

EXPLORE

The Association of Exploration Geochemists Newsletter

NUMBER 61

OCTOBER 1987

President's Message

Stan Hoffman

This newsletter marks the debut of our Reno publication venue. Our newsletter represents one of the more visible benefits of membership in the association. It is the location where announcements are made and calls for papers are issued for future symposia — *but it is more than that*, it is a forum where you, the membership, can be heard.

The association is a non-profit organization whose existence depends entirely on volunteer efforts. Those contributing to the advancement of exploration or applied geochemistry do so as a public service, to help fellow workers better apply geochemical technology.

All readers should consider contributing perhaps 15 minutes or so each time our newsletter arrives with some thought to sharing a case history or piece of newsworthy information which might be of interest to others. This investment in time, if practiced by a large proportion of our membership, will yield dividends I am sure will better focus your own exploration efforts.

For example, in this newsletter is a request for information regarding laboratories, consultants and contractors. The Association is planning to commence regular publication of a manual which lists laboratories and contractors servicing the exploration industry, computer firms catering to our needs, and consultants. The idea is to compliment publication of our membership list and bylaws and perhaps an annual bibliography. Please help Lynda Bloom and your local contractors by completing the form on page 13 of this newsletter to assist her compilation.

CONTENTS

President's Message	1
News & Comment	1
Notes from the Editor	2
Personal	2
Letters	3
Technical Notes	
Magma Series: Chemistry & Mineral Deposits	5
Mobile Mercury: Applications in Search for Gold	6
Black River-Matheson (Brim) Data on Floppy Diskettes	6
Analysts Couch	8
Meeting Reports	
International Geochemical Mapping	8
Workshop on Anomaly Selection Criteria	12
Special Notes	
Professional Registration	13
Questionnaire	13
Calendar of Events	14
Recent Papers	15
Notice of 1988 Dues	17

NEWS & COMMENT

British Columbia Profile

Staff:	Project Geochemist	P.F. Matysek
	2 Contract Geochemists	J. Gravel, S.J. Day

Budget: \$625,000

Distribution of Funds:	Amount	Percentage
Regional Geochemical Sediment Surveys:	\$450,000	\$72%
Research and Development	\$175,000	28%

Formed in 1986, the Geochemistry Section of the Geological Survey is committed to a spectrum of programs designed to aid, stimulate and promote the growth of the exploration and mining industry in British Columbia. To ensure the effectiveness of the Branch's geochemical efforts the Industry Geochemical Advisory Committee has been assembled to make contributions from industry and the University of British Columbia for the conception and formulation of the branch's geochemical programs. The committee meets with the Branch at least twice a year to comment on proposed geochemical projects, review results and to provide feedback on the effectiveness of the programs.

Regional Geochemical Survey Program

The Geological survey Branch has been involved in regional geochemical sediment surveys since 1976. The accumulated database represents multi-element determinations and field observations of reconnaissance stream sediment and water sampling in twenty-eight 1:250 000 National Topographic System quadrangles (Figure 1).

The objectives of this program are threefold:
1. To provide industry with high-quality reconnaissance exploration data to aid in the search for precious and base metals;
2. To provide a consistent national database for 19 elements to serve as a basis for resource appraisal;
3. To provide a comprehensive data set that will delineate the regional geochemical patterns throughout the province and be used as baseline information for more detailed studies.

In 1987, the British Columbia Geological Survey and the Geological Survey of Canada pooled their resources to systematically sample and analyze stream sediments and waters from a 39,000 km² area in northwestern British Columbia. This year's survey resulted in the collection of over 2900 samples, at a sample density of one sample per 13 km² from a predominantly mountainous region modified by glaciation.

Sediment samples were field dried and the -80 mesh (.177 microns) fraction will be analyzed for Au, Zn, Cu, Pb, Ni, Co, Ag, Mn, Fe, continued on page 2

Notes from the Editor

The Proceedings of the 11th International Geochemical Exploration

Symposium held in Toronto during the Spring of 1985 have been mailed to members as volumes 28 and 29 of *The Journal of Geochemical Exploration*. We owe Bob Garrett a great deal of gratitude for this monumental finale to an excellent meeting which he organized with Bill Coker.

Collectively the two volumes constitute more than 950 pages. If you haven't received them, check that your dues were paid for 1987 and write Ines S. Filicetti at P.O. Box 523 (Metropolitan Toronto), Rexdale, Ontario, M9W 5L4, Canada.

Prepublication orders for the **Geo Expo/86 Proceedings** have been sent out. Those

who wish to order a copy may use the form on page 19 of this newsletter. If you did not receive your volume, please correspond with the Vancouver address on this form as opposed to the Rexdale office.

As our **advertisers** are important to the innovations of EXPLORE; please mention seeing their special effort on our behalf when you talk or correspond with them.

We would like to make **The Analysts Couch** and **Technical Notes** are regular columns. Please don't be shy about submitting your contributions. Notes for the *Analysts Couch* will concern the interrelation between the geologist and the laboratory.

We would also like to start a new section called **The Pearl Harbor File** at the suggestion of Stan Hoffman.

It would document pitfalls and failures in geochemical exploration. Usually we only want to publish our successes, but much can be learned from mistakes, too.

Please type your **submittals** double-spaced and send illustrations where possible. Meeting reports may have photographs, for example. Text is actually preferred on paper and 5 1/4 inch IBM-compatible computer diskettes which can go directly to typesetting. (Please indicate the word processor format or ASCII.) Copy deadlines are December 15, March 15, June 15, and September 15. Line drawings and photos with a legend are needed for fillers.

Don't forget to pull out page 17-18 which is your **membership dues notice**, and put it with your bills to be paid!

Chet Nichols

EXPLORE

Newsletter No. 61

October 1987

EDITOR: Chester E. Nichols (702) 331-4223

Associate Editor: Harold F. Bonham (702) 784-6691

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

TELEX, Prof. H.F. Bonham, AEG Newsletter 910 380 6050 NVU LIB

Advertising Rates

Advertising rates are on a per-issue basis (4 issues per year). Frequency discounts and rates for color separations are available. Only camera-ready copy is accepted. Please direct advertising inquiries to: S. Clark Smith, P.O. Box 9777, University Station, Reno, Nevada 89507-9777.

Full Page	254h x 178w mm (10h x 7w in)	U.S.\$600
Half Page	124h x 178w mm (4 7/8h x 7w in)	U.S.\$350
	254h x 86w mm (7h x 3 3/8w in)	U.S.\$350
Quarter Page	124h x 86w mm (4 7/8h x 3 3/8w in)	U.S.\$200
	254h x 40w mm (10h x 1 9/16w in)	U.S.\$200
Eighth Page	60h x 86w mm (2 3/8h x 3 3/8w in)	U.S.\$125
	124h x 40w mm (4 7/8h x 1 9/16w in)	U.S.\$125
Business Cards*	50h x 86w mm (2h x 3 3/8w in)	U.S.\$ 50

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

Advertising submitted as a technical contribution is eligible for the following discounted schedule:

Full Page	U.S.\$420
Half Page	U.S.\$260
Quarter Page	U.S.\$160

The Editor reserves the right to insert the word "Advertisement" on all ads. Advertising and technical contributions should be submitted by March 15, June 15, September 15 and December 15 for publication in the following month.

Technical articles submitted as advertising, and purely scientific contributions are strongly encouraged. Text is preferred on 5 1/4 inch IBM-compatible computer diskettes for which the word processor or ASCII format is indicated. The Newsletter endeavors to become a forum for late advances in exploration geochemistry and a key informational source.

NEWS & COMMENT

continued

Mo, W, U, As, Sb, Cd, V, Ba and LOI. Fluoride, uranium and pH will be determined for stream waters. High quality analytical results are ensured by using specific and sensitive determination techniques and by monitoring of analytical variation by duplicates and standards.

The sampled area is under active exploration by a large number of companies, and it is anticipated that several new mines will be brought into production in the next few years.

Survey results will be released in midsummer 1988. A data packet consisting of a sample location map, detailed listings, statistical summaries and maps for individual elements showing range symbols and values on a geological and topographical base will be available for purchase.

To aid a more thorough and refined assessment of the Regional Geochemical Survey Program data by the exploration community, survey results will also be available on IBM-compatible floppy diskettes. Data from previous surveys are already available in this convenient computer-accessible format.

Orientation Study—Vancouver Island

In preparation for the 1988 Regional Geochemical Survey covering 20,000 square kilometers of northern Vancouver Island, an orientation study was conducted which included the collection of 320 sediment samples from 30 streams in the region. The streams sampled drain a variety of mineral occurrences including Fe-(Au-Cu-Ag) skarns, Pb-Zn-Ag skarns, Au-Ag-Pb-Zn mesothermal veins, Au-Ag epitermal veins and Cu-Mo-(Au) stockworks and porphyries. Areas where no mineral occurrences are known were included to indicate geochemical background.

Five types of samples were

informed the members that he has established a new commercial neutron activation laboratory in conjunction with Technical Service Laboratories. The new company, Activation Laboratories Ltd., is located at 383 Elgin Street, Units #2 & 8, P.O. Box 1420, Brantford, Ontario, Canada, N3T 5T6. (519) 758-0310.

collected from each stream sampling station:

1. Bulk sediment (10 kg minus 1 mm) sieved in the field from coarse gravelly sediment; for determination of heavy minerals (Au, W, rare earths, etc.) from three size fractions ($-60+100$, $-100+200$, -200 mesh) separated by heavy liquid.
2. Bulk sediment (10 kg minus 1 mm) field-sieved from sandy sediments for comparison with sample (1).
3. Fine sand (2 kg) for multi-element analysis of the -80 mesh fraction.
4. Bulk fine sediment (10 kg) for multi-element analysis of the three size fractions mentioned above.
5. Moss mat sample (1 to 2 kg) processed to release entrapped sediment. The -80 mesh fraction of the sediment will be analyzed in the same fashion as samples (3) and (4). This sample type is being tested as a substitute for sampling fine sediments which are often difficult to find in the steeper mountain streams.

In addition, sample types (3), (4) and (5) were collected at up to 12 stations at 500 m intervals along streams draining mineralization to determine

dispersion characteristics and the availability of stream sediments and mosses.

Platinum in Stream Sediments and Soils—South Central B.C.

Despite rapidly increasing interest in exploration for platinum deposits, guidelines are not available to optimize geochemical methods. Little is known about the distribution and behaviour of platinum and associated elements in stream sediments, glacial tills and soils and recommendations on sampling and analysis have to be speculative.

A co-operative study involving the Branch, the University of British Columbia and industry is investigating the subject. Streams and soils profiles were sampled over four geologically distinct platinum occurrences, Alaska-type, alpine-type, alkalic-hosted and skarn-hosted in central British Columbia.

Distribution of Pt-group metals in different soil horizons and size and density fractions of anomalous and background soils and sediments is a main focus of this study. Within-site variability and downstream dispersion

characteristics of Pt-group metals in sediments and physical and chemical speciation of platinum minerals in selected samples is also being examined.

