Queen's University

DEPARTMENT OF
GEOLOGICAL SCIENCES AND
GEOLOGICAL ENGINEERING

GEONews 2020

Greetings from the HEAD

It turns out that attending PDAC 2020 in early March was to be more eventful than the usual fun of connecting with industry people, educators, and alumni! In the weeks following we learned the name and the potential impact of the virus we now call Covid-19, and discovered that some of us might have been in contact with it. By March 13, all in-person classes at Queen's were suspended, and by March 22 we resumed teaching using remote methods. We have been very lucky that all of us are Covid-free owing to the quick action taken by members of the department, the university, and the city. We offer our sincere condolences for those of you who have lost loved ones, and our best wishes for a speedy recovery for those who have been affected by this illness.

Fittingly, in mid-March, we moved the interviews for the new Digital Earth Scientist position on-line. We expect Dr. Hom Nath Gharti, presently hunkered down at Princeton, will arrive in the early New Year. Dr. Gharti is a geophysicist and engineer who uses advanced computing to solve the fundamental earth science problems. We look forward to beginning the renovations of Miller 403 that will provide a central facility for advanced computing for Dr. Gharti, as well as all faculty, grad students, and senior undergrads. We thank Carol Ellis, BSc'82, MBA'94 for the amazing gift that will allow us to undertake these crucial renovations.

Nearly ten months into the pandemic, "Zoom" is now both a noun and a verb, and is part of our day-to-day life for teaching, research, and meetings. It's astonishing how well we have all adapted to this weird life with only limited, approved, and scheduled access to Miller and Bruce. Hardest for me is not seeing students every day in the reading room and classrooms, and missing the day to day interactions with colleagues. We have learned that, in general, students at Queen's and other universities have found that moving to on-line courses has been tough. Students miss opportunities for face to face (or F2F in the parlance) interactions with their professors, TA's, and classmates. We are, however, providing an astonishing array of digital specimens for laboratories, thanks to the efforts of Dr. Layton-Matthews and Dr. Linda Tsuji, our Museum Curator. Since July, hand samples have been photographed in continuous, 3D sweeps, and modeled using SketchFab. These "digital" specimens are made available to students via course webpages. Being forced to think differently about teaching and learning has helped us find creative and innovative solutions, some of which will survive the pandemic.

I'm guessing many of our readers are wondering what has happened to field learning. Given the logistics of physical distancing and a remote school term, all of our field trips were cancelled in the fall. Our 2nd year field methods course, part of which was taught in September and October, will finish up in early May with several days of field work in the Kingston area. We have a preliminary Covid-safety plan, beyond our usual field safety plan, and have a generous offer of help from Dr. Alex Baugart of BGC Engineering. Dr. Baumgart, an Emergency Response Engineer, brings a wealth of knowledge, not just from BGC, but from other field-oriented firms who worked together to develop safety plans during the pandemic. Field school, GEOL 300, cancelled in the summer of 2020, will be offered to two cohorts of students in August 2021. The plans are already underway – and will involve extra buses, additional profs and TA's, and assigned "Field/ travel pods". One thing a GEO education prepares us for is pivoting, problem-solving, and "MacGyvoring", and we will be doing all three to make these field courses the best student experience we can. Further, plans are underway to offer an exciting "Basins" short-course in May, to take the place of cancelled fall 2020 trips (normally to New York and Quebec City), led by Drs. Laurent Godin, Guy Narbonne, Peir Pufahl, and Elisabeth Steel.

In place of the Grinch Gronch, the wonderful tradition of getting all members of the department together for an evening of good food, skits, songs, and other antics, was replaced by an (apparently) equally fun beer tasting and snack event with the local Daft Brewery. Alumnus, geochemist Dr. Ryan Dhillon, PhD'15, is the master brewer with Daft.

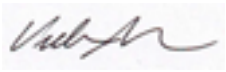
Our alumni have been extraordinarily supportive of all our endeavours – the Field Funds, the Named TAships, the Burns-Berlin for undergrad learning, the GARNET program to support students in the job search and to connect them with young alumni, and the Geology Trust – that affords us the flexibility to undertake activities to support our students and faculty, including important renovations to teaching and learning spaces. A recent, transformative gift, from alumnus Stephen Cheeseman, BSc '85, will enable us to undertake fundamental research in the interactions between the moon and the earth. This new program of research in GeoSelenics, will proceed with the critical mass of faculty – Drs. Alex Braun

(the scientific lead), Laurent Godin, Rob Harrap, Chris Spencer, and Hom Nath Gharti working together with the inaugural Geoselenics Post Doc, Dr. Petar Glisovic.

For those of you thinking of a gift to the department, I invite you to consider the Advancement Priorities on page 20. Should your workplace have the capacity to support a student for a summer job, or a 12 to 16 month paid internship, please email Garnet@queensu.ca and myself vicki.remenda@queensu.ca, for more information on how you might do this. Students are very interested in work experiences to augment their university learning. Furthermore, we are hoping to employ students in research projects in the summer of 2021 and beyond, by implementing a program similar to that of the federal granting agency, NSERC. NSERC summer research grants are awarded to undergrad students, and topped up by participating faculty supervisors, and enable students to undertake summer research in the department. Many faculty and graduate students started their careers as undergrad summer researchers, experiences which can be life-changing. We are proposing a new program, a Named Research Assistant (RA)-ship. Come fall, I hope we will launch a plan for upgrades and renovations to research labs. Originally the plan was to celebrate the 90th birthday of Miller Hall in 2020 to roll out this plan, so instead we will celebrate the 91st birthday!

Since I began my term as Head of Department, July 1, 2017, I have been challenged, occasionally elated and cranky, and but mostly immensely proud of the accomplishments of faculty and staff colleagues, of our truly wonderful undergrad students, of the interesting debate and discussion that goes on in the virtual classrooms of the MEERL program, and of the breadth and depth of the very fine research undertaken by our students. I have been touched by the generous spirit of our alumni, our interactions in person, by email, and now by Zoom! All in all, the good moments have outweighed the cranky moments – which is my way of saying that I have accepted a second term as Head of Department to June 2026.

I'd like to propose a toast to the decades of history of this grand department and all its people, past and present, who have contributed to make it a truly inspiring place. Members of the department have demonstrated a seemingly endless capacity for creativity, innovation, and good humour– and I am confident that we will meet this next decade the same way.



Vicki Remenda
Head of Department

LAND Acknowledgement

Queen's University is situated on Anishinaabe and Haudenosaunee Territory. To acknowledge this territory is to recognize its longer history, one predating the establishment of the earliest European colonies. It is also to acknowledge this territory's significance for the Indigenous peoples who lived, and continue to live, upon it – people whose practices and spiritualities were tied to the land and continue to develop in relationship to the territory and its other inhabitants today. The Kingston Indigenous community continues to reflect the area's Anishinaabek and Haudenosaunee roots. There is also a significant Métis community and there are First Peoples from other Nations across Turtle Island present here today.

