



Mineral Exploration Research Centre

October 2014 - Newsletter

Message from the Director - Dr. Harold Gibson

Notwithstanding the difficult economic times facing our industry, 2014 has been a successful and busy year for MERC. MERC continues to benefit from a close working relationship with Laurentian University's Goodman School of Mines in the areas of new course and workshop development. Three workshops and field trips have been completed and 3 more are planned for 2014. MERC's exploration research projects, which will exceed \$2 M in expenditures in 2014, are conducted globally, cover multiple ore systems with a focus on the Precambrian, and include 66 graduate and 17 undergrad students. As outlined in the newsletter, we have successfully initiated 3 new gold projects in the Abitibi and Wawa greenstone belts this summer and we are developing a Thematic Abitibi Gold Exploration research project and have three industry partners to-date. We have completed our initial discussions with our industry partners to develop an exploration research project that will focus on low-sulfide, footwall PGE mineralization at Sudbury

We welcome Detour Gold Corporation who have joined MERC as a corporate member in 2014.



On the organizational front, we have completed a 5-year business plan and business case to help guide MERC's growth, and to provide measures of success. The Business Plan reviews MERC's current operations, focussing on its achievements to-date and recommends six strategic initiatives, phased over a five year period, to guide future research, broaden organization capacity, improve overall governance, and ensure that MERC remains firmly on a path of increased operational capacity and long term sustainability. The Business Plan will be posted on the MERC website by months' end.

The MERC website will be updated with undergraduate and graduate student CVs in November and with current publications and research presentations in December. The website will be adapted for access by smart phones in January 2015 so that our members, industry partners, sponsors and potential students can more readily access our site.

Lastly we welcome Dr. Matthew Leybourne, who joined the Department of Earth Sciences (DES) and MERC as an Associate Professor, Geochemistry, this July. Professor Leybourne applies elemental and isotopic geochemistry to understand fundamental geochemical processes and address problems of interest to mineral exploration. These include: 1) the study of metal migration from source to sink to optimize the use of geochemistry in mineral exploration and understand ore deposit formation; 2) the geochemistry of magmatic and hydrothermal fluids associated with submarine volcanic arc systems and associated volcanogenic sulfide deposits; 3) elemental and isotopic fractionation during supergene mineral formation; and 4) analytical method development. Prior to joining Laurentian, Professor Leybourne was senior Geochemist with ALS (Vancouver), a Senior Scientist II with GNS (New Zealand), an Assistant professor at the University of Dallas, and a Research Scientist with the Geological Survey of Canada. He is manager of the laser ablation ICP-MS analytical facility at DES/MERC. This facility has particular strengths in U-Pb dating of zircon, laser ablation analyses of sulfide minerals, and laser mapping of minerals for mineral exploration, ore deposit research and paleoenvironmental studies in ancient carbonate rocks. The laboratory is dedicated to the training of students, supporting cutting-edge research, and serving the mineral exploration and mining industry.

Educational Initiatives to October 2014

1. **Workshop: Scientific and Technical Writing** – January 18th taught by experts from government, industry and university.
2. **April 17th Workshop** Associated with the Timmins Northeastern Ontario Mines and Minerals Symposium (April 15 & 16).

Presentations highlighting new Abitibi research projects improving our understanding of, and exploration methods for, gold & base metals by experts from academics, government and graduate students.
3. **Abitibi Metallogenic Field Trip (October 16-19):** 4 day field trip focused on metallogeny and stratigraphy of the Abitibi greenstone belt. This was done for the SEG student chapter and 5 industry participants.



Abitibi field trip participants at the Côté Gold deposit.

