

# EXPLORE

Newsletter for the Association of Exploration Geochemists

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Nigel Radford

## PRESIDENT'S MESSAGE

The 20<sup>th</sup> International Geochemical Symposium has come and gone, and what a great event it was! I wish to convey my thanks to and admiration of the Local Organising Committee, who put on for the 250 or so delegates, a superb conference.

Thanks to all of you on the LOC and all those who helped you. The quality of the papers was excellent, which is great credit to our members, the social events (Chilean night, pub crawl, banquet dinner and the Accompanied Persons' Tours) were excellent, the field trips were great (at least the one I went on was) and the workshops were good and well attended. Exploration *IS* alive and well in South America. Let's hope the flame re-kindles around the world. After all, the world still needs the products we mine. Every ton of ore mined is one less in the resource inventory and therefore one more to be replaced.

During the IGES we held the AEG's annual general meeting. This is one of the few real opportunities that the members of AEG get to put their thoughts and opinions directly to the Council which runs the Association on their behalf. We had a good turnout. For once counting those present to establish a quorum was a formality! A very lively debate ensued, as it always seems to at these meetings held at IGES venues. Several topics were prominent in the minds of members. Firstly, the issue of enlarging the defined scope of membership of the Association was discussed. My feeling was that most people were in favour of widening the definition of qualification for membership from "actively practicing exploration geochemistry at the time of application" to something like "actively engaged in the geochemistry of mineral resources....". Further debate on this issue is contained within this issue of **EXPLORE**. It is Council's intention to ask the Association's Fellows to vote on this issue in the near future. If you hold strong views, and are not a Fellow, you might like to consider upgrading your membership status in time to have your say.

Other issues were discussed that might make AEG even more relevant into the new millennium. There was a lively discussion of what role AEG might play, world-wide, in setting and administering standards of technical competency in geochemical matters. At present no country has a legally recognised Professional Status for geochemists. Does AEG have a role to play here in establishing perhaps a new category of membership which reflects a high level of professional competency and a

willingness on the part of the member to be subject to ethical rules that the Association would establish and monitor? This is a real "hot potato"! Council will be discussing this further and your input is essential if we are to reflect your wishes.

The meeting discussed the demography of our members, which is dominated by North America, Europe, and Australia. Continents like the Indian Sub Continent, Asia and Africa are very poorly represented. The feeling of the meeting was that this is largely an economic factor. In some countries, US\$70 per year for membership of a professional association is just too much relative to real wages. Council is looking for ways to improve this state of affairs. Cliff Stanley (Councilor) and Charles Okujeni (Regional Councilor for Southern Africa) are going to report back with ideas. Have you got any ideas that might make membership of our Association more affordable to colleagues in the developing world?

Discussion also centred on ways we might attract more young people into our Association. The establishment of Student Chapters of the AEG at some key Universities is already taking place. More such Chapters are urgently needed. Can you help establish one near your home? Check with Shea Clark Smith or Mark Elliot for more details of what's involved. (Addresses in **EXPLORE** or on the web site). What else can we do to make AEG attractive to newly graduating earth scientists?

The AEG is your Association. Have your say on what it does, and how it does it. Please contact any member of Council with your ideas. Only then will your Association truly reflect your wishes.

Nigel Radford, *President, 2001.*



"Ladies of the IGES" in Valparaiso



## Analyst's Couch

### Ashed Vegetation: comparison of results using HF-based acid digestion and LiBO<sub>2</sub> fusion

Gwendy E.M. Hall<sup>1</sup>, Colin E. Dunn<sup>2</sup>, Beth B. McClenaghan<sup>1</sup>, Bruce A.Kjarsgaard<sup>1</sup>

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The Geological Survey of Canada (GSC) recently carried out a biogeochemical study of the Peddie kimberlite in the Lake Timiskaming kimberlite field, northern Ontario (McClenaghan et al., in preparation). Six different tree species (and organs thereof) were sampled to document the kimberlite's biogeochemical signature and evaluate the usefulness of these sample media in kimberlite exploration. This note highlights the differences found in elemental concentrations when the common HF-based four-acid digestion and lithium metaborate fusion (LiBO<sub>2</sub>) were applied to the ashed samples. The 118 samples for which both datasets are available comprise mostly twigs of birch, green alder, speckled alder, balsam poplar, balsam fir and trembling aspen.

The samples, representing 3-5 years of growth, were air-dried in paper bags for three months in the Ottawa GSC laboratory. The dry foliage was then easily separated from the twigs and the twigs were ashed at 470°C for 24 hours; the ash yield typically is 2-5% for twigs. The samples were first analysed in the Analytical Chemistry Laboratories of the GSC as follows: - To 0.5 g of sample, 10 ml of HNO<sub>3</sub> and 10 ml of HF were added and evaporated to dryness. Then 10 ml of HCl, 10 ml of HF and 3 ml of HClO<sub>4</sub> were added and the mixture taken to near dryness. Finally, 35 ml of H<sub>2</sub>O and 10 ml of HCl were added to dissolve the residue. On cooling, 5 ml of 0.8% EDTA were added, the solution filtered and the filtrate made up to volume for determination of trace elements by ICP-MS and ICP-ES. The element suite determined comprises Ag, Be, Bi, Cd, Co, Cr, Cs, Cu, Ga, Hf, In, Mo, Nb, Ni, Pb, Rb, Sb, Sc, Sn, Sr, Ta, Te, Th, Tl, U, V, Zn, Zr, the REEs and P.

The ashed vegetation samples were also sent to Acme Laboratories of Vancouver, British Columbia to carry out a lithium metaborate (LiBO<sub>2</sub>) fusion and subsequent analysis. This decision was taken as it was thought that the HF-HClO<sub>4</sub>-HNO<sub>3</sub>-HCl digestion might be inadequate for elements critical in this study such as Cr, Hf, Nb, Ta and Zr. A 0.2 g weight of sample was intimately mixed with 1.5 g of LiBO<sub>2</sub> flux fused at 1050 °C for 25 min and the molten mass dissolved in 100 ml of 5% HNO<sub>3</sub>. The following elements were determined by ICP-MS: Ba, Co, Cs, Ga, Hf, Nb, Rb, Sn, Sr, Ta, Th, Tl, U, V, W, Zr, Y, the REEs, and Cr. Elements which could not be determined by this method because of interferences and hence poor detection capability include Mo, Cu, Pb, Zn, Ni, As, Cd, Sb and Bi. Thus, the elements common to both

datasets comprise Co, Cr, Cs, Ga, Hf, Nb, Rb, Sn, Sr, Ta, Th, Tl, U, V, Zr and the REEs.

