

# The Record

The 2023-2024 newsletter for the Blais lab; Issue 7

## Highlights for 2023/24



**June 2024.** A Yukon vista, one of the few places still relatively undisturbed by human influence (Photo: David Eickmeyer).



### Coring Yukon & NWT lakes

New studies to track Arctic climate



### Alliance grant to study uranium mines

Examining effects of uranium mines on lakes



### River Oil Experiment

New funding to study oil spill impacts on salmon streams

### FIELD SITES

Yukon and NWT; Northern Sask.; Lac de l'Isle Que; River Road Ottawa; Quesnel River Research Centre

### RESEARCH VIGNETTES

Uranium mines; Climate change; Paleoclimate; Arctic history

### MISCELLANEOUS

Collaboration in France,;

## Who we are in 2023/24:



Jules Blais



Jennifer Keir



Linda Kimpe



Jennifer Kissinger



David Eickmeyer



Daniel Dagodzo



Solomon Adefolu



Stephanie Walsh



Bowen Xiao



Adriana Raats



Raphael Siegel



Josie Rogers



Kayla Lurette

## Tracking the history of human occupation in the Arctic

Our studies reveal new details about the history of the Paleo-Inuit and the Thule-Inuit on Somerset Island, (Nunavut).

The Arctic was home to several cultures, including the Paleo-Inuit peoples (from 2500 BCE until about 1250 CE) and the Thule-Inuit (circa 1000-1600 CE). A study from our group published in 2024 using lake sediment cores is adding some new perspectives to these ancient cultures. This study documented evidence of Paleo-Inuit occupation and revealed new findings about Thule-Inuit occupation on Somerset Island in Nunavut, Canada.

A combination of archeological evidence and core samples from the sediments provided detailed histories of site occupation, including evidence of Paleo-Inuit presence where physical evidence of their occupation was lacking, and evidence that the Thule-Inuit arrived earlier than previously thought. These methodologies enabled us to uncover more detailed information about past human history, even in the absence of traditional archaeological artifacts.

We used a combination of generalized additive models (GAMs) and radiocarbon dating techniques to identify key time points in the sediment record corresponding to the expected dates of Thule-Inuit arrival and site abandonment. This approach allowed us to look at the timing of events within the bounds of dating uncertainty to detect different stages of human occupation at this site, providing a



**Somerset Island, Nunavut (in August 2017).** Sampling crew collecting a sediment core at PaJs-13, a Thule-Inuit site with the remnants of whalebone houses visible in the background (Photo: Jules Blais).

chronological framework for understanding the history of human occupation on the island.

Our study “Sedimentary biomarkers and bone specimens reveal a history of prehistoric occupation on Somerset Island (Arctic Canada)” was published open access on July 9 2024 in the *Proceedings of the Royal Society B* journal.

### Media links:

#### uOttawa Media:

<https://www.uottawa.ca/research-innovation/news-all/unveiling-1200-years-human-occupation-canadas-arctic>

#### CBC:

<https://www.cbc.ca/news/canada/ottawa/study-led-by-u-of-o-researchers-suggests-ancestors-of-present-day-inuit-arrived-in-canada-earlier-than-thought-1.7262475>

## Salmon River Oil Experiment

Our goal is to determine how oil spill response in Canada's west coast salmon rivers can be improved.

New pipeline projects in western Canada place added risk to Pacific salmon populations from oil spills. To address these concerns, we have assembled a team of experts including environmental chemists, engineers, and toxicologists to examine oil spill scenarios in rivers where Pacific salmon spawn. This project involves a series of landmark studies on the fate and behaviour of oil and its major chemical constituents following an oil spill into a series of mesocosms to simulate river systems where Pacific salmon spawn.

We conducted our first trials with oil in a river mesocosm in November - December 2024. The experiment consisted of adding weathered oil to gravel in large troughs to simulate a salmon spawning river. We then flowed water through the troughs in which we also buried salmon eggs in gravel to observe how an oil spill affects early salmon development. We tracked oil-derived contaminants to learn how oil and its constituents move through a river system.

