Faculty Members - Research Interests

Earth & Planetary Sciences - McGill University
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This document presents some information about our faculty members and their research interests. A maximum of 5 publications of each member is listed to indicate major topics she/he has been investigating in the last few years.

FULL PROFESSOR DON R. BAKER

(A.B., Chicago, 1979; Ph.D., Pennsylvania State, 1985)
(514) 398-7485
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Subjects taught: cosmochemistry, environmental geology, general geology, geochemical modelling, high-temperature geochemistry and kinetics, introductory geochemistry, introductory igneous, metamorphic and sedimentary petrology, magmatic processes, spectroscopy of minerals.

Chief research interests: Volatiles play fundamental roles in magmatic systems; they control the evolution of magmas, form ore deposits of base (e.g., Ni, Cu), precious (e.g., Au, Pt, Pd), and critical (e.g., Sc, rare Earth elements) metals, create volcanic eruptions, and appear to be the cause of some mass extinctions. My research program investigates, quantifies and models equilibrium and disequilibrium processes involving major and minor volatiles in magmatic systems (= melt +/- crystals +/- fluids). Together with students and colleagues I study volatiles in magmatic systems, their role in the eruptions of volcanoes, their importance for the transport of S and ore metals at magmatic conditions, their influence on the nucleation of bubbles and crystals, their potential to cause mass extinctions through magmatic degassing of Large Igneous Processes (LIPs), and the evidence they provide about the early history of the solar system as preserved in meteorites. This research program is founded upon experimental measurements and computer simulations and involves collaboration with colleagues working in the field. Through study in the laboratory or simulation on the computer, individual processes can be isolated and studied to determine their effects on magmatic systems that can then be tested by field work and rock analysis. Our long-term goal is to understand the behaviour of volatiles in magmatic systems and to construct quantitative models that we and others can use to predict their impacts.

Callegaro, S., Baker, D.R., De Min, A., Marzoli, A., Geraki, K., Betrand, H, Viti, C., and Nestola, F. (2014) Microanalyses link sulfur from Large Igneous Provinces and Mesozoic mass extinctions. Geology, v. 42, 95-898, doi:10.1130/G35983.1

O'Shaughnessy, C.A., Brun, F., Mancini, L., Fife, J.L., and Baker, D.R. (2014) Modeling the failure of magmatic foams with application to Stromboli volcano, Italy. Earth and Planetary Science Letters, v. 403, 246-253

Maneta, V., Baker, D.R. (2014) Exploring the effect of Li on pegmatitic textures-an experimental study. American Mineralogist, v. 99, 1383-1403.

Baker, D.R., Brun, F., O'Shaughnessy, C., Mancini, L., Fife, J.L., and Rivers, M.L. (2012) A 4D x-ray tomographic microscopy study of bubble growth in basaltic foam. Nature Communications, doi:10.1038/ncomms2134.

Baker, D.R. and Alletti M. (2012) Fluid saturation and volatile partitioning between melts and hydrous fluids in crustal magmatic systems: The contribution of experimental measurements and solubility models. Earth-Science Reviews, v. 114, pp. 298-324.

ASSISTANT PROFESSOR KIM BERLO

(drs. Universiteit Utrecht, 2001; PhD University of Bristol, 2006)
(514) 398-5884
kim.berlo@mcgill.ca

Subjects taught: Introduction to petrology, analytical geochemistry
Chief research interests: Volcanology, igneous petrology, isotope geochemistry, micro-analytical techniques. Past projects have focused on the timescales of magmatic processes such as crystallization and degassing. My current main focus is on magma degassing and ascent to the surface for which I study volcanic rocks from a variety of locations and use a combination of volatile, trace-element and isotope analyses.

Berlo, K, van Hinsberg, V.J., Vigouroux, N., Gagnon, J., Williams-Jones, A.E. Sulfide liquid breakdown controls metal signature in volcanic gas at Kawah Ijen volcano, Indonesia. Chemical Geology **371**, 115-127, 2014.

Berlo, K**.,** Tuffen, H., Smith, V., Castro, J.M., Pyle, D.M., Mather, T.A., Geraki, K. Element variations in rhyolitic magma resulting from gas transport. Geochimica et Cosmochimica Acta **121**, 436-451, 2013.

Berlo, K., Turner, S. ^{210}Pb-^{226}Ra disequilibria in volcanic rocks. Earth and Planetary Science Letters, Frontiers **296**, 155-164, 2010.

Berlo, K., Blundy, J., Turner, S., Hawkesworth, C. Textural and chemical variation in plagioclase phenocrysts from the 1980 eruptions of Mount St. Helens, USA, Contributions to Mineralogy and Petrology **154**: 291-308, 2007.

Berlo, K., Blundy, J., Turner, S., Cashman, K., Hawkesworth, C., Black, S. Geochemical precursors to volcanic activity at Mount St. Helens, USA. Science **306**, 1167-1169, 2004.

ASSISTANT PROFESSOR NICOLAS B. COWAN

(B.Sc., McGill University, 2004; Ph.D., University of Washington, 2009)
(514) 398-
nicolas.cowan@.mcgill.ca

Subjects taught: planetary science, remote sensing
Chief research interests: Nick studies planetary climate using space telescopes and novel remote sensing methods. His group focuses on the thousands of planets that have been discovered in recent years orbiting other stars. These exoplanets are much more varied than the Solar System worlds. The group's bread and butter is analyzing and interpreting observations from space telescopes to infer atmospheric temperature, composition, clouds, winds, and seasonal variations of planets tens to hundreds of light years away. Since current space observatories were not designed to perform these kinds of observations, Prof Cowan and his students routinely push the instruments orders of magnitude beyond spec and they are generally interested in the problem of extracting signal from structured noise. Nick has modeled geochemical cycling and how it might affect the surface character of our planet---and by extension other terrestrial planets. His team is also working on the classic inverse problem of inferring a planet's obliquity and surface map based solely on the changing brightness and color of a pale blue dot, and they are heavily involved in the design of experiment for the next-generation of NASA missions to characterize exoplanets.

