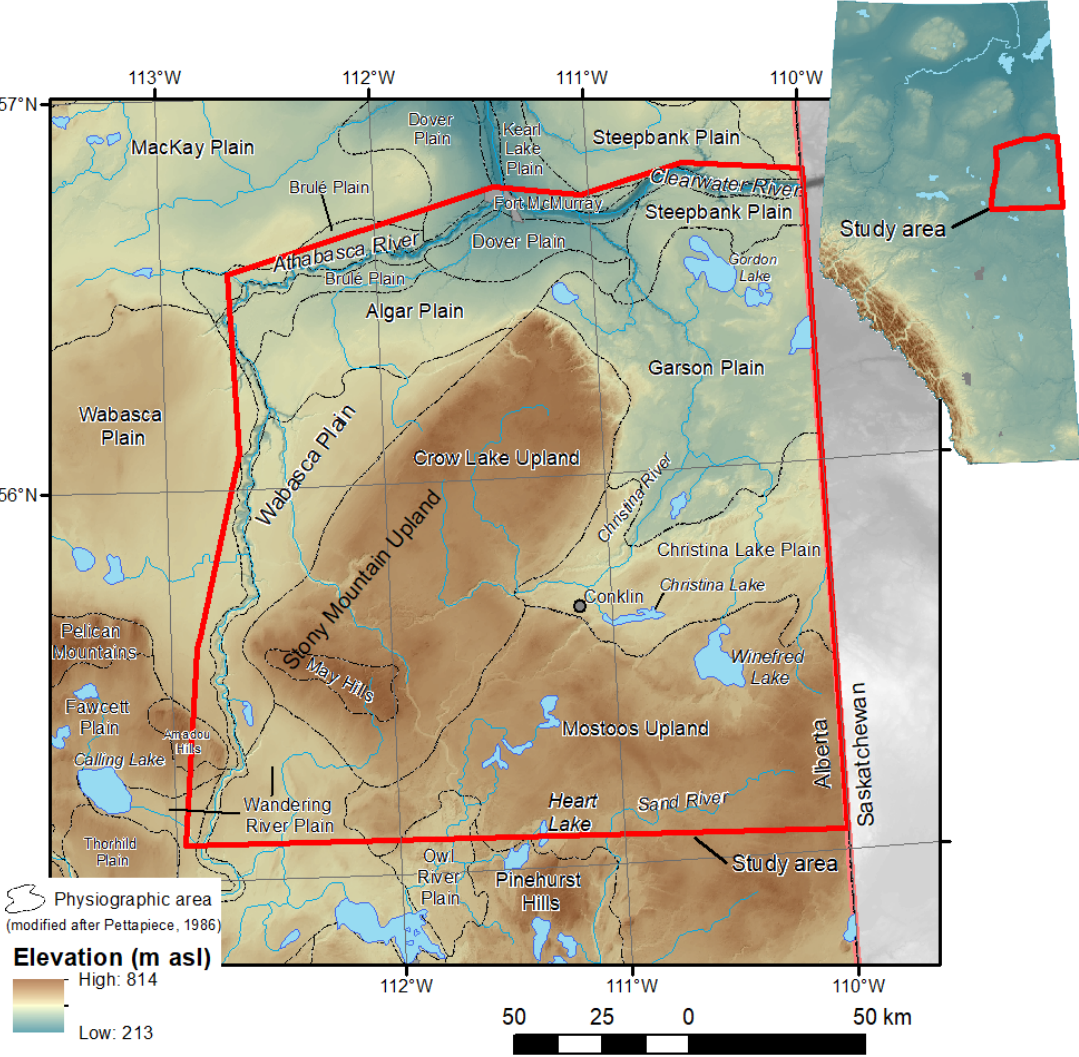
Updates to the Bedrock Topography and Stratigraphic Modelling of Materials above Bedrock in the South Athabasca Oil Sands Region, northeast Alberta

Daniel Utting

Geoconvention 2025



Study area: South Athabasca Oil Sands

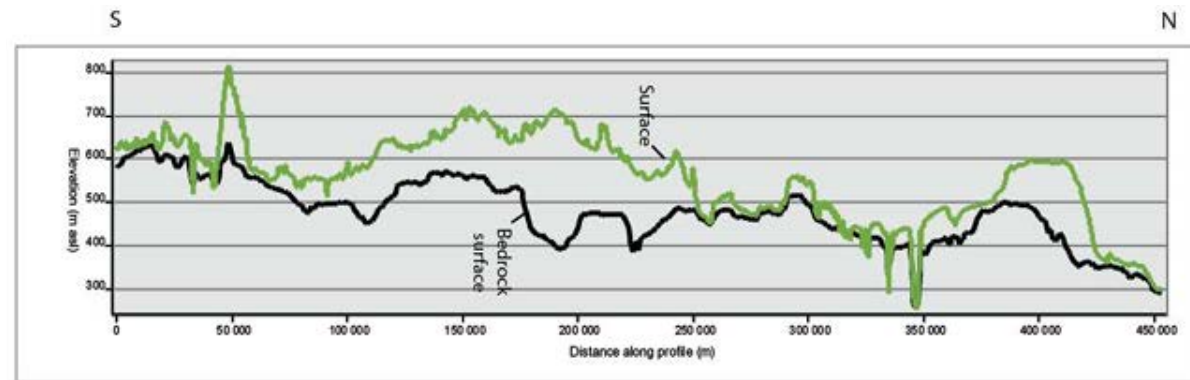
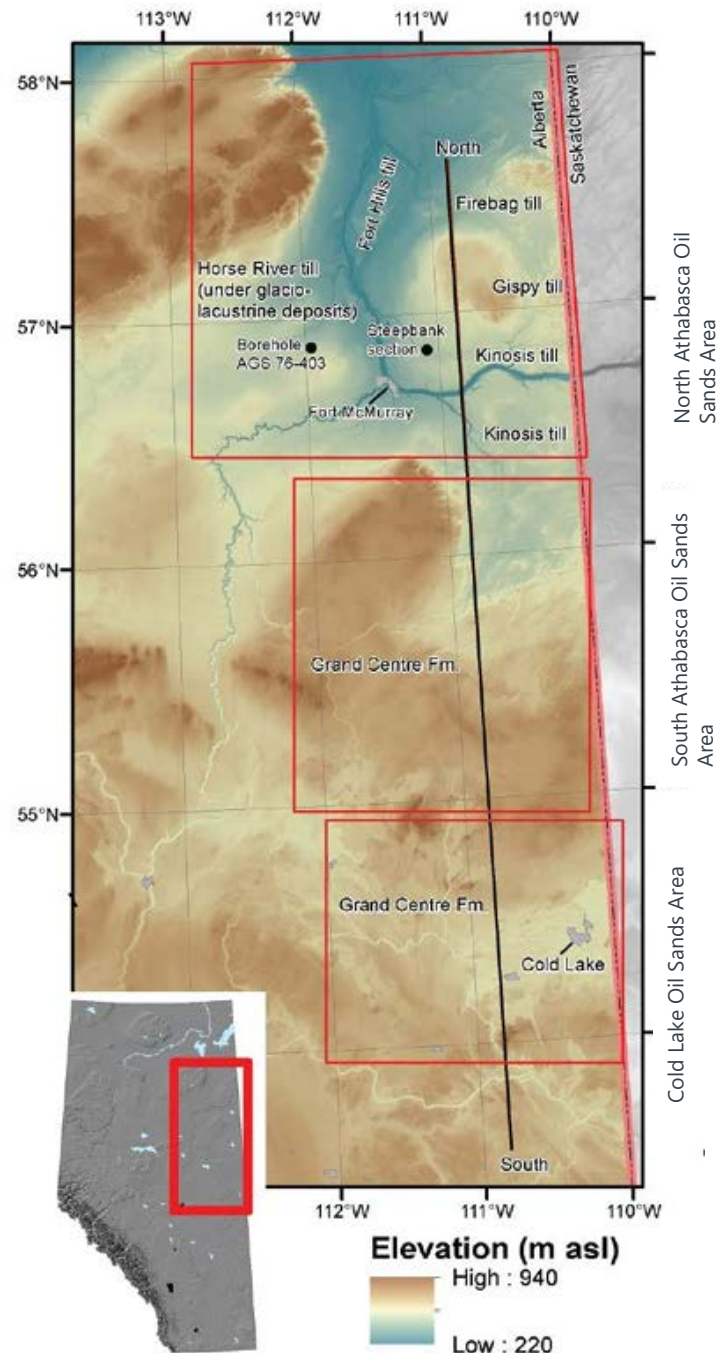


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Study area

Bedrock top data sources:

- Previous work
- Core collected by AGS and industry
- Water well lithologs
- Oil and gas geophysical logs

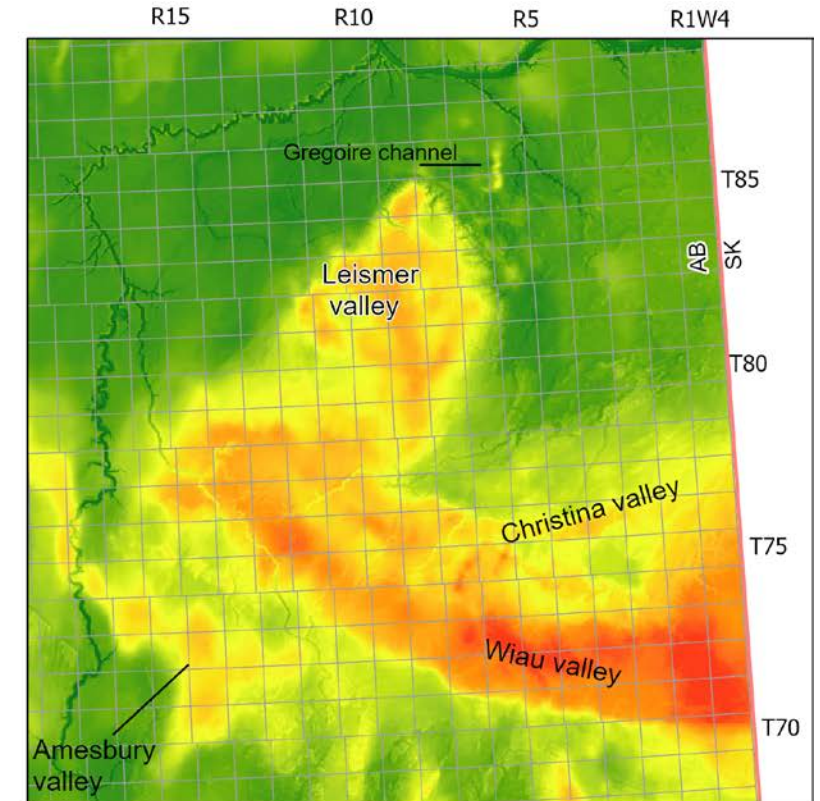
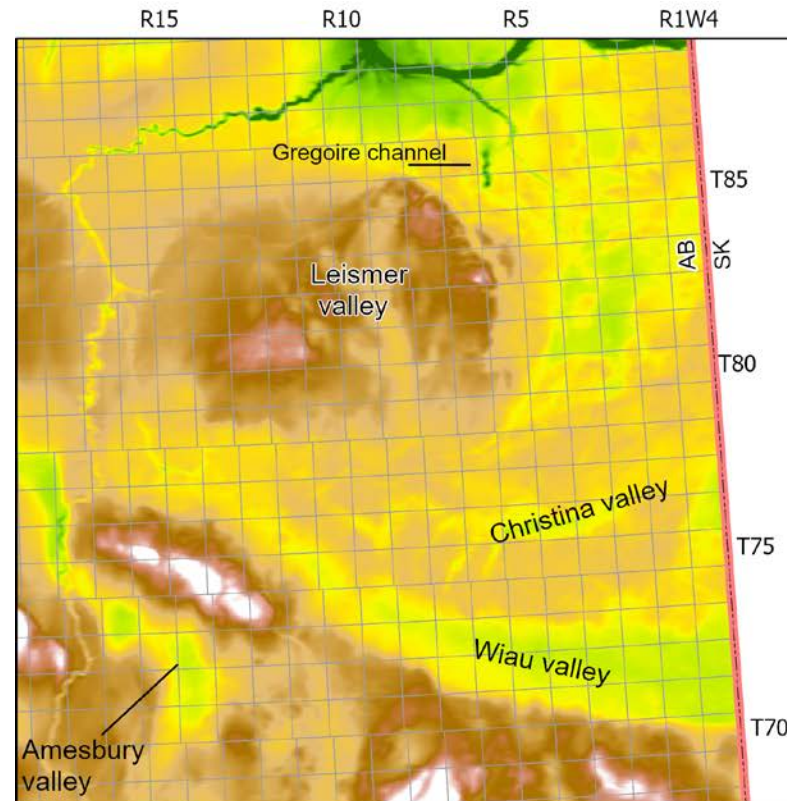


