

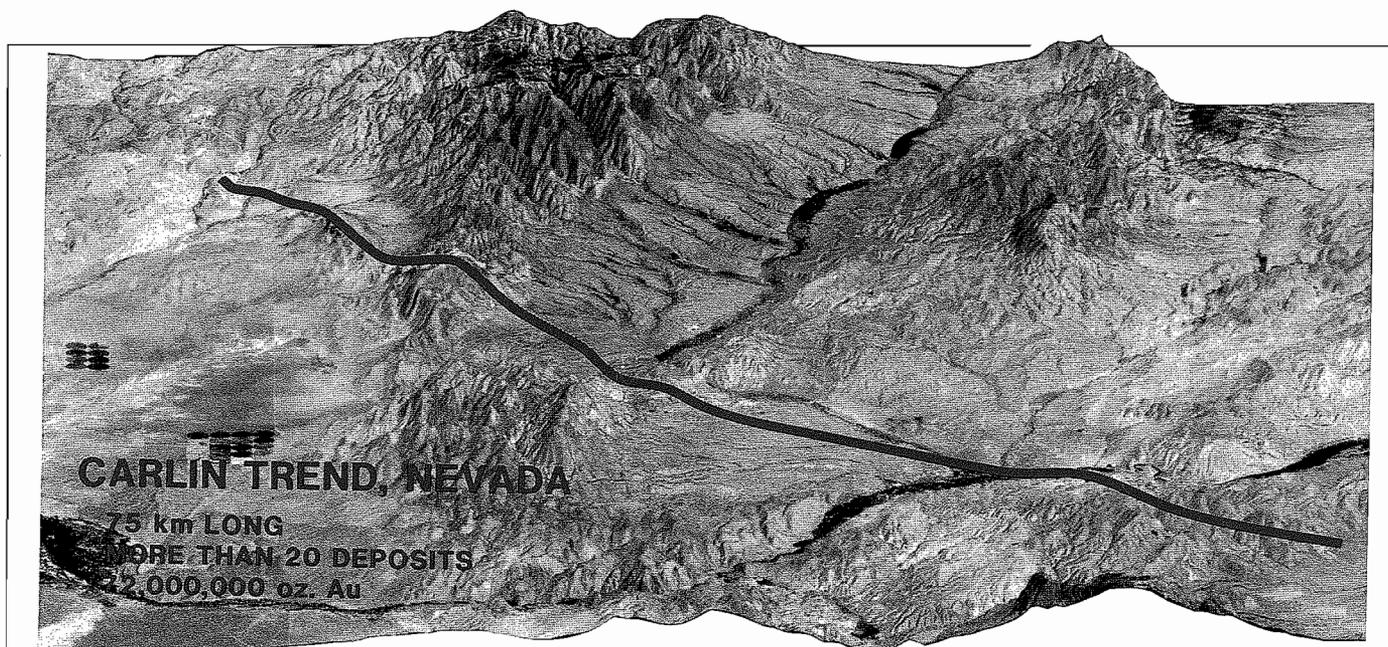
EXPLORE

The Association of Exploration Geochemists Newsletter

NUMBER 71

APRIL 1991

15th International Geochemical Exploration Symposium Reno, Nevada, USA • April 28 to May 1, 1991



LANDSAT imagery draped over digital topography. The view is looking north with the Rain deposit at the southeast end of the Carlin Trend (lower right) and the Dee deposit at the northwest end (upper left). Photo prepared by Newmont Geophysics Department.

The 15th IGES of the Association of Exploration Geochemists will open with a hosted ice-breaker reception on Sunday April 28 at 5:00 pm at Bally's Casino-Resort Hotel in Reno, Nevada. An exciting array of technical sessions will be presented, including geochemistry of gold and platinum deposits, integrated geophysical and geochemical exploration methods, and new analytical techniques.

A total of 65 talks and 65 posters have been accepted for the Symposium. The talks will be given during three days of plenary sessions, from Monday, April 29 through Wednesday, May 1, 1991, with concurrent poster sessions. There will also be 10 field trips, four short courses, and one workshop, split between pre- and post-meeting times. One hundred and fifty industry vendors, consultants, and professional organizations will be present. All Symposium activities, technical sessions, poster sessions, trade exhibits, will be held at the Bally's Casino-Resort Hotel. The preliminary schedule of events for the technical sessions, poster sessions, short courses, and workshop are:

Continued on Page 2

CONTENTS

15th International Geochemical Exploration Symposium	1	Creek - Black Lake Area, Southeastern Alaska	14
Notes from the Editor	2	INAA Applications to Geochemistry	17
Past President's Message	3	Special Notes	
President's Message	3	International Geochemical Mapping Project	18
Forthcoming JGE Contents	4	Meeting Reports	
Business Manager's Report	5	SME Geochemistry Session	20
AEG Council Minutes	5	Pearl Harbor File	21
Letters	6	Recent Papers	23
Committee Reports	8	Journal of Geochemical Exploration	25
AEG Identity	10	New Members	25
Voting Membership	11	Calendar of Events	26
Technical Notes		List of Advertisers	28
Moss-Mat Stream Sediment Sampling in the Threemile			

Information for Contributors to EXPLORE

Scope This Newsletter endeavors to become a forum for recent advances in exploration geochemistry and a key informational source. In addition to contributions on exploration geochemistry, we encourage material on multidisciplinary applications, environmental geochemistry, and analytical technology. Of particular interest are extended abstracts on new concepts for guides to ore, model improvements, exploration tools, unconventional case histories, and descriptions of recently discovered or developed deposits.

Format Manuscripts should be double-spaced and include camera-ready illustrations where possible. Meeting reports may have photographs, for example. Text is preferred on paper and 5¼- or 3½-inch IBM-compatible computer diskettes with ASCII (DOS) format that can go directly to typesetting. Please use the metric system in technical material.

Length Extended abstracts may be up to approximately 1000 words or two newsletter pages including figures and tables.

Quality Submittals are copy-edited as necessary without re-examination by authors, who are asked to assure smooth writing style and accuracy of statement by thorough peer review. Contributions may be edited for clarity or space.

EXPLORE

Newsletter No. 71

APRIL 1991

Editor: Owen P. Lavin (303) 837-5820

Associate Editors: Sherman P. Marsh (303) 236-5521

J. Stevens Zuker (303) 694-4936

Business Manager: S. Clark Smith (702) 849-2235

Assistant Editors: Stephen B. Castor (702) 784-6691

L. Graham Closs (303) 273-3856

Gwendy E. M. Hall (613) 995-4521

Lloyd D. James (303) 741-5199

Paul J. Lechler (702) 784-6691

Richard Meeuwig (702) 784-6691

Frederick P. Schwarz (702) 826-3000

Frederic R. Siegel (202) 994-6194

Pearl Harbor File: Stanley J. Hoffman (604) 684-0069

FAX 303-236-3200, ATTN: Sherman Marsh, USGS

Advertising Rates

Advertising rates are on a per-issue basis.

Frequency discounts and rates for color separations are available.

Only camera-ready copy is accepted. Please direct advertising inquiries to P.O. Box 9777, University Station, Reno, Nevada 89507-9777.

Full Page	254h x 178w mm (10h x 7w in)	U.S.\$800
Half Page	124h x 178w mm (4 7/8h x 7w in)	U.S.\$440
	254h x 86w mm (10h x 3 3/8w in)	U.S.\$440
Quarter Page	124h x 86 w mm (4 7/8h x 3 3/8w in)	U.S.\$240
	254h x 40w mm (10h x 1 9/16w in)	U.S.\$240
Eighth Page	60h x 86w mm (2 3/8h x 3 3/8w in)	U.S.\$150
	124h x 40w mm (4 7/8h x 1 9/16w in)	U.S.\$150
Business Cards*	50h x 86w mm (2h x 3 3/8w in)	U.S.\$ 60

*Business card advertising is restricted to individuals providing consulting or similar services.

The Editor reserves the right to insert the word "Advertisement" on all ads. Advertising submitted as a technical contribution is eligible for the following discounted schedule:

Full Page	U.S.\$560
Half Page	U.S.\$330
Quarter Page	U.S.\$200

EXPLORE is a trademark of the Association of Exploration Geochemists. EXPLORE is typeset by Network Graphics, Inc., Denver, CO (303) 433-1616.

NOTES FROM THE EDITOR

This volume of EXPLORE is scheduled to be published just before the 15th IGES in Reno so it contains some items pertinent to the meeting. Interim reports from two important AEG committees are included as is a summary of the International Geochemical Mapping project. On the technical side, many readers will be interested in articles on moss mat sampling and neutron activation analysis.

The EXPLORE editorial staff was particularly pleased to receive no fewer than three letters from readers commenting on previous articles and we are happy to be able to publish them all in this issue. EXPLORE provides an excellent venue for timely and lively debate on issues that would never be printed in reviewed journals. We invite reader comments and hope to see more in the future.

The **Analysts Couch** column has been deferred this issue so that a longer-than-normal column can be included in the next issue (Number 72, July 91). Look forward to an informative article on analytical quality control by Russ Calow.

I hope to see as many of you as possible in Reno.

Owen P. Lavin
Editor, EXPLORE

IGES

Continued from Page 1

Saturday, April 27

- Biogeochemistry and Geomicrobiology in Mineral Exploration (Short Course, day 1)

Sunday, April 28

- Biogeochemistry and Geomicrobiology in Mineral Exploration (Short Course, day 2)
- The Use of Soil Gases in Geochemical Exploration (AEG Workshop)
- Registration and Reception
- Trade Exhibition

Monday, April 29

- New Analytical Techniques and Improved Methodologies
- The Triassic-Jurassic Magmatic Arc Mineral Systems, Western Nevada and Eastern California and Their Exploration
- 15th IGES Poster Session

Tuesday, April 30

- Concealed Deposits, Case Histories
- Concealed Deposits, Exploration Methods
- Regional Mapping, Geochemical and Geophysical

Wednesday, May 1

- Remote Sensing and Biogeochemistry in Exploration
- Gold Transport and Deposition, Primary Element Dispersion
- General Technical Session

Thursday, May 2

- Statistical Treatment of Exploration and Drill Assay Data (Short Course)
- Geophysical Data Interpretation for the Mineral Exploration Geologist (Short Course, day 1)

Friday, May 3

- A Case Study and Comparison of Varying Ore Estimation Techniques (Short Course)
- Geophysical Data Interpretation for the Mineral Exploration Geologist (Short Course, day 2)

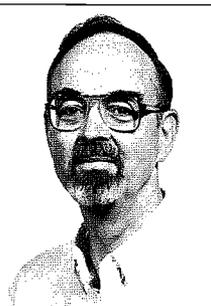
The registration fee is US \$200 for AEG members and US \$250 for non-members. For more information regarding: Technical sessions, short courses, workshops, field trips, registration, exhibits, accommodations, and social programs, please contact Mario Desilets at (702) 784-6691, or Erik Rorem at (702) 359-9330, or write to: 15th International Geochemical Exploration Symposium, PO Box 9126, Reno, NV 89507, USA.

PAST-PRESIDENT'S MESSAGE

I find it hard to believe, but I have now been a member of the AEG for 21 years, since its formation in 1970. During that time I have met and worked with some of the finest people imaginable. People in the AEG comprise a professional family of which we can all be proud. Without exception, I have found the members of the Association to be helpful, reliable, and honest. Different points of view certainly exist within the Council and among the Executive, and such differences are sometimes stated very enthusiastically, but there is never any doubt in my mind about the motives or the sincerity of the individuals involved; however, I now wish to tell you that we very much want and need new people to become involved in the governance of the Association. We need new people who are willing to serve on committees, on the Council, and in the Executive. Our Association includes about 1200 members, but probably less than 100 have ever really been active in the governance of the Association. This represents a terrible waste of the pool of talent that exists among the membership.

Therefore, let me urge each of you to do two things for yourself, for your Association, and for your profession. First, move out of the category of Affiliate Member and become a full-fledged Voting Member (more on that in a moment). Second, contact someone on Council or in the Executive and tell him or her that you are willing to become active in the affairs of the Association. I promise that we won't descend on you like hungry wolves, but you will be invited to participate in activities that are of particular interest to you. Most of the activities of the Association require just a small amount of time, no more than a couple of hours per month, and all jobs are entirely voluntary. I absolutely guarantee that the satisfaction which you will derive from working with other members in guiding the AEG will be much greater than the time you invest.

Now, with regard to the matter of changing from Affiliate Member to Voting Member. The procedure is very simple because Section 2.06 of the Association By-law permits the election of new Voting Members from eligible candidates. In Section 2.06 "eligible candidate" is defined by the following: (1) you have a degree in pure or applied science, (2) you have six years of experience in pure or applied science, with at least two years in exploration geochemistry, and (3) you are presently active in the profession. The only other requirement is that you satisfy Council that you are a fit and proper person to become a Voting Member. Therefore, if you already meet the educational and work requirements in items (1), (2), and (3) above, please write directly to me (see the address on the back cover



Continued on Page 4

PRESIDENT'S MESSAGE

I am writing this message in early March in anticipation of the forthcoming 15th International Geochemical Exploration Symposium, (IGES) in Reno Nevada and of my taking over the Presidency of your Association. This is a good time to raise some of the concerns and topics that I hope we will have the opportunity to discuss — in person at the 15th IGES and later in the pages of future issues of **EXPLORE**.

This issue of **EXPLORE** carries a summary by Alan Coope, Chairman of the *Ad Hoc* Committee on the Identity of the AEG, of the responses his committee has received. As might be expected, there are a wide range of viewpoints on the extent to which the AEG should be involved in a broader range of geochemical activities. I look forward to receiving the deliberations and wise council of Alan's committee.

Perhaps, however, we should also ask ourselves another question "What is an exploration geochemist?" You may have noticed on p. 17 of the last issue of **EXPLORE** (January 1991, Number 70) a notice for Professional Registration of Geoscientists in British Columbia. Without going into "legalese", the Engineer's and Geoscientist's Act of British Columbia "requires the professional application of the principles of geology, geophysics or geochemistry."

Continued on Page 4



If you need to automate
your assay or commercial
mineral laboratory consider...

LabScape™

a full functioning LIMS that
is designed for high volume geochemical
laboratories. LabScape will operate
under almost any O/S and can be customized
to meet your needs.

For more information contact:
The Conifer Group
11560 Penney Road
Conifer, Colorado 80433

(303) 838-9752

Shea Clark Smith

MEG

**MINERALS EXPLORATION &
ENVIRONMENTAL GEOCHEMISTRY**

BIOGEOCHEMISTRY • VAPOR GEOCHEMISTRY

P.O. Box 18325, Reno, Nevada 89511 (702) 849-2235

President's Message

Continued from Page 3

Geoscientists in British Columbia are therefore being forced to address exactly this question: "what is an exploration geochemist and who should practise exploration geochemistry?"

This may all seem very parochial for these pages — except that: (i) the requirement for professional registration is spreading, and (ii) it raises in my mind the issue of "The Education of the Exploration Geochemist." Can we better identify the educational needs of the exploration geochemist — how do they differ to those of the (exploration) geologist? How do we tap the talents of the young geoscientist and involve them in mineral exploration and exploration geochemistry? What curricula advice can we give future geoscientists interested in applying the principles of geochemistry to mineral exploration? Most universities do not have specific programs or even courses in exploration geochemistry — but can we suggest some basic requirements to build on? Might these also meet the requirements for environmental geochemistry?

I will come back to these topics in my future messages. In the meantime I would like to hear your views on "What is an exploration geochemist?" and how should we encourage young geoscientists to learn more about exploration geochemistry. In the meantime I hope to see all of you at the 15th IGES.

W.K. Fletcher

Incoming President, Association of Exploration Geochemists
Department of Geological Sciences
University of British Columbia
Vancouver, BC V6T 2B4
CANADA

Past-President's Message

Continued from Page 3

of this issue of EXPLORE) and indicate your desire to become a Voting Member. In your letter to me please include a summary of your educational background and work experience to show that you satisfy the first three requirements above, and list the names of at least two other professionals who can comment on your professional activities and integrity; importantly, those people do not (repeat, do not) have to be members of the AEG. From that point on, we will let our Membership Committee handle it. Nothing could be simpler. Of course, there is no additional financial cost involved in upgrading your membership. I look forward with pleasure to receiving letters from many of you, as the first step in having your status upgraded from Affiliate to full Voting Member. I also look forward to learning that some of you are willing to become involved in the governance of your Association.

See you in Reno in April!

D. D. Runnells

Outgoing President, Association of Exploration Geochemists
Department of Geological Sciences
University of Colorado at Boulder
Campus Box 250
Boulder, CO 80309-0250
USA
TEL: (303) 492-8323

FORTHCOMING JGE CONTENTS

VOLUME 39, NO. 3

SPECIAL ISSUE

GOLD GEOCHEMISTRY IN FINLAND

edited by

ALF J. BJÖRKLUND

Geological Survey of Finland, Espoo, Finland

CONTENTS

Gold deposits of Finland <i>K. Puustinen (Espoo, Finland)</i>	255
Geological setting, history of discovery and exploration economics of Precambrian gold occurrences in Finland <i>P.A. Nurmi (Espoo, Finland)</i>	273
Gold contamination of the fine fraction of till during sampling and sample preparation <i>E. Kontas (Rovaniemi, Finland)</i>	289
Size, form and composition of gold grains in glacial drift in Ilomantsi, eastern Finland <i>M. Nikkarinen (Kuopio, Finland)</i>	295
Gold in bedrock and glacial deposits in the Ivalojoiki area, Finnish Lapland <i>M. Saarnisto (Espoo, Finland), E. Tamminen (Rovaniemi, Finland) and M. Vaasjoki (Espoo, Finland)</i>	303
Application of till geochemistry to gold exploration, Ilomantsi, Finland <i>A. Hartikainen and M. Damsten (Kuopio, Finland)</i>	323
Till geochemistry of gold, arsenic and antimony in the Seinäjoiki district, Western Finland <i>P. Lestinen (Kuopio, Finland), E. Kontas, H. Niskavaara and J. Virtasalo (Rovaniemi, Finland)</i>	343
Geochemistry of till and humus in the Kotkajärvi Cu-Co-Au prospect, Kalvola, southern Finland <i>V. Peuraniemi (Oulu, Finland)</i>	363
Geochemical gold prospecting at Vinsanmaa, northern Finland <i>M. Ayräs (Rovaniemi, Finland)</i>	379

Gold & Precious Metal Exploration

ACME offers two analytical packages
for gold and precious metal exploration.