The control vegetation ash sample, V6, was inserted (blind) five times in both the GSC and Acme analytical suites. The sample V6 comprises the ash of a well homogenized mixture of jack pine twigs, stems, some needles and bark collected by C. Dunn from the Greenbelt in Nepean, Ontario. Table 1 lists the control data, as mean and standard deviation, for V6 where elements are common to both the GSC HF-based acid digestion and the Acme LiBO<sub>2</sub> fusion.

**Table 1.** Results in ppm for the ash control V6 by LiBO<sub>2</sub> fusion/ICP-MS at Acme Laboratories and HF-HClO<sub>4</sub>-HNO<sub>3</sub>/ICP-MS at the GSC, with ancillary data by LiBO<sub>2</sub> fusion/ICP-MS at the GSC and by INAA at Activation Laboratories.

	Co	Cs	Ga	Hf	Nb
<b>Fusion, Acme, n=5</b>	7.5 ± 0.7	1.04 ± 0.07	9.5 ± 0.5	4.56 ± 0.43	4.7 ± 0.5
<b>HF-acid, GSC, n=5</b>	6.2 ± 0.5	1.06 ± 0.05	9.4 ± 0.3	0.62 ± 0.68	2.39 ± 2.31
<b>Fusion, GSC, n=27</b>		0.96 ± 0.05	10.2 ± 0.5	4.1 ± 0.3	5.1 ± 0.4
<b>INAA, n=11</b>	9.4 ± 0.5	0.9 ± 0.3		4.8 ± 0.3	
	Rb	Sn	Sr	Ta	Th
<b>Fusion, Acme, n=5</b>	51.5 ± 3.7	3.6 ± 0.8	864 ± 124	0.37 ± 0.08	3.34 ± 0.34
<b>HF-acid, GSC, n=5</b>	54.8 ± 1.9	2.7 ± 0.9	813 ± 61	0.14 ± 0.13	3.54 ± 0.52
<b>Fusion, GSC, n=27</b>	48 ± 1.6		754 ± 39	0.3 ± 0.06	3.53 ± 0.20
<b>INAA, n=11</b>	40 ± 6		835 ± 60	<0.5	2.9 ± 0.1
	Tl	U	V	Zr	La
<b>Fusion, Acme, n=5</b>	1.1 ± 0.5	1.76 ± 0.26	45 ± 4	173 ± 24	21.7 ± 0.7
<b>HF-acid, GSC, n=5</b>	0.33 ± 0.05	1.66 ± 0.09	48 ± 2	25.8 ± 25.0	21.4 ± 1.3
<b>Fusion, GSC, n=27</b>	0.46 ± 0.1	1.6 ± 0.1	40 ± 2	164 ± 13	20.3 ± 0.9
<b>INAA, n=11</b>		1.1 ± 0.1			20.5 ± 1.1
	Ce	Cr			
<b>Fusion, Acme, n=5</b>	43.7 ± 1.3				
<b>HF-acid, GSC, n=5</b>	46.2 ± 3.6	52 ± 12			
<b>Fusion, GSC, n=27</b>	43 ± 2	81 ± 10			
<b>INAA, n=11</b>	43 ± 2	70.3 ± 1.6			

Also presented in Table 1 for reference are two other datasets for V6 compiled by C. Dunn: 27 analyses by the GSC LiBO<sub>2</sub> fusion method where first the HF-acid digestion is carried out and then the undissolved residue is fused with LiBO<sub>2</sub> to provide a total analysis; and 11 analyses by INAA at Activation Labs of Ancaster, Ontario. The agreement between the HF and fusion methods is extremely good for Co, Cs, Ga,

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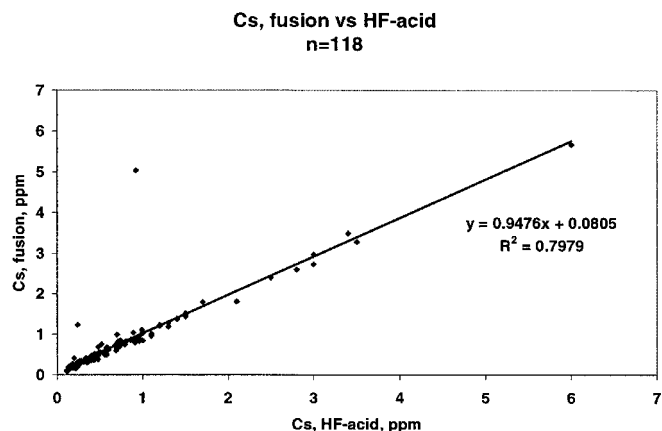
## Analyst's Couch

*continued from Page 2*

Rb, Sr, Th, U, V and the REEs represented by La and Ce. Given that sample weights used were  $\leq 0.5$  g and extremely different decompositions were employed in different laboratories with different ICP-MS instruments and procedures, this agreement is quite remarkable. However, Hf and Zr by the HF-acid digestion appear to be significantly low (and noisy), at  $0.62 \pm 0.68$  (cf  $4.56 \pm 0.43$  ppm by fusion) and  $25.8 \pm 25.0$  ppm (cf  $173 \pm 24$  ppm), respectively. The third set of data, by fusion carried out at the GSC, confirm the Acme fusion data for these elements and indicate that the disagreement pertains to the sample digestion and not the laboratory's calibration of instrumentation. Other results, compiled by C. Dunn, for Zr in V6 by aqua regia and ICP-ES have all reported below the detection limit of 1 ppm. Results for Ta by the HF-acid method also seem to be low ( $0.14 \pm 0.13$ ; cf  $0.37 \pm 0.08$  ppm by fusion) but the data are noisy by this method and too close to the detection limit of 0.05 ppm to evaluate adequately. The HF-acid digestion data for Nb are also too noisy ( $2.39 \pm 2.31$  ppm) to assess the comparison with fusion data ( $4.7 \pm 0.5$  and  $5.1 \pm 0.4$  ppm) and the same is true for Sn ( $2.7 \pm 0.9$  ppm by HF and  $3.6 \pm 0.8$  ppm by fusion). Thallium data are noisy and perhaps slightly high by Acme's fusion (very close to detection limit); there is good agreement between the HF-acid and fusion data from the GSC. Unfortunately, Cr results reported by Acme were negated as a new shipment of flux was found to be high in this element. However, the other three datasets suggest that the HF-acid digestion is incomplete for Cr in the ash ( $52 \pm 12$  ppm; cf  $81 \pm 10$  ppm by GSC fusion and  $70.3 \pm 1.6$  ppm by INAA), as it is for Hf and Zr.

The two sets of results for the ashed vegetation corroborate the similarities and differences found for the control V6. The plots for Cs and Sr in the mixed tissue vegetation (Fig. 1,  $n = 118$ ) are typical of most elements, with agreement

Figure 1. Cs and Sr results in mixed vegetation ash by  $\text{LiBO}_2$  fusion and HF-acid digestion.



