ANNUAL REPORT FOR 2019 / 2020

Submitted by

George P. Demopoulos, PhD, Eng., FCAE
Professor and Chair

Department of Mining and Materials Engineering

McGill University

May 31, 2021
Preamble

Due to COVID-19 and the disruption brought to our operations, we were obliged to produce a combined Annual Report for the last two years. The compilation of data and the preparation of the report would not have been possible without the dedicated efforts of our Administrative Officer, Heather Holowathy!

With this Annual Report, I conclude on May 31st, 2021, my term as Department Chair that started on September 1st, 2015. It was a journey and period of my professional life that brought a lot of challenges but mostly a lot of satisfaction seeing the constant evolution and progress we have made collectively as Department of Mining & Materials Engineering. 2021 is a milestone year as it marks the 150th anniversary since the creation of the Mining Engineering department (the first University Mining program in Canada and second in North America) and the 120th anniversary of the forerunner of Materials Engineering—the Metallurgical Engineering program. So, putting things in perspective, 6 years in the life of the Department is rather brief, but nevertheless very important in ensuring the long chain that connects the past to our collective future remains strong with no weak links. It is important as we declared in our respective strategic plans for Mining in 2015 and Materials in 2016 to continue building on our strengths so we fully materialize all the exciting opportunities for both Mining and Materials. The New Vic is such an opportunity that we should plan carefully for. The foundation is strong and the prospects excellent. Over the period since 2015 we saw the growth of Mining faculty complement from 5 to 7 with the addition of one tenure-track position (filled in 2018 with Alessandro Navarra) and one Faculty Lecturer position occupied since last year by Shahé Shnorhokian. On the Materials side, thanks to the creation of the NSERC-Hydro-Québec IRC, we were granted a new tenure-track position to which Jinhyuk Lee was appointed in January 2020. At the same time, we welcomed Sidney Omelon and Philippe Ouzilleau following the retirement of Professor Mucciardi and the departure of Professor Jung. Other major events during my term as Chair was the $5.8M renovation of the old foundry lab that now features modern labs for a number of our professors. I want here to acknowledge the unbelievable amount of work put to this project by Florence Paray as Project Coordinator for our Department and overall, her diligent management of our space and physical resources in Wong. Our department has limited space to accommodate the ever-growing research enterprise by our innovative professors so the understanding and cooperation of all is of paramount importance. Our undergraduate programs are very strong with enrolments consistently near target (25 for Mining and 60 for Materials) as they are our graduate student activities. In Mining the introduction of the English-stream as well as the MUST program by Mining Director Hani Mitri has been pivotal in growing enrolment by attracting international students and offering industrial-sponsored co-op experience. Successful 6-year accreditation is another accomplishment. Meanwhile a major curriculum renewal/revision exercise was undertaken in Materials by our Academic Committee (led by Marta Cerruti) that should move to implementation planning next. On the graduate side under the leadership of Mathieu Brochu, many structural changes were made such as the creation of discipline-based degrees, the introduction of comprehensive exam, and the mandatory Foundation course modules for the PhD students in Materials. On the admin side, the creation of the payroll officer position and the hiring of June Persaud has greatly improved the admin appointment processes with the ever more complexity imposed by legislation and collective agreements. I take the opportunity here to thank all staff and in particular our Admin Officer Heather Holowathy. Heather is doing an outstanding job. It’s only to mention indicatively the demanding management of the budget and lately the almost seamless (uneventful) transition to Workday HR. As Chair I am highly appreciative of the work of Hani as Mining Director, that of Richard, Mathieu and Marta as Associate Chairs plus the work of all committee members. A final word of deep appreciation and respect goes to Dean Jim Nicell for his support.

In closing, I want to wish my successor Richard Chromik good luck as he takes the reigns of the department in his hands. With the support of all, Richard will make a great Chair! Thank you, George
Description of Unit

The Department of Mining and Materials Engineering is home to two separate programs offering exciting opportunities for B.Eng. or post-graduate education (M.Sc./M.Eng., Ph.D.) and research training (PDF). The Mining program is housed in the FDA building and the Materials program in the Wong building.

