Focus on Geochemical Laboratory Updates

EXPLORE
NUMBER 124 JULY 2004

Newsletter for the Association of Applied Geochemists

Genalysis Laboratory Services.

As Australia's largest privately owned geochemical laboratory our focus on quality is not compromised by excessive pressure from management and shareholders.

The last few years have been difficult for all laboratories and hopefully the newfound optimism from within the industry will produce benefits for all. Key areas of development for Genalysis have been:

New Prep Facility in Johannesburg :- Being one of the largest providers of quality PGE analysis in the southern hemisphere it was only natural to open a sample preparation facility to service new and existing clients in southern Africa. Modern airfreight ensures rapid transport of pulps directly to us in Perth so before you know it you'll be saying "gee, those assays look good!"

Keeping all the instruments under one roof with all the attentive QC supervision guarantees the maintenance of quality. It was great to see Genalysis perform extremely well in the last PGE round robin published in Geochemistry, Exploration, Environment, Analysis 2003 (Hall and Oates).

Robotic Sample Preparation :- Current robotic sample preparation systems are very efficient but prone to significant downtime through breakdowns. A new system which is potentially more reliable is currently being evaluated.

New Methods :- Continuing evaluation of existing methods leads to an improvement in technical results. The evolution of the standard aqua regia digest into test tubes (our BT digest) allows for greater capture of Hg. Epithermal Au explorers should find this useful.

Our Flow Injection Analysis System (FIAS) attachment for the ICP-MS enables us to achieve detection limits close to 1ppb for Te. This should greatly assist those exploring for Au in Archaean greenstone terrains.

The volume of partial digest work increases every year. The decision to develop partial digest technology (our Terraleach digests) with in-house chemists under the supervision of a geologist has been beneficial given the continuing debate about its effectiveness. Like all methods there are caveats, which everyone needs to be aware of. Some digests are inappropriate for a particular terrain and can be irrecoverably compromised by adversely reactive sample media. In reality, this is true for all analytical geochemical methods and the advantage in developing partial digests in-house is that the applicability and limitations from a chemical perspective are well understood.

New Instruments :- A lowering of existing detection limits will be achieved for a whole series of elements with the commissioning of the new Perkin Elmer Dynamic Reaction Cell ICP-MS. This will compliment existing ICP-MS, ICP-

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Technical Note: An Unexpected Aspect of EDTA Partial Digest Extractions

by Roger Fidler, Mark McGeough and Keith Hannan

As a result of our own difficulties with the use of EDTA, we have no trouble sympathising with several contributors to the discussion of the role of carbonate and pH in partial leach extractions. As has been regularly shown, there are a large number of complications that may be associated with partial leaches, but we have come across an effect with which we were not familiar and that may have relevance to aspects of the discussion.

Our work has been concerned with mineral exploration using copper and zinc complexes of EDTA. It had been our expectation that while elements may compete more or less successfully for a given complexing agent, the optimum conditions for the formation of a particular complex would be relatively constant and independent of the presence of other elements. We now have reason to review this assumption.

Knowing the conditions under which the various complexes were stable has been basic to the project and. the computer programs HYDRA and MEDUSA were used to produce speciation models for any particular circumstance. For example, the estimated, relative proportions of EDTA species occurring in the presence of a 20% surplus of EDTA at various pHs for 10μM copper (Figure 1) or 10μM zinc (Figure 2 - see page 2).

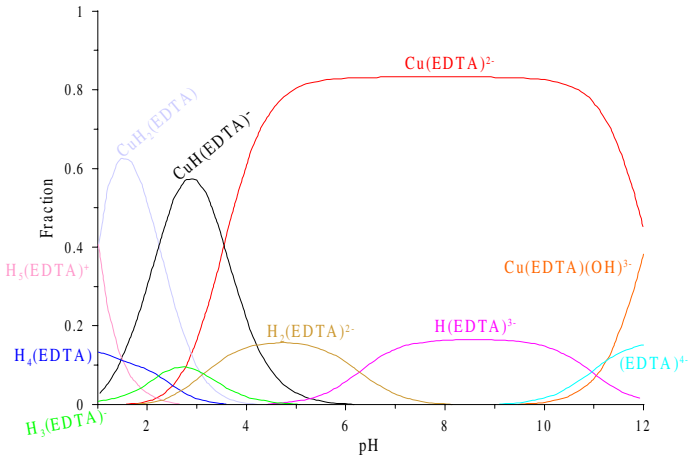

Figure 1. Modelled proportions of EDTA species in the presence of 20% excess of EDTA over that required to complex 10μM copper

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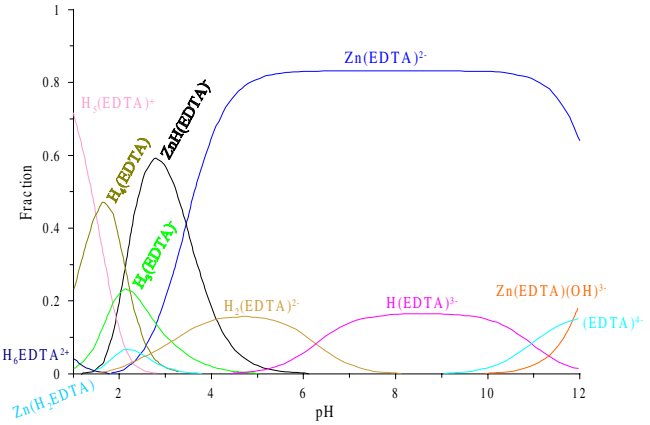

Figure 2. Modelled proportions of EDTA species in the presence of 20% excess of EDTA over that required to complex 10μM zinc.

A rather large number of species are anticipated and even though the diagrams show a superficial similarity, they differ in detail. However, the important feature as far as this discussion is concerned is that in isolation, $Cu(EDTA)^{2+}$ (red) and $Zn(EDTA)^{2+}$ (blue) are predicted to be the dominant and stable species for the respective elements, between about pH4.5 and pH10, the range where geochemical extraction commonly takes place.

As the copper-EDTA complex has a higher stability constant than its zinc counterpart, in circumstances where

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both elements are present and there is insufficient EDTA to form the complexes of both metals, it might be expected that the copper-EDTA complex would be formed, preferentially. If we consider the situation where there there is only 80% of the EDTA required to complex both metals, the curves for $Cu(EDTA)^{2+}$ and $Zn(EDTA)^{2+}$ (Figure 3) show that this is exactly what happens. The pH range of either complex is little altered but most EDTA is complexed by copper with zinc only able to form a complex with that which is left over.

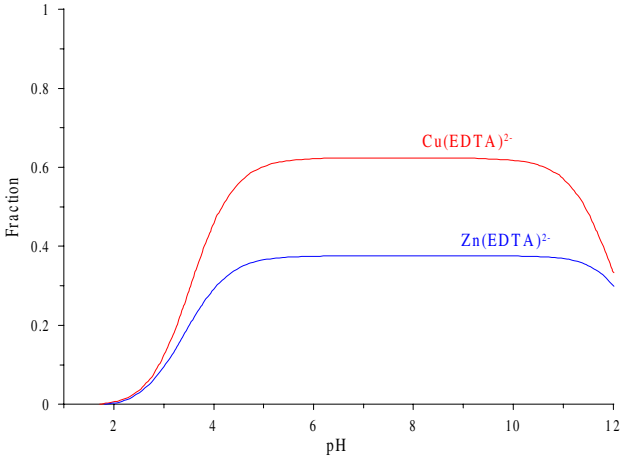

Figure 3. pH stability ranges for $Cu(EDTA)^{2+}$ $Zn(EDTA)^{2+}$ with a deficiency of 20% EDTA

However, the nature of the model is quite different when the amount of EDTA is much lower. For instance, with only 5% of the EDTA necessary to complex all metal, the proportions of the complexes are no longer constant over the pH range and instead, the prediction is that the copper-EDTA complex, alone, will form at low pH and at higher pH, the EDTA will be shared more evenly, such as shown in Figure 4.

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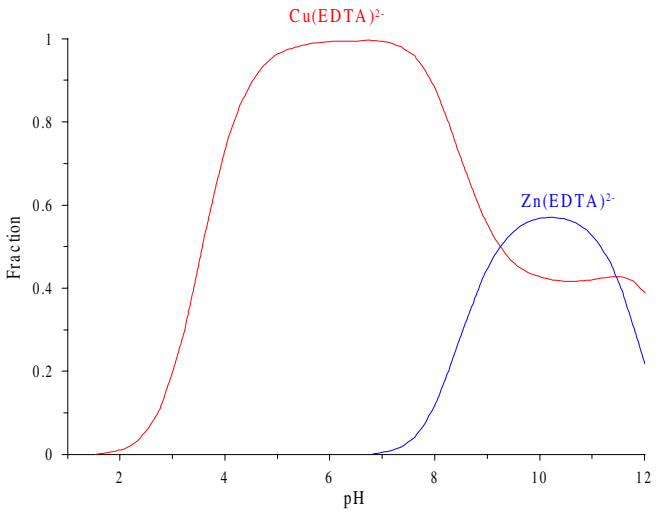

Figure 4. pH stability ranges for $Cu(EDTA)^{2+}$ $Zn(EDTA)^{2+}$ with a deficiency of 95% EDTA

This is a computer simulation of only one aspect of an extraction and not a laboratory measurement but the practical implication is that for an extraction dependent on EDTA complexation, the optimum extraction pH for a particular element is not necessarily independent of other metals present when the ratio of EDTA to metal is low. However, it does have some laboratory support.

