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2023 Science Laboratories Network PaleoLab Workshop Report GSC-Calgary, March 14-16, 2023

M. Bringué and L. Komaromi

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Canada

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Summary

Applied Paleontology remains a pillar for **geoscience and innovation** at the Geological Survey of Canada. The GSC's long standing and evolving expertise, a stronghold in Canada's research ecosystem, actively supports GSC programs, provincial and territorial (P-T) geological surveys, universities and private sector stakeholders, and advances innovation through collaborations with internal and external partners—Canadian, Indigenous, and international.

PaleoLab, part of the GSC's Science Laboratories Network, hosted a 3-day Applied Paleontology workshop in Calgary in March 2023. The hybrid event gathered **25 GSC participants** (20 onsite) from Dartmouth, Iqaluit, Ottawa, Calgary and Vancouver, including research scientists, lab technicians, and collections and Information Management (IM) specialists.

The main **objectives** were:

- to meet, get to know facilities and paleontology labs across divisions, and share current research;
- to discuss best practices, cutting-edge innovation, challenges, opportunities and solutions; and
- to define our vision for Applied Paleontology at the GSC and strategize on ways to implement it.

The main **take-aways** are:

- The GSC is now the **largest Centre of Excellence on Applied Paleontology in Canada**, but HR capacity is lacking, primarily on (1) lab staff, (2) expertise on key fossil groups and (3) information and collections management.
- Applied Paleontology at the GSC has **momentum** with demonstrated usefulness in program support, with the emergence of new fields, and with other P-T geological surveys expressing their needs for continued expertise at the GSC.
- Much like the response of organisms we study across major events in Earth's history, **adaptability and innovation** will be key for Applied Paleontology to emerge renewed and establish new "niches" as GSC research in sedimentary basins shifts focus from hydrocarbon-based energy to minerals and green energy.

Figure 1. Some 2023 PaleoLab workshop participants. From front (bottom) to back (top) row: (front row:) Leanne Komaromi (left), Lynn Dafoe (right); (2nd row:) Krista Boyce (left), Lori Campbell (middle), Michelle Coyne (right); (3rd row:) Jim Haggart (left), Hillary Taylor (middle), Sofie Gouwy (right); (4th row:) Martyn Golding (left), Vania Correia (middle), Jennifer Galloway (right); (back row:) Robert Fensome (left), Jennifer McQuarrie (middle), Manuel Bringué (right). Photograph by M. Bringué. NRCan photo 2023-047.

Acknowledgments

We acknowledge that the workshop took place on the traditional territories of the people of the Treaty 7 region in Southern Alberta. This region is also home to the Métis Nation of Alberta, Region III, the Blackfoot Confederacy which includes the Siksika, the Kainai, the Piikani, the Tsuut'ina and the Stoney Nakoda First Nation, which includes Chiniki, Bearpaw and Wesley First Nations.

GSC-Calgary hosted the event with financial support from GEM-GeoNorth (Michel Plouffe). Organizers also wish to thank Krista Boyce and ClubFed for Pi day, morning coffees and support, Suzanne Twelker for safety considerations and arranging hotelling stations, Steve Tkaczuk for IT support, and many others who made this event a success! Finally, the authors are grateful to Rob MacNaughton (GSC-Calgary) whose review greatly improved the quality of the manuscript.

Abbreviations

CNGO: Canada-Nunavut Geoscience Office
GEM: GeoMapping for Energy and Minerals
GSC: Geological Survey of Canada
HQP: highly qualified personnel
HR: Human Resources
SLN: Science Laboratories Network
Paleo: Paleontology
PaleoLab: Paleontology Laboratories
PRP: Postdoctoral Research Program
RES: Research scientist

Introduction

SLN PaleoLab is the GSC's Applied Paleontology Centre of Excellence. Because scientists, laboratories and collections are spread out across Canada, from coast (Dartmouth) to coast (Iqaluit) to coast (Vancouver) and currently spearheaded from Calgary, keeping abreast of current research, best practices, challenges and opportunities is difficult. Even with the technological adaptations necessitated by the COVID-19 pandemic, PaleoLab members needed more than a virtual meeting to get properly acquainted with fellow scientists/technicians/specialists and their areas of expertise, stay up-to-date with each group's activities, get inspired by each other's successes (or shared struggles) and formulate our vision.

