



Centre of Excellence for Sustainable Mining and Exploration (CESME)

Annual Report to the Office of Research Services

June 2019

Executive Summary

In the past year CESME has achieved the following:

- Continued to develop the CESME strategic plan
- Provided scholarships to support graduate research
- Continued the development of an “Indigenous Certificate in Geological Studies”

CESME goals & objectives

As outlined in the original proposal to the Senate Research Committee the purpose, rationale, mission and goals of the Centre of Excellence in Sustainable Mining and Exploration (CESME) are as follows:

Purpose

CESME will encourage and support research, education and outreach activities regarding the nature and impacts of mineral resource exploration and extraction particularly in Northern Ontario.

Rationale

Northern Ontario’s dynamic mining sector is booming, creating challenges regarding how best to undertake sustainable economic development while ensuring environmental protection and respecting constitutionally protected Aboriginal and Treaty rights. CESME will help address these challenges by linking Lakehead University researchers with partners from First Nation, Métis and local communities, government, and industry. This collaborative approach recognizes that Canadian natural resource development requires sophisticated planning, collaboration, assessment, implementation, and remediation strategies that are calculated to minimize negative environmental, socio-economic, and cultural impacts. CESME uses the term “sustainable” to imply reconciliation of the three pillars of environmental, social equity, and economic demands (2005 World Summit on Social Development) that is now widely recognized by the mining industry. To this end, CESME is structured under three pillars: 1) Mining, Exploration and Mineral Processing; 2) Environmental Impacts; and 3) First Nation, Métis and Local Community Engagement.

Through the Centre academic, community, government, and industry partners will carry out cutting-edge research in discovery, advanced exploration, and development, and address the environmental, social and cultural aspects of mineral extraction.

Mission

CESME will:

- Support the development of community-based research and outreach activities in both the Lakehead University community and the region as a whole;



- Generate research projects that facilitate sustainable resource development in Northern Ontario and evaluate the current and future ecological, social, cultural and economic impacts of development; and
- Apply research outcomes from Northern Ontario projects to broader sustainable development issues in other northern Canadian and international jurisdictions and apply the lessons learned in other jurisdictions to Northern Ontario.

Goals

CESME will:

- Increase the capacity for mineral deposit research at Lakehead University and enhance the reputation of the institution in the region, nationally and internationally;
- Increase the capacity for research into the environmental impacts of mining and the sustainability of this activity in Northern Ontario;
- Increase the capacity for research into the social and cultural impacts of mining, especially the involvement of local and First Nation and Métis communities and the recognition of Aboriginal and treaty rights;
- Increase the capacity for research into mining and mineral processing;
- Initiate interdisciplinary research into these fields and develop multidisciplinary research proposals for funding agencies and research partners;
- Bring together a diverse range of researchers at Lakehead University working in fields related to mining exploration, sustainable mining, and environmental and community impacts; and
- Make Lakehead University the hub for sustainable resource extraction research in Northern Ontario.

Progress towards the Centre's goals

In our original proposal to the Senate Research Committee we indicated that we would achieve the goals of the Centre by undertaking a number of activities. This section lists those activities and highlights progress made.

1. *Initiate discussions with the wider community to shape the research activities of the Centre.*

We have initiated discussions with stakeholders about the development of the Indigenous Certificate in Geology, including First Nations educational organisations.

2. *Generate multidisciplinary research proposals and apply for external funding*

We have initiated discussions with North American Palladium to fund a Research Chair and support graduate research

3. *Invite and fund proposals for research and outreach activities*

We continue to solicit proposals from the University community

4. *Recruit and foster faculty, postdoctoral fellows, postgraduate, graduate, and undergraduate student participation*

CESME is currently supporting two Postdoctoral Fellows (Mills and Wang) and one NOHFC Intern (Dube)

5. *Establish working relationships with similar national and international centres (e.g., Mineral Deposit Research Unit (MDRU) at the University of British Columbia, Mineral Exploration Research Centre (MERC) at Laurentian, CODES – ARC Centre of Excellence in Ore Deposits at the University of Tasmania, Centre for Exploration Targeting (CET) at the University of Western Australia)*

We have a very successful collaboration with CODES and are constantly working to build our relationships with other groups

6. *Develop and maintain a website for the Centre*

We have established a website that highlights CESME activities and acts as a repository for our publications and videos of our guest speakers.