Gold in Stream Sediments—Central British Columbia

Gold content of stream sediment is seriously affected by the low number of gold grains in stream sediments, causing high random sampling errors as a result of selective hydraulic sorting. Recent studies have shown that errors caused by particle scarcity and selective sorting of heavy minerals decrease with decreasing grain size and that sampling for finer grain sizes is therefore advisable.

A study has been implemented to compare the reliability of conventional stream sediment and heavy mineral sampling for various sizes of gold particles. Replicate sediment samples were collected downstream from known anomalous and background drainages to estimate within-site variability, and hence the probability of obtaining a geochemical value indicative of a true anomaly, a false (nonsignificant)

anomaly, a false background (missed anomaly), and a true background.

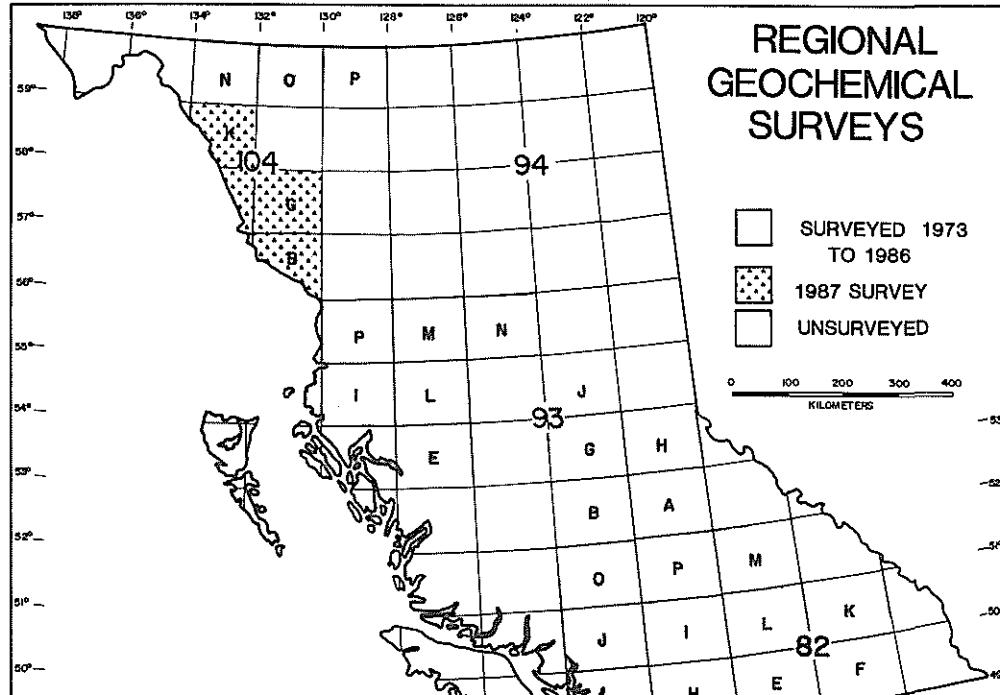
Other Studies

The Geological Survey Branch has also funded a number of geochemical studies in the Department of Geological Sciences at the University of British Columbia. These include wallrock alteration at the Erickson gold mine, an analysis of the effects of seasonal variation on the gold content of an anomalous stream and a number of specific mineral deposit studies.

Results of these geochemical programs as well as other field and research projects undertaken by Branch staff are presented in Vancouver annually at British Columbia's premier earth science forum, the Cordilleran Round-up. The proceedings are published in the Geological Fieldwork volume. The next meeting will be held February 2-5, 1988.

Further information can be obtained by contacting:

Paul Matysek
Project Geochemist
Geological Survey Branch
British Columbia Ministry
of Energy, Mines and
Petroleum Resources
300-756 Fort Street
Victoria, B.C., V8V 1X4



REGIONAL GEOCHEMICAL SURVEYS

- SURVEYED 1973 TO 1986
- 1987 SURVEY
- UNSURVEYED

0 100 200 300 400 KILOMETERS

Letters

Geochemical Atlas of the World

When I received notice earlier this year of the proposal for a Geochemical Atlas of the World, I immediately wrote to AEG Council. My views, in summary, were that it was a wonderfully exciting concept and a practical impossibility. The latter comment arose from personal knowledge of the difficulties of obtaining global cooperation on

Letters

continued

enthusiasm for even a State Atlas in Australia, and a fairly good appreciation of the costs involved.

I have just returned from another month with the Geological Survey of Finland. I have again been exposed to the results of the work of their Geochemistry Department on the Geochemical Atlas of Finland. This Atlas (which will be published later this year) is based on till samples at a density of one sample per 300 km² and the data are presented in a singularly useful fashion. The results are astounding and even the limited geological interpretations yet done are quite startling.

To be brief, and without expounding all the theoretical reasons why such an approach works, and without explaining the range of practical benefits, I now wish to fully support the concept of a World Geochemical Atlas. The practical difficulties are no less formidable than they were a few months ago, but I believe that the potential

benefits are so great that all geochemists and relevant organizations should do their utmost to overcome the problems.

The prospect of extremely low density sampling over large enough areas to reveal mega-geological features of fundamental importance to control of the distribution of mineralization is the most exciting development in exploration geochemistry since the early experiments more than 30 years ago. It may even be enough to dispel the moribund state of the profession alluded to by Glen Allcott. (Newsletter No. 59).

Incidentally, I had similar gloomy thoughts on the membership and future of the Association at the end of my Presidency 10 years ago—but it has grown and prospered magnificently since then. (I don't think membership fee has increased since then)!

Yours faithfully,

**G. J. S. Govett,
University of
New South Wales**

The Analyst's Couch

In a reply to a letter to the editor by Peter D. Tillman (Newsletter, No. 59), L. Kothny elaborated on the reproducibility of gold and PGM analyses, stressing the

interference of common matrix elements whenever some sort of a spectrum is used in the final determination. While there is no doubt that these interferences do exist, they can usually be eliminated by relatively simple chemical steps (an example is the stripping of Fe from the MIBK extract in gold analysis by AAS).

However, I think a much more serious problem, in fact the problem, in this type of analysis has not been mentioned at all by L. Kothny: the notorious inhomogeneity of samples which is typical for all minerals occurring, for various reasons, as discrete and stable grains in the geochemical environment (Sn, W, Nb, Li, Be etc. besides Au, PGM).

Obviously this problem of grain effects, resulting in poor analytical reproducibility, cannot be overcome by chemical procedures but rather is a matter of sample size and sample preparation (homogenization). In the case of metal grains (Au, Ag, PGM) in the sample which cannot be homogenized by fine grinding, a compromise has to be found between convenient and practical sample size and the required analytical precision and accuracy. This problem of

statistical mineral grain distribution naturally effects all analytical techniques, including the fire assay which often is claimed to be the "best" method in precious metals analysis. Even the best technique can only determine what actually is present in the analytic portion of a sample.

The exploration geochemist working on Au, Sn, W, Nb, etc. seems to have to live with this difficulty which apparently is rather difficult to understand and to accept by "pure" chemists with insufficient understanding of the mineralogy and the geochemistry of their samples. Therefore, the problem of poor reproducibility in certain geochemical analyses is in principle not the technique or analytical interferences but the sample itself and its mineralogical-geochemical nature and the chemist (not geo-chemist) who expects the impossible and naturally will get disappointed.

This close interrelation between mineralogy-petrology-field geochemistry and analytical chemistry-laboratory geochemistry again stresses the importance of a thorough understanding of both aspects involved and this, in my opinion, can only be achieved if the geochemist is likewise conversant and in charge of both the field geochemistry and the analytical geochemistry, especially in mineral exploration programs where poor analytical reproducibility is quite common but often insignificant and a characteristic of fast "geochemical" analyses (who does not know the quarrels between the "pure" exploration geologist and the "pure" analytical chemist over the meaning and reproducibility of one or two analytical results?).

Yours faithfully,

**L. Borsch
Chief Geochemist**

AEG SYMPOSIUM 1988



CALL FOR PAPERS

"Geochemistry of Platinum Group Metals" (Deadline 20 November, 1987)

One day symposium sponsored by the Association of Exploration Geochemists as part of the V.M. Goldschmidt Conference outside BALTIMORE, MARYLAND

11th - 13th May, 1988

Abstract forms are available from either:

Goldschmidt Conference Coordinator
410 Keller Building
The Pennsylvania State University
University Park, Pennsylvania 16802, U.S.A.

Colin E. Dunn
Geological Survey of Canada
601 Booth Street
Ottawa, Ontario, K1A OE8, Canada

This significant geochemistry meeting to mark the centennial year of V.M. Goldschmidt's birth, is being organized by the Geochemical Society and sponsored by six major international societies involved in geochemical studies. The meeting will comprise 11

Richard W. Lewis

It is with sadness that we inform you of the death of our colleague and friend Dr. Richard W. Lewis who passed away earlier this year. Richard Lewis spent the last 23 years introducing and practicing exploration geochemistry in Brazil and ably served the Association as regional councillor for the country during much of this time.

Rarely can it be said that any one individual was responsible for the development of an applied science as diverse as exploration geochemistry in a geographic area comprising almost half a continent, but this was very close to the case with Richard Lewis and Brazil. First arriving with the U.S. Geological Survey, he started and managed a commercial geochemical laboratory, Geoquimica Ltd., while consulting on various projects for both private industry and government corporations. Dr. Lewis kept

in close contact with a number of universities in Brazil and did much to encourage the including of geochemical coursework in the geosciences departments.

More recently, Dr. Lewis organized the International Workshop on Geochemical Exploration of Rainforests held in Manaus, Brazil in 1985. In the course of these commercial and scientific efforts, perhaps his largest contribution was the generation of greater awareness and respect in this part of the world for the capabilities of applied exploration geochemistry.

Dr. Richard Lewis's energy and unselfish contributions to the advancement of our science along with his good-natured humor will be sorely missed.

Sincerely yours,

Paul Taufen
c/o Glenda Taufen
Amcongen-Rio
APO Miami, FL 34030-3090

TECHNICAL NOTES**Magma Series:
Chemistry and Mineral Deposits**

The magma series chemical classification of igneous rocks is a fundamentally new earth science breakthrough. It is based on an empirical relationship between magma series chemistry and mineral deposits that has been developed over the past 10 years through inductive logic and computerized multivariate synthesis of a worldwide chemical and isotopic data base of over 8000 mineral systems and 5000 igneous rock suites.

Magma Series Classification

The notion of magma series is the core concept of the classification (Figure). A magma series is a suite of comagmatic igneous rocks that have evolved along a petrochemically and *metallogenetically* distinct differentiation path from a more mafic parental melt. In a sense, mineral deposits are simply the products of "dirty magma"; in the case of epigenetic mineral deposits, the metalliferous hydrous dregs are left over at various stages during the differentiation of a particular magma series.