Thanks to the support of GEM-GeoNorth (Michel Plouffe), PaleoLab was able to host a 3-day, hybrid workshop at GSC-Calgary in mid-March 2023. The event gathered 25 GSC participants (20 onsite) from Dartmouth, Iqaluit, Ottawa, Calgary and Vancouver, including research scientists, lab technicians, and collections and Information Management (IM) specialists (Figure 1, Table 1). Not all participants were formally affiliated with PaleoLab, such as Collections and IM specialists, but everyone's input was constructive and relevant to the work of others.

The main **objectives** for the workshop were:

- to meet, get to know facilities and paleontology labs across divisions, and share current research;
- to discuss best practices, cutting-edge innovation, challenges, opportunities and solutions; and
- to define our vision for Applied Paleontology at the GSC and strategize on ways to implement it.

Participants

Workshop participants (who travelled, joined online or were onsite) are listed in Table 1, along with their focus in Applied Paleontology.

Division	Participant	Focus in Paleontology	Travel	Online	Onsite
GSC-Atlantic	Lori Campbell	Lab technologist	x		
	Vania Correia	PRP (palynology)	x		
	Lynn Dafoe	RES (ichnofossils)	x		
	Rob Fensome	RES (palynology)	x		
	Kate Jarrett	Collections		x	
	Graham Williams	RES (palynology)		x	
GSC-Ottawa	Nikole Bingham-Koslowski	RES (macropaleontology)		x	
	Michelle Coyne	Collections	x		
GSC-Vancouver	Martyn Golding	RES (conodonts)	x		
	Jim Haggart	RES (macropaleontology)	x		
	Hillary Taylor	Lab technician	x		
CNGO-Iqaluit	Shunxin Zhang	RES (conodonts)		x	
GSC-Calgary	Krista Boyce	Information management			x
	Manuel Bringué	RES (palynology)			x
	Keith Dewing	RES (macropaleontology)			x
	Bill Dwyer	Collections			x
	Rick Fontaine	Collections			x
	Jennifer Galloway	RES (palynology)			x
	Sofie Gouwy	RES (conodonts)			x
	Leanne Komaromi	Lab technologist			x
	Rob MacNaughton	RES (ichnofossils)			x
	Sandy McCracken	Volunteer (conodonts)		x	
	Jennifer McQuarrie	Lab support			x
	Godfrey Nowlan	Emeritus (conodonts)			x
	Terry Poulton	Emeritus (macropaleontology)			x
Absent					
GSC-Québec	Esther Asselin	Volunteer (palynology)	Absent		
GSC-Calgary	Dave McNeil	Emeritus (foraminifera)	Absent		
GSC-Calgary	Brian Norford	Volunteer (macropaleontology)	Absent		
GSC-Vancouver	Mike Orchard	Emeritus (conodonts)	Sent notes		

Workshop schedule

Below is the schedule for the three-day workshop. Presentations and group sessions were held in the Assiniboine room of GSC-Calgary, where online participants connected through Teams.