Members of CESME

The Advisory Board for CESME continues to operate efficiently having met three times by teleconference in the past year. The membership comprises:

- Mr. John Mason, CEDC - Chair
- Mr. Glenn Nolan, Noront
- Dr. James Franklin, Consultant
- Dr. Scott Jobin-Bevans, Consultant

We are currently seeking an Indigenous representative to join the Board after the retirement of Peter Moses this year

The service of these individuals is greatly appreciated and we look forward to working with them to strengthen CESME in the coming years.

The following faculty members have agreed to lead the three research pillars of CESME:

- Dr. Peggy Smith has retired from Lakehead and we are currently seeking a new leader of the First Nations Pillar
- Dr. Pedram Fatehi continues as the leader of the Mining, Exploration and Mineral Processing pillar
- Dr. Micharl Rennie, has agreed to replace Dr. Peter Lee as the leader of the Environmental pillar.

The following faculty members have signed up as CESME members:

Dr Ehsan Rezazadeh	Azar	Civil Engineering
Dr Amir	Azimi	Civil Engineering
Dr. Matthew	Boyd	Anthropology
Dr. Lionel	Catalan	Chemical Engineering
Dr. Han	Chen	Natural Resources Management
Dr. Andrew	Conly	Geology



Dr. Bahram	Dadgostar	Business Administration
Dr. Jian	Deng	Civil Engineering
Dr. Amanda	Diochon	Geology
Dr. Martha	Dowsley	Anthropology
Dr. Karen	Drake	Faculty of Law K.Drake has left Lakehead
Dr. A. Ernest	Epp	History
Dr. Pedram	Fatehi	Chemical Engineering
Dr. Philip	Fralick	Geology
Dr. Tony	Gillies	Civil Engineering
Dr. Scott	Hamilton	Anthropology
Dr. Mary Louise	Hill	Geology
Dr. Mary Lou	Kelley	Social Work
Dr. Rhonda	Koster	Outdoor Recreation
Dr. Thamara	Laredo	Sustainability Sciences
Dr. Peter	Lee	Biology (emeritus)
Dr. R. Harvey	Lemelin	Outdoor Recreation
Dr. Baoqiang	Liao	Chemical Engineering
Dr. Nancy	Luckai	Natural Resources Management
Dr. Jason	MacLean	Faculty of Law
Dr. Dawn	Mills	Geology
Dr. Douglas	Morris	Biology
Dr. Rob	Petrunia	Economics
Dr. Wensheng	Qin	Biorefining Research Institute
Dr. Chander	Shahi	Natural Resources Management
Dr. Karl	Skogstad	Economics
Dr. Peggy	Smith	Natural Resources Management
Dr. Darlene	Steven	Nursing
Dr. Robert	Stewart	Geography
Dr. Shannon	Zurevinski	Geology

The following adjunct faculty are also members of CESME:

Dr. Greg	Ross	NOSM
Dr. Robert	Mackereth	Centre for Northern Forest Ecosystem Research

In addition there are two Post Doctoral Fellow (Shiwei Wang & Dawn Mills, Geology), one PhD student (Dan Duckert, NRM) and one NOHFC intern (Mukudzei Dube) affiliated with CESME.

Research Projects & Scholarly Activities

Dr. Dawn Mill's activities

Indigenous Certificate in Geological Studies:

The Working Group (WG) met on June 12, 2018. At this meeting, the WG continued to support a funding strategy in light of the unsuccessful ONCAT application. Discussion at this meeting also included some procedural points related to the structure of the WG. The resolution of support was endorsed and moved by Chief Achneepineskum from Marten Falls

First Nation and seconded by Chief Wabasse, Webequie First Nation, and endorsed by the Provost at Lakehead University. Both Chief Ash and Wabasse were in attendance at the AFN and was passed by the Assembly. In the fall, the Mattawa Management Group of First Nations passed a resolution of support for the continuation of fund raising for the development of the Certificate.