One of several peculiar aspects of the survey that triggered this investigation was that high zinc results came from samples giving high, final pHs (>pH8) when our expectation, based on Dronseika and Evers careful, experimental work, was the opposite. Conversely, the high copper results all came from samples giving low final pHs (<5). As a consequence, even though copper and zinc are thought to have a common source, no sample was anomalous for both copper and zinc. A number of explanations can be devised but few have the advantage of those involving this modelled pH effect of simultaneously accounting for all.

Models of other element pairs suggest that this should not be unique. Lead should interact with the zinc-EDTA complex in a similar fashion to copper, as would, ferric, bismuth, some rare earth elements and many others. Cobalt, however, should do the opposite and push the zinc optimum to a lower pH. The elements mentioned are also predicted to have a geochemically-noticeable effect on the pH range of each other. Common metals such as aluminium and iron III are of particular interest, not only because they are ubiquitous and abundant, but also because some have chemically stable EDTA complexes (but may be limited by the solubility of the minerals in which they occur).

The use of low-concentration EDTA extractants is widespread but since a low EDTA to metal ratio is necessary for this particular problem to arise, one remedy (within limits) would seem straightforward. The use of buffers has been suggested as a means of limiting pH-related extraction problems. Although a varying pH is not beneficial to extraction, limiting pH change would not

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seem an adequate defence from problems arising in this fashion as the optimum pH for a specific element could vary with the composition of the sample and in a manner which might differ from element to element. Forcing a low, constant pH could conceivably even be counterproductive in that it could result in an increase in the level of diverse cations to battle for available ligand, thereby worsening the EDTA to metal ratio.

Though problems of this nature can be prevented in future, their recognition in existing data sets is both a challenge and an opportunity. Some of the unusual results which led to the current hypothesis may thus be of interest to those reviewing existing data and to that end, a more comprehensive communication is being prepared.

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References

Dronseika, E., and Evers, A., 2000. Aspects of EDTA partial digest extractions in variable pH terrains – the vunerability of unbuffered digests, Explore, 109.

Smee, B.L., 2003a. Theory behind the use of soil pH measurements as an inexpensive guide to buried mineralization, with examples. Explore, 118.

Mann, A.W., 2003. Reply to Barry Smee, Explore120.

Smee, B.L., 2003b. Reply to A.W. Mann, Explore 121.

Mann, A.W., 2004. Reply to Barry Smee, Explore122.

The programs HYDRA and MEDUSA were written by Ignasi Puigdomenech of the Royal Institute of Technology, Stockholm.

David Kelley

AAG Presidential Address

The title of David Cohen's article in the last issue of Explore, "Who will teach the last classical exploration geochemistry course," struck a nerve in me. Most of us have been aware that the number of trained applied geochemists entering industry, government and academia has been declining, but the realization that the academic programs where young scientists are trained are disappearing is alarming. Reading further into Gerry Govett's article, one gains a sense for how small our community really is. It's true that there are other areas of applied geochemistry out there, and the broadened scope of our organization will benefit from the interaction with these disciplines. However, I cannot escape the feeling that we are moving down a one-way path. Where will trained applied geochemists come from in the future if not from the programs that exist today? Will we rely on students trained in traditional earth science disciplines to "learn on the job?"

More importantly for the AAG, we need to ask what we can do to help this situation. Clearly if we act now, we can change this trend. The unfortunate loss of two of our members, Steve Cone and Alan Coope, has resulted in two new scholarship funds, which enable us to support student research in applied geochemistry. We need to support these scholarship funds through contributions from you and your employers. No contribution is too small. Our Student Chapters have gone inactive, in part due to the down turn in the minerals industry, but now is the time to encourage students and faculty to initiate new chapters. Obviously, if you are in a position to hire a young geoscientist, even if only for a summer-time position, this can be rewarding to you, your employer and the budding applied geochemist. These are just some of the ways that we can help ensure that the field of applied geochemistry stays vibrant in today's geoscience environment.

I'd like to welcome Brian Townley in his new role as Regional Councilor for Chile. Brian succeeds Alvaro Puig who served in this position for the last several years. Thank you Alvaro for all of your support. Also, Rob Bowell is taking over the Regional Councilor Coordinator position from Philippe Freyssinet. Philippe continues to provide advice and support to Council and we value his input.

Preparation for the AAG's involvement in the SEG 2004 meeting in Perth is progressing well. Four AAG members, Charles Butt, Paul Agnew, Gwendy Hall and myself will be presenting papers on geochemistry at this meeting. We have also secured a sponsor's slot during the meeting which allows us to address the delegates and show a promotional video on our symposium the following year in Perth. Beth McClenaghan has volunteered to develop a new promotional brochure for the AAG, and this will be given to all delegates along with a brochure for GEEA. For more information on this meeting, please go to www.cgm.uwa.edu.au/geoconferences/seg2004.

Sincerely,

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It's Time to Get Involved!

The Association of Applied Geochemists needs your help. It is time that all of us take an active role in the affairs of the Association by helping to increase the membership in AAG.

The Association is not some distant bureaucratic entity but a collection of interacting geoscientists, you and me, with common interests who as a group have assembled a portal of knowledge to the benefit of the whole group through GEEA, the Newsletter, the Web site, Symposia, and everything else that comes with being a member of this organization.

The AAG has weathered some difficult times in the mining industry. With declining budgets, layoffs, and mergers, many organizations and individuals have had to make difficult decisions about renewing their memberships. Consequently our membership ranks have declined from just over 1000 in 1998 to less than 500 currently. Given this trend, and the fact that applied geochemistry covers a wide spectrum of disciplines, the Association has broadened its scope to attract geochemists from diverse backgrounds. This is now reflected in our new name and the change in the focus of the organization as expressed in its by-laws.

Council is asking each and every one of you to help out in some small way to attract new members to our Association. If enough of you volunteer some time, we can significantly increase our ranks without making it an onerous task for anyone. The more members we have, the more activities the AAG can support financially to enhance the benefits of membership to all of us.

The AAG is launching a major new membership drive this year with your help. Some of the ways in which you can help out include:

- Promoting membership in AAG to your fellow employees;
- Identifying universities and research organizations with active research programs in our field; making faculty and students aware of the benefits of membership in AAG;
- Representing the AAG at non-AAG sanctioned conferences and symposia by means of a verbal presentation on AAG benefits and by setting up a booth with promotional materials;
- Identifying small discussion groups of geoscientists with interests in applied geochemistry; establishing contact with them to promote the value of membership in AAG;
- Soliciting memberships from personal contacts in companies you do business with particularly in environmental firms or government agencies; and,
- Contacting lapsed members in your area to encourage them to rejoin AAG.

Another way in which you can participate is by contributing or soliciting papers for GEEA and articles of interest to Explore or our Web site. Any suggestions you have for improving the content or format of Explore or our Web site would also be appreciated.

It is time to use the strength of our Association – we, the members, with all our professional contacts – to get this job done. I ask you to volunteer some of your time to help attract new members. Please indicate your willingness to get involved by contacting me at rgjackson@ctnis.com. Someone from the New Membership Committee will then contact you to help coordinate your efforts with that of other volunteers.

On behalf of Council, thanks for your help.

Robert G. Jackson
Chair, New Membership Committee.

Readers' Forum

The Association of Applied Geochemists: Planning for the Future

I am writing to congratulate the authors of the report "New Membership Committee Report and Recommendations" who address some of the important issues confronting the Association, principally the noticeable decline in membership. The report contains some excellent suggestions for Council to consider. The authors deserve our congratulations for their commitment to the cause we all share.

I suggest that the report needs further amplification in order for this initiative to succeed which include the following suggestions:

1. The authors quite rightly point out the lack of a marketing plan for the AAG. My comment is that marketing is of little impact unless it is contained within an overall financial plan. I suggest that the AAG needs a 5 year Business Plan developed via consultations with members;
2. Additionally one of the most serious problems facing the AAG is the lack of professional recognition of our discipline. This is especially true for legislation-dominated fields such as the environment. I submit that the AAG needs to develop the geochemical equivalent of the Qualified Person. This would make a professional membership far more attractive to others; and,
3. I am also concerned that although the report does recognize that geochemical exploration is the main interest area this area, might not be a very fertile recruiting ground as most practitioners, like myself, are of the gray haired variety. The world economy and the industry have changed dramatically over the last slump and any marketing plan needs to consider this. One of the main vectors in today's economy is the convergence of technology across most organizations. This presents a great opportunity for the AAG to enter into other areas to demonstrate our worth including agriculture, health and others.

Respectfully submitted,
Peter J. Rogers
Santiago de Chile, March 27, 2004

2004 Technical Training Course on Exploration Geochemistry

(For Countries in Africa)
(October 10- November 8, 2004)

AIMS AND NATURE OF THE COURSE

Geochemical techniques have been developed for solving mineral resources and environmental problems in the past 60 years. Geochemical maps of various scales from local to global have been the basic support in the practical application of exploration geochemistry just as geological maps have been in geology.

