GEOLOG

Volume 46
Number / Numéro 4
Winter / Hiver 2017

GEOLOGICAL ASSOCIATION OF CANADA
ASSOCIATION GÉOLOGIQUE DU CANADA

Resources for Future Generations – Few Easy Answers

Can we keep up with a constantly changing world? Can Canada be a leader in this dynamic situation? There are many perspectives on these questions, but we wonder how many would recognize that earth sciences research and natural resources development are critical to the future of a healthy and dynamic Canada.

We know that natural resources development represents jobs across Canada including tax contributions, royalties and exports, but that's always been the case. The difference now is that an evolving world needs more of these resources – energy, minerals and water that are fundamental for meeting the basic needs of the growing global population, maintaining an acceptable and less wasteful standard of living, and developing clean energy, more efficient transportation and other critical breakthroughs. But can we honestly expect to find and deliver more natural resources responsibly?

The finite nature of natural resources was highlighted in 1972 when the Club of Rome released their classic book, *The Limits to Growth*, questioning the viability of continuous growth in resource supply. The book predicted the exhaustion of energy and metal-related natural resources in just a few decades. Since the 1970s, however, we have seen exponential growth in the supply of many commodities extracted from the earth, and yet we still have global reserves of these commodities that are the same or more than those documented by the Club of Rome. How can that be? To this day, people continue to predict pending exhaustion of natural resources. Are these predictions also exaggerated?

Global reserves of natural resources are based on the economics of the day, and do not consider changes in price, and new discoveries that effectively increase the reserve base. Similarly, the development of new technologies can turn resources where extraction is difficult or expensive into profitable reserves.

This is what happened in the U.S., where the use of directional drilling and fracking opened enormous new hydrocarbon reserves. The resulting "shale revolution" drastically cut U.S. dependence on foreign oil and gas – potentially including that from Canadian Oil Sands, and has significantly reduced the amount of coal used in power plants. The production of oil and gas from shales in the U.S. has virtually removed the concept of "Peak Oil" from the fossil fuel debate – perhaps to be replaced eventually by "Peak Demand".

The potential demise of the "Peak" supply concept may be valid in general, but what about all of the metals that we need to create a cleaner and better world – lithium, cobalt, copper and many specialty metals for renewable energy and electric transportation? The answer, again is that our planet has plentiful sources, but other issues may hinder supply.

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GEOLOGICAL ASSOCIATION OF CANADA

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GEOLOG

Vol. 46, No. 4, Winter / Hiver 2017

Publisher / Publié par
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GEOLOG (ISSN 0227-3713; 1712-3747) is the quarterly newsmagazine of the Geological Association of Canada, St. John's, Newfoundland and Labrador. *GEOLOG* is published for the benefit of GAC® members and its content reflects the diversity of the organization. News items and short articles on topics of potential interest to the membership including public geoscience awareness are encouraged. Also encouraged are communications promoting interaction among academic, industry and government sectors. *GEOLOG* accepts and publishes contributions in both of Canada's official languages. Opinions expressed herein are those of the writers and do not necessarily represent the official positions of the GAC®. *GEOLOG* is one of several forums provided by the GAC® for scientists worldwide.

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GEOLOG (ISSN 0227-3713; 1712-3747) est le bulletin trimestriel de l'Association Géologique du Canada, à St. Jean, Terre-Neuve-et-Labrador. *GEOLOG* s'adresse aux members de l'AGC® et son contenu reflète le caractère polyvalent de cette organisation. Nous invitons la soumission de nouvelles et articles courts pouvant intéresser les membres, incluant les thèmes de sensibilisation du public aux sciences de la Terre. Les articles suscitant des échanges d'opinions et d'informations entre les secteurs académique, industriel et ouvernementaux sont également la bienvenue. *GEOLOG* accepte et publie les articles dans les deux langues officielles du Canada. Les idées sont celles des auteurs et ne représentent pas nécessairement la position officielle de l' AGC®. *GEOLOG* n'est qu'un des nombreux forums offerts par l' AGC® aux scientifiques à travers le monde.

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Acknowledgements and Thanks

This *GEOLOG* benefits from the contributions and assistance of / Nous voulons souligner la contribution et l'assistance de: Jennifer Bjorkman, Karen Dawe, Richard Hebda, Dawn Kellett, Ted Lawrence, Robert MacNaughton, Stephen Morison, Brian Pratt, Peir Pufahl, Deanne van Rooyen, Dan Smith, Dennis Waddington, and Jane Wynne. Apologies to any contributors that have been missed. This *GEOLOG* was produced with support from the Royal Alberta Museum. Your contributions for future editions are welcome / Désolé pour ceux qui auraient été involontairement oubliés. Cette copie de *GEOLOG* a été produite grâce à l'assistance du Royal Alberta Museum. Nous sollicitons vos contributions pour les publications à venir.

Contributions for next issue

Please send items for next issue of *GEOLOG* by e-mail to Alwynne.Beaudoin@gov.ab.ca on or before **March 1 2018**.

A cold day for a winter walk on the frozen surface of Astotin Lake, Elk Island National Park, Alberta.

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While new resources and technology may secure the metals that we need, people most affected by potential extractive operations may conclude that the risks to their livelihoods, families, or the environment are greater than the benefits they will likely see. This scenario has played out across Canada and around the world where local concerns resonate in a way that the national economic and geopolitical benefits do not win the day.

So now the question becomes – are human concerns and opposition to development the main constraint on future resource supply? Is this "Peak" tolerance? Can this crisis be avoided through new business models that involve Indigenous people and communities, improved extractive technologies, and real-time monitoring of environmental performance? Will industry, governments or communities drive these fundamental changes? What is the future of Earth Sciences research and how can this work lead in developing future solutions for natural resources development and environmental and societal issues such as climate change? Can the people of Canada lead this debate, seek the best solutions, and demonstrate the way forward?

In June 2018, these questions will be addressed and debated at a major international conference in Vancouver, BC. Participants will examine energy, minerals and water from scientific and societal perspectives, seeking balance in a complex world. Understanding the Earth in terms of geological complexities and environmental constraints, is critical, but the nature of people, how they participate in the delivery of natural resources and how they perceive that process, will determine the future of resource development. Canada is and will continue to be a global leader for these conversations.

Most importantly, young people must be involved in the debate. They will be the consumers, the problem solvers, and the protectors of the environment. Hence the title of the conference – Resources for Future Generations.

John Thompson, General Chair,
Resources for Future Generations (RFG) 2018
Stephen Morison, President,
Geological Association of Canada
Kenneth Thomas, President, Canadian Institute of Mining, Metallurgy and Petroleum (CIM)

On behalf of GAC® Council, I wish you and your family all the best for the holiday season and for a healthy, safe and prosperous 2018.
Stephen Morison,
President, GAC®

Milestones, Memories, and Tributes

A Tribute to T. Kurt Kyser, Friend and Pioneering Geochemist

The geological community lost a friend and trusted colleague with Kurt Kyser's unexpected death while teaching in Bermuda on August 29, 2017. His passing has left an irreparable hole in many of our lives and in the fabric of international isotope science. Kurt was a larger than life personality and world-class geochemist with an exceptional analytical mind. He will be sorely missed.

Born in Montana, Kurt grew up in California and attended the University of California at San Diego for his B.Sc. before moving to the University of California at Berkeley, where he completed his M.A. and Ph.D. Kurt met his wife, April Vuletich, as a postdoctoral fellow while both were working in the isotope laboratories of the United States Geological Survey in Denver. April was a steadfast and influential presence in Kurt's life. Her deep love for Kurt and their students and postdoctoral fellows was the foundation for Kurt's incredible success. Their indelible partnership in life and science inspired hundreds of lives. For those of us privileged enough to be part of Kurt and April's extended family, we are forever grateful.

Kurt's interest in oceanographic research began as an undergraduate working at Scripps Oceanographic Institute in 1973 under the direction of Ray Weiss, a pioneer in the study of gas solubility in seawater. His Ph.D. research with Jim O'Neil involved pioneering work on stable isotope systematics of seafloor basalts. Whilst a NATO postdoctoral fellow at the University of Paris, he also perfected his impeccable French and formidable palate for fine wine. Afterwards, he joined the faculty at the University of Saskatchewan in 1981. Kurt brought renewed vitality to the department, establishing a cutting-edge stable isotope laboratory in very short order. He explored research questions ranging from uranium mineralization to the isotope stratigraphy of the Western Interior Basin, the results of which remain benchmarks for excellence today. He was no "highway-outcrop geochemist". Kurt believed field work must inform geochemistry and regularly

ventured into swamps, jungles, deserts, tundra, and the deepest mines from across the globe to provide this context.

In the 1990s Kurt began a long-time relationship with Noel James, who was instrumental in convincing him to move to Queen's University, first as a Queen's National Scholar, and later as a Queen's Research Chair. Kurt established the Queen's Facility for Isotope Research (QFIR), which remains one of the most outstanding facilities of its type in the world. At QFIR, isotope science is used as a tool to understand the whole Earth system. Kurt imbued a multidisciplinary approach to investigate an astonishing array of questions involving mineral deposits, sedimentology, birds, bugs, human disease, and environmental geochemistry. At the heart of this research were his students and postdoctoral fellows. They became better scientists because they were allowed to not only make their own measurements, but learn how the ironmongery actually worked, understand, with pump oil under their fingernails, what goes into an isotopic measurement, and most importantly, make mistakes and learn from them. QFIR will continue to prosper in this image, for this approach is what has the most impact on those who pass through its doors.

There was formidable substance behind Kurt's bold and "cool" Hawaiian shirts. Together with his more than 100 graduate students, and an equal number of undergraduate and postdoctoral researchers and

colleagues, Kurt amassed about 600 refereed publications, which have attracted more than 7000 citations and an H-index of 42 across the span of science. Numerous awards and accolades recognize his prowess. The most prominent medals include the Duncan R. Derry Medal, Hawley Medal, Willet G. Miller Medal, Past President's Medal of the Mineralogical Association of Canada, and the Past President's Medal of the Geological Association of Canada. In addition to these honours, he was a Fellow of the Royal Society of Canada, a Killam Research Fellow, a Fellow of the Mineralogical Society of America, and recipient of the E.W.R. Steacie Memorial Fellowship.

Kurt's service to the scientific community was also unwavering. He was the Editor-in-Chief of the Geological Society of London's journal *Geochemistry: Exploration, Environment, Analysis*, President of the Mineralogical Association of Canada and an active member of the Mineralogical Society of America, American Geophysical Union, Geochemical Society of America, Association of Applied Geochemists, and the Mineralogical Association of Canada. Kurt had influential roles with the Natural Sciences and Engineering Research Council of Canada that ranged from Chair of the Earth Sciences Grant Selections Committee to Group Chair overseeing all Earth and environmental science and interdisciplinary grant selection committees. He was also commonly called upon to lead reviews for the Canada Foundation for Innovation.

Beyond Kurt's ground-breaking contributions and outstanding record of service, what will be missed most is his friendship. He would fill any room that he entered, not because he was loud, but because he had a magic that made everyone with whom he spoke feel valued. Kurt would give you his undivided attention; he would listen. His affection for his extended family of students, postdoctoral fellows, and colleagues is his lasting legacy. Each was touched in an insightful and inspirational way that not only challenged, but elevated them as people.

Rarely has someone instilled such joy in research, such a sense of camaraderie, and such fierce love of scientific discovery.

Fred J. Longstaffe, Peir K. Pufahl,
and Eric E. Hiatt

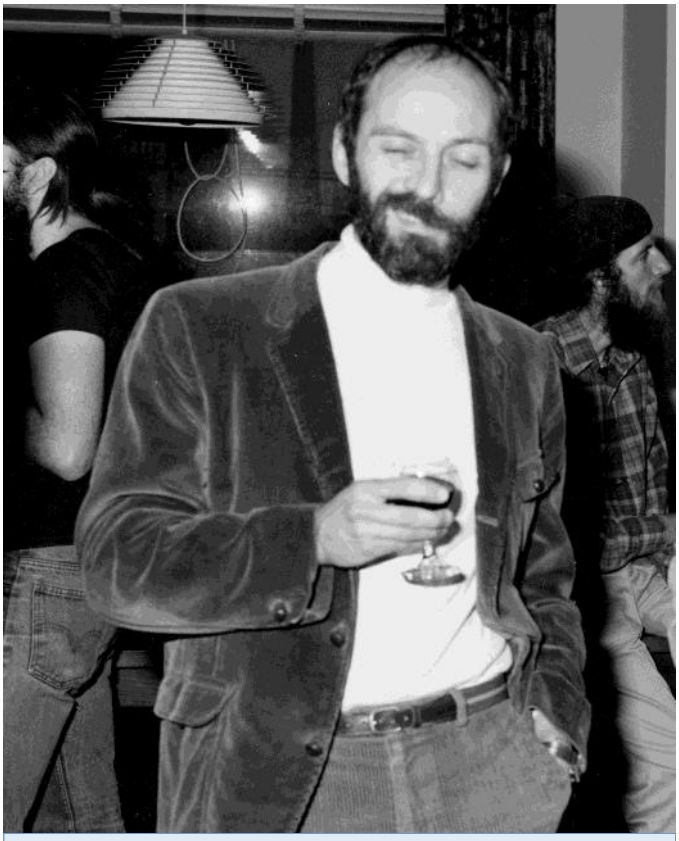
Rolf Ludvigsen
1944–2016

Rolf Ludvigsen was an outstanding, internationally renowned Canadian paleontologist, with expertise in several Paleozoic invertebrate groups but particularly trilobites.

Rolf was born in Denmark and was intensely proud of his parents and his Scandinavian roots. His father fought on the Eastern Front with other Danish volunteers. After the war, however, this remained a stigma that he was unable to shake, and eventually the family immigrated to Canada, initially to Fredericton and later moving to Calgary. Rolf's early academic career took him from the University of Calgary (B.Sc., 1967) to the University of Western Ontario to work with Alf Lenz. Rolf did his M.Sc. on a variety of taxonomic groups in Lower Devonian strata from the Ogilvie Mountains of northern Yukon Territory, which led to five authoritative papers. His Ph.D. thesis on Ordovician trilobite biostratigraphy in the southern Mackenzie Mountains focused on distinguishing various ecological communities. About 13,000 exquisitely silicified trilobites were extracted and identified in order to undertake this analysis and establish the paleogeography of the region in the Ordovician.

Rolf joined the Department of Geology of the University of Toronto in 1975. He came highly recommended as a brilliant young scientist with a reputation for prodigious energy and personal intensity with strong likes and dislikes. Many years later one of his truly admiring research students summed it up much more succinctly, honestly, and clearly: *"Rolf was mercurial, confrontational, charming, demanding, maddening, entertaining, and tremendously intimidating. He challenged his students by expecting nothing but the best from us, and his approach got results."*

He established an unmistakable presence with his long hair, black beard, fumy pipe and the best coffee. He was a superb photomicrographer and his multitudinous photographs of trilobites – which are often quite tiny and not at all like the monsters so familiar in museum displays – were used to illustrate his scientific papers and monographs, of which he published upwards of one hundred altogether, including no fewer than 13 monographs, covering thousands of pages of text and illustrations. In 1984 he was awarded the Geological



Rolf celebrating the inaugural issue of the *Palaeontographica Canadiana* monograph series in 1983.

Association of Canada's Past-President's Medal (now the W. W. Hutchison Medal) for his research achievements as a young scientist. That same year he was promoted to Full Professor.

He was a dedicated professor but he was tough and expected a high level of interest and participation even at the introductory level. Those who rose to the challenge remember him as inspirational. Others just muddled through or foundered, much to his despair. He confided to one of his colleagues about his distress at the university policy of having to assess students whose lives could be badly impacted by poor marks in subjects they simply weren't interested in. He struggled with what for him was a conundrum for years, spent a lot of time soul-searching and improving his pedagogy, and eventually resolved the dilemma by quitting the university system entirely, in 1987.

By that time Rolf had established a strong cadre of trilobite graduate students – no mean achievement as good candidates were few even then. This included Ph.D. students Steve Westrop and Brian Pratt, and M.Sc. students Dave Rudkin, Pam Tuffnell and Graham Young. He was devoted to them as much as they were to him. They jointly co-authored a paper on biostratigraphy for the Paleoscene series in *Geoscience Canada*, which they wrote in the bar on College Street across from the Mining Building. Ed Landing and David Kopaska-Merkel were post-docs from the USA. Cross-pollination from Steve Westrop encouraged Rolf to dig deep into evolutionary theory which was experiencing a renaissance in paleontology, and this inspired his research and teaching at all levels. He also developed an abiding interest in the history of geology and paleontology, which he also brought to the classroom.

He was professionally active in national and international learned societies as a scientific leader, as an organizer/administrator and as an editor. He convinced the Geological Survey of Canada to acquire an extensive collection of trilobites from the Cow Head Group of western Newfoundland made and carefully prepared by Cecil Kindle, components of which are still under study. He was instrumental in establishing the world-class monograph series on paleontology, *Palaeontographica Canadiana*, under the co-sponsorship of the Paleontology Division of the Geological Association of Canada and the Canadian Society of Petroleum Geologists. He was its first editor. There are now 35 volumes in this series; Rolf co-authored four of them, and two more were written by his graduate students.

After extinguishing his pipe for the last time, Rolf became an avid runner. One undergraduate was surprised to be invited on a weekend run with Rolf only to be more startled when the "jog in the park" transpired to be a half-marathon up and down the Don Valley Parklands. He famously led his graduate research team on lunch hour runs through the city. Brian Pratt remembers one time the two of them blundered into a parade on Bloor Street and joined the procession as if they were official participants, flexing their muscles and waving to the crowds before scooting into campus.

Following his resignation from the university, Rolf moved to the Gulf Islands and founded the Denman Institute for Research on Trilobites (DIRT). From there he continued his work on trilobitology and published several monographs with Steve Westrop and his long-time collaborator Brian Chatterton of the University of Alberta. Rolf started an annual newsletter called *The Trilobite Papers* that published essays and research news submitted by contributors from around the world. It was a popular and unifying effort that ran for 19 years, until 2007.

Rolf hammering on the type section of the Rabbitkettle Formation, Mackenzie Mountains, Northwest Territories, in 1984.

Rolf was very interested in public education and helped establish programs with local museums covering various aspects of paleontology and his interests expanded well beyond the Paleozoic. He offered patient advice to many local amateurs in the Vancouver Paleontological Society, and not only was he a mentor to many who attended British Columbia Palaeontological Alliance symposia but he also edited their newsletter. Rolf is remembered fondly by the volunteers who assisted him in excavating the elasmosaur that now has pride of place in the Courtenay and District Museum and Palaeontology Centre.

Rolf's first foray into popularization of paleontology was the inaugural volume in the Fossils of Ontario series, on the trilobites (1979). After moving to British Columbia he co-authored with local amateur Graham Beard the well received *West Coast Fossils: A Guide to the Ancient Life of Vancouver Island* (1998). Before that he edited *Life in Stone: A Natural History of British Columbia's Fossils* (1996), having persuaded a long list of leading specialists to write the chapters on each fossil group, no mean feat as every book editor well knows. Rolf later collaborated with Brian Chatterton to produce a series of vignettes about Canadian paleontologists and the history of paleontology in Canada. These are housed on the NRCan website.

Rolf's science was exacting. The field context was always there and this included a solid understanding of the sedimentological framework and its role for understanding the temporal meaning of biostratigraphy. Besides describing and naming dozens of new species, in the mid 1970s he and Brian Chatterton established the trilobite biofacies approach that incorporated a novel use of statistical methods. In 1985 Rolf published his most controversial paper, with Steve Westrop. They bypassed convention and committee and proposed a stage-level classification for the upper Cambrian of Laurentia. A dozen years later it was finally given the formal stamp of approval by the community at large.

In the late 2000s Rolf began to experience difficulties and eventually was diagnosed with Lewy body dementia, a disease that progressively destroys one's mental and physical capabilities. Rolf died peacefully on 16 December 2016.

Geoff Norris and Brian Pratt

Bernard Mamet
1936–2016

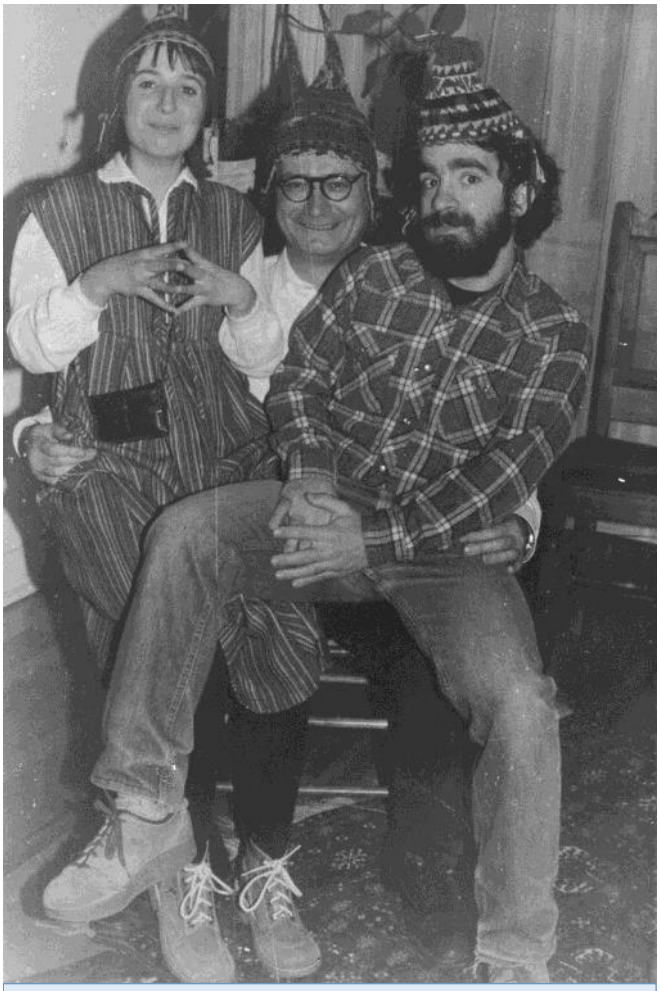
Born in Etterbeek, Belgium (7 February, 1936), Bernard Mamet spent most of his career in Canada, as a professor for many years at the Université de Montréal. He was a brilliant student (he received the coveted Médaille du gouvernement) but he, as his friend and long-time collaborator Alain Préat tells us, was also quite undisciplined – and thus creative. He completed his education at the Université de Bruxelles after which he received a French government scholarship that gave him the opportunity to become a geological engineer with the Institut Français du Pétrole in 1959. He then pursued an M.Sc. in Paleontology at the University of California, Berkeley which he received in 1960. When he was drafted as a sub-lieutenant in the Belgian army, he 'courageously' spent his shifts in a quiet bunker where he wrote his doctoral thesis (under the supervision of Augustin Lombard, Université de Genève), and received a medal for his 'bravery'.

In 1962, he married Margaret Bratley, a biochemist he had met at Berkeley. They were both hired by the Université de Montréal.

His scientific career can be broken down into four phases. Firstly, his doctorate examined the correlation between Carboniferous limestones using at the time a new method which heralded sequence stratigraphy many years before it became recognized – he called it 'sequostratigraphy'.

The second focused on Carboniferous foraminifers. In fact, Soviet paleontologists had already shown their significance, but the iron fist of Stalin had blocked scientific communication at the time. Despite these obstacles, Bernard made two trips to Moscow, and by 1966 the famous 'Mamet zones' were widely used, and by 1974 his work led to a Carboniferous biostratigraphic framework consisting of 25 global biozones.

During the third period, he focused his attention on calcareous algae, not just of the Carboniferous but also of the Ordovician and Silurian of southern Quebec and Anticosti Island. In his fourth period, during retirement, he studied Fe-precipitating bacteria via scanning electron microscopy in collaboration with Alain Préat. Befitting a provocative scientist the implications of their results are still controversial.



Bernard Mamet with two of his favourite graduate students, Sylvie Pinard and Benoit Beauchamp

Bernard's rich career resulted in 200 scientific articles and eight monographs. He erected more than 60 new genera. He has investigated all Carboniferous basins of the world and their respective stratigraphy. But he is especially well known for his work in the Arctic (Alaska, Canadian Arctic Archipelago, Greenland) which includes fundamental contributions to the study of Carboniferous limestone microfacies.

Bernard served four terms as head of department at the Université de Montréal. He was chairman or lead organizer of many international meetings and congresses. Notably, he was co-chair with Colin Stearn of the International Geological Congress in Montréal in 1972, and Honorary Chairman of the International Carboniferous Congress held in Calgary in 1999 just prior to taking his retirement. He then went back to Europe, spending his time between his two hectares of garden in Touraine, and his 'holidays' which he spent in the Laboratoire de géologie of the Université libre de

Bruxelles. This is where he carried out his later research in the company of old friends and colleagues.

For those colleagues, students, friends, who have had the chance to work closely with Bernard Mamet, it is clear that one of his principal qualities was without a doubt his keen sense of observation combined with a phenomenal visual memory, one that would put to shame any digital camera. His scientific journey, which took him from the infinitely large (sequence stratigraphy) to the infinitely small (bacteria), is a lot more than this obvious scale progression. Through his four periods of scientific interests, Bernard managed every time to build from what he had learned and what he had accomplished, opening broad new intellectual venues each time the focus of his sharp intellect shifted to a new realm of curiosity. And he did this by combining a broad geological knowledge, a unique sense of humour, and a genial disposition that made him a wonderful companion.

Bernard was an excellent teacher and a kind, even paternal, supervisor to his graduate students. Sylvie Pinard recalls him reminding her that 'les voyages forment la jeunesse' and she took that to heart, heading to France and even visiting his family home in Belgium. He was a bon vivant and he and his students revived the tradition of an annual departmental oyster party. At the same time, he reminded them that 'la vie n'est pas du sucre' and setbacks will occur. One of those for Bernard was the untimely passing of a favourite protégé, Alain Roux, who was making a name for himself in the study of fossil calcareous algae. Five of his doctoral students became university professors.

Bernard Mamet passed away on December 19, 2016 at his home, surrounded by his loving wife Margaret and two daughters, Françoise and Dominique.

Alain Préat, with contributions from
Benoit Beauchamp, Sylvie Pinard and Brian Pratt

GeoFact: Aug 2 1972: Canada Post issues a series of four commemorative stamps marking the International Congresses being held concurrently in Montreal. Each stamp features one of the four main hosts and themes of the earth sciences congresses: geology, photogrammetry, cartography, and geography.

Fabrizio Aumento
mineralogist, petrologist, geophysicist
1940-2016

Fabrizio (Fab) Aumento died unexpectedly in Italy on 8 October 2016 at the age of 76. He was buried in Civitavecchia, Italy, alongside his parents. Since 2001 he had been an independent researcher at Universita Tuscia in Viterbo.

Liz and I last saw him at his home in Montefiascone, about an hour north of Rome, in 2008. He was the consummate host and tour guide. We visited the hill towns of the area, Etruscan tombs, local historic landmarks and dined at his favourite restaurants. Fab of course chose the local wines that he knew so well, including the famous Est! Est!! Est!!!

I first met Fab when he arrived at Dalhousie University Geology Department in the summer of 1962. I was an undergrad and would become his guide to North Mountain mineral collecting sites. He was collecting zeolites for x-ray diffraction studies that would become the basis for both his M.Sc. and Ph.D. research. His doctoral thesis was entitled "Thermal Transformation of Selected Zeolites and Related Hydro Silicates". This was the start of friendship that spanned more than 50 years.

Following graduation in 1965, Fab joined the Mineralogy Section of the GSC. Initially he undertook mineralogical studies of the asbestos deposits of the Jeffery Mine in Quebec. I joined the Petrology Section the following year and we joined forces once again, notably developing dredging and photographic equipment that we used to gather samples on the Flemish Cap and several Atlantic sea mounts, in the process discovering thick manganese pavements on San Pablo sea mount.

Fab undertook several cruises with BIO to the mid-Atlantic Ridge. Sea floor spreading, petrology and mineralogy of the basaltic rocks of the ridge and fission track dating would become the focus of his research for the next 15 years. During this period he coordinated numerous multidisciplinary teams and published extensively.

He left the Survey in 1970 to return to Dalhousie where he became ever more immersed in investigations of

Ted Lawrence (L) and Fab Aumento in Montefiascone, October 2008

the mid-Atlantic Ridge. He became Chairman of the department in January 1973 and it was under his direction that Dalhousie became immersed in leg 37 of the Deep Sea Drilling Project, drilling a deep bore hole on the Ridge at 45°N. He was awarded the Steacie Fellowship from NSERC in 1976 and was elected to the Royal Society of Canada (FRSC). He took sabbatical leave in 1977-78.

During this period, in Halifax, he became interested in yachting or maybe it was his interest in innovative boat building techniques. He undertook the design and construction of a 40 ft. ferro-concrete yacht that he named the *Manitou*. His knowledge of asbestos led him to test various asbestos fibres as a strengthening element for the concrete that he would use in the construction of the boat.

I am glad I had the opportunity to sail with him. On one occasion we were becalmed in the Bay of Fundy and the motor had failed. We limped back to Nova Scotia for repairs and spent a week in Shelburne. I built a BBQ from an old electrical box from the local bone yard and remember cooking mackerel on the rear deck. What a great time we had turning a misadventure into a summer holiday!

Fab had a wanderlust and was always looking for new challenges. He resigned his teaching and administrative duties at Dalhousie in 1978 to sail his boat to the Azores where he used it as a platform for geophysical and geothermal studies for the Portuguese government. Subsequently he returned to Italy and set up a consulting business in Milan. He undertook a broad spectrum of research for governments and private interests, concentrating on the exploration and development of geothermal power. The company was dissolved on the death of his business partner but Fab continued consulting. He ultimately took up residence in Montefiascone.

He was active even in his “retirement years”, pursuing his research and teaching until the time of his death. He continued his work on geothermal heat flow and the measurement of radon gas both as a tool for exploration and for the evaluation of its environmental and health effects.

Fab was prolific, publishing the results of his research in over 50 juried papers, as well as producing numerous unpublished and confidential reports for his clients.

Fab was a man of ideas, many interests, boundless energy, and an enthusiasm that was contagious. He had the ability to organize and coordinate the work of multidisciplinary research teams and publish their findings. But most of all I will miss his kind and helpful nature, positive outlook and the joy of life that he shared with his friends and colleagues.

Ted Lawrence
Geological Survey of Canada, Ottawa

Montefiascone, Italy, 2006: Photo: Hans Peter Schaefer. Cropped image, used under Creative Commons CC BY-SA 3.0 license

Events and Happenings

2017 Canadian Tectonics Group Annual Workshop and Field Trip Kelowna, BC

The Canadian Tectonics Group (CTG) held another successful annual workshop from October 13 to 15, 2017. This was the 37th such workshop since CTG's formation in 1981, and was ably organized by Kyle Larson and Dan Gibson. The 40 participants who assembled in Kelowna, BC represented a slice through the Canadian tectonic community that ranged from retired professionals who had attended early CTG Workshops (Willem Langenberg, Andrew Okulitch, Fried Schwerdtner) to young geology students, with leading current practitioners from academia, government and industry filling in the rest of the spectrum. There was naturally a distinctly western concentration in domiciles but, as usual, a global scope in the research presented. The strong student representation from seven Canadian universities was one of the encouraging highlights of the weekend's activities. Attendees arrived from as far east as Halifax, as far north as Yellowknife and as far west as Vancouver.

After the informal gathering of a number of the less jet-lagged participants at the conference hotel lounge on the Friday evening, Day 1 got underway in earnest with the Saturday morning departure under Dan Gibson's guidance, for a 60-kilometer traverse across the Shuswap metamorphic core complex (SMCC). Holding the field trip on the first day and getting everyone into a single yellow school bus meant nobody could break away early and getting lost was much harder to do.

Working our way from the eastern SMCC boundary near Revelstoke back to the cover of the westernmost part of the complex in the Sicamous area, the seven stops provided a look at the key components of the SMCC interior, its bounding dislocations and its lowermost cover. The road cuts at all stops were impressive for their photogenicity and viewability, leading to a general sense of admiration for past results forming the basis for current orogenic modelling of the Canadian cordillera. Another highlight was the excellent artisanal brown bag lunch, on a day that threatened, but did not deliver, rain and/or snow showers. Stop 1, in the fault valley containing Revelstoke's Columbia River dam, also illustrated the importance of geological knowledge for engineering megaprojects. And the Stop 6 mylonite zone outcrops at the western boundary were enough to get everyone's tectonic juices flowing even before leaving the bus (see photo overleaf, and the official group photo below which was taken in front of this outcrop).

Group photo of all participants in front of a spectacular mylonite outcrop at Stop 6 of the CTG 2017 workshop field trip.

On Saturday evening, the delicious group supper at Kaya restaurant, only steps from the conference hotel, was a seemingly endless sushi feast that provided ample opportunity for participants to debrief and decompress from the day in the field and re-fuel for the upcoming Day 2 program.

Sunday, Day 2, consisted of the workshop presentations program, smoothly organized by Kyle Larson, at the UBC Okanagan campus, on the warmest and sunniest part of the weekend. It began with a hearty breakfast buffet, from the same caterer as Saturday's field trip lunches and just as good, to set people up for the day's schedule of eighteen 20-minute talks, seven poster sessions and the CTG business meeting.

The range and excellence of the oral presentations and poster sessions were recognized favourably by all, specialists and generalists alike. Perhaps of greatest general interest were the talks in the third session, which provided new information about faulting and fracturing of rocks.

The field guide and the program-with-abstracts volume may be downloaded from the CTG website at www.canadiantectonicsgroup.ca/workshops.html

A vote of thanks needs to be extended to all the organizers and all the contributors.

Stop 2: Monashee Cover Gneiss.
Photo: Dennis Waddington

Stop 6: Mylonitic distributed shear zone.
Photo: Dennis Waddington

At the business meeting we learned that next Canadian Tectonics Group Workshop (2018) will be held in the Sherbrooke area, Québec's Eastern Townships.

The first circular has been posted on the CTG website by organizers David Corrigan and Alain Tremblay. Download the circular from www.canadiantectonicsgroup.ca/uploads/1/0/9/2/109291477/ctg-2018.pdf

We look forward to seeing everyone next year in La Belle Province.

Dennis Waddington and Fried Schwerdtner

Stop 6: Mylonite in the footwall of the Okanagan valley shear zone.
Photo: Eric Thiessen

Precambrian Division Student Travel Awards 2017 – Kingston

The Precambrian Division awarded five travel grants to students attending the Kingston GAC-MAC meeting. Below are their reports from the trips and sessions they attended, and some information on their projects they presented. We're happy to see so many students enjoy opportunities to see these great areas of Canada!

Award Winners 2017

- Carolyn Hill – Western University
- Malcolm Hodgkiss – Stanford University
- Tyler McGee – University of Saskatchewan (award deferred to 2018)
- Siobhan McGoldrick – University of Victoria
- Celine Porter – University of New Brunswick

Carolyn Hill – Western University

My Ph.D. thesis focuses on determining the key indicators of ancient climate, life and sedimentary processes in the Paleoproterozoic Gordon Lake Formation, Huronian Supergroup. The results of my thesis will contribute to our understanding of the surficial, climatic and related biological evolution of Earth approximately 2.3 billion years ago; a time when the planet lacked land vegetation and the rise of atmospheric oxygen had begun.

I presented my latest research at GAC-MAC 2017, where I received valuable feedback and a variety of new ideas to explore moving forward. I had many meaningful discussions about my work and am grateful for the opportunity to share it with the leaders in my field. The student travel grant from the Precambrian Division of the GAC® provided me with the financial assistance to be able to attend the whole conference, which enabled me to attend a higher number and variety of talks. I also attended the dinner at Fort Henry, which was a great opportunity to expand my professional network. I thoroughly enjoyed my time at GAC-MAC 2017 and I am looking forward to attending future GAC-MAC conferences.

Malcolm Hodgkiss – Stanford University

It was a pleasure to participate in GAC-MAC 2017 in Kingston. It provided an excellent environment for me to present my research, and receive constructive feedback from experts in the field. Most importantly, GAC-MAC provided a positive, collegial environment that helped lay the groundwork for future collaborations with other researchers.

Siobhan McGoldrick – University of Victoria

I am an M.Sc. student nearing the end of my studies at the University of Victoria's School of Earth and Ocean Sciences. I am researching the magmatic and thermal history of an ophiolite in the northern Cache Creek terrane, near the BC-Yukon border. Using geochemical constraints, I hope to place my work into a tectonic framework, with implications for models of terrane accretion in the northern Canadian Cordillera.

Siobhan McGoldrick in the beautiful BC mountains.

I attended the GAC-MAC Annual Meeting recently in Kingston, Ontario, thanks in part to funding provided by the Precambrian Division of GAC®. I presented the preliminary conclusions of my study in the GAC® session honouring the career of Dr. Cees van Staal. I have been fortunate enough to be mentored by a former Ph.D. student of Dr. van Staal, and presenting in this session was therefore particularly meaningful. As I will be defending my M.Sc. thesis in the coming months, it was a valuable experience to present at this session and receive feedback from those in attendance. At the GAC® meeting I was also able to attend a variety of presentations and poster sessions, and benefited from discussions with geoscientists. I would like to thank the Precambrian Division for supporting geoscience students in Canada such as myself with financial aid to attend GAC®.

Celine Porter – University of New Brunswick

I am a second year M.Sc. student studying at the University of New Brunswick under the supervision of Deanne van Rooyen (Cape Breton University) and Chris McFarlane (University of New Brunswick). My thesis project focuses on the northern New Quebec Orogen and aims to understand the multi-phase structural and metamorphic evolution across the orogen from the foreland into the hinterland. At the GAC-MAC 2017 conference I had the opportunity to present my results in an oral presentation in the section: The Metamorphic Architecture of Orogenic Belts. Both presenting my presentation and watching others led me to being introduced to many individuals with similar geological interests and gave me many new ideas for further work for my current project. With my Precambrian Division student travel award I was fortunate to attend a four day field trip exploring the major tectonic boundary between the northeastern Composite Arc Belt and the Central Metasedimentary Belt of the Grenville Orogen led by Manuel Duguet and Michael Easton. This four day immersion into the geology of the Grenville Orogen surrounded by so many knowledgeable professionals and fellow students from such diverse backgrounds resulted in a great experience that fed both my enthusiasm and curiosity.

Celine Porter getting acquainted with lower-crustal migmatites on the "Tectonic and metamorphic architecture of the northeastern Composite Arc belt and the Central Metasedimentary belt boundary tectonic zone, Grenville Orogen" field trip.

Howard Street Robinson Medal
Becky Jamieson Robinson Lecturer
2016-2017

Medal presented at the GAC-MAC Annual Meeting, Kingston, May 16 2017

Citation: The Howard Street Robinson Medal of the Geological Association of Canada is awarded annually to meet the bequest of the Howard Street Robinson Fund, which was "for the furtherance of scientific study of Precambrian Geology and Metal Mining".

The Robinson Medal recognizes respected and well-spoken geoscientists who have made exceptional contributions towards the scientific study of Precambrian geology and or metal mining through a presentation of a distinguished lecture series across Canada. The medalist is selected by the Howard Street Robinson Committee and the Executive of the Division sponsoring the tour – the Mineral Deposits Division or the Precambrian Division on an alternating annual basis.

The 2016-2017 Robinson Lecturer could not have been more deserving of this recognition. The Precambrian Division is extremely proud to present the 2016-2017 Robinson Medal to Dr. Becky Jamieson, from Dalhousie University, for her lecture tour, but more importantly in recognition of her invaluable contribution to the understanding of the Precambrian geology through the study of tectonic and metamorphic processes that operate in orogenic belts.

Her field- and laboratory-based research has given us a window into crustal processes that are fundamental to understanding the evolution of orogenic belts worldwide. Becky's contributions include an extensive list of major papers, reports, and maps that span multiple decades and orogenic belts the world over. Her contributions to geoscience as a mentor and teacher are remarkable, her students can be found in all areas of geoscience. It is a special privilege to be able to present this medal in a Special Session filled with so many colleagues and students gathered to honour Becky's work.

On behalf of the Precambrian Division and the Howard Street Robinson Fund Committee, it is my pleasure to hand Dr. Jamieson her Robinson Medal.

Deanne van Rooyen
Precambrian Division Chair

Dr. Becky Jamieson (R) receiving the Howard Street Robinson medal from Deanne van Rooyen (L), Precambrian Division Chair, at the session organized to celebrate her career contributions, "The Metamorphic Architecture of Orogenic Belts", organized by Dawn Kellett (GSC) and Natasha Wodicka (GSC).

The Metamorphic Architecture of Orogenic Belts

Throughout her career, Becky Jamieson has worked on the interactions between metamorphism and tectonics at all scales. She has addressed fundamental questions about heat, rheology, structure, and the metamorphic record by investigating some of Earth's most spectacular orogens, including the Grenville, Himalayan -Tibetan, and Appalachian-Caledonian orogens. Through a combination of metamorphic case studies and numerical modeling, she formed predictions on the relationships between heat, tectonics, and metamorphism in orogenic belts, which continue to be tested by many researchers. Her innovative integration of field, analytical, and modeling research, her scientific rigor, and her exceptional writing skills have inspired the international metamorphic petrology and tectonics research community. Becky was a true mentor for both of us during our graduate studies, as she has been for many other undergraduates, graduate students, and post-doctoral fellows, constantly challenging us to bring our top game in our own research. With a special theme on Tectonics, the Kingston 2017 GAC-MAC meeting was a timely venue to honour Becky's outstanding career contributions on the metamorphic architecture of orogenic belts, as well as her receipt of the 2017 Howard Street Robinson award from the Precambrian division. The two-day special session, which attracted many top researchers, emerging young scientists, and an engaged audience, was a true testament of her major achievements in this field.