Balancing the Energy Budget of Short-Period Giant Planets, Schwartz & Cowan, Monthly Notices of the Royal Astr. Soc., 449, 4192, 2015

The Feeding Zones of Terrestrial Planets and Insights Into Moon Formation, Kaib & Cowan, Icarus, 252, 161, 2015
Features in the Broadband Eclipse Spectra of Exoplanets: Signal or Noise? Hansen, Schwartz & Cowan, Monthly Notices of the Royal Astr. Soc., 444, 3632, 2014
Water Cycling Between Ocean and Mantle: Super-Earths Need Not be Waterworlds, Cowan & Abbot, Astrophysical Journal, 781, 27, 2014
Determining Reflectance Spectra of Surfaces and Clouds on Exoplanets, Cowan & Strait, Astrophysical Journal Letters, 765, 17, 2013

ASSISTANT PROFESSOR NATALYA GOMEZ
(B.Sc., Toronto, 2006; Ph.D, Harvard, 2013)
(514) 398-4885
natalya.gomez@mcgill.ca

Chief research interests: A critical task of climate change research is to constrain the response of present-day ice reservoirs to climate warming and estimate their contribution to future sea-level rise. I work at the intersection between solid Earth geophysics and climate change science, studying the interactions between the solid Earth and climate systems. My research contributes to improving our understanding of past and future climate and ice mass changes by exploring the physics of sea-level changes and Earth deformation, accounting for this physics in state-of-the-art numerical models of ice-sheet evolution, and taking an integrated view of ice sheet – sea level – solid Earth interactions. The goals of my research are to aid in mitigating the impacts of climate warming, improve the interpretation of geophysical observations of the past and present Earth system, and delineate the edges of the Earth's resilience to climate change.

Gomez, N., Pollard, D., and Mitrovica, J.X. (2013). A 3-D coupled ice sheet - sea level model applied to Antarctica through the last 40 ky. Earth Planet. Sci. Lett. 384, 88-99.

Gomez, N., Pollard, D., Mitrovica, J.X., Huybers, P. and Clark, P.U. (2012). Evolution of a Coupled Marine Ice heet - Sea Level Model. J. Geophys. Res. 117, 9 pp.

Gomez, N., Mitrovica, J.X., Huybers, P. and Clark, P.U. (2010). Sea Level Change As a Stabilizing Influence on Marine Ice Sheets. Nature Geosci. 3, 850-853.

Gomez, N., Mitrovica, J.X., Tamisiea, M. and Clark, P.U. (2009). A New Projection of Sea-Level Change in Response to a Collapse of the Antarctic Ice Sheet. Geophys. J. Int. 180, 623-634.

Gomez, N., Gregoire, L.J., Mitrovica, J.X., Payne, A.J. (2015). Laurentide-Cordilleran Ice Sheet saddle collapse as a contribution to meltwater pulse 1A, Geophys. Res. Lett., 42, 3954–3962.

ASSOCIATE PROFESSOR GALEN HALVERSON
TH CLARK CHAIR
(B.A., University of Montana, 1996; Ph.D., Harvard University 2003)
(514) 398-4894
galen.halverson@mcgill.ca

Subjects taught: Sedimentology, stratigraphy, Earth and life history, field school
Chief research interests: Earth's environment has changed over 4.5 billion years from uninhabitable to capable of supporting complex life and ecosystems. Indeed, the evolution of Earth's surface environment and life are deeply intertwined and regulated by a complex system of biogeochemical feedbacks. Both have also been shaped by a combination of gradual, unidirectional change over geological time and singular events, such as catastrophic climate change and mass extinctions. My research entails documenting and interpreting Earth's paleoenvironmental change, with an emphasis on the last billion years of the Precambrian, when eukaryotes diversified and the oceans and atmospheres ultimately became sufficiently oxygenated to sustain large animals. These environmental changes accompanied assembly and break-up of supercontinents and were punctuated by two snowball glaciations. My research group calibrates and interrogates this interval of Earth's history and the interactions between the solid Earth, the biosphere, and the hydrosphere through a combination of field mapping, stratigraphic analysis, and geochemical measurements applied to the sedimentary record. Specific interests include the application of stable (e.g. C, S, Fe, Zn) and radiogenic (Sr, Nd, Os) isotopic systems to documenting changes in the redox state of the oceans and the roles of tectonics and the biosphere in regulating seawater chemistry.

Riedman, L.A., Porter, S.M, Halverson, G.P., Hurtgen, M.T., and Junium, C., 2014. Organic-walled microfossil assemblages from glacial and interglacial Neoproterozoic units of Australia and Svalbard. Geology, 42: 1011–1014.

Ader, M., Sansjofre, P., Halverson, G.P., Busigny, V., Trindade, R.I.F., Kunzmann, M., and Nogueira, A.C.R., 2014. Ocean redox structure across the Late Neoproterozoic Oxygenation Event: A nitrogen isotope perspective. Earth and Planetary Science Letters, 396: 1–13.

Nettle, D., Halverson, G.P., Cox, G.M., Collins, A.S., Schmitz, M., Gehling, J., Johnson, P.R, and Kadi, K., 2014. A middle–late Ediacaran volcano-sedimentary record from the eastern Arabian-Nubian Shield. Terra Nova, 26: 120–129.

