

EXPLORE

NUMBER 110

JANUARY 2001

Newsletter for
the Association
of Exploration
Geochemists



PRESIDENT'S MESSAGE

To those who believe January 1st 2000 was the start of the third millennium, Happy New Year! To those who believe that honour falls to January 1st 2001, the day on which I write this letter to you, Happy New Millennium!

Either way, 2001 is going to be a momentous year for AEG. This year will see the launch of the first volumes of our new journal, *GECHEMISTRY: EXPLORATION, ENVIRONMENT, ANALYSIS*, the most fundamental change that has taken place in the 30 year history of the Association. Along with the recently mailed subscription notices, you will have received a flier outlining the scope of the new Journal. I cannot stress strongly enough to you all how important this new venture is to our Association. The decision to establish a new Journal was not taken lightly. It would have been much easier to roll-over the old contract on JGE. However, in the interests of a vibrant, forward-looking Journal, held firmly in the Association's members' hands, Council decided on the new venture, a collaboration with the Publishing House of the Geological Society of London. The die is cast, and the first edition will be on its way to you shortly.

This new Journal, *YOUR* new Journal, will only be a success if it is well fed with top quality scientific papers. I urge every single member of the Association to think hard about material he or she may have tucked away in a filing cabinet (or in a mental recess) that might make a paper for GEEA. Dig it out, dust it off, and write it up. Don't be modest, and don't wait for "someone else" to do it. We are all busy, but make some time for your new Journal. I too promise to make time to write up a study. Ask your friends and colleagues, talk to contacts at Universities or Research Institutes, twist arms, bully and cajole for all you're worth! Let's get those papers rolling in! Gwendy Hall, GEEA's Editor in Chief, is waiting to hear from you! Instructions to authors are available on our web site (www.aeg.org). Only when the world sees the quality of the papers GEEA presents will its success be assured. It will not be enough just to circulate GEEA to all the AEG members. It needs to be on library shelves. We now have a pricing policy that makes GEEA affordable to institutions and libraries, but the surest guarantee of a library stocking a new journal is if people are continuously asking to see it. That *will* happen if it contains lots of top quality papers.

The second momentous event in AEG's calendar for 2001 is the 20th International Geochemical Exploration Symposium (IGES) to be held in Santiago de Chile from 6th to the 10th of May. The symposium includes pre conference field trips and post conference workshops. The Local Organising Committee has put in an enormous effort and secured a "star-studded" cast of presenters. Their hard work, often in trying circumstances,



Nigel Radford

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PAST-PRESIDENT'S MESSAGE

Happy New Year!

It's the beginning of a new year, a refreshing time for the AEG, and the end of my personal tenure as AEG President. I've been privileged to serve this year with my extremely capable fellow AEG members on Council, and am proud to see a stronger AEG taking shape.

At the beginning of last year, I stated in a president's message that a stable and healthy AEG stands on a "tripod" of:

- 1) **EXPLORE**
- 2) The AEG web site, and
- 3) A strong professional journal, GEEA.

This tripod has grown and stabilized during the year through the efforts of Council and AEG volunteers. The results of their work are outstanding. **EXPLORE** is thriving under the solid direction provided by Editor Lloyd James and Business Manager Dave Kelley. The AEG web site has been updated and expanded under Steve Amor's watchful eye. Through Gwendy Hall's guidance, the new GEEA journal is well poised for a successful beginning and impressive impact on our discipline. Special publications are emerging in parallel with the new journal through Beth McClenaghan's work. I would like to congratulate these individuals and all who worked with them on achieving superlative results for the year in strengthening the AEG. We're well poised for the new millenium, and the continued evolution of our Association.

The AEG membership should be well pleased with the leadership makeup for the next two years. Nigel Radford of Normandy Mining brings extensive international minerals exploration experience and a "down under" Australian flavor to the president's chair. Having worked with Nigel in the early 1980's at BP Minerals, I know he sees the critical importance of combining practical experience with advanced technical insight in integrating geochemistry into minerals exploration programs. Philippe Freysinnet of France's BRGM steps in as



Paul Taufen

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Information for Contributors to EXPLORE

Scope. This newsletter is the prime means of informal communication among members of the Association of Exploration Geochemists, but has limited distribution to non-members. EXPLORE is the chief source of information on current and future activities sponsored by the Association, and also disseminates technical information of interest to exploration and environmental geochemists and analytical chemists. News notes of members are appropriate. We welcome short- to moderate-length technical articles on geochemical tools for exploration, concepts for finding ore, mineral-related environmental geochemistry, new analytical methods, recent deposit discoveries, or case histories. The goal of this newsletter is communication among exploration geochemists, and to that end we encourage papers on new methods and unconventional ideas that are reasonably documented.

Format. Manuscripts and short communications should be submitted in electronic form to minimize errors and speed production. Files can be transmitted on IBM-compatible 3.5 inch diskettes or attached to email. Most popular text and graphics files can be accommodated. Figures and photos can be transmitted in hard copy (which we will scan) or as high quality digital files. Some issues are published with color pages for special maps and figures which should be planned by early communication with the editors.

Length: Technical communications can be up to approximately 1000 words, but special arrangements may be made for longer papers of special interest. High quality figures, photos, and maps are welcome if they present information effectively.

Quality: Submittals are reviewed and edited for content and style through peer reviews. The intent is to improve clarity, not suppress unconventional ideas. If time permits, the author will be shown changes to material, by FAX or email. Time constraints do not allow author review of galley proof from the printer.

All contributions should be submitted to Lloyd James by email (l-njames@central.com) or regular mail to 7059 East Briarwood Drive, Englewood, CO 80112, USA. Only in rare situations should FAX be sent (303-741-5199).

Information for Advertisers

EXPLORE is the newsletter of the Association of Exploration Geochemists (AEG). Distribution is quarterly to the membership consisting of 1200 geologists, geophysicists, and geochemists. Additionally, 100 copies are sent to geoscience libraries. Complimentary copies are often mailed to selected addresses from the rosters of other geoscience organizations, and additional copies are distributed at key geoscience symposia. Currently, EXPLORE is sent to 68 different countries.

EXPLORE is the most widely read newsletter in the world pertaining to exploration geochemistry. Geochemical laboratories, drilling, survey and sample collection, specialty geochemical services, consultants, environmental, field supply, and computer and geoscience data services are just a few of the areas available for advertisers. International as well as North American vendors will find markets through EXPLORE.

The EXPLORE newsletter is produced on a volunteer basis by the AEG membership and is a non-profit newsletter. The advertising rates are the lowest feasible with a break-even objective. Color is charged on a cost plus 10% basis. A discount of 15% is given to advertisers for an annual commitment (four issues). All advertising must be camera-ready PMT, negative or file on disk. Business card advertising is available for consultants only*. Color separation and typesetting services are available through our publisher, Vivian Heggie, Heggie Enterprises.

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President's Message

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is much appreciated. I am sure the Conference will be an outstanding success, and I think it will have the sort of individual flavour that only Latin America can provide. It is only the second time that an IGES has been held in South America, and given the current interest in exploration there, one of the few locations experiencing any sort of exploration boom, it has to be a MUST for most of our members. Details were given in the last edition of Explore (number 109, October 2000, pages 12 and 13) and further information can be found via the AEG website (www.aeg.org) or via email at IGES20@netup.cl. I hope to have chance to meet many of you there over a cerveza or a pisco sour!

I am delighted to be able to announce that two of our senior colleagues, Eion Cameron and Alan Coope, have been elected by AEG Council to the position of Honorary Members. Eion has recently retired from the Geological Survey of Canada and was, as many of you will be aware, Editor in Chief of the Journal of Geochemical Exploration from its inception in 1972 until 2 years ago. Alan may well be considered the Founding Father of the AEG as well as the discoverer of the Carlin trend. His vision and hard work formed the Association in 1970 and has nurtured it over the intervening years. It's hard to comprehend how these men found time to offer so much to the Association and to contribute in such massive ways to exploration geoscience and the interests of their employers. I cannot imagine two more worthy recipients of Honorary Membership of the Association.

In light of the above reference to Eion and Alan, I should say that I am honored by, and more than a little apprehensive of the role you have entrusted with me as President of your Association in this momentous year. I hope that all members will feel they can approach anyone on Council, and myself in particular, with their ideas for making the AEG more effective in advancing our science.