The Institute of Geophysical & Geochemical Exploration (IGGE) , CAGS, China is leading the development of geochemical mapping and exploration techniques in the world. The 2004 Technical Training Course on Exploration Geochemistry is a part of the Chinese assistance and support to the program for Technical Cooperation among Developing Countries (TCDC). This course is sponsored by the Ministry of Commerce of the People's Republic of China. The responsible organization will be the Institute of Geophysical and Geochemical Exploration (IGGE) in cooperation with The Association of Applied Geochemists (AAG).

The aims of the course are to promote the development and improve the quality of exploration geochemistry in developing countries, by transfer of innovative ideas and techniques of geochemical mapping and geochemical exploration developed in China. It is hoped that such training activities will lead to the initiation of geochemical mapping projects in Africa. The information obtained from such projects will be extremely useful for future cost-effective activities of mineral exploration and mining in Africa. The seminar includes the following topics.

COURSE PROGRAMME

1. Introduction: evolution of basic ideas and methodology in exploration geochemistry;
2. Regional geochemical mapping – Regional National Geochemical Mapping Project in China;
3. Global geochemical mapping;
4. Deep-penetrating geochemistry for concealed deposits, particularly focused on desert terrains;
5. Environmental geochemistry: survey, monitoring and assessment;
6. Geochemical field methods;
7. Geochemical analysis 1: Multi-element analytical system and methods;
8. Geochemical analysis 2: Analytical requirements and quality control;
9. Geochemical data management and processing;
10. Geochemical assessment for large ore deposits based on concepts and methodology of geochemical blocks;
11. Application of geochemical maps for mineral exploration and environmental assessment;
12. Case histories.

The training will be conducted through comprehensive approaches, including theoretical lectures, lab work, field practice, demonstration, seminar and study tours, etc. Approximately, 40% of the course time is allocated for lectures, while the rest for lab work, fieldwork, study tour and other activities. The course will also provide the participants with the opportunity to exchange participant's career achievements and discuss geological development in their respective countries. Therefore, each participant is required to prepare a review paper on his/her national geological/geochemical work before coming to China.

DATE AND DURATION

The duration of the training course is from October 10 to November 8, 2004 (28 days).

VENUE

The training course will be conducted at the Institute of Geophysical & Geochemical Exploration, CAGS, Beijing, People's Republic of China.

MEDIUM OF INSTRUCTION:

English.

EXAMINATION AND CERTIFICATE

The performance of the participants shall be assessed by a series of evaluations, which include a final written exam, performance in various kinds of course activities and completion of various reports on lab work, field practice and study tour. A certificate of proficiency will be awarded to the participants on the successful completion of the course.

The allotment of marks will be as follows:

a). Written tests	50%
b). Report on practical work	25%
c). Performance and diligence	25%

PARTICIPANTS QUALIFICATIONS AND REQUIREMENTS FOR ADMISSIONS

The course is targeted at mainly technical and managerial personnel currently engaged in geology/ geochemistry from developing countries (in Africa, South America and Asia). Application by women is strongly encouraged. In general, the applicant should meet the following requirements:

1. Be nominated by his/her related government;
2. Have an educational background of a diploma in geology, geochemistry or other related discipline, or equivalent qualifications, and have worked in geology, geochemistry and/or the geoanalysis sector for at least two years;
3. Be proficient in English reading, listening, speaking and writing;
4. Be in good health, having no infectious diseases and

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Technical Training Course...

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being physically capable of fulfilling all course activities;
5. Pledge to observe all the laws and regulations of the P. R. China and respect the local customs during the training period in China; and,
6. Prepare a review paper on the geological/geochemical development in your respective country and professional experience of participants.

TRAINING EXPENSES

1. The expenditure of training, board and lodging, local transportation for the purpose of training, daily pocket money (30-yuan/per capita), during the training period in China for the participants *funded by Chinese Government* will be borne by the training center.
2. All other expenses including international travel expenses and transit/transfer cost and so on between the home country of participants and Beijing should be borne by the participants themselves, or their employers or their governments or international funding agencies, e.g..
3. The government of the country which sends participants to the training course should assume the responsibility for their insurance, cost of medical care, monthly salary etc. during the training period.
4. Board and lodging will be arranged for the participants by the course organizer during the training period. Participants will be accommodated in double-bed rooms in the guesthouse.

APPLICATION AND ADMISSION APPROVAL

1. The applicants should be nominated by their respective governments. The nominated participants are required to fill in the *Application Form*, which should be endorsed by the department concerned within his/her government, and submited with a valid *Health Certificate* provided by an authorized physician or hospital to *the Economic and Commercial Counselor's Office Chinese Embassy* in the respective country for the examination, endorsement, and recommendation.
2. After endorsement by the Economic and Commercial Counselor's Office of the Chinese Embassy, an *Admission Notice* will be issued to the accepted participants through the department concerned of applicant's government. Using the *Admission Notice*, the admitted participant are required to go through all necessary formalities for entering into China.

INSURANCE

The course organizer does not accept any responsibility for such risks as loss of life, accidents, illness, loss of property, etc.

INSTITUTION AND PERSONS TO CONTACT

1. Economic Consul of the Chinese Embassy in your respective country.
2. Bureau of Foreign Economical Cooperation, Ministry of Commerce of the People's Republic Of China.

Liaison Persons:
Mr. Lin Bin and Mr. Jiang Hao
Fax: 86-10-65197561
Tel: 86-10-65197561
E-mail: xiwei@mofcom.gov.cn

3. Institute of Geophysical & Geochemical Exploration, CAGS.
84 Golden Rd., Langfang, Hebei 065000
People's Republic of China
Liaison Persons: Dr. Wang Xueqiu, Cheng Zhizhong
Tel: 86-316-2212721
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E-mail: xqwang@heinfo.net, geochemistry@sina.com

The Association of Applied Geochemists

is pleased to announce the

2004 AAG

Student Paper Competition

The Association of Applied Geochemists will hold the fifteenth biennial Student Paper Competition this year. Papers eligible* for the competition must address an aspect of exploration geochemistry and represent research performed as a student. The student must be the principal author, and the paper must have been published in any referred scientific journal no more than five years after completion of the degree for which the research was performed. A nomination may be made by anyone familiar with the work of the student. Nominations must be accompanied by four copies of the paper. The deadline for receipt of the nominations is December 31, 2004.

Win $500

and receive a travel allowance to an AAG sponsored meeting

This prize consists of a $500 Canadian cash prize, donated by SGS Canada, a two-year membership to the Association of Applied Geochemists with receipt of Geochemistry - Exploration, Environment, Analysis and EXPLORE, photograph and curriculum vitae of the author and an abstract of the prize-winning paper will be published in EXPLORE as soon as possible after the announcement of the award.

Mail to: Dr. Ian D.M. Robertson
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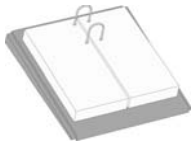
*Full details are available from the Chairman of the competition (address above) or from the AAG Home Page under 'Students" (www.appliedgeochemists.org)



CALENDAR OF EVENTS

International, national, and regional meetings of interest to colleagues working in exploration, environmental and other areas of applied geochemistry.

■ June 27-July 2, 2004 **11th International Symposium on Water-Rock Interaction**, Saratoga Springs, New York, USA (Dr. Susan Brantley, Secretary General, Dept. of Geosciences, The Pennsylvania State University, 239 Deike Building, University Park PA USA 16802, Phone: 814-863-1739 FAX: 814-863-8724 Web: http://www.outreach.psu.edu/C&I/WRI/)

■ August 20-28, 2004 **32nd Session of the International Geological Congress**, Florence, Italy (Chiara Manetti, Dipartimento di Scienze della Terra, Via La Pira, 4 - 50121 Firenze -ITALY, EMail: casaitalia@geo.unifi.it Web: http://www.32igc.org)

■ Aug 21-28, 2004 **Global and Continental-Scale Mineral Resource Assessments, 32nd International Geological Congress**, Florence, Italy , by the Bureau de Recherches Géologiques et Minières; International Union of Geological Sciences; and U.S. Geological Survey. (Joe Briskey, U.S. Geological Survey; 12201 Sunrise Valley Drive, MS-954; Reston, VA 20192, Phone: 703-648-6112 EMail: jbriskey@usgs.gov Web: http://www.32igc.org/home.htm)

■ September 19-22, 2004, **8th International Congress on Applied Mineralogy (ICAM 2004)**, Aguas de Lindoia, Aguas de Lindoia, Sao Paolo, Brazil , by the International Council for Applied Mineralogy (ICAM); International Mineralogical Association - Commission on Applied Mineralogy (IMA-CAM). (Dogan Paktunc, 555 Booth Street, Phone: 613-947-7061 FAX: 613-996-9673 EMail: dpaktunc@nrcan.gc.ca Web: http://www.icam2004.org)

■ Sep 27-Oct 01, 2004, **SEG 2004: Predictive Mineral Discovery Under Cover**, University of Western Australia, Perth, WA, Australia , by the Society of Economic Geologists (SEG), Geoconferences WA, and Society for Geology Applied to Mineral Deposits (SGA). (Susan Ho, P.O. Box 80, Bullcreek WA 6149, Australia, Phone: (61 8) 9332 7350 FAX: (61 8) 9310 6694
EMail: susanho@geol.uwa.edu.au
Web: www.cgm.uwa.edu.au/geoconferences/index.asp)

■ October 10-15, 2004, **SEG International Exposition & 74th Annual Meeting**, Denver, Colorado, US , by the SEG. (Debbi Hyer, 8801 S. Yale, Tulsa OK 74137, Phone: (918) 497-5500 Email: dhyer@seg.org Web: http://meeting.seg.org)

■ November 7-10, 2004, **Annual Meeting of the Geological Society of America**, Seattle, Washington. INFORMATION: TEL 1-800-472-1988, meetings@geosociety.org.

