



A Letter from our President

I write this letter somewhere over the North American continent on my way to Vancouver. My flight was late owing to a security alert, a frequent and unsettling part of modern life. This summer has seen more than enough changes that are unwelcome. In the past month the Association has also been affected by sad news with the untimely deaths of two of our more distinguished fellows.



Rob Howell

In August, Dr. Paul Taufen passed away. Paul was an outstanding geochemist and a past President of our Association. He previously served as Chief Geochemist for WMC and was recently appointed Director of Exploration for Magnus Resources. His involvement in the Association and contributions to the field of exploration geochemistry will be sorely missed.

Dr. Arthur Darnley, formerly Director of the Resource Geophysics and Geochemistry Division of the Geological Survey of Canada passed in early September. Arthur was a founder of the global geochemical mapping program and wrote one of the classic papers on the Zambian copper belt that was still essential reading when I first started working there 20 years after it was published.

As the Association matures so too does our membership and many of our Distinguished members are now gone. However, the contribution they have made in founding and nurturing the Association are not lost but live on in the publications they have contributed, the careers they mentored and the legacy of their character and science that is an inspiration to those who knew them.

In the next few months we hope to announce the details of our Distinguished Geochemists Fund, which is being set up in honour of those members who have made a significant contribution to the science. Although the full details are not finalized we hope that the fund will be used to support student and young researchers in applied geochemistry and attendance at our congress.

AAG can accept donations to the Distinguished Geochemists fund, although cannot as yet issue a tax receipt. Please contact Betty Arseneault at the AAG Business Office if you wish to know more details. Please consider supporting the fund and future generations of applied geochemists it will benefit. They are the future of our Association and as mentioned by myself and others in previous issues of **EXPLORE** are becoming fewer in number than at any time in the history of the Association.

Please note the Association's next AGM is scheduled for November 16, 2006. Please see the notice on page 5 of this issue of **EXPLORE**.

Rob Howell
President, AAG

Industry-funded Exploration Geochemistry Research at CAMIRO

Since the mid 1990s, the Canadian Mining Industry Research Organization (CAMIRO) has participated in 30 industry funded exploration research projects with a total value in excess of CDN\$13 million. CAMIRO is a not-for-profit chartered Canadian company and was formed when several research groups, including the Mining Industry Technology Council (MITEC), merged.

CAMIRO comprises three divisions: 1) mining, 2) metallurgical processing, and 3) exploration. Each division operates its business with a: 1) Chair of Division (industry volunteer), 2) Director of Research Development (full time employee), and 3) volunteer members of expert committees. The Director of Research Development for exploration collaborates with expert committees in geophysics, geology and geochemistry. The geochemistry expert committee includes industry, Canadian federal and provincial government specialists and university researchers. The Exploration Division has maintained an annual membership of 15 to 25 major companies and institutions that are required to pay fees of CND\$2,500 and CND\$1,000 for junior exploration companies and service companies. Application for CAMIRO membership is through contact with the Director (www.camiro.org). Memberships provide up to 50% of the Division's operating budget. Members then take an active role on the management committee and expert advisory committees,

receive periodic updates on research development and receive a discount on sponsorship of specific research projects.

Exploration geochemistry research ideas and proposals are developed in a variety of ways. The Director meets with the geochemistry expert committee of 10 to 12 members, once or twice a year. Collectively the

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Research at CAMIRO... *continued from page 2*

committee reviews new proposals and advises on relevant research directions. One-on-one meetings with experts are equally productive. The Director also meets and interacts with university researchers and industry specialists, particularly analytical laboratories. Meeting venues such as the Association of Applied Geochemists Symposium are often fruitful places for discussions. Proposal ideas often have come from companies, laboratories, and university researchers. The Director spends time with proponents to develop the written proposal and its funding structure and consults industry specialists about specific priorities once the proposal is completed and circulated. Once a project is fully funded, sponsors act as a steering committee that meets a minimum of once a year during the term of the project. Quarterly reports and frequent communication between researchers and sponsors are features of good projects. One of CAMIRO's present interests, directed by the geochemistry expert committee, is to expand exploration geochemistry research into disciplines not previously involved in, e.g. microbiology, hydrology, data analysis.

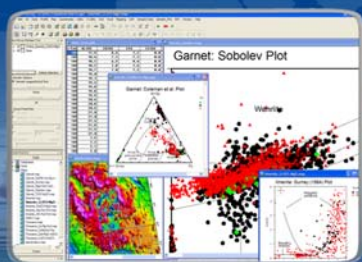
Over the past 15 years, CAMIRO has commonly had a two-year confidentiality period on results and reports from the project and the research group retains the intellectual property, while CAMIRO retains the right to circulate the final report. In some cases, the confidentiality period may be reduced to one year or absent where funding is provided by federal and/or

provincial governments. Federal funding for university research (NSERC – National Science and Engineering Research Council) provides attractive avenues to match industry funding through collaborative research development grants and industry scholarships where students spend part-time with the industry sponsor. Also, Canadian universities have two forms of agreement for submission of industry funds for research: contracts and grants. Confidentiality can be retained through research contracts, but the universities charge 45% to 60% overhead on CAMIRO funds. Large industry contracts in pharmaceuticals, biotechnology and engineering commonly go this route. For mineral exploration-related research in fundamental science, where lesser amounts of funds are available from industry, grants with 20% to 35% overhead allow more research for contributed funds. However, grants do not allow industry to retain intellectual property or confidentiality of results.

In 1996, the geochemistry expert committee identified the need for a scoping project on the state of knowledge and methods used to detect geochemical signatures in surface soils that reflect underlying deeply buried mineralization. The scoping project was carried out by Eion Cameron (emeritus scientist, Geological Survey of Canada) as *CAMIRO Project 97E05: Deep Penetrating Geochemistry*. This study thoroughly examined the literature and research that underpinned at that time the understanding of geochemical processes in the deep subsurface and a comparison of methods used to detect

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Research at CAMIRO... *continued from page 3*

vertical transport of metals from buried mineralization. The project attracted 26 sponsors, a record for a CAMIRO project. The results were published by Cameron in an overview paper in *Geochemistry: Exploration, Environment, Analysis (GEEA)* (Cameron et al., 2004). This study led to a follow-up CAMIRO project, *Project 99E01: Deep Penetrating Geochemistry: Phase 2*, a series of field studies that documented a comparative record of multiple partial extractions, water and gas geochemical methods applied in Chile, Nevada and central Canada by an integrated research group including Eion Cameron, Gwendy Hall (Geological Survey of Canada), Stewart Hamilton (Ontario Geological Survey), Matthew Leybourne (University of Texas at Dallas), Beth McClenaghan (Geological Survey of Canada) and Mary Doherty (International Geochemical Consultants). This project was equally popular with industry and established some guidelines on relative applicability of methods in various terrains. The results of this research have been published as well (Cameron et al., 2002; 2004; Geological Survey of Canada, 2005; Hall et al., 2004; Hamilton et al., 2004a,b).

Between 2002 and 2005, further research was carried out on multiple sites in central Canada under the direction of Lynda Bloom (Analytical Solutions Ltd.) with Robert Jackson (consulting geochemist) and Graham Closs (Colorado School of Mines), CAMIRO *Project 02E01: Three Dimensional Geochemistry*. Funding for this CAMIRO project was enhanced by funding from the Ontario Mineral Exploration Fund (OMET). The results revealed the variability and complexity of geochemical data and anomaly interpretation in varied terrains covered by glacial drift. Documented case histories highlighted the fact that the understanding of partial extraction geochemistry requires careful analysis and differentiation of substrate type, soil depth and patterns of multiple elements. Results of the study are reported in Ontario Geological Survey Miscellaneous Release Data 164 "*Three Dimensional Surficial Geochemistry*" (CAMIRO, 2005).

In 2001, CAMIRO set up a consortium of exploration companies that provided sample suites from a variety buried ore types and kimberlites to be tested using soil gas

hydrocarbons (SGH). SGH is an analytical technique spawned from forensic analysis of medium hydrocarbons from fire insurance court cases. It was developed at Activation Laboratories (ACTLABS) in support of exploration for deeply buried mineral deposits. The project went through two funding phases between 2001 and 2005 (*Projects 97E04 and 01E02: Soil Gas Geochemistry*) with partial support from the Ontario Mining Exploration Technology Fund (OMET). The results of the projects are reported in Ontario Geological Survey Miscellaneous Release Data 165 "*Use of Soil Gas Hydrocarbon Technique to Differentiate Barren Graphitic and Sulphidic Conductors from Ore-bearing Conductors*" (CAMIRO, 2005). Activation Laboratories has documented some of the case histories in their lab brochures and web site. Collaborative experts in microbiology, Gordon Southam (University of Western Ontario) and hydrocarbons, Joel Leventhal (emeritus scientist, United States Geological Survey), recognized the correlation hydrocarbons with populations of micro-biota found in soils and that specific classes of hydrocarbons have affinities with different geologic and mineralizing environments.