Package 1 - US \$8.25*	Wet geochemical gold & 30 element ICP analysis Detection limit: Au 1 ppb
-------------------------------	--

Package 2 - US \$11.30*	Fire Geochemical Gold, Platinum, Palladium & 30 element ICP analysis Detection limits: Au 1 ppb; Pt, Pd 3 ppb.
--------------------------------	--

Pricing Policy: Sample preparation is an extra cost; minimum 10 samples per shipment or add \$5.00 per shipment.

Note: Acme has serviced the mining and exploration industries for 20 years. During that time, the company has served its many clients in a professional fashion, offering high quality analysis at low cost with rapid turnaround of results. For example, during peak periods, over 2 tons of sample material arrives daily, and results are typically returned within 5 days. Please ask for our complete price brochure.

Shipping Address:

By Greyhound Bus

ACME Labs.
c/o Greyhound Bus Depot
Blaine, WA 98230

By UPS

ACME Labs.
250 H Street
Blaine, WA 98230



Acme Analytical Laboratories, Ltd.
852 E. Hastings St.
Vancouver, B.C. V6A 1R6
(604) 253-3158
FAX 604-253-1716

*Prices subject to change without notice.

BUSINESS MANAGER'S REPORT

The position of acting business manager of the AEG was created in late 1990 and I was assigned this duty. As such, it became my responsibility to keep costs of membership low and encourage new membership. Membership, at U.S. \$50 per year (or \$42.50 per year if the current and following year are paid at one time) makes the AEG one of the best opportunities for non-profit organization membership. Our publications and symposia attest to the quality of the science and the organization. Our operating costs per member can be maintained at a low level if we can increase our numbers, with a target of 2200 or greater being optimum. Our current 1200 membership size doubtlessly will be greatly augmented by the decision of the Reno-91 organizing committee to include an option to have the 1991 membership year included with non-member registration; however, our best source of membership comes from readers of **EXPLORE** who know of individuals or corporations who would benefit from being part of the organization. In order to further this, please send a photocopy of business cards of prospective individuals to my attention so that promotional information and **EXPLORE** can be sent to them.

Shortly, the AEG will begin internal discussions regarding the renewal of our contract with Elsevier for the Journal of Geochemical Exploration. Prior to commencing negotiations, it would be useful if members with opinions would advise me of any viewpoints, ideas or additional benefits they feel we should seek. These will be passed along to the Elsevier contract committee when it is constituted.

Lastly, I believe the AEG should be encouraging the publication of manuals or texts of interest to our membership and offer those already in print at special member prices. If you are an author, have your publisher contact me to determine if the AEG can participate in enhancing your book sales. If you are planning a text, again contact me to see if the AEG can be of assistance. Publication sales represent a significant source of AEG income at present, subsidizing membership rates. New volumes are needed to benefit the AEG, its membership and the science.

Stan Hoffman

*Business Manager, Association of Exploration Geochemists
Prime Geochemical Methods Ltd.*

630 - 1199 West Pender St.

Vancouver, BC V6E 2R1

CANADA

TEL: (604) 684-0069

FAX: (604) 682-7354

CONE 
GEOCHEMICAL INC.

**ACCURACY
RESPONSIBILITY INTEGRITY**

810 Quail St., Suite 1 • Lakewood, CO 80215 • Phone (303) 232-8371
4788 Longley Lane • Reno, NV 89502 • Phone (702) 827-3600

AEG COUNCIL MINUTES

Actions of August 30, 1990

1. Council approved applications of 5 Voting, 42 Affiliate, and 8 Student Members.
2. A proposal for offering a reduced rate membership in the AEG without the Journal of Geochemical Exploration was discussed and a motion was passed to have the Voting Membership vote on this issue.
3. A change in the membership application system to make it easier to become a Voting Member was discussed.
4. Council approved a motion to have the AEG co-sponsor a meeting with the Geological Association of Canada in Wolfville, Nova Scotia in May, 1992.
5. Spain, Australia, and Denver, Colorado were suggested as sites for future International Geochemical Exploration Symposia.
6. The Australian Regional Councillor (G. Taylor) announced that they had raised enough funds to sponsor K. Fletcher's Distinguished Lecture Series in Australia, starting October 10, 1990.
7. D. Runnells reported that the first draft of the revised By-laws was completed and sent to By-laws committee for comment.
8. S.C. Smith agreed to remain the Business Manager of **EXPLORE**.
9. S. Hoffman reported that the AEG Directory had been published and mailed to all members of the AEG.

Continued on Page 6

Multi-element Analysis for Routine Exploration Programs

30 Element ICP (Aqua Regia Digestion)

Element	Detection
AG	0.1 ppm
Cd, Co, Cr, Cu, Mo, Mn, Ni, Sr, Zn	1 ppm
As, Au, B, Ba, Bi, La, Pb, Sb, Th, V, W	2 ppm
U	5 ppm
Al, Ca, Fe, K, Mg, Na, Ti	0.01 %
P	0.001 %

Price: US \$3.90 all 30 elements

32 Element ICP

All of the above 30 elements plus TL & Hg US \$4.35
Detection limits: TL 5 ppm; Hg 2 ppm

Digestion Procedure: 0.5 gm sample is digested with 3 mls 3-1-2 HCL-HNO₃-H₂O at 95 degrees for one hour and diluted to 10 mls with water. This leach is near total for base metals, partial for rock forming elements and very slight for refractory elements. Solubility limits Ag, Pb, Sb, Bi, W dissolution for high grade samples.

Pricing Policy: Sample preparation is an extra cost; minimum 10 samples per shipment or add \$5.00 per shipment.

Note: ACME has serviced the mining and exploration industries for 21 years. During that time, the company has served its many clients in a professional fashion, offering high quality analysis at low cost with rapid turnaround of results. For example, during peak periods, over 2 tons of sample material arrives daily, and results are typically returned within 5 days. Please ask for our complete price brochure.

U.S. Shipping Address

By Greyhound Bus
ACME Labs
c/o Greyhound Bus Depot
Blaine, WA 98230

By UPS
ACME Labs
250 H Street
Blaine, WA 98230



Acme Analytical Laboratories, Ltd.
852 E. Hastings Street
Vancouver, B.C.
Canada V6A 1R6
(604) 253-3158
FAX: (604) 253-1716

AEG Council Minutes

Continued from Page 5

Actions of November 14, 1990

1. Council approved applications of 37 Affiliate and 4 Student Members.
2. K. Fletcher completed a successful Distinguished Lecture series to Australia.
3. C. Dunn agreed to organize a Short Course on Biogeochemistry, to be ready for presentation in 1992.
4. Council approved the institution of two medals; one restricted to members of the AEG to recognize outstanding service to the Association, and a second open to any scientist in the field of exploration geochemistry, to recognize outstanding achievement in the science or application of exploration geochemistry.
5. Council approved a motion to move the office and database functions of the AEG to Vancouver, BC, Canada and to retain a part-time office manager to perform the Association business during normal business hours.

Actions of January 17, 1991

1. Council approved applications of 5 Voting, 10 Affiliate, and 4 Student Members.
2. Council approved a column by E. Cameron concerning the status of the *Journal of Geochemical Exploration* to be added to each issue of **EXPLORE** (see this issue).
3. The Treasurer reported that the AEG was in good financial health with assets of \$249,016.

CAMBRIA DATA SERVICES LTD.

MULTI-ELEMENT GEOCHEMISTRY

Data Processing - Map Plotting

In conjunction with **Prime Geochemical Methods Ltd.**, we offer services for the processing of your multi-element data. Our in-house computer systems are optimized for the rapid turnaround of large volumes of data. Enhanced data presentation allows all analytical results to be viewed in map form, ensuring a cost-effective and confident interpretation.

- Forward your sample location map upon completion of the sampling program. Your basemaps are ready for immediate plotting upon completion of the analysis.
- Interpretation and geochemical consulting are available from Dr. Stan Hoffman.
- If your processing requirements are large, talk to us about computer software sales and training.

Cambria Data Services Ltd. also markets and supports software for database, computer-aided map drafting and diamond drill logging applications.

Contact:

Paul J. McGuigan, *Consulting Geologist*
Michael Pond, *Geologist-Programmer*
Bob Sandu, *Programmer*

Cambria Data Services Ltd.
 630 - 1199 West Pender St.
 Vancouver, B.C., Canada V6E 2R1
 Telephone (604) 682-5313
 FAX (604) 682-7354

4. Arrangements were made for the Distinguished Lecturer (K. Fletcher) to give lectures at selected universities in Germany.
5. D. Runnells reported that the 3rd draft of the By-law revisions was being prepared and would be sent to Council for comment.
6. Owen Lavin was approved by Council as the Editor of **EXPLORE**.

Sherman P. Marsh

Secretary, Association of Exploration Geochemists
 U.S. Geological Survey
 MS 973, Denver Federal Center
 Denver, Colorado 80225
 USA

LETTERS

To the Editor:

From the standpoint of an isotope geochemist and ecologist, I am disturbed by the article, "Wilderness in America: should there be limits?" (**EXPLORE**, Number 68, p 21). First and foremost, the article contains numerous—rather blatant—scientific inaccuracies. An article of this caliber does not belong in a newsletter which prides itself as a "key informational source" for the dissemination of scientific facts (**EXPLORE**, Number 68, p. 2).

By far the most pervasively obtrusive theme pertains to legal wording in the wilderness legislation (Public Law 88-577). The article states that the Wilderness ACT represents "a denial of access," that "disease, pests, and fire cannot be controlled" and that "exploration of energy resources and strategic minerals is forbidden." The Wilderness ACT, however, clearly states the following: "that nothing in this ACT shall be deemed to be an interference with the purpose for which National Forests [were] established as set forth in the ACT of June 4, 1897 (30 Stat. 11), and the MULTIPLE USE Sustained ACT of June 12, 1960 (74 Stat. 215)" (Section 4,a,1). The ACT goes on to state, "nothing in this ACT shall prevent...any activity, including prospecting, for the purpose of gathering information about mineral or other sources" (Sec. 4,d,2). Regarding the statement on fire and insects, Section 4,d(1) states, "measures may be taken as may be necessary in the control of fire, insects, and diseases."

Regarding "denial of access," Section 4(b) plainly indicates that, "wilderness areas shall be devoted to PUBLIC purposes of recreational, scenic, scientific, educational, conservation and historical use." The statements made by the author are thusly misleading and in direct opposition to the actual Wilderness ACT language. Finally, prior to wilderness designation, a detailed and professional study of the mineral potential and existing uses (including grazing, logging, etc.) must be completed.

Another disconcerting aspect of the article is that the author passes judgment on wilderness areas by using a series of arguments which are completely, ecologically unsound. To suggest that, "little is known about...ecological impacts" of land "withdrawals" and that "wildlife may suffer the most under wilderness management" indicates ecological illiteracy. A natural assemblage of species coexisting within a natural area is functionally balanced without human intervention or "management". Even in the most basic terms, energy flow, nutrient cycling, population growth, and dynamic ecological structure has been maintained — in one form or another — for millions of years prior to the presence of humans. Homeostasis does not have "game management" as a prerequisite (Kormandy, 1894). It should also be noted that natural fires are an important ecological

Continued on Page 7

Letters

Continued from Page 6

tool. The Lodgepole Pine (*Pinus contorta*) for example, bears serotinous cones which require temperatures in excess of 45° C in order to open and thereby permit germination (Vankat, 1979).

The author further suggests that "profitable cattle ranching is impossible" in and near wilderness areas. A note of clarification appears to be in order here. The simple facts are that the public lands of the West produce only 2% of the U.S. beef supply (S. Johnson, Christian Science Monitor). Because over 98% of all U.S. beef production occurs on private land — primarily on Midwestern feedlots — current wilderness regulations are not inducing unfair economic stresses on U.S. cattle producers. In fact, Western ranchers only pay a fifth of market value for the forage consumed by their sheep and cattle.

The 1988 Public Land Statistics (BLM) lists the total area of the 50 states as 2.3 billion acres. The proposed increase of wilderness lands from 90 million acres to a maximum of 240 million acres represents only about 10% of the total land acreage in the U.S. The author describes the proposed increase of 150 million acres as an example of "exponential growth." Exponentiation is a mathematical expression whereby a given quantity is raised to a power whose number incrementally increases toward infinity; a growth function is usually plotted with respect to time. To imply that a 6% increase in wilderness acreage over a 26 year period (1964-1990) is an example of "exponential growth" is simply incorrect.

The author suggests that economic studies pertaining to wilderness designation did not exist prior to the Wilderness Impact Research Foundation (WIRF) studies. It should be pointed out that numerous legitimate, independent and non-biased research groups at several major universities have been working on this very same issue for a good number of years. Regarding "economic impact" from wilderness areas, Power (1988) and Watt (1986) have demonstrated that a transition away from "one-time use of non-renewable resources" is economically more stable. This type of economic base — as opposed to a "boom and bust" economy — is called "equilibrium economic theory" and is an economic base utilizing a higher proportion of education, research, culture, communication, entertainment, recreation and leisure, health services, medical research, and other social services.

Finally, with regards to "studying wilderness from the human perspective" the author should be reminded that the environment serves not only humankind but other species as well and that natural and human ecosystems are, in reality, one and the same.

In closing, I am truly surprised and distressed that an article which is so sadly misleading and seriously flawed was included in

EXPLORE. I would appreciate it therefore, if you would rectify this problem by publishing this more scientifically accurate account in an upcoming issue of EXPLORE.

Ray Kenny

Dept. of Geology
Stable Isotope Lab
Arizona State University
Tempe, AZ, 85287-1404
USA

Editor's Note: Although the writer references other articles in his letter, no list of references was supplied.

To the Editor:

I recently received a complimentary copy of your association's newsletter, EXPLORE, Number 68. After paging through it I've surmised your emphasis is on mining. This is a subject I know little about, having only limited exposure to the industry. But I did notice one article on an issue I do know something about: "Wilderness in America: Should there be limits?" by Wilderness Impact Research Foundation (WIRF).

I was highly disappointed by the article; not because of its views, but because of its quality. Many of WIRF's assertions are blatantly wrong or grossly over-exaggerated. For example, WIRF states: "Idaho will lose \$730 million annually, Greenlee County, AZ \$19.3 million a year, and Elko County, NV over \$50 million a year..." due to wilderness designation. Where is the documentation? What are

Continued on Page 8

PRIME GEOCHEMICAL METHODS LTD.

Dramatic changes in the methodology of exploration geochemistry have occurred in recent years. A strong competitive advantage is available to those exploration and mine development companies which make a strategic investment in geochemical expertise. Advantages to your program include:

- reduced overall costs.
- enhanced data presentation and interpretation.
- higher confidence in exploration target selection.
- effective "audits" of your sampling and analytical methods.
- efficient follow-up recommendations.

To maximize returns on your investment in geochemical surveys (or on chemical analysis), funds must be well spent. This does not just happen! **Prime Geochemical Methods Ltd.** is in business to service your needs in an efficient and cost-effective manner. For your multi-element plotting requirements contact **Cambria Data Services Ltd.** (see the accompanying advertisement).

Stan Hoffman, Ph.D.
Consulting Geochemist

Prime Geochemical Methods Ltd.
630 - 1199 West Pender St.
Vancouver, B.C., Canada V6E 2R1
Telephone (604) 684-0069
Message (604) 731-8892
FAX (604) 682-7354



SKYLINE LABS, INC.

ASSAYING AND GEOCHEMICAL ANALYSIS FOR GOLD AND ASSOCIATED ELEMENTS

RARE EARTH ELEMENTS BY ICP

EXTRACTIVE METALLURGICAL TESTING

Denver	Reno	Tucson
(303) 424-7718	(702) 355-8826	(602) 622-4836
TLX (ITT) 499-0224		TLX (ITT) 499-0880

Letters

Continued from Page 7

WIRF's references? Similar claims were made by the Western Association of Land Users (WALU) about counties in Southern Utah citing studies by Dr. George Leaming. After prolonged resistance, WALU finally released Leaming's study for analysis by economists at Brigham Young University and the University of Nevada, Reno. They recognized Dr. Leaming's study to be based on invalid assumptions, unsubstantiated resource potentials, and inflated benefit claims. In general it wasn't good science.

Until WIRF provides hard data, their economic analysis has to be questioned. WIRF also claims 240 million acres have been proposed for wilderness designation. This number is high because it is based on proposals by groups such as Earth First, rather than more legitimate proposals from the Sierra Club or Wilderness Society. Current existing wilderness in the Continental U.S. is only 1.5% of the land area. More than this, over 2% is currently covered with concrete and pavement. Even using WIRF's inflated 240 million acres figure; existing and proposed wilderness amounts to only 10.6% of the whole U.S., including Alaska. WIRF is using scare tactics.

I also question their diagram. Why is Alaska smaller than Texas? If they are trying to accurately portray how much land might end up as wilderness, shouldn't the whole diagram be to scale? What would a map with only 1.5% of the land area colored in look like? WIRF further asserts that wilderness is detrimental to wildlife, precludes profitable cattle ranching, drastically reduces the tax base of rural communities, and denies access for recreational uses. What are the facts and figures behind these claims? Somehow I doubt wilderness designation is overly hard on wildlife, cattle ranchers, rural tax coffers, or recreationists. Are there valid studies which

show it is? The one attempt in the article to document its claims appears in the third paragraph when a previous issue of EXPLORE is referenced (Number 61, p. 12). I searched out that reference and with little surprise found it has nothing to do with WIRF's arguments.