Towards that end, communications between us can never have been easier, and I'm thinking here especially of email. After all it is your Association and your views are essential! Please pass them on! It was, to say the least disappointing that the recent Association AGM only managed a quorum by virtue of one proxy placed in the hands of the President. I don't believe that our members are truly apathetic about the running of the Association. I hope that as communications become easier, more members will take an active role in the policy making of the Association.

I cannot close without passing on my thanks to Paul Taufen, who now stands down as President. Paul will continue to serve on Council as Past President. Paul's diplomatic skills have been put to the test several times this last year, and his calm and insightful reflections have ensured the Association's best interests have been served. Many thanks Paul!

Once again, a Happy New Millennium to you all! Successful exploring: may all your budgets be big ones! I look forward to meeting many old friends and making many new ones when we get together for the 20th IGES in Santiago in May!

Nigel Radford

President AEG

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Past-President's Message

Continued from Page 1

First Vice President of the AEG, ready to serve as President in 2002. Philippe has provided refreshing insight into natural geochemical processes in the tropics through his publications over the past several years. Philippe will provide excellent technical and administrative skills to our Association, as well as a European perspective. These gentlemen have a clear vision of how geochemistry techniques in exploration, environment, and analysis can add value to industry and government research organizations, and will help the AEG evolve in a positive direction.

I was struck by reporting on an interesting phenomenon in the local newspaper here (the Denver Post) during the past couple of months. With the recent rise in natural gas prices and a shortage of natural gas supply, companies have been looking for petroleum exploration geoscientists to staff exploration teams. Alarmingly, companies here have found few experienced and trained explorationists available to fill the expanded demand for increased exploration! Under the stress of business pressures, businesses in the petroleum sector have eliminated a core competency in exploration, and now are struggling to respond to a business opportunity with a core competency largely unavailable.

There certainly are parallels in the minerals exploration industry. Business pressures in our industry typically have reduced the size of exploration staff, including minerals exploration geochemists. Our challenge is to not be confined strictly to limited minerals exploration activities, but to understand clearly where our discipline can contribute to a business, and become pro-active in contributing! We can expand our own core competencies, and be ready to adjust where we apply geochemistry within our business in response to business needs.

An executive general manager at the company where I work once commented in conversation about geochemistry, "you know, when you think about it, there is quite a bit of geochemistry in everything we do in this business". This is an insight worth capturing for all of us. Applying our discipline of geochemistry, there are important possibilities to contribute beyond minerals exploration in addressing environmental issues, helping solve mineral processing questions, providing insight into analytical questions, etc. I think this is where our AEG is heading. The destination is captured in our new journal title: Geochemistry: Exploration, Environment, Analysis. It's going to be an exciting journey, and the AEG has the right leadership to take us there!

Thanks for the opportunity to work as AEG President this last year. It's been enjoyable and rewarding, and leaves me excited to see where the AEG will go from here!

Paul Taufen

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TECHNICAL NOTE

Preservation of control reference materials for mercury: contamination from the atmosphere

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Recent control data for Hg in stream sediment control reference materials (CRM), derived by aqua regia ICP-MS analysis at Acme Analytical Laboratories in Vancouver, appeared to be significantly higher than the recommended values. The samples, STSD-2 and STSD-3, are part of a 12-sample set of lake and stream sediments and tills produced by the Geological Survey of Canada (GSC) and marketed by the Canadian Centre for Mineral and Energy Technology (CANMET) (Lynch, 1990, 1996, 1999). They are used to monitor accuracy in the National Geochemical Reconnaissance (NGR) Program of the GSC. The recommended values for STSD-2 and STSD-3 are 46 ± 10 and 90 ± 7 ppb (ng g^{-1}), respectively (Lynch, 1990). The values reported by Acme were 122 ± 15 ($n=3$) and 357 ± 17 ($n=3$) ppb, respectively; the method of standard additions supported these data. These CRMs were sent to another commercial laboratory (CanTech Laboratories, Calgary) which confirmed Acme's apparently high results, reporting 123 ± 14 ($n=6$) and 312 ± 8 ($n=6$), respectively. The method used by CanTech is aqua regia digestion with measurement by cold vapor atomic absorption spectrometry.

The CRMs used in the NGR Program have been stored in their original bottles in open cardboard boxes in various

Ottawa locations, including the basement 'cage' at the GSC where some have remained for 5-6 years. The bottles are glass with white plastic, wide-mouth, screw caps. A selection of these bottles was taken and analysed in triplicate for Hg using the Milestone AMA-254 direct Hg analyser which is based on volatilization by heating to 550°C , amalgamation of Hg vapor on Au, desorption, and measurement by atomic absorption spectrometry (Hall and Pelchat, 1997). A sample weight of 300 mg was used; the bottles were well shaken prior to sampling. New bottles of some of the CRMs in the series were purchased from CANMET and analysed concurrently. Results for all 12 CRMs are presented in Tables 1-3.

Table 1. Results for Hg (using Milestone AMA-254) in various bottles of TILL CRM series, all values in ppb, $n=3$ (300 mg aliquots). Results where (mean \pm SD) is greater than the (mean+SD) of recommended value are underlined.

TILL-1, 92 ± 11 ppb Hg	
Bottle 194, new	92 ± 0.5
Bottle 520	<u>138 ± 1.7</u>
Bottle 1641	<u>165 ± 2.1</u>
Bottle 294	<u>135 ± 0.7</u>
Bottle 1412	<u>135 ± 0.9</u>
TILL-2, 74 ± 13 ppb Hg	
Bottle 972, new	66 ± 0.4
Bottle 504	<u>100 ± 0.2</u>
Bottle 1388	<u>106 ± 0.2</u>
Bottle 866	<u>99 ± 1.1</u>
Bottle 290	67 ± 1.3
TILL-3, 107 ± 15 ppb Hg	
Bottle 1314, new	110 ± 1.5
Bottle 504	<u>156 ± 4.1</u>
Bottle 210	124 ± 1.7
Bottle 967	<u>134 ± 0.3</u>
Bottle 697	<u>177 ± 1.2</u>
TILL-4, 39 ± 12 ppb Hg	
Bottle 1145, new	24 ± 0.3
Bottle 1655	<u>56 ± 2.2</u>
Bottle 377	40 ± 0.1
Bottle 299	<u>63 ± 0.3</u>
Bottle 1531	<u>64 ± 0.5</u>

All data for the 'new CRM bottles' are within the standard deviation limits of the recommended values which were based upon *ca* 40-45 determinations in each CRM made by 5-7 different laboratories (Lynch, 1990). Furthermore, the precision of triplicate analysis on these bottles is extremely good, at 0.6-1.3 % RSD (Tables 1-3), in agreement with that obtained in the original evaluation of the performance of the Milestone AMA-254 by Hall and Pelchat (1997). Interestingly in that paper, duplicate results for TILL-1 were much higher than the recommended value (92 ± 11 ppb), at 144 and 145 ppb, which led the authors to speculate that Hg might be present in a form not amenable

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Preservation of control reference materials

Continued from Page 4

Table 2. Results for Hg (using the Milestone AMA-254) in various bottles of STSD CRM series, all values in ppb, n=3 (300 mg aliquots). Results where (mean ± SD) is greater than the (mean+SD) of recommended value are underlined.