■ November 25 – 27, 2004, **International Karakorum Conference,** Islamabad, Pakistan. Information: Prof. Dr. F. A. Shams, Lahore, Pakistan. pags@yahoo.com or telefax: 092-42-9230236.

■ February 28-March 2, 2005, 2005 **SME Annual Meeting and Exhibit,** Denver, CO. INFORMATION: Meetings Department at 800-763-3132 or 303-973-9550. http://www.smenet.org/meetings/calendar/event_calendar.cfm

■ May 15 through May 18, 2005, **Geological Society of Nevada Symposium 2005** Sparks, Nevada USA, INFORMATION: Geological Society of Nevada (gsnsymp@unr.edu)

Please check this calendar before scheduling a meeting to avoid overlap problems. Let this column know of your events.

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AAG ANNUAL GENERAL MEETING

The Annual General Meeting (AGM) of the Association of Applied Geochemists (AAG) will be held in conjunction with the Society of Economic Geologists (SEG) 2004 Conference to be held in Perth, Western Australia during September 27 - October 1, 2004. The specific date, time, and location for the AGM will be announced by email to AAG members and Fellows as soon as coordination is completed with SEG.

David B. Smith *Secretary AAG*

Geochemical Laboratory Updates...

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OES and AAS instruments and will create exploration opportunities by the detection of subtle haloes around ore systems. Expect improved detection limits for a large range of elements including As and Se.

Quality Control :- The laboratory was successfully audited by the National Association of Testing Authorities (NATA) and has achieved its ISO/IEC 17025 accreditation for a wide range of methods. The "Measurement of Uncertainty" process required by this standard has lead to improvement of laboratory methods by targeting the sources of error in each procedure. In most cases calibration of instruments appears to be the main source of analytical variance and our involvement in "Measurement of Uncertainty" has enabled us to achieve improved accuracy.

Environmental Services :- An increased demand for analysis for environmental monitoring, mine waste management (including Acid-Base Accounting procedures) and leach testing has justified the services of a dedicated environmental chemist.

We will be major sponsors of IGES 2005. We invite all geochemists to visit our newly re-furbished laboratory when they are next in Perth or during the conference.

Ed Dronseika *genalysis@genalysis.com.au*

Reference: Hall, G.E.M., Oates, C.J. 2003 Performance of commercial laboratories in analysis of geochemical standards for Au and Pt group elements. Geochemistry: Exploration, Enviroment, Analysis, Volume 3, No. 2.

SGS Minerals

Since 2002 the SGS minerals laboratory network has grown substantially with the addition of the Analabs and Lakefield Research laboratories into the Group, becoming the leading supplier of minerals services in the world. A key goal of the integration effort, under the impetus of SGS's Six Sigma program, a business improvement process focused on meeting customer requirements, has been to ensure a common product offering from our laboratories anywhere in the world. This has also been an important consideration for many of our clients who have operations in numerous countries and would like to have access to standard methods at regional laboratories.

As a first step to achieving standard methods, methods inventories from all of our labs were compiled and reviewed. The methods have now been combined into a unified product offering with revised method codes. The streamlining of methods has not been at the expense of regional methods that have been developed to deal with the peculiarities of local ores or to cater for specific exploration philosophies. Specialists from the central laboratories ensure that best practices are followed in all of our laboratories with ongoing monitoring by participation in regular internal and external round robin programs. Underpinning the standardization effort is adherence to the ISO 17025 quality standard and roll out of the CCLAS EL LIMS.

The standardization process also provides support for ongoing innovation in our laboratories. Introduction of new crushing equipment such as the TM Terminator system at our Sudbury, Ontario and Ulan Batar Mongolia labs allow efficient fine crushing of samples which is necessary in preparing representative samples for assaying. A laser ablation ICP-OES system at SGS Lakefield Research is able to characterize unknown samples in minutes. A newly installed high sensitivity Varian ICP-MS at Lakefield and an Elan 9000 in Toronto will permit increased sensitivity for a variety of methods.

This increased sensitivity is nowhere more critical than in methods such as the Mobile Metal Ion (MMI) process, where detection limits for elements such as gold are at the 0.01 ppb level. These levels of sensitivity are important in areas of thick overburden where surface soil anomalies for Au are at sub ppb levels. A notable example is in the Assean Lake area in northern Manitoba where low level MMI anomalies have been instrumental in locating drill targets that have recently encountered high grade gold intercepts. Other MMI successes include clear delineation of kimberlite targets under thick glacial cover. A new MMI multi-element leach for up to 40 elements, using a pH neutral extraction, will help in the identification of polymetallic targets or multi-element associations for specific styles of mineralization.

The revival of exploration spending in the last year has led to the expansion of the SGS lab network to service exploration programs worldwide. For example, our sample preparation lab in Tumeremo, Venezuela has been completely refurbished in the last few months to meet local demand. Others will no doubt follow.

Hugh de Souza *(hugh.deSouza@sgs.com)*
Ken Litjens *(Ken.litjens@sgs.com)*

ACTLABS Group of Companies

Activation Laboratories Limited in Ancaster, Ontario underwent a major expansion in 2003 to add 1667 square metres (15,000 square feet) for a total of 4778 square metres (43,000 square feet) at the lab in Ancaster, Ontario. The new state-of-the-art facilities allowed for a new home for the ICP/MS department and the establish-

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Geochemical Laboratory Updates...

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ment of an HPLC (high pressure liquid chromatography) laboratory. We have added four state of the art HPLC systems along with LC/MS and LC/MS/MS capabilities. A high resolution magnetic sector ICP/MS (Finnegan Mat Element 2) was added to our compliment of quadruple ICP/MS instruments. The new mass spec lab and associated preparation laboratories and weighing rooms have been specifically designed to maintain low ambient backgrounds with HEPA filtered air in the rooms and HEPA filtered laminar fume hoods using technologies taken from the semi-conductor industry.

Our Finnegan Mat Element 2 is the only high resolution ICP/MS instrument at a commercial geochemical laboratory anywhere in the world. Advantages for this technology over conventional quadrupole ICP/MS instruments is that the high resolution ICP/MS (magnetic sector) has up to 10,000 resolution versus unit resolution on the quadrupole. This allows most interferences to be resolved rather than to apply correction factors. In addition detection limits are 1 to 2 orders of magnitude lower than conventional ICP/MS.

Using the high resolution ICP/MS technology we have developed methods for the analysis of gold and the PGE in natural water to sub ppt levels in samples without requiring preservation, solving the age old problem of adsorption on the walls of the collection vessel. This technology can also be used for direct analysis of vegetation without ashing or for the analysis of very low trace REE content for lithogeochemistry. Matrices such as barite which usually have very low REE contents and severe interferences of Ba on some of the REE can be analyzed. Detection limits for the PGE in rocks and minerals can now approach low ppt levels.

Our second CAMIRO project on Soil Gas Hydrocarbons (SGH) for mineral exploration is coming to a conclusion in the coming months. While most of the results of this project will remain confidential to the participants, some data on kimberlites has been released due to requirements of partial OMET funding (Ontario Mineral Exploration Technology fund). Figure 1 shows a plot of one of our SGH compounds relative to the location of a Canadian diamond bearing kimberlite pipe. With the SGH method we provide data on 162 organic compounds. Using neural net technology we are able to use a rapid data processing technology to vector towards the kimberlite due to geochromatographic zonation of compounds. Our compliment of gas chromatograph/mass spectrometers (GC/MS) has increased to 5 to be able to adequately provide for the required capacity for rapid turnaround.

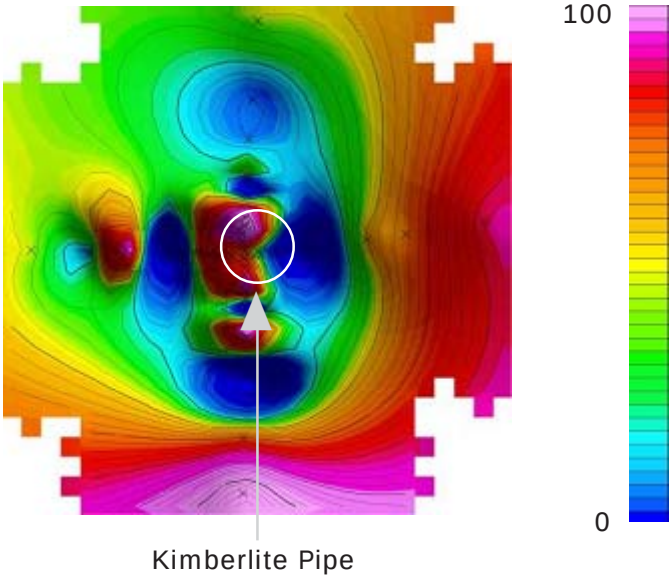

Figure 1. Kimberlite Case Study #1 – SGH Neural Net Score Map for Light Alkanes.