Balance and reasonable designation of wilderness areas in our public lands is an issue which needs to be addressed, but not with unsubstantiated claims and sensationalism. As a scientist, I expect sound factual information in any professional journal. As editor you should be embarrassed for printing this article. As an outsider looking in I can only ask: Are your technical notes as much of a joke as the only part of your journal I knew enough about to evaluate was?

Robert Tubbs Jr.
ARCO Oil & Gas Company
PO Box 1610
Midland, TX 79702
USA

Note from the Editor: Readers are reminded that EXPLORE is not a peer-reviewed journal, such as the Journal of Geochemical Exploration. The philosophy of EXPLORE is to place minimal restrictions on contributing authors and leave all liability with those authors. In this way: 1) information can be published extremely quickly, 2) unconventional ideas and opinions, which might not otherwise be published, can be expressed and 3) lively debate, such as that above, is encouraged. Other opinions are always welcome.

COMMITTEE REPORTS

The Association of Exploration Geochemists maintains a number of committees whose mandate is to examine or monitor specific aspects of Association business or interest. A list of the current committees is provided below.

Committee	Chairman
Admissions	L. D. James
Bibliography	L. G. Closs
By-laws	D. D. Runnells
Identity of the AEG	J. A. Coope
Short Course	W. K. Fletcher
Symposium	C. E. Dunn
Voting Membership	J. A. Jaacks

Timely reports from the **Identity of the AEG** and the **Voting Membership** committees follow.

Continued on Page 10

ACTLABS

ARE YOU EXPLORING USING THE FOLLOWING SAMPLE MEDIA?

VEGETATION • HUMUS • SOIL • ROCK
HEAVY MINERAL CONCENTRATES
STREAM SEDIMENTS • LAKE BOTTOM SEDIMENTS

FOR THE MOST COST EFFECTIVE AND ACCURATE ANALYSES, WITH RAPID TURNAROUND TIME, USE OUR INAA "AU + 34" PACKAGES

For further information:

ACTIVATION LABORATORIES, LTD.

1336 Sandhill Dr. • Ancaster, Ontario, Canada L9G 4V5

Phone: 416-648-9611 FAX: 416-648-9613
Contact: Dr. Eric Hoffman

— SAMPLE PREPARATION FACILITIES —

CANADA
Deer Lake, Newfoundland
Rouyn-Noranda, Quebec
Timmins, Ontario
Mississauga, Ontario
Thunderbay, Ontario
Saskatoon, Saskatchewan
Richmond, British Columbia
North Vancouver, British Columbia
Smithers, British Columbia
Galore Creek, British Columbia

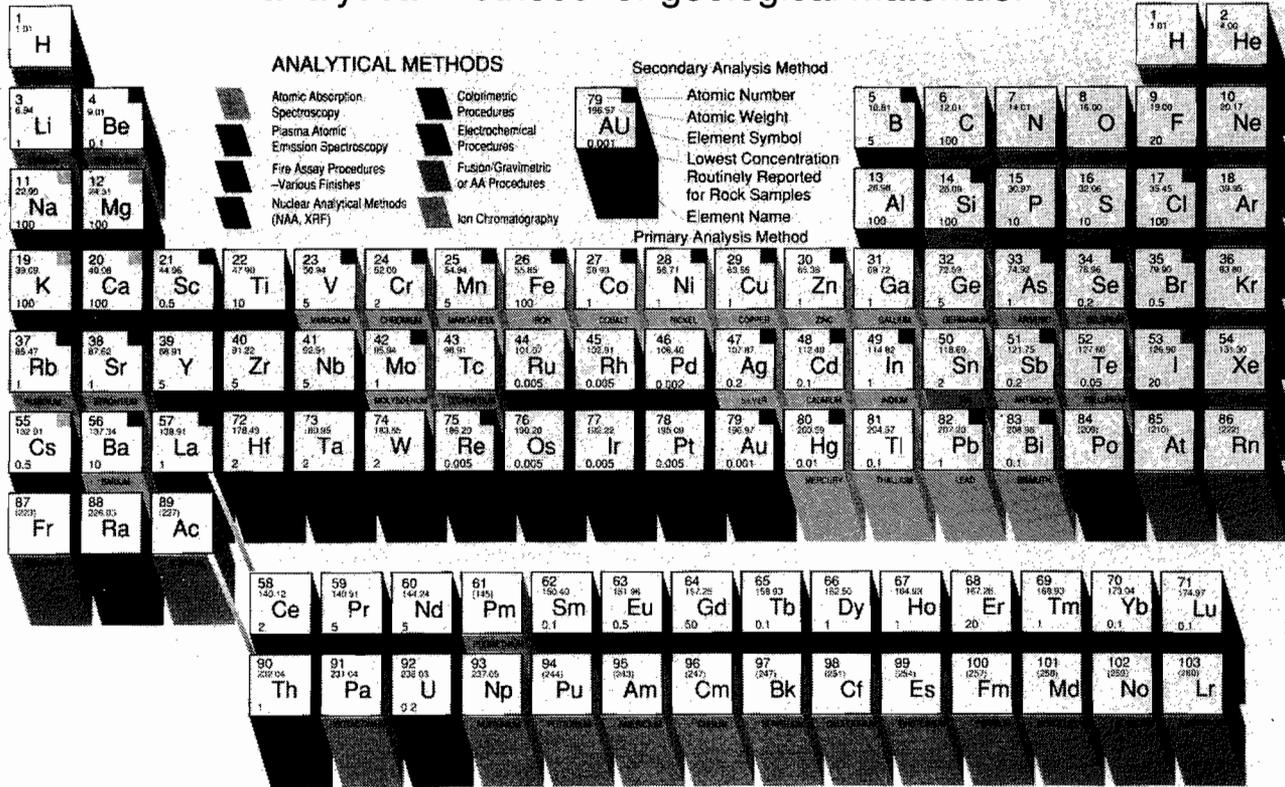
U.S.A.
Rocklin, California
Sparks, Nevada
Carson City, Nevada
Elko, Nevada
Wheat Ridge, Colorado
Tucson, Arizona

NORTHEAST GEOCHEMICAL AND ASSAY CO. 198 Main Street, Yarmouth, Maine 04096

Fire Assay (207) 846-4673
Geochemistry (207) 846-6569

EXPLORE THE ELEMENTS

with this free periodic table color coded to Chemex analytical methods for geological materials.



Your field notebook sized copy of the chart with useful conversion factors is available from any of our ten operating locations.

994 Glendale Avenue, Unit 7
Sparks, Nevada 89431
 Phone 702-356-5395
 Fax 702-355-0179

651 River Street
Elko, Nevada 89801
 Phone 702-738-2054
 Fax 702-738-1728

2723 South Cole Road
Boise, Idaho 83709
 Phone 208-362-3435
 Fax 208-362-3358

5640 B Street
Anchorage, Alaska 99518
 Phone 907-562-5601
 Fax 907-562-6502

103 North Parkmont Industrial Park
Butte, Montana 59701
 Phone 406-494-3633
 Fax 406-494-3721

212 Brooksbank Avenue
North Vancouver
British Columbia V7J 2C1
 Phone 604-984-0221
 Fax 604-984-0218

920 Commerce Street, Unit 5
Thunder Bay, Ontario
P7E 6E9
 Phone 807-475-3329
 Fax 807-475-9196

5175 Timberlea Blvd.
Mississauga, Ontario
L4W 2S3
 Phone 416-624-2806
 Fax 416-624-6163

Westend Industrial Park
Pasadena, Newfoundland
A0L 1K0
 Phone 709-686-2084
 Fax 709-686-2774

175 Industriel, CP 284
Rouyn, Quebec
J9X 5C3
 Phone 819-797-1922
 Fax 819-797-0106

NOW IN TUCSON: 2015 North Forbes Blvd., Suite 101
 Tucson, AZ 85745 Phone 602-798-3818

 **Chemex Labs Ltd.**

- Analytical Chemists
- Registered Assayers
- Geochemists

Committee Reports

Continued from Page 8

AD HOC COMMITTEE ON THE IDENTITY OF THE ASSOCIATION OF EXPLORATION GEOCHEMISTS

The *Association of Exploration Geochemists* was launched at the 3rd International Geochemical Exploration Symposium in Toronto in April, 1970. The objects and purposes of the Association were set out as follows:

1. To form a united and representative group of persons specializing in the field of exploration geochemistry.
2. To advance the science of geochemistry, especially as it relates to exploration and associated research.
3. To foster the common scientific interests of exploration geochemists and to facilitate the acquirement of professional knowledge and information relevant to the science of exploration geochemistry and to promote the interchange thereof among its members.
4. To encourage the research and development of geochemical exploration methods in universities.
5. To advance the status of the profession of exploration geochemistry and to promote and maintain high standards of training and ethics among its members.

The first *Journal of Geochemical Exploration* was published in October, 1972. The scope of the Journal was summarized on the inside cover of this important issue as follows:

The *Journal of Geochemical Exploration* aims to cover all aspects of the application of geochemistry to the search for mineral deposits including petroleum. The topics covered will comprise mathematical

methods of data interpretation, sampling and analytical techniques, and the design of field instrumentation, in addition to papers on exploration methods and the basic geochemical bearing on these methods. By means of this journal, the Association of Exploration Geochemists intends to provide an international medium for the publication of original studies and comprehensive reviews in the field of geochemical exploration and by doing so contribute to the sound development of this branch of science.

The *ad hoc* Committee on the Identity of the AEG (10 Voting Members plus the Chairman) was formed in July 1990, to address the central question whether the Association should continue to focus its energies on its defined objectives and aggressively promote the broader aspects of exploration geochemistry or expand its horizons to include additional geochemical disciplines while attempting to maintain some central focus on exploration geochemistry.

Opinions were solicited from a cross-section of the AEG membership during the summer of 1990 and by November some 28 responses from members employed in different estates and located in different parts of the world had been received. The Committee is currently reviewing these responses together with letters (3) forwarded to President Don Runnells in response to his Presidential Messages in recent issues of **EXPLORE**.

The 28 responses contained a broad spectrum of opinion and much useful comment. They have been classified relative to the following positions:

- (a) Those who feel that the AEG should focus strongly on exploration geochemistry.
- (b) Those who feel the AEG should maintain its central focus on exploration geochemistry, but should expand its traditional horizons to cover those aspects of other geochemical disciplines that are relevant to mineral exploration.
- (c) Those who feel that the AEG is too exploration oriented and should expand into other applied geochemical fields and assume an even broader mandate.

Of the 28, it was noted that *company employees* (4) tended to favour a position to closer to (A) than (B); *government employees* (7) and those from *academia* (8) tended to group much closer to (B) than (A) and the more extreme opinions of some *consultants* (9) tended towards a position between (B) and (C). The consensus of opinion is close to (B). No significant correlation was noted between (A), (B) and (C) and geographic location among the 28 respondees, but letters indicate a stronger focus on the environmental aspects of applied geochemistry in Europe, and the entry of several consultants into the environmental field.

In evaluating these opinions and their own points of view, the Committee is addressing a variety of other questions such as the extent to which the AEG (i) should embrace environmental geochemistry, and (ii) should form closer links with scientists in hydrology, biology, pedology, limnology, physical geography, economic geology, epidemiology etc. Consideration is being given to the suggestion that the Association should initiate another journal

Continued on Page 11



We're a natural resource you can't afford to overlook.

We're Geotemps, and we're an indispensable resource when it comes to providing reliable, qualified, temporary help for all phases of the mining industry. We know the business, and we know our people. We eliminate the hassle and expense of unemployment problems, holiday and vacation obligations and worker's compensation. We're confidential, professional and always able to supply the right person for the right job. Think of us as the natural resource that can help you out in a pinch. Geotemps.



335 West 1st Street • Reno, Nevada 89503
(702) 323-7773 • FAX (702) 322-1228

THEODORE P. PASTER, PH.D.
Consulting Petrographer



- Thin and Polished Thin Sections
- Over 25 Years Experience
- Brochure Upon Request

11425 East Cimarron Drive
Englewood, Colorado 80111
Day or Night: (303) 771-8219

Committee Reports

Continued from Page 10

devoted to environmental geochemistry and the Committee has been asked to evaluate one voting member's suggestion that exploration geochemistry is a sunset science.

At this relatively early stage, it would be premature to predict the Committee's findings on these and several other important issues although the responses to the suggestions that exploration geochemistry is a sunset science and that the AEG initiate another journal are almost unanimously negative.

A summary report on the Committee's further deliberations will be prepared for the Reno symposium and all conclusions and recommendations will be summarized and presented to the membership in upcoming issues of **EXPLORE**.

J. Alan Coope

Chairman, Identity of the AEG Committee
Newmont Exploration Ltd.
1700 Lincoln St
Denver, CO 80203
USA

VOTING MEMBERSHIP COMMITTEE

The Voting Membership Committee was formed during the February, 1990, AEG Council meeting to investigate voting membership trends, determine the probable causes of those trends, and propose possible solutions to counter the apparent loss of Voting Members from the Association. The information for this analysis was provided from the AEG membership data base and is presented in Figures 1 and 2.

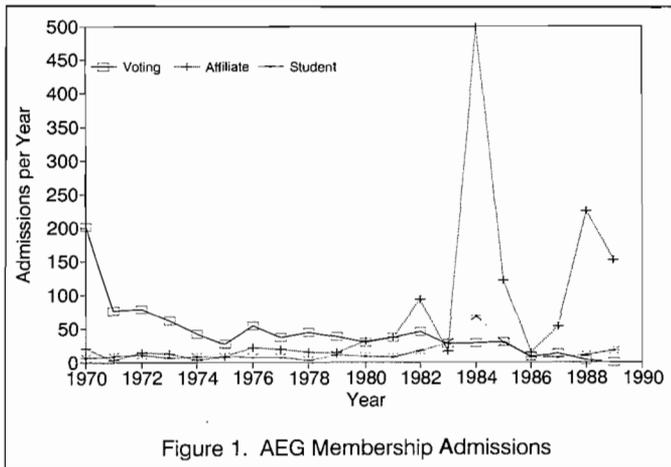


Figure 1. AEG Membership Admissions

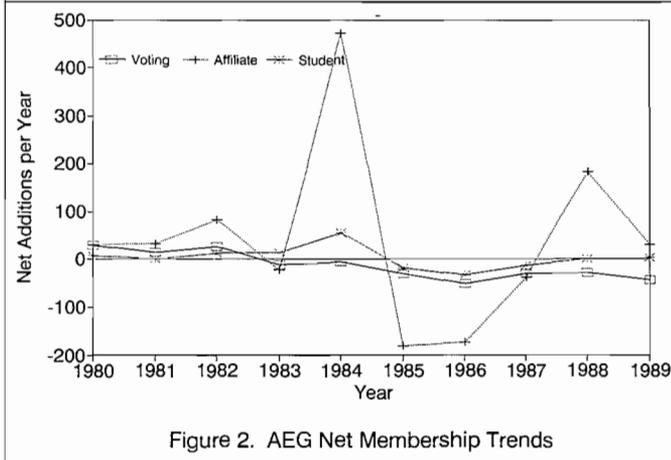
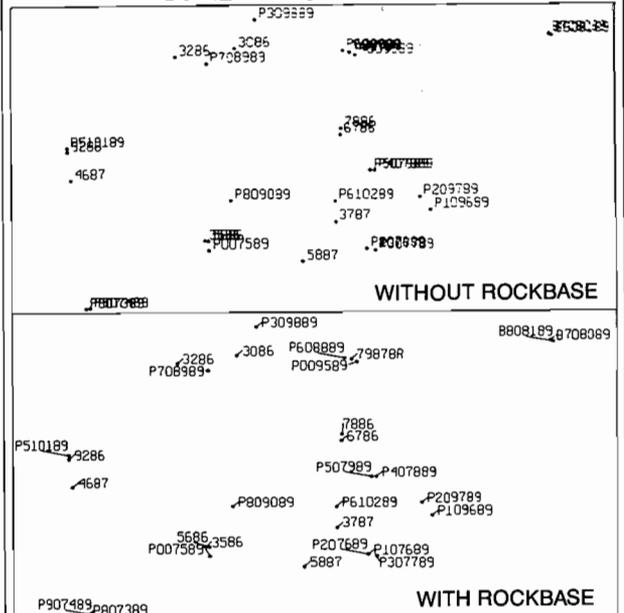


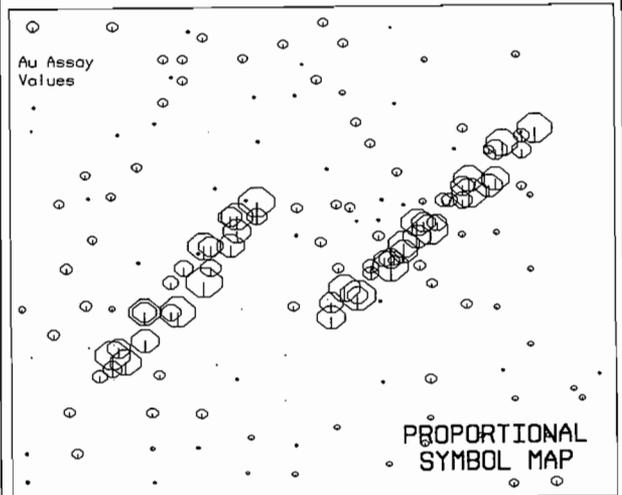
Figure 2. AEG Net Membership Trends

Continued on Page 12

AUTOMATICALLY PLOT SAMPLE LOCATION MAPS WITHOUT OVERPLOTTING ADJACENT SYMBOLS OR LABELS.



The RockBase program costs \$250. It is used to plot maps depicting geochemical samples and borehole locations. RockBase also includes linear and non-linearly scaled proportional symbol maps, survey conversions (traverse-to-xyz), global reference maps (coastlines, islands, rivers, lakes, countries, states, and cities), and image-based data retrieval.