		Day 1 (Mar. 14)	Day 2 (Mar. 15)				Day 3 (Mar. 16)	
AM	8:00 - 8:30	**Welcome**						
	8:30 - 9:00	**Opening** *Assiniboine* - Director & SLN manager welcome - People introduction - Plan for workshop - Overview of paleo facilities in each division - SLN operational model	**Paly** (dinos) RF, GW, MB, VC - Dinos from Scotian Margin and W. Arctic - AI/machine learning for dino ID - Dinos strat ranges - CAPE	**Conodonts** SG, MG, GN - SEM - Collections - Library	**Macro** JH, TP RM, LD, KD	**Labs** LK, JM, LC, HT - Lab proc. techniques - Best practices - Sample mgt	**Collections & Information Management** - Curation of GSC type material (Michelle) - Sample life cycle - IM databases across divisions (Krista, Kate) - Challenges, recommendations - Q & A	
	9:00 - 9:30							
	9:30 - 10:00							
	10:00 - 10:30	Break - π day - Edith Cavill room					Break - Cafeteria	
	10:30 - 11:00	**Tour** Calgary labs/collections/library tour					**Statistics applied to paleo data** (Manuel, Jen G., Sofie) - Overview of biostats - Multivariate analyses, NMDS - Cluster analyses - Graphic correlation, CONOP	
	11:00 - 11:30							
	11:30 - 12:00							
	12:00 - 1:00	Lunch (onsite) - Cafeteria	Lunch (onsite) - Cafeteria				Lunch (off site)	
PM	1:00 - 1:30	**Short science presentations** - GSC-V Paleo: Jim, Martyn - GSC-C Paleo: Sofie, Jen G., Manuel - GSC-O Paleo: Nikole - GSC-A Paleo: Rob F. (Graham), Vania	**Round table** - Future of paleontology at GSC (research directions, collaborations, innovation) - Scientific expertise, lab & collections needs - "Centre of Excellence" vs regional offices				**Paly** Deflandroid discussion (RF, GW, MB)	**Other** SEM time Labs (cont'd)
	1:30 - 2:00							
	2:00 - 2:30							
	2:30 - 3:00	Break - Cafeteria	Break - Cafeteria				Break - Cafeteria	
	3:00 - 3:30	**Short science presentations** (cont'd) - Ichnofossils: Lynn, Rob M. - Event stratigraphy & TSC: Rob F., Manuel - Others?	**Round table (cont'd)** - "Marketing" of paleontology - IP, copyright on publications - PaleoReports - GSC editorial guidelines - Professional associations - Journals, conferences - Etc.				**Paly (cont'd)** Pollen & spores PalyAtlas (RF, JG, VC)	**Other**
	3:30 - 4:00							
	4:00 - 4:30							
	4:30 - 5:00							
	5:00 - 8:00	Social dinner - Jamesons						Hybrid sessions (Assiniboine & Teams)

Day 1 consisted of an Opening session and Tour of the laboratory and collection facilities (virtually for GSC-Atlantic, GSC-Ottawa and GSC-Vancouver facilities) in the morning, followed by short science presentations in the afternoon.

For Day 2, sub-groups were formed to discuss and advance field-specific issues in the morning (palynology, conodonts, macrofossils and labs/collections). The whole group reconvened for round-table discussions in the afternoon.

The morning of Day 3 was dedicated to Collections and Information Management topics, and a session on Statistical methods applied to paleontological data. The afternoon was left open to continue important discussions in sub-groups.

A casual, social diner took place at a local pub on the evening of Day 1.

Summary of Short science presentations

On the afternoon of Day 1, scientists were invited to provide a short overview of their past, current and/or planned research activities. The goal was to bring awareness to everyone working in Applied Paleontology at the GSC of each active specialist's research activities, identify synergies and foster collaborations.

Below is a list of presentations:

- Jim Haggart: Macrofossil paleontology research and associated activities at GSC-Vancouver
- Martyn Golding: Overview of current research [Mesozoic conodont biostratigraphy]
- Sofie Gouwy: Current research activities [Devonian conodont biostratigraphy]
- Jennifer Galloway: Arctic climate of the past 200 myrs: Implications for understanding Earth system processes and Canada's landmass, natural resources, and future
- Manuel Bringué: Research overview [Dinoflagellate cyst-based paleoenvironmental reconstructions and biostratigraphy]
- Nikole Bingham-Koslowski: My background [Paleozoic macropaleontology]
- Rob Fensome: Overview of Robert A. Fensome and Graham L. Williams research at GSC Atlantic [Mesozoic and Cenozoic Palynology, biostratigraphy]
- Vania Correia: Mesozoic palynology
- Lynn Dafoe: Ichnological investigations in sedimentary basins
- Rob MacNaughton: Ichnostratigraphy and Ediacaran-Cambrian biostratigraphy
- Rob Fensome: TimeScale Creator – and how we got there
- Manuel Bringué (et al.): TimeScale Creator as a tool for Canadian stratigraphy

A session on statistical methods applied to paleontological data was also held on the morning of Day 3, in which Manuel Bringué, Jennifer Galloway and Sofie Gouwy presented some statistical techniques useful for analysis and interpretation of microfossil data.