Li, Z-F., Evans, D.A.D, and Halverson, G.P., 2013. Neoproterozoic glaciations in a revised global paleogeography from the breakup of Rodinia to the assembly of Gondwanaland. Sedimentary Geology, 294: 219–232.

Kunzmann, M., Halverson, G.P., Sossi, P.A., Raub, T.D., Payne, J.L., Kirby, J., 2013. Zinc isotope evidence for the resumption of bioproductivity after snowball Earth. Geology, 41: 27–30.

ASSISTANT PROFESSOR REBECCA HARRINGTON
(B.S., UCLA, 2003; M.S., UCLA, 2006; Ph.D., UCLA, 2008)
(514) 398-2722
rebecca.harrington@mcgill.ca

Subjects taught: Applied Geophysics, Earthquake Physics, Introductory Geology
Chief research interests: My research examines what causes earthquakes to start, and what influences how destructive they may be. Are similar sized earthquakes in different fault settings physically the same? How do smaller, more frequent earthquakes differ from larger, less-frequent, more destructive ones? I try to answer such questions by studying the rupture dynamics of earthquakes and non-volcanic tremor in various faulting environments, and related their source characteristics to the physical rupture process.

Horstmann, T., Harrington, R. M**.**, and Cochran, E. S., Using a modified Time Reverse Imaging technique to locate low-frequency earthquakes on the San Andreas Fault near Cholame, California, Geophysical Journal International (revise and resubmit).

Harrington, R. M., Kwiatek, G., and Moran, S. C., Volcanic hybrid earthquakes at Mount St. Helens suggest self-similar scaling properties, Journal of Geophysical Research (revise and resubmit).

Horstmann, T., Harrington, R. M., and Cochran, E. S., Semiautomated tremor detection using a combined cross-correlation and neural network approach, Journal of Geophysical Research, v. 118, 1-20, doi:10.1002/jgrb.50345, 2013

Harrington, R. M., and Benson, P. M., Analysis of laboratory simulations of volcanic hybrid earthquakes using empirical Green's functions, J. Geophy. Res., v. 116, B11303, 2011.

Harrington, R. M., and Brodsky, E. E., Source duration scales with magnitude differently for earthquakes on the San Andreas Fault and on secondary faults in Parkfield, California, Bull. Seismol. Soc. Am., v. 99, n. 4, pp. 2323-2334, 2009.

FULL PROFESSOR OLIVIA JENSEN

(B.Sc., British Columbia, 1964; M.Sc., British Columbia, 1966; Ph.D., British Columbia, 1971)
(514) 398-3587
olivia.jensen@mcgill.ca

Subjects taught: seismology, time series analysis, terrestrial planets, exploration and environmental geophysics
Chief research interests: complexity in geophysics and geology, mechanics and dynamics of the Earth and planets, seismology, stochastic models of geophysical data.

Jensen, O., Hinderer, J. and Crossley, D.J. Noise limitations in the core-mode band of superconducting gravimeter data, Phys. Earth Planet. Int., **90**, 169-191, 1995.

Hinderer, J., Crossley, D. and Jensen, O**.** A search for the Slichter triplet in superconducting gravimeter data, Phys. Earth Planet. Int., **90**, 183-195, 1995.

Jensen, O**.,** Ulrych, T.J. and Gregotski, M.E., Deconvolution of seismic sections to recover a 2-dimensional fractal reflectivity field, Journal of Seismic Exploration **4**, 45-60, 1995.

Gregotski, M.E. and **Jensen, O.** Fractal modeling techniques for spatial data, IEEE Trans. Geosci. Remote Sensing GE-31, 980-988, 1993.

Gregotski, M.E., Jensen, O. and Arkani-Hamed, J. Fractal stochastic models of aeromagnetic data, Geophysics 56, 1706 1715, 1991.

ASSISTANT PROFESSOR JAMES KIRKPATRICK

(MGeol., University of Leeds, 2003; Ph.D., University of Glasgow, 2008)
(514) 398-7442
james.kirkpatrick@mcgill.ca

Subjects taught: Structural geology, field school
Chief research interests: Using field observations to investigate the mechanics of brittle deformation with a focus on fault and earthquake mechanics. My research uses various tools to collect digital measurements of fault and fracture geometry, which are combined with rock microstructure and composition analyses and numerical models to investigate the stresses that drive deformation. The goals are to develop new methodologies for investigating rock mechanics in the field and ultimately bridge the divide between structural geology and seismology. Current and future projects include using fault damage zones to constrain friction, quantifying fault surface geometry to investigate wear, and integrating kinematic indicators to estimate paleo-stress fields.

Kirkpatrick, J. D., Rowe, C. D., Ujiie, K., Moore, J. C., Regalla, C. A., Remitti, F., Toy, V., Wolfson-Schwehr, M., Kameda, J., Bose, S., and Chester, F. M.; 2015: Structure and lithology of the Japan Trench subduction plate boundary fault, *Tectonics*, 34, doi:10.1002/2014TC003695.

Kirkpatrick, J. D. and Brodsky, E. E.; (2014): Slickenline orientations as a record of fault rock rheology, *Earth & Planet. Sci. Lett.*, 408, 24-34, doi:10.1016/j.epsl.2014.09.040.

Chester, F. D., Rowe, C. D., Ujiie, K., Kirkpatrick, J. D., Regalla, C., Remitti, F., Moore, J. C., Toy, V., Wolfson-Schwehr, M., Bose, S., Kameda, J., Mori, J. J., Brodsky, E., Eguchi, N., Toczko, S., and Expedition 343 and 343T Scientists; (2013): A thin and weak plate-boundary decollement in the region of maximum slip, 2011 Tohoku-oki earthquake, Science, 342(6163), 1208-1211, doi:10.1126/science.1243719.

