



Short Courses and Field Trips

Registration for the short courses and field trips should be made through the RFG2018 website (<http://rfq2018.org/en/RFG/2018/Technical-Program/Register%20here>)

Further Information: Visit the RFG2018 website (<http://rfq2018.org>), or contact Dr. Peter Winterburn (pwinterburn@eoas.ubc.ca).

Costs: One day short courses are priced at CAN \$350 for professionals and \$175 for students. The cost includes course notes (memory stick), coffee breaks, and lunch. Short courses are subject to a minimum participation and may be cancelled if the minimum is not achieved.

Sunday, June 17th, 2018 Pre-conference 1 Day short Courses - Association of Applied Geochemists

Mineral Chemistry: Applications to Mineral Exploration - Mineral chemistry methods have long been routinely and successfully employed in diamond exploration, and over the past decade have also been increasingly utilised in base and precious metal exploration. Some of these methods promise great potential to improve assessment of metallogenic fertility and vectoring to mineralisation, and will undoubtedly see much wider application in exploration programs in the years to come. This one-day short course is intended to introduce exploration geologists and geochemist to the state of the art of key mineral chemistry methods used in the exploration for diamond, porphyry copper, epithermal gold and orogenic gold deposits. The short course will be presented by a high-calibre team from industry and academia, and will focus on exploration-relevant applications and case studies, while also providing an adequate understanding of the scientific and analytical fundamentals. Facilitator: Dr. Christian Ihlenfeld.

Exploration Geochemistry: From fundamentals to the field - Geochemistry remains one of the fundamental tools used in mineral exploration along with geology and geophysics, however, underlying fundamentals that govern the behavior of chemical elements in the environment is often poorly understood by geologists leading to inappropriate application. Modern analytical techniques often provide a wealth of trace element information for 50 plus elements at sub ppm level, however, few organisations maximise the value of this information in the context of target selection, prioritisation and geochemical-geological mapping. This short course is intended to introduce the geologist / geochemist to simple fundamental concepts that govern the distribution and dispersion of chemical elements in mineral deposits and the natural environment and apply the principles to the design of surveys, analytical methodology/technology, target selection/prioritisation and lessons to be learnt from survey post-mortems. Facilitator: Dr. Peter Winterburn.

Friday, June 22, 2018 Post-conference 1-Day short Courses - Association of Applied Geochemists

Litho geochemistry: Theory and application from project generation to operation - Litho geochemical studies form a central component of many exploration and research initiatives, however are often poorly understood and applied. Litho geochemistry has applications ranging from regional mineral exploration to around mine and deposit extension studies in addition to geometallurgy and mine waste management. A proper understanding of its application can provide fundamental insights into the chemistry and mineralogy and trace-element-mineralogy associations often buried in complex whole rock datasets. This short course will introduce applications of litho geochemical interpretation from early stage mineral exploration and our understanding of ore deposits through to linking litho geochemistry to geometallurgical studies. This short course provides an insight into how industry leaders and researchers are applying litho geochemistry to answer some of the many questions facing the exploration and mining sector today. The short course will be a full day comprising discussions from both industry leaders (Teck, Anglo American, BHP and First Quantum), consultants and academics and is designed with practical examples of real world application beyond theory. Facilitator: Dr. Ian Dalrymple.

Regolith in deeply weathered terrains - Deeply weathered landscapes occur over wide areas in a range of present-day climatic conditions, from rainforest to semi-arid and from tropical to temperate. They include many highly weathered prospective regions in Australia, South America, Africa and SE Asia and present both problems and opportunities for exploration. The challenge is to explore these areas effectively. Effective geochemical exploration can only be achieved by understanding the regolith and landscape and metal dispersion processes that have occurred within it in different climatic regions. The course will provide an

introduction to the nature and formation of regolith and landscapes of these terrains, comparing and contrasting them across regions, including recommendations for a suitable terminology. Geochemical dispersion will be discussed within the context of regolith-landscape evolution in different regions and illustrated with numerous case studies based on research and exploration experience. Facilitator: Dr. Ravi Anand.

