EGU24-12572, updated on 11 Feb 2025
https://doi.org/10.5194/egusphere-egu24-12572
EGU General Assembly 2024


# Changes in erosion and sediment dynamics in a retreating world: high resolution provenance analysis from detrital apatite

**Scott Jess**[1,2], Lindsay Schoenbohm[2], and Eva Enkelmann[3]
[1]Washington State Univeristy, School of the Environment , Pullman, United States of America (scott.jess@wsu.edu)
[2]Department of Earth Sciences, University of Toronto, Toronto, Ontario M5S 3B1, Canada
[3]Department of Earth, Energy, and Environment, University of Calgary, Calgary, AB, T2N 1N4, Canada

Glacial retreat quickly and dramatically changes erosion dynamics across catchments. As ice retreats, newly exposed valley walls and sediment can become the target of hillslope and fluvial erosion that in turn can significantly increase sediment fluxes downstream. These increasing fluxes have important implications for hydropower generation and water quality, presenting risks to biodiversity, ecosystem stability, and human inhabitants. Determining where this new influx of sediment is derived from, and hence what parts of catchments are experiencing the greatest erosion, requires the ability to trace exactly where is sediment derived from in the catchment.

Recent analytical advances in the dating of apatite have improved its utility as a provenance tool. The advent of LA-ICP-MS techniques now allow thermochronometric, geochronometric, and chemical data to be collected from each individual grains of a detrital sample. As such, we are able to trace sediment sources across a partially glaciated catchment based on lithology, and source-rock elevation. In this work, we collected samples across the Bugaboo Glacier catchment in western Canada, where ice has retreated >2 km in the last century. Detrital samples were collected from the outwash river and two moraine samples, coupled with a bedrock elevation profile. Bedrock samples encompass the catchment's two principal lithologies, a Cretaceous granitic intrusion, and Neoproterozoic metasediments. Thermochronometric dates range from 41.4 Ma at the highest elevation to 23.9 Ma at the lowest, while geochronometric dates range 68.7–151.3 Ma in granites to 90.5–1952 Ma in metasediments. Supplementary chemical data also help to highlight key differences between the lithologies.

Dates and chemistry from moraine samples show they are likely derived primarily from upstream granitic sources, while sample from the modern outwash river suggests a greater mixture of sources. Detrital mixture models and multi-dimensional scaling suggest moraine samples are composed of sediment derived from a wide range of elevations within the catchment, while the sediments of the modern outwash river appear to be derived entirely from erosion of these moraines, left exposed by retreating ice. This suggests the widely documented increase in sediment flux during glacial retreat is primarily driven by the erosion of newly exposed unconsolidated moraines in catchments. Moreover, this work helps to highlight how the analysis of detrital apatite can be harnessed to produce a highly accurate provenance tool in glacial

catchments.