Upcoming Educational Initiatives

Our graduate modular course curriculum continues to educate students from across Canada and globally, and the courses, in whole or in part, are used for professional accreditation by industry. Upcoming MERC modular and professional courses within the next 6 months include:

- **Exploration Geochemistry Modular Course (December 3-16, April 2014)**
- **Exploration for Hydrothermal Ore Deposits Modular Course (February 2015)**

Workshops and Short Courses

1. **November 6, 2014: 1 Day Workshop on Exploration-Focused Research for Magmatic Ni-Cu-PGE & Cr, Gold & VMS.** Presentations by DES faculty, Adjuncts and graduate students.
2. **November 5-7, 2014; Exploration Targeting: Economic Aspects of Exploration Targeting** by Michael Doggett.
3. **December 6 & 7, 2014: 2 Day Workshop on Advances in Surficial Exploration Methods**

Two day workshop within the Exploration Geochemistry Modular Course (December 3-16) Workshop will have a Canadian Shield Focus and be presented by experts from academics, government and industry intended for professionals and students.



Field School III students

DES/MERC Faculty

- Harold L. Gibson, Professor and MERC Director: Economic Geology, Volcanology
- Bruce Jago, Professor and Executive Director, Goodman School of Mines, Economic Geology
- Pedro J. Jugo, Associate Professor: Igneous Petrology, Economic Geology
- Daniel J. Kontak, Professor: Economic Geology
- Bruno Lafrance, Professor and DES Chair: Structural Geology, Economic Geology
- Matthew Leybourne, Associate Professor: Geochemistry
- C. Michael Leshner, Professor: Economic Geology, Igneous Geochemistry
- Andrew M. McDonald, Professor: Mineralogy

- Michael Schindler, Associate Professor: Environmental Mineralogy, Hydrology
- Graeme A. Spiers, Associate Professor: Environmental Geochemistry
- Richard S. Smith, Professor: NSERC IRC in Exploration Geophysics
- Phillips C. Thurston, Adjunct Professor: Precambrian Geology
- Douglas K. Tinkham, Associate Professor: Metamorphic Petrology
- Elizabeth C. Turner, Associate Professor: Carbonate Sedimentology, Invert. Paleontology
- **Clastic Sedimentologist position to be advertised soon**



Côte Gold deposit, Chester Twp. High-grade Au in quartz-carbonate molybdenite vein. Molybdenite samples yielded Re- Os ages of 2737 ± 8 Ma. in a 2740 ± 1 Ma. tonalite-diorite complex (photo by D. Kontak).

MERC is planning to expand research on Abitibi gold deposits by applying for an NSERC CRD matching the funding provided by companies for the ongoing Abitibi projects at the Côte and Detour gold deposits. We plan to use the new funding as seed money to expanded the Abitibi thematic gold project to include additional Abitibi gold deposits. Funding from any new company sponsors would also be matched. New study sites will be chosen in collaboration with the sponsoring companies.

In order to help exploration geologists in their search for new gold deposits using geochemical techniques, the project will characterize and fingerprint different gold deposit types from across the Abitibi Subprovince by integrating a variety of methods including:

- Litho-geochemistry of alteration zones as a basis for mass balance and geochemical characterization of the altering fluids
- Defining the mineralogy and mineral chemistry of alteration zones, which is then integrated with litho-geochemistry to identify the mineralogical origin of elemental signatures (e.g., monazite, molybdenite, scheelite) in syenite associated gold deposits
- Characterization of sulfide textures, which recent work have shown to be related to barren versus mineralized zones
- Chemical characterization of sulfides (e.g., pyrite, arsenopyrite, chalcopyrite) with both point analysis and elemental mapping to fingerprint systems via the use of the LA-ICP-MS method
- Chemical characterization of fluid inclusions to directly fingerprint different fluid generations.

From this database it will be possible to isolate the most discriminating parameters to differentiate and target different gold ore environments.



Dr Matthew Leybourne, Associate Professor of Geochemistry. The newest faculty member of DES/MERC.