RockWare offers a wide variety of affordable software for the earth sciences. Call or write for a free 120 page catalog of PC and Macintosh programs including mapping, digitizing, log-plotting, terrain analysis, statistics, fracture analysis, etc.

RockWare Incorporated
4251 Kipling Street, Suite 595, Wheat Ridge, CO 80033
PH (303) 423-5645 FAX (303) 423-6171

Committee Reports

Continued from Page 11

Affiliate Member Admissions fluctuate dramatically, particularly after 1980, when symposia held in North America attracted professionals who applied for membership as part of the registration process. A dramatic increase in Affiliate Member category occurred after the Saskatoon (1982), Reno (1984), Toronto (1985), and Spokane (1988) symposia (Figure 1). As illustrated in Figure 2, the spectacular gain in Affiliate Membership was followed in the subsequent years by a dramatic loss in Affiliate Membership (1983, 1985, 1986, 1989).

Since 1970, the Association has had a declining rate of Voting Member admissions (Figure 1). After 1981, this amounts to less than 20 Voting Members being admitted into the AEG in any given year. Correspondingly, the AEG has been losing an average of 38 Voting Members every year (Figure 2) since 1980. This represents a net loss of Voting Membership in the Association.

There are several factors which contribute to the net loss of voting membership from the AEG: health of the mining industry in North America (where a majority of the Voting Members reside), members leaving the industry or retiring, lack of students entering exploration geochemistry programs, frustration with the delivery of *The Journal of Geochemical Exploration*, long turn-around time for membership applications, and lack of benefits in belonging to our society other than professional commitment.

At present, planning, commitments, and expenditures are made based upon the total number of members within the AEG, but the information presented above indicates that total membership numbers are erratic due to fluctuations in Affiliate Membership. The

Voting Membership needs to be increased to ensure the health of the Association through the turn of the century. The following recommendations to increase Voting Membership are made for the membership's consideration:

1. **Change the Membership Application Form and mail the Applications under a separate cover.** The current application form could be changed to include an outline of membership benefits, summaries of Association Activities, (e.g. Regional and International Meetings, Technical Seminars, Publications, Awards), Qualifications for Membership Categories, Association By-laws, and the Membership Application. At the moment, the AEG sends out application forms with the application printed on one side and a List of Publications, Dues Notice, and Miscellaneous Items for Sale on the other side. The dues notices and publication advertising should be printed on separate materials and mailed under separate cover to the membership.
2. **Solicit Affiliate Members to become Voting Members.** This method has been tried in the past without a great deal of success. The only difference between Voting and Affiliate membership is the right to vote in Association business. The Association needs to offer sufficient additional benefits to Voting members to induce the Affiliate Members to become Voting Members. In other societies (SME, AGU), the additional benefits include significantly lower meeting costs, discounts to society publications, insurance coverage, and exchange of benefits with other societies of similar interests. In addition, the AEG should attempt to target the Affiliate Membership annually with an invitation to become a Voting Member with a separate mailing.
3. **Solicit New Voting Members from regions where the mining industry is undergoing growth.** This would entail an active membership drive to enlist qualified professionals to join the society in Australia, Europe, Africa, Asia, and South America where the mining industry is in a growth phase. Attempts to achieve this require that the AEG establish and maintain a consistent and reliable points of contact with Council and the Executive Committee, most likely under the auspices of a business manager, and delegate more authority to Regional Councilers in Association matters.
4. **Solicit members from Professional Societies with similar interests.** This would involve communication with executive personnel to establish an exchange of benefits, and obtain membership information (e.g. mailing lists). This endeavor would include, for example, the Society of Economic Geologists, American Geophysical Union, Geological Society of America, Geological Association of Canada, Canadian Institute of Mining and Metallurgy, the Geochemical Society, and the Society of Mining, Metallurgy, and Exploration.
5. **Open the Association to include other Professionals in related fields.** The AEG could open the membership to geotechnical professionals practicing within the environmental industry, which is undergoing rapid growth.
6. **The Association should develop a long-term plan for growth.**

Continued on Page 14

EXPLORE!



OUR NEW
T-SHIRT
OFFER:



Sizes: SML, MED, LGE, XL

Colors: White on Royal Blue
 Dk. Blue on White
 Lt. Green on Gray

Cost: AEG Members \$10
 Non-Members \$12

Send Check or Money Order to:

EXPLORE
c/o Clark Smith
P.O. Box 18325
Reno, NV 89511

Order Your
T-Shirt Today!

"WHEN WORDS
ARE NOT ENOUGH!"

Graphic Harmony

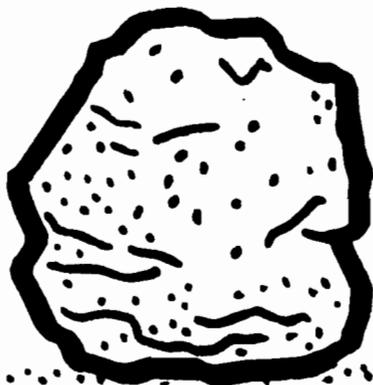
COMPUTER GENERATED
35mm PRESENTATION SLIDES
& OVERHEAD TRANSPARENCIES

702-322-5434
2590 E. 2nd ST. RENO, NEVADA 89502

DRAFTING AND BLUEPRINTING SERVICES ALSO AVAILABLE

We make rocks tell the truth.

Cu 3.46%; Zn 1.14%; Au 0.016 oz/ton
 $\frac{\text{Mg}}{\text{Mg} + \text{Fe}^{+2}} = 0.127; \frac{{}^{87}\text{Rb}}{{}^{86}\text{Sr}} = 8.96; \left(\frac{{}^{40}\text{Ar}}{{}^{39}\text{Ar}}\right)_K = 0.0086$
 K - feldspar ($\text{Or}_{80} \text{Ab}_{20}$) = 13.49 wt %
 SiO₂ 68.34%; TiO₂ 0.53%; Al₂O₃ 12.00%
 Fe₂O₃ 0.56%...



Exploration geologists pick Bondar-Clegg
 for irrefutable assays and geochemical analyses.
 They have for over 25 years.

BC
BONDAR-CLEGG

Bondar-Clegg, Inc.
 Sparks, Nevada
 (702) 359-9330
 Lakewood, Colorado
 (303) 989-1404

Bondar-Clegg & Company Ltd.
 Ottawa, Ontario
 (613) 749-2220
 N. Vancouver, B.C.
 (604) 985-0681

Chimitec Ltée
 Ste-Foy, Québec
 (418) 683-1777

Committee Reports

Continued from Page 12

This requires that the AEG poll its members to determine what membership interests are and their expectations of what AEG benefits should include. This information should then be integrated into the membership database and evaluated to determine a strategy for growth in the future.

This is a preliminary list of recommendations for the membership to consider. In the future, the committee plans to contact other pro-

fessional societies and inquire about their membership trends, and methods which these societies are employing to increase membership. Any additional considerations or recommendations should be communicated to the Voting Membership Committee c/o Jeff Jaacks at the address and phone number given below.

Jeffrey A. Jaacks
 Chairman, Voting Membership Committee
 Westmont Mining, Inc
 4949 South Syracuse Street, Suite 4200
 Denver, CO 80237
 USA
 TEL: (303) 694-4936
 FAX: (303) 773-0733



Engineering Software for Solving Real World Problems

Let Diane Grant Tell You About the TECHBASE Database Management System

"TECHBASE fulfills a number of functions for our group, including the efficient exchange of data with regional offices and the generation of maps by geologists while in the field.

"We have been able to store, update and exchange data with several regional offices internationally. This TECHBASE network encompasses nearly 60 professionals in a dozen offices throughout the United States, Canada, Africa, and Asia.

"The majority of our map-making functions are done by our geologists using lap top computers in the field. We are currently using the system on about 50% of our projects, with map generation as the key function. With the release of TECHBASE Version 2.1, our system will include more geology, including display patterns and downhole geologic interpretations," — Diane Grant, Manager of Exploration Computer Services, BHP Utah International, Inc., San Francisco, CA.



*Diane Grant, Manager
 of Exploration
 Computer Services,
 BHP Utah International,
 Inc., San Francisco, CA*

The TECHBASE database management system provides a comprehensive set of sophisticated tools for a broad range of engineering, geological, and scientific applications. This tool kit approach to problem solving incorporates statistics, graphics, modeling, mine design, and geostatistics capabilities with a DBMS featuring unlimited storage capacity. TECHBASE is compatible with industry standard PCs, workstations, and peripherals. Call or write today for more information.

*Now Available on the MAC!
 Dealer inquiries welcome.*

MINEsoft, Ltd.

**165 South Union Blvd. • Suite 510
 Lakewood, Colorado 80228-2215
 Phone (303) 980-5300 • FAX: (303) 969-0022
 Telex: 981868 TECHBASE**

TECHNICAL NOTES

Moss-Mat Stream Sediment Sampling in the Threemile Creek - Black Lake Area, Southeastern Alaska

In an effort to identify and enhance gold stream sediment anomalies in a reconnaissance exploration program in southeastern Alaska, moss-mat sampling (Matysek et al, EXPLORE, Number 62, 1988) was employed during the 1990 field season.

Previous reconnaissance geologic mapping and conventional stream sediment sampling on lands owned by Sealaska Corporation in the Threemile Creek - Black Lake area had identified a potential porphyry copper-molybdenum terrain. A review of these earlier data within the context of other geologic analogs indicated a further potential for porphyry-type or epithermal gold mineralization.

Location and Physical Features

The Threemile Creek-Black Lake area is located six miles east of the village of Klawock on west-central Prince of Wales Island, approximately 50 miles west-northwest of Ketchikan. The terrain is typical of southeastern Alaska and ranges from moderate to very steep with elevations from near sea level to 4000 feet (Figure 1).

Annual precipitation is high, probably between 100 and 200 inches. Lower elevations are covered by thick, old-growth sitka spruce forests (currently being logged); higher elevations display outcrop, rubble and scree or low alpine vegetation. The higher elevations show effects of recent glaciation.

Access to the lower elevations in the area is via state-maintained highways and logging roads. The higher elevations are best accessed by helicopter.

Geology and Exploration History

Silurian to Ordovician volcanic and sedimentary rocks of the Descon Formation are represented in this area by a weakly metamorphosed package of greywackes, shales and minor carbonates interbedded with and intruded by andesites and subordinate dacite, rhyolite and latite units. These rocks have been intruded by Cretaceous(?) granodioritic to dioritic plutons. Andesites (flows?), presumably contemporaneous with the intrusive activity, are also found locally.

Exploration in the late 1960s focused on the Pin Peak porphyry copper-molybdenum system immediately west of the area. In the late 1970s strong copper and molybdenum stream sediment anomalies were identified in the southeast portion of the area and in the cirque a mile south of Black Lake in the northeast portion of the area. In 1988 a chalcopyrite-molybdenite bearing breccia pipe composed of intensely potassically altered granodiorite clasts within a quartz-pyrite matrix was discovered in section 1 to the east of Black Lake.

Continued on Page 15

Technical Notes

Continued from Page 14

The current exploration effort employs a model of disseminated or vein gold mineralization related to granodioritic rocks intruded into meta-andesites and meta-greywackes peripheral to the porphyry copper-molybdenum mineralization.

Sampling and Analytical Techniques

The 1988 reconnaissance included collection of 30 standard stream sediment samples which were submitted to Bondar-Clegg & Company in North Vancouver, BC, Canada. The -80 mesh fraction of the samples were analyzed by standard AA techniques (with a 0.5-gram sample digested in aqua regia [3-1 HNO₃-HCl]) for Cu, Mo, Pb, Zn and Ag and the fire-assay/AA technique on a 10 gram sample for gold.

In 1990 the area was revisited and 69 moss-mat and seven additional standard stream sediment samples were collected. Samples were submitted to Acme Analytical Laboratories in Vancouver, BC, and the -80 mesh fractions of each were analyzed using the 30-element ICP technique (with a 0.5 gram sample digested in 3:1:2 HCl:HNO₃:H₂O) for base metals and silver. A wet geochemical technique (with a 10-gram sample ignited at 600°C, digested with hot aqua regia, extracted by MIBK and analyzed by graphite furnace AA) was used for gold analysis.

Continued on Page 16

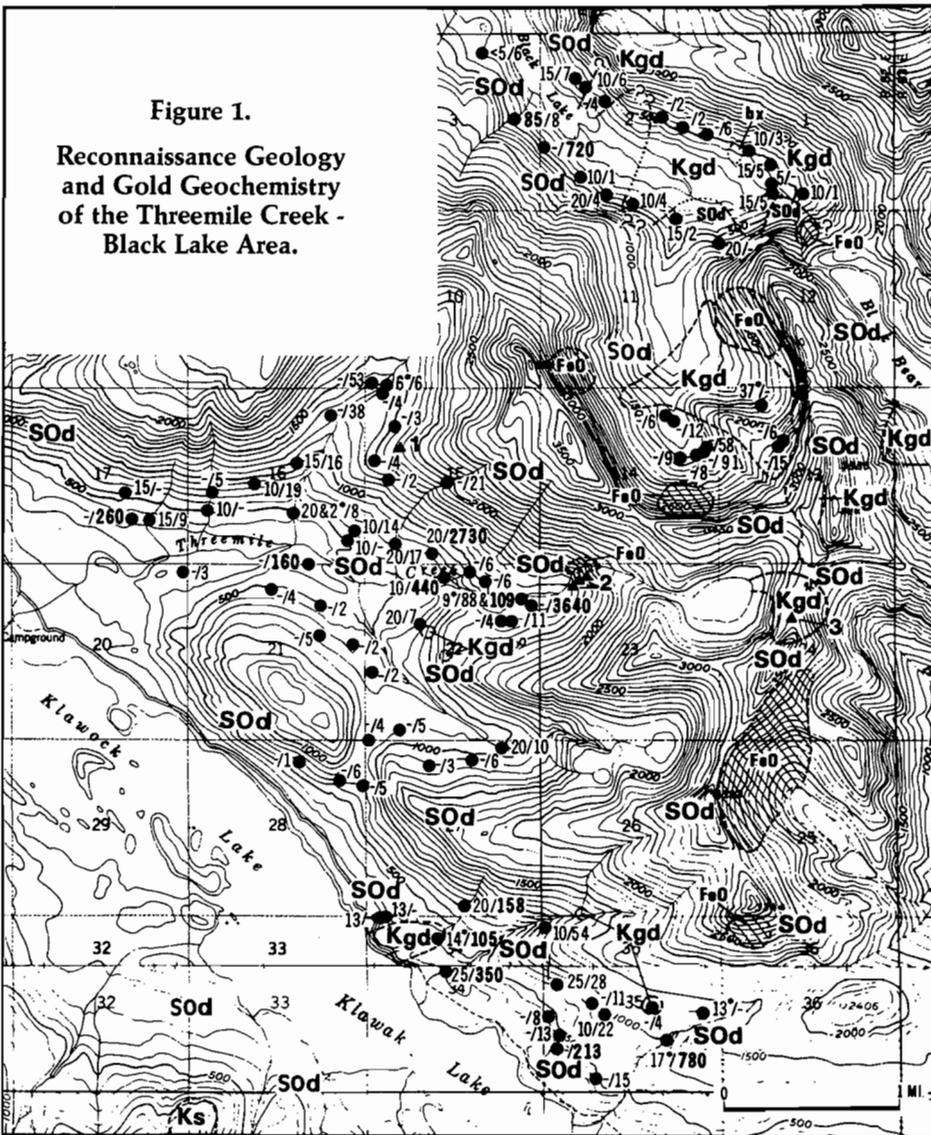
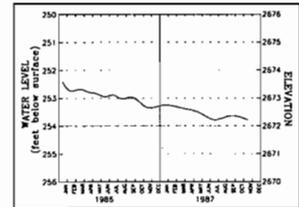


Figure 1.

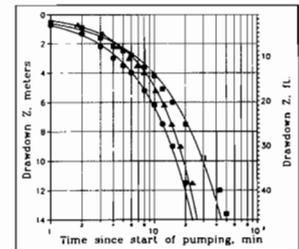
Reconnaissance Geology and Gold Geochemistry of the Threemile Creek - Black Lake Area.

Explanation: Kgd—Cretaceous(?) granodiorite and diorite; bx—hydrothermal breccia pipe; Ks—Cretaceous(?) syenite; SOd—Silurian to Ordovician Descon Formation (metavolcanics and metasediments); FeO—area of iron oxide stain; 10/32—stream sediment sample location with values in ppb for: Au (1988 standard sample)/Au (1990 moss-mat sample). (* indicates 1990 standard sample.) Anomalous values in bold type; ▲—selected rock chip sample location: 1- 18' quartz-pyrite-arsenopyrite vein containing 4671 ppm Cu, 17.0 ppm Ag & 1390 ppb Au. 2- quartz-sulfide vein & breccia float with up to 1939 ppm Cu, 21724 ppm Pb, 25831 ppm Zn, 579 ppm As, 52.8 ppm Ag & 650 ppb Au. 3- 3' quartz-sulfide vein with 1565 ppm Cu, 3977 ppm Pb, 20837 ppm Zn, 7239 ppm As, 63.4 ppm Ag & 21300 ppb Au.

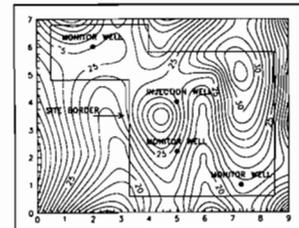
SCIENTIFIC GRAPHICS



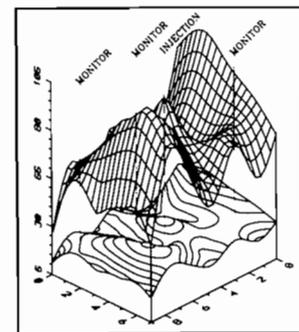
GRAPHER™ accepts your ASCII comma or space delimited file of up to 32000 XY pairs. You may combine an unlimited number of files on each graph. Choose from five types of error bars and six types of best-fit lines. Include an overlay grid for easy data referencing.