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INTERVIEWS with the Head of Department

I thought as alumni you might be interested in the responses of several members of the department to three questions: 1. How has your job changed under Covid? 2. Can you tell us about a memorable moment(s)? Something that touched, or made you proud? 3. Have you adopted a new routine or activity that has helped you cope under Covid conditions?

Dr. Bas Vriens, who started with us in the Fall of 2019 responded by saying:

1. The most drastic change for me has been the redesign and delivery of courses online, a major logistical undertaking for instructors. My experience has been good so far, but I am still learning every day and hope we can return classrooms again very soon! Luckily, my research group has been able to sustain our research at a relatively normal pace: we work with existing data, and new samples that were collected by external partners and shipped to us directly. We had to spend field work money on FedEx bills unfortunately, but I am happy my students have been able to make excellent progress under COVID.

2. I am very proud of the collegiality and team spirit in our department, the resilience of the students and their ability to keep looking forward positively, and the excellent support that is provided by people in QFIR and the university's teaching and learning teams.

3. As an antidote to screen time, I force myself to go outside every day – rain or sun. I also make time to talk to my family abroad every week, even if only briefly, so paradoxically we interact even more than we used to before COVID.

Dr. Linda Tsuji, Museum Curator, responded by saying:

1. My day-to-day definitely changed a lot! Spring and fall I would generally be running multiple school programs every week and interacting with members of the public, and in the summer the museum runs programs for summer camps and is generally pretty busy with Kingston vacationers and locals dropping by for geo immersion. It doesn't leave much time for planning or organization, but with the museum closed to the public, I've been able to do some of that. Over the fall semester I've also been 3-D 'scanning' (really photogrammetry) rock and fossil specimens for use in departmental classes and virtual labs. It's very strange coming into Miller and Bruce when they're so quiet.

2. The museum is doing a virtual "Beyond Classrooms"

program with a class from a local school. I've ventured into filmmaking, recording what I would normally say in person, and then we have a Q&A with the class over Teams. I was so heartened by the enthusiasm the kids are showing for geo topics! There were so many questions, and a lot of them were really good!

3. I've tried to get outside and walk around more during the summer, at least – for a while I had access to a car, so I explored a few of the parks and conservation areas around Kingston. Video calls with friends and family became pretty routine. Also, I've always wanted to knit, and I managed to finish a sweater and a couple of scarves, while catching up on some quality tv. I've found knitting reduces stress, maybe in part because it forces me to unplug, and it's nice to feel like something tangible had been accomplished.

Anya Jacksteit, 4th year GeoEngineering Student, said:

1. As a student, all of my classes are now online due to Covid - labs, lectures, tutorials, everything. As a TA, my labs are also online. I have had to change the way I connect with my classmates and my students, relying on Zoom and email instead of F2F interaction.

2. I TA APSC 151, the first-year Earth Systems Engineering course for engineers. Despite being in all different places, and having never met, getting to see my students bond with each other (and me) through only online communication has been touching. I was really worried about class engagement when the semester started, but today, on the last day of class, my students pulled me into a Zoom room and gave me a big thank you - I almost cried.

3. Thanks to Covid, my dog and I have bonded a lot more! I started taking him to dog parks and on longer walks - we're now up to 10 km per day - so we can both get out, away from the computer, and into the fresh air. This has been helpful as we head into the dark winter under Covid; he helps me see the light at the end of the tunnel.

Emily Darling, 4th year GeoScience Student, engaged in working on a Meteorite for her thesis, and supervised by among others, alumna Dr. Michelle Thompson, of Purdue.

1. This summer I worked on muon veto analysis with the DEAP3600 team at Carleton and Queen's Snolab. As my job was completely remote, I was not able to meet my colleagues in person, and thus lacked the sense of community this job opportunity would have given me otherwise. Thankfully, the field of experimental physics lends itself to remote work, as many collaborations are made with scientists across the world and systems for remote data and computing access are well-established.

2. There were two highlights of the summer. It was very rewarding to present my work at the Canadian Astroparticle Physics Annual National Meeting and receive 1st place for my poster. I loved hearing what other students had been working on and it was great to engage with the astroparticle physics community! The second one is less of a singular moment, but I am proud looking back on the skills I have learned. I went from not knowing coding languages or even how to open linux-based files, to having written many analysis codes in C++ and ROOT and running them on high-powered computing clusters by the end!

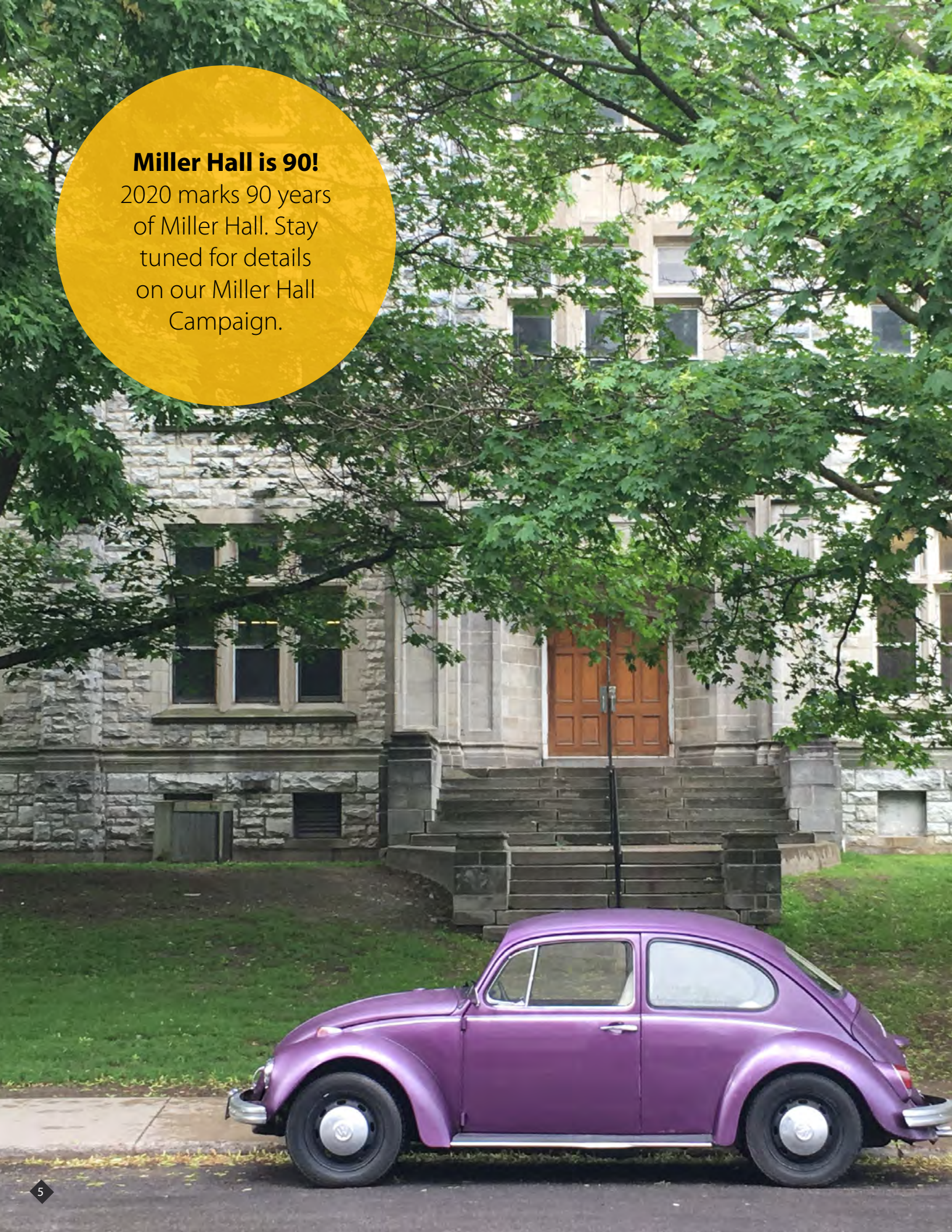
3. I would say the most important coping strategy is to take breaks and go for walks outside! Working from home blurs the line between work and personal life so I try to go for short walks both in the morning and afternoon to clear my head and help me prioritize what I need to get done. And, plan for time to relax later in the day to relax.

