EXPLORE

The Association of Exploration Geochemists Newsletter

NUMBER 63 JULY 1988

President's Message

This is the last newsletter where I will be addressing you as president of the AEG. Many changes have occurred over the past year; most notable of these has been EXPLORE and movement towards broadening our base of membership. An exciting recent development has been our association with the Northwest Mining Association (NWMA) for their November 30 - December 2, 1988 annual convention which will focus on integration of exploration technologies in the search for precious and base metal deposits.

Behind the scenes we have been negotiating for special price advantages to our membership for texts of interest (see Elsevier, Levinson, and IMM notices in this issue). We have been encourgaged by comments and contributions from our membership on subjects ranging from the Journal of Geochemical Exploration through to how the AEG council can better serve its membership. This year will see publication of a directory of laboratories and services which includes a membership list that we hope to publish annually and publication of an updated bibliography of exploration geochemistry. Both are to be sent at no additional cost to members in good standing for 1988. We have also simplified the procedure for becoming an affiliate member using the form on page 25.

The science of geochemistry is turning the corner. Gross oversimplification of past survey procedures and interpretive methods have had a seriously negative impact on exploration effectiveness during the present period of great expansion in the use of geochemical methods. I expect exciting contributions to EXPLORE and the Journal of Geochemical Exploration over the next few years. Look for case histories and technological advances to make it evident that traditional approaches practised by a majority of companies leave "gaping holes" through which an ore deposit can quietly slip. These holes represent opportunities for mineral discovery at low cost for those of the competition which possess the skills to recognize the deficiencies or omissions of others.

Training such as that offerred by the soils short course preceeding the NWMA convention (see page 2) represents one example of the types of upgrading being offered by the AEG. Participation by our membership in bringing new ideas, case histories, and Pearl Harbor files to the attention of others will also promote advancement of the profession.

I would like to thank the management of the Mining Division of BP Resources Canada Limited for their support and encouragement of my efforts on behalf of the AEG.

Stanley J. Hoffman

BULLETIN

NORTHWEST MINING ASSOCIATION

President's Letter

We are pleased to be associated with your excellent technical association for our joint meeting to held in Spokane, November 30 through December 3, 1988. Our working together goes back many years, and yet, this is a big step in that we will jointly sponsor the exploration portion of our meeting. We expect well over 2,000 to attend our convention and trade show, and all members of both associations will be offered the lower registration fees.

What other advantages of a joint meeting? We feel there are many. Our meeting attracts a major portion of the mineral exploration and operating community of North America. Yours is well known as a highly professional group of experts in the application of geochemistry to discovery of mineral deposits. We call this a winning combination.

Jerry Lewis, General Chairman of our 93rd Annual Convention, has arranged an outstanding program with Art Soregaroli, exploration co-chairman and Vice President of AEG, to bring attendees the best technical program yet. We will publish details of the meeting very soon, and invite you to mark your calendars to be in Spokane for the first part of December.

Both Associations will keep you informed of the program, and pre-registration packets will be mailed in mid summer.

We feel privileged to work with you on this event of the year. See you in Spokane!

William B. Booth
President of Northwest Mining Association

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Notes from the Editor

Journal of Geochemical Exploration Volume 30, Number 1 has been issued since the last newsletter. If you have not received it, check to ensure that your 1988 AEG membership was renewed. To follow up discrepancies, send the application on page 25 or a letter mentioning missing issues to Ines S. Filicetti at P. O. Box 523 (Metropolitan Toronto), Rexdale, Ontario, M9W 5L4, Canada.

Volumes 28 and 29, received last year, contained the **Proceedings** of the 11th International Geochemical Exploration Symposium held in Toronto. They may be obtained for US $268.25 from Elsevier Science Publishers, P. O. Box 211, 1000 AE Amsterdam, The Netherlands. *Similar volumes are in progress* for other meetings of the Association and will be sent to members as they are published.

Current members can look forward to a **Supplement** of the *Exploration Geochemistry Bibliography* covering the period October 1984 to October 1987, also at no additional cost. The nonmember price is US $18.00; and members joining after 1988 will pay US $10.00.

This is the **last issue of the EXPLORE** mailed to members whose mailing label says "PAID - 87" instead of "PAID - 88". Those renewing late in the year receive the back issues of the *Journal* and back issues of the newsletter as appropriate. Those establishing new memberships also receive back issues of both publications.

It is with great sadness that the friends of **G. Louis Coetzee** report that he died of a heart attack in his office on *June 27, 1988 while editing* manuscripts for the South African volume of the *Journal*. He has been the Southern Africa Regional Councillor for a number of years.

This issue of EXPLORE owes a special debt of gratitude to **Paul J. Lechler** and **Richard Meeuwig** of the Nevada Bureau of Mines and Geology and **Michael Brady** of Rio Algom Exploration for substantial help in editing.

Issue number 62 was distributed to **4,150 different professionals** from the combined membership lists of the AEG, NWMA, major libraries, and the institution list of Elsevier. Of this number, 740 were distributed by five AEG members to business associates, clients, and attendees at local meetings in Quebec and Toronto. This joint issue is being distributed by the NWMA to a combined group of lists estimated at twice the previous printing.

EXPLORE

Newsletter No. 63 JULY 1988

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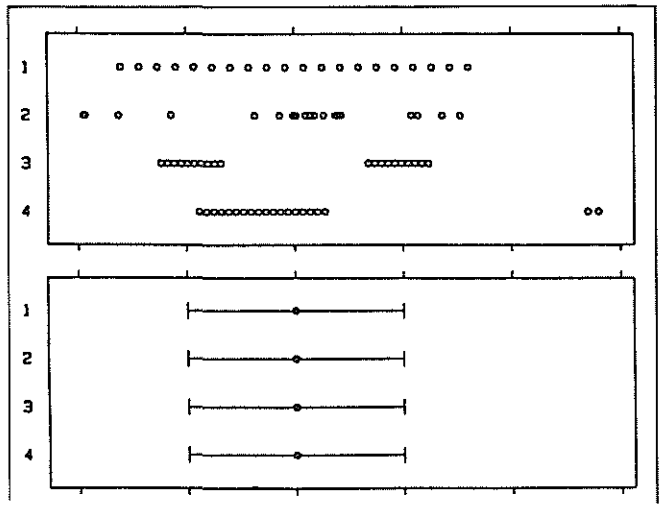
NWMA Soils Short Course

Soil surveys represent the most common form of geochemical survey used by industry and their application has seen a dramatic increase in recent years. Most project geologists are familiar with routine soil surveys and are called upon to manage them as a duty, even though a large majority have never been formally trained in the science. The more often soil surveys are used, the more proficient the project manager becomes at supervision and interpretation. Furthermore, almost everyone within the industry has interacted with geochemical data and most feel relatively comfortable with their own interpretation. Why then is the NWMA offering a soils short course at this time, and is there really a demand in industry for it?

In striking contrast to the sense of the above paragraph, discussions among professional geochemists lament to overall poor quality of survey design, sampling procedures, and interpretive methods existing in industry. The Pearl Harbor file in EXPLORE covers real case histories to illustrate these concerns. Do professional geochemists represent a special interest group trying to create a monopoly on geochemical applications, or are the concerns real?

I believe that in the early years of exploration geochemisty too much emphasis was placed on the simplicity of the science in order to promote its widespread application. The objective succeeded, but misconceptions became imbedded in the science, like defining an anomaly by the mean plus two standard deviations. Fig. 1 graphically explains why such a procedure cannot be used, yet, in a 1984 survey, fully 90% of respondents said they understood its meaning and used it in their work.



Another error is not checking the reliability of soil survey, data. But how much of the data are reproducible? I believe the proportion to be high, but how many professionals have checked or can recognize the deficiencies? These are but two of the deficiencies associated with today's routine work. All need to be minimized if exploration effectiveness is to improve.

The soils short course offered on November 28 to November 30, 1988 by the NWMA represents a significant advance beyond normally-practiced geochemical methods. No holds are barred as an attempt is made to identify problem areas and recommend how to improve soil survey effectiveness. The rationale used by geochemists to plan, undertake, and interpret survey results are described.

The course has a definite industry bias in requiring procedures to meet tests of cost effectiveness and fast turnaround. Recent developments in multielement analysis and computer technology are also addressed. The course I believe will not disappoint the beginner, the geologist, the experienced project manager, or the geochemist. All will gain skills to compete more effectively with their counterparts in industry.

Stanley J. Hoffman
BP-Resources
Vancouver, B.C.

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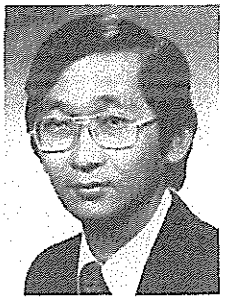
AEG and NWMA Join Forces



Why join us at NWMA?

Ours is a group known for its active support of a strong minerals industry. We work hard to produce an outstanding program each December to allow exchange of information and to update the industry on new discoveries, new technology, new applications, and new management approaches. It seems a natural combination to bring together the experts of the geochemical world and the broad industry cross section of NWMA.

I invite you to consider membership. We offer a highly professional employment assistance program, insurance programs for U.S. members, and an investment program. More recently we have begun limited lobbying in areas where we can bring the intelligence of our specialties to legislative and regulatory actions in the U.S. Of course, members of the NWMA will continue to have reduced convention registration.

The minerals industry is on the upswing, and so is NWMA. Whether you choose to join us as an individual member, a student member, or a company member, we will be pleased to hear from you.

Individual Dues Categories:

Individual member	$50.00/year
Student member	$15.00/year

Company Dues Categories:
by revenues, sales, or exploration budget

Up to $2 million	$ 500/year
$2 million to $10 million	$1000/year
Over $10 million	$2200/year
New Corporate First-Year	$ 200

Ta M. Li,
Membership Chairman, NWMA

Take Charge of Your Future

It's filled with unknowns and things we can't control. As participants in a highly regulated and competitive industry, we have two options: we can sit back and wait for the uncertainties to happen, or we can take charge of our future and give direction to our destiny. If you choose the latter, the Northwest Mining Association can help you gain control.

Get Smart

Before you take charge, you need to know what outside sources and events will impact the future of the mineral resource industry and your career.

The NWMA is an education-oriented organization made up of companies and individuals that do business in the western United States and Canada and around the world. The members, although concentrated in the Northwest, form a network that spans the continent. They share the common interest of seeing that natural resources are developed properly. Since its formation nearly a century ago, NWMA has dedicated itself to improving the general health of the mining industry and to ensuring to professional development of its members.

We are in the business of gathering and sharing information. As a NWMA member, you will become an important link in the communication chain.

ings in the industry as well as an outstanding business development opportunity
- By exchanging ideas at meetings and through various publications
- By learning about proposed government actions before they occur through the monthly newsletter and other communications

Be Heard

Through the NWMA, you can have a say in your future. You can let lawmakers, regulators and the public know your opinions, your needs. By joining with others, you can present a unified voice and provide ideas and facts. And you can help project a positive image for the mineral industry. You, not others, can determine your company's tomorrow:
- By attending public hearings
- By providing accurate facts to the government
- By becoming a part of the NWMA lobbying effort in Washington, D.C., Washington state and Oregon, a new program which started in 1987.

Enhance your Bottom Line

The NWMA offers you opportunities to improve your financial health. In addition to impacting government actions which affect everyone in our industry, you can contribute to your personal well being and career development:
- By listing or advertising in the NWMA Service Directory, a widely used source of industry information
- By subscribing to medical insurance at low group rates through NWMA
- By locating new career opportunities through the NWMA job placement system.

Take Charge

Are you tired of sitting back and watching someone else make the decisions? It's time to take charge of your future.

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Nancy L. Parduhn, Ph.D
PRESIDENT, GEOCHEMIST
CEREUS EXPLORATION TECHNOLOGIES INC.

NWMA Assists Educators and Students

A serious responsibility of any professional or trade association is education. NWMA's program works on many fronts. While the effort is limited because of limited resources, it is a positive step in the long term education of members, students and educators.

Eastern Washington is offering its ***mineral industry teachers education program*** under NWMA sponsorship for the 16th year. Student Chairman **Dr. Ernest Gilmour**, who is also Acting Vice Provost for Graduate Studies and Research, teaches a two-week, intensive accredited course each year to public school educators with aid from NWMA scholarship funds.