Utting and Andriashek (2020)

Bedrock Topography

Method:

- Machine learning method of Pawley et al. (2024)
- Control points required to capture some features
- Some known issues (overprinting of surface features, lack of detail for features like narrow valleys/channels)

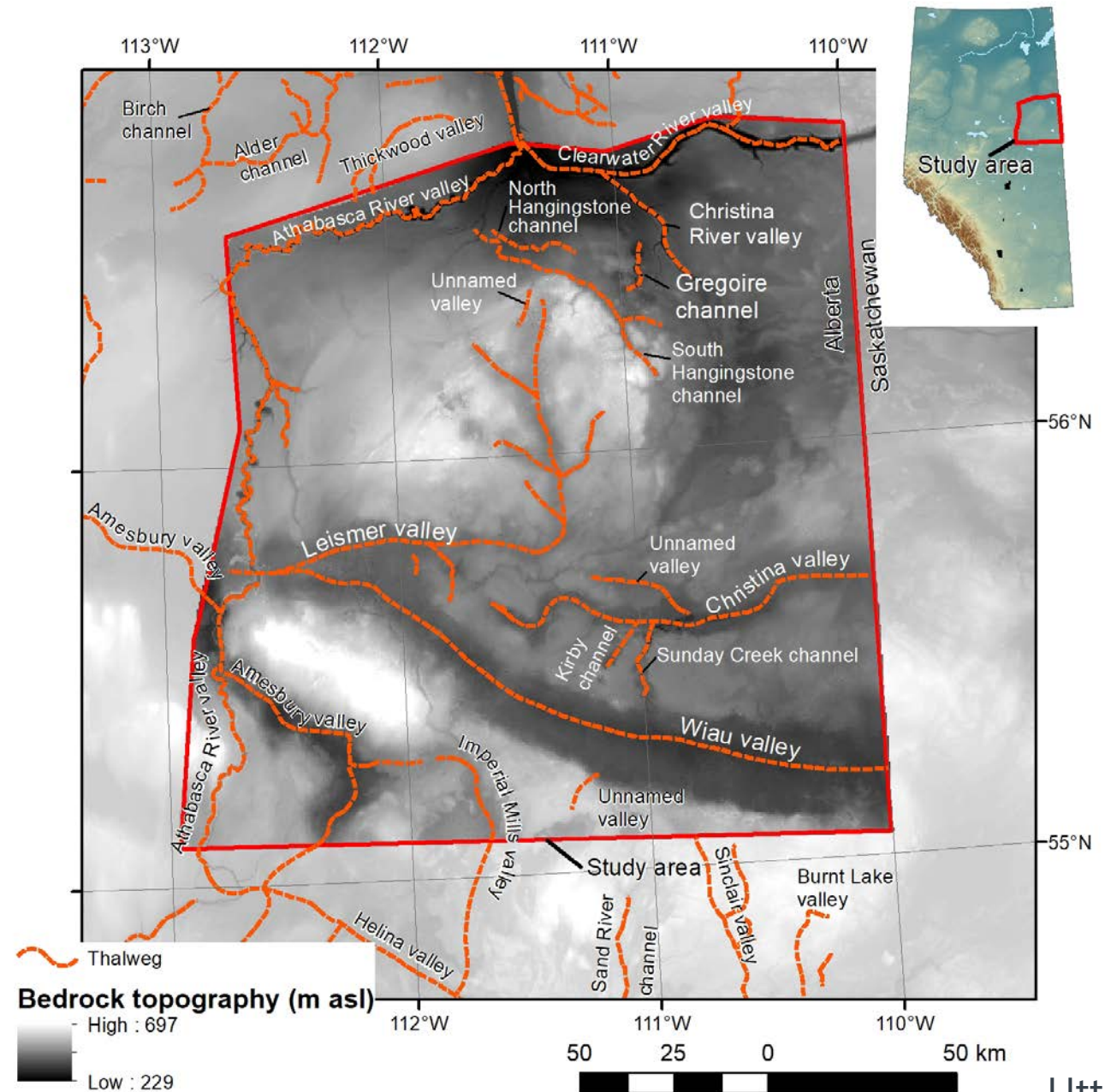


Modified after
Utting (2023)

0 15 30 60 km

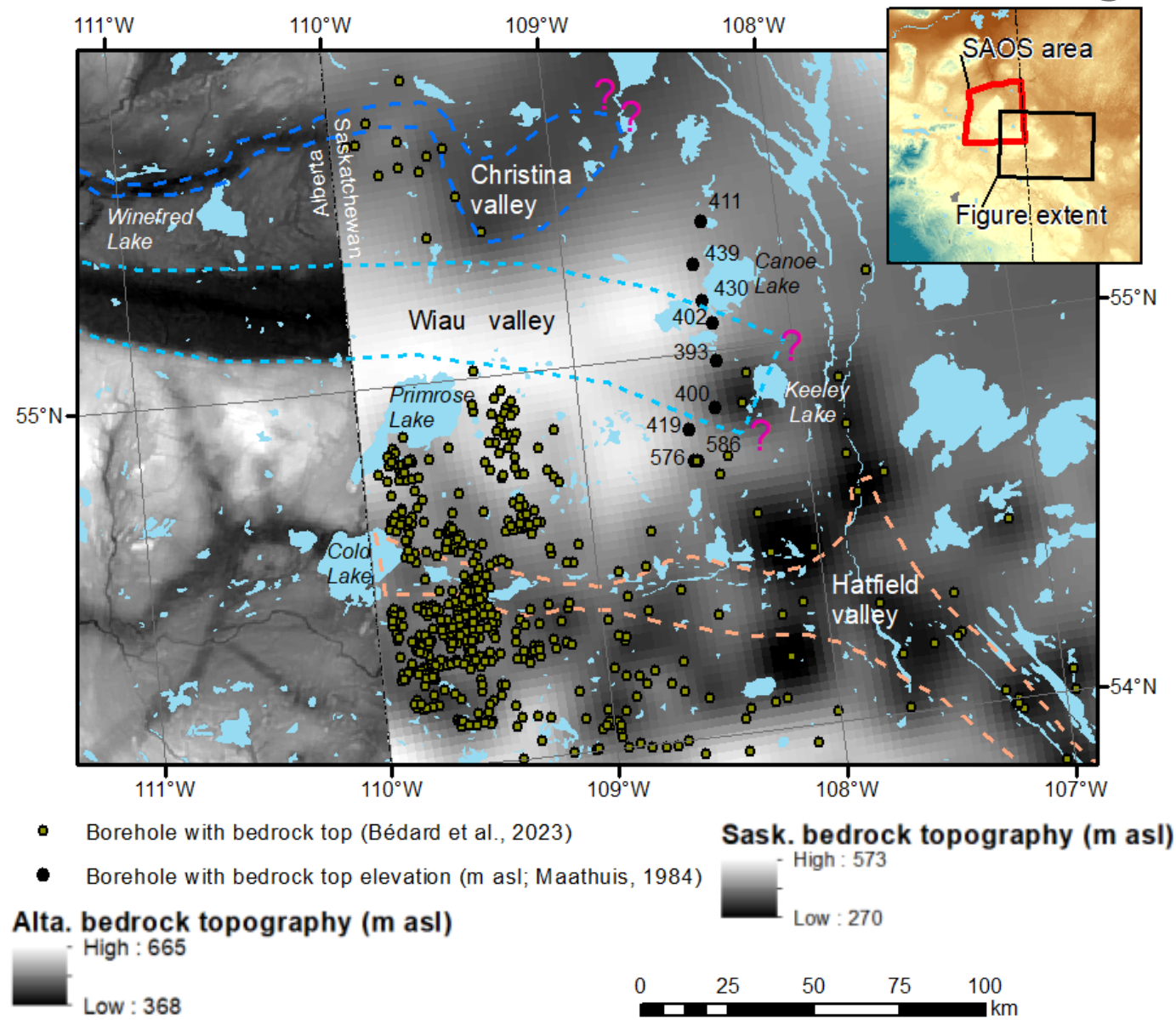
Key updates:

- Addition of North and South Hangingstone channels
- Sunday Creek channel
- Separation of Christina valley from Wiau