Abitibi-Wawa Gold Studies:

Three new graduate theses projects were initiated this past summer to help improve understanding and exploration criteria for epigenetic gold deposits of the Abitibi and Wawa subprovinces. These include two collaborative projects with the Ontario Geological Survey; an MSc focused on the tonalite-hosted Renabie Mine on the northeastern margin of Michipicoten greenstone belt, Wawa Sudprovince, (Kontak, Lafrance), and a PhD focused on gold metalogeny of the southern Swayze belt in the southwestern part of the Abitibi greenstone belt (Kontak, Lafrance). We have also initiated an MSc at the Detour Mine in the northern Abitibi (Kontak, Tinkham, Ayer, Dubé)

Targeting Initiatives

Research in geophysics conducted by Professor Richard Smith is continuing. Two MSc students have completed the project since our last newsletter. Tomas Naprstek has completed a thesis on theoretical modelling of the radio imaging (RIM) method. This method measures the electric field in one borehole when there is a small radio transmitter in a nearby borehole; the method is used in Sudbury for mapping ore between holes. Tomas assumed a whole space model and built a better understanding of the impact of borehole offset, borehole inclination and changes in the physical properties of the intervening material (conductivity, permittivity and magnetic permeability). A computer program (developed in Python) was generated and used to model some field data. He showed that the impact of permittivity was apparent in the data and suggests that this physical property should be accounted for (normally it is not). A second student, Deng Deng has very recently completed his project on measuring the magnetic susceptibility of rocks in the Thompson (Manitoba) area using hand-held resistivity tools. A third student, Christoph Schaub, will be completed his MSc project in a few months. His project concerns the measurement of stress in mines using magnetic field measurements. One of these students (Tomas) will be staying on to do a PhD, and we have attracted a new MSc student (Frédéric Gaucher) who will be working on using geophysics to map low-grade copper deposits. The number of geophysics graduate students in the department will be five, with plans to increase this number in the future.

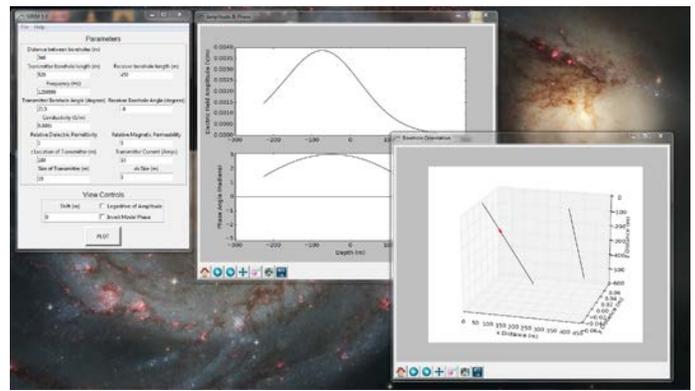


Joshua Lymburner and Devon Parry collecting geophysical data.

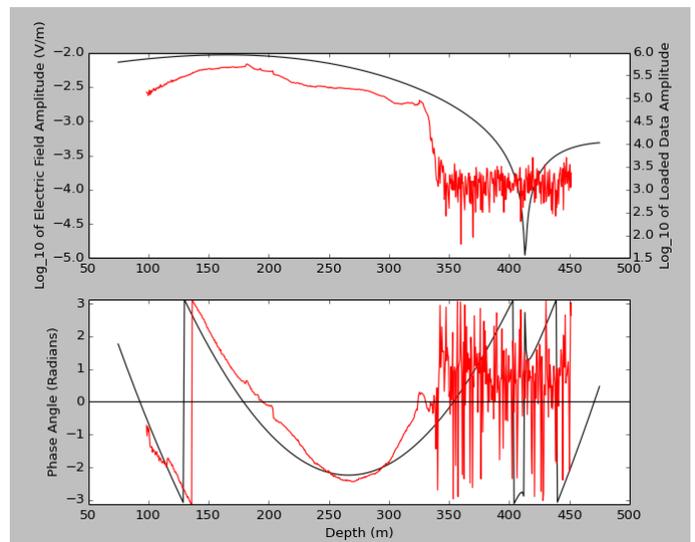
The Industrial Research Chair (IRC) that has been funding the bulk of the geophysics research is due up for renewal. A new proposal to NSERC is in the process of being developed and we are looking for companies interested in participating and funding this

exciting research initiative. If you are interested in getting involved, please let us know.

