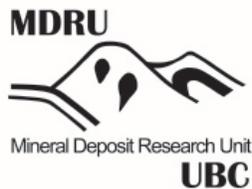




MDRU

2008 ANNUAL REPORT



Mineral
Deposit
Research
Unit



The
University of
British
Columbia

ABOUT MDRU

VISION

To be the global leader in mineral deposit research and training excellence.

MISSION

To increase the understanding of mineral deposits and the methods used for their discovery, through high quality research, training and continuing education.

BACKGROUND

The Mineral Deposit Research Unit (MDRU) is an internationally recognized research group dedicated to solving mineral exploration problems, and providing training to develop the next generation of highly-qualified geologists. MDRU was established in 1989 as a collaborative research venture between the mining and exploration industry, The University of British Columbia (UBC), and the Natural Sciences and Engineering Research Council of Canada (NSERC). Based

within the Department of Earth and Ocean Sciences (EOS) at UBC, MDRU facilitates geological, geophysical and geochemical strategies to mineral exploration problems by integrating industry, academic and government research efforts.

MDRU is the largest economic geology research group in North America with more than 30 graduate students, 14 Research Associates and Faculty contributors and 3 staff. MDRU has a reputation for international research excellence and are the first choice for many students and industry partners looking for collaborative research opportunities around the globe. In addition to Canada, MDRU has graduate students and senior researchers that are active in United States, Perú, Argentina, Chile, Turkey, China (Tibet), New Zealand, and Australia, with expanding opportunities elsewhere. At the end of 2008,

MDRU had 58 corporate, individual and government members, which include major and junior mining and exploration companies.

MDRU assists corporate members by increasing the understanding of mineral deposits and the methods that are used for their discovery, through:

- Collaborative research projects;
- Short courses and workshops;
- Training of highly-qualified geologists;
- Access to the Resource Centre.

In 2008, MDRU laid the groundwork for future multi-company projects, and graduated 13 highly-trained young geoscientists, most of whom are working in the minerals industry. MDRU continues to organize short courses that are well attended by the geologic community. MDRU advanced further on the international scene through overseas visits and visitors combined with the publication of a number of papers in major journals.

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2008 ANNUAL REPORT

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ON THE COVER

Zoned hydrothermal garnet - a binary solution between Ti-rich andradite and grossular, from the Central Replacement Zone, Galore Creek, British Columbia. Courtesy of Janina Micko.

FROM THE DIRECTOR

The Mineral Deposit Research Unit had another extremely successful year in 2008, despite the downturn in the economy. It enters 2009 with significant changes in staff and new research initiatives. MDRU continues to be active on four continents in six broad research themes ranging from traditional hydrothermal ore deposit investigations to kimberlite and diamond investigations to the development of exploration techniques, particularly the integration of geologic and geophysical data to build 3-D earth models.

In 2008, MDRU completed several multi- and single company sponsored collaborative research project, established new projects, and laid the groundwork for future multi-company projects. New projects focus on global porphyry Cu-Au giants, metallogenic framework of the Canadian Cordillera, detecting and mapping porphyry Cu alteration footprints using spectral and litho-geochemical methods, linking geologic information with geophysical data to better map the subsurface in 3-dimensions, sedimentary Cu deposits, Archean orogenic Au deposits, and epithermal deposits.

The end of 2008 also marked a change



As MDRU's new Director I look forward to an opportunity to continue to bolster the unit's established strengths and create some new

directions and perspectives. Combining this new outlook at a time when the mineral exploration industry has gone from boom to bust, presents an additional set of challenges.

MDRU's research strengths in the world of porphyry deposits and Carlin, orogenic and epithermal gold are recognized globally. Few other research units can match MDRU's ability to provide regional framework and metallogenic studies, such as those completed from Turkey to Tanzania to Peru. MDRU's association with UBC-GIF in the development of geophysical inversion

in the Director of MDRU, with Dr. Richard Tosdal moving back to the US, and the arrival of Dr. Craig Hart to assume the position. Dr. Hart comes to MDRU from the Centre for Exploration Targeting at the University of Western Australia and prior to that from the Yukon Geological Survey in Whitehorse. He brings tremendous breadth of new contacts and on-going projects throughout the world.



The downturn in the commodity markets will significantly affect MDRU in the coming year with the expected loss of membership particularly in the junior sector. These losses are extremely unfortunate as they impact the ability of MDRU to provide the opportunity to train the next generation

technologies is globally recognized. Studies on kimberlites and diamond deposits represent a strength that has developed in tandem with the Canadian diamond industry. And MDRU's research on CO2 sequestration is unique and adds significantly to the breadth of the unit. Each of these areas will continue

There are several key avenues for MDRU research in the next few years. Giant porphyry deposits will remain attractive exploration and research targets, and features controlling size and gold distributions are key research directions. Quality gold deposits will always be in demand and will continue to be a fertile research direction for MDRU. Geologically constrained geophysical inversions will build realistic 3-D earth models that will be a driving force in conceptual targeting at all scales, and will be a strong research path for MDRU. Lastly, the unfortunate deficiencies in government geological surveys will continue to generate demand for regionally integrated metallogenic studies.

Current economic shortcomings have

of geoscientists. However, the foresight of the MDRU Board of Directors in building an operating surplus to underwrite the basic administrative and support functions will mitigate the impact of the membership losses. We particularly thank the companies that have maintained their membership into 2009 for their continued support.

Throughout 2008, MDRU continued to disseminate technical information to diamond and metal companies through the independently funded Sheahan – MDRU Literature Service. Some 28 companies and individuals subscribe to the service through which their geoscientists can maintain current knowledge and awareness of the newest scientific and technological advances.

MDRU enters 2009 on a positive note with the prospect of developing a wide-ranging variety of research topics on all the habitable continents of the world.



Dick Tosdal

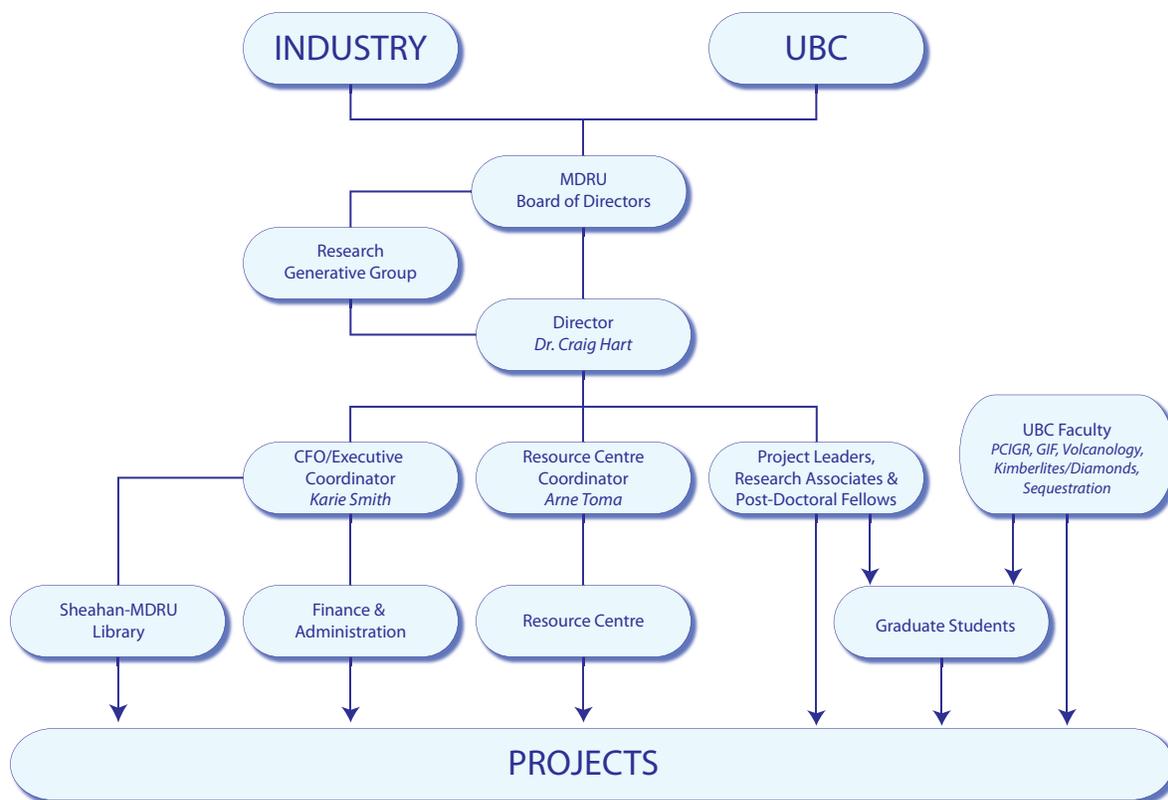
limited operational funding but the demand for projects remains high. In my short time in this position, it is obvious that MDRU is the first choice for many students and companies looking for mineral exploration research projects. There are no shortage of research opportunities or new companies looking to associate with MDRU. This support reaches all the way through the faculty, staff and administration of the university as well as the industry. Despite the economic downturn, MDRU is well placed to weather the storm and come out the other side with full sails.



Craig J.R. Hart

CORPORATE STRUCTURE

MDRU grew from the combined interests of the Vancouver mining and exploration community and The University of British Columbia, and is sustained by high-levels of cooperation between the industry and the university. This model differs from most other economic geology research groups in that MDRU did not result from government-sponsored programs nor does it receive significant financial support for infrastructure from government or directly from university budgets. It was initiated by industry and is sustained by industry.



BOARD OF DIRECTORS

The MDRU Board of Directors is dominated by industry representatives as nominated by each of the Foundation Members, and three independent persons invited by the Foundation Members. Additionally, the Vice President Research of UBC, or his/her nominee, the Head of the UBC Department of Earth and Ocean Sciences, the Chair of the Research Generative Group, and the Director of MDRU all sit as Board Members.

The Board governs MDRU and is charged with ensuring long-term sustainability of the organization, as well as operational, administrative, financial and governance issues of MDRU. In 2008, the Board's main task centred around the search and acquisition of a new Director.

Foundation Member	Director	Alternate
Anglo American plc	Owen Bavinton <i>Head, Exploration & Geology</i>	Ed Yarrow <i>VP Exploration, North America</i>
Barrick Gold Corp.	Paul Dobak <i>Chief Geologist, North America</i>	Francois Robert <i>Chief Geologist</i>
Goldcorp Inc.	Alastair Still <i>Business Development</i>	
Kennecott Exploration Co.	Ian Graham <i>Exploration Manager, Diamonds</i>	David Simpson <i>GM Exploration</i>
Teck Ltd.	Robert Holroyd <i>Director, Exploration Technology</i>	John Thompson <i>VP Research</i> Fred Daley <i>VP Exploration</i>
The University of British Columbia	John Hepburn <i>VP Research</i> Paul Smith <i>Head, Department of Earth and Ocean Science</i>	Simon Peacock <i>Dean Faculty of Science</i>
Independent Director-	James Franklin <i>Franklin Geosciences</i> Neil Adshead <i>Passport Capital</i> John McDonald <i>Independent</i>	
Chair, Research Generative Group	Ron Britten <i>First Point Minerals Corp.</i>	
Director, MDRU	Craig Hart	

RESEARCH GENERATIVE GROUP

A Research Generative Group, composed of representatives of the membership of MDRU, and university and government representatives. It is charged with contributing to the development of MDRU's technical research program, and reports to the Board of Directors, and the MDRU Director. It is currently chaired by Ron Britten.