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Extension of Wiau valley

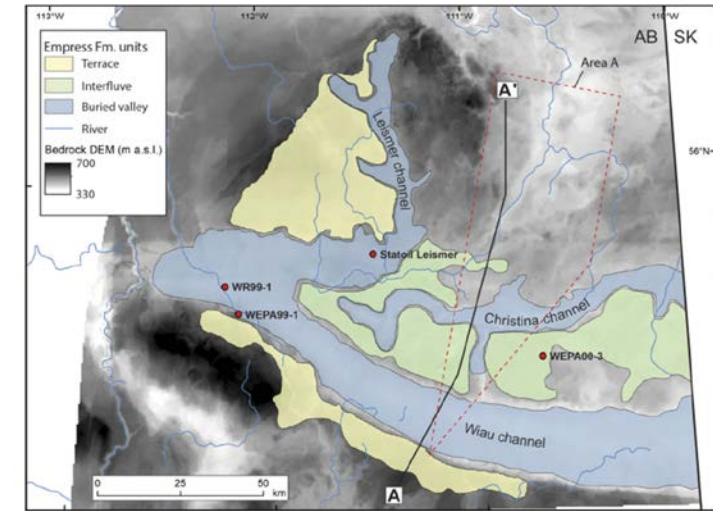
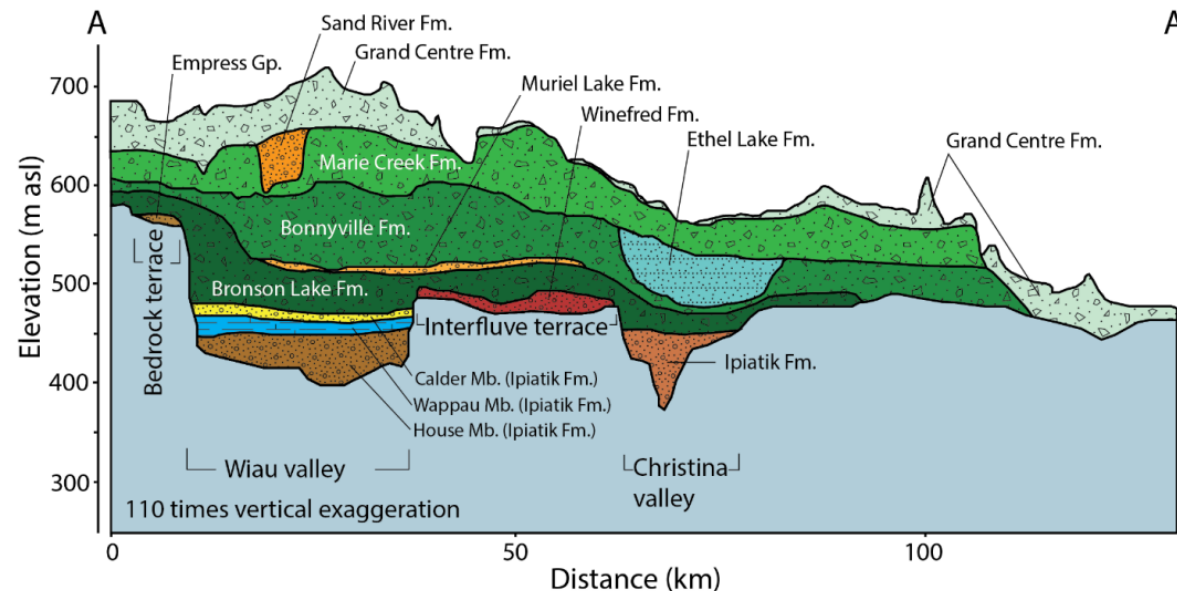
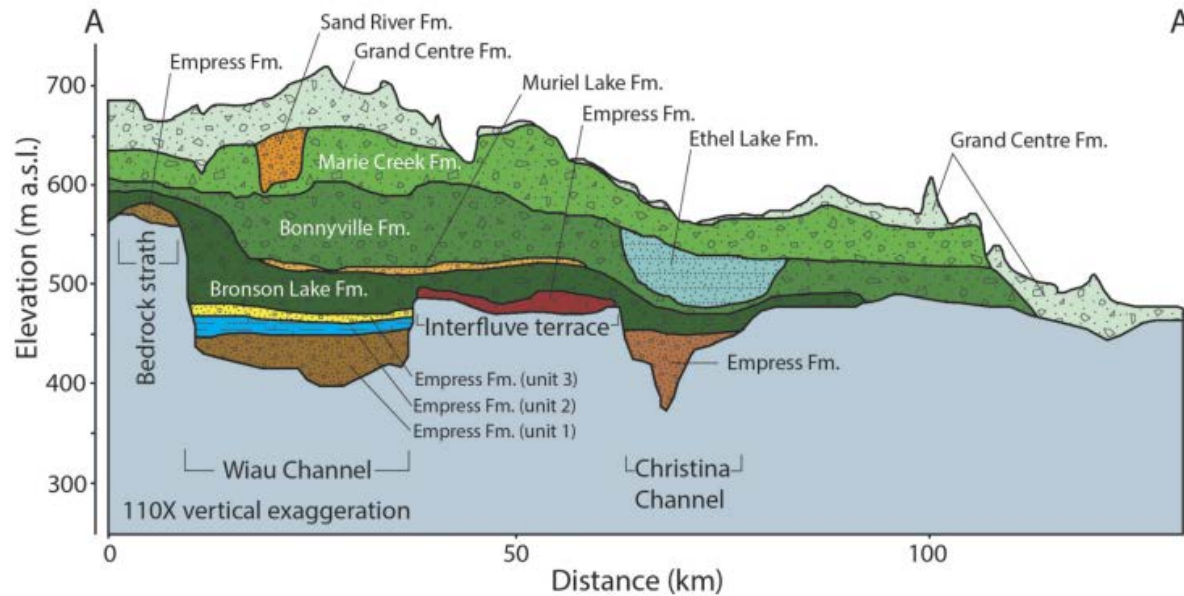


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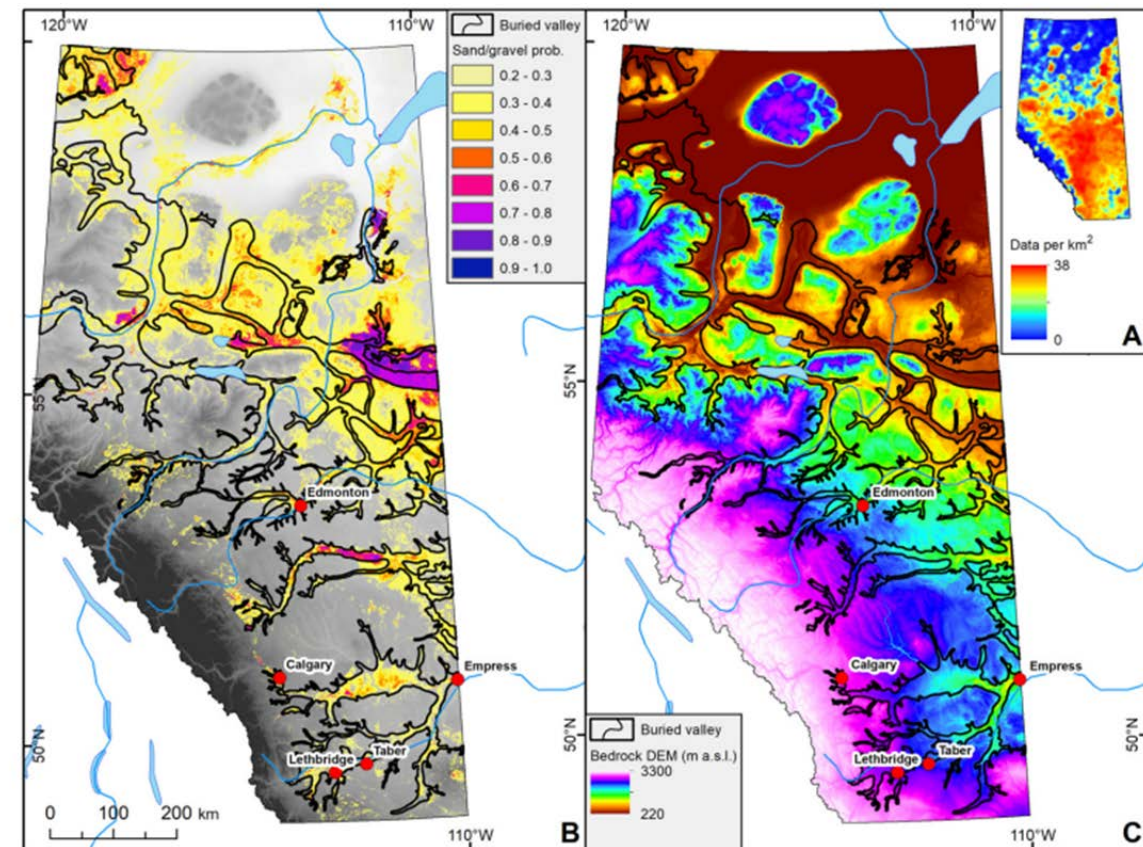
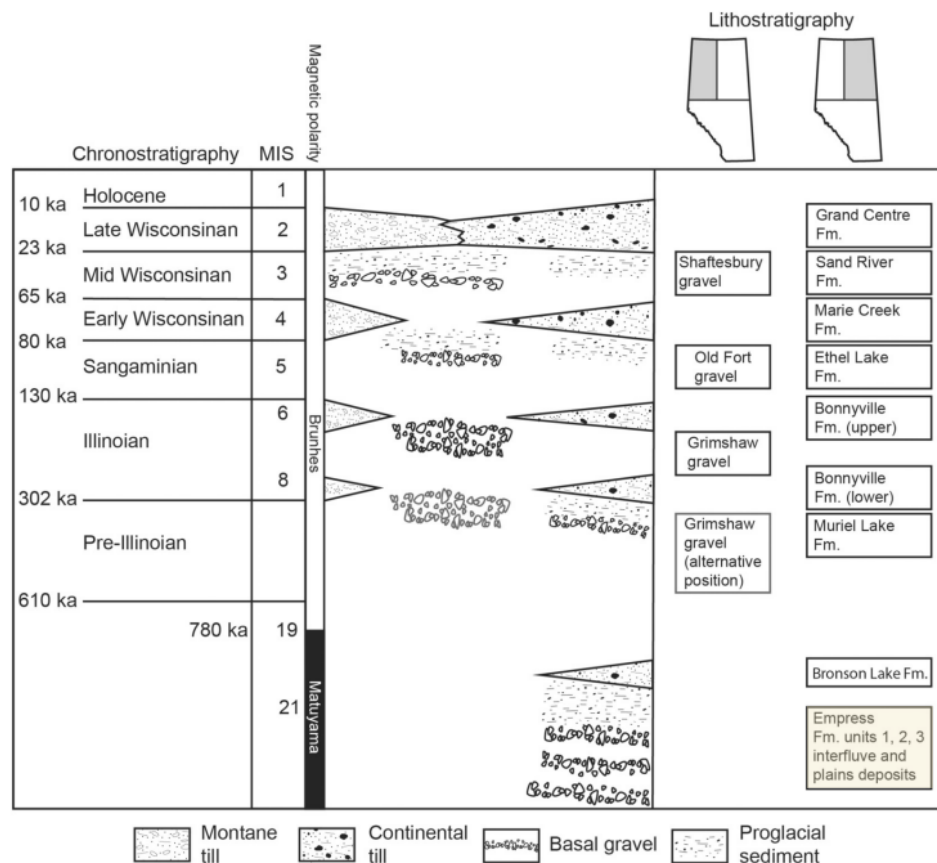
Updates to stratigraphic nomenclature

Key changes:

- Empress Formation elevated to Group status
- Formations subdivided, such as the Ipiatik and Winefred formations
- Previous units 1, 2 and 3 elevated to Member status



Hartman *et al.* (2024)