Use any combination of linear and logarithmic axes with automatic or user-specified tics and labels. Text may contain superscripts, subscripts, and mixed fonts from GRAPHER™'s complete symbol library, including Greek letters and special symbols.



SURFER® creates contour plots from your data quickly and easily. You may specify contour label frequency and format, irregular contour intervals, and data posting. Choose a rectangular border with tics and labels, or a user-defined shape.



SURFER® lets you display your data as a 3-D surface in perspective or orthographic projection, rotated and tilted to any degree or angle. Add axes, posting and titles to your plots. Stack surfaces for impressive results.

GRAPHER™ (PC Editor's Choice) ... \$199
 SURFER® (PC Editor's Choice) ... \$499
 Demo Disk \$10

FREE Brochure

Go ahead give us a call.
 1-800-333-1021
 or (303-279-1021 - fax: 303-279-0909)

GOLDEN SOFTWARE, INC.
 809 14th St., Golden, CO 80401

Purchase orders are welcome for IBM-PC

Technical Notes

Continued from Page 15

The basic procedure used for collecting the moss-mat sediment samples was to grab a handful of moss from a boulder in the active stream channel (but usually above the present water level) and, using a small plastic bucket filled with stream water, wash the entrained sediment from the moss. The moss was then discarded. This procedure would be repeated (usually 10 to 20 times) until 50 to 100 grams of predominantly silt-sized sediment was present in the bottom of the bucket. The water, along with suspended organic material and very fine suspended sediment, was then decanted off, and all of the sediment in the bottom of the bucket put into a sample bag for field drying.

Generally the moss-mat stream sediment sample takes two or three times as long to collect as would a standard stream sediment sample. The moss-mat technique provides a fairly uniform sample that would appear likely to give readily reproducible results. In some cases of particularly bouldery creeks, a moss-mat sample can be collected where a standard sample probably could not be obtained. Conversely, in some very small creeks no moss-mat sample can be collected.

Results

Comparison of Base Metal & Silver Values

At five locations both moss-mat and standard stream sediment samples were collected and analyzed by 30-element ICP (Table 1). Analyses of these samples show that the moss-mat and standard stream sediment samples are roughly comparable for contents of the base metals (Mo, Cu, Pb & Zn) and Ag although the standard samples generally contain from 10% to 50% more metal.

Comparison of Gold Values

Geochemical gold analyses of moss-mat and standard stream sediment samples from the same locations showed wide variations. For the paired 1990 samples, gold contents varied from being identical to the moss-mat sample containing about 15 times more gold.

Thirty streams that had been sampled with standard techniques (and analyzed by AA and fire-assay/AA) in the 1988 work were re-sampled in 1990 using the moss-mat technique. The 1990 samples were not analyzed for base metals and silver, but were analyzed by the wet geochemical gold technique. The 1988 gold analytical work was not as precise as the 1990 work and had a detection limit of 5 ppb Au (vs. 1 ppb Au for 1990); however, some comments can still be made comparing the data from the two surveys.

The 1988 standard stream sediment samples returned analyses ranging from <5 ppb Au to 85 ppb Au. The 1990 moss-mat samples from the same creeks returned analyses ranging from 1 ppb

to 2730 ppb Au. The stream which returned 85 ppb Au in the 1988 work showed only 8 ppb Au in the 1990 moss-mat sample; however, a stream 1000 feet away (and not sampled in 1988) returned a 720 ppb Au moss-mat value.

Other Moss-Mat Samples

An additional 25 moss-mat samples were collected from creeks without duplicate samples and analyzed by 30-element ICP and geochemical gold in 1990. Gold values returned by these samples varied from 1 ppb Au to 3640 ppb Au. Anomalies are also apparent in Mo, Cu, Pb, Zn & Ag.

Figure 1 shows reconnaissance geology and gold geochemistry for the Threemile Creek-Black Lake area. Four areas of anomalous gold geochemistry are indicated.

Immediately south of Black Lake, a 1988 standard stream sediment sample returned a value of 85 ppb Au and an adjacent 1990 moss-mat sample contained 720 ppb Au. In the upper Threemile Creek drainage four moss-mat samples contain 2730, 440, 109 and 3640 ppb Au (gold mineralization has been identified in float and outcrop above these anomalies). Two anomalous zones are indicated in the southern portion of the area: in sections 27 & 34 three moss-mat samples contain 350, 105 and 158 ppb Au and in section 35 two samples contain 213 and 780 ppb Au. Phyllicly altered stream float was noted at each of these sample locations.

Conclusions

Moss-mat stream sediment sampling appears to have clear advantages over standard techniques in identifying gold stream sediment anomalies in southeastern Alaska. Thirty standard stream sediment samples collected in 1988 returned one isolated gold anomaly. Sixty-nine moss-mat samples collected in the same area in 1990 returned twelve apparent anomalies and identified four areas of clustered gold anomalies. Three of these areas were sampled but not identified as anomalous in the 1988 program. Limited follow-up of some of the 1990 anomalies has discovered gold mineralization (Figure 1).

Base metal and silver contents of moss-mat samples seem to be somewhat lower than those returned by standard stream sediment sampling; however, it appears that anomalous and background populations are still readily discernable from one another.

Sealaska Corporation is an Alaska Native Regional Corporation whose total subsurface ownership in southeastern Alaska will approximate 660,000 acres when selections are completed. The corporation's long-term strategy for the development of its subsurface resources includes the involvement, through use agreements and leases, of companies with specific expertise in mineral exploration and development. Parties interested in more information

Continued on Page 17

Table 1. Duplicated sample sites from Threemile Creek-Black Lake Area Sampling: Comparison of Moss-Mat and Standard Stream Sediment Samples.

1990 Moss-Mat Stream Sediment Samples (1)							1988 & 1990 Standard Stream Sediment Samples from the Same Locations														
							1990 Samples (1)							1988 Samples (2)							
Sample No.	Mo ppm	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Au ppb	Sample No.	Mo ppm	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Au ppb	Sample No.	Mo ppm	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Au ppb	
1375-B	1	62	6	104	.1	6	1376-B	4	101	11	171	.1	6	none							
1404-H	1	117	23	132	.2	88	1405-H	4	120	34	169	.6	9	none							
1420-H	25	256	24	203	.3	780	1421-H	35	281	32	151	.2	17	none							
1453-H	1	46	3	49	.2	1	1454-H	2	79	4	72	.1	2	none							
1519-B	-	-	-	-	-	105	130-B	3	96	19	149	.1	14	none							
1527-H	-	-	-	-	-	8	1367-B	7	121	16	825	.4	2	184804-S	1	77	14	503	.6	20	
1531-H	-	-	-	-	-	16	1199-H	1	139	8	138	.2	11	58503-H	2	118	10	87	.1	15	

- (1) 30-element ICP analysis on 0.5-gram sample for base metals and silver; wet geochemical gold analysis on 10-gram sample for gold.
 (2) AA analysis on 0.5-gram sample for base metals and silver; fire-assay/AA analysis on 10-gram sample for gold.

Technical Notes

Continued from Page 16

lands should contact the authors or: Mr. Robert W. Loescher, Executive Vice President - Natural Resources Management, Sealaska Corporation, One Sealaska Plaza - Suite 400, Juneau, AK 99801, USA. TEL: (907) 586-1512.

David A. Hedderly-Smith
D.A. Hedderly-Smith & Associates
PO Box 443
Park City, UT 84060
USA
TEL: (801) 649-8326

Paul S. Glavinovich
PO Box 11-2816
Anchorage, AK 99511
USA
TEL: (907) 345-3646

INAA Applications to Geochemistry

Introduction

When Instrumental Neutron Activation Analysis (INAA) is thought of, the biogeochemical application immediately comes to mind. INAA, however, has many other applications with other geochemical media which are not well known.

INAA has several major advantages which make it a good analytical method for geochemistry. The high sensitivity of INAA for certain elements (indicated with an asterisk in Table 1) combined with the fact that INAA can be performed directly and nondestructively on the sample material without acid dissolution or fire assay procedures make this a powerful tool. Large samples (routinely up to 30 grams although samples up to 1 kg have been analyzed) as well as small samples (as small as can be accurately weighed) can be analyzed without loss of sensitivity. Typically, INAA is a multielement method. As many as 35 elements can be determined simultaneously. The linear dynamic working range for all elements covers virtually any geologic material submitted for analysis without having to develop new working curves or make dilutions which are prevalent with other analytical techniques like AA or ICP-ES. The risk of either contamination or incomplete dissolution is far lower with INAA than other chemical based methods of analysis because there are far fewer steps and no reagents are added with INAA. The cost per sample can be lower than by other analytical methods and is often lower on a per element basis. Turn-around time for certain INAA groupings can be immediate whereas the group of long-lived isotopes requires a seven day decay period to allow Na to decay.

Although INAA is an excellent method, certain types of analysis may be done better by other analytical methods. Whole rock analysis and the Cu, Pb, Ag, Cd, Ni, Zn suite fall into this category for either sensitivity or cost reasons.

Rock, Soils, Stream Sediments, and Lake Bottom Sediments

Multielement INAA packages with detection limits as low as 2 ppb for Au are routinely available on 30 gram subsamples. Such packages contains many of the so-called pathfinder elements (As, Sb, W, Mo, Hg) as well as elements which are useful in defining alteration zones (Na, Ca, Rb, Sr, Cs, Ba). Different rock types are indicated by certain elements (Cr, Co, Ni, REE, Sc, U, Th) as is the petrogenetic history of the rocks (REE, Ta). The cost for this group of elements can be equivalent to fire assay for Au only, on the equivalent sample size. INAA should be less subject to contamination and sample mix up because fewer reagents are used and samples are handled less frequently.

INAA should yield total gold whereas fire assay may encounter losses for certain types of samples which have not been fluxed properly (Hall et al., 1989). Fire assay has the advantage of potentially a faster turnaround time, if necessary. Many large-scale regional geochemical stream sediment surveys conducted by government geological surveys are being done by INAA whereas several years ago Au for these surveys was determined by fire assay. This in-

dicates a growing acceptance of the high quality Au values produced by INAA.

Heavy Minerals

Heavy mineral concentrates from overburden drilling or panned concentrates often provide a limited sample size for analysis. Generally the whole sample must be analyzed to provide meaningful results because of the typical heterogeneity of Au. If any other elements are required, INAA often provides the best alternative because of its non-destructive and multielement capabilities. After analysis, the sample can still be available for petrographic analysis or further analytical work by other methods.

Biogeochemistry

INAA is best known by exploration geochemists for the analysis of humus and vegetation. Organic material which provides problems for other analytical procedures is ideal for INAA as it creates virtually no background and allows ultra low sensitivities for many elements. Large sample sizes (up to 30 grams) are routinely analyzed for gold to as low as 0.05 ppb. Gold anomalies on dry vegetation are generally only a few ppb. Contamination using other analytical methods or potential losses of certain elements, including Au by ashing, make INAA the preferred method of analysis.

Rock-REE-Chondrite Analysis

The research geologist frequently must obtain low levels of REE for plotting chondrite normalized diagrams for petrogenetic studies. INAA provides a means of obtaining the necessary REE analyses for this application at a reasonable cost. The advantage over the other technologies, like ICP-MS, was illustrated by Hall and Plant (1990). They determined that dissolution of certain phases like zircon or sphene was exceptionally difficult. This resulted in erroneous chondrite plots for the REE because of low recovery of the heavy REE with procedures depending on mineral dissolution.

Conclusions

INAA can provide low cost and reliable analytical results for a wide range of elements with a turn-around time of less than two weeks. Rocks, soils, stream sediments, heavy minerals, vegetation and humus can be analyzed for as many as 50 elements by INAA.

References cited:

- Hall, G.E.M., Vaive, J.E., Coope, J.A., and Weiland, E.F., 1989. Bias in the analysis of geological materials for gold using current methods. *JGE* 34: 157-172.
Hall, G.E.M. and Plant, 1990. Are your REE results total? *EXPLORE* 68: 18-20.

Continued on Page 18



- ICP
- Fire Assay
- Geochemical Analyses
- Wet Assay
- Umpire Assay
- B.C. Certified Assayers
- Data via Fax. 24hr Modem, or Disk

International Plasma Laboratory Limited
Head Office & Laboratory
2036 Columbia St., Vancouver, BC V5Y3E1 Ph: 604/879-7878 Fax: 604/879-7898
Prep Lab
50 Freeport Blvd., Unit 9, Sparks, NV 89431 Ph: 702/331-8088
Sample Drop-Off
816 Peace Portal, Box 8195-39, Blaine, WA 98230

Continued from Page 17

Table 1. Typical detection limits for INAA analysis of some geological materials. Detection limits may be enhanced by variation in irradiation-counting procedures. — Not determined.

	VEGETATION	SOIL	ROCK	HEAVY MINERALS	ROCK-RESEARCH
Ag	0.2 ppm	2 ppm	5 ppm	5 ppm	2 ppm
As*	0.01 ppm	1 ppm	2 ppm	2 ppm	1 ppm
Au*	0.1 ppb	2 ppb	5 ppb	5 ppb	2 ppb
Ba*	5 ppm	100 ppm	100 ppm	200 ppm	20 ppm
Br*	0.01 ppm	1 ppm	1 ppm	5 ppm	0.5 ppm
Ca	0.01 %	1 %	1 %	1 %	0.2 %
Co*	0.1 ppm	1 ppm	5 ppm	5 ppm	0.1 ppm
Cr*	0.3 ppm	5 ppm	10 ppm	10 ppm	0.5 ppm
Cs*	0.05 ppm	1 ppm	2 ppm	2 ppm	0.2 ppm
Eu*	0.05 ppm	0.2 ppm	0.2 ppm	0.2 ppm	0.05 ppm
Fe*	0.005 %	0.01 %	0.02 %	0.02 %	0.005 %
Hf*	0.05 ppm	1 ppm	1 ppm	1 ppm	0.2 ppm
Hg	0.05 ppm	1 ppm	1 ppm	5 ppm	1 ppm
Ir	0.1 ppb	5 ppb	5 ppb	50 ppb	1 ppb
K	0.01 %	—	—	—	—
Mo	0.05 ppm	2 ppm	5 ppm	20 ppm	2 ppm
Na*	1 ppm	0.01 %	0.05 %	0.05 %	0.001 %
Ni	2 ppm	50 ppm	50 ppm	200 ppm	50 ppm
Rb	1 ppm	30 ppm	30 ppm	50 ppm	10 ppm
Sb*	0.005 ppm	0.1 ppm	0.2 ppm	0.2 ppm	0.1 ppm
Sc*	0.01 ppm	0.1 ppm	0.1 ppm	0.1 %	0.01 ppm
Se	0.1 ppm	3 ppm	5 ppm	20 ppm	0.5 ppm
Sn	—	0.01 %	0.01 %	—	0.01 %
Sr	10 ppm	0.05 %	0.05 %	0.2 %	100 ppm
Ta*	0.05 ppm	1 ppm	1 ppm	1 ppm	0.3 ppm
Th*	0.1 ppm	0.5 ppm	0.5 ppm	0.5 ppm	0.1 ppm
U*	0.01 ppm	0.5 ppm	0.5 ppm	0.5 ppm	0.1 ppm
W*	0.05 ppm	3 ppm	4 ppm	4 ppm	1 ppm
Zn	2 ppm	50 ppm	50 ppm	200 ppm	10 ppm
La*	0.01 ppm	1 ppm	1 ppm	1 ppm	0.1 ppm
Ce*	0.1 ppm	3 ppm	3 ppm	3 ppm	1 ppm
Nd*	0.3 ppm	5 ppm	5 ppm	10 ppm	3 ppm
Sm*	0.001 ppm	0.1 ppm	0.1 ppm	0.1 ppm	0.01 ppm
Eu*	0.05 ppm	0.2 ppm	0.2 ppm	0.2 ppm	0.05 ppm
Tb*	0.1 ppm	0.5 ppm	0.5 ppm	2 ppm	0.1 ppm
Yb*	0.005 ppm	0.2 ppm	0.2 ppm	0.2 ppm	0.05 ppm
Lu*	0.001 ppm	0.05 ppm	0.05 ppm	0.05 ppm	0.01 ppm

Eric L. Hoffman, President, Activation Laboratories Ltd., 1336 Sandhill Drive, Ancaster, ON L9G 4V5, CANADA

SPECIAL NOTES

International Geochemical Mapping Project

"Geochemical Mapping represents the most urgent and important task within geology for today's society."

— Kalevi Kauranne

Introduction

Geochemical maps are central to the science of geochemistry. At the present time geochemical maps are frequently absent from earth science data bases, yet they are needed for a whole range of economic and environmental studies, including mineral and land-use assessments and global change studies. The International Geochemical Mapping Project (IGCP) Project 259 under the

Continued on Page 19

Special Notes

Continued from Page 18

umbrella of International Union of Geological Sciences and UNESCO, has been established for the purpose of encouraging international scientific cooperation at the working level.

The aim of Project 259 is to provide the scientific framework whereby the present lack of systematic geochemical data for 80% to 90% of the world's surface can be remedied at the earliest opportunity. Details about the organization of the project, together with names and addresses of committee leaders, can be obtained from Dr. A.G. Darnley, Project Leader.

Meetings with IGCP Project 259 Participation in 1990

The principal meeting of the Project for 1990 was held in Prague, Czechoslovakia, in conjunction with the International Symposium on Geochemical Prospecting and the 14th IGES. The organizers, the Geological Survey of Czechoslovakia, made Project 259 activities a major part of the program. A 2-day workshop was followed by a one-day scientific paper session, plus posters (a total of 29 papers and 12 posters). Overflow papers were included in other sessions. Approximately 100 people from 35 countries attended the Project 259 activities.

Posters showed the impressive progress being made with the geochemical mapping of China, where more than half the country has been covered with detailed surveys over the past 10 years. One poster showed a compilation of radiometric data for the whole USSR; some of the highest levels of radioactivity were noted in the vicinity of the Lake Baikal rift.