Additional facilities have been added this year including autoanalyzers for cyanide, a laser particle size analyzer, a total organic carbon analyzer and a new Spectro Cirros ICP. The Spectro Cirros technology allows for improved ICP detection limits as well as analysis of Cl in geological materials as part of a whole rock package. A new LIMS system is currently in the final implementation stage that will link initially all the Actlabs Americas facilities. Additional sample preparation facilities have been added in the last year and further expansion is planned for the coming year. Additional ICP, ICP/MS both quadruple and high resolution are being planned for the coming year.

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Geochemical Laboratory Updates...

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Actlabs-Skyline Peru S.A.C. in Lima Peru have expanded their facilities by adding additional space to more than double the size of the laboratory to meet increasing demand for services. Additional atomic absorption facilities and a mercury analyzer hasve been added. Sample receiving facilities are also now available in Arequipa. The lab is in the final stages of the ISO 9002 accreditation process.

Actlabs Chile S.A. in La Serena has added additional atomic absorption capability and is in the process of developing a full quality system to meet ISO 9002 requirements. Sample preparation in Antofagasta has been modernized and expanded and has already implemented a quality system for sample preparation. Quality of preparation, probably the most important step in the analytical process, has seen a marked improvement since the implementation of the QA system.

Actlabs Skyline in Tucson, Arizona concentrates on analysis of copper and gold including all copper species from exploration to metallurgical products out of their 20,000 square foot laboratory. The laboratory will be increasing staffing and facilities to meet increasing demand. Larger fire assay facilities are in the final planning stage. The laboratory serves the US market as well as northern Mexico.

Actlabs Pacific in Perth, Australia have, in response to requests from major exploration companies, developed affordable analyses that in the past have been prohibitively expensive. A method for aqua Regia/FIAS/ICPMS for Au, Pt and Pd. This method has more than 90% of the recovery of the traditional fire assay ICP/MS and is a lot less expensive when added to the 25 gram aqua regia digest package. Low level Te analysis to a 1 ppb detection limit as a pathfinder for gold deposits has also been developed. New sample preparation facilities were also installed in Kalgoorlie.

ALS Chemex

ALS Chemex has positioned itself as an international leader in analytical services for the minerals exploration industry by continually benchmarking itself against industry standards and client expectations. The company has always been a leader in providing globally-integrated, quality service by employing the latest technology available in the field. The company is maintaining this trend with a significant technical development this past year known internally as the *Open Lab™*. This was accomplished with the implementation of GEMS, a custom-written laboratory management interface to a large centralized Oracle database. Highlights of the system include global communications capabilities on all samples within the database, complete audit trails for a work order, and unprecedented access for clients to all aspects of the laboratory processes.

Global organizations require real-time and effective communications between individual units to function properly. Through the one global system and database, all of our laboratories now have equal access to all the relevant information pertaining to a batch of samples including work instructions, the progress of samples on sites and at all ALS Chemex locations, and access to client reporting information. This global organization also allows for consistent methods for core services at all of our locations as standard operating procedures for managing and analyzing samples are integrated directly into the computer system.

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The tracking of samples is critical in terms of logistics as well as in terms of being able to provide an audit trail for results for our clients and regulators. ALS Chemex has developed a unique sample tracking system that is an integral part of GEMS. By using bar coding and scanning technology, a complete chain of custody records for every stage in the sample preparation and analytical process is captured and stored in the database.

Errata

Correction: Apologies are extended for the mistakes in **EXPLORE 123** when references were made to the new Association name. All references should have been to The Association of Applied Geochemists.

Geochemical Laboratory Updates...

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The mining and mineral exploration industry now requires that the Qualified Person and others associated with projects take an active role in the review and validation of laboratory data. It was with this thought in mind, that ALS Chemex developed the *Open Lab™* system. Clients can now look over the company's shoulder at every step their samples take through the lab with the new version of Webtrieve™. This information can be accessed from any internet portal in the world (via an on-line access account).

The system allows clients to follow the path their samples take through the lab even while the work is in progress. Each batch has an audit trail of which employee handled it, along with where and for how long it was at any step of its analysis. All of this information is stored in the main database and is available on-line and in real time. The *Open Lab™* system provides unmatched access to quality control data. Clients can access the standards run with their samples plus view the results for these same standards when run with all other ALS Chemex clients' samples. Duplicates test results for each batch are also available.

The company also continues to expand geographically. ALS Chemex is opening a major analytical laboratory in Johannesburg in July 2004 to improve services for clients working on the African Continent. This new, state-of-the-art laboratory, serving as a hub for the whole African continent, will specialize in low-level gold and platinum group geochemistry, plus ICP-AES and ICP-MS multi-element packages. ALS Chemex Johannesburg is located in a highly efficient, environmentally controlled and permitted facility and will become one of ALS Chemex's central facilities.

CRCLEME
Cooperative Research Centre for Landscape Environments and Mineral Exploration

CRC LEME is a cooperative research center for regolith geoscience with some 130 contributing researchers from eight core parties around Australia. The center undertakes research and technology developments for mineral exploration as well as for natural resource management. Below is a reproduction of the Minerals Brief which presents scientific advances from just some of its many projects within its core programs and includes contributions from LEME postgraduate students. Details of the full range of the programs, portfolio of projects and publications are available on the website http://crcleme.org.au. For further information please contact the CEO, CRC LEME Dennis Gee email: dennis.gee@csiro.au

METAL MOBILITY IN REGOLITH

Frank Reith at Australian National University (ANU) is looking at the role of microbes (heterotrophic bacteria) in the dissolution, transport and stabilisation of gold in regolith. On the dissolution side, selective sequential leaching suggests that gold in soil is mostly associated with exchangeable clay-bound and carbonate-bound fractions, as well as organic fractions. Most of this gold can be extracted in the laboratory with mild organic leachates in the presence of living microflora, whereas in sterilised samples, little or no gold is mobilised. The dissolution agent may be amino acids, organic acids or cyanide secreted from common soil heterotrophic bacteria – such as *Chromobacterium violaceum*.

On the precipitation side, Frank notes that micronuggets (0.1-1.0mm) have the form of budding cells of *Pedomicrobium australiensis* of 0.5μm size, now presumably fossilised by native gold. He demonstrates in the laboratory that microbes in the soil are active, and capable of precipitating amorphous ferrihydrite on planted gold flakes in a form identical to the micron-scale fossil buds. Some species of bacteria (and fungi) are able to accumulate gold in cell walls, replacing ferrihydrite. DNA staining on gold flakes shows the presence of biofilms on natural gold flakes, and hopefully will determine the precise nature of the precipitating organism. frank.reith@anu.edu.au

Ryan Noble at CUT is looking at dispersal mechanisms of gold, arsenic and antimony, in the vicinity of buried gold deposits near Stawell (Victoria). In the process he is investigating the use of bacterial leaches in partial extractions of regolith samples, which have the potential to enhance the geochemical signature of underlying mineralisation. Results are encouraging in recognising regolith-covered gold deposits using soil bacteria leaching. Here the regolith cover is about 100 metres of Murray Basin sediments. Multi-element suites

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from bacterial leaches were compared with partial leach media such as weak acid, weak H2O2 and total digest HF. The bacterial leach seems to be picking up patterns not identified by the other leaches. These anomalies are being further investigated. noblerr@ses.curtin.edu.au

Chris Gunton at ANU is studying the chemical trapping mechanisms of groundwater-borne metals in regolith, with an initial focus on adsorption of Cu(II) onto synthetic goethite. Previous studies show increased adsorption at higher pH, but Chris is studying the effect of salinity by varying NaCl over a wide range. His laboratory work shows with increasing salinity, adsorption of Cu(II) increases, the opposite of what was expected. This confirms that goethite is a preferred sampling medium, and implies that in a hypersaline oxidising environment, the copper dispersion halo will be minimal. Thus copper anomalies (even at low levels) will be meaningful. Wider implications include the possibility that copper accumulations and anomalies could form in oxidised parts of the regolith where less saline waters mix with saline waters. christopher.gunton@anu.edu.au

Alistair Usher at ANU is studying gold geochemistry and mobility in hypersaline brines. Preliminary gold solubility experiments have highlighted the need to develop a new analytical method for the analysis of trace levels of gold in solution. Suitable mineral phases have been identified, new experimental apparatus designed (ie a Schlenk line) and a new laboratory is being commissioned. Concurrently, a spectrophotometric study of oxidised gold chloride species in hypersaline solution has been undertaken in collaboration with researchers at Monash University and the CRC-LEME node in Adelaide. Experimental data will be used to identify the important Au(III) chloride complexes and derive their thermodynamic properties. The results will be used to help predict gold leaching, transport and deposition in saline and hypersaline brines in regolith and identify optimal environments for exploration. alistair.usher@anu.edu.au

BIOGEOCHEMICAL EXPLORATION

Research under the direction of **Steve Hill** of Adelaide University (AU) is revisiting the vexing question of biogeochemical sampling for metals. **Karen Hulme** also at AU is focussing on river red gums (*E camaldulensis*) which present an ideal sampling medium because of their widespread occurrence in the transported regolith in arid environments, their confinement to watercourses, and their extensive tap roots. Orientation sites have been set up in the Curnamona Craton, on the basis of proximity to various styles of mineralisation. Multi-element analyses have been done on leaves, twigs and bark, with repeat sampling to test for seasonal variation. Significantly, two sites over gold mineralisation had detectable gold with 0.6–1.4 ppb Au in twigs, and 0.2–0.4 ppb Au in leaves.