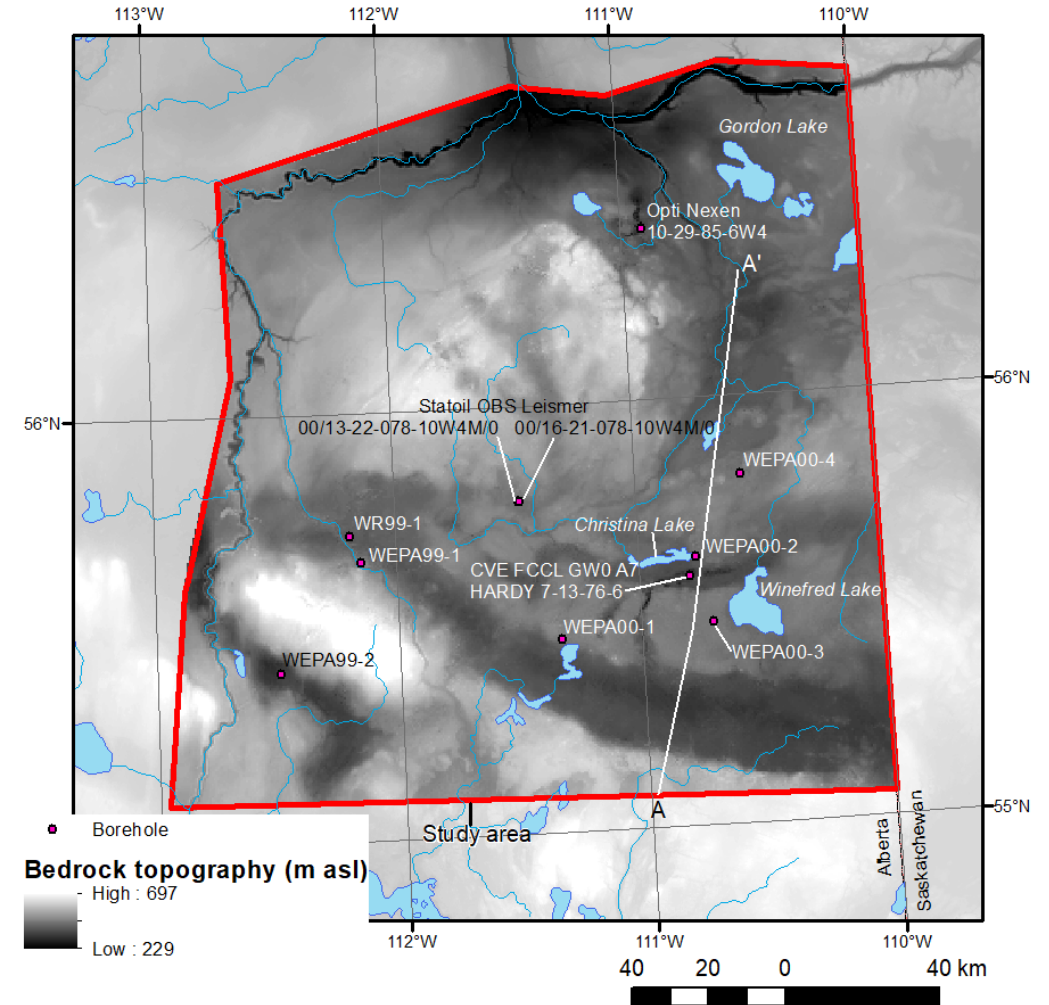
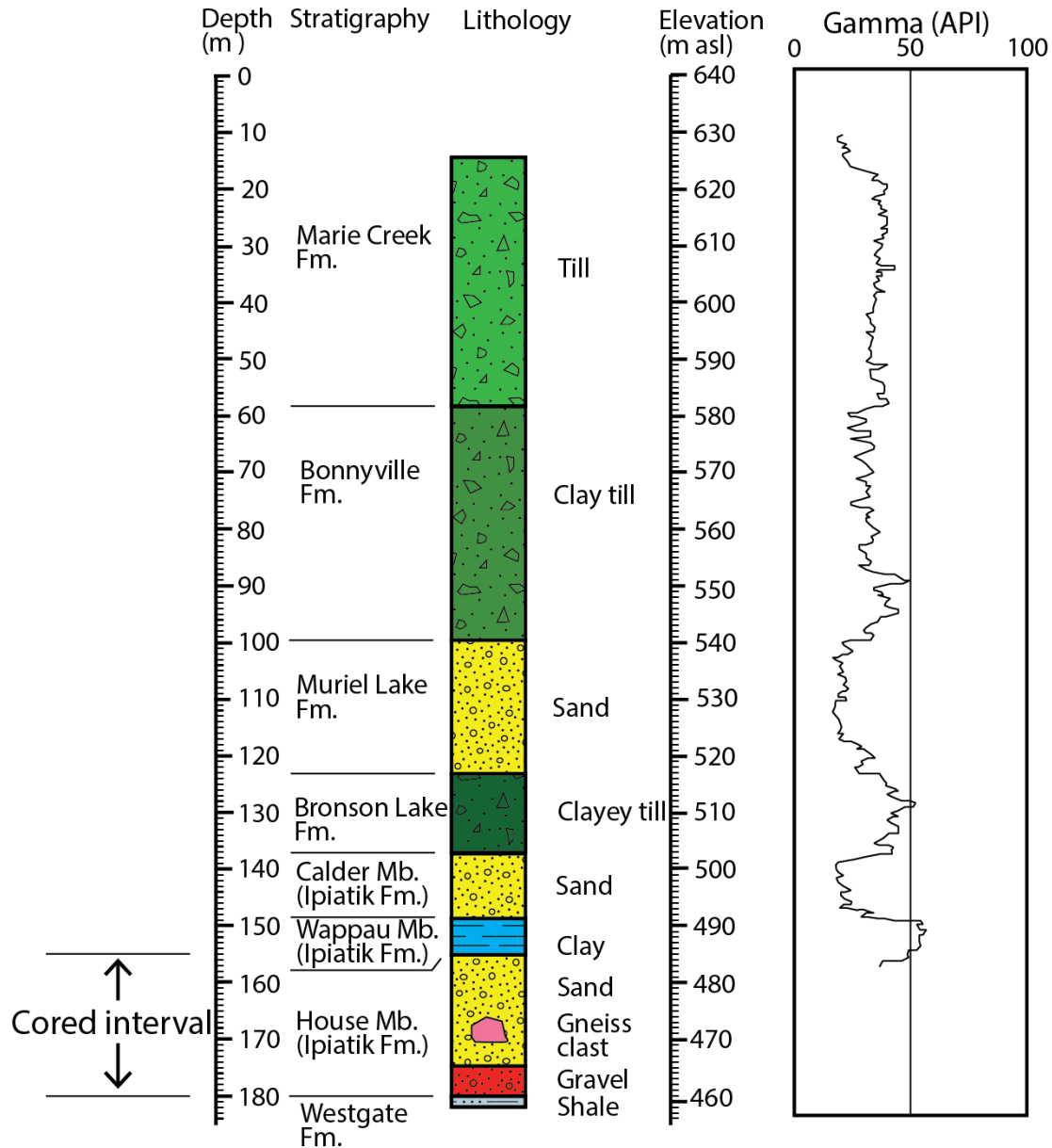


Empress Group:

All sequentially related gravel in a paleo-valley that immediately pre-dates glaciation, as well as conformably overlying fine grained glaciogenic deposits (i.e. glaciolacustrine sediments) and occupy bedrock floored buried valleys.

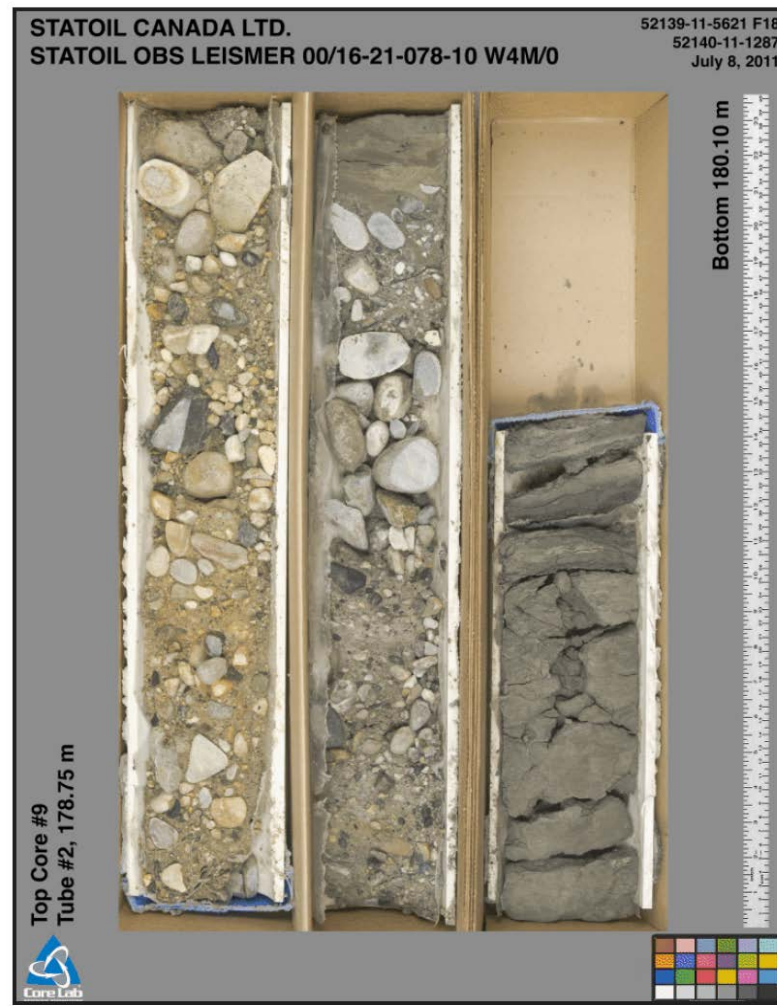
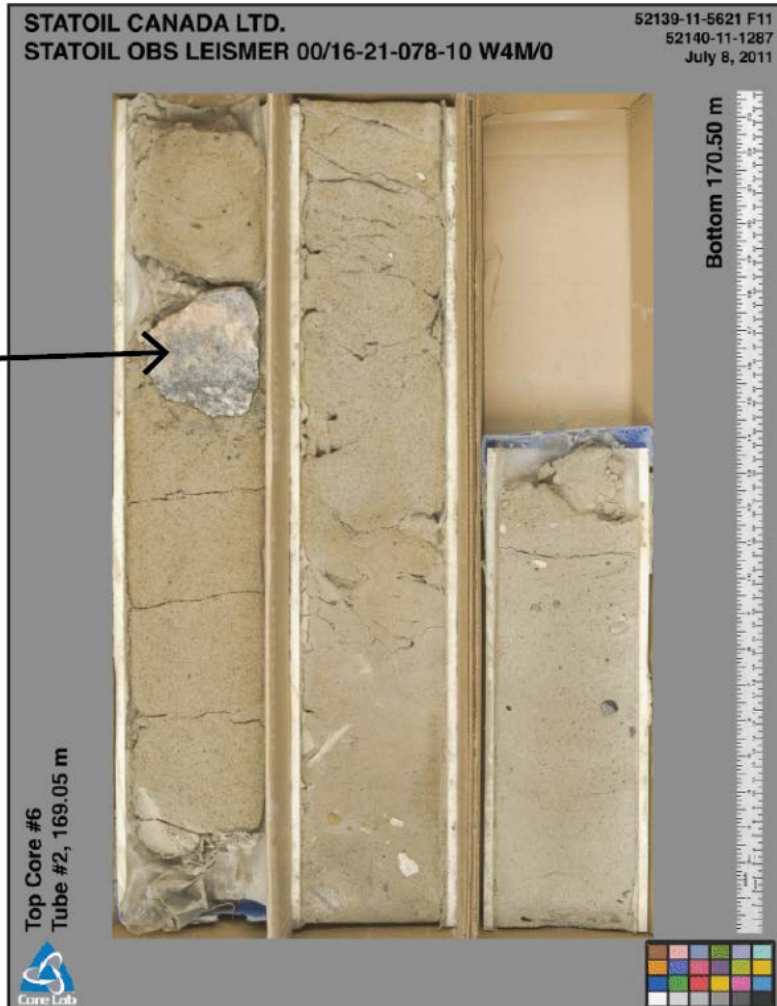
Hartman *et al.* (2024)

Stratigraphic updates



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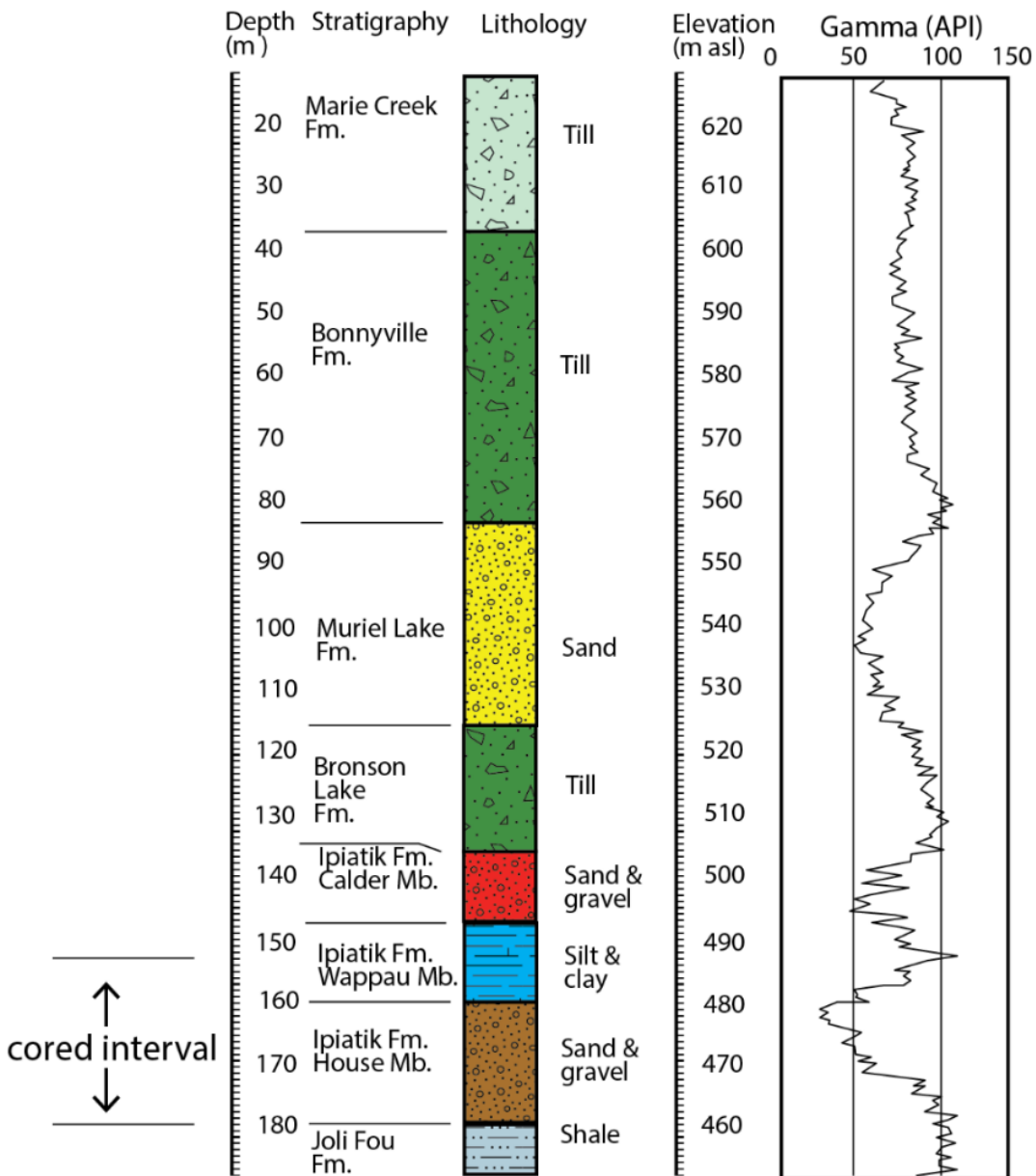
Gneiss clast at 169.4 m depth



