Paleoenvironmental reconstruction of Quaternary Glacial Dynamics at the Mission Flats Section, Kamloops, B.C.

Casey A. Murray [1], *Gillian M. Krezoski* [1], *Crystal A. Huscroft* [2], *Matthew Bolton* [3], *Sophie L. Norris* [1]

[1] University of Victoria, Department of Geography, Victoria, British Columbia.
[2] Thompson Rivers University, Department of Environment, Culture, and Society, Kamloops, British Columbia.
[3] University of Alberta, Department of Earth and Atmospheric Sciences, Edmonton, Alberta.

Refining evidence for multiple glacial cycles in Kamloops.

- Lithostratigraphy aids in reconstructing the sedimentological record, providing insight into past environmental and climatic events, including glacial, volcanic, biogeographical, and depositional processes.
- The Quaternary Period (the last ~2.6 million years) includes repeated glacial-interglacial cycles (Marine Isotope Stages). These cycles resulted in complex depositional environments, introducing challenges such as age uncertainties in reconstructing past climates in the Kamloops region.
- The Last Glacial Maximum (~18 ka) marked extensive ice coverage and significant landscape changes from the Cordilleran Ice Sheet (CIS). It covered British Columbia and eroded previously deposited sediments, introducing further uncertainty in constraining glacial and deglacial cycles.

This research aims to determine how a high-resolution stratigraphic framework at the Mission Flats site in Kamloops compares to regional Quaternary chronology.

Study Site

- Section units at the site were divided and used to create stratigraphic profiles to compare with previous literature.
- Lithological analysis was conducted to interpret glacial transport processes, and a clast fabric analysis was performed to determine paleo-flow direction.

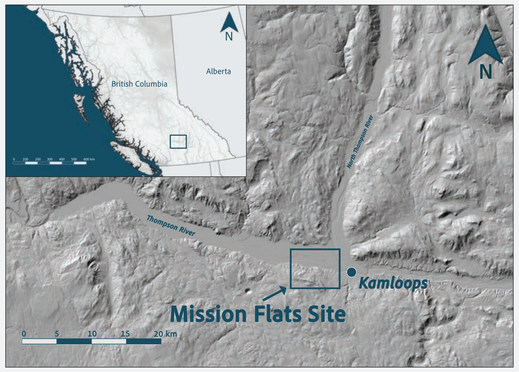


Figure 1: Location of the Mission Flats study site in relation to Kamloops, B.C. Created using a hill shaded ESRI basemap, with projection NAD27.

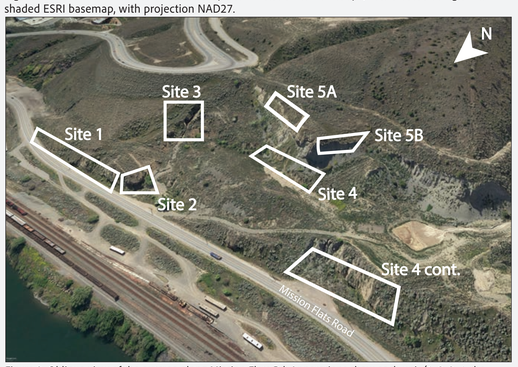
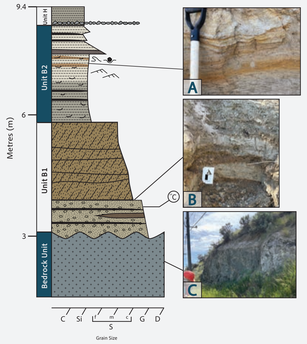
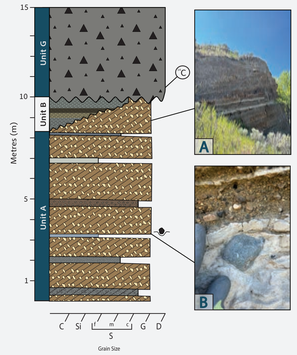


Figure 2: Oblique view of the outcrop along Mission Flats Rd. Annotations show each unit (1, 2, 3, 4, the lateral continuation of Site 4, 5A, and 5B) for the stratigraphic framework. Image taken from Google Earth Pro and annotated in Adobe Illustrator.