In 2019, our department had 22 full-time professors (6 in Mining and 16 in Materials), 1 senior faculty lecturer (Materials), 2 active Emeritus Professors, 1 Post-Retirement Professor and 12 non-academic staff (Administrative Officer, 2 Co-op coordinators, 2 U/G coordinators, 1 Graduate coordinator, 1 Financial Service Team Manager, 1 payroll administrator, 4 technical staff). Of the full-time faculty, 7 were Full Professors, 12 were Associate Professors, and 3 were Assistant Professors.

In 2020, our department had 23 full-time professors (6 in Mining and 17 in Materials), 1 Professor of Practice, 1 senior Faculty Lecturer (Materials), 1 part-time Faculty Lecturer (Mining), 2 active Emeritus Professors and 11 non-academic staff (Administrative Officer, 2 Co-op coordinators, 2 U/G coordinators, 1 Graduate coordinator, 1 Financial Service Team Manager, 1 payroll administrator, 3 technical staff). Of the full-time faculty, 8 were Full Professors, 12 were Associate Professors, and 3 were Assistant Professors.

(Full list of all our faculty staff is given in a Table at the end of the report).

The Department continued registering strong enrolment numbers in our undergraduate programs offered in Mining (~100) and Materials (~250) as per set annual admission targets 25 and 60 respectively. It is noteworthy to mention that both Mining and Materials undergraduate programs require a minimum of 12 months of work experience for students to graduate. Due to recent trends that have seen enrolment substantially increase and more tight conditions in finding placement for our students in industry, we created non-co-op options for our two programs to facilitate timely graduation for exceptional cases of students only. There is no direct admission to these non-co-op options, but students can transfer into them once they have met certain requirements and obtained approval from the departmental adviser. Even during the challenging COVID-19 times in 2020, the overwhelming majority of our students have preferred the co-op program viewed as an advantage in their subsequent careers.

Our faculty continued securing large number of competitive research grants (> $320k/PI), attracting many graduate students, on average 8 MSc/PhD students supervised per professor, and publishing 8 peer-reviewed journal papers on average each. To this we are proud to add the many awards and distinctions conferred to many of our students and several of our colleagues.

Finally, we should acknowledge the successful research ramp-up/phase-in operations following the shutdown caused by the pandemic last Spring 2020 and the cooperation of everyone under the measures implemented by our Expanded/Executive Committee made of Mathieu Brochu, Marta Cerruti, George Demopoulos, Heather Holowathy, Florence Paray, Hani Mitri, and Kristian Waters.

2019/2020 Milestones

- We welcomed Assistant Professor Alexandros Charitos in Materials in April 2019 but he was offered a new career opportunity in Germany and resigned at the end of December 2019
- The renovation of the high-temperature laboratories (“Foundry”) was completed in 2019
- We welcomed Assistant Professor Jinhyuk Lee in Materials in January 2020
- We welcomed Professor of Practice Karim Zaghib in July 2020
- We welcomed Assistant Professor Philippe Ouzilleau in Materials in August 2020
- Professor Mitri completed his 6-year term as Director of Mining Engineering on December 31st, 2020 passing the baton to Professor Mustafa Kumral
Research and Publications: 2019/2020 Highlights

Our research efforts were supported by 33 postdoctoral fellows and 28 research assistants/associates in 2019 and 25 postdoctoral fellows and 21 research assistants/associates in 2020.

Department-wide research funding in 2019 had 155 active research grants totalling $7 million ($1.9 million in mining and $5.1 million in materials). This translates to approx. $318k/researcher. Adding to that, Prof. Nazhat also received a $1.8 million CFI infrastructure grant in 2019 and Prof. Dimitrakopoulos obtained an exceptional third term renewal of the Canada Research Chair (Tier 1) in “Sustainable Mineral Resource Development and Optimization under Uncertainty”.

Department-wide research funding in 2020 included 157 active research grants totalling $8 million ($1.8 million in mining and $6.2 million in materials). This translates to approx. $348k/researcher. Adding to that, Prof. Stephen Yue was awarded a CFI 2020 Innovation award of over $3 million for Advanced Cold Spray Additive Manufacturing. Notable is the high level of industrial research funding our department receives each year. Our researchers attract a lot of NSERC CRD (now Alliance) grants (an area in which other departments are not as active; these grants require substantial cash from industrial partners >35% of total grant) as well as NSERC Strategic Project grants (SPG). Indicatively in 2019 there were 24 active CRD and 10 SPG grants and in 2020 there were 24 active CRD and 6 SPG grants led (as PIs) by members of our department. Unfortunately, the elimination of SPG program by NSERC is a big loss of competitive research funding in which are faculty had success over the years.