STSD-1, 110 ± 11 ppb Hg	
Bottle 845, new	120 ± 0.8
Bottle 1518	<u>125 ± 0.6</u>
Bottle 1312	115 ± 1.0
Bottle 286	<u>134 ± 4.6</u>
Bottle 1455	113 ± 1.1
STSD-2, 46 ± 10 ppb Hg	
Bottle 943, new	49 ± 0.6
Bottle 419	38 ± 0.7
Bottle 713	38 ± 1.9
Bottle 1035	43 ± 2.6
Bottle 617	<u>69 ± 0.7</u>
STSD-3, 90 ± 7 ppb Hg	
Bottle 1351	<u>317 ± 4.1</u>
Bottle 633	<u>137 ± 2.0</u>
Bottle 84	<u>237 ± 2.4</u>
Bottle 1308	<u>280 ± 1.8</u>
STSD-4, 930 ± 76 ppb Hg	
Bottle 465	940 ± 84
Bottle 1207	987 ± 45
Bottle 1549	1053 ± 133
Bottle 1076	873 ± 35

to digestion by a mixture of HNO₃-HCl acids. Also in that paper it was suggested that differences between bottles may exist, as Hg results in two bottles of LKSD-4 were significantly different by this method, at 187 ± 1 and 203 ± 1 ppb, though still within the recommended value (190 ± 17 ppb). The present work supports this conclusion: significantly different concentrations of Hg do exist in different bottles of TILLs 1-4, STSDs 1-3, LKSD-1 and LKSD-4. All these differences are positive and many are well beyond one standard deviation of the recommended value. STSD-3 and the TILL series are the worst cases, the former reporting a mean as high as 317 ± 4 ppb in bottle 1351 compared to a recommended value of 90 ± 7 ppb. Interestingly, the precision within bottles is generally good, at levels better than 6% RSD except for that shown by STSD-4 which deteriorates to 9 and 13% RSD in bottles 465 and 1549, respectively.

As the 'new bottle' data were acceptable and heterogeneity problems were not encountered for Hg in the original round-robin carried out in the certification process, contamination was suspected. Most of the bottles stored in the cage had not been opened previously but it was impossible to know which had, as all appeared to have roughly the original content as purchased. These bottles are not sealed. Mercury had been stored in the cage over the years, in liquid form in

Table 3. Results for Hg (using the Milestone AMA-254) in various bottles of LKSD CRM series, all values in ppb, n=3 (300 mg aliquots). Results where (mean ± SD) is greater than the (mean+SD) of recommended value are underlined.

LKSD-1, 110 ± 15 ppb Hg	
Bottle 1577, new	104 ± 1.2
Bottle 971, new	119 ± 2.1
Bottle 222	105 ± 6.0
Bottle 1080	129 ± 7.6
Bottle 1466	<u>143 ± 0.6</u>
Bottle 139	100 ± 2.9
LKSD-2, 160 ± 19 ppb Hg	
Bottle 826, new	155 ± 2.6
Bottle 728	160 ± 8.7
Bottle 871	162 ± 8.6
Bottle 288	167 ± 5.3
Bottle 971	162 ± 4.6
LKSD-3, 290 ± 36 ppb Hg	
Bottle 1202, new	287 ± 3.6
Bottle 627	288 ± 7.1
Bottle 370	303 ± 9.1
Bottle 1106	284 ± 5.2
Bottle 1042	283 ± 2.3
LKSD-4, 190 ± 17 ppb Hg	
Bottle 708, new	182 ± 1.1
Bottle 786	<u>230 ± 5.7</u>
Bottle 674	<u>230 ± 9.8</u>
Bottle 1686	187 ± 2.9

Table 4. Concentrations of Hg in the air in various rooms in the GSC building

Location	Hg in air, ng m ⁻³
Outside air	1.72 ± 0.05
6 th floor labs 612, 618	12.7 ± 0.2
6 th floor lab, 639	6.32 ± 0.18
7 th floor lab, 739	6.95 ± 0.30
The cage	33.2 ± 0.39

both glass and plastic bottles which were disposed of several years ago. Whether the bottles with the greatest deviations were kept closer to the source(s) of contamination is impossible to determine now. A field portable Hg analyser, known as the 'Tekran' Analyser (Model 2537A; Hall and Pelchat, 1999), was taken to the cage and to other locations in the building to measure Hg in the air. Six readings, each of 5-minute integration times, were made in each location throughout the day; results are given in Table 4. Clearly the cage shows signs of contamination in the air, at 33 ng m⁻³, compared to ambient outside air of 1.7 ng m⁻³. Laboratory air is also elevated but not to the same degree. It is highly probable that the air in the cage contained much higher concentrations of Hg prior to the removal of liquid Hg stored there and during storage of these bottles.

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Preservation of control reference materials

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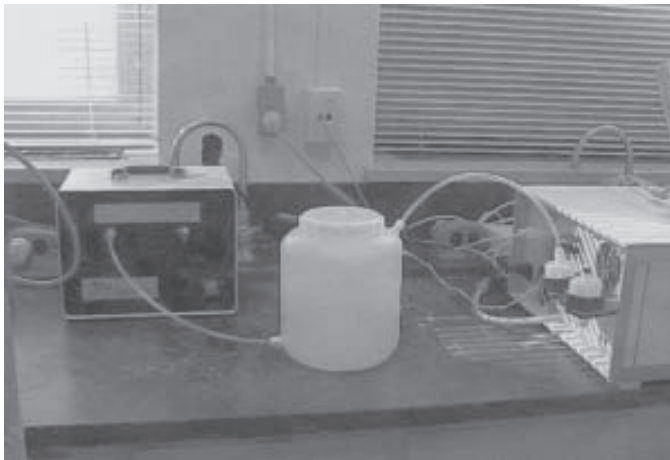


Fig. 1. Experimental set-up to measure Hg vapor transferred through different bottle types located within the 5-l container. Generator of Hg-free air on left, back of Tekran Hg analyser on the right.

Mercury vapor can pass through different kinds of plastics. A separate experiment was carried out to compare the transmission of Hg vapor through 125-ml bottles made of glass, Teflon (FEP), polyethylene terephthalate copolyester (PET), polypropylene (PP), low density polyethylene (LDPE) and high density polyethylene (HDPE). The air in each capped bottle was saturated with Hg vapor and

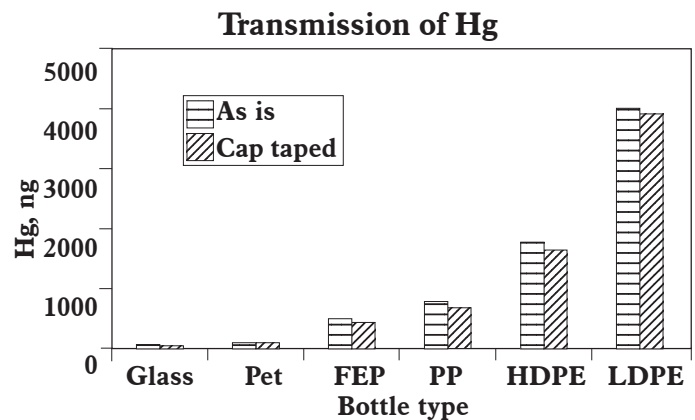


Fig. 2. Mercury transmitted through different bottle materials, caps screwed as usual and taped. Hg values for glass ('as is' and taped) and PET were 39, 16, 44 and 42 ng m⁻³, respectively.

Hg-free air was drawn past each bottle within a larger container and into the Tekran Analyser for measurement (Fig. 1). A minimum of three replicate readings of 5 minutes each was made for each bottle. The experiment was repeated with the bottle caps sealed with black electrical tape. Results are shown in the histogram in Fig. 2. Clearly there is a large range in transmission rates amongst the six materials tested, with that for LDPE being about 100 times higher than that for glass and PET. The order of transmission through the different media is

$$\text{Glass} < \text{PET} < \text{FEP} < \text{PP} < \text{HDPE} < \text{LDPE}$$

Glass was not completely impervious to Hg as its reading (40 ng m⁻³) was about eight times background but 60% of that was transmitted through its black plastic screw cap. The other bottles showed less than 18% difference in response between caps screwed on normally and taped. A glass bottle with a hairline crack was inadvertently used early in the experiment; transmission of Hg through that bottle was off-scale on the Tekran Analyser. Over-tightening the plastic screw caps on glass bottles is easy to do and leads to cracks developing in the caps, again promoting a rapid and high transfer rate of Hg vapor. Some of the variability encountered in Hg results for the different CRM bottles stored in the cage is probably due to differences in the tightness of the plastic screw caps; the type of plastic used in the caps is unknown. Though the main body of the container used for these CRMs is glass, it is thought that the plastic caps are responsible for allowing Hg-contaminated air pass into the samples. In general, The PET bottles are not desirable as they have inferior strength and do not withstand concentrated HNO₃ or heat.

These results indicate that primary international or secondary in-house reference control samples for Hg should be stored in Teflon bottles with Teflon caps to avoid contamination from the atmosphere. They also suggest that CRMs should be kept in cabinets in facilities separate from storage of laboratory instrumentation and equipment such as diffusion pumps! Note that these results and conclusions pertain only to Hg, an unusual element in that it is volatile at room temperature.