In preparation for the large, 6.5-metre trough study, Josie Rogers conducted pilot studies in a smaller scale experiment. The 2-meter trough featured gravel and water in a recirculating system, with a 20 cm section of gravel treated with doses of oil to create dried oil films. Using a regression-based approach, Josie established a dose-response relationship between oil loading and the resulting concentrations of oil-derived contaminants.



**November 2024.** Our experimental system consisted of flowing water over oiled gravel to simulate an oil spill to a salmon spawning habitat. Salmon eggs buried in the gravel (shown as red spheres on the monitor) are observed using an ocular device. (Photo via Josie Rogers)



**August 2024.** Pilot studies with oiled gravel to study chemical weathering of oil in a simulated river environment. (Photo via Josie Rogers)

## Field excursion to the Yukon and NWT

We are studying how lakes have changed after 30 years in a warming climate

In a short expanse, the Yukon and Northwest Territories transitions from Boreal forest to alpine and tundra landscapes. This is a region studded with lakes and ponds, crosses multiple mountain ranges, and over the decades, has experienced some of the fastest warming in the country. These transition areas are susceptible to shifting environmental conditions and can be used as early indicators for how terrestrial and aquatic ecosystems are reacting to a changing world.

By resampling lakes previously studied in 1993, our collaborators at Université Laval had the opportunity to directly measure how diatom assemblage communities have changed after 30 years of climate warming. As the region of interest crossed 9 different First Nation territories, reaching out to the communities, planning, permitting, and logistics began a year in advance. In June 2024, David Eickmeyer and Marie Alibert (from Laval) teamed up again for 3 weeks of sampling, similar to their 2022 work in Nunavik. They collected water, surface sediment, and soil samples from 29 lakes in a transect from Whitehorse to Tuktoyaktuk – a 1400 km drive each way on the Klondike, Dempster and Inuvik-Tuk highways. They spent many hours on the road enjoying the mountain views, hiking into lakes, living and camping out of their truck, dodging forest fires, ferry breakdowns, even a mine collapse. Naturally, there was the obligatory dunking of feet in the Arctic Ocean. Their biggest logistical challenge

was keeping samples cold during the trip; however, an electric cooler and a solar panel were up to the task. The animal sightings were sensational: beavers, black bear, grizzlies, lynx, bald eagles, falcons. And mosquitoes.

Marie will be studying the diatom assemblages of the lakes and directly comparing them to the diatoms found by her PhD supervisor, Reinhard Pienitz, in the same lakes 31 years earlier. Dave collected sediments and soils for GDGT analysis for a future project to construct a calibration set to track temperature for future paleo climate studies.



**June 2024** David Eickmeyer and Marie Alibert (from Laval University) trekked from Whitehorse to Tuktoyaktuk to sample lakes 30 years after an initial survey was done to track how lakes are adapting to climate change. (Photo: Marie Alibert)

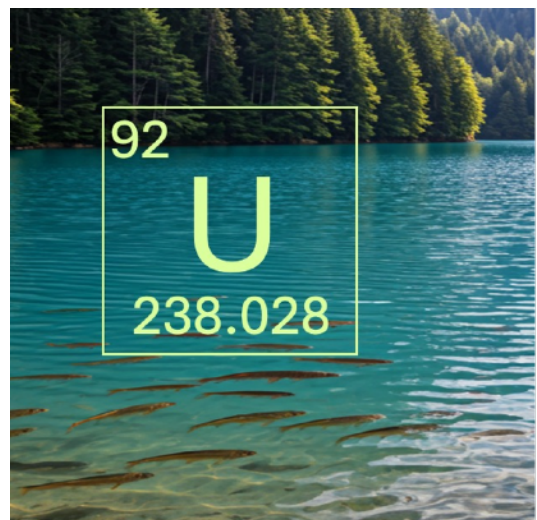
## NSERC Alliance grant on the effects of uranium mines

This project is a new partnership with the Clearwater River Dënë Nation and Canadian Nuclear Laboratories.

