

Centre of Excellence for Sustainable Mining and Exploration (CESME)

Annual Report to the Office of Research Services

June 2020





Executive Summary

In the past year CESME has achieved the following:

- Developed and published 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 continued our 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. A proposal has been submitted to NOHFC and we are awaiting a decision.

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 supported two Postdoctoral Fellows (Mills and Wang) in the past year. Wang has completed his two year term and returned to China to take a teaching position.

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
- Ms. Sue Craig, Consultant
- Mr. Gord Maxwell, Consultant

Mr Maxwell, an indigenous Canadian, agreed to join the Board in March 2020 and Ms Craig was recruited in April 2020.

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. Michael Rennie, continues 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), and one PhD student (Dan Duckert, NRM) affiliated with CESME.

Research Projects & Scholarly Activities

Dr. Dawn Mill's activities

Indigenous Certificate in Geological Studies:



In the late fall, the Faculty of Science and Environmental Studies (FSES) sponsored the creation of a Teaching Guide and Student Study Guide for internet/short course or short term residency teaching and evaluation for Chemistry 1050. The rationale to start with this course is that the Native Nursing Program students require this course, as they will apply the concepts when they take courses related to pharmaceuticals. The success rate unfortunately for this grouping has not been great.

During the re-contextualization process, in discussion with Merce Romanec and Gabriel Oba, the main obstacle identified were the intermediate math skills. To rectify this, the FSES is sponsoring a Teaching Guide and Student Study Guide, as well as a ten-week block pullout (3 hours per week) that will run concurrently with the delivery of Chemistry 1050 in fall term.

Sunday Lake Research Collaboration between CESME and Fort William First Nation:

The Sunday Lake Research Collaboration between CESME and Fort William First Nation in June 2019 saw the collection of black spruce bark samples and leaves from trembling aspen trees on an acreage at Sunday Lake (northeast of Thunder Bay). The goal of the research was to demonstrate underlying mineralogy, prior to continued geological studies. The sample area was close to the Northern American Palladium's claim around Sunday Lake. The black spruce samples were normalized using data from samples from Snow Mountain Manitoba, and the results indicated the possibility of an ultramafic intrusion characteristic of the area. The data collected from the trembling aspen samples did not indicate significant results to warrant further investigation. The results of the black spruce sampling was presented as a poster at Round Up 2020.

Matt Dube, the NOHF Intern, left the Cross Cultural Research Assistant position in mid-July. During the early fall, Mr. Simon Dolega volunteered assisting with the interpretation, analysis of the black spruce data and co-wrote the material for the poster presented at Round Up 2020. Currently there is an invitation to broaden this engagement.

Grant Writing and Fund-Raising:

During late October through to early November was spent responding to a proposal call from Ecampus Ontario for the creation of micro-certificates. CESME sent in a proposal that outlined the possibility of creating the Math (two .5 FCE courses) and the English (two .5 FCE) components of the larger Indigenous Certificate in Geological Studies. Support was indicated from the Working Group, Martin Falls First Nation, Noront, North American Palladium (NAP) and a consulting company – Indigenous Engagement. Unfortunately, we were not given a grant to complete these sections. However, the backing from Martin Falls, Noront, NAP, and Indigenous Engagement continues to suggest a broader support base for those who would be taking up the opportunity for further more formal education.

During Round Up, several mining companies expressed interest in the collaborate research program and our development of the university credit bearing Indigenous Certificate in Geological Studies. The community engagement specialists from Teck and Rio Tinto (Canada) expressed interest for further information about these endeavours. Additional information was sent to Teck and a meeting was arranged at the Prospectors and Developers Association meeting in March. Similarly, information and a follow up call was



arranged with Rio Tinto (Canada). Additionally, I was approached by Jennifer Rogers, Head of Learning, AngloAmerican. Discussed were our goals with respect to life long learning, opportunities for student enhancement and the further development and deployment of the Certificate.

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.

Dr. Wang completed all his analytical work and on the completion of his term returned to China to begin a teaching position. He has submitted one manuscript which is currently under review for Precambrian Research and a second paper will be submitted to the Journal of Petrology in the near future.

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 5, 2020 CESME co-sponsored a workshop by Drs Anne and John Thompson on "Hydrothermal Mineral Deposits – Breccias and Alteration" that was attended by 30 industry geologists and students. We had agreed to support a second course later in the month but that was unfortunately cancelled because of the Covid-19 travel bans.

Undergraduate and graduate training

We have supported two graduate students through the John R. Craig Memorial Scholarship and one through the Dr. Melville Bartley Memorial CESME Award.