This work was funded in part by the Toxic Substances Research Initiative (TSRI) funded by Health Canada.

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TECHNICAL NOTE

The effectiveness of stream-sediment sampling in arid terrains: two contrasting examples from the Arunta Province of central Australia

M.S. Skwarnecki

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Introduction

Base-metal and gold mineralisation are known from the high-grade metamorphic rocks of the central Arunta Province (Warren & Shaw, 1985) and from the greenschist to lower amphibolite facies rocks of the northern Arunta at Jervois (Robertson, 1959; Ypma et al., 1984). These deposits are small and are commonly interpreted to be of metamorphosed volcanogenic origin. In the central Arunta, the mineralisation contains galena, sphalerite, pyrite and chalcopyrite, and typically occurs as lenses and disseminations in cordierite-quartzites, calc-silicate and

'silica-undersaturated' rocks (Warren & Shaw, 1985). The geochemical associations are poorly understood, but include Cu, Pb, Zn, Ag, Au, Cd, Bi and W. No Mn-rich lithologies have been recognised. At Jervois, three types of mineralisation have been recognized, (Ypma et al., 1984), including stratiform chalcopyrite lodes and stratabound argentiferous galena and sphalerite bodies in magnetite-chlorite-garnet rocks and Mn-rich calc-silicate rocks. The geochemical associations include Cu, Pb, Zn, Ag, Mn, W, F, Mo and Bi. Epigenetic gold mineralisation occurs in the central Arunta, near its contact with the Amadeus Basin, in quartz reefs in retrograde shear zones associated with the Devonian/Carboniferous Alice Springs Orogeny (Wygralak & Bajwah, 1998).

A large regional stream-sediment geochemical survey was to be carried out by the Northern Territory Geological Survey (NTGS) to stimulate exploration for base metal deposits in the high-grade metamorphic terranes of the SW Arunta Province. Prior to this, the NTGS contracted CRC LEME to carry out an orientation survey and regolith mapping on local and regional scales (Skwarnecki et al., 2000). The main objectives of the orientation were to:

- (i) determine the elements that best indicate mineralisation;
- (ii) establish the geochemical expressions of the mineralisation, compared to background, in stream sediments;
- (iii) establish best sampling procedures;
- (iv) establish the lengths of geochemical dispersion trails; and
- (v) develop a series of recommendations for the main survey.

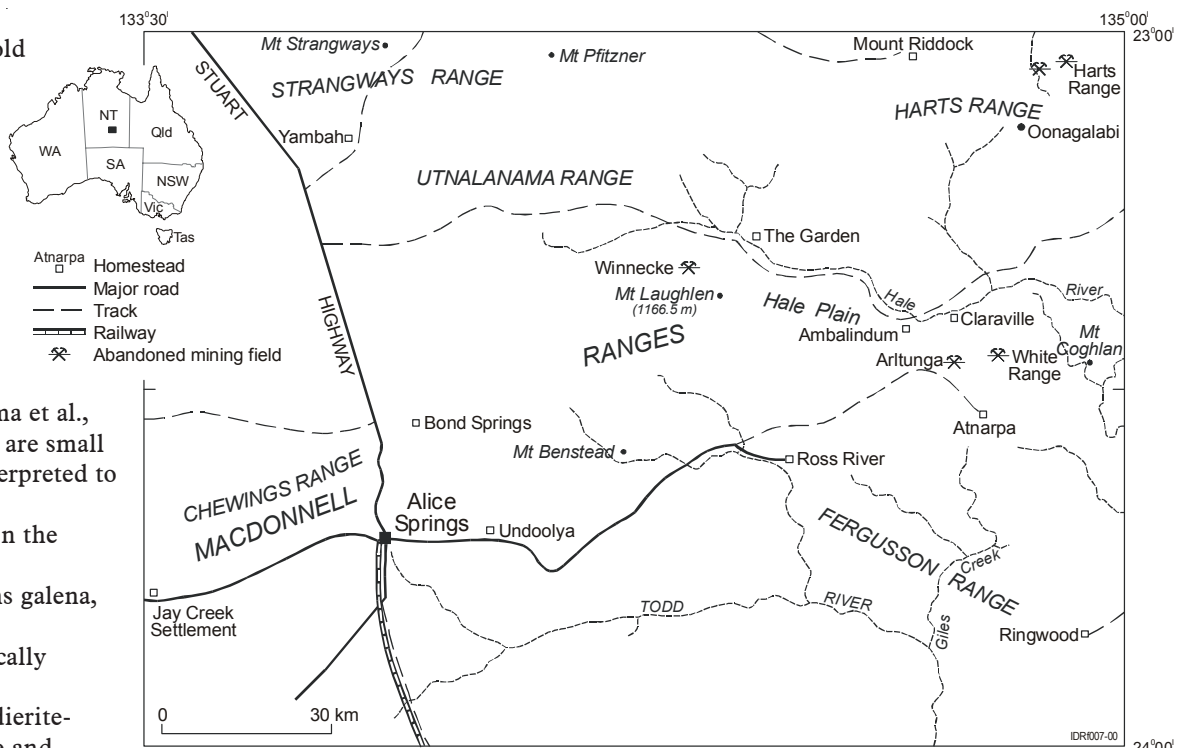


Figure 1. Location of the Winnecke and Oonagalabi areas.

The effectiveness of stream-sediment sampling

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Two sites were chosen in collaboration with the NTGS: the Oonagalabi base-metal prospect and the Winnecke Goldfield. Both areas occur in hilly terrain, with well-developed drainages, and are amenable to stream-sediment sampling. However, contrasting results were obtained, indicating the importance of conducting orientation surveys. The possible reasons for these differences are discussed with reference to the distribution of Cu at Oonagalabi and Au at Winnecke in the bulk <6 mm fractions (although similar results would be obtained from other relevant elements in other size fractions).

Sampling and analysis

Samples were collected in the creeks draining the mineralised areas at Oonagalabi and Winnecke. Only the active channel of the creeks was sampled, and heavy mineral trap sites, erosional gullies and other irregularities in the creeks were avoided. Each sample was collected from 10 cm depth across the full width of the creek, taking care to avoid contamination from the banks or islands of alluvium.

Three size fractions were sieved in the field using plastic and nylon sieves and collected in plastic sample bags: about 1 kg of bulk sample (<6 mm), about 1 kg of the <6>2 mm fraction, and about 2.5-3 kg of <2 mm material. The

<2 mm fraction was further sieved in the laboratory (using plastic/nylon sieves) into the following fractions: 2-0.5 mm, 500-180 mm, 180-75 mm, and <75 mm. The 500-180 mm fraction was not analysed because it was considered to consist largely of aeolian material.

A 100 g aliquot was milled to <75 mm using a low contamination K1045 ring mill (Robertson et al., 1996) with quartz washes between samples. The samples were analysed in random order by ICP-MS by UltraTrace Laboratories (in Perth, Western Australia). Gold was determined on an aqua regia digest, whereas Cu was determined on a mixed acid digest (hydrochloric, nitric and hydrofluoric acids).