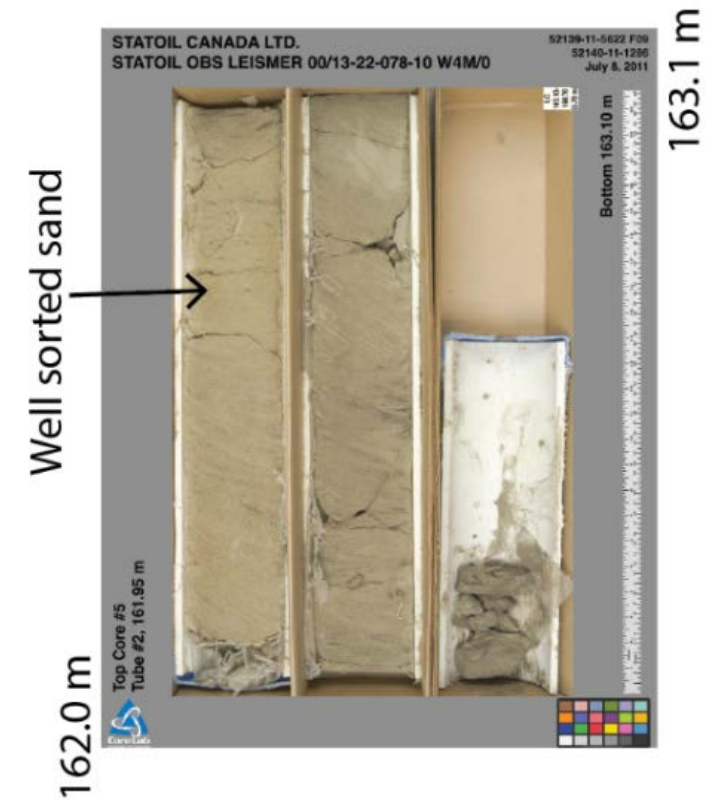
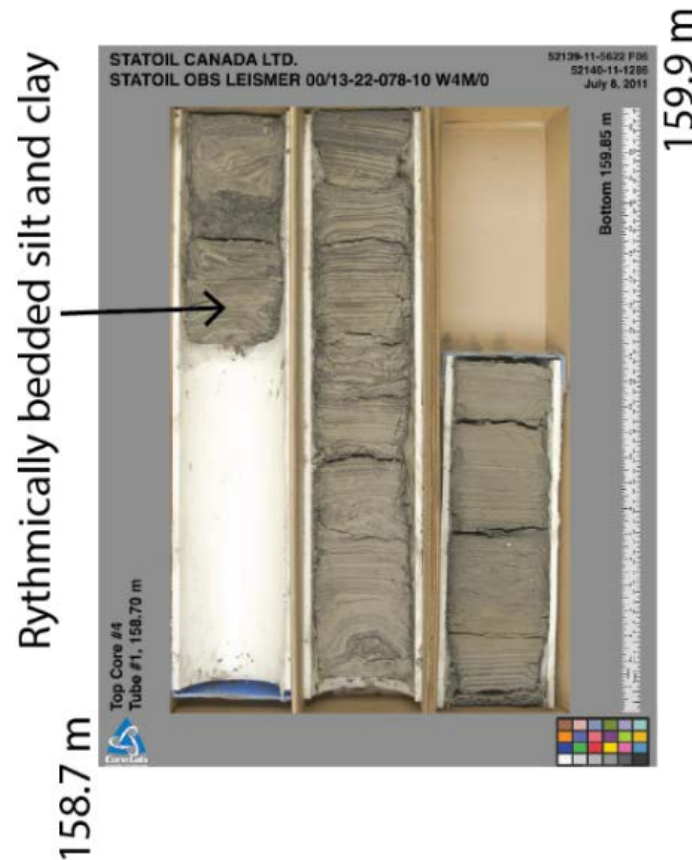
Ipiatik Formation House Member Description:

- Stratified sand and gravel, mainly chert and quartzite derived from Cordillera or local bedrock derived material
- May have clasts derived from Shield in upper portion
- Preglacial in origin
- May have a basal gravel of ~5 m
- Sands light coloured, primarily quartz, with darker chert grains

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Wappau Member:
Stratified silt and clay, fluvial or
glaciolacustrine in origin



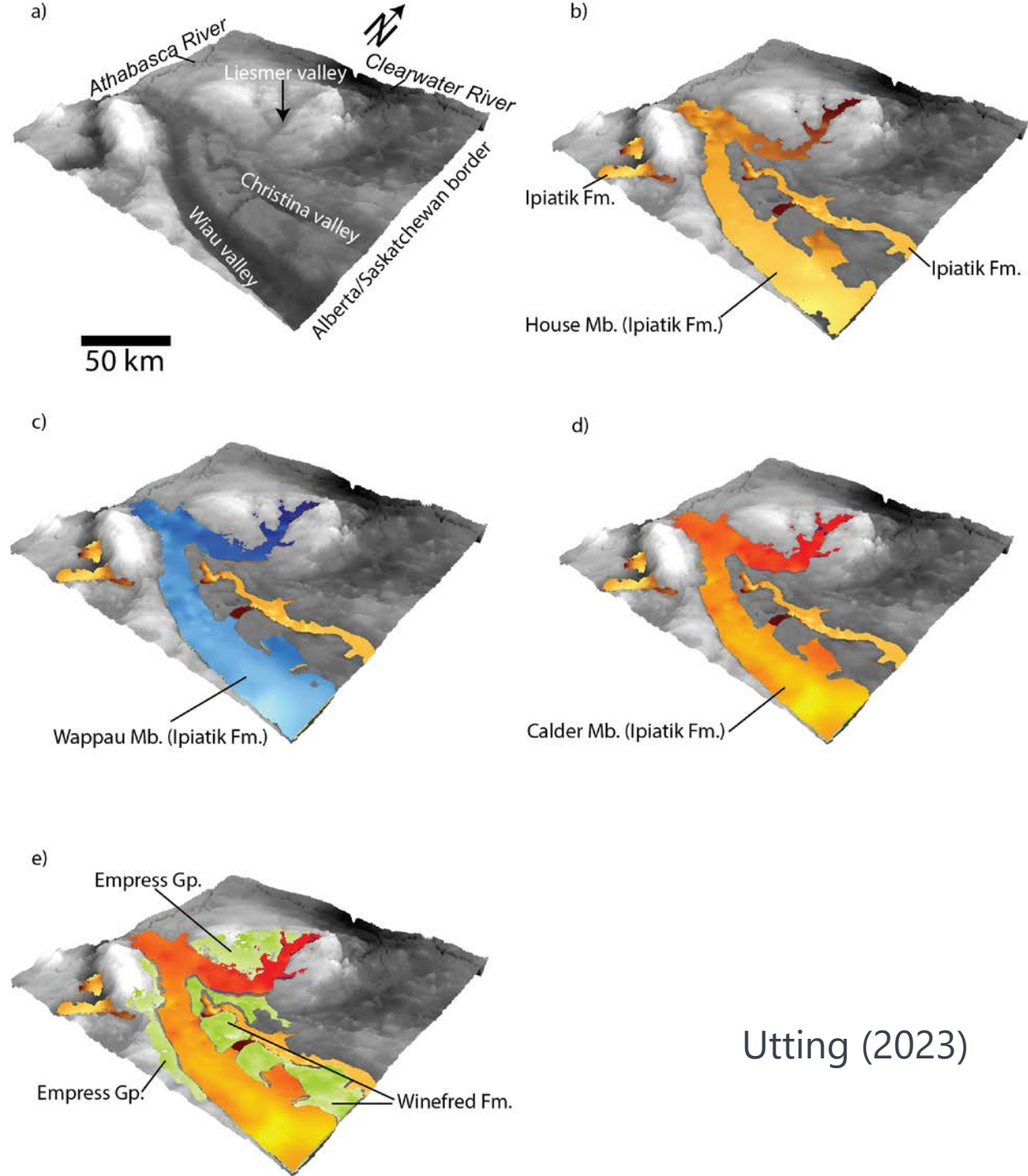
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House Member – preglacial
fluvial deposits

