EXPLORE

The Association of Exploration Geochemists Newsletter

NUMBER 62 FEBRUARY 1988

President's Message

By now you have seen and formed your own opinion on our newly formatted newletter, EXPLORE, and I am confident you were pleased. From the many telephone conversations I had with Chet Nichols and Clark Smith, I know a great deal of effort went into its preparation. On behalf of our membership, I would like to thank them and their helpers, particularly Mary Allen, for this effort in Reno and for the newsletters which will follow.

As part of your contribution to becoming involved in the AEG, I am asking for your observations, viewpoints, compliments, and criticisms regarding the ***Journal of Geochemical Exploration*** *which is the flagship of the AEG. Please write to Dr. Don Runnells (see page 19 of this issue) so that he can compile your comments for our editor, Dr. Eion Cameron, and for the AEG council.*

Certain actions have already been taken, such as ensuring regular publication of issues and prompt notification if you will not be receiving an issue for non-payment of current year dues (see last page of October EXPLORE). But other issues might be of concern to you such as the type of papers being published or the range of subject matter being presented. It is a duty of an organization like the AEG to critically review itself and its organs on a regular basis and to initiate changes where needed or mandated by its membership. Please help Dr. Runnells and Dr. Cameron in this endeavour.

Another subject worthy of critical review is that of the actions (or inactions) of your council on your behalf. I encourage submissions on how you believe the interests of the organization can be improved, particularly at this time when candidates are being nominated for the 1988-1990 term.

I believe the structure of the AEG council should be modified to ensure analytical and environmental representation, and if individuals make themselves and their concerns known to me, we can work together to form a better council. For those who are considering the council of the AEG, please do so only if you have enough time to become actively involved. The profession sorely needs leadership from the AEG if geochemistry is to deliver to its potential.

Stan Hoffman

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NEWS & COMMENT

Gold in Moss-Mat Sediments and Stream Sediments

An article in the last issue of EXPLORE presented current geochemical programs of the British Columbia Geological Survey Branch. Preliminary results for the northern Vancouver Island Regional Geochemical Survey orientation project have just been received, showing some exciting possibilities for the use of stream sediments trapped in moss-mats as a sampling medium in cool, humid, mountainous regions where sandy sediment is not adundant.

As part of the project, which was initiated to compare traditional and innovative sampling techniques, moss-mats were scraped from boulders and logs within the active channel well away from the banks. At each site, 1 to 2 kg of both moss-mats and sandy stream sediments were collected. Collection of moss-mats was very rapid as suitable sample sites are extremely abundant.

In the laboratory, samples of both types were dried at 60 C and moss-mats were hand-pulverised to release the entrapped sediment. Half gram splits of the -80-mesh (-177 μm) fraction from both the sandy sediments and moss-mat sediments were digested with aqua regia. Thirty elements were determined directly by ICP-ES while Sb, As, Se, Ge, Bi and Te were determined by ICP-ES followed by MIBK pre-concentration and graphite furnace AAS finish.

The weight of -80-mesh material obtained from each sample immediately shows a potential advantage of moss-mat samples. Moss-mats typically yielded 50 grams of the fraction which contrasts with an average of 15 grams obtained from sandy sediments. Optimally, the Branch's Regional Geochemical Surveys require 23 g of sediment for the determination of 17 elements by a variety of analytical techniques as well as analysis of two 10 g splits for gold. Fifty-three percent of the conventional stream sediment samples yielded too little material to meet survey standards whereas all moss-mats yielded enough material for analysis in the current project as well as a remainder for future analysis of other elements.

Gold results for two areas of contrasting geology and physiography show the differing responses of moss-mat sediments and stream sediments. The Zeballos Au-Ag-Pb-Zn-Cu mesothermal vein camp is located in very wet, rugged mountains on the westcoast of Vancouver Island; Red Dog molybdenum-copper stockwork deposit is one of several similar occurrences exposed in the till-blanketed lowlands toward the northern tip of Vancouver Island. Results are very simi-

Notes from the Editor

Journal of Geochemical Exploration Volume 27, number 1-2 (October 1987) and number 3 (December 1987) have been issued since the last newsletter. Write Ines S. Filicetti at P.O. Box 523 (Metropolitan Toronto), Rexdale, Ontario, M9W 5L4, Canada about discrepancies.

Members who have not sent in **1988 dues** will receive EXPLORE but not the *Journal of Geochemical Exploration.*

The AEG mailing list has been updated as of the latter part of January to show current payment of dues. If your mailing label does not say **PAID-88** please write Ms. Filicetti at the address in the paragraph above.

The form at the back of this issue may be used for both renewals and new memberships. Payment by VISA and Master Card is available as indicated on the reverse side of the form — a feature of particular convenience to those who do not have ready access to U.S. funds.

As listed under the officers of the Association on the back page, **Dave Jenkins** has agreed to replace **Lynda Bloom** as Treasurer of the Association. We wish to thank Lynda for her gracious service and look forward to continued prosperity with Dave.

Paul Taufen has also assented to replace **Richard Lewis** as Brazillian Regional Counsillor. We're sure that Paul will do his best to fill the boots of his good friend Richard who passed on last year (EXPLORE no. 61, p.5).

Nominations for the third **Distinguised Lecture** series were requested in the previous issue of EXPLORE (p. 16). If you would like to volunteer or make a recommendation, please call D.M. Jenkins at 604-888-0358 without delay.

During the February 11 meeting of Council, **Graham F. Taylor** was approved for the new position of a second Australian Regional Councillor. This reflects the growth of our membership on that continent and the confidence of his peers.

This newsletter needs **Assistant Editors** located in major exploration centers and universities to solicit and prepare extended abstracts for publication and represent the Association in their respective professional communities. Please contact C.E. Nichols at Suite 290, 680 Greenbrae Drive, Sparks, Nevada 89431.

Issue number 61 was distributed to approximately **3,700 different professionals** from the combined membership lists of the Association of Exploration Geochemists, Society of Economic Geologists, Denver Regional Exploration Geologists Society, Geological Society of Nevada, and attendees at the April 1987 GSN Symposium at Reno.