164 peer-reviewed refereed journal papers were published by Departmental faculty (61 in Mining and 103 in Materials) in 2019 and 178 peer-reviewed refereed journal papers were published by Departmental faculty in 2020 (58 in Mining and 120 in Materials). In addition, our faculty and students were very active at presenting and publishing their work in conferences. Refer to the individual faculty member (people) pages (within the sections for the two programs Materials and Mining) as well as the list of refereed journal papers here: http://www.mcgill.ca/minmat/.

Notable mention should be made to IP protection activity in our department. Over the two year period covered by the report, our members filed at least: 4 Reports of Invention; 1 Canadian patent application, 10 U.S. provisional patent applications and 6 international patent applications.

Finally, the faculty staff were very active presenting invited talks in conferences in 2019 and also virtually during 2020 (refer to people pages at: http://www.mcgill.ca/minmat/). Notable among them are:

- Brochu M. “Synergetic aspects defining additive manufacturing of metallic materials”, GKN Aerospace, Sweden, October 9th, 2019
- Cerruti M. “Polymer biomaterial surface modification: the key to integration”. Invited keynote talk at the Annual Meeting of the Canadian Biomaterials Society, Quebec May 21, 2019
- Dimitrakopoulos, R., Keynote Speaker: Real-Time – General Assembly: R. Dimitrakopoulos, Germany, March 2019
- Omelon, S., Keynote lecture: “Too Efficient to Evolve? Similarities between the chemistry of cartilage calcification in elasmobranch fish and mice” International Comparative Cartilage Biology Conference, Banyuls sur Mer, France, June 24-26th, 2019
• Song, J. “Hydrogen trapping and bubble formation in nanovoids in BCC metals: a predictive model” presented in Hydrogen in Metals – current understanding and future needs Workshop, April 2019, Oxford, UK
• Cerruti M. “Graphene aerogels: from self-assembly to applications”. Graphene Canada Conference, virtual meeting, 11/17/2020
• Kumral, M. Invited Speaker, International Webinar on Frontiers in Mining & Geosciences, India Rourkela, Department of Mining Engineering, National Institute of Technology, Rourkela, Odisha, India, November 7-8, 2020
• Lee, J. “Reinventing cathode chemistries for Co-free Li-ion batteries”, Invited talk at the Ulsan National Institute of Science and Technology (2020)
• Nazhat, S. Invited to present in the Special Symposium on Collagen, Elastin and Peptide-based Scaffolds for Regenerative Medicine, 11th World Biomaterials Congress, Virtual Meeting December 11-15, 2020

Teaching and Learning

Undergraduate programs & students: Both academic programs have seen considerable growth over the past years as the summary table below highlights. There were 358 undergraduates enrolled in Mining and Materials Engineering degree programs in 2019 (99 in mining and 259 in materials) and 335 undergraduates enrolled in Mining and Materials Engineering degree programs in 2020 (97 in mining and 238 in materials). This success creates challenges in maintaining our ability to provide full and meaningful co-op jobs. Among the measures taken to address this challenge were placement of several of our co-op students in research trainee positions supervised by our professors or in other department academic labs; generating Canadian and internationally based materials co-op jobs and in parallel we introduced the non-co-op options. Due to the COVID-19 pandemic, the co-op team had to find solutions for students needing summer and fall 2020 co-op work terms to stay on track for graduation. We reached out to alumni and industry friends and were able to provide virtual projects to our co-op students. The students were greatly appreciative of the opportunity to do virtual work terms and be able to stay on track in the program and meet their graduation targets.

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In 2019, a total of 154 materials engineering co-op students were placed (W19=56/ S19=52/ F19=46). In 2020, a total of 118 materials engineering co-op students were placed (W20=42/ S20=51/ F20=25). This was a total of 36 fewer placements than in 2019, but understandable given the pandemic effect on the economy, the availability of jobs and in some cases, students choosing to continue with online classes versus doing virtual work terms.