In 2004, CAMIRO initiated a new project led by the team of Mary Doherty (ALS-Chemex) and Beth McClenaghan (Geological Survey of Canada) with Stu Averill of Overburden Drilling Management Ltd., David Crabtree (Ontario Geological Survey), Ingrid Kjarsgaard (consulting petrologist) and GEMOC to investigate the chemical uniqueness of resistate indicator minerals associated with Ni-Cu-PGE ores and to define dispersion halos of such minerals in surficial sediments, *Project 04E01: Chemistry of Resistate Indicator Minerals from Ni-Cu-PGE deposits*. Samples were collected from surficial materials and bedrock at two sites, Thompson, Manitoba, Canada and West Musgraves, central Australia and from bedrock from Noril'sk, Russia and Jinchuan, China. Key minerals under study include chromite, ilmenite and diopside. Major and trace element compositions are being characterized by electron microprobe and laser ablation ICP-MS. The project is sponsored by five exploration companies and is anticipated to wrap up at the end of 2007.

In 2007, CAMIRO plans to initiate research on the role of microbiology and gases in the vertical transport and fixation in shallow soils of metals and other elements. Proposed research includes experimental studies of sediment columns at the University of Kansas under biogeochemist, David Fowle, in collaboration with Ron Klusman (Colorado School of Mines) and Barbara Sherwood Lollar (University of Toronto), which will combine with field tests to discriminate distinct geochemical signals from buried rock sources and relationships with micro-biota and gas species. A research proposal is also under development to carry out a series of well-constrained, surficial sediment surveys to test multi-media methods for uranium exploration in the Athabasca Basin, Saskatchewan, Canada. Under the plan Robert Jackson (consulting geochemist) will direct surveys for soil

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Research at CAMIRO... *continued from page 4*

and water geochemistry that will apply a variety of techniques over buried uranium mineralization.

In 2006, a meeting of the CAMIRO expert committee of geochemists discussed the need for new research from disciplines in microbiology, biogeochemistry and isotopic chemistry. Key areas for research include improved understanding of surface anomalies and false positives, chemical species that best indicate buried targets, expansion of indicator mineral tools, characterization of elemental signals produced by buried ores, improved application of water geochemistry and regional geochemical tools to characterize prospective terrains. In Canada, the thick glacial overburden prohibits exploration and discovery through much of the North. Future exploration needs improved strategies to encourage exploration in these areas of thick (>10 m) cover. One strategy is to provide numerous workshops on soil selective leach and soil gas methods for explorers in covered terrains. Also, CAMIRO and industry need to establish fundamental research projects that would underpin new industrial research chairs in surficial geochemistry at Canadian universities.

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Notice of Annual General Meeting

The 2006 Annual General Meeting (AGM) of the Association of Applied Geochemists will be held by teleconference on Thursday, November 16, at 5:00 PM Ottawa time (3:00 PM Denver time, 2:00 PM Vancouver time).

You can check

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to find the time in your country.

The AGM will be followed immediately by a regular AAG Council meeting.

If you wish to participate in the AGM, please notify Betty Arseneault (office@appliedgeochemists.org) by at least October 25, 2006. Betty will then make arrangements for a phone line for you and provide you with instructions on how to dial in.

The Officers and Council
of the
Association
hope you will give
serious consideration
to participating in the AGM.

AMIRA International: A Successful Model for Industry Collaboration in Geochemical Research

AMIRA: History and Modus Operandi

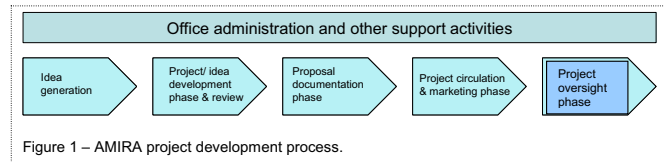
The story of AMIRA International, originally known as the Australian Mineral Industries Research Association Limited, began in 1959. Sir George Fisher together with other captains of the industry, including Sir Ian McLennan, Sir Morris Mawby and other CEOs and Chairmen of the major exploration and mining companies in Australia, created AMIRA as a vehicle for the industry to collaborate in the establishment of Australia Mineral Development Laboratories (AMDEL) Limited. The role of AMIRA quickly morphed into an organisation that develops, brokers and administers collaborative research projects for its members global activity. In developing projects, AMIRA International adopts both a brokerage and a facilitation role, bridging the gap between the research provider and the industry. Since inception AMIRA has developed and administered over 600 projects, worth in excess of US\$500 million (2005\$). These cover exploration, mining, mineral processing, and environment through all of the familiar commodities – gold, diamonds, PGEs, mineral sands, coal, base metals, uranium and iron ore.

AMIRA International’s corporate headquarters is located in Melbourne, Australia but it has offices in Perth, Australia, in Johannesburg, South Africa, in Toronto,

Canada and in Santiago, Chile. It has a membership of some 67 Australian and international companies, which includes over 15 of the 20 largest exploration and mining companies (based on market capitalization). Government bodies and research institutions are not eligible to join the Association.

AMIRA International contracts all R&D to a variety of research institutions around the world, many working collaboratively in single projects. Currently, AMIRA International has links with over 40 different research institutions around the world. Many of the institutions are world leaders in their field. Researchers are an important source of project ideas which we develop and market on their behalf with our members. Historically this has been the principal source of project ideas.

AMIRA International currently has a staff of eleven full-time Research Directors, nine support and administration staff and a network of high-calibre consultants who assist in specialist projects. Research Directors are responsible for developing research projects, seeking industry funding and if successful administering the projects. A simplified summary of AMIRA’s modus operandi is shown in Figure 1.



AMIRA’s growth since 1959 bears no clear correlation with the industry cycles of boom and bust. In its early days, AMIRA’s capacity to grow was limited by the number of personnel that it had to develop and broker projects. Furthermore, broad industry acceptance of collaborative research was yet to fully develop. Mackenzie and May (1992) recognised four broad periods in the early development of AMIRA exploration research activity. The beginning and ending of each of these periods are not sharp events in time but rather fuzzy and transitional. In the early 1960s there was little industry need/want for collaborative research. The research that was undertaken was largely science based and/or curiosity driven and

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AMIRA International... *continued from page 6*

industry generally was unable to apply the results effectively. According to Mackenzie and May (op. cit.), during the 1970s CSIRO sought industry advice on exploration research directions which resulted in the development of long term successful collaborative project streams. The industry became more sophisticated in its approach to collaborative R&D during the 1980s resulting in closer scrutiny of proposals. To stay competitive companies recognised the need for the development of a culture of continuous improvement. Technology was recognised as one of the inputs that must go into the development of a company's business plan which in turn determines what R&D is needed. The expansion in the use of inexpensive and fast desk-top computers in research institutions and industry ushered new opportunities for R&D.

The 1990s was a time of some remarkable changes in attitude; more emphasis on the competitive advantage, an increase in spending on in-house R&D, increasing globalisation and, shift of responsibility for mine-based R&D to the operating sites. Industry became more proactive in leading and defining collaborative R&D. The R&D institutions placed increasing emphasis on the need for external funding. Globalisation has continued into the new millennium. With this globalisation process, R&D investment decisions have become more decentralized.

The new business-driven R&D model facilitates, indeed in many instances requires, increasing collaboration from researchers round the world as well as the inclusion of industry suppliers. This is particularly true in mineral processing projects for example. Industry now seeks the best researchers in the world to undertake its R&D. However, it also recognizes the importance of assisting the local R&D infrastructure in building capacity and achieving world's best practice.

Both the industry-pull and researcher-push models of R&D are still very much alive. Unlike the early years of AMIRA, however, researchers are now very much closer in tune with industry needs. Thus many of the research ideas that fall in the latter category are in general sensitive to industry needs. In many situations it is not a matter of the quality of the science but a matter of priorities: Is this project of sufficient priority for industry to fund? Many of AMIRA's project ideas have traditionally originated from researchers rather than industry.

On average, there are 45 current projects in AMIRA's portfolio, valued at US\$30m, with US\$10-15m of industry funds for new initiatives each year. The current project portfolio has projects in exploration, mining, mineral processing, and sustainable development areas which covers such issues as energy efficiency, environment etc. The source of funding for AMIRA International projects is illustrated in Figure 2. These funds tend to be discretionary in nature and are the first to disappear from the bucket when industry is in a bust cycle. As the figure suggests the majority of a company's R&D funds are focused on internal projects addressing business critical areas.

