New Targets and Trends Identified in Data from the British Columbia, Canada, Regional Geochemical Survey

Just how effective are large, reconnaissance scale geochemical surveys for finding new mineral resources? The Province of British Columbia regional geochemical survey (RGS) aims to identify areas of bedrock with higher geochemical values indicating a greater mineral potential. Outlining areas of higher mineral potential using RGS data allows mining companies and individual prospectors to better focus their exploration activities. Geological Survey of Canada (GSC) sample collection and analysis standards established when the GSC’s national geochemical reconnaissance (NGR) program was originally started in 1974 have been adopted by the RGS. The seamless geochemical database, created by maintaining these standards, has been confidently used, not only for mineral exploration, but also for environmental monitoring and land use evaluation. At an average density of one sample per 13 km² it is unlikely that the RGS will detect the geochemical expression of every mineral occurrence. However, there have been recent examples in British Columbia where prospecting follow up of subdued stream sediment Au values has resulted in the discovery of significant precious metal mineralization.

Ideally reconnaissance scale geochemical sampling should be able to detect element variations over a range of contrasting surface environments. British Columbia’s climate ranges from a temperate, high rainfall zone along the coast, to continental semi-arid conditions in the interior of the province. Topography varies from high mountain ranges to undulating plateaus. Landforms commonly reflect the effects of continental and alpine glaciation and much of the bedrock is concealed beneath a complex veneer of glacial sediment. Stream sediment is the preferred RGS sample media. Over 50,000 stream sediment and water samples, covering over 70 percent of the province, have been collected since the RGS program was started in 1976. Moss is often sampled as an alternative to drainage sediment in mountains because finer textured material is often depleted in fast flowing streams, but is captured by the moss. Lakes are numerous in low relief, swampy areas where streams are absent or poorly developed, thus Lake-bottom organic sediment sampling is often more feasible in these areas for reconnaissance surveys. More detailed...
attendees inquired about membership and it was reassuring to see a number of students attending the workshop.

The conference, for me, confirmed a number of trends in the minerals industry that we as an association should seek to address. Firstly, that greater skill and understanding will be required, in future, to locate and develop mineral deposits to replace rapidly decreasing resources. Most speakers cited deep ore bodies as the future target for mining companies, yet the discovery of deposits like Midway in Nevada and Las Cruces in Spain reflect the fact that near-surface deposits may still be discovered.

However, whether deep or relatively shallow or in unexpected geological terrains a better appreciation of the geological characteristics will be essential in the next generation of targets. I would argue further (admittedly from a biased view) that geochemical characterization of metallic (and many non-metallics) deposits will be essential if companies are to explore successfully and so replenish consumed resources. Despite this, I was greatly surprised and a little disturbed that some of the invited speakers at the SEG conference attributed little success to geochemistry being involved in exploration with a few being highly critical of the role of geochemistry. I would like to counter this image of our science. To this end, I would be interested in hearing from any members (contact details on the back page) who can demonstrate (or provide a reference) where an original mineral deposit discovery can be attributed to geochemistry or where geochemistry played an integral role in the discovery of an economic ore deposit that became a working operation. Only by documenting the contribution of our discipline can we hope to gain just recognition.

Secondly, I was surprised to see just how limited the funding of geological, especially economic geology, research really is. Mr Lassonde reflected, in his presentation, that whilst pharmaceutical companies on average spend more than 50% of their turnover on research and Microsoft some 37% the highest portion of spending in mining is somewhere around 5% of turnover and that is on every aspect of mining. Exploration is probably not even the highest receiver from this 5%. Despite this inequality the merits of research in pharmacy or software development can only be reaped for seven years, thereafter the patent expires and exclusivity is lost. By comparison, discovery of a major mineral deposit can result in an exclusive use of a resource for decades or even a century or more so the actual return on value is significantly greater. Currently council is finalizing the Distinguished Geochemists Fund that we hope to announce in the next months. This fund, in honour of some of our most eminent members, will we hope provide some support for applied geochemistry; be it through research, fieldwork or conference attendance. We hope that as many members as possible will support this fund and provide it with a firm foundation to support the next generation of applied geochemists.

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However not all trends were so pessimistic, I was also pleased to see at the conference a number of students attending the meeting, thanks to sponsorship from the mining companies. One evening was given over to a “mentoring event” and I was pleased to meet not only a student from my old university but one who shared the same tutor. The AAG also hopes to foster our students and promote their studies in applied geochemistry. To this end we have lowered the membership price for students and hope many of them will benefit through the Distinguished Geochemists Fund. So if you are involved in educating students in applied geochemistry, please encourage them to sign up and get the benefit of being a member.

Rob Bowell, President AAG

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till and heavy mineral sampling is used to complement reconnaissance scale sediment surveys for better defining exploration targets. Orientation surveys help refine geochemical survey techniques for different styles of mineralization (Lett and Jackaman, 2000; Lett and Friske, 2006). Figure 1 (see page 1) shows the RG5 coverage by the different types of geochemical surveys in British Columbia.