At the same time, in 2019, a total of 52 mining engineering co-op students were placed (W19=20/ S19=21/ F19=11). In 2020, a total of 39 mining engineering co-op students were placed (W20=16/ S20=19/ F20=4). Some of the job placements were “research” type jobs through MUST, SURE or at other (international) universities. Mining co-op opportunities were reduced in number and availability due to the impact of the pandemic and the climate of uncertainty it created.

Graduation outcomes in 2019 show that 79% of our graduates in materials (53) have found jobs already or have continued on to pursue graduate studies. The latter is an option that seems to be increasingly pursued by materials graduates.

**Undergraduate scholarships and awards:** Entrance scholarships in the amount of $23,626 were awarded to new Undergraduate students in 2019. Several of our undergraduate students received in-course scholarships as well for high academic achievement. The McGill awards given amounted to $40,089 for a total of $63,715 in Undergraduate scholarships for 2019. Several of our students also received external awards, notable among these are: Bashir Ahmed, Rim Koulder, Justin Mak, Simon Lacoste-Bouchet, Antoine Raymond, Matthew Renaud and Adam Stanley were awarded CMIEF Scholarships and Omar Sharebain was awarded the CIM Scholarship award.

Entrance scholarships in the amount of $27,900 were awarded to new Undergraduate students in 2020. As in previous years, our undergraduate students received in-course scholarships for high academic achievement. The McGill awards given amounted to $47,289 for a total of $75,189 in Undergraduate scholarships for 2020. Several of our students also received external awards, notable among these are: Rim Koulder, Justin Mak, Antoine Raymond and Jorge Khouri who were awarded CMIEF Scholarships.

**Graduate programs & students:** Graduate student enrollment remained strong. There were 168 graduate students enrolled in Mining and Materials Engineering degree programs in 2019 (48 in Mining and 120 in Materials). There were 186 graduate students enrolled in Mining and Materials Engineering degree programs in 2020 (59 in Mining and 127 in Materials). Full data is provided in the above table.

The breakdown in terms of graduate degree statistics in 2019 was: Mining: 25 PhD; 33 M.Eng. and Materials: 91 PhD; 29 M.Eng. The corresponding graduation statistics are: Mining: 8 Ph.D., and 5 M.Eng. and for Materials: 12 PhD and 8 M.Eng.

The breakdown in terms of graduate degree statistics in 2020 was: Mining: 27 PhD; 31 M.Eng. plus 1 Graduate Diploma; and Materials: 93 PhD; 34 M.Eng. The corresponding graduation statistics are: Mining: 3 Ph.D., and 11 M.Eng. and for Materials: 14 PhD and 5 M.Eng.

The MEDA awards have provided much needed impetus in attracting Ph.D. students. At $24,000 to $37,000 in value for each scholarship, of which 50% is covered by the Faculty of Engineering, this amounts to extra research support for our graduate students. The department’s Graduate Studies Committee recognizes graduate students for their research excellence. Medals or certificates and monetary prizes (approximately $40,000) were awarded in 2020 based on a student’s overall research publication production while at McGill. Departmental excellence awards were given to PhD students Yan (Helen) Zeng (Gold), Christina Katsari (Silver) and Venkata Vamsi Munagala (Bronze).
New or major continuing teaching initiatives 2019:

• Prof. Kirk Bevan significantly redeveloped and restructured the lecture sets and homework assignments for MIME 262 during the Fall of 2019 in order to improve student engagement in the course and avoid overlapping content in the electrical engineering curriculum.

• Prof. Richard Chromik implemented the “Teamwork Project” in MIME565 consisting of a change to the technical project in MIME565, where instead of literature review, students were asked to act as a consulting team attempting to market a new technology to aerospace companies.

• Prof. Alessandro Navarra has been busy developing a new course “Operations Research of Mining Systems”. The first portions of it are already being taught under course MIME 527 (Selected Topics in Minerals Resource Engineering).

• Dr. Florence Paray created a new laboratory program and lectures for MIME360 including a new concept to create a design portion in the course and add a hands-on experimental part.

• Dr. Florence Paray developed a new experiment for the laboratory program for MIME 362.

• Prof. Mihriban Pekguleryuz included teamwork sessions in MIME 261 and MIME 362.

New or major continuing teaching initiatives 2020:

Due to the pandemic in 2020, remote teaching had a significant impact on the number of hours dedicated to teaching including many meetings introducing new teaching strategies as well as time-intensive preparations to adjust to online teaching and preparing new virtual course materials.

One of the biggest challenges, undertaken by Dr. Florence Paray, was to modify the laboratory programs of several courses and transfer the regular on-campus lab sessions to online formats so the students could have an experience as close to an in-person session as possible. This was done for MIME 260, MIME 261, MIME 317, MIME 362 for which active learning with participation and interactions were still possible during the pandemic context. Lab program videos were also created (August-Oct. 2020). Similar work was undertaken by Professor Omelon and Dr. Uceda for MIME 352.

2019/2020 Student highlights:

• McGill Mining took home the 2nd place prize at the Goodman Gold Challenge that was hosted by Laurentian University in Sudbury in 2019. The McGill delegation was comprised of: Youssef Afifi, Abdelrahman Elzoka, Anas Chazi and Elijah Saragosa.

• The WMC (World Mining Competition) was held in Saskatoon, SK in 2019: McGill University won 1st place with team members: Matt Renaud; Michael Chan, Simon Lacoste-Bouchet and Abdelrahman Elzoka.

• Engineering students share their passion for STEM (Christina Maria Katsari): https://reporter.mcgill.ca/engineering-students-share-their-passion-for-stem/?utm_medium=email&utm_campaign=wn_jan24_eng&utm_source=Envoke-Staff---English&utm_keyword=whats_new_s


• Student William Lepry was awarded the Governor General’s Gold Medal for his PhD thesis.
• Materials PhD students Marianna Uceda (2019), Yee Wei Fong (2019), Bruno Noronha Marques De Castilho (2020) and Rana Yekani (2020) were selected ChangeMakers and gave SED Talks by the Trottier Institute for Sustainable Engineering & Design (TISED)

• The MetSoc McGill Chapter won the 2019 Outstanding MetSoc-CIM Student chapter award and were then declared No 1 in Canada in 2020 [https://cim.us5.list-manage.com/track/click?u=b285e549286d86af513895cece&id=34f36f9c50&e=7737b3df8c]

• Former students doing well with a start-up company: Charles Vincent (B.Eng. '14) and James McGoff (B.Eng. '15): Sustainable Packaging Startup TemperPack Raises $22.5 Million To Take On Styrofoam

2019/2020 Involvement in the Community

• Marta Cerruti wrote an article for a prisoner’s passion for mathematics that became viral (>280,000 views)! See the story here: [https://theconversation.com/an-inmates-love-for-math-leads-to-new-discoveries-130123]

• Marta Cerruti presented her work in the McGill Pick Your Path! project in summer 2020, aimed at increasing recruitment of Indigenous CEGEP students into Science and Engineering

• Philippe Ouzilleau presented at an outreach event in Collège St-Hilaire high school to promote science and engineering career paths

• Start-Up founded by Materials Engineering graduates contributed to the fight against COVID-19 by using 3D printing technology/AM manufacturing: [https://reporter.mcgill.ca/designing-face-shields-to-protect-medical-staff/]

• Steve Yue was guest expert in the TV History Channel 'History Erased' series: Episode 'The Wheel'

2019/2020 Major Honours, Awards, and Prizes:

• Prof. Nate Quitoriano received the 2020 Outstanding Academic Service Award, Faculty of Engineering, McGill

• Prof. Ferri Hassani received the William and Rhea Seath award in Engineering Innovation in 2019

• Prof. Hani Mitri received the CIM Rock Mechanics Award (2019), Canadian Institute of Mining, Metallurgy and Petroleum

• Prof. Agus Sasmito was selected as a recipient of the CIM-Bedford Canadian Young Mining Leaders Award in 2019

• Prof. Raynal Gauvin was appointed Fellow of the Micro Analysis Society of America in 2019

• Prof. Mathieu and co-authors received the AWS A. F. Davis Silver Medal Award – Best paper in Structure Design category of the Welding Journal, June 2019