The distribution of this issue is planned for approximately **4000** to include geologists of the Northwest Mining Association and most libraries with geologic collections.

The next issue will be distributed by the NWMA to a compliation of lists without duplicate names estimated at about **7000**.

Considering the dozens of other such illustrious groups of explorationists in the world which are listed in the Directory of Geoscience Organizations (*Geotimes* October 1987), there are many more people who should be interested in future issues of EXPLORE besides AEG members. We hope to maintain large promotional mailings, and certainly would appreciate a set of mailing labels from other appropriate international, national, regional, and local organizations.

There have been so many requests for additional copies of the October issue that a **reprinting** is being considered. If you or your organization is interested, please write EXPLORE indicating the number of issues wanted at $1.25 US each plus $5.00 per order for handling and shipping. Please respond by March 31.

A few of our bretheren have taken it upon themselves to conduct a **membership compaign** on behalf of the Association. Of these, the most notable is

EXPLORE

Newsletter No. 62 FEBRUARY 1988

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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

Information for Contributors to Explore

Scope In addition to contributions on exploration geochemistry, material on multidisciplinary applications, environmental geochemistry and analytical technology is encouraged. 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.

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.

Deadlines Copy should be received by EXPLORE at Reno, Nevada before the middle of March, June, September and D

Stan Hoffman who sponsored ten of the new voting members listed in this newsletter. Runner-ups are Al Sinclair with four, Ivor Elliott and Pedro Herman with three, and K. Fletcher, Jane Plant, Graham Closs and Larry James with two each. If these busy and productive people have this time for the association, perhaps you do too. Please feel free to reproduce the membership form at the back of this issue.

Chet Nichols

A Note from the Secretary

At this time of the year we are once again faced with sending membership dues to the organization. I thought it might help "ease the pain" a bit if there were some explanation about why we collect the dues when we do and why we are so insistent about receiving payment for the current year before the end of the current year. The reason for this is that Elsevier (our publisher) establishes our total membership on December 31 of each year. This is the number of members used as the basis for substantial royalty payments to the organization. Any memberships for the previous year that are received after December 31 are not recognized by Elsevier as members and are considered as the Association buying a "back issue". As a result, we get no royalty for those members and the royalties are what helps fund your organization. It is very important that your organization receive your dues as early in the current year as possible.

Much of my mail concerns the status of individual members and their receipt (or not) of our publications. In the past it has taken an inordinate amount of time for the Council to approve new members and then notify them of their status. This is an ongoing problem that we are trying to resolve and we hope to be much more responsive to the membership

PERSONAL

Information on Association members is received from around the world. To keep others informed of items such as moves and promotions, send a notice, preferably with photo, to EXPLORE.

Lloyd James wishes to inform members that he is now operating as an independent geochemical consultant. He may be contacted at 6170 E. Briarwood Circle, Englewood, Colorado 80112, U.S.A., (303) 741-5199.

Dr. Nigel W. Radford is now Supervising Geologist (Exploration) with Metana Minerals at 161 Great Eastern Highway, Belmont, W.A. 6104, Australia.

POSITIONS WANTED

Ph.D. Geologist/ Geochemist with 15 years experience in a major old-line mining company and 6 years consulting in Reno proposes to organize and manage a gold exploration and/or mining program in Nevada at a time of unusual opportunity. Call 702-331-4223.

Notices of positions wanted are published without charge to current members. Organizations may also list vacancies without charge by sending the appropriate copy with or without camera-ready logo to EXPLORE.

LETTERS

Nordic Countries Report

At present a local meeting of Nordic geochemists on reconnaissance and interpretation is planned for August 1988. Another meeting of semi-local character (with invited foreigners) on environmental aspects is planned for the first half of 1989. I will let you know more as planning progresses.

I will also set up a system of reporters in response to the request for local news.

Alf Bjorklund
Department of Geology
Abo Akademi
SF-20500 Abo, Finland
Phone: 358-0-298 8297

New Format of Explore

I thought that I should write and congratulate you on a fine effort — both in content and format — represented by EXPLORE. I know that this does not come easy.

Yours sincerely,

Eion M. Cameron
Department of Geology
University of Ottawa
Ottawa, Ontario
KIN GN5 Canada

Misprints Corrected

The newsletter EXPLORE no. 61 October 1987 page 4, "The Analysts Couch" has my name misprinted. L. Kothny is either my brother or my daughter. Also the country of the undersigned is mispelled (Zambia?).

Very truly yours,

E.L. Kothny, Ph.D
20 Rheem Boulevard
Orinda, CA 94563 U.S.A.

Shea Clark Smith
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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 (2 ½ days). Field trips are also being considered. Look for more information in the April issue of EXPLORE. Cost for the short course will be $425.00. Cost for the convention itself will be $75.00 for AEG and NWMA members, or $105.00 for

NEWS & COMMENT

continued from page 1

near Zeballos (Figure 1). Here Au is thought to occur predominantly as coarse, native gold particles (as indicated by erratic results for duplicate analyses of 5 gram splits of conventional sandy sediments).

By comparison, duplicate gold analyses of 5 gram splits of sandy sediments from Red Dog Creek are fairly consistent, suggesting that gold occurs as relatively abundant fine particles. Nevertheless, gold is almost an order of magnitude more abundant in moss-mat sediments than in sandy sediments (Figure 2). In this case, gold concentrations in moss-mat sediments have the advantage of being considerably above the detection limit (1 ppb), providing greater geochemical contrast (relative to background defined as the detection limit) and better analytical precision.

Other elements in the 103-site survey indicate that concentrations in moss-mat sediments and stream sediments are comparable for many elements including Mo, Cu, Pb, Co, Fe, As and Hg. However, stream sediments generally show greater concentrations than moss-mat sediments in Zn, Ni and Mn.

A more detailed discussion can be found in a report by P.F. Matysek and S.J. Day entitled "Geochemical orientation surveys: northern Vancouver Island, fieldwork and preliminary results" in British Columbia Ministry of Energy, Mines and Petroleum Resources Geological Fieldwork and Current Research 1987, to be released in February 1988.