Kirkpatrick, J. D., Rowe, C. D., White, J. C., and Brodsky, E. E.; (2013): Silica gel formation during fault slip: Evidence from the rock record, *Geology*, 41(9), 1015-1018, doi:10.1130/G34483.1.

Kirkpatrick, J. D. and Rowe, C. D.; (2013): Disappearing ink: How pseudotachylytes are lost from the rock record, *J. Struc. Geol.*, **52**, 183-198, doi:10.1016/j.jsg.2013.03.003.

ASSISTANT PROFESSOR YAJING LIU

(B.Sc., Peking University, 2001; M.Sc., Ph.D., Harvard University, 2007)
(514) 398-4085
yajing.liu@mcgill.ca

Subjects taught: Elementary Earth Physics
Chief research interests: My research to date has focused on understanding tectonic fault mechanical behavior and strength evolution in relation to a spectrum of seismic and aseismic deformation modes along major plate boundaries. Current research projects include (1) source mechanism of episodic slow slip events in subduction zones and relation to megathrust earthquakes, (2) source processes of earthquakes and possible aseismic slip on oceanic transform faults, (3) dynamic and static stress triggering of shallow fault creep events on continental strike-slip faults, (4) seismicity in the Charlevoix seismic zone, Quebec, (5) induced seismicity in western Canada, and (6) glacier-bedrock sliding process.

Graduate study (M.Sc. and/or Ph.D.) and undergraduate summer project opportunities are available to work on a variety of earthquake and glacier deformation problems. Contact me for further information.

Wang, B., R. M. Harrington, **Y. Liu**, H. Yu, A. Carey, N. van der Elst, "Isolated cases of remote dynamic triggering in Canada detected using cataloged earthquakes combined with a matched-filter approach", *Geophys. Res. Lett*., doi: 10.1002/2015GL064377, 2015.

Jiang, G.,X. Xu, G. Chen, **Y. Liu**, Y. Fukahata, H. Wang, G. Yu , X. Tan, C. Xu, Geodetic imaging of potential seismogenic asperities on the Xianshuihe Anninghe Zemuhe fault system, southwest China, with a new 3D viscoelastic interseismic coupling model, *J. Geophys. Res.,* doi:10.1002/2014JB011492, 2015.

Liu, Y., Source scaling relations and along-strike segmentation of slow slip events in a 3-D subduction fault model, *J. Geophys. Res.*, 119, doi:10.1002/2014JB011144, 2014.

Wei, M., Y. Kaneko, Y. Liu, and J. J. McGuire, Episodic fault creep events in California controlled by shallow frictional heterogeneity, *Nature Geoscience*, doi:10.1038/ngeo1835, 2013.

Liu, Y., Numerical simulations on megathrust rupture stabilized under strong dilatancy strengthening in slow slip region, *Geophys. Res. Lett*., 40, 1311-1316, doi:10.1002/grl.50298, 2013.

EMERITUS PROFESSOR ROBERT F. MARTIN

(B.Sc., Ottawa, 1963; M.S., Penn. State, 1966; Ph.D., Stanford, 1969)
(514) 398-7370
robert.martin@mcgill.ca

Subjects taught: igneous petrology, mineralogy, crystal chemistry

Chief research interests: Anorogenic felsic magmas, and associated metasomatic activity and mineralization; mineralogy of peraluminous and peralkaline granitic rocks; x-ray diffraction and transmission electron microscopy applied to the characterization of the rock-forming minerals; the mineralogy of feldspar-group and platinum-group minerals in all crustal environments.

Barkov, A.Y. & Martin, R.F. (2015): Anomalous Cr-rich zones in sector-zoned clinopyroxene macrocrysts in gabbro, Mont Royal, Montreal, Quebec, Canada. *The Canadian Mineralogist* **53**, (in press).

Barkov, A.Y., Nikiforov, A.A. & Martin, R.F. (2015): A novel mechanism of spheroidal weathering: a case study from the Monchepluton layered complex, Kola Peninsula, Russia. Bulletin of the Geological Society of Finland (accepted, in press).

Barkov, A.Y., Martin, R.F. & Cabri, L.J. (2015): Rare sulfides enriched in K, Tl and Pb from the Noril'sk and Salmagorsky complexes, Russia: new data and implications. *Mineralogical Magazine* **79**, 529-537.

Martin, R.F. & De Vito, C. (2014): The late-stage mini-flood of Ca in granitic pegmatites: an open-system acid-reflux model involving plagioclase in the exocontact. *The Canadian Mineralogist* **52**, 165-181.

Martin, R.F. & Wülser, P.-A. (2014): Niobium and tantalum in minerals: polyvalent elements, multiple coordinations, and widespread disorder. *Journal of Geochemical Exploration* **147**, 16-25.

Martin, R.F., Randrianandraisana, A. & Boulvais, P. (2014): Ampandrandava and similar phlogopite deposits in southern Madagascar: derivation from a silicocarbonatitic melt of crustal origin. *Journal of African Earth Sciences* **94**, 111-118.

ASSOCIATE PROFESSOR JEFFREY McKENZIE

(B.Sc., McGill, 1997; M.S., Syracuse, 2000; Ph.D., Syracuse, 2005)
(514) 398-3833
jeffrey.mckenzie@mcgill.ca

Subjects taught: Hydrogeology, Investigating the Earth System, others
Chief research interests: Cryohydrogeology – the study of groundwater systems in cold regions undergoing warming and thawing due to climate change. Specific projects include studying the impact of glacial recession on water resources in the tropics, groundwater/ permafrost issues in arctic regions, and simulating heat flux with freezing and porewater flow.