Integration of Exploration Geochemical and Mineralogical Data - Geochemical and mineralogical data are now routinely collected on the same sample material, but the interpretation of these data sets is often done separately. Geochemical data may include assays or multi-element data collected from crushed rock or from surficial material. Mineralogical data may include hyperspectral analyses, semi-quantitative XRD or heavy mineral separates. Integration of complementary data sets such as these on a single interpretive platform allows for a better understanding of geochemical and mineralogical processes associated with hydrothermal mineralisation and secondary dispersion. The short course will enable the interpretation of geochemical and mineralogical data collected on the same samples by various means including fp-XRF, XRD, hyper-spectral, and conventional geochemical techniques. This short course will require participants to bring a laptop computer and download a demonstration copy of ioGAS interpretative software in the week prior to the course if they do not already have a license. Participants will undertake interpretation of published data sets following lectures to provide background on expected geochemical and mineralogical responses from some common hydrothermal mineral deposit types. Facilitator: Dennis Arne.

Advanced Concepts in Evaluating and Interpreting Geochemical Data - Over the last decade there has been a rapid growth in the application of data analytics for data-driven business decisions in virtually every industry. It is our belief that over the next 10 years the mining industry will have to rapidly adopt and apply the power of data analytics to the ever-growing volume of geochemical data sets. However, geochemical data have unique mathematical properties and should not be analyzed without consideration of its structure. Geochemical data are reported as a composition; by definition it will sum to a constant and therefore none of the components (elements/oxides) are free to vary independently. This special property of geochemical data makes the application of standard data analytics methodologies flawed. The workshop will introduce several methods to circumvent problems arising from the compositional nature of geochemical data. Classical raw elemental ratios resolve the constant sum problem and are useful to model stoichiometrically controlled processes. However, these raw ratios restrict geochemical data to positive numbers which limits the application of most data analytics methods; typically developed for variables that are free to range in the positive and negative space of the real numbers. Alternatively, log-ratios of compositional data solve the constant sum problem and range across the entire real number space. The log-ratio transformations make geochemical data amenable to an arsenal of data analytics tools available to unlock the

valuable information contained in data sets, allow for process discovery and subsequent process validation. Participants of this workshop will learn methods for data analytics in geochemistry. The workshop will cover the application of; applying ratios and logratios to compositional data; molar element ratio methods; multivariate methods including principal component analysis, cluster analysis, discriminant analysis, classification and regression trees, multi-fractals, and linear/non-linear geostatistics. Facilitator Dr. Eric Grunsky.

Exploration Geochemistry: Field analysis and characterisation - On-site geochemistry and mineralogy underwent a fast development with mineral exploration and mine site management in the last decade. This brings field teams the opportunity of immediate decisions and dynamic targeting, with significant benefits in time and costs. Systematic field measurements can provide reliable information for lab sample screening and for target selection, prioritisation and geochemical-geological mapping. However, discrepancies between field measurements and laboratory analyses may happen and cast doubt on the former. This cannot be solved without good analytical practice and QA/QC, and with a sufficient geochemical knowledge. This short course is intended to provide the geologist / geochemist an up to date overview of field analytics, how to make profit of them and apply them to the design of exploration surveys, drilling monitoring, ore and waste management and site closure. Facilitator: Dr. Bruno Lemière.

Analytical Quality Control: Data Integrity for the Advancement of Science - Regardless of the field of study, accurate information is essential to maintaining the integrity of research and making correct business decisions. A wide range of technical data is collected for geological, environmental and mining projects and in all cases the accuracy and precision of the information must be measured and understood. Poor quality data results for a research project may result in the inability to repeat and validate the study. For mineral exploration and mining applications, distorted findings can result in wasted resources. This short course will introduce participants to the basics of quality control with an emphasis on collection of geochemical data. Fundamental concepts such as contamination, analytical drift and precision will be introduced using case histories. The methods to monitor and control data quality, such as the insertion of barren materials, reference materials and duplicates will be explained as well as the statistics and graphs necessary to identify quality control failures. Exercises, primarily using Excel spreadsheets, will provide participants with hands-on learning and tools to use in the workplace. The afternoon session will concentrate on the lessons learned since 1999 when the Canadian security exchanges mandated the use of assay quality control in the mining industry. Whereas, the mining industry has generally implemented systematic quality control procedures, questions still arise for practitioners. Common questions around fit for purpose data, correct control limits, application of precision information and legal requirements will be addressed. Facilitator: Lynda Bloom.