The course includes visits to exploration sites and operating mines and involves professionals from industry, academia, and government as speakers. From the program educators learn the importance of minerals and mining, how the industry operates and where to find sources of information to support classroom teaching.

Education Chairman **Dr. Jack Hoskins** has developed an active program to provide public school teachers with data, materials, samples, and speakers. The program includes presentations of source material to teachers at regional meetings and responds to their requests on an individual basis. The program is at work in several states at this time. In a new approach, Dr. Hoskins and his committee have taken a booth at industry trade shows to explain the importance of minerals to specific industries.

The Association has taken an active part in the ***Partners*** program — a pairing up of one company with one school to share ideas and non-financial resources. The Association and the U.S. Bureau of Mines are both Partners, bringing mining, minerals, and earth science information to the classroom as requested by the teaching staff.

As the public recognizes the need for resources, the demand for educational support grows. We can all share in the effort to educate in the broad sense by speaking at service clubs or by participating in programs such as these.

Publications Available

The following publications and working papers are available by contacting the Northwest Mining Association, 414 Peyton Building, Spokane, Washington 99201, phone 509/624-1158, FAX 509/623-1241:

Publications
- ***1981 Mineral Industry Costs***, J. Hoskins ($10.00)
- ***Cornerstones of Spokane***, G. McKelvey ($2.75)
- ***Jesse Livermore: Speculator-King***, P. Sarnoff ($16.95)
- ***Gold***, P. Saroff, Editor

Working Papers From Previous Short Courses (Unedited)
- ***Assays to Assets—Recent Feasibility Case Histories***, 1987 ($40.00)
- ***Contract Mining: How to Contract for Your Surface or Underground Mining***, 1987 ($25.00)
- ***Industrial Minerals—Are They For You?***, 1986 ($40.00)
- ***1986 Mineral Industry Costs***, 1986 ($40.00)
- ***Micro-Computer Applications for the Mineral Industry***, 1985 ($22.00)
- ***Mine Feasibility—Concept to Completion***, 1984 ($22.00)
- ***An In-Depth Study of Five New Silver and Gold Mines***, 1983 ($22.00)
- ***Mine Product Marketing***, 1982 ($18.00)

Proof... major deposits missed by inappropriate sampling.

As shown in the example below, ignoring the possibility of "coarse gold" can result in missed anomalies and valuable deposits. Over 25 years of exploration and assaying experience by Bondar-Clegg has repeatedly proven that expert assessment of sampling characteristics pays off handsomely in the quality and validity of exploration data.

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- There are 900 grams of material.
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THE FACTS

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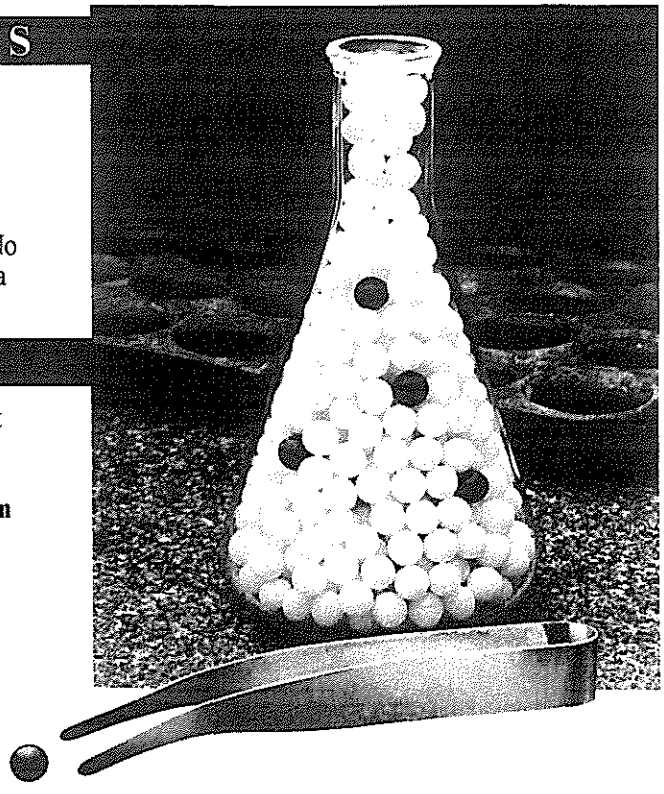
- **Your "odds" of having an assay above detection for this sample are less than 17 per cent!**



BC
BONDAR-CLEGG

A Note from the Secretary

For my column in this issue of EXPLORE I would like to share some of my report given at the Annual General Meeting of the Association of Exploration Geochemists, held in Baltimore, Maryland on May 11, 1988.

It has been an eventful year for the Association and one of the most visible changes has been the publication of our new Newsletter, EXPLORE. This is an outstanding piece of work and a great departure from our previous Newsletter.

Since becoming your Secretary last May, I have received 164 new member applications from the Admissions Committee. This brings our total for 1987 to 865 members and our total, to present, for 1988 is 650 members. We are looking toward a better year in 1988, especially with the publication of EXPLORE.

Our Distinguished Lecture Series this year was given by **Howard McCarthy**. He was very enthusiastically received at the universities he visited and enjoyed giving the lecture series very much.

The Student Prize went to **Don Saxby** for his paper entitled *Behavior of Scheelite in a Cordilleran Stream*.

We have scheduled our International Geochemical Exploration Symposia for each of the next four years, with the next being in Rio de Janeiro, Brazil in 1989.

Our budget is in good health and the new Newsletter will be provided to members with no increase in dues and no increase in dues is expected. Members will also be receiving a *Bibliographic Supplement* and a *Directory of Laboratories* which lists laboratories throughout the world. A current membership listing and the By-laws of the Association will also be in the Directory. Members now receive

We have a new Brazilian Regional Councillor, **Paul Taufen**, due to the untimely death of **Richard Lewis**. We also have an additional Australian Regional Councillor, **Graham Taylor**. All in all, it has been quite an active year for your Association.

Two elections were recently held by the Association. The Council has elected **Donald Runnells** to the position of Second Vice-President. The voting membership has elected six members to the Council for the term of 1988-1990. **Colin Dunn** was re-elected to another term as Councillor and we welcome him back. Five new Councillors were also elected; **Hal Bonham, Jeff Jaacks, Paul Matysek, Fred Siegel,** and **S. Clark Smith**. Let's welcome them all to the Council and look forward to working with them.

Sherman Marsh

L E T T E R S

Call for Papers

Time slots for oral presentations at the Spokane convention have now been filled. In view of the interest in the topic, the Association of Exploration Geochemists plans to publish a special volume which includes papers prepared from oral presentations and case histories not presented in the technical sessions. Please state your intention to submit a paper as soon as possible and before November 1, 1988. A "guide for authors" will be sent to you by return mail to ensure that the format of your paper is correct for this publication. Please send completed manuscripts as soon as possible (but no later than December 9, 1988) and address all correspondence to:

Dr. A. E. Soregaroli
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Congratulations to EXPLORE

As one who was very much involved in the founding of the Association and the initiation of the Newsletter and Journal, I wish to congratulate you on a very fine publication. The content and format is excellent and EXPLORE represents another step in the continuing successful evolution and expansion of the Association. Best wishes for continued success.

John A. Hansuld
President and CEO
Canamax Resources Inc.
Toronto, Ontario

Congratulation on Newsletter No. 61, October 1987 '82 — it's a real "class act". The addition of Technical Notes, expanded News & Com-

J.H. McCarthy, Jr.
U.S. Geological Survey
Branch of Geochemistry
Denver, Colorado 80225

Professional Registration of Geochemists—Update

No responses have been received to the writer's request in Newsletter No. 61, p.13 for information on professional registration of geochemists. The proposal for registration of geoscientists (including geochemists) in British Columbia is proceeding. A proposed new Legislative Act governing professional conduct of Professional Engineers and Professional Geoscientists has been outlined by an Earth Science Task Force chaired by the writer. On the basis of that document, meetings have been requested between the Association of Professional Engineers of B.C. and Senior Administrators in the pertinent government ministry, the Ministry of Advanced Education and Job Training. As of this writing the Minister has agreed to such meetings as a basis for reviewing and analyzing the proposal.

Information for Contributors to EXPLORE

Scope This Newsletter endeavors to become a forum for late 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 deposits.

Format Manuscripts should be double-spaced and include illustrations where possible. Meeting reports may have photographs, for example. Text is preferred on paper *and* 5¼-inch IBM-compatible computer diskettes with ASCII (DOS) format, which can go directly to typesetting. Please include 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 reexamination 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.

NEWS & COMMENT

Newfoundland Profile

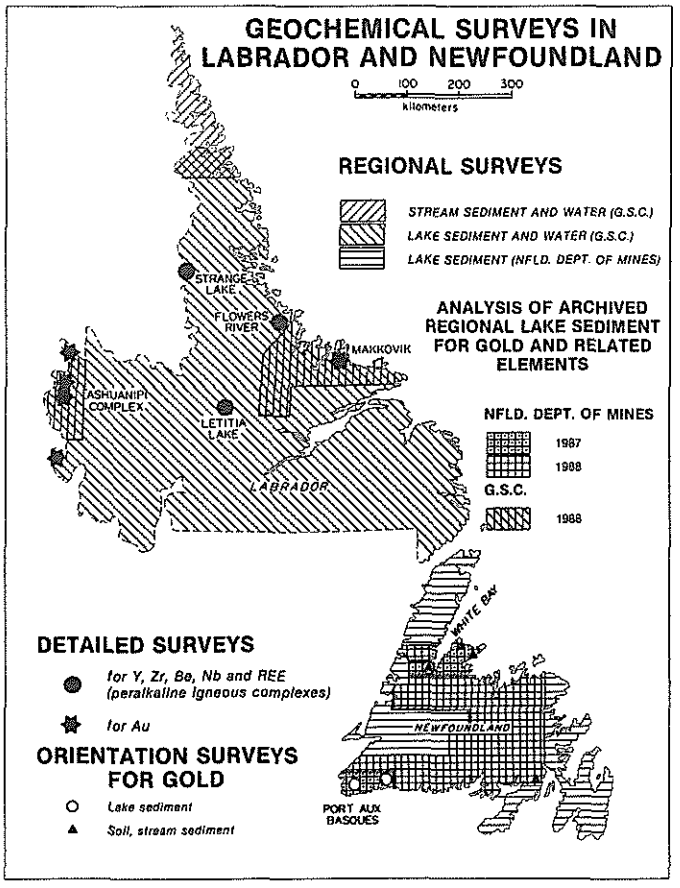
Newfoundland Department of Mines Geochemists:
Peter H. Davenport, John W. McConnell, and A. James Butler.
Geological Survey of Canada Geochemists:
Eldon H.W. Hornbrook and Peter W.B. Friske.

The Geochemistry Section of the Newfoundland Department of Mines was formally established in 1976 as part of the Mineral Development Division although geochemical orientation surveys by the Department were started in 1972. The section has worked closely with the Exploration Geochemistry Subdivision of the Geological Survey of Canada (GSC), which has contributed very significantly to the regional geochemical database for the province through a series of Mineral Development Agreements. This close cooperation has resulted in an efficient and complementary use of resources and compatibility of the regional geochemical data collected by both agencies.

The main objective of the government geochemical surveys is to stimulate and focus exploration in Newfoundland and Labrador. This is accomplished by providing mineral exploration companies with high quality, regional geochemical survey data and by developing geochemical exploration techniques appropriate to local conditions.

Regional Geochemical Surveys

Systematic regional surveys of specific geological terrains commenced in western Newfoundland in 1973 with organic lake sediment



adopted as the most cost-effective reconnaissance sample medium. In 1977 surveys of larger areas and more complex geology were initiated. By 1982 the geochemistry section had completed coverage of the island of Newfoundland (112,300 km²) at an average sample density of 1 site per 7 km². Lake sediments were analysed for Ag, Co, Cu, F, Fe, Mn, Mo, Ni, Pb, U, Zn, and LOI (a measure of organic carbon content). These data along with field information have been released as a series of open file reports.

The Geological Survey of Canada commenced reconnaissance lake sediment and water surveys of Labrador (292,000 km²) in 1977, and coverage to 58° 30'N was completed in 1985. The Torngat Mountain area which lies north of 58° 30'N contains relatively few lakes, and was surveyed in 1986 by stream sediment and water sampling. The average sample density was 1 site per 20 km². Lake sediment and water have been analysed for Ag, Co, Cu, F, Fe, Mn, Mo, Ni, Pb, U, Zn, and LOI. Data from control reference samples analysed in both surveys demonstrate that the results from the island of Newfoundland are directly comparable to those from Labrador, and by implication to National Geochemical Reconnaissance lake sediment data across Canada.

The results of these surveys have led to the staking of many thousands of mineral claims — clear evidence of their effectiveness in focusing and stimulating

A limited time offer is available only to AEG members for the new book
(order must be postmarked within 30 days of receipt of this Newsletter)

"Practical Problems In Exploration Geochemistry"

by A.A. LEVINSON, P.M.D. BRADSHAW AND I. THOMSON
286 pages; typeset; 2-column format (8½ x 11 in.); hard-bound; publication: September, 1987

This unique book is a collection of questions and answers stressing the practical geochemical aspects of 40 exploration projects for many elements (e.g., precious and base metals, Sn, U) and some other commodities (e.g., oceanic Mn deposits, diamonds) from many countries and environments.

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the search for gold and platinum-group metals, although some of the elements are pathfinders for these commodities.

To provide data more relevant to precious-metal exploration, instrumental neutron-activation analysis (INAA) for the multielement determination of gold and several pathfinder elements such as As, Sb, W, and Se was studied in 1987. The results from archived regional samples collected in two areas of known gold mineralization in Newfoundland have shown that gold dispersion from many gold prospects is detectable at a sample density of 1 site per 6-7 km^2. This investigation also shows that the extensive fault-controlled hydrothermal systems which deposited the gold mineralization left *footprints* which are expressed in lake sediment as regional anomalies of elements such as As, Sb, Pb, and Se.

Industry response to the results of the new gold-related element suite in the archived samples has been very positive, with several hundred new mineral claims staked for their gold potential since the data were released.

This program of reanalysis of archived lake sediment samples for gold and its pathfinders by INAA is being extended to include much of the island of Newfoundland (see Figure). The GSC is also reanalysing archived reconnaissance lake-sediment samples from the Central Mineral Belt of Labrador using the same INAA method, and plans to extend this work to cover the Archean Ashuanipi complex in western Labrador (see Figure). The results from both Newfoundland and Labrador are expected to generate considerable interest and activity from mineral exploration companies.

In addition to gold, INAA provides data on 30 other elements and together with ICP/OES it is feasible to determine almost 50 elements in lake sediment at reasonable unit cost. This suite includes: Li, Be, F, Na, Mg, Al, P, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Se, Br, Rb, Sr, Y, Zr, Nb, Mo, Ag, Cd, Sb, Cs, Ba, La, Ce, Sm, Eu, Tb, Yb, Lu, Hf, Ta, W, Au, Pb, Th, and U. A greatly expanded element suite will undoubtedly provide much additional information relevant to both mineral exploration and regional geology. The relationship of the distributions of some of these less familiar elements in organic lake sediment to bedrock geochemistry is currently being studied by examining their dispersion characteristics from mineralization wherever possible.The above list contains some omissions, most notably the platinum group metals (PGM). Further work is required to evaluate the usefulness of PGM distributions in lake sediment in mineral exploration, and such work is planned for the future.

Recent analytical advances permit the building of a much more comprehensive regional geochemical database. This database, combined with a good understanding of the relationship of element distributions in lake sediment to the distribution of mineralization, will permit a much improved assessment of the province's mineral endowment, and (together with other geoscience data) will provide a comprehensive tool for exploration-target selection for most mineral commodities.

Detailed Geochemical Studies

In recent years, detailed studies have focused on geochemical problems associated with two groups of commodities. The first concern has been the distribution in the surficial and bedrock environments of elements related to mineralization in peralkaline rocks of Labrador — particularly Y, Be, Zr, Nb and rare earth elements (REE). The second focus has been on the dispersion of gold and associated elements in Labrador and insular Newfoundland.

The distribution of REE and related elements from peralkaline igneous complexes has been characterized in various sample media including lake and stream sediments, lake and stream waters, soils, and rocks in the Strange Lake, Letitia Lake and Flowers River areas (see Figure). Initial results demonstrated the effectiveness of various geochemical sampling methods in the Strange Lake area where a large tonnage Zr-Y-Nb-Be-REE deposit is known. Positive results from this early work led to the application of lake sediment, water, and soil geochemical surveys in the Letitia Lake area where several occurrences of Y-Nb-Be mineralization associated with peralkaline rocks are known and where the existence of further deposits is suspected.

Studies of element dispersion from gold mineralization (see Figure) began in 1983 with detailed lake-sediment surveys around known gold occurrences in southwest Newfoundland. The application of INAA for gold, arsenic, and antimony (plus several other elements) and of atomic-absorption analysis for silver and base metals, successfully delineated recognizable dispersion patterns around known deposits.

Subsequently, detailed lake-sediment surveys have been conducted in areas of

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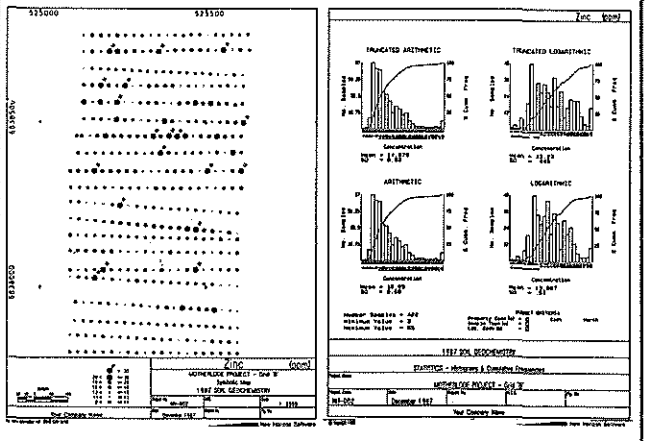

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Newfoundland and Labrador which are regarded as having a high potential for gold mineralization.In addition to lake sediments, orientation surveys using stream sediments and soils have been done near several small gold occurrences on the island to evaluate the effectiveness of various size fractions, heavy mineral techniques, and soil horizons.

During the 1987 field season, soil, stream sediment, lake sediment, and bedrock surveys were conducted to investigate the gold potential of several areas of the Ashuanipi Complex (Archean) in Labrador. Previous geochemical work there has recognized gold anomalies in lake sediment and bedrock. Preliminary results of the rock survey, released in the fall of 1987, indicated new occurrences of gold mineralization with associated lake-sediment anomalies. The results of the soil and lake-sediment surveys will be released in 1988.

The GSC conducted infill lake and stream sediment and water sampling in the Makkovik area of Labrador in 1987. This area contains occurrences of gold and silver, as well as uranium, molybdenum, and base-metal prospects. The results from this work are expected to better define the precious-metal potential of the area, and to provide an improved basis for interpreting the results for gold and related elements from the archived reconnaissance sample suite.

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Mineral Development Opportunities In Minnesota

The State of Minnesota, USA, is actively working to attract mineral exploration and development on a number of fronts. Three of the most important are its mineral rights leasing program, a growing package of tax and leasing incentives, and a rigorous and innovative minerals information base.

The state offers explorers a mineral-rights ownership base of over 12 million acres with excellent potential for base and precious metals. To make state land available for exploration, mineral lease sales are scheduled at least annually. The next opportunity to lease state-owned lands will be in September or October of 1988.

During the period 1966 to 1986, ten non-ferrous metallic mineral lease sales were held. Altogether, over 3 million acres of state owned or administered rights were offered in that period. Fifty-four companies and explorers bid on and received leases covering nearly a million acres in 12 northern Minnesota counties.

1988 Lease Sale

Currently, the Minerals Division of the Minnesota Department of Natural Resources is defining the areas to be offered in the 1988 lease sale in which approximately 2 million acres will be offered. The counties involved are Aitkin, Beltrami, Carlton, Itasca, Koochiching, Lake, Lake of the Woods, Marshall, Norman, Roseau and St. Louis. A map showing the areas under consideration is available.

The exact time of the lease sale will be announced by legal notice at least 30 days prior to the sale. Mining unit books, listing the lands to be offered, will be available following the announcement. For a map of the areas currently under consideration for lease, or for further information, please contact **Kathy A. Lewis**, Mineral Leasing Supervisor, Minnesota Department of Natural Resources, 500 Lafayette Road, St. Paul, MN 55155-4045, telephone (612) 296-4807.

Recent Incentives

Minnesota has become a more attractive exploration target due to several changes in leasing and tax law and new geologic information. In the past two years the Department has drafted amendments to the state's mineral lease rules governing non-ferrous metallic minerals. The amendments are directed at greater potential benefit to private industry, while maintaining an equitable return to the state. This will be accomplished through the following amendments which will take effect in May 1988:

- simplification and reduction of royalty rates,
- subtraction of base smelter treatment charges and smelter losses from ore value,
- modifications in performance requirements, and
- addition of a partial deferral of royalties during mine startup.

The Minnesota Legislature amended the mining tax laws in 1987. The new features of the amended tax law benefit the mining industry by:

- repealing the occupation tax, and replacing it with a corporate-like income tax,
- repealing the *ad valorum* tax on *in situ* metallic minerals ore, and
- incorporating a net proceeds tax which applies to all minerals except iron ore and taconite.

Top-flight geologic information is another major incentive Minnesota offers. Maps, reports, drill core, and exploration data are available for inspection and distribution. Information available is excellent and varied. A recent example is the final report, available this summer, on a regional geochemical

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survey of glacial drift. This state-of-the-art study sought gold occurrences in the Archean, Superior province terrane by looking for traces of gold in the buried glacial drift. Samples were collected in 67 locations, most of which were drilled to bedrock. Elevated gold values were found at several of these sites, adding credibility to both the method and the study findings. A large data base was created from the observations and is available on disk. This and other geologic information is available from: **Richard Ruhanen**, MDNR, Division of Minerals, 1525 3rd Avenue E., Hibbing, MN 55746, (218) 262-6767.

The reformed mining tax law, amended lease rules, and collections of geologic information offer exploration and mining companies an improved business environment. These incentives are expected to result in increased mineral exploration and development. Come explore the possibilities.

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Telephone: (612)296-6159

Platinum-Group Element Exploration in Nevada

Nevada Mining Analytical Laboratory (NMAL) was created by the Nevada Legislature in 1895 to provide the state's prospectors with analytical and mineralogical services. In 1929 the Nevada Bureau of Mines was formed to complement NMAL services. In 1985, reflecting changing needs in Nevada, Nevada Bureau of Mines became Nevada Bureau of Mines and Geology (NBMG) and NMAL was formally abolished. NMAL personnel and equipment were incorporated into NBMG as the Geochemical Laboratory.

Along with this name change came an expanded and somewhat different role for the Laboratory—to conduct research in analytical techniques, geochemical exploration methods, and resource evaluation. The traditional role to provide assaying and analytical services for NBMG staff, the mining industry, and the general public was also retained.

Due to the need to reduce the United States' dependence on foreign sources for strategic metals such as platinum and the strong prices for several of the platinum group elements (PGE's), the [illegible] their PGE potential: 1) a layered gabbroic intrusive in central Nevada near the town of Lovelock, and 2) the Clark County region in southern Nevada with its established production from hydrothermal PGE mineralization. In addition, there is anomalous Pt in a hydrothermal Mn deposit near Eureka, Nevada, and this area will also be investigated.

Humboldt Lopolith

The Humboldt Lopolith, located east of Lovelock in Pershing Co., is a large, layered gabbroic intrusion of Early Jurassic age. Layering consists mainly of lower picrite overlain by gabbro which is in turn overlain by leucogabbro to diorite. Inactive Ni-Co mines in the Stillwater Range produced a small amount of concentrates in the late 1800's from limestone-hosted hydrothermal mineralization.

Preliminary assessment of this area by NBMG has shown primary Ni abundances as high as 800ppm, Co up to 100ppm, and Cr concentrations as high as 3000ppm in fresh picrite. Sampling to date in both unaltered picrite and in [illegible] carefully sampled and analyzed for discrete orthomagmatic "reef" type mineralization and their PGE potential remains unknown.

Southern Nevada Hydrothermal PGE Province

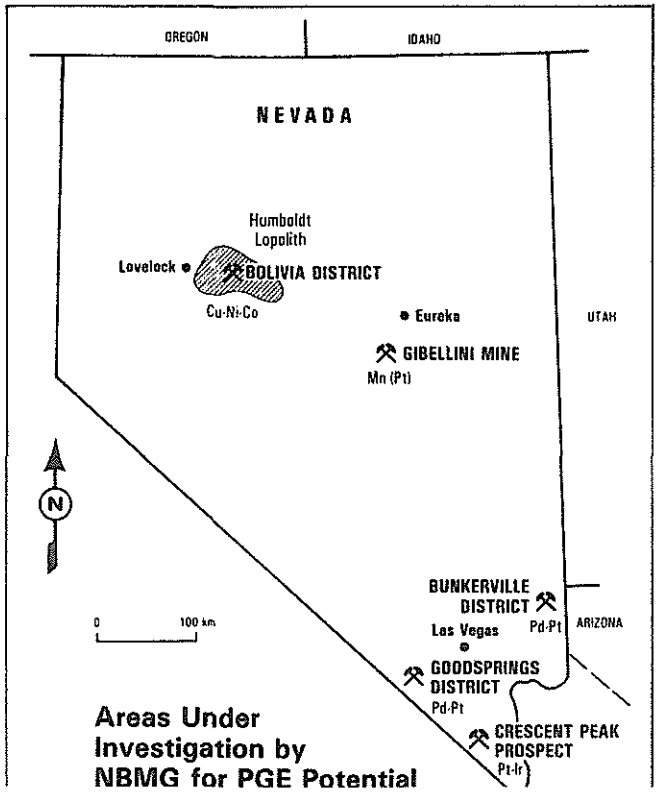
With the recent discovery by NBMG of PGE mineralization at Crescent Peak in extreme southern Nevada, Clark County is emerging as a PGE province. Two other hydrothermal Pd-Pt districts have been known since the mid to late 1800's: the Bunkerville district in the Virgin Mts. 75 miles northeast of Las Vegas and the Goodsprings district 35 miles southwest of Las Vegas. A small amount of PGE production is reported from both districts.

The locations of the Bunkerville and Goodsprings districts occur approximately at the northwestern boundary of a belt of Proterozoic metamorphic rocks extendingin a northwesterly direction through central Arizona into southern Nevada. Clark County hydrothermal PGE mineralization is probably genetically related to these rocks. Most known hydrothermal PGE occurrences exhibit some spatial relationship to mafic or ultramafic igneous rocks or their metamorphic products.

Newly identified PGE mineralization at Crescent Peak is associated with a Mesozoic granitic stock which intrudes Proterozoic mafic and ultramafic rocks of the southern McCullough Range. PGE's accompany stockwork Pb-Zn-Cu-Ag-Au veins hosted by the granitic rocks. PGE abundances in the massive sulfide veins are extremely erratic, assaying from XX ppb to XXXX ppm.

Gibellini Manganese Deposit

The Gibellini hydrothermal Mn-Zn-Ni-V mineralization occurs in Devonian limestone in the Fish Creek Range south of Eureka. Samples of mineralized outcrop material from this property contain from approximately 150 to over 600 ppb Pt, from 18 to 45 ppb Pd, and from 16 to 37 ppb Rh. The scope, variability, and overall tenor and tonnage of PGE mineralization at Gibellini is



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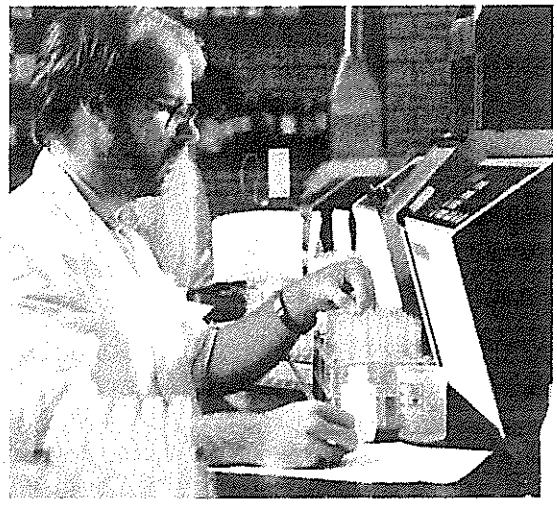

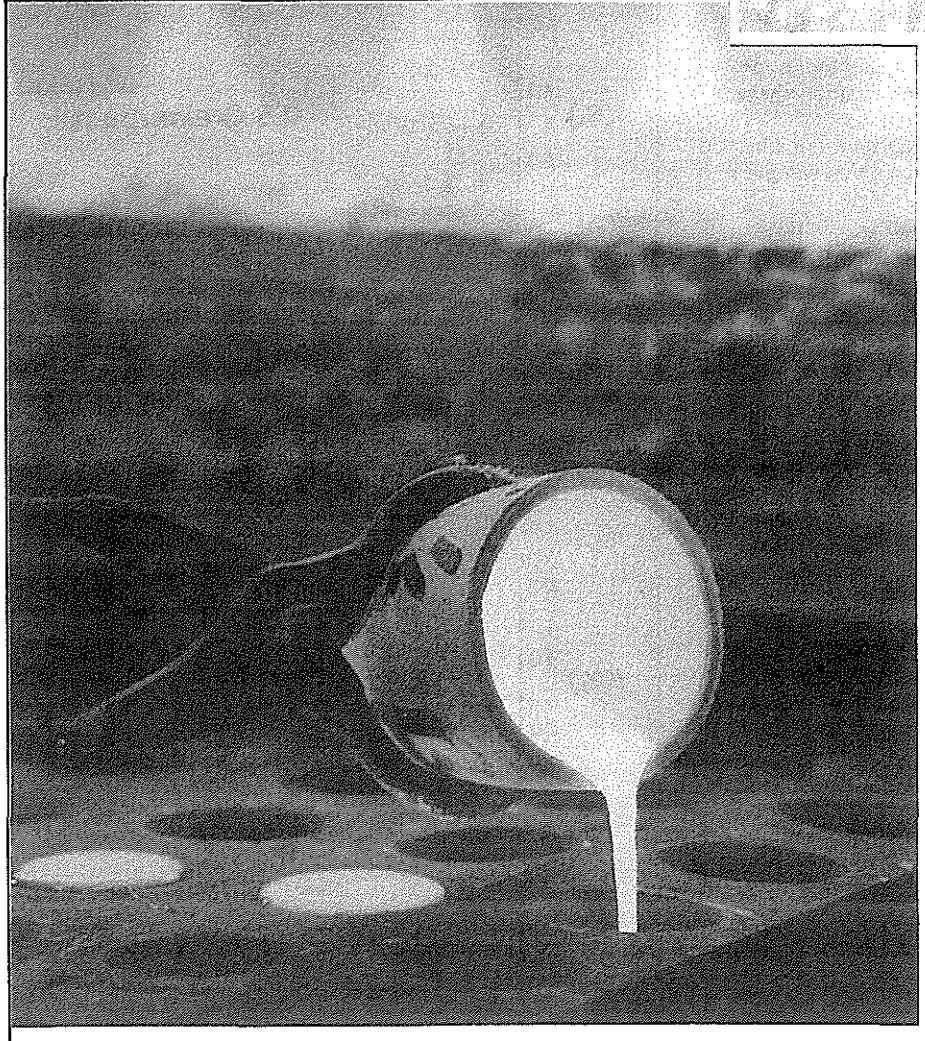

- Two major laboratories each designed to prepare and analyse over 1000 gold samples per day.
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unknown at present.

NBMG archive samples from ten other Nevada manganese deposits were subsequently analyzed for Pt-Pd. None of these samples contained greater than 10ppb Pt or Pd.

Ongoing investigations of the PGE potential of various areas in Nevada will be described regularly in updated NBMG Open File Reports and elsewhere.

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TECHNICAL NOTES

A Test in Pattern Recognition: Defining Anomalous Patterns in Surficial Samples which Exhibit Severe Nugget Effects

Those of us engaged in exploration geochemistry have undoubtedly faced difficulties in the interpretation of geochemical surveys for resistate minerals. Over the past ten years, nugget effects in elements such as tungsten, tin, and now gold have undoubtedly caused many headaches. The large amount of exploration currently underway for Au makes the nugget effects associated with Au particularly important for the exploration geochemist.

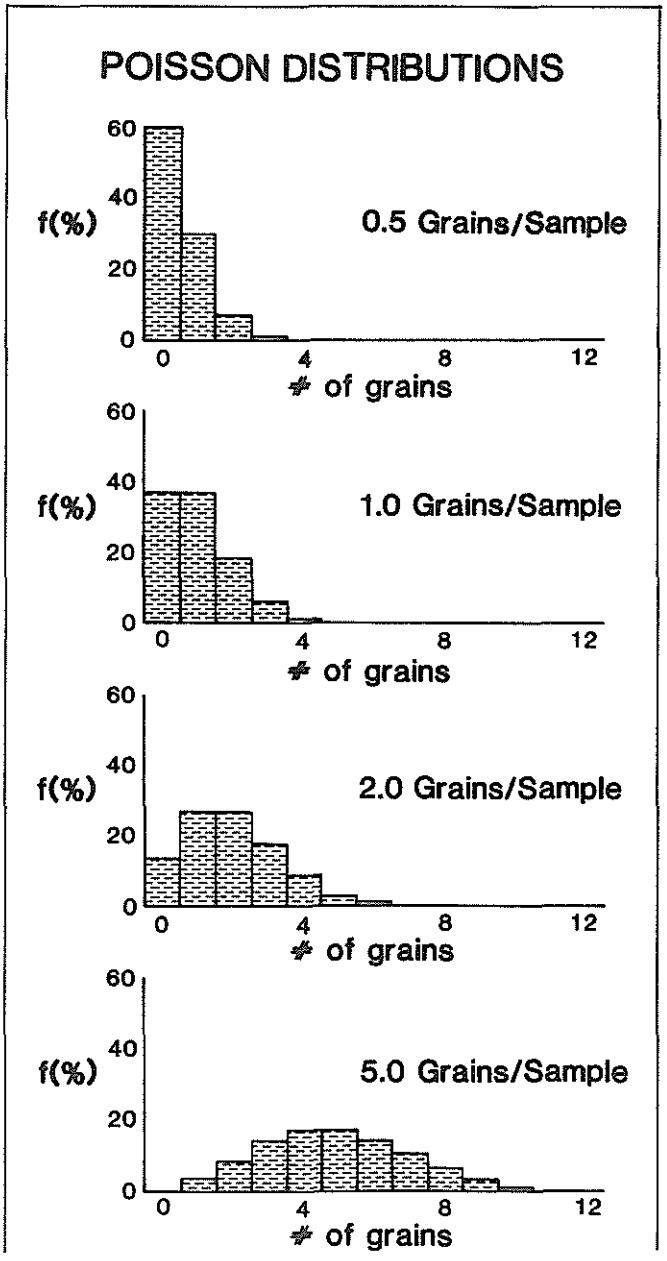
Many geochemists have attempted to reduce nugget effects by taking large samples, taking replicate samples, or analyzing numerous 'check' samples to monitor and estimate sample variability. Most of us would agree that there cannot be too much care taken in sampling for gold. Factors such as target type, sample spacing, sample size, sample media, sample preparation/reduction technique, and sample determination procedure must all be considered during interpretation because each of these factors can influence the observed geochemical signal.

Recently, much ado has been made about the futility of collecting geochemical samples for Au. Sampling theory (Gy 1982), grain size studies (Clifton et al. 1969) and Poisson statistics (Ingamells 1981, Figure 1) invariably show that a mono- [illegible] studies of this type consider only the representiveness of the individual sample. They do not consider the spatial relationships of the, hopefully, several samples which are 'anomalous'.

Attaining reproducible gold results in a given sample is not the ultimate goal of the exploration geochemist. Rather, our goal is to recognize a pattern of element distribution which can be attributed to an economic mineral target or geological feature. This is the crucial point. Since interpretable patterns (anomalies) are, in many cases, composed of groups of samples, the individual sample representiveness need not be at a level where anomaly detection is highly likely. Rather the product of the probability of anomaly detection at an individual sample site times the number of sites which sample anomalous material controls whether a pattern can be recognized. Essentially, there is safety in numbers.

Obviously, a trade-off exists between sample size and sample density. Increasing sample size increases the probability of detecting gold at a specific anomalous sample site. Increasing sample density increases the probability of detecting gold in at least one of several anomalous sample sites. In each [illegible] a simple geological model consisting of a geochemical anomaly on a mineral claim. The geochemical anomaly forms a linear pattern and is subject to rare grain-sampling difficulties similar to what might be expected from a Au-bearing quartz vein (Figure 2). The length and location of the 'vein' was randomly chosen by the computer. Eastward dispersion of the surficial materials (soils) overlying the N-S oriented vein has been simulated by the program and this dispersion decays in an exponential form (Bird and Coker 1987; Shilts 1976). Sample sites located on a series of lines perpendicular to the vein orientation are spaced close enough to ensure that several samples will contain truly anomalous concentrations (either from the Au source or its dispersion train). The sizes of the dots on Figure 2a represent the 'true' relative concentrations (the groundtruth) of the soils on the mineral claim.

Computer-effected sample collection at each site of the groundtruth was done using Poisson statistics to simulate the sample variance pro-



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duced by the existence of rare grains (Figure 1). Due to sampling or laboratory error, the 'background' areas occasionally report detectable Au concentrations.

In each sampling simulation, a different sample size was used to determine the (Poisson) probabilities, at any given concentration, of detecting different numbers of rare grains in the sample. Thus a different expected number of Au grains is contained in each of the sample realizations shown in Figures 2b and 2c. The sampled grid of Figure 2c represents a sample size 4 times larger than the sample size for Figure 2b. Obviously, the reliability of Au detection on an individual sample varies from case to case, but the linear relationship of the pattern of anomalous samples makes detection easier.

Clearly, based on this simple stochastic model, the probability of anomaly detection is some function of sample density and sample size. Both must be considered when designing geochemical surveys for rare resistate minerals.

As a test of your ability to recognize a similar anomaly, Figure 2d contains a realization of an unknown groundtruth, produced using a small sample size. In the next issue of the newsletter, the groundtruth used to generate this realization will be published, along with a similar realization using a larger sample size. It may be interesting to compare your best guess of the location and length of the anomaly on Figure 2d with the groundtruth used to produce the grid. Hopefully, this example allows insight into the control of both sample density and sample size on the reliability of rare resistate mineral analyses and on the probability of anomaly detection.

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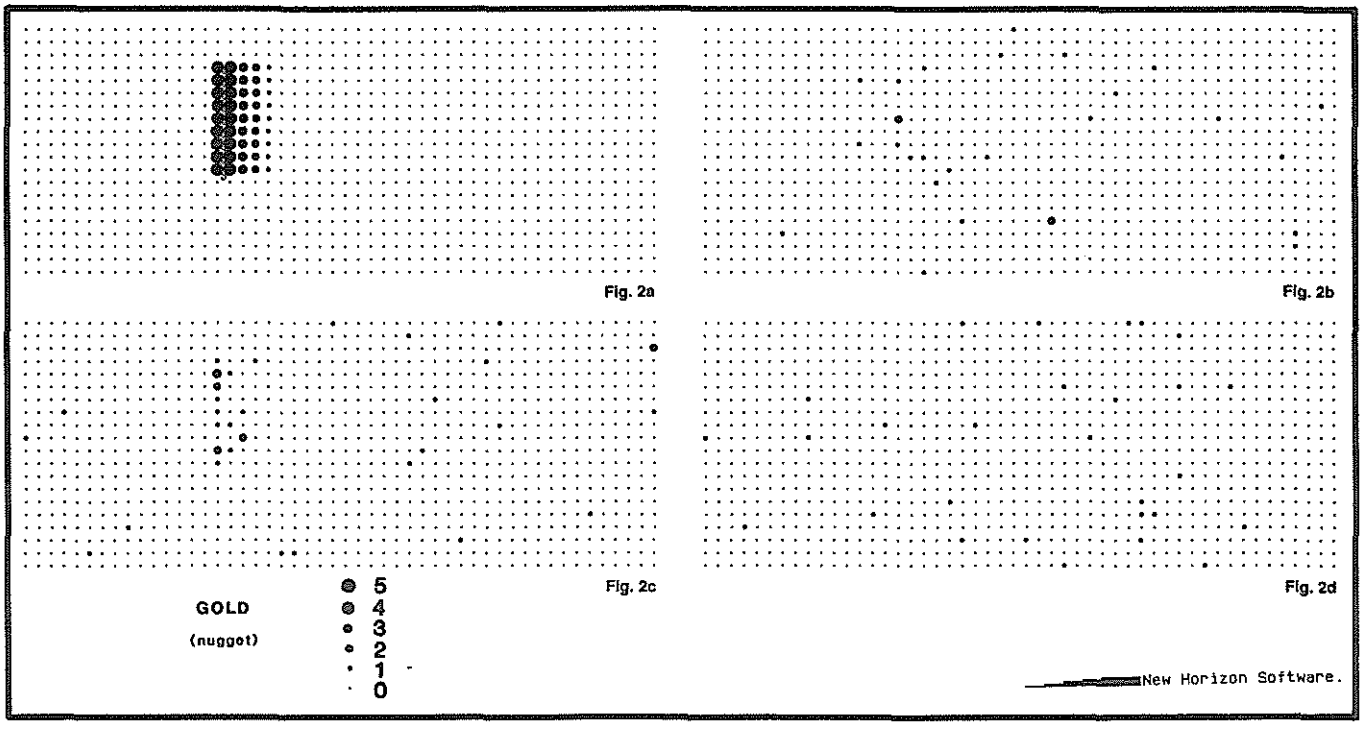
Mapping Hydrothermal Alteration with High-Resolution Remote Sensing Imagery

Carbonate, sulfate, hydroxyl-bearing and water-bearing minerals, including specific clay minerals, can be mapped using recently developed remote sensing instruments with high spectral and spatial resolution such as the Airborne Imaging Spectrometer (AIS). When AIS digital data are used in conjunction with computer software and field and laboratory data, the areal distribution of some hydrothermal alteration assemblages can be delineated (Goetz and others, 1985).

Three flight lines of data were acquired over the Tybo mining district in the southern Hot Creek Range of Nye County, Nevada, by the AIS sensor from a NASA C-130 aircraft. The sensor collects 128 spectral bands for each 12 m picture element in the shortwave infrared between 1200 and 2400 nm (1.2 to 2.4 micrometers). Each of the flight lines covers an area of about 370 m wide by about 13 km long.

The geology and hydrothermal alteration assemblages along AIS flight lines were mapped using conventional field and laboratory methods, Landsat Thematic Mapper imagery, and high-resolution Airborne Imaging Spectrometer data. Silver-lead-zinc-gold, mercury (associated with anomalous gold values), and barite have



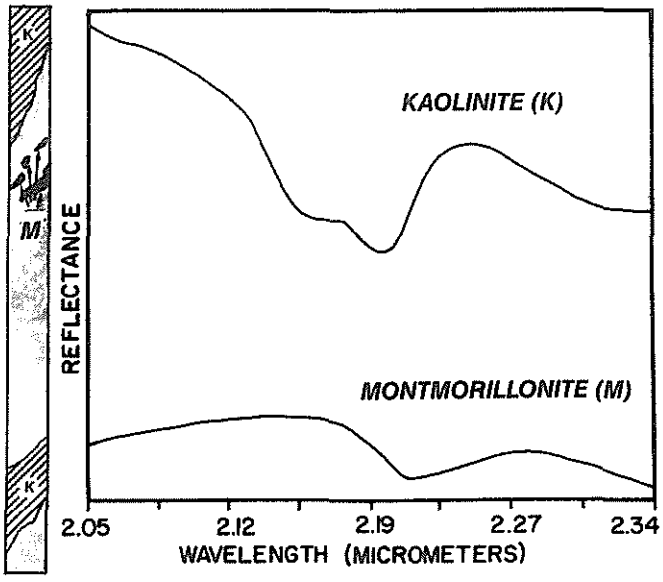


Figure 1. Spectral matching for kaolinite (K) and montmorillonite (M) applied to Red Rock Canyon AIS data. Northeast is at the bottom of the Red Rock Canyon image strip on the left. The image strip is 370 m across. Spectra in the graph are from known minerals and these have been compared by computer with Red Rock Canyon AIS spectra to arrive at the mineralogical identifications in the image strip.

been mined in this part of the southern Hot Creek Range (Kleinhampl and Ziony, 1984). Extensive areas of hydrothermally altered rhyolitic to dacitic ash-flow tuffs have been previously recognized.

AIS remote sensing data were analyzed to determine the distribution of alteration minerals using a signature-matching method, principal component analysis, and band ratios. With the signature matching method, known spectral signatures of minerals (graph in Figure 1), are compared with spectral signatures in the Hot Creek AIS data. Picture elements with similar spectral signatures to the known minerals shown in the graph are identified on the image strip to the left in Figure 1 by the first letter of the mineral name. The signature matching method was found to be the *best method for mineralogical* discrimination and identification, followed by principal component analysis.

were identified in the southern Hot Creek Range by field mapping, X-ray diffraction analysis, and analysis of the remote sensing data. These methods, along with the analysis of thin sections and aeromagnetic, digital Landsat Thematic Mapper, and AIS data were used to produce maps of hydrothermal alteration assemblages. Several areas in the Hot Creek Range were identified for further mineral exploration efforts.

Figure 2 illustrates the addition of spectral information to the stratigraphic section of the southern Hot Creek Range. The identification of argillic and propylitic alteration minerals and the mapping of hydrothermal alteration zones has been made more efficient by the addition of high-resolution remote sensing data. The mapping of hydrothermal alteration minerals with high-resolution remote sensing instruments provides us with a rapid method to extend the limits of field mapping and can be used to direct future exploration efforts

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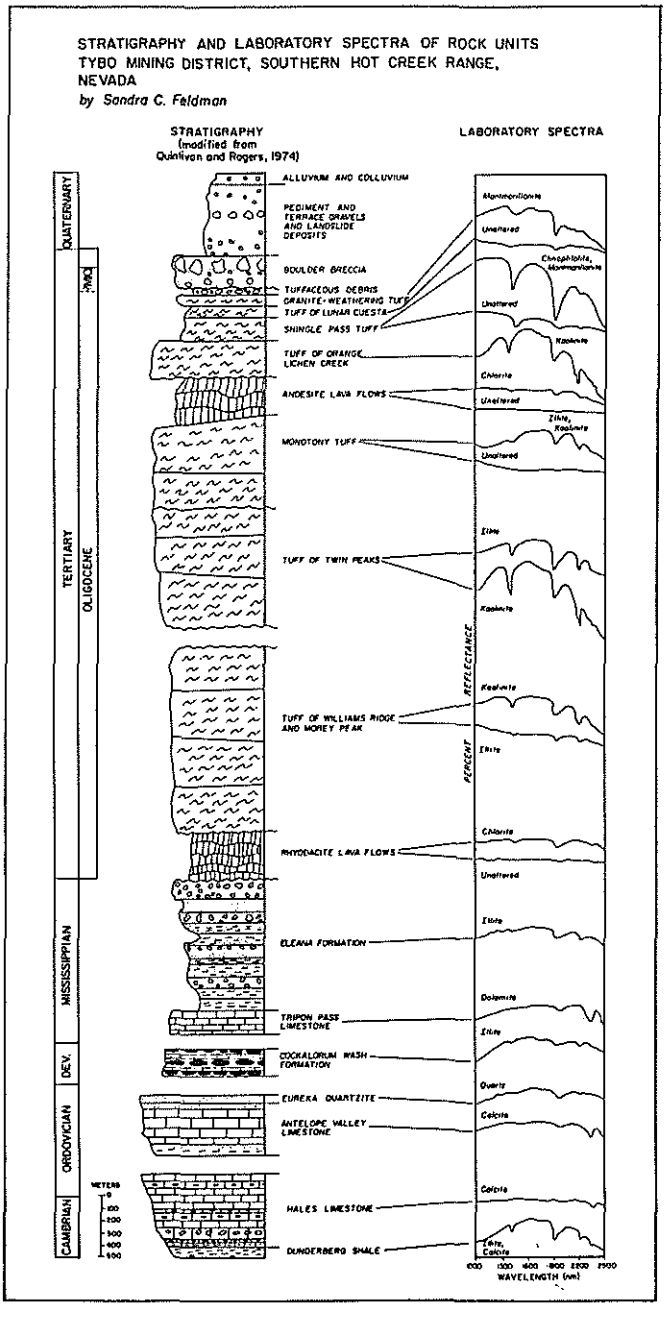

Figure 2. Stratigraphy and laboratory spectra of rock units, Tybo mining district, southern Hot Creek Range, Nevada.

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Special Volume #14 of The Association of Exploration Geochemists

PROBPLOT

An Interactive Computer Program to Fit Mixtures of Normal (or Log-Normal) Distributions with Maximum Likelihood Optimization Procedures

The PROBPLOT program is an interactive computer program written for the IBM-PC and compatible computers which allows the analysis and modeling of cumulative frequency data on probability plots. Optimal mixtures of normal (or log-normal) distributions can be fit to any cumulative frequency data for the purpose of the selection of thresholds to partition data into groups.

The program supports all aspects of probability plot analysis described by Dr. A. J. Sinclair in Special Volume #4, *Application of Probability Graphs in Mineral Exploration*, including data censoring, data truncation correction, logarithmic and arithmetic analysis, polymodal distributions, and threshold selection. Multimodal population destribution modeling and threshold selection can both be done visually by the operator using mathematical optimization procedures to produce unbiased estimates.

Data in a wide variety of formats can be input in the program. Output consists of histograms, probability plots, summary statistics, thresholds, and distribution model parameters. Data sets as large as 3500 cases and 45 variables can be accommodated. Computer system requirements are 256 kilobytes of memory, a disk drive, and a dot-matrix printer. PROBPLOT will support the CGA, EGA, and Hercules tributed on a double-sided double-density 360 kilobyte 5.25-inch floppy disk. This contains an instruction manual file which can be dumped to a printer, the object code files required to run the program, and a sample data set which can be used for instruction. Program source code can be made available to those who wish to modify the code to work on other computer systems.

A combination package of Special Volume #4 (which discusses the theory of probability plot analysis) and #14 (the program to perform the analysis) is available at a $5.00 US discount off the combined price of each special volume. Users unfamiliar with the use and theory of probability plots are encouraged to purchase both special volumes, because the material in the instruction manual of Special Volume #14 is designed to complement Special Volume #4 and does not reiterate the material presented there.

The Association of Exploration Geochemists and anyone else affiliated with the authorship or distribution of the PROBPLOT program assumes no responsibility for any problems or errors that arise from the use of the PROBPLOT program. All users assume use of the PROBPLOT program entirely at their own risk.

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Volcanogenic Massive Sulfides in Newfoundland

In the last issue of EXPLORE a soil survey for Cu, Zn, and Pb (Fig. 1, no. 62, p. 6) was used to search for a volcanogenic massive sulphide (VMS) deposit in Newfoundland. (For those who do not have a copy of Number 62 and want to find out what was said, please refer to the editor's note at the end of this article.) The program was conducted in the 1960's and illustrates data that would have been normally available in that era. We know little else about the survey, except that the sample locations along the baseline were permanently marked with aluminium tags and relocatable in 1987. I assume the quality of sampling also represented the norm for that era and is comparable to the norm today on many exploration programs.

Maximum Cu, Zn, and Pb values of 50 to 100 ppm, 200 to 500

AEG-NWMA JOINT MEETING

CALL FOR PAPERS

Multidisciplinary Exploration Case Histories
Spokane, Washington • November 30 to December 2, 1988

The AEG will be co-sponsoring the annual general meeting of the Northwest Mining Association (NWMA) in Spokane, Washington on the topic of multidisciplinary exploration case histories. The meeting will focus on the use of geology, geochemistry and geophysics in the search for Au and Pt volcanogenic massive sulphides and other types of deposits. The annual NWMA meeting is probably the premiere event within the exploration community in the United States and should be placed on your calender of events worth attending.

Papers are being requested where the use of a multidisciplinary approach can be described and its effectiveness commented upon. It is likely that the meeting will attract many gold papers, but submissions will be accepted on any commodity. Organizers hope to attract papers on many deposit types from North America as well as on other parts of the world.

But time is short. If you would like to contribute a technical paper (or papers), please direct your intentions to the address below by April 15. Extended abstracts of about 500 words are due June 1, 1988.

It is our intention to publish a proceedings volume of papers submitted for that purpose and meeting standards established by an editorial board. It is requested that papers be submitted by October 15, 1988 so that copies can be made and distributed to interested convention participants.

A premeeting geochemical short course is planned for November 28-30 (2½ days). Field trips are also

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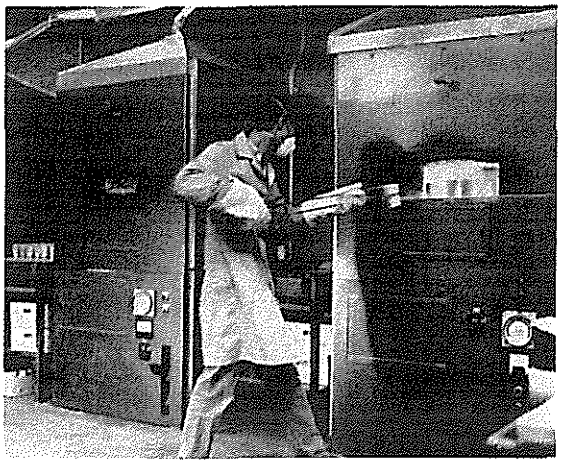

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ppm, and 75 to 100 ppm, respectively, might not seem exceptional in many environments, but in Newfoundland significant VMS discoveries are reflected by comparable values in a comparable landscape. Even in rugged mountains, where talus slopes are common and extensive soil formation is absent, maximum values are perhaps only 3X greater downslope of VMS prospects. Depicted anomalies are thus of interest to exploration.

In 1987 10 g of minus 80 mesh pulps from the 1960's survey were reanalyzed for 30 elements at a commercial laboratory. That work was summarized in EXPLORE no. 62. Did any reader of this column decide that seeing geochemical maps plotted for any of the other 27 elements was one of their priorities? If so, which element(s) did you choose? Space limitations mitigate against showing all the data, but a summary is presented of some of the more outstanding findings:

(1) Extreme accumulation of Fe, to the 10 and 20% levels, occurs erratically across the grid as well as within homogeneous zones. On the same grid many Fe values are less than 1% distributed in a heterogeneous pattern.
(2) Extreme accumulation also characterizes Mn, with many erratically distributed values in the range of 1 to 10%. Many other Mn concentrations are less than 100 ppm.
(3) Many Ca values exceed 1% aqua regia leachable metal. These are accompanied by anomalous levels of Sr, Ba, and P. The Ba content could be particularly important, as aqua regia leachable values exceeding 500 ppm to a maximum of 3000 ppm may be reflecting barite (i.e., in the soil environment I have seen aqua regia dissolve 5 to 15% of the total Ba present in a sample). Barite is known to be associated with VMS deposits in the study area.
(4) Elements which are normally scavenged by Fe oxides (Mo, Cu, Cd, Ag, Sb, V) and Mn oxides (Co, Zn, Ag) are present in anomalous abundance associated with one or both of these scavengers.
(5) Line specific peculiarities are seen 200 m west of Fig. 1 for Ca and Sr. A Ni anomaly is specific to the line immediately east of the 21 at the bottom of the map.

This information suggests that some anomalies are related to sample composition. I anticipate the strong correlation of Cu anomalies 13,15,16,17 and 18; Zn anomalies 3,4,6,8,11 and 14; and Pb anomalies 7,8,11,12,15 and 19 with Fe and Mn indicates that they are probably false anomalies! From your analysis of Figure 1 in the last issue, I hope you didn't plan to spend much money on these anomalies, concluding that the data are unacceptable to guide further exploration. You can find out more about how sampling factors affect trace element distributions by referring to Chapter 3 in Reviews in Economic Geology, Volume 3.

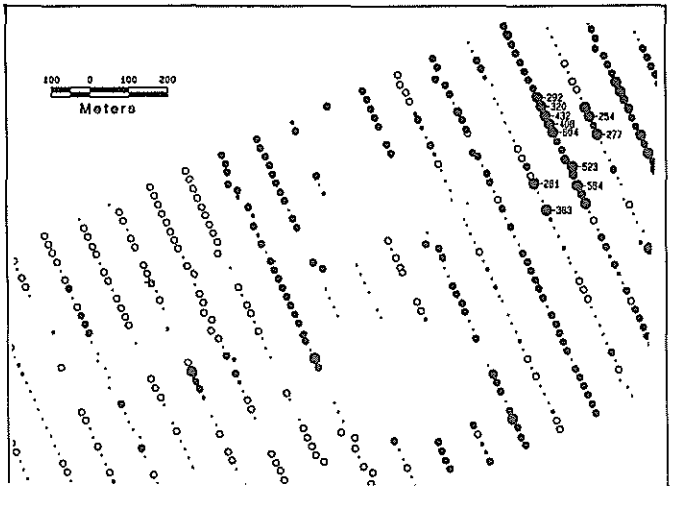
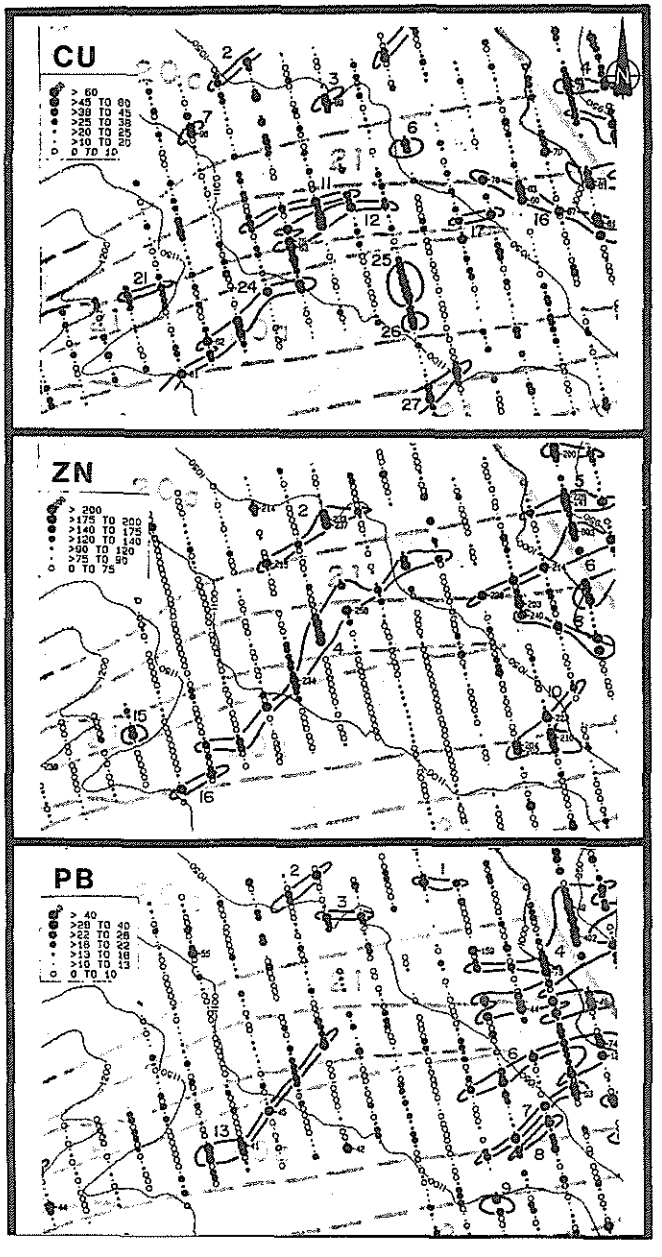


Figure 2 presents results of a resampling program with samples being reanalyzed using the same laboratory and analytical procedure (aqua regia digestion). Samples were collected by individuals trained to recognize soil horizons from more or less the same locations as in Fig. 1. A comparison of Figs. 1 and 2 shows that anomaly patterns are much different. Even where they superficially appear similar, such as the Fig. 2 northeasterly-trending Cu zones of 6,11 and 24, Zn zones 4 and 16, and Pb zone 13 compared to Fig. 1 Cu zones 13,15,16, and 20 and Zn zones 8,12, and 13, note a southeastward displacement of perhaps 100 m on Fig. 2 from Fig. 1.

Some additional interesting geochemical data from the 1987 survey, numbered to correspond with the paragraphs above:

(1) Fe concentrations in soils fall within a tighter range, very few values being less than 2% and few exceeding 7%. The Fe distribution patterns are homogeneous.
(2) Mn concentrations in soils are likewise more normally dis-



tributed, ranging from 150 ppm to 3000 ppm, with only the odd sample exceeding 6000 ppm.

(3) All Ca values are less than 0.5%. Sr, Ba, and P are likewise reduced to maximum values of 20 ppm, 100 ppm, and 0.1%, respectively from initial survey readings of about 50 ppm, 1000 ppm, and 0.2%, respectively.

(4) Association of elements such as Mo, Cu, Cd, Ag, As, Sb, V, Co, and Zn with Fe and/or Mn is not in evidence, except for the odd sample. Most Mo, Ag, As, Sb, and Co anomalies have disappeared compared to the first survey.

(5) Line-specific peculiarities are still present, suggesting an analytical problem. The line which has Cu anomalies 25, 26, and 27 (Fig. 2) also exhibits unusual Ni, Cr, Ba, Sr, Ca, and Mg patterns, suggesting reanalysis is in order.

This information suggests the second soil survey is probably of high quality, with the exception noted in point (5) above which affects only the Cu distribution. Ignoring this artifact, the stage is set to predict the most likely bedrock source of metal.

As the time interval between publication of Number 62 and the preparation for this issue was not great, I will give our readership a chance to digest all the information presented thus far and predict where the bedrock source of metal is likely to be. Please suggest what followup approaches might be used before I conclude this case history. Address your comments, questions, or responses to me in Vancouver.

I have a second case history which I would like to begin in this issue. Figure 3 displays Cr data for a soil survey conducted in the search for epithermal Au mineralization, again in Newfoundland. A preamble concerning sampling, general landscape, and environmental conditions would be similar to that used to describe Fig. 1. Do you recognize any peculiarities in the Cr distribution? If so, what are they, and how do you think they arose? Is remedial action necessary, and what would you recommend? Tell me what you think, and I will continue this case in the next issue of EXPLORE.

Editor's Note: *As EXPLORE is the newsletter of the Association of Exploration Geochemists (AEG), Number 64 will be mailed to all AEG members in good standing for 1988. Those not members of the AEG can join by completing the form on page 25, seek out an AEG member to examine a copy, or write to the author for a copy of the Number 62 or Number 64 Pearl Harbor file, enclosing $2 to cover the costs of mailing and handling.*

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SPECIAL NOTES

Associated Societies

Professionals in exploration and related fields are aware of many nonprofit organizations promoting specialty subjects like geophysics, mining, environment, data processing, and analysis. The cost of running these associations is always increasing, as evidenced by the recent increase in U.S. postal rates which significantly affects promotional material and newsletter distribution. It is in the interests of all societies to help each other in dissemination of newsworthy items in order to reduce costs and reach a larger audience. In this article two such organizations are described. It is our intention to publicize other societies in future issues of EXPLORE on a reciprocal basis.

Cordilleran Section, Geological Association of Canada

The Cordilleran Section, based in Vancouver, British Columbia, has cosponsored two of our more successful symposia, GOLD-81 and GEOEXPO/86, and the ensuing proceedings volumes. We are pleased to reprint the following message from **Gerald G. Carlson**, President of the Cordilleran Section:

The Cordilleran Section has approximately 650 members from the mineral exploration community, University of British Columbia, and the federal and B.C. geological surveys. Our programs reflect a wide range of topics from practical exploration techniques to the frontiers of geologic research.

The cornerstones of our activities include: two or three short courses a year, each lasting from one half to two days; approximately one featured speaker a month during the fall and winter; and an annual meeting. In addition, we cosponsor technical meetings with local and international groups and associations, such as the upcoming meeting with the NWMA and AEG. Our Education Committee provides speakers to schools and other groups. Many of our short courses and technical sessions lead to publication.

Each member receives a bimonthly newsletter containing news of upcoming activities and reviews of recent meetings and courses. It features our popular events calendar, "Dates from the Cordilleran Time Scale". To keep yourself abreast of activities north of the border, and perhaps even participate, please consider joining the Cordilleran Section. The fee is a modest $12.00 per annum, and you will be placed immediately on our mailing list. You may send a cheque, or write for further information to **Ellen Woolverton,** G.A.C. Cordilleran Section, P.O. Box 398, Station 'A ', Vancouver, B.C., V6C 2N2, (604) 684-2754

Two publications from recent short courses are available for sale: *Geophysics for the Exploration Geologist: Traditional Approaches and Recent Innovations.* **D. Woods** (1987), and *Geotechnical Data Collection for Exploration Geologists.* **D. Martin** (1986). Each publication is $20.00, or $25.00 for nonmembers of the Cordilleran Section, with U.S. dollars accepted at par (to account for the higher cost to ship a volume south of the border). Postage and handling charges are $4.50 for each book. Our complete publications list is available upon request.

Smithers Exploration Group and G.A.C. Cordilleran Section will sponsor a conference on geology and metallogeny of northwestern British Columbia, October 15-21, 1988 at Smithers, B.C. The program (October 17-19) will provide overview of northwestern B.C. geology and metallogeny and will focus on the Jurassic stratigraphy which hosts many important precious

served basis. For more information, contact:

Dave Lefebure
Geological Survey Branch
Energy, Mines & Petroleum Resources
Bag 5000, Smithers, B.C. V0J 2N0
(604) 847-7391 or
Bob Anderson
Geological Survey of Canada
4th Floor, 100 W. Pender Street
Vancouver, B.C. V6B 1R8
(604) 666-2693, (604) 666-0529 (messages)

Institute Of Mining And Metallurgy (IMM) — London

The IMM has also assisted the AEG on numerous occasions by distribution of our publicity flyers to the membership which receives the Applied Earth Science Transactions. The IMM has had an ongoing commitment to exploration geochemisty through their biennial *Prospecting in Areas of Glaciated Terrain* and *Prospecting in Areas of Arid Terrain.* The next meeting for

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Prospecting in Areas of Glaciated Terrain will be in Halifax, Nova Scotia on August 28th to September 3rd, 1988.

The following information has been provided by ***Michael J. Jones****, Secretary of the IMM:*

The Institution, which was founded in 1892 and incorporated by Royal Charter in 1915, is a professional body whose members are practising in one or more branches of the minerals industry — mining, metallurgy, mineral processing, geology and petroleum engineering, and oil technology. Through its association with the Engineering Council, its corporate members are Chartered Engineers.

The objectives and purposes for which the IMM is constituted are to advance the science and practice of mining, mineral technology, petroleum engineering, mineral exploration, and mining and engineering geology in respect of minerals other than coal, and of metallurgy in respect of metals other than iron.

From its inception, the IMM has published books and journals, collected technical literature (library and information service), held meetings and organized symposia and conferences, and taken an active part in the furtherance of education and training. The IMM organizes several major international conferences each year — both in the United Kingdom and overseas — and regular one- or half-day discussion meetings and technical visits.

The IMM publishes ***IMM Bulletin*** (monthly — notes and news, forthcoming meetings, courses, book reviews, and library additons) and ***Transactions*** (three quarterly sections — *A: Mining industry, B: Applied earth science, C: Minerals processing and extractive metallurgy).* The library and information service edits ***IMM Abstracts,*** a bimonthly journal of world literature. Information retrieval for members (and fee-paying nonmembers) is based on the computerized database ***IMMAGE.***

Detailed information on membership and all IMM acitivities and services is available from the Secretary, Michael J. Jones, 44 Portland Place, London WIN 4BR, England. Phone 01-580-3802, Telex 261410, and Facs 01-436-5388.

Michael Jones has informed me that AEG members in good standing will qualify for a 40% discount on IMM publications. A list of publications appears on page 24 of this issue.

Stan Hoffman
BP-Resources
Vancouver, B.C.

COUNCIL MINUTES

Actions of February 11, 1988

1. Council accepted the list of nominees for Council for the 1988-90 term.
2. Plans were formalized for the Baltimore, Maryland, Annual General Meeting in May, 1988; the Northwest Mining Association Meeting in November, 1988; the Rio, Brazil Meeting in 1989; and the Prague, Czechoslovakia meeting in 1990.
3. Designs and text for a publicity brochure were discussed along with a simplified application form.
4. The Membership Directory and Directory of Chemical Laboratories was discussed and was projected for publication in early summer.
5. The winner of the student prize was announced: **Don Saxby** for his paper entitled *Behavior of Scheelite in a Cordilleran Stream*.
6. A new supplement to the bibliography of exploration geochemistry was discussed and will be ready for distribution in the summer of 1988.
7. Council appointed **David Jenkins** as Treasurer of the Asso-

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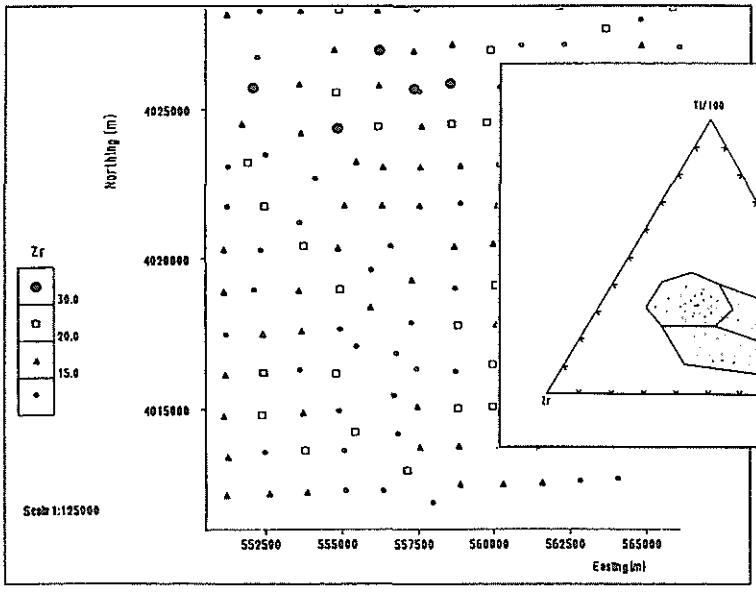

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ciation. He will take over from **Lynda Bloom** who has served the Association very well for many years.
8. **Graham Taylor** was accepted as the second Australian Regional Councillor.

Actions of March 31, 1988

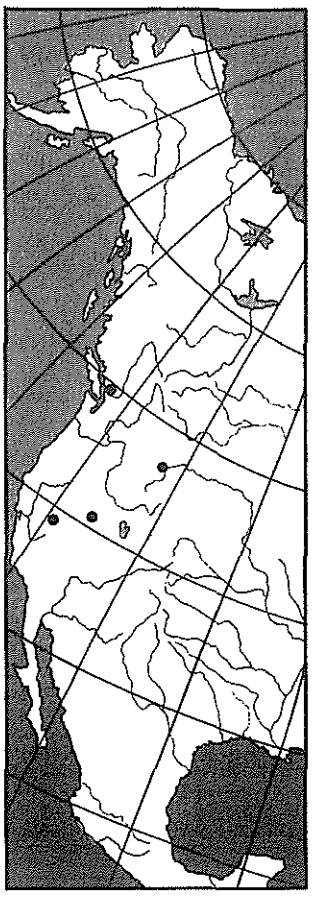
1. EXPLORE seems to have been favorably received by members and nonmembers alike. It was decided to continue in this format and to continue publication.
2. A total of 50 new affiliate and voting members were accepted into the Association.
3. **Lloyd James** was accepted as Chairman of the Membership Committee.
4. Several possible new projects were proposed including a 35mm slide presentation on soil sampling and a VHS video cassette on soil sampling.

Sherman Marsh

28th INTERNATIONAL GEOLOGICAL CONGRESS

Washington, D. C. • July 9 to 19, 1989

Technical and poster sessions, symposia, short courses, workshops, and field trips covering a wide variety of topics are planned. The second circular describing these and other activities is now available. Please write **Dr. B. B. Hanshaw,** Secretary General, 28th International Geological Congress, P. O. Box 1001, Herndon, VA 22070-1001, U.S.A. Telephone 703-684-6053, telex 248418.



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Nomination for Councillor, Association of Exploration Geochemists

We, the undersigned, wish to nominate _____, who by signature below has agreed to stand for election to Councillor for the Association of Exploration Geochemists. This nomination is made in accordance with Article 4.04 of By-Law 1 (1979), with the term starting after the Annual General Meeting in 1989.

PLEASE PRINT

1. *Name* _____ *Signature* _____
   Address _____ *Date* _____
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6. *Name* _____ *Signature* _____
   Address _____ *Date* _____

I _____, a Voting Member of the Association of Exploration Geochemists, agree to serve as

Recent Papers

Recent Papers from Analytical Journals

This list comprises titles that have appeared in major analytical journals received by the GSC library since January 1, 1988. These include: Analytical Chemistry, Analyst, Journal of Analytical Atomic Spectroscopy, Talanta, Applied Spectroscopy, Spectrochimica Acta Part B, Analytical Proceedings, and Atomic Spectroscopy.

Compiled by **Gwendy E.M. Hall**, Analytical Method Development Section, Mineral Resource Division, Geological Survey of Canada, Ottawa, Ontario, KIA 0E8 Canada. Please send new references to Dr. Hall, *not to* EXPLORE.

Ed. Note: This is the inaugural edition of the analytical bibliography. Our thanks to Dr. Hall for providing this welcome addition to EXPLORE.

Hemens, C.M. and Elson, C.M. 1988. *Determination of microgram amounts of zirconium in geological materials by coprecipitation with iron (III) hydroxide and X-ray fluorescence spectrometry.* Analyst, 113: 197-199.

Nakashima, S., Sturgeon, R.E., Willie, S.N. and Berman S.S. 1988. *Acid digestion of marine samples for trace element analysis using microwave heating.* Analyst, 113: 159-163.

Veselsky, J.C., Kwiecinska, B., Wehrstein, E. and Suschny, O. 1988. *Determinationof uranium in minerals by laser fluorimetry.* Analyst, 113: 451-457.

Ajlec, R., Cop, M. and Stupar, J. 1988. *Interferences in the determination of chromium in plant materials and soil samples by flame atomic absorption spectrometry.* Analyst, 113:

Kantipuly, C.J. and Westland, A.D. 1988. *Review of methods for the determination of lanthanides in geological samples.* Talanta, 35: 1-13.

Donaldson, E.M. 1988. *Determination of arsenic in ores, concentrates and related materials by graphite-furnace atomic-absorption spectrometry after separation by xanthate extraction.* Talanta, 35: 47-53.

Rice, T.D. 1988. *Determination of fluorine and chlorine in geological materials by induction furnace pyrohydrolysis and standard-addition ion-selective electrode measurement.* Talanta, 35: 173-178.

Sill, C.W. 1988. *Determination of lead-210 standard samples of soil, ores and mill tailings.* Anal. Chem., 60: 320-323.

Conrad, V.B. and Brownless, W.D. 1988. *Hydropyrolytic-ion chromatographic determination of fluoride in coal and geological materials.* Anal. Chem., 60: 365-369.

Zachmann, D.W. 1988. *Matrix effects in the separation of rare-earth elements, scandium and yttrium and their determination by inductively coupled plasma optical emission spectrometry.* Anal. Chem., 60: 420-427.

Chamsaz, M. and Winefordner, J.D. 1988. *Determination of inorganic and organotin compounds in seawater by graphite furnace atomic absorption spectrometry.* J. Anal. At. Spectrom., 3: 119-124.

Ebarvia, B., Macalalad, E., Rogue, N. and Rubeska, I. 1988. *Determination of silver, cadmium, selenium, tellurium and thallium in geochemical exploration samples by atomic absorption spectrometry.* J. Anal. At. Spectrom., 3: 199-203.

Shan, X., Tie, J. and Xie, G. 1988. *Determination of trace elements in water, sea water and biological samples by inductively coupled plasma atomic emission spectrometry after pre-concentration with ammonium pyrrolidinedithiocarbamate precipitation.* J. Anal. At. Spectrom., 3: 259-263.

Castillo, J.R., Mir, J.M., Martinez, M.C. and Gomez, T. 1988. *Study of the composition of siliceous material by AAS.* At. Spectrosc., 9: 9-12.

Foulkes, M.E., Ebdon, L. and Hill, S. 1988. *Ore and mineral analysis by slurry atomisation plasma emission spectrometry.* Anal. Proc., 25: 92-94.

Chenery, S., Thompson, M. and Timmins, K. 1988. *Laser ablation*

Dickin, A.P., McNutt, R.H. and McAndrew, J.A. 1988. *Osmium isotope analysis by inductively coupled plasma mass spectrometry.* J. Anal. At. Spectrom., 3: 337-342.

Park, C.J. and Hall, G.E.M. 1988. *Analysis of geological materials by inductively coupled plasma mass spectrometry with sample introduction by electrothermal vaporisation. Part 2. Determination of thallium.* J. Anal. At. Spectrom., 3: 355-362.

Cresser, M.S., Ebdon, L. and Dean, J.R. 1988. *Atomic spectrometry update - environmental analysis.* J. Anal. At. Spectrom., 3: 1R-43R. ***Note:*** *this is a yearly review, including the analysis of waters, plants and soils.*

Recent Papers on Exploration Geochemistry

This list comprises titles that have appeared in major publications since the compilation in Newsletter No. 62. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochimica et Cosmochimica Acta (GCA); 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 Applied Earth Science (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, Goldlen, CO 80401, member of the AEG Bibiography Committee. Please send new references to Dr. Closs, *not* EXPLORE.

Aleksandrov, I.R. and Gallyamov, R.M. 1987. *The effects of mineralogical and geochemical factors on the distribution of rare and heavy elements in granitoids.* Geochem. Intern. 24(11): 30-

Anhaeusser, C.R. 1987. *Bibliography of Theses in the Geological Sciences Submitted to Universities in Southern Africa.* Info Circ 195. (Econ. Geol. Res. Unit, Univ Witswatersrand. 82p.

Ballantyne, J.M. and Moore, J.N. 1988. *Arsenic geochemistry in hydrothermal systems,* GCA 52: 475-483.

Barrett, T.J. and Jarvis, I. 1988. *Rare-earth element geochemistry of metalliferous sediments from DSOP Leg 92: The East Pacific Rise transect.* Chem Geol. 67(3/4): 243-260.

Beaty, D.W. et al. 1987. *The origin and significance of the strata-bound, carbonate-hosted gold deposits at Tennessee Pass, Colorado.* EG 82(8): 2158-2178.

Berner, E.K. and Berner, R.A. 1986. *The Global Water Cycle, Geochemistry and Environment.* Prentice-Hall 480p.

Bernier, L. et al. 1987. *Geology and metamorphism of the Montauban North gold zone: A metamorphosed polymetallic exhalative deposit, Grenville Province Quebec.* EG 82(8): 2076-2090.

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CALENDAR OF EVENTS

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

- July 30 - Aug. 4, '88 - **Sedimentology** related to **mineral deposits,** mtg. & field trip, Beijing, China. (Wang Shousong, Intl. Assoc. of Sedimentologists, Institute of Geology, Academia Sinica, Box 634, Beijing. Tel: 445913)
- Aug. 12 - 15, '88 - Mineralogy of **precious metal deposits,** mtg., Golden, Colo. (James A. McGlasson, 7387 S. Flower St., Littleton, Colo., 80123, Tel: 303-972-0376
- Aug. 15 - 18, '88 - **Trace metals in lakes,** intl. mtg., Burlington, Ont., (Ken R. Lum, National Water Research Institute, Box 5050, Burlington, L7R 4A6, Tel: 416-336-4617)

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

■ Sept. 5 - 10, '88 - Geochemistry & mineralization of **proterozoic mobile belts,** mtg., Beijing, China (Sun Dazhong, Tianjin Institute of Geology & Mineral Resources, CAGS, 4, 8th Road, Dazhigu, Tianjin 300170, China)

■ *Sept. 18 - 23, '88 - **Vocabulary & mineral deposits,** mtg. & field* trips, Reno, Nev., (Mining, Div. of Continuing Education, Univ. of Nevada, Reno, 89557-0032, Tel: 702-784-4046)

■ Sept. 25 - 28, '88 - **European Geological** Conference, Nice France, by American Assoc. Petrol. Geologists (AAPG, Box 979, Tulsa, Okla., 74101, Tel: 918-584-2555)

■ Sept. 26 - 29, '88 - Geosciences in **developing countries,** mtg., Nottingham, England (Geosciences in Development Conference, Dept. of Geology, Univ. of Nottingham, Nottingham, NG7 2RD, Tel: 0602-506101, Telex: 37346 UNINOT G)

■ Sept. 26 - 30, '88 - **Contamination control,** intl. symposium, Los Angeles (Janet A, Ehrmann, Institute of Environmental Sciences, k940 E. Northwest Highway, Mount Prospect, Jll., 60056, Tel: 312-255-1561)

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

■ Oct. 12, '88 - **Hydrothermal processes** in volcanic terranes, mtg., Cardiff, Wales, U.K. (Richard E. Bevins, Dept. of Geology, National Museum of Wales, Cardiff, CF1 3NP)

■ Oct. 13 - 15, '88 - **Gold Exploration,** intl. mtg., Reno (Meetings Dept., Soc. of Mining Engineers, Box 625002, Littleton, Colo., 80162)

■ Oct. 20 - 26, '88 - **Remote sensing** of environment, intl. mtg., Abidjan, Cote d' Ivoire (Alan K. Parker, Box 8618, Ann Arbor, Mich., 48107-8618, Tel: 313-994-1200)

■ Oct. 31 - Nov. 3, '88 - **Geological Soc.** of **Americ** ann. mtg., in Denver with associated societies (Jean Kinney, GSA, Box 9140, Boulder Colo., 80301, Tel: 303-4472020)

■ Nov. 6 - 13, '88 - **Latin American Geology,** ann.mtg. Belem, Para, Brazil. (Carlos Oiyi Berbert, Departmento Nacional da Producao Mineral, SAN. Q.01, BI. "B" 70040 Brasilia, DF, Brazil)

■ Nov. 30 - Dec. 2, '88 - **Multidisciplinary Exploration Case Histories** AEG-NWMA joint meeting at Spokane, Washington. (Jerry D. Lewis, Convention Chairman, 414 Peyton Bldg., Spokane, WA 99201) [See no. 62, p. 3]

■ Jan. 15 - 27, '89 - **Oman ophiolite,** intl. mtg. & field trips, Muscat, Oman (Hilal Azry, Ministry of Petroleum & Minerals, Box 551, Muscat)

■ April 23 - 26, '89 - American Assoc. **Petrol. Geologists,** ann. Mtg., San Antonio, Tex. (AAPG, Box979, 1444 S. Boulder, Tulsa, Okla., 74101, Tel: 918-584-2555)

■ June 26 - 30, '89 - Intl. Symposium on **Gold Geology** and Exploration, Shenyang, China (Prof. Zhu Fengsan, The Secretariat of ISGGE, The Chinese Society of Metals, 46 Dongsixi Dajie, Beijing, China)

■ July 9 - 19, '89 - **28th Intl. Geological Congress,** Washington, D.C. (Bruce B. Hanshaw, Box 1001,Herndon, Va., 22070-1001, Tel: 703-648-6053)

■ Oct. 2 - 4, '89 - 13th **International Geochemical Exploration Symposium** (Dorival C. Bruni, Sociedade Brasileiro da Geoquimica, P.O. Box 2432CEP 20010, Rio de Janeiro BR RJ). [See no. 62, p. 10]

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