Financial statement

CESME is in reasonable financial health. The statement provided below covers the 2019-2020 financial year.



Item	Credit	Debit
Carry Forward	\$26,123.85	
Transfer from Research Support Fund	\$11,536.25	
Donations	\$300.00	
NOHFC Intern funding	\$9430.94	
NOHFC Intern salary		\$11,930.13
Travel & Conferences		
(PDAC, Roundup – Hollings, Zurevinski, Mills)		\$7,043.22
PDAC booth rental		\$1,995.42
Telecommunications		\$768.60
Sessional coverage for Director		\$8,550.00
Sponsorship (SEG course)		\$250.00
Printing		\$82.73
Supplies consumable		\$1,533.29
PDAC breakfast		\$878.57
Subtotal	\$47,391.04	\$33,031.96
Balance	\$14,359.08	

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 implement the new Strategic Plan for CESME and the Action Items within 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.
- We continue to engage with faculty across campus to encourage them to participate in and identify CESME activities.

In the medium term we are still 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. As mentioned above we have secured funding from Impala Canada to support an NOHFC Industrial Research Chair. The application was submitted in January 2020 and we are still waiting for a decision. 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

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

2020-2021 Budget*

Item	Cost
Attend PDAC meeting to promote CESME	\$4,000
(2 x\$2,000 people)	
Attend Roundup meeting to promote CESME	\$4,000
(2 x\$2,000 people)	
Conferences for CESME members	\$4,000
Teaching relief for Director	\$7,800
(1 x \$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 recent Covid-19 crisis has impacted both share and commodity prices which will likely have a short-term impact on the mining industry in Northern Ontario. In March 2020 the Provincial Government announced plans to develop a road to the Ring of Fire and we are optimistic that this will lead to significant economic activity in the region. We hope that CESME will be able to play a role in these activities and fulfill our goal to establish and strengthen links between community partners. The need for increased training to meet the growing economic development needs in Northern Ontario means that the ongoing development of the ICGS will be increasingly critical.



Appendix

Media reports, posters and publications



DONOR IMPACT REPORT



PARTNERING WITH IMPALA CANADA (FORMERLY NORTH AMERICAN PALLADIUM)

Researchers at the Centre of Excellence for Sustainable Mining and Exploration (CESME) are excited to be working with Impala Canada to better understand the formation of the Lac des Iles Mine.

Financial support from Impala Canada is supporting Master's student Victoria Currie's project which is investigating the origin of the various dike suites at the mine to establish their link to the mineralized intrusions. Vicky spent the summer working at the mine, allowing her to obtain some great experience in the mining industry, and to get a head start on her project.

In December of 2019, Dr. Pete Hollings was awarded a Natural Sciences and Engineering Research Council Collaborative Research Development award. This award matched the funding from Impala Canada and enabled a second Master's student, Justin Jonsson, to start working on the project at Lac des Iles.

Justin is focused on whole rock and mineral chemistry. His work investigates the evolution of the magma chamber that hosts the mineralization.

"We are thrilled to develop new and collaborative ways to partner with and support Lakehead. The university's breadth of mining, science and engineering-based initiatives and programming complement our business enabling us to see clearly the many advantages of building a long-term future together."

 Erin Satterthwaite, Vice-President, Corporate Affairs and Communications, Impala Canada



IMPALA CANADA AND SUPERIOR SCIENCE AT LAKEHEAD

Impala Canada's contributions go beyond fostering innovative research and launching the professional lives of university students. Recently, they made a \$20,000 donation to Lakehead University's Superior Science – a student-run, non-profit program based at Lakehead Thunder Bay, that introduces children in grades 1 to 8 to fun hands-on activities in the science, engineering, and technology (STEM) fields.

Impala Canada's generosity will support the enhancement of summer camps, girls club programming, community events, and Indigenous outreach throughout Northwestern Ontario. "We anticipate reaching over 4500 children through Impala Canada's generous support," says Ashley Andrea and Michael Coccimiglio, the 2019 Directors of Superior Science.



"CESME is really excited to be working with our local partners to develop exciting new opportunities for our researchers and students while solving critical issues that advance the interests of Northern Ontario. These partnerships are critical to our research and provide outstanding training opportunities for our students."

– Dr. Pete Hollings, CESME Director

EXCEPTIONAL. UNCONVENTIONAL.





NORTHERN ONTARIO PROSPECTOR, Geologist Among Mining Industry Award Recipients



Dr. Rudy Wahl, Sc.D (Hon) of Marathon, Ontario, a prospector and discoverer of several precious metal, diamond and rare earth occurrences in northwestern Ontario, will receive the prestigious Bill Dennis Award from the Prospectors and Developers Association of Canada. This award recognizes industry leaders who have made a significant mineral

discovery, or made an important contribution to the prospecting and/or exploration industry. The award presentation will take place at the PDAC Convention in Toronto March 3, 2020.