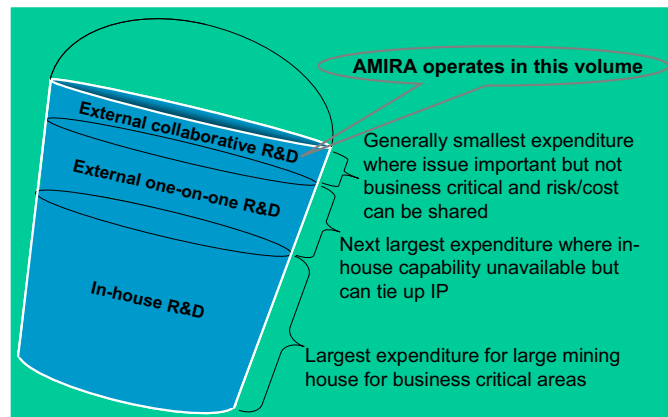


Figure 2: Source of AMIRA project funding

In addition to the industry, additional sources of financial support often come from institutional appropriation funding or competitive grants offered by various government schemes in the countries we operate in.

Research in Geochemistry in Australia

Key AMIRA projects with a geochemical focus over the last 15 years include the following:

- P147B - Geochemistry of granites and related volcanics as aid to exploration
- P240, P240A - Geochemical exploration in complex lateritic environments of Yilgarn Block
- P241, P241A - Gold and associated elements in regolith-dispersion processes

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AMIRA International... *continued from page 7*

- P252 - Geochemical exploration for platinum group elements in weathered terranes
- P258 - Hydrothermal mobilisation, transport and deposition of platinum group elements
- P338 - Exploration for concealed mineralisation - multi-isotopic studies of groundwaters
- P355, P355A - Introduction of geo-electrochemistry into Australia
- P381 - Application of SIROGAS
- P388 - Development of geochemical reference material for mineral exploration and mining
- P408 - Resistate indicator minerals in porphyry Au/Cu exploration
- P409 - Geochemical exploration in areas of transported overburden
- P417 - Geochemical exploration in regolith-dominated terrain of North Queensland
- P453 - Laboratory prototype DMS process for diamond exploration samples
- P471 - Enhancement of diamond indicator mineral identification
- P480 - User friendly isotope technologies in mineral exploration
- P482 - Characterisation of Archaean granitoids in Yilgarn craton
- P504 - Yilgarn supergene gold
- P549 - Evaluation of selective geochemical extractions in wet tropical exploration
- P588 - Epithermal gold-silver deposits: geological, geochemical and isotopic vectors
- P618 - Isotopic discrimination of partial leach geochemical anomalies in covered terrane
- P765 - Transitions & zoning in porphyry-epithermal districts: indicators, discriminators and vectors
- P778 - Predictive Geochemistry in Areas of Transported Overburden (active)
- P821 - Geochemical survey of northern Peru: Stage 1. Preparation of a detailed proposal for undertaking a regional survey, including initial orientation studies.
- P923 - Controls on formation and sulphide trace element signatures of sediment-hosted gold deposits (active)
- P891 - Advancing diamond exploration: novel techniques for the interpretation of indicator minerals (active)

The key results of many of the above projects would have been published by the researchers on expiry of the confidentiality embargo. Some would have been published as government reports. Nevertheless, many of the project reports are only available via AMIRA International and only after the embargo period has expired. However, only members of AMIRA International can access these reports.

In the late 1980's AMIRA International commenced a series of industry funded projects with CSIRO focusing on the Australian regolith. These projects looked at how to explore through the thick cover that blankets most of

Australia. These projects lead by Ray Smith, Charles Butt and Ravi Anand improved our understanding of regolith processes and dispersion of metals in the regolith in particular gold and led to breakthrough for Archean gold exploration particularly in the Yilgarn (Phillips, 2006). An important part of this research was to establish where various components of the regolith profile can host elevated levels of gold and other pathfinder metals. Two important breakthroughs from this work were the recognition of the Fe-rich material (laterite) and calcrete as an important sampling media in regolith-dominated terrains.

Smith (1996) chronicles some of the important results from this early work much of which was done in a series of AMIRA projects. The gold dispersion models developed by Ray Smith and Ravi Anand contributed to the discovery of the Plutonic and Bronzewing gold deposits.

Regolith research received a significant boost by the Australian Government support for the Cooperative Research Centre for Landscape Evolution and Mineral Exploration (CRC LEME). This Centre has gone through two periods of funding. The focus of research in the new Centre has shifted towards understanding mechanisms of metal dispersion in areas of transported cover. AMIRA is now working with the CRC on a major new initiative P778 - *Predictive Geochemistry in Areas of Transported Overburden*.

Surface geochemical anomalies may form above, and be related to, buried mineralisation; however, many anomalies are unrelated to the underlying bedrock and therefore misleading. Various techniques, many related to partial extraction geochemistry applied to soil samples, have been used to try to detect subtle surface signatures of buried mineralization, albeit with limited success. Surface techniques have significant potential advantages for mineral exploration. If definitive, low cost surface or near-surface sampling surveys can be conducted in areas of relatively shallow cover, large areas can be tested and drilling costs reduced. However, not all known buried mineralisation, including many with shallow cover, appear to have surface expression. Some do, some don't, and some explorers may not have revealed all their proprietary techniques! A serious impediment to the adoption of such methods is that they are largely empirical. It is therefore difficult to distinguish between negative results (no mineralisation) and null results, indicating that the

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AMIRA International... *continued from page 9*

technique is inappropriate or that there is no surface expression.

In order to apply geochemical exploration methods confidently in a given area, or to be able to determine that such techniques are inappropriate, it is necessary that to understand the mechanisms by which surface expressions may form. From this understanding, it may then be possible to predict the presence or absence of mineralization given a specific response at the surface. Research is required that will determine which mechanisms are responsible for metal migration through post-mineralization cover.

The AMIRA project P778 recently commenced with the support of eight companies will address what to many is the 'final frontier' in exploration geochemistry, i.e. predictive geochemistry in transported cover. A multi-institutional multidisciplinary team has been assembled to tackle this task which will be led by Dr. Ravi Anand from the CRC LEME/CSIRO. Institutions involved in the project include, CSIRO, Curtin University, Adelaide University, University of Western Australia and the University of Chile. The project team will use innovative approaches to systematically study, for the first time in Australia, the potential role of various chemical and/or biological mechanisms that give rise to surface geochemical anomalies in areas of transported overburden. The project's aim is to determine the mechanism(s) for formation of geochemical anomalies in

transported overburden in a variety of Australian and Chilean environments, and based on these mechanisms, to develop effective and reliable geochemical exploration techniques. The research methodology that will be applied in this project is illustrated in Figure 3.

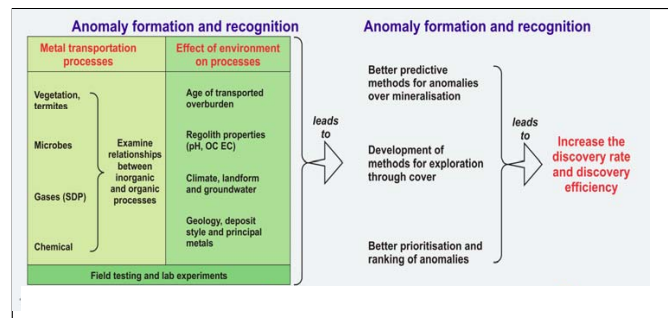


Figure 3. The research methodology used in the new AMIRA project P778 (R. Arand)

Another AMIRA initiative is Data Metallogenica (DM) (www.datametallogenica.com), AMIRA's global mineral deposit web-based database being established with the support of over 100 sponsors including mining and exploration companies, government institutions and professional societies. DM is being developed as a world encyclopedia of ore deposits for reference, training and education purposes. It is also acting as a repository of technical data from mineral deposits all over the world. High quality photographs of over 70,000 samples from more than 300 deposits are being progressively added to the database and are supported by deposit descriptions, map and section data, field and petrologic photos, spectral mineralogy, and thesis data. Geochemical data are also being added and AMIRA would encourage individuals, geological surveys and companies to provide material to add to the extensive data galleries to help build the repository for global use. As examples, photographs of zinc in vegetation geochemical anomalies from Dugald River and HYC lead zinc, silver deposits in Australia and Padaeng zinc deposit in Thailand have been donated to DM, and a detailed lag geochemical case study from the new major Nebo-Babel nickel discovery in central Australia was provided by WMC.

Benefits of Collaborative R&D

There is no doubt that collaborative R&D has made and will continue to make important contributions to the technological progress of the mining industry.

The benefits of collaborative R&D can be summarised as follows:

- Financial and technical risks are shared
- Larger multi disciplinary projects can be undertaken
- Reduces duplication among company's R&D investments
- Broader technical input to problem solving is facilitated
- Networks between industry peers and researchers enhanced
- Enhances the opportunity for participating companies to capture important "spillover" technologies and

continued on page 11

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AMIRA International... *continued from page 10*

solutions facilitated by the need for researchers to be abreast of activities outside their immediate discipline

- Provides validation/comparison opportunities to companies' internal and one-on-one R&D efforts
- Accelerates the transfer and take up of R&D outcomes from researchers to industry
- Facilitates the formulation of a common technological "industry vision" that can guide collaborative R&D investments by companies and research institutions, e.g. AMIRA's Alumina and Copper Technology Roadmaps
- Nurturing of the R&D infrastructure base is enhanced which in turn provides opportunities for the training of future industry and academic leaders

During the period 1990-2004, a total of 324 AMIRA projects were completed, 192 of these projects involved students at various academic levels. The industry contributed some US\$170.8 million (in 2004\$) in cash towards these projects. Of this about US\$124.2 million, or 72.7%, was directed towards university-based projects. This investment excludes matching grants that many projects attracted from government funding agencies. Some 430 students and 65 post-doctoral fellows were associated with AMIRA projects during this 14-year period. Of the former a little over 60% were PhD students.

As Knights (2004) points out, strategic advantage originates not only from quality orebodies, but also from the quality of the human resources, i.e. intellectual capital. Collaborative R&D is a proven mechanism for supporting and nurturing key research centres that provide this intellectual capital. However, to ensure that the R&D infrastructure is sustainable, industry support of this type must be constant across business cycles. One of the dangers of ignoring this at the bottom of the business cycle when attention is focused on costs containment, efficiencies etc, is that when the cycle turns, industry's growth may be severely constrained due to the lack of skilled people as is currently the situation.

A trend in AMIRA collaborative research in the last decade has been the growth of multidisciplinary, multi-institutional projects. To some extent this trend has been in response to the realisation that solving specific industry problems requires a variety of different skills and disciplines. The emphasis is on assembling the right people from different institutions rather than limiting oneself to look inside. This strategy has the added benefit of improving collaboration, breaking down silos between researchers. As Napier-Munn (2005) recently pointed out "*We all live in professional silos - comfort zones, where we talk to like-minded people with the same training, experience and view of the world. We note in passing the existence of other disciplines, but they are tolerated rather than embraced.*" This pattern has been true, for example, between the exploration geologist and the mining engineer and is still very much true between the mining geologist and the metallurgist. But the fences are slowly being torn down. This is evidenced by the types of

projects being undertaken both within and outside of AMIRA. For example within the *pmd**CRC, of which AMIRA is a partner, significant progress in the development of fluid flow modeling, which is important in understanding of ore body genesis and thus greenfields exploration, has been successfully applied to in-mine exploration. The application of this technology by Leviathan at the Stawell gold mine and Placer Dome at the Granny Smith gold mine has yielded significant benefits. This has required closer collaboration between exploration geologists and mine geologists.

Another interesting initiative is the AMIRA P843 project (*Geometallurgical Mapping and Mine Modelling*), a new cross-discipline research platform focused on defining the fundamental relationships between geological characterisation of mineral deposits and their impact on mineral extraction. The fundamental aim of the project is to develop new and improved measures of mining and processing attributes that can be embodied into ore body models that more representatively reflect potential economic value (Walters, 2005). To be successful this will require close collaboration between mine geologist and metallurgist both in the companies and in the research institutions.

Collaborative R&D will continue to make important contributions to the technological progress of the mining industry. However value from collaborative R&D is best created and harvested by bearing in mind that:

- R&D must compete on a value-added basis with other investment opportunities, and
- the nature of the industry's problems and globalization favour multidisciplinary and therefore multi-institutional approach to science and technology development.

Working with AMIRA

AMIRA International utilises a number of different methodologies to identify ideas for collaborative research projects. These include industry roundtables and roadmaps for example, or individual discussions with companies. A significant number of ideas originate directly from researchers themselves. AMIRA does not have a formal application process per se but does expect that researchers submit a short summary of their idea which can be developed into a concise preliminary proposal if it is considered to have merit.

AMIRA is open to approaches from researchers around the world who are interested in working with our members in developing research projects addressing geosciences issues from greenfields exploration to in-mine exploration and development. More specifically,

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Association of Applied Geochemists
web site:

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AMIRA International... *continued from page 11*

innovative solutions addressing gaps and challenges in the following broad areas are of interest to our members:

- Regional studies
- Technology developments
- Data compilations
- Ore deposit & model studies

As mentioned previously AMIRA has been involved in some 28 project with a geochemical focus over the last 15 years. The results of projects for which the confidentiality period has expired are available to members. Although many of the key results are published by the researchers and some are available through relevant government agencies who undertook the research only AMIRA has the capacity to store the results of all these projects centrally. All AMIRA members are entitled to participate in research projects developed by AMIRA. Companies that are non-members occasionally are invited to participate but such companies typically required to pay a premium that is equivalent to the annual membership.

Conclusion

This paper emphasised the following points:

- AMIRA International's 47-year history in delivering value to industry and its sustained vigour during booms and busts is evidence of just how successful the collaborative research model has been. Since inception AMIRA has developed and administered over 600 projects, worth in excess of US\$500 million (2005\$).
- Over the last five or so years AMIRA International has truly gone global. Its members include over 15 of the top 20 largest exploration and mining companies based on market capitalisation.
- Collaboration on R&D is a means, not an end. As growth, return on investment and risk reduction remain the principal drivers, companies must continue to innovate, R&D is an important way of facilitating this.
- Successful collaborative R&D benefits not only the sponsoring companies, but also the scientific institutions and ultimately society.
- Benefits from collaborative R&D will be maximised when a problem is tackled in a multidisciplinary manner and when there is a close partnership between the various scientists in the research institutions and sponsoring company.
- The collaborative model of R&D is alive and well and will continue to deliver value as long as the right projects are developed. This means tackling the right problem and assembling the right multi-disciplinary research team. As well as delivering exploration advances many of these projects will continue to be training grounds for graduates.
- AMIRA International has a long history of involvement in research on exploration geochemistry relating to be

regolith and deposits and continues to develop projects that address important exploration challenges. This is reflected in the new AMIRA project P778 - Predictive Geochemistry in Areas of Transported Overburden that aims to develop effective and reliable geochemical exploration techniques. Data Metallogenica is also acting as a repository of geochemical data for global ore deposits.

AMIRA International is ideally positioned to service its members around the world and continues to work with the best researchers to deliver value. We are always open to ideas from researchers interested in addressing industry problems.

Acknowledgements

I would like to thank Ravi Anand and Graham White for reading the manuscript and suggesting improvements. I particularly would also like to acknowledge the help of my colleague Alan Goode in the preparation of the paper. The P778 research proposal was source of some of the material used herein.

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AAG Annual Report

Report from the AAG Business Office

For 2005, the AAG had a total of 593 members compared to 552 members for 2004. For 2005, the total comprises 217 Fellows (voting members), 332 Members (affiliate), 39 Student Members, 1 Corporate Member and 4 Honorary Members. These numbers include 75 new memberships.

As a reminder to our members, your 2005 AAG membership fee entitles members to: the journal *Geochemistry: Exploration, Environment, Analysis*, Volume 5 Parts 1,2,3,4 and the EXPLORE Newsletter #'s 126, 127, 128 & 129.

At this present time (Sept., 2006), we have 536 AAG members for 2006 (36 Students, 298 Members, 198 Fellow Members and 4 Honorary Memberships). These numbers include 31 new memberships for 2006.

Betty Arseneault

Business Manager

Association of Applied Geochemists

September 2006

Report for EXPLORE Newsletter

Chris Benn stepped down as **EXPLORE** editor after the publication of **EXPLORE** Issue No. 130 in April 2006. He served as **EXPLORE**'s editor for two years and during his tenure published several relevant and timely focus issues. AAG thanks Chris for his efforts. Beth McClenaghan has taken over the editor's duties from Chris and will be assisted by two or three Associate Editors. She is in the process of lining them up.

EXPLORE Issue 131 was published in July, and two more issues in 2006 are due in October and December. The December issue of **EXPLORE** will be a special focus issue that will highlight commercial heavy mineral processing labs and indicator mineral picking services.

Dave Seneshen continues in his role as Business Manager for **EXPLORE**. He is continuing in his efforts to secure new advertisers for **EXPLORE**. He reports that **EXPLORE** finances are in good shape.

Beth McClenaghan, Editor

Dave Seneshen, Business Manager

EXPLORE,

September 2006

AAG Report for *Geochemistry: Exploration, Environment, Analysis* (GEEA)

GEEA has again been published efficiently and in a timely manner, with excellent communication between Ottawa and the Geological Society Publishing House (Neal Marriott, Director, and Sally Oberst, our Copy Editor). Several special issues are being published in 2006, namely: 'Natural analogues for radioactive waste disposal' (from a Goldschmidt Conference); and a double issue from the Geological Survey of Canada, 'Multi-media study of the environment surrounding smelters'.

By the end of this year GEEA is on track to have an Impact Factor and will appear in the 2006 Journal Citation Reports, Science Edition. We have certainly benefited from our inclusion in the GeoscienceWorld (GSW, <http://www.geoscienceworld.org/>) electronic distribution, having more than doubled the number of libraries subscribing to GEEA in full text. Furthermore, the number of abstracts requested on-line through Ingenta and GSW more than tripled in the last year. The financial status of our young journal has also improved dramatically this year. There are several substantial actions being taken by our partners, the Geological Society of London, to increase the visibility of GSL journals; these will be reported on in the next year.

Marcia Scrimgeour, our conscientious office manager, and I would be delighted to receive more papers for publication in GEEA, so keep the flow going!

Gwendy Hall, Editor-in-Chief

GEEA, Ottawa

August 2006

AAG President's Report

My first few months in the position seem to have flown past remarkably and somewhat alarmingly fast. Due, in part, to the pace of activity in the mining industry at present. The Association has also been active this year.

Firstly, the AAG web site has been re-developed and the new style website has been active for several months. Bob Eppinger and Andrew Ransome continue to give many hours of their time to improvement and management of this resource. If you have not done so, please go to the site and see the many benefits and features put there for members. The Association owes both gentlemen appreciation for their contribution in getting this fine resource up and running.

Another individual who has been working behind the scenes for the Association is one of our Patriarchs, Dr. Eion Cameron. Despite having retired from "official" AEG/AAG duties on several occasions, we always seem to find just one more task for his many talents. Eion is an accomplished explorer not only of the Canadian shield and Andean peaks, but also in the finding of those buried deposits deep in the overburden of the global stock markets. So successful was his stock market prospecting on behalf of the Association, dividends in 2005 enabled the Association to cover a deficit in the accounts without dipping into our savings. We are hoping he will continue to explore for us on the "electronic goldfields" and glad we have such a talented prospector to grubstake. Many, many thanks Eion.

The Association has had a push on publications in 2006. The ever youthful Gwendy Hall continues to expand GEEA and push towards the all important citation index. On behalf of GEEA please, please, please send good original research papers for possible inclusion

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AAG Annual Report... *continued from page 13*

in GEEA. Only by the support of our members can we hope to firmly establish GEEA as a leader in the field of applied geochemistry. Having a new journal is a great privilege and honour for any association, but also takes great commitment, not only from the editorial board, but also from the membership. As always, Marcia Scrimgeour is a great benefit in helping Gwendy with the task of getting GEEA papers organized and reviews in. By the way, in addition to papers we also always need referees, if you are interested in taking up the challenge please contact the GEEA office, thanks.

Now, if the Herculean task of editing GEEA were not enough, Gwendy also manages the AAG limited treasury, and this is in addition to a demanding "day job". Despite the workload, she manages to maintain her graceful composure even when the Association's President stands her up on a dinner date! Thanks Gwendy (and once again, sorry.....).

Although GEEA is our flagship publication, we are equally keen to see your articles in **EXPLORE**, our quarterly newsletter. This has been overseen for two years by Chris Benn, who managed to balance a heavy workload and travel schedule with editing **EXPLORE**. Chris is succeeded in post by Beth McClenaghan. I would like to publicly thank Chris for his hard work and welcome Beth into her position. Once again, we can only send you the newsletter if we have the articles. Beth would be very happy to receive topical articles in the field of applied geochemistry, even a few controversial ones!(subject to taste and legal limitations of course).

To add to the items we deliver to you as members, we are pleased to announce that the Association will join other geochemistry and mineralogical societies in the publication *Elements*. This is a unique multi-society publication managed through the Mineralogical Association of Canada. This will start arriving in 2007 with no increase in the annual membership fee. We hope that by participating in this the Association and GEEA will get a broader recognition amongst the scientific community. AAG Councillor David Lentz has agreed to take on the task as the Association's representative with *Elements*.

Although one person's name appears as President of the Association, I doubt anyone could undertake the position alone. This is certainly the case for me. I have greatly appreciated the advice and support of not only past President Dave Kelley in my first year but also from the Association's Vice President Dave Cohen. Betty Arseneault continues to provide a sterling service to the association as our business manager. I doubt anyone could do my position without her help, many thanks Betty.

I would also like to thank the current councillors who give freely of their time and energy to support the Association's activities. This brings me onto a plea. We urgently need nominations or volunteers for Council to progress the Association, support its activities and help guide our decisions. The Councillors are an important and integral part in the governing of the Association and I look forward to seeing new blood on Council. Please send

nominations before the end of October to Betty in the AAG office, thanks.

The Association also saw a change in some Regional Councillors this year. Dr Charles Okujeni stood down as councillor for southern Africa after many years of service. Taking up the responsibility of representing the Association in this capacity is Professor Theo Davies of the University of Kano in northern Nigeria. Gentlemen many thanks to both of you.

On Councillors still, Professor Jorge Loredó is convening our biennial IAGS symposium next year in Oviedo, Spain. Jorge is a seasoned expert in the organization of conferences and, speaking from personal experience, a host with few equals! The meeting promises to be a highly interesting and enjoyable experience and I hope as many as possible of our members are able to attend. Oviedo is the beautiful medieval capital of Spain situated on the northern coast of the country. It has a long history of mining with gold, fluorspar and coal mining still active in the region.

My final item in this letter is a big public thank you to Dave Smith, the Association's hardworking secretary. Dave is organized, diligent and ever supportive. Dave, many thanks on behalf of the Association for all your hard work.

I look forward to joining as many of you as possible of you in Spain in June 2007.

Rob Bowell

*AAG President
September, 2006*

AAG Treasurer's Report

Our investments have been in the extremely capable hands of Eion Cameron since my last report in August 2005. Although the current balance (~\$465K Cdn) is up by ~\$23K from that time, the difference is actually greater by ~\$30K which we needed to carry out the operations of the AAG. This operating deficit in running the AAG office will be offset by the increase in membership fees that took place this year.

In addition to the good news on the investment front, thanks to Eion, we must congratulate the organisers of the 22nd IGES in Perth, led by Paul Morris and Nigel Radford. They not only provided us with the essence of a thoroughly successful conference - such as excellent organisation, superb facilities/events for mingling, and delicious food - but they turned a profit of ~\$55K Aus. Revenue from our conferences is a vital component of the budget.

Many thanks go to Betty and Al Arseneault at the AAG office for their diligent work in keeping our books accurate and the office running smoothly.

Gwendy Hall

*AAG Treasurer
August 2006*



Obituary

A Tribute to Paul Taufen (1952 - 2006)

Paul M. Taufen enjoyed a 30-year career in geochemistry and mineral exploration with both major and junior mining companies. His work took him to most locations in the Americas, Australasia and Africa. He was recognized by his peers as one of the best in the practice of exploration geochemistry and was involved in numerous innovations in exploration methods involving gas, water and soil media. His technical capabilities were only exceeded by his passion for team work, mentoring and establishing a positive spirit in all things involving work and play.

Paul's accomplishments are impressive. He obtained a Bachelor of Science degree in Chemistry from Georgetown University, and both a Masters degree in Geochemistry and a Doctorate degree in Aqueous Geochemistry from the Colorado School of Mines. He was Manager of Geochemistry for Texasgulf Sulphur, served as Chief Geochemist for BP Minerals based in Brazil, and Chief Geochemist – Global Exploration for WMC based in Australia and later in Denver. In 2003 he started a successful consulting business, providing comprehensive and innovative geochemical services to several mining and exploration companies. In 2005 he was appointed Director of Exploration for Magnus Resources International and most recently became a Director of Australian Mineral Fields. Paul was also involved with several professional societies and served as President of the Association of Exploration Geochemists in 2000, and was a Fellow of the Society of Economic Geologists and the Australian Institute of Mining and Metallurgy.

While finishing his degree in Chemistry, he took a geology class to fill out his course work and this opened his eyes to a whole new world. Paul quickly saw that geology offered an avenue for him to apply what he had learned in chemistry, and soon he ventured west to pursue his new dream, enrolling in the geochemistry department at the Colorado School of Mines. Clark Smith remembers sharing an office with Paul at CSM and referred to him as the "young whipper-snapper" because he was 4 years younger and full of enthusiasm. It was during this time that Paul's greatest achievement was realized, meeting and then marrying his wife Glenda. Glenda was his life-long companion and best friend, and together they raised their three beautiful children, Art, Amber and Justin.

Much of Paul's work ethic, technical approach and attitude were developed at an early stage in his work at Texasgulf Sulphur. He joined Texasgulf at its Golden,



Colorado headquarters in 1977 and worked within a small team of geologists, geochemists and geophysicists exploring for porphyry copper, volcanogenic massive sulphide, tin, uranium, biogenic sulfur deposits and epithermal silver and gold deposits under the leadership of Leo Miller and John Ruckmick. During this time, he developed a unique use of carbon isotopes in the exploration for biogenic sulphur deposits in West Texas. Exploration programs took him to Alaska, eastern Canada and Australia. There are many stories from his coworkers in this period involving bushcamp experiences in Alaska, helicopter reconnaissance in the Hells Canyon region of Idaho and Oregon, and surreptitious night-time trespasses over known biogenic sulphur deposits in West Texas to test new methods. The staff of Miners exploration supply in Riggins, Idaho for sometime spoke of the guy that landed in their parking lot in a helicopter to pick up a fresh supply of sample bags.

In 1983, Paul left Texasgulf and joined BP Minerals in Rio de Janeiro. Over the following four years Paul established the first major exploration analytical laboratory in Brazil and developed many innovations in laboratory quality assurance and quality controls. He coordinated geochemical surveys for over 70 projects in a search for base metals, gold and diamonds in the country and participated in three discoveries. While in Brazil he chaired the first international conference on exploration geochemistry in Brazil.

Paul joined WMC in 1987 and became the Chief Geochemist for the Exploration Division in 1997 with global responsibility. His strong leadership during this time led to the formation of one of the largest exploration geochemistry groups ever seen in the industry. Such a

Paul Taufen... *continued from page 15*

large group allowed geochemists to be an integral part of the exploration team on each project. This would not have happened if not for Paul's persistent demonstration to management that geochemistry added value. A highlight during this time was the annual WMC geochemistry meeting Paul organized that allowed each geochemist to present their work and provided an opportunity to review research results. It was also an opportunity for the geochemists to socialize and many great friendships exist today as a result of these interactions.

Paul's enthusiasm that Clark Smith witnessed early on was part of his personality and is one attribute that sets Paul apart from many other great geochemists. As David Seneshen noted, "Paul was happiest with his sleeves rolled up and a shovel in his hand." Paul loved field work as this was a way for him to pursue his natural curiosity and to share his knowledge and learn from his colleagues. Michelle Carey remembers Paul coming to Kambalda to conduct an orientation survey at Lake Lefroy. Paul was completely un-phased by the thick layer of dense salt that lay on top of the gooey organic muck that they wished to sample. Paul dug pit after pit as Michelle watched and

wondered how anyone could be so enthusiastic about collecting samples. His enthusiasm must have worn off because she later returned to graduate school to obtain her PhD in Aqueous Geochemistry with Paul's support and mentoring.

Paul was very serious about his work but he also had a keen sense for what was important in life and his family was always first. He had a humorous side that made him fun to work with and it was never too hard to convince him to play 9 holes of golf before or after work, which offered more opportunity to talk about the latest innovation in geochemistry or other interesting subjects that he always seemed to be thinking of. Paul will be remembered most for his positive and supporting spirit, his loyalty, his enthusiasm for mentoring, and his strong sense of family.

Dave Kelley
Larry Smith
Dave Seneshen
Michelle Carey
Shea Clark Smith

Obituary

A Tribute to Arthur G. Darnley 1930 – 2006

Education provides the passport to life; it is character - created by an indefinable mix of genes, parenting, environment and belief – that charts the course and stages the achievements. Arthur's education was as good as any, but it was his character that led to success. He grew up in wartime and post-war England. I know of no other person, certainly in England at that time, whose university entrance examination included geology. Geology was not taught at his school, he learned from books and from solo field work. This led to Cambridge University, where he became president of the Sedgwick Club, graduating in geology in 1952. Between school and Cambridge, he served with the Royal Air Force, maintaining aircraft flying the Berlin Airlift. His first geology job was with Selection Trust as a field geologist in the Northern Rhodesian Copperbelt. There he developed ideas that differed from the conventional views on the origins of these deposits. There was an urge to do more than was possible as a company geologist, so he gathered his rocks and returned to Cambridge for a PhD study. With no economic geology professor at Cambridge, Arthur had to replicate his "teach yourself" experience from school. His 1960 paper on the Copperbelt remains a classic. From Cambridge he moved to London in 1957 to join the



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Arthur G. Darnley... *continued from page 16*

British Geological Survey. Lingering economic effects of the war made it difficult to get support; nevertheless he developed an important program on uranium deposits that complemented the contemporary development of nuclear power.

The 1960s were a boom time for geology in Canada and it was to the Geological Survey of Canada that Arthur went in 1966. The timing was good. Management of the GSC were among the elite of Canadian science; moreover they included the last explorers of Canada's north.

Although a government organization, bureaucracy had not crossed the threshold. His managers were looking for men with dreams. Arthur's dream was to build a very sensitive airborne gamma ray spectrometer. Uranium, thorium and potassium emit gamma rays that can be distinguished from one another. These elements occur in different proportions in different rocks. So, theoretically, if one were to fly across the country with such an instrument, one could map the different rocks, as well as identifying uranium deposits. Good idea, but there was a problem. Gamma ray intensities decrease with height and enough time must be spent over each location to accumulate sufficient counts. Helicopters can do this by flying close to the ground and slowly, but this was not a practical way of covering large areas. Thus Arthur established a team that built the first highly sensitive spectrometer and installed it in an aircraft. Regional radiometric surveys were born. But there was to be more than surveys of geology.

In January, 1978, the nuclear-powered Soviet satellite Cosmos reentered the atmosphere and spread debris across the Barren Lands of northern Canada. A large team from the United States military based in Nevada flew into Edmonton to search for radioactive debris. Their equipment included helicopters with gamma ray spectrometers. These worked well in Nevada, but the helicopters did not have the range for the expanses of the Barren Lands. And their spectrometers were insufficiently sensitive to be carried in aircraft that did have range. The only instrument in the world with sufficient sensitivity was, fortuitously, at the GSC in Ottawa. This instrument was rushed to Edmonton, installed on a Hercules aircraft, and, after several months of work, all the pieces of radioactive debris were located.

In 1971, Arthur added geochemistry to his mandate and became Director of the Resource Geophysics and Geochemistry Division (RGG). With nuclear power becoming more important, uranium resources were scarce, and the price moved higher. This situation prompted a Federal-Provincial Uranium Reconnaissance Program using both ground geochemistry and airborne radiometric surveys. To maintain a consistent quality of work, national survey protocols were established cooperatively by GSC staff and provincial geoscientists. In 1975 survey work started, carried out by contractors over large blocks of Canada. Maps and data were published before the start of the following field season, to be used by

companies for exploration. But federal priorities changed and in 1979, funding of the program ceased. Fortunately, by then the usefulness of the surveys had been recognized, and the work has continued to this day, largely funded by the provinces, but carried out to the same national standards established in 1975.

By the 1980s, the character of the GSC was changing and people with dreams were not viewed in the same light as 20 years before. The productivity and focus of Arthur's division had brought increases in staff and budgets. In 1986 a decision was made by GSC management to disassemble RGG and disperse its staff and budget to other divisions. For a lesser man this would have been a signal to exit stage left. Instead, it was the spur to his greatest accomplishment. He turned his attention to the international scene. Regional geochemical surveys, originally carried out for use in mineral exploration, had been shown to be even more valuable for providing environmental data. For this purpose, consistent standards for sampling and analysis are even more important. Without this, surveys become as useful as train tracks that change gauge at each political boundary. Arthur moved to extend to countries the same consensus-building that had developed between federal and provincial geoscientists. He established the Global Geochemical Mapping and Global Geochemical Baselines programs, under the aegis of the International Union of Geological Sciences. It is one thing to build a program when one has money to dispense, but for these programs Arthur had none. It was through discussion and persuasion that national organizations agreed to consistent standards. Much has since been accomplished, including published geochemical maps for Europe and for China.

The portrait to this point may give the impression of a life of science. Wrong. Arthur devoted even more care and effort to his family. More than most he led a balanced life. Robert, Ann and Ian, the three children of Arthur and Joan, have grown up to have an equally satisfying and balanced family life. Joan, the children and grandchildren have been the inspiration for his scientific work.

Superimposed on work and family, and contributing to both, was his love of flying. Starting in Africa, continuing with his own aircraft in Canada, he flew until a short time before his death. The day after he passed away, the office of the Association of Applied Geochemists sent an announcement to its members. There were several replies. One writer described how much Arthur had contributed to geochemistry in his country. The last sentence of this message read: "*He was a good man.*"

Eion Cameron
September, 2006



Website of The Association of Applied Geochemists

<http://appliedgeochemists.org/>

Administration

The Association of Applied Geochemists website committee is presently composed of two individuals, the committee chair and the webmaster. The committee chair acts as a liaison and main point of contact for the AAG Council and members, prioritizes incoming work for the webmaster, and brings website-related issues to the attention of the AAG Council for resolution. The webmaster maintains the website itself, makes necessary changes and content updates, and keeps abreast of changes in website-related technology. The webmaster is currently a volunteer position. Website changes and updates are facilitated by use of an administrative webpage where website action items can be posted, reviewed, and acted upon by committee members.

General Website Features

Numerous changes, added functionality, and content updates have been made to the AAG website over the last year and more are planned in the future. Association news and information about upcoming meetings are found in the center of the AAG homepage, including links to presentations, abstracts and photographs from recent meetings. If you have information on upcoming geochemistry-related meetings, please let us know and we will post them (see 'Feedback' link on the left side of the homepage).

The banner on the left of the homepage contains links to a wealth of information.

- The 'Association' link contains information on AAG, its Committees, Awards, and Honorary Members.
- The 'Membership' link has details on the types of AAG membership, membership application and renewal forms, and *new secure on-line membership options*.
- The 'Journal' link provides guides to authors, an example manuscript, the list of Editorial Board members, and the current contents for the AAG journal *GEOCHEMISTRY: Exploration, Environment, Analysis*.
- The 'Newsletter' link provides access to past issues of the *EXPLORE* newsletter (starting with issue #108), contacts for *EXPLORE*, and details on contributing an article, advertising, and subscribing to *EXPLORE*.
- The 'Publications' link has details on AAG and other publications and details on how to order them.
- The 'Students' link provides details on AAG student membership (only \$10 USD!!), the Student Paper Prize, Student Chapters, and the ioStipend grant.
- The 'Careers' page provides links to job openings sent to the AAG website and to job listings posted with Earth Works, InfoMine, and Mining Journal.
- The 'Bibliography' link gives the address of Graham Closs, who compiles geochemistry-related references from a variety of international journals and publishes these in the *EXPLORE* newsletter. Please send new

reference listings to Graham for inclusion in the bibliography. The bibliography is available to AAG members for download from the Members Area (more information later in this article).

- The 'Periodic Table' link has some interesting periodic and "beeriodic" tables.
- The 'Links' page contains an abundance of links to various commercial, government, academic, and professional society sites. Many of these third-party sites are dynamic and ever-changing, so *if you discover a broken link, please let us know and we will try to update the 'Links' page*. This is a never-ending process!
- The 'Poster Gallery' is a link to posters honoring esteemed AAG colleagues, including honorary members, distinguished lecturers, medalists, and student prize winners; and to posters of AAG student chapters. This area of the website is in need of *your contributions*, as it has not been updated in several years.

At the bottom of the homepage are links to news from AAG regions (currently only Australia, Scandinavia, and China). This area of the site could use some updating and geochemical news from additional regions of the world. *Please consider taking on the task of providing new, relevant information to the website for your region of the world*. The 'Memorials' link contains memorials and photographs of preeminent geochemists who have passed on, including Harold Bloom, Bob Boyle, Robert Brooks, Frank Canney, Steve Cone, Alan Coope, Ken Lovstrom, and Paul Theobald. *Photographs for some of these scientists are needed*. Unfortunately, this is an area of the website that will continue to grow as our membership ages. Memorials for Al Levinson, Paul Taufen, and Arthur Darnley will be appearing soon.

The Members Area

The Members Area (link on homepage left banner) of the AAG website has been changed to increase security for this part of the website and the information within. The Members Area now has a username/password combination for access. To aid in the transition process, the Members Area login page now has two options: (1) a 'username/password' and (2) the older, less secure, method using 'current member number/first name/last name'. To choose a username and password, simply log in using the old method. Doing this automatically navigates you to your Profile, where you can choose a username and password. After adding the username and password to your profile, and clicking Update at the bottom of the page, you will be required to use this method for accessing the Members Area. Your new password must be at least 6 characters in length, but there are no other restrictions. However, you are encouraged to choose a combination of uppercase, lowercase, and special characters to make the password more secure.

Upon entering the Members Area, a world map appears at the bottom of the page. You are welcome to add your name, location, and optional photograph to this

The AAG Website... *continued from page 18*

Frapp! map. Currently there are about 30 AAG members shown from the Americas, Australia, and Western Europe. African, Asian, eastern European, Central American, and more South American members need to add their names to the map to demonstrate the truly worldwide membership of AAG.

You can now edit your own profile in the Members Area. Just click on 'My Profile' on the upper right of the page. Please keep your contact information up to date, as this information is used by the searchable Members Database in the Members Area. Minutes from past AAG Council meetings are available for download from the Members Area, for meetings from 2002 to present. Minutes are added after approval by Council. Also available from this area are results from the "Deep Penetrating Geochemistry" project of Eion Cameron and colleagues.

The AAG bibliography available from the Members Area is presently undergoing revision as well. At present, two Excel files are available: the 1940-1994 bibliography and the 1995-2003 bibliography. As time permits, a student under my (Eppinger) direction is collating the recent bibliographies since 2003 from Graham Closs' 'Recent Papers' sections of past *EXPLORE* newsletters, and converting them from individual text files to one Excel file. Eventually, the three bibliography Excel files will be merged into a single file and will be available for download to members in either Access or Excel format.

A final major task under development for the Members Area is *on-line voting capability*. This new functionality is planned for implementation prior to the upcoming Council election in the Fall of 2006.

Summary

Many things have changed on the AAG website over the last 1 1/2 years. In fact, a few minor changes have likely taken place since this article was written! Check it out (<http://appliedgeochemists.org/>) and provide comments/suggestions using the 'Feedback' link on the left side of the homepage. New or updated content for the website are always welcome, as are notices of broken links. Contribute to your website and help us make it better and more relevant to AAG members.

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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

2006

- October 22-25, 2006. **Geological Society of America (GSA) Annual Meeting**, Philadelphia, USA website: www.geosociety.org/meetings/2006
- November 14-16, 2006. **China Mining**. Beijing, China. Website: www.china-mining.com
- December 6-8, 2006. **Northwest Mining Association Annual Meeting**, Reno, USA. Website: www.nwma.org/
- December 13-15, 2006. **9th Australasian Environmental Isotope Conference and 2nd Australasian Hydrogeology Research Conference: Integrating Research and Innovation**. CRC-LEME, Adelaide, Australia. Website: <http://crcleme.org.au/NewsEvents/Events/newconf.html>

2007

- January 29 - February 1, 2007 **Mineral Exploration Roundup 07**. Vancouver, B.C. Canada. Website: amebc.ca/roundupoverview.htm
- 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**, Oveido, Spain
Contact: Jorge Laredo, University of Oviedo, Spain
Email: jlaredo@correo.uniovi.es
- August 13-18, 2007. **WRI-12 International Symposium on Water-Rock Interaction**, Kunming, China, Abstracts are due in December 2006, Website: www.wri12.org
- September 2007 **Exploration 07** Toronto, Canada. Website: <http://www.exploration07.com/>
- October 22-24, 2007 **World Gold 2007** Cairns, Australia. Website: www.ausimm.com/gold2007

2008

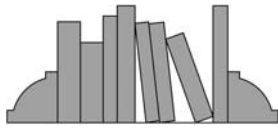
- August 5-14, 2008. **33rd International Geological Congress**, Oslo, Norway. Website: <http://www.33igc.org>.

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

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RECENT PAPERS

This list comprises titles that have appeared in major publications since the compilation in **EXPLORE** Number 131. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochimica et Cosmochimica Acta (GCA); the USGS Circular (USGS Cir); 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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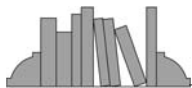
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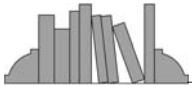
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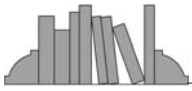


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New Members and Fellows

FELLOWS

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Mr. Jing Zhang

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AAG Membership # 3921

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Membership # 3911

Mr. Goao Yuyan

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Membership # 3912

The Association of Applied Geochemists*announces the*

**2006 AAG
Student
Paper
Competition**



SGS

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
School of BEES
The University of New South Wales
UNSW NSW 2052
Australia
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/>



Association of Applied Geochemists
Student Membership: \$10. US

Encourage a student to join!



Geology and Exploration of New Zealand Mineral Deposits (MONOGRAPH 25)



The AusIMM's latest monograph is an important contribution to the exploration of New Zealand's mineral deposits, and is a successor to the 1989 monograph on Mineral Deposits of New Zealand.

The volume contains a comprehensive collection of 47 papers from 70 authors that review selected mineral deposit types or describe individual mineral deposits, plus an introduction that sets the exploration scene in New Zealand. The authors are from the minerals industry, universities, and government research organisations, and summarise a large amount of unpublished exploration information.

Topics covered include the geological setting of mineralisation, epithermal Au-Ag (21 papers), orogenic Au±Sb±W (9), placer Au (4), ironsands (3), placer ilmenite, intrusion-related Au, platinum, clay, zeolite, onshore and offshore volcanic massive sulfides and offshore ferromanganese nodule deposits.

The volume is 350 pages and is available in hard copy and CD ROM format. A full contents list is available via The AusIMM online bookshop at www.shop.ausimm.com.au

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Toronto, Canada Sept 9 to 12, 2007

Invitation

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- » Who should attend
- » Information Booklet

Technical Program

- » Publication of Proceedings

Training and Events

- » Exhibition
- » Field School
- » Commercial Presentations
- » Company Visits

Accommodations

Contact Us

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 stake holders 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

**23rd INTERNATIONAL GEOCHEMICAL EXPLORATION SYMPOSIUM
and 2nd INTERNATIONAL APPLIED GEOCHEMISTRY SYMPOSIUM**



EXPLORING OUR ENVIRONMENT

Jointly organized by the Department of Exploration and Mining of the University of Oviedo (Spain), the Geological and Mining Institute of Spain (IGME) and the Association of Applied Geochemistry

**14 - 19 JUNE 2007. PRÍNCIPE FELIPE CONFERENCE HALL
OVIEDO, ASTURIAS. SPAIN**

Preliminary Announcement

Technical Sessions
Poster and Trade Exhibition
Workshops
Social Programme
Field Visits
Accompanying Persons Programme

INVITATION TO EXPLORE OUR ENVIRONMENT



The 23rd International Geochemical Exploration Symposium and 2nd International Applied Geochemistry Symposium will be held in Oviedo (Spain) from 14th to 19th 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 last 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 week end between 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 the 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.