At this stage of the study, results are tentative. More analytical results are expected shortly, and next year a site-specific study is planned to investigate the causes of observed differences in trace element concentrations in moss-mat and sandy sediments.

Further information can be obtained from:

P.F. Matysek, S.J. Day or **J.L. Gravel**
British Columbia Geological Survey Branch
300-756 Fort Street
Victoria, British Columbia
V8V 1X4 Canada
Telephone: (604) 387-3234

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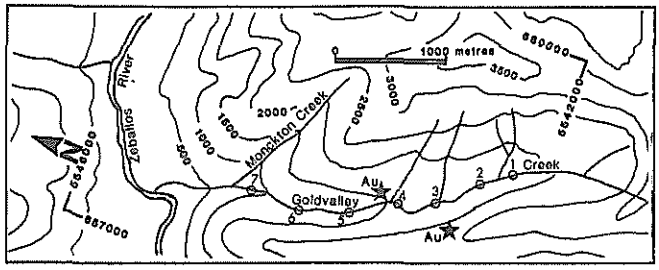


Figure 1a. Area of Zeballos camp with location of small mines shown by stars.

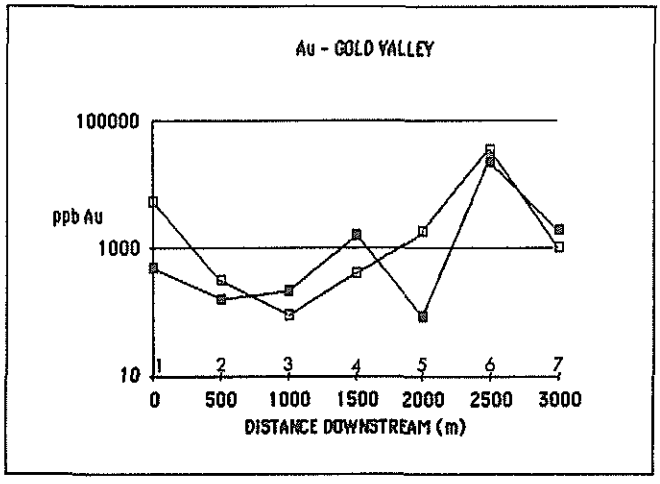


Figure 1b. Moss-mat sediment results (open squares) are similar to stream sediments in the Zeballos area.

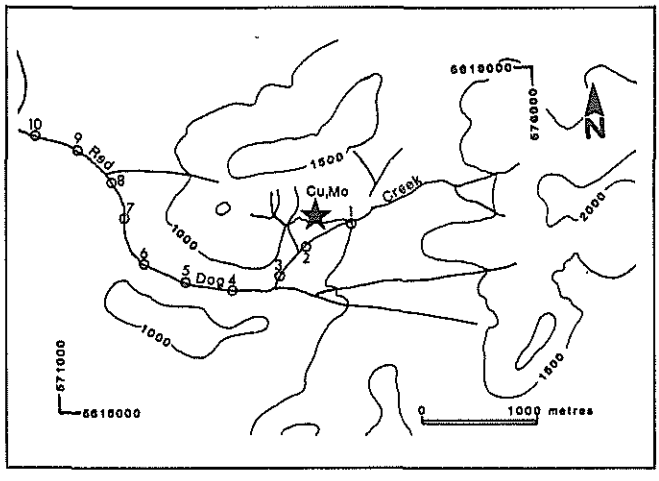
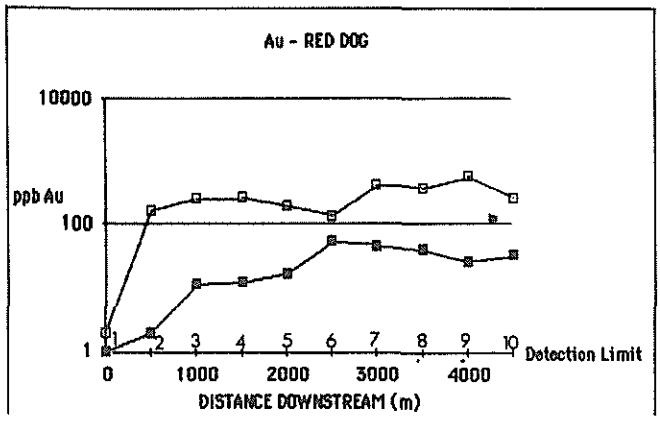


Figure 2a. Area of Red Dog stockwork deposit.



TECHNICAL NOTES

Microbial Methods of Mineral Exploration

The idea of prospecting for mineral deposits using microorganisms is not new. The Soviets in the late 1950's were the first to investigate whether the distribution of sulfur metabolizing bacteria in soils could be used in mineral exploration. Since then others have shown that several sulfur metabolizing microorganisms, *Thiobacillus* spp. and *Desulfovibrio* spp., are useful in locating ore. Although sulfur-utilizing bacteria may show promise in locating sulfur-rich deposits, such as sulfide and native sulfur ore, these organisms are not useful indicators of sulfur-poor deposits.

Alternatives to using sulfur-metablizing microbes in mineral exploration have been twofold: the development of assays that determine metal and anitibiotic resistances in soil bacterial populations associated with mineralized bedrock, and the development of a *Bacillus cereus* assay in which increases in populations indicate the presence of metalliferous terrain.

Although the former method has shown some promise in delineating metalliferous terrain, it is the latter method that has received the most attention primarily because of the cost effectiveness of the technique and the ease with which it can be applied. The *B. cereus* method was introduced in 1982 by John Watterson of the U.S. Geological Survey in Denver.

Watterson's interest in the distribution of *B. cereus* originated as a result of a study by Timoney and others in 1978. They were the first to show that heavy metals in the environment can selectively enhance antibiotic resistance in bacteria. This study led Watterson to investigate the location of metalliferous soils associated with subsurface mineralized bedrock.