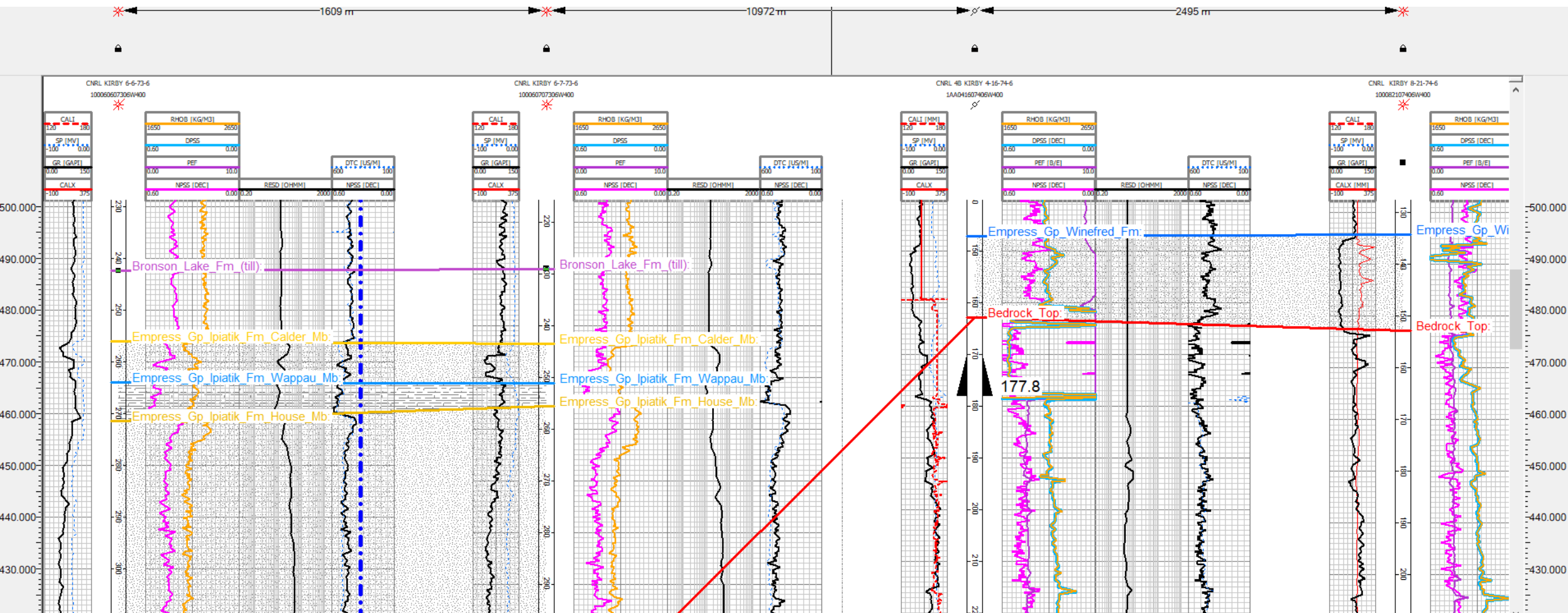
Wappau Member –
glaciolacustrine

Calder Member –
fluvial/glaciofluvial

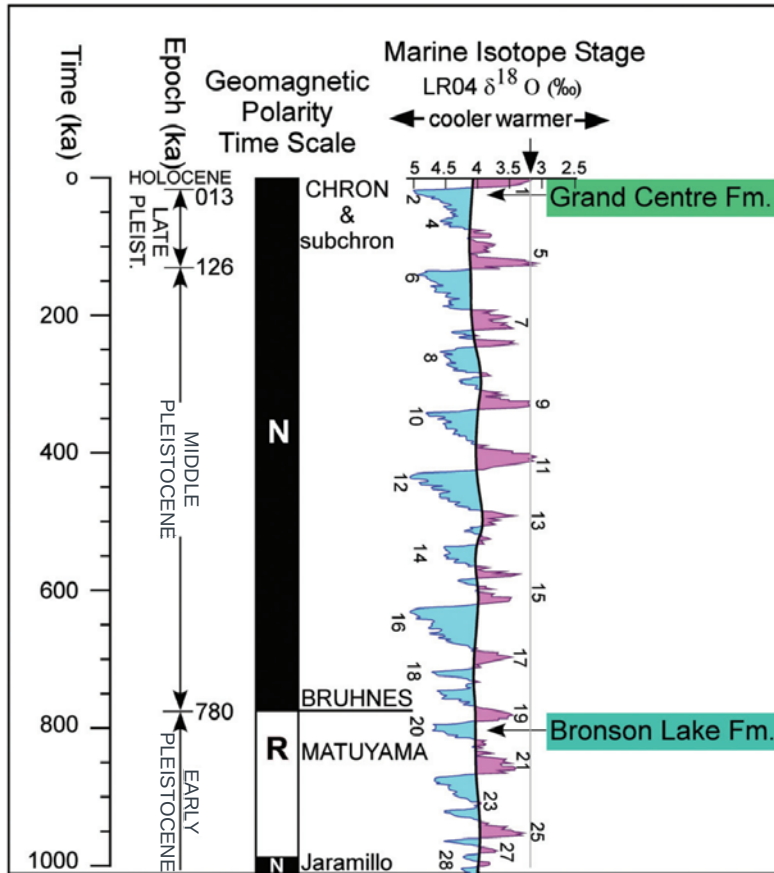
Winefred Formation – terrace
deposits containing shield
material



Utting (2023)

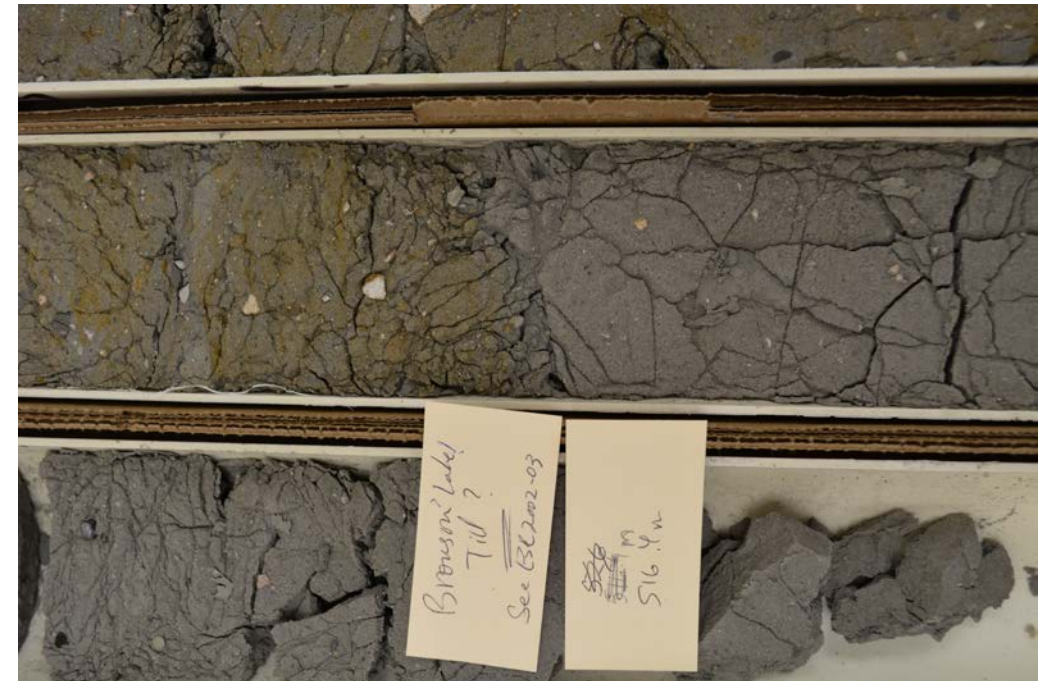


Empress Group on interfluvial (Winefred Formation) disconnected from Empress Group in the Wiau Valley (Ipiatik Formation). Possibly originally continuous but subsequently separated as a result of compaction of Wappau Member sediments.



Bronson Lake Formation:

- Oldest, lowest till
- Not many clasts, dark grey brown, clayey diamicton
- Reversely magnetized



ARTICLE

Evidence for Early Pleistocene glaciation from borecore stratigraphy in north-central Alberta, Canada

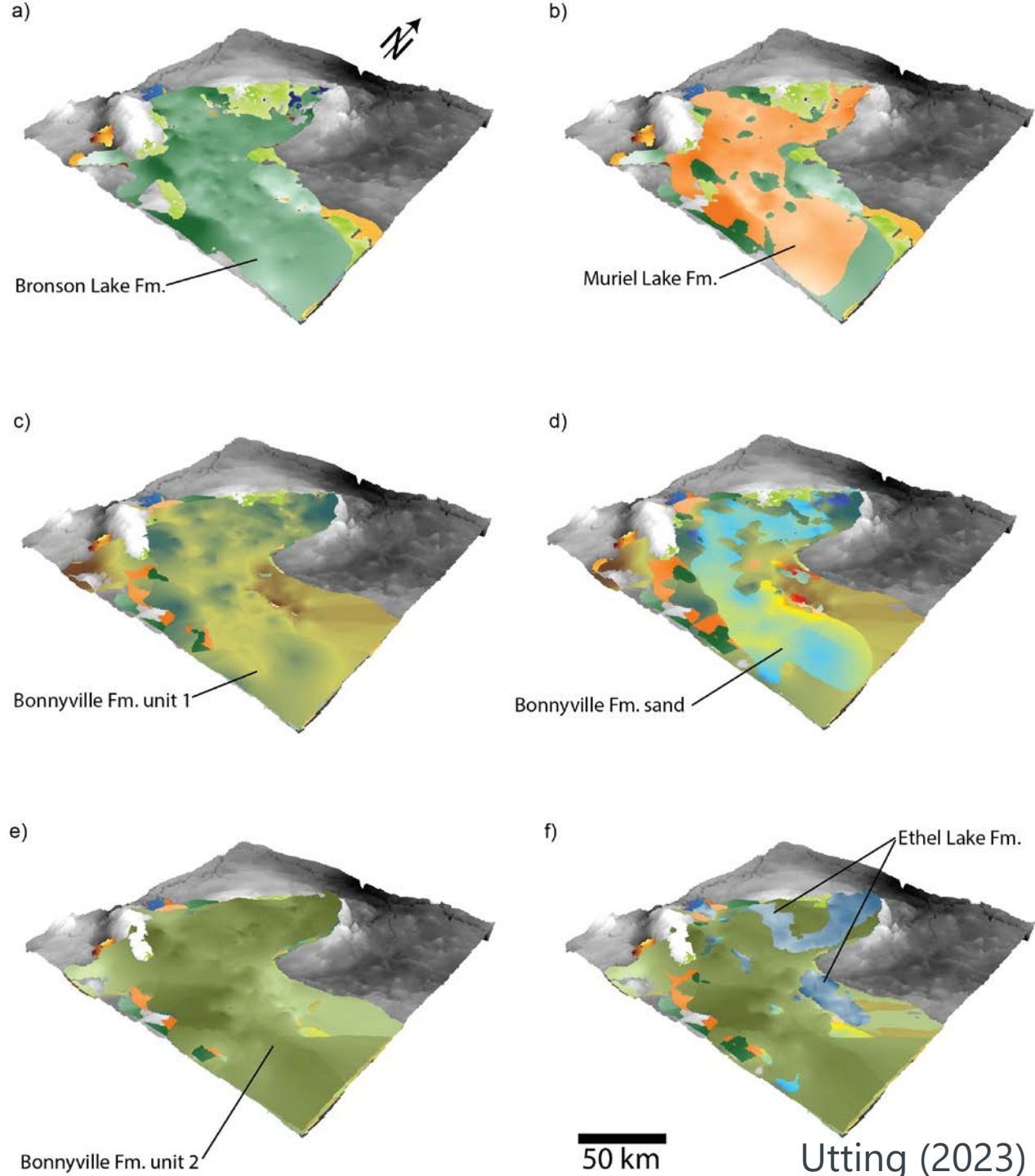
Laurence D. Andriashek and René W. Barendregt

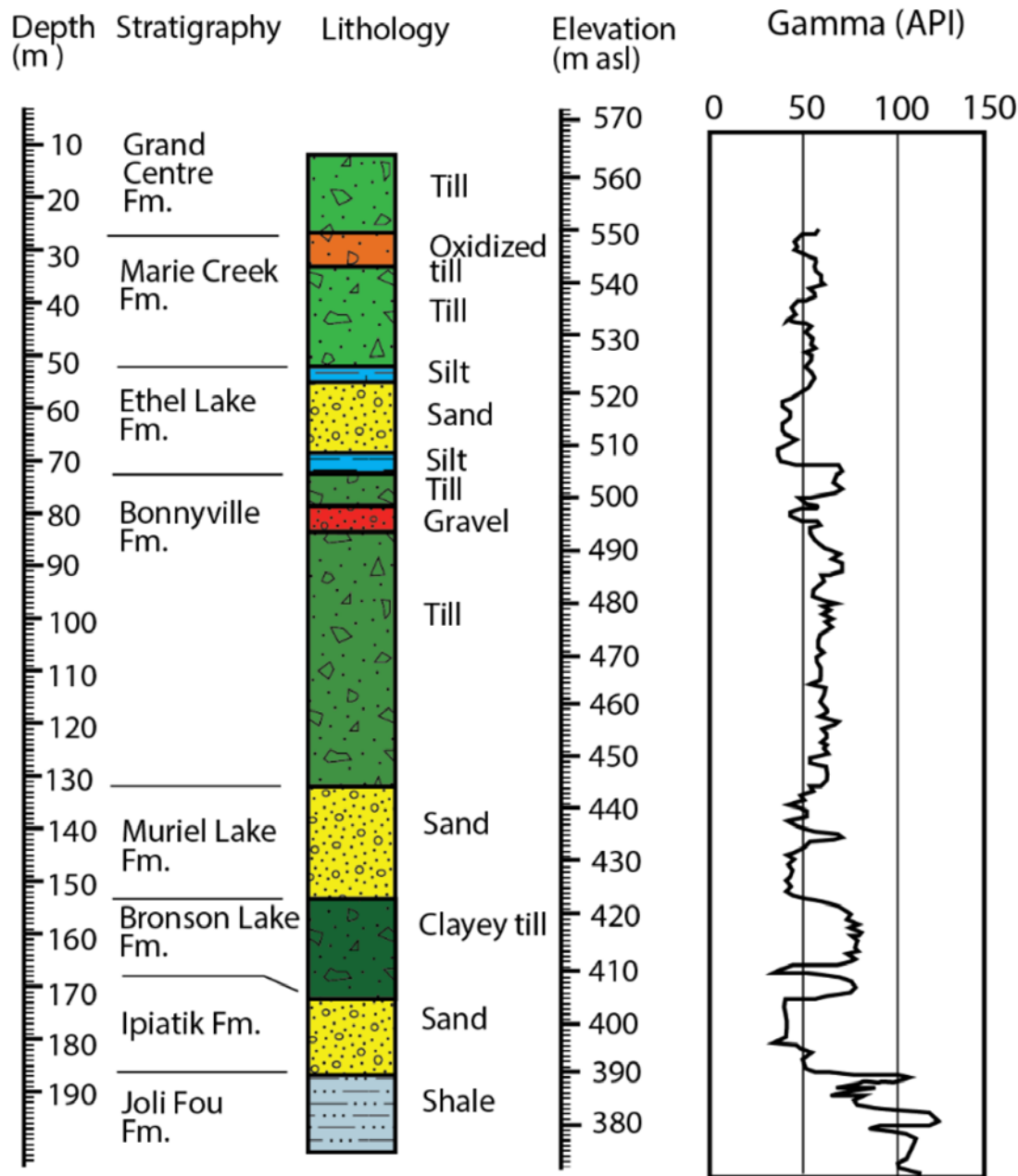
Andriashek and Barendregt (2017)