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There are significant levels of As, Cu and Zn in leaves and twigs. All other elements in the suite of 24 were below detection. These preliminary results offer promise of a convenient sampling medium in areas of transported arid regolith.
steven.hill@adelaide.edu.au,
karen.hulme@student.adelaide.edu.au

EXPLORATION SPIN-OFF FROM ACID SULPHATE SOILS

Research on the environmental geochemistry of acid sulphate soils (ASS) at CSIRO Land & Water has spin-offs for mineral exploration. ASS in saline seeps develop in advance of a rising watertable as a result of land clearing, and bring salt and other solutes to the surface. These seeps present opportunities for regional mineral exploration.

In the Mt Lofty area (SA) **Marian Skwarnecki** and **Rob Fitzpatrick** (CSIRO LW) have released a model to account for high metal discharges. In areas with sulphide-rich basement rocks, rising ground waters can be rich in sulphate, and have elevated As, Pb and Zn. These become further concentrated by evaporative transpiration. In soils of high organic carbon in waterlogged conditions, cyanobacteria reduce these sulphates, forming secondary framboidal pyrite and micro-filamentous authigenic sphalerite in soils near the surface. With further rise of the watertable these re-oxidise and produce scums and gels of Al and Fe hydroxy minerals (eg ferrihydrite) in discharge areas, with element concentration. This pilot study identified a multitude of anomalies, many of which correlate with known mineralisation, and some of which are new unexplained anomalies. This new sampling medium has potential to produce enhanced anomalies of large footprint, drawn from a wider basement substrate.
rob.fitzpatrick@csiro.au

Andrew Baker at AU is using lead isotopes to model the interaction of groundwater with bedrock (including mineralisation), in the vicinity of ASS seeps. The lead isotope signatures from mineralised basement extend for about one kilometre in groundwaters. The lessons for exploration are that soils in ASS seeps are good sampling points to detect blind mineralisation, but the bulls-eye anomalies are not necessarily point-source with respect to mineralisation. andrew.baker@student.adelaide.edu.au

Also **Steve Rogers** of CSIRO LW Adelaide is looking at the role of sulphur oxidising bacteria in the formation of ASS. Rather than a phyllogenic approach, he is researching functional attributes of the bacterial genes that encode the enzymes responsible for biogeochemical oxidation. These attributes derive from the molecular analysis of extracted DNA from field samples, which in turn enables the reaction kinetics of a large diversity of bacterial 'species' to be defined. The application of functional molecular biology to the organisms (both oxidising and reducing) involved in the formation of ASS may have application in designing new bioleaches for mineral exploration and mineral processing.
steve.rogers@csiro.au

EXPLORATION UNDER TRANSPORTED REGOLITH

The Western NSW Regolith project led by **Patrice de Caritat** of Geoscience Australia (GA) aims to stimulate mineral exploration in regolith-dominated terrains by providing knowledge on regolith landforms and geochemistry of transported regolith. A focus is the Teilta 1:100K sheet, where groundwater, calcrete, gypsum and plant samples have been collected and analysed. This data will be combined with basement geology to provide a 4-D model of landscape evolution and geochemical dispersion. Major and trace element concentrations, isotope ratios and geochemical modelling enable the detection of sites near sulphide accumulations under as much as 100 m of sediments in the basins around Broken Hill. Groundwater is emerging as a sampling medium to give vectors to mineralisation under cover. Groundwater has been analysed for S, Sr and Pb isotopes. Some groundwater around Broken Hill has contents of sulphur significantly greater than can be accounted for by normal rainfall, evaporation or mixing with connate waters. Most importantly, those samples have 34S-depleted sulphur indicating likely derivation from basement mineralisation.
patrice.deCaritat@ga.gov.au

The Girilambone project, led by **Ken McQueen** (ANU), is developing methods to assist mineral explorers in regolith-dominated areas of the western Lachlan Fold Belt. It is also building an understanding of regolith-related controls on target-pathfinder element dispersion in the region and establishing a geochemical data base for background variation. Scientific advances include:

- Development of regolith-landform mapping methods for mineral explorers, and for routine map production;
- Characterisation of the aeolian component (geochemical diluent) in soils;
- Improved understanding of lag geochemistry in the Cobar area; and,
- New geochemical targets for gold exploration.

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Chlorite-sericite alteration associated with gold

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mineralisation at the Tunkillia Prospect of the Central Gawler Gold Province has been mapped through transported cover by integrating interpreted aeromagnetic and airborne electromagnetic data. **Lisa Worrall** and **Richard Lane** (GA) used aeromagnetic data to define zones of magnetite destruction in regional structures and AEM to locate chlorite-sericite alteration within these zones. AEM can map chlorite- sericite alteration in this region because deep weathering has enhanced the contrast between the electrical properties of altered and unaltered rocks. lisa.worrall@ga.gov.au, richard.lane@ga.gov.au

Ian Lau and **Tom Cudahy** (CSIRO EM) successfully calibrated spectral characteristics of the newly-acquired wide-band ASD field spectrometer with those of the HyMapTM airborne scanner. The ASD identifies, by spectral signatures, iron oxides, phyllosilicates and carbonate minerals at the surface, as well as clay minerals. Trial swathes over the White Dam gold deposit show that the airborne scanner can detect the boundary between *insitu* regolith (including saprolite) and transported regolith, from the kaolinite crystallinity index. Thus we have a prototype of an airborne system to rapidly map regolith minerals. The next step is to map regional alteration trends in *insitu* regolith, no matter how degraded. thomas.cudahy@csiro.au

In the pursuit of making geochemistry work through transported regolith **John Keeling** (PIRSA) described evidence of upward capillary movement of copper-bearing solutions into transported clays 5 – 15 m thick, above the Poona (Moonta SA) Cu–Au deposit. Atacamite nodules were developed in transported kaolin/illite/smectite clays and in thin seams of alunite-halloysite clay. This happens where there is direct contact between transported clay and underlying weathered porphyry. The alunite-halloysite is interpreted to form by acid-sulphate weathering of the transported clay. Here we have additional means of detecting mineralisation using spectral logging to identify alunite-halloysite in the transported regolith. keeling.john@saugov.sa.gov.au

K P Tan of ANU found no detectable pathfinder elements in the 40-70m thick transported regolith above the Portia Cu-Au deposit in SA. However he found strong geochemical signals in the palaeovalley fills at the interface with the weathered saprolite. The geochemical signals are from locally distributed saprolite clasts. kokpaing.tan@ga.gov.au

Ray Smith (CSIRO EM) is working on recognition of criteria diagnostic of base-metal sulphide deposits in basal units of transported cover. Currently, his focus is the basal lateritic conglomerate that forms the thin cover surrounding the Golden Grove Gossan Hill Cu-Zn-Au VHMS deposit, using CSIRO orientation sampling carried out before disturbances from mining operations. His approach is to establish what textural and compositional features can be recognised in clasts, lateritic nodules and other detrital grains in the basal conglomerate. The work involves extensive scanning electron microscope and electron microprobe investigations. His intent is to then translate findings from this and other orientation studies where cover is thin to establish models for exploration where cover is hundreds of metres thick. raymond.e.smith@csiro.au

Annamalai Mahizhnan (CUT) has studied the red-brown hardpans in the Eastern Goldfields (WA). He found that hardpans occur well south of the Menzies Line which therefore does not mark the southern boundary of red-brown hardpan in the Yilgarn Craton. The cement in these well indurated clastic hardpan sheets is composed of disordered kaolinite and opal A. As such the hardpan would not normally be expected to have post-cementation chemical reactivity or permeability, in which case the only possibility of geochemical gold lies with detrital flakes, despite the abundance of goethite/hematite in nodules that would absorb up hydromorphic gold. Yet these sheets have calcrete replacements that do represent a suitable sampling medium for hydromorphic gold. annamalai.mahizhnan@csiro.au

Rob Hough, **Cajetan Phang** and **Ravi Anand** at CSIRO EM, Perth continue to study mineral phases and mineral associations that act as hosts for trace levels of metals in regolith materials. In hardpans and clastic ferricrete immediately above the primary/supergene gold deposit in the enterprise Pit (Mt Gibson gold project), they micro-mapped eminently detectable gold using LA-ICPMS and SEM(BE). Gold occurs with a number of mineral hosts including kaolinite, hematite clasts, hematite cutans, and calcite. This is consistent with late stage hydromorphic dispersion of gold in transported regolith. ravi.anand@csiro.au