Working Group Attendance June 12, 2018:

Denise Baxter (Lakehead U.); Nancy Bouchard (AETS); Kari Chiappetta; Beedahbin Desmoulin (Four Rivers); Amy Farrell Morneau (Lakehead U.); Pete Hollings (Lakehead U.); Gordon Kakegamic (Oshki-Wenjack); John Kimball (Lakehead U.); Nancy Luckai (Lakehead U.); Gerry Martin (Lakehead U.); Dawn Mills (Lakehead U.); Peter Moses (Four Rivers MATAWA); Todd Randall (Lakehead U.); and, Michael Smith (Métis Nation of Ontario)

The WG met again on October 26, 2018. At that meeting efforts focused on developing 1) communication protocols, and 2) responsibilities of P. Dawn Mills. In general, through a Google Folder, the WG has been given access to all material that is related to the development of the Indigenous Certificate in Geological Studies. During the October 26, the another application to ONCAT was which was due December 17, 2018. The sub-committee of Drs. N. Luckai (Deputy Provost (Academic)); P. Hollings (Director of CESME and Chair of Geology) and P.D Mills (Associate Director of Indigenous Natural Resources – CESME) submitted on behalf of the WG the ONCAT proposal under the Innovation Transfer Program. A Terms of Reference for the WG were drafted and circulated.

Working Group Attendance, October 26, 2018:

Nancy Bouchard (AETS); Mary Tait (SLAAMB); Marie Seymour (SW-B); Amy Farrel-Monteau (Indigenous Curriculum Specialist LU); Elder Gerry Martin (LU); Todd Randall (Dean of the Faculty of Science and Environmental Studies LU); Gordon Kakegamic (OW); Denise Baxter (Vice Provost Aboriginal Initiatives LU); Paul Cappon (Executive Director MATAWA FNMG); Pere Hollings (Chair of Geology LU); Lawrence Baxter (Marten Fall First Nation); Michael Smith (MMO); Beedahbin Desmoulin (Four Rivers MATAWA FNMG); P. Dawn Mills (CESME LU).

In late March 2019, ONCAT informed us that the second application was unsuccessful. After much consideration, the Deputy Provost, Vice-Provost for Aboriginal Initiatives, the Dean of Science and Environmental Studies, the Chair of Geology and the Associate Director of Indigenous Natural Resources have elected to go ahead with a pilot project to develop a course associated with the first term Chemistry 1050 – start date to be determined. The search for funding for the larger project is ongoing.

Cross Cultural Non-intrusive Research Program:

In June 20, 2018, CESME submitted a proposal to the Northern Ontario Heritage Fund Corporation to hire a Research Intern to assist with the development of a cross-cultural non-invasive early mineral research program. The goal of the Applied Research Internship is to assist with the development of a cross-cultural exploration methodology that focuses on non-intrusive strategies for mineral exploration. In December 23, 2018 we learned that CESME had been awarded the grant. Mr. M. Dube who holds a Master's degree in Geology from Brock University accepted the position. His thesis work was related to the geology in

the mid-Atlantic, and he comes to the position with considerable industry experience in South Africa and Zimbabwe.

With respect to the Cross Cultural Non-intrusive Research Program, there is substantive interest from Fort William First Nation (Sunday Lake Area); the Nokiwin Tribal Council (eastern shores of Lake Nipigon) and from Webequie First Nation and Marten Falls (Ring of Fire). It is the intention to engage with Fort William First Nation to produce a pilot of the research over the summer as means to further engage with the Nokiwin Tribal Council Communities, Webequie First Nation and Marten Falls (Ring of Fire). The secondary goal is to solicit a graduate student from the above regions to further the project in the specific locations. In addition, to broaden the impact of this project, the Anthropology, Geography (Geospatial Data Centre), Claude E. Garton Herbarium, and Lakehead's Centre for Analytical Services have been engaged as research partners. In addition to the above, the Team is mentoring a First Nation senior high school student, Ms. A. French from Fort William, within Lakehead's Aboriginal Mentorship Program.

Progress to date:

On June 12th, 2019, members of the Herbarium took the research team around the Thunder Bay Campus to identify the following trees and shrubs: Black Spruce; Birch; Willow; Jack Pine; Aspen; Alder; and Labrador Tea. These trees and shrubs are very common to this transition zone, and are known to take up and store common base metals.