*Continued on Page 4*

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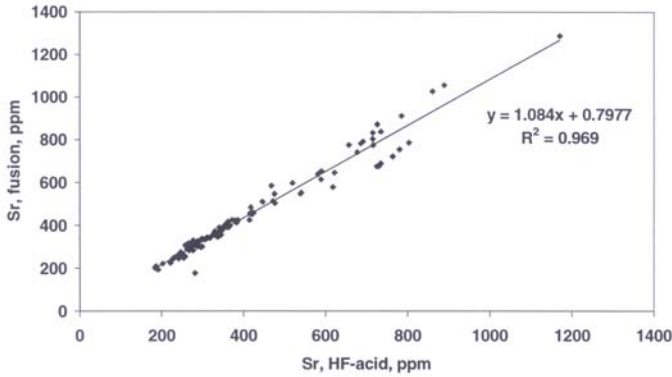


# Analyst's Couch

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Figure 1... continued

Sr, fusion vs HF-acid  
n=118



between the two methods being excellent; slopes of the regression lines are close to unity and the R<sup>2</sup> values are 0.80 for Cs and 0.97 for Sr. The data for Nb are rather noisy (Fig. 2) as many values are close to detection limits, unlike the situation for Cs and Sr, but there does not seem to be any particular bias (slope of 0.91 and R<sup>2</sup> of 0.50). However, the mixed tissue samples show significant differences in results between the fusion and HF-acid digestion methods for Hf and Zr, the slope of the linear regression (poor relationship,

Figure 2. Nb by LiBO<sub>2</sub> fusion (DL = 0.1 ppm, shown as dotted line) and by HF-acid digestion (DL = 0.05 ppm). Concentrations below DL plotted as DL/2.

Nb, fusion vs HF-acid  
n=118

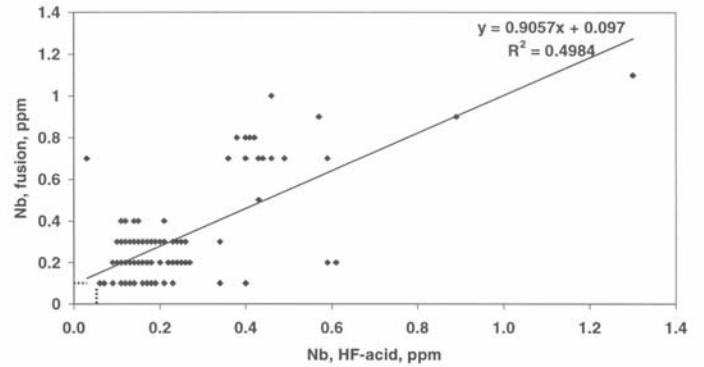


Figure 3. Hf by LiBO<sub>2</sub> fusion (DL = 0.05 ppm, shown as a dotted line) and by HF-acid digestion (DL = 0.05 ppm). Concentrations below DL plotted as DL/2.

Hf, fusion vs HF-acid  
n=118

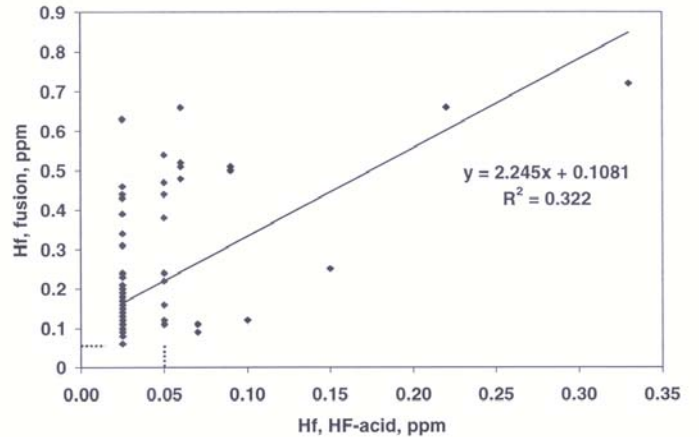
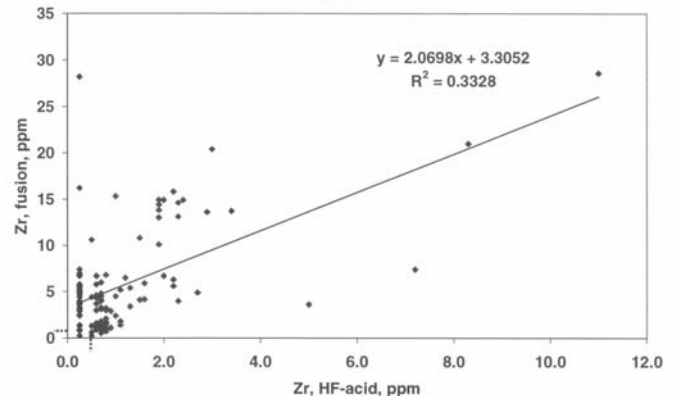


Figure 4. Zr by LiBO<sub>2</sub> fusion (DL = 0.5 ppm) and by HF-acid digestion (DL = 0.5 ppm). Concentrations below DL plotted as DL/2.

Zr, fusion vs HF-acid  
n=118





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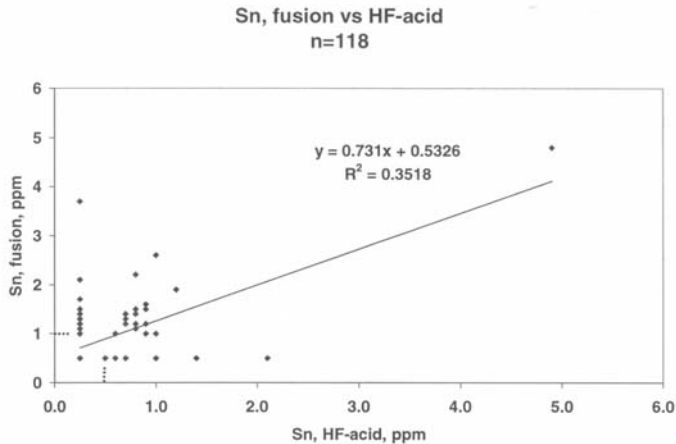
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## Analyst's Couch

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Figure 5. Sn by LiBO<sub>2</sub> fusion (DL = 1 ppm) and by HF-acid digestion (DL = 0.5 ppm). Concentrations below DL plotted as DL/2.



$R^2 = 0.3$ ) being greater than two (Figs. 3, 4). Thus, results for the ashed vegetation for Hf and Zr are low, and randomly so, by the HF-acid digestion. Tantalum also appears to be low as the results range from <0.02 ppm to 0.87 ppm by fusion but are below detection (0.05 ppm) by the HF-acid digestion except for two samples at 0.08 and 0.09 ppm. As with V6, results for Sn by both methods are not significantly different but the agreement is poor ( $R^2 = 0.35$ ; Fig. 5).