As anomalous trace metal expressions of a magma series, the metallogenic data can be and is being used to construct a chemical classification of a magma series by integration with more conventional petrochemical data of the magma suite. Rather than surveying other petrologists about how they use a term such as andesite, Au:Ag ratios of precious metal deposits associated with andesites were consulted. A high potassium group of andesite systems associated with hydrous alkali-calcic metaluminous magmatism

Magma Series Chemical Classification

Every igneous taxonomic distinction in the magma series petrochemical classification has been constructed with such off-plot empirical background metallogenic information in mind. The classification takes the form of a logical hierarchy based on serial chemistry of igneous rocks. First, second and third order distinctions are made based on aluminum, alkaline and trace element content of the magma series and identify the magma series "family" and by implication the "parent" magma source region in the crust or mantle.

The fourth order distinctions based on iron content can be empirically tied to the presence of anhydrous (iron-rich) or hydrous (iron-poor) mineral content. As such, iron content measures the capability of the magma series to produce either a hydrous metallogenic phase which is epigenetically deposited in veins in the iron poor case or magmatic metalliferous segregation in the anhydrous iron-rich case.

Fifth order distinctions are based on oxidation state of the magma series as measured by ferric: ferrous ratio. Use of oxidation state allows an additional major "miniseries" level subdivision of metallogenic affinity previously defined at higher levels based on 3rd order alkalinity criteria (Figure).

Oxidation state constitutes the most direct link to mineral system deposition and economics because it is the final control of metal content in the magma before it is released into ore fluids. Oxidation state also offers an intriguing reconciliation of

GOLD & PRECIOUS METAL EXPLORATION**Acme Analytical's 1987 Special Offer****Geochemical Gold & 30 element ICP Analysis**

\$10.25/sample

Detection: Au 1 ppb.

Geochem Au, Pt, Pd, Rh + 30 element ICP Analysis

\$16.00/sample

Minimum 20 samples per batch or \$5.00 surcharge.

Rocks, add \$3.00; Soils, add \$.75 for preparation



Acme Analytical Laboratories Ltd.
852 E. Hastings St.,

TECHNICAL NOTES *continued*

wallrock assimilation can exert a major influence on oxidation state or charge balance of a magma whereas it takes massive assimilation of wallrock to change the mass properties of incoming mantle derived magmas. More oxidized magmas release chlorine, base metals, and molybdenum into the dissolved fluid phase whereas Au, Ti, As, Sb, Se, and Hg are released into hydrothermal fluids under more reduced conditions.

Exploration Application

The most direct practical application of magma series petrochemistry is to mineral exploration, because it enables the explorationist to empirically tie mineral systems to their ultimate economic potential early in

the property evaluation process, thus providing timely and inexpensive evaluation of a particular mineral system. An example of how the system works is its employment in the search for Round Mountain-type volcanic-hosted Au deposits in the Great Basin of the southwestern United States. Existing exploration models predict any volcanic-hosted quartz-adularia epithermal precious metal system may potentially yield a Round Mountain type deposit. The magma series approach suggests that only quartz-adularia stockwork systems associated with metaluminous hydrous iron-poor calc-alkalic andesite to rhyodacite hypabyssal intrusions will yield the

grade/tonnage parameters of a Round Mountain-type Au deposit.

Silver-rich quartz adularia systems (e.g. Tonopah, NV) associated with metaluminous hydrous iron-poor alkali-calcic volcanism or quartz-adularia gold veins (with beryllium geochemical anomalies) associated with metaluminous quartz alkalic volcanism simply will not yield Round Mountain-type gold deposits. In the Great Basin these non-Round Mountain silver or gold-beryllium biased quartz adularia systems account for about *two-thirds* of the volcanic-hosted Round Mountain-type targets that many explorationists consider fair exploration game.

Much time and energy has been spent looking at the wrong quartz adularia precious-metal systems—systems that with preliminary inexpensive geochemical

screening could have been avoided for Round Mountain potential at the initial stage of exploration decision making.

Earth Model Implications

Beyond mineral exploration, which this abstract has only touched upon, probably the most profound implication of magma series chemistry is for earth science in general, because it provides an empirically based petrologic model that can be used to more clearly decipher the structure and chemistry of the earth's mantle and crust. As such, the classification constitutes a logical paradigm for petrology, mineral deposits and geodynamics in a space-time context.

**Stanley B. Keith
Monte M. Swan**

*MagmaChem Exploration, Inc.
9831 South 51st Street, Suite C
Phoenix, Arizona 85044
(602) 893-1434*

Black River—Matheson (Brim) Data on Floppy Diskettes

The Ontario Geological Survey has undertaken overburden sampling north-eastern Ontario, in an area of potential gold mineralization. Overburden samples were collected in 1984 and 1985, using rotasonic drilling and backhoe trenching, in the Black River—Matheson area. Approximately 1000 samples were processed to produce –250 mesh, –10 mesh and non-magnetic heavy mineral fractions, and analyzed for 15 elements.

The geochemical, mineralogical and textural data for these samples have been made public in Ontario Geological Survey Maps 80761 to 80796, and 80838 to 80893. The data were also released on 5½" IBM-

compatible floppy diskettes in March, 1987.

New files are now available to be used in conjunction with the data. These files contain UTM coordinates, drill hole elevations, sample intervals and stratigraphic units of the holes. Documentation is included which describes individual file contents and format. This data set provides a useful test database for explorationists working in glaciated terrains.

**Lynda Bloom
Ken Steel**
*Ontario Geological Survey,
Geophysics/Geochemistry
77 Grenville St., Room 806
Toronto, M7A 1W4 Canada
(416) 965-5503.*

Mobile Mercury Application in the Search for Gold

The use of mercury as a pathfinder for buried metallic ore bodies was first proposed by Saurkov in 1946

mercury content in metallic ore bodies is almost always higher than in their associated gangue rocks

Magma Series	Ox*	Metallogeny
CALCIC	R O	Au Au Ag
CALC—ALKALIC		Ag W Be Pb Zn
ALKALI—CALCIC	sR sO	Sn W Cu Li F C Ag W U
ALKALIC	O sO	U Be
MAGNESIAN	sR R wO	Au As Ni Cu Pd Cr
CALCIC	sR R wO	Platinoids Au Cu Ni Co As Cu Zn Fe
CALC—ALKALIC	R wO O	Au Hg Sb As Cu Au W Cu Mo Ag Pb Zn Mn
ANORTHOSITIC	R	Tl V Fe P
ALKALI-CALCIC	R O sO	Sn B Ag Ge Ga In As Ag Pb Za Mo F W Mn Fe Be F U
PERALKALIC	RwO O sO	Hg Li U Ti Sc Tb Hf Zr U Th Nb F Y Be F
QUARTZ ALKALIC	R O sO	Au Platinoids Cu Pb Za Mn U Th F U Th F
NEPHELINE ALKALIC	R wO sO	Au Te Platinoids As Cu Li RE F U Nb
ULTRA ALKALIC	R O	Diamonds Cu Ti P Zr V Cu U Nb F

develop primary aureoles, while in later stages the mercury liberated by supergene processes would generate secondary halos in the host rocks.

Saukov (1946) proposed the analysis of mercury vapor in soil-gas as an exploration method for buried or blind ore bodies. Since this pioneering work of Saukov, applications of mercury vapor as a pathfinder for ore bodies has received numerous trials. However, it was found that the content of mercury vapor in the soil-gas is strongly affected by climatic and atmospheric factors which frequently produced unreliable data.

As an alternative, the analysis of total mercury content in solids and rocks was postulated as a way to generate stable and reliable results. This method of analysis, although stable and reproducible, results in very mixed reviews. The major problem with the analysis of total mercury content is the low anomaly/background ratio, which generally yields very poor resolving power when exploring for buried ore bodies.

The difficulty in applying mercury as a pathfinder, lies in an oversimplification in the understanding of the various modes of occurrence of mercury containing minerals, and in the differentiation of these mercury forms in the natural environment. Volatile, temperature dependent, and more soluble mercury forms are capable of traveling the greatest distances from the ore zone and so form the best exploration pathfinders for buried deposits.

Many higher temperature forms occur in and very near the ore zone which are very useful in predicting proximity to the ore forming processes. In fact, by examining the mercury over a wide temperature range, which includes high temperature forms, it is possible to vector the direction of an ore body from a set of borehole

between the primary and secondary halos.

Failure to recognize the importance of these various mercury forms is compounded by mercury analysis techniques, which use high temperature retorting (up to 600°C) to release the mercury from the solid phase. This type of total mercury analysis mixes these low and high temperature compounds during analysis and destroys the information conveyed by the presence of

each of these individual mercury compounds.

A new extraction and analysis technique has been developed which employs differential thermal analysis (DTA) for the characterization of these various mercury forms. This DTA technique yields superior results as compared to the conventional analysis of making a total mercury measurement which combines all the mercury liberated from its different

compounds. The superior performance of the DTA method also allows one to determine the most diagnostic low temperature forms of mercury which have the highest potential as a pathfinder for buried ore deposits.

Mr. J. B. Maciolek
Dr. V. T. Jones
Exploration Technologies, Inc.
1441 Park 10 Boulevard
Houston, Texas 77084
Phone: (713) 578-7510

GEOCHEMICAL MAPPING IN THE REGIONAL CORRELATION OF GEOLOGICAL TERRANES AND METALLOGENIC ANALYSIS

*A special session
to be held during the 1988 annual meeting of
The Geological Association of Canada
The Mineralogical Association of Canada
The Canadian Society of Petroleum Geologists*

ST. JOHN'S, NEWFOUNDLAND, CANADA
May 22-25, 1988

Aim

The aim of this special session is to present examples of how regional geochemical patterns characterize major geological terranes and metallogenic features of the earth's crust. It is expected that papers will cover many aspects of techniques and results of geochemical mapping, including:

- the relationship between regional geochemical patterns and metallogenic belts;
- deep crustal and mantle influence on regional geochemical patterns at the earth's surface;
- sample media and sampling strategy for geochemical mapping;
- radiometric surveys as a geochemical mapping tool;
- methods of correlating geochemical mapping based on different sample media;
- methods of data reduction for, and presentation of regional geochemical maps;
- uses of geochemical mapping in regional geological correlation.

GENERAL FORMAT

This special session will form an integral part of the GAC-MAC-CSPG annual meeting which covers all aspects of geology during three days of technical sessions and social events, with field trips and short courses before and after the meeting.

SESSIONS WITH RELATED THEMES

Several sessions will run concurrently, and many will have relevance to geochemical mapping, including those with the following themes:
 Middle Proterozoic sequences and tectonic evolution of the North American and Scandinavian Shields
 New developments in Appalachian-Caledonian geology,
 Progress in ICP/MS analytical techniques
 Groundwater flow systems in mineral exploration.

FIELD TRIPS

A wide range of field trips will be offered covering various aspects of the Appalachian geology displayed in Newfoundland, including visits to mineral deposits and prospects.

Address correspondence to:

Dr. P.H. Davenport, Newfoundland Department of Mines,
 95 Bonaventure Avenue, P.O. Box 4750,
 St. John's, Newfoundland, Canada A1C 5T7.