On June 17th & 19th, 2019 sampling of bark from the Black Spruce and new growth (leaves) from the Aspen Trees at Sunday Lake (private property of Ms. C. Banning and Fort William First Nation Member)/

On June 24 & 25, 2019 the Aspen twig and leaf samples and the Black Spruce bark samples were prepared for analysis. Additional preparation and final metal analysis will be completed by Lab personnel over the next couple of weeks. On June 24, 2019 Dr. Mills was introduced to members of the North American Palladium (NAP) Geological and Community Engagement team by the Fort William First Nation representative, Ms. C. Banning. The project was introduced, and NAP offered to share their geochemical and seismic data for comparison with our biogeochemical results. On the same day the team attended a Fort William Community Engagement evening, and was invited to introduce the collaborative Non-Intrusive Early Mineral Exploration Project to the attending Fort William students and other Band Members.

Dr. Shiwei Wang's activities

Dr. Wang's research project is focusing on diamondiferous and potentially diamondiferous lamprophyres in the Superior Province, specifically around the Marathon area of Northwestern Ontario, in collaboration with Churchill Diamond Corporation. Churchill Diamond Corporation is a junior exploration company that has led the renewed exploration interest in the area. Exploration for diamonds in this area has proven to be difficult, where many of the more traditional exploration methods, such as till sampling for indicator minerals, has been shown to be ineffective due to the extensive glaciation history of the Superior Province. Less traditional methods of exploration need to be developed and tested to aid in discovery of new deposits and shorten the time to mine development. This project is testing some of the less traditional techniques to develop new tools that can be used in the diamond exploration industry, particularly in NW Ontario.

To date more than 50 samples have been assessed for this study. This has involved preparation of a standard polished thin section (for microscope and scanning electron microscopic analysis), as well as a standard 2.5 cm puck cut and polished for mineral analysis and Laser ablation ICP-MS analysis. Three additional samples were processed for zircon analysis (full zircon separation and epoxy grain mount), during the summer of 2018 at the University of Hefei, China. Mineralogy work with a petrographic microscope has been completed on all of the samples. As of the beginning of September, all mineral chemistry that can be determined using the Scanning electron microscope (Lakehead University) has been completed. Dr. Wang is currently analyzing the samples at the University of Manitoba using the Electron Microprobe in preparation for trace element analysis of the mineral phases using laser ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS). Dr. Wang is targeting minerals such as pyroxene, apatite, plagioclase, perovskite and zircon.

Dr Wang recently completed the majority of the analytical work at the University of Alberta and is currently interpreting the data with a view to preparing manuscripts for publication.

Other activities

CESME is continuing to engage with local mining companies by hosting “Discovery Days” when researchers at Lakehead present their work to company representatives in order to develop new partnerships.

Educational Activities

On March 29, 2018 CESME sponsored two talks by Dr. Alan Good “Characteristics of magma generated in the SCLM during the Early Stage of the Midcontinent Rift: Evidence from mafic rocks in the Coldwell Complex” and John McBride “Pilot study: Using ambient noise passive seismic surveys for Ni-Cu-PGE mineral exploration at the Marathon PGM-Cu deposit, Marathon, Ontario”. The two talks were held back to back with ~50 people in attendance.

On March 1, 2019 CESME co-sponsored a short course by Dr. Hamid Mumin “IOCG Deposit Geology and Exploration” that was attended by ~25 students and industry geologists

Undergraduate and graduate training

We have supported two graduate students through the John R. Craig Memorial Scholarship and we have been successful in seeking funding to support CESME-related scholarships that will be used to support undergraduate and graduate research in the coming years.

Financial statement

CESME is in reasonable financial health. The statement provided below covers the 2018-2019 financial year.

Item

Credit

Debit



Carry Forward	\$41,642.82	
Transfer from Research Support Fund	\$13,907.50	
Donations	\$1,250.00	
Travel & Conferences (PDAC, Roundup – Hollings, Zurevinski)		\$9,647.64
PDAC booth rental		\$2,063.69
Telecommunications		\$768.60
Sessional coverage for Director		\$8,325.00
Sponsorship (SEG course)		\$250.00
Printing		\$202.50
Supplies consumable		\$1,600.42
PDAC Breakfast costs		\$1,146.59
ICGS costs		\$6,669.03
Subtotal	\$56,800.32	\$30,673.47
Balance	\$26,126.85	

In addition to the items listed above CESME received a grant from Churchill Diamonds to support a Postdoctoral Fellow for a period of two years and funding from the Provost's Office to support Dr. Dawn Mills.