Results from his study in which soils were collected above the Poorman Creek porphyry deposit in Montana, show that penicillin resistance in total *Bacillus* spp. correlates significantly with soil metal content and that the most numerous of the *Bacillus* species displaying this resisitance phenomenon was *Bacillus cereus*. It was concluded that either penicillin resistance in total *Bacilluss species or increases in B. cereus* might be useful as an exploration method.

Since the introduction of the new microbial method to the exploration community, many surveys have been conducted over a variety of gold deposits: gold-quartz veins in the Empire District, Colorado; the Reid deposit veins near Redding, California; and disseminated gold deposits at Mesquite, Hemlo, and Hog Ranch.

Survey results from soils collected at the Hog Ranch deposit are illustrated in the Figure. Both soil gold and concentrations of *B. cereus* populations show anomalous values displaced slightly downslope from the known location of ore. Anomalous gold concentrations are subtle in comparison to *B. cereus* populations which increase to as much as 40,000 times local background. Results from the survey at Mesquite show that the greatest advantage over other exploration methods is that *B. cereus* populations are able to delineate ore as deep as 300 feet in extremely arid climates.

The need to integrate microbial surveys with geochemistry is evident, especially in areas where have not clearly answered the question of which specific metals *B. cereus* is responding to, suggesting a more complicated ecological relationship. However, with the advent of new micro-analytical techniques and the development of methods for studying soil microbial ecology, many of these questions will be answered. Interest in the distribution of microbes in relation to ore deposits will hopefully stimulate research in the field of microbial ecology as we now realize the amount of information available by looking at biological systems in relation to geologic problems.

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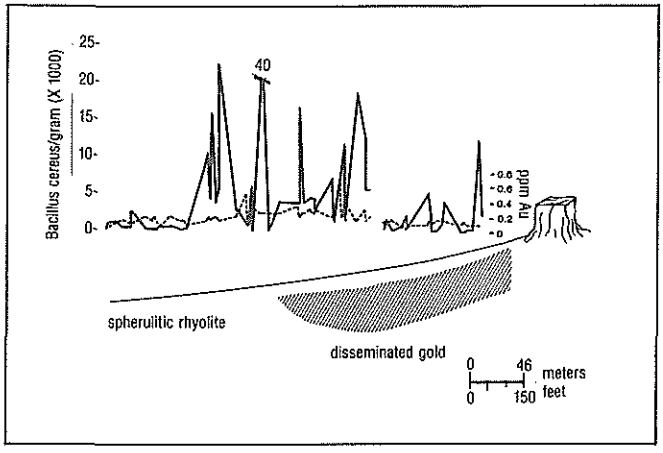

Plot of *Bacillus cereus* per gram of soil and ppm Au in soil overlying disseminated gold mineralization at the Hog Ranch deposit in Washoe County, Nevada.

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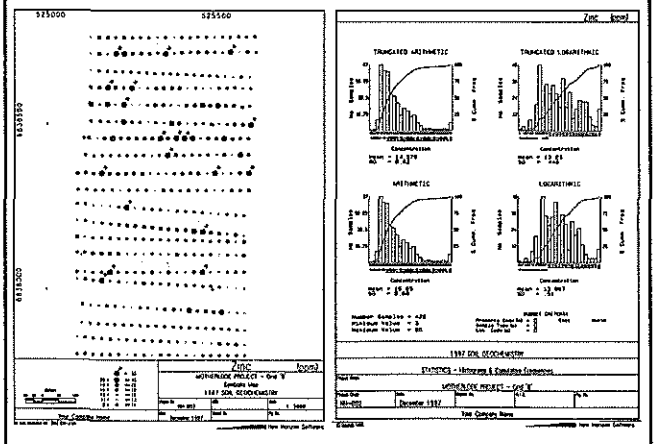

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TECHNICAL NOTES *continued*

Geochemical Signature of the El Realito Gold Prospect, Sonora, Mexico

Heap leach Au potential along an oxidized mesothermal vein system has been investigated recently by the Luz del Oro S.A. de C.V. joint venture at the El Realito concession which lies 130 kms ESE of Hermosillo, Sonora, Mexico in the San Antonio Mining District near San Antonio de la Huerta. Geochemistry has augmented geology in rugged terraine with few outcrops. Initial exploration indicates from 400,000 to 800,000 tonnes of 2.5 grams per tonne Au in vein gossans. Au and Ag veins and Au placers have been exploited in the district since Spanish colonial times.

Vein wallrocks at El Realito include hornsfelsed west-dipping shales, calcareous siltstones, sandstones, and conglomerates of the Upper Triassic Barranca Formation. Metamorphism and mineralization may be related to abundant local granite and granodiorite intrusives. Pebbles of intrusive rocks in middle Tertiary conglomerates suggest a Laramide age for intrusion.

The 25 sq. km San Antonio District shows geochemical zoning characteristic of porphyry Cu systems. Zoning is centered on the Luz del Cobre Mine — a breccia pipe which has produced 200,000 tonnes of 3% Cu, and which contains 4,000,000 drill-proven tonnes of 1.4% Cu.

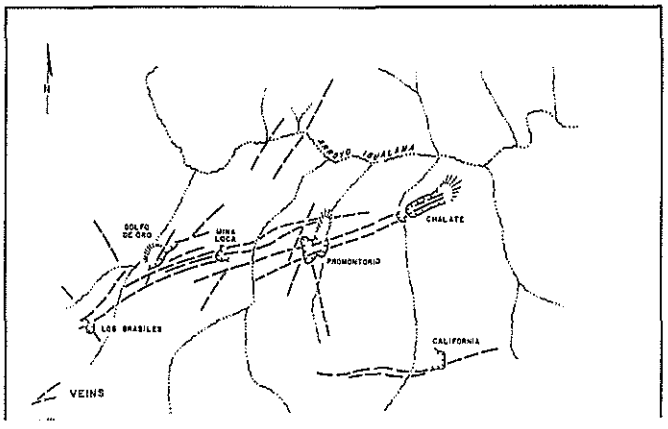
The district is one of several spaced at approximately 10 km intervals along a 50 km ENE- trending regional zone of Cu-Pb-Zn-W-Au-Ag mineralization.