The low results by acid digestion for Hf and Zr, and perhaps for other elements such as Ta and Cr, are also evident in another project focused on the use of vegetation for diamond exploration (Seneshen et al., 2001). This low recovery may be due to (1) refractory mineral matter intimately associated with the ash itself and/or (2) formation of "insoluble" forms of these elements during the ashing procedure. It is highly unlikely that Hf and Zr would exist in "insoluble" forms within the dry vegetation. Previous work by Hall et al. (1990) showed that the ashing procedure led to the formation of an "acid-insoluble" form of Pd in vegetation, perhaps through creation of the strong Pd-O bond. Repeated and lengthy digestion with the strong oxidizing acid, HClO<sub>4</sub>, finally brought Pd into solution; alternatively, the ashing temperature was raised from 470 °C to 870 °C whereupon this bond was destroyed and the recovery of Pd was then complete in an HF-acid mixture. Direct digestion of the dry vegetation with HF-HClO<sub>4</sub>-HNO<sub>3</sub> was successful in fully recovering the Pd. This phenomenon may also apply to elements such as Hf and Zr under study here which do form strong oxide bonds, thereby requiring a fusion to bring them completely into solution.

In conclusion, an orientation survey is highly recommended to define the optimum digestion of ashed vegetation when these elements (Hf, Zr, Ta, Cr, Nb and perhaps others) are considered to be pathfinders in biogeochemical exploration. At this stage of knowledge, we do not yet know whether we actually need to obtain total concentrations of these elements to best assist in defining mineralization (or host

lithologies), or if the best indications are from the more readily soluble fraction of these elements. Work is ongoing to identify the cause of this disparity between decomposition methods, and further study is required to resolve the question "do we need total or partial extraction of these elements from vegetation?"

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## STUDENT PAPER PRIZE **XRAL**

### KATHRYN A. LAURUS FELIKS



The Association of Exploration Geochemists and XRAL Laboratories, a Division of SGS Canada, take pleasure in announcing the 2000 Student Paper Competition Award. This is awarded for the best paper in a refereed scientific journal by a student, on work performed as a student. It must

be published within five years of graduation and must address an aspect of exploration geochemistry. The student must be the principal author and nominations may be made by anyone familiar with the student's work.

Entries closed at the end of 2000 for the Association's thirteenth biennial Student Paper Competition. We received a total of five entries from four entrants including Canada, China and Australia. They were of a high standard but the choice was very clear. The winner is Kathryn A. Laurus Feliks. Her winning paper is based on research for her M.Sc. Thesis, at the University of British Columbia, entitled 'Gold distribution in glacial sediments and soils at Spyder Lake, Hope Bay Greenstone Belt, NWT; and the effects of a permafrost environment'. Her thesis was completed in 1995 and was supervised by Prof. W.K. Fletcher.

Kathryn obtained her B.Sc (Hons) in Geology from Carleton University, Ottawa, Ontario in 1991. During this she gained experience with the Terrain Sciences Division of

the Canadian Geological Survey. After graduating, but prior to her M.Sc., she continued with the Canadian Geological Survey as a research assistant for Beth McClenaghan, compiling a geochemical database and in petrological investigations of glacial drift. Since completing her M.Sc., her talents have been used both in the environmental aspects of geochemistry and in exploration for base and precious metals in Canada and Mexico. She has worked for the Environmental Geology Section of the B.C. Geological Survey, for Prime Geochemical Methods Ltd, Canamera Geological Ltd, Premier Minerals Ltd and Norecol, Dames and Moore, in the fields of acid rock drainage, geochemical sampling, mapping, statistical data manipulation and database management.

She receives a \$500 cash prize from XRAL, a two year membership of the Association of Exploration Geochemists, together with the Journal and Explore, a certificate of recognition and \$500 towards expenses to attend the 20th IGES in Santiago, where the award was presented.

Her award-winning paper is entitled "Gold distribution in glacial sediments and soils at Boston Property, Nunavut, Canada" which was published at the end of 1999 in the Journal of Geochemical Exploration, Volume 67 and was co-authored with W.K. Fletcher. She also presented this paper at the 19th IGES in Vancouver. The abstract follows:-

"Geochemical exploration for gold in the Slave Structural Province, Nunavut, Canada is hampered by a complex cover of Quaternary sediments and a lack of information on the effects of glacial dispersion and periglacial conditions on gold distribution. This study investigates distribution of gold in surficial materials on the Boston Property in the southeastern portion of the Hope Bay Greenstone Belt, 650 km northeast of Yellowknife, N.W.T. The principal surficial materials are till with a discontinuous veneer of post-glacial marine sediments. In areas of shallow overburden, frost boils mix weathered bedrock with drift and bring bedrock fragments to the surface. Samples were collected from till and from soil profiles on lines across the mineralized zone. The -212 and -53  $\mu\text{m}$  fractions were separated by wet sieving and heavy mineral concentrates (HMCs) prepared. Gold was determined by fire assay-atomic absorption spectroscopy (FA-AAS) or by a more sensitive aqua regia-column preconcentration-ICP procedure. There are two types of gold anomalies: (1) anomalies in the regional till, and (2) anomalies developed by ongoing frost boil action and colluvial processes. Anomalies are absent in marine sediments. Gold values in the regional till range from 15 to 1030 ppb in -106+53  $\mu\text{m}$  HMCs and from 10 to 65 ppb in the -53  $\mu\text{m}$  fraction, which contains 60% of the total gold content. Anomalous values extend at least 2 km down-ice from the gold mineralisation. In profile, the most recent gold anomaly is mushroom-shaped, up to ~100 m wide at the surface, and drapes over a ridge of mineralized bedrock. The anomaly in near-surface horizons is 10-50 m broader than the anomaly in the underlying horizons. Maximum gold values (>5000 ppb) are found in areas of weathered bedrock and where frost boils include abundant fragments of mineralized bedrock. For reconnaissance-scale exploration, frost boils in the regional till should be sampled on a 500 x 40 m grid with lines perpendicular to

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## 20th IGES — In Review...

### The 20<sup>th</sup> IGES, Northern Peru Field Trip.

The 20<sup>th</sup> IGES organised a field trip immediately before the conference to visit the two major high sulphidation epithermal Au-Ag deposits in northern Peru, namely at Pierina and Yanacocha. A select group of seven of us, 4 Australians, 2 Americans and a Moroccan, took advantage of the trip.

Todd Wakefield did the ground work for arranging the trip before he left Peru to return to Nevada. We are all grateful to Todd for this, and also to Owen Lavin who stepped into the breach when Todd had to stand down.