Oonagalabi

Geological setting

The Oonagalabi prospect occurs in a sequence of quartzo-feldspathic gneisses, amphibolites and mafic granulites of the Strangways Metamorphic Complex (Warren & Shaw, 1985). The mineralised zone comprises a complexly deformed series of magnesian-amphibole schists, garnet quartzites, forsterite marbles, magnetite-spinel pyroxenite, calc-silicate rocks, and rare pods of scheelite-bearing skarn within quartzo-feldspathic gneisses and amphibolites. The calc-silicate rocks, along the contact between the marble and the magnesian-amphibole schist, are the main host for the mineralisation (Skidmore, 1996). In

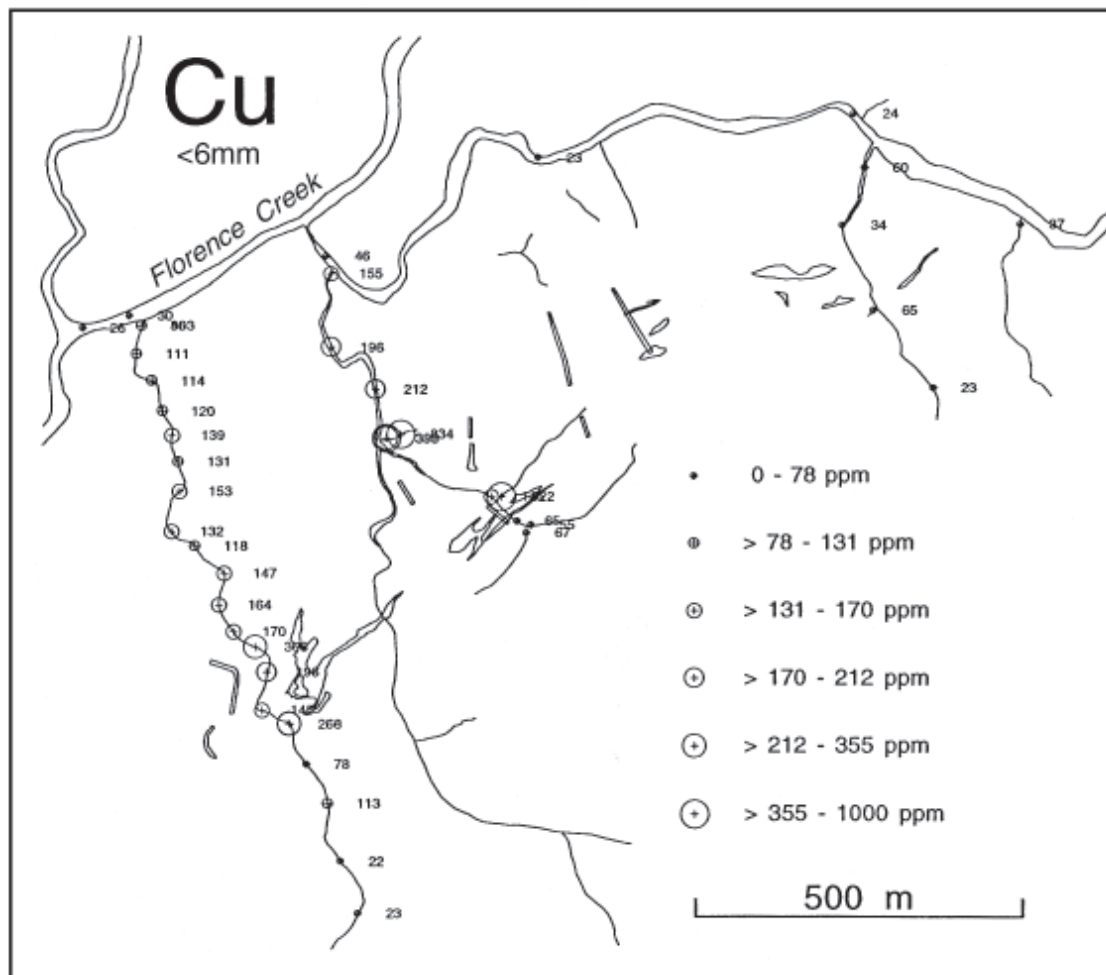


Figure 2. Map of the Oonagalabi orientation survey area showing Cu concentrations in the bulk <6 mm fraction. Outlines of the outcrops of the mineralised calc-silicate units and exploration trenches are also shown.

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outcrop, the most prominent indication of mineralisation is malachite staining, whereas in fresh rock, chalcopyrite, sphalerite and other sulfides occur as patches, disseminations and veinlets mainly within calc-silicate rocks. The deposit is considered to be sub-economic, with probable reserves estimated at 6 Mt of ore at 2% Zn and 0.8% Cu (Silver, 1985). Soil sampling (<200 mesh (<75 mm) fraction) outlined a contiguous zone anomalous in Cu (>250 ppm), Pb (>50 ppm), Zn (>250 ppm) and Ag (>0.1 ppm) over a strike of 1400 m and a width of 320 m (Joyce, 1981). Over outcropping mineralisation, maximum values obtained were 2.09% Cu, 4200 ppm Pb, 5.5% Zn and 11.6 ppm Ag.

Regolith-landform setting

The regolith-landform setting is largely erosional. The topography is hilly. Valley sides are commonly steep and the creeks are deeply incised, particularly in first-, second-, and third-order streams, which drain from north to south. The material in the creeks varies from sand to boulders; outcrops in the creeks are common. Detritus is mainly derived from quartz-feldspar-biotite gneiss and mafic amphibolite and gneiss. Less common is material that is derived from malachite-stained magnesian-amphibole schist, marble,

diopside-bearing lithologies and calc-silicate rocks. Larger creeks (such as Florence Creek) drain to the west and southwest, are relatively broad, locally contain sand and/or gravel bars, and cut into an undulating landscape. Stream sediments within these fourth-order creeks are commonly rich in garnet, derived from the mechanical breakdown of the garnetiferous Irindina Gneiss to the north.

Results

Copper concentrations are similar for each size fraction, with a trend towards greater concentrations in the 6-2 mm and <75mm fractions. Copper clearly defines the location of the mineralised zones and downstream dispersion from them, with concentrations above background (78 ppm; estimated from normal probability plots). Detailed sampling of the western-most creek in relation to the position of the mineralised zone (Figure 2) indicates that Cu concentrations are low upstream, but are uniformly above background downstream for about 700 m to Florence Creek, where Cu is below background.

The Oonagalabi prospect has a distinct Au-Bi-Cd-Cu-Pb-Sn-W-Zn signature in all size fractions of the stream sediments (Skwarnecki et al., 2000). There is no apparent scavenging of these elements by Fe and Mn oxides – the elements have been incorporated into the stream sediments by erosion of the mineralised zones. Any size fraction would detect the mineralised zone and provide downstream

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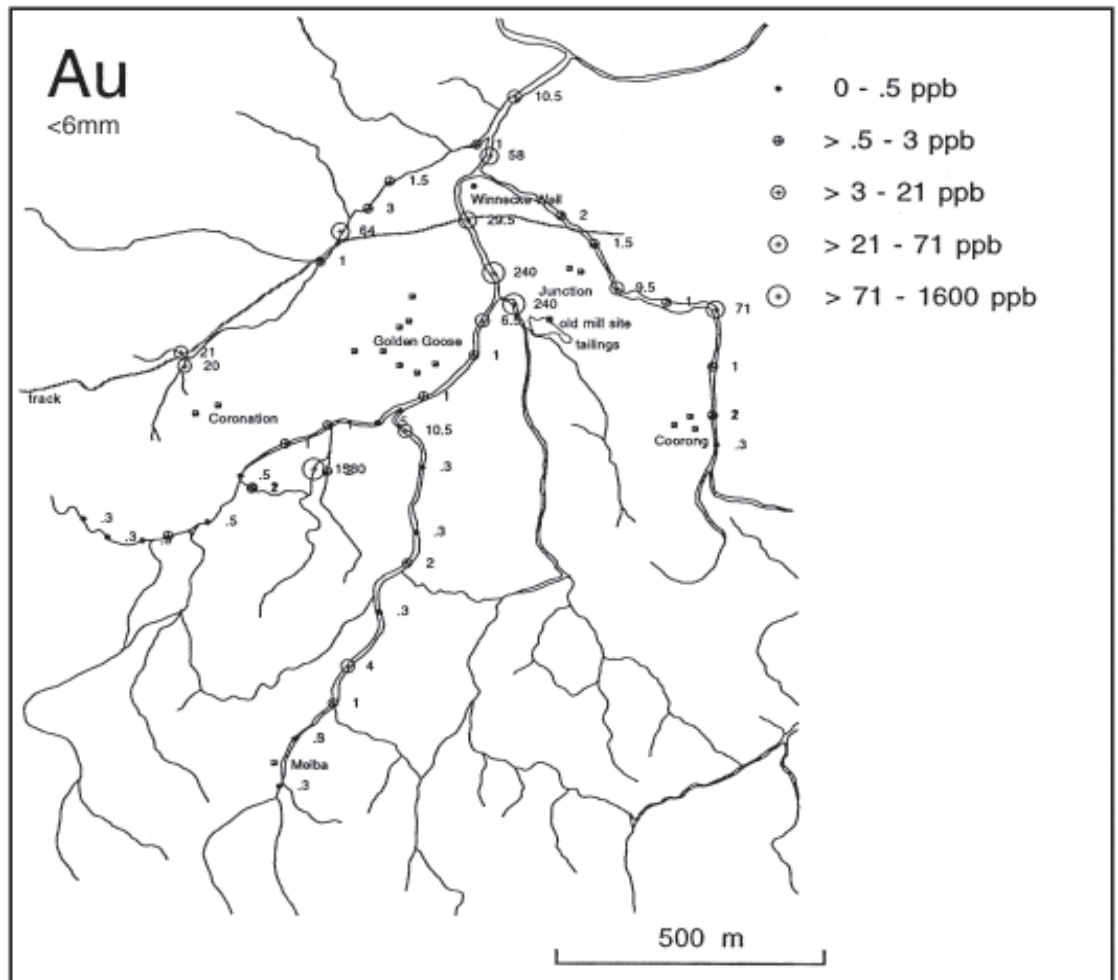


Figure 3. Map of the Winnecke orientation survey showing Au concentrations in the bulk <6 mm fraction.