Routine sediment sample collection, analysis and quality control

Systematically recording information about the sample site during the survey and maintaining strict quality control are key factors for ensuring the high quality RGS geochemical database. The present field data collection forms are designed for helicopter-supported surveys where careful collection and accurate information

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recording must be balanced by collection efficiency (Fig. 2). Routine quality control starts with randomly selected field duplicate samples taken at a frequency of one duplicate pair in every batch of 20 samples. Samples are preferably dried in the field and screened in the laboratory to minus 80 mesh (< 0.177 mm). Analytical duplicate samples and standard reference materials are randomly inserted into each batch of 20 prepared samples before analysis.

Figure 2. Helicopter supported stream sediment and water sampling in northwestern British Columbia. Roughly 2 kg of fine textured sediment is being collected from a stream bar in the active channel above the current low water level. Extremely high or low energy stream sites are avoided where ever possible so that the sample is representative of the sediment. A 250 ml bulk water sample is also being taken from the stream for later analysis of pH and other elements.

The minus 80 mesh fraction of sediment is analyzed by aqua regia digestion and inductively coupled plasma mass spectrometry (ICP-MS) to determine the following elements: Al, Ag, As, Ba, Bi, Cd, Ca, Cr, Co, Cu, Ga, Au, Fe, La, Pb, Mg, Mn, Hg, Mo, Na, Ni, P, K, Sb, Sc, Se, Sr, S, Te, Ti, Th, Ti, W, U, V and Zn. It is also analyzed by instrumental neutron activation (INAA) for: Au, Ag, Sb, As, Ba, Br, Cd, Ce, Cs, Cr, Co, Eu, Hf, Ir, Fe, La, Lu, Mo, Na, Ni, Rb, Sm, Sc, Se, Ta, Tb, Th, U, Yb, Zn and Zr.

Atomic absorption spectrophotometry (AAS) was employed after aqua regia digestion to determine metals present in earlier surveys. Sediment samples are also analysed for loss on ignition (LOI) at 500°C and for fluoride by a fusion-specific ion electrode method. Samples with anomalous Au contents are routinely checked by a second Au analysis. Unfiltered stream water samples are routinely analysed for pH, conductivity, uranium and fluoride. Selected water samples are filtered and acidified in the field and later analysed for trace and major elements by ICP-MS.

Geological trends and prospecting targets

British Columbia bedrock geology reflects periodic post Paleozoic collision and accretion of oceanic plates against the Precambrian North American continent to form a series of northwest trending tectonically distinct belts or terranes (Fig. 3). The rocks comprising each terrane host different types of mineralization. They can also have a distinct geochemical signature that may be identified by variations in regional stream sediment geochemistry. Neutron activation results are perhaps best suited for detecting lithogeochemical patterns because the technique determines almost total element abundances. A number of REE that can help discriminate between terranes are also determined by neutron activation. La to Lu ratios plotted in Figure 4 highlight an area in southeastern British Columbia where volcanic and intrusive rocks may have been contaminated by older crustal rocks during tectonic evolution. Source areas for stream sediment with elevated La:Lu ratio have the potential to host skarn and Fe oxide Cu-Au deposits.

Among the more common styles of base and precious metal mineralization in British Columbia are volcanogenic massive sulphide, porphyry Cu-Au, porphyry Cu-Mo and epithermal Au deposits. Elevated As, Sb and Hg levels are commonly associated with epithermal Au mineralization.
One simple method for identifying new Au prospects using RGS geochemical data is to screen the database for samples with Au values above the 99th percentile (> 120 ppb Au) and with a similar Au value in the recheck analysis. Anomalous samples located on a mineral claim and < 3 km from a known mineral occurrence are also excluded. In mid March 2006 screening revealed that there were 23 RGS sites that met these criteria. Closer examination of the area surrounding these 23 anomalous samples using the BC Geological Survey MapPlace site (http://www.em.gov.bc.ca/Mining/Geolsurv/MapPlace/) showed that many of the sites were close to existing mineral claims or were in areas of active exploration.

Weaker geochemical anomalies may be less attractive as targets, but can also reflect the presence of a significant mineral occurrence. An example is the discovery of the Skoonka Creek Au property near Spences Bridge in southern British Columbia by a junior mining company, Almaden Minerals, in 2003. Prospecting in a tributary of Skoonka Creek where a value of 21 ppb Au in the stream sediment had been reported from a previously published government geochemical survey (Jackaman and Matysek, 1994) led to the discovery of quartz vein float containing over 55 ppm Au. Further prospecting resulted in discovery of mineralized quartz veins that are hosted by the Spences Bridge Group, a Cretaceous volcanic assemblage previously unexplored for Au. The discovery of the veins illustrates the value of re-examining previously published geochemical data. While the original RGS had been carried out in 1983, the samples were only analysed for Au by INAA in 1994 as part of an RGS archive sample re-analysis program. Almaden staff examined the weakly anomalous Au values in 2003 and focused their prospecting on the Skoonka Creek area. The location of the mineral property is shown in Figure 1 and a detailed map of the RGS stream sediment Au geochemistry in the area is shown in Figure 6.