The district is characterized by a swarm of pyritiferous veins cutting, and extending 4 kms WSW from, the Luz del Cobre pipe. Intense oxidation has reduced veins and nearby wallrocks to gossans of silica, clay, and limonite. Au and electrum — as well as Pb, Zn, Mn, and Cu oxides, native Ag, and barite — can be panned from these gossans. From 1982 to 1984, small pits along the veins at Chalate, Promontorio, Golfo de Oro, and California (Figure 1) yielded 100,000 tonnes of 3.0 gpt Au ore. The San Antonio District also contains important placers.

Veins, generally less than 1 meter thick, are accompanied locally by sheeted, multistranded, enechelon veinlet swarms in zones 5 to 30 meters wide. Gossany material also occurs along the veins in stockworks, in breccias, and along bedding laminae of favorable sedimentary units. Best Au values and the strongest vein, stockwork, and breccia development occur along veins where they are intersected by cross-faults (Figure 1).

The base of sulfide oxidation, exposed in canyon walls at El Realito, gradually rises to the west. This profile, not parallel with the modern arroyo profile, is parallel with, and possibly related to, a profile defined by elevations of ridgespurs. Thus, the veins are now probably oxidized mostly being dissected at present.

Rock-chip geochemical data from a 0.5 sq. km grid of the district (figures 2, 3, & 4) show a zoned distribution of base metals and Ag — with



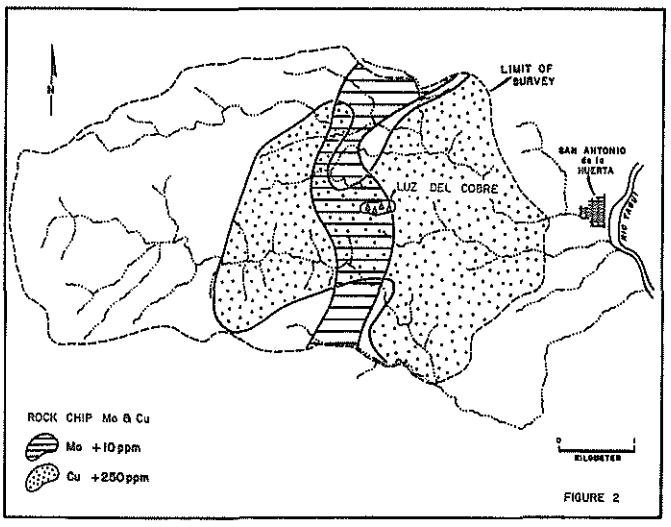


FIGURE 2

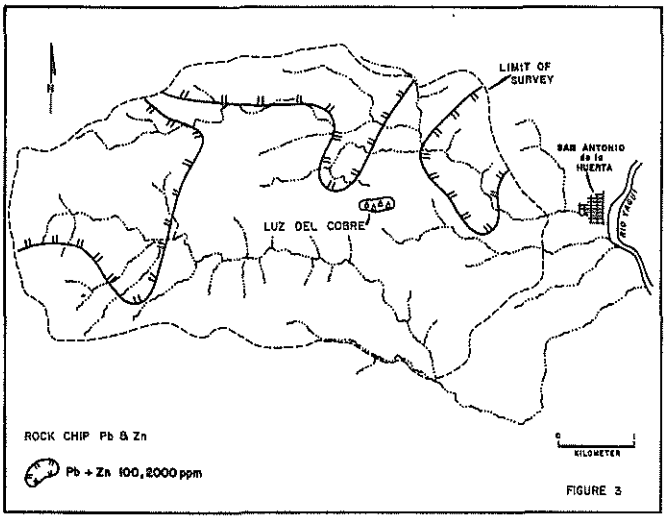


FIGURE 3

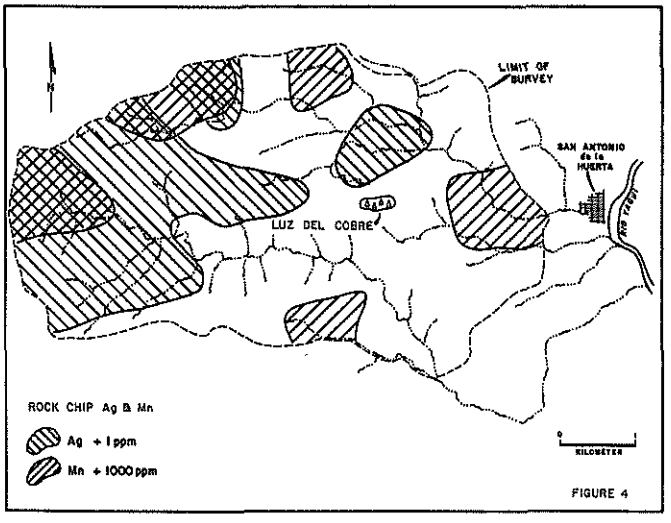


FIGURE 4

Luz del Cobre breccia pipe, a 10 ppm Mo envelope is approximately surrounded by an envelope of 250 ppm Cu. This zone is surround by a halo showing plus 100 ppm Pb, 2000 ppm Zn, and 1000 ppm Mn. The 1 ppm Ag isograd overlaps and appears to be more peripheral than the Mn, Zn, and Pb anomalies. For the 61 samples taken, Au was below spectrographic and AA detection limits.

In a district-wide survey of arroyo sediments (Figure 5), each of 256 samples reflects a drainage area of not more than 0.5 sq. km. Samples were sieved to minus 80 mesh and analyzed for Au, Ag, and As. Excepting very high assays invariably downdrainage of current or historic workings, Au shows values up to 2.59 ppm, with an average at 0.37 ppm. Ag ranges up to 15.4 ppm, with an average at 2.75 ppm. As ranges up to 500 ppm, with an average at 153 ppm.

Soil samples (Figure 6) were taken at 10 m spacings along fences 50 m apart crossing the vein trends. A total of 1388 samples were seived to minus 80 mesh and analyzed for Au, Ag, and As. Values for Au ranged to 2.86 ppm, with an average at 0.22ppm. Values for Ag ranged to 4.80 ppm, with an average at 1.29 ppm. Values for As ranged to 450 ppm, with an average at 96.27 ppm.

Patterns of anomalous metals in soil confirm the continuity of vein mineralization and extend vein trends into mined areas. The data also indicates that the El Realito ENE trending veins are zoned: Au dominates to the east towards Luz del Cobre; strongly correlative Ag and As dominate to the west.

Thus, the rock-chip survey results reflect the regional structural setting, zonation, and the general limits of a Laramide porphyry Cu system centered on the Luz del Cobre breccia pipe. Arroyo sediments confirmed this setting and located current and historic Au/Ag prospects. Soil samples traced and projected the Au-bearing veins which are superimposed on a porphyry Cu system.

In past economic climates, location of Au in placers and veins was used with hypogene and supergene zoning concepts to point towards possible porphyry Cu deposits. At the El Realito survey, metal distribution patterns in a porphyry Cu system has focused and encouraged exploration for heap leach Au potential.

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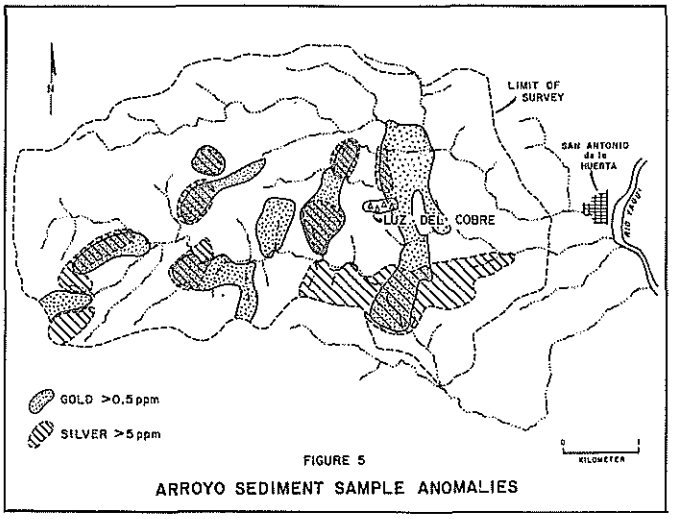

FIGURE 5
ARROYO SEDIMENT SAMPLE ANOMALIES

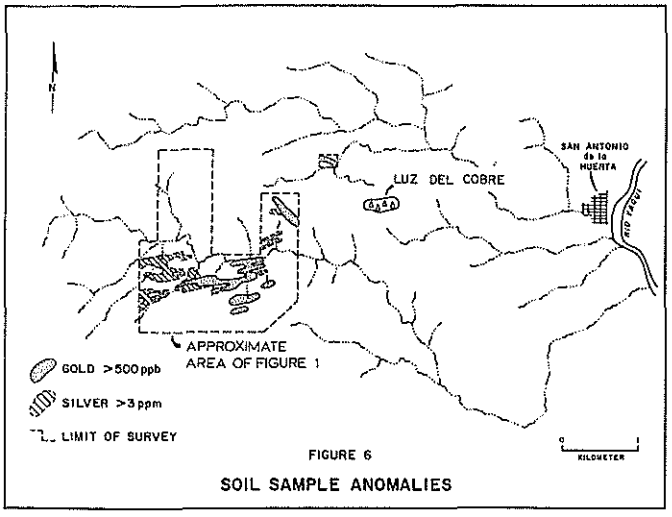

FIGURE 6
SOIL SAMPLE ANOMALIES

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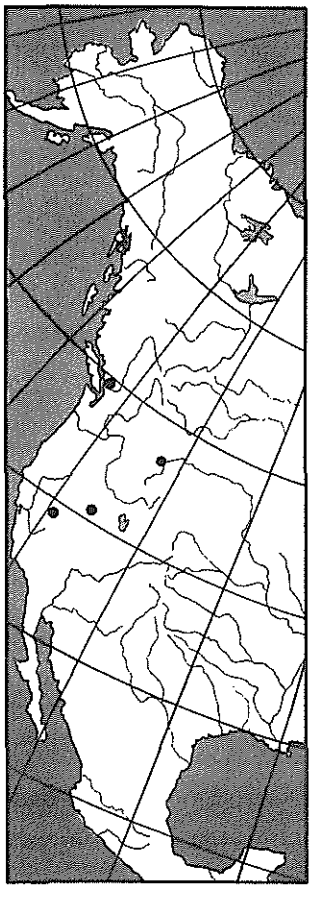

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Pearl Harbor File

The Pearl Harbor file is planned as a regular column in EXPLORE to publicize problems, deficiencies, omissions, and otherwise total disasters encountered by our readers on geochemical programs. We hope that by sharing real exploration experiences all can learn something from them. I have agreed to act as assistant editor for these case histories, and would appreciate your submissions.

I believe it is too simple to just present a Pearl Harbor file study in a narrative format. Rather, I think much more interest would be generated if the readership is first given a chance to consider the case history, identify one (or more) deficiency(ies) and recommend what remedial action(s) you would take if the project were yours. Readers are asked to define the anomalies, rate them by priority, and plan an appropriate followup program. The following is a case history of a recent soil survey from an exploration program looking for volcanogenic massive sulphide deposits (VMS) in Newfoundland, Canada.

The survey area lies within central Newfoundland. The landscape is gently rolling and covered by a boreal forest. The climate is cool with a yearly rainfal of about 75 cm. Snow covers the ground from December through April. Contour interval on the accompanying geochemical maps is 18 m (50 feet), rising to a hill in the southwest. Accumulations of organic material are locally significant, and "holes" in the sampling plan denote areas where bogs could not be penetrated by a 1.3 m soil auger, the device used for soil sampling on the property.

Soils are normally podzols, except in boggy areas. Following the soil horizon nomenclature of Chapter 3, Reviews in Economic Geology, Volume 3, a typical profile comprises:

0-20 cm	LH	black, leaf-humus layer
20-40 cm	AE	white, leached A horizon
40-50 cm	BF	black, zone of organic and Fe/Mn accumulation
45-60 cm	BF	medium red-brown, zone of Fe enrichment
60+ cm	BM	medium olive brown horizon

The red brown BF is the horizon sampled.

Overburden comprises glacial till of variable thickness with outcrop exposed over perhaps 1% of the landscape. Overburden thickness from limited drilling in the area appears to be about 8-10 m. The area lies near a centre of ice accumulation during the Pleistocene, and ice flow appears to have been either to the northwest or to the southeast.

Figure 1 presents geochemical data for Cu, Zn and Pb superimposed on a topographic and geologic (bold screened lines) base. The three elements are part of the 30-element suite determined on the minus 80-mesh fraction with aqua regia

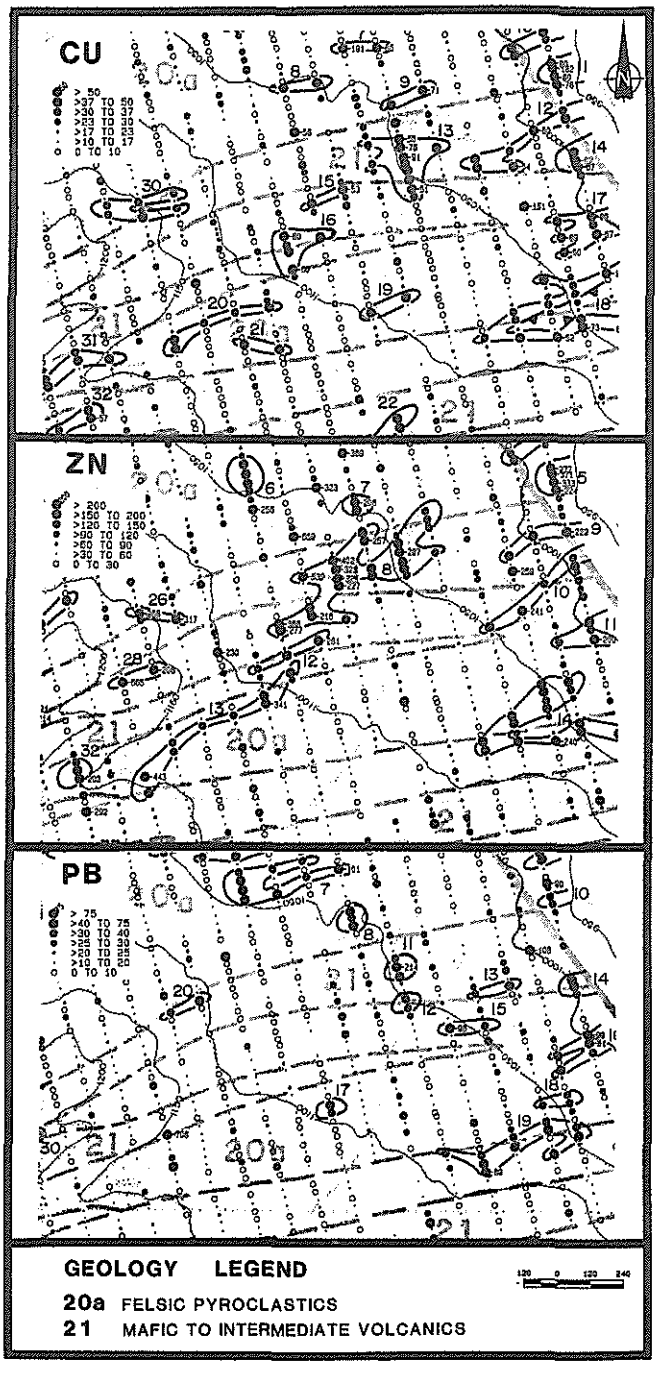

Figure 1

digestion. Results are part of a larger grid and anomalous conditions, representing at least contiguous pairs of anomalous samples, are outlined by the unscreened contour lines (an anomaly number label is attached). These highlight 5 to 10% of the survey area,which is about 3 times larger than that depicted on Figure 1.

Based on the data presented, which anomalies (if any) would you propose to followup and what procedures would you use? Recognizing that it is not possible in an article such as this to give you all the information you might need, is there any critical information you would require? Let me know so that I can incorporate your ideas in my response in the next issue of EXPLORE.

To give you a flavour of why this example is in a Pearl Harbor

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the applicability of constant depth sampling for routine surveys. A standard profile could be described as having a thin (<1 cm) leaf humus (LH) surface horizon, underlain by a 2 to 6 cm A horizon with humus (AH), a non-descript B zone (BM) and a calcareous C horizon parent material (CA). The BM horizon would normally be sampled for routine work.

Soils examined near Montana Tunnels and Jardine suggested that a potential problem exists. Topographic depressions and gullys often contain accumulations of AH material up to 60 cm and greater in thickness. Soil sampling at constant depth would have the effect of collecting BM material most of the time and AH material some of the time.

Table 1

Selected trace element content (ppm) from two soil profiles near Montana Tunnel

Profile 1

	Mo	Cu	Pb	Zn	Ag	Au	Mn	Fe
AH	8	330	2100	960	5.9	420	1400	1.7
BM	8	100	2400	360	7.4	950	95	1.3
CA	17	159	4100	190	8.0	165	22	1.8

Au in ppb, Fe in %

Profile 2

	Mo	Cu	Pb	Zn	Ag	Au	Mn	Fe
AH	7	56	157	214	5.4	21	4200	1.6
BM	13	57	174	877	13.1	135	8700	2.1
CA	10	52	88	211	4.9	29	5500	1.7

Au in ppb, Fe in %

Table 1 from the Montana Tunnels area illustrates the character of some of the interhorizon trace element variations. There is evidence that, at least locally for some elements, the AH horizon is a zone of accumulation.

Suppose a routine survey were completed using samples taken at a constant depth, and the samplers were unaware that recognition of soil horizon was important. Deep development of the AH horizon in a shallow valley could produce a linear geochemical pattern following the valley. This anomaly would likely be interpreted as related to a geological structure, due to its linear shape. A drill or trench target might be identified in a depression as a consequence of coincidence of a very strong geochemical anomaly in the AH horizon and a mineralized structure, as in the case of profile 1.

By contrast, a more subtle geochemical anomaly in the BM horizon, also related to bona fide minierlization, as in the case of profile 2, might be missed. As a further complication, a false anomaly may be created as an artifact of sampling the AH horizon, with a resulting waste of time and money spent following it up.

How might this precious metal anecdote relate to the VMS example? I would appreciate your ideas and suggestions. Feel free to summarize a work program on an overlay to Fig. 1. The *VMS example is to be continued in the next issue of* EXPLORE. Please address your comments and/or your own case histories for following issues to:

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MEETING REPORTS

Exploration 87

The Exploration 87 convention held in Toronto, Canada between September 26 and October 1, 1987 was attended by 970 delegates from 77 nations. The symposium was convened to examine and review technological advances in the fields of exploration geophysics and exploration geochemistry in the 10 years since the Exploration 77 meeting was held in Ottawa, Canada. Exploration 87 was the third in a series of meetings, the next of which is expected to be held in 1997.

In a world where numerous technical symposia are held each year, these decennial events are indeed unique, firstly for their international audience and secondly for their review nature. Think back to the norms of exploration 10 years ago. Exploration technology has seen an enormous expansion in data production; for example in readily available routine multielement analysis using ICP and DCP determination methods, and in data management using micro-computers.

Geophysics has seen the miniturization of field equipment and become a colourful science, with computer colour graphics now the norm for data presentation. These are but a few of the many significant advancements which are giving us new tools with which to do our jobs better as explorationists.

The convention, with its oral presentations and poster displays, was preceeded by field schools for both geochemical and geophysical training. During the meeting itself, evening discussions were held to review the contents of sessions held on the first two days. At the second of these discussions, a fundamental structural flaw in contemporary exploration philosophy became the focus of debate, that of the widespread failure of the various exploration deciplines to integrate with each other. Exploration 87 was structured for geophysicists and geochemists, and, although a geological thread held the program together, geologists were not mentioned by name.

An early geophysical topic, how to best represent IP data in pseudosection format, appeared to be very complicated, and the mathematical implications held geochemists and others in awe. The mystique was shattered when Phil Haloff explained that the most commonly accepted format was the norm simply because graph paper was readily available to display the data, the reason being no more complicated than that!

These discussions highlighted the fact that geophysicists could talk in a spirited fashion to each other, but exactly how the implication of these discussions would affect drill target selection was lost on the audience. Undoubtedly, geochemists could also have become involved in an esoteric discussion on some minor technical point to the distraction of the exploration theme.

Within the exploration industry it has long been recognized that the three main diciplines employed in the search process (geology/prospecting, geochemistry, geophysics) more often than not compete for funds rather than cooperate for progress. An example of this counterproductive attitude concerned whether or not airborne radiometric surveys are geophysical or geochemical surveys.

It is a pity that geochemists and geophysicists do not realize just how much they have in common. This is particularly true of the electrical and magnetic techniques of geophysics and the whole-rock alteration studies of geochemistry. Both are looking at changes in rock compositions. What is a magnetic survey but an expression of the relative abundance of iron and its oxidation state? Similarly, changes in resisitivity and/or chargeability can be due to water reactions, potassic metasomatism, silicification, and sulphidation reactions in rock. Both diciplines need to cooperate to provide the best possible interpretation of survey data. The radiometric example is surely a case in point.

Within my own career, I have seen various methods of operation. The most effective approach, in my opinion, was generated by an exploration geophysicist with a company who was able to commission more geochemical surveys than I could ever have achieved on my own, simply by asking a project manager one question: "What criteria do you need to define a drill target?". With the answer to the question in mind, the exploration process can then establish the most cost effective route to achieve the objective.

In this particular case, previous experience had indicated that a large number of geophysical anomalies would result from a geophysical survey covering a large area, and not all anomalies could be tested by drilling. The most effective way toestablish a priority for targets was a geochemical survey. If there were no geochemical anomaly, then money could be saved by not conducting the more expensive follow-up geophysical survey. If anomalies were outlined, then a more restricted geophysical survey coverage could be planned, also saving money.

I predict that, over the next 10 years, this much-needed cooperation will be one of the main advances initiated by Exploration 87. In that regard, I would encourage more geophysically-oriented individuals to join the association and authors to include geophysical aspects to case histories submitted

AEG 1989 ANNUAL GENERAL MEETING

CALL FOR PAPERS

13th International Geochemical Exploration Symposium
Rio de Janeiro, Brazil • October 2-4, 1989

This symposium is jointly sponsored by the Association of Exploration Geochemists and the Brazilian Geochemical Society. It will consist of three days of technical sessions, pre-symposium workshops, and field excursions both before and after the scheduled technical sessions.
Principal themes for the symposium are as follows:

1) *Geochemical exploration in humid and tropical areas* 2) *New techniques in geochemical* exploration for Au and PGE 3) Geochemical exploration for petroleum 4) Analytical techniques with emphasis on the precious metals 5) Computer applications in exploration geochemistry

Brazil has a well-developed minerals industry and a number of interesting, world-class ore deposits. Preliminary contacts with mining companies are now being made to arrange excursions to some of these, and possible technical visits include:

1) The Carajas Mineral Belt (Fe, Al, Mn, Cu, Au, Sn deposits) 2) The Minas Gerais Alkaline Complexes (world's largest Nb reserves and large Ti and phosphate deposits) 3) Jacobina Witswatersrand-type Au deposits 4) The Iron Quadrangle — Quadrilatero Ferrifero Au and Fe deposits of Minas Gerais 5) The Au and Ni deposits of Goias State.

In addition to the technical program, a worthwhile social program is being arranged for accompanying guests and for time available outside of the technical sessions. A first circular announcing the 13th IGES will be sent out shortly.

Please contact:
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