Levelling of data from different sources is one of the key scientific problems facing Project 259. A paper by Garrett, et al. received considerable attention; data for lake-sediment samples collected over adjoining blocks of a 300,000 km² area in eastern Canada by different agencies and involving different sample densities and analytical methods, have been levelled on a percentile-equivalent basis with convincing results. Another approach, suggesting the use of airborne gamma-ray spectrometry for levelling all soil and drainage sediment surveys containing K and Th data, was advocated in another poster. In other work illustrating an application of regional compilations, Davenport, Steinfeld, et al. used large blocks of regional data from Greenland and Labrador to provide evidence with respect to continental reconstruction of that part of the North Atlantic region.

Other meetings of IGCP participants in 1990 included those of the West European Geological Surveys (WEGS) group that took place at the British Geological Survey in March; at BRGM in Orleans, France, in June; and at the Institute of Geology and Mineral Exploration, Athens, Greece, in October.

A meeting of the Analytical Committee of the Project was held in conjunction with Geoanalysis '90 in Huntsville, Canada, in June. In addition, a session was devoted to Project 259 at the biennial meeting of the Geochemical Section of the Geological Society of Portugal in Lisbon, in December. Portugal intends to proceed with a systematic geochemical mapping program.

The project also exhibited an information poster at the International Association for the Genesis of Ore Deposits (IAGOD) meeting in Ottawa, Canada, in August and at the 15th Colloquium on African Geology in Nancy, France, in September. Both meetings attracted new participants to the Project.

Activities Planned for 1991 and 1992

IGCP Project 259 will participate in several international meetings in 1991. The 15th International Geochemical Exploration Symposium, to be held in Reno, Nevada, April 26 to May 4, will provide an opportunity to bring Project 259 to the attention of exploration geochemists in the North America. There will be a business session for North American participants, an information and poster display, and papers on regional mapping.

The principal Project 259 meeting for 1991 will be held at Uppsala, Sweden, September 14-19, in conjunction with the 2nd International Symposium on Environmental Geochemistry, sponsored by the International Association of Geochemistry and Cosmochemistry and the Society for Environmental Geochemistry and Health. The Symposium is organized by the Geochemistry Division of the Geological Survey of Sweden and the Swedish University of Agricultural Science.

On Sunday, September 15, there will be a workshop on "Environmental Geochemistry and the International Geochemical Mapping Project," with invited speakers to launch a discussion on "What does environmental geochemistry need from IGCP Project 259, and what can the project provide?" Topics to be considered include animal and human health, forest health, agricultural productivity, natural radioactivity, man-made fallout, and land-use planning. The workshop will be preceded by a Project 259 business meeting on Saturday, September 14. During the main symposium, September 16-19, scientific papers relating geochemical mapping to environmental issues will be presented and a display of recent regional geochemical maps from many countries will also be displayed.

The workshop is being organized by a committee chaired by Professor A. Björklund, Abo Academi, Finland, to whom queries should be addressed. Anyone wishing to present a paper during the main symposium, or requiring information about local arrangements, should contact Dr. O. Selinus, Geological Survey of Sweden, Geochemistry Dept., PO Box 670, S-75128 Uppsala, Sweden.

EUROLAT '91, to be held in Berlin, Germany, August 23-24, will provide an opportunity for those concerned with the special problems of regional geochemical mapping in arid and semiarid areas to meet together. Those needing further information should contact Dr. G. Matheis, Tech University, Seur. BH4, E. Reuterplatz 1, D-1000, Berlin 12, Germany, TEL: (30) 314-72646.

Several regional meetings in 1991 will also have Project 259 participation. Two such meetings have been scheduled in Australia in 1991. The first was held in February in Sydney. The second is a workshop that will be held in conjunction with the National Conference on the Management of Geoscience Information and Data. For further information, contact Dr. R.E. Smith at the CSIRO-Division of Exploratory Geoscience, Private Bag, PO, Wembley, WA 6014, Australia, TEL: (9) 387-0376.

IGCP Project 259 will also meet in Edinburgh, Scotland, September 2-4, in conjunction with the Ninth Prospecting in Areas of Glaciated Terrain Conference. For further information, contact Dr. J. Ridgway of the British Geological Survey, Kentworth, Nottingham, England TEL: (607) 76111. There will be an IGCP 259 session at the next International Geological Congress to be held in Japan in August 1992.

Continued on Page 20



Becquerel Laboratories Inc.
6790 Kitimat Rd., Unit 4
Mississauga, Ontario
Canada, L5N 5L9
Telephone (416) 826-3080
Fax (416) 826-4151

USE NEUTRON ACTIVATION TO
CONFIRM YOUR ANALYSES

NO CHEMICALS AND FEW STEPS
PRODUCES ACCURATE AND
PRECISE RESULTS

Special Notes

Continued from Page 19

Other regional meetings for Project 259 include a half day meeting for North America to be held in conjunction with the Goldschmidt Conference in Reston, VA during May, 1992. For further information, contact Dr. Peter Davenport, Newfoundland Department of Mines, TEL: (709) 576-2171. A Project 259 session is also scheduled for November in Hanoi, Vietnam, in conjunction with a symposium on the Geology of Vietnam. For information, contact Dr. Nguyen Khac Vinh, Director of the Research Institute of Geology and Mineral Resources of Vietnam in Hanoi.

Recent Publications and Reports

The use of gamma ray data to define the natural radiation environment. 1990. Ed. A.Y. Smith. IAEA-TECDOC-566, IAEA, Vienna, 48pp.

Geochemical mapping of Western Europe towards the year 2000, Pilot project report and proposal. 1990. Eds. B. Bolviken, et al. GSN Reports 90-105 and 90-106, Geol. Surv. Norway, 600pp.

International Geochemical Mapping—IGCP Project 259. 1990. Eds. A.G. Darnley and R.G. Garrett. Journal of Geochemical Exploration, v. 39, 253pp.

The Proceedings of a symposium held in Australia in 1989 on "Chemistry and the Environment," edited by B.N. Noller and M.S. Chadha, is now available from the Commonwealth Science Council, Marlborough House, London, UK. This volume includes papers summarizing the links between organic and inorganic geochemistry and health.

Forthcoming IGCP Project 259 Publications

- 1) Nine papers presented in 1989 at the International Geochemical Mapping Sessions, held as part of the 29th International Geological Congress in Washington, D.C., will be published in 1991 in the Transactions of the Institution of Mining and Metallurgy, London. These papers illustrate various facets of the project; e.g.: the status of geochemical mapping in Canada and China; the status of radiometric mapping, world wide and in the USA; the problem of mapping in carbonate terrains lacking normal drainage; the economic and health implications of geochemical mapping in Jamaica; the use of regional maps in recognizing hydrothermal alteration zones; the use of low sample density data; and methods for low-density biogeochemical mapping.
- 2) A conference proceedings volume, containing selected papers from the 1990 Prague meeting, will be published in 1991 by the Geological Survey of Czechoslovakia, Prague.

Commentary

To quote an attendee at the Prague meeting, "Overall, the international interest in geochemical mapping is very strong and is increasing." Unfortunately, a shortage of funds is restricting progress in developed, as well as developing, countries. There can be little doubt that the absence of systematic geochemical base-line data for much of the world is a fact that will eventually be recognized and remedied. In the meantime, progress depends upon persistence, communication, and the exchange of information between participants in the project and the science community at large.

As a postscript: The International Association of Geochemistry and Cosmochemistry recently approved the formation of a Working Group on Global Geochemical Mapping. This replaces the earlier WG on Geochemical Prospecting. Whereas the IGCP 259 project has a finite life, this new WG will continue into the future. This formal recognition is important in putting geochemistry on the map and raises the probability that recommendations on methodologies, standards, etc. will be internationally noticed and eventually adopted. There will be more about this at the 15th IGES meeting in Reno, Nevada.

Countries Involved in Project (* indicates countries active this year)

*Algeria	Ghana	Nigeria
Argentina	*Greece	*Norway
*Australia	*Greenland	Pakistan
*Austria	Guinea	Philippines
*Belgium	Guyana	Poland
Botswana	*Holland	*Portugal
Brazil	*Hungary	Sierra Leone
*Bulgaria	*India	Somalia
Burkino Faso	*Indonesia	South Africa
*Canada	Iran	*Spain
Chile	Iraq	Sri Lanka
*China	*Ireland	*Sweden
Columbia	*Israel	Switzerland
Congo	*Italy	Syria
*Costa Rica	Ivory Coast	*Tanzania
Cyprus	*Japan	*Thailand
*Czechoslovakia	Kenya	Togo
*Denmark	*Korea	Uganda
Dominica	Malaysia	*UK
Ecuador	Mali	*USA
*Egypt	Mexico	*USSR
*Finland	*Mongolia	*Venezuela
*France	*Morocco	*Vietnam
Gabon	Mozambique	*Yugoslavia
*Germany	New Zealand	Zambia
		Zimbabwe

Arthur G. Darnley

Project Leader, IGCP Project 259

Geological Survey of Canada

601 Booth Street

Ottawa, ON K1A 0E8

CANADA

MEETING REPORTS

SME Geochemistry Session

An exploration geochemistry session was sponsored by the Geochemistry Unit Committee of the Society of Mining, Metallurgy, and Exploration as part of the annual SME and AIME meetings in Denver, Colorado, USA, held February 25-28, 1991. The session, entitled "Geochemical Techniques - Collection Through Interpretation" was organized and chaired by Robert R. Craig and co-chaired by Jeffrey A. Jaacks. An attendance of greater than 300 was present during the talks. A brief summary of the presentations is provided below. Abstracts for these presentations are published in the 1991 SME Annual Meeting Program.

The Use of Chemical Zonation Diagrams in Exploration Programs by P. F. O'Hara, Kaaterskill Exploration, Prescott, AZ. Chemical associations, representing alteration associations, were derived from factor analysis and used to construct a chemical zonation diagram applying topological concepts and phase diagram rules. Evaluation of the chemical zonation diagram helped to model the geologic and geochemical processes associated with mineralization.

Metal Zoning in Carlin-type Gold Deposits by B. K. Jones, consulting geologist, Sandy, UT, and R. A. Leveille, Kennecott Exploration Company, Salt Lake City, UT. Metal zonation in Carlin-type deposits was evaluated using public-domain and company lithogeochemical data. Tungsten correlated spatially with the center of the mineralized systems, As and Tl are broadly distributed from the center to the periphery, Cu and Zn are enriched at the periphery of the system, and Hg and Ba form a very broad halo over and distal to some deposits.

Continued on Page 21

Meeting Reports

Continued from Page 20

Multivariate Methods for Treating Geochemical Data from Gold Deposits by C. E. Nelson, consulting geologist, Boulder, CO. A litho-geochemical data matrix (47 elements) was used to discriminate jasperoids from barren and productive mineralized systems using factor and discriminant analysis. The association and utilization of Au, Ag, Sb, Mo, Mn, P, Ba, and Ni can be used to discriminate barren from productive systems. The discriminant function had less effective results for deposits within the siliciclastic sediments of the upper plate as opposed to the carbonate assemblage of the lower plate.

A Multivariate Approach to a Comparative Geochemical Study Within the Redmoor Sheeted-Vein Complex, East Cornwall, UK by P. S. Newall, Camborne School of Mines, Redruth, Cornwall, UK. Rock float and soil samples were collected in an area of relatively thin soil cover. The samples were analyzed for 19 major and trace elements. Factor analysis for both rock float and soil produced similar element associations and plots of factor scores produced similar spatial relationships. In addition, the soil evaluation indicated additional areas for further exploration not indicated in the mineralized float association.

Stream Sediment Geochemical Signature of Tungsten-Skarn Mineralization, Pilot Mountains, Mineral County, Nevada by J. S. Zuker, Westmont Mining Inc., Denver, CO, and L. G. Closs, Colorado School of Mines, Golden, CO. A geochemical orientation survey was conducted near known W-skarn mineralization. Eight fractions of sediment were analyzed for 31 elements by AAS and DC-ES methods. Tungsten, Ag, Bi, Mo, Mg, and Zn are enriched in the -60 mesh (0.25 mm) sediment, and in the non-magnetic heavy-mineral concentrate fractions. These elements are dispersed up to 2.5 km down drainage from mineralization.

Pediment Exploration: Application of Soil Geochemistry by B.R. Putnam, W.B. Henderson, and M.D.G. Rogers, Geochemical Services Inc., Rocklin, CA. Soil samples were collected over a deeply buried Au occurrence on the Carlin Trend. The -200 mesh (0.074 mm) fraction of the soil samples were split and digested by a partial digestion technique (ascorbic acid) and analyzed by ICP-ES and GF-AA. Anomalous Au, Cu, Hg, Bi, Zn, and Mo were observed over surface projections of mineralization delineated by drilling in an area overlain by Tertiary sediments, alluvium, and colluvium. Similar geochemical response was observed for an area as yet untested by drilling.

Robert R. Craig
Newmont Exploration Ltd.
PO Box 669
Carlin, NV 89822
USA

Jeffrey A. Jaacks
Westmont Mining Inc
4949 S Syracuse St, Ste 4200
Denver, CO 80237
USA

PEARL HARBOR FILE

Russ Calow has submitted a letter in which he comments on issues raised in previous Pearl Harbor columns. Mr. Calow's letter is printed here, followed by a reply from Stan Hoffman, then the normal Pearl Harbor file.

Dear Stan:

A number of recommendations were made in the Pearl Harbor File of EXPLORE, Numbers 68 and 69, concerning the appropriateness of various analytical methodologies. Unfortunately, very important information regarding inherent problems associated with the aqua regia/MIBK technique for Au, the ICP-ES determination of Bi and Sb and the aqua regia extraction for Al, Ba, Sb and W was not presented.

I would like to present some differences of opinion that I have with the printed submissions. The concerns expressed below are shared by many of my colleagues involved with the analysis of geological materials.

1) Aqua Regia/MIBK Technique for Au

The aqua regia/MIBK method for the analysis of Au is usually a partial extraction method that yields lower Au values than fire assay preconcentration methods or Instrumental Neutron Activation Analysis (INAA). The method is also subject to a number of other problems that can result in erratic Au data. Hall et al., (*Journal of Geochemical Exploration*, 34, (1989) 157-171) noted a 24 to 42 % low bias for Au on a series of soil samples using this method. This low bias should not be taken lightly. The potential for less than "total" Au data may create situations where the aqua regia/MIBK method does not discern subtle, low-level gold anomalies that would be shown by Fire Assay or INAA methods. The most disconcerting finding is that the low bias is not consistent, but depends on the matrix, of the soil sample. Thus, one could be comparing apples and oranges for soil geochemical Au data taken from the same general area or even the same sample grid due to changes in the soil matrix throughout the exploration property. The example published in the EXPLORE Number 68 seemed not to suffer from this problem, but it would be dangerous to extrapolate this one example to a broad spectrum of exploration targets and exploration terrains. As the old adage goes, "you may never know what you have missed." The traditional fire assay lead collection-flame AAS, or plasma measurement technique has been tried and proven in all sample types, including high organic humic material. Fire assay should be the recommended method for Au or, as a minimum, used to check aqua regia/MIBK Au geochemical analyses for potential problems.

2) ICP-ES

The ICP-ES provides good data for many geologically significant elements; however, two real problem elements are Bi and Sb. The strongest available spectral lines are subject to many interferences, like Cu, Fe and Ti for Bi and Fe, Al, V, Ti, Ni and Cr for Sb. Although inter-element corrections can be made, the interferences are severe enough that even the most optimistic analytical chemist would not quote detection levels better than 5 ppm from an aqua regia extraction. Alternate spectral lines for Bi and Sb are not useable due to lower line intensities and severe interferences. Thus, we may be able to start "seeing" reliable Bi and Sb data at 15 to 20 ppm, 3 to 4 times the background level of 5 ppm. Yet these "safe" levels are generally too high to be truly useful for exploration geochemistry. A more suitable approach would be to couple the ICP-ES method with other analytical techniques that can effectively handle elements like Bi and Sb. A better choice of analytical technique for Bi would be the traditional aqua regia flame AAS Bi determination that has a detection level of 1 ppm. A better choice of analytical technique for Sb would be INAA, which provides a detection level in the 0.2 ppm range.

3) Aqua Regia Digestion

The aqua regia digestion is a partial extraction technique that provides inconsistent extractions for Al, Ba, Sb, W. The fraction of Al, Ba, Sb and W that dissolves is subject to precipitation during and subsequent to the digestion procedure. The extraction is sensitive to heat, time, and acid strength. Thus, the aqua regia-ICP-ES analytical determination for the above elements may not be dependant on the geology. It would be prudent to use analytical techniques for these elements that do not involve aqua regia extractions, e.g., INAA for W, Sb and XRF for Ba.

There is no question that aqua regia-ICP-ES based multi-element geochemistry has proved a boon to geochemists and for those laboratories specializing in ICP-ES technology; however, ICP-ES multi-element packages are being treated as "black boxes" with little thought to the inherent strengths and weakness of the ICP-ES and the aqua regia extraction. The cost per sample and computer generated statistical packages appear to have become much more important to some than the basic requirement for truly meaningful geochemical data of

Continued on Page 22

Pearl Harbor File

Continued from Page 21

adequate quality. As professionals working in the field of exploration geochemistry we should recommend analytical methods that are cost effective, yet have the sensitivity, reliability and quality necessary for exploration success. This should include multi-element packages combining a number of analytical techniques, eg., Fire Assay preconcentration for Au, aqua regia-ICP-ES for the base metals, Flame Atomic Absorption for Bi, INAA for As, Sb and W, etc. By limiting ourselves to one analytical technique, or approach, we risk compromising the success of many geochemical exploration programs and provide a disservice to the exploration community.

Analytical chemistry has not yet produced a simple analytical method that can provide quality, sensitive data for the entire periodic table. A "black box" does not exist. All analytical techniques have their strengths and weaknesses which must be taken into account during selection of methods.