One-year and five-year plans

The immediate goals of CESME are as follows:

- Work with the Advisory Board to continue to develop the Strategic Plan for CESME and the Action Items that stem from it
- We are seeking funding both from research councils and donors to support graduate and undergraduate research.
- We are still considering the possibility of hosting another conference at Lakehead or alternatively providing support to other related events on campus. Specifically we are planning two workshops. One will be for CESME members to share research plans and discuss our strategic vision whereas the second will bring together representatives of the mining industry and local communities with CESME members to discuss research needs and highlight the work of Lakehead faculty.
- We continue to engage with faculty across campus to encourage them to participate in and identify CESME activities.

In the medium term we are seeking to establish three research chairs, one related to each of the CESME pillars (Mining and Exploration, Environmental Impacts and First Nation, Métis and Local Community Engagement). These chairs are critical to the long-term success of CESME as they will provide the core researchers around which Centre activities can be developed. In addition to funding the Chair we are seeking ways to support graduate students and Post-Graduate Fellows who will undertake much of the research. We are investigating a number of mechanisms to fund these chairs, including:

- The NOHFC Industrial Research Chairs program;
- Corporate donations;

- Philanthropy; and
- NSERC Industrial Research Chairs program

We are working closely with the Office of Research Services and External Relations to achieve this goal.

2018-2019 Budget*

Item	Cost
Attend PDAC meeting to promote CESME (2 x\$2,000 people)	\$4,000
Attend Roundup meeting to promote CESME (2 x\$2,000 people)	\$4,000
Conferences for CESME members	\$4,000
Teaching relief for Director (1 x \$7,800)	\$7,800
Promotional materials	\$1,000
Invited speakers	\$3,500

* Scholarships provided by CESME are not included here.

Emerging Trends

CESME activities are more important than ever in the face of changing developments and conditions in the mining sector in northern Ontario. The new provincial government has made strong commitments to develop infrastructure to support the development of the Ring of Fire, and CESME has the potential to play a role in this. The mining and exploration industry is picking up in Northern Ontario and we are anticipating increased interest in CESME activities. This has been reflected in meetings we have hosted with local mining companies who are keen to work with CESME researchers.

Appendix

Media reports, posters and publications

Winter 2019

DONOR IMPACT REPORT



INDIGENOUS CERTIFICATE IN GEOLOGICAL STUDIES (ICGS)

The Centre of Excellence for Sustainable Mining and Exploration (CESME), in collaboration with Indigenous education organizations, is working to develop a university level micro-credential that furthers STEM studies, particularly in Geology. The objective is to re-contextualize existing first-year courses in Mathematics, Physics, Chemistry, Geology and English, to an Indigenous worldview. The ultimate goal is to increase participation in the Sciences, particularly Geology and Water Resource Science, amongst the Indigenous communities in Northern Ontario.

We have received considerable support from Indigenous leadership and educational institutions categorically stating that this innovative transfer pathway is needed.

At the 39th Annual Meeting (July 24 - 27, 2018), the Assembly of First Nations unanimously passed a resolution of support for Lakehead University's

development of the ICGS. A resolution of support that outlined the regional need for ICGS, was also passed by the Matawa Chiefs in Council (September 28, 2018).

As we move forward with this endeavor we will be working closely with our partners in communities and industry in order to develop a program that benefits everyone.

“We are very excited to partner with the Centre of Excellence for Sustainable Mining and Exploration and others to help make the ICGS a reality. It is an area that is under represented by the Indigenous population and helping create something that will help support the accessibility for Indigenous learners is vital.”

– Brent Tookenay, Chief Executive Officer, Seven Generations Education Institute



“We are truly grateful for the support CESME is receiving from our partners in Northern Ontario – whether through the employment of our students, supporting our scholarship and bursary programs or engaging with us to solve the pressing research issues in the North.”

– Dr. Pete Hollings, CESME Director

**EXCEPTIONAL.
UNCONVENTIONAL.**



**Lakehead
UNIVERSITY**

EXCITING PARTNERSHIP DEVELOPMENTS

Dr. Pete Hollings and his research team have a strong record of partnering with industry and academia. The recently completed AMIRA P1153 project was a collaboration between Lakehead, Barrick Gold Corp's. Hemlo Mine and the University of Tasmania.

Graduate students Joseph Vrzovski and Emily Gorner, along with HBS students Liam Fay and Andrew Jedemann, worked with researchers at the University of Tasmania and geologists at the mine to investigate the mineral chemistry of the alteration halo around the Hemlo Mine. These results proved very promising and are already being integrated into Barrick's exploration strategies at Hemlo.

With P1153 complete, Lakehead is now working on P1202, this time collaborating with Freeport McMoRan in British Columbia. MSc students Patrick Hamilton and Andrew Jedemann are studying the alteration footprint of the porphyry and lithocap system in the Pemberton Hills area of Vancouver Island. Even though they only completed their field work in October 2018, the results are already looking very exciting!

CESME HIGHLIGHTS

One of the primary goals of CESME is to recruit and foster faculty, postdoctoral fellows, postgraduate, graduate, and undergraduate student participation.

Highlights from CESME in include:

Dr. Jim Franklin

CESME ADVISORY BOARD MEMBER AND SUPPORTER OF THE DR. MELVILLE BARTLEY MEMORIAL CESME AWARD

Was inducted into the Canadian Mining Hall of Fame in January 2019 – congratulations.

Dr. Dawn Mills

One of CESME's two dedicated research fellows has been working hard to develop the **Indigenous Certificate in Geological Studies**

We continue to engage with local partners through our 'Discovery Days' providing insight into the exciting research activities at Lakehead.

DR. MELVILLE BARTLEY MEMORIAL CESME AWARD RECIPIENT



Channele Boucher was the 2017/18 recipient of the Dr. Melville Bartley Memorial CESME Award. This award is supporting Channele as she

works on her MSc in the Geology Department at Lakehead University investigating the genesis of komatiites in Lake of the Woods, Ontario. Her research will help us understand the processes that formed the Superior Craton 2.7 billion years ago.



Thank you to our donors for generously supporting the following Awards currently available to graduate students, who are learning an interdisciplinary approach to research. This approach is providing a learning experience that better prepares them for the unique regional needs of Northern Ontario.

- SNC Lavalin CESME Graduate Scholarship
- John R. Craig Memorial CESME Award
- Dr. Melville Bartley Memorial CESME Award



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For more information, please contact

Kathryn Davidson
Philanthropy Director, External Relations

807-343-8476 or
kathryn.davidson@lakeheadu.ca



Lakehead University SEG Student Chapter is pleased to offer a short course in:

IOCG Deposit Geology and Exploration

March 1st, 2019 8:30am – 4:30 pm

Oliver Road Community Centre, 563 Oliver Rd, Thunder Bay

Dr. Hamid Mumin received his Bachelor and Master's degrees in Applied Science and Engineering from the University of Toronto, specializing in Mineral Exploration and the Geology of Ore Deposits. He completed his Ph.D. (1994) and Post-Doctoral Fellowship at Western University in Economic Geology. He has worked on successful exploration and development projects in Canada and overseas since 1981. Hamid has been a Professor of Economic Geology at Brandon University since 1995.



His research has investigated the geology of IOCG (iron oxide copper-gold), gold, VMS, carbonatite and epithermal deposit types, with a particular interest in the application to mineral exploration. He is a past CIM Distinguished Lecturer and a past-president of Geoscientists Canada. Hamid is currently Chair of the Department of Geology, and serves on the Brandon University Senate, Foundation and Board of Governors. He continues to work with industry, government and his students on various exploration and development projects across Canada.

IOCG Deposit Geology and Exploration provides an overview of IOCG deposits geology, geotectonic setting, alteration and mineralization. It provides spatial, temporal and genetic context, and gives an explanation for the seemingly disparate range of associated deposit types. The course reviews the secular evolution of IOCG systems and their relationship to magmatic hydrothermal ores such as porphyry and epithermal deposits. The course will give a global overview with a focus on some of the spectacular exposures of IOCG systems in Canada. Some of the key criteria for exploration in the Canadian context such as hydrothermal alteration mapping and geophysics will be discussed. The course finishes with a hands-on challenge for participants to recognize and interpret a wide range of IOCG alteration and mineralization styles that are present in rock specimen and drill core samples.



Lakehead
UNIVERSITY

Department of
Geology



CENTRE OF EXCELLENCE FOR
SUSTAINABLE MINING
& EXPLORATION

Free Public Lecture

Presents Guest Speakers



DR. DAVID GOOD

Associate Professor at University of Western Ontario

Characteristics of magma generated in the SCLM during the Early Stage of the Midcontinent Rift: Evidence from mafic rocks in the Coldwell Complex



JOHN McBRIDE

Senior Project Geologist, Stillwater Canada Inc.

Pilot study: Using ambient noise passive seismic surveys for Ni-Cu-PGE mineral exploration at the Marathon PGM-Cu deposit, Marathon, Ontario

FRIDAY, MARCH 29, 2019 AT: 2:30 pm IN: CB 2019

SUDBURY

MINING SOLUTIONS JOURNAL

Lithium plant on the horizon

■ Feasibility study is underway

BY NORM TOLLINSKY

An Australian company with a patented process for producing lithium carbonate for the rechargeable battery market has selected Sudbury for a 5,000-tonne per year processing facility.

There were several reasons for zeroing in on Sudbury, said Joe Walsh, managing director of Lepidico. Among them were the close proximity to a source of sulfuric acid and markets in the Great Lakes region for byproducts from the process.

"Our L-Max process is quite acid intensive," explained Walsh. "We consume approximately one tonne of sulfuric acid for every tonne of lepidolite concentrate that we process, so proximity to an abundant source of affordable sulfuric acid is important."

According to Walsh, Lepidico will require between 40,000 and 50,000 tonnes of acid, or approximately five per cent of the one million tonnes of sulfuric acid produced as a byproduct of Sudbury's smelters.

Lepidico's hydrometallurgical process "doesn't just produce lithium carbonate," said Walsh. "It also produces a range of byproducts, and to be economically viable, we need to be able to maximize the value of those byproducts."

Among them are sulphide of potash fertilizer and amorphous silica, which has many applications. Assuming the company can find markets for all of the byproducts, the process for converting lepidolite concentrate into lithium carbonate will be competitive with other sources of lithium, as well as being waste-free.

"That's a fantastic eco-friendly outcome," said Walsh.

A feasibility study is underway, the results should be known by February or March and the final report is expected to be available by April.

Bench-scale laboratory tests in Australia have demonstrated the viability of the L-Max process, and a scaled up pilot plant the company hopes to come onstream in April is planned to provide further confirmation.



Mini plant run for the L-Max process in Australia produced a high-specification lithium carbonate product with a purity of 99.5 per cent.

"We're looking to have this pilot plant and the data from our feasibility study available for prospective financiers and off-takers to evaluate," said Walsh. "They will be able to see the process in operation. That's going to be essential to get the best off-take and financing outcome for our shareholders."

The objective, if all goes well, is to make a final investment decision on the Sudbury plant by the middle of 2019.

A capital cost of \$45 million was cited in the company's pre-feasibility study completed in early 2017, but recent test work for the feasibility study persuaded Lepidico to double the throughput rate from 3.6 tonnes per hour to 7 tonnes per hour, equating to annual production of 5,000 tonnes per year of lithium carbonate.

The capital required for the proposed 36,000-square-foot Sudbury plant will increase, but won't double, said Walsh.

Down the road, annual production could be increased to 10,000 tonnes per year by expanding the plant or building a new one.

Lithium carbonate is currently produced from the lithium mineral spodumene and from brines in Chile and Argentina, but with increasing demand for lithium, Lepidico sees an opportunity to add lepidolite as a source of supply.