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dispersion, but the most effective size fractions are 6-2 mm (for all except Au) and <75 mm (for all except Sn and W).

Winnecke

Geological setting

The Winnecke Goldfield straddles the structural contact between the Ankala Block of the Palaeoproterozoic Arunta Province and the basal Neoproterozoic sequence of the Amadeus Basin (Shaw & Langworthy, 1984). The principal lithologies are biotite schists and gneisses, quartzofeldspathic gneisses, amphibolites, calc-silicate rocks and marbles.

The Winnecke Au deposits occur in greenschist retrograde schists, mainly within rocks of the Arunta Province. The schists are related to faulting and thrusting along deformation zones within the Arltunga Nappe Complex during the Devonian/Carboniferous Alice Springs Orogeny (Forman, 1971). The age of the mineralisation is presumed to be 322 Ma (Carboniferous; Stewart, 1971). The main type of mineralisation (Wygralak & Bajwah, 1998) consists of auriferous quartz veins, with native Au concentrated in those portions of the veins that are composed of cellular and limonitic quartz. The total recorded production is about 1500 oz (46.54 kg; including 127 oz (3.95 kg) of alluvial gold). The largest deposit is Golden Goose, where quartz reefs are the dominant mineralisation. The veins form a zone 10-20 m wide that can be traced for 90 m along strike. A soil sampling grid (<80 mesh (<180 mm) fraction) defined Au (>50 ppb) and W (>20 ppm) anomalies (200 by 280 m) over the mineralised zone (James, 1991). In bedrock, some of the higher-grade zones (>1 ppm Au) are anomalous in Cu (up to 490 ppm), Pb (up to 230 ppm), As (up to 135 ppm), W (up to 250 ppm), and Ag (up to 6 ppm; Pigott, 1984, 1985), but there appears to be little regularity in the distributions of these elements.

Regolith-landform setting

The topography of the area is generally hilly, with some alluvial flats in the Golden Goose-Coronation area. To the south, the terrain becomes mountainous towards the contact between rocks of the Arunta Province and the Amadeus Basin. Over the Arunta lithologies, apart from the alluvial flats, the regolith-landform domain is erosional, and the area is covered by residual soils and lag derived from Arunta lithologies and the quartz veins transecting them. Sediment in the creeks varies from sand to gravel and boulders; outcrops locally occur in creek banks. In a few places, cellular quartz or quartz with Fe oxide boxworks, similar to that hosting mineralisation at Golden Goose, is found in the stream sediments. However, the dominant lithologies in almost all first-, second-, third-, or higher order creeks are quartzite and chert derived from the Heavitree Quartzite (the basal unit of the Amadeus Basin) to the south (Mt Laughlen); these have significantly diluted detritus from the Arunta Province rocks. The only exception is the second-order creek draining the old Coronation workings, where the

stream sediments are derived exclusively from local outcrops.

Results

Gold concentrations are generally low (typically <11 ppb), although there are several anomalous values in each fraction and there is a general trend to greater concentrations in the 180-75 mm and <75 mm fractions. In the bulk <6 mm fraction, the most prominent Au anomaly is related to downstream dispersion of tailings from the old mill (Figure 3). Anomalous concentrations are recorded (Figure 3), some of which are proximal to known occurrences of mineralisation, others may be local alluvial concentrations. In the Coronation creek, Au concentrations are generally greater than in other drainages.

There are no consistent stream-sediment Au anomalies, related to the mineralised zones, in those creeks where dilution of local materials by quartz-rich detritus from the Heavitree Quartzite has occurred. Only in the Coronation creek, where there is no quartzite dilution, can the response be confidently attributed to mineralisation. Element concentrations appear to be largely controlled by Fe and Mn oxides and the occurrence of heavy detrital minerals (Skwarnecki et al., 2000). Copper, Ni, Zn, Ba and Pb are associated with Mn oxides, whereas Ce, Pb, Rb, Ti, U, W, Sn, Sr and Zr are associated with Fe oxides and heavy detrital minerals. Gold is the best indicator of mineralisation and the fine fractions (<180 mm) provide the best sampling medium. Only Bi, Sb and W in the fine fractions are likely pathfinders for Winnecke-style Au mineralisation (Skwarnecki et al., 2000).

Discussion

The orientation stream-sediment sampling programme has demonstrated that stream sediments are a valid sampling medium for detecting mineralisation at Oonagalabi. Only first- to third-order drainages should be sampled, whereas sampling of fourth-order (or higher) creeks, such as Florence Creek, should be avoided, since no base-metal anomalies were detected (Figure 2). In contrast, at Winnecke, despite the erosional regime, the geochemical signature of the mineralisation has been diluted severely by quartzite detritus derived from the south; only drainages with locally derived material are likely to provide consistent geochemical responses for Au. The Golden Goose area is topographically in a relatively low area, and local detrital contribution to the creeks is relatively low compared to the higher inputs from mountainous areas to the south. The resistance of the quartzite to weathering and comminution exacerbates the dilution of the local geochemical signature by exotic material. Only the fine fractions (<180 mm) provide an adequate sampling medium (Skwarnecki et al., 2000). Gold is the best indicator of mineralisation; Bi, Sb and W in the fine fractions are likely pathfinders for Winnecke-style Au mineralisation.

The potential problems associated with the distribution, sampling and analysis of Au in stream sediments have been summarised by Nichol et al. (1994). It is possible that processing of larger sample weights or that investigation of

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the heavy mineral fraction may have yielded more consistent results at Winnecke. However, in this case, the principal controlling factor on the distribution of Au in stream sediments appears to be the degree of dilution of detritus derived from the mineralised zones by resistant, exotic quartzite.

This study illustrates the value of conducting meaningful orientation surveys within a geological and regolith-landform framework. For stream-sediment sampling to be effective, it is imperative to sample those creeks that contain detritus derived from local lithologies. Stream-sediment sampling, for example, large third- or fourth order creeks such as Florence Creek at Oonagalabi, is unlikely to yield results relevant to the local geology and mineralisation.

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Acknowledgements

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Geosoft

STUDENT CHAPTER NEWS

New South Wales/Australian Capital Territory Student Chapter of the AEG

A meeting was held at University of Canberra (UC) on 18 December, 2000 to establish a NSW/ACT student chapter of the AEG. Michael Whitbread (UC) has accepted an offer to act as the inaugural president of the chapter. Nominations have also been received from students willing to join the provisional committee, from the Universities of Canberra, Wollongong, New South Wales and New England.

The provisional committee will soon be formalizing their articles of association (including membership rules) and planning activities for 2001. Ken MacQueen and Dave Cohen will be assisting the new chapter as required, under the guidance of Clark Smith and Mark Elliot.



BOOK REVIEW

Wounding the West: Montana, Mining, and the Environment

by David Stiller [University of Nebraska Press, 2000, 212 p., \$25.00]

Some writers have the ability to describe complex subjects in simple phrases that are clear, informative, and enjoyable; David Stiller shows these skills in *Wounding the West*. While taking us on hikes to the Continental Divide and along the Blackfoot River of northwestern Montana, Stiller narrates about early and modern mineral exploration, pragmatic mining methods in the 1940's and 1950's, and a catastrophic tailings failure in 1975 that contaminated 15 miles of prime trout fishery (which was the scene of Maclean's groundbreaking 1963 novella *A River Runs Through it*). Stiller eases us into diverse issues, from the Mining Law of 1872 to mining and milling methods to aquatic habitat and reclamation, with easy phrases that carry substance and compassion. This purportedly non-scientific book can inform AEG members about mining and environmental topics beyond our specialties or provide details about what we think we know.