Analysts Couch

Analytical Imprecision and Data Interpretation

Acceptable precision limits for interpretation of single element patterns are higher than limits required for a multi-element interpretation. This is because the errors inherent in the data are added together (either as absolute or percentage uncertainties) when mathematical functions are applied to the data.

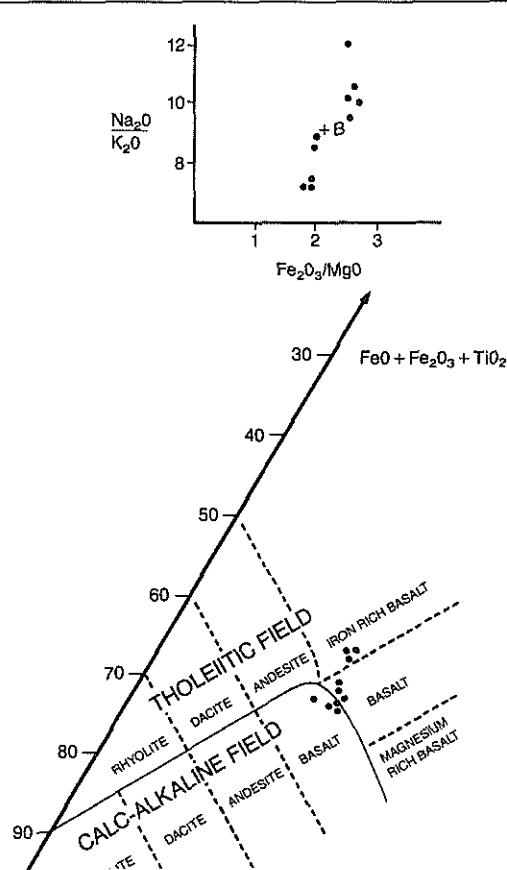
An empirical approach has been used to demonstrate the importance of taking into account variations in the data caused by normal analytical imprecision. A mafic volcanic rock sample was analyzed for 10 major oxides. Each data point was then altered by a random factor of 0.85 to 1.15, representing data falling within $\pm 15\%$ precision limits. Data for 10 fictitious samples were generated.

The data for the 10 samples were then plotted on bivariate and ternary diagrams (Figures). It is apparent that a trend is developed on the bivariate plot, and a range of rock names can be applied to the same sample.

This treatment of the data represents a 'worst case' scenario because precision limits would hopefully be less than 15% for at least some elements. This is an interesting exercise to carry out on your own data sets using multi-variate plots commonly in use. It may be worthwhile to show 'error bars' on bivariate and ternary plots.

Lynda B. Bloom

665 Roselawn Avenue, Apt. 214
Toronto, Ontario M5N 1L1, Canada



MEETING REPORTS

International Geochemical Mapping

Summary report on the workshop discussion held at BRGM, Orleans, France 22 April, 1987.

This workshop took place on the opening day of the 12th International Geochemical Exploration Symposium.

The workshop was co-chaired by Dr. A.G. Darnley of the Geological Survey of Canada, Professor Alf Bjorklund of the Abo Akademi, Finland, and Professor P.V. Koval of the A.P. Vinogradov Institute of Geochemistry, USSR. A recommendation to commence the preparation of worldwide geochemical maps (including radioelement maps) had been made previously at an Advisory Group Meeting of the International Atomic Energy Agency in October 1985.

The recommendation was further elaborated at a later Advisory Group meeting on "The Use of Airborne Radiometric Data to Define the Natural Background Radiation Environment". A proposal for action was drawn up by Dr. A. G. Darnley of the Geological Survey of Canada, Chairman of the above meetings, in October 1985 and circulated to a wide international group of earth scientists for comment.

After modification it was submitted in February 1987 to the International Geological Correlation Program (IGCP) at UNESCO. The submission was returned for additional information and supporting examples with the request to resubmit in the Fall of this year. Discussion at the workshop focussed on the steps to be followed in preparing the necessary modifications and additions.

The original proposal drew heavily on recommendations

for the proposed execution of the project.

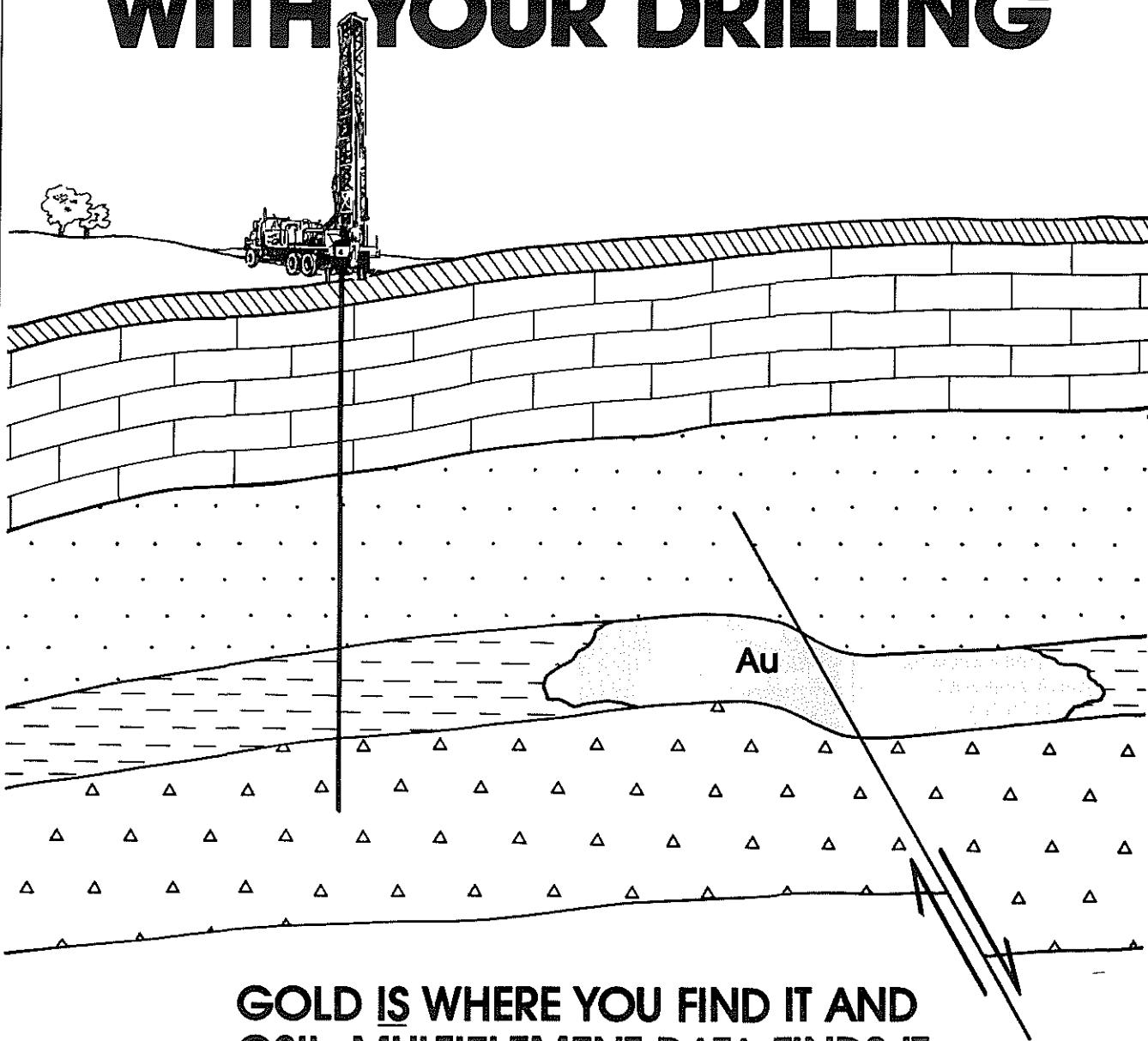
During the workshop brief presentations were given by national and other representatives showing examples of the type of results that have been obtained in geochemical mapping programmes to date.

Finland: Dr. Bjorklund presented examples of experiments carried out on data from the Nordkalott project and the regional sampling programme of the country to examine what information could be obtained from very low density surveys (1 sample/300km²). Using a total of 900 samples from the country, maps were prepared showing element distributions. These maps delineated the major geological blocks of the country.

In addition, several of the mineral belts were able to be correlated with mobile belts in the Soviet Union that had been defined by geological mapping. In one instance a prominent element trend never before recognized was found to crosscut major lithological and structural trends. The cause of this is not known, but one hypothesis proposes that this trend may be related to a major feature of element distribution in the mantle.

Newfoundland, Canada: Geochemical surveys have been carried out over the island of Newfoundland and Labrador. On the island stream sediments were sampled at a density of 1 sample/7 km² while in Labrador lake sediments were sampled at a density of 1 sample/13 km². The lake sediment data shows a striking correlation of uranium between northern Labrador and Greenland.

GET ON THE TREND WITH YOUR DRILLING



**GOLD IS WHERE YOU FIND IT AND
GSI's MULTIELEMENT DATA FINDS IT...
ASK YOUR COMPETITION.**



2741 Toledo Street, Suite 201
Torrance, California 90503
Telephone 213/320-3680
FAX 213/320-9480

Free statistics and contour maps for each program. Please call or write for detailed information.

MEETING REPORTS

continued

cover 3 million km², using stream sediments analyzed for 39 elements. Sample densities range from 1 sample/km² to 1 sample/4 km². 1.4 million km² have already been covered.

Of interest is the effort taken to standardize the methods and particularly the analyses carried out in different provincial laboratories throughout the country. National primary standards were prepared for each province. These are used to calibrate large quantities of secondary standards that are prepared in each province to control analytical quality between batches and between map sheets.

The Chinese delegate proposed that China might be able to supply primary standards for the International Geochemical Mapping Project. In any case their experience in preparing very large quantities of standard materials would be invaluable to the project.

France: In France geochemical sampling is approached in a different way. Sampling is undertaken over major units but is aimed at areas of greatest mineral potential. Sample density is approximately 3 samples/km². The French workers question the value of low density sampling such as 1 sample/300-500 km².

Greenland: The Greenland Geological Survey has been carrying out geochemical surveys of the exposed parts of the island for a number of years. Sample media have been stream sediments, glacial till and in some cases residual soils. Recently work has been carried out using various data treatment methods to try to define the sample densities required to detect features in the order of 100 km wide. These experiments

Norway has been completed at various densities, from 1 sample/300 km² to 1 sample/500 km², using several media. The country has been covered with 7000 samples. Of particular interest was the remarkable definition in the southern part of the country of the large region of contamination due to atmospheric pollution (acid rain) coming from beyond the borders of the country.

International Association of Geochemistry and Cosmochemistry: Professor P.V. Koval (USSR), Secretary of the Working Group on Geochemical Prospecting of the International Association of Geochemistry and Cosmochemistry, and co-chairman of the Workshop reported on the results of a

questionnaire the Association had circulated to its membership on the project. The replies received were uniformly positive.