"If we go back five or six years, the demand growth for lithium chemical was in the low single digits per annum and the price was \$5,000 to \$6,000 per tonne," said Walsh. "At that rate, existing producers

could easily satisfy the incremental increase in annual demand. But with the advent of lithium-ion batteries and the emergence of electric vehicles, demand for lithium chemical has increased quite substantially. In 2017, it hit approximately 200,000 tonnes and projections are that it could be anywhere from 800,000 to one million tonnes per annum by 2025. That's a four

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EIGHTEEN PIECES OF EQUIPMENT SOLD TO TUNNELING CONSORTIUM20

Lakehead part of global research to improve targeting

BY GRAHAM STRONG

New research involving Lakehead University's Department of Geology is comparing the effectiveness of short-wave infrared core scanning with laser ablation in identifying the size and location of some ore deposits that display alteration halos. This technique can help direct more targeted drilling, and ultimately reduce drilling costs.

"We know that certain minerals show geochemical trends around ore deposits, and that big ore deposits have a different signature compared to smaller ore deposits," said Dr. Peter Hollings, director of the Centre of Excellence for Sustainable Mining & Exploration (CESME) and chair of the Department of Geology at Lakehead University in Thunder Bay.

"Although with the visible footprint (of a deposit) we could see was maybe a kilometre, looking at the mineral chemistry we can actually see changes in the rock maybe three kilometres and in the case of some of the really big porphyry deposits in Chile, maybe as much as 10 kilometres. So we've made a bigger target for companies to aim for," Hollings said.

AMIRA international research project P1153, completed this summer, studied techniques for using laser ablation to detect those changes in the rock. However, the laser ablation process itself can be cost-prohibitive. "We're seeing companies incorporating laser ablation analyses into their exploration programs. But there is always pushback to do it cheaper," Hollings said. "We are now both trying to get laser ablation cheaper, but also finding other tools that companies can use to get the same results or close to the same results."

A new AMIRA project named P1202 "Far field and near mine footprints - finding and defining the next generation of Tier 1 ore deposits" launched immediately after P1153 as the next in a series of related projects. If successful, the research could pave the way to a more effective way of finding drilling targets at a lower cost.

Automation of data analysis is helping to reduce the cost of laser ablation, eliminating the need to analyze data by hand. "It takes out a lot of the human error potential and



Peter Hollings, head of geology at Lakehead University. Lakehead's involvement with the latest AMIRA international research project will build upon past research focused on detecting geochemical signatures of alteration halos.

speeds up the process, reducing the cost of doing that work," Hollings said.

New tools include hyperspectral infrared (IR) imaging, which measures the reflective responses within a core sample to determine the minerals present. A full core scan allows you to see how the downhole variation of the alteration changes. The handheld IR units tend to be of lower resolution than full core scanners, with magnification similar to a hand lens, Hollings said.

Both IR and laser ablation work on the same principles to examine the mineral chemistry of alteration halos. Laser ablation is more precise than IR but IR is less expensive, and the information gleaned might be all that is needed for exploration.

"We've been playing with ways to correlate the IR information with the laser ablation information," Hollings said. "Does it tell you the same things, or do you still have to go back to the laser ablation?"

The technology also helps make any

core analysis more quantifiable, converting visual images into a series of pixels and number values.

"You're getting a much more empirical description of your alteration," Hollings said. "If I put the same box of core in front of five different geologists, I'd probably have five - maybe more - descriptions of the alteration. They'd all be close, but they'd all be slightly different due to human nature and subjectivity."

The research, which receives funding from 11 industry partners, will also investigate how the technique works in other geological systems. "Rather than just the porphyry systems that we've looked at a lot, we looked at Hemlo and Red Lake to see whether the same things worked around orogenic gold systems, and it looks like they do."

Fieldwork is or will be taking place in several locations in Canada as well as Arizona, Australia, Sweden, Indonesia,

Chile, and Argentina. That presents an incredible opportunity for students at Lakehead University. Hollings said that smaller schools such as Lakehead offer more research opportunities for undergrads. Conversely, graduate students can sometimes lose out on certain opportunities such as working on advanced equipment only available at larger programs. This series of research projects has allowed grad students at Lakehead the best of both worlds because, through the AMIRA partnership, they travel to the CODES (Centre for Ore Deposit and Earth Sciences) at the University of Tasmania for a month of analysis work on the big equipment.

"They work with the research team there and actually collect their own data. It's important to see how the method works and to understand the process," Hollings said. "It's a really positive experience for them." ■



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