McKenzie, J.M**.**, C.I. Voss, 2013, Permafrost thaw in a nested groundwater-flow system, *Hydrogeology Journal*, DOI: 10.1007/s10040-012-0942-3.

Briggs, M.A., M.A. Walvoord, J.M. McKenzie, C.I. Voss, F.D. Day-Lewis, J.W. Lane, *2014*, New Permafrost is Forming Around Shrinking Arctic Lakes, But Will It Last? *Geophysical Research Letters*. DOI: 10.1002/2014GL059251.

Gordon, R., L.K. Lautz, J.M. McKenzie, B.G. Mark, D. Chavez, M. Baraer, 2015, Sources and pathways of stream generation in tropical proglacial valleys of the Cordillera Blanca, Peru, *Journal of Hydrology* 522:628-644. doi:10.1016/j.jhydrol.2015.01.013.

Baraer, M., B.G. Mark, B.G., J.M. McKenzie, 2014, Contribution of groundwater to the outflow from ungauged glacierized catchments: a multi-site study in the tropical Cordillera Blanca, Peru. *Hydrological Processes*. DOI: 10.1002/hyp.10386.

Kurlyk*, B., K.T.B. MacQuarrie, J.M. McKenzie, 2014, Climate change impacts on groundwater and soil temperatures in cold and temperate regions: Implications, mathematical theory, and emerging simulation tools. *Earth Science Reviews.* DOI: 10.1016/j.earscirev.2014.06.006.

PROFESSOR WILLIAM MINARIK

(B.A., St. Olaf College, 1984; M.Sc., University of Washington, 1989; Ph.D., Rensselaer 1994)
(514) 398-2596
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Subjects taught: metamorphic petrology, geochemistry, geoscience data analysis and statistics
Chief research interests: I am primarily responsible for technique development using our laser ablation plasma mass spectrometry (LA-ICP-MS) facility. I am also studying the petrology, geochemistry, and tectonics of the Appalachian lithosphere using both LA-ICP-MS trace element data and the Re-Os isotopic system. Other research interests include high pressure and temperature experimental petrology focusing on the: diffusion in and thermodynamics of melts and minerals and on the interfacial energies of geologic materials. I've also developed classroom demonstrations and computer models for teaching.

Minarik W. G**.**; 2004: Use of a Reaction Cell to reduce vanadium and iron interferences during Laser Ablation ICPMS. 9th International Conference on Plasma Source Mass Spectrometry.

Fei Y., Li J., Hirose K., Minarik W., Van Orman J., Sanloup C., van Westrenen W., Komabayashi T., and Funakoshi K.; 2004: A critical evaluation of pressure scales at high temperatures by in-situ X-ray diffraction measurements. Physics of the Earth and Planetary Interiors **143-144**: 515-526.

Fei Y., Van Orman J., Li J., van Westrenen W., Sanloup C., Minarik W., Hirose K., Komabayashi T., Walter M., and Funakoshi K.; 2004: Experimentally determined postspinel transformation boundary in Mg2SiO4

using MgO as an Internal Pressure Standard and its geophysical implications. Journal of Geophysical Research-Solid Earth **109**(B2), B02305.
Minarik B.; 2003: The Core of Planet Formation. Nature **422**, 126-128.
Rushmer, T., Minarik, W. G. and Taylor, G. J.; 2000: Physical Processes of Core Formation. In: Righter, K. and Canup, R. M. (ed) Origin of the Earth and Moon. University of Arizona Press/LPI, pp. 227-243.

FULL PROFESSOR ALFONSO MUCCI

(B.Sc. Montréal, 1976; M.Sc., Montréal, 1978; Ph.D., RSMAS/Miami, 1981)
(514) 398-4892
alfonso.mucci@mcgill.ca

Subjects taught: chemical oceanography, low-temperature geochemistry and diagenesis, principles of geochemistry, aqueous geochemistry, introductory physical geology (plate tectonics)
Chief research interests: application of chemical thermodynamics, kinetics and surface chemistry to the characterization of mineral-solution interactions in aquatic environments, carbonate geochemistry, ocean acidification, early diagenesis of marine and coastal sediments, trace metal and environmental geochemistry in freshwater and marine systems, CO_2 sequestration in geological formations

Mucci A**.**, Bernier G. and Guignard C. (2015) Mercury remobilization in Saguenay Fjord (Quebec, Canada) sediments: Insights following a mass-flow event and its capping efficiency. Applied Geochemistry **54:** 13-26. doi.org/10.1016/j.apgeochem.2014.12.008.
Giesbrecht K.E., Miller L.A., Zimmerman S., Carmack E., Johnson W.K., Macdonald R.W., McLaughlin F., Mucci A., Williams W.J., Wong C.S. and Yamamoto-Kawai M. (2014) Measurements of the dissolved inorganic carbon system and associated biogeochemical parameters in the Canadian Arctic, 1974-2009. Earth System Science Data **6:** 91-104. doi: 10.5194/essdd-6-91-2014.
Pratte S., Mucci A**.** and Garneau M. (2013) Historical record of atmospheric metal deposition along the St. Lawrence Valley (eastern Canada) based on peat bog cores. Atmospheric Environment **79:** 831-840. http://dx.doi.org/10.1016/j.atmosenv.2013.07.063.
Madison A.S., Tebo B.M., Mucci A**.**, Sundby B. and Luther III G. (2013) Abundant Mn(III) in sediment porewaters reveals new complexity in the sedimentary redox system. Science **341:** 875-878.
Lefort S., Mucci A**.** and Sundby B. (2012) Sediment response to 25 years of persistent hypoxia. Aquatic Geochemistry **18:** 461-474. doi:10.1007/s10498-012-9173-4.
Mucci A., Sundby B., Gilbert D. and Starr M. (2011) Acidification of the bottom waters in the St. Lawrence Estuary since the 1930s. Atmosphere-Ocean **49:** 206-213. doi:10.1080/07055900.2011.599265

ASSOCIATE PROFESSOR JEANNE PAQUETTE

(B.Sc., McGill, 1983; M.Sc., McGill, 1987; Ph.D., SUNY at Stony Brook, 1991)
(514) 398-4402
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Subjects taught: mineralogy, carbonate geochemistry

Chief research interests: Chemistry and crystallography of carbonate minerals. The effect of environmental factors (e.g. solution composition and temperature) on the morphology and composition of calcite is investigated experimentally. The results help us to relate compositional zoning patterns in natural carbonate minerals (including dolomite) to specific growth mechanism and eventually determine the conditions that controlled their crystallization. Techniques involved include cathodoluminescence microscopy, electron probe microanalysis, differential interference contrast microscopy and transmission electron microscopy.

Chouinard, A., Paquette, J**.**, Williams-Jones, A.E.; 2005: Crystallographic controls on trace-element incorporation in auriferous pyrite from the Pascua epithermal high-sulfidation deposit, Chile-Argentina. Canadian Mineralogist **43**: 951-963.

Friis, A.K., Davis, T.A., Figueira, M.M., Paquette, J., Mucci, A. 2003 : Influence of Bacillus subtilis cell walls and EDTA on calcite dissolution rates and crystal surface features. Environmental Science and Technology **37** (11): 2376-2382.

Temmam, M., Paquette, J**.**, Vali, H.; 2000: Mn and Zn incorporation into calcite as a function of chloride aqueous concentration. Geochimica et Cosmochimica Acta **64** (14): 2417-2430.

Paquette J**.,** Vali H. and Mountjoy E.W.; 1999: Novel TEM approaches to imaging of microstructures in carbonates: growth mechanisms in calcite and dolomite. American Mineralogist, **84**: 1939-1949.

ASSISTANT PROFESSOR CHRISTIE ROWE
WARES FACULTY SCHOLAR

(A.B., Smith College, 2000; Ph.D., UC Santa Cruz, 2007)
(514) 398-2769
christie.rowe@mcgill.ca

Subjects taught: structural geology, field methods, tectonics, crustal rheology, physics and geology of earthquakes, field school I, field school II

Chief research interests: How faults preserve records of ancient earthquakes, how the brittle-ductile transition works, non-continuous and catastrophic deformation in geological materials, clays and other particularly ugly minerals, field geology, shear zones, soft sediment deformation, X-ray diffraction, rock fabrics, rheology.

Rowe, C. D. and Griffith, W. A. (2015) Do faults preserve a record of seismic slip: A second opinion. Invited Review, *Journal of Structural Geology*, v. 78, 1-26.

Wakabayashi, J. and **Rowe, C. D.** (2015) Whither the Megathrust? Localization of large-scale subduction slip along the contact of a melange. *International Geology Review* **57** 5-8, 854-870.

Kirkpatrick, J., **Rowe, C.D.**, Ujiie, K., Moore, J.C., *Regalla, C.A., Remitti, F., Toy, V., Wolfson-Schwehr, M., Kameda, J., Bose, S., and Chester, F M., (2015) Structure and lithology of the Japan Trench subduction plate boundary fault. *Tectonics* **34** 1 53-69.

*Faber, C., **Rowe, C. D.**, Miller, J. A., Fagereng, Å., Neethling, J. H. (2014) Silica gel in a fault slip surface: field evidence for palaeo-earthquakes? *Journal of Structural Geology* v. 69 108-121.

*Backeberg, N. R., **Rowe, C. D.**, van Hinsberg, V. J., and *Bellefroid, E. J. (2014) The deformation history of the Finlayson Lake greenstone belt, Ontario, Canada: A structural perspective on a Mesoarchaean greenstone belt. *Precambrian Research* v. 249, 100-114.

*Melosh, B. L., **Rowe, C. D.,**, *Smit, L., *Groenewald, C., *Lambert, C. W., and Macey, P. (2014) Snap, Crackle, Pop: Dilational fault breccias record seismic slip below the brittle-ductile transition. *Earth & Planetary Science Letters* v. 403 432-445.

Chester, F. M., **Rowe, C. D.**, Ujiie, K., Kirkpatrick, J., Regalla, C., Remitti, F., Moore, J. C., Toy, V., Wolfson-Schwehr, M., Bose, S., Kameda, J., Mori, J. J., Brodsky, E., Eguchi, N., Toczko, S., and Expedition 343 and 343T Scientists (2013) Structure and composition of the plate-boundary slip-zone for the 2011 Tohoku-oki earthquake. *Science* v. 342 1208-1211.

Rowe, C. D. (2013) RESEARCH FOCUS - Shaking Loose: Sand volcanoes and Jurassic earthquakes. *Geology* v. 41 n. 10 1135-1136.

Rowe, C. D., Moore, J. C., Remitti, F., and the IODP Expedition 343 Science Party (2013) The thickness of subduction plate boundary faults from the seafloor into the seismogenic zone. *Geology* v. 41 n. 9 991-994

Kirkpatrick, J. D., **Rowe, C. D.**, White, J. C. and Brodsky, E. E. (2013) Silica gel formation during fault slip: Evidence from the rock record. *Geology* v. 41 n. 9 1015-1018.

Kirkpatrick, J. D. and **Rowe, C. D.** (2013) Disappearing ink: How pseudotachylytes are lost from the rock record. *Journal of Structural Geology* v. 52 183-198.