Jorge Loredó
23rd IGES Chairman



In the next issue of EXPLORE...
Overviews of heavy mineral processing and picking lab services

Mineral Exploration Research Centre • *Centre de recherche en exploration minérale*

MERC

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 litho-geochemistry; 2) quality control and quality assurance; 3) introduction to litho-geochemistry, 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 litho-geochemistry 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.earthsciences.laurentian.ca/coursework_msc.htm or obtained by contacting :

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Mineral Exploration Roundup 2007

January 29 to February 1, 2007, The Westin Bayshore, Vancouver, British Columbia, Canada

Mineral Exploration Roundup 2007 - Short Courses

Short Course #1 [Exploration and Mining 101](#). Presented by the Association for Mineral Exploration BC (AME BC) and Dr. Rob Stevens (BCIT)
Dates: January 27 & 28, 2007 **Course Overview:** This two-day course will present an overview of mineral exploration and mining for non-technical personnel working in this exciting industry (investor relations personnel, accountants, lawyers, management, administrative support, and investors). Topics that will be discussed include geology and mineral deposits, exploration methods, drilling, resource and reserve calculations, and common mining methods. The course includes an overview of how to read technical news releases, understand drill and assay results and evaluate exploration properties and companies. Case studies using companies and properties in the news will augment the material presented. This course is adapted from the popular four-day course called Exploration and Mining for Investment Advisors and Investors offered by AME BC and the BC Institute of Technology. A course manual will be provided.

Short Course #2 [Practical Structural Geology for Exploration and Mining](#). Presented by the Association for Mineral Exploration BC (AME BC) and T. Campbell McCuaig (Centre for Exploration Targeting, University of Western Australia)
Dates: January 27 & 28, 2007 **Course Overview:** This two-day course will be very practical and highly interactive. The main focus is on geometrical analysis of mineral systems from drill core and outcrop to the regional scale with the intent of improved resource delineation and targeting. Participants will leave with an increased awareness of structural controls on mineral systems, and increased confidence in applying structural geology to their exploration and mining projects. The course comprises alternating sessions of brief lectures and practical exercises/case studies from world class mineralization systems around the world such as lode gold in the Birimian of West Africa, Copper skarn mineralization in the Andes, giant lode gold and intrusive related systems of Australia, deformed Archean systems, Porphyry copper/epithermal gold systems in Papua New Guinea, amongst others. The course notes are extensive and will serve as an ongoing reference manual for participants.

Short Course #3 [Applied Volcanology and Breccias for the Explorationist -Working from Description to Interpretation](#). Presented by the Association for Mineral Exploration BC (AME BC) and Jocelyn McPhie (CODES, University of Tasmania), David Cooke (CODES, University of Tasmania), Kirstie Simpson (Geological Survey of Canada) and Andrew Davies (Teck Cominco Limited)
Dates: Friday, January 26-28, 2007, **Course Overview:** This three-day short course will provide the participant with basic fundamental physical volcanology skills including understanding eruptive processes, fragmentation processes and transport, and depositional processes. Emphasis will be placed on the use of descriptive, non-genetic terminology and subsequent use of key textures, deposit characteristics and relationships to assist in genetic interpretations. Specific topics will include the description and interpretation of volcanic and subsurface hydrothermal breccias, effects of hydrothermal alteration, and applications to exploration. Lectures will be supplemented with hand specimens illustrating important textures and relationships. *Space is limited to 50 participants.*

Short Course #4 [View from the Fringe - Far Field Alteration Around Ore Deposits](#). Presented by Mineral Deposit Research Unit (MDRU), University of British Columbia
Dates: January 27- 28, 2007 **Course Overview:** Hydrothermal systems are much larger in areal extent than any concentration of metals. The ability to identify the scale of those systems and recognize where an altered outcrop or drill hole sits within a paleohydrothermal system can provide important vectors toward undiscovered resources. This two-day course will examine the fringes of ore deposits in a range of environments including sedimentary rock hosted ore deposits (SEDEX, Sedimentary Cu, Carlin Au), volcanic rock hosted (VMS), and intrusion hosted and centred (porphyry, skarn and cordilleran base metal deposits). The course is aimed at mineral exploration, government, academic and student geologists, and provides an opportunity to meet and exchange data and views with leading researchers in the field. **For more information on the course, visit MDRU's website: www.mdru.ubc.ca/home/courses/offered.php**

Short Course #5 [NI 43-101 Standards of Disclosure for Mineral Projects](#). Presented by the Association for Mineral Exploration BC (AME BC) and the BC Securities Commission
Dates: January 26, 2007 **Course Overview:** This one-day course is **free** to attend and will review what can be learned from Canadian mining industry disclosure and filing practices in 2006. The course will consist of a series of special sessions on the following: Good disclosure practices, or "Learn from others' examples"• Technical disclosure in mining prospectus filings, or "Getting it right the first time", or "Learn from others' mistakes"• Results of analysis of problematic prospectus filings - Failure of due diligence? or just poor preparation of disclosure documents?• Forward-looking information on mineral projects - Safe Harbours and NI 43-101 requirements• Relying on previously filed documents to meet NI 43-101 requirements• Points to consider - or "The grandfathers may be getting a little old"• The always popular - questions and answers. This course will be presented by: Greg Gosson, Chief Mining Advisor, and Robert Holland, Senior Securities Analyst, BC Securities Commission; Deb McCombe, Chief Mining Consultant, Ontario Securities Commission.

Short Course #6 [Kimberlite Geology, Basics, Advances & Economics](#). Presented by the Association for Mineral Exploration BC (AME BC), Mineral Services Canada and Scott Smith Petrology Inc.
Dates: February 2, 2007 **Course Overview:** This one-day short course will start with an introductory overview of the nature of kimberlite, including a review of mineralogical and textural classification. This will be illustrated with examples from around the world. Kimberlites display a range of emplacement and eruption styles thought to reflect variations in magma composition (volatile content), host-rock geology, and hydrology. These result in kimberlite bodies with very different geological characteristics that have a direct bearing on the quantity and distribution of diamonds. Differing styles of kimberlite emplacement will be discussed in some detail, with specific reference to Canadian examples. The diamond content of kimberlites is critically dependent on sampling of appropriate diamond source rocks. Thus understanding the nature of the "mantle sample" in kimberlites is critical for reliable determination of economic potential and this aspect of kimberlite geology will be briefly reviewed. The methodology used in building kimberlite geology models will be described before concluding with a discussion of how intrusion processes and kimberlite geology impact on the economics of kimberlites. Recent advances in the field of kimberlite petrology and volcanology emerging from the International Kimberlite Workshop held in Saskatchewan in September 2006 will be incorporated into the course.

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.

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(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)

(Professor/ AAG Fellow Signature) (Printed Name and Title)

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

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***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**

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EXPLORE

Newsletter No. 132

OCTOBER 2006

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EXPLORE is published quarterly by the Association of Applied Geochemists, P.O. Box 150922, Lakewood, CO 80215-0922, USA. **EXPLORE** is a trademark of the Association of Applied Geochemists.

Type and layout of EXPLORE: Vivian Heggie, Heggie Enterprises, Thornton, CO (303) 288-6540; <vjmheggie@comcast.net>

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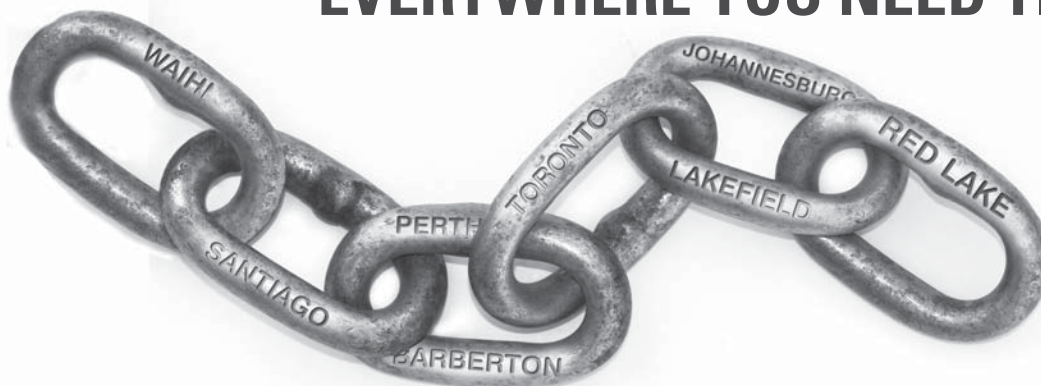
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