Bonnyville Formation Unit 1:
clayey diamicton

Bonnyville Formation Sand:
sand unit between units 1 and 2

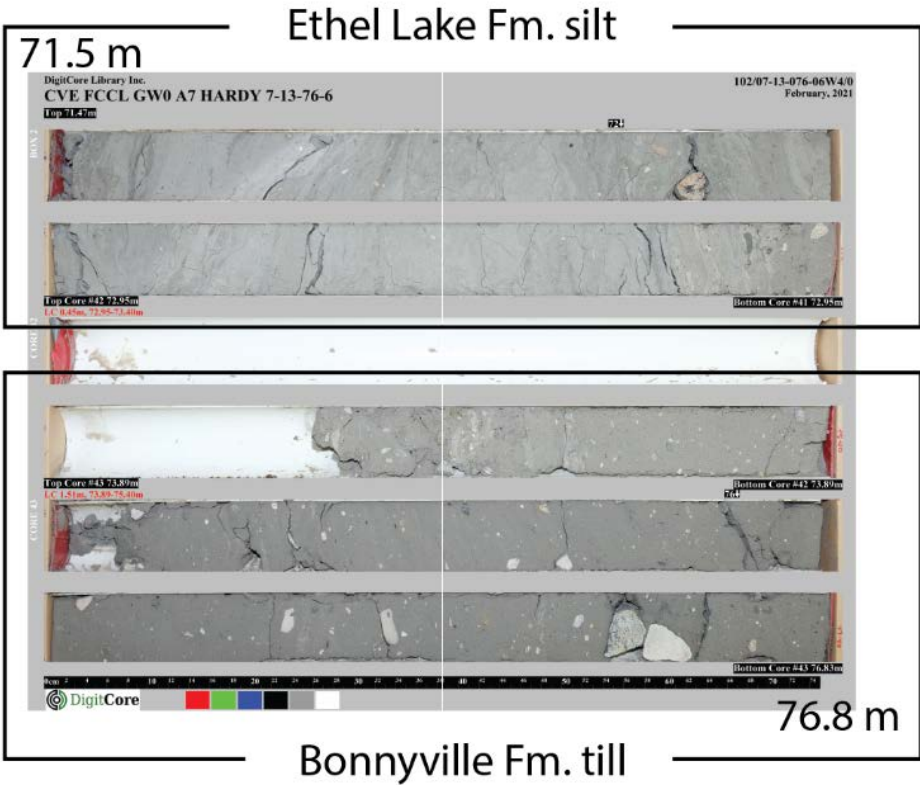
Bonnyville Formation Unit 2:
sandy diamicton





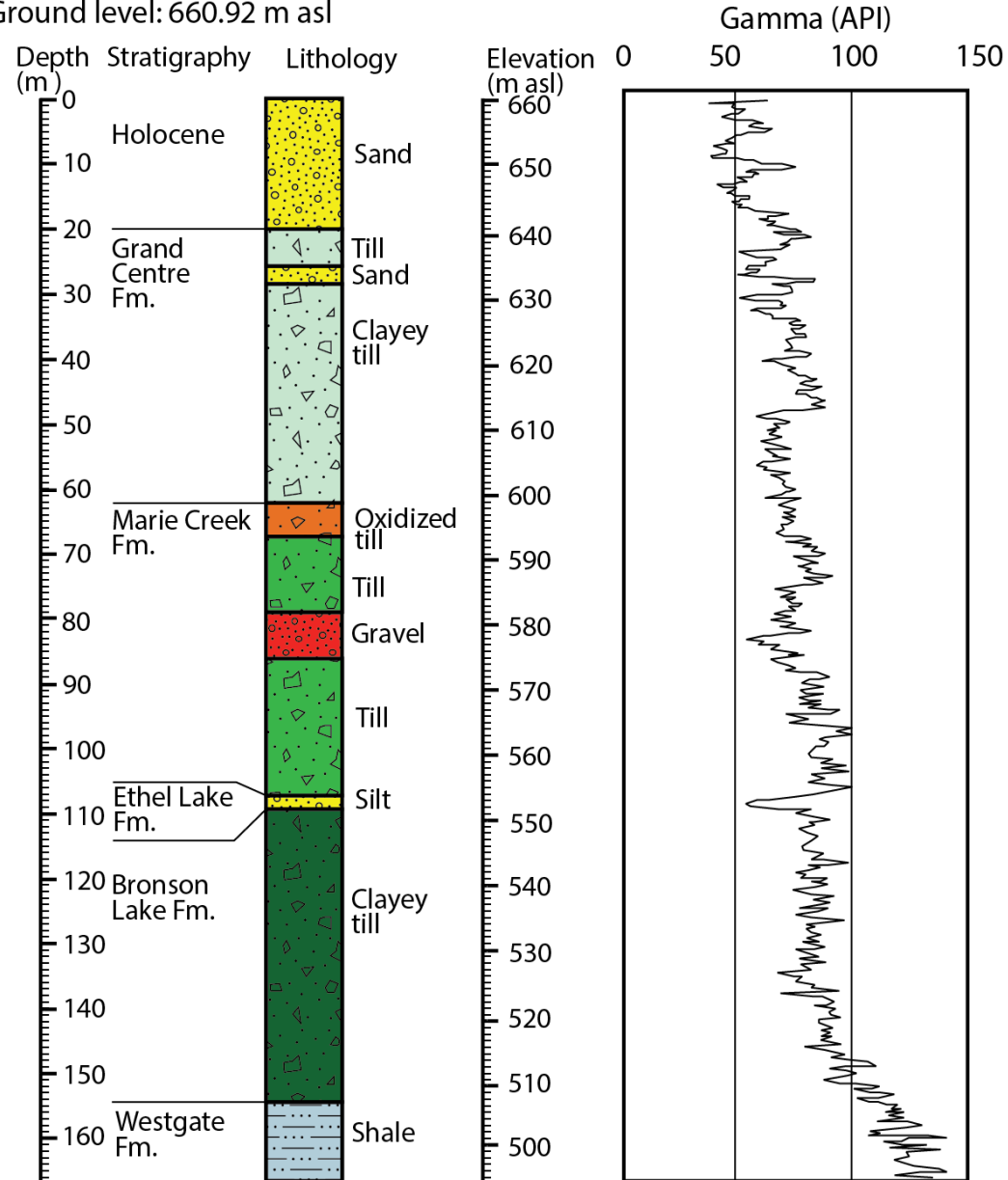
Ethel Lake Formation:

- Clay, silt, sand, and gravel
- Distribution likely based on predeposition topography

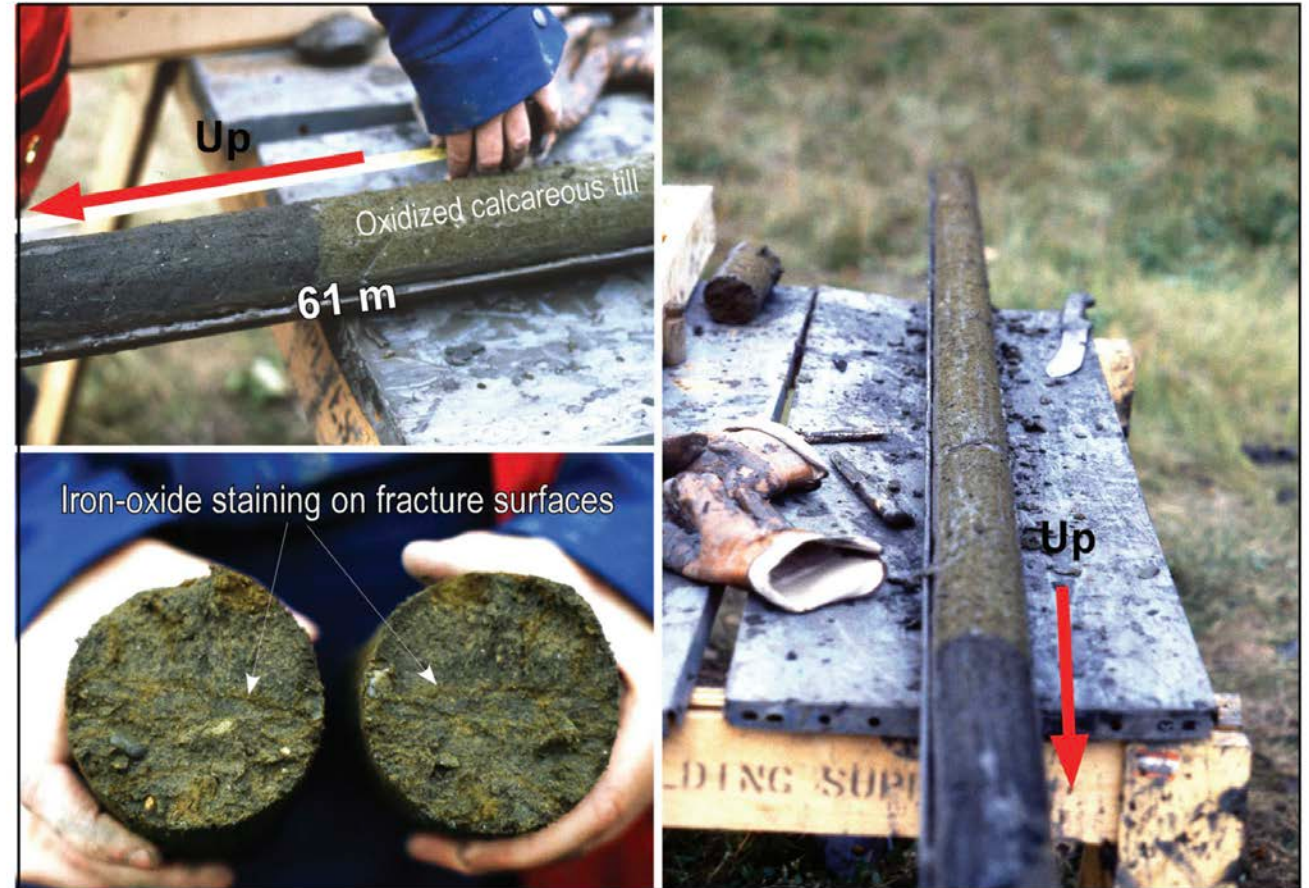


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WEPA99-1
 03-08-77-14W4
 Ground level: 660.92 m asl