FULL PROFESSOR JOHN STIX

(A.B., Dartmouth, 1980; M.Sc., Toronto, 1985; Ph.D., Toronto, 1989)
(514) 398-5391
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Subjects taught: volcanology, natural disasters, environmental geology, field school
Chief research interests: My main interest is understanding how magmas migrate and evolve as they are transported out of the mantle, pass through the crust, and emerge at the surface as active volcanoes. I am also intrigued by how magmas and volcanoes are influenced and controlled by tectonics and vice versa. Another interest of mine is volatile elements, since this is the stuff that drives volcanic eruptions, in particular explosive activity. I am also fascinated by supervolcanoes, their eruptions, the resulting deposits, and the calderas they form. Finally, I like to try new approaches and new methodologies; currently I am using high-speed infrared videography to study lava lakes and lava flows, and I am planning on instrumenting drones with sensors to measure carbon dioxide fluxes from volcanoes.

Longpré, M.-A., J. Stix, C. Burkert, T. Hansteen, and S. Kutterolf, 2014. Sulfur budget and global climate impact of the AD 1835 eruption of Cosigüina volcano, Nicaragua. Geophys. Res. Lett., 41, doi:10.1002/2014GL061205.

Lucic, G., J. Stix, B. Sherwood Lollar, G. Lacrampe-Couloume, A. Muñoz, and M. Ibarra C., 2014. The degassing character of a young volcanic center: Cerro Negro, Nicaragua. Bull. Volcanol., 76: 850, doi:10.1007/s00445-014-0850-6

Longpré, M.-A., J. Stix, F. Costa, E. Espinoza, and A. Muñoz, 2014. Magmatic processes and associated timescales leading to the January 1835 eruption of Cosigüina volcano, Nicaragua. J. Petrol., 55: 1173-1201.

Longpré, M.-A., A. Klügel, A. Diehl, and J. Stix, 2014. Mixing in mantle magma reservoirs prior to and during the 2011-2012 eruption at El Hierro, Canary Islands. Geology, 42: 315-318.

ADJUNCT PROFESSOR BJØRN SUNDBY

Professor, Institut des Sciences de la Mer (ISMER)
Université du Québec à Rimouski
(Ph.D. University of Bergen, 1966; Dr. Philos. U. of Bergen, 1987)
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Subjects taught: Advances in oceanography (Joint doctorate program in oceanography)

Chief research interests: Early diagenesis of sediments in environments ranging from salt marshes to deep basins in the Arctic Ocean. My research focuses on redox chemistry and is relevant to any element whose distribution in sediments is related to the carbon cycle. They include major elements such as Fe and Mn, nutrient elements such as N, P, and Si, and trace elements such as Cd, Mo, U, and Re. The interactions between living organisms (bacteria, animals and plants) and sediments receive special attention. Recent and ongoing projects include the use of a solid state voltammetric microelectrode to measure redox species directly in sediment pore water; recent changes in sediment chemistry in the deep Arctic Ocean basins as a result of global warming; the cycle of lead in the root zone of salt marsh sediments; the coupled geochemistry of Mn, N and I in sediments; geochemistry of Mo, Cd, U and Re in view of their use as paleo redox-tracers.

Sundby, B., Lecroart, P., Anschutz, P., Katsev, S., Mucci. A. (2015) When deep diagenesis in Arctic Ocean sediments compromises manganese-based geochronology. Marine Geology **366**: 62–68.

Richard, D., Sundby, B., and Mucci, A. (2012) Kinetics of manganese adsorption, desorption and oxidation in coastal marine sediments. Limnology & Oceanography, **58**: 987–996.

Michaud, E., Desrosiers, G. Aller, R.C., Mermillod-Blondin, F., Sundby, B., Stora, G. (2009) Spatial interactions in the Macoma balthica community control microbial ecology and biogeochemical fluxes at the sediment-water interface. Journal of Marine Research, **67**: 43–70.

Gilbert, D., Sundby, B., Gobeil, C., Mucci, A., Tremblay, G.H. (2005) A seventy-two-year record of diminishing deep-water oxygen in the St. Lawrence estuary: The northwest Atlantic connection. Limnology and Oceanography **50** (5): 1654-1666.

Sundby, B**.,** Caetano, M., Vale, C., Gobeil, C., Luther, G.W., and Nuzzio, D.B. (2005) Root-induced cycling of lead in salt marsh sediments. Environmental Science and Technology **39** (7): 2080-2086.

Sundby, B., Martinez, P., Gobeil, C. (2004) Comparative geochemistry of rhenium, uranium, cadmium, and molybdenum during diagenesis of marine sediments. Geochimica et Cosmochimica Acta **68** (11): 2485–2493.

Sundby, B., Vale, C., Caetano, M., and Luther, G.W. (2003) Redox chemistry in the root zone of a salt marsh sediment in the Tagus Estuary, Portugal. Aquatic Geochemistry **9** (3): 257-271.

ASSISTANT PROFESSOR VINCENT VAN HINSBERG
OSISKO FACULTY SCHOLAR
(Doctorandus, Universiteit Utrecht, 2001; Ph.D., University of Bristol, 2006)
(514) 398-8112
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Subjects taught: Metamorphic Geology, Field School, Geostatistics

Chief research interests: My research, and that of my group, focuses on using minerals to reconstruct the pressure, temperature and fluid compositions of their host environment, both for the present and back in time to the earliest history of our planet. We combine field- and labwork on natural samples with experiments and modeling of mineral-fluid element partitioning to calculate the compositions of ore-forming fluids, determine the changes in ocean water composition through time, characterize element release from the subducting slab, and reconstruct a history of volcanic activity at the Kawah Ijen crater lake in Indonesia. I have a diverse interest in geochemistry, petrology, thermodynamics and geostatistics. I also have a special interest in the mineral tourmaline.