Clearly low contrast reconnaissance scale sediment Au anomalies can be a useful guide to mineralization. A further screening of the RGS database was used to identify samples with Au in the 95 to 98-percentile range (17 to 40 ppb) with a similar Au value in the repeat analysis. Again, anomalous sites were excluded if located on a mineral claim and < 3 km from a known mineral occurrence. In addition, only sites with > 20 ppm As in...
the sediment were selected. A total of 36 sites meeting these criteria were identified and their locations are shown on Figure 7. Closer examination of the area around the 36 selected sites reveals that more than half of them have no known bedrock source of precious metal.

While there are other techniques of interpreting RGS survey data to identify prospecting targets in British Columbia (Smyth, 2005), simple screening based on criteria such as those described above can be very effective as a preliminary approach.

Figure 6. Skoonka Creek Claims showing the original RGS stream sediment sample location, as well as the location of subsequent discovery of the Au-rich quartz vein material.

Figure 7. Thirty-six prospecting targets identified using the following criteria: 1) Gold values in the 17 to 40 ppb range with a similar Au value in the repeat sample; 2) are not located on a claim; 3) are > 3 km from a mineral occurrence; and 4) contain > 20 ppm As.

Adding value to the RGS

The British Columbia RGS has created a high quality geochemical database that helps identify areas of high mineral potential and also new prospecting targets. Current activities that will add value to the present RGS include:

- Conducting new regional geochemical surveys.
- Re-analysing archive geochemical samples by INAA and aqua regia digestion with ICP-MS.
- Conducting orientation studies designed to improve existing geochemical survey methods.
- Adding new information to the database.

There are several ways of gaining public access to RGS data. Digital data can be downloaded from the
New Targets and Trends... continued from page 6

British Columbia Geological Survey Regional Geochemistry page:
http://www.em.gov.bc.ca/Mining/Geolsurv/Geochinv/rgs.htm

ARC shape files that can imported into most Geographic Information (GIS) software may be downloaded from:
http://www.em.gov.bc.ca/Mining/Geolsurv/MapPlace/geoData.htm

Metadata for the RGS database can be viewed at:
http://www.em.gov.bc.ca/Mining/Geolsurv/MapPlace/Metadata/geochem_metadata.htm

RGS values can also be viewed on the British Columbia Geological Survey interactive MapPlace site in combination with other geoscience themes such as bedrock geology, topography, drainage, road and rail routes, communities, parks, mineral occurrence information from the MINFILE database, rock geochemistry, and mineral tenure.
http://www.em.gov.bc.ca/Mining/Geolsurv/MapPlace/

Acknowledgements
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References


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CALENDAR OF EVENTS

International, national, and regional meetings of interest to colleagues working in exploration, environmental and other areas of applied geochemistry. These events also appear on the AAG web page at: www.appliedgeochemists.org


• July 3-7, 2006 Protection and Restoration of the Environment VIII. Chanoa island, Crete, Greece. Website www.pre8.enveng.tuc.gr

• August 21-23, 2006. 6th International Mining Geology Conference, Darwin, Australia Website: www.ausimm.com/image2006


• September 11-13, 2006 Environmental Toxicology 2006 – 1st International Conference on Environmental Toxicology. Mykonos island, Greece. Website www.wessex.ac.uk/conferences/2006/toxic06/index.html

• September 13-15, 2006 First International Seminar on Mine Closure, Perth, Western Australia. Website www.acq.uwa.edu.au

• September 24-29, 2006 2006 IGCP 486 Au-Ag-telluride-selenide deposits. Field Workshop, Izmir, Turkey. Email ismet.ozgenc@deu.edu.tr


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• September 25-30, 2006 7th International Symposium on Environmental Geochemistry (2006) Beijing, China


• December 6-8, 2006. Northwest Mining Association Annual Meeting, Reno, USA. Website: www.nwma.org/


2007

• March 4-7, 2007. Prospectors and Developers Association of Canada Annual Convention Toronto, Canada. Website: www.pdac.ca

• May 27-31 2007. IMWA Symposium: Water in mining environments. Cagliari, Sardinia, Italy. University of Cagliari, Department of Earth Sciences, E-mail Rosa Cidu @ cidur@unica.it

• June 14-19, 2007 23rd International Applied Geochemistry Symposium, Oviedo, Spain Contact: Jorge Laredo, University of Oviedo, Spain Email: jloredo@correo.uniovi.es


Please let this column know of your events by sending details to:

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Summary of the SEG Workshop
Geochemistry in Mineral Resource Development

The workshop “Geochemistry in Mineral Resource Development” was conducted on May 12th 2006 as part of the Society of Economic Geologists Wealth Creation in the Minerals Industry meeting held in Keystone, CO, USA. This workshop consisted of an international panel of eleven speakers who addressed a diverse range of current applications of geochemistry in mineral exploration/exploitation. In line with the wealth creation theme of the conference, many of these talks focused on the importance of sound geochemical investigations to minimize financial and “lost opportunity” risks associated with improper sampling and/or analytical problems in mineral resource development. The presentations were divided into two broad sessions: Mineral Resource Development Sequence and Evolving Scientific and Technical Developments and Trends. The following is a brief description of the talks (not in order).