The figures below shows some images of the RIM program developed by Tomas Naprstek. The first image shows the panel for entering the modelling parameters (left), the middle panel is the data generated and the right panel is the borehole geometry with the transmitter position shows as a red dot. The second figure shows some field data in red and the model data in black. The model is a whole space of relatively high resistivity, such that the fit is reasonable on the amplitude (top), but quite good on the phase data (bottom). Below a depth of 320 m, the measured data is significantly attenuated (primarily noise), indicating a much more conductive zone.



Graphical user interface for the SIRIM program (Studies Investigating the Radio Imaging Method).



SIRIM Forward Model (black) and field data (red).

Graduate and Undergraduate Student Thesis/Project Topics

PhD	Thesis
Baldwin, Geoffrey	Stratigraphy and geochemistry of the Rapitan Iron Formation, NWT & YT
Burns, Michael	Role of fluids in the evolution of a rare metal LCT pegmatite
Cafagna, Fabio	Experimental study on the role of Bi and Te on the mobility of Pt and Pd
Carson, Heather	Stratigraphy, geochemistry, and petrogenesis of the Black Thor Mafic-Ultramafic Complex and associated Cr and Ni-Cu-PGE mineralization, McFaulds Greenstone Belt, Ontario
Engelbert, Meg	Volcanological and structural reconstruction of the Upper Chsiel Succession, host to the gold-enriched Lalor and Photo Lake VMS deposits, Snow Lake, MB
Gourcerol, Blandine	The role of iron formation geochemistry in BIF-associated gold mineralization.
Hahn, Katherine	Origin of rift-related deep-water carbonate mounds in the Mesoproterozoic Borden Basin, Nunavut
Haring, Monika	Crystal chemistry of borosilicate mineral focussing on tadhikite group
Hastie, Evan	Metallogeny of Au mineralization in the southerh Swayze greenstone belt, Abitibi Subprovince, Canada
Hechler, Johannes	Geochemistry and mineralogy of sulphide tailings
Hunter, Rebecca	Geological investigation of uranium mineralization along the Qavvik-Tatiggaq Trend, northeast Thelon Basin, Nunavut
Joergensen, Taus	Evolution of the Sudbury Igneous Complex contact metamorphic aureole and contact anatexis
Katz, Laura	Origin of the Archean Cote Gold Au-(Cu) intrusion-related gold deposit, northern Ontario
Kerr, Mitchell	Volatiles in ore-forming fluids: Case studies from the Meguma terrane, Nova Scotia, and Hope Bay Greenstone Belt, Nunavut
Kolaj, Michal	Mapping laterally varying conductance
Li, Yongxing	Modelling the response of the Radio Imaging method
Mahmoodi, Omid	Using physical properties to determine lithological information
Mealin, Caroline	Geology, geochemistry, and metallogenesis of the Booth River Complex, Northwest Territories
Olaniyan, Oladele	3-D structural reconstruction of the Sudbury Basin
Petrus, Joseph	Mineralogical, chemical, and isotopic evolution in bombarded rocks and minerals
Rubingh, Kate	Origin of, and controls on, gold mineralisation, New Britannia Mine, Snow Lake, MB
Stewart, Craig	Alteration in the footwall and granophyre of the Sudbury Igneous Complex
Toth, Zsuzsanna	BIF-hosted Au deposits - Beardmore-Geraldton district area: structural setting, footprint and exploration implications
Wang, Yujian	Evolution of the Sublayer of the Sudbury Igneous Complex, Sudbury, ON
MSc	Thesis
Adibpour, Mojgan	Trace element distribution in sulfide assemblages from the Levack-Morrison ore system, Sudbury, Ontario: Looking for chemical fingerprints of ore processes using Laser Ablation ICP-MS methods
Caplette, Jaime	Rock coatings; forensic tools of their past and present geochemical environment
Deng, Deng	A comparative study of magnetic susceptibility instruments
Durocher, Jennifer	A synchrotron study on the speciation of U in secondary minerals of the Athabasca basin
Farhangi, Naghmeh	Mineralogy, geochemistry, and petrogenesis of Ni-Cu-PGE mineralization in the Black Thor Mafic-Ultramafic Complex, McFaulds Greenstone Belt, Ontario

Franchuk, Anatoliy	High tenor NI-PGE sulfide mineralization of the South Manasan Ultramafic Intrusion, Thompson Nickel Belt
Friesen, Vanessa	Evolution and emplacement of the Powder House Dacite, Snow Lake, MB
Gaucher, Frederic	Electromagnetic methods of Cu-Au mineralization, Quebec
Hall, Marshall	Emplacement of low-sulphide Cu-PGE veins, Broken Hammer, Sudbury, ON
Lam, Judy	Metamorphic reaction history and metal mobility at the gold-enriched Lalor VMS deposit, Snow Lake, MB
Lee, Jang-Hyeon	Experimental studies on sulphide and oxide phase equilibria applied to ore genesis
Legrand, Christine	Weathering features of Cr- and V-bearing minerals, Ring of Fire, Canada
MacInnis, Linette	Nature of the Grey Gabbro and the alteration related to Cu-PGE footwall mineralization in the Podolsky deposit, Sudbury
Malcolm, Kelly	Geology of the South Au zone of the Detour Au deposit, Northern Ontario
Mathieu, Jordan	Diagenetic history and economic potential of Proterozoic and Paleozoic dolostones on Victoria Island, Arctic Canada
McDivitt, Jordan	The Renabie gold deposit, Wawa Greenstone Belt, ON
Mehrmanesh, Kaveh	Stratigraphy, geochemistry, and petrogenesis of the Black Label Chromite Zone of the Black Label Mafic-Ultramafic Complex, McFaulds Greenstone Belt, Ontario
Moll, Marilyn	Hangingwall alteration at the Wolverine VMS Deposit, Yukon
Monter, AHIRAM	Structural and stratigraphic analysis of the gold- and silver-enriched, Rey de Plata VMS Deposit, Mexico
Naprstek, Tomas	Studies in modeling the response measured with the Radio Imaging Method
O'Hare, Sean	Neoproterozoic black shale in the Mackenzie Mountains, NWT
Poulin, Remy	Scheelite chemistry as an Indicator of Intrusion-related W-Mo-(Au) Mineralization
Schaub, Christoph	Testing the feasibility of using electrical and magnetic measurements to monitor stress underground
Slater, Evan	A mineralogical and chemical study of the Minas Pirquitas Sn-Zn-Ag deposit, Jujuy, northern Argentina
Smith, Jocelyn	Role of structure in the formation of the Cote Gold Au-(Cu) Deposit, Northern Ontario
Spath, Charles	Geology and genesis of mobilized chromitite in the Black Label Zone of the Black Thor Mafic-Ultramafic Complex, McFaulds Greenstone Belt, Ontario
Tokaryk, Scott	Nature and origin of Proterozoic (?) Au Mineralization on the Pistol Bay Trend, Nunavut

Applied MSc	Research Project
Andrzejewski, Anna	The application of statistical analysis to geochemical data at the ZNT exploration project, West Central BC, Canada, Hunter Dickenson Inc.
Bewcyk, Jamie	The geochemistry of the Ore Interval hosting Paleoproterozoic VMS deposits at Flin Flon, Manitoba, HudBay Minerals Inc
Flank, Steven	To be determined, Transition Metals Corp.
Guest, Nicolas	Geochemistry of felsic volcanic rocks, Musslewhite area, ON, Goldcorp Inc.
Halverson, Andrew	Geophysical fingerprinting of the Overman deposit, Suriname, Iamgold Corp.
Joyette, Michelle	To be determined, Iamgold Corp.
Kirwan, Ashley	Lithological controls on gold mineralization of the Loma Larga high-sulfidation epithermal deposit, Azuay province, Ecuador, Orix Geoscience Inc.
Lapointe, Matthieu	To be determined, Iamgold Corp.
LaRiva-Bell, Jorge	To be determined, Newmount Mining Corp.
Ngindi, Siamon	A geostatistical approach to resource evaluation of Bralorne Gold Deposit, Bridge River District, British Columbia
Samiei, Ahoora	Structural Geology of Gold zones, Baffin Iron Mines Corp.
Tomczuk, Brian	To be determined, Iamgold Corp.
Tuck, Loughlin	To be determined, Iamgold Corp.
Verma, Ramona	Spatial distribution of hexagonal pyrrhotite, Sudbury, ON, Vale Mining Co.
Verzyden, Christopher	To be determined, KGHM International Ltd.

Bouchard, Melanie	Characterization of metamorphic mafic mineral assemblages and the relative timing of metamorphism and shear fabric development
Cavan, Donald	Potential migration pathways of volatile organic compounds in selected stratigraphic units of the Greater Sudbury area
Csath, Julia	Allochems examined in the Hess River, Rabbit kettle, and Duo Lake Formations of the Misty Creek Embayment In the Northwest Territories
Dzilums, Shayna	Active pedogenic processes on the Copper Cliff Tailings, Sudbury, Ontario
Gelinas, Brigitte	Characterization of the mineralization and alteration of Tower Mountain, Cnmee Township, Shebandowan Greenstone belt
Harrison, Susanna	Petrography and geochemistry of iron formation and related breccias at the Golden Harp occurrence, Shining Tree belt, Ontario
Kerr, Mary	A study of the cathodoluminescence response of quartz in samples from the Sudbury basin
Lotan, Lindsay	The weathering of carbonatites
Mathiasen, Seija	Trace elements in olivines from different sources, assessing compositional ranges
Mayer, Cedric	Geochemical analysis of the Weese Lake mafic intrusion in the Fort Hope Greenstone Belt, Uchi subprovince, and its relationship to regional mafic intrusions
Podrucky, Geoff	Measuring the resistivity and chargeability of drill cores using the Sample Core Induced Polarization tester
Principe, Emilia	Bioleaching of arsenic-rich tailings material
Sterner, Sabrina	Characterizing the PGE and their distribution in the low sulfide zone at the Nickel Rim South, Sudbury
Szummylo, Nicholas	Deformation history of the Baltic D outcrop
Taylor, Sarah	The mineralogical characterization of the Uranium roll front deposit in Kiggavik, Nunavut
Wawrzonkowski, Paul	Evolution of massive sulfides within the footwall deposit in the Morrison mine and polymorphism of millerite within the Sudbury basin
Roy, Destiny	An examination of the morphological and chemical changes in selected Sudbury pedons induced by the re-greening process



Silicified pillow lava from the Paleoproterozoic Snow Lake District.

MERC Members

Foundation Members



Ontario Geological Survey, Ontario
Ministry of Northern Development
and Mines



Teck

Teck Resources Ltd.

Tier 1 Members



Detour Gold Corp.



GOLD FIELDS

Gold Fields Exploration Inc.



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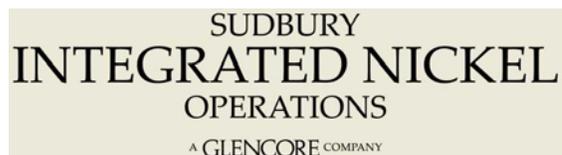
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