This project is designed to create a decolonized and culturally diverse environment, providing partners with an improved model to manage the environmental impacts and risks associated with uranium mines. We aim to develop an evidence-based approach to improve risk assessment and risk mitigation in the vicinity of north Saskatchewan's uranium mines. Our overall goals are to conduct research on the historical and current impacts of uranium mines on lakes near decommissioned, active, and projected uranium mines, and set the foundations for a Risk Management Committee consisting of community representatives, university researchers, and industry experts to determine and communicate risk to the public.

Our research will consist of three parts: (1) We will assess historical impacts from past uranium mine activities using dated lake sediment cores to determine how uranium mines have affected aquatic ecosystems in the past during periods (especially in the 1950s and 60s) when environmental monitoring was not required. Our team has pioneered the concept of paleoecotoxicology as a way to estimate changes in contaminants to waterways in previous decades, and linking them to biological responses, providing a historical context to the issue of contaminants from uranium mines. (2) We will examine the distribution of contaminants of potential

concern (COPCs) in aquatic food webs adjacent to uranium mines and determine if animal feeding behaviours (pelagic vs benthic) and trophic position affect the distribution of contaminants in food webs. (3) We will form a Risk Management Committee comprised of Indigenous and non-Indigenous partners to review risks associated with existing and projected uranium mines with a focus on our Clearwater River Dënë Nation partner community.



New project logo for the NSERC Alliance project on uranium mines..



McClean Lake uranium mill in northern Saskatchewan. (Photo via The Canadian Press.)

## 2024 PALS CONFERENCE IN KINGSTON, ONTARIO



**May 2024:** The Blais lab made a great impression at the 2024 Quebec-Ontario Paleolimnology Symposium, showcasing their research through three engaging oral presentations and one insightful poster. Their work highlighted the versatility of sediment core studies, covering topics such as tracking climate proxies through bacterial membrane lipids, reconstructing historical salmon populations, and investigating temporal shifts in petroleum hydrocarbon sources. A fantastic effort by everyone involved –well done!

## 2024 VISITING SCIENTIST IN PARIS:



**May 2024:** Our collaborations continued this year with Dr. Arnaud Huguet at METIS (Milieux environnementaux, transferts et interactions dans les hydrosystèmes et les sols) at Sorbonne Université in Paris, who hosted Jules and Linda in May 2024. The visit consisted of seminar presentations and instruction into emerging techniques for paleoclimate studies. Several publications are now in the works from this partnership.



## Publications in 2023/24

Yang Z, Shah K, Hollebone B, Laforest S, MacGillivray M, Dey D, Rodriguez JL, Lalonde B, Yang C, Beaulac V, Blais JM, Hanson ML, Orihel DM. 2024. Occurrence, characterization, and ecological risk analysis of petroleum hydrocarbons in water and sediments following large-scale field simulated oil spills at the Experimental Lakes Area, Northwestern Ontario, Canada. *Marine Pollution Bulletin* 209, Part B: <https://doi.org/10.1016/j.marpolbul.2024.117235>

Papas W, Aranda-Rodriguez, R, Fan X, Kubwabo C, Lee JSL, Fantin EML, Zheng ED, Keir JLA, Matschke D, Blais JM, White PA. 2024. Occupational exposure of on-shift Ottawa firefighters to flame retardants and polycyclic aromatic hydrocarbons. *Toxics* 12 (9), 677 <https://doi.org/10.3390/toxics12090677>

Gallant LR, Hargan KE, Kimpe LE, Michelutti N, Grooms C, Savelle JM, Smol JP, Blais JM. 2024. Sedimentary biomarkers and bone specimens reveal a history of prehistoric occupation on Somerset Island (Arctic Canada). *Proceedings of the Royal Society B*. 291: 20232915. <https://doi.org/10.1098/rspb.2023.2915>