The speakers in the Mineral Resource Development Sequence section outlined the important roles that geochemical investigations play in efficient resource development. Graham Closs and Robert Jackson outlined the methodology of early stage (reconnaissance) exploration and target definition/testing, respectively. Both speakers stressed the necessity of understanding the target commodity, appropriate deposit and secondary dispersion models, and local geologic/geomorphologic conditions to develop effective exploration strategies. Sound exploration strategies lead to appropriate sampling methods, precise analytical data, and ultimately appropriate data interpretation, and as illustrated by Robert Jackson, inappropriate sampling can lead to “missed opportunity”. Bill Chavez and Rob Bowell used numerous real-life examples to illustrate how geochemistry is applied to risk minimization in mine planning and operations monitoring/remediation, respectively. Chavez discussed the fundamental importance of ore and waste classification to most effectively process complex ores and appropriately handle wastes in an appropriate responsible manner. Bowell provided a similar discussion, but added examples of ore recovery issues and remediation decisions that are driven by geochemical considerations.

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Barry Smee offered two talks in this section that addressed estimation of risk using quality control data and the role of the Qualified Person in resource evaluation. In the first talk, Smee outlined the general guidelines for how to collect field, preparation and pulp duplicates. He then showed how these data can be used to assess the variation (errors) in geochemical data resulting from collection, preparation and analysis of inherently heterogeneous geologic samples. His second talk outlined the various regulatory descriptions of Qualified Persons and the QP’s vital role in verifying and assessing all aspects of resource delineation (i.e. much of the previously discussed material). These responsibilities include verification and assessment of field sampling media and methods, sample preparation, laboratory analytical techniques and data reproducibility.

The Evolving Scientific and Technical Developments and Trends session was conducted in the afternoon and included two ‘scientific’ talks. David Kelley opened with an overview of dispersion, focusing on a wide variety of secondary dispersion processes. This discussion had direct bearing on planning exploration strategies, as discussed in the morning session. Brenda Caughlin discussed the evolving, increasingly interactive relationship between laboratories and clients. She included several important issues pertinent to the duties of qualified persons, including the need to verify laboratory analytical technique accreditation, understand variation in reference material and project standard analyses, and select appropriate analytical techniques based on project objectives and budgets. The final talk of the day was given by Erik Grunsky, who presented case studies of statistical techniques for mapping geology and/or ore deposits using multi-variate data.

Sandwiched between these presentations were ‘evolving technologies’ talks that described three evolving exploration techniques. Gwendy Hall discussed selective extraction analysis used for exploration of deeply buried deposits. She included sample data and graphics, impacts of various parameters on leaching results, and proposed mechanisms for element transfer to the shallow sampling depth. Soil gas technology, an alternative exploration tool for buried deposits, was discussed by Jeffrey Jaacks. Jaacks outlined soil gas measurement instrument types and costs, and showed case studies (including a comparison to selective extraction data) illustrating the potential of this technique in some geologic environments. The final evolving technologies presentation was presented by Richard Glanzman who talked about field portable X-ray fluorescence, Near-Infrared and Shortwave Infrared and Raman instruments. These instruments, originally developed for remote and military applications, are now commercially available and can provide real time field-based chemical and mineralogical data.

As an economic geologist with the bulk of my experience in grass roots exploration, I felt that this workshop provided, as advertised, a broad stroke overview of the role of geochemistry in various aspects of mineral resource development. While I would have been interested in more specific talks on ore deposit geochemistry and data presentation, the wide range of topics within this workshop had broad-based appeal. Although slight reorganization of the talks may have made it easier to inter-relate topics, the individual talks were generally well arranged and concise. Inclusion of the printed and digital versions of the talks was very advantageous and has already proven useful. Overall, the workshop was very worthwhile. Thanks to the workshop chairs Graham Closs and David Kelley and all presenters for their time and effort in making this workshop a success.

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RECENT PAPERS

This list comprises titles that have appeared in major publications since the compilation in EXPLORE Number 130. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochemistry et Cosmochimica Acta (GCA); the USGS Circular (USGS Cr); and Open File Report (USGS OFR); Geological Survey of Canada papers (GSC paper) and Open File Report (GSC OFR); Bulletin of the Canadian Institute of Mining and Metallurgy (CIM Bull.); Transactions of Institute of Mining and Metallurgy, Section B: Applied Earth Sciences (Trans. IMM). Publications less frequently cited are identified in full. Compiled by L. Graham Closs, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, CO 80401-1887, Chairman AEG Bibliography Committee. Please send new references to Dr. Closs, not to EXPLORE.


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The Association of Applied Geochemists

announces the

2006 AAG Student Paper Competition

The AAG is calling for nominations for the 16th biennial Student Paper Competition. The paper must address an aspect of exploration geochemistry or environmental geochemistry related to mineral exploration and represent research performed as a student. The student must be the principal author and the paper must have been published in an English language refereed scientific journal no more than five years after completion of the degree. A nomination may be made by anyone familiar with the work of the student and must be accompanied by four copies of the paper (hard copy or digital).

Deadline for receipt of nominations is December 31, 2006.