REGIONAL MINERAL EXPLORATION

Baohong Hou (PIRSA) has published a series of articles on identifying Tertiary palaeodrainages on the Gawler Craton, SA. Two new papers address facies and sequence stratigraphy of Eocene valley fills (*Sedimentary Geol*, 163: 111-130); and heavy mineral sand (HMS) deposit models based on facies interpretation and stratigraphy of fluvial and marine units (*AJES* 50: 955-965). The models substantially revise earlier ideas of HMS accumulation in the massive and complex coastal barrier sands forming the Ooldea, Barton and Paling Ranges. Renewed HMS exploration interest in the area has been driven in part by these new models. hou.baohong@saugov.sa.gov.au

Peter de Broekert (ANU/CSIRO) has completed a PhD study of palaeochannel sediments in the Kalgoorlie region. He developed a 3-D lithofacies model to predict the style of the fill and to reconstruct the palaeogeography. ravi.anand@csiro.au

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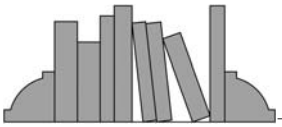
Mark Paine at Curtin University of Technology (CUT), whilst looking at landscape evolution in western Victoria, has developed a rapid method to quantify a diverse suite of heavy mineral grains using the AutoGeoSEM. The SEM can count 10,000 heavy mineral grains per hour. Heavy minerals with a simple unique composition and X-ray spectrum, such as chromite, ilmenite, zircon, monazite, spinel, rutile, Fe oxides and xenotime can be readily distinguished. This will enable the identification of heavy mineral facies relationships, which will give HMS miners a means to predict distribution of grade. mark.paine@csiro.au.

CRC LEME is an unincorporated joint venture between The Australian National University, Commonwealth Scientific and Industrial Research Organisation, Curtin University of Technology, Geoscience Australia, Minerals Council of Australia, NSW Department of Mineral Resources, Primary Industry and Resources South Australia, University of Adelaide, established and supported under the Australian Government's Cooperative Research Centres Program.



RECENT PAPERS

This list comprises titles that have appeared in major publications since the compilation in **EXPLORE** Number 123. 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) 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 80401-1886, Chairman AAG Bibliography Committee. Please send new references to Dr. Closs, not to **EXPLORE**.

Aggarwal, J.K, Sheppard, D., Mezger, K., and Pernicka, E., 2003. Precise and accurate determination of boron in the Ngawha geothermal system, New Zealand. Chem. Geol. 199(3/4): 331.

Anderson, S.P. and Blum, A.E. (eds.), 2003. Special Issue on Chemical Weathering Chem. Geol. 202(3/4).

Arcuri, T. and Brimhall, G., 2003. The Chloride Source for Atacamite Mineralization at the Radomiro Tomic Porphyry Copper Deposit, Northern Chile. EG 98(8): 1667-1681.

ATTENTION!!

If you have not been receiving email updates for the Association, your email address may be outdated.
Please contact Betty Arseneault (aeg@synapse.net) to update your member profile.

Aubert, D. Probst, A. and Stille, P., 2004. Distribution and origin of major and trace elements (Particularly REE, U, and Th) into labile and residual phases in an acid soil profile (Vosges Mountain, France). Applied Geochem. 19(6): 899-916.

Baker, T., Van Achtenberg, E, Ryan, C.G., and Lang, J.R., 2004. Composition and evolution of ore fluids in a magmatic-hydrothermal skarn deposit. Geology 32(2): 117-120.

Ball, J.W. and Izbicki, J.A., 2004. Occurrence of hexavalent chromium in ground water in the western Mojave Desert, California. Applied Geochem. 19(7): 1123-1135.

Barron, L.M., 2003. A simple model for the pressure preservation index of inclusions in diamond. Am. Min. 88(10): 1615-

Bertolino, S. and Lagaly, G. (eds.), 2003. Special Issue on Clay Minerals and the Environment. Applied Clay Science 24(1/2): 1-

Beskin, S.M. and Marin Yu, B., 2003. About the evolution of the rare-metal granite mineral – and ore forming processes during geological history. Proc. Russian Min. Soc. 132(2): 1-14.

Bird, D.A., 2003. Characterization of anthropogenic and natural sources of acid rock drainage at the Cinnamon Gulch abandoned mine land inventory site, Summit County, Colorado. Environ. Geol. 44(8): 919-

Black, L.P. and Jagodzinski, E.A., 2003. Importance of establishing sources of uncertainty for the derivation of reliable SHRIMP ages. Aust. J. Earth Sci. 50(4): 503-512.

Camas, F., 2003. Geologia de los Sistemas Porfiricos en los Andes de Chile. Servicio National de Geologia y Mineria, Santiago, Chile. 267 p. (in Spanish only).

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RECENT PAPERS

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Cannon, W.F., Woodruff, L.G. and Pimley, S. 2004. Some statistical relationships between stream sediment and soil geochemistry in northwestern Wisconsin – can stream sediment compositions be used to predict compositions of soils in glaciated terranes. J. Geochem. Explor. 81(1-3): 29-

Carrillo-Chavez, A., et al., 2003. Environmental geochemistry of the Guanajuato mining district, Mexico. Ore Geol. Rev. 23(3/4): 277-

Centeno, L.M., Faure, G., Lee, G, and Talnagi, J., 2004. Fractionation of chemical elements including the REEs and ^{226}Ra in stream contaminated with coal-mine effluent. Applied Geochem. 19(7): 1085-1095.

Chabaux, F. et al., 2003. Tracing and dating recent chemical transfers in weathering profiles by trace-element geochemistry and ^{238}U – ^{234}U – ^{230}Th disequilibria: The example of the Kaya lateritic toposequence (Burkina-Faso). Comptes Rendus Geosciences 335(16): 1219-

Clark, A.H. and Kontak, D.J., 2004. Fe-Ti-P Oxide Melts Generated through Magma Mixing in the Antauta Subvolcanic Center, Peru: Implications for the Origin of Nelsonite and Iron-Oxide-Dominated Hydrothermal Deposits. EG 99(2): 377-395.

Coveney, R.M., Jr. and Paava, J., 2004. Diverse connections between ores and organic matter. Ore Geol. Rev. 24(1-2): 1-6.

Dehaan, R.L. and Taylor, G.R., 2004. A remote-sensing method of mapping soils and surface logs from a deeply weathered arid region, near Cobar, NSW, Australia. Geochemistry: Exploration, Environment, Analysis 46(4): 99-112.

deSilva, E.F., Zhang, C., Pinto, L.S., Patinha, C., and Reis, P., 2004. Hazard assessment on arsenic and lead in soils of Castromil gold mining area, Portugal. Applied Geochem. 19(6): 887-

Deines, P. et al., 2003. Standards for publication of isotopes ratio and chemical data in chemical geology. Chem. Geol. 202(1/2): 1-4.

Ely, K.S. and Phillips, G.N. (eds.), 2003. Yandal Gold Province: Geoscience and Exploration Success. CSIRO Explores 1. 219 p.

Fitzgerald, D. and McInerney P., 2003. Achieving better geology through better geophysics. First Break 21(11): 69-76.

Garrett, R.G., Lalor, G.C., and Vatchkov, M., 2004. Geochemical exploration for gold in Jamaica: A comparison of stream sediment and soil surveys. Geochemistry: Exploration, Environment, Analysis 4(2): 161-170.

Geptner, A.P., et al., 2003. Mineralized microbiota: A possible indicator of hydrocarbon flows in the rift zone of Iceland. Lith. And Min. Res. 38(6): 509-

Hammarstrom, J.M., et al., 2003. Weathering of sulfide shale and copper mine waste: secondary minerals and metal cycling in Great Smoky Mountains National Park, Tennessee and North Carolina, USA. Environ. Geol. 45(1): 35-

Hattori, K.H. and Cameron, E.M., 2004. Using the High Mobility of Palladium in Surface Media in Exploration for Platinum Group Element Deposits: Evidence from the Lac des Iles Region, Northwestern Ontario. EG 99(1): 157-171.

Heath, C.J. and Campbell, I.H., 2004. A New Geochemical Technique for Gold Exploration: Alkali Element Mobility Associated with Gold Mineralization in the West Australian Goldfields. EG 99(2): 313-324.

Hulbert, L., 2003. Magmatic Platinum Group Element Environments in Canada: Present and Future Exploration Target Areas. GAC Howard Street Robinson Distinguished Lecture 2002. CD-ROM. Geol. Assoc. Canada.

Kirk, J. Ruiz, J., Chesley, J., and Titley, S., 2003. The origin of Gold in South Africa. Am. Scient. 91(6): 534-540.

Kyle, J.R. and Ketcham, R.A., 2003. In Situ Distribution of Gold using High-Resolution X-Ray Computing Tomography. EG 98(8): 1697-1701.