Summary of Round table discussions

Minutes were recorded for all the main common sessions and are available (see "Resources" section below). A summary of the main topics discussed is provided here.

Vision for Applied Paleontology at the GSC
With most major (C-base) GSC research programs currently heavily focussed on minerals, and with a growing focus on climate change and green energy, it is increasingly necessary to rethink research strategies in Canada's sedimentary basins. While Applied Paleontology has consistently proved to be innovative and critical to deliver on GSC mandates, and both internal and external stakeholders (e.g., GSC scientists, P-T geological surveys) have expressed the need for increased Paleo expertise and capacity at the GSC, HR pressures have made it extremely difficult to maintain and develop expertise, staff labs and manage collections. Where do we see Applied Paleontology at the GSC in 5 or 10 years? A separate report soon will articulate our Vision for Applied Paleontology at the GSC but here is a short summary of discussions.

Mid-to-late career and emeriti scientists at the table provided some historical perspective. The GSC has long been struggling to maintain its work force in Applied Paleontology, and past efforts to promote it internally (to GSC management) and externally (for instance, through media) have had mixed results. However, a 2016 "white paper" on the status of Applied Paleontology in the organization led GSC management to formally acknowledge the ongoing need for our expertise within the organization. Even though our current numbers are only a fraction of the workforce in the GSC's "golden age", the fact is that we are still standing and we have managed to hire new talent since 2016; in fact, the GSC is now the **largest Centre of Excellence on Applied Paleontology in Canada**.

"Service work", where GSC scientists answer internal and external stakeholder's need for expertise, as opposed to their own research interests, is very time-consuming. At the same time, it constitutes a golden opportunity to advance paleontological knowledge and innovation, foster collaborations, and support Canadians in general.

The first major challenge we face is a dire HR limitation, particularly in terms of lab personnel, scientific expertise, and information & collections management. Current staff is stretched very thin in all Divisions, particularly in labs and collections. We also need to bring in new talent to maintain (and advance) expertise in several groups of demonstrated importance for biostratigraphy, environmental studies and beyond (e.g., macrofossils, foraminifers), with most experts in those specialties being near retirement or having already retired.

A second major challenge is the increasing difficulty to train the next generation of applied paleontologists at the GSC (HQP). Lack of funding and prohibitive paperwork make it very challenging for project leaders to recruit graduate students. Yet, student contribution to GSC research is paramount for innovation, to deliver on GSC core mandates, and for the transmission of knowledge to the next generation of scientists.

Undoubtedly, one of the greatest strengths of Applied Paleontology workers are their flexibility and adaptability. They can apply their set of skills to one geological problem one day, and to a completely different environmental issue the next. We will need to leverage that ability to emerge renewed in a mineral-focussed era.

New (and old) research directions, aligned with both the traditional GSC pillars and emerging priorities, make for an exciting new phase of research in Applied Paleontology. Continued contributions to refining the Geological Time Scale, something most geologists look at as end-users, are critical. Traditional methods in biostratigraphy can leverage recent technological advances (e.g., machine learning) to bring an "old" field of study to a new age. Documenting the occurrence of critical minerals in sedimentary deposits (e.g., BC Golden Triangle, black shales) will bring greater awareness of the potential for minerals outside the Canadian Shield and help convince management to support stratigraphy and sedimentary basin studies. Advancing paleobiogeography would complement detrital zircon-based provenance studies. And putting current environmental changes in the context of Earth's history will help us understand and forecast Earth systems (e.g., ocean anoxia, atmosphere, temperature).

The GSC has a long tradition of excellence in Applied Paleontology, which it can leverage to bring the field into a new era of impactful research with direct benefits to Canada, its economy and the sustainable development of its resources. To do this, all we need is: (1) scientists to ensure and demonstrate alignment with current GSC priorities; (2) HR support for labs, scientific expertise, and collections & information management, and; (3) a streamlined process to train HQP and leverage their contributions.