Our thanks also go to the two companies and their staff who showed us around. At Pierina, Hector Aspajo entertained us on behalf of Minera Barrick Misquichilca, and at Yanacocha the hard work was done on behalf of Minera Yanacocha by Brad Leach, Louis Teal, Ronald Lujan, and Pat Malette. To you and your employers we offer our sincere thanks.

We discussed the geochemical aspects of both deposits' discoveries. At Pierina, several companies had sampled the argillic alteration downslope of the deposit, but it was Arequipa Resources in 1994 who first sampled the vuggy silica rocks uphill from the argillic alteration and recognised their Au bearing potential. A lesson for us all from this might be to sample extensively around obvious "colour anomalies" as well as within them.

Rock chip sampling again was extensively used in the discovery of the main orebodies at Yanacocha. Mapping and sampling of silica "ledges" led directly to the discovery of most of the currently known deposits. However, from a geochemical point of view, the deposits at Yanacocha were clearly evident within the data from the British Geological Survey stream sediment sampling programme conducted nearly 20 years before the final discovery. This was truly a "sleeper" sitting in the files for many years!

Alteration mineralogy provides many clues to the origin and shape of these deposits. Both deposits have similar alteration assemblages but interesting differences also exist. Barrick made in excess of 14,000 readings using the Portable Infra-red Mineral Analyser (PIMA) to augment geologists' observations in the compiling of a comprehensive alteration map of the property.

### Student Paper Prize - *Continued from Page 6*

ice-flow direction. The -53  $\mu\text{m}$  fraction should be analyzed for gold with a detection limit of 1 ppb or lower. At the property scale, with anticipated higher gold values, it is feasible to analyze the coarser -212  $\mu\text{m}$  fraction from near-surface samples collected at a 10-20 m spacing along grid lines 100 m apart."

The Association of Exploration Geochemists would like to thank XRAL Laboratories for, once again, supporting this worthy cause, which encourages young geochemists to publish their research in a timely manner.

**I.D.M. Robertson**

*Coordinator, Student Paper Competition*



*IGES Peru field trip group (excluding the author who was on the other end of the camera) at Pierina. From left to right are Rohan Worland, Abdelhafid Miri, Russel Evans, Hector Aspajo, Geoff Balfe, Steve Zuker, and Owen Lavin.*

We all had a fascinating trip to a beautiful part of Peru. Our use of a charter plane for access allowed us to appreciate the scenery far more than we could have done in commercial flights, even if such had been available. The social side was well catered for, with Thai cuisine in Huaraz (I for one didn't expect to find Thai food in the high Andes!) and an unforgettable fondue at Cajamarca.

Once more, our thanks to Barrick and Minera Yanacocha and their staff, and especially to Owen Lavin for pulling it all together when once or twice it looked like it was coming apart at the seams! Thanks guys, it was fabulous!

**Nigel Radford**

*AEG President, 2001*

### Awards Dinner

The Association of Exploration Geochemists' Awards Dinner was held during the 20<sup>th</sup> International Geochemical Exploration Symposium in Santiago, Chile on Wednesday 9<sup>th</sup> May 2001. The Association dinner, held during each IGES, is always a special event, but this year we able to honour two elder statesmen of the Association, and one young "rising star".

Every two years, AEG holds a competition open to students who have published geochemical research work. The competition is judged by a panel of experts, coordinated by Ian Robertson of CRC-LEME in Australia. XRAL Laboratories generously donate a cash prize to the winner, who this year was Kathy Laurus Feliks. Kathy's paper, "Gold distribution in glacial sediments and soils at Boston Property, Nunavut, Canada" can be found in JGE (1999) volume 67. AEG was delighted to be able to help Kathy with the costs of attending the conference. We even prepared a

*Continued on Page 8*

## 20th IGES — In Review...

----- continued from Page 7



*Kathy Feliks, Student Paper Award winner with Nigel Radford and Ian Robertson, Chairman, Student Paper Competition Committee.*

poster to honour the event, but unfortunately, as can be seen in the photo, the hair colour on the poster no longer matched the hair on the head! Congratulations again to Kathy, and thanks to XRAL Details of how to enter the competition can be found on the AEG's website at [www.aeg.org](http://www.aeg.org). AEG encourages all researchers, especially students, to publish their work in the AEG's new Journal, **Geochemistry: Exploration: Environment: Analysis**, and where appropriate, to enter the Student Competition.

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*Eion Cameron accepting Honorary Membership from Nigel Radford*



*Owen Lavin accepting the Honorary membership award for Alan Coope from Nigel Radford*

The AEG has provision under its By Laws to appoint Honorary Members. This doesn't happen very often, few of us get close to the level of contribution to the science that is required. This year it was a huge personal honour and privilege for me to be able to present two Honorary Memberships. They went to Alan Coope and to Eion Cameron. I won't repeat the citations here, but listening to them made me realise how little most of us actually do in our lives, and how some people have the energy and drive to contribute so much. To Alan and Eion, we say "thank you"! Eion was able to be present at the IGES and accepted his award with his usual modesty and good humour. Alan was unable to attend the conference but Owen Lavin accepted the award on Alan's behalf, and read a message from him.

I would like to close this article with words from both of our new Honorary Members. Alan Coope writes as follows:

*"At the appropriate opportunity, I would be grateful if you would extend my deep appreciation to Council (and all others involved with my nomination) and relay to those present at the Santiago symposium my very best wishes with the sincere hope that the Association will continue to provide them with focus and an effective means of communication to advance geochemical frontiers, build satisfying careers, and generally contribute to a healthy, productive, sustainable economic prosperity and social well-being*

*Continued on Page 9*



## 20th IGES — In Review...

-----continued from Page 8

*among the nations of the world. Times are tough, but, as they say, this is the time the tough get going. The opportunities are still there."*

And Eion Cameron thus:

*"I have been most fortunate in my professional career. For 13 years I had administrative responsibility for applied geochemistry in the GSC at a time when the GSC as a whole was at its peak of influence and support. Following this I was a part-time prof for 16 years at the University of Ottawa in a department where academic politics was absent, because individual members of faculty genuinely liked each other. Most recently I have been involved with the mining industry as a consultant and as a researcher; roles that have been as rewarding as the best of my previous experiences. The common link between all these periods is my association as an active member of the AEG. It is perhaps best to be part of a society of moderate size, because one can develop a camaraderie with all of the other active members. That is the best award of all."*