The winner will receive:

- A cash prize of $1000CAD generously donated by SGS Minerals Services.
- A 2-year membership of AAG, including the society’s journal (GEEA), EXPLORE newsletter, publication of an abstract and CV of the winner, a certificate of recognition and $500US towards expenses to attend an AAG-sponsored meeting, courtesy of AAG.

Nominations should be sent to:

Dr David Cohen  
Chair, Student Paper Competition  
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Email: d.cohen@unsw.edu.au

The results of the 2006 competition will be announced at the 23rd IGES in Oviedo, Spain, in June 2007.

Further details are available from the chair of the committee or the AAG Students’ page at http://www.appliedgeochemists.org/
23rd INTERNATIONAL GEOCHEMICAL EXPLORATION SYMPOSIUM
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EXPLORING OUR ENVIRONMENT

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Preliminary Announcement

Technical Sessions • Poster and Trade Exhibition • Workshops • Social Programme
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The 23rd International Geochemical Exploration Symposium and 2nd International Applied Geochemistry Symposium will be held in Oviedo, Spain, from the 14th to the 19th of June 2007.

Oviedo, with 215,664 inhabitants, is the capital of Asturias, in northern Spain. The Symposium will take place in the Conference Hall of the City, located in the heart of Oviedo and within walking distance to hotels and amenities.

The Organizing Committee has planned an assorted program about applied geochemistry, covering the latest advances in geochemical techniques for mining exploration and environment. Pre- and post-symposium field trips are being organized combining both technical and tourist visits in Spain and Portugal. A full slate of workshops will take place on the weekend during the Symposium (16th-17th June). An exciting social and cultural program will be organized for participants and accompanying persons, including a full program of one-day tours to places of interest in the region.

On behalf of the Organizing Committee and the Association of Applied Geochemistry, I have great pleasure to invite you to join us in Oviedo in June 2007 to participate in this Symposium. We look forward to meeting you in Oviedo next year.

The technical program will develop on four days, introduced by distinguished keynote speakers, leaders in their respective knowledge fields.

Tentative Technical Sessions are:

- New trends in applied geochemistry
- Lithogeochemistry
- Soil geochemistry
- Hydrogeochemistry
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- Hydrocarbon geochemistry
- Geochemistry, environment and health
- Environmental geochemistry in old mine districts
- Role of geochemistry in mine rehabilitation
- Advances in analytical techniques
- Sample design
- Statistical treatment
- Geochemical mapping
- Commercial session.

The Organizing Committee invites you to submit papers for oral and poster presentations. Abstracts with a maximum extension of 500 words must be received before 20th December 2006 according to the format included in the web page.

Symposium Information:

Tel: 34-985104295/75
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Relevant information will be continuously updated on the web site.
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The AAG Needs You as a Councillor

Each year the President of the Association of Applied Geochemists issues a plea to AAG Fellows for individuals willing to stand for election to the position of “Ordinary Councillor”. Unfortunately, this plea is usually relegated to the trash bin by most Fellows. Fortunately, however, each year some of our most outstanding Fellows are ready, willing, and able to meet this challenge. We thought that an article in *EXPLORE* summarizing the job and how one goes about getting on the ballot might entice more to step forward for election to this most important position.

Job Description

The AAG By Laws state that “the affairs of the Association shall be managed by its board of directors, to be known as its Council.” The affairs managed by Council vary from reviewing and ranking proposals to hosting our biennial Symposium to approving application for new membership to developing marketing strategies for sustaining and growing our membership. These affairs are discussed and decisions made at Council teleconferences usually held 3-4 times per year. Each teleconference lasts about 90 minutes. In addition, there is often a running email discussion about a selected issue or two between each teleconference. So for a commitment of about 8 hours of your time per year, you can help influence the future of your Association. If you want to spend more than the minimum time required, there is plenty of opportunity to do so through committee assignments and voluntary efforts that greatly benefit the Association.

Qualifications and length of term

The only qualification for serving as Councillor is to be a Fellow in good standing with the Association. Please note the difference between being a Member of AAG and being a Fellow. A Fellow is required to have more training and professional experience than a Member. Consult the AAG web site, Membership section, for further details.

Each Councillor serves a term of two years and can then stand for election to a second two-year term. The By Laws forbid serving more than two consecutive terms, although someone who has served two consecutive terms can stand for election again after sitting out for at least one year. Elections are usually held in the fall of the year for a term covering the following two years. Our next election will be in the fall of 2006 for the term of 2007-08.

How to get on the ballot

If you are interested in placing your name into consideration for election to AAG Council, simply express your interest to the AAG Secretary (Dave Smith, dsmith@usgs.gov) by August 31, 2006 and include a short (no more than 250 words) summary of your career experience. All that is asked is that you bring energy and ideas to Council and are willing to share in making decisions that will carry the Association forward into a successful future. We look forward to hearing from you.