"Marketing" of Applied Paleontology

Applied Paleontology is commonly (and mistakenly) perceived as strictly "service work" using old, stagnant science. A rebranding is direly needed! Applied Paleontology is indeed practical, useful and critical to framework geoscience, but it is also constantly evolving, reflecting exciting scientific innovations, leveraging recent technological advances and serving new applications (e.g., environmental sciences, paleogeography and Earth System processes).

Upper management needs to hear more about the great work we do, as we both support core GSC mandates and develop innovative approaches even with limited resources. Our ranks need to better showcase their work (e.g., ADM briefs, social media) to bring awareness to the higher spheres of decision-making for increased HR support and funding.

Centre of Expertise

Should we aim to concentrate all paleontology activities in Calgary as a Centre of Expertise, or keep expertise and labs spread out across several divisions?

The consensus was that expertise should remain available in regions where they can work on local geology issues and be embedded with local priorities. Scientists may still elect to work amongst larger numbers of their peers in Calgary to optimize interactions, collaborations and growth, regardless of the localities they study. Labs, on the other hand, might more easily get consolidated in Calgary in the future, but some lab support should remain where scientists work. So long as we maintain open lines of communication, the Centre of Excellence can be spread across the country.

Paleontology reports

GSC Paleontology reports, or Paleoreports, are documents produced by GSC paleontologists in which they report on fossil identification and interpretations (e.g., age, depositional environment) from samples submitted to PaleoLabs by internal or external "clients". Paleoreports represent a lot of work, for which scientists currently get little to no recognition, despite the long-standing value of these products to the work of the GSC. The question arose whether we should continue producing such reports, or rather publish the results through other channels (e.g., GSC Open Files).

The consensus was that Paleoreports still provide a viable means to deliver analysis results (even when samples are barren) and record them in corporate databases; scientists still have the option to publish the data if results are promising. However, scientists currently do not get recognized for this sizable work and efforts should be made towards co-authorship (of maps and other products), acknowledgement and recognition in the RES career progression.

Summary of Collections and Information Management discussions

Discussions held on Collections and IM during the Day 2 round table and Day 3 morning session are summarized here.

The life span of a sample extends far beyond its collection on the field and analysis, and paleontologists are heavy users of fossil collections. In theory, collections and IM are integrated with the laboratories'

workflow, but in practice, large gaps remain. The workshop provided an opportunity for Collections and IM specialists to bring forward challenges, opportunities, and best practices to all scientific staff.

Collections hosted at GSC-O (including the type collections recently moved to the Museum of Nature), GSC-A, GSC-C and GSC-V host samples collected as far back as the 1800s; they are sizable and invaluable. Collections management is part of the GSC's Strategic Plan. However. a severe lack of HR resources was identified, in particular for collections management in GSC-O, GSC-V and GSC-A. A critical concern is the transfer of knowledge from specialists nearing retirement since several collections remain to be properly catalogued.

In terms of IM, the GSC has developed some great tools but practices have historically differed between divisions, and more stakeholders (collections and IM specialists, but also scientific personnel) should be encouraged to use them. GSC-C collections and IM, which have suffered fewer HR pressures relative to other divisions, have implemented a robust model that other GSC collections could follow. A new IM system that will replace SMS and SAMS is currently being developed.

GSC-A has developed and maintains several databases focused on marine samples (e.g., Expedition Database, BASIN). The majority of this content is available to the public and is heavily used; however, keeping databases updated and accessible on the web is a big task that requires HR support.

GSC-V collections and IM need HR support to conduct first pass inventories, catalogue all samples and save archival data. GEM supported the hiring of temporary help and storage space during the COVID-19 pandemic, but support for the vast GSC-V collections now needs buy-in from management.

Resources

The following resources are available by request to Manuel Bringué (manuel.bringue@nrcan-rncan.gc.ca):

- Pictures taken during the workshop (photo credit: Manuel Bringué)
- PDFs of presentations:
    - Day 1: Opening
    - Day 1: Short science presentations
    - Day 2: Round table
    - Day 3: Collections and statistics
- Resources shared by participants that will help in defining our vision for Applied Paleontology at the GSC.
- Meeting minutes (common sessions).

Participants agreed to make their presentations and contributions accessible to the GSC community, but none of the material should be reused without the author's permission.