INDIGENOUS CERTIFICATE IN GEOLOGICAL STUDIES

CESME continues to move forward with the Indigenous Certificate in Geological Studies (ICGS) given the strong interest from Indigenous leadership and educational institutions to build capacity in the STEM fields. The ICGS is a university level micro-credential that will recontextualize the courses that make up the first year of the Geology degree at Lakehead and frame them within Indigenous world views. Thanks to support from the Dean of the Faculty of Science and Environmental Studies, we have started work on the recontextualization of the first year Chemistry course as a pilot study that can also be applied to other First Nations focused programs at Lakehead.

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 include:

CESME's Strategic Plan

Working with the Advisory Board, CESME's leadership team has developed a Strategic Plan for the Centre charting the way forward for the next 5 years. Copies of the strategic plan can be found on the CESME website.

CESME Researchers

CESME researchers are continuing to work with Freeport-McMoRan and NSERC in a study of the alteration system around the Pemberton Hills porphyry system in British Columbia.

Pat Hamilton and Andrew Jedemann

The two MSc students are back after spending three months at CODES, our research partner at the University of Tasmania. Their analytical work, supported by the Mitacs program, is producing exciting results that is refining our industry partner's exploration strategies.



For generously supporting the following CESME 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

RESEARCH SUPPORTS The Cesme Environmental Impact Pillar



This year's recipient of the Dr. Melville Bartley Memorial CESME Award was Kyle Stratton who is investigating the Steelhead fishery on Lake Superior's North Shore which has undergone dramatic fluctuations over the last few decades.

Kyle's work falls under the environmental pillar of CESME and will help to advance the understanding of the Great Lakes by determining how naturalized self-sustaining populations of Steelhead respond to changes in selective pressures such as overharvest, competition and predation.

The results from this study will be applied to the other Great Lakes as all the species examined in Kyle's study are found in each of the Great Lakes.



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For more information, please contact

Kathryn Davidson Philanthropy Director, External Relations 807-343-8476 or

kathryn.davidson@lakeheadu.ca

The Lakehead University SEG Student Chapter and CESME is pleased to offer a short course in

Hydrothermal Mineral Deposits – Breccias and Alteration



Thursday, March 5th, 2020 Oliver Road Community Centre, 563 Oliver Road, Thunder Bay, Ontario





John and Anne Thompson (Co-editors of the Atlas of Alteration) will be offering a 1-day short course in Hydrothermal Mineral Deposits – Breccias and Alteration



The course will discuss major types of hydrothermal deposits, the character and importance of breccias found in these deposits, the nature and importance of hydrothermal alteration, techniques and tools for quantifying hydrothermal alteration, and applications to hydrothermal deposit models and exploration.

John Thompson obtained his BA from Oxford University and M.Sc. and Ph.D. degrees from the University of Toronto. In 1982, he joined the BP Minerals group (Rio Tinto) initially in Australia, followed by positions in the UK and Salt Lake. In 1991, Thompson became Director of the Mineral Deposit Research Unit (MDRU) at the University of British Columbia managing exploration-related research for over twenty companies. He returned to industry in 1998 as Chief Geoscientist for Teck, and then Vice President Technology and Development. In the latter role he managed technology and innovation programs and was involved in corporate development including resource and technology-related transactions. He left Teck in 2012 and became the Principal for PetraScience Consultants based in Vancouver, an exploration, development and technology consultancy. Thompson is a Director (past-Chair and founder) of Geoscience BC, a member of the Global Agenda Council on the Future of Mining and Metals with the World Economic Forum, and a board member of Genome BC. He was a co-founder and President of the Canada Mining Innovation Council and President of the Society of Economic Geologists (SEG). He has board and advisory positions with public and private companies and other organizations.

Anne Thompson obtained her BA from Harvard College and an M.Sc. in Economic Geology from the University of Toronto. Since 1995 she has been the President of PetraScience Consultants, based in Vancouver, BC. She has 35 years of experience working in and consulting to the mineral exploration industry, including field work and applied mineralogy, providing innovating approaches to mapping alteration minerals. Anne held a Councilor position with the SEG from 2017-2019, as well as serving as Chair ad hoc SEG Diversity and Inclusion Committee and Chair of the SEG Awards Committee in 2019. She has also been the past RFG2018 editor of resource Quarterly. Anne and John are both co-editors of the Atlas of Alteration, a valuable resource for exploration geologists.

Course Agenda Thursday, March 5th, 2020, 8:30 a.m. to 5:00 p.m.

8:30 Welcome and Introductions

8:35 Lecture 1: Introduction to hydrothermal deposits and mineralizing processes – John Thompson and Anne Thompson

9:00 Lecture 2: Breccias: importance, classification and interpretation – John Thompson

10:30 Coffee Break

10:50 Lecture 3: Hydrothermal alteration: basic principles of alteration mineralogy, observations and interpretation – John Thompson

12:30 Lunch

1:30 Lecture 4: Alteration methodology: Identifying alteration using applied mineralogy and supporting analytical techniques – Anne Thompson

3:00 *Coffee break*

3:20 Lecture **5:** Deposit models and alteration Review major hydrothermal deposit models, alteration and exploration implications – John Thompson

4:30 Discussion

5:00 *Close*





ABSTRACT

Mineral resource exploration uses various methods to determine the composition of the bedrock. The research partnership amongst the Centre of Excellence for Sustainable Mining and Exploration (CESME) – Lakehead University, Fort William First Nation, and Fort William Member chose for the CESME Sunday Lake Project (CSLP) to utilize a sampling method using the bark of black spruce (*Picea mariana*) and twigs/leaves from trembling aspen trees (Populus tremuloides). At the CSLP site, sample collection included the outer bark of ten black spruce trees (Picea mariana), and twigs/leaves from three trembling aspen trees (Populus tremuloides). The CSLP is on a leased patent and within Fort William First Nation's traditional territories (approximately 25km northeast of Thunder Bay, Ontario). Incorporated into the sampling procedure was the ritual of thanking the individual tree for its information by depositing tobacco and a word of thanks.

Twenty-six elements (Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, Se, Si, Sr, Ti, Tl, V, Zn) were analysed for each sample. In our results, the copper and nickel values are elevated. The correlation between copper and iron in the biogeochemical samples suggests that these samples originated from the same sources, possibly chalcopyrite ($CuFeS_2$). This correlation may be an important vector for mineral exploration at Sunday Lake.

CONTACT

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Introduction

Prospectors use various methods for mineral exploration. The objective of CESME Sunday Lake Project (CSLP) is to utilize a simple, cost effective, environmentally friendly exploration technique for mineral prospecting. The goal is to use these exploration techniques to teach, mentor and collaborate with Indigenous communities to become successful, independent mineral prospectors.

Regional Geology

The CSLP is within the Superior Province, one of the world's largest stable Archean craton spanning about 1,565,000 km² (Thurston, 1991) (Figure 1). More specifically, the project is in the Quetico subprovince, a subprovince dominated by granitoid-metasedimentary assemblages. Lithologies within the Quetico subprovince are dominated by felsic and mafic turbidites (Fralick et al., 1992) metamorphosed from greenschist to amphibolite facies with localized zones of granulite facies metamorphism (Pan et al., 1994). Felsic to intermediate intrusions, including tonalites, biotite leucogranites and peraluminous granites are also abundant, while mafic to felsic extrusive rocks, gabbroic and ultramafic rocks are not commonly exposed on surface within the Quetico subprovince (Williams, 1991).



Figure 1: A map of the Superior Province. The red star denotes the CSLP site location within the Quetico subprovince. Modified from Stott et al. (2011).

Biogeochemical Analysis of Black Spruce Bark at Sunday Lake: A Partnership Fort William First Nation and Centre of Excellence for Sustainable Mining & Exploration P. Dawn Mills PhD, Simon Dolega MSc – Lakehead University (CESME), Catherine Banning, Robert Pierre, Aliyah French – Fort William First Nation & Members



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Williams, H. R. 1991. Quetico Subprovince, in Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part I, p383-403.

and environmentally-friendly, potential mineral exploration tool when outcrop exposures are minimal.

Indigenous community members can use their knowledge of plants and landforms in their territories to collaborate in mineral exploration. More importantly, partnerships between Indigenous Community Members and Exploration Teams will foster cross-cultural and complimentary knowledge exchanges.

Acknowledgements

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- D. Benson North American Palladium
- M. Cummins Claude E. Garton Herbarium, Lakehead University
- S. Dolega Research Associate, Lakehead University
- M. Dube NOHFC Intern
- C. Dunn Colin Dunn Consulting Inc.
- A. French Senior, Westgate High School Thunder Bay
- K. Dysievick Claude E. Garton Herbarium, Lakehead University
- P. Hollings Chair Department of Geology, Lakehead University
- R. Pierre Fort William Economic Development Consultation Officer
- W. Scott North American Palladium
- M. Waneki North American Palladium



during ion transport and black spruce

growth.

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