The title *Wounding the West* put me off (I expected an anti-mining tirade), but I found a balanced and fair account of one hundred years of discovery, mining, neglect, and reclamation. In his chronicle of the Mike Horse mine, Stiller does not mince words: he shows us countless examples of methods that abused the environment while describing the companies and the individuals. But he also is quick to absolve them of blame: there were no rules. Stiller reaches the sad conclusion that no one cared until the 1970's and is concerned that we may not have learned from the Mike Horse example.

A former hydrologist and environmental consultant with more than 30 years experience living in Montana and working on Montana mines, Stiller did not work professionally on the Mike Horse mine. He started with some curiosity, but spent five years assembling the full story of this failure through numerous interviews and stacks of corporate and state records that are referenced in unobtrusive footnotes. Along the guided tours, Stiller describes the history and negative consequences of the U.S. Mining Law of 1872, showing that it is the major culprit. He provides a detailed and dramatic narrative of an extreme storm in 1975 that caused a derelict tailings impoundment to fail while scientists and regulators watched from circling helicopters.

Then he describes the environmental devastation with thorough accounts of biota and water quality from which anyone concerned with environmental science can learn. One also can learn from the prospectors, corporate managers, and Federal land managers that Stiller befriends, criticizes, and praises. Intended to inform the general citizenry, this easy read also can educate professional geochemists and would be good for a university seminar on environmental science.

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FREE SOFTWARE FROM GEOSOFT

Geosoft recently released a free version of its Oasis montaj Core Technology for earth science decision-making. The v5.0 interface is an internet-enabled software application that gives geoscience professionals an easy-to-use technology for verifying data, developing interpretations with team members, and making faster, more effective decisions.

"The free interface provides the earth science industry with its first intelligent software client capable of accessing very large spatial data residing locally on PCs or Internet-based servers, and delivering data directly to the desktop for manipulation and decision-making," said Tim Dobush, CEO. "It also represents a significant break from previous generations of software - enabling professionals to exchange data and results easily via the Internet."

One of the main benefits is that professionals can now work with many different types of data, maps and images using a single interface — eliminating the need to deal with time-consuming data format issues. The software also facilitates greater collaboration through exchange of E-maps — a technology for compressing maps, grids and map data and sending compressed results securely via E-mail. And when hardcopy results are required for interpretation and presentation, the user can prepare reports using images copied from the desktop or simply print results to a variety of output devices.

Available for download at www.geosoft.com, the free Interface represents a special class of software called a "thin client". Thin clients are standalone software environments that can be expanded to "thick clients" via a variety of applications focused to the needs of geologists, geochemists, and geophysicists. Regardless of whether professionals are using the thin or thick client, the objective is to enable more effective communication of results with managers, team members, clients or contractors responsible for earth science quality control, interpretation and decision-making.

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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:

<u>Issue</u>	<u>Publication date</u>	<u>Contributor's Deadline</u>
111	April 2001	February 28, 2001
112	July 2001	May 31, 2001
113	October 2001	August 31, 2001
114	January 2002	November 30, 2001

IN MEMORY

Frank C. Canney, a founding member of the AEG, died October 7, 2000, one day before his 80th birthday, after a brief illness. Frank was one of the early developers of geochemical exploration techniques in the 1950s to 1970s.

Born in Ipswich, Massachusetts, Frank earned a BS in geology at the Massachusetts Institute of Technology (MIT), then served in the U. S. Navy during World War II as a gunnery officer on the aircraft carrier Franklin, where he was one of the crew members who saved the ship after she was kamikazied and nearly sunk by Japanese warplanes. Following the war, Frank returned to MIT, where he earned his PhD degree in geochemistry, specializing in the determination of the alkali metals in pelitic rocks through emission spectrography.

Because of his expertise in emission spectrography, Frank was recruited by the U. S. Geological Survey to work with A. T. Myers and F. N. Ward to develop the first truck-mounted D.C. arc emission spectrographic laboratory for use in geochemical exploration field projects. This instrument was described in *Economic Geology*, v. 52, no. 3, 1957. Sceptics claimed that such a delicate optical instrument could not function properly after having been driven long distances in a truck, sometimes over rough roads; but the original spectrograph outlasted three truck chassis, and always produced accurate precise results, much to the credit of its designers.

With Harold Bloom and John Hansuld, Frank was an organizer of the second International Geochemical Exploration Symposium held in April, 1968 at the Colorado School of Mines, at which initial efforts were made to establish the present Association of Exploration Geochemists. Frank was the chief editor of the proceedings of this geochemical symposium, published as a Quarterly of the Colorado School of Mines in January, 1969.

Employed his entire career by the U. S. Geological Survey, Frank undertook field geochemical projects at the Cobalt District, Idaho; in Maine, where he worked on developing field methods for geochemical exploration in glaciated terrain; and finally in primitive areas being considered for inclusion in the national wilderness system. With D. B. Hawkins, he developed a field analytical method, cold acid-extractable copper using the colorimetric reagent 2,2' biquinoline, and he was one of the early researchers to recognize the scavenging effect of manganese-iron oxide minerals in surficial materials. He trained several exploration geochemists who later established careers in the Geological Survey and the mining industry.

Frank was a member of the American Chemical Society, the Geological Society of America, the Society

Geochemistry: Exploration, Environment, Analysis.

Please support your new Journal.

You all know by now that the Association of Exploration Geochemists embarks early next year into a new and exciting venture. We will start to publish our new journal called "**GEOCHEMISTRY: EXPLORATION, ENVIRONMENT, ANALYSIS**" in conjunction with the Publishing House of the Geological Society of London. The new journal (GEEA for short) will be the prime showcase for our science. Launching a new journal is no small task and enormous effort has already gone into setting it up.

One thing we cannot manage without is **TOP QUALITY SCIENTIFIC PAPERS**. Whilst we already have papers in the pipeline for several issues, **WE NEED LOTS MORE!** This is your journal. You, the members of the Association, are showcasing our science. Let's make this a great new journal by really making the effort to put pen to paper (or fingers to the keyboard) and get some real top-drawer new papers to the Editor. Instructions for authors are to be found on our web site (www.aeg.org).

So come on folks, get cracking, write up that study you did years ago. Someone out there might need to see your data and your conclusions! Especially us people out there in the Exploration Industry! For too long we've been moaning about our industry being in the doldrums, let's get out and show we're scientists, not wimps!!

Put it on paper for GEEA today!

of Economic Geologists, the Association of Exploration Geochemists, the Society of Mining Engineers of AIME and the Denver Region Exploration Geologists Society.

He is survived by his wife, Isabel and a son, Randy, a Denver attorney.

Edwin V. Post
Lakewood, Colorado



CALENDAR OF EVENTS

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

■ February 26-28, 2001, **Society for Mining, Metallurgy, and Exploration (SME) annual meeting**, Denver, Colorado. Contact: SME (sme@smenet.org). SME, Meetings Dept., P.O. Box 277002, Littleton, CO 80127, 800-763-3132. http://www.smenet.org/annual_meeting/2001/index.html

■ March 12-14, 2001, **Northeastern GSA Sectional Meeting**. Chair: Barry Doolan, Burlington, Vermont. Information: Andrea Lini, (802) 656-8136, fax 802-656-0045.

■ March 20-23, 2000, **Minex 2001—International Mining and Exploration Conference**, Perth, Western Australia. INFORMATION: Conference Organizers (minex@debretts.com.au)

■ April 5–6, 2001, **Southeastern GSA Sectional Meeting**. Chair: Edward Stoddard, Raleigh, North Carolina. Information: Edward Stoddard, (919) 515-7939, fax 919-515-7802.

■ April 9–11, 2001, **Cordilleran GSA Sectional Meeting**. Chair: Peter Weigand, Northridge, California. Information: Peter W. Weigand, (818) 677-2564, fax 818-677-2820.