Post-Conference Field Trips - Association of Applied Geochemists

Navigating a porphyry Cu hydrothermal system: Alteration and geochemical dispersion mapping - Yerington, Nevada, USA

2.5 days - Friday, June 22 to Sunday, June 24, 2018 \$470 Include: transportation, luncheons and accommodation; ex-Reno, Nevada.

This 2.5-day field trip will examine the geology, hydrothermal alteration mineralogy, and geochemical dispersion around Yerington, Nevada. Yerington is a classic locality where porphyry Cu deposits, high level Fe-oxide deposits, and volcanic and plutonic complex have been tilted 80° on to their side so that a complete 3-D picture of a zoned magmatic-hydrothermal system is exposed. Day 1 of the field trip will focus on the geology of the porphyry Cu system beginning 3 km beneath to the level of copper precipitation. Day 2 will focus on the upper 3 km of the porphyry Cu system. Each day will link the geology of the tilted system with the alteration mineralogy together with the whole rock major and trace element geochemical changes in rocks that can be mapped using modern exploration methodology. Short hikes of up to 2 hours in duration are involved each day. Facilitated by: Richard Tosdal and John Dilles

Highland Valley Porphyry Copper Deposits: District-Scale Footprints - Merritt, British Columbia

2.5 days - Friday, June 22 to Sunday, June 24, 2018 \$600 Include: transportation, luncheons, accommodation and guidebook

This 2.5 day post-conference field trip (June 22-24) will examine the magmatic evolution, mapped alteration, hyperspectral response, and the litho-geochemical and C isotope footprints around the Highland Valley Porphyry Cu (HVC) deposits hosted in the Guichon Creek batholith in southcentral British Columbia. The review of the district will focus on the integration of the disparate data sets to better define the extent of the porphyry related hydrothermal alteration. Additionally, we will visit some key surficial geology sites and discuss the composition and mineralogy of till and its relationship to dispersion from the porphyry centers.

The volume of hydrothermally altered rocks outboard of economically significant concentrations of Cu-Fe-sulfide minerals is termed the porphyry footprint. An understanding of the fluid types that can be present during porphyry Cu formation, how they manifest in the footprint and their spatial distribution with respect to Cu-mineralized portions of the system is critical to developing better exploration tools. Four major porphyry Cu (\pm Mo) systems, hosted in various intrusive facies of the Late Triassic calc-alkalic Guichon Creek batholith, occur in the HVC district. Exposure and airborne magnetic data indicate that the batholith has an oval shape,

elongate to the northwest, with a long axis of approximately 60 km and a short axis of 25 km. Due to its size and low degree of exposure (~3%), the HVC district is a realistic natural laboratory in which to investigate the large-scale footprint of porphyry Cu deposits and has been the subject of recent detailed mapping and sampling by the NSERC-Canadian Mining Innovation Council Footprints project. The field review of the district-scale footprint will consist of a traverse of representative outcrops, with accompanying data-sheets, from the margins of the batholith towards Cu mineralization associated with the actively mined porphyry centers. The focus will be on the regional alteration footprint and will not include a mine tour. Facilitated by: Kevin Byrne, University of Alberta. Guillaume Lesage, Mineral Deposit Research Unit. Alain Plouffe, Geological Survey of Canada. Robert Lee, Mineral Deposit Research Unit.

Geochemical Field Techniques - Mt Washington, Vancouver Island, British Columbia

3 days - Friday, June 22 to Sunday, June 24, 2018 \$1050 Include: transportation, meals, accommodation and guidebook.

All successful geochemical surveys begin with collecting good samples, that in turn, rely on in-the-field recognition of appropriate sample media. The explorationist must identify the landforms (especially in glaciated terrains) from which the media are drawn to accurately interpret source provenance of any anomalous results. This field trip is targeted to geoscientists who want to learn more about interpreting glacial landforms and the sampling of soils, tills, sediments and vegetation from leading industry experts in quaternary geology, biogeochemistry, exploration geochemistry and analytical chemistry. The field trip will visit two mineral deposits (an active massive sulphide mine and a porphyry Cu-Au prospect) on Vancouver Island. In situ analyses using field portable instruments (e.g. pXRF) combined with subsequent lab analyses of collected samples will give the participants a full appreciation of discovering geochemical anomalies and tracing these to mineralization. Facilitated by John Gravel.