Members felt that a uniform approach should be taken to world mapping. Demonstration maps should be prepared for large regions and a reference base should be prepared to obtain comparable results in the future. No clear decision was expressed as to whether the primary (bedrock) or secondary (surficial) environment should be sampled, nor whether single or composite samples should be used. The view was widely expressed that the project should co-operate closely with other international geological projects.

International Geological Correlation Programme: The Secretary of the IGCP (UNESCO), Dr. E. Dudich, explained the programme and the reasons why the project proposal has been returned. He recommended

that both primary and secondary objectives be more clearly defined to stress the aspects of geological correlation and co-ordination of international activities.

Mention should be made of the proposed map scale and several examples from model areas should be included.

The project should be formulated for a period of five years but certainly no more than seven. He suggested that supporting documents should be provided from institutions that intended to support the project indicating the form of support proposed. Since the funds available from the IGCP are very small (<2000-5000/year) they could only be regarded as seed money. An indication of other sources of funds would be of interest.

Following the above presentations discussion continued on various technical aspects of the project: whether a single sample medium could serve for coverage of the whole world and if not how could data from different media be combined; what sample density should be selected; how to provide consistent analytical standards; who should carry out the analyses — a single major laboratory or many separate laboratories; what analytical methods should be used for what elements; on what scale should the data be presented; what data treatment methods should be used.

These questions could not be answered during the workshop but would require separate working groups to examine and report on them. These working groups would be similar to the Agency's Consultant Groups.

It was clear that those who had carried out, or been involved in, large regional geochemical programmes were in favour of pressing the use of very low density sampling (1/500 km² or less), whilst those that had not had difficulty with the concept.

FREEPORT-McMoRan Gold Company

A PREMIER NORTH AMERICAN GOLD PRODUCER

UNITED STATES

NEVADA

6110 Plumas Street
PO. Box 41330
Reno, Nevada 89504
(702) 826-3000

Mountain City Star Route
Elko, Nevada 89801
(702) 738-5600

MONTANA

1424 National
Helena, Montana 59601
(406) 442-0860

CANADA

Suite 57
200 Granville Street
Vancouver, BC V6C 1S4

ICP-AFS WIZARDRY

Since the installation of our new ICP-AFS, or inductively coupled plasma - atomic fluorescence spectrometer, we have been able to consistently deliver accurate **platinum, gold and palladium** determinations for much less than the price of a regular platinum assay.

Fire assay preconcentration

The analysis of your precious metals begins with a customized fire assay preconcentration of 20 grams of material. The resulting dore bead is digested and then analyzed with the ICP-AFS, which employs a hollow cathode lamp-excited spectrometer.

Wizardry explained

The ICP-AFS spectrometer is based on the principle of atomic fluorescence (in contrast to the ICP-AES which utilizes atomic emission). The spectrometer employs an inductively coupled plasma as the sample atomization cell and hollow cathode lamps (HCL) operated in the pulsed current mode as excitation sources. Generated atomic fluorescence signals pass through optical interference filters located in front of the separate photodetectors and are then measured and quantified. The system is automated from sample changing to computer transfer of data resulting in both time and cost savings.

Why an ICP-AFS for platinum, gold and palladium?

The instrument retains the principal advantages of atomic absorption, which are freedom from spectral interferences and simplicity of operation. Many features of the ICP-AES including simultaneous multielement analysis capability and large linear dynamic ranges are also inherent in the ICP-AFS. And compared to conventional atomic absorption, the ICP-AFS has better detection limits for Pt (5ppb), Au (2 ppb) and Pd (2 ppb) based on superior optical and baseline stability.

Why not apply the ICP-AFS advantage to your precious metals exploration programs?



212 Brooksbank Avenue, North Vancouver, B.C., Canada
V7J 2C1 Telephone: (604) 984-0221 Telex: 04-352597
Fax: (604) 984-0218
Mississauga, ON — Pasadena, NF
1-800-222-0218

994 Glendale Avenue, Unit 7, Sparks, Nevada
U.S.A. 89431 Telephone: (702) 356-5395
Rouyn, PQ — Elko, NV
1-800-222-0218

MEETING REPORTS

continued

comprise, along with the co-chairmen of the workshop Dr. A.G. Darnley and Dr. A. Bjorklund, representatives of Norway, China, USSR, CSSR and France. The Committee will attempt to meet in September at "Exploration-87" in Toronto, Canada, and again at the

Symposium on "Geochemical Mapping in Regional Correlation of Geological Terrains and Metallogenic Analysis", to be held by the Geological Association of Canada and Newfoundland in May 1988.

A.Y. Smith, IAEA

Workshop on Anomaly Selection Criteria: Summary Report

The 12th International Geochemical Exploration Symposium workshop on Anomaly Selection Criteria was attended in April at Orleans, France, by 42 scientists from 17 countries. The discussion emphasized methods for identifying and enhancing anomalies related to mineralization. Short presentations were made on a variety of topics. The principal findings of the session were as follows:

1. Geochemical anomalies are unusually high or low concentrations of elements that produce patterns in two or three dimensions. Anomalies are relative, not absolute. The participants concluded that there are no hard and fast rules for determining what is anomalous. In a study area containing altered or mineralized rock, the threshold values and other statistical parameters for many elements will vary depending on the percentage of samples collected from altered and mineralized sites as compared to local background and more distant background sites.

2. For many geochemical surveys, especially those in small areas where there is relatively simple geology and where only a few chemical elements are determined, the use of histograms and cumulative frequency plots, as well as simple ranking

techniques, such as geographic information systems (also known as image analysis systems), can be used to rapidly screen large amounts of spatially related data for anomalies. These techniques vary from the simple plotting of a single variable to complex combinations of multivariate data derived from several disciplines, such as geology, geochemistry, geophysics, and remote sensing.

Multivariate statistical techniques, which are also computer-based, are effectively used to separate background and anomalous populations and also to separate different ore-related suites of elements in a single data set. This last topic was only briefly mentioned because it was discussed in more detail in another workshop.

4. Choosing special types of samples can enhance anomalies in a given area. Examples noted include (1) using samples enriched in secondary sesqui-oxides, such as ferricretes (lateritic crusts) and Fe- and Mn-oxide coated sediment, to enhance anomalies in humid tropical regions and (2) using heavy-mineral concentrates derived from stream sediment, as compared to the untreated stream sediment, to enhance anomalies for many ore-related elements.

Anomalies can also be enhanced by using special techniques. For example, selective chemical extraction techniques can sometimes differentiate and enhance

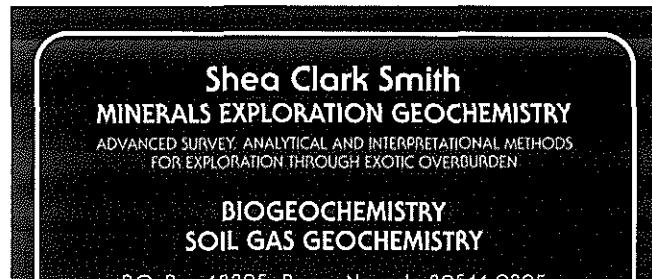
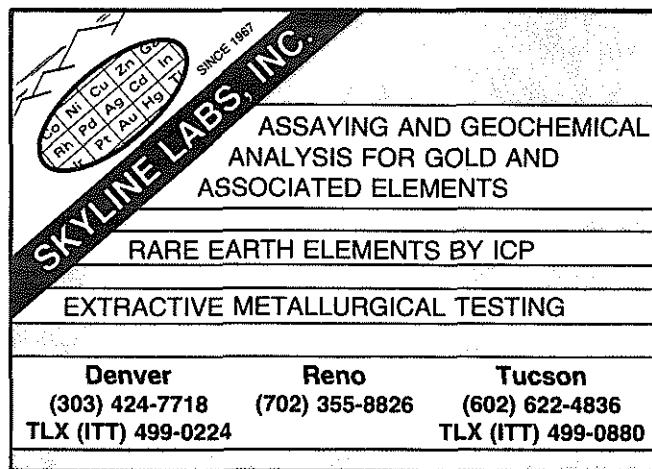
anomalies that are not apparent using analytical methods based on other digestions.

5. Combinations of elements are often useful for defining mineral deposits. For example, anomalies based on some combination of pathfinder elements such as Ag, As, Hg, Sb, Tl, and W can be used to identify certain types of Au deposits. Concentration levels of groups of elements that are all relatively immobile in hydrothermal solutions such as those in the rare-earth suite, Th, and Zr, can be used to distinguish ore-related plutons from barren plutons. The abundances of these elements can also help to distinguish the concentrations of ore-related elements found in rock-forming minerals from the concentrations of these elements found in ore-related minerals. Elements that are commonly mobile in hydrothermal solutions, such as K, Ca, and Na, can sometimes be useful in delineating regional hydrothermal alteration.

6. For a given data set, the spatial distribution of anomalies is at least as important as (1) the statistical distributions and abundances of elements, element ratios, and so on, or (2) the rank order of samples that is based on their chemical characteristics, such as factor scores derived from factor analysis.

7. For the future, the workshop participants wished to emphasize the importance of using a multidisciplinary approach to developing methods for identifying and understanding anomalies. The participants felt that it is important that geochemical data be integrated as much as possible with geological, geophysical, and remotely sensed information. This integration is particularly important in the search for blind and buried mineral deposits.

M.A. Chaffee
U.S. Geological Survey



SPECIAL NOTES

Professional Registration

Professional registration of geochemists commonly is required for legal reasons in various jurisdictions. Requirements for such registration vary dramatically and have been of some concern to various members of the Association over the past few years. In Canada, for example, registration allowing legal professional practice of exploration geochemistry is obtained through various provincial associations of Professional Engineering. In most cases individuals are evaluated for registration in an ad hoc manner and no uniform standards exist across the country. In only one province (Alberta) does a separate registration stream exist for Professional Geophysicists and Geologists (including Professional Geochemists). At least one other province (British Columbia) recently has been investigating the possibility of registering Professional Geoscientists (Geologists, Geochemists and Geophysicists). The British Columbian study has been undertaken by an Earth Science Task Group established by the Association of Professional Engineers of British Columbia and Chaired by the writer. Part of the purpose of that Task Group was to establish demand for professional registration among geoscientists in B.C., a goal approached through a widely distributed questionnaire. The nature and results of that questionnaire are appended here as reported by the writer (Professional Engineer of B.C., 1986, July, p. 24), as one indication of local interests among geoscientists (including a significant geochemistry component) for professional registration.

Publication of such local information in the *AEG Newsletter* is principally to motivate discussion among members as to how the Association should become involved. A number of factual situations should be addressed.

1. Registration of earth science professionals is required by law in many jurisdictions.
2. No national, let alone international, standards exist as to the qualifications that constitute a professional geochemist.
3. Registration implies a form of "policing" mechanism, not only to monitor acceptance of registrants but also to monitor continuing quality of work by members. In particular, the policing body requires a mechanism to respond to complaints about the quality of work by members.