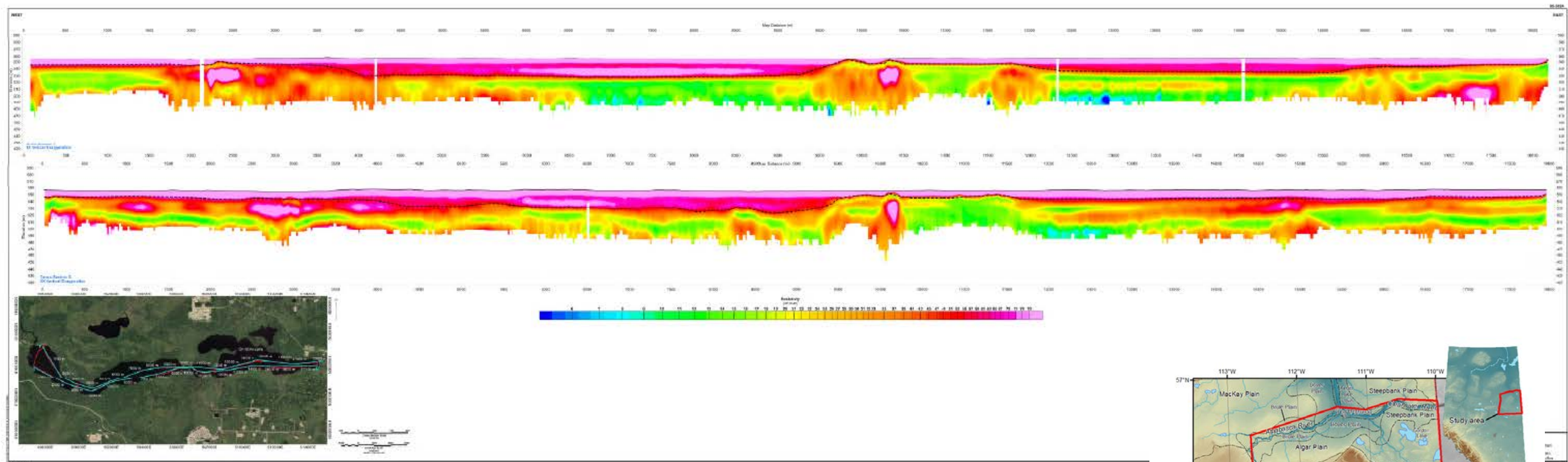


Marie Creek Formation: Oxidized calcareous till



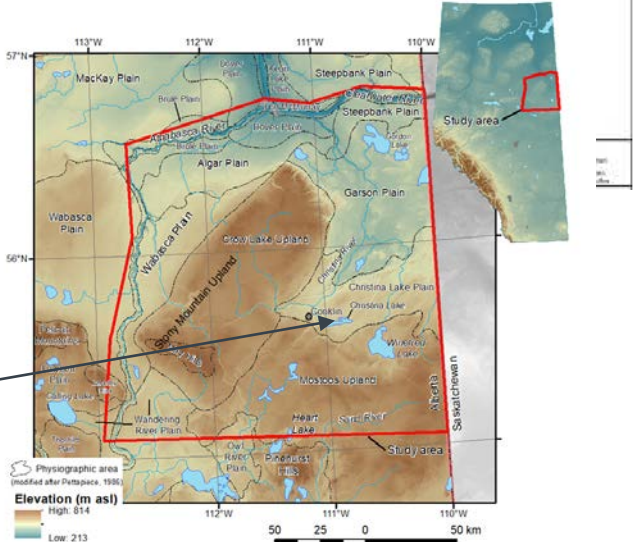
Utting (2023)

tTEM survey

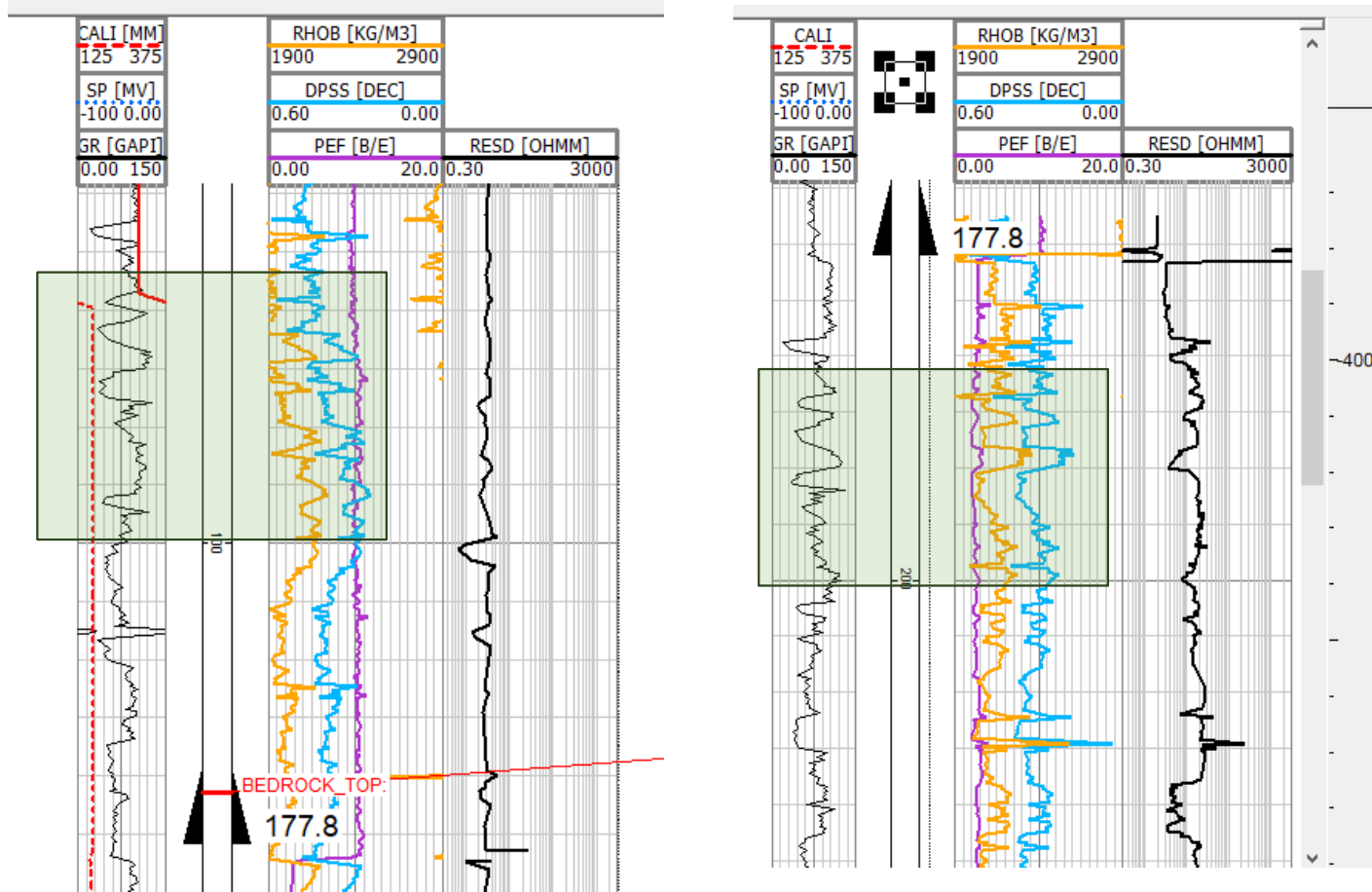


tTEM survey
collected by BGC
Engineering

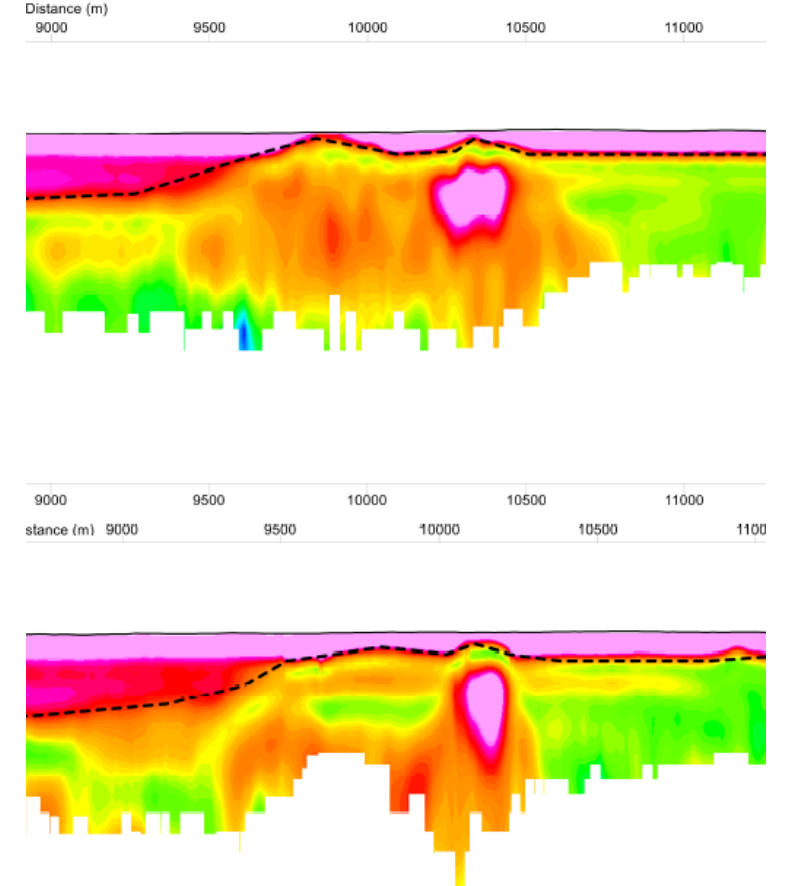
Christina Lake



tTEM survey



Similar log signature in both logs, with the highlighted portion of the log on the left interpreted as a raft at depth of 87-100 m, with log on right in place Grand Rapids Formation at 180-195 m



Highlighted portion of tTEM survey close to the well with the interpreted raft of Grand Rapids Formation

Summary

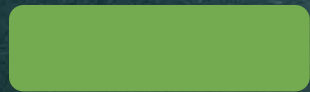
- Updates to bedrock topography: improved modelling method, additional pick coverage, added features identified by industry
- Updates to stratigraphic nomenclature
- Updates to modelled surfaces: additional pick coverage, improved modelling methods
- Future work including mapping rafts of Grand Rapids Formation

Acknowledgements

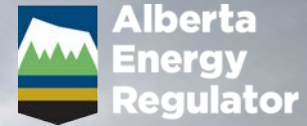
- This work was partially funded under the Oil Sands Monitoring (OSM) Program. It is independent of any position of the OSM Program.

References

- Andriashek, L.D. and Barendregt, R.W. (2017): Evidence for Early Pleistocene glaciation from borecore stratigraphy in north-central Alberta, Canada; Canadian Journal of Earth Sciences, v. 54, no. 4, p. 445–460, doi:10.1139/cjes-2016-0175.
- Hartman, G.M.D., Pawley, S.M, Utting, D.J., Atkinson, N., and Liggett, J.E. (2024): The Empress Group in Alberta, Canada. Canadian Journal of Earth Sciences. 61(1): 86-101. <https://doi.org/10.1139/cjes-2022-0143>
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- Utting, D.J. (2023): Revised bedrock topography and stratigraphy above bedrock in the South Athabasca Oil Sands (SAOS) region, northeastern Alberta; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Open File Report 2023-05, 30 p.
- Utting, D.J. and Andriashek, L.D. (2020): Revised bedrock topography and characterization of Quaternary sediments in the Fort McMurray region, northeastern Alberta; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Report 101, 171 p., <https://ags.aer.ca/publication/rep-101>
- Utting, D.J. and Pawley, S.M. (2021): Bedrock topography in the South Athabasca Oil Sands (SAOS) region (gridded data. ASCII format); Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Digital Data 2021-0026.



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