Russ Calow

Manager, Geochemical Department
Bondar-Clegg & Company Ltd.
130 Pemberton Avenue
North Vancouver, BC V7P 2R5
CANADA

Reply

Mr. Calow aptly summarizes points which are well known to geochemists, but perhaps are not overly appreciated by the main clients of exploration geochemistry, the project managers who are familiar with geochemical data but are not entirely sure what all of it means. I await responses from our readers to the issues raised, for publication in the next Pearl Harbor file.

Pearl Harbor File

Of interest to readers of *EXPLORE*, Activation Laboratories Ltd. has offered to reanalyze soil pulps for the survey of Cat Mountain described in *EXPLORE* Number 69 using Instrumental Neutron Activation Analysis (INAA). Trench and drill core are also being evaluated by both the aqua regia and INAA methods. Results should be available for publication in the next *EXPLORE*.

EXPLORE Number 70, Figure 1 presented a regional stream sediment survey conducted at a sample density of one sample per 13 km²(5 mi²) and asked if a peculiarity could be observed amongst the data. Figure 1, shown here, presents the same data, only sampling in year one is indicated by size-coded dots and sampling in year two by size-coded diamonds. Geochemical legends are the same for both symbol types. Presented in this fashion, I am confident the reader recognizes the vast majority of high values ("anomalies" to some) are found within areas sampled in year one. This is likely an analytical artifact, and because the element is mercury, may be reflecting different sample preparation methodologies (i.e., samples were oven dried at different temperatures) or digestion/analysis techniques.

As is typical with such examples, preparation and analytical procedures prescribed in advance were constant for both years, yet results suggest something was very different. This type of result promotes several routine recommendations to be made for all geochemical exploration projects:

1. Once a laboratory is selected for a project, it should not be changed without cause, and price differentials between laboratories are not normally sufficient to provide cause. If a laboratory change is needed, all existing sample pulps in areas of interest should be reanalyzed at the new laboratory.
2. Fill-in sampling programs in areas where greater detail is required, should also require resampling of initial sites which identified the anomalous conditions.
3. Do not mix and match analytical procedures for a single element under any circumstance.

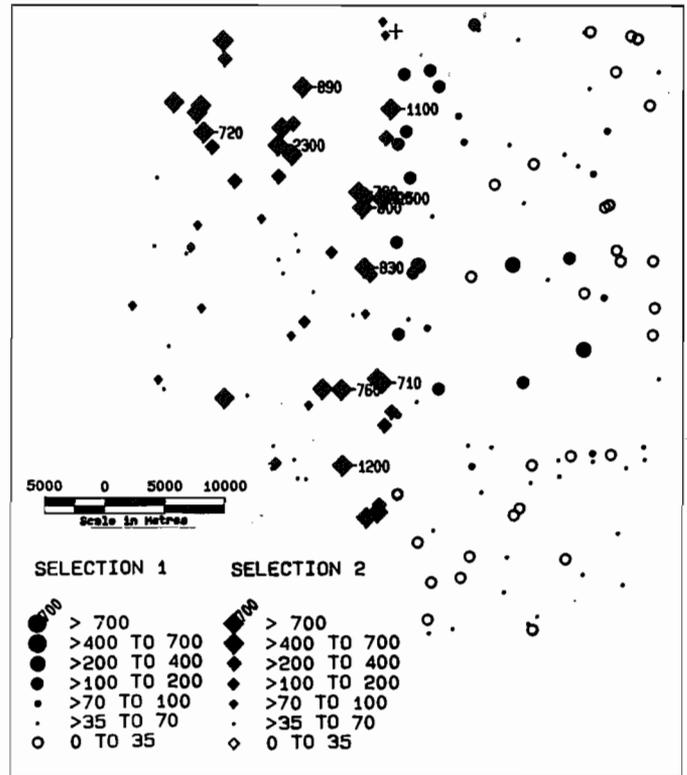


Figure 1. Same Hg data (ppb) as was presented in Figure 1 of *EXPLORE* Number 70; but different size-coded symbol types are used to indicate sampling took place in two different years.

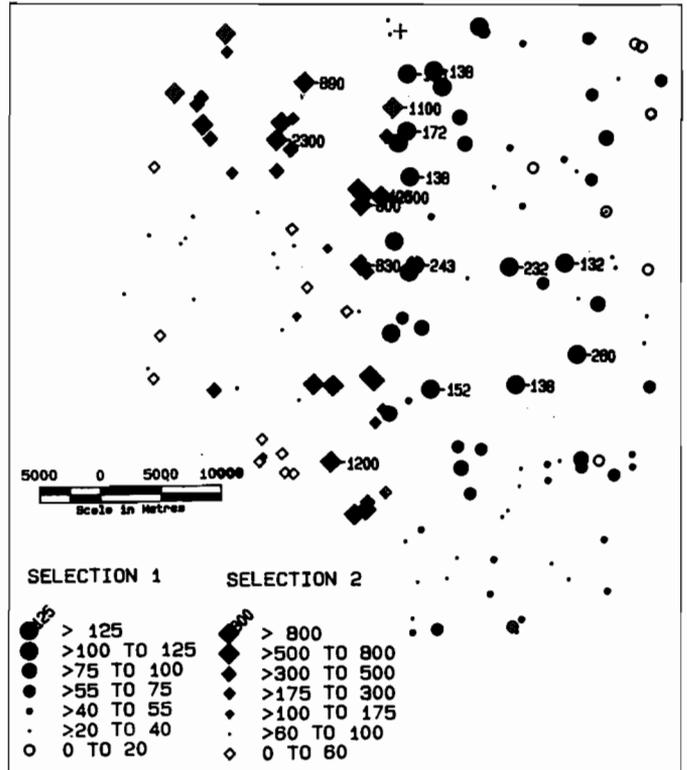


Figure 2. Isoanomalous condition assumes anomalous condition can be determined for each year and data represented by size-coded symbols, but geochemical legends are different.

Continued on Page 23

Pearl Harbor File

Continued from Page 22

An interpretive procedure which aims to eliminate the analytical problems manifest in Figure 1 assumes anomalous conditions can be defined independently for each year. The two sets of data can then be juxtaposed on a map which shows approximately isoanomalous conditions (Fig. 2).

The Pearl Harbor File column thus far has looked at sampling and analytical aspects of geochemical exploration, and will return to these components of an exploration program in the future. In the next few issues, however, I propose to examine interpretive methodologies. Again, I emphasize that I would appreciate readers' comments, viewpoints and examples. The objective of this column is to appreciate geochemical principles from the examples of others which will not normally appear in the pages of scientific journals.

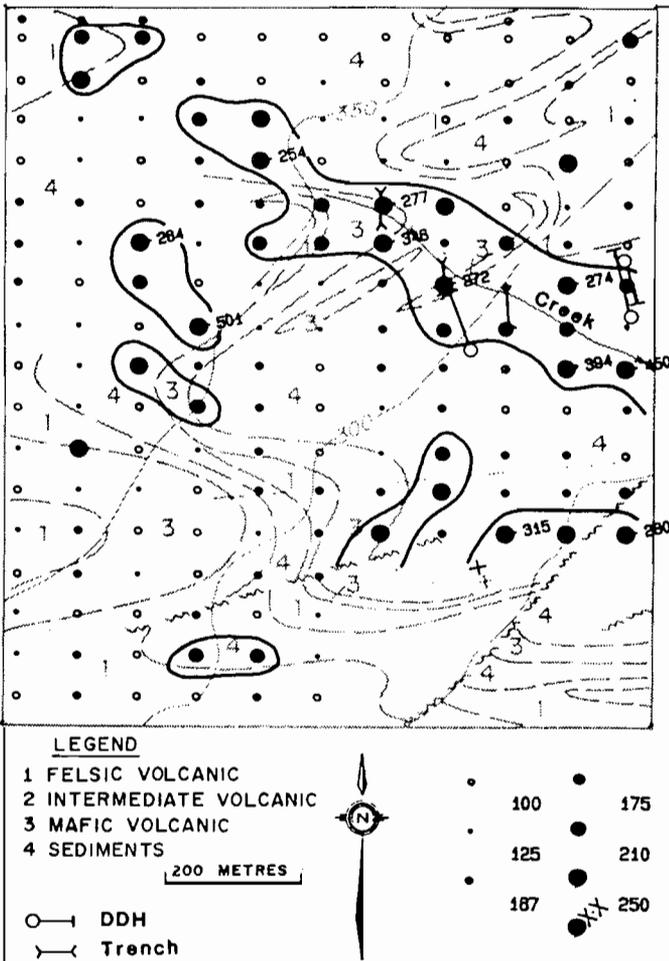


Figure 3. A geochemical map showing geology, topography, Zn values and trench/drill holes from a public domain map. Where is the mineralization?

To commence a discussion of geochemical interpretation, Figure 3 presents a geochemical map in a format which I would like to see as standard (i.e. geochemical data are presented on a topographic and geologic base map). Within this area lies a high grade suboutcropping volcanogenic massive sulphide occurrence lying beneath a maximum 2 m of overburden comprising local rubble derived from underlying bedrock (i.e., residual-like). If these were your data, could you locate the position the massive sulphide occurrence and what follow-up steps would you use to locate and/or test the mineralized zone.

Please send your comments, observations, ideas, examples, etc., to:

Stan J. Hoffman
 Prime Geochemical Methods Ltd.
 630 - 1199 West Pender Street
 Vancouver, BC V6E 2R1
 CANADA
 TEL: (604) 684-0069
 FAX: (604) 682-7354

Editor's Note: Dr. Hoffman has shown us how he likes to portray geochemical data in Figure 3 above. How do you like to see it? **EXPLORE** proposes a friendly contest called "MAP WARS." Readers would submit a map for a data set to be specified by **EXPLORE**. The entries would be published in **EXPLORE** and our readers could vote on the map that best portrays the data together with other relevant features. Look for details in an up-coming issues of **EXPLORE**.

RECENT PAPERS

This list comprises titles that have appeared in major publications since the compilation in **EXPLORE** Number 70. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochimica et Cosmochimica Acta (GCA); The USGS Circulars (USGS Cir); and Open File Reports (USGS OFR); Geological Survey of Canada Papers (GSC Paper) and Open File Reports (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); American Association of Petroleum Geologists (AAPG). Publications less frequently cited are identified in full. Compiled by L. Graham Closs, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, Colorado 80401, Chairman AEG Bibliography Committee. Please send new references to Dr. Closs, not to **EXPLORE**.

Aspie, D. and Barnes, R.J. 1990. *Infill-sampling design and the cost of classification errors*. Math. Geol. 22(8): 915-932.

Barlow, R. 1989. *Statistics: A Guide to the Use of Statistical Methods in the Physical Sciences*. Wiley. 204 p.

Bartos, P.J. 1990. *Metal ratios of the Quiruvilca Mining District, Northern Peru*. EG 85(7): 1629-1644.

Baturin, G.N. 1990. *Geochemistry and origin of ferromanganese nodules*. Intern. Geol. Rev. 32(9): 916-929.

Beeson, R. 1990. *The geochemical environment of the Wilcherry Hill base metal mineralization, South Australia*. Min. Deposita. 25(3): 179-189.

Belyayev, A.A., Ibragimova, T.A. and Sultankhodzhayev, A.N. 1990. *Evaluation of the comparability of geochemical monitory data*. Geochem. Intern. 27(8): 137-143.

Benedetti, M. and Boulegue, J. 1990. *Transfer and deposition of gold in the Congo watershed*. Earth Planet. Sci. Letters 100(1/3): 108-117.

Brindle, I.D. and Le, X. 1990. *D.C. Plasma atomic emission spectrometry in geochemical applications*. Geoscience Canada. 17(1): 41-48.

Coleman, T.B. 1989. *Exploration for Metalliferous and Related Minerals in Britain: A guide*. British Geol. Surv. 52 p.

Cook, H.J., Hallas, C. and Kaspersen, P.O. 1990. *The geology of the Sulitjelma ore field, northern Norway - Some new interpretations*. EG 85(8): 1720-1737.

Cook, N.J. 1990. *Mineralogical examination of gold-bearing samples*. CIM Bull. 83(944): 51-55.

Continued on Page 24

Recent Papers

Continued from Page 23

- Crocket, J.H. 1990. Noble metals in seafloor hydrothermal mineralization from the Juan de Fuca and mid-Atlantic ridges: A fractionation of gold from platinum metals in hydrothermal fluids. *Can. Min.* 28 (3): 639-648.
- Dingyuan, Zhang. 1989. Signal analysis of gold secondary halo in Doranasai gold deposit. *Bull. Nanjing Inst. Geol. and Min. Res., Chinese Acad. Geol. Sci.* 10(3): 94-
- Duke, J.M. 1990. Mineral deposit models: nickel sulfide deposits of the Kambalda type. *Can. Min.* 28(3): 379-388.
- Eppinger, R.G. and Closs, L.G. 1990. Variation in trace elements and rare earth elements in fluorite: A possible tool for exploration. *EG 85(8)*: 1896-1907.
- Green, W.R. 1990. *Exploration with a Computer*. Pergamon. 240p.
- Groen, J.C., Craig, J.R. and Rimstidt, J.D. 1990. Gold-rich rim formation on electrum grains in placers. *Can. Min.* 28(2): 207-228.
- Groves, D.I. and Vearncombe, J.R. 1990. The scale of ore-depositional systems: an important constraint on epigenetic vs. remobilized syngenetic origins for Archean mesothermal gold deposits. *Geologische Rundschau* 79(2): 345-354.
- Grunsky, E.C. and Agterberg, F.P. 1991. SPFAC: A FORTRAN-77 program for spatial factor analysis of multivariate data. *Computers and Geosciences* 17(1): 115-131.
- Harney, D.M.W., Merkle, R.K.W. and Von Gruenewaldt, G. 1990. Platinum-group element behavior in the lower part of the upper zone, eastern Bushveld Complex - Implications for the formation of the Main Magnetite layer. *EG 85(8)*: 1777-1789.
- Hodgson, C.J. 1990. Uses (and abuses) of ore deposit models in mineral exploration. *Geoscience Can.* 17(2): 79-89.
- Hood, P.J. 1991. The tools of the trade. *Northern Miner Mag.* 12-40.
- Hutchinson, R.W. 1990. Precious metals in massive base metal sulfide deposits. *Geologische Rundschau.* 79(2): 241-264.
- Hutchinson, R.W. 1990. Unconventional thinking in earth science. *Australian Geol. Newsletter* 76: 4-9.
- Khovanskiy, A.D. and Cherousov, S.Y. 1990. Landscape geochemistry of the northeast Black Sea. *Geochem. Intern.* 27(7): 41-49.
- Kontak, D.J. 1990. The east Kemptville topaz-muscovite leucogranite, Nova Scotia. I. Geological setting and whole-rock geochemistry. *Can. Min.* 28(4): 787-825.
- Kucha, H. 1990. Geochemistry of the Kupferschiefer, Poland. *Geologische Rundschau.* 79(2): 387-401.
- Large, R. 1990. The gold-rich seafloor massive sulphide deposits of Tasmania. *Geologische Rundschau.* 79(2): 265-278.
- Leblanc, M. and Billand, P. 1990. Zoned and recurrent deposition of Na-Mg-Fe-Si exhalites and Cu-Fe sulfides along synsedimentary faults (Bleida, Morocco). *EG 85(8)*: 1759-1769.
- Leitch, C.H.B. and Day, S.J. 1990. NEWGRES: a Turbo Pascal program to solve a modified version of Gresen's hydrothermal alteration equation. *Computers and Geosciences* 16(7): 925-932.
- Lundberg, C.G. and Holm, G. 1990. Challenges and promises of integrating knowledge engineering and qualitative methods. *Computers and Geosciences* 16(6): 847-856.
- Mattavelli, L. and Novelli, L. 1990. Geochemistry and habitat of the oils in Italy. *AAPG Bull.* 74(10): 1623-1639.
- Mazor, E. and Vuataz, F.D. 1990. Hydrology of a spring complex, studied by geochemical time-series data, Acquarossa, Switzerland. *Applied Geochem.* 5(5/6): 563-569.
- McKibben, M.A., Williams, A.E. and Hall, G.E.M. 1990. Solubility and transport of platinum-group elements and Au in saline hydrothermal fluids: Constraints from geothermal brine data. *EG 85(8)*: 1926-1934.
- Megill, R.E. 1989. *The Business Side of Geology*. AAPG. 54 p.
- Miller, J.W., Jr. 1991. Optimization of grid-drilling using computer simulation. *Math. Geol.* 23(2): 201-218.
- Naldrett, A.J. and Wilson, A.H. 1990. Horizontal and vertical variations in noble-metal distribution in the Great Dyke of Zimbabwe: A model for the origin of the PGE mineralization by fractional segregation of sulfide. *Chem. Geol.* 88(3/4): 279-300.
- Naldrett, A.J., Brugmann, G.E. and Wilson, A.H. 1990. Models for the concentration of PGE in layered intrusions. *Can. Min.* 28(3): 389-408.
- Noble, D.C. and Vidal, C.E. 1990. Association of silver with mercury, arsenic, antimony, and carbonaceous material at the Huanavelica District, Peru. *EG 85(7)*: 1645-1650.
- Parker, H.M. 1991. Statistical treatment of outlier data in epithermal gold deposit reserve estimation. *Math. Geol.* 23(2): 175-179.
- Petersen, E.U., Petersen, U. and Hackbarth, C.J. 1990. Ore zoning and tetrahedrite compositional variation at Orcopampa, Peru. *EG 85(7)*: 1491-1503.
- Plyusnin, A.M., Mironov, A.G., Belamestrova, N.V. and Chernigova, S.Y. 1990. Laboratory studies on gold-bearing sulfide oxidation. *Geochem. Intern.* 27(8): 45-53.
- Presser, T.S. and Swain, W.C. 1990. Geochemical evidence for Se mobilization by the weathering of pyritic shale, San Joaquin Valley, California, USA. *Applied Geochem.* 5(5/6): 703-717.
- Ragland, P.C. 1989. *Basic Analytical Petrology*. Oxford. 369p.
- Ripley, E.M. 1990. Se/S ratios in the Virginia Formation and Cu-Ni sulfide mineralization in the Babbitt area, Duluth Complex, Minnesota. *EG 85(8)*: 1935-1940.
- Ripley, E.M., Shaffer, N.R. and Gilstrap, M.S. 1990. Distribution and geochemical characteristics of metal enrichment in the New Albany Shale (Devonian-Mississippian), Indiana. *EG 85(8)*: 1790-1807.
- Schroll, E. 1990. Die metallprovinz der Ostalpen im Lichte der Geochemie - the metal province of the eastern Alps in the light of geochemistry. *Geologische Rundschau.* 79(2): 479-494.
- Shabashev, V.Y. 1990. Biogeochemical phosphorus aureoles at East Siberian apatite deposits. *Geochem. Intern.* 27(6): 73-81.
- Swennen, R. and Viaene, W. 1990. Lithogeochemical patterns around Pb-Zn mineralizations in Dinantian carbonate rocks of (eastern) Belgium. *Min. Deposita.* 25(4): 251-261.
- VanGaans, P.F.M. and Vriend, S.P. 1990. Multiple linear regression with correlations among the predictor variables. Theory and computer algorithm RIDGE (FORTRAN 77). *Computers and Geosciences* 16(7): 933-952.
- Weber, L. and Davis, J.C. 1990. Multivariate statistical analysis of stream-sediment geochemistry in the Grazer Palaozoikum, Austria. *Min. Deposita.* 25(3): 213-220.
- Wilson, G.C., Rucklidge, J.C. and Kilius, L.R. 1990. Sulfide gold content of skarn mineralization at Rossland, British Columbia. *EG 85(6)*: 1252-1259.
- Wood, S.A. 1990. The aqueous chemistry of the rare-earth elements and yttrium. 2. Theoretical predictions of speciation in hydrothermal solutions to 350°C at saturation water vapor pressure. *Chem. Geol.* 88(1/2): 99-125.
- Wood, S.A. 1990. The interaction of dissolved platinum with fulvic acid and simple organic acid analogues in aqueous solutions. *Can. Min.* 28(3): 665-674.
- Wood, S.A. and Vlassopoulos, D. 1990. The dispersion of Pt, Pd and Au in surficial media about two PGE-Cu-Ni prospects in Quebec. *Can. Min.* 28(3): 649-664.
- Xun, Liu. 1990. The mechanism of structural control of ore formation and geochemical characteristics in the massive sulfide deposits of the Wushan copper ore field, Jiangxi. *Acta Geologica Sinica* 64(1): 22-32.