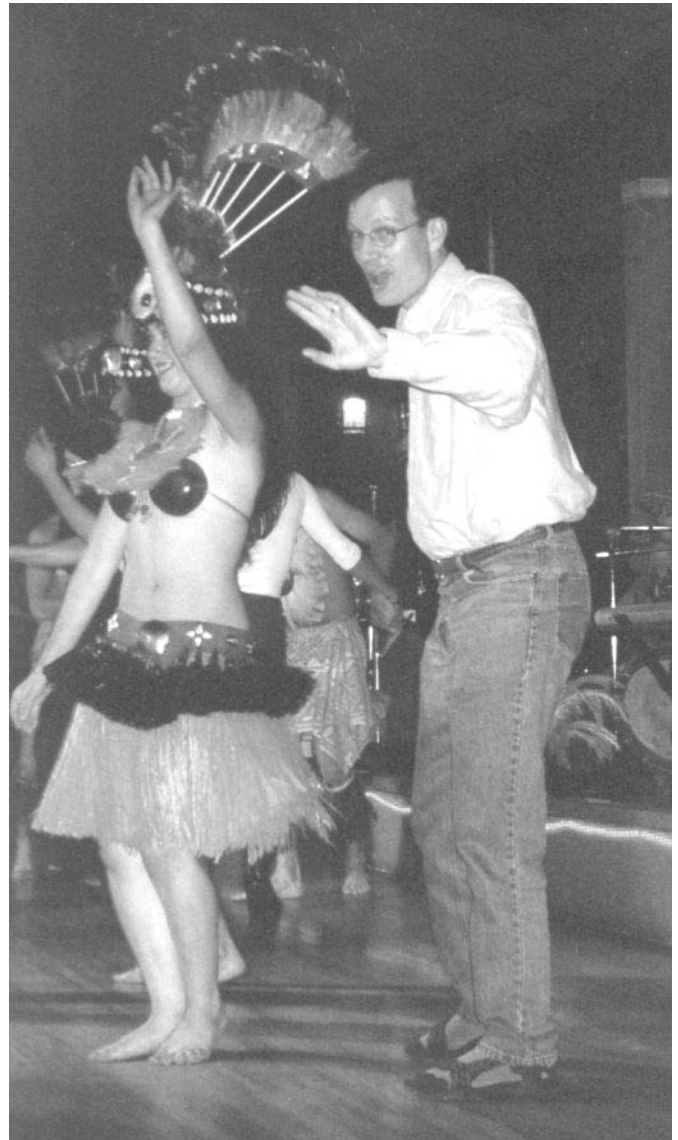
### **Nigel Radford**

*AEG President, 2001.*



## On the town...

*Cliff Stanley about to dance with an Easter Islander?*



*Linda Radford, Richard Carver and Brenda Mazzuchelli enjoying a joke over dinner.*



 **On the town...** continued from Page 9



*Gwendy Hall at the Chilean night dancing  
with an Easter Islander.*



*Shea Clark Smith*  
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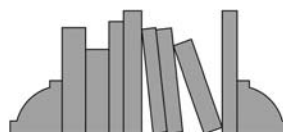
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Dave Evans has a complete set of the Journal of Geochemical Exploration (volumes 1 to 68) that he would like to donate to an individual or organization that will make good use of them. He also has a few years of Applied Geochemistry as well as some early Geochemical Symposium Volumes. Everything is a good shape with no highlighting and only his name or initial marking the front or first page.

The only condition is that the recipient pays for the shipping charges.

**D. S. Evans, Ph.D., P. Geol.,**  
Senior Consultant  
CSC Project Management Services  
Calgary, Alberta, Canada  
403-233-7994  
[CSCDaveE@cs.com](mailto:CSCDaveE@cs.com)



## RECENT PAPERS

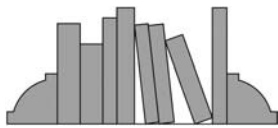
This list comprises titles that have appeared in major publications since the compilation in **EXPLORE** Number 111. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochimica et Cosmochimica Acta (GCA); the USGS Circular (USGS Cir); and Open File Report (USGS 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 80401-1887, Chairman AEG Bibliography Committee. Please send new references to Dr. Closs, not to **EXPLORE**.

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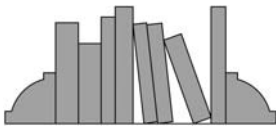
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*continued from Page 10*

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*Continued on Page 12*





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*continued from Page 10*

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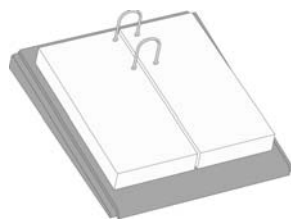
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Please note that acceptance of proposals will be acknowledged by early spring 2002

We are looking forward to hearing about new ideas that can contribute to the success of the Congress.

Gian Gaspare Zuffa  
(Chairman of the 32nd IGC Scientific Program Committee)  
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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.

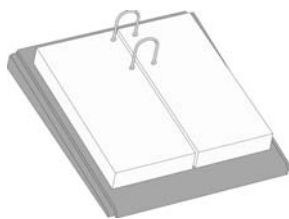
- July 29-August 2, 2001, **International Conference on the Biogeochemistry of Trace Elements**, University of Guelph, Guelph, Ontario, Canada. INFORMATION: Dr. Kim Bolton, Department of Land Resource Science, University of Guelph, Guelph, Ontario, Canada, N1G 2W1, Phone: (519)824-4120 ext. 2531 E-Mail: [icobte@lrs.uoguelph.ca](mailto:icobte@lrs.uoguelph.ca) Web: <http://icobte.crle.uoguelph.ca>
- July 29-August 04, 2001, **12th International Clay Conference**, Bahia Blanca, Argentina (Fernanda Cravero, Secretary-General 12 ICC, Departamento de Geologia, Universidad Nacional del Sur, 8000 Bahia Blanca, Argentina, Phone: 54 291 459 51 01 x30 41 EMail: [12icc@criba.edu.ar](mailto:12icc@criba.edu.ar) Web: <http://www.12ICC.criba.edu.ar>)
- July 30-August 3, 2001, **50th Annual Denver X-ray Conference**, Steamboat Springs, Colorado, USA. INFORMATION: Conference Coordinator, International Centre for Diffraction Data, 12 Campus Blvd., Newtown Square, PA 19073, (610) 325-9814, fax 610-325-9823.
- August 27- 29, 2001, **The 6th Biennial Society For Geology Applied To Mineral Deposits, Mineral Deposits at the Beginning of the 21st Century**, Krakow, Poland. <http://galaxy.uci.agh.edu.pl/~sga>
- August 31-September 12, 2001 **Field Excursion to the Skaergaard Intrusion, Skaergaard area**, Kangerdlugssuaq, East Greenland, by the Camborne School of Mines, IGCP Project 427, SGA. (Dr. Jens C. Andersen, Camborne School of Mines, University of Exeter, Redruth, Cornwall, TR15 3SE, UK, Phone: +44 1209 714866 EMail: [andersen@csm.ex.ac.uk](mailto:andersen@csm.ex.ac.uk) Web: <http://www.ex.ac.uk/CSM/news/conf.htm>)
- September 6-8, 2001, **Cathodoluminescence in Geosciences: New Insights from CL in Combination with other Techniques**, Society for Luminescence Microscopy and Spectroscopy (SLMS) and the German Mineralogical Society (DMG), Freiberg, Germany. INFORMATION: CL 2001 Secretariat, Freiberg University of Mining and Technology, Department of Mineralogy, Brennhausgasse 14, D-09596 Freiberg, Germany, Tel.: +49-(0)3731-392628, Fax: +49-(0)3731-393129. Jens Götze, e-mail:

[goetze@mineral.tu-freiberg.de](mailto:goetze@mineral.tu-freiberg.de). Ulf Kempe, e-mail: [kempe@mineral.tu-freiberg.de](mailto:kempe@mineral.tu-freiberg.de). <http://www.mineral.tu-freiberg.de/>

- September 10-14, 2001, **20th International Meeting on Organic Geochemistry IMOG 2001**, Palais des Congres, Nancy, France (Patrick Landais, UMR7566 G2R Université Henri Poincaré BP239 54506 Vandoeuvre, EMail: [imog2001@g2r.uhp-nancy.fr](mailto:imog2001@g2r.uhp-nancy.fr) Web: <http://www.imog.uhp-nancy.fr>)
- October 5-12, 2001, **27th Ann. Conf. of Federation of Analytical Chemistry & Spectroscopy Societies**. Detroit, MI. INFORMATION: Div. of Analytical Chemistry. FACSS, (505) 820-1648, fax (505) 989-1073, Internet: <http://FACSS.org/info.html>
- October 21-24, 2001, **Third South American Symposium on Isotope Geology**, Gran Hotel Pucón, Pucón, Chile, by the Servicio Nacional de Geología y Minería de Chile (SERNAGEOMIN); Dept. de Geología, Universidad de Chile; and Sociedad Geológica de Chile. (Eugenia Fonseca, Laboratorio Sernageomin, Til-Til 1993 Ñuñoa, Santiago, Chile, Phone: 56-2-2385292 EMail: [ssagi@sernageomin.cl](mailto:ssagi@sernageomin.cl) Web: <http://www.sernageomin.cl/ssagi/>)
- November 5-8, 2001, **Annual Meeting of the Geological Society of America**, Boston, Massachusetts. INFORMATION: TEL 1-800-472-1988, [meetings@geosociety.org](mailto:meetings@geosociety.org).  
December 2-3, 2001, **2001 Arizona Conference**, Doubletree Hotel at Reid Park, Tucson, Arizona. INFORMATION: Sam Rasmussen, 2001 Arizona Conference Program Chair, [srasmussen@phelpsdodge.com](mailto:srasmussen@phelpsdodge.com)
- December 16-18, 2001, **ICCE - 2001 International Congress of Chemistry and Environment**, Indore, M.P., India (Dr. Shankar Lal Gargh, A/80, Scheme No. 54, Vijay Nagar, Indore 452 010 (M.P.) India, Phone: +91/731-552837 EMail: [chemjyot@sancharnet.in](mailto:chemjyot@sancharnet.in) Web: <http://www.chemenviron.com>)
- February 25 - 27, 2002, **Society for Mining, Metallurgy, and Exploration (SME) annual meeting**, Phoenix, Arizona. William Wilkinson Jr., Phelps Dodge Mining Co., 2600 N. Central Ave., Phoenix, AZ 85004, (602) 234-6080, Fax: (602) 234-4847. E-mail: [wwilkinson@phelpsd.com](mailto:wwilkinson@phelpsd.com).
- March 10-13, 2002, **AAPG Annual Convention and Exhibition**, George R. Brown Convention Center, Houston, Texas, by the American Association of Petroleum Geologists. (AAPG Convention Department, 1444 S. Boulder Ave., Tulsa, OK 74119 USA, Phone: 800-364-2274 or 918-560-2679 EMail: [convene@aapg.org](mailto:convene@aapg.org) Web: <http://www.aapg.org>)

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## CALENDAR OF EVENTS

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■ April 7-11, 2002, **223rd ACS Natl. Mtg. Orange County Convention/Civil Center, Orlando, Fla.** INFORMATION: ACS Meetings, 1155 16th St., N.W., Washington, D.C. 20036-4899, (800) 227-5558, (202) 872-4396, fax (202) 872-6128, e-mail: natlmtgs@acs.org

■ June, 8-14, 2002, **AMERICAN SOCIETY for SURFACE MINING and RECLAMATION (ASSMR) 18th National Meeting**, Lexington, KY. [http://www.ca.uky.edu/assmr/Upcoming\\_Events.htm](http://www.ca.uky.edu/assmr/Upcoming_Events.htm)

■ July 22-27, 2002, **The Earth System and Metallogenesis: A Focus on Africa**, Windhoek, Namibia, by The Geological Society of Namibia, The Geological Society of South Africa, and The Geological Society of Zambia. (The Secretary, IAGOD/ GEOCONGRESS 2002, P.O. Box 44283, Linden 2104, South Africa, EMail: gssa@pop.onwe.co.za Web: <http://www.gssa.org.za>)

■ October 27-30, 2002, **Annual Meeting of the Geological Society of America**, Denver, Colorado. INFORMATION: TEL 1-800-472-1988, [meetings@geosociety.org](mailto:meetings@geosociety.org). February 24-26, 2003, **Society for Mining, Metallurgy, and Exploration (SME) annual meeting**, Cincinnati, OH. Contact: SME ([sme@smenet.org](mailto:sme@smenet.org)). SME,

Meetings Dept., P.O. Box 277002, Littleton, CO 80127, 800-763-3132. [SME \(sme@smenet.org\)](mailto:sme@smenet.org)

■ November 2-5, 2003, **Annual Meeting of the Geological Society of America**, Seattle, Washington. INFORMATION: TEL 1-800-472-1988, [meetings@geosociety.org](mailto:meetings@geosociety.org).

■ 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](mailto:dhyer@seg.org) Web: <http://meeting.seg.org>)

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

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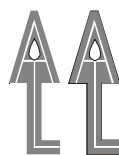


## Deadlines for the Next Four Issues of EXPLORE

Contributors's deadlines for the next four issues of  
**EXPLORE** are as follows:

Issue	Publication date	Contributor's Deadline
113	October 2001	August 31, 2001
114	January 2002	November 30, 2001
115	April 2002	February 28, 2002
116	July 2002	May 31, 2002

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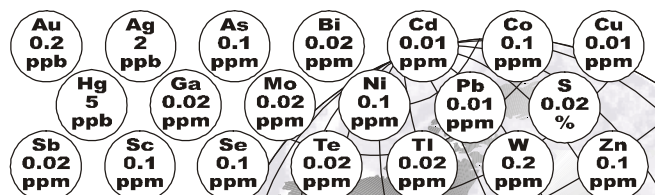


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## New Members...