• Prof. Marta Cerruti was elected to the Royal Society of Canada College of New Scholars, Artists and Scientists in 2019

• Prof. Roderick Guthrie was awarded the TMS Fellow Award-Class of 2019

• Prof. Ferri Hassani with PDF Hamed Rafezi were awarded the DiPierro Innovation Fellowship Award by the Faculty of Engineering in 2020

• Prof. Stephen Yue and PhD student André Liberati got a shout out in news articles: [https://www.macleans.ca/education/university-rankings/canadas-top-medical-doctoral-university-2021-mcgill/] and TVA reporting: [https://www.tvanouvelles.ca/2020/10/03/des-poisees-de-portes-anti-covid-sure-le-point-detre-creees]
Postdoctoral Researcher William Lepry (supervised by Prof. Showan Nazhat) was the recipient of the 2020 Global Young Bioceramicist Award from the American Ceramic Society.


Emeritus Professor Jim Finch was honoured with the Lifetime Achievement Award from the International Mineral Processing Council (IMPC).

Prof. Marta Cerruti was appointed co-Director of the McGill Institute for Advanced Materials (MIAM).

Prof. Stephen Yue was re-appointed Director of the McGill Institute for Aerospace Engineering (MIAE).

Prof. R. Dimitrakopoulos continued serving as Editor-in-chief, Mathematical Geosciences (Springer).

Prof. H. Mitri continued serving as Co-Editor, International Journal of Mining Science and Technology.

Prof. M. Pekguleryuz appointed Editor-in Chief, Engineering, Experimental Results, Cambridge University Press.

Prof. K. Waters continued serving as Editor of Minerals Engineering (Elsevier).

Prof. Karim Zaghib received the 2019 Lionel Boulet Prix du Québec and was appointed strategic advisor to Investissement Québec in 2020: https://montreal.ctvnews.ca/investissement-quebec-hopes-renowned-researcher-can-help-develop-lithium-battery-sector-1.4991597

Respectfully submitted by

George P. Demopoulos
May 2021
APPENDIX: Professors and Rank/Title/Position in Mining and Materials Engineering for 2019 and 2020

**Full Professor**

Chromik, Richard (promoted in 2020), G. Hatch Faculty Fellow, Materials Engineering, Associate Dean-Faculty Affairs
Demopoulos, George, Gerald Hatch Chair, Materials Engineering, and Department Chair
Dimitrakopoulos, Roussos, Canada Research Chair I, Mining Engineering
Gauvin, Raynald, Birks Chair & Industrial Research Chair, Materials Engineering
Guthrie, Roderick, Macdonald Professor, Director of MMPC, Materials Engineering
Hassani, Faramarz, Webster Chair, Mining Engineering
Mitri, Hani, Director of Mining Engineering
Yue, Stephen, James McGill Professor, Trottier Chair and Director of MIAE, Materials Engineering

**Associate Professor**

Bevan, Kirk, Materials Engineering
Brochu, Mathieu, G. Hatch Faculty Fellow, Materials Engineering, Associate Chair-Graduate Studies
Cerruti, Marta, Canada Research Chair II, Materials Engineering, Associate Chair-Academic-Materials and co-Director of MIAM
Hasan, Mainul, Materials Engineering
Kumral, Mustafa, Mining Engineering
Nazhat, Showan, Materials Engineering
Omelon, Sidney, Materials Engineering
Pekguleryuz, Mihriban, Materials Engineering
Quitoriano, Nathaniel, Director of Materials CO-OP Program, Materials Engineering
Sasmito, Agus, Mining Engineering
Song, Jun, William Dawson Scholar, Materials Engineering
Waters, Kristian, Materials Engineering

**Assistant Professor**

Navarra, Alessandro, Mining Engineering
Ouzilleau, Philippe (New hire in August 2020), Materials Engineering

**Senior Faculty Lecturer**

Paray, Florence, Associate Director, Materials Characterization (MMC) Facilities

**Part-Time Faculty Lecturer**

Shnorhokian, Shahé (appointed in 2020), Mining Engineering

**Emeritus Professor (Active)**

Finch, James
Jonas, John

**Professor of Practice**

Zaghib, Karim (appointed in 2020)