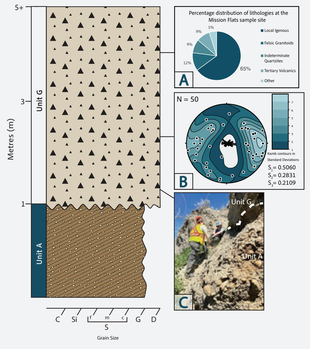
Site 1



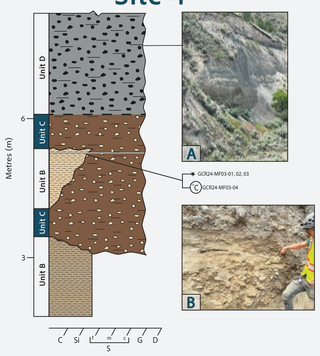
Site 2



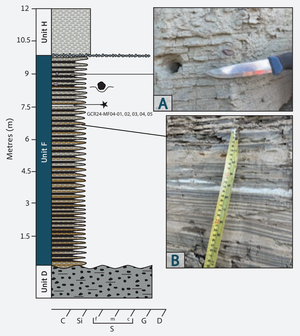
Site 3



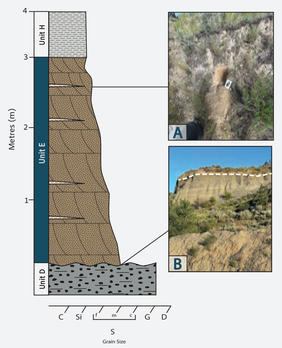
Site 4

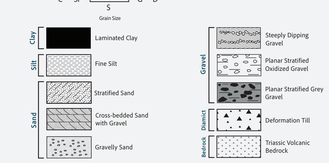


Site 5A



Site 5B





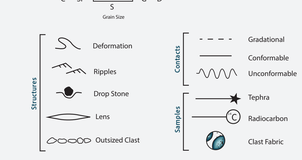


Figure 3: Stratigraphic profiles of each respective site at the Mission Flats outcrop. Each site displays the sediment units present, and associated field pictures for their visualization. Samples of organics, tephra, clasts for lithological analysis, and clast fabric analysis are also represented within the profiles.

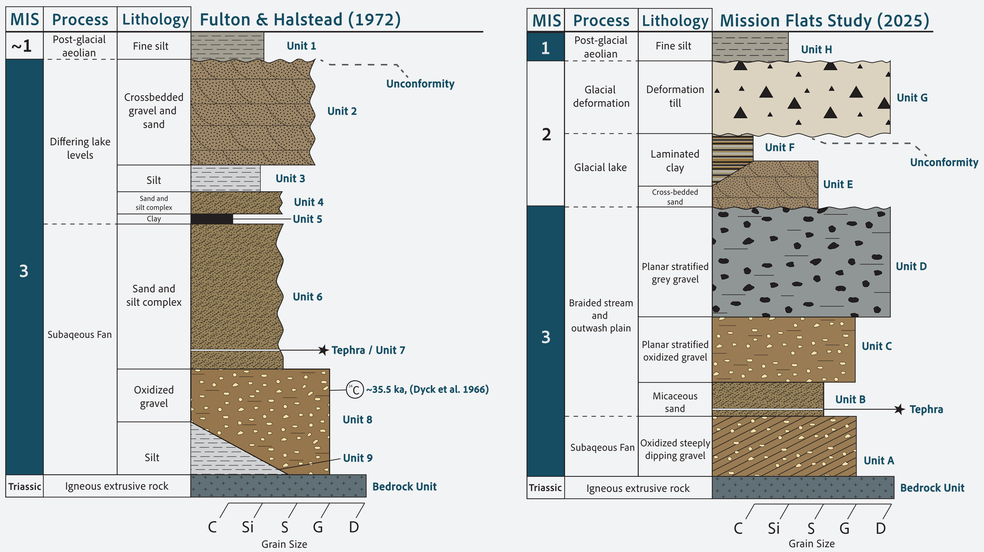
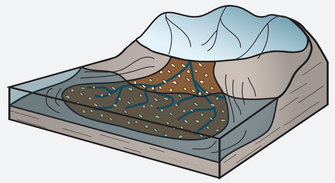
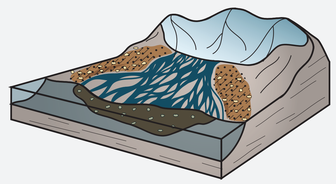