Hargan KE, Duda MP, Michelutti N, Blais JM, Smol JP. 2024. Assessing long-term diatom changes in sub-Arctic ponds receiving high fluxes of seabird nutrients. *Ecology and Evolution* 14 (2), e11034. *Science: Processes and Impacts* 24, 1508-1516. <https://doi.org/10.1039/D1EM00543>

Cheney CL, Eccles KM, Kimpe LE, Lehnherr I, Blais JM. 2024. Mercury deposition to lake sediments near historic gold mines in northern Canada. *Environmental Pollution* 342: 123038. <https://doi.org/10.1016/j.envpol.2023.123038>

Auger B, Nevalainen L, Blais JM, Thienpont JR, Korosi JB. 2023. A comparative reconstruction of trends in Chydorus UV exposure associated with shoreline retrogressive thaw slumping in lakes of the Mackenzie Delta uplands (Northwest Territories, Canada). *Journal of Paleolimnology* 70: 1-12 <https://doi.org/10.1007/s10933-023-00290-z>

Walsh SJ, Bond M, Guérin N, Blais JM, Rowan D. 2023. A sensitive method to determine <sup>210</sup>Po and <sup>210</sup>Pb in environmental samples by alpha spectrometry using CuS micro-precipitation. *Scientific Reports*, 13:19754. <https://doi.org/10.1038/s41598-023-46230-9>

Keir JLA, Papas W, Wawrzynczak A, Arande-Rodriguez R, Blais JM, White PA. 2023. Use of silicone wristbands to measure firefighters' exposures to polycyclic aromatic hydrocarbons (PAHs) during live fire training. *Environmental Research* 239: 117306 <https://doi.org/10.1016/j.envres.2023.117306>

Kissinger JA, Gregory B, Clarkson C, Libera N, Eickmeyer DC, Kimpe LE, Kurek J, Smol JP, Blais JM. 2023. Tracking pollution from fur farms using forensic paleolimnology. *Environmental Pollution* 335: 122307 <https://doi.org/10.1016/j.envpol.2023.122307>

doi.org/10.1016/j.envpol.2023.122307  
<http://hdl.handle.net/10393/45316>

Duda MP, Grooms C, Sympson L, Blais JM, Dagodzo D, Feng W, Hayward KM, Julius ML, Kimpe LE, Lambertucci SA, Layton-Matthews D, Lougheed SC, Massafiero J, Michelutti N, Pufahl PK, Vuletich A, Smol JP. 2023. A ~2200-year record of Andean Condor diet and nest site usage reflects natural and anthropogenic stressors. *Proceedings of the Royal Society B* 290: 20230106. <https://doi.org/10.1098/rspb.2023.0106>

Graves SD, Mason JJ, Rodriguez-Gil JL, Séguin JY, Blais JM, Hanson ML, Hollebone BP, Palace VP, Clark I, Cundall L, Layton-Matthews D, Leybourne MI, Orihel DM. 2023. Radio- and stable isotope analysis reveals minimal assimilation of petrogenic carbon into an oligotrophic freshwater food web after experimental spills of diluted bitumen. *Chemosphere*, 138608. DOI: <https://doi.org/10.1016/j.chemosphere.2023.138608>

Stoyanovich SS, Saunders LJ, Yang Z, Hanson ML, Hollebone BP, Orihel DM, Palace V, Rodriguez-Gil JR, Mirnaghi FS, Shah K, Blais JM. 2023. Chemical weathering patterns of diluted bitumen spilled into freshwater limnocostracans. *Environmental Science & Technology* 57 (25): 9266-9276. <https://doi.org/10.1021/acs.est.2c05468>

Gregory BRB, Bell MA, Sproule A, Shields SW, Overy DP, Blais JM. 2023. Exploring within-ecodistrict lake organic matter variability and identifying possible environmental organic

biomarkers using sedimentomics. *Science of the Total Environment*, 871: 161981 <https://doi.org/10.1016/j.scitotenv.2023.161981>

Black TA, Paterson MJ, Timlick L, Cederwall J, Blais JM, Hollebone B, Orihel DM, Palace VP, Rodriguez-Gil JL, Hanson ML. 2023. The challenges of characterizing the zooplankton community response following simulated spills of diluted bitumen into Boreal lake limnocostracans. *Bulletin of Environmental Contamination and Toxicology* 110: 46 <https://doi.org/10.1007/s00128-022-03680-7>

Keir JLA, Kirkham TL, Aranda-Rodriguez R, White PA, Blais JM. 2023. Effectiveness of reducing firefighters' exposure to PAHs and genotoxins by implementing dermal cleaning interventions. *Journal of Occupational and Environmental Hygiene*, <https://doi.org/10.1080/15459624.2022.2150768>

## Conference presentations in 2023/24

Raats A, Siegel R, Kimpe LE, Huguet A, Blais JM. Applying microbial membrane lipid analysis to develop a temperature calibration for Canadian paleoclimate reconstruction. Presented to the Ontario-Quebec Paleolimnology Symposium (PALS). Kingston, ON. May 14-15, 2024.

Dagodzo D, Eickmeyer D, Kimpe LE, Selbie D, Smol JP, Blais JM. Recent progress in tracking Sockeye salmon (*Oncorhynchus nerka*)

population dynamics from sediment core records. Presented to the Ontario-Quebec Paleolimnology Symposium (PALS). Kingston, ON. May 14-15, 2024

Blais JM. Développements dans les études paléoenvironnementales: Les animaux migrants et le climat. Séminaire à Sorbonne Université, le 15 mai, 2024. Hôte: Dr. Arnaud Huguet (invité).

Blais JM. Développements dans les études paléoenvironnementales: Les Thulés Inuits et les Paléo-Inuits. Séminaire à Sorbonne Université, le 7 mai, 2024. Hôte: Dr. Arnaud Huguet (invité).

Rogers, JA., Eickmeyer, DC., Thienpont JR., Kimpe, LE., Chin, K., Blais, JM. Has oil exploration led to an increase in organic pollutants in the Norman Wells region? Ontario-Quebec Paleolimnology Symposium (PALS). Kingston, ON. May 14-15, 2024.

Rautio M, Prėskienis V, Kivilä H, Blais JM, Cheecham-Uhrich D. Greenhouse gases in clear-water lakes along a 2000 km environmental gradient from the Prairies to tundra, Western Canada. SIL International Congress on Limnology, Foz do Iguacu, Brazil, May 5-9, 2024.

Smol, JP, Libera, N, Rühland KM, Kurek J, Campbell J, Jones A, Kimpe LE, Kissinger JA, Meyer-Jacob C, and Blais, JM. Forensic paleolimnology: Investigating the effects of mink fur farming versus other potential stressors on SW Nova Scotia (Canada) lakes.

SIL International Congress on Limnology, Foz do Iguacu, Brazil, May 5-9, 2024.

Raats A, Kimpe LE, Huguet A, Blais JM. Developing a GDGT-temperature calibration for lake sediment paleoclimate reconstructions across a gradient of Canadian ecozones. Presented at the 2nd International GDGT Workshop in Zurich, Switzerland, September 6-8, 2023.

Blais JM. Using isotopic methods and other proxies in dated sediment cores to track seabird population dynamics over centennial and millennial timescales. Invited platform presentation for the annual Advances in Stable Isotope Techniques and Applications Conference, Ottawa, ON, June 11-14, 2023.

Hanson M, Hollebone B, Babaei H, Petticrew E, Raine J, Mumford KG, Kennedy C, Barker C, Variano E, Blais JM, Orihel DM. Planning for a study into the fate and effects of diluted bitumen in model freshwater salmon-bearing river ecosystems. SETAC Prairie and Northern Chapter Conference, Saskatoon, SK, June 18-20, 2023.

Blais JM. New developments in paleoenvironmental studies: Using sediment cores to track seabird population dynamics over centennial and millennial timescales. Invited seminar at Canadian Nuclear Laboratories, Chalk River, ON. April 28, 2023.