David B. Smith  
*Secretary, Association of Applied Geochemists*
Mineral Exploration Research Centre • Centre de recherche en exploration minérale

Modular Course in Exploration Geochemistry
06-15 December 2006
Mineral Exploration Research Centre, Department of Earth Sciences, Laurentian University

This is a ten-day lecture- and laboratory-based course in exploration geochemistry covering the following topics: 1) sampling, sample preparation and analytical techniques in surficial and lithogeochemistry; 2) quality control and quality assurance; 3) introduction to lithogeochemistry, igneous processes, rock classification and applications to volcanic and intrusive stratigraphy; 4) alteration geochemistry, mass balance calculations and alteration indexes; 5) stable and radiogenic isotopes and applications; 6) partial and sequential extractions and applications to surficial geochemistry; 7) REDOX applications in surficial geochemistry; drift prospecting and applications to precious metals, kimberlite and diamond exploration; 8) mineralogy and application of microanalytical methods to exploration geochemistry and mineral processing; 9) tour of Laurentian University’s Virtual Reality Laboratory and applications; 10) advanced topics and case studies in lithogeochemistry including: felsic and mafic volcanic rocks associated with VMS mineralization; hydrothermal sediment geochemistry and iron formations; magmatic Ni-Cu-PGE deposits; sediment-hosted ore systems; magmatic and orogenic gold deposits; and Sn-W deposits.

Confirmed Speakers: Gary Beakhouse, Wayne Goodfellow, Stewart Hamilton, Balz Kamber, Dan Kontak, Michael Lesher, Peter Lightfoot, Andy McDonald, Beth McClenaghan, Jan Peter, and Steve Piercey.

Additional information may be found at: http://www.earthsciencies.laurentian.ca/coursework_msc.htm or obtained by contacting:

Steve Piercey (course organizer)
Mineral Exploration Research Centre
Department of Earth Sciences
Laurentian University
Phone: +1.705.675.1151 x2364
FAX: +1.705.675.4898
E-mail: spiercey@laurentian.ca

Laurentian University
Mineral Exploration Research Centre
935 Ramsey Lake Road, Sudbury, Ontario, Canada P3E 2C6
Telephone: (705) 671-1151 x6575; Facsimile: (705) 675-4898
E-mail: DES@nickel.laurentian.ca

Université Laurentienne
Centre de recherche en exploration minérale
935 Chemin du lac Ramsey, Sudbury (Ontario) Canada P3E 2C6
Téléphone: (705) 671-1151 x6575; Télécopieur: (705) 675-4898
Courrier électronique: DES@nickel.laurentian.ca
Forthcoming Joint Publication by the Geological Association of Canada and the Geological Survey of Canada

Mineral Resources of Canada
A Synthesis of Major Deposit-types, District Metallogeny, the Evolution of Geological Provinces, and Exploration Methods
Edited by Wayne D. Goodfellow

The volume is the culmination of a two-year Geological Survey of Canada CCGK project (X15) on the Consolidation and Synthesis of Mineral Deposits Knowledge, and represents our current understanding of mineral resources in Canada. It consists of five major themes:

- Value and history of mining in Canada
- Current synthesis of major deposit-types in Canada - a global perspective and a national focus. Major deposit-types are: 1) kimberlite diamonds, 2) magmatic Ni-Cu-PGE, 3) lode gold (three types), 4) VMS, 5) SEDEX, 6) MVT, 7) porphyry, 8) unconformity uranium, and 9) IOCG
- The metallogeny of economically important mining districts in Canada
- The evolution and metallogeny of geological provinces, i.e., Appalachians, Cordillera, Arctic Islands, Grenville, Slave, Churchill, Trans-Hudson and Superior
- Evaluation of geophysical and geochemical exploration methods from the perspective of what works for different deposit-types

The volume will also contain a DVD containing the following digital data:

- National and global expert spreadsheets containing about 30 key parameters of nine major deposit-types
- National and global comprehensive GIS databases of the major deposit-types with geology and culture
- Ore Photo Library with supporting maps and diagrams of 30-40 major current or past producing ore deposits

The volume is estimated to contain 45 papers (see Table of Contents on back) comprising approximately 900 printed pages. The volume will be bound by hard covers and printed on and high quality glossy paper in unrestricted colour.
Mineral Resources of Canada: A Synthesis of Major Deposit-types, District Metallageny, the Evolution of Geological Provinces, and Exploration Methods

Edited by Wayne D. Goodfellow

Introduction and Mining History

Mineral Resources of Canada - An Introduction and Summary of Findings. Wayne Goodfellow

Synthesis of Major Deposit-types

Greenstone-hosted Quartz-carbonate Vein Deposits (Orogenic, Mesothermal, Lode Gold, Shear-zone-related Quartz-carbonate or Gold-only Deposits). Bo Dube and Patrice Gosselin
Gold-rich Volcanogenic Massive Sulphide Deposits. Bo Dube, Patrice Gosselin, Mark Hannington and Alan Galley
Epithermal Gold Deposits. Bruce Taylor
Intrusive-associated gold deposits. Craig Hart
Volcanogenic Massive Sulphide (VMS) Deposits. Alan Galley
Sedimentary-Exhalative (SEDEX) Zn-Pb-Ag Deposits. Wayne Goodfellow and John Lydon
Mississippi Valley-type (MVT) Lead-Zinc Deposits. Suzanne Paradis, Peter Hannigan, and Keith Dewing
Magmatic Nickel-Copper-Platinum Group Element Deposits. O. Roger Eckstrand and Larry Hubbert
Porphyry Deposits. W.D. Sinclair
Iron Oxide Copper-Gold (±Ag ±Nb ±REE ±U) Deposits: A Canadian Perspective. Louise Corriveau
Kimberlite Diamond Deposits. Bruce Kjarsgaard