To All Voting Members:

Pursuant to Article Two of the Association's By-Law No.1, names of the following candidates, who have been recommended for membership by the Admissions Committee, are submitted for your consideration. If you have any comments, favorable or unfavorable, on any candidate, you should send them in writing to the Secretary within 60 days of this notice. If no objections are received by that date, these candidates will be declared elected to membership. Please address comments to David B. Smith, Secretary AEG, USGS, Box 25046, MS 973, Denver, CO 80225, USA.

**Editors note:** Council has decided that all new applicants will receive the journal and newsletter upon application for membership. The process of application to the Nepean office, recommendation by the Admissions Committee, review by the Council, and publication of applicant's names in the newsletter remains unchanged.

### Fellowship

#### McQueen, K.G.

*Associate Professor*  
University of Canberra  
Canberra, AUSTRALIA

*Continued on Page 18*

#### Seoane, Carlos

*Visiting Lecturer*  
Universidade Federal de Pernambuco  
Recife, BRAZIL

#### Sjoekri, Adi Adriansyah

*Senior Evaluation Geologist*  
Newmont Pacific Nusantara  
Jakarta, INDONESIA

#### Nordin, Roger

*Exploration Manager Chile*  
Cia Minera Boiden Westmin Chile Ltda.  
Antofagasta, CHILE

### Non-Voting Membership

#### Shaoping Yang

*Senior Geochemist*  
Institute of Geophysical and Geochemical Exploration  
Hebei, CHINA

#### Zhongjun Sun

*Senior Geochemist*  
Institute of Geophysical and Geochemical Exploration  
Hebei, CHINA

#### O'Sullivan, Kerry

*Manager Professional Development*  
Australian Mineral Foundation  
Glenside, SA, AUSTRALIA

#### Cameron, Ian Norman

*Principal Geologist*  
TGV Erawan Mining Ltd  
Changwat Phichit, THAILAND

#### Britt, Allison

*Research Scientist*  
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## AEG Council...

Several changes were announced at the recent AEG Council meeting held in Santiago, Chile. Steve Amor, based in Burlington, Ontario, Canada, has accepted the post of 2nd Vice-President. Rob Bowell, Principal Geochemist, SRK Consulting, Cardiff, Wales, has agreed to fill Steve Amor's position on Council. Rob Bowell was the second runner up in the recent vote for councillors. Dee Flight, Geochemist, Geological Survey of Northern Ireland, Belfast, Northern Ireland, has accepted the role as Regional Councillor for the United Kingdom.



## Letter to the Editor

29 April 2001

Dr L James  
The Editor

### EXPLORE

Dear Sir,

As a participant in the fateful AEG establishment meeting in Toronto in 1970 (and as a Past President of the Association) I have been stirred to activity by Nigel Radford's article, *AEG Membership Debate* (EXPLORE 111, April 2001). Whereas my main concern of latter years is to make my olive grove a commercial success (to help replace lack of income from exploration geochemistry!), I do maintain an active, albeit silent, interest in the Association.

To abandon the name Association of *Exploration* Geochemists perhaps would be a traumatic event to those of my generation. I do recall, however, that I survived the change from *Geochemical Prospecting* that I had been used to at the *Geochemical Prospecting Research Centre* at Imperial college in the 1950s. In those early days we used also to speak of Applied Geochemistry.

If there is to be a name change (and I reluctantly think that there must) I would like to suggest the *Association of Applied Geochemists* for consideration. This has the advantage of being discipline-neutral but is all-embracing. A re-write of the preamble to the By-Laws as proposed by David Garnett (reported by Nigel Radford in his article in EXPLORE 111, April 2001), and the consequential modification of the By Laws, would seem to satisfy all objectives. A possible problem might be a perceived conflict with the Journal of Applied Geochemistry (if it still exists).

Yours faithfully,

**GJS Govett**

(Emeritus Professor)

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## EXPLORE

Newsletter No. 112

JULY 2001

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# THE ASSOCIATION OF EXPLORATION GEOCHEMISTS APPLICATION FOR NON-VOTING MEMBERSHIP\*

Please complete the section relevant to the class of membership sought and supply your address on this form.  
Mail the completed application, together with annual dues, to the address below.

**\*Details of requirements and application forms for voting membership (fellowship) can be obtained from the AEG website (<http://www.aeg.org>) or business office.**

**MEMBER**

I \_\_\_\_\_ wish to apply for election as a Member of the Association of Exploration Geochemists. I am presently employed by:

\_\_\_\_\_ as a \_\_\_\_\_  
(employer) (employment title)

I am actively engaged in scientific or technological work related to geochemical exploration and have been so for the past two years. Upon receipt of the Code of Ethics of the Association I will read them and, in the event of being elected a Member, agree to honour and abide by them. Witness my hand this \_\_\_\_\_ day of \_\_\_\_\_ 19\_\_\_\_.

(Signature of applicant)

**STUDENT MEMBER**

I \_\_\_\_\_ wish to apply for election as a Student Member of the Association of Exploration Geochemists. I am presently engaged as a full-time student at \_\_\_\_\_, where I am taking a course in pure or applied science. Upon receipt of the Code of Ethics of the Association and in the event of being elected a Student Member agree to honour and abide by them. Witness my hand this \_\_\_\_\_ day of \_\_\_\_\_ 19\_\_\_\_.

(Signature of applicant)

Student status must be verified by a Professor of your institution or a Fellow of the Association of Exploration Geochemists. I certify that the applicant is a full-time student at this institution.

(Signature)

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Please note: Your completed form should be mailed to the Business Office of the Association and 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 Association 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:

# THE ASSOCIATION OF EXPLORATION GEOCHEMISTS

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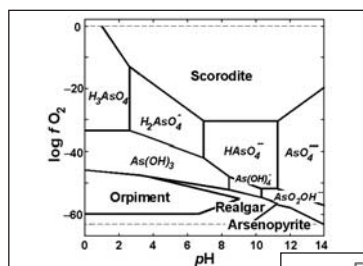
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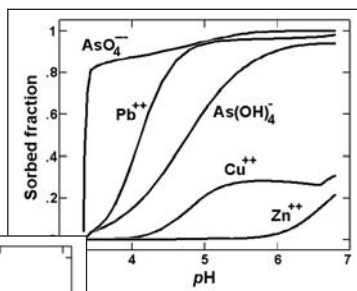
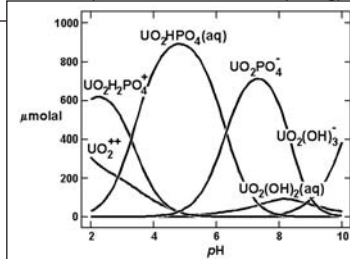
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