The writer will act as a clearing house for members' contributions directed towards establishing policy and action by the Association of Exploration Geochemistry. Outlines of government legislation that defines and controls "Professional Geochemists" would be appreciated, as well as detailed comments, opinions and discussions that will lead to policy development. It would be particularly useful to have contributions as to detailed requirements deemed important for a geochemist to attain legal registration.

A. J. Sinclair, Head

*Dept. of Geological Sciences
University of British Columbia
Vancouver, B.C. V6T 2B4, Canada*

Earth Science Task Group

Summary report of questionnaire regarding professional registration of earth sciences.

Introduction

In February and March of 1986 the Earth Science Task Group of the Association of Professional Engineers of BC conducted a

QUESTIONNAIRE

for Contributions to the **Handbook of Exploration and Applied Geochemistry**

A. The following **laboratories** are

1. _____ known or used

2. _____

(NOTE: You may xerox that portion of a laboratory brochure which shows current address as a substitute for the listing above. Feel free to include all laboratories or mineral processing firms with which you are familiar.)

B. The following **contractors** are

1. _____ known or used

2. _____

(Contractors refer to geochemical samplers, blasters, diamond drillers, orthophotographers, etc.).

C. The following **computer service group(s)** is

_____ known or used

(Product specialties should be included, i.e., soil geochemistry, diamond drill plotting, mining applications).

D. The following **consultants** are

1. _____ known or used

2. _____

(Specify type of work: geochemistry, geophysics, geologic mapping, permitting, staking, etc.)

E. Other comments or category suggestions:



SPECIAL NOTES *continued*

lists supplied by the Geological Association of Canada, the Canadian Institute of Mining and Metallurgy, the MEG Discussion Group, the Vancouver Geotechnical Society, the Vancouver Exploration Geochemistry Group and the Vancouver Geophysical Society.

A 1-page, 7-point questionnaire was designed and distributed using the assembled mailing list. By March 17th, 1986 a total of 557 replies had been received which provided the basis for this summary report.

Summary of Responses to Questionnaire

1. Are you in favour, in principle, of the development of a system for recognizing and registering professional earth scientists (non-engineers) in British Columbia?

An overwhelming number of responses (507 or 91%) are in favour of professional registration of earth scientists.

2. Are you in favour of professional recognition of earth scientists being incorporated in an amended version of the Engineers Act? The implication here is that registration would be handled by earth scientists within the framework of the Association of Professional Engineers of BC?

Registration under the "umbrella" of the Association of Professional Engineers was supported by 442 respondents (82.3%)

3. Please indicate your current professional earth science affiliations:

Geological Assoc. of Canada	354
Assoc. of Professional Engineers of BC	192
Canadian Institute of Mining and Metallurgy	321
Member of "Other" Organizations <i>only</i>	23

4. Are you interested in being actively involved in convincing the Provincial Government of the importance of professional registration of earth scientists?

A total of 162 respondents (29.1%) indicated a willingness to assist personally with matters related to professional registration.

5. Indicate the general nature of your present professional activities:

Mineral Exploration	410
Geochemical	80
Geotechnical	75
Geophysical	63
Petroleum Geology	20
Other	62

6. Check which you favour: PGeol or PGeo?

A total of 326 respondents (69.5%) of the 469 respondents to this question favour the title PGeol over PGeo.

7. Additional comments can be listed on the other side:

A number of comments and concerns were expressed by 45 respondents. These relate mostly to alternative procedures for professional registration and will be considered by the Task Group during the next few months.

A. J. Sinclair, Chairman

A. Wessen, Secretary

Earth Science Task Group

Nov. 23-26, '87 — Fourth South American Symposium of **Cogeodata**, Duro Preto, Minas Gerais. (Prof. Hubert Roeser, Dept. of Geology, Federal University of Duro Preto, P.O. Box 50, 35400 Duro Preto MG, Brazil. Phone 031-551-1637 or 1015).

Nov. 30 - Dec. 5, '87 — **Northwest Mining Association**, ann. mtg., Spokane, Wash. (NMA, 414 Peyton Bldg., Spokane, 99201.)

Dec. 14-18, '87 — **Iberian geochemistry**, mtg., Aveiro, Portugal. (M.S. Pinto, Departamento de Geociencias, Universidade de Aveiro, 3800 Aveiro, Portugal)

Feb. 16-18, '88 — **Ground-water geochemistry**, mtg., Denver (National Water Well Association, Education Foundation, 6375 Riverside Drive, Dublin, Ohio, 43017. Phone: 614-761-1711)

Mar. 8-11, '88 — **Asian mining**, mtg. Kuala Lumpur, Malaysia. (Conference Office, Institution of Mining & Metallurgy, 44 Portland Place, London, WIN 4BR, U.K. Phone: 01-580-3802)

Mar. 17-18, '88 — **Mineral diagenesis**, mtg., Cambridge, U.K. (C.V. Jeans, Dept. of Applied Biology, Pembroke Street, Cambridge, CB2 3DX)

Apr. 7-9, '88 — **Mineralogy, petrology & geochemistry**, mtg., Bochum, West Germany. (Institut fur Mineralogie, Ruhr-Universitat, Postfach 10 21 48, D-4630 Bochum 1)

May 1-4, '88 — **Intl. Ground Water Symposium**, Halifax, N.S., by the Intl. Association of Hydrogeologists (D.S. MacFarlane, Jacques Whitford & Associates, 1046 Barrington St., Halifax, B3H 2R1) Topics include hydrogeochemistry of ore zones, and ground water in ore gensis.

May 5-6, '88 — **Pacific northwest metals & minerals**, mtg., Spokane, Wash. (Northwest Mining Association, 414 Peyton Bldg., Spokane, 99201, Phone: 509-624-1150)

May 11-13, '88 — **Association of Exploration Geochemists**, Annual General Meeting, Symposium on Geochemistry of **Platinum Group Metals** and **V.M. Goldschmidt** Conference, Baltimore, MD (Goldschmidt Conference Coordinator, Pennsylvania State University, 410 Keller Bldg., University Park, 16802)

May 22-25, '88 — **Geological Association of Canada** and **Mineralogical Association of Canada**, ann. mtg., St. Johns, Newfoundland. (John Fleming, Newfoundland Dept. of Mines & Energy, Box 4750, St. Johns, A1C 5T7, Phone: 709-576-2768)

Sept. 6-10, '88 — Geochemistry & mineralization of **Proterozoic mobil belts**, mtg., Beijing, China. (Sun Dazhong, Tianjin Institute of Geology & Mineral Resources, C.A.G.S., 4, 8th Road, Dazhigu, Tianjin 300170, China)

Aug. 29 - Sept. 2, '88 — Int'l Conference of **Geochemistry & Cosmochemistry**, Paris (Pr. C.J. Allegre, Laboratoire de Geochemie et Cosmochimie, 4, Place Jussieu — Tour 14-15, 3eme. Etage, 75252 Paris Cedex, France)

Sept. 26-30, '88 — **Contamination control**, int'l. symposium, Los Angeles (Janet A. Ehmann, Institute of Environmental Sciences, 940 E. Northwest Highway, Mount Prospect, Ill., 60056, Phone: 312-255-1561)

Oct. 1-2, '88 — **Hazardous wastes & hydrology**, Atlanta (American Institute of Hydrology, Box 14251, St. Paul, 55114, Phone: 612-379-1030)

July 9-19, '89 — 28th **International Geological Congress**, Washington, D.C. (B.B. Hanshaw, P.O. Box 1001, Herndon, VA 22070-1001, USA)

Oct. 2-4, '89 — 13th **International Geochemical Exploration Symposium**, Rio de Janeiro (Dorival C. Bruni, Sociedade Brasileira da Geoquímica, P.O. Box 2432 CEP 20010, Rio de Janeiro, BR RJ)

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

Calendar of Events

International, National and Regional Meetings of Interest to Explorationists including Applied Geochemists.

Recent Papers on Exploration Geochemistry

This list comprises titles that have appeared in major publications since the compilation in Newsletter No. 59. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochimica et Cosmochimica Acta (GCA); The USGS Journal of Research (USGS JR); Circular (USGS CIR); and Open File Report (USGS OFR); Geological Survey of Canada Papers (GCS Paper) and Open File Report (GSC OFR); Bulletin of the Canadian Institute of Mining and Metallurgy (CIM Bull); Transactions of Institute of Mining and Metallurgy, Section B: Applied Earth Sciences (Trans IMM). Publications less frequently cited are identified in full. Compiled by L. Graham Closs, Department of Geology and Geological Engineering, Colorado School of Mines, Member AEG Bibliography Committee.

Ahmed, W.A., Elzarke, M. and Al-Dabbas, M. 1986. Petrographical and geochemical studies of Cretaceous carbonate rocks, Ain Zalah oilfield, north Iraq. *J. Petroleum Geol.* 9(4): 429-438.

Barnes, S.J. and Naldrett, A.J. 1987. Fractionation of the platinum-group elements and gold in some komatiites of the Abitibi Greenstone Belt, Northern Ontario. *EG* 82(1): 165-183.

Barton, H.N. 1987. Sample locality map and results of carrier distillation emission spectrographic analysis of stream sediment samples Chandler Lake Quadrangle, Alaska. USGS OFR 87-0021. 7 p + map.

Bodine, M.W., Jr. 1987. CLAYFORM; a Fortran 77 computer program apportioning the constituents in the chemical analysis of a clay or other silicate mineral into a structural formula. Computer and Geosciences 13(1): 77-88.

Bowie, S.H.U. and Thornton, U. (Eds.). 1985. Environmental Geochemistry and Health: Report to the Royal Society's British National Committee for Problems of the Environment. D. Reidel. 140 p.

Boyle, R.W. 1986. Gold deposits in turbidite sequences: Their geology, geochemistry, and history of the theories of their origin. In Keppie, J.D. et al.