Metallgeny of Major Mining Districts

Red Lake District, Ontario. Benoit Dubé
Yellowknife District, Northwest Territories. John Kerswell
Mineral Occurrences of the Betts Cove Complex Baie Verte Peninsula, Newfoundland. Al Sangster
Metallgeny of the Sudbury Mining Camp, Ontario. Doreen Ames
Voisey's Bay District, Labrador, Newfoundland. Tony Naldrett
Magnetic Ni-Cu (PGE) deposits of the Thompson Nickel Belt. Daniel Layton-Matthews and Michael Lesher
Metallgeny of the Raglan district, northern Quebec. Michael Lesher

Metallgeny of the Bathurst Mining Camp, New Brunswick. Wayne Goodfellow
Flin Flon and Snowlake Districts, Manitoba. Doreen Ames and Alan Galley
Metallgeny of the Noranda District, Quebec and Ontario. Harold Gibson, Alan Galley et al.
Finlayson Lake District, Yukon. Jan Peter, Steve Piercey et al.
Base Metal Metallgeny of the Selwyn Basin, Canada. Wayne Goodfellow
Synopsis of the Belt-Purcell Basin. John Lydon
Pine Point Mississippi Valley-Type Zinc-Lead District, Southern Northwest Territories. P.K. Hannigan
Metallgeny of the Robb Lake Carbonate-hosted Zn-Pb district, Northeastern British Columbia. Suzanne Paradis and JoAnne Nelson
Synopsis of the Polaris Zn-Pb-Cu District, Canadian Arctic Islands, Nunavut. Keith Dewing, Robert J. Sharp and Elizabeth Turner

Evolution and Metallgeny of Geological Provinces

Tectonics and Metallgeny of the British Columbia, Yukon and Alaskan Cordillera, 1.8 GA to Present. JoAnne Nelson and Maurice Colpron
Pre-Carboniferous metallgeny of the Canadian Appalachians. Cees R. van Staal
Metallgeny of the Grenville Province. Louise Corriveau and Serge Perreault
Geology and Metallgeny of the Superior Province, Canada. John A. Percival
Geology and Metallgeny of the Trans-Hudson Orogen. David Corrigan
Geology and Metallgeny of the Western Churchill... Sally Pehrsson, Subhas Tella
The Slave Craton: Geological and Metallgenic Evolution. Wouter Bleeker and Brian Hall
Metallgeny of Large Igneous Provinces (LIPs). Richard Ernst

Geophysical and Geochemical Exploration Methods

Overview of Geophysical Signatures Associated with Canadian Ore Deposits. K. Ford, P. Keating and M.D. Thomas
Application of Till Geochemistry and Mineralogy to Kimberlite Diamond Exploration. Beth McClennenaghan and Bruce Kjarsgaard
Aqueous Geochemistry in Mineral Exploration. Matthew Leybourne
Alteration Vectors to Metamorphosed Hydrothermal Systems in Gneissic Terranes. Anne-Laure Bonnet et Louise...
Invitation

Exploration 07 is the fifth in a series of once-a-decade meetings organized by the Canadian mineral exploration community to review the major advances in exploration technology made over the previous 10 years.

Designed with the global exploration community in mind, earlier meetings were attended by up to 1,000 delegates from as many as 60 countries. In addition to a world-class set of presentations and supporting workshops, a full documentation of the proceedings is one of the established traditions of these decennial reviews.

As with previous meetings, Exploration 07 will present the state of the art in exploration technology, with the focus on geophysics, geochemistry, remote sensing, data processing and integration and the application of these disciplines to ore discovery.

The organizing committee of Exploration 07 invites its colleagues from around the world to convene in Toronto in September 2007 to network with their international colleagues, build on their exploration expertise and to celebrate another 10 years of advancement of the exploration geosciences.

Theme

Exploration 07 will review the current state of the art in geophysics, geochemistry, remote sensing, data processing and integration. Given the industry-wide emphasis of better integration of scientific capabilities and business imperatives, the meeting will seek to highlight the strategic linkage between the technological and commercial sides of the exploration industry from primary ore discovery to risk management through the entire mining cycle.

Who Should Attend

The activities of Exploration 07 will be of interest and value to a wide spectrum of stakeholders in mineral exploration, including geologists, geochemists, geophysicists as well as managers, academics and government scientists involved with mineral exploration and mining-related environmental programs.

Information and Registration

To receive the information that you will need to participate as a delegate or exhibitor to Exploration 07, you should fill in the form on the information booklet and fax it back to the organizing committee at 1-905-474-1968, or email your contact details and items of interest to: interest@exploration07.com
Much has been said and written about the broadening gulf between the demand for qualified explorationists and the supply coming out of our colleges, technical institutes and universities. One merely has to attend any geo-conference and gaze out over the sea of grey to fully grasp the situation our industry faces. This is all the more evident in the field of exploration geochemistry whose members have always been in short supply.