Donald Lougheed, PhD Student, said:

1. Since lab work has not been available, or is only available in very specific scheduled slots, I've needed to set clearer plans for my research, and stick to them. I've spent time organizing data to ensure that I have a clear picture of what I have and what I need so that any time I have on instruments is both targeted, and efficient.

2. I've had two papers submitted and accepted since quarantine began, which was initially stressful as I knew that I did not have the opportunity for quick follow-up analysis. I focussed on categorizing and revisiting all the data I had and found that I had a clear picture without the need for follow-up. It was nice to "tear the band-aid off" all the little worries that I'd built up over the course of the project, even if it was a bit of a troubling task to start.

3. The ability to fit short work-outs and bouts of house chores into breaks during the work day has left me with more time in the evenings/weekends. At the same time, these breaks in my work-day on campus would normally be spent with some form of casual socializing, so I've had to focus on staying in touch with people. I still miss little casual chats in the hallway, though!



Miller Hall is 90!
2020 marks 90 years of Miller Hall. Stay tuned for details on our Miller Hall Campaign.

DEPARTMENTAL UPDATES

COVID Response

All faculties and departments were required to and the best possible solutions for remote student learning for the Fall of 2020.

As a department, we elected to offer two core GEO courses in each of second, third and fourth years, in compressed 6 week half-terms in the fall. The decision to have two compressed terms was made because research indicates that students do better when they are juggling fewer things at a time, especially when learning remotely. This means that in either 6 week period, students would have only 3 courses to keep track of but still be able to fulfill their course load for the fall.

Faculty worked hard through the summer to find ways to provide synchronous (Q&A, tutorials, discussions, eg) and asynchronous (videos, narrated slides, readings) teaching materials, and virtual labs. We made sure to have plenty of TA's available to assist with students' learning and many staff and faculty were busy creating a library of virtual specimens for labs.

As you probably guessed, there was no field work this fall in any course. We plan to offer a field component of GEOE/L 221 Field Methods.

The department and individual profs invited students to provide feedback on how they felt the two compressed terms was working. In general there was positive feedback. The winter will continue to be remote, with some in-person elements in the 4th year thesis and design courses. Owing to the later start of the winter term, two compressed terms is not possible.

Equity, Diversity, and Inclusivity

TThe events over the summer of 2020 made it clear that serious and systemic racial injustices and violence are being committed against Black people, Indigenous peoples, and minorities in Canada and elsewhere. We at the Queen's University GSGE Department condemn anti-Black and anti-Indigenous racism, and the biases embedded in academic life. Addressing past and ongoing violence and discrimination against Black, Indigenous, and racialized people requires both immediate action and continuous work, and we are committed to working towards building a welcoming and supportive environment for all members of these communities.

We acknowledge the ways in which geological exploration and exploitation disproportionately affect Black, Indigenous, and other racialized groups around the world, and will support and contribute to developing efforts to address these issues collaboratively with those affected. We have an obligation to fight the systemic racism that plagues our society and to acknowledge these inequities in geoscience and geological engineering.

The GSGE Department recognizes that action is required, and in response we have formed a departmental Equity, Diversity, and Inclusivity Committee in order to look into systems of oppression in our own department and to promote the creation of a more equitable and diverse community. The EDI committee, led by Dr. Heather Jamieson, is composed of faculty, staff, graduate students and alumni from the GSGE Department.

EDI Committee Priorities

- **Plan** for department-wide Indigenous Land Acknowledgement Training
- **Integrate** sustainable resource development and relationship building as core knowledge components of an undergraduate degree
- **Review** hiring procedures for graduate students
- **Address** financial inaccessibility concerns for marginalized students
- **Connect** with graduate students to discuss departmental support, resources and TA experiences

To stay up to date on what the GSGE EDI Committee is working on next, check out our webpage, Inclusive Geo.

We want to hear from you! Please share your comments, ideas and opinions with us through an anonymous form at Inclusive Geo. We can only move forward as a department by representing the diversity within our group – students, alumni, faculty members and staff.

FACULTY UPDATES

New FACULTY

Dr. Hom Nath Gharti, Digital Earth Scientist

hng1@queensu.ca

The Department welcomes its newest faculty member, Dr. Hom Nath Gharti.

Dr Gharti's research area encompasses applied mathematics and computational (geo)mechanics, including (an)elastic-gravitational wave propagation, co-seismic deformation and post-earthquake relaxation, glacial isostatic adjustment, gravity/magnetic anomalies, microearthquakes; and scientific visualization. He has co-developed a number of soft ware packages to solve problems in these and other areas of earth sciences.

RETIREMENTS

April Vuletich

Congratulations to April Vuletich on her retirement from the department after over two decades of service. April devoted her energy, talent and deep knowledge to building and sustaining the Queen's Facility for Isotope Research (QFIR).

Dr. Noel James

By Dr. Peir Pufahl

Noel P. James retires with a long-lasting legacy

Noel James retires after an illustrious 52-year career. Noel is a Member of the Order of Canada, Fellow of the Royal Society, Logan Medal awardee, and the recipient of six additional national and international awardsAlthough renowned worldwide for his pioneering research on limestones (*in 2019 Dr. James was ranked 59th out of 12,609 (or in the top 0.3%) in his field), he is beloved in the department for his superlative teaching and mentorship.

Noel has trained a generation of sedimentologists with the simple guiding principle: fear no rock and have fun. He inspires with a contagious enthusiasm and knows exactly how to tease out the very best in his students and colleagues. We are fortunate that Noel remains active in the life of the department. He can still be found on the second floor of Miller Hall mentoring graduate students, interacting with colleagues, and publishing at a frantic pace. Thankfully nothing has changed!

Please feel free to drop Noel a line (jamesn@queensu.ca). He would love to hear from you. Once things are normal, all alumni are invited to a celebration of Noel's (still ongoing) career.

Faculty ACCOMPLISHMENTS

Dr. Jennifer Day awarded funds from Queen's University Catalyst

Dr. Jennifer Day has been awarded funds from the Queen's University Catalyst Fund. The project is titled, "Investigating the geomechanics and public safety risks associated with the instability potential of popular rock formations for geotourism and forecasting risk associated with climate change evolution".

Dr. Laurent Godin and Colleagues Discover New Fault System in Nepal

Dr. Laurent Godin and colleagues from Lancaster University and University of Alberta have discovered a new fault system in Nepal. The resulting article was published in the Proceedings of the National Academy of Sciences (USA). And, they created a video abstract to accompany their paper.

Dr. Jean Hutchinson Elected Fellow of the Canadian Academy of Engineering

Dr. Jean Hutchinson has been elected as a Fellow of the Canadian Academy of Engineering (CAE). Fellows of the Academy are nominated and elected by their peers, in view of their distinguished achievements and career-long service to the engineering profession.

Drs. Leybourne and Steel Receive CFI JELF Awards

Dr. Matthew Leybourne and Dr. Elisabeth Steel have received funds from the Canada Foundation for Innovation's (CFI) John R. Evans Leaders Fund (JELF). The funds will support Dr. Leybourne's research project on "Advancing Detection Limits and In Situ Isotopic Chemical Chromatography for Astroparticle and Geochemical Research" and Dr. Steel's research on "Source to Sink Transport Dynamics: Exploring Evolution of Deltaic and Deepwater Systems through Physical Modelling".

Dr. Christopher Spencer Awarded GSA Donath Medal

Dr. Christopher Spencer has received the 2020 Young Scientist Award (Donath Medal) from the Geological Society of America (GSA). The Young Scientist Award was established in 1988 to be awarded to a young scientist (35 or younger) for outstanding achievement in contributing to geologic knowledge through original research that marks a major advance in the earth sciences. Dr. Spencer seeks to understand the formation, destruction, and secular evolution of the conti nental crust. Chris does "world-class research on a range of fundamental topics in geoscience" and is the instigator of the Traveling Geologist which highlights the importance of field geology.

FACULTY VIRTUAL ABSTRACTS

Dr. Laurent Godin and colleagues - "Active strike-slip faults and an outer frontal thrust in the Himalayan foreland basin". View the video abstract.

Dr. Matthew Leybourne and colleagues- "Glimpses of oceanic lithosphere of the Challenger Deep forearc segment in the southernmost Marianas". View the video abstract.

GEOSELENIC Research Project

The Geoselenic Research Project was established and funded by alumnus Stephen Cheeseman in 2020 to address fundamental questions of the interactions between the Earth and the moon.

The project will focus on the integration of multi -disciplinary research to improve our understanding of the relevance of the Moon - Earth processes including plate tectonics, core and mantle convection/geochemistry, magnetohydrodynamics, the geodynamo and the evolution of the future of life on Earth.

Dr. Petar Glisovic

The project is collaborative in nature and will give team members opportunities to continue existing and establish new collaborations with international research groups in geodynamics and planetary sciences. Under the auspices of this project, members will conduct fundamental and integrate of Geoselenic research.

The department is pleased to announce that Dr. Petar Glisovic has accepted the inaugural Geoselenic's PostDoc and began his work on December 1, 2020. Petar is a geodynamic modeller who worked on many large-scale Earth processes from the core to surface processes. His latest global numerical models have advanced understanding of smaller scale regional tectonic processes, which was not possible since recently. For example, in a recent project he was able to explain why the Nile river region has been kept at such high elevations for 30 million years owing to mantle material pushing upward (Nature Geosciences, Faccenna et al., 2019). Petar has proposed a comprehensive approach to model not only the impact that generated the moon, but also the continuous interactions in gravitation.

Petar has recently worked in research at the University of Texas and the University of Quebec a Montreal.

Engineer and Scientist WORLD-WIDE RANKINGS

Congratulations to Dr. Guy Narbonne, Dr. Mark Diederichs and Dr. Christopher Spencer, who are among the top 2% of scientists/ engineers in their fields globally, for 2019.

Past and present Geological Sciences and Geological Engineering professors ranked highly among 7.8 million scientists and engineers for whom data was acquired, among the top 2% for career standing. They include Drs. Alan Clark, Raymond Price, Robert Dalrymple, Noel James and Kurt Kyser. The worldwide career ranking calculates the citation index of each scientist and engineer since 1834, before Queen's University was even established as an institution. Dr. Narbonne stands in the top 0.28% for citations in geology, since 1834. Impressive!

The rankings can be found on the Department of Geological Sciences and Geological Engineering website.

Faculty YouTube VIDEOS

In these digital times and with the recent need for remote learning, many faculty members in Geological Sciences and Geological Engineering have taken to virtual formats for both promoting their own research, and teaching.

Some examples of these woth having a look at include:

- Dr. Diederichs' APSC 151 Lessons
- Dr. Spencer's "Travelling Geologist"
- Dr. Jamiesons' talk on Giant Gold Mine, Yellowknife
- Dr. Hutchinson's Glossop Medal Lecture

Many more will be posted to the departmental website soon!

NEW FACULTY Mentorship Program

By Dr. Georgia Fotopoulos

At the start of the Winter 2020 term, we rolled out a new faculty mentoring program. This program was designed to facilitate the success of Assistant Professors early in their careers through monthly lunch meetings coordinated with senior faculty members and all of the Assistant Professors in the department. Topics of discussion included excellence in research, teaching and professional service. The mentoring program provided opportunities for professors of all ranks to communicate about departmental matters, university guidelines, collaborations, networking and resources across disciplines in an open and informal environment. While the program got off to a good start, the pandemic moved the mentoring online for a few months and finally wrapped up this summer with physically distant meetings outdoors. Thanks to all of the senior faculty volunteers for participating. Feedback from the Assistant Professors was positive stating that it was awesome to experience faculty engagement while being provided extremely useful information. A special thanks to all of our great new faculty members (pictured below) who enthusiastically got on board with the program.