Figure 4: Profile comparison between the units from this study and a modified composite profile nearby the Mission Flats site from Fulton & Halstead (1972). Depicted are the relationships of each unit to their respective marine isotope stage, depositional and/or transportational process, and their lithological characteristics.

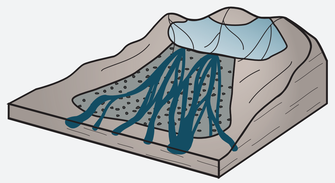
Environmental Evolution



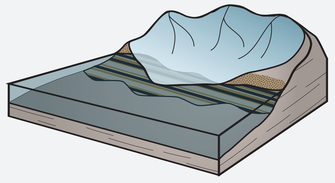
T1 – Alpine Glaciers Present (MIS 3)
A glacial lake formed with a proglacial delta depositing gravel nearby alpine glaciers, creating a subaqueous delta fan (Unit A).



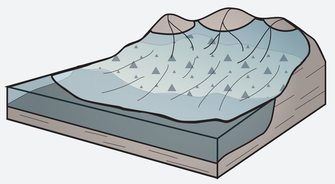
T2 – Olympia Interglacial (MIS 3 cont.)
As the glacial mass shifted, a braided stream became more active, and lake levels dropped, leading to sand and gravel deposition (Units B and C).



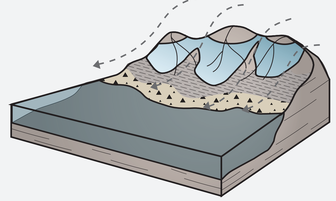
T3 – Glacial reduction and Outwash Plain Formation (MIS 3 cont.)
With the ice retreat, an outwash plain developed, and a large braided stream deposited thick gravel layers (Unit D).



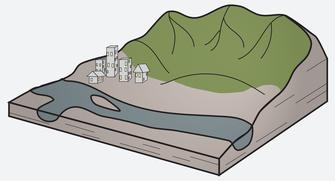
T4 – Climate Shift and Ice Sheet Advancement (~MIS 2)
The Cordilleran Ice Sheet formed, resulting in a higher-level glacial lake. Laminated clays, silts, and reworked sandy shorelines were deposited, with ice lobes contributing dropstones (Units E and F).



T5 – Last Glacial Maximum (LGM) and Ice Sheet Dominance (MIS 2 cont.)
The Cordilleran Ice Sheet covered the region during MIS 2, eroding previously deposited sediments and depositing deformation till (Unit G).



T6 – Deglaciation of the CIS
As the ice sheet melted, glacial lakes persisted, marking the transition into the next interglacial cycle. Wind-deposited silty loess covered the landscape (Unit H)



T7 – Post-Glacial Processes and Soil Formation, Current day (MIS 1)
Wind-deposited loess became the parent material for modern soils and supporting vegetation growth, and development occurs in the Kamloops area.