CORPORATE MEMBERSHIP

Corporate Membership allows direct participation of mineral industry community in MDRU operations

and projects. Membership is offered at several levels to recognize diversity within the industry. Foundation Members are those companies wishing to participate in the corporate and strategic operations of MDRU on the Board of Directors. Any member of MDRU can be a Foundation Member. Corporate Members range from those companies with operating mines to junior explorers who wish to take advantage of membership benefits and participate in research projects. Junior Explorers can also become members through the donation of Treasury Shares. Government and individual members, as well as sponsorships are also welcome.

At the end of 2008, MDRU had five Foundation Members, 46 Corporate Members and four Individual Members. All members have opportunities to contribute to the strategic focus of the organization, and to suggest potential research projects and directions. MDRU also has collaborations with The Geological Survey of Canada (GSC), the Geological Survey Branch of the B.C. Ministry of Employment and Investment (BCGSB), the Yukon Geological Survey, and Geoscience BC who all continue to be active participants.

A list of corporate members is on the back cover.

PEOPLE

MDRU is the largest integrated minerals research group in North America with 3 full time staff, 4 Research Associates, 10 associated faculty members, and more than 30 graduate students.

MDRU STAFF

In 2008, MDRU had three full time staff members. Dr. Richard Tosdal, is the Director and is responsible for the management, operations and scientific leadership of the organization. The MDRU Financial and Administrative supported is co-ordinated by Karie Smith as Executive Coordinator, and Technical support is provided by Arne Toma.

RESEARCH STAFF

MDRU Research Associates and Post doctoral Fellows are a driving component of the MDRU research engine and include Thomas Bissig, Farhad Bouzari, Graham Andrews and Shawn Barker.

FACULTY

Associated Faculty are critical components in proving research breadth, academic and student support. In 2008, more than 10 UBC Faculty members participated in MDRU projects, including Ken Hickey, Kelly Russell, Greg Dipple, Jim Mortensen, Maya Kopylova, Doug Oldenberg, James Scoates, Lori Kennedy, Lee Groat and Dominique Weiss.

STUDENTS

More than 30 students were actively undertaking research projects at MDRU in 2008. The students represent a wide range of backgrounds and nationalities which contribute to the diversity and enthusiasm of the group.

STAFF CHANGES

Kirstie Simpson completed her contribution as a joint MDRU-CODES Research Associates who was working on the Alkalic Systems project. She has moved to become Vice President

Research at Geoscience BC but still contributes to MDRU projects and students.

Ilkay Kuscü completed components of the Turkey project and is back to his position as Professor at Mulga University in Turkey. He still contributes to the MDRU.

Richard Tosdal resigned as Director of MDRU as he has moved out of the area. He continues to be very actively involved with MDRU activities through projects and supervision of students. He is currently based in the United States where he is an independent consultant to the minerals industry.

MDRU TEAM IN 2008

Administrative Staff	
Hart, Craig	Director (as of Jan. 1, 2009)
Tosdal, Richard	Former Director
Smith, Karie	CFO/Executive Coordinator
Toma, Arne	Resource Centre Coordinator

Project Coordinators - Senior Research Staff	
Andrews, Graham	Kimberlite Volcanology
Barker, Shaun	Carlin Vectors
Bissig, Thomas	Alkalic Systems, Peru
Bouzari, Farhad	Archean Gold Footprints
Kuscü, Ilkay	Tethyan Metallogeny, Turkey
Mackenzie, Doug	Klondike District
Simpson, Kirstie	Alkalic Systems

Professors and Associates		Affiliation	Project
Chapman, Rob	Professor	Leeds	Placer Gold
Cooke, David	Lecturer	CODES	Alkalic Systems
Craw, Dave	Professor	Otago	Klondike District
Dilles, John	Professor	Oregon State	Porphyry Footprints
Dipple, Greg	Associate Professor	UBC	Metamorphic Petrology
Dube, Benoit	Research Geologist	GSC	Archean Gold Footprints
Gleeson, Sarah	Associate Professor	U of Alberta	Sedimentary Cu
Groat, Lee	Professor	UBC	Pegmatites and Gemstones
Hickey, Ken	Assistant Professor	UBC	Carlin District, MDRU-GIF
Kennedy, Lori	Associate Professor	UBC	Structural Geology
Kopylova, Maya	Assistant Professor	UBC	Kimberlites & Diamonds
Mortensen, Jim	Professor	UBC	Geochronology, Cordilleran Tectonics
Oldenburg, Doug	Professor	UBC	Inverse Theory / Electromagnetic Geophysics
Piercey, Steve	Associate Professor	MERC	Massive Sulphide Deposits
Rhys, David	President	Panterra	Orogenic Gold
Russell, Kelly	Professor	UBC	Geochemistry and Volcanology
Scoates, James	Associate Professor	UBC	Magmatic Ore Deposits
Weis, Dominique	Professor	UBC	Isotope Geochemistry

Graduate Students		Project	Supervisor
Ahmed, Ayesha	M.Sc.	Carlin Gold Systems	Ken Hickey
Alva-Jiminez, Tatiana	M.Sc.	Porphyry Footprints	Ken Hickey
Barnes, Elspeth	Ph.D.	Yukon Pegmatites	Lee Groat
Beranek, Luke	Ph.D.	Cordilleran Tectonics	Jim Mortensen
Blevings, Scott	M.Sc.	Taseko Lakes: Structural control	Lori Kennedy
Breitsprecher, Katrin	Ph.D.	Isotope geochemistry	James Scoates & Dominique Weis
Brett, Curtis	M.Sc.	Kimberlite Volcanology: Diavik	Kelly Russell
Byrne, Kevin	M.Sc.	Intrusion related Cu-Au	Richard Tosdal
Cade, Andrea	Ph.D.	Geology of gemstone deposits	Lee Groat
DeStefano, Andrea	Ph.D.	Jericho kimberlite (N. Slave, Canada)	Maya Kopylova
Dohaney, Jacqueline	M.Sc.	Chilcotin Group Basalts	Kelly Russell
Escalante, Abraham	Ph.D.	Central Peru	Greg Dipple
Farrell, Rebecca-Ellen	M.Sc.	Chilcotin Group basalts	Kelly Russell
Greene, Andrew	Ph.D.	Triassic Wrangellia oceanic plateau	James Scoates
Henry, Amber	M.Sc.	Alkalic Systems: Lake Cowal	Richard Tosdal
Hollis, Lucy	M.Sc.	Taseko Lakes: Porphyry-epithermal mineralization	Lori Kennedy
Hood, Shawn	M.Sc.	Minto Cu-Au Deposit	Ken Hickey
Jackson, Meghan	M.Sc.	Alkalic Systems: Mt. Polley	Richard Tosdal
Jago, Paul	M.Sc.	Alkalic Systems: Mt. Milligan	Richard Tosdal
Leslie, Christopher	M.Sc.	Misty Creek Embayment, NT	Jim Mortensen
MacNeil, Dan	M.Sc.	Donlin Creek Gold Deposit	Richard Tosdal

Micko, Janina	Ph.D.	Alkalic Systems: Galore Creek	Richard Tosdal
Mitchinson, Dianne	Ph.D.	MDRU-GIF: Timmins	Richard Tosdal
Morisset, Caroline-Emmanuelle	Ph.D.	Proterozoic anorthosites	James Scoates & Dominique Weis
Moss, Stephen	M.Sc.	Kimberlite Volcanology: Diavik	Kelly Russell & Richard Tosdal
Oliver, Shelly	M.Sc.	Chilcotin Basalts	Kelly Russell
Poblete, Jaime	M.Sc.	Cerro Bayo, Chile	Richard Tosdal & Thomas Bissig
Peterson, Nils	M.Sc.	BC mantle lithosphere	Kelly Russell
Pizarro, Nicolas	M.Sc.	MDRU-GIF: Flin Flon	Richard Tosdal
Rasmussen, Kirsten	M.Sc.	Mid-Cretaceous Intrusions - Selwyn Mountains	Jim Mortensen
Razique, Abdul	Ph.D.	Reko Diq, Pakistan	Richard Tosdal & Ken Hickey
Ruks, Tyler	Ph.D.	VMS deposits, Sicker Group, BC	Jim Mortensen
Shannon, Andrew	M.Sc.	Hope Bay Greenstone Belt, NU	Richard Tosdal
Simmons, Adam	Ph.D.	Quellaveco Cu-Mo Porphyry, Peru	Richard Tosdal
Stock, Lizzie	Ph.D.	Red Lake Gold Deposit	Richard Tosdal
Tafti, Reza	Ph.D.	Gangdese Arc, Tibet, China	Jim Mortensen
van Straaten, Bram	Ph.D.	Kimberlite Volcanology: Victor	Maya Kopylova
Vaughan, Jeremy	Ph.D.	Carlin Gold	Ken Hickey
Wainwright, Alan	Ph.D.	Oyu Tolgoi, Mongolia	Richard Tosdal
Wallier, Stefan	Ph.D.	Manantial Espejo, Argentina	Richard Tosdal
Washburn, Malissa	M.Sc.	Cadia, NSW, Australia	Richard Tosdal
Williams, Nick	Ph.D.	MDRU-GIF: Leonora-Wiluna	Richard Tosdal & Doug Oldenburg
Wilson, Sasha	Ph.D.	CO2 Sequestration	Greg Dipple
Winter, Lawrence	Ph.D.	Tambogrande, Peru	Richard Tosdal



Greg Dipple explaining garnet mineralogy to Elizabeth Stock (Ph.D. candidate), Red Lake Gold Mines core shack, Ontario.

RESEARCH ACTIVITIES

MDRU initiates and funds research projects on a wide variety of topics and scales. Where possible, research is undertaken in large project environments supported by an industry consortium as these scales of projects generate significant results because of the critical mass of intellectual talent and resources to address the questions posed. In addition to the larger projects, small site-specific or topic-specific projects are established with single company support. Overall, research within MDRU & EOS revolves around six themes in which we have established expertise.

Support for current and past projects comes from industry sponsors, NSERC, Yukon Geological Survey, Geological Survey of Canada, British Columbia Geological Survey Branch, Geoscience BC, and the Science Council of British Columbia.

Research funded through MDRU involves EOS faculty as well as geologists in various government, industry, and university institutions in Canada, United States, Europe and Australia. EOS faculty members also coordinate several of the research themes, and their involvement within the activities of MDRU is vital. Faculty managed research groups such as the Diamond Laboratory (Maya Kopylova) and the Geophysical Inversion Facility (UBC-GIF, Doug Oldenburg) are important compliments to MDRU and to the success of the research programs. The state-of-the-art analytical facility of the Pacific Centre for Isotopic and Geochemical Research (PCIGR, Dominique Weis, James Scoates, James Mortensen, Greg Dipple) is a critical partner in many research projects. Their collaboration with MDRU contributes greatly to the success of projects, and their continued involvement is critical to the future of MDRU.

Research Associates and Post-Doctoral Fellows are essential contributors and represent the bulk of the senior research staff. During 2008,

there were five. Post-graduate thesis projects are essential to MDRU, and to date MDRU has supported 50 theses. At the end of 2008, MDRU supported 25 Ph.D. and 20 M.Sc. projects. Thirteen graduate-level theses were completed in 2008.