Some of our newest faculty pictured in front of Miller Hall

STUDENTS

GEOL/E 401 field trip 2019 with Ryan Dhillon, PhD'15 (far left), Dr. Noel James and Dr. Laurent Godin (left back two rows)

STUDENT Accomplishments

Students Win CGS Student Competition Group Report Award

Caitlin Fisher, BSc'20, Mark McDonald, BSc'20, and Emily Miszk, BSc'20, won first place in the group report category of the Canadian Geotechnical Society (CGS) student competition. The winning report is titled, "Intermontane Mining Ltd. Open Pit Mine Wall Pushback Design Project".

Two Students Receive SRK Consulting Graduate Scholarship Awards

PhD student Collette Pilsworth, and MASc student Caitlin Fischer, both received SRK Consulting graduate scholarship awards. The SRK Graduate Scholarship program aims to support students undertaking mining industry related graduate studies.

Visiting PhD Student Receives Outstanding Student Poster Award

Visiting PhD student, Fangge Chen, received an Outstanding Student Poster Award from the Sedimentary Geology Division/ SEPM of the Geological Society of America (GSA). Fangge is a visiting PhD student from the China University of Geoscience, Beijing.

Grad Students Receive KEGS Foundation Awards

Master's students, Stephanie Bringeland, Fadhli Atarita, and Fouad Faraj, each received scholarship awards from the Canadian Exploration Geophysics Society (KEGS).

PhD student Aawarded SEG Scholarships

PhD student Callum Walter, BSc'16, has been awarded the 2020 Society of Exploration Geophysicists (SEG) Lucien LaCoste Scholarship, and the SEG Foundation Scholarship. Callum's research focuses on integrating remotely piloted aircraft systems (UAVs) with high-resolution total field magnetometers.

Undergraduate Student Receives CMIEF Scholarship Award

MSc student, Siobhan Keane, received a scholarship award from the Canadian Mineral Industry Education Foundation (CMIEF). Siobhan attended the Foundation's award dinner on Monday, March 10, 2020.

Undergraduate Student Receives First Place at PDAC Poster Competition

Geological Sciences student, Lauren Norenberg, on receiving first place at the Prospectors and Developers Association of Canada (PDAC) poster competition in the BSc Category. Lauren's project, superviesd by Dr. Laurent Godin and Drs. Stéphane Perrouty and Ben Frieman from Laurentian Unviersity, is titled, "Structural setting and kinematic history related to vein emplacement and shear localization and the Van Horne prospect in Dryden, ON".

PDAC- SEG Student Mineral Colloquium Poster Awards

During the 11th Annual PDAC-SEG Student Mineral Colloquium, MSc student, Selcuk lkay Cevik, co-supervised by Dr. Julian Ortiz (cross-appointed) and Dr. Gema Olivo, received third place for the M.Sc. Poster Award, and Geological Sciences student Catherine Gavaris, received third place for the BSc Poster Award.

Students, staff, and faculty gathered virtually this fall to celebrate recent accomplishments, and congratulate Named TAship Award winners from the previous term

MASTER OF EARTH AND ENERGY RESOURCES LEADERSHIP

Congratulations to MEERL ’20

In the spring of 2020, we celebrated the graduation of MEERL ’20. What an incredible group of people we had the privilege of getting to know! Nine individuals with diverse backgrounds, work experience, and education spent 20 months together honeing their skills, knowledge and leadership capacity for the natural resource industry. We are so proud of our grads and can’t wait to see what they do next!

Get to Know MEERL

37 Students Alumni & Current	40% from the Mining Sector	7.5 Average Years of Work Experience	Canada, US, Peru, Argentina, UK
1/3 Female 2/3 Male	60% from the Energy Sector	34 Average Age (Range 22 – 47)	Engineering, Geology, Finance, Policy, Economics

Fun Fact:

Four MEERL students completed their undergraduate degrees at Queen’s University.

Welcome MEERL '22

Ten students began in the MEERL '22 cohort in August of this year. Owing to the global pandemic, we did our first ever virtual "residential". Highlights included a keynote address by alumnus Zohrab Mawani, GeoSci 1994, entrepreneur and CEO of Refuel the Future, on the movement toward a circular economy vs. an extractive economy, workshops on working in teams and leadership, as well as networking with MEERL alumni. We look forward to bringing them to Queen's University soon!

What do you hope to take away from MEERL?

"In undertaking the MEERL program, I expect to broaden my perspective of the natural resource industry, develop non-technical strengths and increase leadership skillsets. I hope to understand how to balance social, environmental, and economic considerations across the resource lifecycle. I am eager to learn from the experiences of the instructors, guest speakers and fellow classmates, to understand diverse perspectives and build my global network." · Gerald Ouellette, MEERL '22

Nancy Manchak, P. Eng., MEERL
Asset Integrity Engineer
Enbrige
Edmonton, Alberta

Student Spotlight

Can you tell us about your MEERL experience?

I am incredibly grateful to have experienced MEERL and learn from the diverse perspectives that were shared by my professors and fellow classmates. The natural resource sector is facing complex challenges and I believe that MEERL has equipped me with the skills needed to support future solution development.

What's next for you after graduation?

I am excited to apply the knowledge gained through MEERL through my professional work and volunteer activities. I was recently elected as a publicly elected Senator for the University of Alberta and am specifically keen to leverage stakeholder engagement learnings from MEERL coursework with audiences beyond the natural resource sector. Overall, my aim is to keep the interdisciplinary mindset instilled through MEERL top of mind in my daily life.

Highlights from 2020

MEERL Tuition Award

With the use of bursary funds, we were able to create and award the first ever tuition award for MEERL students. Two students were each granted $10,000. The students were required to demonstrate financial need and were tasked with writing an essay on the greatest challenges facing the natural resource industry today and how MEERL will help them make an impact.

Geology Bootcamp

We recently launched a new resource for the MEERL students, the "Geology bootcamp. It is an introduction to the fundamental concepts of geological sciences for graduate students entering the programs from fields outside of geology or geological engineering. Thanks are owing lead Rob Harrap, and contributors and Elizabeth Steel, Bas Vriens, Brad Wilson and Christa Pufahl.

If you have ideas, suggestions, or questions about the MEERL program we would love to hear from you. We are always looking for guest speakers, project ideas and new ways to grow the program. Reach out to the Program Manager, Brittany Jennings at meerl@queensu.ca

Queen's University | MASTER OF EARTH AND ENERGY RESOURCES LEADERSHIP

GEOS IN SPACE

Geology goes far beyond the study of our planet's rocks and minerals. In fact, the discipline fosters the fundamental knowledge necessary not only for understanding the Earth, but other planetary objects as well! As we set out to explore other planetary bodies, scientists and engineers will use the tools and conceptual models of geology. Join the Department of Geological Sciences and Geological Engineering as we explore the out-of-this-world achievements of our alumni, students, and faculty!

DR. DREW FEUSTEL – *Queen's GEO in Space*

Dr. Andrew Feustel (right), pictured with Dr. Herb Helmstaedt (left)

Dr. Andrew Feustel is a NASA Astronaut and Geological Scientist specialising in seismology. Drew is the only Queen's alumnus who has been to space, one of only 550 people worldwide, and one of two geologists to ever become astronauts! Drew received both his Bachelor of Science and Master of Science degrees from Purdue University in West Lafayette, Indiana, before moving to Kingston, Ontario to pursue us doctoral studies. Under the supervision of Drs. Paul Young and Herb Helmelstaedt, Drew graduated with his PhD from Queen's University in 1995. He joined NASA in 2000 and currently serves as an active Astronaut. Drew's primary role is to act as his office's Special Project Lead. In this role he works with different NASA teams to coordinate successful surface explora tion operations, including space walks. Additional duties include working in mission control, looking after the provisional supplies for astronauts, and serving on boards to select both the next class of astronauts and build new spacesuits!

Looking to the future, Drew hopes that Canadian GEOs continue their fundamental role in the fields of space exploration and robotics.

Drew notes that geological knowledge will be critical to human exploration of other planetary surfaces

Make sure to follow Drew on Instagram and Twitter @astro_feustel

DR. CHRIS HERD – *Martian Meteorites and the Perseverance Rover*

Dr. Chris Herd currently works as a Professor of Earth & Atmospheric Sciences at the University of Alberta in Edmonton, Alberta. Chris graduated from Queen's with a degree in Geological Sciences in 1997 and received his PhD from the University of New Mexico in 2001. He is an internationally recognized expert in Martian meteorites and the geology of Mars. (Faculty of Science, University of Alberta)

Chris is a member of the NASA Mars 2020 Perseverance Rover mission working as a Returned Sample Scientist. Perseverance was launched on July 30, 2020 and its mission is to determine if Mars was ever habitable, look for signs of past life, collect data on the planet's geology, and prepare for future exportation. (CSA, https://asc-csa.gc.ca/eng/astronomy/mars/missions/mars-2020.asp). Perseverance is set to make history by collecting samples (dust and rock core) that will be sealed and stored for an eventual return to Earth for analysis. While the samples will not be earthbound for some time, the mission is setting the stage for the ground-breaking return of the first samples from Mars! Chris has the exciting task of being part of the leadership team that helps to set the strategic science goals of the Perseverance mission. Chris and his colleagues have the challenging job of looking ahead and anticipating the needs of the future scientists who will one day analyse these Martian samples, which will (hopefully) cover a variety of rock types, and may hold evidence for past life. (NASA, https://mars.nasa.gov/news/8611/nasa-adds-return-sample-scientists-to-mars-2020-leadership-team/)

Chris' Geological Sciences education at Queen's helped to play a role in preparing him for his study of space! Chris shares "my degree from Queen's gave me a solid foundation that will serve me well as I am actively involved in the Perseverance mission. We will be exploring an ancient delta with carbonates at the lake margin; I haven't thought much about those types of rocks since taking classes in Geological Sciences!"

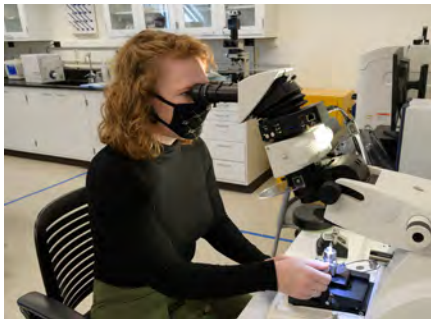
We are excited to continue to learn more about the Perseverance mission as it lands on February 18, 2021, and about future missions to retrieve the cached samples!

DR. MICHELLE THOMPSON

– Planetary Science and Space Weathering

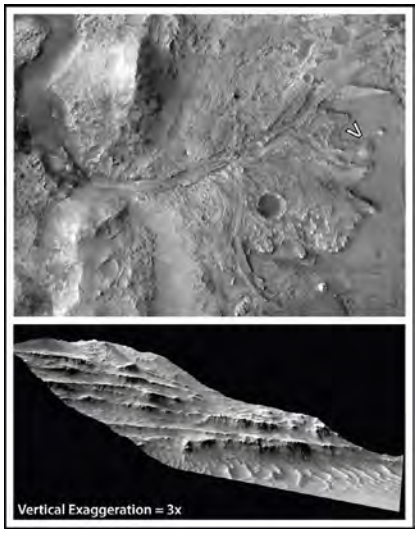
Dr. Michelle Thompson is a Planetary Scientist and currently an Assistant Professor in the Department of Earth, Atmospheric, and Planetary Sciences at Purdue university in West Lafayette, IN. Michelle graduated from Queen's with degrees in Geological Engineering and Biology in 2011, before moving on to graduate school in Planetary Sciences at the University of Arizona and eventually a NASA Postdoctoral Fellowship at Johnson Space Center. Her work focuses on the characterization of extraterrestrial materials. She studies samples from the Moon returned by the Apollo missions and materials from asteroids that have been returned to Earth by spacecraft missions, or that have fallen too Earth's surface as meteorites.

Michelle mostly studies samples from the surfaces of airless bodies - planetary bodies that don't have an atmosphere- to try and understand a process called space weathering. Airless bodies like the Moon or asteroids don't have the protection of an atmosphere, or a magnetic field like we have on Earth. As a result the surfaces of these bodies are continually bombarded with high velocity dust impacts and energetic particles from the solar wind which change the microstructure, chemistry, mineralogy, and optical properties of the surface that we can observe with remote sensing spacecraft. Space weathering is similar to weathering on Earth, but instead of being driven by wind, water, or biological activity, weathering on airless planets is caused by exposure to the harsh space environment. Michelle uses a combination of electron microscopy and laboratory spectroscopy to analyze these materials and understand how planetary bodies are evolving throughout the history of the solar system. Michelle is currently co-supervising GEO undergrad student Emily Darling, whose research focuses on moon dust! (Michelle Thompson)



DR. TIM GOUDGE *– UT Planetary Surface Processes Group and the Jezero Crater*

Dr. Tim Goudge currently works as an Assistant Professor at the University of Texas at Austin's Jackson School of Geosciences in Austin, TX. Tim graduated from Queen's in Geological Engineering (with a focus in Geotechnical Engineering) in 2009, before moving



on to graduate school at Brown University where he received his PhD in 2015. Tim leads the UT Austin Planetary Surface Processes Group, which uses quantitative remote sensing analyses to explore how surface processes evolve planetary landscapes, including that of Earth and Mars (https://www.jsg.utexas.edu/goudge/). The Group focuses on areas such as the early Mars sedimentary rock record, comparative planetary surface processes, paleolake systems on Mars, VNIR (visible to near-infrared) spectroscopy of sedimentary deposits, and remote sensing of sedimentary systems.