Van Hinsberg V, Zinngrebe E, Melzer S, van der Laan S, Jonckbloedt R (2013) Influence of Texture and Trace Element Composition on Hematite to Wüstite Reduction Rates of Fine Iron ore Fragments. ISIJ International 53: 2018–2027.

van Hinsberg VJ, Henry DJ, Dutrow BL (2011) Tourmaline as a forensic mineral providing a record its geological past. Elements 7: 325-332

van Hinsberg VJ, Williams-Jones AE, Migdisov, AA (2010) Reading the mineral record of fluid composition from element partitioning. Geology 38:847-850

van Hinsberg VJ, Schumacher JC (2007) Using estimated thermodynamic properties to model accessory phases: the case of tourmaline. Journal of Metamorphic Geology 25:769-779

van Hinsberg VJ, Schumacher JC (2007) Intersector element partitioning in tourmaline; a powerful single rystal thermometer. Contributions to Mineralogy and Petrology 153:289-301

PROFESSOR ANTHONY E. WILLIAMS-JONES
LOGAN CHAIR
(B.Sc., Natal, 1967; M.Sc., Natal, 1969; Ph.D., Queen's, 1973)
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Subjects taught: economic geology, metamorphic petrology, ore petrology

Chief research interests: The interplay of felsic magmatism and hydrothermal processes in the formation of metallic mineral deposits, particularly of lithophile elements such as tin, tungsten and REE, and the precious metals, gold and silver. Field-based studies of the relationships between igneous evolution and economic metal concentration by hydrothermal processes are combined with theoretical and experimental studies of mineral equilibria, water-rock interaction and metallic mineral solubility. Currently Professor Williams-Jones, research associates and students are investigating: rare metal (Be, Li, Mo) zonation and pegmatite genesis in peraluminous granites; water-rock interaction (greisen formation) and Sn mineralization in peraluminous granites; vapour transport of gold in active volcanoes: Hemlo-style archean Au-Mo metallogenesis; brine/hydrocarbon degassing in

peralkaline granites and rare metal mineralization (REE, Y, Zr); brine/CO_2 degassing in carbonatites and REE mineralization; the solubility and speciation of Au, Ag, Hg and REE in hydrothermal fluids; epithermal Au-Ag mineralization; and the metallogeny of Sb.

Hurtig, N.C. and Williams-Jones, A.E. (2015). Porphyry-epithermal Au-Ag-Mo ore formation by vapor-like fluids: New insights from geochemical modeling. Geology, doi: 10.1.1130/G36685.1.

Fuchs, S., Schumann, D., Williams-Jones, A.E., and Vali, H. (2015). The growth and concentration of uranium and titanium minerals in hydrocarbons of the Carbon Leader Reef, Witwatersrand Supergroup, South Africa. Chemical Geology, 393-394, 55-66.

Vasyukova, O and Williams-Jones, A.E., (2014). Fluoride-silicate melt immiscibility and its role in REE ore formation: Evidence from the Strange Lake rare metal deposit, Quebec-Labrador, Canada. Geochimica et Cosmochimica Acta, 139, 110-130.

Gysi, A. and Williams-Jones, A.E. (2015). The thermodynamic properties of bastnäsite-(Ce) and parasite-(Ce). Chemical Geology, 392, 87-101.

Williams-Jones, A.E. and Migdisov, A.A. (2014) Experimental constraints on the transport and deposition of metals in ore-forming hydrothermal systems. SEG Special Publication 18, 77-95.

ASSOCIATE PROFESSOR BOSWELL WING
DAWSON CHAIR

(A.B., Harvard, 1996; M.A., Johns Hopkins, 1998; Ph.D., Johns Hopkins, 2004)
(514) 398-6772
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Subjects taught: Earth system science, isotope geology

Chief research interests: Earth system processes leave behind a geochemical 'memory' of their operation. In order to constrain the presence and vigor of these processes in the recent and ancient past, my research exploits the persistence of this memory in solid Earth archives and the unique ability of stable isotope measurements to recover it. Recent topics of study are varied and extend from the atmospheric trace gases that control the habitability of the planet to the deep crustal fluids involved in metamorphism and mountain building. Upcoming research will use high-precision measurements of total oxygen (^{16}O, ^{17}O, ^{18}O) and sulfur (^{32}S, ^{33}S, ^{34}S, ^{36}S) stable isotope abundances to investigate microbial biogeochemistry under an anoxic Archean atmosphere, to constrain mass fluxes in the Phanerozoic geologic sulfur cycle, and to track processes that control the pollution-cleansing oxidants (OH, O_3) in the modern atmosphere.

Johnston, D.T., Wing, B.A., Farquhar, J., Kaufman, A.J., Strauss, H., Lyons, T.W., Kah, L.C. and Canfield, D.E.; 2005: Active microbial sulfur disproportionation in the Mesoproterozoic. Science, **310**: 1477-1479.

Farquhar, J., and Wing, B.A.; 2003: Multiple sulfur isotopes and the evolution of the atmosphere. Earth Plan. Sci. Lett. **213**: 1-13.

Wing, B.A. and Ferry, J.M.; 2002: Three-dimensional geometry of metamorphic fluid flow during Barrovian regional metamorphism from an inversion of combined petrologic and stable isotopic data. Geology, **30**: 639-642.

Farquhar, J., Wing, B.A., McKeegan, K.D., Harris, J.W., Cartigny, P. and Thiemens, M.H.; 2002: Mass-independent sulfur of inclusions in diamond and sulfur recycling on early Earth. Science, **298**: 2369-2372.