Dawn Kellett and Natasha Wodicka
Geological Survey of Canada

Canadian Paleontology Conference

The twenty-sixth Canadian Paleontology Conference was held in Calgary, Alberta, from September 29 to October 2, 2017. This year, the Calgary office of the Geological Survey of Canada (GSC-Calgary) had a double reason to celebrate—it being the GSC's 175th anniversary and GSC-Calgary's 50th anniversary—and so the Paleontology Section at GSC-Calgary volunteered to organize the meeting. We were happy to partner with the Alberta Palaeontological Society (APS), which brought Calgary's enthusiastic avocational paleontology community to the table. Our organizing committee also included representatives from the geoscience departments at Mount Royal University and the University of Calgary. The meeting was dedicated to the memory of Dr. Art Sweet, a former Chief Paleontologist of the Geological Survey of Canada who passed away earlier this year, and was a friend to many of us in the Calgary paleontology community.

The meeting began on the Friday with a field trip to view "Fossils of the Middle Cambrian Stephen Formation at Stanley Glacier, Kootenay National Park, BC". The trip was led by University of Calgary Ph.D. candidate Chad Morgan and Jean-Bernard Caron of the Royal Ontario Museum. The participants enjoyed good weather and fine fossils. That evening, there was an informal icebreaker at the conference venue.

Technical sessions extended through Saturday and Sunday. Talks were wide-ranging, covering everything from Cambrian ichnology to Holocene palynology, and from the history of GSC paleontology to the challenges of doing public outreach on natural history in Calgary—a large city without a dedicated natural history museum. Posters were similarly wide-ranging in subject matter. There were several strong presentations by students, and the Paleontology Division's Bolton Award for best student presentation was presented to Brittany Cheung for her talk, "Redescription of the middle Cambrian *Amiskwia sagittiformis* as a stem Lophotrochozoan", coauthored with Jean-Bernard Caron.

Saturday evening the conference banquet was held at the conference venue. The highlight was the presentation of the 2017 Billings Medal to Dr. George Pemberton of the University of Alberta, "…in recognition of his outstanding contributions to Canadian paleontology as an ichnological researcher, an educator, and a mentor". Following the medal presentation, Dr. Pemberton gave a keynote address entitled "Assessing permeability/porosity trends in bioturbated media", a very accessible introduction to a highly technical subject.

Field trip participants enjoyed clear skies and mild temperatures on the climb to Stanley Glacier.

George Pemberton accepts the 2017 Billings Medal from Paleontology Division Chair Melissa Grey.

On Sunday afternoon, the APS sponsored a pair of free public lectures in the conference venue. Dr. Donald Henderson (Royal Tyrrell Museum) explained how "Sauropod dinosaurs were the colossal corks of the Mesozoic" and Dr. Jean-Bernard Caron (Royal Ontario Museum) spoke on "The latest discoveries from the middle Cambrian Burgess Shale site in Marble Canyon". Both lectures were very well attended and we think it was very worthwhile to include an element of public outreach in the conference program.

Monday morning dawned on a snowstorm, a reminder of just how changeable Calgary's weather can be. A field trip had been planned to study "Upper Cretaceous Campanian to Maastrichtian) ammonites and semi-precious gemstones of the Bearpaw Formation, along Saint Mary's River, Southern Alberta". However, this would have required a three-hour drive from Calgary to Magrath, Alberta, to visit the ammolite quarry operated by Korite Limited. The poor highway conditions meant that some quick rethinking was needed. Happily, the conference venue provided a

Brittany Cheung receiving the Bolton Award for best student presentation from Paleontology Division Chair Melissa Grey.

meeting room so that field trip leader Barry Richards (GSC-Calgary) could give a background lecture. Then, the staff of Korite Limited provided an extended tour of the Calgary factory where they manufacture jewelry from ammolite mined at Magrath. Participants saw numerous beautiful specimens and had the opportunity to talk with the artists that created them.

We would like to thank all the members of the organizing committee, as well as all the participants, for helping to make CPC-2017 a success.

Robert B. MacNaughton and Leanne Tingley
Co-chairs, Organizing Committee, CPC-2017

Calgary Skyline 2016. *Photo: Kevin Cappis. Cropped image, used under Creative Commons BY-SA 4.0 license*

Reading on the Rocks

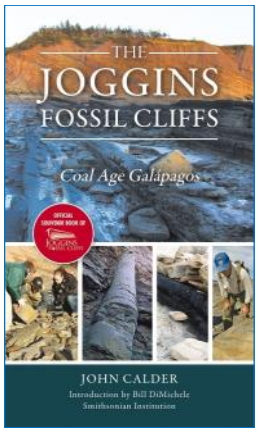
***The Joggins Fossil Cliffs: Coal Age Galápagos* by John Calder, 2017. 96 pages. Formac Publishing Co. Ltd, Halifax, Nova Scotia.**

Canada has few UNESCO World Heritage sites, however three of them are fully or partly set aside to preserve our fossil heritage. I bet most Canadians and even many people involved in Earth history do not know what and where they are. Calder's book on the Joggins fossil beds in Nova Scotia brings to life the site with the longest history and arguably the most important one in the development of modern scientific thought. The liberally illustrated 80-page book is neither field guide nor scientific account. It lies somewhere in between, thus having strengths and weaknesses. It is laid out magazine-style with short contributions on many topics related to the history, people, geology and paleontology of the site.

The content broadly covers topics such as the "Coal Age", and the Coal Age world and its relationship to the fossil site. It touches on how geologists read the rocks and the puzzle of time. Footprints at Joggins and *Hylonomus lyelli*, the first reptile, get lots of coverage. There is a rather short section on the fossils at Joggins. A large part of the book describes bits and pieces of the history of the site and its contribution to the history and the development of science. Toward the end several pages are devoted to the role of the residents of the local area past and present.

Generally, I like the book because it provides an interesting though somewhat quirky view of Joggins. I like the way humans are woven into the fabric of the story. In doing so the author includes some excellent quotes, such as those from a letter by Charles Lyell concerning the identity of the creature found inside fossilized hollow tree trunks. In another, William Dawson notes the importance of doing field work rather than being shut up in a museum—a favourite rant of mine too!

The frontispiece includes a great quote from William Dawson's *Acadian Geology* pertaining to *Hylonomus lyelli*: "*This little animal was not a squalid, slimy dweller in mud,….but rather a beautiful and sprightly tenant of the Coal Formation thickets…*"



I applaud the whole ecosystem approach to describing the fossils. The book views the fossils as examples of organisms living together rather than as fossil bits, remnants of organisms outside of the context of their environment.

The writing style is very readable and the whole publication well-illustrated including historical photographs, drawings, modern pictures and cartoons. Calder paints an evocative living picture of the landscape and its creatures in the introductory section "Welcome to the Coal Age" where we hear "only the sound of wind whistling through long lycopsid leaves and stirring the leathery fronds of seed ferns, the faint whirring of insects, and in the distance and ominous role of thunder." The illustrations are well placed and pertinent to the text.