2020 has been an exciting year for Tim and the Planetary Surface Processes Group with the launch of NASA's Mars 2020 Perseverance Rover mission. Tim was part of a group of scientists who participated in landing site workshops and debated over where on Mars to send the Perseverance Rover on its mission to determine if Mars was ever habitable. Tim argued that

Jezero Crater, a dried-up lake, was a good candidate for exploration. Two ancient deltas used to flow into the lake, each with different minerals and origins, and the site has carbonates and clay that suggest the lake may have been filled with freshwater! These debates began over six years ago, and Jezero Crater was selected as the successful landing site in 2018!

If you'd like to learn more about Tim and his research group, please visit the UT Austin Planetary Surface Processes Group's website www.jsg.utexas.edu/goudge

DR. KEVIN CANNON

- Planetary Science

Dr. Kevin Cannon is a Planetary Scientist, and currently an Assistant Professor at the Colarado School of Mines. Dr. Cannon's research focuses on learning how to use local materials as resources on other planetary bodies including the Moon and Mars in order to support sustained human exploration and space development. He uses geospatial analysis and remote sensing to map and study potential resources, for example water ice on the Moon; He also carries out laboratory experiments to synthesize and analyze materials in order to develop and test resource extraction methods.

Dr. Cannon notes, "All this work is built on a foundation of basic geology that goes back to my education at Queen's, particularly the courses in mineralogy and GIS. Queen's is also where I got my first taste of research experience as an undergrad, and that's carried through grad school up to my present position as Professor of Space Resources at Mines."
To learn more about Kevin's research, you can visit his website: www.kevincannon.rocks

GORDON BARDELL –

Terraforming Mars Space Camp

Gordon Bardell is a fourth year Geological Sciences student who has developed a GEO-themed summer camp for 9 to 12-year- olds. The camp takes simple geology topics and subjects (including paleontology, mineralogy, engineering, mining, and environmental impacts) and connects these subjects to the theme of terraforming mars! Each day will introduce a different topic through a show-and-tell and hands- on learning. For example, the campers will have a lesson on minerals and then apply their learnig to specimens. By taking these building-blocks of geology and applying them to the future of space exploration, Gordon has created what will be an engaging summer camp experience.

Gordon took astrology in his first year of study and it sparked an interest in planetary science. He wanted to share his passion in earth science and show how the fundamentals of geology can be applied to the study of Mars. The camp has a new and exciting topic not covered by any other local summer camp programs and is a fantastic opportunity to grow an interest in

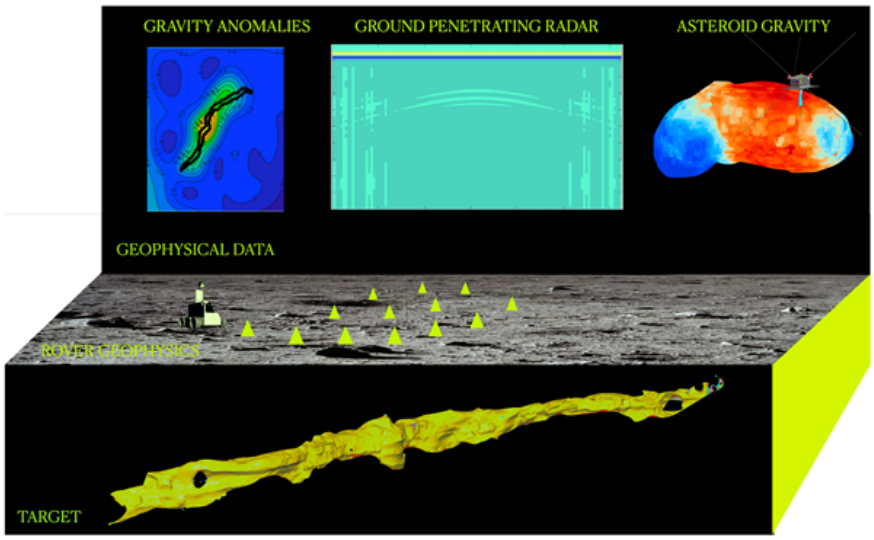
the earth sciences! Unfortunately plans to run the camp this summer fell through due to COVID-19, but we look forward to running the "Terraforming Mars" camp, either virtually or in-person, during summer 2021!

Geo's in Space continued on the next page.

Planetary Geophysics at Queen's?

By Dr. Alex Braun

It is a far stretch to travel to other celestial objects such as the Moon, Mars or asteroids, but it is not far stretched to apply the same geophysical exploration tools as on Earth, eventually, these are just another rock. Recently, a number of Prof. Braun's research projects revolved around that topic, specifically, "Detectability of asteroid density distribution and boulder mass from spacecraft orbital data and asteroid surface gravimetry" funded by NSERC and in collaboration with GEDEX, and "Rover-based system for Scouting and Mapping lava tubes from the Moon's surface using gravimetric surveying" funded by the European Space Agency and in collaboration with Canadensys Aerospace Corp. The main objectives of these projects are to provide insights into the sub-surface structure based on rover geophysics. Compared to the Earth, were a geophysicist could simply stay another day or come back the following week to complete a survey, on celestial objects, there is only on opportunity and for a very short time with a very small amount of power and a miniturized sensor with a rover with a limited reach. All of those parameters turn every geophysical survey into a challenging endeavour, which requires to optimize and de-risk the survey design. The main instrument considered for rover geophysics is the VEGA space gravimeter developed under the leadership of Dr. Kieran Carroll (Canadensys). The following students have worked on this project (Oday Dabboor (MASc, 2018), Matthias Noeker (visiting MSc student, TU Delft), Frank de Veld (visiting MSC student, TU Delft, and Stephanie Bringeland (BASc, 2020, MASc started in September). The projects are naturally based on synthetic data assuming a sub-surface density distribution, then forward modelling to obtain gravity signals, and then run an inversion after adding uncertainties. Variations of station spacing, target depths and sensor sensitivity allow for an assessment of what target parameters can be resolved. The Figure shows some example results from the two projects, gravity anomalies from a lunar lava tube (using an Earth analogue of the Cueva de los siete lagos, Lanzarote), Ground Penetrating Radar over a horizontal cylinder surrounded by regolith and basalt, and gravity anomalies of asteroid Itokawa.