As consultants and service industries, we owe our livelihood to mining and exploration and thus have a vested interest in its development. We believe that any aid to promote fresh faces into our sector is helping to secure our future.

Acme Analytical Laboratories Ltd. and ioGlobal are taking the bold initiative of directly aiding students in the geosciences via the ioStipend. The ioStipend is a grant available to students conducting exploration-related geochemical studies at a recognized educational institution. The grant is in the form of analytical services using any package provided by Acme Analytical Laboratories Ltd. Students and/or their teachers/advisors can apply for the grant by submitting the application to ioGlobal who will vet the proposals.

The grant is intended to promote the collection of high quality, base-line data for comparison with more “esoteric data” (eg, isotopic data, partial digests, non-standard sample media) generated during the course of research, and to promote broad training in fundamental geochemical principals across the geosciences.

The ioStipend allows for amounts of approximately $5,000 (AUD, CAD or equivalent) for in-kind analytical work. Successful applicants will also be provided with 3 academic licences of ioGAS, the new exploratory data analysis software package available from ioGlobal.

The application form is available at www.ioglobal.net.

It is envisaged that three or four of these awards will be made each year.

Applications are reviewed by an expert group of ioGlobal’s geochemists

Eligibility Criteria
Preference will be given to:
• students with no other source of funding
• students working on exploration geochemistry projects
• projects no or very minimal confidentiality requirements

The ioStipend is international. Applications are welcome from qualified institutions globally.

Some technical input may be provided by ioGlobal on request.

Requirements for receiving the ioStipend
Firstly, there are minimal strings attached. Recipients would have to agree to
1. Have their project promoted on the ioGlobal web site in an area devoted to R&D carried out under the program (couple of passport photo shots, brief description)
2. Acknowledge ACME Labs and ioGlobal for support in technical and public presentations of results
3. Write a short article for Explore describing the project outcomes, and allow this to be published on the ioGlobal web site.

David Lawie, John Gravel
Association of Applied Geochemists
APPLICATION FOR MEMBERSHIP*

Please complete only the relevant section for membership. See below for mailing instructions.

I, ______________________________________________, wish to apply for election as a ___Member / ___Student Member of the Association of Applied Geochemists. I have read the Code of Ethics of the Association and in the event of being elected a Member/ Student Member agree to honour and abide by them.

MEMBER: State Employer and Employee title
I am actively engaged in scientific or technological work related to applied geochemistry exploration and have been so for the past two years. as a ___________________________.
(employer)                  (employment title)

STUDENT MEMBER: Student status must be verified by a Professor of your institution or a Fellow of the AAG
I certify that the applicant is a full-time student at ___________________________ in pure or applied science.
(institution)

Witness my hand this ______ day of____________, 20______.
(Signature of applicant)

NAME AND ADDRESS: PLEASE PRINT (to be completed by applicant)

Name:    __________________________________________________       Telephone bus: ________________________
Address: ___________________________________________________      fax: _____________________________
___________________________________________________________     home: ____________________________
_______________________________________________    e-mail: ________________________________________

Annual Dues:
All applications must be accompanied by annual dues. All payments must be in US funds. Select one of the four listed below.

1 2006 member dues US$ 100 ____________
2 2006 student member dues 10 ____________
   - If receipt required, include a self-addressed envelope and add 2 ____________
   - If your check is not drawn from a U.S.A. or Canadian bank, add 15 ____________
   TOTAL ____________

Payment by check, International Money Order, UNESCO Coupons, International Postal Orders, VISA, American Express and Master Card are acceptable. For credit cards users, minor variations in your billing may reflect currency exchange rate fluctuations at time of bank transaction.

Type: VISA ___ American Express ___ Master Card ___  Credit card account number: ____________________________________________
Expiry date: ______________ Name: __________________________________ Signature: __________________________________

*Application for voting membership requires the sponsorship of three voting members. Request a voting member application from the Association office.

Please note: Your application form will be acknowledged upon receipt. The Admissions Committee reviews all applications and submits recommendations to Council, who will review these recommendations at the next Council Meeting or by correspondence. If no objection is raised the names, addresses and positions of candidates will be listed in the next issue of the AAG Newsletter. If after a minimum of 60 days have elapsed following submission of candidate information to the membership no signed letters objecting to candidates admission are received by the Secretary of the Association from any Member, the Candidate shall be deemed elected, subject to the receipt by the Association of payment of required dues. Send completed application, together with annual dues to:

Association of Applied Geochemists
P.O. Box 26099, 72 Robertson Road, Ottawa, Ontario, CANADA K2H 9R0
TEL: (613) 828-0199, FAX: (613) 828-9288, email: office@appliedgeochemists.org  WEBSITE: http://www.appliedgeochemists.org
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SGS Minerals Services boasts an unmatched network of international analytical laboratories. Our commitment to quality is exemplified by continuously expanding our chain of ISO 17025 accredited laboratories.

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SGS Minerals Services
canada@sgs.com