■ April 23–24, 2001, **North-central GSA Sectional Meeting**. Chairs: Robert G. Corbett, Skip Nelson, Bloomington-Normal Illinois. Information: Robert Nelson, (309) 438-7808, fax 309-438-5310.

■ April 24-27, 2001, **II International Congress for Prospectors and Explorationists ProEXPLO 2001**, Lima Marriott Hotel. INFORMATION: Hilda Postigo, Phone (511) 349-4262, extension 309, Fax (511) 349-3721. E-mail: proexplo@iimp.org.pe. www.proexplo.com.

■ April 29–May 2, 2001, **South-central and Rocky Mountain GSA Sectional Meeting**. Chair: Kevin Urbanczyk, Albuquerque, New Mexico. INFORMATION: John Geissman, (505) 277-3433, fax 505-277-8843.

■ May 6-10, 2001, **Geochemistry and exploration in Latin America, Santiago de Chile**. INFORMATION: 20th International Geochemical Exploration Symposium, Santiago, Chili. Phone: 56 2 748 6771. E-mail: proper3@attglobal.net.

■ May 20-24, 2001, **Eleventh Annual V.M. Goldschmidt Conference**, Hot Springs, Virginia, USA. LeBecca Simmons at the Lunar and Planetary Institute in Houston, Texas, USA, via e-mail at simmons@lpi.usra.edu or by fax (fax number 281-486-2125). <http://www.lpi.usra.edu/meetings/gold2001/>.

■ May 28-31, 2001, **6th International Symposium on Mining in the Arctic - Mining and Man**, KATUAQ, Greenland Cultural Centre, Nuuk, Greenland, by the Bureau of Minerals and Petroleum, Government of Greenland, and the International Arctic Mining Advisory Council. (Hans Kristian Olsen, Bureau of Minerals and Petroleum, Government of Greenland, P.O. Box 930, DK-3900 Nuuk, Greenland, Phone: (+299) 34 68 00 EMail: bmp@gh.gl Web: www.bmp.gl)

■ May 25-27, 2001, **Geochemistry of sediments and sedimentary rocks: secular evolutionary considerations mineral-deposit-forming environments**, premeeting MDD-GAC short course, St. Johns, Newfoundland, Canada. INFORMATION: Prof. David Lentz, Dept. of Geology, University of New Brunswick, Box 4400, 2 Bailey Drive, Fredericton, New Brunswick, E3B 5A3 CANADA, Tel: (506) 447-3190. E-mail: dlentz@unb.ca.

■ May 27-30, 2001, **Joint Annual Meeting of Geological Association of Canada - Mineralogical Association of Canada**, St. Johns, Newfoundland, Canada, by the Geological Association of Canada and the Mineralogical Association of Canada. INFORMATION: E-Mail: dgl@zeppo.geosurv.gov.nf.ca Web: www.geosurv.gov.nf.ca

■ June, 2-7 2001, **AMERICAN SOCIETY for SURFACE MINING and RECLAMATION (ASSMR) 18th National Meeting**, Crown Plaza Hotel, Albuquerque, NM. Bruce A. Buchanan, Buchanan Consultants, Ltd, P.O. Box 2549, Farmington, New Mexico 87499. http://www.ca.uky.edu/assmr/Upcoming_Events.htm

■ June 16-20, 2001, **Clay Minerals Society 38th Annual Meeting**, Madison, WI. Contact: Will Bleam (wbleam@facstaff.wisc.edu)

■ June 10-15, 2001 **WRI-10: International Symposium on Water-Rock Interaction, Sardinia, Italy**, by the International Association of Geochemistry and Cosmochemistry. INFORMATION: Rosa Cidu, Department of Science della Terra, via Trentino 51, I-09127 Cagliari, Italy, E-Mail: cidur@unica.it

■ June 24-28, 2001, **Earth systems processes, Edinburgh, Scotland**. GSA-GSL International meeting. INFORMATION: Ian Datzel, Ian@utig.ig.utexas.edu or Ian Fairchild, i.j.fairchild@keele.ac.uk.

■ June 25-July 1, 2001, **Securing the Future: International Conference on Mining and Environment**, Skellefteå, SWEDEN, Contact: Expolaris Kongresscenter, Skellefteå (kongresscenter@skelleftea.se)

■ 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:

Calendar of Events *Continued from Page 13*

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■ 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>

■ Aug 31-Sep 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 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. Ulf Kempe, e-mail: kempe@mineral.tu-freiberg.de

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■ Oct. 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>

■ November 5-8, 2001, **Annual Meeting of the Geological Society of America**, Boston, Massachusetts. INFORMATION: TEL 1-800-472-1988, 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, sasmussen@phelpsdodge.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.

■ 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

■ July 22-27, 2002, **The Earth System and Metallogensis: 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.

■ February 24-26, 2003, **Society for Mining, Metallurgy, and Exploration (SME) annual meeting**, Cincinnati, OH. Contact: Contact: SME (sme@smenet.org). SME, Meetings Dept., P.O. Box 277002, Littleton, CO 80127, 800-763-3132. SME (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.

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

Virginia T. McLemore

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RECENT PAPERS

This list comprises titles that have appeared in major publications since the compilation in **EXPLORE** Number 109. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochimica et Cosmochimica Acta (GCA); the USGS Circular (USGS Cir); and Open File Report (USGS OFR); Geological Survey of Canada Papers (GSC Paper) and Open File Report (GSC OFR); Bulletin of the Canadian Institute of Mining and Metallurgy (CIM Bull.): Transactions of Institute of Mining and Metallurgy, Section B: Applied Earth Sciences (Trans IMM).

Publications less frequently cited are identified in full. Compiled by **L. Graham Closs**, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, CO 80401-1887, email: lcloss@Mines.edu, Chairman AEG Bibliography Committee. Please send new references to Dr. Closs, not to **EXPLORE**.

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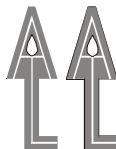
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THE ASSOCIATION OF EXPLORATION GEOCHEMISTS APPLICATION FOR NON-VOTING MEMBERSHIP*

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.

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

_____ as a _____
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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)

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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)

(Printed Name and Title)

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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:

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TEL: (613) 828-0199, FAX: (613) 828-9288, email: aeg@synapse.net**

Recent Papers *continued from Page 20*

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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.

FELLOWS

Kelly, Allan J.

Sr. Exploration Geochemist
 WMC – Leinster Nickel
 Wilson, WA, AUSTRALIA

Wang, Xuegiu

Chief Geochemist
 Inst. Geophysical and Geochemical Exploration
 Langfang, Hebei, CHINA

MEMBER

Dimas, James E.

Engineer/Sales Tech.
 IDEMITSU/Apollo America Corp.
 Rochester Hills, MI, USA



ANNUAL ELECTION RESULTS

The ballots have been counted in the election for AEG Councilors for 2001-2002. The new Councilors are (in alphabetical order): Steve Amor, Mary Doherty, Dave Kelley, Christopher Oates, and Cliff Stanley. Paul Taufen, as AEG's outgoing President, will serve as an *ex officio* member of Council for the next year.

AEG wishes to thank all the candidates who stood for election as well as the outgoing Council members. Your dedication will keep AEG strong.



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Mary E. Doherty
Dave Kelley
Christopher Oates
Cliff Stanley

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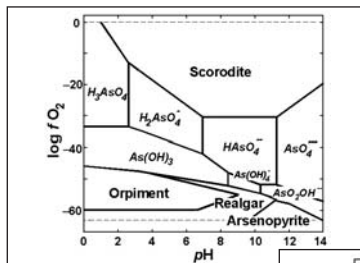
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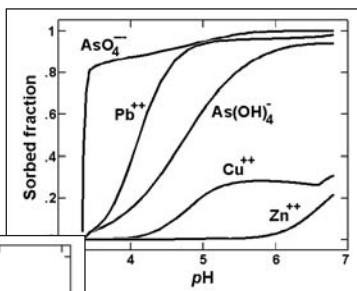
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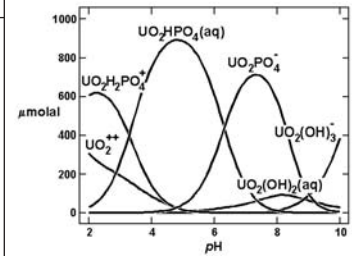


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