This line of research is supposed to continue and two additional proposals have been submitted to the Canadian Space Agency and the European Space Agency, with the aim of eventually finding a mission to take VEGA to the Moon or other rocks in space.

ALUMNI UPDATES

Alumni REUNIONS

Vancouer RoundUp: January 21, 2020






Homecoming: October 16, 2020

Thank you to everyone who came out to GEO alumni events this year! Although there are no photos, the annual PDAC Toronto was also a great success.

We look forward to seeing many of you in 2021!

Geos Who BREW

Geological Sciences and Geological Engineering's own Ryan Dhillon, PhD'15, is the Master Brewer at a local Kingston brewery, Daft Brewery. Don Lougheed, a current PhD student in the department, is also the head chef for the brewery. Daft opened its doors in January 2020. In the beginning of the Covid-19 pandemic, Daft Brewery was featured locally for using their resources to produce and distribute hand sanitizer to local health care workers for free.

According to Ryan Dhillon, "At Daft, I am regularly experimenting with new beer styles and unique flavour combinations so I lean heavily on my background in experimental design and the scientific method. My PhD in geochemistry also comes in handy since a good brewer needs to understand water chemistry. I adjust the chemical profile of our water for every beer and I think my education from Queen's gives me an edge over others in the brewing industry".

Another alumnus, Ted Fleming, BSc'01, has started a micro-brewery in Calgary called Partake. Partake specializes in high quality non-alcoholic beer, since Ted himself had to give up alcohol due to a medical condition. Read more about Ted and his story on the Partake website.

In MEMORIAM

Many of you will remember Dr. Edward Farrar, Emeritus Professor. Sadly, Dr. Farrar passed on November 8, 2020. He joined the department in 1966, where he established his own Geochronology Lab and served as Head of Department from 1981 to 1986. Dr. Farrar's teaching and research at Queen's centered on problems in geophysics, geochronology and geotectonics. His PhD thesis and early work at Queen's were a major contribution to the field of geochronology. His demonstration that the A.E.I. MS-10 mass spectrometer - an inexpensive, simple leak detector - could be re-purposed to do accurate and precise quantitative Ar isotope analyses was revolutionary. The fact that most modern geochronology labs are in geoscience departments can be traced back to Ed's work. Read more.

Give to Queen's Geo: Advancement PRIORITIES

As always, donations to the Field Funds, the Geology Trust, and the Named TA ships are very welcome and help us provide the our students with the best earth science education in the country. However, our newest priorities are to 1. create undergrad summer research jobs through named RA-ships and 2. renovate vastly out of date research laboratories.

Why summer research jobs?

Summer research jobs can set students on a path to research, to consulting, to exploration, to government, to the astronaut training program – in short, they can make a difference in an undergraduate student's trajectory. They may write a paper or present a poster at a conference, and like Emily Darling, have the further distinction of taking first place in a student poster session at a national conference! Many of those highlighted in the GEOs in Space section of the newsletter had opportunities to conduct research during their undergrad degrees. As Dr. Kevin Cannon tells us, "Queen's is also where I got my first taste of research experience as an undergrad". Undergrads work with graduate students, post docs and professors – in the field and in labs – and can experience that amazing "Aha" moment of discovery.

Why lab renovations?

Great faculty are attracted to places where they can flourish which in the academic world that means teaching and research. And more often than not, excellent laboratory spaces are a deal-breaker for attracting new faculty. The exciting research of today, whether it is determining the shape of the earth, investigating rock falls on railways and roads using LiDAR, exploring lava tubes on the moon, or developing new exploration techniques, leads not only to increasing our knowledge of the earth but also to the lectures and research and design projects of tomorrow. Is there a better way to engage students than to show them the excitement of discovery and invite them to participate? That is why lab renovations are critical, and because some of our lab space, especially in Miller is nearly un-useable.

We are inviting classes to "adopt a lab" for renovations. For example, would the Class of '70 or '85 be willing to join forces to raise the funds to redo one of the un-useable labs on the third floor of Miller Hall?

We are grateful to all our amazing alumni – who support us through the generous gifts of their time and their money.

Kyser Memorial Scholarship

A quick update on the Kyser Memorial fund. The terms of reference have been signed by Queen's representatives and next steps include the award being formally approval by the Arts and Science Awards committee and the Senate Committee in December.

The award is on track to be granted in July 2021 and disbursed to a student in August 2021.

ALUMNI Accomplishments

Alumna Carol Evenchick , PhD'86, was awarded the R.J.W. Douglas Medal for outstanding contributions to the understanding of sedimentary geology in Canada, one of the highest technical awards of the Canadian Society of Petroleum Geologists.

Alumna Shelby Yee, BSc'16, was named one of the "30 Under 30" for the Manufacturing & Industry category by Forbes magazine. Shelby and a fellow Queen's student Matthew Gubasta, founded their company Rockmass in 2016.

Alumnus Connor Langford, BSc'08, PhD'13, was named "Young Tunneller of the Year" by the Tunelling Association of Canada (TAC).

GARNET - Geo-Alumni Resource Network

The Geo-Alumni Resource Network (GARNET) program was launched in January 2020. The program was created to foster a relationship between young alumni and current students by pairing them together in a mentor-mentee capacity for career development. GARNET reinforces the relationship that exists between industry and academia and helps to keep our programs relevant and ahead of current industry trends. Thanks to our young alumni who expressed a wonderful willingness to support this new program; all were eager to provide career advice and support to our current students! These alumni went above-and-beyond in the mentorship duties by helping to recruit their former classmates as mentors for the program. The feedback we received from both mentors and mentees was overwhelmingly positive. One mentee noted that:

What I appreciated most about the program was the honest evaluation of their careers and the advice received. Too often when speaking with people at career fairs or events, they simply relate any career advice back to the benefits of their own company. With the mentor signing up for the program, you know that they will offer great insights for your career.

The GARNET mentor-mentee program is well underway this academic year, with the program expanding to include third-year students! Despite the challenges of the COVID-19 pandemic, the GARNET Speaker Series is continuing virtually. The series provides an opportunity for geo-alumni to "visit" the department and present on a topic of their choice. An example would be career development and the journey from an undergraduate student to a successful Geo-Alumnus! If you would like to become involved in the GARNET program either as a mentor or to give a talk, please contact Larke Zarichny, GARNET Coordinator (garnet@queensu.ca).

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