Continued on Page 25

Recent Papers

Continued from Page 24

Yingwen, X. and Yuquan, Z. 1989. *Geological characteristics and REE geochemistry of Sn-mineralization granitoids in the Mt. Hengduanshan region - a preliminary study.* *Geochimica* 4: 303-313.

Yeliseyeva, O.P. and Volovikova, I.M. 1990. *The behavior of uranium in greisenization.* *Geochem. Intern.* 27(6): 61-73.

Zakharov, Y.P. 1990. *Correction for mercury fugacity and sorption in geochemical prospecting.* *Geochem. Intern.* 27(5): 45-53.

Zhitán, W. and Kezhang, Q. 1989. *REE geochemistry of porphyry copper multi-metal metallogenic series and its application in ore exploration in the Manzhouli-Xinbaerhuyougi area.* *Geochimica* 4: 314-367.

JOURNAL OF GEOCHEMICAL EXPLORATION

The 1991 publication year comprises volumes 39, 40, and 41. The first issue, a special issue on Geochemical Mapping, edited by Arthur Darnley and Bob Garrett, was distributed in January. This will be followed by Gold Geochemistry in Finland, edited by Alf Björklund. In June the Proceedings of the Rio IGES will be published. This was edited by Art Rose and Paul Taufen and is estimated to be 560 pages. In the second half of the year there will be three issues of regular papers. In total, volumes 39-41 will comprise 1200 to 1300 pages. Looking forward to 1992, the first issue is likely to be on Fluid Inclusions in Exploration, which has been organized and edited by Steve Kesler. The publication schedule is firm through to the end of 1993 with special issues, for which commitments have been made, and with regular issues.

Since I hear from subscribers about the irregularity of the publication schedule, an explanation is worthwhile. For regular papers, issues are published when sufficient papers have been received to fill the issue. If we only published regular papers, the schedule would be fairly evenly distributed over the year. However, special issues make up a substantial part of our volumes and these are less predictable. Editors must often wait past deadlines for manuscripts to be received. This can result in gaps in the schedule, that are followed by the publication of a cluster of issues. One way to avoid this is to build a backlog of papers for publication, so that if issues are delayed, there is material to fill the gap. But this is even less desirable, since authors like to see their papers published as soon as possible. The current year is one where we have a moderate (involuntary) backlog. In 1991, issues will be more regularly spaced than usual, but the time taken to publish articles will be somewhat longer.

Eion M. Cameron

Editor-in-Chief, Journal of Geochemical Exploration
Derry Laboratory,
Department of Geology
University of Ottawa
Ottawa, ON K1N 6N5
CANADA

Advertise in

EXPLORE!

Support Your Newsletter!

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 Sherman P. Marsh, Secretary AEG, U.S. Geological Survey, Mail Stop 973, Denver Federal Center, Denver, Colorado 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 Toronto office, recommendation by the Admissions Committee, review by the council, and publication of applicant's names in the newsletter remains unchanged.

VOTING MEMBERS

Janatka, Jiri
Senior Geochemist
Dept. Gold, Geindustria
Prague, CZECHOSLOVAKIA

Komov, Igor
Professor
Institute of Geochem.
Kiev, USSR

Mrna, Frantisek
Geochemist
Geological Survey
Prague, CZECHOSLOVAKIA

Noble, Donald C.
Professor
Univ. Nevada - Reno
Reno, NV, USA

Plant, Jane A.
Chief Geochemist
British Geological Survey
Keyworth, Nottingham, UK

AFFILIATE MEMBERS

Bahrey, Darren
Geologist
Richmond, BC, CANADA

Bourque, Andrew D.
Geochemist
Westminer Canada Ltd.
Halifax, NS, CANADA

Butler, Thomas A.
Consulting Geologist
Missoula, MT, USA

Carroll, John L.
JL Carroll Min Expl Oper.
New York, NY, USA

Dugal, Dennis R.
Owner
The Dugal Co.
Missoula, MT, USA

Espinoza, Jorge I.
Geologist
Santiago, CHILE

Georgees, Charlie
Principal
C. Georgees & Assoc.
Townsville, Qld, AUSTRALIA

Hayward, Sandra F.
Geochemist
Western Mining Corp.
Garbutt, Qld, AUSTRALIA

Henningsgaard, Jeff
Newmont Exploration Ltd.
Elko, NV, USA

Horwitz, Mark H.
Senior Geologist
Canyon Resources Corp.
Reno, NV, USA

Howard, Robert W.
Senior Geologist
Kalgoorlie, WA, AUSTRALIA

Macansh, J. Donald
Project Geologist
Townsville, Qld, AUSTRALIA

Marr, Patrick
Prospector
Milleville, NB, CANADA

Mayerle, Ron
Spokane, WA, USA

Continued on Page 26

New Members

Continued from Page 25

McKinlay, Todd
Geologist
Monopros Ltd.
Thunder Bay, ON, CANADA

Nunnemaker, Samuel G.
Minnova (USA) Inc.
Sparks, NV, USA

Osborne, Robert C.
Manager of Exploration
Ingold Holdings
Jakarta, INDONESIA

Phillips, Geoffrey N.
Professor
James Cook University
Townsville, Qld, AUSTRALIA

Rolley, Peter
Chief Geologist
Mawson Pacific Ltd.
Southern Cross, WA
AUSTRALIA

Schneider, Albrecht
Exploration Geologist
BGR
Hannover, GERMANY

Sevcik, Karel
Graduate Student
Prague, CZECHOSLOVAKIA

Severin, Paul, W.A.
Reg. Expl. Manager
Falconbridge Ltd.
Falconbridge, ON, CANADA

Skinner, Brian J.
Yale University
New Haven, CT, USA

Toohy, Jeff
Teck Explorations
Garibaldi Highlands, BC,
CANADA

Watters, Sheila
Geol. Consultant
Sussex, UK

Youngren, Elizabeth B.
Geologist
Boulder City, NV, USA

STUDENT MEMBERS

Colleran, Aaron
W. A. School of Mines
Beckenham, WA
AUSTRALIA

Hill, Scott J.
University of Utah
Draper, UT, USA

Hope, Sabine
University of Newcastle
NSW, AUSTRALIA

Kelemen, Tibor
University of B.C.
Vancouver, BC, CANADA

Margolis, Jacob
University of Oregon
Eugene, OR, USA

Trudu, Alfonso G.
Monash University
Clayton, Victoria, AUSTRALIA

CALENDAR OF EVENTS

International, National and Regional Meetings of Interest to Colleagues Working in Exploration and Other Areas of Applied Geochemistry

■ Apr. 15-19, '91 **Environmental pollution Mtg.**, Lisbon, by European Centre for Pollution Research and others (Int'l Conference on Environmental Pollution, 11-12 Pall Mall, London SW1Y 5LU, TEL: 01-930-6825; FAX: 01-976-1587)

■ Apr. 21-28, '91 **2nd AusIMM-SME World Gold '91**, Cairns, Australia (Meetings Dept., SME, TEL: (303) 973-9550, FAX: (303) 979-3461, Telex: 881988, or Mrs. J.M. Webber, CEO, AusIMM, P.O. Box 122, Parkville, Vic 3052, Australia, TEL: (613) 347-3166, FAX: (613) 347-8525, Telex: AA 33552)

■ Apr. 26-May 1, '91 **15th International Geochemical Exploration Symposium**, Reno, Nev. (Keryl Fleming and Mario Desilets, Nevada Bureau of Mines & Geology, Univ. of Nevada, Reno, NV 89557-0088. TEL: (702) 784-6691)

■ Apr. 29-May 2, '91 **Eighth Thematic Conference Geologic Remote Sensing**, Denver, Colorado (Nancy Wallman, Environmental Research Institute of Michigan, Box 8618, Ann Arbor, Mich. 48107-8618, TEL: (313) 994-1200, x3234, FAX: (313) 994-1575)

■ May 5-10, '91 **Geology of industrial minerals mtg.**, Banff, Alberta (Wylie Hamilton, Alberta Research Council, Alberta Geological Survey Department, Box 8330, Station F, Edmonton, Alberta, T6H 5X2, TEL: (403) 438-7676)

■ May 13-17, '91 **Brazil Gold '91** (USA-Charles Thorman, USGS (Denver), FAX: (303) 236-5448; Canada-C.Jay Hodgson, Queens U., FAX: (613) 545-6592; UK-Robert Foster, U. Southampton, FAX: 59-3052; Australia-David Groves, U. Western Australia, FAX: 9386-6577)

■ May 27-29, '91 **GAC-MAC (Annual mtg.)**, Toronto, Canada (J. Fawcett, Department of Geology, University of Toronto, Toronto, Canada M5S 1A1)

■ Aug. 30 - Sept. 3, '91 **Source, transport and deposition of metals mtg.**, Nancy, France (25 Years SGA Meeting, CREGU BP 23, 54501 Vandoeuvre-les-Nanvy Cedex, France, TEL: 33-83-44-1900, FAX: 33-83-44-0029)

■ Aug. 11-24, '91 **XX General Assembly IUGG**, Vienna, Austria (IUGG Organizing Committee, c/o ZAMG Hohe Warte 38, A-1190 Vienna, Austria, TEL: +43-222-36 4453 ext. 2001)

■ Sept. 2-4, '91 **Prospecting in areas of Glaciated Terrain, mtg.**, Edinburgh, Scotland (Conference Office, Institution of Mining and Metallurgy, 44 Portland Place, London, W1N 4BR, UK)

■ Sept. 11-13, '91 **Gold and Platinum in Central Africa**, Bujumbura, Burundi (W. Pohl, Institute of Geosciences, Technical University, P.O. Box 3329, D-33 Braunschweig, Federal Republic of Germany)

■ Sept. 16-19, '91 **2nd International Symposium on Environmental Geochemistry** Uppsala, Sweden (Prof. Dr. Mats Olsson, Department of Forest Soils, Swedish University of Agricultural Sciences, Box 7001, S-750 07 Uppsala, Sweden, TEL: 46 18 672212, FAX: 46 18 300831)

■ Sept. 21-24, '91 **Denver GeoTech/Geochautauqua '91**, Denver, Colorado (ExpoMasters, 11100 E. Dartmouth Ave., Ste. 190, Aurora, CO 80033, USA, TEL: (303) 752-4951, FAX: (303) 752-4970)

■ Oct. 21-24, '91 **Geological Society of America, ann. mtg.**, San Diego, California (Vanessa George, GSA, Box 9140, Boulder, CO 80301, USA, TEL: (303) 447-2020)

■ Nov. 11-28, '91 **5th International Circum-Pacific Terrane Conference**, Santiago, Chile (D.G. Howell, U.S. Geological Survey, MS 902, 345 Middlefield Road, Menlo Park, CA 94025, USA, TEL: (415) 329-5430)

Continued on Page 28

EXPLORE!

OUR NEW
T-SHIRT OFFER:



Sizes:

SML, MED, LGE, XL

Colors:

- White on Royal Blue
 Dk. Blue on White
 Lt. Green on Gray

Cost:

- AEG Members \$10
 Non-Members \$12

**Order Your
T-Shirt Today!**

Send Check or Money Order to:

EXPLORE
c/o Clark Smith
P.O. Box 18325
Reno, NV 89511

Calendar of Events

Continued from Page 26

■ Feb. 4-6, '92 **Minerals, metals and the environment, mtg.**, Manchester, England (Institution of Mining and Metallurgy, 44 Portland Place, London, W1N 4BR, UK)

■ May 22-24, '92 **Pan American Current Research on Fluid Inclusions (PACROFI IV)**, Lake Arrowhead, California, USA. (Michael A. McKibben, Dept. of Earth Sciences, University of California, Riverside, CA 92521-0423, USA, TEL: (714) 787-3444, FAX: (714) 787-4324)

■ May 25-27, '92 **GAC-MAC, ann. mtg.**, Wolfville, Nova Scotia (Aubrey Fricker, Atlantic Geoscience Centre, Bedford Institute of Oceanography, Box 1006, Dartmouth, Nova Scotia, B2Y 4A2, Canada, TEL: 902-426-6759)

■ Aug. 24-Sept. 3, '92 **29th International Geological Congress**, Kyoto, Japan (Secretary General, IGC-92 Office, P.O. Box 65, Tsukuba, Ibaraki 305, Japan, TEL: 81-298-54-3627; FAX: 81-298-54-3629)

■ Oct. 26-29, '92 **Geological Society of America, ann. mtg.**, Cincinnati (Vanessa George, GSA, Box 9140, Boulder, CO 80301, USA, TEL: 303-447-2020)

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

Fred Siegel

The George Washington University
Department of Geology
Washington, D.C. 20052
USA

LIST OF ADVERTISERS

Acme Analytical Laboratories, Ltd.	4,5
Activation Laboratories Ltd.	8
Becquerel Laboratories, Inc.	19
Bondar-Clegg	13
Cambria Data Services, Ltd.	6
Chemex Labs Ltd.	9
Cone Geochemical, Inc.	5
Geotemps, Inc.	10
Golden Software, Inc.	15
Graphic Harmony	12
International Plasma Laboratory Ltd.	17
LabScope — The Conifer Group	3
MEG Shea Clark Smith	3
MINEsoft, Ltd.	14
Northeast Geochemical and Assay Company	8
Theodore P. Paster	10
Prime Geochemical Methods, Ltd.	7
RockWare, Inc.	11
Skyline Labs, Inc.	7
T-Shirts — EXPLORE	12, 26

President:
Donald D. Runnells
Department of Geological Sciences
University of Colorado at Boulder
Campus Box 250
Boulder, Colorado 80309-0250
USA TEL: (303) 492-8323

Vice Presidents:
W. Kay Fletcher
Department of Geological Sciences
University of British Columbia
Vancouver, British Columbia V6T 2B4
Canada TEL: (604) 228-2392

Jeffrey A. Jaacks
Westmont Mining Inc.
4949 S. Syracuse, Suite 4200
Denver, Colorado 80237
USA TEL: (303) 694-4936

Secretary:
Sherman P. Marsh
U.S. Geological Survey
Federal Center, MS 973
Denver, Colorado 80225
USA TEL: (303) 236-5521

Treasurer:
David M. Jenkins
Suite 525 890 West Pender Street
Vancouver, British Columbia V6A 1J9
Canada TEL: (604) 684-6463

Councillors:
1989-1991
Maurice A. Chaffee (ex officio)
J. Alan Coope
Peter H. Davenport
Colin E. Dunn
Gwendy M. Hall
Erick F. Weiland

1990-1992
Harold F. Bonham
Ray E. Lett
Peter J. Rogers
S. Clark Smith
Arthur E. Soregaroli (ex officio)
Paul Taufen

Regional Councillors:
Australia: 1989-1991
Eric C. Grunsky
Graham F. Taylor

Europe: 1990-1992
Günter Matheis

Southern Africa: 1989-1991
Cecil C. Begley

Brazil: 1990-1992
John M.A. Forman

Northern Countries: 1989-1991
Alf J. Björklund

The Association of Exploration Geochemists Newsletter

U.S. Geological Survey, Federal Center MS 973, Denver, CO 80225, U.S.A.

Please send changes of address to:
P.O. Box 523 (Metropolitan Toronto)
Rexdale, Ontario, M9W 5L4 Canada.
EXPLORE does not maintain its own mailing list.



44 Voting PAID-91
ROBERT G. GARRETT
GEOLOGICAL SURVEY OF CANADA
601 BOOTH ST.
OTTAWA, ON K1A 0E8
CANADA