What I did not really like was the jumping from topic to topic. A section describing the Coal Age Ecosystem at Joggins is followed immediately with one about the artist who illustrated the book—both good sections but strangely juxtaposed. It's hard to anticipate what comes next as you turn the page. I also felt that there just was not enough text on the science topics, such as the Puzzle of Time. I was hoping to see more illustrations of fossils from the site; only about ten are pictured, some of which are trackways. I was looking forward to reading more about the Joggins Fossil Institute including how it was laid out and what one might expect to see.

Overall at $18.00 this book is worth buying especially if you are going to visit the site or are thinking about it. It is also very much worth reading if you have an interest in the history of paleontology in general and especially in paleontology in Canada.

One thing for sure, the book demonstrates clearly why the Joggins fossil site merits its designation as a UNESCO World Heritage site and why Canadians should take pride in it and learn more about it.

Richard J. Hebda
Victoria, BC

Announcements

Canadian Geological Foundation Invitation for Grant Applications

The **Canadian Geological Foundation** invites all interested parties to submit grant proposals for the next round of grants selection. The secretary must receive your application by March 31, 2018. The Foundation is a non-profit, charitable organization dedicated to assist in the development of geological sciences in Canada. In principle, grants are made only in support of activities of national interest and broad significance, with emphasis on those of long-term importance. Grants are made only on the basis of written applications giving a summary and detailed budget of the proposed project. The Foundation disburses more than $175,000 annually. Note that grants are paid upon completion of the project.

The CGF uses a three-tiered grant system related to the size of the grants being requested: small grants (<$10,000), medium grants ($10,001 to $30,000) and one large grant per year of up to $45,000. In addition, the Foundation will consider the possibility of Multi-Year Grants (i.e. approval of a continuing grant for specific amounts to be paid in each of up to 4 years).

Application forms and detailed instructions are available on the CGF website at www.canadiangeologicalfoundation.org Please submit applications electronically as a PDF file to the Secretary. Applicants are urged to read the instructions carefully to ensure that their application meets the Foundation's grant criteria and that it is complete. Incomplete applications will not be returned for correction and any material in the application in excess of the five page limit will not be circulated for review.

Queries about the Canadian Geological Foundation should be addressed to the Secretary:

Jane Wynne
B 9561 Canora Road
Sidney, BC, V8L 1P4
Tel: 250-656-6681
Email: jane.wynne@shaw.ca

CFES National Earth Science Mentorship Medal

It is the time of the year when the CFES Mentorship Medal committee invites CFES members to nominate deserving individuals in their respective organization for the CFES Mentorship Medal award.

The CFES mentorship award was created in 2008 to recognize the sustained and inspirational mentorship of colleagues and employees including peers, graduate students, undergraduate students and technicians. The award was set up in honour of Paul F. Williams, a geologist known for scientific and mentoring excellence, candour and integrity.

Details about the award, as well as the nomination form (in Word and pdf formats) are available on the CFES website at www.cfes-fcst.ca/mentorship-medal

Please note that the deadline for receipt of nominations is January 15, 2018.

Graziella Kirtland Grech
President-Elect, Canadian Federation of Earth Sciences (CFES)

Environmental Careers Organization of Canada (ECO Canada) wage funding program

The program gives eligible employers who work in science, technology, engineering, mathematics (STEM) or natural resources up to 50% of an intern's salary (up to $15,000) for new full-time environmental jobs.

To find out more and check eligibility, go to www.eco.ca/employers/internship-program/

This project was undertaken with support from Environment and Climate Change Canada and Natural Resources Canada.

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Abstracts will be accepted until January 15, 2018.

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Geological Setting	Environment-Performance	Water & Resources	Geophysics	Indigenous	Indigenous
Nuclear	Exploration Technology		Marine Geosciences	Public	Social
	Geochemistry & Exploration		Planetary Geology	Teaching	Sustainability
	Geometallurgy		Quaternary Systems		
	Major Minerals		Sedimentary Geology		
	New Sources		Structure/Tectonics		
			Volcanology & Petrology		

The cost to submit an abstract is **$50 CAD** payable by credit card during the abstract submission process. This standard practice ensures that abstracts submitted are from committed authors/presenters and provide rich content for the technical program. Payment will be part of the submission process and will generate the appropriate confirmation and receipt.

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Howard Street Robinson Fund

The Robinson Fund was established in 1977 by the Geological Association of Canada, using a bequest from the estate of Howard Street Robinson. The fund is dedicated to the furtherance of scientific study of Precambrian Geology and Metal Mining by:

- sponsoring an annual Distinguished Lecturer Tour whose focus alternates between Precambrian research and economic geology (lecturer alternately chosen by the GAC®'s Precambrian and Mineral Deposits divisions)
- supporting Special Projects including publications, symposia and conferences.

Proposals for special projects on Precambrian Geology or Metal Mining should be submitted to the Robinson Fund Committee. Projects should be sponsored or organized through the GAC® or one of its Divisions or Sections. Proposals that have a wide appeal or degree of accessibility to the GAC® membership are preferred.

For further information and proposal submissions, please contact: Dr. Stephen Piercey, Chair, Robinson Fund, c/o Department of Earth Sciences, Memorial University of Newfoundland, St. John's, NL A1B 3X5 Canada, E-mail: spiercey@mun.ca

The Last Word

The last few months have challenged my time management skills. If you check GAC's administrative information on p. 3, you'll see that I have a new worksite address. During the past six months or so, I have been focussed on packing up my office and an associated lab ready to move to a new building. Since late November, work has been all about unpacking. Of course, this was a team effort, with everyone in my work group fully engaged with the move. With our microscopes set up and lab functional, I am looking forward to getting back to earth science research and writing, as well as planning new projects. I may even have time now to write an abstract for RFG2018! Alwynne B. Beaudoin, *GEOLOG* Editor

Information for Contributors

Contributions should be submitted by e-mail to Alwynne.Beaudoin@gov.ab.ca, with GEOLOG in the subject line. Contributions are welcome in either of Canada's two official languages. MS Word (.doc or .docx) is the preferred format for contribution but generic word processing (.rtf or .txt) files are also fine. Please do not submit PDF files. Up to four hi-res images may be submitted per contribution: preferred format is .jpg, RGB colour, with a minimum 300 dpi resolution at 5" x 3" size. Please ensure that images are cropped and colour-corrected, and provide a caption for each image, and an image credit line if needed. Contributors are responsible for securing permission to publish for any third-party images or images of living recognizable people. Diagrams (vector graphics) may also be submitted. Preferred format for graphics is Adobe Illustrator (.ai); make sure that the file is saved with "save text as lines" option enabled to ensure no font substitutions. Additional information on other file formats can be obtained from the Editor. Please do not embed images or graphics in your text document; images or graphics should be submitted as separate files. In your text, use a call-out in parentheses to indicate the approximate placement of each image and graphic. If files are larger than 10 mb, please contact the Editor for alternate delivery arrangements. Your contribution will be copy-edited to ensure consistent spelling and orthography and to correct any obvious typos or errors. Contributions may also be edited for clarity and length. If the Editor has questions about specific information in the text, she will contact contributors for clarification. Contribution deadlines are March 1, June 1, September 1 and December 1.

Consignes aux auteurs

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