Kulmala, S. and Suomi, J., 2003. Current status of modern analytical luminescence methods. Analytica Chimica Acta. 500(1/2): 21-

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RECENT PAPERS

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Larson, P.B., et al., 2003. Copper isotope ratios in magmatic and hydrothermal ore-forming environments. Chem. Geol. 201(3/4): 337-

Liaghat, S., Hosseini, H., and Zarasvandi, A., 2003. Determination of the origin and mass change geochemistry during bauxitization processes at the Hangam deposit, SW Iran. Geochem. J. 37(5): 627-

Liu, L.M. and Peng, S.L., 2004. Prediction of hidden ore bodies by synthesis of geological, geophysical, and geochemical information based upon dynamic model in Fenghuangshan ore field, Tongling district, China. J. Geochem. Explor. 81(1-3): 81-

Lord, R.A., Prichard, H.M., Sa, J.H.S., and Neary, C.R., 2004. Chromite Geochemistry and PGE Fractionation in the Campo Formosa Complex and Ipueira-Medrado Sill, Bahia State, Brazil. EG 99(2): 339-363.

Lussier, C., Veiga, V., and Baldwin, S., 2003. The geochemistry of selenium associated with coal waste in the Elk River Valley, Canada. Environ. Geol. 44(8): 905-

Marfia, A.M., Krishnamurthy, R.V., Atekwana, E.A., and Panton, W.F., 2004. Isotopic and geochemical evolution of ground and surface waters in a karst dominated geological setting: a case study from Belize, Central America. Applied Geochem. 19(6): 937-946.

Martley, E., Gulson, B., Louis, H., Wu, M., and Di, P., 2004. Metal partitioning in soil profiles in the vicinity of an industrial complex, New South Wales, Australia. Geochemistry: Exploration, Environment, Analysis 4(2): 171-179.

McCloskey, R.B., Nortstrom, D.R., and Maest, A.S., 2004. Preservation of water samples for arsenic (III/V) determinations: an evaluation of the literature and new analytical results. Applied Geochem.

McKnight, D.M. and Duren, S.M., 2004. Biogeochemical processes controlling mid-day ferrous iron maxima in stream waters affected by acid rock drainage. Applied Geochem. 19(7): 1075-1084.

Munk, L. and Faure, G., 2004. Effects of pH fluctuations on potentially toxic metals in the water and sediment of the Dillon Reservoir, Summit County, Colorado. Applied Geochem. 19(7): 1065-1074.

Munoz, N., Charrier, R., and Jordan, T., 2002. Interactions between basement and cover during the evolution of the Salar de Atacama basin, northern Chile. Revista Geol. De Chile 29(1): 55-

Nahon, D., 2003. Material transfers at the Earth's surface. Comotes Rendue Geosciences 335(16): 1101-

Neaman, A., Mouele, F., Trolard, F., and Bourrie, G., 2004. Improved methods for selective dissolution of Mn oxides: applications for studying trace element associations. Applied Geochem. 19(6): 973-979.

Nelson, M.G. and Riddle, N.K., 2004. Sampling and analysis of optimal ore-grade control. Min. Eng. 56(4): 55-59.

Niskavaara, H., Kontas, E., and Reimann, C., 2004. Regional distribution and sources of Au, Pd, and Pt in moss and O-, B-, and C-horizon podzol samples in the European Arctic. Geochemistry: Exploration, Environment, Analysis 4(2): 143-159.

Oregkes, N. and LeGrande, H. (eds.), 2001. Plate Tectonics: An Insider's History of the Modern Theory of the Earth. Westview Press. 424 p.

Park, Y.R. et al., 2004. Stable Isotopic Constraints on Fluid-Rock Interaction and Cu-PGS-S Redistribution in the Sonja lake Intrusion, Minnesota. EG 99(2): 325-338.

Pasava, J. et al., 2203. Environmental impacts of mining Ni-Mo black shale-hosted deposits in the Zunyi region, southern China: Preliminary results of the study of toxic metals in the system rock-soil-plant. Bull. Geoscience, Czech Geol. Surv. 78(3): 251-276.

Piatak, N.M., Seal, R.R., II., and Hammerstrom, J.M., 2004. Mineralogical and geochemical controls on the release of trace elements from slag produced by base- and precious-metal smelting at abandoned mine sites. Applied Geochem. 19(7): 1039-1064.

Pirlo, M.C. and Giblin, A.M., 2004. Application of groundwater-mineral equilibrium calculations to geochemical exploration for sediment-hosted uranium: observations from the Frome Embayment, South Australia. Geochemistry: Exploration, Environmental, Analysis 4(2): 113-127.

Polito, P.A., Kyser, T.K., Marlatt, J., Alexandre, P., Bajwah, Z., and Drever, G., 2004. Significance of Alteration Assemblages for the Origin and Evolution of the Proterozoic Naburlek Unconformity-Related Uranium Deposit, Northern Territory, Australia. EG 99(1): 113-139.

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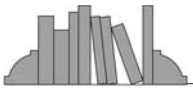

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continued from Page 18

Prichard, H.M., Hutchinson, D., and Fisher, P.C., 2004. Petrology and Crystallization History of Multiphase Sulfide Droplets in a Mafic Dike from Uruguay: Implications for the Origin of Cu-Nu-PGE Sulfide Deposits. EG 99(2): 365-376.

Proffett, J.M., 2003. Geology of the Bajo de la Alumbrera Porphyry Copper-Gold Deposit, Argentina. EG 98(8): 1535-1574.

Qicong, L. and Congqiang, L., 2003. Geochemical behavior of REE and other trace elements during the formation of strata-bound skarns and related deposits: A case study of the Dongguashan Cu (Au) deposit, Anhui province, China. Acta Geologica Sinica. 77(1): 246.

Ranville, M., Rough, D., and Flegal, A.R., 2004. Metal attenuation of the abandoned Spenceville copper mine. Applied Geochem. 19(5): 803-815.

Richards, J.P., 2003. Tectono-Magmatic Precursors for porphyry Cu-(Mo-Au) Deposit Formation. EG 98(8): 1515-1533.

Risacher, F., Alonso, H., and Salazar, C., 2003. The origin of brines and salts in Chilean Salars: A hydrochemical review. Earth Sci. Rev. 63(3/4): 249.

Robinson, G.R., Jr. and Aynso, R.A., 2004. Use of spatial statistics and isotopic tracers to measure the influence of arsenical pesticide use on stream sediment chemistry in New England, USA. Applied Geochem. 19(7): 1097-1110.

Rouxel, O., Ludden, J., and Fouquet, Y., 2003. Antimony isotope variations in natural systems and implications for their use as geochemical tracers. Chem. Geol. 200(1/2): 25.

Samson, I., Anderson, A., and Marshall, D. (eds.), 200. Fluid Inclusions: Analysis and Interpretation. Min. Assoc. Can. Short Course Series V. 32. 384 p.

Sander, L., 2003. How airborne gravity surveys can make for cost effective exploration. First Break 21(11): 77-

Schulze, D.J., 2003. A classification scheme for mantle-derived garnets in kimberlite: A tool for investigating the mantle and exploring for diamonds. Lithos 71(2-4): 195-

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Verma, S.P. and Carrusco-Nunez, G., 2003. Reappraisal of the geology and geochemistry of Volcan Zamorano, central Mexico: Implications for discriminating the Sierra Madre Occidental and Mexican volcanic belt provinces. Intern. Geol. Rev. 45(8): 724-

Vuai, S.A., Nakamura, K., and Tokuyama, 2003. Geochemical characteristics of runoff from acid sulfate soils in the northern area of Okinawa Island, Japan. Geochem. J. 37(5): 579-

Wang, D., Gu, X., and Ying, H., 2003. The discovery and study of gold mineralization related to modern hot springs in western Sichuan Province. Geol. Rev. (Geol. Soc. China) 49(2-5): 314-

Whitbread, M.A. and Moore, C.L., 1004. Two lithogeochemical approaches to the identification of alteration patterns at the Elura Zn-Pb-Ag deposit, Cobar, NSW, Australia: use of Pearce Element Ratio analysis and Isocon analysis. Geochemistry: Exploration, Environmental, Analysis 4(2): 129-141.

Wilburn, D.R., 2004. Annual Review – Exploration Review. Min. Eng. 56(5): 25-37.

Zhao, Y., Dong, Y., Li, D., and Bi, Ch., 2003. Geology, mineralogy, geochemistry, and zonation of the Bajranzi dolostone-hosted Zn-Pb-Ag skarn deposit, Liaoning Province, China. Ore Geol. Rev. 23(3/4): 153-

Zhou, T., Phillips, G.N., Denn, S., and Burke, S., 2003. Woodcutters goldfield: Gold in an Archean granite, Kalgoorlie, Western Australia. Aust. J. Earth Sci. 50(4): 553-

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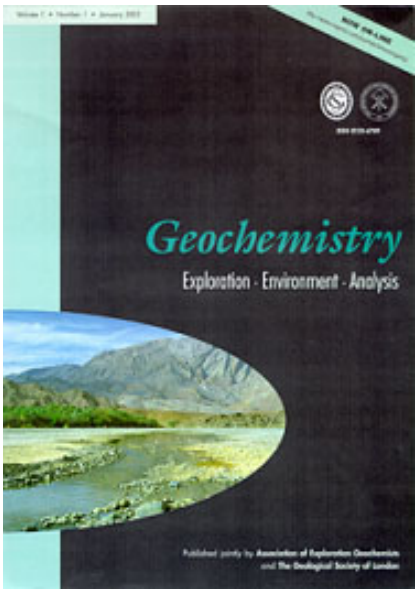

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