- Zn deposit (Niari syncline, People's Republic of the Congo). Arguments in favor of a hydrothermal origin. Min. Deposita* 22(1): 64-77.
- Butt, C.R.M. 1987. A basis for geochemical exploration models for tropical terrains. *Chem. Geol.* 60: 5-16.
- Cabri, L.J. 1987. The mineralogy of precious metals: New developments and metallurgical implications (MAC Presidential Address). *Can. Mineralogist* 25(1): 1-7.
- Canil, D. 1987. The geochemistry of komatiites and basalts from the Deadman Hill area, Munro Township, Ontario, Canada. *Can. J. Earth Sci.* 24(5): 998-1008.
- Cathles, L.M. 1986. The geologic solubility of gold from 200-350°C, and its implications for gold-base metal ratios in vein and stratiform deposits. In Clark, L.A. (Ed.) 1986. Gold in the Western Shield. CIM Spec. Vol. 38. 537 p.
- Crocket, J.H. et al. 1986. Distribution of gold and arsenic in turbidites at Harrigan Cove, Nova Scotia: Implications on gold mineralization. In Keppie, J.D. et al. (Eds.) Turbidite-Hosted Gold Deposits. *Geol. Assoc. Can. Spec. Paper* 32: 149-159.
- Croft, P.E. 1986. Geochemical Analysis: The role of the consulting laboratory. In Thornton, I. and Howarth, R.J. (Eds.) Applied Geochemistry in the 1980's. Halsted (Wiley): 185-190.
- Cronan, D.S. 1986. Exploration geochemistry for deep sea mineral deposits. In Thornton, I. and Howarth, R.J. (Eds.) Applied Geochemistry in the 1980's. Halsted (Wiley): 241-259.
- Crouse, R.G. 1986. Geochemistry and human health in the 1980's in Thornton, I. and Howarth, R.J. (Eds.) Applied Geochemistry in the 1980's. Halsted (Wiley): 337-345.
- Day, S.J., Broster, B.E. and Sinclair, A.J. 1987. Sulphide eratics applied to subglacial exploration: St. Elias Mountains, British Columbia. *Can. J. Earth Sci.* 24(4): 723-730.
- DeWitt, E. and Waegli, J. 1986. Gold in the United Verde massive sulfide deposit, Jerome, Arizona. USGS OFR 86-0585. 41 p.
- DiLabio, R.N.W. and Coker, W.C. 1987. Mineral Exploration in study from Sri Lanka. *Chem. Geol.* 60: 137-144.
- Donaldson, M.J. et al. Comparison of Archean dunites and komatiites associated with nickel mineralization in Western Australia: Implications for dunite genesis. *Min. Deposita* 21(4): 296-305.
- Dubinin, A.V. and Bolkov, I.I. 1986. The rare-earth elements in East Pacific Rise metalliferous sediments. *Geochem. Intern.* 23(9): 62-76.
- Fyfe, W.S. 1986. The transport of gold. In Clark, L.A. (Ed.) Gold in the Western Shield. CIM Spec. Vol. 38: 156-16.
- Gize, A.P. and Barnes, H.L. 1987. The organic geochemistry of two Mississippi Valley-type lead-zinc deposits. *EG* 82(2): 457-470.
- Goldfarb, R.J. and Smith, S.C. 1986. Geochemical map showing the distribution of anomalous element suites in non-magnetic heavy-mineral concentrates from the Chugach National Forest, Alaska. USGS MF-1645G. 18 p. + Map.
- Govett, G.J.S. 1986. Geochemistry: its achievements and potential in mineral exploration. In Thornton, J. and Howarth, R.J. (Eds.) Applied Geochemistry in the 1980's. Halsted (Wiley): 1-38.
- Grondin, D. and Barbeau, C. 1986. Selective extraction of anthropogenic lead from sediments using iron. *Applied Geochem.* 1(6): 697-704.
- Haynes, S.J. 1986. Geology and chemistry of turbidite-hosted gold deposits, greenschist facies, eastern Nova Scotia. In Keppie, J.D. et al. (Eds.) Turbidite-Hosted Gold Deposits. *Geol. Assoc. Can. Spec. Paper* 32: 161-177.
- Heald, P., Foley, N.K. and Hayba, D.O. 1987. Comparative anatomy of volcanic-hosted epithermal deposits: acid-sulfate and adularia-sericite types. *EG* 82(1): 1-26.
- Hitchon, B. et al. (Eds.) 1984. Proceedings on the First Canadian/American conference on hydrogeology; practical applications of groundwater geochemistry. Worthington, Ohio. Natl. Water Well Assoc.
- Hood, P.J. 1987. Mineral Exploration: Trends and developments. *Can. Min. J.* 108(1): 24-44.
- Howarth, R.J. and Garrett, R.G. 1986. The role of computing in applied geochemistry. In Thornton, I. and Howarth, R.J. (Eds.) Applied Geochemistry in the 1980's. Halsted (Wiley): 100-120.
- Meyer, W.T., Lovell, J.S. and Hale, M. 1986. Detection of concealed mineral and energy resources by vapour geochemistry. In Thornton, I. and Howarth, R.J. (Eds.) Applied Geochemistry in
- Keppe, J.D., Boyle, R.W. and Haynes, S.J. (Eds.) Turbidite-Hosted Gold Deposits. *Geol. Assoc. Can. Spec. Paper* 32. 186 p.
- Klinkhammer, G. et al. 1986. Manganese geochemistry near high-temperature vents in the Mid-Atlantic Ridge rift valley. *Earth Planet. Sci. Letters* 80(3/4): 230-251.
- Korobeynikov, A.F. 1986. Gold distribution in black shale associations. *Geochem. Intern.* 23(5): 114-124.
- Korobeynikov, A.F. 1986. The gold distribution in differentiation products of basic and acid magmas of various ages. *Geochem. Intern.* 23(7): 101-110.
- Kuhnel, R.A. 1987. The role of cationic and anionic scavengers in laterites. *Chem. Geol.* 60: 31-40.
- Lewis, E. 1986. Geochemistry and animal health. In Thornton, I. and Howarth, R.J. (Eds.) Applied Geochemistry in the 1980's. Halsted (Wiley): 260-269.
- Macko, S.A. and Quick, R.S. 1986. A geochemical study of oil migration at source rock reservoir contacts: Stable isotopes. *Organic Geochemistry* 10(2): 199-206.
- Manning, D.A.C. 1986. Assessment of the role of organic matter in ore transport processes in low-temperature base-metal systems. *Trans IMM*: B195-200.
- Marshall, B.T. and Herman, J.S. 1986. Trace element distribution in the soils above deeply weathered pegmatites, Virginia, USA: implications for exploration. *Applied Geochem.* 1(6): 681-690.
- Mazzucchelli, R.H. 1986. A perspective on the application of geochemistry in mineral exploration south of the equator. In Thornton, I. and Howarth, R.J. (Eds.) Applied Geochemistry in the 1980's. Halsted (Wiley): 39-59.
- McCarthy, J.H., Jr. 1986. The use of gases in geochemical exploration. In Butler, L.R. (Ed.) Analytical Chemistry in the Exploration, Mining and Processing of Materials. Blackwell Publ: 171-180.
- Metz, R.A. (Ed.) 1985. Applied Mining Geology: Problems of Sampling and Grade Control. SME/AIME. 165 p.

Mironov, A.G. et al. 1986. A radioisotope study of the traces of gold in sulfides and magnetite. *Geochem. Intern.* 23 (9): 117-128.

Mookherjee, A. and Tenginkai, S.G. 1987. Some unusual geochemical features of the oxidized zone at the central sector of the Singhblum copper belt, India. *Chem. Geol.* 60: 51-62.

Nair, N.G.K., Santosh, M. and Mahadevan, R. 1987.

Lateritisation as a possible contributor to gold placers in Nilambur Valley, southwest India. *Chem. Geol.* 60: 309-318.

Nichol, I. 1986. *Geochemical exploration for gold; A special problem.* in Thornton, I. and Howarth, R.J. (Eds.) *Applied Geochemistry in the 1980's.* Halsted (Wiley): 60-85.

Norman, D.I. and Sawkins, F.J. 1987. *Analysis of volatiles in fluid inclusions by mass*

spectrometry. *Chem. Geol.* 61: 1-10.

Ogura, Y. (Ed.) 1987. *Special Issue: Proceedings of an International Seminar on Laterite. Oct. 14-17, 1985, Tokyo, Japan.* *Chem. Geol.* 60: 1-396.

Ogura, Y., Murata, K. and Iwai, M. 1987. Relation between chemical composition and particle-size distribution of ores in the profile of nickeliferous Laterite deposits of the Rio Tuba Mine, Philippines. *Chem. Geol.* 60: 259-272.

Palacious, C.M., Hein, U.F. and Dulski, P. 1986. Behavior of rare earth elements during hydrothermal alteration of the Buena Esperanza copper-silver deposit, northern Chile. *Earth Planet. Sci. Letters.* 80(3/4): 208-229.

Paterson, C.J. 1986. Controls on gold and tungsten mineralization in metamorphic-hydrothermal systems, Otago, New Zealand. in Keppie, J.D. et

al. (Eds.) *Turbidite-Hosted Gold Deposits.* *Geol. Assoc. Can. Spec. Paper* 32: 25-39.

Patocka, F. *The geochemistry of mafic metavolcanics: implications for the origin of the Devonian massive sulfide deposits of Zlate Hory, Czechoslovakia.* *Min. Deposita.* 22(2): 144-150.

Perl'man, A.I. 1986. *Geochemical barriers; theory and practical applications.* *Applied Geochem.* 1(6): 669-680.

Peters, W.C. 1987. *Exploration and Mining Geology.* 2nd Ed. Wiley. 685 p.

Plant, J.A. et al. 1986. *Regional geochemistry in the detection and modelling of mineral deposits.* in Thornton, I. and Howarth, R.J. (Eds.) *Applied Geochemistry in the 1980's.* Halsted (Wiley): 103-139.

Pomarleanu, V. and Neazu, E.A. 1987. *Significance of fluid inclusions for determining the temperature gradients of hydrothermal solutions and their application to metallogenesis.* *Chem. Geol.* 61: 147-152.

Purdy, T.L., Milton, N.M. and Eiswerth, B.A. 1986. *Spectral reflectance of vegetation in the Idaho cobalt district; potential for exploration using remote sensing.* USGS OFR 86-0587. 9 p.

Ranta, D.E. (Ed.) 198 . *Applied Mining Geology: Ore Reserve Estimation.* SME/AIME. 202 p.

Rao, A.B. 1987. *Lateritised gravel bed: A new guide horizon for lateritic gold.* *Chem. Geol.* 60: 287-292.

Rao, A.B. 1987. *Guide horizons for gold mineralization in lateritic crusts.* *Chem. Geol.* 60: 293-298.

Romberger, S.B. 1986. *The solution chemistry of gold applied to the origin of hydrothermal deposits.* in Clark, L.A. (Ed.) *Gold in the Western Shield.* CIM Spec. Vol. 38: 168.

Roy, A., Mitra, E.N. and Lahiri, D. 1985. *Endogenic trace element dispersion haloes around Rakha, Kendadih, Surda and Mosabani mines — a comparative study.* *Indian Minerals* 39(1): 1-11.

Royle, A.G. 1986. *Alluvial sampling formula and recent advances in alluvial deposit valuation.* *Trans. IMM:* B179-182.

Sarazin, G. et al. 1986. *Geochemical study of the geothermal field of Antsirabe (Madagascar).* *Geochim. J.* 20 (1): 41-50.

Savichev, A.S. et al. 1986. *Accumulation of finely divided*

Quaternary Glaciations in the Northern Hemisphere. *Quat. Sci. Rev.* 5, 510 p.

Smith, P.A. 1986. *Exploration geochemistry in the shallow marine environment.* in Thornton, I. and Howarth, R.J. (Eds.) *Applied Geochemistry in the 1980's.* Halsted (Wiley): 212-240.

Smith R.E. 1987. *Current research at CSIRO Australia on multielement laterite geochemistry for detecting concealed mineral deposits.* *Chem. Geol.* 60: 205-214.

Tauer, M.F., Turdel, P. and Perrault, G. 1986. *Geochimie de la biotite associee et certains gisements d'or de Val d'Or Malartic et Chibougamau.* *Can. Min.* 24(4): 761-774.