Legend

- Oxidized Gravel
- Micaceous Sand
- Grey Gravel
- Fine Sand
- Diamiction
- Oxidized Clay
- Glacial lake water
- Loess
- Glacial Ice
- Base sediment
- Fluvial systems
- Post-glacial vegetation
- Kamloops, B.C.
- Aeolian processes

Figure 5: Time series figures depicting the change in environment over time at the Mission Flats study site. Time series are denoted by T1, T2, T3, and so on to represent gradual changes between Marine Isotope Stages.

This study addresses uncertainties in geochronological estimates in Kamloops and presents initial findings. By comparing our results with previous studies, we have established evidence for fluctuating lake levels and glacial depositional dynamics, as well as their correlation with past research. Future steps include radiocarbon dating and additional analyses to further refine age estimates with greater accuracy.

References

Clague, J. J. (2000). Recognizing order in chaotic sequences of Quaternary sediments in the Canadian Cordillera. Quaternary International, 68–71, 29–38. https://doi.org/10.1016/S1040-6182(00)00030-6

Clague, J. J. (2017). Deglaciation of the Cordillera of Western Canada at the end of the Pleistocene. Cuadernos de Investigación Geográfica, 43(2), 449–466. https://doi.org/10.18172/cig.3232

Clague, J. J., & Ward, B. (2011). Pleistocene Glaciation of British Columbia. In Developments in Quaternary Sciences (Vol. 15, pp. 563–573). Elsevier. https://doi.org/10.1016/B978-0-444-53447-7.00044-1

Dalton, A. S., Dyke, H. E., Margold, M., Heyman, J., Clague, J. J., Froese, D. G., Gauthier, M. S., Hughes, A. L. C., Jennings, C. E., Norris, S. L., & Stoker, B. J. (2023). Deglaciation of the North American ice sheet complex in calendar years based on a comprehensive database of chronological data: NADI-1. Quaternary Science Reviews, 321, 108345. https://doi.org/10.1016/j.quascirev.2023.108345

Dyck, W., Lowdon, J. A., Fyles, J. G., & Blake, W. (1966). Geological Survey of Canada radiocarbon dates V. Radiocarbon, 8, 96–137. https://doi.org/10.1017/S0033822200000071

Fulton, R. J. (1967). Deglaciation studies in Kamloops region, an area of moderate relief, British Columbia (154; p. 154). https://doi.org/10.4095/101467

Fulton, R. J., Halstead, E. C., & International Geological Congress. (1972). Quaternary geology of the southern Canadian Cordillera.

Fulton, R. J., & Smith, G. W. (1978). Late Pleistocene stratigraphy of south-central British Columbia. Canadian Journal of Earth Sciences, 15(6), 971–980. https://doi.org/10.1139/e78-101

Lesemann, J., Brennand, T. A., Lian, O. B., & Sanborn, P. (2011). A refined understanding of the paleoenvironmental history recorded at the Okanagan Centre section, an MIS 4 stratotype, south-central British Columbia, Canada. Journal of Quaternary Science, 26(8), 729–747. https://doi.org/10.1002/jqs.1495

Menounos, B., Goehring, B. M., Osborn, G., Margold, M., Ward, B., Bond, J., Clarke, G. K. C., Clague, J. J., Lakeman, T., Koch, J., Caffee, M. W., Gosse, J., Stroeven, A. P., Seguinot, J., & Heyman, J. (2017). Cordilleran Ice Sheet mass loss preceded climate reversals near the Pleistocene Termination. Science, 358(6364), 781–784. https://doi.org/10.1126/science.aan3001

Westgate, J. A., & Fulton, R. J. (1975). Tephrostratigraphy of Olympia interglacial Sediments in South-central British Columbia, Canada. Canadian Journal of Earth Sciences, 12(3), 489–502. https://doi.org/10.1139/e75-042

Special thanks to the Tk'emlúps te Secwepemc within the unceded lands of the Secwépemc Nation, Secwepemcúlecw.

Any questions? Contact caseymurray@uvic.ca or scan the code