Research was active in all six themes during the year. Four projects were supported by multi-company consortium. The Shallow and Deep-Level Alkalic Mineral Deposits, Tethyan Metallogenesis – Turkey, and Carbon Sequestration projects entered their final years. The Footprints in Archean Lode-Gold Deposits project entered Year 2. Groundwork was laid for projects to begin in 2008 with efforts focused on expanding the Magmatic-Hydrothermal research theme. New projects will involve faculty, research associates, post-doctoral fellows, graduate students, and research assistants. Seventy-seven faculty, researchers, graduate students, and administrative staff participated in projects associated with MDRU during 2008.

Research expenditures for all MDRU projects are projected to be approximately \$1.815 million for 2008. Of this figure, about 43% is directly from industry contributions and 57% derives from non-industry sources such as NSERC, provincial and territorial governments.

Projects completed in 2008:

- Alkalic systems – AngloGold Ashanti, Barrick Gold, Newmont USA, Teck Cominco, Amarc Resources, Imperial Metals, Newcrest Mining, NovaGold Resources Canada, Lysander Minerals, Geoscience BC, NSERC – CRD
- Taseko Lake porphyry systems – Galore Lakes, Geoscience BC
- Turkey Metallogeny – Barrick Gold, Teck Cominco
- Eastern Mexico magmatism: Almaden Minerals (Canada) Ltd,

NSERC

- Fe-Ti Oxide Mineralization in Proterozoic Anorthosites Québec - Rio Tinto Iron and Titanium Inc., NSERC
- Turnagain Ni-Cu-PGE Project, B.C. - Hard Creek Nickel Corporation
- Wrangellia Flood Basalts - Rocks to Riches Program, Yukon Geological Survey, B.C. Geological Survey

New projects in 2008:

- Mineral mapping and litho-geochemistry of far-field alteration around porphyry Cu systems
- Reconstructing the low-sulfidation epithermal deposits at Cerro Bayo, Chile
- The porphyry Cu-Au deposit at Reko Diq, Pakistan

THEME 1 - MAGMATIC-HYDROTHERMAL DEPOSITS

Dr. Richard Tosdal - Research Coordinator

Shallow and deep-level alkalic mineral deposits: An integrated exploration model.

Dr. Thomas Bissig, Project Coordinator

Alkalic deposits have features atypical of 'classic' porphyry and epithermal systems that distinguish them from the sub-alkalic systems, and encourage an alkalic porphyry classification. Although known around the world, there is a notable lack of suitable individual deposit descriptions in the public domain. In contrast to their more common calc-alkalic cousins, there has been less progress towards developing a coherent model that integrates the characteristics of various alteration styles that can develop in either a shallow- or deep-level alkalic igneous setting. Instead, the calc-alkalic model has driven the community's view of alkalic deposits historically.

This multidisciplinary project advances understanding of the characteristics of individual alkalic systems and integrates that information into a holistic model for the porphyry

and epithermal environment. The project, which is close to completion, is a joint effort with the Centre for Ore Deposit Research (CODES) at the University of Tasmania where Dr. David Cooke heads that research group. The results of this study will be published in a special issue of *Economic Geology*, and efforts towards completion are underway.

Nine companies support the project, including Amarc Resources, AngloGold Ashanti, Barrick Gold, Lysander Minerals, Newmont Mining, Newcrest Mining, Imperial Metals, Novagold, and Teck Cominco. Additional financial support derives from GeoscienceBC and from the Collaborative Research and Development program of the Natural Sciences and Engineering Research Council of Canada. Study sites include Galore Creek, Mount Milligan, Lorraine and Mount Polley in B.C.; E42 and E41 in the Cowal district N.S.W. Australia; and Ladolam and Porgera in Papua New Guinea.

Nine graduate students from MDRU and CODES contributed to the project. Four MSc theses have been completed at MDRU during the past year (Paul Jago on Mt Milligan, Meghan Jackson on Mt. Polley, Amber Henry on E42 Cowal and Kevin Byrne on Galore Creek). PhD candidates expected to graduate in 2009 or early 2010 include Heidi Pass, CODES on Mt Polley; Janina Micko, MDRU, on Galore Creek Lorraine Adam Bath, CODES on Lorraine; Wojciech Zukowski, CODES, on E 41, Cowal; and Jacqueline Blackwell on Ladolam, CODES on Ladolam.



Dick Tosdal and Kevin Byrne discussing structural deformation of the western high-wall of the Galore Creek valley, BC. Photo by Danette Schwab.

Theses completed in 2008

Amber Henry, M.Sc.

Fracture reactivation and gold mineralization in the epithermal environment: Structural evolution of the Endeavour 42 gold deposit, New South Wales, Australia.

Meghan Jackson, M.Sc.

Evolution of the Northeast Zone breccia body, Mount Polley mine, British Columbia.

Paul Jago, M.Sc.

Metal- and alteration-zoning, and hydrothermal flow paths at the moderately-tilted, silica-saturated Mt. Milligan Cu-Au alkalic porphyry deposit.

Malissa Washburn-Groome, M.Sc.

Architecture of the Silurian Sedimentary Cover Sequence in the Cadia Porphyry Au-Cu District, NSW, Australia: Implications for post-mineral deformation.

Porphyry and Epithermal Deposits

Dr. Richard Tosdal and Dr. Thomas Bissig, Project Coordinators

Continental margin tectonics strongly influences the formation and preservation of porphyry Cu deposits. A project at the geologic setting and evolution of the giant Quellaveco porphyry Cu-Mo deposit in southern Perú was established in 2007. Anglo American Exploration Peru sponsors the Ph.D. project by Adam Simmons. A new project was also established at the Miocene Reko Diq porphyry Cu-Au deposit in western Pakistan. Tethyan Copper (a joint venture between Barrick Gold and Antofagasta Minerals) is sponsoring Abdul Raziq, one of their geologists, on the project. Lastly, Imperial Metals and Geoscience BC established funding for a study of the Red Chris alkalic porphyry Cu-Au deposit in northern British Columbia.

This last project will initiate in the summer of 2009.

A new epithermal project was initiated in late 2008. The geologic, stratigraphic, structural, and geochemical controls on ore shoot formation in the Cretaceous Cerro Bayo silver-rich mineral district in the Chilean Patagonia will be established. It will also contribute to the understanding of the epithermal ore forming volcanic environment in Patagonia. Jaime Poblete is the PhD candidate active on this project which is supported by Coeur d'Alene Mines Corporation. The project continues MDRU research on epithermal systems in Patagonia and builds on Stefan Wallier's PhD study on Manantial de Espejo in Argentina. Detailed mapping of Manantial Espejo low-sulfidation style epithermal deposits has defined the paragenesis, zoning, and volcanologic setting of the vein deposits. Pan American Silver is supporting the project.

Thesis completed in 2008

Alan Wainwright, Ph.D.

Volcanostratigraphic framework and magmatic evolution of the Oyu Tolgoi porphyry Cu-Au district, South Mongolia.

Mineral Mapping and Litho-geochemical Footprints of Far-Field Alteration around Porphyry Cu Systems

Dr. Richard Tosdal and Dr. Greg Dipple, Project Coordinators

Alteration systems associated with hydrothermal ore bodies are generally mineralogically and geochemically zoned. The challenge is how to utilize the knowledge of the zoning to understand where to go next in an exploration program. This question is of paramount importance as exploration for these economically important

deposits becomes more challenging and requires exploration under cover or in areas of very limited outcrop.

This project establishes a collaborative working relationship between Dr. John Dilles (Oregon State University) and Dr. Scott Halley (Mineral Mapping Services, Perth, Australia) and MDRU to investigate the alteration patterns around porphyry Cu deposits focusing on developing techniques that are easy to utilize during the normal course of an exploration program. The full project is sponsored by BHP Billiton, Barrick Gold, Imperial Metals, and Teck Corporation with Vale Inco sponsoring just the D-vein module. Additional support is provided by Geoscience BC. Research sites for the project include Yerington, Highland Valley and Red Chris, with additional sites still being evaluated. Currently, Tatiana Alva (MDRU) is undertaking a study at Highland Valley, and Julia Cohen (OSU) will begin a project on the D-veins in all the deposits. This is a new project for 2008 and will continue for three years.

Nature, Origin and Structural Controls of Phanerozoic Orogenic Gold Deposits

Dr. Jim Mortensen, Project Coordinator

Phanerozoic orogenic gold deposits (OGDs) are commonly associated with rich and extensive placer deposits, and therefore represent attractive exploration targets. However many critical features of OGDs remain poorly understood, and uncertainties concerning specific controls on their formation hamper exploration. Detailed studies of OGDs are underway in the Klondike Gold District in western Yukon, the Otago Schist Belt in South Island, New Zealand (both collaborations with colleagues from the University of Otago), and the Cariboo Gold District in east-central British Columbia (collaboration with Panterra

Geoservices, Inc.).

A new geological map and structural interpretation of the Klondike District has been completed and several publications related to this work are either published or in preparation. Ongoing research in the Klondike include geochronological studies of gold-bearing vein systems, and lead isotopic investigations to better constrain metal sources. A detailed investigation of the age and lead isotopic characteristics of gold bearing vein systems and shear zones in the Otago Schist Belt was begun in 2006. This work builds on over twenty years of structural and metamorphic studies in the region by Dave Craw, Doug Mackenzie and other colleagues at the University of Otago. Two manuscripts summarizing the results of this work have been submitted for publication. One of these discusses new Ar-Ar age and Pb isotopic constraints on the main Cretaceous gold-bearing vein systems and suggests that the veining is directly related to ridge subduction.

The other manuscript discusses the nature and metal sources for Miocene to Recent gold-bearing veins and breccias in the Southern Alps of New Zealand. Investigations of orogenic gold in the Cariboo Gold District in east-central BC, carried out jointly with Dave Rhys and Kika Ross of Panterra Geoservices, focuses on gold-bearing vein and replacement deposits in the historic Wells-Barkerville gold camp, which are hosted by metamorphic rocks of the Barkerville terrane and closely resemble OGD mineralization in the Klondike District. We are also studying gold-bearing vein systems and shear zones hosted within structurally higher and much less metamorphosed Triassic sedimentary units at the Spanish Mountain and Fraser gold deposits. Our work thus far suggests that these deposits may represent a higher-level manifestation of the same hydrothermal systems that operated in the Wells-Barkerville camp.

Global Volcanogenic Massive Sulfide Deposits

Dr. Jim Mortensen, Project Coordinator

A study of the volcanological and paleotectonic settings in which precious metal enriched VMS mineralization occurs within the Stikinia terrane in western and northwestern British Columbia was completed in 2007. A separate project focusing on the volcanological and paleotectonic setting of VMS deposits in the mid-Paleozoic Sicker Group on Vancouver Island (including the Myra Falls deposits) and regional potential for undiscovered VMS deposits is also underway with Tyler Ruks (PhD candidate with Mortensen). This project is currently funded by four mineral exploration companies, with matching funds from Geoscience BC.

A new project was initiated in 2007 aimed at developing a detailed chronostratigraphic framework (using U-Pb zircon dating methods) for the Mt. Read Volcanic Belt (MRVB) in Tasmania. This work is being done in collaboration with Bruce Gemmill from CODES at the University of Tasmania. The MRVB is one of the most productive VMS districts in the world; however, additional research into the nature and genesis of deposits in the belt is currently hampered by very limited age constraints on magmatism associated with VMS formation. A total of 52 samples of intrusive and extrusive rock units from throughout the MRVB were collected for U-Pb zircon dating during 2007 and 2008. Zircons have been separated from all of the samples, and U-Pb dating, using both high precision chemical abrasion TIMS methods as well as laser ablation ICP-MS, is now underway. Initial results have demonstrated that it is possible to obtain ages with accuracy and precision of less than 0.1% (<1 m.y.). This level of

precision is needed in order to resolve the timing of short-lived magmatic events within the belt.

Thesis completed in 2008

Lawrence Winter, Ph.D.

The genesis of 'giant' Cu-Zn-Au-Ag volcanogenic massive sulphide (VMS) deposits at Tambogrande, Perú: Age, tectonic setting, paleomorphology, litho-geochemistry and radiogenic isotopes.

Base Metals Carbonate Replacement Deposit Project, central Peru

Dr. Richard Tosdal, Project Coordinator

This project was mostly complete in 2006, but the successful completion of Abraham Escalante's PhD thesis extends the knowledge and exploration tools that were created by this project.

Thesis completed in 2008

Abraham Escalante, Ph.D.

Patterns of distal alteration zonation around Antamina Cu-Zn skarn and Uchucchacua Ag-base metal vein deposits, Peru: Mineralogical, chemical and isotopic evidence for fluid composition, and infiltration, and implications for mineral exploration.

High-Grade Hydrothermal Copper in Foliated Granites: Structural control on the spatio-temporal distribution of ore at the Minto Cu-Au deposit

Dr. Kenneth Hickey, Project Coordinator

The Minto Cu-Au deposit (~8.6 Mt averaging 1.97% Cu and 0.72 g/t Au) is hosted within granodiorite of the Early Jurassic Granite Mountain batholith

in central Yukon. Mineralization at Minto occurs as disseminated to massive bornite-chalcopyrite in foliated units of the Granite Mountain batholith. The foliated zones dip shallowly to the north and appear to have sharp boundaries with non-mineralized, non-foliated granodiorite. The mineralization is commonly associated with biotite and magnetite. Since 2005, extensive drilling programs and exposure of the main orebody in the open-pit have significantly improved the geological information available and provide an unique opportunity to resolve the geometry and nature of structural controls involved in formation of the Minto deposit. The overall goal of the research is to understand the effect of pre-, syn- and post-mineralization structural controls on the ore and grade distributions in the Minto deposits. Specific objectives are; (i) To characterize the style and spatio-temporal distribution of alteration and mineralization at the Minto deposit. (ii) To develop a geometric and kinematic model for the structural development of the deposit and determine the paragenesis of alteration and mineralization relative to it. (iii) To understand the influence of deformation on spatio-temporal distribution of mineralization and associated mineral alteration. (iv) To develop an improved genetic model for the Minto deposit. The results of the study will assist in developing an improved genetic model for Minto style deposits that will facilitate exploration for other Cu-Au deposits in the district. The research team includes Dr Kenneth Hickey, Dr Maurice Colpron (Yukon Geological Survey), and Shawn Hood (MSc student). This project is sponsored by Capstone Mining Corp. and the Yukon Geological Survey.

THEME 2 - METALLOGENIC FRAMEWORK

Dr. Kenneth Hickey - Research Coordinator

Mapping the Resource Potential Beneath the Chilcotin Flood Basalts

Dr. Graham Andrews and Dr. J. Kelly Russell, Project Coordinators

The Neogene Chilcotin Group basalts cover significant areas of British Columbia's Interior Plateau, including regions of significant hydrocarbon, epithermal, and copper-porphyry potential. The Interior Basin has been the focus of several multi-million dollar geophysical, geological, and geochemical studies in the past 3 years; and as the uppermost, most extensive geological unit, a better understanding of the Chilcotin Group is essential to interpreting these new data-sets.

In 2007 a new conceptual model was established for lateral thickness variations in the Chilcotin Group, based on the identification of "thick" (50–150 m) valley-filling sequences and "thin" (< 50 m thick) inter-fluvial sequences. In 2008 we have sought to further this hypothesis by field-testing, geospatial analysis, and integration of existing and new geophysical surveys. We have confirmed and refined our 2007 model, and have produced a new Chilcotin Group distribution map for the southern Interior Basin that can be used in the interpretation of regional-scale

geophysical and geochemical surveys.

Current research can be summarized into three areas: (1) internal stratigraphy and geochronology; (2) a re-assessment of the Chilcotin Group's distribution; and (3) studies of the physical property variations within the basalts. Graham Andrews and MSc candidate Rebecca-Ellen Farrell have continued to assess the "paleo-valley model" in particular along the Fraser and Chilcotin River valleys, and at Chasm Provincial Park. The distribution of unconformities and new Ar/Ar ages demonstrates the complex temporal-spatial evolution of the Chilcotin Group and contemporaneous evolution of the Fraser Basin drainage system. Better understanding of the Neogene to Holocene drainage system could have a profound impact on exploration for placer deposits and interpretation of fluvial and till geochemistry in the region.

Fieldwork has been backed up by a geospatial re-assessment of the Chilcotin Group in the Taseko Lakes and Bonaparte Lake areas by MSc candidate Jacqueline Dohaney, and thickness modeling of water-well data by Andrews. Combined, these efforts have contributed to a new map of the 3D distribution of the Chilcotin Group in the southern Interior Basin that is

already being used in the interpretation of new geophysical and geochemical surveys. In brief, this work has confirmed the thinness of the Chilcotin Group and a corresponding decrease in its actual areal distribution. Finally, Kelly Russell has led a developing effort to measure a range of physical rock properties of Interior Basin rocks, starting with the Chilcotin Group, to allow for better interpretation of regional geophysical surveys.

In conjunction with the Geological Survey of Canada, we have collected a comprehensive suite of density, porosity, seismic velocity, magnetic susceptibility, and resistivity data to characterize the Chilcotin Group. This data is already being used by several geophysics teams to aid in the interpretation of regional-scale seismic, aeromagnetic, gravity, and magneto-telluric surveys, in particular in the hydrocarbon-prospective Nechako Basin.

Eastern Mexico Magmatism and Metallogeny

Dr Jim Mortensen, Project Coordinator

A U-Pb zircon dating, Pb isotopic and litho-geochemical study is underway investigating widespread



East face of Chasm Gorge in Chasm Provincial Park near Clinton, B.C. showing a stack of up to 12 basalt lavas filling an ancient paleo-valley.

Tertiary intrusions that host or are associated with a wide variety of mineral occurrences in eastern Mexico, in a belt that stretches from the US border as far south as Vera Cruz. This project is fully funded by Almaden Minerals Ltd., who have very extensive mineral properties in this region. It is a collaboration between Jim Mortensen at MDRU and Morgan Poliquin from Almaden Minerals, who is undertaking a PhD thesis project focusing on the intrusive history and intrusion-related metallogeny of eastern Mexico. Approximately 40 U-Pb zircon ages have been generated thus far for intrusions in eastern Mexico, and analyses of 30 feldspar and sulphide samples are underway. These results are shedding new light on the magmatic history for this large and poorly understood part of Mexico, and provide a critical framework within which to understand the mineral potential of the region.

Metallogenesis of the Tethyan Collage: Magmatic-associations and the Age of Ore Deposition in Turkey

Dr. Ilkay Kuscu, Project Coordinator

The Mesozoic and Cenozoic

Tethyan collage stretching from Europe across southern Eurasia is an extremely complex geologic terrane caught between colliding continents. Although complicated, the geodynamic setting of the Tethyan collage is reasonably well known as a result of decades of geologic investigation. However, a similar understanding of the metallogenic evolution of the region is not available or only sparsely known. With the opening or potential opening of much of this region to mineral exploration as a result of political events of the last decade and hopefully continuing into the future coupled with the presence of world class deposits within the Tethyan collage, developing a metallogenic framework for the region will aid future exploration. The project focuses initially

on transects across the belt in western and central Turkey. Barrick Gold and Teck Cominco supported the initial stages of the project. Tüprag Metal Madencilik Sanayi ve Ticaret Limited, a subsidiary of El Dorado Gold, joined the project as a sponsor in 2007. The project will end in 2008.

Geology of the Hope Bay greenstone belt, Nunavut

Dr. Richard Tosdal, Project Coordinator

The Hope Belt greenstone belt is the site of active exploration for shear zone hosted gold deposits. Andrew Shannon completed a volcanology and petrochemistry study of the stratigraphy to better define the distribution of rocks that are favorable host units to the significant gold deposits and prospects currently known in the belt. The project was completed in early 2008.

Thesis completed in 2008

Andrew Shannon, M.Sc.

Volcanic framework and geochemical evolution of the Archean Hope Bay Greenstone Belt, Nunavut, Canada.

Taseko Lakes Project

Dr. Lori Kennedy and Dr. Kenneth Hickey, Project Coordinators

The Taseko Lakes projects were in southwestern British Columbia along the contact between the Coast Plutonic Complex (CPC) and the Southeast Coast Belt (SECB). The area has long been recognized for its potential for porphyry-, epithermal, and mesothermal-style mineral deposits. Galore Resources Inc., a Vancouver-based mineral exploration company, funded two M.Sc projects in the area.

Lucy Hollis investigated the Hub, Charlie and Northwest Copper spatially related mineral showings (Cu ± Mo) in

the Tchaikazan River area of southwest British Columbia. Multiple episodes of magmatic-hydrothermal activity are associated with three centres of porphyry-style mineralization. The oldest dated pluton, the Hub diorite, has a U-Pb zircon age of 81.19 ± 0.78 Ma and an emplacement depth of >4 km. Numerous other porphyry intrusions are centers of mineralization and hydrothermal alteration. This thesis will be completed in early 2009.

Scott Blevings focused on deposit-scale examinations of mineral occurrences in the Taseko Lakes area. The Empress porphyry Cu formed at ~87 Ma at depths of ~5 km. The Pellaire gold-telluride mineralization formed at 85 Ma along south-vergent contractional faults. Taylor-Windfall high-sulphidation epithermal Au-Ag deposit formed from magmatic-dominated hydrothermal fluids with high temperature fluids forming a core of vuggy silica that is overprinted by lower temperature advanced argillic assemblages. This thesis was completed in 2008.

Thesis completed in 2008

Scott Blevings, M.Sc.

Geologic framework for late Cretaceous magmatic-hydrothermal mineralization in the Taseko Lakes region, southwestern BC.

THEME 3 - EXPLORATION METHODOLOGY

Dr. Richard Tosdal - Research Coordinator

Thermal and geochemical footprints of low-temperature sedimentary rock-hosted hydrothermal Au-systems: Identifying far-field vectors toward ore

Dr. Kenneth Hickey, Project Coordinator

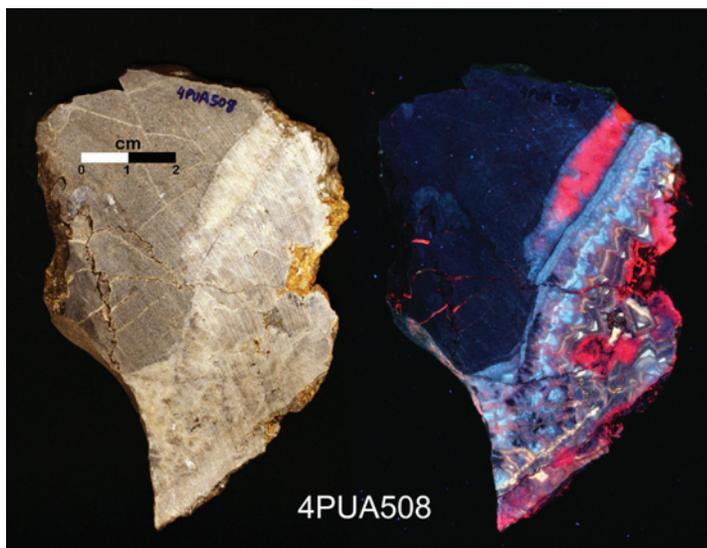
One of the main challenges faced by companies exploring for Carlin-type deposits is to be able to search under the sequences of Paleozoic to Quaternary rocks overlying the Lower Paleozoic, carbonate dominated, rock units that form the main host for mineralization. The current project builds upon the existing MDRU research with the aim of developing an integrated model for the exploration of Carlin-type deposits that maximizes the potential for success under cover. The project combines a well-constrained geological understanding of the paleogeographical, tectonic and magmatic environment of gold deposition with a range of thermochronometers, and litho-geochemical, isotopic and mineralogical tracers to delineate the location and scale of Eocene

hydrothermal fluid circulation and where it may manifest under cover. These tracers will also provide a means to define direction and scale of fluid flow and help delineate feeder structures within areas of Eocene hydrothermal activity. The study encompasses major Carlin-type deposits in the Great Basin west of the Ruby Mountains. The results of the project have implications beyond the Great Basin, and have the potential to assist in the evaluation and exploration of other terranes favorable for Carlin-type gold deposits, or other sedimentary rock-hosted deposits. The research team includes Drs Kenneth Hickey, Greg Dipple and Shaun Barker (Post-doc), Jeremy Vaughan (PhD student), Ayesha Ahmed and Moira Cruickshanks (MSc students), and Abe Torchinsky and Christian Sampaleanu (undergraduate Hons students). This project is sponsored by Barrick Gold Corp., Newmont Mining Corp., and Teck Resources Ltd, with matching funds provided by a Collaborative Research and Development grant from the Natural Sciences and Engineering Research Council.

Integrating paleogeography-tectonics, geochemistry and thermochronology to develop vectors towards ore: Redstone Sedimentary Copper Belt, NWT.

Dr. Kenneth Hickey, Project Coordinator

This project seeks to improve understanding of the controls on sedimentary Cu mineralization and develop better far-field tracers of the mineralization to aid the detection of deposits in the subsurface. The project will focus on the Redstone copper belt in the eastern Mackenzie Mountains of the NWT, Canada. The research proceeds on regional and prospect scales and seeks to define the basin architecture and tectonic / sedimentological framework for sediment-hosted Cu deposits. It also examines mineralogical, geochemical, and thermal expressions of the hydrothermal flow to help develop vectors toward ore. When complete, the project will provide a better understanding of sediment-hosted Cu systems, and provide data to help regional exploration in sedimentary copper belts. The research team includes Dr Kenneth Hickey, Dr Sarah Gleeson (U of Alberta) and Jack Milton (PhD student). This project is sponsored by Western Copper Corporation and supported by the Northwest Territories Geoscience Office.



UV fluorescence is an effective method for vectoring in ore systems as they can discriminate between carbonate veins related to mineralized or barren silver-veins at Uchucchacua, Peru. Photo by Abraham Escalante.

Geochemistry, Mineralogy and Morphology of Gold: Applications to Exploration and Understanding Placer /lode relationships

Dr. Jim Mortensen, Project Coordinator

The relationship between placer and lode gold deposits is generally not well understood, and in many parts of the world, placer gold deposits of substantial size exist for which no lode source has been convincingly identified. From an exploration standpoint, placer gold clearly indicates the potential for significant lode sources, but because the linkage is poor, there is little constraint on what type of deposit might be providing the placer gold. Understanding this linkage is thus an unsolved question that has practical implications.

Rob Chapman (University of Leeds) and Bill LeBarge (Yukon Geological Survey) are collaborators on this study. The basic premise is that major, minor and trace element compositions of placer gold, together with the nature of the contained micro-inclusion suite, should provide a unique signature that can be used to constrain the specific type of lode source(s) from which the gold was derived. Conversely, the information may constrain how placer gold might be modified or augmented by in situ growth within the surficial environment.

A separate component of this study focuses on the evolution of the shape(s) of placer gold grains during alluvial/ fluvial transport. This provides a very valuable new tool for better delimiting possible source area(s) for placer gold. Evan Crawford, an MSc student with Mortensen who completed in 2007, utilized the geochemistry, mineralogy and morphology of gold grains to investigate the linkages between lode gold occurrences in the Klondike District in west-central Yukon and placer deposits derived from them.

Footprints of Archean Orogenic Gold Systems

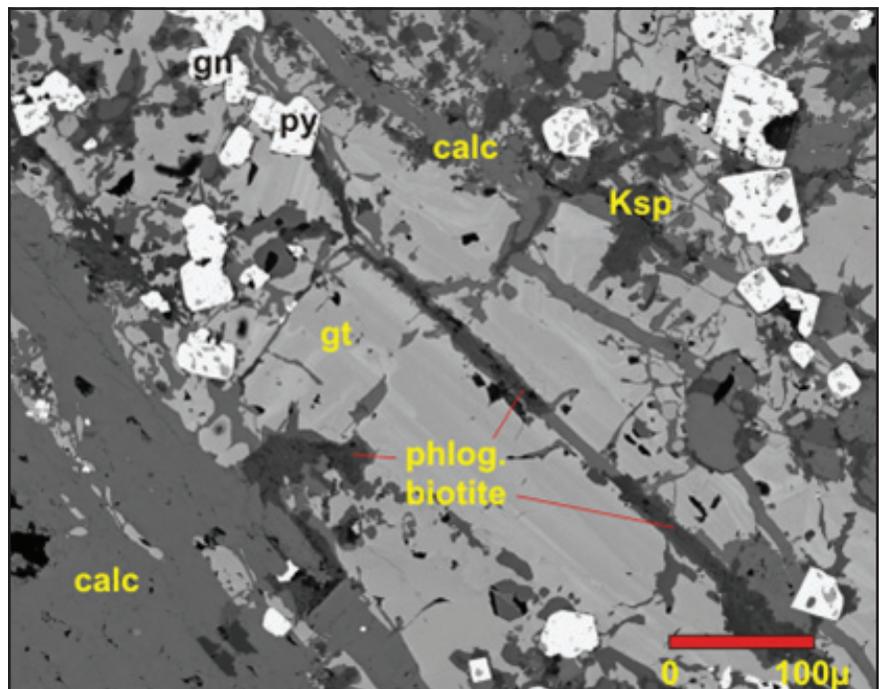
Dr. Farhad Bouzari, Project Coordinator

Archean orogenic gold systems are of significant economic importance and are attractive exploration targets, particularly in the vast Archean terrains of the Superior and Slave cratons of central and northern Canada. Whereas the structural setting of these gold-only deposits is well-studied, fundamental aspects of the hydrothermal system and their architecture remain elusive despite many years of excellent research, largely in Canada and Australia. Thus, predictive models of hydrothermal systems showing mineralogical and geochemical relationships in detail are not widely available to guide exploration or are subject to conflicting interpretation. The overriding project goal is to characterize and distinguish the mineralogical and geochemical footprints of each stage of a gold-rich hydrothermal system. Once established, these footprints will provide robust

guidelines to identify each stage within a broader zone of alteration exposed in surface outcrops, leading to the recognition of the fluid pathways related to gold deposition.

Current research at the Red Lake Gold Mines (31 Moz at 21 gpt) in northwestern Ontario, in which underground mining is developed to depths of 2 km below the surface and extends over 2 km along strike. The deposit is a carbonate-quartz lode hosted in Fe-tholeiite, komatiite and minor felsic volcanic rocks near the folded contact with a sequence of younger chemical and clastic sedimentary rocks. Gold is concentrated along major NW-trending penetrative deformation zones cutting pervasively altered host rocks.

This Red Lake Gold project is collaborative and is supported by Goldcorp Canada and NSERC to examine the hydrothermal alteration on the camp and deposit scales. The first stage of the project has been completed during which field observations, mapping and sampling were carried



SEM backscatter image of endoskarn from Antimina, Peru, showing relationships between ore and gangue minerals. Image by Abraham Escalente.

out at both Red Lake mine and district scales. At the district scale, an area of ~10×10 km around the Red Lake mine was investigated by mapping and sampling outcrops and collar portion of surface drill holes. At the mine scale, alteration and mineralization have been studied along two, 3 km-long northeast-oriented cross sections that are 2 km deep. Over 20,000 m of drill-core was re-logged and 2120 hand samples were collected and described in detail in addition to the 878 district surface samples. Selected samples were further examined by thin section petrographic and XRD analysis.

Alteration mineral assemblages and their spatial relationship to the gold mineralization were studied to characterize their zoning and overall anatomy of the hydrothermal system. Alteration mineralogy, moreover, was studied by spectral analyses of all collected samples using Terraspec mineral analyzer. A total of 2196 samples, representing various alteration assemblages and host rocks, were analyzed for major and trace elements. Results produced a series of predictive mineralogical and geochemical maps and cross sections to vector toward gold in the Red Lake area with exploration implications for elsewhere in Canada and other regions.

Further detail study of alteration footprints is underway through a Ph.D. investigation by Elizabeth Stock by analyzing trace and/or isotopic composition of biotite, chlorite, garnet, carbonate, pyrrhotite, pyrite, arsenopyrite and stibnite.

Combining Geology, Physical Properties, and Geophysical Inversion for 3-D Integrated Earth Models

Dr. Doug Oldenberg and Dr. Ken Hickey, Project Coordinators

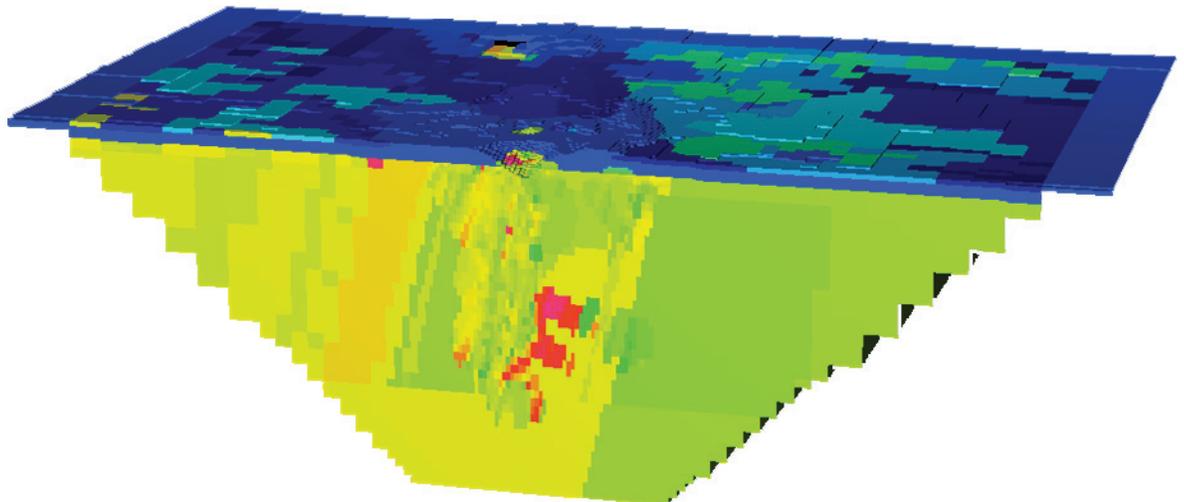
Geophysicists can now generate 3-D models of subsurface physical properties by inverting a wide range of geophysical survey data. There is still much to be learned about how to best extract specific geologic information from geophysical inversion results and how best to integrate geologic constraints and information into the geophysical inversion process in order to refine models of ore deposits and associated geology. This project seeks to delineate more explicitly how inversion tools and geologic information can be used together to help answer geologic questions in a range of mineralized environments. The project combines the expertise in MDRU, with the UBC Geophysical Inversion Facility (GIF) headed by Doug Oldenberg. Study areas include the northern Carlin trend Nevada (Ken Hickey), Kabanga in Tanzania, Timmins area of Ontario (Dianne Mitchinson), Flin Flon and Rio Blanco (Nicolas Pizarro), and the Lenora-Wiluna

Greenstone belt of Western Australia (Nick Williams). AngloGold North America, Anglo American, Barrick Gold, Geoinformatics Exploration, Inco Technical Services (now part of Vale Inco), Noranda Falconbridge (now part of XStrata), Placer Dome Exploration (now part of Barrick Gold), Teck Cominco, WMC International (now part of BHP Billiton) are financially and logistically supported the project. Williams and Pizarro completed their PhD and MSc theses, respectively, in 2008, and Mitchinson will complete in 2009.

Theses completed in 2008

Nicolas Pizarro, M.Sc.
Magnetic susceptibility scaling of rocks using geostatistical analysis: An approach to geologic and geophysical model integration.

Nick Williams, Ph.D.
Geologically-constrained UBC-GIF gravity and magnetic inversions with examples from the Agnew-Wiluna greenstone belt, Western Australia.



Geologically-constrained, 3D geophysical inversion models such as these provide significant improvements over otherwise unconstrained geophysical inversions. Image created by Nick Williams.

THEME 4 - MAGMATIC SULFIDE DEPOSITS

Dr. James Scoates - Research Coordinator

Layered mafic-ultramafic intrusions and flood basalts from Large Igneous Provinces worldwide are major sources of economic Ni-Cu-PGE deposits. This past year was mostly a wrap-up year with the completion of three projects.

Andrew Greene (Ph.D.) finished his dissertation on the volcanological, geochemical and stratigraphic architecture of flood basalts from the giant Triassic Wrangellia terrane that is exposed over 2000 km along the west coast of North America from Vancouver Island to Alaska. An additional component of the Wrangellia project includes assessing the magmatic sulfide potential of the basalts and underlying sills using whole rock PGE chemistry as a monitor of sulfide saturation state; recent work has involved comparison of the Wrangellia PGE chemistry with that of large igneous provinces worldwide. The Wrangellia project has been generously supported by the former B.C.-Yukon Chamber of Mines Rock to Riches Program, NSERC, and research grants from the Yukon and B.C.

geological surveys.

Caroline-Emmanuelle Morisset (Ph.D.) completed her dissertation on the origin of massive Fe-Ti oxide ores (hemo-ilmenite \pm rutile) in Proterozoic anorthosite complexes in Quebec based on a comprehensive petrologic, geochemical, isotopic and geochronologic study of the deposits and their associated host rocks. This project was supported by Rio Tinto Iron and Titanium, NSERC-CRD and NSERC.

A recently completed Honours BSc project by Corey Wall involved uranium-lead geochronology of granophyres from the Archean Stillwater Complex in Montana (USA), which is host to the PGE-rich J-M Reef. This project provided characterization of uranium-bearing accessory minerals (zircon, titanite, rutile) and preliminary dating results. Future work related to this project will involve high-precision dating of the cumulate rocks of the Stillwater Complex, including the host rocks to the J-M Reef. Funding is from

NSERC.

Katrin Breitsprecher, a PhD candidate is in her final-year of a major geochemical and isotopic study (Sr-Nd-Hf-Pb) of Mesozoic porphyry intrusions across southern B.C. from the Quesnel and Stikine terranes with the aim of linking subduction cycles to magma genesis and mineralization style. Funding is from the Geological Survey of Canada's TGI-3, and from Geoscience BC.

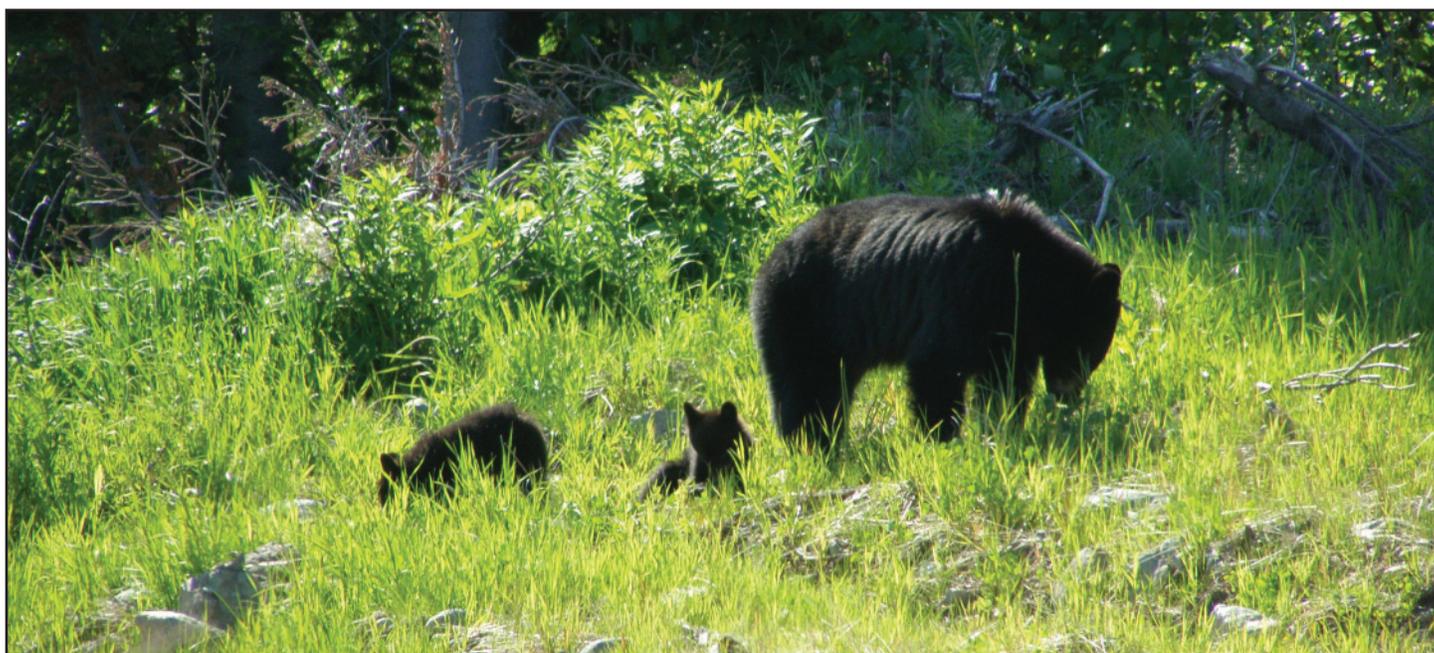
Theses completed in 2008

Andrew Greene, Ph.D.

Wrangellia flood basalts in Alaska, British Columbia and Yukon: exploring the growth and magmatic history of a Late Triassic oceanic plateau.

Caroline-Emmanuelle Morisset, Ph.D.

Origin of rutile-bearing ilmenite Fe-Ti deposits in Proterozoic anorthosite massifs of the Grenville Province.



Some of the locals at Mt. Milligan, BC.

THEME 5 - KIMBERLITES AND DIAMONDS

Dr. Maya Mopylova and Dr. J. Kelly Russell - Research Coordinators

Mapping and interpretation of volcanic facies is now recognized as a critical tool in the prediction of diamond distribution and in the evaluation of kimberlite during exploration. The active MDRU research program is addressing fundamental issues concerning the eruption of kimberlite volcanoes and the practical issues of how volcanic facies relate to diamond grade distributions.

Volcanological Framework in Kimberlite Craters, Victor Mine

Dr. Maya Kopylova, Dr. J. Kelly Russell and Dr. Barbara Scott Smith, Project Coordinators

Currently, De Beers Canada and NSERC are funding project to establish a volcanological framework for the two (Main and Northwest) crosscutting kimberlite craters that form part of the Victor diamond mine (Ontario). The PhD project of Bram van Straaten has established a petrological and volcanological explanation for the heterogeneous distribution of diamond in Victor Main crater. In the subsequent years of his project, the PhD candidate has established a detailed reconstruction of the volcanic stratigraphy of the Northwest crater, which encompasses enigmatic coherent-looking rocks that likely formed by subaerial fire fountaining processes. Results of this work will have a direct impact on the mining and further evaluation of the Victor diamond deposit and all northern Ontario kimberlites. The increased scientific knowledge on kimberlites will help future diamond explorationists in determining volcanic facies of diamond deposits, their geological model and diamond grades.

Kimberlite volcanology and implications for diamond distribution at Diavik

Dr. J. Kelly Russell, Project Coordinator

I am in the last year of funding for a 4-year grant on kimberlite volcanology that has been funded by Diavik Diamond Mines, a Rio Tinto-Harry Winston (formerly Aber) joint venture. Our goal has been to use field mapping and petrographic analysis to understand the volcanic processes that produced deposits within the main Diavik kimberlite pipes (A154N, A154S, A418, and A21). Stephen Moss' PhD research is aimed at testing the hypothesis that the diamond distributions may reflect the volcanic facies (including re-sedimentation) of the deposits superposed on original compositional differences between kimberlites. The first two years of his research have elucidated the volcanological properties of the kimberlite deposits at in the A154N and A154S kimberlite bodies. This work has led to a model for the eruption of the A154N kimberlite volcano which produced a deep, water-filled, steep-walled crater by the end of the eruption. Our analysis showed that the upper 60 m of kimberlite deposits in this pipe actually derive from another source. These "orphaned deposits" are diamond-rich and appear to be pyroclastic kimberlite deposits produced by another kimberlite volcano but captured by this kimberlite volcano's empty crater. We suggest that this is a fairly common phenomena because: a) kimberlites occur in clusters, and kimberlite eruption produce broad shallow volcanic craters underpinned by deep (> 400 m) steep-walled, 100-200 m diameter conduits that are largely empty (forming lakes) and volcanism in kimberlite clusters overlaps in time. These open holes resulting from kimberlite eruptions act as receptacles for "orphaned" deposits from adjacent

kimberlite volcanoes. Stephen Moss will defend his dissertation in October 2009.

A project that characterized the mineralogy and geochemistry of individual phases of kimberlite at Diavik has been recently completed (2009) by MSc student Curtis Brett. His research comprised detailed studies of olivine crystals within kimberlite. These studies demonstrated that virtually all olivine in kimberlite is mantle-derived and xenocrystic; there are no real phenocrysts. Late stage crystallization of olivine modifies smaller olivine xenocrysts to produce pseudo-phenocrysts. These results have import for the timing and amounts of crystallization that kimberlite undergoes during ascent and, thus, constrains the thermal evolution and ascent rates of these enigmatic magmas. Brett's study of olivine further identified an ordered sequence of textural elements related to processes attending kimberlite ascent, including: a) decompression cracks filled with fluid-derived minerals (sealed and healed cracks), b) mechanical rounding of olivines, and c) overgrowths on the rounded olivine xenocrysts. These results have placed new quantitative constraints on the process and rates of kimberlite ascent and have resulted in a new model for kimberlite transport.

Scientific results from this project have been presented at major international meetings including the International Kimberlite Conference held in Frankfurt August 2008. Moss won the best oral presentation by a student at this meeting.

Most recently, Dr. Lucy Porritt won a Commonwealth Fellowship for a 1 year research position to pursue kimberlite volcanology on the A418 kimberlite body at Diavik. Dr. Porritt completed her PhD degree with Ray Cas at Monash University where she worked on the Ekati pipes. She will begin field work at Diavik in the fall of 2009.

THEME 6 - SUSTAINABILITY

Dr. Greg Dipple - Research Coordinator

Carbon Sequestration in Mine Tailings

Dr. Greg Dipple and Dr. Gordon Southam (University of Western Ontario), Project Coordinators

The Carbon Sequestration in Mine Tailings project examined the potential for using mine waste to store atmospheric carbon dioxide, thereby mitigating industrial greenhouse gas emissions. Specifically, the project sought to identify and quantify any ongoing carbon sequestration that results from mining, and to develop a predictive model for accelerating carbon uptake in mine tailings. The third and final project year ended in 2008, and PhD students Sasha Wilson and Ian Power are working to defend their dissertations by the end of this calendar year. The project was sponsored by BHP Billiton, Diavik Diamond Mine Inc., and the Natural Sciences and Engineering Research Council of Canada (NSERC). It examined carbon uptake and cycling in tailings from two active mines: the Mount Keith Nickel Mine, Western Australia and the Diavik Diamond Mine, NWT, Canada.

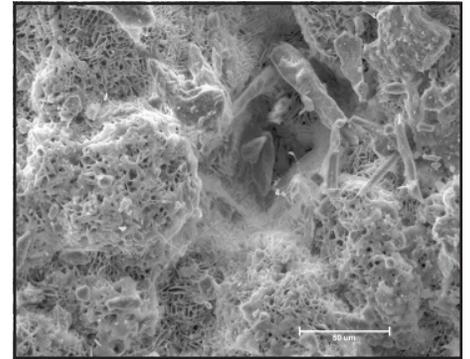
Carbon dioxide is trapped at Mount Keith and Diavik in mineral precipitates as surface crusts (efflorescences) and cements in tailings within months of tailings deposition. The mineral hosts to carbon dioxide include the magnesium carbonate minerals nesquehonite and hydromagnesite, which are volumetrically the most important hosts, and other Mg, Ca, and Na carbonate minerals of limited abundance. The atmosphere has been identified as the primary source of carbon bound in these minerals using a three-isotope fingerprinting system.

Postdoctoral fellow Shaun Barker developed a new acid leach method for carbon-13 and radiocarbon analysis.

This technique allowed selective isotopic analysis of nesquehonite and hydromagnesite that avoids contamination from bedrock carbonate minerals magnesite and dolomite. Radiocarbon analysis has proven essential for distinguishing between trapping of atmospheric carbon dioxide and recycling of carbon from bedrock minerals.

Sasha Wilson (PhD student, UBC) completed the mineralogical and isotopic analysis of an extensive tailings sample suite to produce a statistically valid assessment of the rates of carbon uptake. NSERC-funded undergraduate summer research assistants Shelley Oliver and Claire Brown worked in the lab with the graduate students and also completed individual research projects. In order to facilitate quantitative mineralogical work, postdoctoral fellow Stuart Mills solved the structures of several gangue minerals present in the tailings at Diavik and Mount Keith. With these structures, quantitative mineralogical procedures have been adapted and calibrated to give precise measurements of carbon fixation within minerals present at trace to readily detectable abundances. These measurements have resulted in empirical rates for carbon sequestration that indicate that active mines are able to fix on the order of 10,000 to 100,000 tonnes/year of CO₂ by passive weathering. The rate at which carbon is fixed is strongly influenced by climate and industrial processes with increased fixation of carbon occurring within hydraulically unsaturated mine tailings in hot, arid environments.

Carbon fixation occurs by both abiotic and microbially mediated pathways. Key mineral dissolution rates laws were determined experimentally by PhD candidate James Thom



SEM image interlocking carbonate minerals growing in mine tails and sequestering CO₂. Image by Siobhan Wilson

and have been incorporated into a geochemical model for identifying acceleration scenarios. PhD student Ian Power has examined microbial acceleration of carbon fixation in the field and experimentally. His work with laboratory-based bioreactors that use both sulfur-oxidizing and salt-tolerant photosynthetic microbes (cultivated from tailings storage facilities) indicates that microbes may be used to enhance dissolution of silicate minerals and accelerate mineralization of carbon.

The final results of our three-year study at Diavik and Mount Keith are an accurate and adaptable method for identifying and quantifying carbon sequestration, a predictive geochemical and geomicrobiological model for producing the mineral hosts to carbon, and a set of laboratory-tested strategies for accelerating carbon sequestration in mine tailings. Extending our knowledge of the rates and mechanisms of carbon cycling to other mine types and climates, and further identification and demonstration-scale testing of acceleration scenarios will be the basis of a proposal for a follow-on carbon sequestration project that will be circulated to MDRU members in the coming months.

TRAINING AND OUTREACH

SHORT COURSES

In 2008, MDRU ran four short courses to provide industry, researchers and students with access to knowledge that benefits exploration. The very popular Yerrington field mapping course was presented twice, emphasizing the demand for such courses. The various courses were attended by 170 registrants.

SC 47 Squeezing more out of rocks:

By Ken Hickey (MDRU), Peter Lewis (Lewis Geoscience), David Rhys (Panterra Geosciences), and Richard Tosdal (MDRU). AMEBC Mineral Exploration Roundup, Vancouver, 26-27 January 2008.

SC 48 Field mapping of ore deposits: anatomy of a tilted porphyry cu batholith and its hydrothermal alteration features, Yerrington, Nevada (USA):

By John Dilles and Richard Tosdal, Joint MDRU - Oregon State University, 20-28 March 2008

SC 49 Mineral project assessment and investment decisions:

By Micheal Doggett, Doggett & Associates. Held at UBC Robson Square, 18-22 February 2008.

SC 50 Field mapping of ore deposits: anatomy of a tilted porphyry cu batholith and its hydrothermal alteration features, Yerrington, Nevada (USA):

By John Dilles and Richard Tosdal, Joint MDRU - Oregon State University, 03-11 April 2008.

RESOURCE CENTRE

The MDRU Resource Centre is a facility that provides a wide range of services to MDRU members, researchers and students to facilitate research and analytical needs. The Centre has many resources but is also a central location for seminar presentations and a focal point for casual interactions with journals, newsletters and trade magazines. The Centre is mainly within the Resource Room, (Rm 202) in the EOS-Main Geology building at UBC, which contains the following equipment:

- Petrographic and binocular microscopes
- GIS computer with dedicated to map preparation and spatial data manipulation
- Various computers with specialized software applications and database access
- Digitizer and Plotter for map and poster production
- Work areas for reading, meeting, presentations map preparation
- Fluid inclusion analytical equipment

Databases include GEOREF, B.C. Minfile, and Yukon Minfile. Arne Toma supervises the Resource Centre and his office also provides space for visiting researchers and Individual Members undertaking research initiatives. Improvements to the computer facilities and software upgrades are an ongoing minor part of the MDRU budget. Access to various petrographic and analytical services, such as fluid Inclusion analysis, XRD, Microprobe and SEM is typically undertaken as small contracts arrangements with either MDRU, research Associates, or the various analytical laboratories in the Department.

Improving member services and student support is an on-going issue. Computer hardware and software have been expanded to better facilitate GIS, geophysical and 3-D modelling, printing and networking capabilities. In addition, microscopy and photographic equipment are all candidates for updating as equipment improves, research needs change, and budgets allow.

SHEAHAN-MDRU LITERATURE SERVICE

MDRU operates the Sheahan-MDRU Literature Service which provides monthly newsletters that record the most up-to-date contributions to the diamonds/kimberlites and precious/base metal scientific and technical literature. The service operates as a non-profit that is wholly sustained by subscribing mineral exploration companies. The number of subscribers continued to hold steady in 2008 with twenty-eight major and junior companies combined receiving the service. The service also makes the scientific literature available to industry subscribers and populates an online database. The database contained over 100,000 highly relevant references at the end of 2008. MDRU also operates an economic geology library that hosts the Island Copper Archive - BHP archive files, data, and core from Island Copper. The Sheahan-MDRU Literature Service finished 2008 with its first ever surplus which was transferred to MDRU to partially offset previous losses. Karie Smith, MDRU's Executive Coordinator, manages this service.

SOCIETY OF ECONOMIC GEOLOGISTS UBC STUDENT CHAPTER

MDRU is an active supporter of the UBC Society of Economic Geologists Student Chapter. The Chapter is open to UBC undergraduate and graduate students interested in the study of economic geology. MDRU's role is to support the chapter's initiatives as a training and research resource and discussion forum, by facilitating industry input, presentations and field trips.

The major activity of the Student Chapter each year is an annual student-organized international trip to a region

of the world with notable geology and mineral wealth. Each two-week trip, usually in May, aims to visit several world-class mines, including type examples of particular deposit styles, as well as a range of different deposit types to broaden participants' understanding of mineralizing process. In addition the tours aim to expose students to different landscapes and cultures.

Eastern Europe was the destination for the 2008 trip (see http://www.mdru.ubc.ca/home/resources/seg/seg_ft/2008eu.php), with Turkey's Western Anatolia region scheduled for 2009 (see http://www.mdru.ubc.ca/home/resources/seg/seg_fieldtrips.php).

As a non-profit society with no membership fees, the Student Chapter must gather funds through fund-raising activities. Our sincere thanks to the SEG, the GAC, Anglo American Ltd., Barrick Gold Corp. and Equity Engineering Ltd. for providing essential funding for the 2008 UBC-SEG-GAC student chapter mine tour. Industry participants from Teck Cominco Ltd. Hunter Dickinson Inc., Tüprag Metal Madencilik, and Wallbridge Mining Company, Ltd., and Mikkel Schau and Lyle Hansen are also thanked for their contributions in making the trip a success.



Participants from the 2008 SEG Eastern Europe fieldtrip at the Rosia Poieni open pit, Romania. Photo courtesy Lyle Hansen.

EXPENDITURE AND BUDGET

MDRU ACCOUNTS

MDRU runs its operations through three accounts: an Industry account that contains membership fees and other income and expenses related to operations; an Endowment account that contains funds incurred from the endowment; and a Short course account that services income and expenses related to short courses, workshops and field trips. All three of these accounts contribute to operating expenditures for the organization. Individual project accounts are managed independently and used to support research projects and student theses. In 2008, there was approximately \$1.8M in project funding.

2008 REVENUE AND EXPENDITURES

Revenues and expenditures for 2008 are reported in Table 1. MDRU fees obtained through corporate memberships were as projected and include the acquisition of Goldcorp as a new Foundation Member. Revenues from short courses are significantly higher reflecting high levels of participation in response to the positive tenor of the mineral exploration industry in 2008. Endowment revenue

was slightly less than projected due to a late year reduction resulting from general economic decline. Increased salary recoveries were higher than anticipated as technical support was charged out to projects requiring additional assistance. The Sheahan-MDRU Library incurred a reasonable surplus (\$12,000) to help mitigate significant losses accumulated over previous years.

Expenses in 2008 were as projected with slight increases in salaries being offset by reductions in overall operating expenses, travel, equipment and the search costs for a new Director. Budgeted expenses for accounts audit was not spent in 2008, but will be part of 2009 expenses. Costs for the Annual Research Review meeting and training courses are shown as separate items being previously within operating expenses.

Overall, the MDRU operating accounts ended the year with an operational surplus. This feature is a reflection of MDRU's ability to benefit from the positive state of the mineral exploration industry and good fiscal management. A key feature that contributes to the surplus is the ability to recover operational salary dollars through contributions from

the projects. This operational surplus combines with a carry forward amount from 2007 to generate an accumulated surplus of \$359,000. This amount is approaching MDRU's operational budget for one year, which is considered by the MDRU Board of Directors to be a minimum accumulate balance to be carried forward to ensure stability in the organization.

IN-KIND SUPPORT

MDRU continues to generously receive a wide range of in-kind support from various university, government and industry organizations. In particular, The University of British Columbia provides operational and laboratory space for MDRU's projects as well as assistance from Financial Services and other UBC departments. Contributions from UBC Faculty members are especially appreciated. Many of MDRU's Corporate Members also provide a considerable amount of donated time, expertise and energy, particularly those participating on the Board of Directors, or on research projects.

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AUDITORS' REPORT
ON SCHEDULE OF REVENUE, EXPENDITURES AND ACCUMULATED SURPLUS

To the Members of the Mineral Deposit Research Unit ("MDRU"),

At the request of the Board of Directors of MDRU, we have audited the Schedule of Revenue, Expenditures and Accumulated Surplus as at and for the year ended December 31, 2008. This financial information is the responsibility of the management of MDRU. Our responsibility is to express an opinion on this financial information based on our audit.

We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we plan and perform an audit to obtain reasonable assurance whether the financial information is free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial information. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial information.

In our opinion, this Schedule presents fairly, in all material respects, the revenue, expenditures and accumulated surplus of MDRU, derived and reported on a basis as explained in footnote (a) to the Schedule, as at and for the year ended December 31, 2008.

"De Visser Gray LLP"

CHARTERED ACCOUNTANTS

Vancouver, British Columbia
April 9, 2009

Table 1. Schedule of Revenue, Expenditures and Accumulated Surplus (a).
As at and for the year ended December 31, 2008.
(All figures presented in thousands of Canadian dollars).

	Actual	Budget
REVENUE		
MDRU fees - Foundation	95.0	80.0
MDRU fees - general	136.6	154.9
Salary recoveries	70.1	40.3
Endowment projection	98.3	107.9
Short Courses (net)	62.5	35.0
Publications (net)	0.3	0.8
Other	1.1	-
Sheahan Library (net)	12.0	-
	475.9	418.9
EXPENDITURES		
Salaries & benefits	304.1	286.9
Operating expense	12.6	16.0
Travel & conferences	5.1	10.0
Equipment	4.8	6.0
Accounts audit	-	15.0
Director search	38.9	50.0
Meetings	10.0	-
Training	2.3	-
Other	6.9	-
	384.7	383.9
OPERATING SURPLUS, for the year	91.2	35.0
ACCUMULATED SURPLUS, beginning of the year	267.8	270.9 (b)
ACCUMULATED SURPLUS, end of the year	359.0	305.9 (c)
	(d)	

(a) MDRU's financial records are comprised of, and limited to, certain accounts within the Department of Earth and Ocean Sciences at the University of British Columbia ("UBC"), and they are therefore consolidated with UBC's accounts on an ongoing basis. These administrative arrangements have evolved informally over time as a means of meeting MDRU's requirements within the university's financial reporting structure. MDRU has no separate legal status as an entity, nor does it maintain cash or other asset balances separate from those of UBC. Accordingly, a complete formal financial statement presentation under Canadian generally accepted accounting principles ("GAAP") is not possible.

Although the above presentation is broadly consistent with Canadian generally accepted accounting principles, the organization's lack of independence from UBC does require the use of considerable management discretion as to what is reportable as an MDRU balance or transaction, and how these should be presented. For example, certain funds administered by MDRU are excluded from presentation when their receipt and expenditure are not related to MDRU's core activities.

MDRU's accounts as presented above are not reflective of any cash flows directly related to project funding or expenditures.

(b) The previously published ending accumulated surplus figure for 2007 of \$270.9 was decreased during 2008 for previously underaccrued Sheahan Library losses of \$3.4 and a miscellaneous adjustment of \$0.3.

The 2008 board-approved budget was based on this original amount of opening accumulated surplus.

(c) Accumulated surplus can be considered, practically-speaking, to be unrestricted cash-equivalent assets available for the exclusive use of MDRU, subject legally to the consent and control of UBC.

(d) Accumulated surplus at December 31, 2008 is exclusive of \$4.2 of deferred membership revenue to be recognized in income as to \$1.4 in each of 2009, 2010 and 2011.

2009 BUDGET

The proposed budget for 2009 is presented in Table 2. There are significant changes from the 2008 budget reflecting the realities of the depressed economic situation for 2009. We anticipate reduced revenue from membership fees, particularly from the Junior sector. Salary charge outs to projects which have played a key role in financial management in the past few years, have been reduced.

UBC has indicated that payments from the Endowment will be significantly reduced, by about 50% from past years. We also anticipate reduced revenues from short courses which will be in lower demand in 2009. The MDRU-Sheahan Library will break even. Expenses however, will remain similar in most ways to 2008 levels with small salary increases, in part to accommodate an increase in a 2-day a week financial clerical support, plus \$15,000 for the audit report is budgeted. The result is a projected loss of \$118,500 which can be managed through contributions from the accumulated surplus. As a result, we project a carry-forward amount of approximately \$245,000 by the end of 2009, or about 65% of our annual operating expenses.

Table 2. Schedule of Projected Revenue, Expenditures and Accumulated Surplus for the year 2009.
(All figures presented in thousands of Canadian dollars).

	Budget
REVENUE	
MDRU Fees - Foundation	95.0
MDRU Fees - General	92.1
Salary recoveries	20.5
Endowment projection	50.0
Short Courses (net)	10.0
Publication (net)	0.2
	267.8
EXPENDITURES	
Salaries & Benefits	323.3
Operating Expense	16.0
Travel & Conferences	10.0
Equipment	6.0
MDRU Research Review Meeting	7.0
MDRU Roundup Reception	4.0
Publications	0.0
Training	5.0
Accounts Audit	15.0
Sheahan Library	0.0
	386.3
ACCUMULATED SURPLUS, beginning of the year	363.2 (a)
Total 2009 Budgeted Revenue	267.8
Total 2009 Budgeted Expenditures	386.3
OPERATING SURPLUS, for the year	(118.5)
ACCUMULATED SURPLUS, end of the year	244.7

(a) Accumulated surplus at December 31, 2008 is inclusive of \$4.2 of deferred membership revenue to be recognized in income as to \$1.4 in each of 2009, 2010 and 2011.

LOOKING AHEAD

ADMINISTRATION & MEMBERSHIP

Despite major setbacks in the global economic situation and concurrent retrenchment of exploration programs, MDRU continues to develop large-scale regional or thematic research projects around global issues, such as the Porphyry Footprints project. However, the economic realities of these times dictates that industry is more supportive of smaller, shorter duration and more focused projects that are more suited to the interests of one or two companies. These opportunities are reflected in the new research projects and opportunities that will arise in 2009, and such projects are critical to maintain membership and attract new members. MDRU's capacity to continue to offer a large number of smaller projects is limited by available faculty, and emphasize the need to acquire projects that fund new Post-Doctoral Fellows and Research Associates who can accept responsibility for managing projects and student researchers.

Access to high quality research projects and highly qualified human resources are among the most important reasons for companies to belong to MDRU. New projects that have sufficient relevance and appeal to attract funding under the present circumstances are critical for survival. In addition to research, the continued delivery of high-quality short courses is important, particularly for attracting junior companies and non-Canadian companies as members. Maintaining the facilities in the Resource Centre is particularly critical to attract Individual members.

RESEARCH

Research expenditures for all MDRU projects for 2009 are projected to be approximately \$1.815 million. Of this figure, about 43% is directly from industry contributions and 57% derives from non-industry sources such

as NSERC, provincial and territorial governments.

Active projects that will carry through to 2009:

- Mineral mapping and lithogeochemistry of far-field alteration around porphyry Cu systems
- Sedimentary Copper in northwestern Canada: Western Copper, NSERC CRD grant pending
- Reconstructing the low-sulfidation epithermal deposits at Cerro Bayo, Chile
- The porphyry Cu-Au deposit at Reko Diq, Pakistan
- Footprints of Porphyry Cu deposits: Barrick Gold, Teck, BHP Billiton, Valé, Imperial Metals, Codelco, Geoscience BC; NSERC-CRD
- Vectors toward Carlin-type Au deposits: Barrick Gold, Newmont Mining, Teck Cominco, NSERC-CRD
- Structure and tectonic controls on porphyry Cu and epithermal deposits- NSERC discovery grant with NSERC industrial graduate scholarship
- Footprints in Archean lode gold system: Goldcorp Canada, NSERC-CRD
- Peru porphyry Cu-Mo – Anglo American Exploration
- CO₂ sequestration – WMC, Kennecott, Yukon Geological Survey, NSERC-CRD
- Diavik volcanology – Diavik Mining, NSERC-CRD
- Chilcotin Plateau – Geoscience BC
- Victor : DeBeers, NSERC-CRD
- Kimberlites of Slave: NSERC Discovery
- Cariboo Gold: Geoscience BC
- Sicker Group: Geoscience BC

New projects for 2009

- Red Chris: Geoscience BC, Imperial Metals
- Volcanology and Geochemistry of the Nicola Arc: Geoscience BC

RESOURCE CENTRE

The Resource Centre will undergo minor improvements to ensure that it will

continue to be a focus of MDRU activity. Software improvements geophysical modelling software, Upgraded facilities can be made available at cost or shared with other members of the Department.

SHORT COURSES

Three short courses will be presented in the first half of 2009.

Sources and sinks in hydrothermal systems exploration:

Steve Cox (ANU), Kurt Kyser (Queen's), Wayne Goodfellow (GSC), Stuart Simmons (Hot Solutions, Inc.), Micheal Lescher (Laurentian) and Peter Hollings (Lakehead). AMEBC Mineral Exploration Roundup, January 2009.

Mineral project assessment and investment decisions:

By Michael Doggett, February, 2009.

Yerrington field mapping of ore deposits:

By John Dilles (Oregon State University) and Richard Tosdal (MDRU), May 2009

INTERNATIONAL NETWORKS

MDRU continues to work domestically and internationally to increase exposure through research projects, collaboration with other research groups, interaction with companies, and presentation of short courses and presentations. Efforts are continuing to seek international members and to consolidate the reputation of MDRU within the industry. MDRU has established collaborative working relations with the University of Tasmania (CODES), Oregon State University, Leeds University, and the Royal School of Mines at Imperial College in London, England. MDRU is continuing to investigate collaborative research efforts with universities in the US, Australia, Europe, and in Perú.

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GRADUATE THESES

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