Thompson, M. 1986. *The future role of inductively-coupled plasma atomic emission spectrometry in applied geochemistry.* in Thornton, I. and Howarth, R.J. (Eds.) *Applied Geochemistry in the 1980's.* Halsted (Wiley): 191-211.

Thornton, I. et al. 1986. *The interaction between geochemical and pollutant metal sources in the environment; Implications for the community.* in Thornton, I. and Howarth, R.J. (Eds.) *Applied Geochemistry in the 1980's.* Halsted (Wiley): 270-308.

Thornton, I. and Howarth, R.J. (Eds.) 1986. *Applied Geochemistry in the 1980's.* (J.S. Webb Volume). Halsted (Wiley). 346 p.

Unwin, D. 1981. *Introductory Spatial Analysis.* Methuen. 212 p.

Viewing, K.A., Topping, N.J. and Hatherley, R.J. 1986.

Geochemical patterns in the granite terrain of Zimbabwe. in Thornton, I. and Howarth, R.J. (Eds.) *Applied Geochemistry in the 1980's.* Halsted (Wiley): 140-162.

Vogt, J.H. and Kollenberg, E. 1987. *Genetic implications of geochemical factor analysis in a sediment-hosted Cu-Pb-Ba mineralization.* *Min. Deposita.* 22(2): 151-160.

Watanabe, K. 1987. *Geochemical behavior of iron and manganese ions in the Ningyo-Toge uranium deposit district, southwest Japan.* *Chem. Geol.* 60: 299-308.

Werniuk, J. 1987. *Going for platinum.* *Can. Min. J.* 108(4): 17-23.

Wylie, A.W. 1985. *An Introduction.* Elsevier. 344 p.

Zenina, T.A. 1986. *Biological uptake coefficients for dispersed*

A.E.G. DISTINGUISHED LECTURE SERIES

Nominations for the 1988-1989 Series

The Association's Distinguished Lecturer will visit three schools in the western United States in the Fall of 1988 and three schools in western Canada in the Spring of 1989.

To nominate a person for this honor, please respond with the following information by DECEMBER 15, 1987 to David M. Jenkins, Ainsworth-Jenkins Consultants, Suite 330, 890 West Pender Street, Vancouver, B.C. V6C 1J9, Canada.

I nominate: Name _____

Address _____

Phone (_____) _____

for the honor of 1988-1989 A.E.G. Distinguished Lecturer. The nominee is worthy of this honor because:

Signature _____



GeoExpo/86 Proceedings

Publication date was late August, 1987. The proceedings **do not** form part of your annual subscription to the AEG but, if desired, may be purchased at a cost of \$32.50 U.S. or \$45.00 CDN. post paid (surface mail). In order to guide your decision, the table of contents of this volume is reproduced on the reverse. Prepayment is required in the form of cheque, money order, or by VISA/MASTER CARD account, and should be sent to:

**GEOEXPO/86
330 - 890 West Pender Street
Vancouver, B.C.
V6C 1K5**

The abstract volume (89 pp.) of all 56 papers presented at the conference can still be ordered at a cost of \$4.00 U.S. (\$5.00 CDN.) per copy.

GEOEXPO/86 copies \$32.50 U.S. or \$45.00 CDN. _____

Abstract volume _____ copies \$ 4.00 U.S. or \$ 5.00 CDN. _____

TOTAL Enclosed: _____

Your name and address:

NAME: _____

TITLE: _____

ADDRESS: _____

Charge: Master Card VISA

Credit Card Account

Expiration date _____

Signature _____

Contents

Symposium Committee

Foreword

- Mineral Deposits in British Columbia; A Review of Their Tectonic Settings
W.J. McMILLAN, A. PANTALEYEV and T. HOY

Distribution of Mineral Deposits in the Pacific Border Ranges and Coast Mountains of the Alaskan Cordillera
R.J. GOLDFARB, S.W. NELSON, H.C. BERG AND T.D. LIGHT

Geology of Newmont Gold Company's Gold Quarry Deposit, Eureka County, Nevada
J.C. ROTA

Geochemistry and Geology of the Wind River Gold Prospect, A Cascade Epithermal Precious Metal System
K.I. McGOWAN

Geology and Soil Geochemistry of the Quesnel River Gold Deposit, British Columbia
P.E. FOX, R.S. CAMERON and S.J. HOFFMAN

A. Multidisciplinary Exploration Case History of the Shasta Epithermal Gold-Silver Deposit, British Columbia, Canada
B.W. DOWNING and S.J. HOFFMAN

Soil and Plant Geochemical Orientation Surveys on the Congress Property, Bridge River District, B.C.
B.J. COOKE and J.J. BARAKSO

Comparison of Rock Geochemistry and Mineralogical Alteration Guides for Cordilleran Epithermal Precious and Base Metal Vein-Type Deposits in Bolivia and Peru
J.D. APPLETON, J. CLAROS and W. RODRIGUEZ

Application of R-Mode Factor Analysis to Geochemical Studies in the Eureka Mining District and Vicinity, Eureka and White Pine Counties, Nevada
M.A. CHAFFEE

Variation of Trace Elements in Hydrothermal Tourmalines Associated with Mineralization: El Correo, Sonora, Mexico
S.M. SMITH, I.G. CLOSS and P.K. THEOBALD

Geochemical Characterization of Two Mineral Provinces in the Healy Quadrangle, Alaska
T.D. LIGHT, R.B. TRIPP and H.D. KING

Pb-Isotope Signatures of Devonian-Mississippian Massive Sulphide Deposits in Alaska and their Significance to Mineral Exploration
S.E. CHURCH, J.E. GRAY, M.H. DELAVAUX and A.P. LEHURAY

Analysis of Fluid Inclusion Gases in Jasperoid as an Exploration Method for Micron Gold Deposits
P.S. HAYNES and S.E. KESLER

Fluid Inclusion Constraints on the Genesis of the Alaska-Juneau Gold Deposit
D.L. LEACH, R.J. GOLDFARB and T.D. LIGHT

Nature of Ore Fluids in the Coquihalla Gold Belt, B.C.
J.B. MUROWCHICK, K. MUEHLENBACHS and B.E. NESBITT

Diamond Exploration in the North America Cordillera
H.T. DUMMETT, C.E. FIPKE and S.L. BLUSSON

Behaviour of Scheelite in a Cordilleran Stream
D. SAXBY and W.K. FLETCHER

Current Atomic Absorption and Inductively Coupled Plasma Optical Emission Methods for Geochemical Investigations
J.S. KANE and A.F. DORRZAPF, JR.

Comparison of Some Multielement Analytical Techniques Applied to Massive Sulfides from the Juan de Fuca Ridge and to Sulfide Standards
J.A. PHILPOTTS, J.S. KANE, R.G. JOHNSON, A.F. DORRZAPF, JR., Z.A. BROWN, J.S. MEE, H. KIRSCHENBAUM, N. RAIT, C. SKEEN, W. CRANDELL, C. PALMER, J. MARINENKO and F. BROWN

Classical Chemical Analysis of Forms of Bound Sulfur in Massive Sulfides with an Application to Chimney Samples from the Juan de Fuca Ridge
H. KIRSCHENBAUM and J.A. PHILPOTTS

Determination of Anions by Ion Chromatography — Application to Pedogeochemical Exploration for Metallic Mineralization
P.J. LECHLER and M.O. DESILETS

Gallium: An Overview, Markets, Supplies and Occurrence
R.W. TEKVERK and J.E. FAY

Workshop Report, Exploration in Desert Environments
P.K. THEOBALD

Workshop Report, Heavy Mineral Sampling

NOTICE OF 1988 DUES



Your 1988 dues renewal form has been included on page 17 of this newsletter. The cost of running the Association is such that we would appreciate payment of annual dues as soon as possible.

In order to facilitate payment we will accept VISA and MASTERCARD charges. Your cooperation is requested, as determining the size of our membership early each year facilitates our planning process and helps to determine what new projects may be undertaken.

A label prepared from AEG files is affixed to your membership renewal form. If it indicates that dues are still unpaid for 1987, please consider paying dues for two years. All 1987 issues of the *Journal of Geochemical Exploration* may be received by paying 1987 dues before December 31 of this year. Previous issues are available to members through the Rexdale office (see below) at U.S. \$50 per year.

Our past methods of reminding existing members of their membership status have been lax, and, if this has adversely affected your subscription to the Journal, please accept our apologies. Elsevier operates on a prepayment basis, and they must receive monies from the Association (as we receive the dues from you) before journal issues are mailed.

Issues of the *Journal of Geochemical Exploration* will not be mailed by Elsevier for 1988 until dues are paid. I have asked our publisher to notify members in arrears at the time that the first two or three journals are mailed out each year.

Please contact the association offices at P.O. Box 523, (Metropolitan Toronto), Rexdale, Ontario, Canada M9W 5L4, if Elsevier's records appear to be at variance to yours. Remember that there is probably a month to six weeks delay period from your mailing of annual dues to us until our notice to Elsevier is received and acted upon by Elsevier.

You will receive our newsletter for the January and April issues, even if your dues are not current. The address label will indicate if we have received your annual dues. After those two issues the newsletter mailings will be discontinued.

'We appreciate your membership which is needed to keep the organization strong. The cost of running the Association has been maintained at \$42.50 U.S. per capita for 13 years. We intend to increase our membership and maintain this reasonable cost to you.'

Stan Hoffman
President

EXPLORE

The Association of Exploration Geochemist Newsletter

P.O. BOX 9777 UNIVERSITY STATION, RENO, NEVADA 89507-9777, U.S.A.

BULK RATE
U.S. POSTAGE
PAID
PERMIT NO. 458
RENO, NEVADA

President:

S.J. Hoffman
BP - Selco
890 West Pender Street
Suite. 700
Vancouver, British Columbia V6C 1K5
Canada Phone: (604) 682-8345

Vice Presidents:

M.A. Chaffee
United States Geological Survey
Federal Center M.S. 973
Denver, Colorado 80225
U.S.A. Phone: (303) 236-1855

A.E. Soregaroli
Westmin Resources
1055 Dunsnur Street
Suite 904
Vancouver, British Columbia V7X 1C4
Canada Phone: (604) 681-2253

Secretary:

S.P. Marsh
United States Geological Survey
Federal Center, M.S. 973
Denver, Colorado 80225
U.S.A. Phone: (303) 236-5521

Treasurer:

L.B. Bloom
665 Roselawn Avenue
Apt. 214
Toronto, Ont. M5N 1J1
Canada

Councillors:

1986-88	1987-89
C. Dunn	G.H. Alcott
D.M. Jenkins	R.K. Glanzman
M. Mason	E.L. Hoffman
W.R. Miller	B.W. Snee
C.E. Nichols	E.F. Weiland
J.P.G. Saheurs	
I. Thomson	

Australian Regional Councillor:
B.L. Farrell

European Regional Councillor:
E. Wilhelm

Southern Africa Regional Councillor: